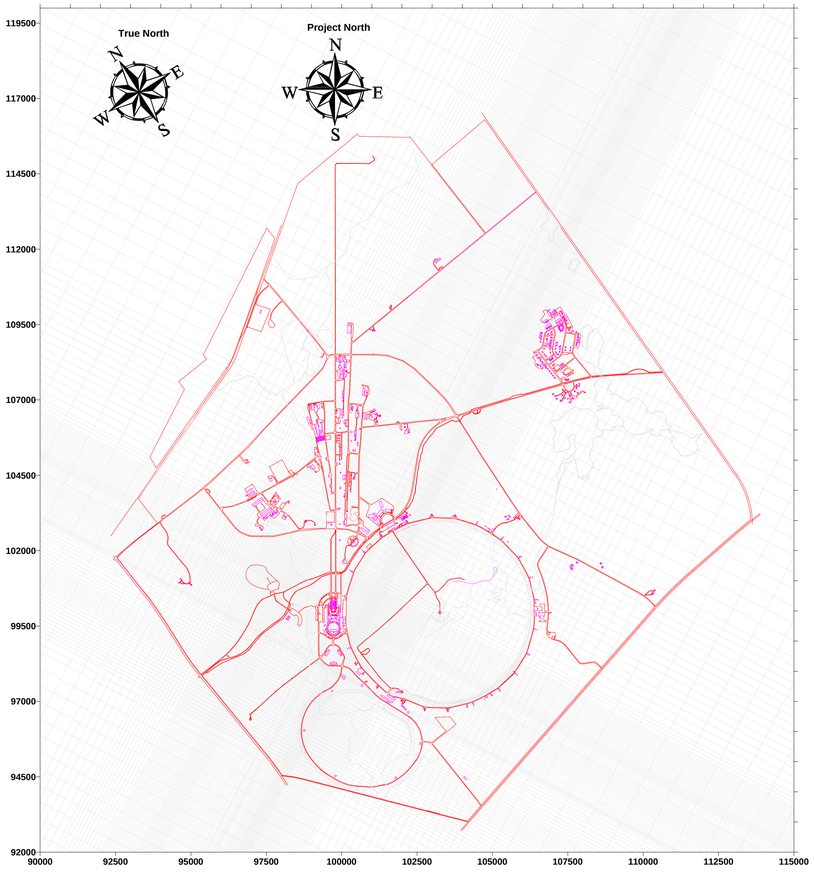
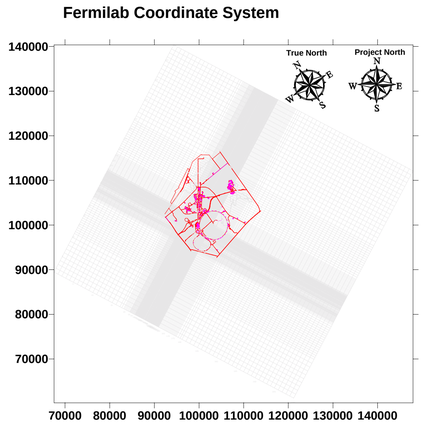
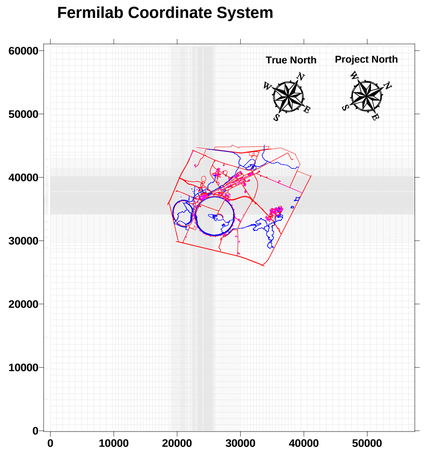
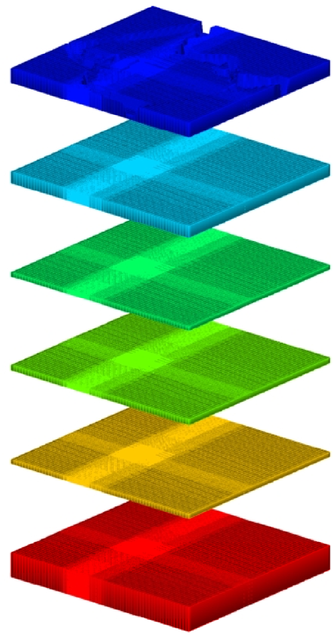








Grid Dimensions:

- 75 Rows
- 71 Columns
- 6 Layers

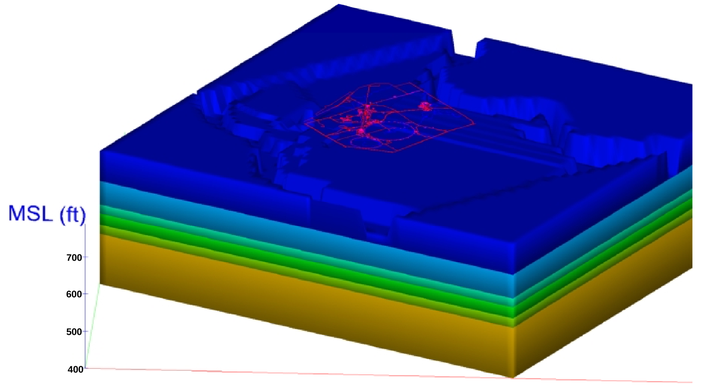
Coordinate Transformations:

X Offset = 121183.76

Y Offset = 61251.52

Rotation = 62.28 degrees

Grid Spacings:	Min.	Max.
Rows (Delta-Y)	27 ft	978.74 ft
Columns (Delta-X)	27 ft	998.15 ft



Analysis of groundwater flow in the area of the NuMI Tunnel was accomplished using finite difference groundwater flow model techniques. The model used was MODFLOW, a groundwater flow model developed by the United States Geological Survey. MODFLOW is the industry standard for groundwater flow modeling. Finite difference groundwater flow modeling involves the discretization of the model area into a rectangular grid. The finite difference model grid (Illustrated above) consisted of 75 rows and 71 columns with a total of 31,950 cells, of which 19,872 cells were active. The finite difference cells were constructed as a variable grid with grid spacing ranging from 27 feet to greater than 900 feet in the X and Y directions.

The groundwater flow model was subdivided into six (6) model layers representing each major geologic unit at FNAL. These units included the surficial till overlying the Silurian Dolomites which are underlain by the Makoqueta Shale. The Silurian Dolomite unit was further subdivided into the Joliet, Kankakee, Elwood, and Wilhelmi Formations. This model construction allowed for the calculation of the horizontal and vertical groundwater flow gradients and velocities across the site and in the immediate vicinity of the NuMI Tunnel.

The finite difference grid was oriented along the direction of the NuMI Tunnel in order to better calculate groundwater inflows and piezometric heads along the tunnel. In order to accomplish this, the finite difference grid had to be modified from the FNAL coordinate system. Transformation of the FNAL grid to the groundwater flow model grid involved both translation and rotation of the FNAL grid. The X axis offset was 121,183.76 feet, and the Y axis offset was 61,251.517 feet. The grid was then rotated 62.28 degrees azimuth in order to align the model grid along the direction of the NuMI Tunnel.

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Plate A.

Orientation of Finite Difference Grid and Site Geology
NuMI Groundwater Flow Model
Fermi National Accelerator Laboratory
Batavia, Illinois