NORTH QUARRY SUBSURFACE TEMPERATURE MONITORING PROBES (TMPs) WORK PLAN

Administrative Settlement Agreement and Order on Consent for Removal Actions

Prepared for:
Bridgeton Landfill, LLC
West Lake Landfill Superfund Site
Bridgeton, Missouri

May 2016

Prepared by:

Engineering for a Better World
FEEZOR
ENGINEERING, INC.

406 East Walnut Street • Chatham, IL 62629
3377 Hollenberg Drive • Bridgeton, MO 63044

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APPENDICES:

1.0 INTRODUCTION

This Work Plan describes the design, installation (including schedule), and operation of additional Temperature Monitoring Probes (TMPs) for the North Quarry of the Bridgeton Landfill. This work plan is being submitted to satisfy the requirement specified in Section VIII.35.e of the April 28, 2016 Administrative Settlement Agreement and Order on Consent (ASAOC) issued by Region 7 of the United States Environmental Protection Agency (USEPA). Feezor Engineering, Inc., on behalf of Bridgeton Landfill, LLC, (Bridgeton) has developed this North Quarry Subsurface TMP Work Plan for all site employees, contractors, and subcontractors who may be tasked with the installation and operation of the TMP monitoring system.

Section VIII.35 e. of the ASAOC specifies that the North Quarry Subsurface TMP Work Plan provide for:

1) A system of TMPs capable of monitoring landfill temperatures that could be a precursor to or indicative of an SSR (Subsurface Reaction) in the North Quarry that could come into contact with RIM (Radiologically Impacted Materials) in OU-1, Area 1of the West Lake Landfill.

2) Description of TMP operation, maintenance, performance metrics, and replacement procedures, including frequency.

3) Triggers to be used to indicate a need for installation of additional TMPs elsewhere in OU-1 Area 1 and/or the Bridgeton Landfill North Quarry to monitor for a SSR; including temperatures greater than 185° F or 1500 ppm of carbon monoxide in a gas extraction well, or temperatures greater than 200° F in a temperature monitoring probe.

4) Provisions for ongoing regular reporting of temperature data, along with providing raw data, to EPA and the Missouri Department of Natural Resources (MDNR).

This work plan will supplement the existing temperature monitoring network and complement the "Inert Gas Injection Work Plan for Hot Spot Remediation," submitted to USEPA and MDNR on May 20, 2016; resulting in a comprehensive monitoring system for the North Quarry. This work plan proposes installation of 10 additional TMP strings which will result in a monitoring system comprised of a total of 32 gas extraction wells, and 22 TMP strings (92 total buried thermocouples) in the North Quarry. In addition, two replacement TMP strings will be installed in the Neck Area (TMP 2 and TMP 11). Daily observations, weekly monitoring, monthly monitoring, and laboratory analyses will assure that conditions in the North Quarry are well-known at all times and will allow rapid and thorough response to protect the RIM in Area 1, OU-1 from unusual conditions.

2.0 TEMPERATURE MONITORING PROBE SYSTEM

> Reference Item 1: *A system of TMPs capable of monitoring landfill temperatures that could be a precursor to or indicative of an SSR in the North Quarry that could come into contact with RIM in OU-1, Area 1of the West Lake Landfill*.

2.1 Temperature Monitoring Technology

The temperature measuring devices proposed are type T thermocouples with 20 gauge type T, Teflon coated wire leads. A thermocouple is a sensor for measuring temperature. It consists of two dissimilar metal wires, joined at one end. When the junction of the two metals is heated or cooled a voltage is produced that can be correlated to a thermocouple thermometer or other thermocouple-capable device at the other end. When properly configured, thermocouples can provide temperature measurements over a wide range of temperatures. Thermocouples are available in different combinations of metals or calibrations. The most common are the "Base Metal" thermocouples known as Types J, K, T, E and N. The proposed thermocouple to be used is a Type T thermocouple (calibration type) that supports a temperature range between -358 degrees F and 662 degrees F. These units represent having a standard limits of error to be the greater of 1.0 degree C (1.8 degrees F) or 0.75%, while the specified limits of error is the greater of 0.5 degree C (0.9 degrees F) or 0.4%.

A TMP involves installing a series of thermocouples spaced vertically within a single borehole. Typically the vertical spacing is no more than twenty vertical feet. The thermocouple strings are supported by a fiberglass rod during installation, and are encased in a 3/4 inch diameter pryrojacket abrasive sheath. Once the thermocouple string is lowered in position, the TMP is encased with a specialized cement bentonite grout that provides the ultimate support of the TMP in the waste. The TMP thermocouple wires are encased in a ¾ inch CPVC Schedule 80 casing on the ground surface and are connected to a selector switch for readings. Before the wires are connected to the selector switch (the switch used for the readings) they are directed through a fiberglass enclosure, where the Teflon is removed from the outer sleeve and then connected to the selector wires. The fiberglass box enclosure is connected to a draining type conduit seal. The installation drawings are included in **Appendix A**. Improvements to the TMP design may be incorporated before installation such as multiple TMP conduits in one TMP boring to allow easier replacement, and changes in the surface feature as the proposed depth intervals are monitored (to allow for automated data collection).

2.2 Proposed TMP Locations

The ASAOC has requested that TMPs be installed in the North Quarry to form a line of temperature measurements approaching the OU-1, Area 1 (which contains Radiologically Impacted Materials). These proposed TMPs are positioned to augment the existing TMP locations that are shown on Drawing 003 in **Appendix A**.

As shown on Drawing 002 and 003 (**Appendix A**), the identified RIM in OU-1, Area 1 is located north of the North Quarry high-wall, near the bottom of the landfill cell. Ten additional TMPs will be installed in the North Quarry along a line due south of the identified RIM. The TMPs will be approximately equally spaced along the proposed alignment. The depths of the quarry bottom and the proposed vertical distribution of the thermocouple strings for all TMPs are depicted on Drawing 004 in **Appendix A.**

Per the MDNR's additional request to replace TMP 1, 2, and 11, Bridgeton Landfill, LLC has evaluated the current performance of these respective TMPs; and as part of this work plan scope, TMP 2R and 11R will be installed as replacements for TMP 2 and 11, and are depicted on Drawings 003 and 004. TMP 1 has experienced historical performance issues that were due to connections at the surface interface. These were corrected in March 2015 and monitoring data since that time has been valid and reliable and therefore replacement is not warranted at this time.

2.3 TMP Installation Method

The TMPs will be installed within four inch boreholes advanced with a sonic drill rig. Sonic drilling is often used for geo-environmental investigative programs. Sonic drilling offers the benefit of nearly zero drill cuttings and reduced fluid production. The ability to cause vibration to the casing string eliminates the complication of backfill bridging common to other drilling methods and reduces the risk of casing lockup allowing for easy casing withdrawal during grouting.

Some heat generation may occur within the borehole due to the use of sonic drilling. Liquid (potable water) will be injected down the drill string to reduce potential heat generation. No liquid return to the top of the boring is anticipated.

TMP installation will use the "lost tip method" where a disposable tip is temporarily welded to the lowest section of the advancing sonic casing. Once the final proposed depth of the TMP is obtained, the driller will withdraw the casing a few feet, and then the driller will insert a metal rod connected to a cable down the hollow casing and tap off the tip to be left at the bottom of the borehole. Then the strings of thermocouples encased in the abrasive sheath will be inserted inside the drill casing that is advanced to the target depths. A cement / bentonite grout mix is then pumped into the casing via tremie pipe methods. Once the TMP thermocouple strings are installed and the grout placed, the sections of sonic casings are carefully extracted, using the vibratory oscillations of the sonic technology to help extract the casing without displacing the grout and the thermocouple string. Other methods of installation (for example a non-lost tip method for sampling) could allow the waste to push back into the open bottom and displace or catch the thermocouple wires and therefore the interval of TMP reading could be less deep than the overall length. Therefore the lost tip method is imperative to successful TMP installation and no sampling is possible using this method.

After the TMP has been installed and the grout has cured, the individual thermocouple strings will be connected to a selector switch which is within a fiberglass enclosure mounted to uni-strut bracing which is connected to a concrete base. This configuration comprises the surface detail that is depicted on Drawing 004 in **Appendix A**. Readings of the TMPs will commence after a period of time has occurred to allow the TMP to equilibrate and be representative of waste temperatures.

2.3.1 TMP Depth Determination

TMP borings will be advanced to the target depth of the bottom of the proposed unit. Based on the historical TMP measurements taken within South Quarry the bottom of the additional TMPs has been based on the following overall thermocouple guidelines:

- For total waste thickness of 80 feet or less, to within 10 feet of the quarry floor,
- For total waste thickness of greater than 80 ft but less than 120 feet, to within 20 feet of the quarry floor, and
- For total waste thickness depths greater than 160 ft, to within 40 feet above the quarry floor but not exceeding 180 feet in depth.

No less than 2 thermocouples will be installed in any TMP and thermocouple spacing will not exceed 20 feet in the vertical direction. The closest unit to the surface will typically be 20 feet below grade but not less than 15 feet. In the event the less than 20 foot distance is used, the CPVC conduit will be shortened accordingly. A preliminary depth of installation table is included on Drawing 004 in **Appendix A**.

3.0 MONITORING OF TMPS

> Reference Item 2: *Description of TMP operation, maintenance, performance metrics, and replacement procedures, including frequency.*

3.1 TMP Data Collection and Validation

The Neck Area TMPs (TMP 1, TMP 2R, TMP-3R, TMP-4R, TMP-10, TMP-11R, and TMP-14R), the existing North Quarry TMPs and the additional North Quarry TMPs will be read weekly. A handheld TMP reading device will be used to manually obtain the temperature reading at each thermocouple interval (in degrees F) weekly. The following data will be recorded during the weekly reading:

- Date,
- TMP ID,
- Depth of Thermocouple,
- Temperature Reading (Degrees F),
- Resistance Reading (Ohms), and
- Comment (if any).

The readings will be recorded manually, and then entered into a database. Validation and quality control checks of the readings will be conducted weekly to determine if the readings were recorded and entered correctly. These readings will be plotted on temperature vs. depth charts for each TMP, similar to the example in **Appendix B**.

As previously described, each TMP consists of multiple thermocouples in a single TMP location. Each thermocouple is independent within one TMP string. For each reading event, the individual thermocouple temperature and resistance is read and recorded. To qualify the temperature reading, the resistance (ohms) is compared to a baseline value based on the thermocouple and wire lead length. If a temperature reading is anomalous, the reading will be rechecked and the resistance in ohms will be recorded. If recorded resistance is out of limits, the individual thermocouple on the respective TMP string is deemed compromised and the temperature reading is not used in the current data set. To further evaluate the physical condition of the respective thermocouple, conductivity testing is performed on individual thermocouples to evaluate if corrections or other physical conditions may be affecting the unit's resistivity.

Bridgeton Landfill, LLC may elect to employ data collectors to reduce the manual labor required to obtain the readings. Any data collector will be compatible with the temperature sensors installed. A reduction in the frequency of readings may be proposed in the future if conditions warrant.

3.2 Maintenance and Replacement of TMPs

The TMPs will be monitored for changes in resistance, which is an indicator that the TMP may be failing. In addition, the connections to the selector switch may corrode, as well as the selector switch itself. Corrosion may increase resistance. During the weekly readings, any noticeable corrosion will be noted on the field forms, and Bridgeton Landfill, LLC will perform monthly maintenance of the system such as cleaning the connections and applying corrosion inhibitors on the connections. The resistance of the TMPs will be checked during the monthly maintenance. If a TMP resistance is determined to be beyond normal range, typically 20% higher or lower than the rated ohms per foot of the wire, the TMPs will be tested directly on the thermocouple leads. This will determine if resistance is being generated by the selector switch or other connections. This conductivity test will be performed to determine if the individual thermocouple units have become connected via failure of insulation wire breakage or liquid accumulation at the switch or ground penetration. If this condition is identified, then the TMP thermocouple interval will be taken out of service.

TMPs installed in waste have a discrete life. When some thermocouples fail, the TMP can still be used if a general trend in the TMP can be inferred, as compared to historical records of that specific thermocouple interval. This can be seen in the historical analysis in **Appendix B**. However, if more than three consecutive thermocouple intervals fail (a vertical interval over 60 feet is not monitorable), then the entire TMP will be replaced, or the missing intervals may be replaced with a shorter neighboring TMP.

4.0 RESPONSE STEPS TO TRIGGER VALUES

> <u>*Reference Item 3:*</u> *Triggers to be used to indicate a need for installation of additional TMPs elsewhere in OU-1 Area 1 and/or the Bridgeton Landfill North Quarry to monitor for a SSR; including temperatures greater than 185° F or 1500 ppm of carbon monoxide in a gas extraction well, or temperatures greater than 200° F in a temperature monitoring probe.*

In accordance with the North Quarry ASAOC, certain triggers will be used to indicate the need for further investigation of the possibility of an SSR in the North Quarry. The proposed triggers are:

- Temperatures greater than 185° F or 1500 ppm of carbon monoxide in a gas extraction well, and
- Temperatures greater than 200° F in a TMP.

If a TMP reading indicates a possible trigger exceedance, a verification process will be followed to ensure the reading is a true exceedance. The conductance of the thermocouple string will also be checked.

A verified achievement of a trigger value could indicate either the presence of a subsurface oxidation event (SSO), or the presence of an SSR, or just a non-typical or transient reading that is neither an SSO nor an SSR. Procedures for investigating, verifying, and remediating an SSO are presented in the "Inert Gas Injection Work Plan for Hot Spot Remediation."

If it is suspected that the triggers suggest a possible independent SSR is developing, an initial investigation will commence within 12 hours of the observations of symptoms of a potential SSR. Bridgeton Landfill will notify MDNR within one day of this respective commencement of investigation. Additional confirmatory measures will be used to identify the lateral and spatial configuration of the conditions. This will involve identifying the existing TMPs and gas wells within a 100 foot radius of the triggered TMP or gas extraction well. Gas wells will be temporarily profiled with a downhole Resistive Thermal Device (RTD) to ascertain elevated temperature regions within the depth of the well. Three additional TMPs will be installed around the triggered TMP or gas well at a minimum distance of 50 feet from the affected element. The new TMPs will be installed to a depth equal to 20 feet below the suspected elevated interval. Once the spatial orientation and temperature profile of the affected area is determined, remedial and/or management plans and schedules will be submitted to the USEPA and MDNR in the form of a work plan.

5.0 REPORTING OF DATA

> *Reference Item 4:* *Provisions for ongoing regular reporting of temperature data, along with providing raw data, to EPA and the Missouri Department of Natural Resources (MDNR).*

The weekly data (after quality control review) and temperature verses depth graphs will be submitted to the USEPA and MDNR weekly on a one week offset (the previous week's data will be submitted the current week). An example of this report with the latest available TMP readings for the North Quarry TMPs (May 9, 2016) is included in **Appendix B**.

Each weekly report will be prepared describing the existing North Quarry TMPs and the newly proposed North Quarry TMPs. This report will summarize the data, describe the operation and maintenance, and discuss any non-conforming TMP intervals. The report format will consist of:

- Cover letter that summarizes the report contents and explains any unusual conditions or occurrences,
- Data summaries,
- Equipment maintenance and performance,
- Results and proposed future activity.

The weekly report will be due the Friday of the following week; uploaded to the Bridgeton Data portal shared with the USEPA and the MDNR.

6.0 IMPLEMENTATION SCHEDULE

Once the North Quarry Subsurface TMP Work Plan is approved by the USEPA, the ten additional North Quarry TMPs and the two additional Neck Area TMPs will be installed based upon the schedule presented below. The thermocouple and the surface measuring infrastructure parts require a lead time of approximately eight weeks for delivery. During that time, drilling can be coordinated and drilling pads constructed. The below schedule is highly dependent upon the availability of the drilling team with prior history of TMP installation:

- USEPA approval of North Quarry Subsurface TMP Work Plan – start construction phase. To be integrated with installation of Heat Extraction Barrier project construction.
- Order thermocouple and surface measuring infrastructure – approximately 8 weeks
- Build drilling pads – approximately 4 weeks (can be completed concurrently with part order)
- Driller availability – to be determined based upon the date of USEPA approval
- TMP Installation (drilling and surface termination completion) – approximately 4 weeks.
- TMP Calibration and Normalization – 2 weeks.

7.0 REFERENCES

Omega, 2016, Revised Thermocouple Reference Tables Type T
http://www.omega.com/temperature/Z/pdf/z223.pdf

Omega, 2016, Thermocouples – Using Thermocouples to Measure Temperature
http://www.omega.com/prodinfo/thermocouples.html

SCS Engineers, 2016, Inert Gas Injection Plan for Hot Spot Remediation, Revised May 20

USEPA, 2016. Administrative Settlement Agreement and Order on Consent for Removal Actions – West Lake Landfill Superfund Site. CERCLA Docket No. 07-2016-0005. United States Environmental Protection Agency. April.

Appendix A
Additional North Quarry TMP Drawings

DESIGN DRAWINGS FOR

TWELVE ADDITIONAL TEMPERATURE MONITORING PROBE INSTALLATION IN NORTH QUARRY

BRIDGETON LANDFILL

BRIDGETON, ST. LOUIS COUNTY, MISSOURI

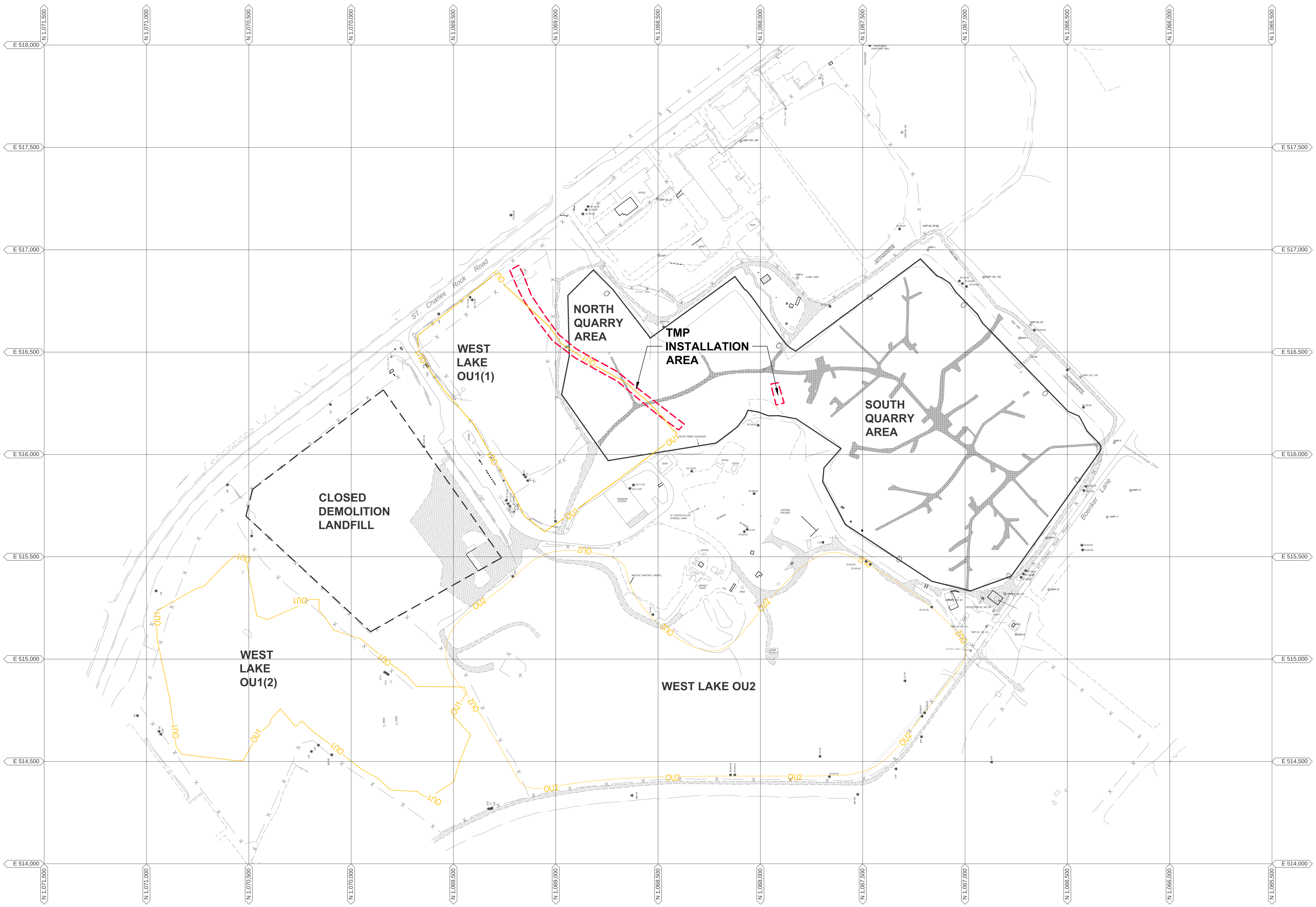
MAY 2016

PREPARED FOR:
BRIDGETON LANDFILL, LLC.

Engineering for a Better World
FEEZOR ENGINEERING, INC.

3377 HOLLENBERG DRIVE
BRIDGETON, MO 63044
TEL. (217) 836-8842

INDEX OF DRAWINGS



LEGEND

	SOLID WASTE BOUNDARY
GMP-4	GAS MONITORING PROBE
PZ-105-SS	PIEZOMETER MONITORING WELL
	QUARRY WALL
	WEST LAKE AREA 1
	WEST LAKE AREA 2
	DEMOLITION LANDFILL AREA

0 200 400 Feet

BRIDGETON LANDFILL, LLC
13570 ST. CHARLES ROCK ROAD
BRIDGETON, MISSOURI 63044

BRIDGETON LANDFILL
NORTH QUARRY AOC
NEW TEMPERATURE
MONITORING PROBES

FULL SITE PLAN VIEW

Engineering for a Better World
FEEZOR ENGINEERING, INC.

MAY 2016
DESIGNED BY: IN
APPROVED BY: DRF

REVISION	DATE

DRAWING NO.: **002**

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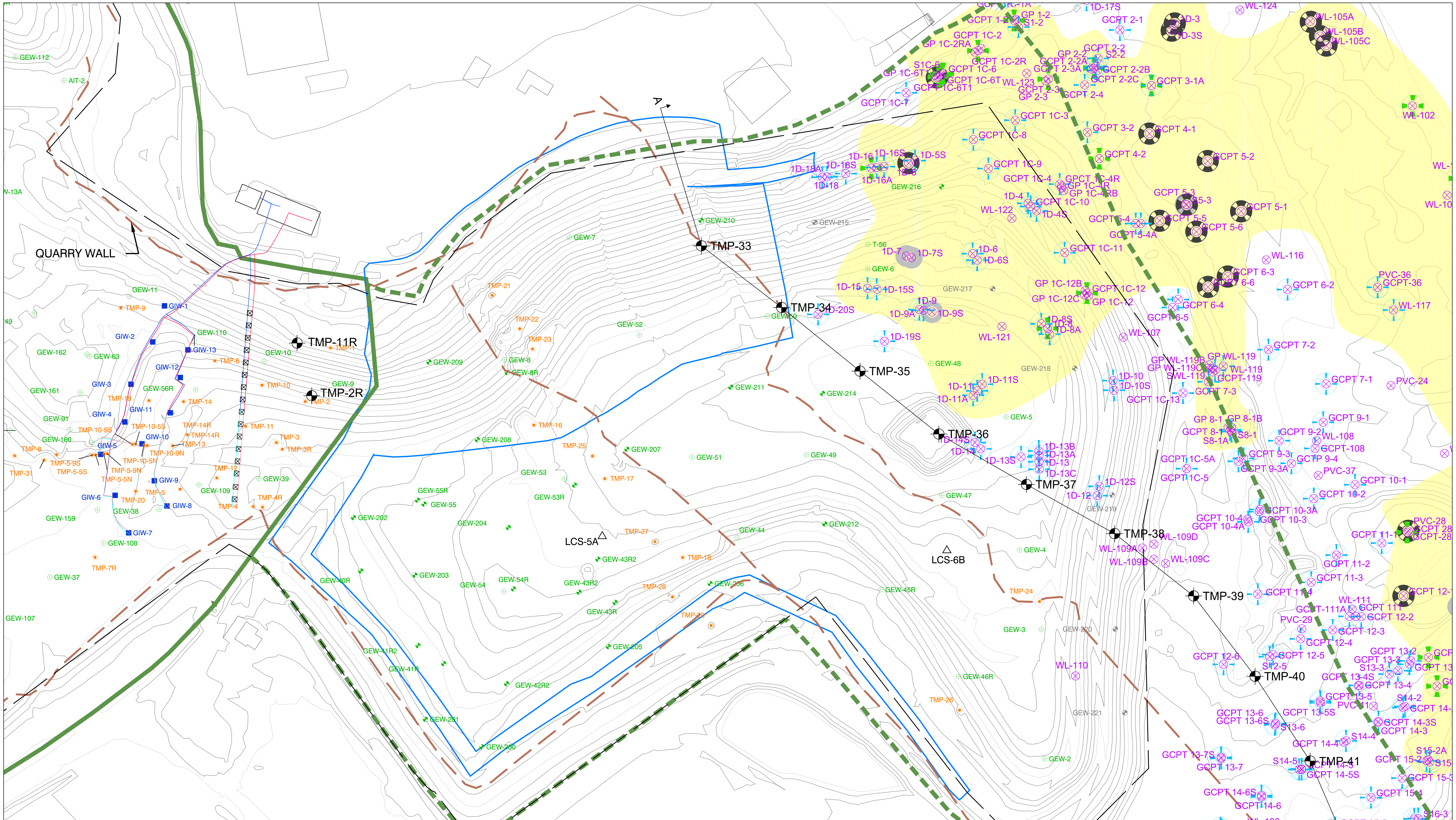
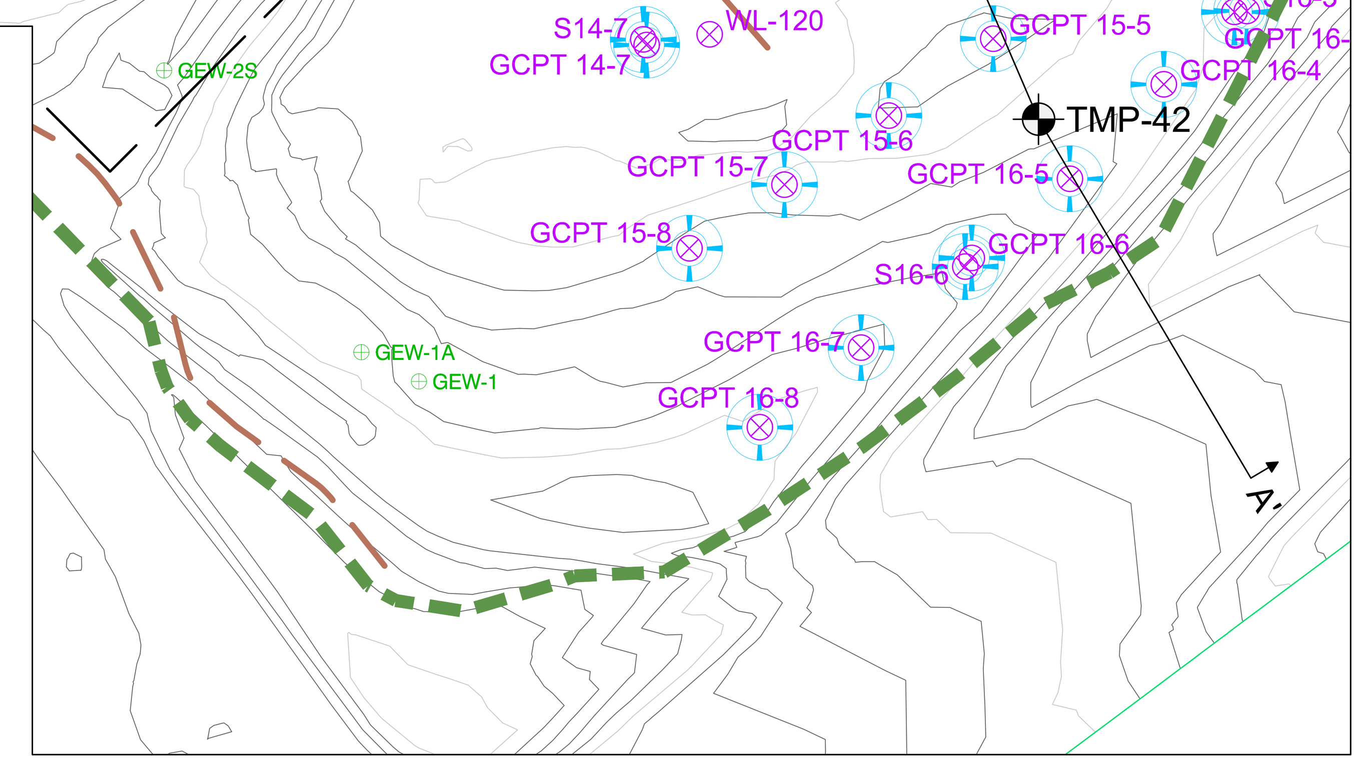
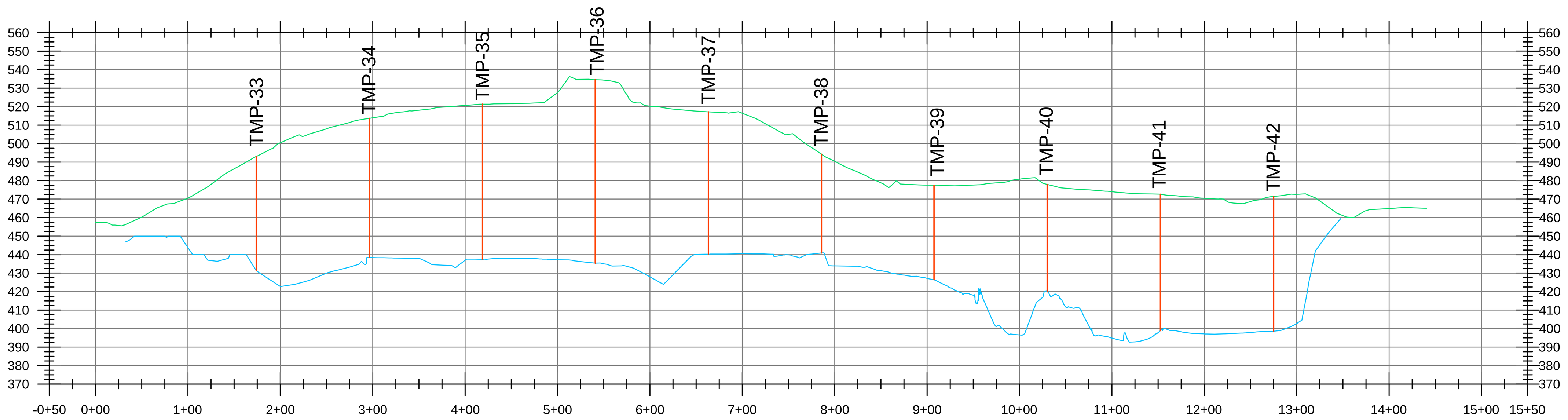




Profile View of Alignment A Vertical Exaggeration x2



TMP number	Northing	Easting	Surface Elevation	Bottom Quarry Elevation	Depth (feet)
33	1,068,398.95	516,143.60	493.12	431.26	61.86
34	1,068,496.09	516,218.23	513.70	438.46	75.24
35	1,068,591.14	516,295.37	521.35	437.35	84.00
36	1,068,686.48	516,371.50	534.61	435.34	99.27
37	1,068,792.61	516,432.62	517.23	440.24	76.99
38	1,068,899.41	516,492.20	494.27	440.88	53.39
39	1,068,995.14	516,567.70	477.57	426.42	51.15
40	1,069,069.53	516,664.98	477.99	419.91	58.08
41	1,069,136.14	516,767.69	472.65	398.88	73.77
42	1,069,184.54	516,880.23	471.43	398.52	72.92
2R	1,067,927.08	516,325.14	491.57	245.75	73.92
11R	1,067,909.37	516,261.40	468.00	340.00	74.92

LEGEND

- EXISTING SOLID WASTE PERMIT BOUNDARY
- QUARRY HIGHWALL
- EXISTING FML CAP BOUDARY
- PROPOSED CAP PHASE BOUNDARY
- NORTH QUARRY EVOH COVER LIMITS
- BASE TOPOGRAPHY (2' CONTOUR)
- 500 — BASE TOPOGRAPHY (10' CONTOUR)
- EXTENT OF RIM
- TMP-33 — NEW TEMPERATURE MONITORING PROBE (TMP)
- TMP-6 — EXISTING TEMPERATURE MONITORING PROBE (TMP)
- GEW-6 — EXISTING LFG EXTRACTION WELL (GEW)
- GEW-15 — REPLACED LFG EXTRACTION WELL (GEW)
- GEW-17 — PROPOSED LFG EXTRACTION WELL (GEW)
- GIW-17 — EXISTING GAS INTERCEPTOR WELL (GIW)
- LCS-6B — EXISTING LEACHATE COLLECTION SUMP (LCS-5 AND 6)
- GCPT 14-2 — AREA 1 SOIL BORING
- <25,000 / 25,000-100,000 / 100,000-500,000 / >500,000 — PRESENCE OF ELEVATED GAMMA (COUNTS PER MINUTE)

0 50 100 Feet

NOTES:
- AERIAL TOPOGRAPHY PROVIDED BY COOPER AERIAL SURVEYS, INC. AND IS DATED FEBRUARY 27, 2016.
- LOCATIONS OF THE PROPOSED TMPS MAY BE MODIFIED TO AVOID CONFLICT WITH NORTH QUARRY INFRASTRUCTURE. ALL FIELD MODIFICATIONS WILL HAVE APPROVAL FROM THE EPA'S ON-SCENE COORDINATOR BEFORE TMP INSTALLATION OCCURS

BRIDGETON LANDFILL 13570 ST. CHARLES ROCK ROAD BRIDGETON, MISSOURI 63044	BRIDGETON LANDFILL NORTH QUARRY AOC NEW TEMPERATURE MONITORING PROBES	Engineering for a Better World FEEZOR ENGINEERING, INC.	MAY 2016 DESIGNED BY: IN APPROVED BY: ---	DRAWING NO.: **003**
SITE MAP AND PROFILE VIEW			REVISION / DATE	
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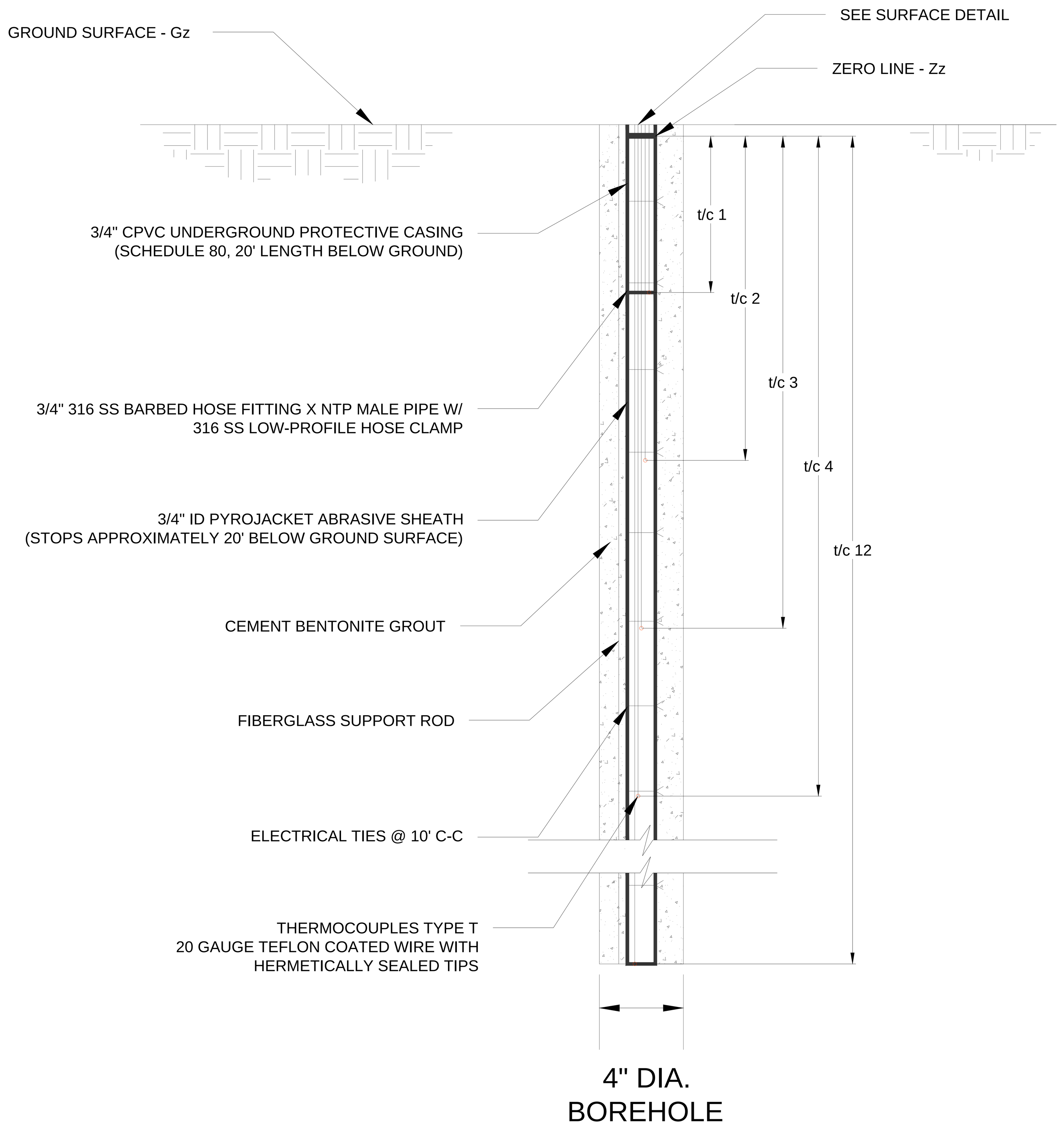
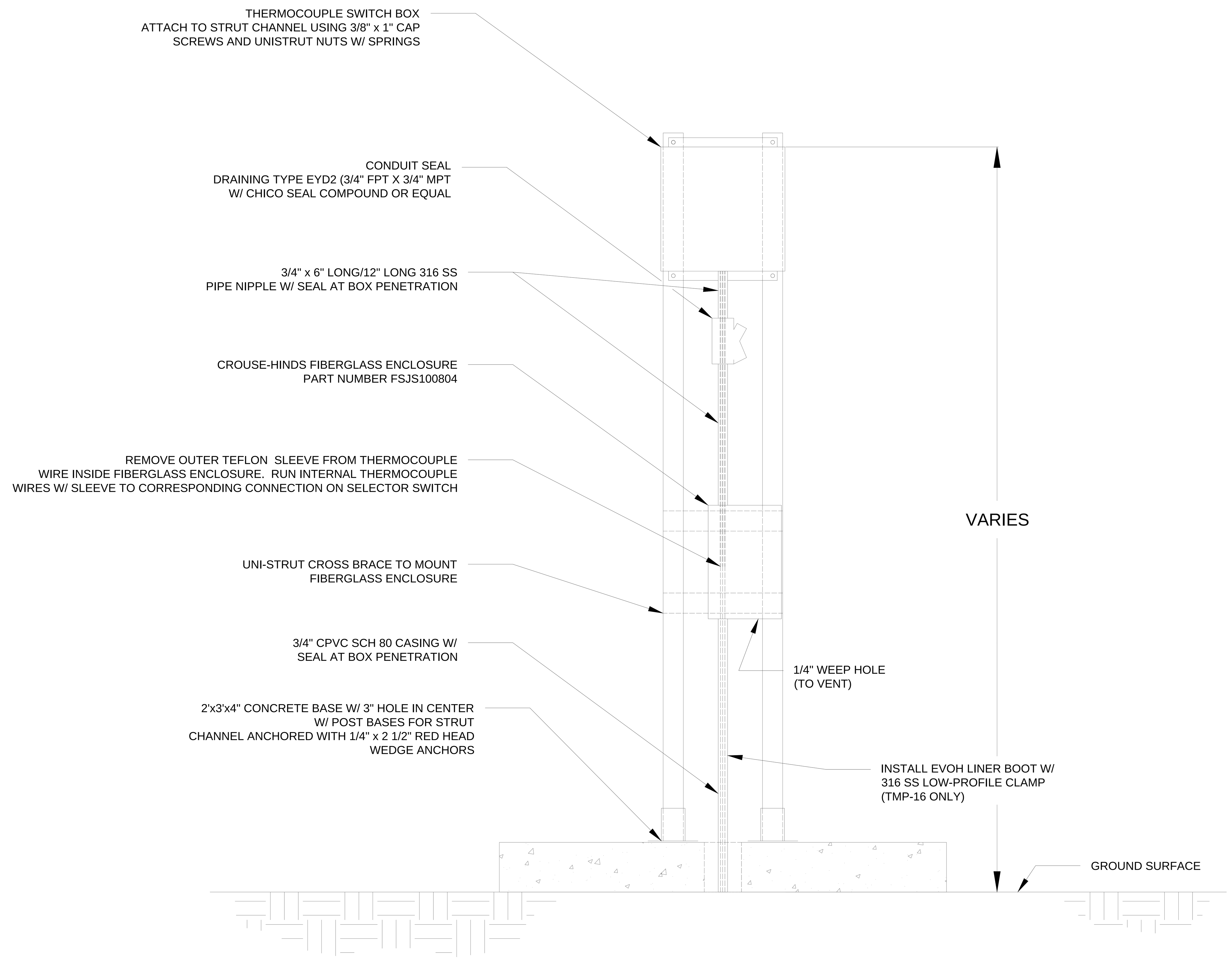


SUBSURFACE DETAIL



SURFACE DETAIL

1 / 004 TEMPERATURE MONITORING PROBE (TMP)

NTS

NOTES:

1:) SWITCH BOX IS SAGINAW CONTROL & ENGINEERING ENCLOSURE 1210ELJ - PANEL IS SCE-12P10J WITH JIC SWING OUT PANEL KIT - MOUNTED WITH HINGE ON RIGHT.
2.) HOLE FOR ROTARY SWITCH TO ACCOMODATE SW142G-12-B
3.) ALL PERFORATIONS AND CLAMPS NEMA 4 RATED

TMP number	T/C 1 Depth (feet)	T/C 2 Depth (feet)	T/C 3 Depth (feet)	T/C 4 Depth (feet)	T/C 5 Depth (feet)
33	20	40	60		
34	20	40	60	74	
35	20	40	60	80	
36	20	40	60	80	98
37	20	40	60	75	
38	20	40	52		
39	20	40	50		
40	20	40	57		
41	20	40	60	72	
42	20	40	60	71	
2R	20	40	60	72	
11R	20	40	60	73	

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NORTH QUARRY AOC
NEW TEMPERATURE
MONITORING PROBES

DETAILS

Engineering for a Better World
FEEZOR ENGINEERING, INC.

MAY 2016
DESIGNED BY: IN
APPROVED BY: DRF

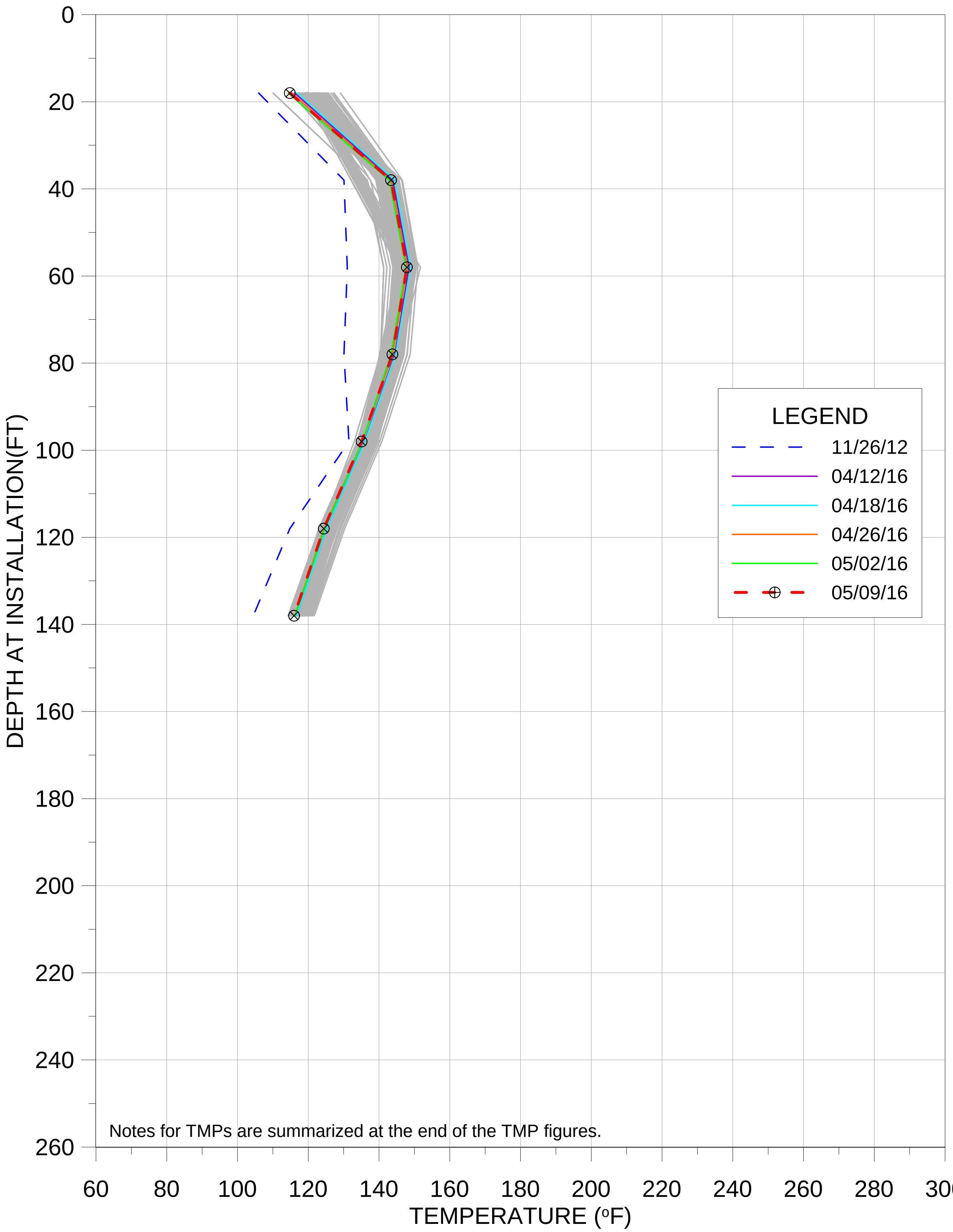
REVISION	DATE

DRAWING NO.: **004**

PROJECT NUMBER: BT-113 FILE PATH: C:\Users\Paul\Dropbox\BT-113 Task - Action Plan Figure 3\Additional TMP Drawings\working\Drawings 1 & 4 Title & Details\BT-113-004 (Details).dwg

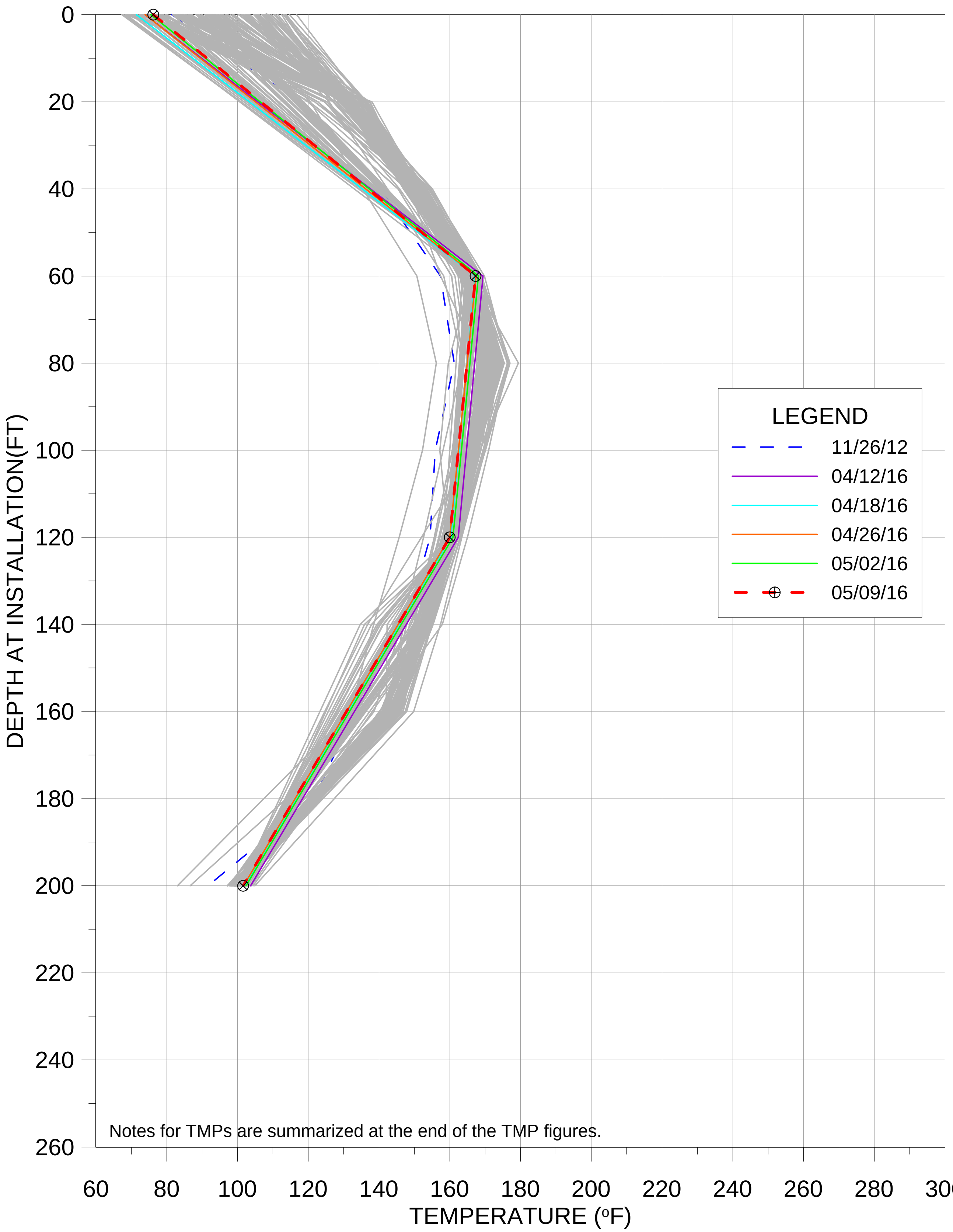
Appendix B
Current TMP readings as of May 9, 2016 and Notes

TMP-1



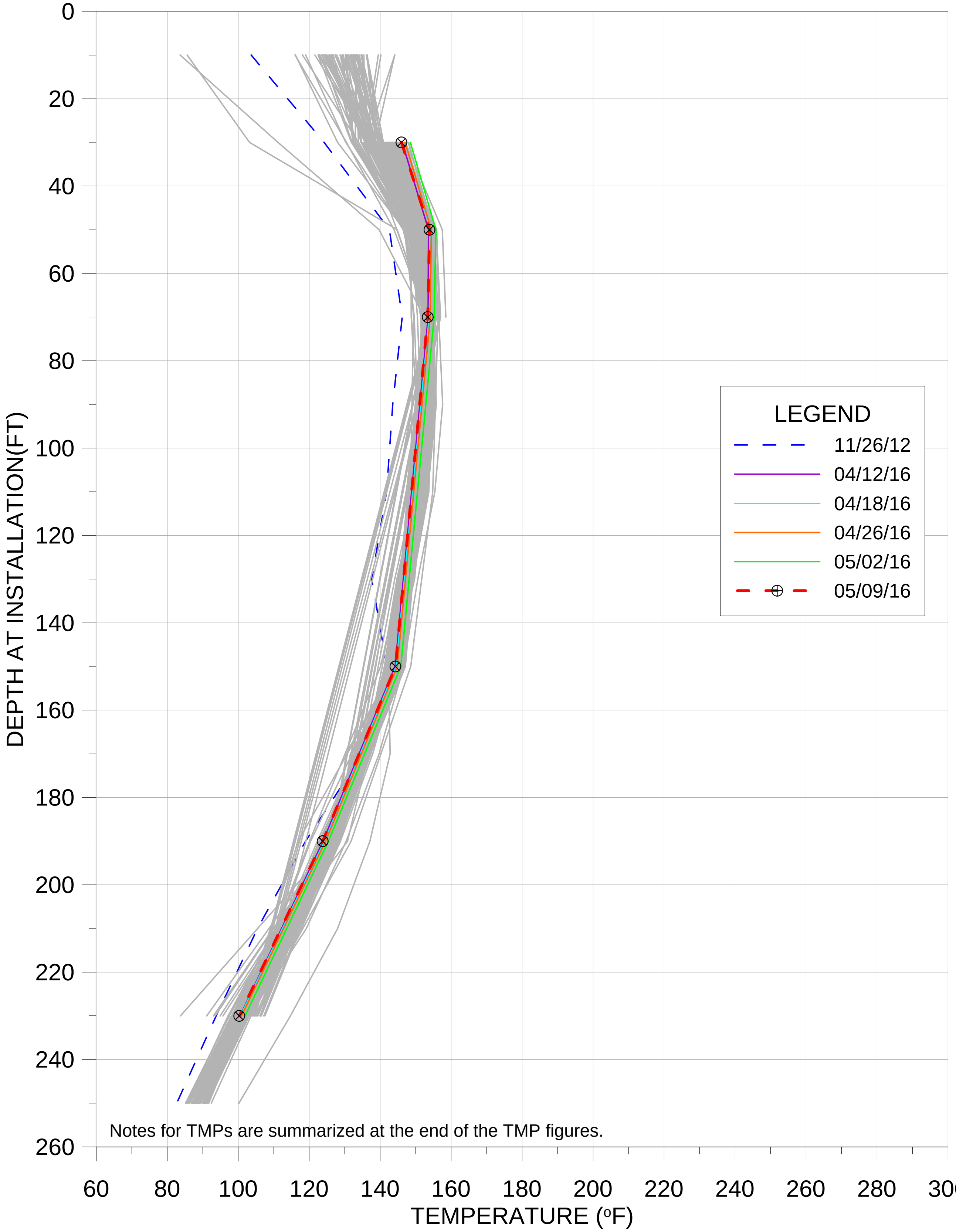
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-2



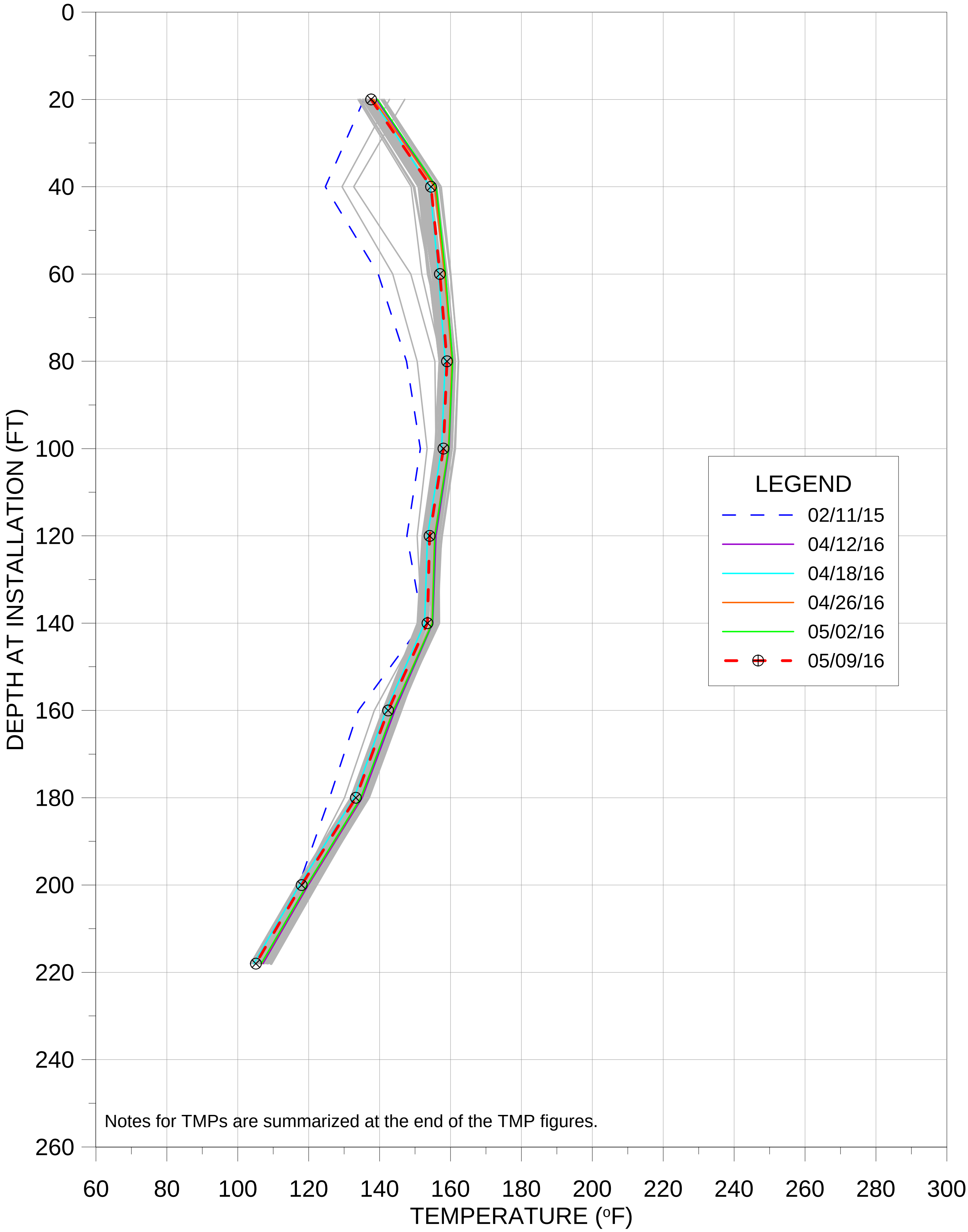
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-3



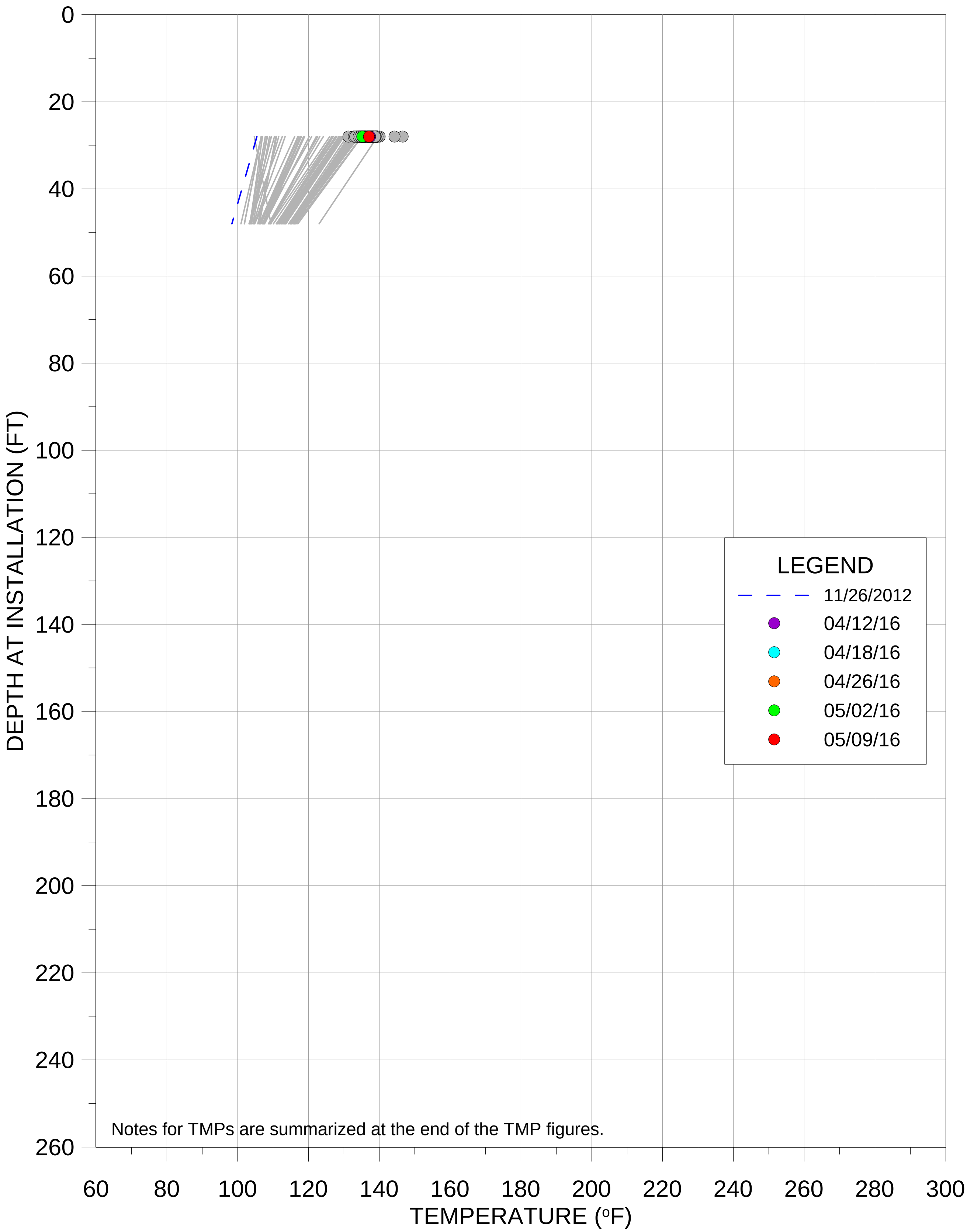
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-3R



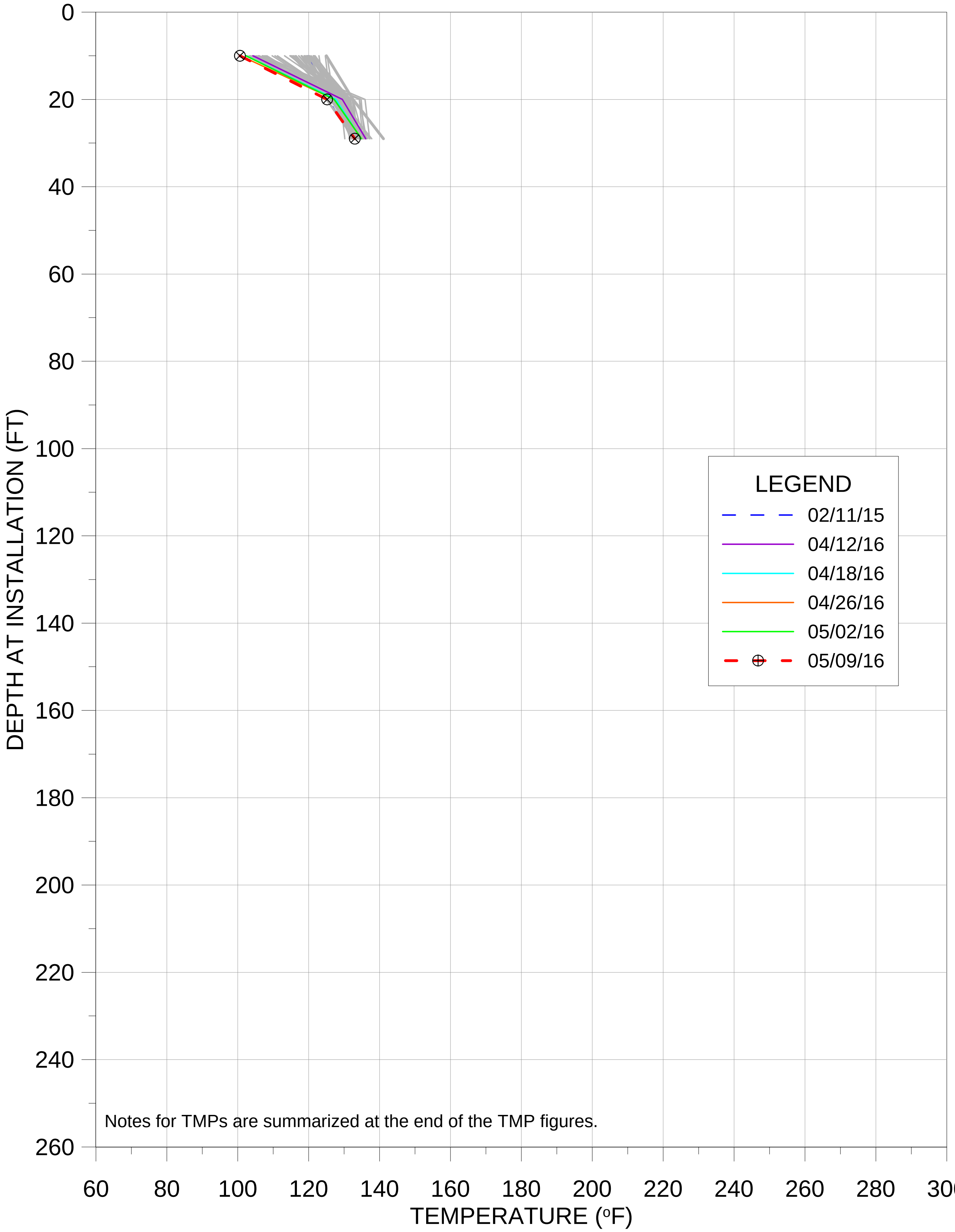
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-4



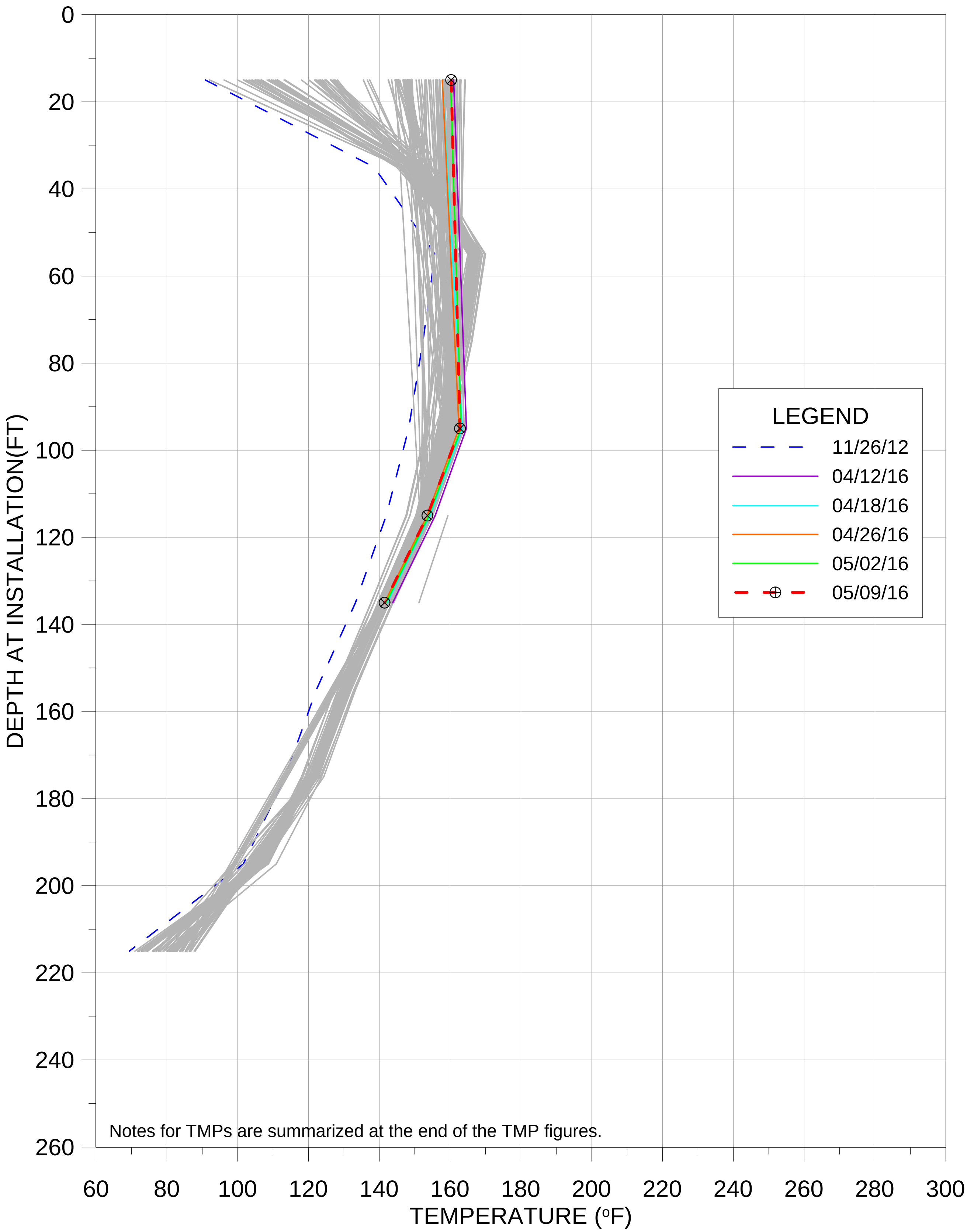
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-4R



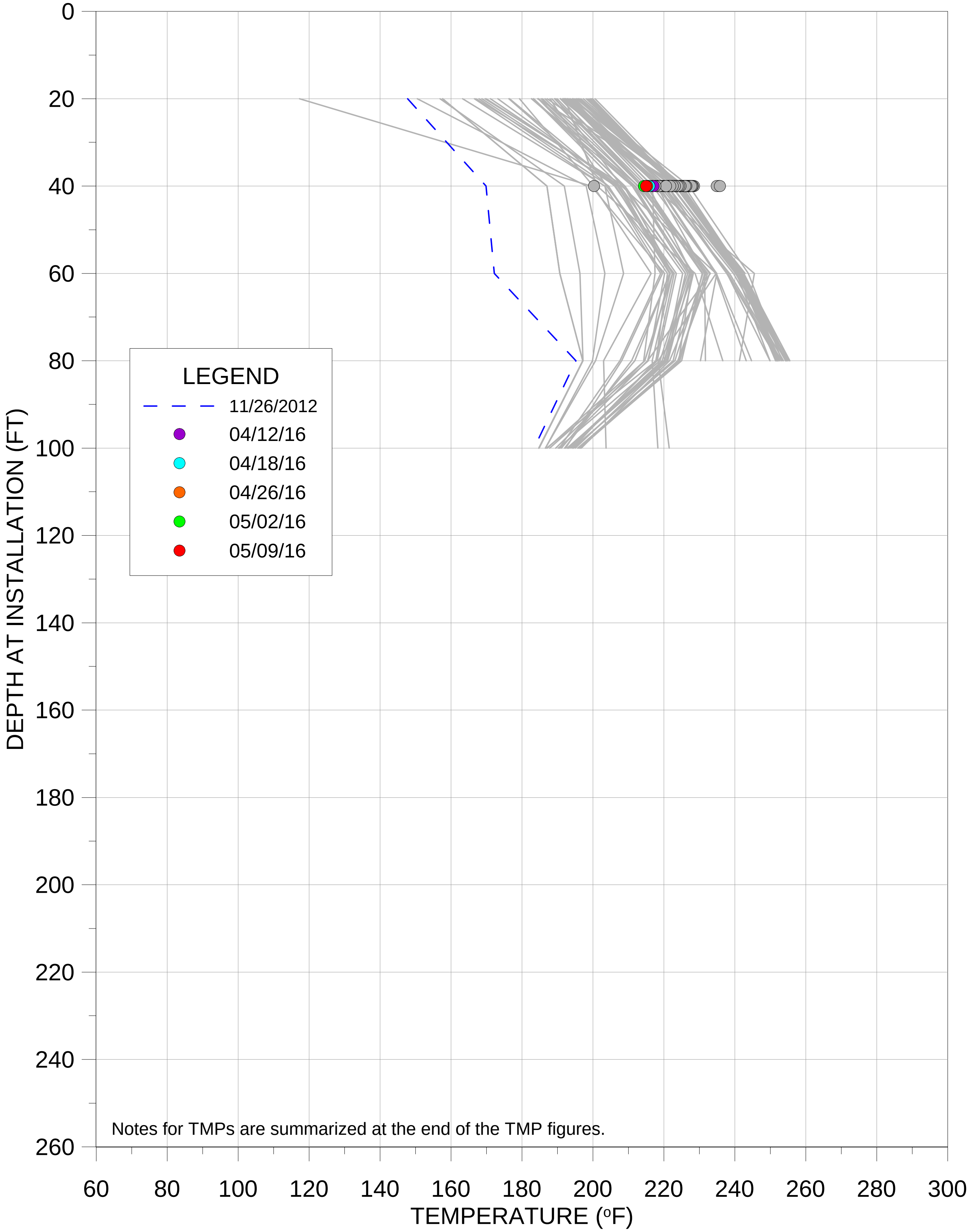
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-6



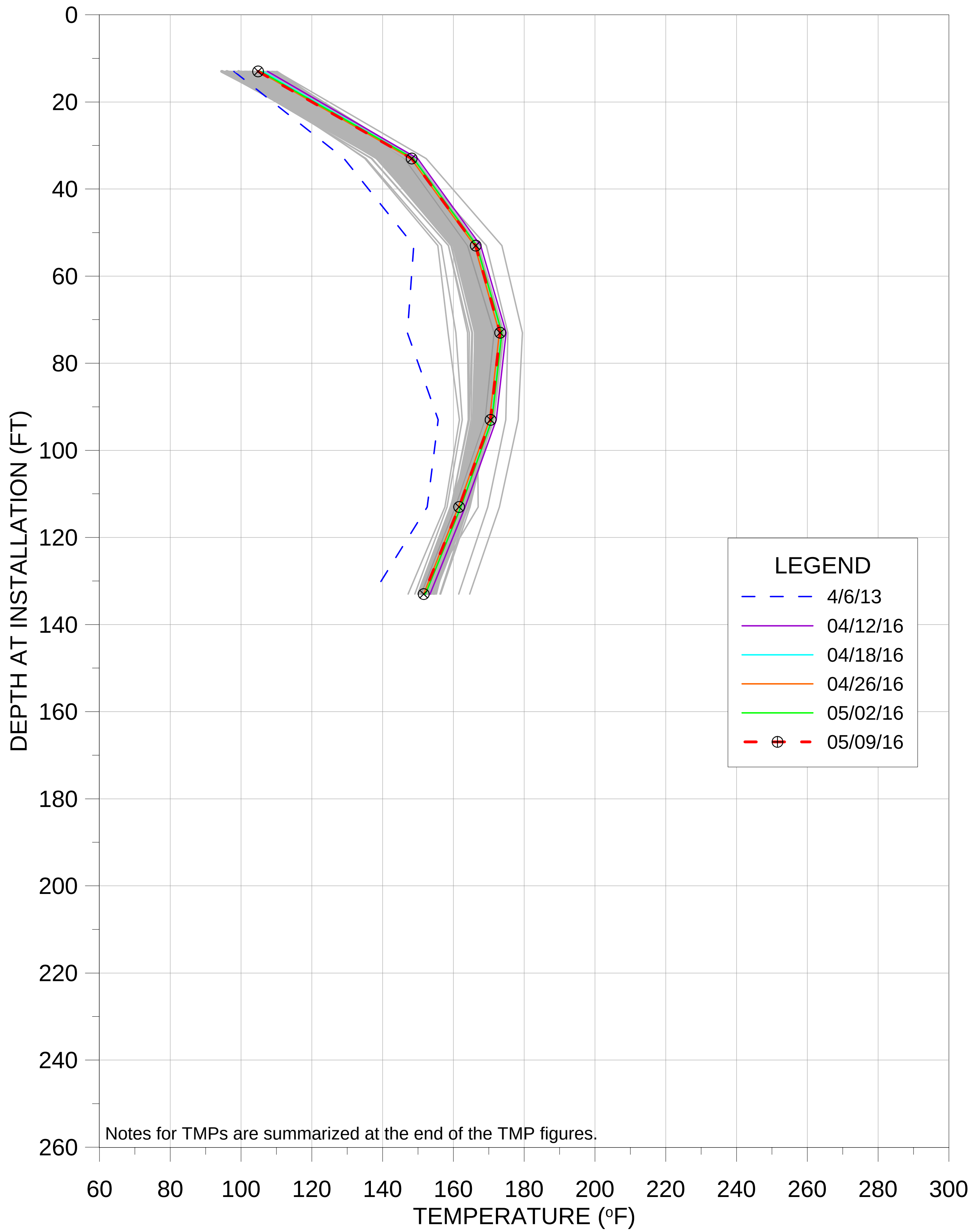
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-9



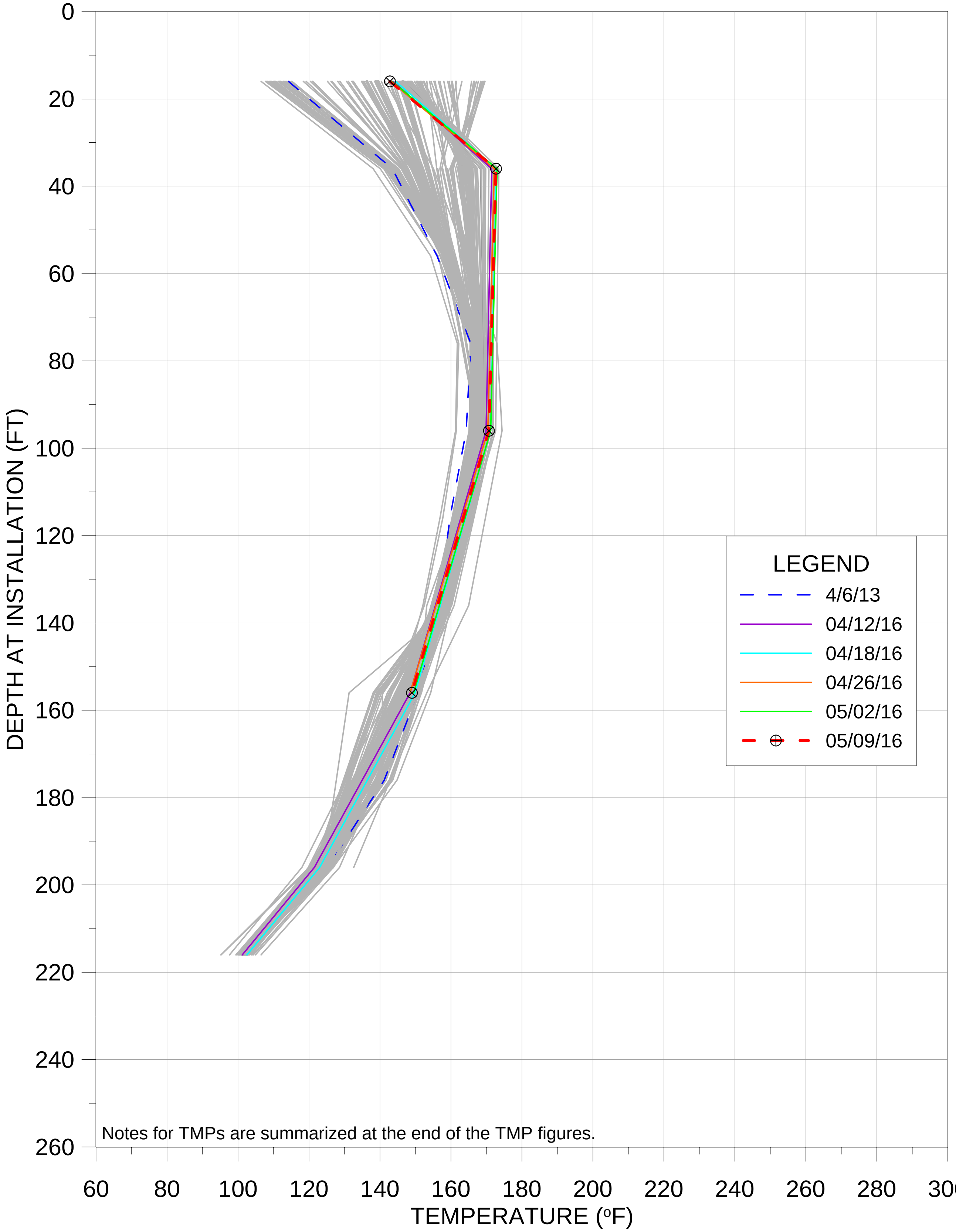
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-10



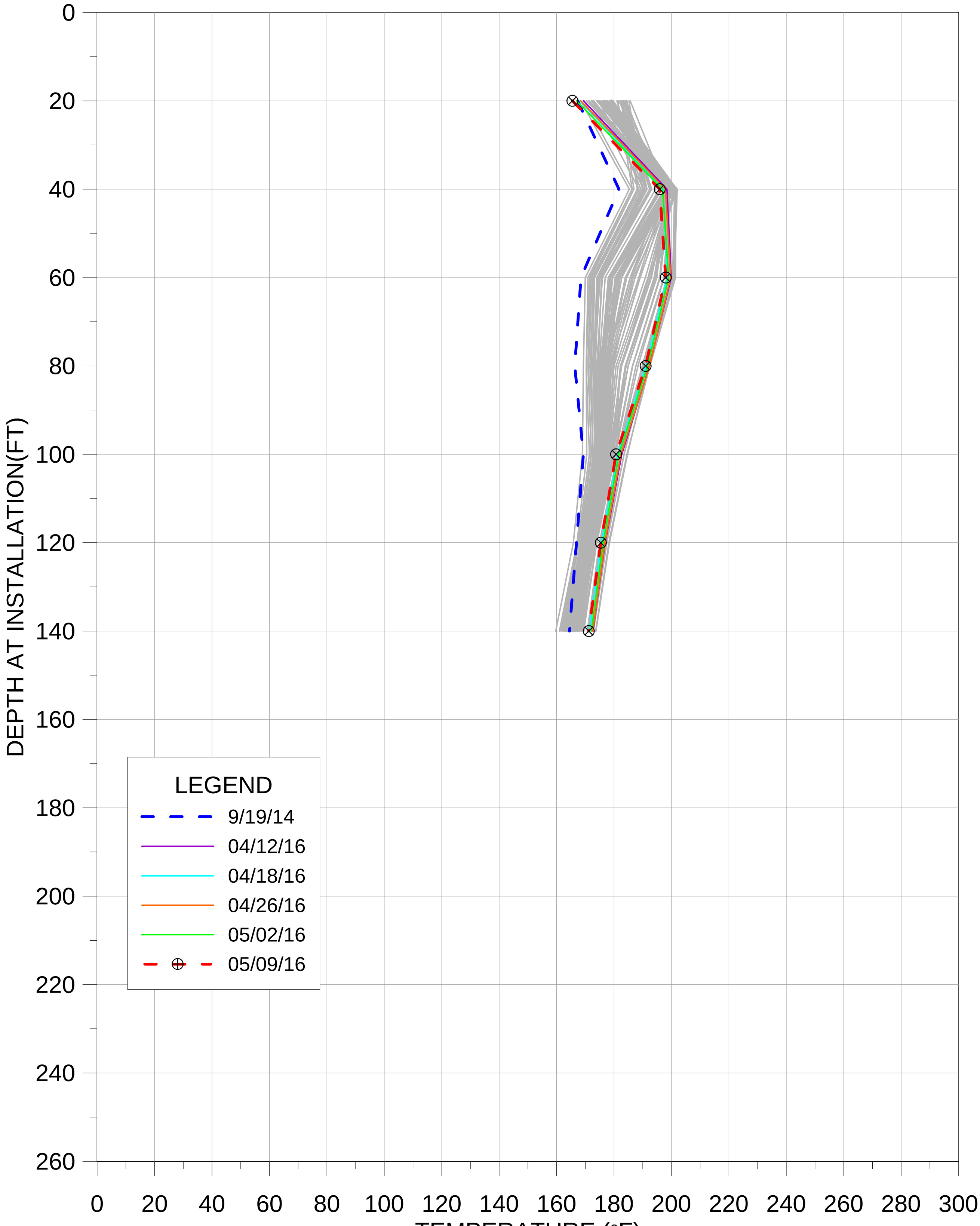
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-11



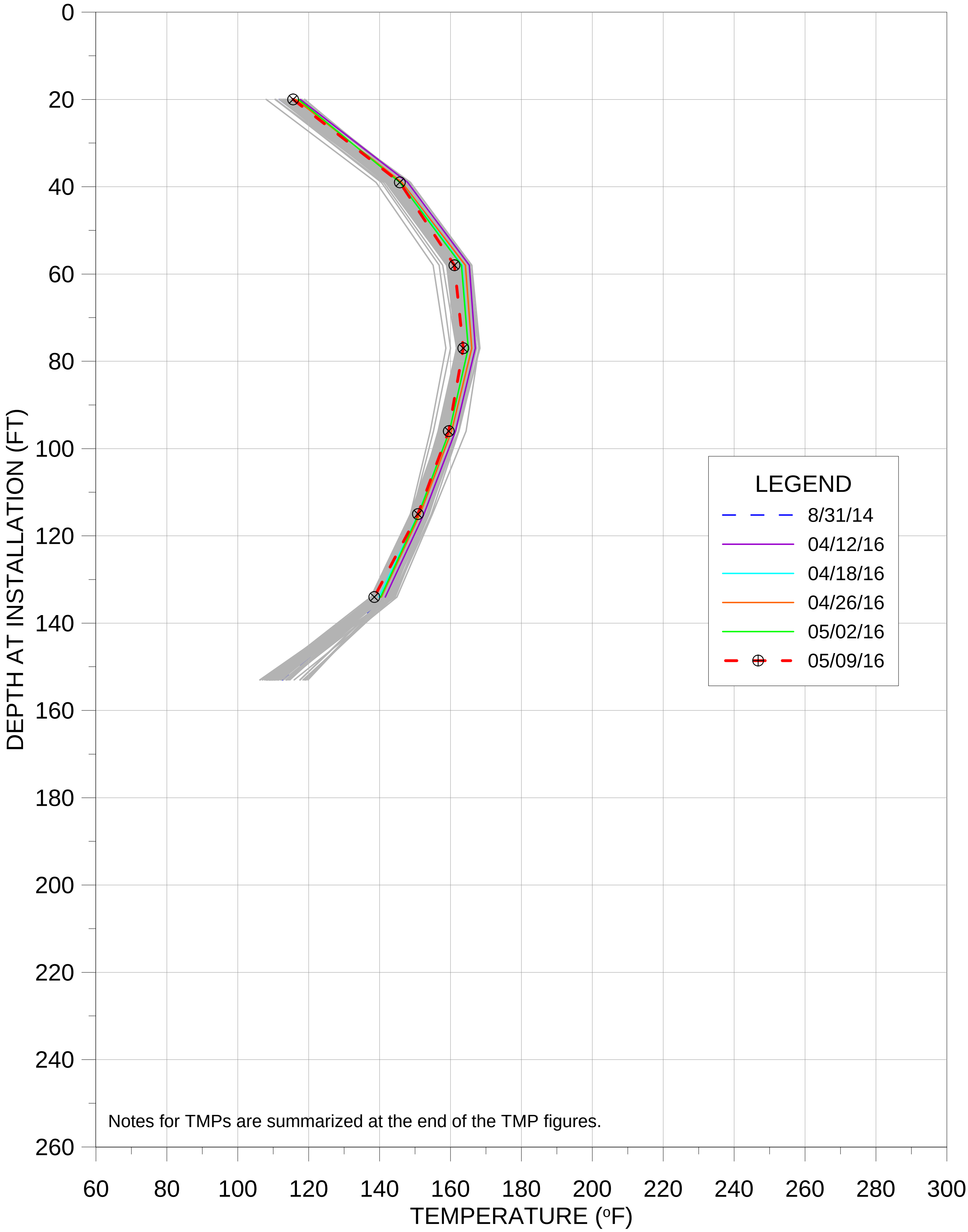
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-14R



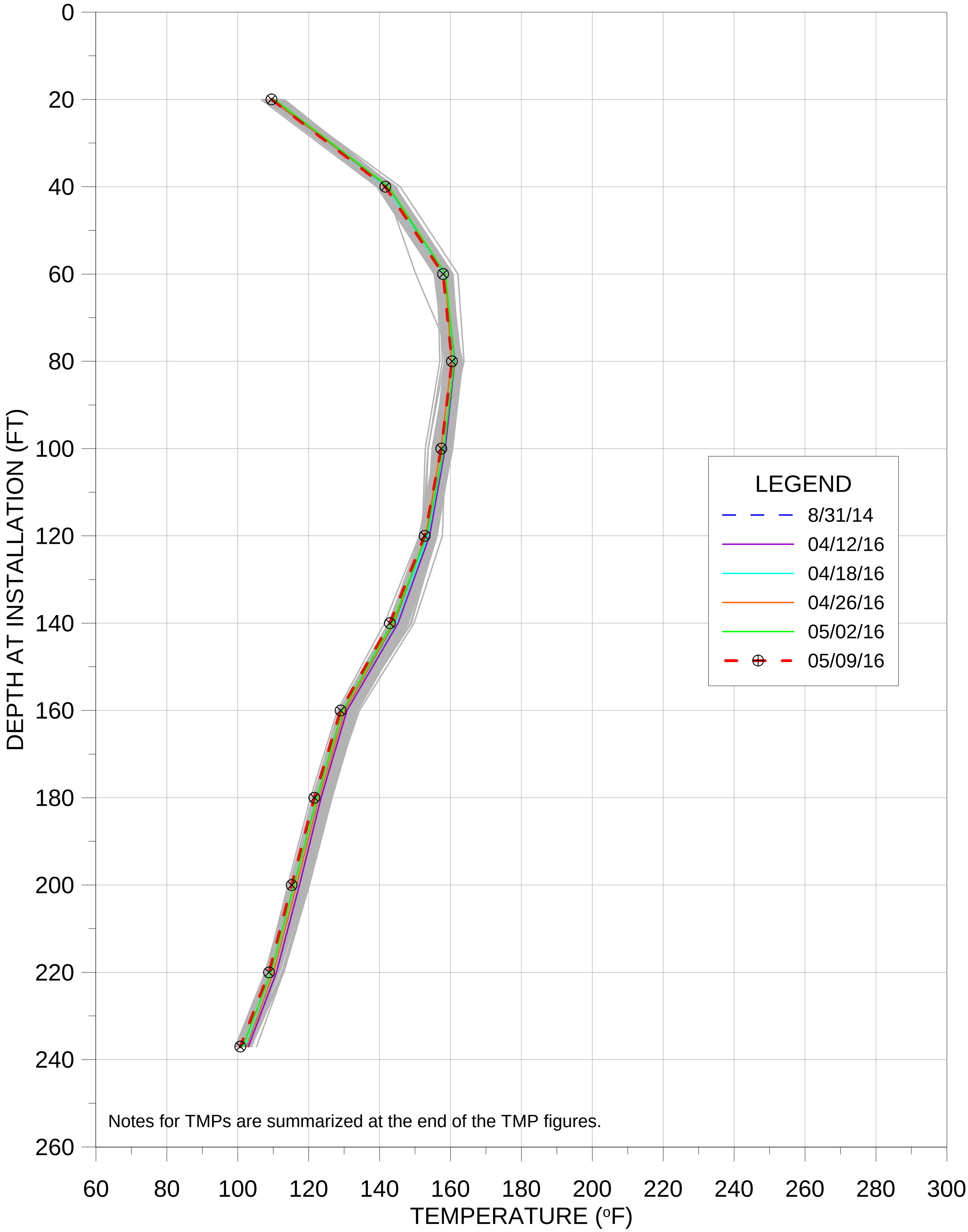
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-16



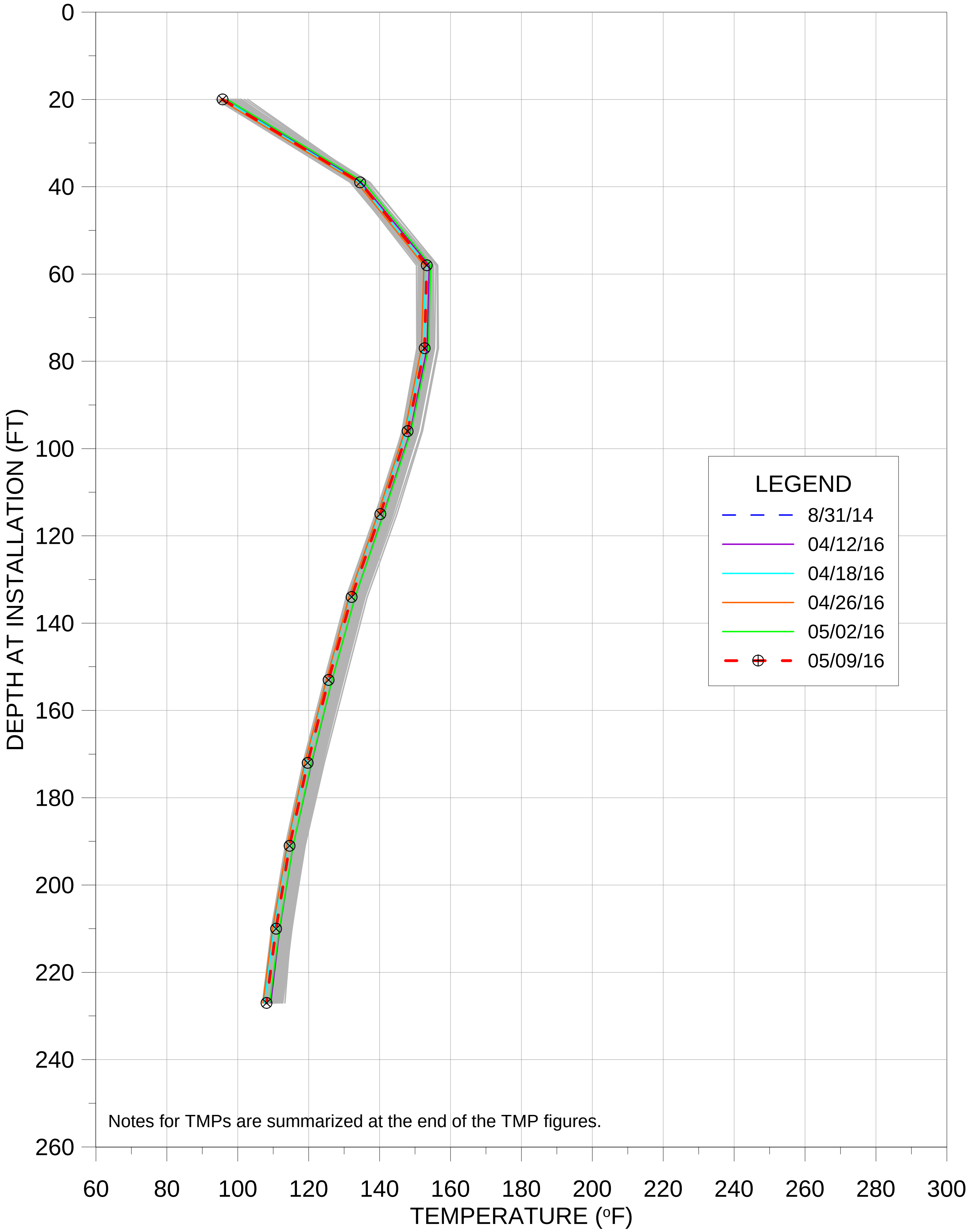
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-17



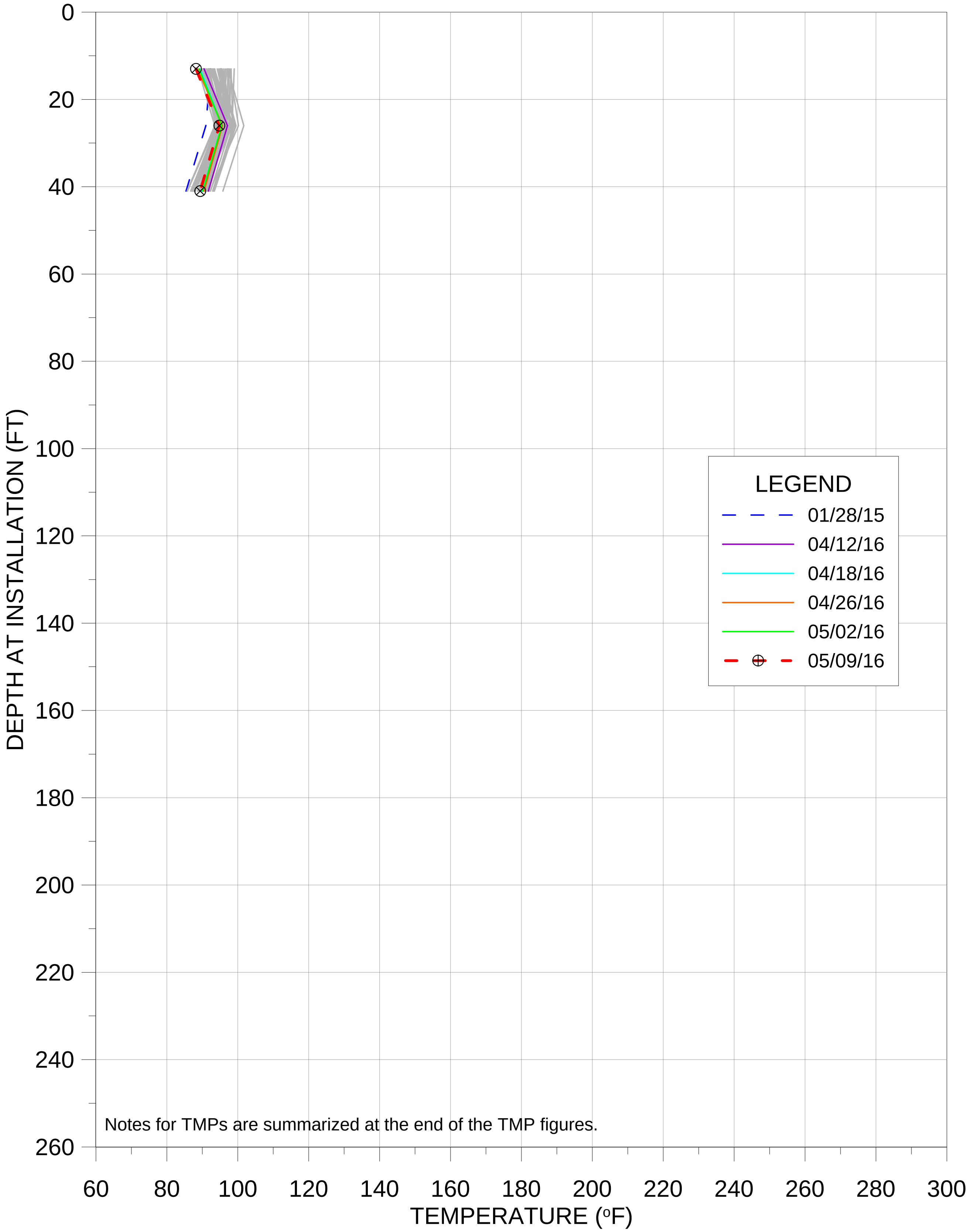
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-18



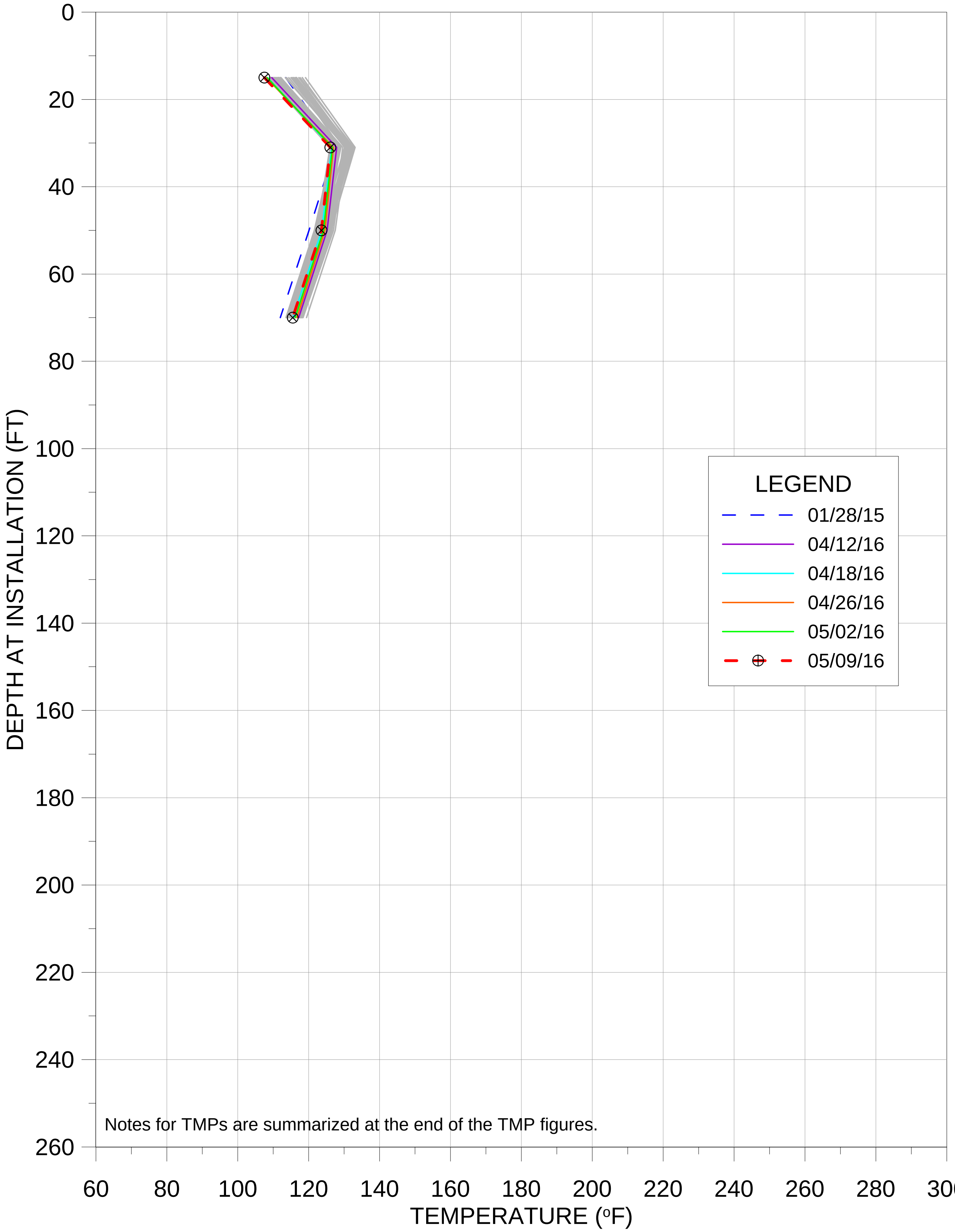
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-21



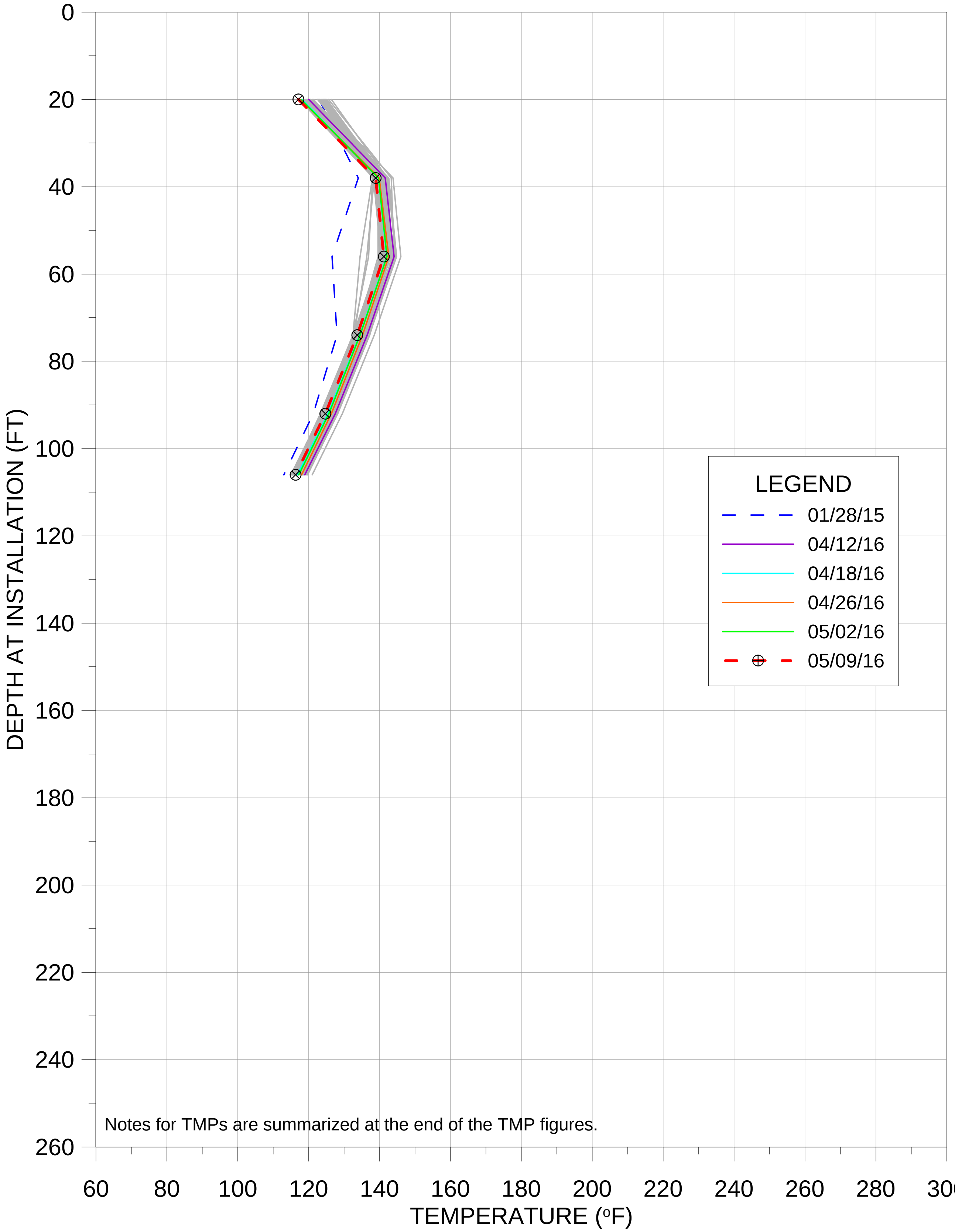
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-22



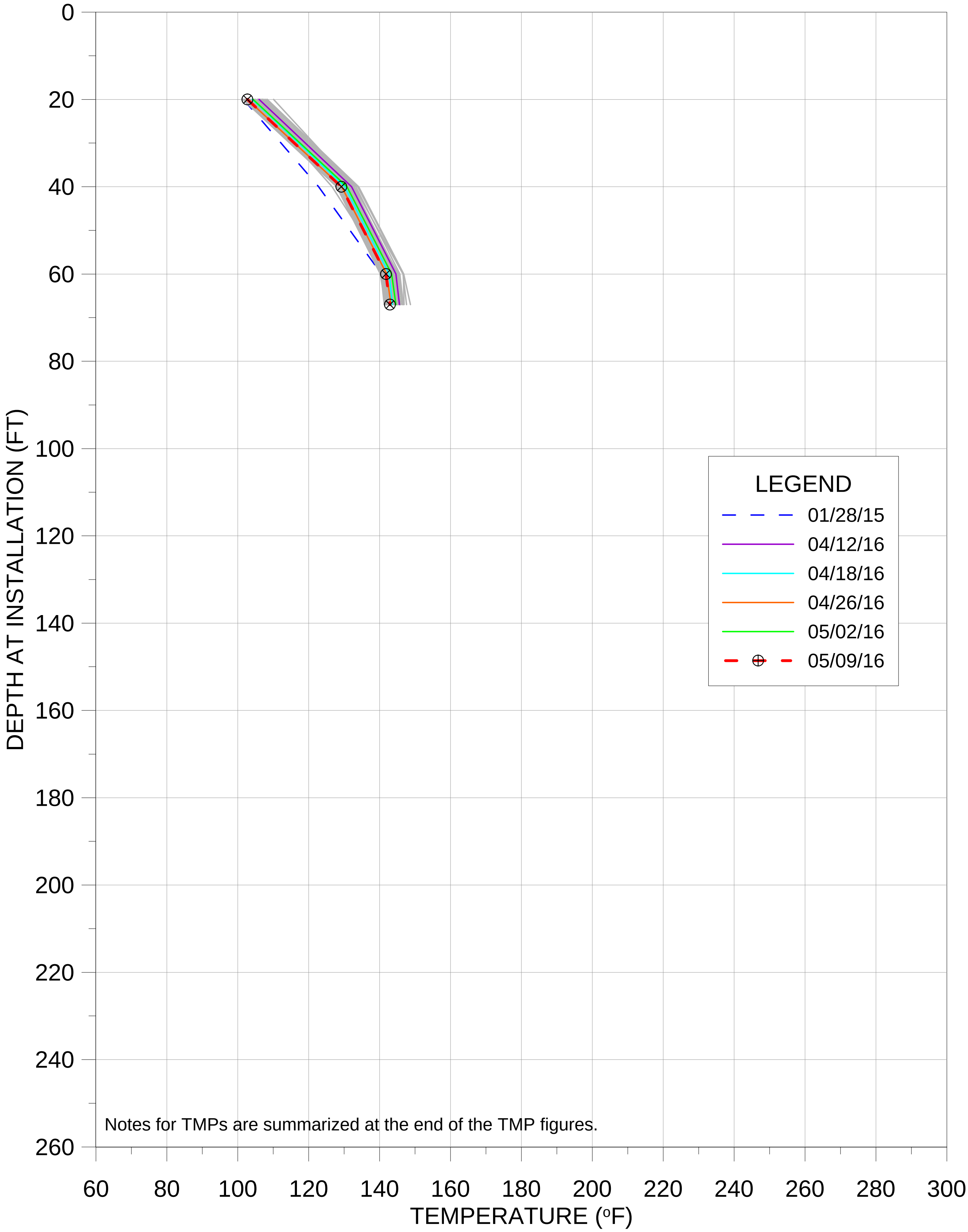
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-23



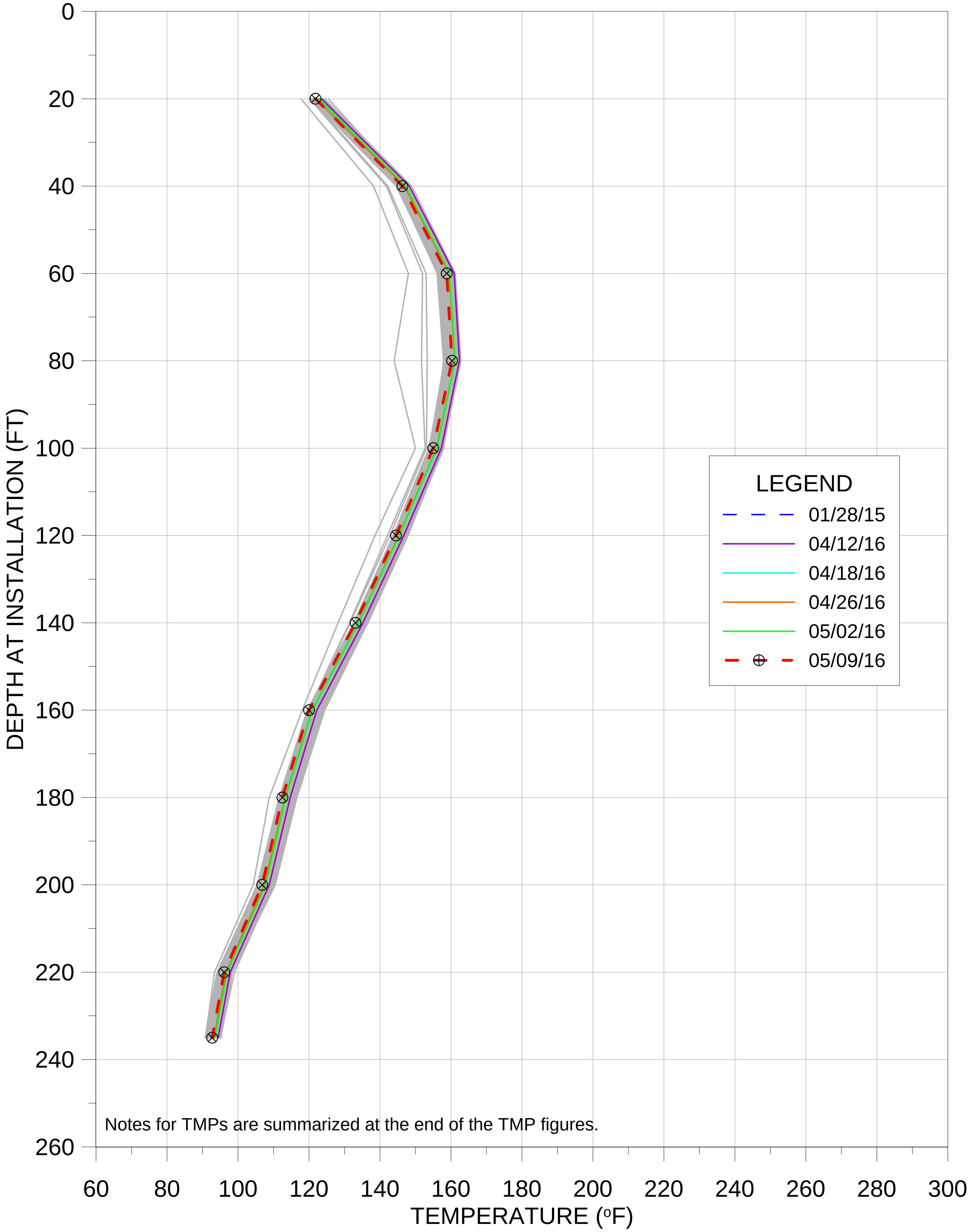
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-24



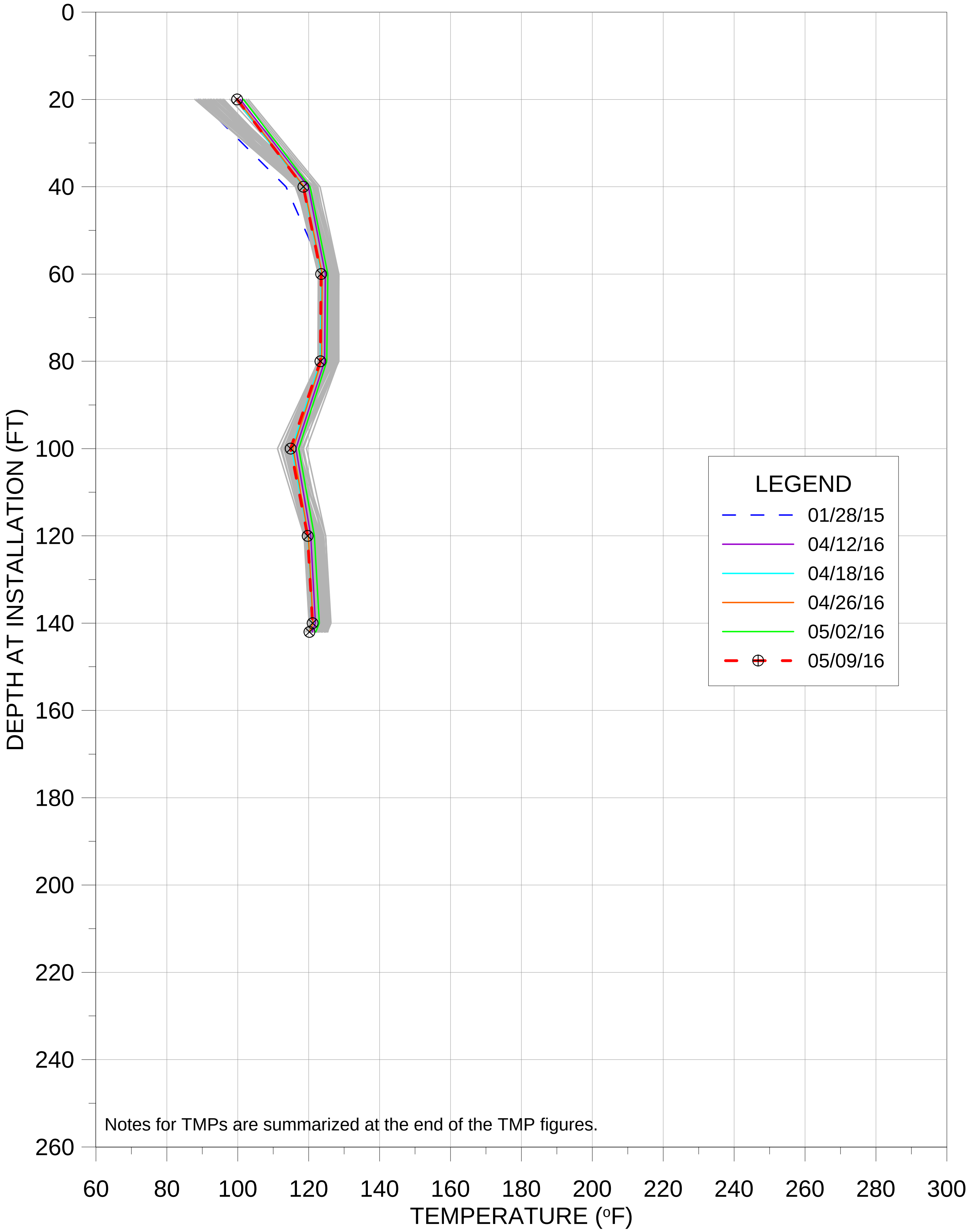
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-25



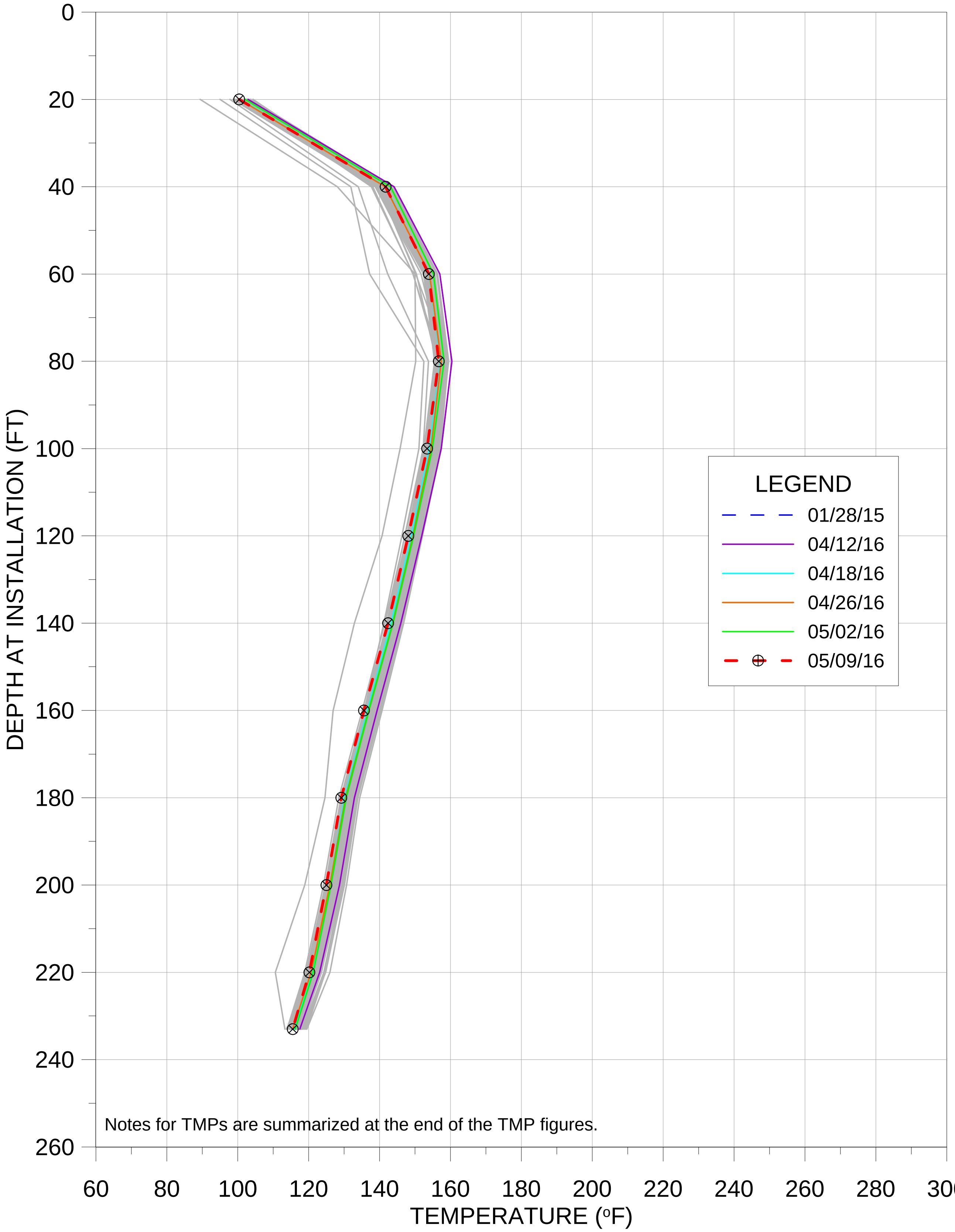
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-26



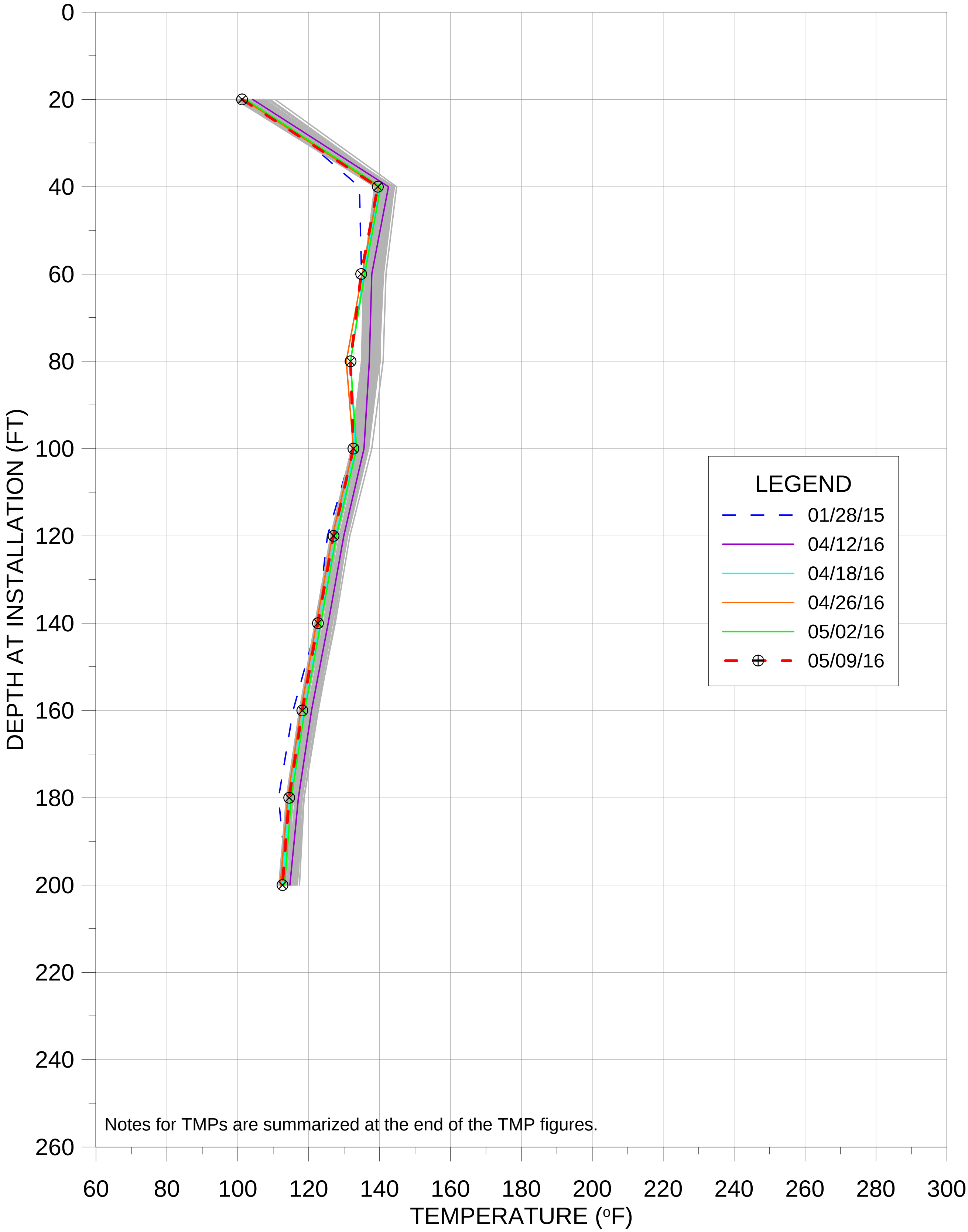
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-27



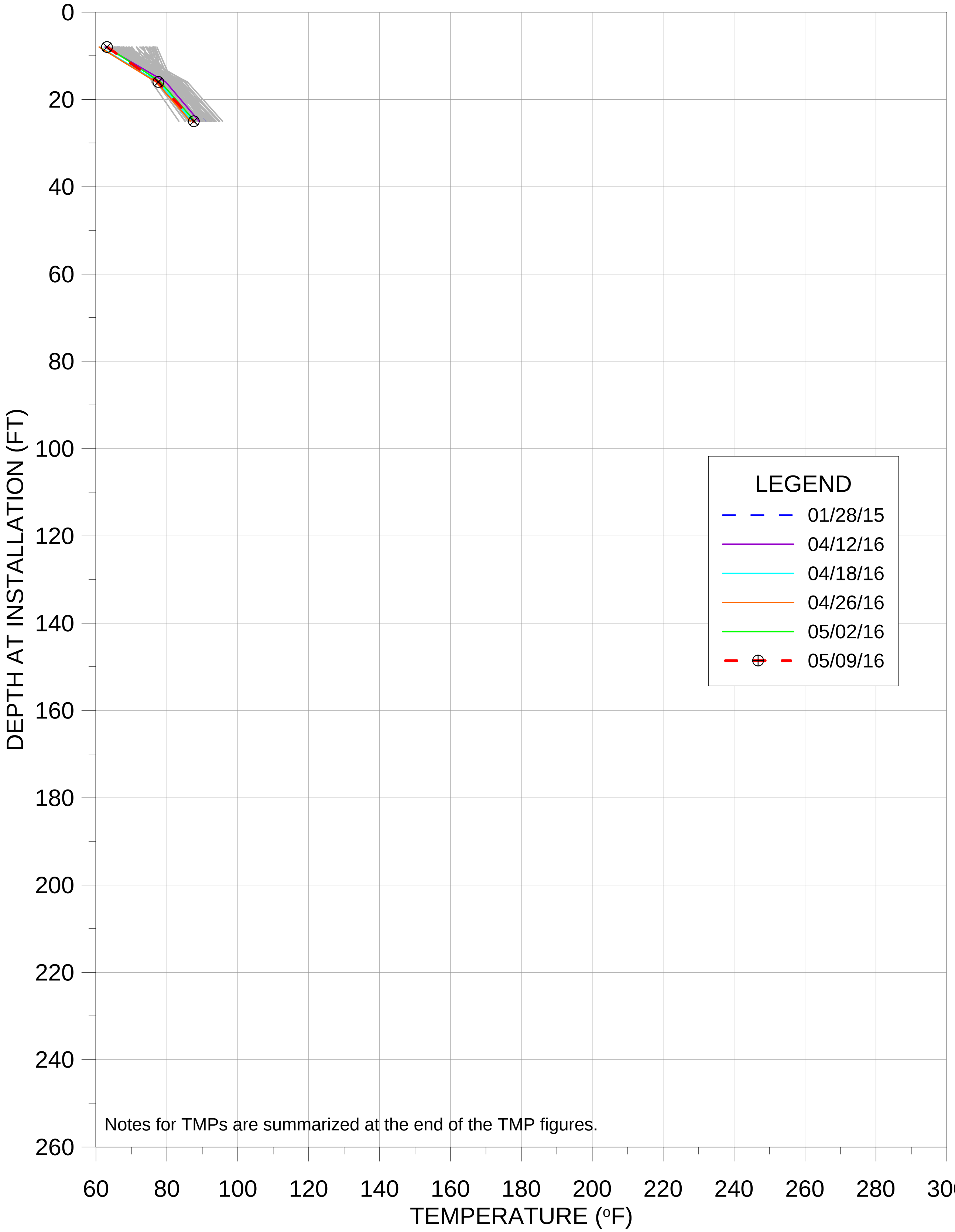
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-28



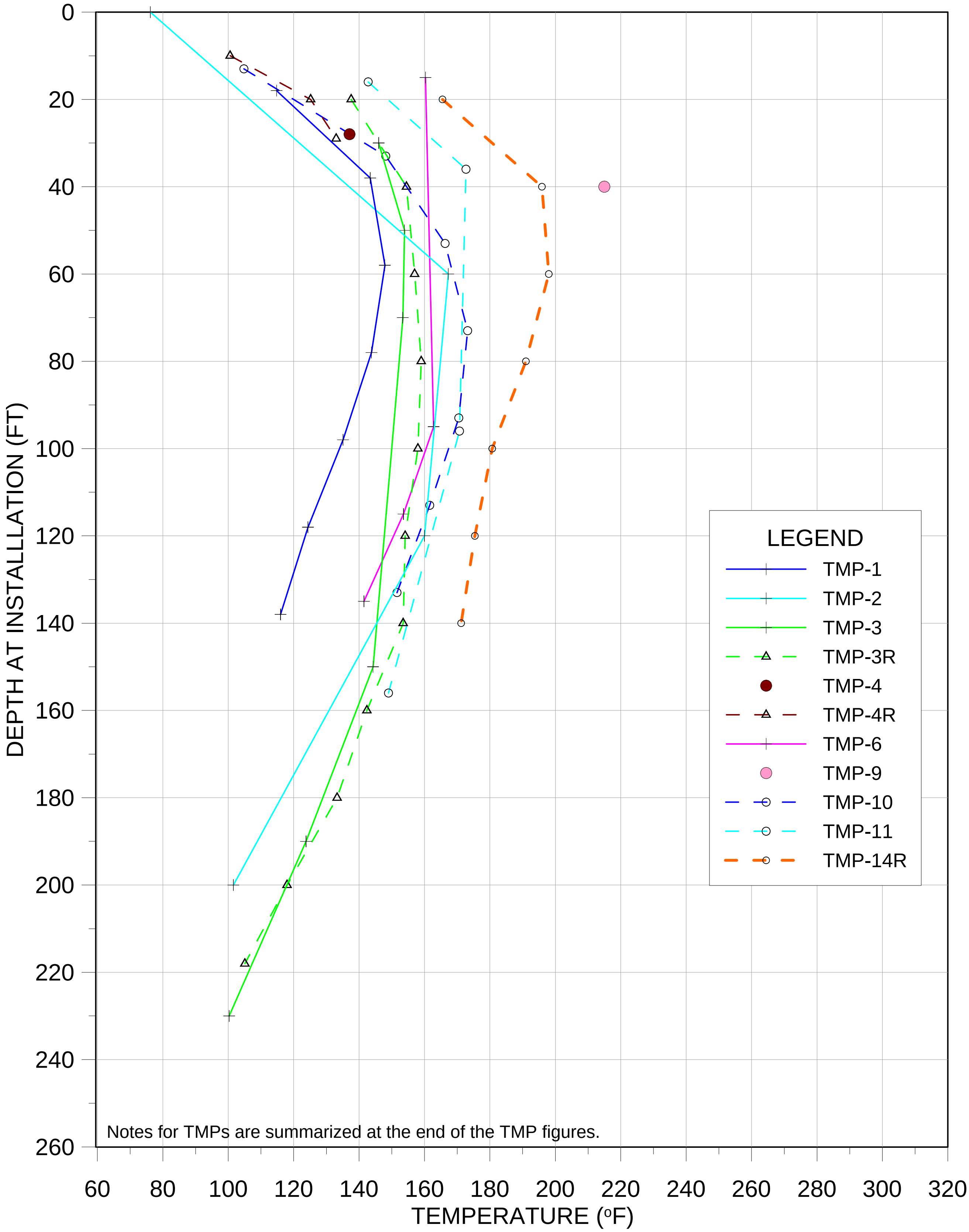
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

TMP-29



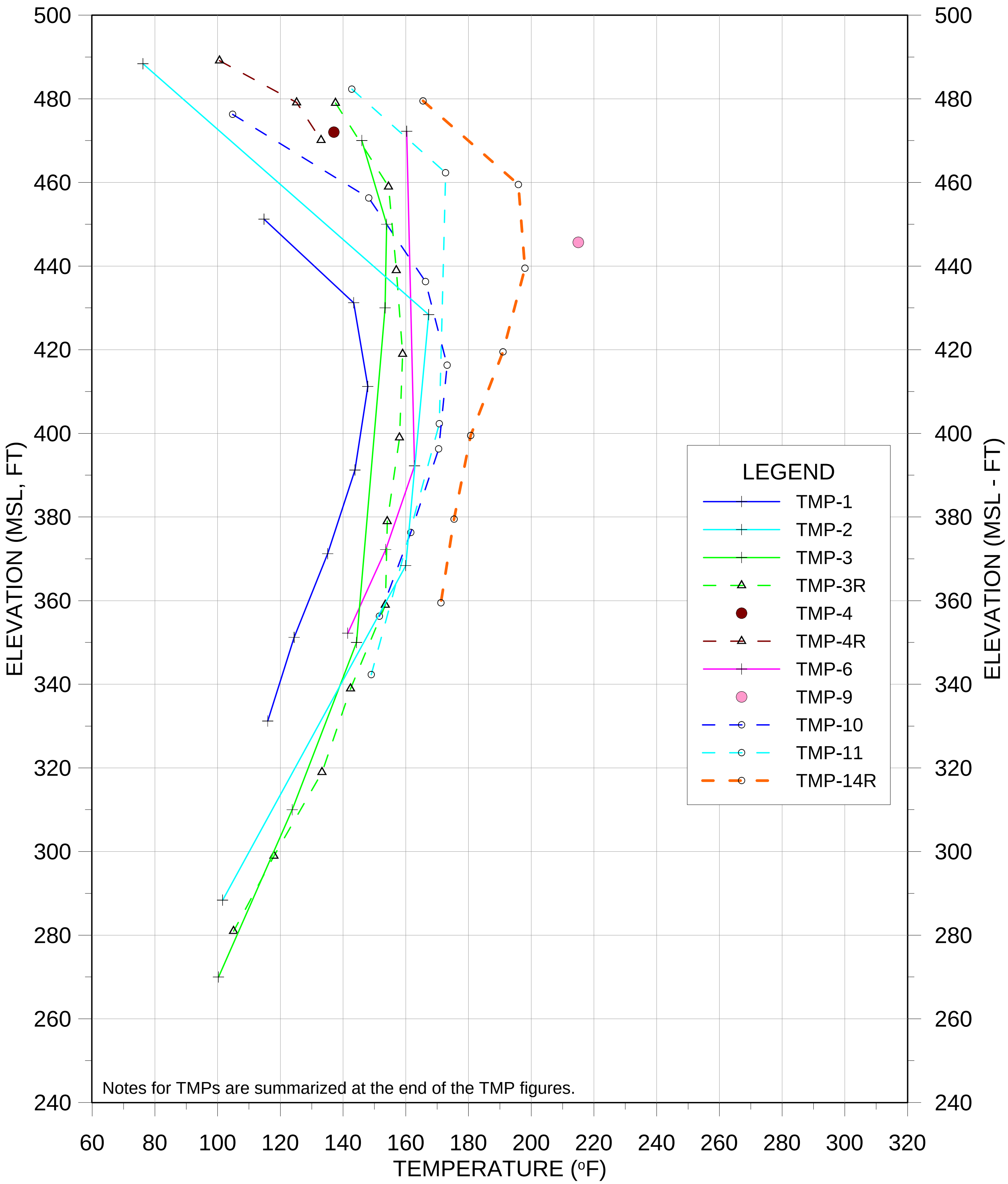
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

5/9/2016



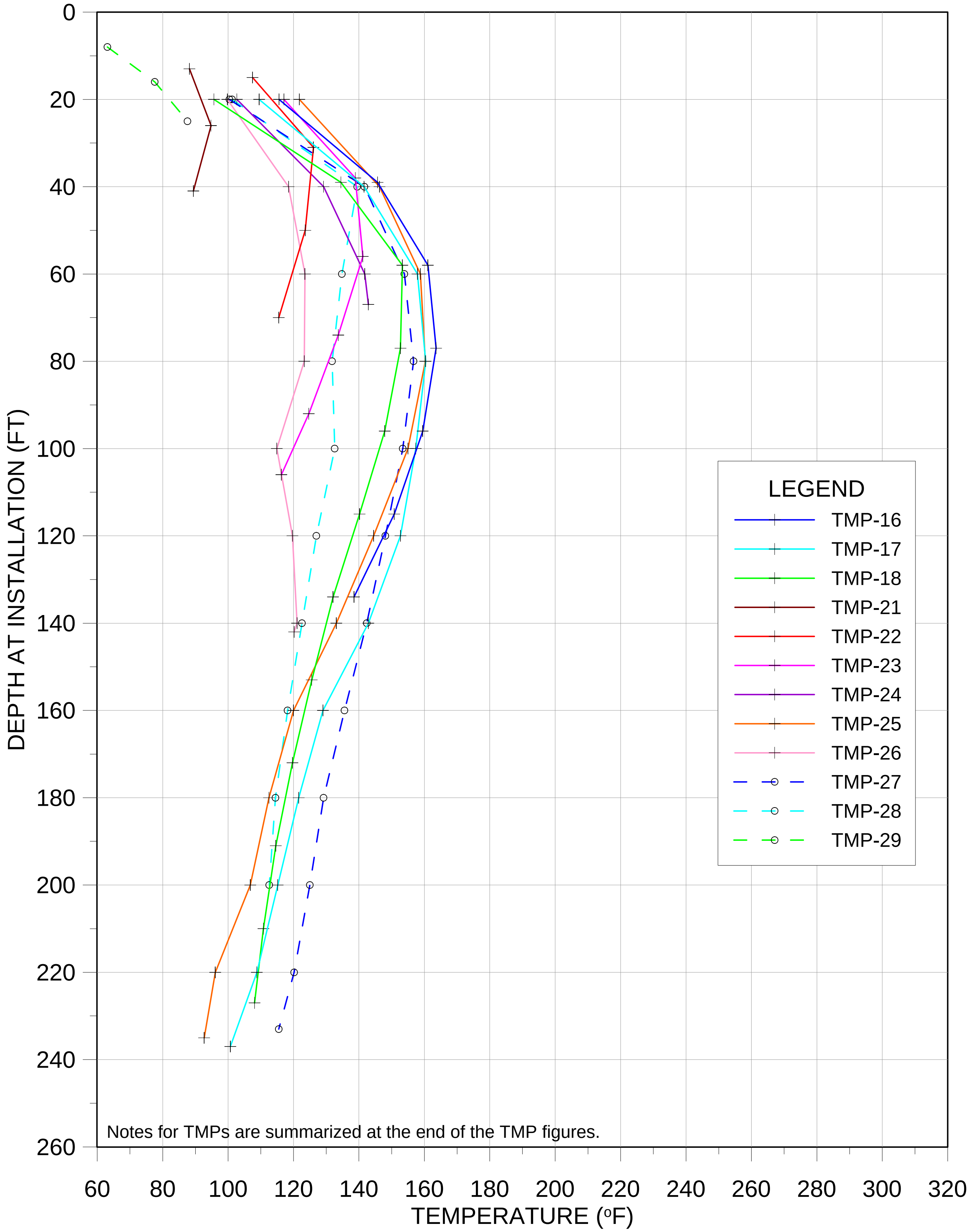
TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

5/9/2016



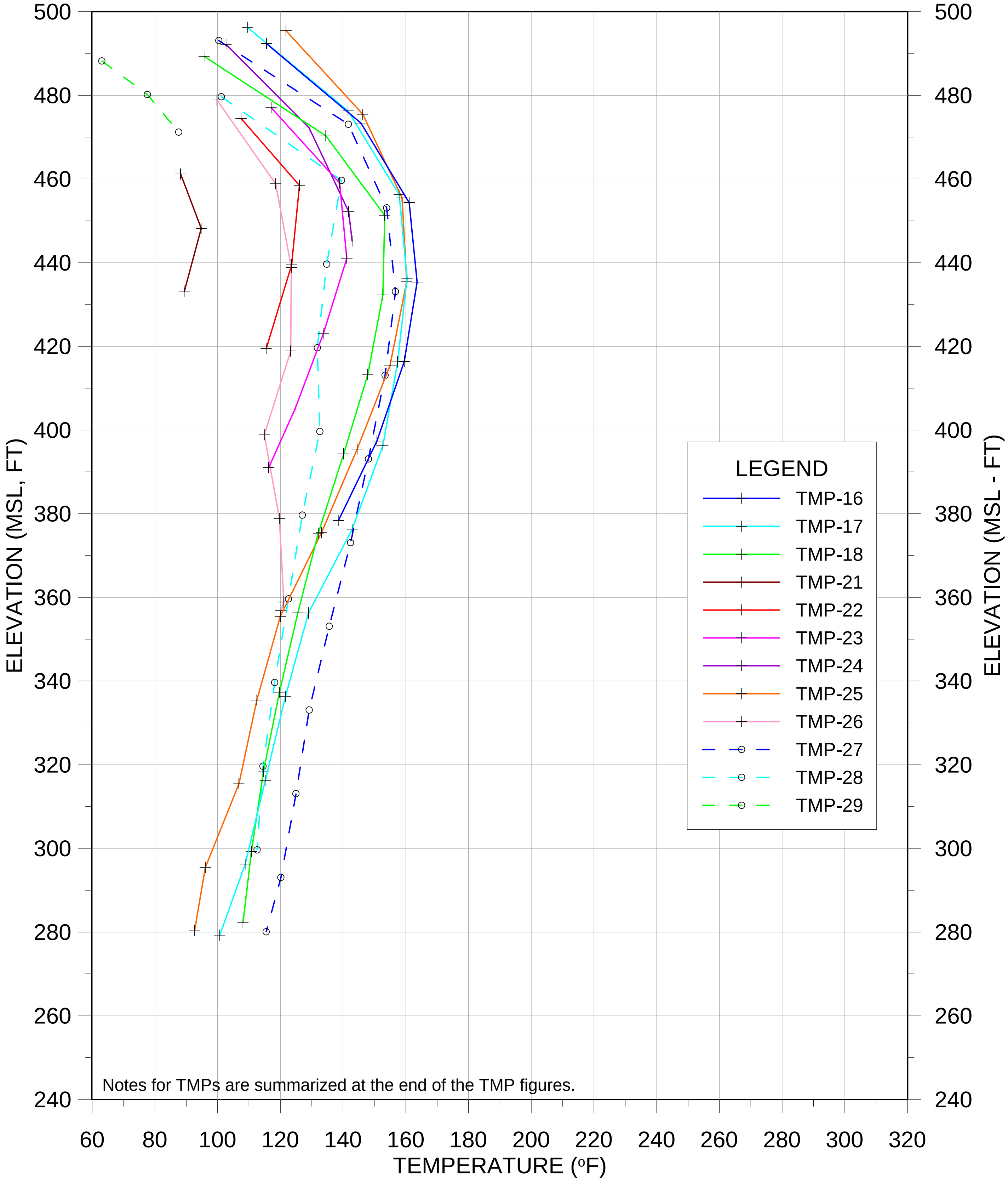
TEMPERATURE VS ELEVATION
BRIDGETON LANDFILL

5/9/2016 - NORTH QUARRY



TEMPERATURE VS DEPTH
BRIDGETON LANDFILL

5/9/2016 - NORTH QUARRY



TEMPERATURE VS ELEVATION
BRIDGETON LANDFILL

TMP BRIDGETON LANDFILL NOTES

TMP-1:

1. No reliable temperature readings at 138 ft depth from 8/1/2014 to 3/24/2015.
2. No reliable temperature readings at 78 ft depth from 8/13/2014 to 3/24/2015.
3. No reliable temperature readings at 38 ft depth from 8/2/2014 to 3/24/2015.

TMP-2:

1. Unit at 180 ft depth had resistance reading above allowable and is no longer working. No reliable reading has been obtained since 11/26/2012.
2. The resistance reading was high and no temperature readings were obtained at 160 ft depth since 6/19/2014.
3. Unit at 120 ft depth had high resistance readings that were fluctuating on 10/22/14 & from 11/5-12/6/2014 and on 12/16/2014.
4. Unit at 60 ft depth had fluctuating high resistance readings from 11/12/14 – 12/6/14 and no resistance reading between 2/11/2015 and 2/25/15, therefore the temperatures are unreliable during those dates.
5. The conductivity tests on 3/19/15 conducted by Feezor Engineering showed that units at 20’, 40’, 80’, 100’, 140’ are no longer reliable.

TMP-3:

1. No reliable temperature readings have been obtained at 170' depth since 1/29/2014, except on 3/13/2014.
2. The conductivity tests on 4/11/14 conducted by CEC showed that units at 10', 90', 130’, 210' and 250' are no longer reliable.
3. No reliable temperature readings were obtained at 230' depth from 8/01/2014 – 12/6/14 and 2/11/15 – 2/25/15.
4. No reliable temperature readings were obtained at 190' depth from 9/12 to 10/17/14, from 11/5 to 11/26/14 and on 12/16/14.
5. The conductivity tests on 10/28/14 conducted by Feezor Engineering showed that units at 10', 90', 110', 130', 210' and 250' are not reliable.
6. The unit at 150' no temperature or unreliable readings between 9/12/14 and 3/3/15.
7. The unit at 230' had unreliable or no readings from 10/22/-12/6/2014, between 2/11/15 – 2/25/15.
8. The unit at 190' had unreliable or no readings from 12/16/14 – 2/17/15.

TMP-3R: NONE

TMP-4:

1. The conductivity tests on 4/11/14 conducted by CEC showed that the unit at 48' depth is no longer reliable.

TMP-4R: NONE

TMP-5: TMP NO LONGER IN SERVICE– Verified by Conductivity testing by Feezor Engineering in March 2015.

TMP-6:

1. Unit at 195 ft depth had a resistance reading above acceptable on 11/20/2013.
2. Unit at 155 and depth had resistance readings above acceptable since 3/19/2014. No temperature readings were obtained.
3. Units at 195 ft depths had resistance readings above acceptable and no temperature readings obtained from 3/19/2014 to 4/11/2014.
4. The conductivity tests on 4/11/14 conducted by CEC showed that units at 35', 55', 75', 155', 175', and 195' depths are no longer reliable.
5. No reliable temperature readings were obtained at the unit at 95' on 5/13/14, 5/28-7/2/14, 10/1-10/8/14, 10/22/14, 11/12-12/6/14, 1/14/15 & 2/4/15–4/7/15. The temperatures between 12/16/14-1/8/15 are questionable due to high/fluctuating resistivity.
6. No reliable temperature readings were obtained at the 15' unit on 5/28-6/13/14, 6/25/14, 8/1-9/2/14, 10/1-10/8/14, 11/19-12/6/14, 1/2/15, & between 1/28/15 – 3/18/15. The temperature obtained on 12/16/14 is questionable due to high resistivity.
7. No reliable temperature readings were obtained at the unit at 215' since 6/13/14.

TMP-7R: TMP NO LONGER IN SERVICE

TMP-8:

1. Lines connecting data over distance of > 40' are to identify the data set and should not be used for temperature estimation.
2. The presented TMP readings represent the thermocouples that were operational on those dates.
3. No acceptable readings were obtained between 7/25/13 to 10/10/13.
4. Acceptable readings were obtained resuming on 10/16/13 from 20' to 80' depths.
5. Resistance of the unit at 80' indicates the reading is not reliable since 12/04/13.
6. The conductivity tests on 10/28/14 conducted by Feezor Engineering showed that units at 40' and 60' are not reliable.
7. A conductivity test conducted by Feezor Engineering showed that the unit at 20’ is not reliable on 9/9/15.

TMP-9:

1. All units had resistivity readings higher than acceptable levels on 7/3, 7/18, 7/25, 8/14, 8/20, 8/27, and 9/3/2013. Values shown on and between those dates are for informational purposes and should not be considered reliable. Resistivity readings since 9/11/2013 were acceptable for all units except 100'.

2. Unit at 100' depth had an inaccurate temperature reading on 8/1/2013 and no reading since 8/6/2013.
3. Unit at 80' depth had a high resistivity and no temperature readings on 4/1/2014.
4. The conductivity tests on 4/11/14 conducted by CEC showed that units at 20', 60', 80', and 100' depths are no longer reliable.
5. Unit at 40' depth had a resistance lower than credible on 11/12/14. The unit requires assessment.
6. Unit at 40' depth had a resistance which is fluctuating from week to week between 11/19 & 11/26/14. The readings are considered unreliable during that time.

TMP-10:

1. Resistance readings for 7/18 and 7/25/2013 were acceptable; however the temperature readings appear inaccurate. This issue appears to be resolved as of the 8/1/2013 readings.
2. No reliable temperature reading was obtained at 113’ depth between 3/3/15 and 3/18/15.

TMP-11:

1. None of the units had acceptable resistivity readings on 7/3/2013. The units at TMP-11 were subsequently re-read on 7/8/2013. Resistance readings for 7/8/2013 were acceptable.
2. All units had resistivity readings higher than acceptable levels on 7/18/2013. Values shown for that date are for informational purposes and should not be considered reliable.
3. All units had acceptable resistance readings starting on 7/25/13, except a high resistance reading at 116' depth since 10/30/13.
4. No temperature reading was obtained at 176' since 1/17/2014.
5. The unit at 156' depth had high or questionable resistance since 1/17/14. No temperatures were obtained between 1/17/14 and 5/13/14, on 6/19/14, between 8/13/14 and 10/17/2014, and since 2/11/15. Readings were either not obtained or deemed unreliable between 8/13/14 and 3/31/15, except for on 10/22/14 and 12/10/14.
6. The unit at 56' depth had a high resistance reading since 3/19/14 & no temperatures were obtained.
7. The conductivity tests on 4/11/14 conducted by CEC showed that units at 56', 116', and 176' depths are no longer reliable.
8. No temperature was obtained on 6/25/14 at 216' depth.
9. The conductivity tests on 10/28/14 conducted by Feezor Engineering showed that units at 56', 116' and 176' are not reliable.
10. The Unit at 76' depth had either no readings or unreasonable readings between 11/12 & 12/6/14, 12/24/14, on 1/14/15, on 2/17/15 and from 3/10/15 – 3/31/15.
11. The Unit at 16' depth had either no readings or unreasonable readings between 11/19 & 12/6/14 and 12/16/14 – 1/28/15.
12. The Units at 196’ and 216’ had high resistance readings since 4/26/16 and the temperature was unreliable.

TMP-12:

1. All units were verified by Conductivity testing by Feezor Engineering in October 2015 to be unreliable.

TMP-13: TMP NO LONGER IN SERVICE

TMP-14:

1. All units were verified by Conductivity testing by Feezor Engineering in March 2016 to be unreliable.

TMP-14R:

1. Due to the Conductivity test results by Feezor Engineering on TMP-14 (see note above), TMP-14R is added to this reporting data set as of 3/7/16.

TMP-15: TMP WAS NEVER IN SERVICE

TMP-16:

1. A conductivity test conducted by Feezor Engineering showed that the units on TMP-16 may not be reliable since 9/9/15. Further testing at the end of September 2015 showed possible connectivity on some of the units. The resistivity and temperatures will continue to be monitored.
2. The unit at 153 ft depth had a low resistance reading and unreliable temperature since 12/21/15.

TMP-17: NONE

TMP-18: NONE

TMP-19: NOT PART OF THIS SUBMITTAL (HEAT EXTRACTION TMP)

TMP-20: NOT PART OF THIS SUBMITTAL (HEAT EXTRACTION TMP)

TMP-21: NONE

TMP-22: NONE

TMP-23: NONE

TMP-24: NONE

TMP-25: NONE

TMP-26: NONE

TMP-27: NONE

TMP-28:

1. The unit at 217 ft depth has had no resistance or temperature readings since installation.

TMP-29: NONE

TMP vs DEPTH and TMP vs ELEVATION (for 5/9/16):

1. There were no reliable temperature readings for TMP-13 since 3/19/2014.
2. There were no reliable temperature readings for TMP-7R, as determined by the conductivity test on 4/11/14.
3. There were no reliable temperature readings for TMP-5 from 7/17-9/2/2014 and since 11/5/14.
4. There were no reliable temperature readings for TMP-9 from 11/19 - 12/26/2014.
5. There were no reliable temperature readings for TMP-12 from 11/19/2014 – 3/31/15, except 2/4/15. There were no reliable temperature readings for TMP-12 since 9/28/15.
6. There were no reliable temperature readings for TMP-8 since 9/9/15.
7. There were no reliable temperature readings for TMP-14, confirmed since 3/7/16.