Figure 1. Shaded relief map of the tracer test site showing the 'Meyer' dye release well southeast of the Malad Gorge by 2.26 miles. Higher elevations are shown as blue tones, mid levels as yellow tones and lower elevations as brown tones. Nearby wells shown with black symbol.

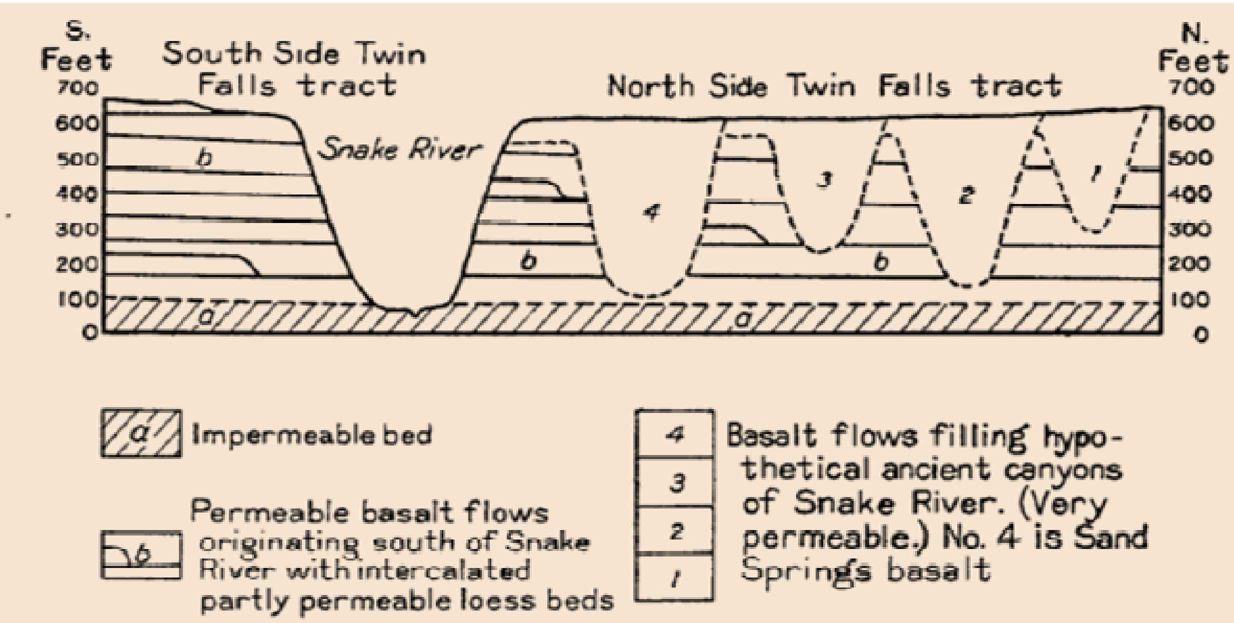


FIGURE 10.--Diagrammatic section showing postulated conditions beneath the North Side Twin Fall tract.

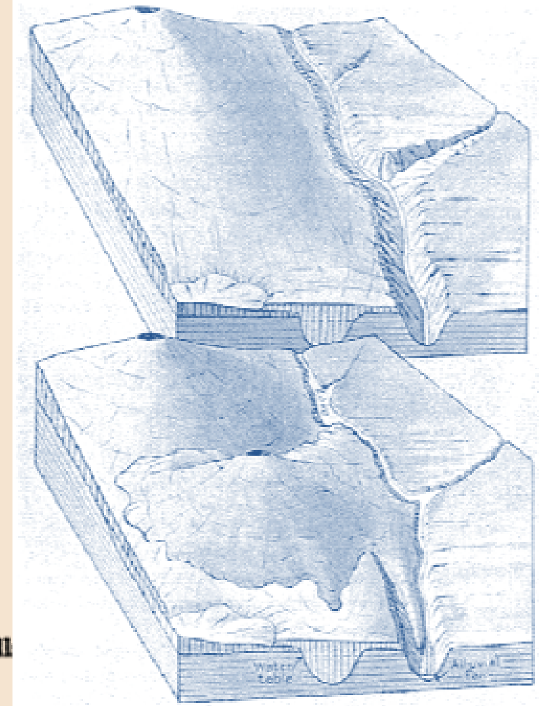


FIG. 6.—Diagram showing displacement of Snake River by lava flows

Figure 2. Diagrams from Stearns and others (1938) showing how the present Snake River and Canyon have been displaced in a southward progression by volcanic eruptions filling the canyon and displacing the river only to re-cut a new canyon.

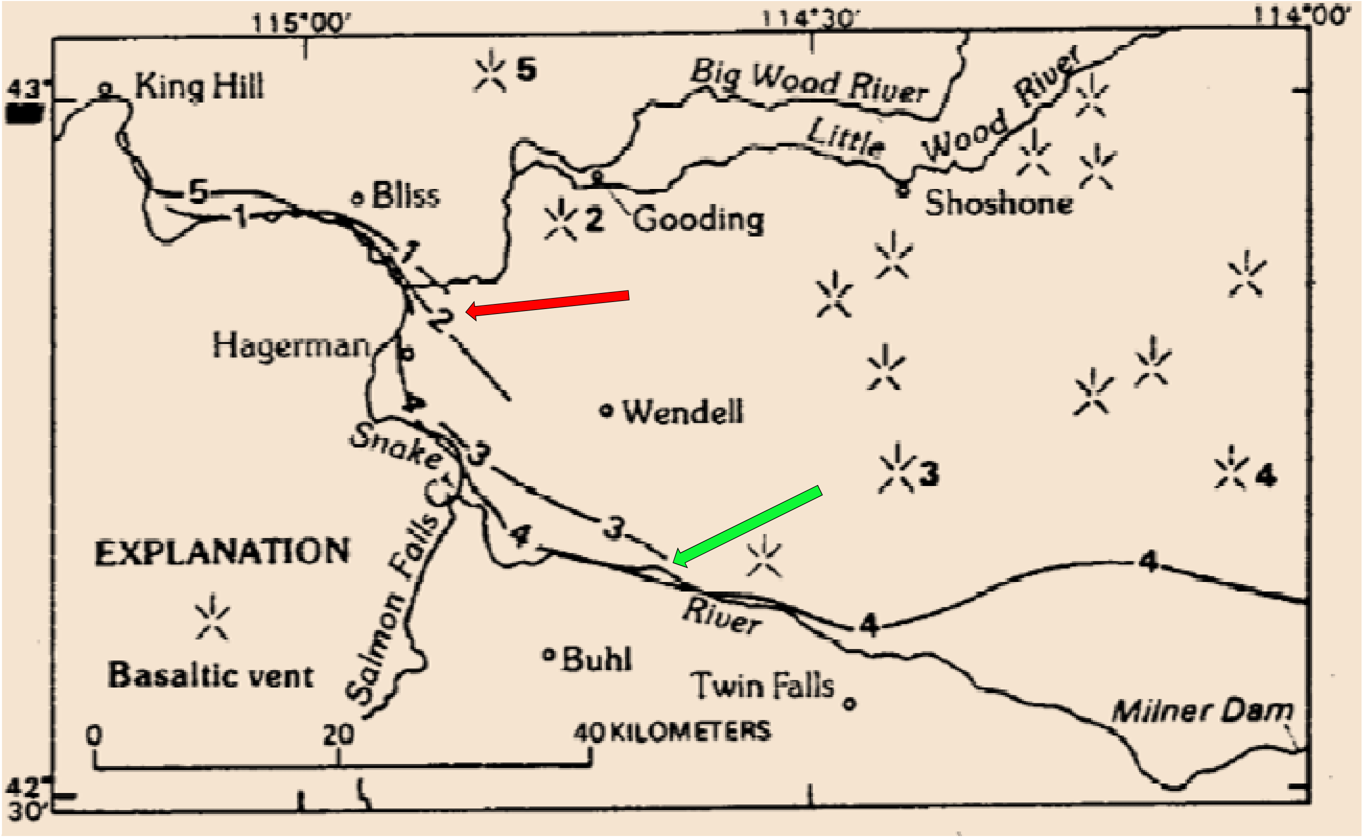


Figure 3. Map from Malde (1991) showing the approximate location of each ancestral canyon numbered 1 through 5 from oldest to youngest. Canyon #1 may be a major control for the dye traces south of Malad Gorge. Note the flow paths of the traces have the same azimuth as both Canyon #1 and #2. The canyons near the green arrow correlate with the depressed water table in the southeast corner of the contour lines in Figure 14.

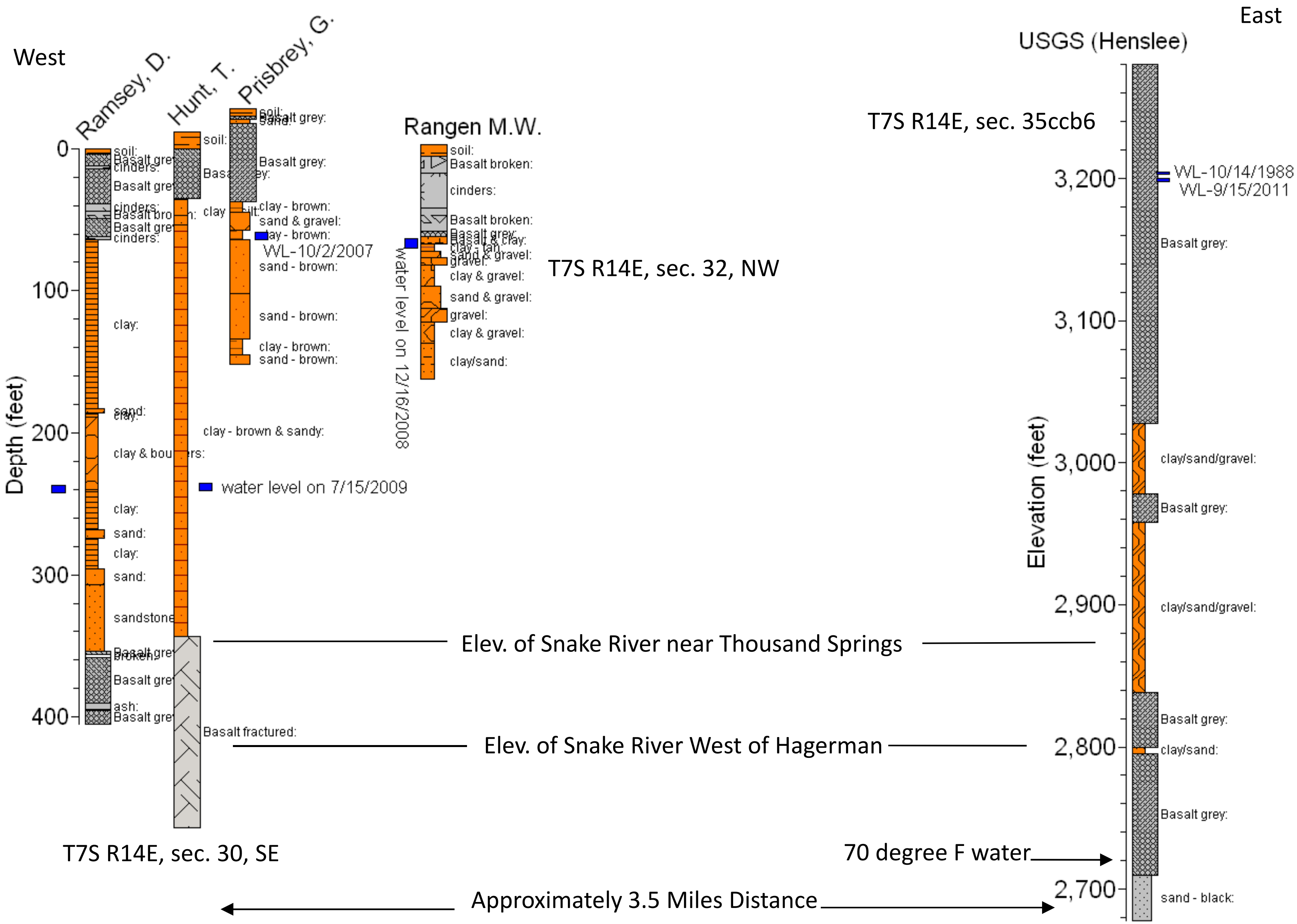


Figure 4. Geology of Vader grade area and USGS ‘Henslee’ well

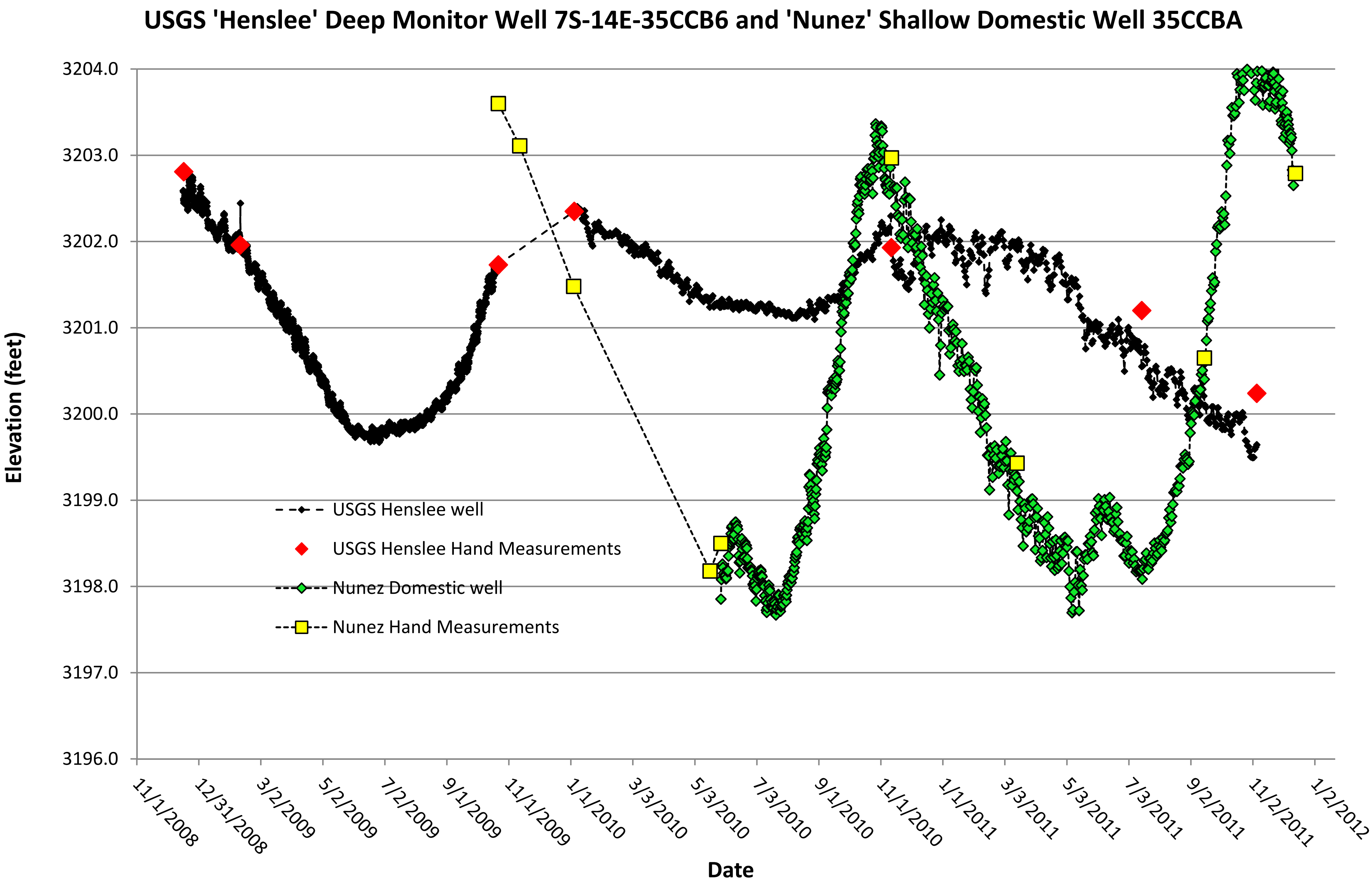


Figure 5. Hydrograph for USGS 'Henslee' well completed in the lower basalt.

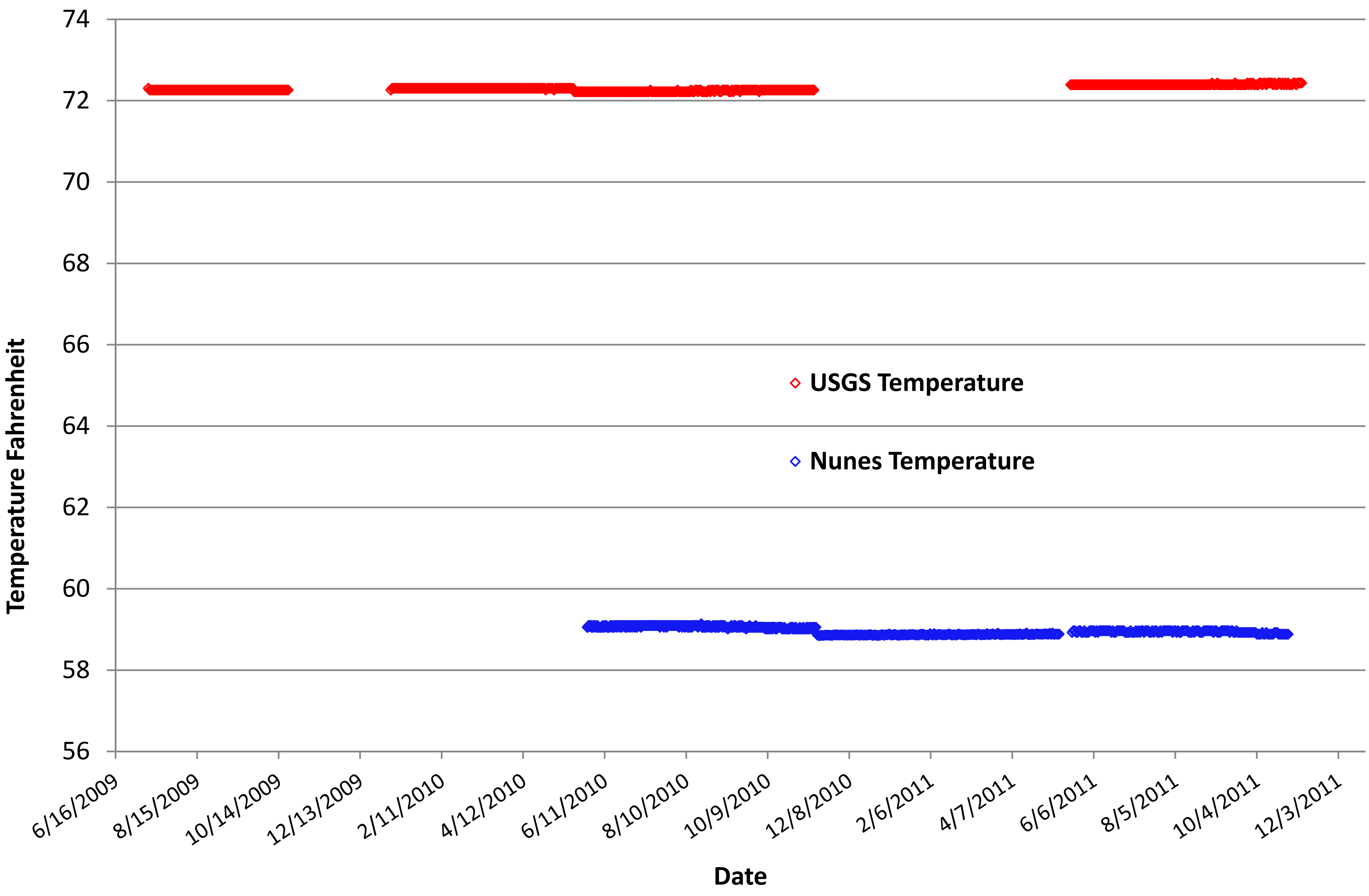


Figure 6. Temperature data for USGS Henslee well showing over 72 degree Fahrenheit water at 600 foot depth and the temperature for the 123 foot deep domestic well (Nunes D0023382) 60 feet south of the USGS well.

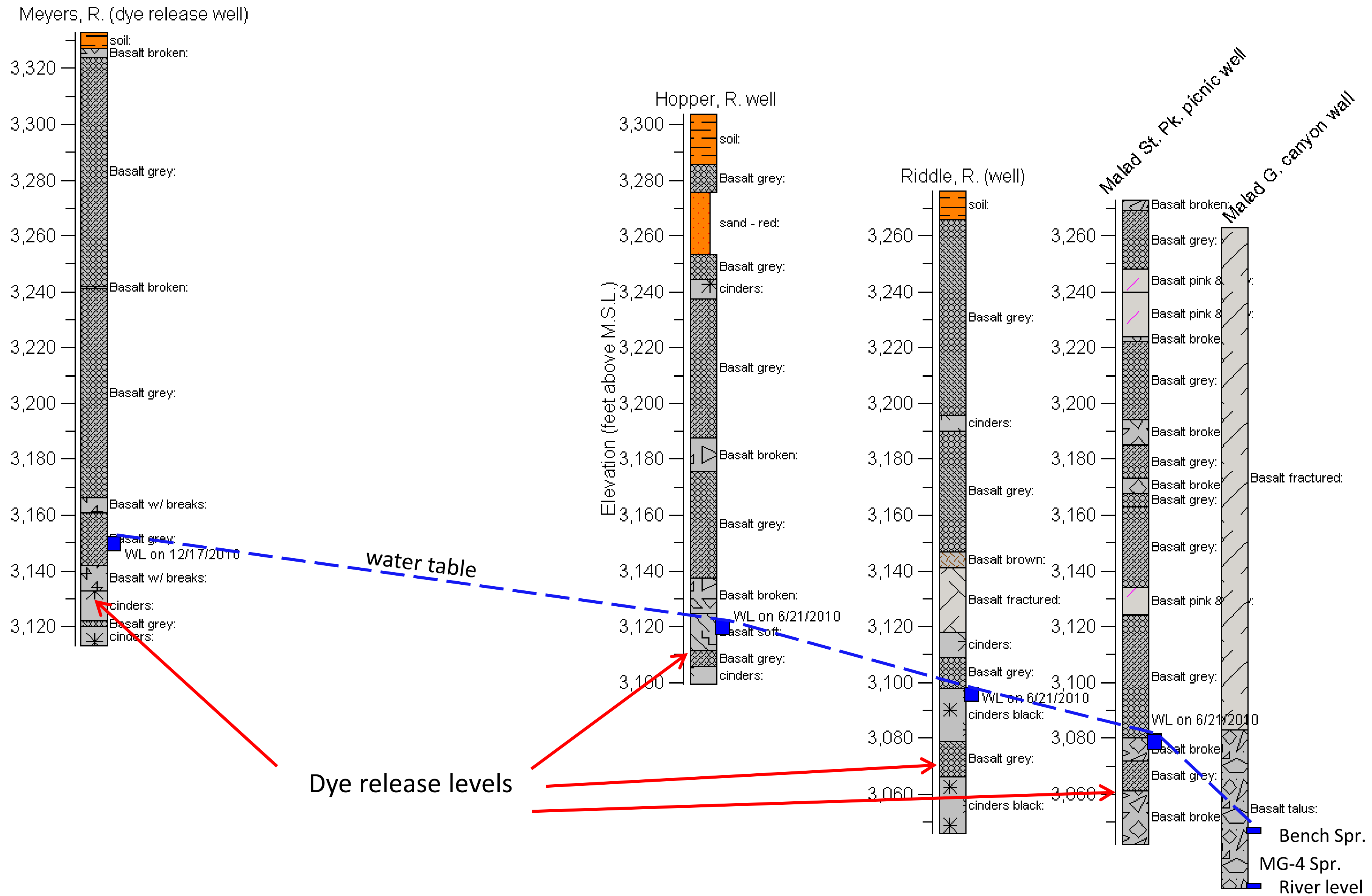


Figure 7. Geologic cross section of four wells and the Gorge wall showing elevations of dye release related to the geology and water table. The distance between the Meyer well and the Gorge is 2.26 miles. The Hopper well is about 1 mile and Riddle well about ½ mile.

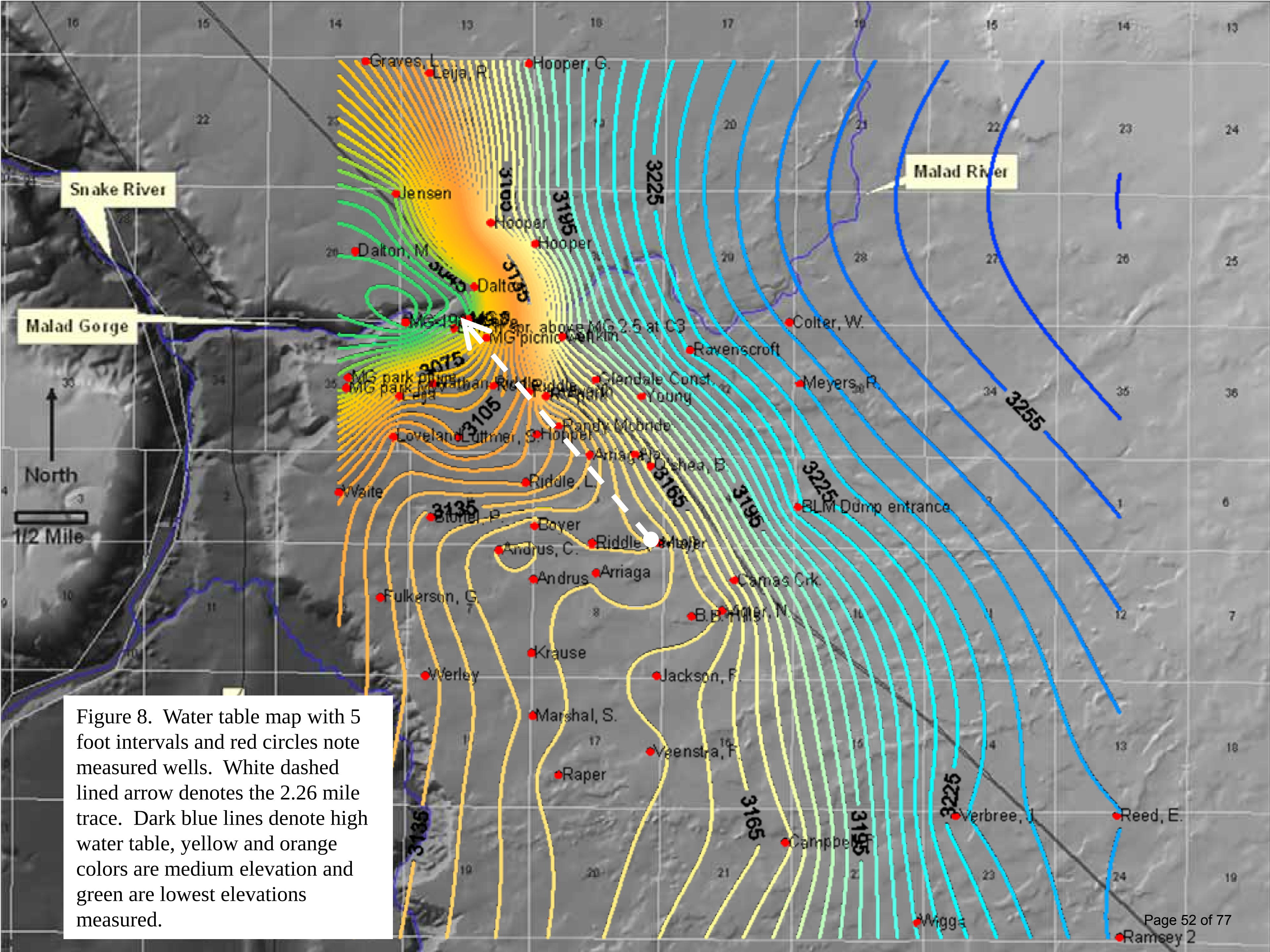


Figure 8. Water table map with 5 foot intervals and red circles note measured wells. White dashed lined arrow denotes the 2.26 mile trace. Dark blue lines denote high water table, yellow and orange colors are medium elevation and green are lowest elevations measured.

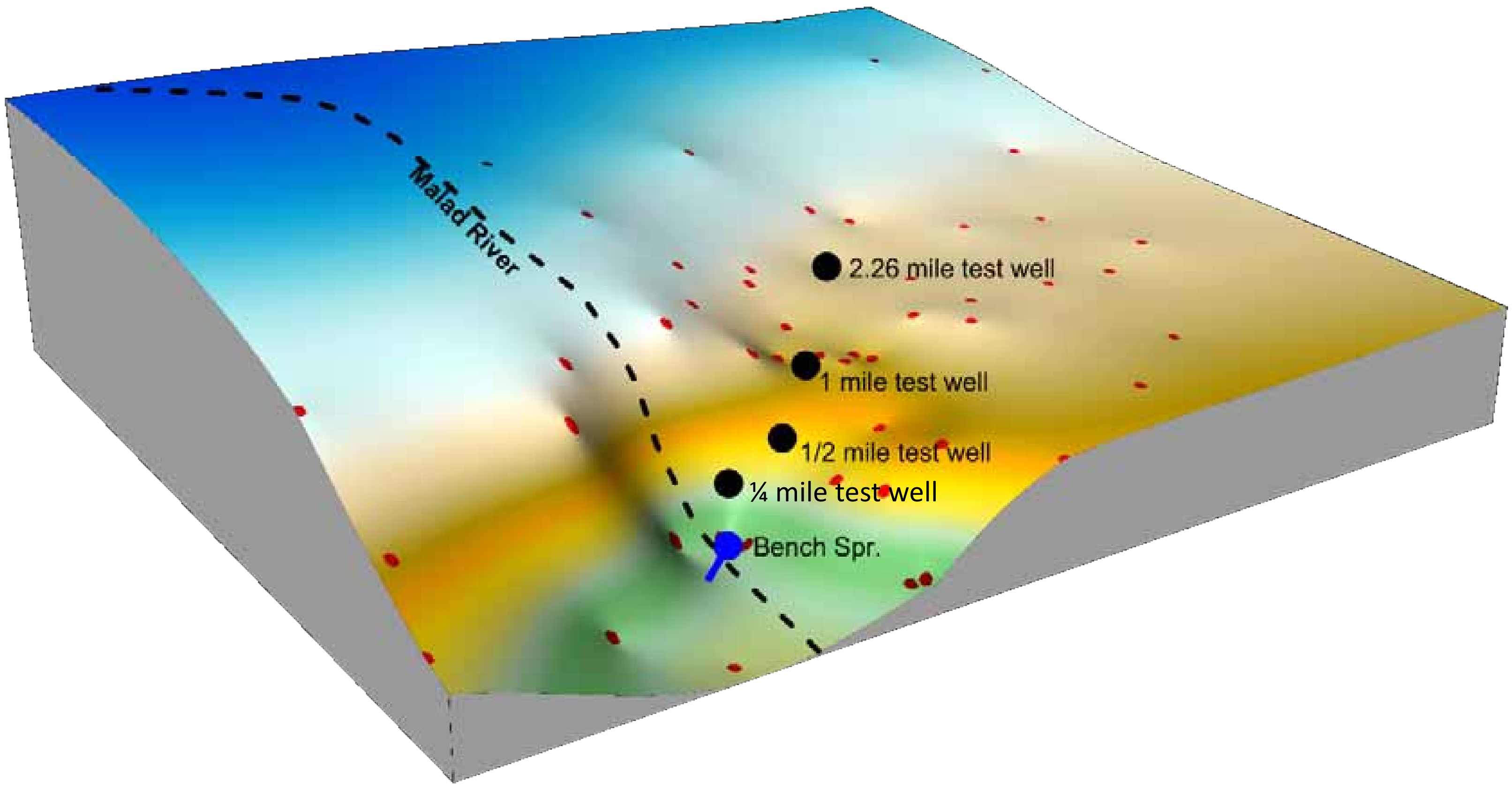


Figure 9. 3-D water table map with locations of tracer test wells in the same flow path. Note the steep water table around Malad Gorge where the 'Bench' spring is located. View angle is to the southeast.

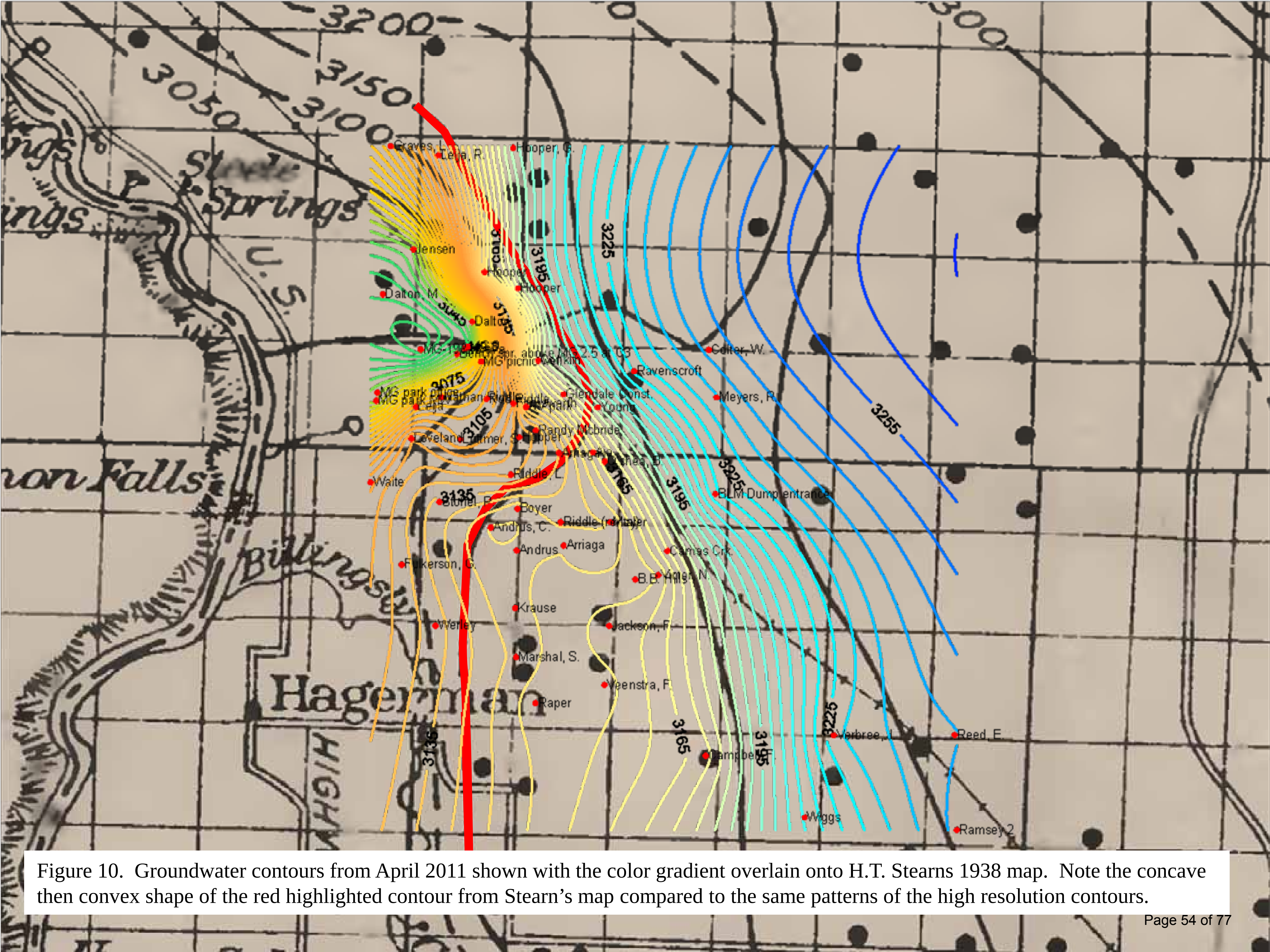


Figure 10. Groundwater contours from April 2011 shown with the color gradient overlain onto H.T. Stearns 1938 map. Note the concave then convex shape of the red highlighted contour from Stearn's map compared to the same patterns of the high resolution contours.

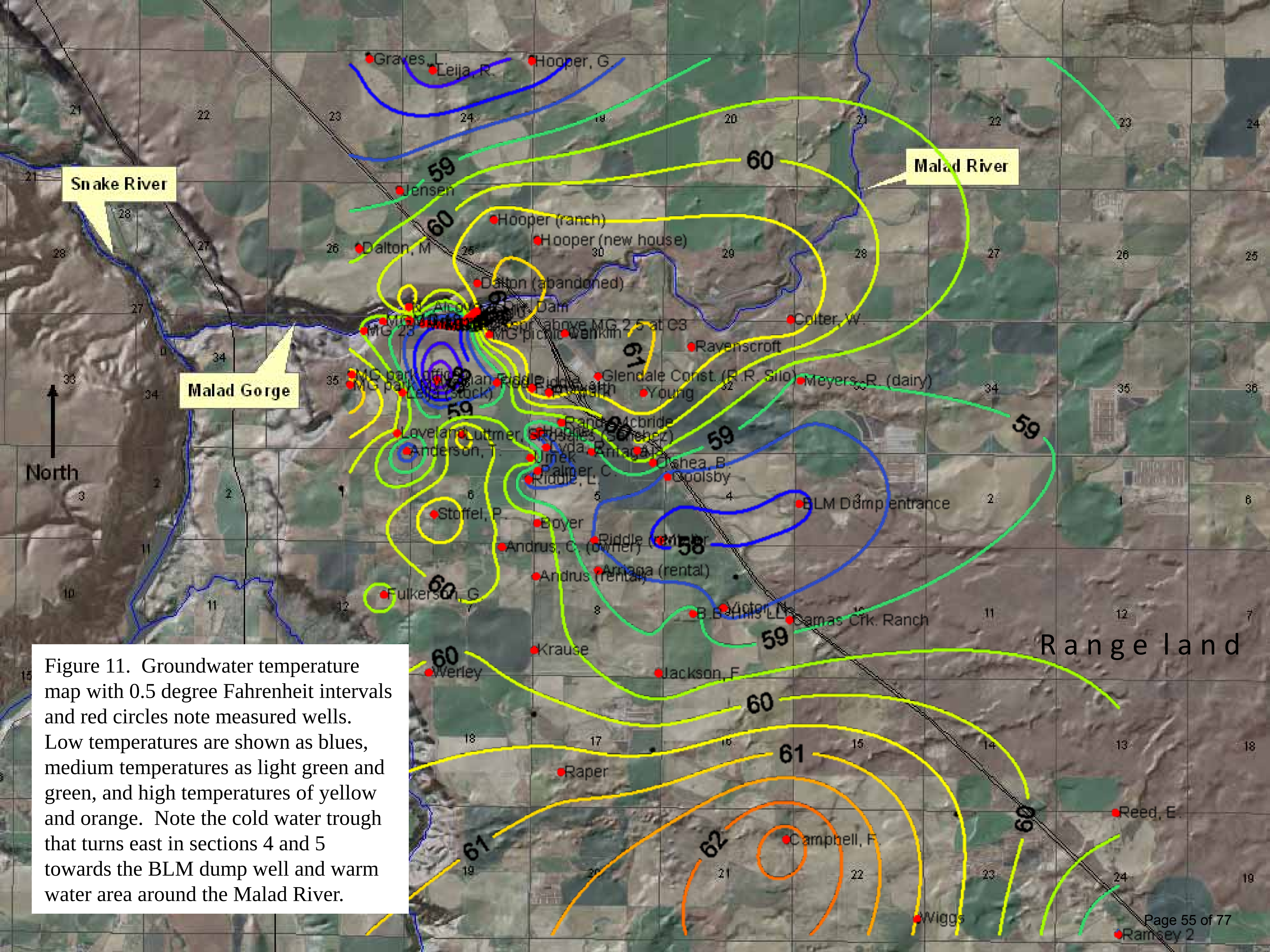


Figure 11. Groundwater temperature map with 0.5 degree Fahrenheit intervals and red circles note measured wells. Low temperatures are shown as blues, medium temperatures as light green and green, and high temperatures of yellow and orange. Note the cold water trough that turns east in sections 4 and 5 towards the BLM dump well and warm water area around the Malad River.

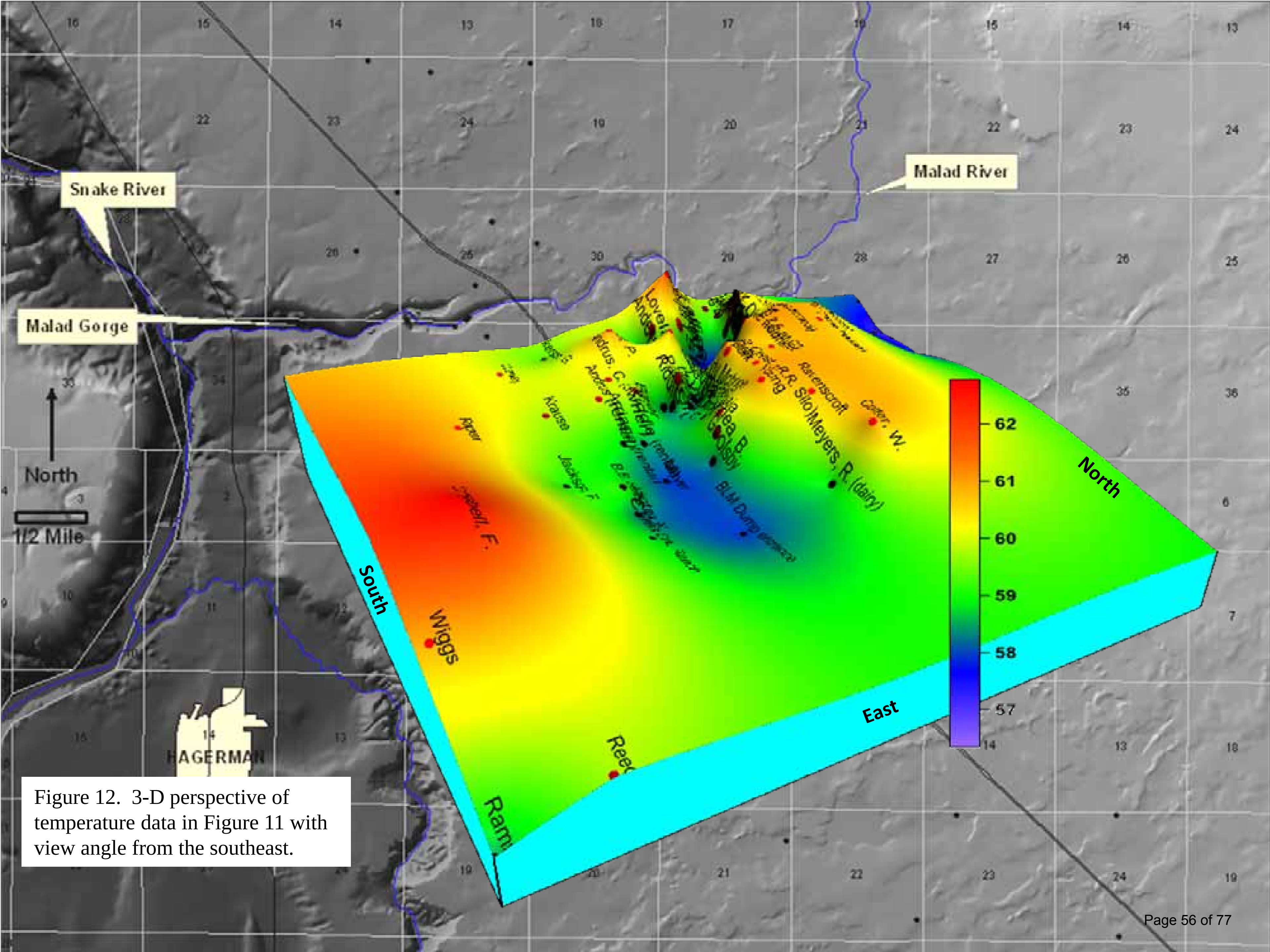


Figure 12. 3-D perspective of temperature data in Figure 11 with view angle from the southeast.

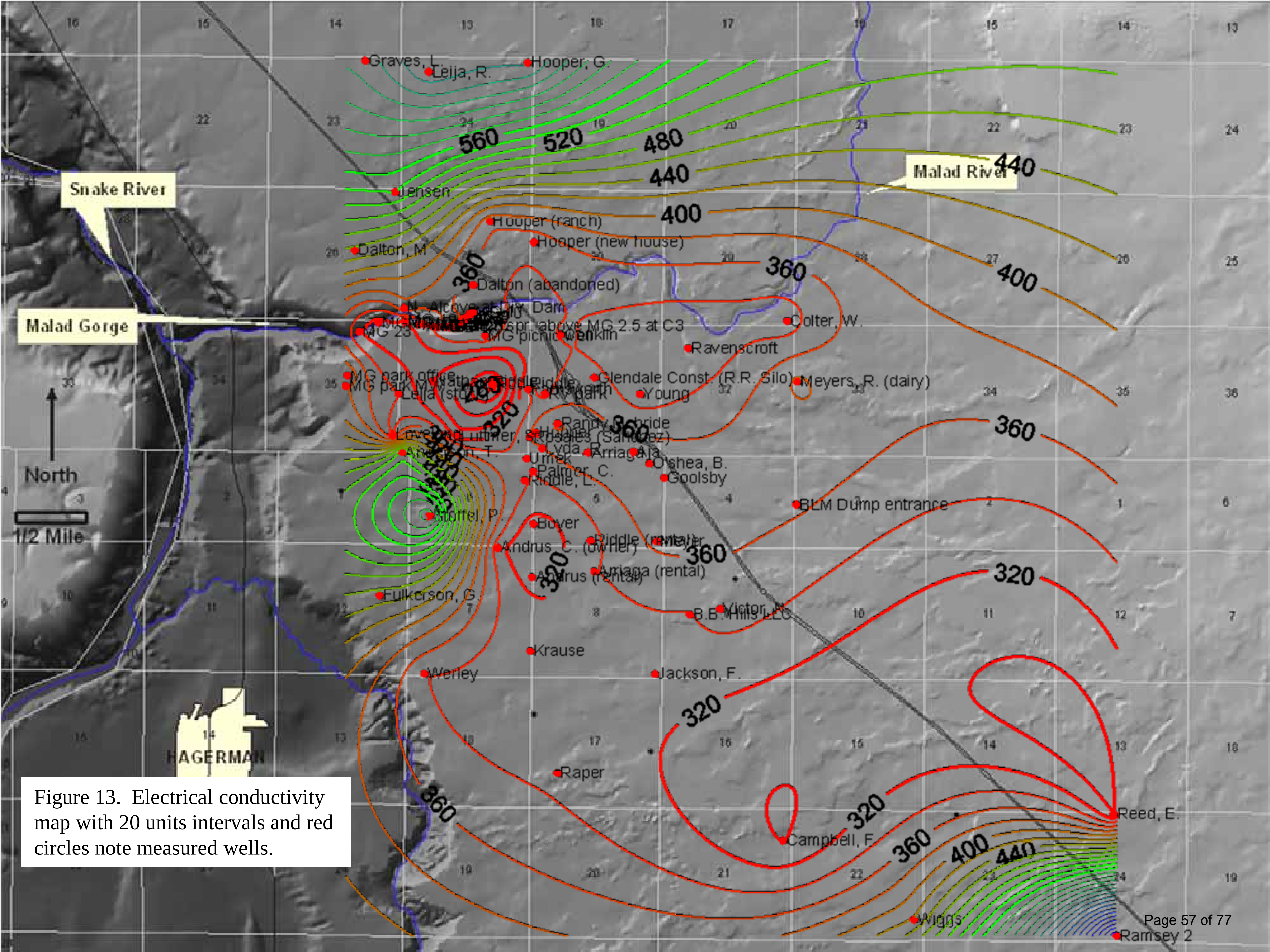


Figure 13. Electrical conductivity map with 20 units intervals and red circles note measured wells.

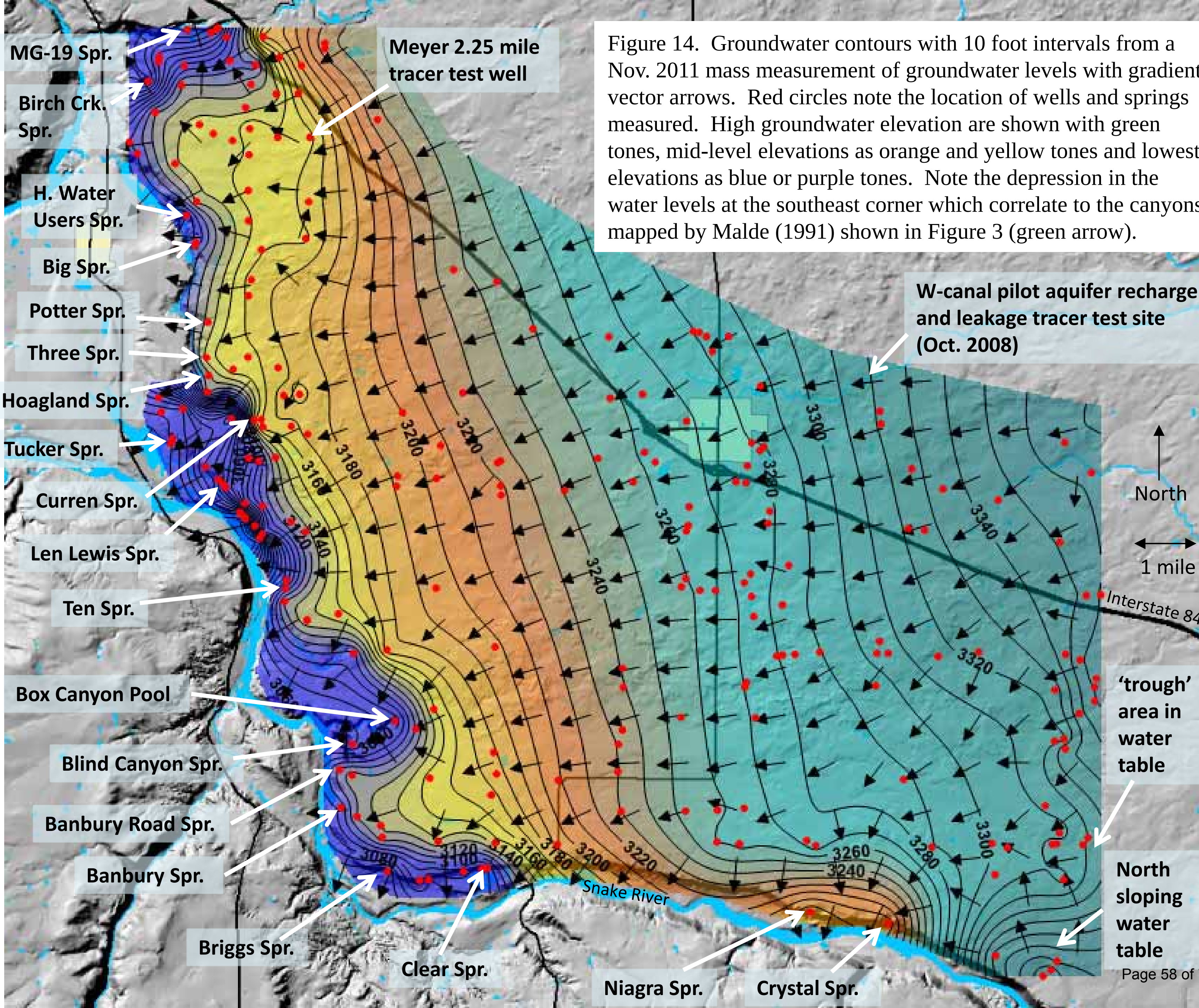


Figure 14. Groundwater contours with 10 foot intervals from a Nov. 2011 mass measurement of groundwater levels with gradient vector arrows. Red circles note the location of wells and springs measured. High groundwater elevation are shown with green tones, mid-level elevations as orange and yellow tones and lowest elevations as blue or purple tones. Note the depression in the water levels at the southeast corner which correlate to the canyons mapped by Malde (1991) shown in Figure 3 (green arrow).

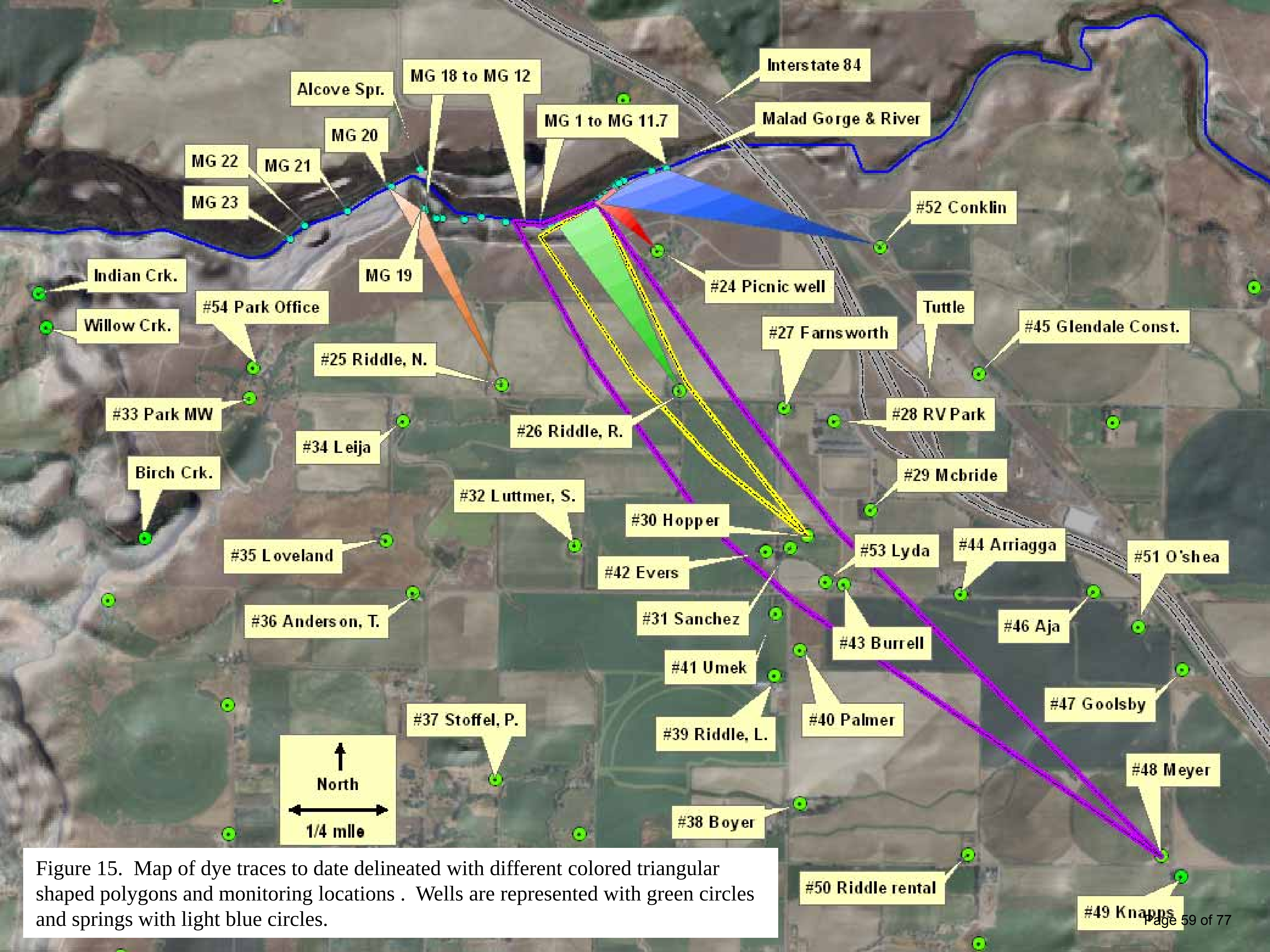
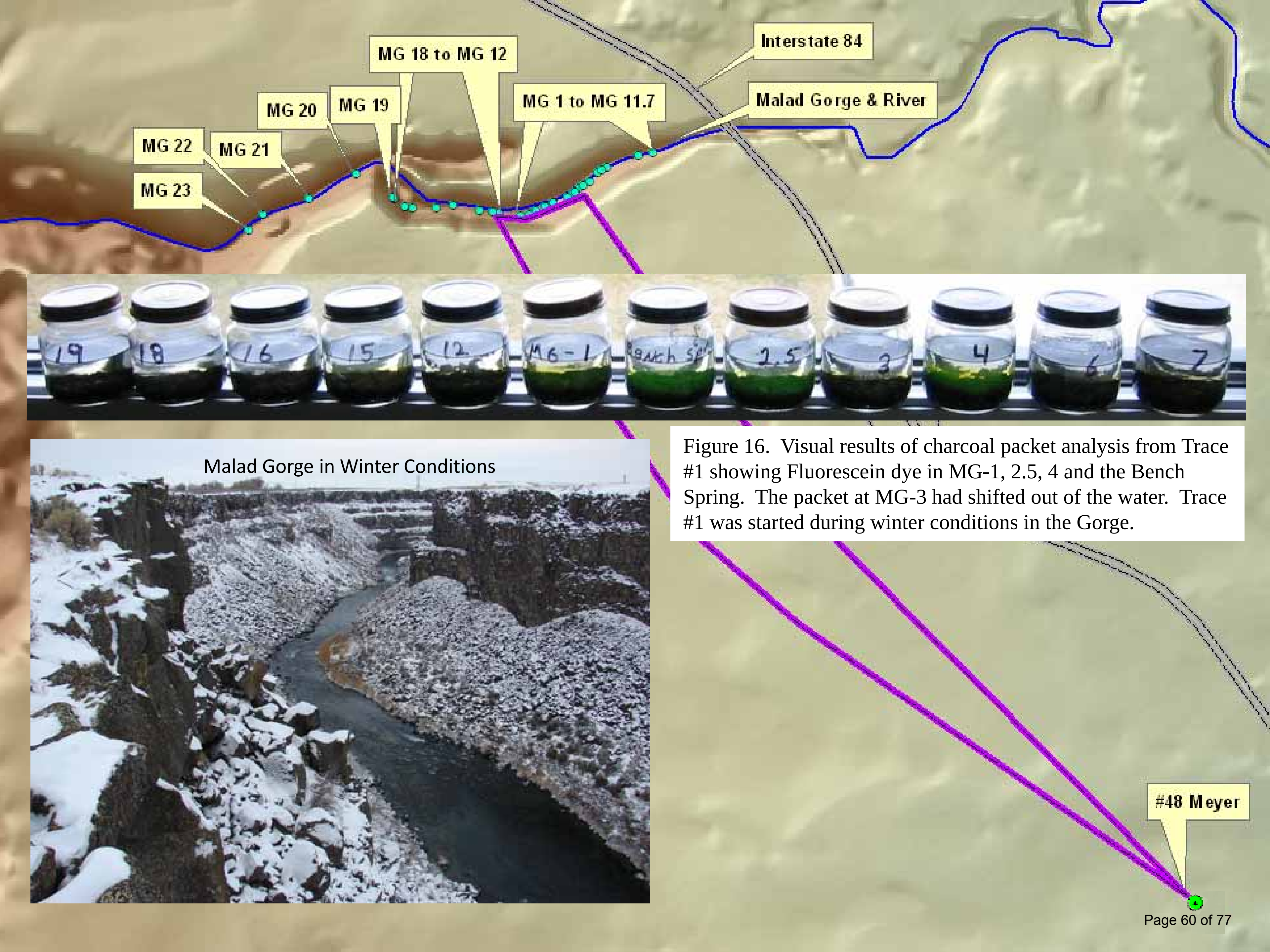


Figure 15. Map of dye traces to date delineated with different colored triangular shaped polygons and monitoring locations . Wells are represented with green circles and springs with light blue circles.



Malad Gorge in Winter Conditions

Figure 16. Visual results of charcoal packet analysis from Trace #1 showing Fluorescein dye in MG-1, 2.5, 4 and the Bench Spring. The packet at MG-3 had shifted out of the water. Trace #1 was started during winter conditions in the Gorge.

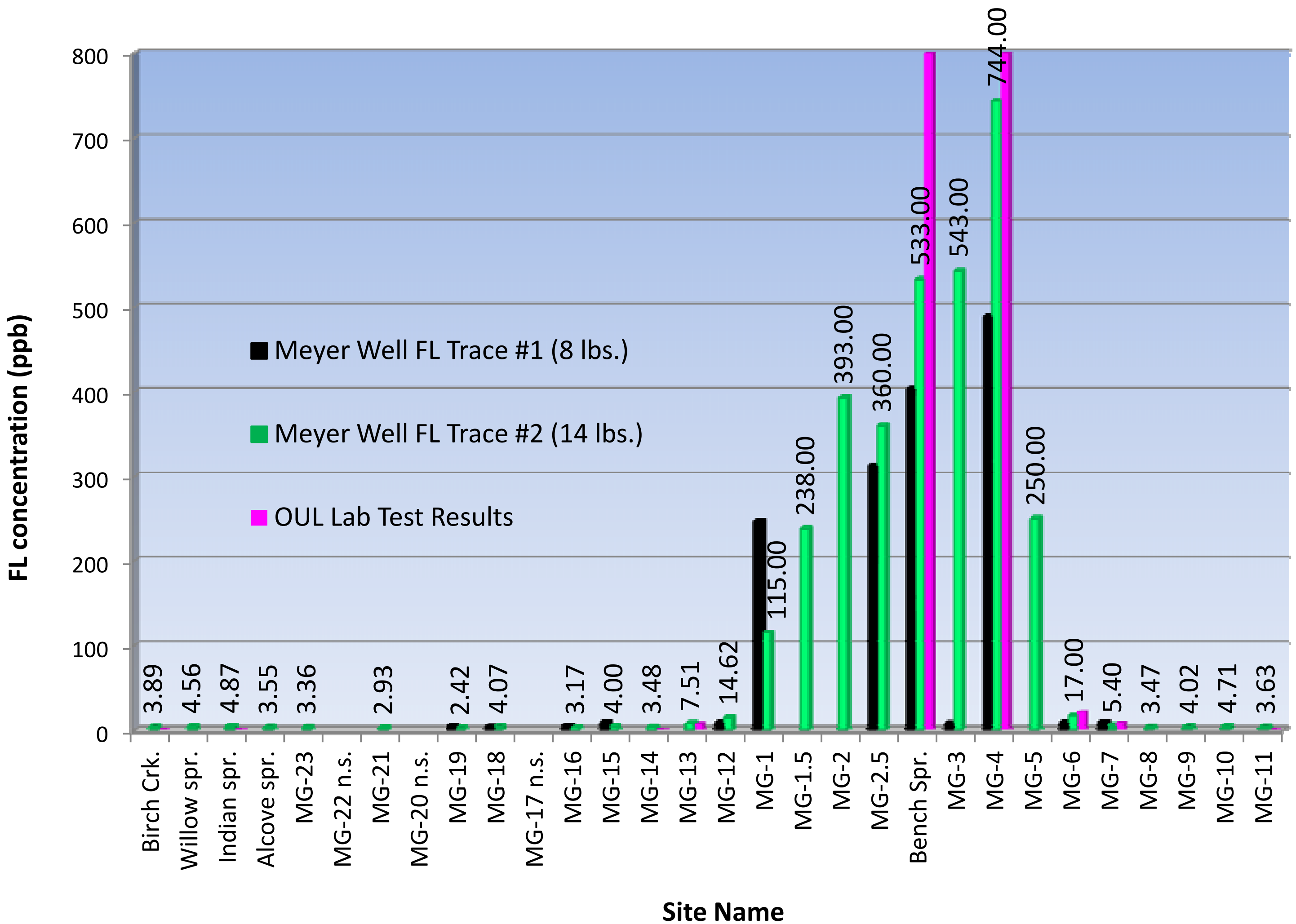


Figure 17. Charcoal packet results from springs in the Gorge and other nearby springs for both Meyer Well #48 traces along with lab analysis results (pink bars) from the second test. Note the increase in concentrations in the springs that correspond to an increase of dye released from 8 pounds to 14 pounds. MG-1 appears to have a lab error. Numerical values shown on graph are for Trace #2 results only.

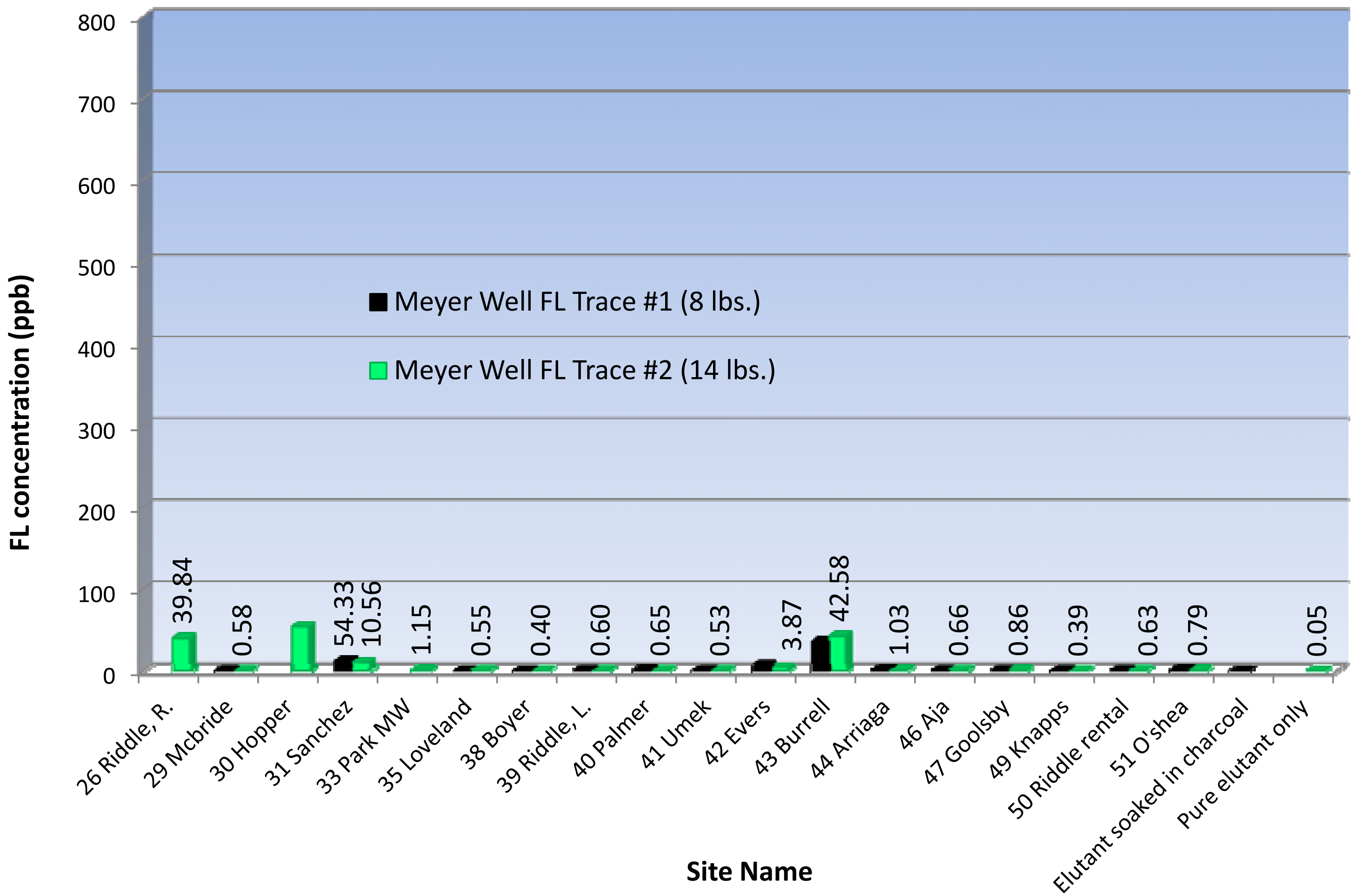


Figure 18. Charcoal packet results from toilet tanks (essentially wells) for both Meyer Well #48 traces. Note the increase in concentration in the charcoal packet at well #43 Burrell which corresponds to an increase in dye released from 8 to 14 pounds of dye released. Toilet use patterns, storage in the pressure tank and delivery pipe, and depth to pump intake all effect the results of toilet tank methods of detection with charcoal packets. Raw numerical values for Trace #2 are shown on the same vertical scale as Figure 16 and they are not adjusted to the pure elutant tested after soaking in unused charcoal.

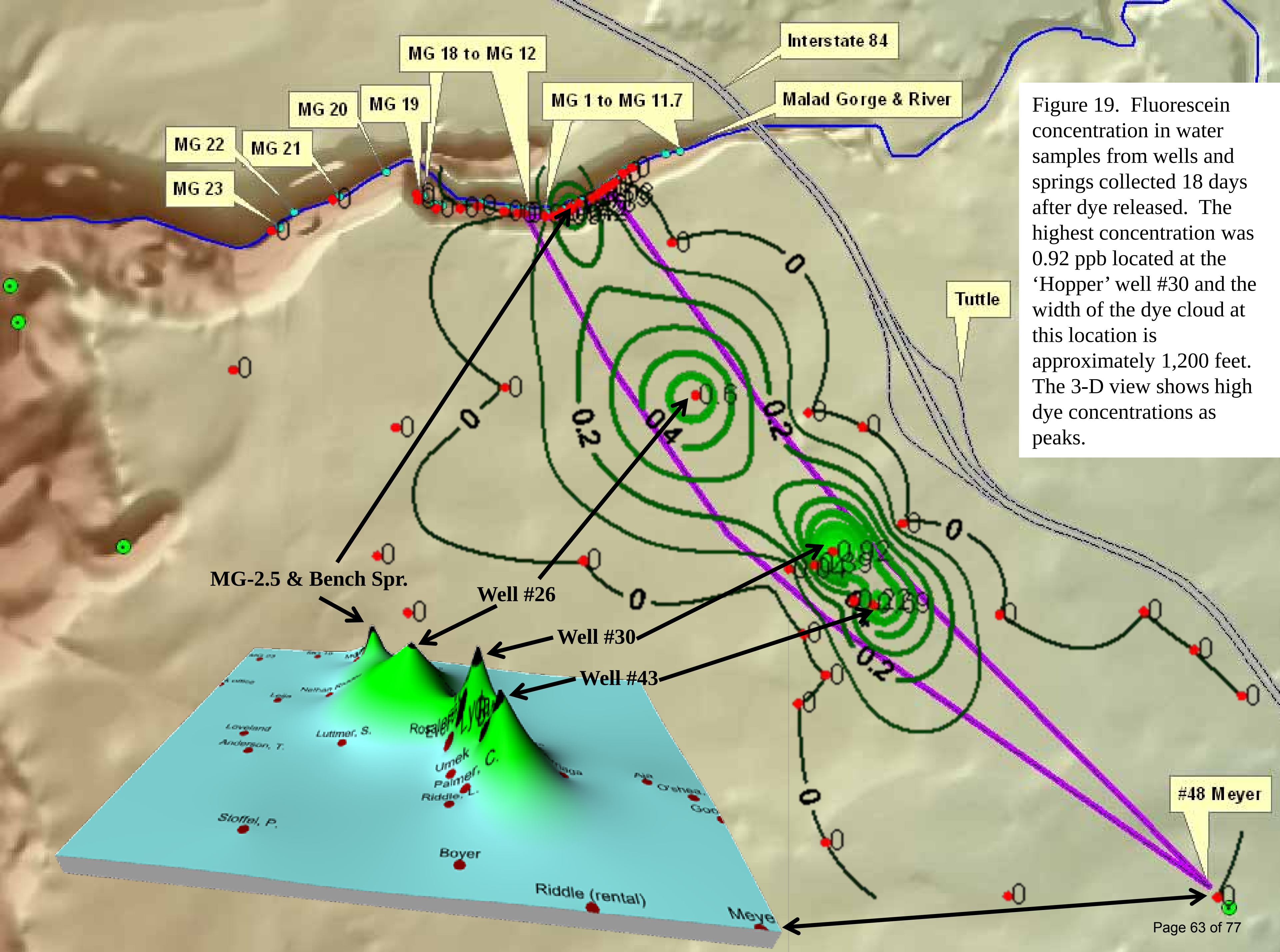


Figure 19. Fluorescein concentration in water samples from wells and springs collected 18 days after dye released. The highest concentration was 0.92 ppb located at the ‘Hopper’ well #30 and the width of the dye cloud at this location is approximately 1,200 feet. The 3-D view shows high dye concentrations as peaks.

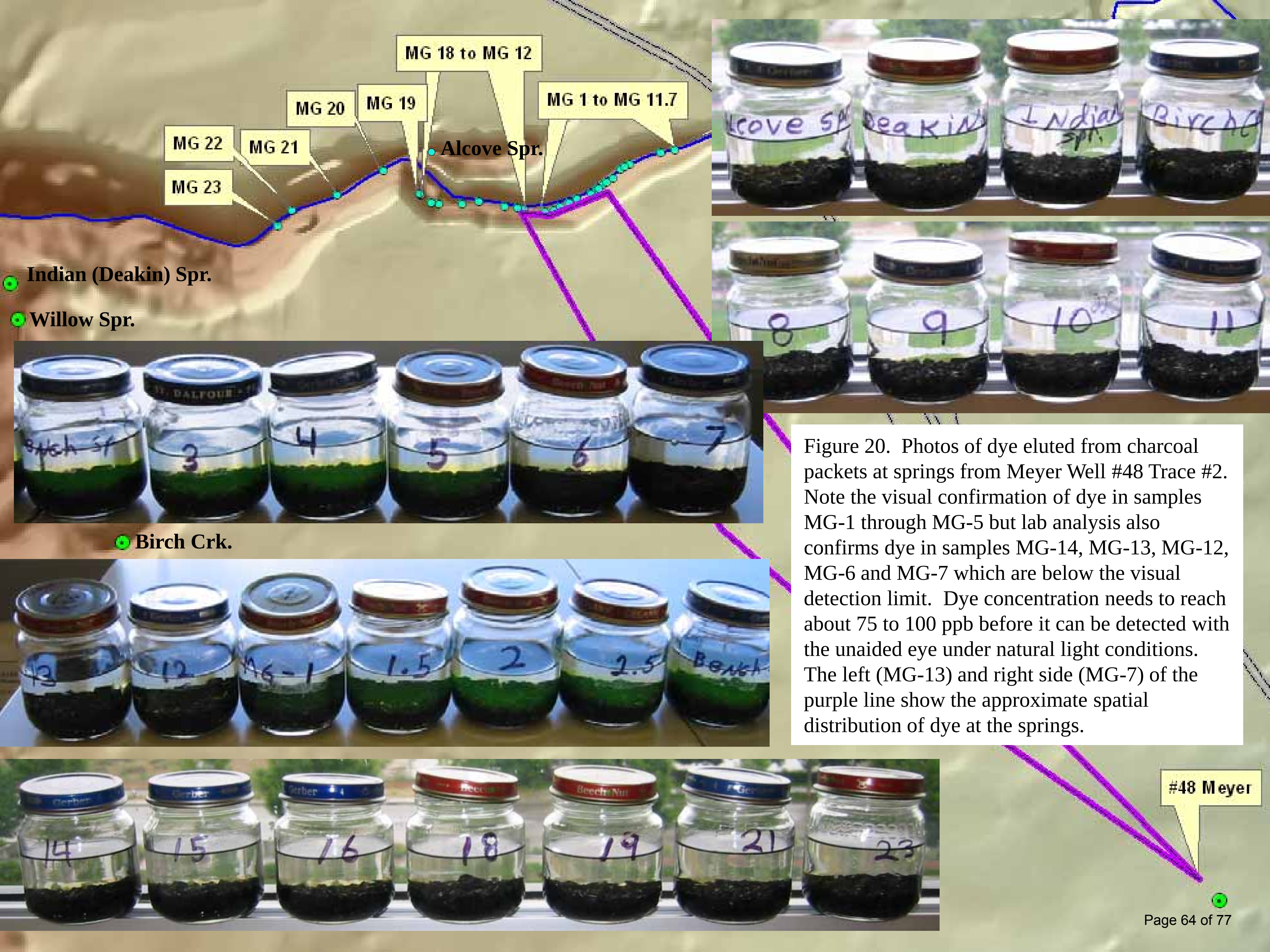


Figure 20. Photos of dye eluted from charcoal packets at springs from Meyer Well #48 Trace #2. Note the visual confirmation of dye in samples MG-1 through MG-5 but lab analysis also confirms dye in samples MG-14, MG-13, MG-12, MG-6 and MG-7 which are below the visual detection limit. Dye concentration needs to reach about 75 to 100 ppb before it can be detected with the unaided eye under natural light conditions. The left (MG-13) and right side (MG-7) of the purple line show the approximate spatial distribution of dye at the springs.

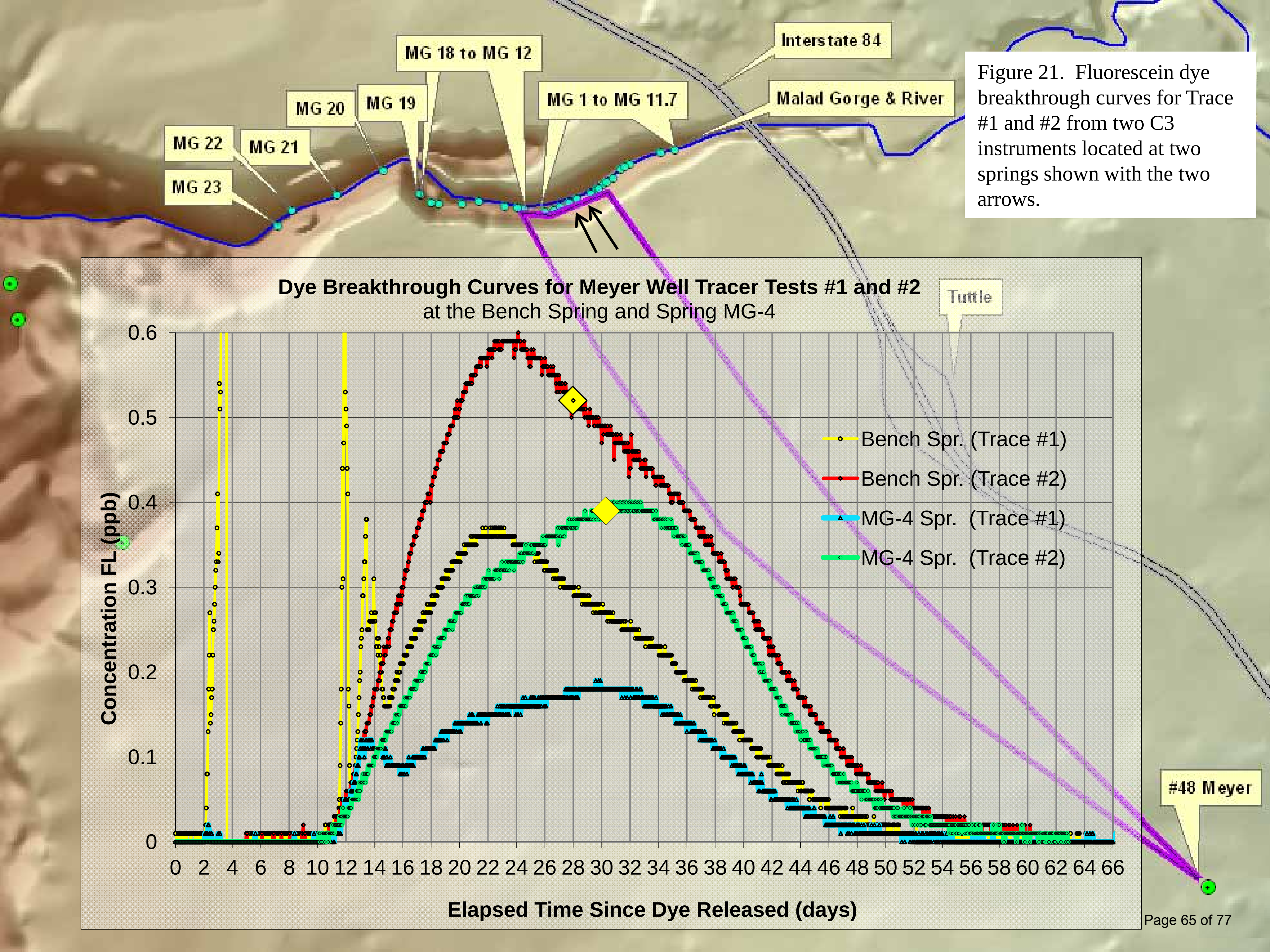


Figure 21. Fluorescein dye breakthrough curves for Trace #1 and #2 from two C3 instruments located at two springs shown with the two arrows.

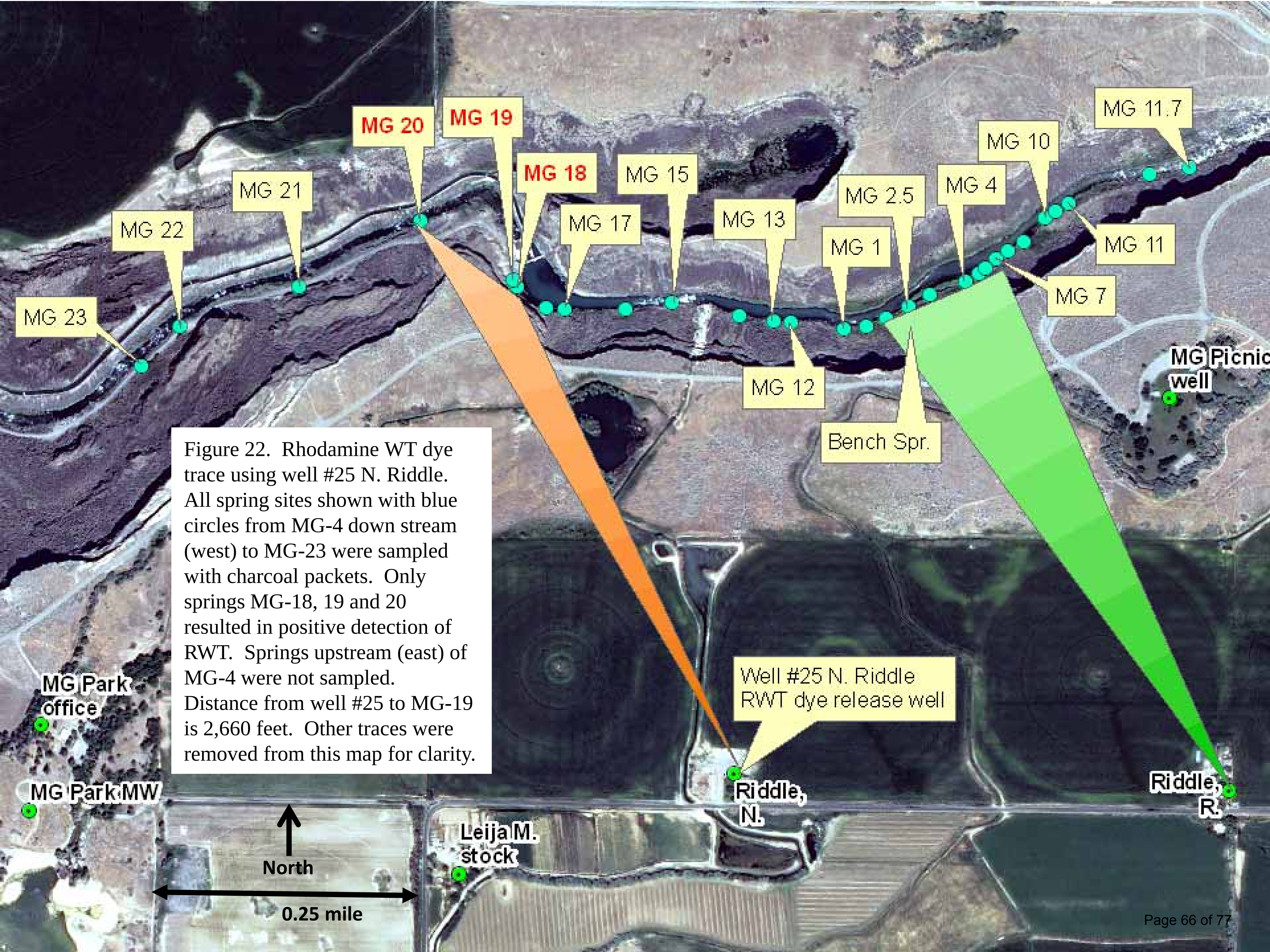


Figure 22. Rhodamine WT dye trace using well #25 N. Riddle. All spring sites shown with blue circles from MG-4 down stream (west) to MG-23 were sampled with charcoal packets. Only springs MG-18, 19 and 20 resulted in positive detection of RWT. Springs upstream (east) of MG-4 were not sampled. Distance from well #25 to MG-19 is 2,660 feet. Other traces were removed from this map for clarity.

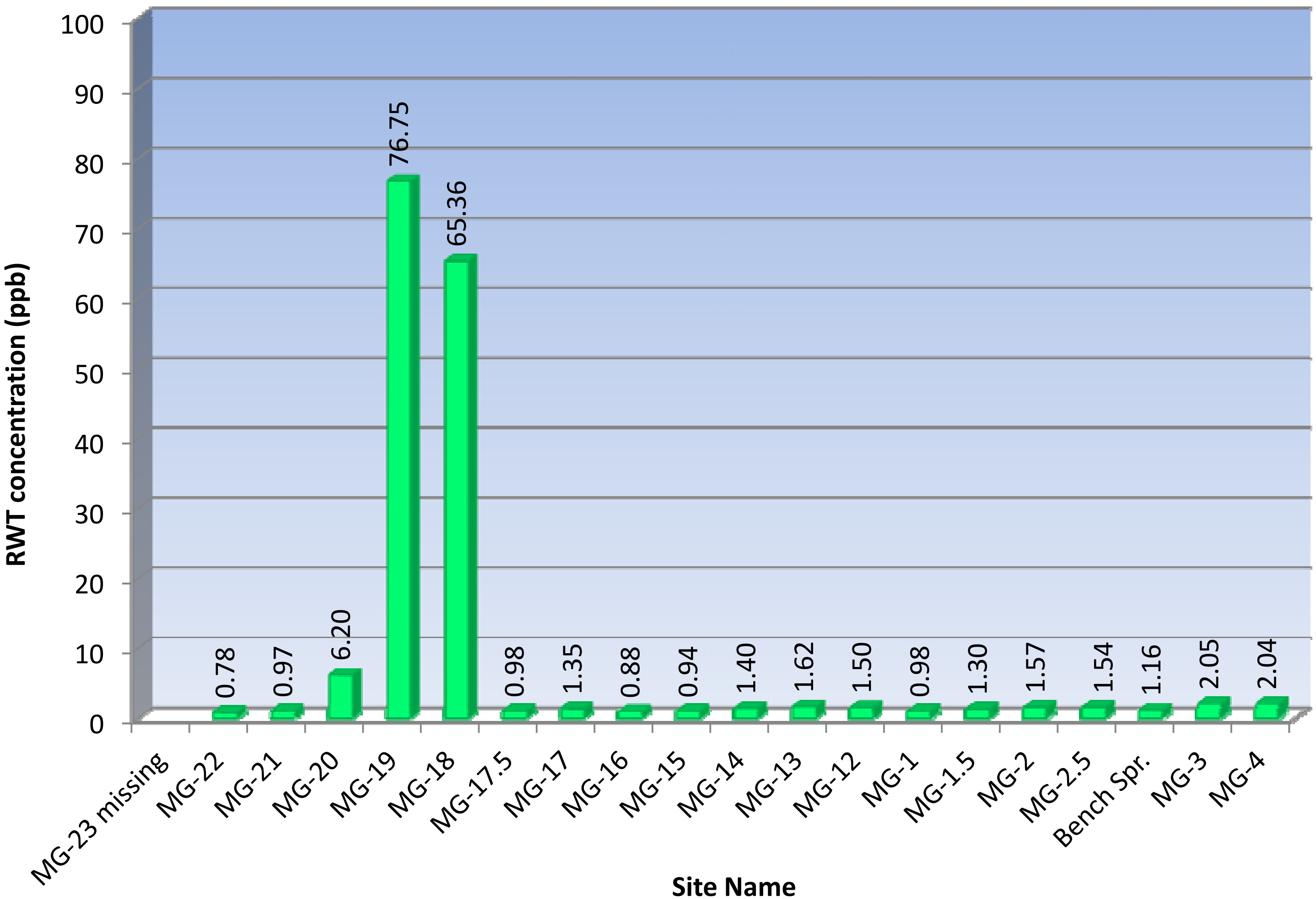


Figure 23. Graph of results from charcoal packets for N. Riddle well #25 Rhodamine WT trace. Dye was detected with positive results at sites MG-18, 19 and 20 at about 50 to 70 times above the ambient background fluorescence with the remaining sites negative. MG-23 was missing.

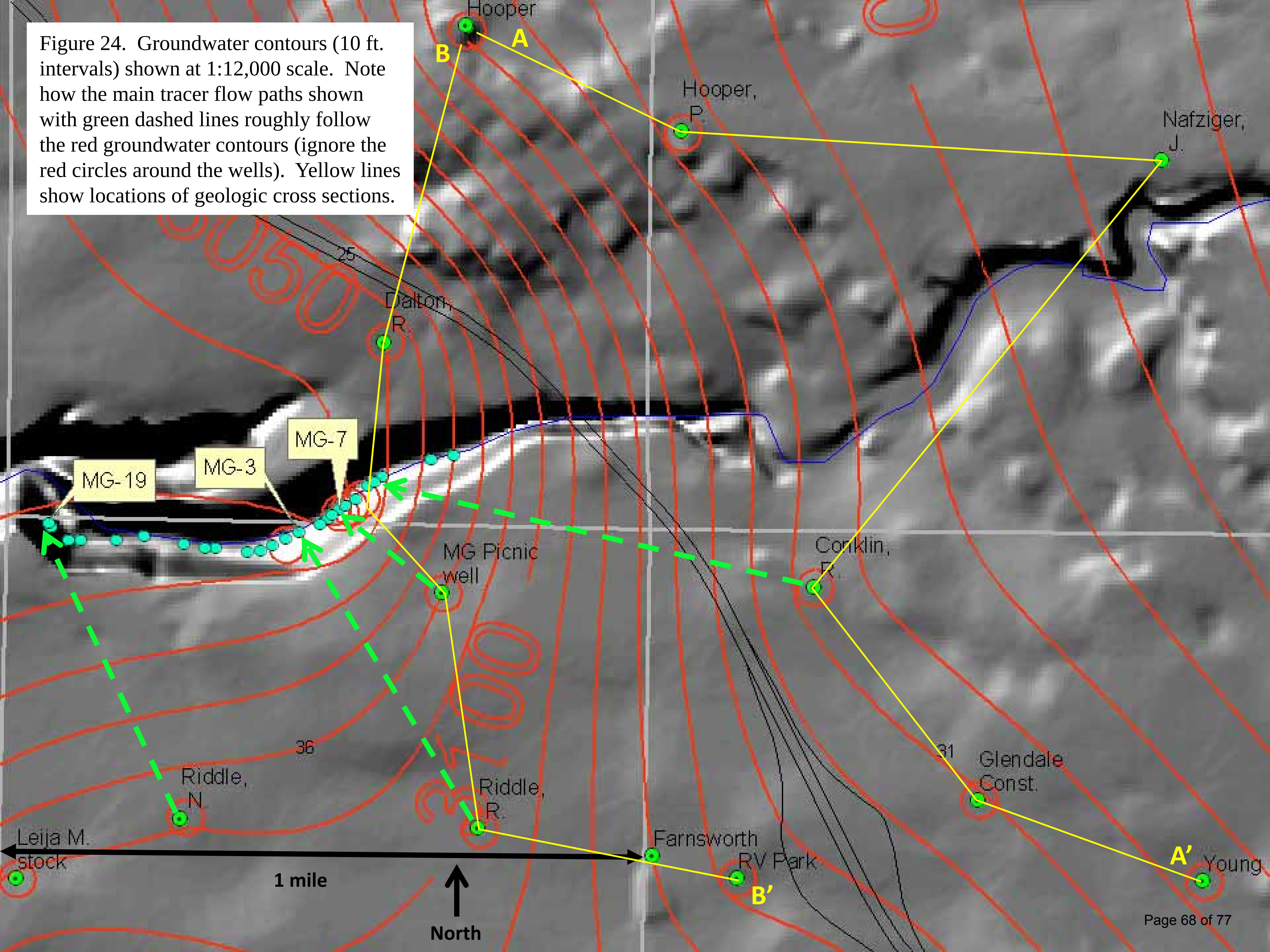


Figure 24. Groundwater contours (10 ft. intervals) shown at 1:12,000 scale. Note how the main tracer flow paths shown with green dashed lines roughly follow the red groundwater contours (ignore the red circles around the wells). Yellow lines show locations of geologic cross sections.

Geologic Cross Section A-A'

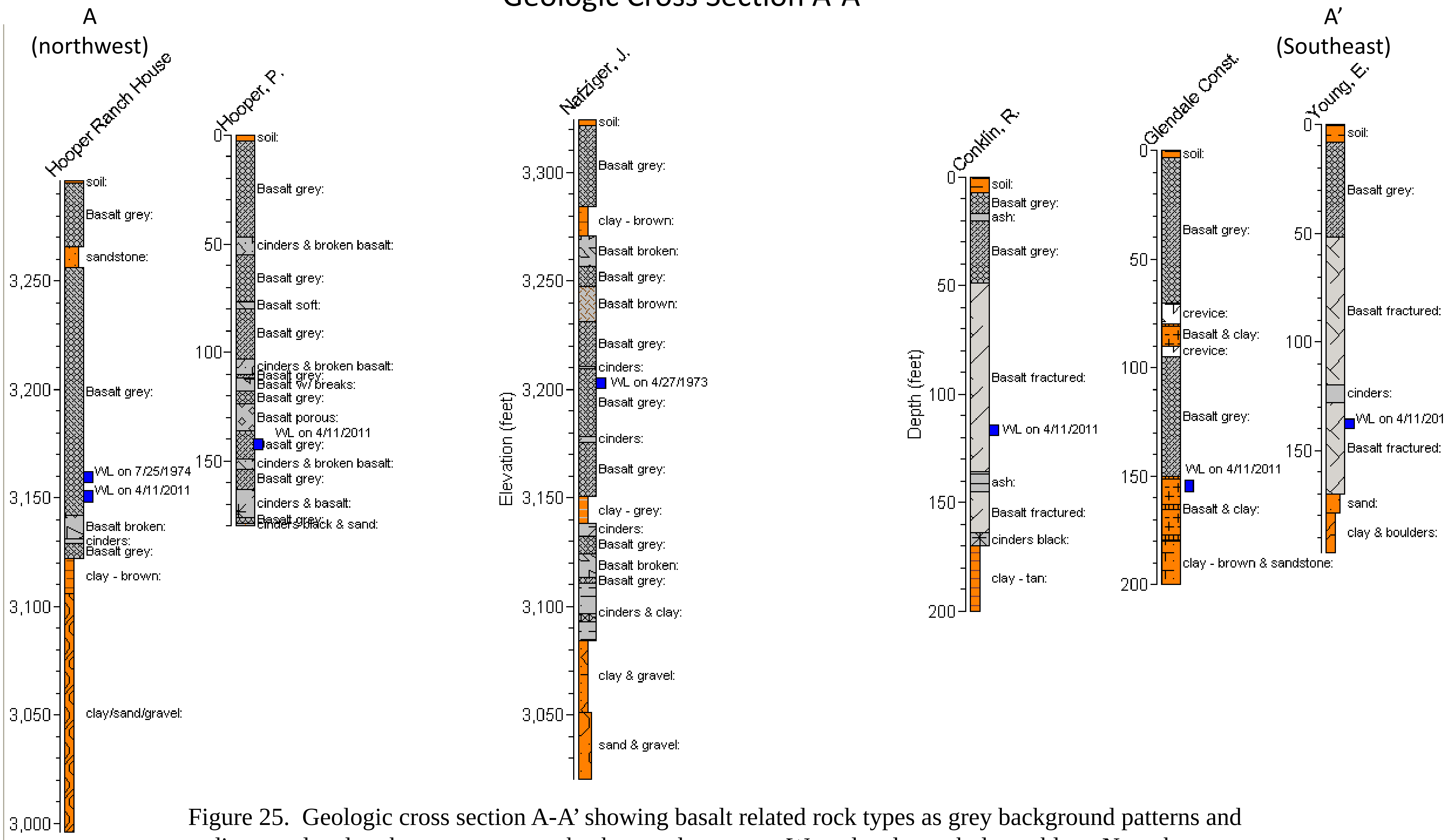


Figure 25. Geologic cross section A-A' showing basalt related rock types as grey background patterns and sediment related rock types as orange background patterns. Water levels symbols are blue. Note the thickness of the sediments in the lower levels of the wells ranging from about 50 to 120 feet which would be atypical for paleosol interbeds and suggest this is the top of the Tuana Gravel and/or Glenns Ferry Formations.

Geologic Cross Section B-B’

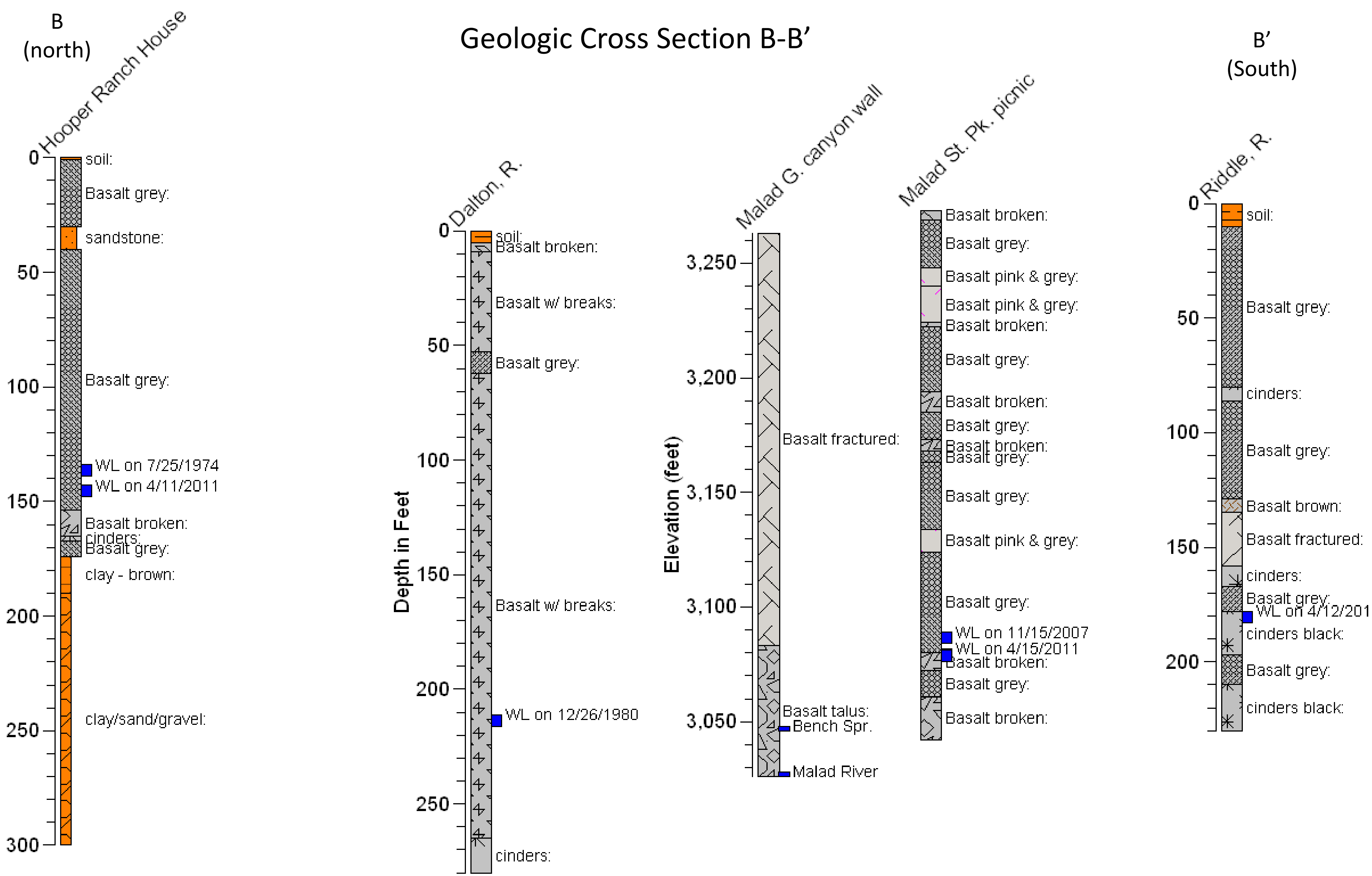
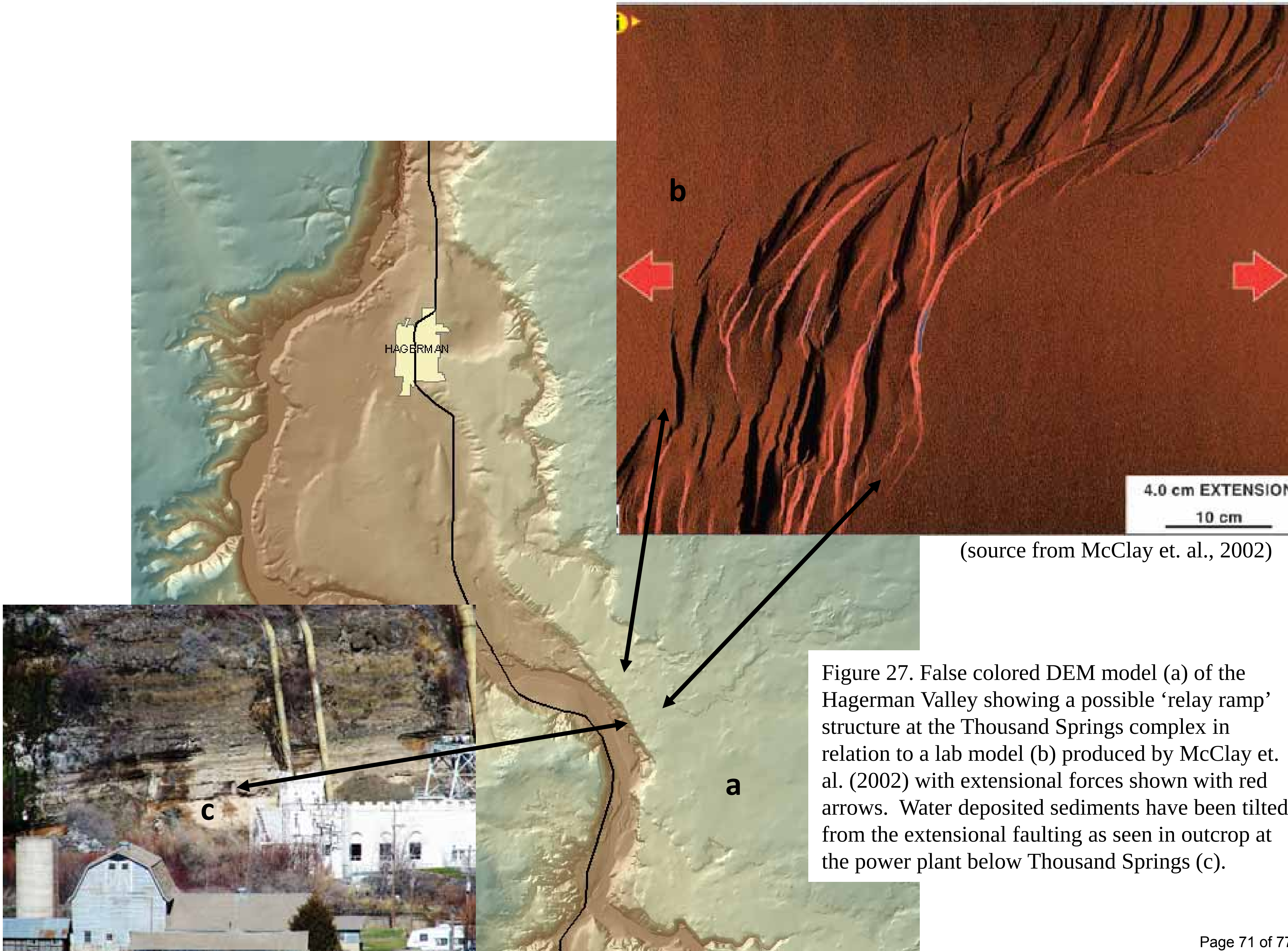


Figure 26. Geologic cross section B-B’ showing basalt related rock types as grey background patterns and sediment related rock types as orange background patterns. Water levels symbols are blue. Note the lack of sediments near the Malad Gorge at these depths compared to cross section A-A’ east of the Gorge.



(source from McClay et. al., 2002)

Figure 27. False colored DEM model (a) of the Hagerman Valley showing a possible ‘relay ramp’ structure at the Thousand Springs complex in relation to a lab model (b) produced by McClay et. al. (2002) with extensional forces shown with red arrows. Water deposited sediments have been tilted from the extensional faulting as seen in outcrop at the power plant below Thousand Springs (c).

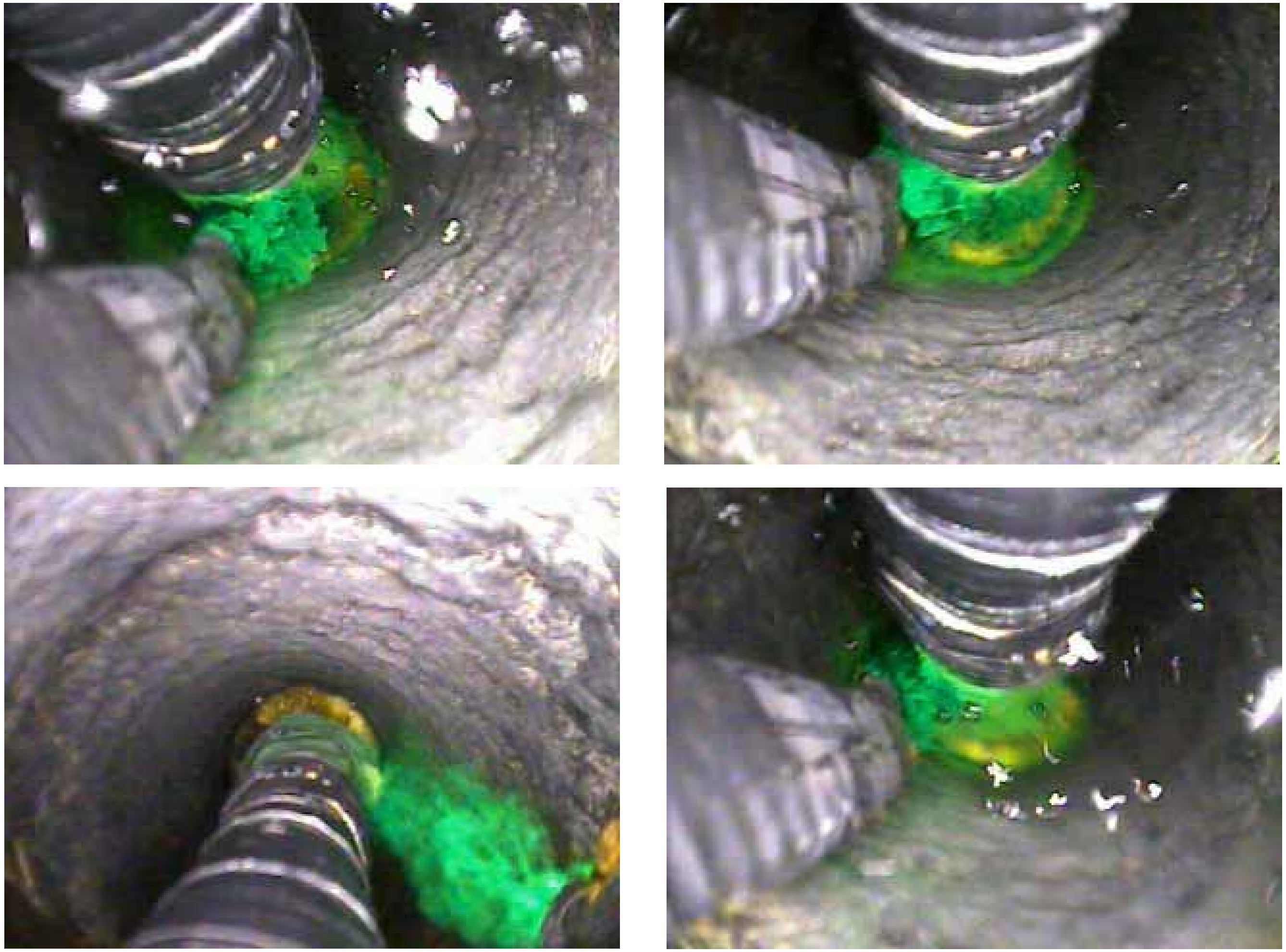


Figure 28. Fluorescein dye being released in the Conklin Well #52 through poly-tubing with the top of the pump column visible. The well is 6 inches in diameter and the dye release tubing is about ½ inch in diameter. Due to the strong downward flow in the well the dye was carried past the pump and out of the well. Large air bubbles traveled up the well, medium sized bubbles hovered and small bubbles were carried down with the flow.

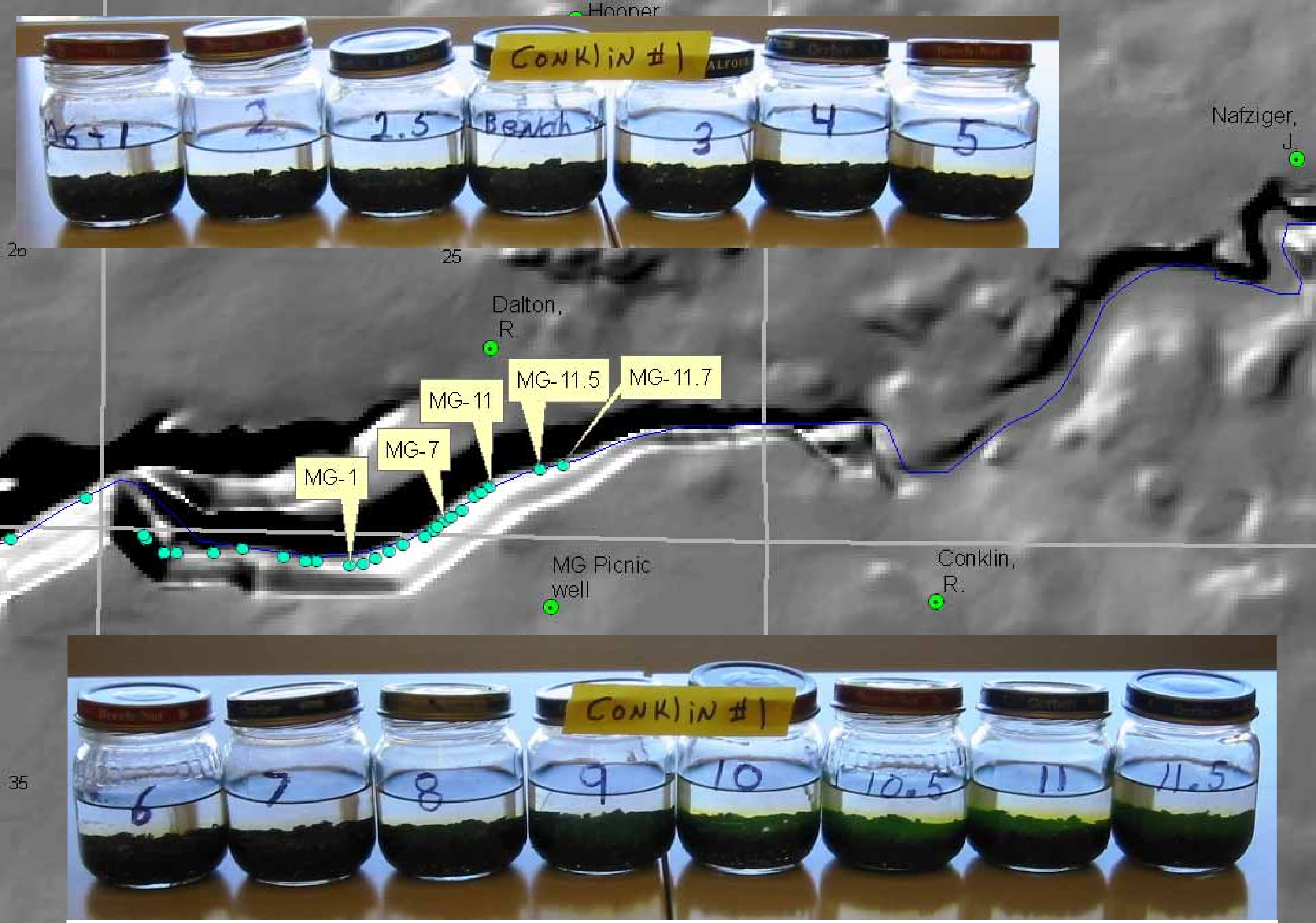


Figure 29. Charcoal packet results for Conklin well #52 Trace #1 showing visual green dye in MG-9 through 11.5.

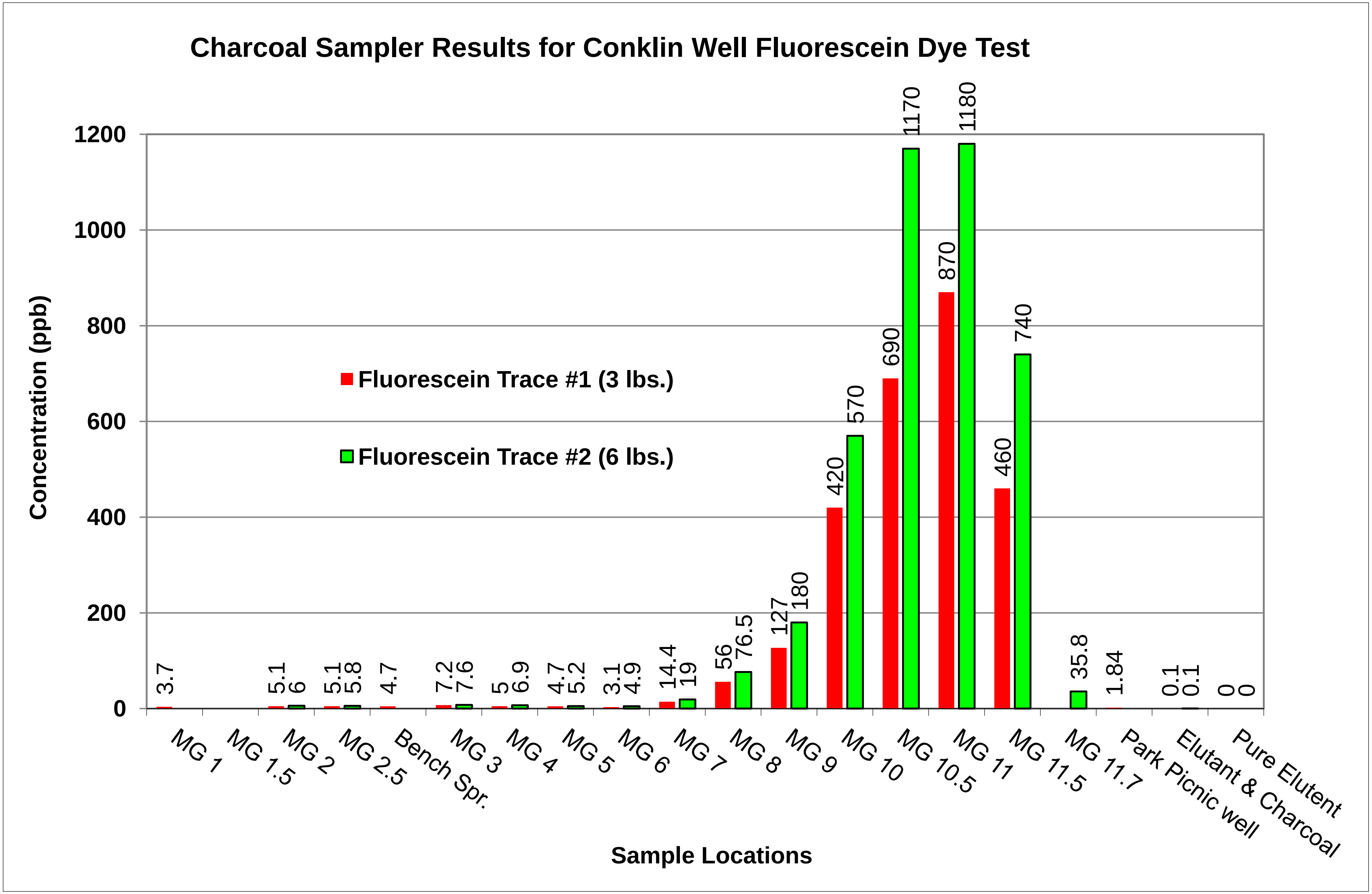


Figure 30. Charcoal packet results for Conklin well #52 Trace #1 and #2 the Gorge springs.

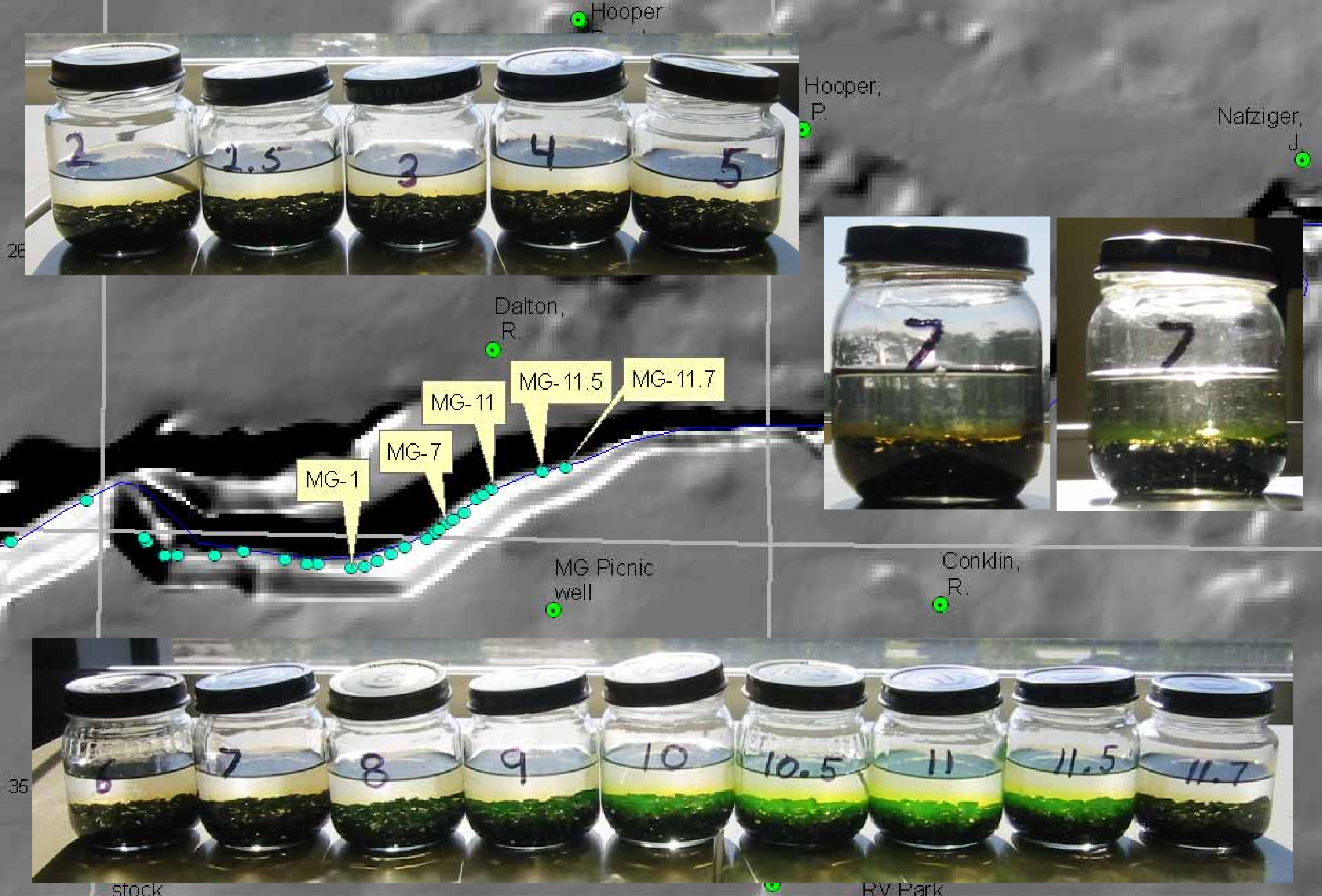


Figure 31. Charcoal packet results for Conklin well #52 Trace #2 visually showing green dye in MG-7 through 11.5. Placing the samples on a stainless steel surface improves visibility of the dye as seen in the right image of sample #7 comparison.

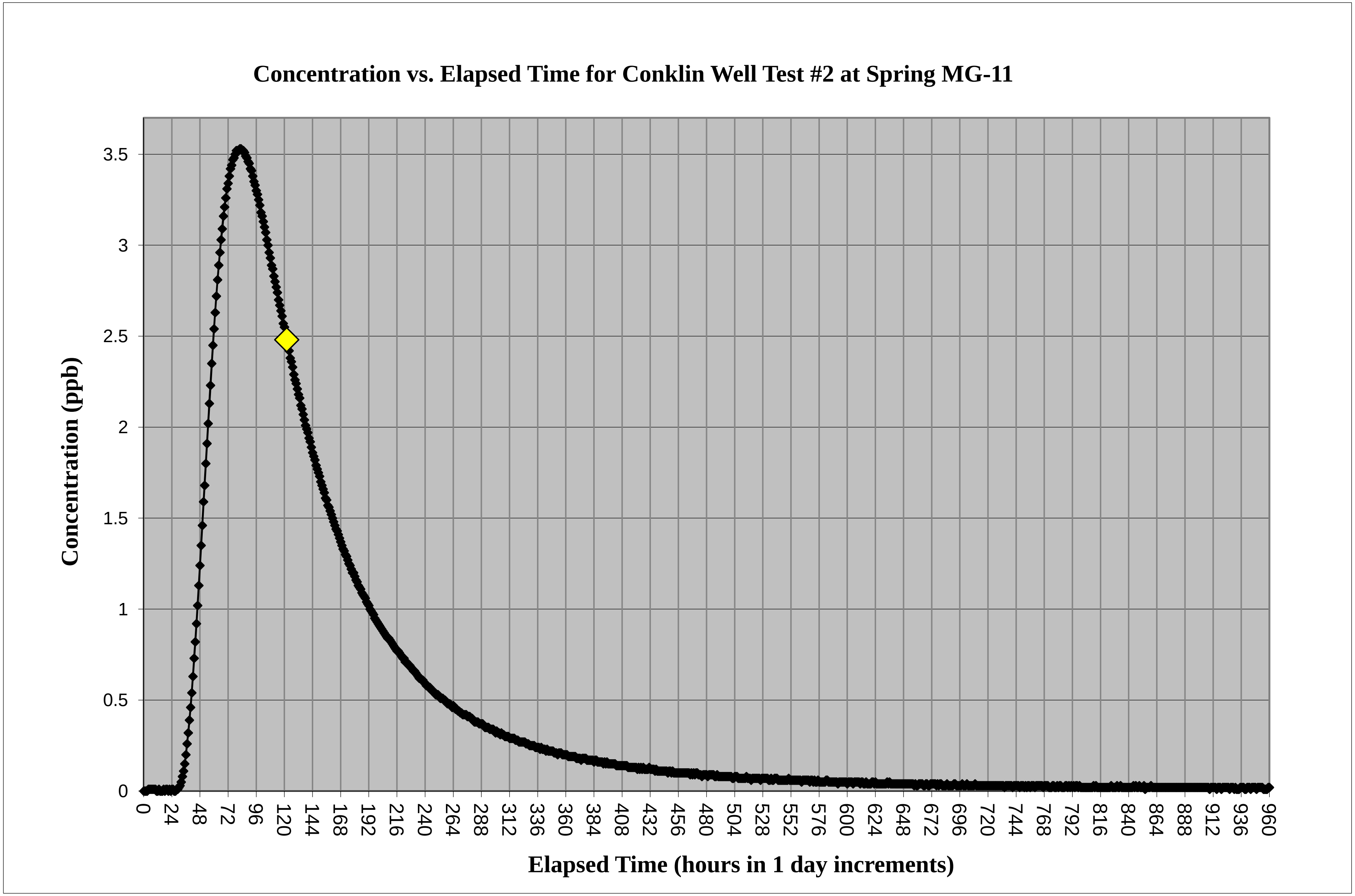


Figure 32. Dye breakthrough curve for Trace #2 from spring MG-11. Six pounds of 75% concentration FL dye was release from the Conklin well #52.

Date	Name	Distance (feet)	Dye (type & mass)	Volume of dye mixture released (gallons)	Max GW Velocity ft./day	Ave. GW Velocity ft./day	Dominant Flow Velocity ft./day	Approx. Time of Passage (days)	Peak Water Conc. (ppb)	Peak Charcoal Packet Conc. (ppb)	Gradient
April 7, 2009	Park picnic well #24	1,100	1 lb. FL (75% conc.)	3	n.a.	n.a.	n.a.	n.a.	n.a.	1,310 @ MG-7	0.04
June 23, 2009	Park picnic well #24	1,100	0.21 lb. RWT (100% conc.)	1 (2.5% conc.)	5,640	n.a.	Same as below	n.a.	0.37 @ MG-7	n.a.	0.04
June 29, 2009	Park picnic well #24	1,100	0.21 lb. RWT (100% conc.)	1 (2.5% conc.)	5,640	880	Same as below	4.2 estimated	0.43 @ MG-7	n.a.	0.04
Sept. 22, 2009	Park picnic well #24	1,100	0.63 lb. RWT (100% conc.)	3 (2.5% conc.)	5,640	880	1st peak = 2,037 2nd peak = 791	4.2	0.91 @ MG-7	n.a.	0.04
Oct. 20, 2009	R. Riddle well #26	2,865	3 lb. FL (75% conc.)	6	n.a.	n.a.	n.a.	n.a.	n.a.	8,160 @ MG-3	0.024
March 1, 2010	R. Riddle well #26	2,865	2 lb. RWT (100% conc.)	4	2,455	800	868	11	1.8 @ MG-3	388 @ MG-3	0.024
April 19, 2010	Hopper well #30	5,490	4.84 lb. FL (75% conc.)	7.75	n.a.	n.a.	n.a.	n.a.	n.a.	1,498 @ MG-2.5	0.014
May 21, 2010	Hopper well #30	5,490	5.01 lb. FL (75% conc.)	8	2,000	664	958	16	1.10 @ MG-2.5	1,640 @ MG-2.5	0.014
Dec. 17, 2010	Meyer well #48	11,900	8 lb. FL (75% conc.)	15	1,102	n.a.	n.a.	40	0.37 @ Bench spr.	489 @ MG-4	0.010
March 25, 2011	Meyer well #48	11,900	14 lb. FL (75% conc.)	14	1,095	410	517	41	0.59 @ Bench spr.	744 @ MG-4	0.010
June 7, 2011	N. Riddle well #25	2,660	0.46 lb. RWT (100% conc.)	0.25	n.a.	n.a.	n.a.	n.a.	n.a.	76.75 @ MG-19	0.027
July 11, 2011	R. Conklin well #52	3,653	3 lb. FL (75% conc.)	3	n.a.	n.a.	n.a.	30	n.a.	870 @ MG-11	0.040
Aug. 19, 2011	R. Conklin well #52	3,653	6 lb. FL (75% conc.)	6	2,922	720	1,069	30	3.53 @ MG-11	1180 @ MG-11	0.040
1936	H. Stearns					750					

Table 7. Table of selected attributes for all traces with H.T. Stearns (1936) estimate for an area extending from Blue Lakes to Wilson Lake .