Headquarters U.S. Air Force

Integrity - Service - Excellence

FORMER WILLIAMS AFB
ST012 SITE
STEAM ENHANCED EXTRACTION

BCT UPDATE

26 FEBRUARY 2015

ED_005025_00002189-00001

Headquarters U.S. Air Force

Integrity - Service - Excellence

SITE ST012,

FORMER LIQUID FUELS STORAGE AREA

REMEDIAL ACTION

SEE System Updates

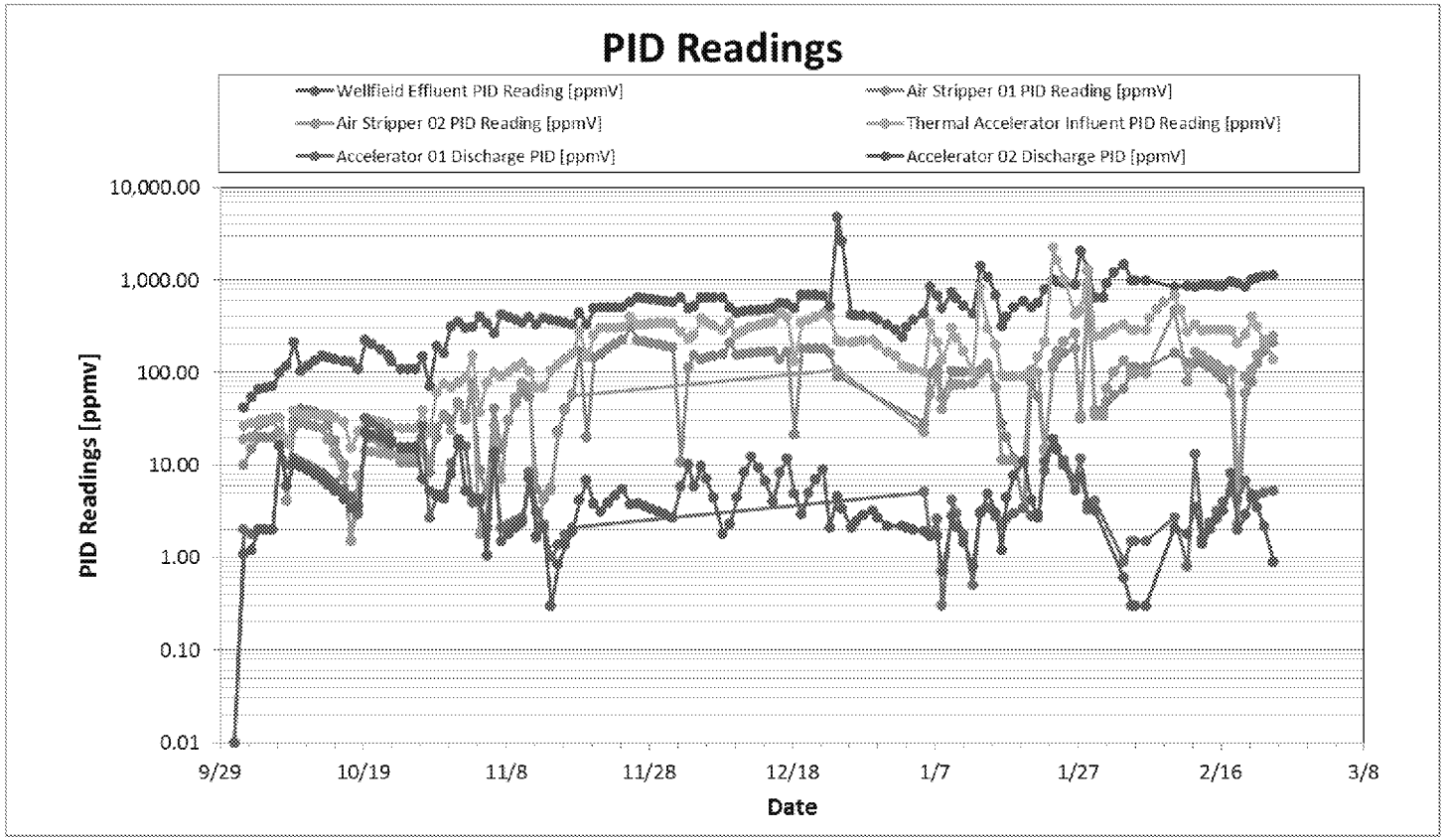
ED_005025_00002189-00003

ST012 SEE SYSTEM STATUS - SUMMARY

Summary

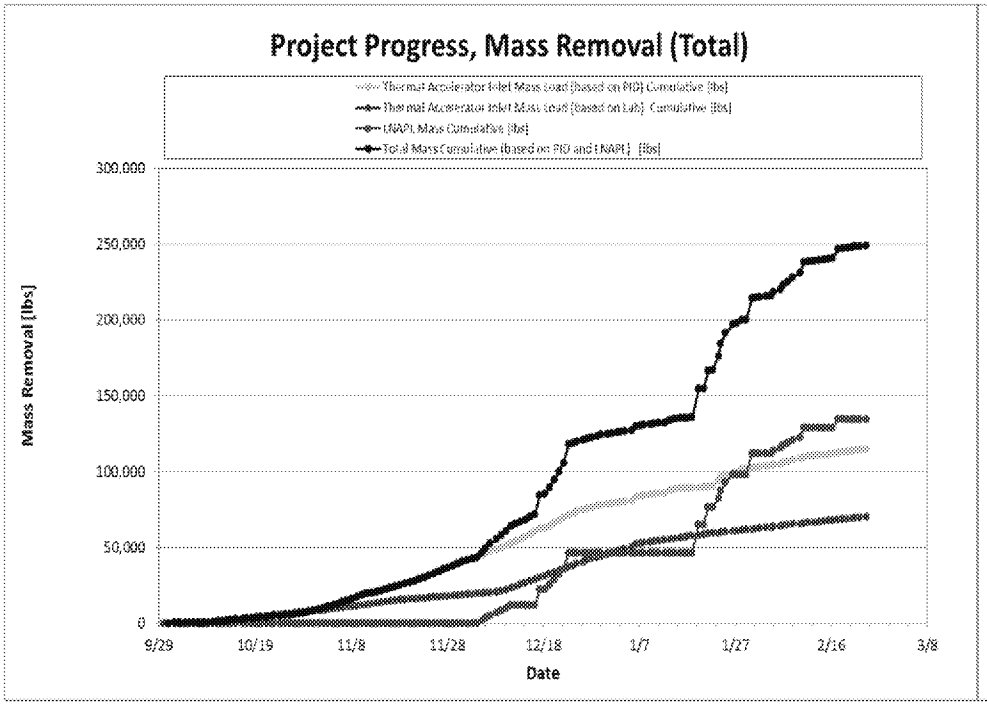
	Value	Unit
Target Treatment Zone (TTZ) Soil Volume	410,000	cubic yards (cy)
Area	199,000	square feet (ft^2)
Upper Depth of Treatment	145	feet (ft) below ground surface (bgs)
Lower Depth of Treatment	245	ft bgs
Vapor Liquid Treatment Started	09/29/14	
Thermal Operations Started	09/29/14	
Last Process Data Update	02/23/15	
Last Temperature Data Update	02/23/15	
Estimated Total Days of Operation	422	days
Days of Operation	147	days
Days of Operation vs. Estimate	35	percent (%)
Estimated Total Energy Usage	11,343,000	kilowatt hours (kWh)
Total Energy Used	1,188,443	kWh
Used Electrical Energy vs. Estimate	10	%
Total Steam Injected	76.5	million pounds (lbs)
Projected Total Steam Injection	320	million lbs
Steam Injected Vs Projected	24	%
Mass Removed in Vapor Based on Photoionization Detector (PID) Readings	114,575	lbs
Mass Removed as NAPL	134,328	lbs
Total Vapor and Liquid Mass Removal (based on PID readings)	248,903	lbs
Average Power Usage Rate Last Week	341	kilowatts (kW)
Average Wellfield Vapor Extraction Rate Last Week	1,245	standard cubic feet per minute (scfm)
Average Condensate Production Rate Last Week	5.3	gallons per minute (gpm)
Average Water Extraction Rate Last Week	104	gpm
Total Water Extracted	20,229,287	gallons
Recovered Light Non-Aqueous Phase Liquid (LNAPL)	24,573	gallons
Average Water Discharge Rate Last Week	152	gpm
Total Treated Water Discharge	24,774,000	gallons

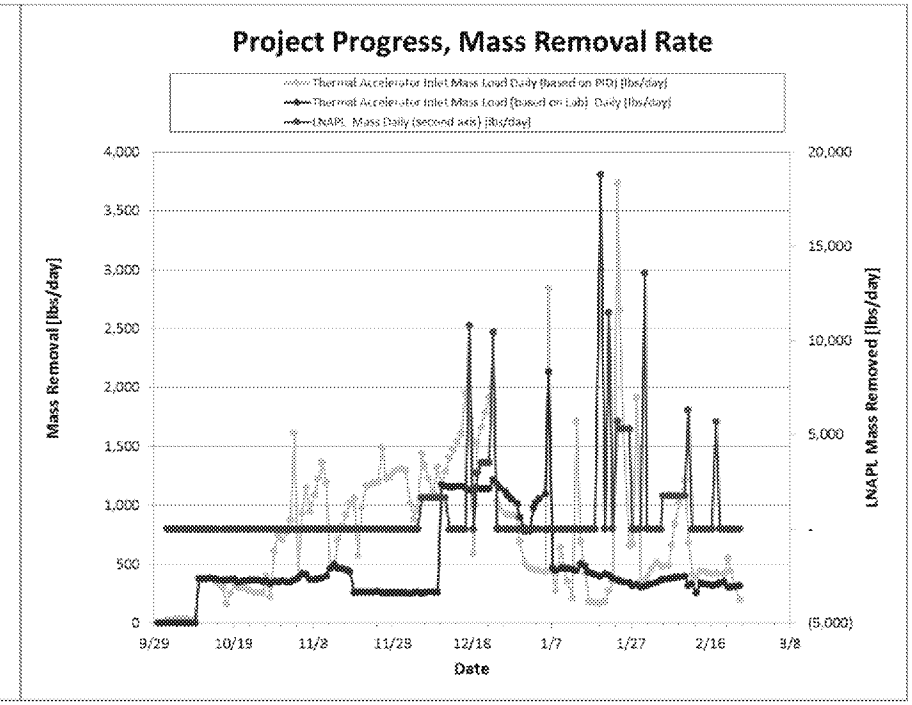
ST012 SEE SYSTEM PID READINGS



- Vapors continue to be rich in organics
- FID readings discontinued February 10, 2015 due to continued instrument(s) issues

ST012 SEE SYSTEM MASS REMOVAL





- NAPL recovery continues

ST012 Steam Injection Status

ED_005025_00002189-00007

ST012 SEE OPERATIONAL PROGRESS

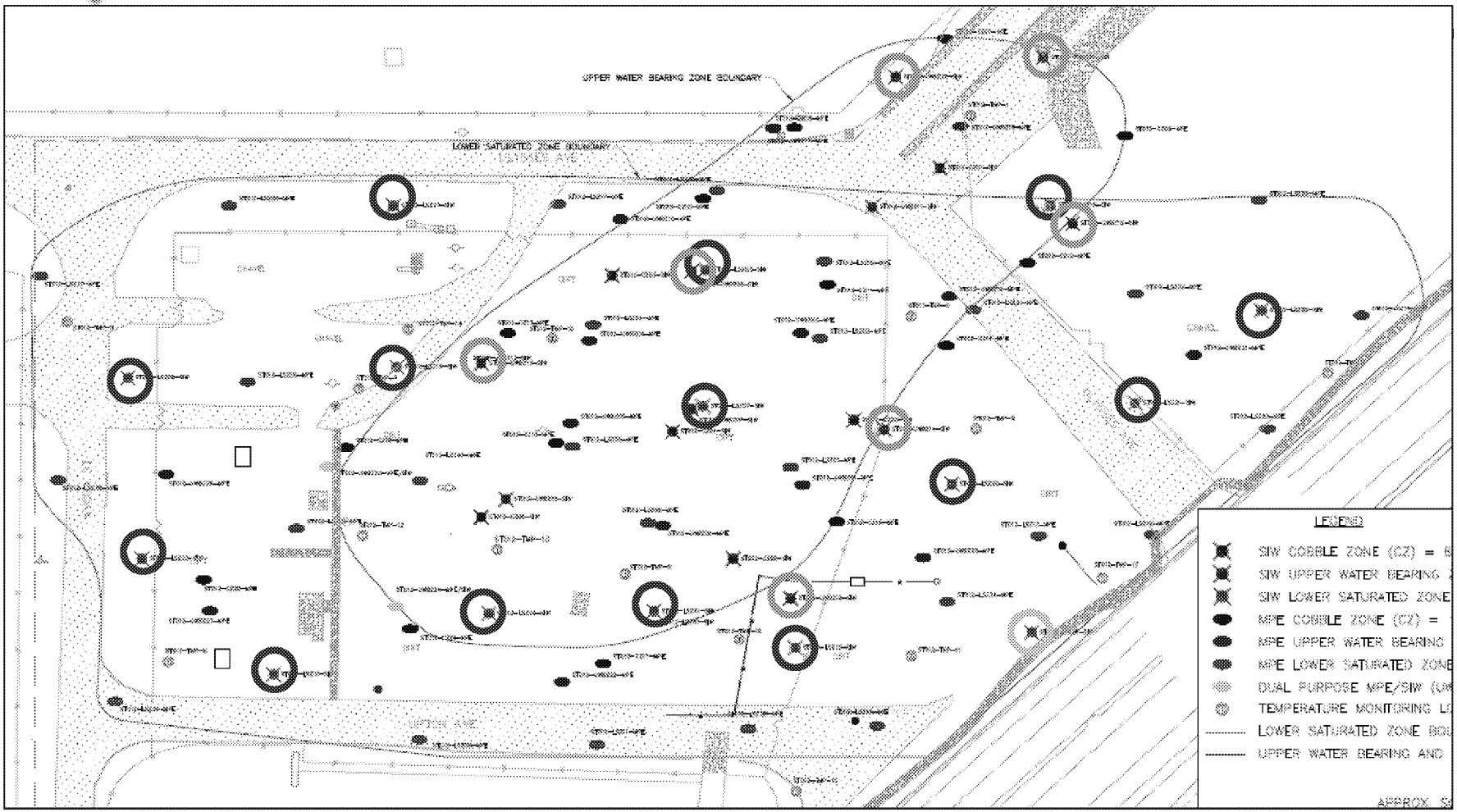
- SEE Startup — 29 Sep
- Extraction Only Phase — 29 Sep – 15 Oct
  - All CZ, UWBZ, and LSZ MPE wells turned on
  - Extraction System Optimization/Troubleshooting
  - Perimeter Monitoring to Demonstrate Hydraulic Control
- Steam Injection Step 1 — 16 Oct – 3 Nov
  - 9 Exterior LSZ wells
  - Perimeter and Temperature Monitoring for Effects
- Steam Injection Step 2 — 3 Nov – 4 Dec
  - Same 9 Exterior LSZ wells from Step 1
  - Add 6 Interior LSZ wells
  - Perimeter and Temperature Monitoring for Effects
- Steam Injection Step 3 – revised — 4 Dec – 22 Dec
  - Same 15 LSZ wells from Step 2
  - Add 7 Exterior UWBZ wells
  - Perimeter and Temperature Monitoring for Effects

ST012 SEE OPERATIONAL PROGRESS - CONTINUED

- **Liquid Treatment System Cleanouts/ Changeouts** — **23 Dec – 5 Jan**
  - Accumulated biomass cleaned out of process tanks
  - Liquid carbon vessel changeout

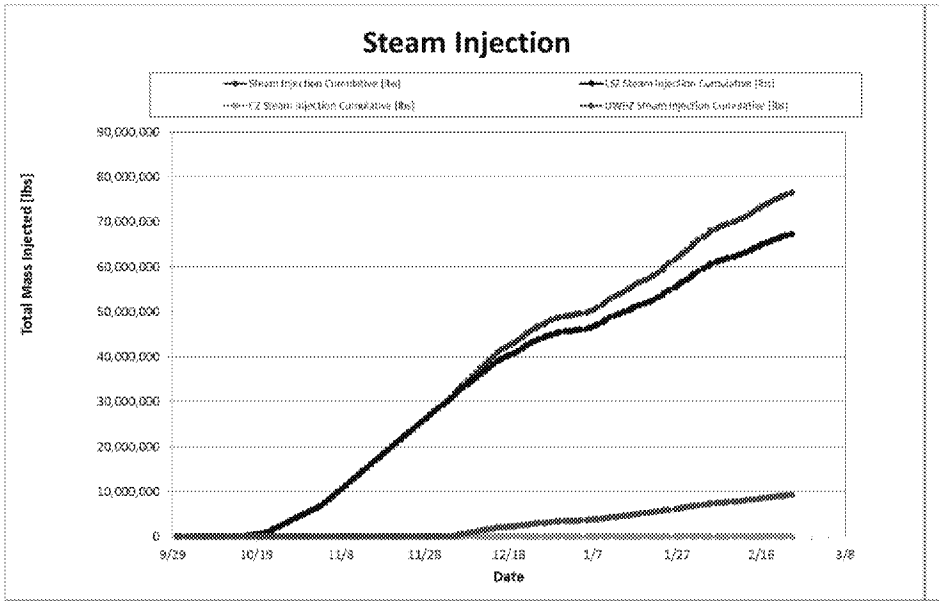
- **SEE System Operations** — **6 Jan – 23 Feb**
  - Average liquid extraction rate of 86 gpm
  - From January 6 through January 19 typically three eductor skids were online at a time
  - From January 20 to present, typically four eductor skids were online at a time – beginning February 18, eductor skid 6 (primarily servicing the down gradient edge of the treatment zone) has been operated continuously
  - Average steam injection rates of 18,700 lbs per hour in the LSZ and 4,900 lbs per hour in the UWBZ
  - Twenty-one steam wells are currently online (see next slide) – injection rates at wells have varied due to boiler issues and in preparation for MPE transition piece preventative replacement
  - On February 16 Injection well SIW 26 was shut down in preparation for the MPE transition piece preventative replacement

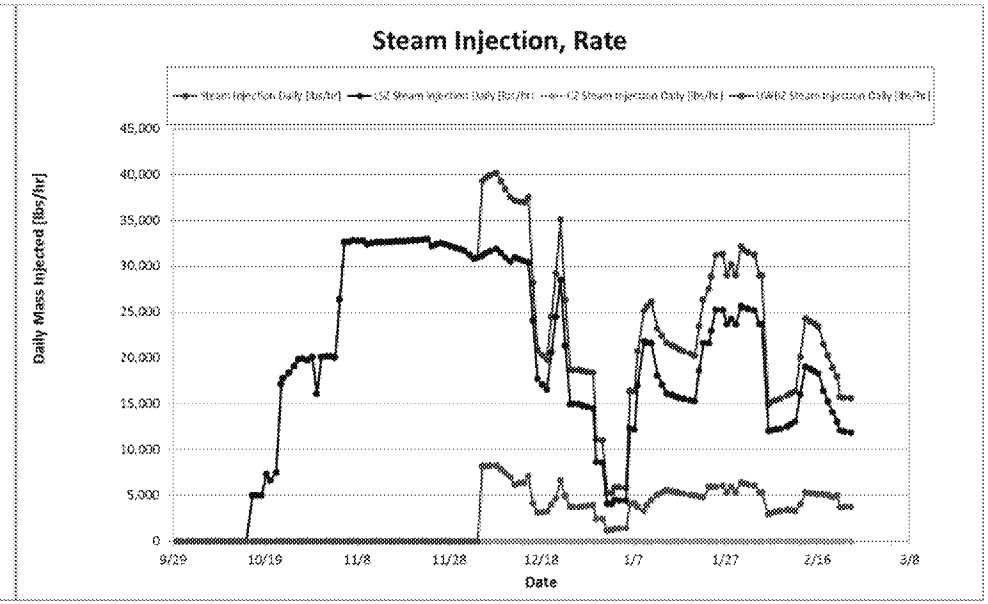
ST012 STEAM INJECTION – MODIFIED STEP 3 PERIMETER UWBZ



- LSZ wells online (14)
- UWBZ wells online (7)
- LSZ well currently offline (1)

ST012 SEE STEAM INJECTION





- **Average steam injection:**
  UWBZ 4,900 lbs/hr ~ 10 gpm as water,
  LSZ 18,700 lbs/hr ~ 37 gpm as water total

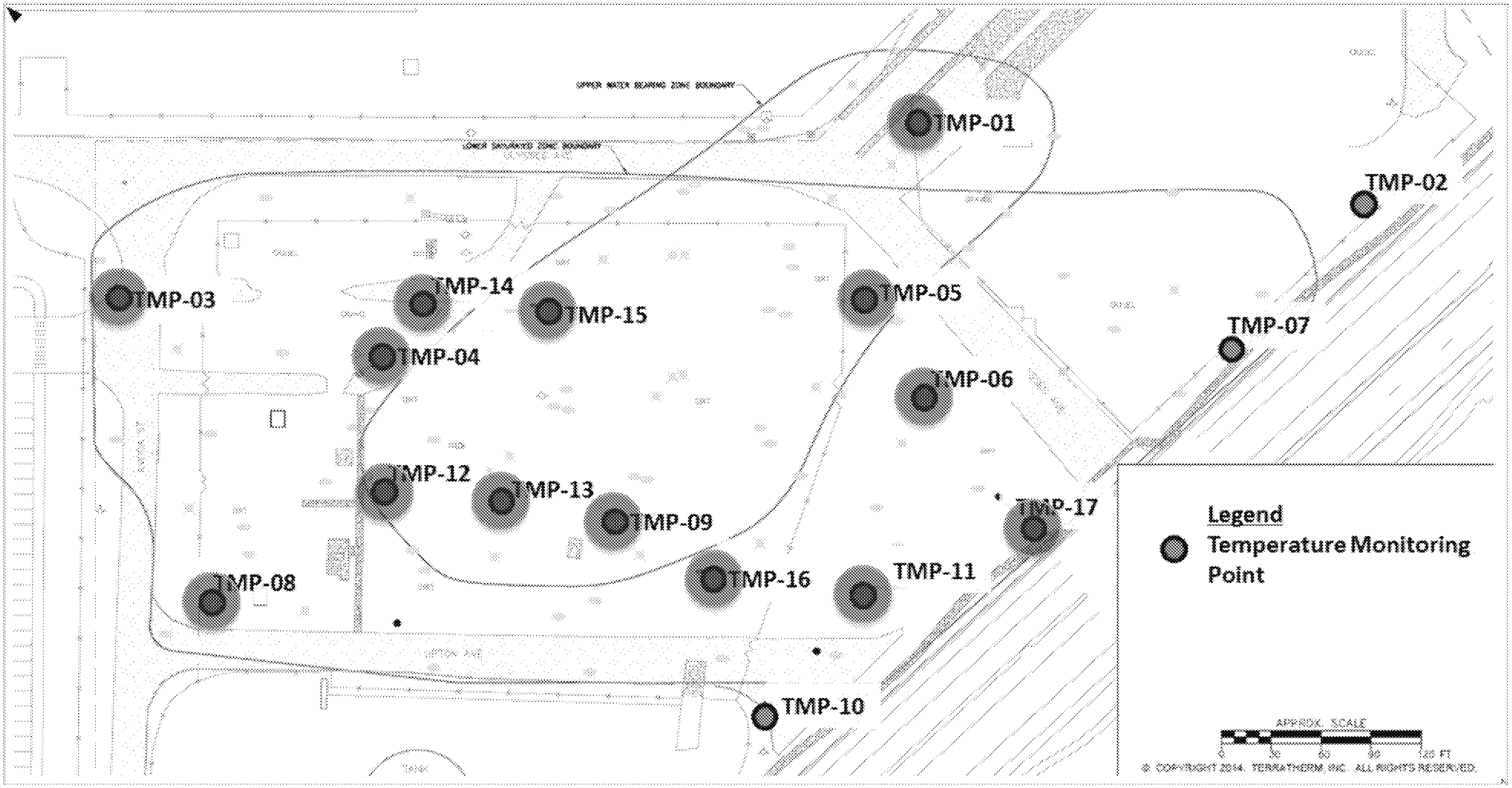
- **Total steam injection rate equivalent to 47 gpm of water**

ST012 SEE DISCHARGE COMPLIANCE

- A Written Report on Non-Compliance documenting the nature of this discharge was submitted to the City of Mesa on 22 January 2015
- Based on the January 2015 Monthly Process Water Sampling results, the treatment system achieved effluent limitations of the Permit.
- Automatic resampling per permit requirements was conducted over a four-day period from 2 February 2015 through 5 February 2015. No permit exceedances were noted. These results were submitted to the City of Mesa on 23 February 2015.
- We continue to collect weekly samples of carbon influent, midfluent, and effluent to monitor for breakthrough. In addition, midfluent is sampled twice per week for pesticides.
- Coordination has continued with the City of Mesa throughout January and February 2015 and the City has not identified any additional actions or concerns.

ST012 Steam Injection Influence at Temperature Monitoring Points

ST012 TEMPERATURE MONITORING POINTS



- Highlighted TMPs show heat up

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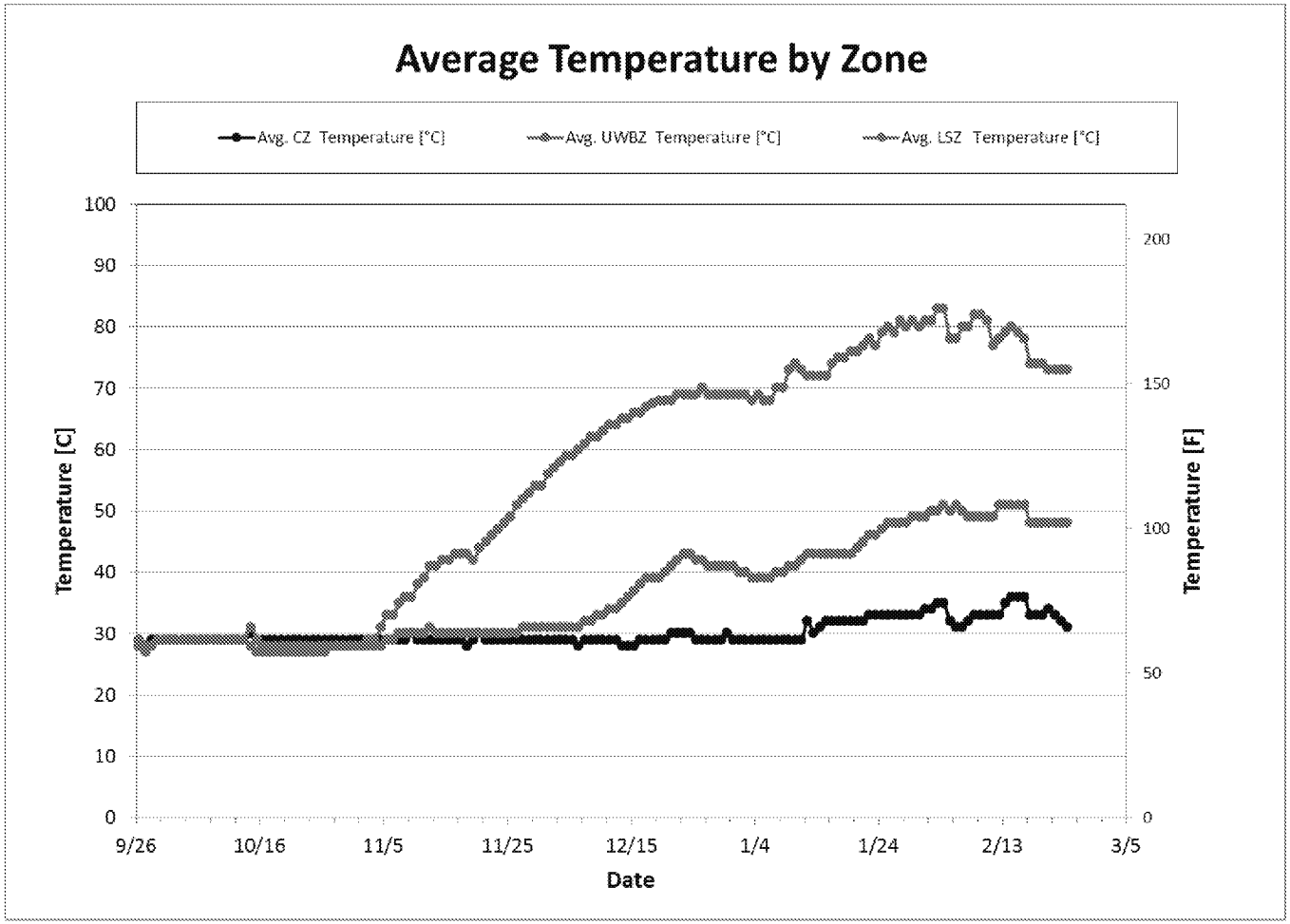
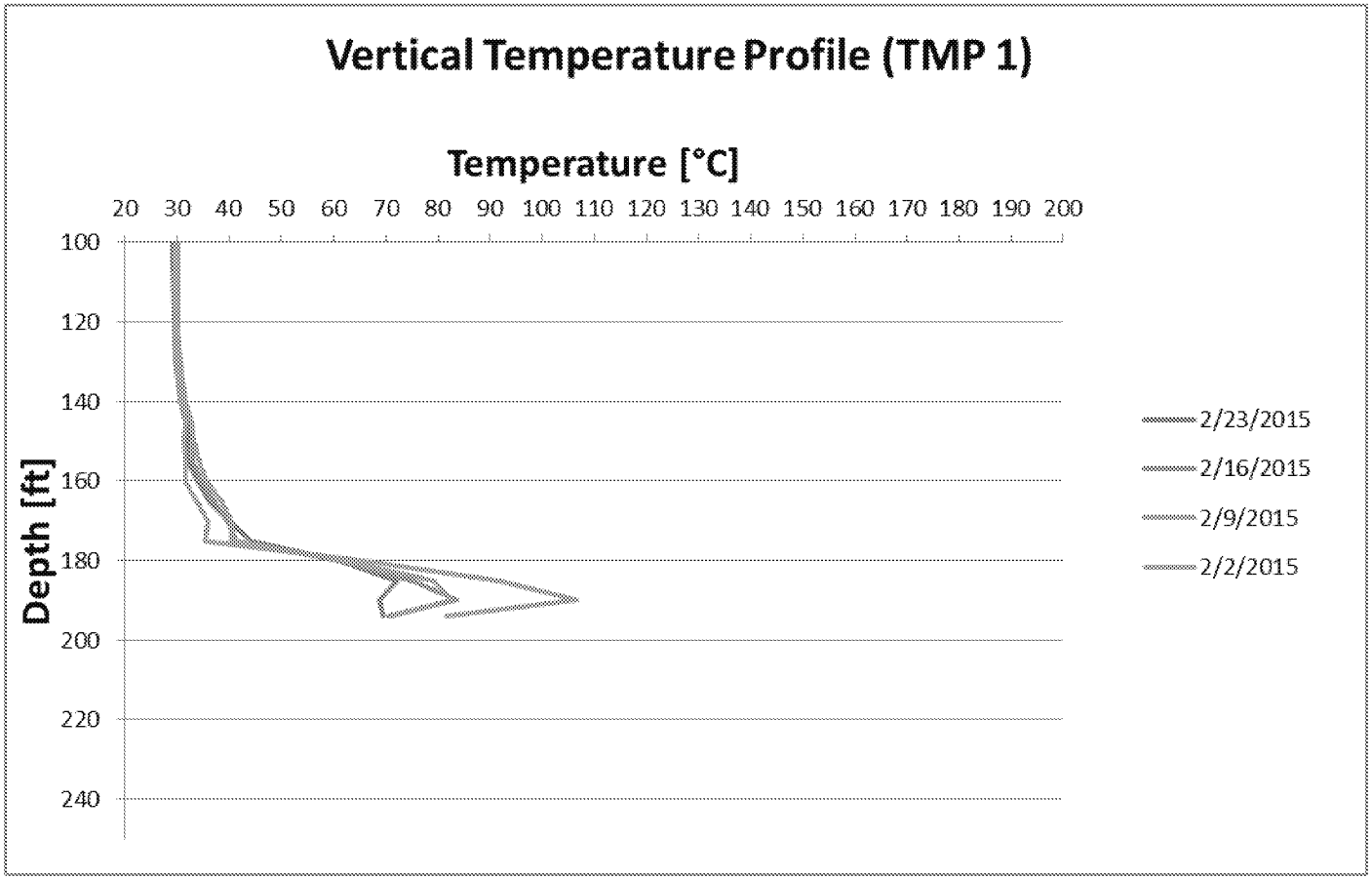
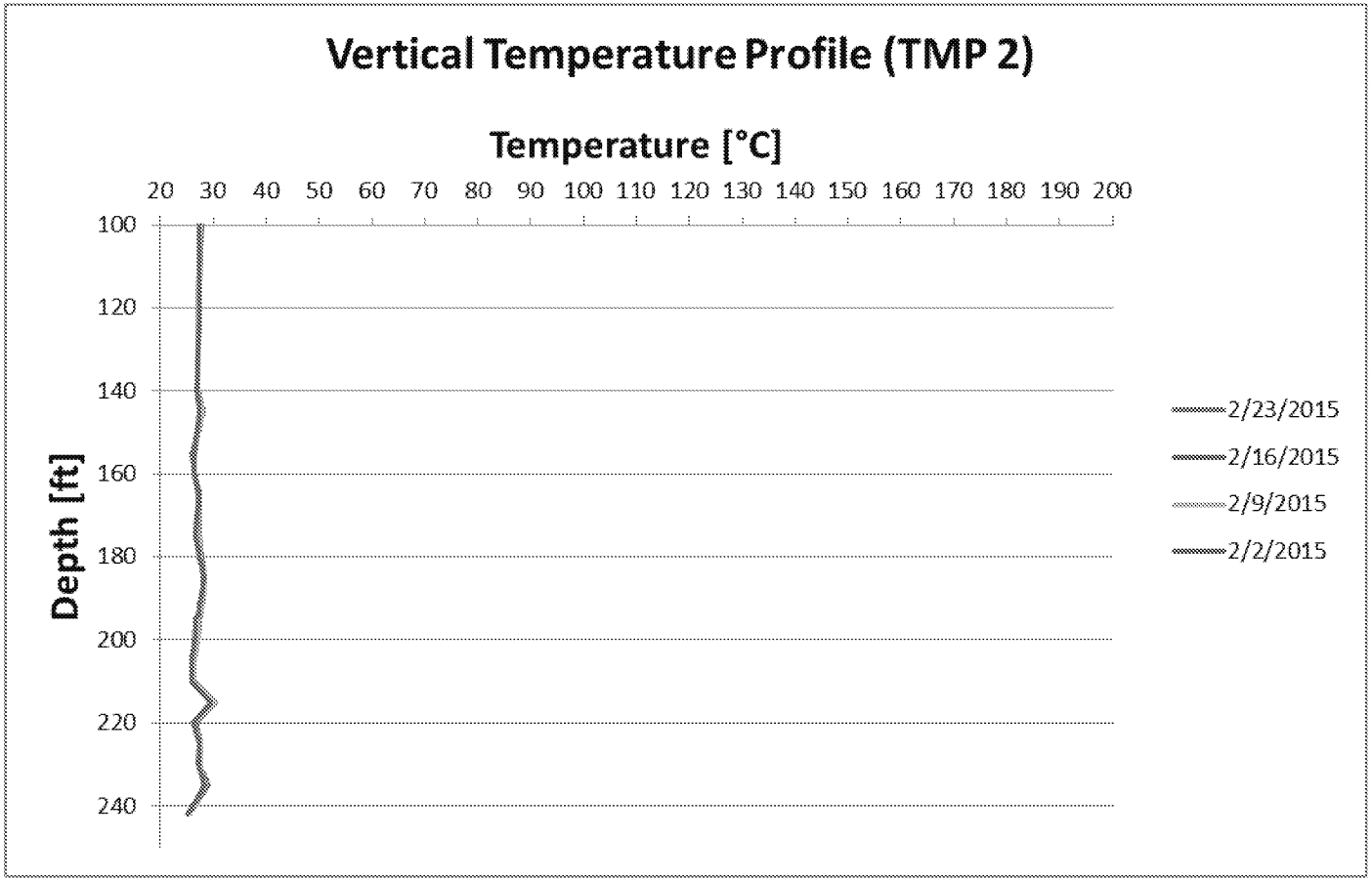
ST012 SEE CO-LOCATED TEMPERATURES AT EXTRACTION WELLS BY ZONE




Vertical Temperature Profile (TMP 1)
Temperature [°C]
20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Depth [ft]
100
120
140
160
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015


Vertical Temperature Profile (TMP 2)
Temperature [°C]
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Depth [ft]
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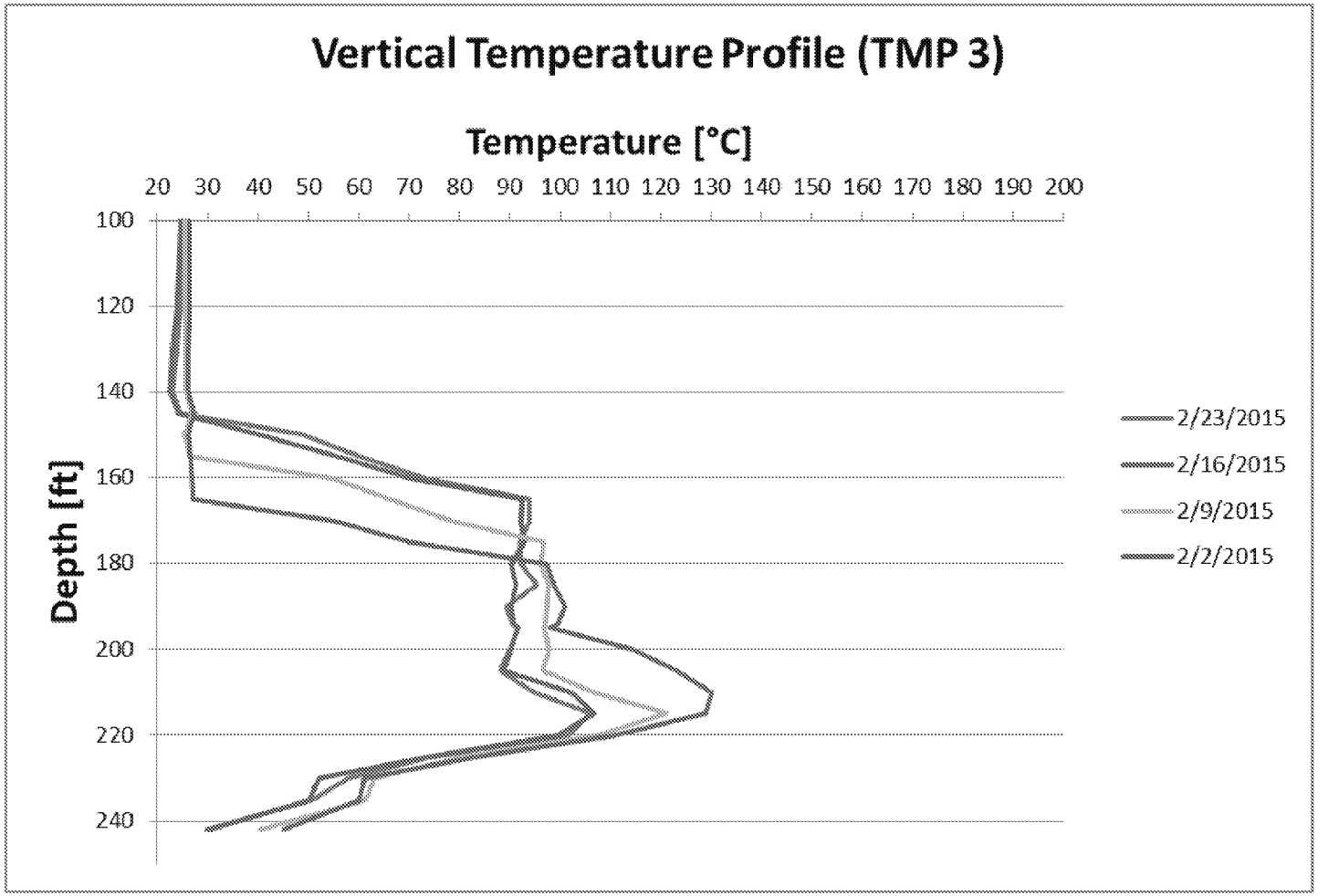
120
140
160
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015


Vertical Temperature Profile (TMP 3)
Temperature [°C]
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Depth [ft]
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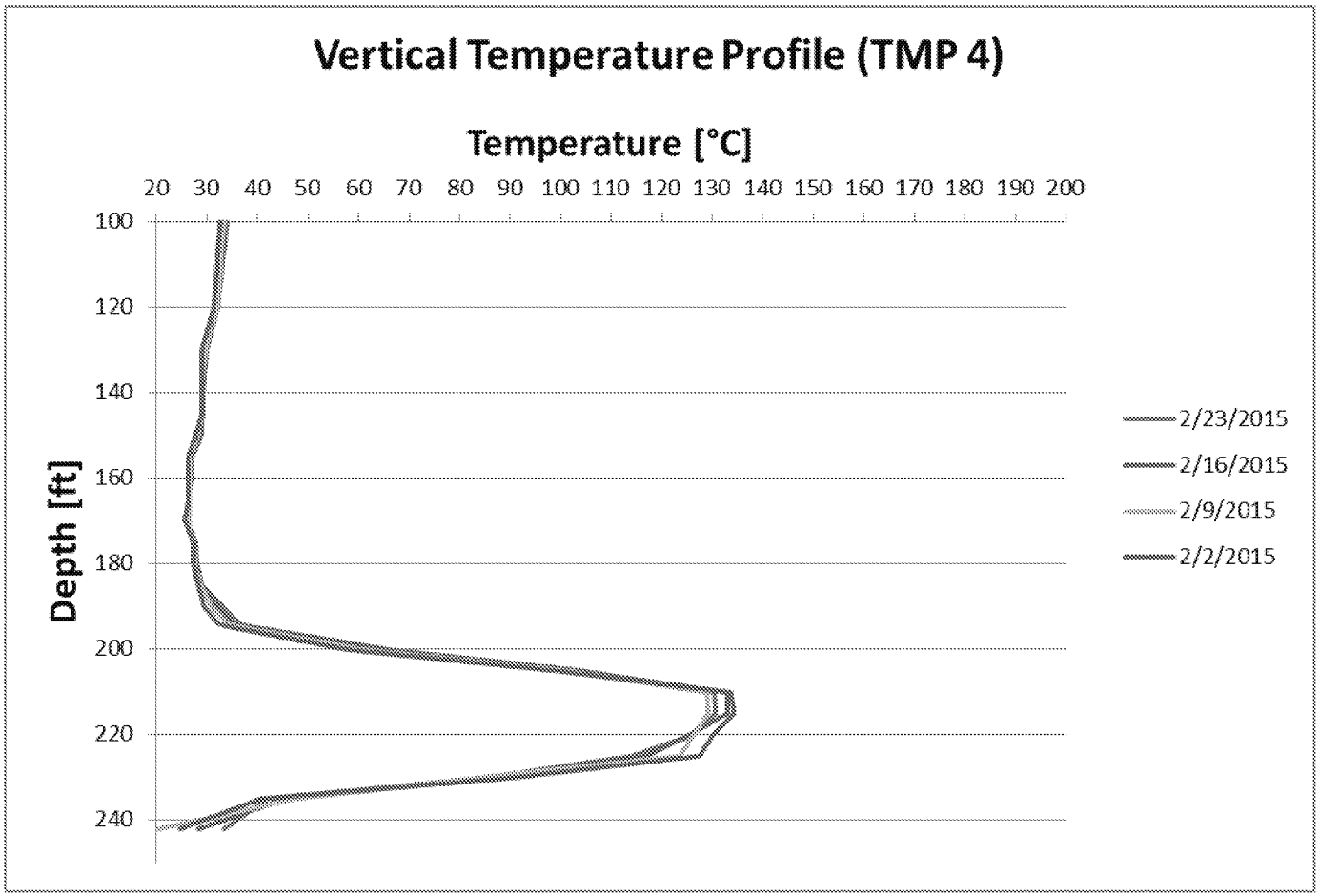
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015


Vertical Temperature Profile (TMP 4)
Temperature [°C]
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Depth [ft]
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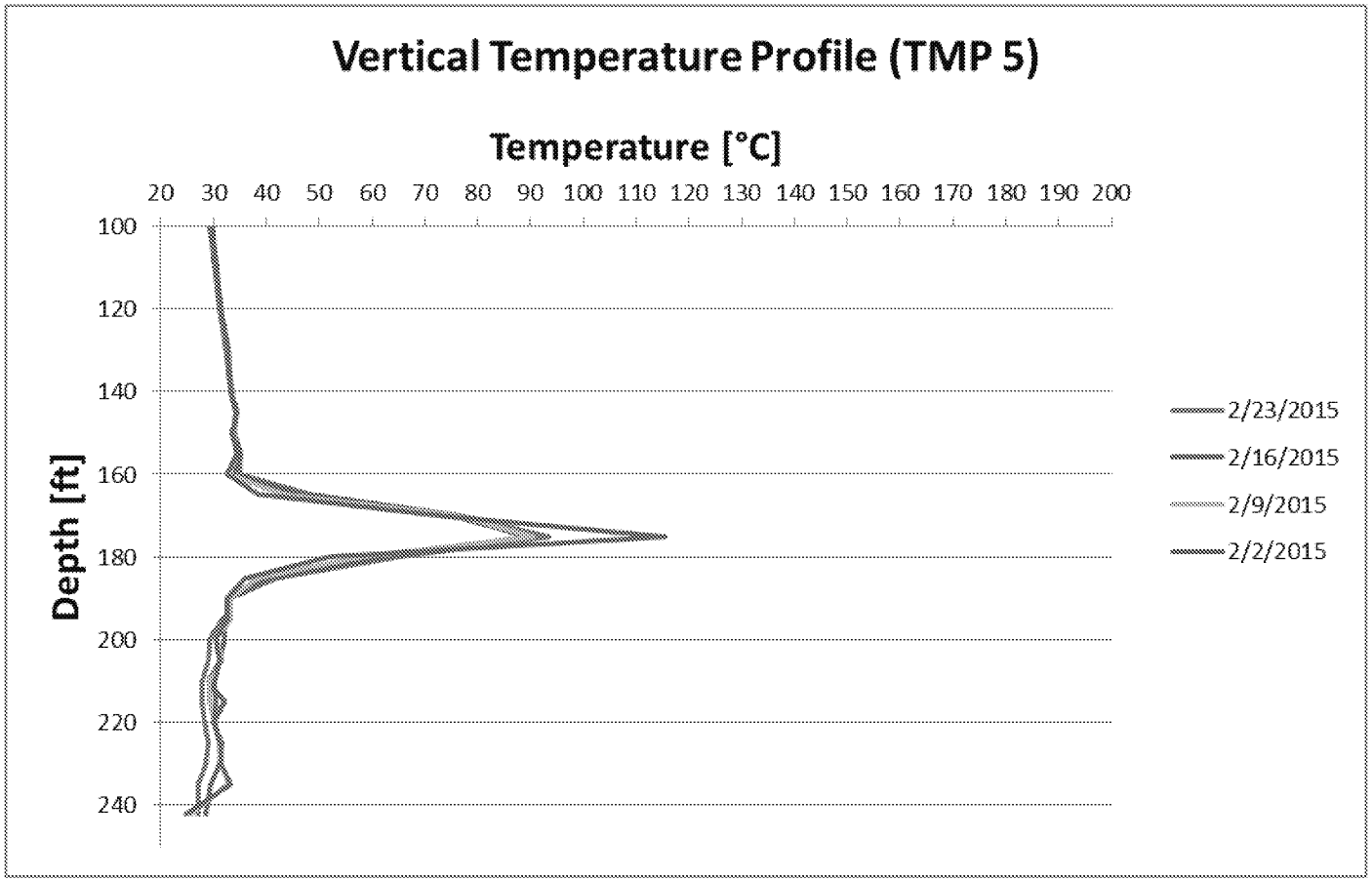
140
160
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015


Vertical Temperature Profile (TMP 5)
Temperature [°C]
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Depth [ft]
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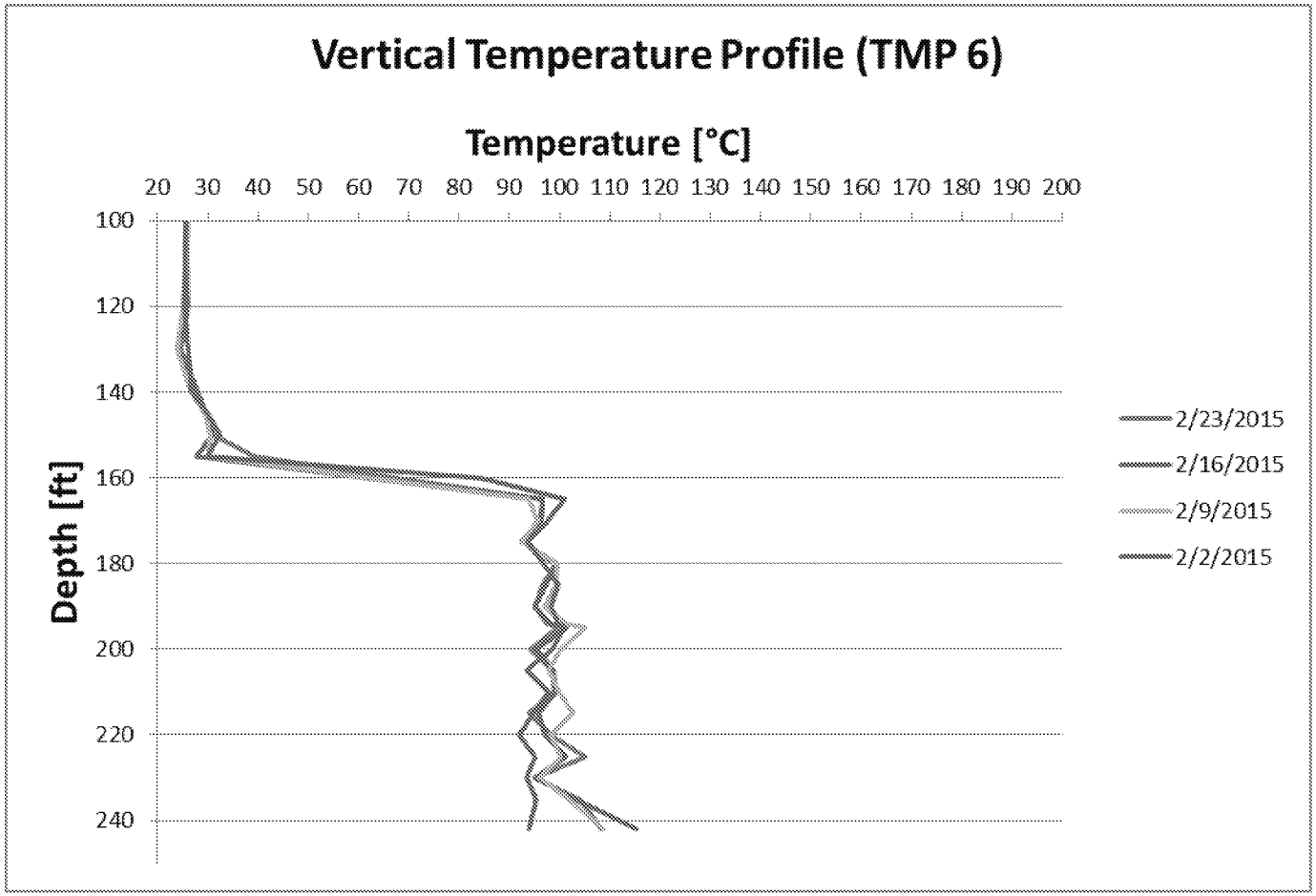
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015


Vertical Temperature Profile (TMP 6)
Temperature [°C]
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Depth [ft]
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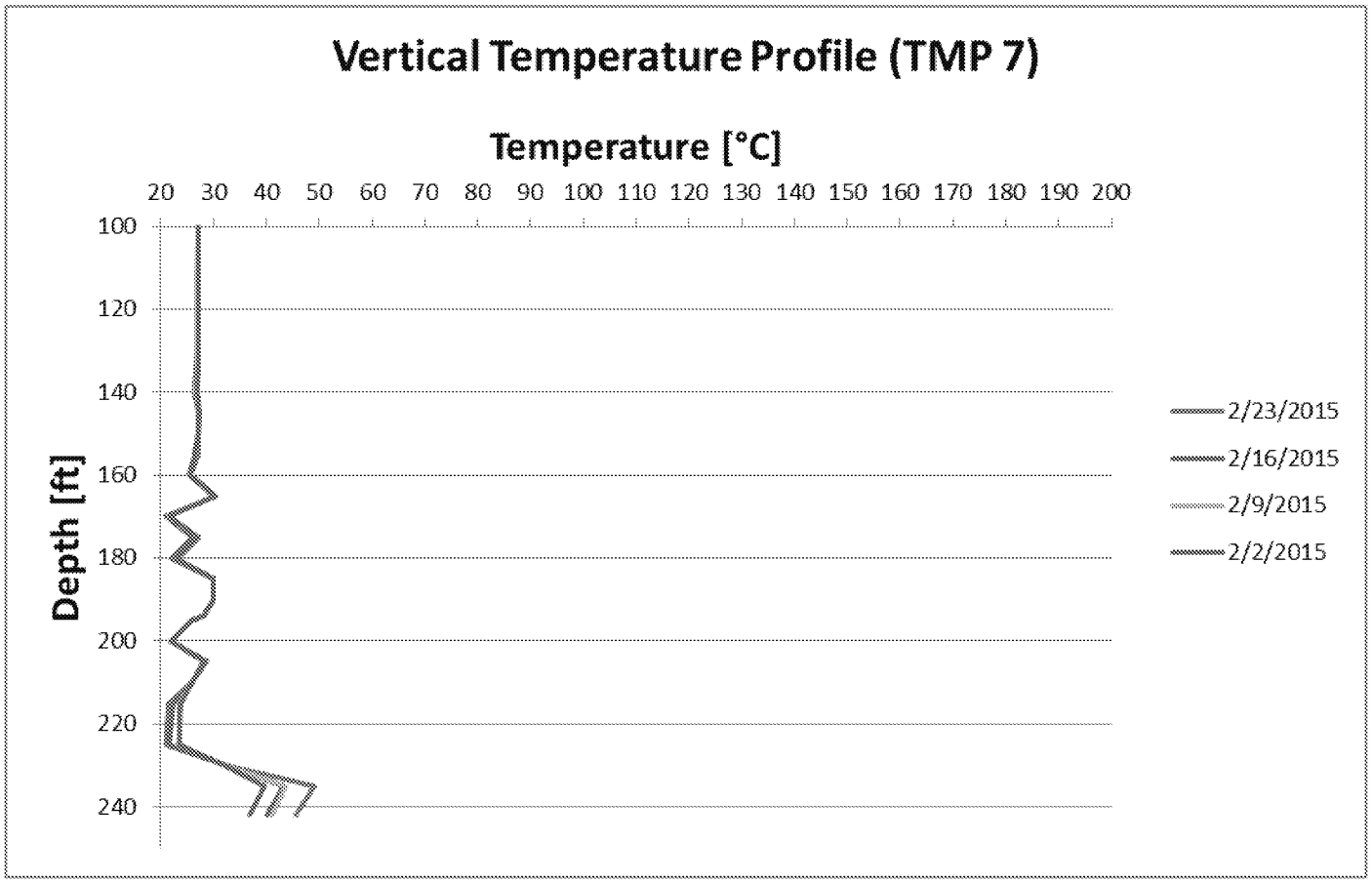
160
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015


Vertical Temperature Profile (TMP 7)
Temperature [°C]
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Depth [ft]
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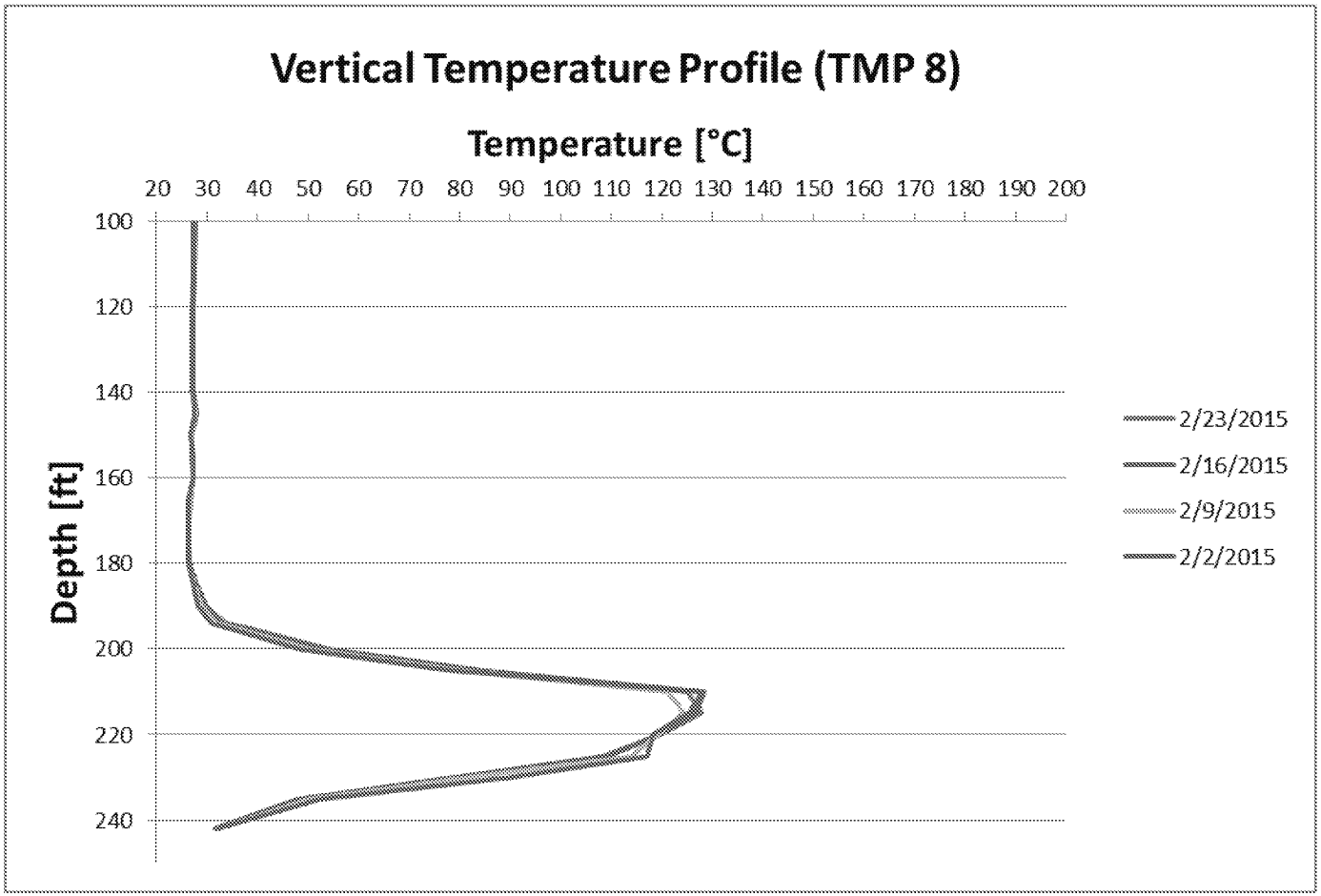
160
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015


Vertical Temperature Profile (TMP 8)
Temperature [°C]
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Depth [ft]
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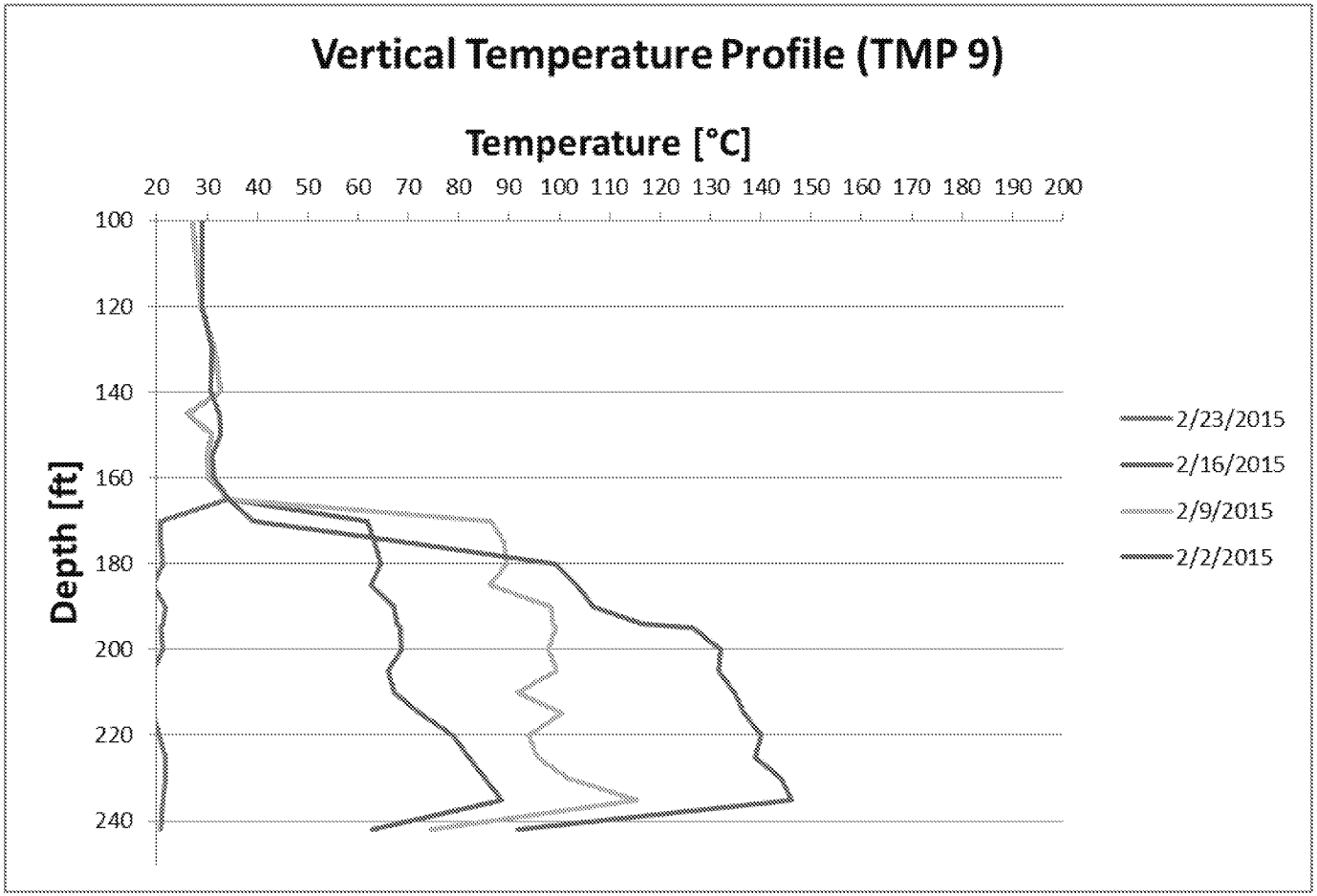
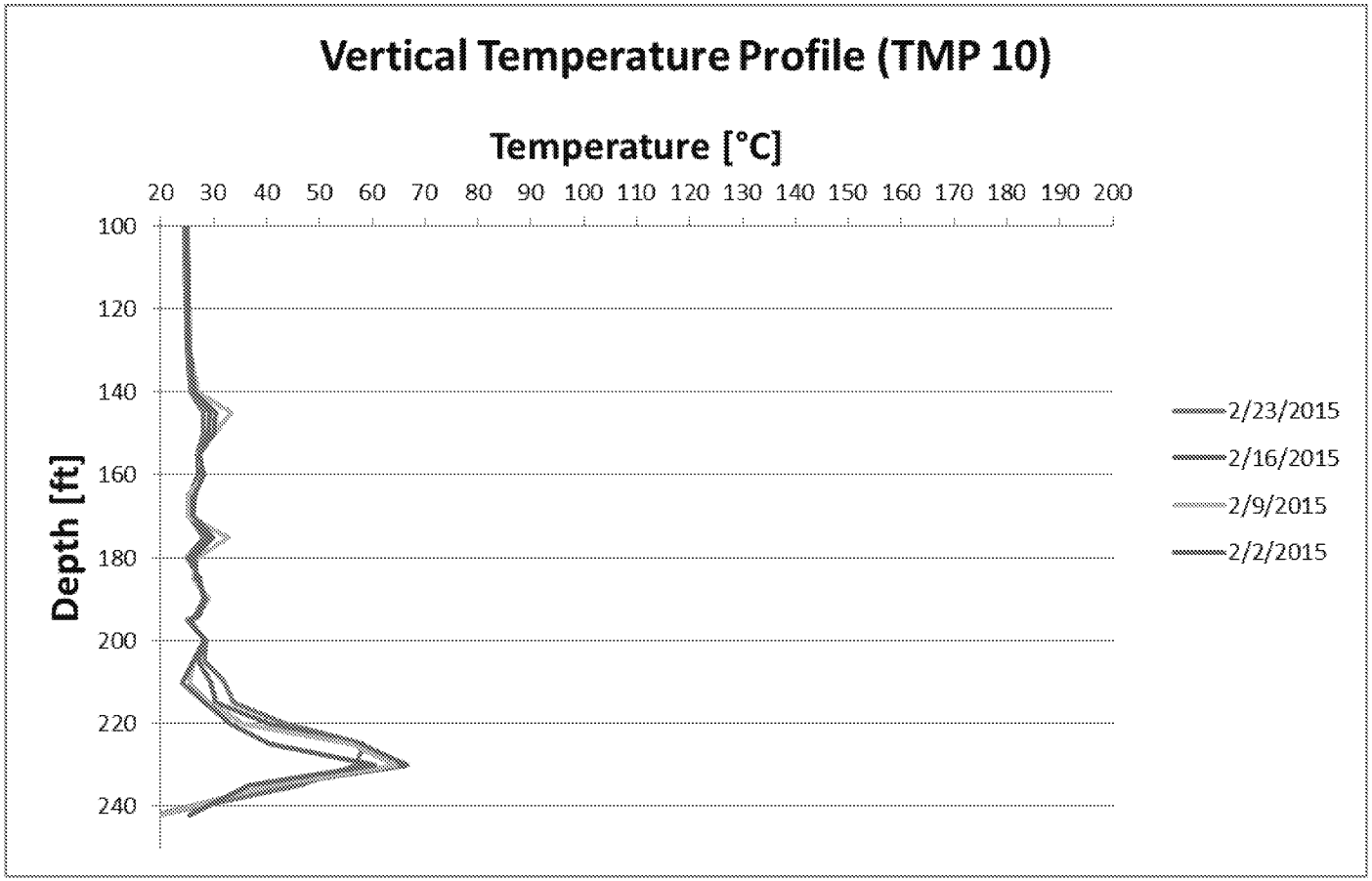
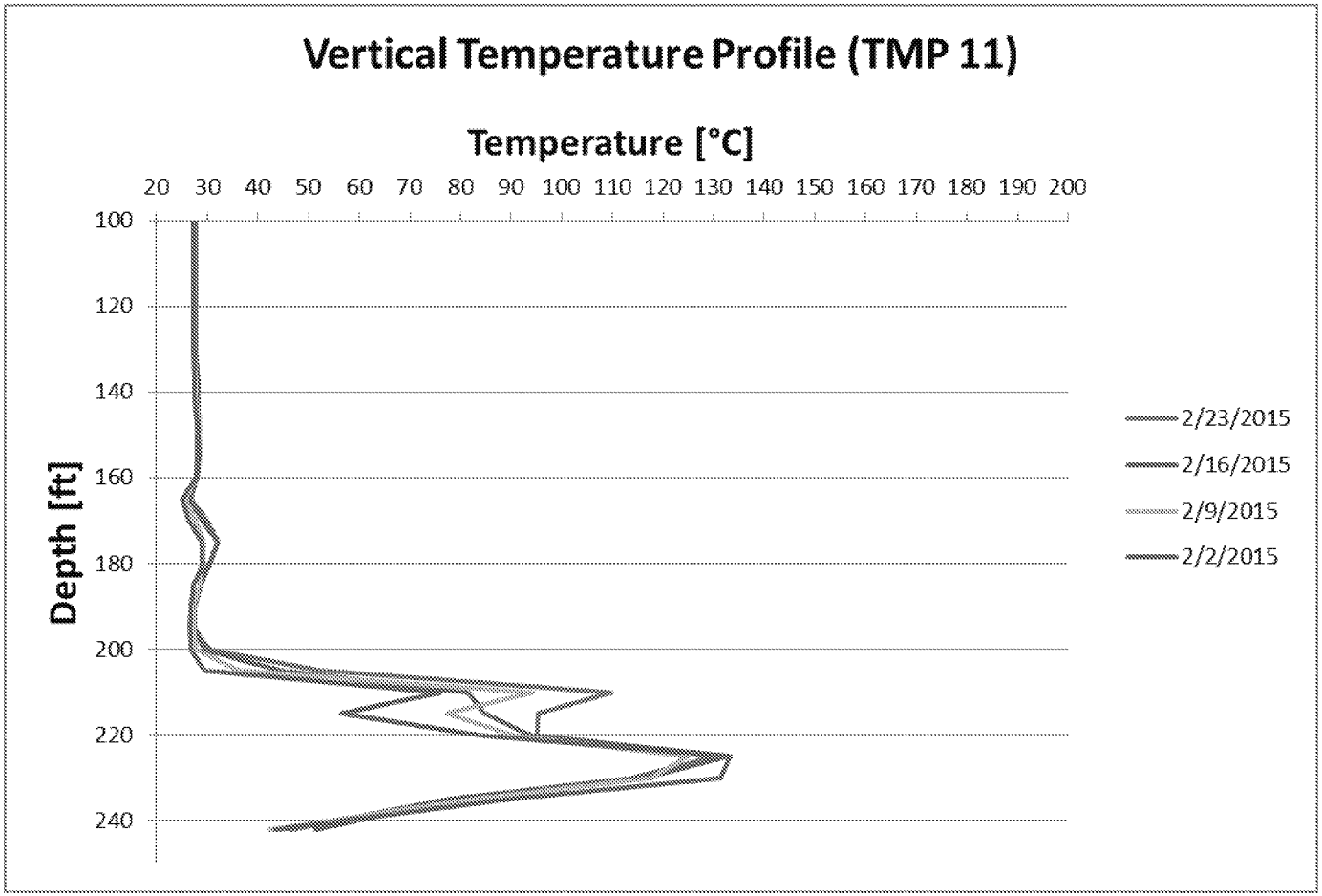
120
140
160
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015



Note: TMP is currently being troubleshot


Vertical Temperature Profile (TMP 10)
Temperature [°C]
20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Depth [ft]
100
120
140
160
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015


Vertical Temperature Profile (TMP 11)
Temperature [°C]
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Depth [ft]
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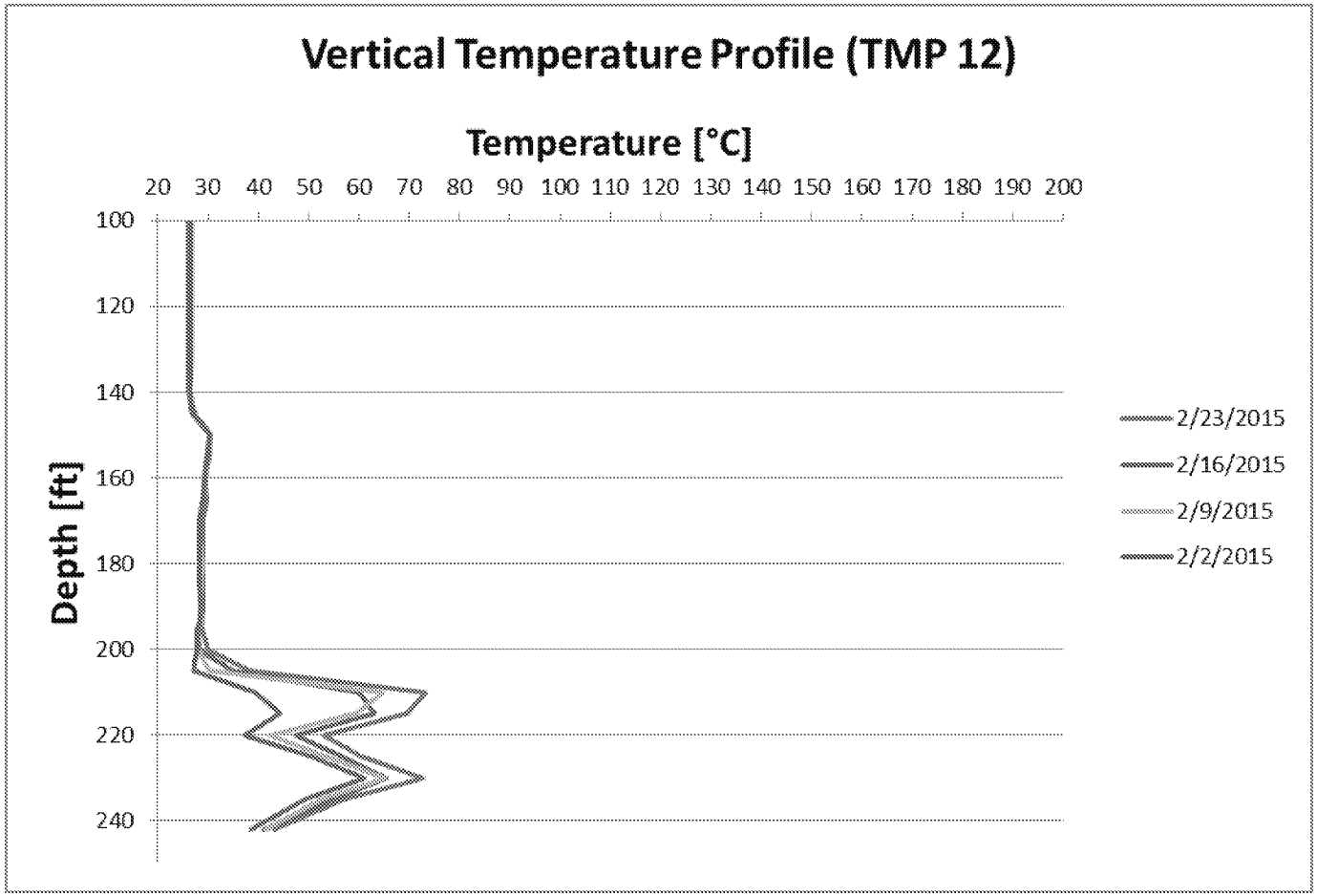
120
140
160
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015


Vertical Temperature Profile (TMP 12)
Temperature [°C]
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Depth [ft]
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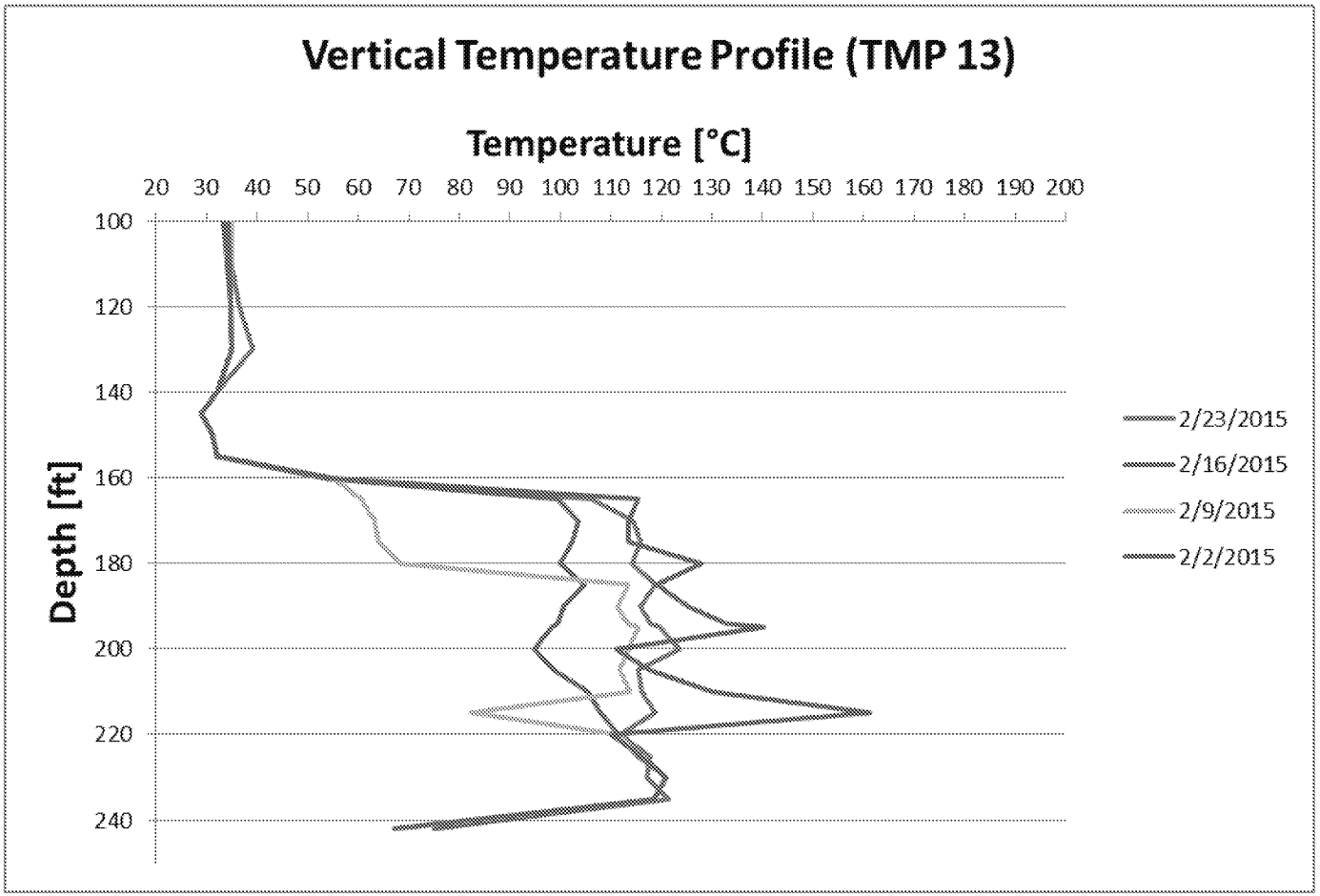
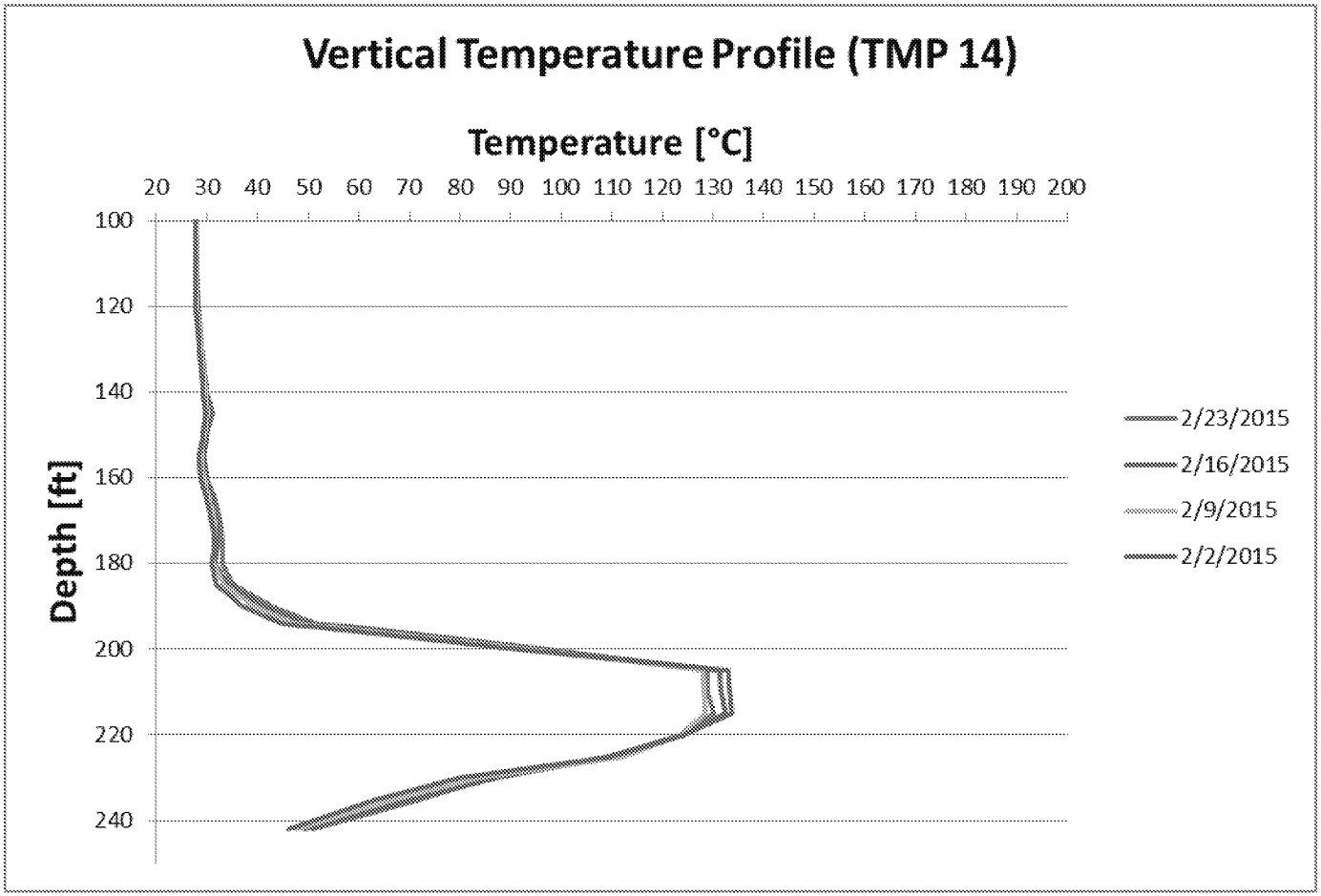
120
140
160
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015



Note: TMP is currently being troubleshot


Vertical Temperature Profile (TMP 14)
Temperature [°C]
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Depth [ft]
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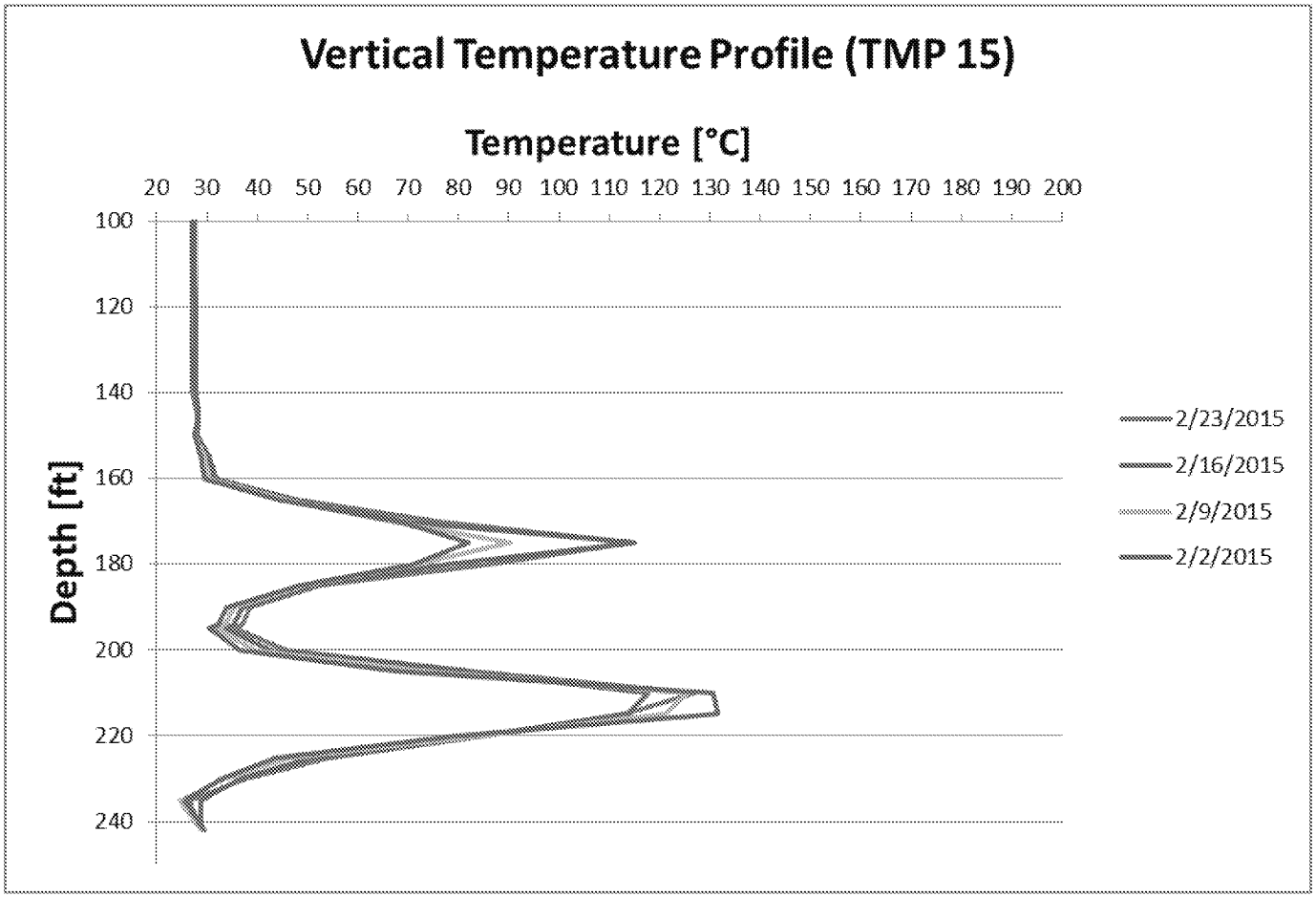
120
140
160
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015


Vertical Temperature Profile (TMP 15)
Temperature [°C]
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Depth [ft]
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120
140
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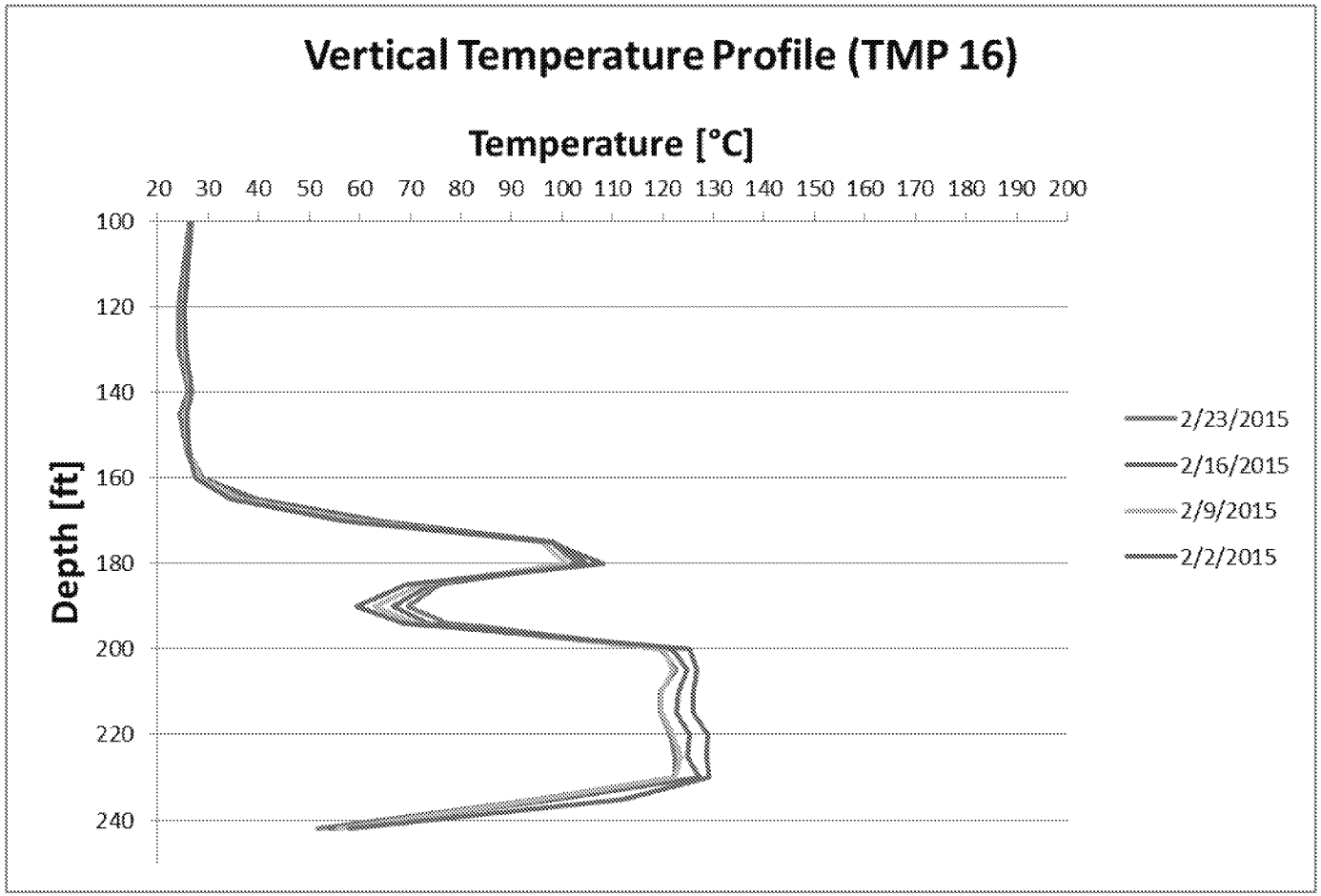
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015


Vertical Temperature Profile (TMP 16)
Temperature [°C]
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Depth [ft]
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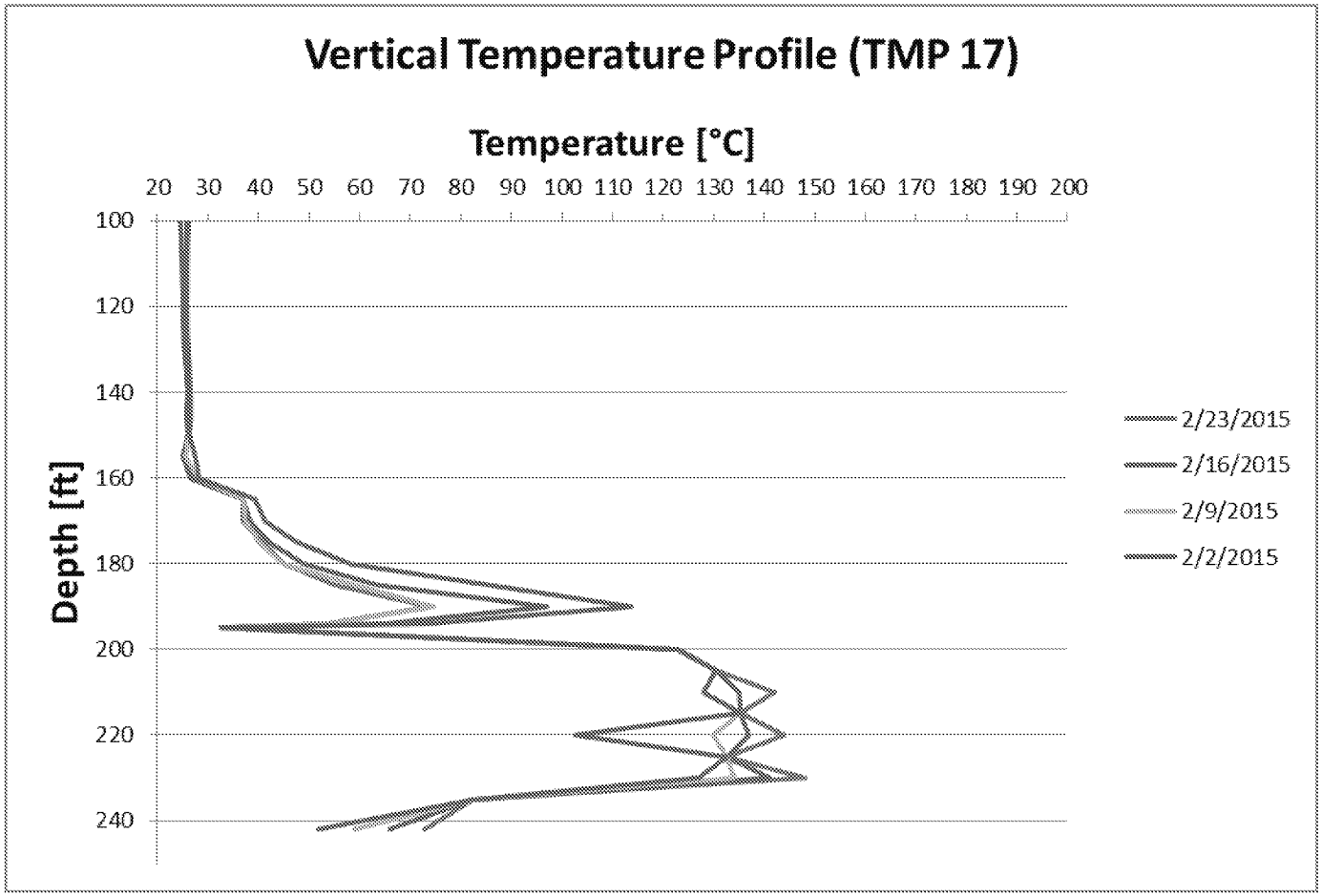
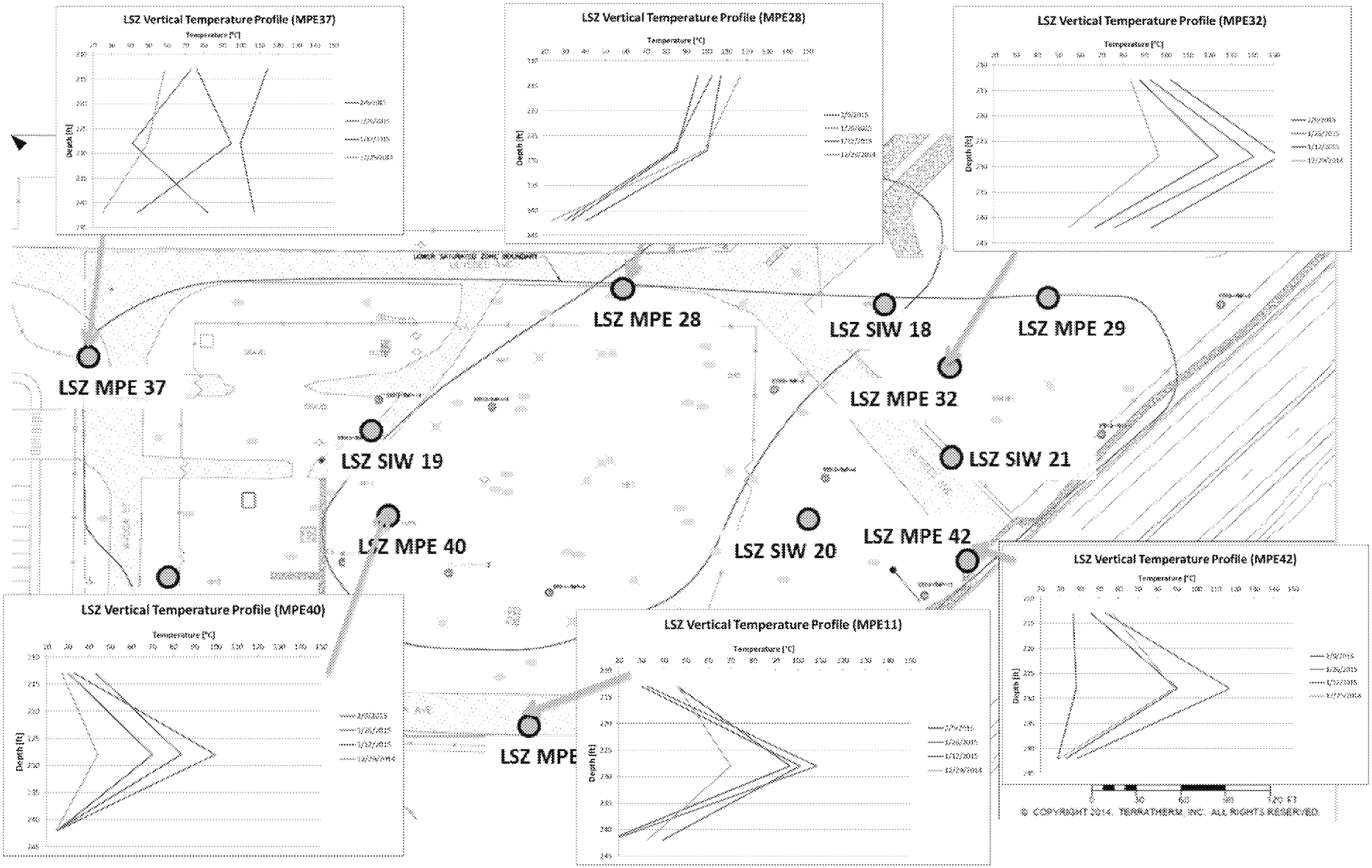
140
160
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015


Vertical Temperature Profile (TMP 17)
Temperature [°C]
20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Depth [ft]
100
120
140
160
180
200
220
240
2/23/2015
2/16/2015
2/9/2015
2/2/2015

Subsurface Heat up Progression Measured at Co-Located Extraction Well Thermocouples

ED_005025_00002189-00033

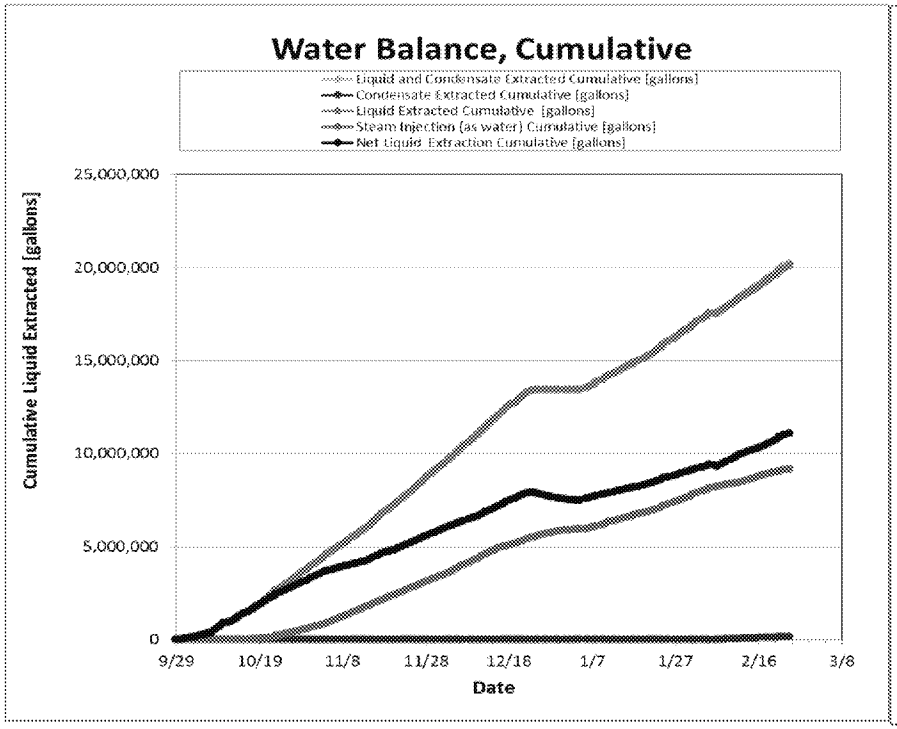
ST012 SEE CO-LOCATED TEMPERATURES AT LSZ EXTRACTION WELLS: 12/29-2/9

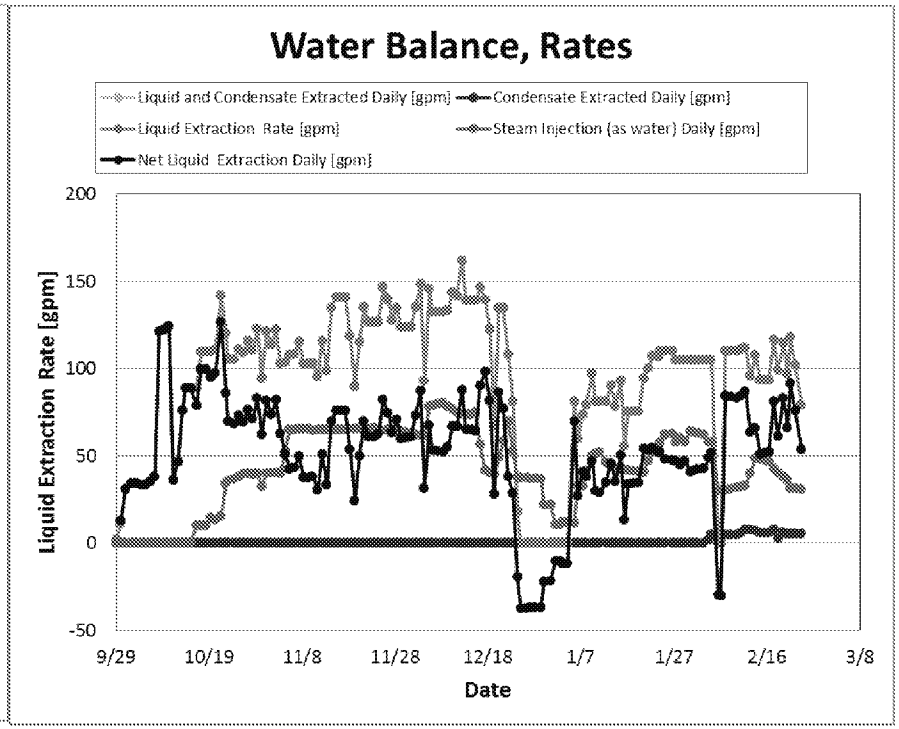


ST012 Injection/Extraction Balance Status

ED_005025_00002189-00035

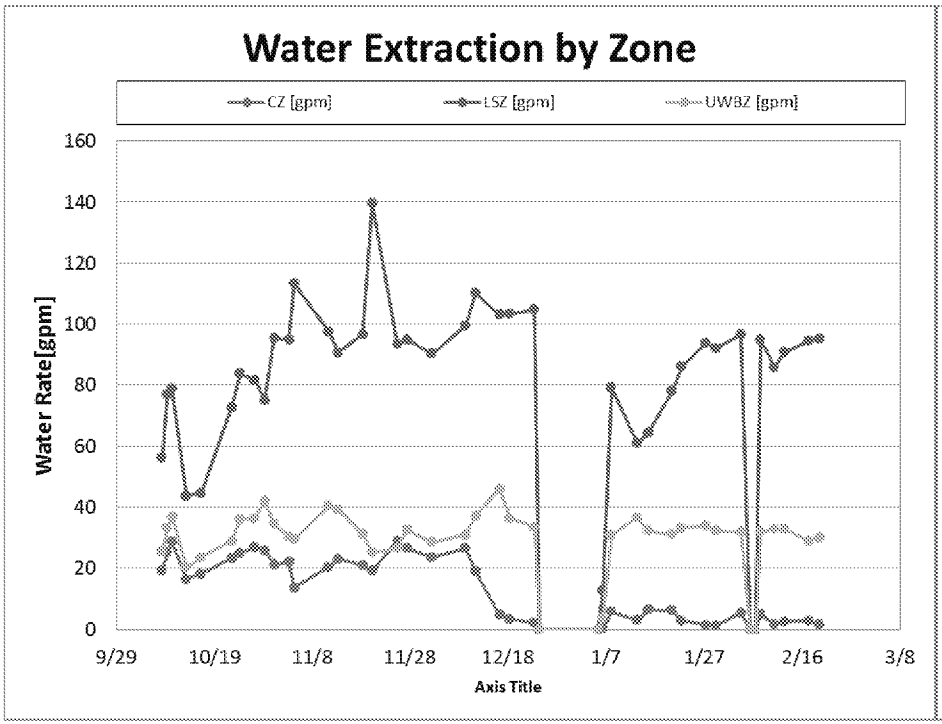
ST012 SEE SYSTEM WATER EXTRACTION BY ZONE

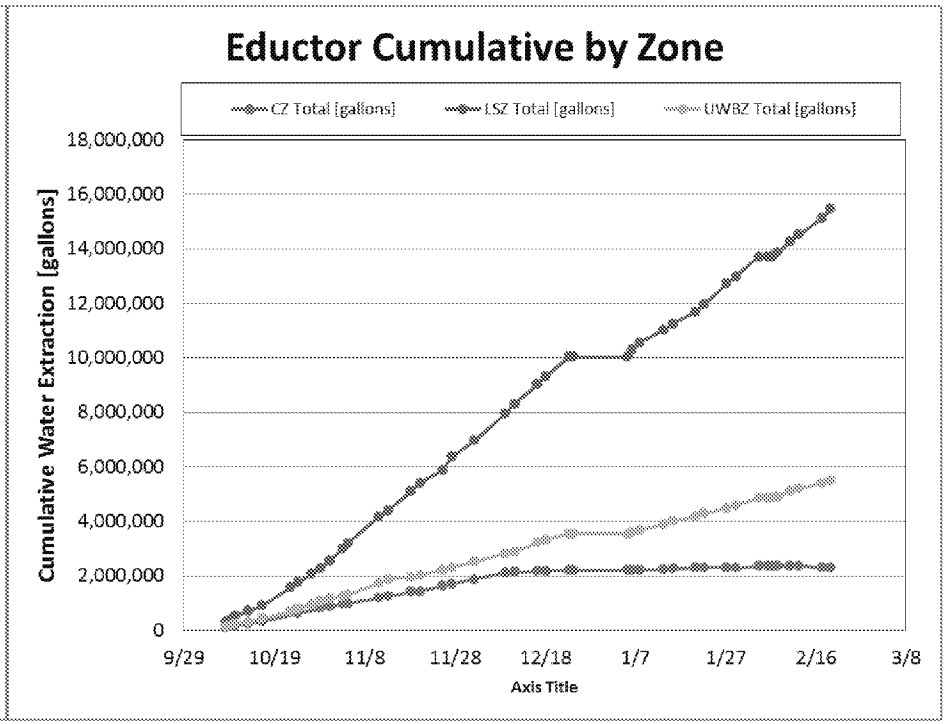




- **Condensate production began on February 4 indicating steam breakthrough at the first extraction well (LSZ6)**
- **Current condensate production is ~6 gpm corresponding to the extraction of an estimated 1,000 scfm of steam from the wellfield**

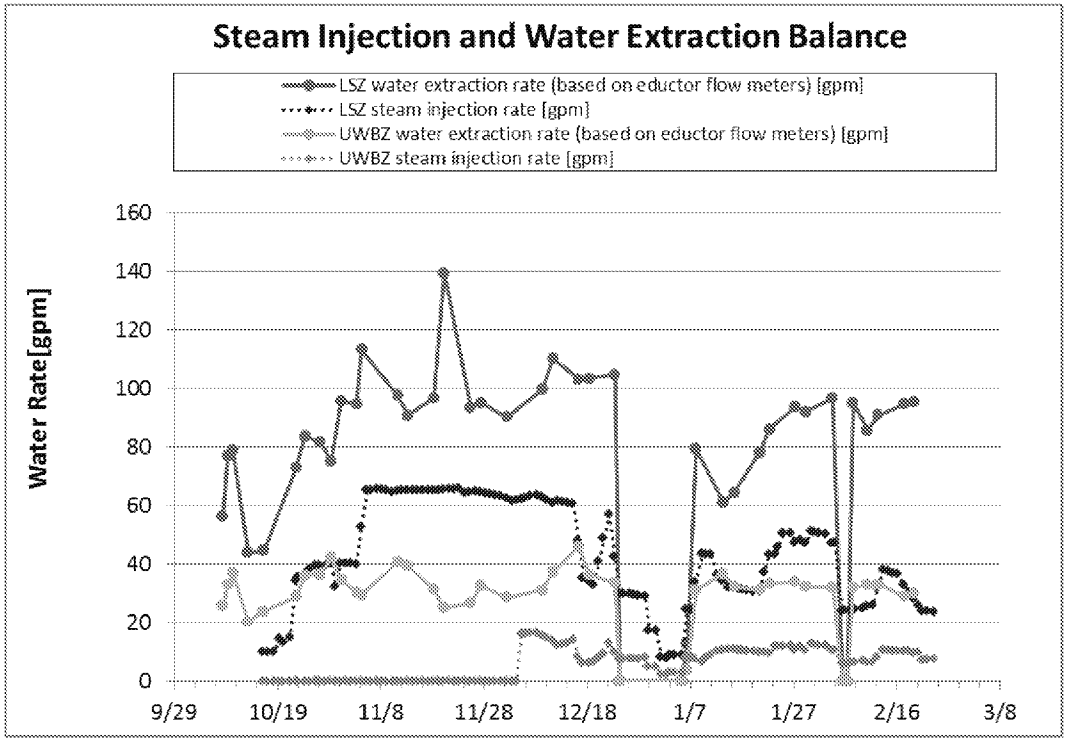
ST012 SEE SYSTEM WATER EXTRACTION BY ZONE





- **Eductor extraction rates per zone are based on individual eductor feed and return meters**

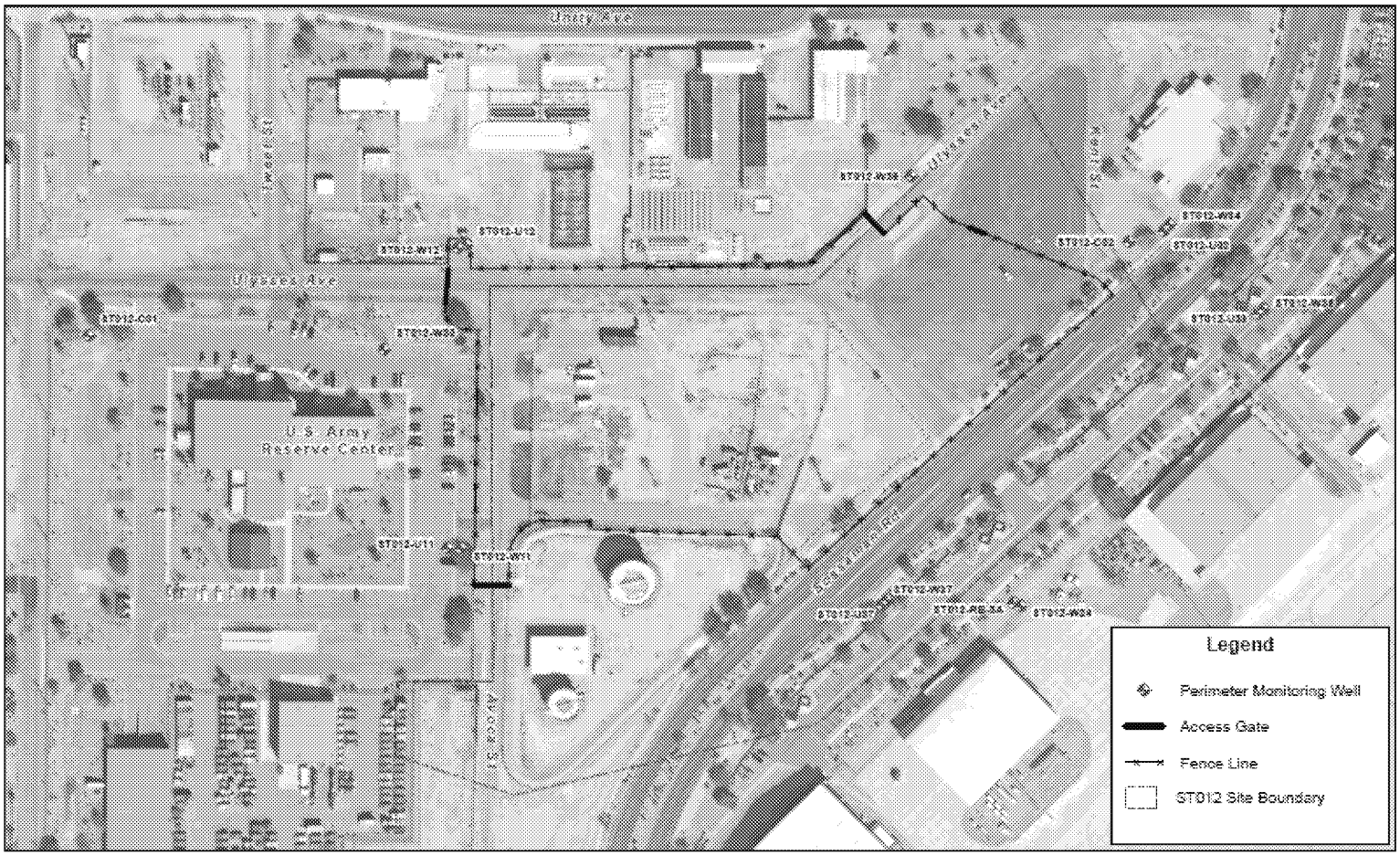
ST012 SEE SYSTEM INJECTION/EXTRACTION BALANCE



	CZ [gallons]	UWBZ [gallons]	LSZ [gallons]
Water extracted	2,300,000	5,499,000	15,463,000
Water injected (as steam)	0	1,108,000	8,075,000
Net extraction	2,300,000	4,391,000	7,388,000

- **Note: water extracted to date per zone is based on eductor individual meters**

ST012 SEE PERIMETER GROUNDWATER MONITORING WELLS



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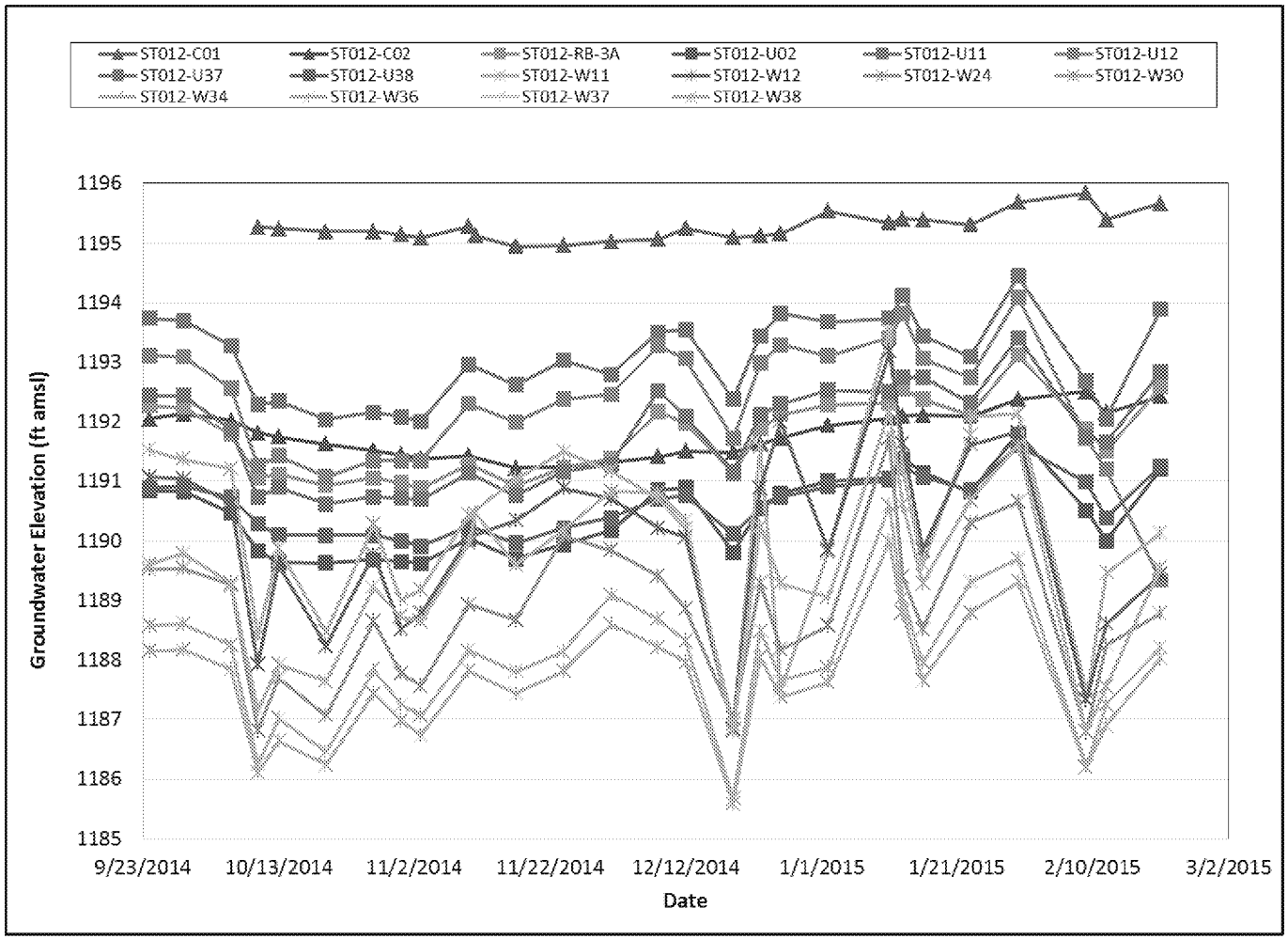
ST012 SEE PERIMETER GROUNDWATER LEVEL DATA

Monitoring Well	2/9/2015		2/12/2015		2/20/2015	
	Change from Baseline	Change from Previous	Change from Baseline	Change from Previous	Change from Baseline	Change from Previous
CZ/UWBZ Wells						
ST012-C01	0.00	0.15	-0.46	-0.45	-0.22	0.27
ST012-C02	-0.11	0.13	-0.48	-0.36	-0.24	0.27
UWBZ Wells						
ST012-RB-3A	-0.95	-1.23	-1.34	-0.38	-0.29	1.08
ST012-U02	-0.90	-1.29	-1.42	-0.51	-0.24	1.21
ST012-U11	-1.63	-1.77	-2.27	-0.63	-0.46	1.84
ST012-U12	-1.96	-2.37	-2.49	-0.52	-4.38	-1.86
ST012-U37	-1.26	-1.66	-1.37	-0.10	-0.21	1.19
ST012-U38	-0.47	-0.61	-0.22	0.26	-0.61	0.00
LSZ Wells						
ST012-W11	-4.61	-4.66	-2.64	2.12	-2.00	0.67
ST012-W12	-4.32	-4.51	-3.05	1.28	-2.25	0.83
ST012-W24	-3.31	-3.88	-1.85	1.47	-1.35	0.53
ST012-W30	-3.87	-4.68	-2.98	0.91	-0.86	2.15
ST012-W34	-2.94	-3.49	-1.91	1.04	-0.99	0.95
ST012-W36	-3.39	-4.81	-2.64	0.76	-0.67	2.00
ST012-W37	-4.29	-9.84	N/A	N/A	-2.27	N/A
ST012-W38	-2.52	-3.11	-1.83	0.70	-0.74	1.12

ST012 SEE PERIMETER GROUNDWATER ELEVATIONS



- **Water level increases are temporary**

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ST012 SEE OPERATIONAL CHALLENGES

- Iron Fouling
- Bio Fouling
- Eductor Pump Pulling and Replacement
- Perimeter Water Levels
- Temperature Monitoring Point Thermocouples
- Boiler Maintenance
- Heat Response at TMP10
- Product at ST012-W37 and ST012-W11

ST012 SEE PERIMETER LNAPL THICKNESSES (FT)

Monitoring Well	9/24/2014	2/9/2015	2/9/2015	2/12/2015	2/20/2015	2/20/2015
CZ/UWBZ Wells		Before Bailing	After Bailing		Before Bailing	After Bailing
ST012-C01		0.00	0.00	0.00	0.00	0.00
ST012-C02	0.00	0.00	0.00	0.00	0.00	0.00
UWBZ Wells						
ST012-U02	0.00	0.00	0.00	0.00	0.00	0.00
ST012-U11	0.00	0.00	0.00	0.00	0.00	0.00
ST012-U12	0.00	0.00	0.00	0.00	0.00	0.00
ST012-U37	0.00	0.00	0.00	0.00	0.00	0.00
ST012-U38	0.00	0.00	0.00	0.00	0.00	0.00
ST012-RB-3A	0.00	0.00	0.00	0.00	0.00	0.00
LSZ Wells						
ST012-W11	0.30	12.71	0.27	0.72	0.00	0.00
ST012-W12	0.00	0.00	0.00	0.00	0.00	0.00
ST012-W24	0.00	0.00	0.00	0.00	0.00	0.00
ST012-W30	0.01	0.00	0.00	0.00	0.00	0.00
ST012-W34	0.00	0.00	0.00	0.00	0.00	0.00
ST012-W36	0.00	0.00	0.00	0.00	0.00	0.00
ST012-W37	0.42	70.04	70.04	Not measured	9.62	5.61
ST012-W38	0.00	0.00	0.00	0.00	0.00	0.00

ST012 SEE REVISED OPERATIONAL STRATEGY

- Continue to run system at approximately 400 gpm (eductor loop flow)
- Increase extraction flow when the result of the de-foamer test is complete
- Preventative replacement of selected eductor transition pieces
- Ramp up steam injection when both boilers are back online and preventative replacement of selected eductor transition pieces is complete
- Continue to monitor perimeter temperature response and make operational adjustments as necessary

ST012 SEE OPERATIONAL PLAN – UPDATE

Operational Plan through March

- **Continue operating the current SIW wells at reduced input until both boilers are online and until selected eductors have been replaced.**
  - Fourteen (total of fifteen) of the exterior and interior LSZ steam wells are operating at reduced capacity
  - All seven exterior UWBZ steam wells are operating
  - Total system is operating at approximately 100 gpm liquid extraction and 47 gpm steam injection (24,000 lbs/hr)
- **Complete Modified Step 3 (once MPE preventative replacement is complete, estimated mid-March)**
  - Fifteen exterior and interior LSZ wells are operating
  - Seven exterior UWBZ wells are operating
  - No CZ wells operating
  - Total system operating at ~120 gpm liquid extraction and 60 gpm steam injection (30,000 lbs/hr)
  - Balancing the flows to maintain an acceptable water balance
  - Look for options to increase and optimize injection and extraction rates
- **Modified Step 4 (interior UWBZ)**
  - Same 15 exterior and interior LSZ wells as Step 3
  - Same exterior UWBZ wells as Step 3
  - Add interior UWBZ wells
  - Injection rates will continue to be balanced across the wellfield to maintain an acceptable water balance

ST012 Backup Slides

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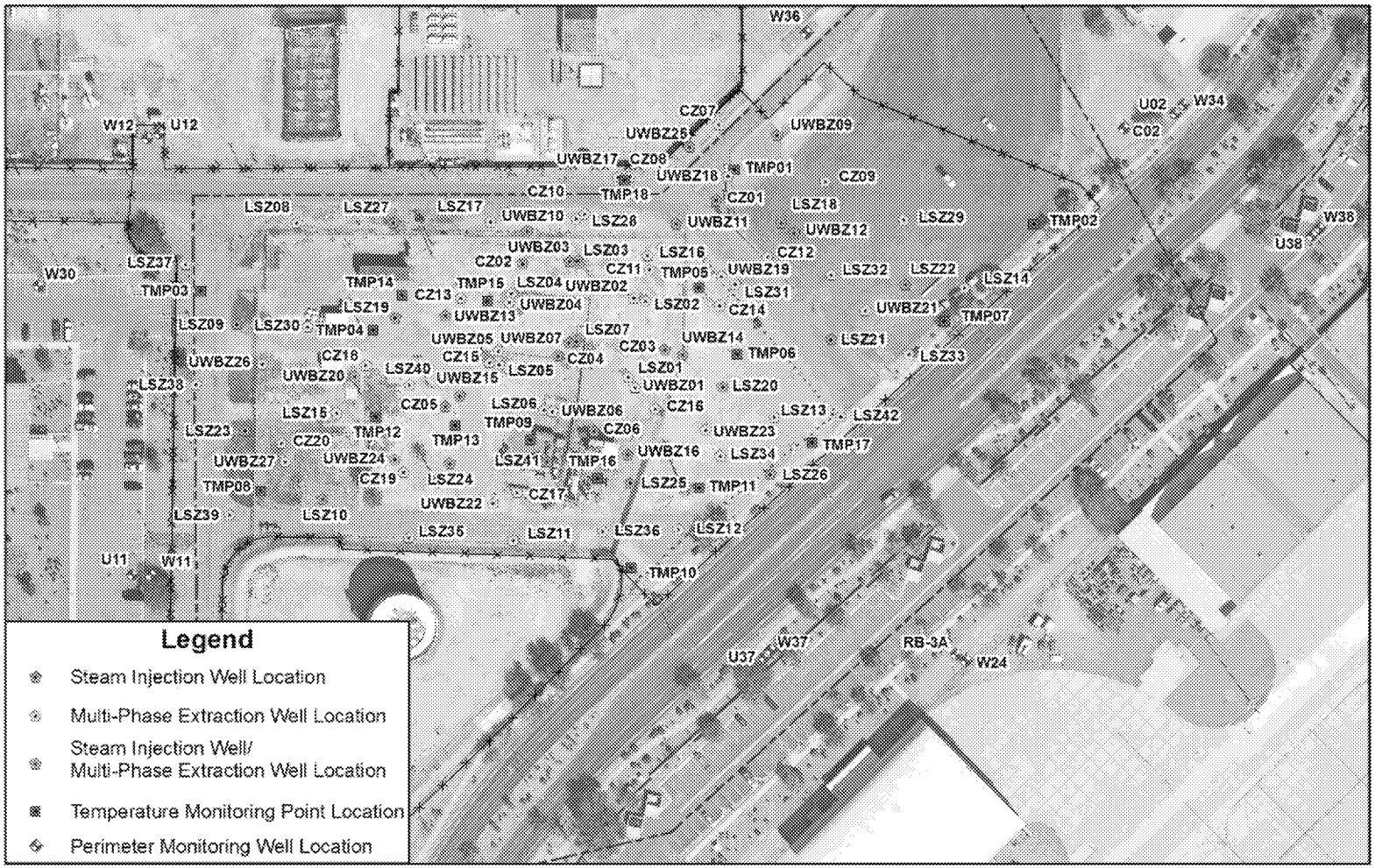
ST012 SEE WELLS



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