

# Helena Area Projects

- North Hills
- Scratchgravel Hills



The Helena area projects include the North Hills Groundwater Investigation Project and the Scratchgravel Hills Groundwater Investigation Project

# North Hills Area Update

## May 2010

- Aquifer testing completed at Panoramic Meadows near Lake Helena
- Two new bedrock aquifer test sites constructed
- Monitoring well network in place
- Request for Bids for four additional drilling contracts out for bid at this time, including another aquifer test site

Aquifer testing at Panoramic Meadows near Lake Helena included step drawdown tests and a six-day constant-rate pumping test, using an array of existing, unused wells at a new subdivision.

Two new bedrock aquifer test sites constructed, one in the fractured bedrock aquifer in an undeveloped area near a rock quarry, and one in vicinity of a major fault, the Helena Valley Fault at the base of the North Hills near the north end of Applegate Drive

The Water Quality Protection District's groundwater monitoring network has been enhanced by re-activating numerous former monitoring sites and a few new ones.

Request for Bids has been released for three North Hills drilling projects, including up to 12 wells and 3 exploratory borings. Numerous wells with split-spoon sampling and rock coring are proposed, and 1 to 3 sites will be set up for aquifer testing, depending on the conditions encountered

# North Hills Area Update

## May 2010

- Contracted services with Lewis and Clark Co. Water Protection District
- Geophysical studies by Montana Tech Geophysics Department
- Stream Monitoring sites on Silver Creek
- Gathering and evaluating aquifer test data from previous work

Continued contract for  $\frac{1}{4}$  professional level FTE with Lewis and Clark Local Water Quality Protection District and the services of there technician for monthly groundwater level monitoring

Geophysical work including seismic, resistivity, gravity, and magnetics is underway and planned in a selected areas of interest (work performed by the Montana Tech Geophysics Department)

Three stream monitoring sites with seasonal stage recorders and peizometers in place on Silver Creek

Data gathered from some 70 aquifer tests conducted by previous workers in the area

# North Hills Area Update

## January 2010

- Flow being measured in Helena Valley Irrigation District canals and drains
- Groundwater model framework in development
- Borehole data evaluation underway
- A major water quality sampling effort was conducted during April, 2010
- Crest gages installed in selected ephemeral drainages

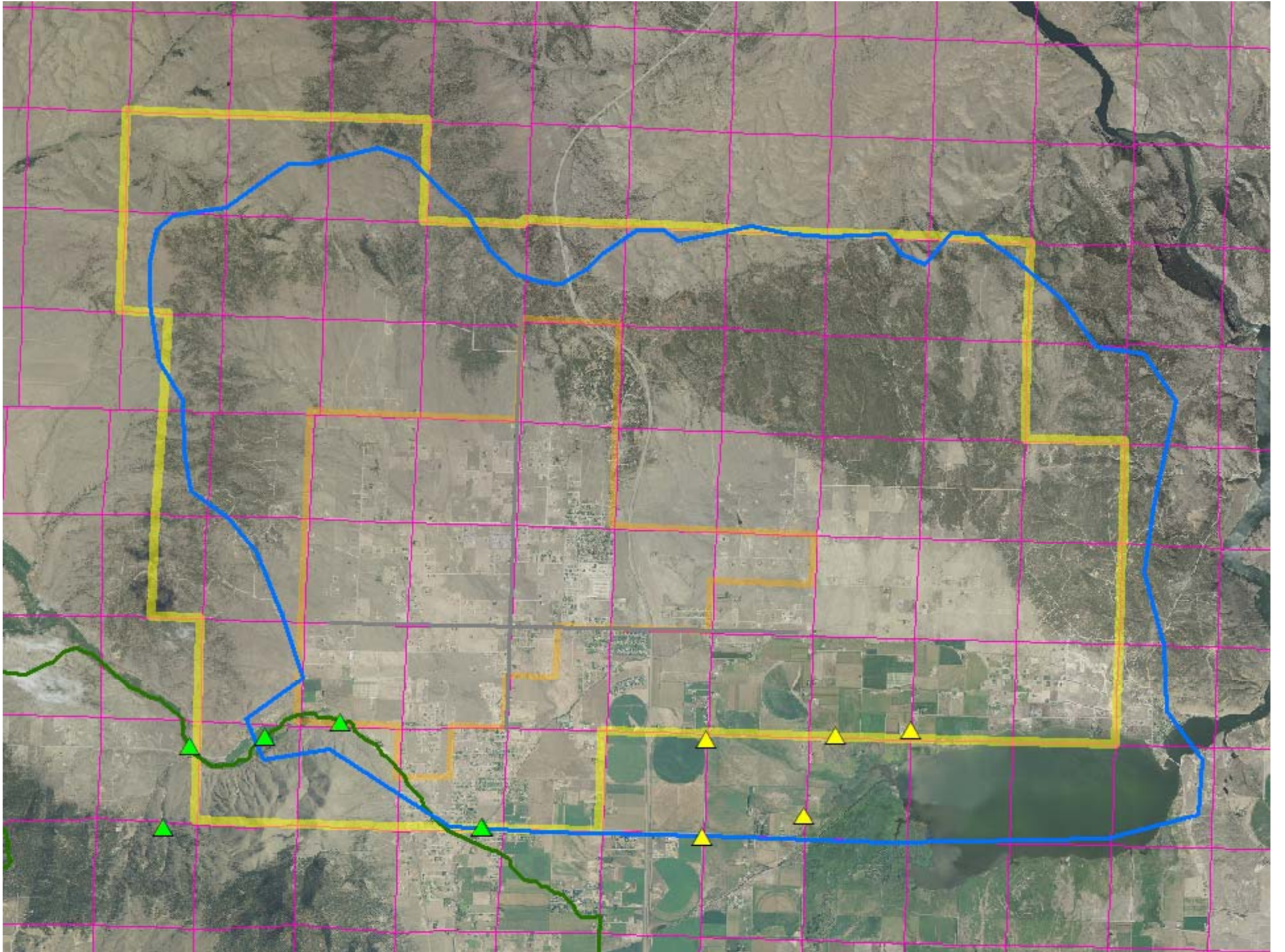
The flow in the Helena Valley Irrigation District Canal is being measured by the Irrigation District in many places, and we are augmenting their measurements with flow measurements on the main canal where it enters the study area along John G. Mine Road

The aquifer geometry is being analyzed with existing well log data and geologic maps. Several hundred deeper well log locations have been verified against the cadastral database, and work analyzing these deeper well logs is underway. Digital Elevation Models and map and aerial photo imagery for the study area has been projected into the Montana State Plane, Feet, NAD83 coordinate system for the groundwater model effort, and static water level data sets are being prepared for the groundwater modeling effort.

Borehole data for the several hundred deeper well logs is being prepared for automated upload into the Groundwater Modeling System (GMS) software

Water quality samples have been collected from 23 North Hills wells, numerous irrigation drains, surface water sites, and the Helena Valley Irrigation District Canal. The samples will be tested for general water chemistry as well as metals and nitrate. Selected samples will be analyzed for concentrations of specific oxygen, sulfur, and hydrogen isotopes to determine the potential of the isotopes to evaluate water sources and sinks

Crest gages have been installed in selected area drainages with buried temperature logger buttons to evaluate any flows that occur in the larger, normally dry drainages



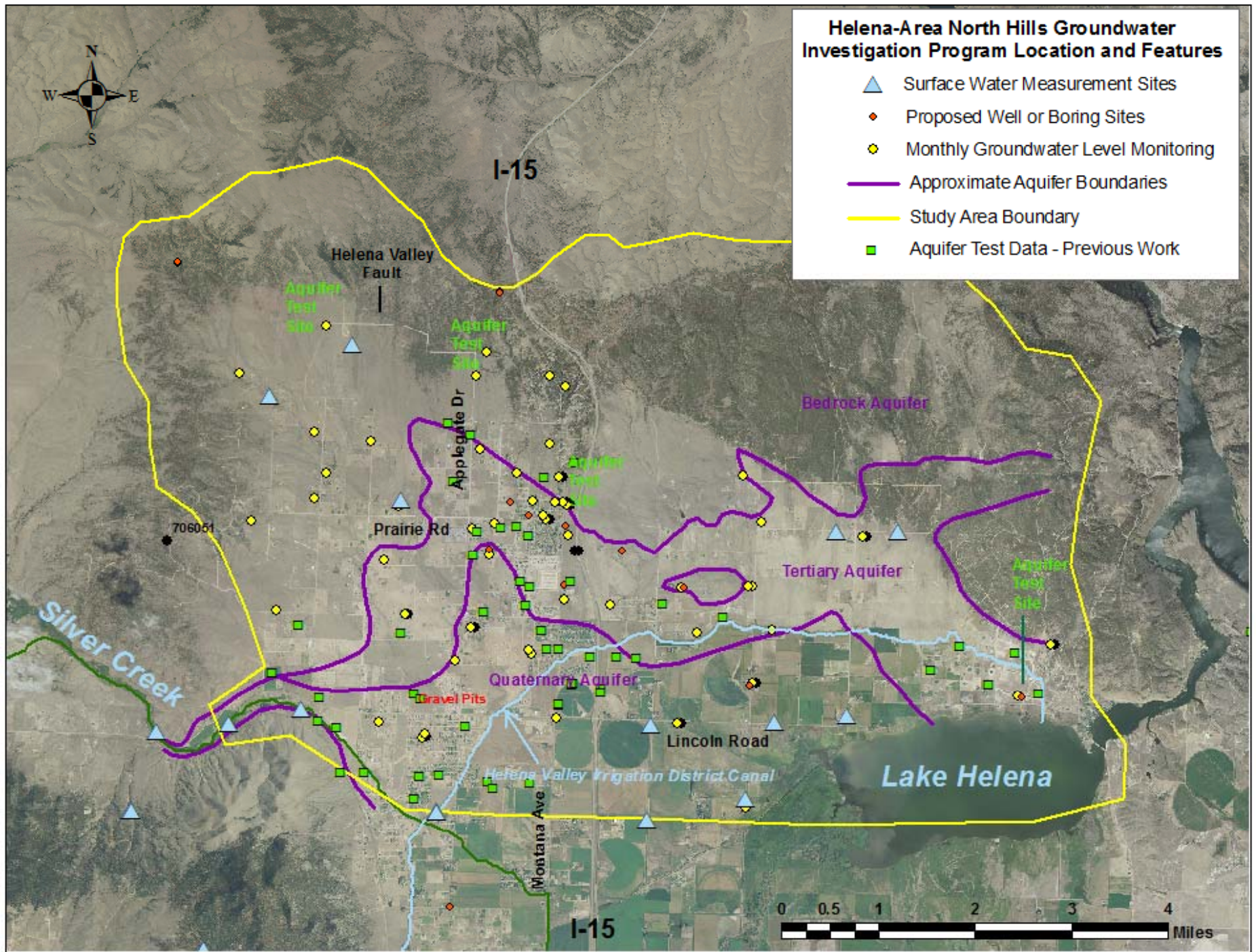
## Project History Map

Yellow – DNRC Controlled Groundwater Area, established in 2002, and study area for MBMG Open File Report 544, 2006

Orange – DNRC Controlled Groundwater Area, 2008

Blue – North Hills GWIP study area

Green – Nearby Scratchgravel Hills GWIP study area (area extends beyond map view)



## Project Activities Map

Yellow line – study area boundary

Note Silver Creek, Lake Helena, Irrigation Canal, and the fact that much of the west, north and east boundaries are along topographic divides

Note irrigated lands below the canal, and denser housing areas (N. Montana Ave. and near Green Meadow Drive south of Lincoln Road)

Purple lines – James Madison's aquifer boundaries

Bedrock – fractured and faulted Spokane Group red, green, and tan argillites - variable well yields depending on well depth, construction, and how fractured the rock is at a given site.

(Argillite - ar'-je-lite – a highly compacted sedimentary or slightly metamorphic rock consisting primarily of particles of clay or silt. Argillite differs from mudstone in that it does not have the same fine laminations, and from shale and slate in that it is not fissile)

Tertiary – Generally clayey, poorly consolidated sediments with some water-bearing gravel, sand, or fractured claystone. Well yields typically low, and well are commonly drilled through it to the underlying fractured bedrock aquifer

Quaternary – Sand and gravel valley fill sediments, such as are exposed in quarries along Lincoln Road. Variable thickness and underlain by older Tertiary materials and bedrock at depth.

Yellow dots – current monitoring well distribution – monthly and continuous data logger sites

Orange-red dots – planned drilling locations

White squares – aquifer test data collected from previous investigations

# Examples and photos

- The following slides provide some examples and photographs of work being conducted as part of the North Hills groundwater investigation

# Panoramic Meadows Pump Test

- 144 Hour (6 day) Constant Rate Pump Test
  - (11/18/09-11/24/09)
- Average Pumping Rate = 38.2 gpm
- Used 10 pre-existing wells (1 pumping, 9 observation)
- Near Lake Helena; East Side of Study area
- Wells in well lithofied fractured Oligocene bedrock.
- Monitor drawdown and recovery to determine aquifer characteristics

GWIP Project Area: North Hills, Lewis and Clark County



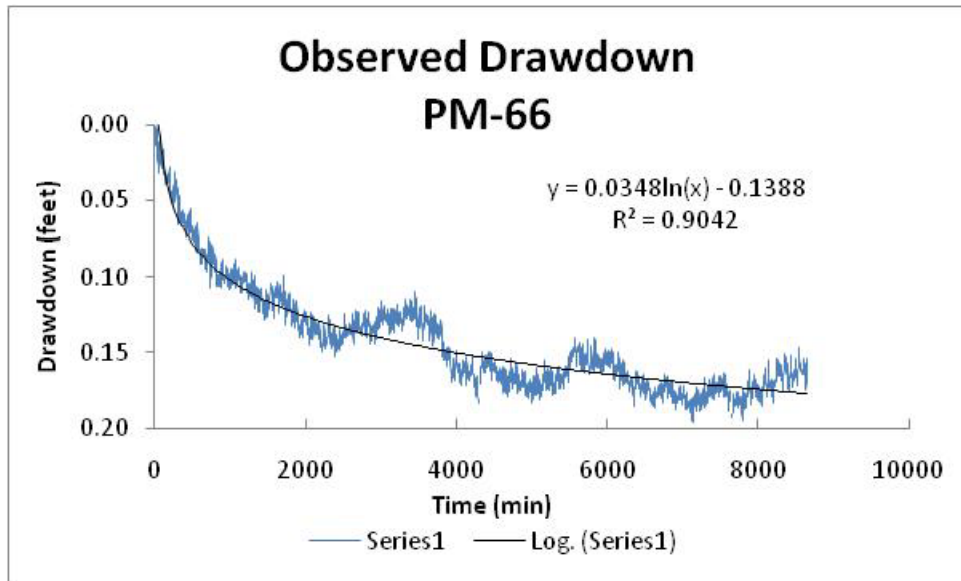
◆ Panaramic\_Meddows\_Wells

### Panaramic Meadows Pump Test

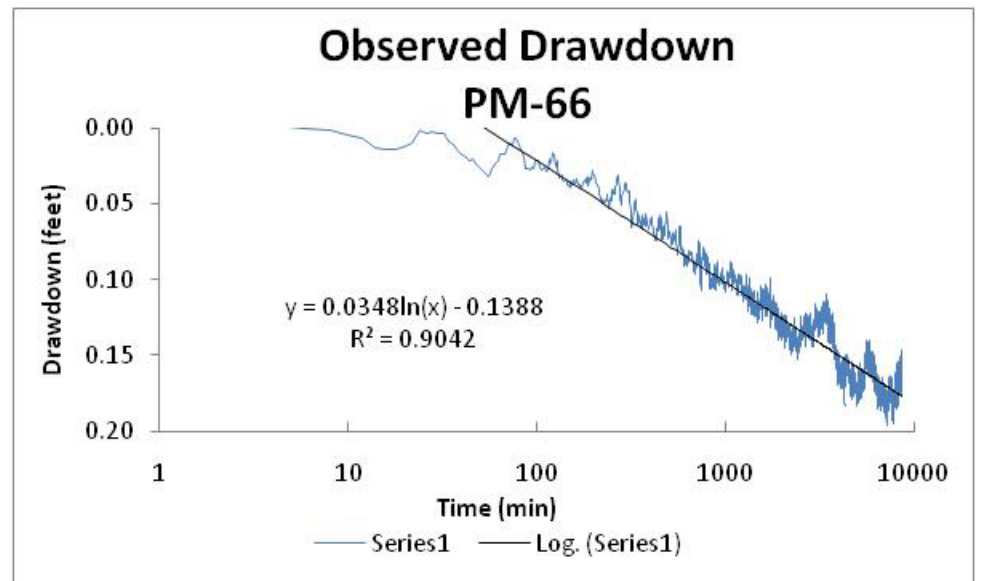


0 70 140 280 Feet

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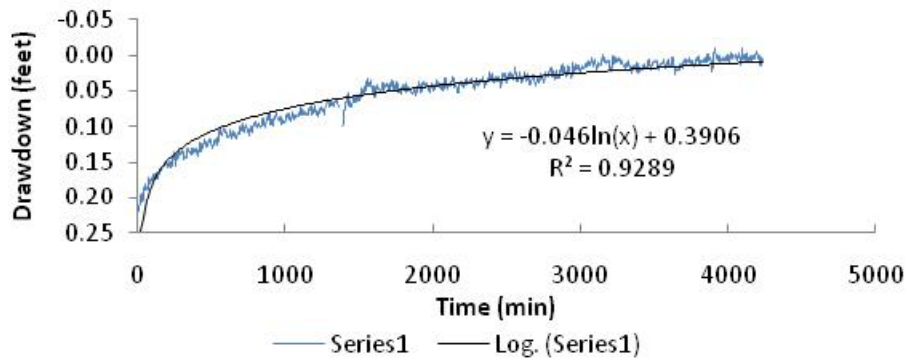
Drawdown in PM-66



Examples of drawdown plotted as drawdown versus time and as drawdown versus log-normal time. Note the long duration of the pumping test (six days – over 8500 minutes)

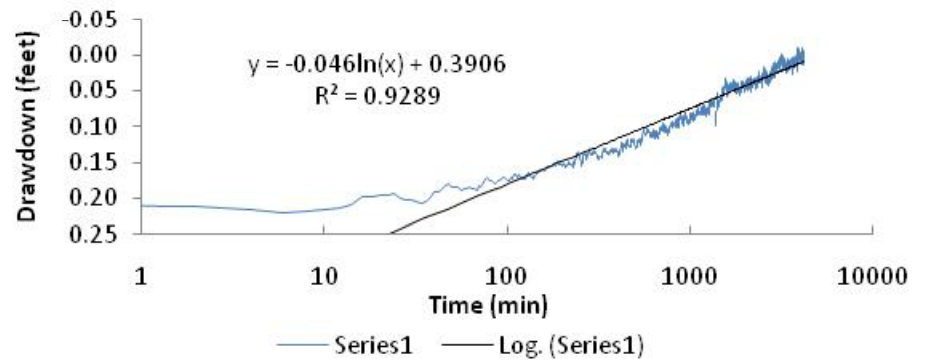
Drawdown data from wells during constant-rate pumping typically plots as a straight line using the semi-log plot shown in the second graph

### Observed Recovery PM-66



Recovery in PM-66

### Observed Recovery PM-66



Recovery data – shows the recovery of water water levels. Note the relatively fast rebound of water levels in the first day after pumping (1440 minutes). The water level recovery approaches 100% after some 4200 minutes, about half the time of the pumping period.

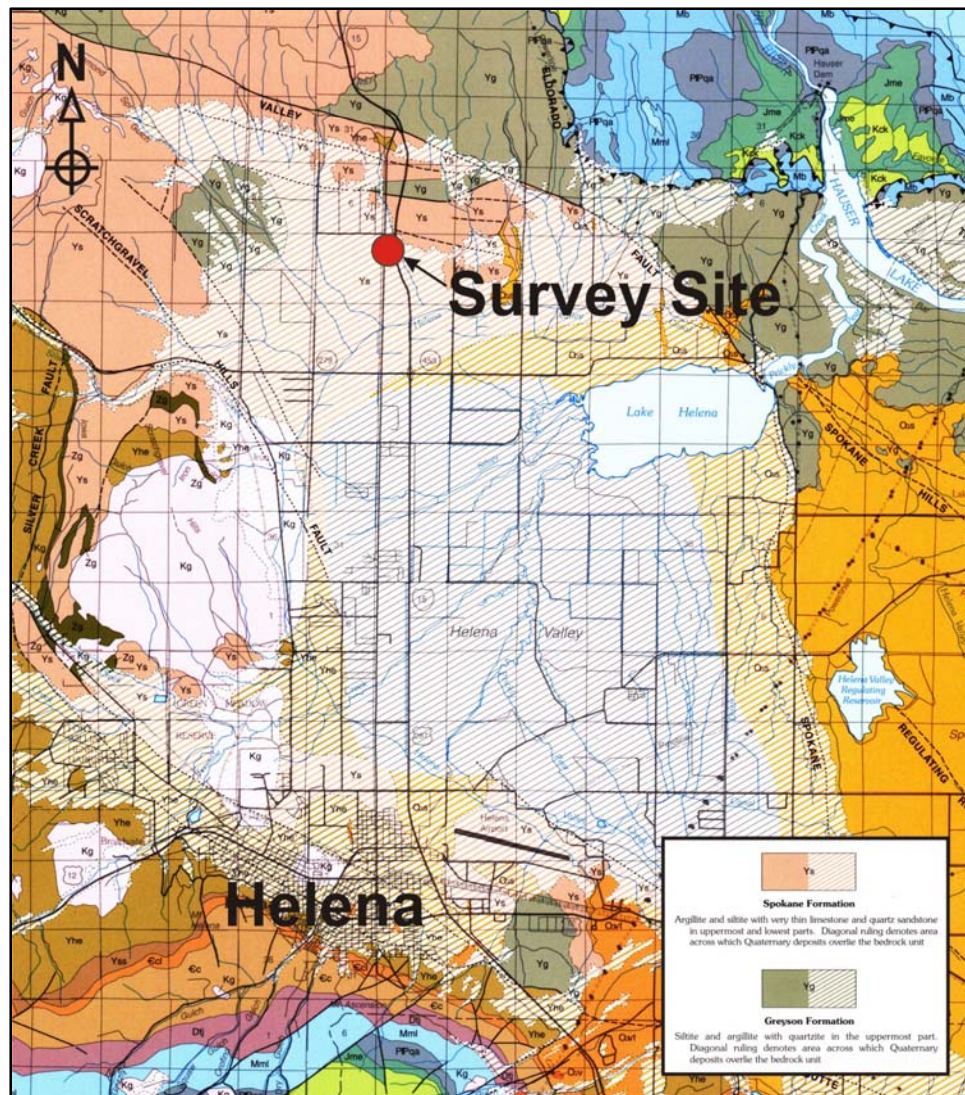
### Panoramic Meadows Subdivision Aquifer Test Results

Well	Method	T (ft <sup>2</sup> /d)	K (ft)	Ss	S
Well 63	Theis	9,019.8	—	—	0.02754
Well 63	Neuman	5,175.2	—	—	0.02212
Well 63	Barker	9,025.1	97.59	0.000296	0.027346
<b>Average for Well 63</b>		<b>7,740.0</b>			<b>0.025669</b>
Well 66	Theis	7,527.2	—	—	0.01372
Well 66	Neuman	1,015.0	—	—	0.006048
Well 66	Barker	2,225.1	24.06	1.00E-10	1.08E-12
<b>Average for Well 66</b>		<b>3,589.1</b>			<b>0.006589</b>
Well 67	Theis	9,759.4	—	—	0.0424
Well 67	Neuman	9,598.4	—	—	0.04311
Well 67	Barker	1,929.1	20.86	1.37E-10	1.48E-12
<b>Average for Well 67</b>		<b>7,095.6</b>			<b>0.028503</b>
<b>Average for all Wells:</b>		<b>6,141.6</b>			<b>0.020254</b>

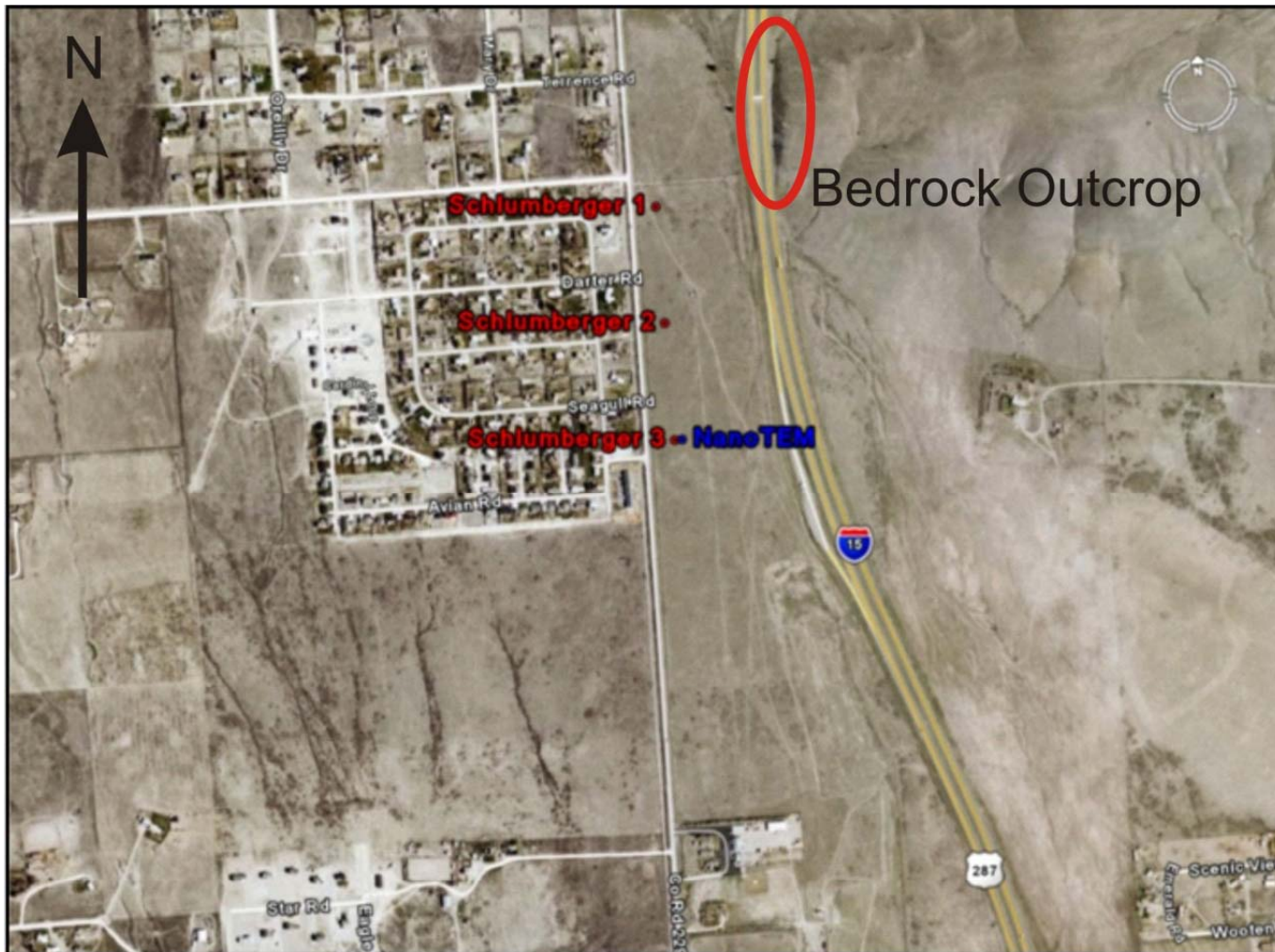
Note: Aquifer thickness = 92.48 ft.

Preliminary results from various aquifer test analyses for comparison. The averages are provided for comparison only, the best or most applicable method will be determined in the final analysis.

# Geophysical Test Site – MT Tech students Brian Williams and David Sunwall



# Site Details

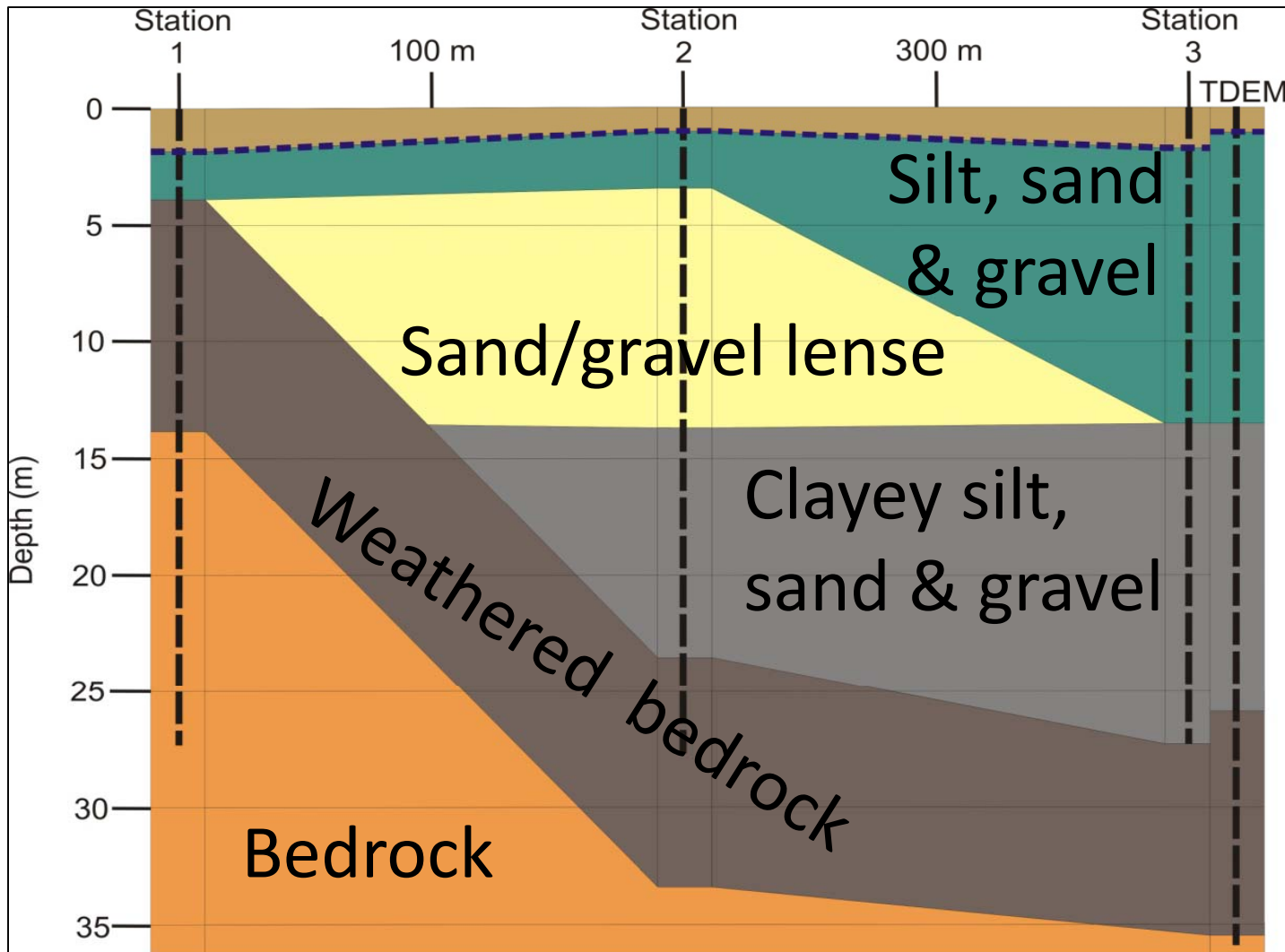


Electrical resistivity surveys of two types were conducted on the State-owned property just east of Montana Avenue near the State Lands Office

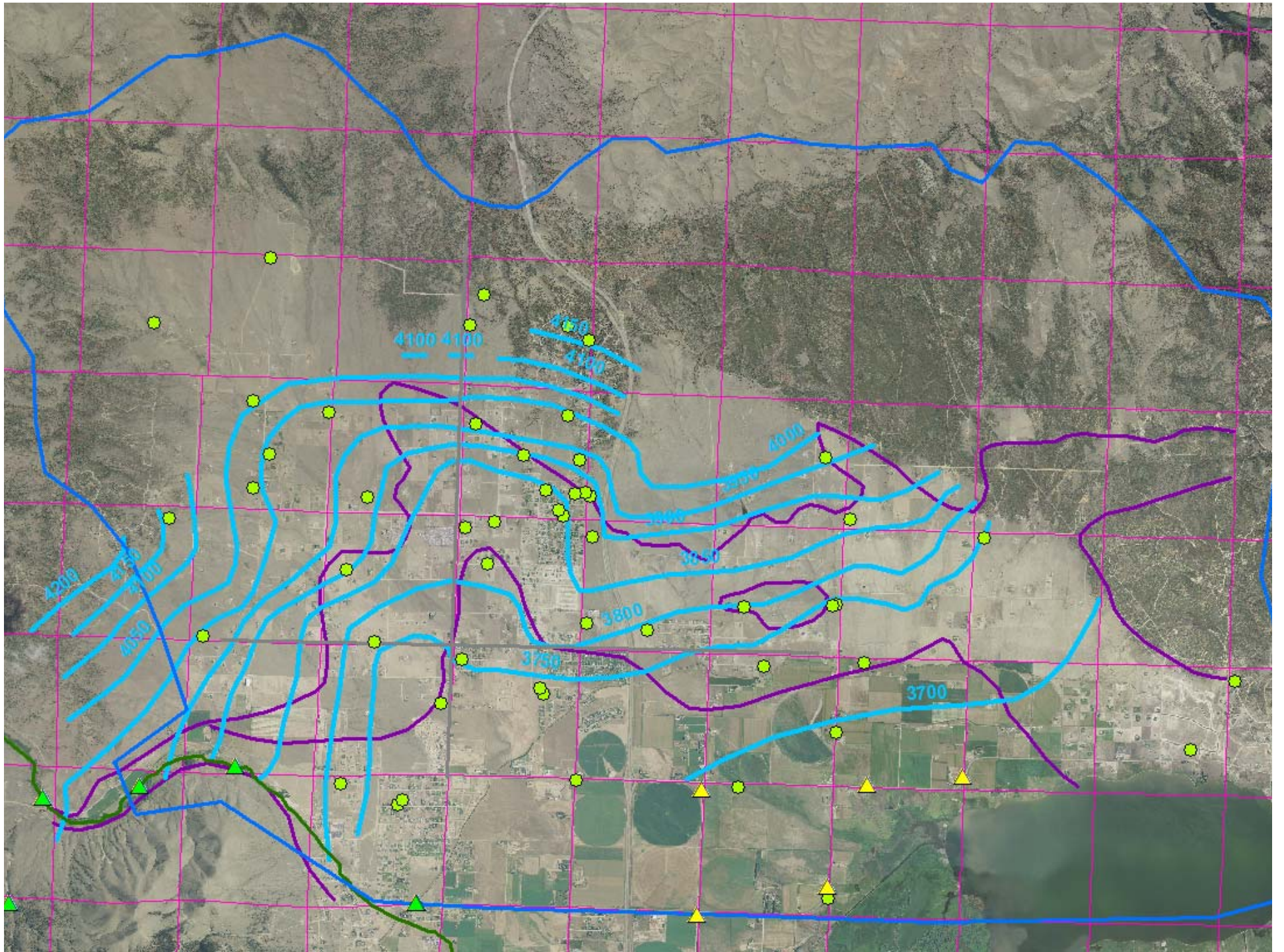
# Geophysical profile

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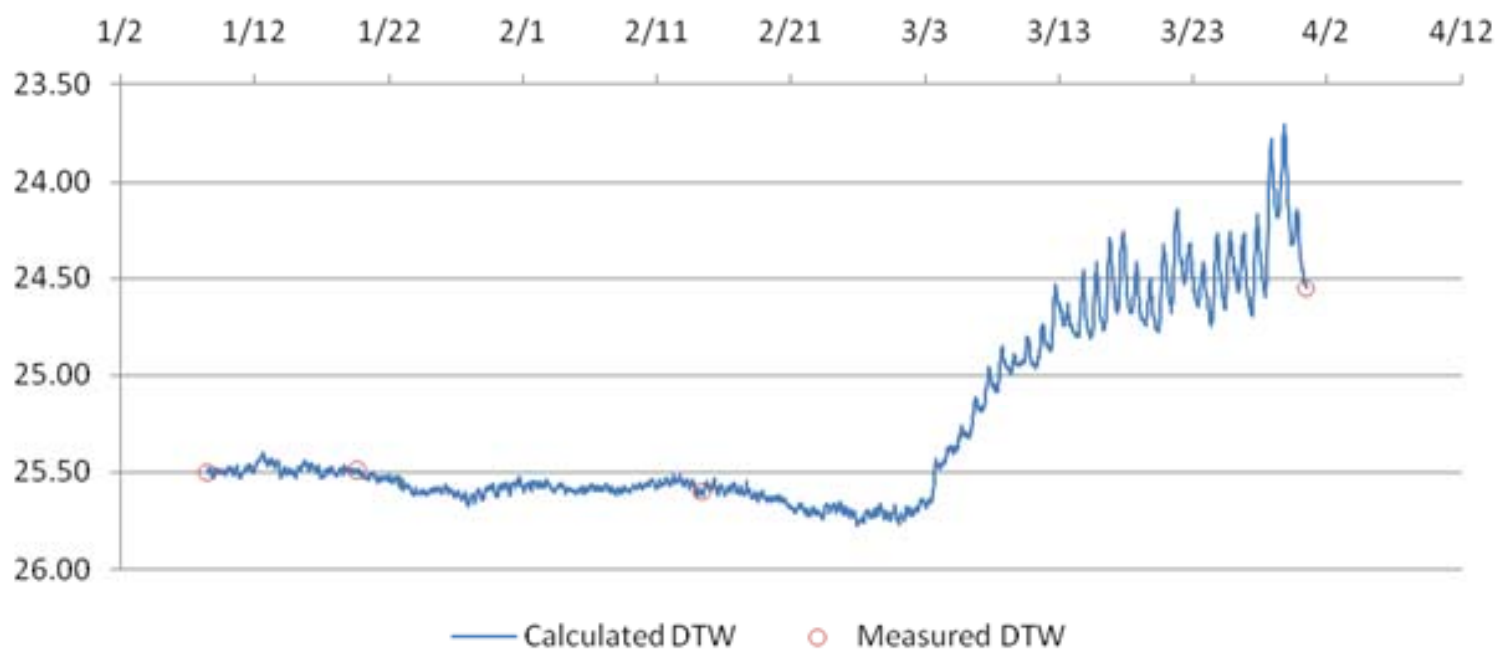


A schematic cross section showing the results of the students work. An exploratory boring with specific sampling methodology is planned at this site to compare to the geophysical work



Groundwater surface map from MBMG Open File Report 544, 2006. The data for current potentiometric surface maps is being assembled at this time for the development of the groundwater model

# Diamond Hills Shallow Well GWIC ID 253818



Example of groundwater depth data from a continuously recording pressure transducer located in well 253818 near the north end of Applegate Drive, in Section 31, T12N, R03W. The erratic groundwater levels appearing in the month of March may be related to recharge from melting snow.



A stilling well and staff gage site that will record the stage of Silver Creek. The stream was not flowing at the time this picture was taken, but was flowing by late April.



Irrigation drains are being measured at the downstream end of the study area. This is Drain D2, the largest irrigation drain that feeds into Lake Helena. A stilling well data recorder site is visible in the middle of the channel. This drain is monitored by Lewis and Clark Water Quality Protection District. The drains MBMG monitor are typically much smaller, and drain the study area north of Drain D2.



H and L Drilling was contracted to install wells as part of an aquifer site near the Valley  
Excavating rock quarry.



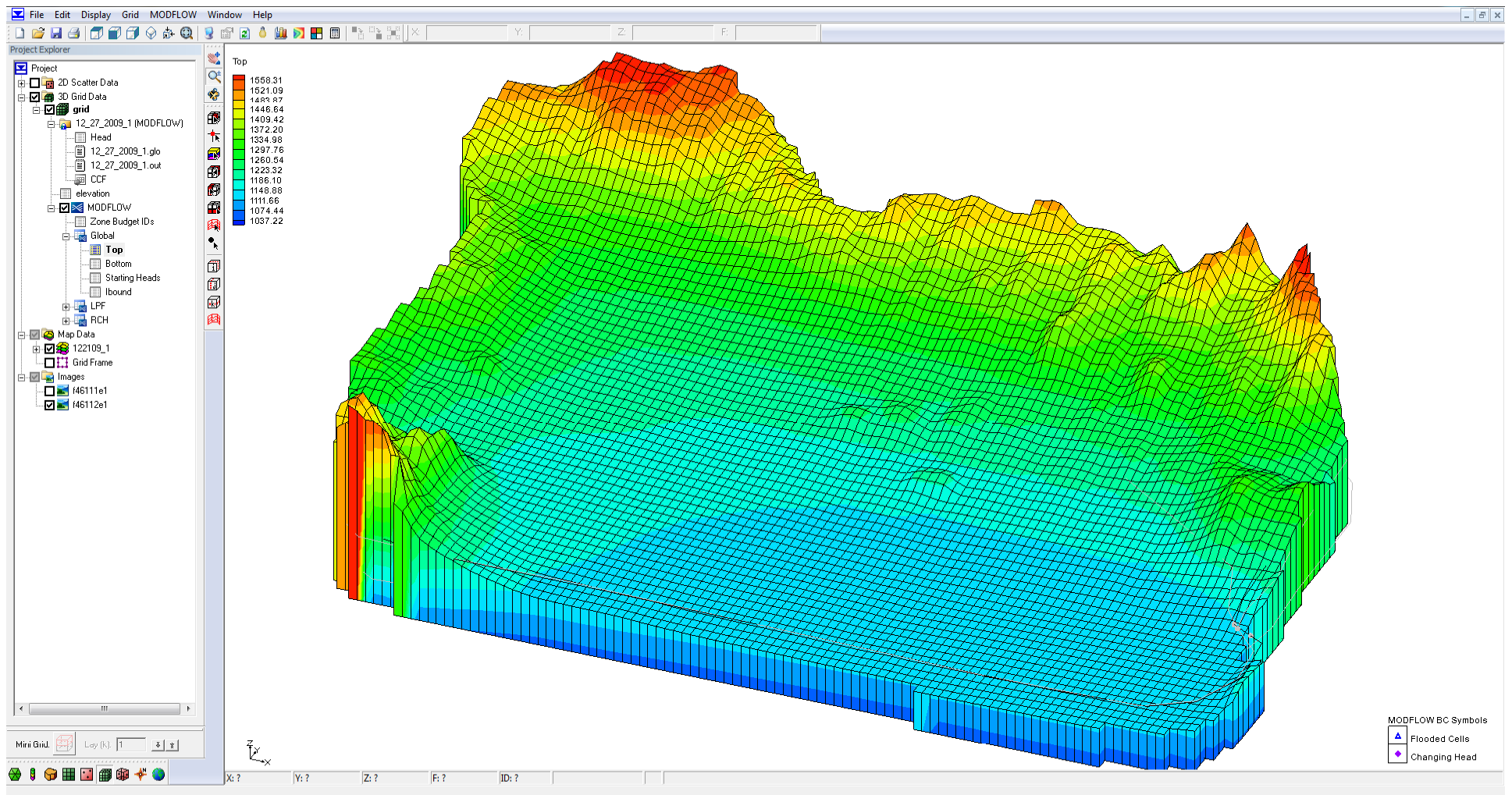


Area maps and aerial photos have been projected into the groundwater model coordinate system, which will be the Montana State Plane system, North American Datum 1983, in feet.



This early groundwater model grid will be reworked numerous times as the groundwater model is developed and modified.

- Assign elevations using Digital Elevation Models (DEM's)

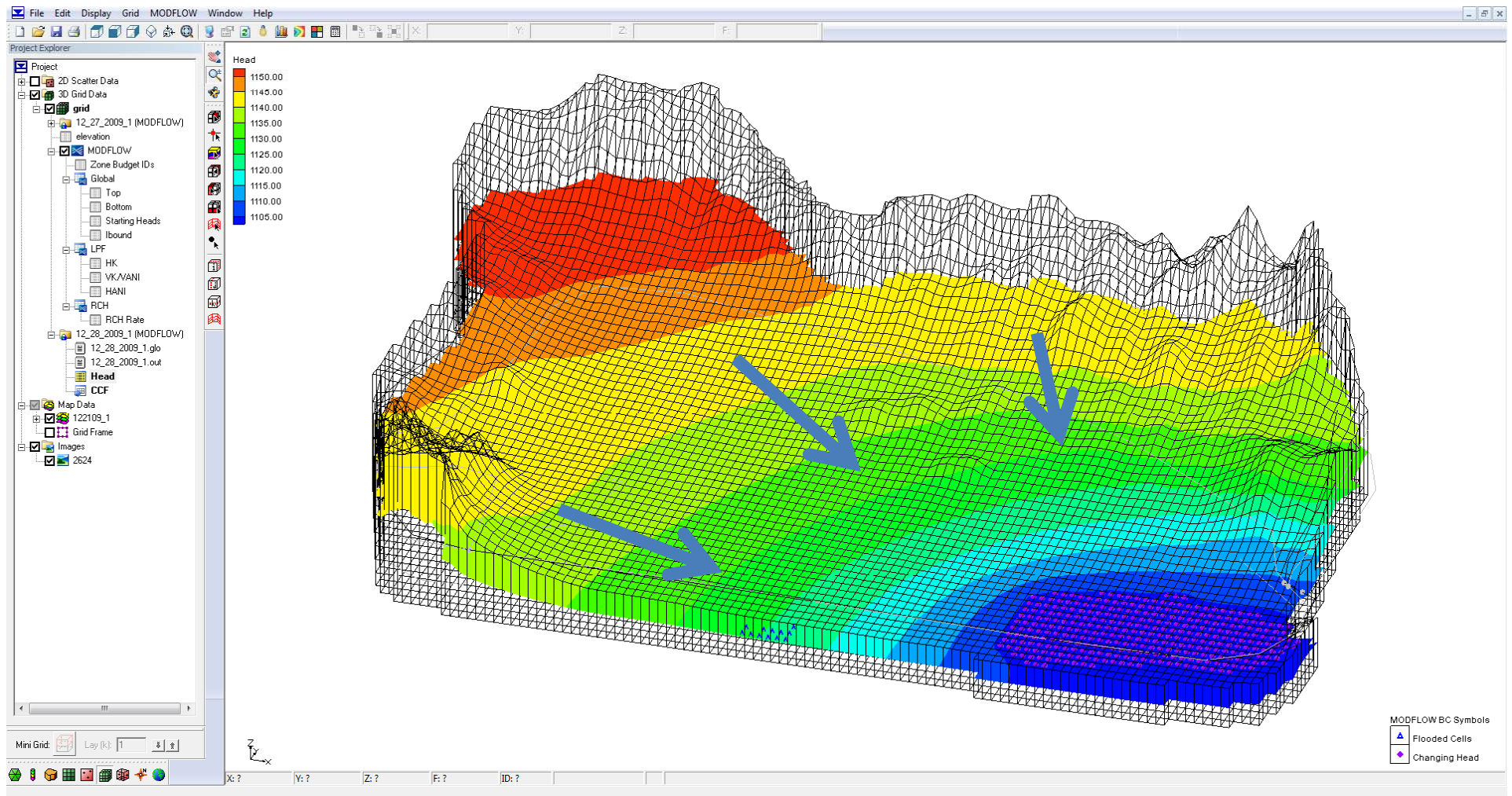


Digital elevation models (DEMs) have also been projected to the groundwater model coordinate system, and will be used to define the upper surface of the groundwater models.



Maps and aerial photos can be overlaid onto the 3-dimensional groundwater model. This early image has been superceded with full coverage maps and aerial photo images.

- Preliminary groundwater surface generated from areal recharge and known water elevation of the Lake Helena discharge zone, arrows showing groundwater flow direction



This test model generated a basic groundwater surface by adding recharge from precipitation to the model. Water is naturally driven toward Lake Helena. Lake Helena is maintained at a nearly constant elevation of 3,650 feet.

# Scratchgravel Hills Area Update

## January 2010

- Contracted services with Lewis and Clark Co. Water Protection District
- Three stream monitoring sites with seasonal stage recorders and peizometers in place on Silver Creek, and three in place along Seven Mile Creek
- Monitoring well network is up and running
- Drilling and aquifer test sites drilling bids have been released
- Investigation of faults planned

Contract for ¼ professional level FTE with Lewis and Clark Local Water Quality Protection District and monthly monitoring contract for up to 50 additional wells (North Hills + Scratchgravel)

Stream monitoring sites that include stilling wells for continuous stage recorders, peizometers to measure shallow groundwater levels next to the creek, and periodic stream flow measurements are in place at six sites along Seven Mile Creek and Silver Creek

# Scratchgravel Hills Area Update

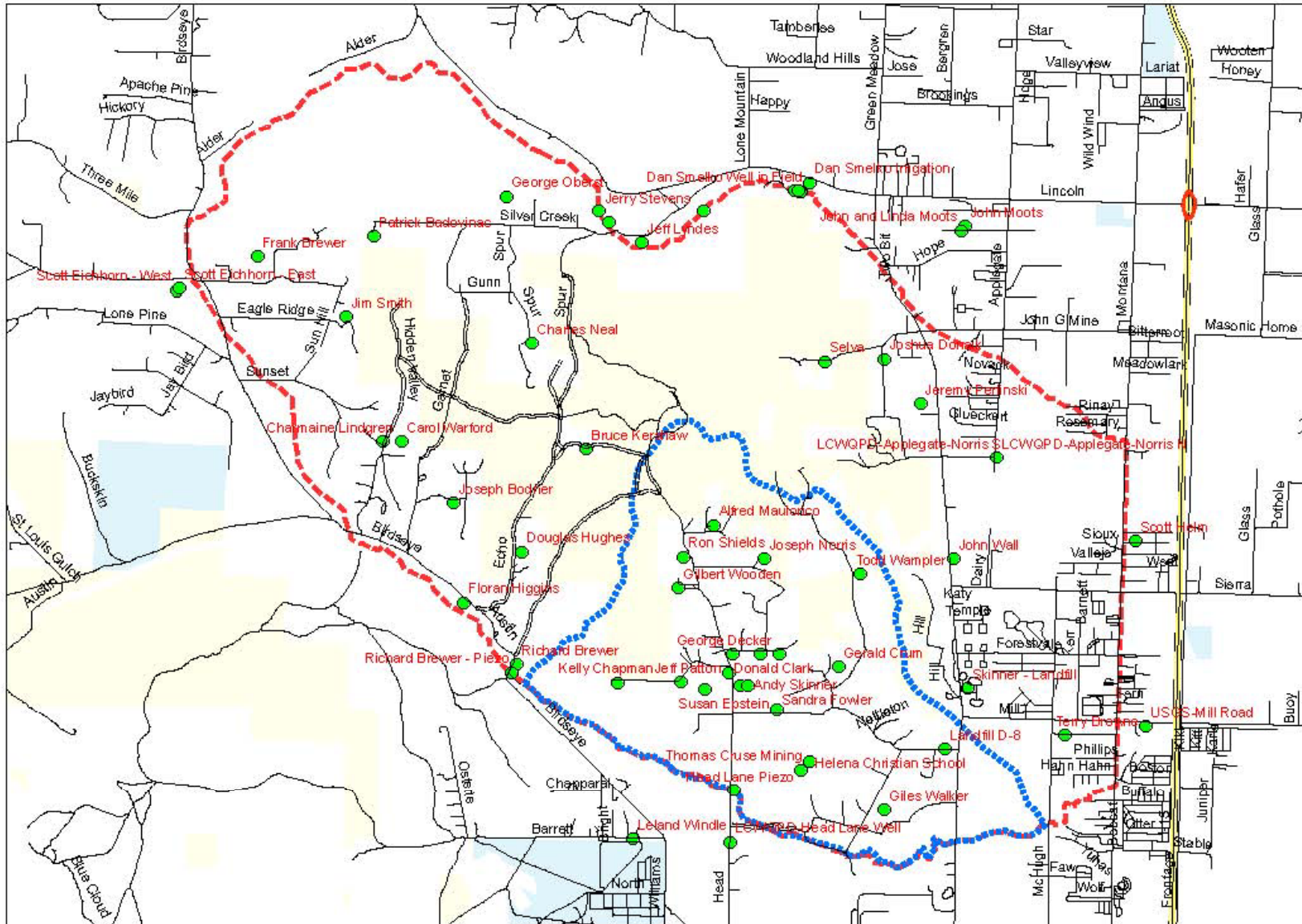
## January 2010

- Spring monitoring has been implemented
- Crest Gages have been installed at numerous sites
- Continuous recorders have been installed in dedicated monitoring wells as possible
- Flow in the Helena Valley Irrigation District Canal is measured where the canal enters and exits the study area

The flow at area springs is being measured periodically

Crest gages and buried temperature loggers have been placed in ephemeral drainages to record any intermittent flows

Continuous groundwater level recording devices have been installed in dedicated monitoring wells



● Monthly Wells

### Scratchgravel Monitoring Sites

0 0.5 1 2 Miles

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ALB; 4/19/10

Groundwater levels are being measured monthly in over 50 wells in the Scratchgravel Hills study area

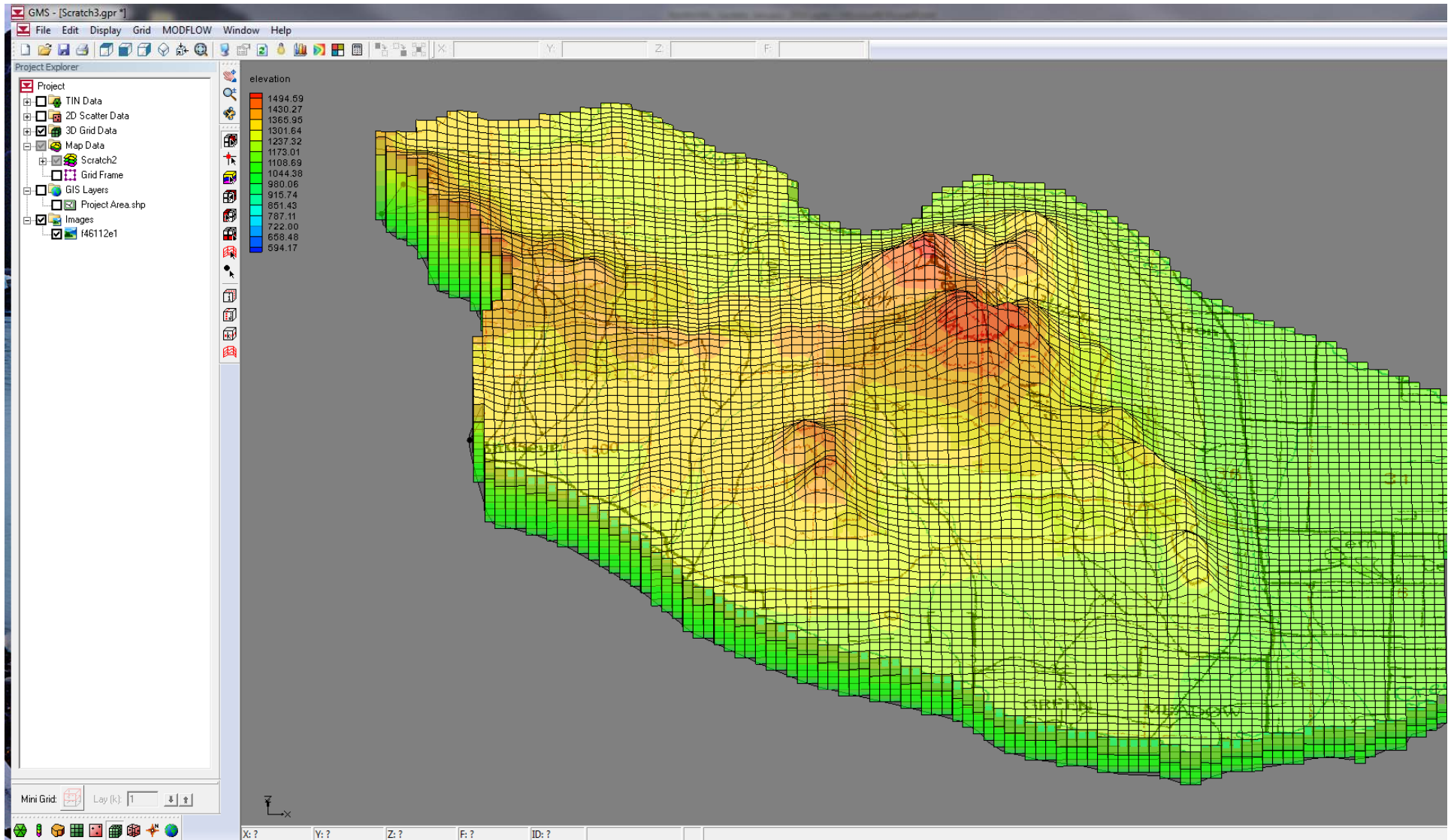


A crest gage and temperature buttons stand ready to record any flows down an ephemeral drainage



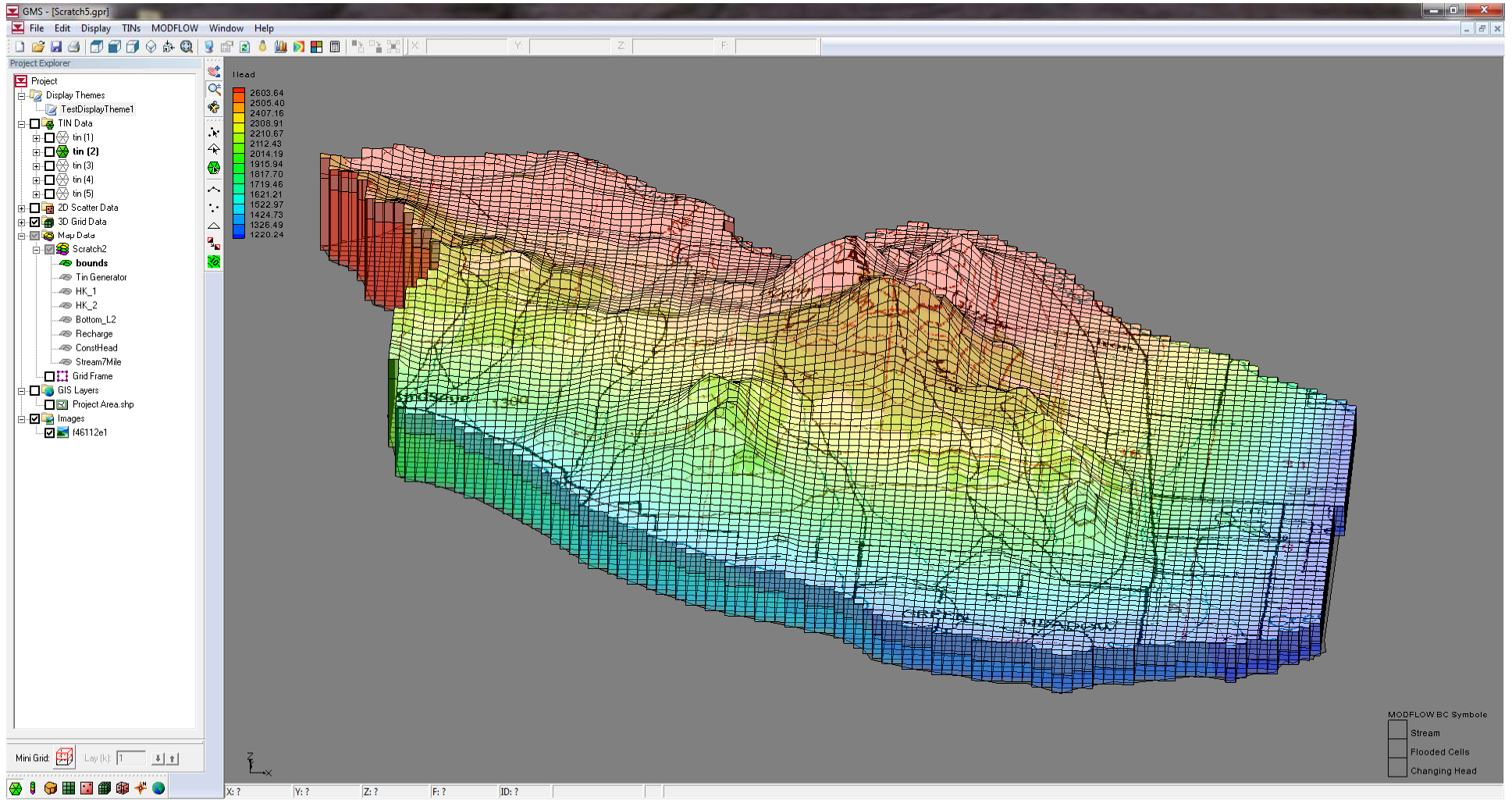
The flow in the Helena Valley Irrigation District Canal is measured on a windy day with an acoustic doppler cross section profiler, an advanced instrument for measuring stream flows. The canal was flowing at about 70 cubic feet per second during this measurement.

- Early formulation and testing of the Scratchgravel groundwater model format is underway



As with the North Hills area, area maps, aerial photos, and digital elevation models (DEMs) have been projected into the groundwater model coordinate system, which will be the Montana State Plane system, North American Datum 1983, in feet.

- Testing stream flow routing package on Sevenmile Creek



The Scratchgravel Hills offers an interesting area in which to develop a groundwater model. Recharge to the modeled area will be initially modeled as recharge from precipitation and snowmelt.

# Other agencies and groups

- Other agencies and groups we are in contact with regarding both studies include:
- DNRC Water Resources Division
- Lewis and Clark County Water Quality Protection District
- Lewis and Clark County Conservation District
- Lake Helena Watershed Monitoring Committee
- EPA
- Montana Watershed Coordinating Council
- Department of Environmental Quality

The project is proceeding as planned, and as of May 2010 the staff is extremely engaged in field work and data collection. Interpretive products are created as time allows, and the detailed groundwater modeling efforts are scheduled to get fully underway in June 2010.