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From: Monarque, Stephen
Sent: Sunday, October 14, 2012 5:34 PM
To: ComanchePeakCOL Resource
Subject: FW: 2012-10-02 Woodlan - Advance material for hydrology meeting on 10-11
Attachments: NRC-Luminant GW meeting 10-11-12.pdf

From: Woodlan, Don [mailto:Donald.Woodlan@luminant.com]
Sent: Tuesday, October 02, 2012 5:25 PM
To: Roy, Tarun
Cc: Monarque, Stephen; Conly, John; Evans, Todd; russell_bywater@mnes-us.com; Nicholas_Kellenberger
Subject: 2012-10-02 Woodlan - Advance material for hydrology meeting on 10-11

Tarun,

Here is the presentation material we have developed for the upcoming meeting. The material may change slightly prior to the meeting but hopefully this will help your technical staff to prepare for the meeting.

Donald R. Woodlan
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Hearing Identifier: ComanchePeak_COL_Public
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NRC Public Meeting
Comanche Peak Nuclear Power Plant
Units 3 and 4
Combined License Application
Chapter 2, Section 2.4
October 11, 2012

DRAFT 10-2-12

Agenda

- 2012 Groundwater Monitoring
- Site Conceptual Model
- Site Data
  - Locations and Results
  - 3D visualization
- Excavation Geometry and Fill Configuration
  - 3D visualization
- Groundwater Flow Model
  - 3D visualization
- Conclusions/Summary

Objectives

- Present information from the 2012 water level measurements
- Review components of the conceptual model for the site relative to conducting groundwater modeling
- Discuss numerical model setup and results
- Solicit feedback from NRC

2012 Groundwater Monitoring

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Historic Groundwater Gauging Activities

- Monthly groundwater gauging was performed for 18 months between 2006 and 2008.
- Regolith (soil and fill) monitoring wells indicated equilibrium conditions.
- Many deep and shallow bedrock monitoring well groundwater elevations did not show signs of equilibrium conditions (slowly rising groundwater levels).

Supplemental Groundwater Gauging

- Monthly gauging of the CPNPP Units 3 & 4 COLA monitoring wells was resumed for a limited period on August 17, 2012.

- Two monthly events have been completed (August 17 and September 12, 2012) with additional events planned in October through December 2012.

Supplemental Groundwater Gauging

- Gauging was performed to provide the best estimate of equilibrium pre-construction groundwater elevations and support the CPNPP groundwater model efforts.

- Preliminary indications are that groundwater monitoring wells are at equilibrium levels.

Regolith Wells
4/25/2008 to 8/17/2012 and 2012 Monthly

Monitoring Well	4/25/2008 (ft amsl)	5/28/2008 (ft amsl)	Difference ft	8/17/2012 (ft amsl)	Difference ft	9/12/2012 (ft amsl)	Difference ft
MW-1201a	856.92	855.88	↘ -1.04	854.16	↘ -1.72	853.58	↘ -0.58
MW-1203a	856.43	855.88	↘ -0.55	852.17	↓ -3.71	852.36	→ 0.19
MW-1204a	824.45	824.49	→ 0.04	822.76	↘ -1.73	822.65	↘ -0.11
MW-1205a	845.65	846.30	→ 0.65	850.15	→ 3.85	849.79	↘ -0.36
MW-1206a	813.67	813.62	↘ -0.05	811.24	↓ -2.38	811.22	↘ -0.02
MW-1207a	841.68	839.81	↘ -1.87	839.74	↘ -0.07	839.80	→ 0.06
MW-1208a	783.64	783.54	↘ -0.10	782.01	↘ -1.53	782.00	↘ -0.01
MW-1209a	783.58	783.46	↘ -0.12	780.18	↓ -3.28	781.69	→ 1.51
MW-1211a	775.48	774.87	↘ -0.61	774.61	↘ -0.26	774.99	→ 0.38
MW-1212a	787.71	787.56	↘ -0.15	786.99	↘ -0.57	787.08	→ 0.09
MW-1214a	781.83	781.05	↘ -0.78	778.34	↓ -2.71	778.47	→ 0.13
MW-1215a	839.70	839.87	→ 0.17	840.23	→ 0.36	840.23	→ 0.00
MW-1216a	829.26	829.49	→ 0.23	829.26	↘ -0.23	828.89	↘ -0.37
MW-1217a	829.53	829.52	↘ -0.01	828.56	↘ -0.96	828.55	↘ -0.01
MW-1218a	830.20	826.56	↓ -3.64	823.07	↓ -3.49	823.76	→ 0.69
MW-1219a	792.53	792.59	→ 0.06	788.78	↓ -3.81	788.78	→ 0.00

↑ Water Level Rise greater than 20 feet
↗ Water Level Rise between 5 and 20 feet
→ Water Level Rise between 0 and 5 feet
↘ Water Level Decline between 0 and 2 feet
↓ Water Level Decline greater than 2 feet

- **Regolith wells (soil and existing fill) showed a general decline in water levels from 2008 to 2012.**
- **This decline continued from August 2012 to September 2012.**
- **Potential reason for the general decline may be due to the extended drought currently impacting Texas.**

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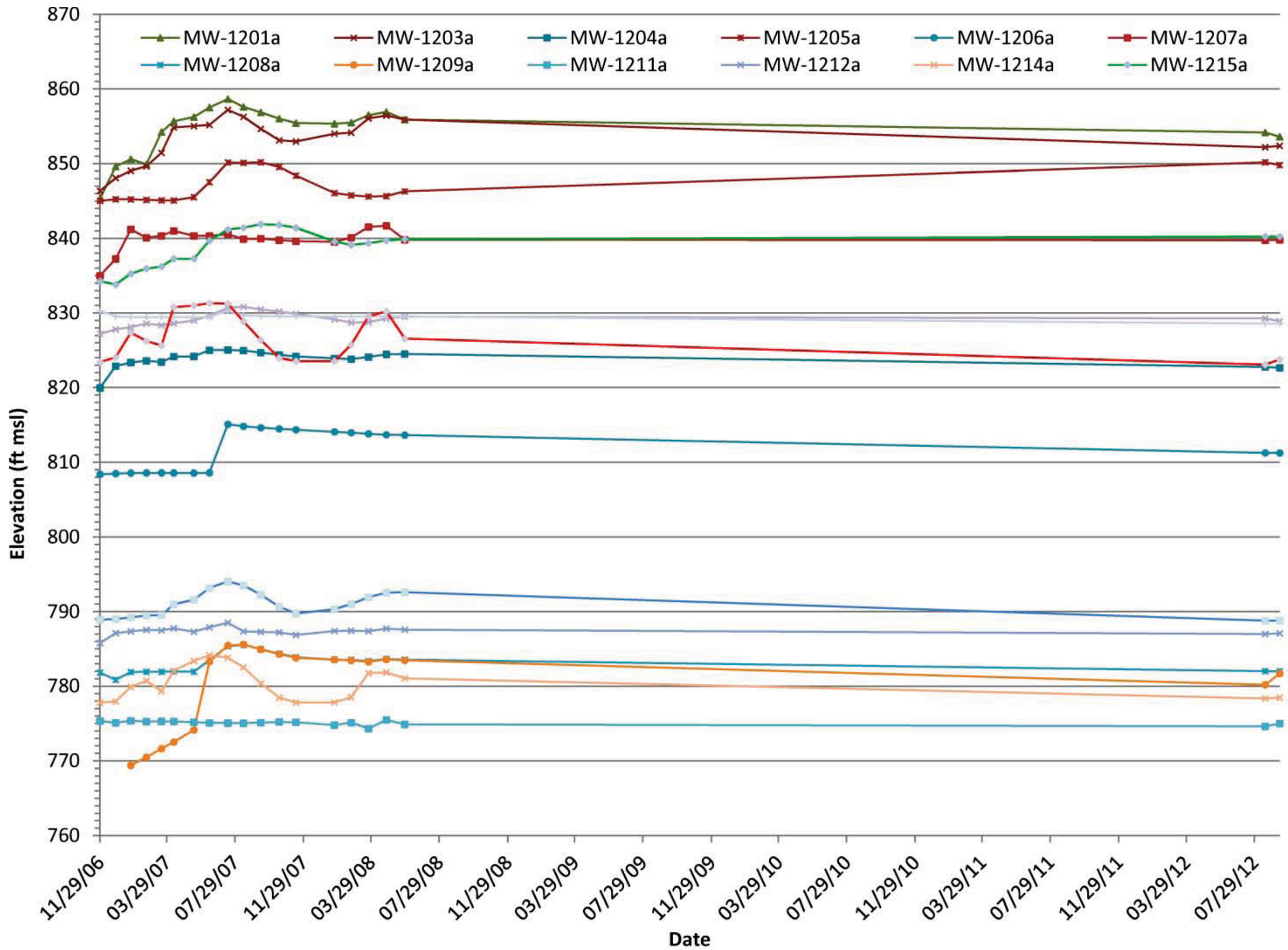
Regolith (Soil) Monitoring Wells



- **Current 2012 monitoring shows the regolith monitoring wells were at equilibrium conditions during the 2006-2008 monitoring period, reflecting seasonal variations.**

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Shallow Bedrock Wells
4/25/2008 to 8/17/2012 and 2012 Monthly

Monitoring Well	4/25/2008 (ft amsl)	5/28/2008 (ft amsl)	Difference ft	8/17/2012 (ft amsl)	Difference ft	9/12/2012 (ft amsl)	Difference ft
MW-1200b	799.54	800.04	0.50	806.57	6.53	806.59	0.02
MW-1201b	831.75	831.46	-0.29	830.43	-1.03	830.30	-0.13
MW-1202b	798.96	799.52	0.56	830.82	31.30	829.81	-1.01
MW-1203b	837.21	836.77	-0.44	837.07	0.30	836.05	-1.02
MW-1204b	800.73	801.36	0.63	817.68	16.32	817.75	0.07
MW-1205b	803.82	804.29	0.47	819.47	15.18	819.67	0.20
MW-1206b	784.66	785.04	0.38	791.74	6.70	791.75	0.01
MW-1207b	831.16	829.40	-1.76	827.99	-1.41	828.07	0.08
MW-1209b	775.37	774.84	-0.53	774.95	0.11	775.11	0.16
MW-1210b	787.50	787.53	0.03	789.94	2.41	789.86	-0.08
MW-1211b	775.45	774.85	-0.60	775.06	0.21	774.97	-0.09
MW-1212b	785.31	784.37	-0.94	782.71	-1.66	783.36	0.65
MW-1213b	795.58	796.45	0.87	817.68	21.23	817.77	0.09
MW-1215b	833.51	833.31	-0.20	832.24	-1.07	832.25	0.01
MW-1216b	823.15	823.31	0.16	827.17	3.86	827.27	0.10
MW-1217b	821.33	820.17	-1.16	822.43	2.26	822.40	-0.03

Water Level Rise greater than 20 feet
Water Level Rise between 5 and 20 feet
Water Level Rise between 0 and 5 feet
Water Level Decline between 0 and 2 feet
Water Level Decline greater than 2 feet

- Some shallow bedrock wells showed a mix of minimal change and slight declines in water levels from 2008 to 2012, while some showed significant increases in water level from the last recorded 2008 level.
- Those wells showing large increases in level between 2008 and 2012 did not have indications of equilibrium conditions in 2008.

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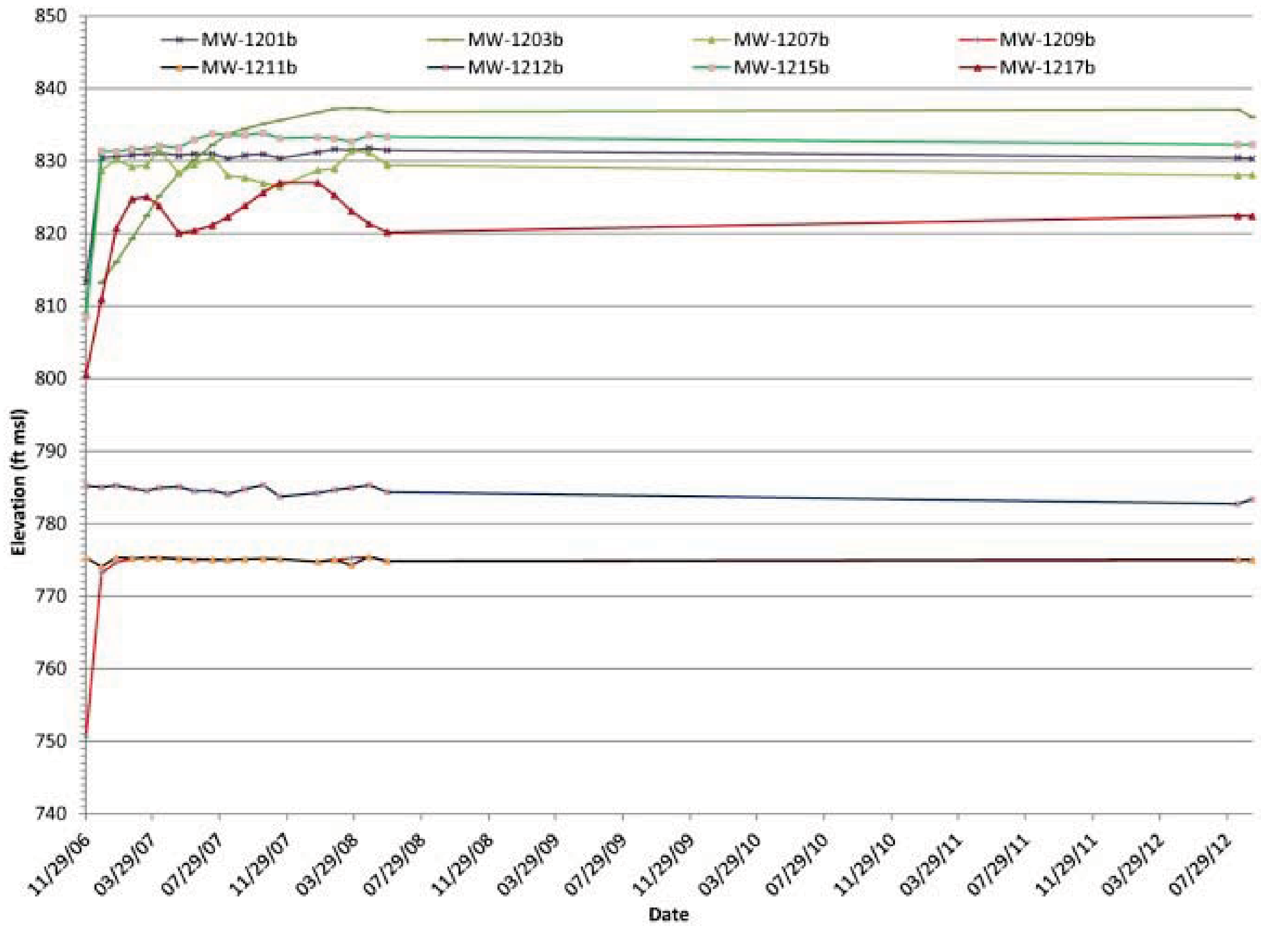
Shallow Bedrock Monitoring Wells



- Eight shallow bedrock monitoring wells appeared to be at equilibrium conditions during the 2006-2008 monitoring period, reflecting seasonal variations.
- From August 2012 to September 2012 there was little change in groundwater levels validating that equilibrium levels had been attained.

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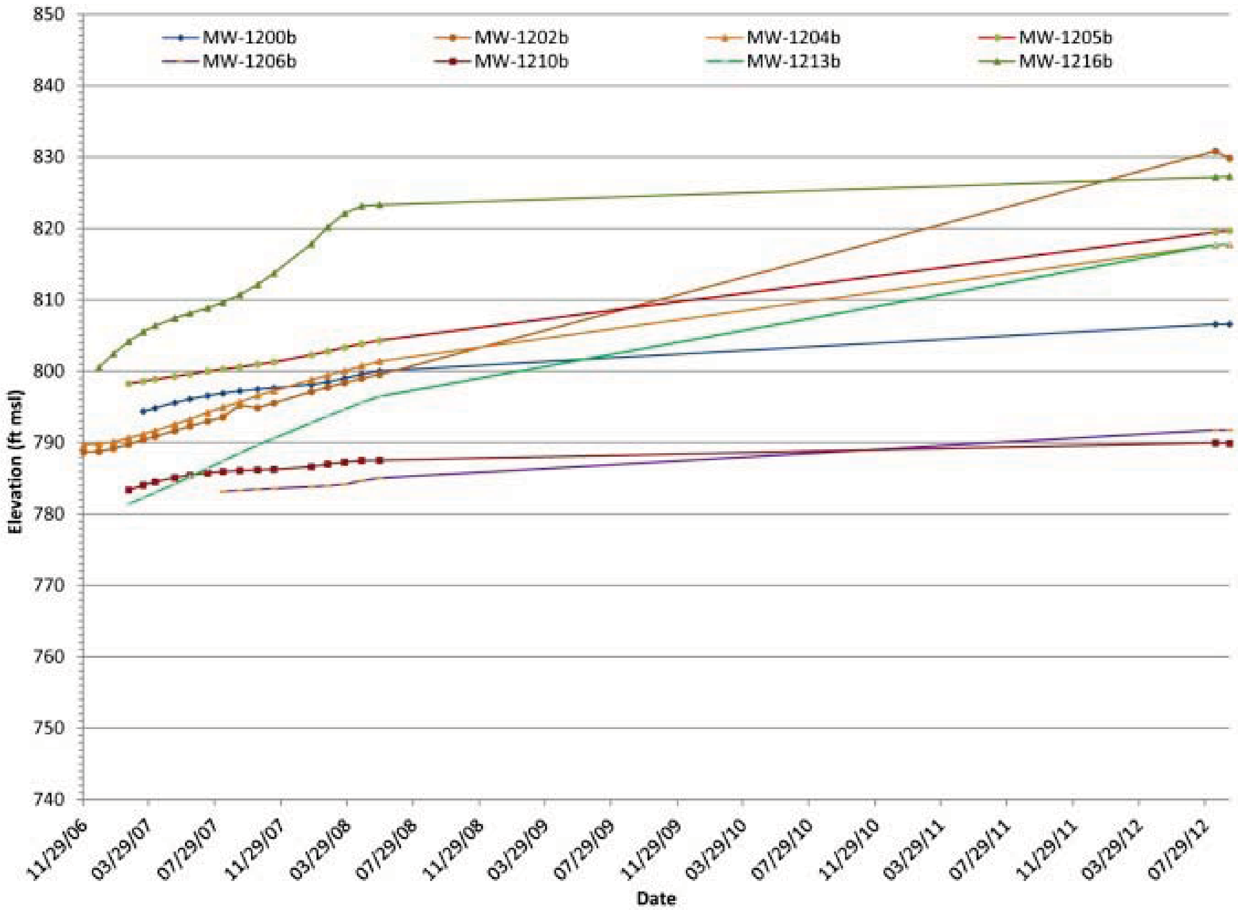
Shallow Bedrock Monitoring Wells



- **Eight shallow bedrock wells did not show evidence of equilibrium during 2006 – 2008 monitoring period (slow steady rise in groundwater levels).**
- **All eight wells showed a 4 to 30 foot rise in water levels between 2008 and 2012.**
- **From August 2012 to September 2012 there was little change in groundwater levels suggesting equilibrium levels have been attained.**

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Deep Bedrock Wells
4/25/2008 to 8/17/2012 and 2012 Monthly

Monitoring Well	4/25/2008 (ft amsl)	5/28/2008 (ft amsl)	Difference ft	8/17/2012 (ft amsl)	Difference ft	9/12/2012 (ft amsl)	Difference ft
MW-1200c	754.07	754.07	0.00	756.77	2.70	756.82	0.05
MW-1201c	786.37	786.94	0.57	808.77	21.83	808.91	0.14
MW-1202c	754.36	754.46	0.10	760.43	5.97	760.53	0.10
MW-1203c	798.85	799.57	0.72	819.65	20.08	819.86	0.21
MW-1204c	756.21	756.49	0.28	766.03	9.54	766.16	0.13
MW-1205c	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW-1206c	751.25	751.51	0.26	762.94	11.43	763.08	0.14
MW-1207c	800.82	802.28	1.46	814.75	12.47	814.67	-0.08
MW-1209c	745.26	747.11	1.85	775.17	28.06	775.04	-0.13
MW-1210c	748.37	748.44	0.07	752.67	4.23	752.73	0.06
MW-1212c	742.75	743.24	0.49	758.91	15.67	759.22	0.31
MW-1213c	757.31	757.43	0.12	763.54	6.11	763.61	0.07
MW-1215c	782.79	783.25	0.46	803.62	20.37	803.66	0.04
MW-1216c	781.09	781.30	0.21	790.91	9.61	791.04	0.13
MW-1217c	775.63	775.79	0.16	783.78	7.99	783.78	0.00

Water Level Rise greater than 20 feet
Water Level Rise between 5 and 20 feet
Water Level Rise between 0 and 5 feet
Water Level Decline between 0 and 2 feet
Water Level Decline greater than 2 feet
Dry — Dry Wells

- Most deep bedrock wells showed a general increase in water levels during the 2006 – 2008 monitoring period and a moderate rise in water levels from 2008 to 2012.
- One well (MW-1205c) was dry throughout the entire 2006-2008 monitoring period and remained dry in 2012.

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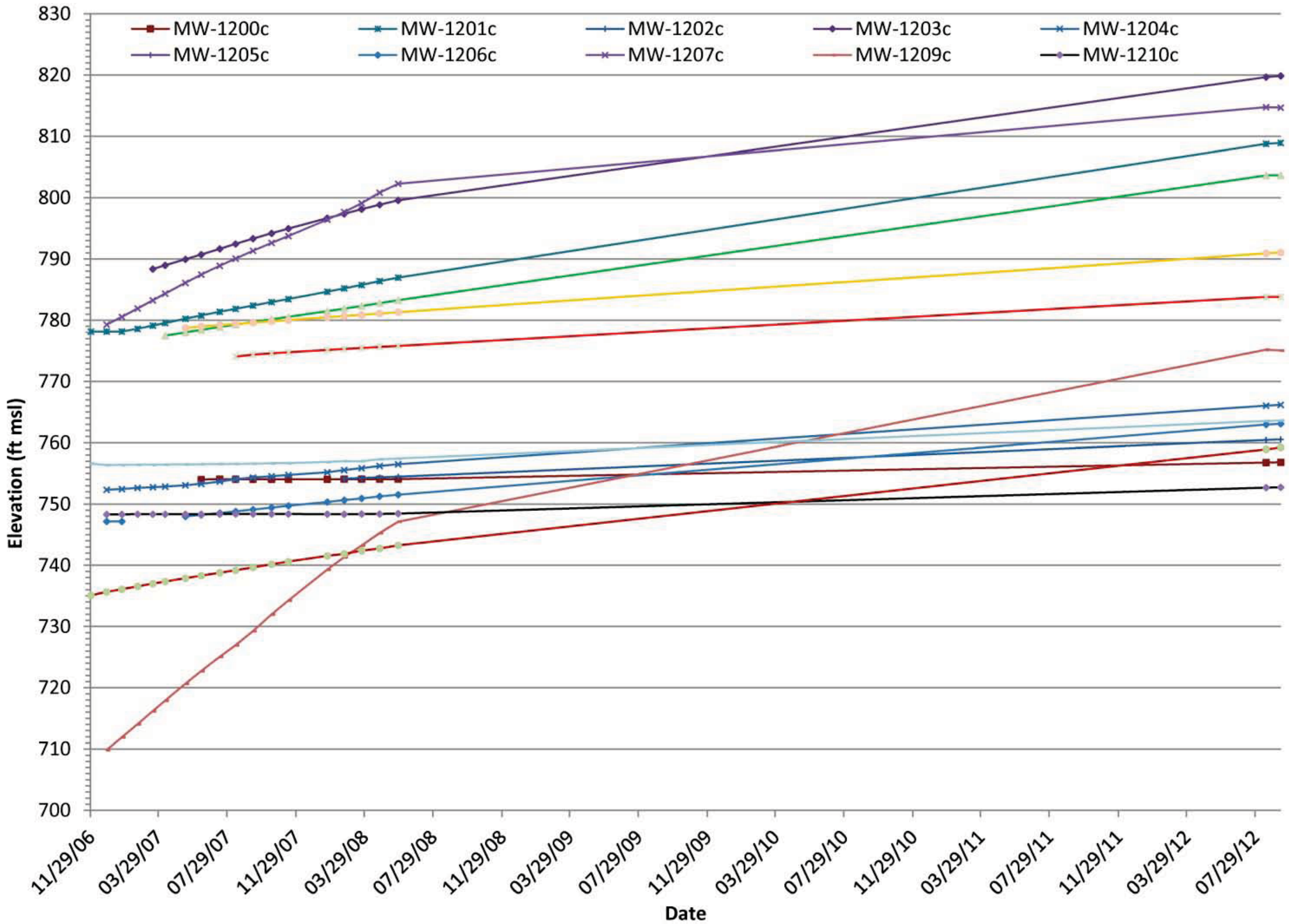
Deep Bedrock Monitoring Wells



- All deep bedrock wells showed a 3 to 28 foot rise in water levels between 2008 and 2012.
- From August 2012 to September 2012 there was little change in groundwater levels suggesting equilibrium levels have been attained.

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Summary

- Preliminary data (August and September 2012 gauging events) suggests that equilibrium conditions have been achieved.

- The new data has been reviewed and the increase in water levels have been considered for support of the current groundwater modeling efforts.

Future Site Activities

- Groundwater gauging of the CPNPP Units 3 & 4 COLA monitoring wells will continue until December 2012 to assess the seasonal transition from the summer drought to fall rains.
- Final groundwater data, evaluation, and conclusions will be presented in a Project Report following the final groundwater gauging event.

Groundwater Level Analysis

MODFLOW Model

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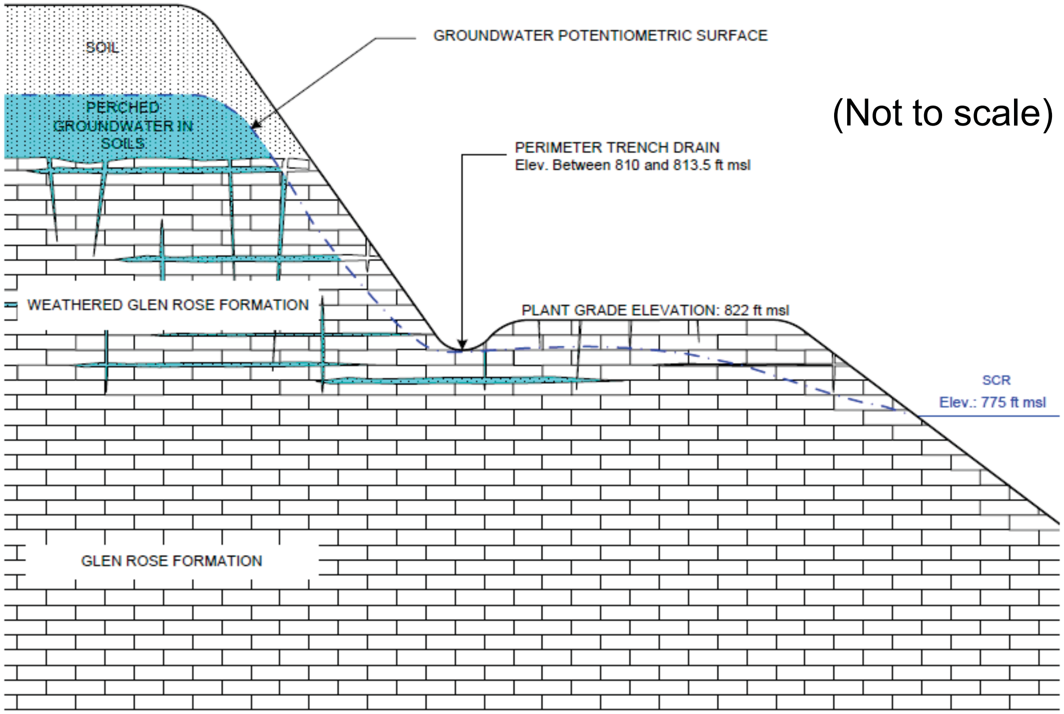
Site Conceptual Model (Post-construction Conditions)



(Not to scale)

- Groundwater primarily in Regolith/Soil/Fill
- Consolidated limestone
- Primarily horizontal fractures associated with bedding planes
- Overall low hydraulic conductivity of bedrock

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Site Conceptual Model

- Dense sections of limestone interspersed with more shaley material
- Unknown spatial continuity of observed variations

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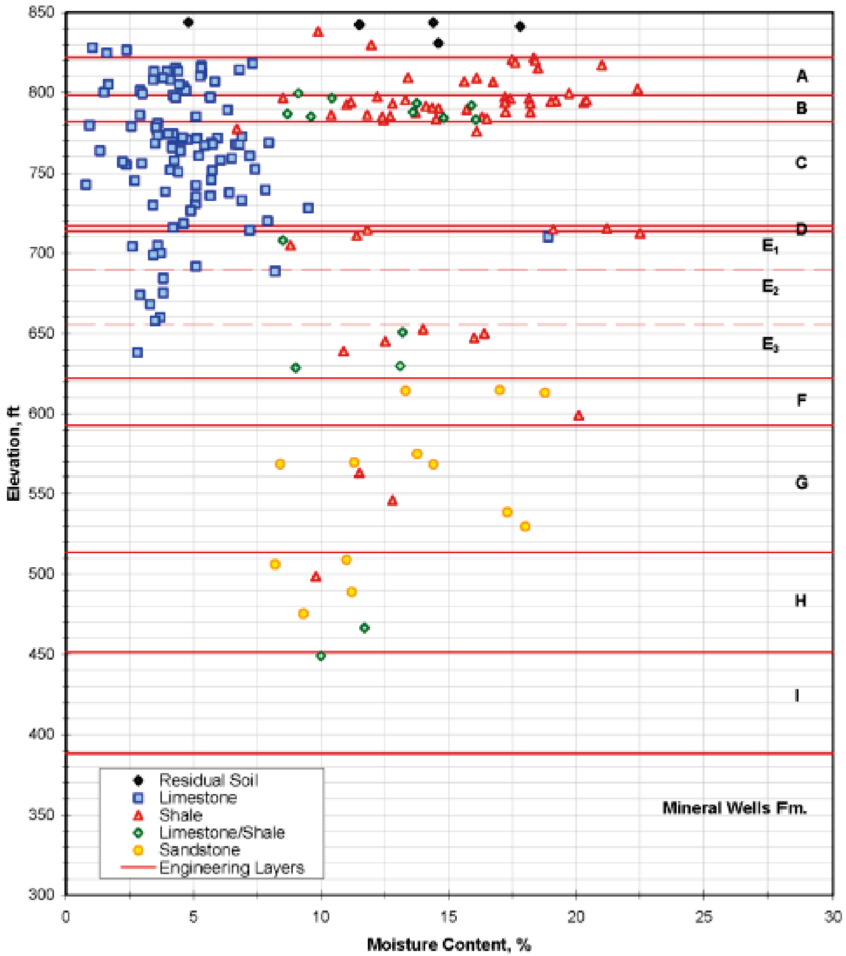
Site Conceptual Model

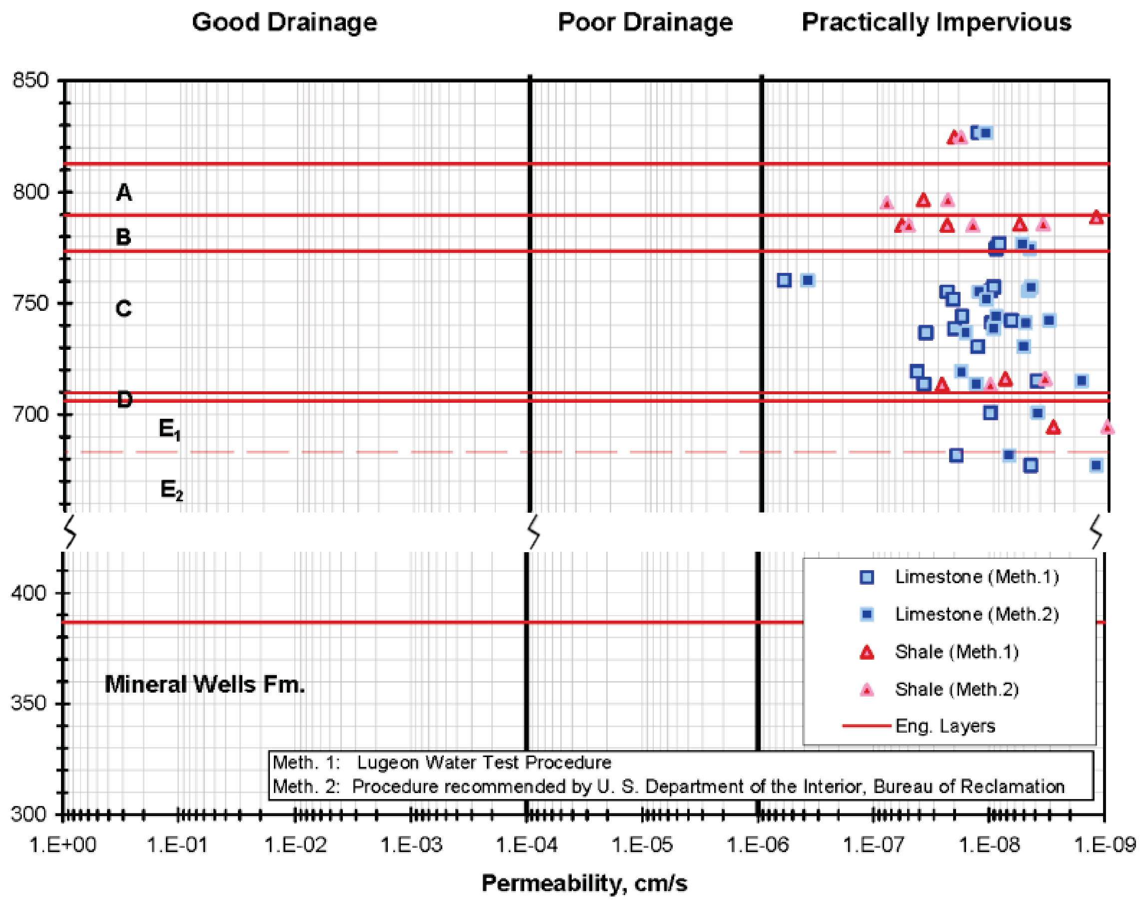
- Some variability in subsurface materials illustrated in core
- Note that many fractures in core are thought to be due to mechanical breakage associated with drilling

Site Conceptual Model



- Overall low moisture content in subsurface materials
- Letters indicate Engineering Zones (see FSAR for explanation)

Site Conceptual Model



- Low hydraulic conductivity values in subsurface materials (Figure from FSAR)

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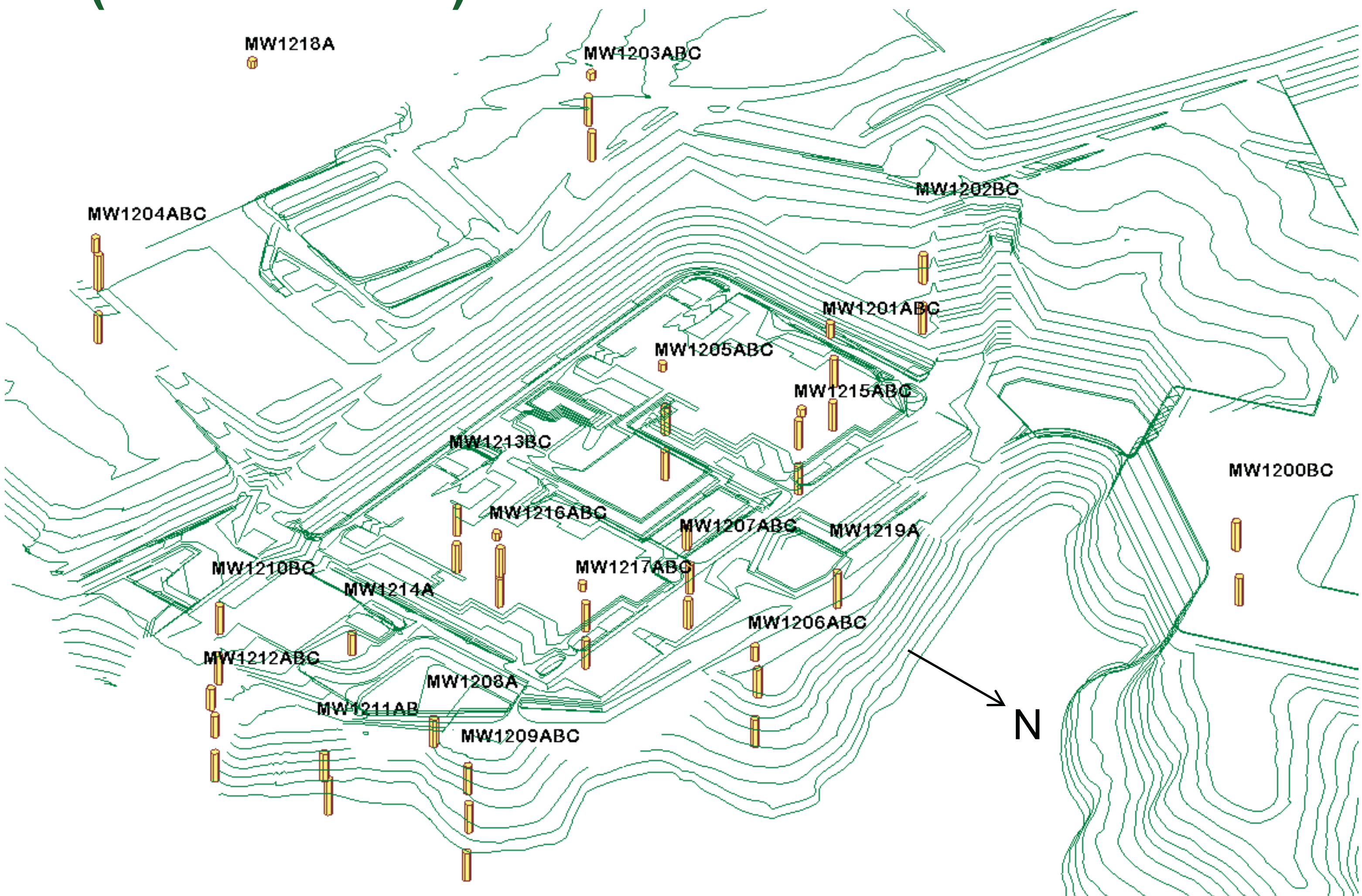
Site Data (Water Levels)



- Positions of wells screens

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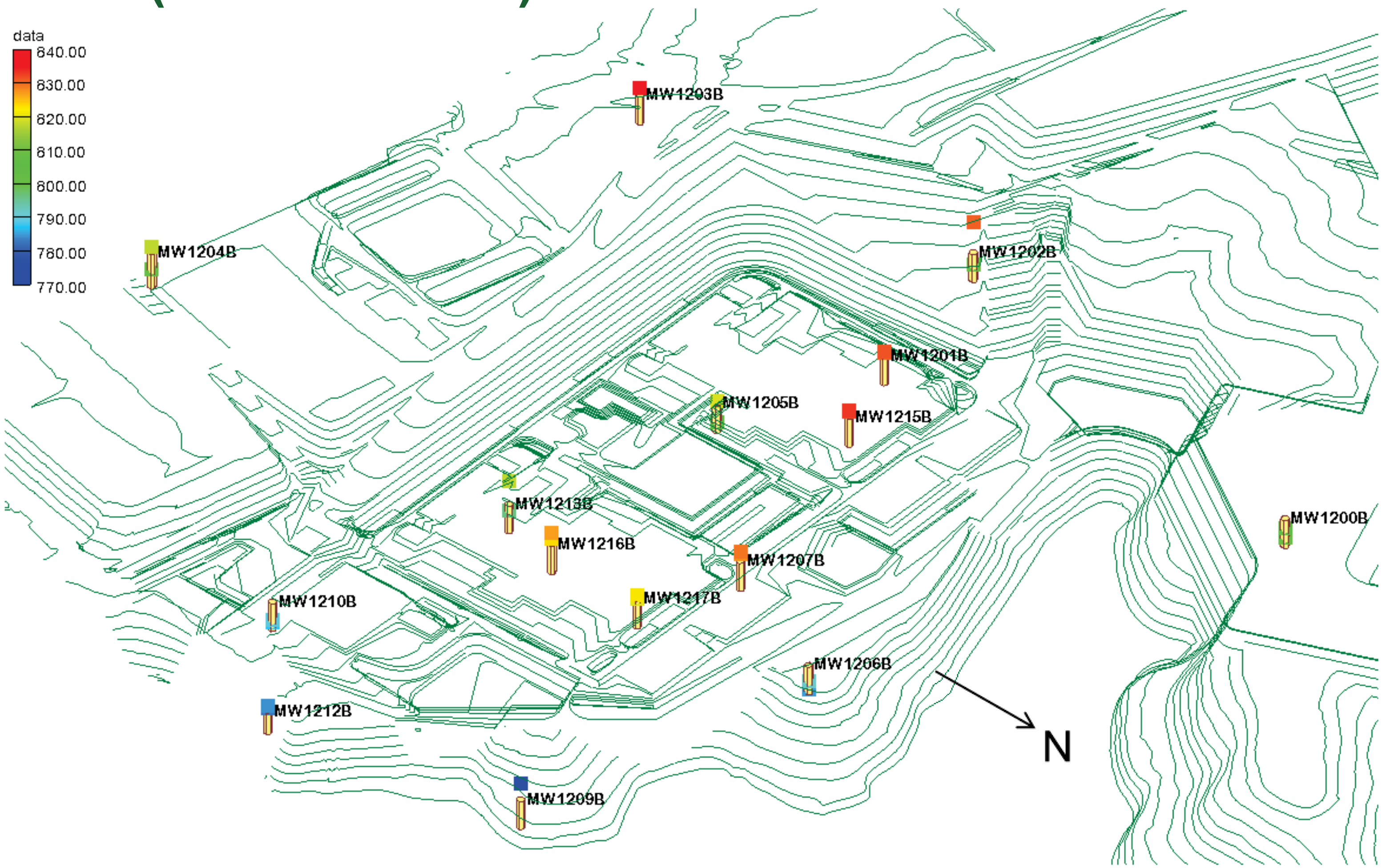
Site Data (Water Levels)



- **Water levels measured May 2008 and August 2012, B wells**

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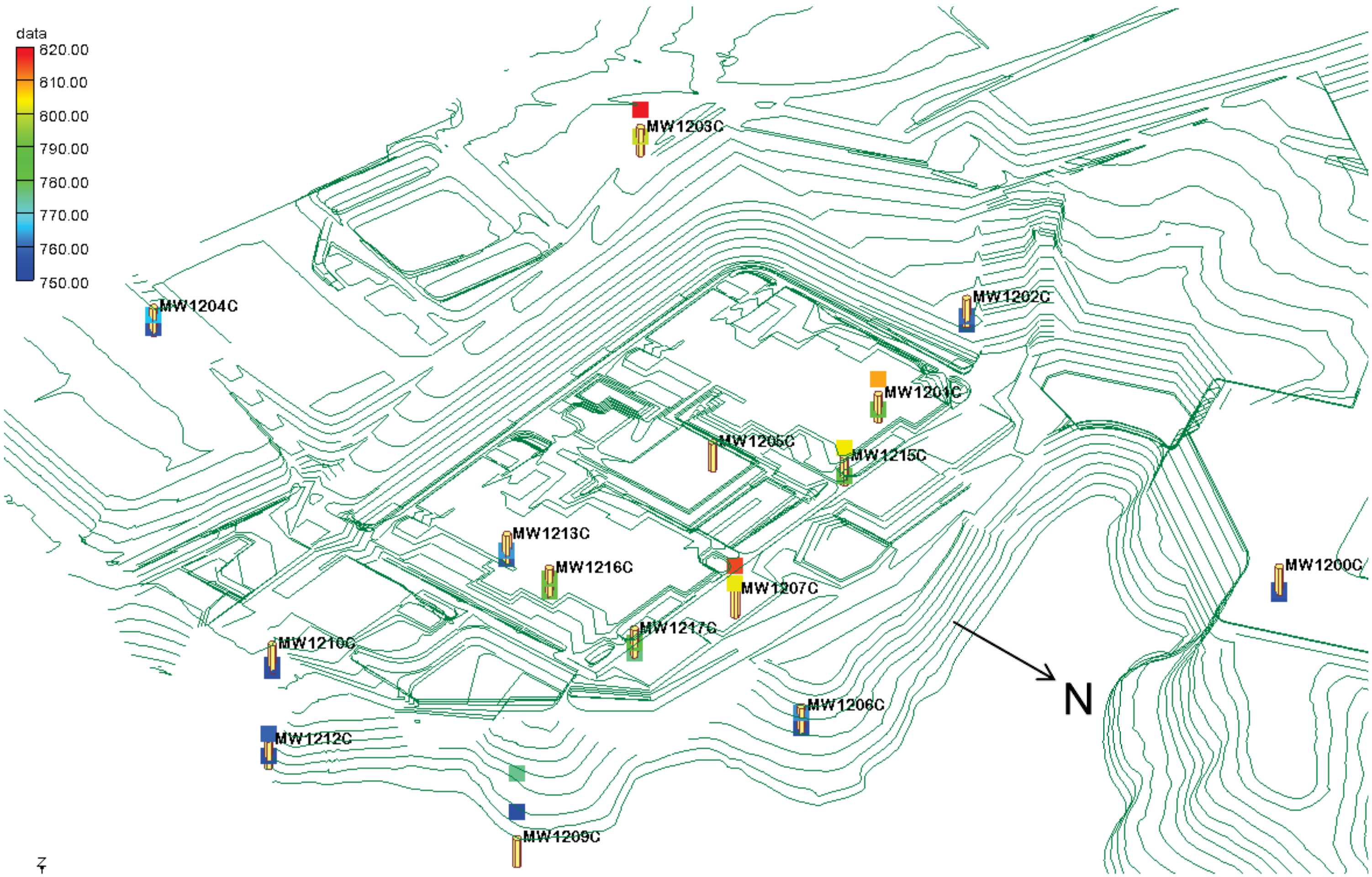
Site Data (Water Levels)



- Water levels measured May 2008 and August 2012, C wells

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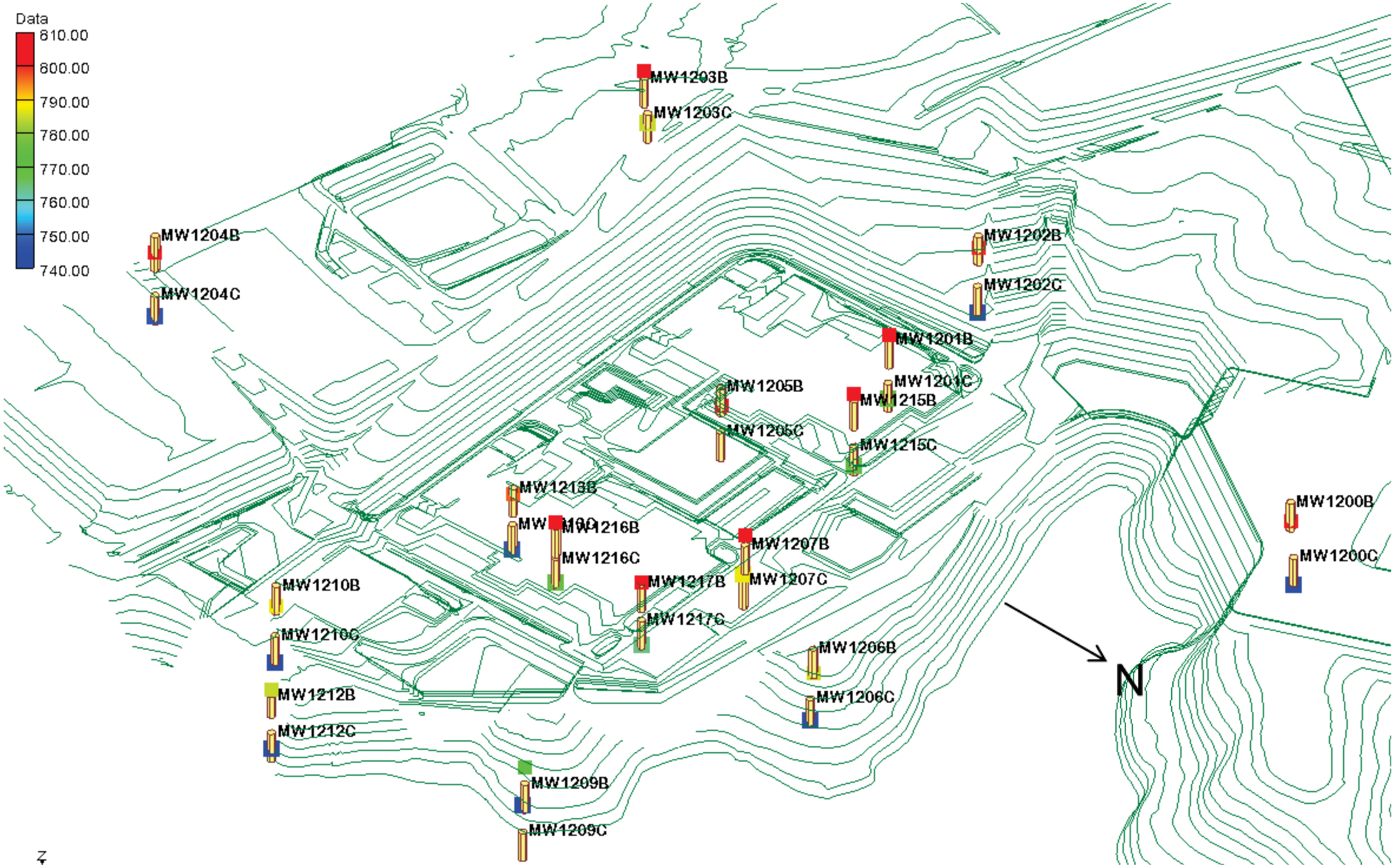
Site Data (Water Levels)



- Water levels measured May 2008 in B and C wells – note consistent downward hydraulic gradients

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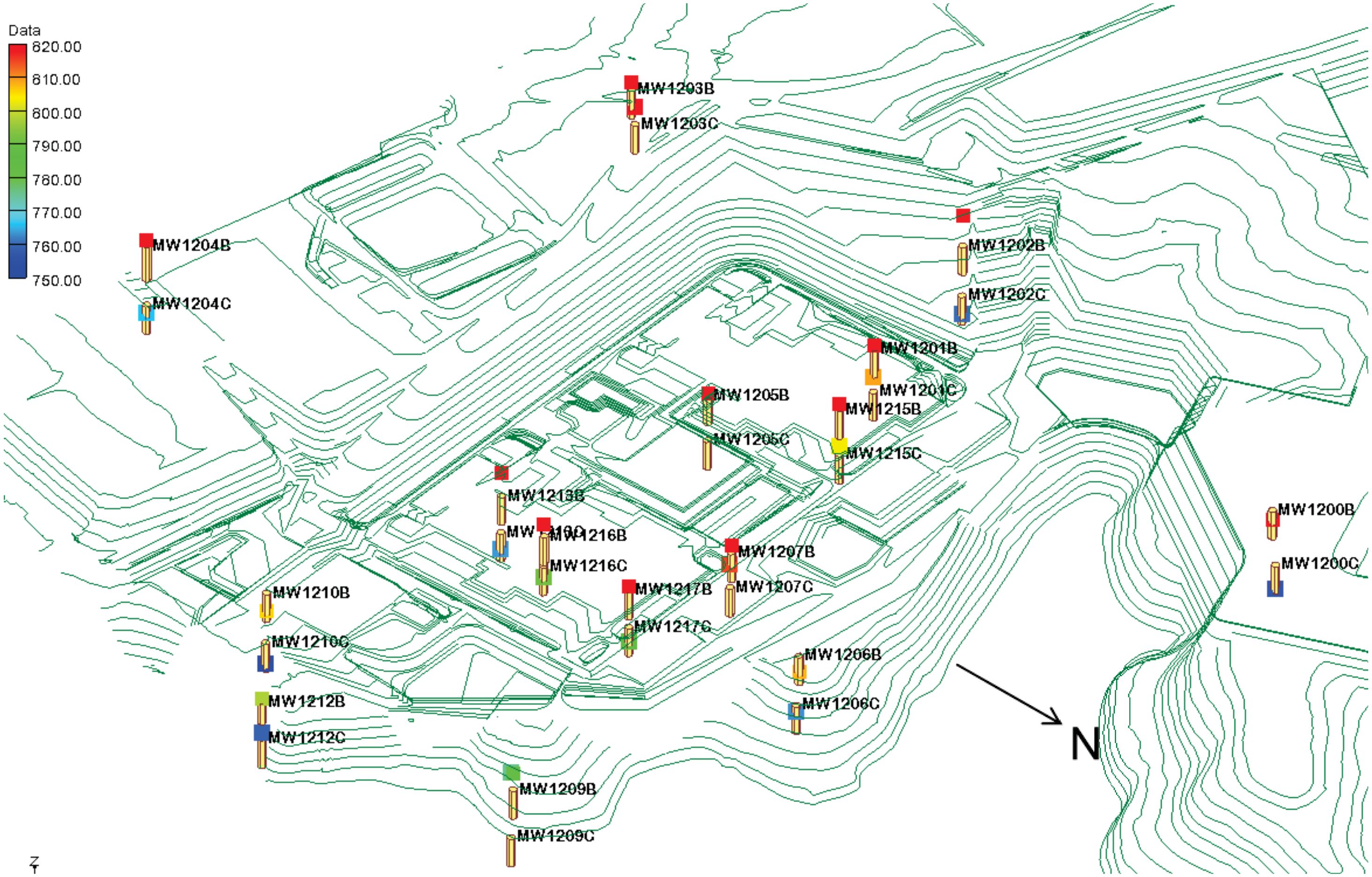
Site Data (Water Levels)



- Water levels measured August 2012 in B and C wells – note consistent downward hydraulic gradients

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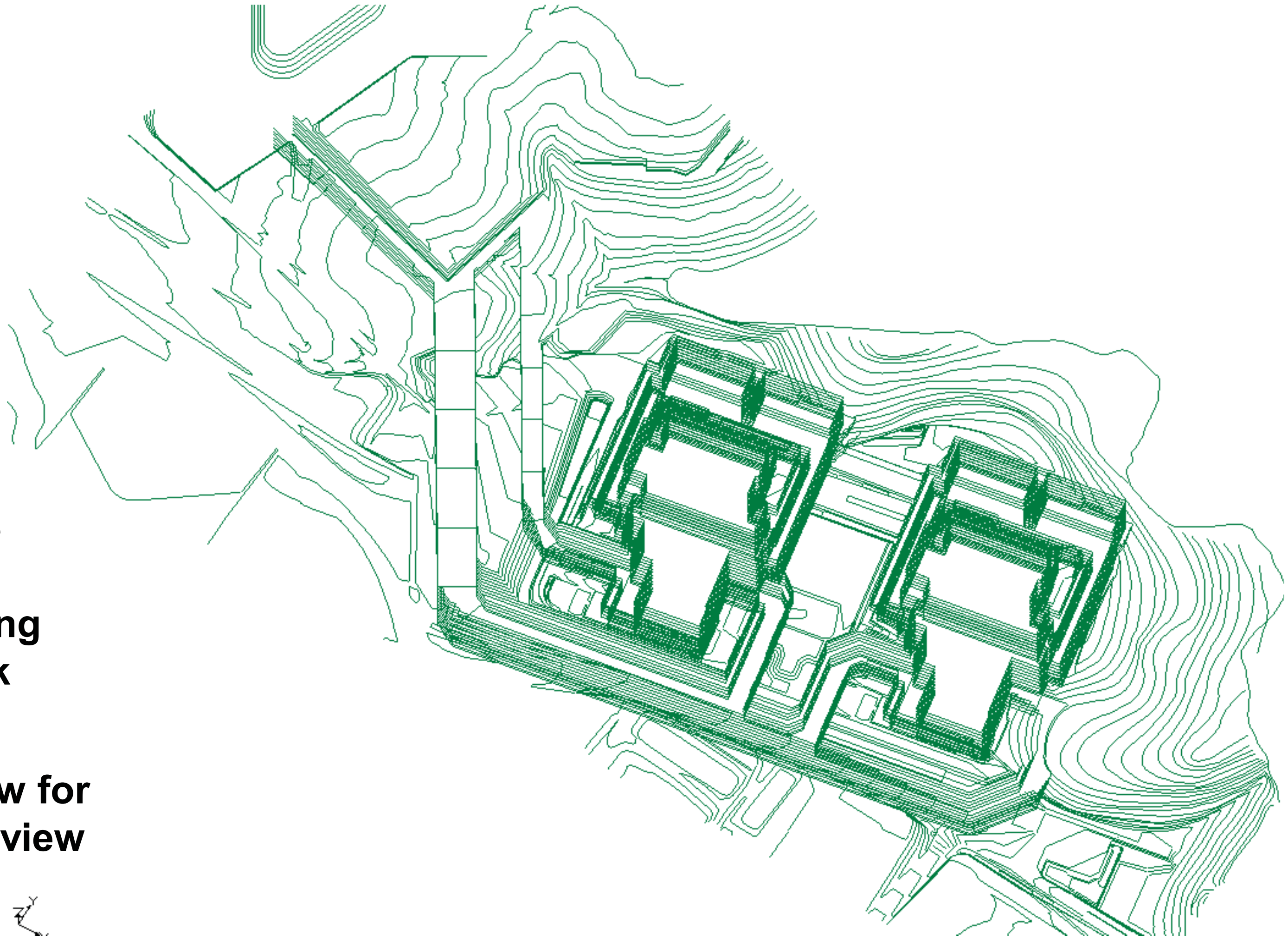
Excavation Geometry and Fill Configuration



- 3D view of the excavations illustrated using the top of rock surface
- See triad below for orientation of view

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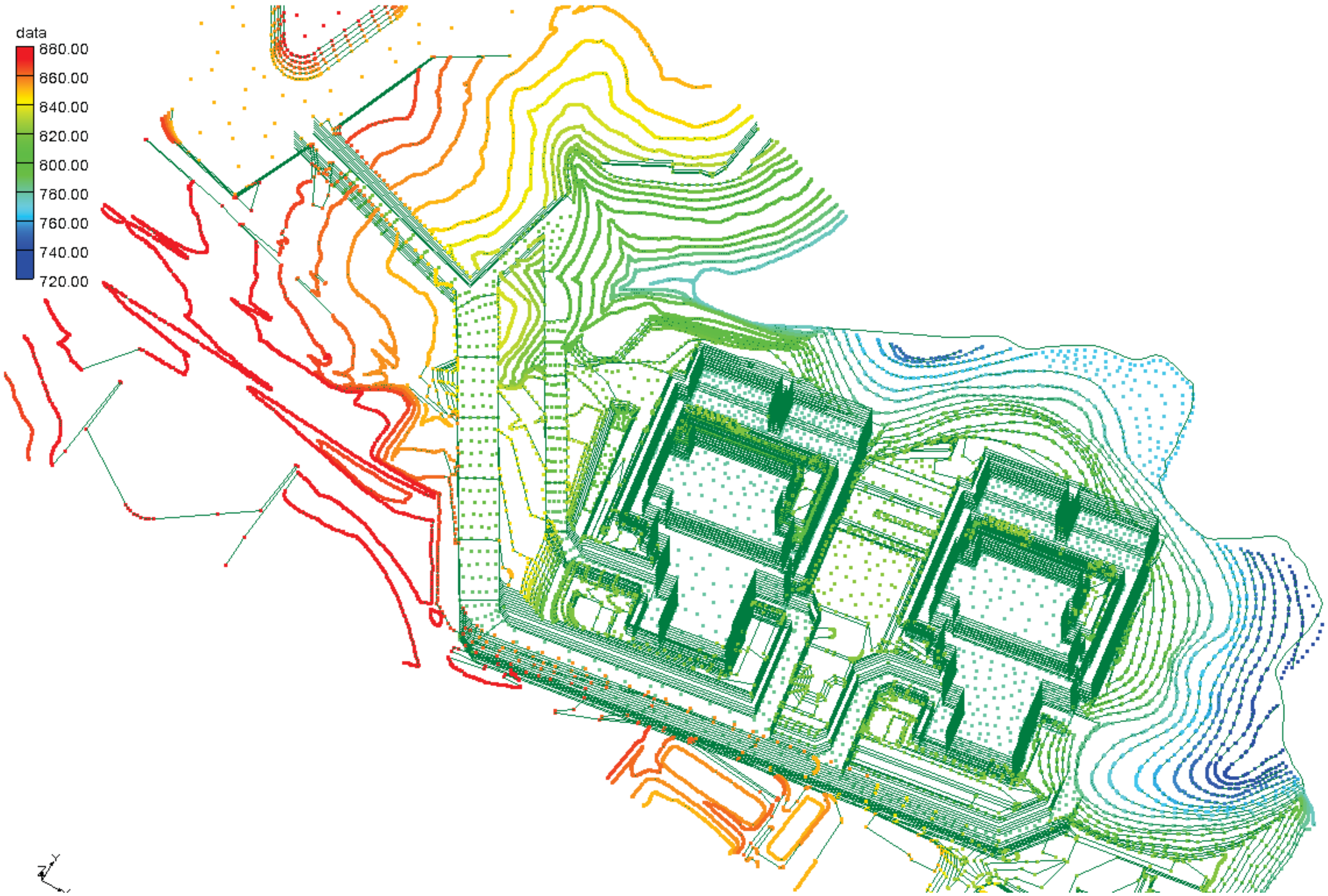
Excavation Geometry and Fill Configuration



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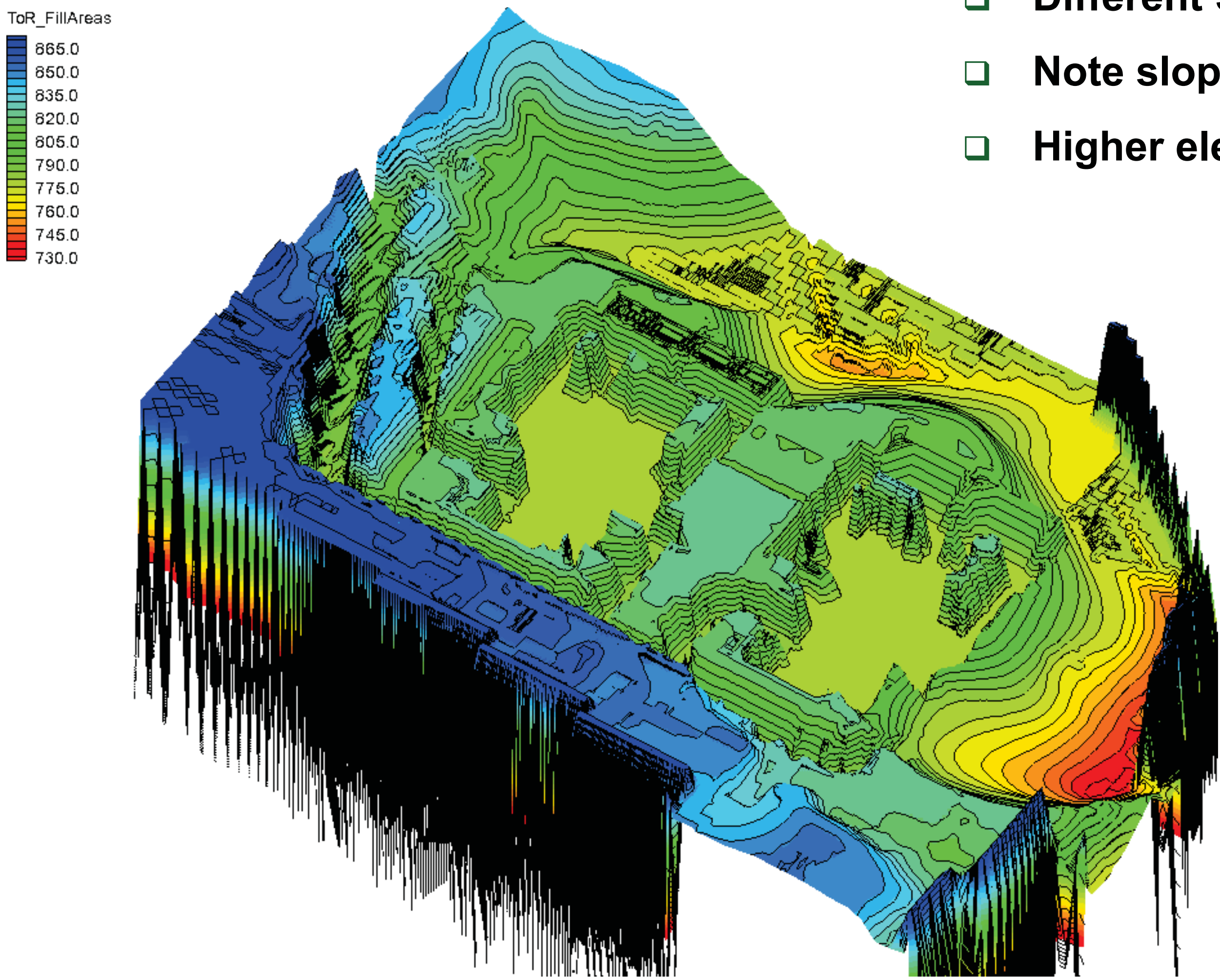
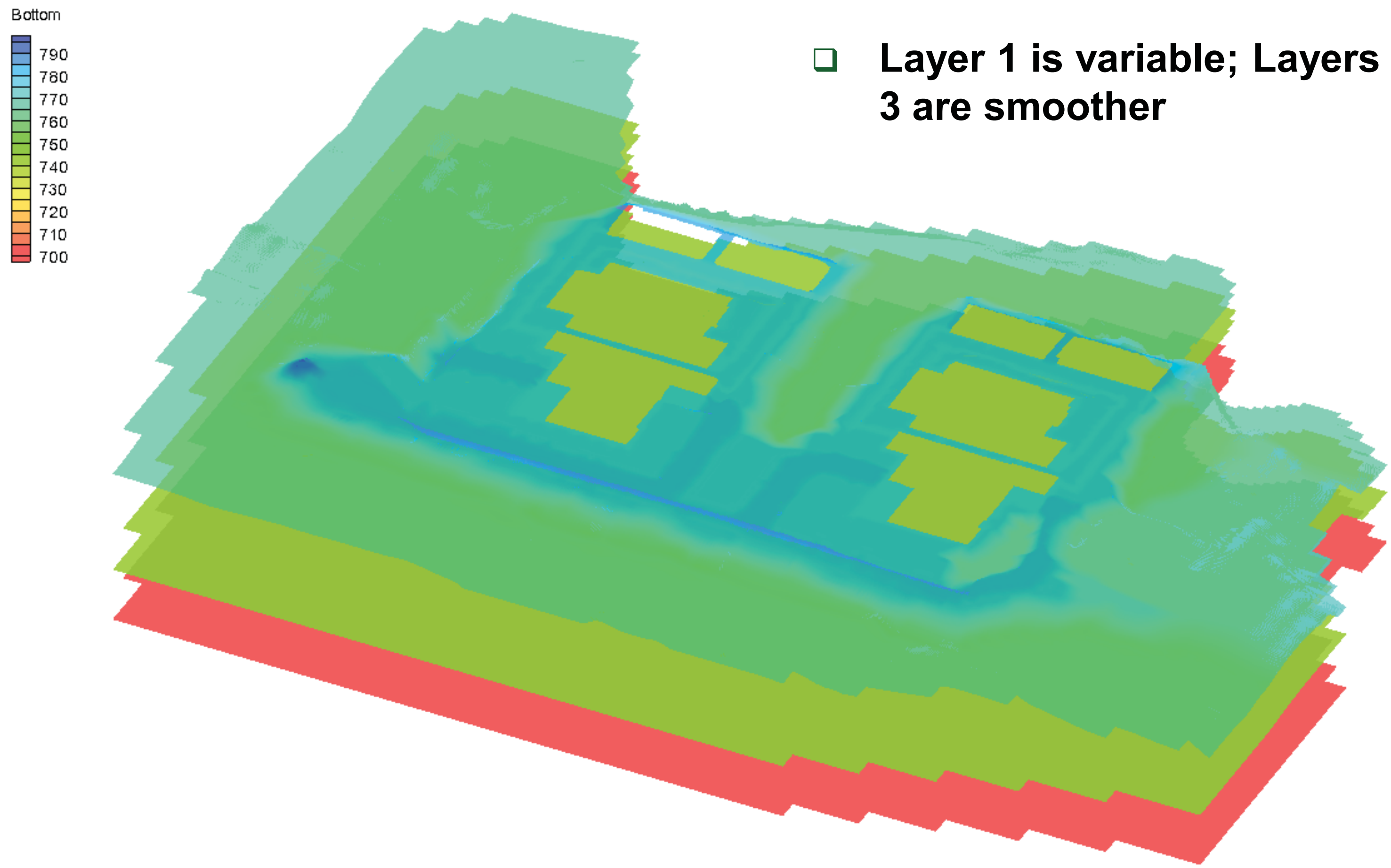
Excavation Geometry and Fill Configuration

Excavation Geometry and Fill Configuration



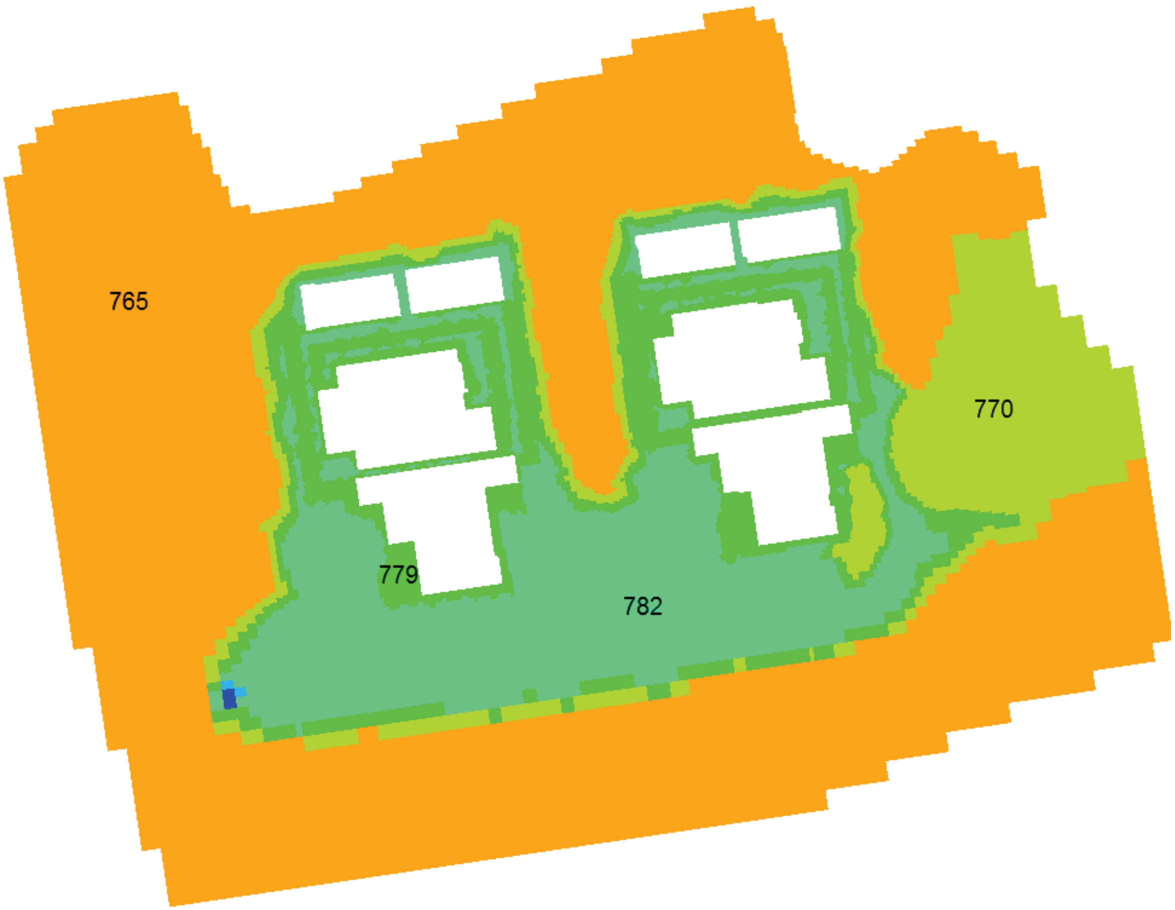
- Different 3D view of excavations
- Note slope off to existing fill areas
- Higher elevations in blue

Groundwater Flow Model



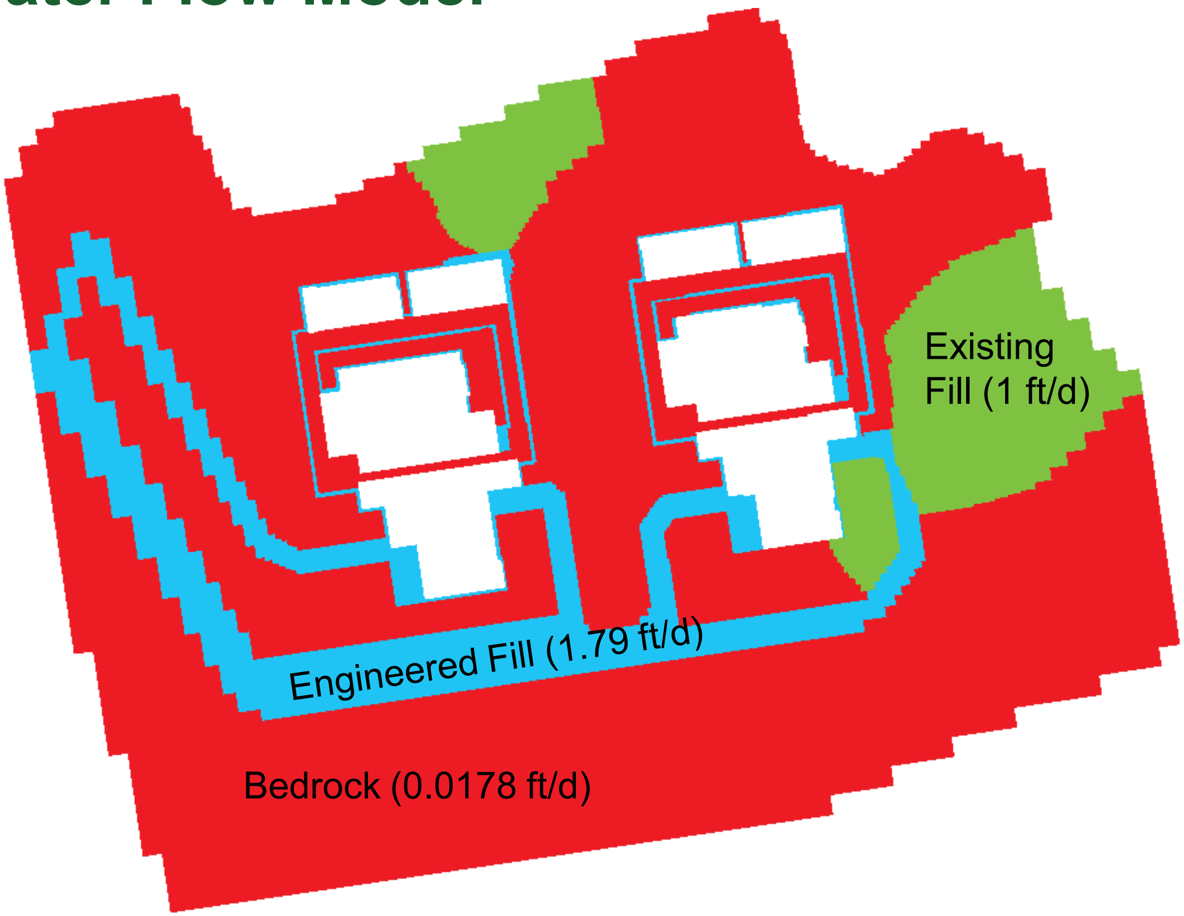
- Bottom elevations of each layer in MODFLOW model
- Layer 1 is variable; Layers 2 and 3 are smoother

Groundwater Flow Model



- Color fill contour of bottom of MODFLOW Layer 1

Groundwater Flow Model



- **Hydraulic conductivity zones in Layer 1**

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Groundwater Flow Model

- Recharge areas in model (applied to uppermost active cell)

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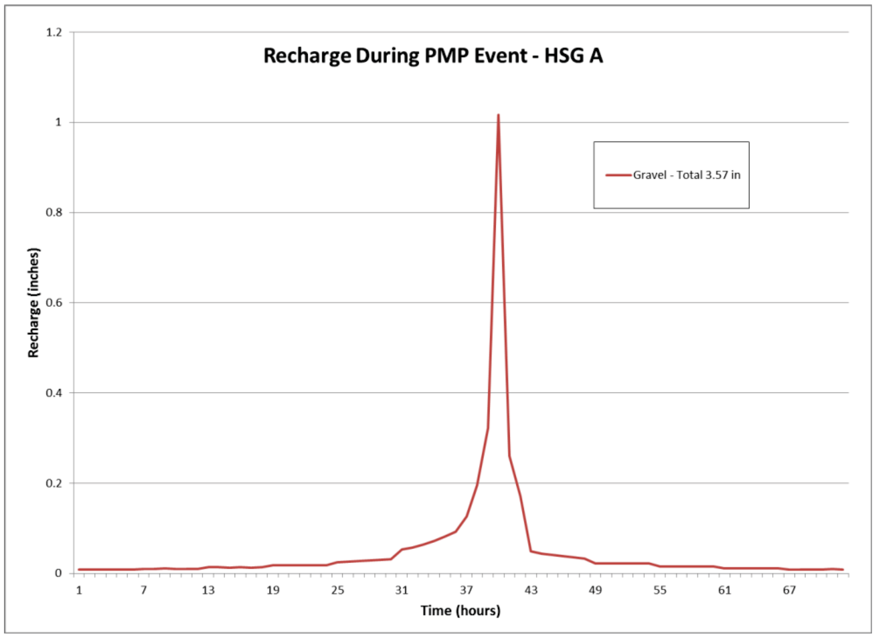
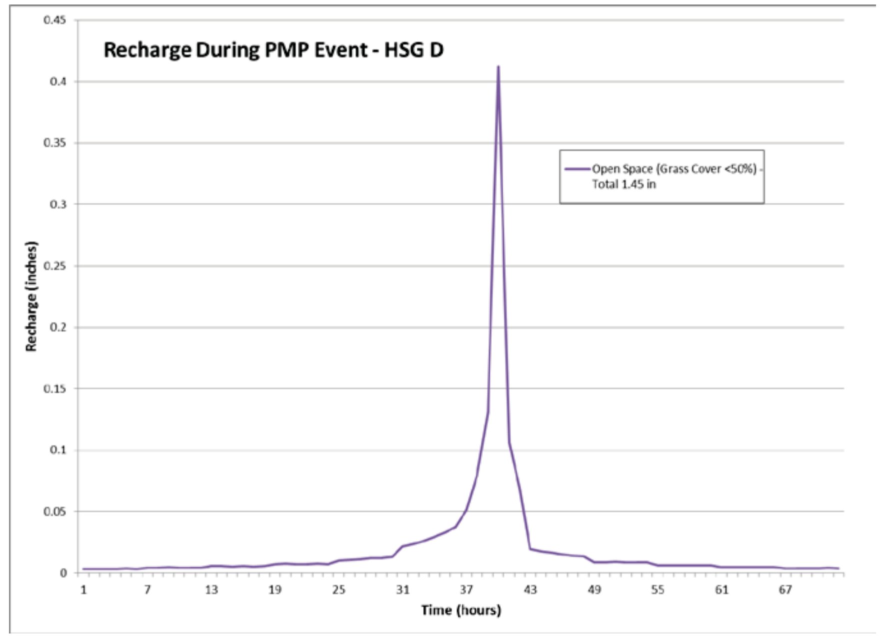
Groundwater Flow Model





- Recharge during PMP event
- HSG A soils – gravel
- HSG D soils – fine-grained

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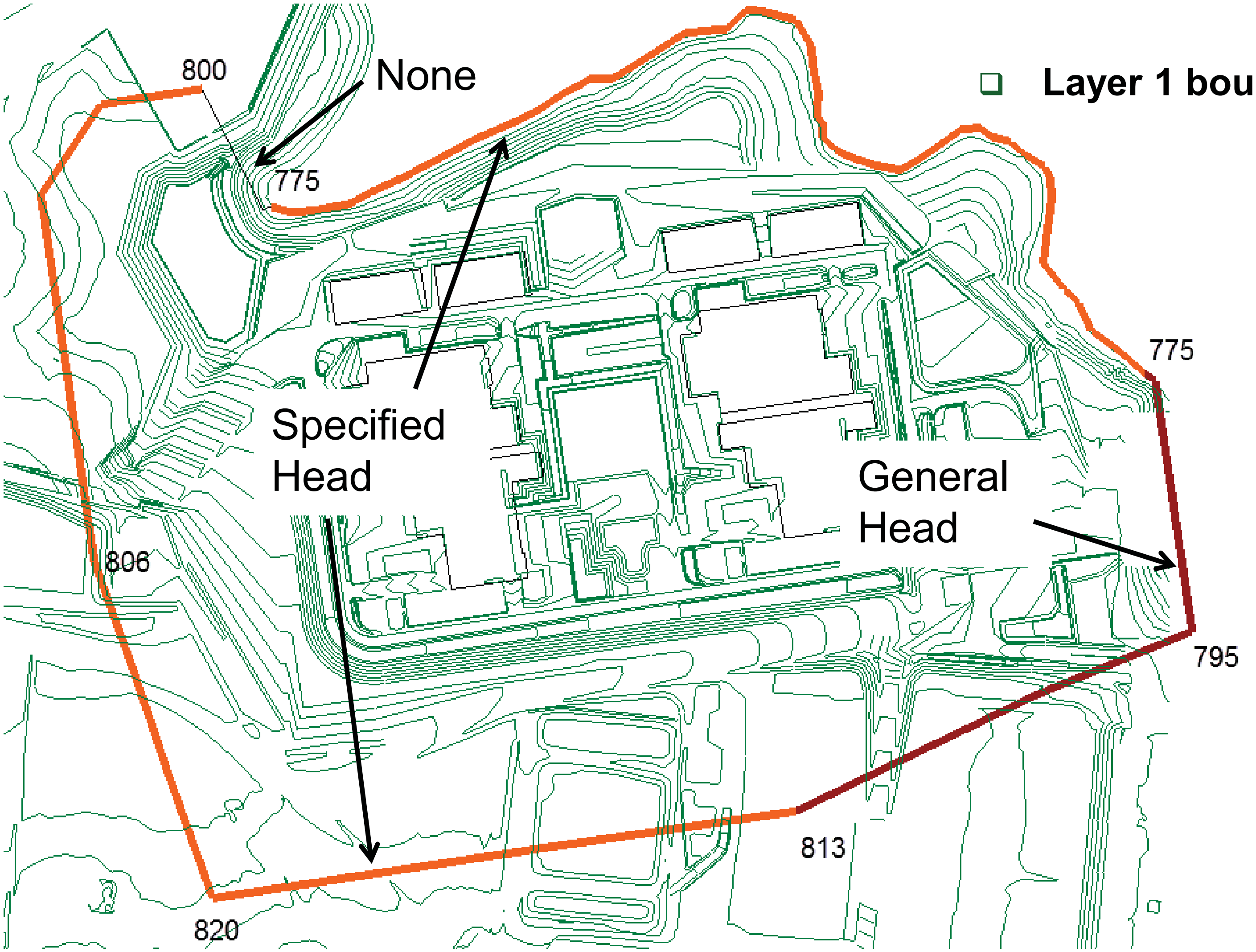
Groundwater Flow Model



- Layer 1 boundaries

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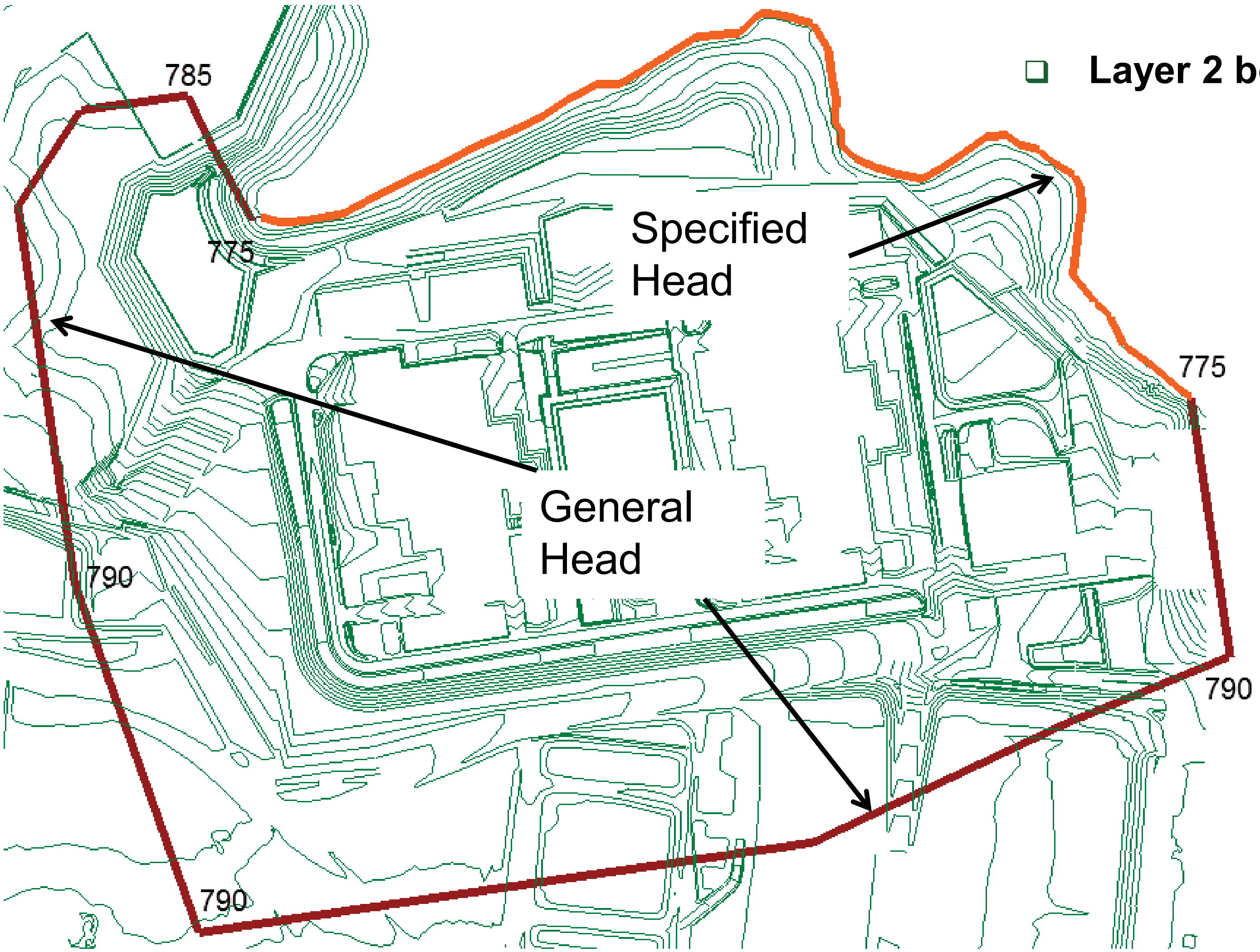
Groundwater Flow Model



- Layer 2 boundaries

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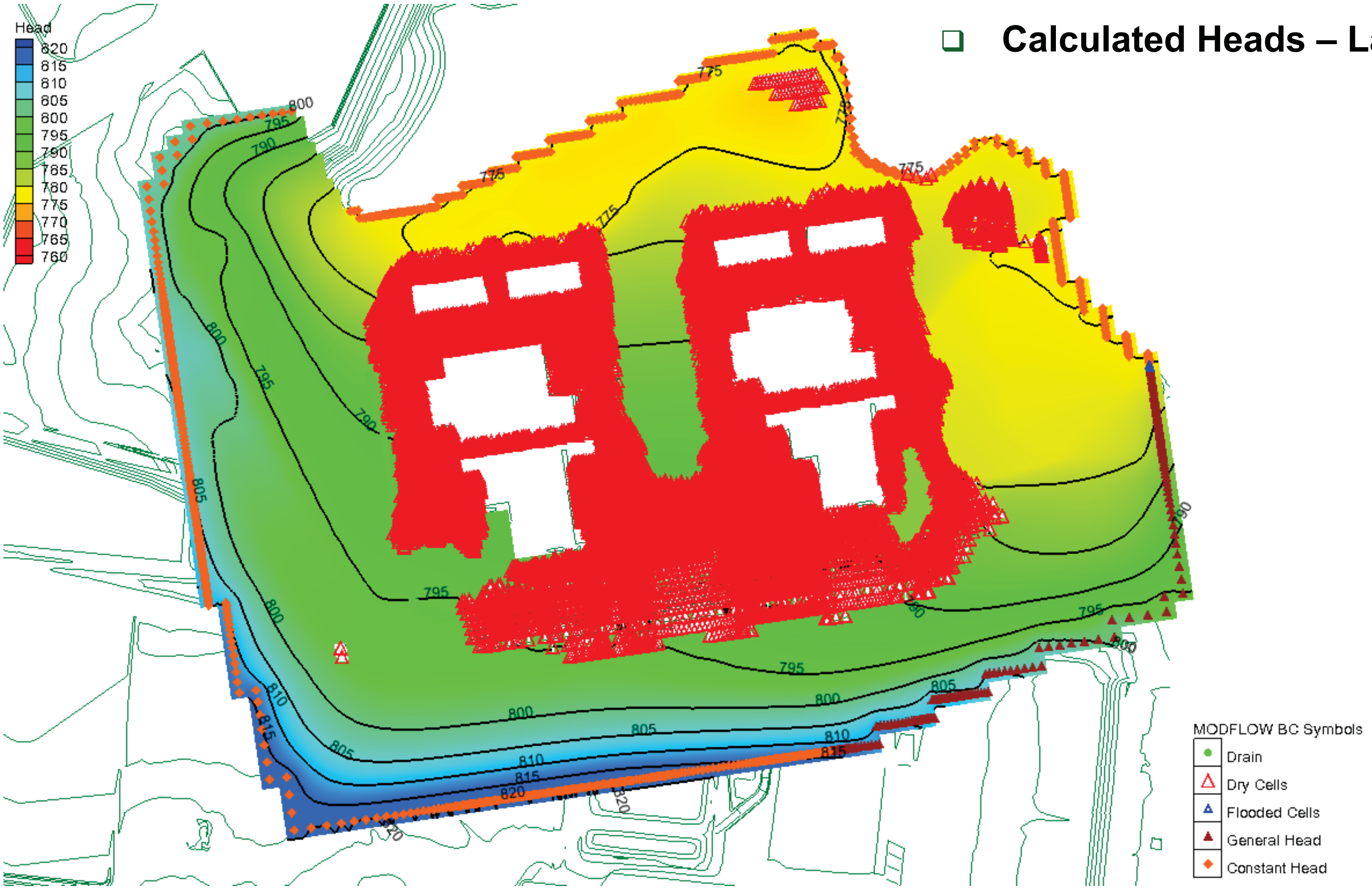
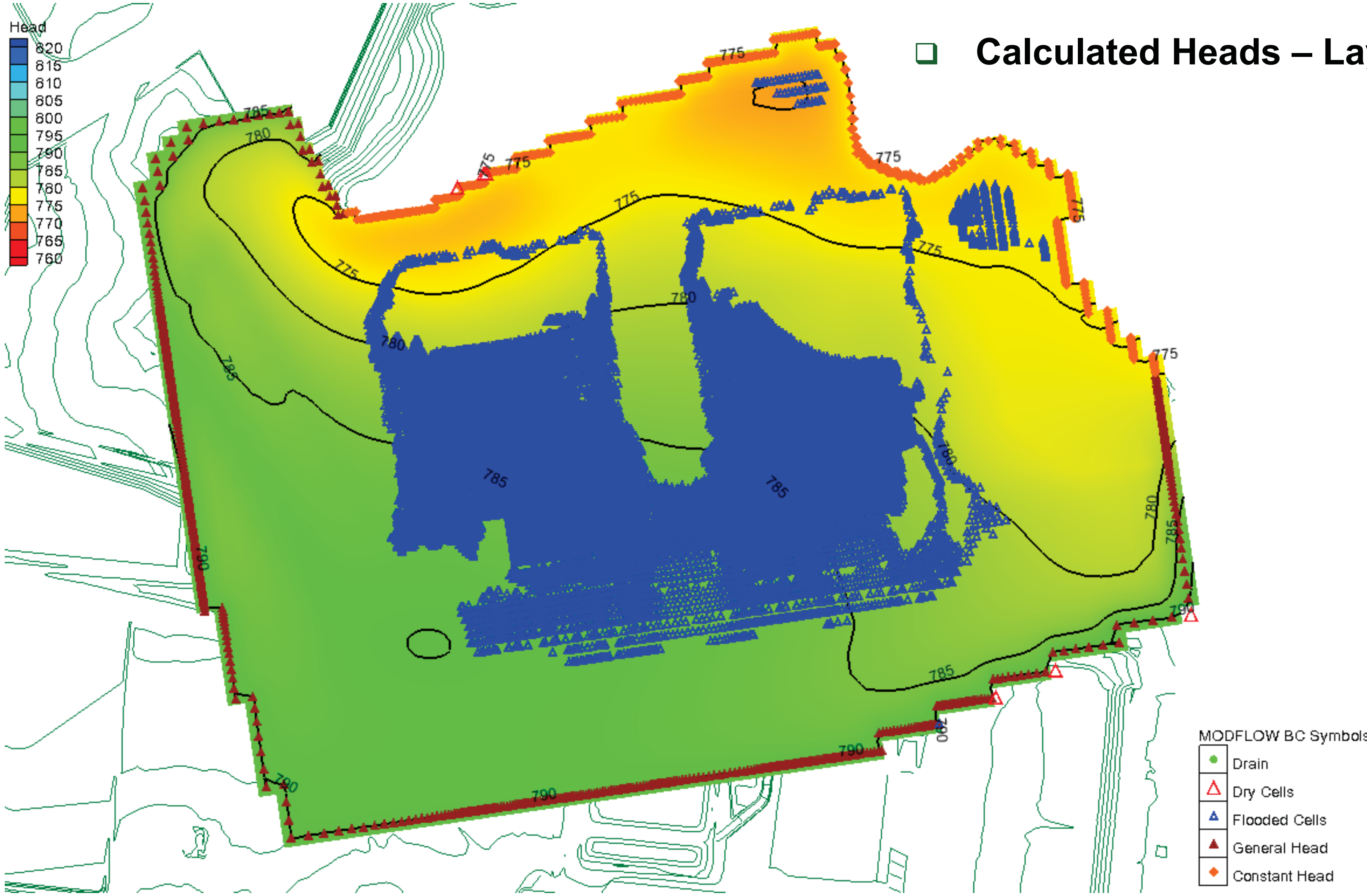
Groundwater Flow Model

- Calculated Heads – Layer 1



Groundwater Flow Model



- Calculated Heads – Layer 2

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Groundwater Flow Model

❑ Sensitivity Analyses

MODFLOW MODEL INPUT PARAMETERS

Run #	Description	File Name	Initial Heads	Layers 1 and 2 Hydraulic Conductivity (K) in ft/d			Layers 1 and 2 Specific Yield (S_y), dimnensionless			NI and UHS	Areas of Engineered Fill	Bedrock
				Existing Fill	Engineered Fill	Bedrock	Existing Fill	Engineered Fill	Bedrock	Percent of Preciptation		
1	Steady-State (SS) Run	FinalV1_B.gpr	810 ft MSL	1	1.79	0.0178	17.0%	17.0%	11.9%	0%	8.5%	3.4%
2	Base Transient Run	Final_V1_B_TR_2.gpr	From SS Run	1	1.79	0.0178	17.0%	17.0%	11.9%	0%	8.5%	3.4%
3	Reduce K by 20%	Final_V1_B_TR_3.gpr	From SS Run	0.8	1.432	0.0142	17.0%	17.0%	11.9%	0%	8.5%	3.4%
4	Vertical anisotropy x 0.5	Final_V1_B_TR_4.gpr	From SS Run	1	1.79	0.0178	17.0%	17.0%	11.9%	0%	8.5%	3.4%
5	Base, Max Sy	Final_V1_B_TR_5.gpr	From SS Run	1	1.79	0.0178	20.0%	20.0%	11.9%	0%	8.5%	3.4%
6	Base Plus 5-ft	Final_V1_B_TR_6.gpr	SS Run +5 ft	1	1.79	0.0178	17.0%	17.0%	11.9%	0%	8.5%	3.4%
7	Increase Recharge by 10%	Final_V1_B_TR_7.gpr	From SS Run	1	1.79	0.0178	17.0%	17.0%	11.9%	0%	9.4%	3.7%

NOTES

Sy Specific Yield, the drainable portion of the water table aquifer

Initial head in SS run started at 810; heads from each run were assigned to subsequent runs to reach convergence

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Conclusions/Summary

- Configuration of excavations and fill areas significant to potential subsurface flow
- Low K materials present in subsurface; Engineered fill emplaced in excavations into this material creates numerical difficulty for modeling
- Pathway analysis being developed using MODPATH
- Additional actions