AGENCY REVIEW DRAFT
SUPPLEMENTAL REMEDIAL INVESTIGATION REPORT – PHASE 3
CHELAN CHEVRON
CLEANUP SITE ID: 6660
232 East Woodin Avenue
Chelan, Washington

August 17, 2020

Prepared for:
Washington State Department of Ecology
1250 West Alder Street
Union Gap, Washington 98903

Prepared by:
Leidos, Inc.
18939 120th Avenue NE, Suite 112
Bothell, Washington 98011

On Behalf of:
Chevron Environmental Management Company
6001 Bollinger Canyon Road
San Ramon, California 94583

leidos

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Russell S. Shropshire, PE
Principal Engineer

leidos

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SUPPLEMENTAL REMEDIAL INVESTIGATION REPORT – PHASE 3
CHEVRON SERVICE STATION NO. 9-6590

1. INTRODUCTION AND OBJECTIVES

Leidos, Inc. (Leidos), on behalf of Chevron Environmental Management Company (Chevron), prepared this report to summarize the results of the third phase of Supplemental Remedial Investigation activities (SRI Phase 3) conducted at the Chelan Chevron site (the Site), located at 232 East Woodin Avenue in Chelan, Washington (Figure 1). The SRI Phase 3 field activities were performed beginning in November 2017 and were completed in March 2019. SRI activities for the Site are being performed pursuant to the terms of Agreed Order No. DE 10629, which was entered into by Chevron and the Washington State Department of Ecology (Ecology) in June 2014,

The objective of the SRI Phase 3 activities was to expand upon previous work performed to address data gaps regarding the presence of petroleum hydrocarbon contamination and light non-aqueous phase liquid (LNAPL) at the Site. Specifically, the SRI Phase 3 field activities included the following investigation elements:

1. Performance of LNAPL baildown testing to collect additional data regarding LNAPL transmissivity at the Site; and
2. Performance of a non-intrusive geophysical survey to investigate the potential that one or more orphaned underground storage tanks (USTs) or other fueling service infrastructure may be present in the vicinity of monitoring well MW-21, and continuing to provide an additional source of gasoline-range petroleum contamination to the Site.

Investigation activities summarized in this report were performed according to the procedures described in the Supplemental Remedial Investigation Work Plan – Phase 3 (SRI Phase 3 Work Plan), dated October 18, 2017, which was conditionally approved by Ecology by letter dated November 27, 2017.

2. PROJECT BACKGROUND

Pursuant to the terms of an earlier Agreed Order for the Site (Agreed Order No. DE 02TCPCR-4905), Science Applications International Corporation (SAIC, a predecessor of Leidos), on behalf of Chevron, submitted a Remedial Investigation and Feasibility Study (RI/FS) report to Ecology in December 2006 (SAIC, 2006). In consultation with Ecology, the 2006 RI/FS identified Alternative 2C as the preferred cleanup alternative for the Site, which consisted of natural attenuation for soil, periodic LNAPL removal by bailing, and monitored natural attenuation of groundwater in the shallow perched aquifer. The 2006 RI/FS was approved by Ecology with no comments, by letter dated January 29, 2007, which completed the requirements of Agreed Order No. DE 02TCPCR-4905. Following approval of the 2006 RI/FS and satisfaction of the original Agreed Order, Chevron worked cooperatively with Ecology to develop a draft Cleanup Action Plan (CAP) for the Site.

By letter dated November 1, 2012, Ecology rescinded approval of the 2006 RI/FS and requested that Chevron conduct a Supplemental Feasibility Study to evaluate more aggressive cleanup technologies for the Site. In June 2014, Chevron and Ecology entered into Agreed Order No. DE 10629, which requires that Chevron complete a Supplemental Remedial Investigation (SRI) and Supplemental Feasibility Study (SFS), and prepare a draft CAP for the Site. Following execution of the 2014 Agreed Order, Leidos, on behalf of Chevron, planned and executed the first phase of SRI activities, which included two rounds of Tier 2 vapor intrusion assessment sampling, LNAPL transmissivity evaluation by baildown testing, and an expanded scope of groundwater monitoring. That work is documented in reports prepared by Leidos that were submitted to Ecology in December 2015 and June 2016 (Leidos, 2015 and 2016).

In October and November 2016, Leidos conducted a second round of SRI activities (SRI Phase 2) at the Site, which included use of laser-induced fluorescence (LIF) technology to allow collection and real-time analysis of LNAPL distribution data in soil. This phase of SRI activities also included soil core collection and analysis, installation of two new monitoring wells (MW-38 and MW-39), and a shallow soil sampling investigation near monitoring well MW-5. Results of the SRI Phase 2 field activities are presented in a summary report dated May 31, 2017 (Leidos, 2017).

In November 2017, Leidos initiated the third round of SRI activities (SRI Phase 3), which are the subject of this report. The SRI Phase 3 field activities were not completed until March of 2019. During this period, Leidos planned and implemented a fourth phase of SRI activities at the Site (SRI Phase 4), which were completed in October and November 2018. The results of the SRI Phase 4 activities are presented in a draft summary report that was submitted to Ecology on July 8, 2018 (Leidos, 2018).

3. LNAPL TRANSMISSIVITY TESTING

As described in the SRI Phase 3 Work Plan, an evaluation of LNAPL transmissivity by baildown testing was proposed to build upon previous LNAPL baildown test data collected at the Site in July 2015, as part of SRI Phase 1 activities. The objective of the SRI Phase 3 LNAPL transmissivity testing was to collect additional data from multiple rounds of testing in order to better understand how temporal changes in Site conditions (such as groundwater elevation levels) may affect LNAPL occurrence and recovery throughout the Site. The work was also intended to evaluate whether LNAPL recoverability in the existing monitoring well network could be increased by redevelopment of the wells to improve hydraulic communication between the wells and the surrounding formation. To achieve these objectives, the SRI Phase 3 work plan proposed the following three phases of additional baildown testing:

1. An initial round of baildown testing to be completed under "as-is" conditions. The objective of this phase of testing was to collect transmissivity data that could be directly compared to the results of the July 2015 baildown event, in order to assess how temporal variability in subsurface conditions (e.g., groundwater elevation) might affect LNAPL transmissivity results.
2. Redevelopment of the baildown test wells in order to remove accumulated sediments and/or biological growth that could impede communication between the wells and the surrounding formation.
3. A second round of baildown testing to be completed after well redevelopment, in order to evaluate whether redevelopment resulted in an increase in LNAPL recovery rates or transmissivity values.

Additional details regarding the scope of work for LNAPL baildown testing proposed for the SRI Phase 3 field activities, including the justification for selection of the wells tested, can be found in the SRI Phase 3 Work Plan.

3.1 NOVEMBER 2017 BAILDOWN FIELD ACTIVITIES

The initial round of SRI Phase 3 LNAPL transmissivity testing was performed from November 18 – 22, 2017. Baildown testing was performed at monitoring wells MW-9, MW-10, MW-12, MW-16, MW-21, and MW-27. Prior to this baildown testing event, the most recent LNAPL removal event at these well locations occurred on April 1, 2016, when the wells were sampled for LNAPL finger-printing analysis. The following table presents the initial fluid levels for each of the test wells prior to the November 2017 baildown testing event.

Monitoring Well I.D.	DTP (ft btoc)	DTW (ft btoc)	LNAPL Thickness (ft)
MW-9	27.11	36.22	9.11
MW-10	23.82	26.92	3.10
MW-12	20.24	24.53	4.29
MW-16	32.07	44.43	12.36
MW-21	19.54	34.63	15.09
MW-27	21.70	34.16	12.46

Notes:

1. DTP = Depth to product (LNAPL)
2. DTW = Depth to water
3. ft btoc = feet below top of well casing

Baildown testing was performed as described in Section 2.2 of the SRI Phase 3 Work Plan. Due to the depth at which LNAPL is typically encountered at the Site, LNAPL removal from the wells was performed manually using disposable bailers. All fluid interface measurements (i.e., DTP and DTW) were made manually using an electronic interface probe.

Baildown test data are provided in Appendix A and a discussion of the analysis is provided in Section 3.4.

3.2 APRIL 2018 WELL REDEVELOPMENT FIELD ACTIVITIES

Redevelopment of the LNAPL transmissivity testing wells was completed from April 26 – 28, 2018. The following table presents the initial fluid levels for each of the wells that were redeveloped.

Monitoring Well I.D.	DTP (ft btoc)	DTW (ft btoc)	LNAPL Thickness (ft)
MW-9	25.33	30.73	5.40
MW-10	21.83	23.36	1.53
MW-12	19.15	20.88	1.73
MW-16	32.78	43.51	10.73
MW-21	18.63	34.70	16.07
MW-27	20.72	33.56	12.84

Baildown testing well redevelopment was performed as described in Section 2.3 of the SRI Phase 3 Work Plan. Initial fluid measurements (DTP, DTW, and total well depth) were first measured and used to calculate the total volume of liquids present in the well casing. This result was used to calculate the minimum purge volume for the well, which was specified as three times the original liquid column in the well. A disposal bailer was then used to remove the LNAPL present in the well to a thickness of approximately 0.05 foot or less. After LNAPL removal, alternating periods of surging the well with a stainless steel bailer and purging the well with a disposable bailer were repeated until a purge volume equal to three times the original liquid column had been removed. Depth to bottom measurements and visual observations of water quality improvement during the redevelopment activities indicated that this work was successful in reducing fine sediment and biological growth accumulations in the baildown test wells.

3.3 MARCH 2019 BAILDOWN FIELD ACTIVITIES

The second round of SRI Phase 3 baildown testing was performed from March 26 – 29, 2019. This event was delayed until this time due to insufficient LNAPL thickness in several wells, which was assessed using LNAPL thickness data provided from quarterly monitoring events conducted by Gettler-Ryan Inc. Initial fluid levels measured during this event are presented in the following table.

Monitoring Well I.D.	DTP (ft btoc)	DTW (ft btoc)	LNAPL Thickness (ft)
MW-9	34.20	36.83	2.63
MW-10	27.27	27.72	0.45
MW-12	22.97	28.09	5.12
MW-16	39.37	46.69	7.32

MW-21	24.25	34.79	10.54
MW-27	24.78	33.63	8.85

Based on the initial fluid level results, baildown testing was not performed at monitoring well MW-10 because this well did not contain the minimum LNAPL thickness (0.5 foot) that is recommended for baildown testing by the ASTM method (ASTM, 2013). Baildown testing for this event was conducted by the same methods as described in Section 3.1. Test data are provided in Appendix A and a discussion of the analyses is provided in Section 3.4.

3.4 BAILDOWN TESTING DATA ANALYSIS

As proposed in the SRI Phase 3 Work Plan, baildown testing data were evaluated both qualitatively and quantitatively to assess the viability of LNAPL recoverability in the monitoring wells tested.

Qualitative Analysis

Qualitative analysis of the baildown test results was performed by plotting LNAPL thickness recovery data versus time (on a semi-logarithmic scale) for each of the monitoring wells tested. These graphs are presented as Figures 2 through 7. For monitoring wells MW-10, MW-12, and MW-16, data from the July 2015 baildown tests are also included for comparison. When available, longer-term data points provided by follow-up LNAPL gauging conducted by Leidos or Gettler-Ryan have also been included. These additional data points generally fall within the range of 10,000 to 100,000 minutes (approximately 7 to 70 days) following the start of LNAPL thickness recovery monitoring. All of the graphs were plotted using the same horizontal and vertical axis scales in order to facilitate visual comparison of the recovery curves.

Based on our evaluation of these data, Leidos has made the following observations and conclusions:

- When comparing the results from multiple baildown test events for a single monitoring well, there are generally fairly significant differences between the recovery curves. The exception to this are the results for monitoring well MW-27, which show two curves that generally track each other fairly well. Some similarities are also observed in the recovery curves for monitoring well MW-12.
- Multiple curves (e.g., MW-9 [2017], MW-21 [2019], MW-27 [2017]) show a “bump” (increasing trend followed shortly after by a decreasing trend) in the first 10 to 30 minutes of recovery monitoring. Leidos believes this phenomenon may be due to redistribution of LNAPL back into the well filter-pack that occurs in conjunction with the recovery of groundwater to the test wells. Although Leidos attempted to limit the amount groundwater removed from each test well during LNAPL bailing, some amount of groundwater removal was inevitable due to the manual bailing technique required. Also, even if removal of groundwater could be eliminated from the baildown process, some groundwater recovery would be expected in most cases due to the extent of groundwater depression that would result from several feet of LNAPL being present in a monitoring well.

- When comparing the results of the 2017 and 2019 baildown test events, it appears that Site conditions in 2017 were more favorable for LNAPL recovery. Initial LNAPL thickness, LNAPL thickness recovery rates, and the LNAPL thickness magnitudes attained at approximately 100,000 minutes were all generally higher in the 2017 test results. The exception is the results for monitoring well MW-12; however, the differences in results between each testing event at this well are relatively insignificant.

Quantitative Analysis

As previously conducted for the 2015 SRI Phase 1 transmissivity testing, quantitative analysis of baildown test data was performed using the most recent version of the American Petroleum Institute (API) LNAPL Transmissivity Workbook and user guide (API, 2013). The work book is a Microsoft Excel software based tool, which is a generally accepted standard for analysis of baildown test data and is consistent with the current ASTM standard (ASTM, 2013) for baildown test data analysis.

Input and output results from the API workbook for each of the SRI Phase 3 baildown tests are included in Appendix B. Table 1 presents a summary of transmissivity results based on Leidos' quantitative analysis using the API workbook. This table also includes results from the SRI Phase 1 baildown testing conducted in July 2015.

As shown in Table 1, there appears to be a significant amount of variability within the results, not only temporally and spatially across the Site, but also often between the various analysis methods of the same data set. It is possible that some of this variability may be the effect of how the data were analyzed. Although this methodology provides a relatively quick and seemingly simple solution for analysis of baildown test data, in Leidos' experience the tool is actually somewhat complex and the results can be sensitive to user supplied inputs, such as the range of data used, J-ratios, and time cuts. In general, Leidos provided user-supplied inputs that would result in more conservative (i.e., higher) LNAPL transmissivity values. However, we generally did utilize data sets containing at least 24 hours (1440 minutes) of monitoring data when it was available, as these data sets were considered more representative of long-term LNAPL recovery. Use of shorter-term data sets (for example only the first 100 minutes of LNAPL recovery monitoring) would have resulted in higher LNAPL transmissivity values. In summary, based on our experience to date using the API Workbook, Leidos suggests that these results be considered as "order-of-magnitude" estimates only.

LNAPL transmissivity values calculated by Leidos for both the SRI Phase 1 and SRI Phase 3 baildown testing range from 0.00 to 1.73 square feet per day (ft^2/day), with mean values ranging from 0.05 to 1.20 ft^2/day. Values of 1 or more were found only for monitoring well MW-27. The Interstate Technology & Regulatory Council's (ITRC) December 2009 guidance document, "Evaluating LNAPL Remedial Technologies for Achieving Project Goals" indicates that ITRC LNAPL Team member's experience indicates that hydraulic or pneumatic recovery systems can practically reduce LNAPL transmissivity to values between 0.1 to 0.8 ft^2/day. Therefore, results of LNAPL baildown testing conducted to date at the Site suggest that LNAPL transmissivity values are at or near the point of impracticability for recovery by hydraulic or pneumatic recovery systems.

3.4 TRANSMISSIVITY TESTING CONCLUSIONS

Leidos believes that the SRI Phase 3 LNAPL baildown testing activities were beneficial in furthering our understanding of the temporal and spatial variability of LNAPL occurrence at the Site. The data collected to date have further highlighted the significant spatial differences between LNAPL occurrence in monitoring well MW-10 in comparison to the LNAPL-bearing monitoring wells in the western portion of the Site, such as MW-16, MW-21, and MW-27. The data also confirm significant variability in LNAPL thickness trends at the Site, which are believed to be associated with long-term temporal changes in Site conditions, such as changes in groundwater elevation levels. These differences will be important to understand to further assess the feasibility of potentially implementing more aggressive LNAPL recovery methods at the Site. Further evaluation of LNAPL occurrence at the Site and possible removal strategies will be necessary to determine whether mobile LNAPL can be eliminated in a cost-effective and safe manner that does not result in increased risks to the public.

4. GEOPHYSICAL SURVEY

Results of the SRI Phase 3 geophysical survey were previously reported in the second quarterly progress report for 2018, dated July 11, 2018, and were also provided as an attachment to the Supplemental Remedial Investigation Work Plan – Phase 4 (Leidos, 2018). However, a discussion of this work is also being included here because the work was conducted as part of the SRI Phase 3 activities.

As discussed in more detail in the SRI Phase 3 Work Plan, the SRI Phase 3 geophysical survey was conducted to investigate the potential that orphaned USTs or other subsurface fueling-station infrastructure are present in the vicinity of monitoring well MW-21. Specific interest in this area was driven shallow impacts to soil at monitoring well MW-21, the recent occurrence LNAPL at this well with LNAPL thickness measurements exceeding 10 feet, and the known history of former service station operations on the property at 141 East Woodin Avenue.

Leidos contracted Geophysical Survey LLC (Geophysical of Kennewick, Washington to conduct the survey. This work was completed on April 27, 2018. Geophysical Survey LLC utilized electromagnetic (EM) and ground-penetrating radar (GPR) methodologies to complete the survey, which covered the sidewalk and street areas at the northwest corner of the intersection of East Woodin Avenue and Emerson Street. EM data collected during the survey were inconclusive due to the presence of steel reinforcing mesh in the concrete sidewalk portions of the survey area. However, the GPR data were used to delineate three subsurface anomalies that were characteristic of USTs. Geophysical Survey LLC’s investigation report is included in Appendix C.

The presence of the USTs identified by the SRI Phase 3 geophysical survey was confirmed by SRI Phase 4 field activities completed by Leidos in October and November 2018. The results of that work were reported in the draft SRI Phase 4 investigation report prepared by Leidos (Leidos, 2019).

5. SRI PHASE 3 SUMMARY AND CONCLUSIONS

Results of the SRI Phase 3 LNAPL baildown testing were beneficial in furthering our understanding of LNAPL behavior at the Site. As expected, these results confirmed our belief regarding the temporal variability of LNAPL transmissivity in response to changes in environmental conditions, such as groundwater elevation. In addition, these results provide a greater understanding of the spatial variability of LNAPL transmissivity, and how temporal changes have affected LNAPL occurrence differently in different areas of the Site.

Results of LNAPL baildown testing conducted at the Site to date suggest that LNAPL transmissivity values are at or near the point of impracticability for recovery by hydraulic or pneumatic recovery systems. However, further evaluation will be necessary to determine how future temporal changes impact LNAPL occurrence at the Site and whether a safe and cost-effective strategy for LNAPL removal can be implemented.

Performance of the geophysical survey in the vicinity of monitoring well MW-21 was successful in identifying subsurface anomalies in this area that were later confirmed to be USTs. The use of GPR and other geophysical methods has since been used to also identify anomalies located on the property at 221 East Woodin Avenue (Leidos, 2019). Leidos recommends that these non-intrusive technologies be considered for further investigation at the Site to identify other former service station infrastructure, or other USTs such as heating oil tanks, that may be contributing petroleum hydrocarbon impacts to the Site.

6. REFERENCES

ASTM (2013). ASTM Standard E2856-13, "Standard Guide for Estimation of LNAPL Transmissivity." May.

Hampton, D.R. (2003) *Improving Bail-Down Testing of Free Product Wells*, Proceedings of Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Assessment and Remediation Conference 2003, National Ground Water Association, pp. 16-30.

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Leidos (2018). "Agency Review Draft Supplemental Remedial Investigation Report – Phase 2." May 31.

Leidos (2019). "Final Supplemental Remedial Investigation Work Plan – Phase 4, Chevron Service Station No. 9-6590." October 22.

SAIC (2006). "Final Remedial Investigation / Feasibility Study Report, Chevron Service Station No. 9-6590." December 2006.

LIMITATIONS

This technical document was prepared on behalf of Chevron and is intended for its sole use and for use by the local, state, or federal regulatory agency that the technical document was sent to by Leidos. Any other person or entity obtaining, using, or relying on this technical document hereby acknowledges that they do so at their own risk, and Leidos shall have no responsibility or liability for the consequences thereof.

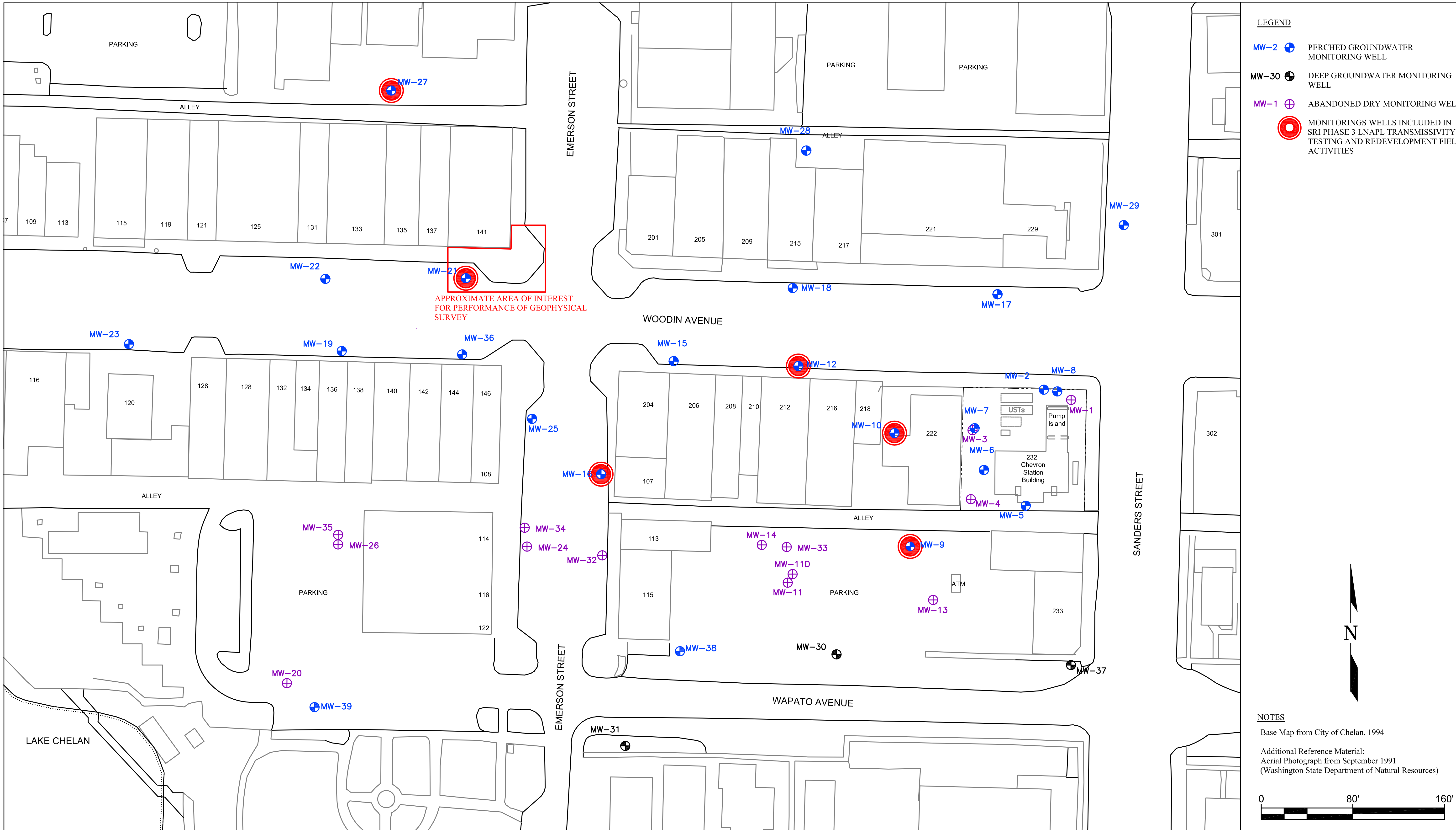
Site history and background information provided in this technical document are based on sources that may include interviews with environmental regulatory agencies and property management personnel and a review of acquired environmental regulatory agency documents and property information obtained from Chevron and others. Leidos has not made, nor has it been asked to make, any independent investigation concerning the accuracy, reliability, or completeness of such information beyond that described in this technical document.

Recognizing reasonable limits of time and cost, this technical document cannot wholly eliminate uncertainty regarding the vertical and lateral extent of impacted environmental media.

Opinions and recommendations presented in this technical document apply only to site conditions and features as they existed at the time of Leidos site visits or site work and cannot be applied to conditions and features of which Leidos is unaware and has not had the opportunity to evaluate.

All sources of information on which Leidos has relied in making its conclusions (including direct field observations) are identified by reference in this technical document or in appendices attached to this technical document. Any information not listed by reference or in appendices has not been evaluated or relied on by Leidos in the context of this technical document. The conclusions, therefore, represent our professional opinion based on the identified sources of information.

Figures



Chevron Service Station No. 96590
232 East Woodin Avenue
Chelan, Washington

FIGURE 1
Site Map

FILE NAME: 96590_Site Map_2017.dwg

DATE: 5/22/2020

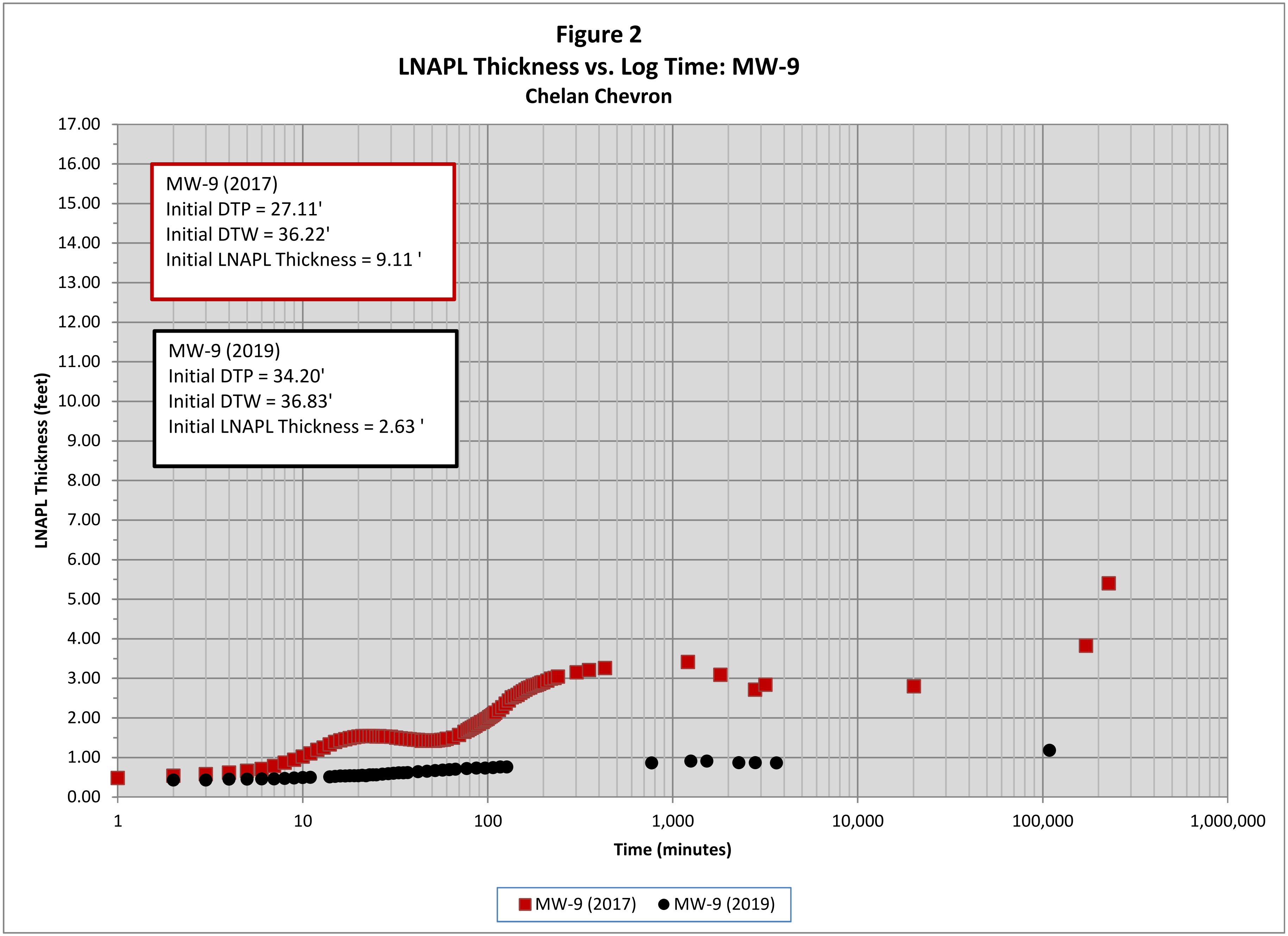


Figure 2
LNAPL Thickness vs. Log Time: MW-9
Chelan Chevron
MW-9 (2017)
Initial DTP = 27.11'
Initial DTW = 36.22'
Initial LNAPL Thickness = 9.11 '
MW-9 (2019)
Initial DTP = 34.20'
Initial DTW = 36.83'
Initial LNAPL Thickness = 2.63 '
LNAPL Thickness (feet)
17.00
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1
10
100
1,000
10,000
100,000
1,000,000
Time (minutes)
MW-9 (2017)
MW-9 (2019)

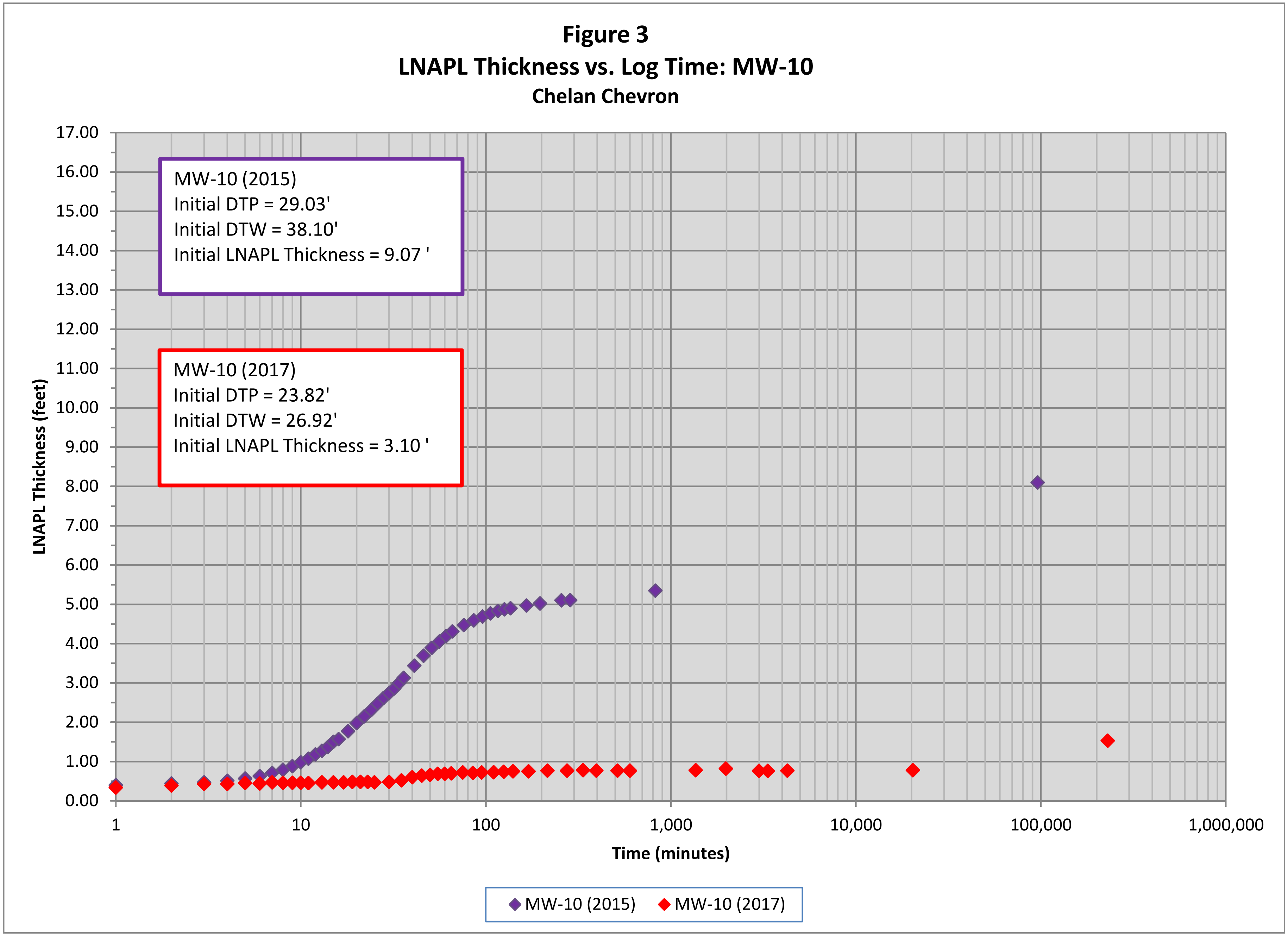


Figure 3
LNAPL Thickness vs. Log Time: MW-10
Chelan Chevron
MW-10 (2015)
Initial DTP = 29.03'
Initial DTW = 38.10'
Initial LNAPL Thickness = 9.07 '
MW-10 (2017)
Initial DTP = 23.82'
Initial DTW = 26.92'
Initial LNAPL Thickness = 3.10 '
LNAPL Thickness (feet)
17.00
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1
10
100
1,000
10,000
100,000
1,000,000
Time (minutes)
MW-10 (2015)
MW-10 (2017)

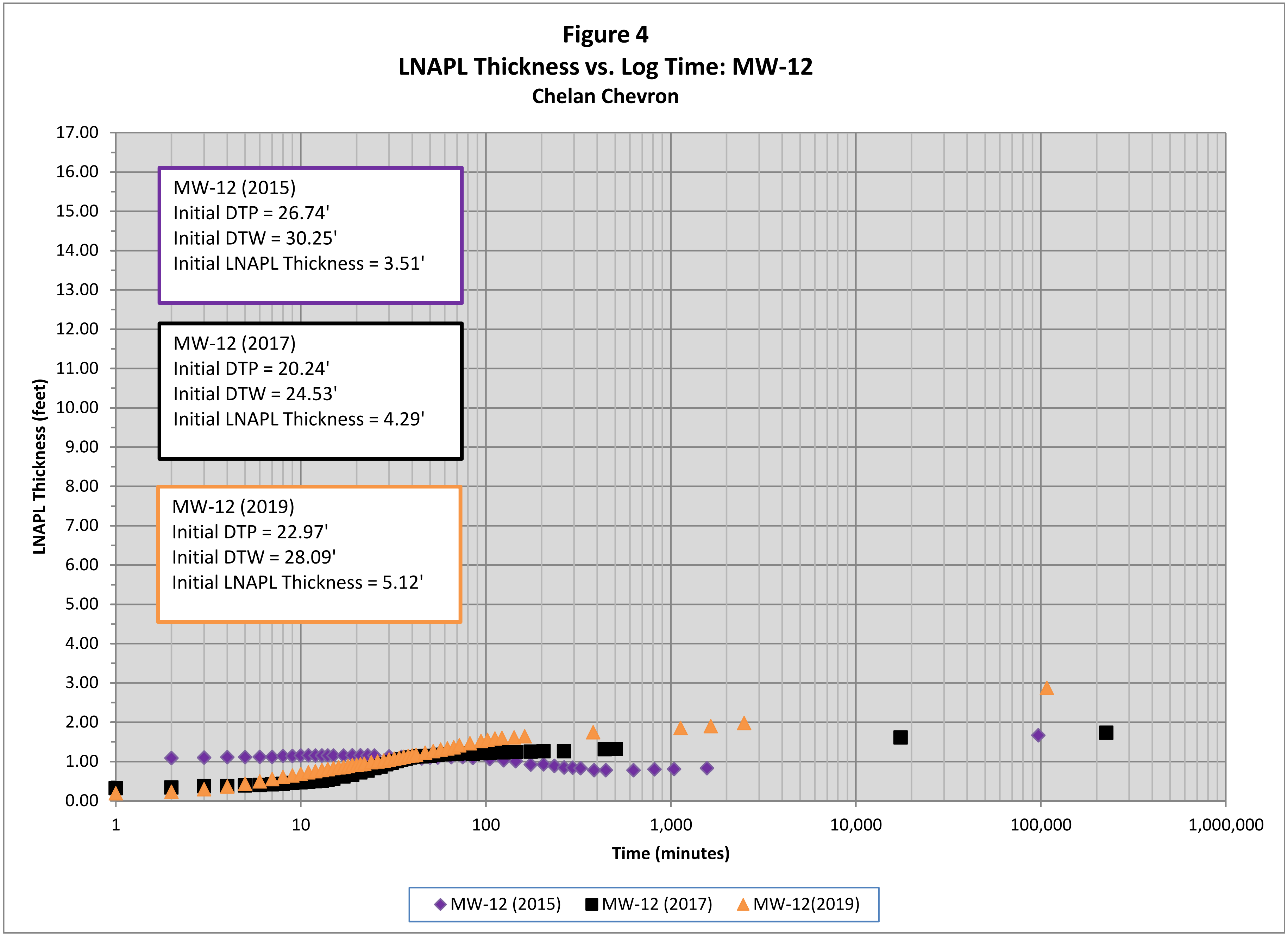
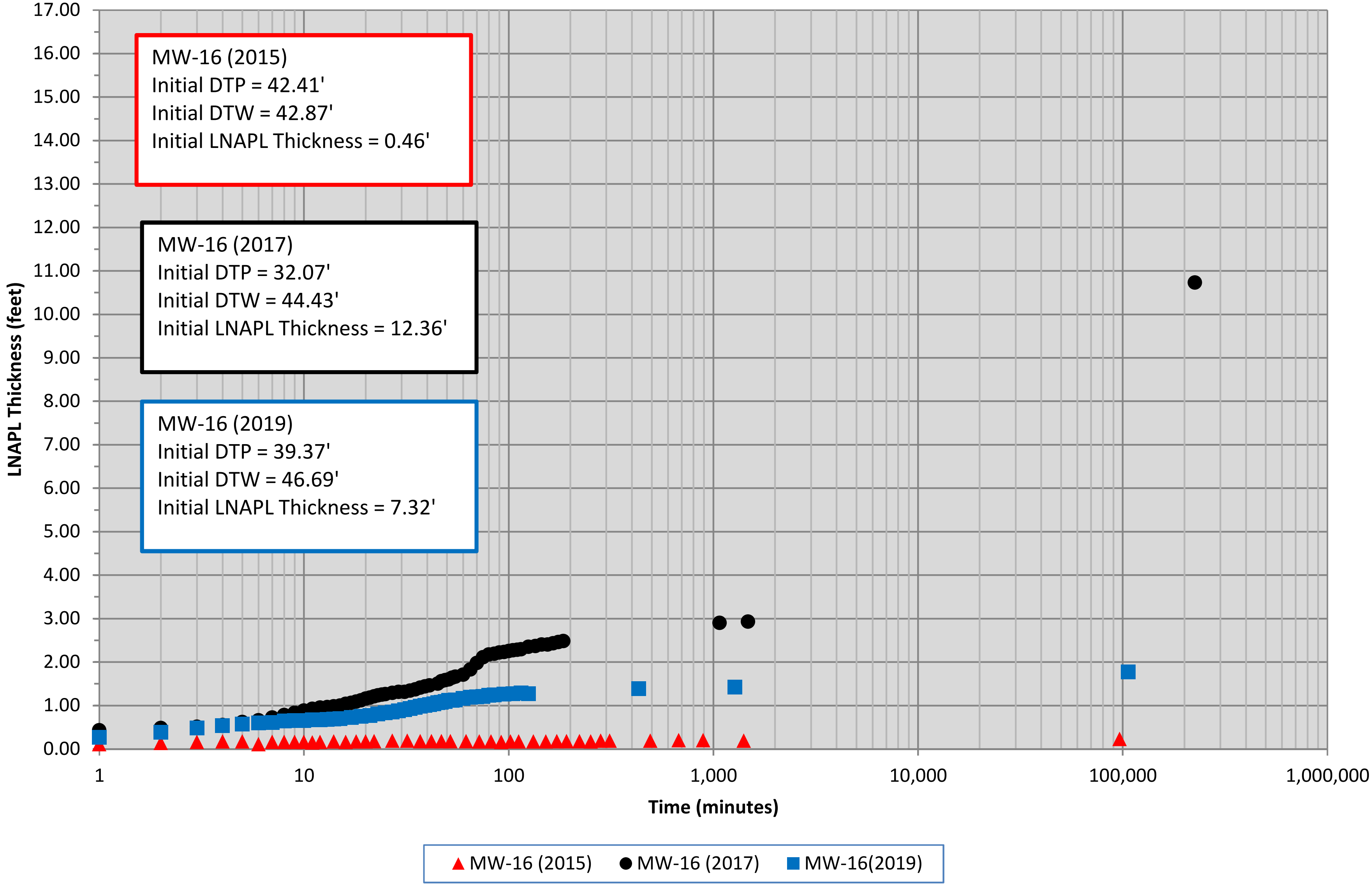


Figure 4
LNAPL Thickness vs. Log Time: MW-12
Chelan Chevron
MW-12 (2015)
Initial DTP = 26.74'
Initial DTW = 30.25'
Initial LNAPL Thickness = 3.51'
MW-12 (2017)
Initial DTP = 20.24'
Initial DTW = 24.53'
Initial LNAPL Thickness = 4.29'
MW-12 (2019)
Initial DTP = 22.97'
Initial DTW = 28.09'
Initial LNAPL Thickness = 5.12'
LNAPL Thickness (feet)
17.00
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1
10
100
1,000
10,000
100,000
1,000,000
Time (minutes)
MW-12 (2015)
MW-12 (2017)
MW-12(2019)

Figure 5
LNAPL Thickness vs. Log Time: MW-16
Chelan Chevron



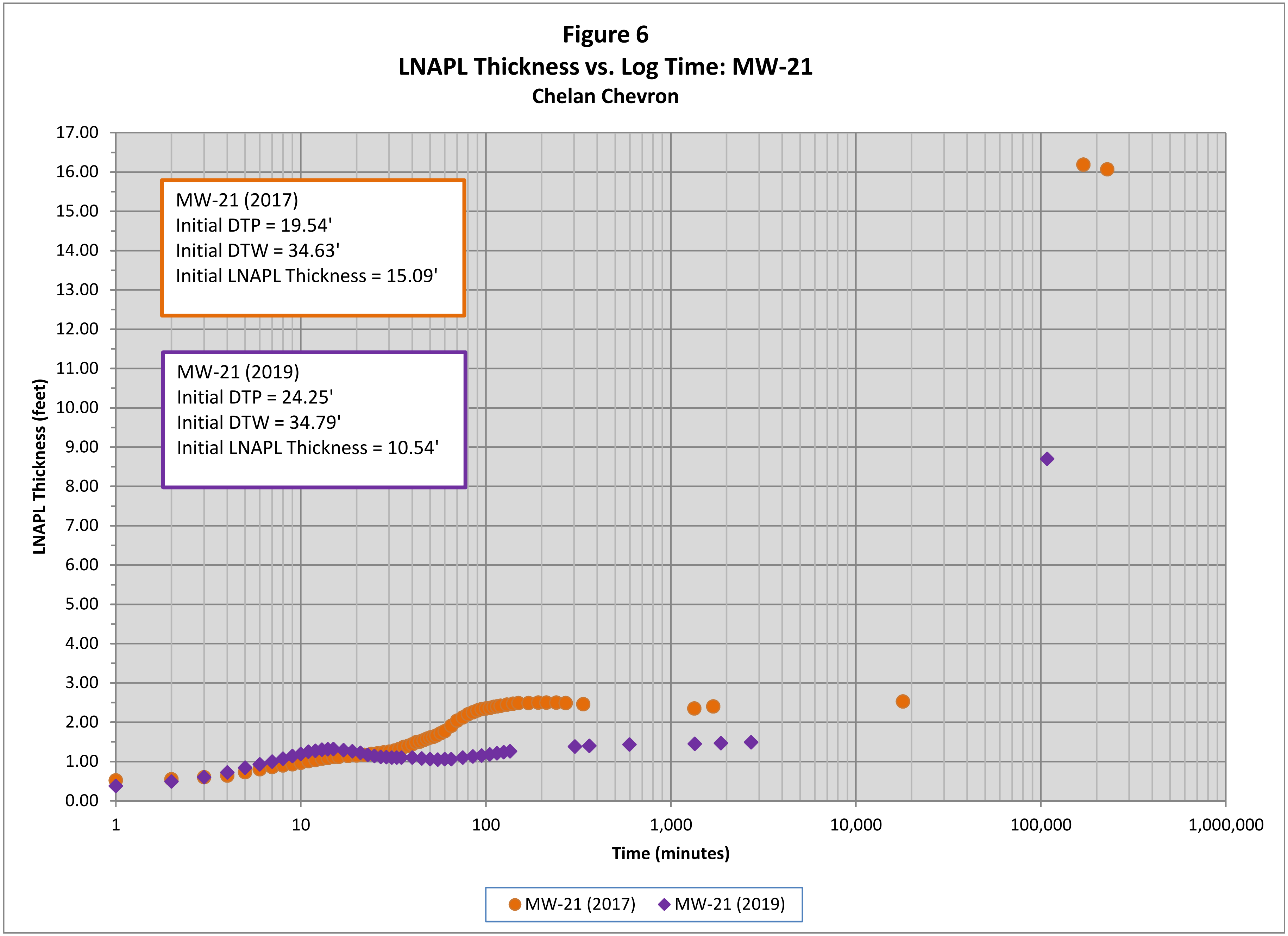


Figure 6
LNAPL Thickness vs. Log Time: MW-21
Chelan Chevron
MW-21 (2017)
Initial DTP = 19.54'
Initial DTW = 34.63'
Initial LNAPL Thickness = 15.09'
MW-21 (2019)
Initial DTP = 24.25'
Initial DTW = 34.79'
Initial LNAPL Thickness = 10.54'
LNAPL Thickness (feet)
17.00
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1
10
100
1,000
10,000
100,000
1,000,000
Time (minutes)
MW-21 (2017)
MW-21 (2019)

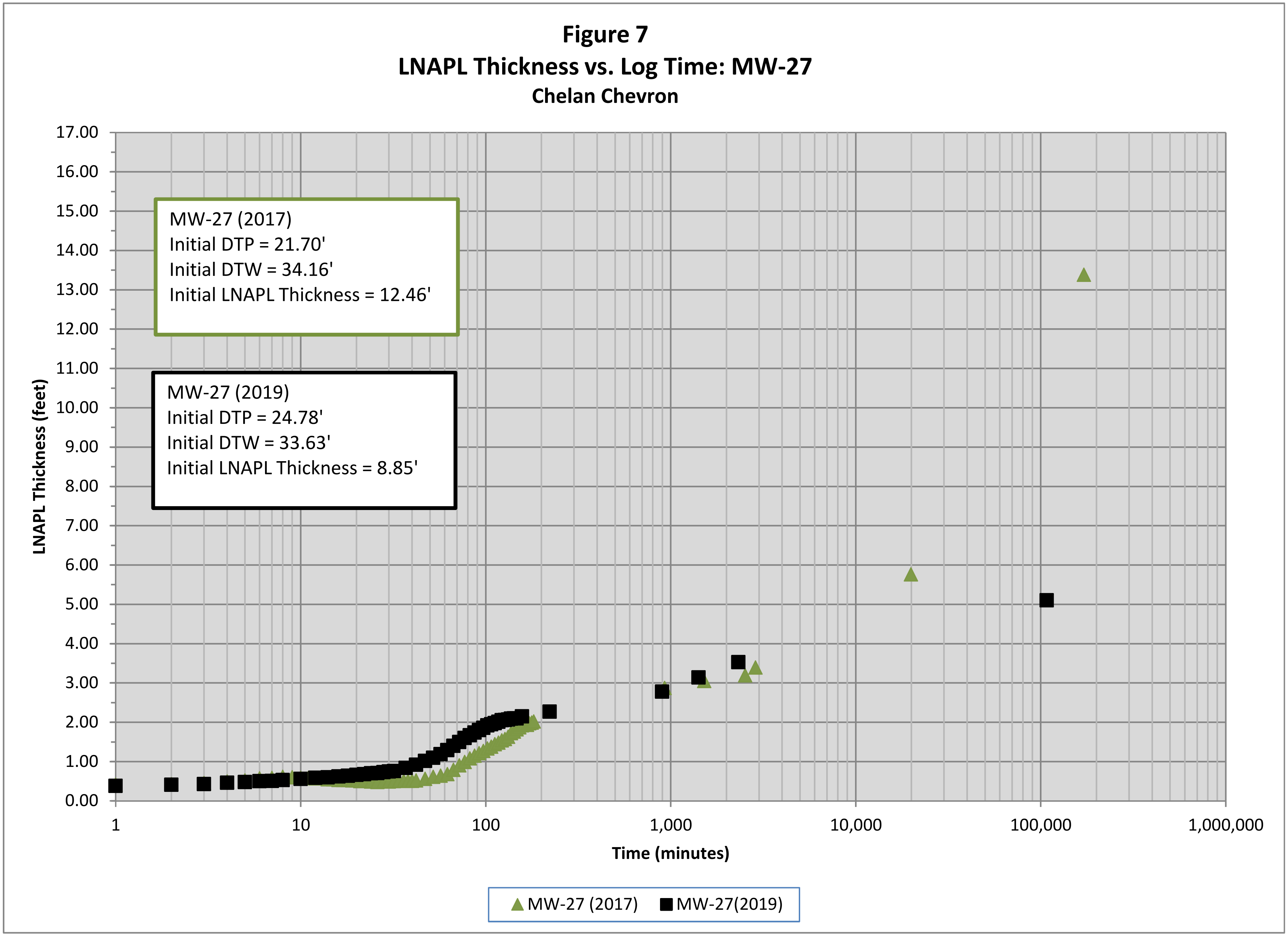


Figure 7
LNAPL Thickness vs. Log Time: MW-27
Chelan Chevron
MW-27 (2017)
Initial DTP = 21.70'
Initial DTW = 34.16'
Initial LNAPL Thickness = 12.46'
MW-27 (2019)
Initial DTP = 24.78'
Initial DTW = 33.63'
Initial LNAPL Thickness = 8.85'
LNAPL Thickness (feet)
17.00
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1
10
100
1,000
10,000
100,000
1,000,000
Time (minutes)
MW-27 (2017)
MW-27(2019)

Tables

Table 1
Summary of LNAPL Transmissivity Results from API Workbook
Chelan Chevron

Monitoring Well ID	Test Date	Initial DTP (feet)	Initial DTW (feet)	Initial LNAPL Thickness (feet)	LNAPL Transmissivity (ft^2/day) Bouwer and Rice (1976)	Cooper and Jacob (1946)	Cooper, Bredehoeft, and Papadopoulos (1967)	Mean	Standard Deviation	Coeffecient of Variation
MW-9	Nov-17	27.11	36.22	9.11	0.52 ± 0.02	0.42	0.30	0.41	0.11	0.27
	Mar-19	34.20	36.83	2.63	0.03 ± 0.00	0.04	0.07	0.05	0.02	0.44
MW-10	Jul-15	29.03	38.10	9.07	0.46 ± 0.04	0.76	0.90	0.68	0.26	0.38
	Nov-17	23.82	26.92	3.10	0.00 ± 0.00	0.03	0.32	0.12	0.18	1.52
MW-12	Nov-17	20.24	24.53	4.29	0.12 ± 0.01	0.15	0.28	0.19	0.09	0.48
	Mar-19	22.97	28.09	5.12	0.03 ± 0.01	0.20	0.34	0.19	0.16	0.84
MW-16	Jul-15	42.41	42.87	0.46	0.00 ± 0.00	0.01	0.06	0.03	0.03	1.20
	Nov-17	32.07	44.43	12.36	0.22 ± 0.03	0.67	0.83	0.58	0.31	0.55
	Mar-19	39.37	46.69	7.32	0.06 ± 0.02	0.30	0.55	0.31	0.24	0.80
MW-21	Nov-17	19.54	34.63	15.09	0.81 ± 0.03	0.70	0.67	0.73	0.07	0.10
	Mar-19	24.25	34.79	10.54	0.01 ± 0.00	0.03	0.28	0.11	0.15	1.42
MW-27	Nov-17	21.70	34.16	12.46	1.50 ± 0.01	0.81	1.30	1.20	0.35	0.29
	Mar-19	24.78	33.63	8.85	0.11 ± 0.03	0.51	1.73	0.78	0.85	1.08

DTP = Depth-to-product (LNAPL)
DTW = Depth-to-water

Appendix A:
Baildown Test Data

Results of LNAPL Baildown Test (MW-9) **11/19/2017**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	27.11
Initial Depth to Water (feet)	36.22
Initial LNAPL Thickness (feet)	9.11

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
11/19/17 12:11	1.00	34.91	35.39	0.48	
11/19/17 12:12	2.00	34.75	35.29	0.54	
11/19/17 12:13	3.00	34.63	35.21	0.58	
11/19/17 12:14	4.00	34.52	35.14	0.62	
11/19/17 12:15	5.00	34.39	35.05	0.66	
11/19/17 12:16	6.00	34.28	34.99	0.71	
11/19/17 12:17	7.00	34.17	34.95	0.78	
11/19/17 12:18	8.00	34.05	34.92	0.87	
11/19/17 12:19	9.00	33.95	34.89	0.94	
11/19/17 12:20	10.00	33.85	34.87	1.02	
11/19/17 12:21	11.00	33.75	34.85	1.10	
11/19/17 12:22	12.00	33.65	34.84	1.19	
11/19/17 12:23	13.00	33.57	34.82	1.25	
11/19/17 12:24	14.00	33.47	34.80	1.33	
11/19/17 12:25	15.00	33.39	34.78	1.39	
11/19/17 12:26	16.00	33.31	34.74	1.43	
11/19/17 12:27	17.00	33.25	34.71	1.46	
11/19/17 12:28	18.00	33.18	34.67	1.49	
11/19/17 12:29	19.00	33.11	34.62	1.51	
11/19/17 12:30	20.00	33.05	34.58	1.53	
11/19/17 12:31	21.00	33.00	34.54	1.54	
11/19/17 12:32	22.00	32.95	34.49	1.54	
11/19/17 12:33	23.00	32.90	34.44	1.54	
11/19/17 12:34	24.00	32.85	34.39	1.54	
11/19/17 12:35	25.00	32.80	34.33	1.53	
11/19/17 12:36	26.00	32.75	34.29	1.54	
11/19/17 12:37	27.00	32.71	34.24	1.53	
11/19/17 12:38	28.00	32.66	34.19	1.53	
11/19/17 12:40	30.00	32.57	34.09	1.52	
11/19/17 12:42	32.00	32.48	33.98	1.50	
11/19/17 12:44	34.00	32.39	33.87	1.48	
11/19/17 12:46	36.00	32.32	33.79	1.47	
11/19/17 12:48	38.00	32.24	33.70	1.46	
11/19/17 12:50	40.00	32.16	33.61	1.45	
11/19/17 12:52	42.00	32.10	33.54	1.44	
11/19/17 12:54	44.00	32.02	33.44	1.42	

11/19/17 12:56	46.00	31.95	33.38	1.43	
11/19/17 12:58	48.00	31.88	33.31	1.43	
11/19/17 13:00	50.00	31.81	33.23	1.42	
11/19/17 13:02	52.00	31.75	33.17	1.42	
11/19/17 13:04	54.00	31.68	33.11	1.43	
11/19/17 13:06	56.00	31.62	33.06	1.44	
11/19/17 13:08	58.00	31.55	33.00	1.45	
11/19/17 13:10	60.00	31.48	32.95	1.47	
11/19/17 13:15	65.00	31.32	32.82	1.50	
11/19/17 13:20	70.00	31.15	32.72	1.57	
11/19/17 13:25	75.00	30.97	32.62	1.65	
11/19/17 13:28	78.00	30.88	32.57	1.69	
11/19/17 13:30	80.00	30.82	32.54	1.72	
11/19/17 13:32	82.00	30.75	32.50	1.75	
11/19/17 13:34	84.00	30.68	32.46	1.78	
11/19/17 13:36	86.00	30.63	32.43	1.80	
11/19/17 13:38	88.00	30.56	32.40	1.84	
11/19/17 13:40	90.00	30.52	32.37	1.85	
11/19/17 13:42	92.00	30.45	32.34	1.89	
11/19/17 13:44	94.00	30.41	32.31	1.90	
11/19/17 13:46	96.00	30.35	32.28	1.93	
11/19/17 13:48	98.00	30.30	32.26	1.96	
11/19/17 13:50	100.00	30.25	32.23	1.98	
11/19/17 13:52	102.00	30.20	32.22	2.02	
11/19/17 13:54	104.00	30.15	32.19	2.04	
11/19/17 13:56	106.00	30.09	32.16	2.07	
11/19/17 13:58	108.00	30.04	32.14	2.10	
11/19/17 14:00	110.00	29.99	32.12	2.13	
11/19/17 14:05	115.00	29.87	32.07	2.20	
11/19/17 14:10	120.00	29.75	32.02	2.27	
11/19/17 14:15	125.00	29.63	31.99	2.36	
11/19/17 14:20	130.00	29.50	31.94	2.44	
11/19/17 14:25	135.00	29.36	31.88	2.52	
11/19/17 14:30	140.00	29.27	31.82	2.55	
11/19/17 14:35	145.00	29.19	31.77	2.58	
11/19/17 14:40	150.00	29.11	31.74	2.63	
11/19/17 14:45	155.00	29.04	31.71	2.67	
11/19/17 14:50	160.00	28.98	31.69	2.71	
11/19/17 14:55	165.00	28.93	31.68	2.75	
11/19/17 15:00	170.00	28.90	31.67	2.77	
11/19/17 15:05	175.00	28.86	31.67	2.81	
11/19/17 15:10	180.00	28.84	31.66	2.82	
11/19/17 15:15	185.00	28.81	31.65	2.84	
11/19/17 15:20	190.00	28.78	31.64	2.86	
11/19/17 15:25	195.00	28.75	31.64	2.89	
11/19/17 15:30	200.00	28.74	31.64	2.90	
11/19/17 15:40	210.00	28.69	31.63	2.94	
11/19/17 15:50	220.00	28.64	31.63	2.99	
11/19/17 16:00	230.00	28.61	31.62	3.01	
11/19/17 16:10	240.00	28.59	31.63	3.04	

11/19/17 17:13	303.00	28.46	31.61	3.15	
11/19/17 18:03	353.00	28.40	31.61	3.21	
11/19/17 19:21	431.00	28.37	31.63	3.26	
11/20/17 8:18	1208.00	28.33	31.74	3.41	
11/20/17 18:23	1813.00	28.82	31.91	3.09	
11/21/17 10:40	2790.00	29.45	32.16	2.71	
11/21/17 17:02	3172.00	29.15	31.99	2.84	End of recovery monitoring by Leidos
12/3/17 12:00	20150.00	29.58	32.38	2.80	Data collected by Gettler-Ryan
3/18/18 12:00	171350.00	25.60	29.42	3.82	Data collected by Gettler-Ryan
4/26/18 11:25	227475.00	25.33	30.73	5.40	Data collected by Leidos

Results of LNAPL Baildown Test (MW-9) **3/26/2019**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	34.20
Initial Depth to Water (feet)	36.83
Initial LNAPL Thickness (feet)	2.63

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
3/26/19 19:05	2.00	36.34	36.77	0.43	
3/26/19 19:06	3.00	36.30	36.73	0.43	
3/26/19 19:07	4.00	36.27	36.72	0.45	
3/26/19 19:08	5.00	36.25	36.70	0.45	
3/26/19 19:09	6.00	36.23	36.69	0.46	
3/26/19 19:10	7.00	36.21	36.67	0.46	
3/26/19 19:11	8.00	36.19	36.66	0.47	
3/26/19 19:12	9.00	36.17	36.65	0.48	
3/26/19 19:13	10.00	36.15	36.64	0.49	
3/26/19 19:14	11.00	36.13	36.63	0.50	
3/26/19 19:17	14.00	36.12	36.63	0.51	
3/26/19 19:18	15.00	36.10	36.62	0.52	
3/26/19 19:19	16.00	36.08	36.61	0.53	
3/26/19 19:20	17.00	36.07	36.60	0.53	
3/26/19 19:21	18.00	36.06	36.60	0.54	
3/26/19 19:22	19.00	36.05	36.59	0.54	
3/26/19 19:23	20.00	36.04	36.58	0.54	
3/26/19 19:24	21.00	36.02	36.57	0.55	
3/26/19 19:25	22.00	36.02	36.56	0.54	
3/26/19 19:26	23.00	36.00	36.56	0.56	
3/26/19 19:27	24.00	35.99	36.55	0.56	
3/26/19 19:28	25.00	35.98	36.54	0.56	
3/26/19 19:30	27.00	35.95	36.53	0.58	
3/26/19 19:32	29.00	35.93	36.52	0.59	
3/26/19 19:34	31.00	35.91	36.51	0.60	
3/26/19 19:36	33.00	35.89	36.50	0.61	
3/26/19 19:38	35.00	35.87	36.48	0.61	
3/26/19 19:40	37.00	35.85	36.47	0.62	
3/26/19 19:45	42.00	35.81	36.45	0.64	
3/26/19 19:50	47.00	35.77	36.42	0.65	
3/26/19 19:55	52.00	35.73	36.40	0.67	
3/26/19 20:00	57.00	35.70	36.38	0.68	
3/26/19 20:05	62.00	35.66	36.35	0.69	
3/26/19 20:10	67.00	35.63	36.33	0.70	
3/26/19 20:20	77.00	35.56	36.28	0.72	
3/26/19 20:30	87.00	35.51	36.24	0.73	

3/26/19 20:40	97.00	35.46	36.19	0.73	
3/26/19 20:50	107.00	35.41	36.15	0.74	
3/26/19 21:00	117.00	35.36	36.12	0.76	
3/26/19 21:10	127.00	35.31	36.07	0.76	
3/27/19 7:54	771.00	34.78	35.64	0.86	
3/27/19 15:56	1253.00	34.61	35.52	0.91	
3/27/19 20:33	1530.00	34.57	35.48	0.91	
3/28/19 9:01	2278.00	34.77	35.64	0.87	
3/28/19 17:38	2795.00	34.86	35.73	0.87	
3/29/19 7:41	3638.00	35.07	35.93	0.86	End of recovery monitoring by Leidos
6/10/19 12:00	109017.00	35.88	37.06	1.18	Data collected by Gettler-Ryan

Results of LNAPL Baildown Test (MW-10) **7/16/2015**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	29.03
Initial Depth to Water (feet)	38.10
Initial LNAPL Thickness (feet)	9.07

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
7/16/15 18:45	1.00	37.12	37.52	0.40	
7/16/15 18:46	2.00	37.03	37.47	0.44	
7/16/15 18:47	3.00	36.96	37.43	0.47	
7/16/15 18:48	4.00	36.89	37.40	0.51	
7/16/15 18:49	5.00	36.80	37.37	0.57	
7/16/15 18:50	6.00	36.73	37.36	0.63	
7/16/15 18:51	7.00	36.65	37.36	0.71	
7/16/15 18:52	8.00	36.57	37.36	0.79	
7/16/15 18:53	9.00	36.49	37.37	0.88	
7/16/15 18:54	10.00	36.40	37.38	0.98	
7/16/15 18:55	11.00	36.32	37.39	1.07	
7/16/15 18:56	12.00	36.23	37.41	1.18	
7/16/15 18:57	13.00	36.15	37.42	1.27	
7/16/15 18:58	14.00	36.05	37.42	1.37	
7/16/15 18:59	15.00	35.93	37.43	1.50	
7/16/15 19:00	16.00	35.86	37.43	1.57	
7/16/15 19:02	18.00	35.67	37.44	1.77	
7/16/15 19:04	20.00	35.47	37.45	1.98	
7/16/15 19:06	22.00	35.31	37.46	2.15	
7/16/15 19:08	24.00	35.15	37.46	2.31	
7/16/15 19:10	26.00	34.98	37.45	2.47	
7/16/15 19:12	28.00	34.81	37.43	2.62	
7/16/15 19:14	30.00	34.66	37.40	2.74	
7/16/15 19:16	32.00	34.50	37.36	2.86	
7/16/15 19:18	34.00	34.33	37.33	3.00	
7/16/15 19:20	36.00	34.17	37.30	3.13	
7/16/15 19:25	41.00	33.79	37.23	3.44	
7/16/15 19:30	46.00	33.45	37.14	3.69	
7/16/15 19:35	51.00	33.17	37.06	3.89	
7/16/15 19:40	56.00	32.93	36.98	4.05	
7/16/15 19:45	61.00	32.72	36.91	4.19	
7/16/15 19:50	66.00	32.57	36.88	4.31	
7/16/15 20:00	76.00	32.31	36.78	4.47	
7/16/15 20:10	86.00	32.13	36.72	4.59	
7/16/15 20:20	96.00	32.00	36.69	4.69	

7/16/15 20:30	106.00	31.90	36.67	4.77	
7/16/15 20:40	116.00	31.82	36.65	4.83	
7/16/15 20:50	126.00	31.77	36.64	4.87	
7/16/15 21:00	136.00	31.72	36.62	4.90	
7/16/15 21:30	166.00	31.65	36.62	4.97	
7/16/15 22:00	196.00	31.60	36.62	5.02	
7/16/15 23:00	256.00	31.55	36.65	5.10	
7/16/15 23:30	286.00	31.54	36.65	5.11	
7/17/15 8:28	824.00	31.51	36.86	5.35	End of recovery monitoring by Leidos
9/21/15 12:00	96076.00	29.45	37.55	8.10	Data collected by Gettler-Ryan

Results of LNAPL Baildown Test (MW-10) **11/19/2017**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	23.82
Initial Depth to Water (feet)	26.92
Initial LNAPL Thickness (feet)	3.10

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
11/19/17 9:26	1.00	25.70	26.04	0.34	
11/19/17 9:27	2.00	25.62	26.01	0.39	
11/19/17 9:28	3.00	25.54	25.97	0.43	
11/19/17 9:29	4.00	25.49	25.92	0.43	
11/19/17 9:30	5.00	25.41	25.86	0.45	
11/19/17 9:31	6.00	25.38	25.82	0.44	
11/19/17 9:32	7.00	25.32	25.79	0.47	
11/19/17 9:33	8.00	25.29	25.75	0.46	
11/19/17 9:34	9.00	25.25	25.71	0.46	
11/19/17 9:35	10.00	25.21	25.67	0.46	
11/19/17 9:36	11.00	25.19	25.64	0.45	
11/19/17 9:38	13.00	25.11	25.58	0.47	
11/19/17 9:40	15.00	25.05	25.52	0.47	
11/19/17 9:42	17.00	25.00	25.47	0.47	
11/19/17 9:44	19.00	24.95	25.43	0.48	
11/19/17 9:46	21.00	24.90	25.38	0.48	
11/19/17 9:48	23.00	24.85	25.33	0.48	
11/19/17 9:50	25.00	24.82	25.29	0.47	
11/19/17 9:55	30.00	24.74	25.22	0.48	
11/19/17 10:00	35.00	24.67	25.19	0.52	
11/19/17 10:05	40.00	24.60	25.20	0.60	
11/19/17 10:10	45.00	24.55	25.19	0.64	
11/19/17 10:15	50.00	24.52	25.18	0.66	
11/19/17 10:20	55.00	24.48	25.17	0.69	
11/19/17 10:25	60.00	24.46	25.15	0.69	
11/19/17 10:30	65.00	24.44	25.14	0.70	
11/19/17 10:40	75.00	24.41	25.13	0.72	
11/19/17 10:50	85.00	24.40	25.11	0.71	
11/19/17 11:00	95.00	24.38	25.10	0.72	
11/19/17 11:15	110.00	24.36	25.09	0.73	
11/19/17 11:30	125.00	24.34	25.08	0.74	
11/19/17 11:45	140.00	24.32	25.07	0.75	
11/19/17 12:15	170.00	24.30	25.05	0.75	
11/19/17 13:00	215.00	24.26	25.03	0.77	
11/19/17 14:00	275.00	24.23	25.00	0.77	
11/19/17 15:00	335.00	24.20	24.98	0.78	

11/19/17 16:00	395.00	24.18	24.95	0.77	
11/19/17 18:00	515.00	24.17	24.94	0.77	
11/19/17 19:26	601.00	24.17	24.94	0.77	
11/20/17 8:06	1361.00	24.18	24.96	0.78	
11/20/17 18:28	1983.00	24.38	25.20	0.82	
11/21/17 11:20	2995.00	24.60	25.36	0.76	
11/21/17 17:06	3341.00	24.50	25.26	0.76	
11/22/17 8:26	4261.00	24.48	25.25	0.77	End of recovery monitoring by Leidos
12/3/17 12:00	20315.00	24.64	25.42	0.78	Data collected by Gettler-Ryan
4/27/18 18:48	229523.00	21.83	23.36	1.53	Data collected by Leidos

Results of LNAPL Baildown Test (MW-12) **7/16/2015**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	26.70
Initial Depth to Water (feet)	30.21
Initial LNAPL Thickness (feet)	3.51

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
7/16/15 6:29	2.00	29.50	30.59	1.09	
7/16/15 6:30	3.00	29.41	30.51	1.10	
7/16/15 6:31	4.00	29.35	30.46	1.11	
7/16/15 6:32	5.00	29.30	30.41	1.11	
7/16/15 6:33	6.00	29.24	30.36	1.12	
7/16/15 6:34	7.00	29.20	30.32	1.12	
7/16/15 6:35	8.00	29.15	30.29	1.14	
7/16/15 6:36	9.00	29.11	30.25	1.14	
7/16/15 6:37	10.00	29.07	30.22	1.15	
7/16/15 6:38	11.00	29.03	30.19	1.16	
7/16/15 6:39	12.00	29.00	30.15	1.15	
7/16/15 6:40	13.00	28.98	30.13	1.15	
7/16/15 6:41	14.00	28.95	30.10	1.15	
7/16/15 6:42	15.00	28.92	30.07	1.15	
7/16/15 6:44	17.00	28.87	30.02	1.15	
7/16/15 6:46	19.00	28.82	29.98	1.16	
7/16/15 6:48	21.00	28.78	29.94	1.16	
7/16/15 6:50	23.00	28.73	29.89	1.16	
7/16/15 6:52	25.00	28.70	29.85	1.15	
7/16/15 6:57	30.00	28.63	29.76	1.13	
7/16/15 7:02	35.00	28.55	29.67	1.12	
7/16/15 7:07	40.00	28.47	29.58	1.11	
7/16/15 7:12	45.00	28.41	29.49	1.08	
7/16/15 7:17	50.00	28.33	29.43	1.10	
7/16/15 7:22	55.00	28.26	29.36	1.10	
7/16/15 7:32	65.00	28.12	29.23	1.11	
7/16/15 7:42	75.00	28.02	29.13	1.11	
7/16/15 7:52	85.00	27.93	29.02	1.09	
7/16/15 8:12	105.00	27.78	28.84	1.06	
7/16/15 8:32	125.00	27.70	28.73	1.03	
7/16/15 8:52	145.00	27.60	28.61	1.01	
7/16/15 9:22	175.00	27.52	28.44	0.92	
7/16/15 9:52	205.00	27.45	28.38	0.93	
7/16/15 10:22	235.00	27.40	28.29	0.89	
7/16/15 10:52	265.00	27.36	28.21	0.85	
7/16/15 11:22	295.00	27.31	28.15	0.84	

7/16/15 11:52	325.00	27.28	28.11	0.83	
7/16/15 12:52	385.00	27.25	28.03	0.78	
7/16/15 13:52	445.00	27.20	27.98	0.78	
7/16/15 16:55	628.00	27.13	27.91	0.78	
7/16/15 20:02	815.00	27.12	27.92	0.80	
7/16/15 23:47	1040.00	27.18	27.99	0.81	
7/17/15 8:35	1568.00	27.16	27.99	0.83	End of recovery monitoring by Leidos
9/21/15 12:00	96813.00	25.99	27.66	1.67	Data collected by Gettler-Ryan

Results of LNAPL Baildown Test (MW-12) **11/21/2017**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	20.24
Initial Depth to Water (feet)	24.53
Initial LNAPL Thickness (feet)	4.29

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
11/21/17 8:36	1.00	23.61	23.93	0.32	
11/21/17 8:37	2.00	23.52	23.86	0.34	
11/21/17 8:38	3.00	23.45	23.82	0.37	
11/21/17 8:39	4.00	23.40	23.77	0.37	
11/21/17 8:40	5.00	23.32	23.71	0.39	
11/21/17 8:41	6.00	23.27	23.67	0.40	
11/21/17 8:42	7.00	23.21	23.63	0.42	
11/21/17 8:43	8.00	23.15	23.58	0.43	
11/21/17 8:44	9.00	23.09	23.54	0.45	
11/21/17 8:45	10.00	23.05	23.52	0.47	
11/21/17 8:46	11.00	23.00	23.48	0.48	
11/21/17 8:47	12.00	22.95	23.45	0.50	
11/21/17 8:48	13.00	22.91	23.42	0.51	
11/21/17 8:49	14.00	22.86	23.40	0.54	
11/21/17 8:50	15.00	22.82	23.38	0.56	
11/21/17 8:52	17.00	22.72	23.34	0.62	
11/21/17 8:54	19.00	22.63	23.29	0.66	
11/21/17 8:56	21.00	22.53	23.25	0.72	
11/21/17 8:58	23.00	22.45	23.22	0.77	
11/21/17 9:00	25.00	22.37	23.20	0.83	
11/21/17 9:02	27.00	22.30	23.17	0.87	
11/21/17 9:04	29.00	22.23	23.16	0.93	
11/21/17 9:06	31.00	22.16	23.13	0.97	
11/21/17 9:08	33.00	22.10	23.11	1.01	
11/21/17 9:10	35.00	22.03	23.08	1.05	
11/21/17 9:12	37.00	21.97	23.04	1.07	
11/21/17 9:14	39.00	21.92	23.02	1.10	
11/21/17 9:16	41.00	21.87	22.98	1.11	
11/21/17 9:18	43.00	21.82	22.95	1.13	
11/21/17 9:20	45.00	21.79	22.92	1.13	
11/21/17 9:22	47.00	21.75	22.89	1.14	
11/21/17 9:25	50.00	21.71	22.85	1.14	
11/21/17 9:30	55.00	21.62	22.79	1.17	
11/21/17 9:35	60.00	21.55	22.73	1.18	
11/21/17 9:40	65.00	21.49	22.68	1.19	
11/21/17 9:45	70.00	21.44	22.63	1.19	

11/21/17 9:50	75.00	21.38	22.59	1.21	
11/21/17 9:55	80.00	21.33	22.54	1.21	
11/21/17 10:00	85.00	21.29	22.49	1.20	
11/21/17 10:10	95.00	21.21	22.42	1.21	
11/21/17 10:20	105.00	21.15	22.37	1.22	
11/21/17 10:40	125.00	21.06	22.29	1.23	
11/21/17 11:00	145.00	21.00	22.24	1.24	
11/21/17 11:30	175.00	20.94	22.19	1.25	
11/21/17 12:00	205.00	20.74	22.00	1.26	
11/21/17 13:00	265.00	20.81	22.07	1.26	
11/21/17 15:55	440.00	20.76	22.07	1.31	
11/21/17 16:58	503.00	20.74	22.06	1.32	End of recovery monitoring by Leidos
12/3/17 12:00	17485.00	20.62	22.23	1.61	Data collected by Gettler-Ryan
4/27/18 7:08	225993.00	19.15	20.88	1.73	Data collected by Leidos

Results of LNAPL Baildown Test (MW-12) **3/27/2019**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	22.97
Initial Depth to Water (feet)	28.09
Initial LNAPL Thickness (feet)	5.12

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
3/27/19 14:19	1.00	27.09	27.28	0.19	
3/27/19 14:20	2.00	27.02	27.25	0.23	
3/27/19 14:21	3.00	26.93	27.22	0.29	
3/27/19 14:22	4.00	26.85	27.21	0.36	
3/27/19 14:23	5.00	26.77	27.20	0.43	
3/27/19 14:24	6.00	26.70	27.19	0.49	
3/27/19 14:25	7.00	26.63	27.18	0.55	
3/27/19 14:26	8.00	26.56	27.16	0.60	
3/27/19 14:27	9.00	26.49	27.13	0.64	
3/27/19 14:28	10.00	26.43	27.11	0.68	
3/27/19 14:29	11.00	26.36	27.08	0.72	
3/27/19 14:30	12.00	26.30	27.05	0.75	
3/27/19 14:31	13.00	26.24	27.02	0.78	
3/27/19 14:32	14.00	26.17	26.97	0.80	
3/27/19 14:33	15.00	26.11	26.94	0.83	
3/27/19 14:34	16.00	26.05	26.90	0.85	
3/27/19 14:35	17.00	26.01	26.87	0.86	
3/27/19 14:36	18.00	25.95	26.83	0.88	
3/27/19 14:37	19.00	25.88	26.79	0.91	
3/27/19 14:38	20.00	25.85	26.76	0.91	
3/27/19 14:39	21.00	25.80	26.73	0.93	
3/27/19 14:40	22.00	25.76	26.70	0.94	
3/27/19 14:42	24.00	25.67	26.65	0.98	
3/27/19 14:44	26.00	25.60	26.60	1.00	
3/27/19 14:46	28.00	25.54	26.56	1.02	
3/27/19 14:48	30.00	25.47	26.52	1.05	
3/27/19 14:50	32.00	25.40	26.47	1.07	
3/27/19 14:52	34.00	25.34	26.43	1.09	
3/27/19 14:54	36.00	25.28	26.40	1.12	
3/27/19 14:56	38.00	25.22	26.36	1.14	
3/27/19 14:58	40.00	25.17	26.32	1.15	
3/27/19 15:00	42.00	25.12	26.29	1.17	
3/27/19 15:05	47.00	24.98	26.20	1.22	
3/27/19 15:10	52.00	24.86	26.12	1.26	
3/27/19 15:15	57.00	24.75	26.05	1.30	
3/27/19 15:20	62.00	24.66	25.99	1.33	

3/27/19 15:25	67.00	24.57	25.93	1.36	
3/27/19 15:30	72.00	24.47	25.88	1.41	
3/27/19 15:40	82.00	24.34	25.80	1.46	
3/27/19 15:52	94.00	24.21	25.73	1.52	
3/27/19 16:00	102.00	24.13	25.68	1.55	
3/27/19 16:10	112.00	24.05	25.63	1.58	
3/27/19 16:20	122.00	23.99	25.59	1.60	
3/27/19 16:40	142.00	23.92	25.53	1.61	
3/27/19 17:00	162.00	23.84	25.48	1.64	
3/27/19 20:38	380.00	23.62	25.36	1.74	
3/28/19 9:08	1130.00	23.69	25.54	1.85	
3/28/19 17:43	1645.00	23.73	25.63	1.90	
3/29/19 7:46	2488.00	23.91	25.89	1.98	End of recovery monitoring by Leidos
6/10/19 12:00	107862.00	24.93	27.80	2.87	Data collected by Gettler-Ryan

Results of LNAPL Baildown Test (MW-16) **7/16/2015**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	42.70
Initial Depth to Water (feet)	43.23
Initial LNAPL Thickness (feet)	0.53

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
7/16/15 8:49	1.00	43.47	43.58	0.11	
7/16/15 8:50	2.00	43.43	43.57	0.14	
7/16/15 8:51	3.00	43.40	43.56	0.16	
7/16/15 8:52	4.00	43.36	43.53	0.17	
7/16/15 8:53	5.00	43.33	43.50	0.17	
7/16/15 8:54	6.00	43.36	43.47	0.11	
7/16/15 8:55	7.00	43.28	43.44	0.16	
7/16/15 8:56	8.00	43.26	43.42	0.16	
7/16/15 8:57	9.00	43.24	43.40	0.16	
7/16/15 8:58	10.00	43.22	43.38	0.16	
7/16/15 8:59	11.00	43.20	43.35	0.15	
7/16/15 9:00	12.00	43.18	43.34	0.16	
7/16/15 9:02	14.00	43.14	43.31	0.17	
7/16/15 9:04	16.00	43.11	43.27	0.16	
7/16/15 9:06	18.00	43.07	43.24	0.17	
7/16/15 9:08	20.00	43.03	43.20	0.17	
7/16/15 9:10	22.00	43.00	43.18	0.18	
7/16/15 9:15	27.00	42.92	43.11	0.19	
7/16/15 9:20	32.00	42.86	43.05	0.19	
7/16/15 9:25	37.00	42.81	42.99	0.18	
7/16/15 9:30	42.00	42.76	42.94	0.18	
7/16/15 9:35	47.00	42.71	42.89	0.18	
7/16/15 9:40	52.00	42.67	42.85	0.18	
7/16/15 9:50	62.00	42.61	42.79	0.18	
7/16/15 10:00	72.00	42.56	42.73	0.17	
7/16/15 10:10	82.00	42.52	42.69	0.17	
7/16/15 10:20	92.00	42.49	42.65	0.16	
7/16/15 10:30	102.00	42.46	42.63	0.17	
7/16/15 10:40	112.00	42.44	42.61	0.17	
7/16/15 11:00	132.00	42.40	42.57	0.17	
7/16/15 11:20	152.00	42.38	42.55	0.17	
7/16/15 11:40	172.00	42.37	42.55	0.18	
7/16/15 12:00	192.00	42.35	42.53	0.18	
7/16/15 12:30	222.00	42.34	42.52	0.18	
7/16/15 13:00	252.00	42.34	42.51	0.17	
7/16/15 13:30	282.00	42.32	42.51	0.19	

7/16/15 14:00	312.00	42.32	42.51	0.19	
7/16/15 17:00	492.00	42.31	42.50	0.19	
7/16/15 20:05	677.00	42.28	42.48	0.20	
7/16/15 23:40	892.00	42.27	42.47	0.20	
7/17/15 8:18	1410.00	42.30	42.49	0.19	End of recovery monitoring by Leidos
9/21/15 12:00	96672.00	41.93	42.16	0.23	Data collected by Gettler-Ryan

Results of LNAPL Baildown Test (MW-16) **11/20/2017**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	32.07
Initial Depth to Water (feet)	44.43
Initial LNAPL Thickness (feet)	12.36

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
11/20/17 16:06	1.00	40.08	40.51	0.43	
11/20/17 16:07	2.00	39.92	40.40	0.48	
11/20/17 16:08	3.00	39.77	40.28	0.51	
11/20/17 16:09	4.00	39.63	40.18	0.55	
11/20/17 16:10	5.00	39.49	40.11	0.62	
11/20/17 16:11	6.00	39.34	40.00	0.66	
11/20/17 16:12	7.00	39.17	39.89	0.72	
11/20/17 16:13	8.00	39.02	39.80	0.78	
11/20/17 16:14	9.00	38.88	39.71	0.83	
11/20/17 16:15	10.00	38.76	39.64	0.88	
11/20/17 16:16	11.00	38.64	39.56	0.92	
11/20/17 16:17	12.00	38.52	39.47	0.95	
11/20/17 16:18	13.00	38.41	39.37	0.96	
11/20/17 16:19	14.00	38.30	39.28	0.98	
11/20/17 16:20	15.00	38.16	39.16	1.00	
11/20/17 16:21	16.00	38.02	39.06	1.04	
11/20/17 16:22	17.00	37.92	38.98	1.06	
11/20/17 16:23	18.00	37.80	38.89	1.09	
11/20/17 16:24	19.00	37.70	38.82	1.12	
11/20/17 16:25	20.00	37.61	38.77	1.16	
11/20/17 16:26	21.00	37.52	38.70	1.18	
11/20/17 16:27	22.00	37.44	38.65	1.21	
11/20/17 16:28	23.00	37.36	38.59	1.23	
11/20/17 16:29	24.00	37.28	38.53	1.25	
11/20/17 16:30	25.00	37.20	38.46	1.26	
11/20/17 16:32	27.00	37.05	38.34	1.29	
11/20/17 16:34	29.00	36.91	38.22	1.31	
11/20/17 16:36	31.00	36.78	38.09	1.31	
11/20/17 16:38	33.00	36.65	37.99	1.34	
11/20/17 16:40	35.00	36.52	37.89	1.37	
11/20/17 16:42	37.00	36.40	37.81	1.41	
11/20/17 16:44	39.00	36.31	37.75	1.44	
11/20/17 16:46	41.00	36.22	37.68	1.46	
11/20/17 16:50	45.00	36.13	37.63	1.50	
11/20/17 16:52	47.00	36.05	37.61	1.56	
11/20/17 16:54	49.00	35.97	37.55	1.58	

11/20/17 16:56	51.00	35.90	37.50	1.60	
11/20/17 16:58	53.00	35.78	37.42	1.64	
11/20/17 17:00	55.00	35.72	37.38	1.66	
11/20/17 17:05	60.00	35.61	37.32	1.71	
11/20/17 17:10	65.00	35.47	37.30	1.83	
11/20/17 17:15	70.00	35.32	37.30	1.98	
11/20/17 17:20	75.00	35.21	37.32	2.11	
11/20/17 17:25	80.00	35.15	37.32	2.17	
11/20/17 17:30	85.00	35.11	37.30	2.19	
11/20/17 17:35	90.00	35.07	37.29	2.22	
11/20/17 17:40	95.00	35.04	37.27	2.23	
11/20/17 17:45	100.00	35.01	37.26	2.25	
11/20/17 17:50	105.00	34.98	37.25	2.27	
11/20/17 17:55	110.00	34.97	37.25	2.28	
11/20/17 18:00	115.00	34.96	37.25	2.29	
11/20/17 18:10	125.00	34.91	37.26	2.35	
11/20/17 18:20	135.00	34.88	37.25	2.37	
11/20/17 18:30	145.00	34.86	37.26	2.40	
11/20/17 18:40	155.00	34.86	37.26	2.40	
11/20/17 18:50	165.00	34.86	37.29	2.43	
11/20/17 19:00	175.00	34.83	37.29	2.46	
11/20/17 19:10	185.00	34.83	37.31	2.48	
11/21/17 9:59	1074.00	34.65	37.55	2.90	
11/21/17 16:41	1476.00	34.87	37.80	2.93	End of recovery monitoring by Leidos
4/26/18 6:45	225520.00	32.78	43.51	10.73	Data collected by Leidos

Results of LNAPL Baildown Test (MW-16) **3/28/2019**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	39.37
Initial Depth to Water (feet)	46.69
Initial LNAPL Thickness (feet)	7.32

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
3/28/19 10:36	1.00	43.51	43.78	0.27	
3/28/19 10:37	2.00	43.38	43.76	0.38	
3/28/19 10:38	3.00	43.25	43.73	0.48	
3/28/19 10:39	4.00	43.15	43.68	0.53	
3/28/19 10:40	5.00	43.06	43.63	0.57	
3/28/19 10:41	6.00	42.97	43.57	0.60	
3/28/19 10:42	7.00	42.90	43.51	0.61	
3/28/19 10:43	8.00	42.81	43.45	0.64	
3/28/19 10:44	9.00	42.75	43.40	0.65	
3/28/19 10:45	10.00	42.68	43.33	0.65	
3/28/19 10:46	11.00	42.61	43.28	0.67	
3/28/19 10:47	12.00	42.56	43.23	0.67	
3/28/19 10:48	13.00	42.51	43.19	0.68	
3/28/19 10:49	14.00	42.45	43.14	0.69	
3/28/19 10:50	15.00	42.40	43.10	0.70	
3/28/19 10:52	17.00	42.30	43.02	0.72	
3/28/19 10:54	19.00	42.20	42.95	0.75	
3/28/19 10:56	21.00	42.11	42.88	0.77	
3/28/19 10:58	23.00	42.02	42.82	0.80	
3/28/19 11:00	25.00	41.94	42.77	0.83	
3/28/19 11:02	27.00	41.87	42.72	0.85	
3/28/19 11:04	29.00	41.80	42.67	0.87	
3/28/19 11:06	31.00	41.73	42.63	0.90	
3/28/19 11:08	33.00	41.67	42.60	0.93	
3/28/19 11:10	35.00	41.61	42.56	0.95	
3/28/19 11:12	37.00	41.55	42.53	0.98	
3/28/19 11:14	39.00	41.50	42.50	1.00	
3/28/19 11:16	41.00	41.45	42.47	1.02	
3/28/19 11:18	43.00	41.41	42.45	1.04	
3/28/19 11:20	45.00	41.37	42.43	1.06	
3/28/19 11:22	47.00	41.33	42.40	1.07	
3/28/19 11:24	49.00	41.29	42.38	1.09	
3/28/19 11:26	51.00	41.25	42.37	1.12	
3/28/19 11:28	53.00	41.23	42.35	1.12	
3/28/19 11:30	55.00	41.20	42.33	1.13	
3/28/19 11:35	60.00	41.13	42.29	1.16	

3/28/19 11:40	65.00	41.07	42.26	1.19	
3/28/19 11:45	70.00	41.03	42.23	1.20	
3/28/19 11:50	75.00	40.99	42.20	1.21	
3/28/19 11:55	80.00	40.95	42.18	1.23	
3/28/19 12:00	85.00	40.92	42.16	1.24	
3/28/19 12:10	95.00	40.87	42.13	1.26	
3/28/19 12:20	105.00	40.83	42.10	1.27	
3/28/19 12:30	115.00	40.80	42.09	1.29	
3/28/19 12:40	125.00	40.80	42.07	1.27	
3/28/19 17:46	431.00	40.68	42.06	1.38	
3/29/19 7:51	1276.00	40.82	42.24	1.42	End of recovery monitoring by Leidos
6/10/19 12:00	106645.00	42.03	43.80	1.77	Data collected by Gettler-Ryan

Results of LNAPL Baildown Test (MW-21) **11/20/2017**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	19.54
Initial Depth to Water (feet)	34.63
Initial LNAPL Thickness (feet)	15.09

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
11/20/17 12:31	1.00	27.37	27.89	0.52	
11/20/17 12:32	2.00	27.21	27.76	0.55	
11/20/17 12:33	3.00	27.06	27.66	0.60	
11/20/17 12:34	4.00	26.90	27.54	0.64	
11/20/17 12:35	5.00	26.73	27.46	0.73	
11/20/17 12:36	6.00	26.56	27.36	0.80	
11/20/17 12:37	7.00	26.40	27.26	0.86	
11/20/17 12:38	8.00	26.25	27.15	0.90	
11/20/17 12:39	9.00	26.12	27.05	0.93	
11/20/17 12:40	10.00	25.98	26.95	0.97	
11/20/17 12:41	11.00	25.84	26.85	1.01	
11/20/17 12:42	12.00	25.71	26.75	1.04	
11/20/17 12:43	13.00	25.57	26.64	1.07	
11/20/17 12:44	14.00	25.46	26.55	1.09	
11/20/17 12:45	15.00	25.36	26.47	1.11	
11/20/17 12:46	16.00	25.26	26.38	1.12	
11/20/17 12:48	18.00	25.08	26.22	1.14	
11/20/17 12:50	20.00	24.90	26.05	1.15	
11/20/17 12:52	22.00	24.71	25.88	1.17	
11/20/17 12:54	24.00	24.53	25.72	1.19	
11/20/17 12:56	26.00	24.37	25.58	1.21	
11/20/17 12:58	28.00	24.22	25.45	1.23	
11/20/17 13:00	30.00	24.06	25.31	1.25	
11/20/17 13:02	32.00	23.91	25.19	1.28	
11/20/17 13:04	34.00	23.78	25.10	1.32	
11/20/17 13:06	36.00	23.65	25.02	1.37	
11/20/17 13:08	38.00	23.53	24.93	1.40	
11/20/17 13:10	40.00	23.42	24.86	1.44	
11/20/17 13:12	42.00	23.31	24.80	1.49	
11/20/17 13:14	44.00	23.21	24.72	1.51	
11/20/17 13:16	46.00	23.11	24.65	1.54	
11/20/17 13:18	48.00	23.02	24.60	1.58	
11/20/17 13:20	50.00	22.93	24.54	1.61	
11/20/17 13:22	52.00	22.85	24.48	1.63	
11/20/17 13:24	54.00	22.77	24.43	1.66	
11/20/17 13:27	57.00	22.65	24.37	1.72	

11/20/17 13:30	60.00	22.54	24.31	1.77	
11/20/17 13:35	65.00	22.33	24.24	1.91	
11/20/17 13:40	70.00	22.15	24.19	2.04	
11/20/17 13:45	75.00	22.03	24.15	2.12	
11/20/17 13:50	80.00	21.93	24.13	2.20	
11/20/17 13:55	85.00	21.86	24.11	2.25	
11/20/17 14:00	90.00	21.80	24.10	2.30	
11/20/17 14:05	95.00	21.75	24.08	2.33	
11/20/17 14:10	100.00	21.71	24.06	2.35	
11/20/17 14:15	105.00	21.69	24.05	2.36	
11/20/17 14:20	110.00	21.65	24.04	2.39	
11/20/17 14:25	115.00	21.63	24.03	2.40	
11/20/17 14:30	120.00	21.61	24.03	2.42	
11/20/17 14:40	130.00	21.57	24.02	2.45	
11/20/17 14:50	140.00	21.54	24.01	2.47	
11/20/17 15:00	150.00	21.51	24.00	2.49	
11/20/17 15:20	170.00	21.50	23.99	2.49	
11/20/17 15:42	192.00	21.48	23.98	2.50	
11/20/17 16:02	212.00	21.47	23.97	2.50	
11/20/17 16:30	240.00	21.47	23.97	2.50	
11/20/17 17:00	270.00	21.48	23.97	2.49	
11/20/17 18:06	336.00	21.50	23.96	2.46	
11/21/17 10:48	1338.00	21.88	24.23	2.35	
11/21/17 16:47	1697.00	21.79	24.19	2.40	End of recovery monitoring by Leidos
12/3/17 0:00	17970.00	22.12	24.65	2.53	Data collected by Gettler-Ryan
3/18/18 12:00	169890.00	18.51	34.70	16.19	Data collected by Gettler-Ryan
4/28/18 6:04	228574.00	18.63	34.70	16.07	Data collected by Leidos

Results of LNAPL Baildown Test (MW-21) **3/27/2019**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	24.25
Initial Depth to Water (feet)	34.79
Initial LNAPL Thickness (feet)	10.54

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
3/27/19 10:46	1.00	31.60	31.98	0.38	
3/27/19 10:47	2.00	31.44	31.93	0.49	
3/27/19 10:48	3.00	31.21	31.81	0.60	
3/27/19 10:49	4.00	30.93	31.65	0.72	
3/27/19 10:50	5.00	30.65	31.49	0.84	
3/27/19 10:51	6.00	30.43	31.36	0.93	
3/27/19 10:52	7.00	30.23	31.23	1.00	
3/27/19 10:53	8.00	30.03	31.10	1.07	
3/27/19 10:54	9.00	29.83	30.97	1.14	
3/27/19 10:55	10.00	29.66	30.85	1.19	
3/27/19 10:56	11.00	29.47	30.72	1.25	
3/27/19 10:57	12.00	29.33	30.60	1.27	
3/27/19 10:58	13.00	29.19	30.49	1.30	
3/27/19 10:59	14.00	29.07	30.38	1.31	
3/27/19 11:00	15.00	28.97	30.29	1.32	
3/27/19 11:02	17.00	28.82	30.11	1.29	
3/27/19 11:04	19.00	28.66	29.92	1.26	
3/27/19 11:06	21.00	28.53	29.75	1.22	
3/27/19 11:08	23.00	28.39	29.56	1.17	
3/27/19 11:10	25.00	28.29	29.43	1.14	
3/27/19 11:12	27.00	28.16	29.28	1.12	
3/27/19 11:14	29.00	28.06	29.17	1.11	
3/27/19 11:16	31.00	27.96	29.06	1.10	
3/27/19 11:18	33.00	27.88	28.98	1.10	
3/27/19 11:20	35.00	27.80	28.90	1.10	
3/27/19 11:25	40.00	27.62	28.72	1.10	
3/27/19 11:30	45.00	27.50	28.58	1.08	
3/27/19 11:35	50.00	27.36	28.42	1.06	
3/27/19 11:40	55.00	27.24	28.29	1.05	
3/27/19 11:45	60.00	27.12	28.18	1.06	
3/27/19 11:50	65.00	27.02	28.08	1.06	
3/27/19 12:00	75.00	26.82	27.92	1.10	
3/27/19 12:10	85.00	26.66	27.79	1.13	
3/27/19 12:20	95.00	26.53	27.68	1.15	
3/27/19 12:30	105.00	26.43	27.61	1.18	
3/27/19 12:40	115.00	26.35	27.56	1.21	

3/27/19 12:50	125.00	26.27	27.51	1.24	
3/27/19 13:00	135.00	26.21	27.47	1.26	
3/27/19 15:48	303.00	25.84	27.22	1.38	
3/27/19 16:48	363.00	25.80	27.20	1.40	
3/27/19 20:42	597.00	25.78	27.21	1.43	
3/28/19 9:12	1347.00	25.96	27.41	1.45	
3/28/19 17:50	1865.00	26.03	27.50	1.47	
3/29/19 7:57	2712.00	26.17	27.66	1.49	End of recovery monitoring by Leidos
6/10/19 12:00	108075.00	26.10	34.80	8.70	Data collected by Gettler-Ryan

Results of LNAPL Baildown Test (MW-27) **11/19/2017**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	21.70
Initial Depth to Water (feet)	34.16
Initial LNAPL Thickness (feet)	12.46

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
11/19/17 16:59	1.00	28.26	28.67	0.41	
11/19/17 17:00	2.00	28.10	28.52	0.42	
11/19/17 17:01	3.00	27.89	28.34	0.45	
11/19/17 17:02	4.00	27.66	28.15	0.49	
11/19/17 17:03	5.00	27.50	28.02	0.52	
11/19/17 17:04	6.00	27.32	27.89	0.57	
11/19/17 17:05	7.00	27.18	27.76	0.58	
11/19/17 17:06	8.00	27.02	27.63	0.61	
11/19/17 17:07	9.00	26.90	27.50	0.60	
11/19/17 17:08	10.00	26.76	27.34	0.58	
11/19/17 17:09	11.00	26.63	27.21	0.58	
11/19/17 17:10	12.00	26.55	27.12	0.57	
11/19/17 17:11	13.00	26.44	27.01	0.57	
11/19/17 17:12	14.00	26.32	26.87	0.55	
11/19/17 17:13	15.00	26.21	26.76	0.55	
11/19/17 17:14	16.00	26.12	26.65	0.53	
11/19/17 17:15	17.00	26.03	26.56	0.53	
11/19/17 17:16	18.00	25.94	26.47	0.53	
11/19/17 17:17	19.00	25.86	26.38	0.52	
11/19/17 17:18	20.00	25.79	26.31	0.52	
11/19/17 17:19	21.00	25.72	26.22	0.50	
11/19/17 17:20	22.00	25.65	26.16	0.51	
11/19/17 17:22	24.00	25.52	26.01	0.49	
11/19/17 17:24	26.00	25.42	25.90	0.48	
11/19/17 17:26	28.00	25.31	25.80	0.49	
11/19/17 17:28	30.00	25.20	25.69	0.49	
11/19/17 17:30	32.00	25.11	25.61	0.50	
11/19/17 17:32	34.00	25.01	25.52	0.51	
11/19/17 17:34	36.00	24.93	25.44	0.51	
11/19/17 17:36	38.00	24.86	25.37	0.51	
11/19/17 17:38	40.00	24.79	25.30	0.51	
11/19/17 17:40	42.00	24.71	25.23	0.52	
11/19/17 17:45	47.00	24.55	25.11	0.56	
11/19/17 17:50	52.00	24.41	25.02	0.61	
11/19/17 17:55	57.00	24.30	24.94	0.64	
11/19/17 18:00	62.00	24.18	24.86	0.68	

11/19/17 18:05	67.00	24.07	24.86	0.79	
11/19/17 18:10	72.00	23.98	24.88	0.90	
11/19/17 18:15	77.00	23.91	24.90	0.99	
11/19/17 18:20	82.00	23.84	24.92	1.08	
11/19/17 18:25	87.00	23.78	24.93	1.15	
11/19/17 18:30	92.00	23.73	24.94	1.21	
11/19/17 18:35	97.00	23.68	24.95	1.27	
11/19/17 18:40	102.00	23.64	24.97	1.33	
11/19/17 18:45	107.00	23.60	24.98	1.38	
11/19/17 18:50	112.00	23.56	25.00	1.44	
11/19/17 18:55	117.00	23.53	25.01	1.48	
11/19/17 19:00	122.00	23.50	25.04	1.54	
11/19/17 19:05	127.00	23.49	25.06	1.57	
11/19/17 19:10	132.00	23.45	25.08	1.63	
11/19/17 19:15	137.00	23.42	25.14	1.72	
11/19/17 19:20	142.00	23.40	25.16	1.76	
11/19/17 19:25	147.00	23.38	25.20	1.82	
11/19/17 19:30	152.00	23.36	25.23	1.87	
11/19/17 19:35	157.00	23.34	25.26	1.92	
11/19/17 19:40	162.00	23.33	25.28	1.95	
11/19/17 19:45	167.00	23.32	25.25	1.93	
11/19/17 19:50	172.00	23.31	25.28	1.97	
11/19/17 19:55	177.00	23.30	25.29	1.99	
11/19/17 20:00	182.00	23.28	25.30	2.02	
11/20/17 8:25	927.00	22.89	25.76	2.87	
11/20/17 18:15	1517.00	23.07	26.12	3.05	
11/21/17 11:05	2527.00	23.15	26.34	3.19	
11/21/17 16:51	2873.00	22.98	26.37	3.39	End of recovery monitoring by Leidos
12/3/17 12:00	19862.00	22.88	28.64	5.76	Data collected by Gettler-Ryan
3/18/18 12:00	171062.00	20.57	33.95	13.38	Data collected by Gettler-Ryan
4/26/18 17:40	227562.00	20.72	33.56	12.84	Data collected by Leidos

Results of LNAPL Baildown Test (MW-27) **3/27/2019**
Chevron 96590, Chelan, Washington

Initial Test Conditions

Initial Depth to LNAPL (feet)	24.78
Initial Depth to Water (feet)	33.63
Initial LNAPL Thickness (feet)	8.85

Baildown Test Data

Time	Elapsed Time	DTP (Ft)	DTW (Ft)	LNAPL Thickness (Ft)	Notes
3/27/19 18:18	0.00			0.00	
3/27/19 18:19	1.00	28.96	29.34	0.38	
3/27/19 18:20	2.00	28.83	29.24	0.41	
3/27/19 18:21	3.00	28.71	29.14	0.43	
3/27/19 18:22	4.00	28.60	29.06	0.46	
3/27/19 18:23	5.00	28.48	28.96	0.48	
3/27/19 18:24	6.00	28.39	28.89	0.50	
3/27/19 18:25	7.00	28.30	28.81	0.51	
3/27/19 18:26	8.00	28.22	28.75	0.53	
3/27/19 18:28	10.00	28.07	28.63	0.56	
3/27/19 18:30	12.00	27.92	28.51	0.59	
3/27/19 18:32	14.00	27.77	28.37	0.60	
3/27/19 18:34	16.00	27.63	28.25	0.62	
3/27/19 18:36	18.00	27.51	28.15	0.64	
3/27/19 18:38	20.00	27.39	28.05	0.66	
3/27/19 18:40	22.00	27.28	27.96	0.68	
3/27/19 18:42	24.00	27.16	27.86	0.70	
3/27/19 18:44	26.00	27.06	27.77	0.71	
3/27/19 18:46	28.00	26.98	27.71	0.73	
3/27/19 18:48	30.00	26.90	27.65	0.75	
3/27/19 18:50	32.00	26.84	27.60	0.76	
3/27/19 18:55	37.00	26.69	27.53	0.84	
3/27/19 19:00	42.00	26.58	27.50	0.92	
3/27/19 19:05	47.00	26.48	27.50	1.02	
3/27/19 19:10	52.00	26.40	27.50	1.10	
3/27/19 19:15	57.00	26.33	27.52	1.19	
3/27/19 19:20	62.00	26.26	27.55	1.29	
3/27/19 19:25	67.00	26.19	27.59	1.40	
3/27/19 19:30	72.00	26.14	27.64	1.50	
3/27/19 19:35	77.00	26.09	27.69	1.60	
3/27/19 19:40	82.00	26.05	27.72	1.67	
3/27/19 19:45	87.00	26.02	27.76	1.74	
3/27/19 19:50	92.00	26.00	27.80	1.80	
3/27/19 19:55	97.00	25.98	27.84	1.86	
3/27/19 20:00	102.00	25.95	27.87	1.92	
3/27/19 20:05	107.00	25.93	27.88	1.95	

3/27/19 20:10	112.00	25.92	27.90	1.98	
3/27/19 20:15	117.00	25.90	27.91	2.01	
3/27/19 20:20	122.00	25.88	27.93	2.05	
3/27/19 20:25	127.00	25.88	27.94	2.06	
3/27/19 20:30	132.00	25.87	27.94	2.07	
3/27/19 20:35	137.00	25.86	27.95	2.09	
3/27/19 20:40	142.00	25.85	27.95	2.10	
3/27/19 20:45	147.00	25.85	27.95	2.10	
3/27/19 20:55	157.00	25.82	27.97	2.15	
3/27/19 22:00	222.00	25.77	28.04	2.27	
3/28/19 9:16	898.00	25.67	28.45	2.78	
3/28/19 17:54	1416.00	25.69	28.83	3.14	
3/29/19 9:01	2323.00	25.76	29.29	3.53	End of recovery monitoring by Leidos
6/10/19 12:00	107622.00	27.90	33.00	5.10	Data collected by Gettler-Ryan

Appendix B:
API LNAPL Transmissivity Workbook Output

Well Designation:	MW-9	
Date:	19-Nov-17	

Ground Surface Elev (ft msl)	1124.2	Enter These Data	**Drawdown Adjustment (ft)**
Top of Casing Elev (ft msl)	1123.7		
Well Casing Radius, r_c (ft):	0.083	r_{e1}	
Well Radius, r_w (ft):	0.333		3
LNAPL Specific Yield, S_y:	0.175		
LNAPL Density Ratio, ρ_r:	0.780		
Top of Screen (ft bgs):	15.0		
Bottom of Screen (ft bgs):	40.0		
LNAPL Baildown Vol. (gal.):	4.0		
Effective Radius, r_{e3} (ft):	0.158	Calculated Parameters	
Effective Radius, r_{e2} (ft):	#NUM!		
Initial Casing LNAPL Vol. (gal.):	1.47		
Initial Filter LNAPL Vol. (gal.):	3.90		

Enter Data Here

	Time (min)	DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)	Water Table Depth (ft)	LNAPL Drawdown s_n (ft)	Average Time (min)	LNAPL Discharge Q_n (ft^3/d)	s_n (ft)	b_n (ft)	r_e (ft)	DTP (ft bgs)	DTW (ft bgs)	LNAPL Volume (gallons)	Ave. r_e (ft)
Initial Fluid Levels:	0	27.11	36.22	27.61	36.72	29.61					9.11					
Enter Test Data:	1.0	34.91	35.39	35.41	35.89	35.52	4.80				0.48				0	0.158
	2.0	34.75	35.29	35.25	35.79	35.37	4.64	1.5	6.810	4.72	0.54	0.158	35.33	35.84	0.04	0
	3.0	34.63	35.21	35.13	35.71	35.26	4.52	2.5	4.540	4.58	0.58	0.158	35.19	35.75	0.06	0.158
	4.0	34.52	35.14	35.02	35.64	35.16	4.41	3.5	4.540	4.47	0.62	0.158	35.08	35.68	0.08	0.317
	5.0	34.39	35.05	34.89	35.55	35.04	4.28	4.5	4.540	4.35	0.66	0.158	34.96	35.60	0.11	0.475
	6.0	34.28	34.99	34.78	35.49	34.94	4.17	5.5	5.675	4.23	0.71	0.158	34.84	35.52	0.14	0.634
	7.0	34.17	34.95	34.67	35.45	34.84	4.06	6.5	7.945	4.12	0.78	0.158	34.73	35.47	0.18	0.792
	8.0	34.05	34.92	34.55	35.42	34.74	3.94	7.5	10.215	4.00	0.87	0.158	34.61	35.44	0.23	0.950
	9.0	33.95	34.89	34.45	35.39	34.66	3.84	8.5	7.945	3.89	0.94	0.158	34.50	35.41	0.27	1.109
	10.0	33.85	34.87	34.35	35.37	34.57	3.74	9.5	9.080	3.79	1.02	0.158	34.40	35.38	0.32	1.267
	11.0	33.75	34.85	34.25	35.35	34.49	3.64	10.5	9.080	3.69	1.10	0.158	34.30	35.36	0.37	1.426
	12.0	33.65	34.84	34.15	35.34	34.41	3.54	11.5	10.215	3.59	1.19	0.158	34.20	35.34	0.42	1.584
	13.0	33.57	34.82	34.07	35.32	34.34	3.46	12.5	6.810	3.50	1.25	0.158	34.11	35.33	0.45	1.742
	14.0	33.47	34.80	33.97	35.30	34.26	3.36	13.5	9.080	3.41	1.33	0.158	34.02	35.31	0.50	1.901
	15.0	33.39	34.78	33.89	35.28	34.20	3.28	14.5	6.810	3.32	1.39	0.158	33.93	35.29	0.54	2.059
	16.0	33.31	34.74	33.81	35.24	34.12	3.20	15.5	4.540	3.24	1.43	0.158	33.85	35.26	0.56	2.218
	17.0	33.25	34.71	33.75	35.21	34.07	3.14	16.5	3.405	3.17	1.46	0.158	33.78	35.23	0.58	2.376
	18.0	33.18	34.67	33.68	35.17	34.01	3.07	17.5	3.405	3.11	1.49	0.158	33.72	35.19	0.60	2.534
	19.0	33.11	34.62	33.61	35.12	33.94	3.00	18.5	2.270	3.04	1.51	0.158	33.65	35.15	0.61	2.693
	20.0	33.05	34.58	33.55	35.08	33.89	2.94	19.5	2.270	2.97	1.53	0.158	33.58	35.10	0.62	2.851
	21.0	33.00	34.54	33.50	35.04	33.84	2.89	20.5	1.135	2.92	1.54	0.158	33.53	35.06	0.62	3.010
	22.0	32.95	34.49	33.45	34.99	33.79	2.84	21.5	0.000	2.87	1.54	0.158	33.48	35.02	0.62	3.168
	23.0	32.90	34.44	33.40	34.94	33.74	2.79	22.5	0.000	2.82	1.54	0.158	33.43	34.97	0.62	3.326
	24.0	32.85	34.39	33.35	34.89	33.69	2.74	23.5	0.000	2.77	1.54	0.158	33.38	34.92	0.62	3.485
	25.0	32.80	34.33	33.30	34.83	33.64	2.69	24.5	-1.135	2.72	1.53	0.158	33.32	34.86	0.62	3.643
	26.0	32.75	34.29	33.25	34.79	33.59	2.64	25.5	1.135	2.67	1.54	0.158	33.28	34.81	0.62	3.801
	27.0	32.71	34.24	33.21	34.74	33.55	2.60	26.5	-1.135	2.62	1.53	0.158	33.23	34.77	0.62	3.960
	28.0	32.66	34.19	33.16	34.69	33.50	2.55	27.5	0.000	2.58	1.53	0.158	33.19	34.72	0.62	4.118
	30.0	32.57	34.09	33.07	34.59	33.40	2.46	29.0	-0.567	2.51	1.52	0.158	33.12	34.64	0.61	4.356
	32.0	32.48	33.98	32.98	34.48	33.31	2.37	31.0	-1.135	2.42	1.50	0.158	33.03	34.54	0.60	4.673
	34.0	32.39	33.87	32.89	34.37	33.22	2.28	33.0	-1.135	2.33	1.48	0.158	32.94	34.43	0.59	4.989
	36.0	32.32	33.79	32.82	34.29	33.14	2.21	35.0	-0.567	2.25	1.47	0.158	32.86	34.33	0.58	5.306
	38.0	32.24	33.70	32.74	34.20	33.06	2.13	37.0	-0.567	2.17	1.46	0.158	32.78	34.25	0.58	5.623
	40.0	32.16	33.61	32.66	34.11	32.98	2.05	39.0	-0.567	2.09	1.45	0.158	32.70	34.16	0.57	5.940
	42.0	32.10	33.54	32.60	34.04	32.92	1.99	41.0	-0.567	2.02	1.44	0.158	32.63	34.07	0.57	6.257
	44.0	32.02	33.44	32.52	33.94	32.83	1.91	43.0	-1.135	1.95	1.42	0.158	32.56	33.99	0.55	6.573
	46.0	31.95	33.38	32.45	33.88	32.76	1.84	45.0	0.567	1.88	1.43	0.158	32.49	33.91	0.56	6.890
	48.0	31.88	33.31	32.38	33.81	32.69	1.77	47.0	0.000	1.81	1.43	0.158	32.42	33.85	0.56	7.207
	50.0	31.81	33.23	32.31	33.73	32.62	1.70	49.0	-0.567	1.74	1.42	0.158	32.35	33.77	0.55	7.524
	52.0	31.75	33.17	32.25	33.67	32.56	1.64	51.0	0.000	1.67	1.42	0.158	32.28	33.70	0.55	7.841
	54.0	31.68	33.11	32.18	33.61	32.49	1.57	53.0	0.567	1.61	1.43	0.158	32.22	33.64	0.56	8.157
	56.0	31.62	33.06	32.12	33.56	32.44	1.51	55.0	0.567	1.54	1.44	0.158	32.15	33.58	0.57	8.474
	58.0	31.55	33.00	32.05	33.50	32.37	1.44	57.0	0.567	1.48	1.45	0.158	32.08	33.53	0.57	8.791

60.0	31.48	32.95	31.98	33.45		32.30	1.37		59.0	1.135	1.41	1.47	0.158		32.02	33.48	0.58	9.108

Figure 1

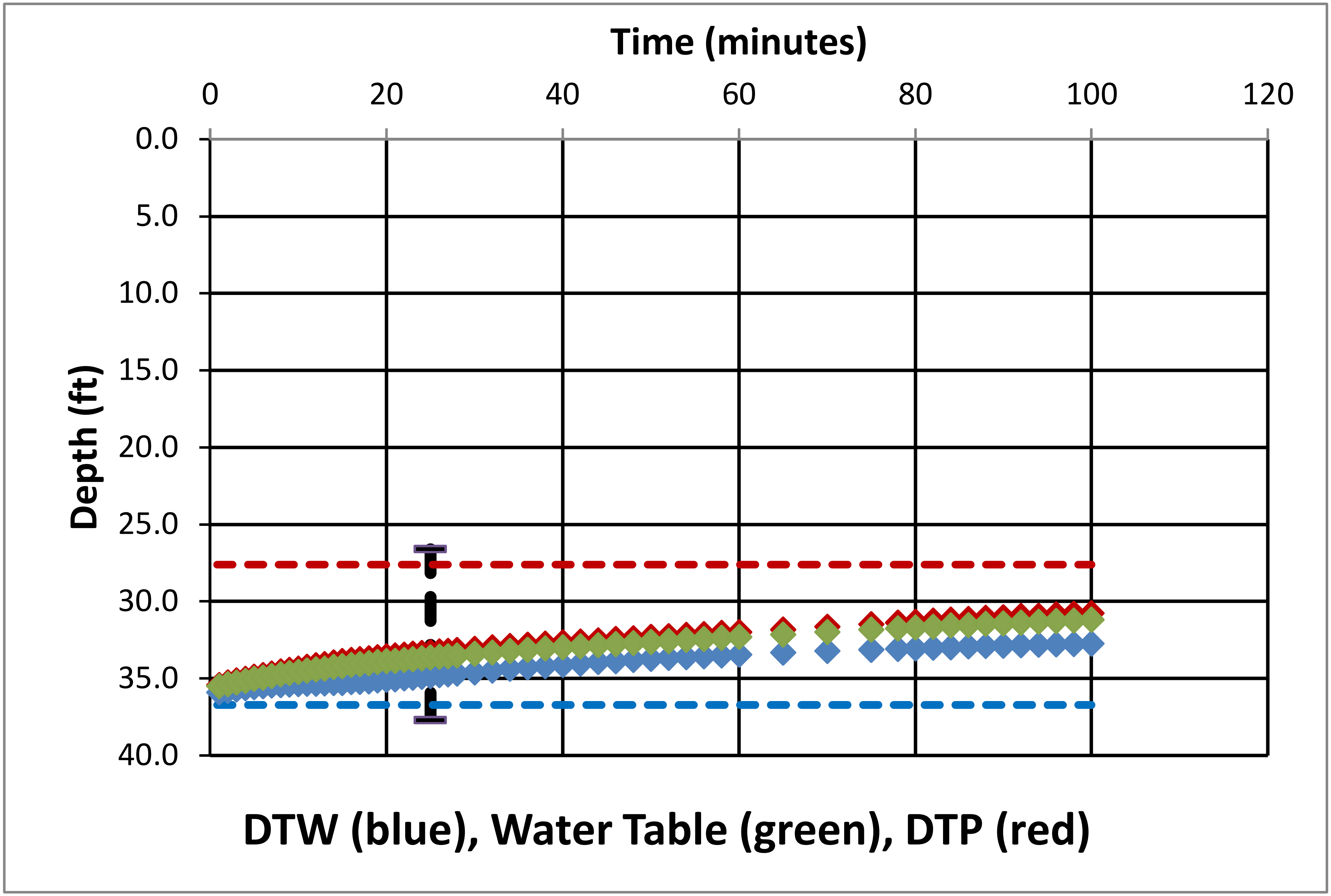
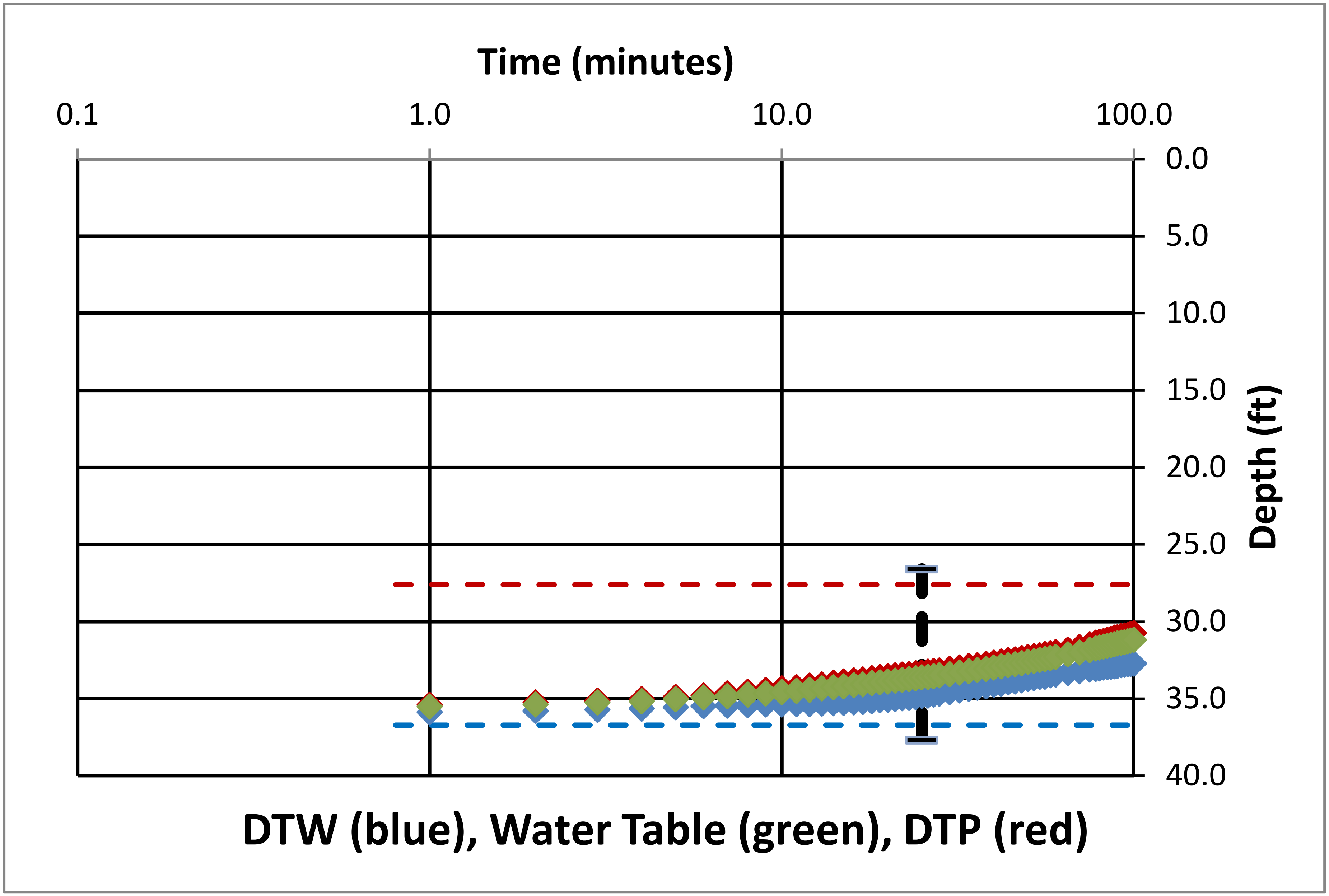

Time (minutes)
0
20
40
60
80
100
120
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 2



Time (minutes)
0.1
1.0
10.0
100.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 3

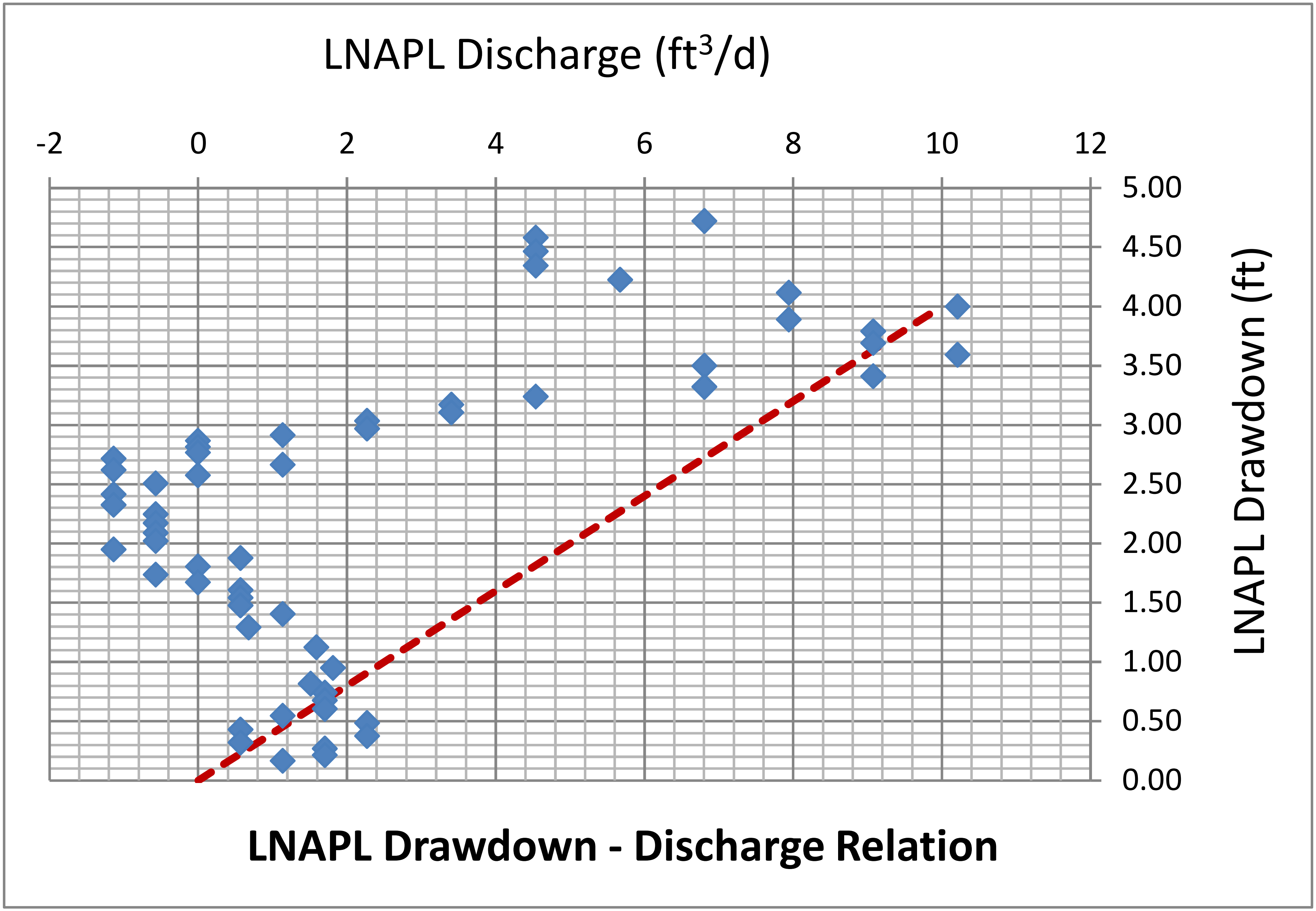
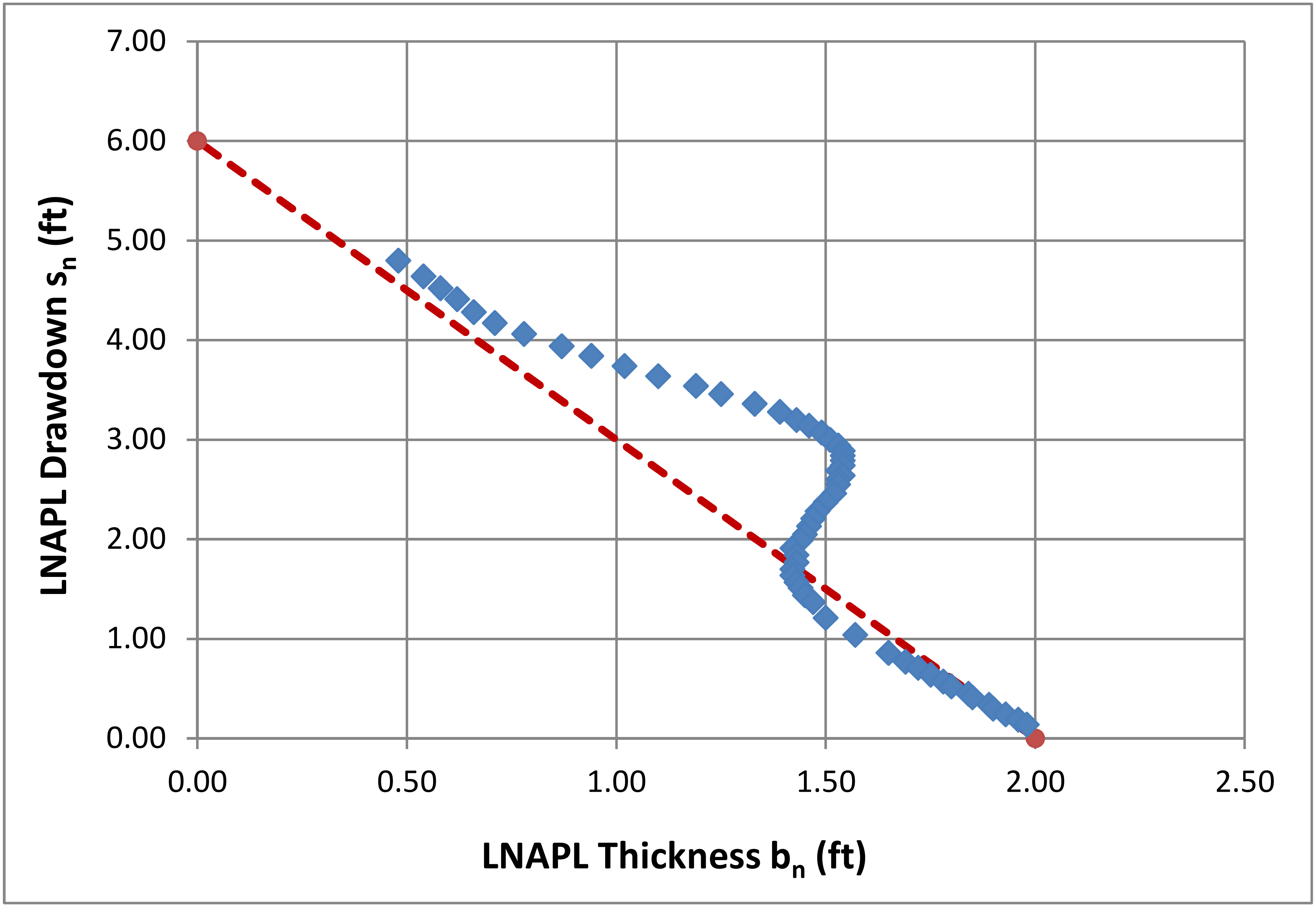

LNAPL Discharge (ft3/d)
-2
0
2
4
6
8
10
12
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Discharge Relation

Figure 4



MW-9 (November 2017)
Baildown Test Data Analysis

Figure 5

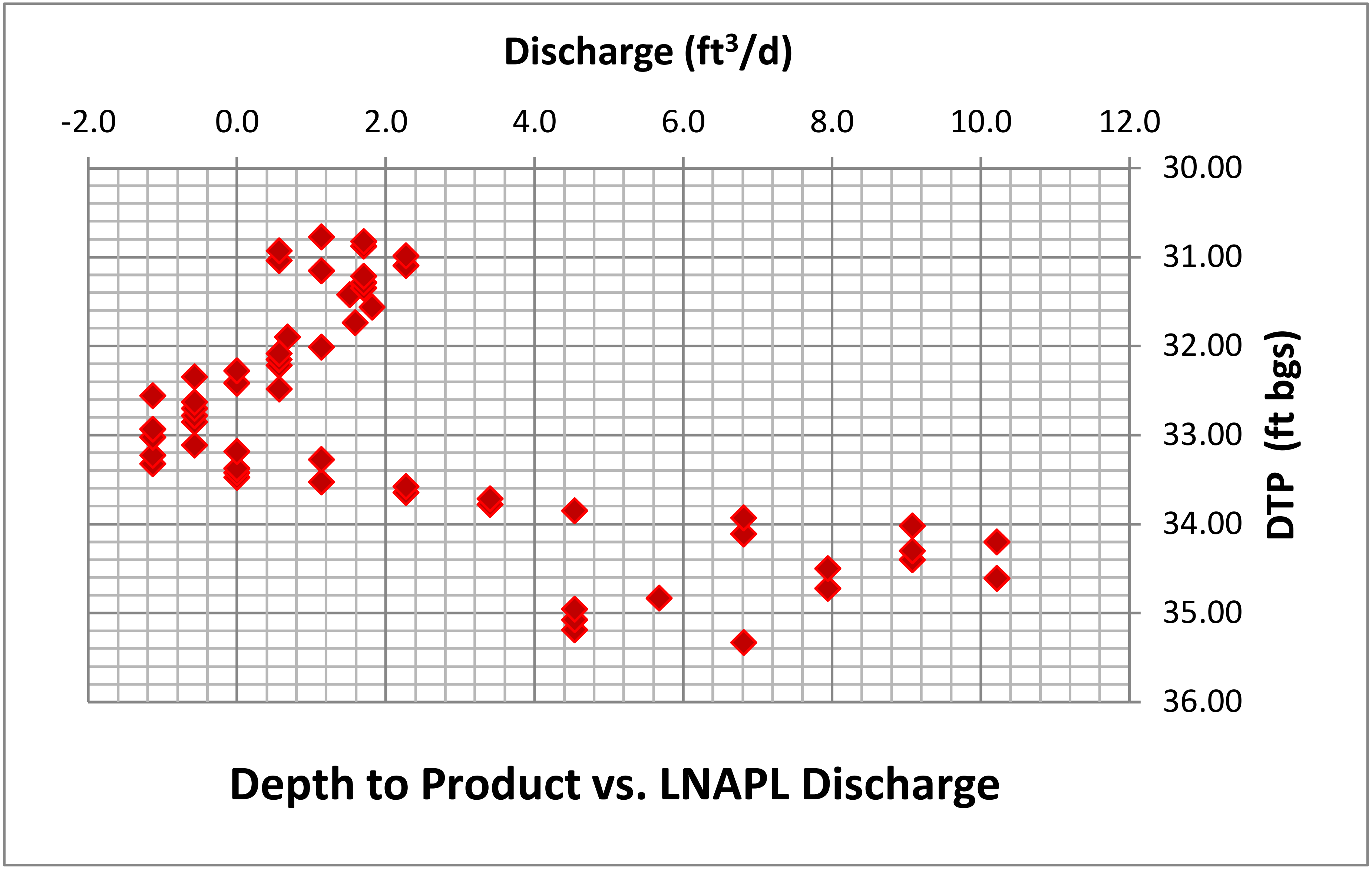
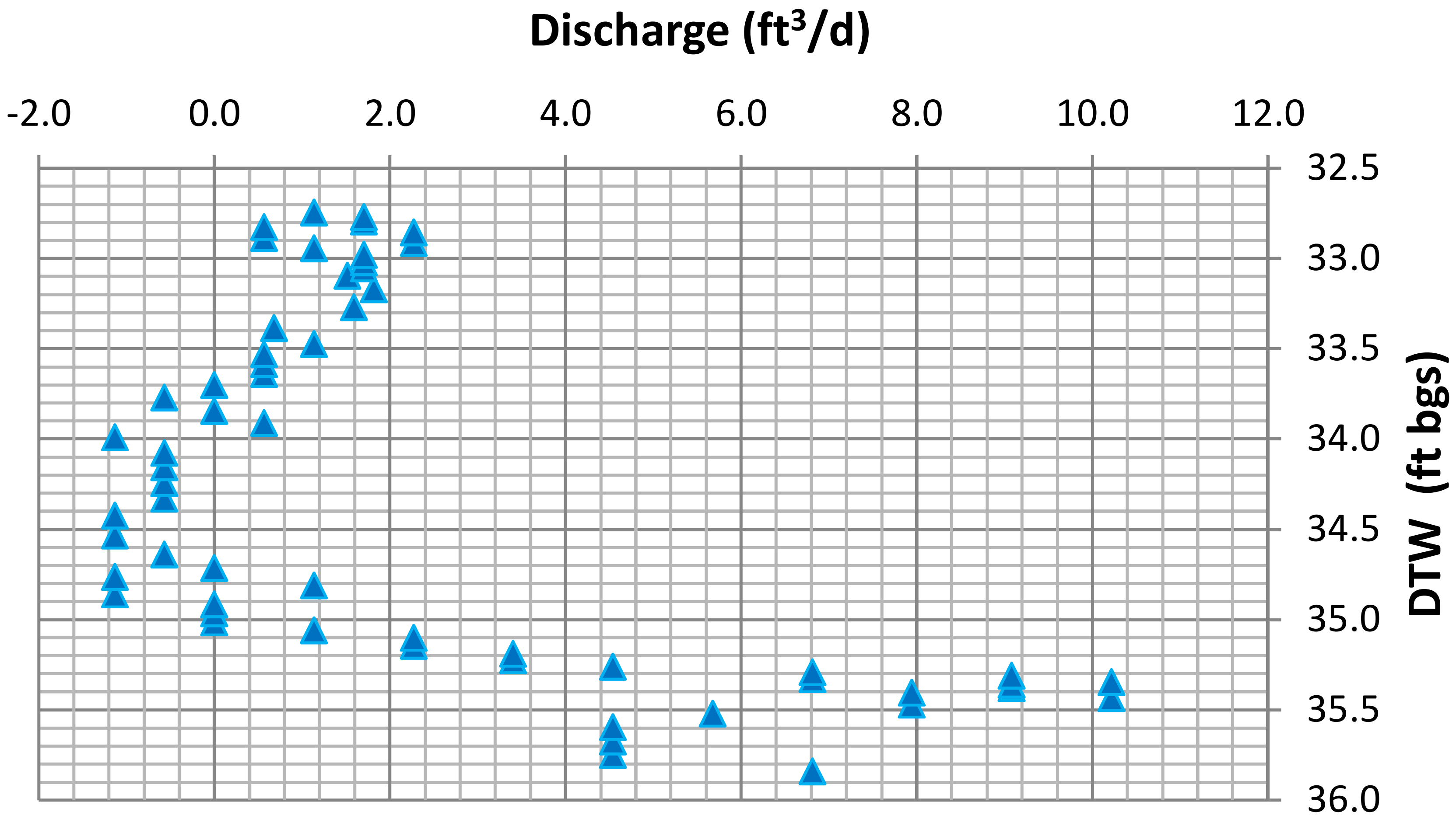
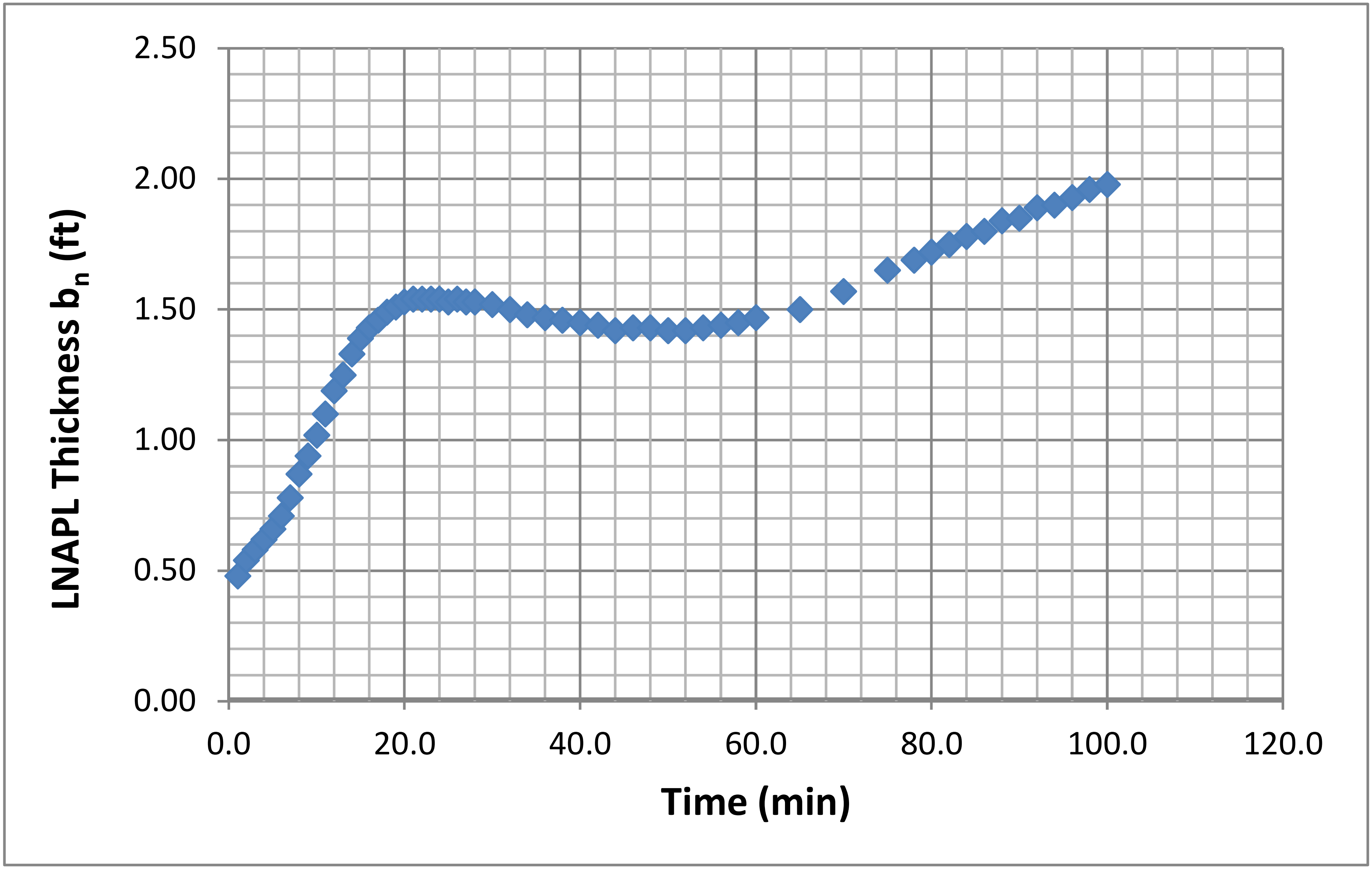

Discharge (ft^3/d)
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
30.00
31.00
32.00
33.00
34.00
35.00
36.00
DTP (ft bgs)
Depth to Product vs. LNAPL Discharge

Figure 6



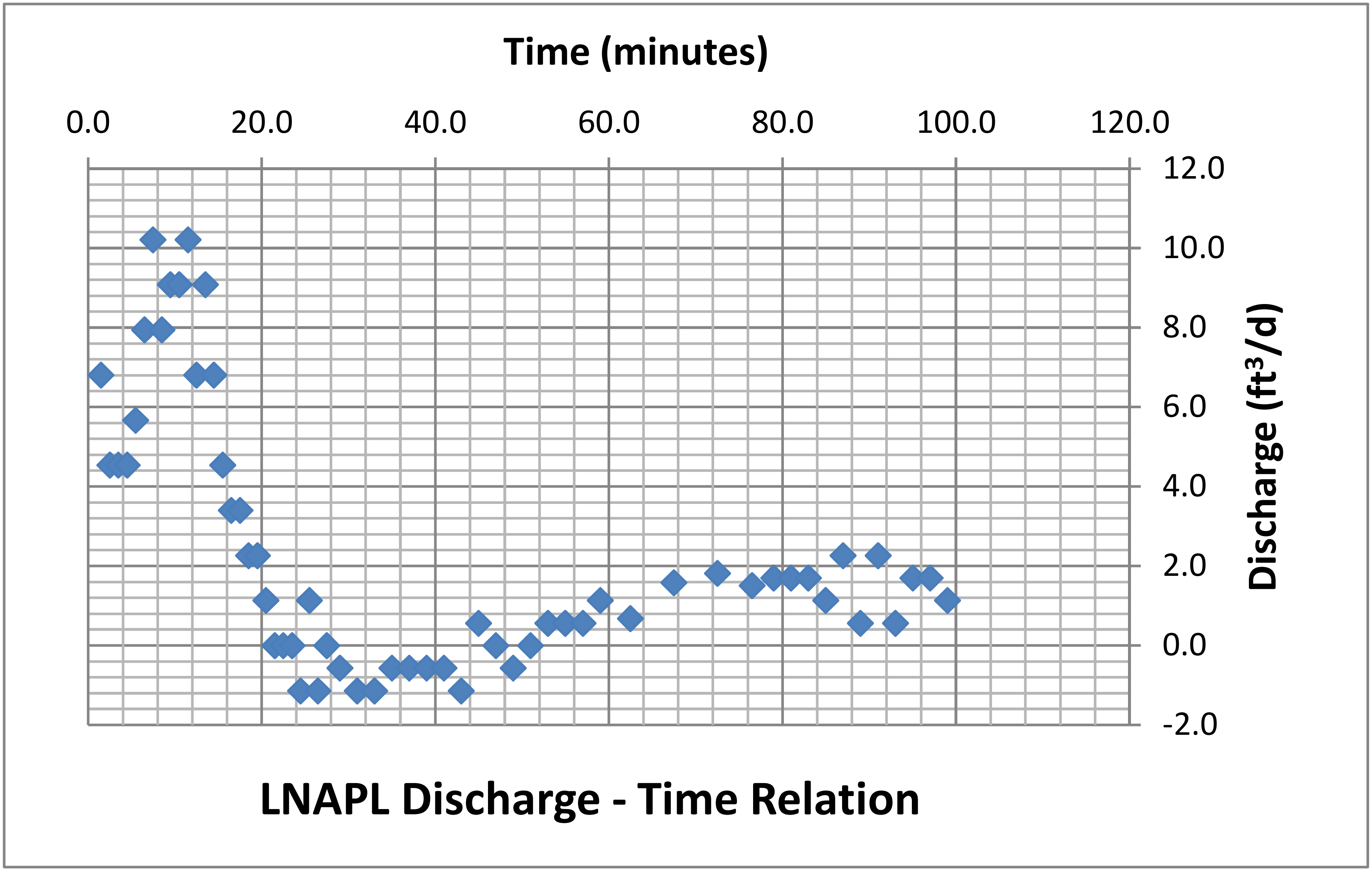
Depth to Water vs. LNAPL Discharge

Figure 7



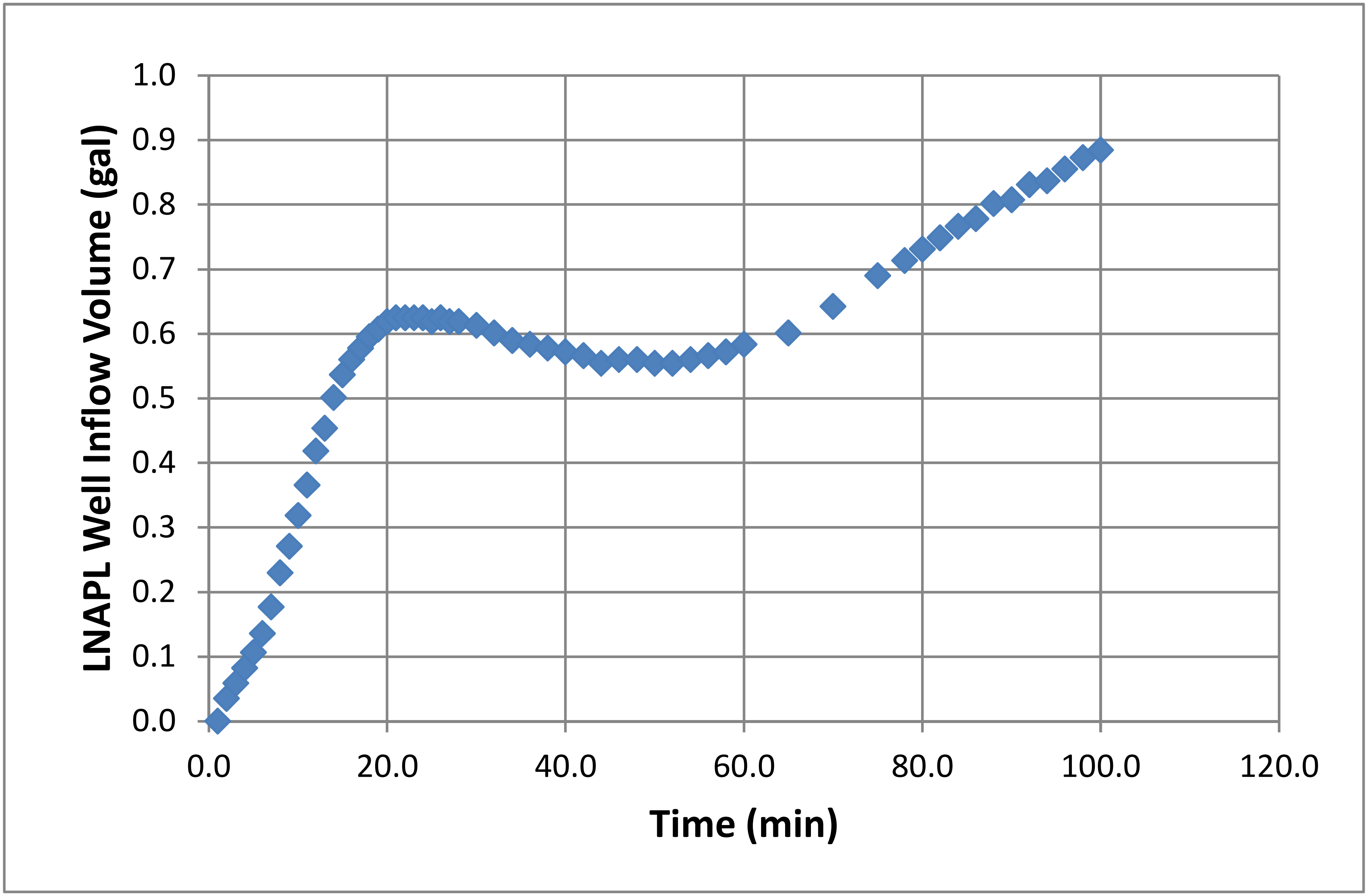
MW-9 (November 2017)
Baildown Test Data Analysis

Figure 8



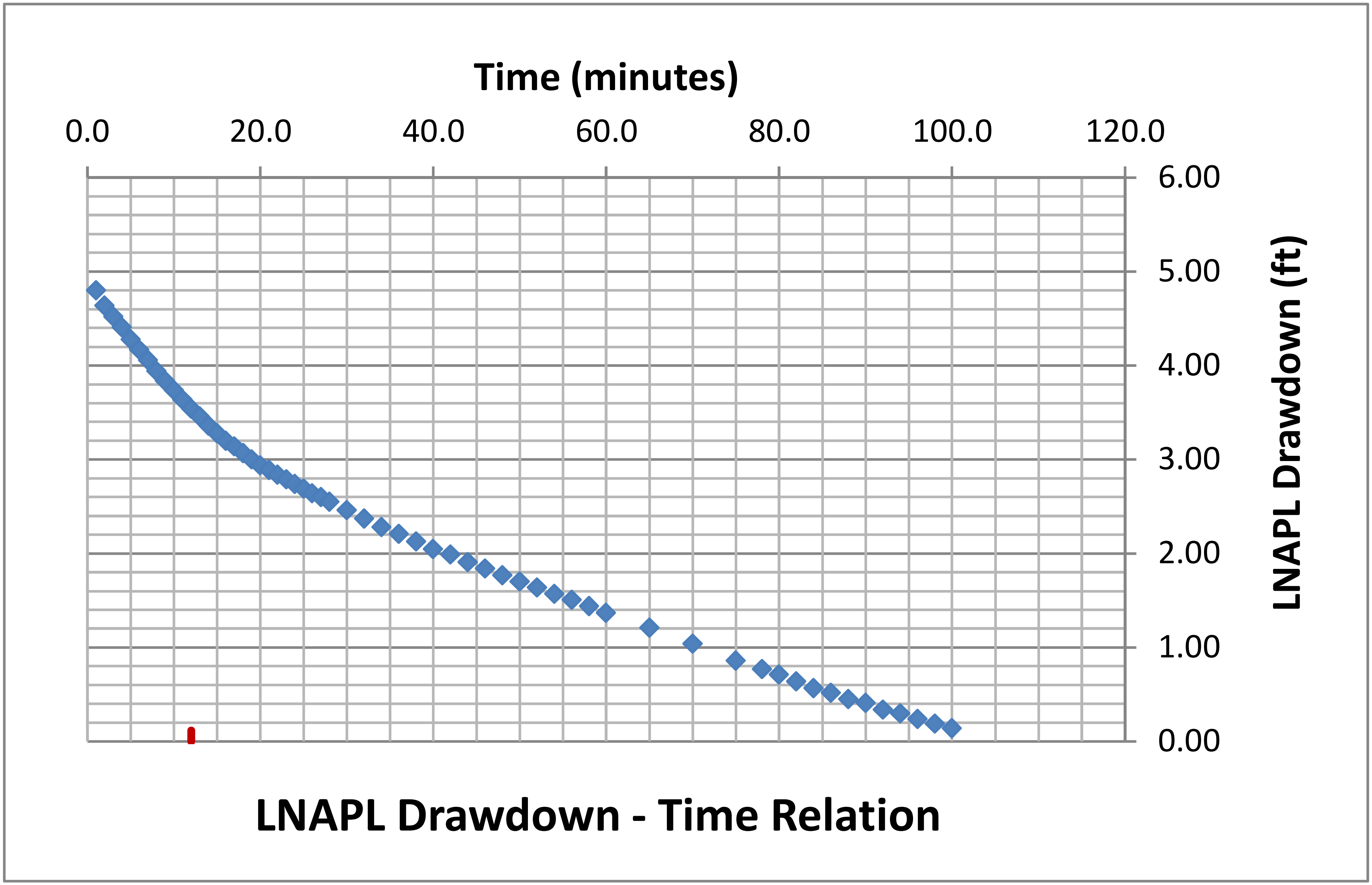
MW-9 (November 2017)
Baildown Test Data Analysis
Page 10 of 17

Figure 9



1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
LNAPL Well Inflow Volume (gal)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
Time (min)

Figure 10



Time (minutes)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
6.00
5.00
4.00
3.00
2.00
1.00
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Time Relation

Generalized Bouwer and Rice (1976)

Well Designation:	MW-9
Date:	19-Nov-17

$$T_n = \frac{r_e^{\,2} \ln(R/r_e)\ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

Enter early time cut-off for least-squares model fit

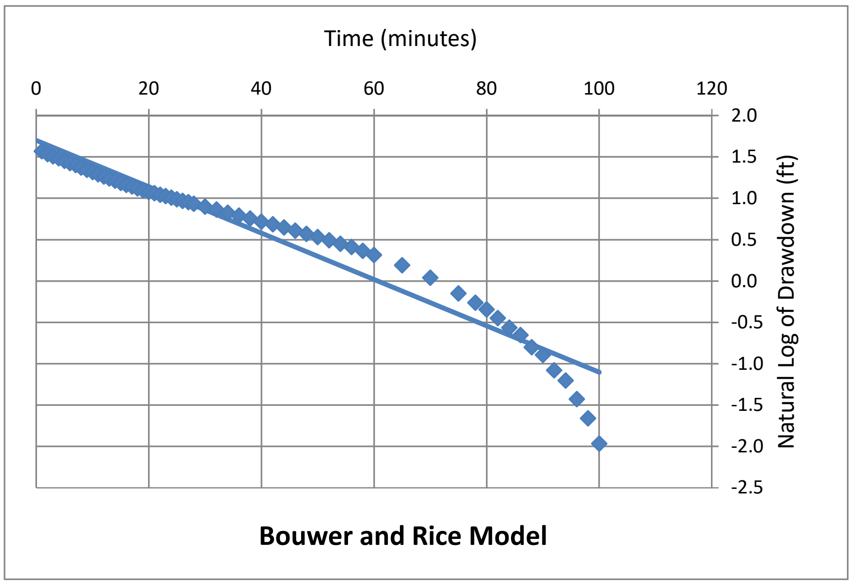
$Time_{cut}$	0	<- Enter or change value here

Model Results: T_n (ft^2/d) = 0.52 +/- 0.02 ft^2/d

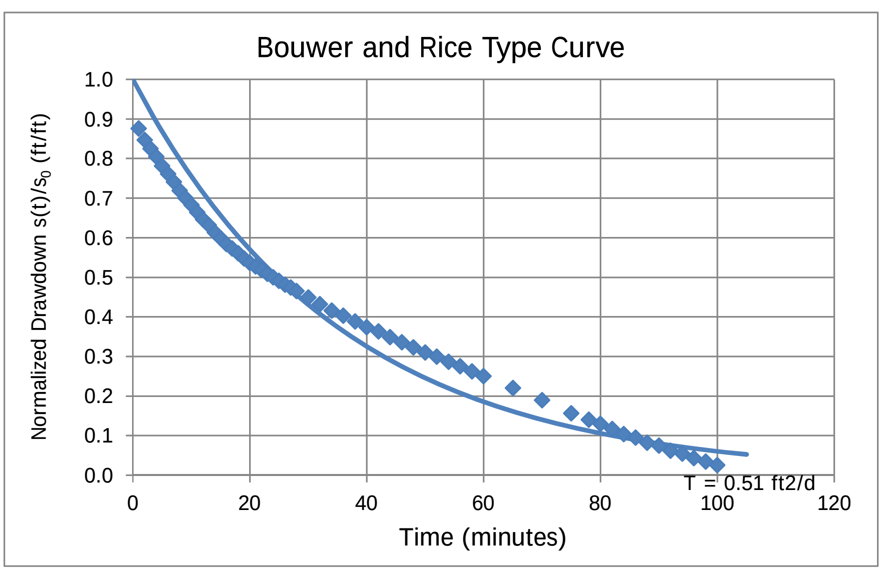
L_e/r_e
57.5
C
3.10
R/r_e
21.63

J-Ratio
-3.000

Coef. Of Variation
0.03



C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW-9
Date:	19-Nov-17

$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

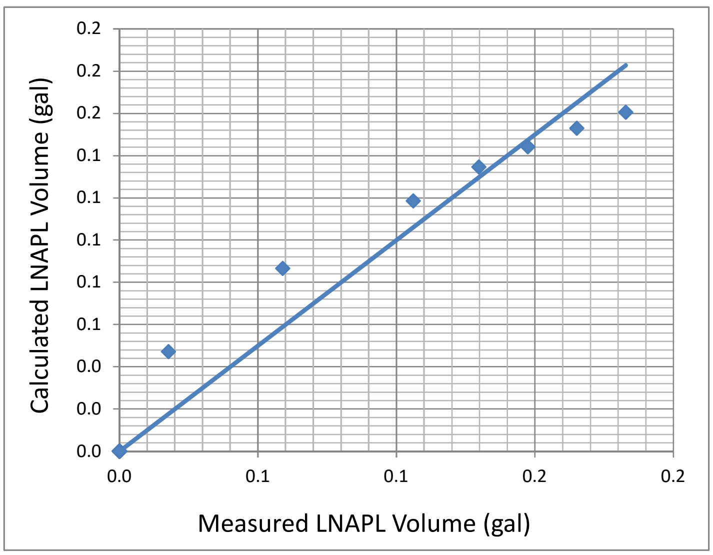
Enter early time cut-off for least-squares model fit

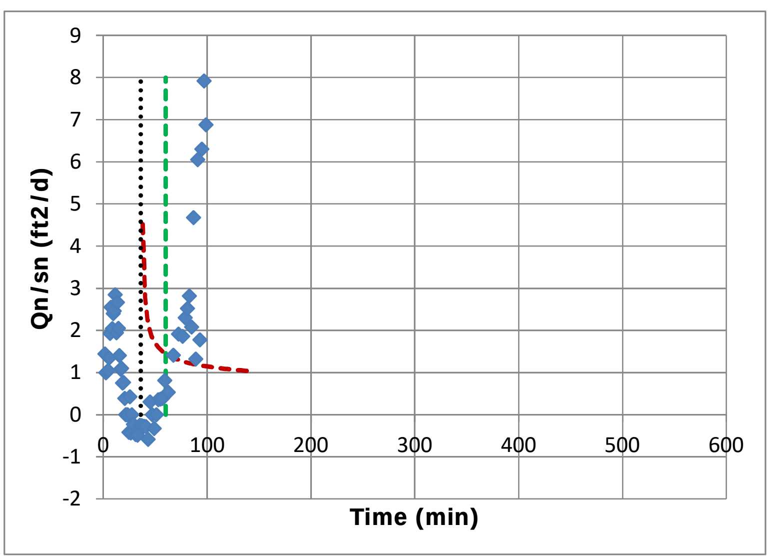
$Time_{cut}$ (min):	60	<- Enter or change values here
Time Adjustment (min):	36	

Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	0.050	<-- Minimize this using "Solver"
	0.016	<-- Working S_n
Trial T_n (ft^2/d):	0.421	<-- By changing T_n through "Solver"

Add constraint T_n > 0.00001

Model Result: T_n (ft^2/d) = **0.42**





Height

8

Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	MW-9
Date:	19-Nov-17

Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Initial Drawdown s_n (ft):	4.8	

Trial S_n: d <-- Enter d for default

Root-Mean-Square Error: 0.196 <-- Minimize this using "Solver"

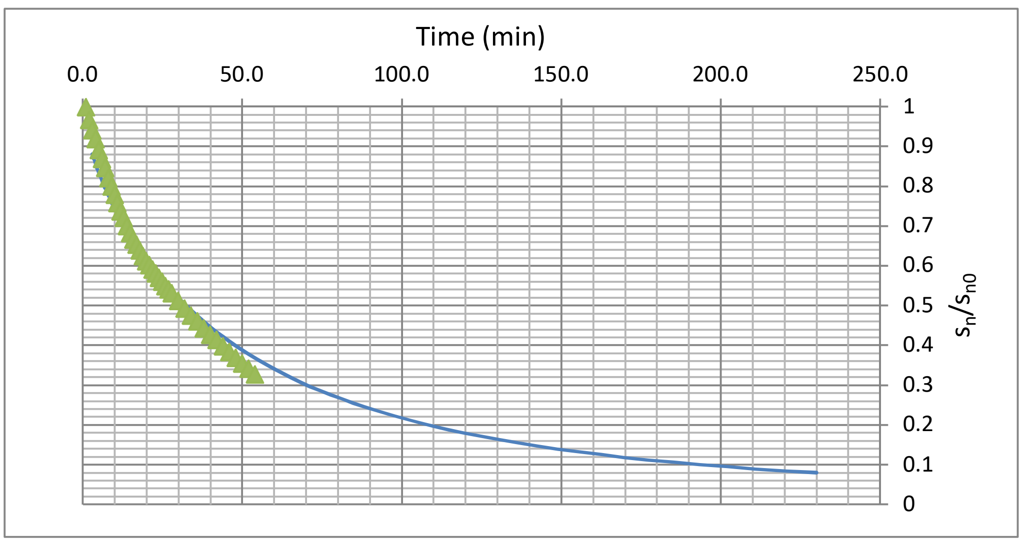
Trial T_n (ft^2/d): 0.296 <-- By changing T_n through "Solver"

0.014 <-- Working S_n

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **0.30**

T_{min}	3
T_{max}	230



J-Ratio
-3.000

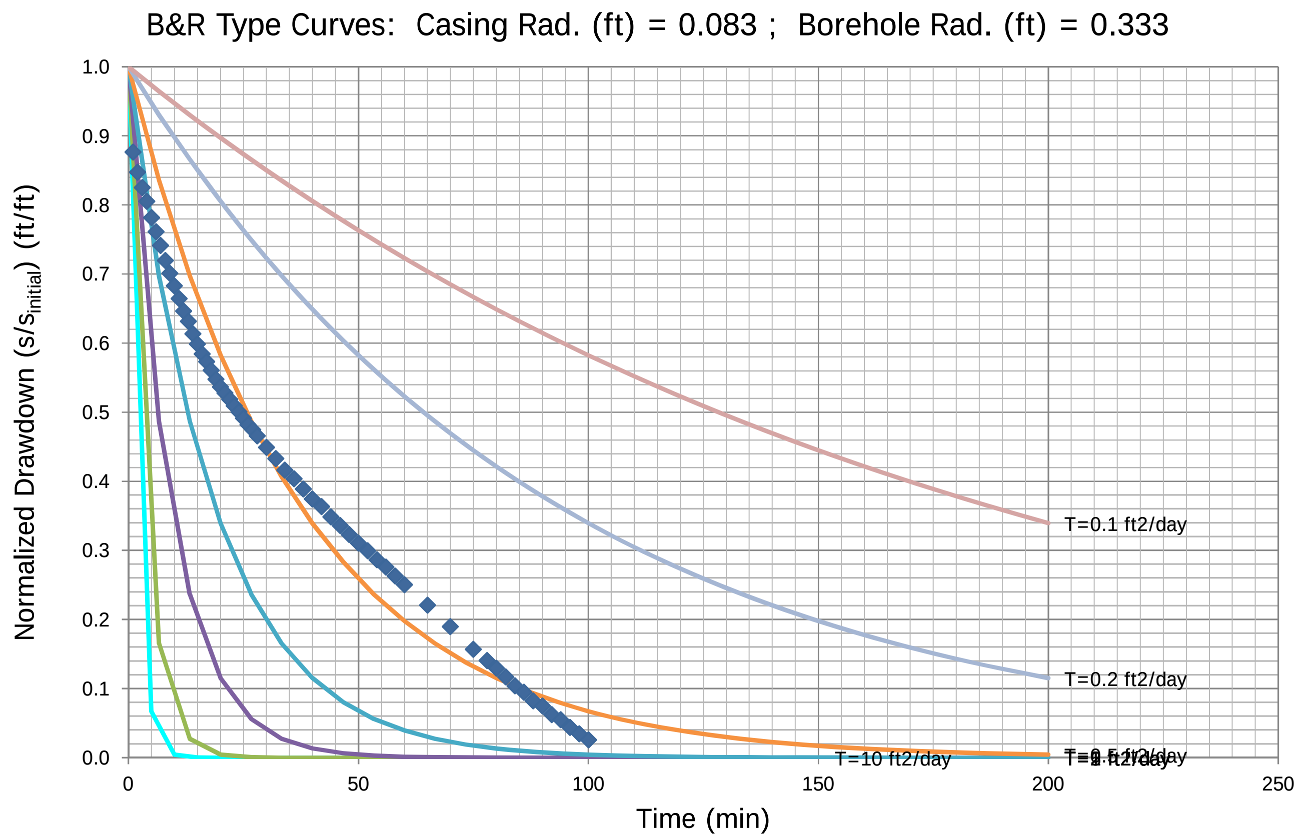
Bouwer and Rice Short Term LNAPL Mobility Test Type Curves

B&R Type Curves: Casing Rad. (ft) = 0.083 ; Borehole Rad. (ft) = 0.333

Enter these values

Type Curve ID	Type Curve Name	Notes	Max Time (min)	Transmissivity (ft^2/day)
1	T=10 ft2/day		150	10
2	T=5 ft2/day		200	5
3	T=2 ft2/day		200	2
4	T=1 ft2/day		200	1
5	T=0.5 ft2/day		200	0.5
6	T=0.2 ft2/day		200	0.2
7	T=0.1 ft2/day		200	0.1

J-Ratio		
-3.000	<-- If uncertain use	
		-0.22



API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)

0.41

Standard Deviation (ft^2/d)

0.11

Coefficient of Variation

0.27

Well Designation:	MW-9	
Date:	26-Mar-19	

Ground Surface Elev (ft msl)	0.0	Enter These Data	**Drawdown Adjustment (ft)**
Top of Casing Elev (ft msl)	0.0		
Well Casing Radius, r_c (ft):	0.085	r_{e1}	0.4
Well Radius, r_w (ft):	0.333		
LNAPL Specific Yield, S_y:	0.175		
LNAPL Density Ratio, ρ_r:	0.780		
Top of Screen (ft bgs):	0.0		
Bottom of Screen (ft bgs):	0.0		
LNAPL Baildown Vol. (gal.):	0.0		
Effective Radius, r_{e3} (ft):	0.159	Calculated Parameters	
Effective Radius, r_{e2} (ft):	#NUM!		
Initial Casing LNAPL Vol. (gal.):	0.45		
Initial Filter LNAPL Vol. (gal.):	1.12		

	Enter Data Here Time (min)	DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)	Water Table Depth (ft)	LNAPL Drawdown s_n (ft)	Average Time (min)	LNAPL Discharge Q_n (ft^3/d)	s_n (ft)	b_n (ft)	r_e (ft)	DTP (ft bgs)	DTW (ft bgs)	LNAPL Volume (gallons)	Ave. r_e (ft)
Initial Fluid Levels:	0	34.20	36.83	34.20	36.83	34.78					2.63					
Enter Test Data:	2.0	36.34	36.77	36.34	36.77	36.43	1.74				0.43				0	0.159
	3.0	36.30	36.73	36.30	36.73	36.39	1.70	2.5	0.000	1.72	0.43	0.159	36.32	36.75	0.00	0
	4.0	36.27	36.72	36.27	36.72	36.37	1.67	3.5	2.295	1.69	0.45	0.159	36.29	36.73	0.01	0.159
	5.0	36.25	36.70	36.25	36.70	36.35	1.65	4.5	0.000	1.66	0.45	0.159	36.26	36.71	0.01	0.319
	6.0	36.23	36.69	36.23	36.69	36.33	1.63	5.5	1.148	1.64	0.46	0.159	36.24	36.70	0.02	0.478
	7.0	36.21	36.67	36.21	36.67	36.31	1.61	6.5	0.000	1.62	0.46	0.159	36.22	36.68	0.02	0.637
	8.0	36.19	36.66	36.19	36.66	36.29	1.59	7.5	1.148	1.60	0.47	0.159	36.20	36.67	0.02	0.796
	9.0	36.17	36.65	36.17	36.65	36.28	1.57	8.5	1.148	1.58	0.48	0.159	36.18	36.66	0.03	0.956
	10.0	36.15	36.64	36.15	36.64	36.26	1.55	9.5	1.148	1.56	0.49	0.159	36.16	36.65	0.04	1.115
	11.0	36.13	36.63	36.13	36.63	36.24	1.53	10.5	1.148	1.54	0.50	0.159	36.14	36.64	0.04	1.274
	14.0	36.12	36.63	36.12	36.63	36.23	1.52	12.5	0.383	1.53	0.51	0.159	36.13	36.63	0.05	1.593
	15.0	36.10	36.62	36.10	36.62	36.21	1.50	14.5	1.148	1.51	0.52	0.159	36.11	36.63	0.05	1.911
	16.0	36.08	36.61	36.08	36.61	36.20	1.48	15.5	1.148	1.49	0.53	0.159	36.09	36.62	0.06	2.070
	17.0	36.07	36.60	36.07	36.60	36.19	1.47	16.5	0.000	1.48	0.53	0.159	36.08	36.61	0.06	2.230
	18.0	36.06	36.60	36.06	36.60	36.18	1.46	17.5	1.148	1.47	0.54	0.159	36.07	36.60	0.07	2.389
	19.0	36.05	36.59	36.05	36.59	36.17	1.45	18.5	0.000	1.46	0.54	0.159	36.06	36.60	0.07	2.548
	20.0	36.04	36.58	36.04	36.58	36.16	1.44	19.5	0.000	1.45	0.54	0.159	36.05	36.59	0.07	2.708
	21.0	36.02	36.57	36.02	36.57	36.14	1.42	20.5	1.148	1.43	0.55	0.159	36.03	36.58	0.07	2.867
	22.0	36.02	36.56	36.02	36.56	36.14	1.42	21.5	-1.148	1.42	0.54	0.159	36.02	36.57	0.07	3.026
	23.0	36.00	36.56	36.00	36.56	36.12	1.40	22.5	2.295	1.41	0.56	0.159	36.01	36.56	0.08	3.185
	24.0	35.99	36.55	35.99	36.55	36.11	1.39	23.5	0.000	1.40	0.56	0.159	36.00	36.56	0.08	3.345
	25.0	35.98	36.54	35.98	36.54	36.10	1.38	24.5	0.000	1.39	0.56	0.159	35.99	36.55	0.08	3.504
	27.0	35.95	36.53	35.95	36.53	36.08	1.35	26.0	1.148	1.37	0.58	0.159	35.97	36.54	0.09	3.743
	29.0	35.93	36.52	35.93	36.52	36.06	1.33	28.0	0.574	1.34	0.59	0.159	35.94	36.53	0.10	4.061
	31.0	35.91	36.51	35.91	36.51	36.04	1.31	30.0	0.574	1.32	0.60	0.159	35.92	36.52	0.10	4.380
	33.0	35.89	36.50	35.89	36.50	36.02	1.29	32.0	0.574	1.30	0.61	0.159	35.90	36.51	0.11	4.698
	35.0	35.87	36.48	35.87	36.48	36.00	1.27	34.0	0.000	1.28	0.61	0.159	35.88	36.49	0.11	5.017
	37	35.85	36.47	35.85	36.47	35.99	1.25	36.0	0.574	1.26	0.62	0.159	35.86	36.48	0.11	5.335
	42	35.81	36.45	35.81	36.45	35.95	1.21	39.5	0.459	1.23	0.64	0.159	35.83	36.46	0.13	5.893
	47	35.77	36.42	35.77	36.42	35.91	1.17	44.5	0.230	1.19	0.65	0.159	35.79	36.44	0.13	6.689
	52	35.73	36.40	35.73	36.40	35.88	1.13	49.5	0.459	1.15	0.67	0.159	35.75	36.41	0.14	7.486
	57	35.70	36.38	35.70	36.38	35.85	1.10	54.5	0.230	1.12	0.68	0.159	35.72	36.39	0.15	8.282
	62	35.66	36.35	35.66	36.35	35.81	1.06	59.5	0.230	1.08	0.69	0.159	35.68	36.37	0.15	9.078
	67	35.63	36.33	35.63	36.33	35.78	1.03	64.5	0.230	1.05	0.70	0.159	35.65	36.34	0.16	9.875
	77.0	35.56	36.28	35.56	36.28	35.72	0.96	72.0	0.230	1.00	0.72	0.159	35.60	36.31	0.17	11.069
	87.0	35.51	36.24	35.51	36.24	35.67	0.91	82.0	0.115	0.93	0.73	0.159	35.54	36.26	0.18	12.662
	97.0	35.46	36.19	35.46	36.19	35.62	0.86	92.0	0.000	0.88	0.73	0.159	35.49	36.22	0.18	14.254
	107.0	35.41	36.15	35.41	36.15	35.57	0.81	102.0	0.115	0.83	0.74	0.159	35.44	36.17	0.18	15.847
	117.0	35.36	36.12	35.36	36.12	35.53	0.76	112.0	0.230	0.78	0.76	0.159	35.39	36.14	0.20	17.440
	127.0	35.31	36.07	35.31	36.07	35.48	0.71	122.0	0.000	0.73	0.76	0.159	35.34	36.10	0.20	19.032
	771.0	34.78	35.64	34.78	35.64	34.97	0.18	449.0	0.018	0.44	0.86	0.159	35.05	35.86	0.26	71.113
	1253.0	34.61	35.52	34.61	35.52	34.81	0.01	1012.0	0.012	0.09	0.91	0.159	34.70	35.58	0.29	160.781
				#N/A	#N/A	#N/A	#N/A	0.0	#N/A	#N/A	#N/A	0.000	#N/A	#N/A	#N/A	0.000
				#N/A	#N/A	#N/A	#N/A	0.0	#N/A	#N/A	#N/A	0.000	#N/A	#N/A	#N/A	0.000

Figure 1

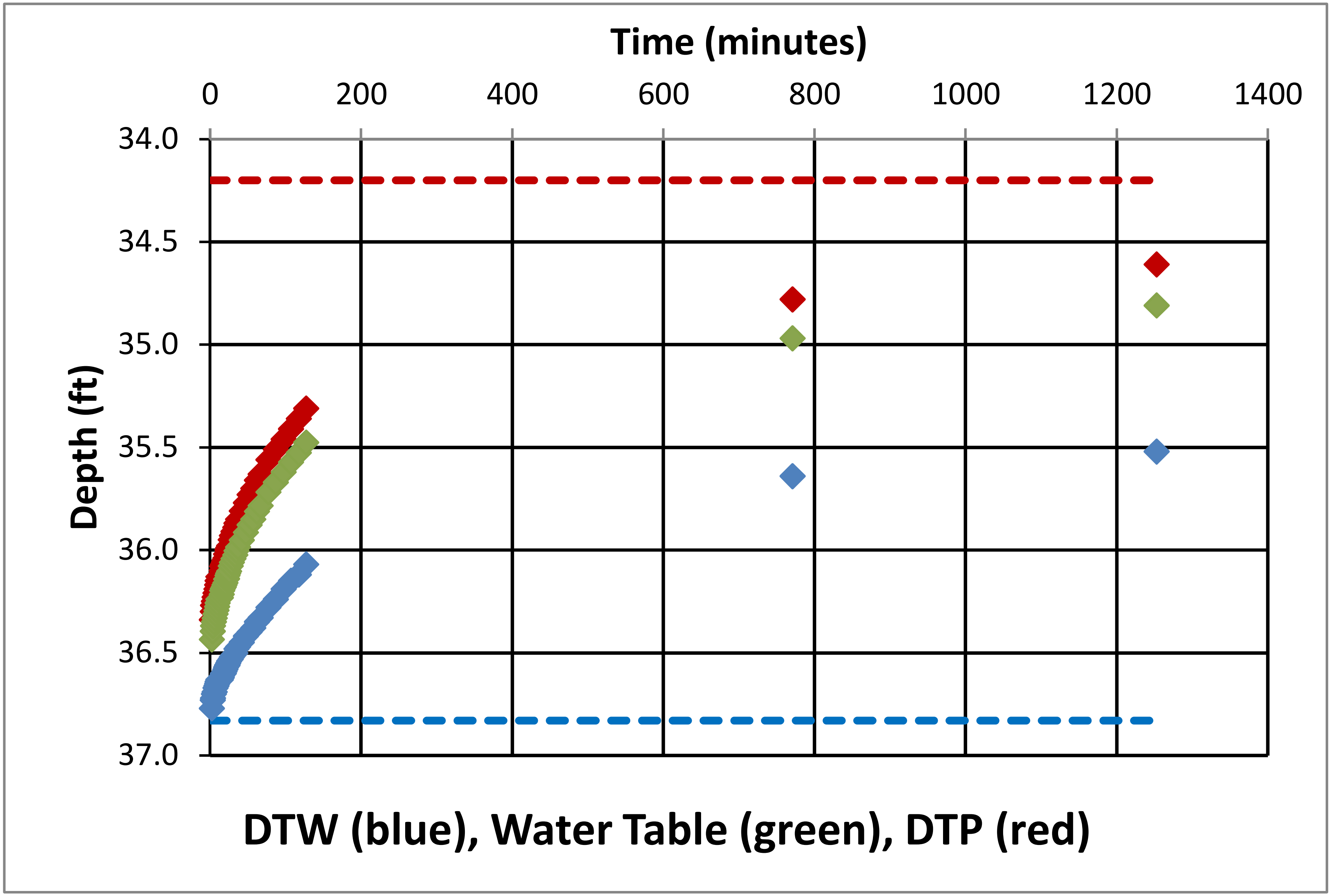
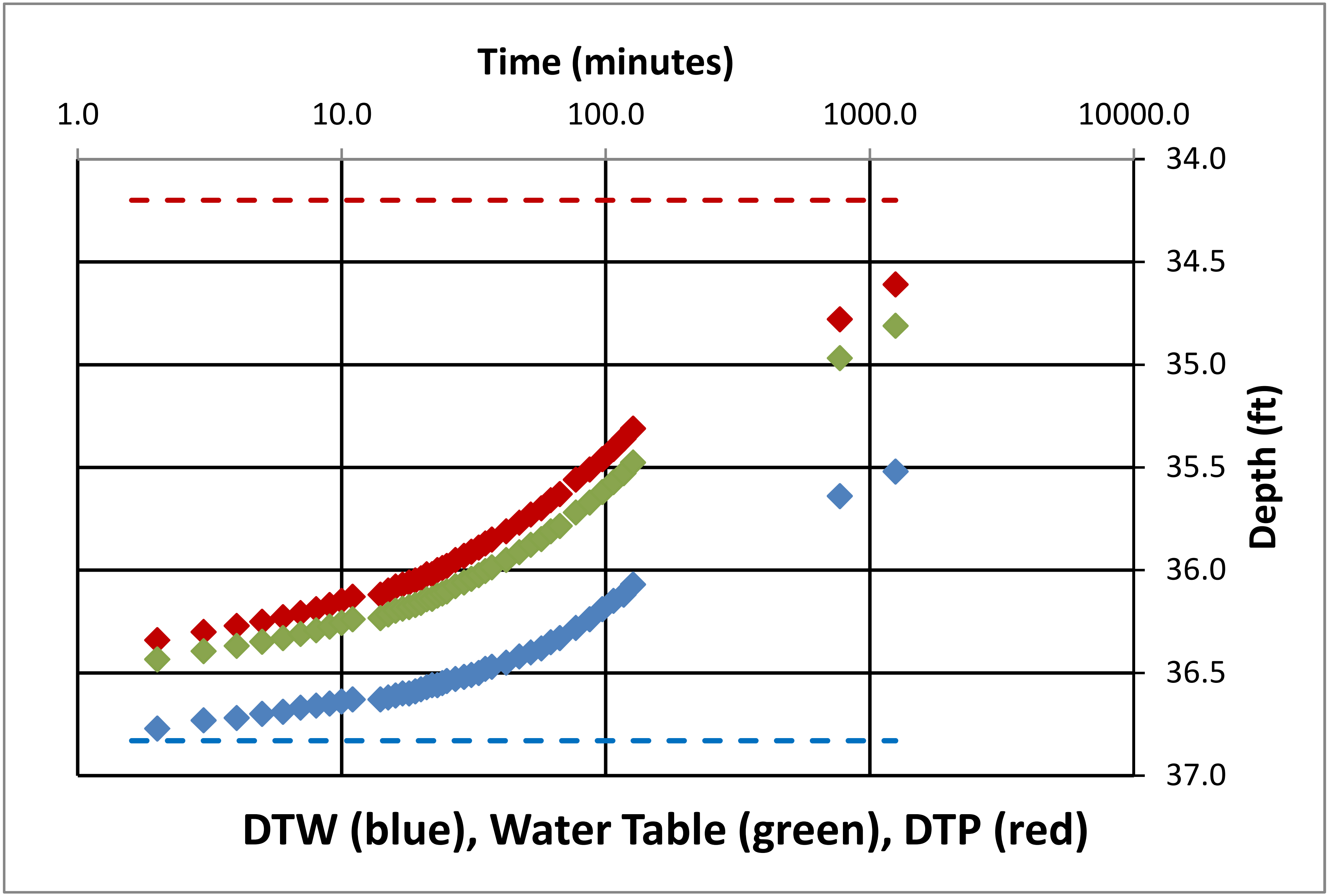

Time (minutes)
0
200
400
600
800
1000
1200
1400
34.0
34.5
35.0
35.5
36.0
36.5
37.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 2



Time (minutes)
1.0
10.0
100.0
1000.0
10000.0
34.0
34.5
35.0
35.5
36.0
36.5
37.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 3

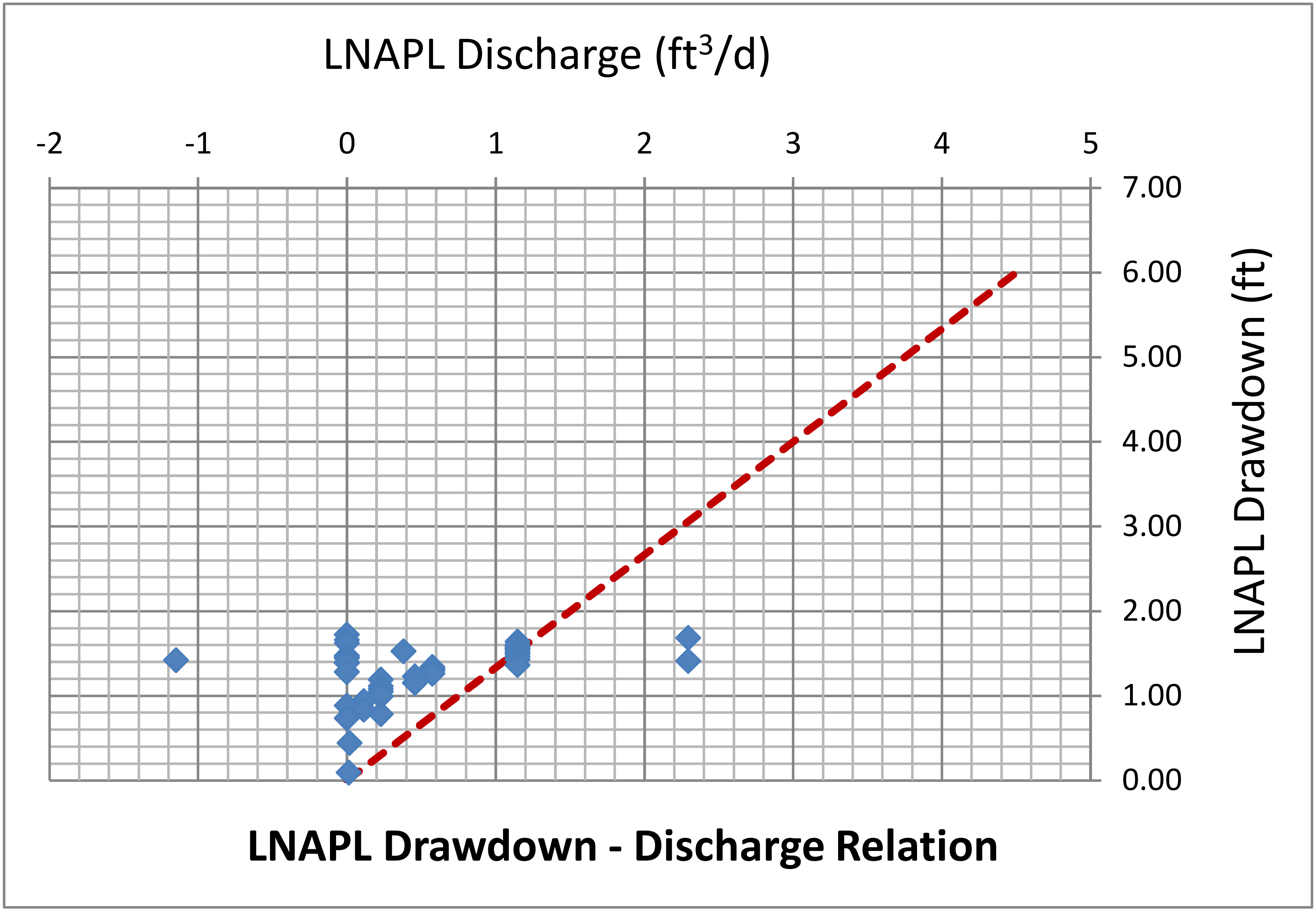

LNAPL Discharge (ft³/d)
-2
-1
0
1
2
3
4
5
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Discharge Relation

Figure 4

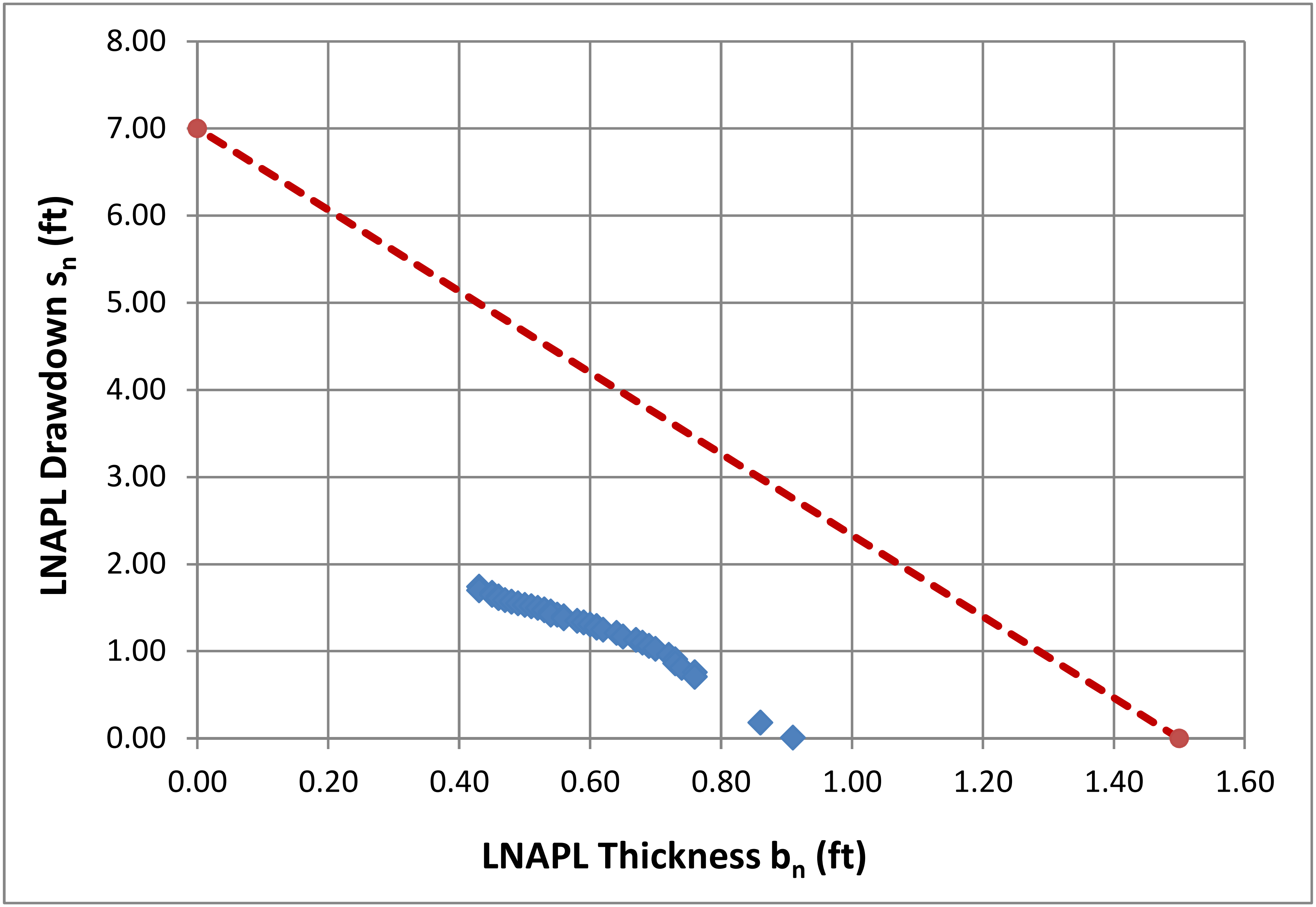
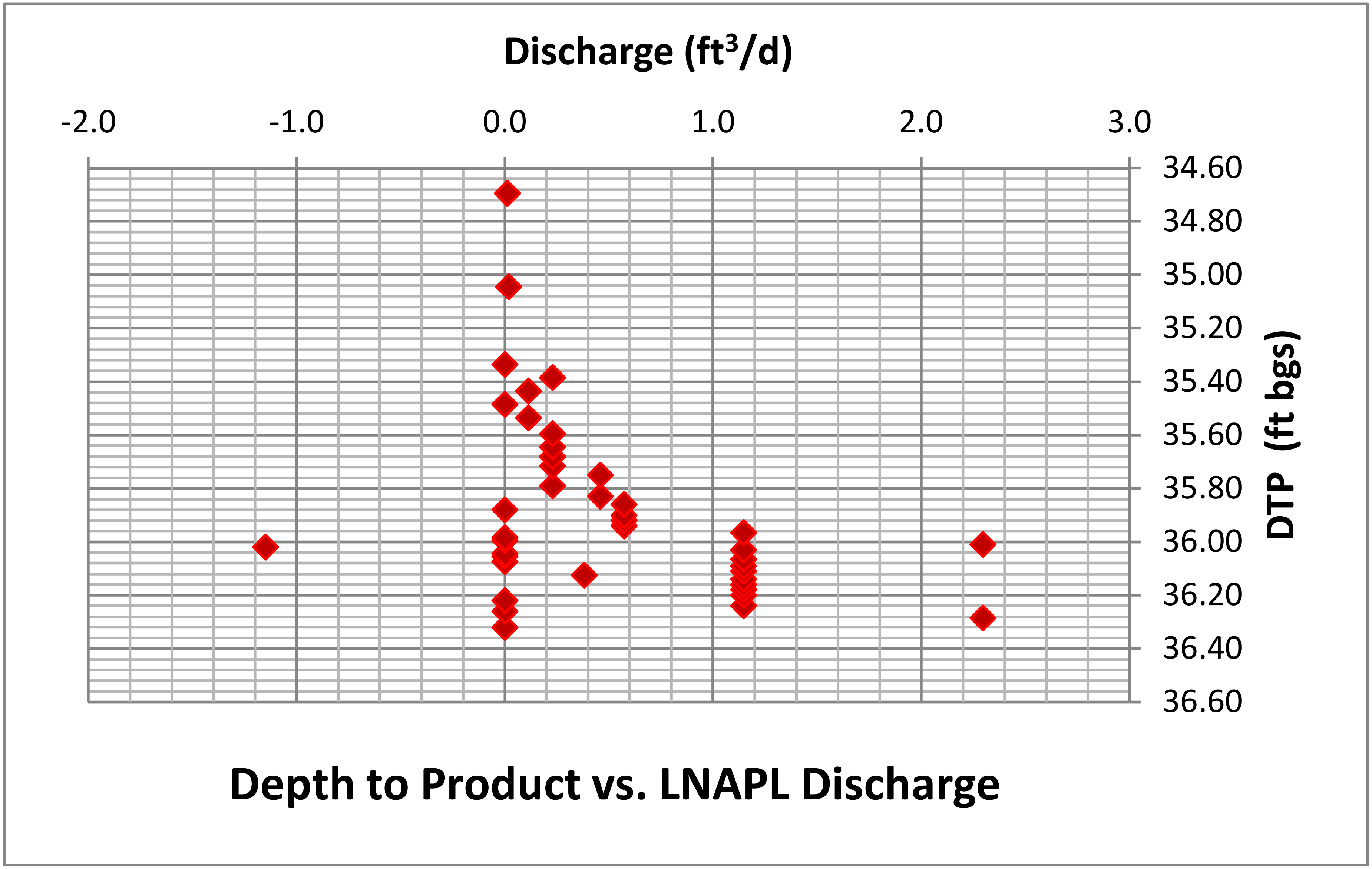
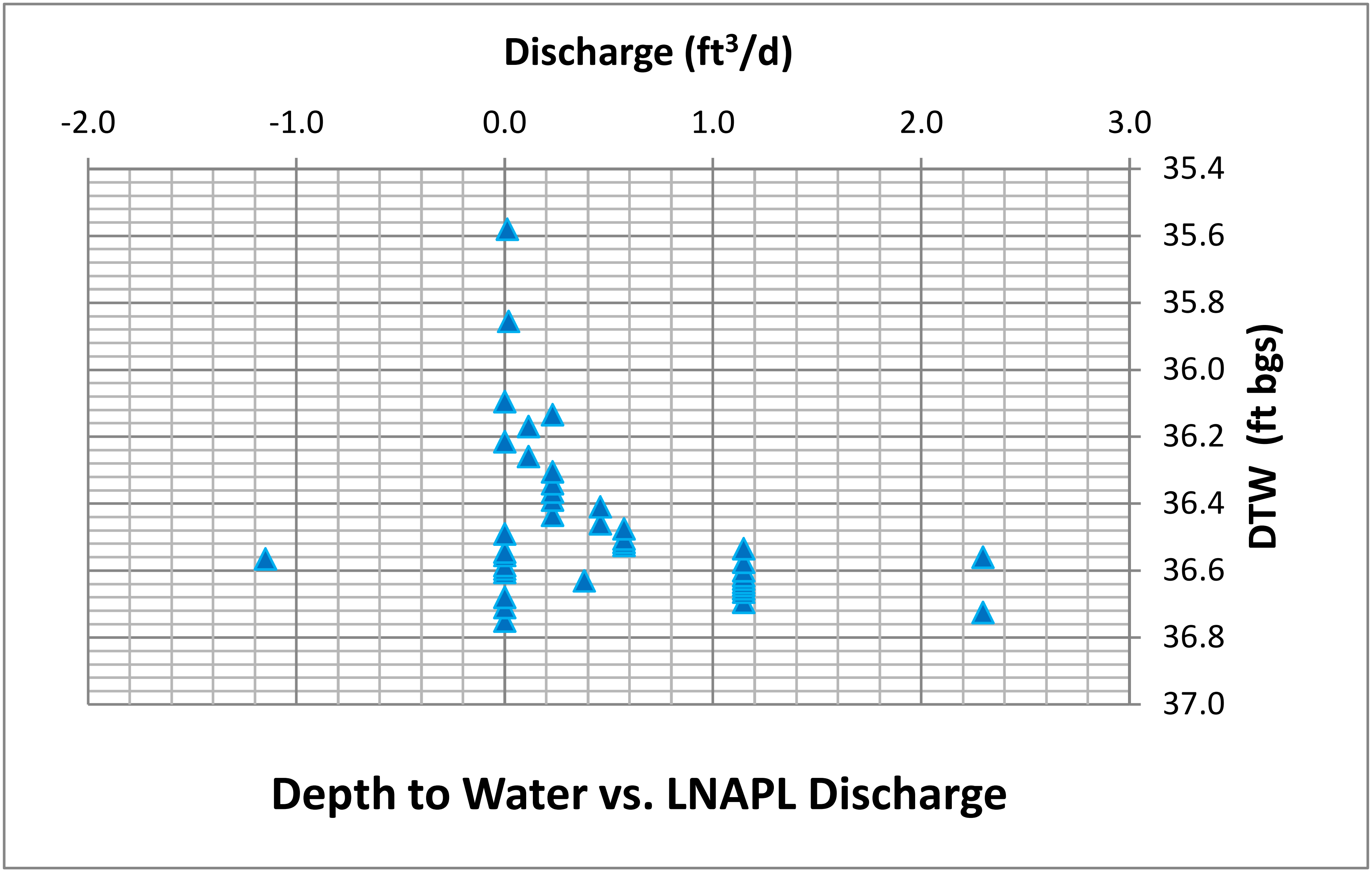

8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
LNAPL Drawdown s_n (ft)
LNAPL Thickness b_n (ft)

Figure 5



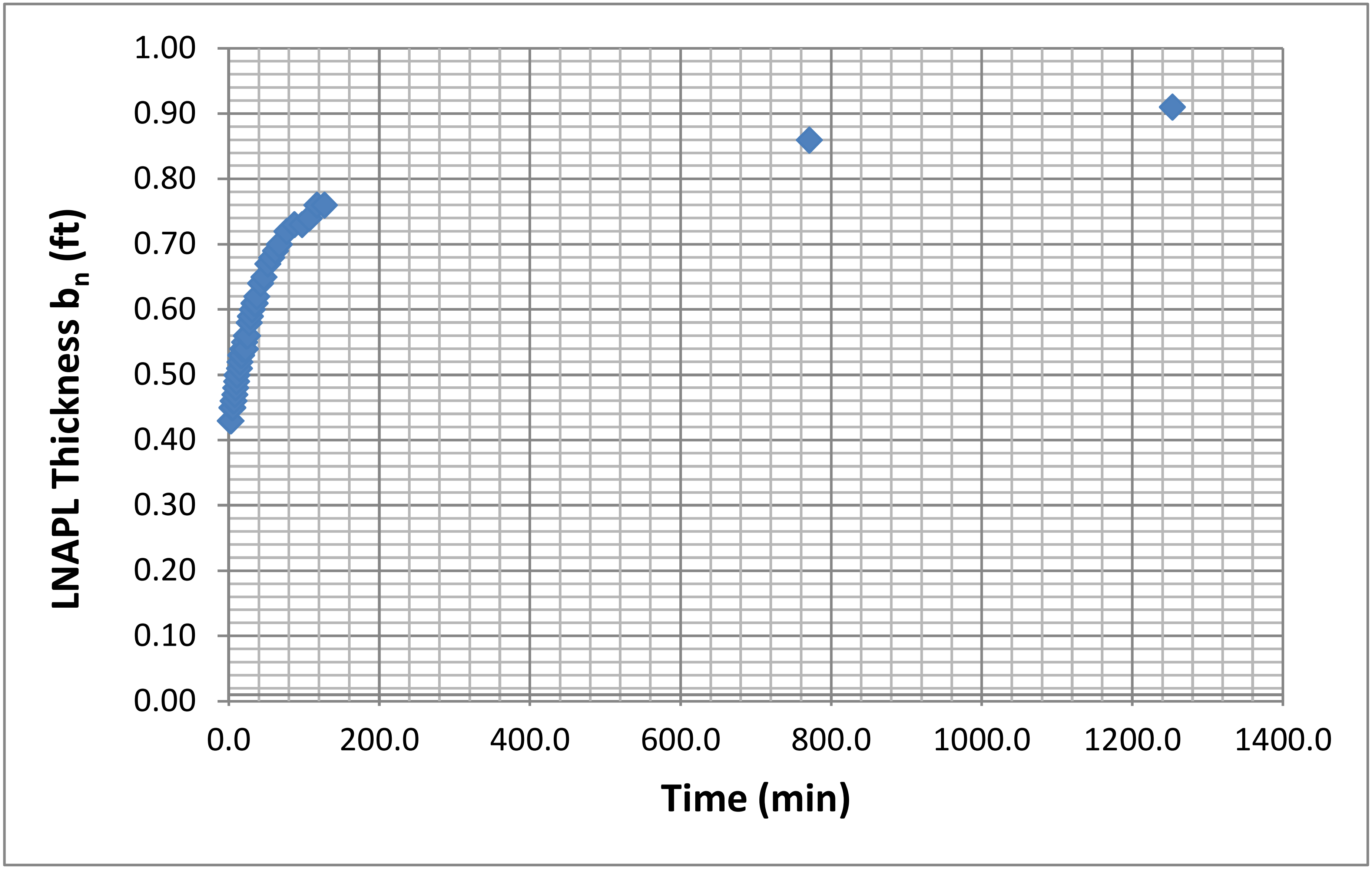
Discharge (ft³/d)
-2.0
-1.0
0.0
1.0
2.0
3.0
34.60
34.80
35.00
35.20
35.40
35.60
35.80
36.00
36.20
36.40
36.60
DTP (ft bgs)
Depth to Product vs. LNAPL Discharge

Figure 6



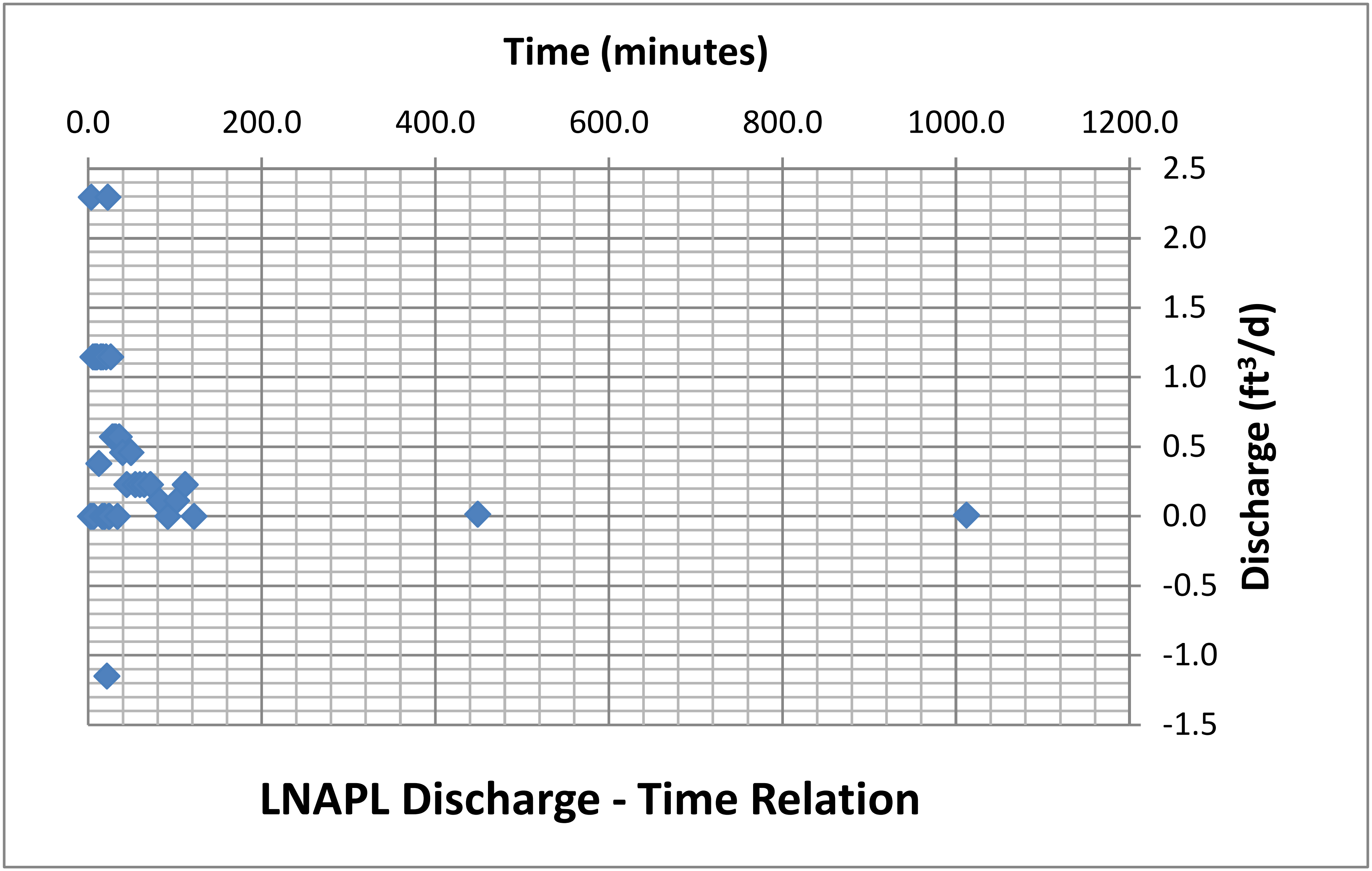
Discharge (ft³/d)
-2.0
-1.0
0.0
1.0
2.0
3.0
35.4
35.6
35.8
36.0
36.2
36.4
36.6
36.8
37.0
DTW (ft bgs)
Depth to Water vs. LNAPL Discharge

Figure 7



1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
LNAPL Thickness b_n (ft)
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
1400.0
Time (min)

Figure 8



MW-9 (March 2019)
Baildown Test Data Analysis

Figure 9

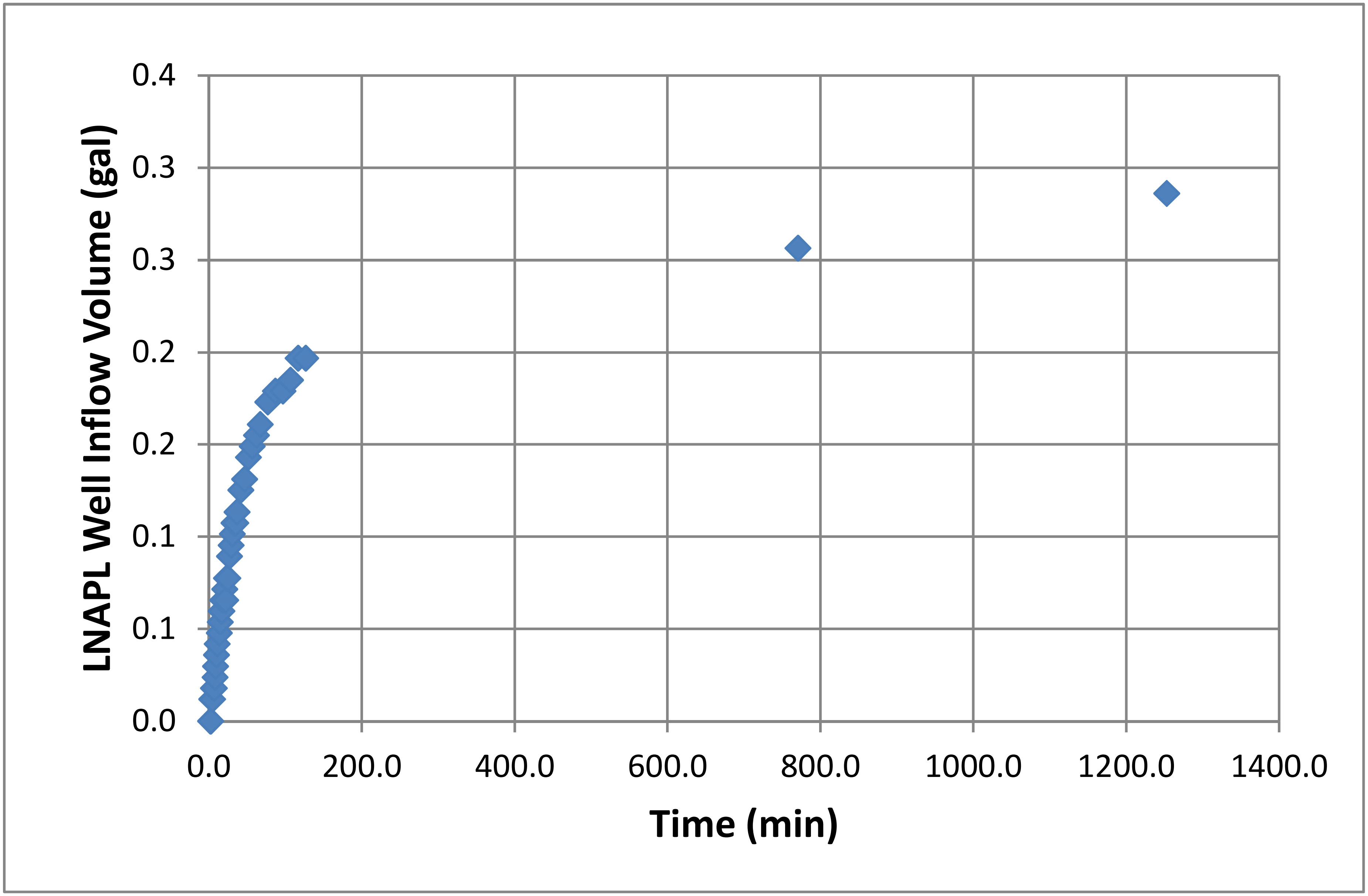
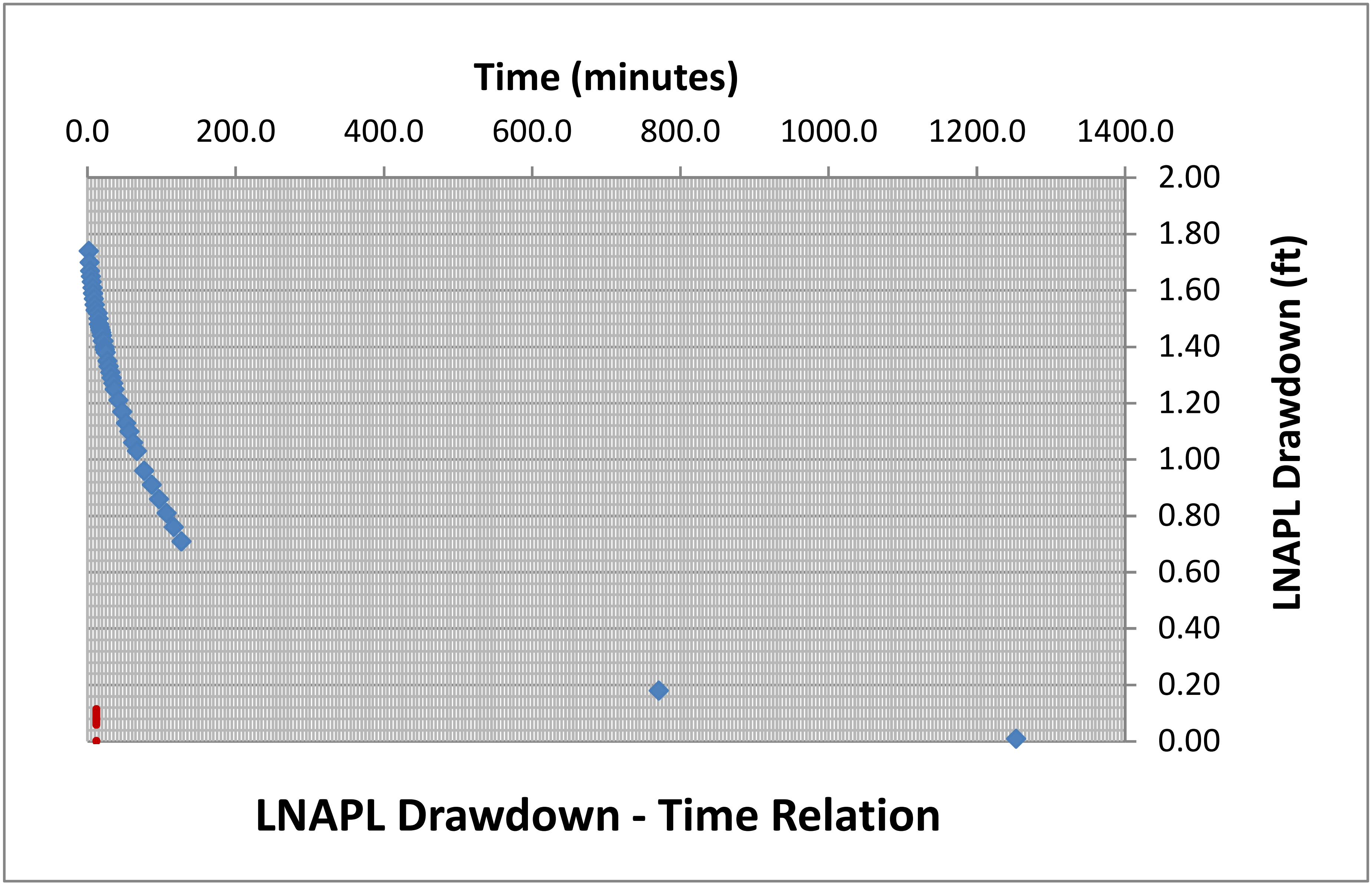

0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
LNAPL Well Inflow Volume (gal)
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
1400.0
Time (min)

Figure 10


Time (minutes)
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
1400.0
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Time Relation

Generalized Bouwer and Rice (1976)

Well Designation:	MW-9
Date:	26-Mar-19

$$T_n = \frac{r_e^2 \ln(R/r_e)\ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

Enter early time cut-off for least-squares model fit

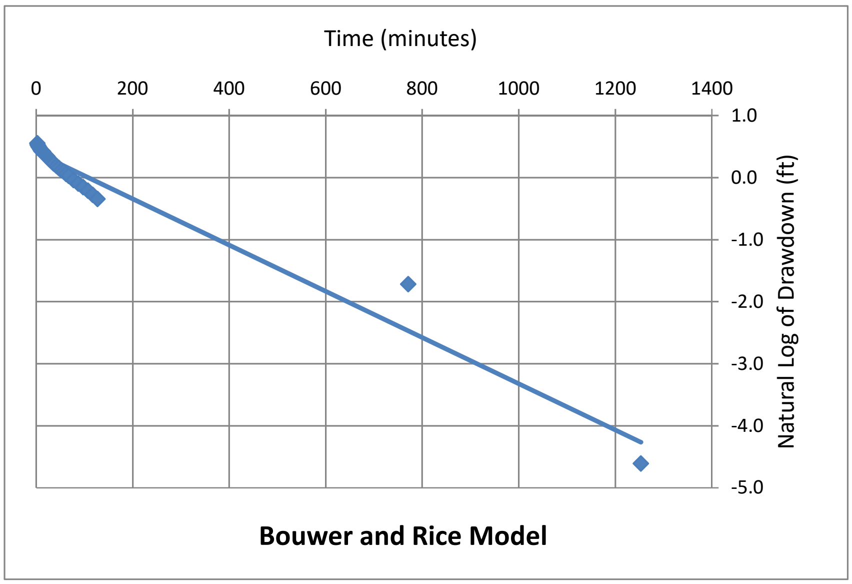
$Time_{cut}$	0	<- Enter or change value here

Model Results: T_n (ft^2/d) = 0.03 +/- 0.00 ft^2/d

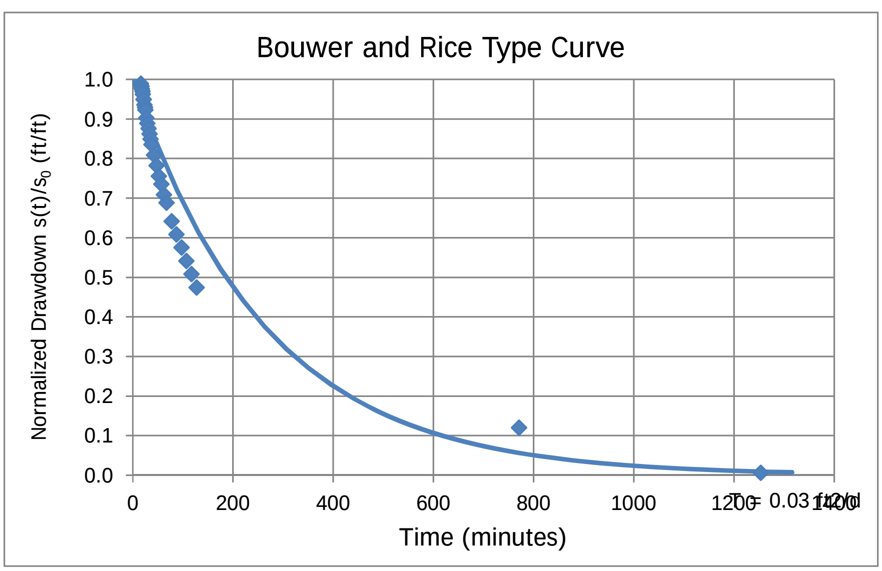
L_e/r_e
16.5
C
1.45
R/r_e
8.03

J-Ratio
-4.667

Coef. Of Variation
0.03



C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW-9
Date:	26-Mar-19

$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Time Adjustment (min):	0	

Trial S_n: d <-- Enter d for default or enter S_n value

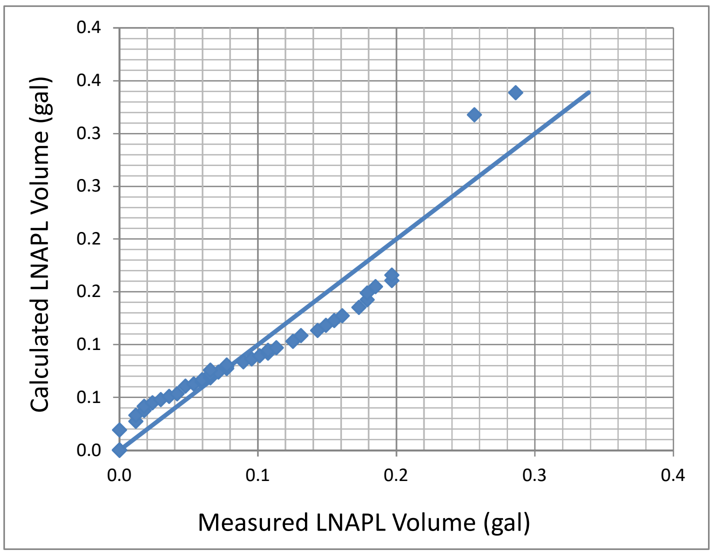
Root-Mean-Square Error: 0.151 <-- Minimize this using "Solver"

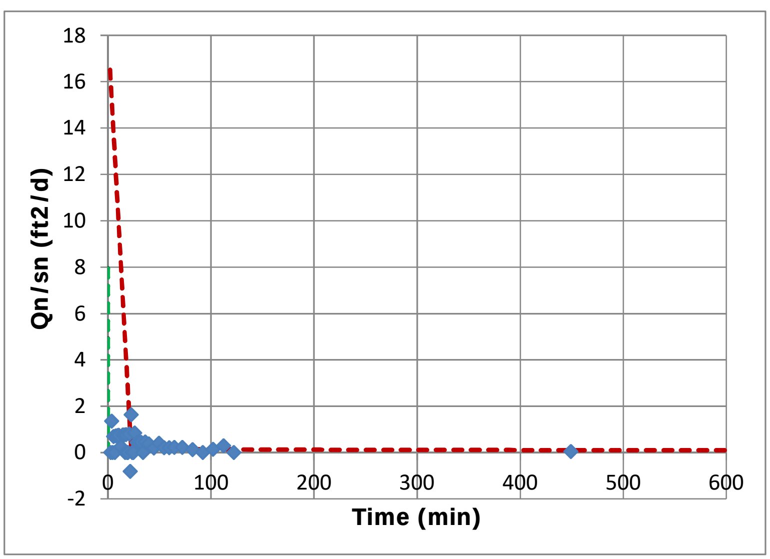
0.005 <-- Working S_n

Trial T_n (ft^2/d): 0.044 <-- By changing T_n through "Solver"

Add constraint T_n > 0.00001

Model Result: T_n (ft^2/d) = **0.04**





Height

8

Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	MW-9
Date:	26-Mar-19

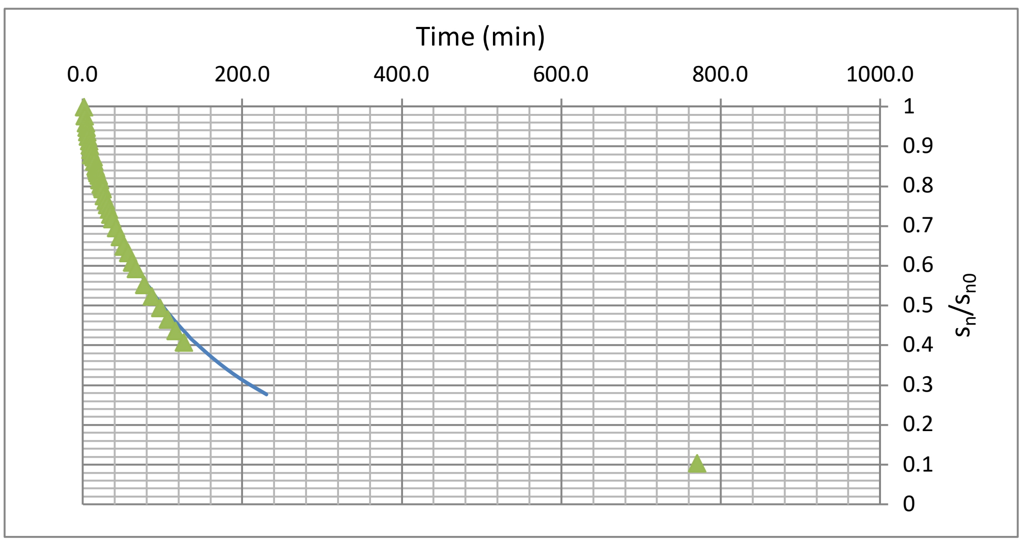
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Initial Drawdown s_n (ft):	1.74	
Trial S_n:	d	<-- Enter d for default
Root-Mean-Square Error:	0.102	<-- Minimize this using "Solver"
Trial T_n (ft^2/d):	0.073	<-- By changing T_n through "Solver"
	0.007	<-- Working S_n

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **0.07**

T_{min}	3
T_{max}	230



J-Ratio
-4.667

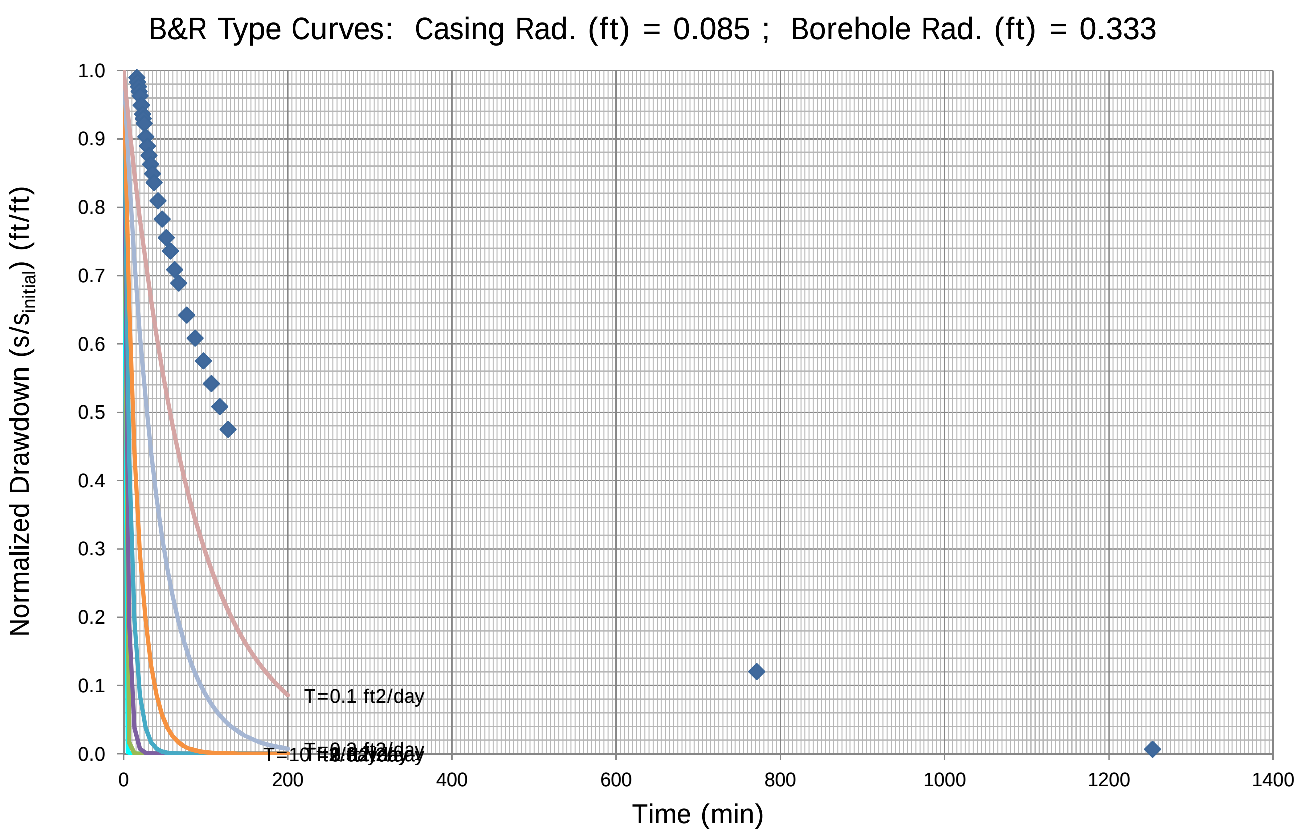
Bouwer and Rice Short Term LNAPL Mobility Test Type Curves

B&R Type Curves: Casing Rad. (ft) = 0.085 ; Borehole Rad. (ft) = 0.333

Enter these values

Type Curve ID	Type Curve Name	Notes	Max Time (min)	Transmissivity (ft^2/day)
1	T=10 ft2/day		150	10
2	T=5 ft2/day		200	5
3	T=2 ft2/day		200	2
4	T=1 ft2/day		200	1
5	T=0.5 ft2/day		200	0.5
6	T=0.2 ft2/day		200	0.2
7	T=0.1 ft2/day		200	0.1

J-Ratio	
-4.667	<-- If uncertain use
	-0.22



API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)

0.05

Standard Deviation (ft^2/d)

0.02

Coefficient of Variation

0.44

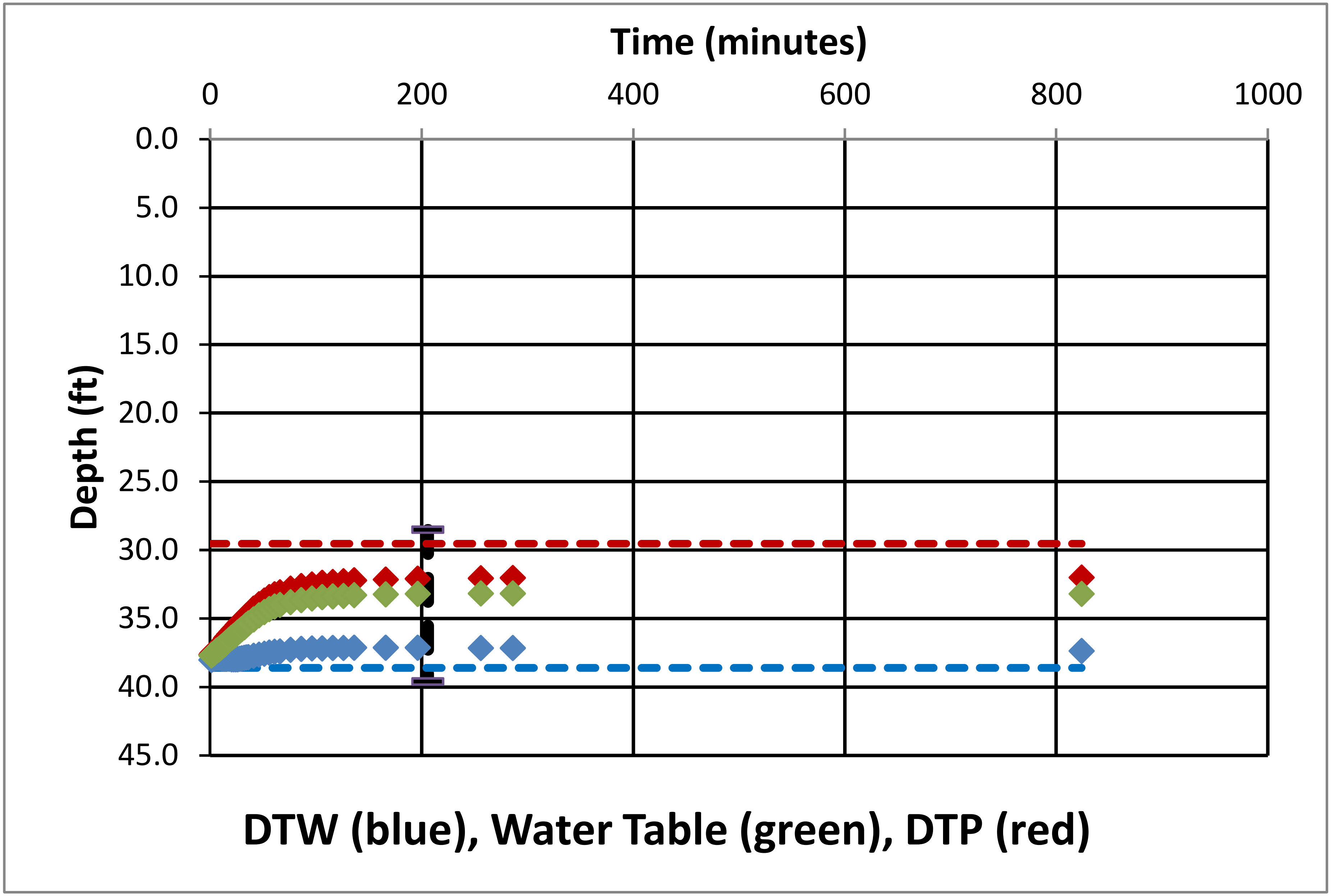
Well Designation:	MW-10	
Date:	16-Jul-15	

Ground Surface Elev (ft msl)	1124.2	Enter These Data	**Drawdown Adjustment (ft)**
Top of Casing Elev (ft msl)	1123.7		
Well Casing Radius, r_c (ft):	0.083	r_{e1}	
Well Radius, r_w (ft):	0.333		2.47
LNAPL Specific Yield, S_y:	0.175		
LNAPL Density Ratio, ρ_r:	0.780		
Top of Screen (ft bgs):	15.0		
Bottom of Screen (ft bgs):	40.0		
LNAPL Baildown Vol. (gal.):	5.0		
Effective Radius, r_{e3} (ft):	0.158	Calculated Parameters	
Effective Radius, r_{e2} (ft):	0.057		
Initial Casing LNAPL Vol. (gal.):	1.47		
Initial Filter LNAPL Vol. (gal.):	3.88		

Enter Data Here

	Time (min)	DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)	Water Table Depth (ft)	LNAPL Drawdown s_n (ft)	Average Time (min)	LNAPL Discharge Q_n (ft^3/d)	s_n (ft)	b_n (ft)	r_e (ft)	DTP (ft bgs)	DTW (ft bgs)	LNAPL Volume (gallons)	Ave. r_e (ft)
Initial Fluid Levels:	0	29.03	38.1	29.53	38.6	31.53					9.07					
Enter Test Data:	1.0	37.12	37.52	37.62	38.02	37.71	5.62				0.40				0	0.158
	2.0	37.03	37.47	37.53	37.97	37.63	5.53	1.5	4.540	5.57	0.44	0.158	37.57	38.00	0.02	0
	3.0	36.96	37.43	37.46	37.93	37.56	5.46	2.5	3.405	5.50	0.47	0.158	37.50	37.95	0.04	0.158
	4.0	36.89	37.40	37.39	37.90	37.50	5.39	3.5	4.540	5.43	0.51	0.158	37.43	37.92	0.06	0.317
	5.0	36.80	37.37	37.30	37.87	37.43	5.30	4.5	6.810	5.35	0.57	0.158	37.35	37.89	0.10	0.475
	6.0	36.73	37.36	37.23	37.86	37.37	5.23	5.5	6.810	5.27	0.63	0.158	37.27	37.86	0.14	0.634
	7.0	36.65	37.36	37.15	37.86	37.31	5.15	6.5	9.080	5.19	0.71	0.158	37.19	37.86	0.18	0.792
	8.0	36.57	37.36	37.07	37.86	37.24	5.07	7.5	9.080	5.11	0.79	0.158	37.11	37.86	0.23	0.950
	9.0	36.49	37.37	36.99	37.87	37.18	4.99	8.5	10.215	5.03	0.88	0.158	37.03	37.86	0.28	1.109
	10.0	36.40	37.38	36.90	37.88	37.12	4.90	9.5	11.350	4.95	0.98	0.158	36.95	37.88	0.34	1.267
	11.0	36.32	37.39	36.82	37.89	37.06	4.82	10.5	10.215	4.86	1.07	0.158	36.86	37.89	0.40	1.426
	12.0	36.23	37.41	36.73	37.91	36.99	4.73	11.5	12.485	4.78	1.18	0.158	36.78	37.90	0.46	1.584
	13.0	36.15	37.42	36.65	37.92	36.93	4.65	12.5	10.215	4.69	1.27	0.158	36.69	37.92	0.51	1.742
	14.0	36.05	37.42	36.55	37.92	36.85	4.55	13.5	11.350	4.60	1.37	0.158	36.60	37.92	0.57	1.901
	15.0	35.93	37.43	36.43	37.93	36.76	4.43	14.5	14.755	4.49	1.50	0.158	36.49	37.93	0.65	2.059
	16.0	35.86	37.43	36.36	37.93	36.71	4.36	15.5	7.945	4.40	1.57	0.158	36.40	37.93	0.69	2.218
	18.0	35.67	37.44	36.17	37.94	36.56	4.17	17.0	11.350	4.27	1.77	0.158	36.27	37.94	0.81	2.455
	20.0	35.47	37.45	35.97	37.95	36.41	3.97	19.0	11.917	4.07	1.98	0.158	36.07	37.95	0.93	2.772
	22.0	35.31	37.46	35.81	37.96	36.28	3.81	21.0	9.647	3.89	2.15	0.158	35.89	37.96	1.03	3.089
	24.0	35.15	37.46	35.65	37.96	36.16	3.65	23.0	9.080	3.73	2.31	0.158	35.73	37.96	1.13	3.405
	26.0	34.98	37.45	35.48	37.95	36.02	3.48	25.0	9.080	3.57	2.47	0.158	35.57	37.96	1.22	3.722
	28.0	34.81	37.43	35.31	37.93	35.89	3.31	27.0	8.512	3.40	2.62	0.158	35.40	37.94	1.31	4.039
	30.0	34.66	37.40	35.16	37.90	35.76	3.16	29.0	6.810	3.24	2.74	0.158	35.24	37.92	1.38	4.356
	32.0	34.5	37.36	35.00	37.86	35.63	3.00	31.0	6.810	3.08	2.86	0.158	35.08	37.88	1.45	4.673
	34.0	34.33	37.33	34.83	37.83	35.49	2.83	33.0	7.945	2.91	3.00	0.158	34.92	37.84	1.53	4.989
	36.0	34.17	37.30	34.67	37.80	35.36	2.67	35.0	7.377	2.75	3.13	0.158	34.75	37.81	1.61	5.306
	41.0	33.79	37.23	34.29	37.73	35.05	2.29	38.5	7.037	2.48	3.44	0.158	34.48	37.77	1.79	5.861
	46.0	33.45	37.14	33.95	37.64	34.76	1.95	43.5	5.675	2.12	3.69	0.158	34.12	37.69	1.94	6.653
	51.0	33.17	37.06	33.67	37.56	34.53	1.67	48.5	4.540	1.81	3.89	0.158	33.81	37.60	2.06	7.445
	56.0	32.93	36.98	33.43	37.48	34.32	1.43	53.5	3.632	1.55	4.05	0.158	33.55	37.52	2.15	8.237
	61.0	32.72	36.91	33.22	37.41	34.14	1.22	58.5	3.178	1.33	4.19	0.158	33.33	37.45	2.23	9.029
	66.0	32.57	36.88	33.07	37.38	34.02	1.07	63.5	2.724	1.15	4.31	0.158	33.15	37.40	2.31	9.820
	76.0	32.31	36.78	32.81	37.28	33.79	0.81	71.0	1.816	0.94	4.47	0.158	32.94	37.33	2.40	11.008
	86.0	32.13	36.72	32.63	37.22	33.64	0.63	81.0	1.362	0.72	4.59	0.158	32.72	37.25	2.47	12.592
	96.0	32	36.69	32.50	37.19	33.53	0.50	91.0	1.135	0.57	4.69	0.158	32.57	37.21	2.53	14.176
	106.0	31.9	36.67	32.40	37.17	33.45	0.40	101.0	0.908	0.45	4.77	0.158	32.45	37.18	2.58	15.760
	116.0	31.82	36.65	32.32	37.15	33.38	0.32	111.0	0.681	0.36	4.83	0.158	32.36	37.16	2.61	17.344
	126.0	31.77	36.64	32.27	37.14	33.34	0.27	121.0	0.454	0.29	4.87	0.158	32.30	37.15	2.64	18.928
	136.0	31.72	36.62	32.22	37.12	33.30	0.22	131.0	0.340	0.25	4.90	0.158	32.25	37.13	2.65	20.512
	166.0	31.65	36.62	32.15	37.12	33.24	0.15	151.0	0.265	0.19	4.97	0.158	32.19	37.12	2.69	23.680
	196.0	31.60	36.62	32.10	37.12	33.20	0.10	181.0	0.189	0.13	5.02	0.158	32.13	37.12	2.72	28.432
	256.0	31.55	36.65	32.05	37.15	33.17	0.05	226.0	0.151	0.07	5.10	0.158	32.07	37.14	2.77	35.560
	286.0	31.54	36.65	32.04	37.15	33.16	0.04	271.0	0.038	0.04	5.11	0.158	32.05	37.15	2.78	42.687
	824	31.51	36.86	32.01	37.36	33.19	0.01	555.0	0.051	0.03	5.35	0.158	32.03	37.26	2.92	87.672

Figure 1



Time (minutes)
0
200
400
600
800
1000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 2

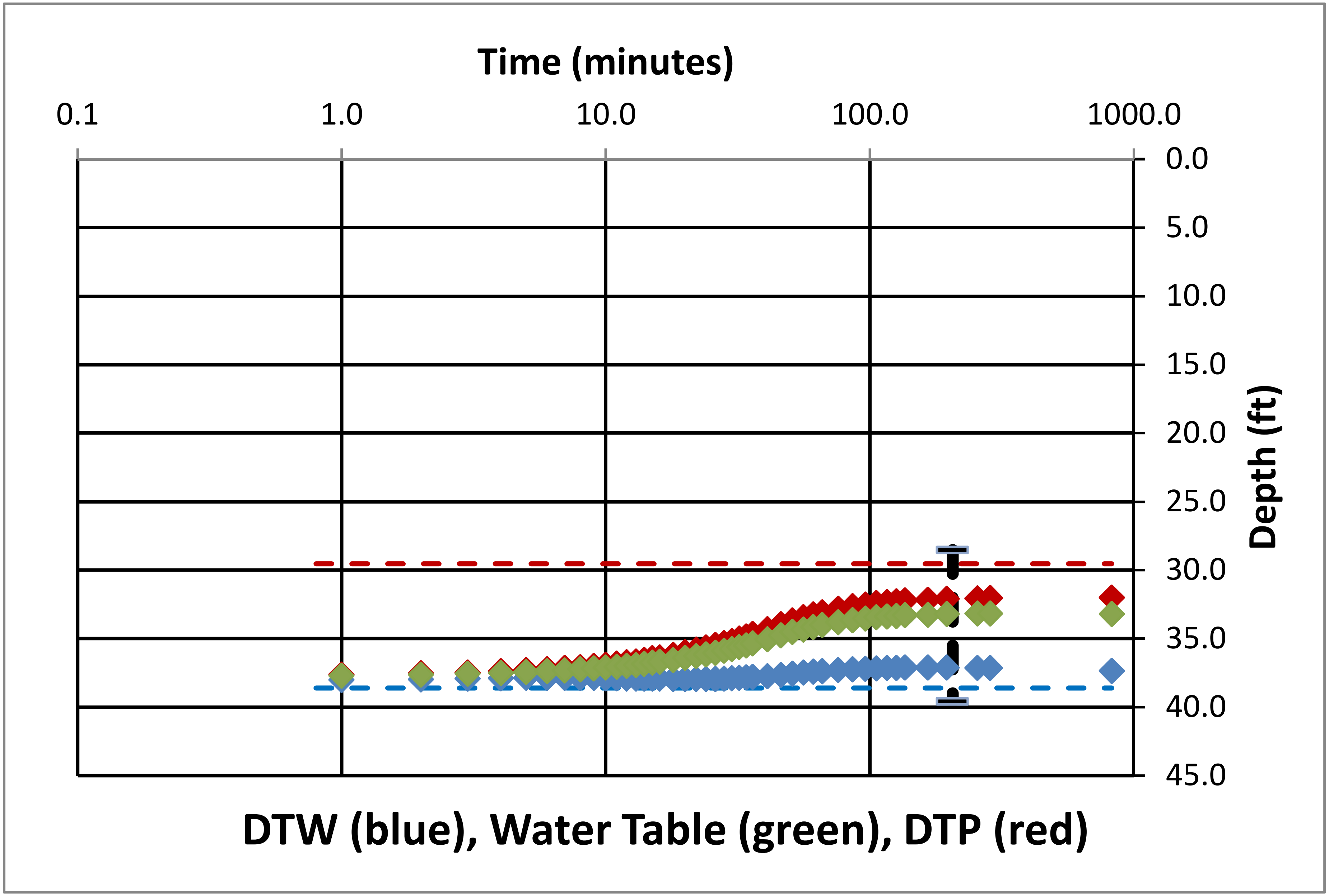
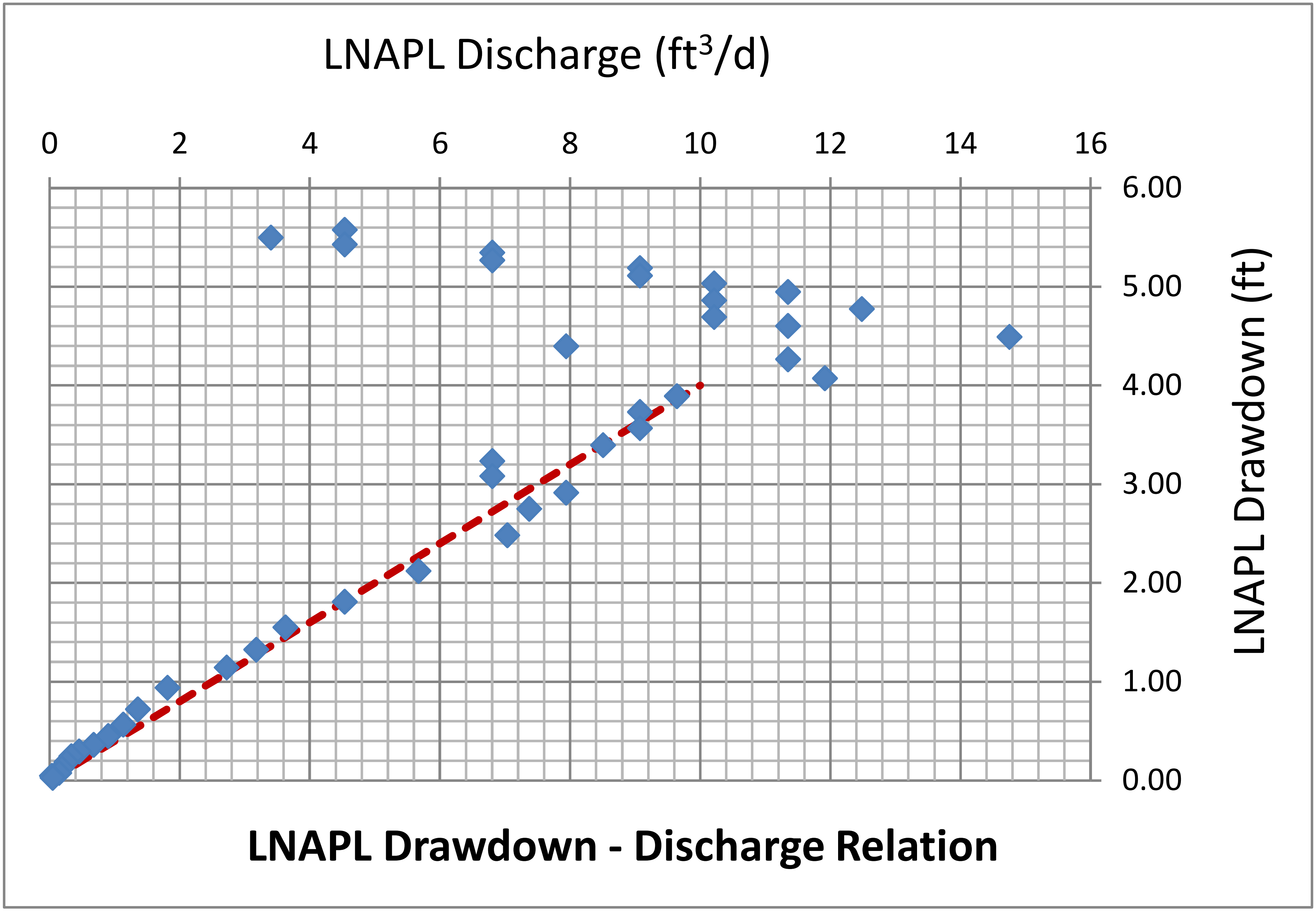
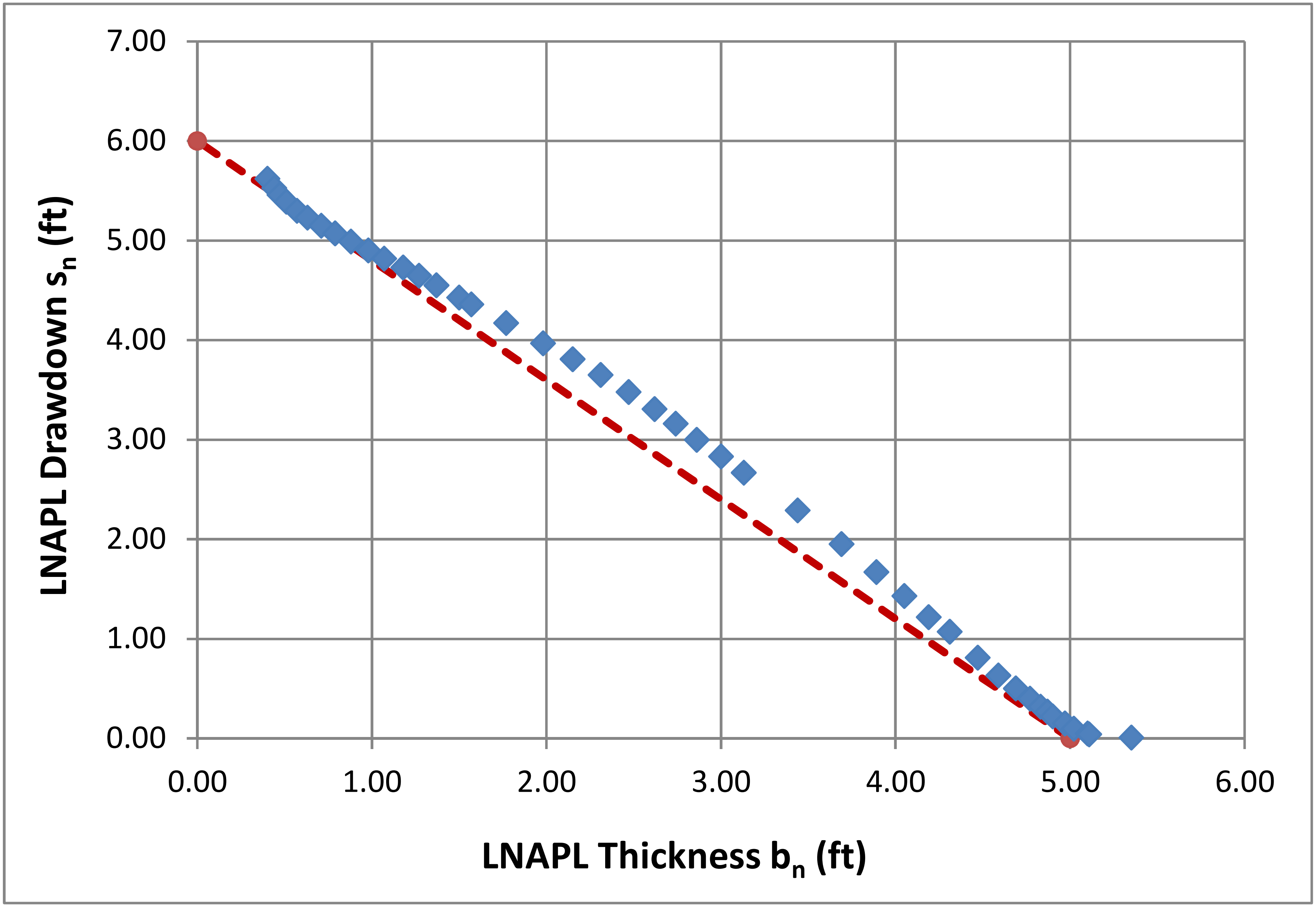

Time (minutes)
0.1
1.0
10.0
100.0
1000.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 3



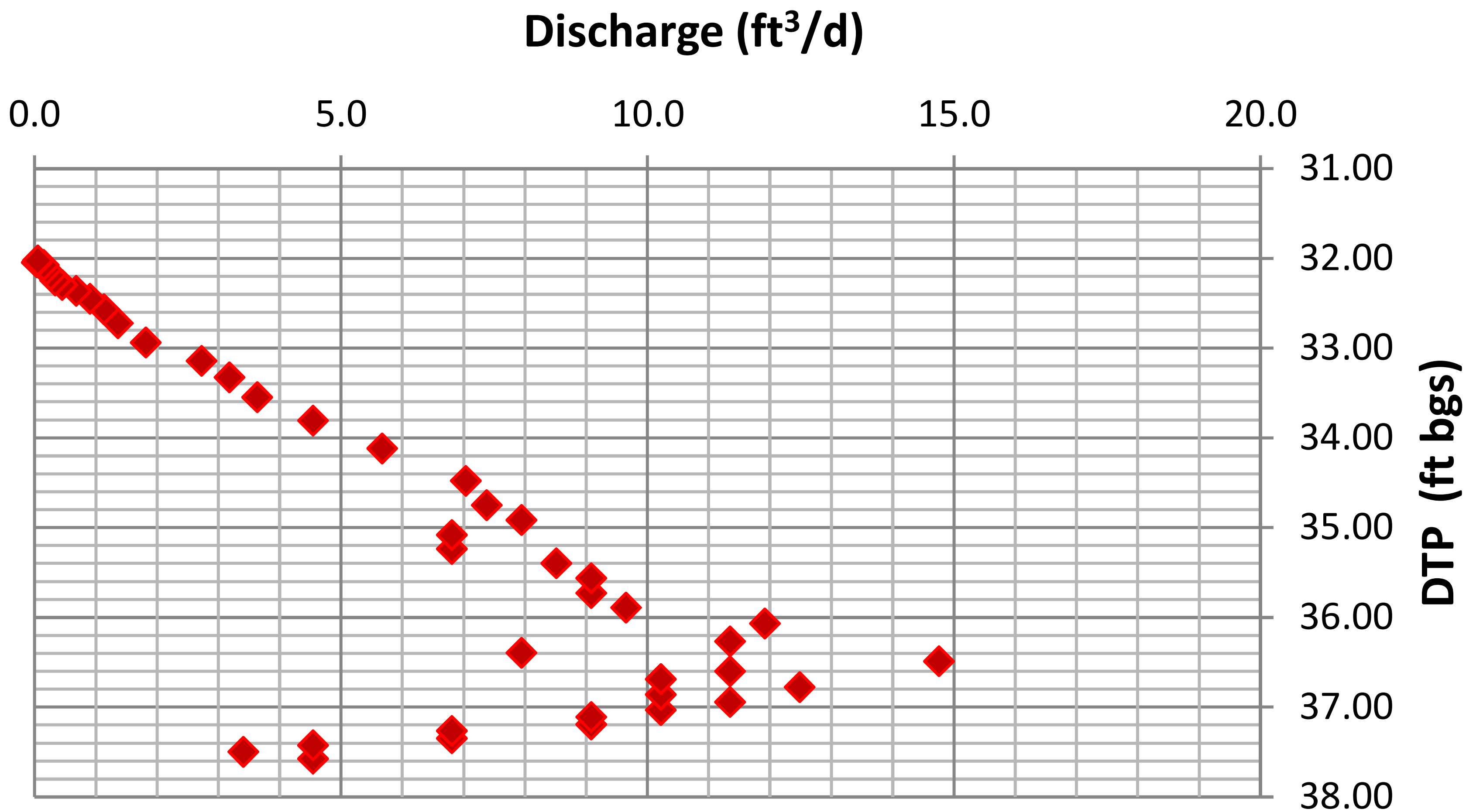
LNAPL Discharge (ft³/d)
0
2
4
6
8
10
12
14
16
6.00
5.00
4.00
3.00
2.00
1.00
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Discharge Relation

Figure 4



MW-10 (July 2015)
Baildown Test Data Analysis

Figure 5



Depth to Product vs. LNAPL Discharge

Figure 6

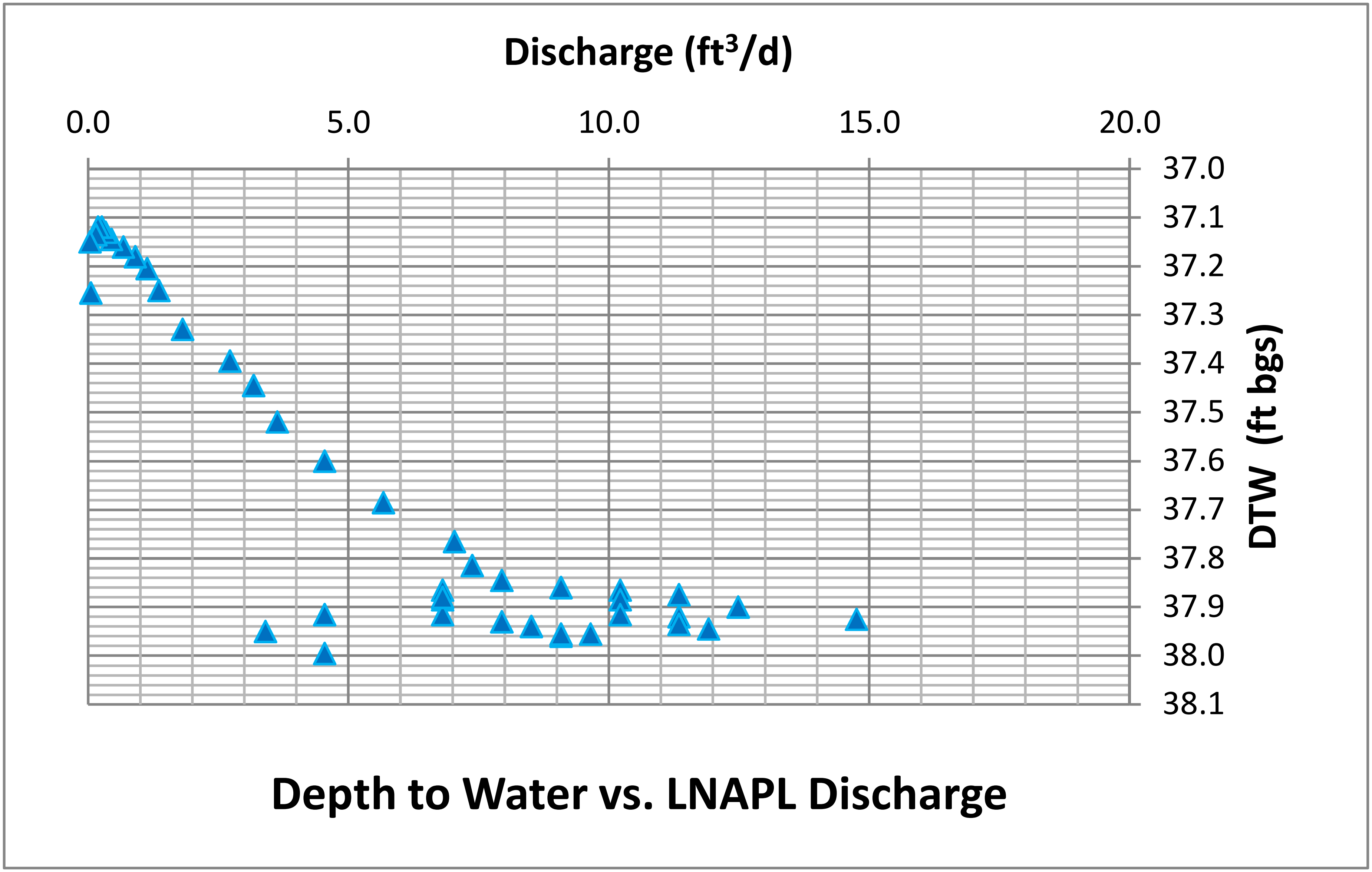
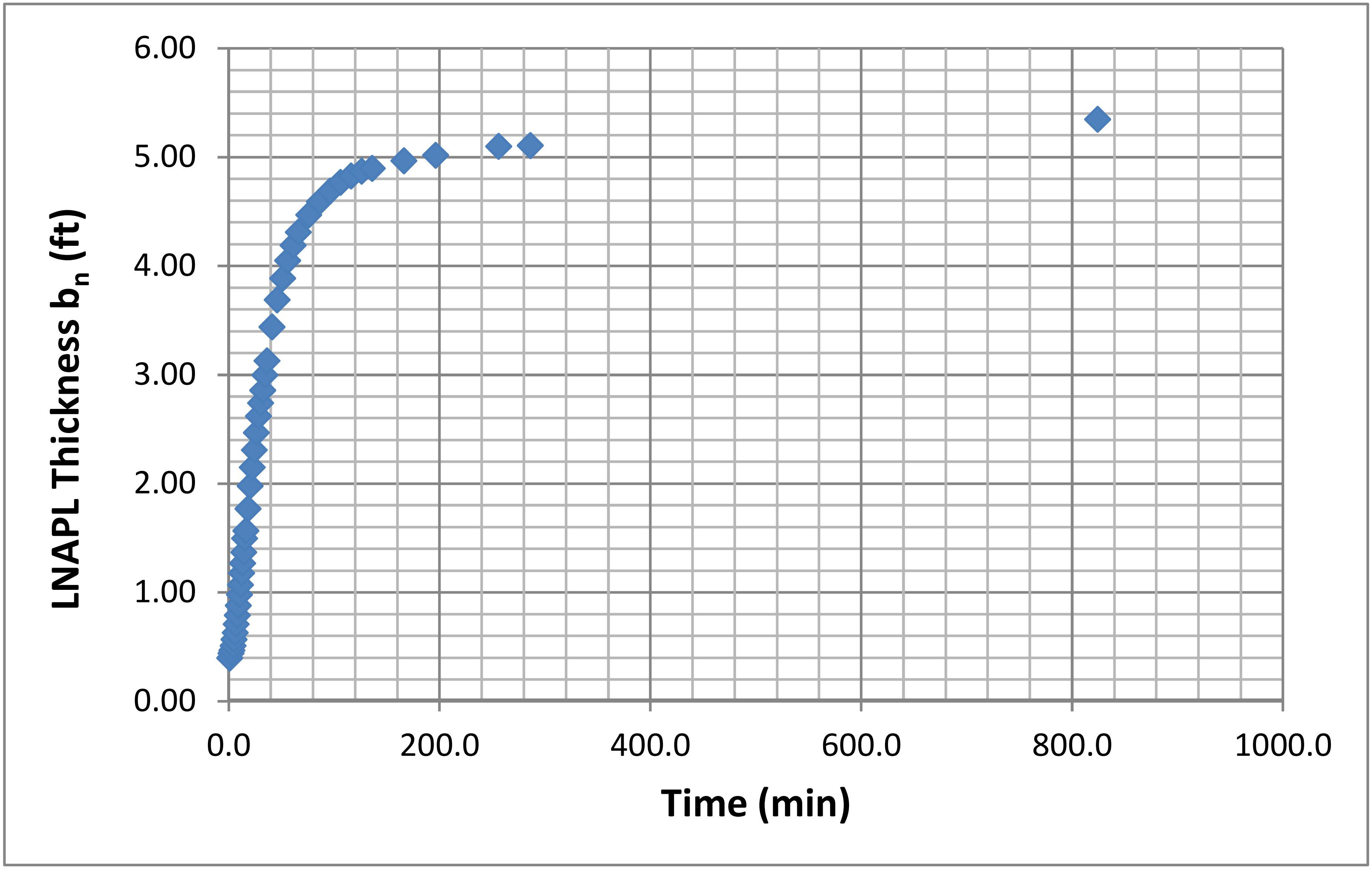

Discharge (ft³/d)
0.0
5.0
10.0
15.0
20.0
37.0
37.1
37.2
37.3
37.4
37.5
37.6
37.7
37.8
37.9
38.0
38.1
DTW (ft bgs)
Depth to Water vs. LNAPL Discharge

Figure 7



6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.0
200.0
400.0
600.0
800.0
1000.0
LNAPL Thickness b_n (ft)
Time (min)

Figure 8

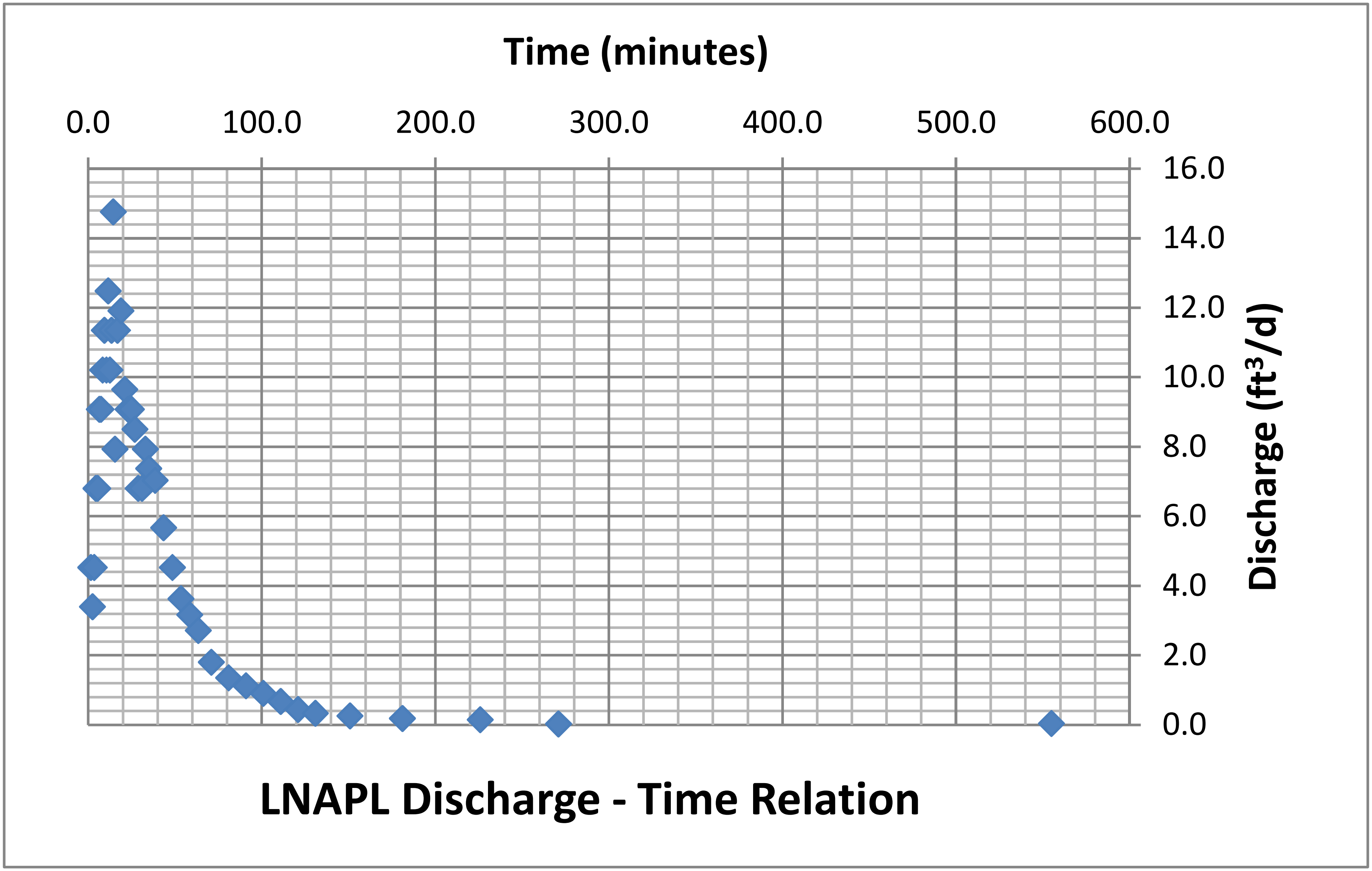
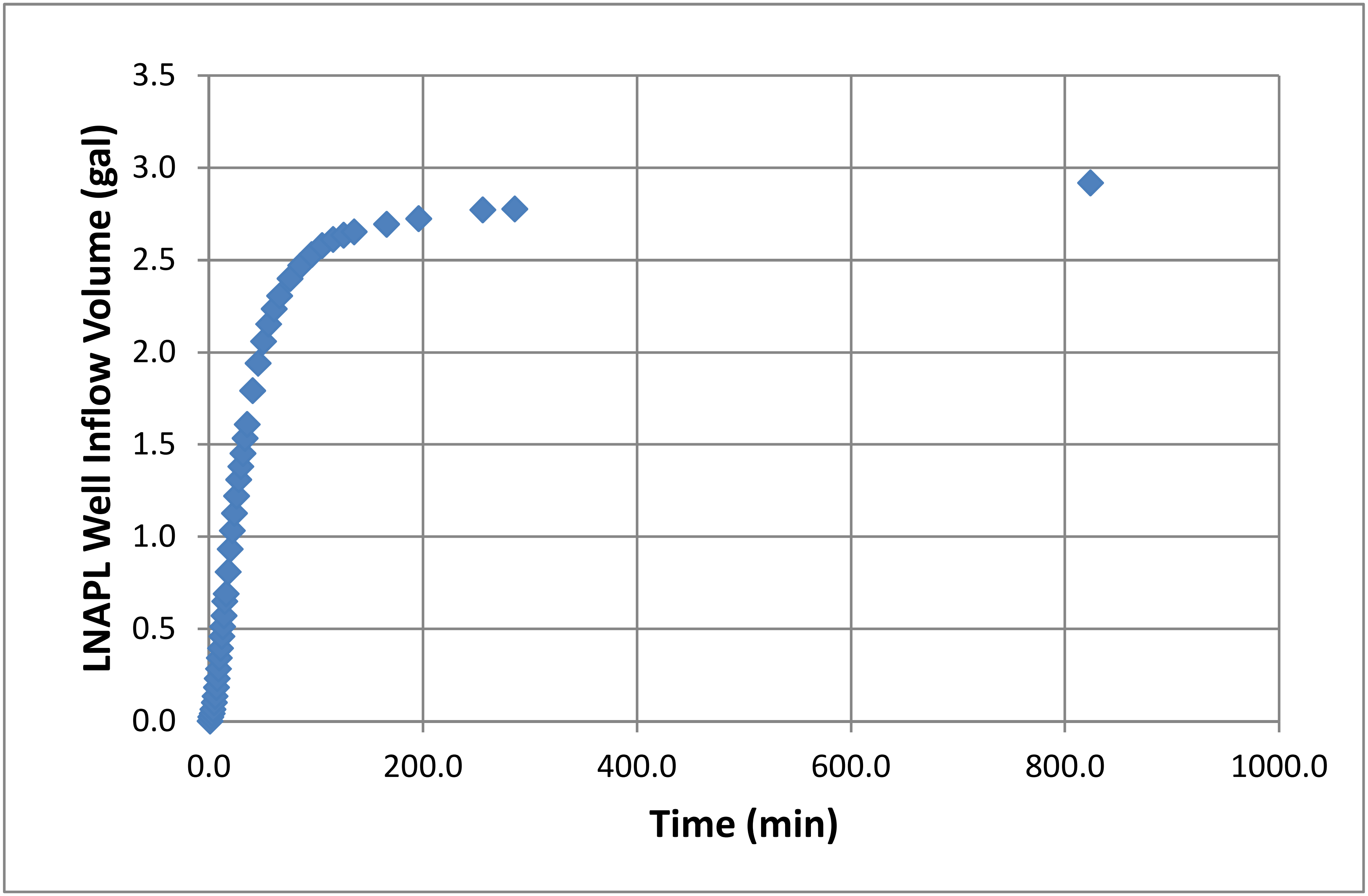
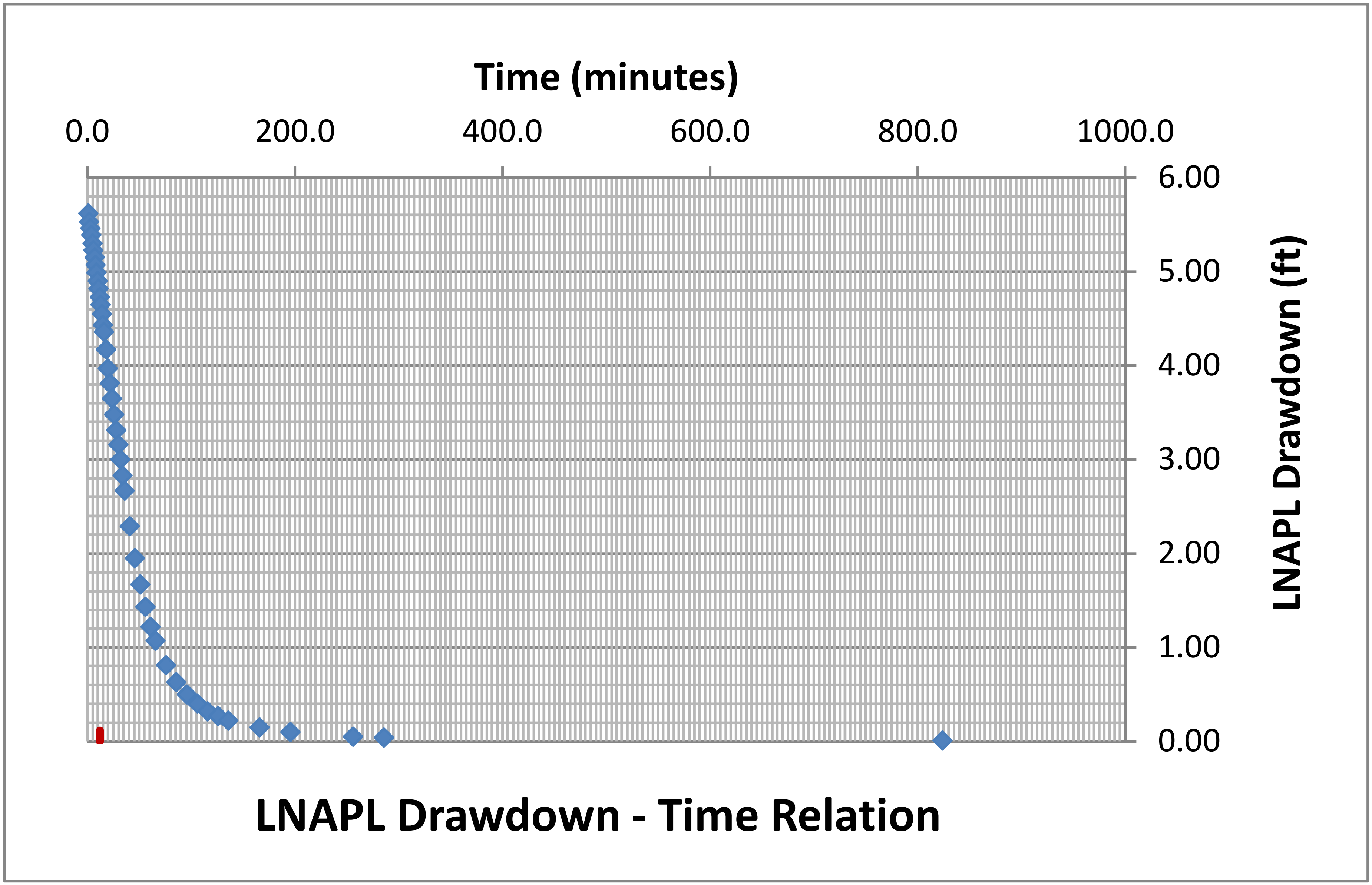

Time (minutes)
0.0
100.0
200.0
300.0
400.0
500.0
600.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Discharge (ft³/d)
LNAPL Discharge - Time Relation

Figure 9



3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
LNAPL Well Inflow Volume (gal)
0.0
200.0
400.0
600.0
800.0
1000.0
Time (min)

Figure 10



Time (minutes)
0.0
200.0
400.0
600.0
800.0
1000.0
6.00
5.00
4.00
3.00
2.00
1.00
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Time Relation

Generalized Bouwer and Rice (1976)

Well Designation:	MW-10
Date:	16-Jul-15

$$T_n = \frac{r_e^{\,2} \ln(R/r_e)\ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

L_e/r_e
57.3
C
3.09
R/r_e
21.56

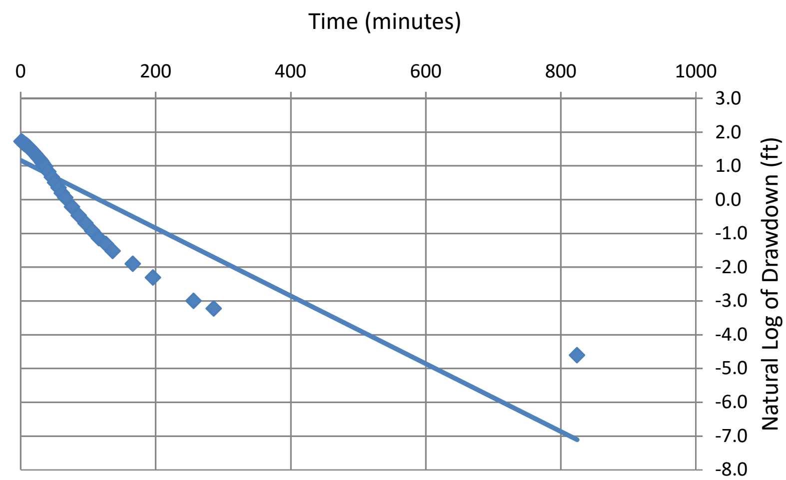
J-Ratio
-1.200

Coef. Of Variation
0.09

Enter early time cut-off for least-squares model fit

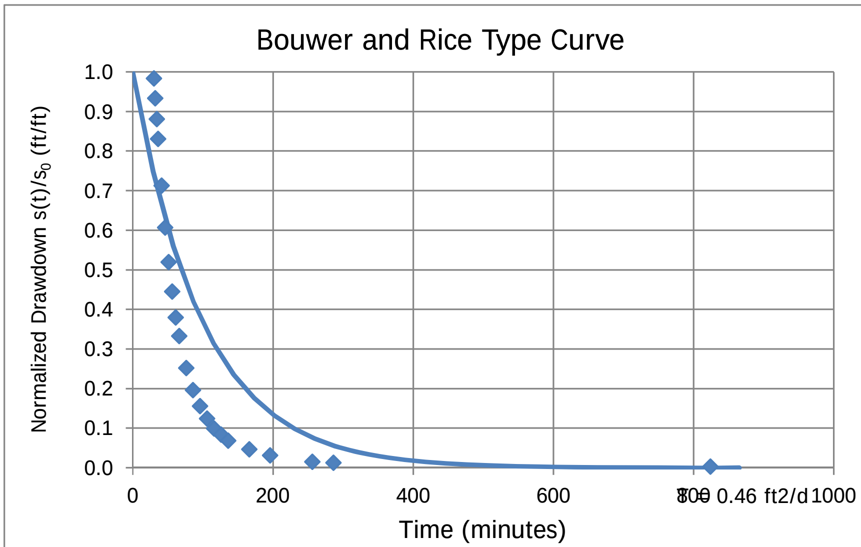
$Time_{cut}$	0	<- Enter or change value here

Model Results: T_n (ft^2/d) = 0.46 +/- 0.04 ft^2/d



Bouwer and Rice Model

C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW-10
Date:	16-Jul-15

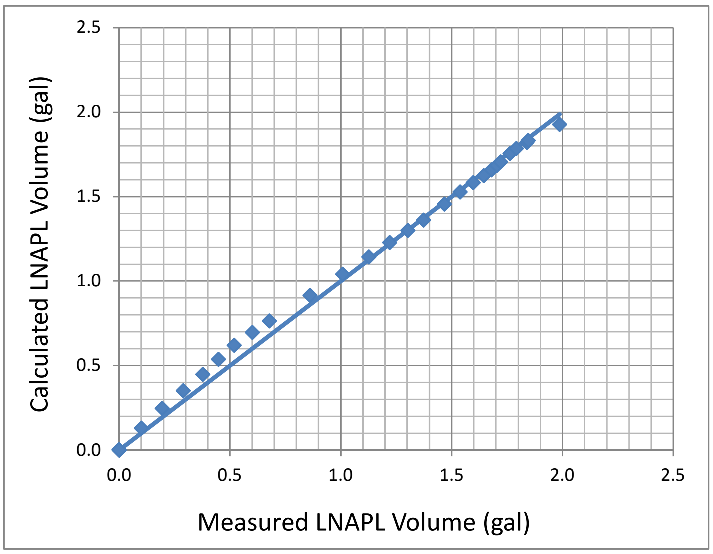
$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

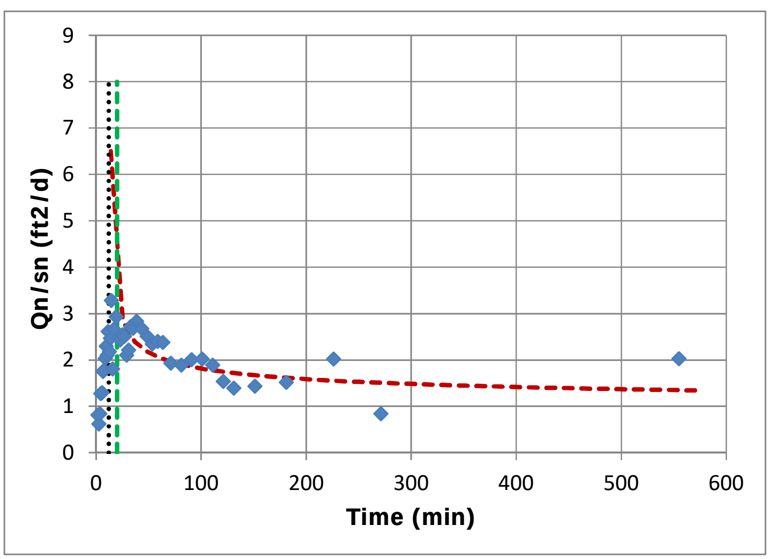
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	20	<- Enter or change values here
Time Adjustment (min):	12	
Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	0.241	<-- Minimize this using "Solver"
	0.022	<-- Working S_n
Trial T_n (ft^2/d):	0.759	<-- By changing T_n through "Solver"

Add constraint T_n > 0.00001

Model Result: T_n (ft^2/d) = **0.76**





Height

8

Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	MW-10
Date:	16-Jul-15

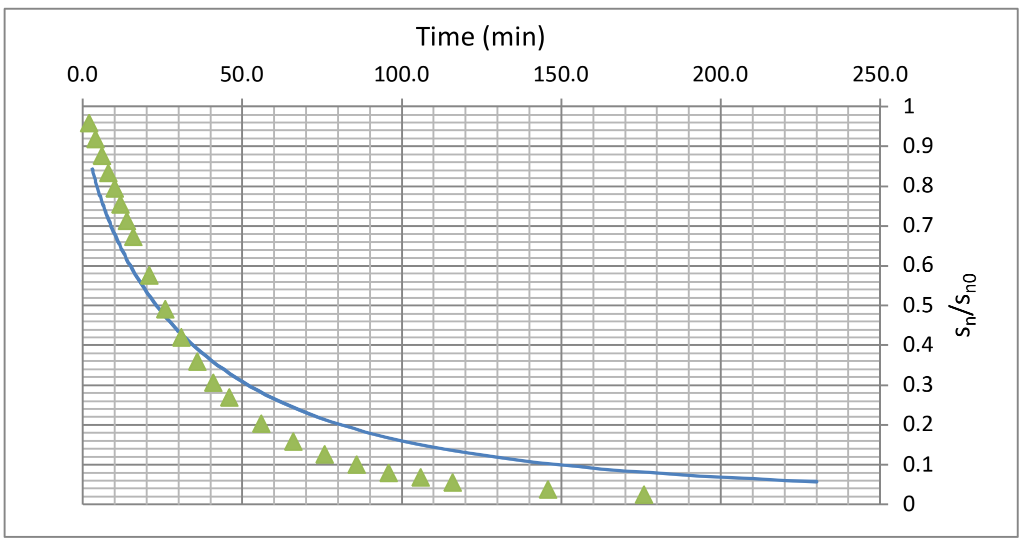
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	20	<- Enter or change values here
Initial Drawdown s_n (ft):	3.97	
Trial S_n:	d	<-- Enter d for default
Root-Mean-Square Error:	0.394	<-- Minimize this using "Solver"
Trial T_n (ft^2/d):	0.896	<-- By changing T_n through "Solver"
	0.024	<-- Working S_n

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **0.90**

T_{min}	3
T_{max}	230



J-Ratio
-1.200

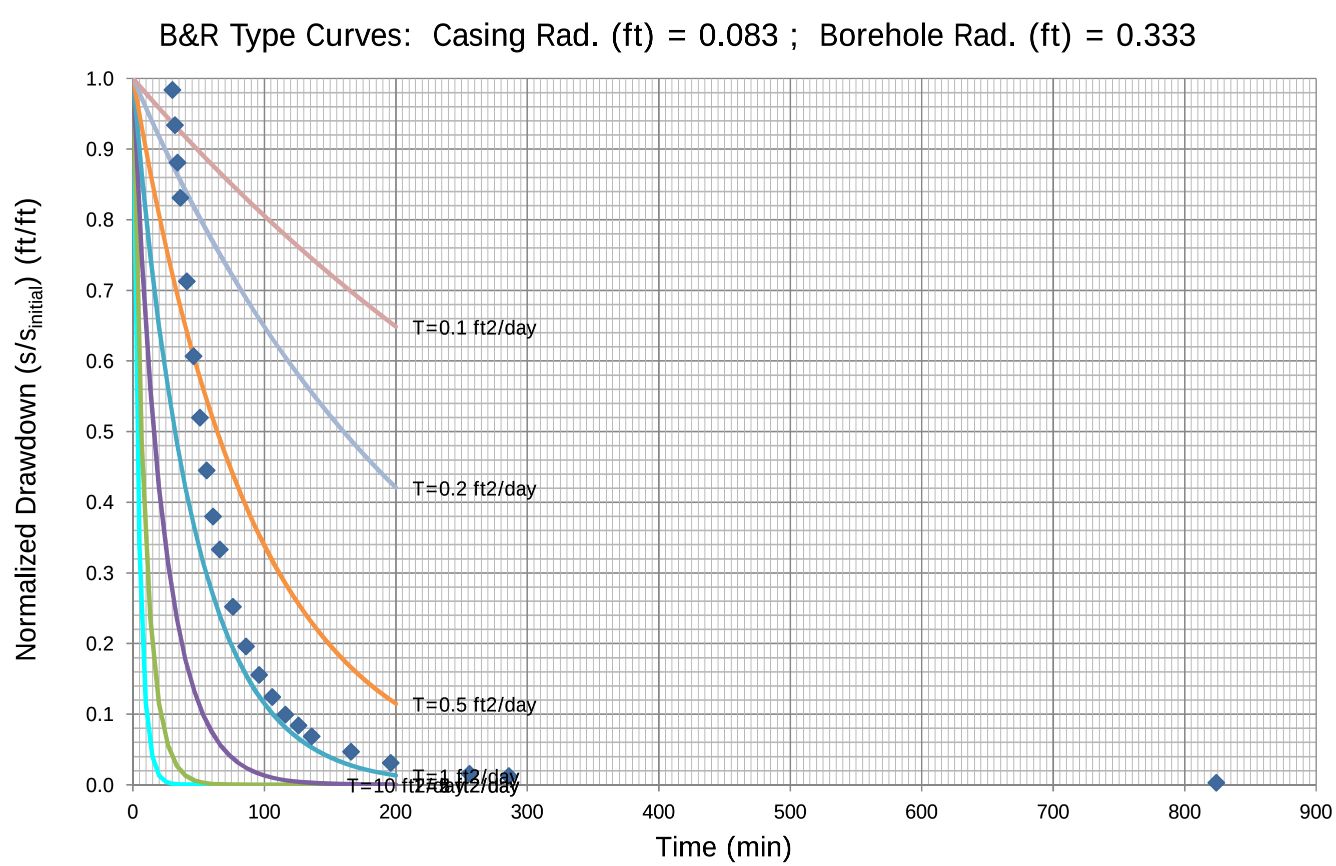
Bouwer and Rice Short Term LNAPL Mobility Test Type Curves

B&R Type Curves: Casing Rad. (ft) = 0.083 ; Borehole Rad. (ft) = 0.333

Enter these values

Type Curve ID	Type Curve Name	Notes	Max Time (min)	Transmissivity (ft^2/day)
1	T=10 ft2/day		150	10
2	T=5 ft2/day		200	5
3	T=2 ft2/day		200	2
4	T=1 ft2/day		200	1
5	T=0.5 ft2/day		200	0.5
6	T=0.2 ft2/day		200	0.2
7	T=0.1 ft2/day		200	0.1

J-Ratio		
-1.200	<-- If uncertain use	
		-0.22



API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)
0.68

Standard Deviation (ft^2/d)
0.26

Coefficient of Variation
0.38

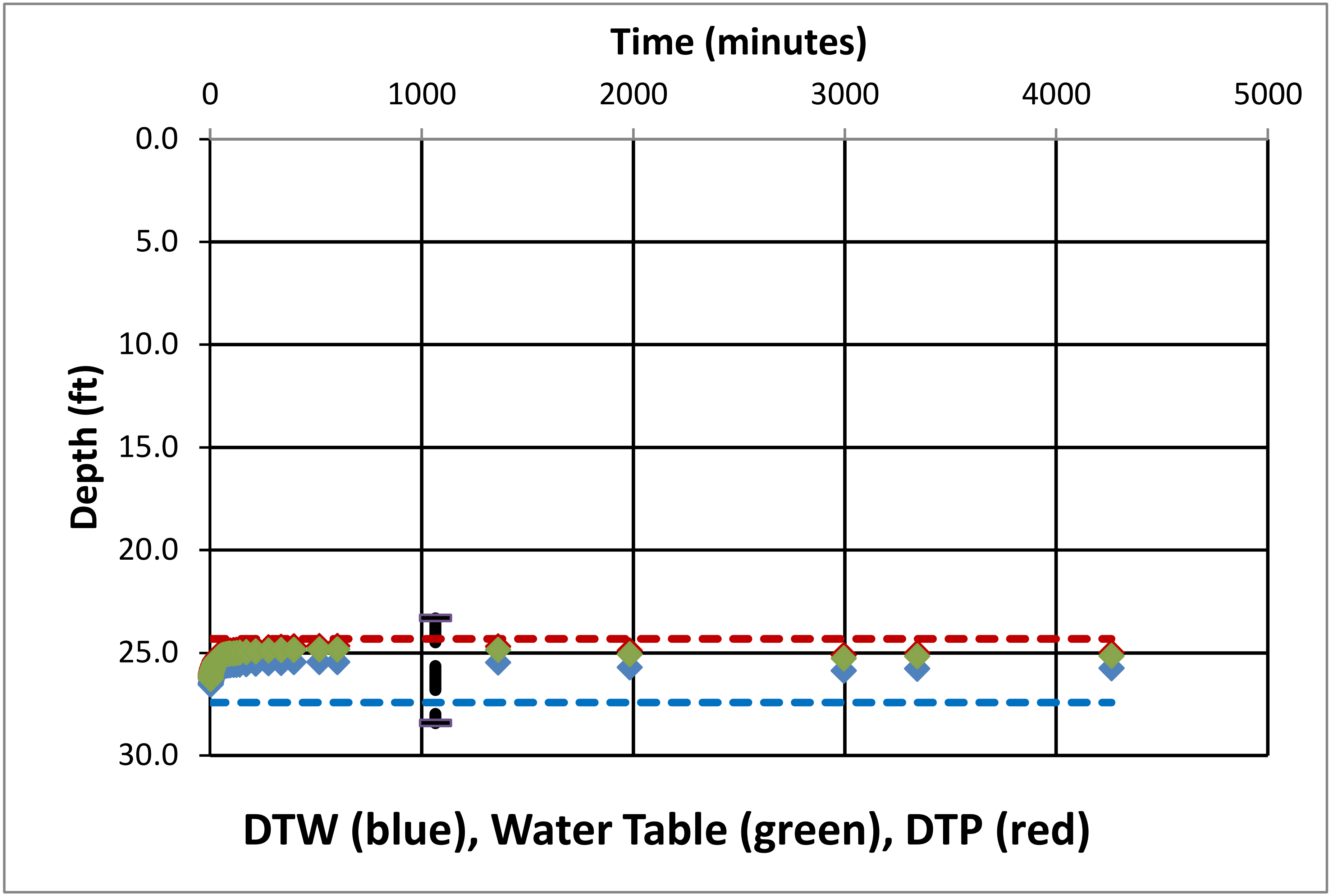
Well Designation:	MW-10	
Date:	19-Nov-17	

Ground Surface Elev (ft msl)	1124.2	Enter These Data	**Drawdown Adjustment (ft)**
Top of Casing Elev (ft msl)	1123.7		
Well Casing Radius, r_c (ft):	0.083	r_{e1}	
Well Radius, r_w (ft):	0.333		0.25
LNAPL Specific Yield, S_y:	0.175		
LNAPL Density Ratio, ρ_r:	0.780		
Top of Screen (ft bgs):	15.0		
Bottom of Screen (ft bgs):	40.0		
LNAPL Baildown Vol. (gal.):	4.0		
Effective Radius, r_{e3} (ft):	0.158	Calculated Parameters	
Effective Radius, r_{e2} (ft):	#NUM!		
Initial Casing LNAPL Vol. (gal.):	0.50		
Initial Filter LNAPL Vol. (gal.):	1.33		

Enter Data Here

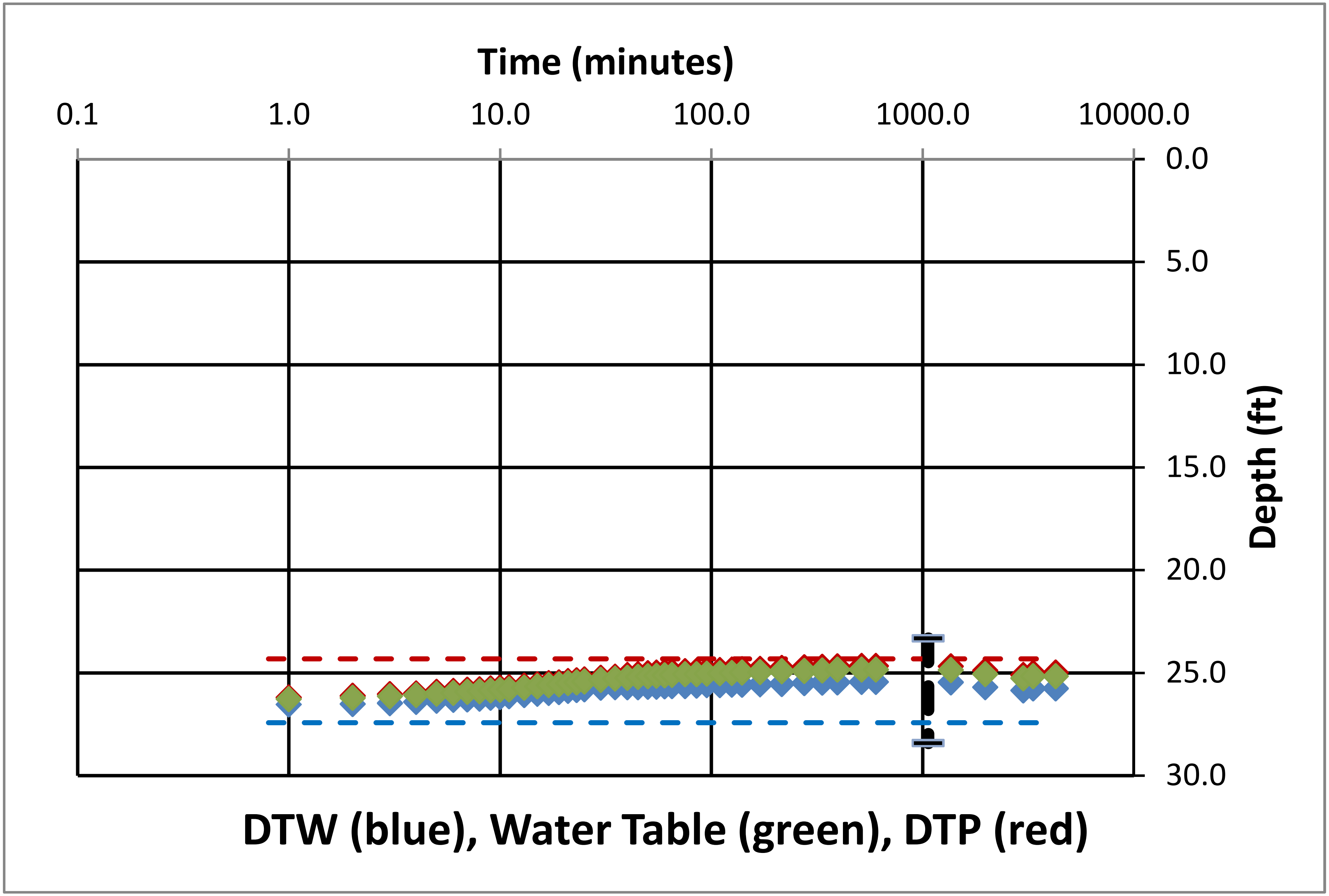
	Time (min)	DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)	Water Table Depth (ft)	LNAPL Drawdown s_n (ft)	Average Time (min)	LNAPL Discharge Q_n (ft^3/d)	s_n (ft)	b_n (ft)	r_e (ft)	DTP (ft bgs)	DTW (ft bgs)	LNAPL Volume (gallons)	Ave. r_e (ft)
Initial Fluid Levels:	0	23.82	26.92	24.32	27.42	25.00					3.10					
Enter Test Data:	1.0	25.70	26.04	26.20	26.54	26.27	1.63				0.34				0	0.158
	2.0	25.62	26.01	26.12	26.51	26.21	1.55	1.5	5.675	1.59	0.39	0.158	26.16	26.53	0.03	0
	3.0	25.54	25.97	26.04	26.47	26.13	1.47	2.5	4.540	1.51	0.43	0.158	26.08	26.49	0.05	0.158
	4.0	25.49	25.92	25.99	26.42	26.08	1.42	3.5	0.000	1.45	0.43	0.158	26.02	26.45	0.05	0.317
	5.0	25.41	25.86	25.91	26.36	26.01	1.34	4.5	2.270	1.38	0.45	0.158	25.95	26.39	0.06	0.475
	6.0	25.38	25.82	25.88	26.32	25.98	1.31	5.5	-1.135	1.33	0.44	0.158	25.90	26.34	0.06	0.634
	7.0	25.32	25.79	25.82	26.29	25.92	1.25	6.5	3.405	1.28	0.47	0.158	25.85	26.30	0.08	0.792
	8.0	25.29	25.75	25.79	26.25	25.89	1.22	7.5	-1.135	1.24	0.46	0.158	25.80	26.27	0.07	0.950
	9.0	25.25	25.71	25.75	26.21	25.85	1.18	8.5	0.000	1.20	0.46	0.158	25.77	26.23	0.07	1.109
	10.0	25.21	25.67	25.71	26.17	25.81	1.14	9.5	0.000	1.16	0.46	0.158	25.73	26.19	0.07	1.267
	11.0	25.19	25.64	25.69	26.14	25.79	1.12	10.5	-1.135	1.13	0.45	0.158	25.70	26.16	0.06	1.426
	13.0	25.11	25.58	25.61	26.08	25.71	1.04	12.0	1.135	1.08	0.47	0.158	25.65	26.11	0.08	1.663
	15.0	25.05	25.52	25.55	26.02	25.65	0.98	14.0	0.000	1.01	0.47	0.158	25.58	26.05	0.08	1.980
	17.0	25.00	25.47	25.50	25.97	25.60	0.93	16.0	0.000	0.96	0.47	0.158	25.53	26.00	0.08	2.297
	19.0	24.95	25.43	25.45	25.93	25.56	0.88	18.0	0.567	0.91	0.48	0.158	25.48	25.95	0.08	2.614
	21.0	24.90	25.38	25.40	25.88	25.51	0.83	20.0	0.000	0.86	0.48	0.158	25.43	25.91	0.08	2.930
	23.0	24.85	25.33	25.35	25.83	25.46	0.78	22.0	0.000	0.81	0.48	0.158	25.38	25.86	0.08	3.247
	25.0	24.82	25.29	25.32	25.79	25.42	0.75	24.0	-0.567	0.76	0.47	0.158	25.33	25.81	0.08	3.564
	30.0	24.74	25.22	25.24	25.72	25.35	0.67	27.5	0.227	0.71	0.48	0.158	25.28	25.76	0.08	4.118
	35.0	24.67	25.19	25.17	25.69	25.28	0.60	32.5	0.908	0.64	0.52	0.158	25.21	25.71	0.11	4.910
	40.0	24.60	25.20	25.10	25.70	25.23	0.53	37.5	1.816	0.57	0.60	0.158	25.14	25.70	0.15	5.702
	45.0	24.55	25.19	25.05	25.69	25.19	0.48	42.5	0.908	0.50	0.64	0.158	25.07	25.70	0.18	6.494
	50.0	24.52	25.18	25.02	25.68	25.17	0.45	47.5	0.454	0.47	0.66	0.158	25.04	25.69	0.19	7.286
	55.0	24.48	25.17	24.98	25.67	25.13	0.41	52.5	0.681	0.43	0.69	0.158	25.00	25.68	0.21	8.078
	60.0	24.46	25.15	24.96	25.65	25.11	0.39	57.5	0.000	0.40	0.69	0.158	24.97	25.66	0.21	8.870
	65.0	24.44	25.14	24.94	25.64	25.09	0.37	62.5	0.227	0.38	0.70	0.158	24.95	25.65	0.21	9.662
	75.0	24.41	25.13	24.91	25.63	25.07	0.34	70.0	0.227	0.36	0.72	0.158	24.93	25.64	0.22	10.850
	85.0	24.40	25.11	24.90	25.61	25.06	0.33	80.0	-0.113	0.34	0.71	0.158	24.91	25.62	0.22	12.434
	95.0	24.38	25.10	24.88	25.60	25.04	0.31	90.0	0.113	0.32	0.72	0.158	24.89	25.60	0.22	14.018
	110.0	24.36	25.09	24.86	25.59	25.02	0.29	102.5	0.076	0.30	0.73	0.158	24.87	25.59	0.23	15.998
	125.0	24.34	25.08	24.84	25.58	25.00	0.27	117.5	0.076	0.28	0.74	0.158	24.85	25.58	0.24	18.374
	140.0	24.32	25.07	24.82	25.57	24.98	0.25	132.5	0.076	0.26	0.75	0.158	24.83	25.57	0.24	20.750
	170.0	24.30	25.05	24.80	25.55	24.97	0.23	155.0	0.000	0.24	0.75	0.158	24.81	25.56	0.24	24.314
	215.0	24.26	25.03	24.76	25.53	24.93	0.19	192.5	0.050	0.21	0.77	0.158	24.78	25.54	0.25	30.253
	275.0	24.23	25.00	24.73	25.50	24.90	0.16	245.0	0.000	0.18	0.77	0.158	24.75	25.52	0.25	38.569
	335.0	24.20	24.98	24.70	25.48	24.87	0.13	305.0	0.019	0.15	0.78	0.158	24.72	25.49	0.26	48.073
	395.0	24.18	24.95	24.68	25.45	24.85	0.11	365.0	-0.019	0.12	0.77	0.158	24.69	25.47	0.25	57.577
	515.0	24.17	24.94	24.67	25.44	24.84	0.10	455.0	0.000	0.11	0.77	0.158	24.68	25.45	0.25	71.832
	601.0	24.17	24.94	24.67	25.44	24.84	0.10	558.0	0.000	0.10	0.77	0.158	24.67	25.44	0.25	88.147
	1361.0	24.18	24.96	24.68	25.46	24.85	0.11	981.0	0.001	0.11	0.78	0.158	24.68	25.45	0.26	155.148
	1983.0	24.38	25.20	24.88	25.70	25.06	0.31	1672.0	0.007	0.21	0.82	0.158	24.78	25.58	0.28	264.599
	2995.0	24.60	25.36	25.10	25.86	25.27	0.53	2489.0	-0.007	0.42	0.76	0.158	24.99	25.78	0.25	394.008
	3341.0	24.50	25.26	25.00	25.76	25.17	0.43	3168.0	0.000	0.48	0.76	0.158	25.05	25.81	0.25	501.558
	4261.0	24.48	25.25	24.98	25.75	25.15	0.41	3801.0	0.001	0.42	0.77	0.158	24.99	25.76	0.25	601.822

Figure 1



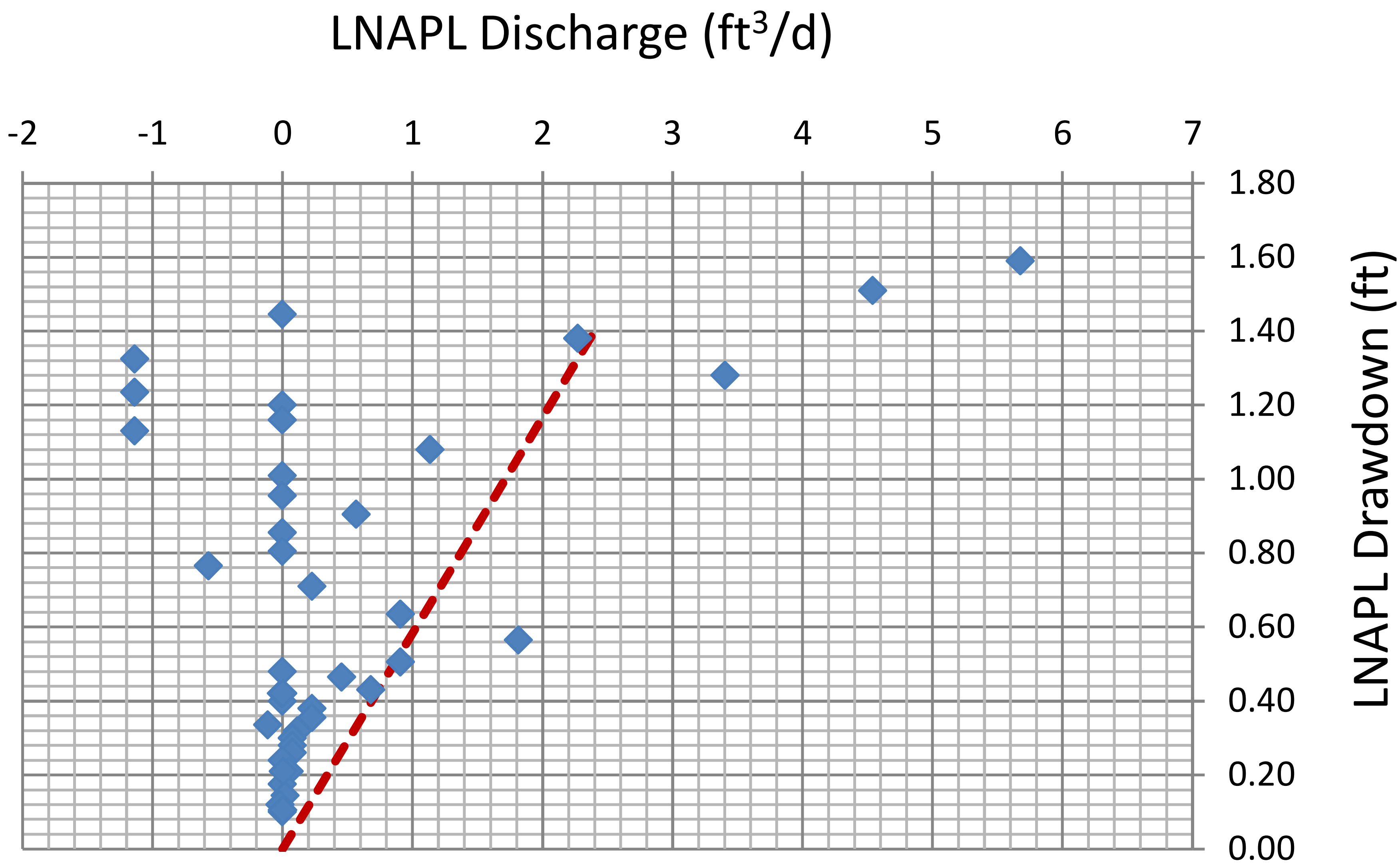
MW-10 (November 2017)
Baildown Test Data Analysis

Figure 2



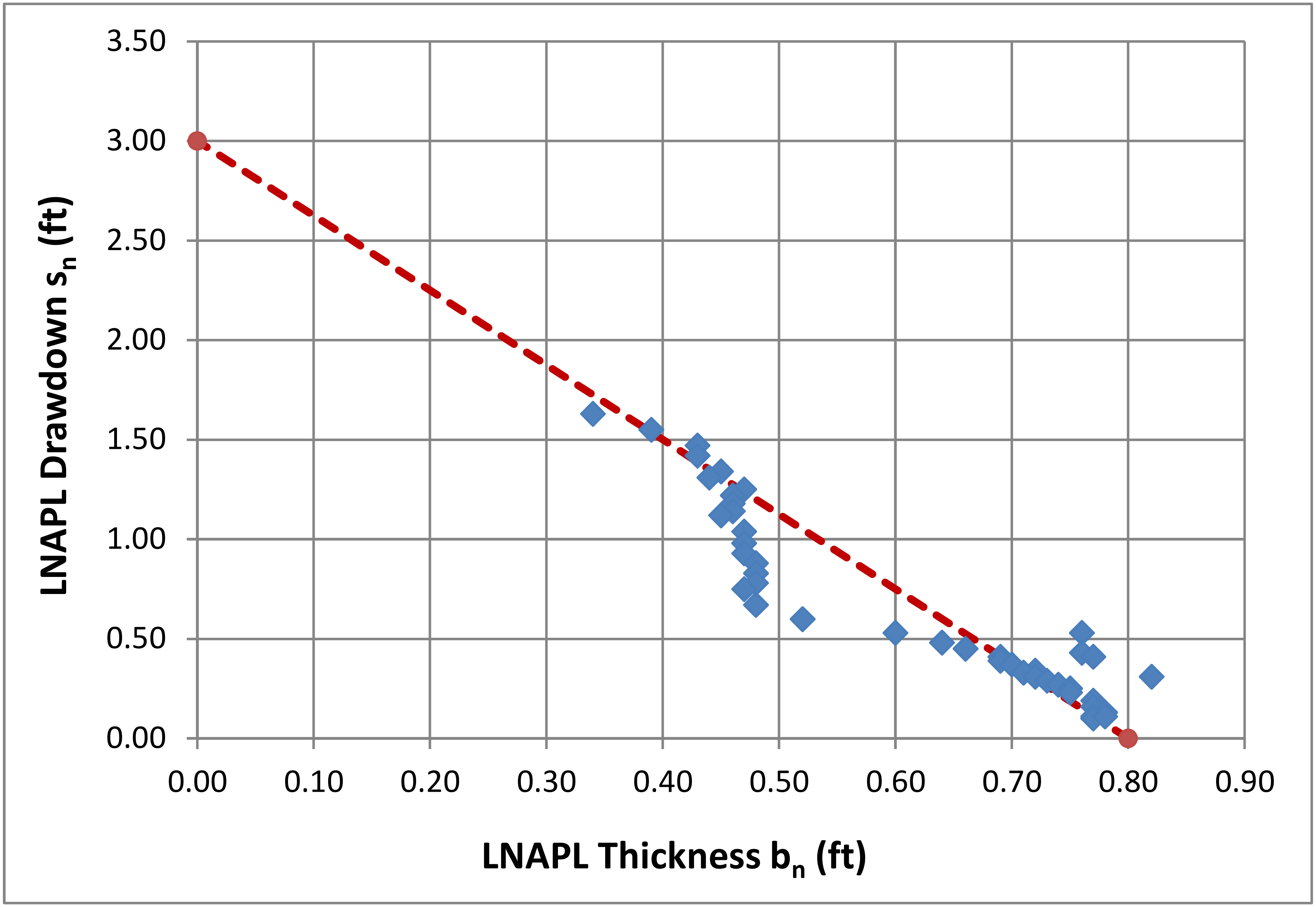
Time (minutes)
0.1
1.0
10.0
100.0
1000.0
10000.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 3



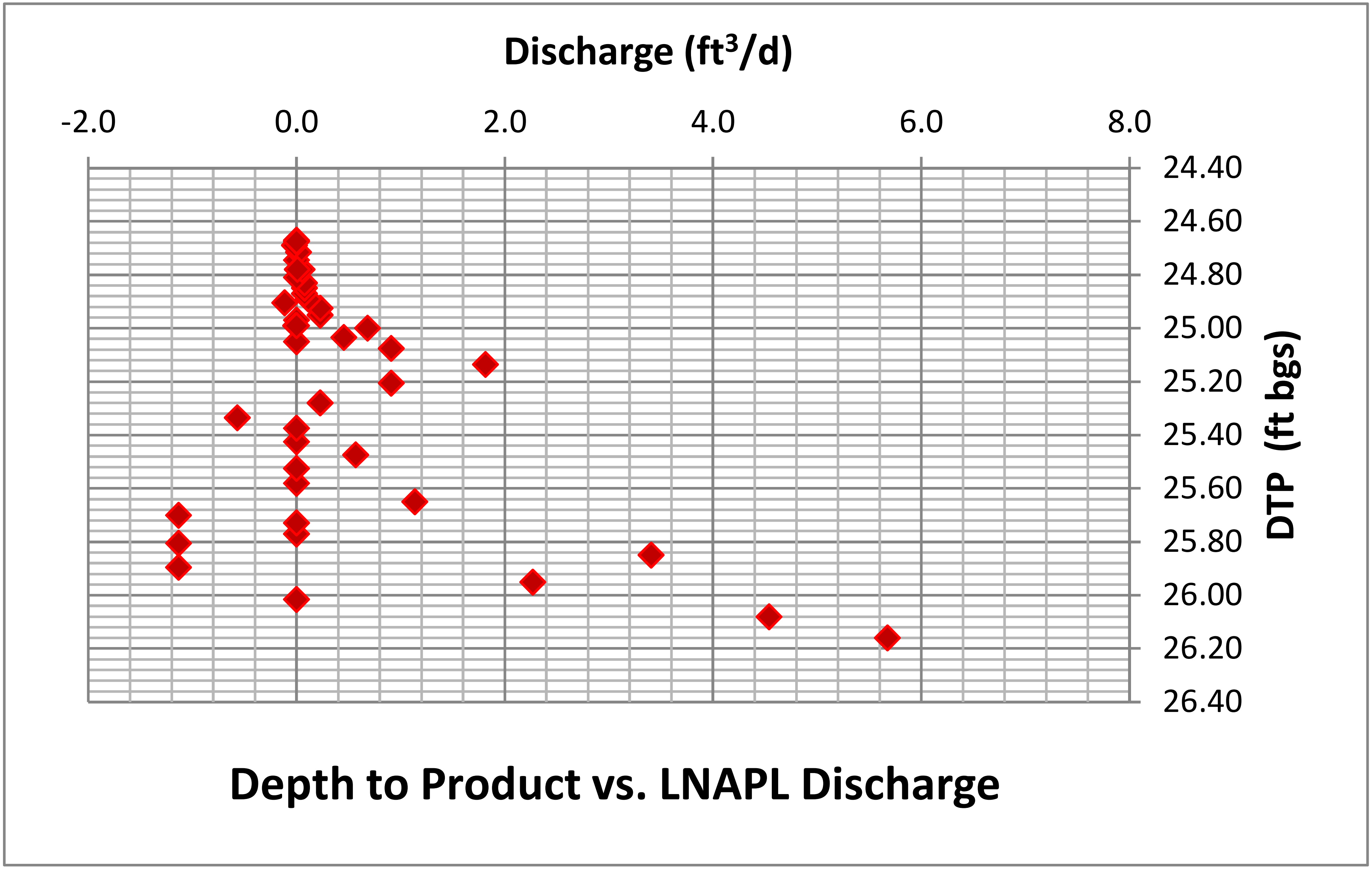
LNAPL Drawdown - Discharge Relation

Figure 4



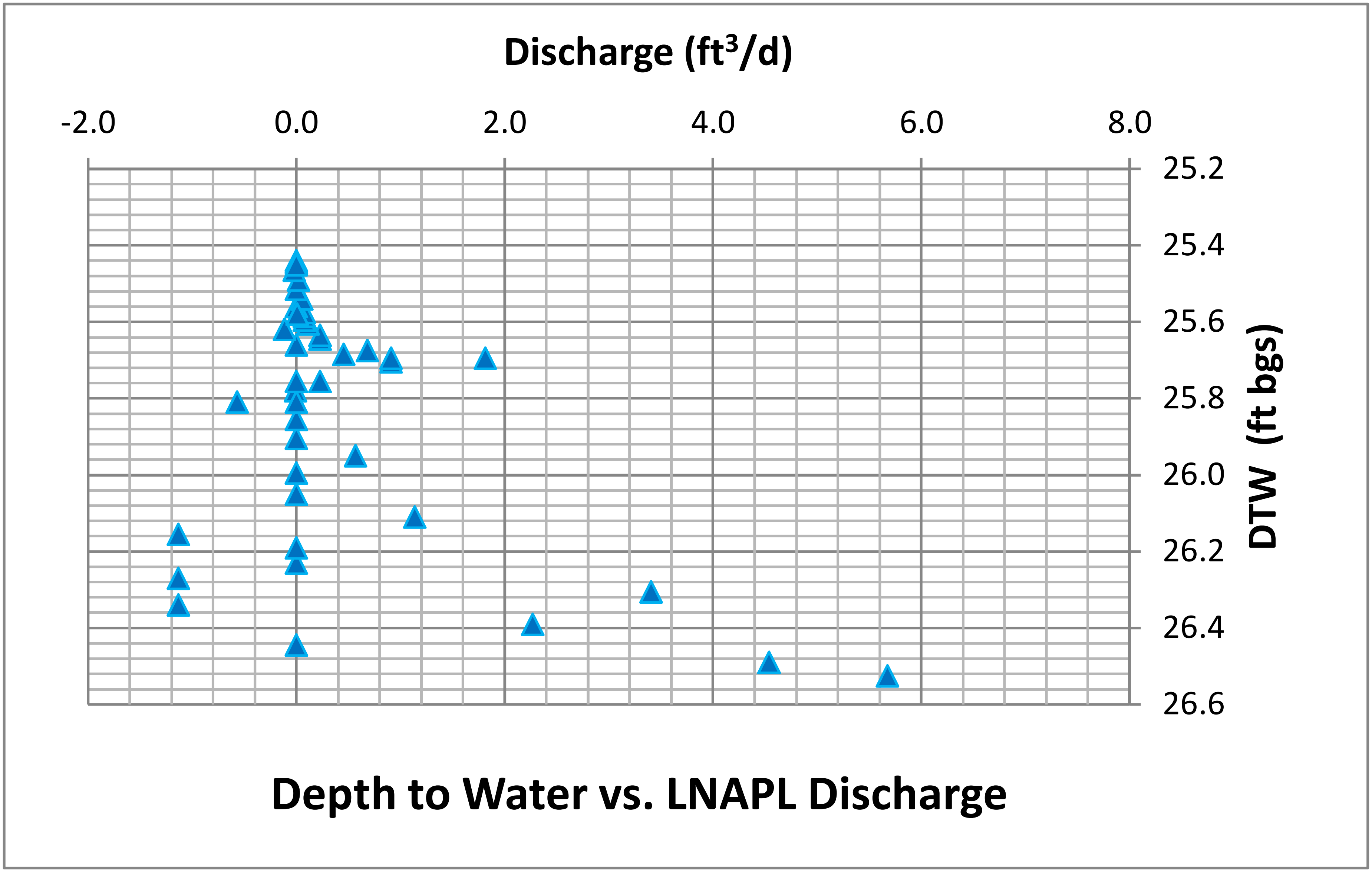
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
LNAPL Drawdown s_n (ft)
LNAPL Thickness b_n (ft)

Figure 5



Discharge (ft^3/d)
-2.0
0.0
2.0
4.0
6.0
8.0
24.40
24.60
24.80
25.00
25.20
25.40
25.60
25.80
26.00
26.20
26.40
DTP (ft bgs)
Depth to Product vs. LNAPL Discharge

Figure 6



Discharge (ft³/d)
-2.0
0.0
2.0
4.0
6.0
8.0
25.2
25.4
25.6
25.8
26.0
26.2
26.4
26.6
DTW (ft bgs)
Depth to Water vs. LNAPL Discharge

Figure 7

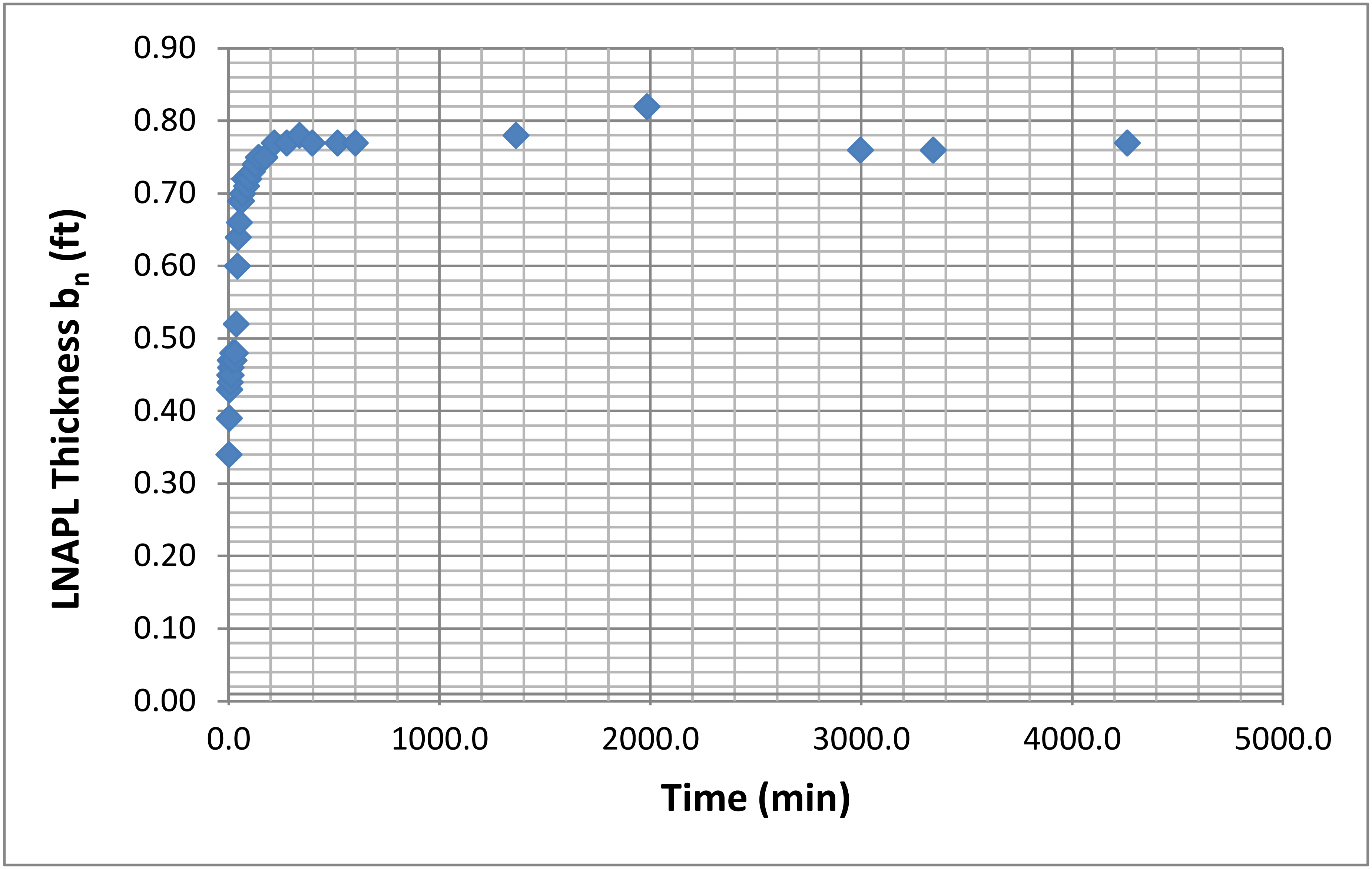

0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.0
1000.0
2000.0
3000.0
4000.0
5000.0
LNAPL Thickness b_n (ft)
Time (min)

Figure 8

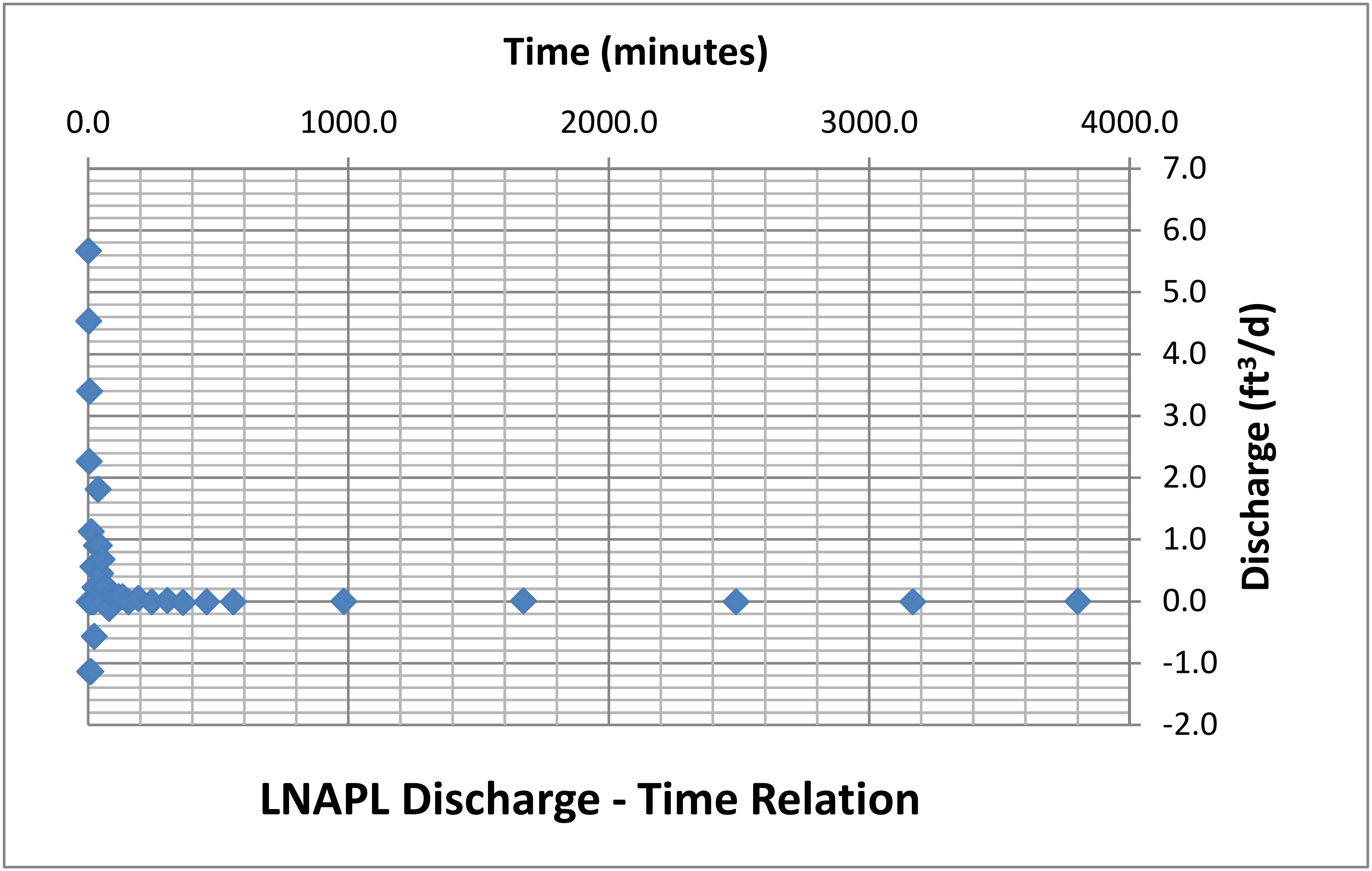
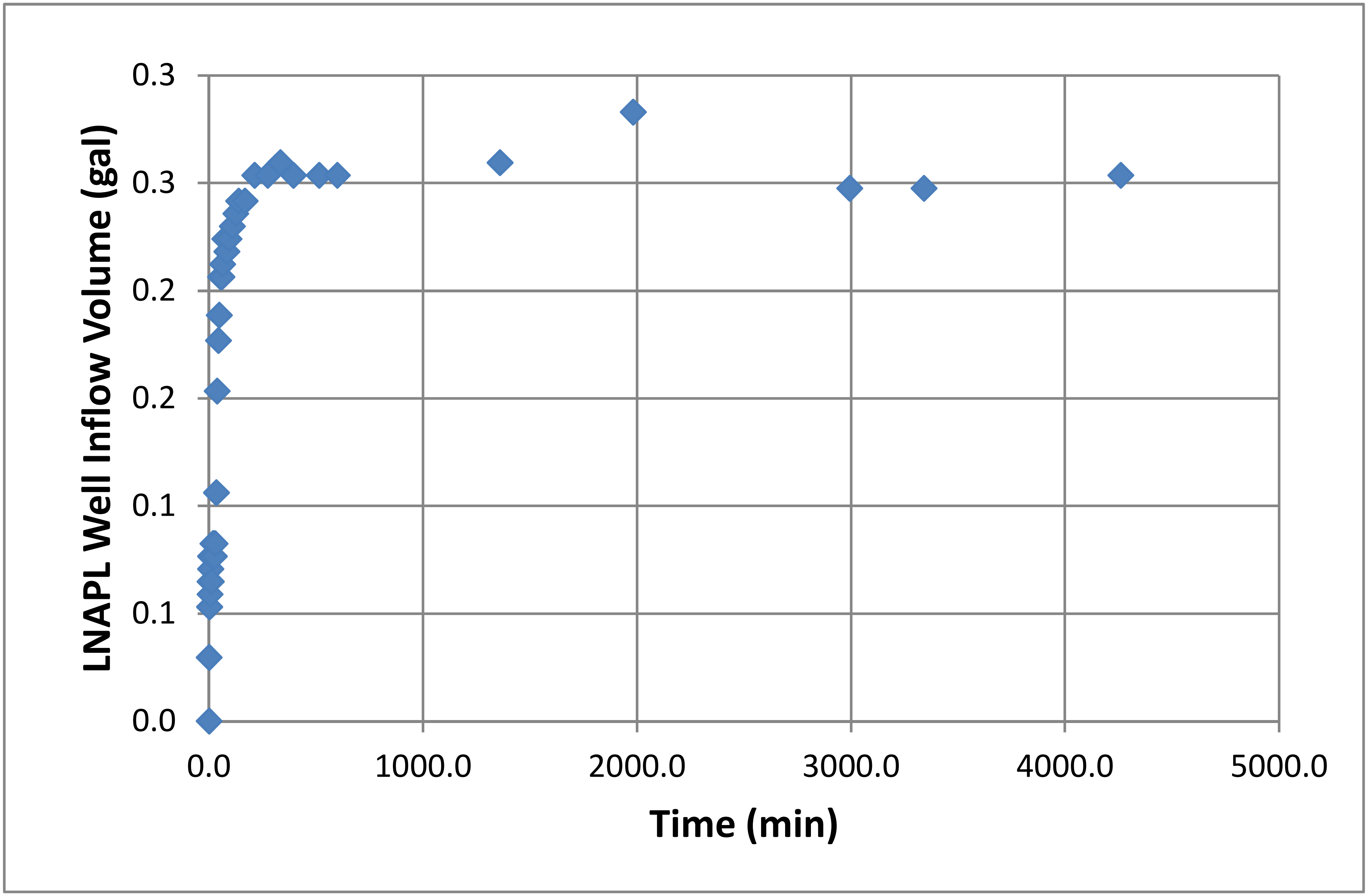
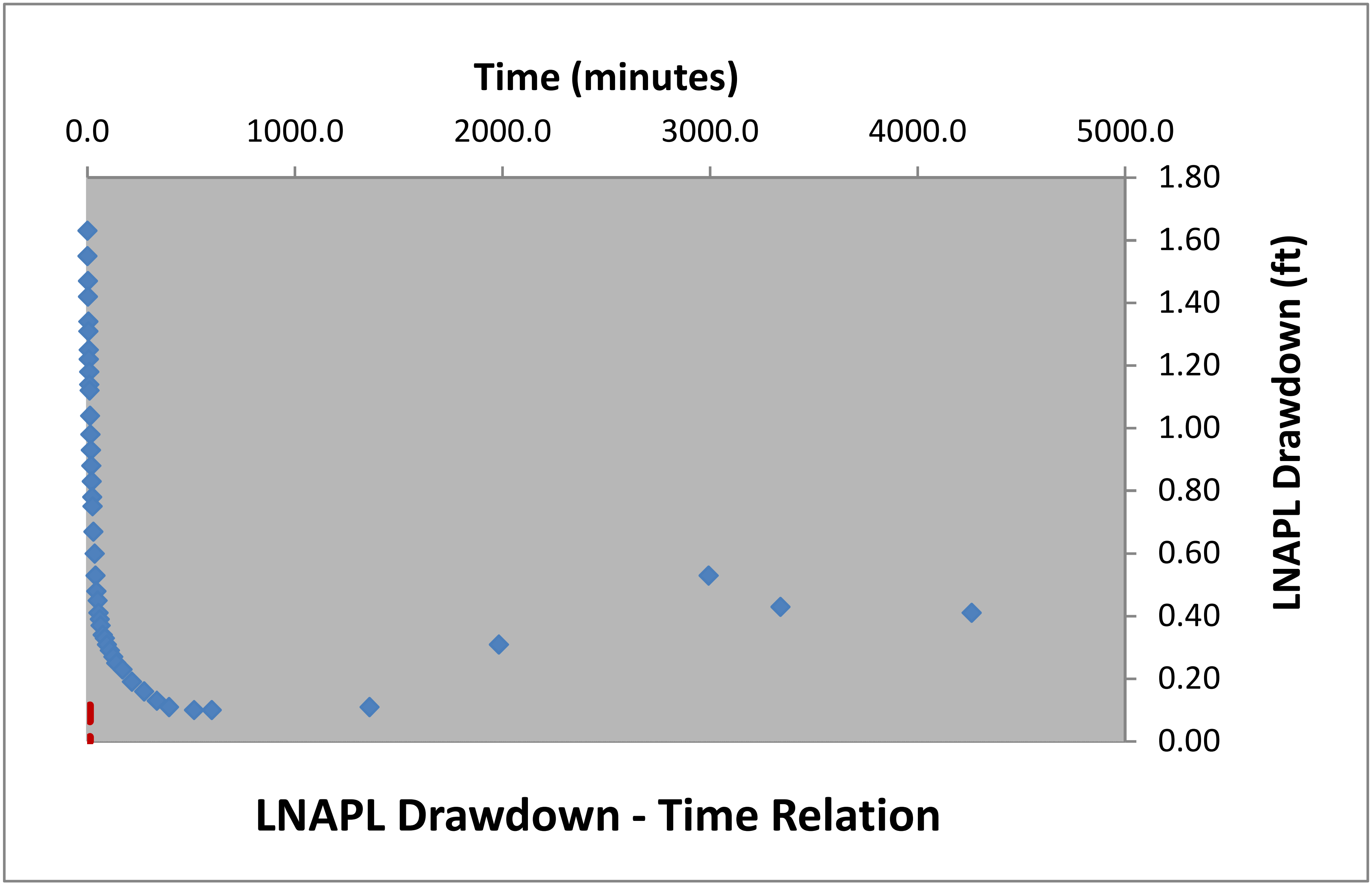

Time (minutes)
0.0
1000.0
2000.0
3000.0
4000.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
Discharge (ft³/d)
LNAPL Discharge - Time Relation

Figure 9



MW-10 (November 2017)
Baildown Test Data Analysis

Figure 10



MW-10 (November 2017)
Baildown Test Data Analysis

Generalized Bouwer and Rice (1976)

Well Designation:	MW-10
Date:	19-Nov-17

$$T_n = \frac{r_e^{\,2}\ln(R/r_e)\ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

L_e/r_e
19.6
C
1.57
R/r_e
9.22

J-Ratio
-3.750

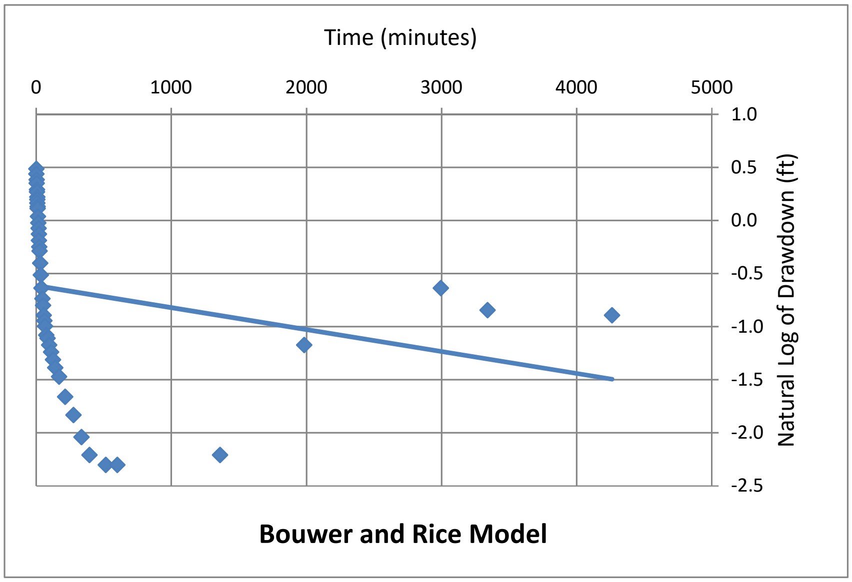
Enter early time cut-off for least-squares model fit

$Time_{cut}$	0

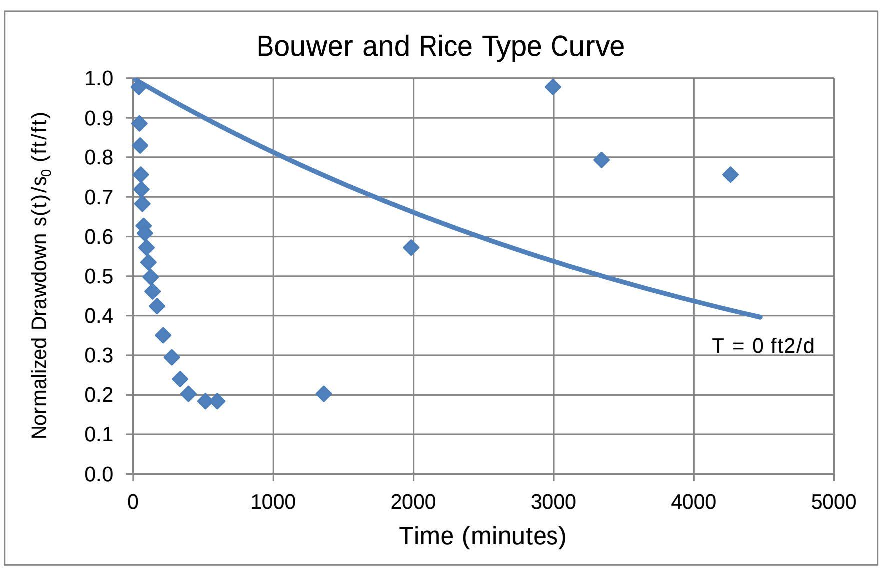
<- Enter or change value here

Model Results: T_n (ft^2/d) = 0.00 +/- 0.00 ft^2/d

Coef. Of Variation
0.64



C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW-10
Date:	19-Nov-17

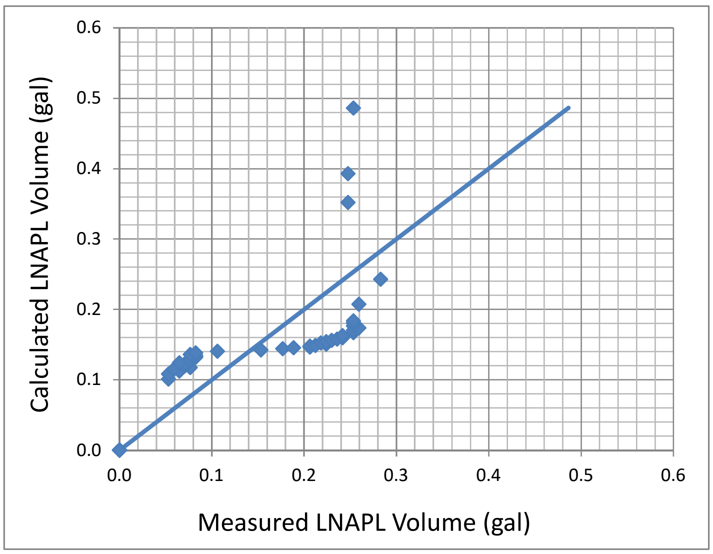
$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

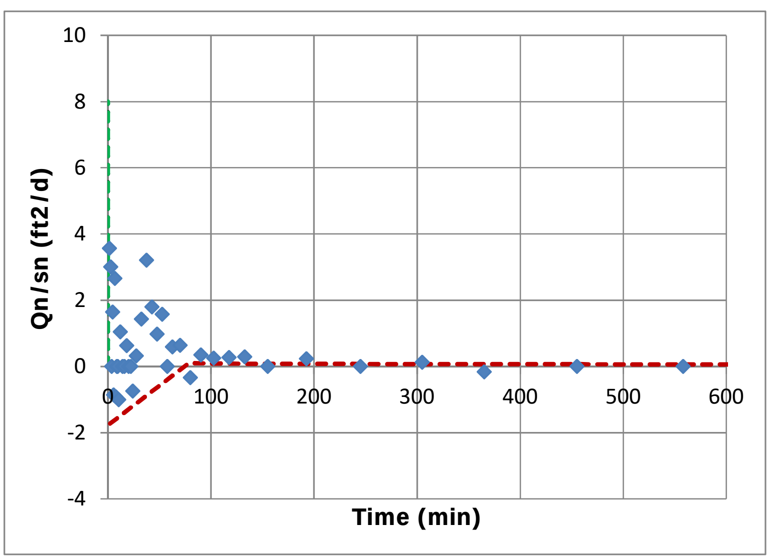
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<-- Enter or change values here
Time Adjustment (min):	0	
Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	0.479	<-- Minimize this using "Solver"
	0.004	<-- Working S_n
Trial T_n (ft^2/d):	0.027	<-- By changing T_n through "Solver"

Add constraint $T_n > 0.00001$

Model Result: T_n (ft^2/d) = **0.03**





Height

8

Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	MW-10
Date:	19-Nov-17

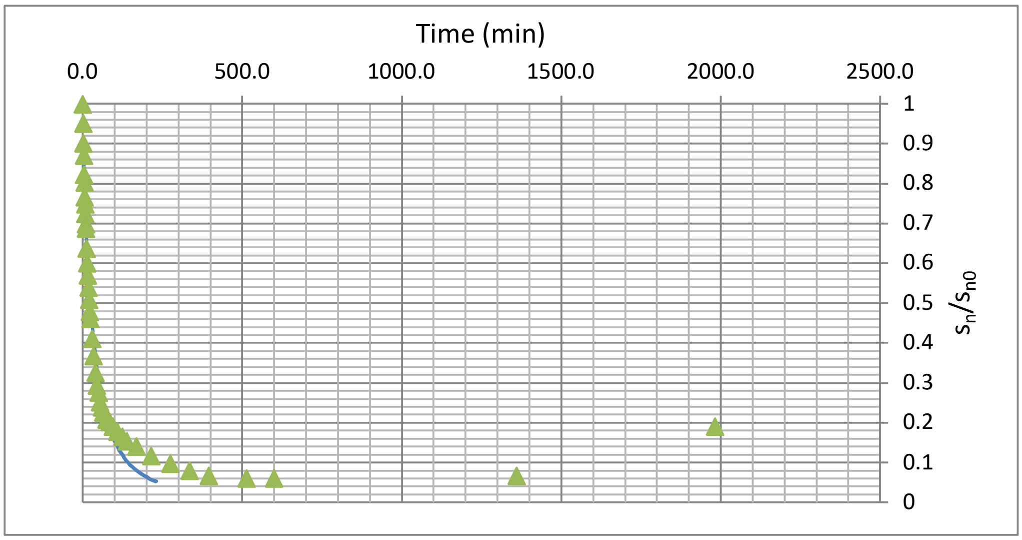
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Initial Drawdown s_n (ft):	1.63	
Trial S_n:	d	<-- Enter d for default
Root-Mean-Square Error:	0.303	<-- Minimize this using "Solver"
Trial T_n (ft^2/d):	0.320	<-- By changing T_n through "Solver"
	0.014	<-- Working S_n

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **0.32**

T_{min}	3
T_{max}	230



J-Ratio
-3.750

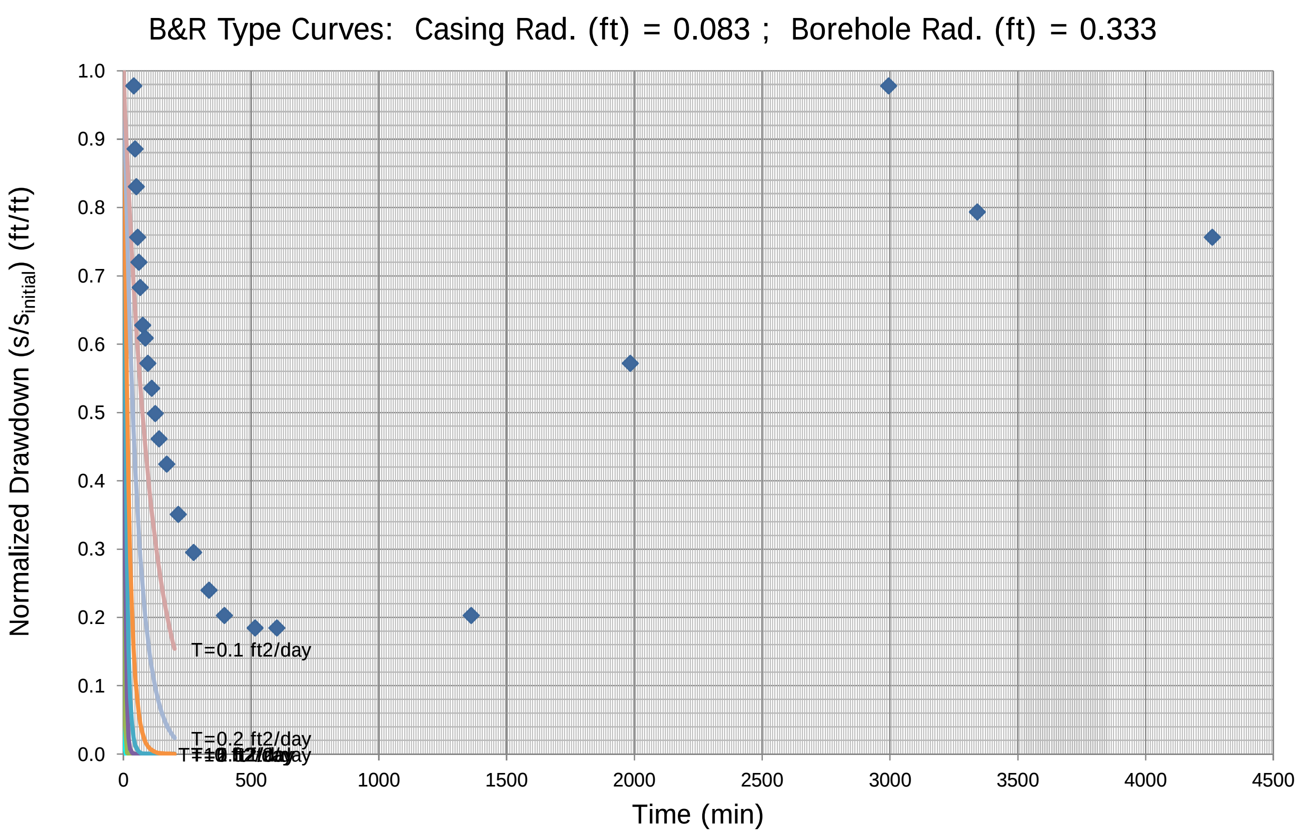
Bouwer and Rice Short Term LNAPL Mobility Test Type Curves

B&R Type Curves: Casing Rad. (ft) = 0.083 ; Borehole Rad. (ft) = 0.333

Enter these values

Type Curve ID	Type Curve Name	Notes	Max Time (min)	Transmissivity (ft^2/day)
1	T=10 ft2/day		150	10
2	T=5 ft2/day		200	5
3	T=2 ft2/day		200	2
4	T=1 ft2/day		200	1
5	T=0.5 ft2/day		200	0.5
6	T=0.2 ft2/day		200	0.2
7	T=0.1 ft2/day		200	0.1

J-Ratio	
-3.750	<-- If uncertain use
	-0.22



API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)

0.12

Standard Deviation (ft^2/d)

0.18

Coefficient of Variation

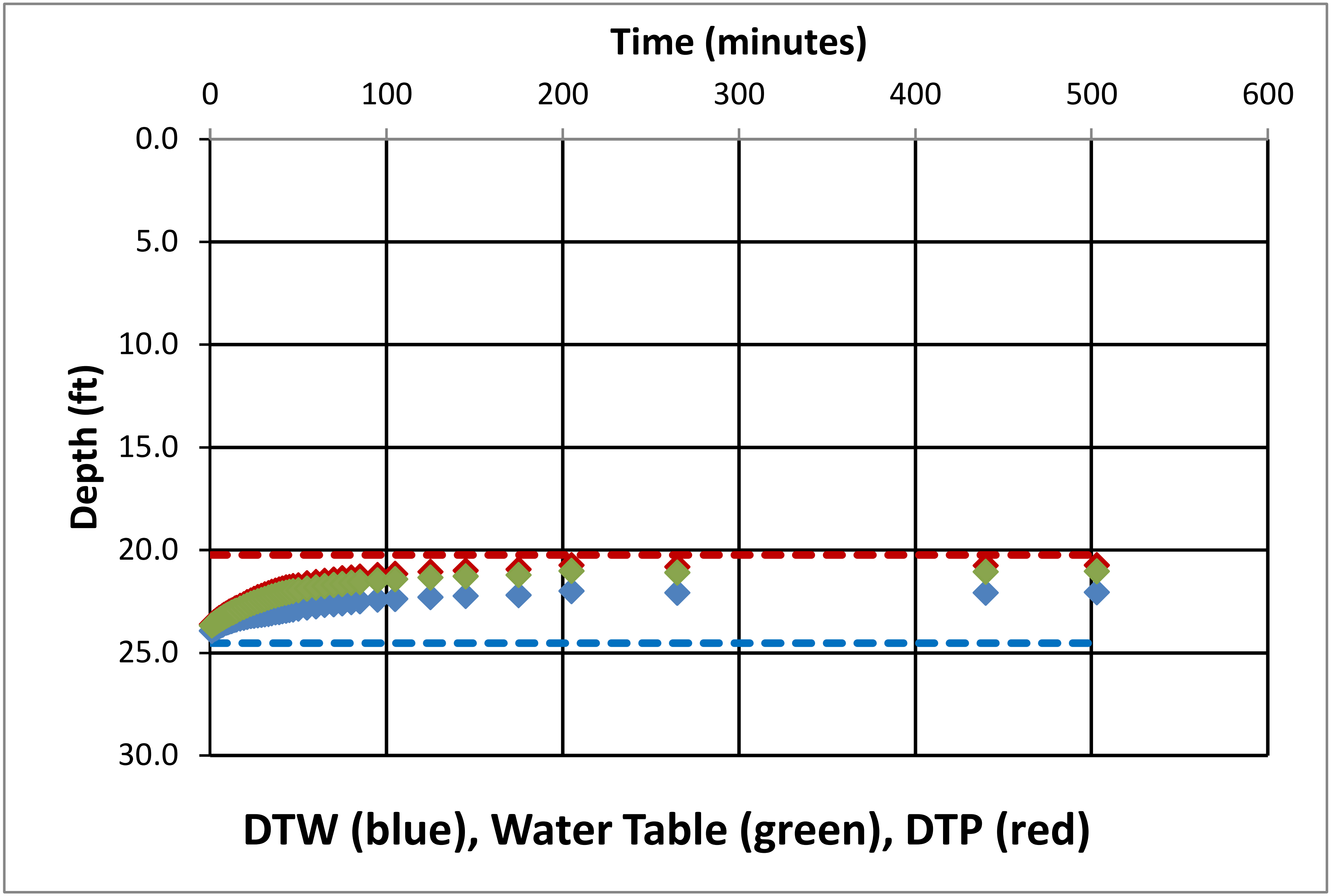
1.52

Well Designation:	MW-12	
Date:	21-Nov-17	

Ground Surface Elev (ft msl)	0.0	Enter These Data	**Drawdown Adjustment (ft)**
Top of Casing Elev (ft msl)	0.0		
Well Casing Radius, r_c (ft):	0.085	r_{e1}	0.4
Well Radius, r_w (ft):	0.333		
LNAPL Specific Yield, S_y:	0.175		
LNAPL Density Ratio, ρ_r:	0.780		
Top of Screen (ft bgs):	0.0		
Bottom of Screen (ft bgs):	0.0		
LNAPL Baildown Vol. (gal.):	0.0		
Effective Radius, r_{e3} (ft):	0.159	Calculated Parameters	
Effective Radius, r_{e2} (ft):	#NUM!		
Initial Casing LNAPL Vol. (gal.):	0.73		
Initial Filter LNAPL Vol. (gal.):	1.83		

	Enter Data Here					Water Table Depth (ft)	LNAPL Drawdown s_n (ft)	Average Time (min)	LNAPL Discharge Q_n (ft^3/d)	s_n (ft)	b_n (ft)	r_e (ft)	DTP (ft bgs)	DTW (ft bgs)	LNAPL Volume (gallons)	Ave. r_e (ft)
	Time (min)	DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)											
Initial Fluid Levels:	0	20.24	24.53	20.24	24.53	21.18					4.29					
Enter Test Data:	1.0	23.61	23.93	23.61	23.93	23.68	2.97				0.32				0	0.159
	2.0	23.52	23.86	23.52	23.86	23.59	2.88	1.5	2.295	2.93	0.34	0.159	23.57	23.90	0.01	0
	3.0	23.45	23.82	23.45	23.82	23.53	2.81	2.5	3.443	2.85	0.37	0.159	23.49	23.84	0.03	0.159
	4.0	23.40	23.77	23.40	23.77	23.48	2.76	3.5	0.000	2.79	0.37	0.159	23.43	23.80	0.03	0.319
	5.0	23.32	23.71	23.32	23.71	23.41	2.68	4.5	2.295	2.72	0.39	0.159	23.36	23.74	0.04	0.478
	6.0	23.27	23.67	23.27	23.67	23.36	2.63	5.5	1.148	2.66	0.40	0.159	23.30	23.69	0.05	0.637
	7.0	23.21	23.63	23.21	23.63	23.30	2.57	6.5	2.295	2.60	0.42	0.159	23.24	23.65	0.06	0.796
	8.0	23.15	23.58	23.15	23.58	23.24	2.51	7.5	1.148	2.54	0.43	0.159	23.18	23.61	0.07	0.956
	9.0	23.09	23.54	23.09	23.54	23.19	2.45	8.5	2.295	2.48	0.45	0.159	23.12	23.56	0.08	1.115
	10.0	23.05	23.52	23.05	23.52	23.15	2.41	9.5	2.295	2.43	0.47	0.159	23.07	23.53	0.09	1.274
	11.0	23.00	23.48	23.00	23.48	23.11	2.36	10.5	1.148	2.39	0.48	0.159	23.03	23.50	0.10	1.433
	12.0	22.95	23.45	22.95	23.45	23.06	2.31	11.5	2.295	2.34	0.50	0.159	22.98	23.47	0.11	1.593
	13.0	22.91	23.42	22.91	23.42	23.02	2.27	12.5	1.148	2.29	0.51	0.159	22.93	23.44	0.11	1.752
	14.0	22.86	23.40	22.86	23.40	22.98	2.22	13.5	3.443	2.25	0.54	0.159	22.89	23.41	0.13	1.911
	15.0	22.82	23.38	22.82	23.38	22.94	2.18	14.5	2.295	2.20	0.56	0.159	22.84	23.39	0.14	2.070
	17.0	22.72	23.34	22.72	23.34	22.86	2.08	16.0	3.443	2.13	0.62	0.159	22.77	23.36	0.18	2.309
	19.0	22.63	23.29	22.63	23.29	22.78	1.99	18.0	2.295	2.04	0.66	0.159	22.68	23.32	0.20	2.628
	21.0	22.53	23.25	22.53	23.25	22.69	1.89	20.0	3.443	1.94	0.72	0.159	22.58	23.27	0.24	2.946
	23.0	22.45	23.22	22.45	23.22	22.62	1.81	22.0	2.869	1.85	0.77	0.159	22.49	23.24	0.27	3.265
	25.0	22.37	23.20	22.37	23.20	22.55	1.73	24.0	3.443	1.77	0.83	0.159	22.41	23.21	0.30	3.584
	27.0	22.30	23.17	22.30	23.17	22.49	1.66	26.0	2.295	1.70	0.87	0.159	22.34	23.19	0.33	3.902
	29.0	22.23	23.16	22.23	23.16	22.43	1.59	28.0	3.443	1.63	0.93	0.159	22.27	23.17	0.36	4.221
	31.0	22.16	23.13	22.16	23.13	22.37	1.52	30.0	2.295	1.56	0.97	0.159	22.20	23.15	0.39	4.539
	33.0	22.10	23.11	22.10	23.11	22.32	1.46	32.0	2.295	1.49	1.01	0.159	22.13	23.12	0.41	4.858
	35.0	22.03	23.08	22.03	23.08	22.26	1.39	34.0	2.295	1.43	1.05	0.159	22.07	23.10	0.44	5.176
	37.0	21.97	23.04	21.97	23.04	22.21	1.33	36.0	1.148	1.36	1.07	0.159	22.00	23.06	0.45	5.495
	39	21.92	23.02	21.92	23.02	22.16	1.28	38.0	1.721	1.31	1.10	0.159	21.95	23.03	0.46	5.813
	41	21.87	22.98	21.87	22.98	22.11	1.23	40.0	0.574	1.26	1.11	0.159	21.90	23.00	0.47	6.132
	43	21.82	22.95	21.82	22.95	22.07	1.18	42.0	1.148	1.21	1.13	0.159	21.85	22.97	0.48	6.450
	45	21.79	22.92	21.79	22.92	22.04	1.15	44.0	0.000	1.17	1.13	0.159	21.81	22.94	0.48	6.769
	47	21.75	22.89	21.75	22.89	22.00	1.11	46.0	0.574	1.13	1.14	0.159	21.77	22.91	0.49	7.087
	50	21.71	22.85	21.71	22.85	21.96	1.07	48.5	0.000	1.09	1.14	0.159	21.73	22.87	0.49	7.486
	55	21.62	22.79	21.62	22.79	21.88	0.98	52.5	0.689	1.03	1.17	0.159	21.67	22.82	0.51	8.123
	60	21.55	22.73	21.55	22.73	21.81	0.91	57.5	0.230	0.95	1.18	0.159	21.59	22.76	0.51	8.919
	65.0	21.49	22.68	21.49	22.68	21.75	0.85	62.5	0.230	0.88	1.19	0.159	21.52	22.71	0.52	9.715
	70.0	21.44	22.63	21.44	22.63	21.70	0.80	67.5	0.000	0.83	1.19	0.159	21.47	22.66	0.52	10.512
	75.0	21.38	22.59	21.38	22.59	21.65	0.74	72.5	0.459	0.77	1.21	0.159	21.41	22.61	0.53	11.308
	80.0	21.33	22.54	21.33	22.54	21.60	0.69	77.5	0.000	0.72	1.21	0.159	21.36	22.57	0.53	12.104
	85.0	21.29	22.49	21.29	22.49	21.55	0.65	82.5	-0.230	0.67	1.20	0.159	21.31	22.52	0.52	12.901
	95.0	21.21	22.42	21.21	22.42	21.48	0.57	90.0	0.115	0.61	1.21	0.159	21.25	22.46	0.53	14.095
	105.0	21.15	22.37	21.15	22.37	21.42	0.51	100.0	0.115	0.54	1.22	0.159	21.18	22.40	0.54	15.688
	125.0	21.06	22.29	21.06	22.29	21.33	0.42	115.0	0.057	0.47	1.23	0.159	21.11	22.33	0.54	18.077
	145.0	21.00	22.24	21.00	22.24	21.27	0.36	135.0	0.057	0.39	1.24	0.159	21.03	22.27	0.55	21.262
	175.0	20.94	22.19	20.94	22.19	21.22	0.30	160.0	0.038	0.33	1.25	0.159	20.97	22.22	0.55	25.244

Figure 1



MW-12 (November 2017)
Baildown Test Data Analysis

Figure 2

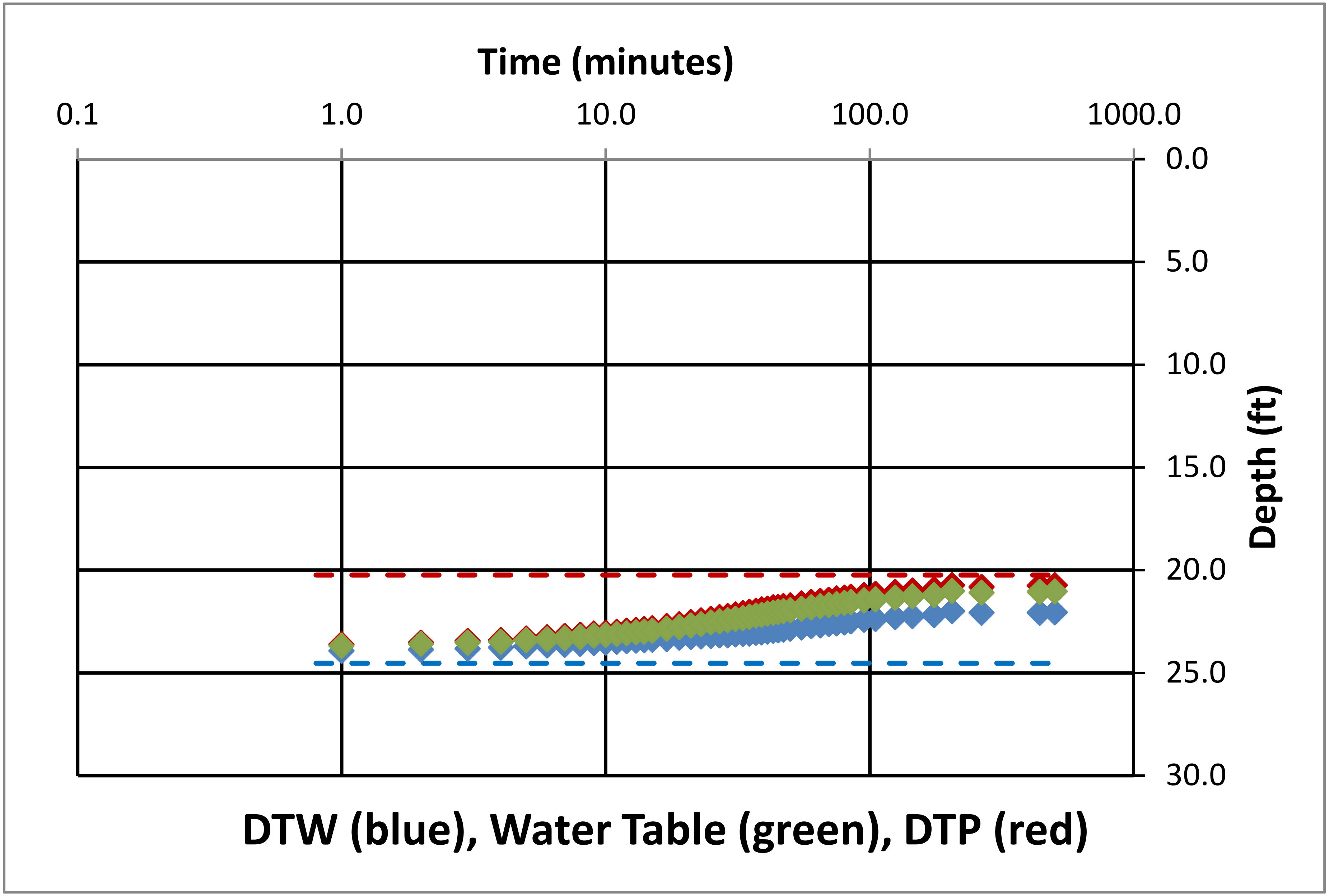
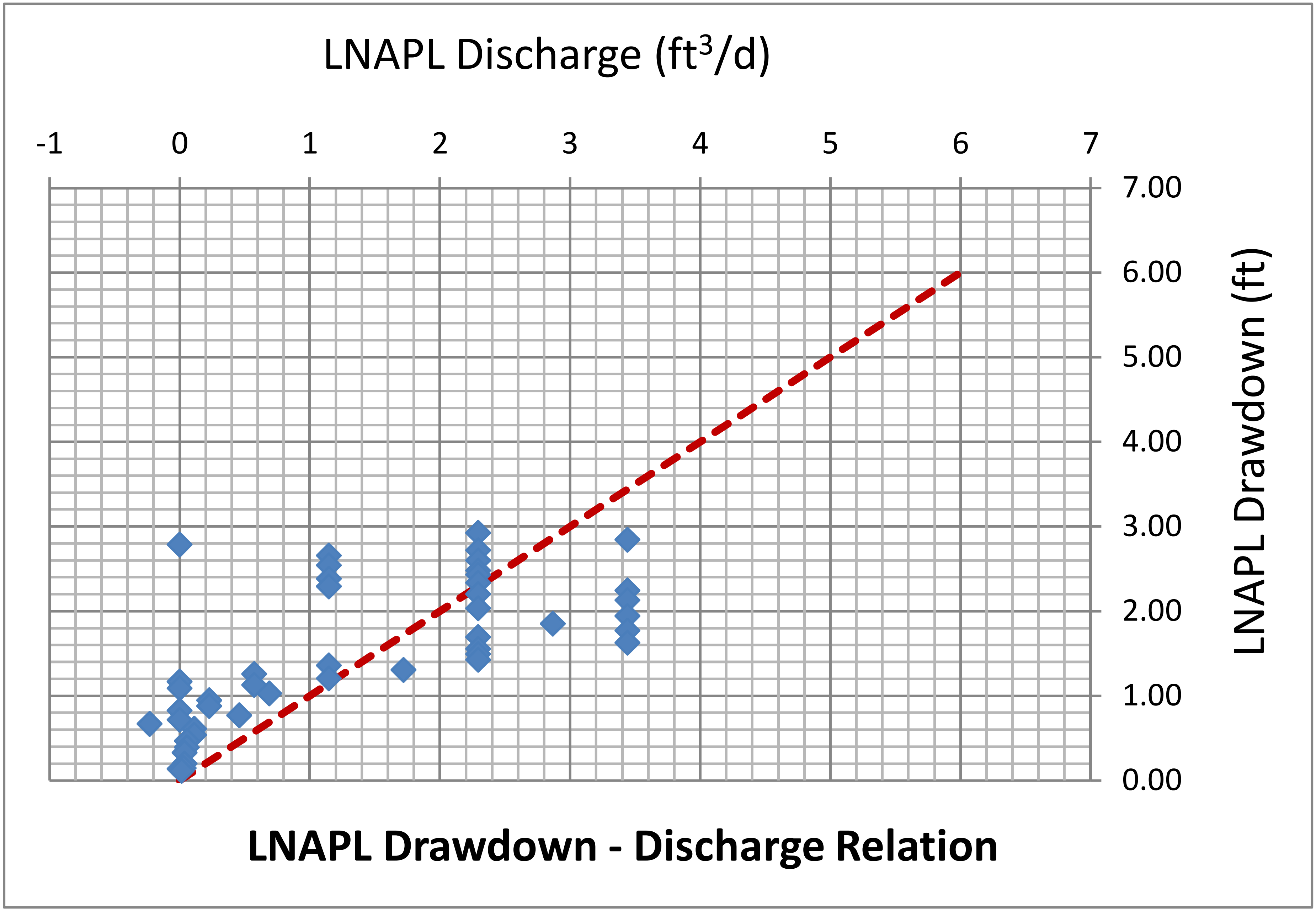
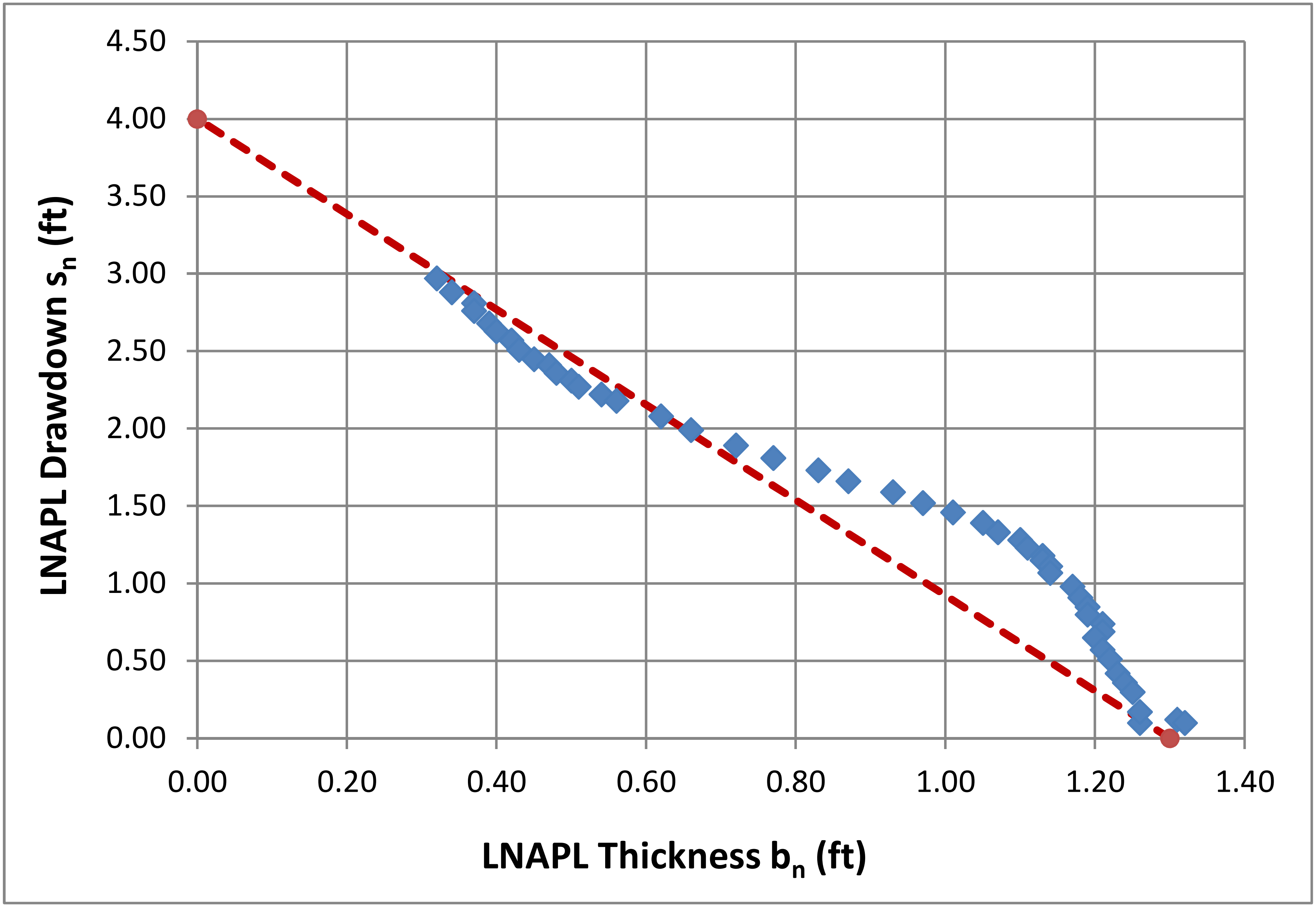

Time (minutes)
0.1
1.0
10.0
100.0
1000.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 3



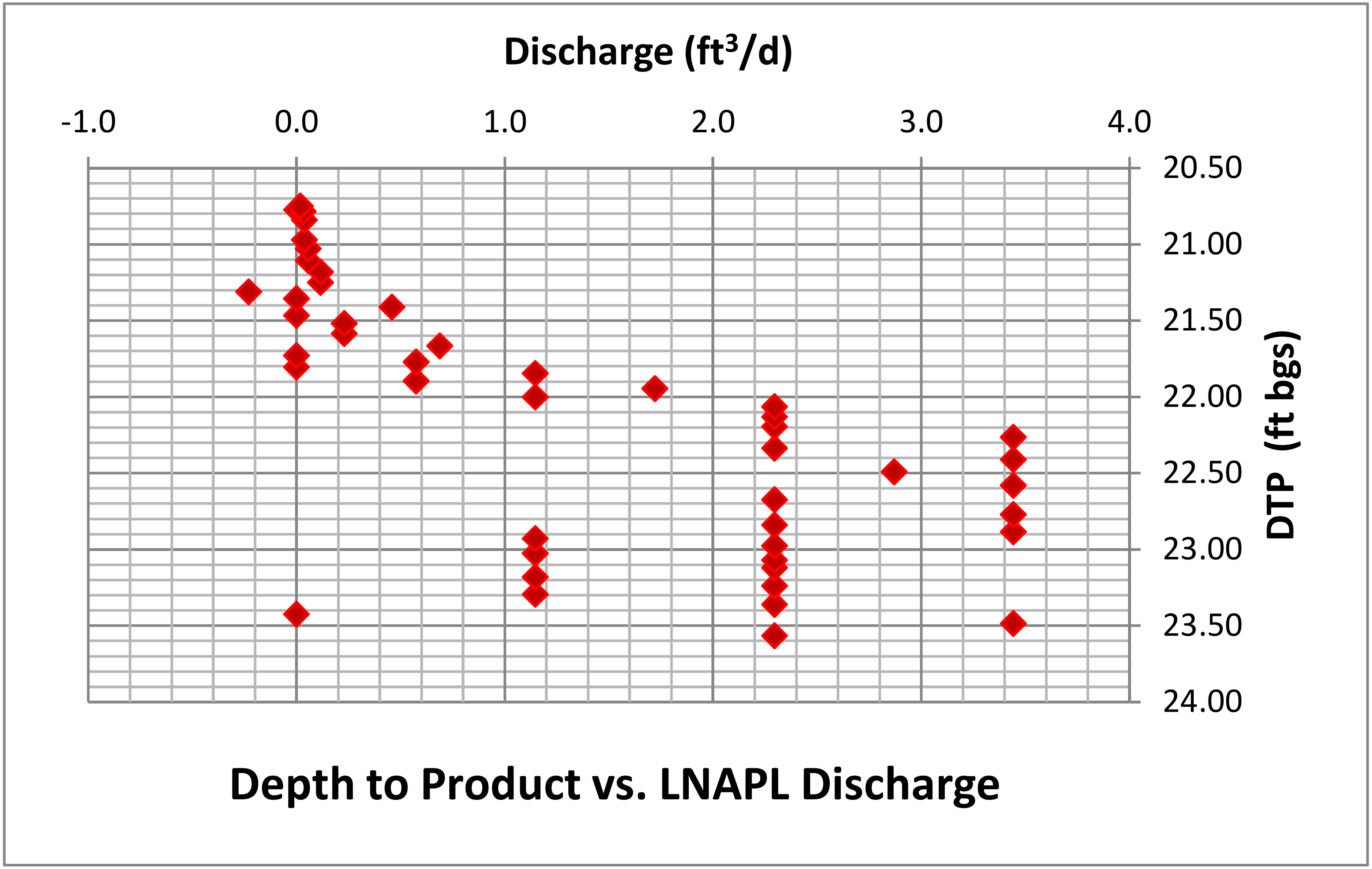
LNAPL Discharge (ft³/d)
-1
0
1
2
3
4
5
6
7
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Discharge Relation

Figure 4



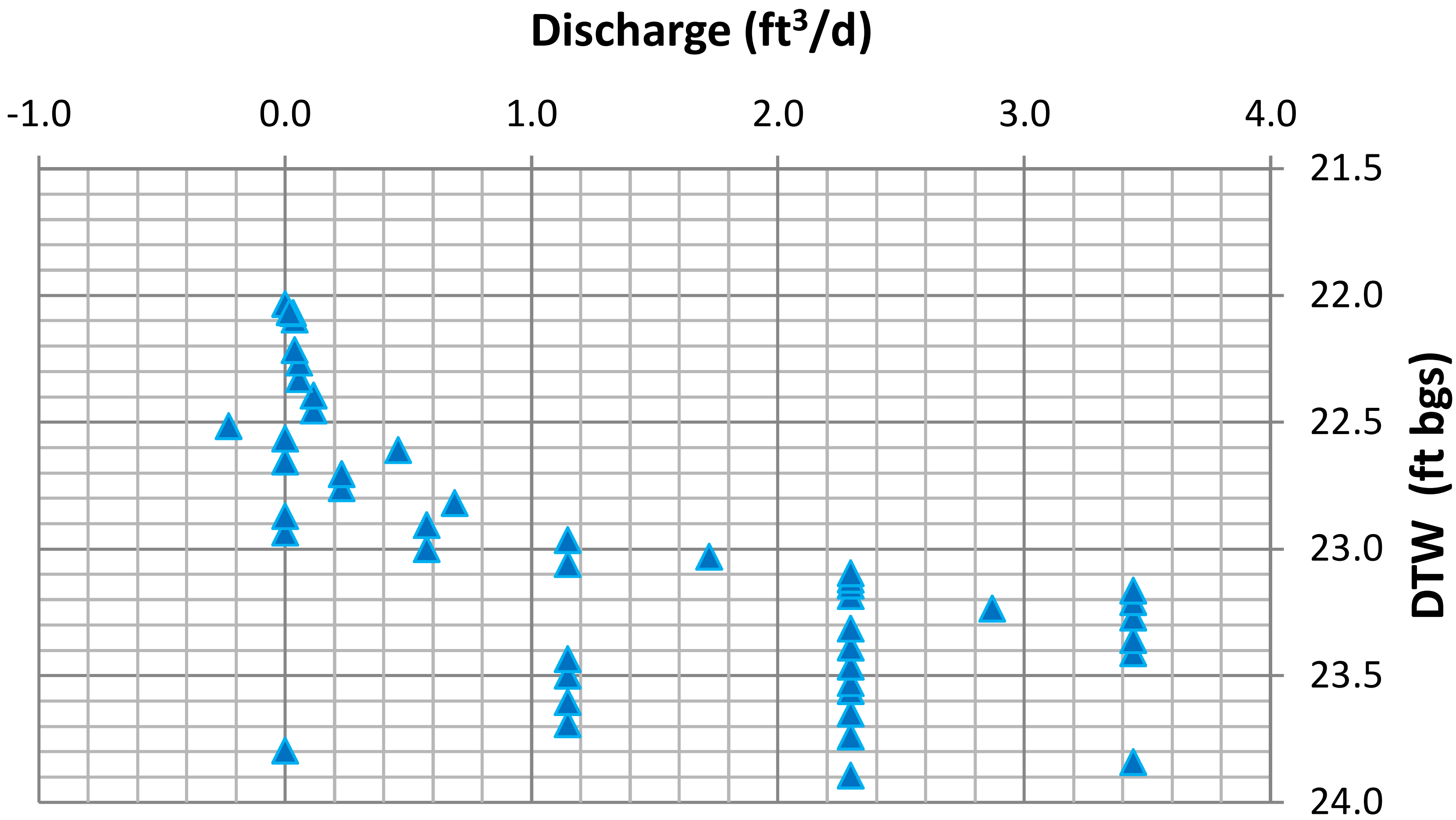
MW-12 (November 2017)
Baildown Test Data Analysis
Page 5 of 16

Figure 5



MW-12 (November 2017)
Baildown Test Data Analysis

Figure 6



Depth to Water vs. LNAPL Discharge

Figure 7

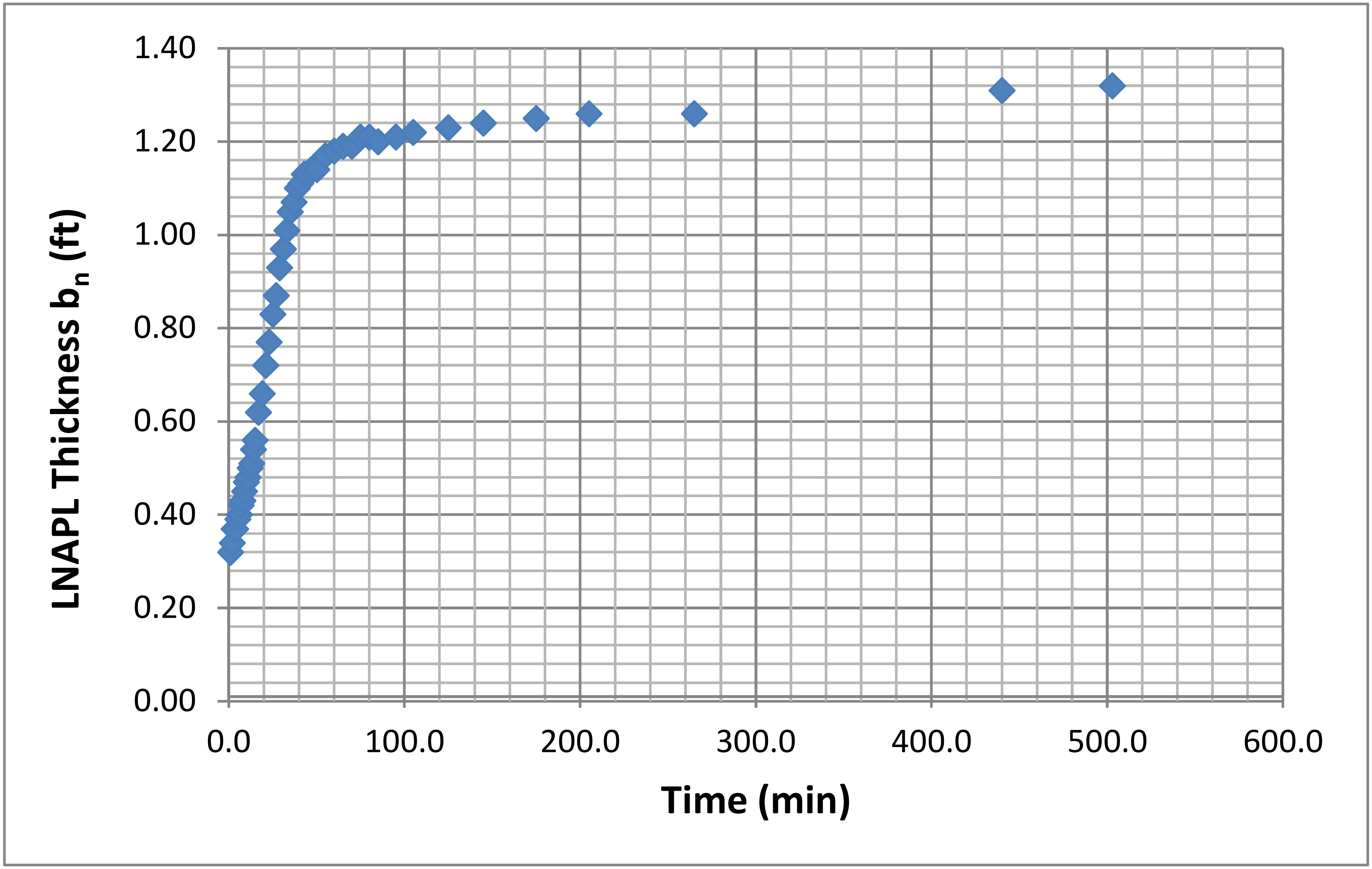

1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
LNAPL Thickness b_n (ft)
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Time (min)

Figure 8

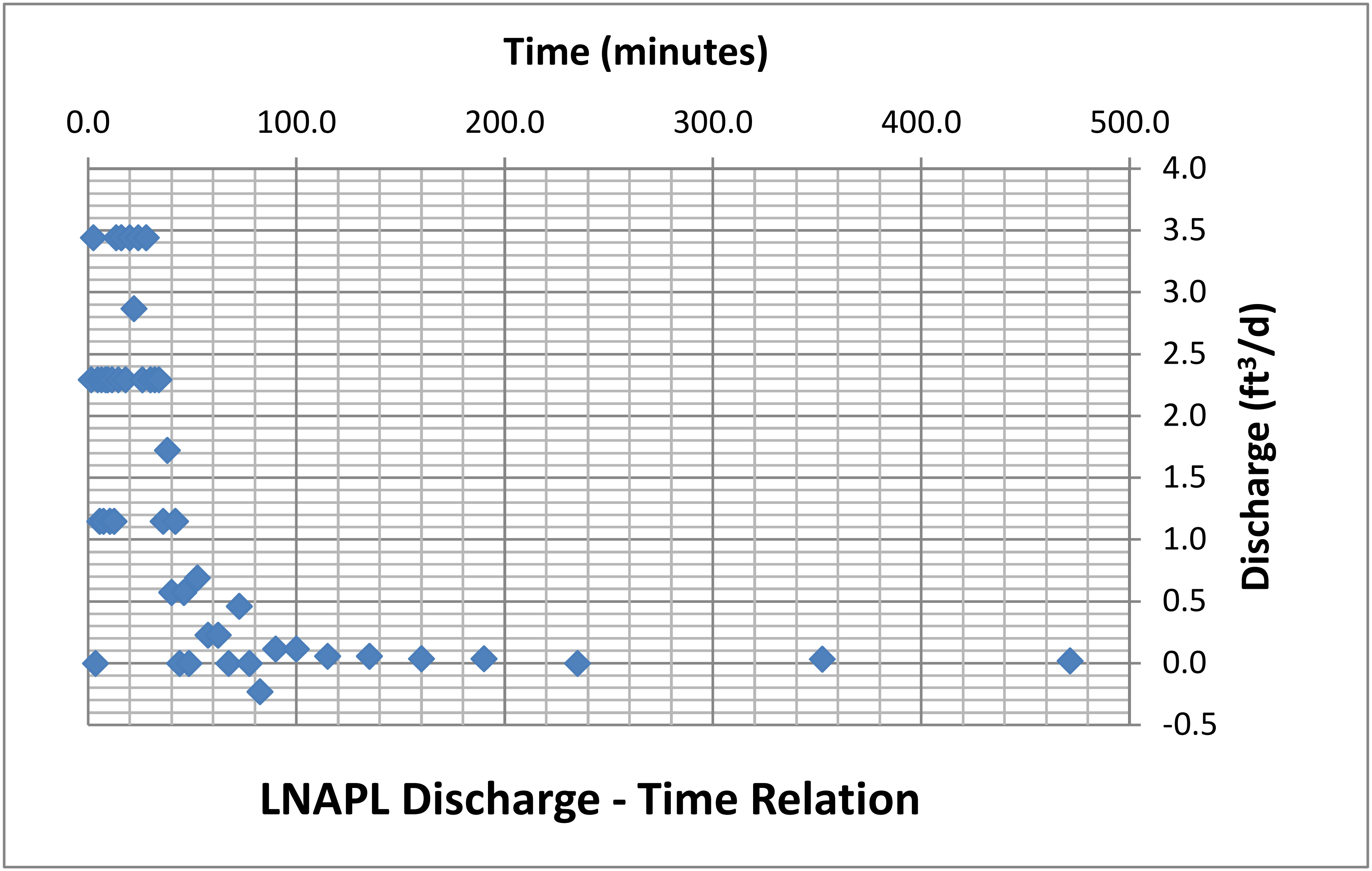

Time (minutes)
0.0
100.0
200.0
300.0
400.0
500.0
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
Discharge (ft³/d)
LNAPL Discharge - Time Relation

Figure 9

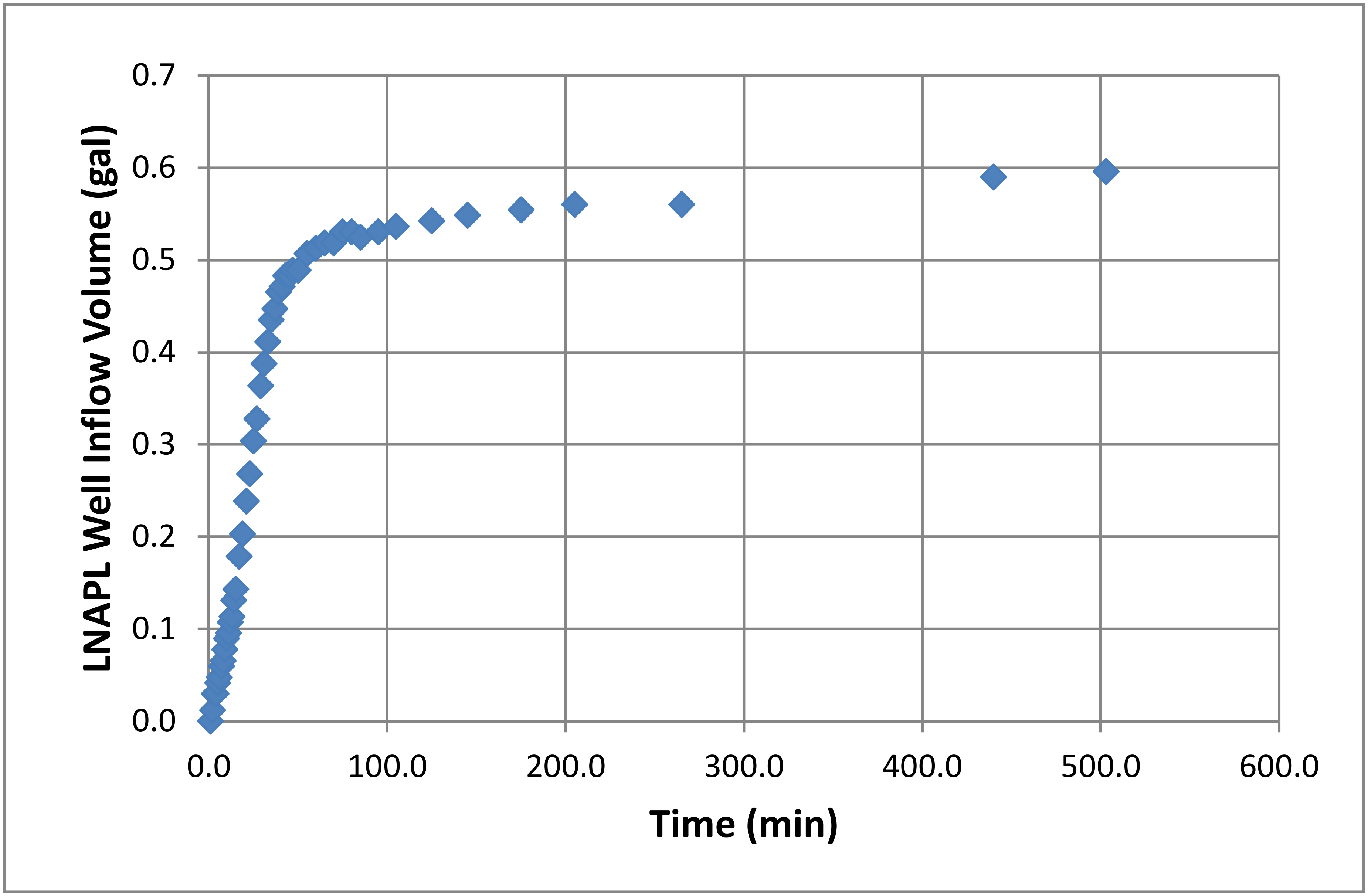
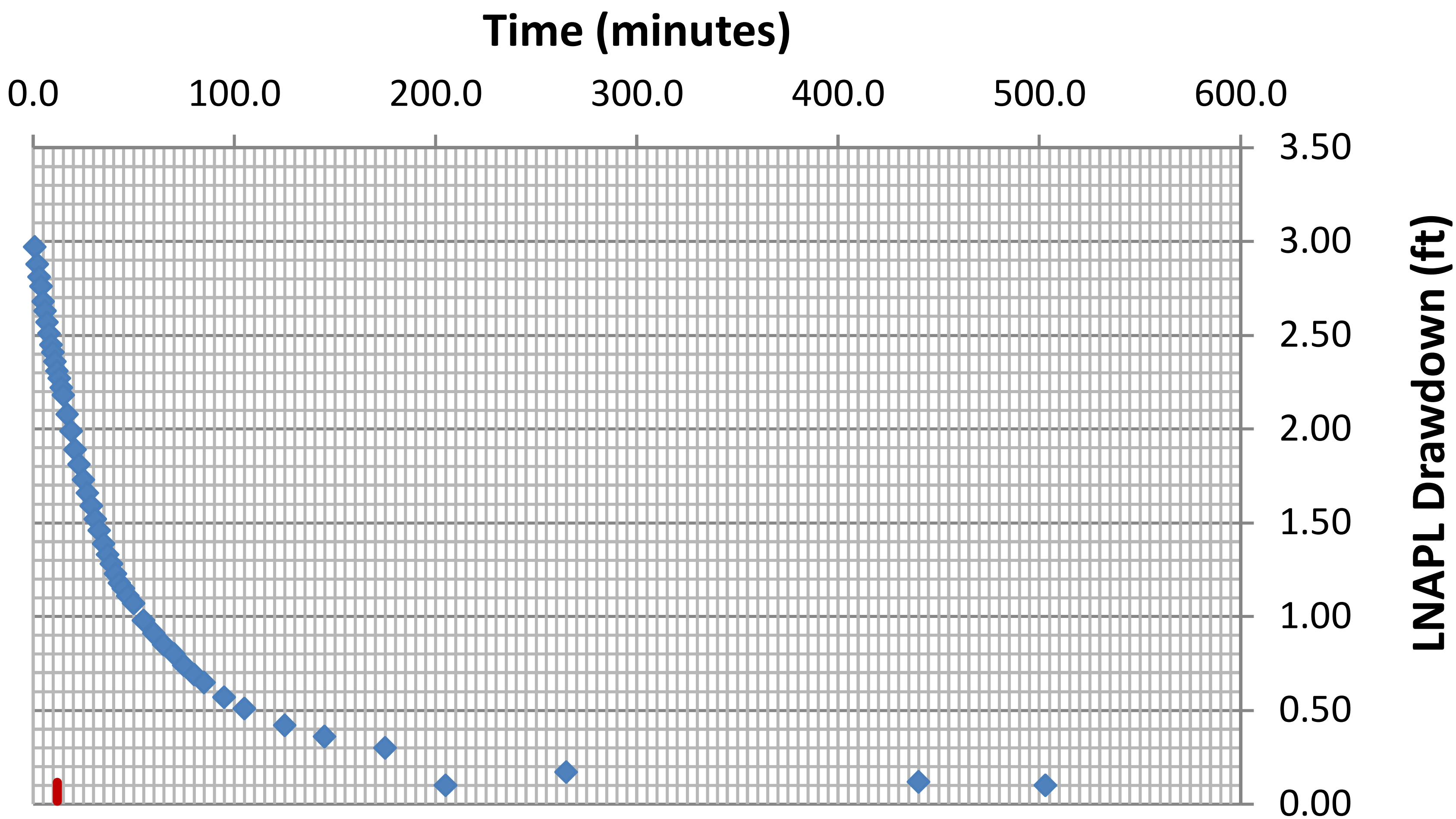

0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
LNAPL Well Inflow Volume (gal)
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Time (min)

Figure 10



LNAPL Drawdown - Time Relation

Generalized Bouwer and Rice (1976)

Well Designation:	MW-12
Date:	21-Nov-17

$$T_n = \frac{r_e^{\,2}\ln(R/r_e)\ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

Enter early time cut-off for least-squares model fit

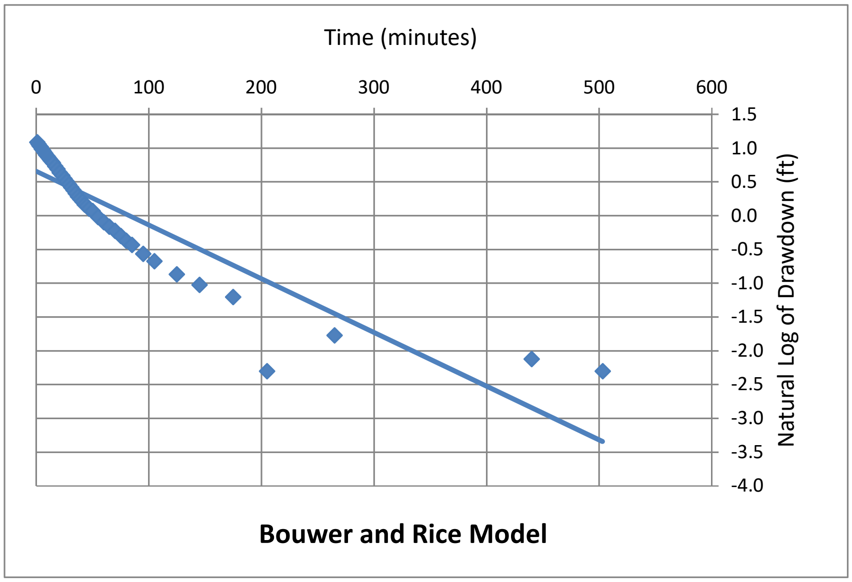
$Time_{cut}$	0	<- Enter or change value here

Model Results: T_n (ft^2/d) = 0.12 +/- 0.01 ft^2/d

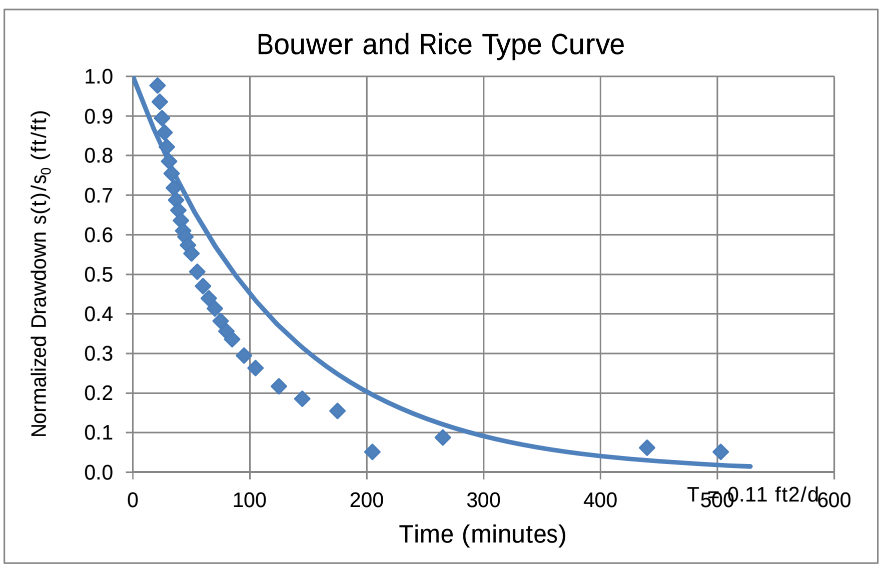
L_e/r_e
26.9
C
1.87
R/r_e
11.93

J-Ratio
-3.077

Coef. Of Variation
0.07



C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW-12
Date:	21-Nov-17

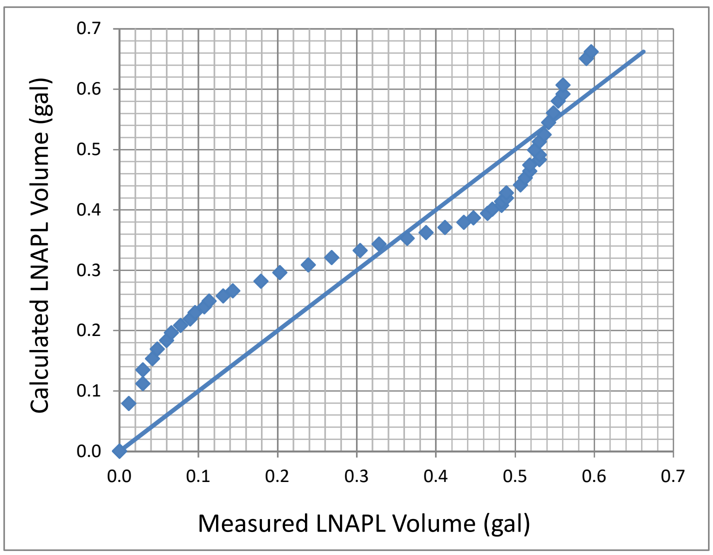
$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

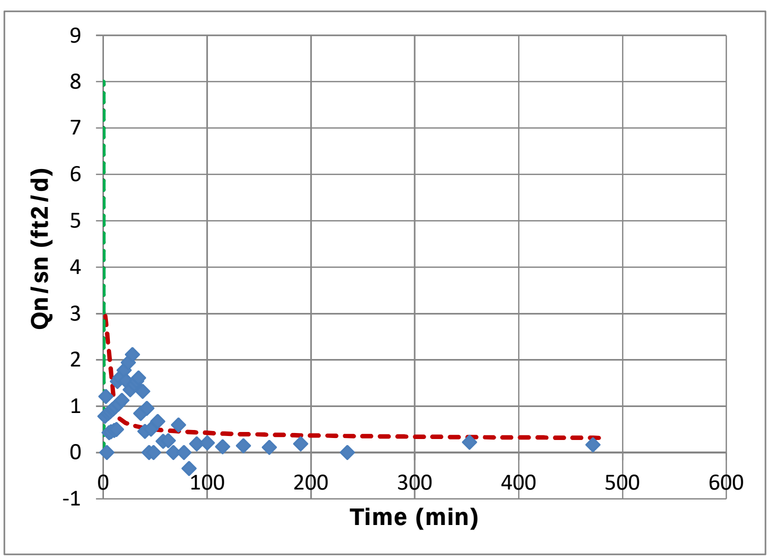
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Time Adjustment (min):	0	
Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	0.545	<-- Minimize this using "Solver"
	0.010	<-- Working S_n
Trial T_n (ft^2/d):	0.154	<-- By changing T_n through "Solver"

Add constraint T_n > 0.00001

Model Result: T_n (ft^2/d) = **0.15**





Height

8

Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	MW-12
Date:	21-Nov-17

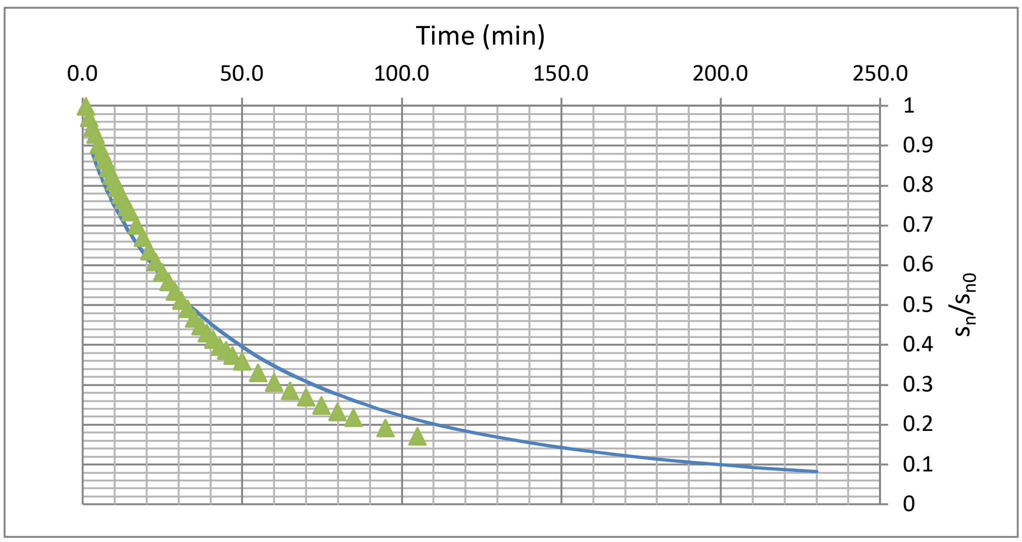
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Initial Drawdown s_n (ft):	2.97	
Trial S_n:	d	<-- Enter d for default
Root-Mean-Square Error:	0.295	<-- Minimize this using "Solver"
Trial T_n (ft^2/d):	0.285	<-- By changing T_n through "Solver"
	0.013	<-- Working S_n

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **0.28**

T_{min}	3
T_{max}	230



J-Ratio
-3.077

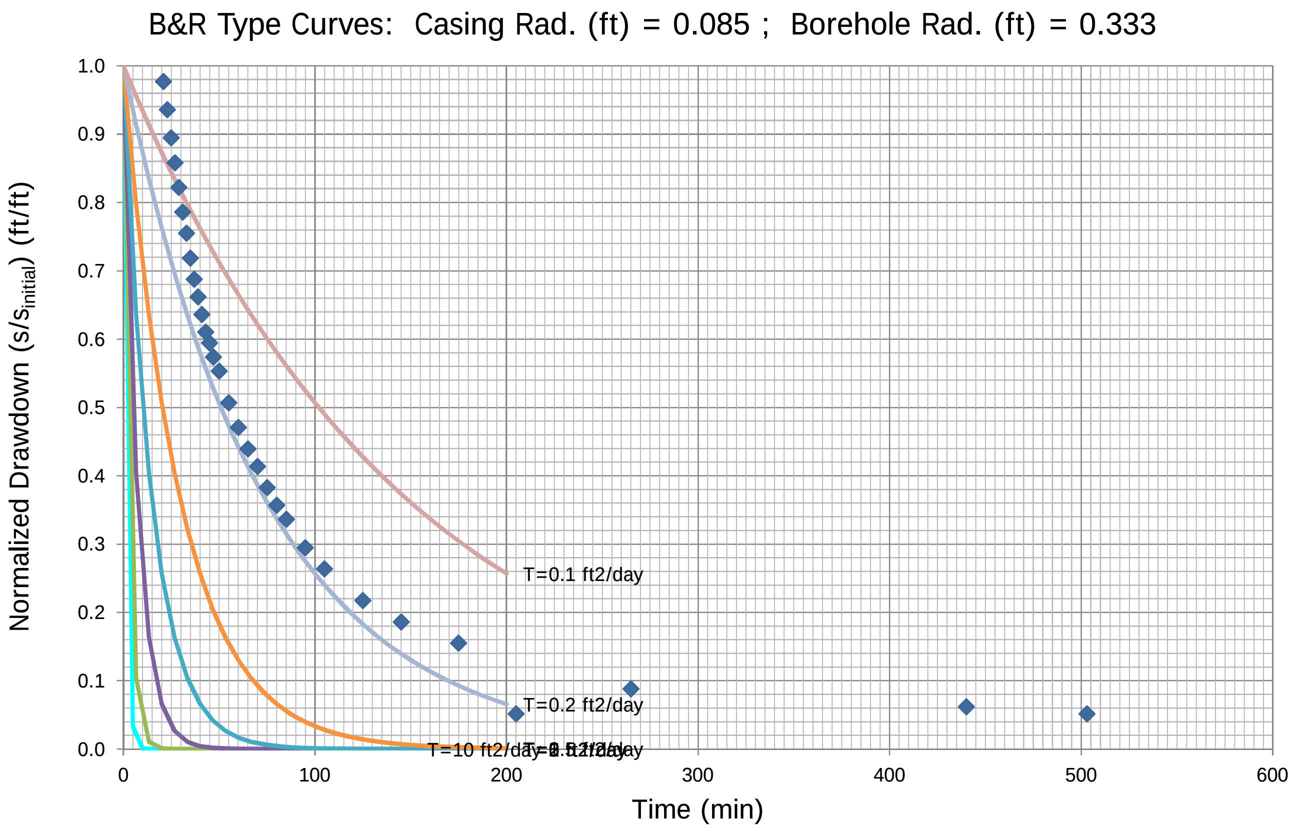
Bouwer and Rice Short Term LNAPL Mobility Test Type Curves

B&R Type Curves: Casing Rad. (ft) = 0.085 ; Borehole Rad. (ft) = 0.333

Enter these values

Type Curve ID	Type Curve Name	Notes	Max Time (min)	Transmissivity (ft^2/day)
1	T=10 ft2/day		150	10
2	T=5 ft2/day		200	5
3	T=2 ft2/day		200	2
4	T=1 ft2/day		200	1
5	T=0.5 ft2/day		200	0.5
6	T=0.2 ft2/day		200	0.2
7	T=0.1 ft2/day		200	0.1

J-Ratio: -3.077 <-- If uncertain use -0.22



API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)	0.19
Standard Deviation (ft^2/d)	0.09
Coefficient of Variation	0.48

Well Designation:	MW-12	
Date:	27-Mar-19	

Ground Surface Elev (ft msl)	0.0	Enter These Data	**Drawdown Adjustment (ft)**
Top of Casing Elev (ft msl)	0.0		
Well Casing Radius, r_c (ft):	0.085	r_{e1}	0.6
Well Radius, r_w (ft):	0.333		
LNAPL Specific Yield, S_y:	0.175		
LNAPL Density Ratio, ρ_r:	0.780		
Top of Screen (ft bgs):	0.0		
Bottom of Screen (ft bgs):	0.0		
LNAPL Baildown Vol. (gal.):	0.0		
Effective Radius, r_{e3} (ft):	0.159	Calculated Parameters	
Effective Radius, r_{e2} (ft):	#NUM!		
Initial Casing LNAPL Vol. (gal.):	0.87		
Initial Filter LNAPL Vol. (gal.):	2.18		

	Time (min)	**Enter Data Here** DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)	Water Table Depth (ft)	LNAPL Drawdown s_n (ft)	Average Time (min)	LNAPL Discharge Q_n (ft^3/d)	s_n (ft)	b_n (ft)	r_e (ft)	DTP (ft bgs)	DTW (ft bgs)	LNAPL Volume (gallons)	Ave. r_e (ft)
Initial Fluid Levels:	0	22.97	28.09	22.97	28.09	24.10					5.12					
Enter Test Data:	1.0	27.09	27.28	27.09	27.28	27.13	3.52				0.19				0	0.159
	2.0	27.02	27.25	27.02	27.25	27.07	3.45	1.5	4.590	3.49	0.23	0.159	27.06	27.27	0.02	0
	3.0	26.93	27.22	26.93	27.22	26.99	3.36	2.5	6.885	3.41	0.29	0.159	26.98	27.24	0.06	0.159
	4.0	26.85	27.21	26.85	27.21	26.93	3.28	3.5	8.033	3.32	0.36	0.159	26.89	27.22	0.10	0.319
	5.0	26.77	27.20	26.77	27.20	26.86	3.20	4.5	8.033	3.24	0.43	0.159	26.81	27.21	0.14	0.478
	6.0	26.70	27.19	26.70	27.19	26.81	3.13	5.5	6.885	3.17	0.49	0.159	26.74	27.20	0.18	0.637
	7.0	26.63	27.18	26.63	27.18	26.75	3.06	6.5	6.885	3.10	0.55	0.159	26.67	27.19	0.21	0.796
	8.0	26.56	27.16	26.56	27.16	26.69	2.99	7.5	5.738	3.03	0.60	0.159	26.60	27.17	0.24	0.956
	9.0	26.49	27.13	26.49	27.13	26.63	2.92	8.5	4.590	2.96	0.64	0.159	26.53	27.15	0.27	1.115
	10.0	26.43	27.11	26.43	27.11	26.58	2.86	9.5	4.590	2.89	0.68	0.159	26.46	27.12	0.29	1.274
	11.0	26.36	27.08	26.36	27.08	26.52	2.79	10.5	4.590	2.83	0.72	0.159	26.40	27.10	0.32	1.433
	12.0	26.30	27.05	26.30	27.05	26.47	2.73	11.5	3.443	2.76	0.75	0.159	26.33	27.07	0.33	1.593
	13.0	26.24	27.02	26.24	27.02	26.41	2.67	12.5	3.443	2.70	0.78	0.159	26.27	27.04	0.35	1.752
	14.0	26.17	26.97	26.17	26.97	26.35	2.60	13.5	2.295	2.64	0.80	0.159	26.21	27.00	0.36	1.911
	15.0	26.11	26.94	26.11	26.94	26.29	2.54	14.5	3.443	2.57	0.83	0.159	26.14	26.96	0.38	2.070
	16.0	26.05	26.90	26.05	26.90	26.24	2.48	15.5	2.295	2.51	0.85	0.159	26.08	26.92	0.39	2.230
	17.0	26.01	26.87	26.01	26.87	26.20	2.44	16.5	1.148	2.46	0.86	0.159	26.03	26.89	0.40	2.389
	18.0	25.95	26.83	25.95	26.83	26.14	2.38	17.5	2.295	2.41	0.88	0.159	25.98	26.85	0.41	2.548
	19.0	25.88	26.79	25.88	26.79	26.08	2.31	18.5	3.443	2.35	0.91	0.159	25.92	26.81	0.43	2.708
	20.0	25.85	26.76	25.85	26.76	26.05	2.28	19.5	0.000	2.30	0.91	0.159	25.87	26.78	0.43	2.867
	21.0	25.80	26.73	25.80	26.73	26.00	2.23	20.5	2.295	2.26	0.93	0.159	25.83	26.75	0.44	3.026
	22.0	25.76	26.70	25.76	26.70	25.97	2.19	21.5	1.148	2.21	0.94	0.159	25.78	26.72	0.45	3.185
	24.0	25.67	26.65	25.67	26.65	25.89	2.10	23.0	2.295	2.15	0.98	0.159	25.72	26.68	0.47	3.424
	26.0	25.60	26.60	25.60	26.60	25.82	2.03	25.0	1.148	2.07	1.00	0.159	25.64	26.63	0.48	3.743
	28.0	25.54	26.56	25.54	26.56	25.76	1.97	27.0	1.148	2.00	1.02	0.159	25.57	26.58	0.49	4.061
	30.0	25.47	26.52	25.47	26.52	25.70	1.90	29.0	1.721	1.94	1.05	0.159	25.51	26.54	0.51	4.380
	32	25.40	26.47	25.40	26.47	25.64	1.83	31.0	1.148	1.87	1.07	0.159	25.44	26.50	0.52	4.698
	34	25.34	26.43	25.34	26.43	25.58	1.77	33.0	1.148	1.80	1.09	0.159	25.37	26.45	0.54	5.017
	36	25.28	26.40	25.28	26.40	25.53	1.71	35.0	1.721	1.74	1.12	0.159	25.31	26.42	0.55	5.335
	38	25.22	26.36	25.22	26.36	25.47	1.65	37.0	1.148	1.68	1.14	0.159	25.25	26.38	0.57	5.654
	40	25.17	26.32	25.17	26.32	25.42	1.60	39.0	0.574	1.63	1.15	0.159	25.20	26.34	0.57	5.973
	42	25.12	26.29	25.12	26.29	25.38	1.55	41.0	1.148	1.58	1.17	0.159	25.15	26.31	0.58	6.291
	47	24.98	26.20	24.98	26.20	25.25	1.41	44.5	1.148	1.48	1.22	0.159	25.05	26.25	0.61	6.849
	52	24.86	26.12	24.86	26.12	25.14	1.29	49.5	0.918	1.35	1.26	0.159	24.92	26.16	0.64	7.645
	57.0	24.75	26.05	24.75	26.05	25.04	1.18	54.5	0.918	1.24	1.30	0.159	24.81	26.09	0.66	8.441
	62.0	24.66	25.99	24.66	25.99	24.95	1.09	59.5	0.689	1.14	1.33	0.159	24.71	26.02	0.68	9.238
	67.0	24.57	25.93	24.57	25.93	24.87	1.00	64.5	0.689	1.05	1.36	0.159	24.62	25.96	0.70	10.034
	72.0	24.47	25.88	24.47	25.88	24.78	0.90	69.5	1.148	0.95	1.41	0.159	24.52	25.91	0.73	10.830
	82.0	24.34	25.80	24.34	25.80	24.66	0.77	77.0	0.574	0.84	1.46	0.159	24.41	25.84	0.76	12.025
	94.0	24.21	25.73	24.21	25.73	24.54	0.64	88.0	0.574	0.71	1.52	0.159	24.28	25.77	0.79	13.777
	102.0	24.13	25.68	24.13	25.68	24.47	0.56	98.0	0.430	0.60	1.55	0.159	24.17	25.71	0.81	15.369
	112.0	24.05	25.63	24.05	25.63	24.40	0.48	107.0	0.344	0.52	1.58	0.159	24.09	25.66	0.83	16.803
	122.0	23.99	25.59	23.99	25.59	24.34	0.42	117.0	0.230	0.45	1.60	0.159	24.02	25.61	0.84	18.395
	142.0	23.92	25.53	23.92	25.53	24.27	0.35	132.0	0.057	0.39	1.61	0.159	23.96	25.56	0.85	20.784

Figure 1

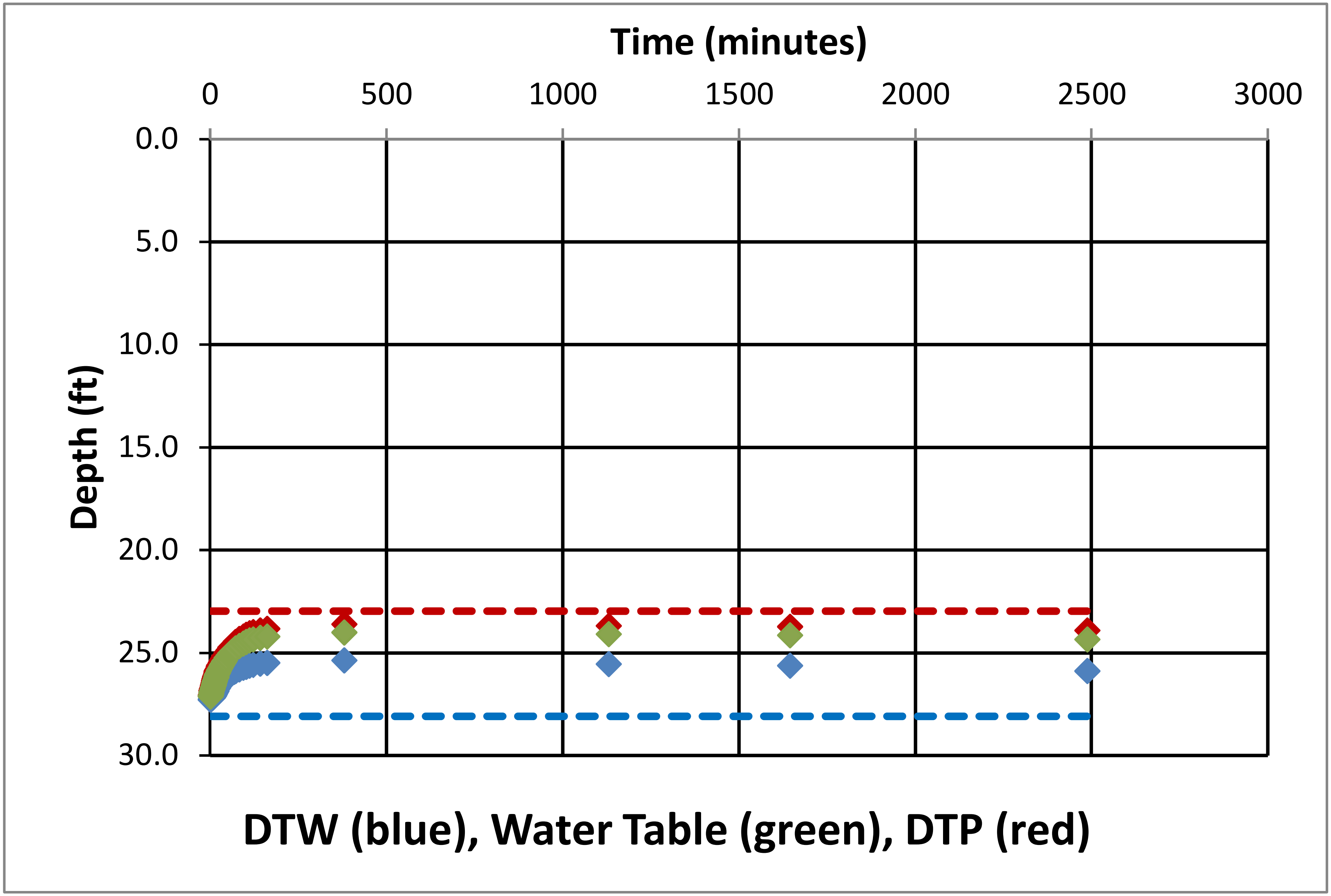
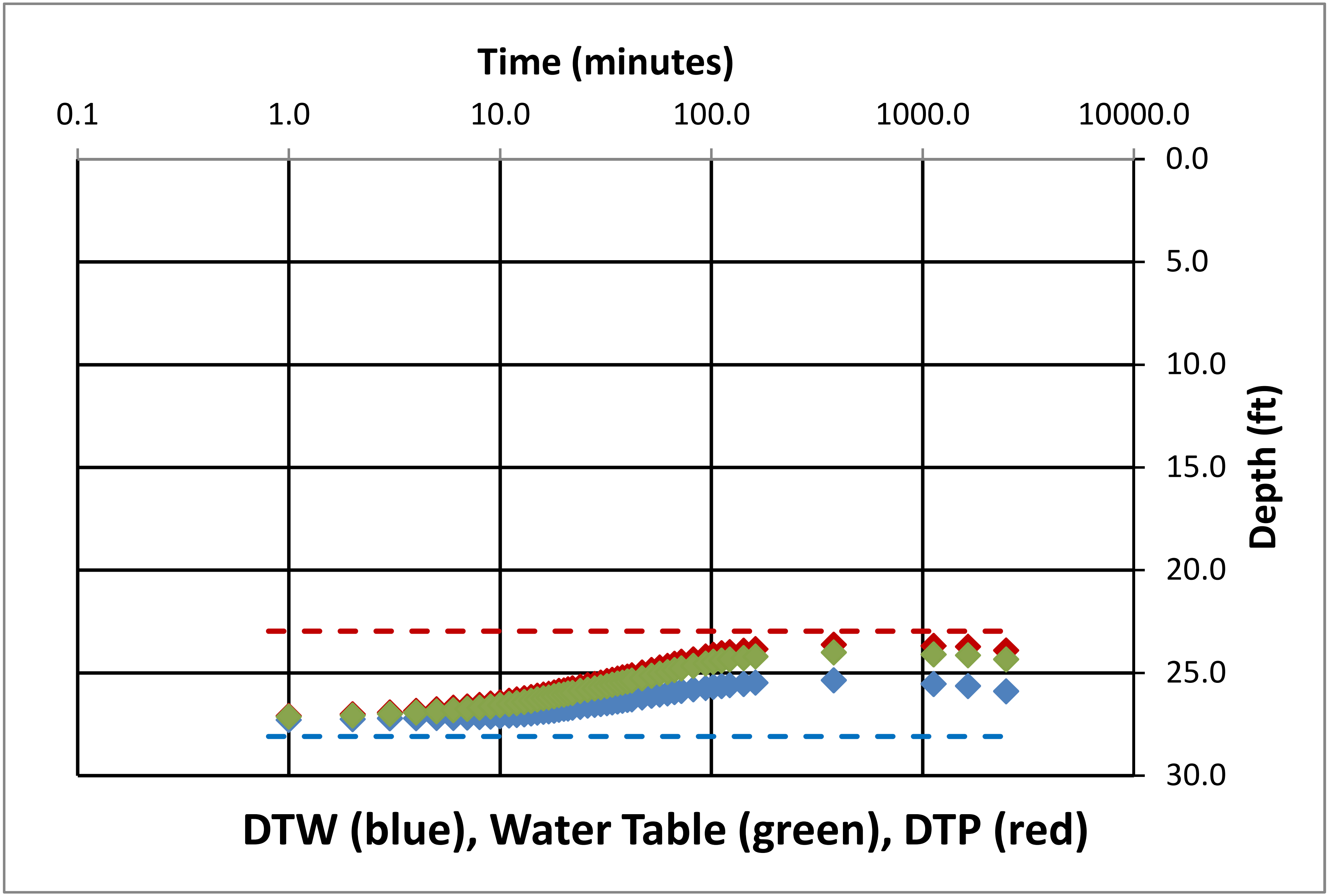
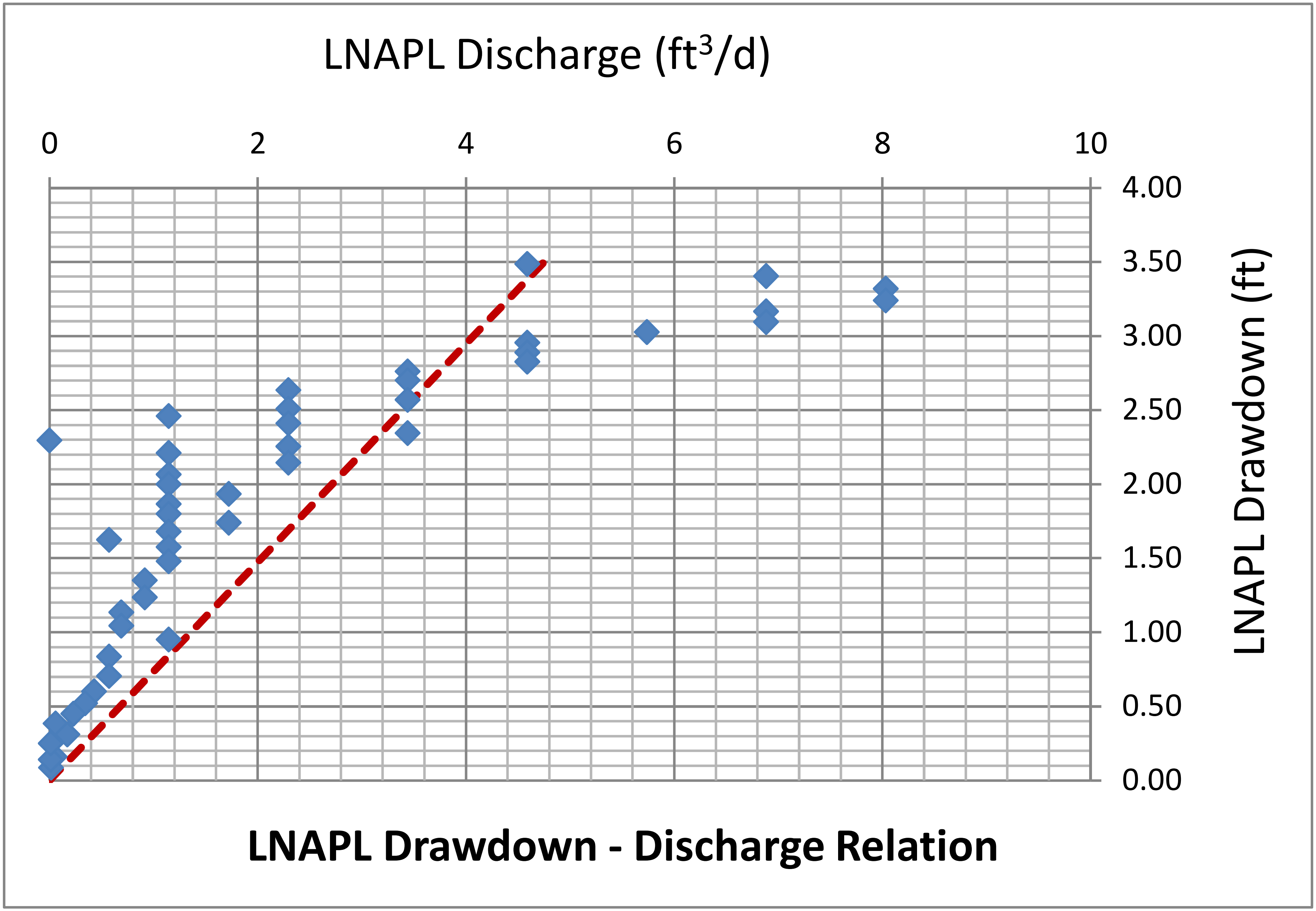

Time (minutes)
0
500
1000
1500
2000
2500
3000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 2



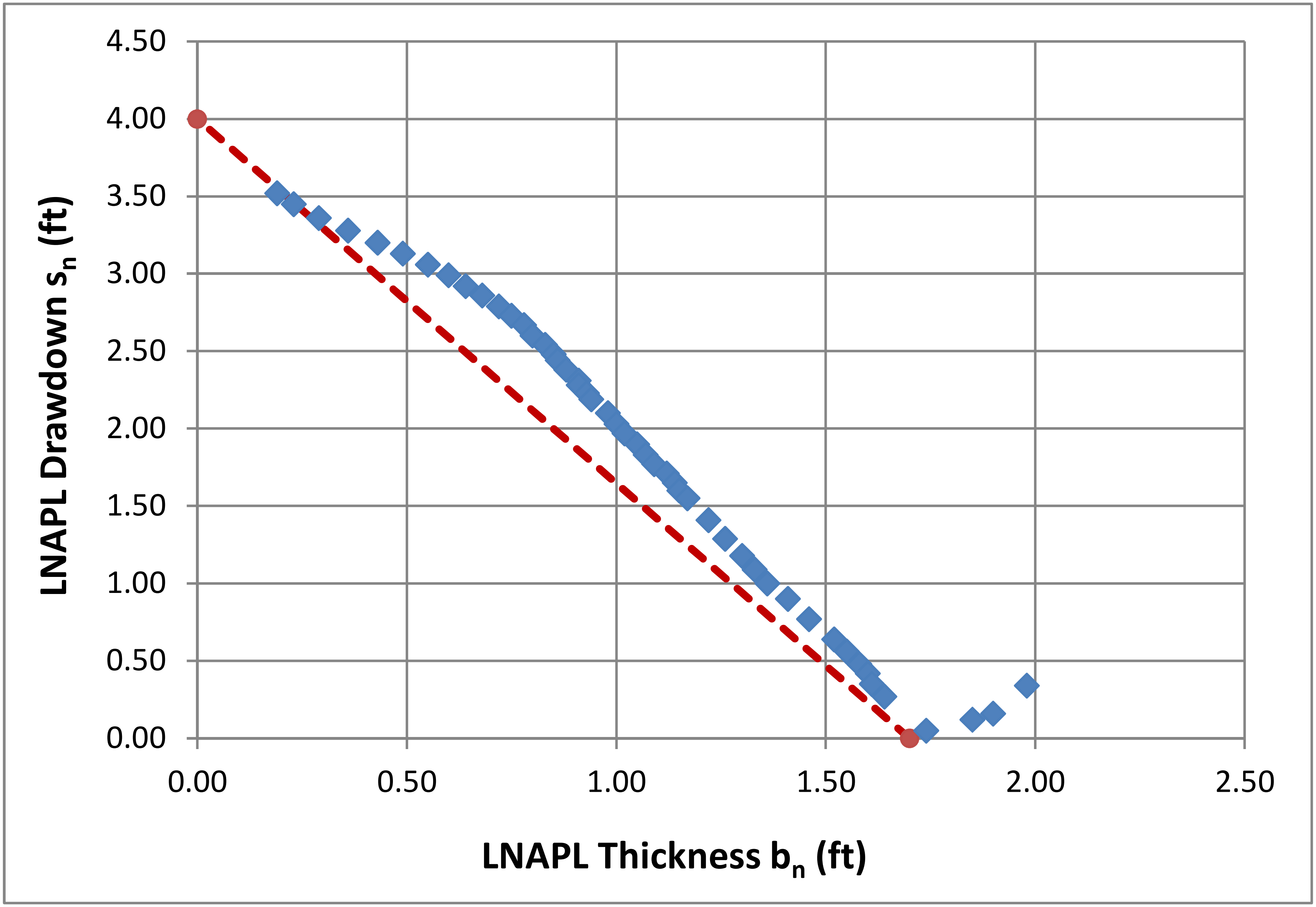
MW-12 (March 2019)
Baildown Test Data Analysis

Figure 3



MW-12 (March 2019)
Baildown Test Data Analysis

Figure 4



MW-12 (March 2019)
Baildown Test Data Analysis
Page 5 of 16

Figure 5

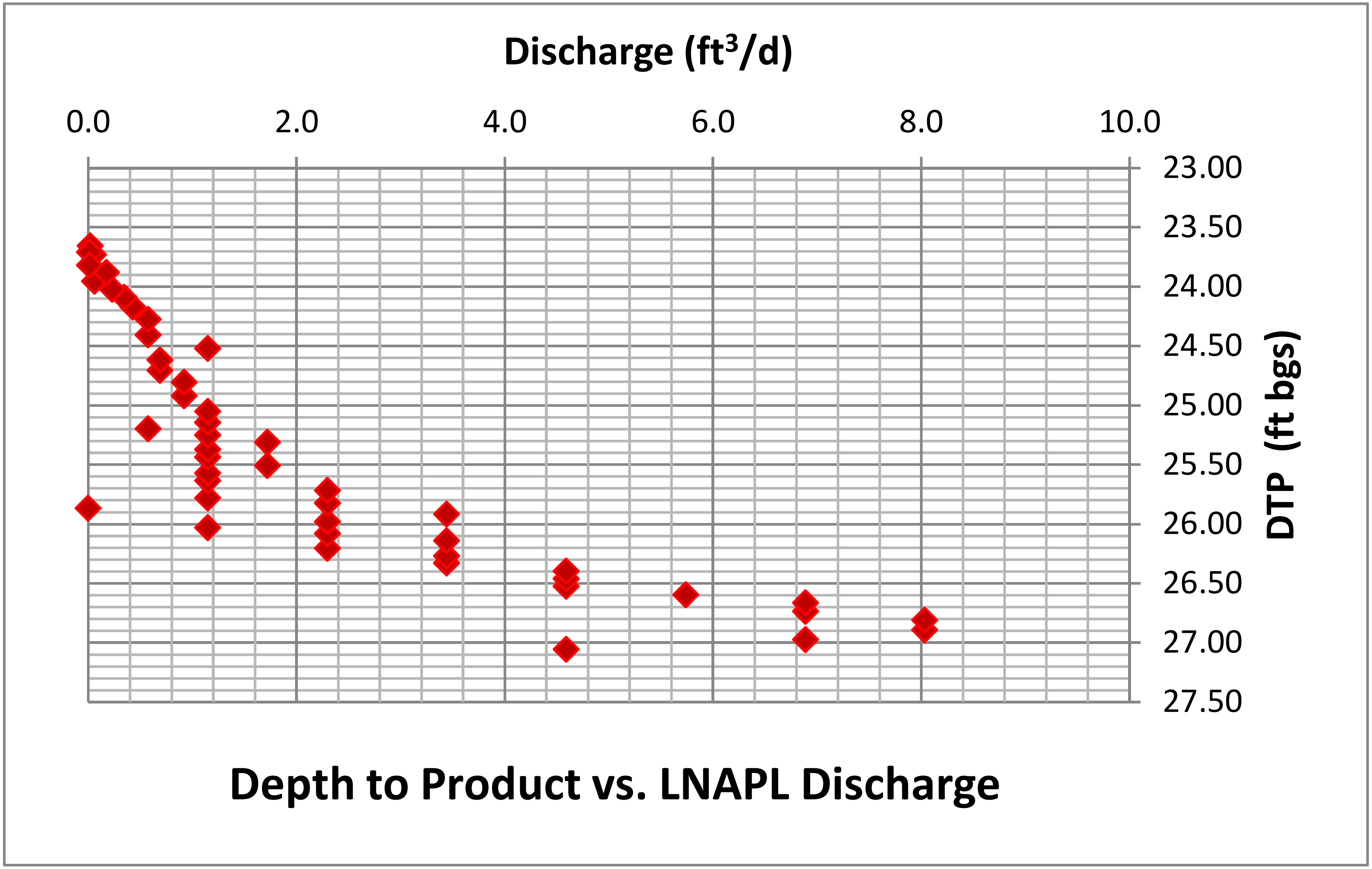
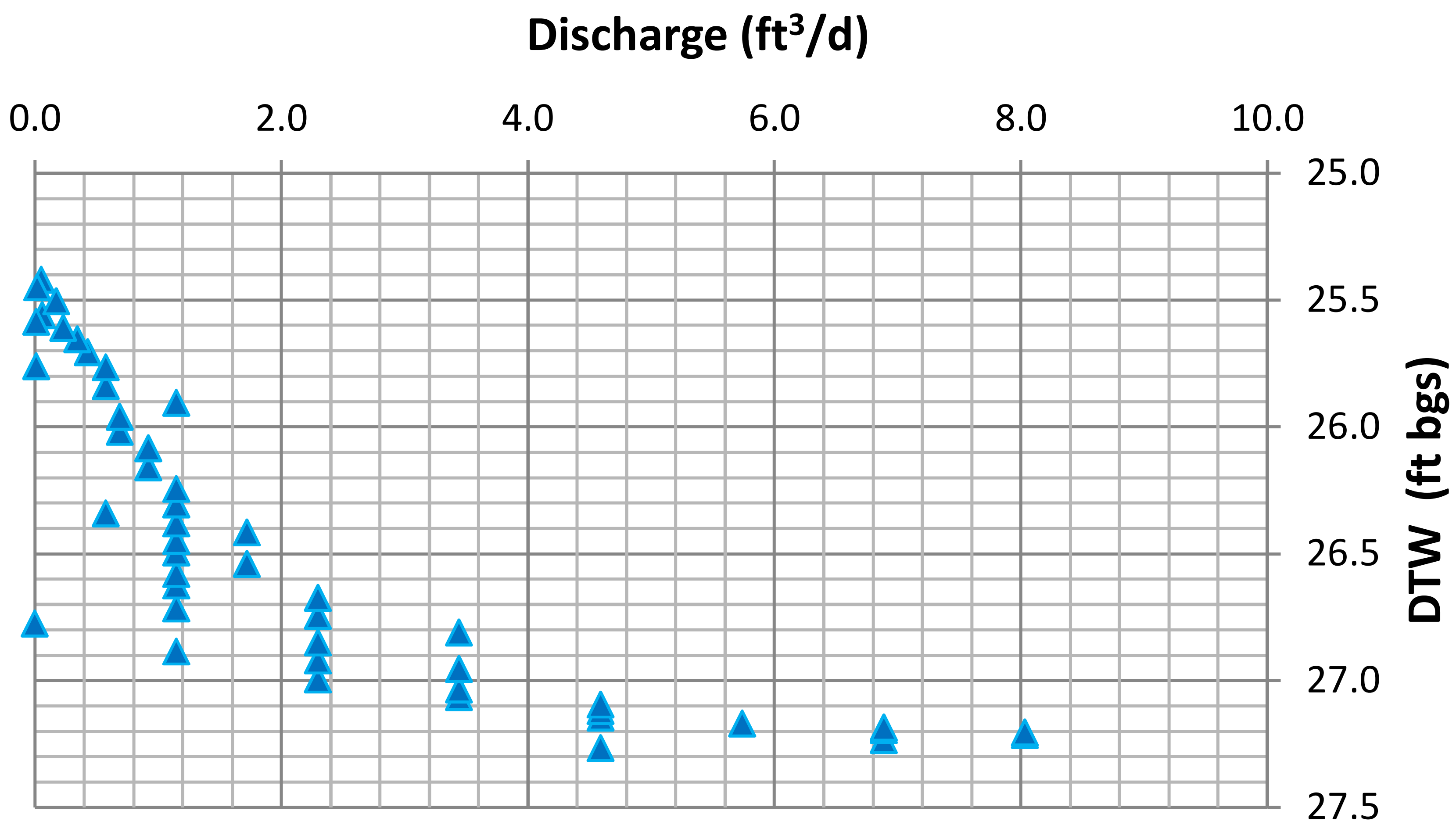

Discharge (ft³/d)
0.0
2.0
4.0
6.0
8.0
10.0
23.00
23.50
24.00
24.50
25.00
25.50
26.00
26.50
27.00
27.50
DTP (ft bgs)
Depth to Product vs. LNAPL Discharge

Figure 6



Depth to Water vs. LNAPL Discharge

Figure 7

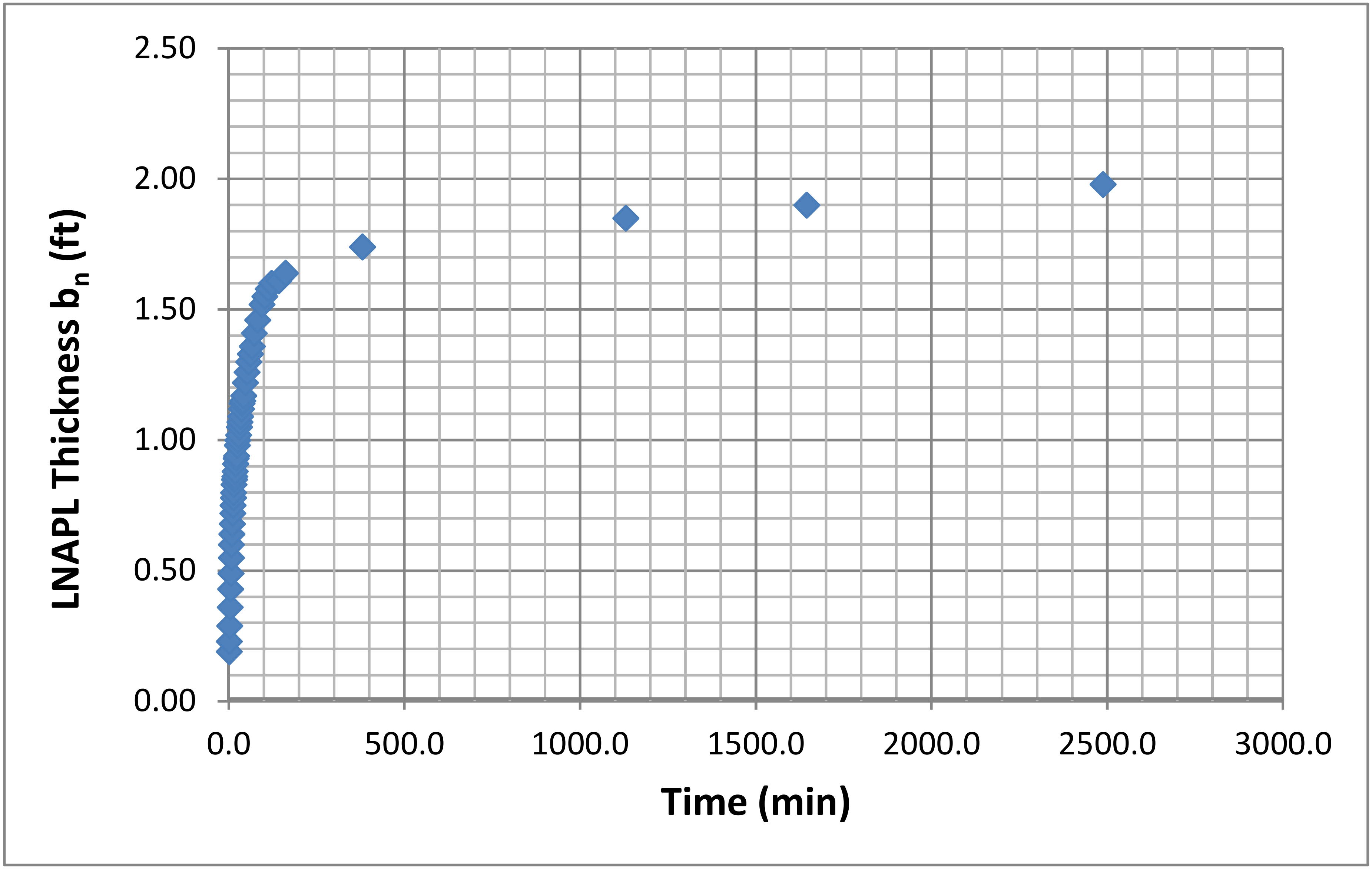

2.50
2.00
1.50
1.00
0.50
0.00
LNAPL Thickness b_n (ft)
0.0
500.0
1000.0
1500.0
2000.0
2500.0
3000.0
Time (min)

Figure 8

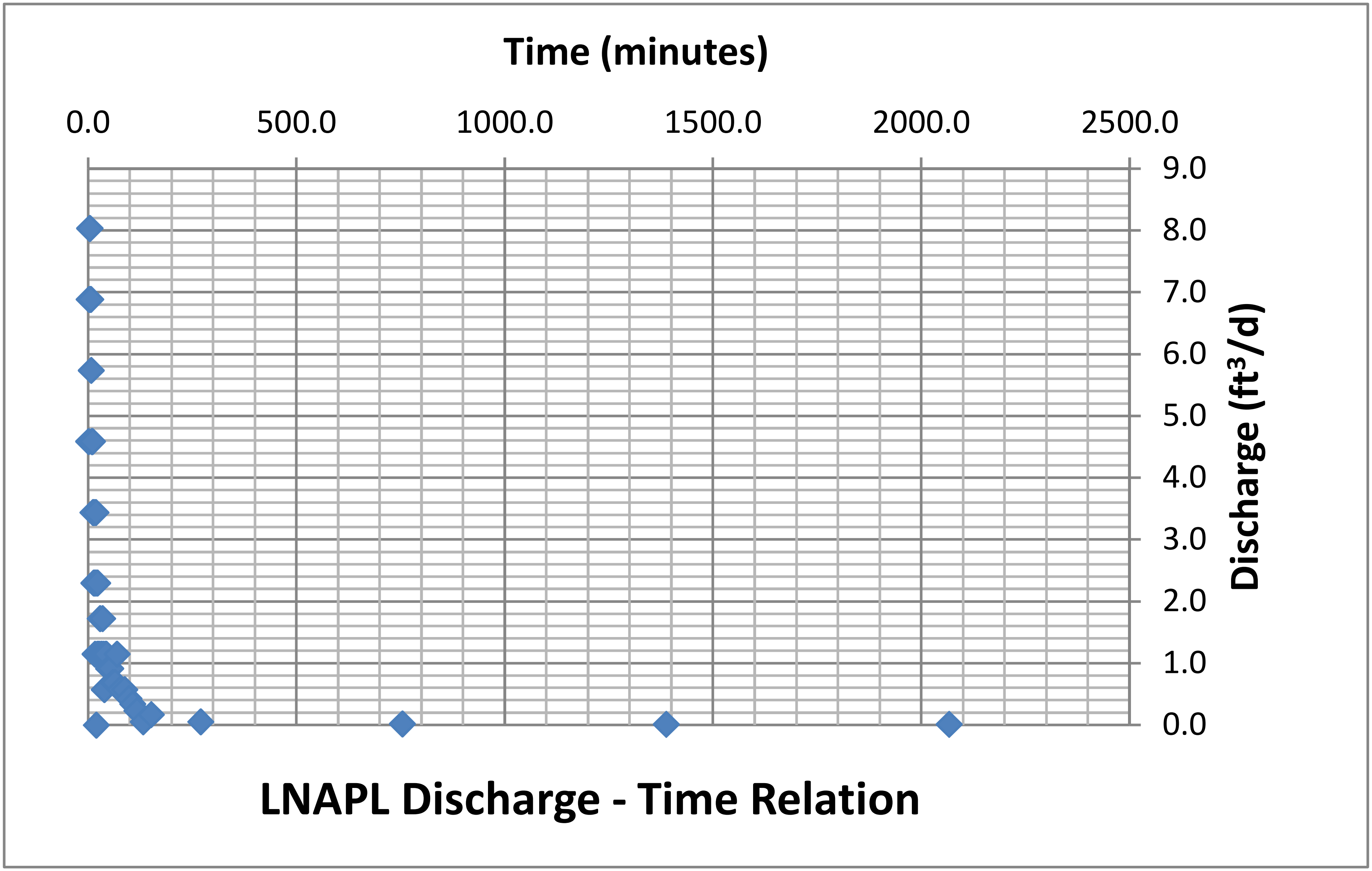
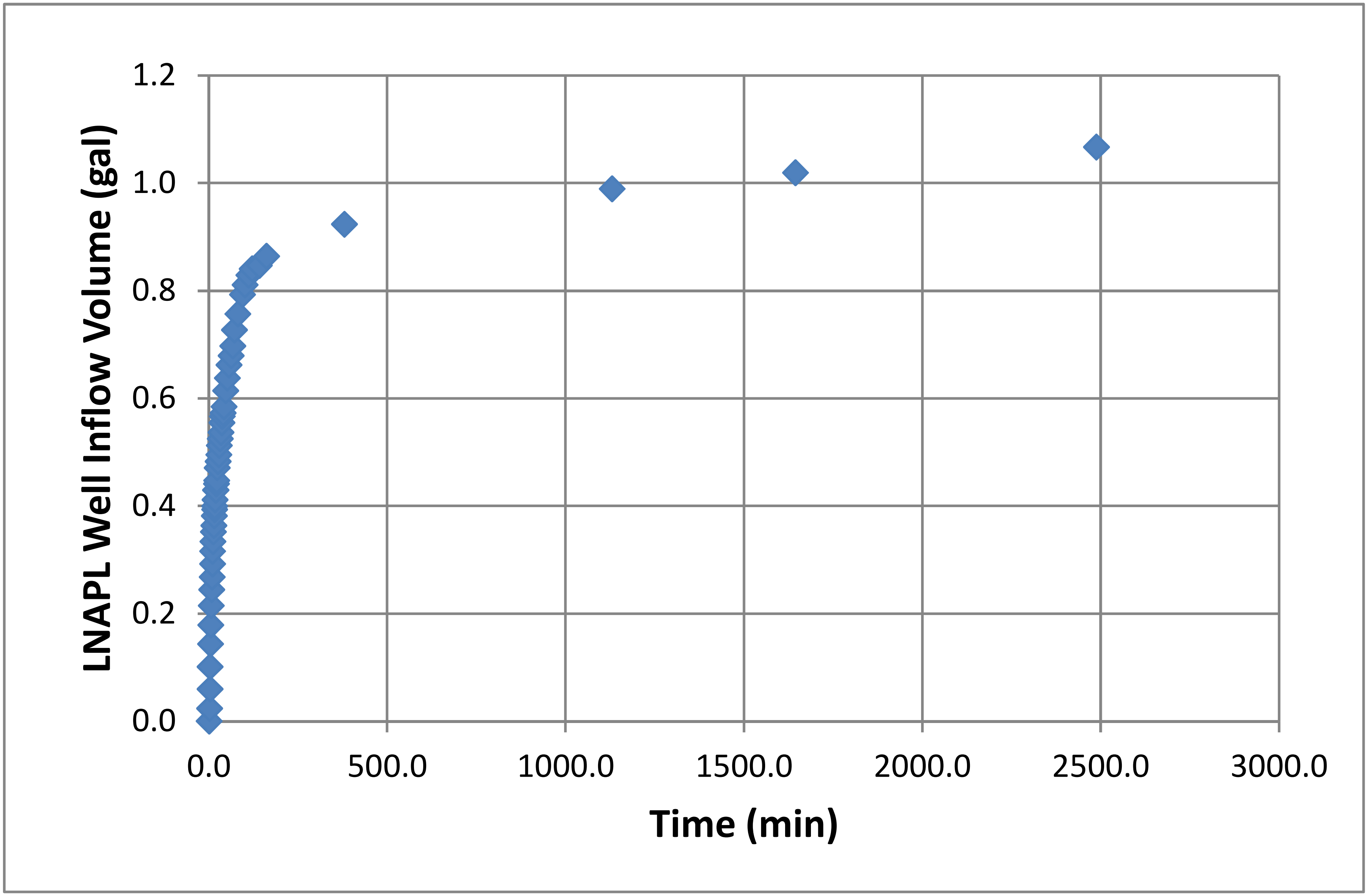
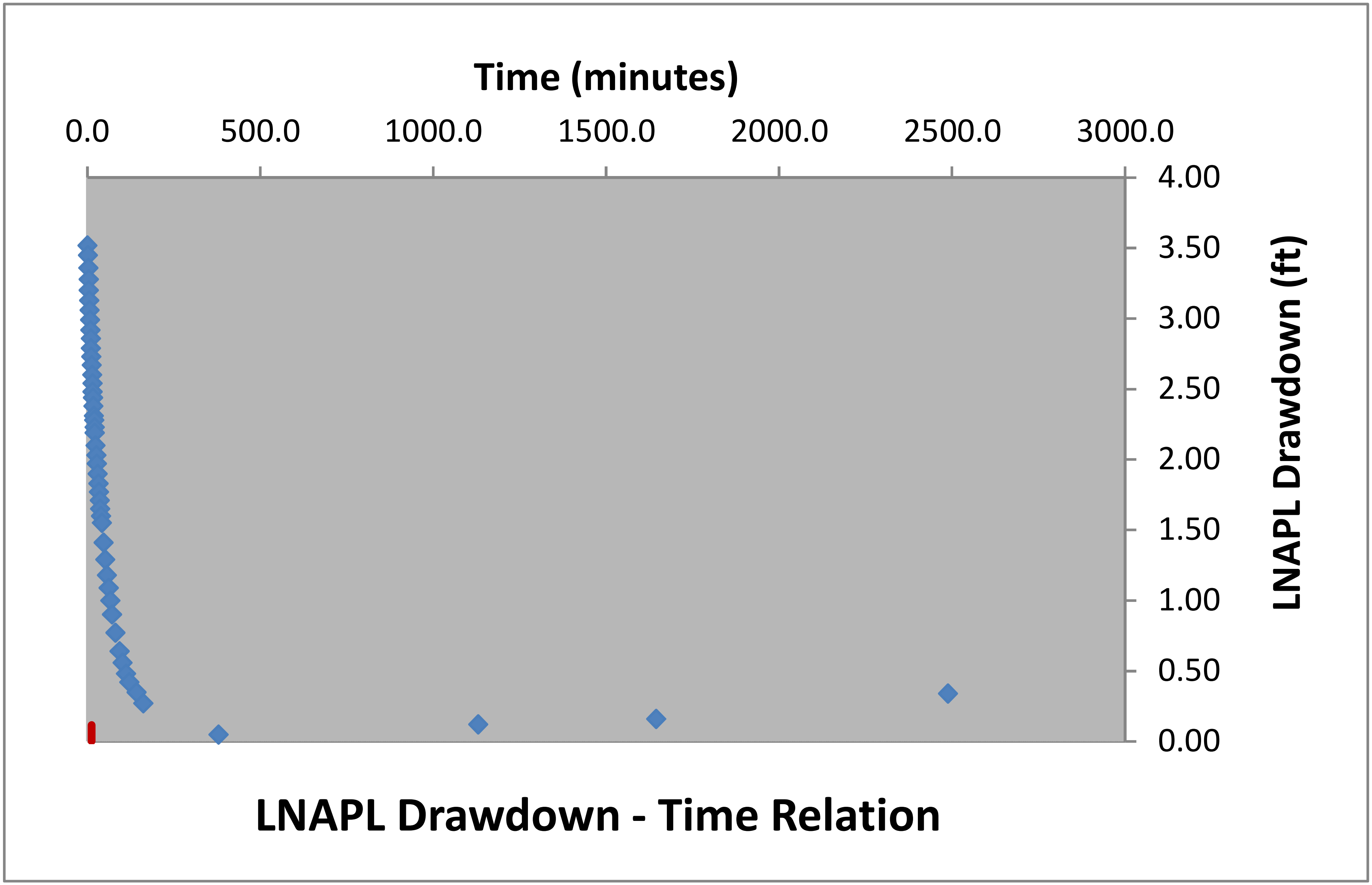

Time (minutes)
0.0
500.0
1000.0
1500.0
2000.0
2500.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Discharge (ft³/d)
LNAPL Discharge - Time Relation

Figure 9



MW-12 (March 2019)
Baildown Test Data Analysis

Figure 10



MW-12 (March 2019)
Baildown Test Data Analysis

Generalized Bouwer and Rice (1976)

Well Designation:	MW-12
Date:	27-Mar-19

$$T_n = \frac{r_e^{\,2} \ln(R/r_e)\ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

L_e/r_e
32.1
C
2.08
R/r_e
13.75

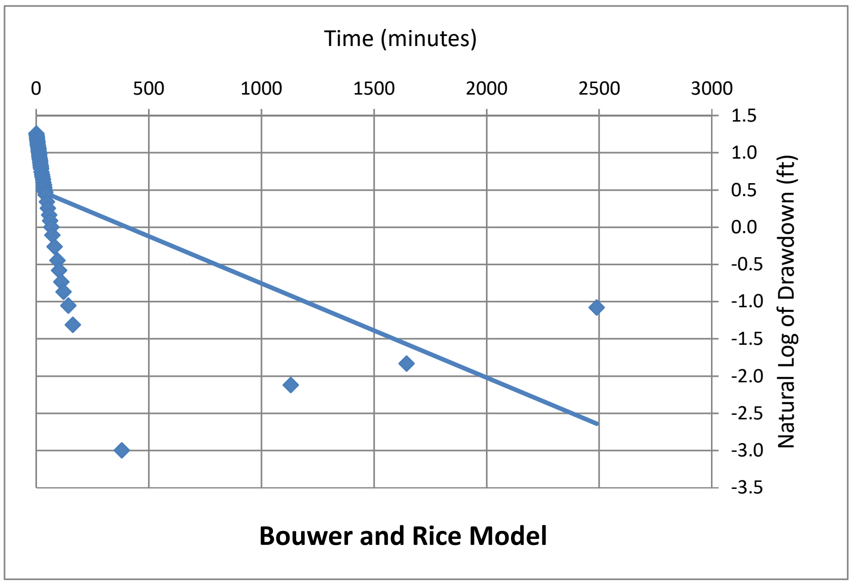
J-Ratio
-2.353

Enter early time cut-off for least-squares model fit

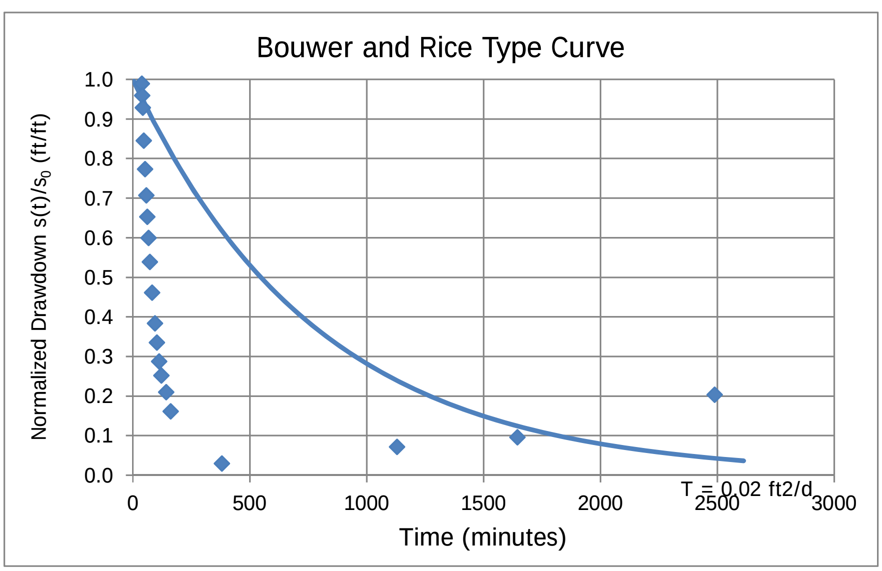
$Time_{cut}$	0	<- Enter or change value here

Model Results: T_n (ft^2/d) = 0.03 +/- 0.01 ft^2/d

Coef. Of Variation
0.21



C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW-12
Date:	27-Mar-19

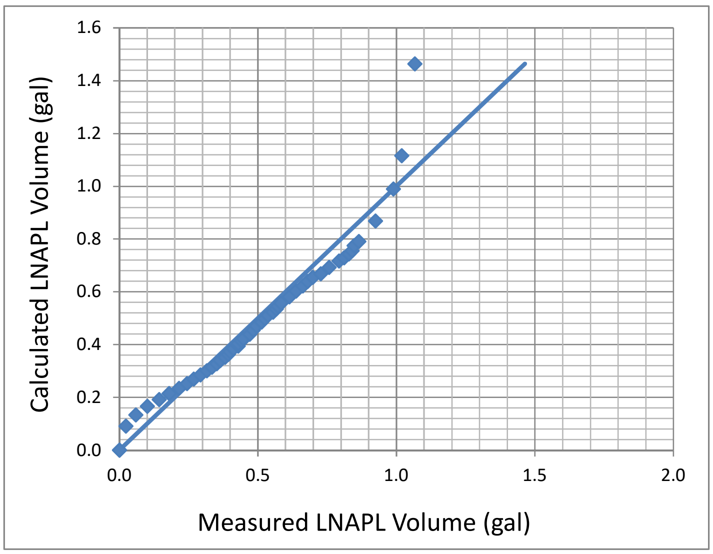
$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

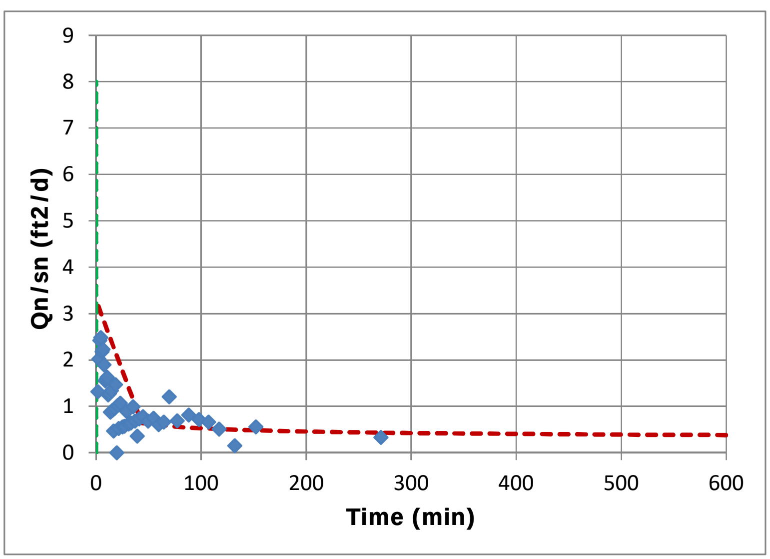
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Time Adjustment (min):	0	
Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	0.506	<-- Minimize this using "Solver"
	0.011	<-- Working S_n
Trial T_n (ft^2/d):	0.195	<-- By changing T_n through "Solver"

Add constraint $T_n > 0.00001$

Model Result: T_n (ft^2/d) = **0.20**





Height

8

Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	MW-12
Date:	27-Mar-19

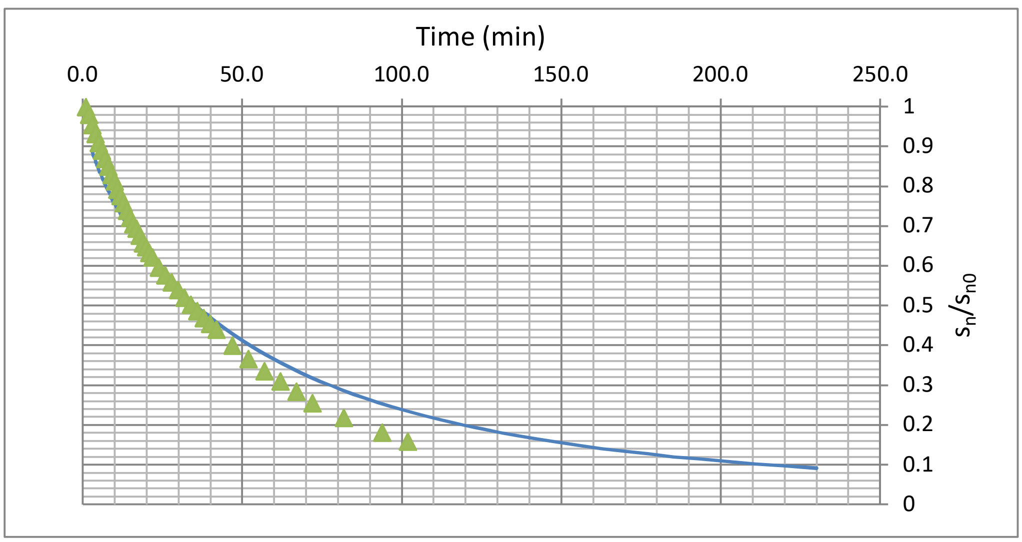
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Initial Drawdown s_n (ft):	3.52	
Trial S_n:	d	<-- Enter d for default
Root-Mean-Square Error:	0.285	<-- Minimize this using "Solver"
Trial T_n (ft^2/d):	0.342	<-- By changing T_n through "Solver"
	0.015	<-- Working S_n

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **0.34**

T_{min}	3
T_{max}	230



J-Ratio
-2.353

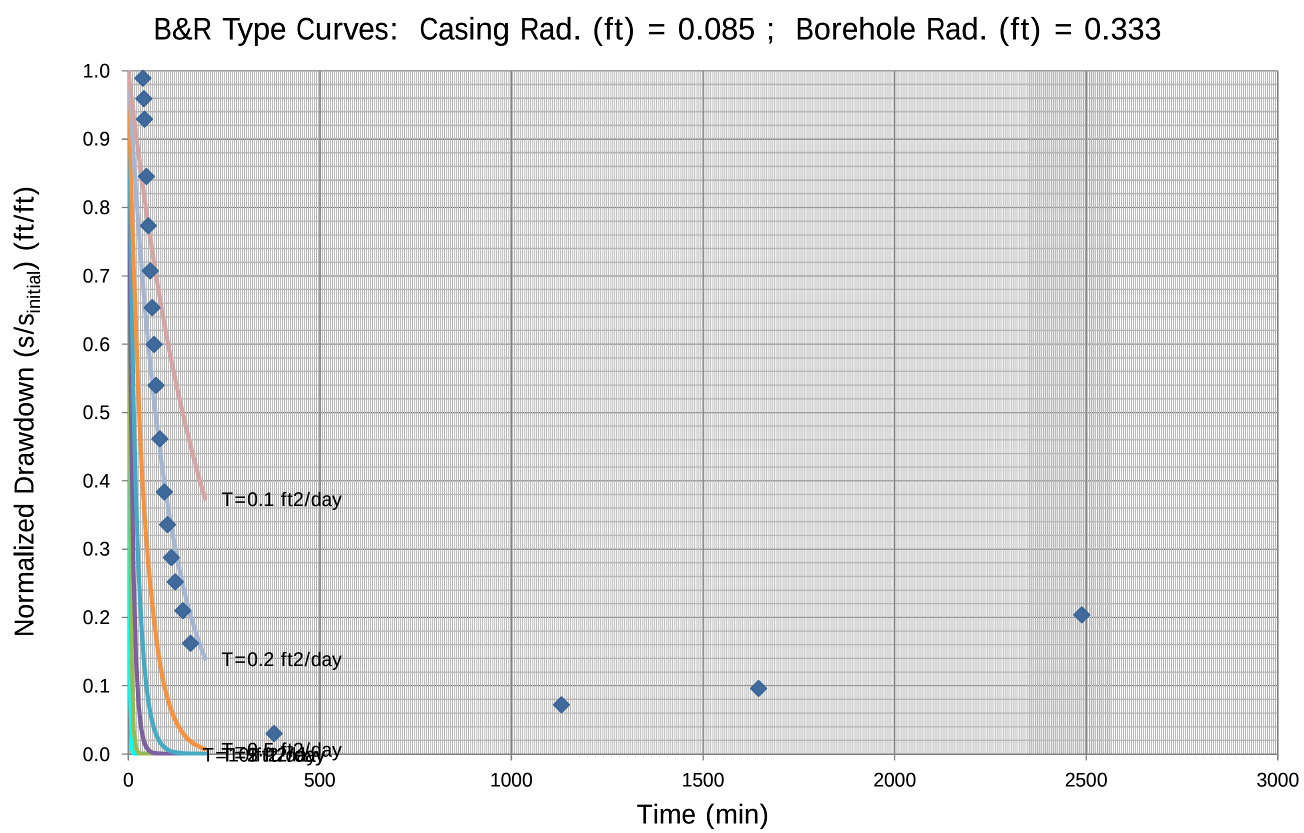
Bouwer and Rice Short Term LNAPL Mobility Test Type Curves

B&R Type Curves: Casing Rad. (ft) = 0.085 ; Borehole Rad. (ft) = 0.333

Enter these values

Type Curve ID	Type Curve Name	Notes	Max Time (min)	Transmissivity (ft^2/day)
1	T=10 ft2/day		150	10
2	T=5 ft2/day		200	5
3	T=2 ft2/day		200	2
4	T=1 ft2/day		200	1
5	T=0.5 ft2/day		200	0.5
6	T=0.2 ft2/day		200	0.2
7	T=0.1 ft2/day		200	0.1

J-Ratio	
-2.353	<-- If uncertain use
	-0.22



API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)

0.19

Standard Deviation (ft^2/d)

0.16

Coefficient of Variation

0.84

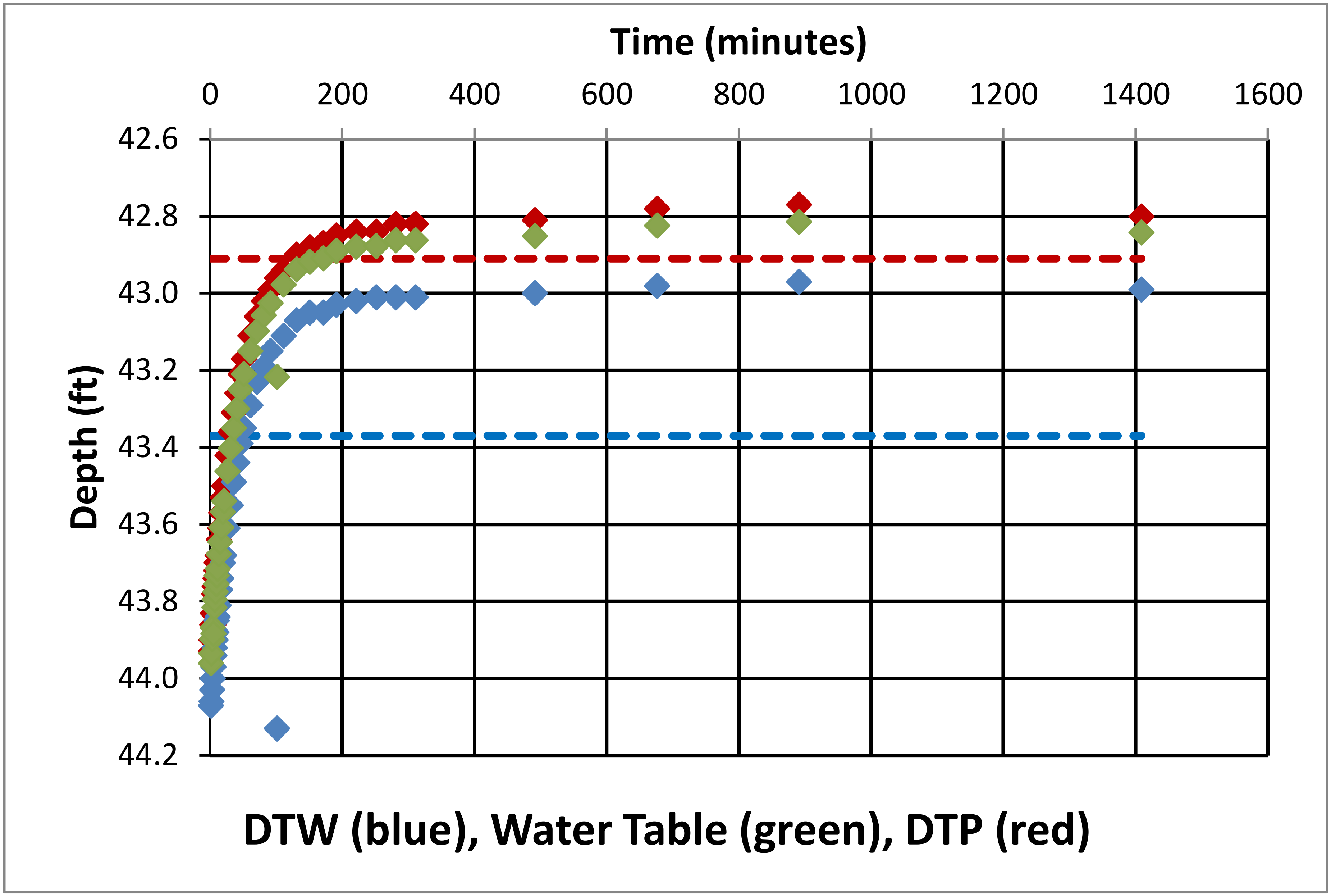
Well Designation:	MW16	Beckett and Lyverse (2002)
Date:	16-Jul-15	

Ground Surface Elev (ft msl)	1122.2	Enter These Data	**Drawdown Adjustment (ft)**
Top of Casing Elev (ft msl)	1121.7		
Well Casing Radius, r_c (ft):	0.083	r_{e1}	
Well Radius, r_w (ft):	0.333		-0.18
LNAPL Specific Yield, S_y:	0.175		
LNAPL Density Ratio, ρ_r:	0.780		
Top of Screen (ft bgs):	0.0		
Bottom of Screen (ft bgs):	0.0		
LNAPL Baildown Vol. (gal.):			
Effective Radius, r_{e3} (ft):	0.158	Calculated Parameters	
Effective Radius, r_{e2} (ft):	#NUM!		
Initial Casing LNAPL Vol. (gal.):	0.07		
Initial Filter LNAPL Vol. (gal.):	0.20		

Enter Data Here

	Time (min)	DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)	Water Table Depth (ft)	LNAPL Drawdown s_n (ft)	Average Time (min)	LNAPL Discharge Q_n (ft^3/d)	s_n (ft)	b_n (ft)	r_e (ft)	DTP (ft bgs)	DTW (ft bgs)	LNAPL Volume (gallons)	Ave. r_e (ft)
Initial Fluid Levels:	0	42.41	42.87	42.91	43.37	43.01					0.46					
Enter Test Data:	1.0	43.43	43.57	43.93	44.07	43.96	1.20				0.14				0	0.158
	2.0	43.40	43.56	43.90	44.06	43.94	1.17	1.5	2.270	1.19	0.16	0.158	43.92	44.06	0.01	0
	3.0	43.36	43.53	43.86	44.03	43.90	1.13	2.5	1.135	1.15	0.17	0.158	43.88	44.05	0.02	0.158
	4.0	43.33	43.50	43.83	44.00	43.87	1.10	3.5	0.000	1.11	0.17	0.158	43.84	44.02	0.02	0.317
	5.0	43.36	43.47	43.86	43.97	43.88	1.13	4.5	-6.810	1.11	0.11	0.158	43.84	43.99	-0.02	0.475
	6.0	43.28	43.44	43.78	43.94	43.82	1.05	5.5	5.675	1.09	0.16	0.158	43.82	43.96	0.01	0.634
	7.0	43.26	43.42	43.76	43.92	43.80	1.03	6.5	0.000	1.04	0.16	0.158	43.77	43.93	0.01	0.792
	8.0	43.24	43.40	43.74	43.90	43.78	1.01	7.5	0.000	1.02	0.16	0.158	43.75	43.91	0.01	0.950
	9.0	43.22	43.38	43.72	43.88	43.76	0.99	8.5	0.000	1.00	0.16	0.158	43.73	43.89	0.01	1.109
	10.0	43.20	43.35	43.70	43.85	43.73	0.97	9.5	-1.135	0.98	0.15	0.158	43.71	43.87	0.01	1.267
	11.0	43.18	43.34	43.68	43.84	43.72	0.95	10.5	1.135	0.96	0.16	0.158	43.69	43.84	0.01	1.426
	13.0	43.14	43.31	43.64	43.81	43.68	0.91	12.0	0.567	0.93	0.17	0.158	43.66	43.82	0.02	1.663
	15.0	43.11	43.27	43.61	43.77	43.65	0.88	14.0	-0.567	0.89	0.16	0.158	43.63	43.79	0.01	1.980
	17.0	43.07	43.24	43.57	43.74	43.61	0.84	16.0	0.567	0.86	0.17	0.158	43.59	43.76	0.02	2.297
	19.0	43.03	43.20	43.53	43.70	43.57	0.80	18.0	0.000	0.82	0.17	0.158	43.55	43.72	0.02	2.614
	21.0	43	43.18	43.50	43.68	43.54	0.77	20.0	0.567	0.78	0.18	0.158	43.52	43.69	0.02	2.930
	26.0	42.92	43.11	43.42	43.61	43.46	0.69	23.5	0.227	0.73	0.19	0.158	43.46	43.65	0.03	3.485
	31.0	42.86	43.05	43.36	43.55	43.40	0.63	28.5	0.000	0.66	0.19	0.158	43.39	43.58	0.03	4.277
	36.0	42.81	42.99	43.31	43.49	43.35	0.58	33.5	-0.227	0.60	0.18	0.158	43.33	43.52	0.02	5.069
	41.0	42.76	42.94	43.26	43.44	43.30	0.53	38.5	0.000	0.55	0.18	0.158	43.29	43.47	0.02	5.861
	46.0	42.71	42.89	43.21	43.39	43.25	0.48	43.5	0.000	0.50	0.18	0.158	43.24	43.42	0.02	6.653
	51.0	42.67	42.85	43.17	43.35	43.21	0.44	48.5	0.000	0.46	0.18	0.158	43.19	43.37	0.02	7.445
	61.0	42.61	42.79	43.11	43.29	43.15	0.38	56.0	0.000	0.41	0.18	0.158	43.14	43.32	0.02	8.633
	71.0	42.56	42.73	43.06	43.23	43.10	0.33	66.0	-0.113	0.35	0.17	0.158	43.08	43.26	0.02	10.216
	81.0	42.52	42.69	43.02	43.19	43.06	0.29	76.0	0.000	0.31	0.17	0.158	43.04	43.21	0.02	11.800
	91.0	42.49	42.65	42.99	43.15	43.03	0.26	86.0	-0.113	0.27	0.16	0.158	43.01	43.17	0.01	13.384
	101.0	42.46	43.63	42.96	44.13	43.22	0.23	96.0	11.463	0.24	1.17	0.158	42.98	43.64	0.61	14.968
	111.0	42.44	42.61	42.94	43.11	42.98	0.21	106.0	-11.350	0.22	0.17	0.158	42.95	43.62	0.02	16.552
	131.0	42.4	42.57	42.90	43.07	42.94	0.17	121.0	0.000	0.19	0.17	0.158	42.92	43.09	0.02	18.928
	151.0	42.38	42.55	42.88	43.05	42.92	0.15	141.0	0.000	0.16	0.17	0.158	42.89	43.06	0.02	22.096
	171.0	42.37	42.55	42.87	43.05	42.91	0.14	161.0	0.057	0.14	0.18	0.158	42.88	43.05	0.02	25.264
	191.0	42.35	42.53	42.85	43.03	42.89	0.12	181.0	0.000	0.13	0.18	0.158	42.86	43.04	0.02	28.432
	221.0	42.34	42.52	42.84	43.02	42.88	0.11	206.0	0.000	0.11	0.18	0.158	42.84	43.03	0.02	32.392
	251.0	42.34	42.51	42.84	43.01	42.88	0.11	236.0	-0.038	0.11	0.17	0.158	42.84	43.02	0.02	37.144
	281.0	42.32	42.51	42.82	43.01	42.86	0.09	266.0	0.076	0.10	0.19	0.158	42.83	43.01	0.03	41.895
	311.0	42.32	42.51	42.82	43.01	42.86	0.09	296.0	0.000	0.09	0.19	0.158	42.82	43.01	0.03	46.647
	491.0	42.31	42.50	42.81	43.00	42.85	0.08	401.0	0.000	0.08	0.19	0.158	42.81	43.01	0.03	63.279
	676.0	42.28	42.48	42.78	42.98	42.82	0.05	583.5	0.006	0.06	0.20	0.158	42.80	42.99	0.04	92.186
	891.0	42.27	42.47	42.77	42.97	42.81	0.04	783.5	0.000	0.04	0.20	0.158	42.78	42.98	0.04	123.865
	1409.0	42.30	42.49	42.80	42.99	42.84	0.07	1150.0	-0.002	0.05	0.19	0.158	42.79	42.98	0.03	181.917

Figure 1



MW-16 (July 2015)
Baildown Test Data Analysis

Figure 2

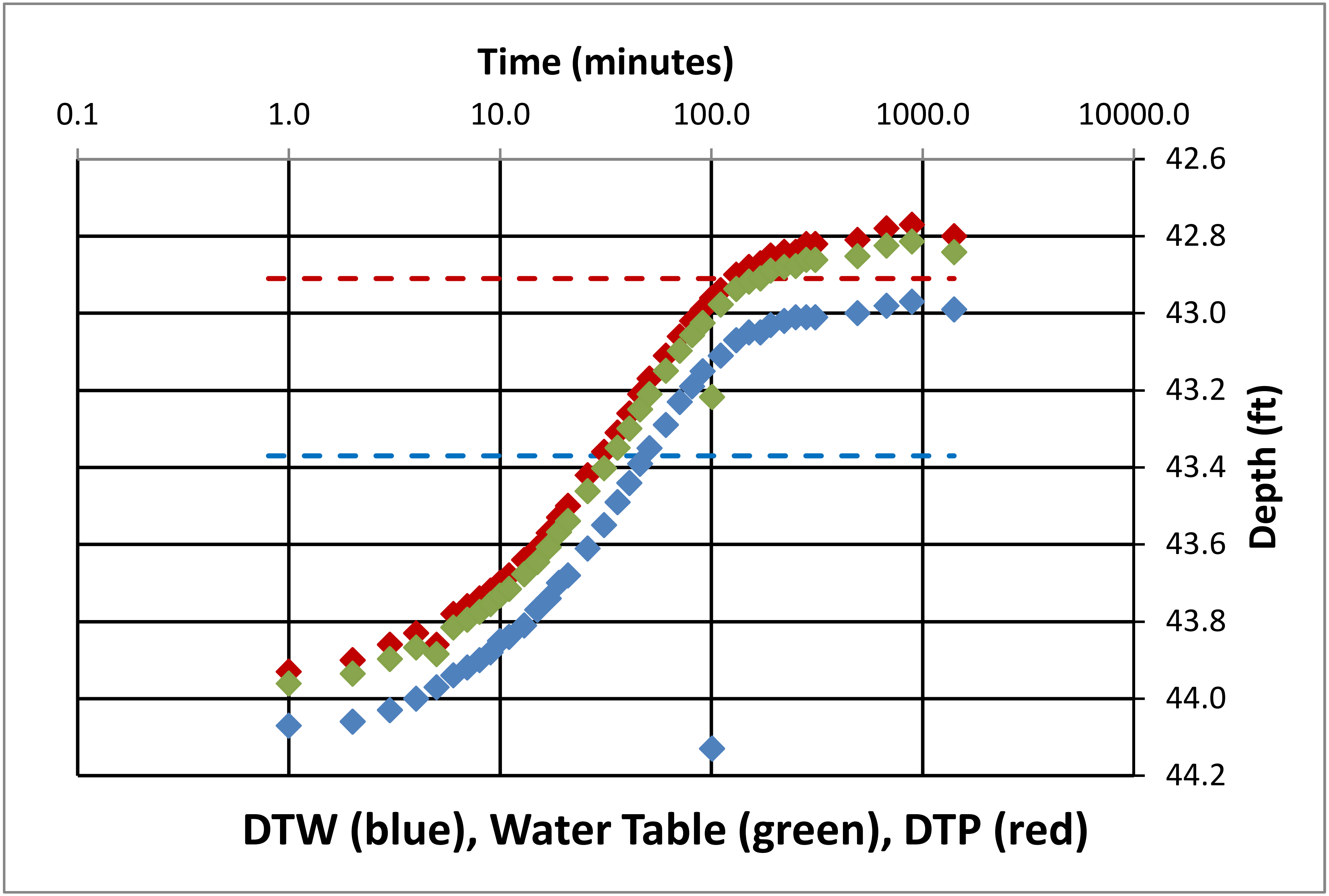

Time (minutes)
0.1
1.0
10.0
100.0
1000.0
10000.0
42.6
42.8
43.0
43.2
43.4
43.6
43.8
44.0
44.2
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 3

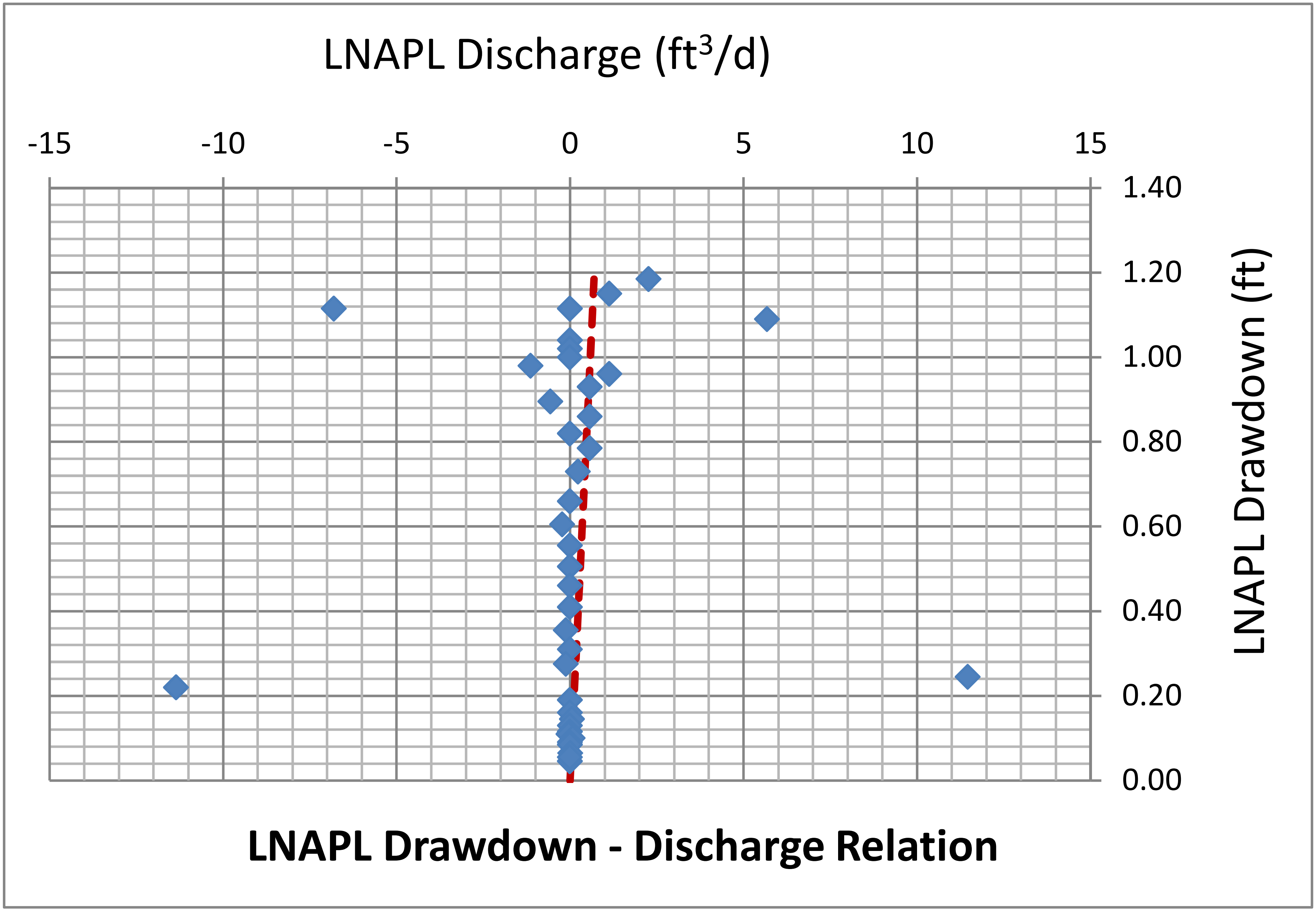
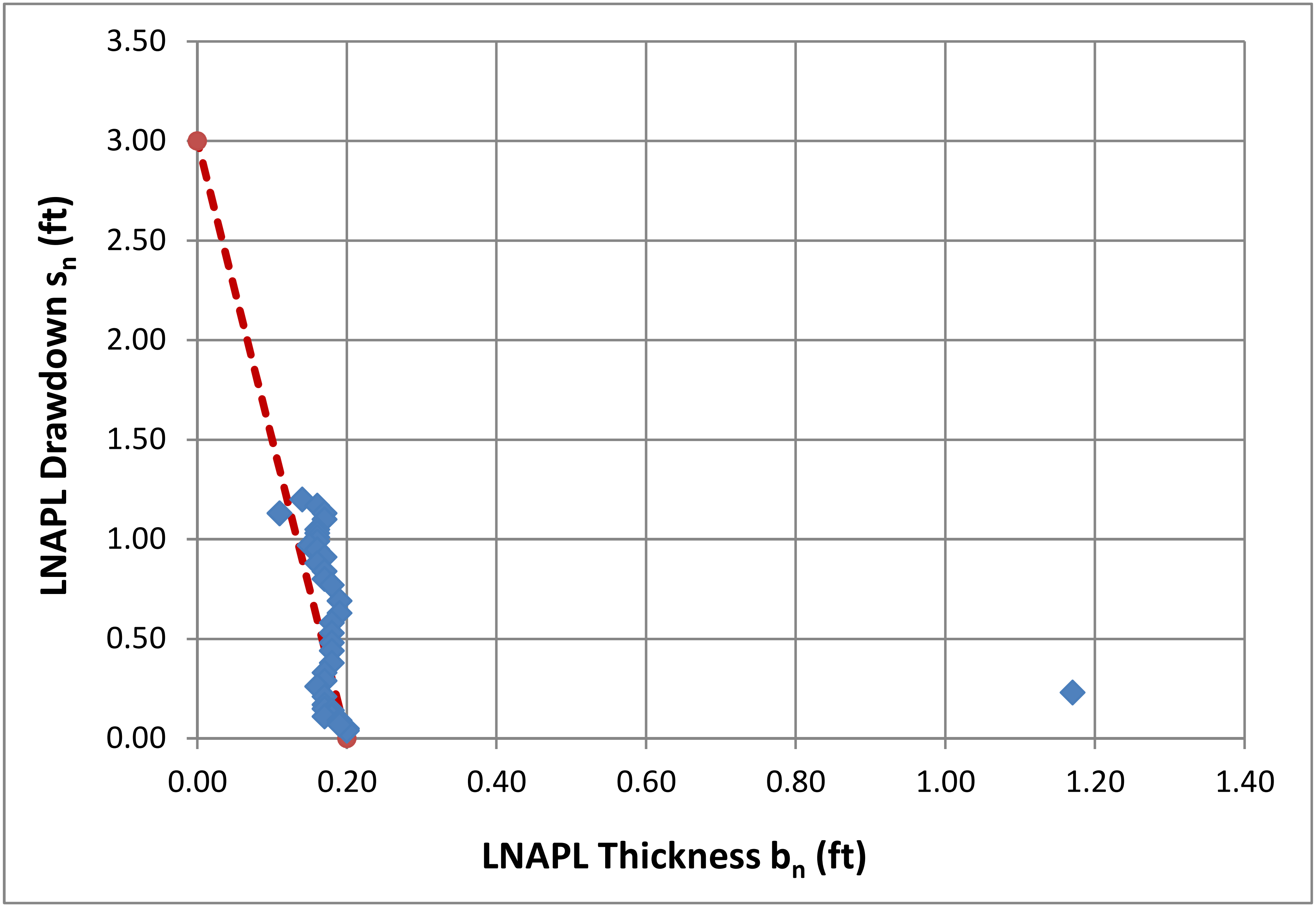
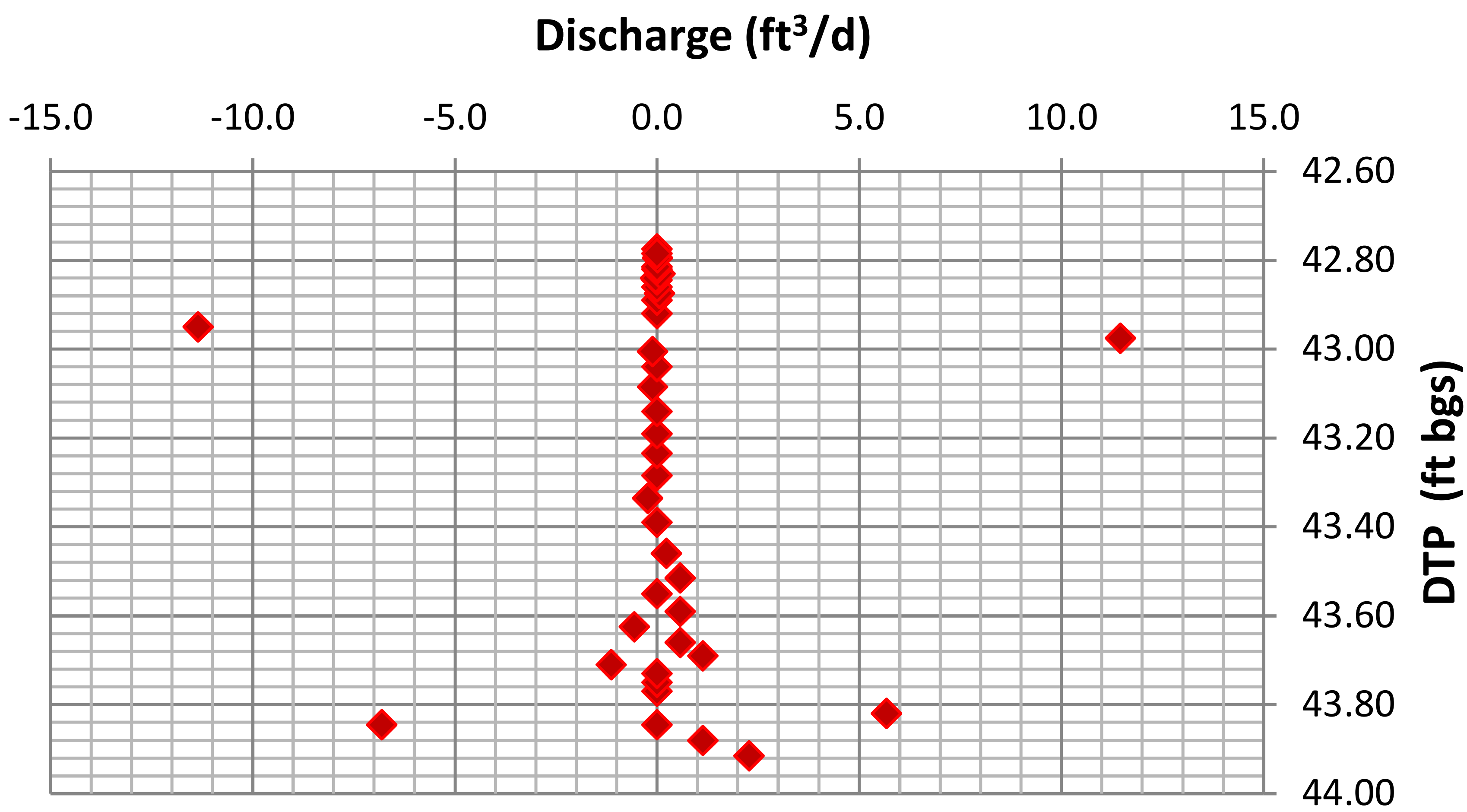

LNAPL Discharge (ft3/d)
-15
-10
-5
0
5
10
15
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Discharge Relation

Figure 4



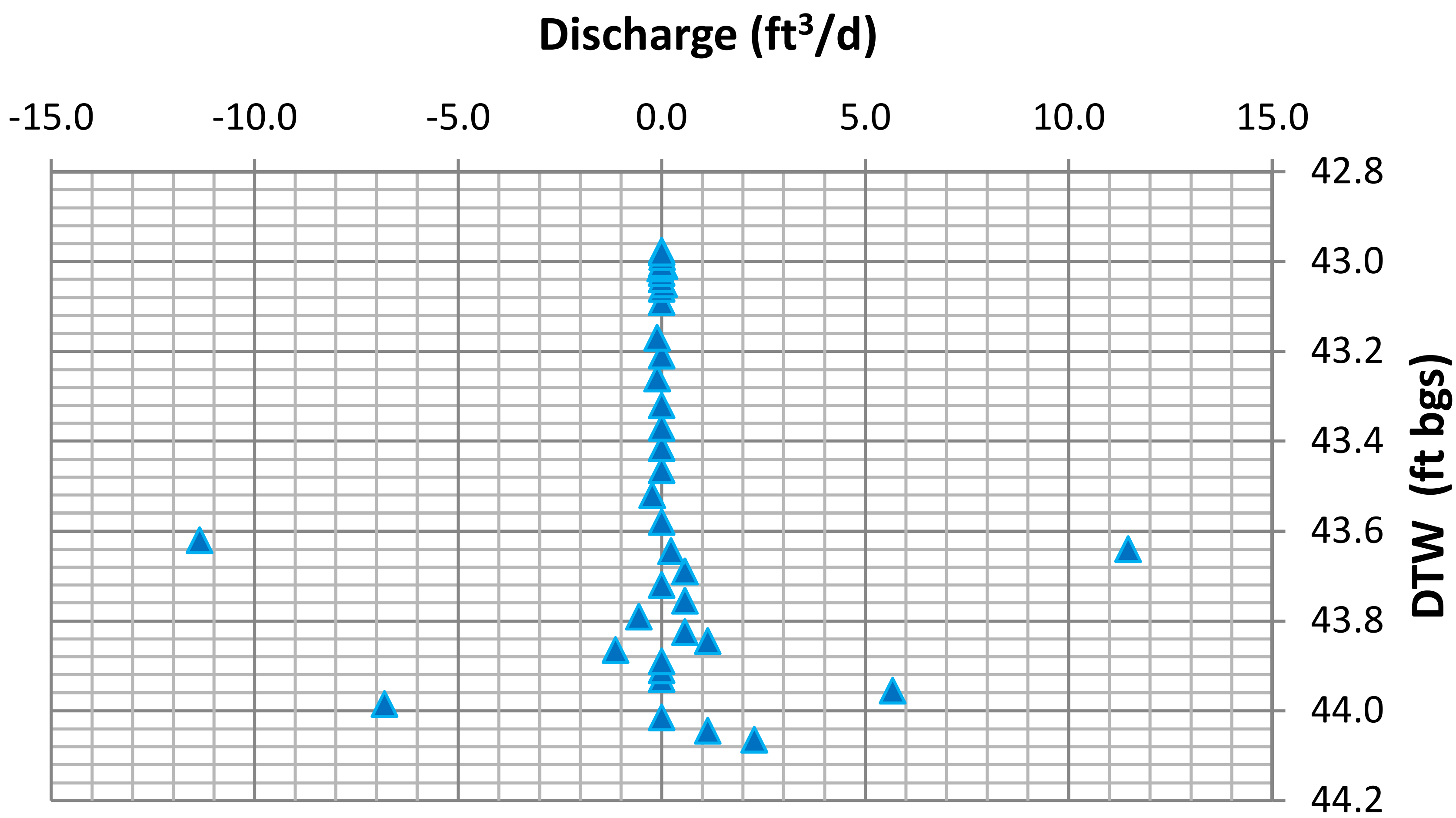
MW-16 (July 2015)
Baildown Test Data Analysis
Page 5 of 16

Figure 5



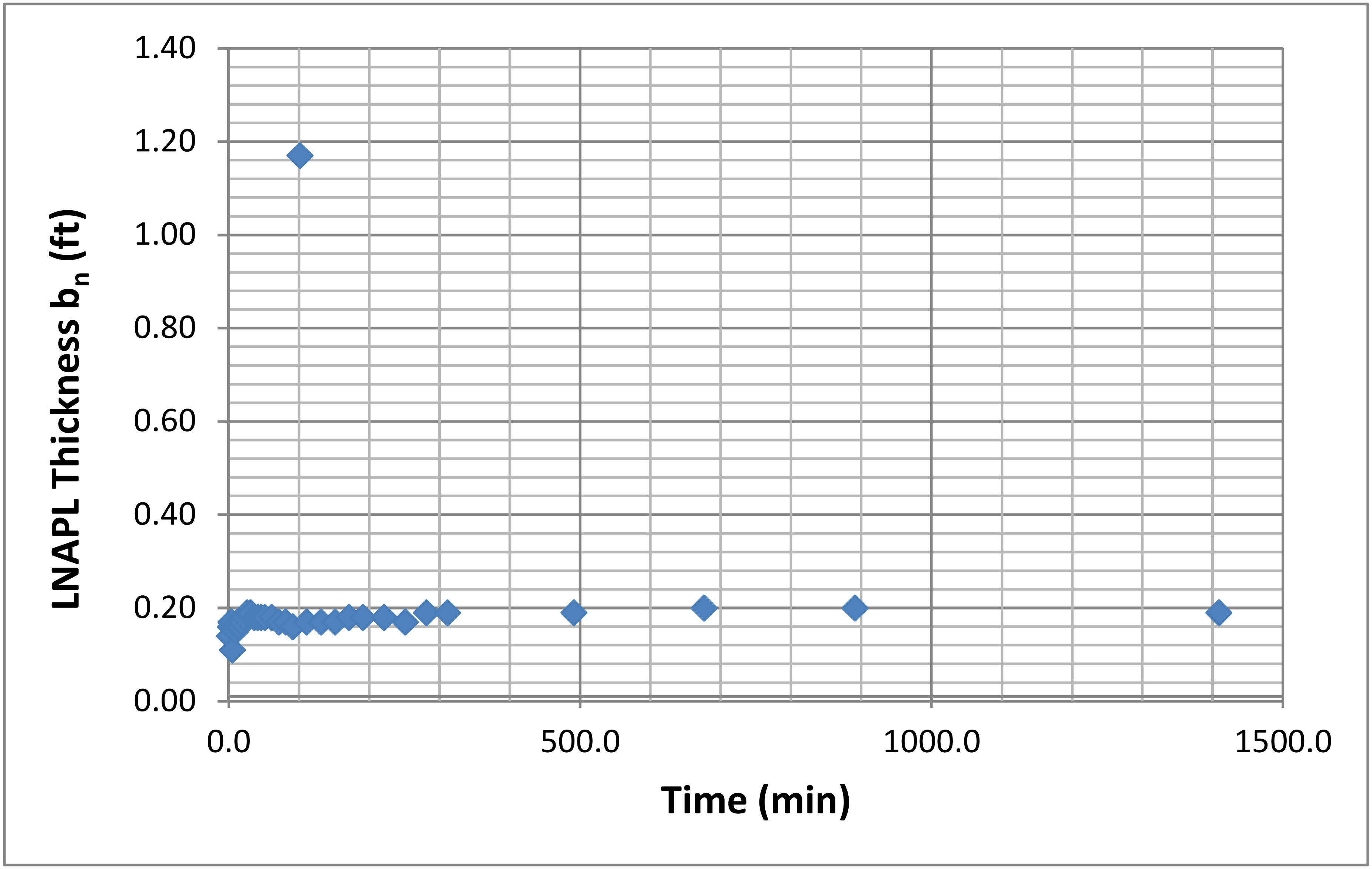
Depth to Product vs. LNAPL Discharge

Figure 6



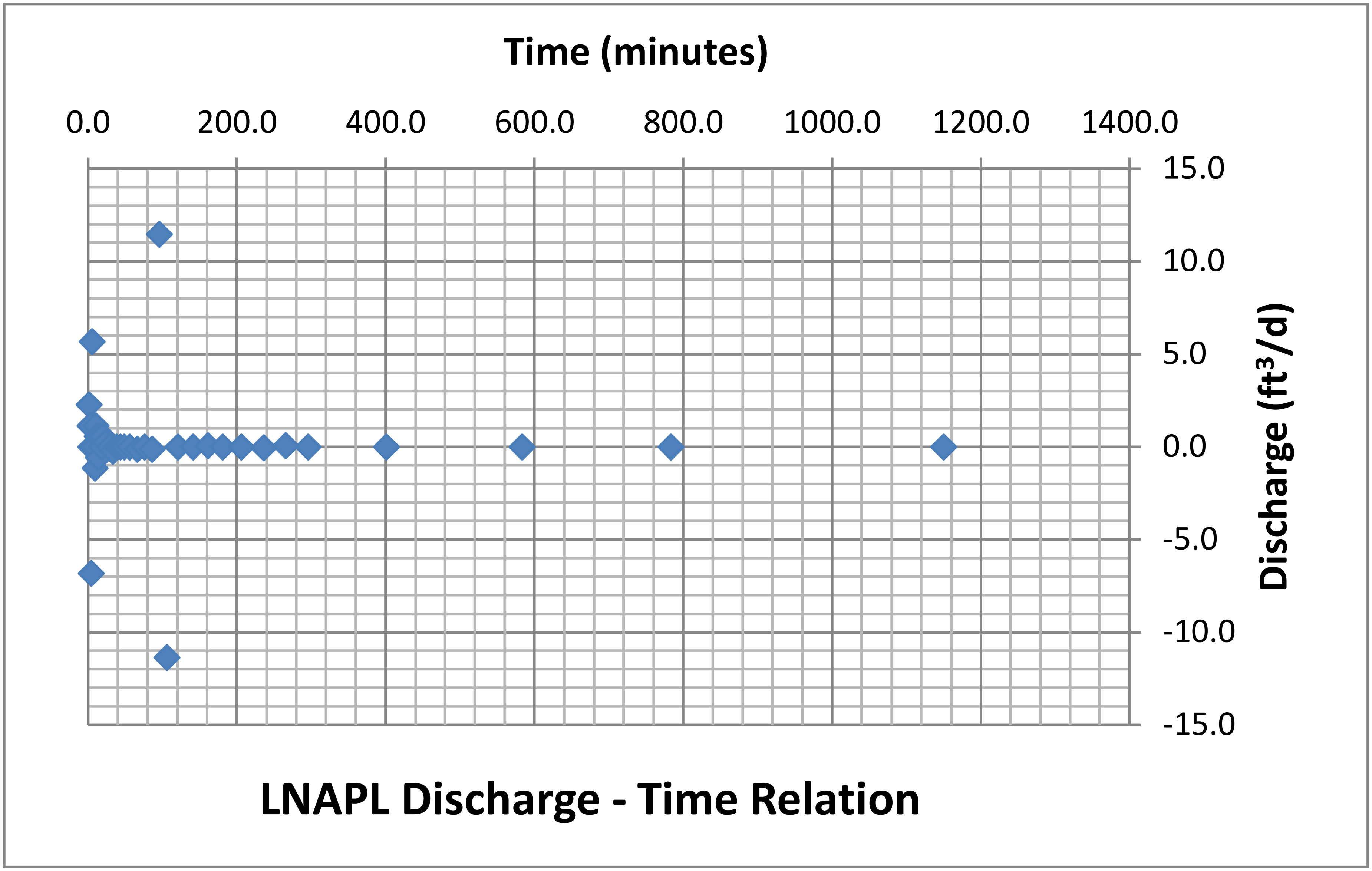
Depth to Water vs. LNAPL Discharge

Figure 7



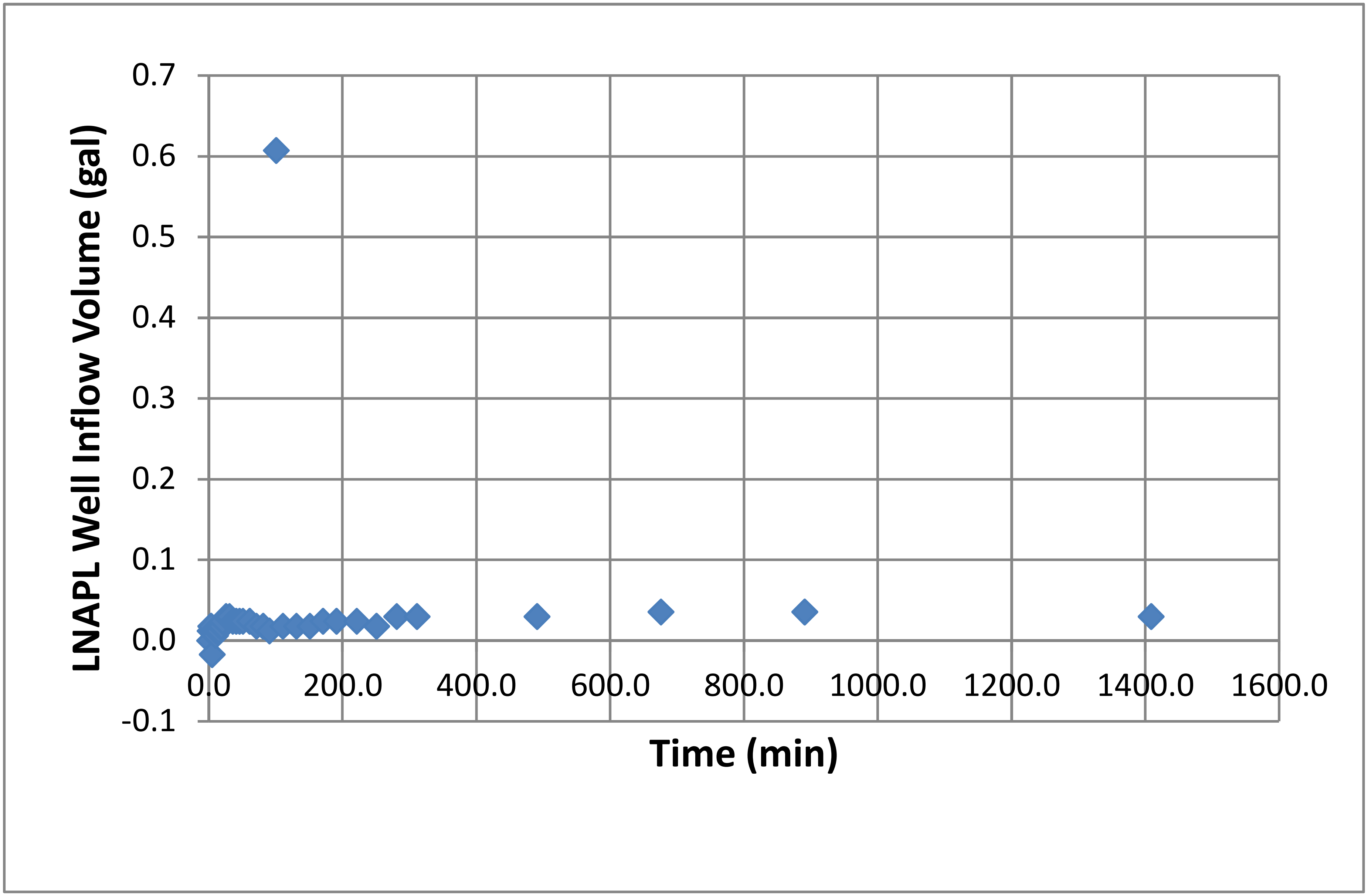
MW-16 (July 2015)
Baildown Test Data Analysis

Figure 8



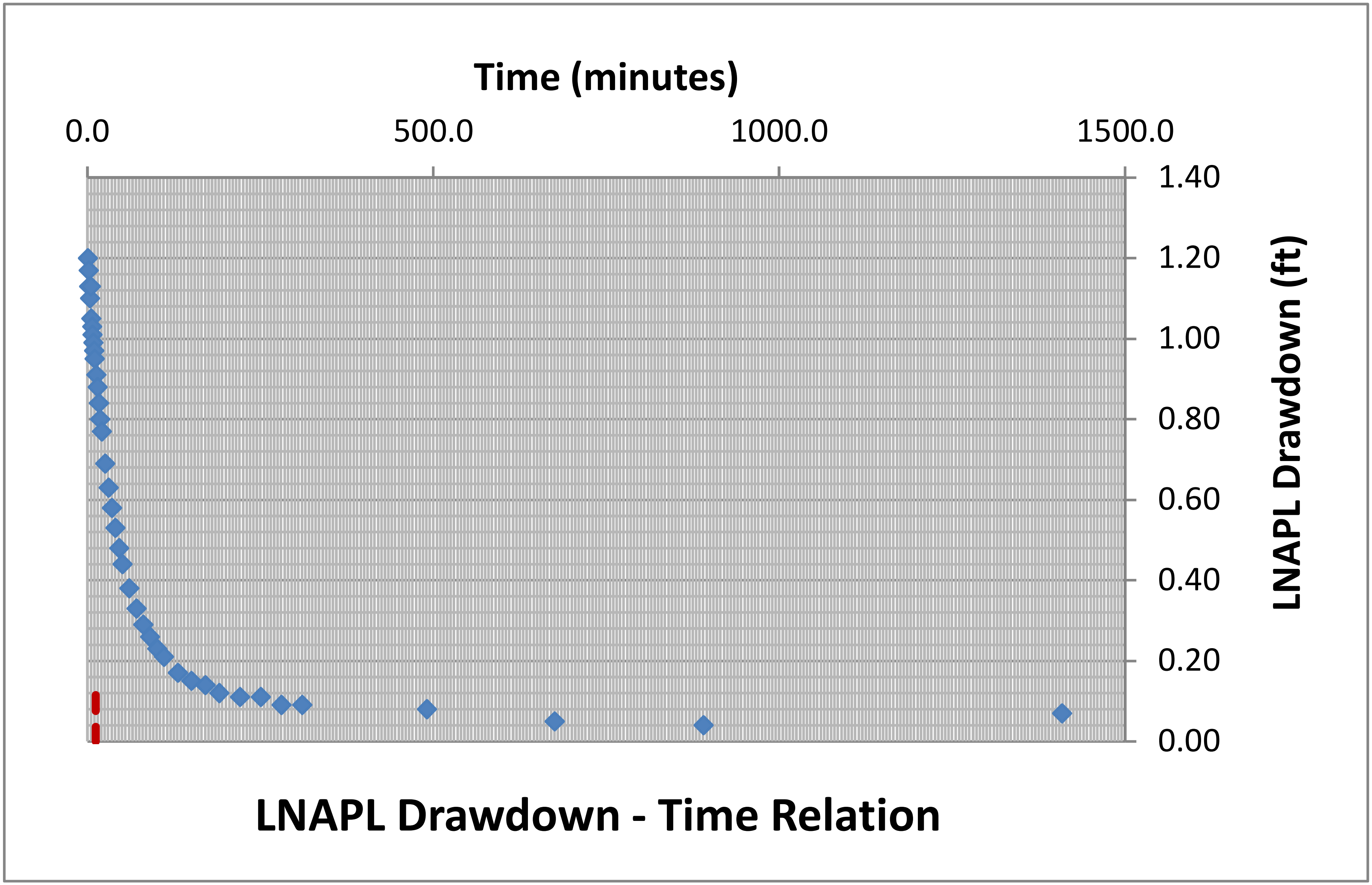
MW-16 (July 2015)
Baildown Test Data Analysis

Figure 9



0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
LNAPL Well Inflow Volume (gal)
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
1400.0
1600.0
Time (min)

Figure 10


Time (minutes)
0.0
500.0
1000.0
1500.0
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Time Relation

Generalized Bouwer and Rice (1976)

Well Designation:	MW16
Date:	16-Jul-15

$$T_n = \frac{r_e^{\,2} \ln(R/r_e) \ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

L_e/r_e
2.9
C
0.91
R/r_e
2.10

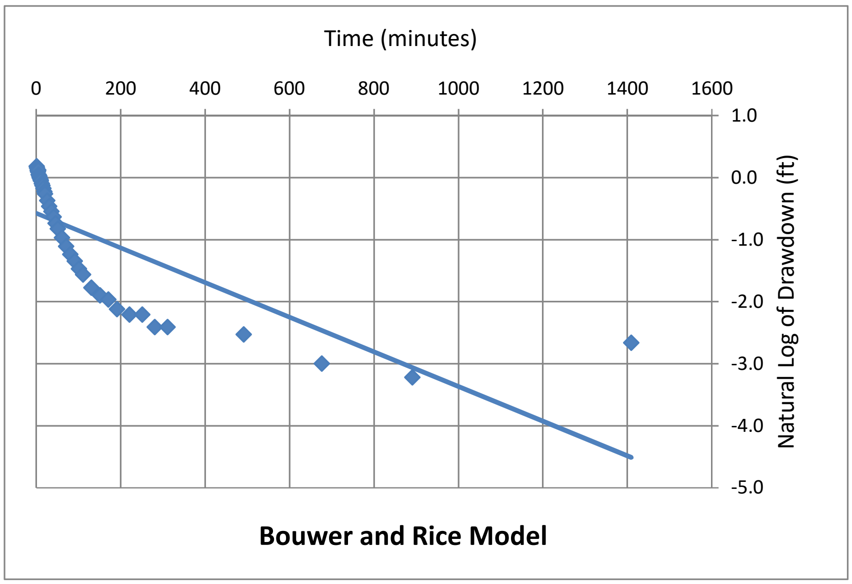
Enter early time cut-off for least-squares model fit

Time_{cut}	0	<- Enter or change value here

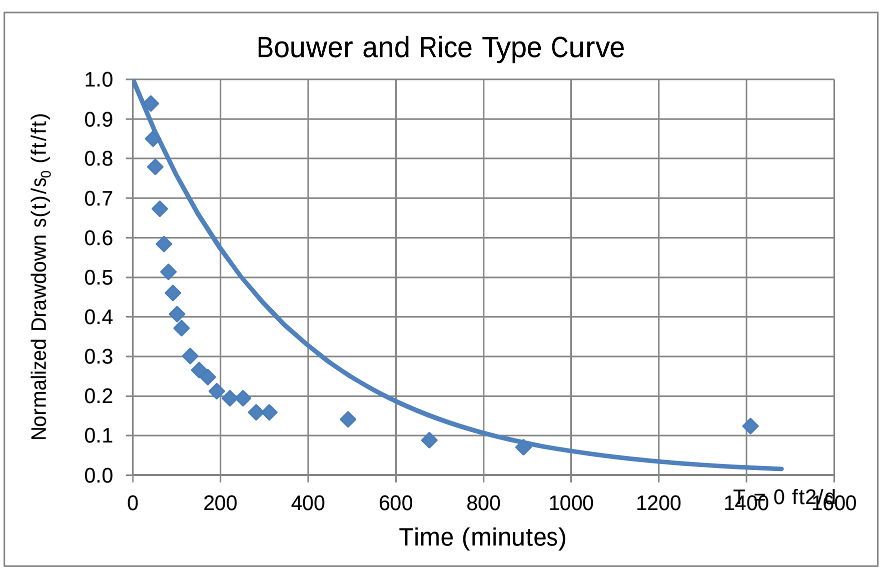
Model Results: T_n (ft^2/d) = 0.00 +/- 0.00 ft^2/d

J-Ratio
-15.000

Coef. Of Variation
0.14



C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW16
Date:	16-Jul-15

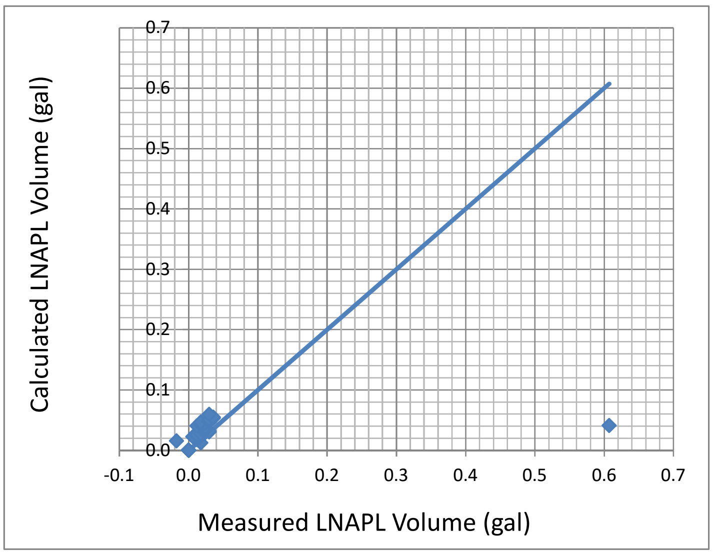
$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

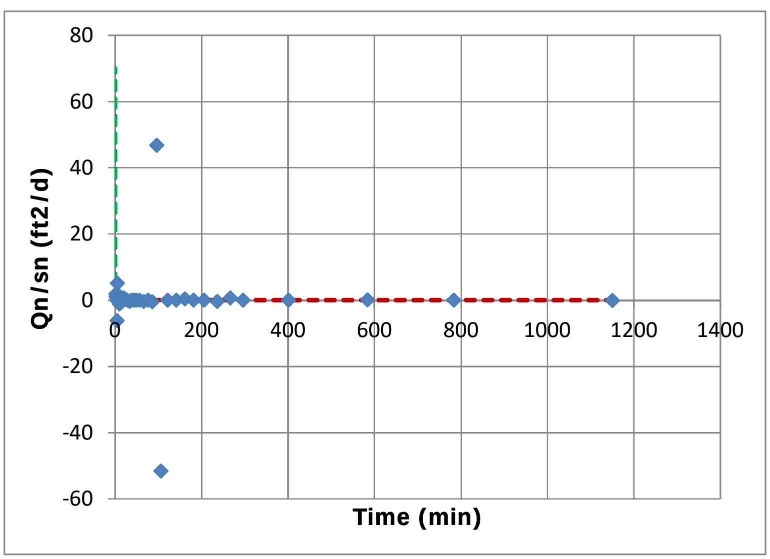
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Time Adjustment (min):	0	
Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	0.577	<-- Minimize this using "Solver"
	0.003	<-- Working S_n
Trial T_n (ft^2/d):	0.015	<-- By changing T_n through "Solver"

Add constraint T_n > 0.00001

Model Result: T_n (ft^2/d) = **0.01**





Height

70

Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	MW16
Date:	16-Jul-15

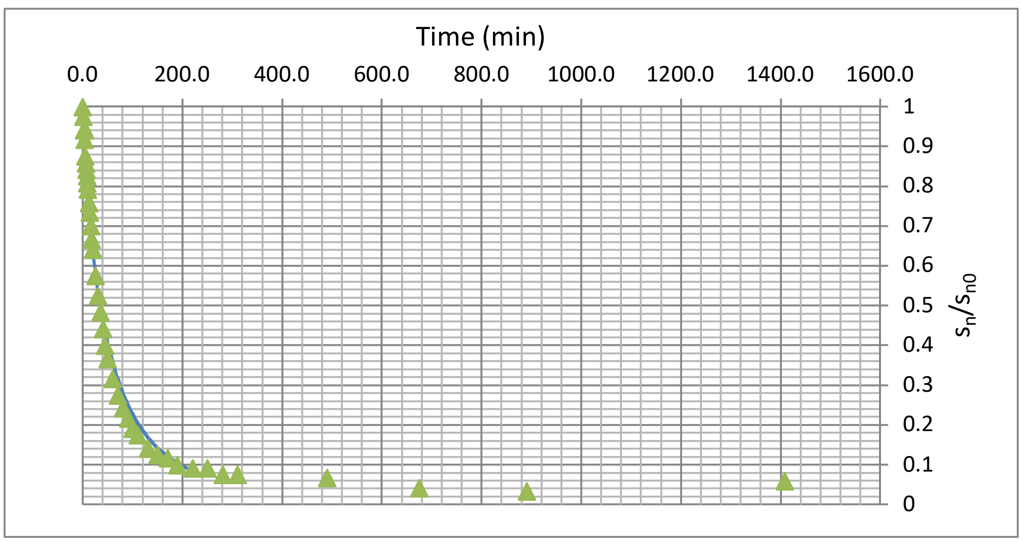
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Initial Drawdown s_n (ft):	1.2	
Trial S_n:	d	<-- Enter d for default
Root-Mean-Square Error:	0.219	<-- Minimize this using "Solver"
Trial T_n (ft^2/d):	0.064	<-- By changing T_n through "Solver"
	0.006	<-- Working S_n

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **0.06**

T_{min}	3
T_{max}	230



J-Ratio
-15.000

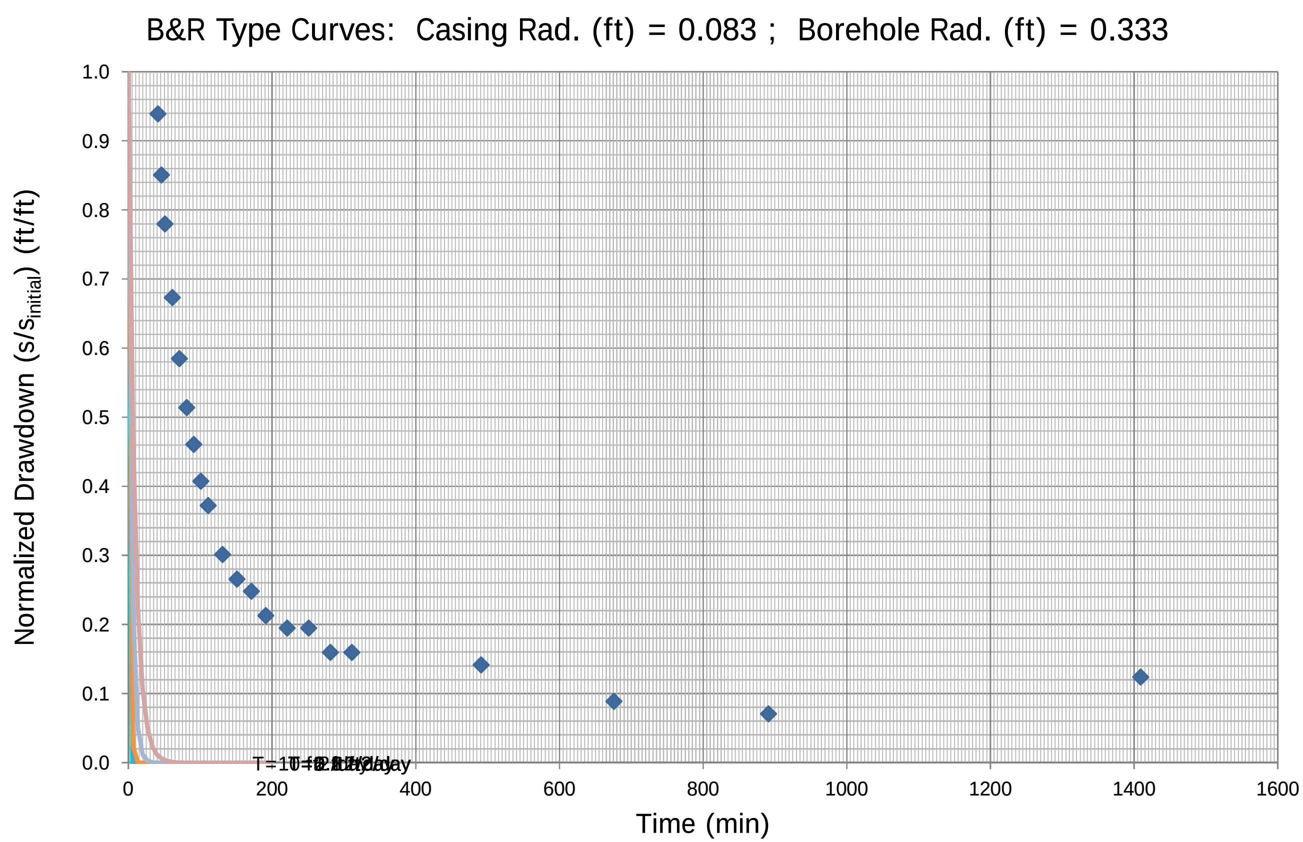
Bouwer and Rice Short Term LNAPL Mobility Test Type Curves

B&R Type Curves: Casing Rad. (ft) = 0.083 ; Borehole Rad. (ft) = 0.333

Enter these values

Type Curve ID	Type Curve Name	Notes	Max Time (min)	Transmissivity (ft^2/day)
1	T=10 ft2/day		150	10
2	T=5 ft2/day		200	5
3	T=2 ft2/day		200	2
4	T=1 ft2/day		200	1
5	T=0.5 ft2/day		200	0.5
6	T=0.2 ft2/day		200	0.2
7	T=0.1 ft2/day		200	0.1

J-Ratio	
-15.000	<-- If uncertain use
	-0.22



API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)	0.03
Standard Deviation (ft^2/d)	0.03
Coefficient of Variation	1.20

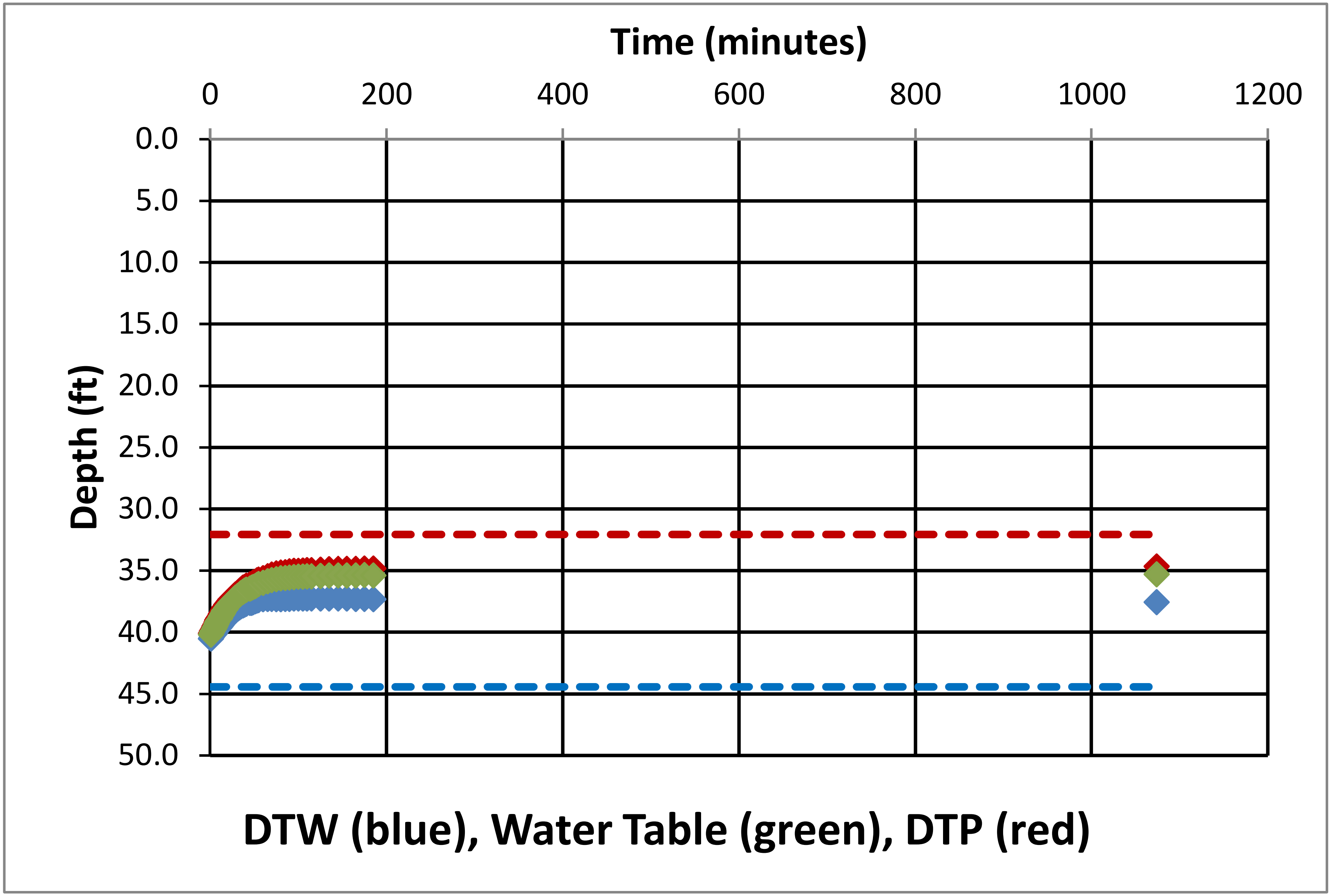
Well Designation:	MW-16	
Date:	20-Nov-17	

Ground Surface Elev (ft msl)	0.0	Enter These Data	**Drawdown Adjustment (ft)**
Top of Casing Elev (ft msl)	0.0		
Well Casing Radius, r_c (ft):	0.085	r_{e1}	2.5
Well Radius, r_w (ft):	0.333		
LNAPL Specific Yield, S_y:	0.175		
LNAPL Density Ratio, ρ_r:	0.780		
Top of Screen (ft bgs):	0.0		
Bottom of Screen (ft bgs):	0.0		
LNAPL Baildown Vol. (gal.):	0.0		
Effective Radius, r_{e3} (ft):	0.159	Calculated Parameters	
Effective Radius, r_{e2} (ft):	0.042		
Initial Casing LNAPL Vol. (gal.):	2.10		
Initial Filter LNAPL Vol. (gal.):	5.27		

	Enter Data Here															
	Time (min)	DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)	Water Table Depth (ft)	LNAPL Drawdown s_n (ft)	Average Time (min)	LNAPL Discharge Q_n (ft^3/d)	s_n (ft)	b_n (ft)	r_e (ft)	DTP (ft bgs)	DTW (ft bgs)	LNAPL Volume (gallons)	Ave. r_e (ft)
Initial Fluid Levels:	0	32.07	44.43	32.07	44.43	34.79					12.36					
Enter Test Data:	1.0	40.08	40.51	40.08	40.51	40.17	5.51				0.43				0	0.159
	2.0	39.92	40.40	39.92	40.40	40.03	5.35	1.5	5.738	5.43	0.48	0.159	40.00	40.46	0.03	0
	3.0	39.77	40.28	39.77	40.28	39.88	5.20	2.5	3.443	5.28	0.51	0.159	39.85	40.34	0.05	0.159
	4.0	39.63	40.18	39.63	40.18	39.75	5.06	3.5	4.590	5.13	0.55	0.159	39.70	40.23	0.07	0.319
	5.0	39.49	40.11	39.49	40.11	39.63	4.92	4.5	8.033	4.99	0.62	0.159	39.56	40.15	0.11	0.478
	6.0	39.34	40.00	39.34	40.00	39.49	4.77	5.5	4.590	4.85	0.66	0.159	39.42	40.06	0.14	0.637
	7.0	39.17	39.89	39.17	39.89	39.33	4.60	6.5	6.885	4.69	0.72	0.159	39.26	39.95	0.17	0.796
	8.0	39.02	39.80	39.02	39.80	39.19	4.45	7.5	6.885	4.53	0.78	0.159	39.10	39.85	0.21	0.956
	9.0	38.88	39.71	38.88	39.71	39.06	4.31	8.5	5.738	4.38	0.83	0.159	38.95	39.76	0.24	1.115
	10.0	38.76	39.64	38.76	39.64	38.95	4.19	9.5	5.738	4.25	0.88	0.159	38.82	39.68	0.27	1.274
	11.0	38.64	39.56	38.64	39.56	38.84	4.07	10.5	4.590	4.13	0.92	0.159	38.70	39.60	0.29	1.433
	12.0	38.52	39.47	38.52	39.47	38.73	3.95	11.5	3.443	4.01	0.95	0.159	38.58	39.52	0.31	1.593
	13.0	38.41	39.37	38.41	39.37	38.62	3.84	12.5	1.148	3.90	0.96	0.159	38.47	39.42	0.32	1.752
	14.0	38.30	39.28	38.30	39.28	38.52	3.73	13.5	2.295	3.79	0.98	0.159	38.36	39.33	0.33	1.911
	15.0	38.16	39.16	38.16	39.16	38.38	3.59	14.5	2.295	3.66	1.00	0.159	38.23	39.22	0.34	2.070
	16.0	38.02	39.06	38.02	39.06	38.25	3.45	15.5	4.590	3.52	1.04	0.159	38.09	39.11	0.36	2.230
	17.0	37.92	38.98	37.92	38.98	38.15	3.35	16.5	2.295	3.40	1.06	0.159	37.97	39.02	0.38	2.389
	18.0	37.80	38.89	37.80	38.89	38.04	3.23	17.5	3.443	3.29	1.09	0.159	37.86	38.94	0.39	2.548
	19.0	37.70	38.82	37.70	38.82	37.95	3.13	18.5	3.443	3.18	1.12	0.159	37.75	38.86	0.41	2.708
	20.0	37.61	38.77	37.61	38.77	37.87	3.04	19.5	4.590	3.09	1.16	0.159	37.66	38.80	0.44	2.867
	21.0	37.52	38.70	37.52	38.70	37.78	2.95	20.5	2.295	3.00	1.18	0.159	37.57	38.74	0.45	3.026
	22.0	37.44	38.65	37.44	38.65	37.71	2.87	21.5	3.443	2.91	1.21	0.159	37.48	38.68	0.46	3.185
	23.0	37.36	38.59	37.36	38.59	37.63	2.79	22.5	2.295	2.83	1.23	0.159	37.40	38.62	0.48	3.345
	24.0	37.28	38.53	37.28	38.53	37.56	2.71	23.5	2.295	2.75	1.25	0.159	37.32	38.56	0.49	3.504
	25.0	37.20	38.46	37.20	38.46	37.48	2.63	24.5	1.148	2.67	1.26	0.159	37.24	38.50	0.49	3.663
	27.0	37.05	38.34	37.05	38.34	37.33	2.48	26.0	1.721	2.56	1.29	0.159	37.13	38.40	0.51	3.902
	29	36.91	38.22	36.91	38.22	37.20	2.34	28.0	1.148	2.41	1.31	0.159	36.98	38.28	0.52	4.221
	31	36.78	38.09	36.78	38.09	37.07	2.21	30.0	0.000	2.28	1.31	0.159	36.85	38.16	0.52	4.539
	33	36.65	37.99	36.65	37.99	36.94	2.08	32.0	1.721	2.15	1.34	0.159	36.72	38.04	0.54	4.858
	35	36.52	37.89	36.52	37.89	36.82	1.95	34.0	1.721	2.02	1.37	0.159	36.59	37.94	0.56	5.176
	37	36.40	37.81	36.40	37.81	36.71	1.83	36.0	2.295	1.89	1.41	0.159	36.46	37.85	0.58	5.495
	39	36.31	37.75	36.31	37.75	36.63	1.74	38.0	1.721	1.79	1.44	0.159	36.36	37.78	0.60	5.813
	41	36.22	37.68	36.22	37.68	36.54	1.65	40.0	1.148	1.70	1.46	0.159	36.27	37.72	0.61	6.132
	45	36.13	37.63	36.13	37.63	36.46	1.56	43.0	1.148	1.61	1.50	0.159	36.18	37.66	0.64	6.610
	47.0	36.05	37.61	36.05	37.61	36.39	1.48	46.0	3.443	1.52	1.56	0.159	36.09	37.62	0.67	7.087
	49.0	35.97	37.55	35.97	37.55	36.32	1.40	48.0	1.148	1.44	1.58	0.159	36.01	37.58	0.69	7.406
	51.0	35.90	37.50	35.90	37.50	36.25	1.33	50.0	1.148	1.37	1.60	0.159	35.94	37.53	0.70	7.724
	53.0	35.78	37.42	35.78	37.42	36.14	1.21	52.0	2.295	1.27	1.64	0.159	35.84	37.46	0.72	8.043
	55.0	35.72	37.38	35.72	37.38	36.09	1.15	54.0	1.148	1.18	1.66	0.159	35.75	37.40	0.73	8.362
	60.0	35.61	37.32	35.61	37.32	35.99	1.04	57.5	1.148	1.10	1.71	0.159	35.67	37.35	0.76	8.919
	65.0	35.47	37.30	35.47	37.30	35.87	0.90	62.5	2.754	0.97	1.83	0.159	35.54	37.31	0.83	9.715
	70.0	35.32	37.30	35.32	37.30	35.76	0.75	67.5	3.443	0.82	1.98	0.159	35.40	37.30	0.92	10.512
	75.0	35.21	37.32	35.21	37.32	35.67	0.64	72.5	2.984	0.70	2.11	0.159	35.27	37.31	1.00	11.308

80.0	35.15	37.32	35.15	37.32	35.63	0.58	77.5	1.377	0.61	2.17	0.159	35.18	37.32	1.04	12.104
85	35.11	37.30	35.11	37.30	35.59	0.54	82.5	0.459	0.56	2.19	0.159	35.13	37.31	1.05	12.901
90	35.07	37.29	35.07	37.29	35.56	0.50	87.5	0.689	0.52	2.22	0.159	35.09	37.30	1.07	13.697
95	35.04	37.27	35.04	37.27	35.53	0.47	92.5	0.230	0.48	2.23	0.159	35.06	37.28	1.07	14.493
100	35.01	37.26	35.01	37.26	35.51	0.44	97.5	0.459	0.45	2.25	0.159	35.03	37.27	1.08	15.290
105	34.98	37.25	34.98	37.25	35.48	0.41	102.5	0.459	0.42	2.27	0.159	35.00	37.26	1.10	16.086
110	34.97	37.25	34.97	37.25	35.47	0.40	107.5	0.230	0.40	2.28	0.159	34.98	37.25	1.10	16.882
115	34.96	37.25	34.96	37.25	35.46	0.39	112.5	0.230	0.40	2.29	0.159	34.97	37.25	1.11	17.679
125	34.91	37.26	34.91	37.26	35.43	0.34	120.0	0.689	0.36	2.35	0.159	34.94	37.26	1.14	18.873
135	34.88	37.25	34.88	37.25	35.40	0.31	130.0	0.230	0.32	2.37	0.159	34.90	37.26	1.16	20.466
145	34.86	37.26	34.86	37.26	35.39	0.29	140.0	0.344	0.30	2.40	0.159	34.87	37.26	1.17	22.059
155	34.86	37.26	34.86	37.26	35.39	0.29	150.0	0.000	0.29	2.40	0.159	34.86	37.26	1.17	23.651
165	34.86	37.29	34.86	37.29	35.39	0.29	160.0	0.344	0.29	2.43	0.159	34.86	37.28	1.19	25.244
175	34.83	37.29	34.83	37.29	35.37	0.26	170.0	0.344	0.27	2.46	0.159	34.85	37.29	1.21	26.837
185	34.83	37.31	34.83	37.31	35.38	0.26	180.0	0.230	0.26	2.48	0.159	34.83	37.30	1.22	28.429
1074	34.65	37.55	34.65	37.55	35.29	0.08	629.5	0.054	0.17	2.90	0.159	34.74	37.43	1.47	100.020

Figure 1



Time (minutes)
0
200
400
600
800
1000
1200
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 2

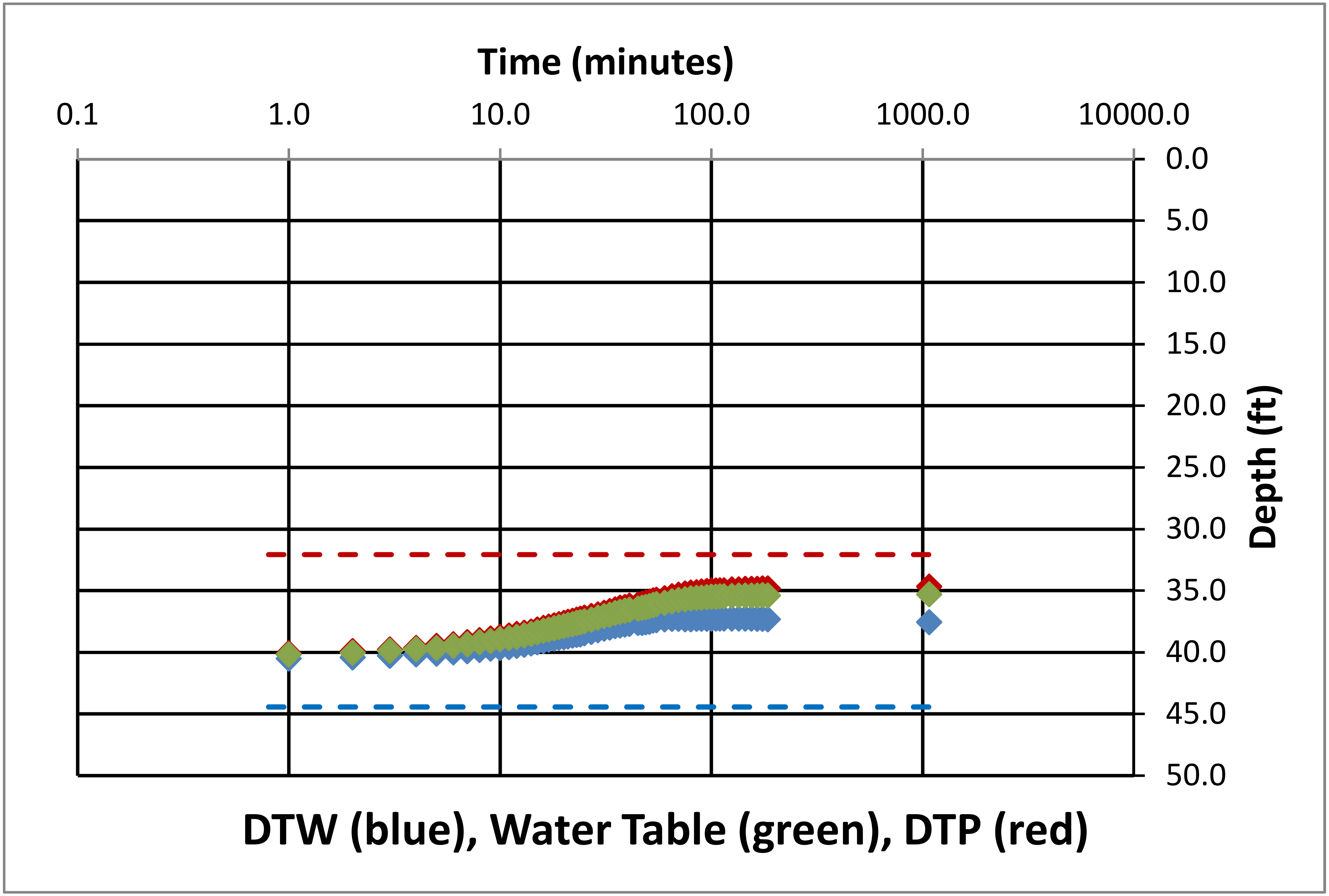
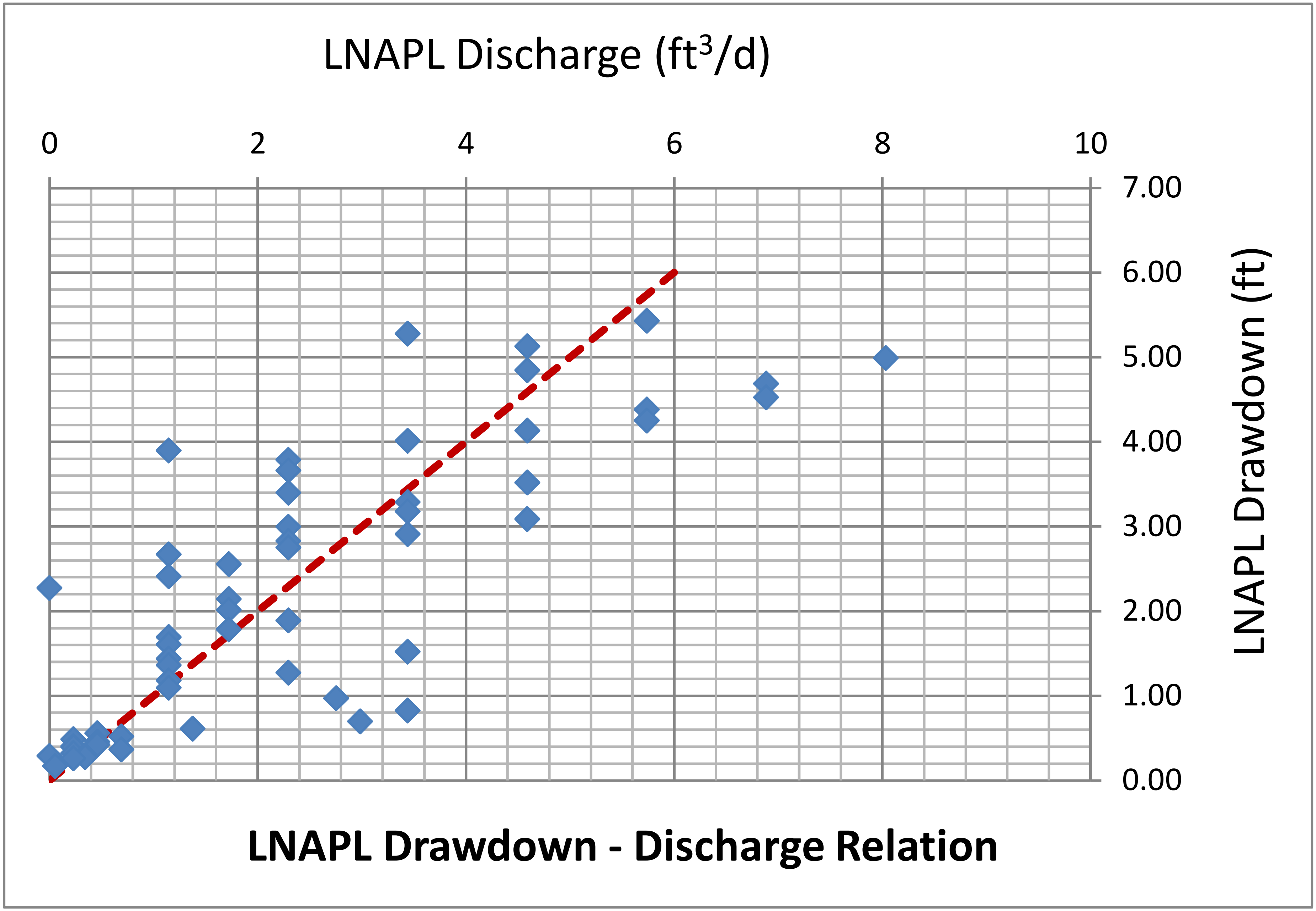
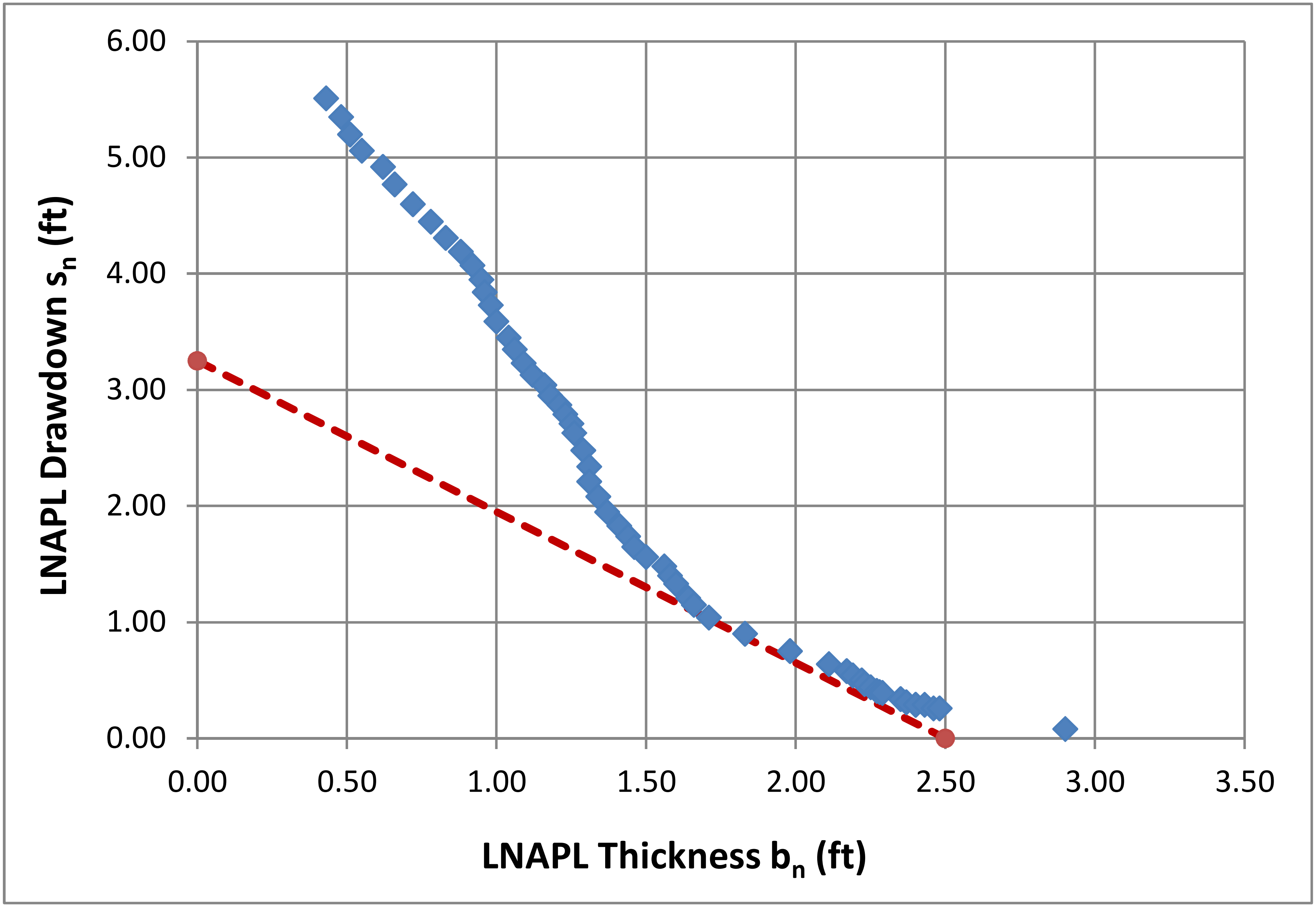

Time (minutes)
0.1
1.0
10.0
100.0
1000.0
10000.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 3



LNAPL Discharge (ft³/d)
0
2
4
6
8
10
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Discharge Relation

Figure 4



6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
LNAPL Drawdown s_n (ft)
LNAPL Thickness b_n (ft)

Figure 5

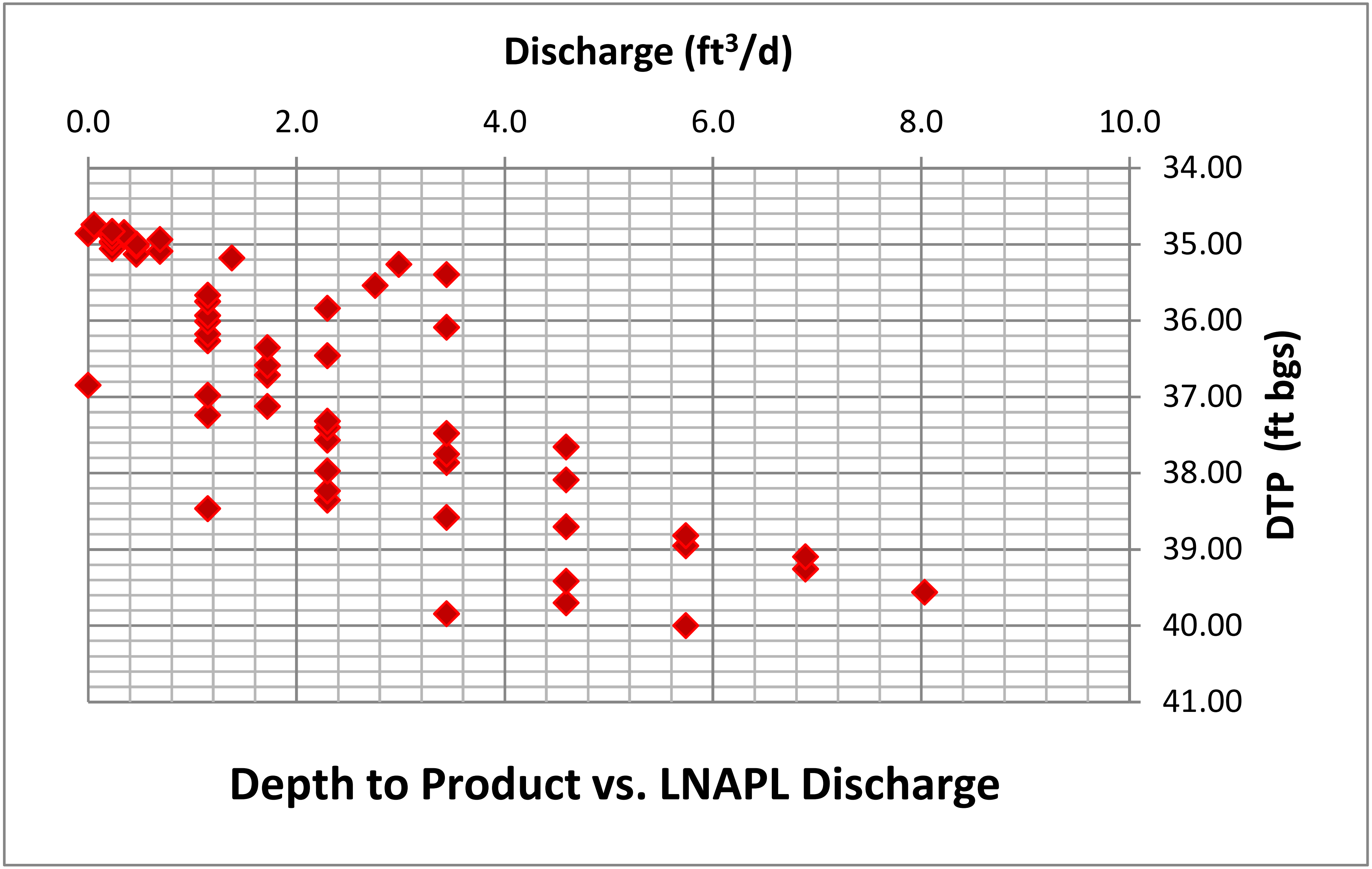
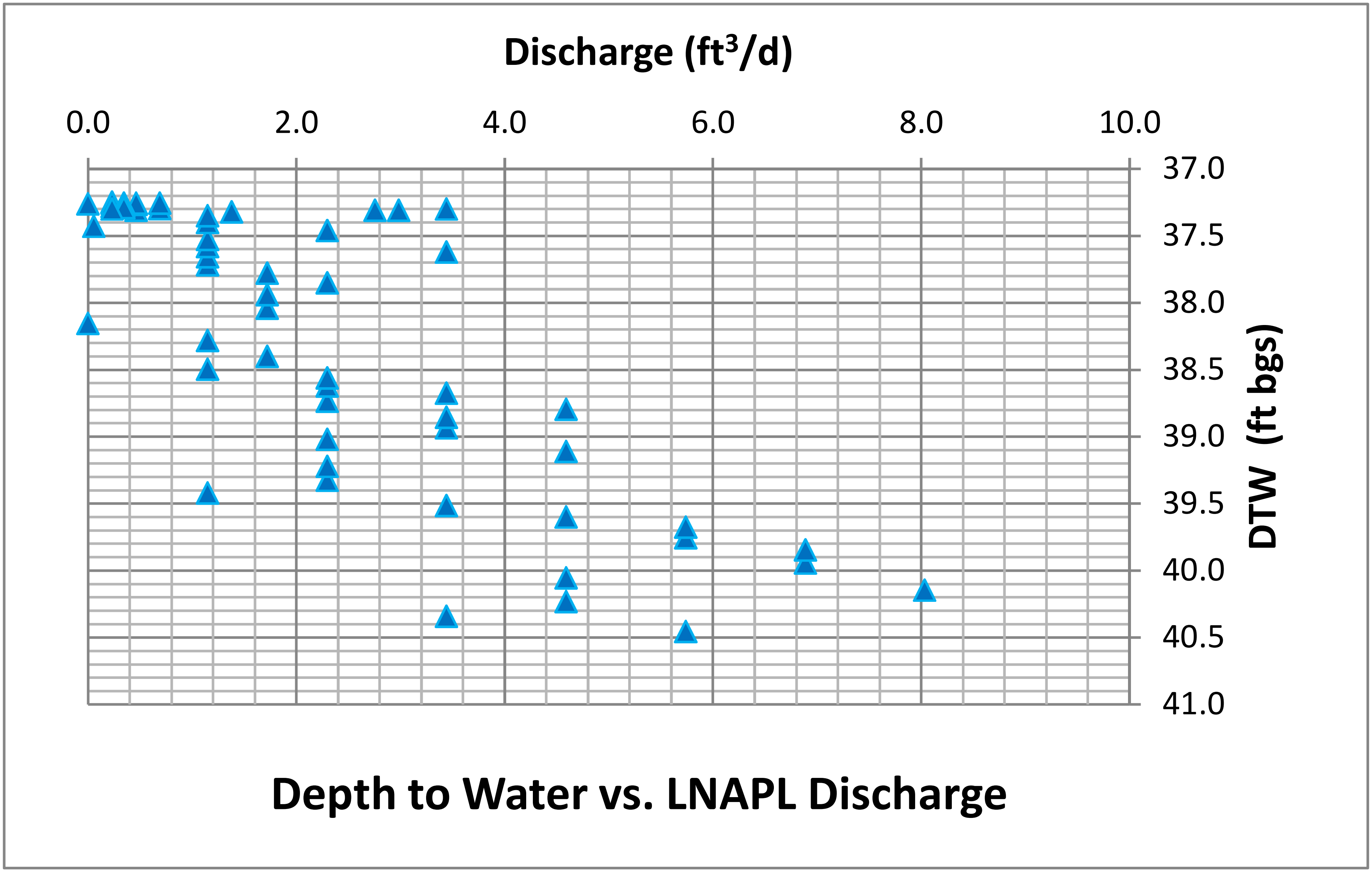
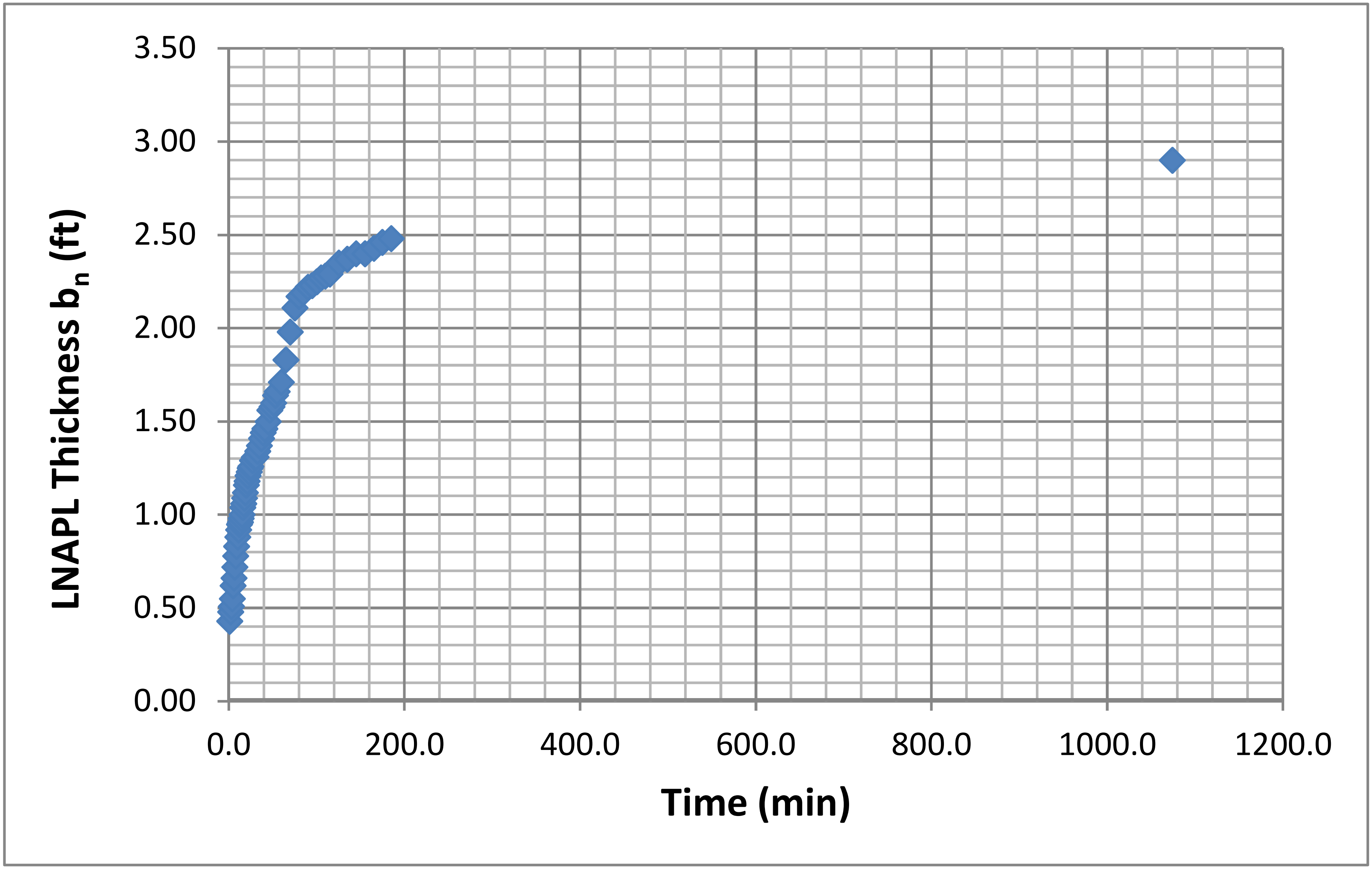

Discharge (ft³/d)
0.0
2.0
4.0
6.0
8.0
10.0
34.00
35.00
36.00
37.00
38.00
39.00
40.00
41.00
DTP (ft bgs)
Depth to Product vs. LNAPL Discharge

Figure 6



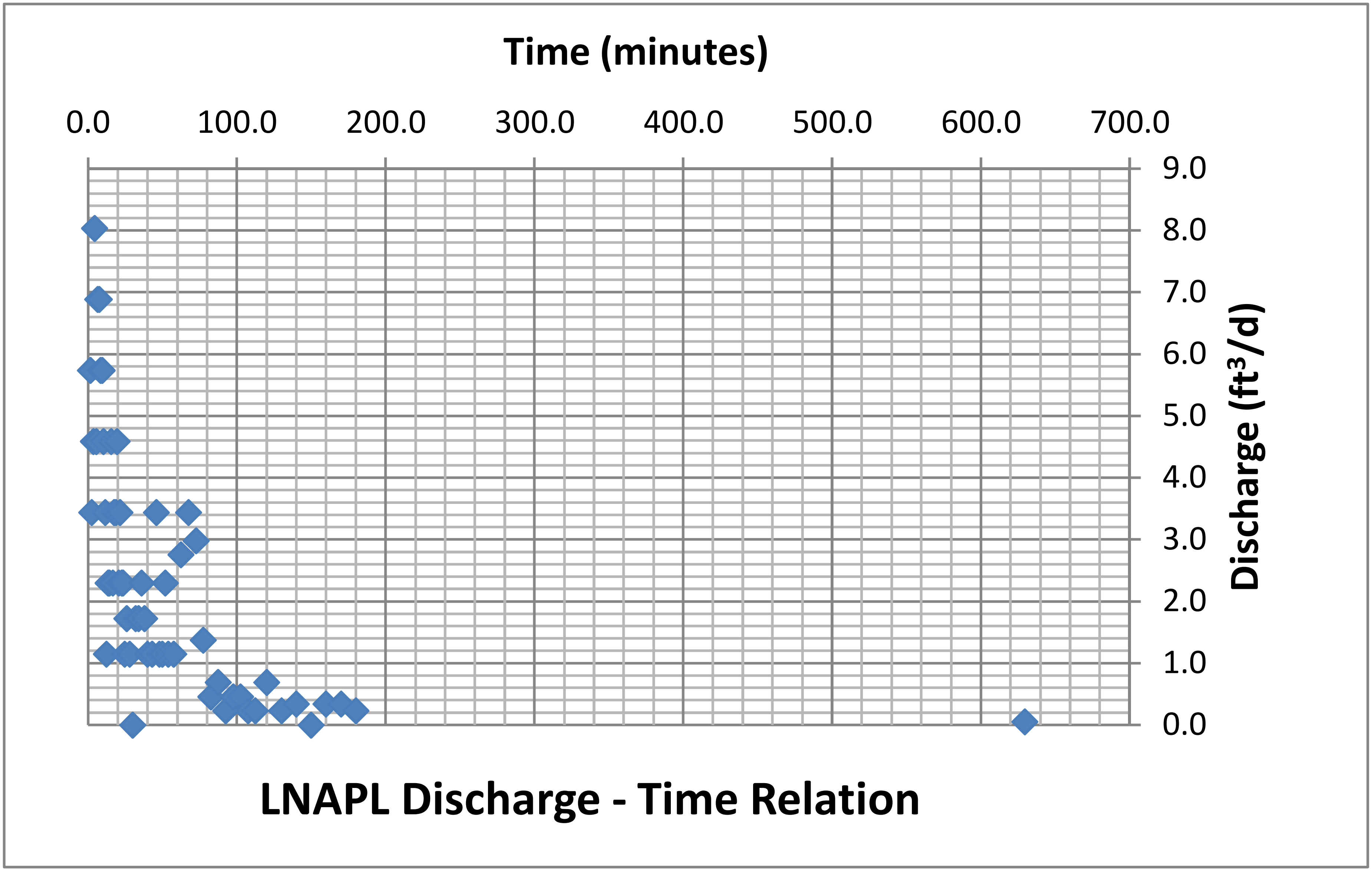
MW-16 (November 2017)
Baildown Test Data Analysis

Figure 7



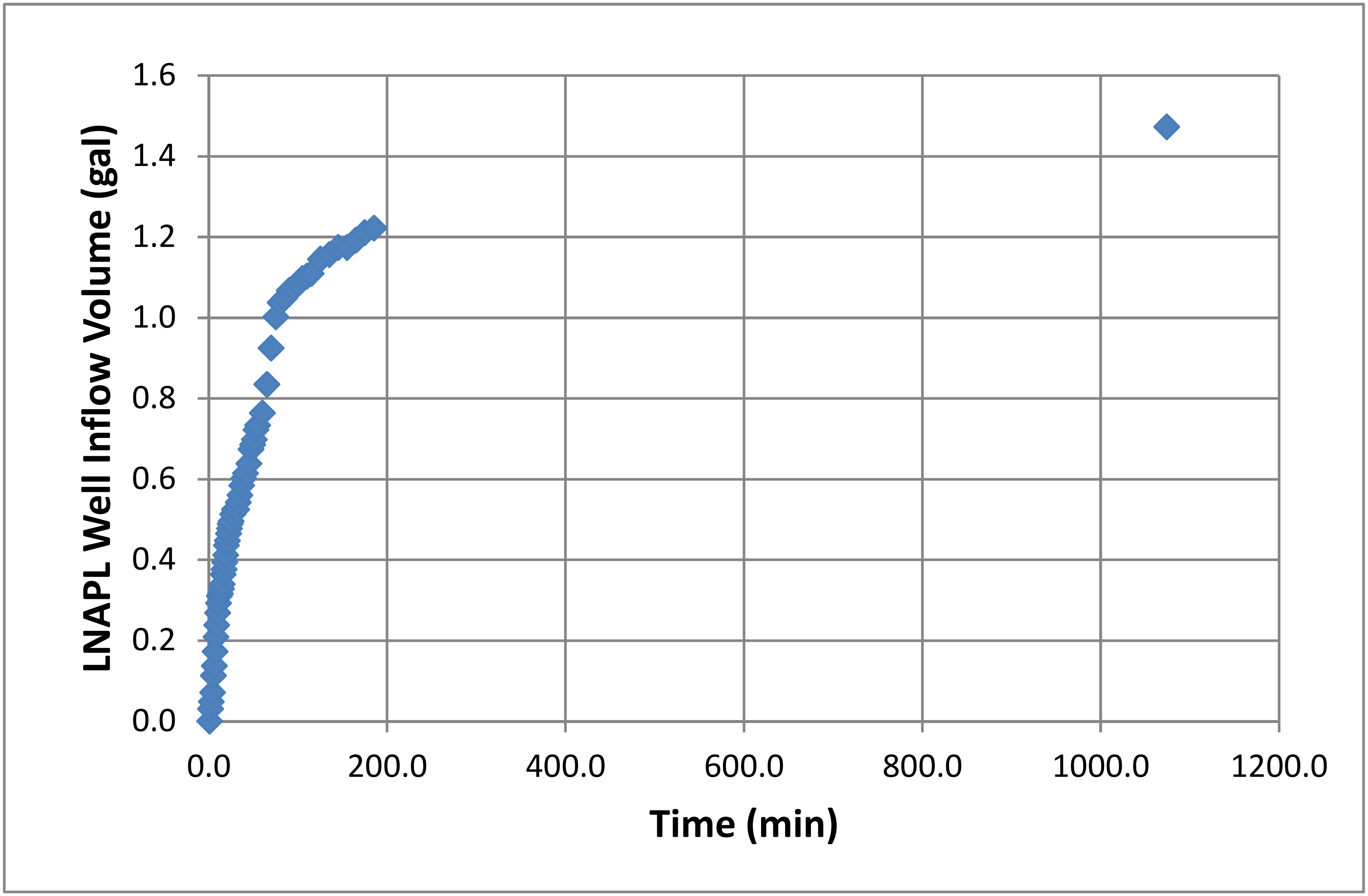
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
LNAPL Thickness b_n (ft)
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
Time (min)

Figure 8



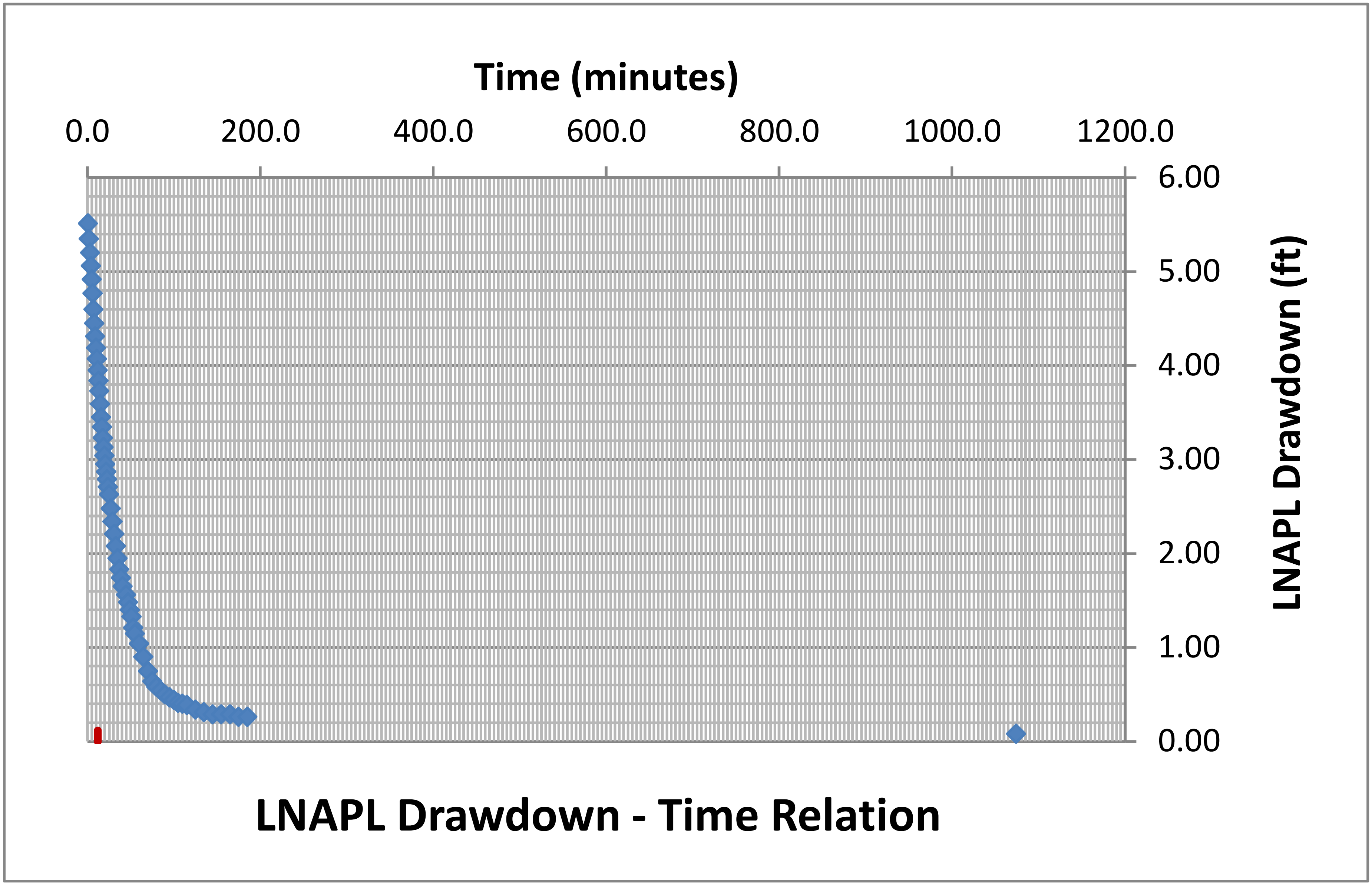
MW-16 (November 2017)
Baildown Test Data Analysis

Figure 9



1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
LNAPL Well Inflow Volume (gal)
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
Time (min)

Figure 10


Time (minutes)
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
6.00
5.00
4.00
3.00
2.00
1.00
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Time Relation

Generalized Bouwer and Rice (1976)

Well Designation:	MW-16
Date:	20-Nov-17

$$T_n = \frac{r_e^{\ 2} \ln(R/r_e)\ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

L_e/r_e
77.6
C
3.91
R/r_e
27.08

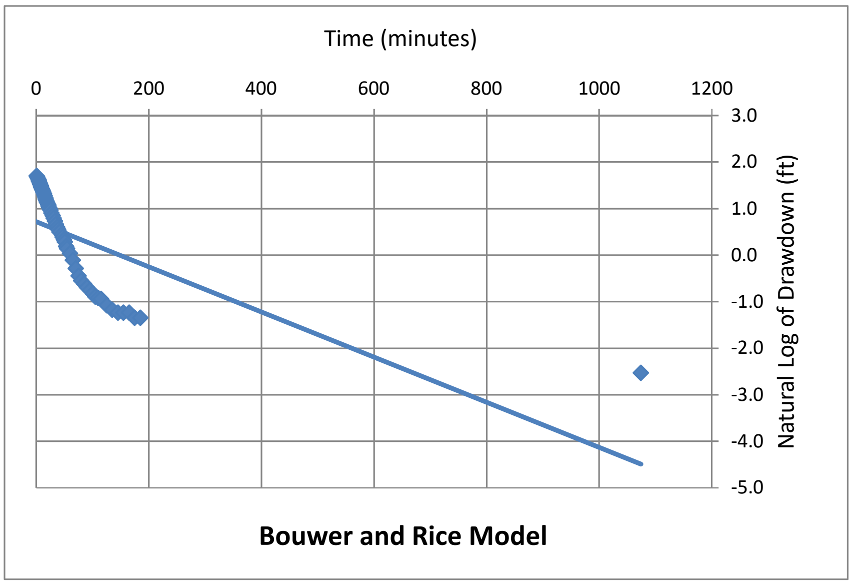
J-Ratio
-1.300

Coef. Of Variation
0.15

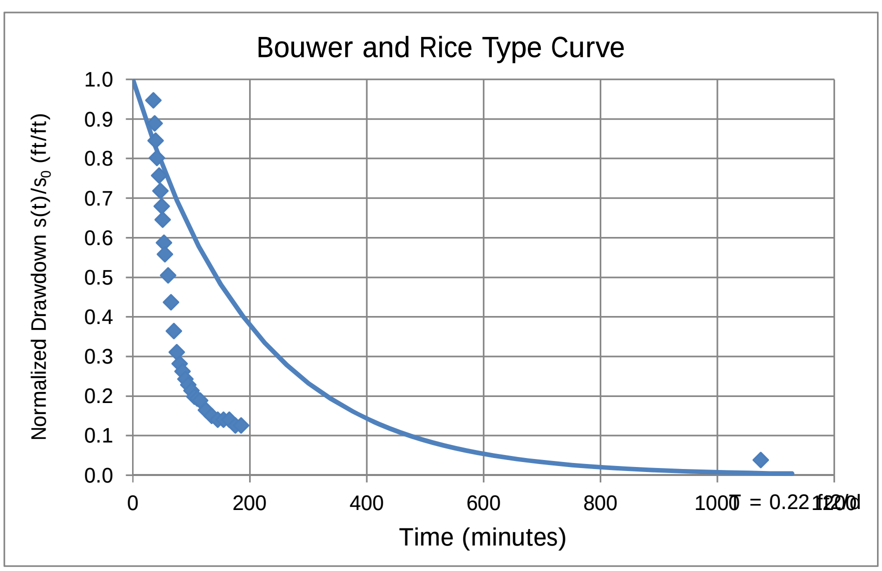
Enter early time cut-off for least-squares model fit

$Time_{cut}$	0	<- Enter or change value here

Model Results: T_n (ft^2/d) = 0.22 +/- 0.03 ft^2/d



C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW-16
Date:	20-Nov-17

$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

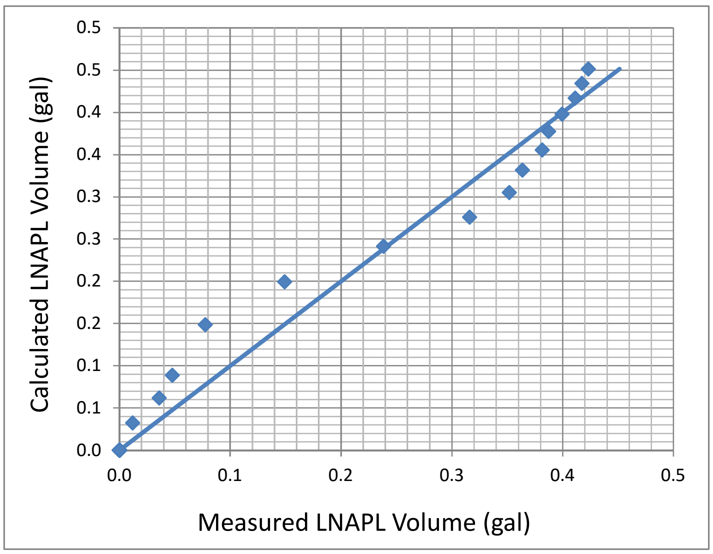
Enter early time cut-off for least-squares model fit

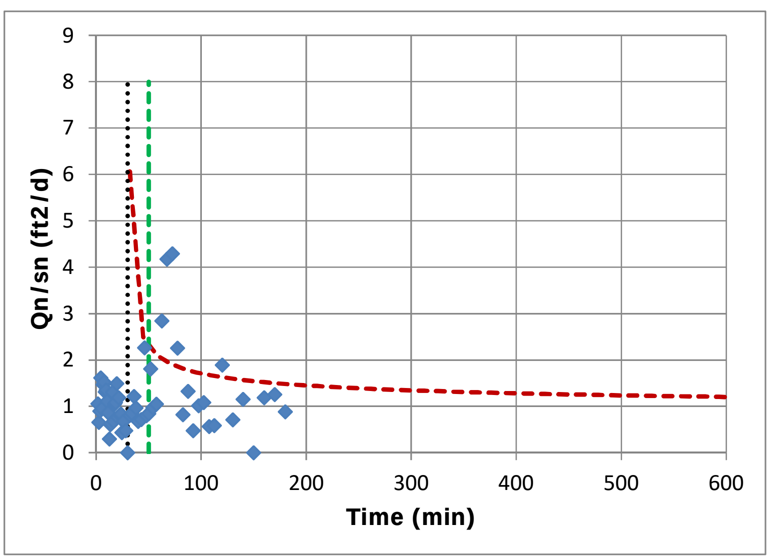
$Time_{cut}$ (min):	50	<- Enter or change values here
Time Adjustment (min):	30	

Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	0.131	<-- Minimize this using "Solver"
	0.021	<-- Working S_n
Trial T_n (ft^2/d):	0.673	<-- By changing T_n through "Solver"

Add constraint T_n > 0.00001

Model Result: T_n (ft^2/d) = **0.67**





Height

8

Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	MW-16
Date:	20-Nov-17

Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Initial Drawdown s_n (ft):	5.51	

Trial S_n: d <-- Enter d for default

Root-Mean-Square Error: 0.408 <-- Minimize this using "Solver"

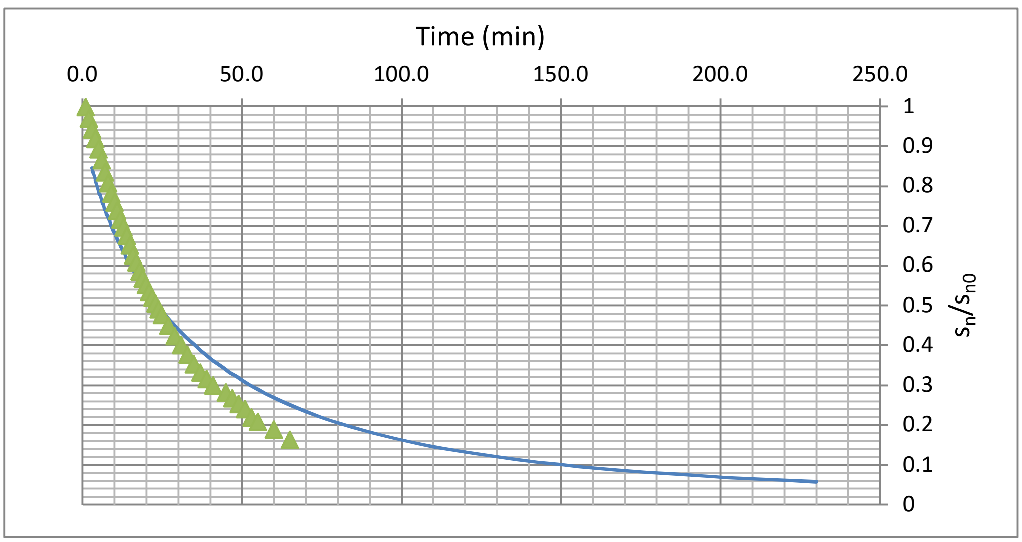
Trial T_n (ft^2/d): 0.831 <-- By changing T_n through "Solver"

0.023 <-- Working S_n

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **0.83**

T_{min}	3
T_{max}	230



J-Ratio
-1.300

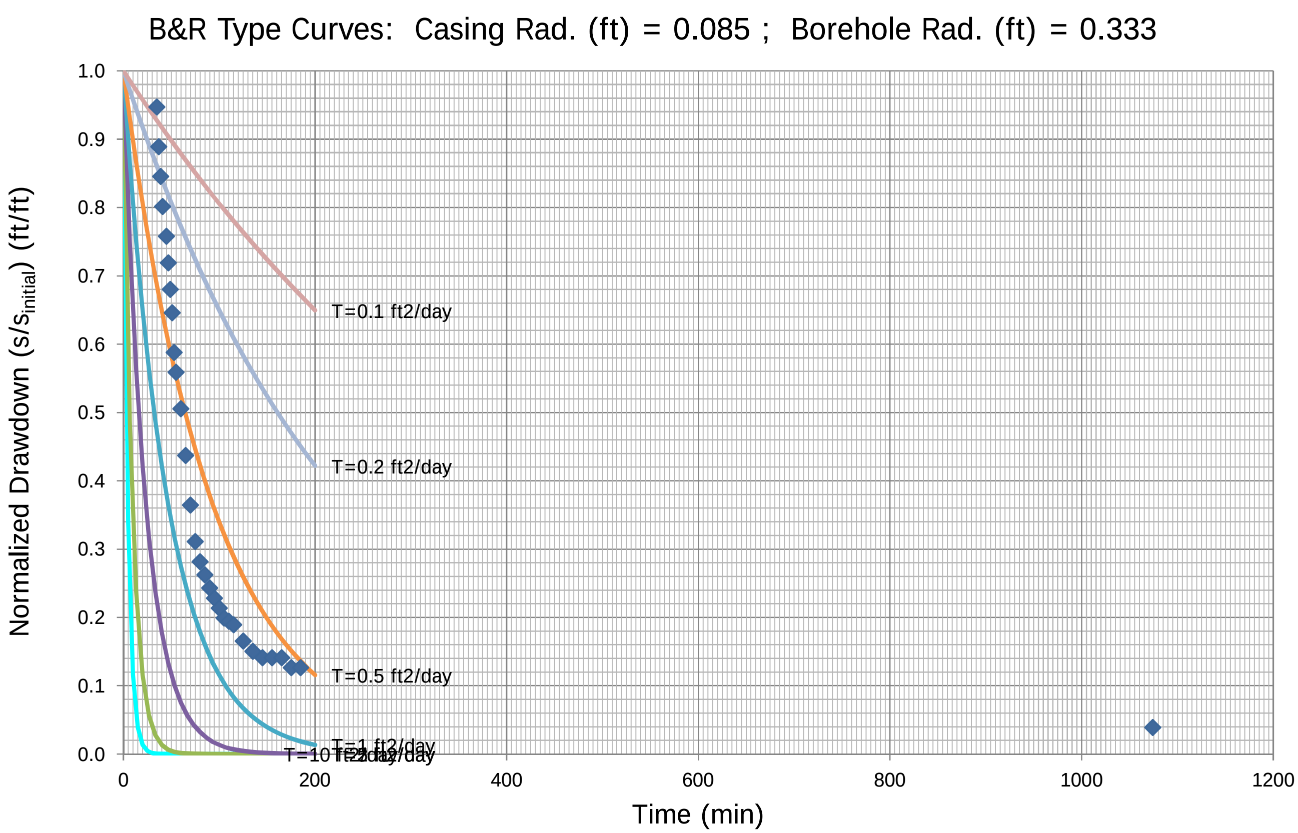
Bouwer and Rice Short Term LNAPL Mobility Test Type Curves

B&R Type Curves: Casing Rad. (ft) = 0.085 ; Borehole Rad. (ft) = 0.333

Enter these values

Type Curve ID	Type Curve Name	Notes	Max Time (min)	Transmissivity (ft^2/day)
1	T=10 ft2/day		150	10
2	T=5 ft2/day		200	5
3	T=2 ft2/day		200	2
4	T=1 ft2/day		200	1
5	T=0.5 ft2/day		200	0.5
6	T=0.2 ft2/day		200	0.2
7	T=0.1 ft2/day		200	0.1

J-Ratio		
-1.300	<-- If uncertain use	
	-0.22	



MW-16 (November 2017)
Baildown Test Data Analysis

API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)
0.58

Standard Deviation (ft^2/d)
0.31

Coefficient of Variation
0.55

Well Designation:	MW-16	
Date:	28-Mar-19	

Ground Surface Elev (ft msl)	1100.0	Enter These Data	**Drawdown Adjustment (ft)**
Top of Casing Elev (ft msl)	1099.5		
Well Casing Radius, r_c (ft):	0.085	r_{e1}	
Well Radius, r_w (ft):	0.333		1.3
LNAPL Specific Yield, S_y:	0.175		
LNAPL Density Ratio, ρ_r:	0.780		
Top of Screen (ft bgs):	20.0		
Bottom of Screen (ft bgs):	50.0		
LNAPL Baildown Vol. (gal.):	0.0		
Effective Radius, r_{e3} (ft):	0.159	Calculated Parameters	
Effective Radius, r_{e2} (ft):	#NUM!		
Initial Casing LNAPL Vol. (gal.):	1.24		
Initial Filter LNAPL Vol. (gal.):	3.12		

Enter Data Here

	Time (min)	DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)	Water Table Depth (ft)	LNAPL Drawdown s_n (ft)	Average Time (min)	LNAPL Discharge Q_n (ft^3/d)	s_n (ft)	b_n (ft)	r_e (ft)	DTP (ft bgs)	DTW (ft bgs)	LNAPL Volume (gallons)	Ave. r_e (ft)
Initial Fluid Levels:	0	39.37	46.69	39.87	47.19	41.48					7.32					
Enter Test Data:	1.0	43.51	43.78	44.01	44.28	44.07	2.84				0.27				0	0.159
	2.0	43.38	43.76	43.88	44.26	43.96	2.71	1.5	12.623	2.78	0.38	0.159	43.95	44.27	0.07	0
	3.0	43.25	43.73	43.75	44.23	43.86	2.58	2.5	11.475	2.65	0.48	0.159	43.82	44.25	0.13	0.159
	4.0	43.15	43.68	43.65	44.18	43.77	2.48	3.5	5.738	2.53	0.53	0.159	43.70	44.21	0.15	0.319
	5.0	43.06	43.63	43.56	44.13	43.69	2.39	4.5	4.590	2.44	0.57	0.159	43.61	44.16	0.18	0.478
	6.0	42.97	43.57	43.47	44.07	43.60	2.30	5.5	3.443	2.35	0.60	0.159	43.52	44.10	0.20	0.637
	7.0	42.90	43.51	43.40	44.01	43.53	2.23	6.5	1.148	2.27	0.61	0.159	43.44	44.04	0.20	0.796
	8.0	42.81	43.45	43.31	43.95	43.45	2.14	7.5	3.443	2.19	0.64	0.159	43.36	43.98	0.22	0.956
	9.0	42.75	43.40	43.25	43.90	43.39	2.08	8.5	1.148	2.11	0.65	0.159	43.28	43.93	0.23	1.115
	10.0	42.68	43.33	43.18	43.83	43.32	2.01	9.5	0.000	2.05	0.65	0.159	43.22	43.87	0.23	1.274
	11.0	42.61	43.28	43.11	43.78	43.26	1.94	10.5	2.295	1.98	0.67	0.159	43.15	43.80	0.24	1.433
	12.0	42.56	43.23	43.06	43.73	43.21	1.89	11.5	0.000	1.92	0.67	0.159	43.08	43.76	0.24	1.593
	13.0	42.51	43.19	43.01	43.69	43.16	1.84	12.5	1.148	1.87	0.68	0.159	43.04	43.71	0.24	1.752
	14.0	42.45	43.14	42.95	43.64	43.10	1.78	13.5	1.148	1.81	0.69	0.159	42.98	43.67	0.25	1.911
	15.0	42.40	43.10	42.90	43.60	43.05	1.73	14.5	1.148	1.76	0.70	0.159	42.93	43.62	0.26	2.070
	17.0	42.30	43.02	42.80	43.52	42.96	1.63	16.0	1.148	1.68	0.72	0.159	42.85	43.56	0.27	2.309
	19.0	42.20	42.95	42.70	43.45	42.87	1.53	18.0	1.721	1.58	0.75	0.159	42.75	43.49	0.29	2.628
	21.0	42.11	42.88	42.61	43.38	42.78	1.44	20.0	1.148	1.49	0.77	0.159	42.66	43.42	0.30	2.946
	23.0	42.02	42.82	42.52	43.32	42.70	1.35	22.0	1.721	1.40	0.80	0.159	42.56	43.35	0.32	3.265
	25.0	41.94	42.77	42.44	43.27	42.62	1.27	24.0	1.721	1.31	0.83	0.159	42.48	43.30	0.33	3.584
	27.0	41.87	42.72	42.37	43.22	42.56	1.20	26.0	1.148	1.24	0.85	0.159	42.41	43.25	0.35	3.902
	29.0	41.80	42.67	42.30	43.17	42.49	1.13	28.0	1.148	1.17	0.87	0.159	42.33	43.20	0.36	4.221
	31.0	41.73	42.63	42.23	43.13	42.43	1.06	30.0	1.721	1.10	0.90	0.159	42.27	43.15	0.38	4.539
	33.0	41.67	42.60	42.17	43.10	42.37	1.00	32.0	1.721	1.03	0.93	0.159	42.20	43.12	0.39	4.858
	35.0	41.61	42.56	42.11	43.06	42.32	0.94	34.0	1.148	0.97	0.95	0.159	42.14	43.08	0.41	5.176
	37.0	41.55	42.53	42.05	43.03	42.27	0.88	36.0	1.721	0.91	0.98	0.159	42.08	43.05	0.42	5.495
	39	41.50	42.50	42.00	43.00	42.22	0.83	38.0	1.148	0.86	1.00	0.159	42.03	43.02	0.44	5.813
	41	41.45	42.47	41.95	42.97	42.17	0.78	40.0	1.148	0.81	1.02	0.159	41.98	42.99	0.45	6.132
	43	41.41	42.45	41.91	42.95	42.14	0.74	42.0	1.148	0.76	1.04	0.159	41.93	42.96	0.46	6.450
	45	41.37	42.43	41.87	42.93	42.10	0.70	44.0	1.148	0.72	1.06	0.159	41.89	42.94	0.47	6.769
	47	41.33	42.40	41.83	42.90	42.07	0.66	46.0	0.574	0.68	1.07	0.159	41.85	42.92	0.48	7.087
	49	41.29	42.38	41.79	42.88	42.03	0.62	48.0	1.148	0.64	1.09	0.159	41.81	42.89	0.49	7.406
	51	41.25	42.37	41.75	42.87	42.00	0.58	50.0	1.721	0.60	1.12	0.159	41.77	42.88	0.51	7.724
	53	41.23	42.35	41.73	42.85	41.98	0.56	52.0	0.000	0.57	1.12	0.159	41.74	42.86	0.51	8.043
	55.0	41.20	42.33	41.70	42.83	41.95	0.53	54.0	0.574	0.55	1.13	0.159	41.72	42.84	0.51	8.362
	60.0	41.13	42.29	41.63	42.79	41.89	0.46	57.5	0.689	0.50	1.16	0.159	41.67	42.81	0.53	8.919
	65.0	41.07	42.26	41.57	42.76	41.83	0.40	62.5	0.689	0.43	1.19	0.159	41.60	42.78	0.55	9.715
	70.0	41.03	42.23	41.53	42.73	41.79	0.36	67.5	0.230	0.38	1.20	0.159	41.55	42.75	0.55	10.512
	75.0	40.99	42.20	41.49	42.70	41.76	0.32	72.5	0.230	0.34	1.21	0.159	41.51	42.72	0.56	11.308
	80.0	40.95	42.18	41.45	42.68	41.72	0.28	77.5	0.459	0.30	1.23	0.159	41.47	42.69	0.57	12.104
	85.0	40.92	42.16	41.42	42.66	41.69	0.25	82.5	0.230	0.27	1.24	0.159	41.44	42.67	0.58	12.901
	95.0	40.87	42.13	41.37	42.63	41.65	0.20	90.0	0.230	0.23	1.26	0.159	41.40	42.65	0.59	14.095
	105.0	40.83	42.10	41.33	42.60	41.61	0.16	100.0	0.115	0.18	1.27	0.159	41.35	42.62	0.60	15.688
	115.0	40.80	42.09	41.30	42.59	41.58	0.13	110.0	0.230	0.15	1.29	0.159	41.31	42.59	0.61	17.281
	431	40.68	42.06	41.18	42.56	41.48	0.01	273.0	0.033	0.07	1.38	0.159	41.24	42.57	0.66	43.241
	1276	40.82	42.24	41.32	42.74	41.63	0.15	853.5	0.005	0.08	1.42	0.159	41.25	42.65	0.69	135.696

Figure 1

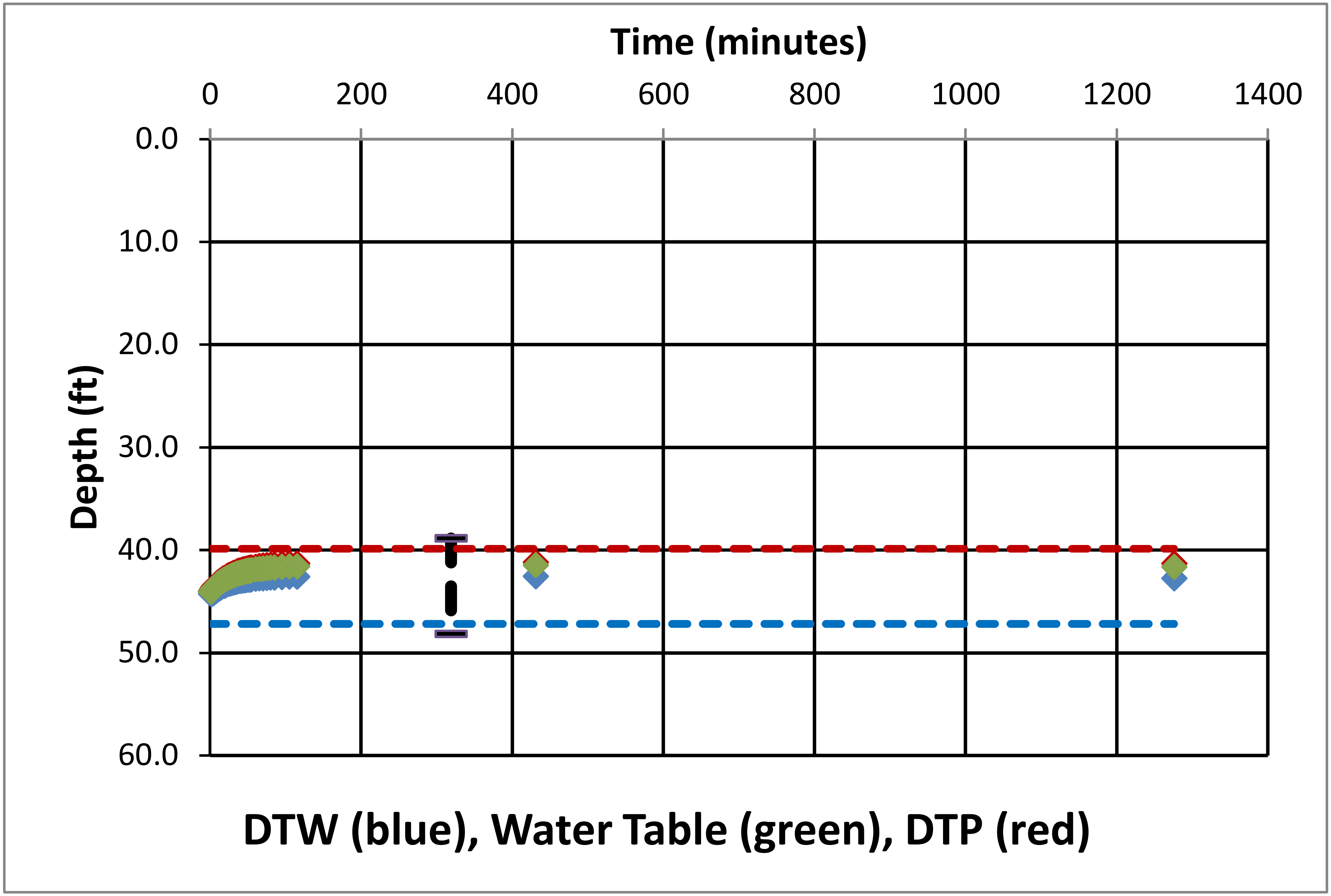
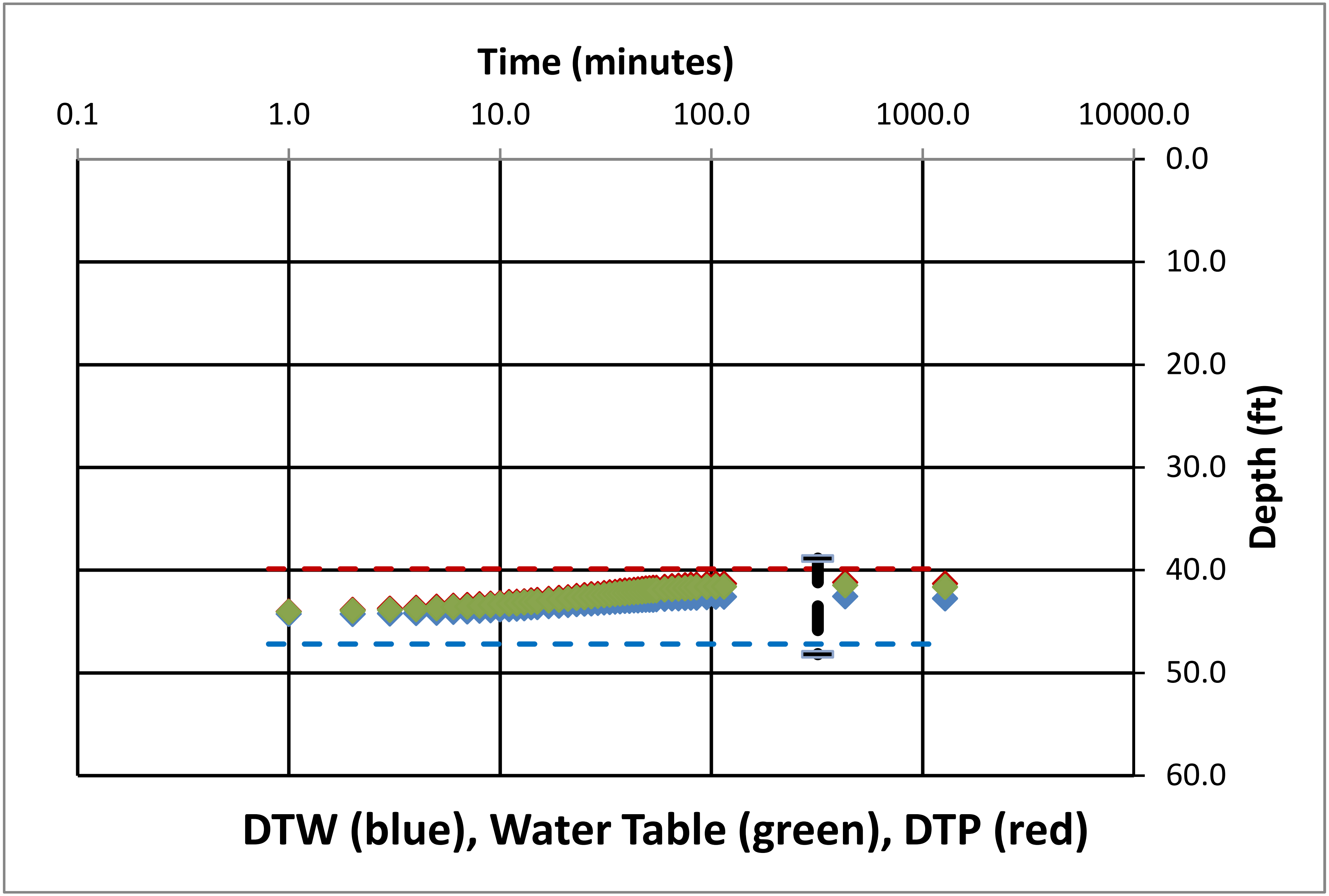

Time (minutes)
0
200
400
600
800
1000
1200
1400
0.0
10.0
20.0
30.0
40.0
50.0
60.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 2



MW-16 (March 2019)
Baildown Test Data Analysis

Figure 3

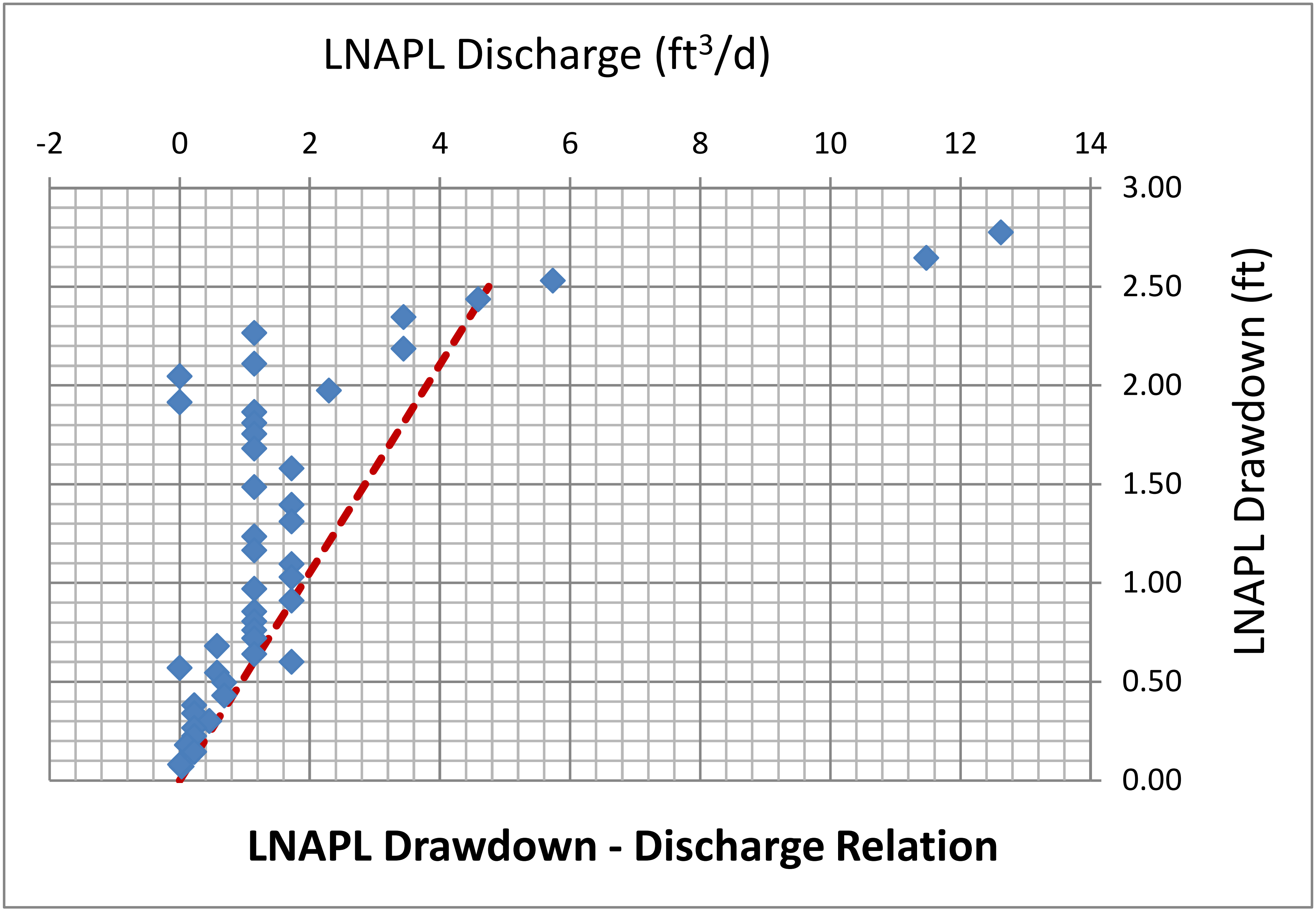

LNAPL Discharge (ft³/d)
-2
0
2
4
6
8
10
12
14
3.00
2.50
2.00
1.50
1.00
0.50
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Discharge Relation

Figure 4

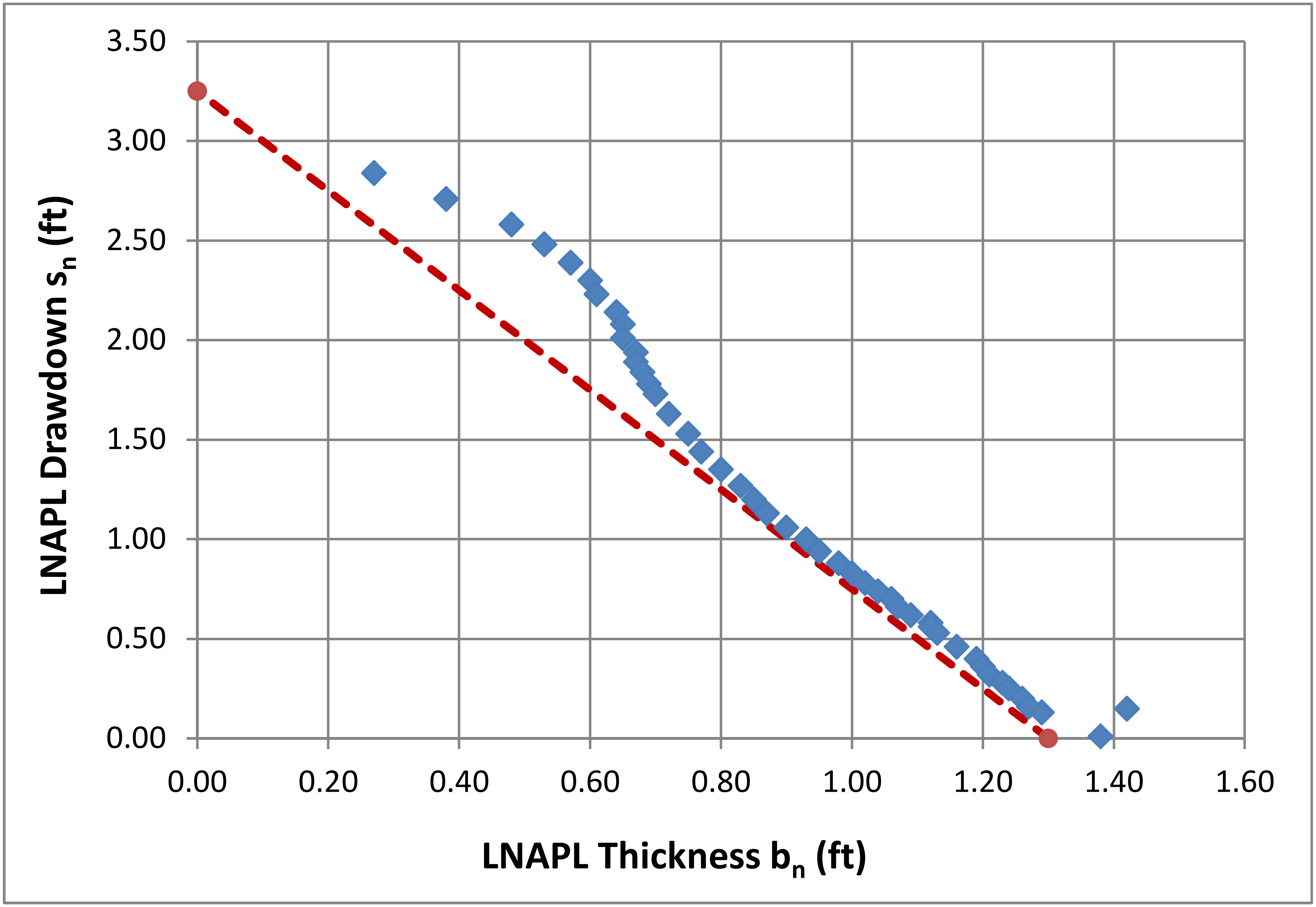
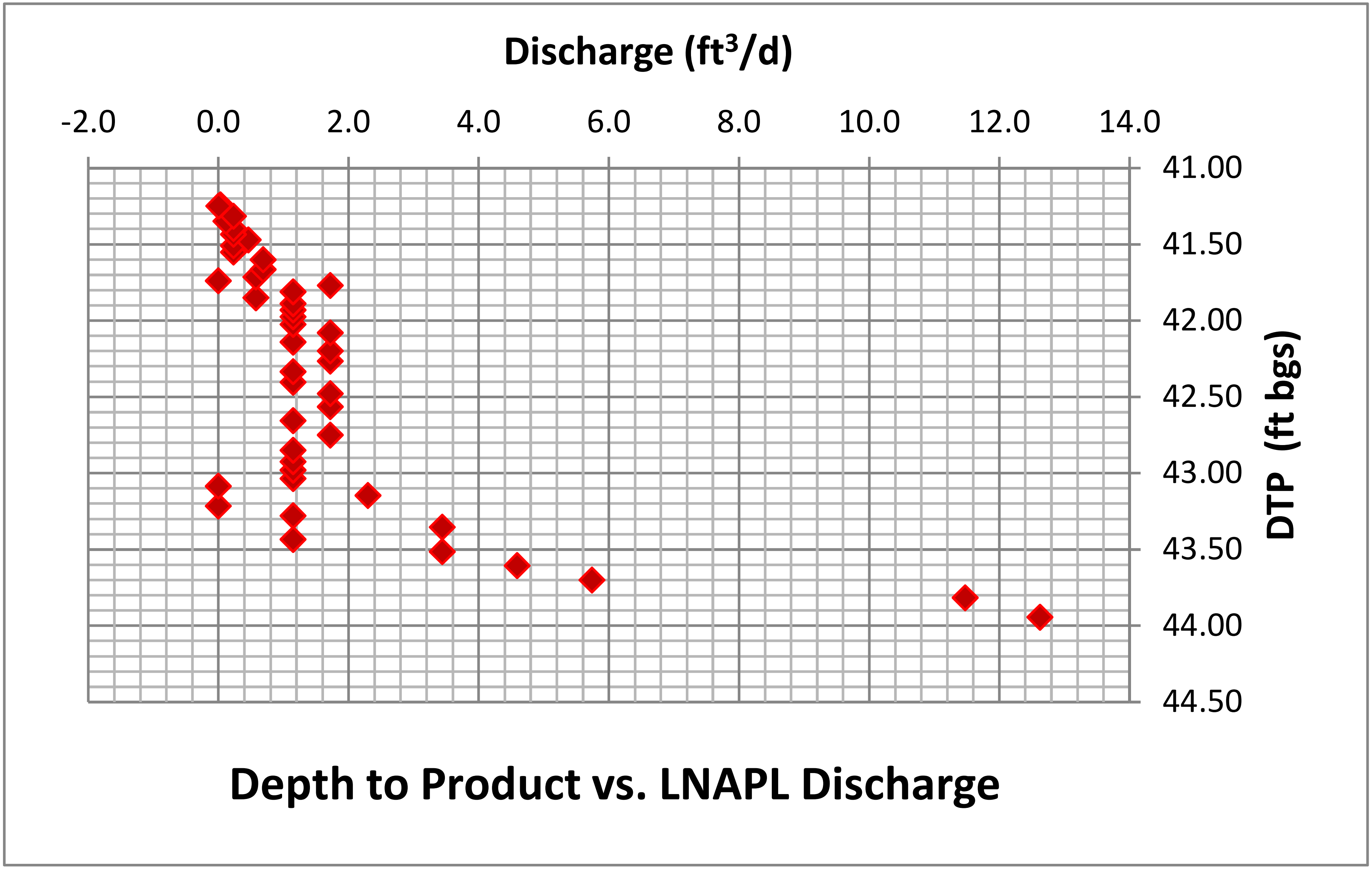
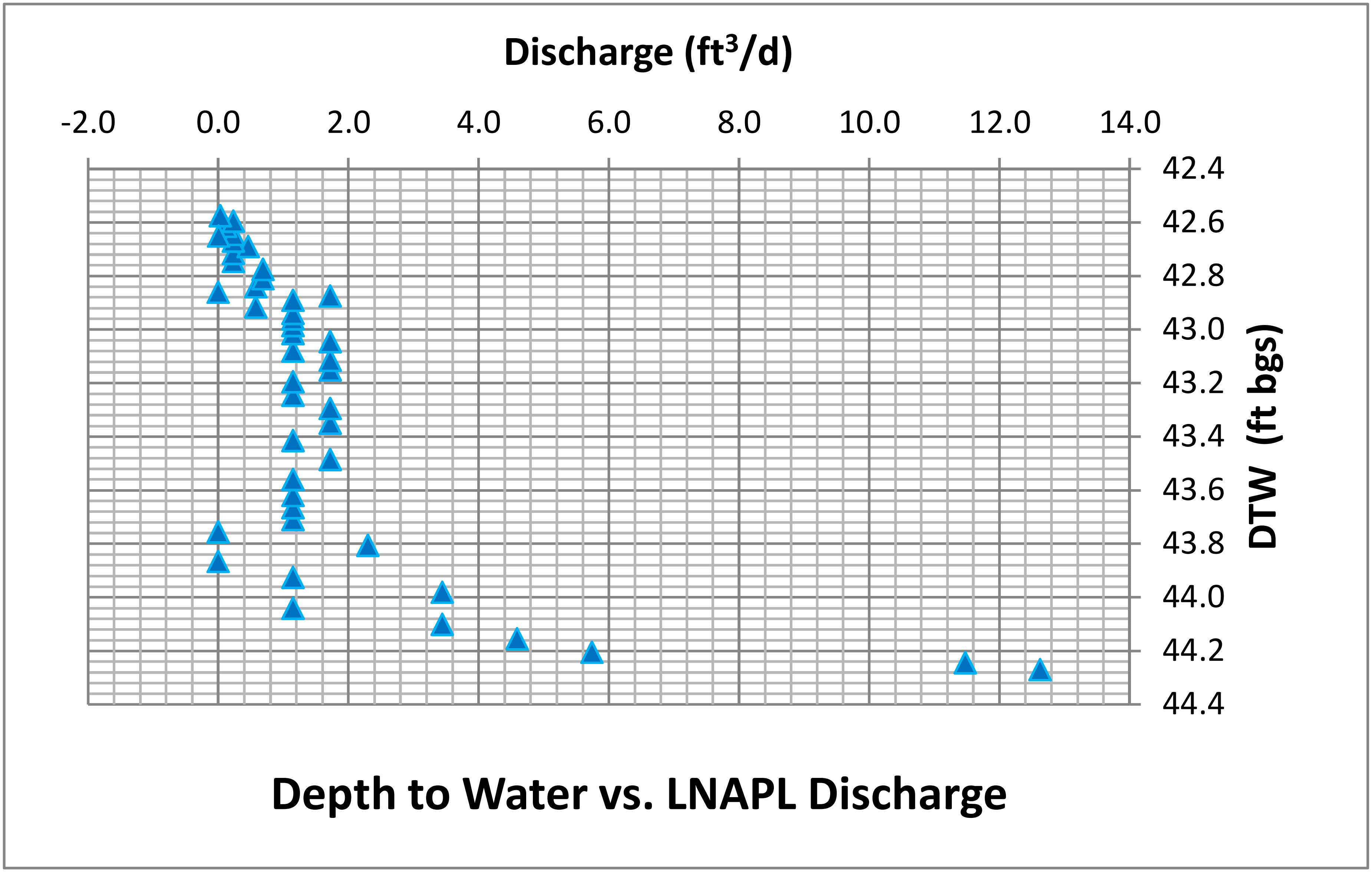

3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
LNAPL Drawdown s_n (ft)
LNAPL Thickness b_n (ft)

Figure 5



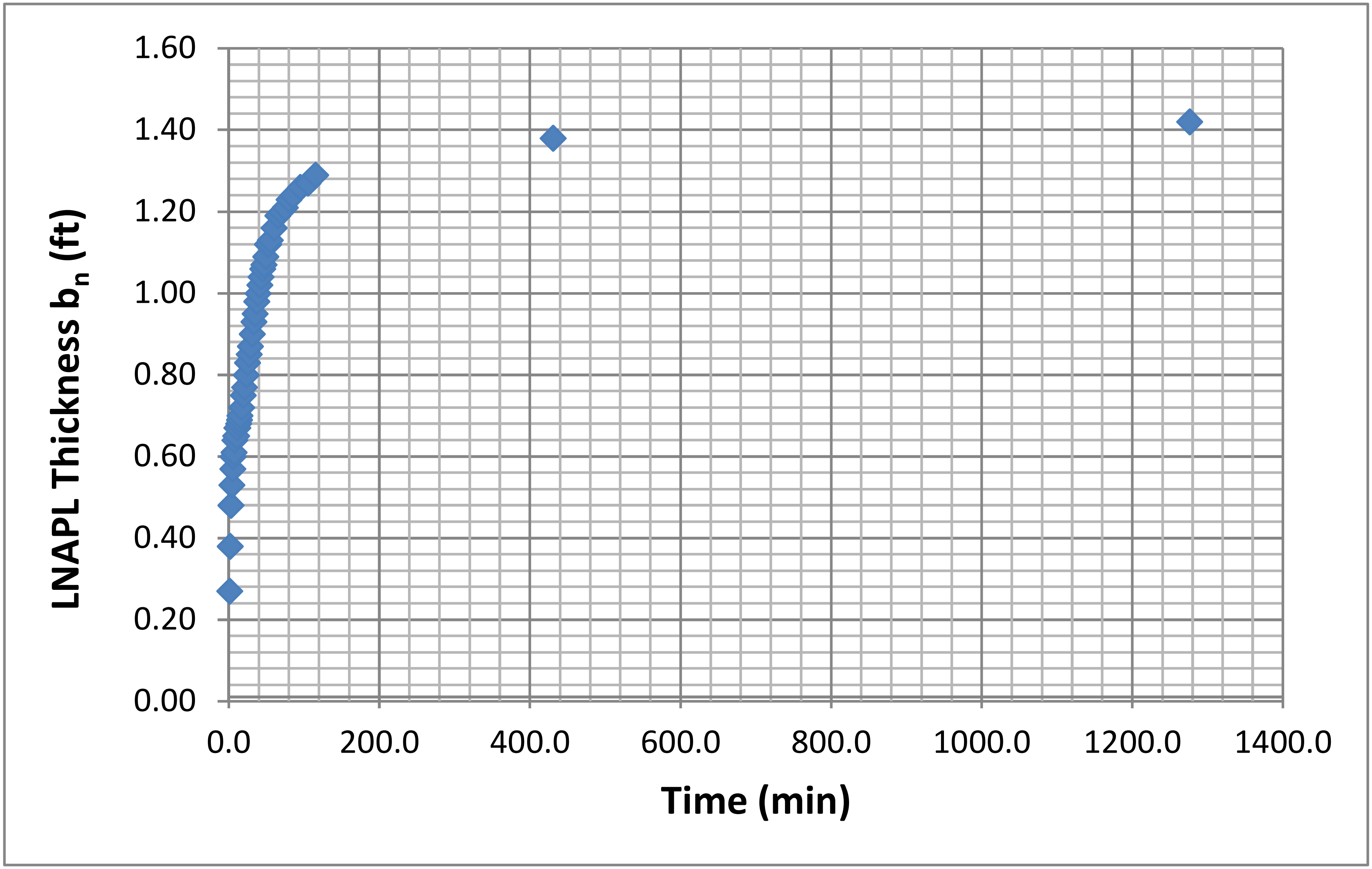
Discharge (ft³/d)
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
41.00
41.50
42.00
42.50
43.00
43.50
44.00
44.50
DTP (ft bgs)
Depth to Product vs. LNAPL Discharge

Figure 6



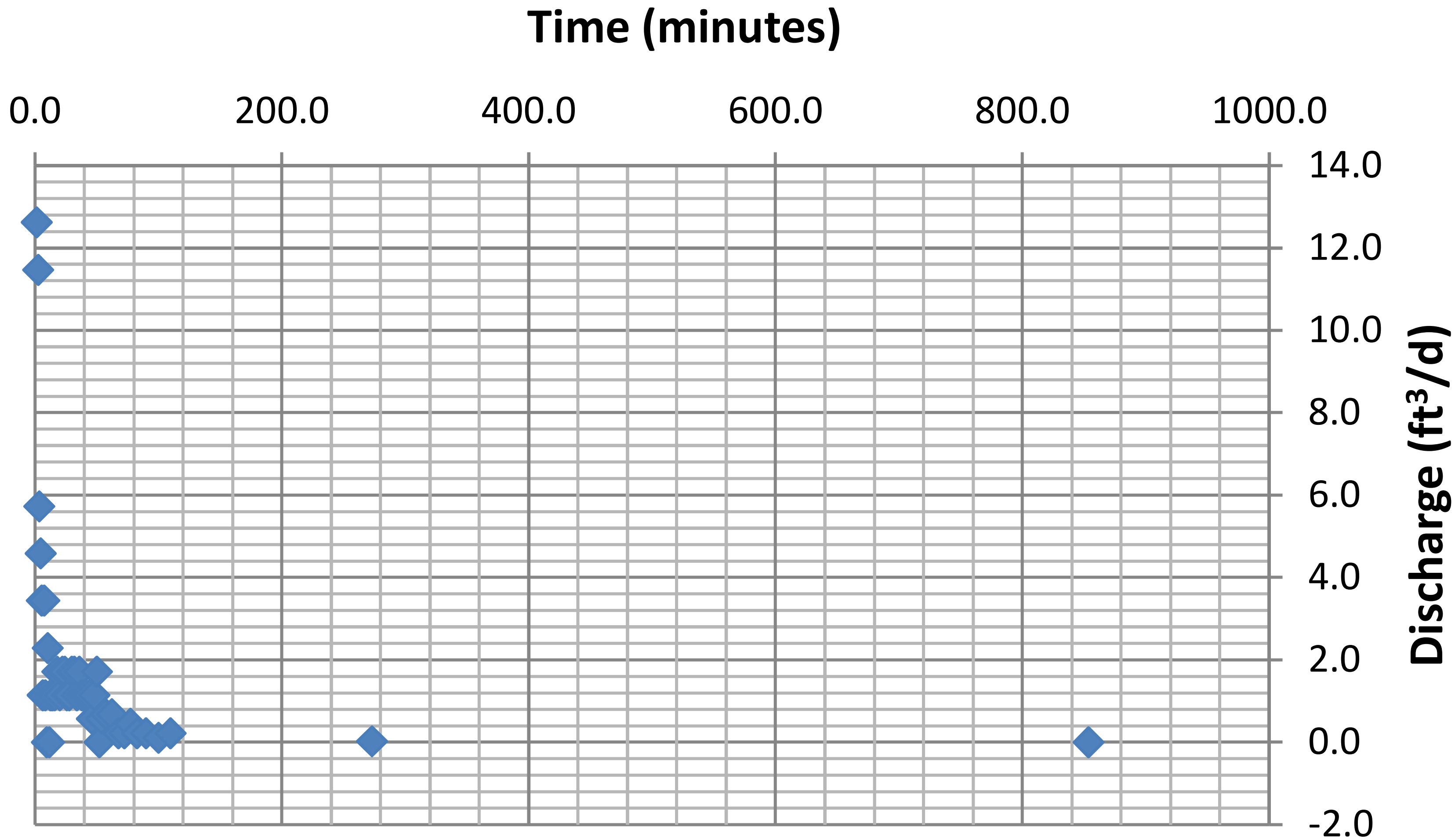
Depth to Water vs. LNAPL Discharge

Figure 7



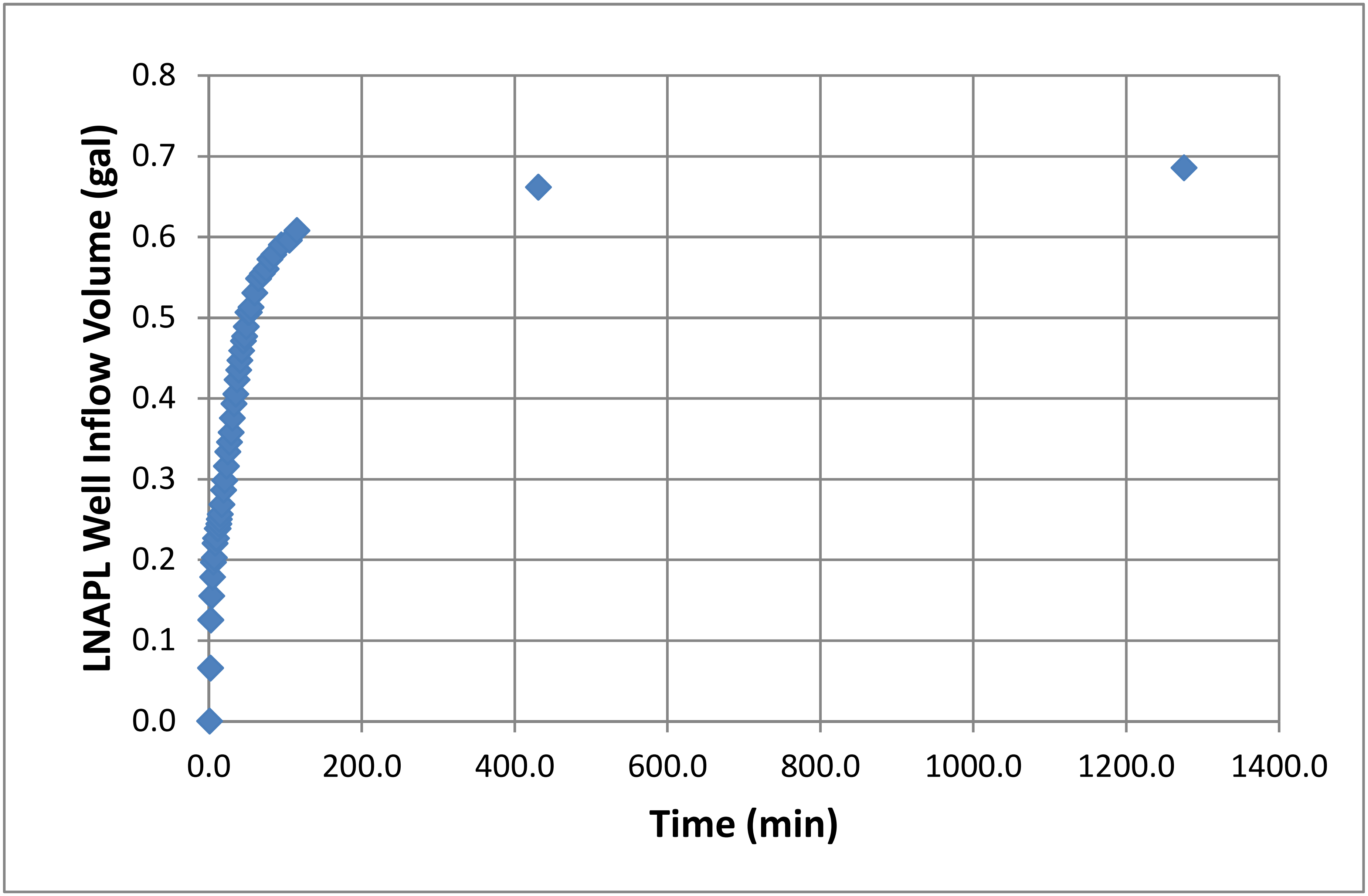
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
LNAPL Thickness b_n (ft)
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
1400.0
Time (min)

Figure 8



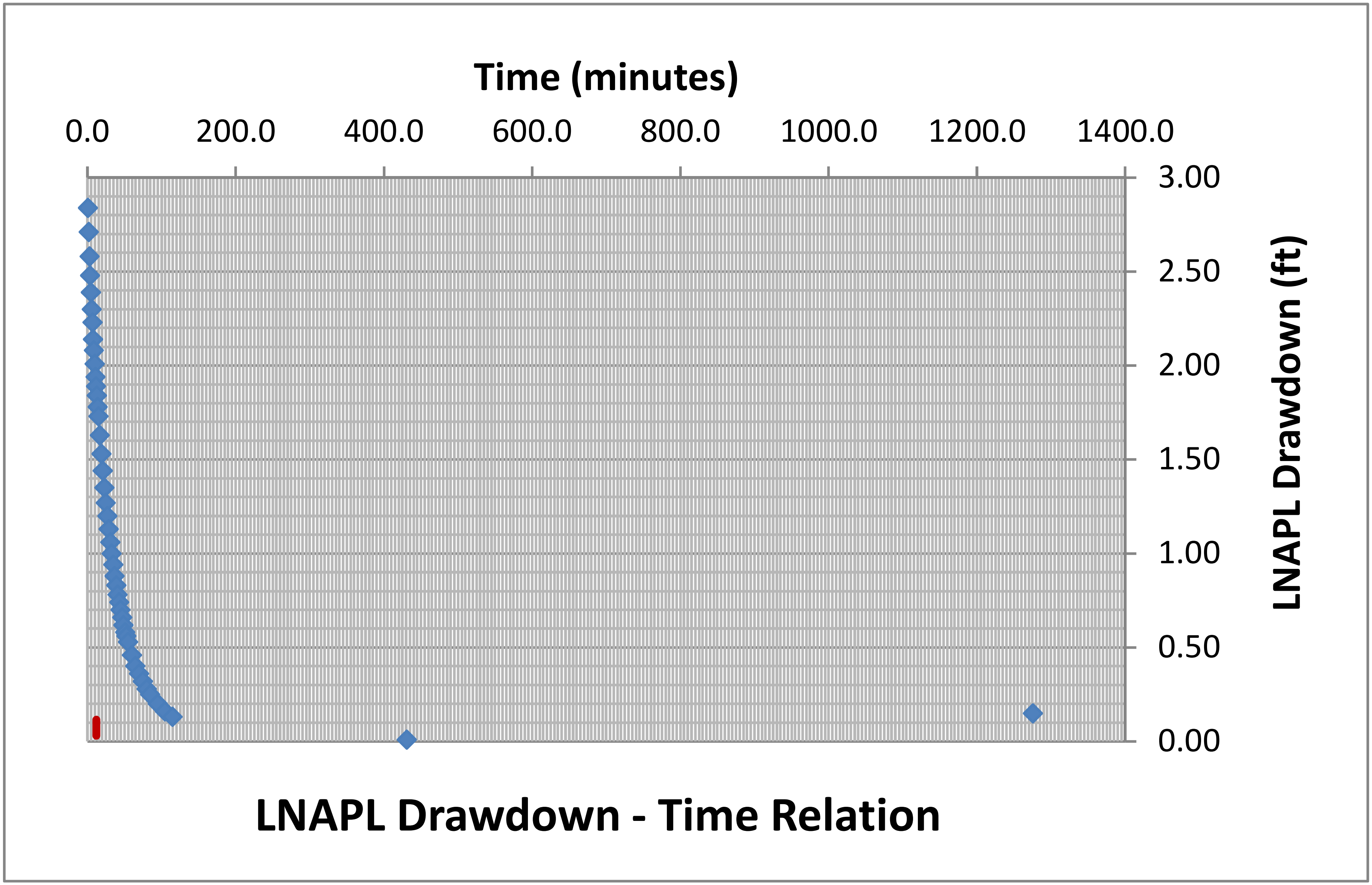
LNAPL Discharge - Time Relation

Figure 9



0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
LNAPL Well Inflow Volume (gal)
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
1400.0
Time (min)

Figure 10



Time (minutes)
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
1400.0
3.00
2.50
2.00
1.50
1.00
0.50
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Time Relation

Generalized Bouwer and Rice (1976)

Well Designation:	MW-16
Date:	28-Mar-19

$$T_n = \frac{r_e^{\,2} \ln(R/r_e)\ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

L_e/r_e
46.0
C
2.63
R/r_e
18.21

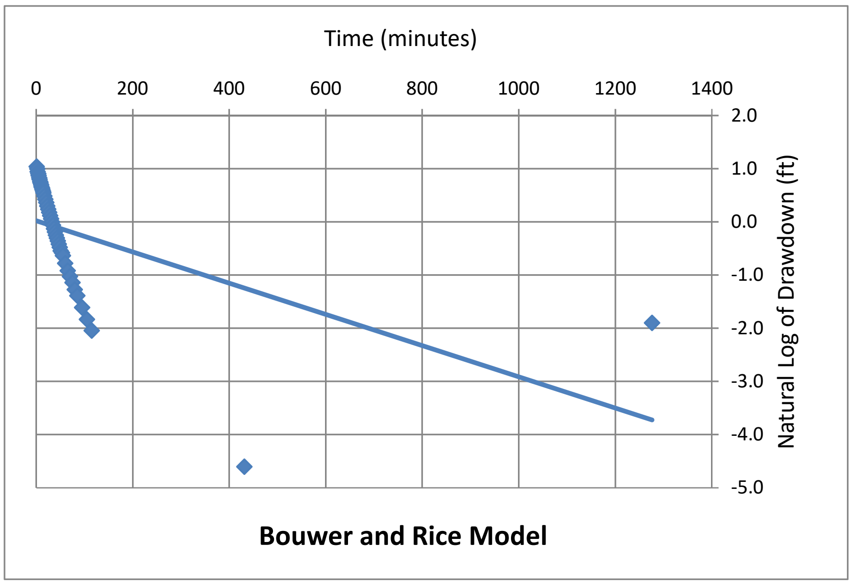
Enter early time cut-off for least-squares model fit

$Time_{cut}$	0	<- Enter or change value here

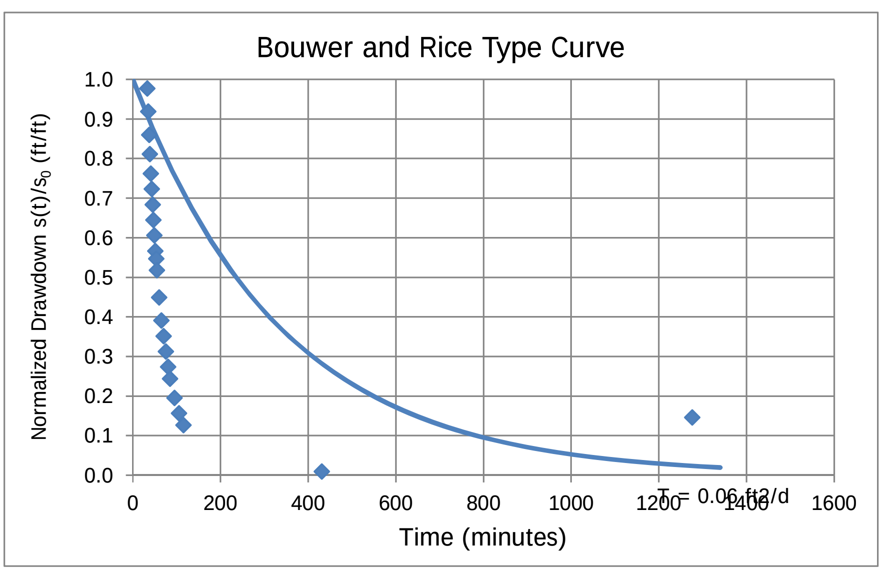
Model Results: T_n (ft^2/d) = 0.06 +/- 0.02 ft^2/d

J-Ratio
-2.500

Coef. Of Variation
0.25



C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW-16
Date:	28-Mar-19

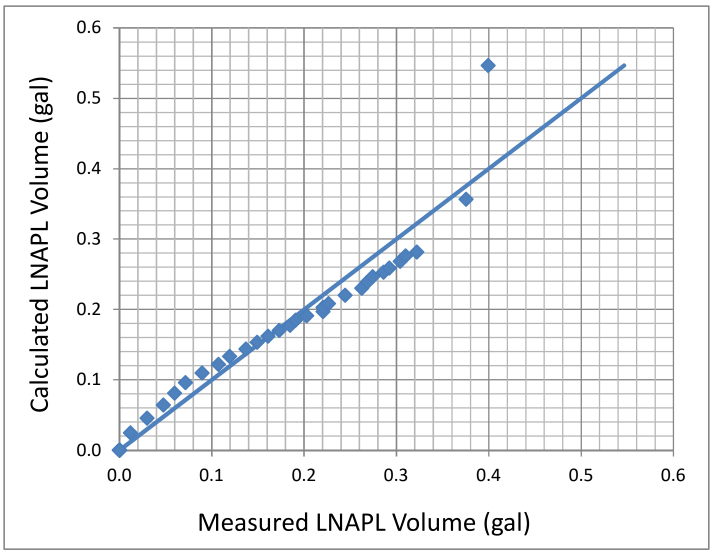
$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

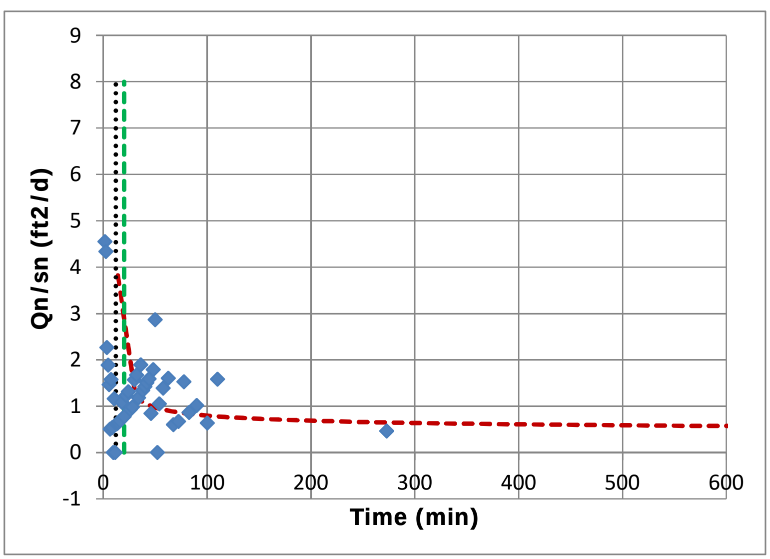
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	20	<- Enter or change values here
Time Adjustment (min):	12	
Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	0.189	<-- Minimize this using "Solver"
	0.014	<-- Working S_n
Trial T_n (ft^2/d):	0.303	<-- By changing T_n through "Solver"

Add constraint T_n > 0.00001

Model Result: T_n (ft^2/d) = **0.30**





Height

8

Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	MW-16
Date:	28-Mar-19

Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Initial Drawdown s_n (ft):	2.84	

Trial S_n: d <-- Enter d for default

Root-Mean-Square Error: 0.341 <-- Minimize this using "Solver"

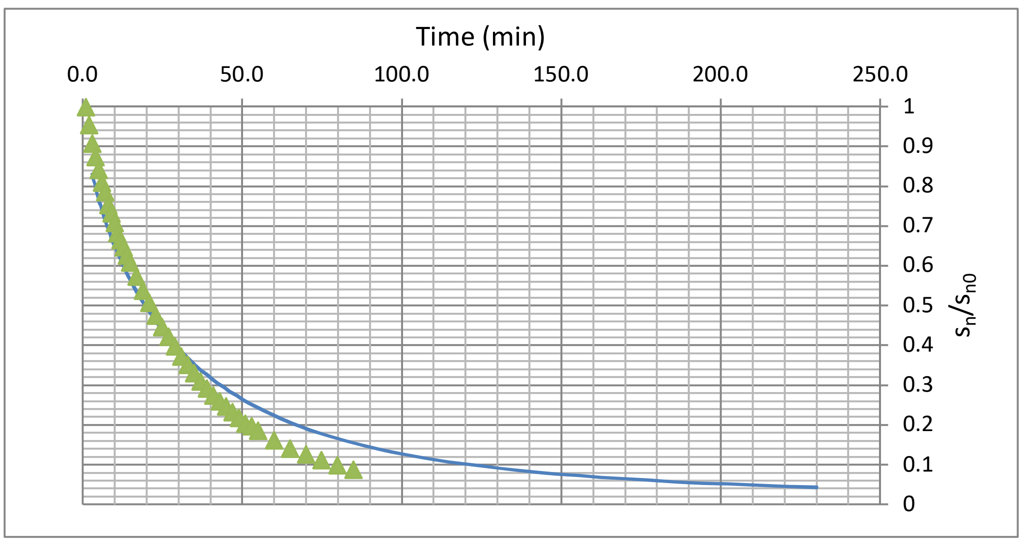
Trial T_n (ft^2/d): 0.550 <-- By changing T_n through "Solver"

0.019 <-- Working S_n

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **0.55**

T_{min}	3
T_{max}	230



J-Ratio
-2.500

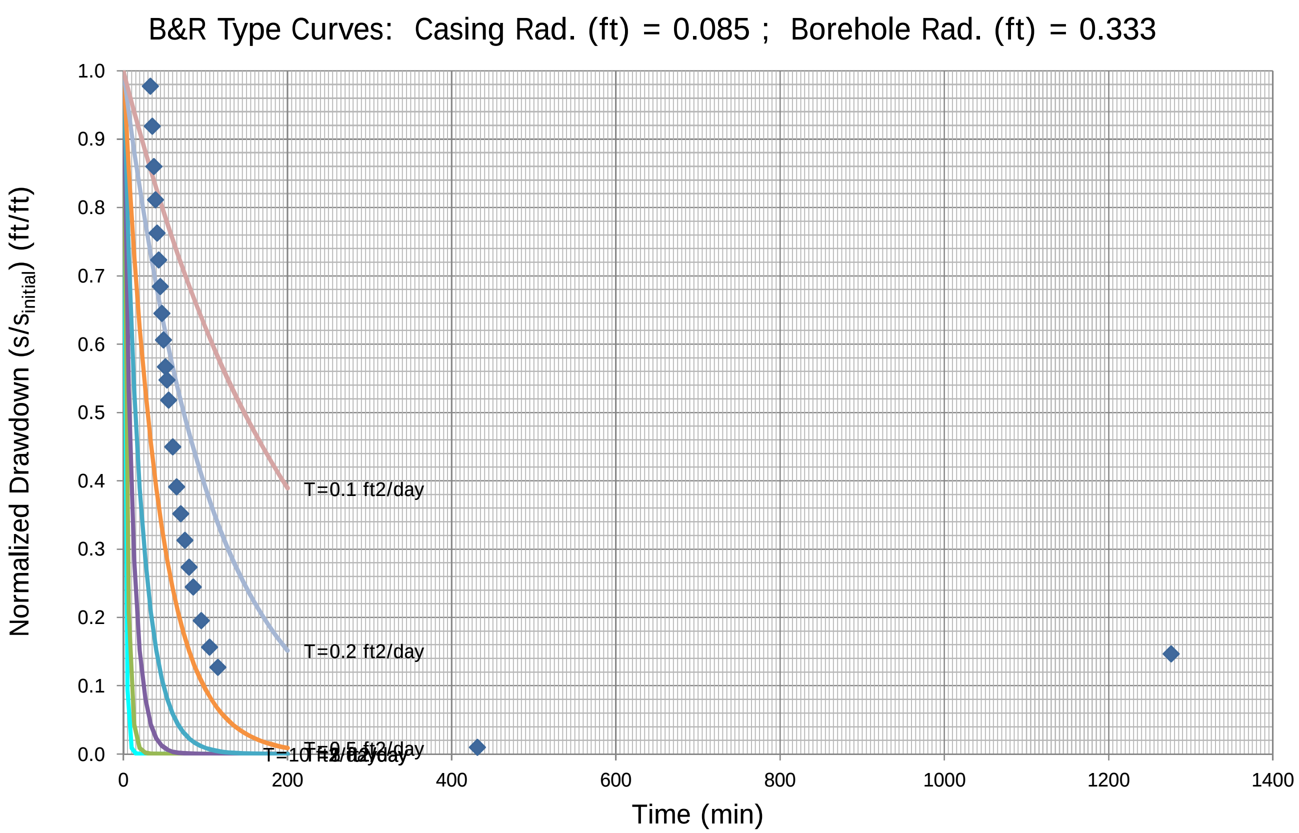
Bouwer and Rice Short Term LNAPL Mobility Test Type Curves

B&R Type Curves: Casing Rad. (ft) = 0.085 ; Borehole Rad. (ft) = 0.333

Enter these values

Type Curve ID	Type Curve Name	Notes	Max Time (min)	Transmissivity (ft^2/day)
1	T=10 ft2/day		150	10
2	T=5 ft2/day		200	5
3	T=2 ft2/day		200	2
4	T=1 ft2/day		200	1
5	T=0.5 ft2/day		200	0.5
6	T=0.2 ft2/day		200	0.2
7	T=0.1 ft2/day		200	0.1

J-Ratio	
-2.500	<-- If uncertain use
	-0.22



API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)
0.31

Standard Deviation (ft^2/d)
0.24

Coefficient of Variation
0.80

Well Designation:	MW-21	
Date:	20-Nov-17	

Ground Surface Elev (ft msl)	0.0	Enter These Data	**Drawdown Adjustment (ft)**
Top of Casing Elev (ft msl)	0.0		1.8
Well Casing Radius, r_c (ft):	0.085	r_{e1}	
Well Radius, r_w (ft):	0.333		
LNAPL Specific Yield, S_y:	0.175		
LNAPL Density Ratio, ρ_r:	0.780		
Top of Screen (ft bgs):	0.0		
Bottom of Screen (ft bgs):	0.0		
LNAPL Baildown Vol. (gal.):	0.0		
Effective Radius, r_{e3} (ft):	0.159	Calculated Parameters	
Effective Radius, r_{e2} (ft):	#NUM!		
Initial Casing LNAPL Vol. (gal.):	2.56		
Initial Filter LNAPL Vol. (gal.):	6.43		

Enter Data Here

	Time (min)	DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)	Water Table Depth (ft)	LNAPL Drawdown s_n (ft)	Average Time (min)	LNAPL Discharge Q_n (ft^3/d)	s_n (ft)	b_n (ft)	r_e (ft)	DTP (ft bgs)	DTW (ft bgs)	LNAPL Volume (gallons)	Ave. r_e (ft)
Initial Fluid Levels:	0	19.54	34.63	19.54	34.63	22.86					15.09					
Enter Test Data:	1.0	27.37	27.89	27.37	27.89	27.48	6.03				0.52				0	0.159
	2.0	27.21	27.76	27.21	27.76	27.33	5.87	1.5	3.443	5.95	0.55	0.159	27.29	27.83	0.02	0
	3.0	27.06	27.66	27.06	27.66	27.19	5.72	2.5	5.738	5.80	0.60	0.159	27.14	27.71	0.05	0.159
	4.0	26.90	27.54	26.90	27.54	27.04	5.56	3.5	4.590	5.64	0.64	0.159	26.98	27.60	0.07	0.319
	5.0	26.73	27.46	26.73	27.46	26.89	5.39	4.5	10.328	5.48	0.73	0.159	26.82	27.50	0.13	0.478
	6.0	26.56	27.36	26.56	27.36	26.74	5.22	5.5	8.033	5.31	0.80	0.159	26.65	27.41	0.17	0.637
	7.0	26.40	27.26	26.40	27.26	26.59	5.06	6.5	6.885	5.14	0.86	0.159	26.48	27.31	0.20	0.796
	8.0	26.25	27.15	26.25	27.15	26.45	4.91	7.5	4.590	4.99	0.90	0.159	26.33	27.21	0.23	0.956
	9.0	26.12	27.05	26.12	27.05	26.32	4.78	8.5	3.443	4.85	0.93	0.159	26.19	27.10	0.24	1.115
	10.0	25.98	26.95	25.98	26.95	26.19	4.64	9.5	4.590	4.71	0.97	0.159	26.05	27.00	0.27	1.274
	11.0	25.84	26.85	25.84	26.85	26.06	4.50	10.5	4.590	4.57	1.01	0.159	25.91	26.90	0.29	1.433
	12.0	25.71	26.75	25.71	26.75	25.94	4.37	11.5	3.443	4.44	1.04	0.159	25.78	26.80	0.31	1.593
	13.0	25.57	26.64	25.57	26.64	25.81	4.23	12.5	3.443	4.30	1.07	0.159	25.64	26.70	0.33	1.752
	14.0	25.46	26.55	25.46	26.55	25.70	4.12	13.5	2.295	4.18	1.09	0.159	25.52	26.60	0.34	1.911
	15.0	25.36	26.47	25.36	26.47	25.60	4.02	14.5	2.295	4.07	1.11	0.159	25.41	26.51	0.35	2.070
	16.0	25.26	26.38	25.26	26.38	25.51	3.92	15.5	1.148	3.97	1.12	0.159	25.31	26.43	0.36	2.230
	18.0	25.08	26.22	25.08	26.22	25.33	3.74	17.0	1.148	3.83	1.14	0.159	25.17	26.30	0.37	2.469
	20.0	24.90	26.05	24.90	26.05	25.15	3.56	19.0	0.574	3.65	1.15	0.159	24.99	26.14	0.38	2.787
	22.0	24.71	25.88	24.71	25.88	24.97	3.37	21.0	1.148	3.47	1.17	0.159	24.81	25.97	0.39	3.106
	24.0	24.53	25.72	24.53	25.72	24.79	3.19	23.0	1.148	3.28	1.19	0.159	24.62	25.80	0.40	3.424
	26.0	24.37	25.58	24.37	25.58	24.64	3.03	25.0	1.148	3.11	1.21	0.159	24.45	25.65	0.41	3.743
	28.0	24.22	25.45	24.22	25.45	24.49	2.88	27.0	1.148	2.96	1.23	0.159	24.30	25.52	0.42	4.061
	30.0	24.06	25.31	24.06	25.31	24.34	2.72	29.0	1.148	2.80	1.25	0.159	24.14	25.38	0.44	4.380
	32.0	23.91	25.19	23.91	25.19	24.19	2.57	31.0	1.721	2.65	1.28	0.159	23.99	25.25	0.45	4.698
	34.0	23.78	25.10	23.78	25.10	24.07	2.44	33.0	2.295	2.51	1.32	0.159	23.85	25.15	0.48	5.017
	36.0	23.65	25.02	23.65	25.02	23.95	2.31	35.0	2.869	2.38	1.37	0.159	23.72	25.06	0.51	5.335
	38.0	23.53	24.93	23.53	24.93	23.84	2.19	37.0	1.721	2.25	1.40	0.159	23.59	24.98	0.52	5.654
	40	23.42	24.86	23.42	24.86	23.74	2.08	39.0	2.295	2.14	1.44	0.159	23.48	24.90	0.55	5.973
	42	23.31	24.80	23.31	24.80	23.64	1.97	41.0	2.869	2.03	1.49	0.159	23.37	24.83	0.58	6.291
	44	23.21	24.72	23.21	24.72	23.54	1.87	43.0	1.148	1.92	1.51	0.159	23.26	24.76	0.59	6.610
	46	23.11	24.65	23.11	24.65	23.45	1.77	45.0	1.721	1.82	1.54	0.159	23.16	24.69	0.61	6.928
	48	23.02	24.60	23.02	24.60	23.37	1.68	47.0	2.295	1.73	1.58	0.159	23.07	24.63	0.63	7.247
	50	22.93	24.54	22.93	24.54	23.28	1.59	49.0	1.721	1.64	1.61	0.159	22.98	24.57	0.65	7.565
	52	22.85	24.48	22.85	24.48	23.21	1.51	51.0	1.148	1.55	1.63	0.159	22.89	24.51	0.66	7.884
	54.0	22.77	24.43	22.77	24.43	23.14	1.43	53.0	1.721	1.47	1.66	0.159	22.81	24.46	0.68	8.202
	57.0	22.65	24.37	22.65	24.37	23.03	1.31	55.5	2.295	1.37	1.72	0.159	22.71	24.40	0.72	8.600
	60.0	22.54	24.31	22.54	24.31	22.93	1.20	58.5	1.913	1.26	1.77	0.159	22.60	24.34	0.75	9.078
	65.0	22.33	24.24	22.33	24.24	22.75	0.99	62.5	3.213	1.10	1.91	0.159	22.44	24.28	0.83	9.715
	70.0	22.15	24.19	22.15	24.19	22.60	0.81	67.5	2.984	0.90	2.04	0.159	22.24	24.22	0.91	10.512
	75.0	22.03	24.15	22.03	24.15	22.50	0.69	72.5	1.836	0.75	2.12	0.159	22.09	24.17	0.95	11.308
	80.0	21.93	24.13	21.93	24.13	22.41	0.59	77.5	1.836	0.64	2.20	0.159	21.98	24.14	1.00	12.104
	85.0	21.86	24.11	21.86	24.11	22.36	0.52	82.5	1.148	0.56	2.25	0.159	21.90	24.12	1.03	12.901
	90.0	21.80	24.10	21.80	24.10	22.31	0.46	87.5	1.148	0.49	2.30	0.159	21.83	24.11	1.06	13.697

95.0	21.75	24.08	21.75	24.08	22.26	0.41	92.5	0.689	0.44	2.33	0.159	21.78	24.09	1.08	14.493
100	21.71	24.06	21.71	24.06	22.23	0.37	97.5	0.459	0.39	2.35	0.159	21.73	24.07	1.09	15.290
105	21.69	24.05	21.69	24.05	22.21	0.35	102.5	0.230	0.36	2.36	0.159	21.70	24.06	1.10	16.086
110	21.65	24.04	21.65	24.04	22.18	0.31	107.5	0.689	0.33	2.39	0.159	21.67	24.05	1.11	16.882
115	21.63	24.03	21.63	24.03	22.16	0.29	112.5	0.230	0.30	2.40	0.159	21.64	24.04	1.12	17.679
120	21.61	24.03	21.61	24.03	22.14	0.27	117.5	0.459	0.28	2.42	0.159	21.62	24.03	1.13	18.475
130	21.57	24.02	21.57	24.02	22.11	0.23	125.0	0.344	0.25	2.45	0.159	21.59	24.03	1.15	19.670
140	21.54	24.01	21.54	24.01	22.08	0.20	135.0	0.230	0.22	2.47	0.159	21.56	24.02	1.16	21.262
150	21.51	24.00	21.51	24.00	22.06	0.17	145.0	0.230	0.19	2.49	0.159	21.53	24.01	1.17	22.855
170	21.50	23.99	21.50	23.99	22.05	0.16	160.0	0.000	0.17	2.49	0.159	21.51	24.00	1.17	25.244
192	21.48	23.98	21.48	23.98	22.03	0.14	181.0	0.052	0.15	2.50	0.159	21.49	23.99	1.18	28.589
212	21.47	23.97	21.47	23.97	22.02	0.13	202.0	0.000	0.14	2.50	0.159	21.48	23.98	1.18	31.933
240	21.47	23.97	21.47	23.97	22.02	0.13	226.0	0.000	0.13	2.50	0.159	21.47	23.97	1.18	35.756

Figure 1

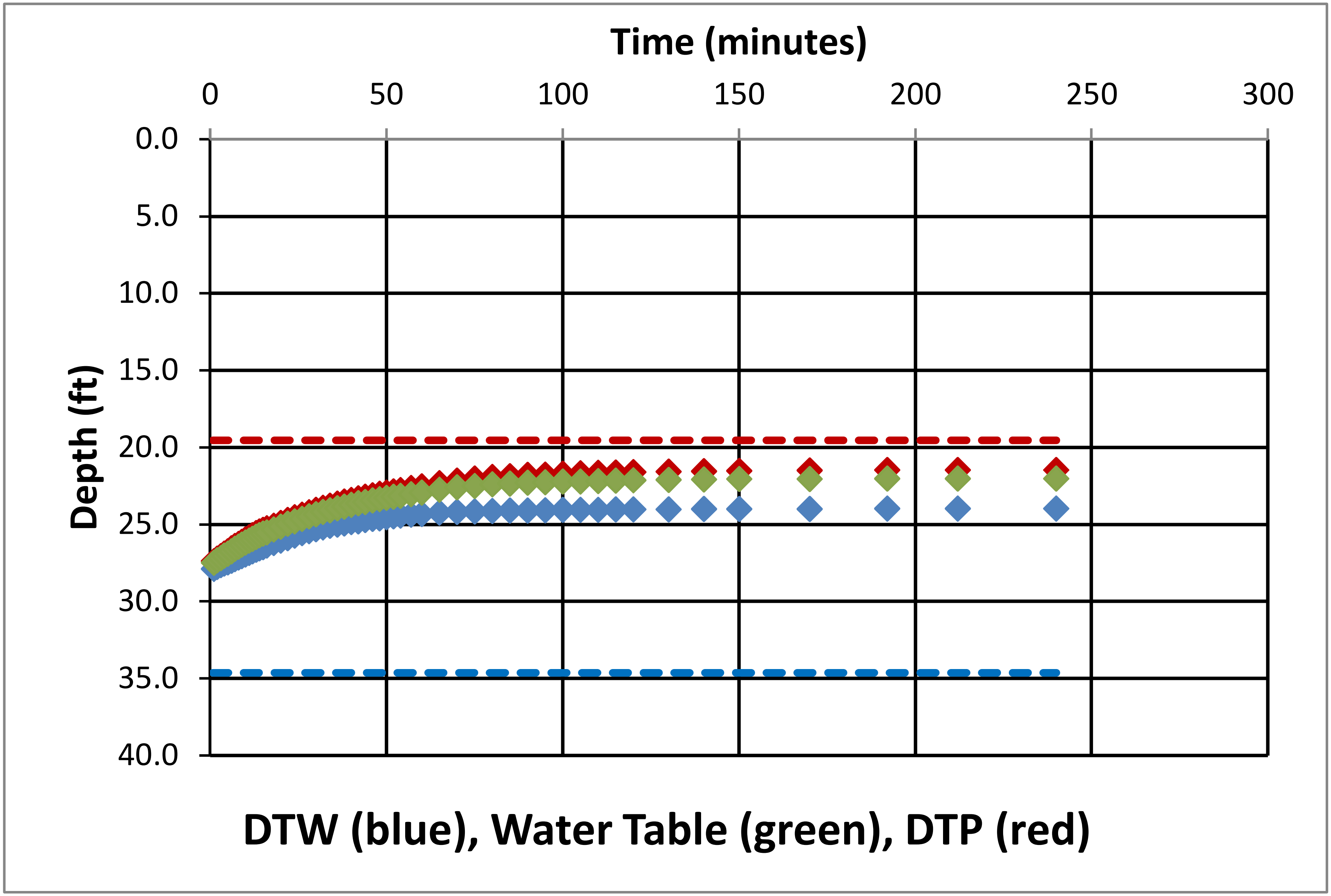
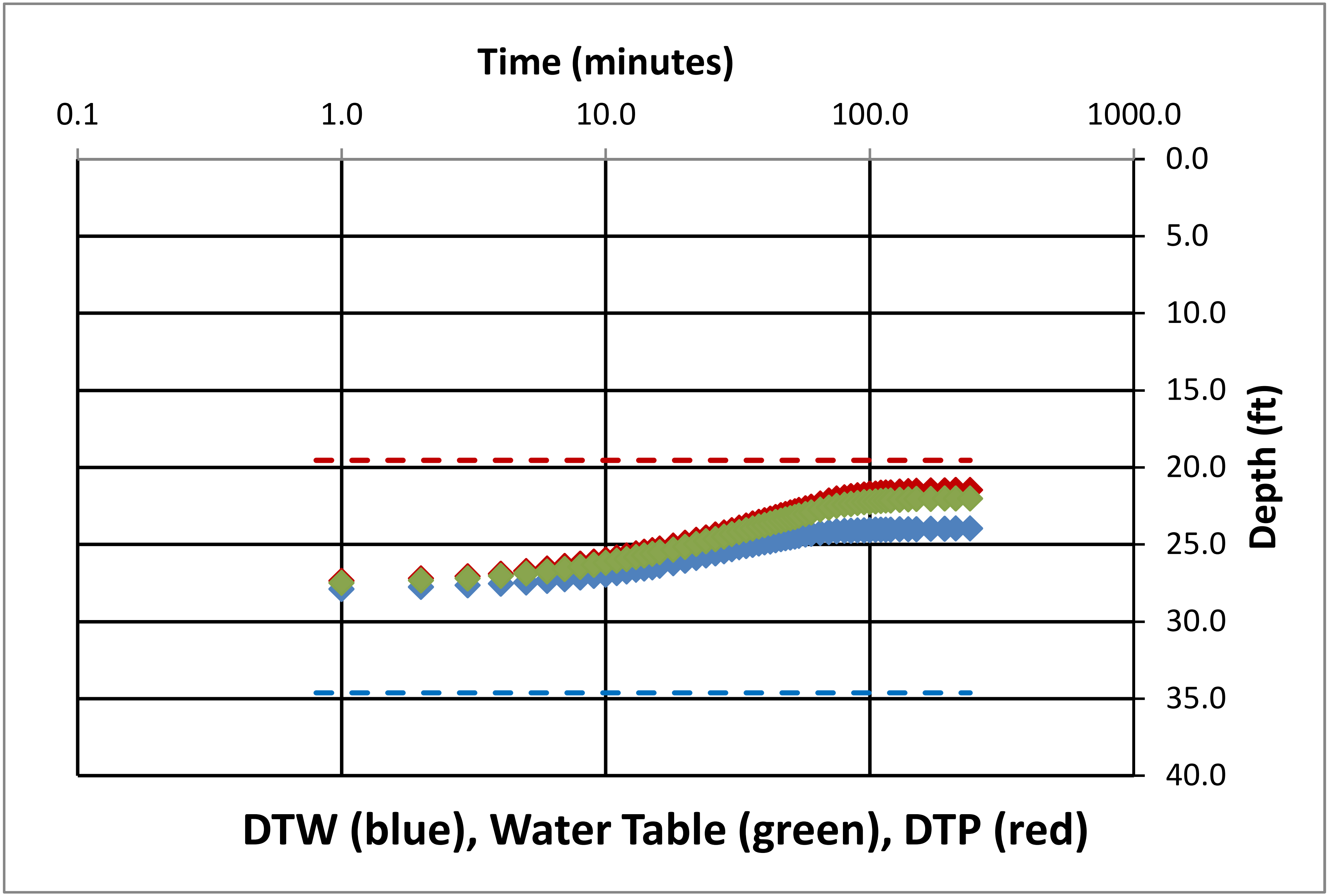
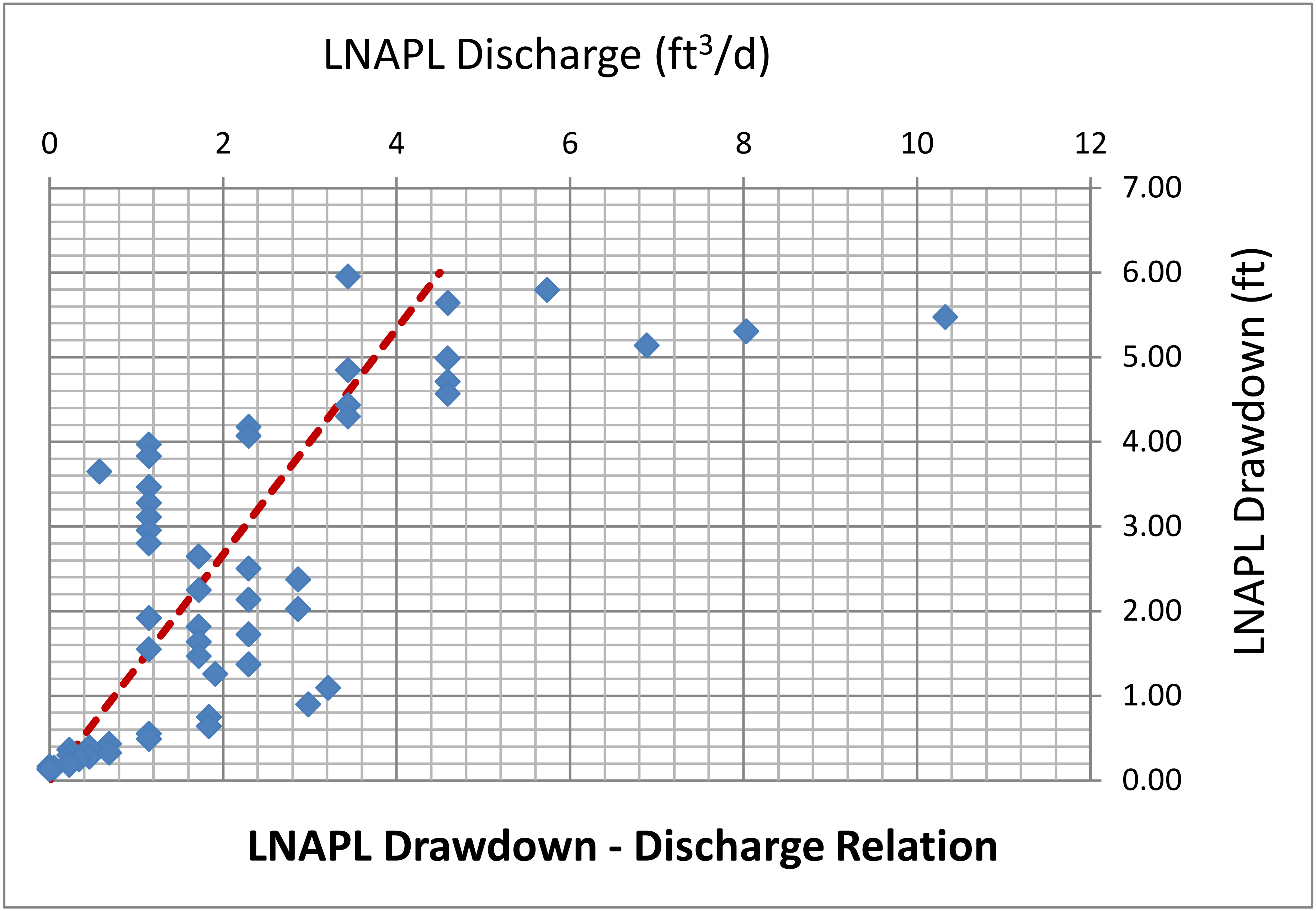

Time (minutes)
0
50
100
150
200
250
300
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 2



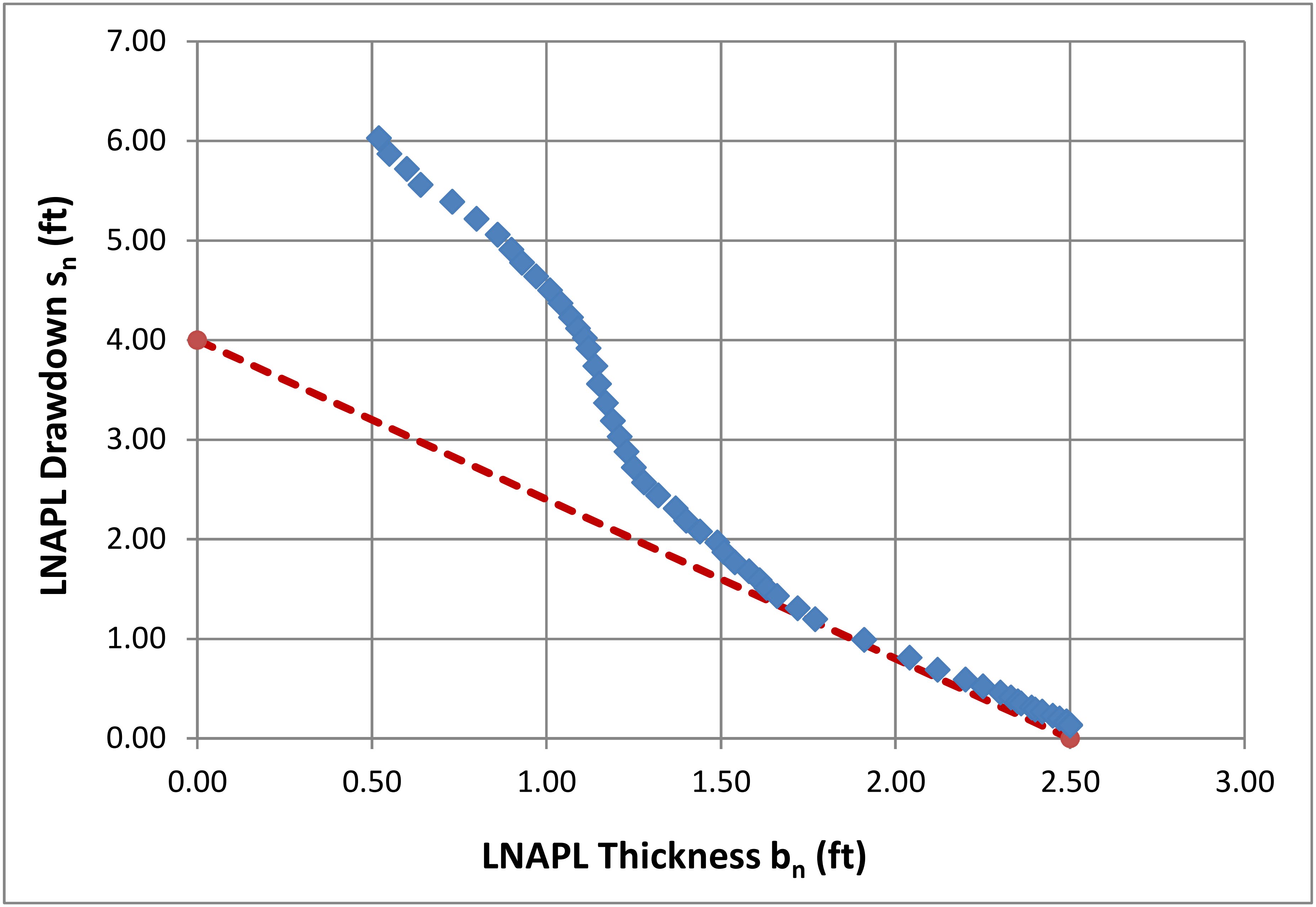
MW-21 (November 2017)
Baildown Test Data Analysis

Figure 3



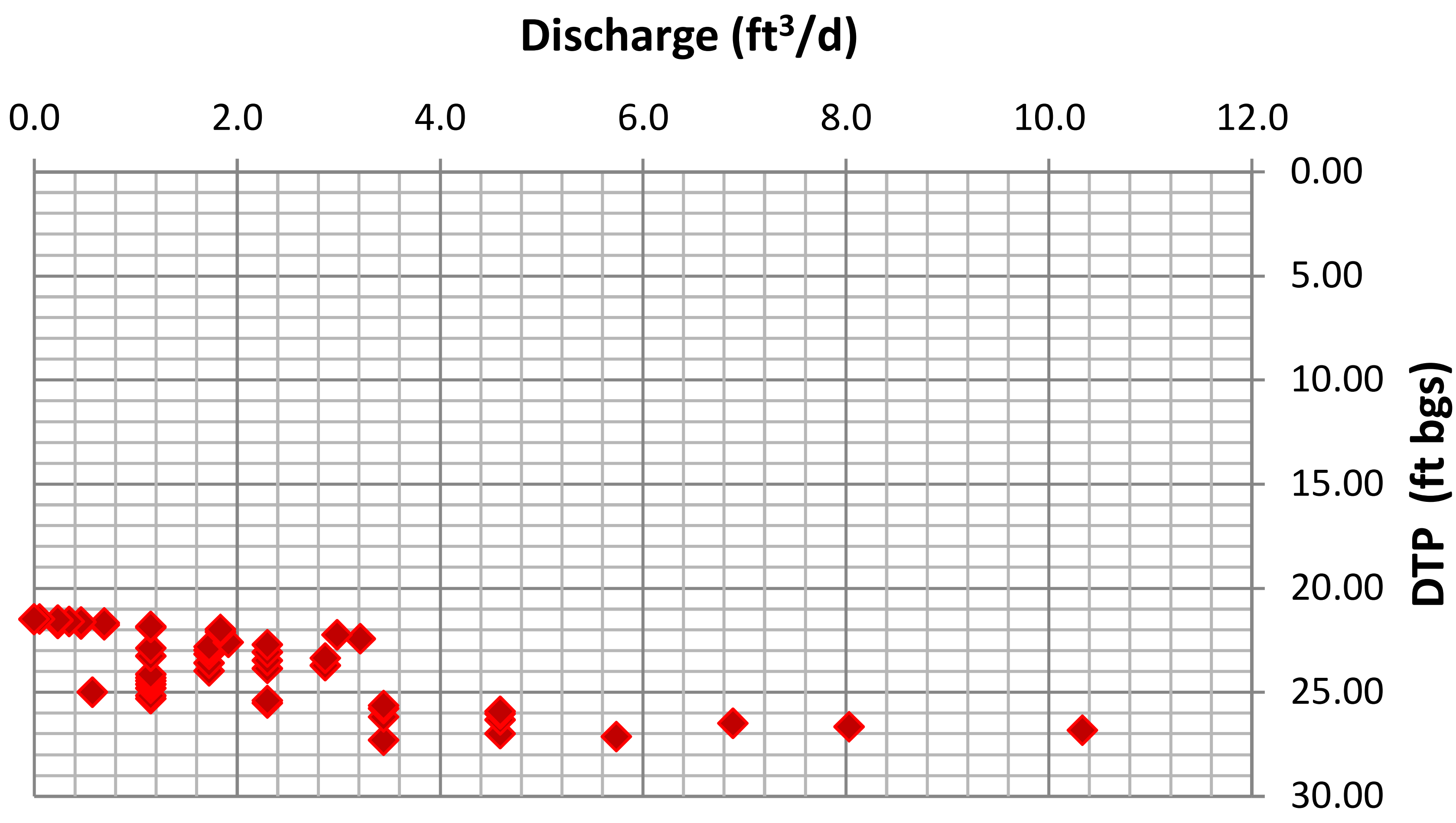
LNAPL Discharge (ft³/d)
0
2
4
6
8
10
12
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Discharge Relation

Figure 4



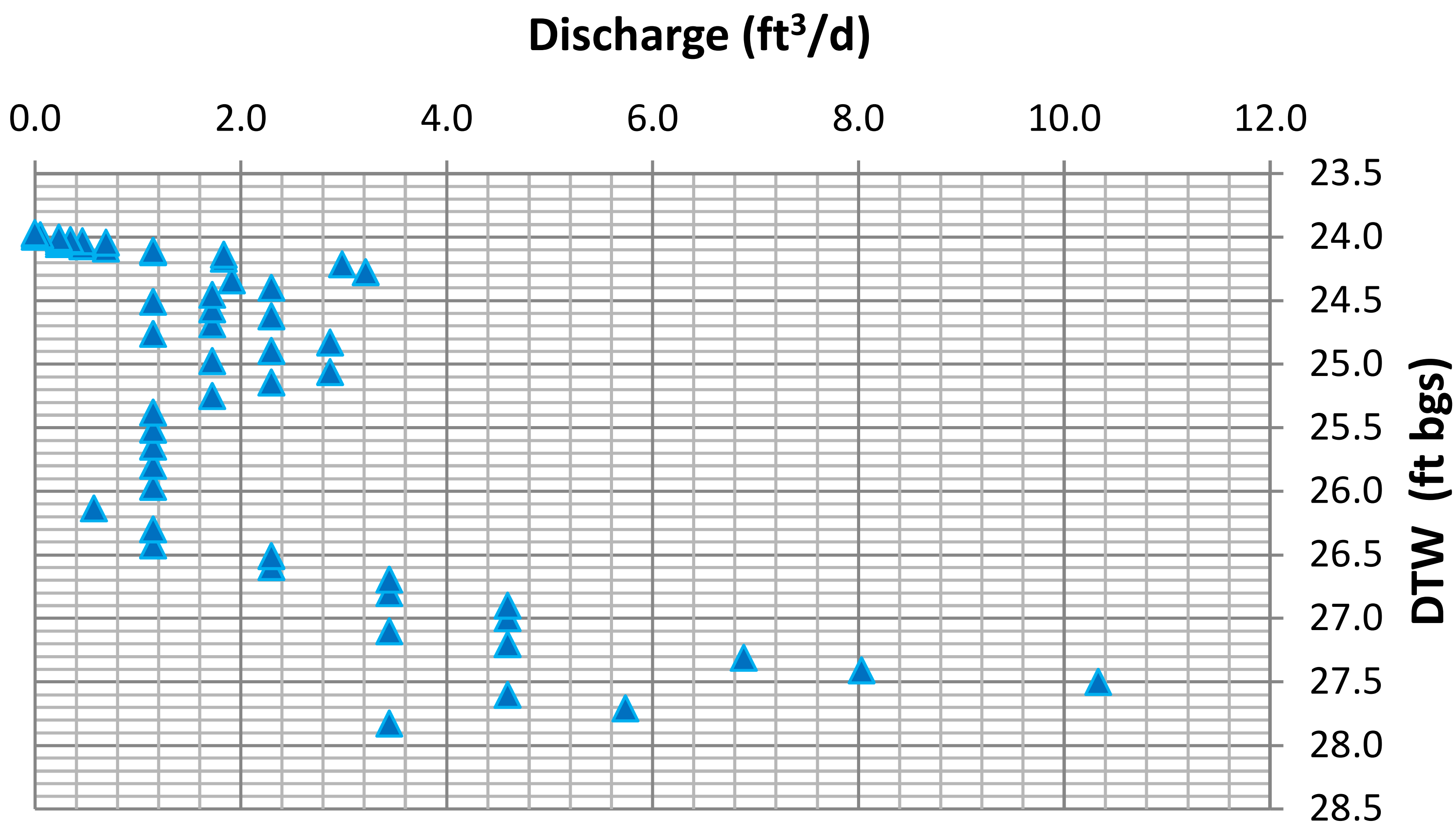
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
LNAPL Drawdown s_n (ft)
LNAPL Thickness b_n (ft)

Figure 5



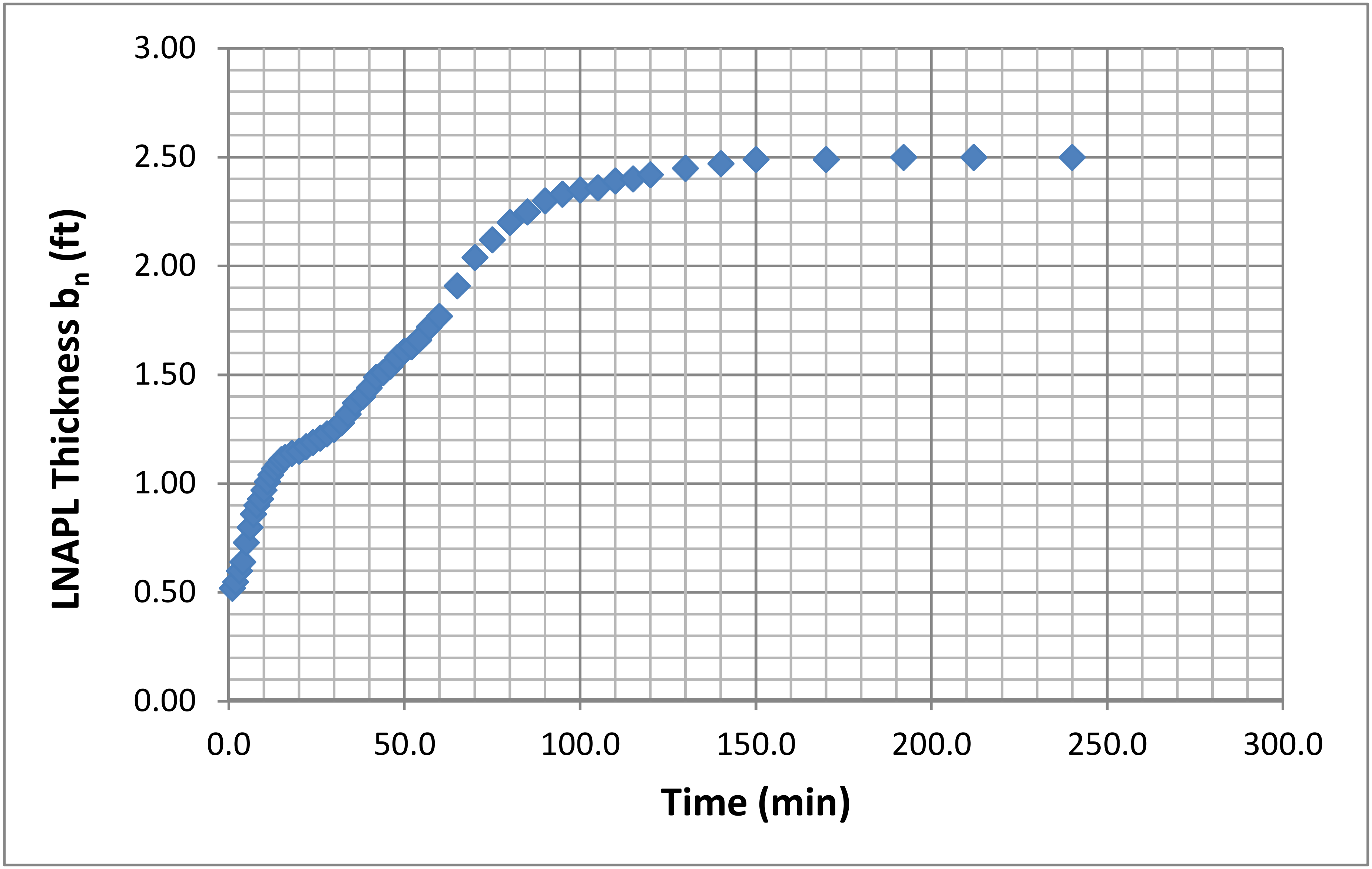
Depth to Product vs. LNAPL Discharge

Figure 6



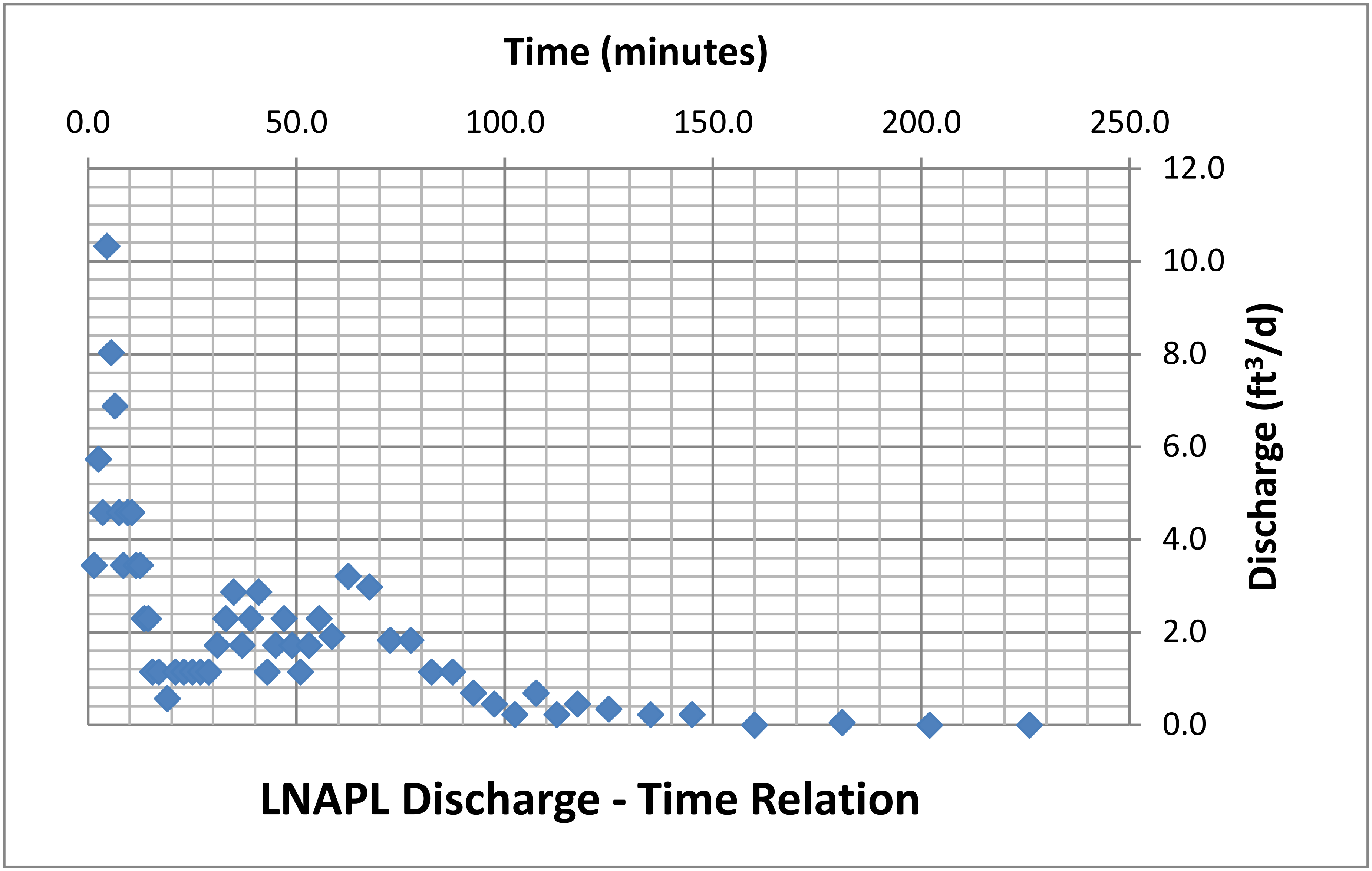
Depth to Water vs. LNAPL Discharge

Figure 7



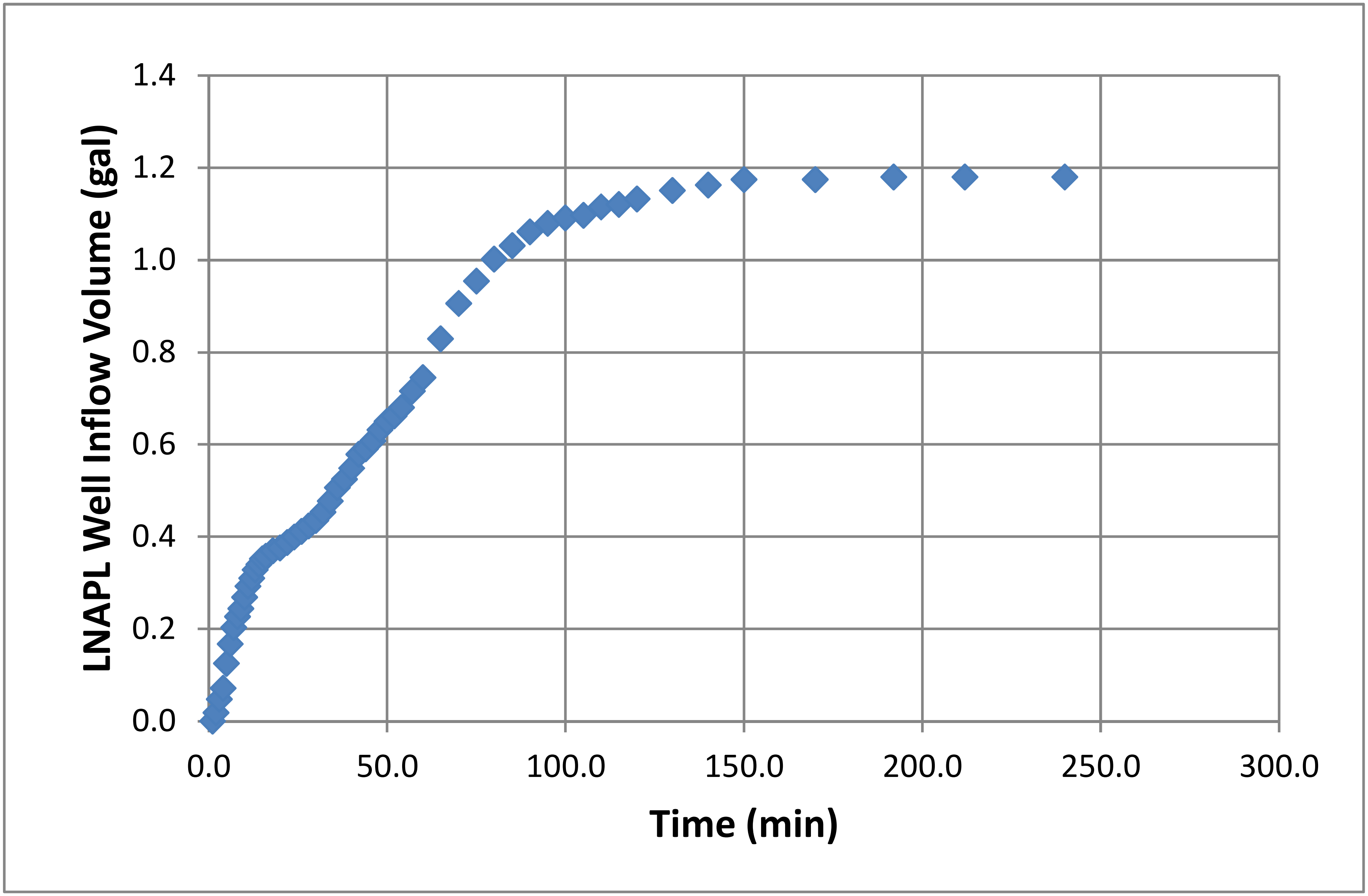
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.0
50.0
100.0
150.0
200.0
250.0
300.0
LNAPL Thickness b_n (ft)
Time (min)

Figure 8



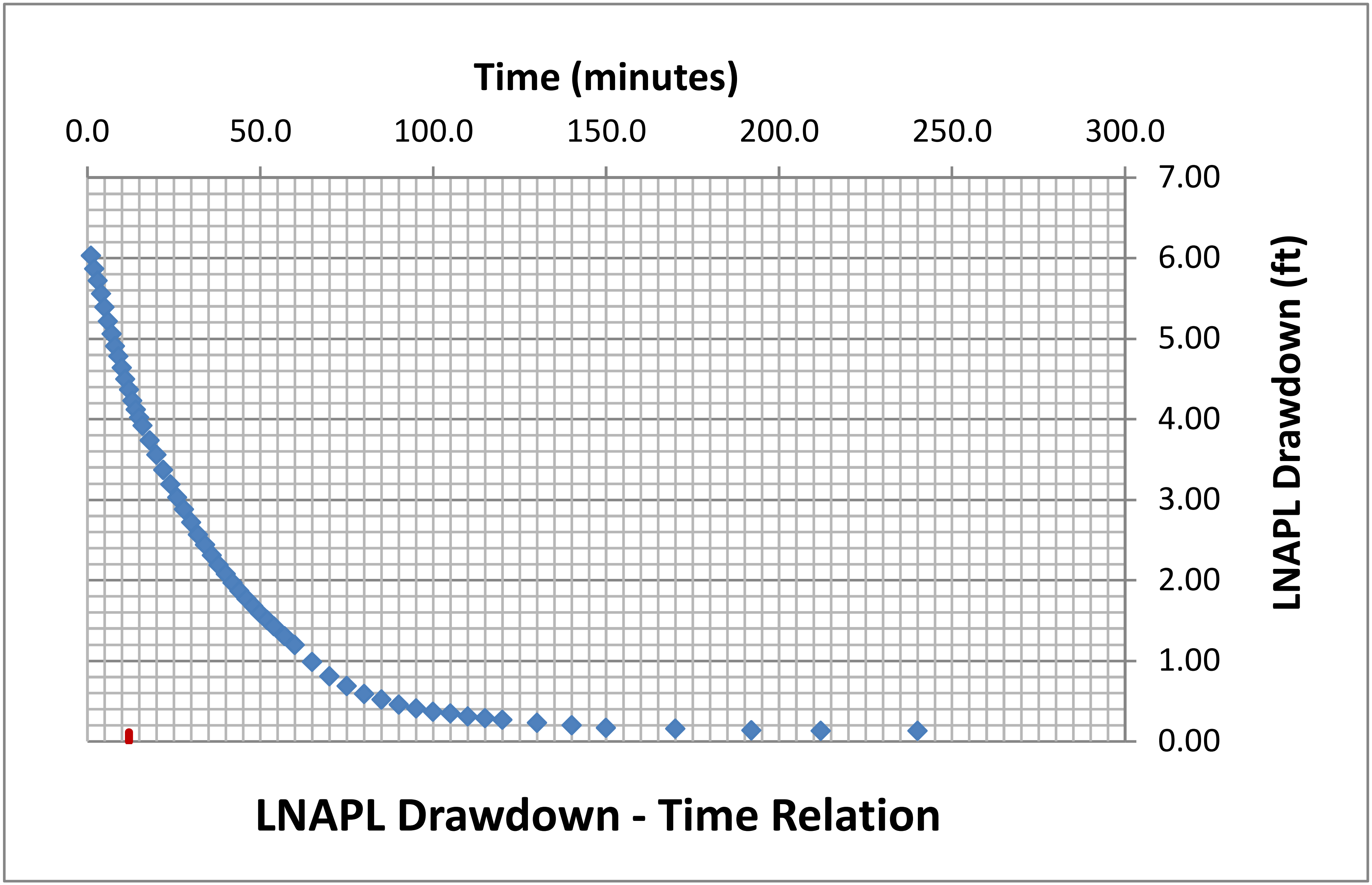
Time (minutes)
0.0
50.0
100.0
150.0
200.0
250.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Discharge (ft³/d)
LNAPL Discharge - Time Relation

Figure 9



1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
LNAPL Well Inflow Volume (gal)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
Time (min)

Figure 10



MW-21 (November 2017)
Baildown Test Data Analysis

Generalized Bouwer and Rice (1976)

Well Designation:	MW-21
Date:	20-Nov-17

$$T_n = \frac{r_e^{\,2}\ln(R/r_e)\ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

L_e/r_e
94.7
C
4.61
R/r_e
31.33

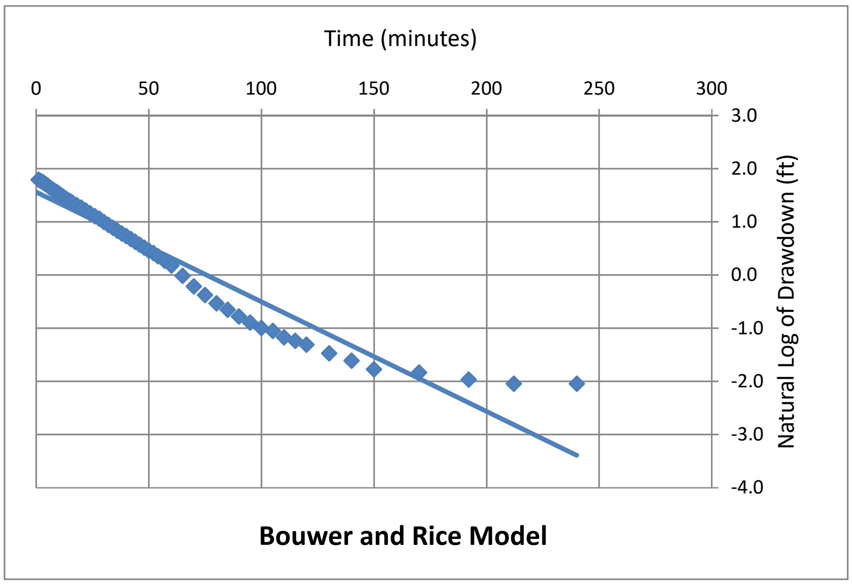
J-Ratio
-1.600

Coef. Of Variation
0.04

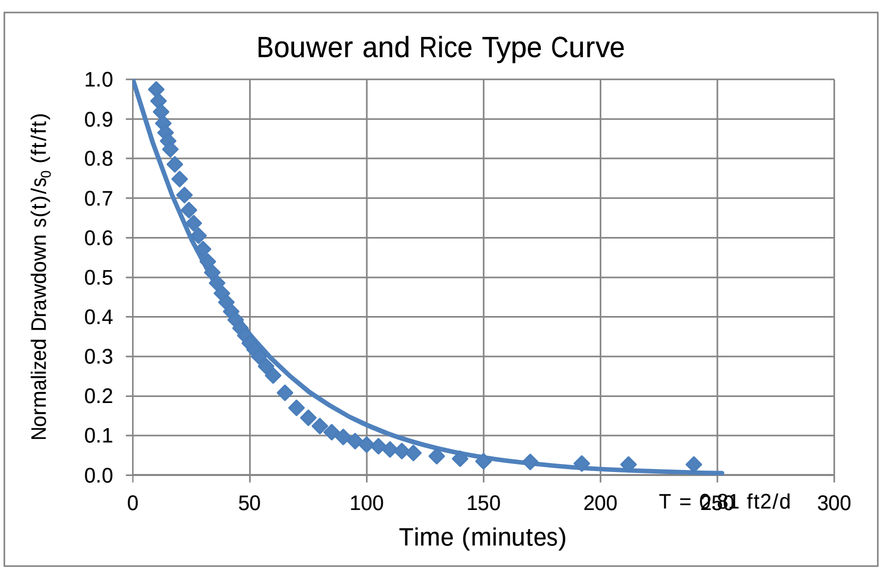
Enter early time cut-off for least-squares model fit

Time_{cut}	0	<- Enter or change value here

Model Results: T_n (ft^2/d) = 0.81 +/- 0.03 ft^2/d



C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW-21
Date:	20-Nov-17

$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

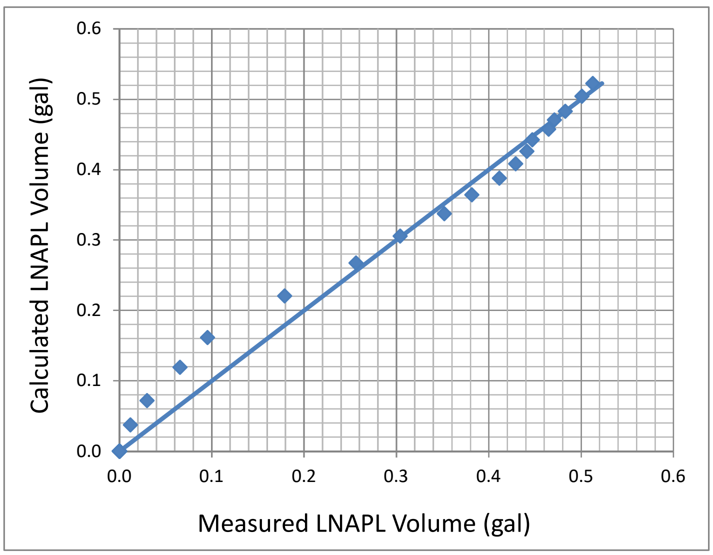
Enter early time cut-off for least-squares model fit

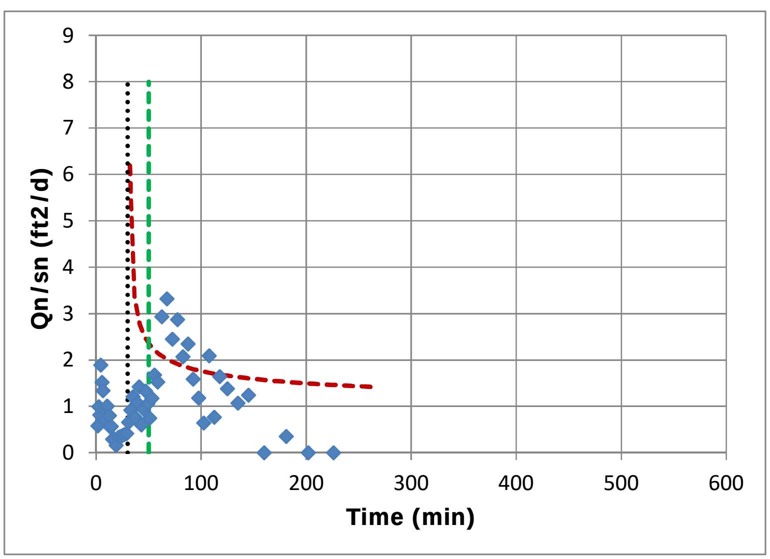
$Time_{cut}$ (min):	50	<- Enter or change values here
Time Adjustment (min):	30	

Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	0.116	<-- Minimize this using "Solver"
	0.021	<-- Working S_n
Trial T_n (ft^2/d):	0.696	<-- By changing T_n through "Solver"

Add constraint $T_n > 0.00001$

Model Result: T_n (ft^2/d) = **0.70**





Height

8

Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	MW-21
Date:	20-Nov-17

Enter early time cut-off for least-squares model fit

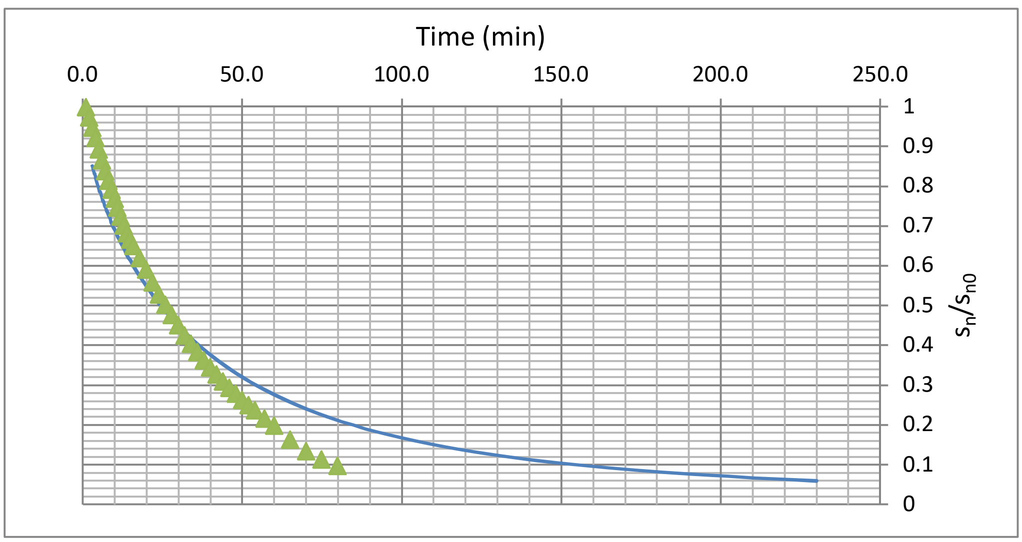
$Time_{cut}$ (min):	0	<- **Enter or change values here**
Initial Drawdown s_n (ft):	6.03	

Trial S_n:	d	<-- **Enter d for default**
Root-Mean-Square Error:	0.432	<-- **Minimize this using "Solver"**
Trial T_n (ft^2/d):	0.670	<-- **By changing T_n through "Solver"**
	0.020	<-- **Working S_n**

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **0.67**

T_{min}	3
T_{max}	230



J-Ratio
-1.600

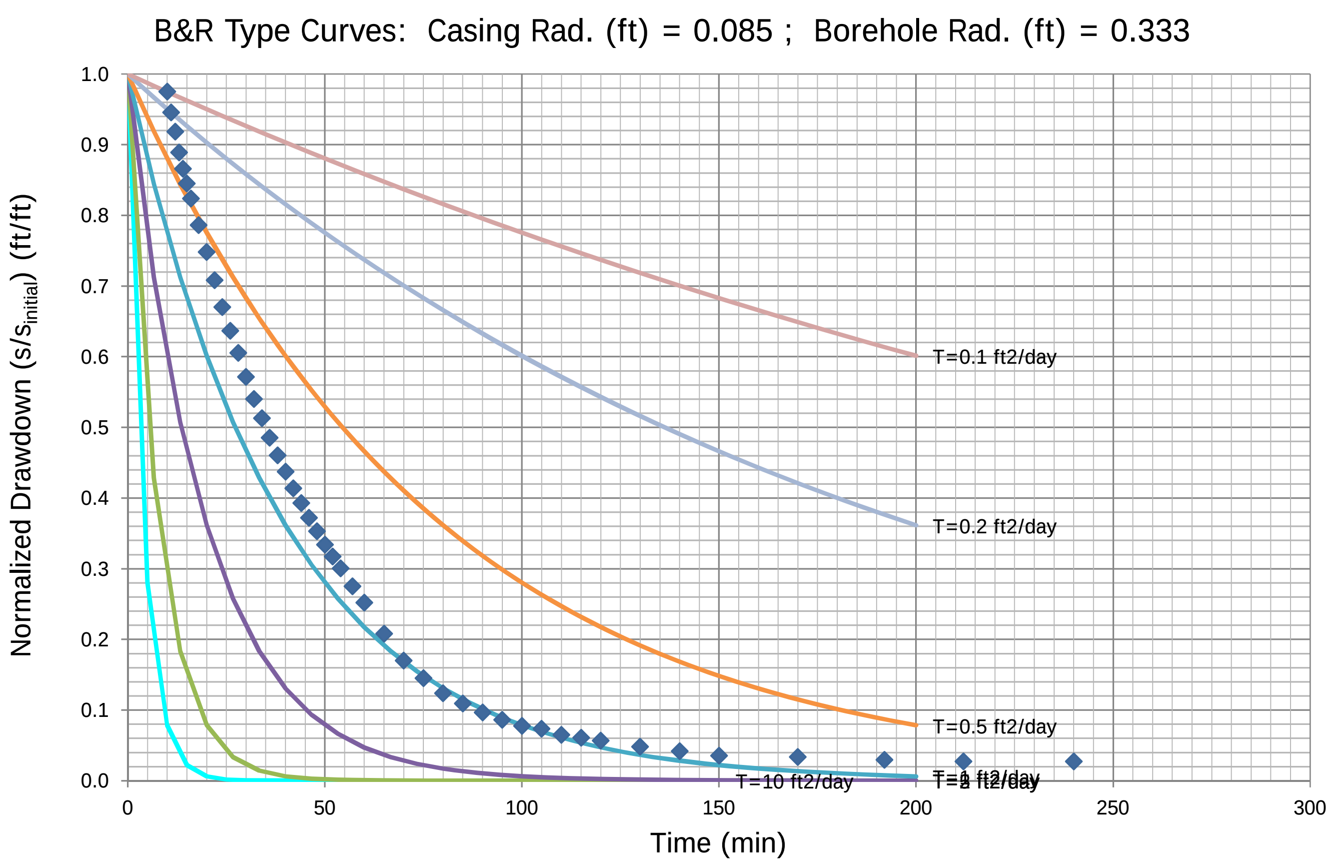
Bouwer and Rice Short Term LNAPL Mobility Test Type Curves

B&R Type Curves: Casing Rad. (ft) = 0.085 ; Borehole Rad. (ft) = 0.333

Enter these values

Type Curve ID	Type Curve Name	Notes	Max Time (min)	Transmissivity (ft^2/day)
1	T=10 ft2/day		150	10
2	T=5 ft2/day		200	5
3	T=2 ft2/day		200	2
4	T=1 ft2/day		200	1
5	T=0.5 ft2/day		200	0.5
6	T=0.2 ft2/day		200	0.2
7	T=0.1 ft2/day		200	0.1

J-Ratio	
-1.600	<-- If uncertain use
	-0.22



API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)

0.73

Standard Deviation (ft^2/d)

0.07

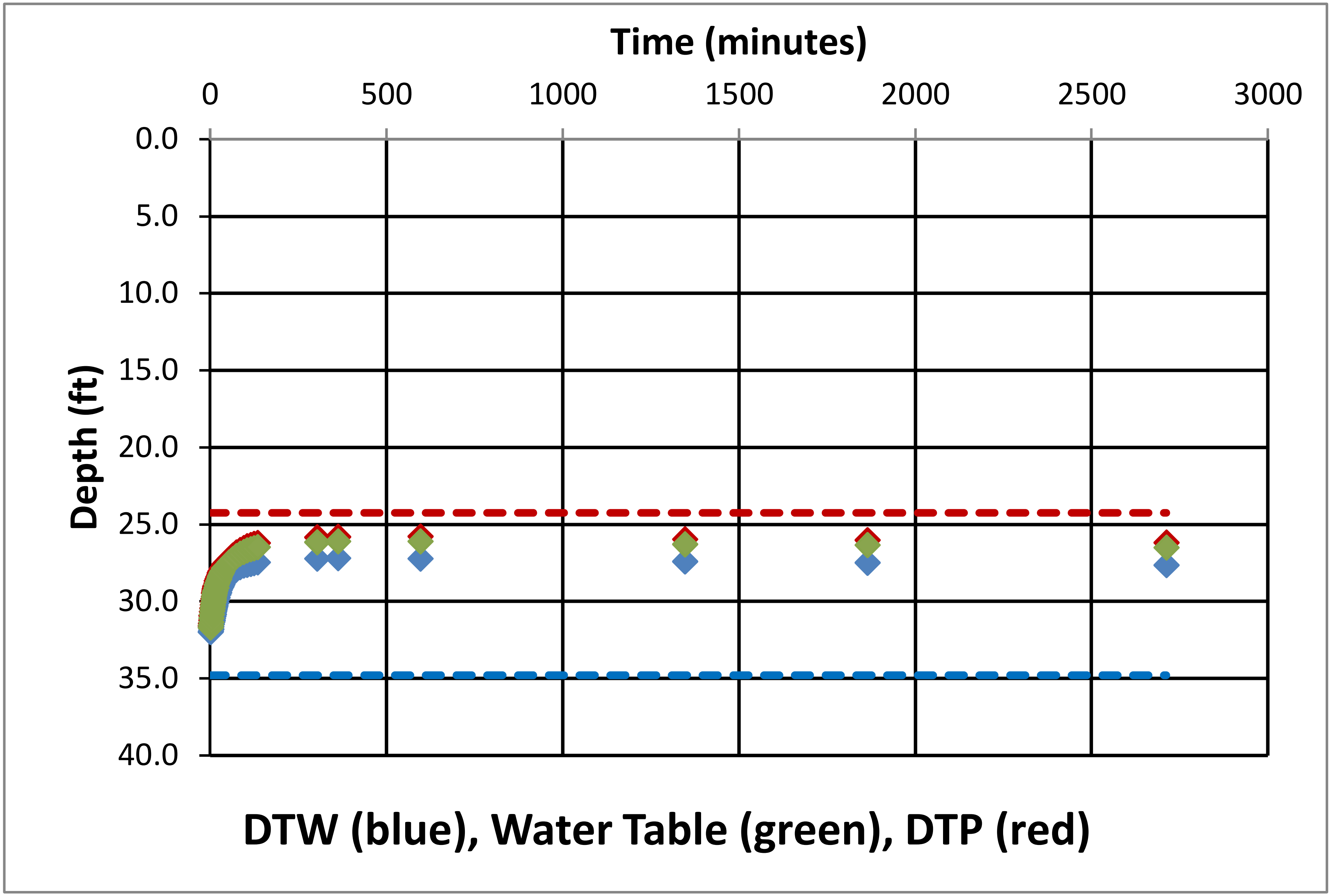
Coefficient of Variation

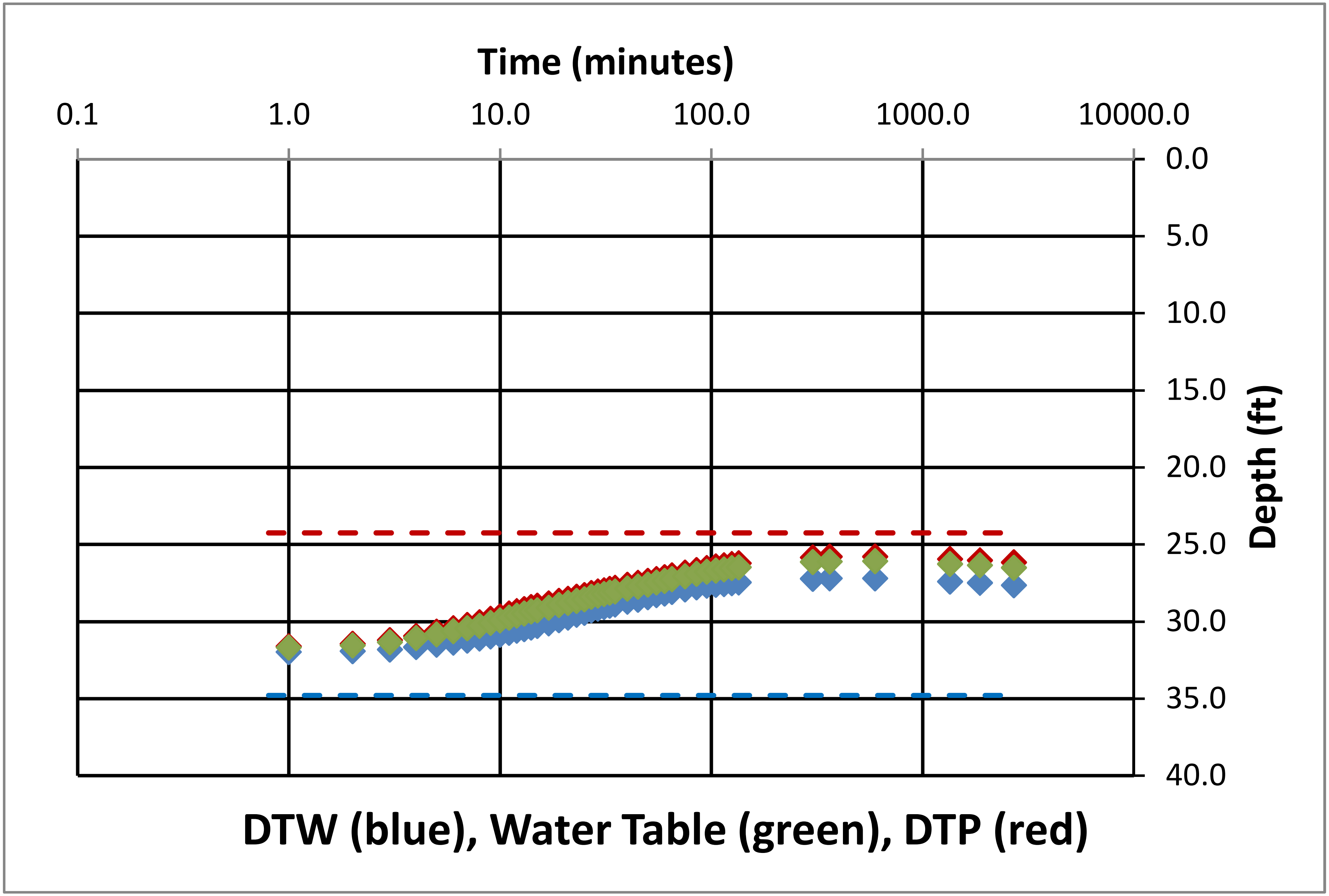
0.10

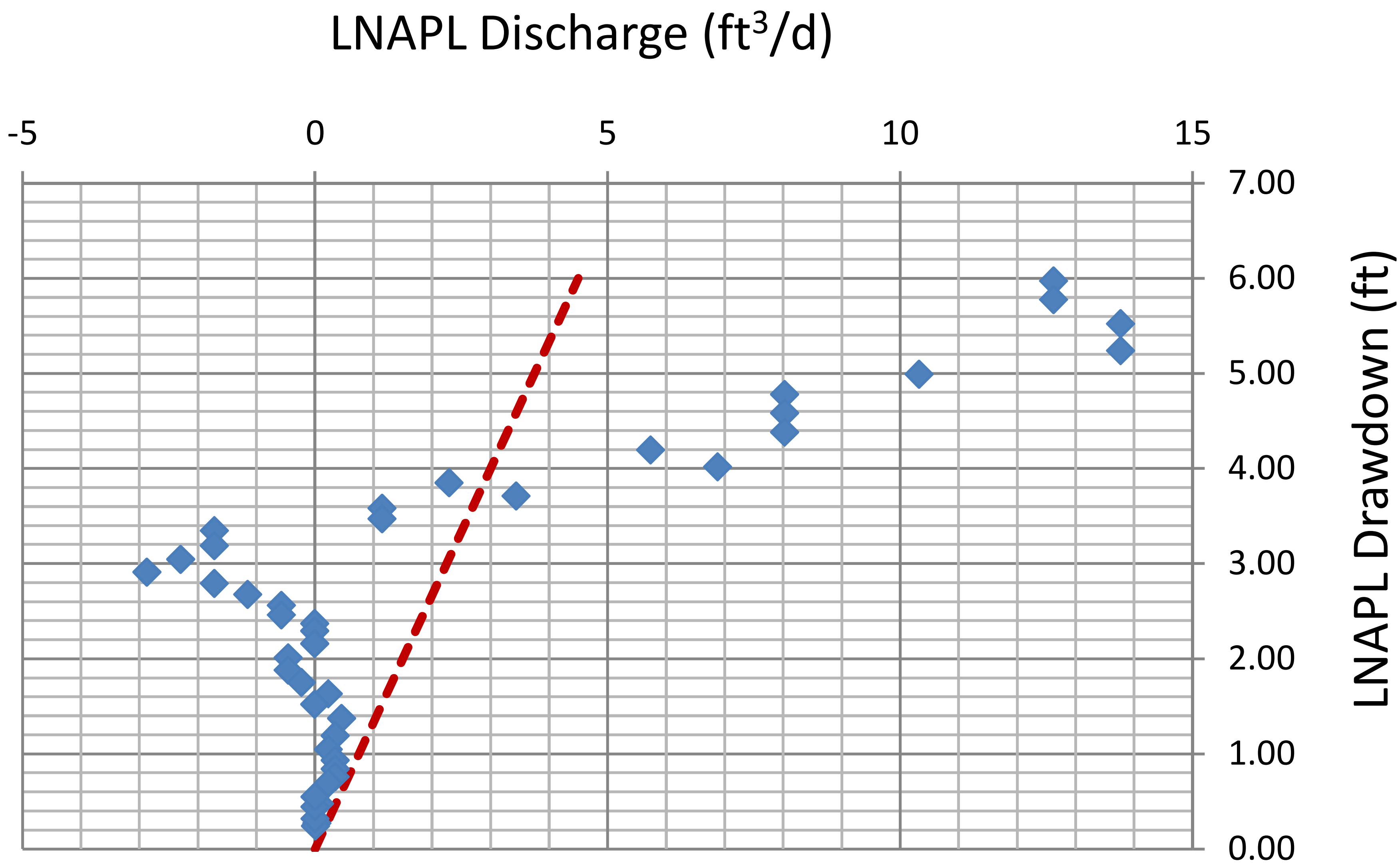
Well Designation:	MW-21	
Date:	27-Mar-19	

Ground Surface Elev (ft msl)	0.0	Enter These Data		**Drawdown Adjustment (ft)**
Top of Casing Elev (ft msl)	0.0			
Well Casing Radius, r_c (ft):	0.085	r_{e1}		
Well Radius, r_w (ft):	0.333			1.3
LNAPL Specific Yield, S_y:	0.175			
LNAPL Density Ratio, ρ_r:	0.780			
Top of Screen (ft bgs):	0.0			
Bottom of Screen (ft bgs):	0.0			
LNAPL Baildown Vol. (gal.):	0.0			
Effective Radius, r_{e3} (ft):	0.159	Calculated Parameters		
Effective Radius, r_{e2} (ft):	#NUM!			
Initial Casing LNAPL Vol. (gal.):	1.79			
Initial Filter LNAPL Vol. (gal.):	4.49			

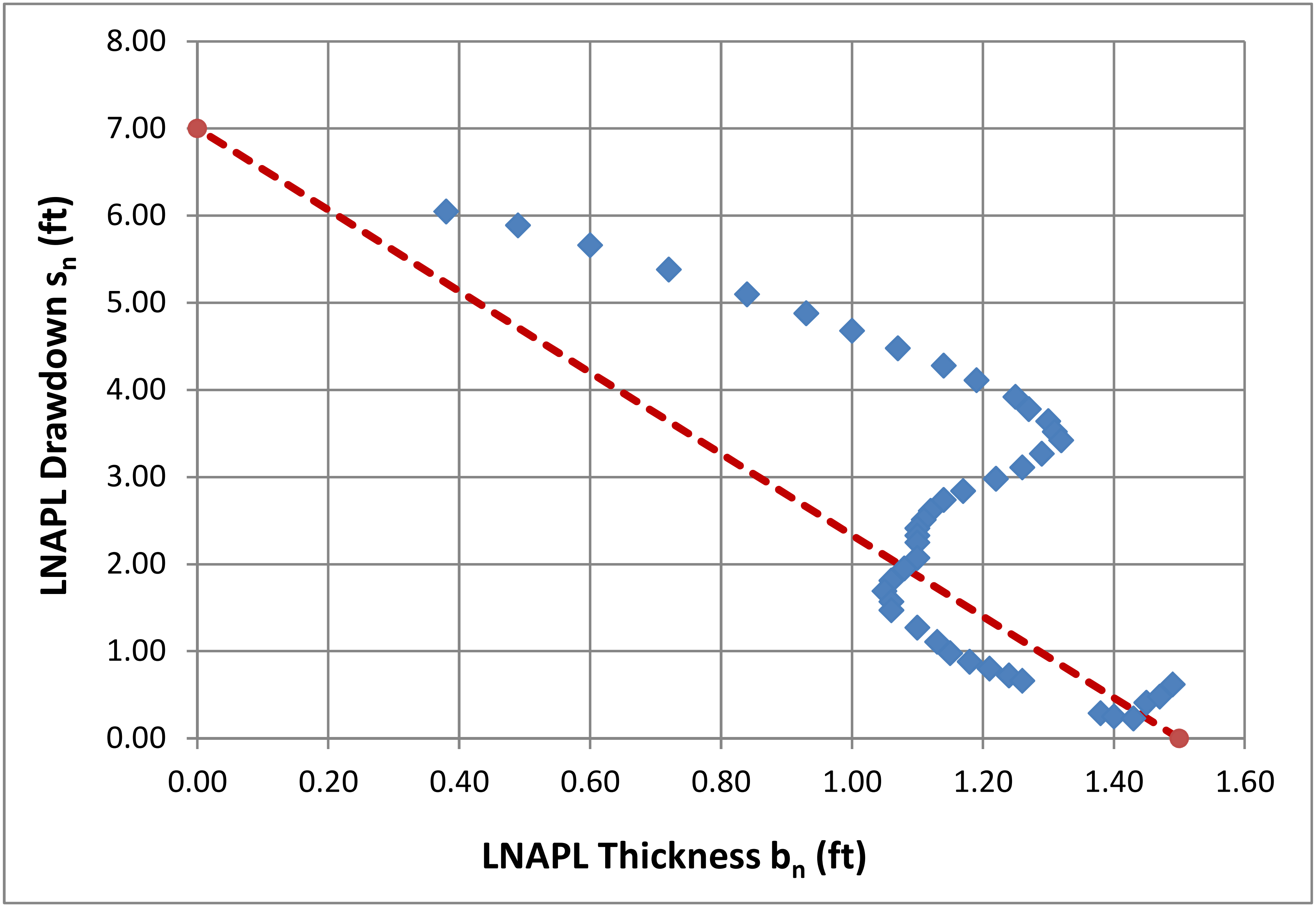
	Enter Data Here					Water Table	LNAPL		LNAPL							LNAPL	Ave.
						Depth	Drawdown	Average	Discharge	s_n	b_n	r_e	DTP	DTW	Volume	r_e
	Time (min)	DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)	(ft)	s_n (ft)	Time (min)	Q_n (ft^3/d)	(ft)	(ft)	(ft)	(ft bgs)	(ft bgs)	(gallons)	(ft)
Initial Fluid Levels:	0	24.25	34.79	24.25	34.79	26.57					10.54					
Enter Test Data:	1.0	31.60	31.98	31.60	31.98	31.68	6.05				0.38				0	0.159
	2.0	31.44	31.93	31.44	31.93	31.55	5.89	1.5	12.623	5.97	0.49	0.159	31.52	31.96	0.07	0
	3.0	31.21	31.81	31.21	31.81	31.34	5.66	2.5	12.623	5.78	0.60	0.159	31.33	31.87	0.13	0.159
	4.0	30.93	31.65	30.93	31.65	31.09	5.38	3.5	13.770	5.52	0.72	0.159	31.07	31.73	0.20	0.319
	5.0	30.65	31.49	30.65	31.49	30.83	5.10	4.5	13.770	5.24	0.84	0.159	30.79	31.57	0.27	0.478
	6.0	30.43	31.36	30.43	31.36	30.63	4.88	5.5	10.328	4.99	0.93	0.159	30.54	31.43	0.33	0.637
	7.0	30.23	31.23	30.23	31.23	30.45	4.68	6.5	8.033	4.78	1.00	0.159	30.33	31.30	0.37	0.796
	8.0	30.03	31.10	30.03	31.10	30.27	4.48	7.5	8.033	4.58	1.07	0.159	30.13	31.17	0.41	0.956
	9.0	29.83	30.97	29.83	30.97	30.08	4.28	8.5	8.033	4.38	1.14	0.159	29.93	31.04	0.45	1.115
	10.0	29.66	30.85	29.66	30.85	29.92	4.11	9.5	5.738	4.20	1.19	0.159	29.75	30.91	0.48	1.274
	11.0	29.47	30.72	29.47	30.72	29.75	3.92	10.5	6.885	4.02	1.25	0.159	29.57	30.79	0.52	1.433
	12.0	29.33	30.60	29.33	30.60	29.61	3.78	11.5	2.295	3.85	1.27	0.159	29.40	30.66	0.53	1.593
	13.0	29.19	30.49	29.19	30.49	29.48	3.64	12.5	3.443	3.71	1.30	0.159	29.26	30.55	0.55	1.752
	14.0	29.07	30.38	29.07	30.38	29.36	3.52	13.5	1.148	3.58	1.31	0.159	29.13	30.44	0.55	1.911
	15.0	28.97	30.29	28.97	30.29	29.26	3.42	14.5	1.148	3.47	1.32	0.159	29.02	30.34	0.56	2.070
	17.0	28.82	30.11	28.82	30.11	29.10	3.27	16.0	-1.721	3.35	1.29	0.159	28.90	30.20	0.54	2.309
	19.0	28.66	29.92	28.66	29.92	28.94	3.11	18.0	-1.721	3.19	1.26	0.159	28.74	30.02	0.52	2.628
	21.0	28.53	29.75	28.53	29.75	28.80	2.98	20.0	-2.295	3.05	1.22	0.159	28.60	29.84	0.50	2.946
	23.0	28.39	29.56	28.39	29.56	28.65	2.84	22.0	-2.869	2.91	1.17	0.159	28.46	29.66	0.47	3.265
	25.0	28.29	29.43	28.29	29.43	28.54	2.74	24.0	-1.721	2.79	1.14	0.159	28.34	29.50	0.45	3.584
	27.0	28.16	29.28	28.16	29.28	28.41	2.61	26.0	-1.148	2.68	1.12	0.159	28.23	29.36	0.44	3.902
	29.0	28.06	29.17	28.06	29.17	28.30	2.51	28.0	-0.574	2.56	1.11	0.159	28.11	29.23	0.44	4.221
	31.0	27.96	29.06	27.96	29.06	28.20	2.41	30.0	-0.574	2.46	1.10	0.159	28.01	29.12	0.43	4.539
	33.0	27.88	28.98	27.88	28.98	28.12	2.33	32.0	0.000	2.37	1.10	0.159	27.92	29.02	0.43	4.858
	35.0	27.80	28.90	27.80	28.90	28.04	2.25	34.0	0.000	2.29	1.10	0.159	27.84	28.94	0.43	5.176
	40.0	27.62	28.72	27.62	28.72	27.86	2.07	37.5	0.000	2.16	1.10	0.159	27.71	28.81	0.43	5.734
	45.0	27.50	28.58	27.50	28.58	27.74	1.95	42.5	-0.459	2.01	1.08	0.159	27.56	28.65	0.42	6.530
	50	27.36	28.42	27.36	28.42	27.59	1.81	47.5	-0.459	1.88	1.06	0.159	27.43	28.50	0.41	7.326
	55	27.24	28.29	27.24	28.29	27.47	1.69	52.5	-0.230	1.75	1.05	0.159	27.30	28.36	0.40	8.123
	60	27.12	28.18	27.12	28.18	27.35	1.57	57.5	0.230	1.63	1.06	0.159	27.18	28.24	0.41	8.919
	65	27.02	28.08	27.02	28.08	27.25	1.47	62.5	0.000	1.52	1.06	0.159	27.07	28.13	0.41	9.715
	75	26.82	27.92	26.82	27.92	27.06	1.27	70.0	0.459	1.37	1.10	0.159	26.92	28.00	0.43	10.910
	85	26.66	27.79	26.66	27.79	26.91	1.11	80.0	0.344	1.19	1.13	0.159	26.74	27.86	0.45	12.503
	95	26.53	27.68	26.53	27.68	26.78	0.98	90.0	0.230	1.05	1.15	0.159	26.60	27.74	0.46	14.095
	105.0	26.43	27.61	26.43	27.61	26.69	0.88	100.0	0.344	0.93	1.18	0.159	26.48	27.65	0.48	15.688
	115.0	26.35	27.56	26.35	27.56	26.62	0.80	110.0	0.344	0.84	1.21	0.159	26.39	27.59	0.49	17.281
	125.0	26.27	27.51	26.27	27.51	26.54	0.72	120.0	0.344	0.76	1.24	0.159	26.31	27.54	0.51	18.873
	135.0	26.21	27.47	26.21	27.47	26.49	0.66	130.0	0.230	0.69	1.26	0.159	26.24	27.49	0.52	20.466
	303.0	25.84	27.22	25.84	27.22	26.14	0.29	219.0	0.082	0.48	1.38	0.159	26.03	27.35	0.60	34.641
	363.0	25.80	27.20	25.80	27.20	26.11	0.25	333.0	0.038	0.27	1.40	0.159	25.82	27.21	0.61	52.797
	597.0	25.78	27.21	25.78	27.21	26.09	0.23	480.0	0.015	0.24	1.43	0.159	25.79	27.21	0.63	76.210
	1347.0	25.96	27.41	25.96	27.41	26.28	0.41	972.0	0.003	0.32	1.45	0.159	25.87	27.31	0.64	154.569
	1865.0	26.03	27.50	26.03	27.50	26.35	0.48	1606.0	0.004	0.45	1.47	0.159	26.00	27.46	0.65	255.545
	2712.0	26.17	27.66	26.17	27.66	26.50	0.62	2288.5	0.003	0.55	1.49	0.159	26.10	27.58	0.66	364.245

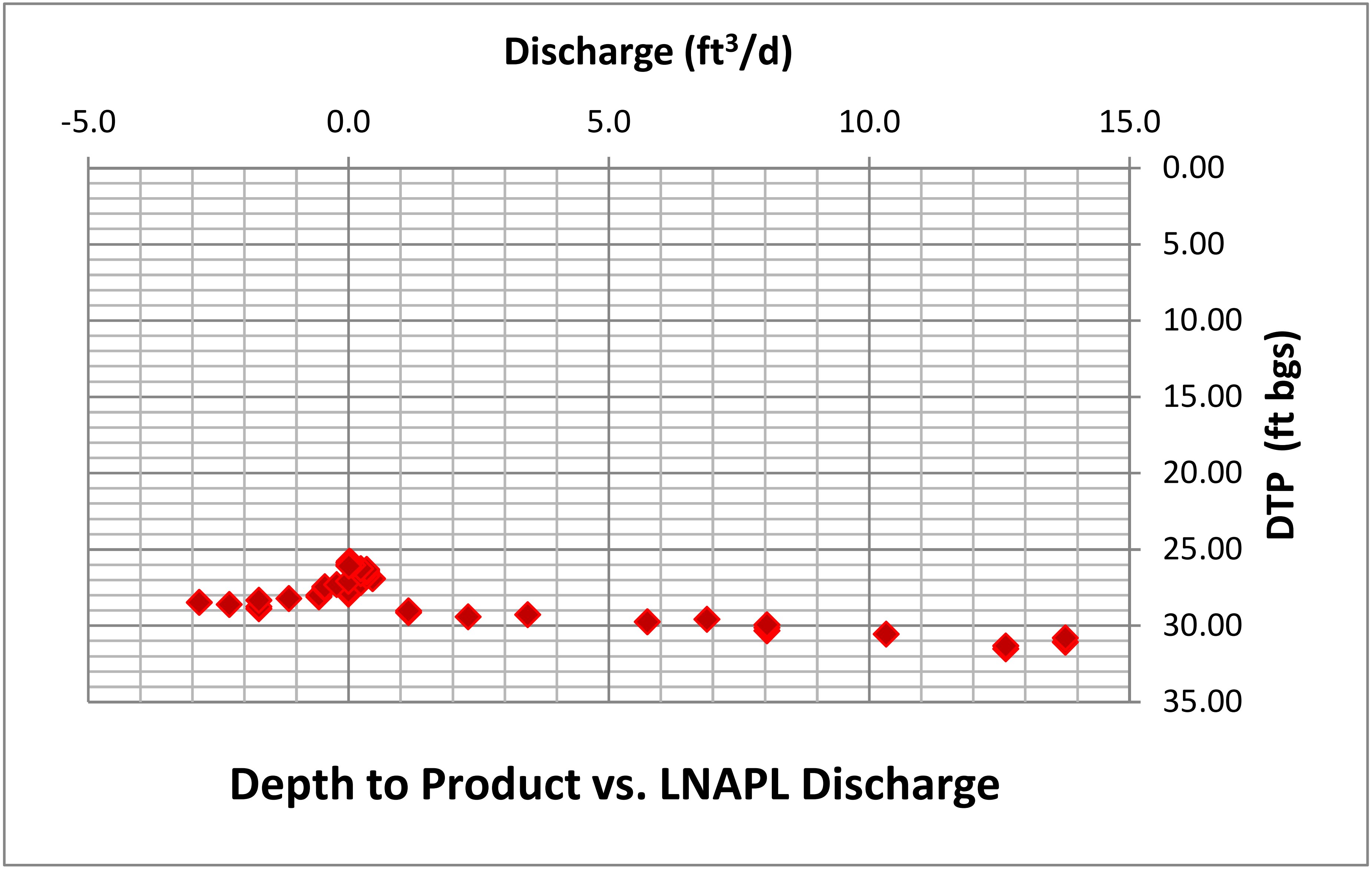

Time (minutes)
0
500
1000
1500
2000
2500
3000
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)


Time (minutes)
0.1
1.0
10.0
100.0
1000.0
10000.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

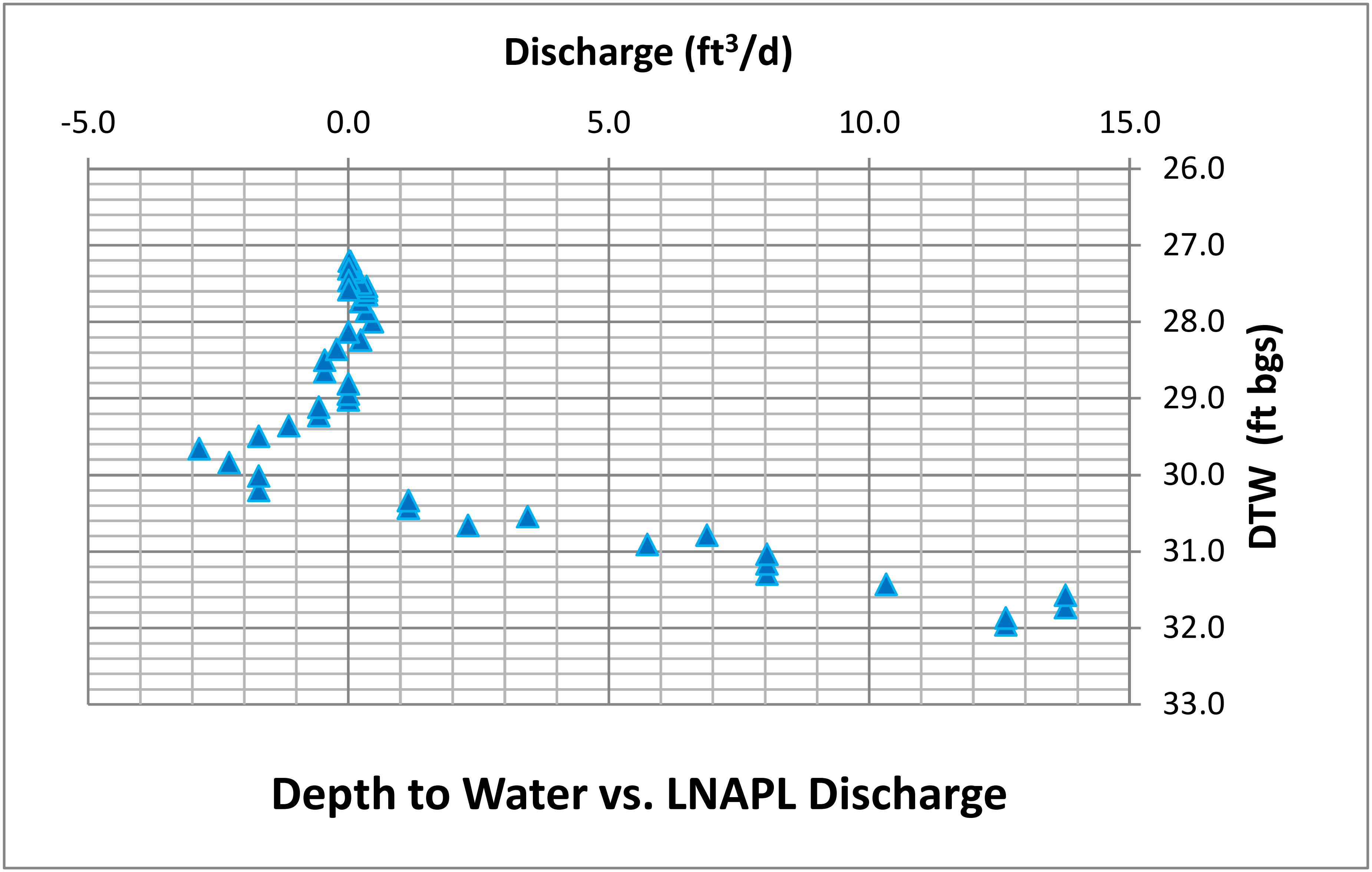


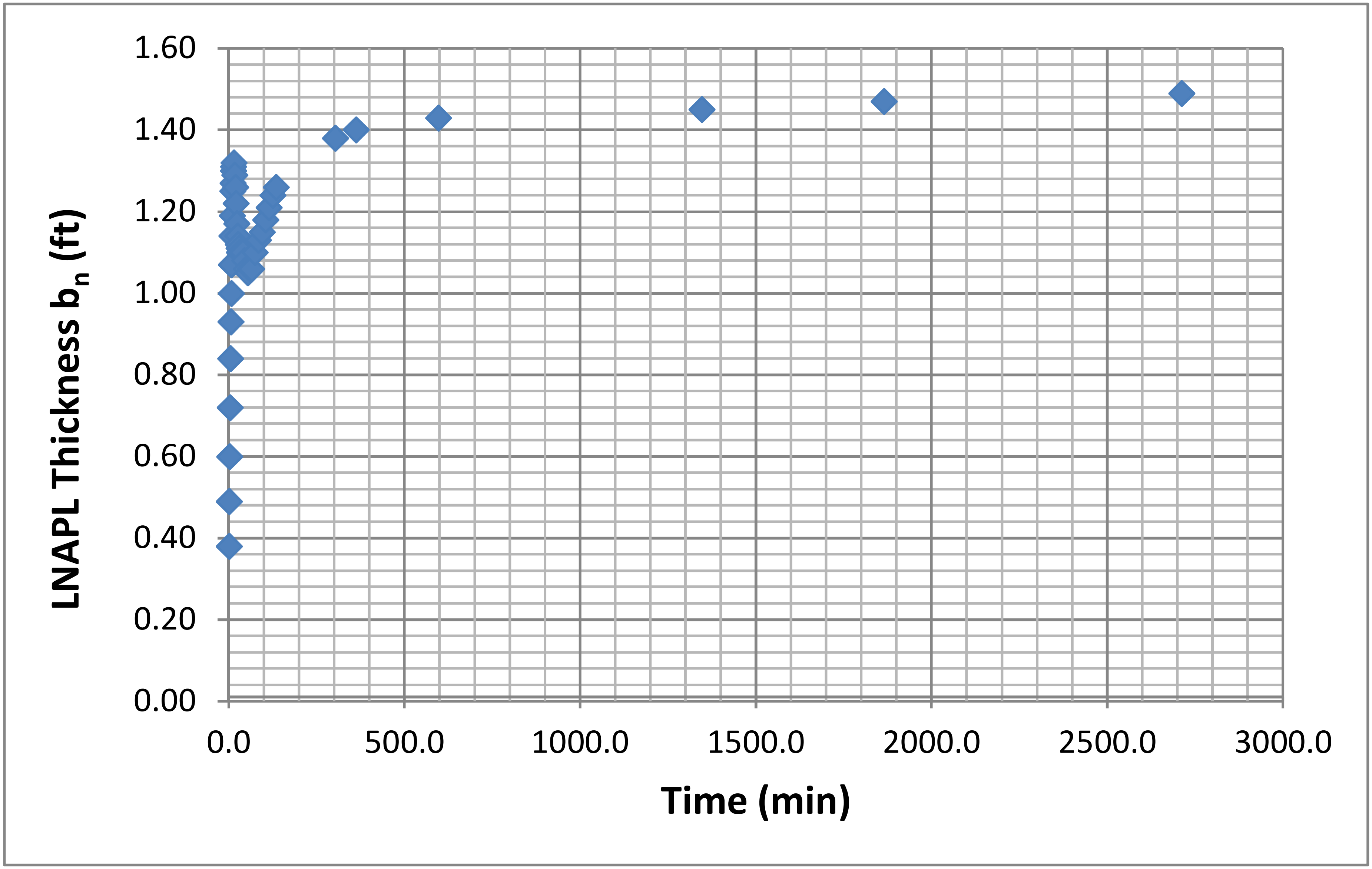
LNAPL Drawdown - Discharge Relation


8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
LNAPL Drawdown s_n (ft)
LNAPL Thickness b_n (ft)

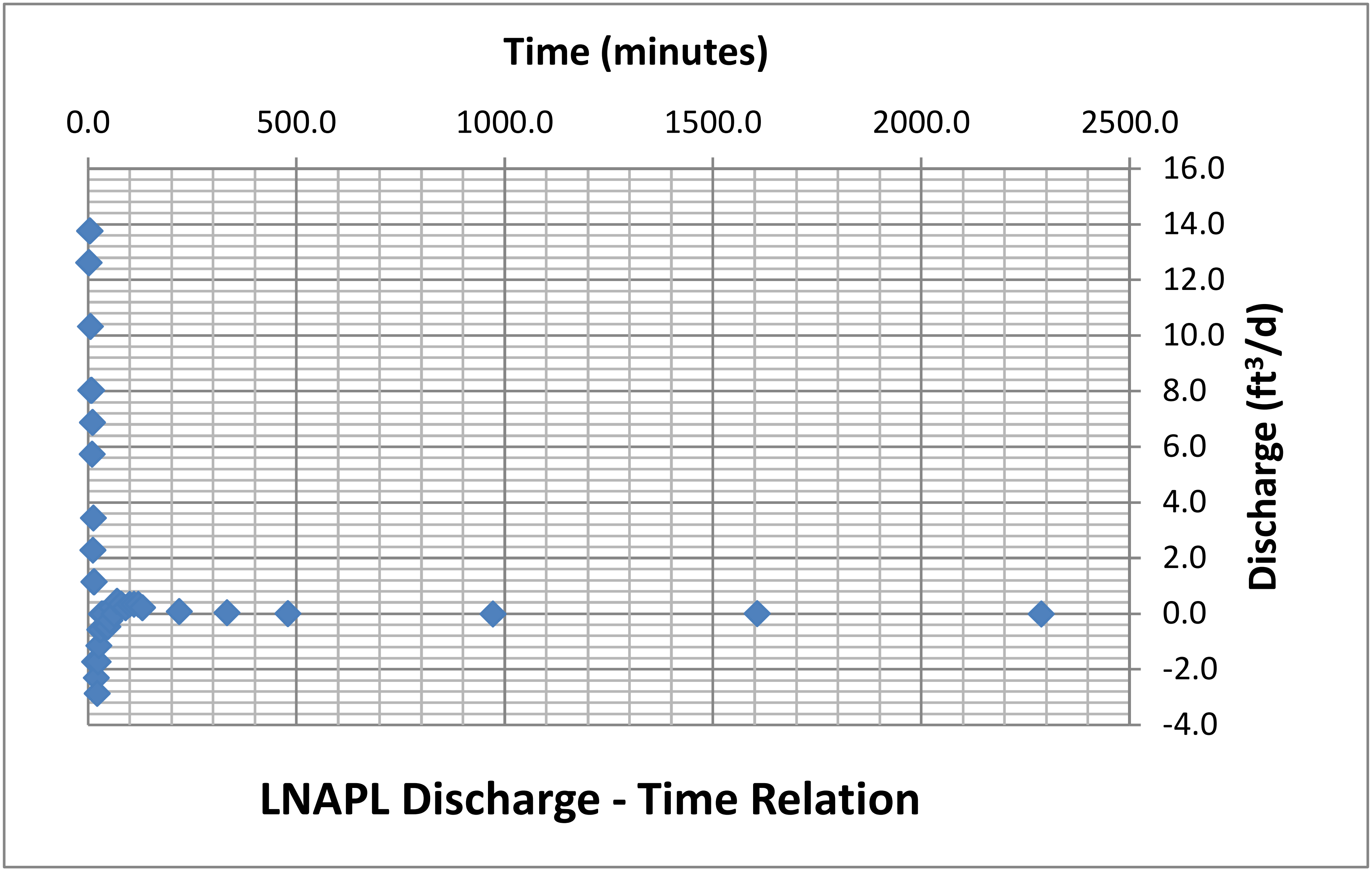


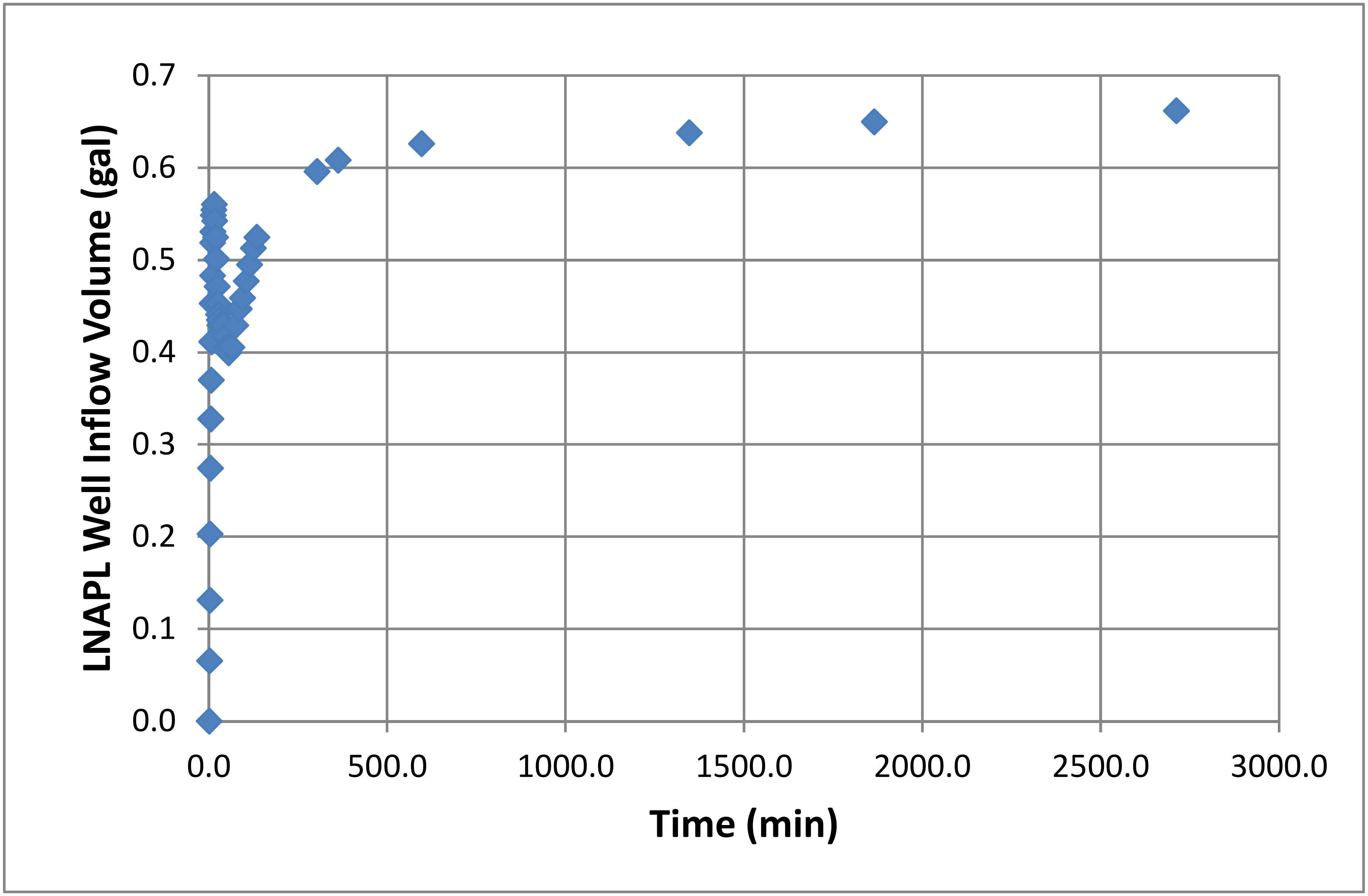
Discharge (ft³/d)
-5.0
0.0
5.0
10.0
15.0
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
DTP (ft bgs)
Depth to Product vs. LNAPL Discharge


Discharge (ft³/d)
-5.0
0.0
5.0
10.0
15.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0
DTW (ft bgs)
Depth to Water vs. LNAPL Discharge

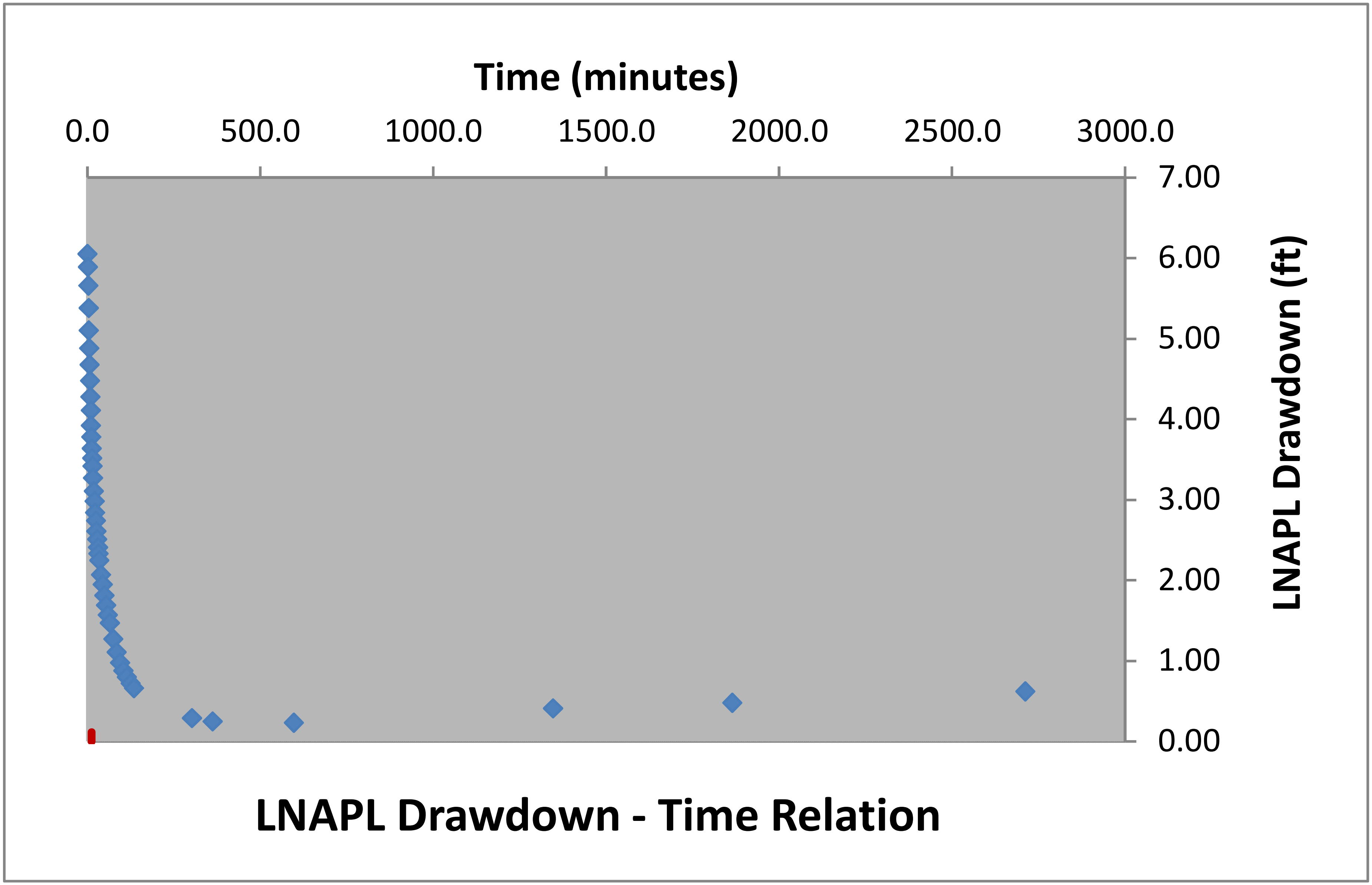


1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.0
500.0
1000.0
1500.0
2000.0
2500.0
3000.0
LNAPL Thickness b_n (ft)
Time (min)


Time (minutes)
0.0
500.0
1000.0
1500.0
2000.0
2500.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
Discharge (ft³/d)
LNAPL Discharge - Time Relation



0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
LNAPL Well Inflow Volume (gal)
0.0
500.0
1000.0
1500.0
2000.0
2500.0
3000.0
Time (min)



Time (minutes)
0.0
500.0
1000.0
1500.0
2000.0
2500.0
3000.0
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Time Relation

Generalized Bouwer and Rice (1976)

Well Designation:	MW-21
Date:	27-Mar-19

$$T_n = \frac{r_e^{\,2} \ln(R/r_e) \ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

L_e/r_e
66.2
C
3.45
R/r_e
24.05

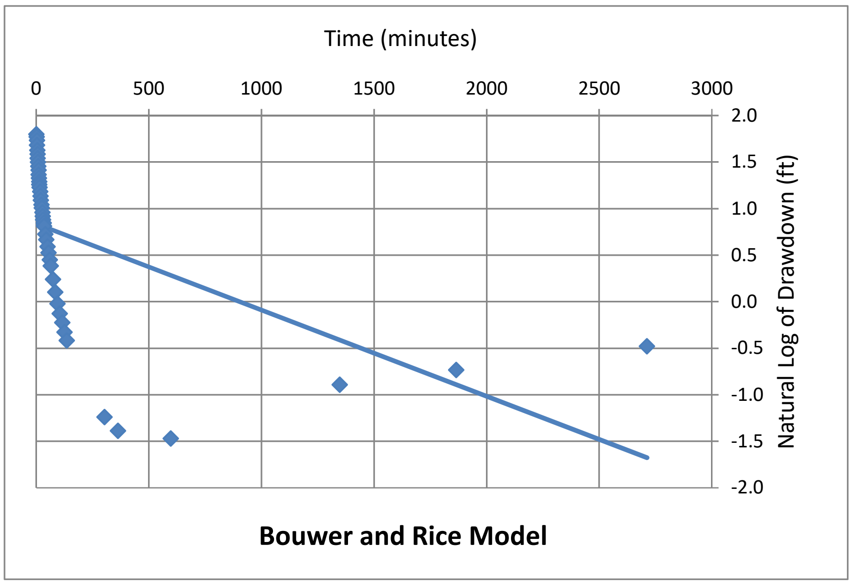
Enter early time cut-off for least-squares model fit

$Time_{cut}$	0	<- Enter or change value here

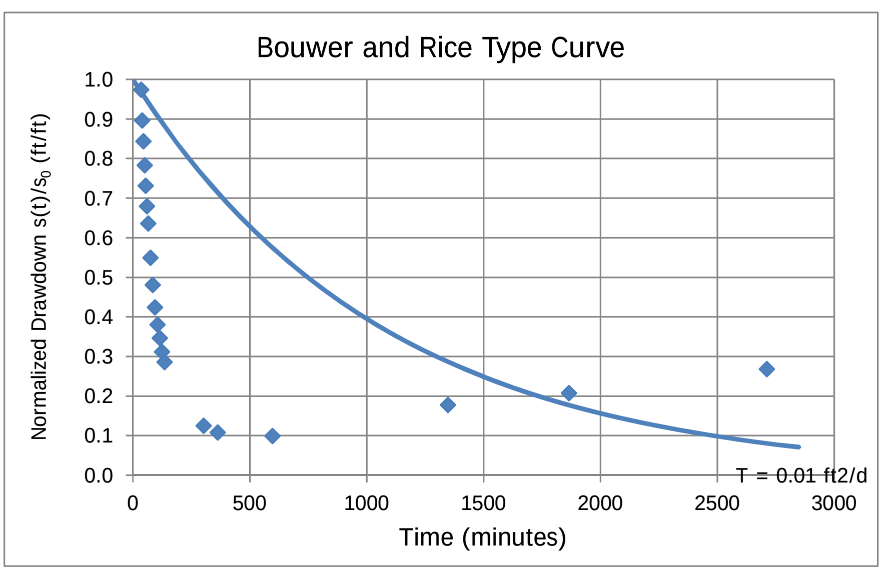
Model Results: T_n (ft^2/d) = 0.01 +/- 0.00 ft^2/d

J-Ratio
-4.667

Coef. Of Variation
0.24



C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW-21
Date:	27-Mar-19

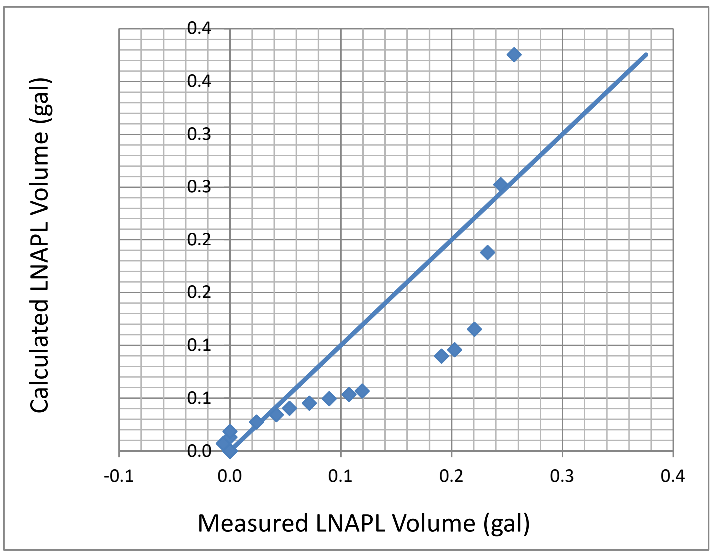
$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

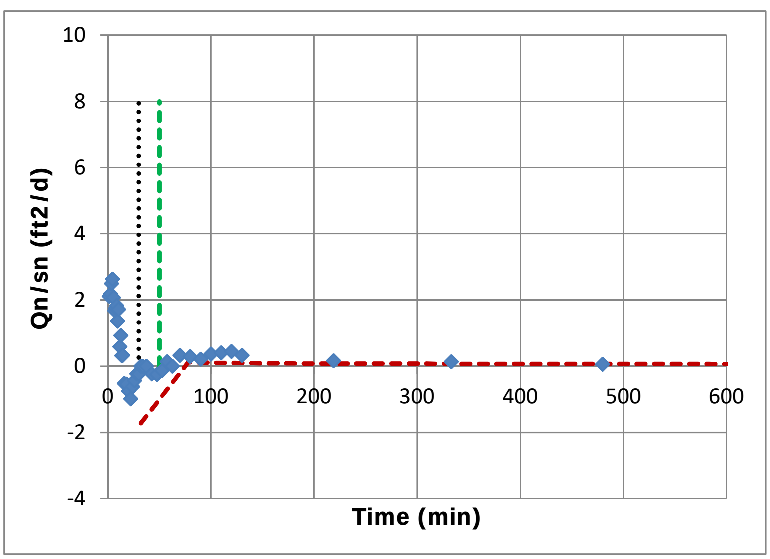
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	50	<- Enter or change values here
Time Adjustment (min):	30	
Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	0.242	<-- Minimize this using "Solver"
	0.004	<-- Working S_n
Trial T_n (ft^2/d):	0.028	<-- By changing T_n through "Solver"

Add constraint $T_n > 0.00001$

Model Result: T_n (ft^2/d) = **0.03**





Height

8

Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	MW-21
Date:	27-Mar-19

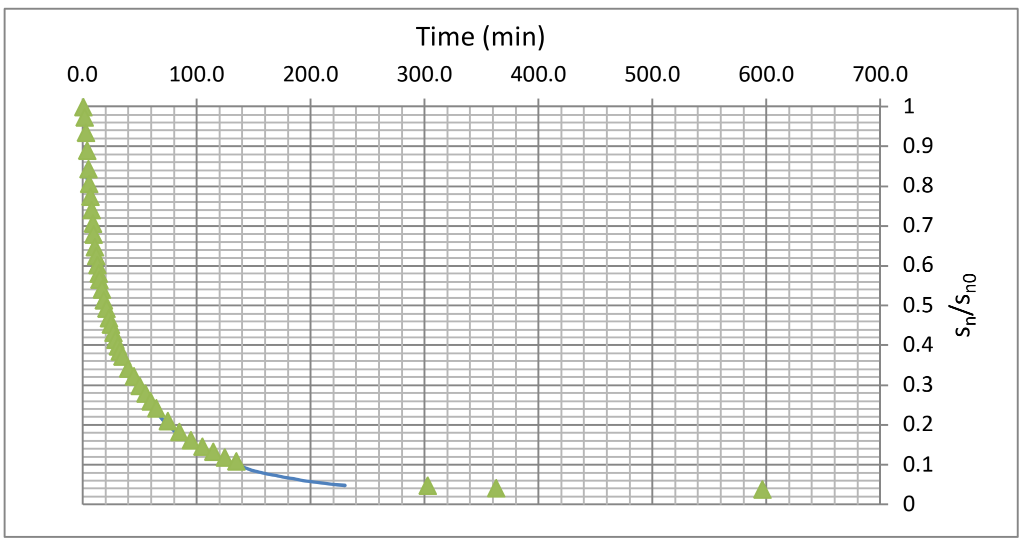
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Initial Drawdown s_n (ft):	6.05	
Trial S_n:	d	<-- Enter d for default
Root-Mean-Square Error:	0.204	<-- Minimize this using "Solver"
Trial T_n (ft^2/d):	0.281	<-- By changing T_n through "Solver"
	0.013	<-- Working S_n

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **0.28**

T_{min}	3
T_{max}	230



J-Ratio
-4.667

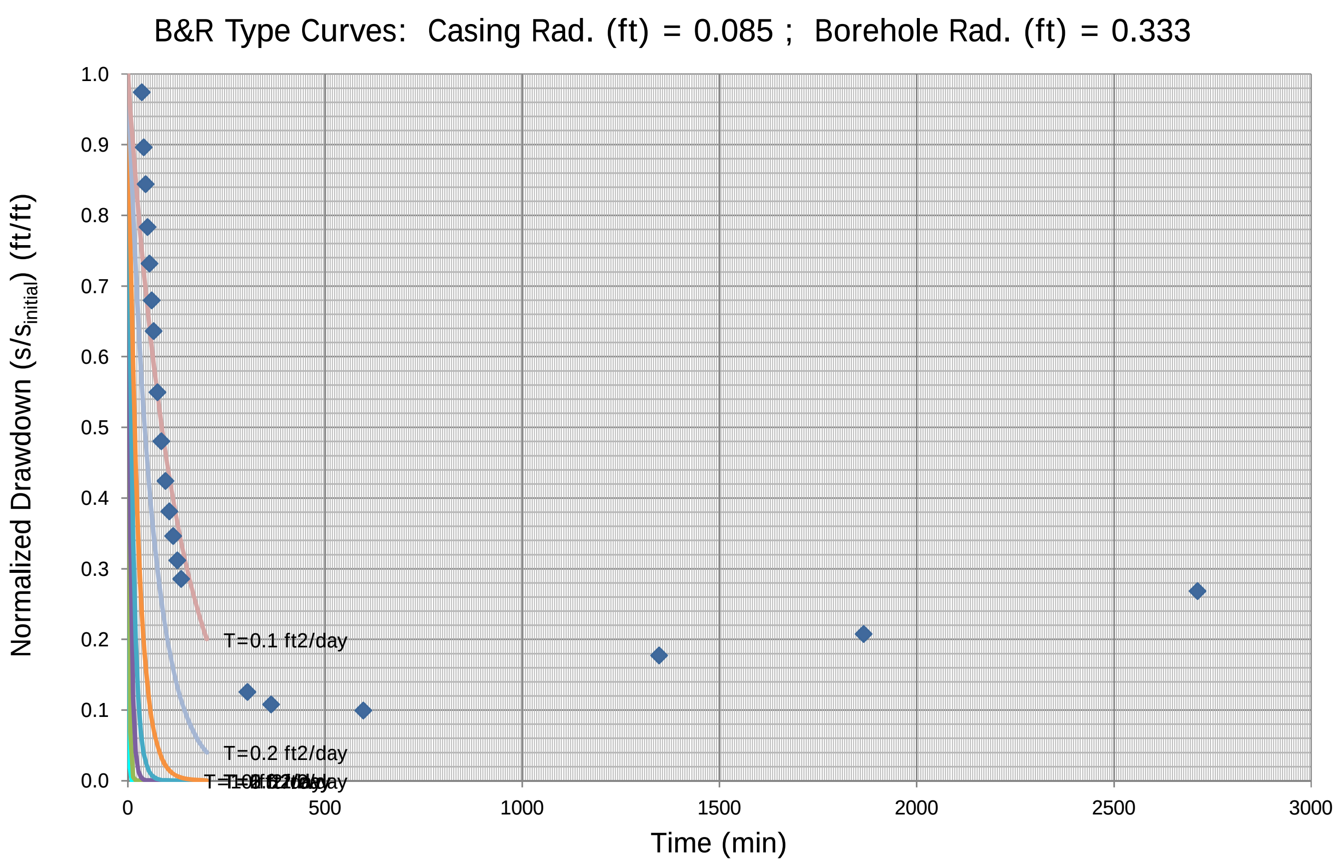
Bouwer and Rice Short Term LNAPL Mobility Test Type Curves

B&R Type Curves: Casing Rad. (ft) = 0.085 ; Borehole Rad. (ft) = 0.333

Enter these values

Type Curve ID	Type Curve Name	Notes	Max Time (min)	Transmissivity (ft^2/day)
1	T=10 ft2/day		150	10
2	T=5 ft2/day		200	5
3	T=2 ft2/day		200	2
4	T=1 ft2/day		200	1
5	T=0.5 ft2/day		200	0.5
6	T=0.2 ft2/day		200	0.2
7	T=0.1 ft2/day		200	0.1

J-Ratio	
-4.667	<-- If uncertain use
	-0.22



API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)	0.11
Standard Deviation (ft^2/d)	0.15
Coefficient of Variation	1.42

Well Designation:	MW-27	
Date:	19-Nov-17	

Ground Surface Elev (ft msl)	0.0	Enter These Data
Top of Casing Elev (ft msl)	0.0	
Well Casing Radius, r_c (ft):	0.085	r_{e1}
Well Radius, r_w (ft):	0.333	
LNAPL Specific Yield, S_y:	0.175	
LNAPL Density Ratio, ρ_r:	0.780	
Top of Screen (ft bgs):	0.0	
Bottom of Screen (ft bgs):	0.0	
LNAPL Baildown Vol. (gal.):	0.0	
Effective Radius, r_{e3} (ft):	0.159	Calculated Parameters
Effective Radius, r_{e2} (ft):	0.097	
Initial Casing LNAPL Vol. (gal.):	2.12	
Initial Filter LNAPL Vol. (gal.):	5.31	

Drawdown Adjustment (ft)
1.5

Enter Data Here

	Time (min)	DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)	Water Table Depth (ft)	LNAPL Drawdown s_n (ft)	Average Time (min)	LNAPL Discharge Q_n (ft^3/d)	s_n (ft)	b_n (ft)	r_e (ft)	DTP (ft bgs)	DTW (ft bgs)	LNAPL Volume (gallons)	Ave. r_e (ft)
Initial Fluid Levels:	0	21.70	34.16	21.70	34.16	24.44					12.46					
Enter Test Data:	1.0	28.26	28.67	28.26	28.67	28.35	5.06				0.41				0	0.159
	2.0	28.10	28.52	28.10	28.52	28.19	4.90	1.5	1.148	4.98	0.42	0.159	28.18	28.60	0.01	0
	3.0	27.89	28.34	27.89	28.34	27.99	4.69	2.5	3.443	4.80	0.45	0.159	28.00	28.43	0.02	0.159
	4.0	27.66	28.15	27.66	28.15	27.77	4.46	3.5	4.590	4.58	0.49	0.159	27.78	28.25	0.05	0.319
	5.0	27.50	28.02	27.50	28.02	27.61	4.30	4.5	3.443	4.38	0.52	0.159	27.58	28.09	0.07	0.478
	6.0	27.32	27.89	27.32	27.89	27.45	4.12	5.5	5.738	4.21	0.57	0.159	27.41	27.96	0.10	0.637
	7.0	27.18	27.76	27.18	27.76	27.31	3.98	6.5	1.148	4.05	0.58	0.159	27.25	27.83	0.10	0.796
	8.0	27.02	27.63	27.02	27.63	27.15	3.82	7.5	3.443	3.90	0.61	0.159	27.10	27.70	0.12	0.956
	9.0	26.90	27.50	26.90	27.50	27.03	3.70	8.5	-1.148	3.76	0.60	0.159	26.96	27.57	0.11	1.115
	10.0	26.76	27.34	26.76	27.34	26.89	3.56	9.5	-2.295	3.63	0.58	0.159	26.83	27.42	0.10	1.274
	11.0	26.63	27.21	26.63	27.21	26.76	3.43	10.5	0.000	3.50	0.58	0.159	26.70	27.28	0.10	1.433
	12.0	26.55	27.12	26.55	27.12	26.68	3.35	11.5	-1.148	3.39	0.57	0.159	26.59	27.17	0.10	1.593
	13.0	26.44	27.01	26.44	27.01	26.57	3.24	12.5	0.000	3.30	0.57	0.159	26.50	27.07	0.10	1.752
	14.0	26.32	26.87	26.32	26.87	26.44	3.12	13.5	-2.295	3.18	0.55	0.159	26.38	26.94	0.08	1.911
	15.0	26.21	26.76	26.21	26.76	26.33	3.01	14.5	0.000	3.07	0.55	0.159	26.27	26.82	0.08	2.070
	16.0	26.12	26.65	26.12	26.65	26.24	2.92	15.5	-2.295	2.97	0.53	0.159	26.17	26.71	0.07	2.230
	17.0	26.03	26.56	26.03	26.56	26.15	2.83	16.5	0.000	2.88	0.53	0.159	26.08	26.61	0.07	2.389
	18.0	25.94	26.47	25.94	26.47	26.06	2.74	17.5	0.000	2.79	0.53	0.159	25.99	26.52	0.07	2.548
	19.0	25.86	26.38	25.86	26.38	25.97	2.66	18.5	-1.148	2.70	0.52	0.159	25.90	26.43	0.07	2.708
	20.0	25.79	26.31	25.79	26.31	25.90	2.59	19.5	0.000	2.63	0.52	0.159	25.83	26.35	0.07	2.867
	21.0	25.72	26.22	25.72	26.22	25.83	2.52	20.5	-2.295	2.56	0.50	0.159	25.76	26.27	0.05	3.026
	22.0	25.65	26.16	25.65	26.16	25.76	2.45	21.5	1.148	2.49	0.51	0.159	25.69	26.19	0.06	3.185
	24.0	25.52	26.01	25.52	26.01	25.63	2.32	23.0	-1.148	2.39	0.49	0.159	25.59	26.09	0.05	3.424
	26.0	25.42	25.90	25.42	25.90	25.53	2.22	25.0	-0.574	2.27	0.48	0.159	25.47	25.96	0.04	3.743
	28.0	25.31	25.80	25.31	25.80	25.42	2.11	27.0	0.574	2.17	0.49	0.159	25.37	25.85	0.05	4.061
	30.0	25.20	25.69	25.20	25.69	25.31	2.00	29.0	0.000	2.06	0.49	0.159	25.26	25.75	0.05	4.380
	32.0	25.11	25.61	25.11	25.61	25.22	1.91	31.0	0.574	1.96	0.50	0.159	25.16	25.65	0.05	4.698
	34.0	25.01	25.52	25.01	25.52	25.12	1.81	33.0	0.574	1.86	0.51	0.159	25.06	25.57	0.06	5.017
	36.0	24.93	25.44	24.93	25.44	25.04	1.73	35.0	0.000	1.77	0.51	0.159	24.97	25.48	0.06	5.335
	38.0	24.86	25.37	24.86	25.37	24.97	1.66	37.0	0.000	1.70	0.51	0.159	24.90	25.41	0.06	5.654
	40.0	24.79	25.30	24.79	25.30	24.90	1.59	39.0	0.000	1.63	0.51	0.159	24.83	25.34	0.06	5.973
	42.0	24.71	25.23	24.71	25.23	24.82	1.51	41.0	0.574	1.55	0.52	0.159	24.75	25.27	0.07	6.291
	47.0	24.55	25.11	24.55	25.11	24.67	1.35	44.5	0.918	1.43	0.56	0.159	24.63	25.17	0.09	6.849
	52.0	24.41	25.02	24.41	25.02	24.54	1.21	49.5	1.148	1.28	0.61	0.159	24.48	25.07	0.12	7.645
	57.0	24.30	24.94	24.30	24.94	24.44	1.10	54.5	0.689	1.16	0.64	0.159	24.36	24.98	0.14	8.441
	62.0	24.18	24.86	24.18	24.86	24.33	0.98	59.5	0.918	1.04	0.68	0.159	24.24	24.90	0.16	9.238
	67.0	24.07	24.86	24.07	24.86	24.24	0.87	64.5	2.525	0.93	0.79	0.159	24.13	24.86	0.23	10.034
	72.0	23.98	24.88	23.98	24.88	24.18	0.78	69.5	2.525	0.83	0.90	0.159	24.03	24.87	0.29	10.830
	77.0	23.91	24.90	23.91	24.90	24.13	0.71	74.5	2.066	0.75	0.99	0.159	23.95	24.89	0.35	11.627
	82.0	23.84	24.92	23.84	24.92	24.08	0.64	79.5	2.066	0.68	1.08	0.159	23.88	24.91	0.40	12.423
	87.0	23.78	24.93	23.78	24.93	24.03	0.58	84.5	1.607	0.61	1.15	0.159	23.81	24.93	0.44	13.219
	92.0	23.73	24.94	23.73	24.94	24.00	0.53	89.5	1.377	0.56	1.21	0.159	23.76	24.94	0.48	14.016
	97.0	23.68	24.95	23.68	24.95	23.96	0.48	94.5	1.377	0.51	1.27	0.159	23.71	24.95	0.51	14.812

102.0	23.64	24.97	23.64	24.97	23.93	0.44	99.5	1.377	0.46	1.33	0.159	23.66	24.96	0.55	15.608
107.0	23.60	24.98	23.60	24.98	23.90	0.40	104.5	1.148	0.42	1.38	0.159	23.62	24.98	0.58	16.405
112.0	23.56	25.00	23.56	25.00	23.88	0.36	109.5	1.377	0.38	1.44	0.159	23.58	24.99	0.61	17.201
117.0	23.53	25.01	23.53	25.01	23.86	0.33	114.5	0.918	0.35	1.48	0.159	23.55	25.01	0.64	17.997
122	23.50	25.04	23.50	25.04	23.84	0.30	119.5	1.377	0.32	1.54	0.159	23.52	25.03	0.67	18.794
127	23.49	25.06	23.49	25.06	23.84	0.29	124.5	0.689	0.30	1.57	0.159	23.50	25.05	0.69	19.590
132	23.45	25.08	23.45	25.08	23.81	0.25	129.5	1.377	0.27	1.63	0.159	23.47	25.07	0.73	20.386
137	23.42	25.14	23.42	25.14	23.80	0.22	134.5	2.066	0.24	1.72	0.159	23.44	25.11	0.78	21.183
142	23.40	25.16	23.40	25.16	23.79	0.20	139.5	0.918	0.21	1.76	0.159	23.41	25.15	0.80	21.979
147	23.38	25.20	23.38	25.20	23.78	0.18	144.5	1.377	0.19	1.82	0.159	23.39	25.18	0.84	22.775
152	23.36	25.23	23.36	25.23	23.77	0.16	149.5	1.148	0.17	1.87	0.159	23.37	25.22	0.87	23.572
157	23.34	25.26	23.34	25.26	23.76	0.14	154.5	1.148	0.15	1.92	0.159	23.35	25.25	0.90	24.368
162	23.33	25.28	23.33	25.28	23.76	0.13	159.5	0.689	0.14	1.95	0.159	23.34	25.27	0.92	25.164
167	23.32	25.25	23.32	25.25	23.74	0.12	164.5	-0.459	0.13	1.93	0.159	23.33	25.27	0.91	25.961
172	23.31	25.28	23.31	25.28	23.74	0.11	169.5	0.918	0.12	1.97	0.159	23.32	25.27	0.93	26.757
177	23.30	25.29	23.30	25.29	23.74	0.10	174.5	0.459	0.11	1.99	0.159	23.31	25.29	0.94	27.553

Figure 1

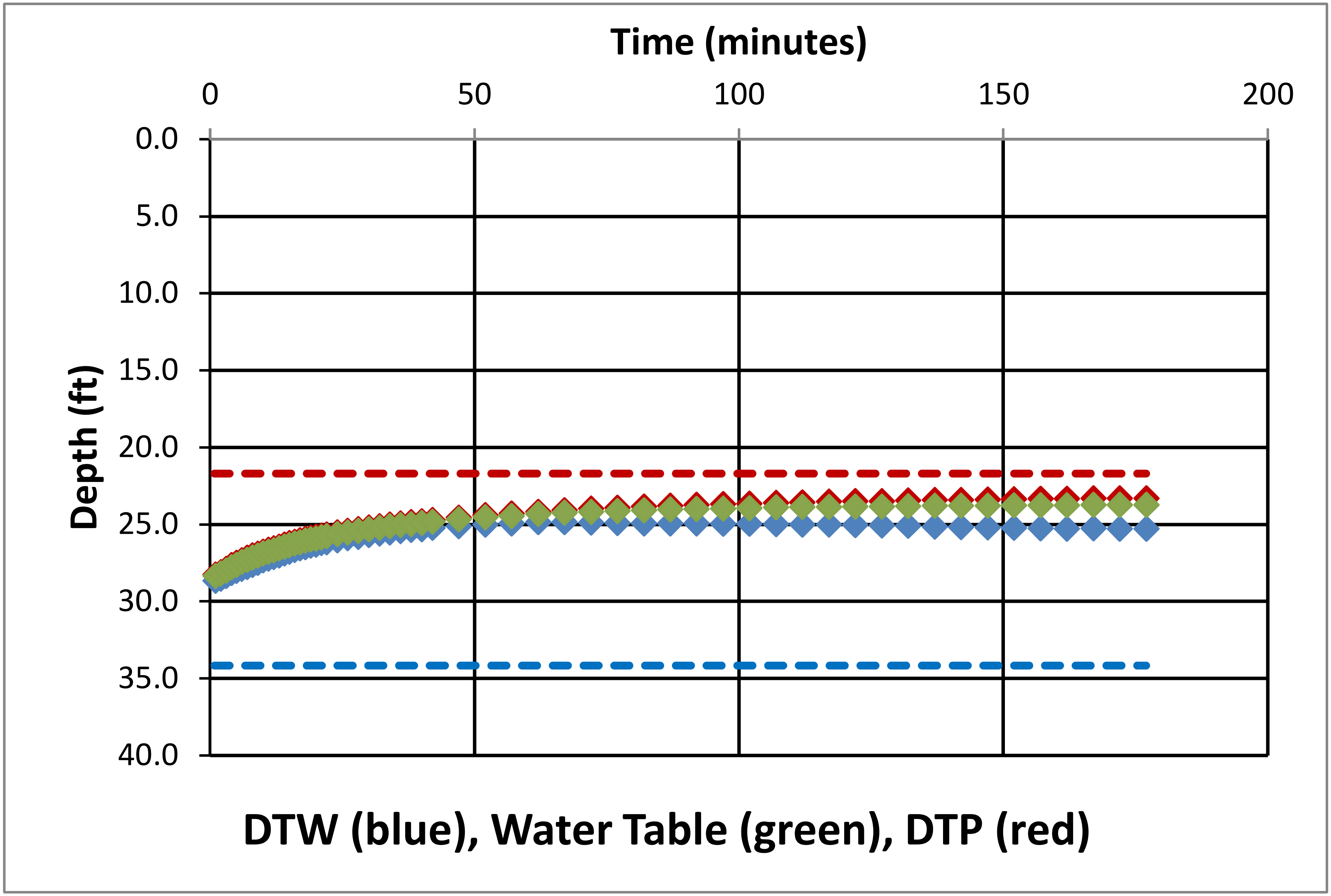

Time (minutes)
0
50
100
150
200
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 2

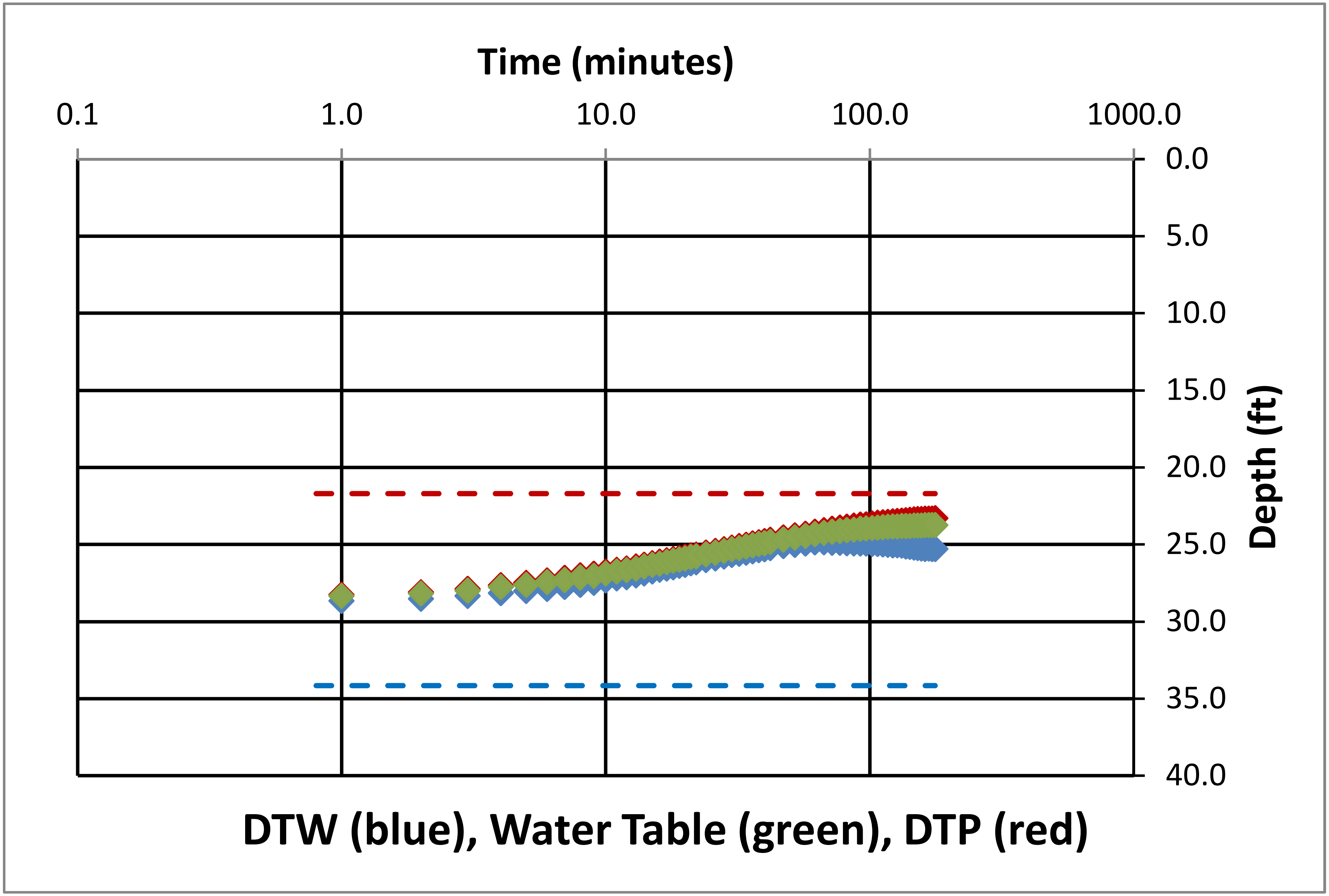

Time (minutes)
0.1
1.0
10.0
100.0
1000.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 3

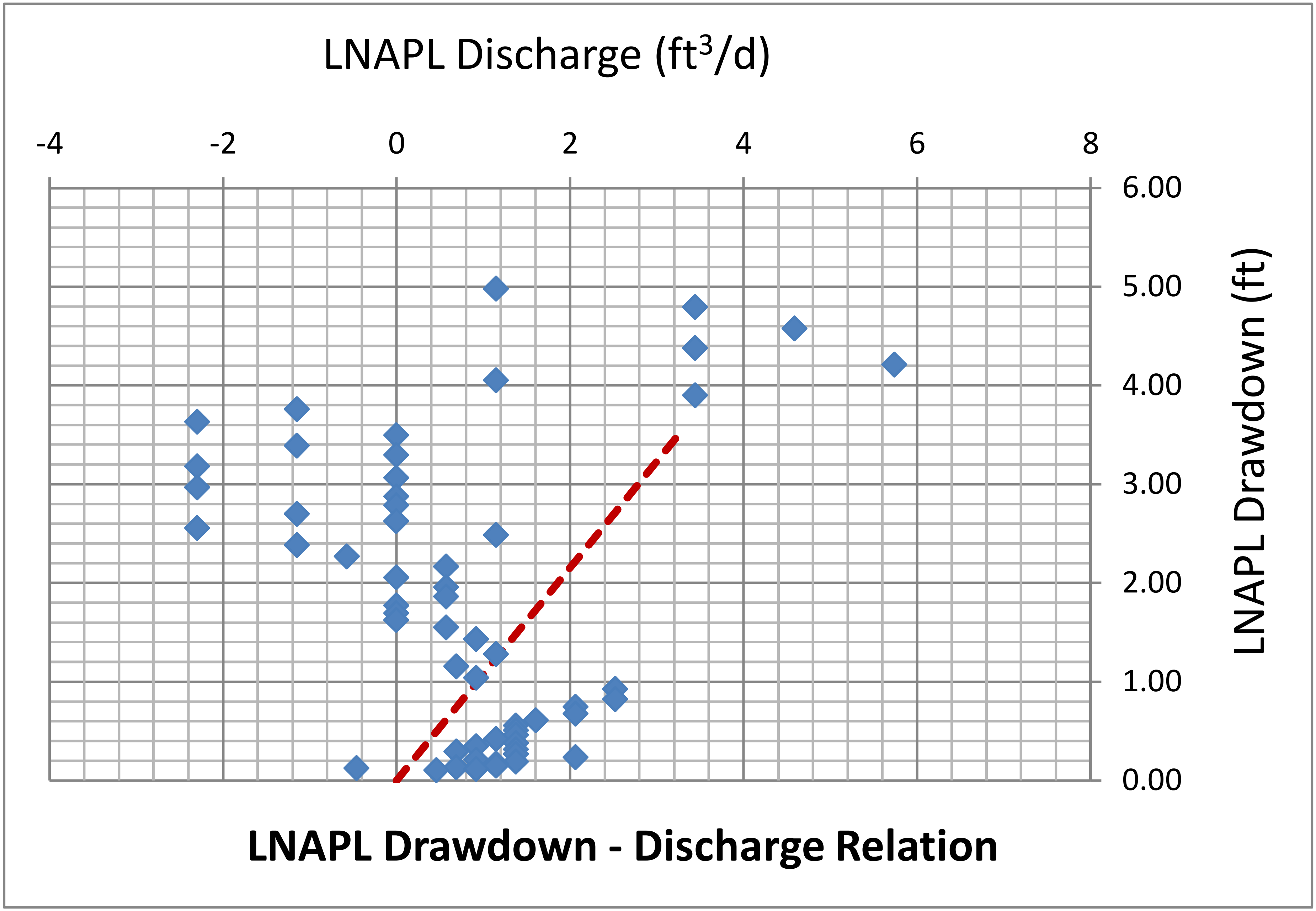
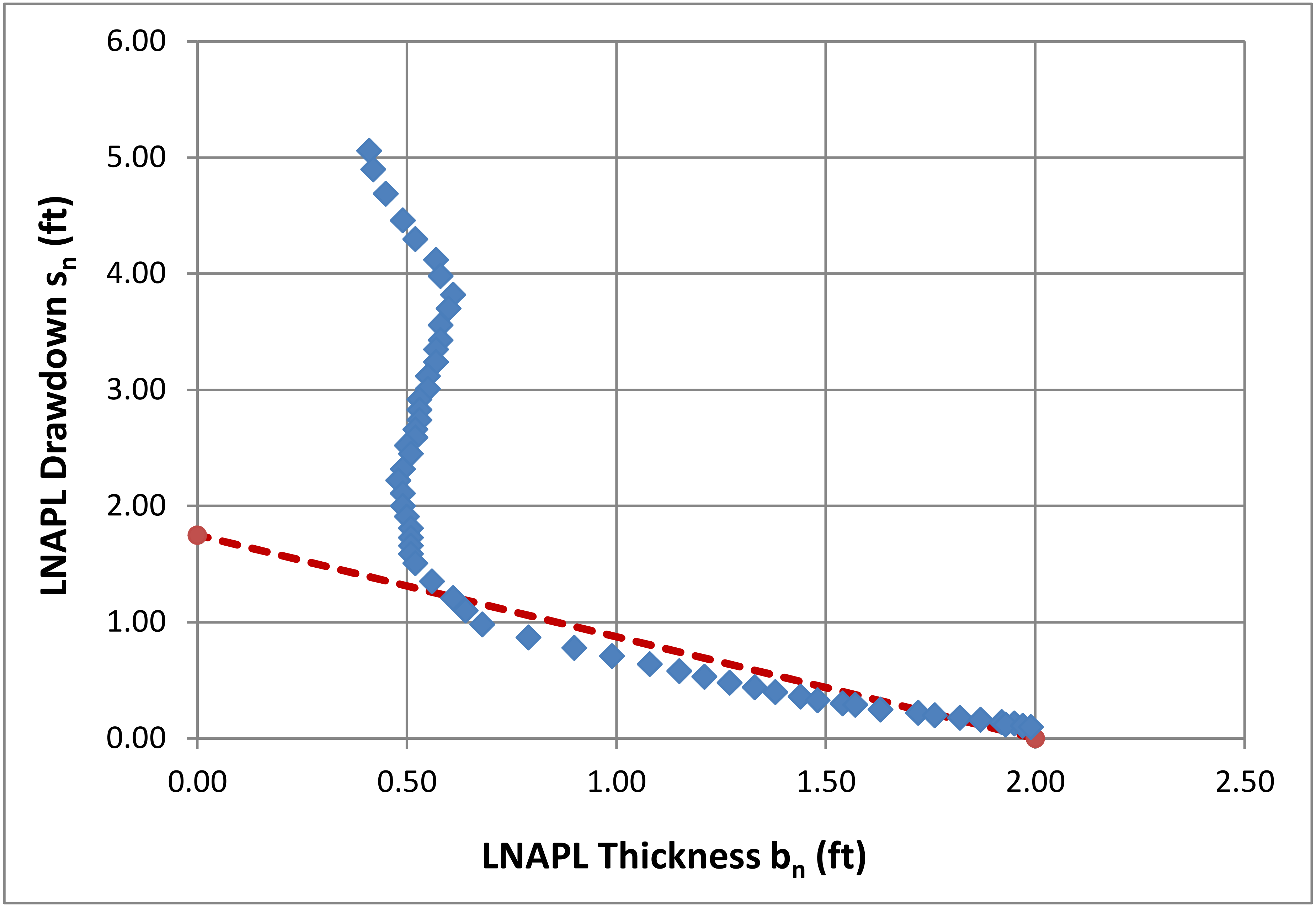

LNAPL Discharge (ft³/d)
-4
-2
0
2
4
6
8
6.00
5.00
4.00
3.00
2.00
1.00
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Discharge Relation

Figure 4



MW-27 (November 2017)
Baildown Test Data Analysis

Figure 5

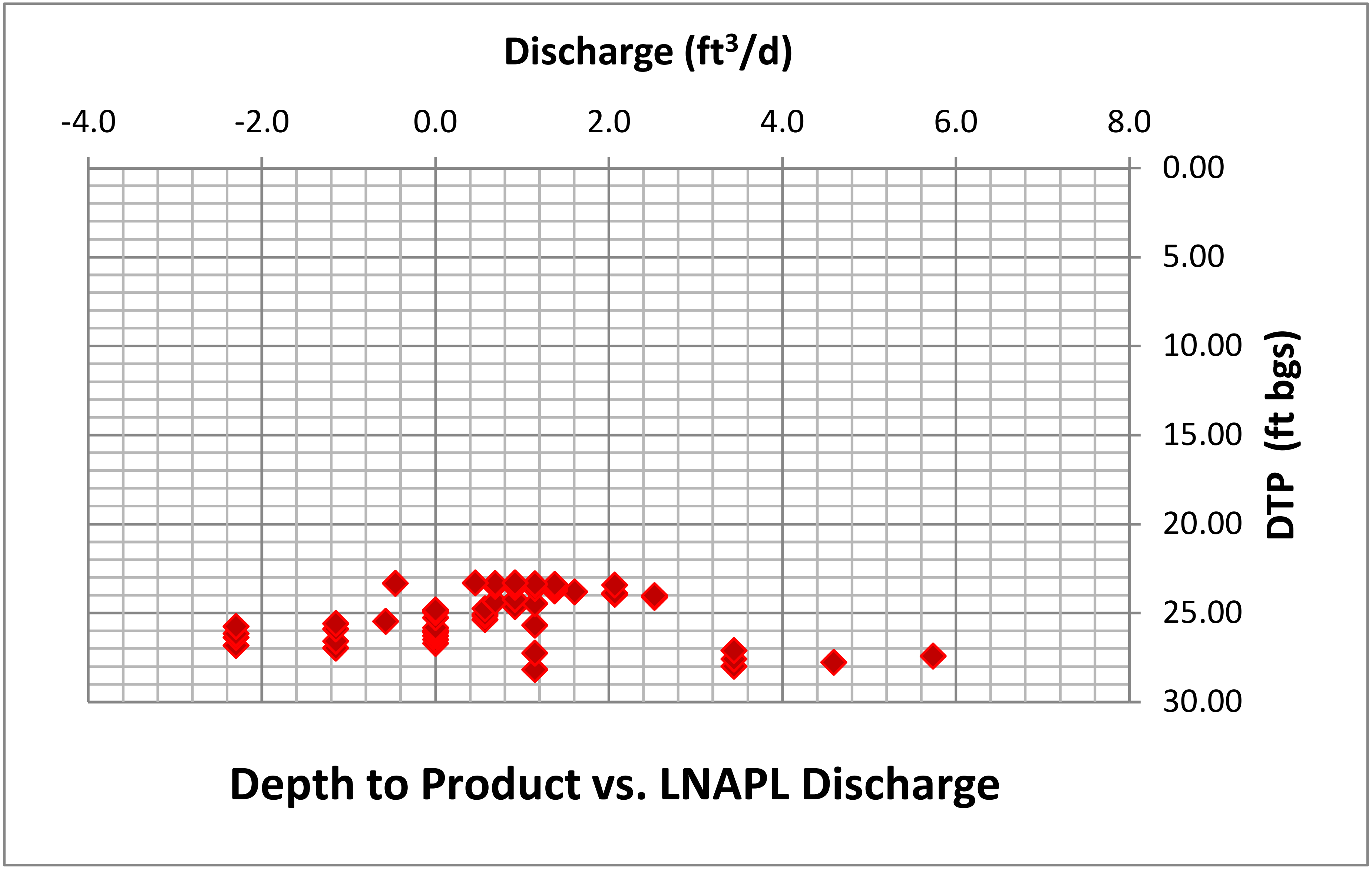
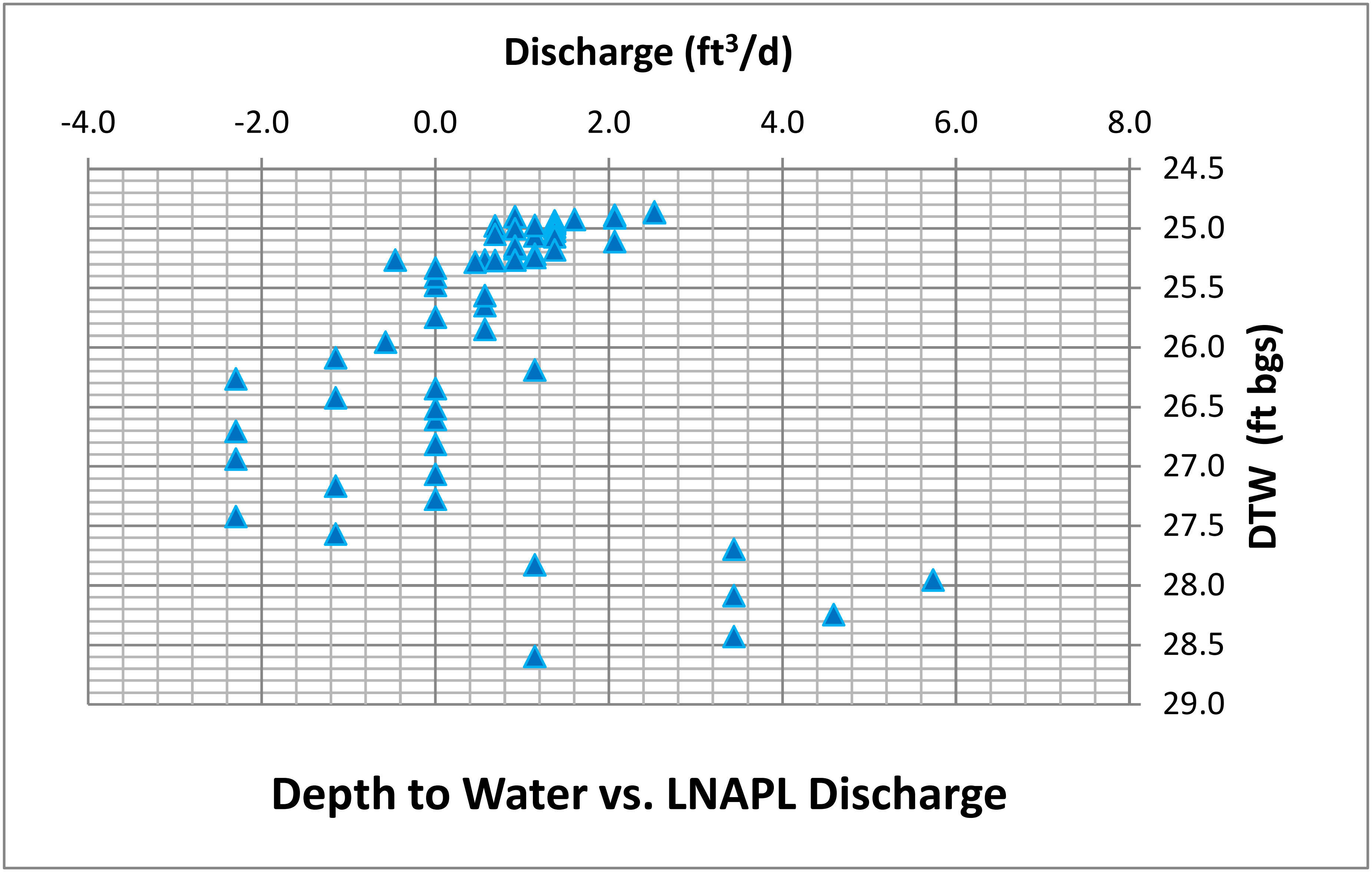
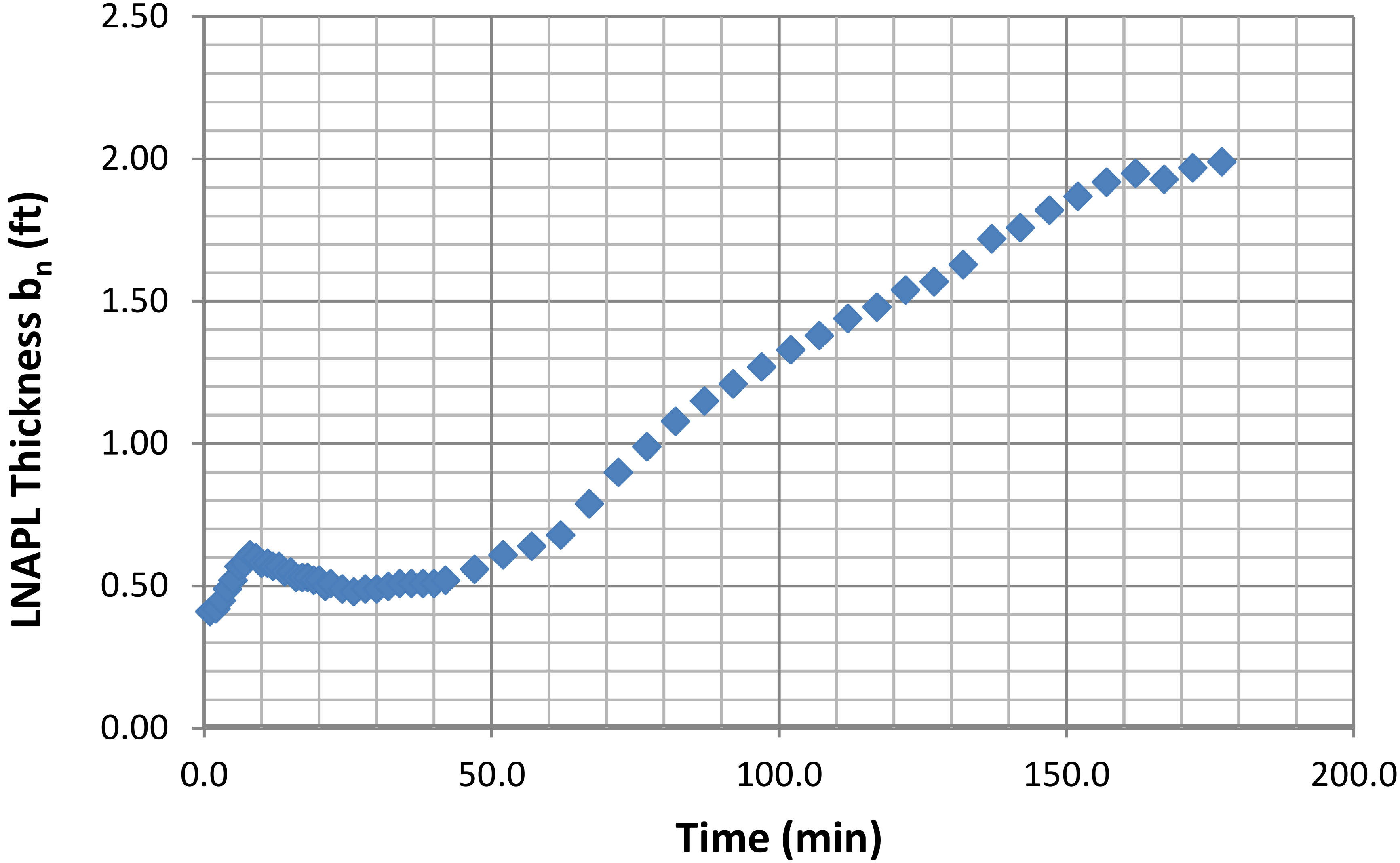

Discharge (ft³/d)
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
0.00
5.00
10.00
15.00
20.00
25.00
30.00
DTP (ft bgs)
Depth to Product vs. LNAPL Discharge

Figure 6



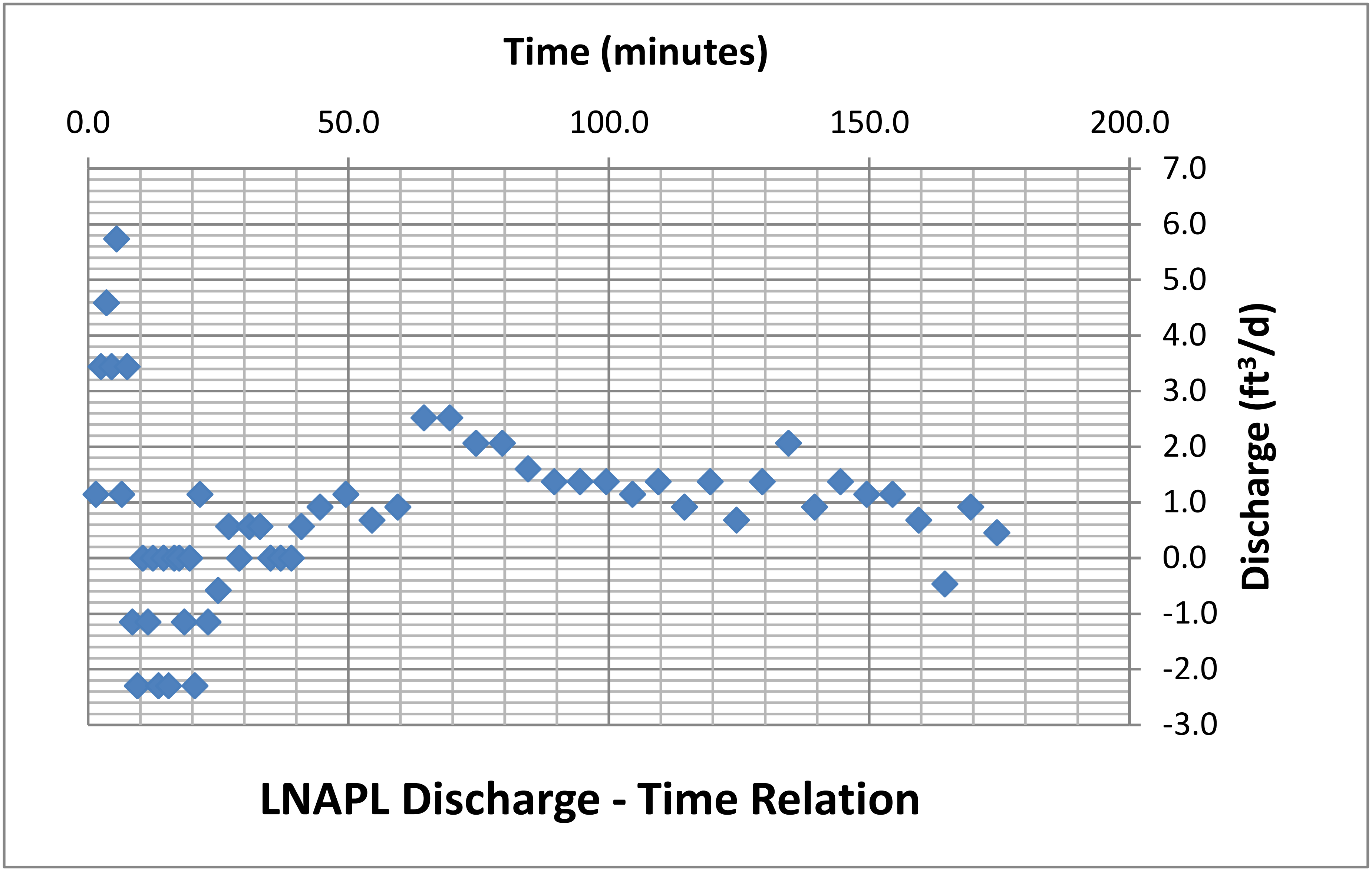
Discharge (ft³/d)
-4.0
-2.0
0.0
2.0
4.0
6.0
8.0
24.5
25.0
25.5
26.0
26.5
27.0
27.5
28.0
28.5
29.0
DTW (ft bgs)
Depth to Water vs. LNAPL Discharge

Figure 7



MW-27 (November 2017)
Baildown Test Data Analysis
Page 9 of 17

Figure 8



MW-27 (November 2017)
Baildown Test Data Analysis

Figure 9

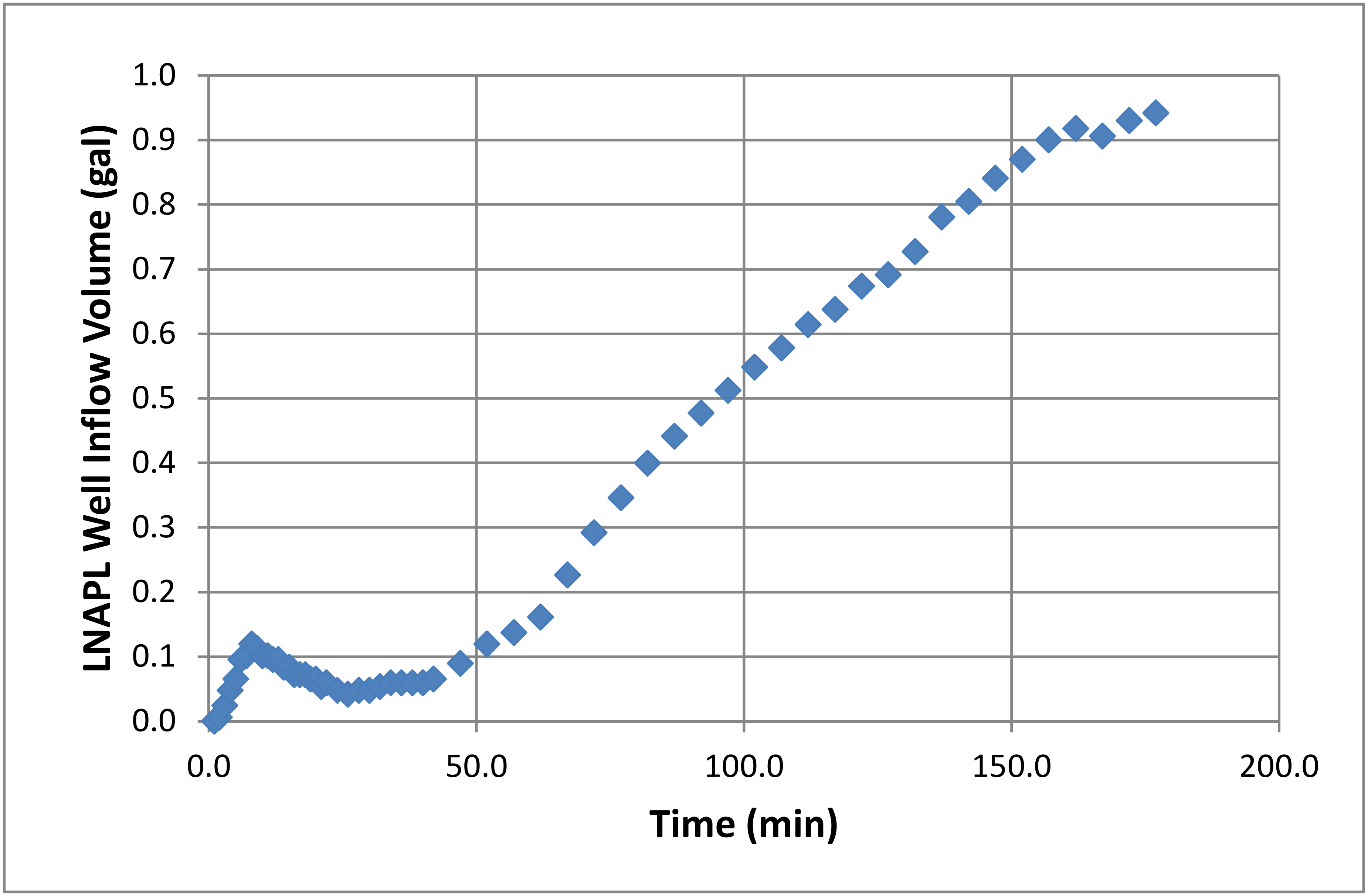
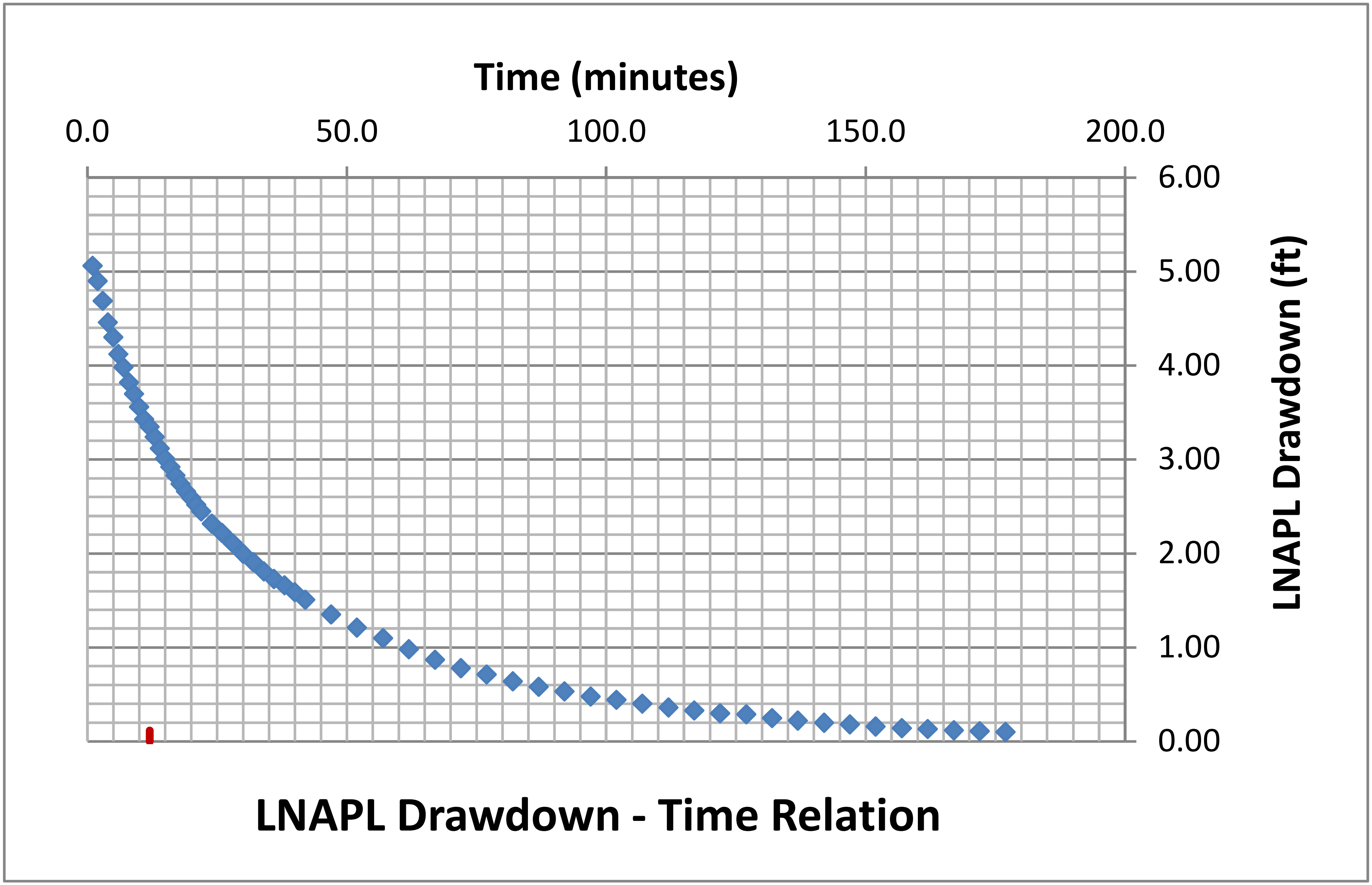

LNAPL Well Inflow Volume (gal)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
50.0
100.0
150.0
200.0
Time (min)

Figure 10



Time (minutes)
0.0
50.0
100.0
150.0
200.0
6.00
5.00
4.00
3.00
2.00
1.00
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Time Relation

Generalized Bouwer and Rice (1976)

Well Designation:	MW-27
Date:	19-Nov-17

$$T_n = \frac{r_e^{\,2} \ln(R/r_e) \ln(s_n(t_1)/s_n(t))}{2(-J)(t - t_1)}$$

Enter early time cut-off for least-squares model fit

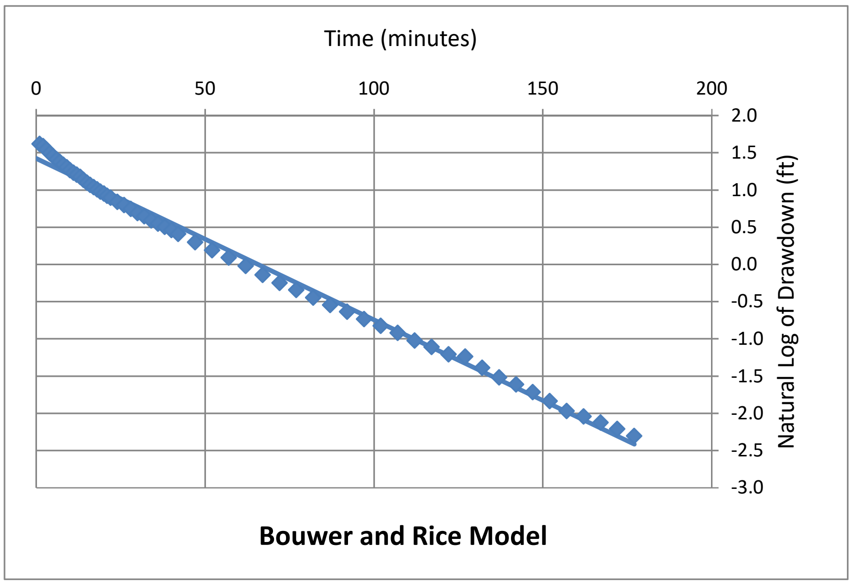
$Time_{cut}$	0	<- Enter or change value here

Model Results: T_n (ft^2/d) = 1.50 +/- 0.01 ft^2/d

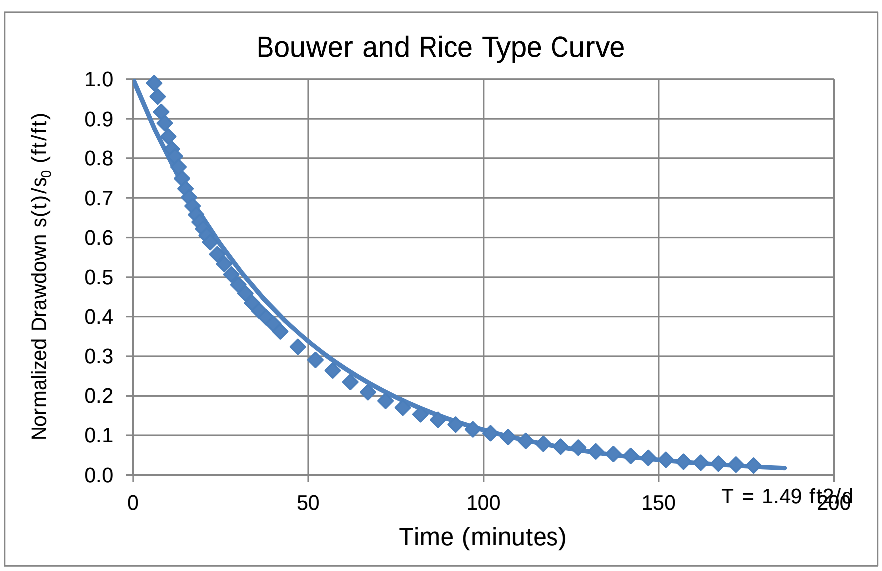
L_e/r_e
78.2
C
3.93
R/r_e
27.24

J-Ratio
-0.875

Coef. Of Variation
0.01



C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW-27
Date:	19-Nov-17

$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

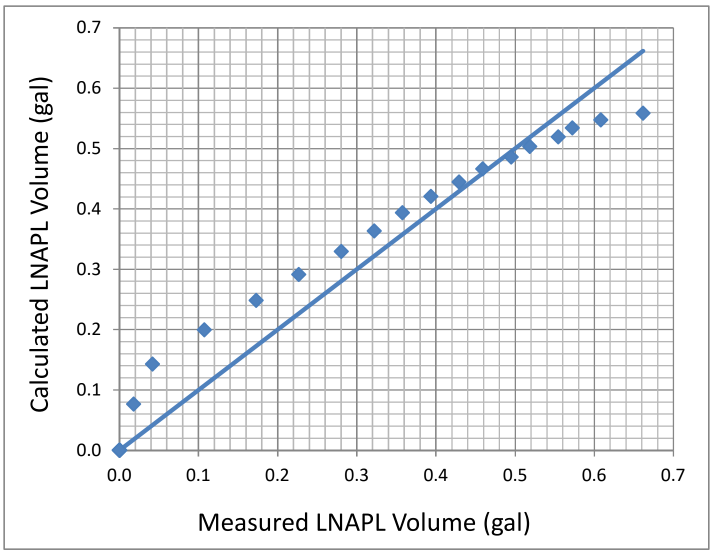
Enter early time cut-off for least-squares model fit

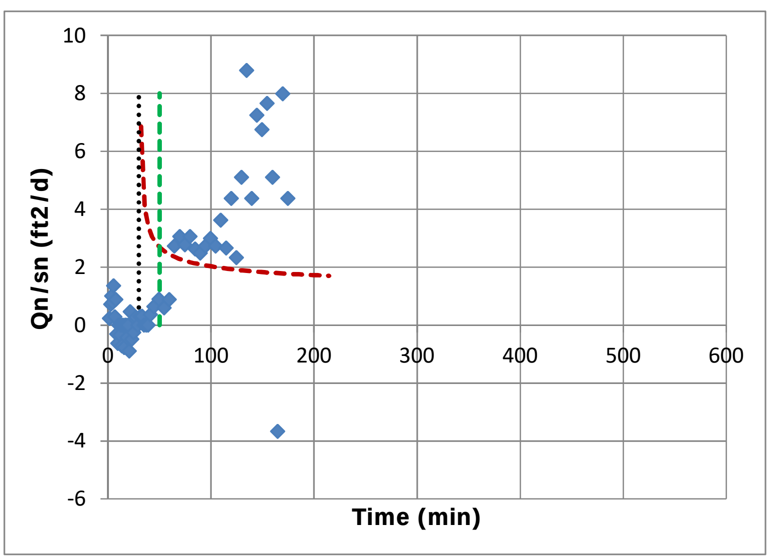
$Time_{cut}$ (min):	50	<- Enter or change values here
Time Adjustment (min):	30	

Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	0.236	<-- Minimize this using "Solver"
	0.023	<-- Working S_n
Trial T_n (ft^2/d):	0.813	<-- By changing T_n through "Solver"

Add constraint T_n > 0.00001

Model Result: T_n (ft^2/d) = **0.81**





Height
8

Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	MW-27
Date:	19-Nov-17

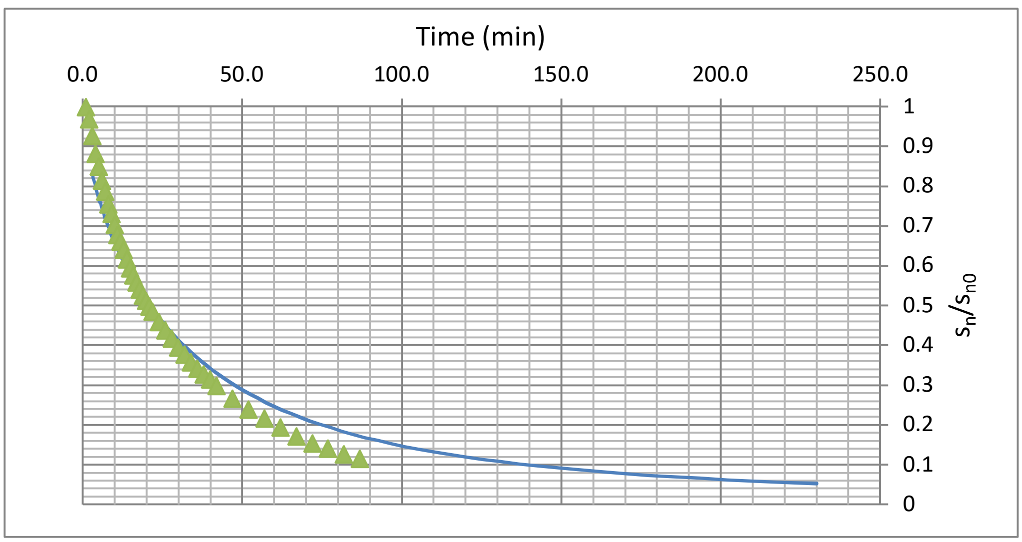
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Initial Drawdown s_n (ft):	5.06	
Trial S_n:	d	<-- Enter d for default
Root-Mean-Square Error:	0.299	<-- Minimize this using "Solver"
Trial T_n (ft^2/d):	1.298	<-- By changing T_n through "Solver"
	0.028	<-- Working S_n

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **1.30**

T_{min}	3
T_{max}	230



J-Ratio
-0.875

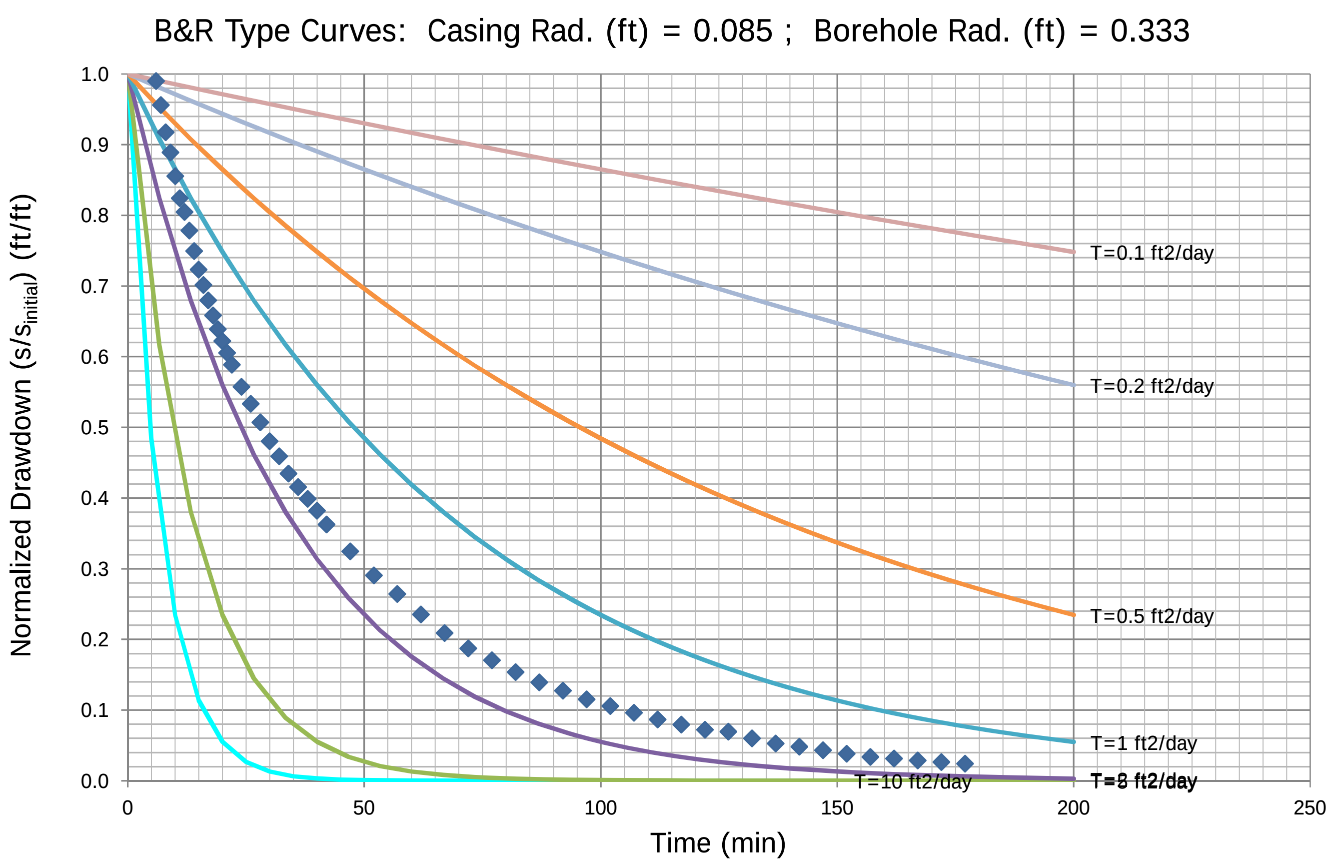
Bouwer and Rice Short Term LNAPL Mobility Test Type Curves

B&R Type Curves: Casing Rad. (ft) = 0.085 ; Borehole Rad. (ft) = 0.333

Enter these values

Type Curve ID	Type Curve Name	Notes	Max Time (min)	Transmissivity (ft^2/day)
1	T=10 ft2/day		150	10
2	T=5 ft2/day		200	5
3	T=2 ft2/day		200	2
4	T=1 ft2/day		200	1
5	T=0.5 ft2/day		200	0.5
6	T=0.2 ft2/day		200	0.2
7	T=0.1 ft2/day		200	0.1

J-Ratio	
-0.875	<-- If uncertain use
	-0.22



API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)

1.20

Standard Deviation (ft^2/d)

0.35

Coefficient of Variation

0.29

Well Designation:	MW-27	
Date:	27-Mar-19	

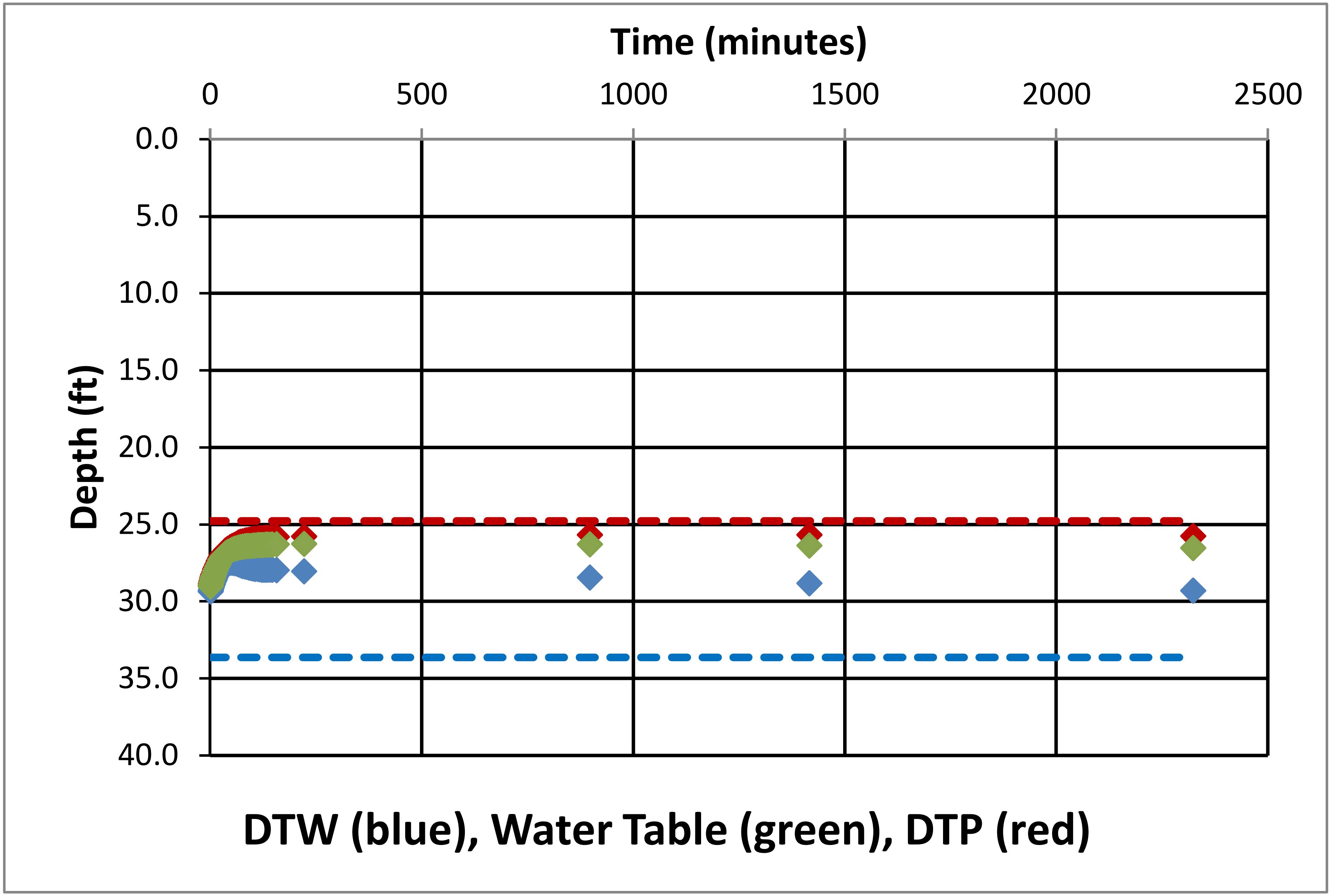
Ground Surface Elev (ft msl)	0.0	Enter These Data	**Drawdown Adjustment (ft)**
Top of Casing Elev (ft msl)	0.0		
Well Casing Radius, r_c (ft):	0.085	r_{e1}	
Well Radius, r_w (ft):	0.333		0.75
LNAPL Specific Yield, S_y:	0.175		
LNAPL Density Ratio, ρ_r:	0.780		
Top of Screen (ft bgs):	0.0		
Bottom of Screen (ft bgs):	0.0		
LNAPL Baildown Vol. (gal.):	0.0		
Effective Radius, r_{e3} (ft):	0.159	Calculated Parameters	
Effective Radius, r_{e2} (ft):	0.120		
Initial Casing LNAPL Vol. (gal.):	1.50		
Initial Filter LNAPL Vol. (gal.):	3.77		

Enter Data Here

	Time (min)	DTP (ft btoc)	DTW (ft btoc)	DTP (ft bgs)	DTW (ft bgs)	Water Table Depth (ft)	LNAPL Drawdown s_n (ft)	Average Time (min)	LNAPL Discharge Q_n (ft^3/d)	s_n (ft)	b_n (ft)	r_e (ft)	DTP (ft bgs)	DTW (ft bgs)	LNAPL Volume (gallons)	Ave. r_e (ft)
Initial Fluid Levels:	0	24.78	33.63	24.78	33.63	26.73					8.85					
Enter Test Data:	1.0	28.96	29.34	28.96	29.34	29.04	3.43				0.38				0	0.159
	2.0	28.83	29.24	28.83	29.24	28.92	3.30	1.5	3.443	3.37	0.41	0.159	28.90	29.29	0.02	0
	3.0	28.71	29.14	28.71	29.14	28.80	3.18	2.5	2.295	3.24	0.43	0.159	28.77	29.19	0.03	0.159
	4.0	28.60	29.06	28.60	29.06	28.70	3.07	3.5	3.443	3.13	0.46	0.159	28.66	29.10	0.05	0.319
	5.0	28.48	28.96	28.48	28.96	28.59	2.95	4.5	2.295	3.01	0.48	0.159	28.54	29.01	0.06	0.478
	6.0	28.39	28.89	28.39	28.89	28.50	2.86	5.5	2.295	2.91	0.50	0.159	28.44	28.93	0.07	0.637
	7.0	28.30	28.81	28.30	28.81	28.41	2.77	6.5	1.148	2.82	0.51	0.159	28.35	28.85	0.08	0.796
	8.0	28.22	28.75	28.22	28.75	28.34	2.69	7.5	2.295	2.73	0.53	0.159	28.26	28.78	0.09	0.956
	10.0	28.07	28.63	28.07	28.63	28.19	2.54	9.0	1.721	2.62	0.56	0.159	28.15	28.69	0.11	1.195
	12.0	27.92	28.51	27.92	28.51	28.05	2.39	11.0	1.721	2.47	0.59	0.159	28.00	28.57	0.13	1.513
	14.0	27.77	28.37	27.77	28.37	27.90	2.24	13.0	0.574	2.32	0.60	0.159	27.85	28.44	0.13	1.832
	16.0	27.63	28.25	27.63	28.25	27.77	2.10	15.0	1.148	2.17	0.62	0.159	27.70	28.31	0.14	2.150
	18.0	27.51	28.15	27.51	28.15	27.65	1.98	17.0	1.148	2.04	0.64	0.159	27.57	28.20	0.15	2.469
	20.0	27.39	28.05	27.39	28.05	27.54	1.86	19.0	1.148	1.92	0.66	0.159	27.45	28.10	0.17	2.787
	22.0	27.28	27.96	27.28	27.96	27.43	1.75	21.0	1.148	1.81	0.68	0.159	27.34	28.01	0.18	3.106
	24.0	27.16	27.86	27.16	27.86	27.31	1.63	23.0	1.148	1.69	0.70	0.159	27.22	27.91	0.19	3.424
	26.0	27.06	27.77	27.06	27.77	27.22	1.53	25.0	0.574	1.58	0.71	0.159	27.11	27.82	0.20	3.743
	28.0	26.98	27.71	26.98	27.71	27.14	1.45	27.0	1.148	1.49	0.73	0.159	27.02	27.74	0.21	4.061
	30.0	26.90	27.65	26.90	27.65	27.07	1.37	29.0	1.148	1.41	0.75	0.159	26.94	27.68	0.22	4.380
	32.0	26.84	27.60	26.84	27.60	27.01	1.31	31.0	0.574	1.34	0.76	0.159	26.87	27.63	0.23	4.698
	37.0	26.69	27.53	26.69	27.53	26.87	1.16	34.5	1.836	1.24	0.84	0.159	26.77	27.57	0.27	5.256
	42.0	26.58	27.50	26.58	27.50	26.78	1.05	39.5	1.836	1.11	0.92	0.159	26.64	27.52	0.32	6.052
	47.0	26.48	27.50	26.48	27.50	26.70	0.95	44.5	2.295	1.00	1.02	0.159	26.53	27.50	0.38	6.849
	52.0	26.40	27.50	26.40	27.50	26.64	0.87	49.5	1.836	0.91	1.10	0.159	26.44	27.50	0.43	7.645
	57.0	26.33	27.52	26.33	27.52	26.59	0.80	54.5	2.066	0.83	1.19	0.159	26.37	27.51	0.48	8.441
	62.0	26.26	27.55	26.26	27.55	26.54	0.73	59.5	2.295	0.76	1.29	0.159	26.30	27.54	0.54	9.238
	67.0	26.19	27.59	26.19	27.59	26.50	0.66	64.5	2.525	0.70	1.40	0.159	26.23	27.57	0.61	10.034
	72.0	26.14	27.64	26.14	27.64	26.47	0.61	69.5	2.295	0.64	1.50	0.159	26.17	27.62	0.67	10.830
	77.0	26.09	27.69	26.09	27.69	26.44	0.56	74.5	2.295	0.58	1.60	0.159	26.12	27.67	0.73	11.627
	82.0	26.05	27.72	26.05	27.72	26.42	0.52	79.5	1.607	0.54	1.67	0.159	26.07	27.71	0.77	12.423
	87.0	26.02	27.76	26.02	27.76	26.40	0.49	84.5	1.607	0.50	1.74	0.159	26.04	27.74	0.81	13.219
	92.0	26.00	27.80	26.00	27.80	26.40	0.47	89.5	1.377	0.48	1.80	0.159	26.01	27.78	0.85	14.016
	97.0	25.98	27.84	25.98	27.84	26.39	0.45	94.5	1.377	0.46	1.86	0.159	25.99	27.82	0.88	14.812
	102.0	25.95	27.87	25.95	27.87	26.37	0.42	99.5	1.377	0.43	1.92	0.159	25.97	27.86	0.92	15.608
	107.0	25.93	27.88	25.93	27.88	26.36	0.40	104.5	0.689	0.41	1.95	0.159	25.94	27.88	0.94	16.405
	112.0	25.92	27.90	25.92	27.90	26.36	0.39	109.5	0.689	0.40	1.98	0.159	25.93	27.89	0.95	17.201
	117.0	25.90	27.91	25.90	27.91	26.34	0.37	114.5	0.689	0.38	2.01	0.159	25.91	27.91	0.97	17.997
	122.0	25.88	27.93	25.88	27.93	26.33	0.35	119.5	0.918	0.36	2.05	0.159	25.89	27.92	1.00	18.794
	127.0	25.88	27.94	25.88	27.94	26.33	0.35	124.5	0.230	0.35	2.06	0.159	25.88	27.94	1.00	19.590
	132.0	25.87	27.94	25.87	27.94	26.33	0.34	129.5	0.230	0.34	2.07	0.159	25.88	27.94	1.01	20.386
	137.0	25.86	27.95	25.86	27.95	26.32	0.33	134.5	0.459	0.33	2.09	0.159	25.87	27.95	1.02	21.183
	142.0	25.85	27.95	25.85	27.95	26.31	0.32	139.5	0.230	0.32	2.10	0.159	25.86	27.95	1.03	21.979
	147.0	25.85	27.95	25.85	27.95	26.31	0.32	144.5	0.000	0.32	2.10	0.159	25.85	27.95	1.03	22.775

157.0	25.82	27.97	25.82	27.97		26.29	0.29		152.0	0.574	0.31	2.15	0.159	25.84	27.96	1.06	23.970
222.0	25.77	28.04	25.77	28.04		26.27	0.24		189.5	0.212	0.26	2.27	0.159	25.80	28.01	1.13	29.942
898.0	25.67	28.45	25.67	28.45		26.28	0.14		560.0	0.087	0.19	2.78	0.159	25.72	28.25	1.43	88.951
1416.0	25.69	28.83	25.69	28.83		26.38	0.16		1157.0	0.080	0.15	3.14	0.159	25.68	28.64	1.65	184.034
2323	25.76	29.29	25.76	29.29		26.54	0.23		1869.5	0.049	0.20	3.53	0.159	25.73	29.06	1.88	297.512

Figure 1



Time (minutes)
0
500
1000
1500
2000
2500
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 2

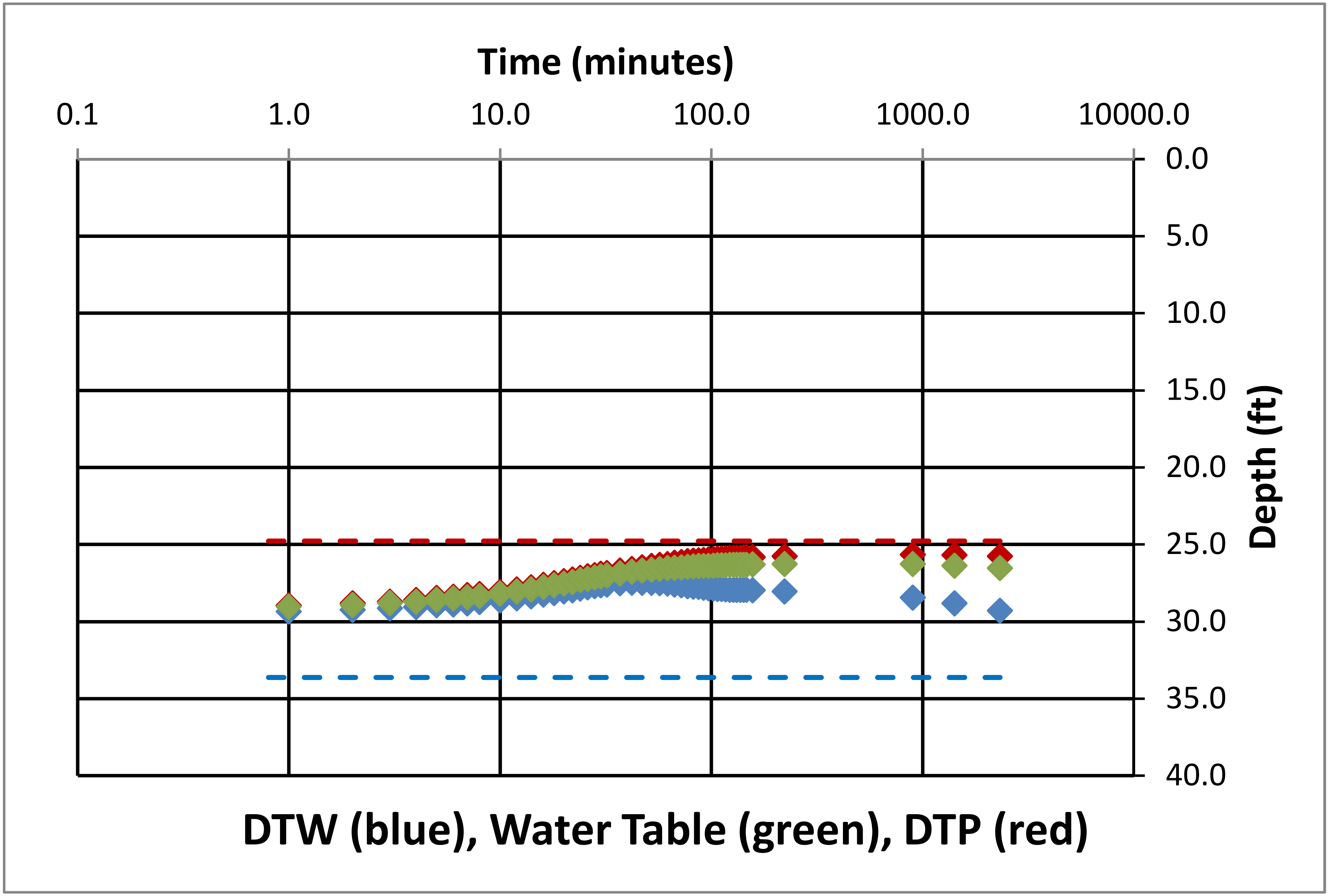

Time (minutes)
0.1
1.0
10.0
100.0
1000.0
10000.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Depth (ft)
DTW (blue), Water Table (green), DTP (red)

Figure 3

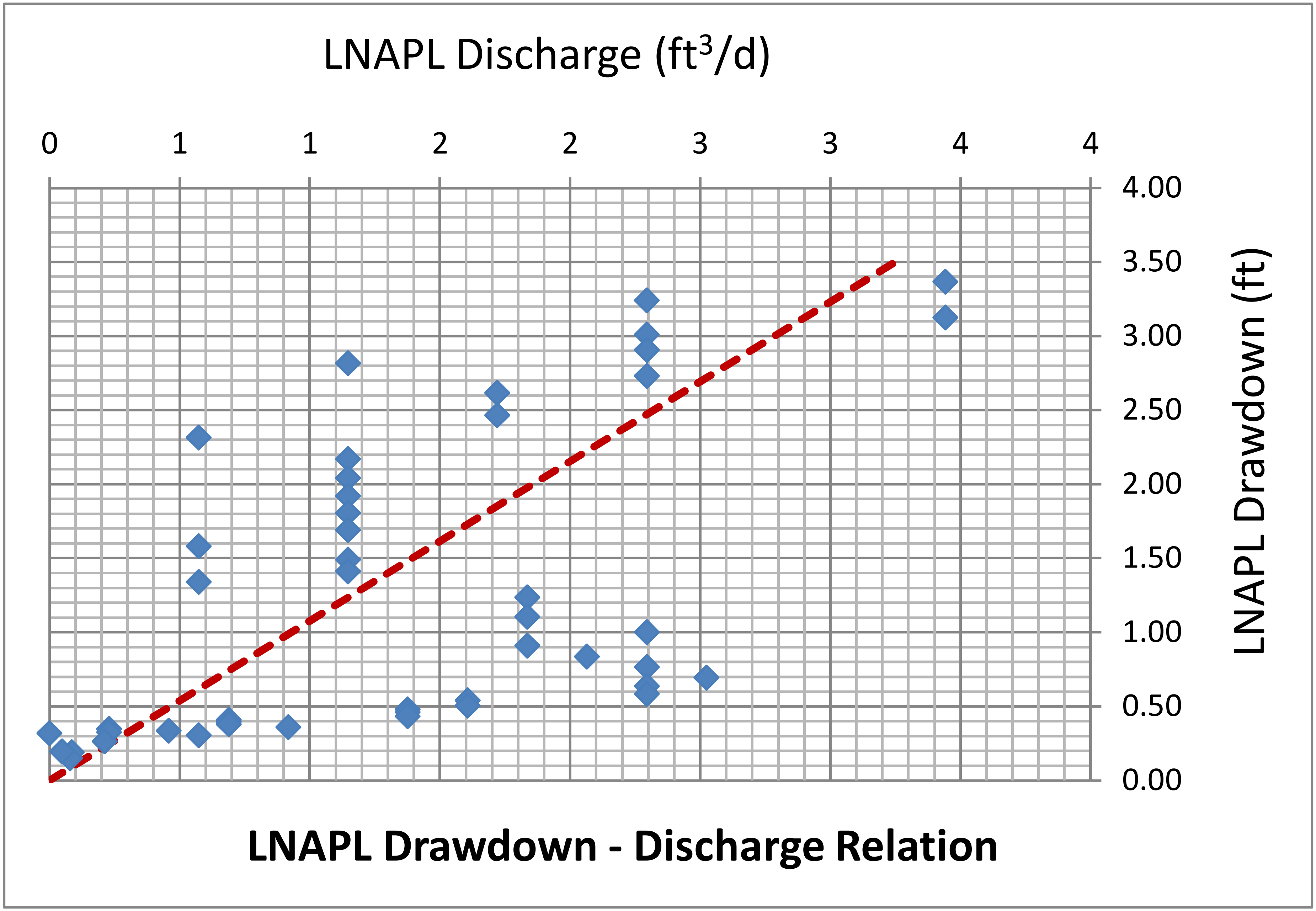
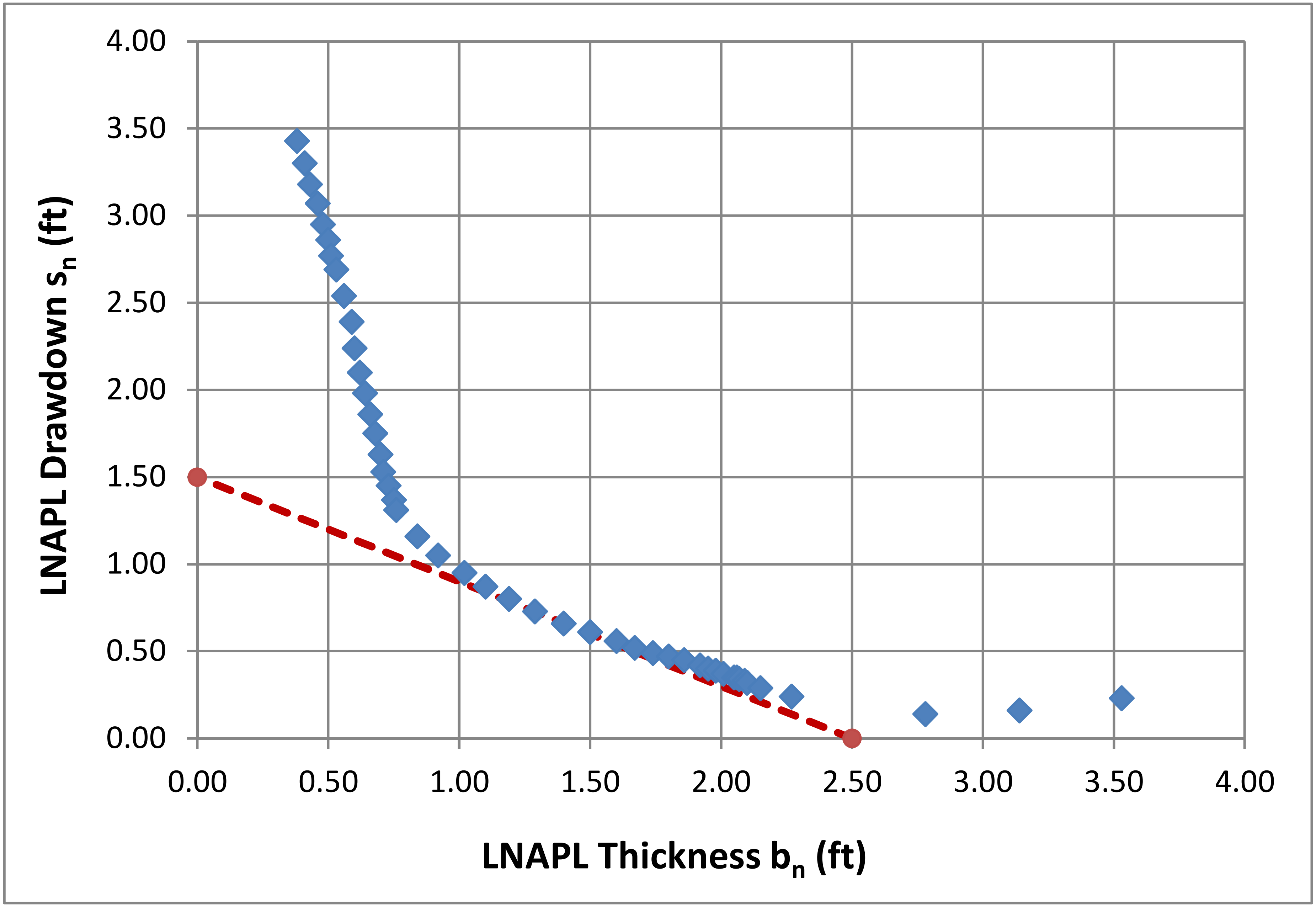
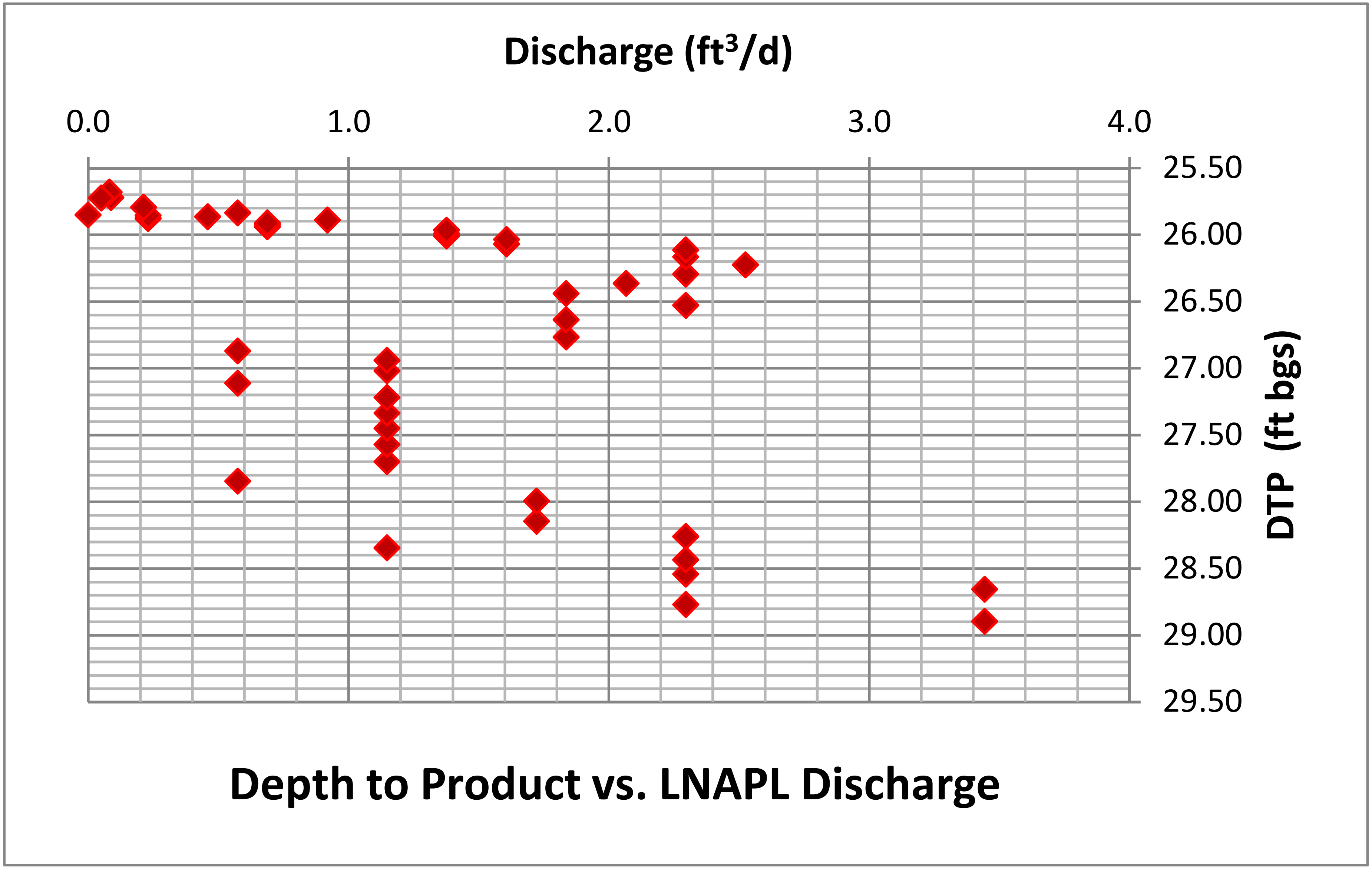

LNAPL Discharge (ft³/d)
0
1
1
2
2
3
3
4
4
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Discharge Relation

Figure 4



LNAPL Drawdown s_n (ft)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
LNAPL Thickness b_n (ft)

Figure 5



Discharge (ft^3/d)
0.0
1.0
2.0
3.0
4.0
25.50
26.00
26.50
27.00
27.50
28.00
28.50
29.00
29.50
DTP (ft bgs)
Depth to Product vs. LNAPL Discharge

Figure 6

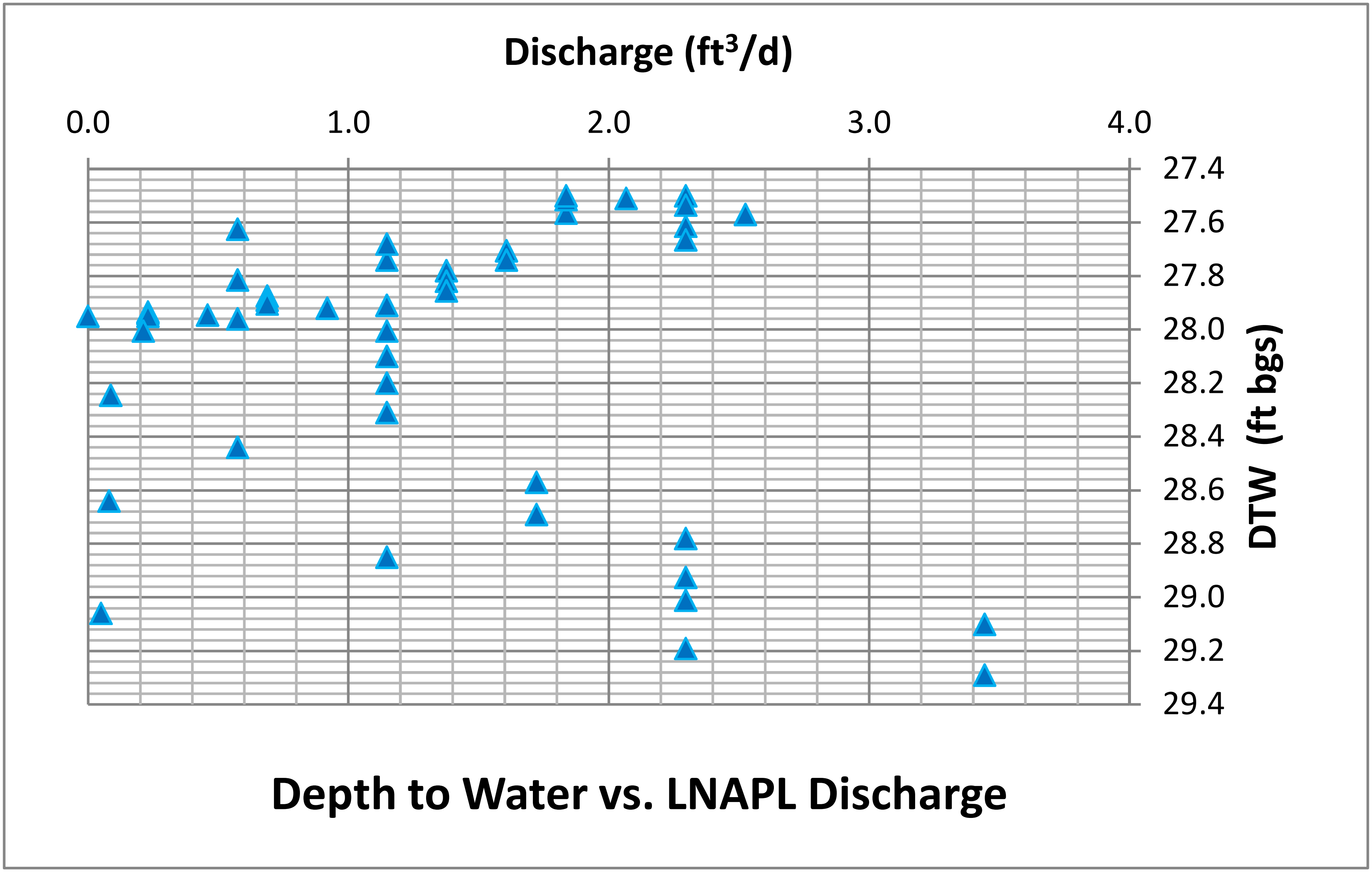

Discharge (ft^3/d)
0.0
1.0
2.0
3.0
4.0
27.4
27.6
27.8
28.0
28.2
28.4
28.6
28.8
29.0
29.2
29.4
DTW (ft bgs)
Depth to Water vs. LNAPL Discharge

Figure 7

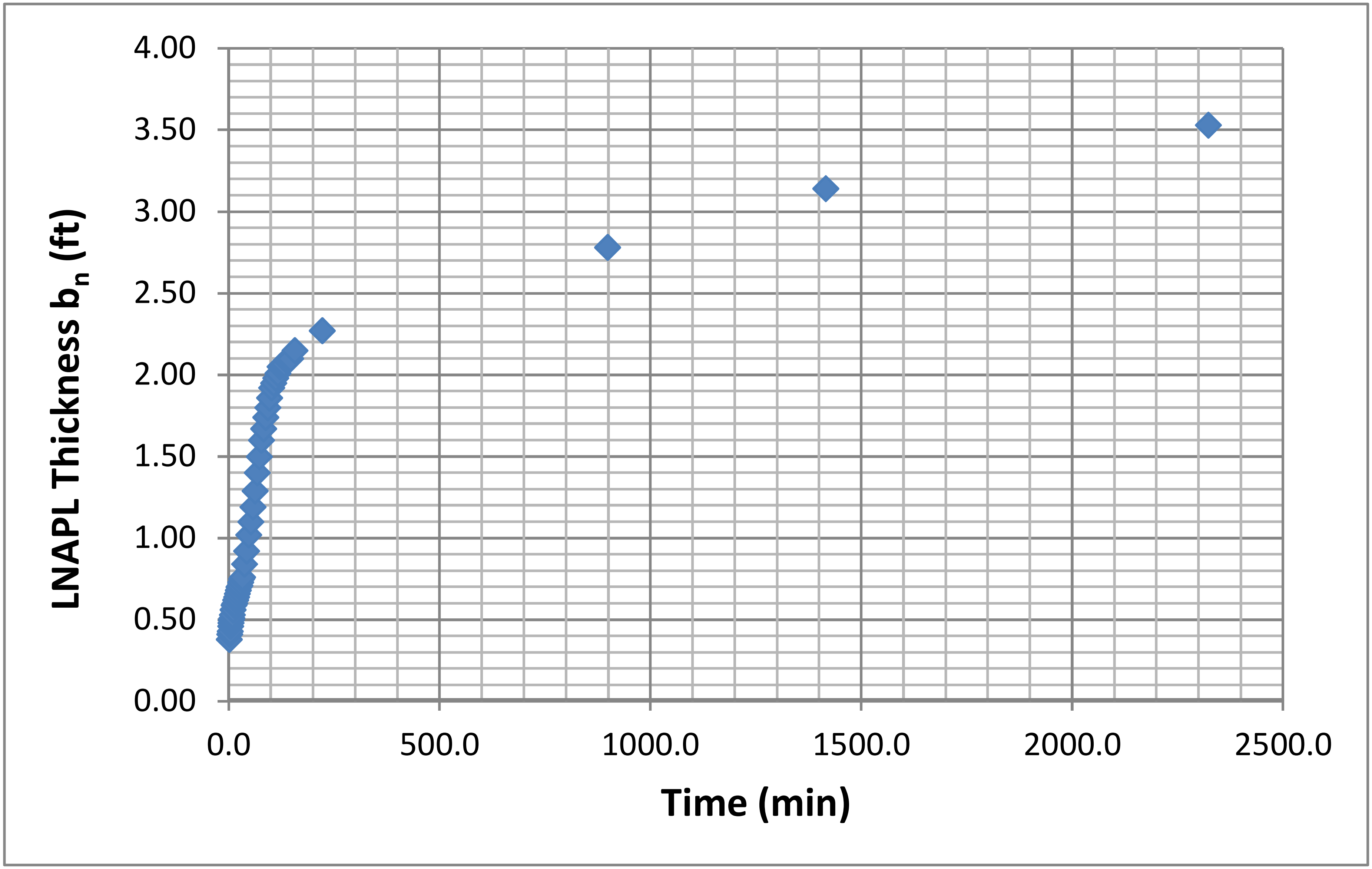
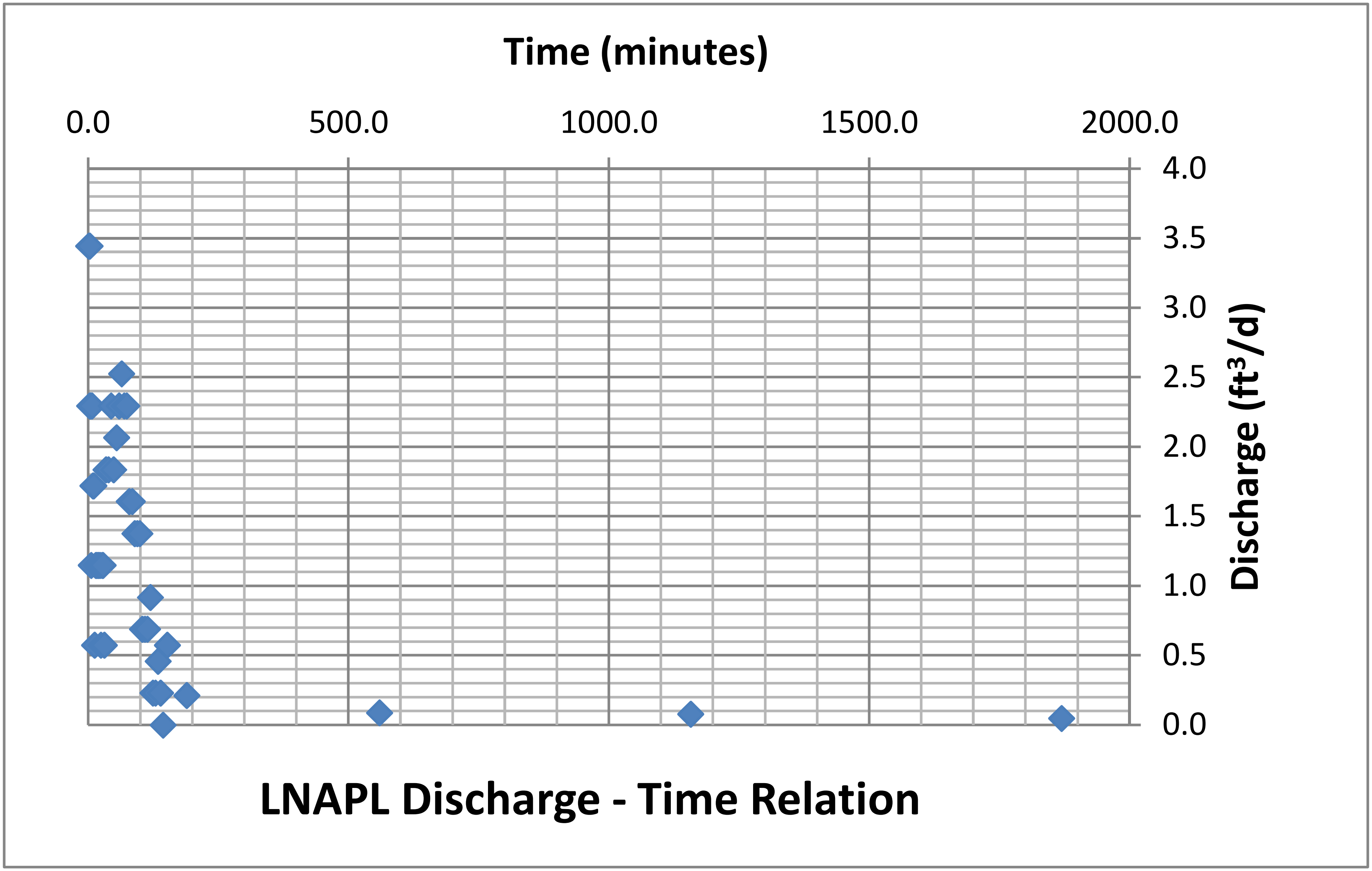
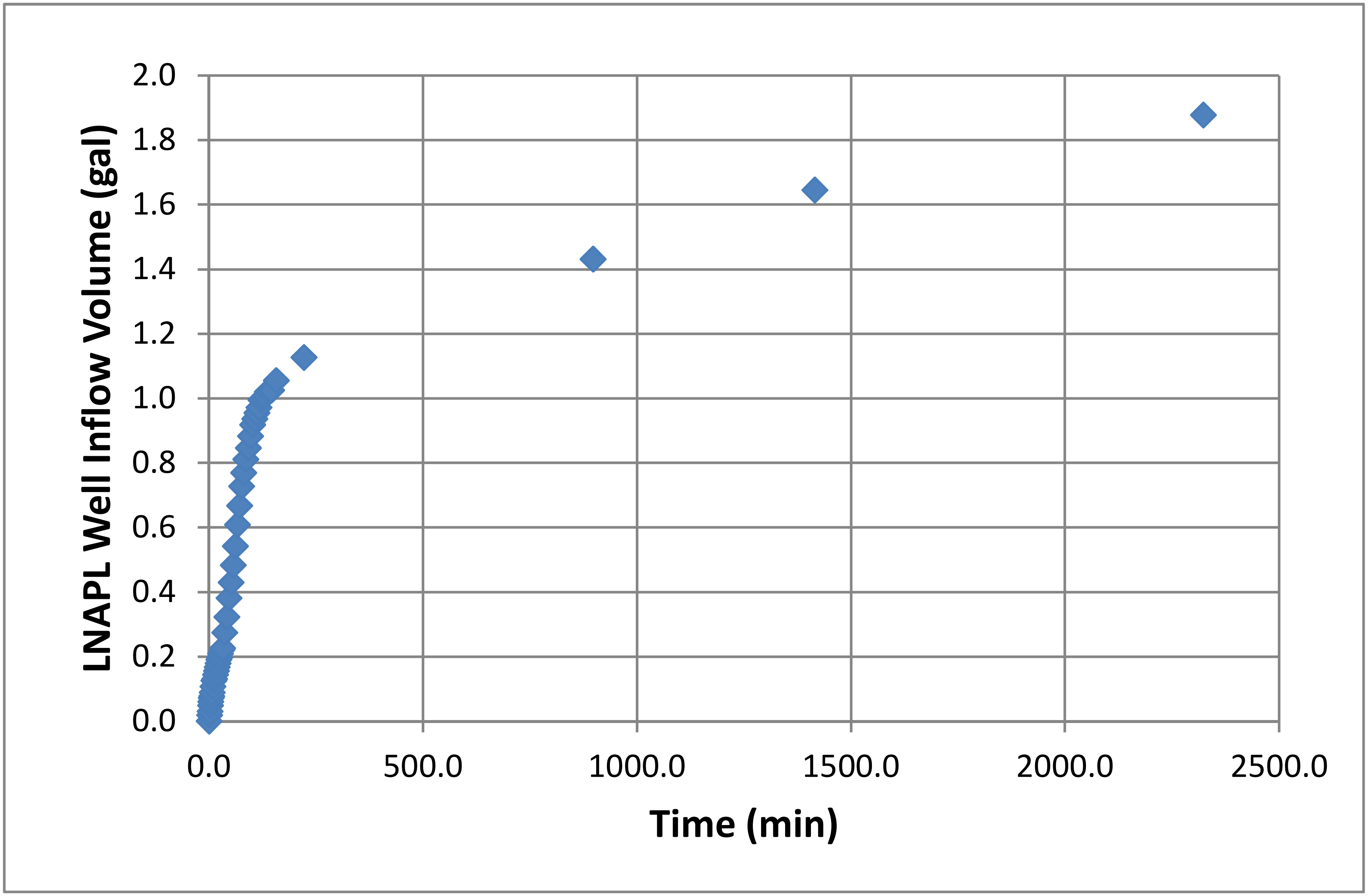

4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
LNAPL Thickness b_n (ft)
0.0
500.0
1000.0
1500.0
2000.0
2500.0
Time (min)

Figure 8



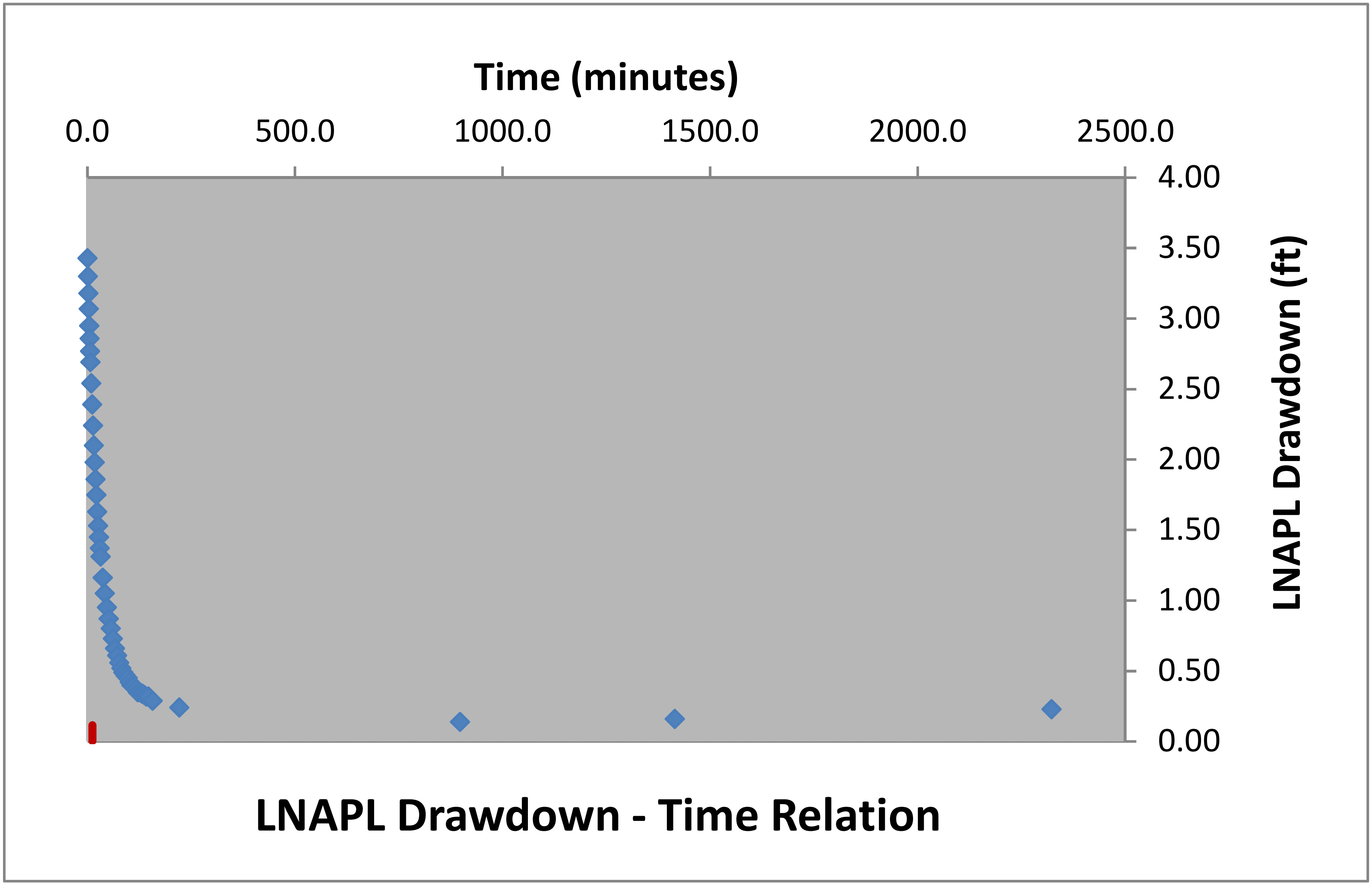
MW-27 (March 2019)
Baildown Test Data Analysis

Figure 9



LNAPL Well Inflow Volume (gal)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
500.0
1000.0
1500.0
2000.0
2500.0
Time (min)

Figure 10



Time (minutes)
0.0
500.0
1000.0
1500.0
2000.0
2500.0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
LNAPL Drawdown (ft)
LNAPL Drawdown - Time Relation

Generalized Bouwer and Rice (1976)

Well Designation:	MW-27
Date:	27-Mar-19

$$T_n = \frac{r_e^{\,2} \ln(R/r_e)\ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

L_e/r_e
55.6
C
3.02
R/r_e
21.07

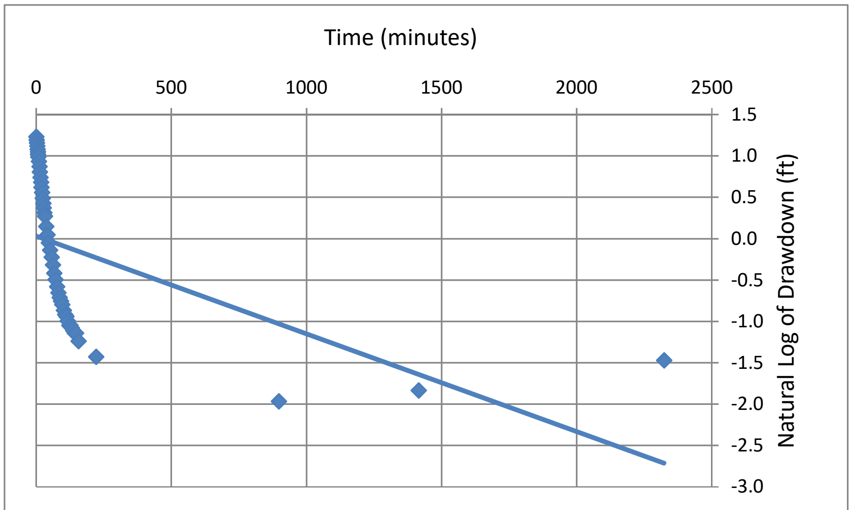
Enter early time cut-off for least-squares model fit

$Time_{cut}$	0	<- Enter or change value here

Model Results: T_n (ft^2/d) = 0.11 +/- 0.03 ft^2/d

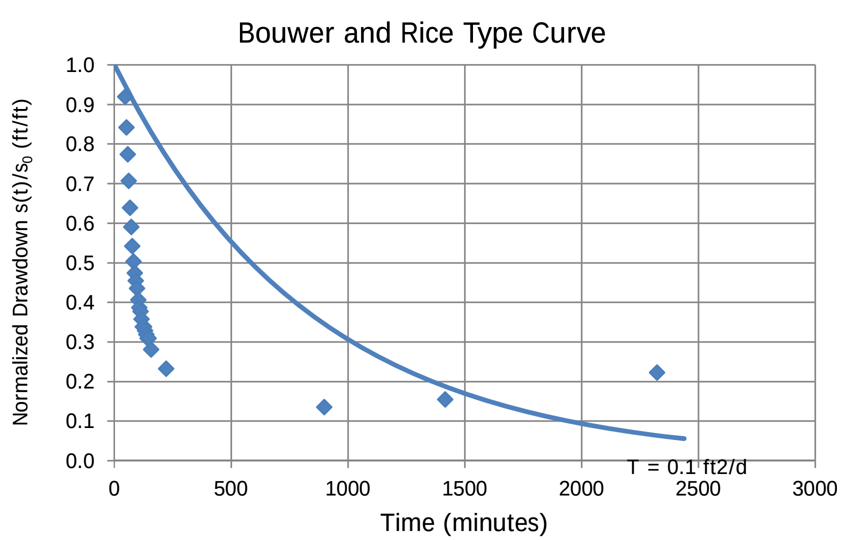
J-Ratio
-0.600

Coef. Of Variation
0.25



Bouwer and Rice Model

C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper and Jacob (1946)

Well Designation:	MW-27
Date:	27-Mar-19

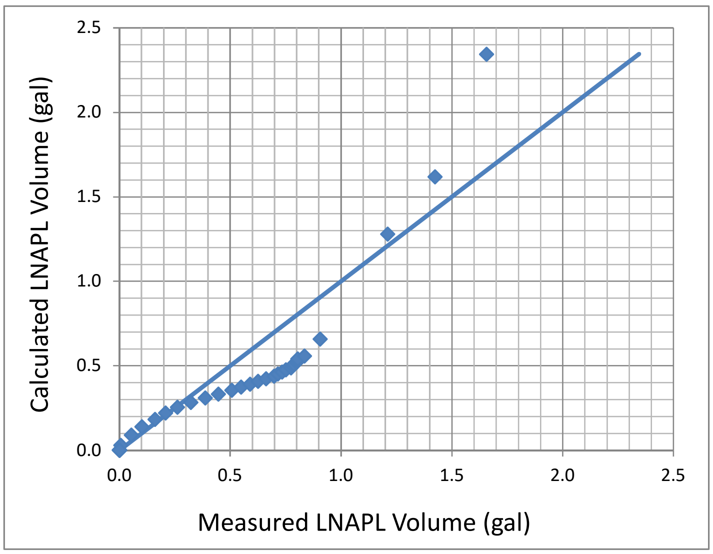
$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

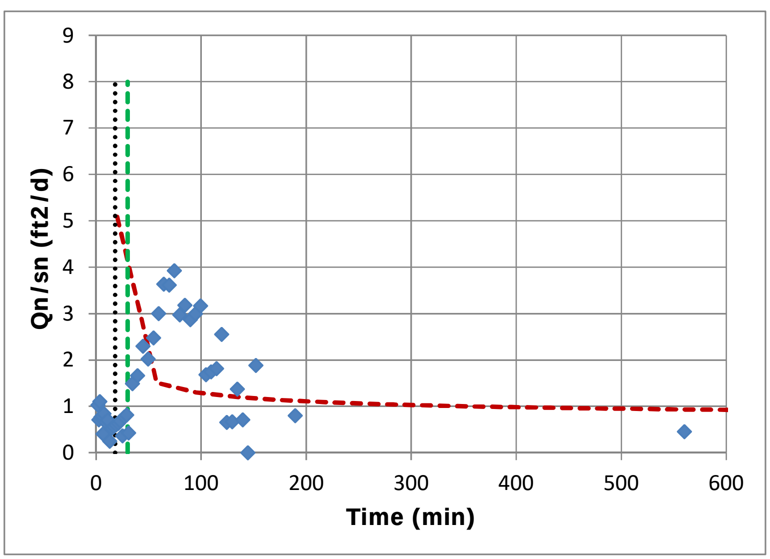
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	30	<- Enter or change values here
Time Adjustment (min):	18	
Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	1.274	<-- Minimize this using "Solver"
	0.018	<-- Working S_n
Trial T_n (ft^2/d):	0.508	<-- By changing T_n through "Solver"

Add constraint $T_n > 0.00001$

Model Result: T_n (ft^2/d) = **0.51**





Height

8

Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	MW-27
Date:	27-Mar-19

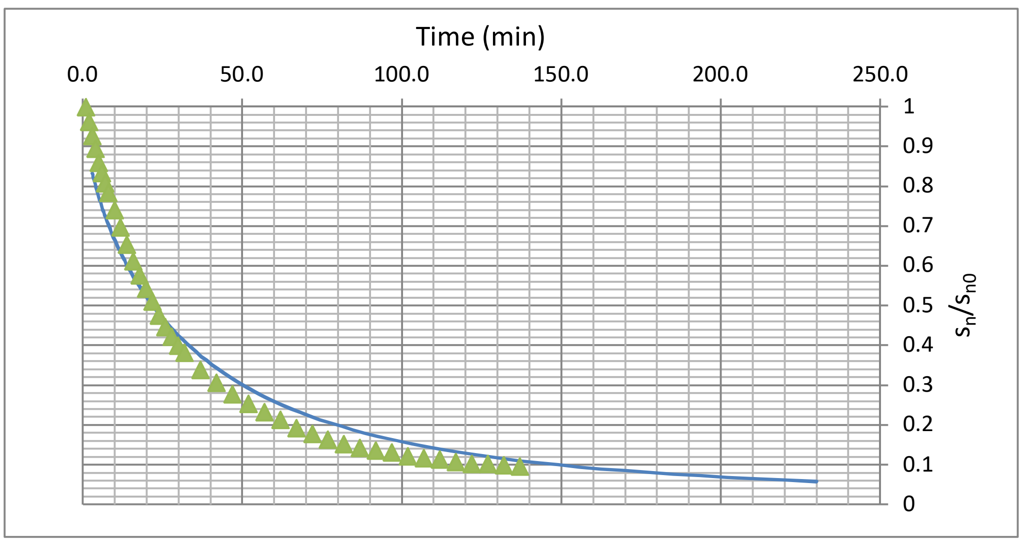
Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	0	<- Enter or change values here
Initial Drawdown s_n (ft):	3.43	
Trial S_n:	d	<-- Enter d for default
Root-Mean-Square Error:	0.324	<-- Minimize this using "Solver"
Trial T_n (ft^2/d):	1.734	<-- By changing T_n through "Solver"
	0.033	<-- Working S_n

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **1.73**

T_{min}	3
T_{max}	230



J-Ratio
-0.600

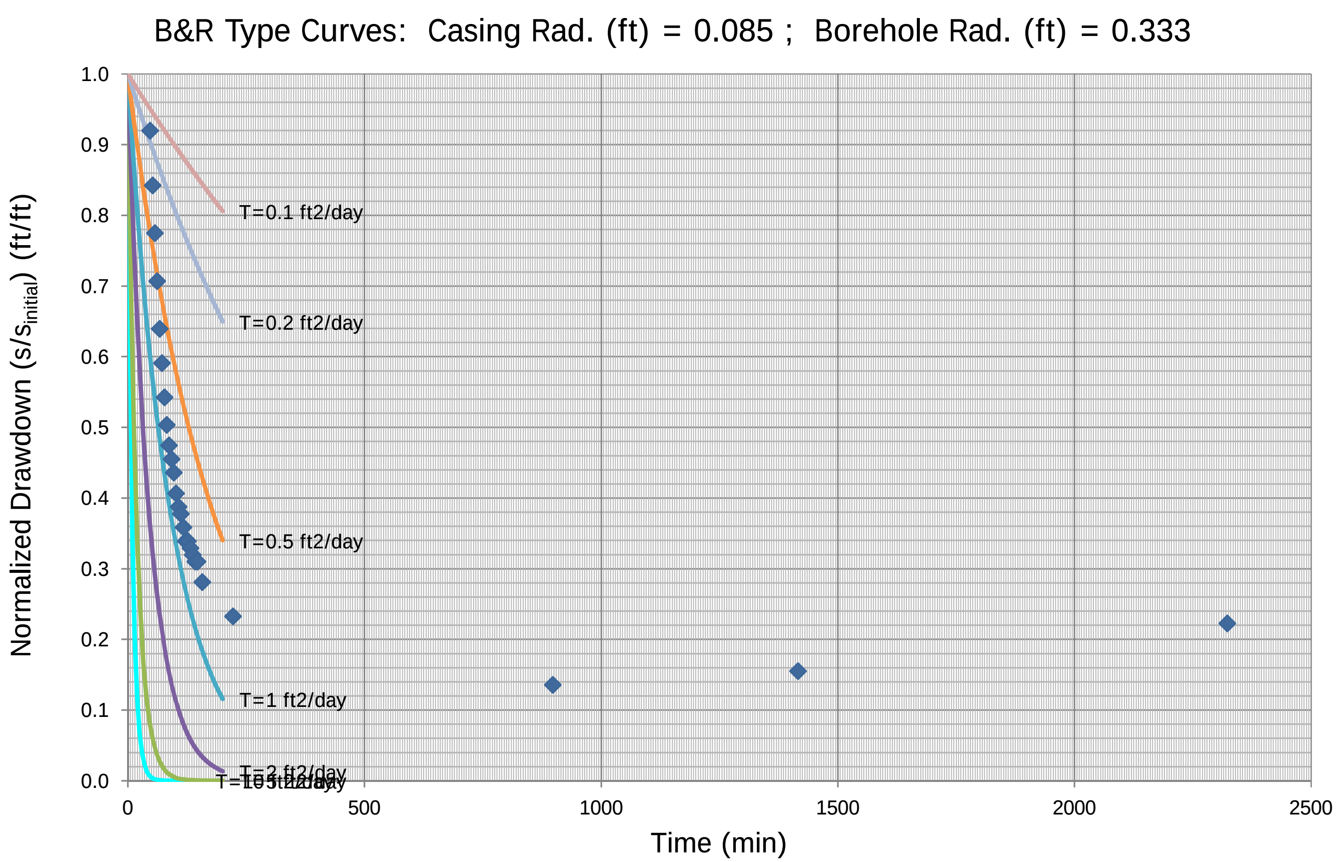
Bouwer and Rice Short Term LNAPL Mobility Test Type Curves

B&R Type Curves: Casing Rad. (ft) = 0.085 ; Borehole Rad. (ft) = 0.333

Enter these values

Type Curve ID	Type Curve Name	Notes	Max Time (min)	Transmissivity (ft^2/day)
1	T=10 ft2/day		150	10
2	T=5 ft2/day		200	5
3	T=2 ft2/day		200	2
4	T=1 ft2/day		200	1
5	T=0.5 ft2/day		200	0.5
6	T=0.2 ft2/day		200	0.2
7	T=0.1 ft2/day		200	0.1

J-Ratio	
-0.600	<-- If uncertain use
	-0.22



API LNAPL Transmissivity Workbook

Calculation of LNAPL Transmissivity from Baildown Test Data

STEP 1: RESET OUTPUT SUMMARY

STEP 2: ENTER DATA & VIEW FIGURES

STEP 3: CHOOSE WELL CONDITIONS

STEP 4: LNAPL TRANSMISSIVITY SUMMARY

Mean LNAPL Transmissivity (ft^2/d)

0.78

Standard Deviation (ft^2/d)

0.85

Coefficient of Variation

1.08

Appendix C:
Geophysical Investigation Report

Geophysical Survey LLC
711 S Tacoma Street
Kennewick, Washington 99336

May 2, 2018

Russell Shropshire
Leidos
18912 North Creek Parkway, Suite 101
Bothell, WA 98011

Re: ***Geophysical Investigation***
Project #323781.00.17.W.161D.0706.0101
Chelan, WA

Mr. Shropshire:

Geophysical Survey LLC conducted a geophysical investigation at the northwest corner of the intersection of E Woodin Avenue and N Emerson Street in Chelan, Washington on April 27, 2018. The objective of the survey was to detect and delineate underground storage tanks (USTs).

Methodology

Time Domain Electromagnetic Method (EM61)

Time domain electromagnetic methods involve generating a signal of known frequency and voltage from a transmitter. In the presence of metallic objects an EM signal is induced when the transmitted signal is applied. When the transmitter is turned off the induced signal decays at a rate proportional to the metal mass in which it was induced.

The Geonics EM61MK2 consists of a transmitter (Tx) and receiver (Rx) coil and a coincident receiver coil located 12 inches above the bottom coil. The transmitter coil is energized by a pulse of current and the receiver coils measure the response decay at fixed time intervals. Three time gates of data from the bottom coil and the top coil are recorded, differential data is the top coil minus channel 3 bottom coil data. Differential data is useful in negating effects of surface metal.

Ground-Penetrating Radar

Ground-penetrating radar (GPR) uses a transducer to transmit FM frequency electromagnetic energy into the ground. Interfaces in the subsurface, defined by contrasts in dielectric constants, magnetic susceptibility, and to some extent, electrical conductivity, reflect the transmitted energy. The GPR system then measures the travel time between transmitted pulses and arrival of reflected energy. Buried objects such as pipes, barrels, foundations, and buried wires can cause all or a portion of the transmitted energy to be reflected back towards a receiving antenna. Geologic features such as crossbedding, lateral and vertical changes in soil properties, and rock interfaces can also cause reflections of a portion of the EM energy.

The dielectric constant and magnetic susceptibility of the medium primarily control the velocity of the EM energy. Values of EM velocities, for depth calculations, are determined by measurement, experience in an area, by ties to known buried reflectors, and from knowledge of the subsurface medium.

The depth of investigation is a function of the transmit power, receiver sensitivity, frequency of the antenna, and attenuation of the transmitted energy due to the geologic medium. The maximum depth of investigation may vary significantly as a result of the changing soil conditions. High attenuation, and consequent smaller penetration depths, of the EM energy typically occurs where the soil conductivity is greater than 25 milli-siemens per meter and/or in areas with numerous reflective interfaces. Depth of investigation is also affected by highly conductive material, such as metal drums and pipes that essentially reflect all the energy. The method cannot "see" directly below areas of highly reflective material because all of the energy is reflected.

Electromagnetic Line Locating

Utility line locating equipment operates through the principles of electromagnetics (EM), designed to detect underground utilities constructed of electrically conductive materials. An active signal is applied to the underground utility by means of a radio frequency (RF) transmitter and then traced with a receiver. With direct coupling, an RF signal is applied to a cable or pipe where there is access to a contact point. With no access to the utility, the indirect mode is used. A transmitter is placed on the ground surface above the conductor and the signal is induced through earth onto the pipe or cable.

The active signal is created from current flowing from the transmitter, along the conductor (utility line), and back to the transmitter thru the ground. The signal can also return thru other utility lines. This type of return can distort the electromagnetic field and cause erroneous locations.

Passive signals include power transmission (60Hz) and radio transmission (15kHz-27kHz). 60Hz signals are present in conductors carrying electric current and from utilities carrying return current (indirect induction). Radio signals are created by high power, low frequency communication transmitters. Conductive utilities re-radiate the signal. A receiver is used to trace power and radio transmissions.

FIELD SURVEY

Mapping Control

A Trimble Pro6H GPS with sub-foot level accuracy was used for location control of EM data and mapping of surface features.

EM61 Data Acquisition

Electromagnetic data were collected using a Geonics EM61MK II metal detector. Data were collected at 0.6 foot intervals on transects spaced 3 feet apart. EM data were collected using NAV61 software from Geomar on an Allegro CX datalogger.

GPR Data Acquisition

GPR data were acquired with a Geophysical Survey Systems, Inc. (GSSI) SIR3000 control unit, a 400 MHz antenna. GPR data were collected at 15 scans/foot with a 50 nanoSecond window (approximately 7 feet with a dielectric constant of 8). Data transects were spaced 3 feet apart in two orthogonal directions.

DATA PROCESSING

EM Data Processing

Electromagnetic data were processed using Trackmaker61MK2 software from Geomar. EM 61 Channels 1-3 and top channel data were output to .xyz format and transformed to geo-referenced format using Didger from Golden Software. Data was gridded and contoured using a Kriging algorithm in Surfer 13 from Golden software.

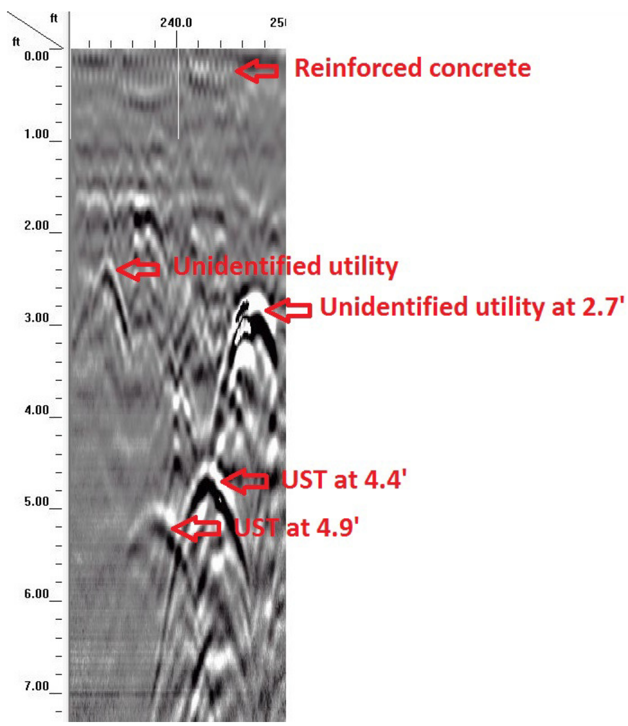
GPR Data Processing

GPR data was processed using Radan 7.0 from GSSI. A finite response filter was used as a background filter.

RESULTS AND INTERPRETATION

EM data was inconclusive due to a 6 x 6 inch reinforcing mesh.

Three anomalies characteristic of USTs were delineated with GPR in the investigation. Two five foot by three foot USTs at a depth of approximately 4.3 feet and one UST fifteen by five feet at a depth of 4.9 feet were detected.



Three unidentified utility lines were detected around the interpreted USTs. The hyperbolic anomaly interpreted as a utility line at 2.7 feet may represent a fourth UST. Full investigation of this anomaly was not attempted with GPR due to landscaping.

CLOSURE

Geophysical surveys performed as part of this survey may or may not successfully detect or delineate any or all subsurface objects or features present. Locations, depths and scale of buried objects or subsurface features mapped as a result of this survey are a result of geophysical interpretation, and should be considered as confirmed, actual, or accurate only where recovered by excavation or drilling.

Geophysical Survey LLC performed this work in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No warranty, express or implied, beyond exercise of reasonable care and professional diligence, is made. This report is intended for use only in accordance with the purposes of the study described within.

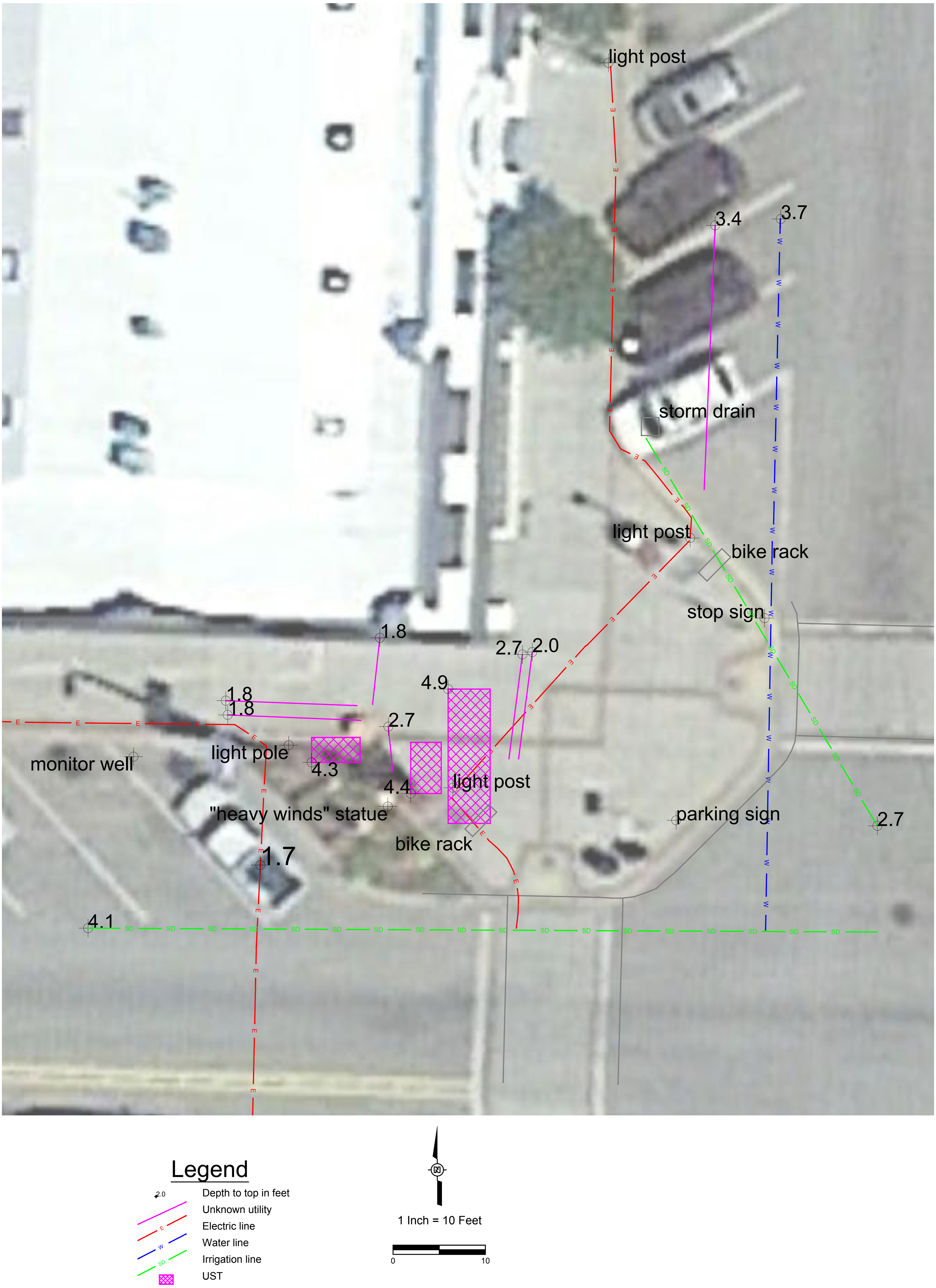
Respectfully,

Geophysical Survey LLC

Mark Villa L.G.
Geophysicist

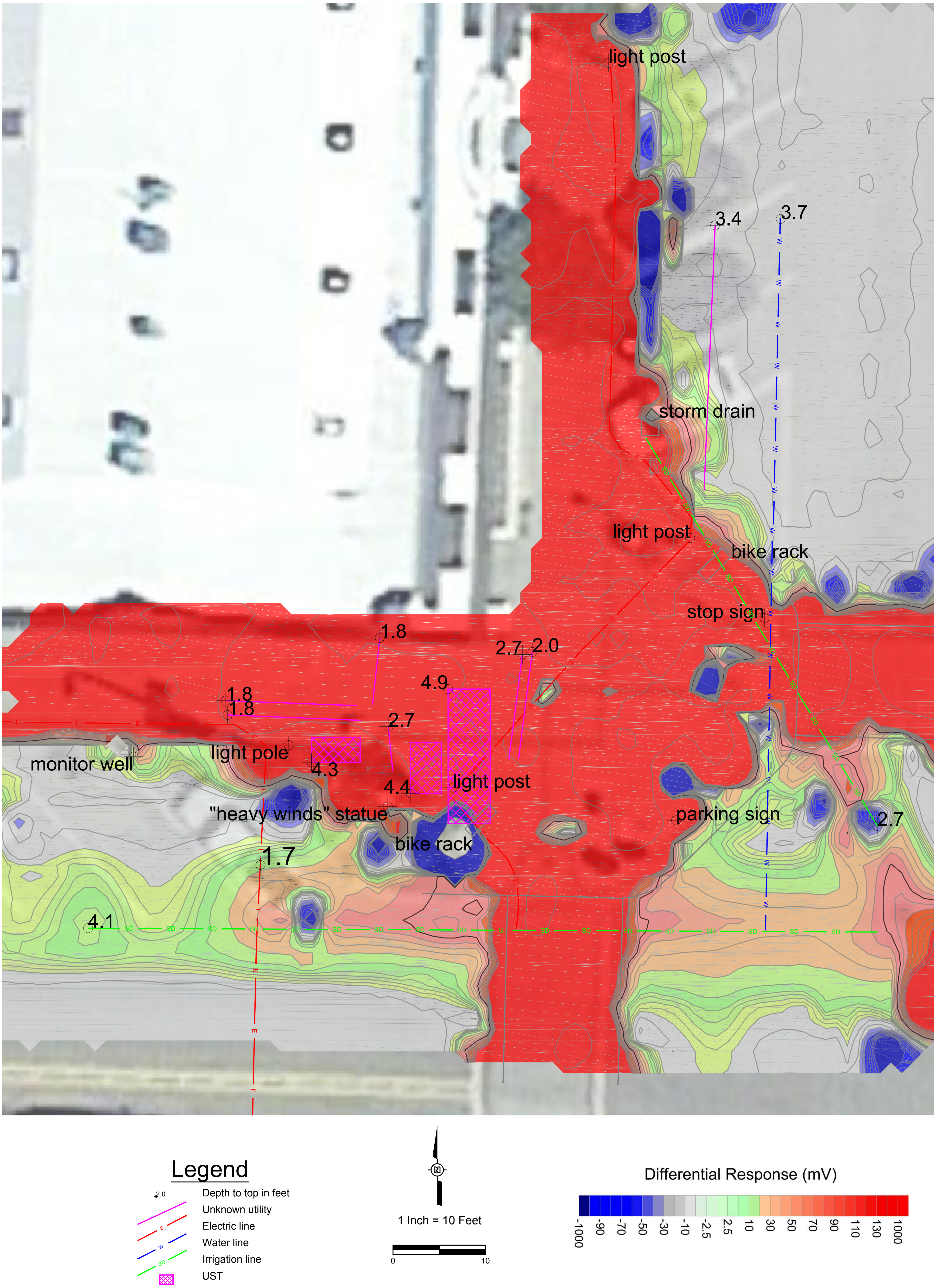
Geophysical Investigation
E Woodin Avenue and N Emerson Street
Chelan, WA

LIST OF FIGURES



Geophysical Survey LLC

FIGURE 1
Geophysical Interpretation
Chelan, WA



GEOPHYSICAL SURVEY LLC

FIGURE 2
EM Data Contours
Chelan, WA