# Simulation of Ground-Water Flow Leetown, West Virginia

- **The primary objectives of the modeling effort were to 1) develop a hydraulic budget for the Leetown area, 2) assess the potential impact of ground-water withdrawals on the Center's springs and wells, and 3) assess the potential impacts of drought and other stresses on the availability of water to the center.**

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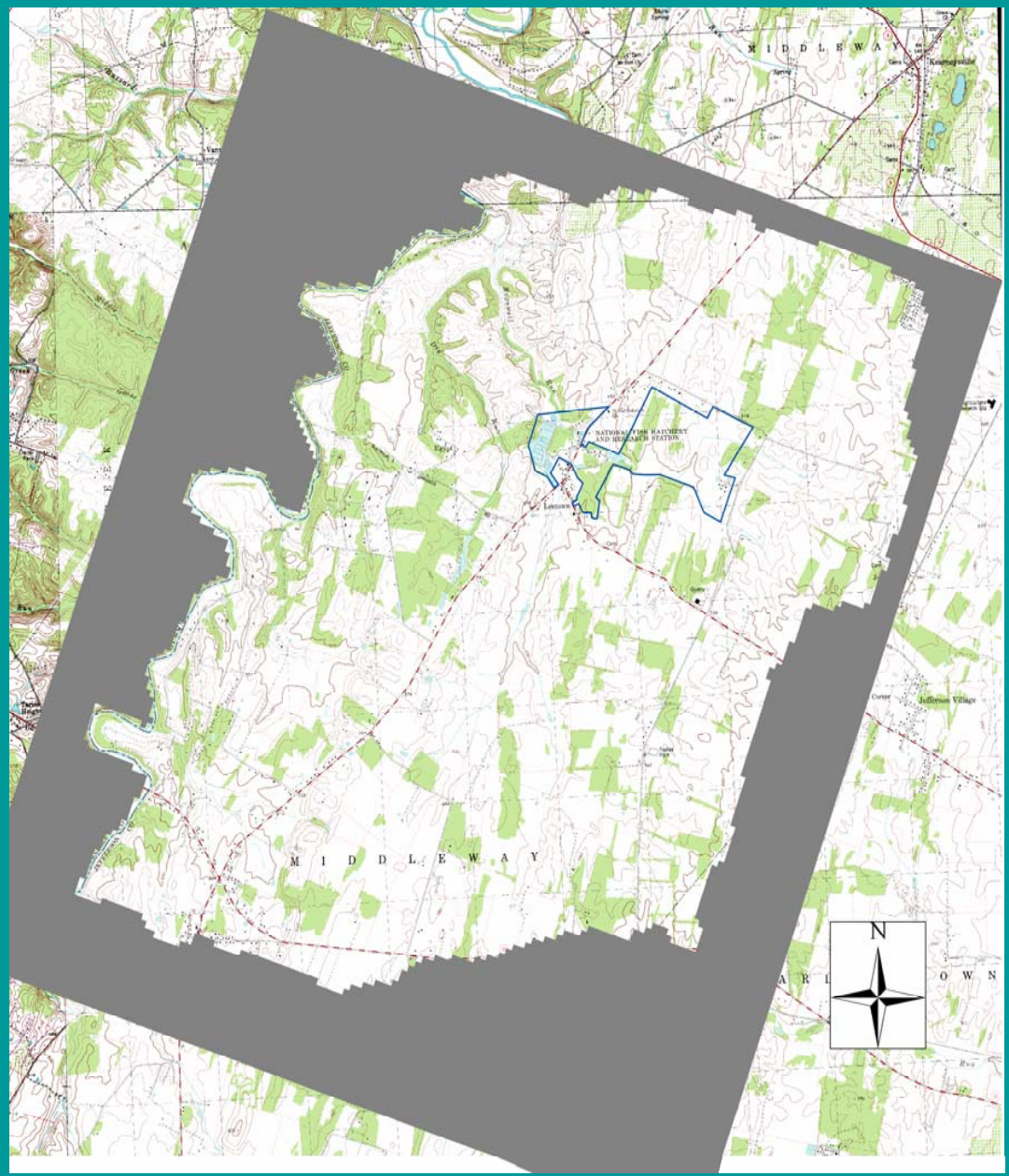
# Study Area – Model Domain

1) Comprises an area of approximately 20 $mi^2$.

2) Contains 22,880 nodes in a 140 column by 163 row grid.

3) Contains the entire Hopewell Run basin plus several smaller tributary streams.

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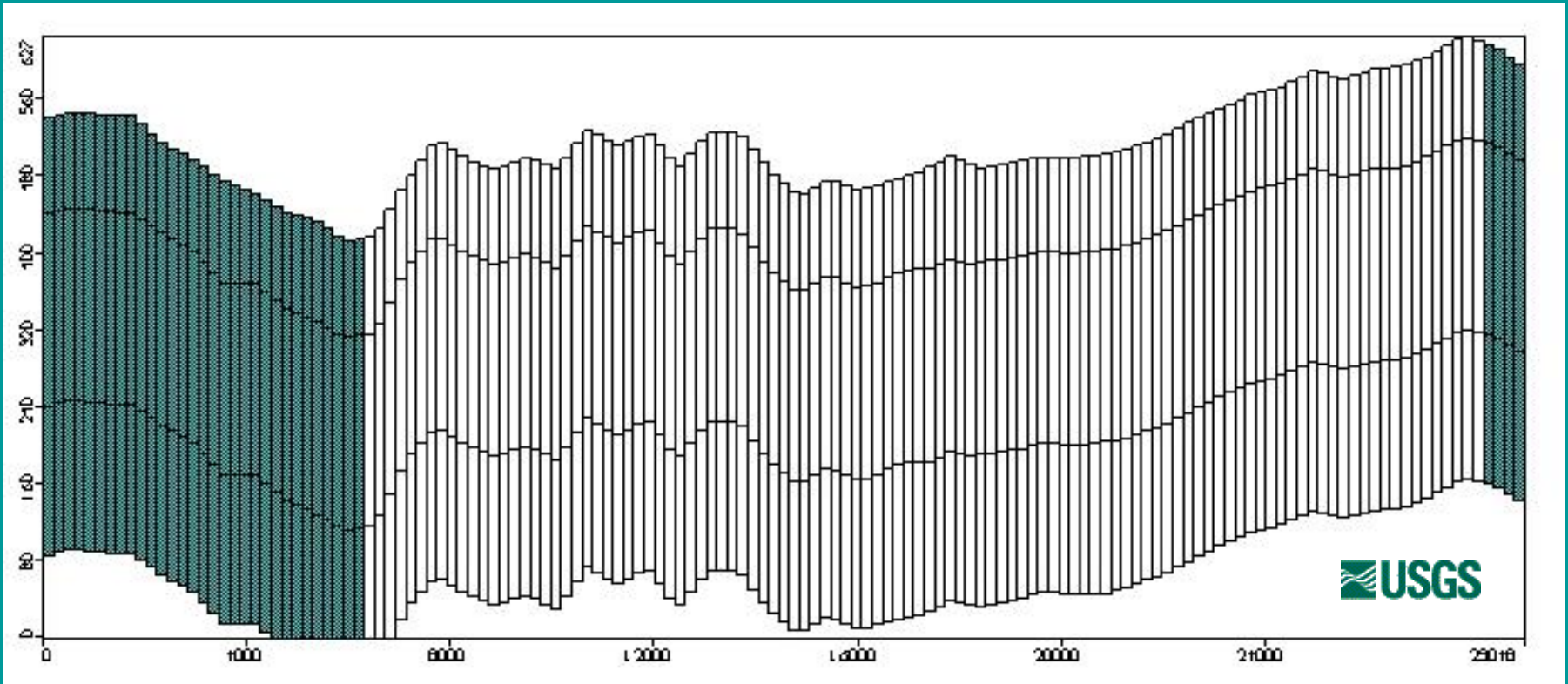
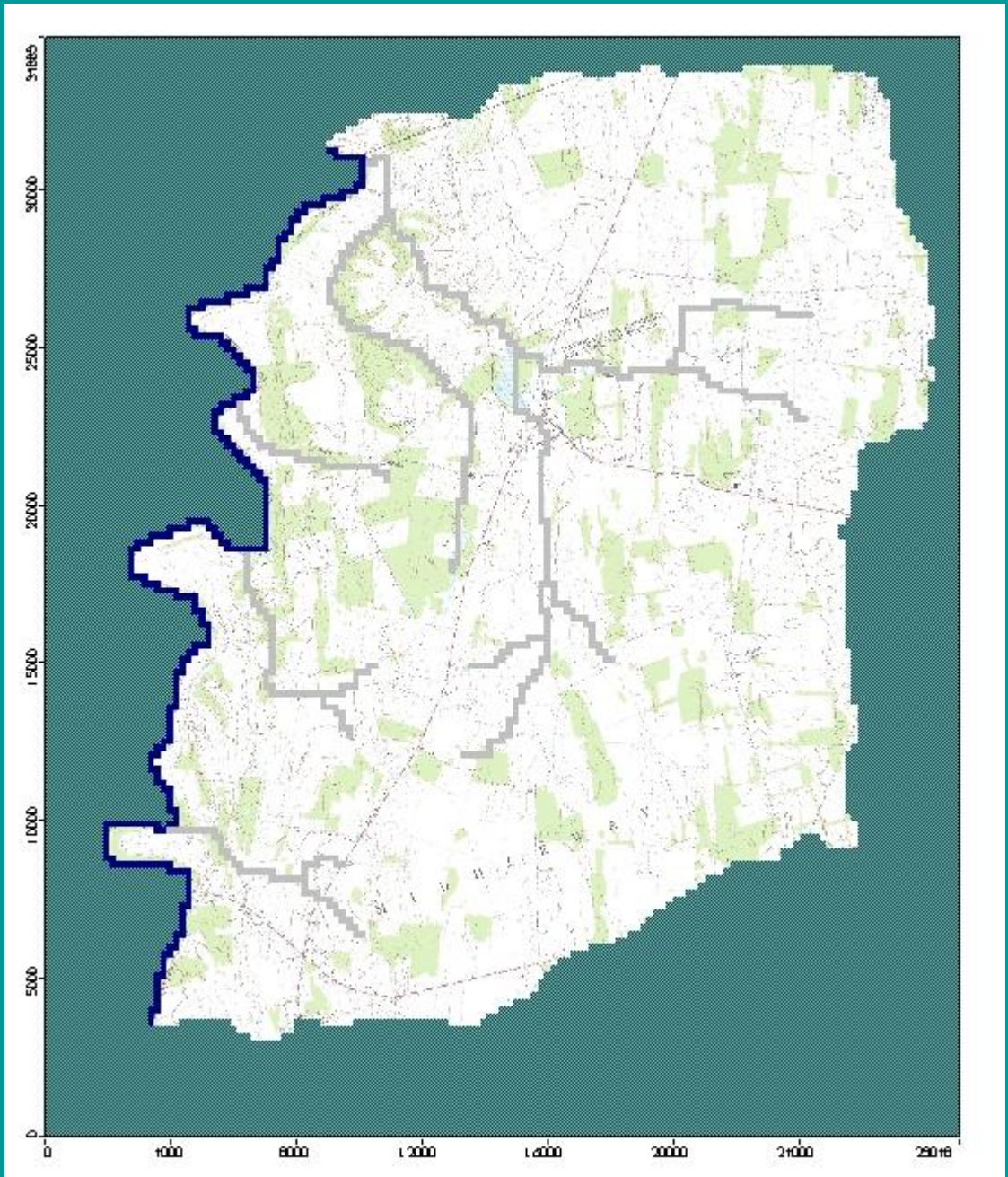
# Ground-Water Flow Model Layers and Thickness

1) Model comprised of three layers. 2) Upper layer is 100 feet thick and represents the epikarst. 3) Middle layer is 150 feet thick and represents the area where most wells are completed. 4) The lower layer is approximately 100 feet thick and represents the lowest conductivity zone. 5) The lower layer extends to an elevation near sea level.



# Boundary Conditions

1) Three primary boundary conditions were used in the model.
2) River nodes were used to simulate Opequon Creek.
3) Drain nodes were used to simulate tributary streams.
4) No flow cells were used to simulate topographic divides.
5) Recharge, based on hydrograph analysis set at 17 in/yr.

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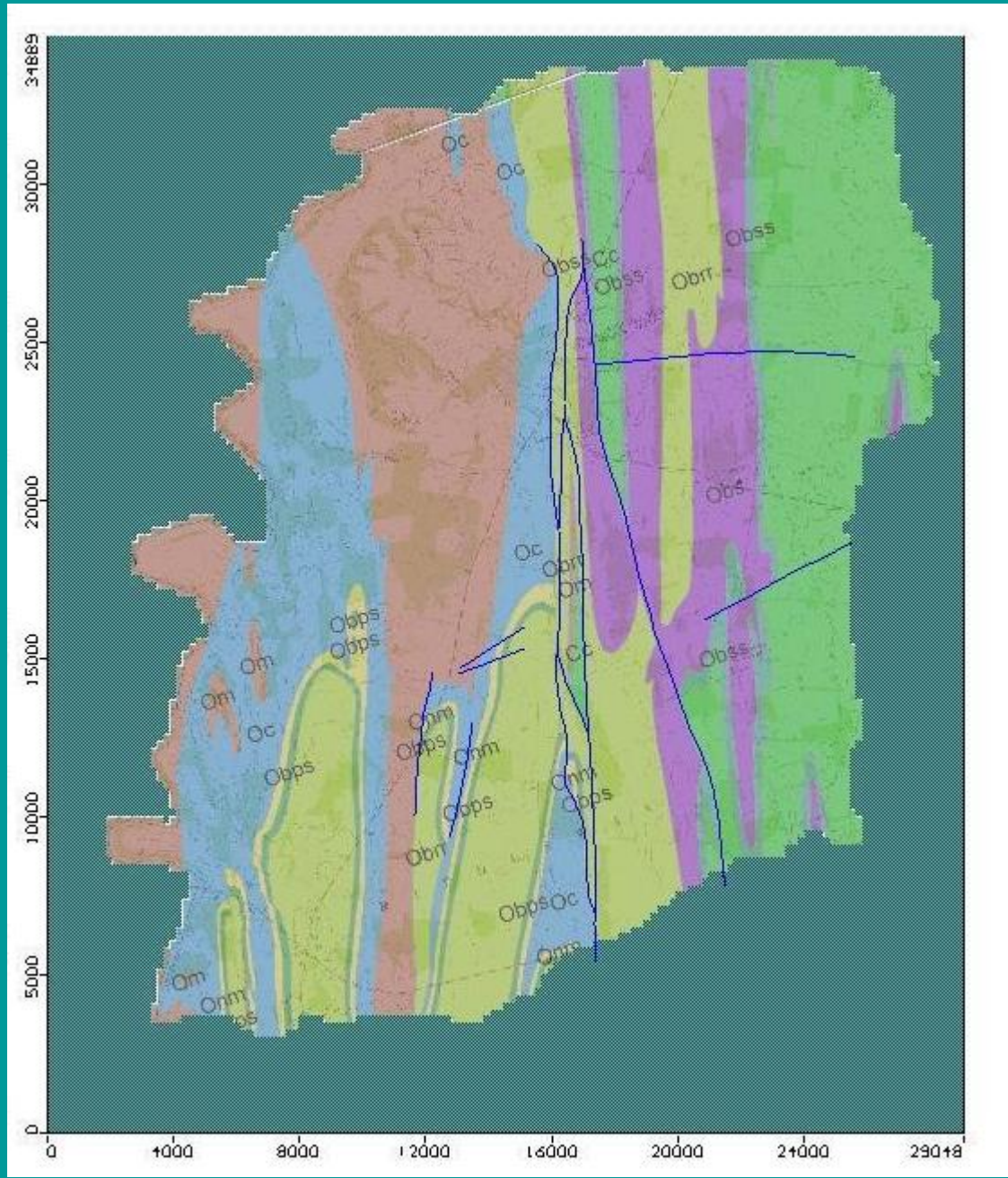
# Geology – Lithology/Faults

1) Geologic maps were used to help develop hydraulic conductivity for model layers.
2) Faults were an integral part of the simulation.
3) Aquifer test data collected as part of the Leetown and county studies was used to establish layer properties.

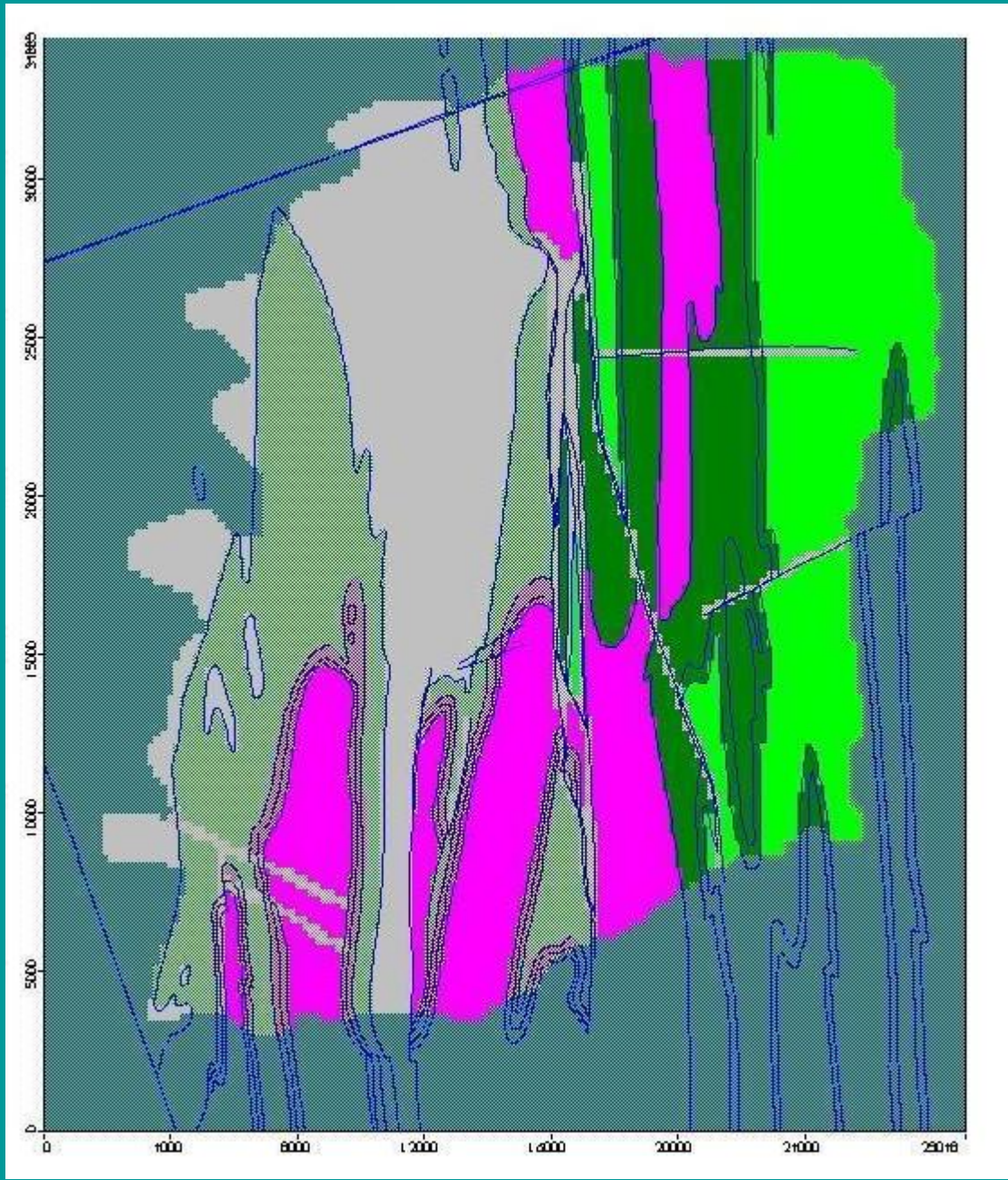


# Hydraulic Conductivity

1) Conductivity was assigned for each major lithologic unit.

2) Conductivity for each layer was apportioned using hydraulic and surface geophysics data.

3) Model did not calibrate well until the faults were simulated.

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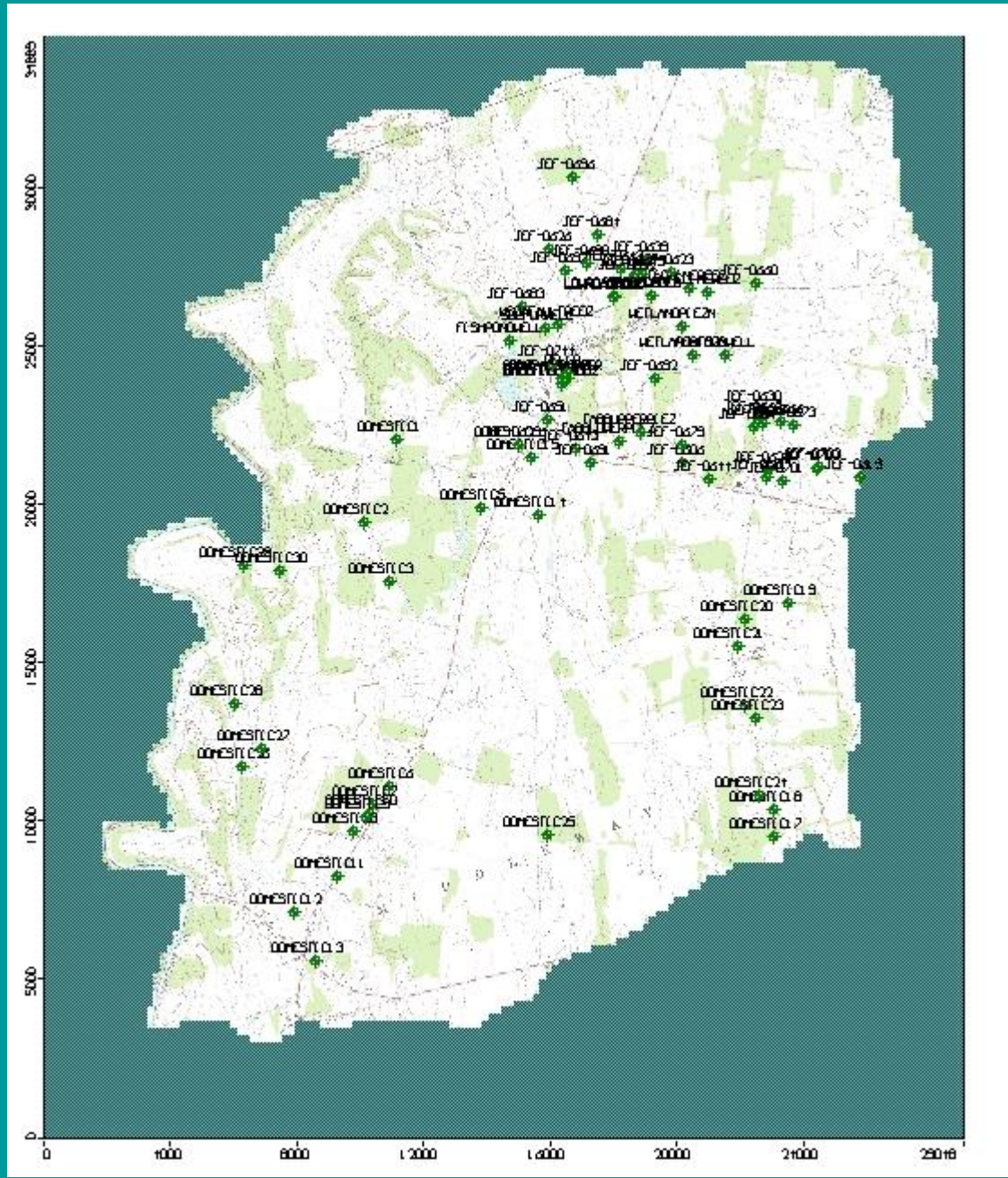
# Calibration Dataset

1) Stream discharge and water levels measured in 90 wells and used to provide a dataset for model calibration.

2) Single well aquifer tests were conducted on 60 of the wells to provide hydraulic data to construct the model.

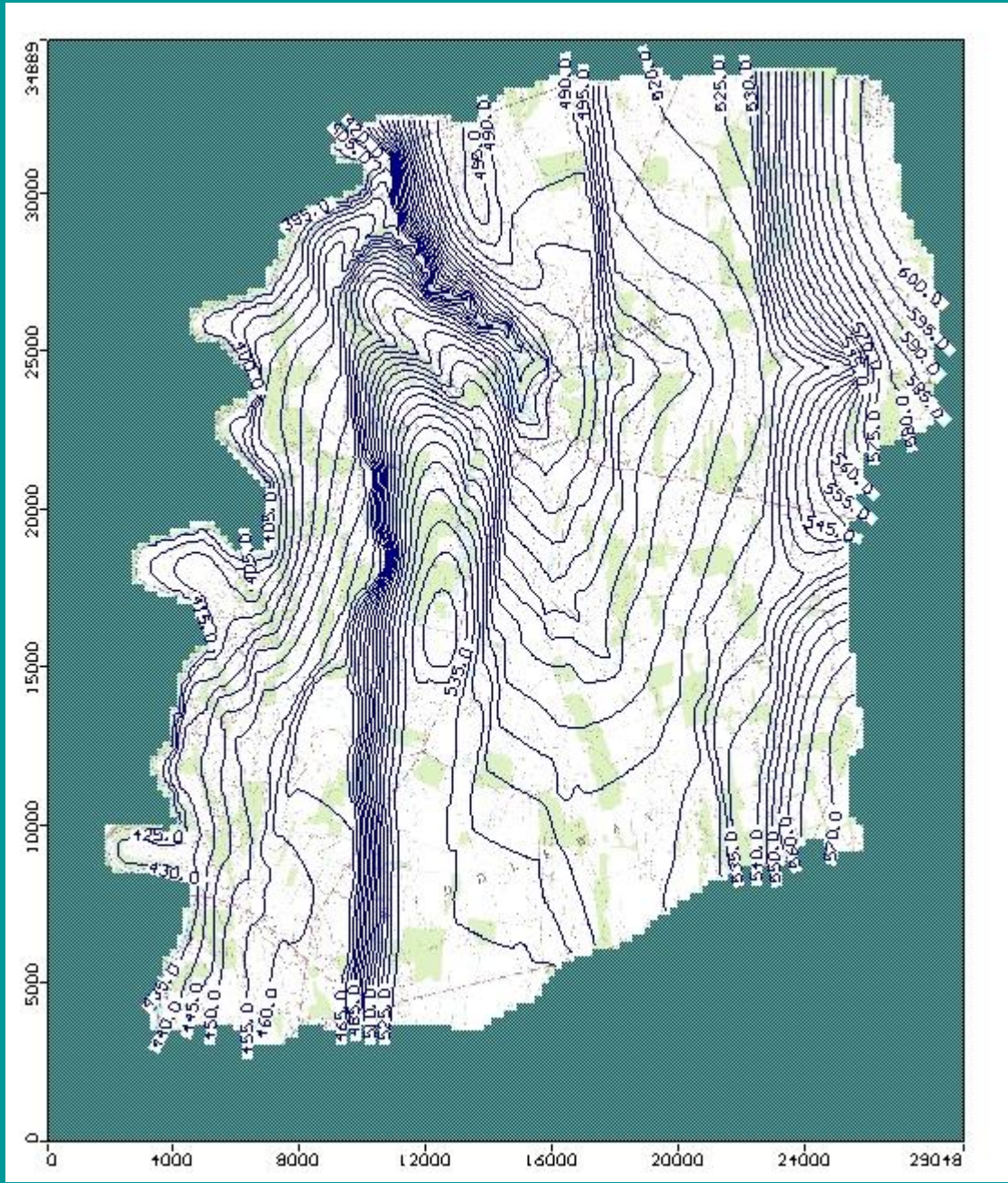


# Simulated Water Level Map

1) Simulated water levels provide insight into ground-water flow in the Leetown area.

2) The USGS Leetown Science Center is uniquely situated with respect to ground-water.

3) Large quantities of water over a broad area are funneled through the Leetown area.

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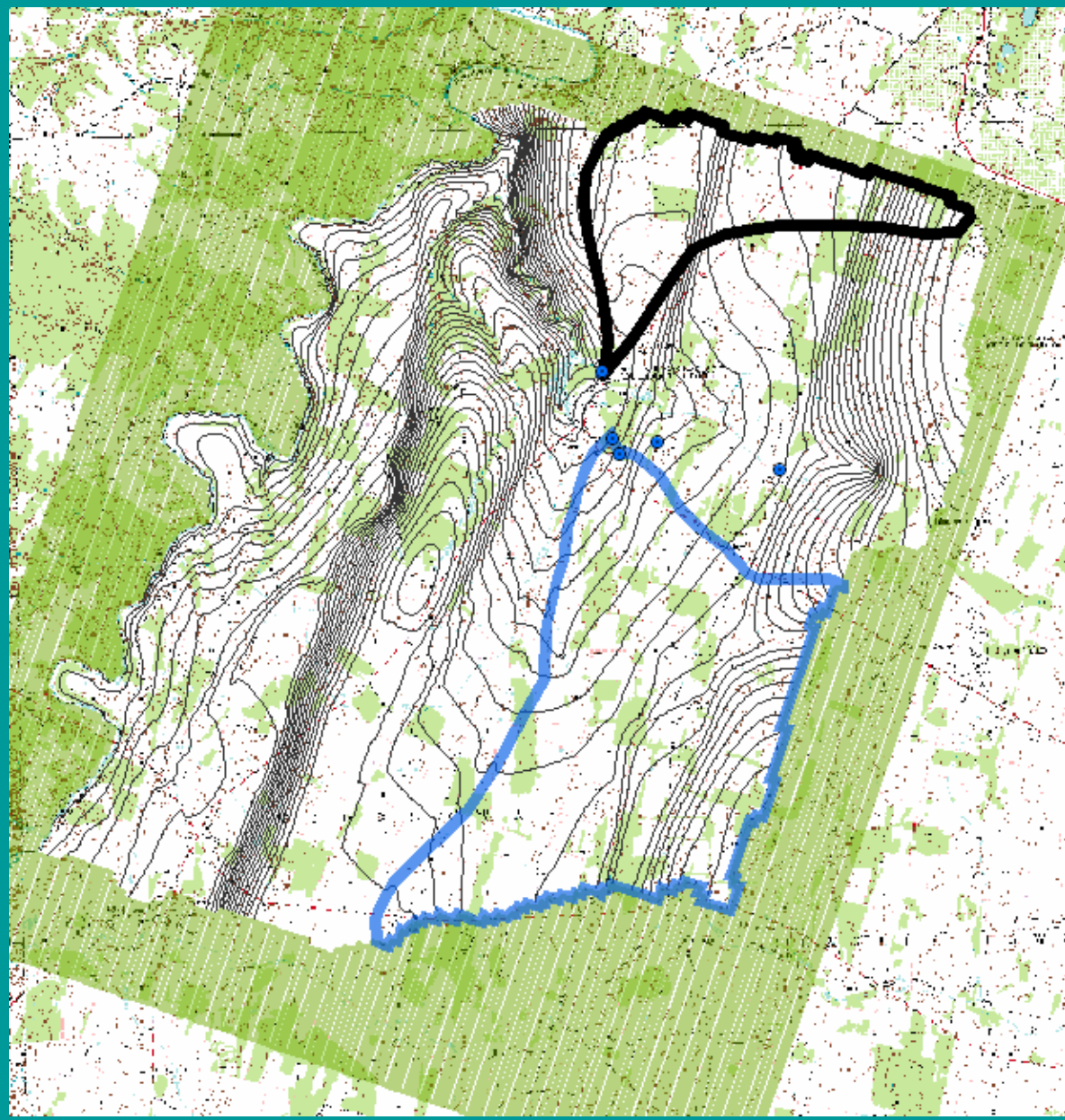
# Spring Recharge Areas

1) Preliminary recharge areas for the primary springs in Leetown were delineated using hydrualic head and dye tracer data.

2) Principal recharge to Blue and Gray Springs is derived from an area to the south and east.

3) Balch Spring derives recharge primarily from the North.



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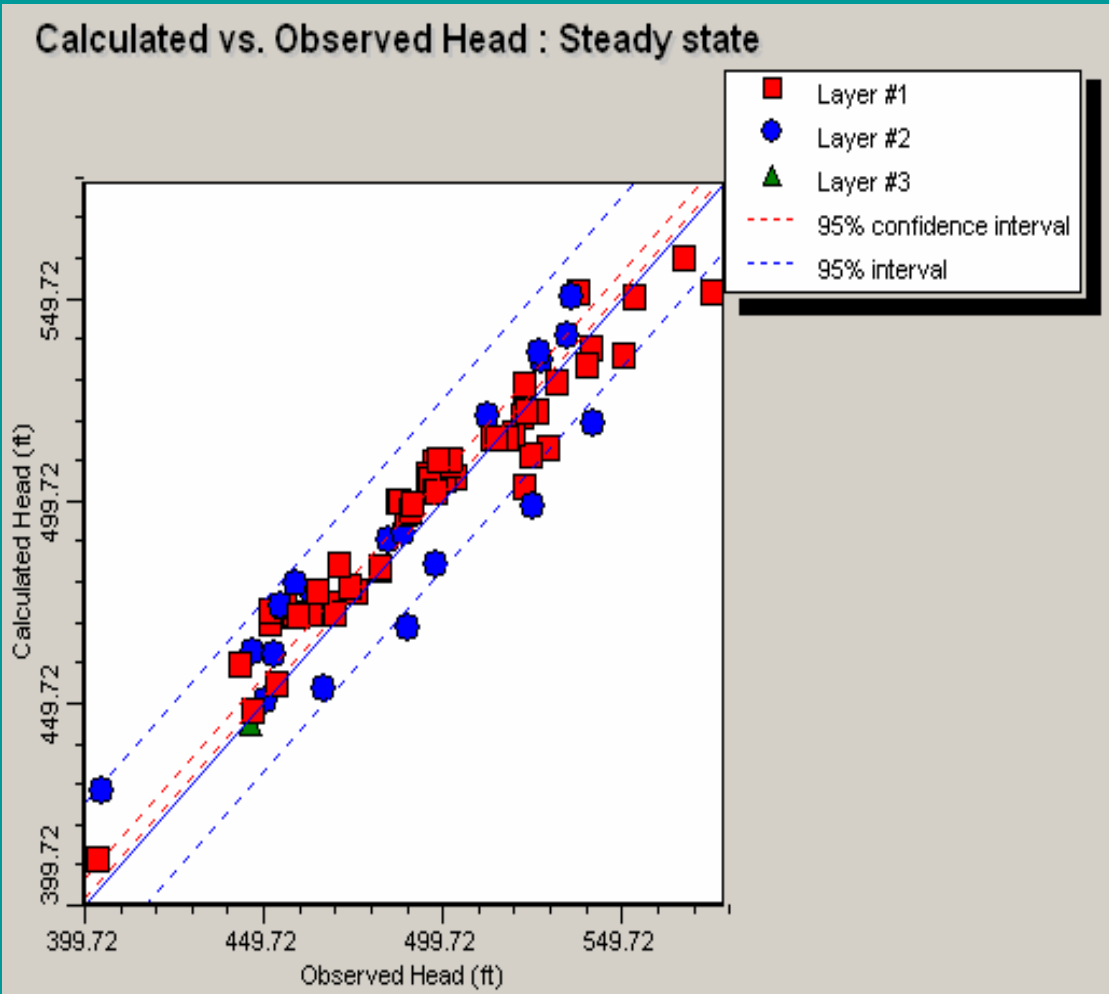
# Calibration Statistics

1) Mean error in the model is 1.14 feet.
2) The correlation coefficient between simulated and observed water levels is 0.96.
3) Simulated flow in Hopewell Run matched flow data for the Hopewell Run gage at Leetown.




Num. of Data Points : 86
Max. Residual: -26.562 (ft) at DOMESTIC7/1
Min. Residual: 0.298 (ft) at DOMESTIC26/1
Residual Mean : 4.308 (ft)
Abs. Residual Mean : 9.419 (ft)

Standard Error of the Estimate : 1.139 (ft)
Root Mean Squared : 11.348 (ft)
Normalized RMS : 6.604 ( % )
Correlation Coefficient : 0.955

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# Results and Discussion

- **The current model matches well the conceptual model of ground-water flow in the Leetown area and reasonably represents water levels and flow.**
- **Under average to high water table conditions, no adverse impact to streams or springs was indicated based on results of simulated ground-water withdrawals.**

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# Additional Work to be Completed

- **Final calibration of the flow model is expected in January.**
- **Scenario modeling of effects of drought and other stresses is scheduled to be completed in February.**
- **Preparation of the modeling report will begin in January and a final report is due by September 30, 2006.**

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