CLAY BED MODELING
ELIOT QUARRY- CEMEX AGGREGATES
ALAMEDA COUNTY, CALIFORNIA

PREPARED FOR: CEMEX CONSTRUCTION MATERIALS PACIFIC LLC
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AND

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DATE: DECEMBER 3, 2018

TABLE OF CONTENTS

FIGURES

EXECUTIVE SUMMARY

Jeff Light Geologic Consulting ("JLGC") has been retained by Compass Land Group to evaluate and model the distribution of clay beds at the CEMEX Eliot Quarry in Alameda County, California. An understanding of the distribution of clay beds is crucial to establish whether or not potential aquitards are present in the study area. This understanding will inform future evaluations of impacts related to planned mining depths. This report demonstrates the absence of continuous clay beds across the study area that may form aquitards, and presents the results of geologic interpretations and models that support this conclusion. In addition, JLGC reviewed the Zone 7 Water Agency's preliminary interpretations relating to the distribution of clay beds and compared those interpretations to JLGC's findings based on the geologic model. JLGC finds that Zone 7's interpretations do not accurately portray the existing subsurface site conditions.

JLGC's conclusions are summarized as follows:

1. All of the borings drilled at the site are comparable relative to the percentage of clay encountered while drilling, independent of the drilling or logging methods used (Figure 1). JLGC has used all of the available data in developing its interpretation and understanding of the subsurface. Conversely, Zone 7 does not include the 21 Becker Hammer drill holes (2013) in their dataset, all of which are valid data points.
2. By relying on an incomplete data set, Zone 7's interpretation projects clay layers into locations where no clay deposits are physically present (e.g. into the sidewalls of Lake B). While Zone 7 appears to solely rely on e-logs for defining the extent of clay beds, Zone 7 projects at least three different clay layers through at least six boreholes at depths for which the e-logs show no occurrence of clay.
3. Zone 7 interprets that Clay 6 should crop out in the walls of Lake B. There are no clay beds observed in the walls of Lake B.
4. The sand and gravel being mined at the CEMEX Eliot facility was deposited in a braided stream environment (see Figure 2). Generally, braided streams do not provide for continuous bank-to-bank clay beds that form aquitards.
5. There were no lake bed deposits observed across the most recent 2018 drilling, except near the bottom of Hole 2018-E at the west end of Lake A. Lake bed deposits, where present, have the potential to form aquitards.
6. Zone 7 clay correlations are too steep, and are inconsistent with a braided stream depositional environment and observed site geomorphology.
7. Zone 7 appears to have ignored basic geological parameters in their interpretation of the Eliot site, including clay bed slope, clay bed attitude/orientation, depositional environments, and in some cases geophysical properties of the beds.
8. All 6 modeled clay intervals were determined to be <u>discontinuous</u> over the study area.

1.0 INTRODUCTION

Jeff Light Geologic Consulting ("JLGC") has been retained by Compass Land Group to evaluate and model the distribution of clay beds at the CEMEX Eliot Quarry in Alameda County, California. An understanding of the distribution of clay beds is crucial to establish whether or not potential aquitards are present in the study area. This understanding will inform future evaluations of impacts related to planned mining depths. This report demonstrates the absence of continuous clay beds across the study area that may form aquitards, and presents the results of geologic interpretations and models that support this conclusion. In addition, JLGC reviewed the Zone 7 Water Agency's ("Zone 7's") preliminary interpretations relating to the distribution of clay beds and compared those interpretations to JLGC's findings based on the geologic model. JLGC finds that Zone 7's interpretations do not accurately portray the existing subsurface site conditions.

Data made available to JLGC and used in the analysis included: current and historical aerial photos, USGS topographic maps, CAD topographic maps (2018), 57 drill hole logs (Reverse Circulation, Becker Hammer and Sonic) and geophysical log data. In addition, JLGC was present on-site for the duration of sonic drilling that occurred between April 30, 2018 and May 18, 2018 and was able to observe existing quarry pit face conditions at Lake B and Lake J.

All data made available was used in this analysis and incorporated into the model. The subsurface modelling was conducted by JLGC and is original work. Correlation and interpretations are conducted in the CAD software program SURPAC under licensed sentinel #32309.

2.0 BRAIDED STREAM ENVIRONMENT

Figure 2 shows that the Arroyo del Valle is a braided stream depositional environment. Braided streams are characterized by high sediment loads, with proximal highlands and relatively steep stream gradients. The channel system consists of several anastomosing channels that jump and migrate frequently due to the high sediment load (Figure 3). These can result in abandoned channels that can be later filled by a future depositional event. Outside of the channel system is an off-channel flood plain. Sands and gravels are prevalent in the channel system and fine-grained silts and clays are restricted to floodplain deposits and abandoned channel fills. Channel deposits consist of coarse materials deposited in point bars and bed loads. Floodplain deposits consist of fining upward beds of silt and clay. A fining upward sequence represents a single depositional event where the coarser materials (such as gravels) are deposited earlier in the event and finer materials (such as clays) are deposited as the flood flow velocity begins to decrease over time. Channel fills are old abandoned channels that are low spots and collect fines during flood events and stagnant water periods. Examples of geophysical logs (gamma response) and depositional environment correlations are provided in Figures 4 and 5. Gamma response patterns give clues to the distribution of clay in the deposit and depositional environments can be inferred from those patterns.

3.0 EXISTING GEOMORPHOLOGY

Figure 28 show the Arroyo del Valle channel path and the stream and topographic gradients of the Arroyo del Valle floodplain. Stream gradients are around 0.6% and the topographic gradient is between 0.2% and 1%. The orientation of the floodplain gradient is approximately 302 degrees azimuth to the NE. Any channel deposits, channel fill deposits and floodplain deposits found within the near surface (top few hundred feet) of Arroyo del Valle should share those rough orientations. Based on review of historical aerial imagery for the site, it is apparent that the Arroyo del Valle has previously been realigned by a few hundred feet to the southwest; however, that realignment is not observed to have had any major impact on the orientation and gradient of the floodplain. Clays when deposited by standing water are typically flat to near flat and will run with the topographic gradient. That is, clays that are thought to be connected and continuous in the immediate Arroyo del Valle subsurface should dip roughly 0.2%-1% to the west-northwest and strike to the north-northeast. Figure 27 shows the strike lines of the dipping clays as interpreted by JLGC and are consistent with Figure 28.

4.0 MODELING

Accurate geologic modeling requires that all known geologic parameters be utilized in the process. At Eliot, the depositional environments, sedimentary bed attitude/orientation, structural geologic features, and geophysical logging have all been considered. See Figures 6 through 8, as well as Figures 26 through 28.

Prior to entering data into the geologic model, and to attempt to better understand why Zone 7 chose not to use the 2013 Becker Hammer data in their preliminary interpretations, JLGC checked the 2013 and 2018 drill hole data for potential logging bias. There was no observed bias in the percentage of clay logged between the 2013 Becker Hammer holes and the 2018 sonic holes (Figure 1). As such, consistent with standard geologic practice, all available data is used.

There is subsurface evidence of a major erosional unconformity. Hole 2018-E (at the west end of Lake A) had what appeared to be an erosional contact between the overlying braided stream deposits and the older underlying blue clays that could be representative of a lacustrine (lake bed) deposit. Several down dip holes appeared to show a similar relationship. Figures 9 and 10 show the modeled erosional unconformity surface. The erosional surface appears to dip to the northwest into the basin.

There were 6 different clay intervals differentiated in the data. Those interpretations are shown in Figures 6-24. Each clay interval (a surface interval and clays 4-8) was determined and correlated based on the following criteria:

1) Try to stay consistent with the measured stream gradient and topographic gradients of 0.2% to 1%.

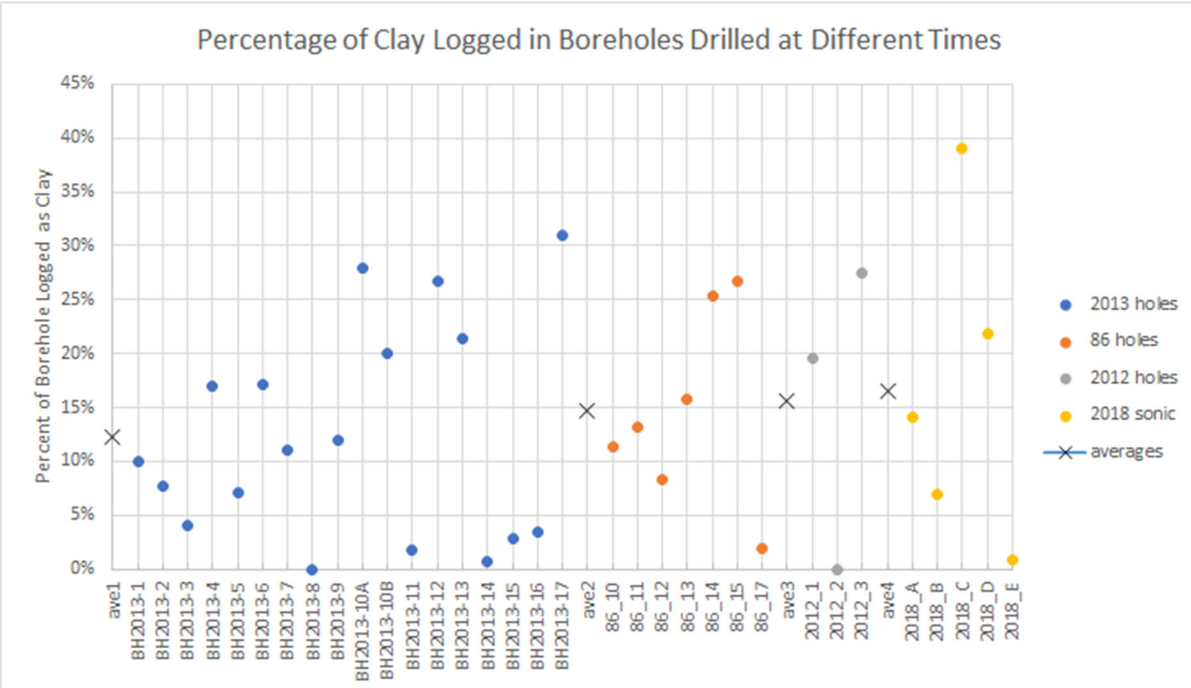


Figure 1. Comparison of the feet of clay logged divided by the total drill depth for the 2013, 86, 2012 and 2018 data. There appears to be no bias in percentage of clay logged between the different drilling and logging methods.

2) Try to stay consistent with the observed strike and dip of the flood plain with dips to the northwest ~ 302 degree azimuth.
3) Connect clay lenses looking down a strike view with similar elevations.
4) When available use gamma ray patterns to establish more continuous/thinner fining upward sequences. Interpret channel fills when thicker blockier gamma ray responses are observed and there are few to no correlative clays along the strike view.
5) Where clay extends above an interpreted plane and no correlative clay lens exists then a clay channel fill is interpreted which is localized and channelized.
6) When the gamma ray response conflicts with the log description (like how many of the Brown and Caldwell logs are re-interpreted), put more weight on the gamma response.
7) If there is no clay interval logged or gamma ray kick then no clay was interpreted.
8) Roughly interpreted that a clay stops half way between clay interval hole and a no clay interval log.

All 6 clay intervals were determined to be discontinuous over the study area and did not display floodplain overbank characteristics based on gamma responses that might indicate some continuity and connection across the data set. There were no lake bed deposits observed across the 2018 drilling, except in the material below the erosional unconformity observed in Hole 2018-E.

All cross-sections presented in this report (Figures 6 through 25) are two-dimensional representations of a three-dimensional model, and may have localized perspective constraints that will appear to project thicker or thinner clay lenses than what is actually modeled. For example, on Figure 17 the two-dimensional figure depicts Clay 5 around Lake J as being significantly thicker than modeled because the lens is slightly higher to the northeast than it is to the northwest (meaning it is dipping toward the viewer).

5.0 ZONE 7 INTERPRETATIONS

JLGC observes the following related to Zone 7's preliminary interpretations:

1. All of the borings drilled at the site are comparable relative to the percentage of clay encountered while drilling, independent of the drilling or logging methods used (Figure 1). However, Zone 7 does not include 21 Becker Hammer drill holes in their dataset, all of which are in the study area.
    - That data should not be excluded. Pete Cotter from CEMEX logged those holes. Mr. Cotter was an experienced geologist and California Registered Geophysicist and would understand the economic importance (cost) of knowing where and how thick clay lenses were at the CEMEX operations. He would not have overlooked logging clay intervals if they were encountered during drilling.
    - Analysis of the logged feet of clay per feet of hole drilled for the 2013 Becker Hammer holes are similar to that logged in the most recent 2018 sonic holes. There is no reason to exclude those 21 holes from the dataset.
2. By relying on an incomplete data set, Zone 7's interpretation projects clay layers into locations where no clay deposits are physically present (e.g. into the sidewalls of Lake B).
    - Zone 7 interprets that Clay 6 should crop out in the walls of Lake B; however, there are no clay beds observed in the walls of Lake B..
3. Zone 7 interprets clay where there is no gamma ray response on the log.
    - Clay 5 in Hole 3S-1E-14J3
    - Clay 6 in Hole 2018-B and 2018-D
    - Clays 5 and 6 in Hole 3S-1E-13P9
    - Clay 4 in Holes 3S-1E-12K1 and 3S-1E-12Q4
4. Zone 7's interpretation appears to be inconsistent with a braided stream depositional environment.

- The current depositional environment for Arroyo del Valle is a braided stream.
- There were no lake bed deposits observed across the 2018 drilling, except in the material below the erosional unconformity observed in Hole 2018-E.
- The braided stream depositional environment appears to persist at depth to below 280 feet below ground surface as observed in the 2018 sonic holes A, B, C and D.
- Clay beds in braided stream systems tend to be either floodplain overbank deposits or channel fill deposits and tend to be de-coupled from one another and disconnected. These fine grained deposits tend to be cut-off and eroded by future channel migrations. This results in abundant truncated and discontinuous fine-grained beds preserved in the subsurface. This is not compatible with the Zone 7 interpretation of fine-grained beds depicted as continuous, wide spread aquitards.

5. Zone 7 clay correlation is too steep, and is inconsistent with a braided stream depositional environment (Figure 25 and Figure 29).
    - The angle at which the clays are connected in the Zone 7 interpretation are too steep. The Zone 7 correlation gradient of 3%-6% far exceeds the 0.2%-1% topographic gradient and 0.6% stream gradient observed within the Arroyo del Valle floodplain. Even with tectonic basin dropping as a potential effect on the dip of geologic units. The impact on beds that are only a few hundred feet below the surface should be minimal and the 400' drop in elevation along a single clay bed (Clays 6 and 7) starting at 100' below the current topographic surface seems very aggressive.
    - Correlation of clays along the depositional strike should be relatively flat and that depositional strike should be roughly perpendicular to the stream and floodplain dip direction. Zone 7 clay correlation results in a clay deposit dip direction that is roughly 5 degrees east of north (Figure 26), that dip direction is rotated 60 degrees clockwise from the current stream and floodplain gradient observed in Arroyo del Valle (Figure 27 and 28).
    - Current surface geology does not display a consistent and complete clay lens that drapes across the entire surface of the Arroyo del Valle floodplain. There are clays at the surface on the north and northwest side of the study area but most of the geology exposed at the surface is clean sand and gravel.
    - Braided stream environments do not deposit thick continuous clay lenses across the entire flood plain. Rather, during flood the main and side channels will continue to be clay free with high water flow. The main channel will never deposit clay in it until it is abandoned and covered by later flood events. So by definition any single one flood event cannot create a continuous clay bed. It will be truncated by the current channel system.

In summary, Zone 7 appears to have ignored basic geological parameters in their interpretation of the Eliot site, including clay bed slope, clay bed attitude/orientation, depositional environments, and in some cases geophysical properties of the beds.

6.0 LIMITATIONS

Professional statements and illustrations presented in this report are based on evaluations of the technical data and information available at this time. Conclusions are based on sound geologic judgment. These interpretations and conclusions may change with the presentation of previously undisclosed data, the acquisition of new data, or changes in site conditions. No warranty is made, expressed or implied, on this work.

Respectfully submitted.

Jeff Light
Professional Geologist
#7661

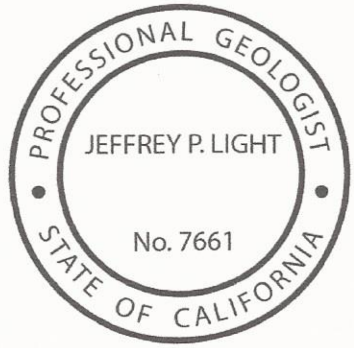
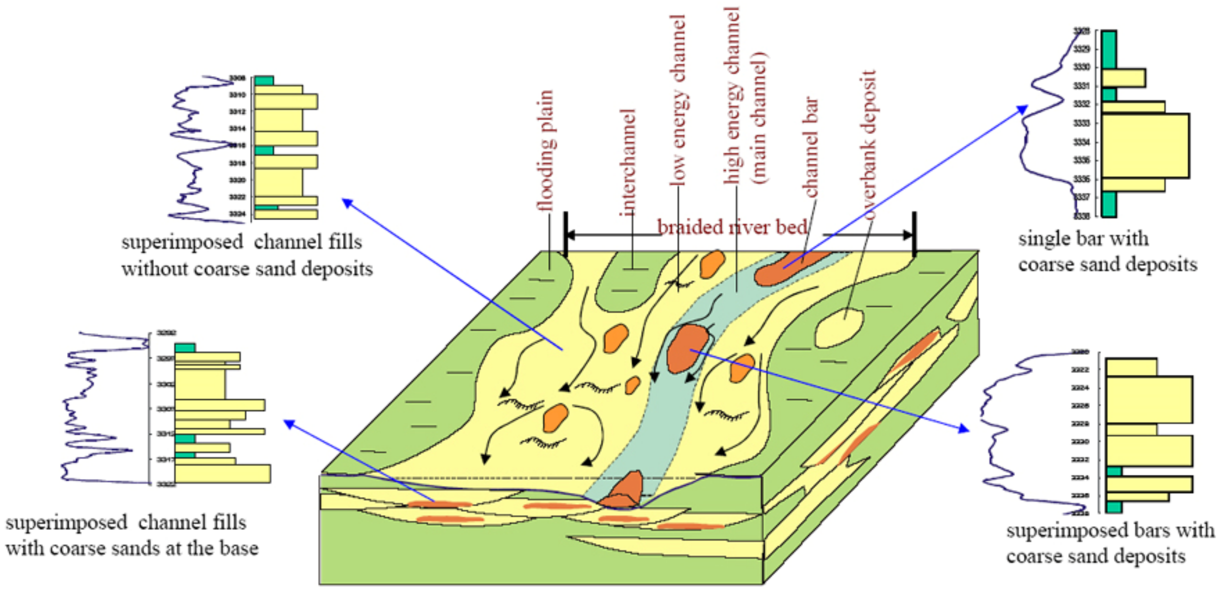
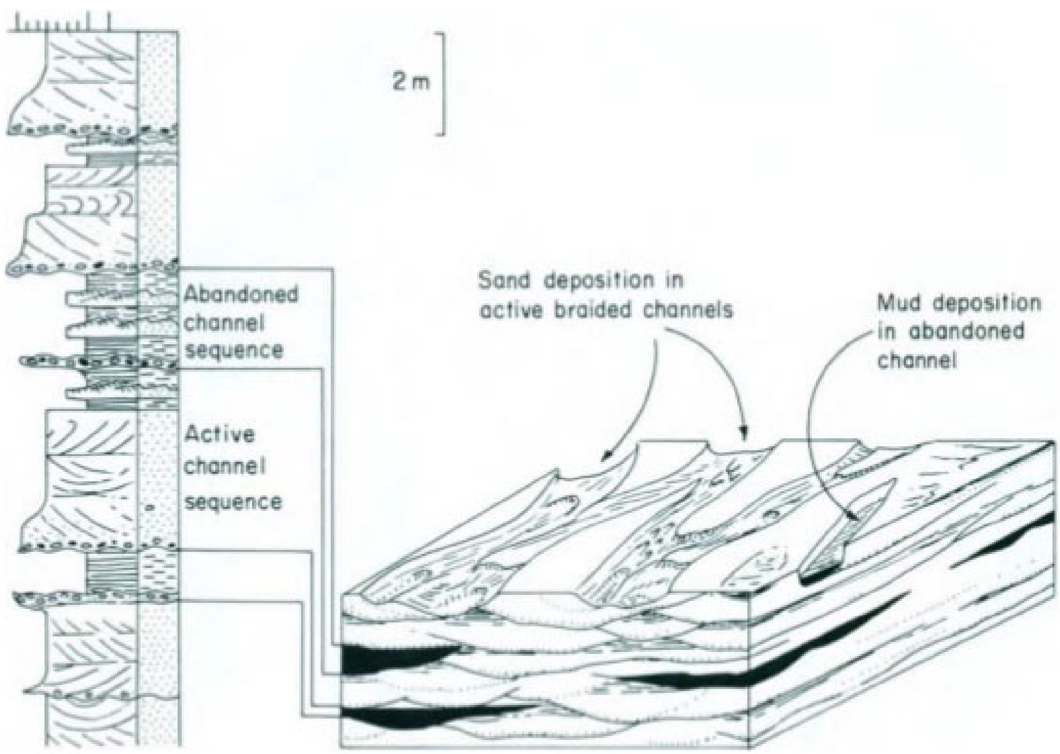


Figure 2. Google Earth aerial photos from 6/11/1993 and 10/30/2002 showing a multiple channel braided depositional system. The photo shows the area over the eastern portion of Lake B. Isabel Rd runs north-south along the right side of the photos. Over a ten year period the channel that was up against Vineyard Ave and the north point of Ruby Mill Blvd had been abandoned and the main channel was no 225’ to the northeast.





Physiography and deposits of a braided alluvial channel system. Sedimentation occurs almost entirely in the rapidly shifting complex of channels. Silts are rarely deposited in abandoned channels. A floodplain is absent.

Figure 3. Block diagrams of braided alluvial channel systems. Both diagrams show the discontinuous nature of fine-grained materials in this type of depositional system. Clay beds are spotty and eroded by frequently migrating channels resulting in discontinuous and unconnected clay beds. Source: *Principles of Sedimentology and Stratigraphy* (4th Ed.), Sam Boggs.

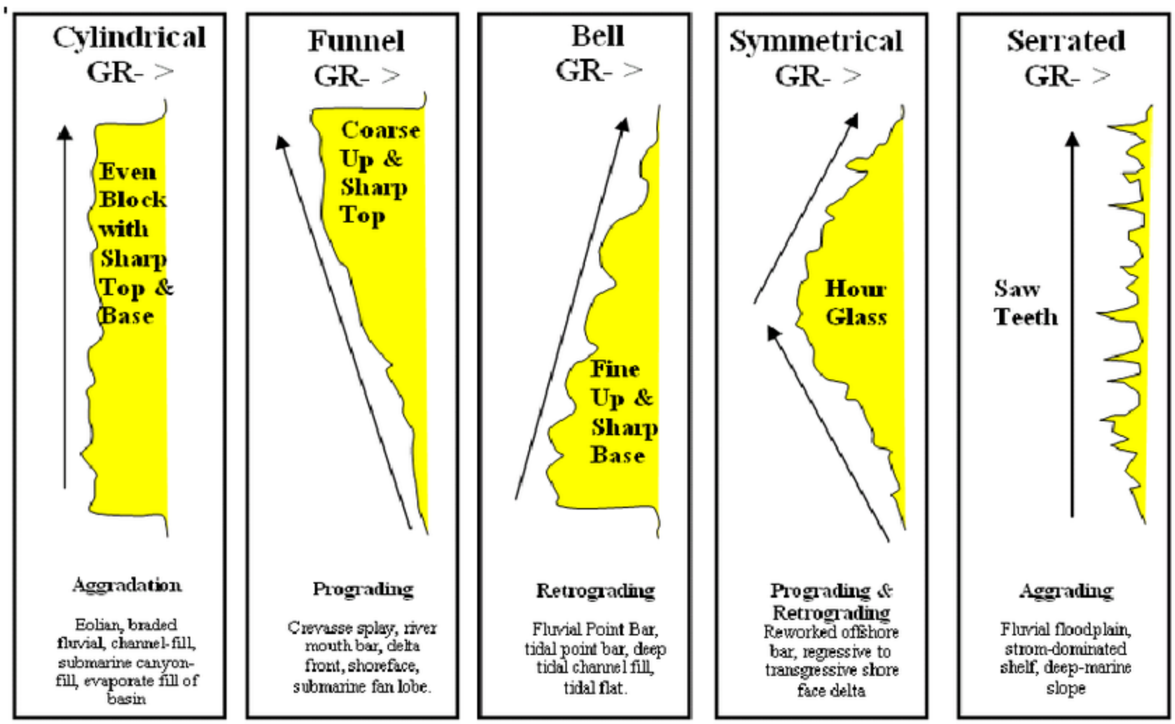
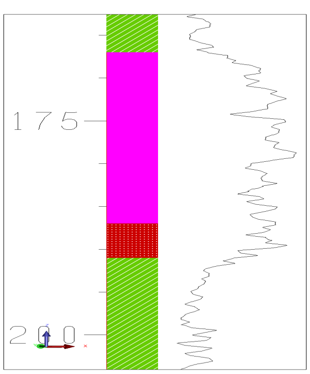
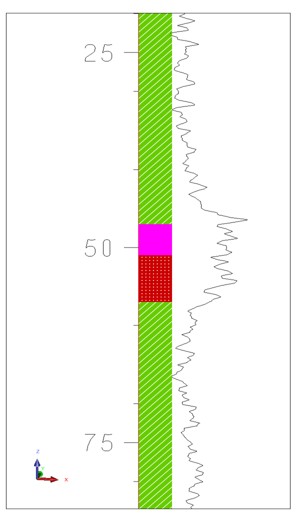


Figure 4. Diagrams showing the gamma ray response to changes in deposit grain-size and clay content. Gamma ray geophysical tools measures the natural radiation given off by decaying radioactive elements native to the geologic material being sampled. In deposits that contain clay (clay contains abundant Potassium) there is natural increase in radioactivity with an increase in clay content. The pattern to the gamma response gives clues to the distribution of clay in the deposit and depositional environments can be inferred from that pattern. Source: *Principles of Sedimentology and Stratigraphy* (4th Ed.), Sam Boggs.

Serrated fining-upwards floodplain

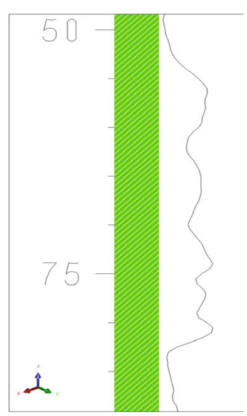


Serrated fining-upwards floodplain



Clay 4 in Hole 2018-A
Fining upwards clay is exposed in Vulcan high wall

Blocky, abrupt channel fill



Blocky, abrupt channel fill

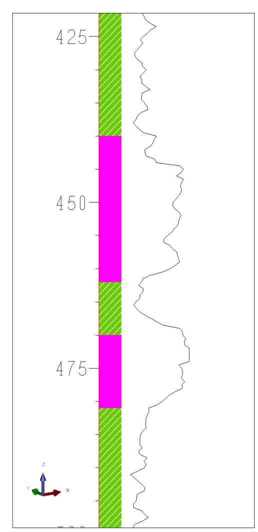
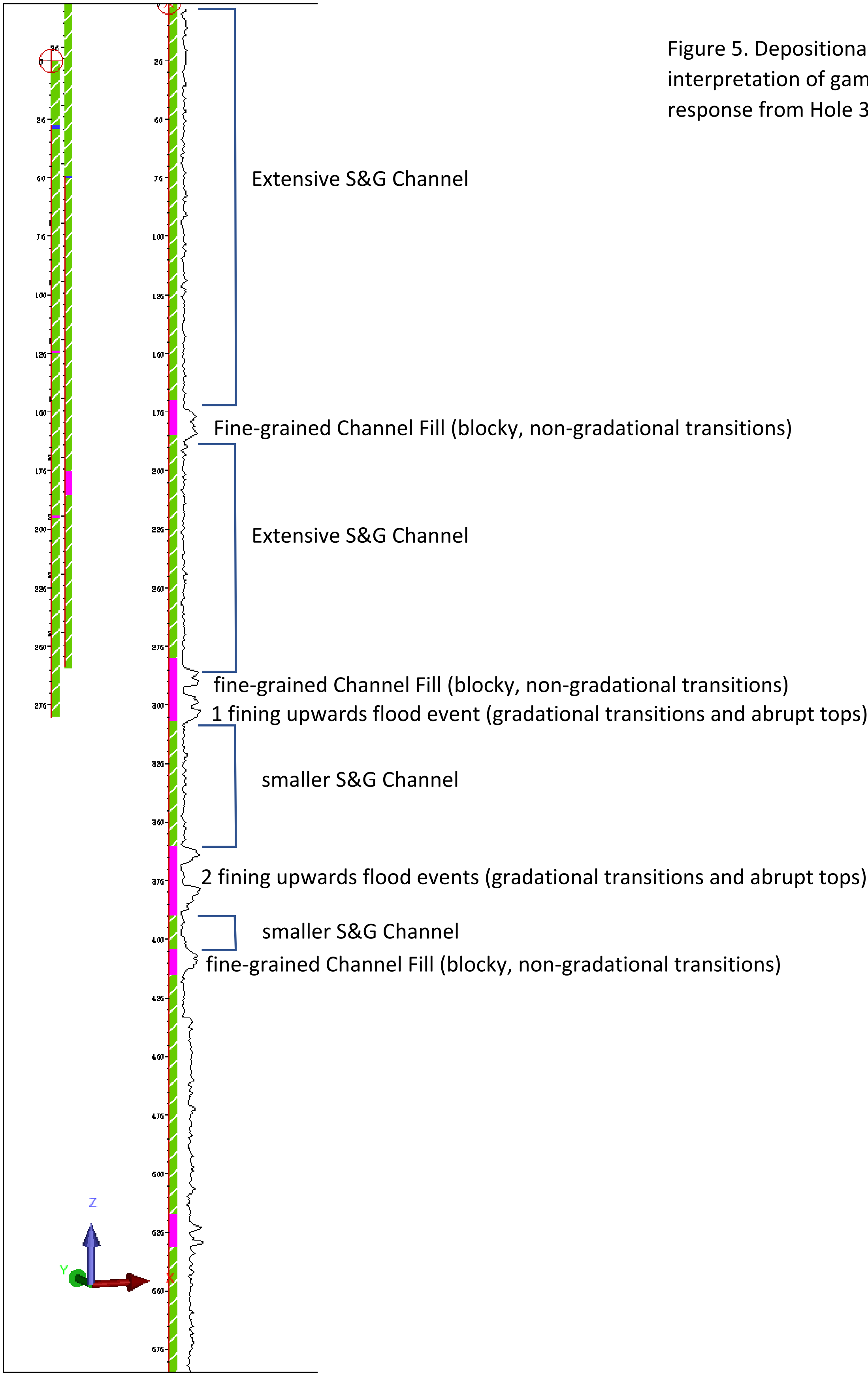


Figure 5. Depositional interpretation of gamma response from Hole 3S-1E-13P9



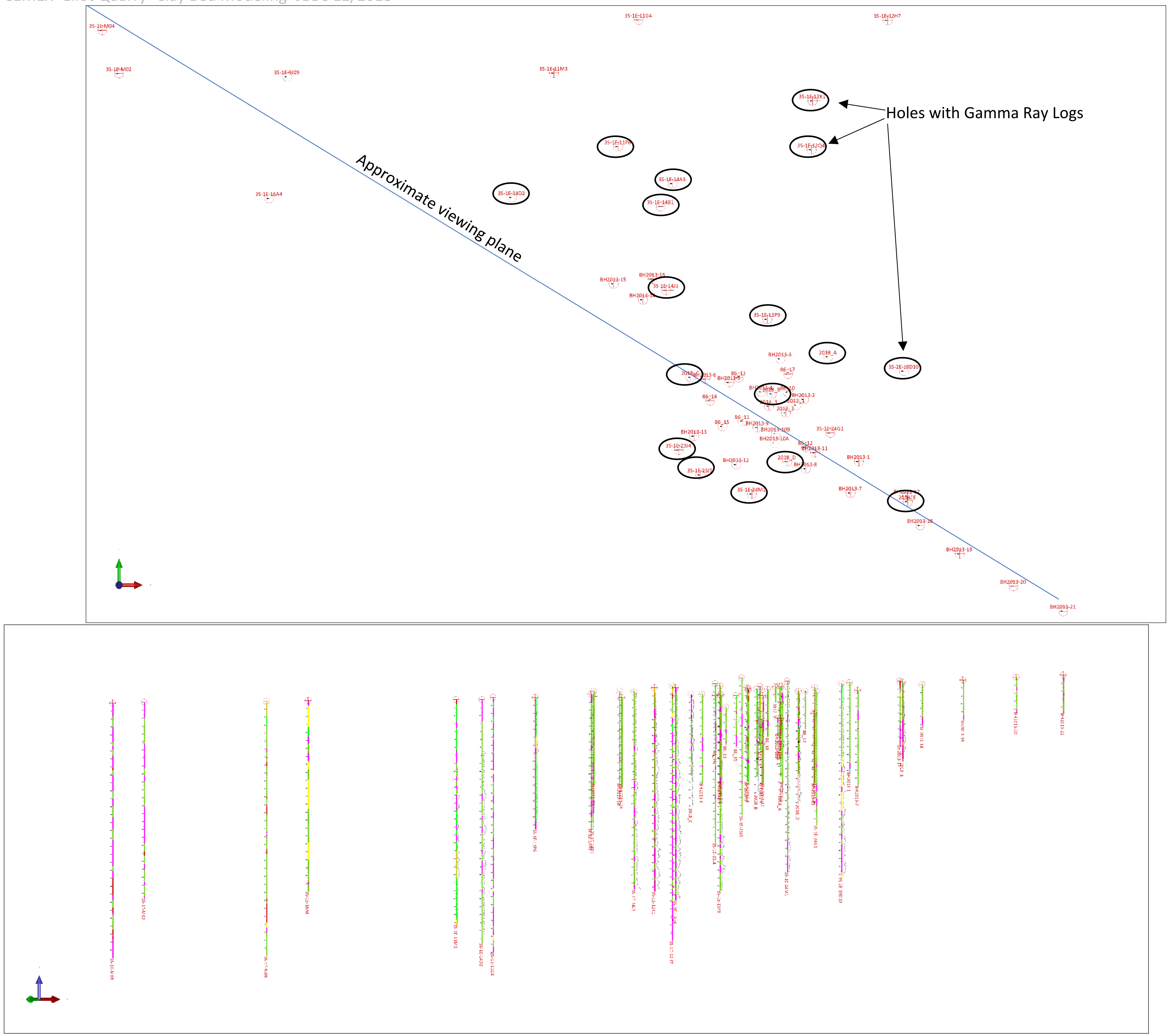


Figure 6
Drill Hole Locations, Gamma Ray Logs and Projection Description
10x vertical exaggeration

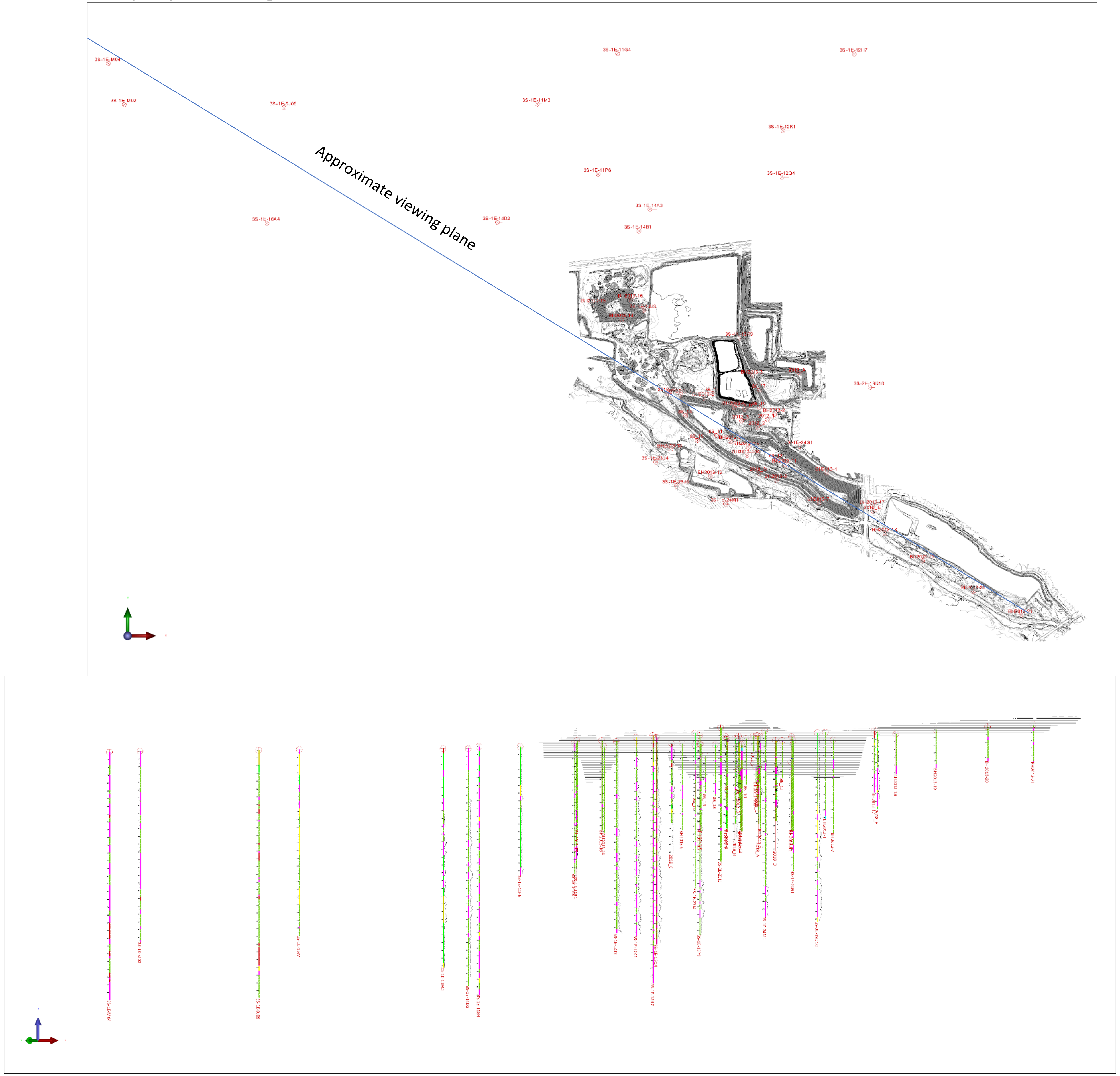


Figure 7.
Drill Hole Locations and 2018 Topography
10x vertical exaggeration

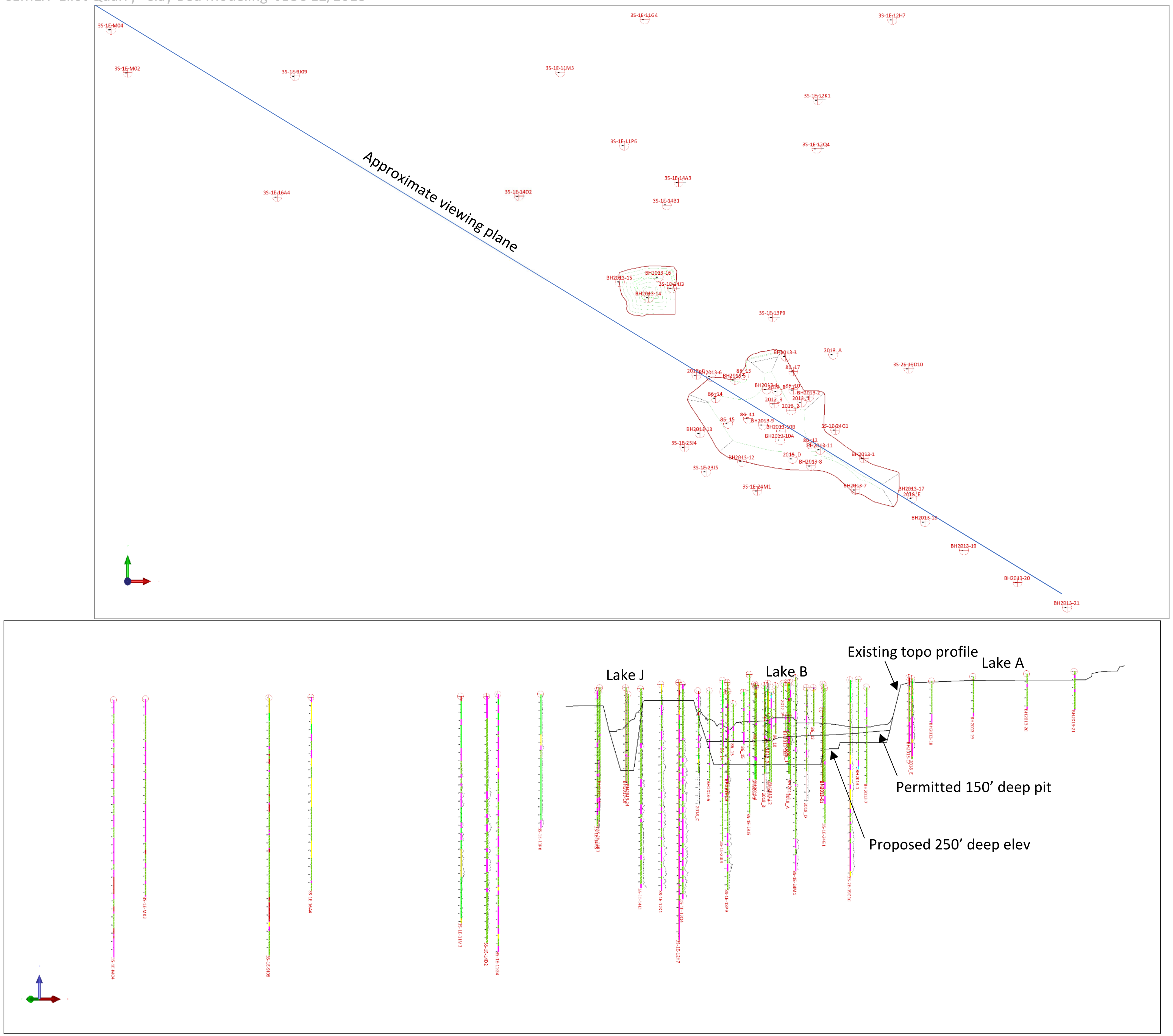


Figure 8.
Drill Hole Locations and Permitted and Proposed Outlines
10x vertical exaggeration

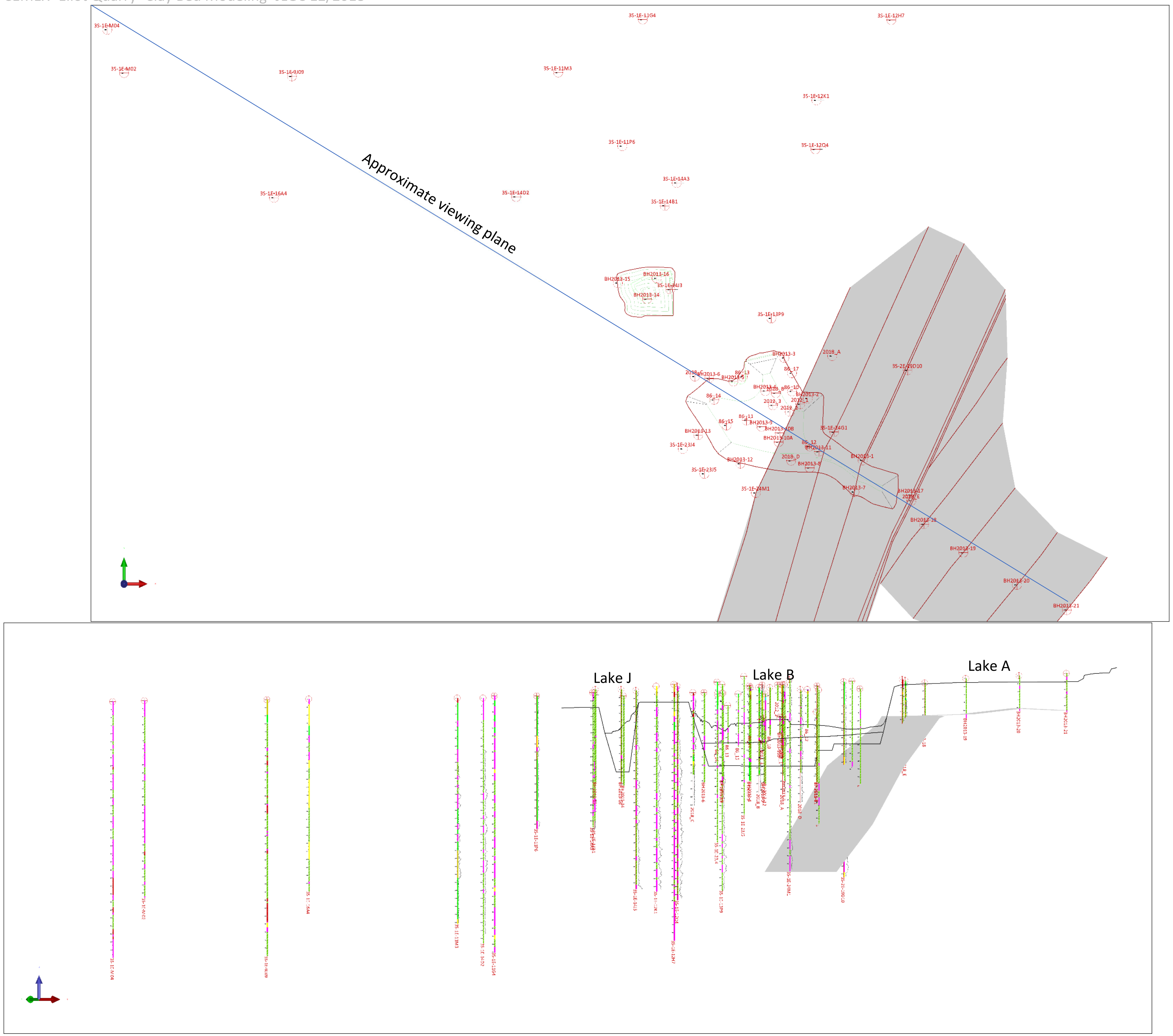


Figure 9.
Erosional Unconformity Location Map
10x vertical exaggeration

IMPORTANT NOTE:

This is a two-dimensional depiction of a three-dimensional model. The “Older Geologic Deposits” (shown in grey) do not intersect Lake B, but run behind Lake B to the northeast. This note applies to Figures 9 through 26.

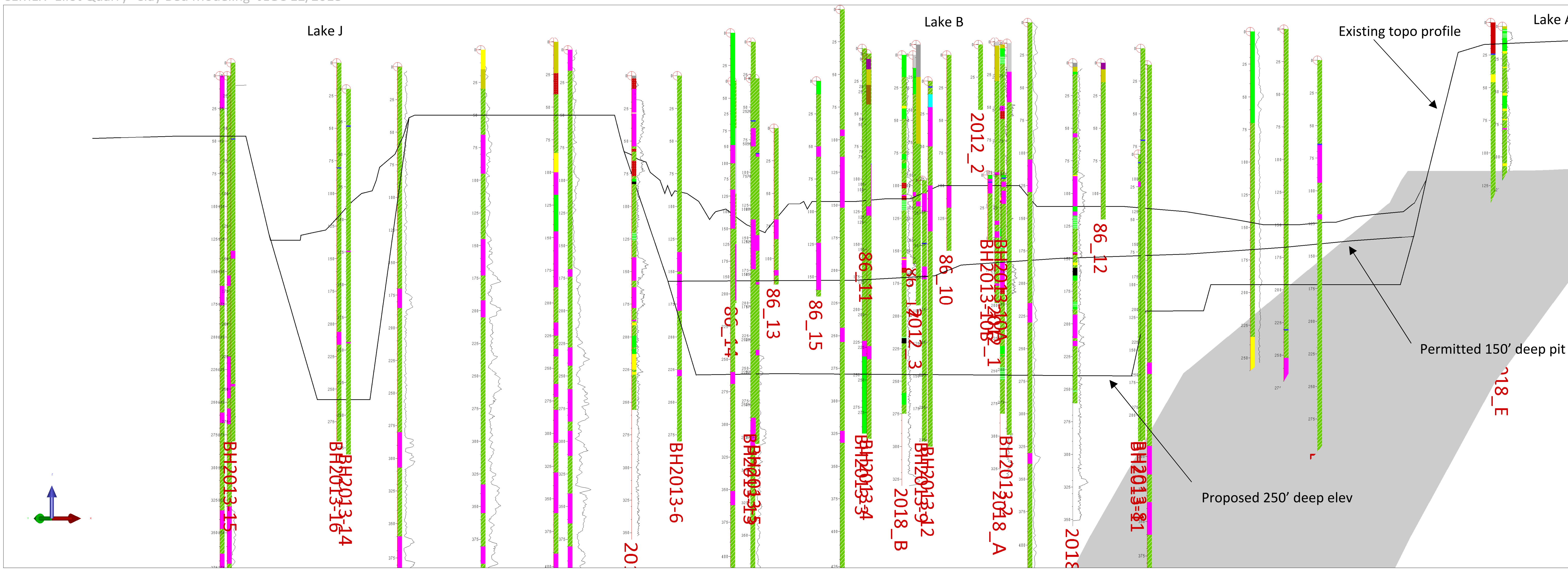


Figure 10.
Erosional Unconformity Location Map
(blow up)
10x vertical exaggeration

Key for drill hole colors

- Silt and Clay
- Clay
- Silt
- Sand
- Clay w/ minor pea gravel
- Clean Sand and Gravel
- Clayey Sand and Gravel
- Silty Sand and Gravel
- Older Geologic Deposits

IMPORTANT NOTE:

This is a two-dimensional depiction of a three-dimensional model. The "Older Geologic Deposits" do not intersect Lake B, but run behind Lake B to the northeast.

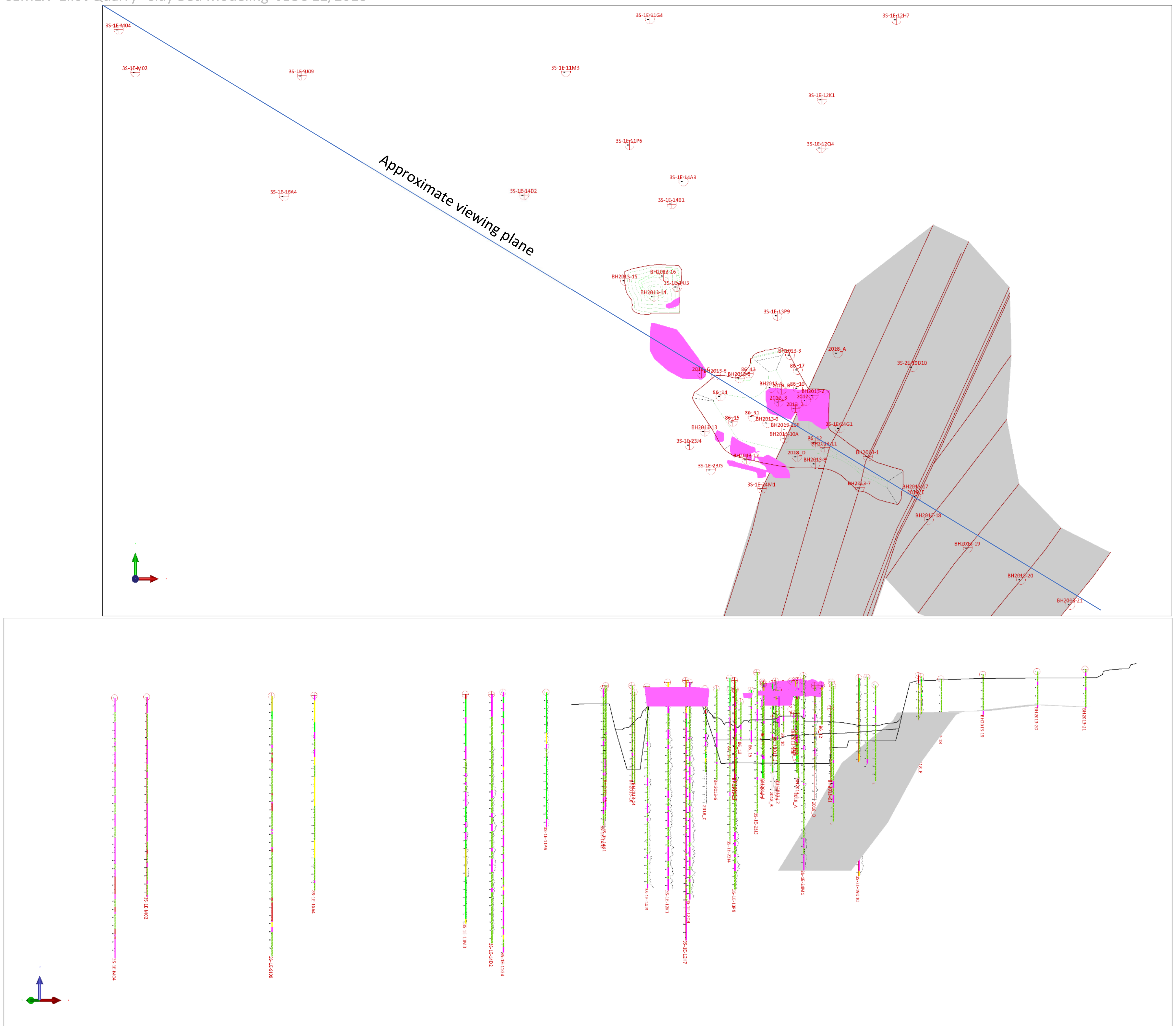


Figure 11.
Pond Deposits Map
10x vertical exaggeration

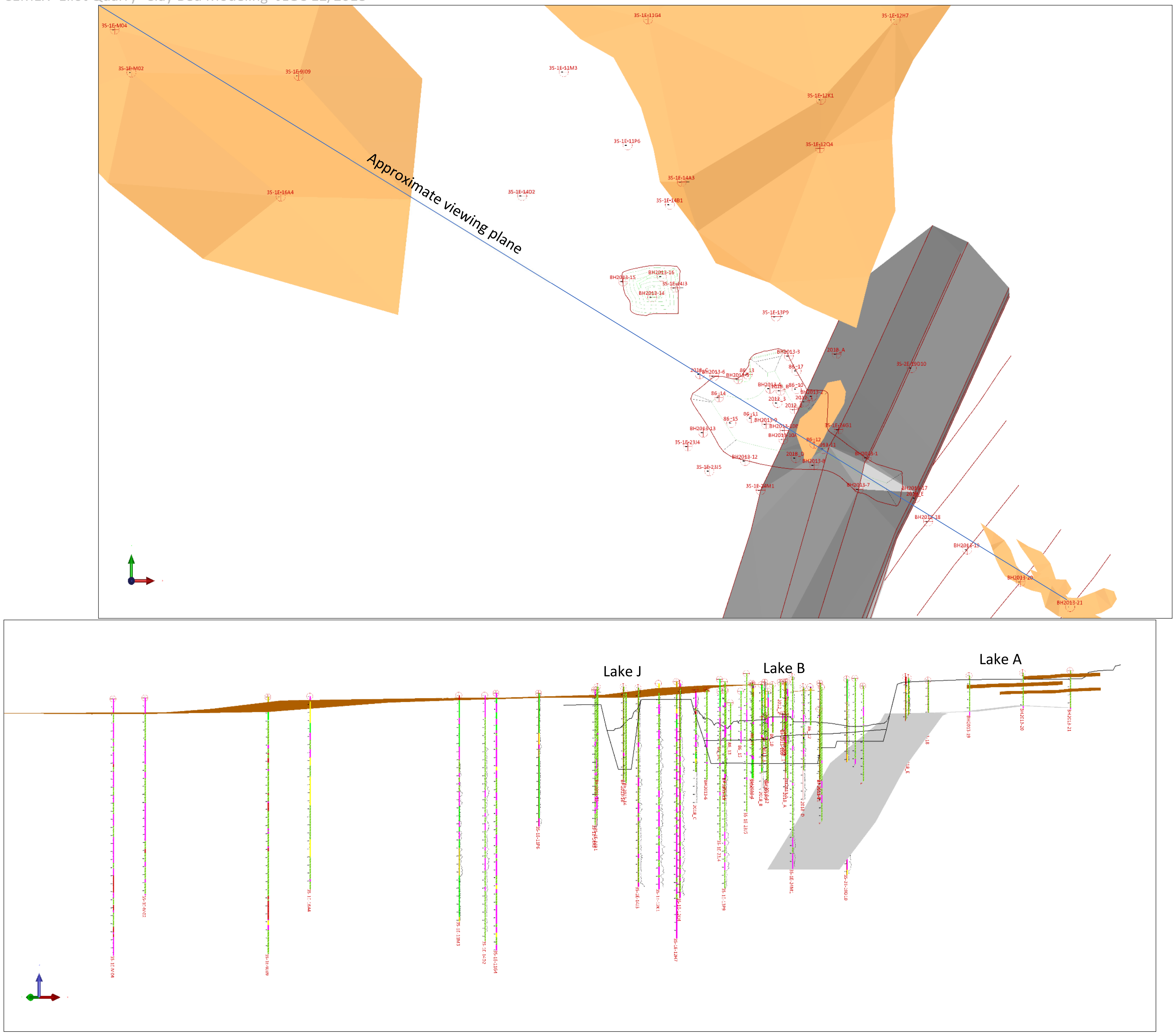


Figure 12.
Surface Clays
10x vertical exaggeration

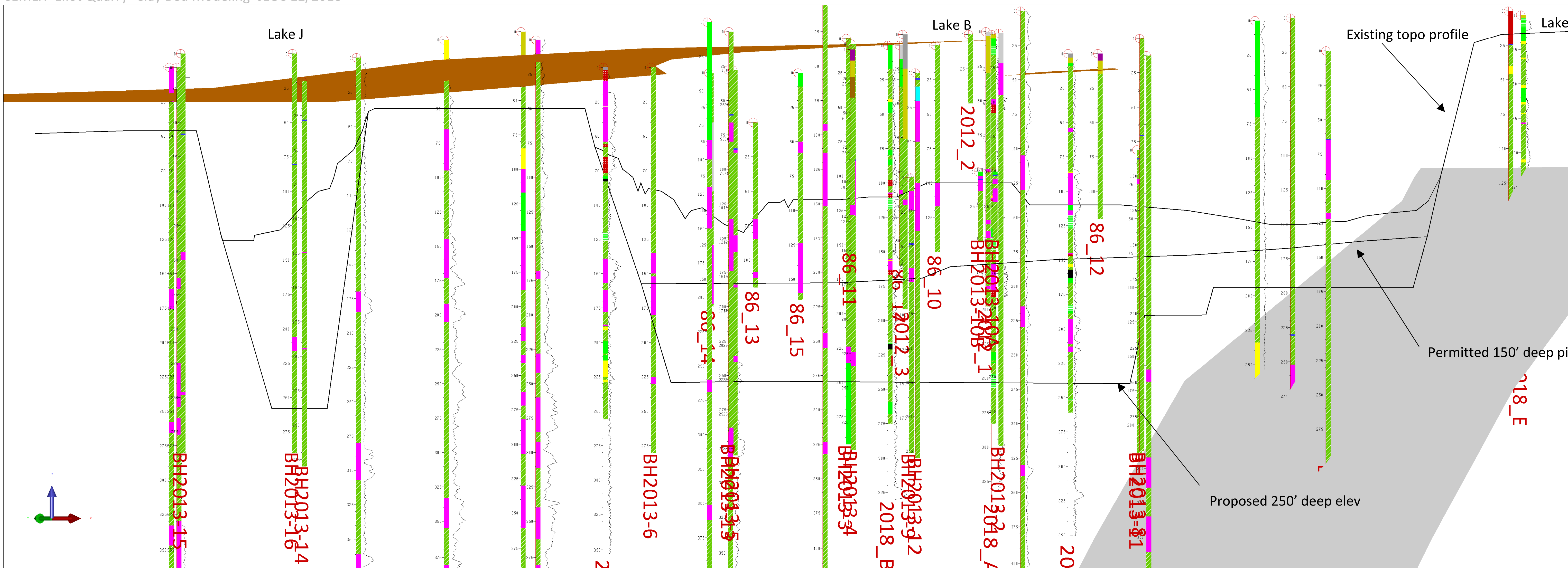


Figure 13.
Surface Clays (blow up)
10x vertical exaggeration

CEMEX- Eliot Quarry- Clay Bed Modeling- JLGC 12/2018

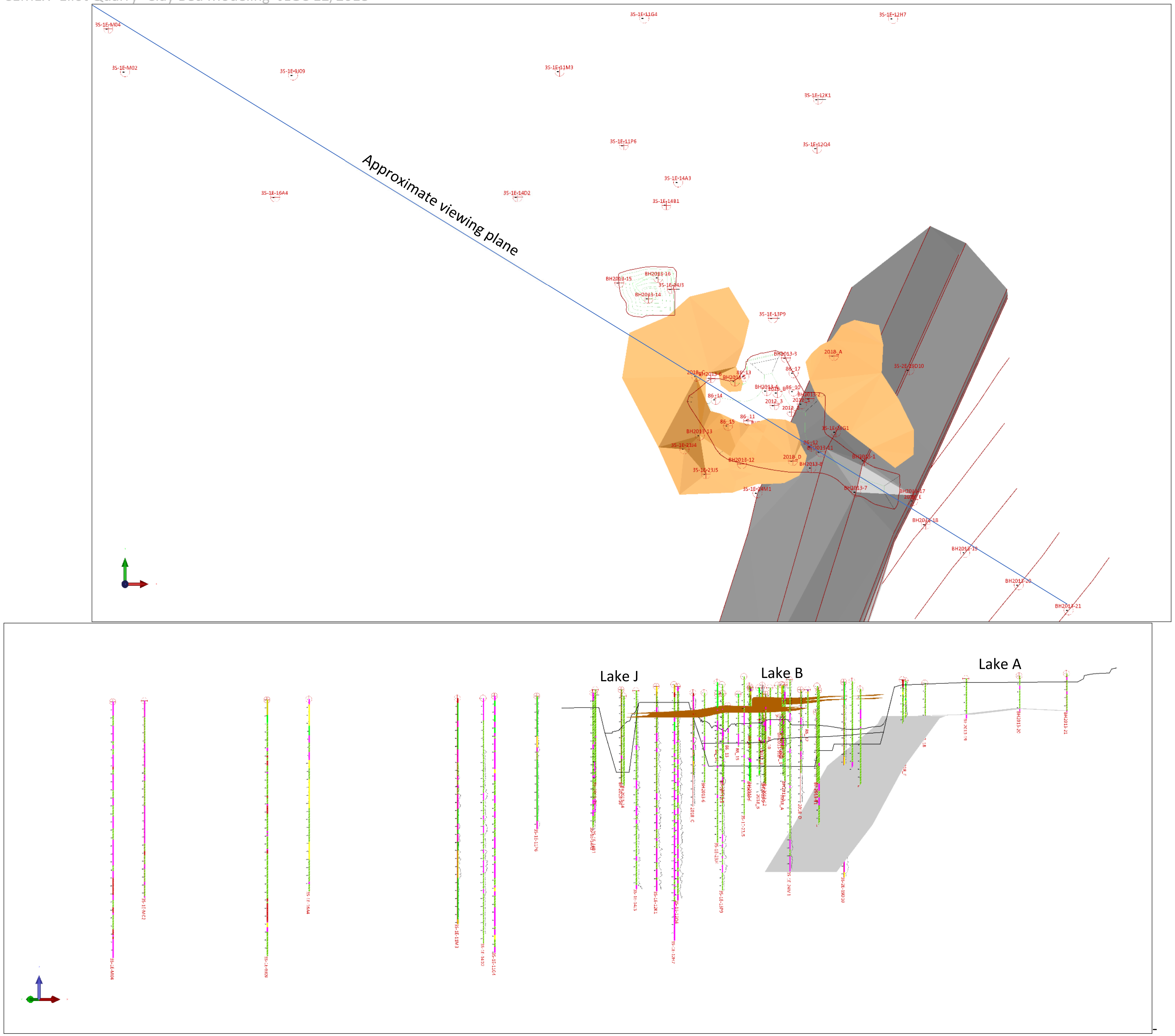


Figure 14.
Distribution of Clay 4 (1st clay body encountered below surface clay)
10x vertical exaggeration

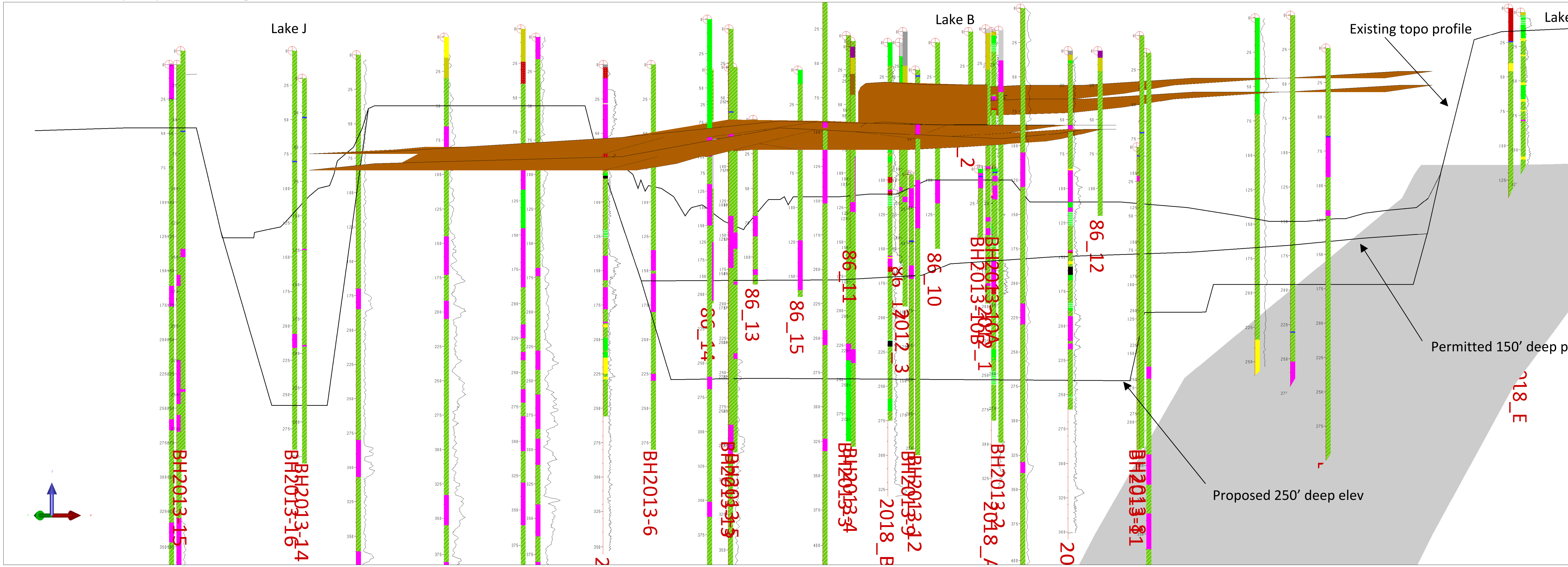
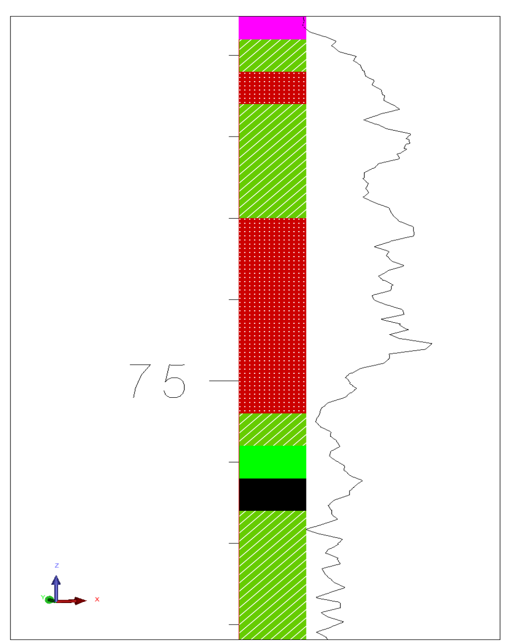
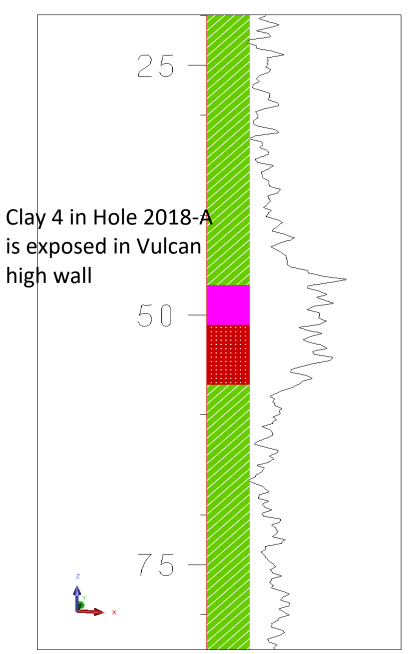


Figure 15.
Distribution of Clay 4 (blow up)
(1st clay body encountered below surface clay)
10x vertical exaggeration

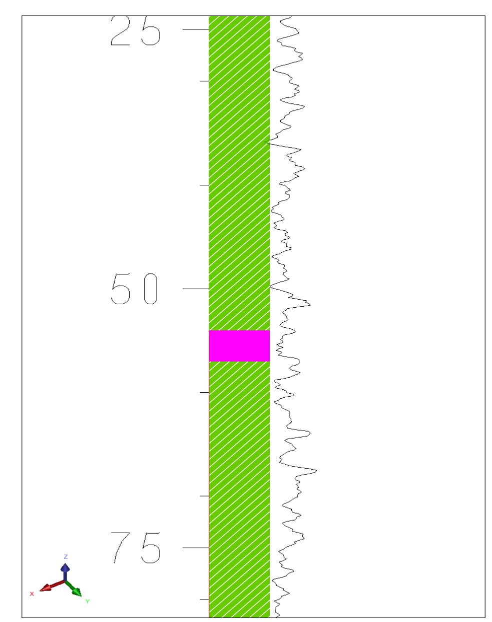
Clay 4 Gamma Patterns



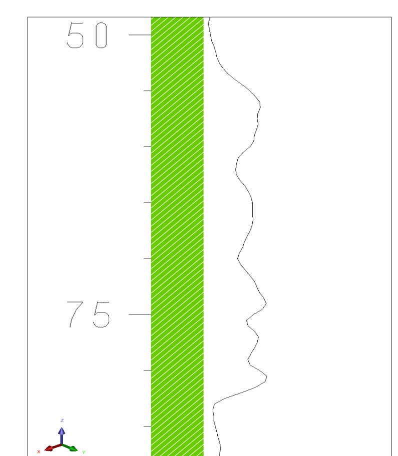
Gamma Signature
Clay A- Hole 2018 C



Gamma Signature
Clay A- Hole 2018 A



Gamma Signature
Clay A- Hole 2018 B



Gamma Signature
Clay A- 3S-1E-24M1

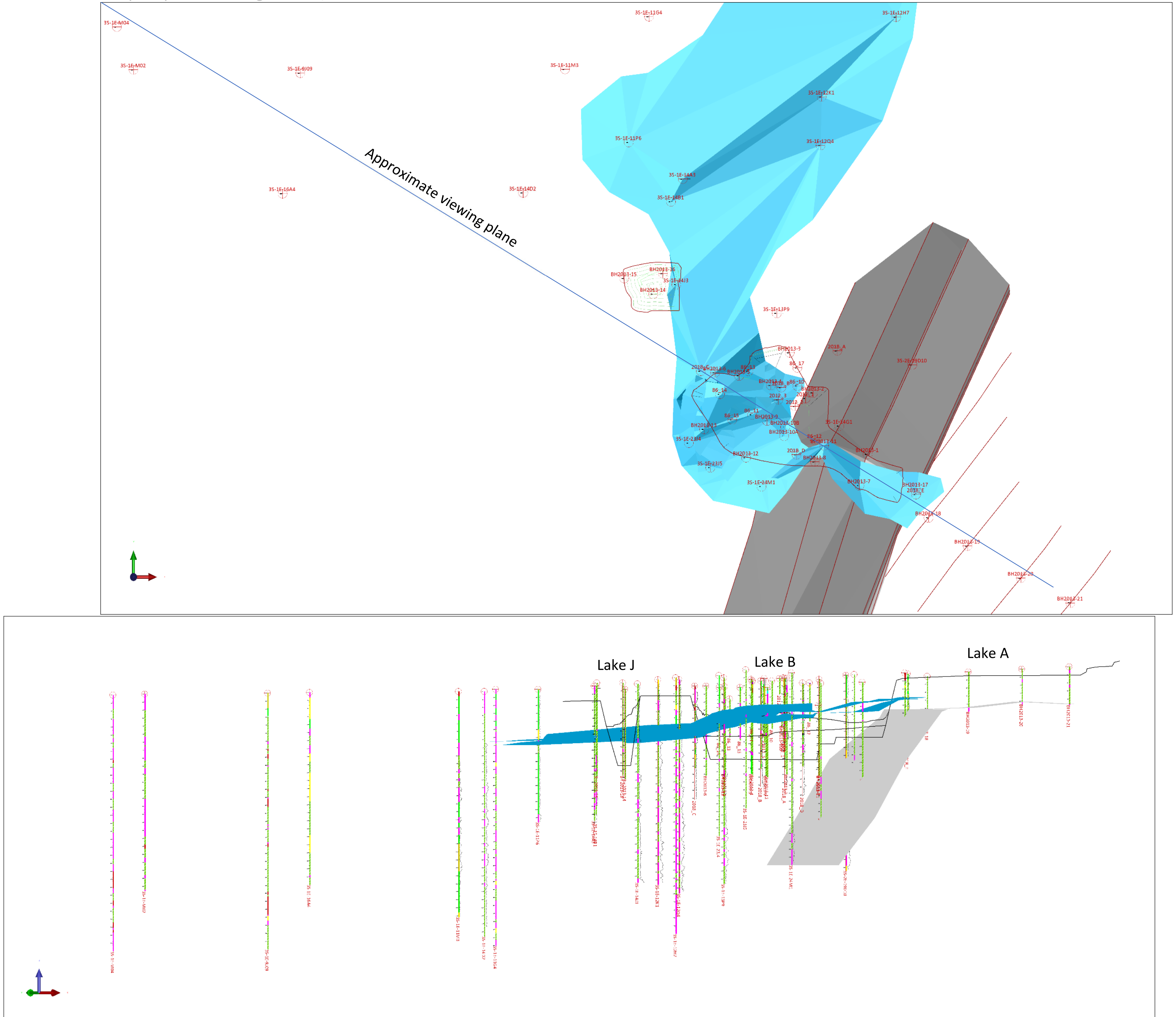


Figure 16.
Distribution of Clay 5 (2nd clay body encountered below surface clay)
10x vertical exaggeration

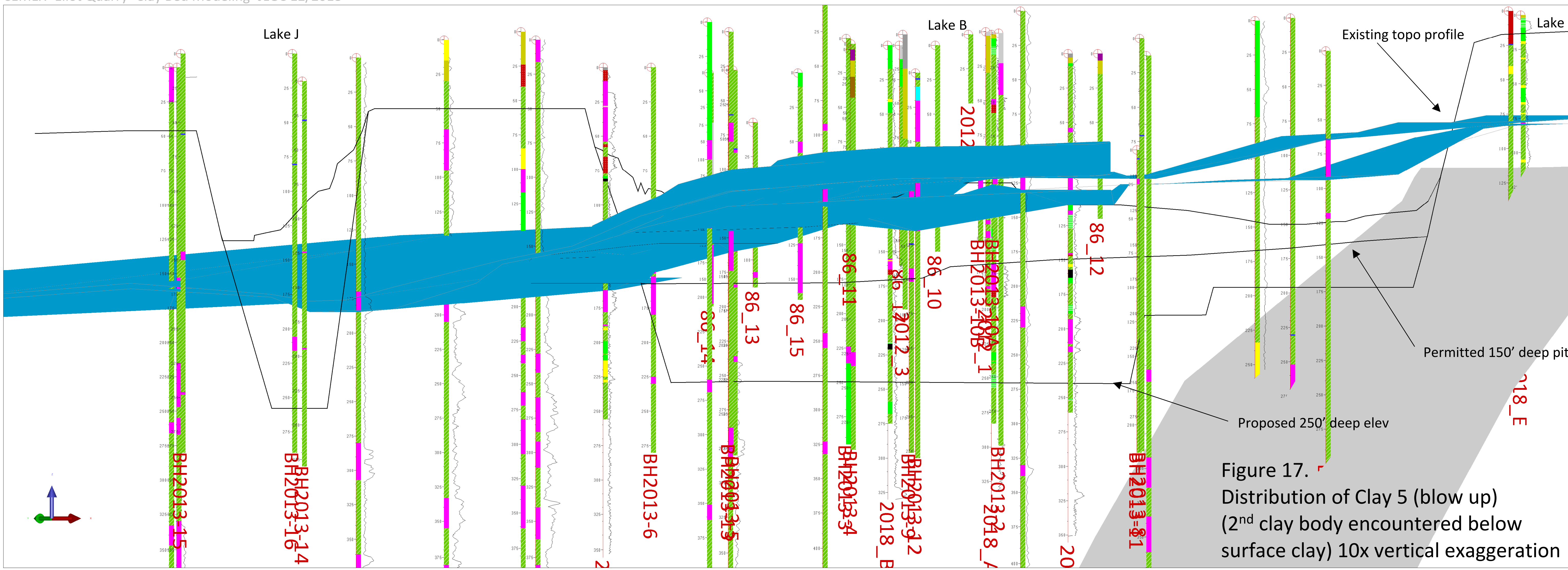
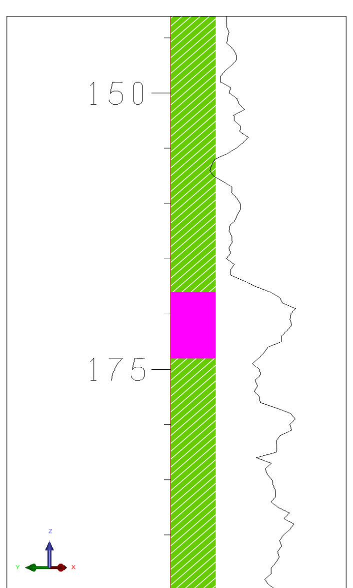
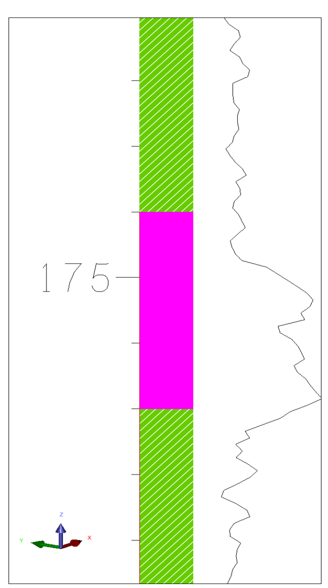


Figure 17. Distribution of Clay 5 (blow up) (2nd clay body encountered below surface clay) 10x vertical exaggeration

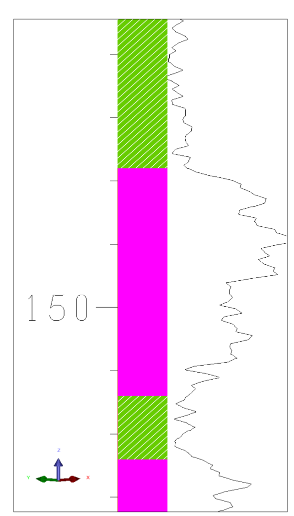
Clay 5 Gamma Patterns



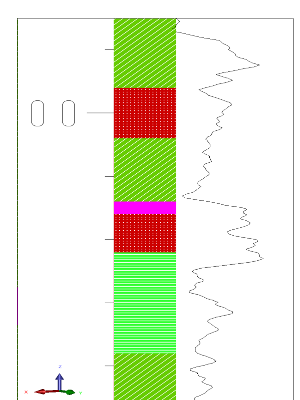
Gamma Signature
Clay 5- Hole 3S-1E-12Q4



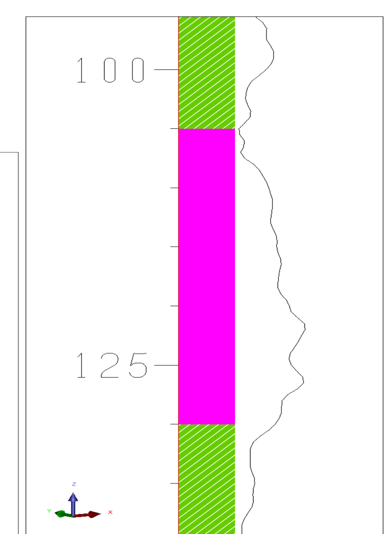
Gamma Signature
Clay 5- Hole 3S-1E-14J3



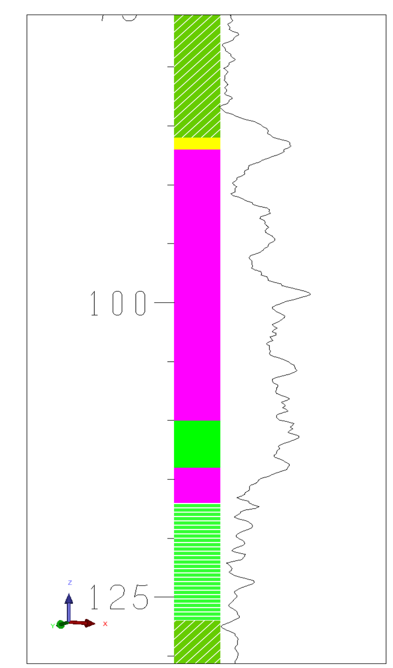
Gamma Signature
Clay 5- Hole 2018 D



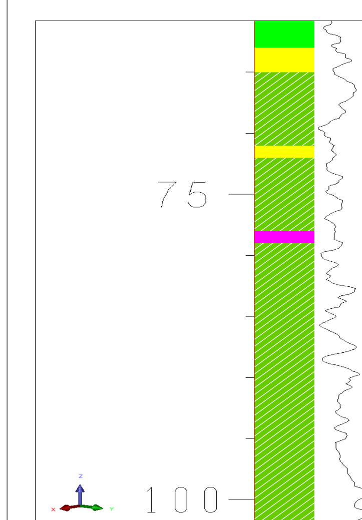
Gamma Signature
Clay 5- Hole 2018 B



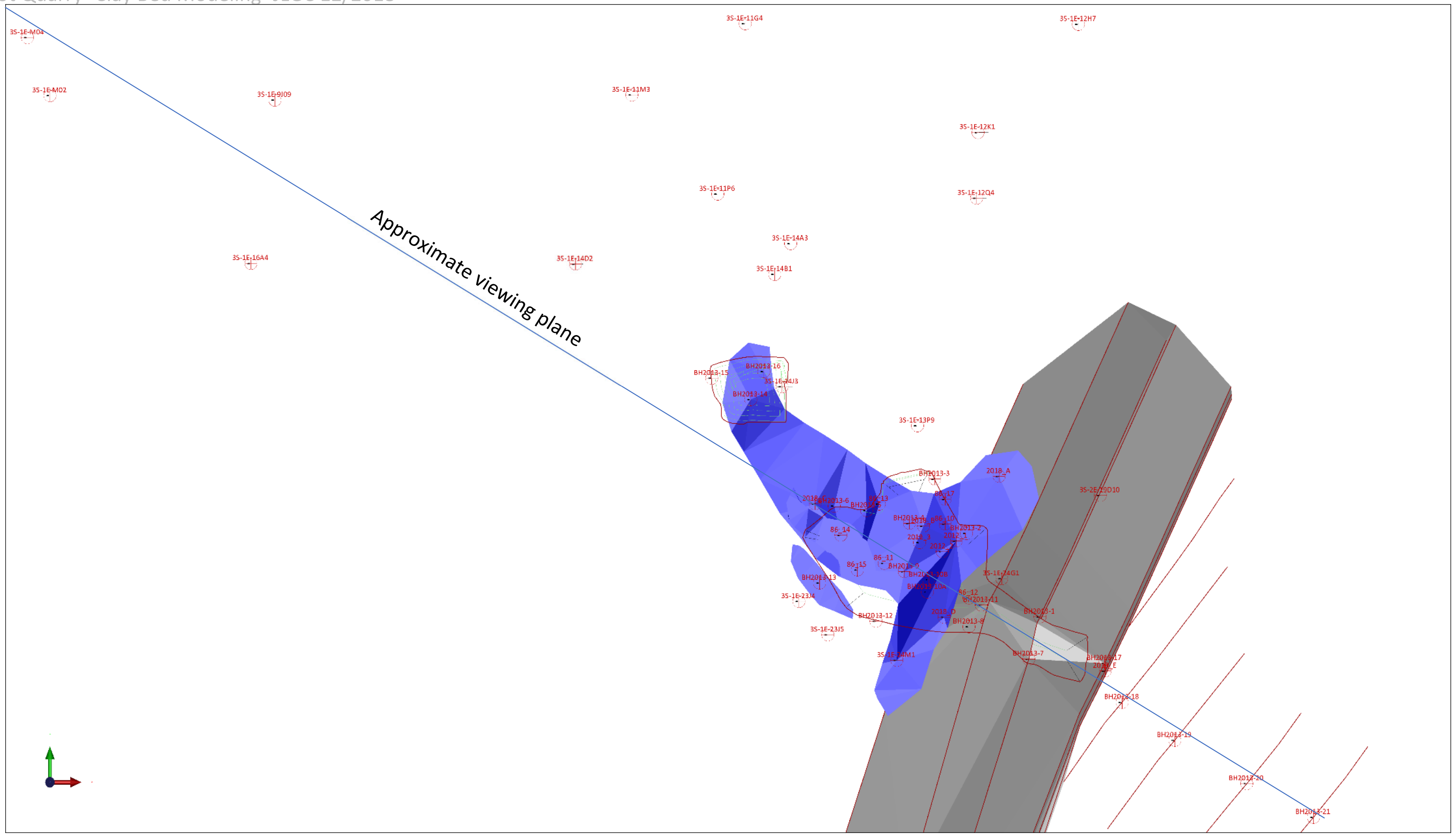
Gamma Signature
Clay 5- Hole 3S-1E-24M1



Gamma Signature
Clay 5- Hole 2018 D



Gamma Signature
Clay 5- Hole 2018 E



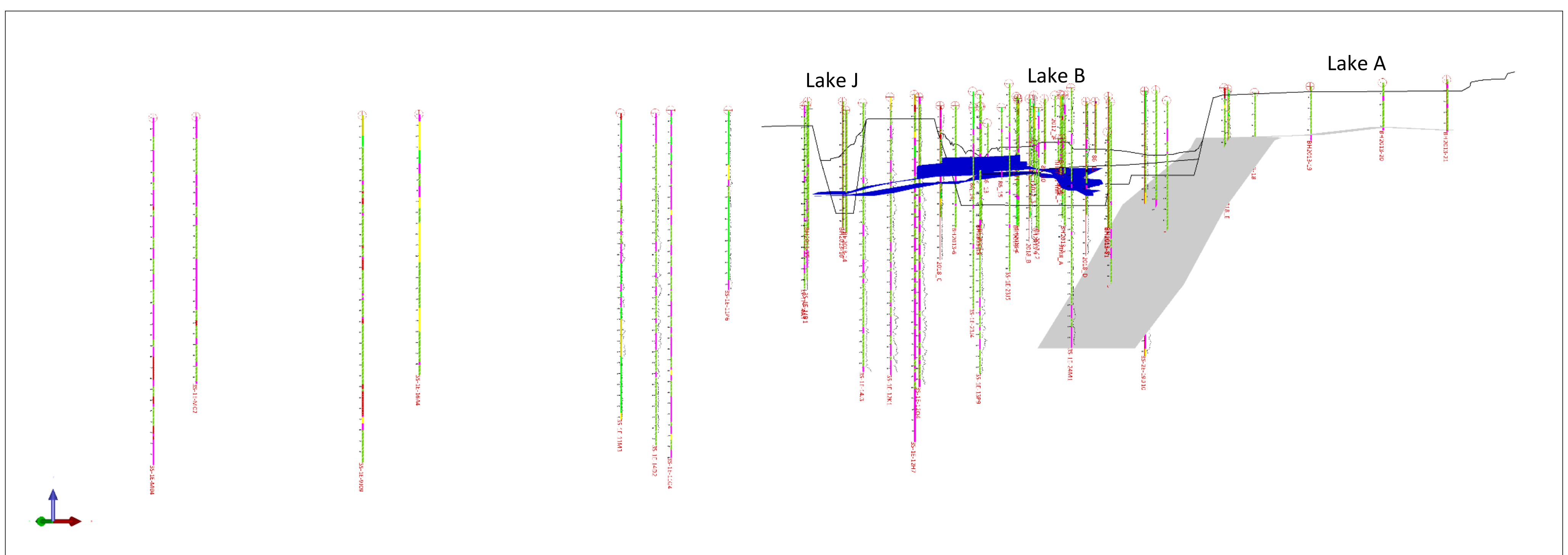
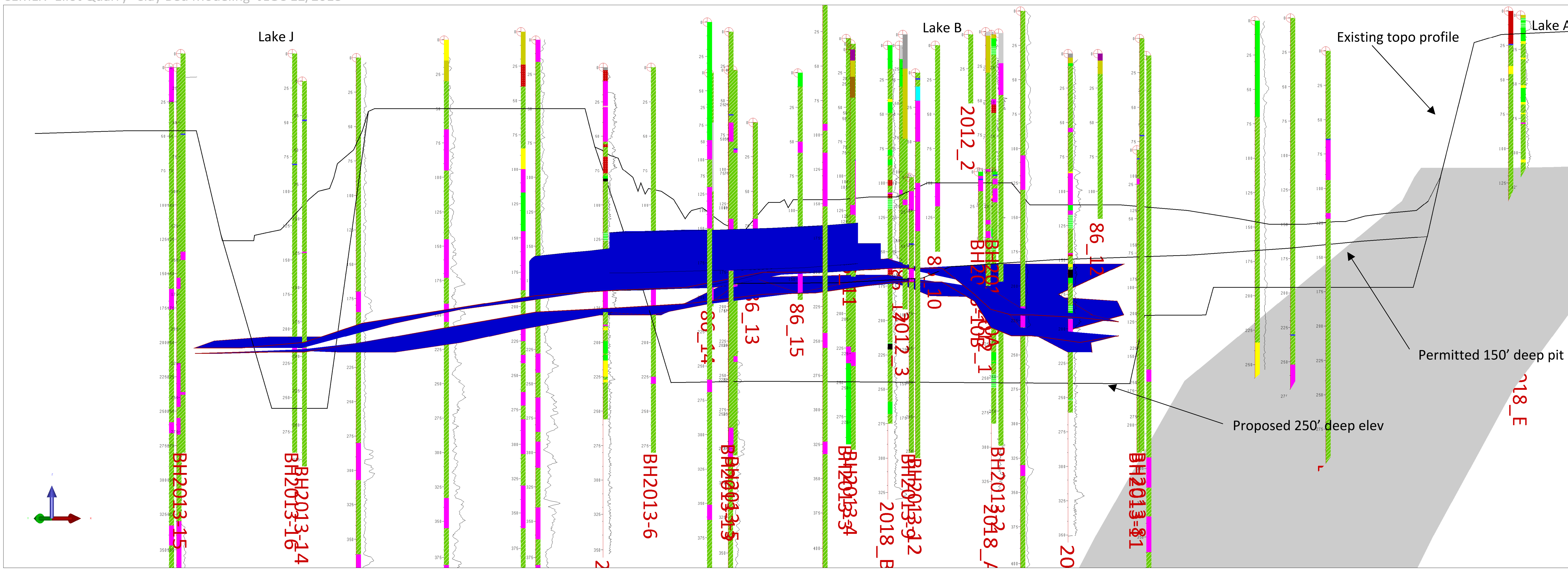
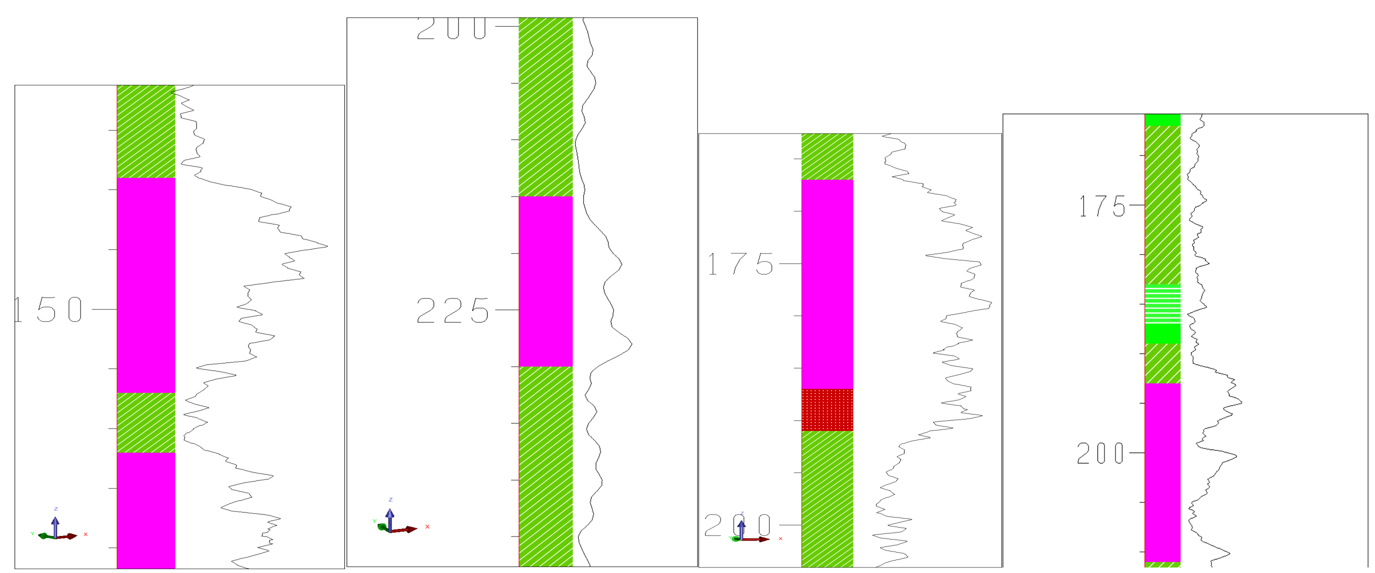


Figure 18.
Distribution of Clay 6 (3rd clay body encountered below surface clay)
10x vertical exaggeration



Clay 6 Gamma Patterns



Gamma Signature
Clay 6- Hole 2018 A

Gamma Signature
Clay 6- Hole 3S-1E-24M1

Gamma Signature
Clay 6- Hole 2018 A

Gamma Signature
Clay 6- Hole 2018 D

Figure 19.
Distribution of Clay 6 (blow up)
(3rd clay body encountered below surface clay)
10x vertical exaggeration

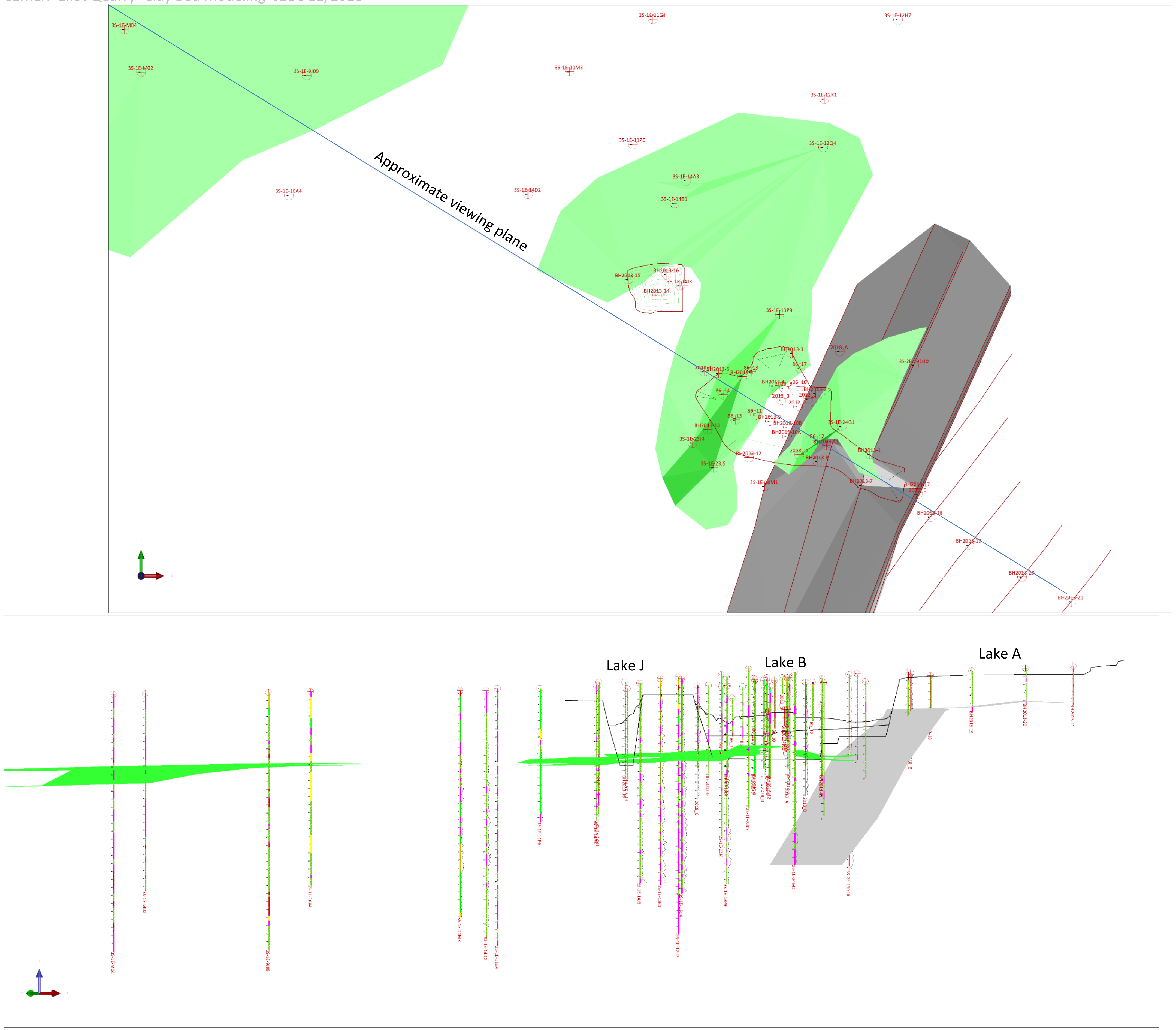
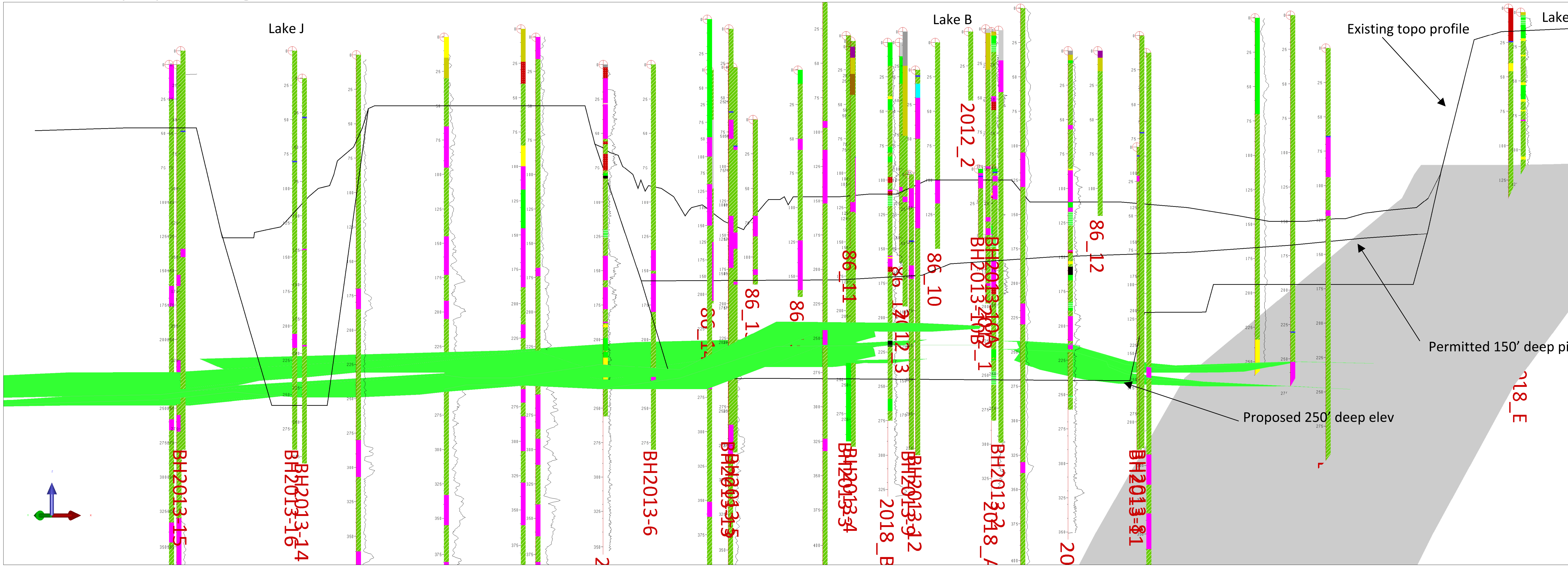
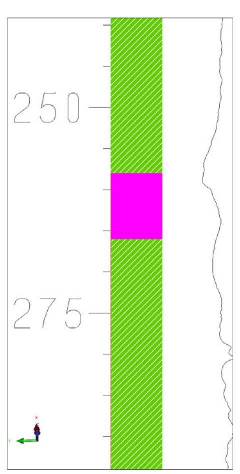


Figure 20.
Distribution of Clay 7 (4th clay body encountered below surface clay)
10x vertical exaggeration

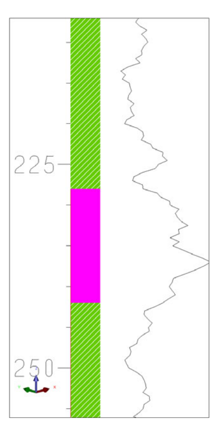


Clay 7 Gamma Patterns

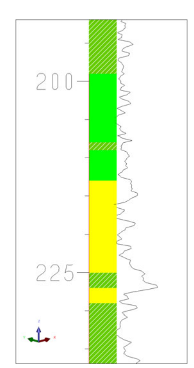
Figure 21.
Distribution of Clay 7 (blow up)
(4th clay body encountered below surface clay)
10x vertical exaggeration



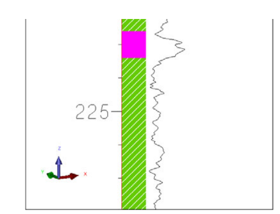
Gamma Signature
Clay 7- Hole 3S-1E-14A3
Curve looks like resistivity data, not gamma data



Gamma Signature
Clay 7- Hole 3S-1E-12Q4



Gamma Signature
Clay 7- Hole 2018 C



Gamma Signature
Clay 7- Hole 2018 D

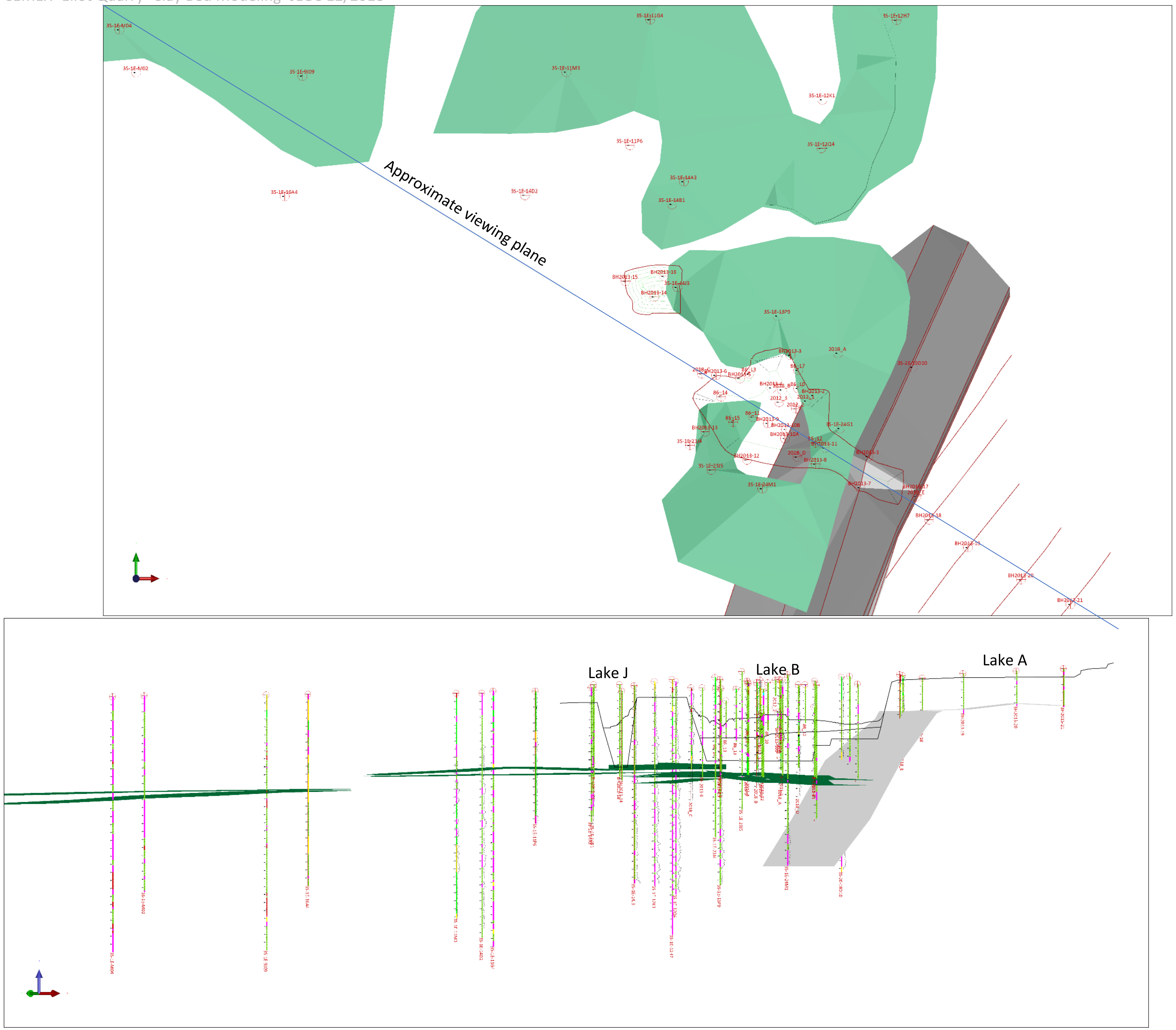


Figure 22.
Distribution of Clay 8 (5th clay body encountered below surface clay)
10x vertical exaggeration

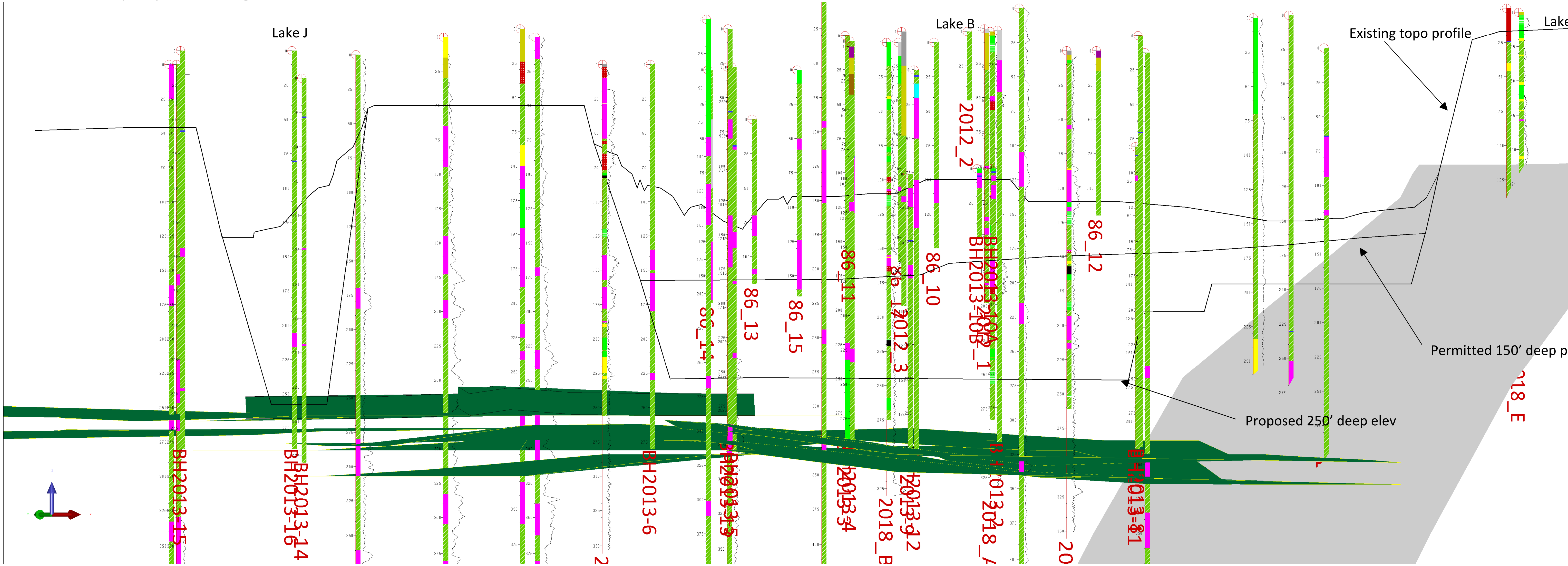


Figure 23.
Distribution of Clay 8 (blow up)
(5th clay body encountered below surface clay)
10x vertical exaggeration

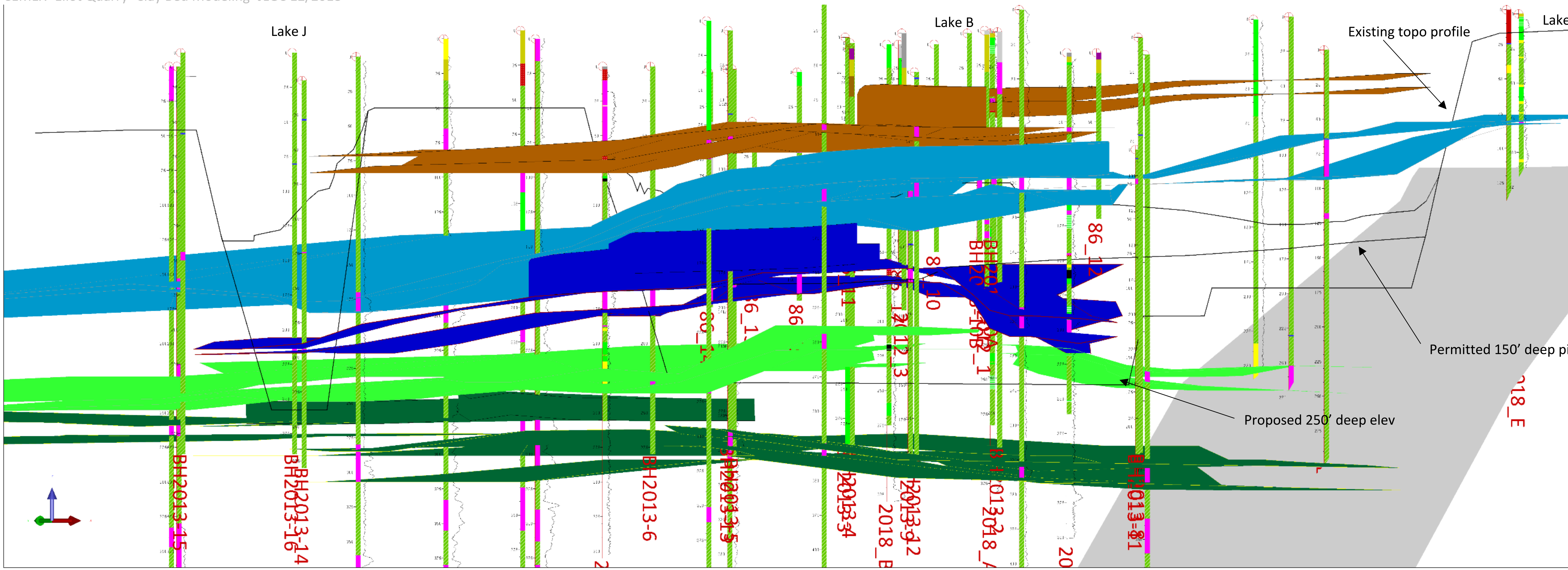


Figure 24.
Distribution of all Clays 4-8 (blow up)
10x vertical exaggeration

The figure represents a two-dimensional snap-shot of a three-dimensional model. The reader should be careful not to interpret the distinct clay layers as continuous. In the three-dimensional model, when rotated on a different axis, the discontinuous nature of the clay layers is apparent (i.e., separation between clays where sand and gravel exists).

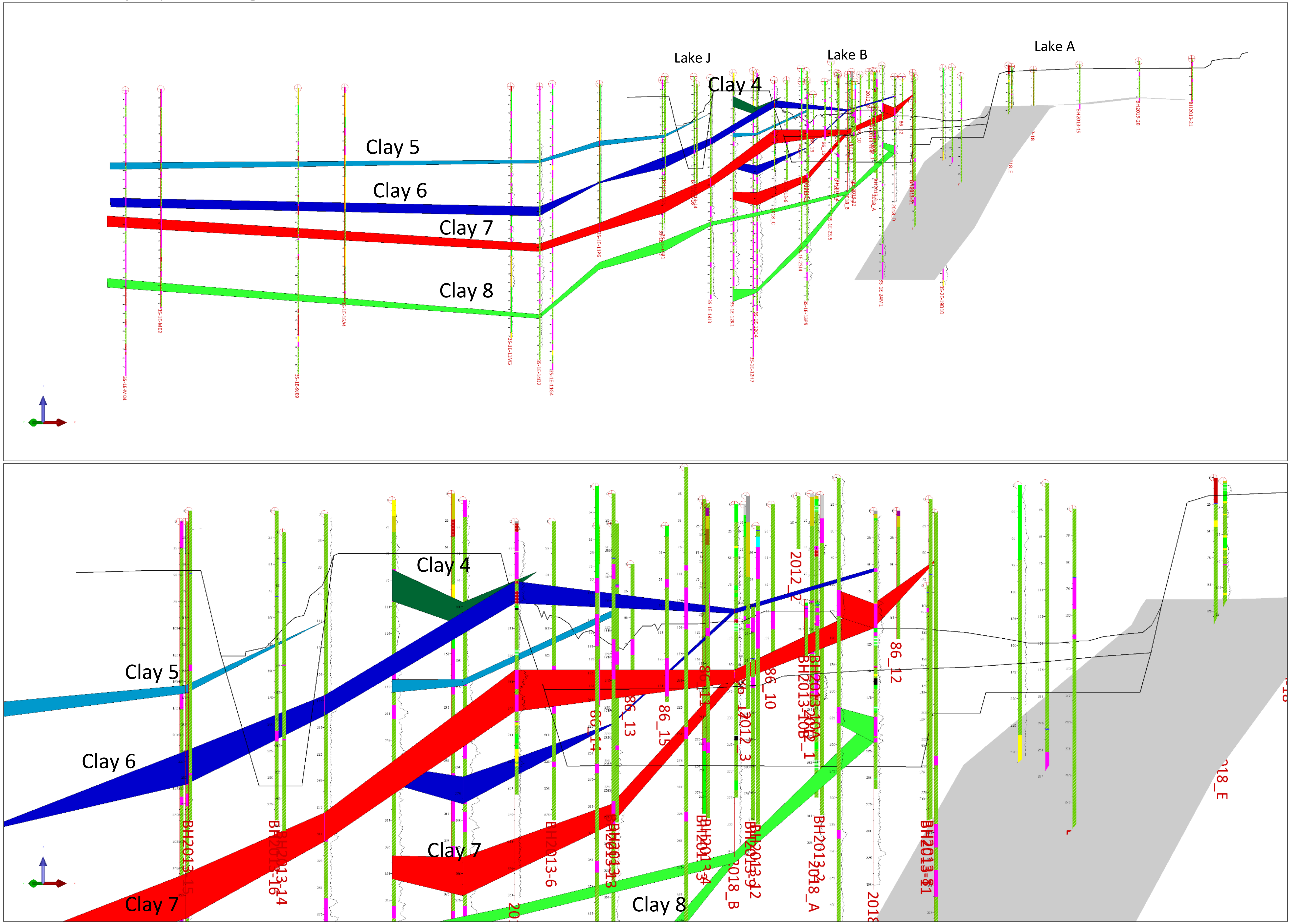


Figure 25.
Zone 7 clay correlations
10x vertical exaggeration

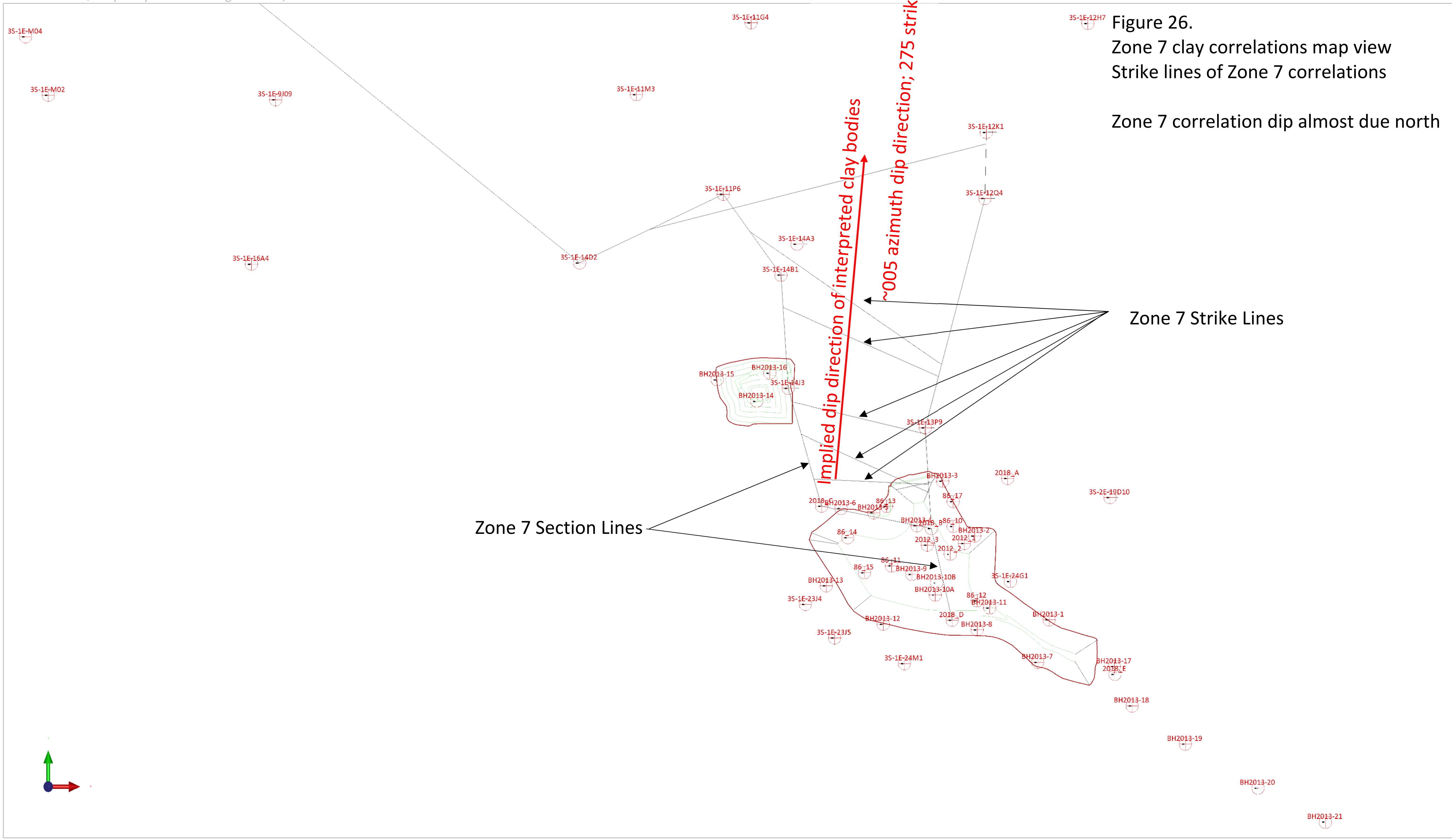


Figure 26.
Zone 7 clay correlations map view
Strike lines of Zone 7 correlations

Zone 7 correlation dip almost due north

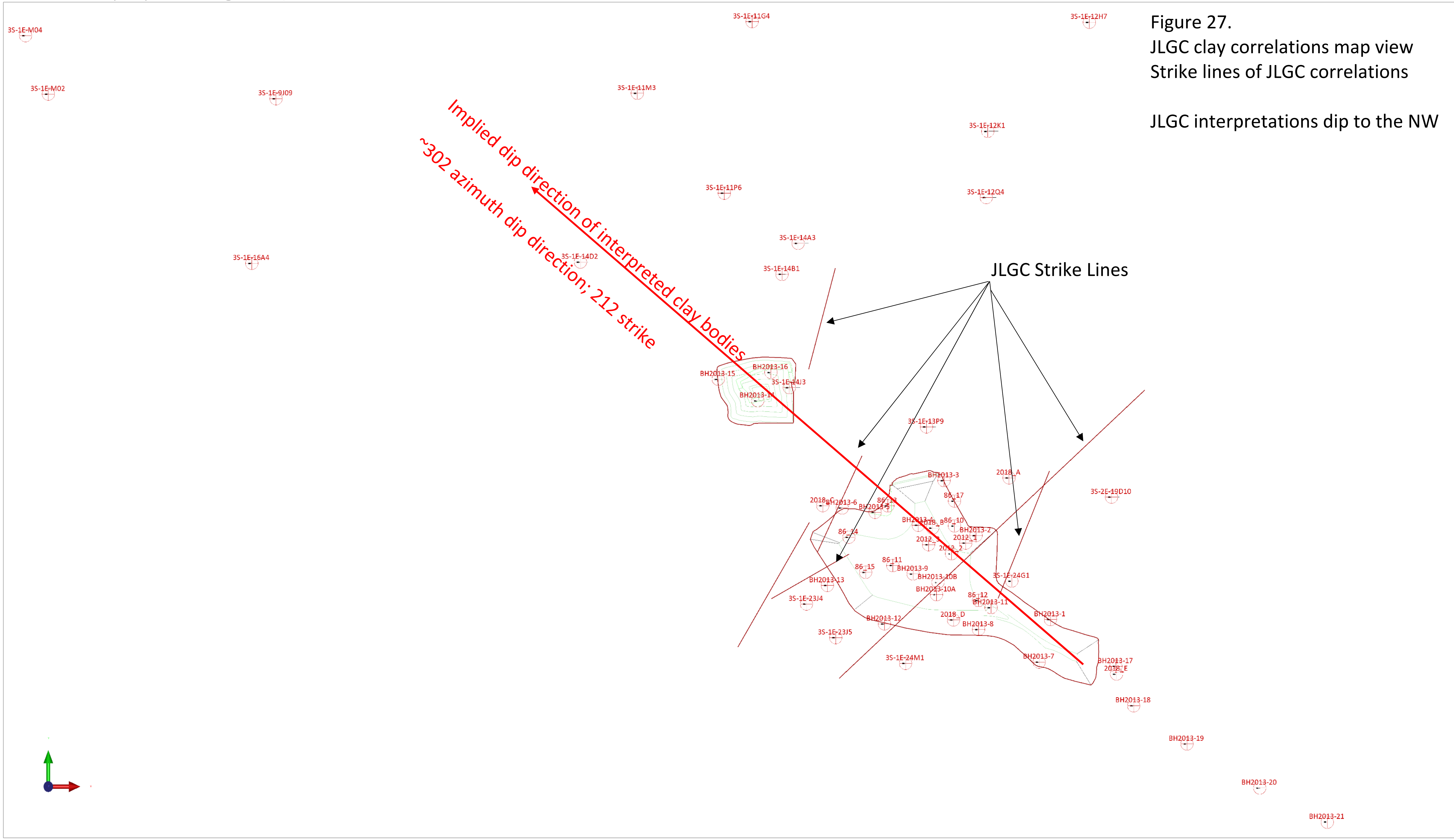


Figure 27.
JLGC clay correlations map view
Strike lines of JLGC correlations

JLGC interpretations dip to the NW

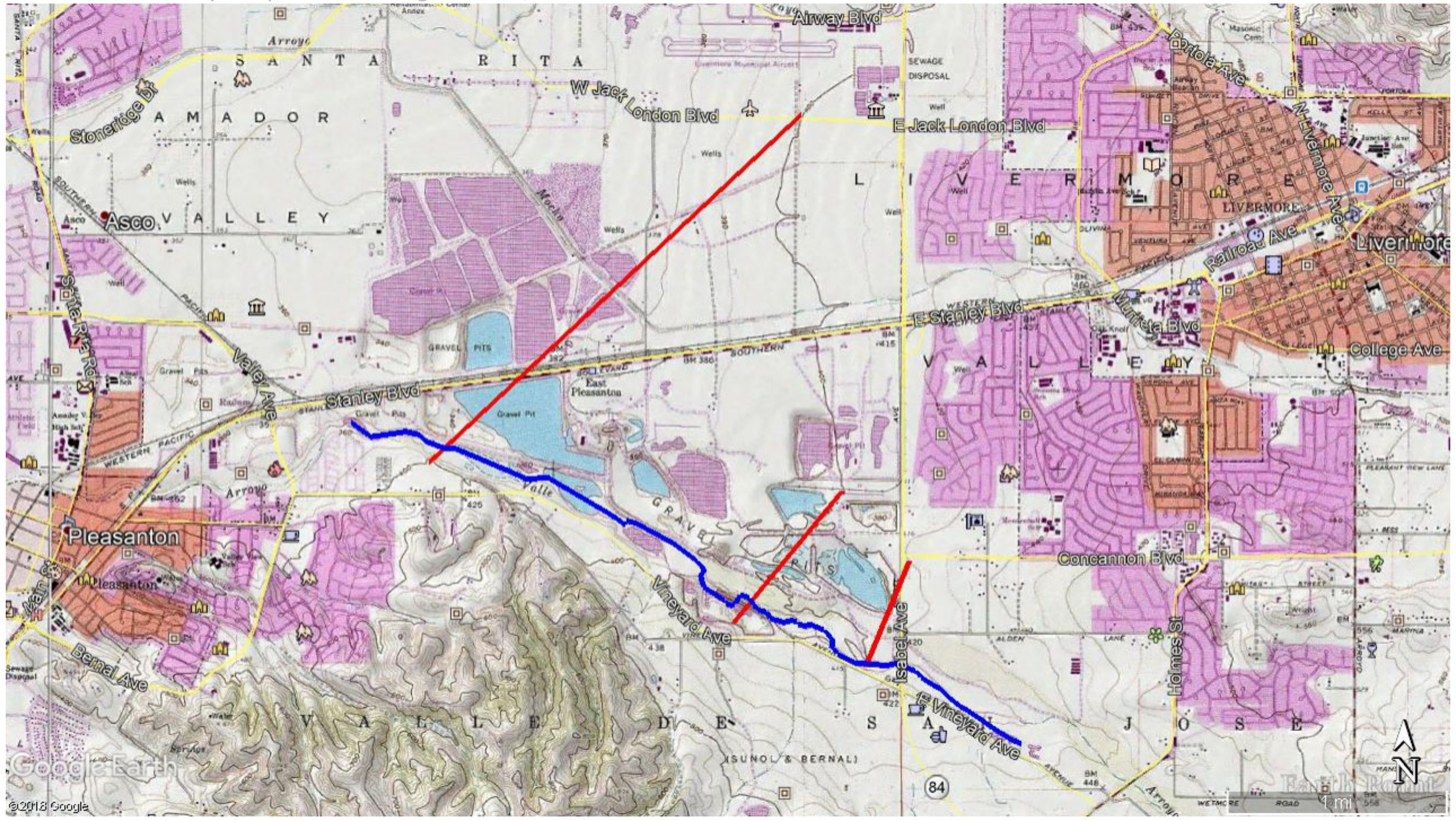
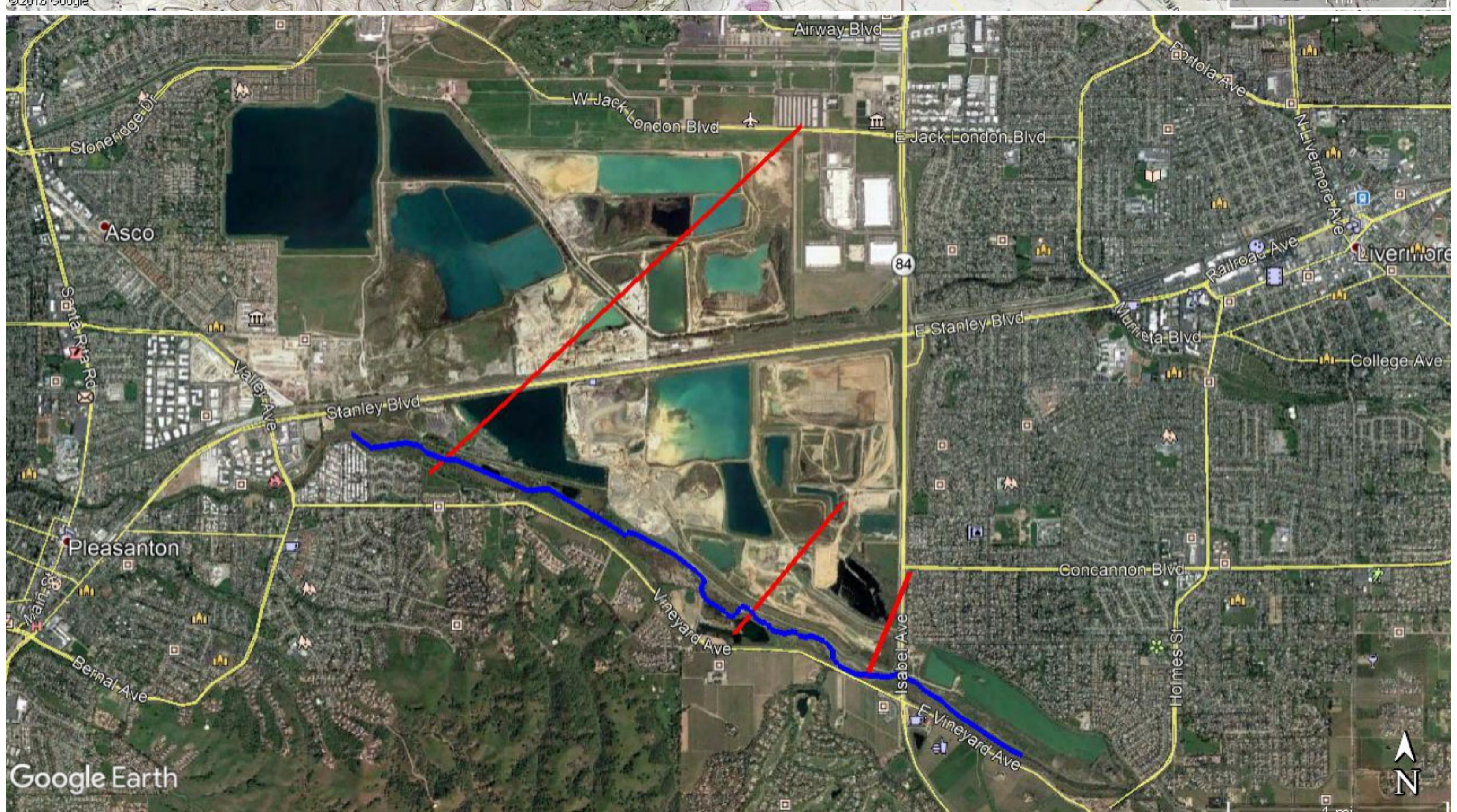


Figure 28.
USGS topographic map
Red lines show lines of equal topo elevation across the Arroyo del Valle and Arroyo Mocho floodplain

Floodplain topographic gradient is ~ 0.2%-1% grade (red lines) ~ 300^{o} dip direction and the Arroyo del Valle stream gradient is ~ 0.6% grade (blue line) ~290^{o} dip direction



GOOGLE Earth aerial photo 4/22/2018
Red lines show lines of equal topo elevation across the Arroyo del Valle floodplain

Floodplain topographic gradient is ~ 0.2%-1% grade (red lines) ~ 300^{o} dip direction and the Arroyo del Valle stream gradient is ~ 0.6% grade (blue line) ~290^{o}

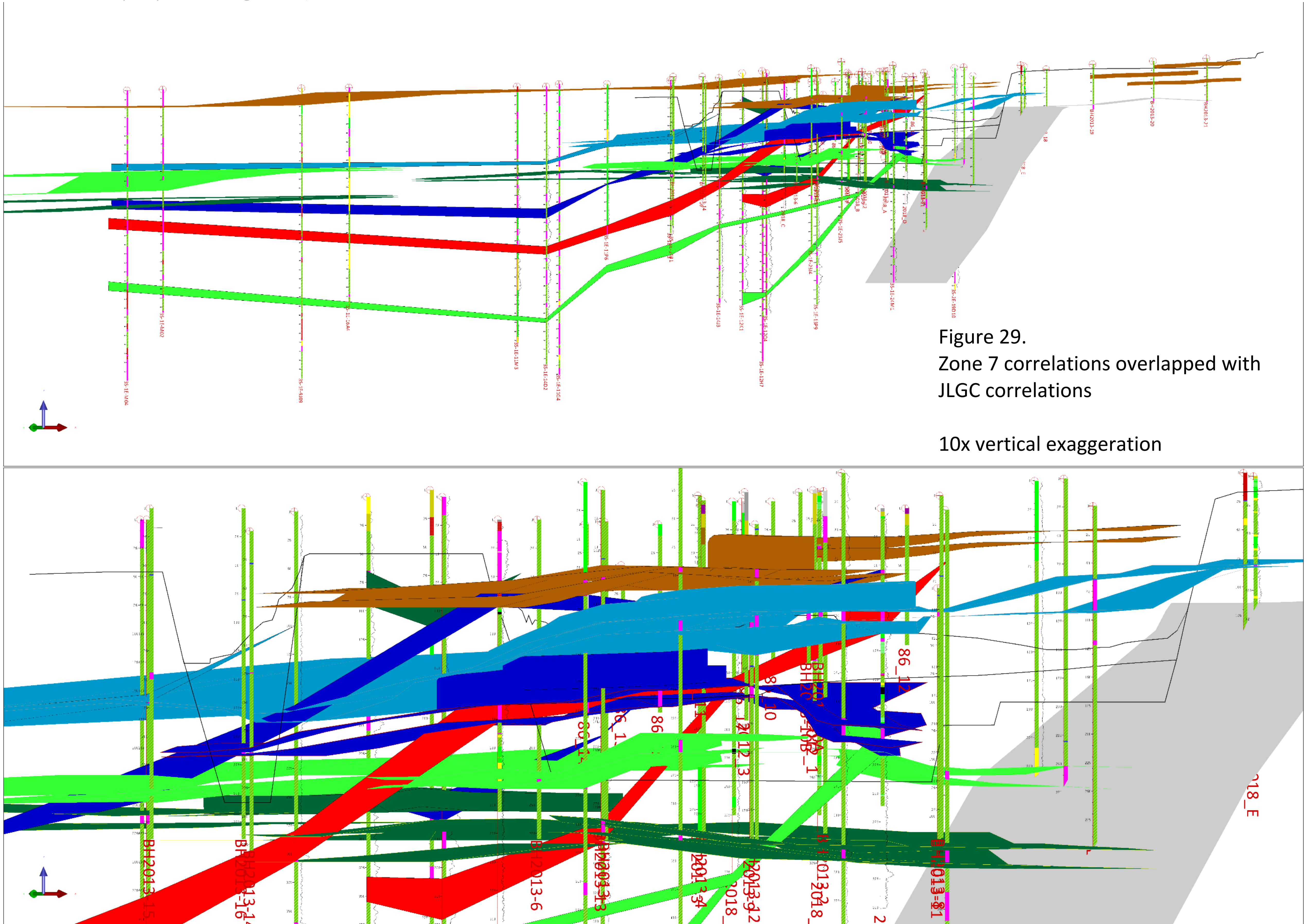


Figure 29.
Zone 7 correlations overlapped with JLGC correlations

10x vertical exaggeration

The figure represents a two-dimensional snap-shot of a three-dimensional model. The reader should be careful not to interpret the distinct clay layers as continuous. In the three-dimensional model, when rotated on a different axis, the discontinuous nature of the clay layers is apparent (i.e., separation between clays where sand and gravel exists).