



# Floyd Hill Groundwater Planning

Cassidy Budge, Gabe Gonzales, Jonah Howe, Katie Kerstiens, Anna Kollmorgen,  
Nicole Rooney, Austin Toussaint  
Colorado School of Mines, SOLVE, Floyd Hill HOA

## Background

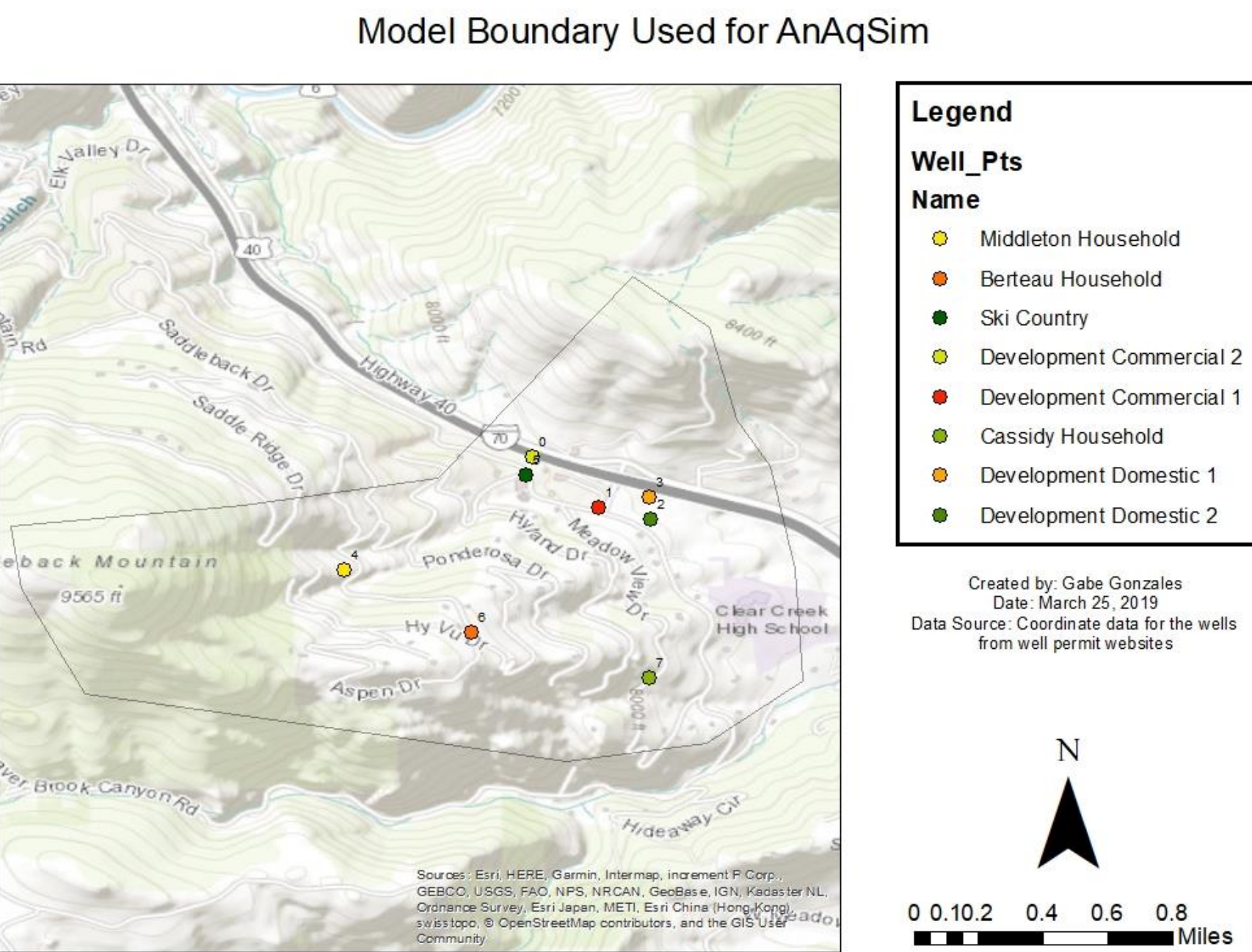
The Floyd Hill Water Engineers were tasked with determining if a new development in the Floyd Hill area would have negative effects on the water supply for the existing homeowners. After a few weeks we learned that the developer pulled out of the deal, but we still continued the work as it would be beneficial to the community for future reference.

## Objectives

- Create a 3D model of the Floyd Hill Area
- Current water levels with water quality sampling
- Characterization of aquifer
- Determine recharge and reuse rates of the 500 or more wells within the area.
- Determine the age of water

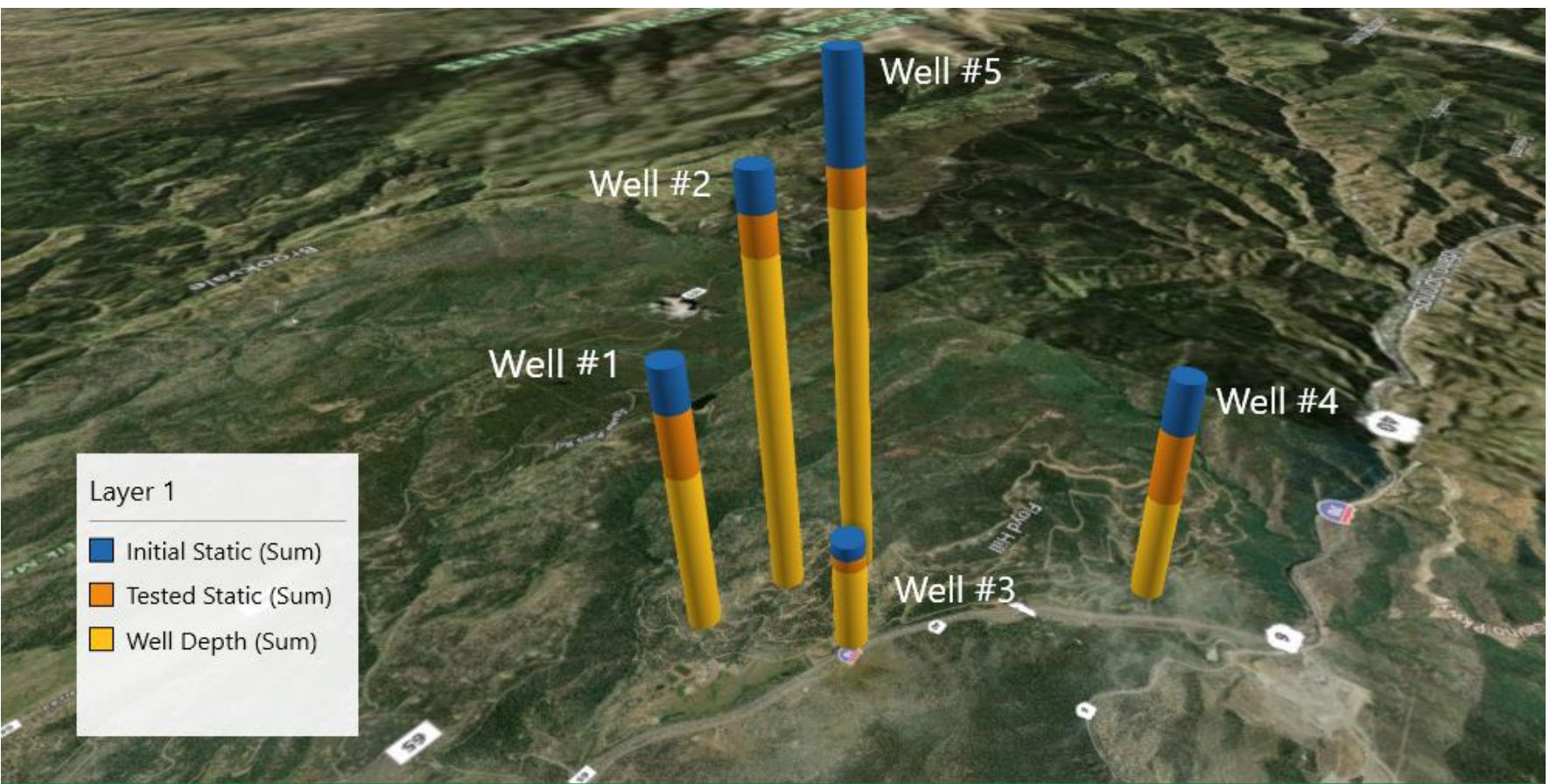
## Boundaries and Assumptions

- The aquifer is within fractured bedrock, and to simplify the model it was made as steady state showing changes in elevation.
- Created using assumptions from the Beaver Brook Residence Development (BBRD) hydraulic report and location of tested wells
- Domestic usage rate and geologic parameters were assumed values based on research by USGS



## Water Depth Testing

Well depths were measured at five locations throughout the area to assess the recharge and reuse rates. The values were also used for the hydraulic model.

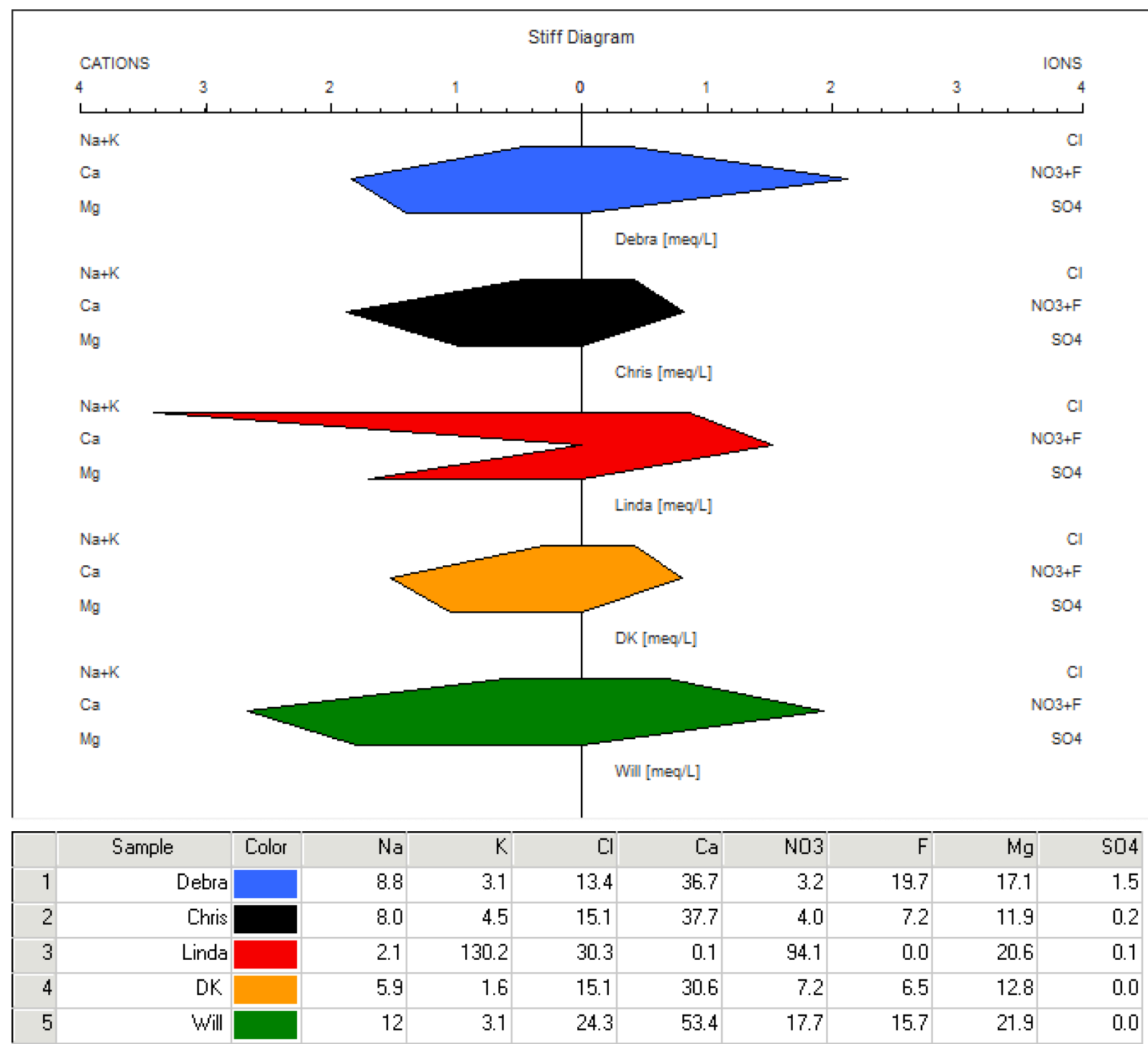


Well ID	Depth Measured 2019 (ft)	Depth on Well Permit and Year (ft)	Difference (ft)
1	110	75 (1973)	-35
2	61	61 (1981)	0
3	23	25 (1977)	2
4	128	90 (1973)	-38
5	56	150 (1977)	56

The data showed that two of the wells dropped significantly and the other three increased. Because of the fractured bedrock, it is difficult to draw any conclusions.

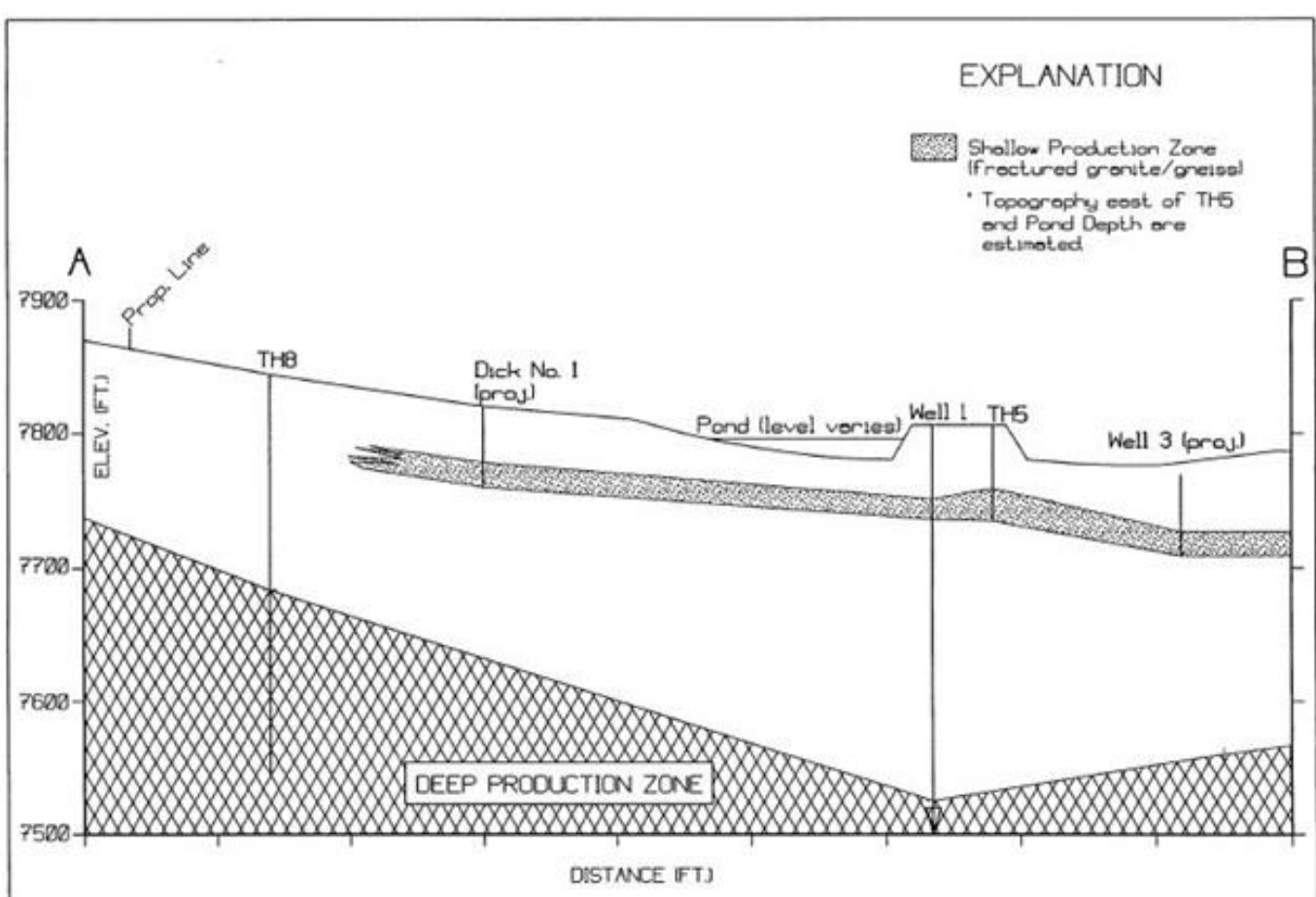
## Water Quality Testing

IC and ICP Analysis were conducted on samples collected from the wells of several houses throughout the area. The results were used to help determine the connectivity of water between wells.



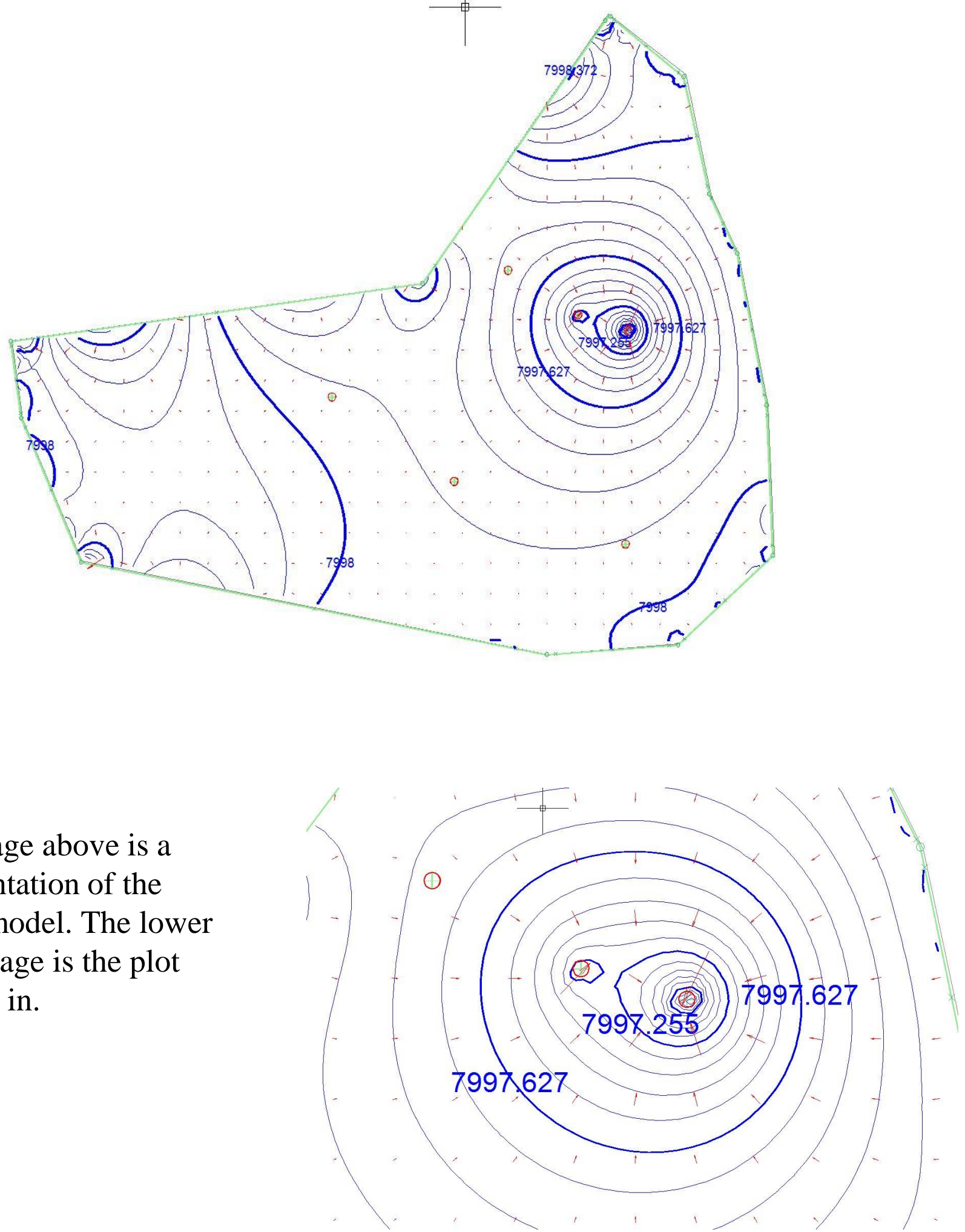
## Hydrologic Modeling

The proposed development is located on a thin layer of Piney Creek Alluvium, on top of that (or interbedded with the alluvium) is a layer of colluvium. Below all these levels, there are igneous and metamorphic rocks containing mostly granite, gneisses, and amphibolite.



The Beaver Brook Hydraulic Report provided a profile of the subsurface around the development area.

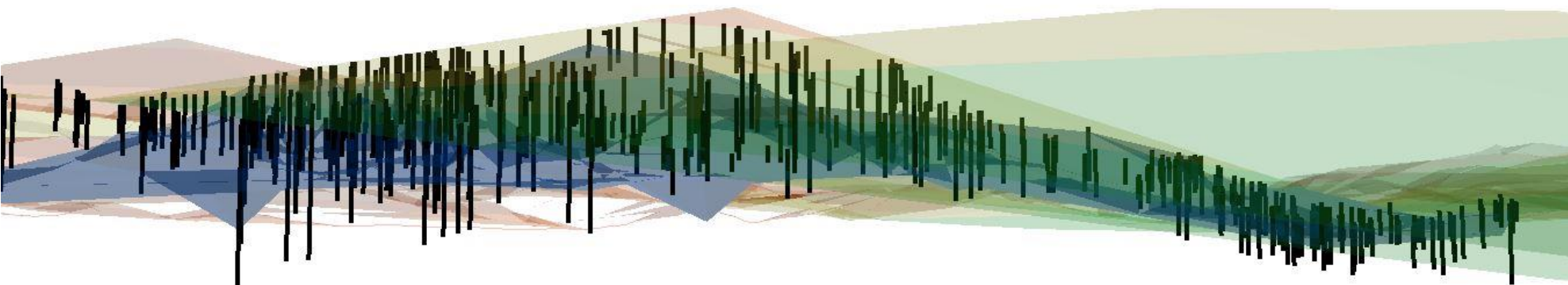
The parameters required to solve the model were all put into AnAqSim, a hydrogeological modeling software, and the model was run according to the data collected. After the AnAqSim model was solved according to the pumping of the six wells, the plot below was created.



The image above is a representation of the whole model. The lower right image is the plot zoomed in.

## 3D Modeling

A 3D map of all the wells in the Floyd Hill, Beaver Brook, and Saddleback Mountain was constructed using ArcGIS.



The data to create this map was taken from each individual well permit that was found on the State of Colorado website. The map consists of roughly five-hundred wells.

## Conclusion

- Wells with similar water chemistry could be drawing from the same aquifer, but cannot be certain due to the fractured bedrock
- Development would decrease the water level in the available aquifer for pumping and can be an issue if not enough water replaced to be self-sufficient
- The degree at which the water level would decrease with building a new development is uncertain due to the unknown volume of the aquifer because of the fractured bedrock
- Further research and testing would need to be conducted to determine actual recharge rates.
- Water quality testing revealed several anion and cation components above maximum contaminant levels in the area.

Contaminant	Recommended Level (mg/L)	Water Samples Exceeding Recommended Level (mg/L)
Fluoride*	4.0	None
Chloride**	250.0	None
Nitrite*	1.0	476 Aspen (1.53) Linda 2: tap (2.56)
Bromide***	Trace amounts-0.05	477 Aspen (0.14) 476 Aspen (0.17) Linda 2: tap (0.06)
Nitrate*	10.0	Will (17.73) Linda (94.10) Linda 2: tap (80.29) Linda 2: raw (69.31) 1300 Ponderosa: tap (29.64) 1300 Ponderosa: raw (33.43) 476 Aspen (15.69)
Phosphate***	0.005-0.05	None
Sulfate**	250.0	None