Appendix C
Historical Instrumentation Data

December 2019

TABLE OF CONTENTS

LIST OF ANNEXES

1. SUMMARY OF INSTRUMENTATION

This Appendix summarizes the available data from various instrumentation and monitoring devices installed at or near the Vale S.A. ("Vale") Córrego do Feijão Mine Dam I ("Dam I") in Brumadinho, Brazil. The types of instruments from which data are summarized in this Appendix are identified below, along with their Portuguese language term:

- Rain Gauges ("Pluviômetros");
- Weather Station ("Estações Meteorológicas");
- Reservoir Gauge ("Medidor de Nível do Reservatório");
- Piezometers ("Piezômetros") – Casagrande, Vibrating Wire, Pressure Transducer;
- Water Level Indicators ("Medidores de Nível de Água");
- Flow Meters ("Medidores de Vazão");
- Inclinometers ("Inclinômetros"); and
- Deep Horizontal Drains ("Drenos Horizontales Profundos" or "DHPs").

Information regarding the instrumentation and data recorded from the instrument are provided in tables and figures attached to this Appendix. Where available (and unless otherwise noted), the figures in the Appendix present data from the five-year period prior to the failure of Dam I, that is January 2014 through January 2019. The instruments are categorized as active, inactive, or inoperative. Based on a review of available documents, it is understood that "active" instruments are those that were operative as of the date of the failure and for which installation information was available. "Inactive" instruments are understood to be those that were not recording data for a prolonged period prior to the failure. "Inoperative" instruments are those for which measurement data were not available or those which were reported during field inspections to have been destroyed before the date of the failure. Where data were available for inactive and inoperative instruments for a period of time before they became inactive, that data are included in this Appendix.

For some of the piezometers, water level indicators, and flow meters, no data were available, or the top or bottom elevations could not be verified, or certain data showed inconsistencies or anomalies that appear to indicate that they are erroneous. In these instances, the data in question were determined not to be reliable and therefore are not included in this Appendix. These instances are identified in Sections 5, 6, and 7 of this Appendix.

In addition to the instruments addressed in this Appendix, survey markers (prisms) were present at Dam I to monitor vertical and horizontal displacements of the ground surface along the crest. The survey markers summarized in Appendix D.

2. RAIN GAUGES

Rain gauges are meant to record precipitation amount and intensity at a given location. Rainfall measurements may be used to inform overall conditions at the dam site and provide information as to the amount of surface water entering the catchment area behind the dam during rainfall events.

2.1 Location Information

Data were available from four rain gauges, which are identified below. Location information for the rain gauges is presented in Table 2-1, and the approximate locations of the three active rain gauges are provided in Figure 2-1.

- An active rain gauge, CFJ_PLUV_01 (also referred to as "CFJPL002"), is located near the site laboratory, which is 1.4 kilometers (km) south of Dam I.

- Two active rain gauges are located offsite, for which Northing and Easting coordinates and surface elevation information were not provided. One rain gauge was reported to be located near the CPX Mine in Jardim Canadá ("F18-BFE-01") approximately 1.4 km northwest of Dam I, and the other was reported to be located near Comunidade Feijão ("F11-BJC"), approximately 18.6 km northeast of Dam I.

- Two inactive rain gauges were installed in the Dam I site office ("CFJPL001") and in the structure of Dam VI ("CFJPL003"). Information was available from CFJPL001 until November 2008 and from CFJPL003 until April 2014.

In addition to these rain gauges, this Appendix summarizes data from a rain gauge located offsite, maintained by the Instituto Nacional de Meteorologia ("INMET"), referred to as the Ibirité station, for which Northing and Easting coordinates and elevation were retrieved from the INMET website.[1] The rain gauge is located approximately 15.4 km northeast of Dam I, and is shown in Figure 2-1.

2.2 Available Data

The rainfall readings are recorded in millimeters. Daily (weekdays only) measurements for gauge CFJ_PLUV_01 were reported from January 1999 to January 2019. Data for the gauge near F18-BFE-01 were recorded hourly between March 2017 and January 2019. Data for the gauge F11-

[1] http://www.inmet.gov.br

BJC were recorded hourly between April 2015 and January 2019. Rain data for the INMET Ibirité station were recorded hourly.

From the recorded data, the daily and monthly cumulative rainfall measurements from January 2014 through January 2019 for the four active rain gauges identified above were calculated and are presented in Figures 2-2 to 2-11. The data for the two inactive rain gauges (i.e., CFJPL001 and CFJPL003) were not included in the plots because there were no data or very little data since January 2014 and data were available for the same periods from the active rain gauges.

3. WEATHER STATION DATA

Weather stations measure ambient air temperature, humidity, atmospheric pressure, wind speed, and wind direction. Temperature, humidity, and pressure readings can provide general information about conditions experienced at a dam. Wind speed and direction monitoring are commonly used at dam sites to assess wave run-up in the impoundment.

3.1 Location Information

Vale recorded weather data at two stations, F18-BFE-01 and F11-BJC (described above). Weather data was also recorded at the INMET Ibirité station. A summary of information recorded at these three weather stations is presented in Table 3-1.

3.2 Available Data

Measurement data for weather station F11-BJC is available for the period April 2015 to January 2019. Measurement data for weather station F18-BFE-01 is available for the period March 2017 to January 2019. Weather data from the weather station INMET Ibirité from 1980 to January 2019. Data for daily temperature, humidity, pressure, wind speed, and wind direction for the period January 2014 to January 2019 are presented in Figures 3-2 to 3-6, and monthly data for that same time period and parameters are presented in Figures 3-7 to 3-11.

4. RESERVOIR GAUGE

A reservoir gauge measures the surface water elevation within a tailings pond. A reservoir gauge can be useful in understanding the hydrologic and hydrogeologic conditions within the retained tailings.

4.1 Installation Information

Data were available for one active reservoir gauge that was installed along the right abutment of Dam I. The reservoir gauge is identified as CFJBRR001, and its location is shown in Figure 4-1. Installation information for the reservoir gauge is presented in Table 4-1. The reservoir gauge is

installed at Elevation (El.) 937 meters (m), referenced to mean sea level (msl), and its bottom elevation is El. 930 m msl.

4.2 Available Data

Measurement data for the reservoir gauge were recorded between June 2005 and July 2017. The reservoir levels are recorded as the elevation of the water surface. Readings of the reservoir levels were recorded manually with a ruler. From July 2005 to September 2006, reservoir measurements were taken daily. From January 2007 to December 2009, measurements were recorded once per week. After December 2009, measurement frequency decreased to approximately once a month. Available data indicate that the reservoir gauge reading measurements were discontinued in July 2017. It is understood that after tailings were no longer placed in the impoundment, the level of water in the reservoir dropped to a level below that which could be measured using the reservoir gauge. After that time, the levels of water in the reservoir were monitored using other methods. Figure 4-2 presents the reservoir level readings that were available for the five-year period prior to the failure. Elevations presented in Figure 4-2 are m msl.

5. PIEZOMETERS

Three types of piezometers existed at Dam I: Casagrande piezometers, vibrating wire piezometers, and pressure transducers.

A Casagrande piezometer (also known as an "open standpipe" or "open well") is a simple type of piezometer and consists of a pipe (typically plastic) having an opening, called a screen, at its lower end installed inside a borehole. Water entering the pipe represents the water level within the unit in which the screen is located. Water levels within a Casagrande piezometer are commonly measured through a manual reading using a water level meter. The data available for Dam I use the term "Casagrande piezometer" to denote piezometers for which groundwater level measurements were made manually.

Vibrating wire piezometers and pressure transducers are electronic devices installed in a borehole that measure water pressure electronically. The electronic measurement is converted to a frequency signal in the device using a diaphragm, a tensioned steel wire, and an electromagnetic coil to monitor pore water pressure. These devices have the advantage of long-term durability and the ability to collect readings frequently. Additionally, they can be used in open standpipes, zoned piezometers, or fully grouted piezometers. Information from these devices can be downloaded from the device in the field at regular intervals, or they can be connected to automated systems (e.g., dataloggers and radios or cell phone connections) that can transmit data from the instrument to a data cloud where the user can download and review the data without having to go out into the field.

In August 2018, 49 of the Casagrande piezometers were converted to automated piezometers by installing vibrating wire piezometers inside the standpipe. As discussed further below, at the time

of the Dam I failure, 46 of the piezometers had been connected to an automated system and were transmitting data automatically.

5.1 Installation Information

Installation information for the piezometers is presented in Table 5-1, and the locations are provided in Figure 5-1. The piezometers were installed at various times over the dam's 43-year history and were located across various elevations and sections of Dam I. Based on the data available, they appear to have included:

- 48 manually measured "active" piezometers;
- Eight manually measured "inactive" piezometers;
- 46 piezometers that were manually measured and then fitted with automated measuring devices in August 2018;
- One manually measured "inoperative" piezometer; and
- 20 vibrating wire piezometers.

Installation data for these 123 piezometers are summarized in the timeline below.[2] Unless otherwise noted below, the data from these piezometers are believed to be reliable and are included in this Appendix.

- *April 1996, within the First, Second, and Third Raisings*: 23 piezometers were installed between El. 853.0 m msl and 898.6 m msl, with casing lengths ranging from 6.8 m to 37.8 m. Five piezometers were installed within the foundation soil; seven were installed within the Starter Dam; two were reportedly installed within the "right shoulder" (i.e., the right abutment) of the dam; seven were installed within the tailings; and two were installed within the embankment.
- *July 1999, within the Fourth and Fifth Raisings*: Eight piezometers between El. 904.9 m msl and 911.1 m msl, with casing lengths ranging from 8.9 m to 22.5 m, were installed within the tailings.
- *July 2000, within the Sixth Raising*: Eight piezometers were installed between El. 915.8 m msl and 917.4 m msl, with casing lengths ranging from 6.1 m to 10.9 m. Two

[2] Several piezometers were identified in reports maintained by Vale for which no records of monitoring data were available: piezometers PZC 42 to PZC 47, PZE-01 to PZE-07, PZE-10, PZM-18, PZM-19, PZ-15C, PZ-16C, and PZ FUGRO 2016. Piezometers for which there were no data are not included in this Appendix.

piezometers were installed within the tailings, and six were installed within the embankment.

- *October 2002, within the Seventh Raising*: Seven piezometers were installed between El. 921.9 m msl and 923.0 m msl, with casing lengths ranging from 5.3 m to 9.1 m. These seven piezometers had a screening interval of 0.5 m: three were installed within the tailing deposits, and four were installed within the embankment.

- *July 2003*: One piezometer was installed within the Starter Dam at El. 869.1 m msl, with a casing length of 14.5 m.

- *September 2004*: One piezometer was installed within the tailings at El. 904.6 m msl, with a casing length of 12.2 m.

- *April 2005, within the Eighth Raising*: Seven piezometers were installed between El. 929.2 m msl and 930.0 m msl, with casing lengths ranging from 6.5 m to 21.2 m. Two piezometers were installed within the tailings, and five were installed within the embankment. Two additional piezometers were installed in April 2005 between El. 904.0 m msl and 917.8 m msl, with casing lengths of 17.2 m and 5.5 m, respectively. The deeper piezometer was installed within the tailings and the shorter piezometer within the embankment.

- *2006*: Two separate installations occurred in February and October 2006 when four and five piezometers were placed within the dam, respectively. Piezometers were installed between El. 871.3 m msl and 898.7 m msl, with casing lengths ranging from 11.0 m to 21.8 m. Three piezometers were installed within the foundation soil, four piezometers were installed within the Starter Dam, and two piezometers were installed within the tailings.

- *September 2007, within the Ninth Raising*: Seven piezometers were installed between El. 937.2 m msl and 937.3 m msl, with a length of casing of 13.0 m, and were screened within the tailings.

- *July 2008*: Two piezometers were installed between El. 904.7 m msl and 915.8 m msl, with casing lengths of 11.1 m and 6.2 m, and were screened within the tailings and the embankment, respectively.

- *February 2010*: One piezometer was installed within the tailings at El. 922.5 m msl, with a casing length of 8.4 m.

- *December 2011*: One piezometer was installed within the embankment at El. 929.4 m msl, with a casing length of 6.6 m.

- *2013, within the Ninth Raising*: Two separate installations of four piezometers occurred in April and May 2006. The piezometers were installed between El. 939.9 m msl and 940.3 m msl, with casing lengths of approximately 5.7 m. One piezometer was installed within the tailings and seven piezometers within the embankment.

- *June 2016*: Five piezometers were installed along the downstream face of the dam, between El. 855.6 m msl and 866.4 m msl, with casing lengths ranging from 18.0 m to 24.2 m. Two additional piezometers were installed within the foundation at El. 901.6 m msl and 898.9 m msl, with casing lengths of 31.4 m and 31.5 m, respectively.

- *September 2016*: Two piezometers were installed within the tailings at El. 909.5 m msl and 904.8 m msl, with casing lengths of 21.0 m and 22.0 m, respectively.

- *August 2018, Automation Project*: In August 2018, Vale automated the water level readings at 49 piezometers by installing pressure transducers within existing standpipe piezometers and connecting them to dataloggers. From September to December 2018, Vale collected data from 46 of these instruments once a month. On January 10, 2019, the datalogger began sending data to the centralized system for 46 of the 49 piezometers, at five-minute intervals, up until the time of the failure.

- *December 2018 to January 2019*: 20 vibrating wire piezometers were installed during this period, shortly before the failure of the dam. Two piezometers were installed in a single borehole. The remaining 18 piezometers were installed in four boreholes, with several piezometers to a borehole. No survey of the actual locations of these piezometers was found. The boreholes in which the piezometers were installed were fully grouted using a mixture of cement and bentonite clay.

- *Piezometers without installation dates*: There are nine manually measured piezometers for which installation dates were not provided. Based on the dates for which data is available for these piezometers, as shown in Table 5-1, they appear to have been installed in 2004 or earlier.

5.2 Available Data

Piezometric data were available for the period April 1996 to January 25, 2019. The data recording frequency of the piezometers varied, with readings recorded on either a weekly, biweekly, or monthly basis. The figures attached to this Appendix present the data that were available for the period January 2014 to January 2019.[3]

[3] In addition to the data shown in the figures, additional data was also available for two piezometers from the date of June 11, 2018, following an incident in connection with the drilling of a deep horizontal drain (described further

Data were available for 113 of the 123 piezometers. For 10 of the 123 piezometers, no measurement data were provided, but the piezometers were reported to be dry.[4] The data for the 20 vibrating wire piezometers installed in December 2018 and January 2019 had no reliable survey information and had not yet shown an established trend of consistent readings; hence, those data are not included in this Appendix. 11 piezometers had reported top elevations that were significantly different than the ground elevation shown in the 2018 topographic map for the site; the actual elevations of the top and bottoms of these 11 piezometers[5] could not be verified, and so the actual piezometric elevations reported for these piezometers are not considered reliable and are not included in this Appendix. Data for 33 of the piezometers predated January 2014 and therefore are not included in the figures attached to this Appendix. Accordingly, data for 49 of the 113 piezometers are presented in Figures 5-2 to 5-50 attached to this Appendix.[6] Elevations presented in Figures 5-2 to 5-50 are in m msl.

5.3 Data from Automated Piezometers

In or around August 2018, measurements at 49 of the piezometers were automated. From September to December 2018, monthly readings were available from 46 of these 49 piezometers. Beginning on January 10, 2019, the 46 automated piezometers were connected to a datalogger, and data collection began at five-minute intervals for these piezometers.[7] The data recorded by the datalogger in January 2019 for 17 of the 46 automated piezometers did not appear consistent with the trends for those piezometers. A report prepared by a third party, IBPTech,[8] regarding this occurrence confirms that a transmission error affected the recording of these automated piezometers. As the IBPTech report describes, data were recorded incorrectly in the datalogger, resulting in the switching of piezometer identification (i.e., "tags") for these piezometers. As described by IBPTech, 50 local dataloggers (device serial numbers 014131 to 014180) were installed at the dam, of which 49 were connected to piezometers and one was not. Data generated by the local dataloggers at these piezometers were transmitted to the remote terminal unit ("RTU") from which they were stored in the concentrator datalogger and then accessed and downloaded by

in Appendix A). Those piezometer readings are not reflected in the attached plots and are discussed instead in Appendix A.

4 These piezometers included PZ-45C, PZ-52C, PZ-54C, PZM-6, PZC-33, PZC-34, PZC-36, PZC-38, PZC-39, and PZC-40.

5 The piezometers for which the top and bottom elevations could not be verified include PZC-41 to PZC-47, PZC-16.6A, PZ-45C-1, PZF-11, and PZ-32C.

6 Unless otherwise noted, the figures included in this Appendix include plots of all available data. In some instances, the piezometer data shows inconsistencies or anomalies that do not coincide with the piezometer trend or otherwise appear to be erroneous. These issues are addressed in Appendix G.

7 In some instances, the automated piezometer data recorded for certain five-minute intervals prior to the event is recorded as "zero" or "NAN", apparently due to a lack of connection with the datalogger. These intervals were disregarded in the attached figures, based on the interpretation that these readings were due to a technical error and not representative of any actual piezometric elevation measurement.

8 Instituto Brasileiro de Peritos em Comercio Electronico e Telematica Ltda Technical Report (February 9, 2019) ("IBPTech Report").

the facility operations personnel. All 50 local dataloggers were registered in the RTU, but only 46 were registered in the concentrator datalogger. The failure to connect the remaining four dataloggers to the concentrator datalogger resulted in a "tag-switch" issue, which caused readings to become associated with the wrong piezometer for 17 of the automated piezometers. It was possible to line up the erroneous tags to the appropriate piezometers and correct the data associated with 13 of the 17 piezometers. The data from the remaining four piezometers for January 2019 were lost.[9] The figures attached to this Appendix for the affected piezometers have been corrected to resolve the datalogger error.

6. WATER LEVEL INDICATORS

The water level indicators measure the free water level in the embankment or tailings. Unlike the piezometers discussed in Section 5, water level indicators do not have a screened zone, and so they generally measure the highest piezometric head elevation within the profile of the borehole, not the average piezometric head over an interval of depth. The water level indicator devices used by Vale are referred to in some documents as standpipes or "INAs."

6.1 Installation Information

Location information for the water level indicators is presented in Table 6-1, and a plan view of the water level indicator locations, with the field code names used by Vale, is provided in Figure 6-1. Water level indicators were installed downstream and adjacent to the dam, and within the Starter Dam, embankment, and tailings.

Measurement and installation data for 50 water level indicators were available for 41 active and nine inactive water level indicators as follows:

- 41 active water level indicators:
    - One water level indicator with the last available monitoring data in July 2018;
    - 30 water level indicators with the last available monitoring data in November 2018; and
    - 10 water level indicators with the last available monitoring data in December 2018.
- Nine inactive water level indicators.

[9] The piezometers for which data were lost were PZC-20C (CFJB1PZ047), PZM-20 (CFJB1PZ067), PZ-47C (CFJB1PZ036), and PZC-45 (CFJB1PZ099). IBPTech Report.

The timeline below summarizes the history of water level indicator installations at Dam I. Unless otherwise noted below, the data from these water level indicators are believed to be reliable and are included in this Appendix.

- *October 2005*: Four water level indicators were installed within the tailings between El. 897.7 m msl and 923.3 m msl, with casing lengths ranging from 20.8 m to 21.1 m.

- *November 2005*: Five water level indicators were installed between El. 898.0 m msl and 922.0 m msl, with casing lengths ranging from 10.9 m to 20.9 m. Two water level indicators were installed within the tailings, and three water level indicators were installed within the embankment.

- *December 2005*: Five water level indicators were installed between El. 897.7 m msl and 930.4 m msl, with casing lengths ranging from 20.5 m to 22.5 m. Three water level indicators were installed within the tailings, and two water level indicators were installed within the embankment.

- *October 2006*: Three water level indicators were installed within the tailings between El. 890.0 m msl and 904.6 m msl, with casing lengths ranging from 6.6 m to 21.2 m.

- *September 2007, within the Ninth Raising*: Seven water level indicators were installed within the embankment between El. 937.2 m msl and 937.3 m msl, with a casing length of 9.0 m.

- *April 2013, within the Tenth Raising*: Eight water level indicators were installed within the embankment between El. 942.5 m msl and 942.7 m msl, with casing lengths ranging from 5.7 m to 5.9 m.

- *June 2016*: Six water level indicators were installed between El. 897.8 m msl and 905.0 m msl, with casing lengths ranging from 3.1 m to 21.0 m. One water level indicator was installed within the Starter Dam; one water level indicator was reportedly installed within the "left shoulder" (i.e., at the left abutment) of the dam; two water level indicators were installed within the tailings; and two water level indicators were installed within the embankment.

- *September 2016*: Three water level indicators were installed within the tailings between El. 898.4 m msl and 937.2 m msl, with casing lengths ranging from 19.1 m to 29.1 m.

- *Water level indicators without installation dates*: There are 11 water level indicators for which the installation date was not available. These 11 water level indicators were installed between El. 861.0 m msl and 926.8 m msl, and have casing lengths ranging from 0.9 m to 28.9 m. Two water level indicators were installed within the Starter Dam, and one water

level indicator was installed within the tailings. No information was provided regarding the material in which the remaining water level indicators were installed.

6.2 Available Data

Water level measurement data were available for the period April 1996 through January 2019. The data recording frequency of the water level indicators varied and was either monthly, biweekly, or weekly. The figures attached to this Appendix present the data that was available for the period January 2014 to January 2019.

Data were available for the 50 identified water level indicators.[10] Of these, nine only had data that predated January 2014. In addition, 13 water level indicators were reported as "dry" since 2012. Five water level indicators had top elevations reported that were significantly different than the ground elevation shown in the 2018 topographic map for the site. The actual elevations of the tops and bottoms of these water level indicators[11] could not be verified, and so the actual piezometric elevations reported for these water level indicators are not considered reliable and are therefore not included in this Appendix. Accordingly, the data for the period January 2014 to January 2019 for 23 of the 50 INAs are presented in Figures 6-2 to 6-24. Elevations presented in Figures 6-2 to 6-24 are m msl.

7. FLOW METERS

Flow meters are used to measure the flow of water at a certain location. Data from the flow meters can be used to assess the effectiveness of the subsurface drains, the physical condition of the drains, and the nature of water flow through the dam and tailings. At Dam I, flow meters were used to measure the flow of water coming from subsurface drains at the location where they discharged to surface drainage channels.

7.1 Installation Information

Location information for the flow meters is presented in Table 7-1, and a plan view of the flow meter locations with their field code names is provided in Figure 7-1.

Information was reported for 54 flow meters, including:

[10] Several water level indicators were identified for which no records of monitoring data were available: INA 17, INA 39 to 43, MNA 15C, MNA 2C, INA 16-2, INA 16-3, INA 16-4, and INA 16-5A. These water level indicators appear to have been installed, but data from them were either not collected or not retained. These water level indicators are not included in the figures to this Appendix because no associated data are available.

[11] The water level indicators for which the top and bottom elevations could not be verified include INA 39/16, INA 40/16, INA 41/16, INA 42/16, and INA 17 (CFJB1NA027). Source documents identify two water level indicators having the same field code (i.e., INA 17). The INA 17 identified in this footnote appears to be a different instrument than the instrument for which there is no measurement data that is referenced in footnote 9.

- 53 actively monitored flow meters ("D-XX", "PS-XX", and "PS-XXA" series); and
- One active direct flow meter that was noted to convey surface water flow collected from Dam I to Dam VI (e.g., residual flow).

The timeline below summarizes the history of the flow meter installation at Dam I.

- *January 1990, within the Second Raising*: Four triangular flow meters were installed between El. 872.9 m msl and 882.0 m msl.
- *January 1993, within the Third Raising*: One triangular flow meter was installed at El. 890.3 m msl.
- *June 1993, within the Third Raising*: 23 triangular flow meters were installed between El. 887.6 m msl and 897.4 m msl.
- *June 1995, within the Fourth Raising*: 14 triangular flow meters were installed between El. 896.9 m msl and 890.0 m msl.
- *1998, within the Fifth Raising*: Two separate installations occurred in January and June 1998 when four and two triangular flow meters were installed within the dam, respectively, between El. 904.1 m msl and 904.5 m msl.
- *January 2000, within the Sixth Raising*: Five triangular flow meters were installed between El. 909.1 m msl and 910.2 m msl.
- *November 2016*: One residual flow meter was installed at El. 898.0 m msl.

7.2 Available Data

Flow meter data were available for 54 identified flow meters and included measurement data from April 1996 to December 2018.[12] The data recording frequency of the flow meters was approximately monthly. Figure 7-2a presents a plan view of the active drains grouped together by location on the dam, and Figure 7-2b presents the measured flow rates between January 2014 and January 2019. Figure 7-3 identifies the active drains that had an average flowrate of greater than 0.5 cubic meters per hour (m^3/hr) between January 2014 and January 2019, and those that had an average flowrate of less than 0.5m^3/hr over that period. The measured flow rates between January 2014 and January 2019 for the individual flow meters are presented in Figures 7-4 to Figure 7-56,

[12] Several flow meters were identified in reports maintained by Vale for which no records of monitoring data were available. These flow meters were either not installed or data from them were neither collected nor retained. These flow meters are not included in this Appendix because no associated data are available. The flow meters for which there were no data and therefore are not included in this report are MI-01 to MI-09.

and the measurement data for the residual flow meter between Dam I and Dam VI are presented in Figure 7-57.

8. INCLINOMETERS

Inclinometers measure changes in angles (i.e., deformations or movement) over depth within the embankment and tailings material. Measurements are recorded in two perpendicular directions to measure lateral movement. Movement of embankments and tailings over time can be measured using inclinometers.

8.1 Installation Information

Data were reported for six active inclinometers and for two inoperative inclinometers, which are summarized below.

- Six active inclinometers were installed across Dam I within the embankment and tailings at three approximate elevations: El. 900 m msl, El. 915 m msl, and El. 930 m msl; and

- Two inoperative inclinometers were installed, but the longitude, latitude, and elevation information for these inclinometers are not available.

The active inclinometer installation information is summarized in Table 8-1, and a plan view of the active inclinometer locations with their field code names is provided in Figure 8-1.

8.2 Available Data

The six active inclinometers were read manually for both the "A" axis and "B" axis directions. Measurement data for two inclinometers (INC-01 and INC-02) were available from May 2016 to December 2018, with readings taken approximately every other month over that time period. The remaining four inclinometers (INC-03 through INC-06) were installed in early December 2018 and were measured once in late December 2018. Positive readings for the "A" axis represent downstream movement, and negative readings represent upstream movement. Positive readings for the "B" axis represent movement towards the left portion of the embankment, and negative readings represent movement towards the right portion of the embankment. Figures 8-2 to 8-17 present the measurement data for the active inclinometers. Presented elevations on Figures 8-2 to 8-17 are m msl.

Data for the two inoperative inclinometers were only available between March 2006 and April 2007. The available data for the two inoperative inclinometers were not included in this Appendix because the locations of the inclinometers were not available, the data were available for only a short period of time, and the data were obtained more than 10 years prior to dam failure.

9. DEEP HORIZONTAL DRAINS

Deep horizontal drains ("DHPs") are lateral drains installed within the dam and tailings that are intended to drain water from within the dam and tailings. Flow data for the DHPs can be used to assess the levels of water within the tailings, the physical condition of the drains, and the nature of water flow through the dam and tailings. Measurements at the DHPs recorded the flow of water coming from the DHPs at the location where they discharged to surface drainage channels.

9.1 Installation Information

DHPs were installed at Dam I between February and June 2018. Installation information for the DHPs is provided in Table 9-1, and the locations of the DHPs are shown in Figure 9-1. The horizontal and vertical location data are shown in Table 9-1.[13] As shown in Table 9-1, the installation of 15 DHPs was attempted, but only 13 DHPs were completed (DHP 6 and DHP 15 were started but not completed).

- 13 DHPs were installed at three locations:
    - At the toe of the Fourth Raising at approximately El. 899 m msl (i.e., DHPs 1, 2, 3, 7, 11, 12, 13, and 14);
    - At the right (DHP 4) and left (DHP 5) abutments of the dam between El. 880 m msl and 882 m msl; and
    - Between El. 910 m msl and 944 m msl (i.e., DHPs 8, 9, and 10).
- Two DHP installations were attempted but not completed to installation specifications. The first, DHP 6, was attempted at the toe of the Fourth Raising berm and flow was never observed. The other, DHP 15, was attempted at the lower right abutment of the dam near the Starter Dam. Although DHP 15 was not completed, a device was installed at this location that allowed the measurement of flows from this location.

9.2 Available Data

Flow data are available for nine of the 13 installed DHPs (i.e., DHPs 1, 2, 3, 4, 7, 11, 12, 13, and 14) and the instrument installed at the location of DHP 15. Measurement data for these locations were available for May through July 2018 and October through December 2018, with one reading reported for each location in each month. The data are provided in Table 9-2.

[13] The reported elevations (vertical locations) for DHPs 6 and 8-10 are not consistent with topographic information and could not be verified.

Appendix C

Annex 1 – Figures

December 2019

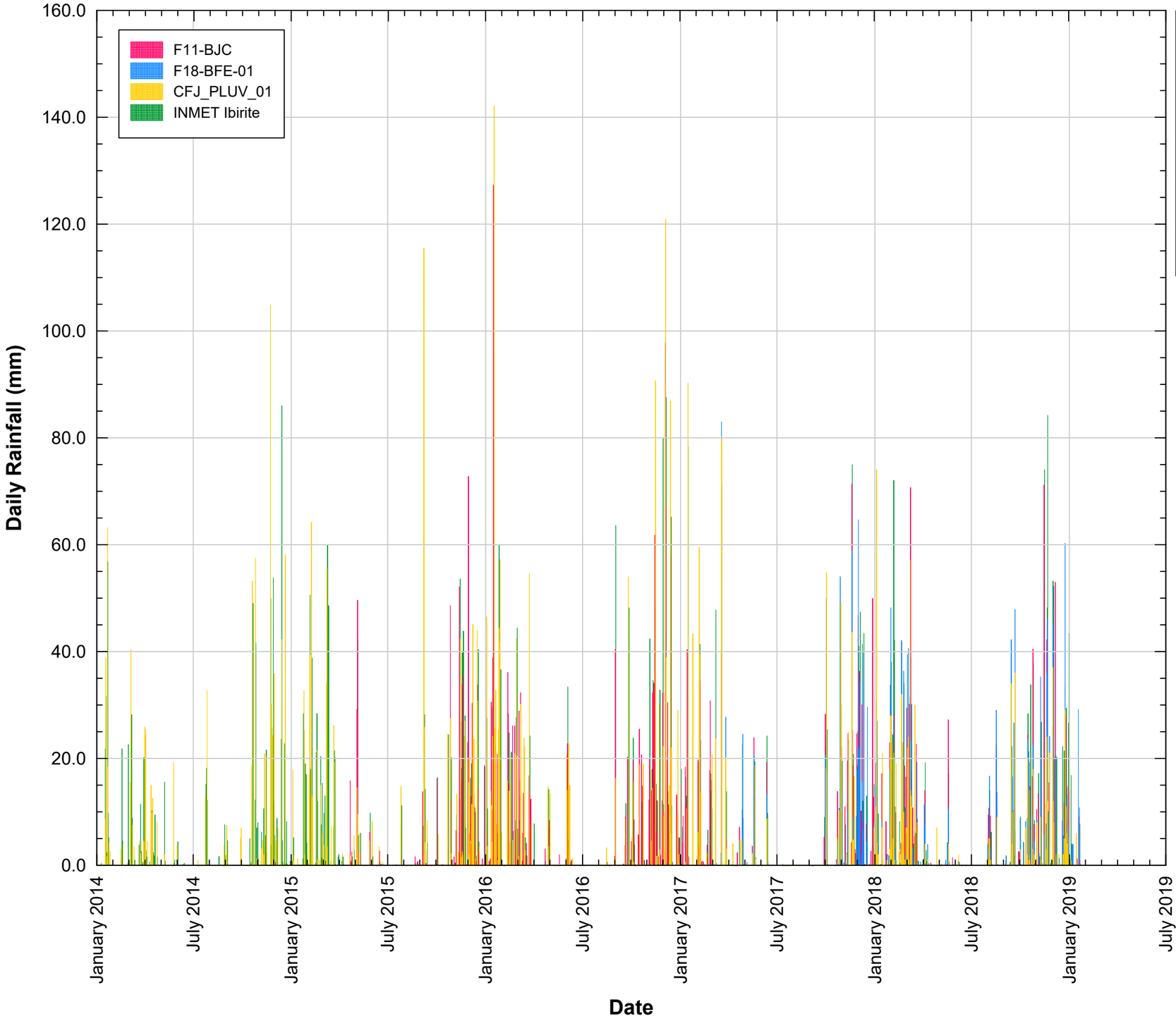
LIST OF FIGURES

PLAN VIEW: RAINFALL GAUGES

Rainfall Data					
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**	**Approximate Elevation (m)[(1)]**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6	1322
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4	1072
CFJ_PLUV_01	1/1/2006	1/15/2019	Once on Weekdays	1.4	816.8
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4	1199

Notes:
1. The location information for rain gauges F11-BJC and F18-BFE-01 are approximate based on station descriptions. The reported values for "Distance from Dam I" and "Elevation" for these stations should be considered approximate.
2. Map was created in Google Earth on 9 October 2019.

PLAN VIEW: RAINFALL GAUGES
FIGURE 2-1

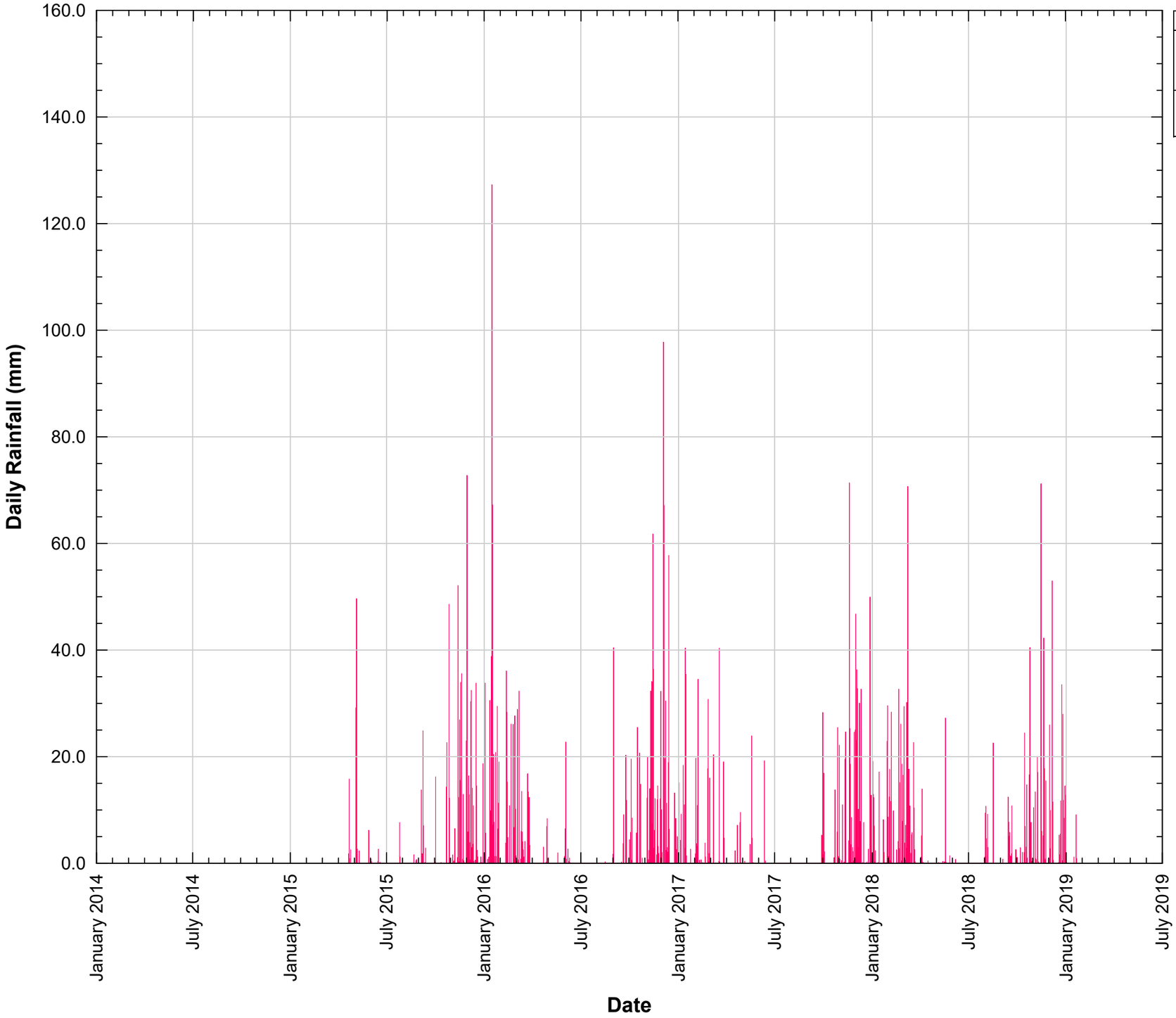


Rainfall Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4
CFJ_PLUV_01	1/1/2006	1/15/2019	Once on Weekdays	1.4
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

5-YEAR DAILY RAINFALL DATA:
F11-BJC, F18-BFE-01, CFJ_PLUV_01, INMET IBIRITÉ

FIGURE 2-2

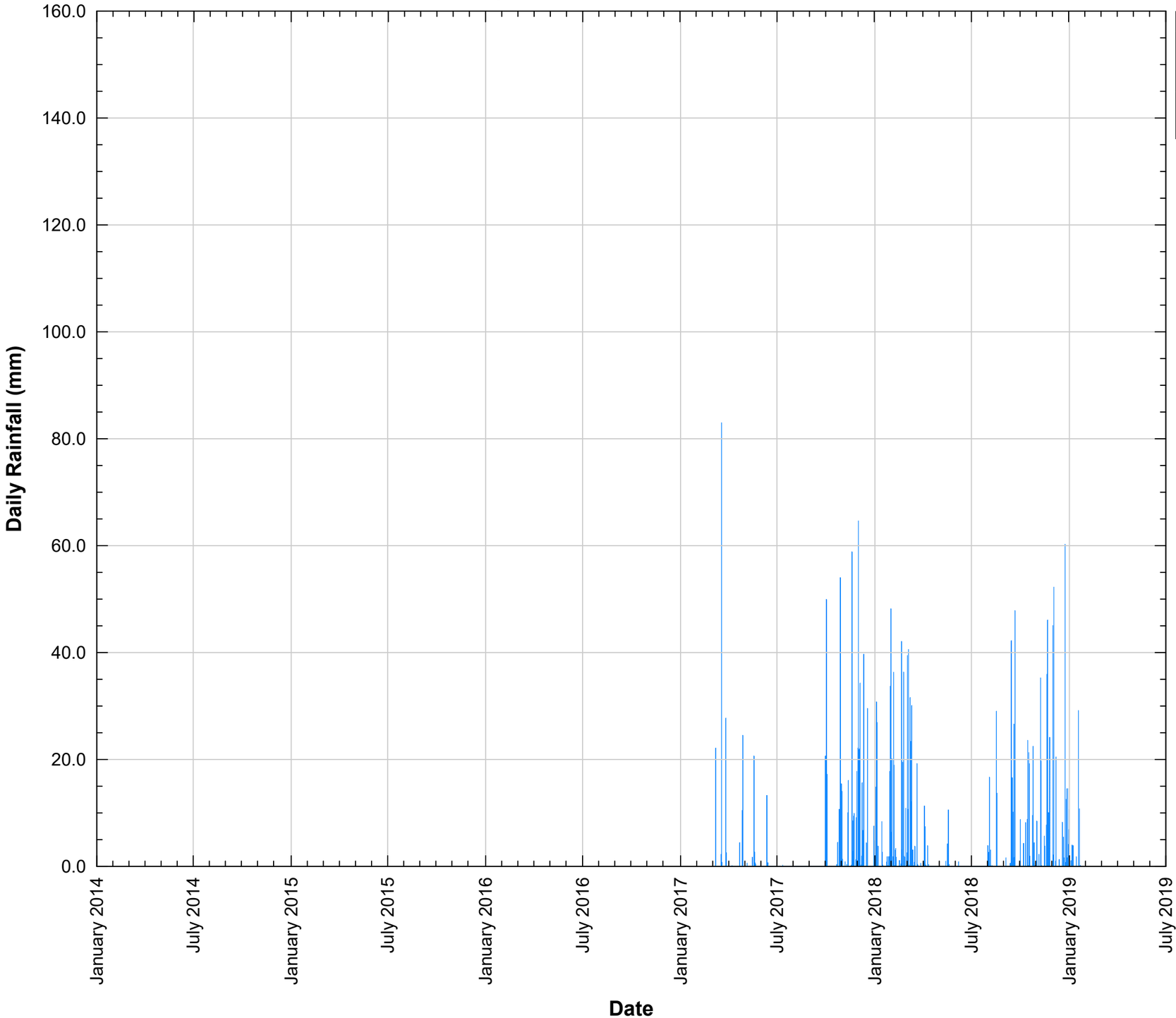
5-Year Daily Rainfall Data: F11-BJC



Rainfall Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6

5-YEAR DAILY RAINFALL DATA: F11-BJC

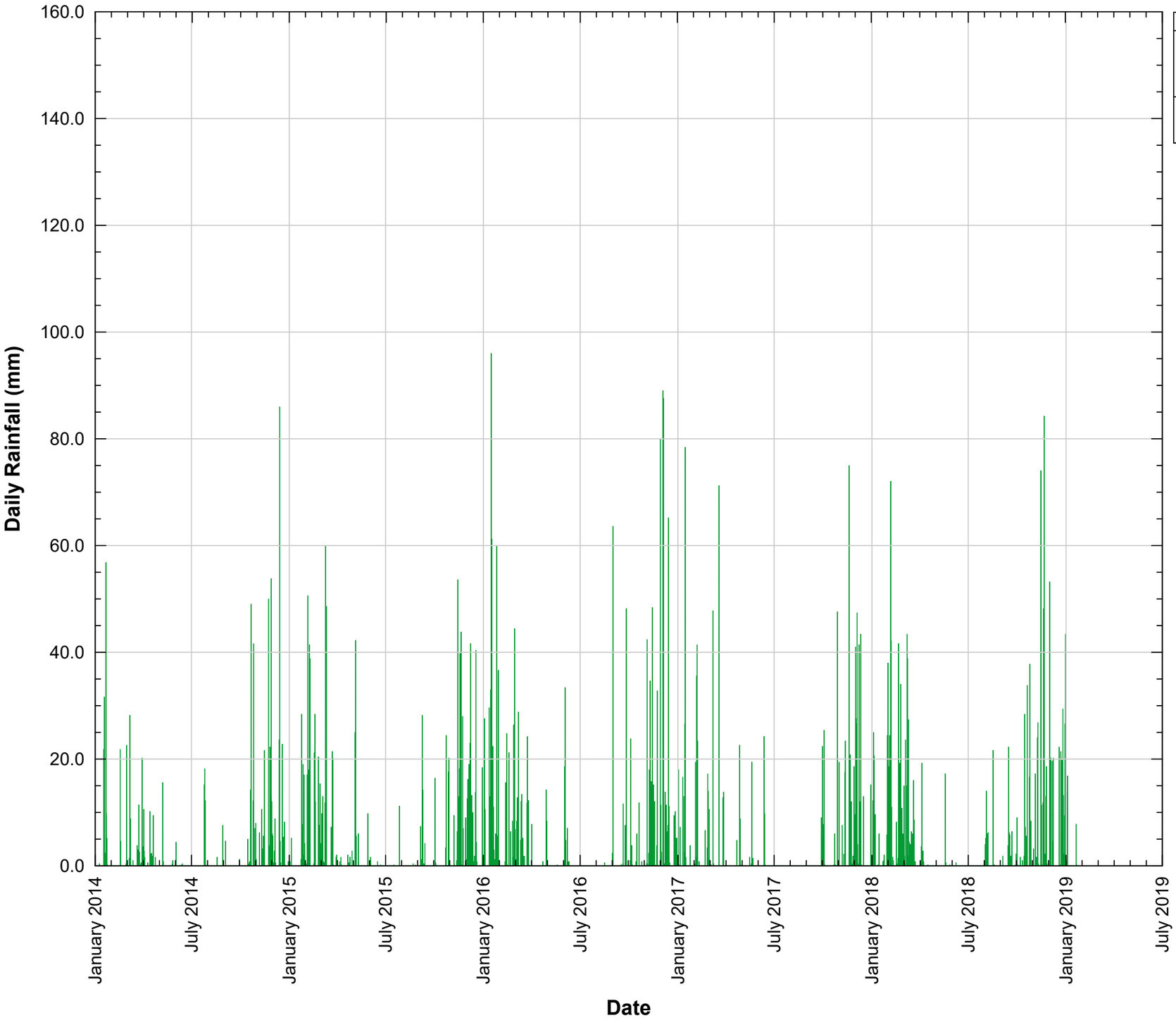
FIGURE 2-3



Rainfall Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4

5-YEAR DAILY RAINFALL DATA: F18-BFE-01

FIGURE 2-4

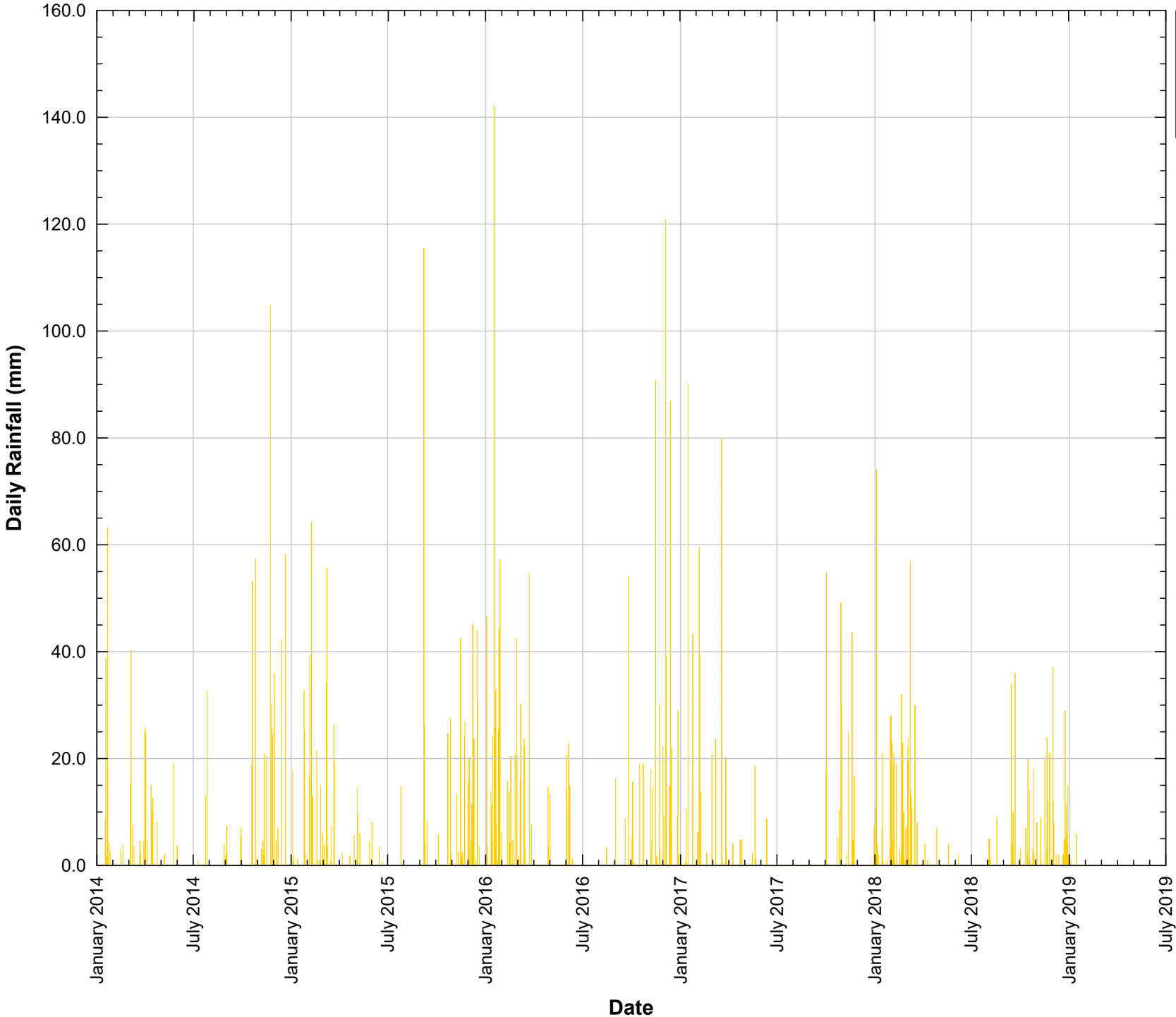


Rainfall Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

5-YEAR DAILY RAINFALL DATA: INMET IBIRITÉ

FIGURE 2-5

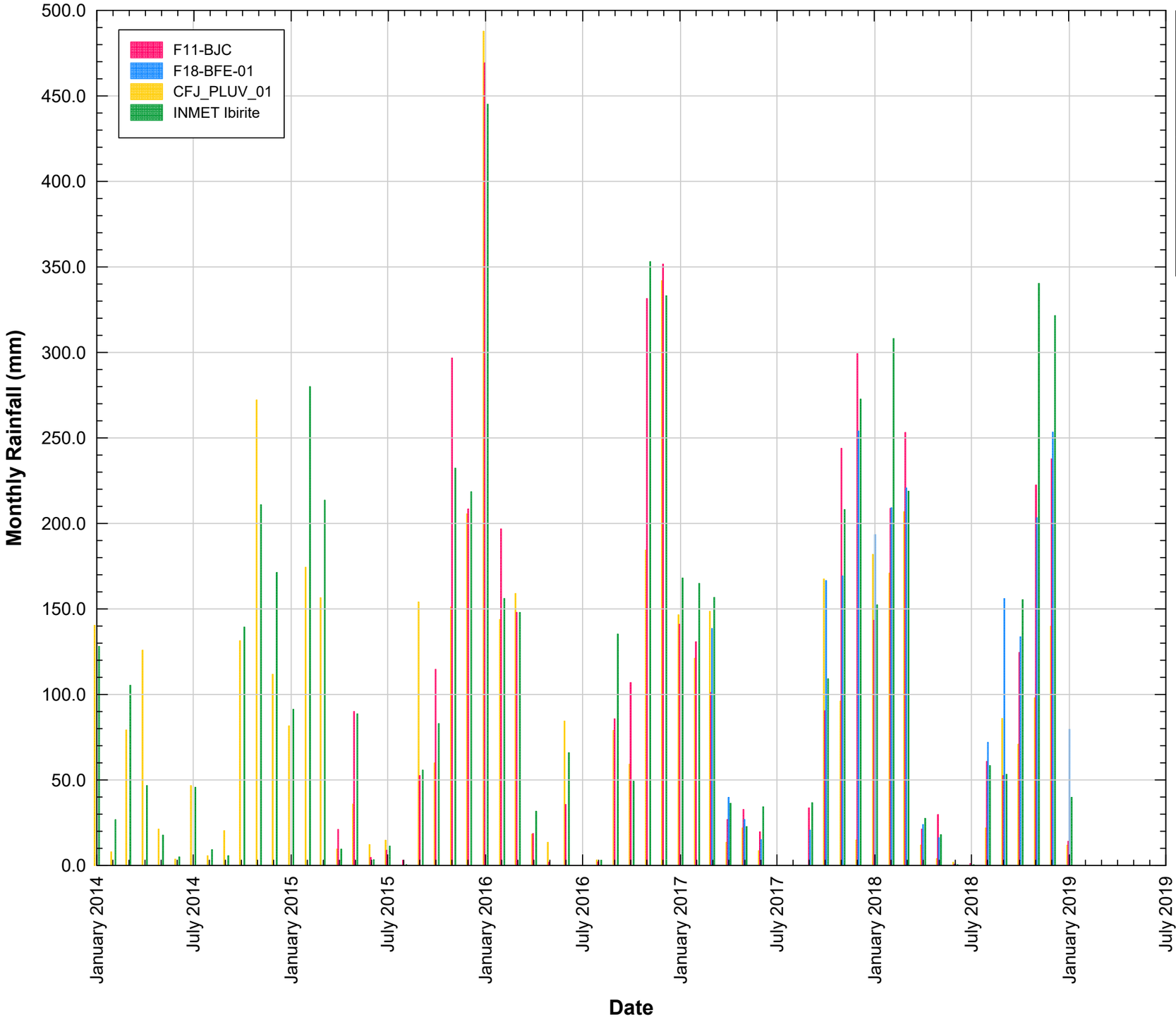
5-Year Daily Rainfall Data: CFJ_PLUV_01



Rainfall Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
CFJ_PLUV_01	1/1/2006	1/15/2019	Once on Weekdays	1.4

5-YEAR DAILY RAINFALL DATA: CFJ_PLUV_01

FIGURE 2-6

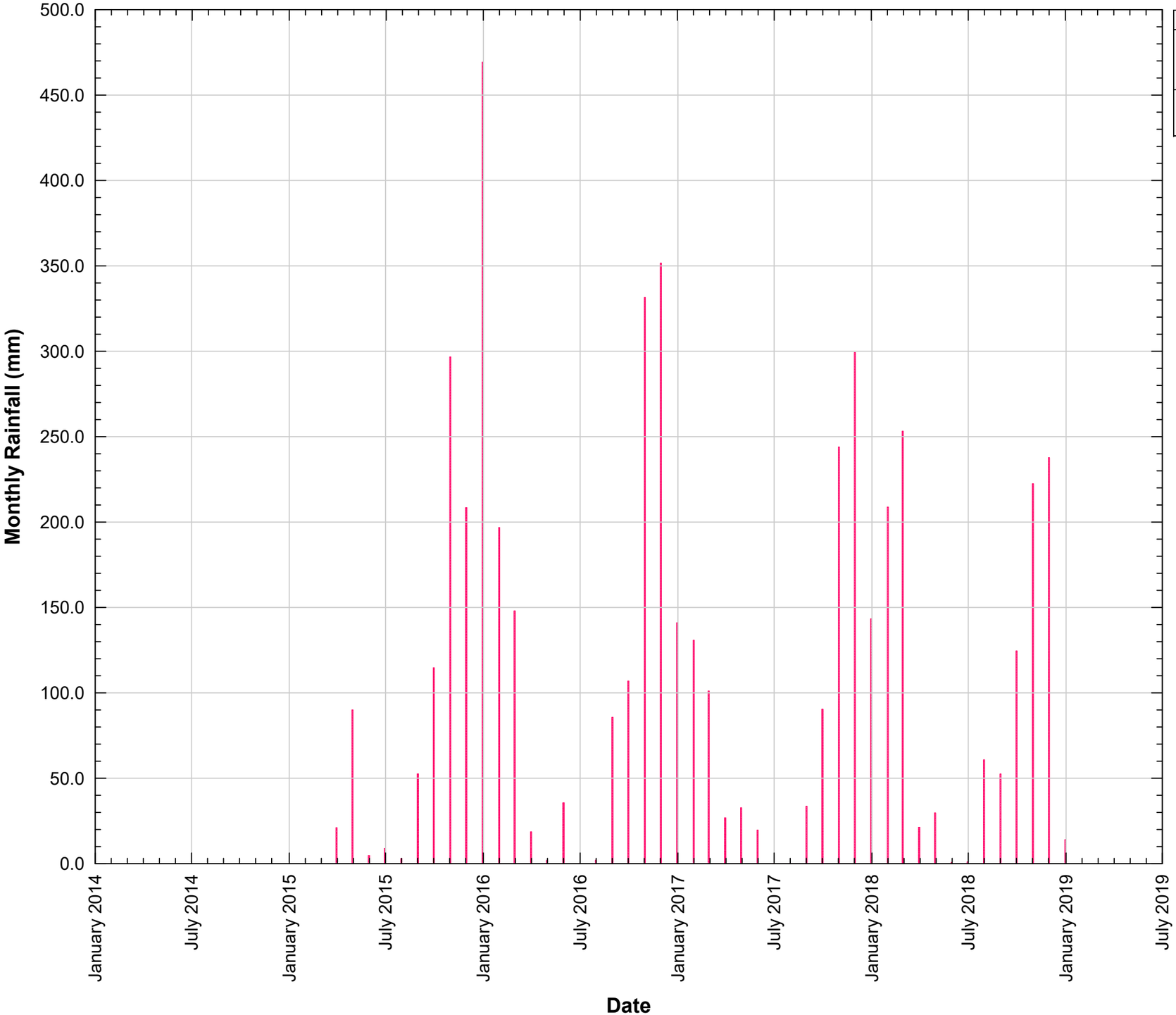


Rainfall Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4
CFJ_PLUV_01	1/1/2006	1/15/2019	Once on Weekdays	1.4
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

5-YEAR MONTHLY RAINFALL DATA:
F11-BJC, F18-BFE-01, CFJ_PLUV_01, INMET IBIRITÉ

FIGURE 2-7

5-Year Monthly Rainfall Data: F11-BJC

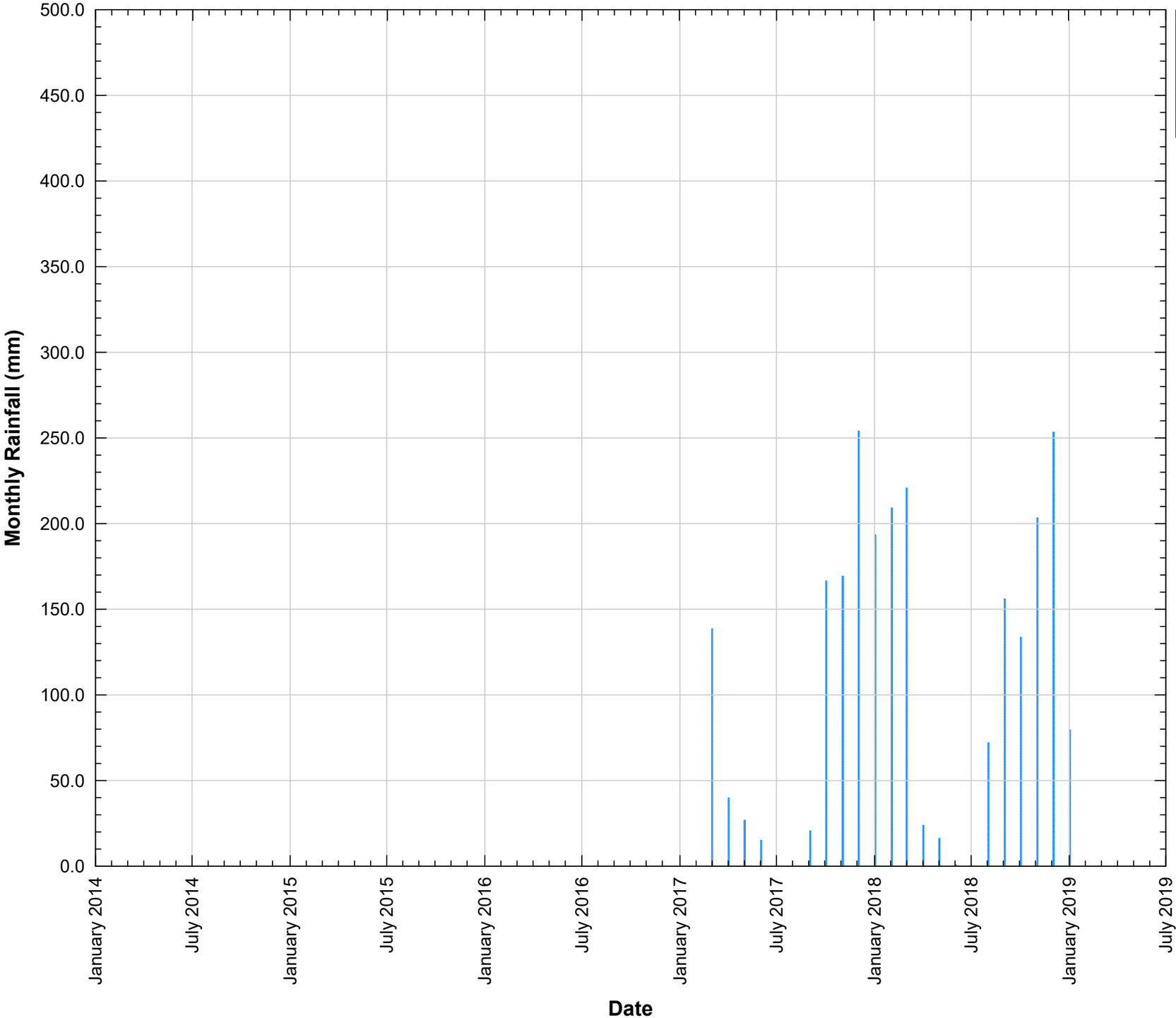


Rainfall Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6

5-YEAR MONTHLY RAINFALL DATA: F11-BJC

FIGURE 2-8

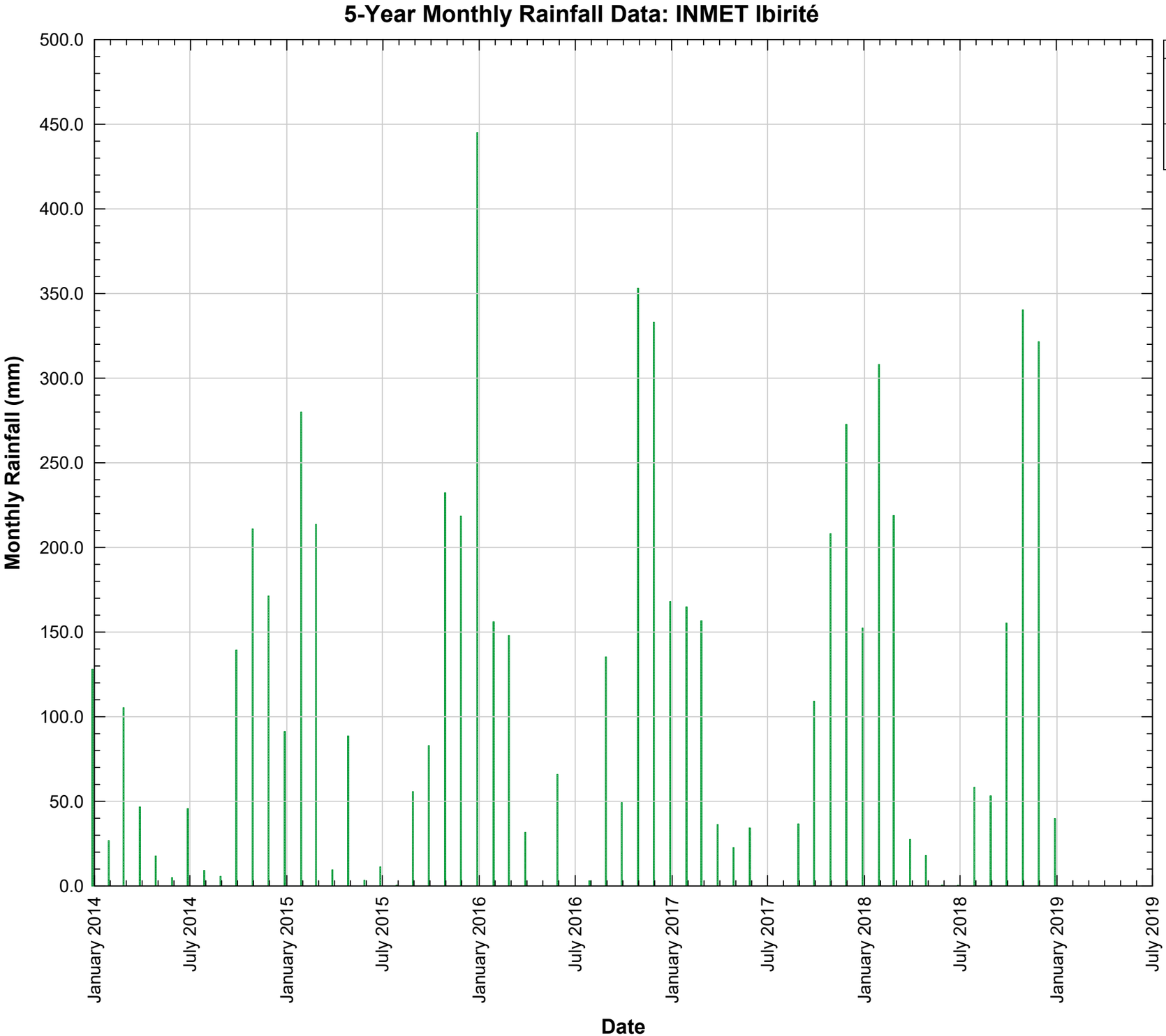
5-Year Monthly Rainfall Data: F18-BFE-01



Rainfall Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4

5-YEAR MONTHLY RAINFALL DATA: F18-BFE-01

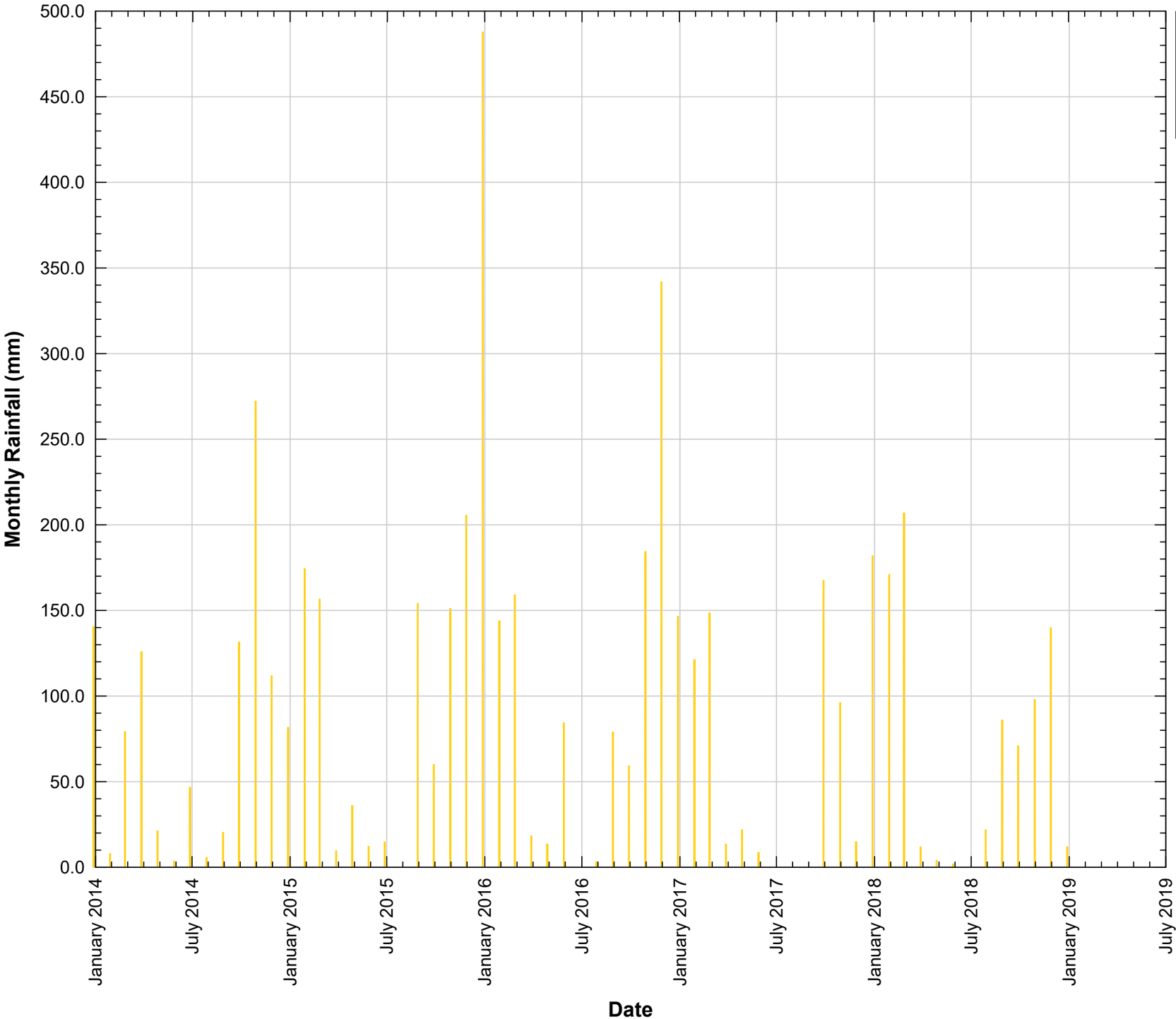
FIGURE 2-9



Rainfall Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

5-YEAR MONTHLY RAINFALL DATA: INMET IBIRITÉ

FIGURE 2-10



Rainfall Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
CFJ_PLUV_01	1/1/2006	1/15/2019	Once on Weekdays	1.4

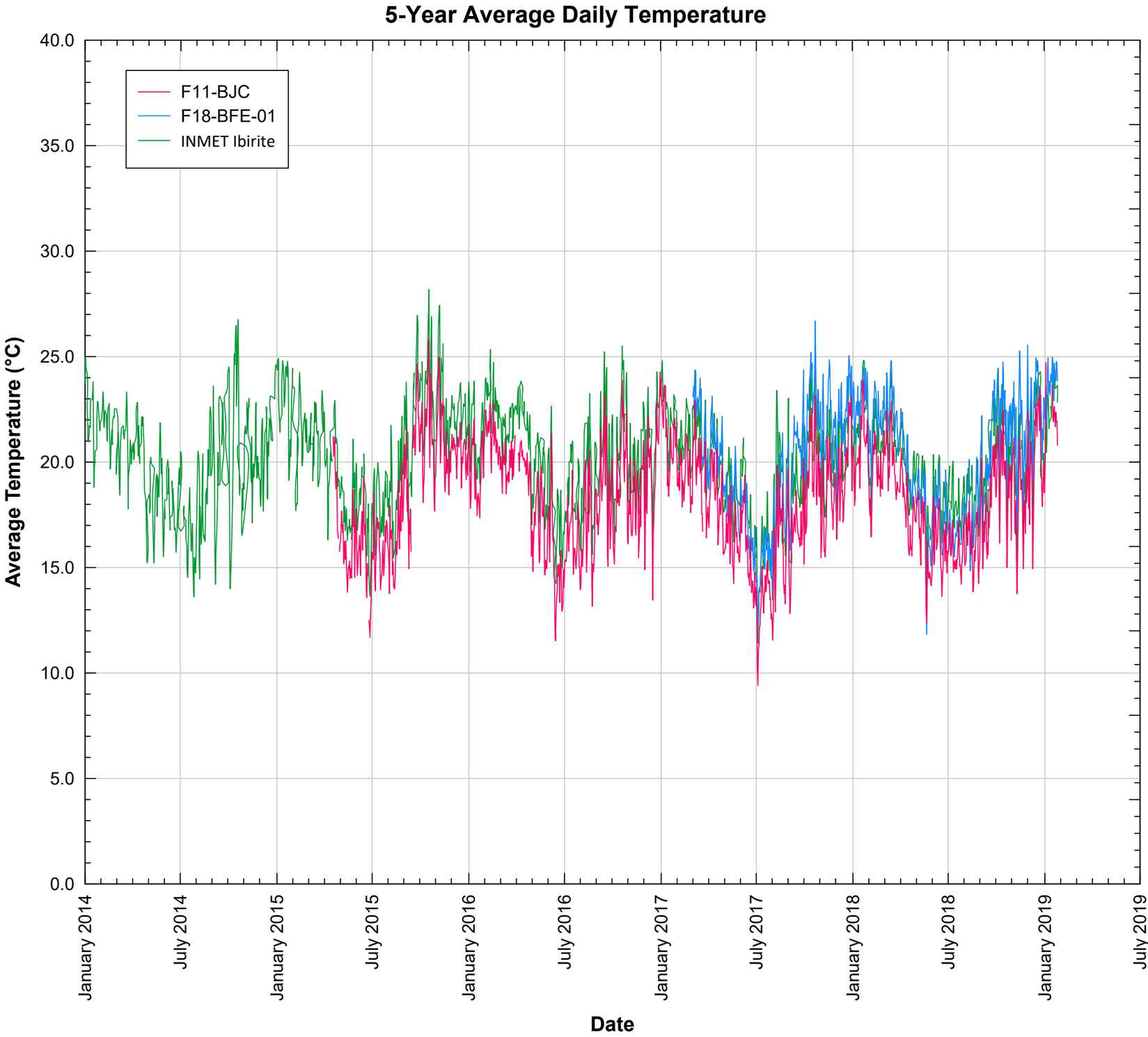
5-YEAR MONTHLY RAINFALL DATA: CFJ_PLUV_01
FIGURE 2-11

PLAN VIEW: WEATHER STATIONS

Weather Station Data					
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**	**Approximate Elevation (m)[1]**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6	1322
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4	1072
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4	1199

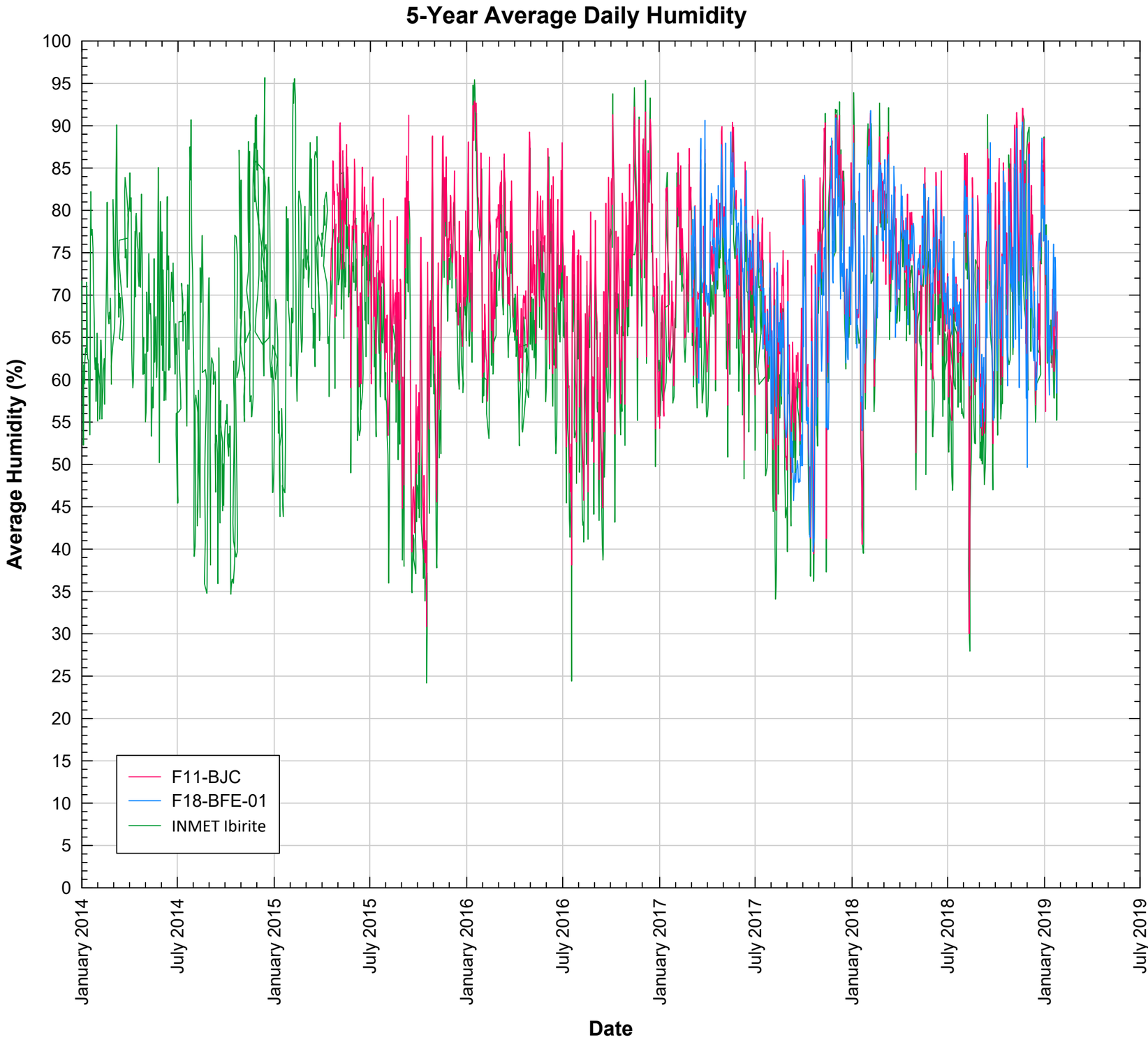
Notes:
1. The location information for weather stations F11-BJC and F18-BFE-01 are approximate based on station descriptions. The reported values for "Distance from Dam I" and "Elevation" for these stations should be considered approximate.
2. Map was created in Google Earth on 9 October 2019.

PLAN VIEW: WEATHER STATIONS
FIGURE 3-1



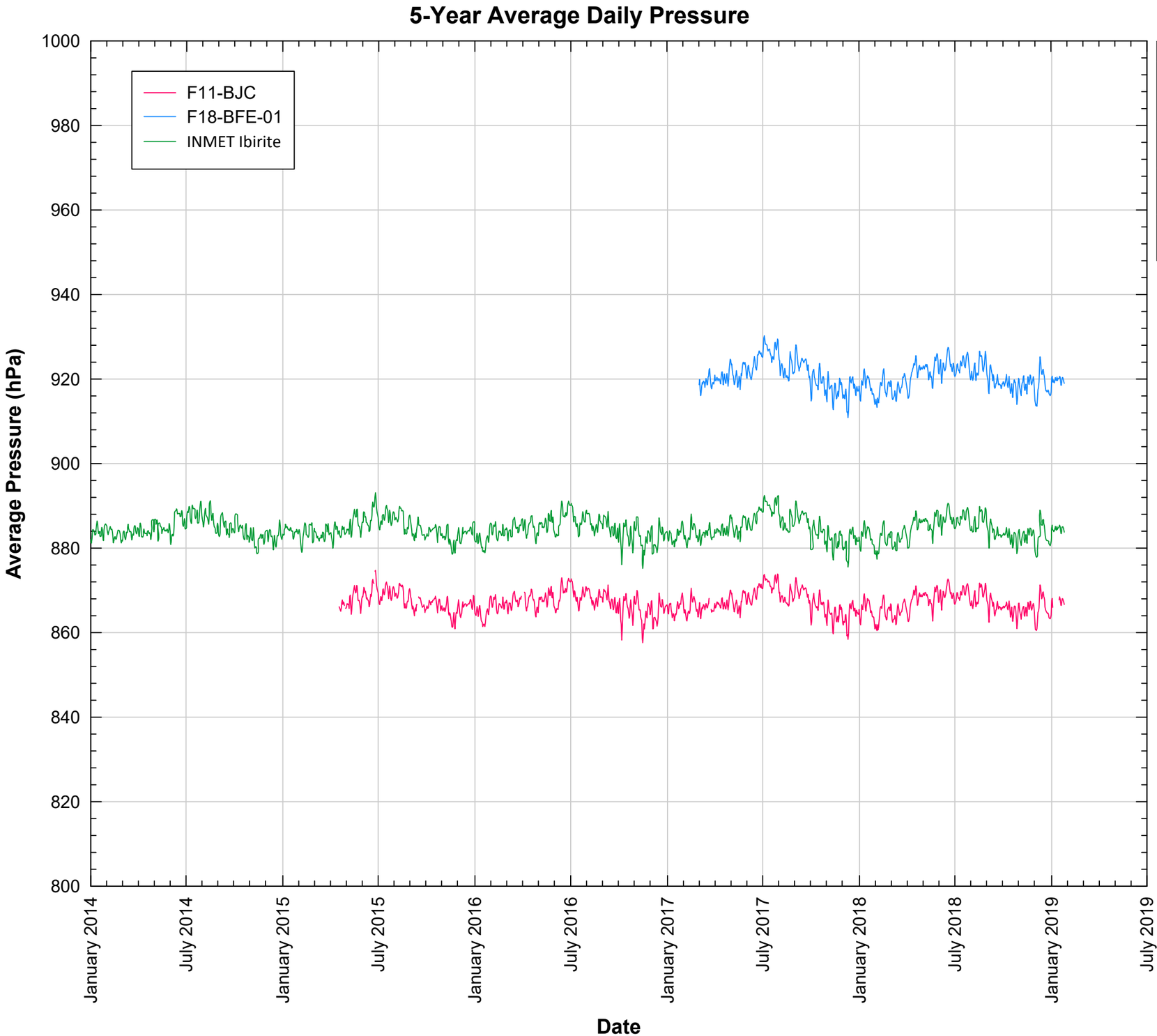
Temperature Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

5-YEAR AVERAGE DAILY TEMPERATURE
FIGURE 3-2



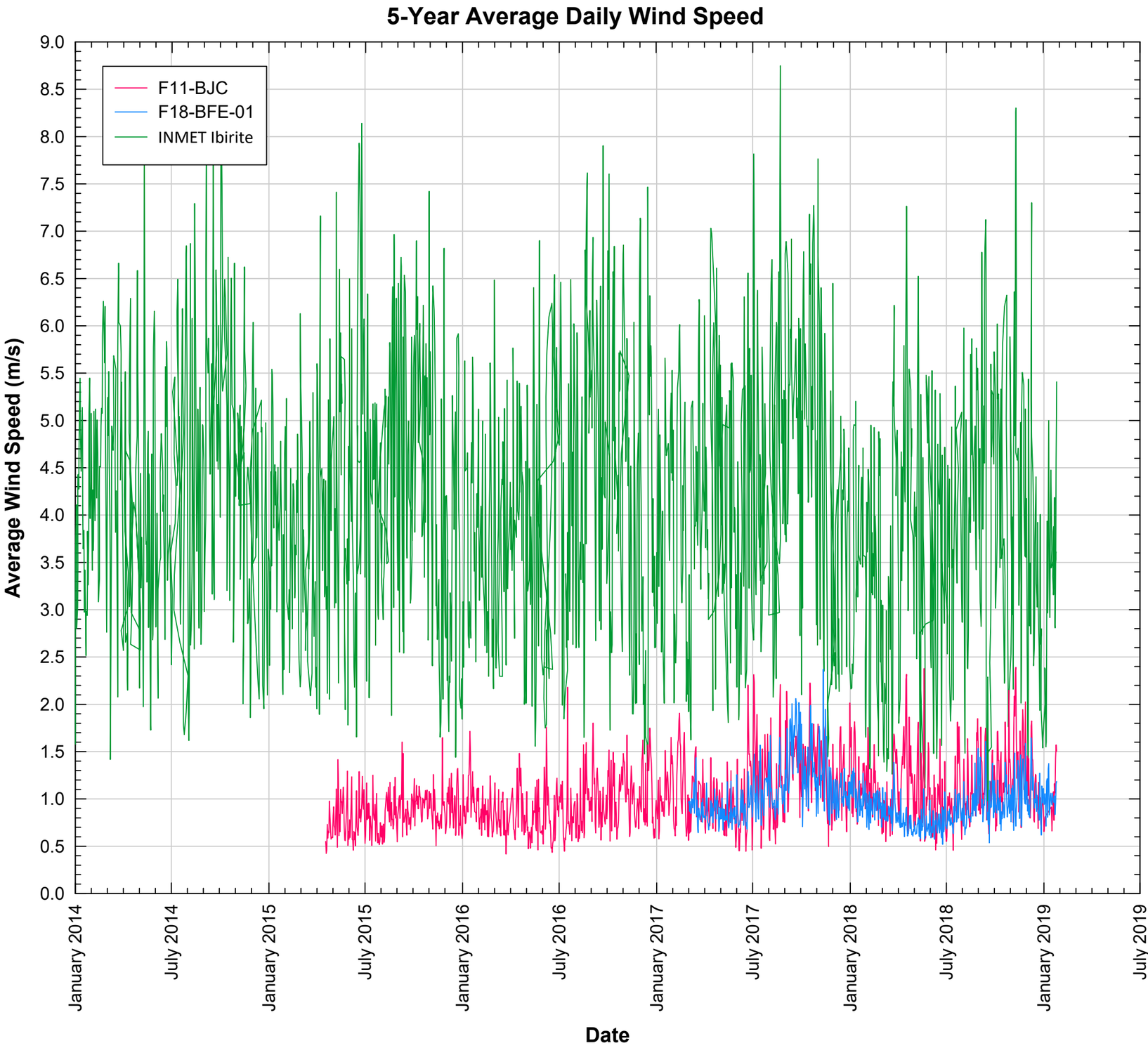
Humidity Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

5-YEAR AVERAGE DAILY HUMIDITY
FIGURE 3-3



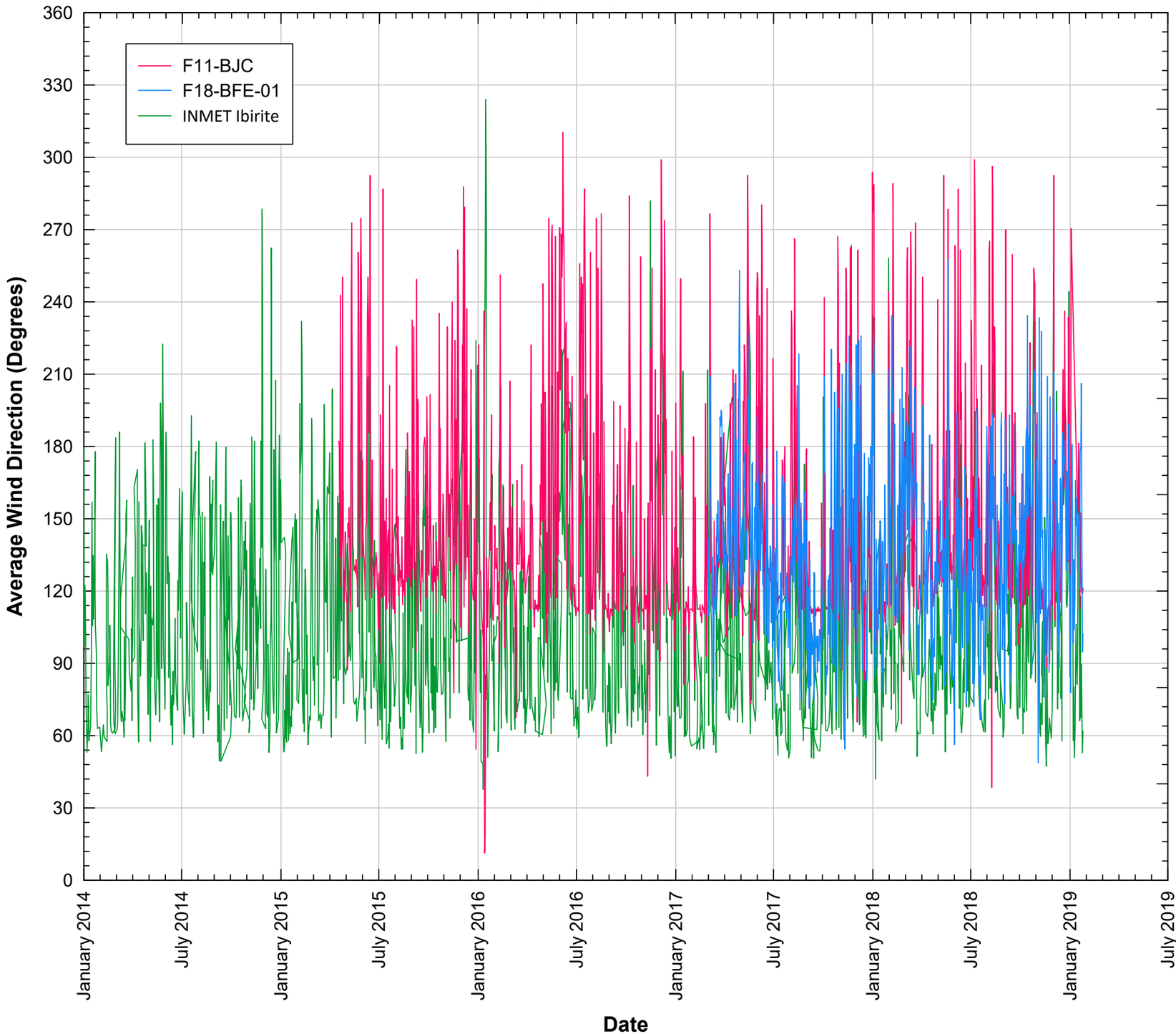
Pressure Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

5-YEAR AVERAGE DAILY PRESSURE
FIGURE 3-4



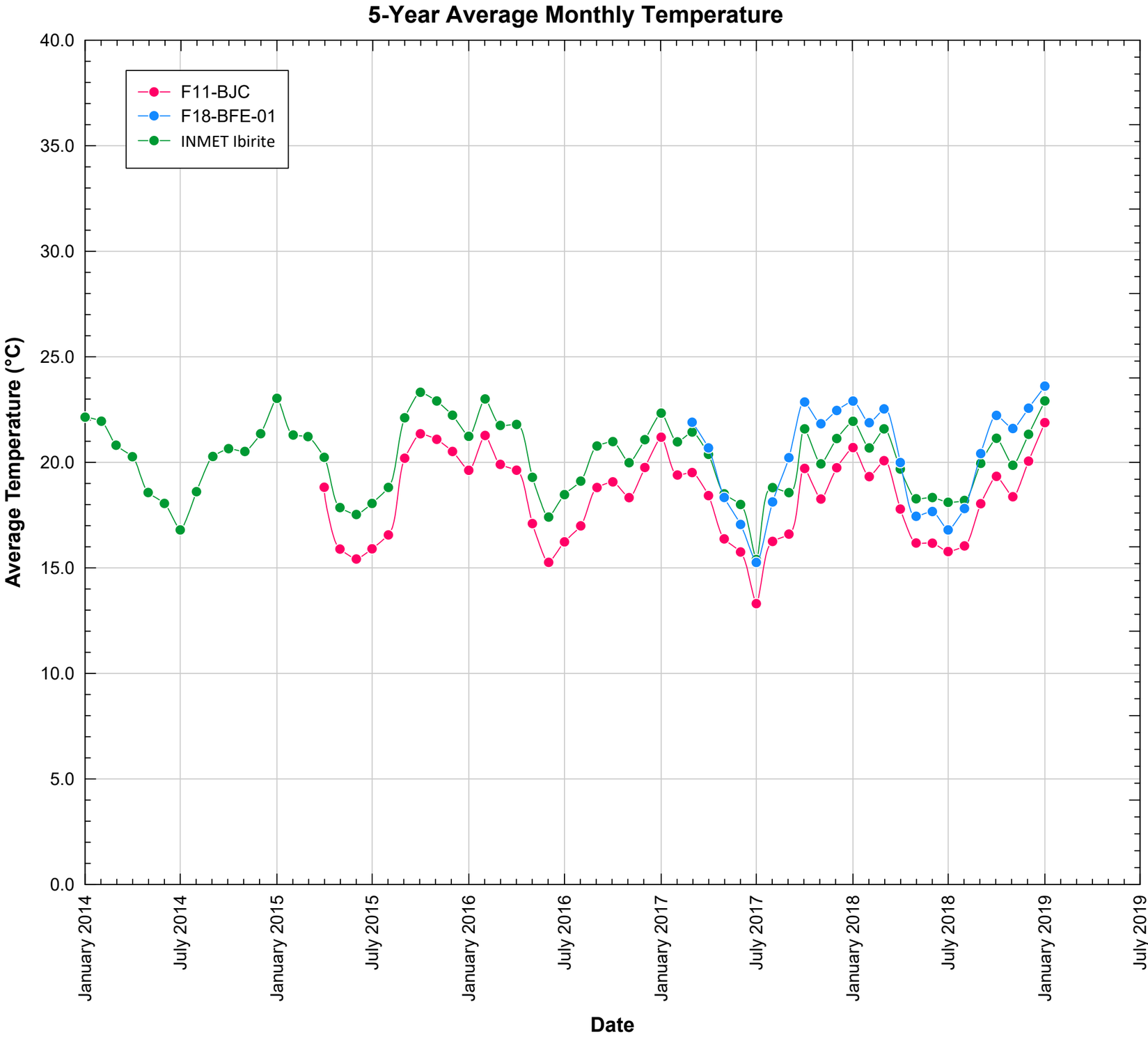
Wind Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

5-YEAR AVERAGE DAILY WIND SPEED
FIGURE 3-5



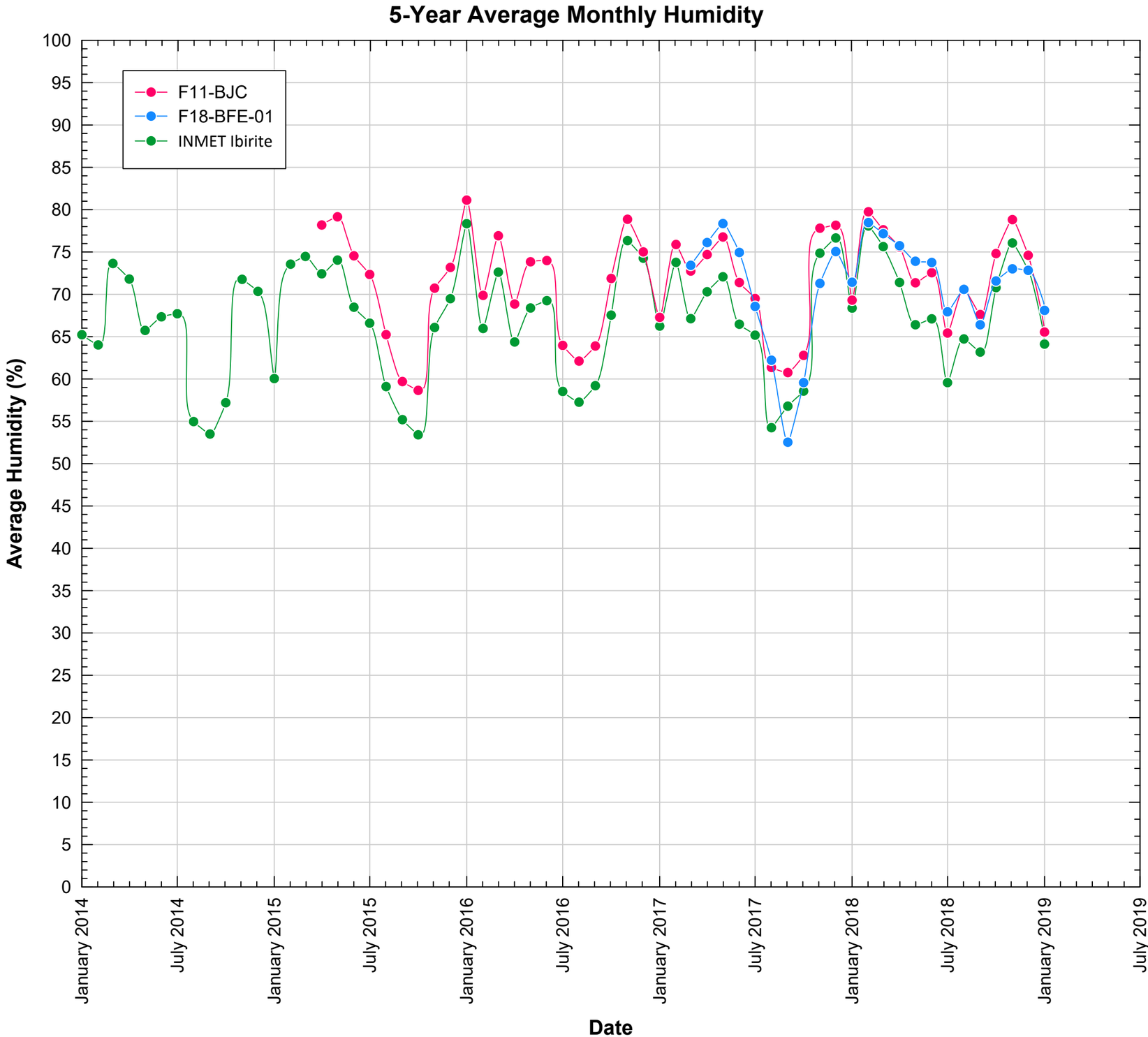
Wind Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

5-YEAR AVERAGE DAILY WIND DIRECTION
FIGURE 3-6



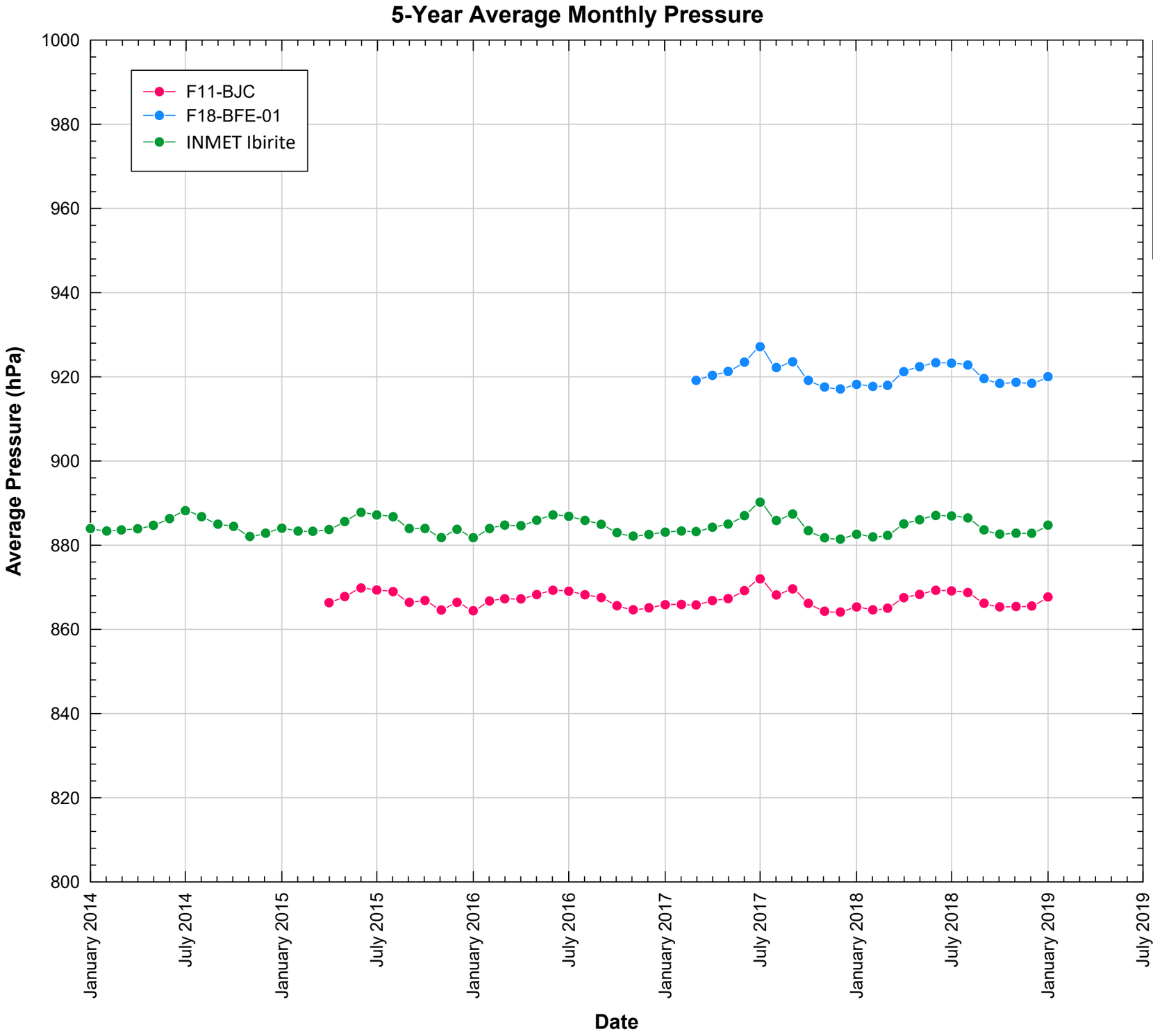
Temperature Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

5-YEAR AVERAGE MONTHLY TEMPERATURE
FIGURE 3-7



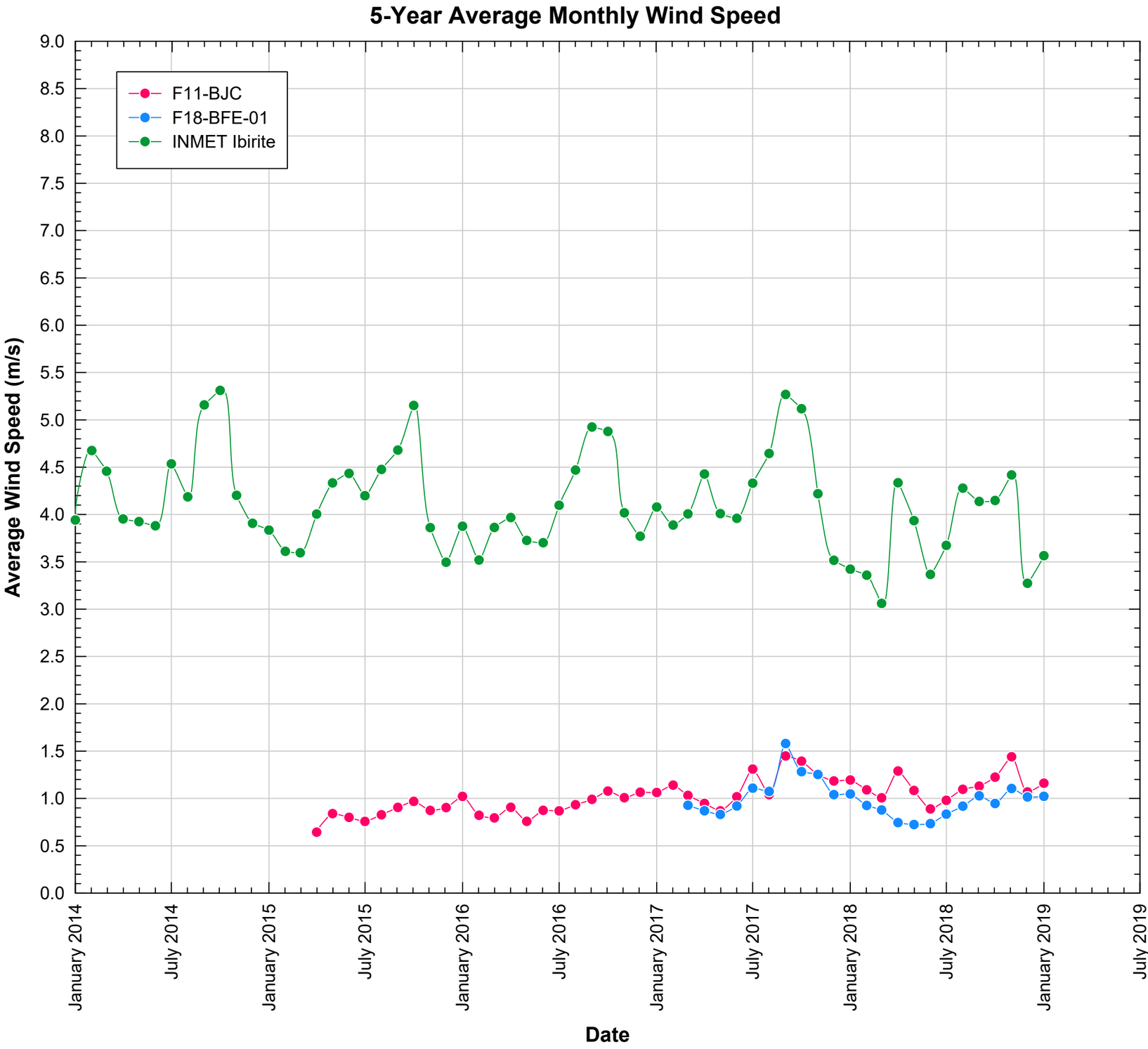
Humidity Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

5-YEAR AVERAGE MONTHLY HUMIDITY
FIGURE 3-8



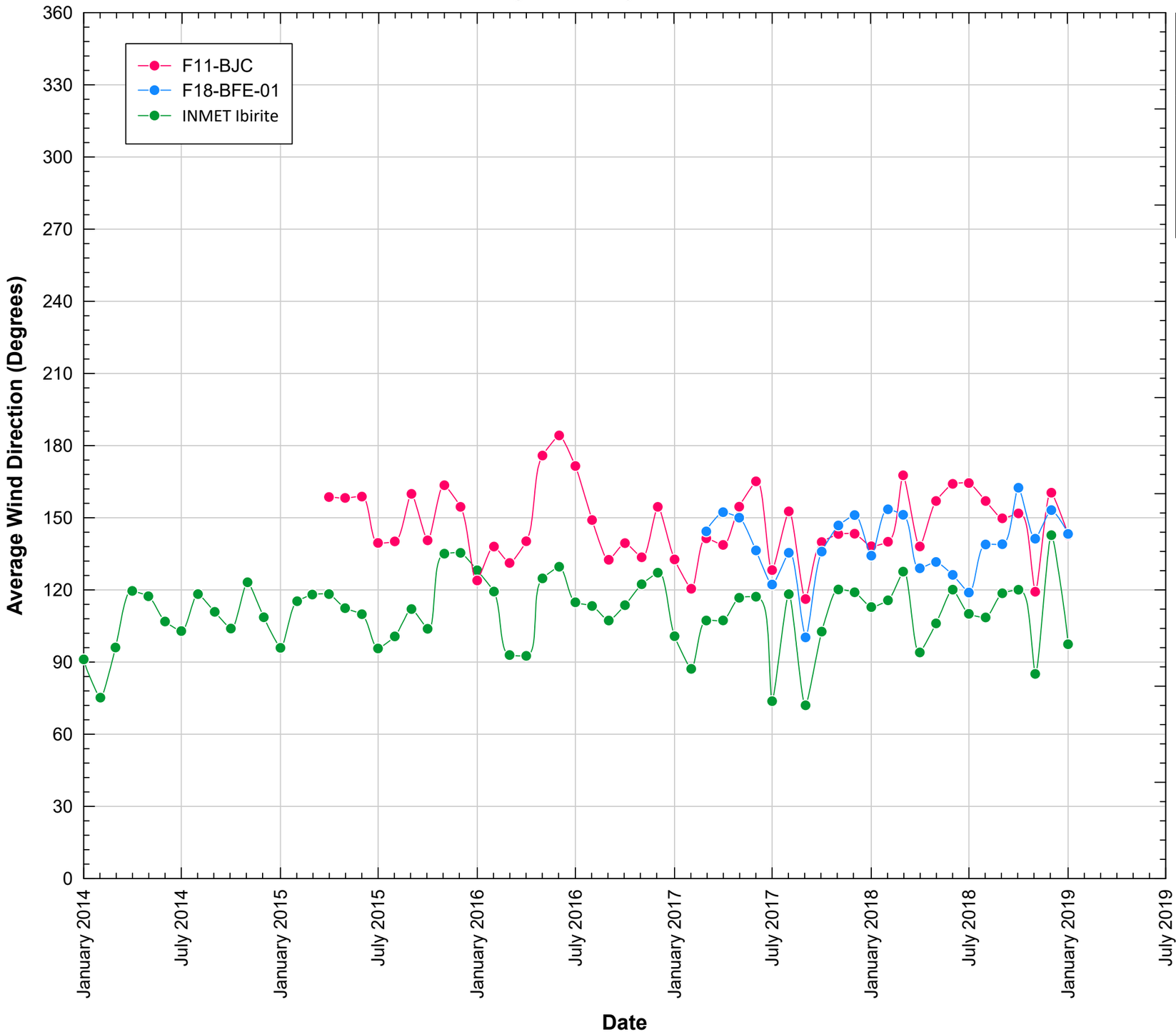
Pressure Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

5-YEAR AVERAGE MONTHLY PRESSURE
FIGURE 3-9



Wind Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

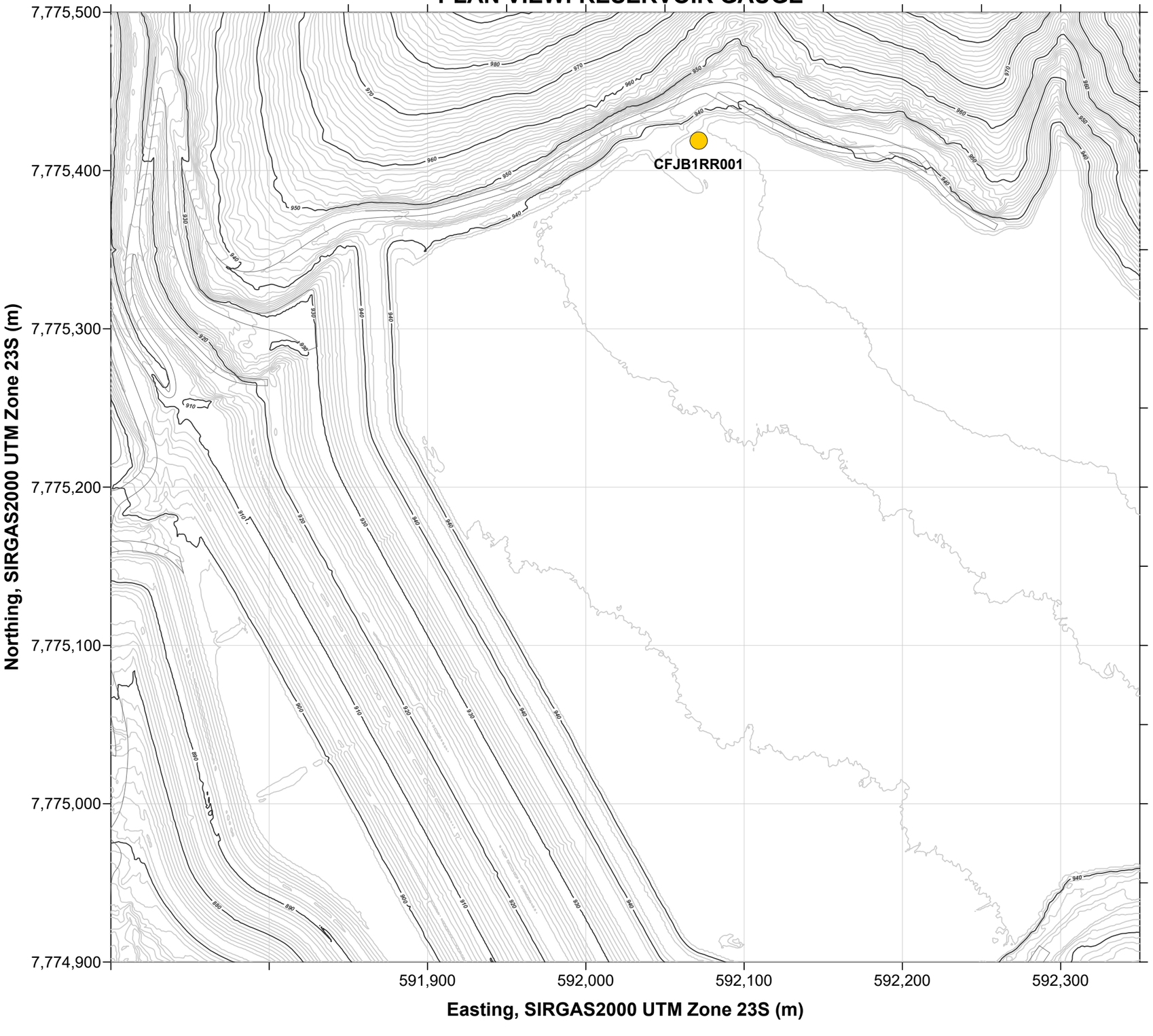
5-YEAR AVERAGE MONTHLY WIND SPEED
FIGURE 3-10



Wind Data				
Instrument	**From**	**To**	**Average Frequency of Reading**	**Approximate Distance from Dam I (km)**
F11-BJC	4/18/2015	1/25/2019	Hourly	18.6
F18-BFE-01	3/2/2017	1/25/2019	Hourly	1.4
INMET Ibirité	6/6/2008	1/25/2019	Hourly	15.4

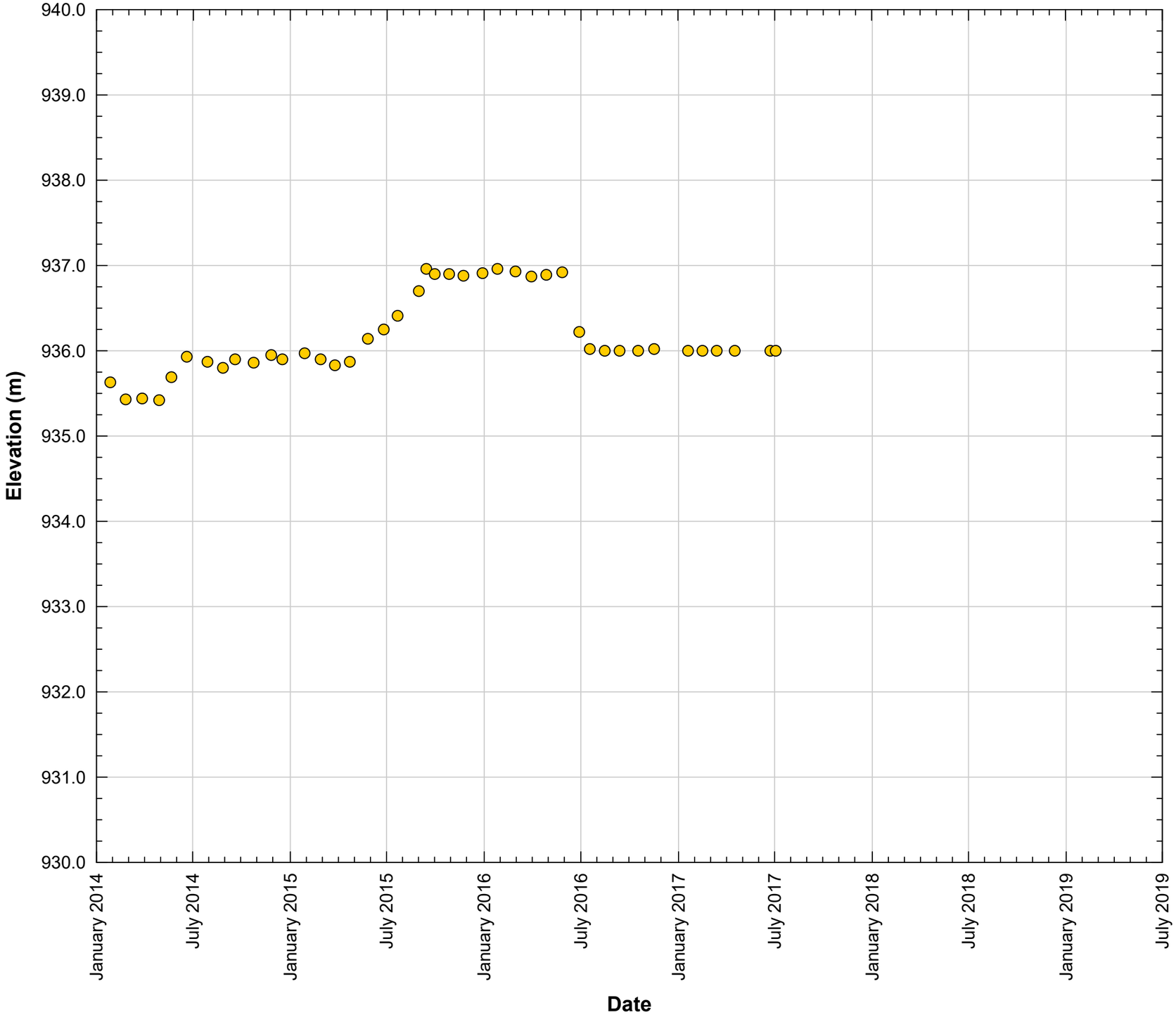
5-YEAR AVERAGE MONTHLY WIND DIRECTION
FIGURE 3-11

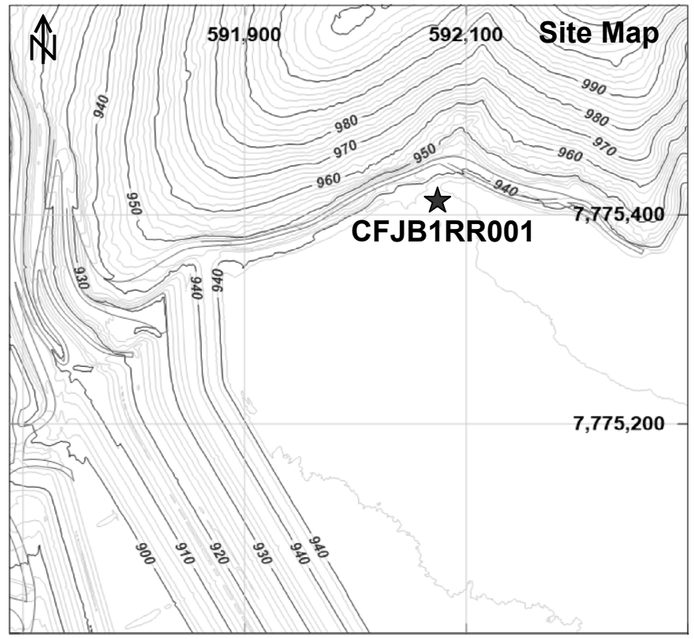
PLAN VIEW: RESERVOIR GAUGE



Note:
1. Horizontal datum is SIRGAS2000 UTM Zone 23S in meters, Vertical datum is Mean Sea Level in meters.

PLAN VIEW: RESERVOIR GAUGE
FIGURE 4-1



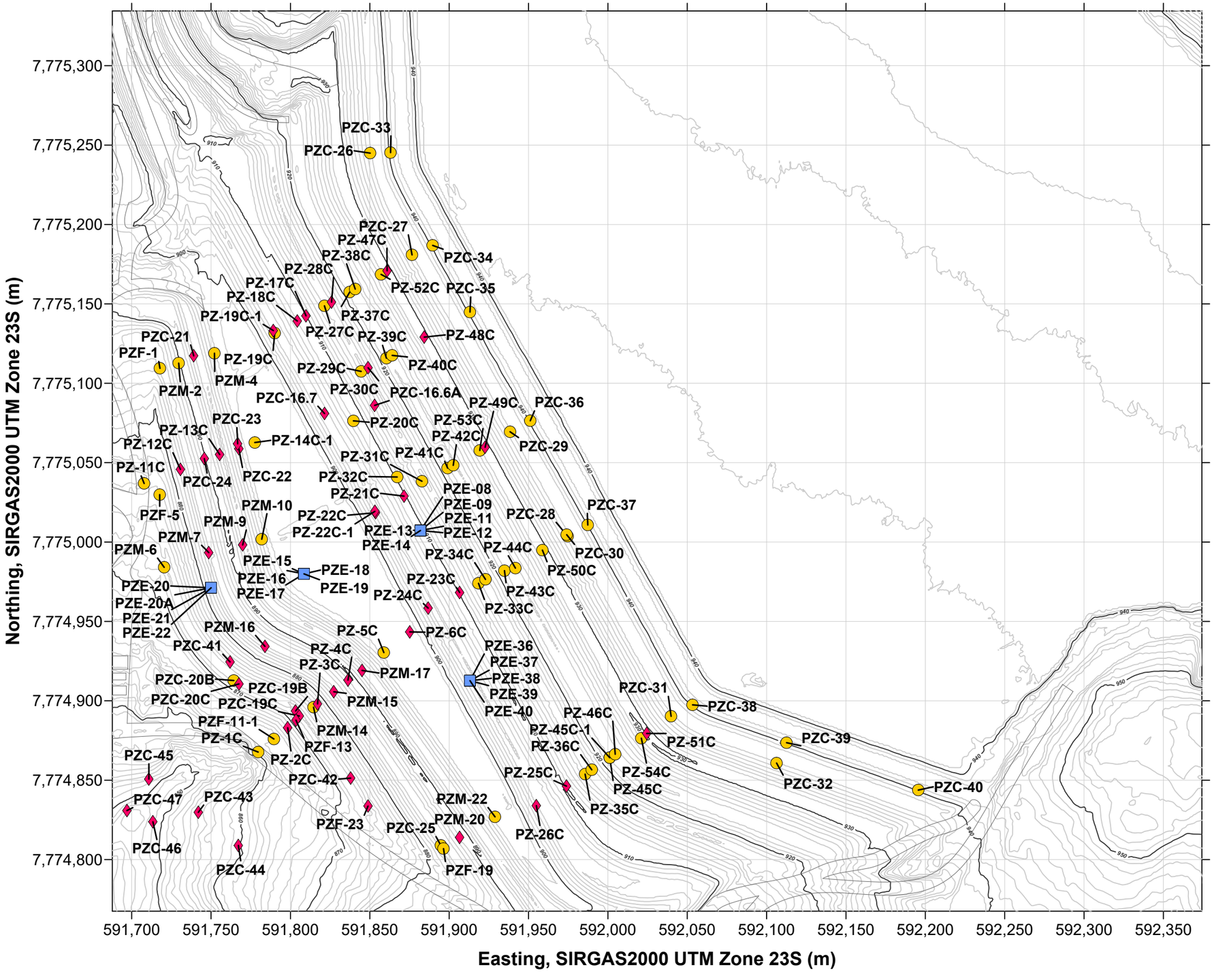


CFJB1RR01			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	6/29/2005	9/12/2006	Daily
	1/27/2007	4/17/2007	Every Other Day
	4/24/2007	3/4/2008	Once Per Week
	4/25/2008	7/3/2017	Monthly

5-YEAR RESERVOIR LEVEL DATA: CFJB1RR01

FIGURE 4-2

PLAN VIEW: PIEZOMETERS

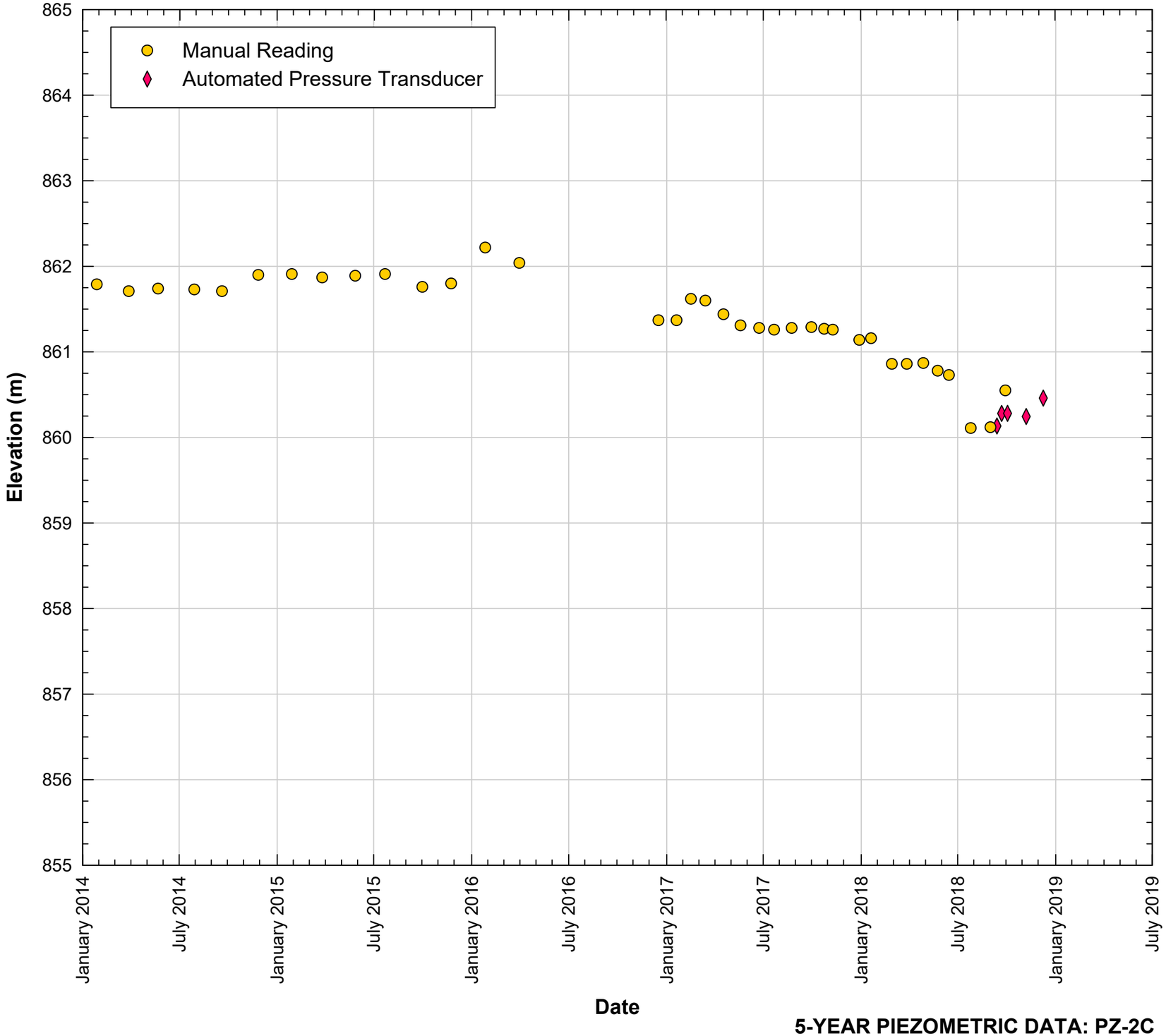


Symbol	Piezometer Type
●	Manually Read
■	Vibrating Wire Piezometer
◆	Automated Pressure Transducer

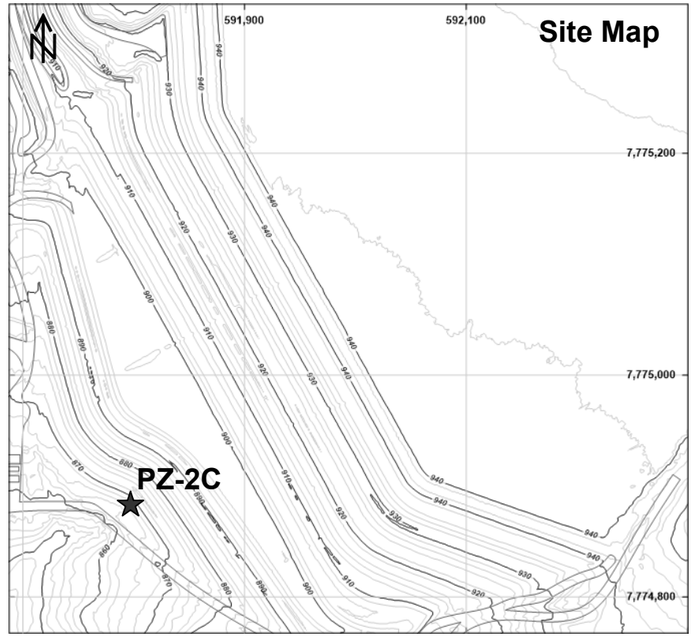
Note:
1. Horizontal datum is SIRGAS2000 UTM Zone 23S in meters, Vertical datum is Mean Sea Level in meters.

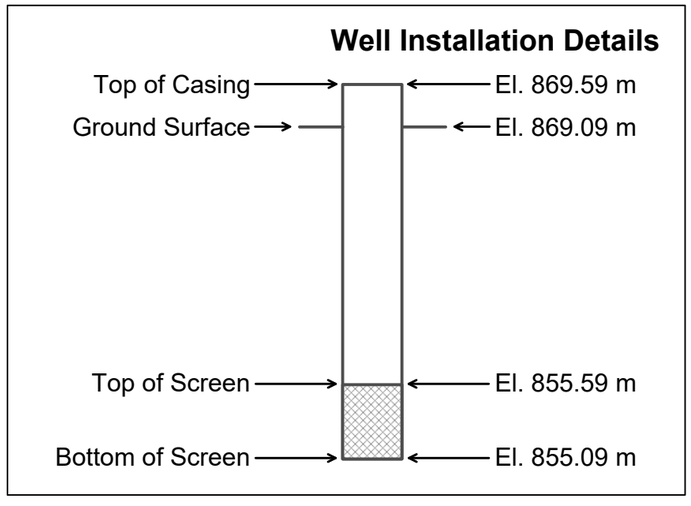
PLAN VIEW: PIEZOMETERS
FIGURE 5-1

5-Year Piezometric Data: PZ-2C



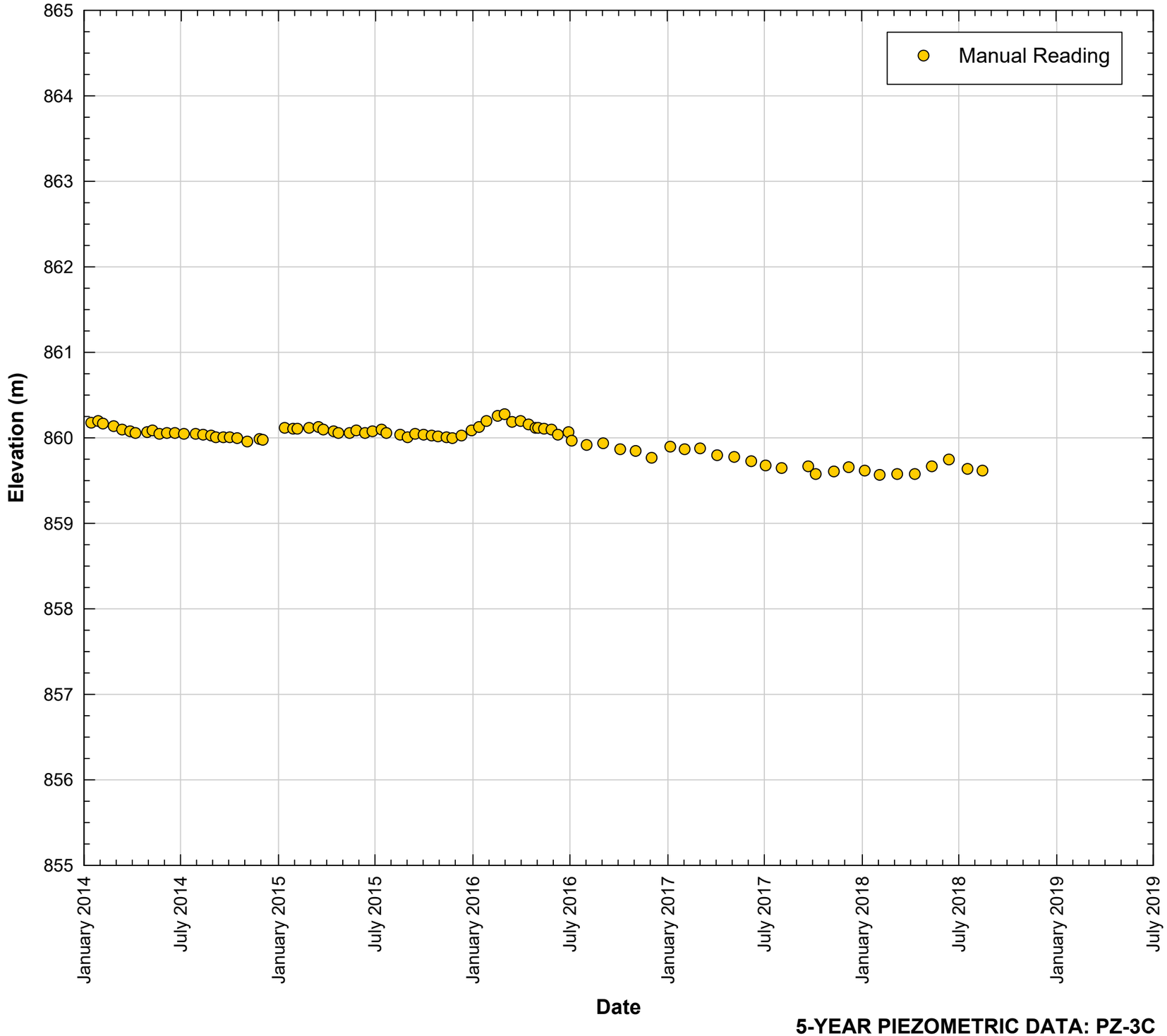
5-YEAR PIEZOMETRIC DATA: PZ-2C
FIGURE 5-2



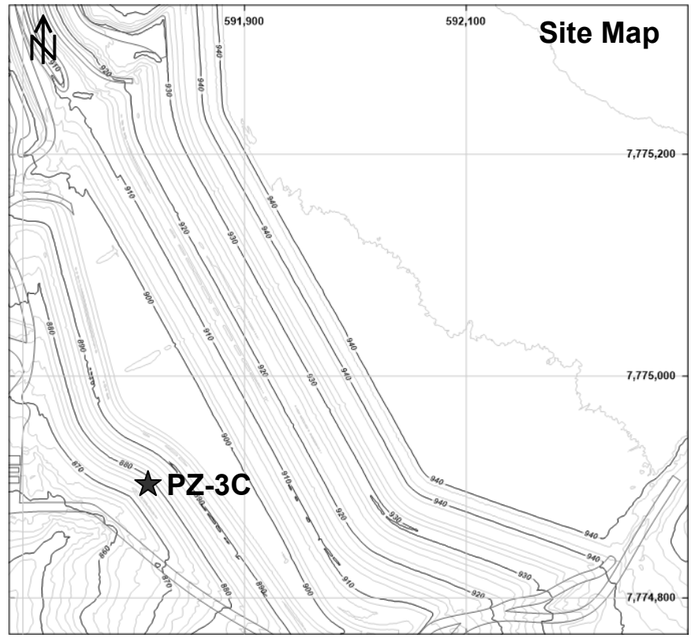


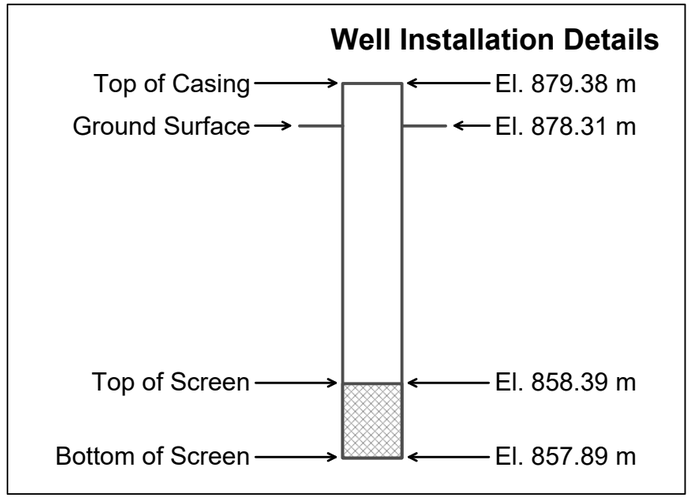
PZ-2C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/12/2004	5/12/2004	Monthly
	3/11/2005	1/24/2007	Once per 2 weeks
	4/4/2007	12/16/2016	Once per 2 months
	1/19/2017	9/28/2018	Monthly
Automated Pressure Transducer	9/12/2018	12/8/2018	Monthly

5-Year Piezometric Data: PZ-3C



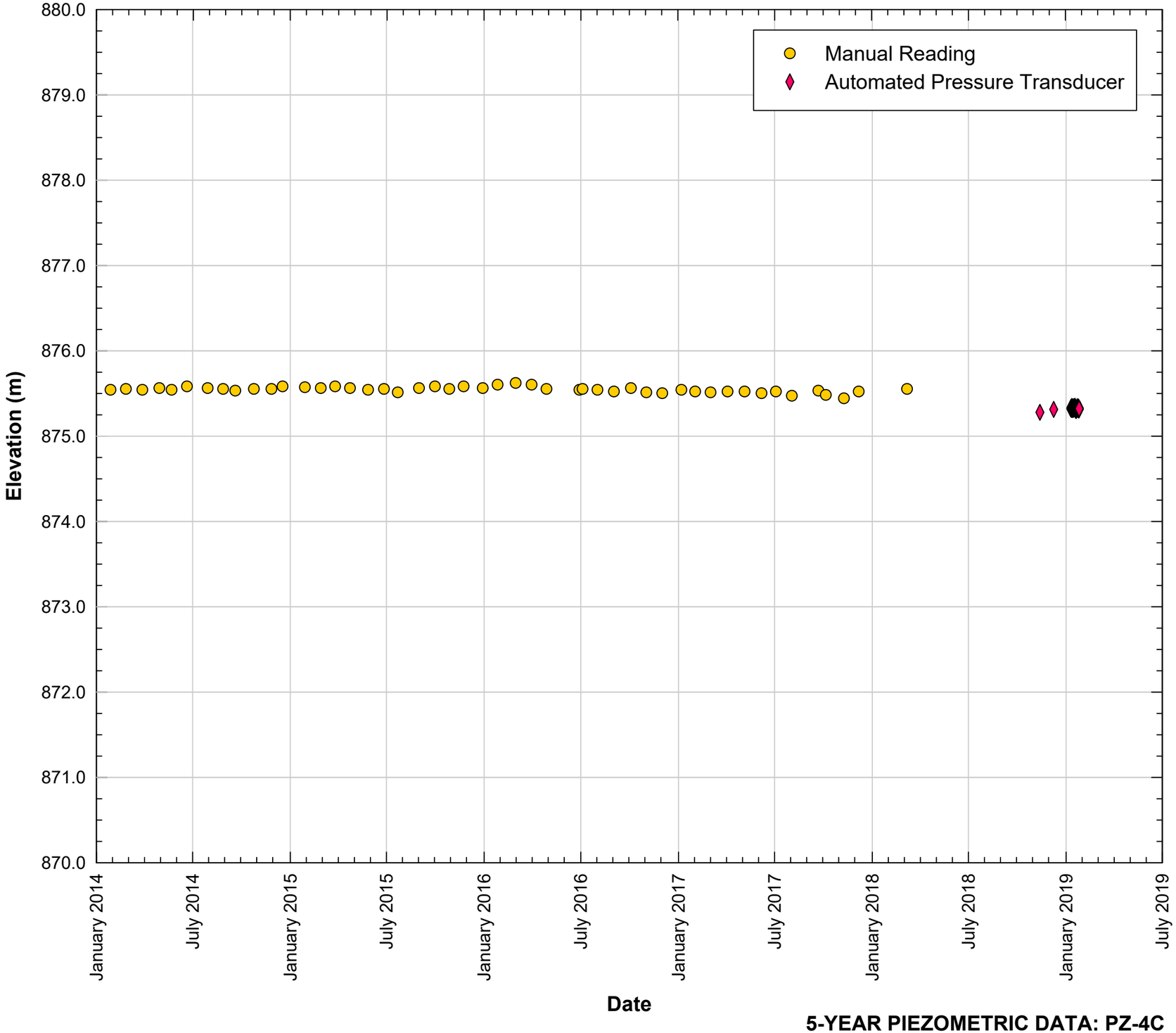
5-YEAR PIEZOMETRIC DATA: PZ-3C
FIGURE 5-3



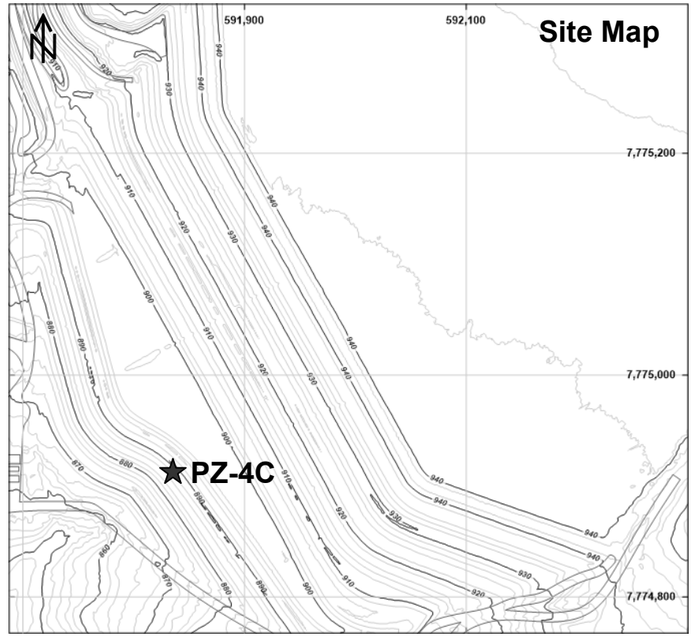


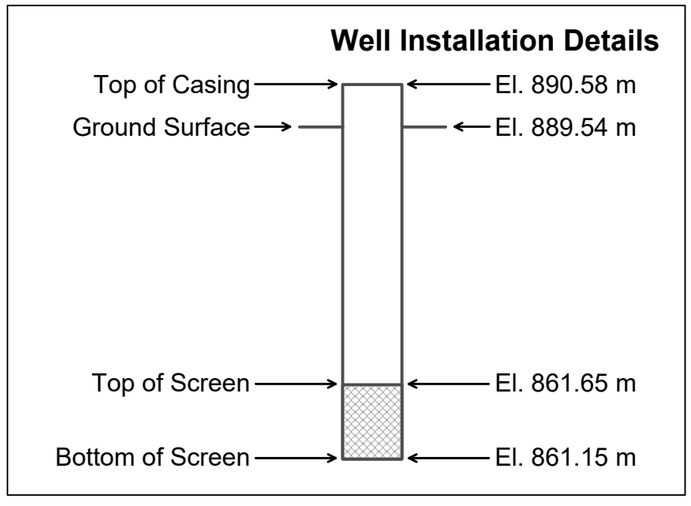
PZ-3C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	2/10/2005	Monthly
	3/11/2005	9/27/2012	Once per 2 weeks
	10/3/2012	5/31/2013	Weekly
	6/6/2013	6/28/2016	Once per 2 weeks
	7/4/2016	8/14/2018	Monthly

5-Year Piezometric Data: PZ-4C

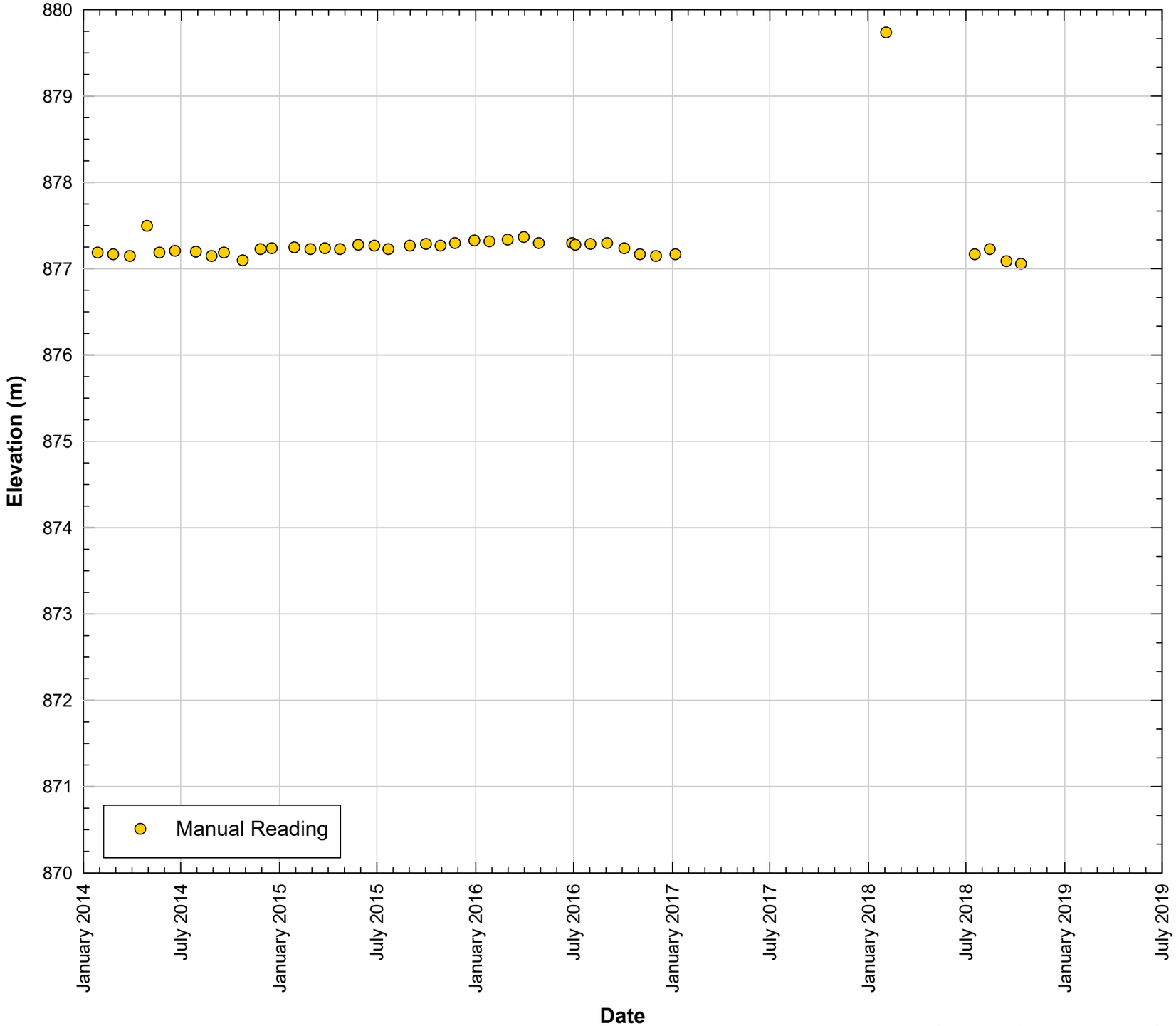


5-YEAR PIEZOMETRIC DATA: PZ-4C
FIGURE 5-4

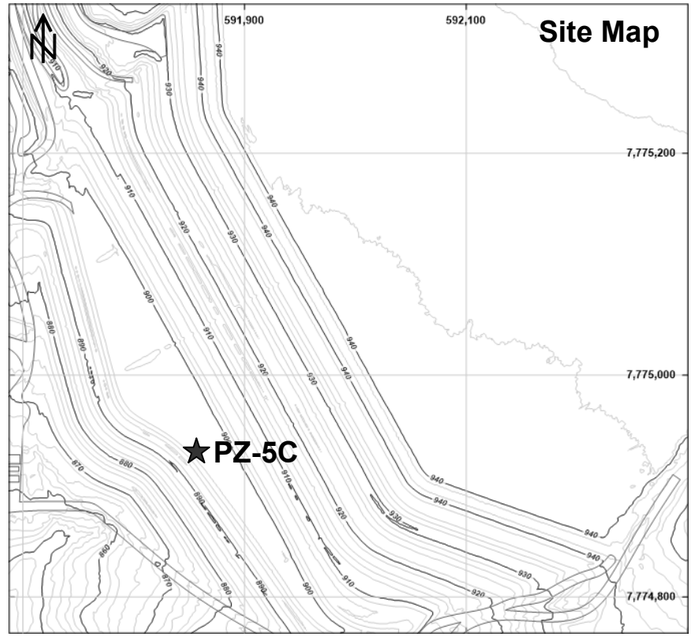


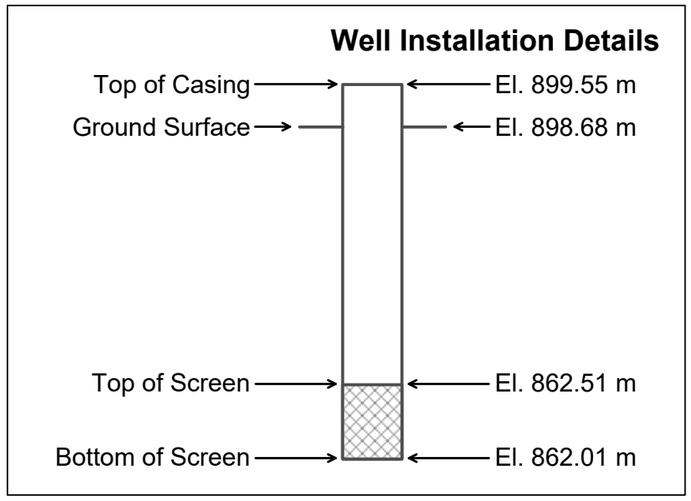


PZ-4C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	3/7/2018	Monthly
Automated Pressure Transducer	11/12/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute



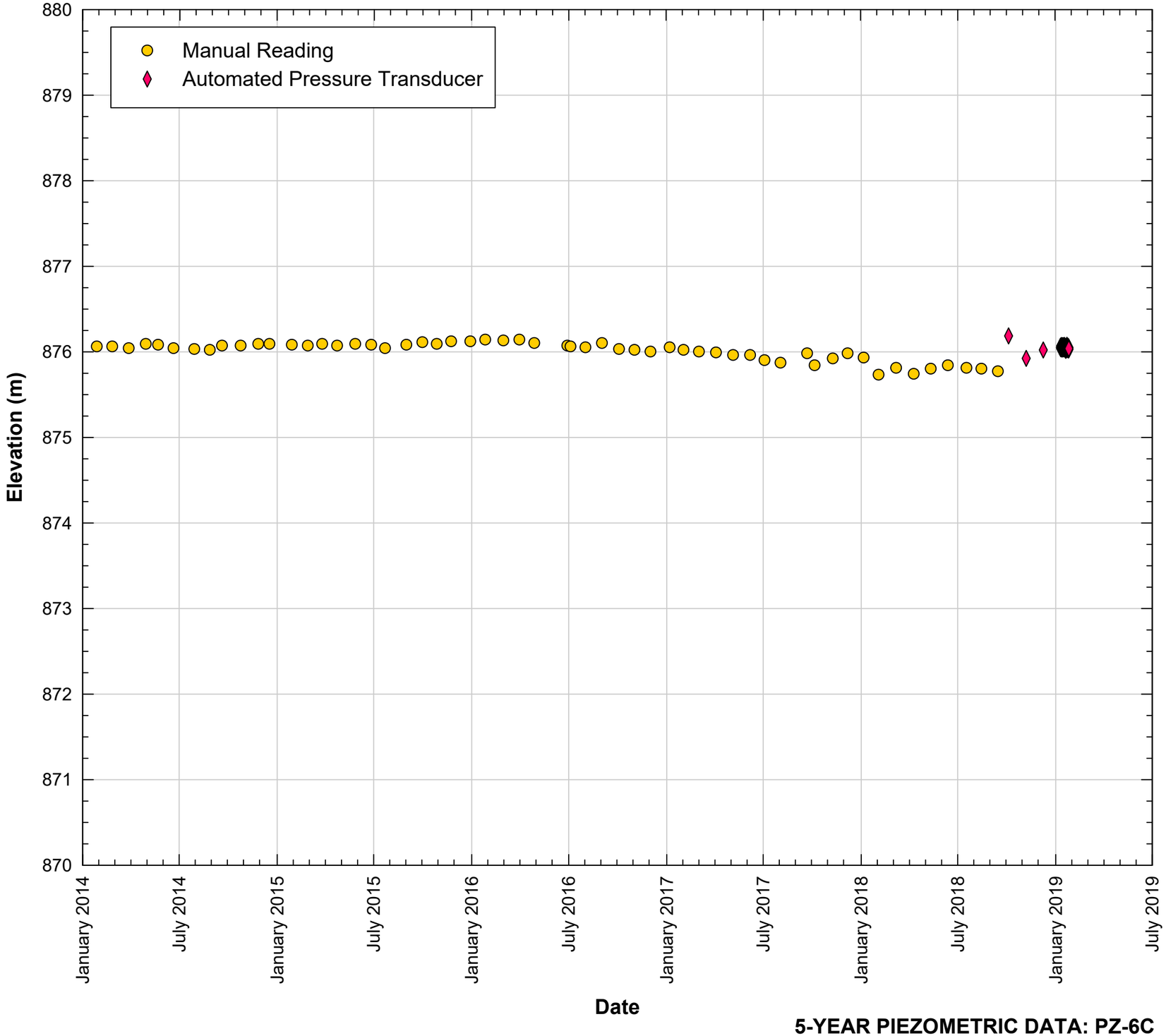
5-YEAR PIEZOMETRIC DATA: PZ-5C
FIGURE 5-5



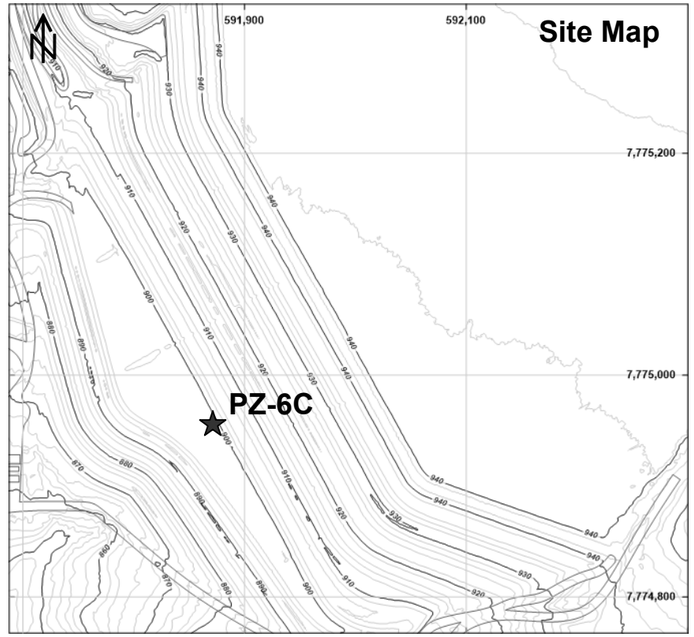


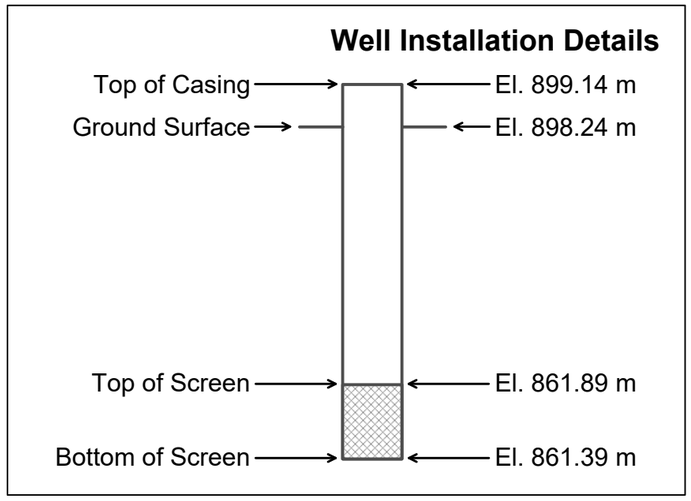
PZ-5C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	10/11/2018	Monthly

5-Year Piezometric Data: PZ-6C



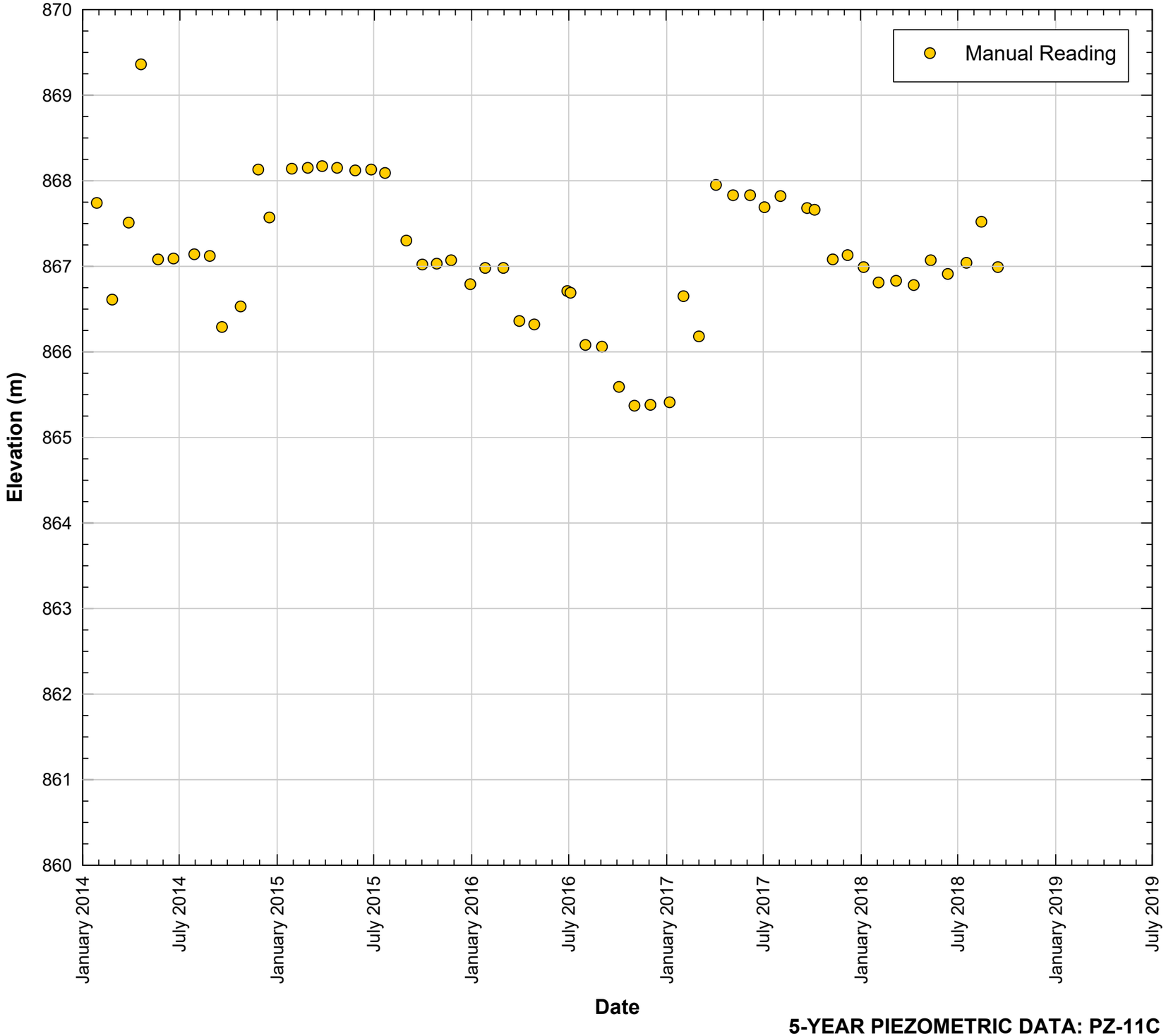
5-YEAR PIEZOMETRIC DATA: PZ-6C
FIGURE 5-6



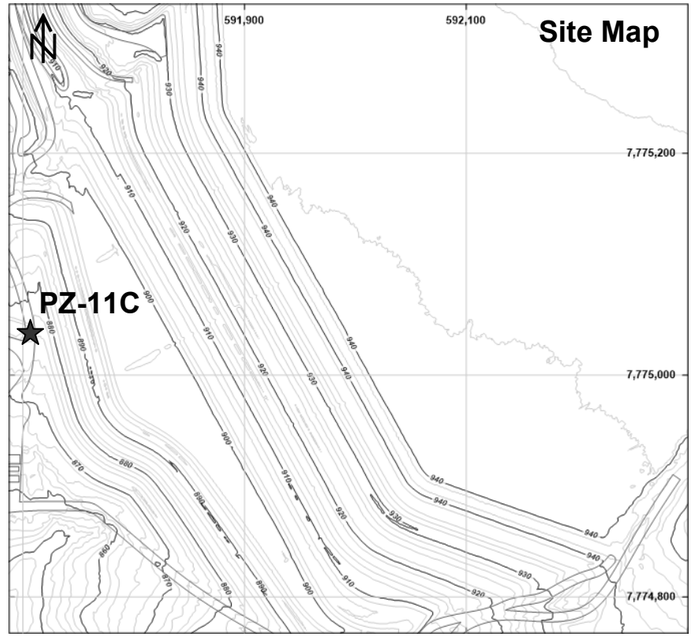


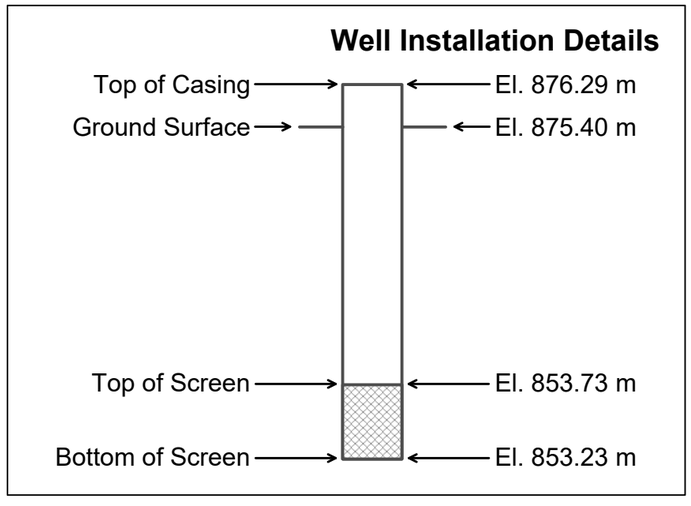
PZ-6C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	5/30/1996	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	9/14/2018	Monthly
Automated Pressure Transducer	10/4/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZ-11C



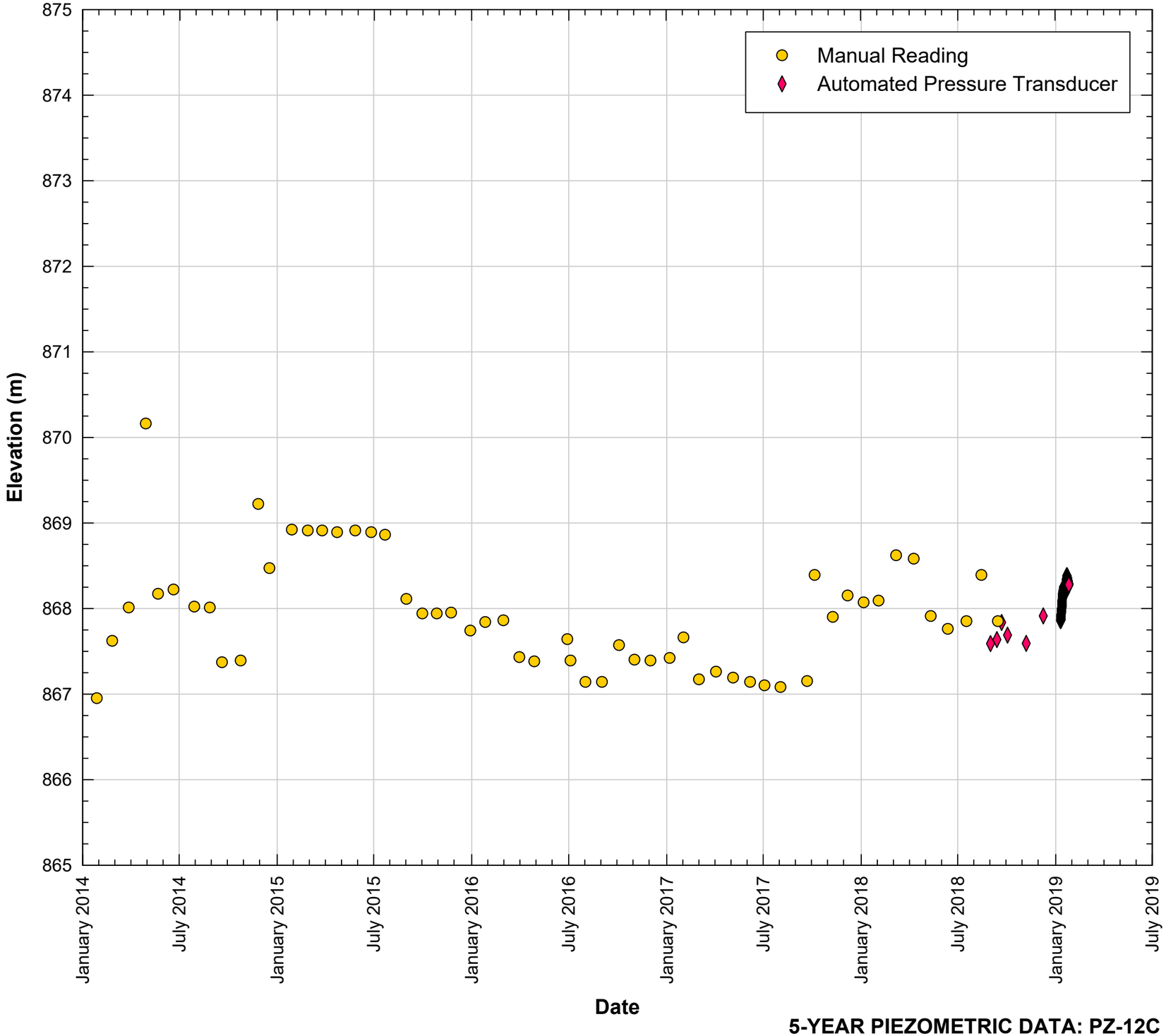
5-YEAR PIEZOMETRIC DATA: PZ-11C
FIGURE 5-7



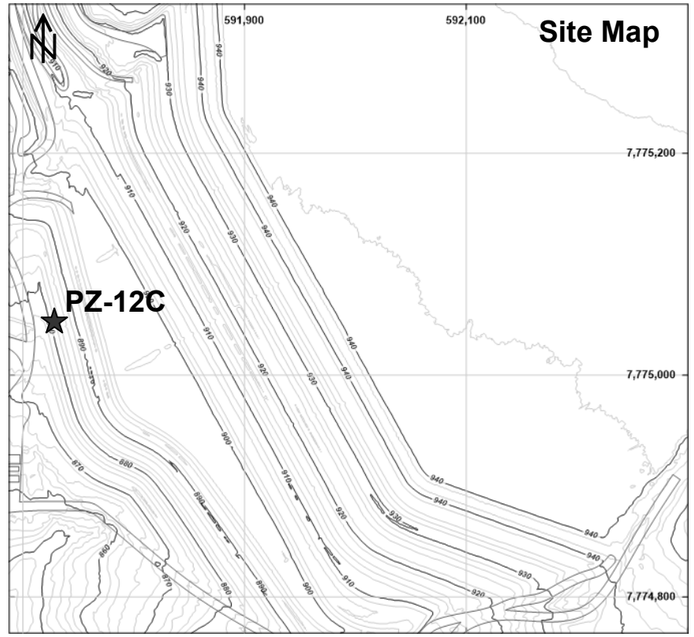


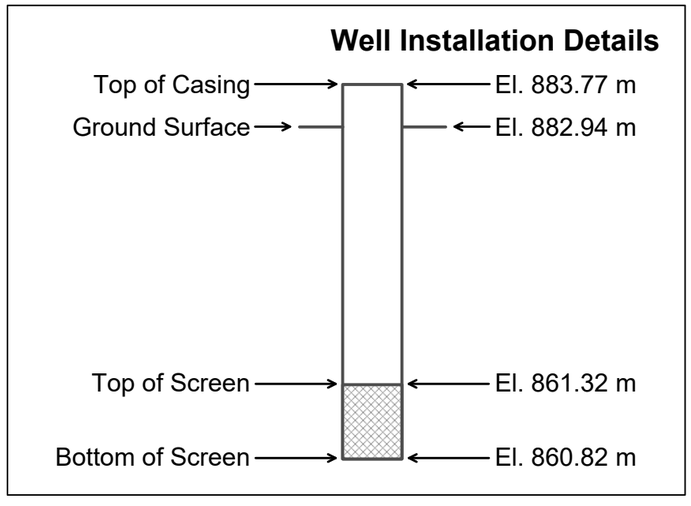
PZ-11C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	9/14/2018	Monthly

5-Year Piezometric Data: PZ-12C



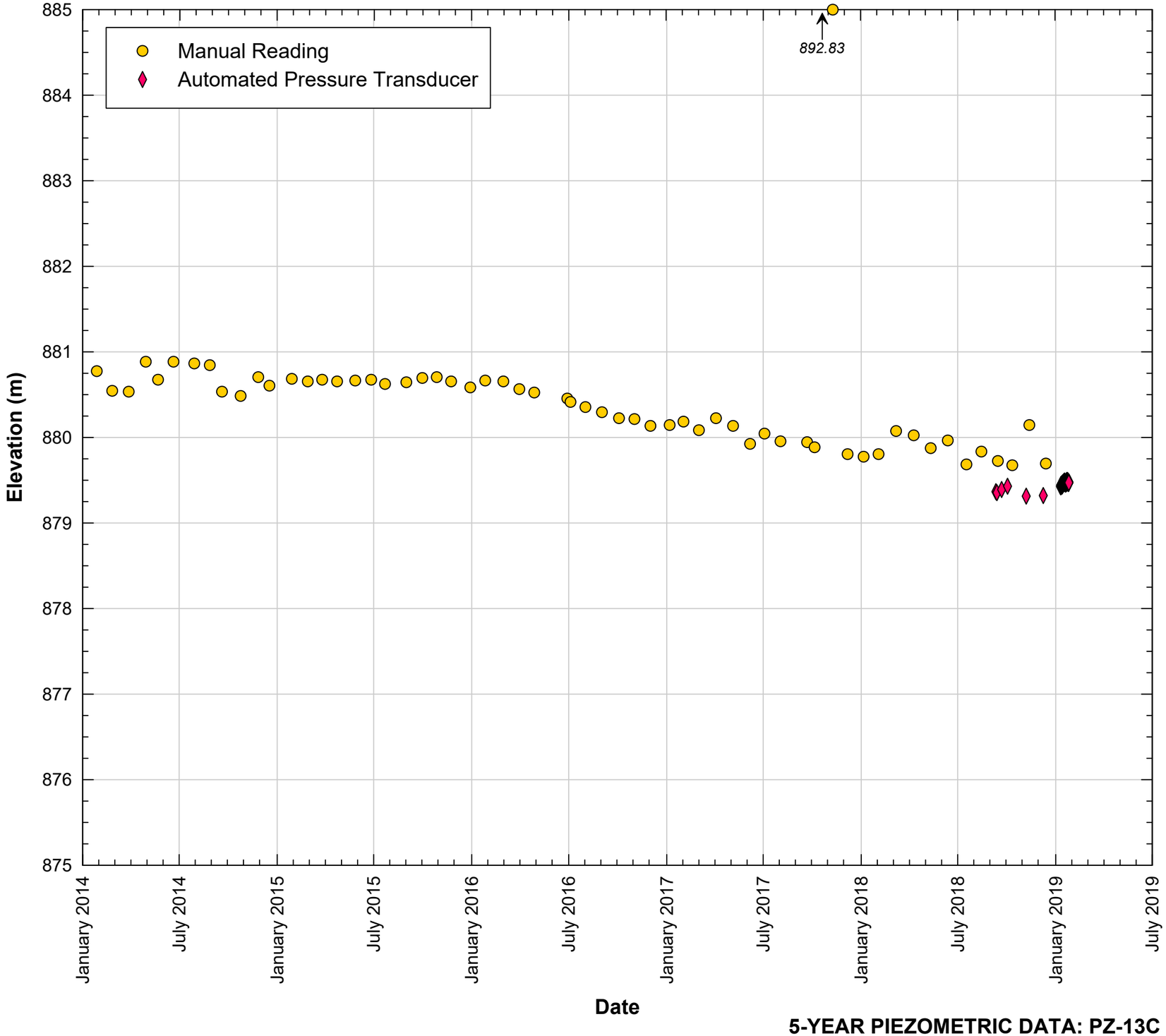
5-YEAR PIEZOMETRIC DATA: PZ-12C
FIGURE 5-8



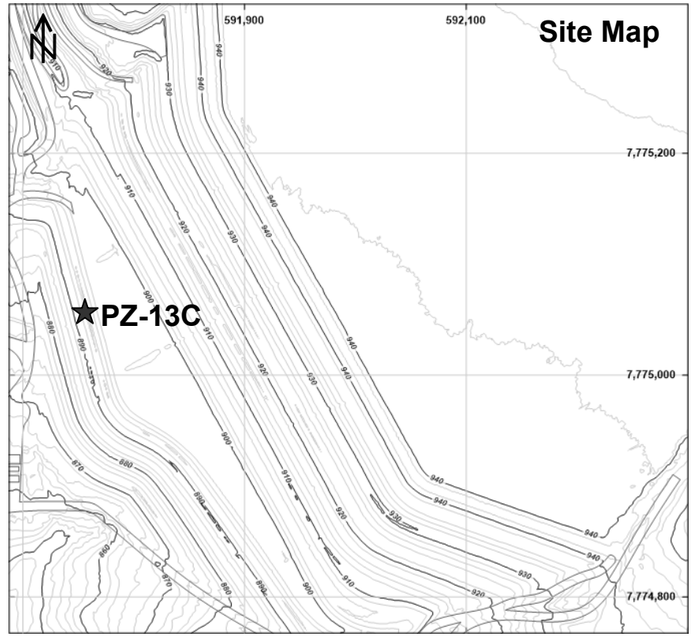


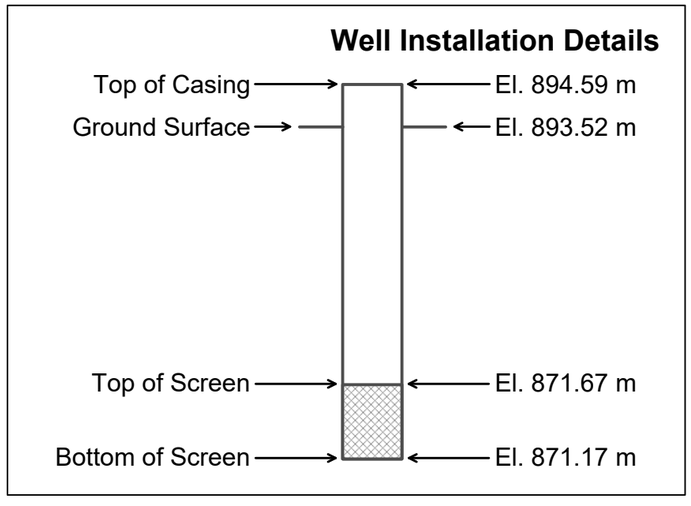
PZ-12C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	9/14/2018	Monthly
Automated Pressure Transducer	8/31/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZ-13C



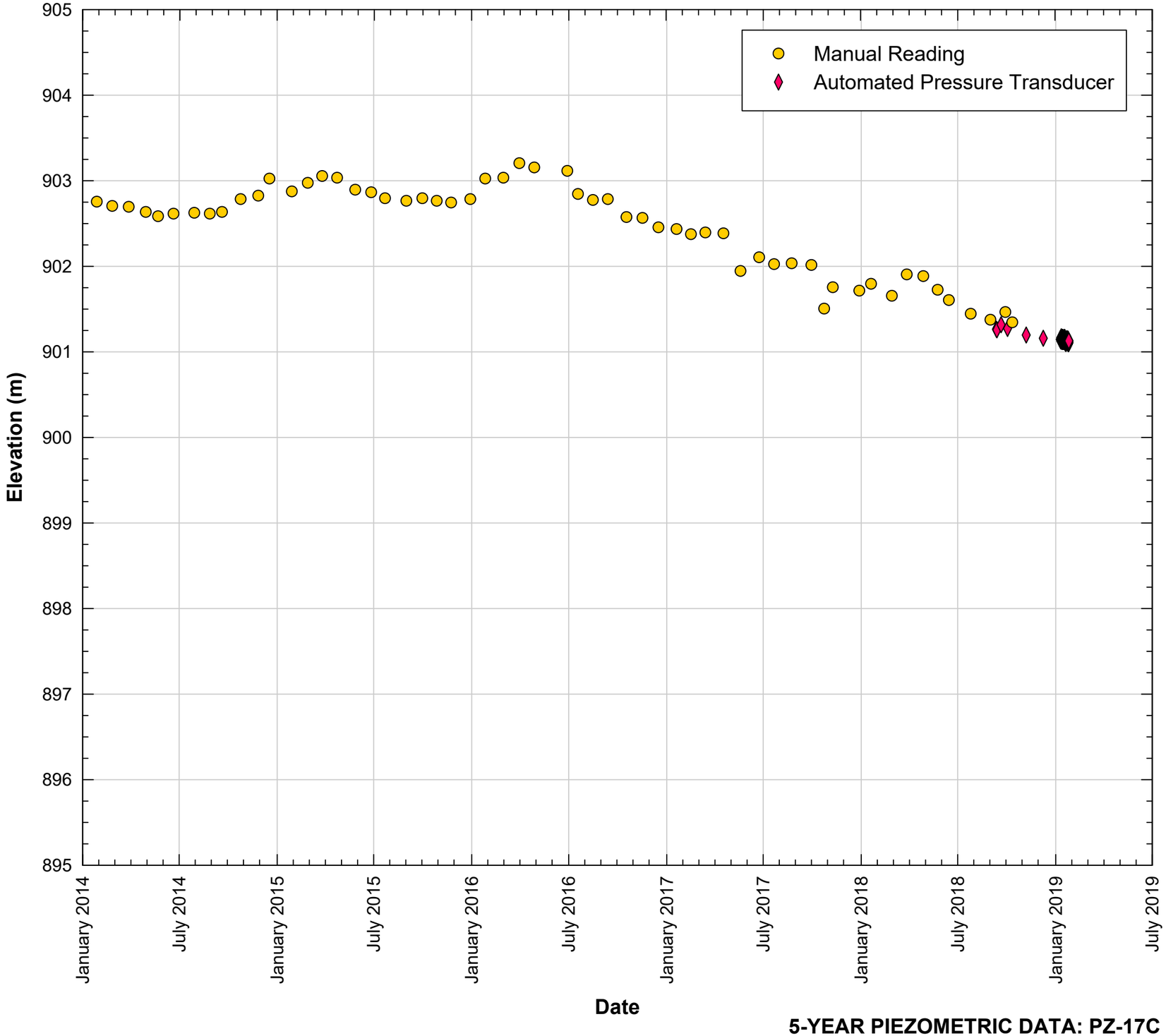
5-YEAR PIEZOMETRIC DATA: PZ-13C
FIGURE 5-9



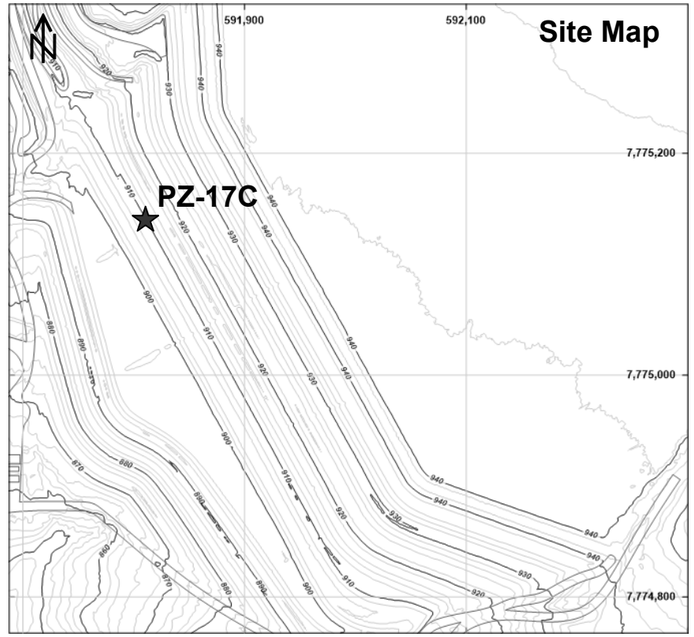


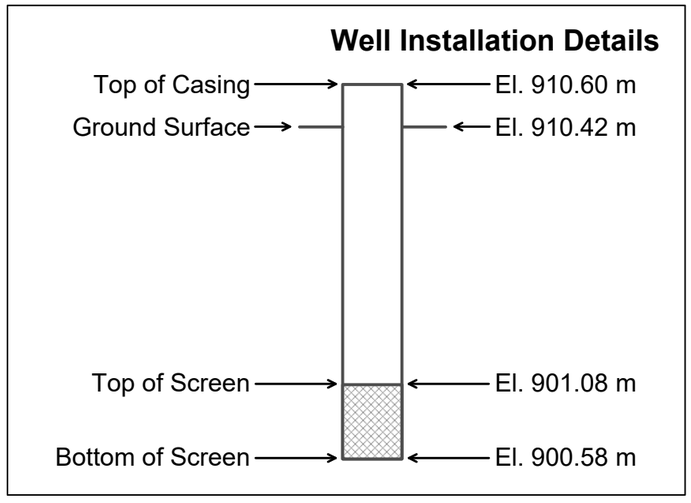
PZ-13C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	12/13/2018	Monthly
Automated Pressure Transducer	9/10/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZ-17C



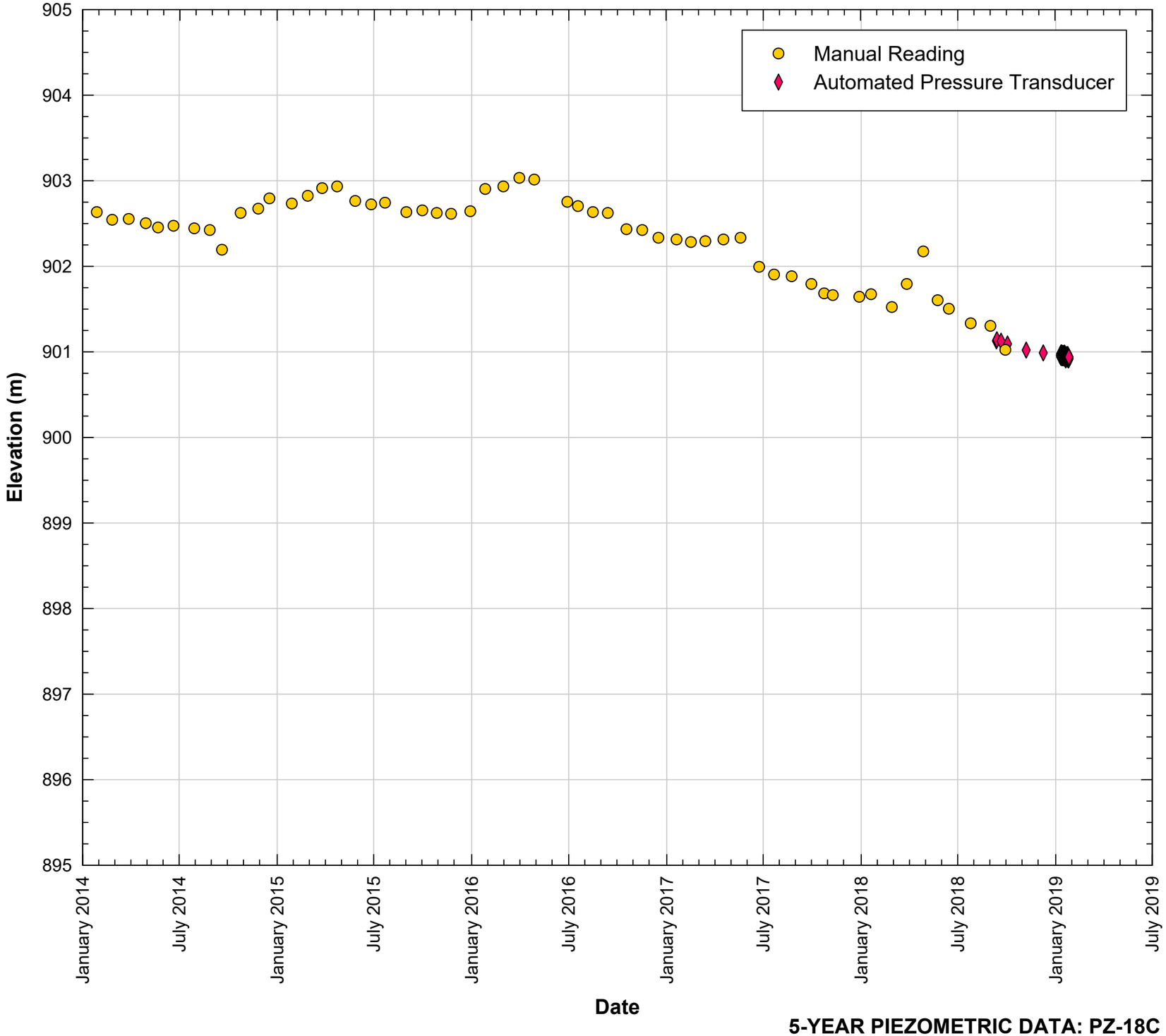
5-YEAR PIEZOMETRIC DATA: PZ-17C
FIGURE 5-10



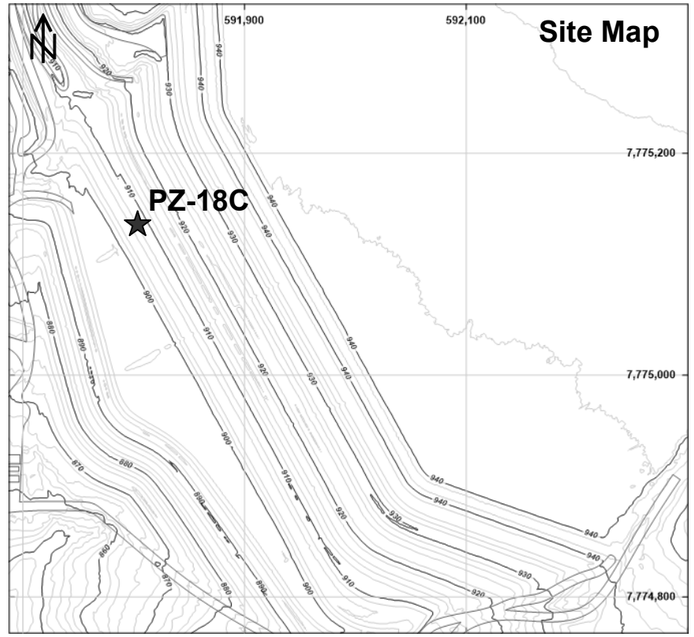


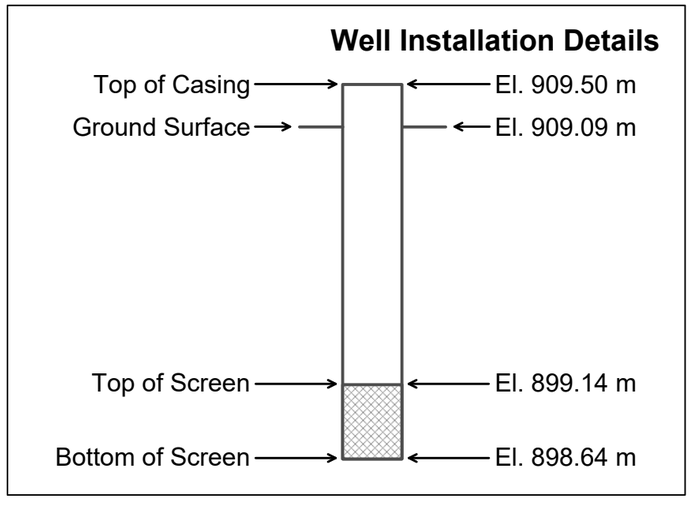
PZ-17C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	8/21/1999	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	10/11/2018	Monthly
Automated Pressure Transducer	9/11/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZ-18C



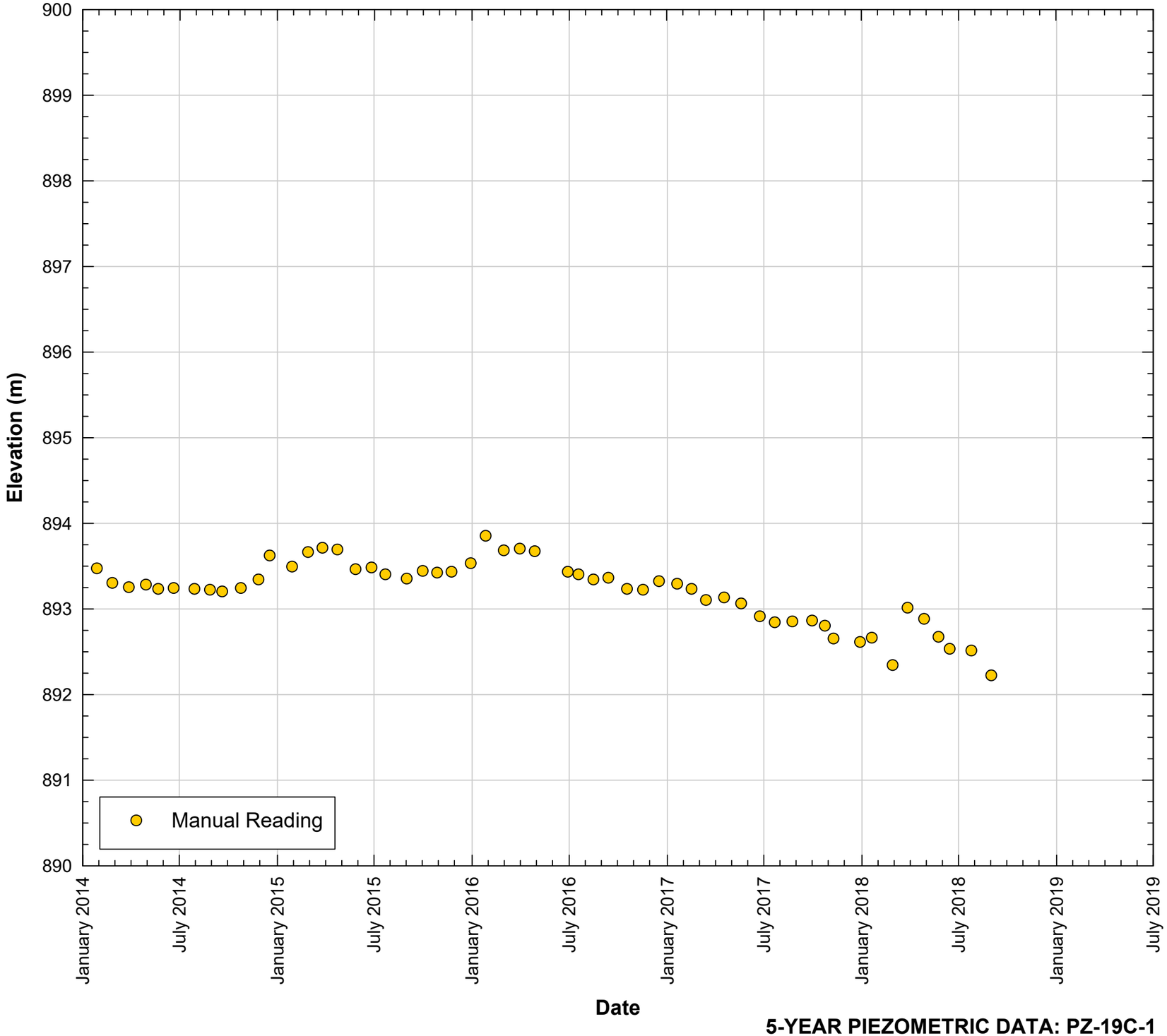
5-YEAR PIEZOMETRIC DATA: PZ-18C
FIGURE 5-11

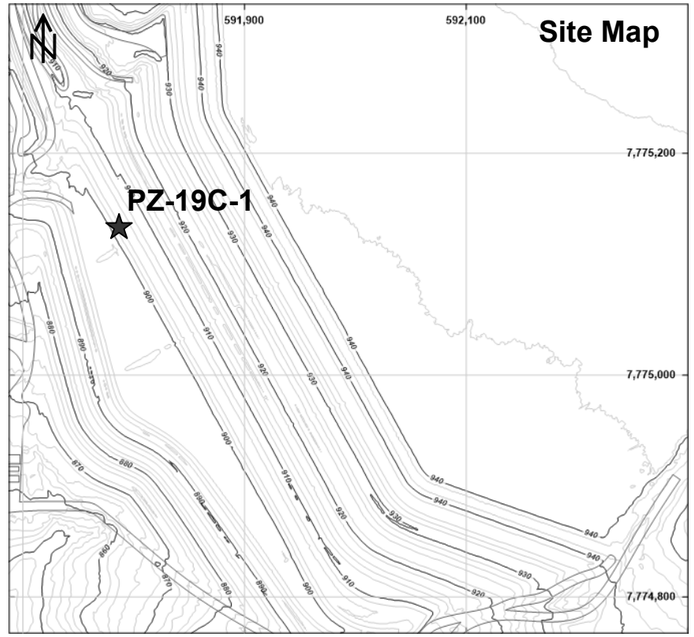


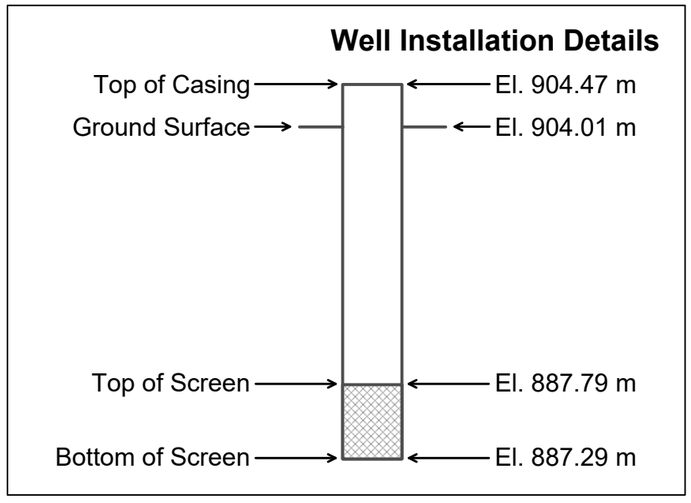


PZ-18C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	8/21/1999	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	9/28/2018	Monthly
Automated Pressure Transducer	9/11/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZ-19C-1



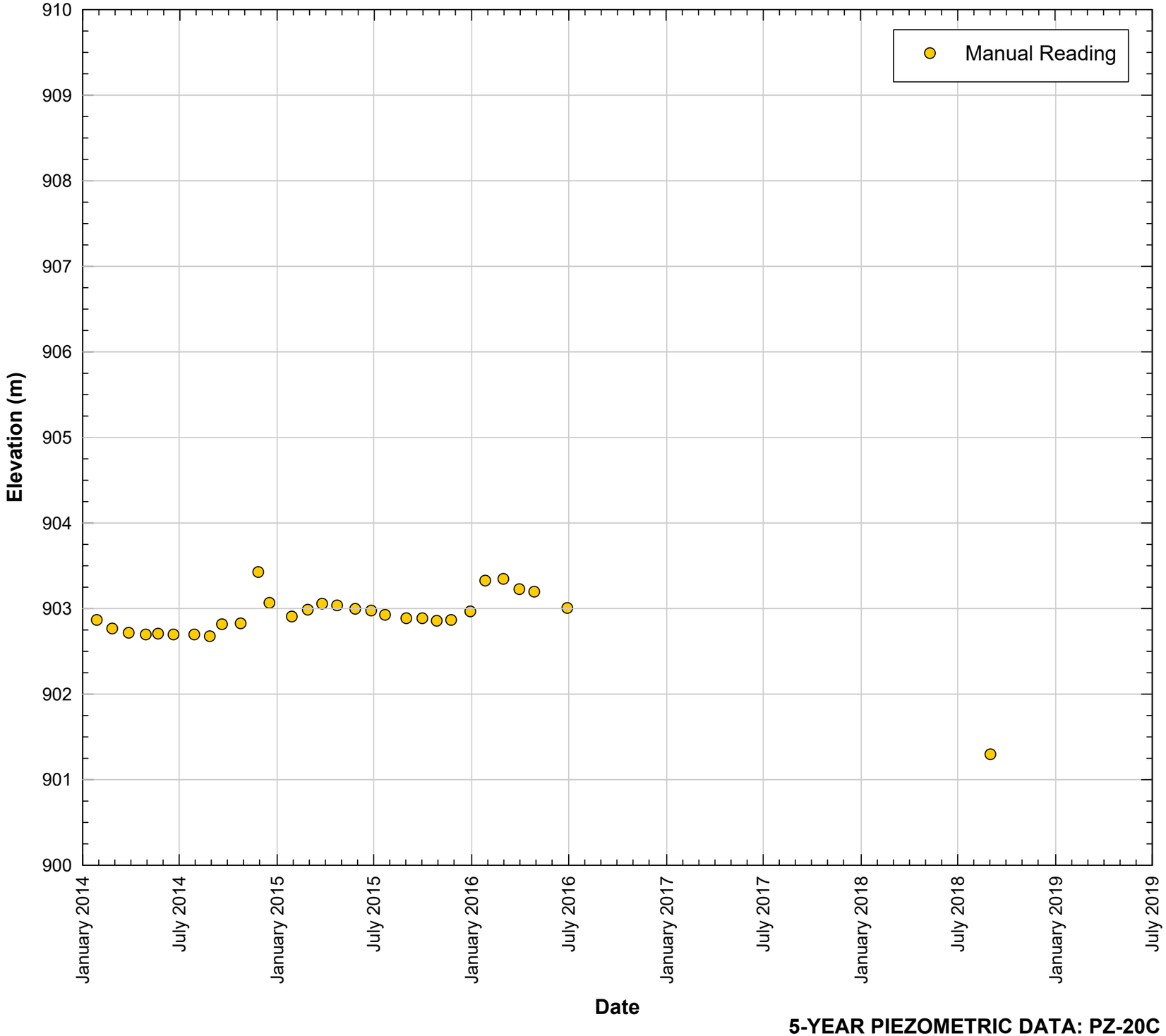




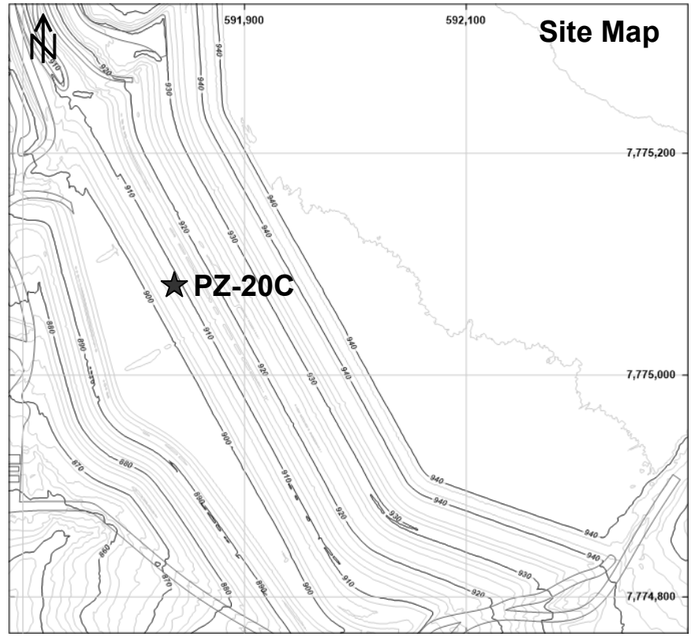
PZ-19C-1			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	5/16/2005	1/28/2008	Once per 2 weeks
	2/26/2008	8/31/2018	Monthly

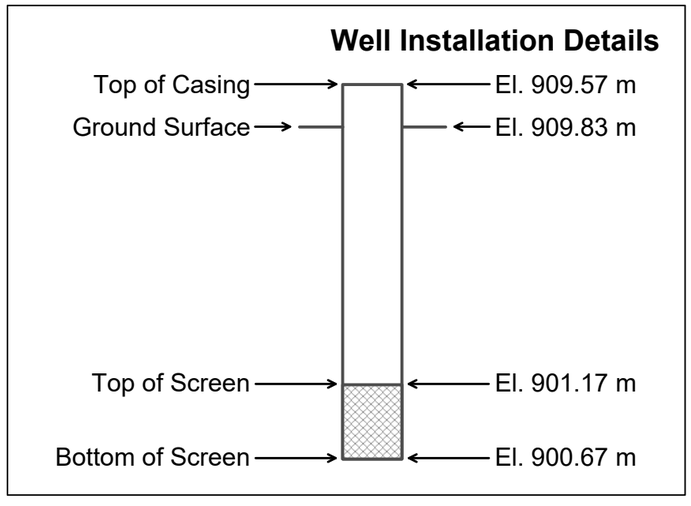
5-YEAR PIEZOMETRIC DATA: PZ-19C-1
FIGURE 5-12

5-Year Piezometric Data: PZ-20C



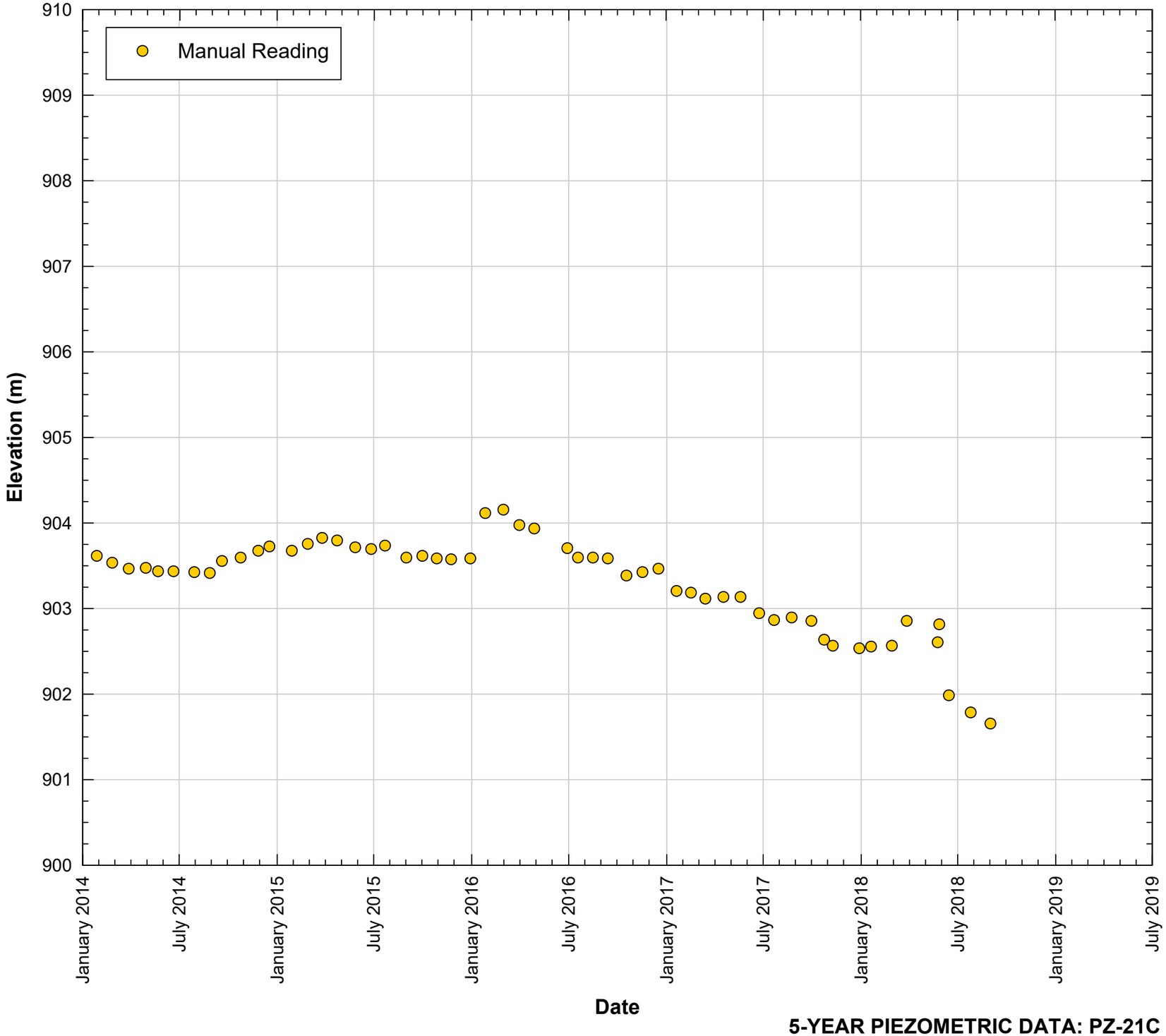
5-YEAR PIEZOMETRIC DATA: PZ-20C
FIGURE 5-13



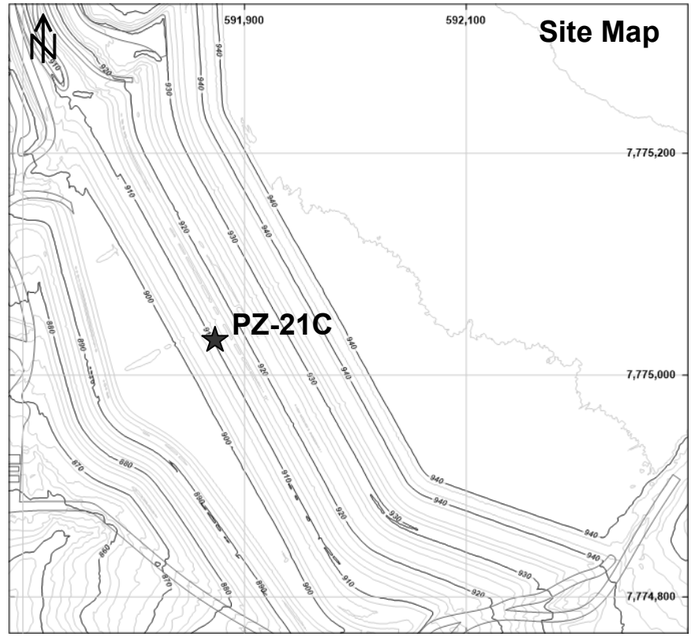


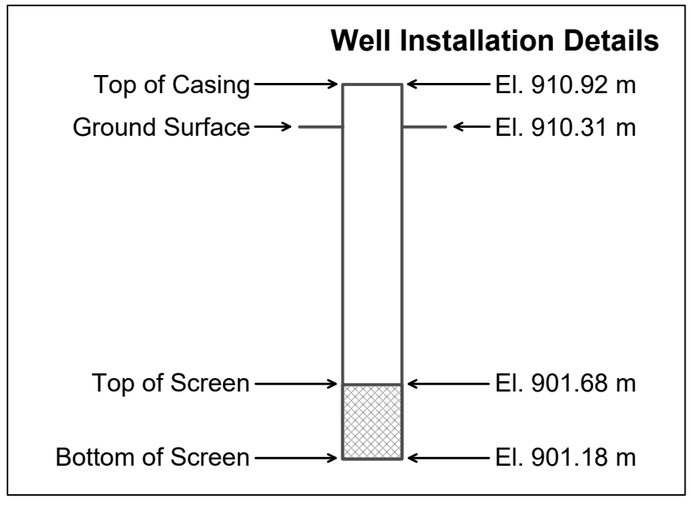
PZ-20C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	8/21/1999	2/10/2005	Monthly
	3/11/2005	10/31/2007	Once per 2 weeks
	11/26/2007	8/31/2018	Monthly

5-Year Piezometric Data: PZ-21C



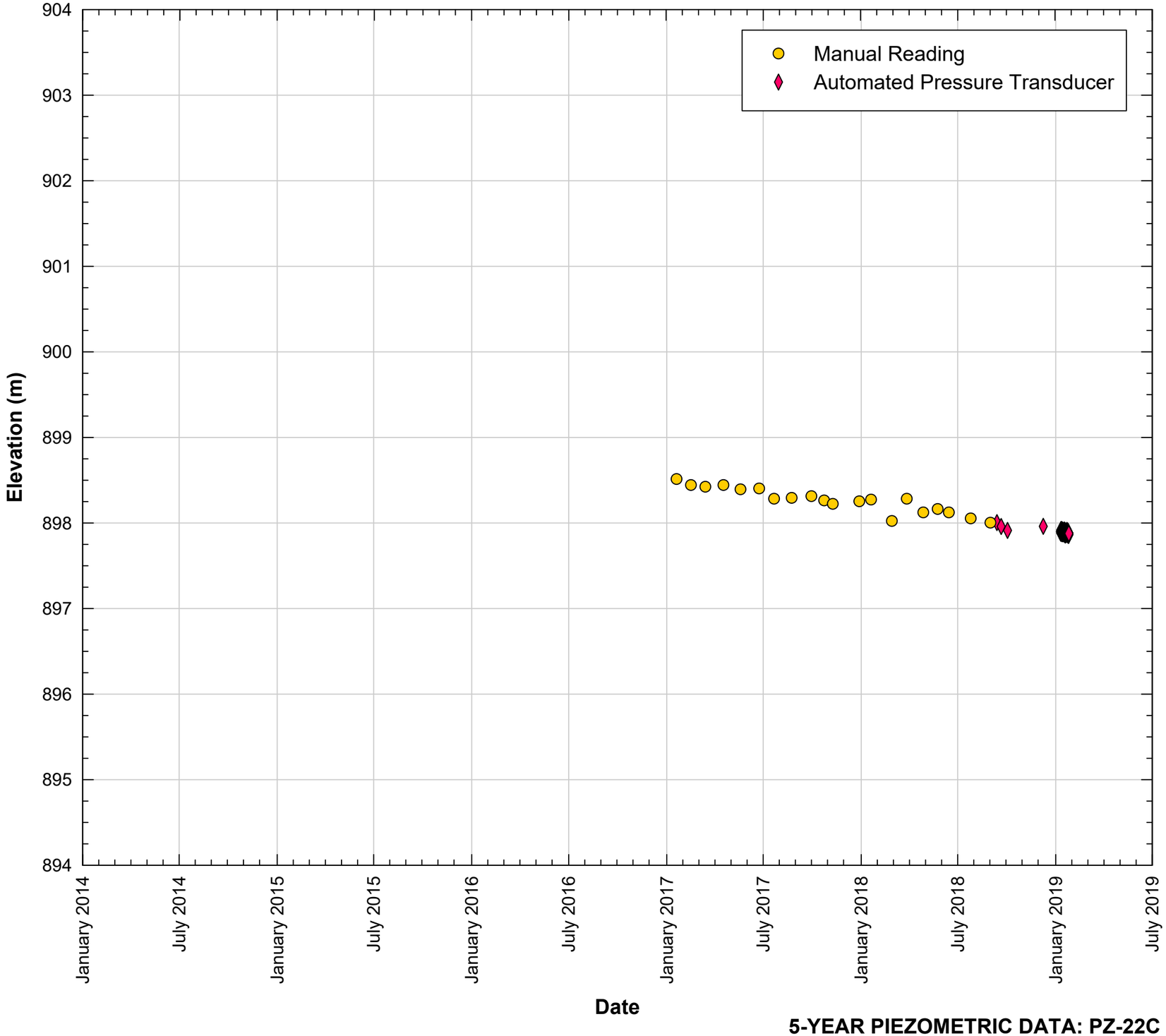
5-YEAR PIEZOMETRIC DATA: PZ-21C
FIGURE 5-14



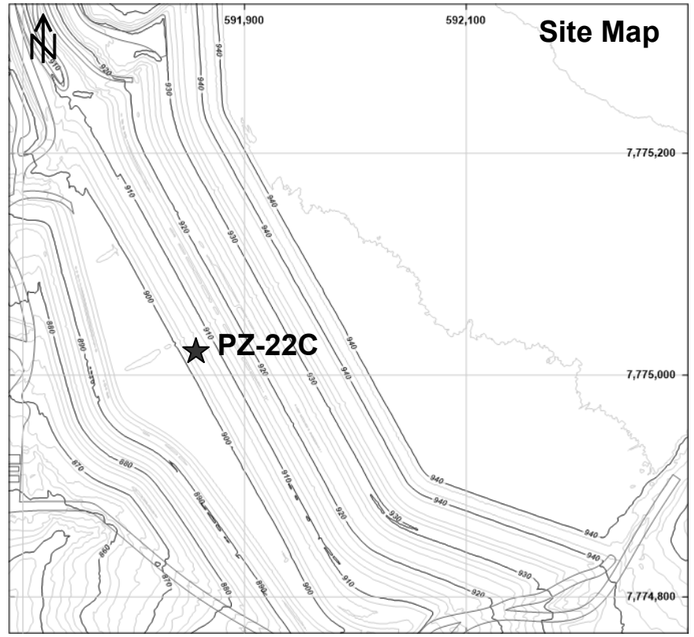


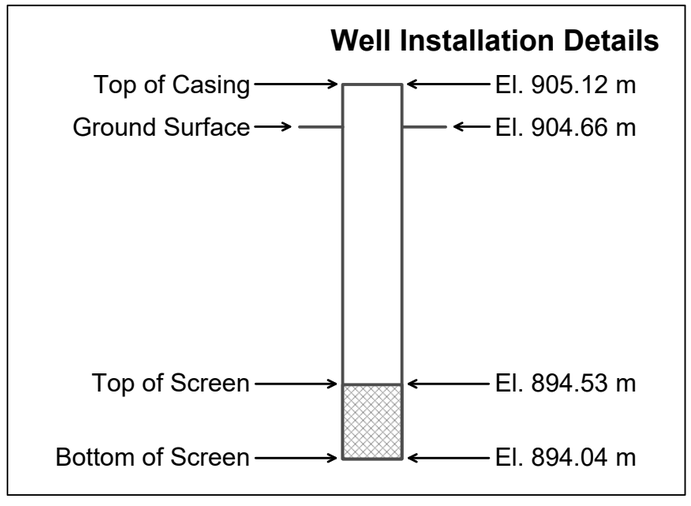
PZ-21C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	8/21/1999	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	8/31/2018	Monthly

5-Year Piezometric Data: PZ-22C



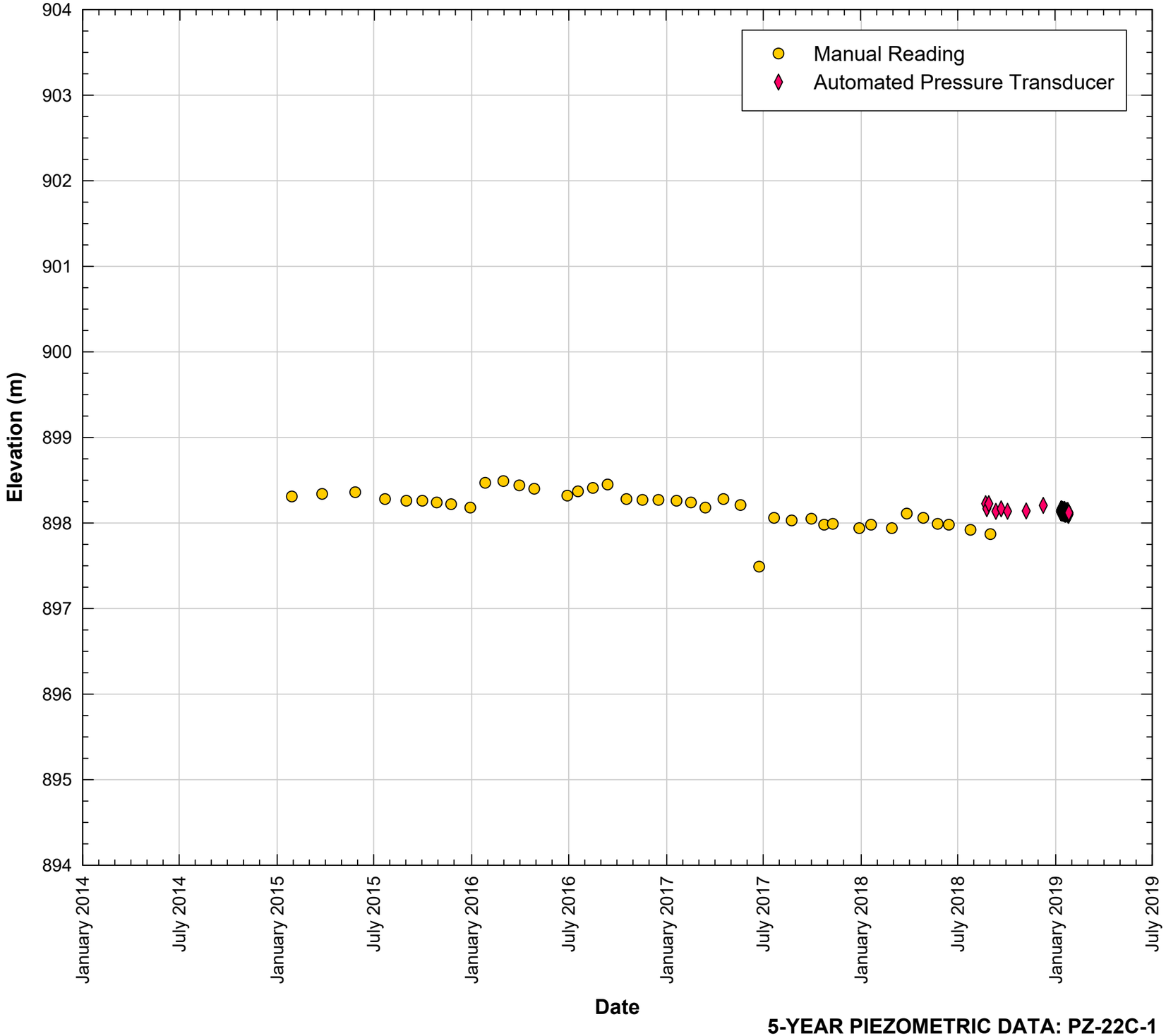
5-YEAR PIEZOMETRIC DATA: PZ-22C
FIGURE 5-15



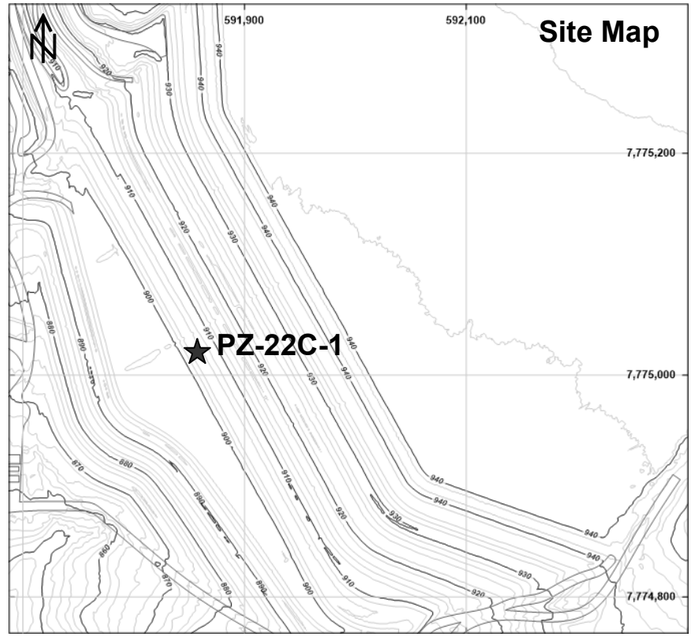


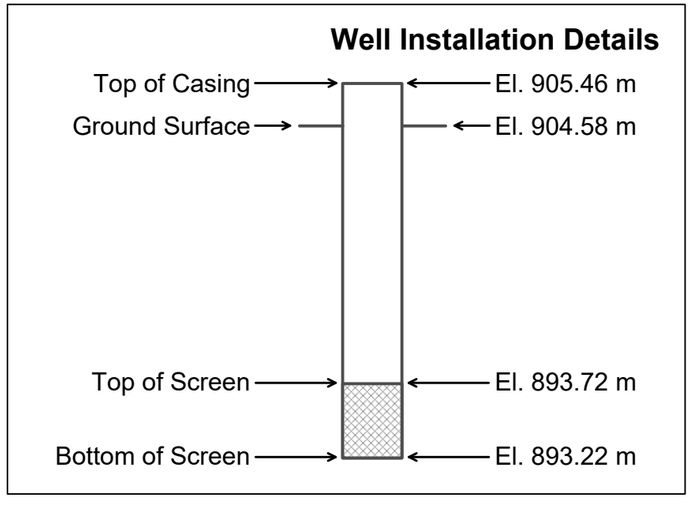
PZ-22C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	8/21/1999	3/11/2005	Monthly
	6/16/2005	8/25/2005	Once per 2 weeks
	1/19/2017	8/31/2018	Monthly
Automated Pressure Transducer	9/12/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZ-22C-1



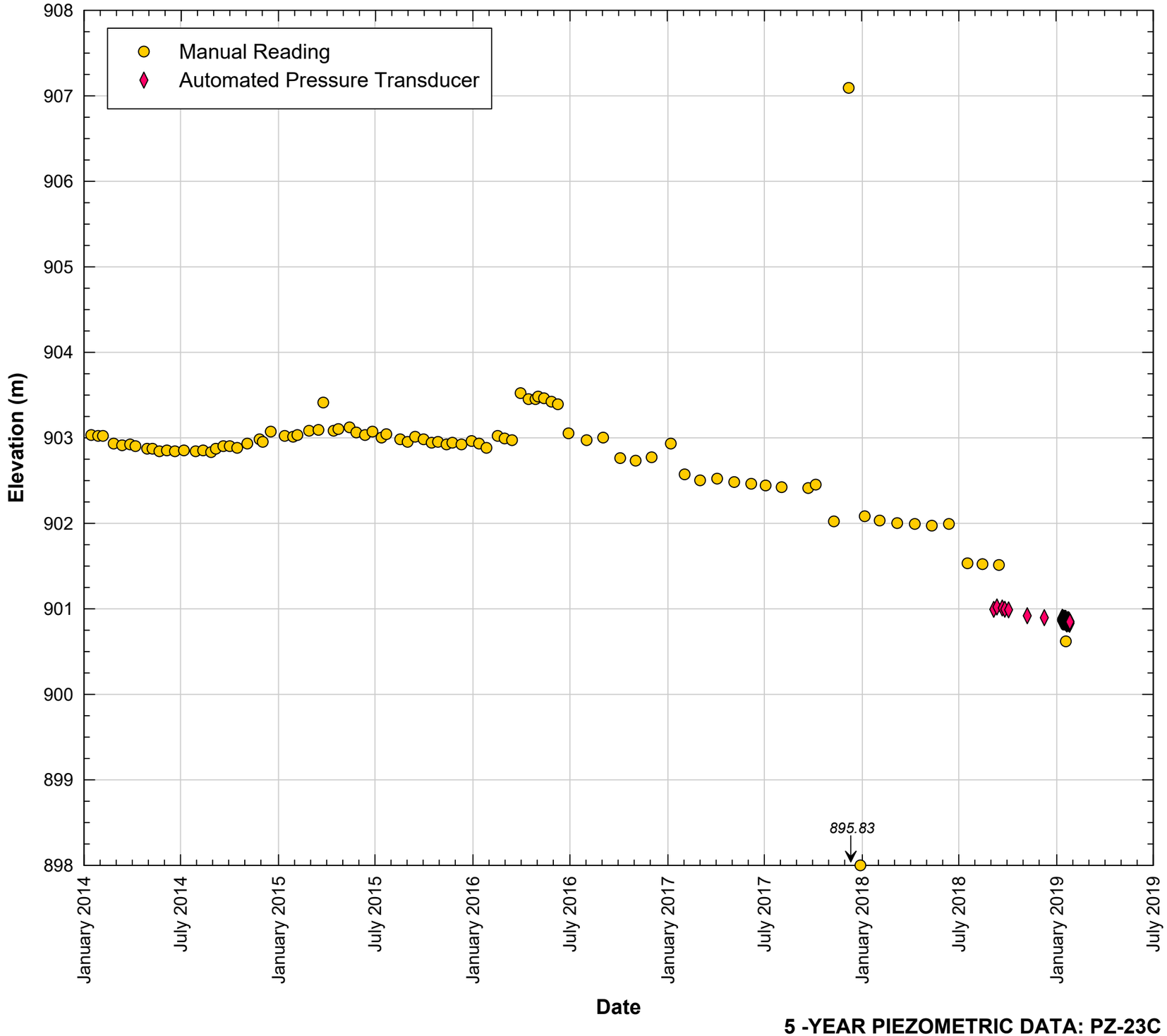
5-YEAR PIEZOMETRIC DATA: PZ-22C-1
FIGURE 5-16



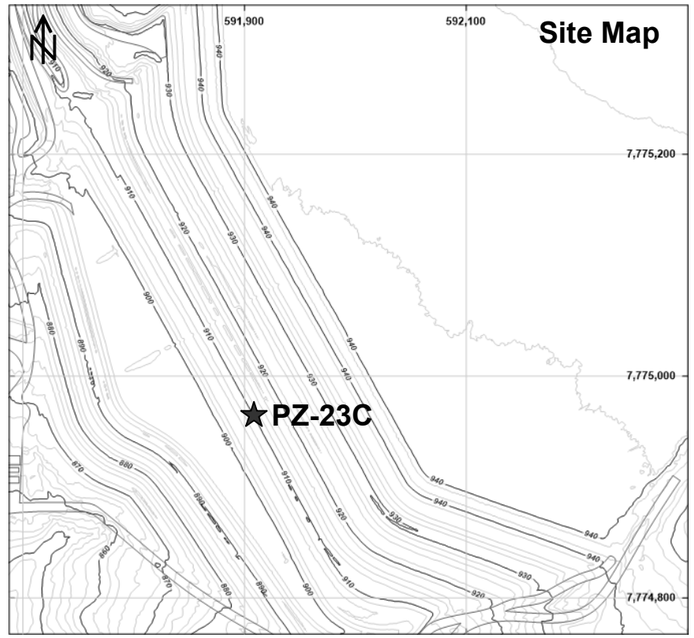


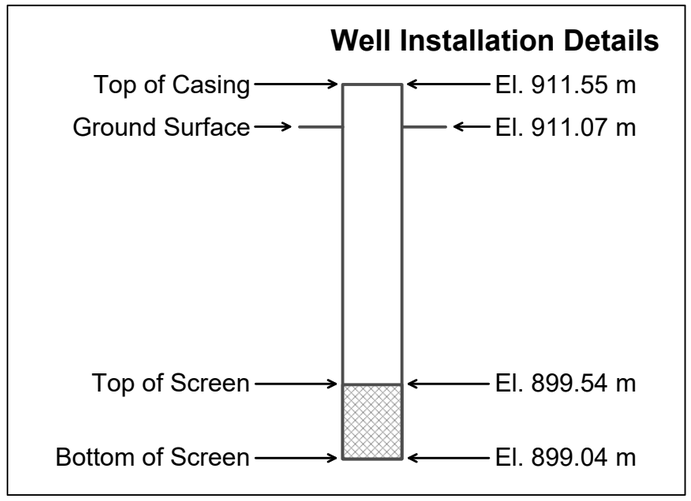
PZ-22C-1			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/12/2004	2/10/2005	Monthly
	3/11/2005	10/31/2007	Once per 2 weeks
	11/26/2007	6/30/2018	Monthly
	3/1/2011	2/24/2012	Monthly
	1/28/2015	8/31/2018	Monthly
Automated Pressure Transducer	8/22/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZ-23C



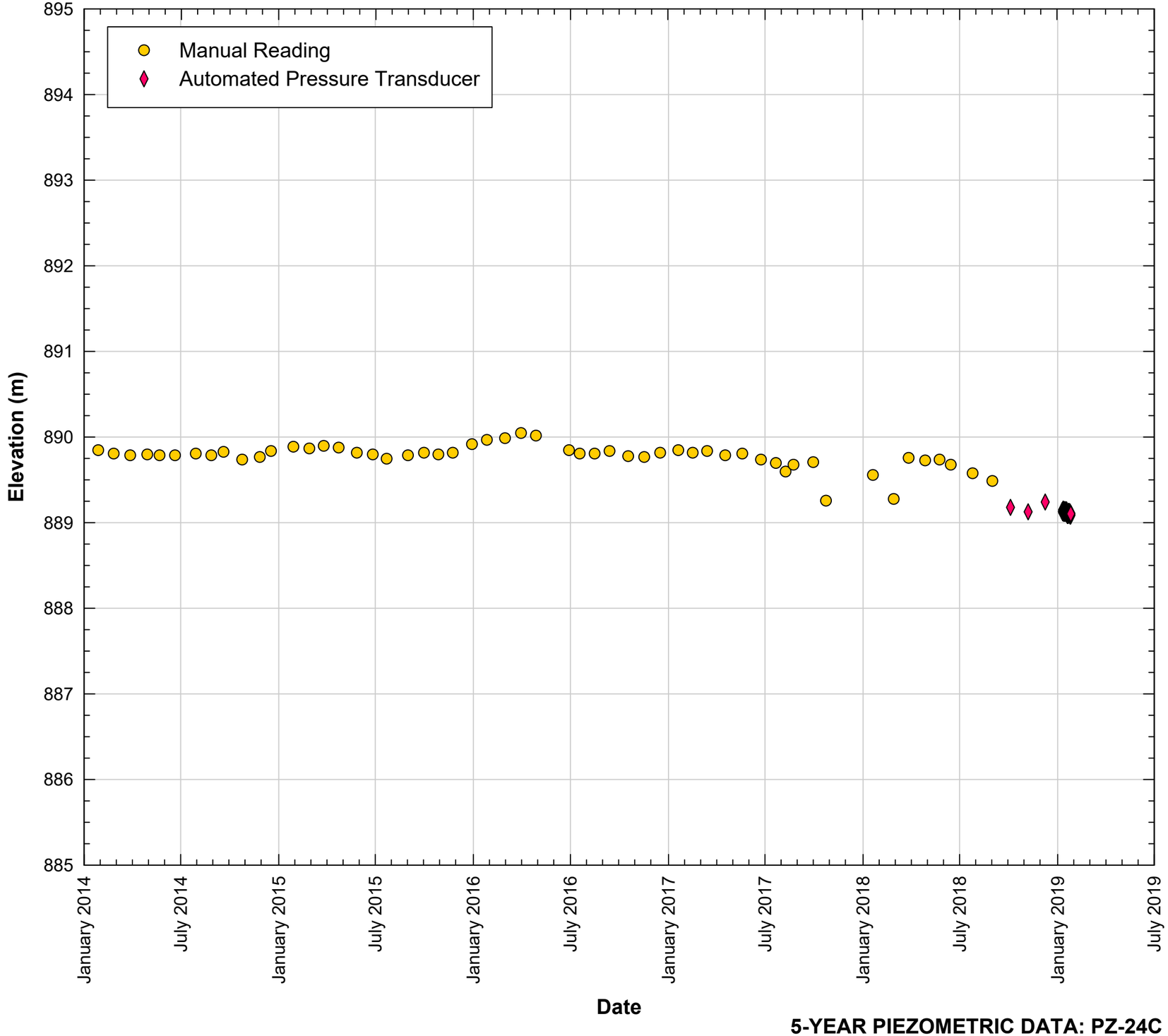
5 -YEAR PIEZOMETRIC DATA: PZ-23C
FIGURE 5-17



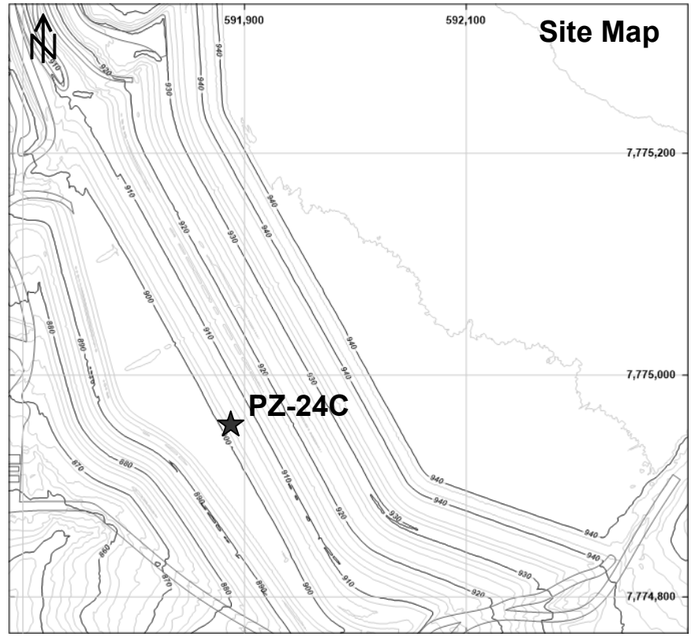


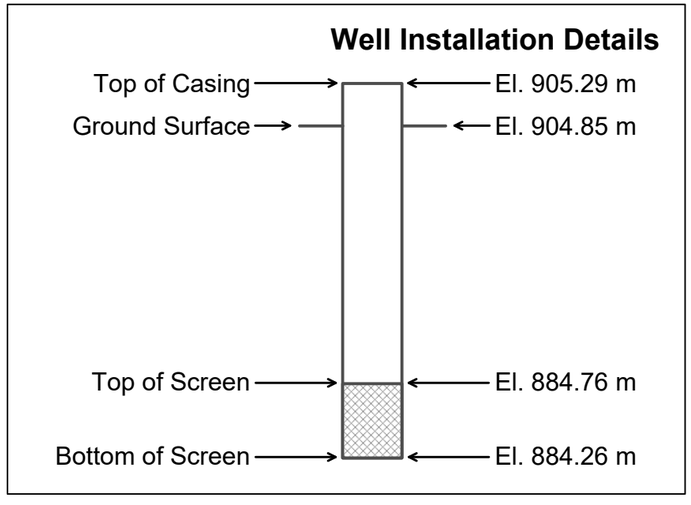
PZ-23C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	8/21/1999	2/10/2005	Monthly
	3/11/2005	9/27/2012	Once per 2 weeks
	10/3/2012	6/6/2013	Weekly
	6/26/2013	6/28/2016	Once per 2 weeks
	8/1/2016	9/14/2018	Monthly
Automated Pressure Transducer	9/4/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZ-24C



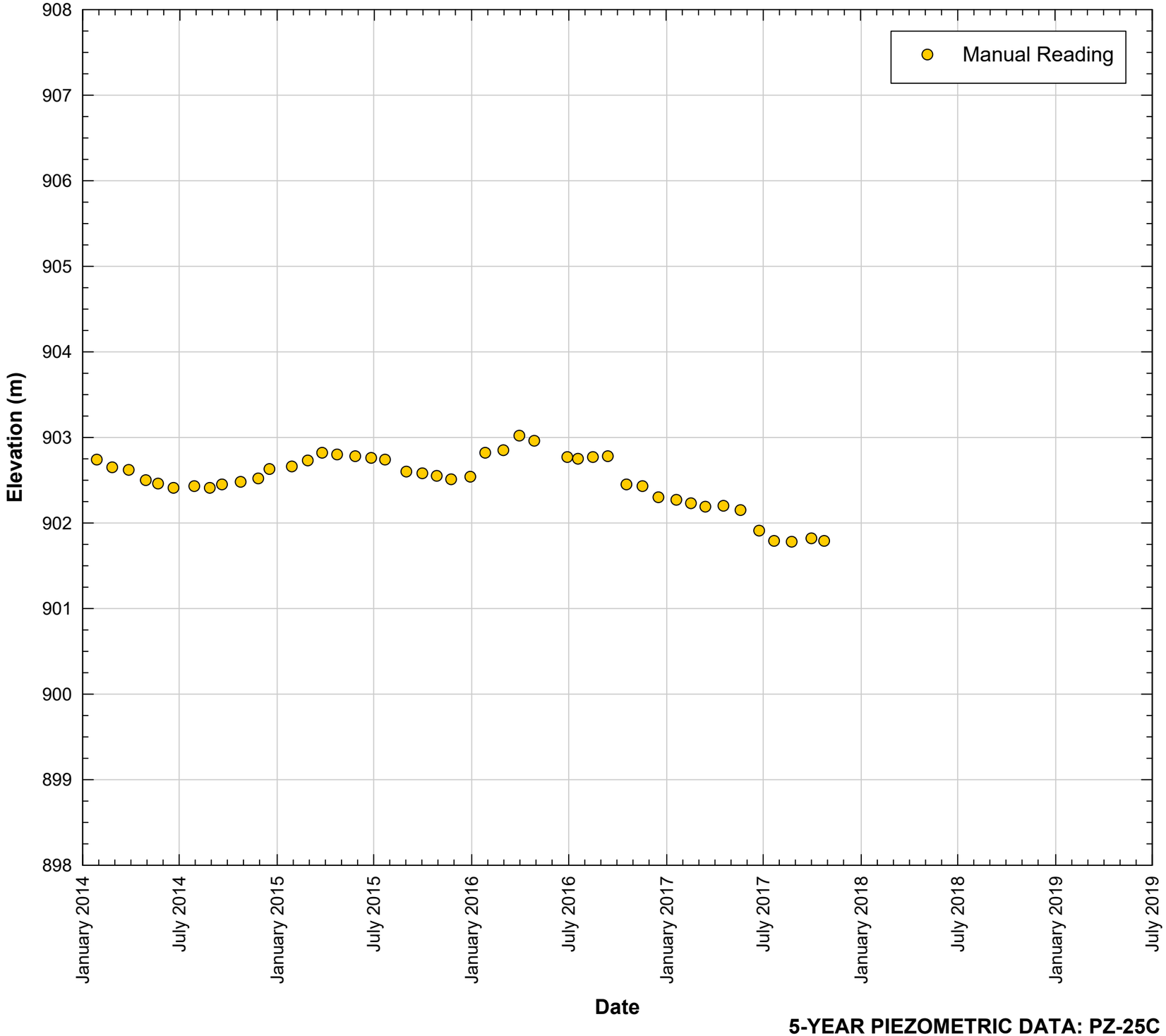
5-YEAR PIEZOMETRIC DATA: PZ-24C
FIGURE 5-18



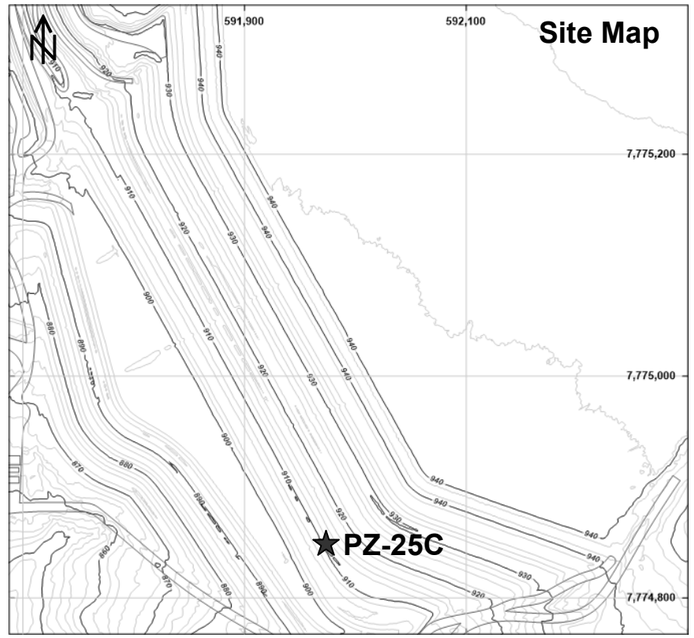


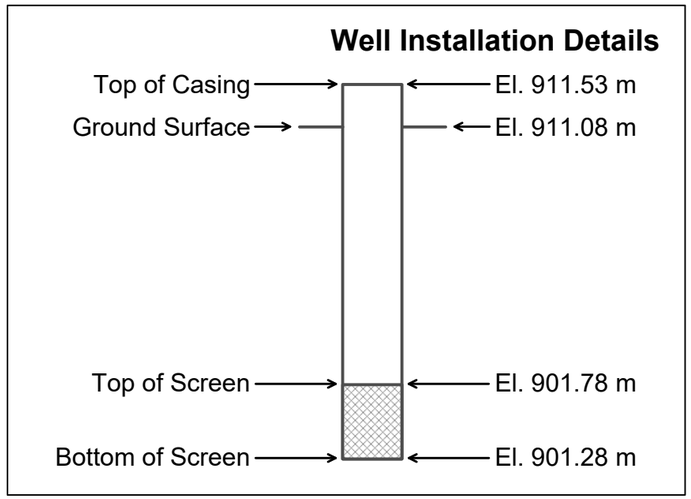
PZ-24C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	8/21/1999	2/10/2005	Monthly
	3/11/2005	10/31/2007	Once per 2 weeks
	11/26/2007	8/31/2018	Monthly
Automated Pressure Transducer	10/4/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZ-25C



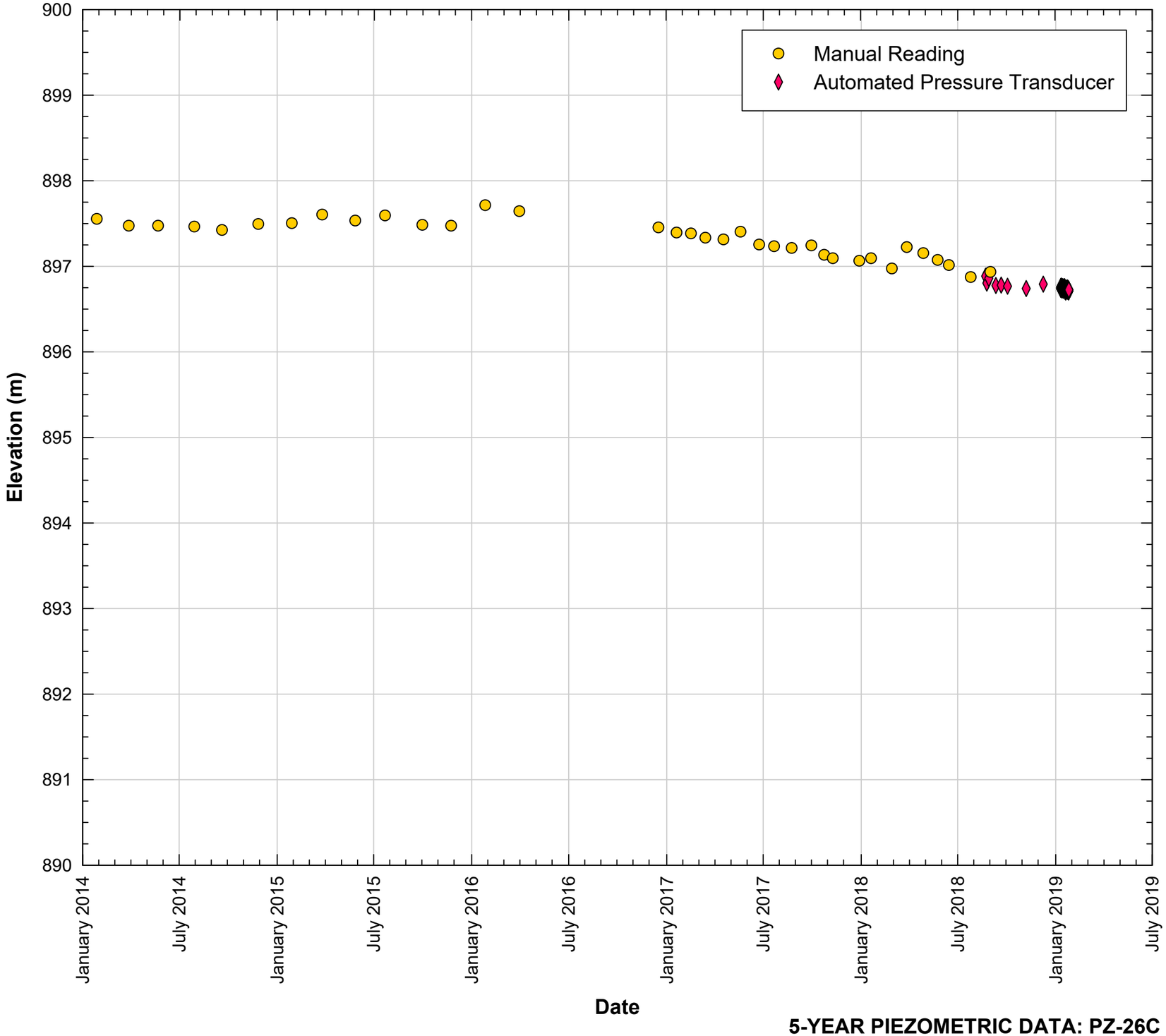
5-YEAR PIEZOMETRIC DATA: PZ-25C
FIGURE 5-19



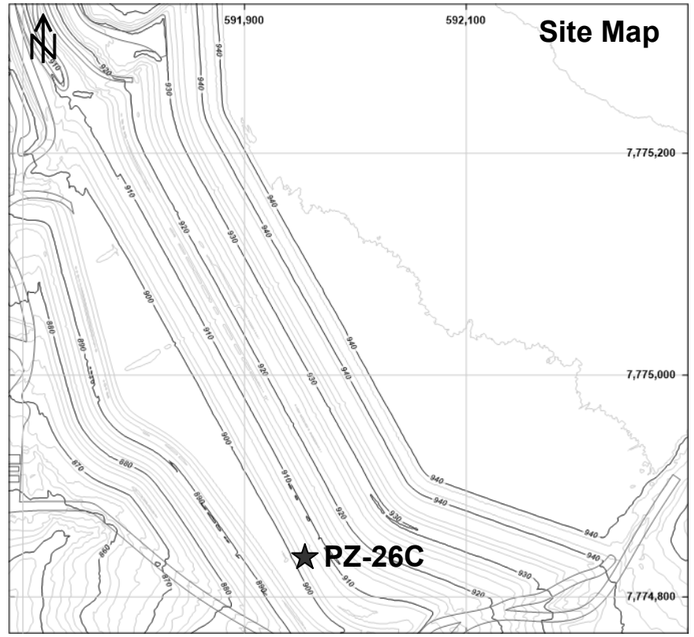


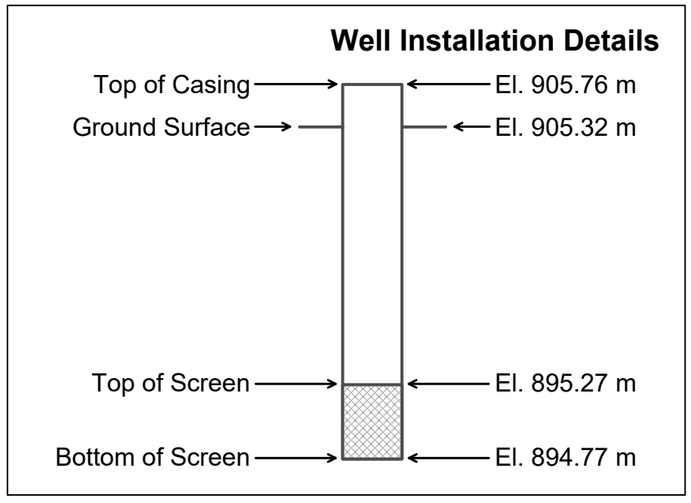
PZ-25C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	2/12/2000	2/10/2005	Monthly
	3/11/2005	10/31/2007	Once per 2 weeks
	11/26/2007	10/23/2017	Monthly

5-Year Piezometric Data: PZ-26C



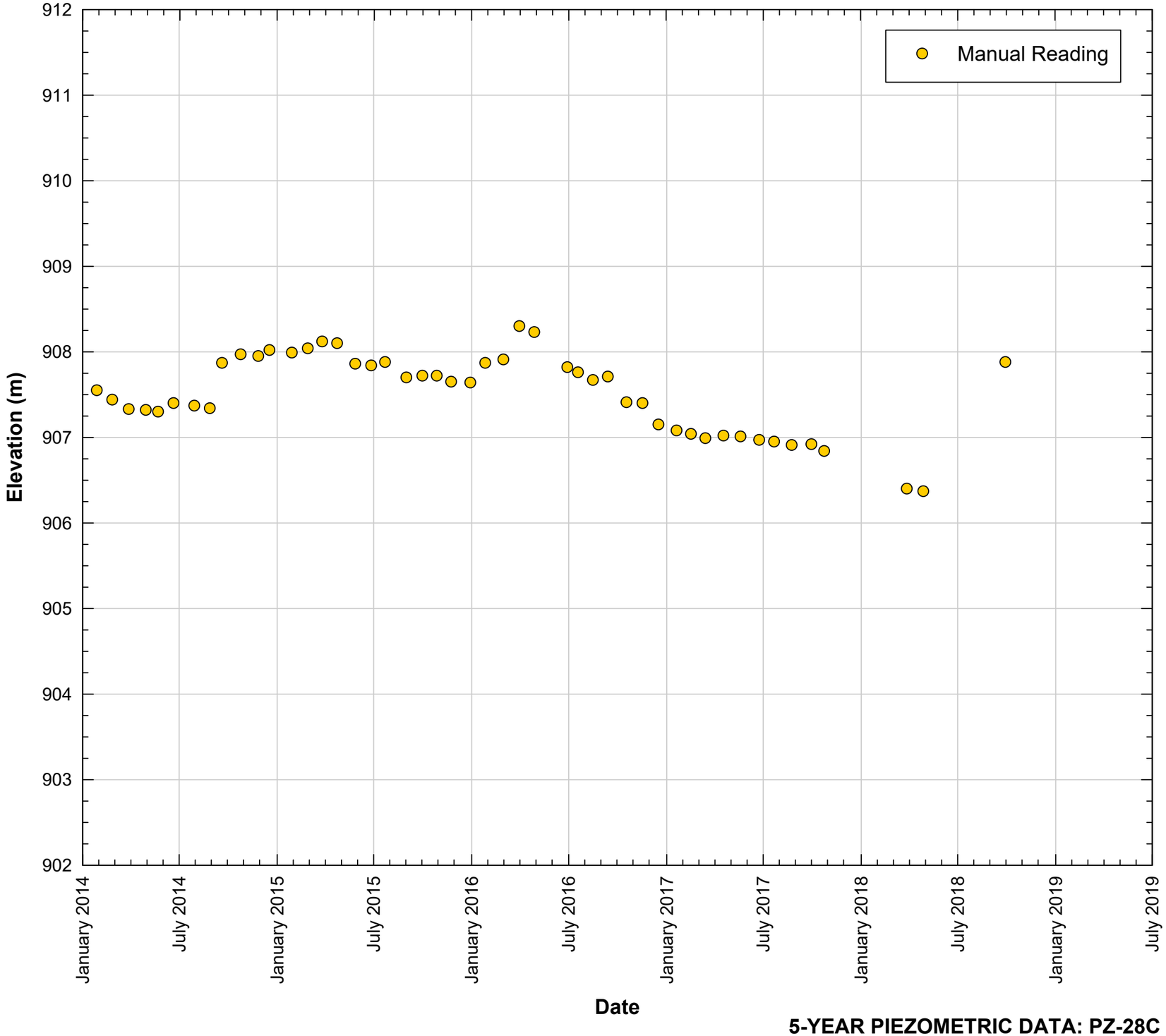
5-YEAR PIEZOMETRIC DATA: PZ-26C
FIGURE 5-20



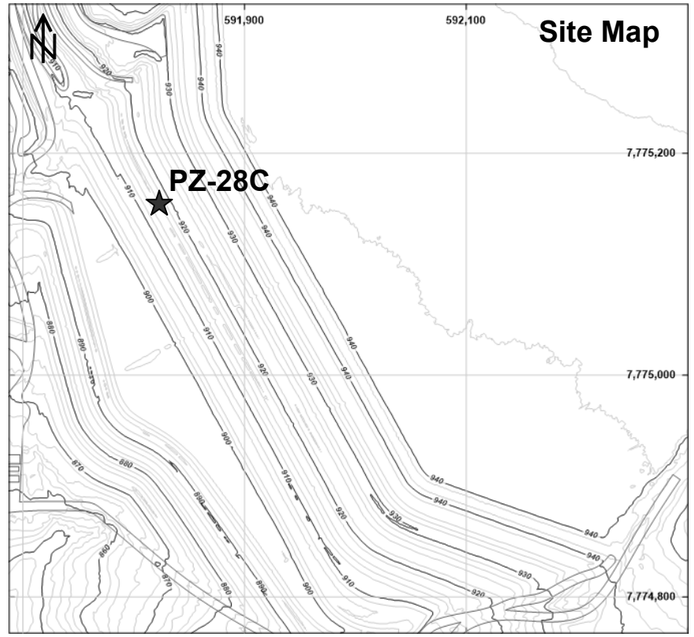


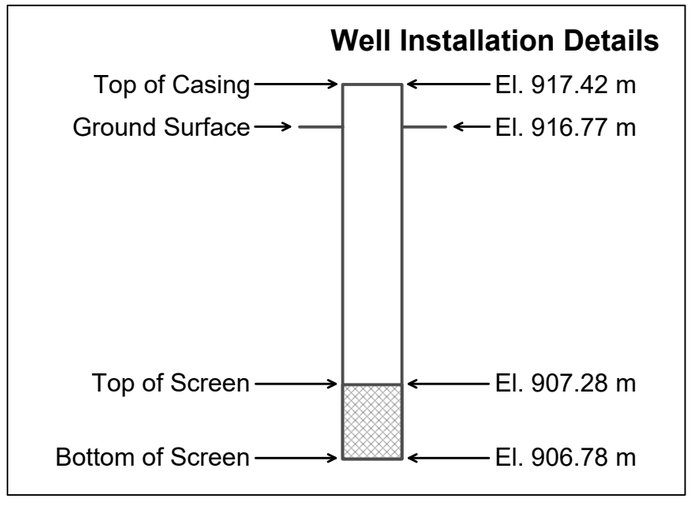
PZ-26C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	8/21/1999	2/10/2005	Monthly
	3/11/2005	1/27/2007	Once per 2 weeks
	4/4/2007	3/30/2016	Once per 2 months
	12/16/2016	8/31/2018	Monthly
Automated Pressure Transducer	8/22/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZ-28C



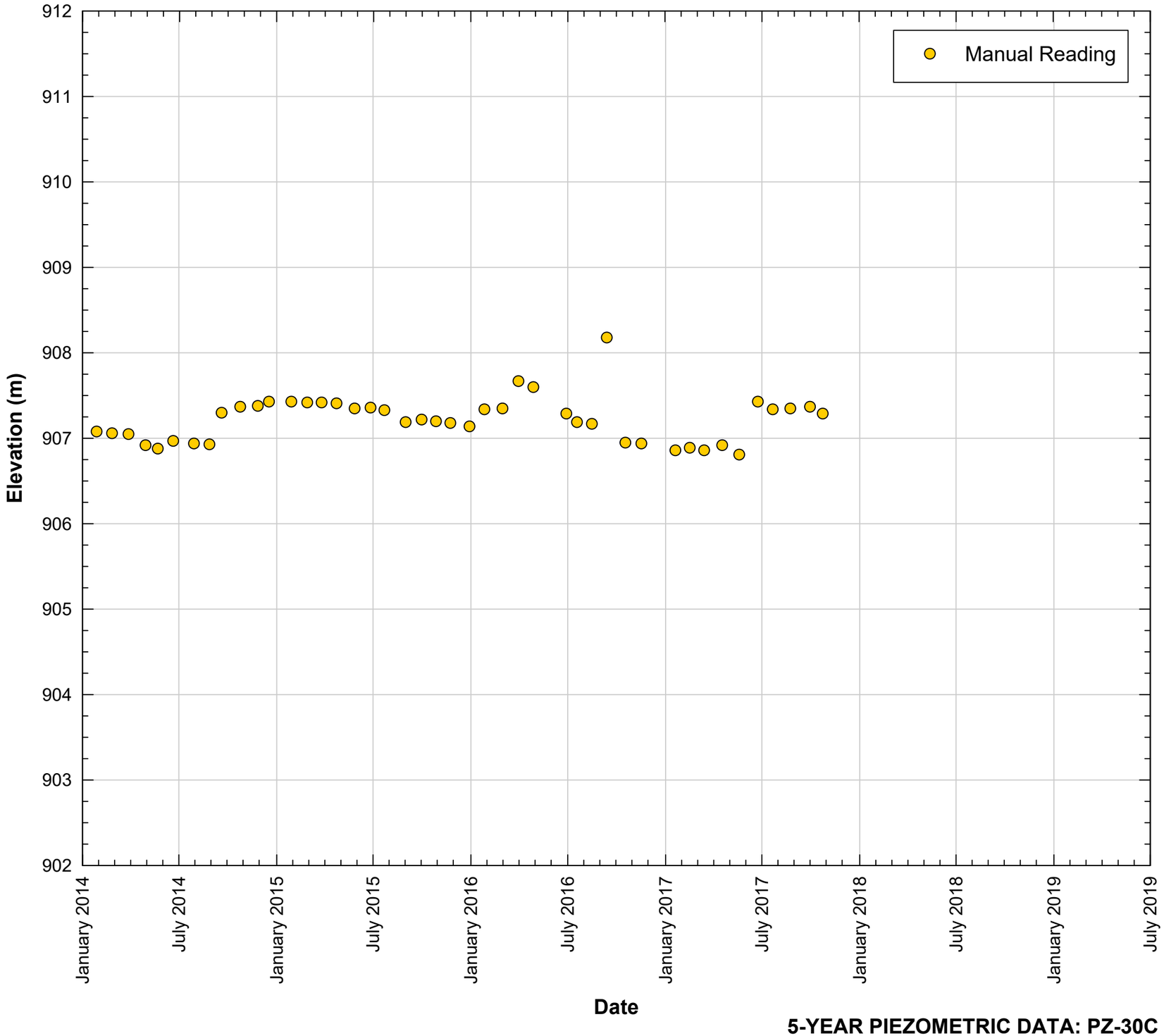
5-YEAR PIEZOMETRIC DATA: PZ-28C
FIGURE 5-21



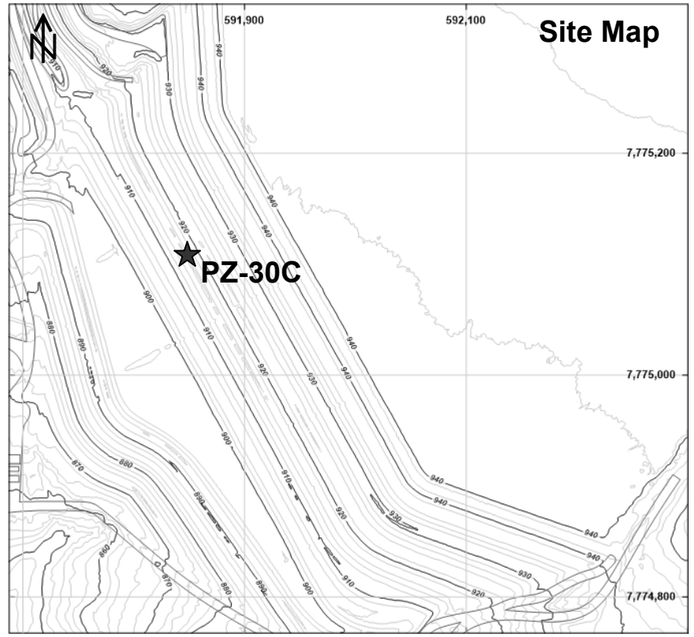


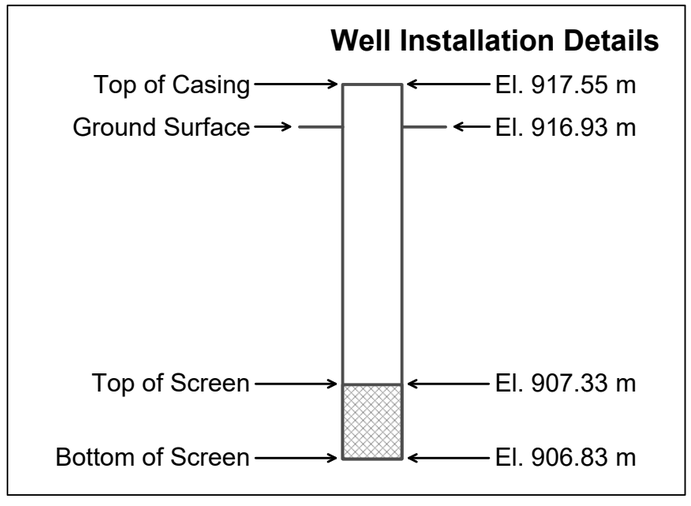
PZ-28C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	9/12/2000	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	9/28/2018	Monthly

5-Year Piezometric Data: PZ-30C



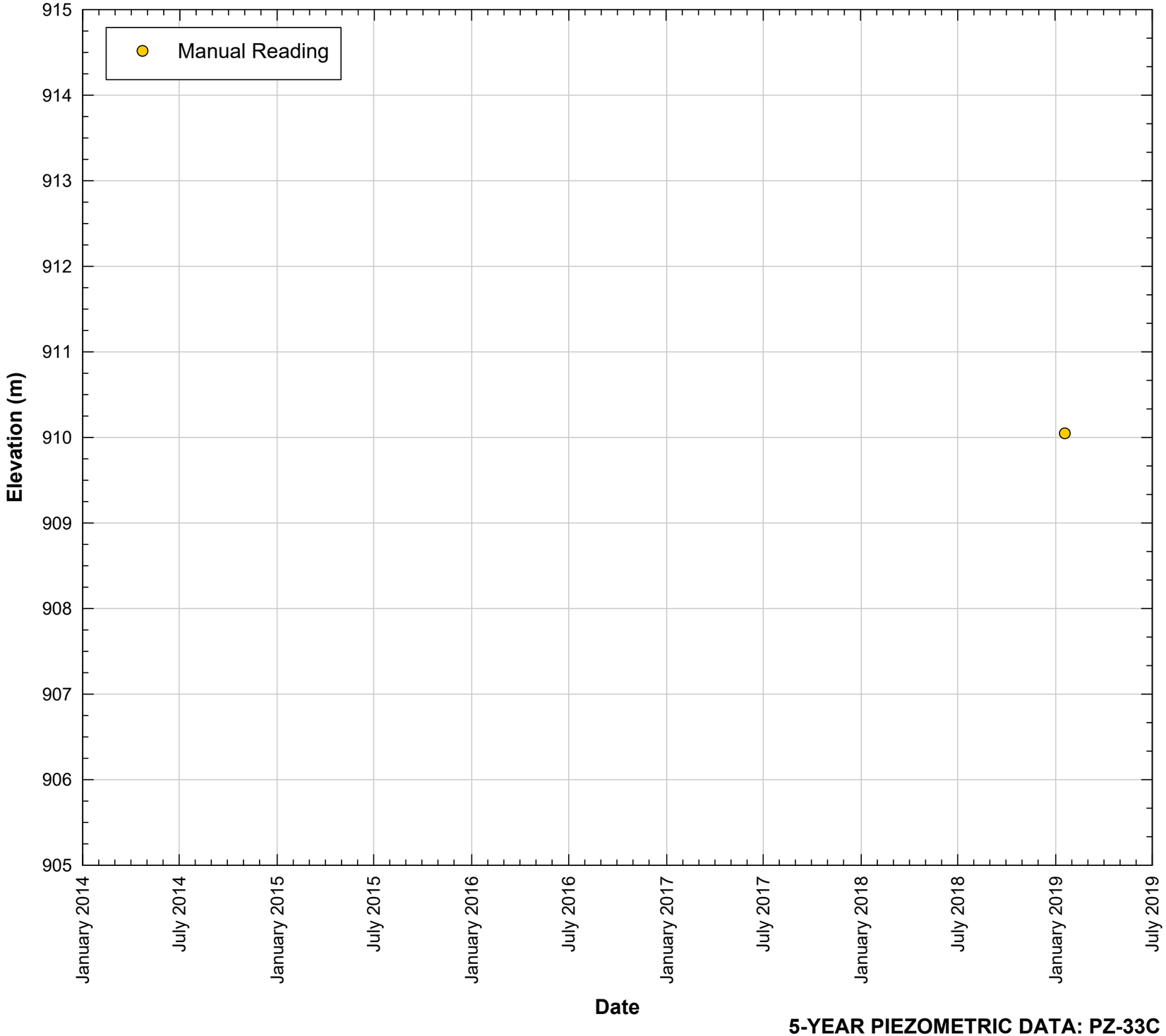
5-YEAR PIEZOMETRIC DATA: PZ-30C
FIGURE 5-22



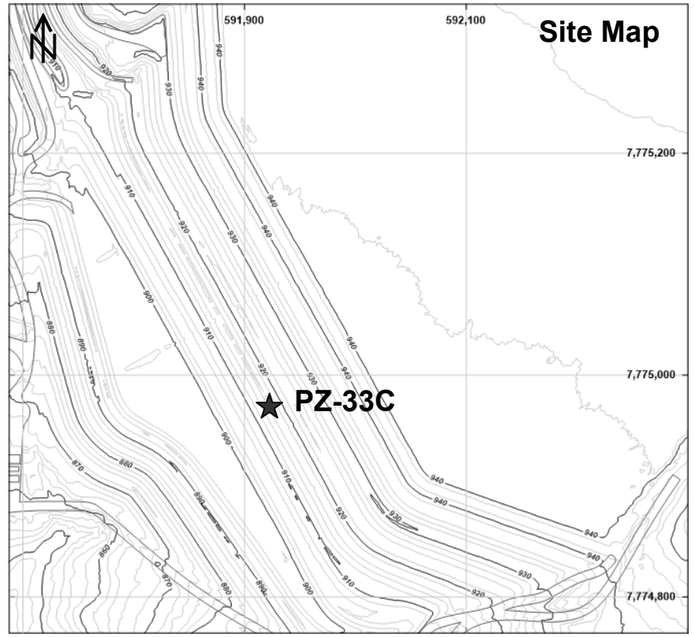


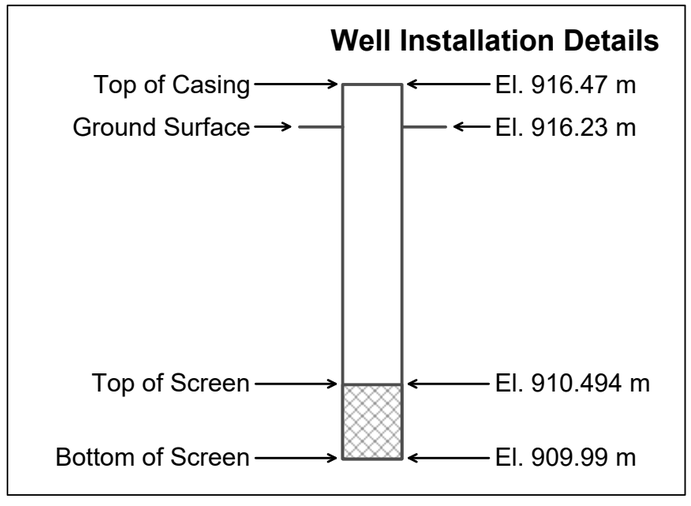
PZ-30C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	8/12/2000	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	10/23/2017	Monthly

5-Year Piezometric Data: PZ-33C



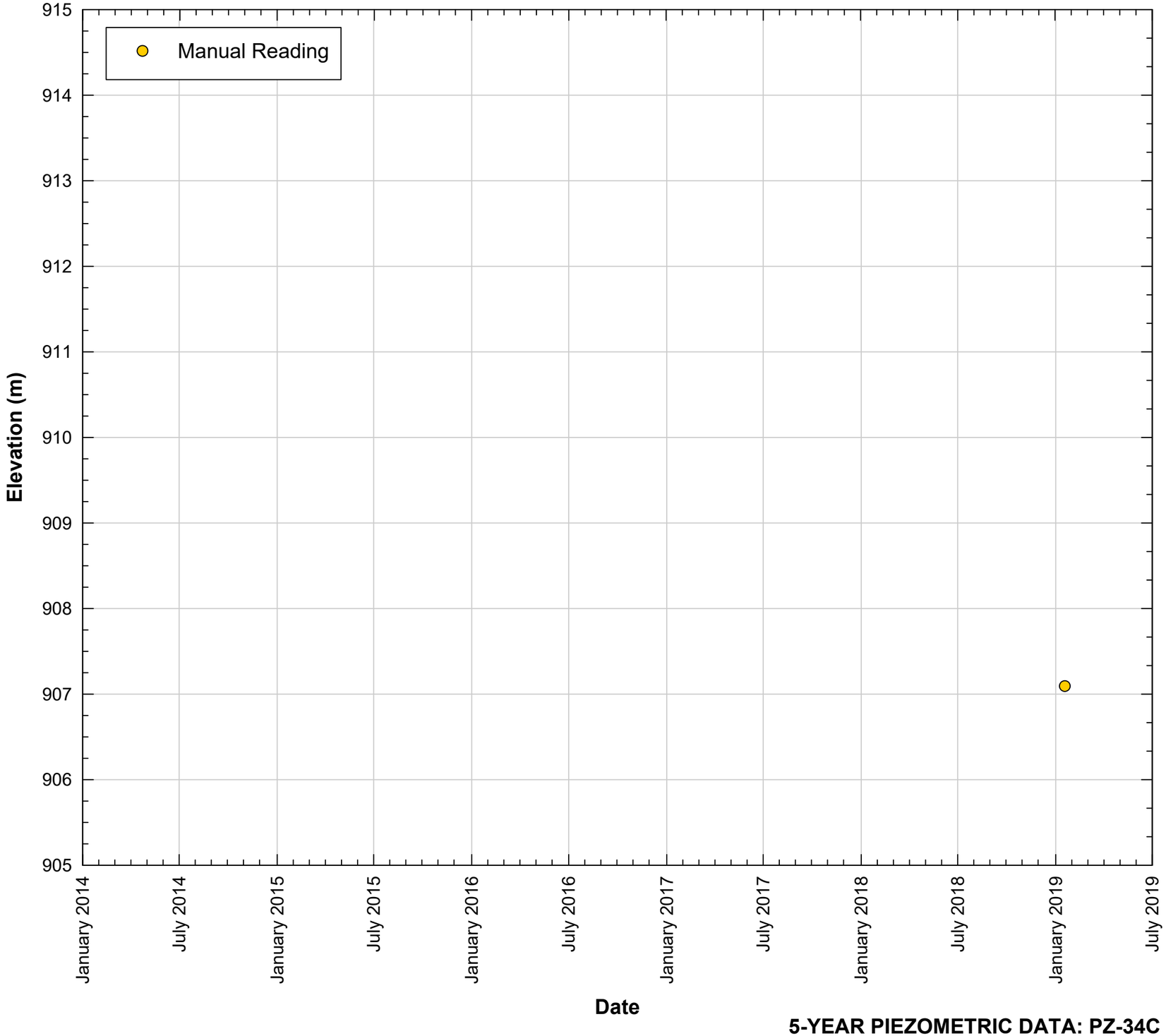
5-YEAR PIEZOMETRIC DATA: PZ-33C
FIGURE 5-23



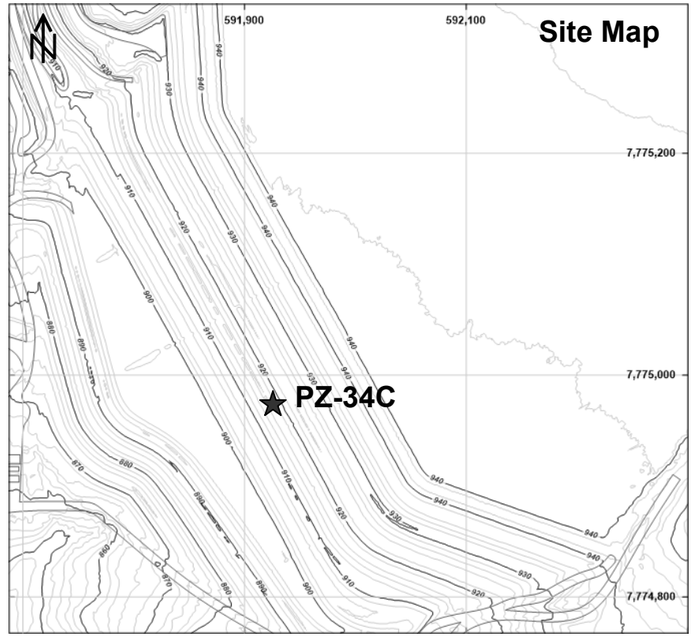


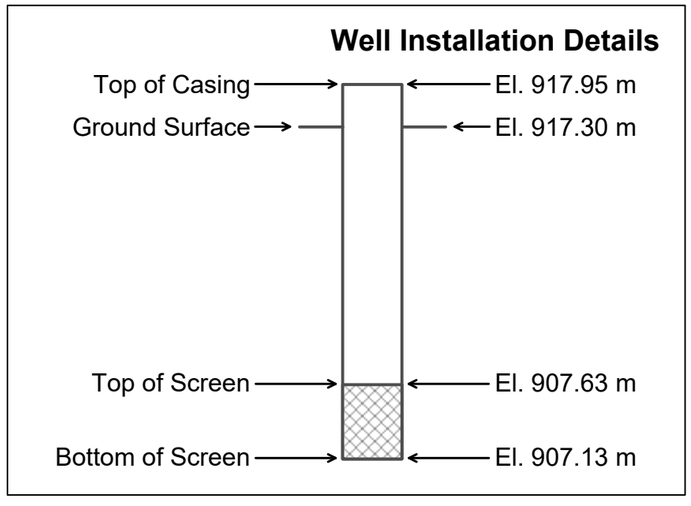
PZ-33C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	10/12/2000	1/18/2019	Monthly

5-Year Piezometric Data: PZ-34C



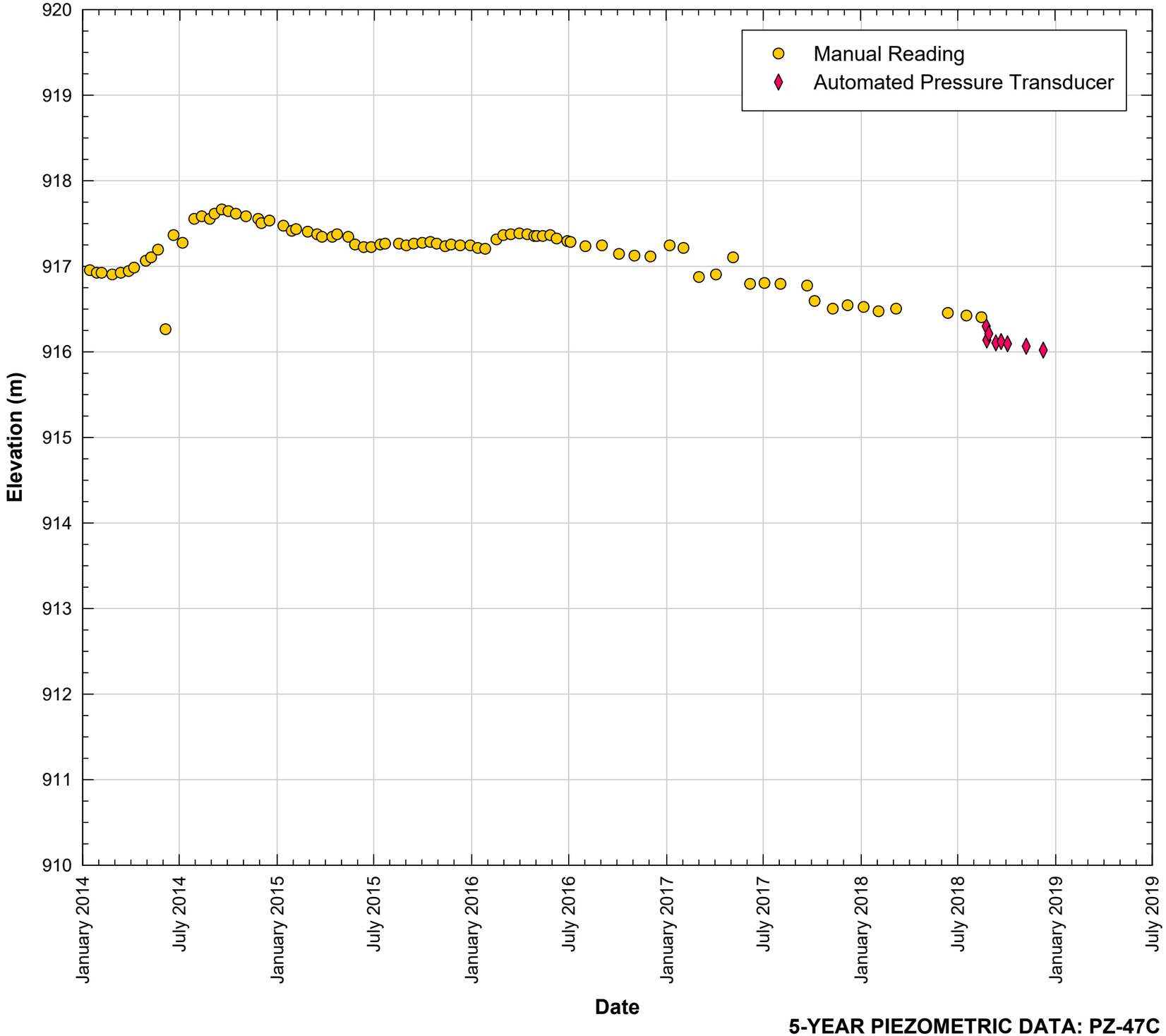
5-YEAR PIEZOMETRIC DATA: PZ-34C
FIGURE 5-24



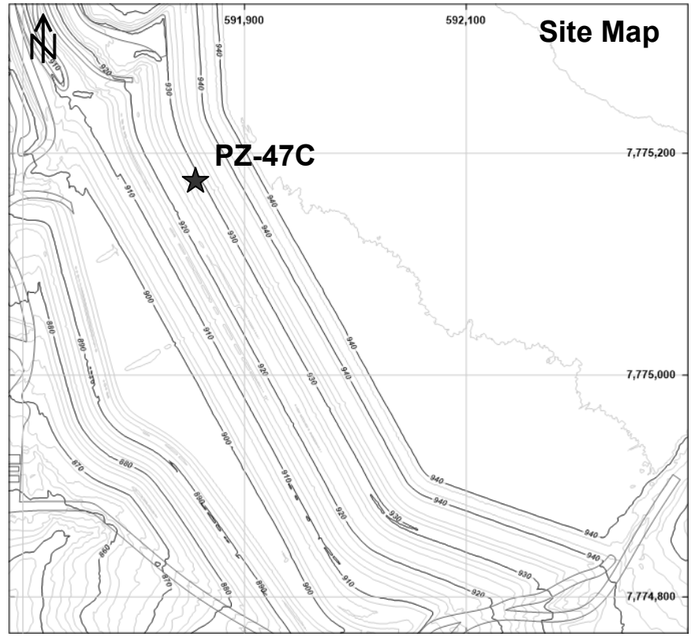


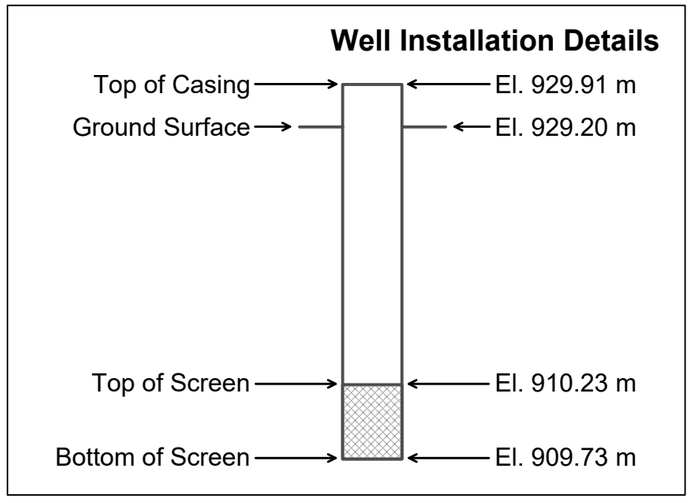
PZ-34C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	3/11/2005	1/18/2019	Monthly

5-Year Piezometric Data: PZ-47C



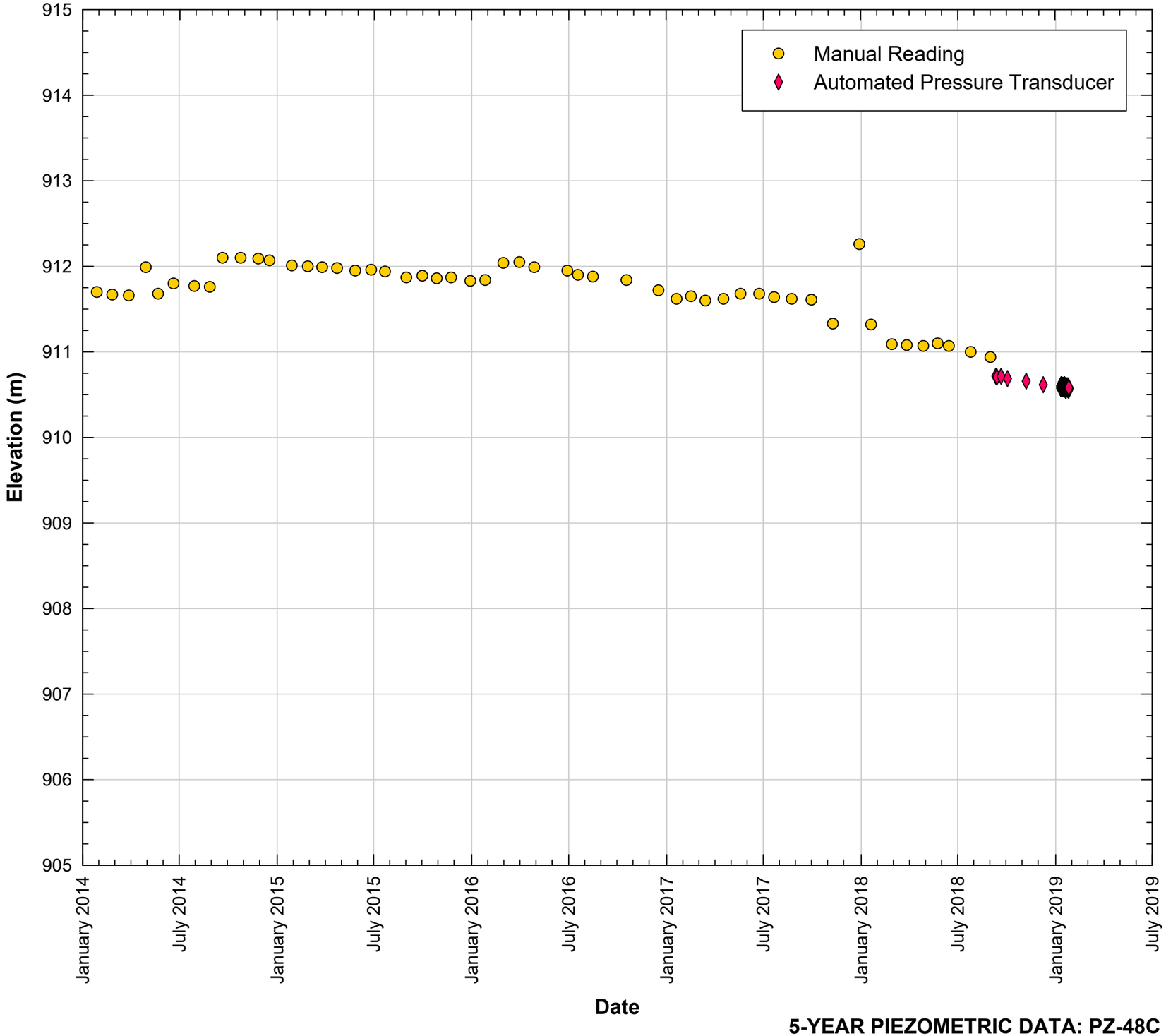
5-YEAR PIEZOMETRIC DATA: PZ-47C
FIGURE 5-25



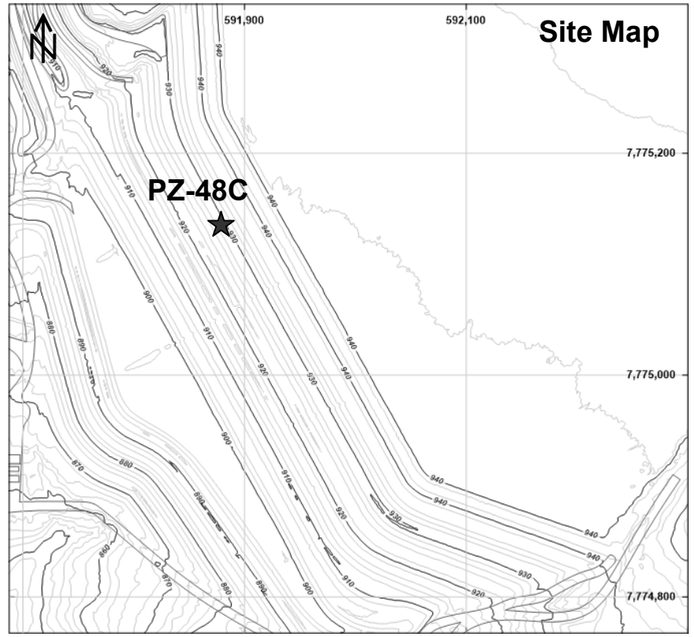


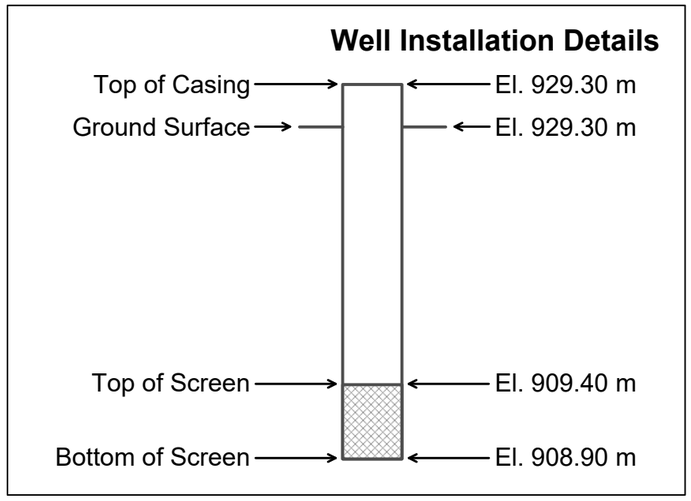
PZ-47C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	3/28/2005	9/27/2012	Once per 2 weeks
	10/3/2012	6/6/2013	Weekly
	6/26/2013	6/28/2016	Once per 2 weeks
	7/4/2016	8/14/2018	Monthly
Automated Pressure Transducer	8/23/2018	12/8/2018	Monthly

5-Year Piezometric Data: PZ-48C



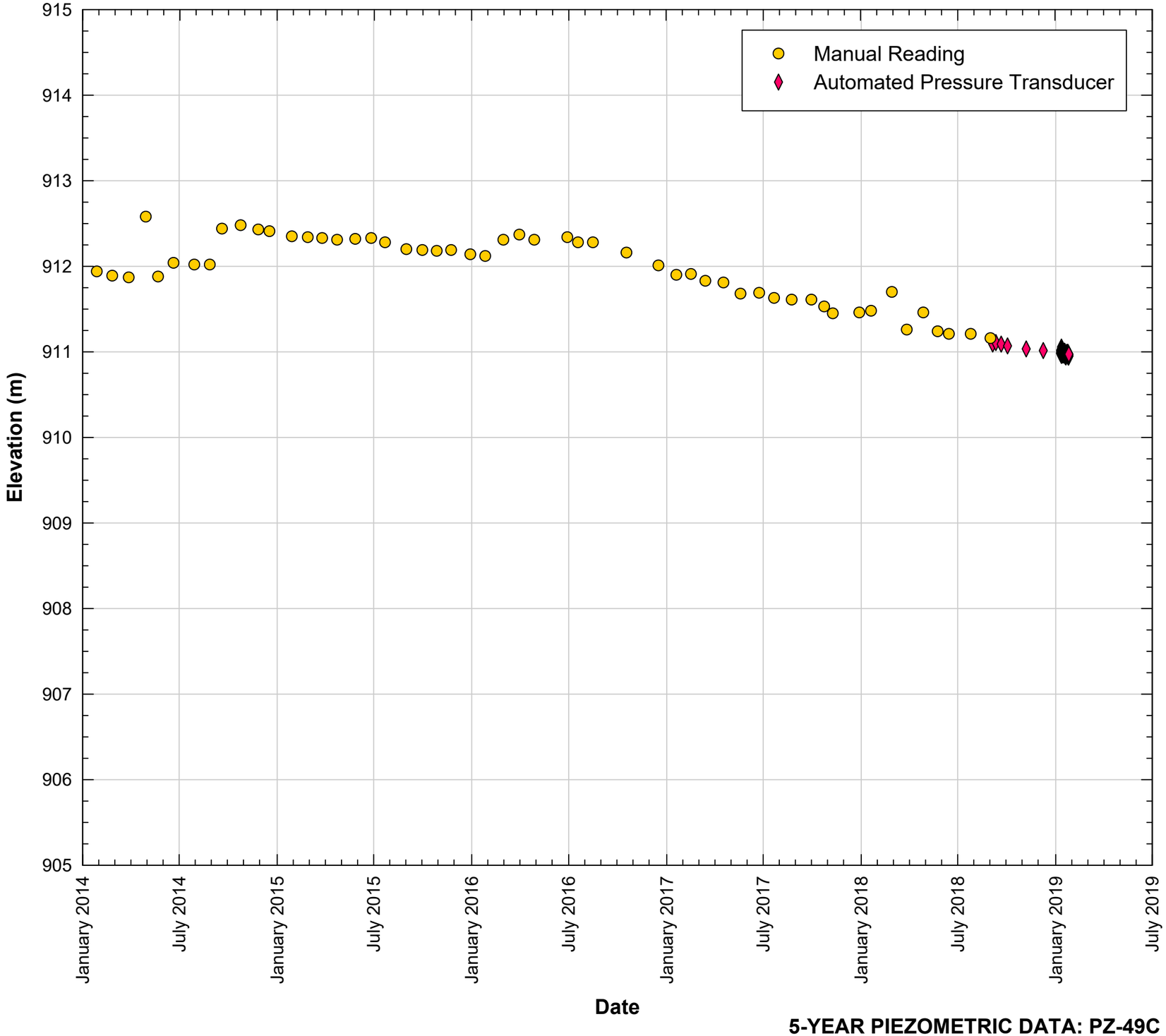
5-YEAR PIEZOMETRIC DATA: PZ-48C
FIGURE 5-26



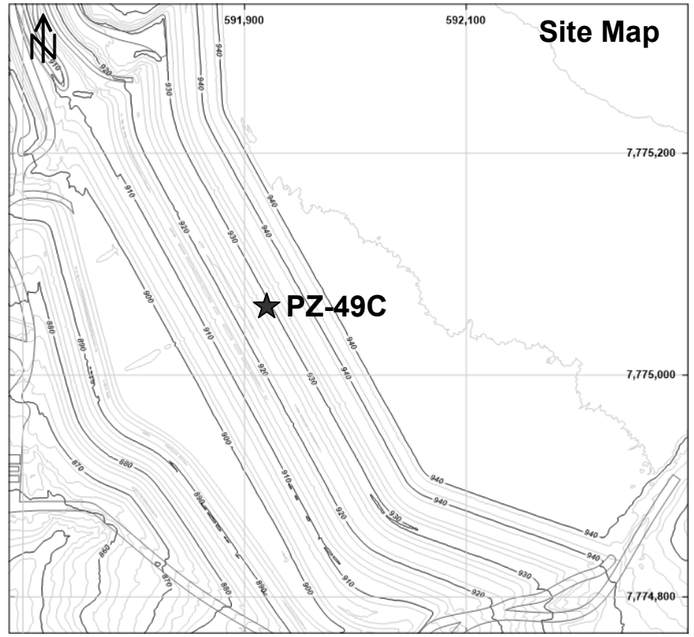


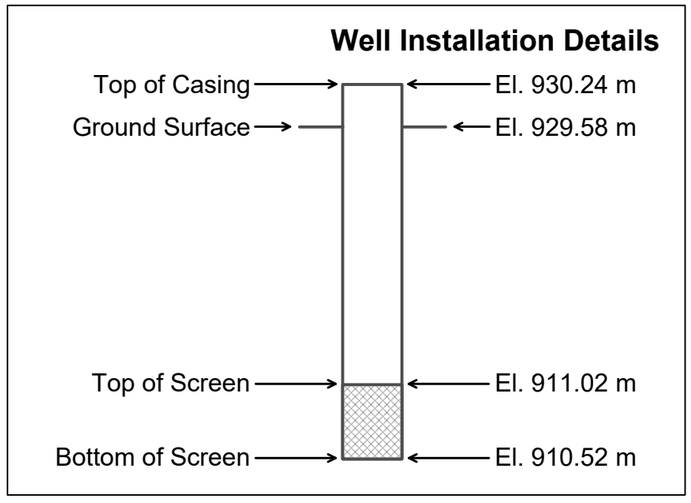
PZ-48C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/12/2004	10/19/2006	Once per 2 weeks
	1/7/2008	8/31/2018	Weekly
Automated Pressure Transducer	9/10/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZ-49C



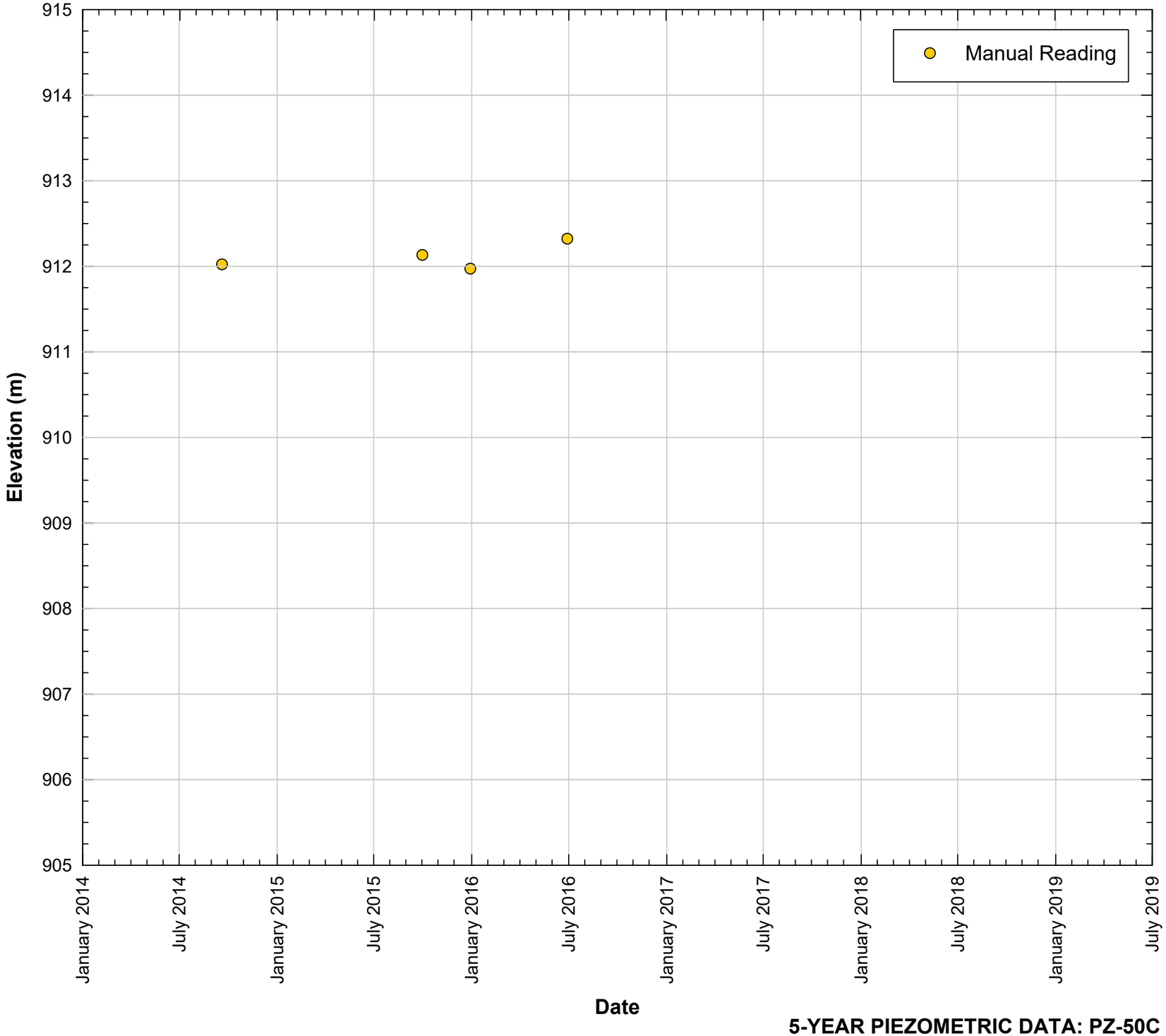
5-YEAR PIEZOMETRIC DATA: PZ-49C
FIGURE 5-27



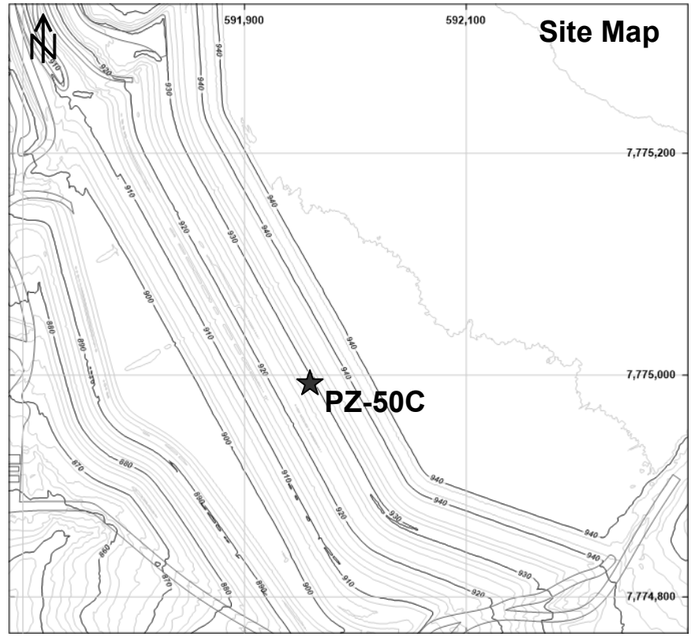


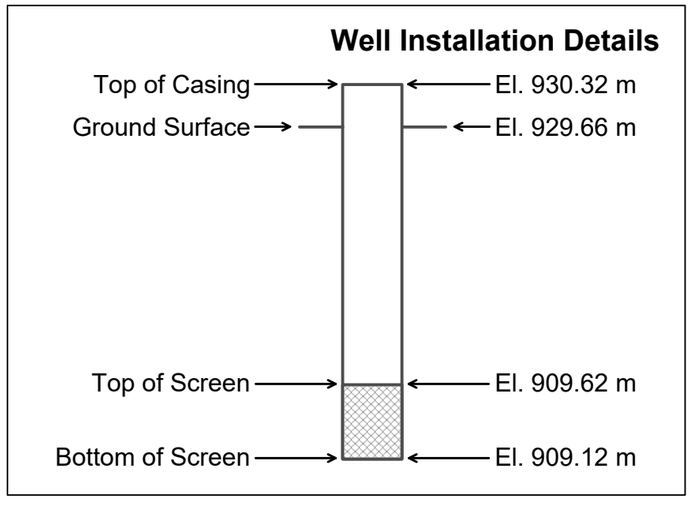
PZ-49C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	3/28/2005	1/28/2008	Once per 2 weeks
	2/26/2008	8/31/2018	Monthly
Automated Pressure Transducer	9/4/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZ-50C



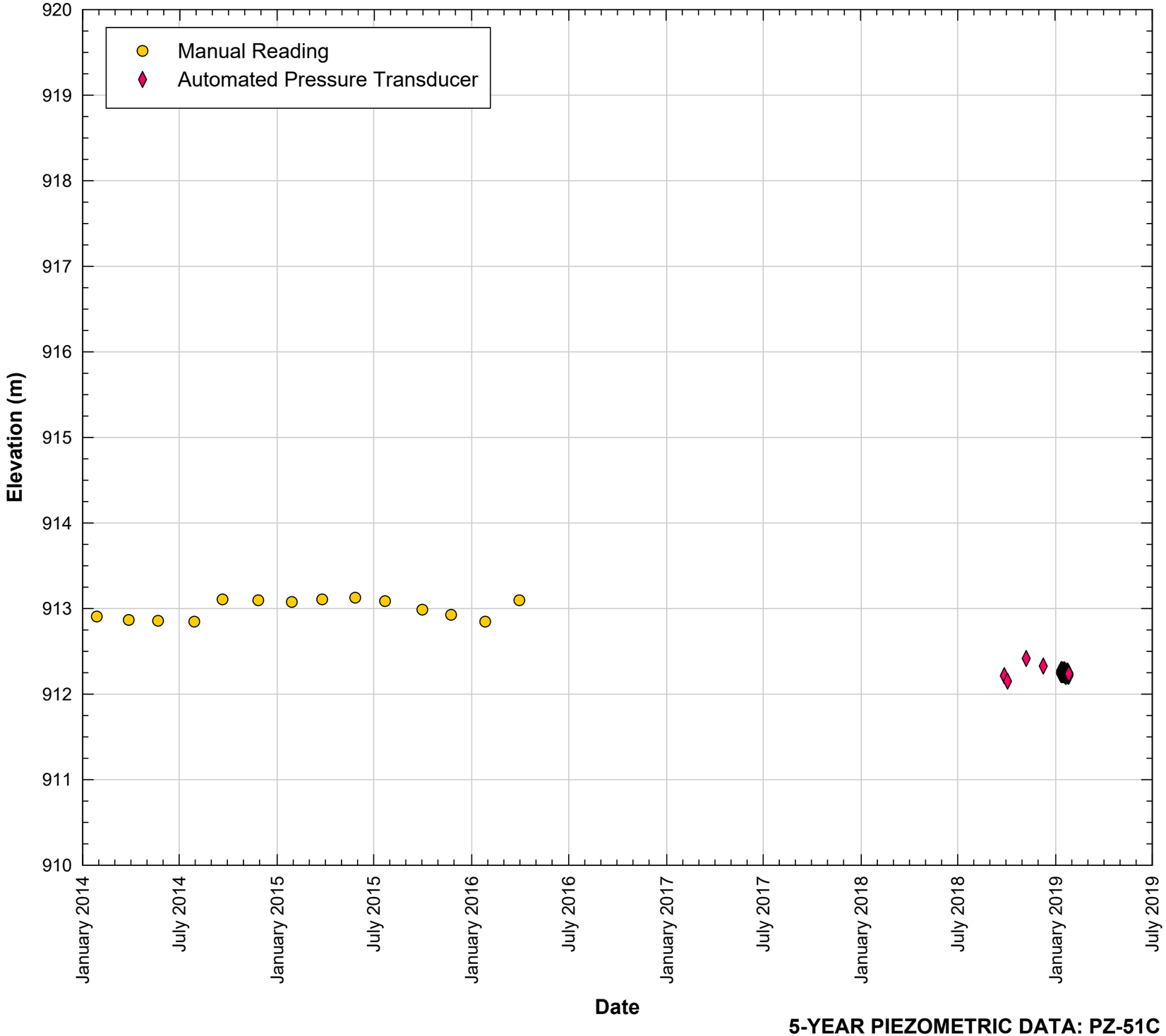
5-YEAR PIEZOMETRIC DATA: PZ-50C
FIGURE 5-28



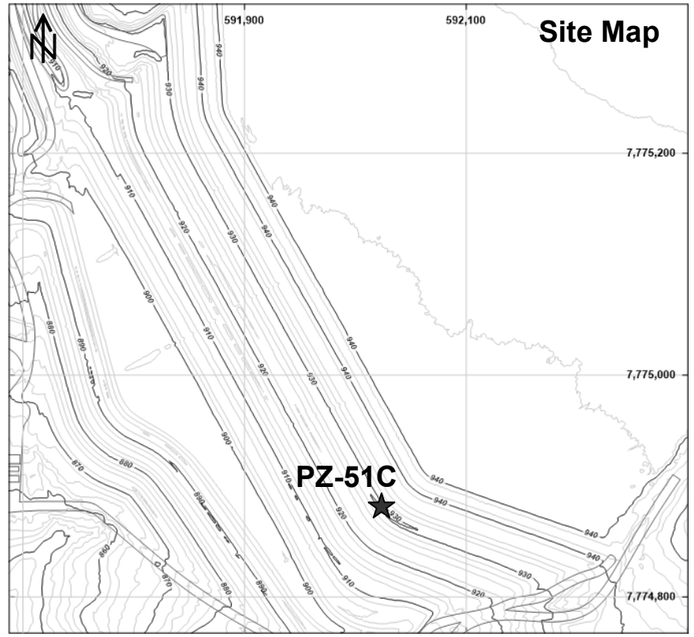


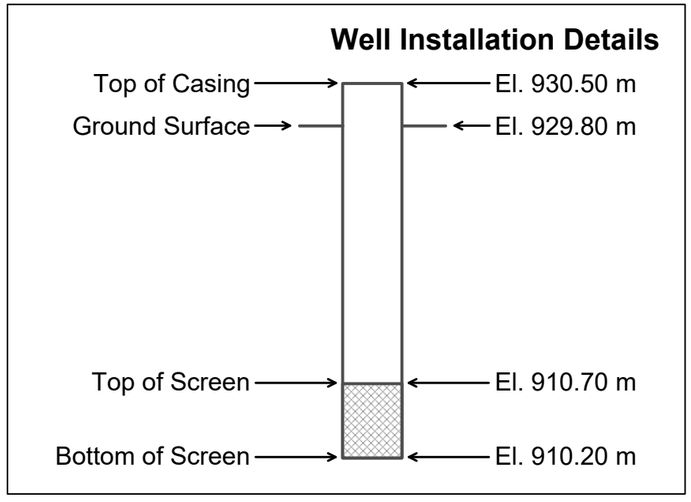
PZ-50C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	3/28/2005	1/27/2007	Once per 2 weeks
	7/12/2007	9/30/2013	Once per 3 months
	9/19/2014	6/28/2016	Yearly

5-Year Piezometric Data: PZ-51C



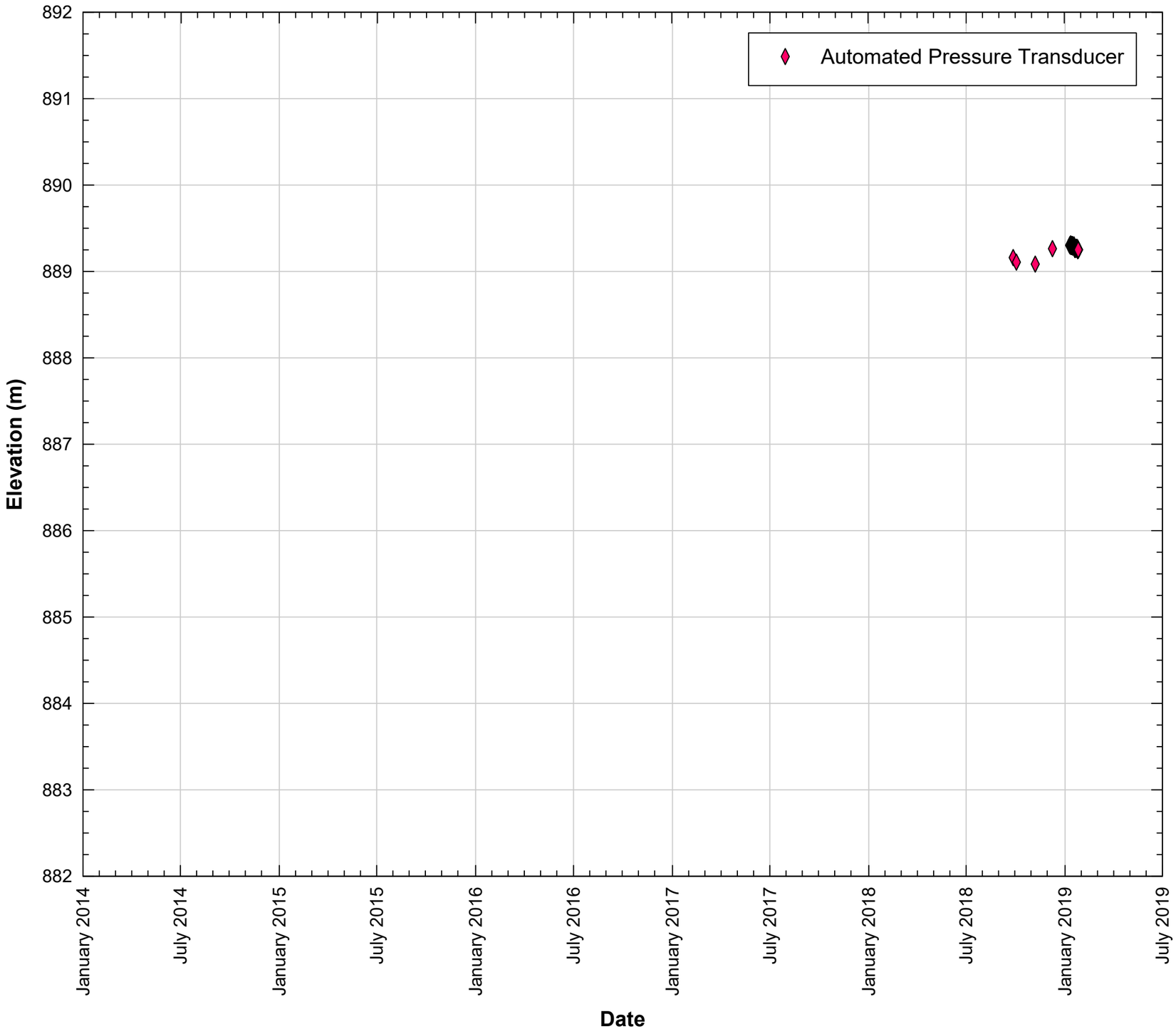
5-YEAR PIEZOMETRIC DATA: PZ-51C
FIGURE 5-29



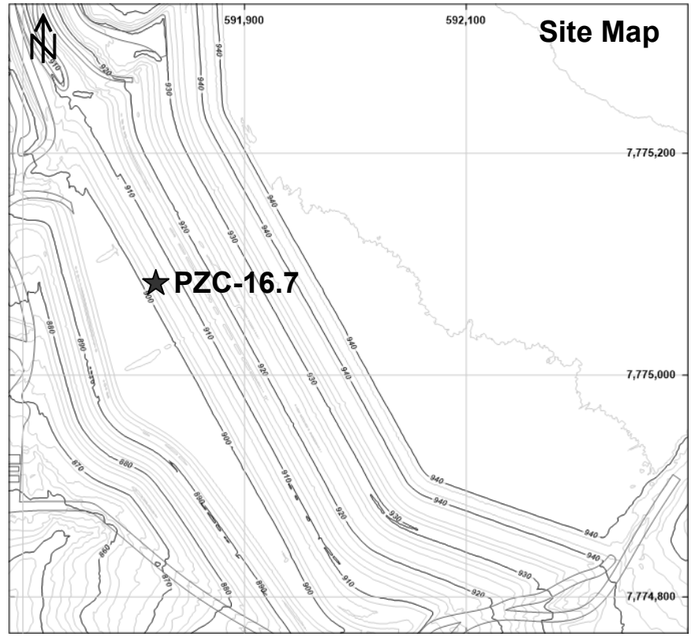


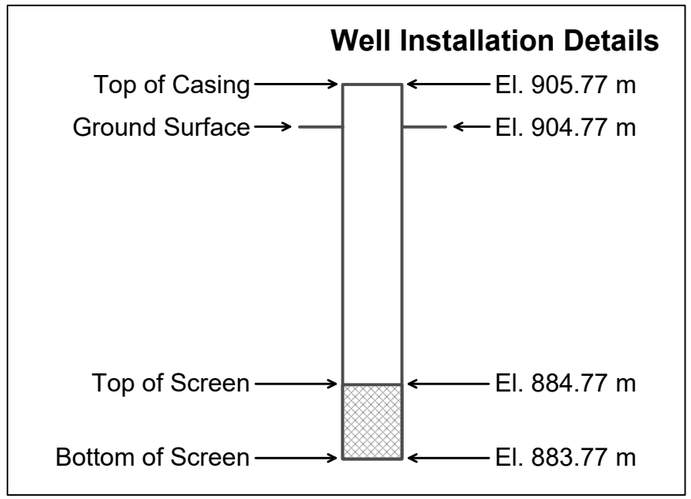
PZ-51C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	11/17/1996	1/27/2007	Once per 2 weeks
	4/4/2007	3/30/2016	Once per 2 months
Automated Pressure Transducer	9/26/2018	12/8/2018	Monthly
	1/10/2019	1/25/2018	5-Minute

5-Year Piezometric Data: PZC-16.7



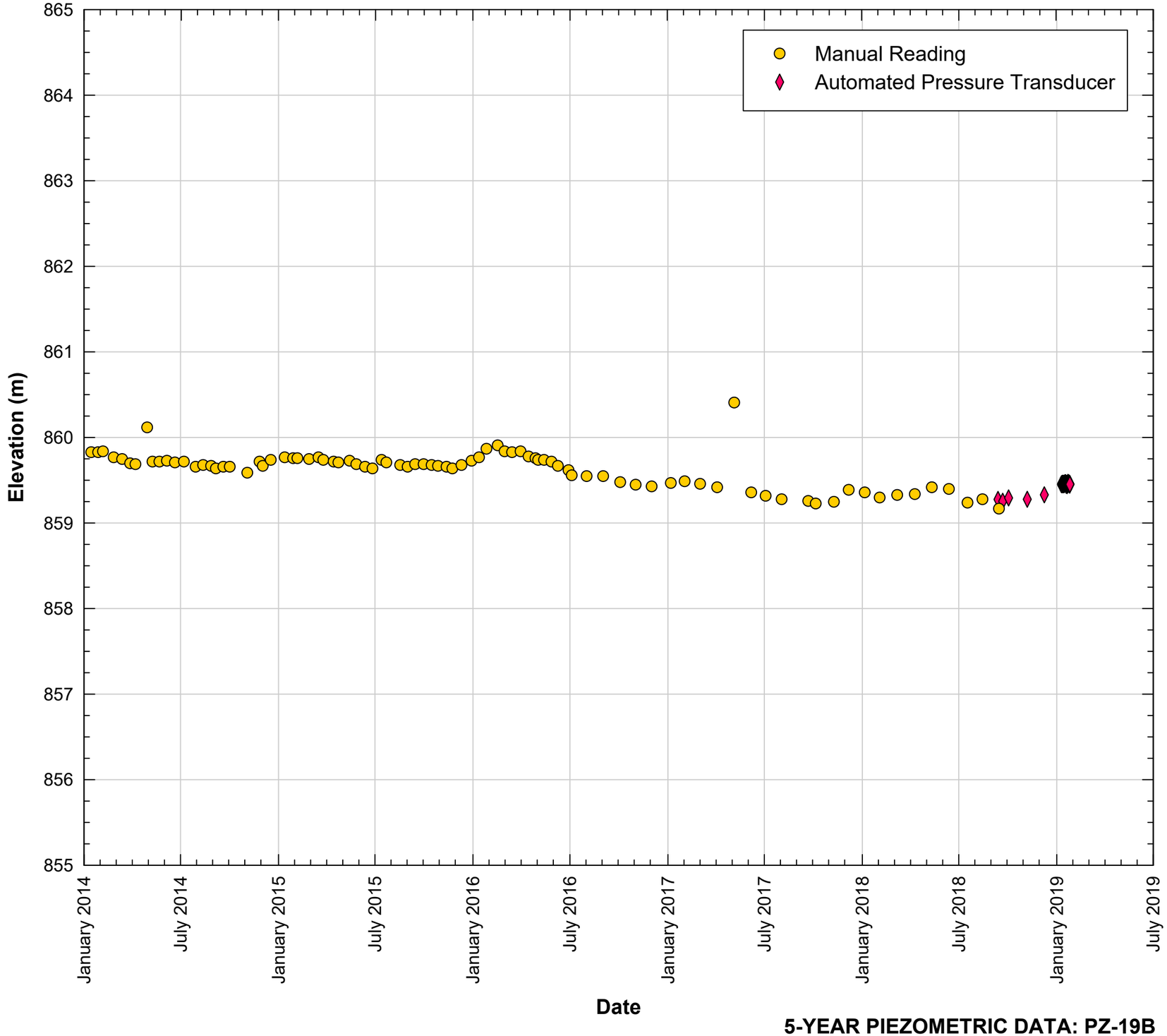
5-YEAR PIEZOMETRIC DATA: PZ-16.7
FIGURE 5-30



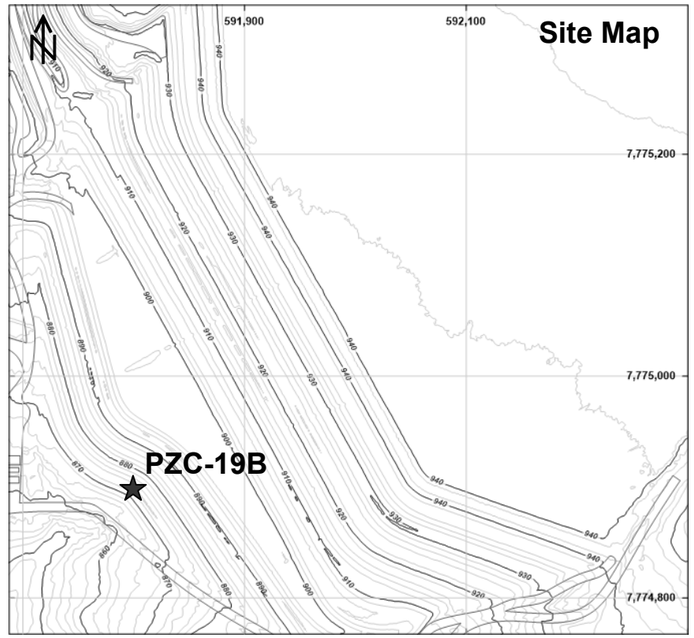


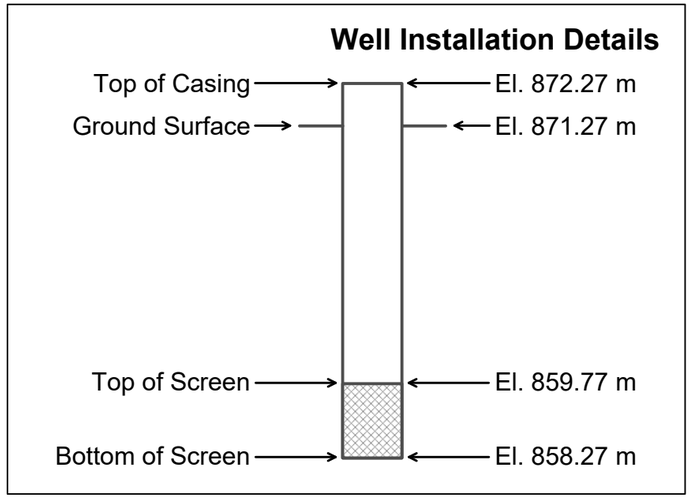
PZC-16.7			
Measurement	**From**	**To**	**Average Frequency of Reading**
Automated Pressure Transducer	9/26/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZC-19B



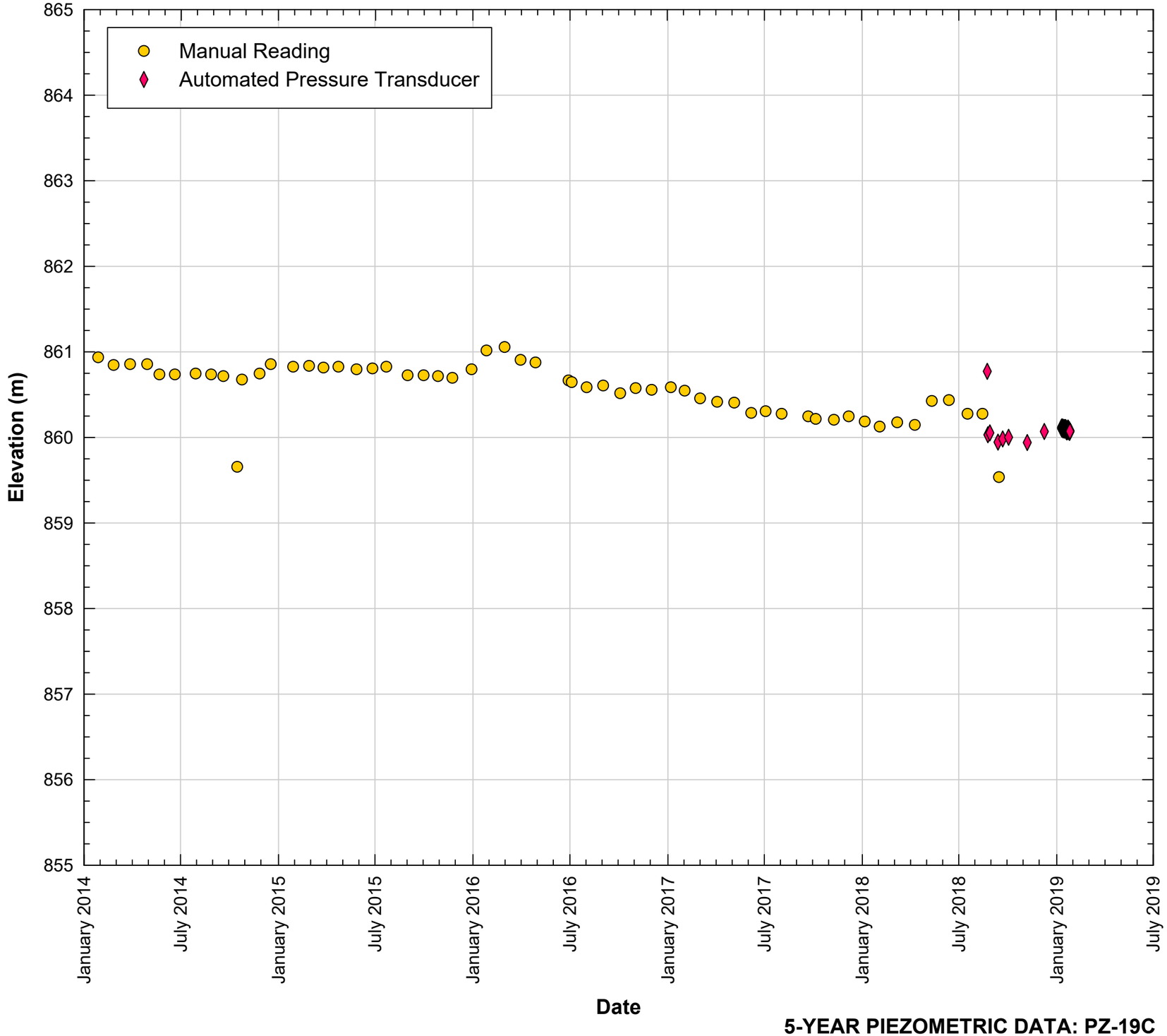
5-YEAR PIEZOMETRIC DATA: PZ-19B
FIGURE 5-31



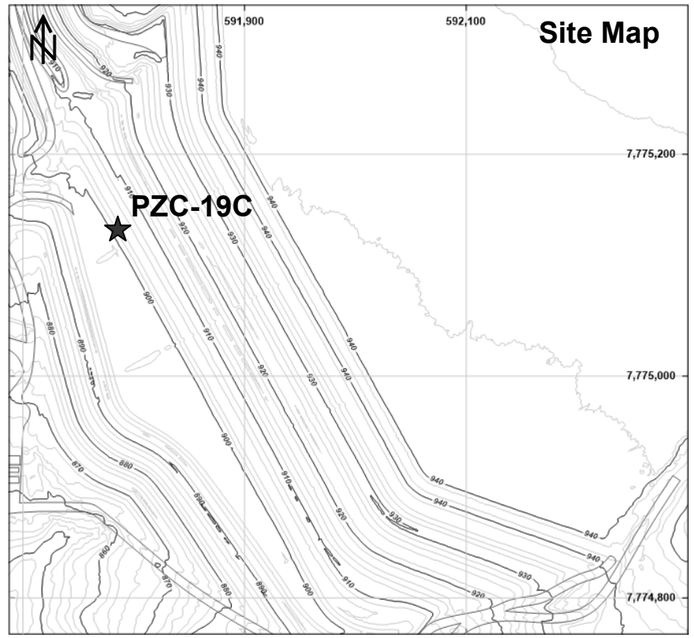


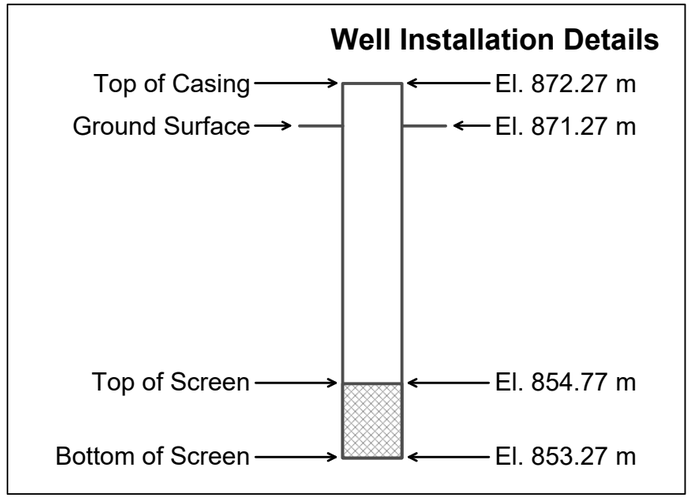
PZC-19B			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	2/13/2006	9/27/2012	Once per 2 weeks
	10/3/2012	5/31/2013	Weekly
	6/6/2013	6/28/2016	Once per 2 weeks
	7/4/2016	9/14/2018	Monthly
Automated Pressure Transducer	9/12/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZC-19C



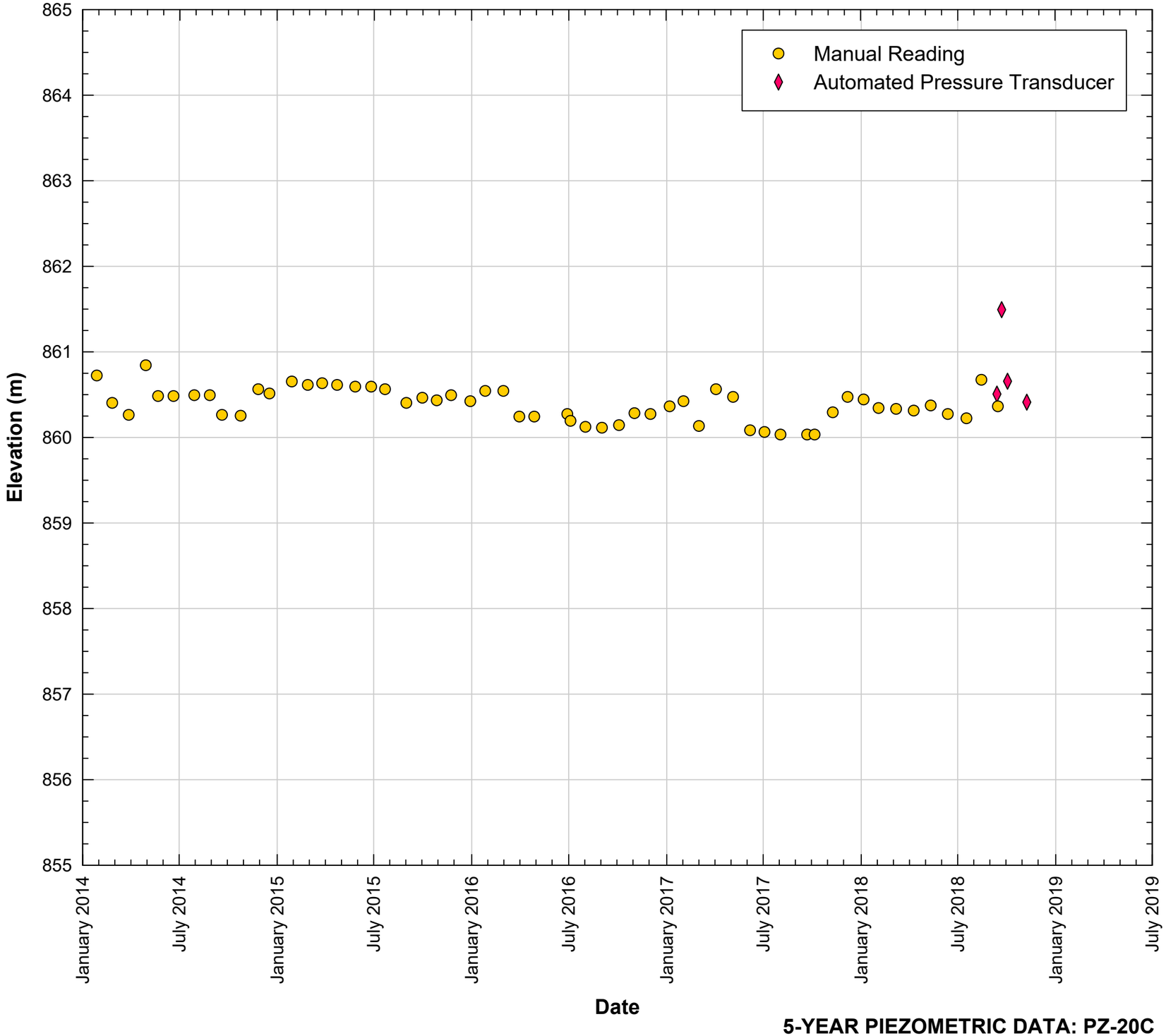
5-YEAR PIEZOMETRIC DATA: PZ-19C
FIGURE 5-32



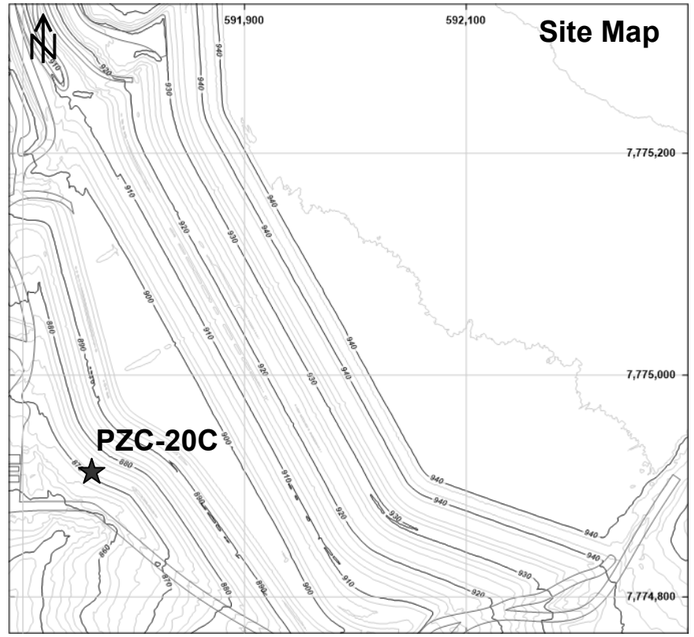


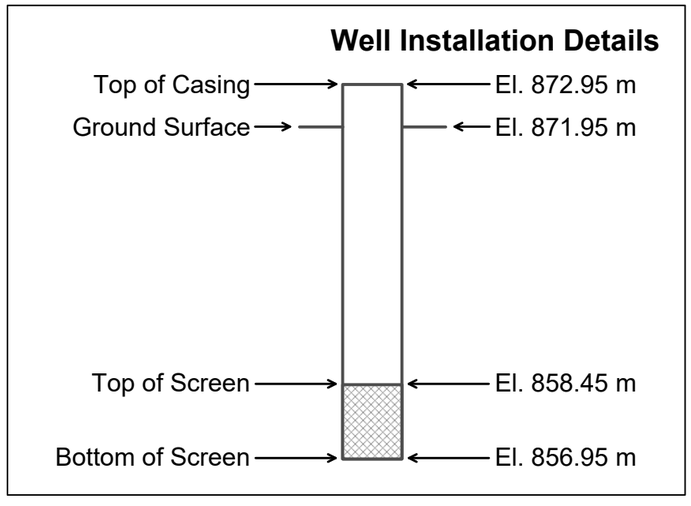
PZC-19C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	2/13/2006	1/28/2008	Once per 2 weeks
	2/26/2008	9/14/2018	Monthly
Automated Pressure Transducer	8/23/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZC-20C



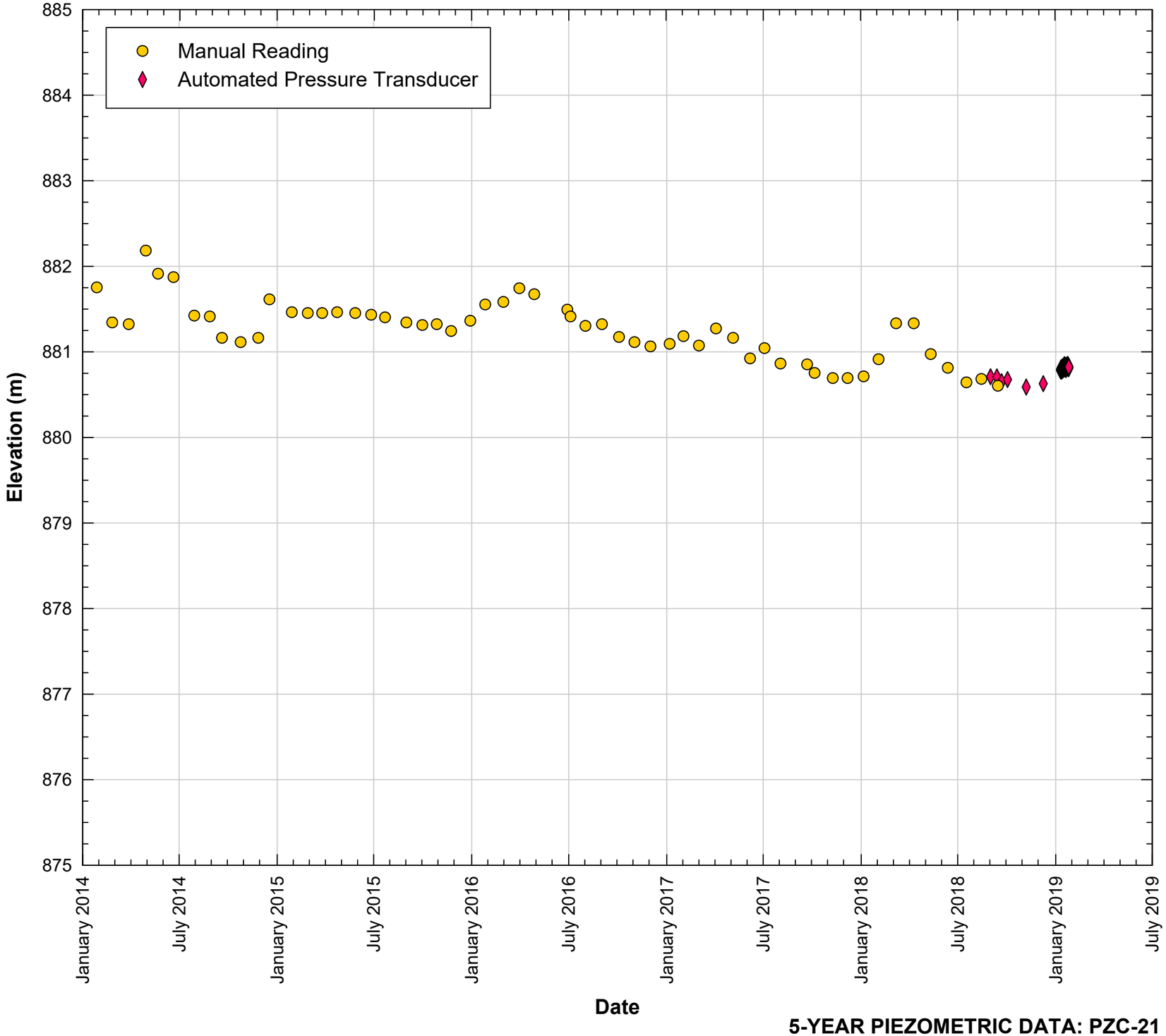
5-YEAR PIEZOMETRIC DATA: PZ-20C
FIGURE 5-33



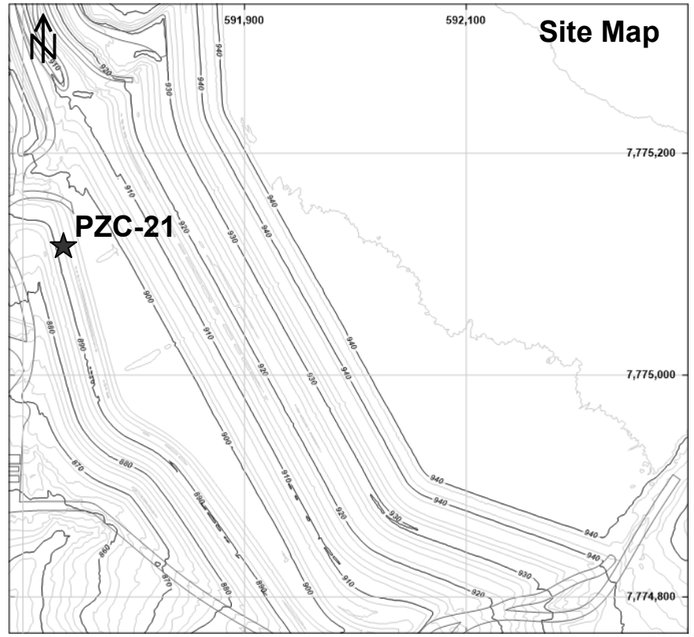


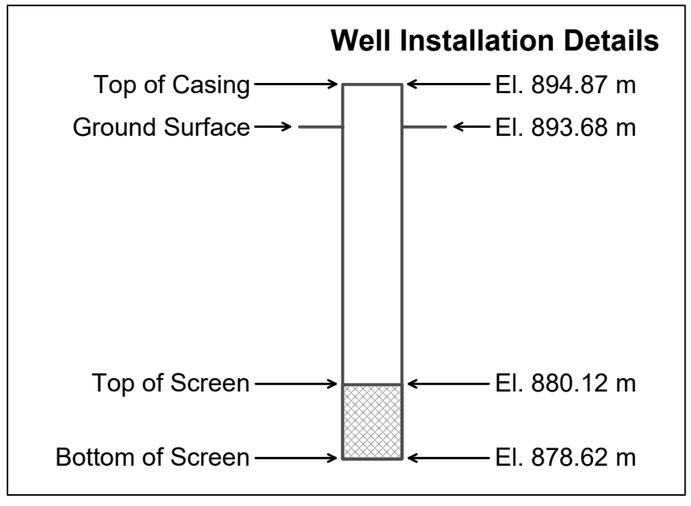
PZC-20C			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	2/13/2006	1/28/2008	Once per 2 weeks
	2/26/2008	9/14/2018	Monthly
Automated Pressure Transducer	9/12/2018	11/7/2018	Monthly

5-Year Piezometric Data: PZC-21



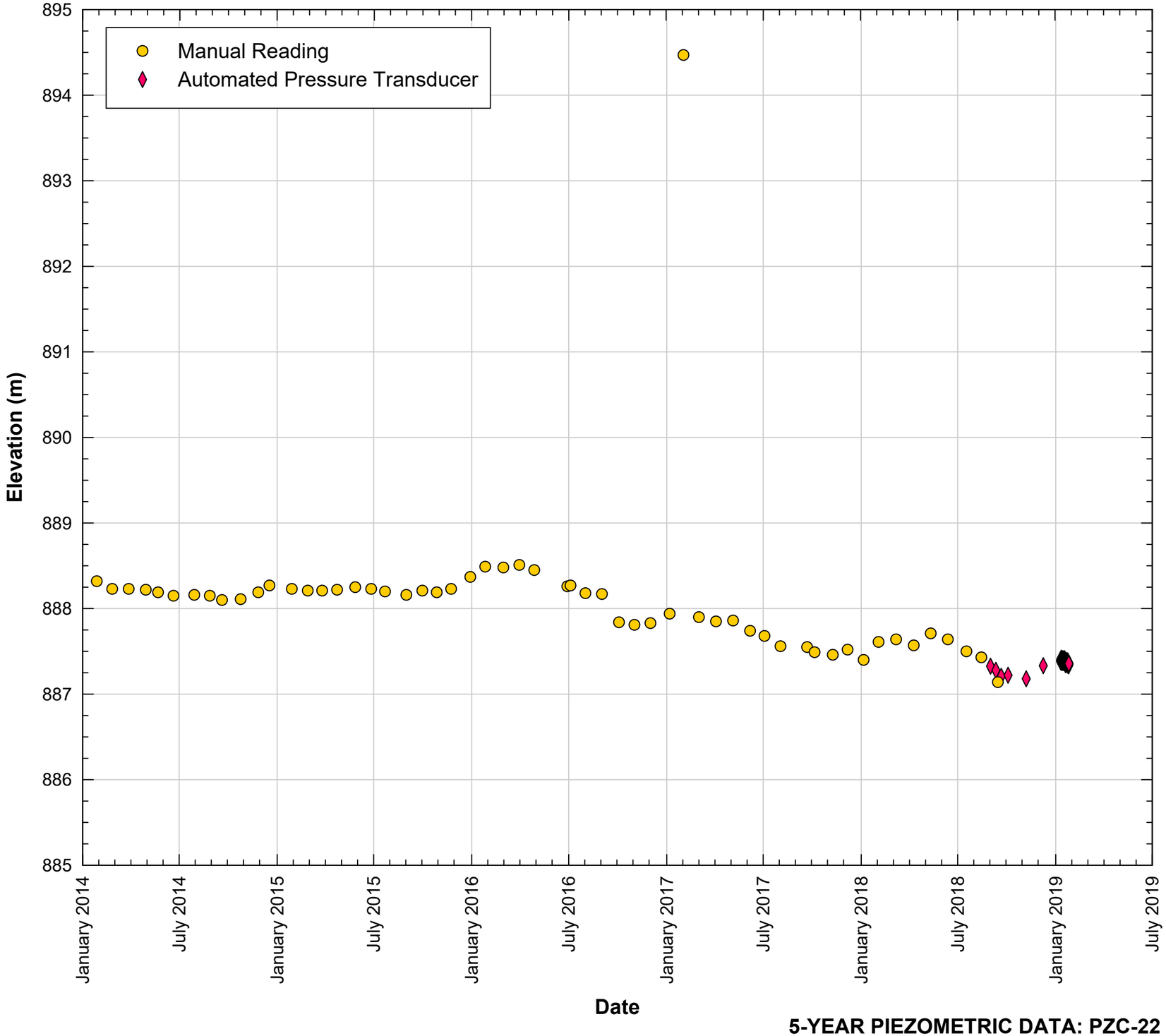
5-YEAR PIEZOMETRIC DATA: PZC-21
FIGURE 5-34



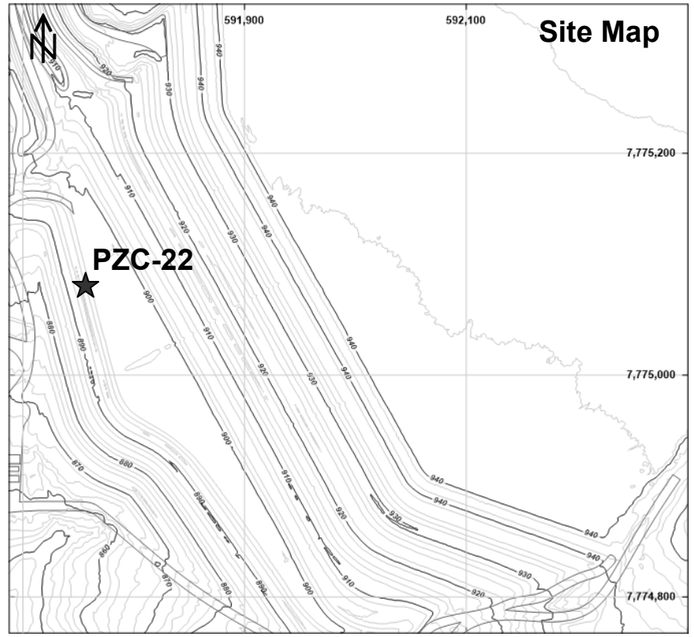


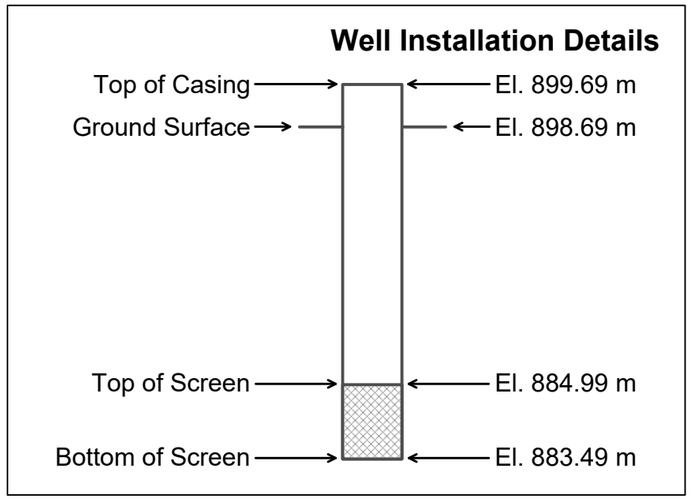
PZC-21			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/24/2007	1/28/2008	Once per 2 weeks
	2/26/2008	9/14/2018	Monthly
Automated Pressure Transducer	8/31/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZC-22



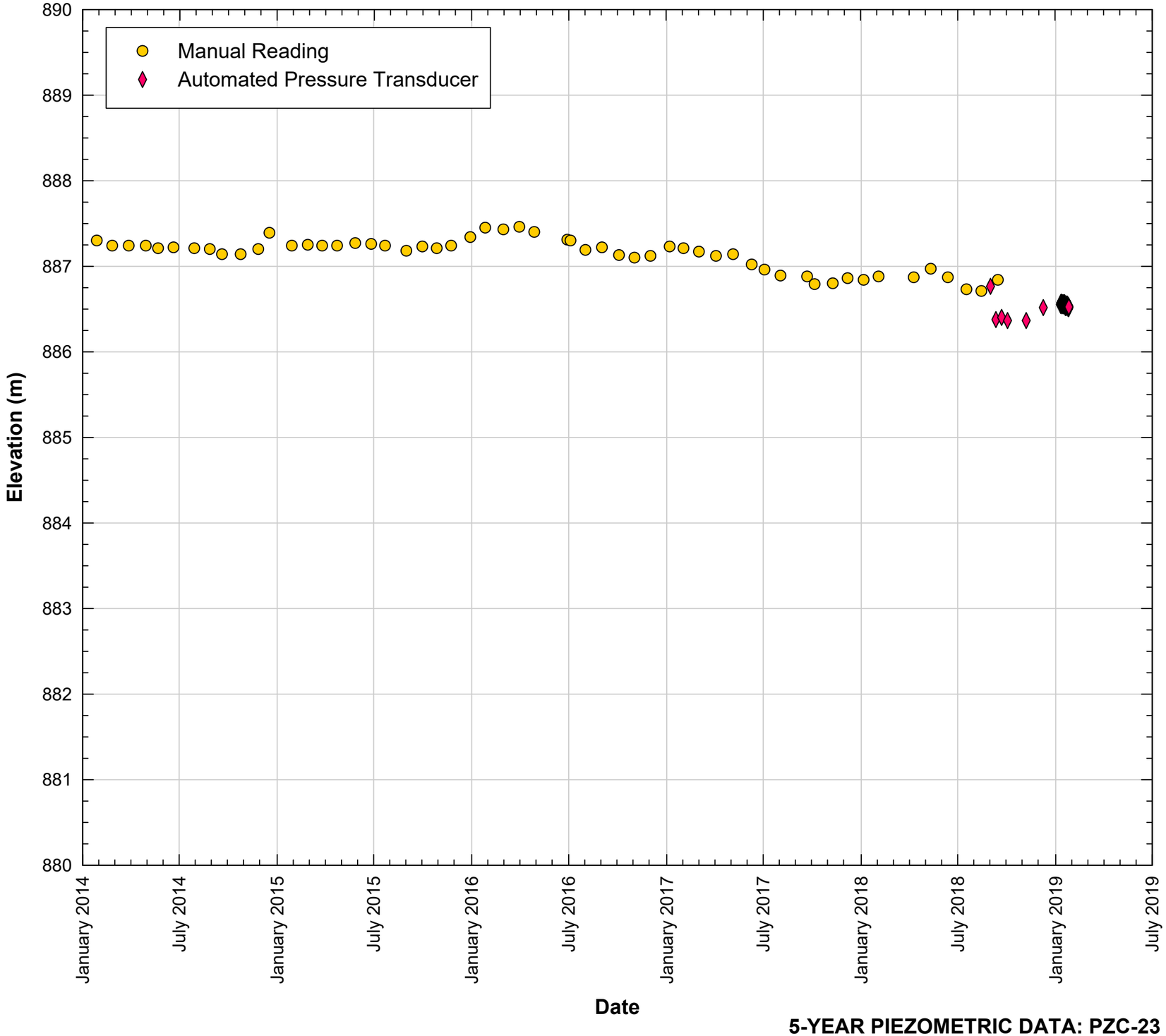
5-YEAR PIEZOMETRIC DATA: PZC-22
FIGURE 5-35



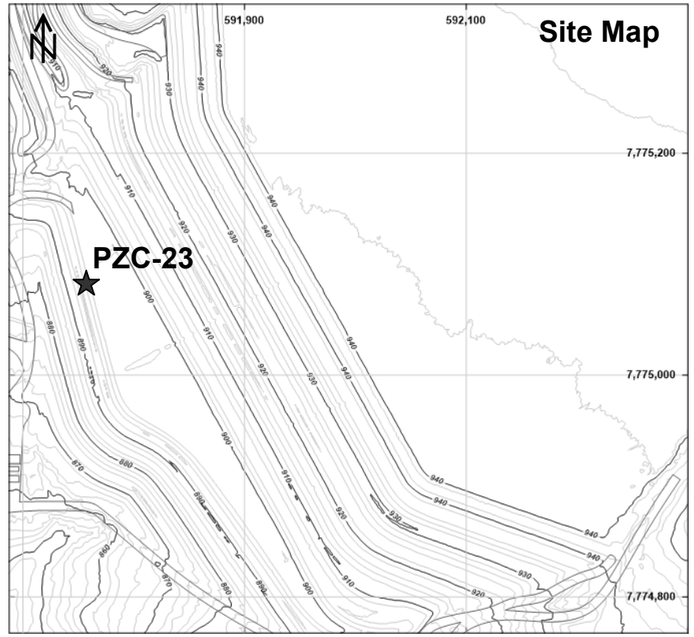


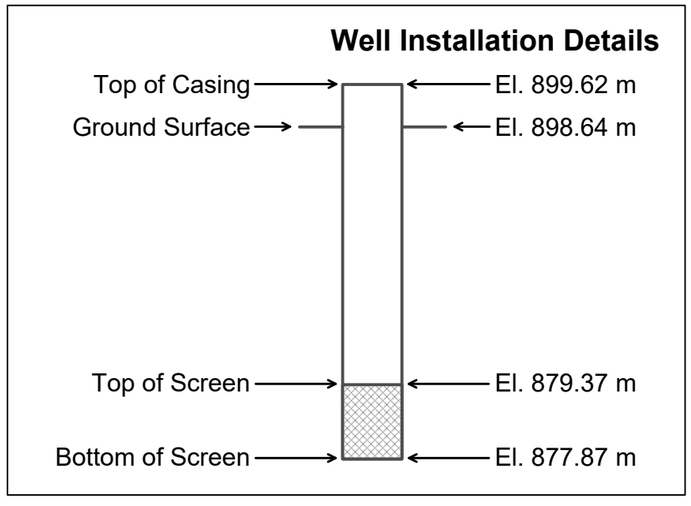
PZC-22			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/24/2007	1/28/2008	Once per 2 weeks
	2/26/2008	9/14/2018	Monthly
Automated Pressure Transducer	8/31/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZC-23



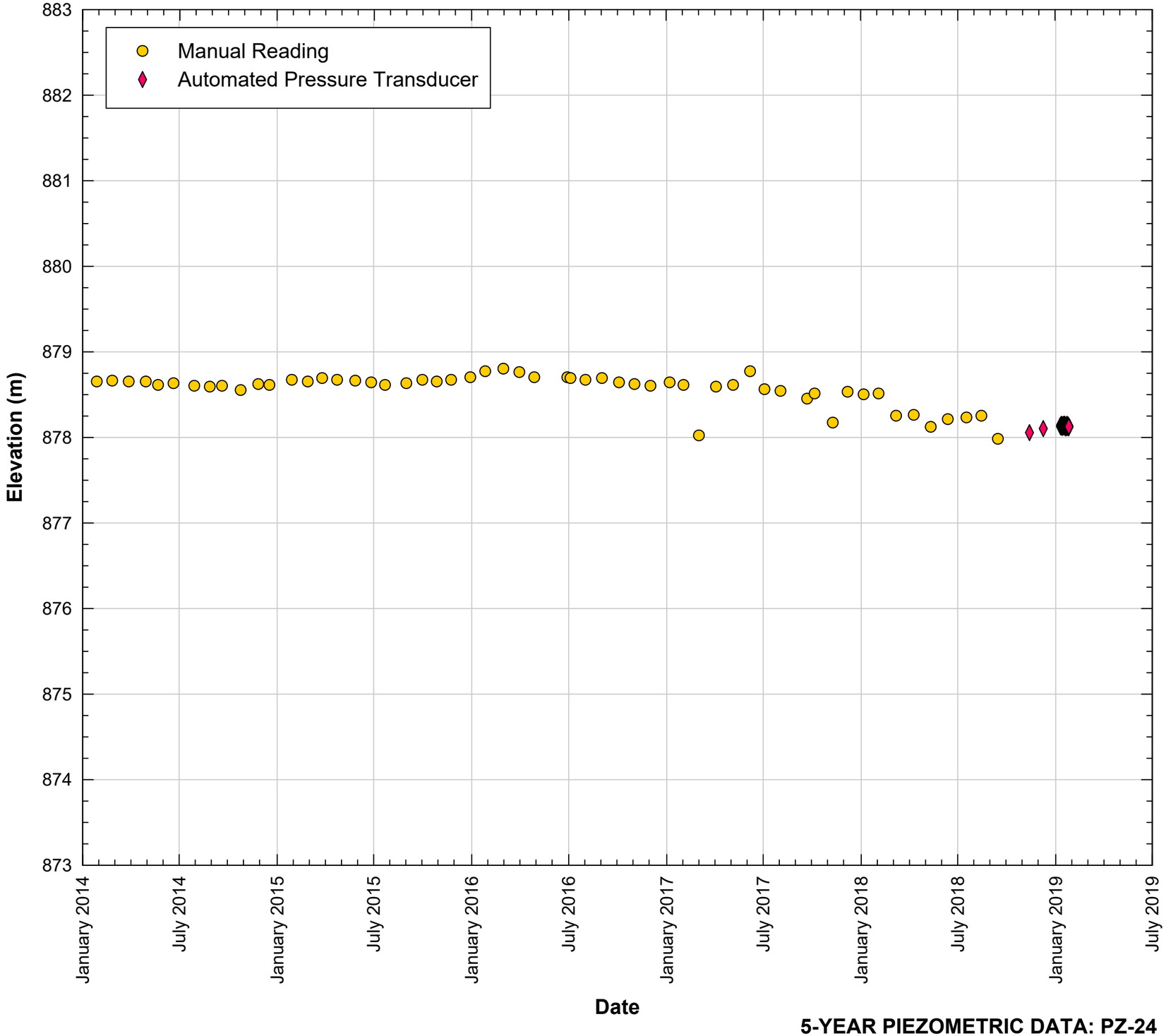
5-YEAR PIEZOMETRIC DATA: PZC-23
FIGURE 5-36



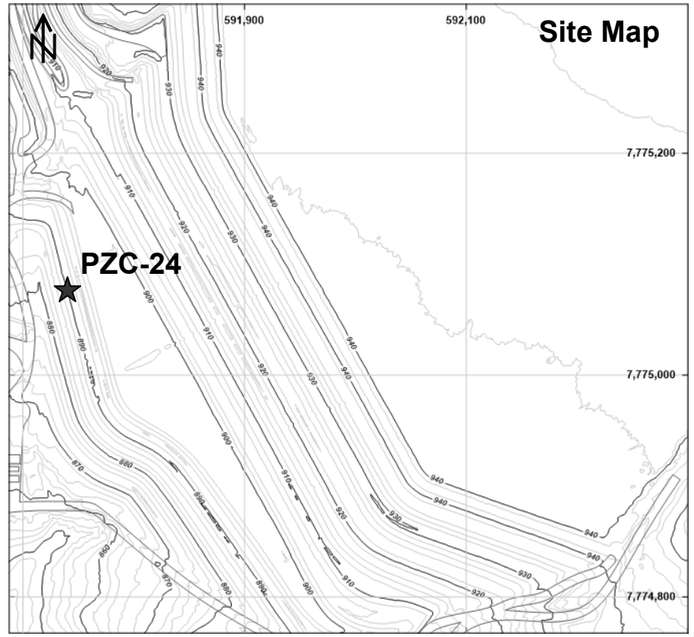


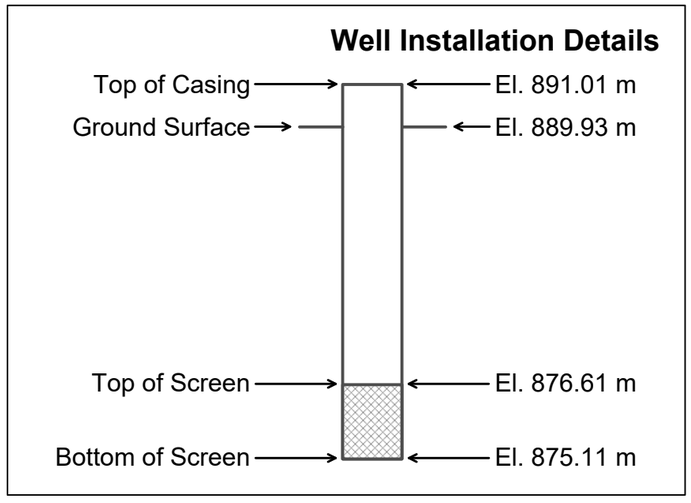
PZC-23			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/24/2007	10/31/2007	Once per 2 weeks
	11/26/2007	9/14/2018	Monthly
Automated Pressure Transducer	8/31/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZC-24



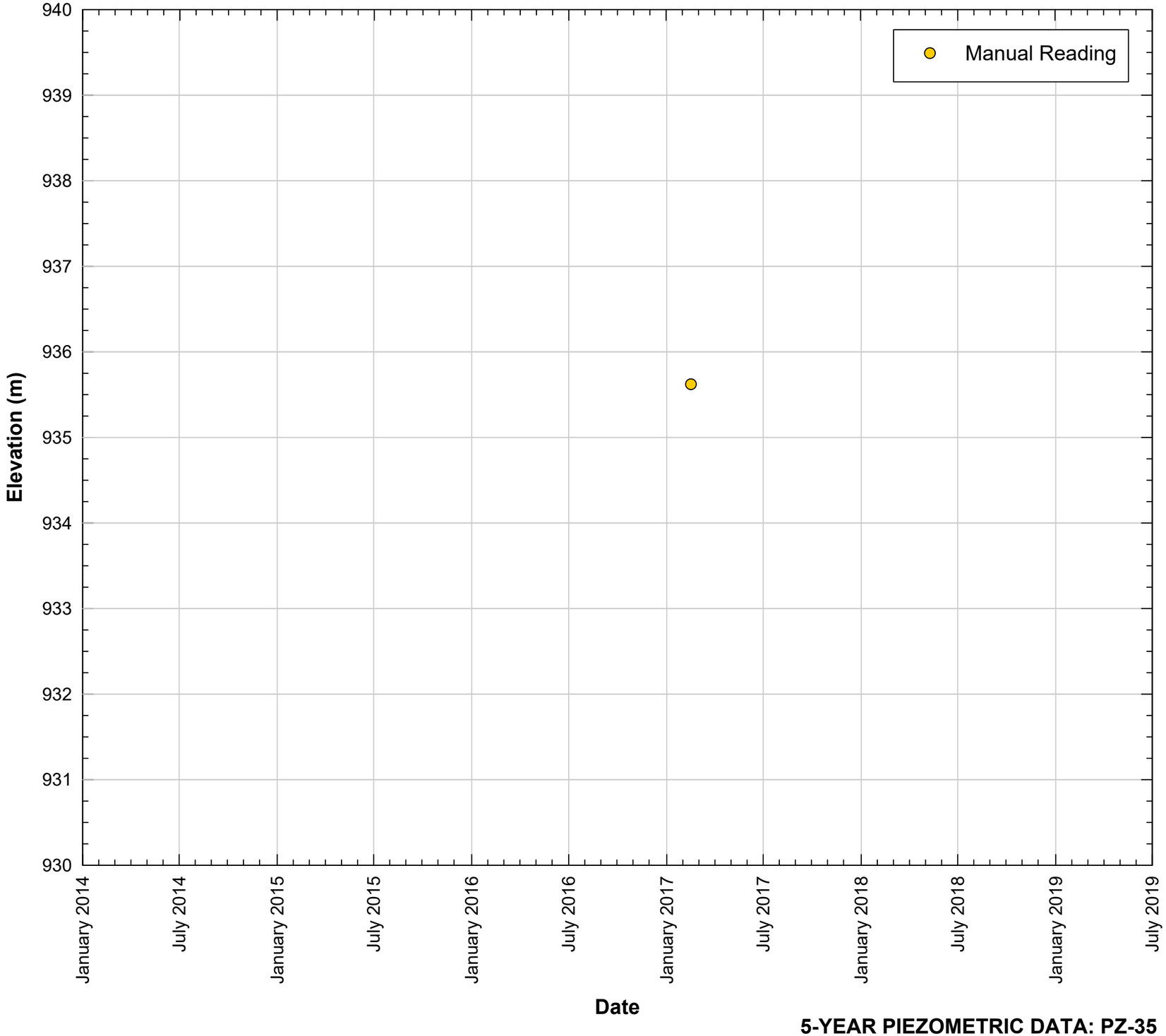
5-YEAR PIEZOMETRIC DATA: PZ-24
FIGURE 5-37

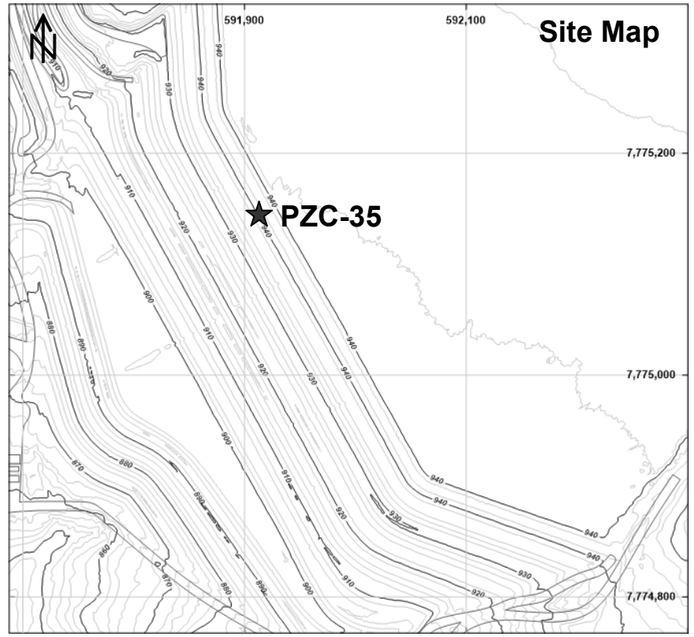


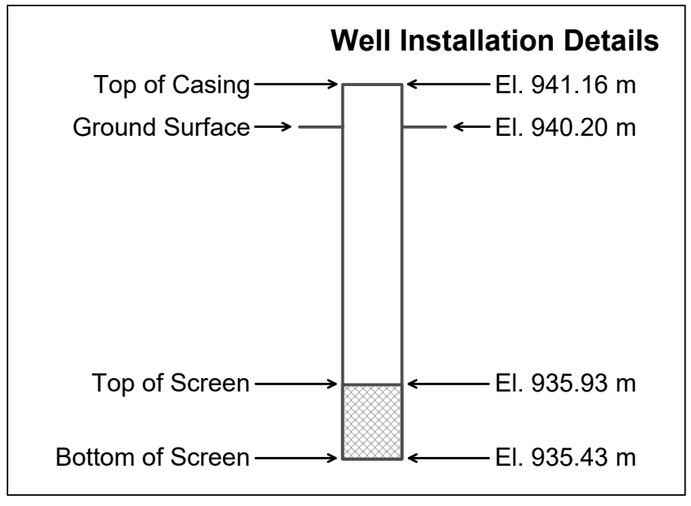


PZC-24			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/24/2007	1/28/2008	Once per 2 weeks
	2/26/2008	9/14/2018	Monthly
Automated Pressure Transducer	11/12/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZC-35

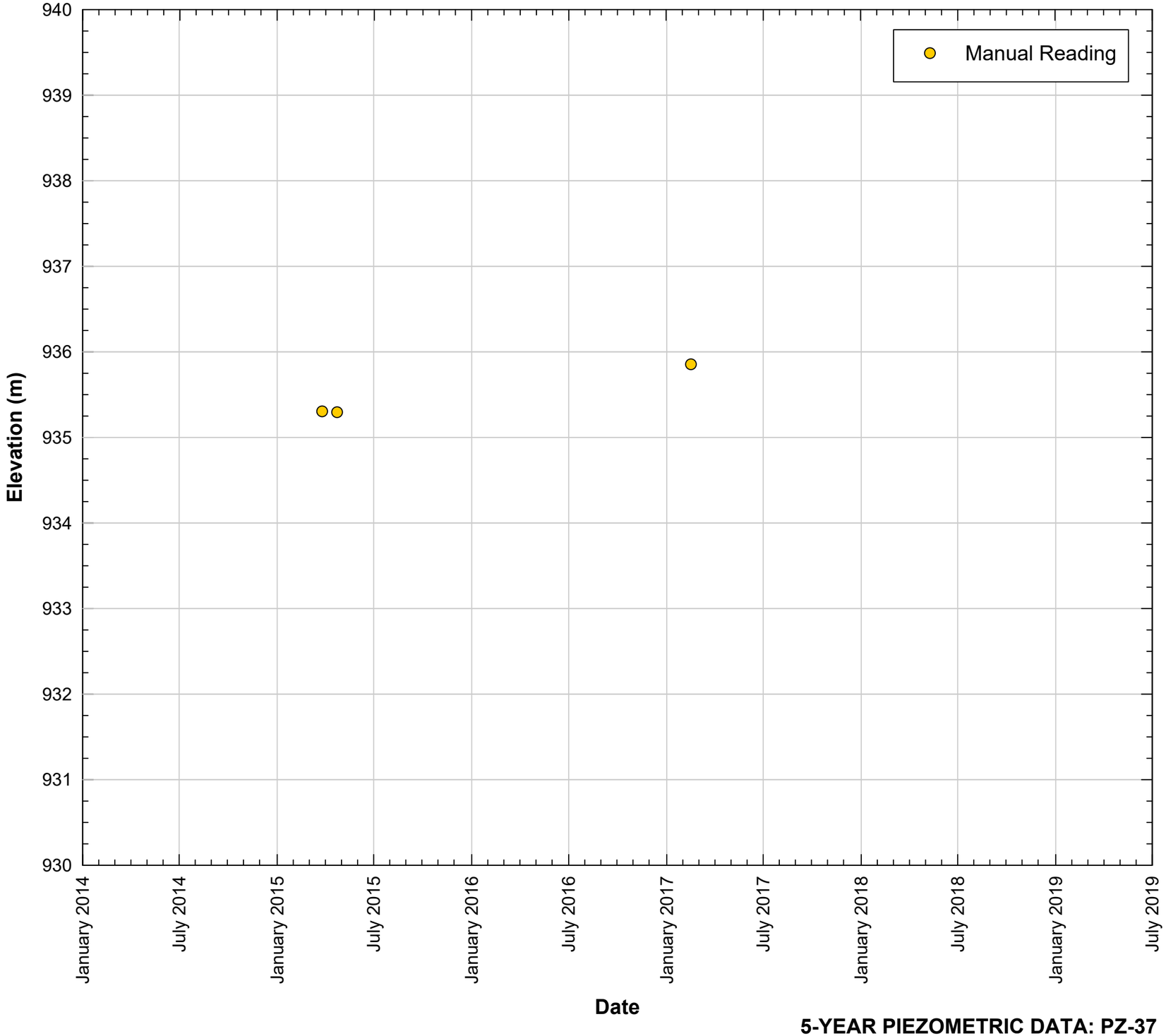




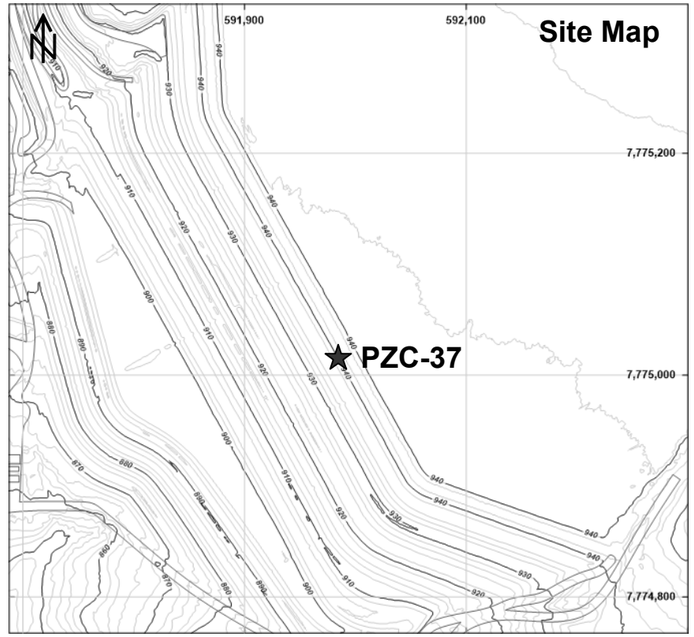


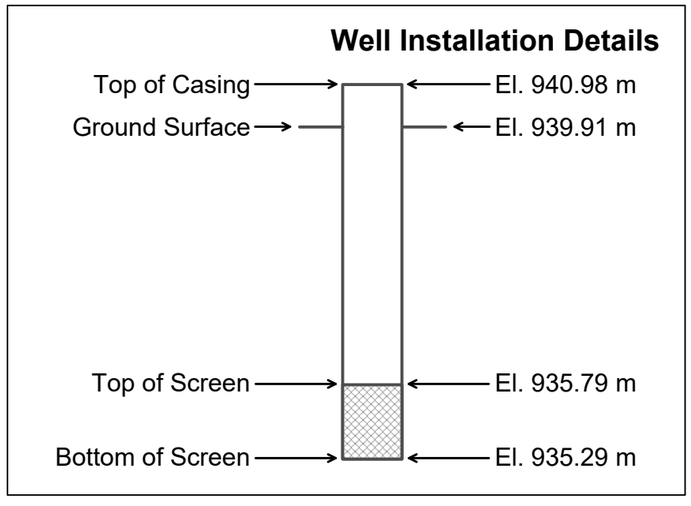
PZC-35			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	2/15/2017	2/15/2017	Monthly

5-YEAR PIEZOMETRIC DATA: PZ-35
FIGURE 5-38



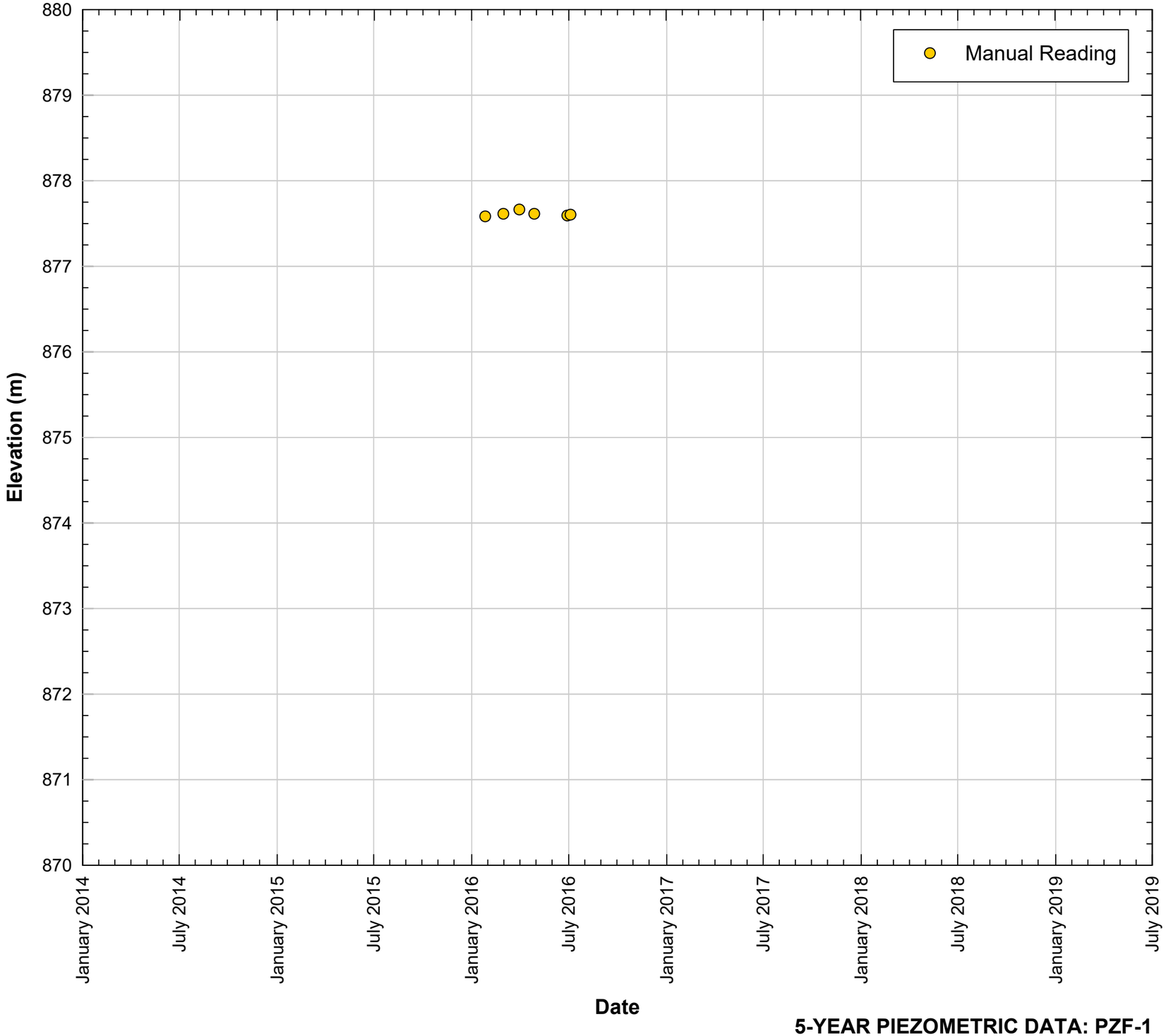
5-YEAR PIEZOMETRIC DATA: PZ-37
FIGURE 5-39



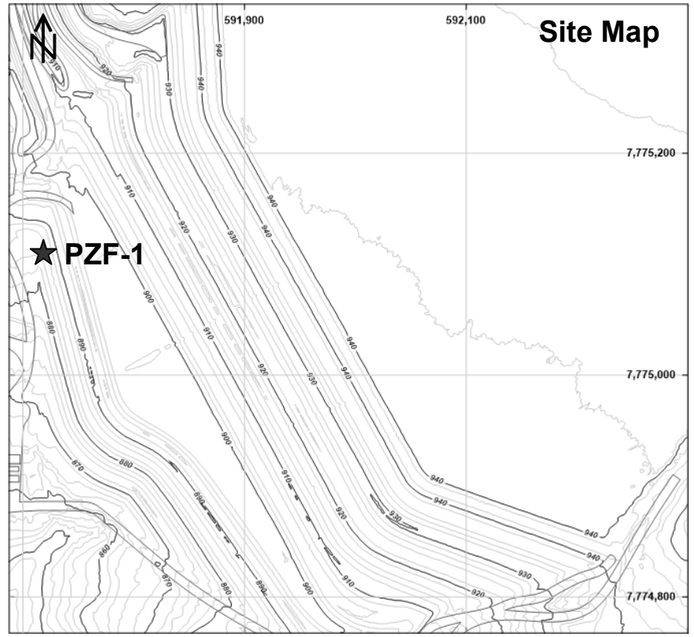


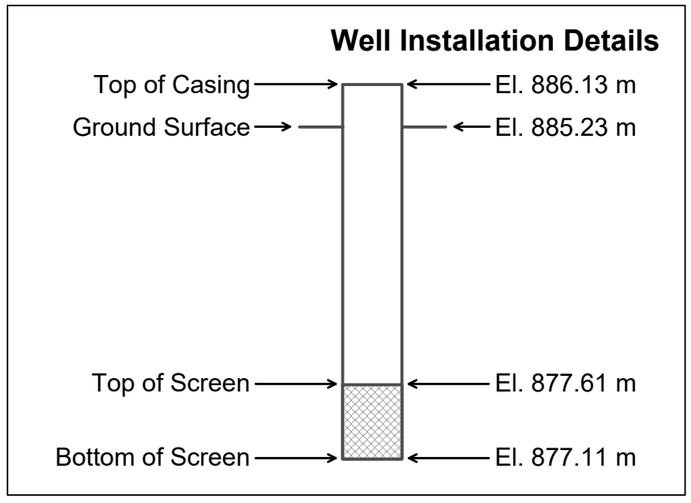
PZC-37			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	3/26/2015	2/15/2017	Monthly

5-Year Piezometric Data: PZF-1



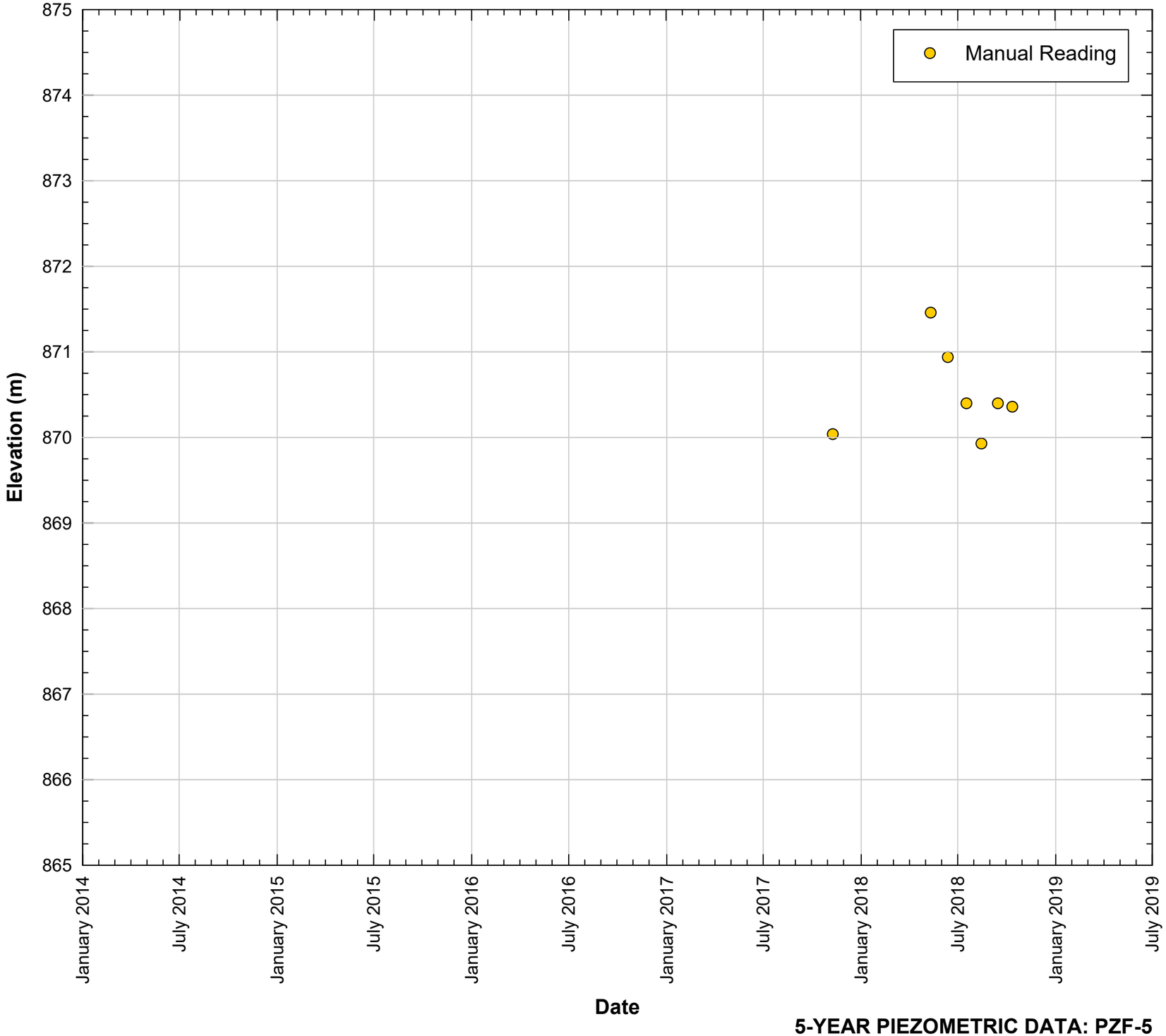
5-YEAR PIEZOMETRIC DATA: PZF-1
FIGURE 5-40

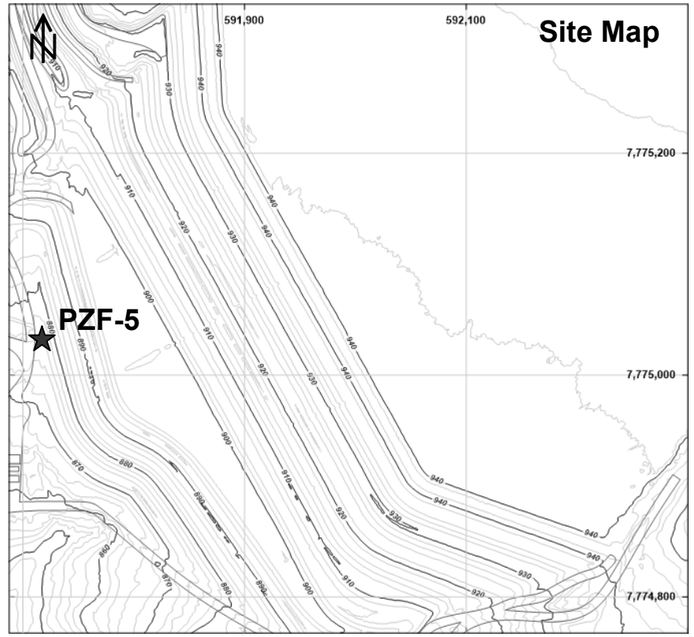


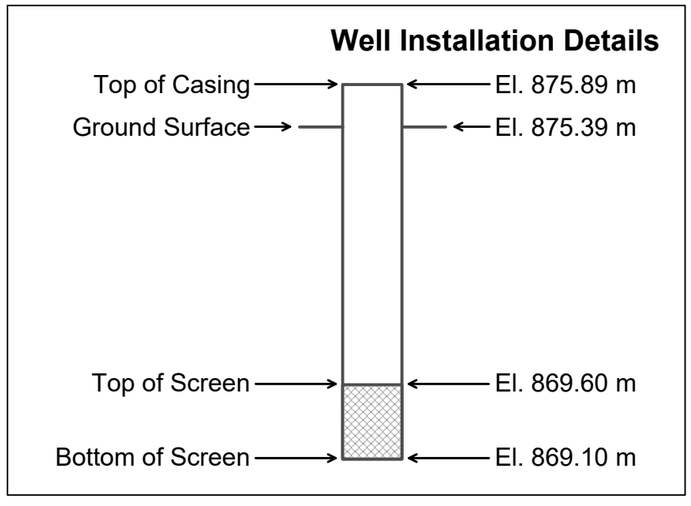


PZF-1			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	11/6/1998	2/10/2005	Monthly
	3/11/2005	7/25/2007	Once per 2 weeks
	1/7/2008	7/4/2016	Monthly

5-Year Piezometric Data: PZF-5



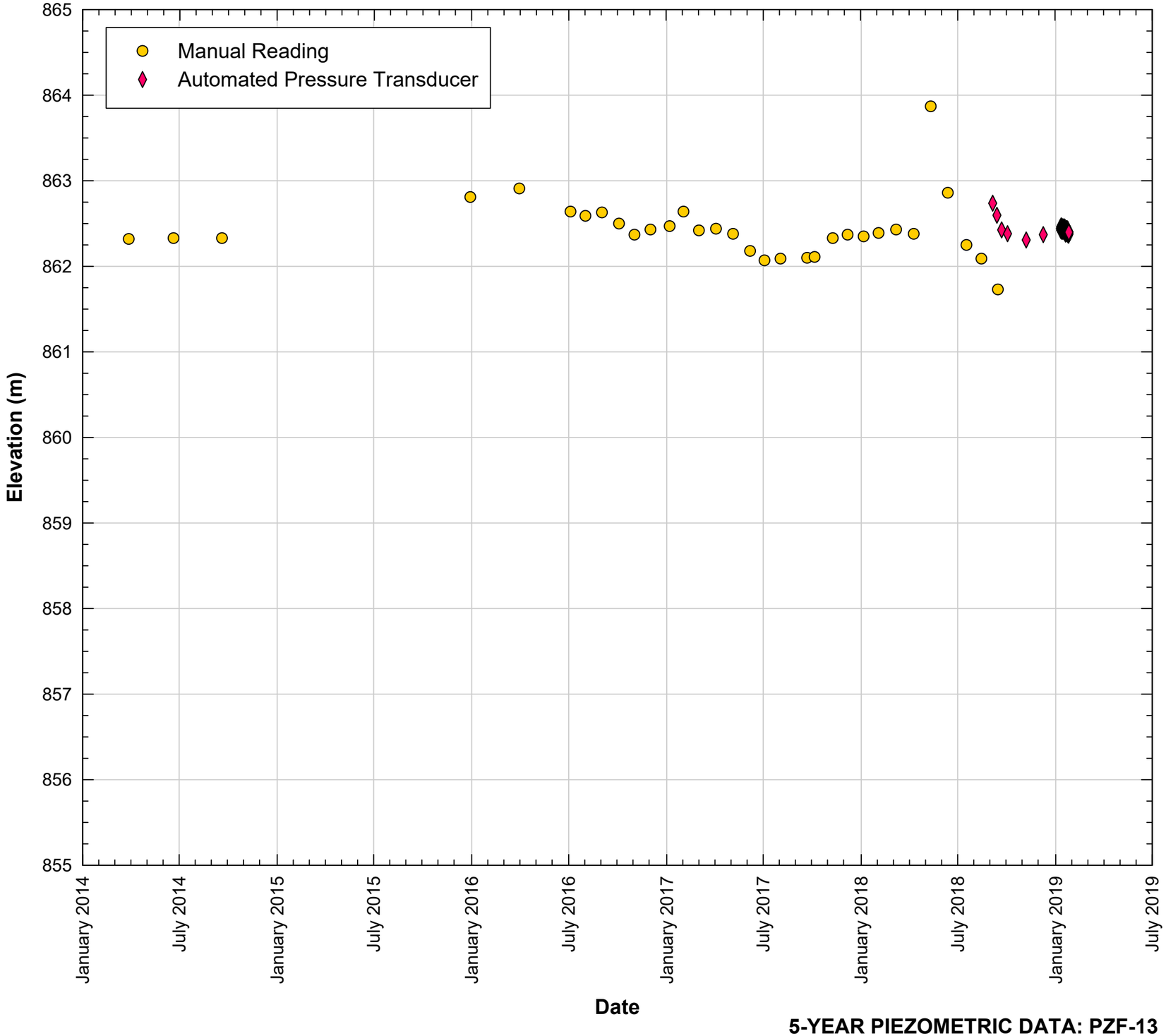




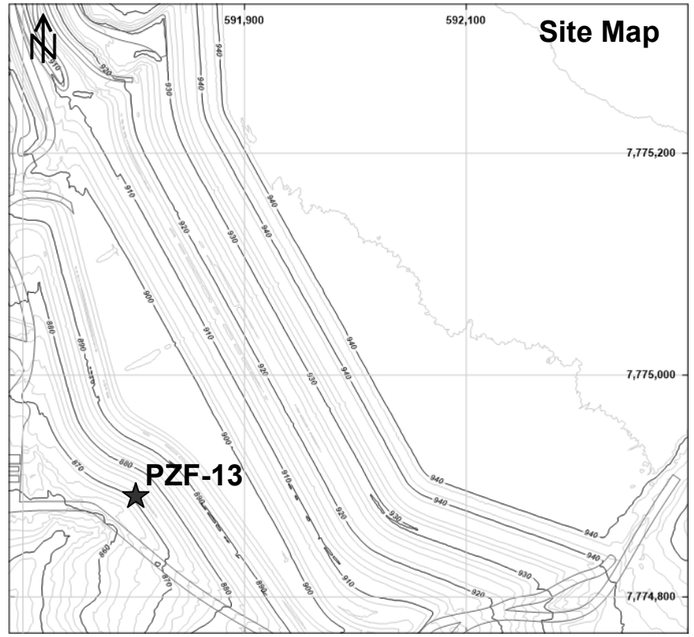
PZF-5			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	10/11/2018	Monthly

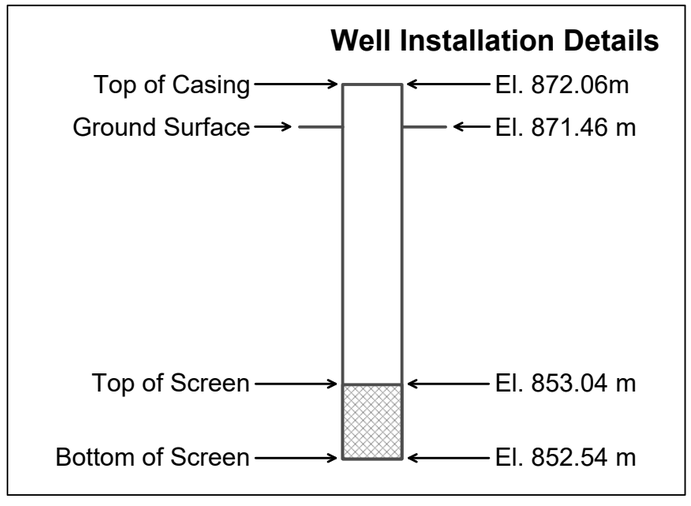
5-YEAR PIEZOMETRIC DATA: PZF-5
FIGURE 5-41

5-Year Piezometric Data: PZF-13



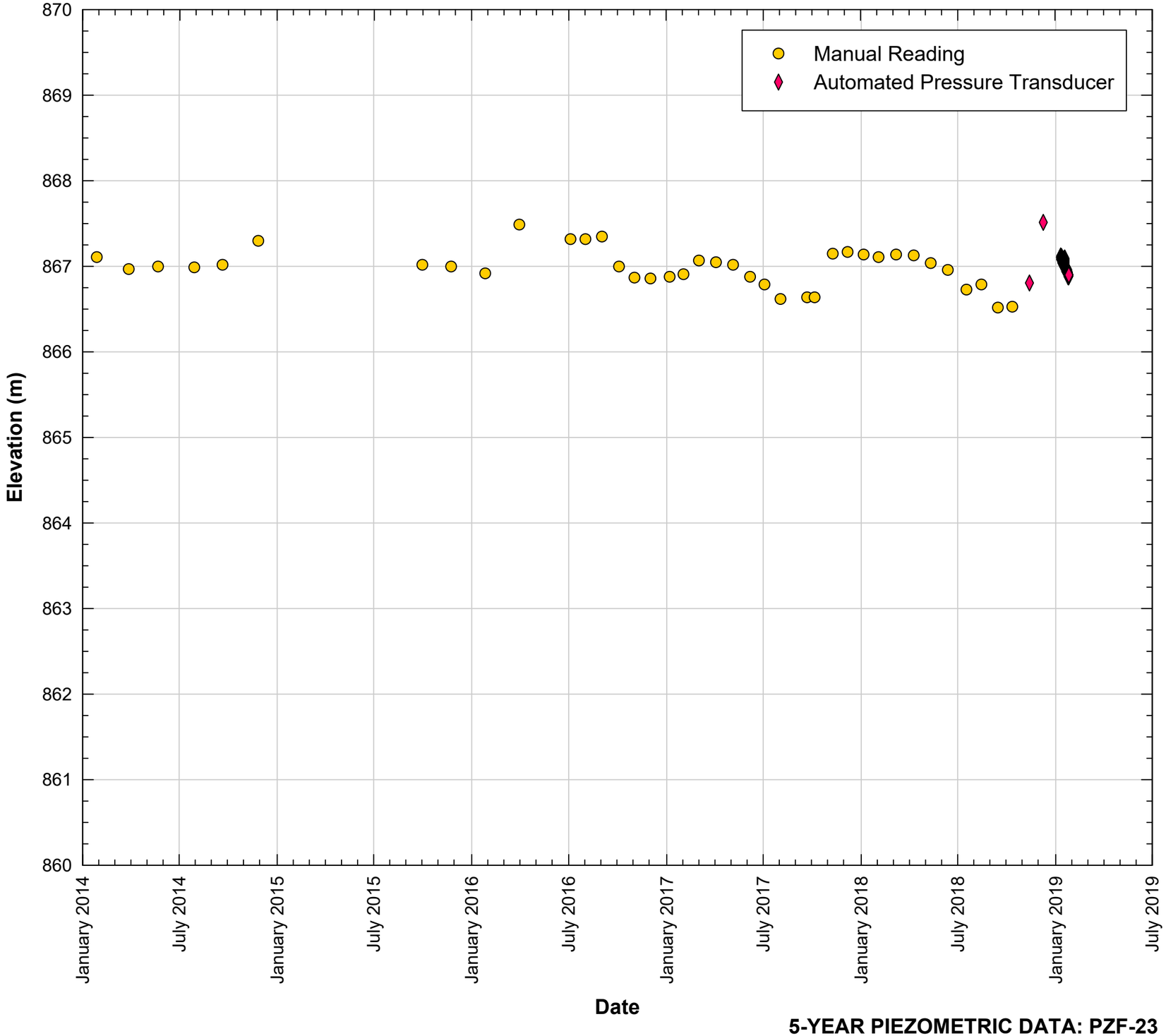
5-YEAR PIEZOMETRIC DATA: PZF-13
FIGURE 5-42



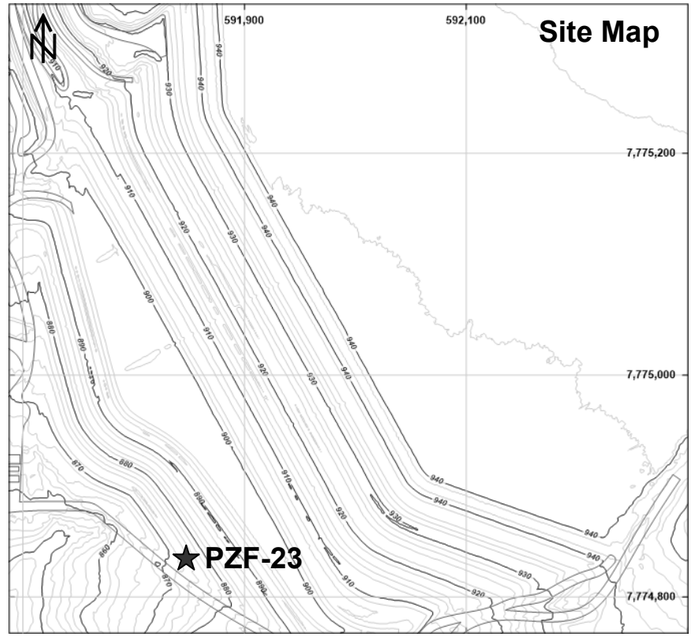


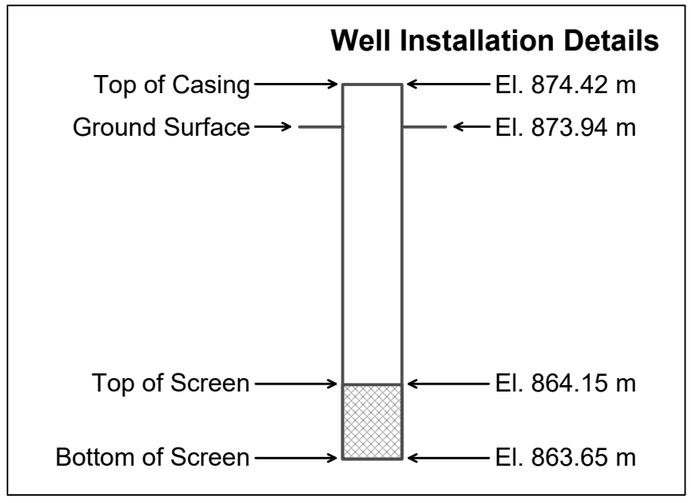
PZF-13			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	2/10/2005	Monthly
	3/11/2005	1/27/2007	Once per 2 weeks
	7/12/2007	3/30/2016	Once per 3 months
	7/4/2016	9/14/2018	Monthly
Automated Pressure Transducer	9/4/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZF-23



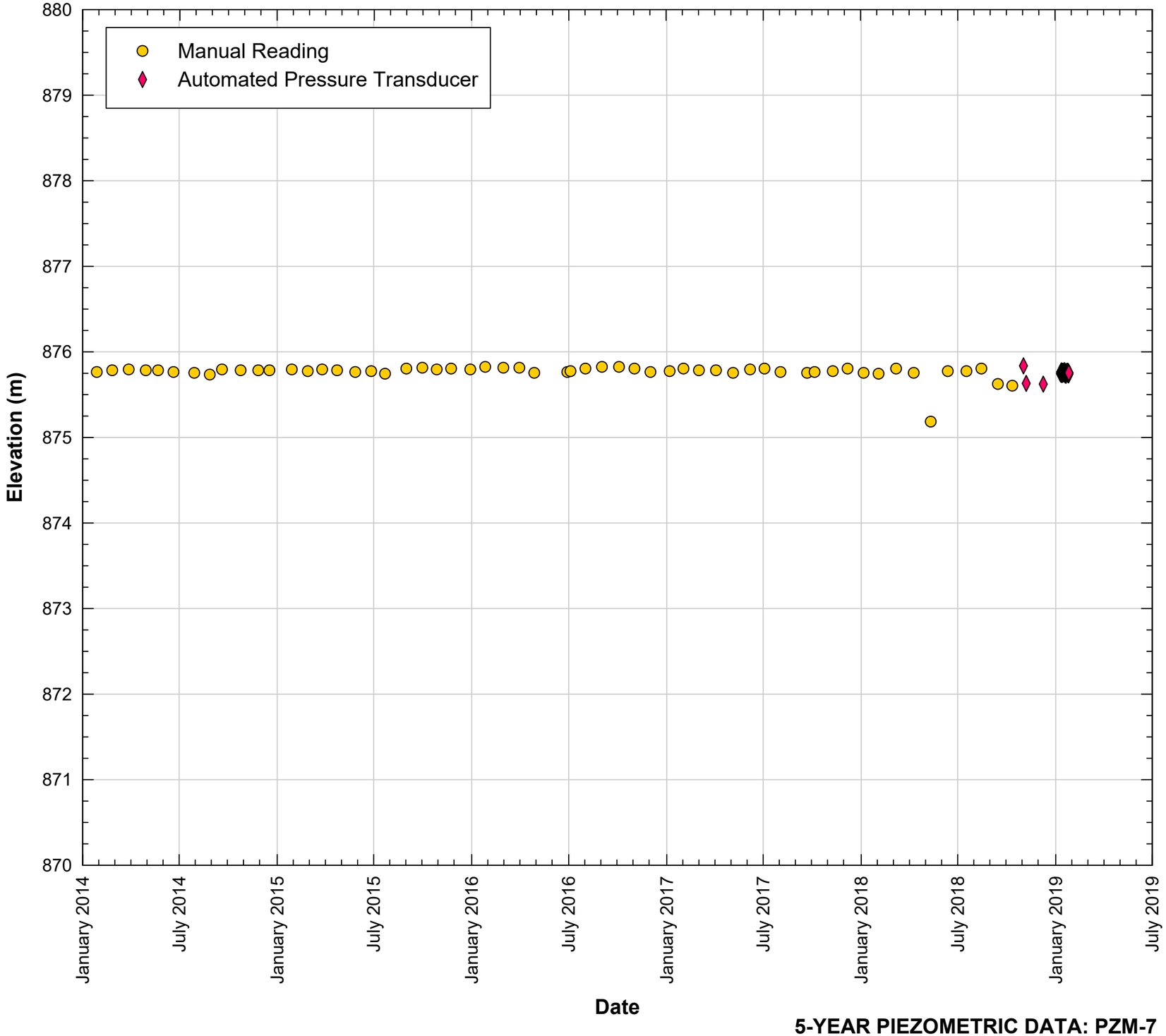
5-YEAR PIEZOMETRIC DATA: PZF-23
FIGURE 5-43



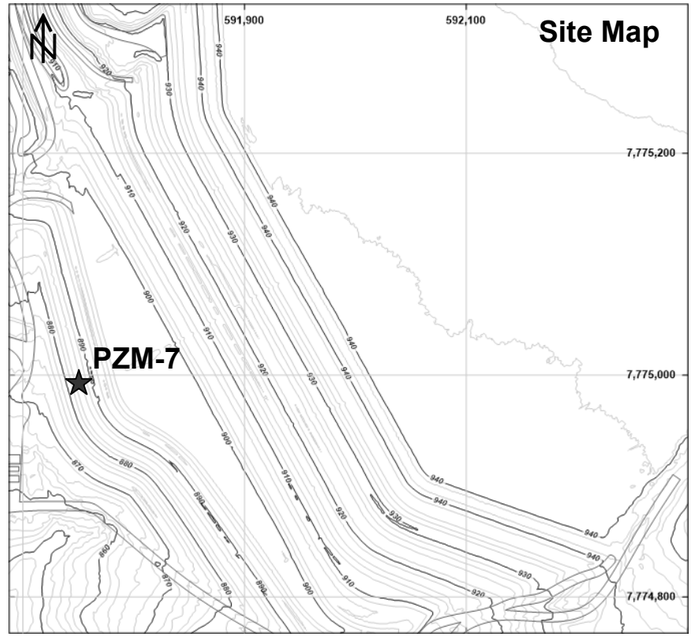


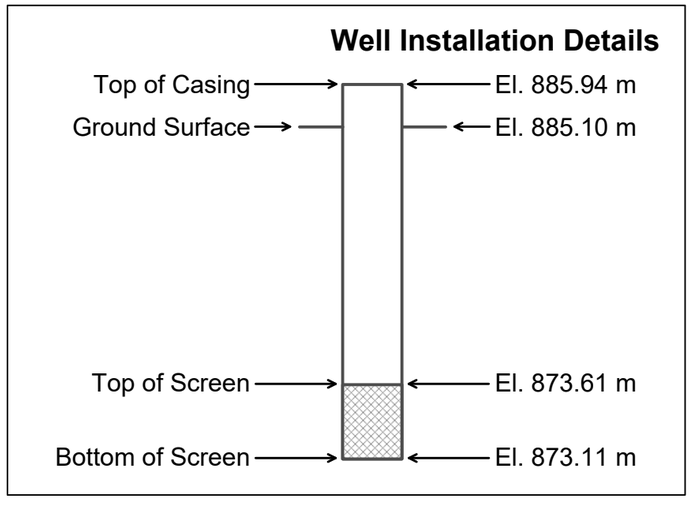
PZF-23			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	2/10/2005	Monthly
	3/11/2005	1/27/2007	Once per 2 weeks
	4/4/2007	3/30/2016	Once per 3 months
	7/4/2016	10/11/2018	Monthly
Automated Pressure Transducer	11/12/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZM-7



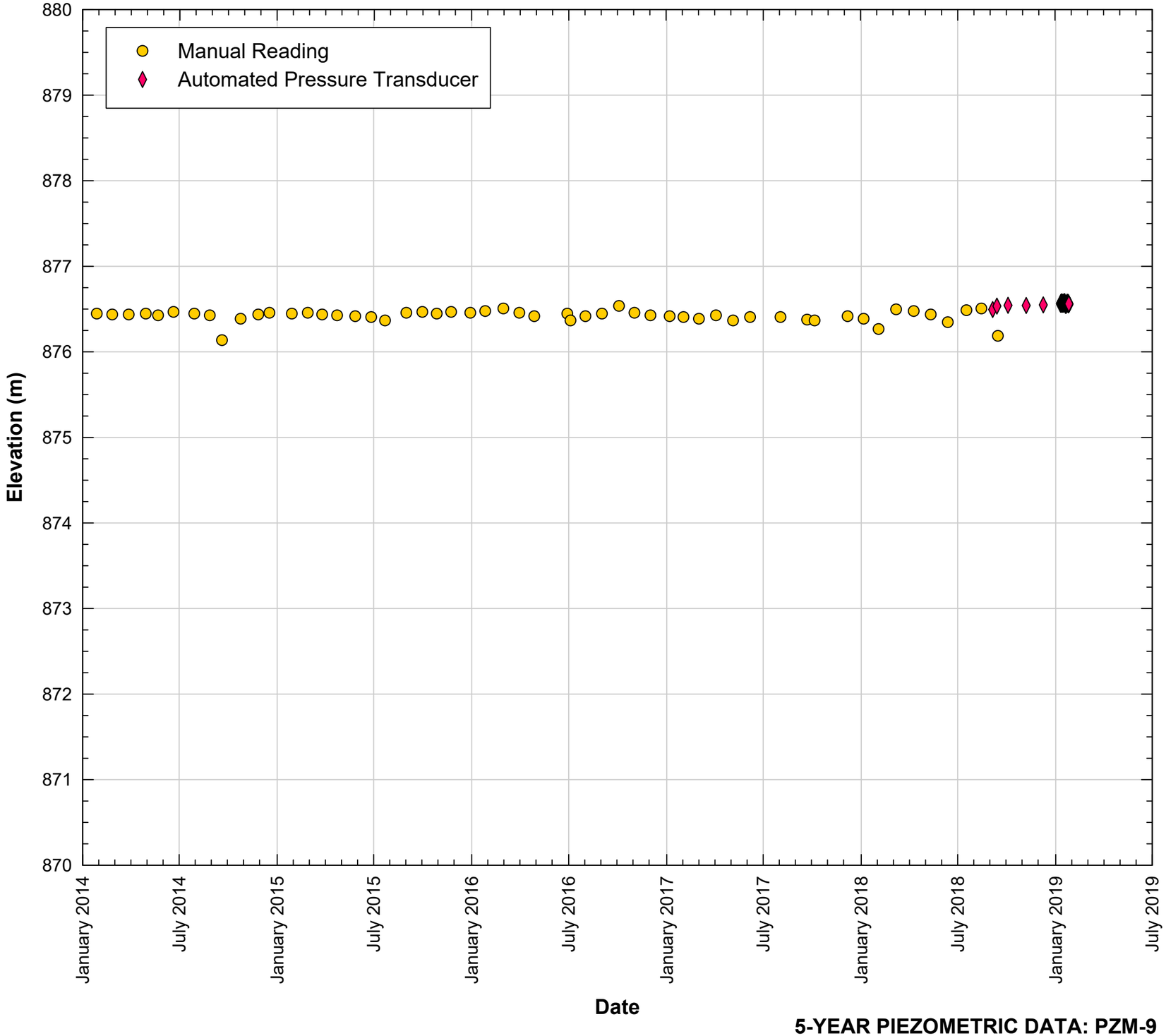
5-YEAR PIEZOMETRIC DATA: PZM-7
FIGURE 5-44



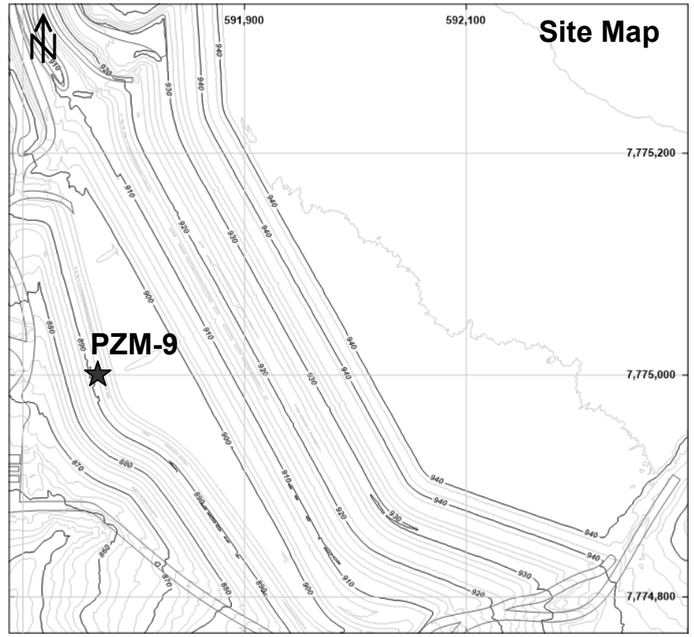


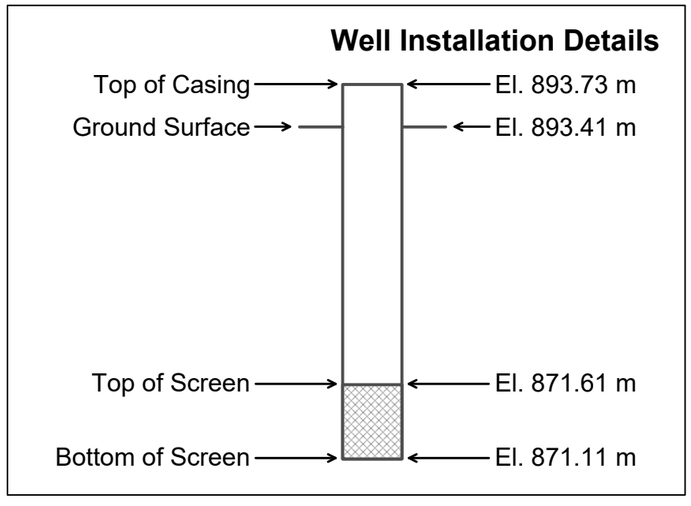
PZM-7			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	10/11/2018	Monthly
Automated Pressure Transducer	11/1/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZM-9



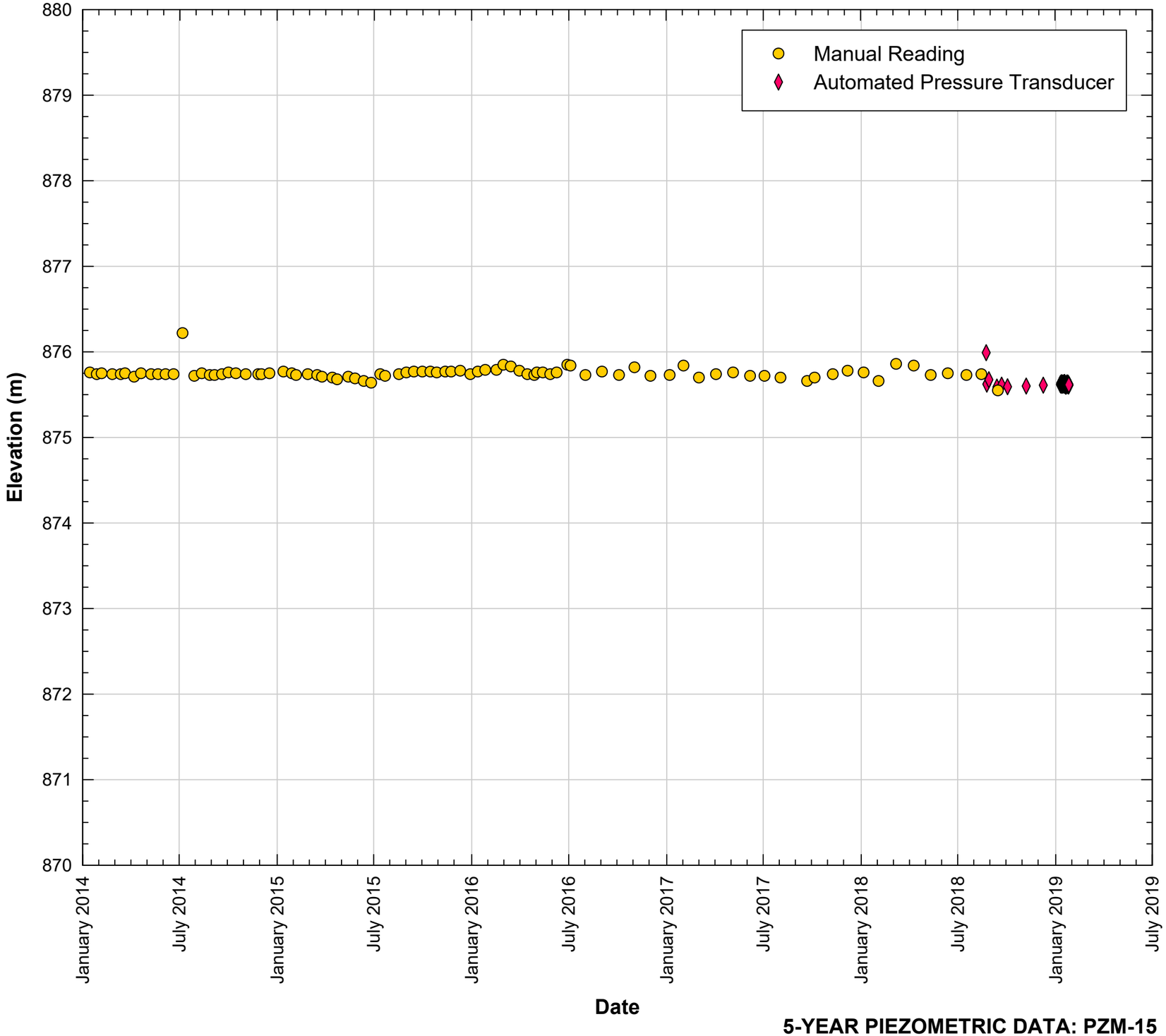
5-YEAR PIEZOMETRIC DATA: PZM-9
FIGURE 5-45



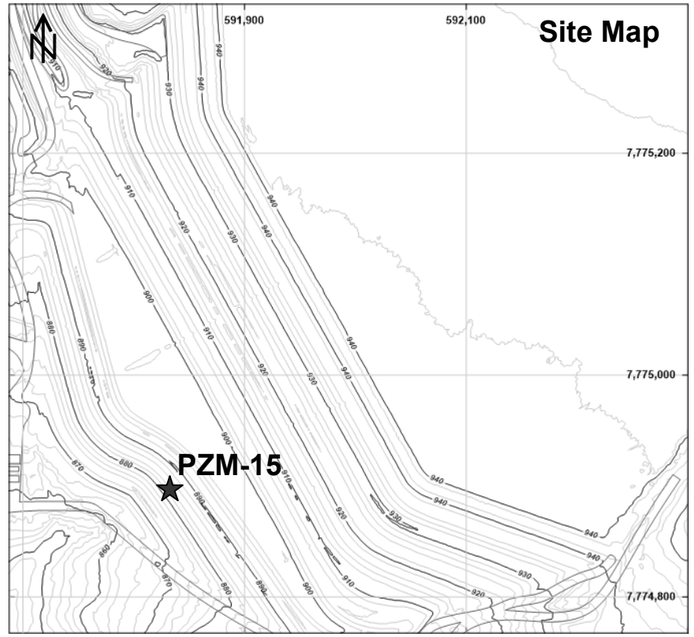


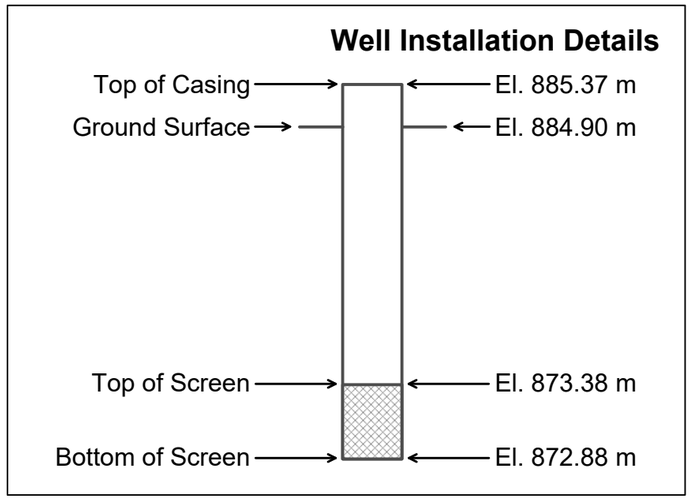
PZM-9			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	5/30/1996	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	9/14/2018	Monthly
Automated Pressure Transducer	9/4/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZM-15



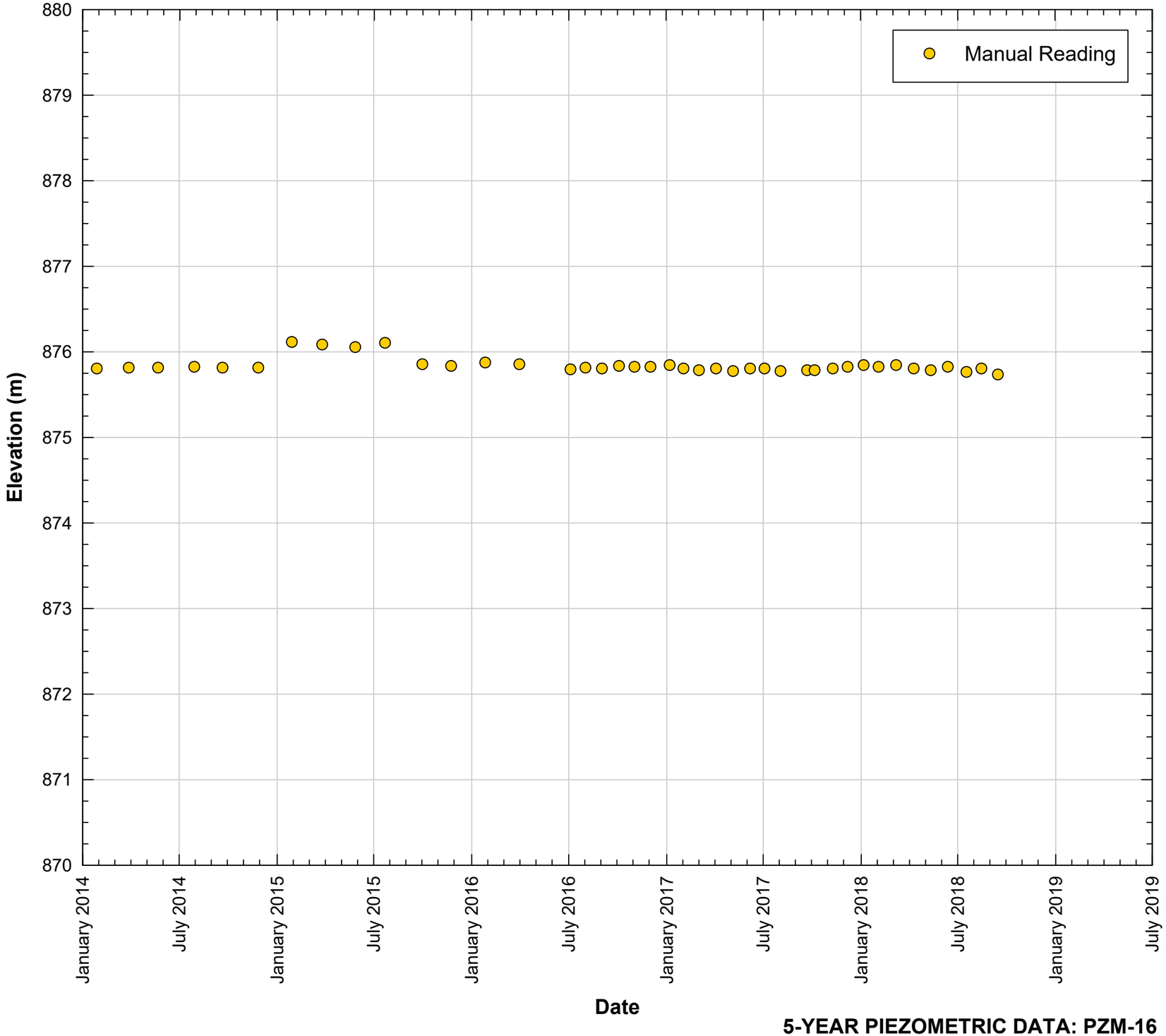
5-YEAR PIEZOMETRIC DATA: PZM-15
FIGURE 5-46



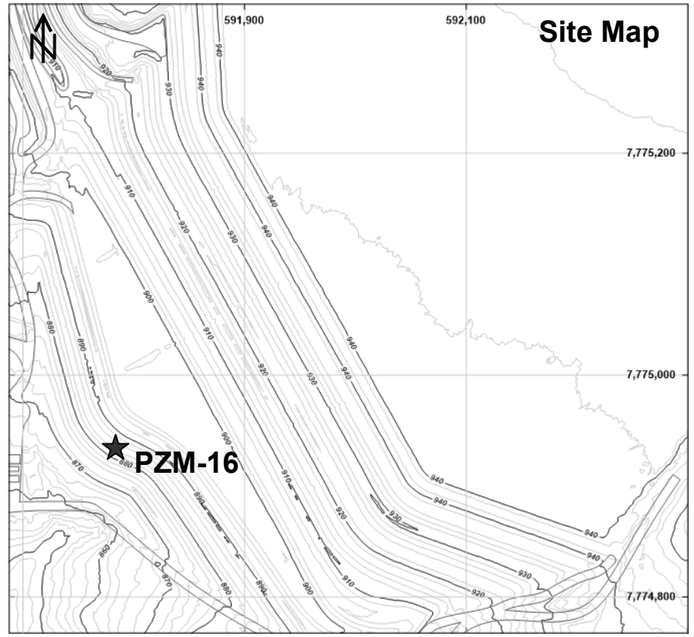


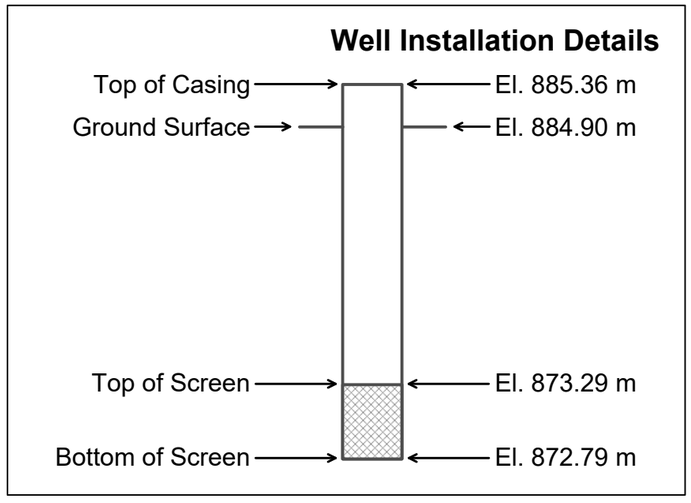
PZM-15			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	2/10/2005	Monthly
	3/11/2005	9/27/2012	Once per 2 weeks
	10/3/2012	5/31/2013	Weekly
	6/6/2013	6/28/2016	Once per 2 weeks
	7/4/2016	9/14/2018	Monthly
Automated Pressure Transducer	8/23/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZM-16



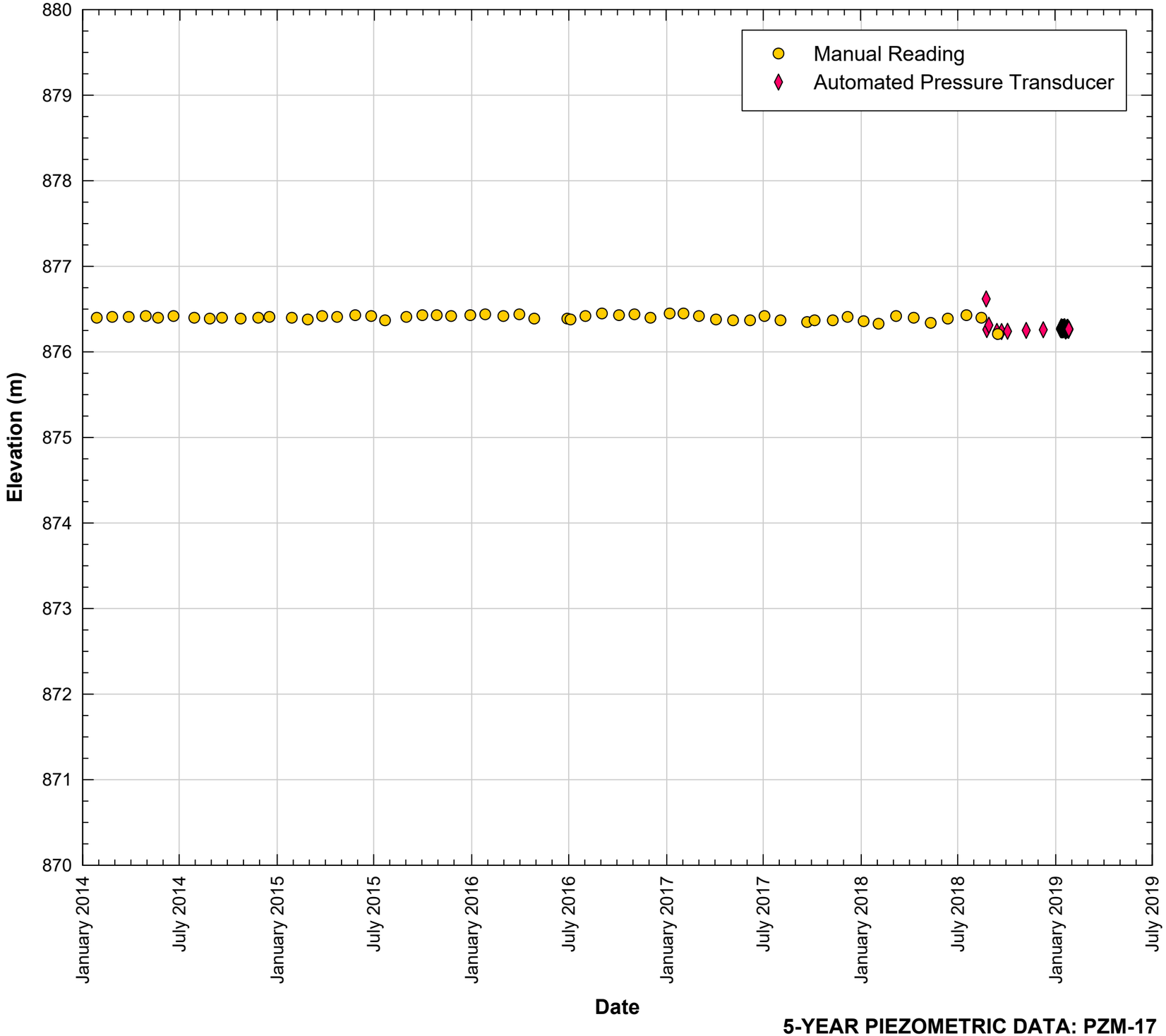
5-YEAR PIEZOMETRIC DATA: PZM-16
FIGURE 5-47



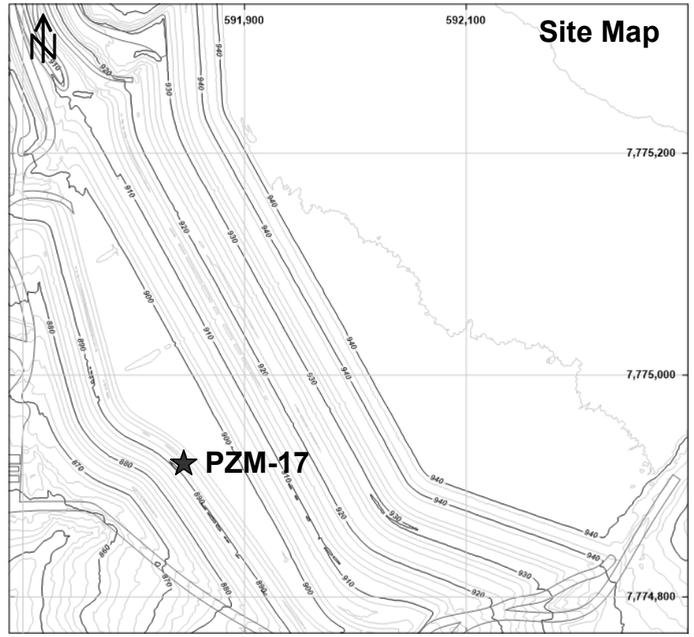


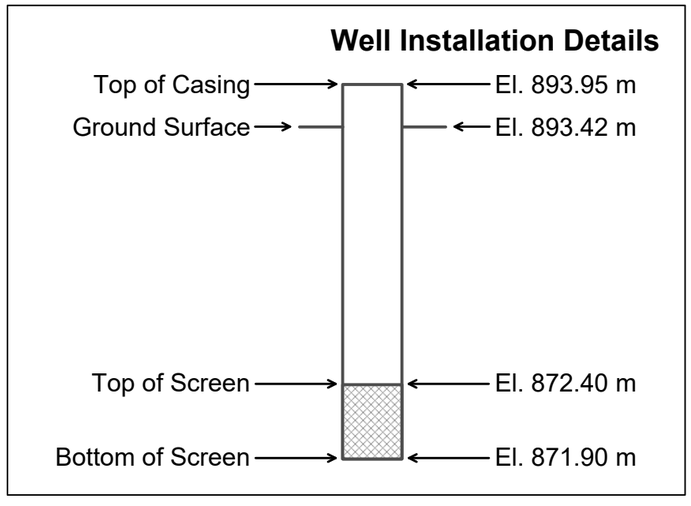
PZM-16			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	2/10/2005	Monthly
	3/11/2005	1/27/2007	Once per 2 weeks
	4/4/2007	3/30/2016	Once per 2 months
	7/4/2016	9/14/2018	Monthly

5-Year Piezometric Data: PZM-17



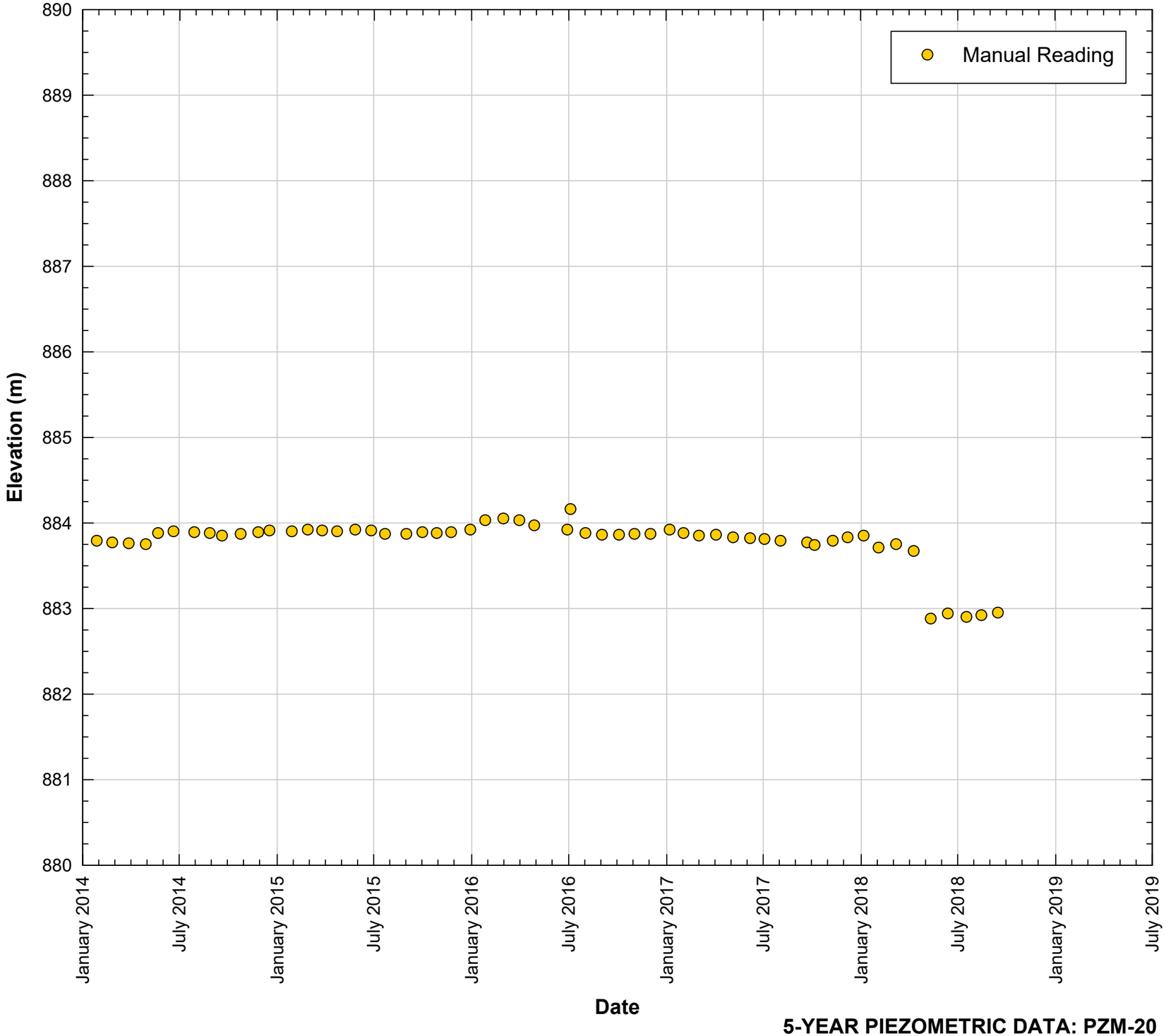
5-YEAR PIEZOMETRIC DATA: PZM-17
FIGURE 5-48



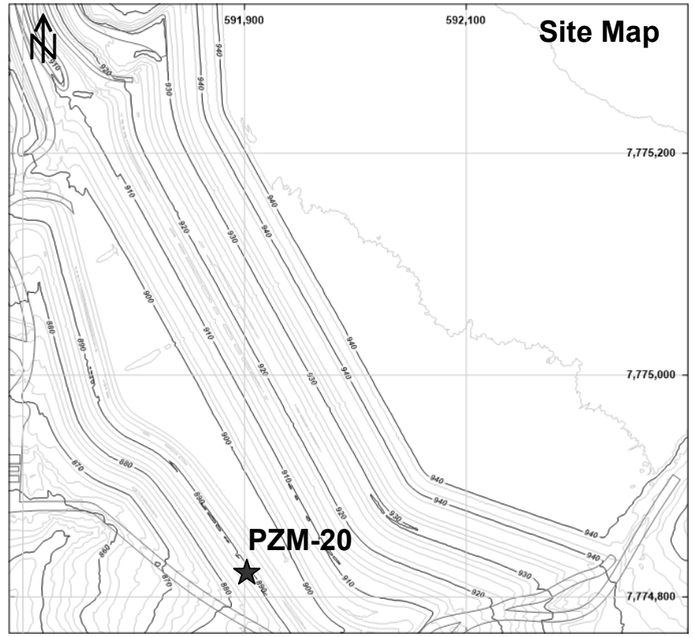


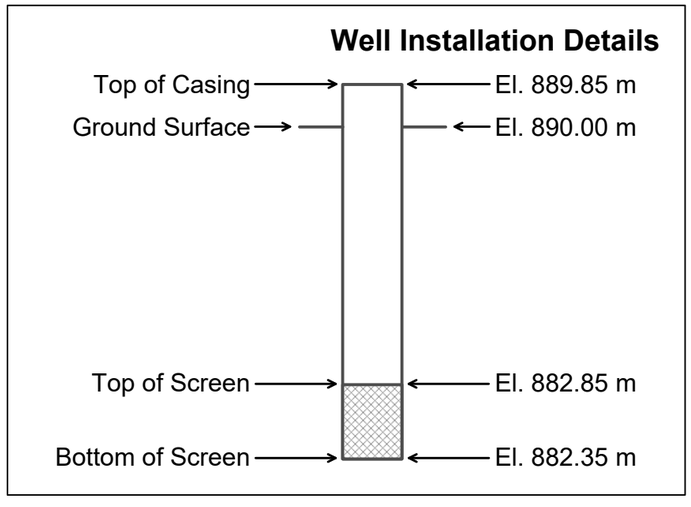
PZM-17			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	2/10/2005	Monthly
	3/11/2005	1/28/2008	Once per 2 weeks
	2/26/2008	9/14/2018	Monthly
Automated Pressure Transducer	8/23/2018	12/8/2018	Monthly
	1/10/2019	1/25/2019	5-Minute

5-Year Piezometric Data: PZM-20



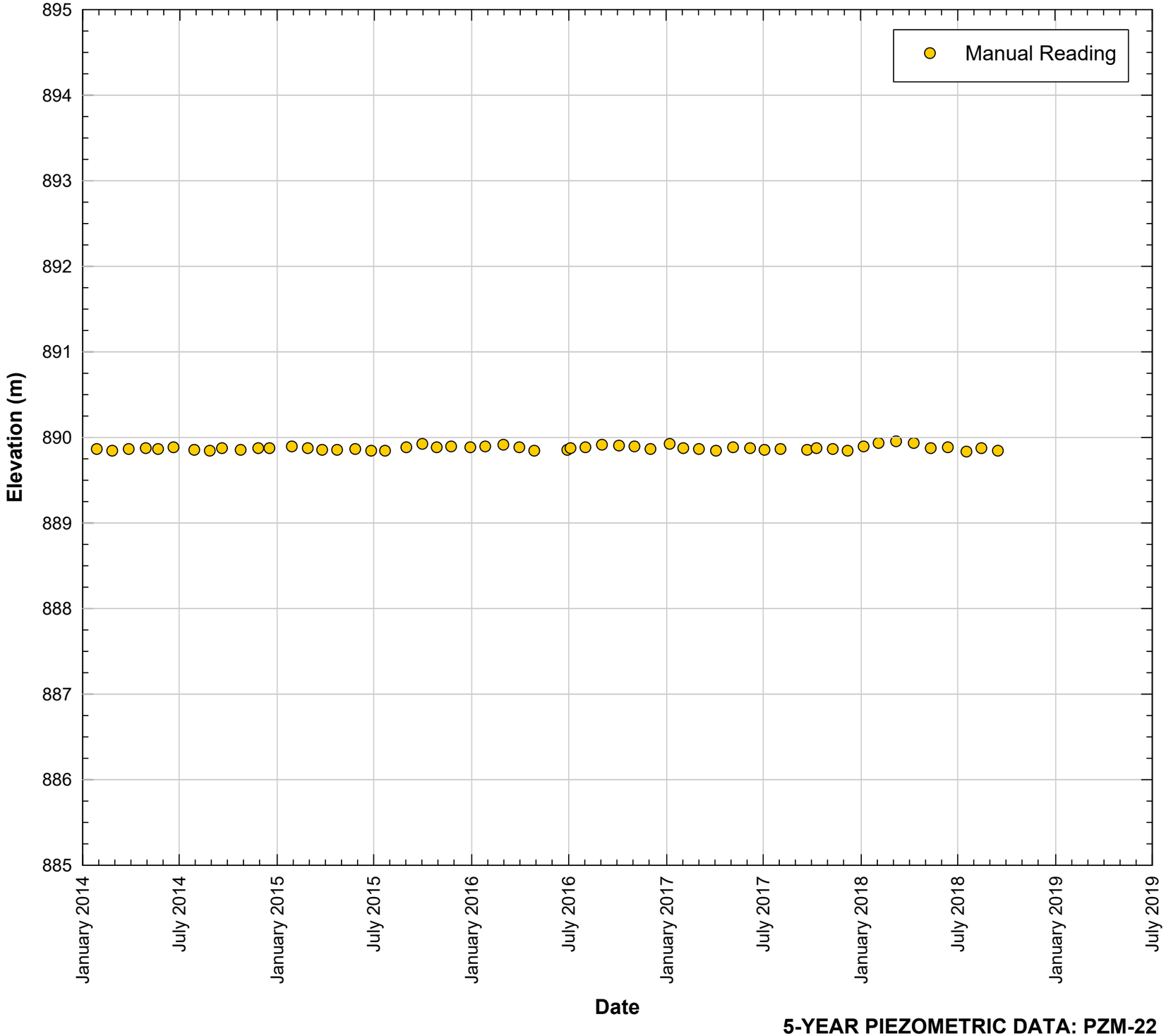
5-YEAR PIEZOMETRIC DATA: PZM-20
FIGURE 5-49



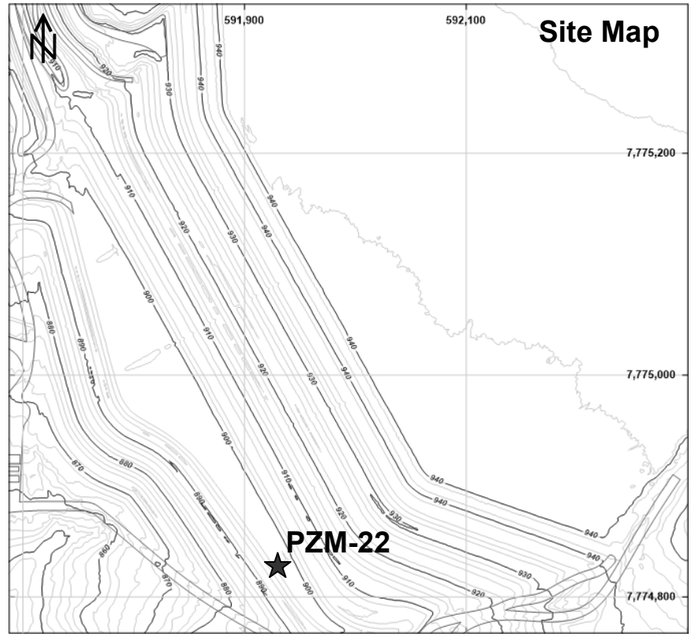


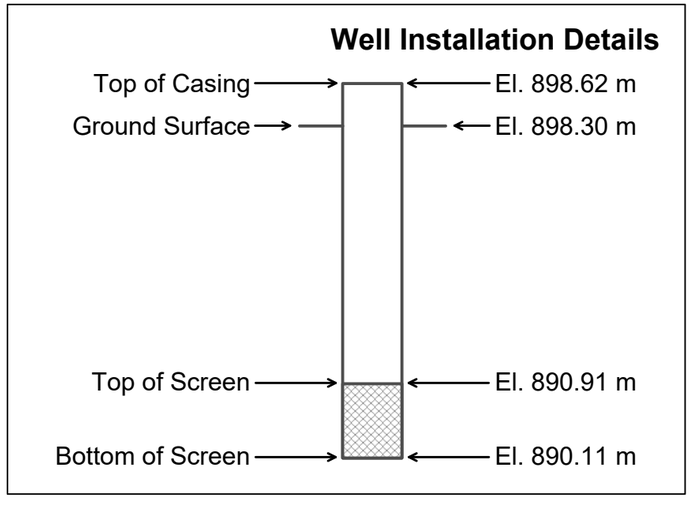
PZM-20			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/30/1996	2/10/2005	Monthly
	3/11/2005	10/31/2007	Once per 2 weeks
	11/26/2007	9/14/2018	Monthly

5-Year Piezometric Data: PZM-22



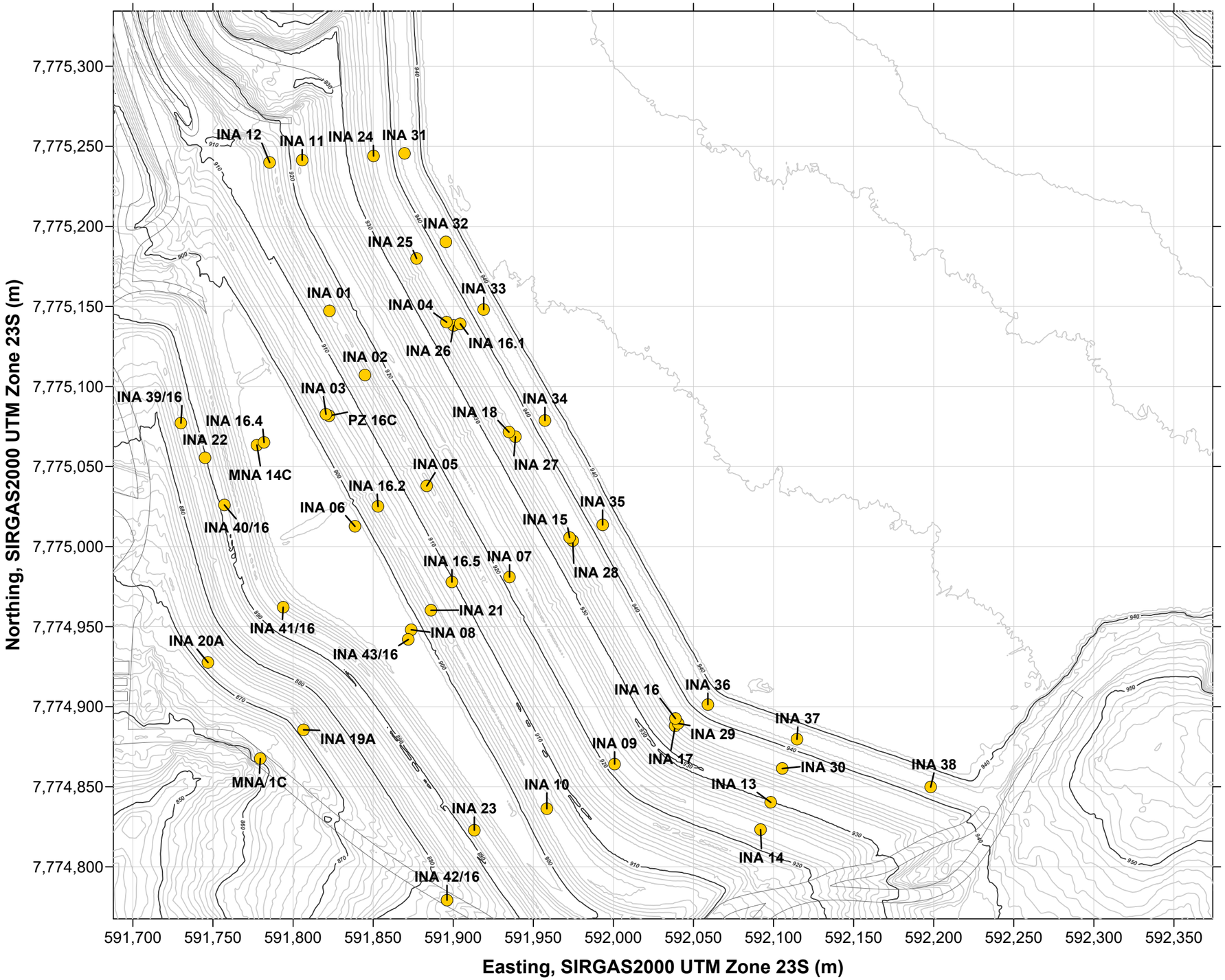
5-YEAR PIEZOMETRIC DATA: PZM-22
FIGURE 5-50





PZM-22			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	11/12/2000	2/10/2005	Monthly
	3/11/2005	9/26/2006	Once per 2 weeks
	10/4/2006	9/14/2018	Monthly

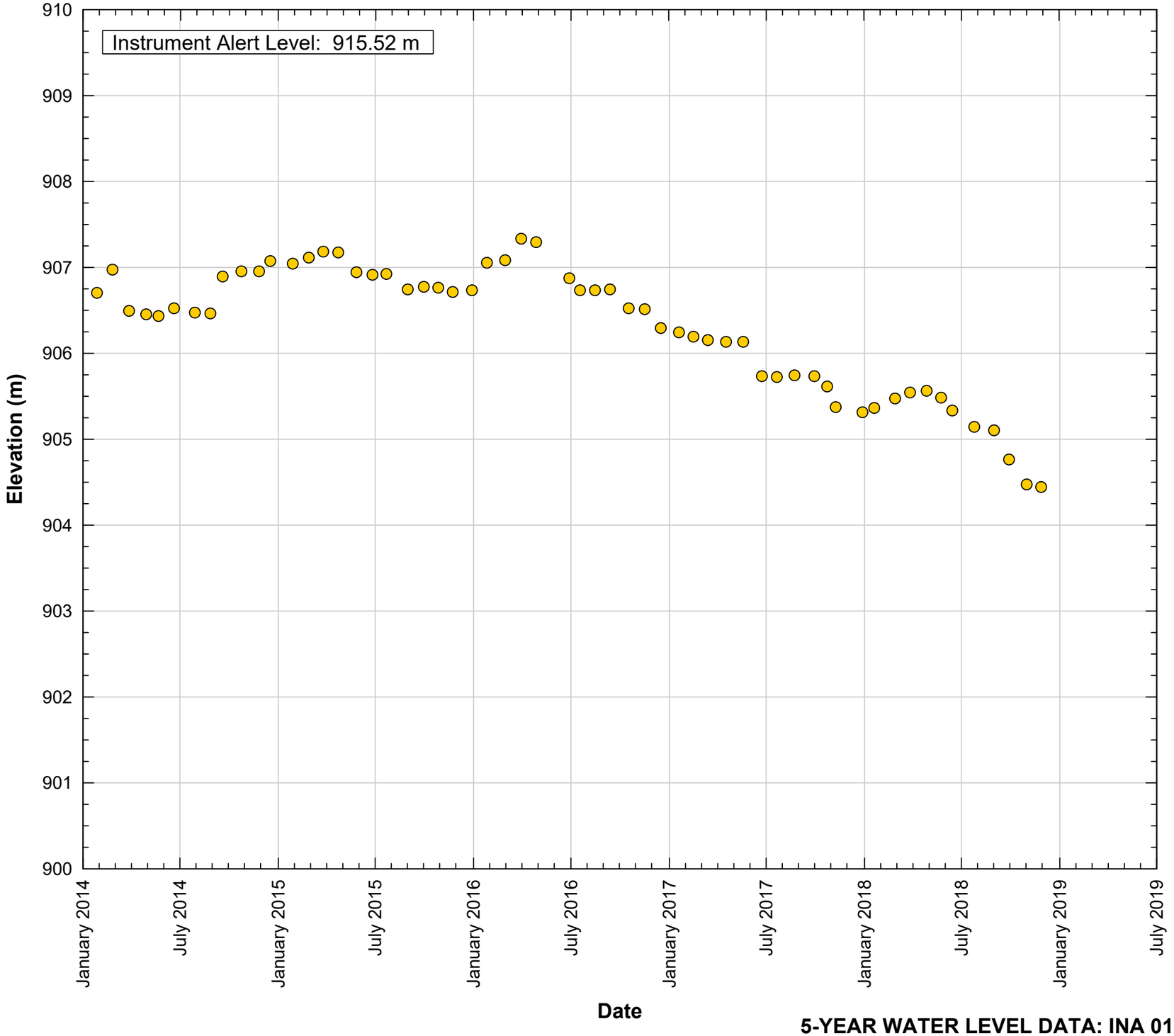
PLAN VIEW: WATER LEVEL INDICATORS (INAs)



Note:
1. Horizontal datum is SIRGAS2000 UTM Zone 23S in meters, Vertical datum is Mean Sea Level in meters.

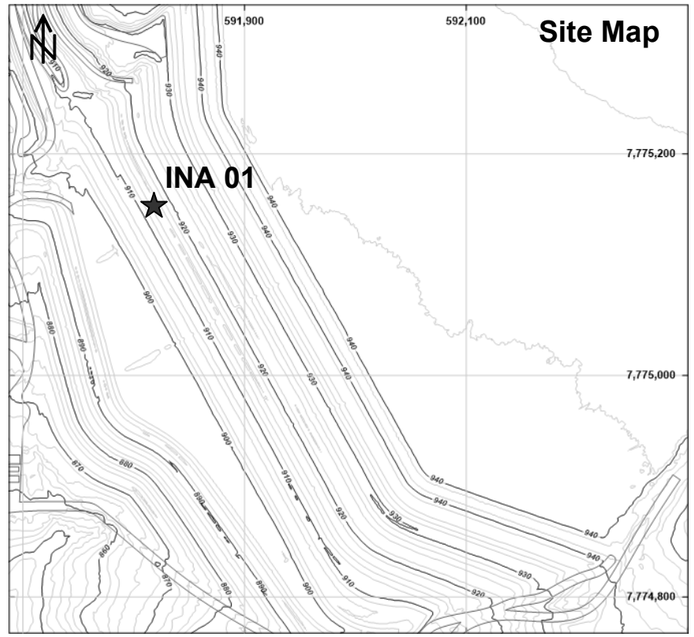
PLAN VIEW: WATER LEVEL INDICATORS (INAs)
FIGURE 6-1

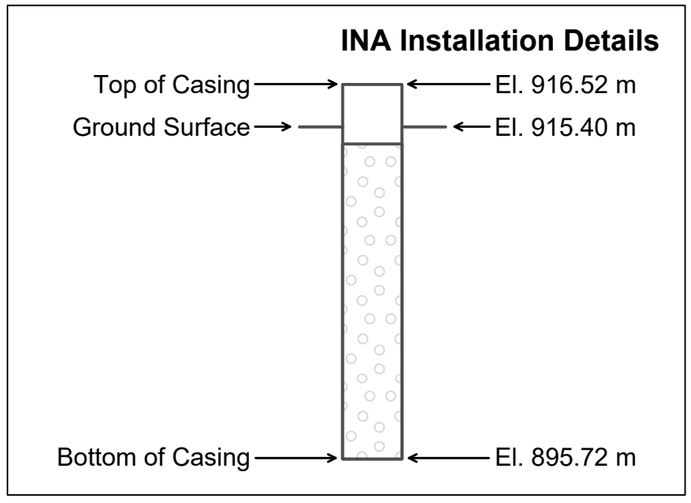
5-Year Water Level Data: INA 01



5-YEAR WATER LEVEL DATA: INA 01

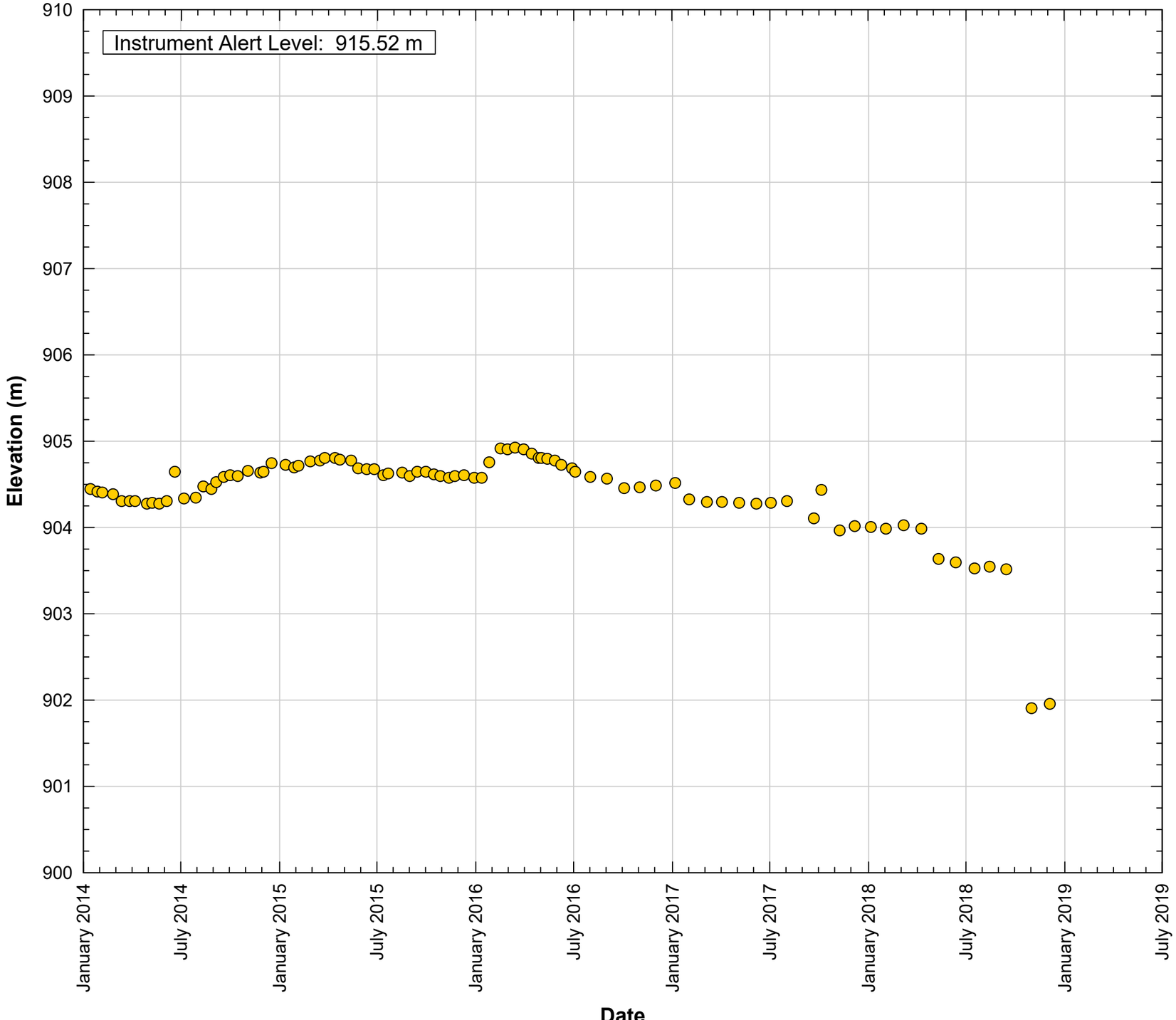
FIGURE 6-2





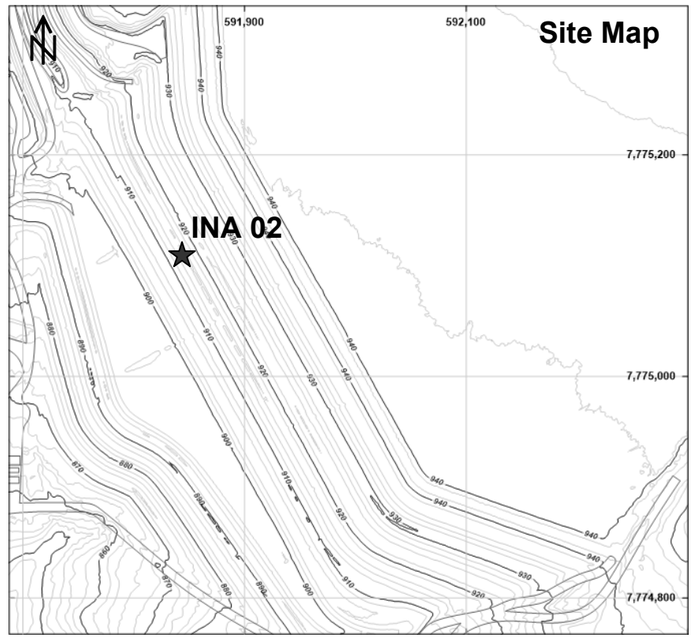
INA 01			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/12/2006	11/27/2018	Monthly

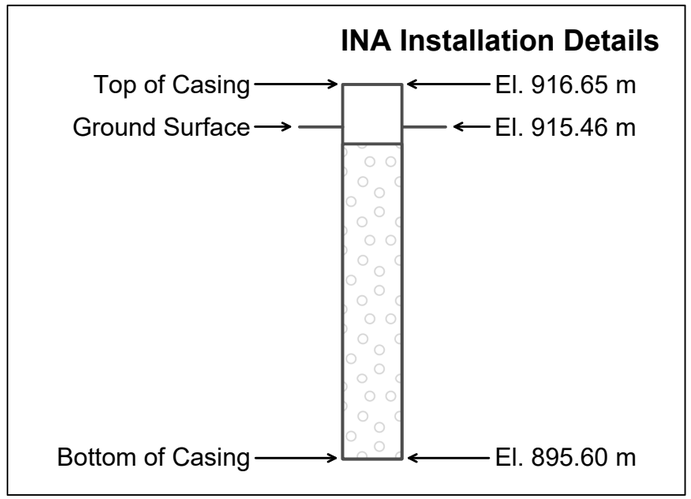
5-Year Water Level Data: INA 02



5-YEAR WATER LEVEL DATA: INA 02

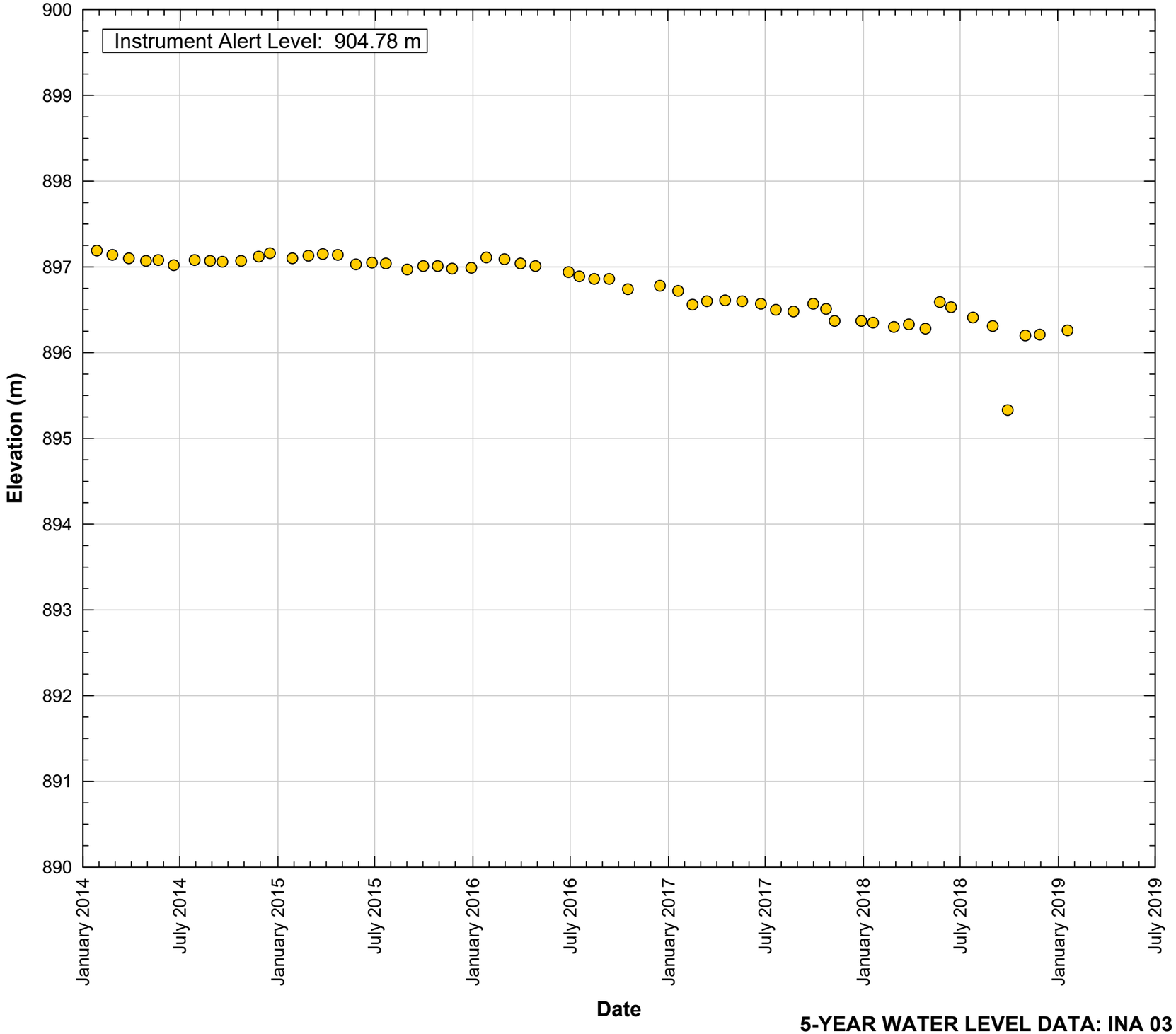
FIGURE 6-3

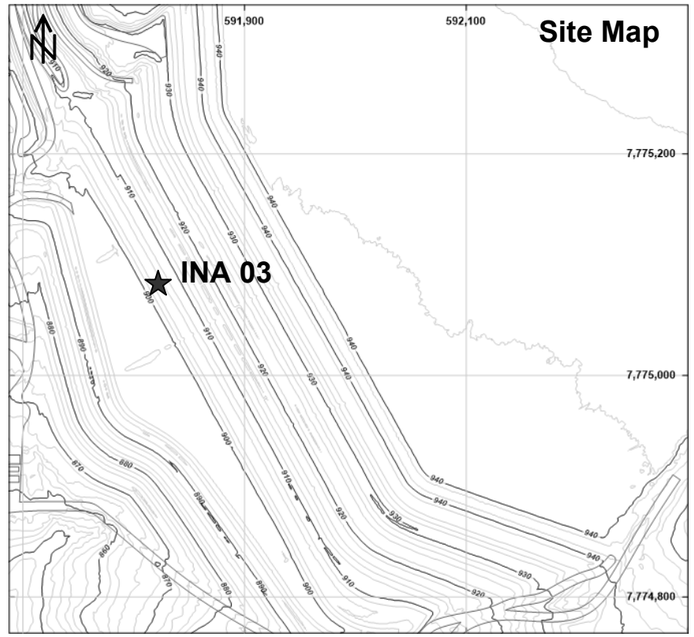


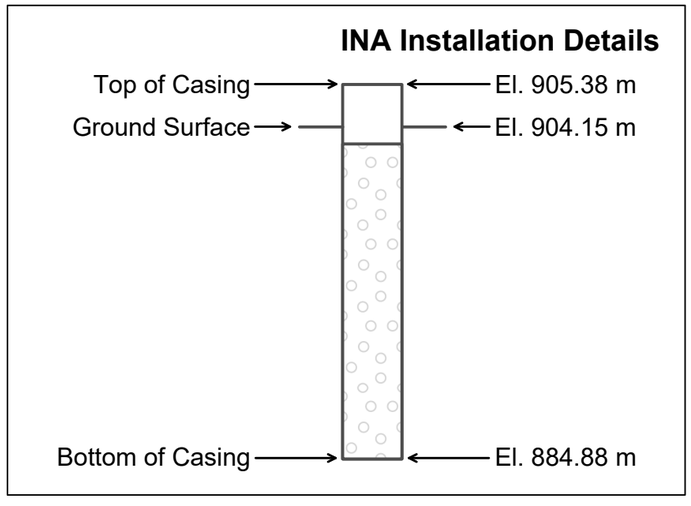


INA 02			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/12/2006	9/27/2012	Once per 2 weeks
	10/3/2012	5/31/2013	Weekly
	6/6/2013	6/28/2016	Once per 2 weeks
	7/4/2016	12/4/2018	Monthly

5-Year Water Level Data: INA 03



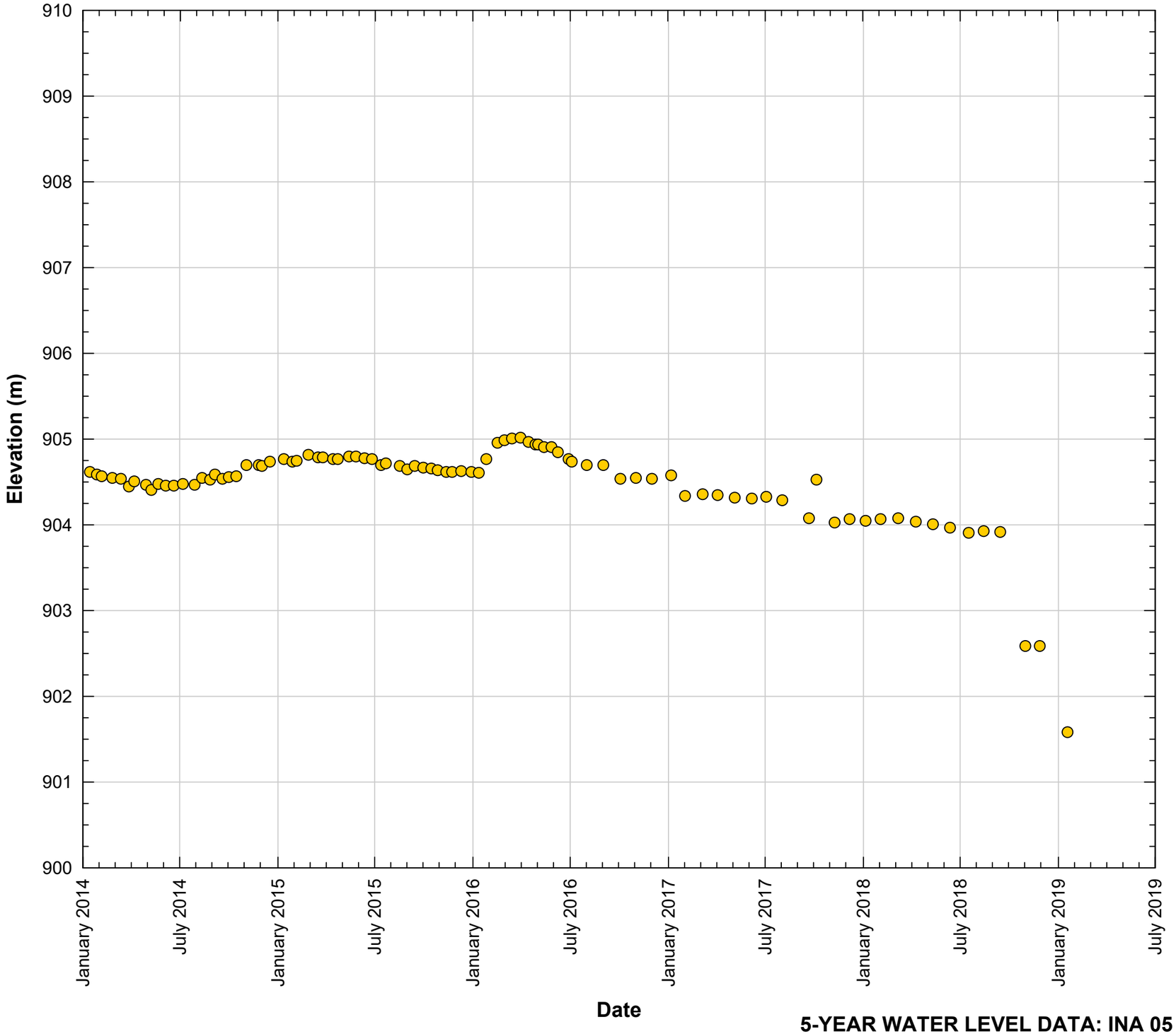




INA 03			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	12/25/2005	1/18/2019	Monthly

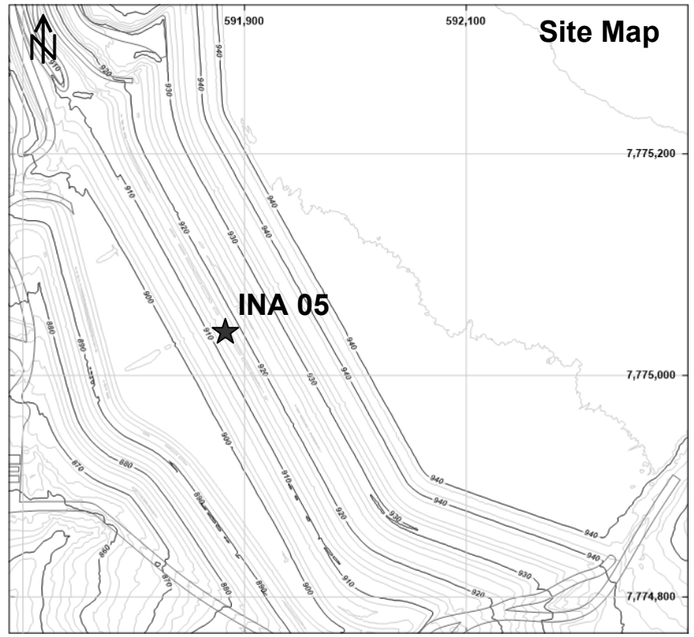
5-YEAR WATER LEVEL DATA: INA 03

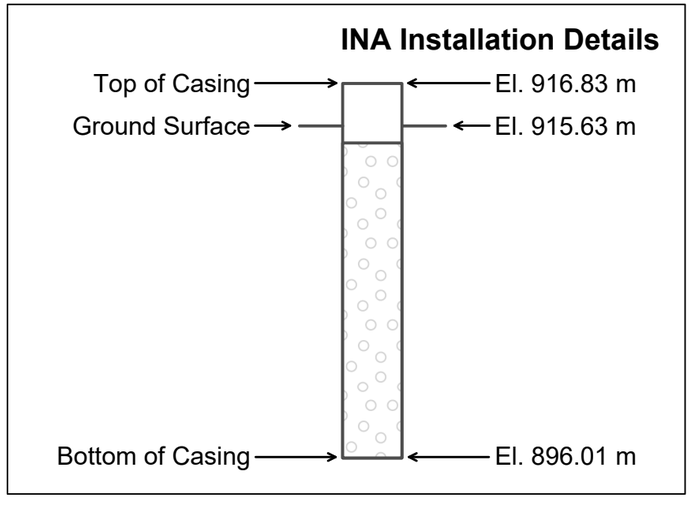
FIGURE 6-4



5-YEAR WATER LEVEL DATA: INA 05

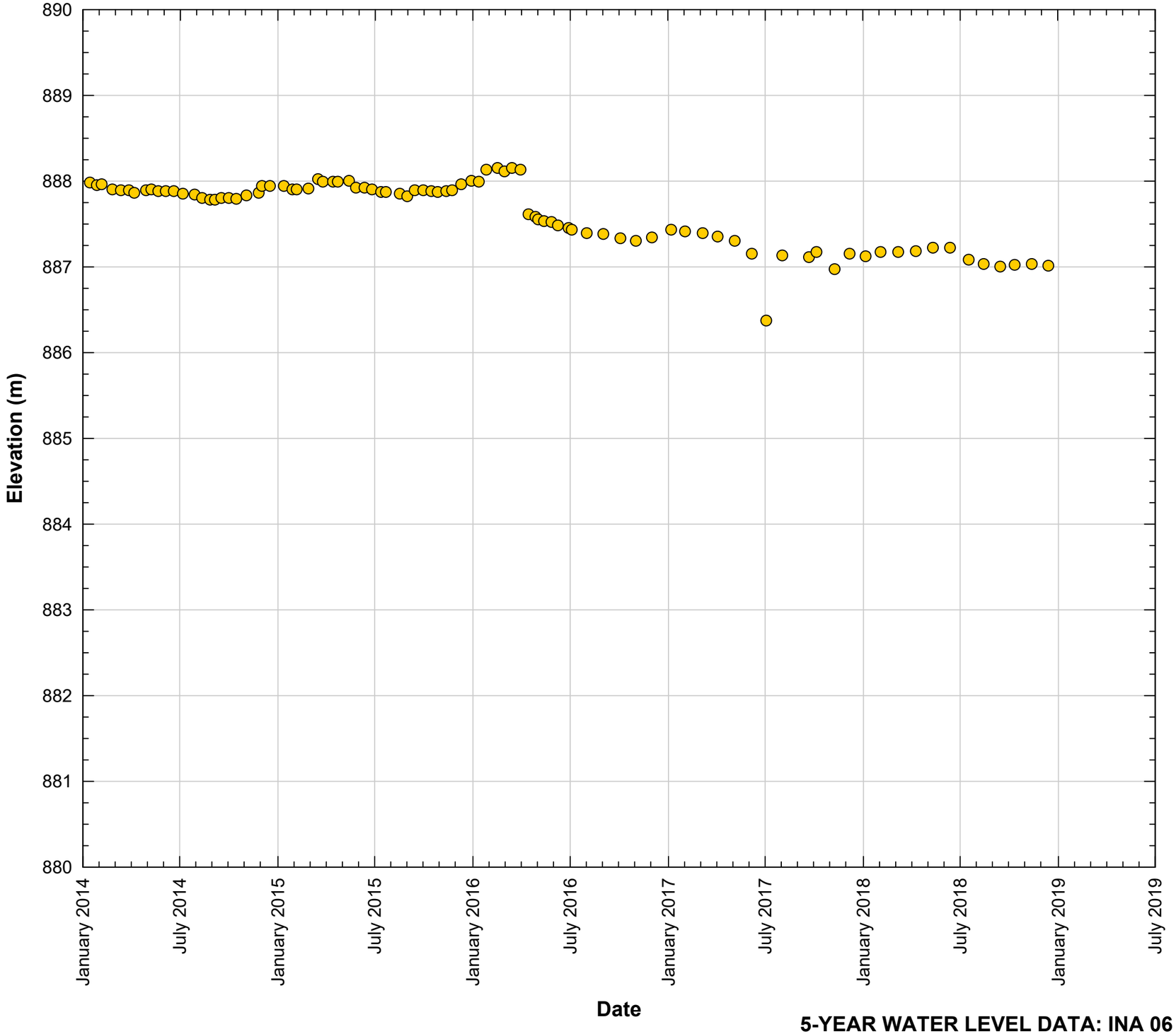
FIGURE 6-5

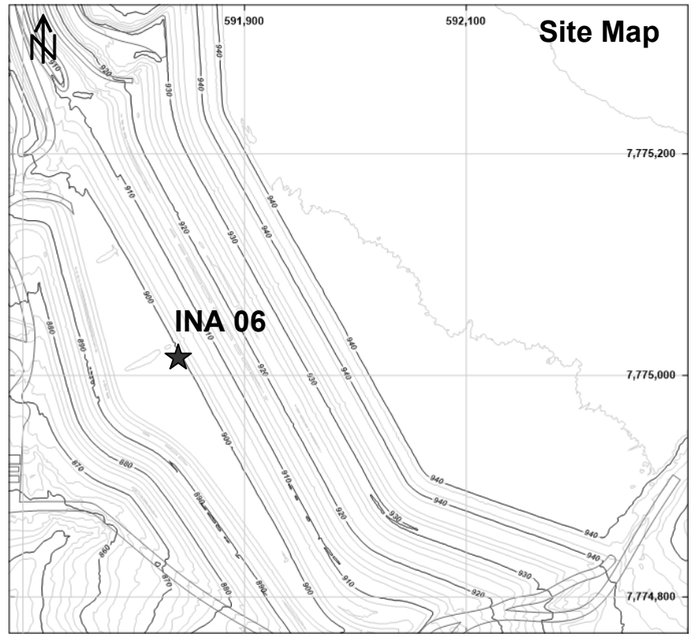


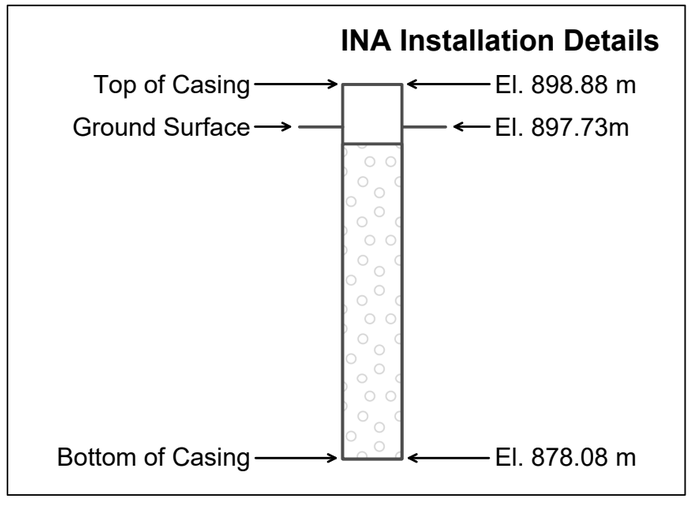


INA 05			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	12/25/2005	9/27/2012	Once per 2 weeks
	10/3/2012	5/31/2013	Weekly
	6/6/2013	6/28/2016	Once per 2 weeks
	7/4/2016	1/18/2019	Monthly

5-Year Water Level Data: INA 06





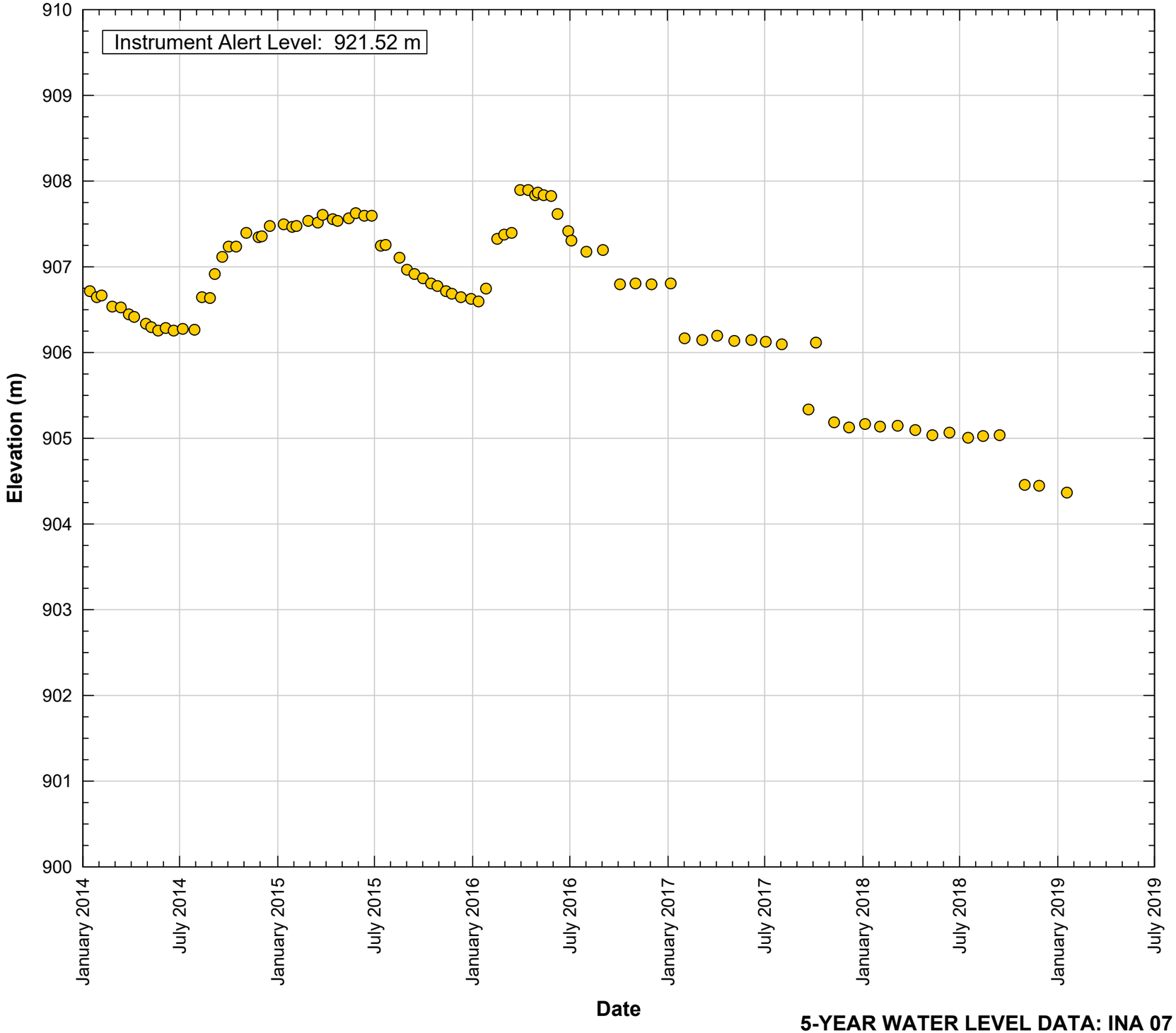


INA 06			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	12/25/2005	9/27/2012	Once per 2 weeks
	10/3/2012	5/31/2013	Weekly
	6/6/2013	6/28/2016	Once per 2 weeks
	7/4/2016	12/13/2018	Monthly

5-YEAR WATER LEVEL DATA: INA 06

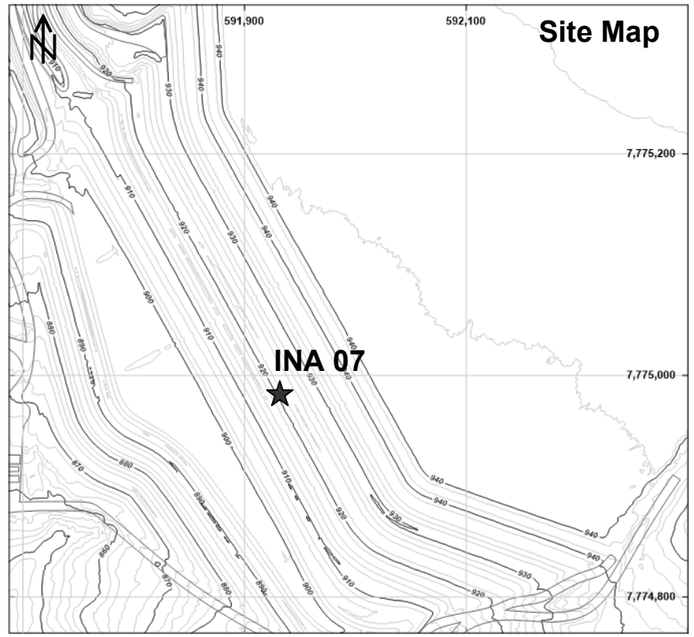
FIGURE 6-6

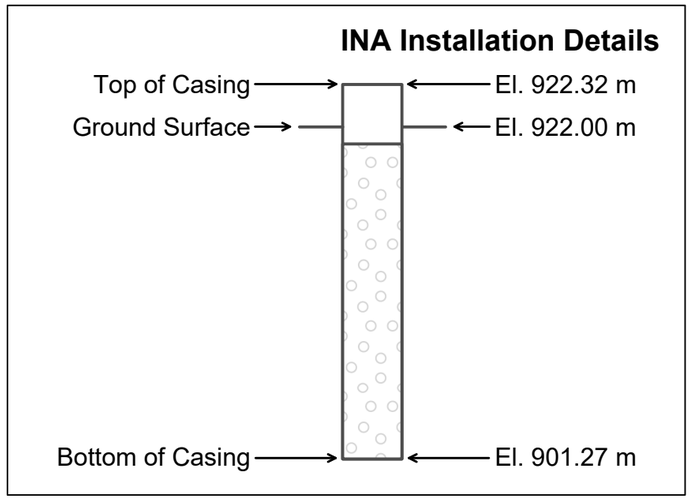
5-Year Water Level Data: INA 07



5-YEAR WATER LEVEL DATA: INA 07

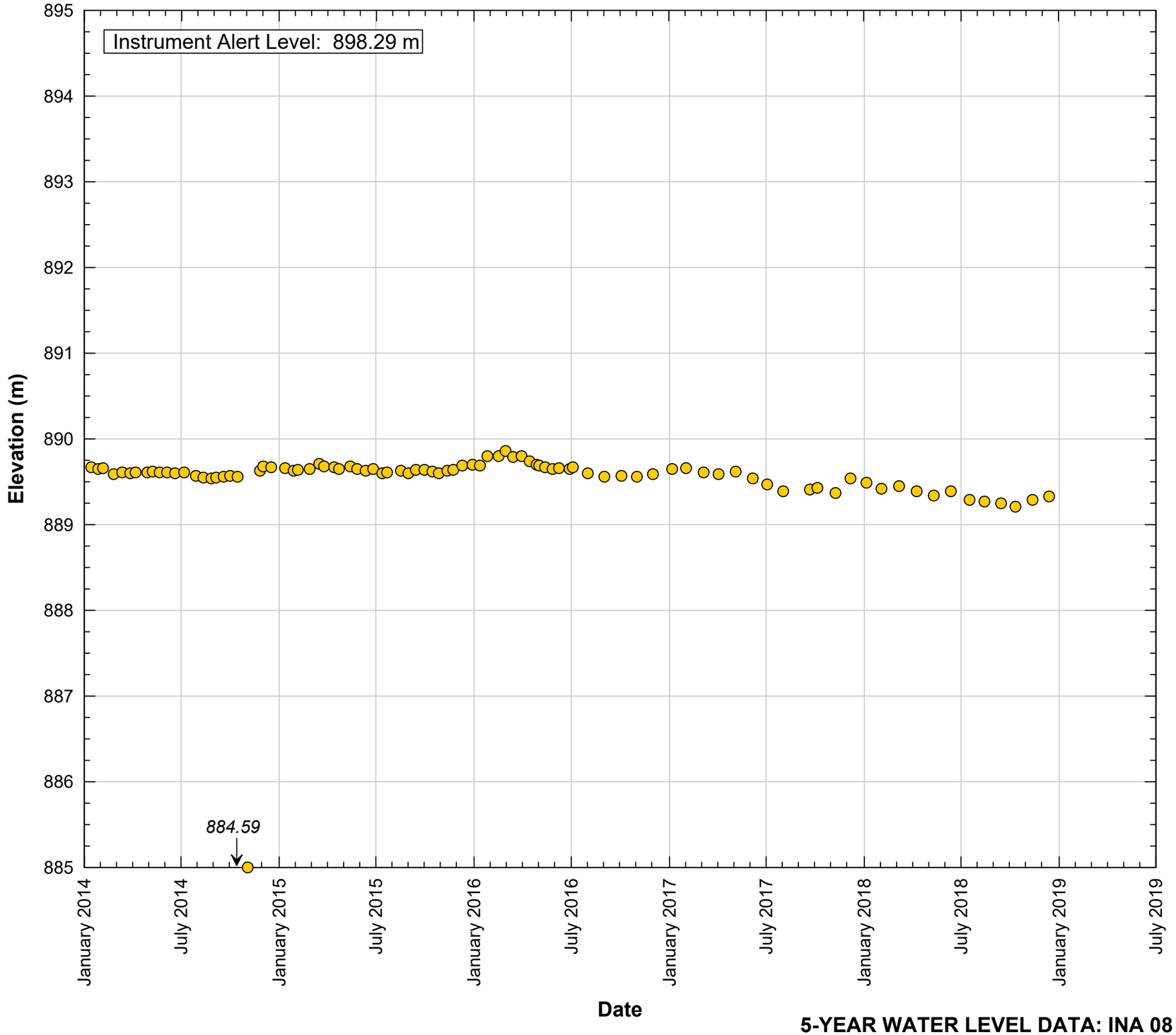
FIGURE 6-7





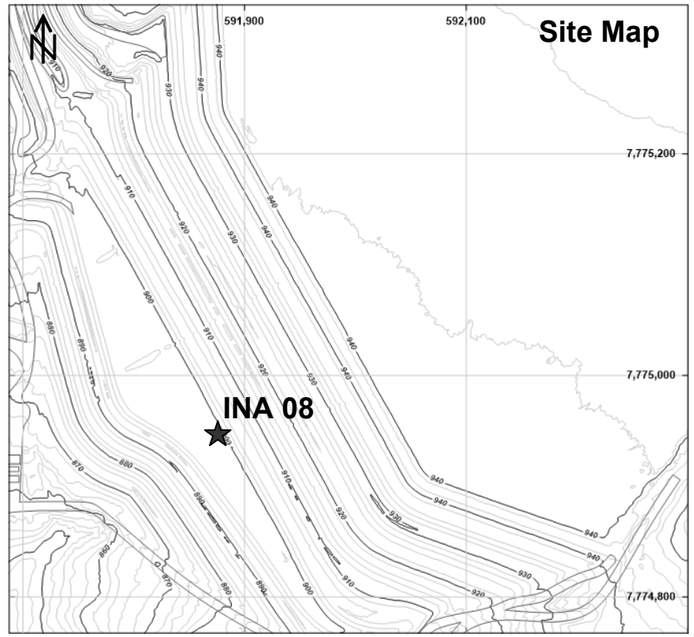
INA 07			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/12/2006	9/27/2012	Once per 2 weeks
	10/3/2012	5/31/2013	Weekly
	6/6/2013	6/28/2016	Once per 2 weeks
	7/4/2016	1/18/2019	Monthly

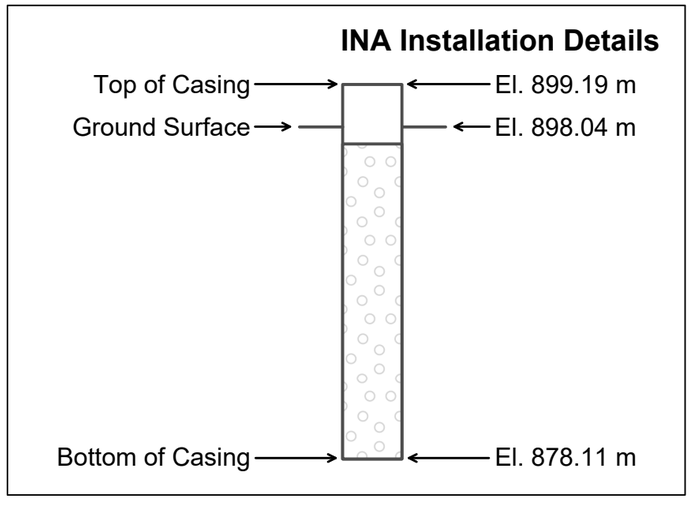
5-Year Water Level Data: INA 08



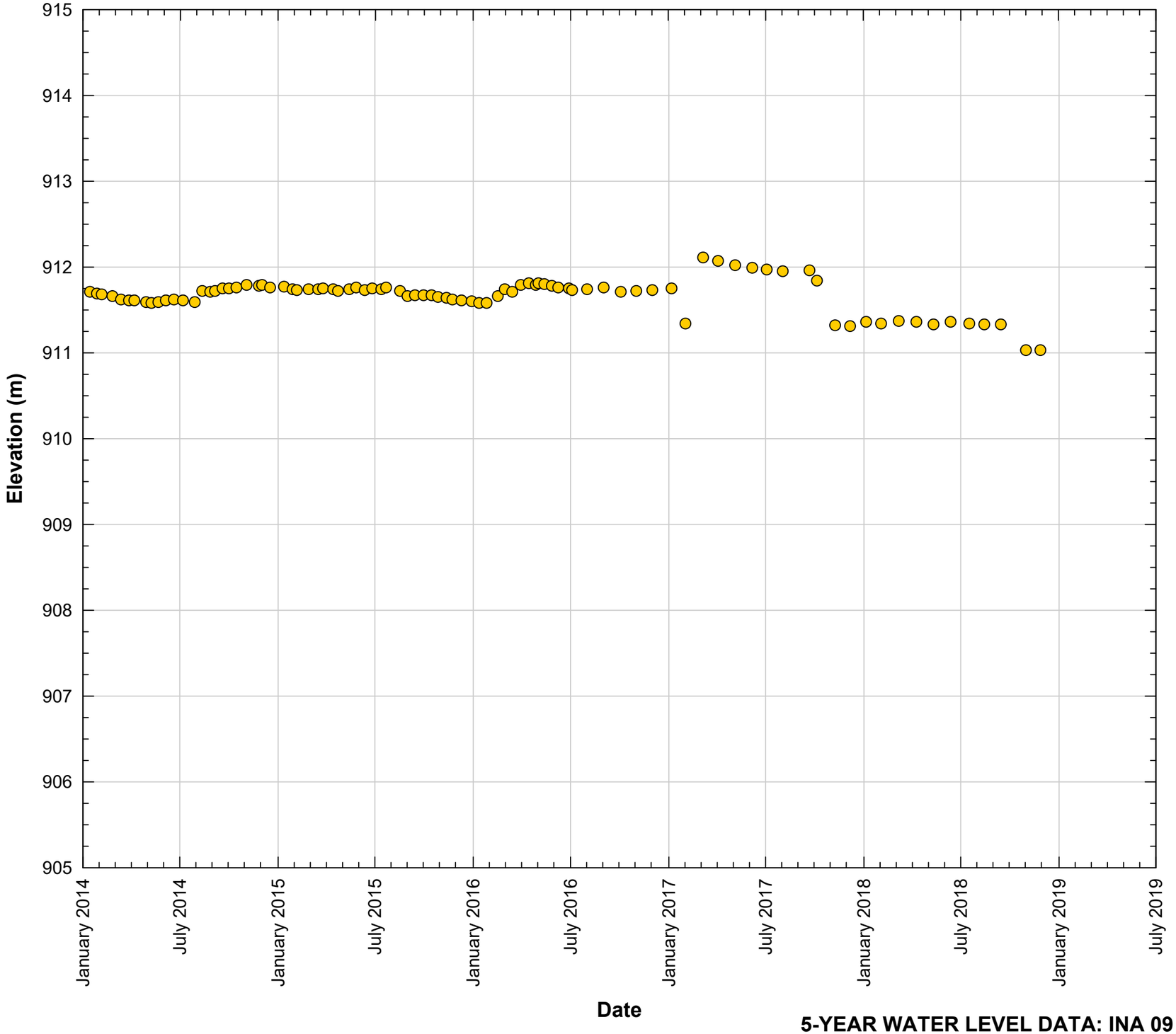
5-YEAR WATER LEVEL DATA: INA 08

FIGURE 6-8



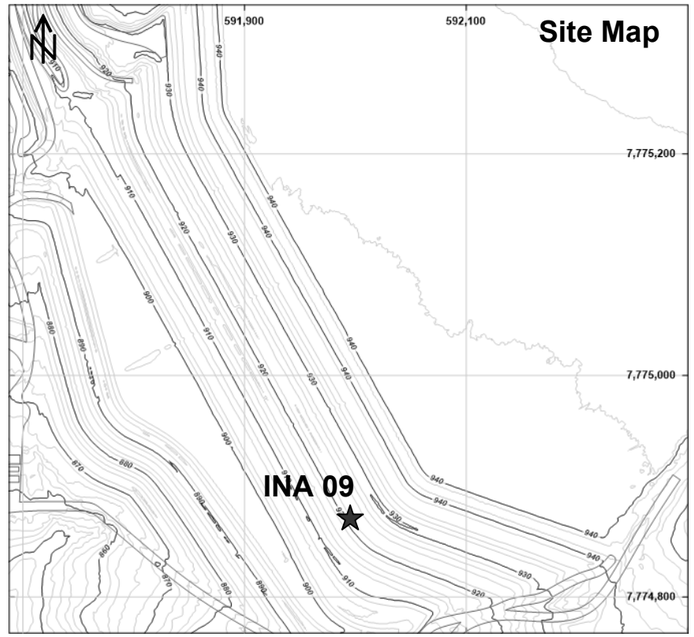


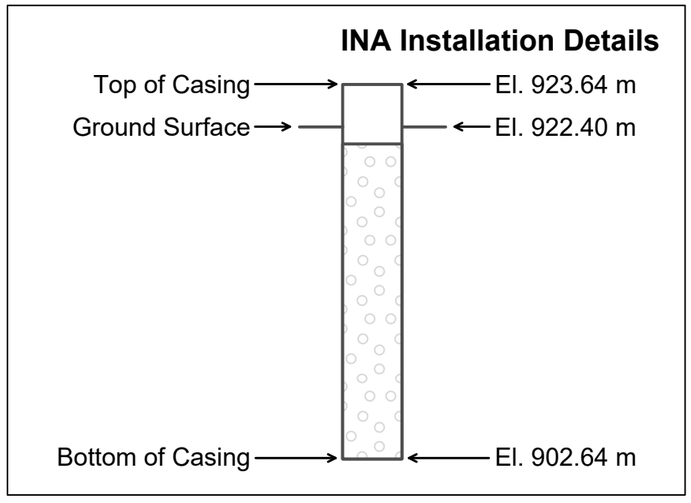
INA 08			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	12/25/2005	9/27/2012	Once per 2 weeks
	10/3/2012	5/31/2013	Weekly
	6/6/2013	6/28/2016	Once per 2 weeks
	7/4/2016	12/13/2018	Monthly



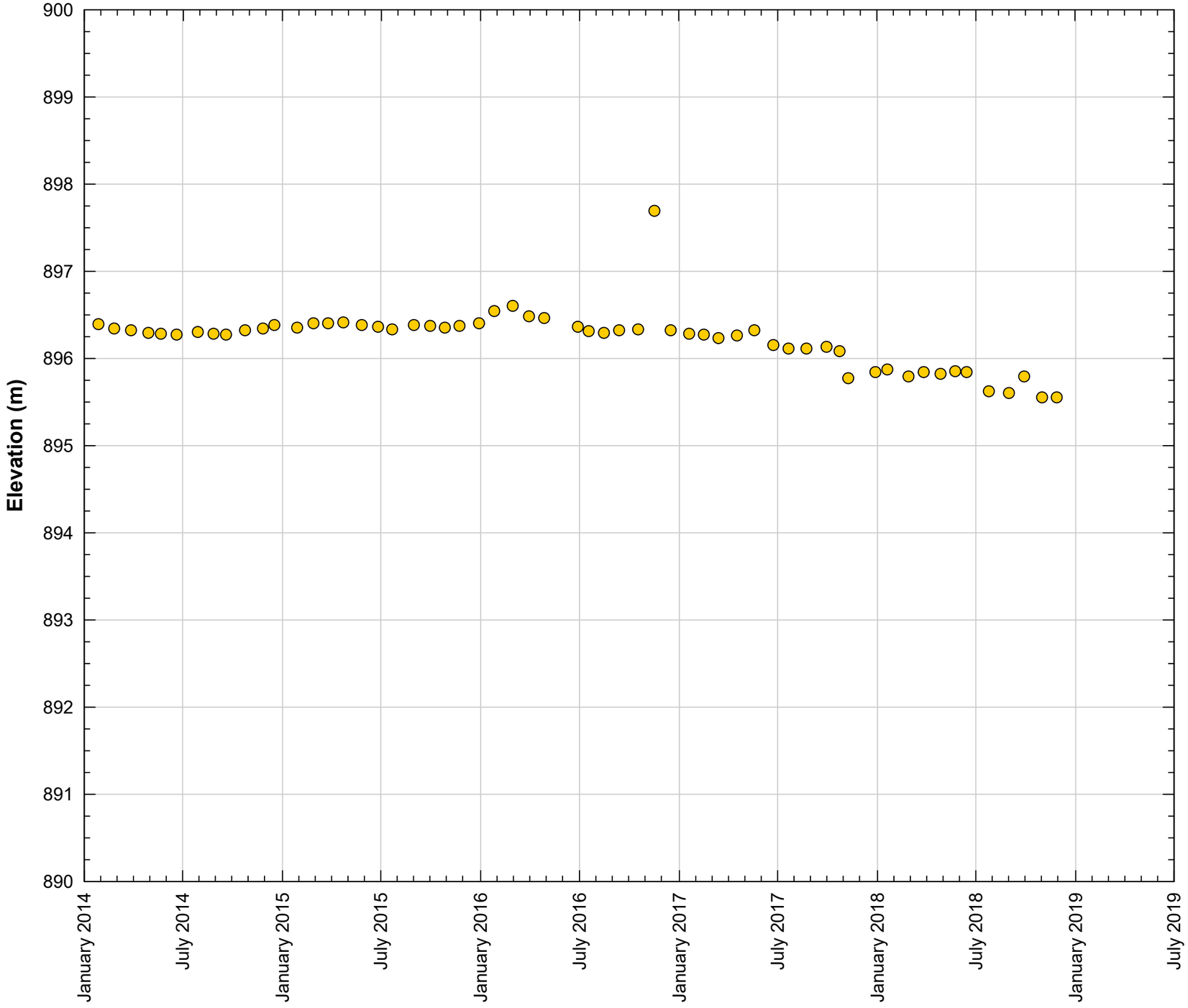
5-YEAR WATER LEVEL DATA: INA 09

FIGURE 6-9



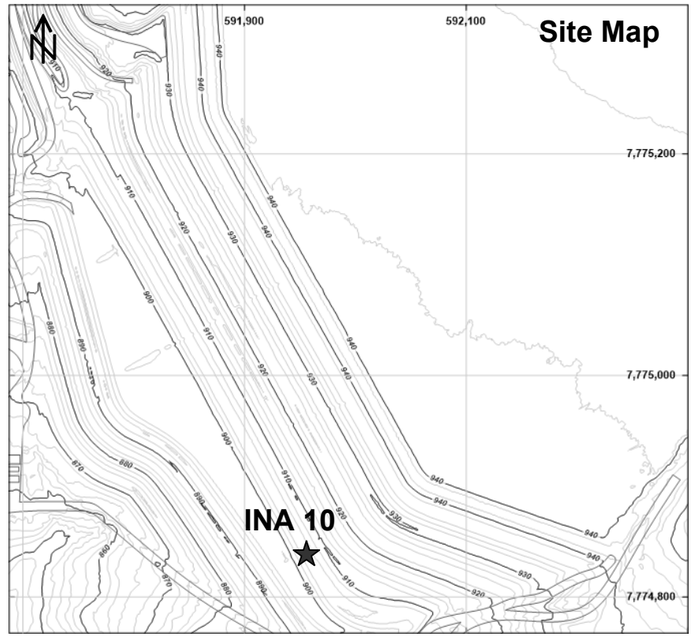


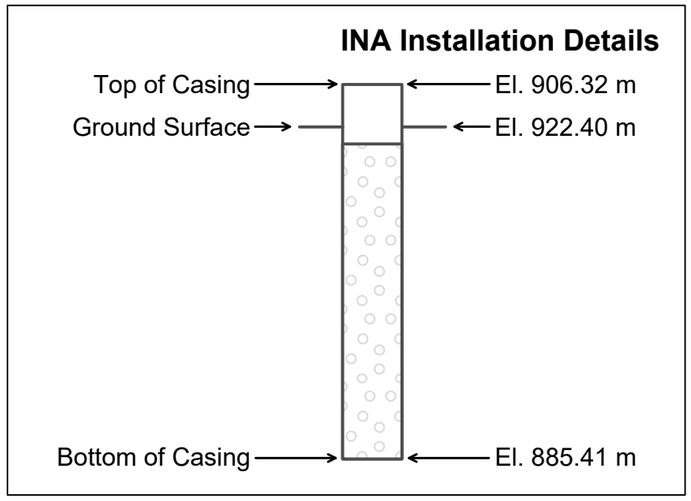
INA 09			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/12/2006	9/27/2012	Once per 2 weeks
	10/3/2012	5/31/2013	Weekly
	6/6/2013	6/28/2016	Once per 2 weeks
	7/4/2016	11/27/2018	Monthly



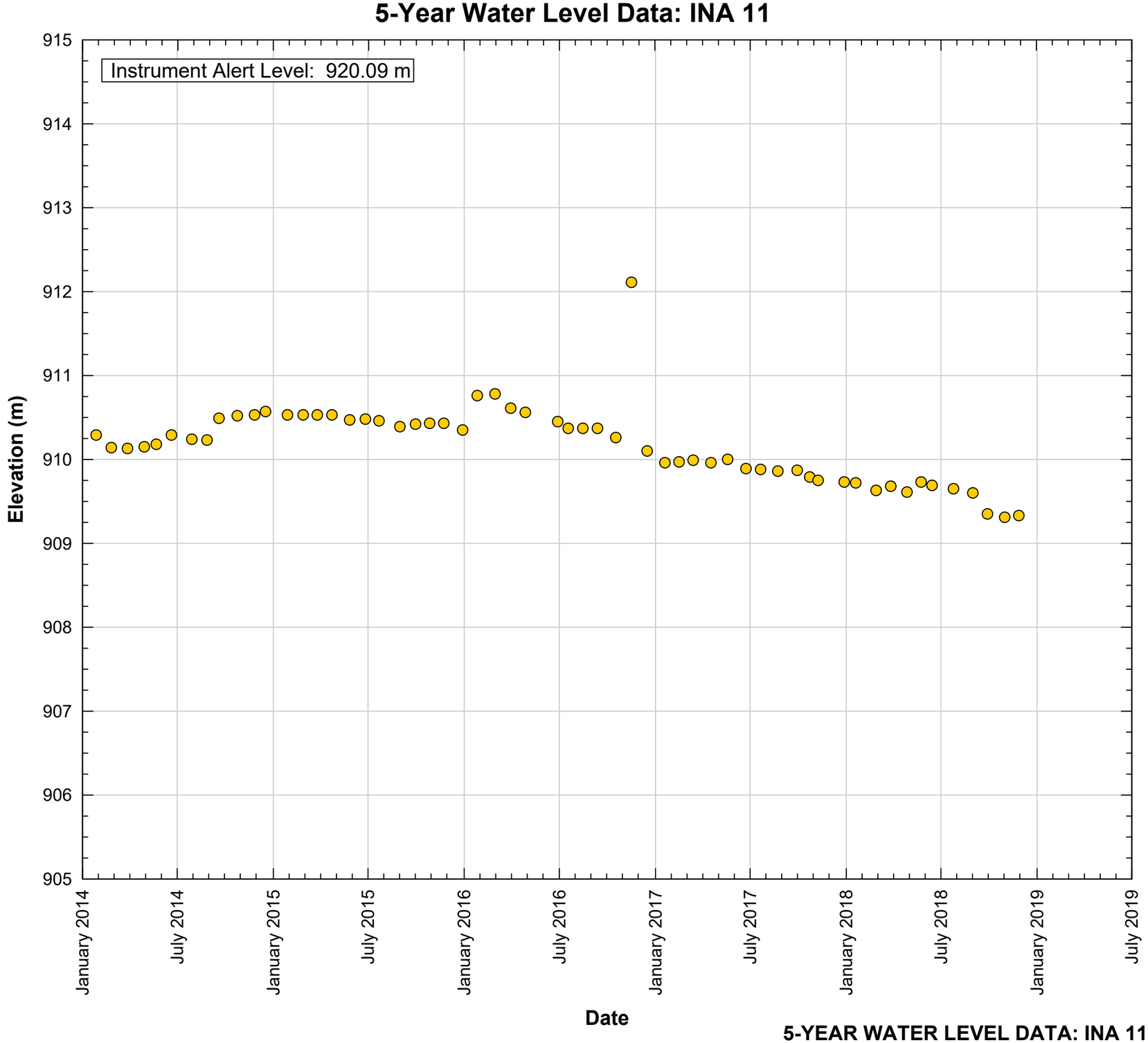
5-YEAR WATER LEVEL DATA: INA 10

FIGURE 6-10



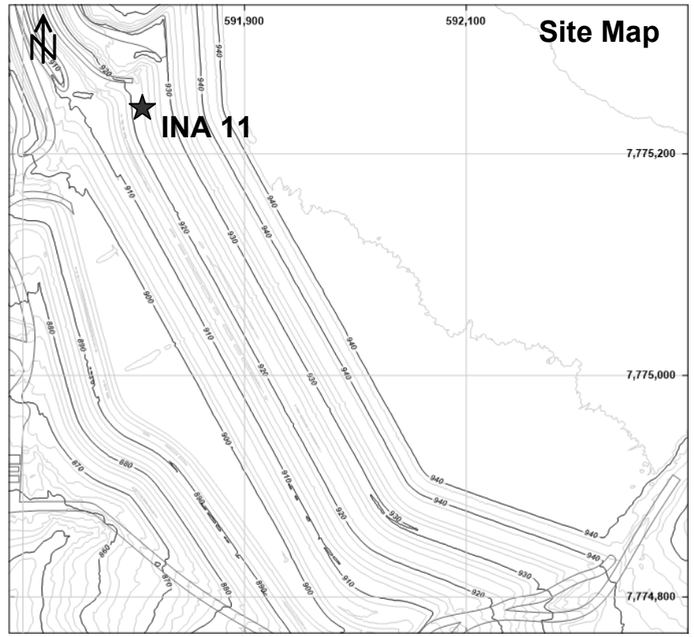


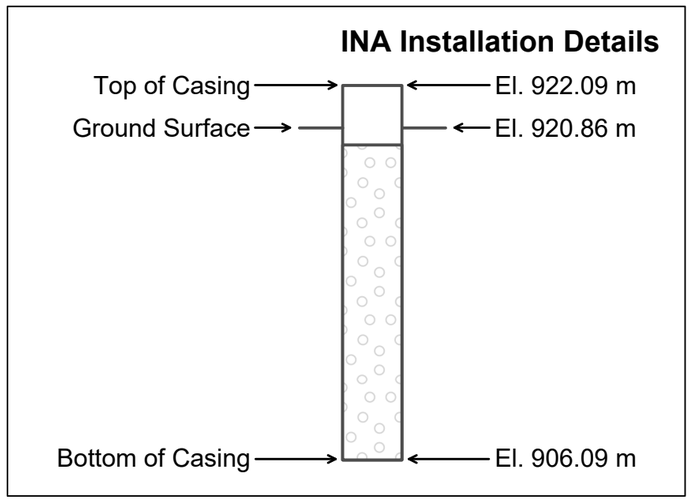
INA 10			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/12/2006	11/27/2018	Monthly



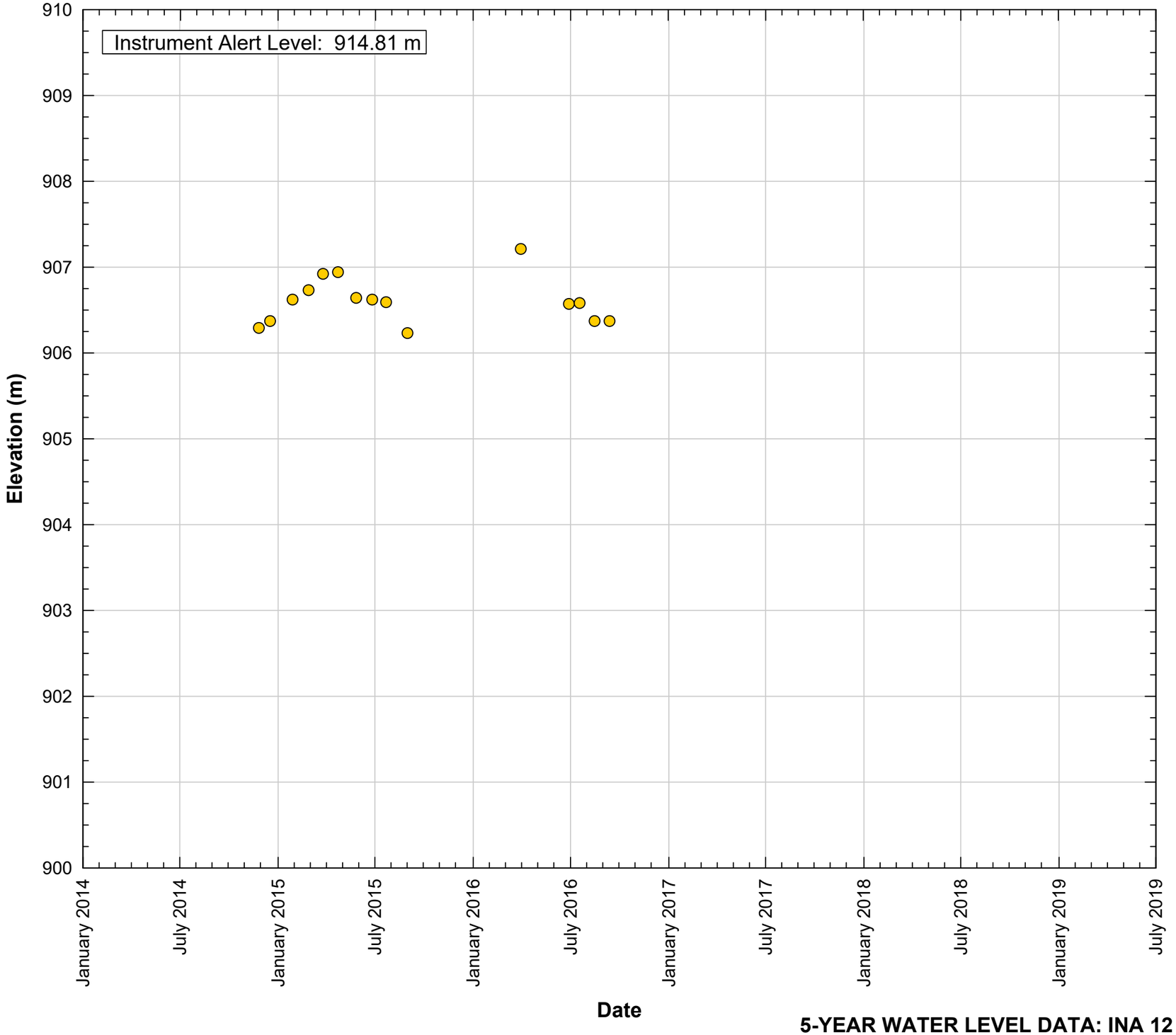
5-YEAR WATER LEVEL DATA: INA 11

FIGURE 6-11



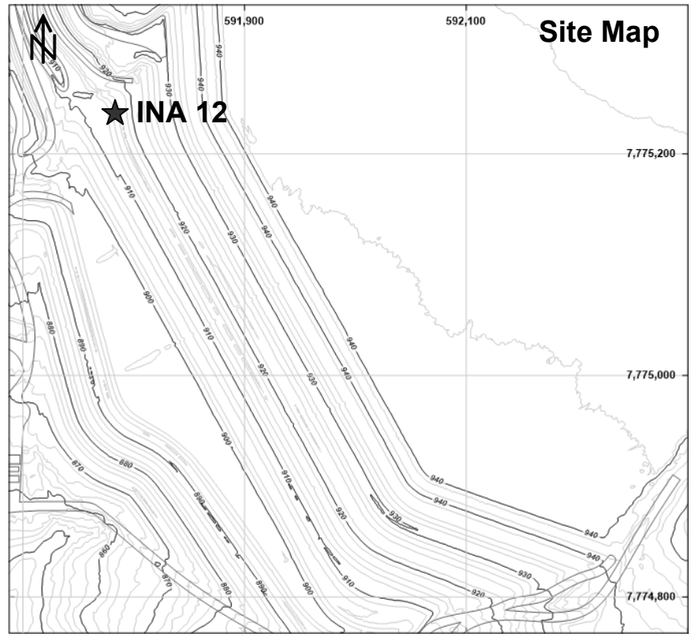


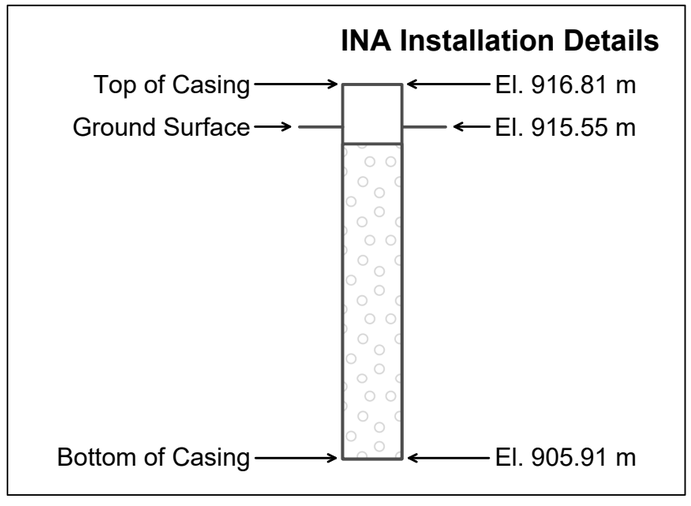
INA 11			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	11/30/2005	11/27/2018	Monthly



5-YEAR WATER LEVEL DATA: INA 12

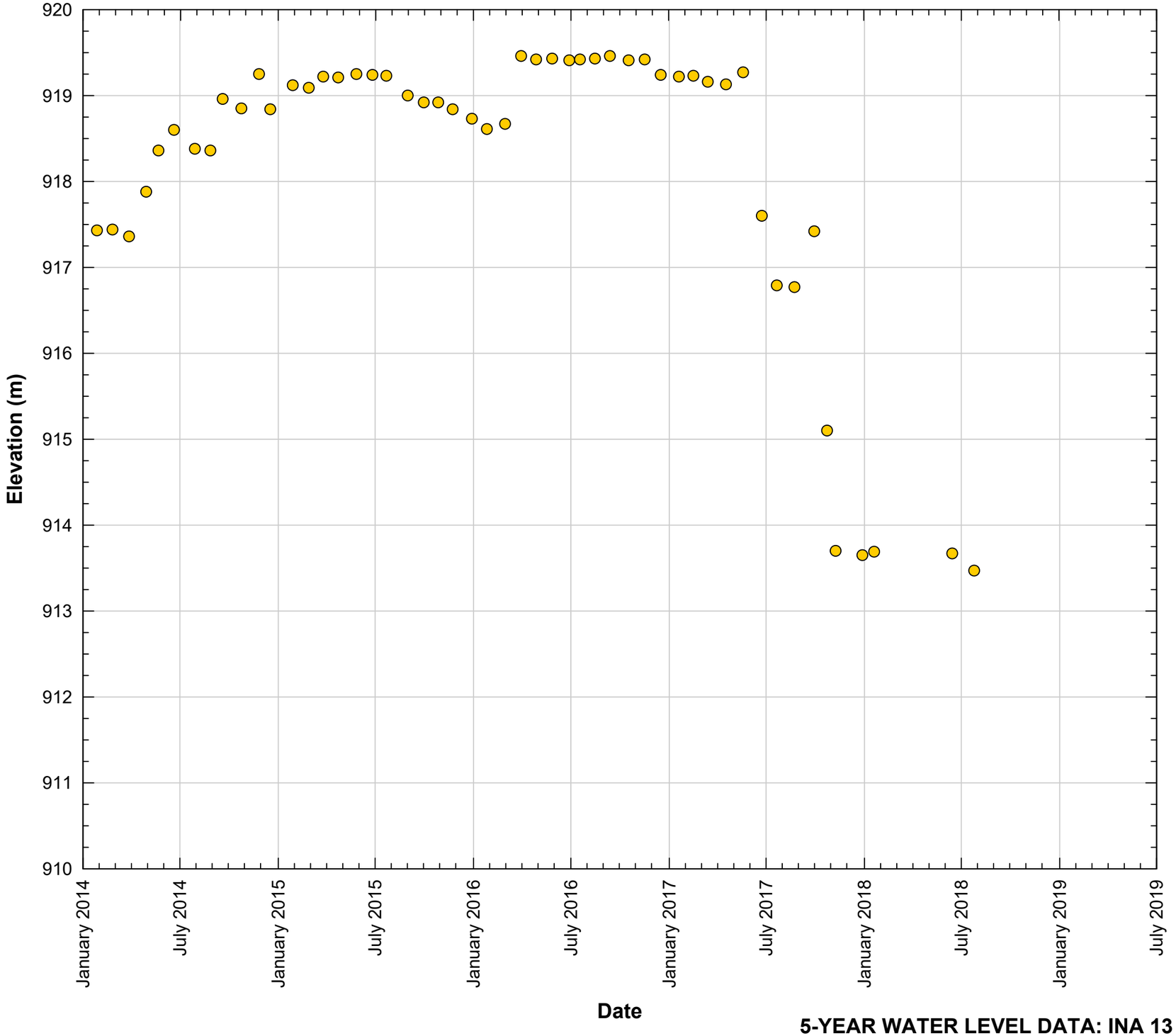
FIGURE 6-12

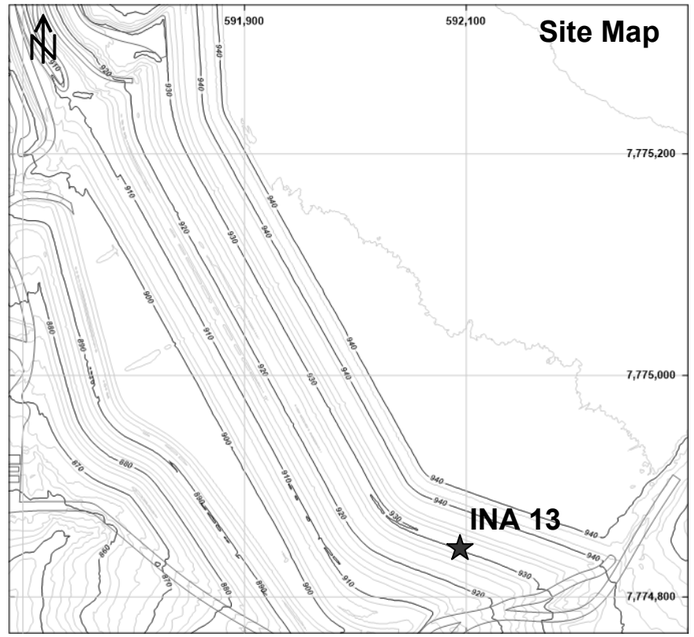


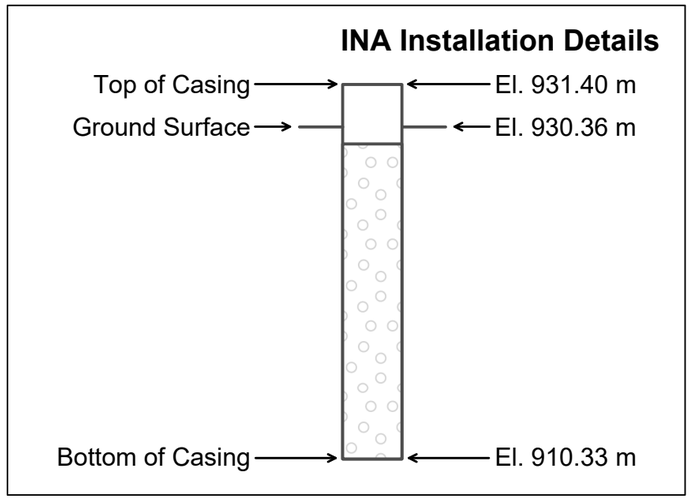


INA 12			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/12/2006	11/27/2018	Monthly

5-Year Water Level Data: INA 13



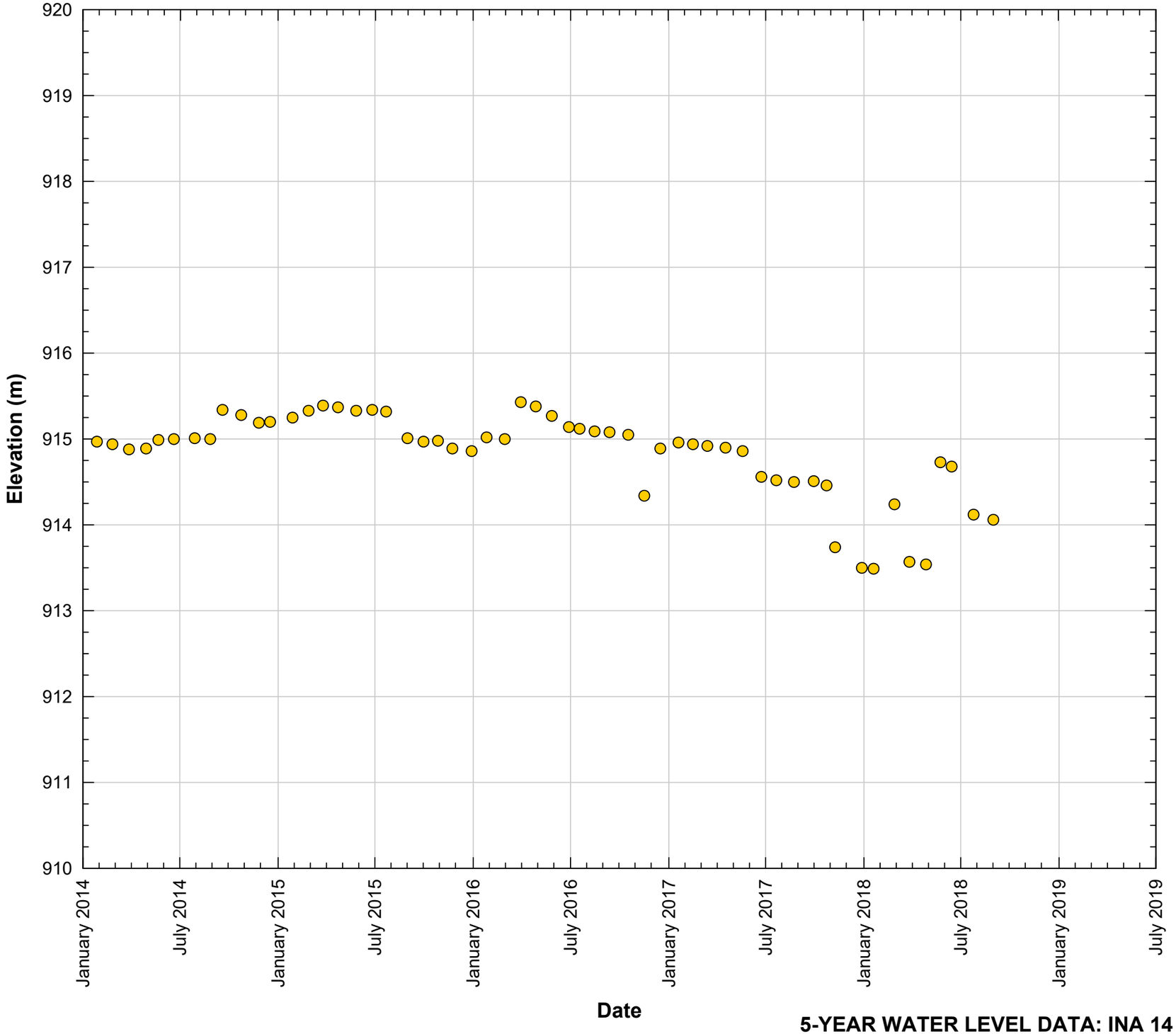


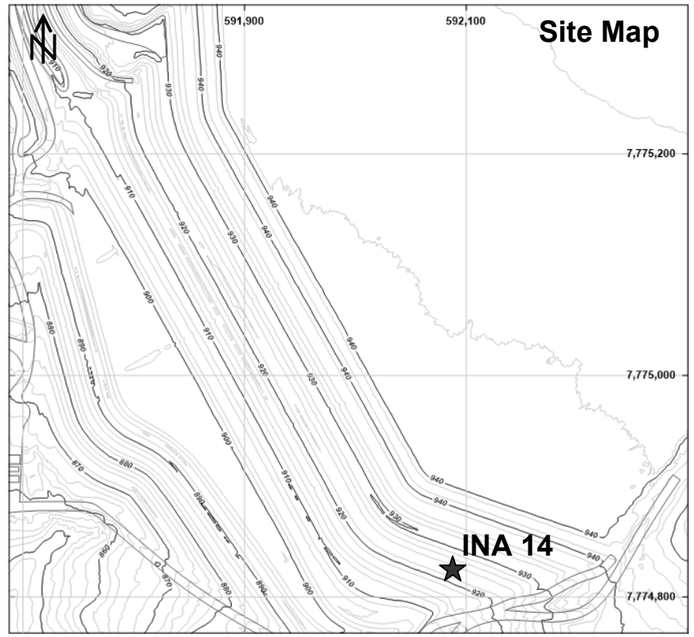


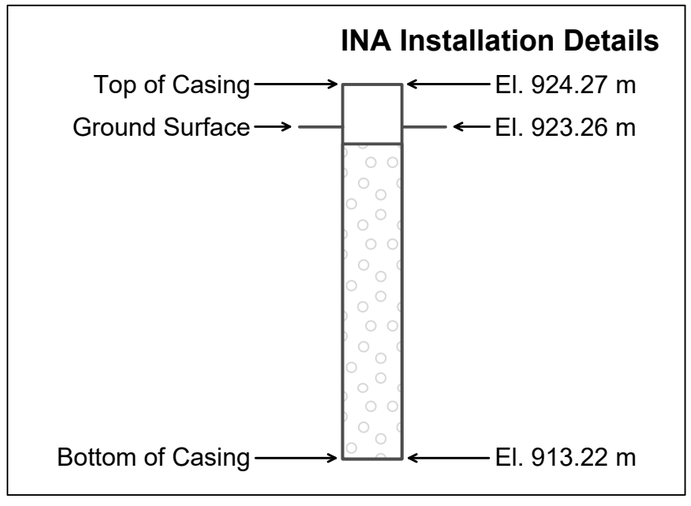
INA 13			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	12/25/2005	7/25/2018	Monthly

5-YEAR WATER LEVEL DATA: INA 13

FIGURE 6-13



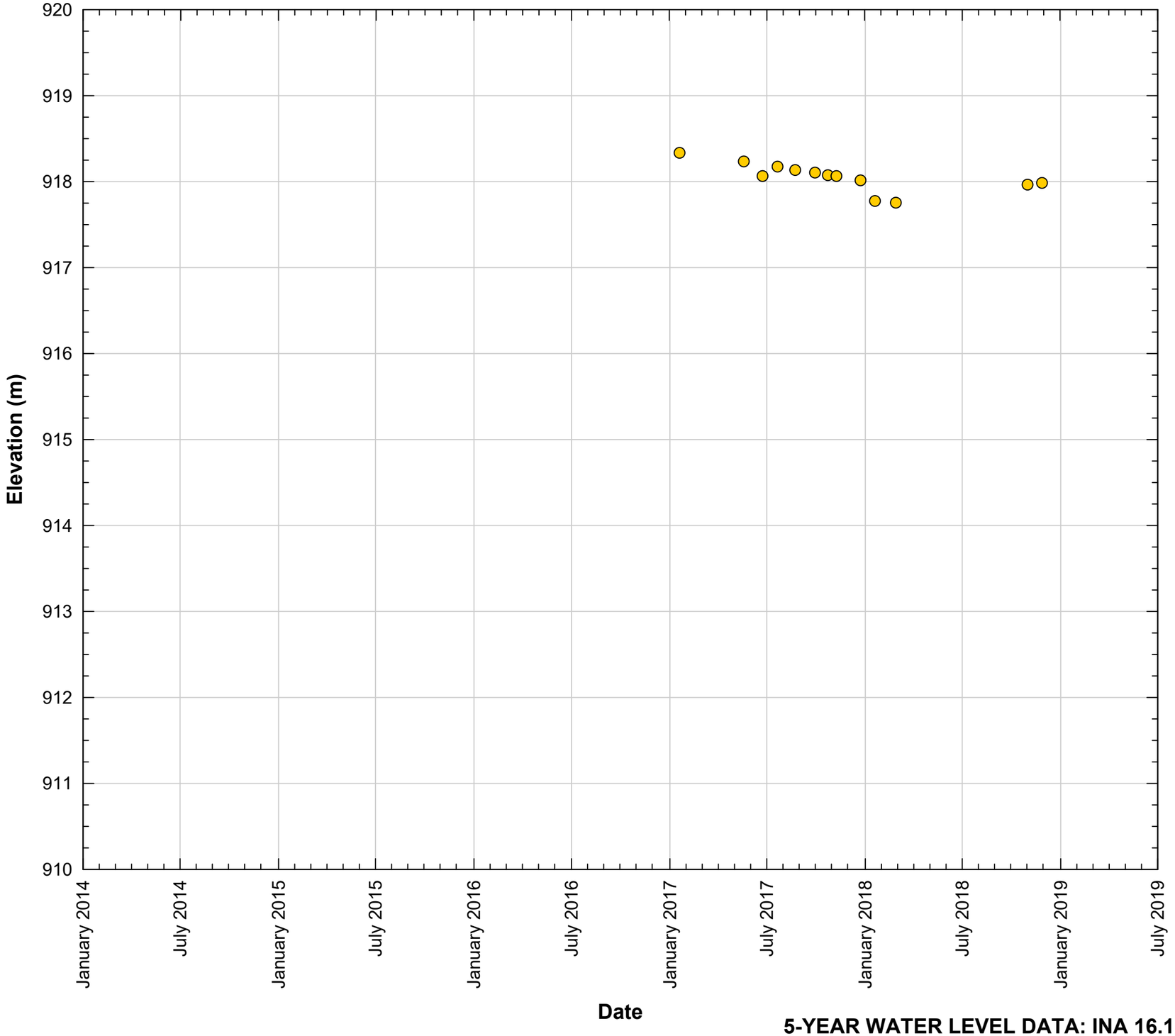




INA 14			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/12/2006	11/27/2018	Monthly

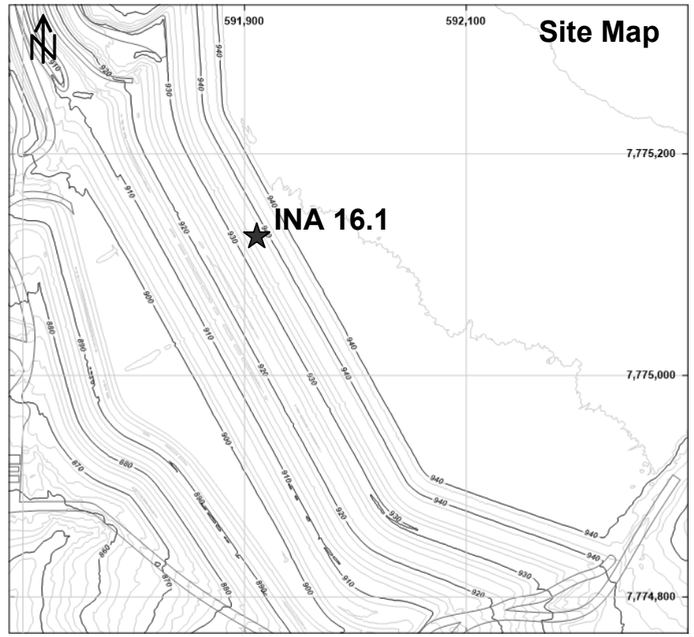
5-YEAR WATER LEVEL DATA: INA 14

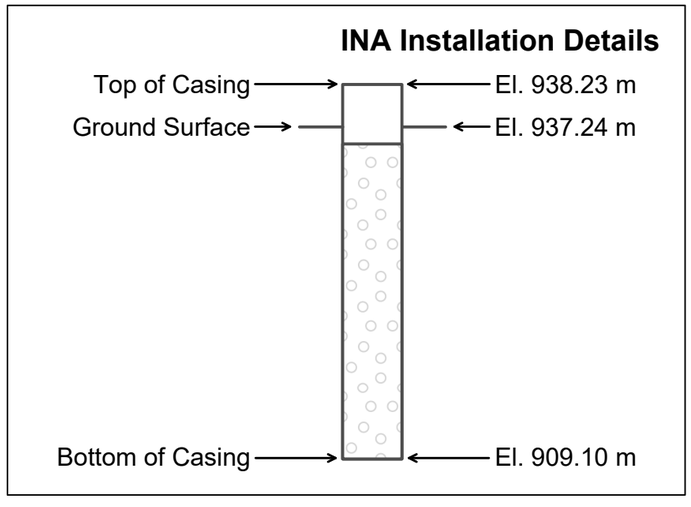
FIGURE 6-14



5-YEAR WATER LEVEL DATA: INA 16.1

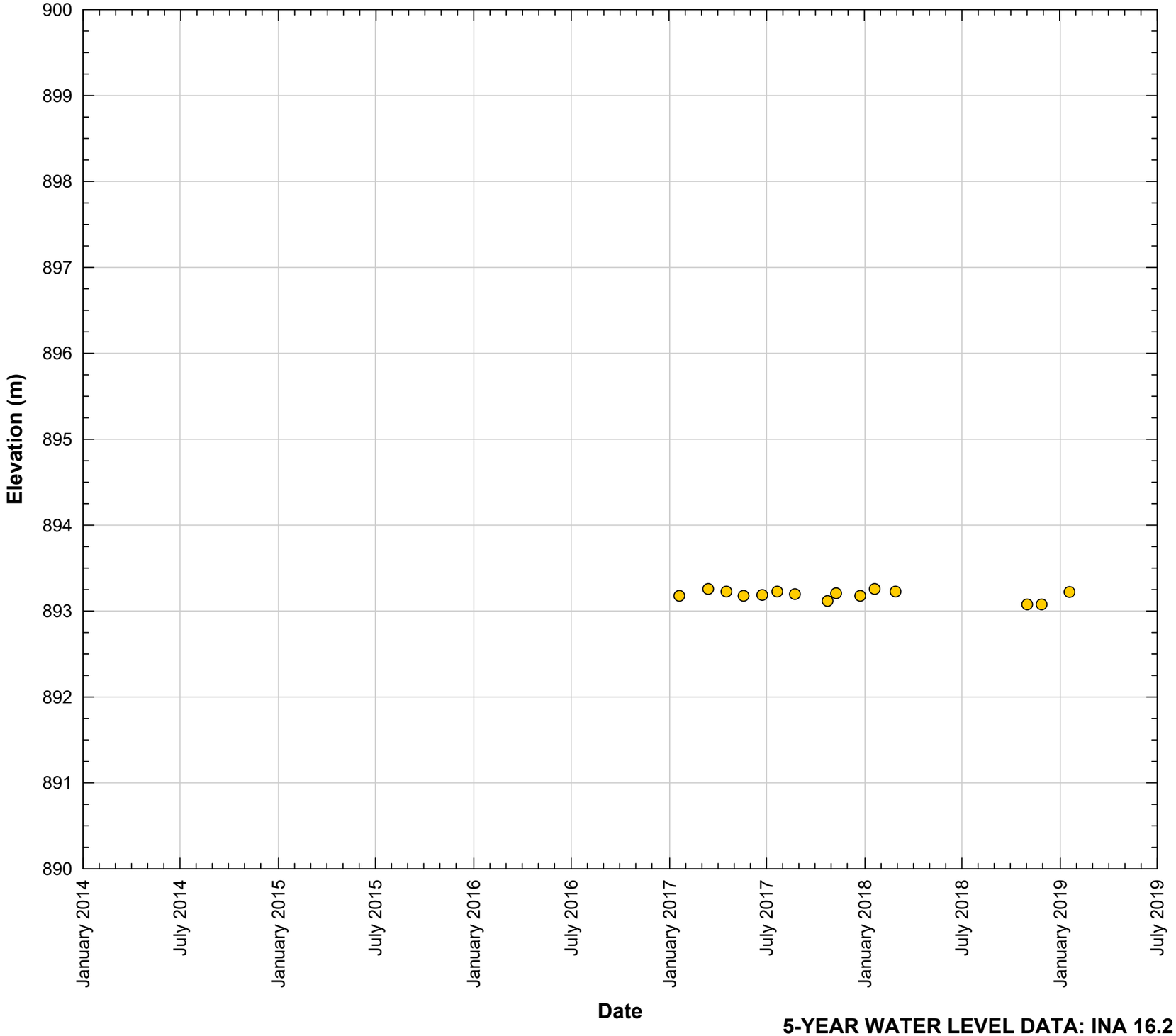
FIGURE 6-15





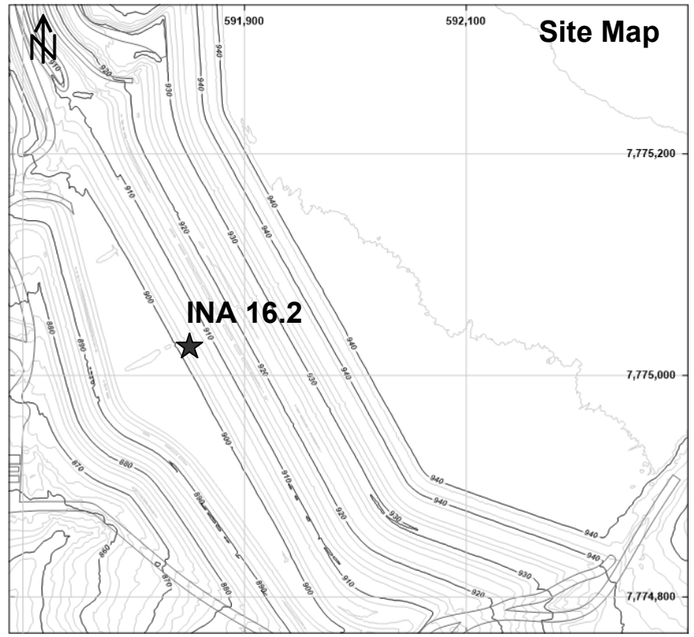
INA 16.1			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/19/2017	11/27/2018	Monthly

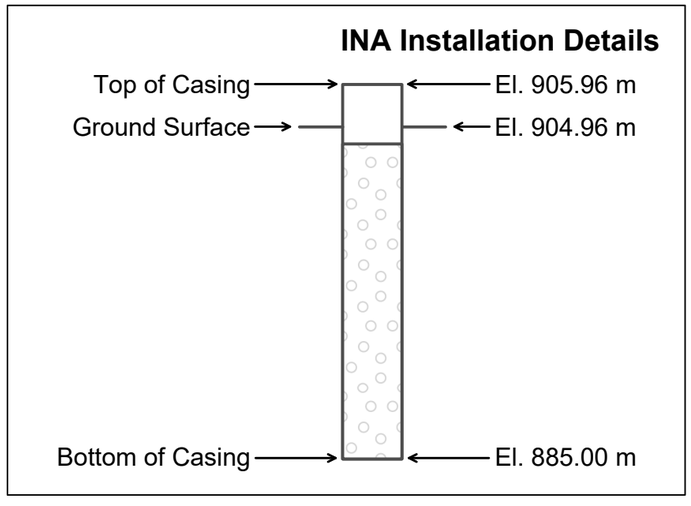
5-Year Water Level Data: INA 16.2



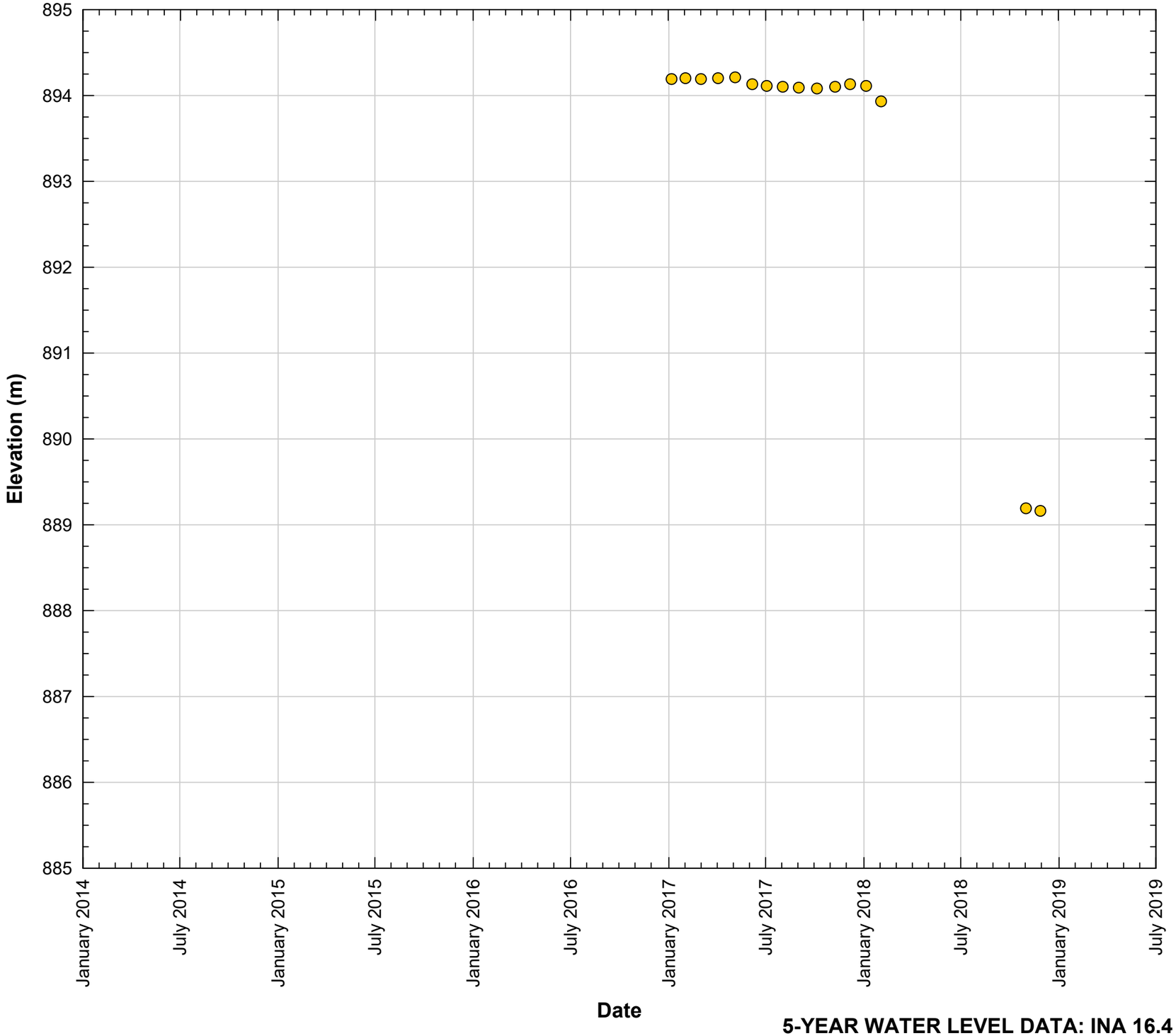
5-YEAR WATER LEVEL DATA: INA 16.2

FIGURE 6-16



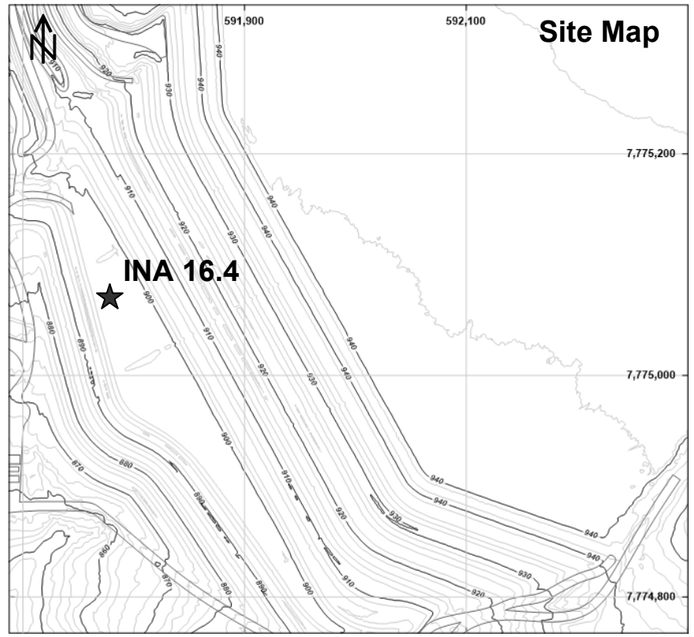


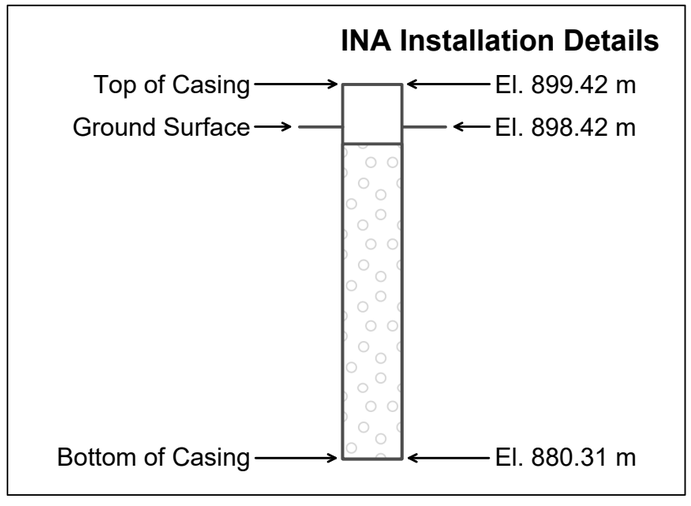
INA 16.2			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/19/2017	1/18/2019	Monthly



5-YEAR WATER LEVEL DATA: INA 16.4

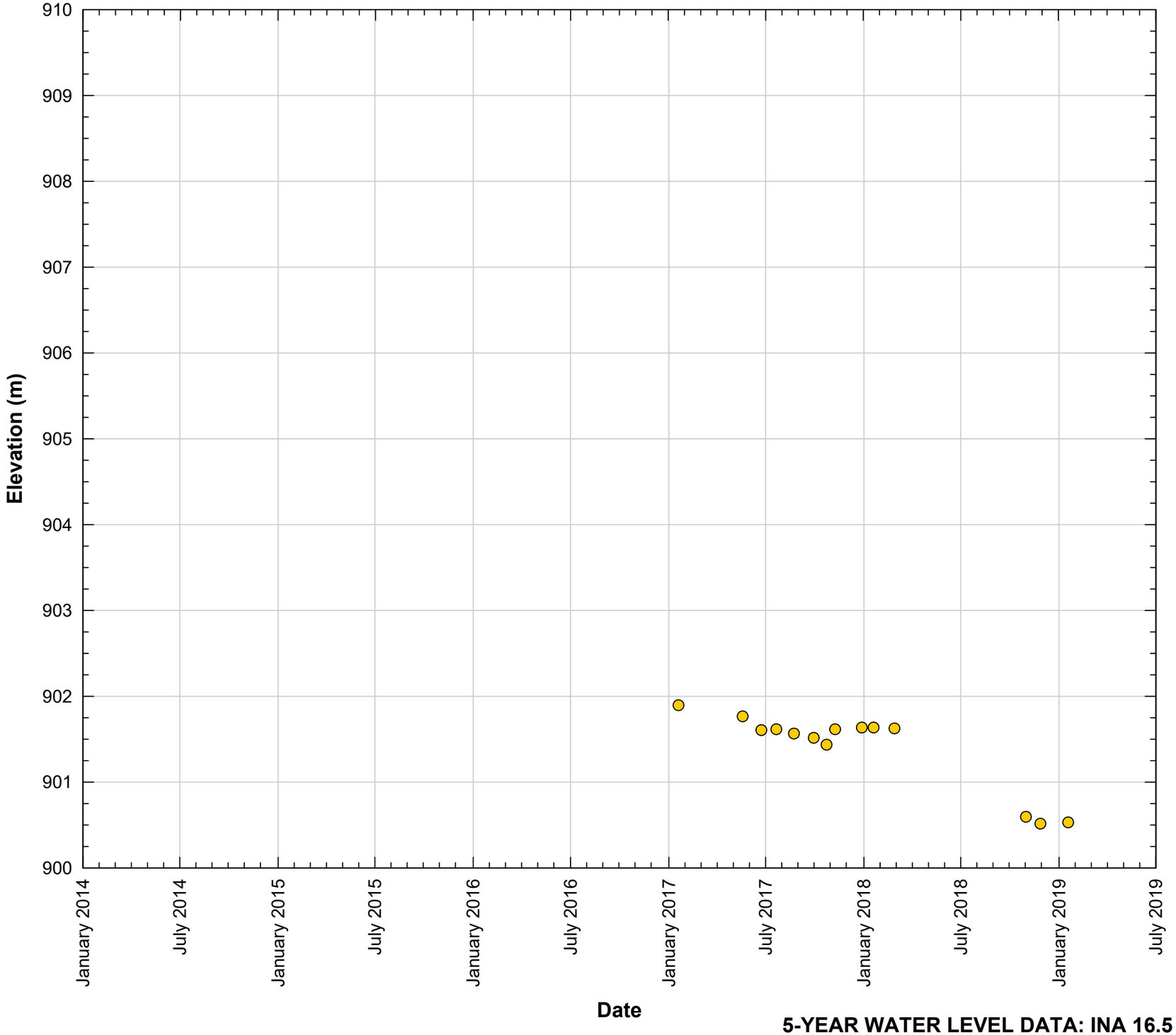
FIGURE 6-17

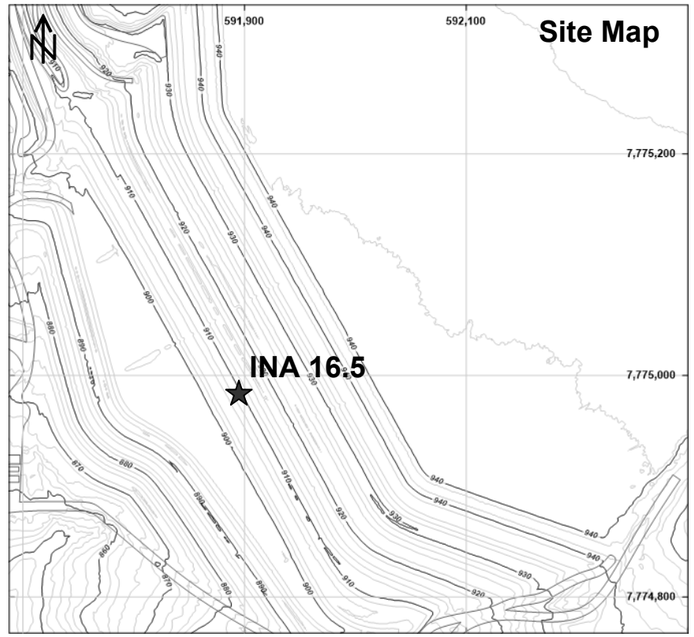


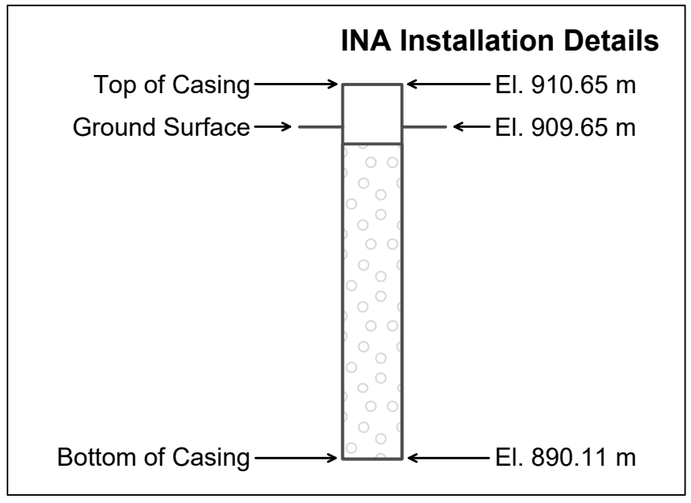


INA 16.4			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/6/2017	11/27/2018	Monthly

5-Year Water Level Data: INA 16.5





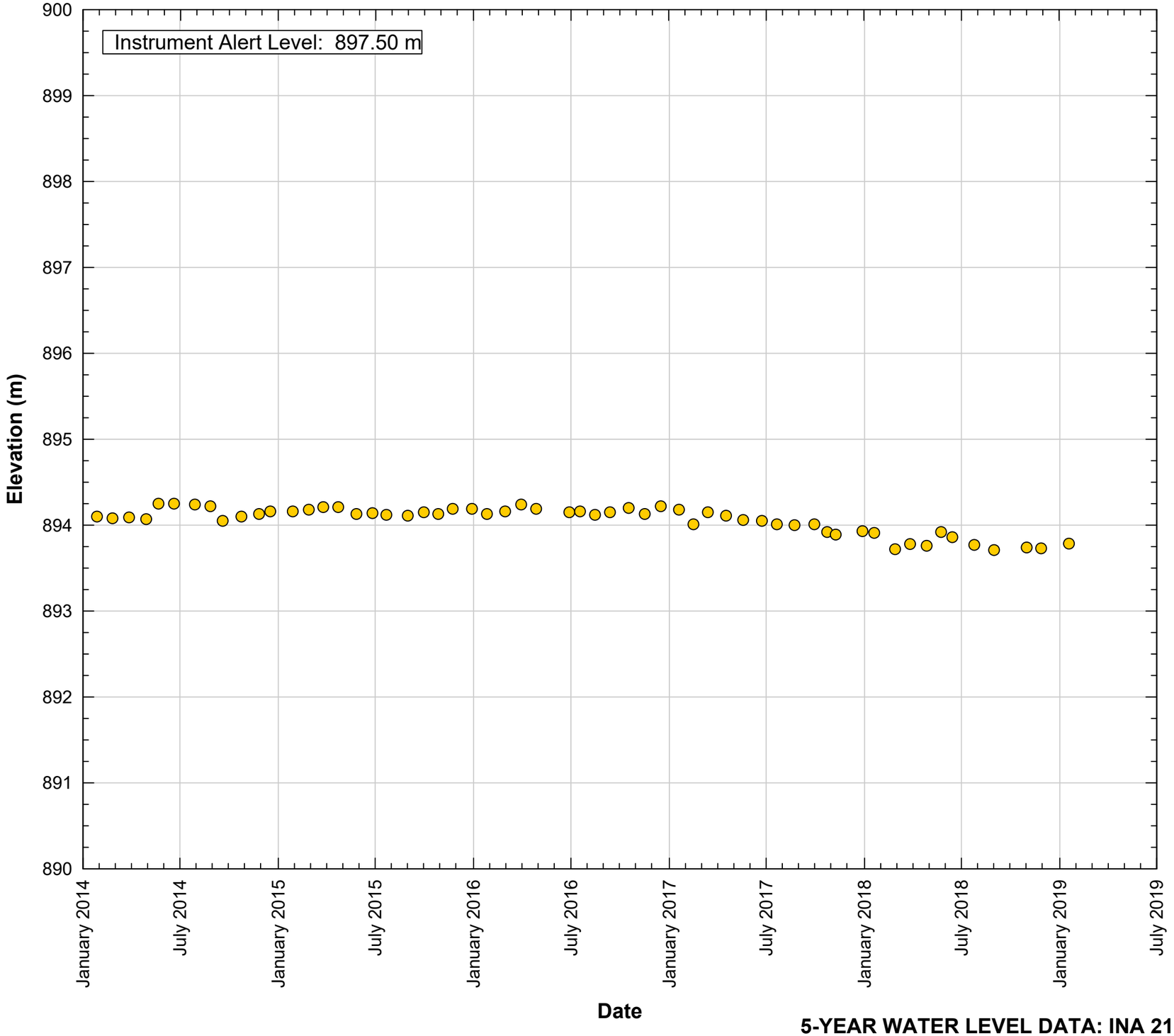


INA 16.5			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/19/2017	1/18/2019	Monthly

5-YEAR WATER LEVEL DATA: INA 16.5

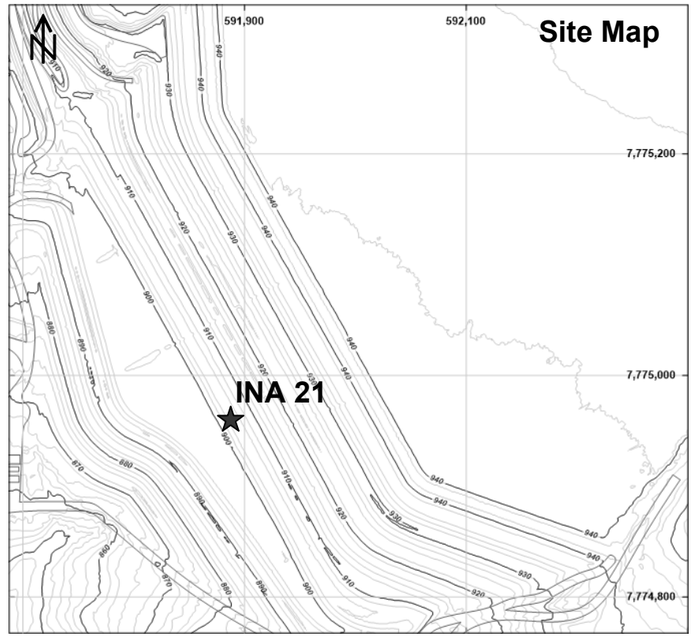
FIGURE 6-18

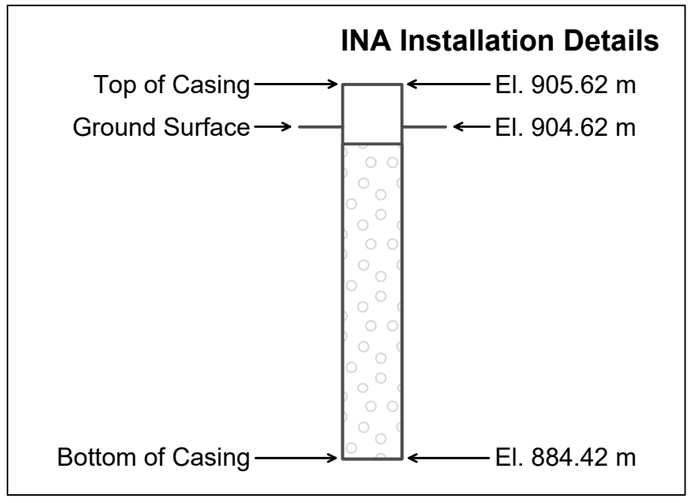
5-Year Water Level Data: INA 21



5-YEAR WATER LEVEL DATA: INA 21

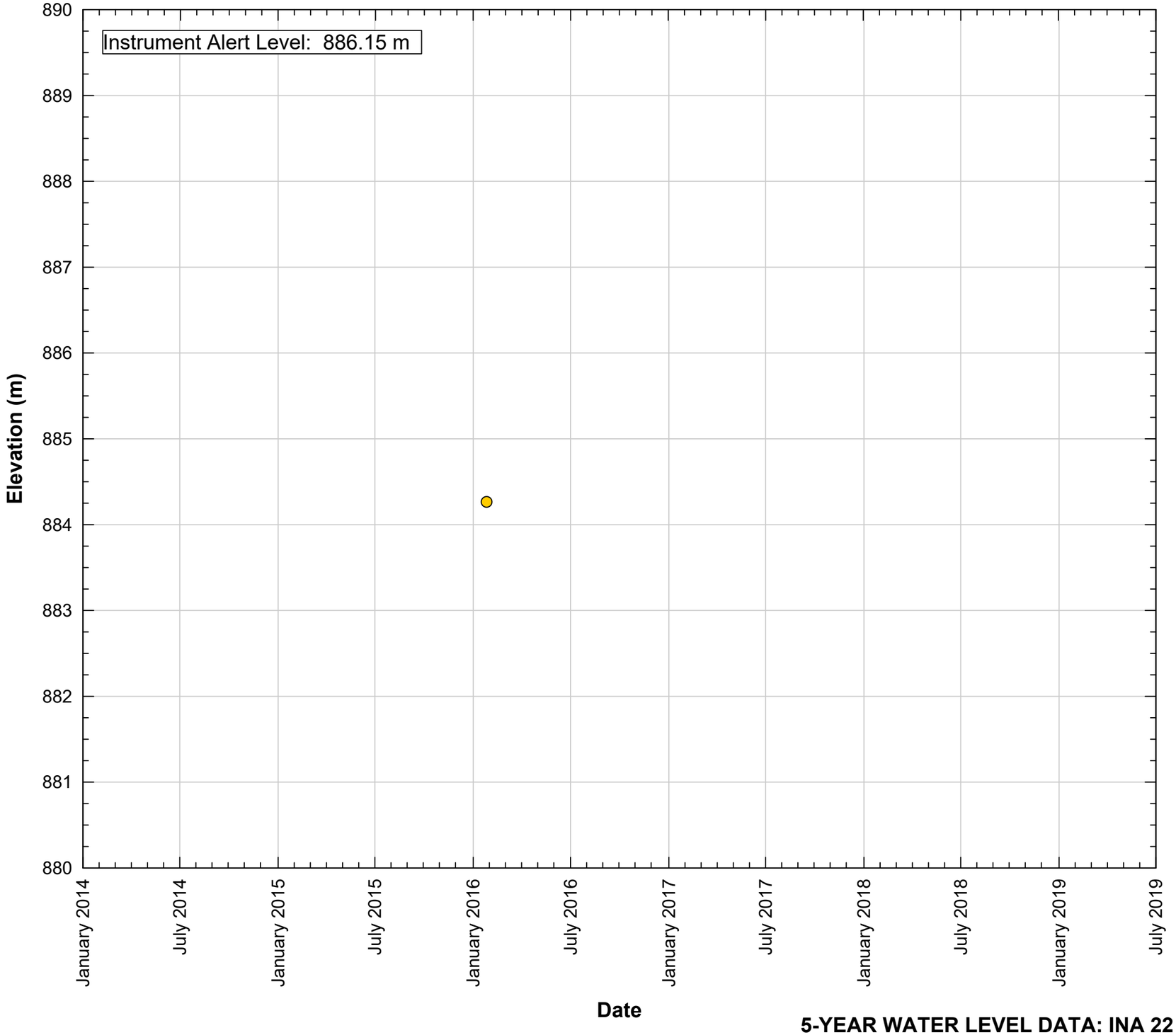
FIGURE 6-19

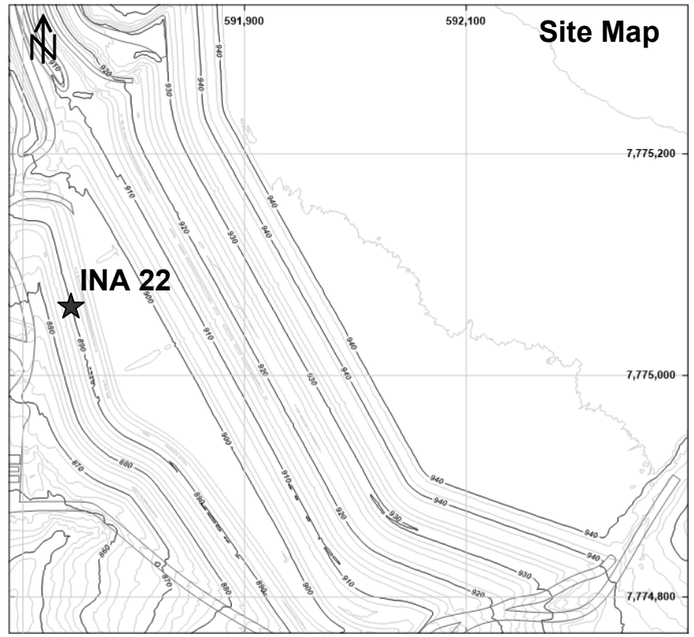


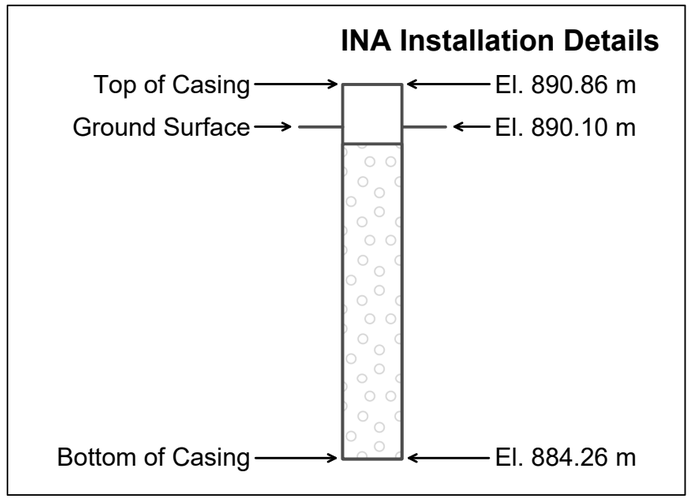


INA 21			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/7/2008	1/18/2019	Monthly

5-Year Water Level Data: INA 22



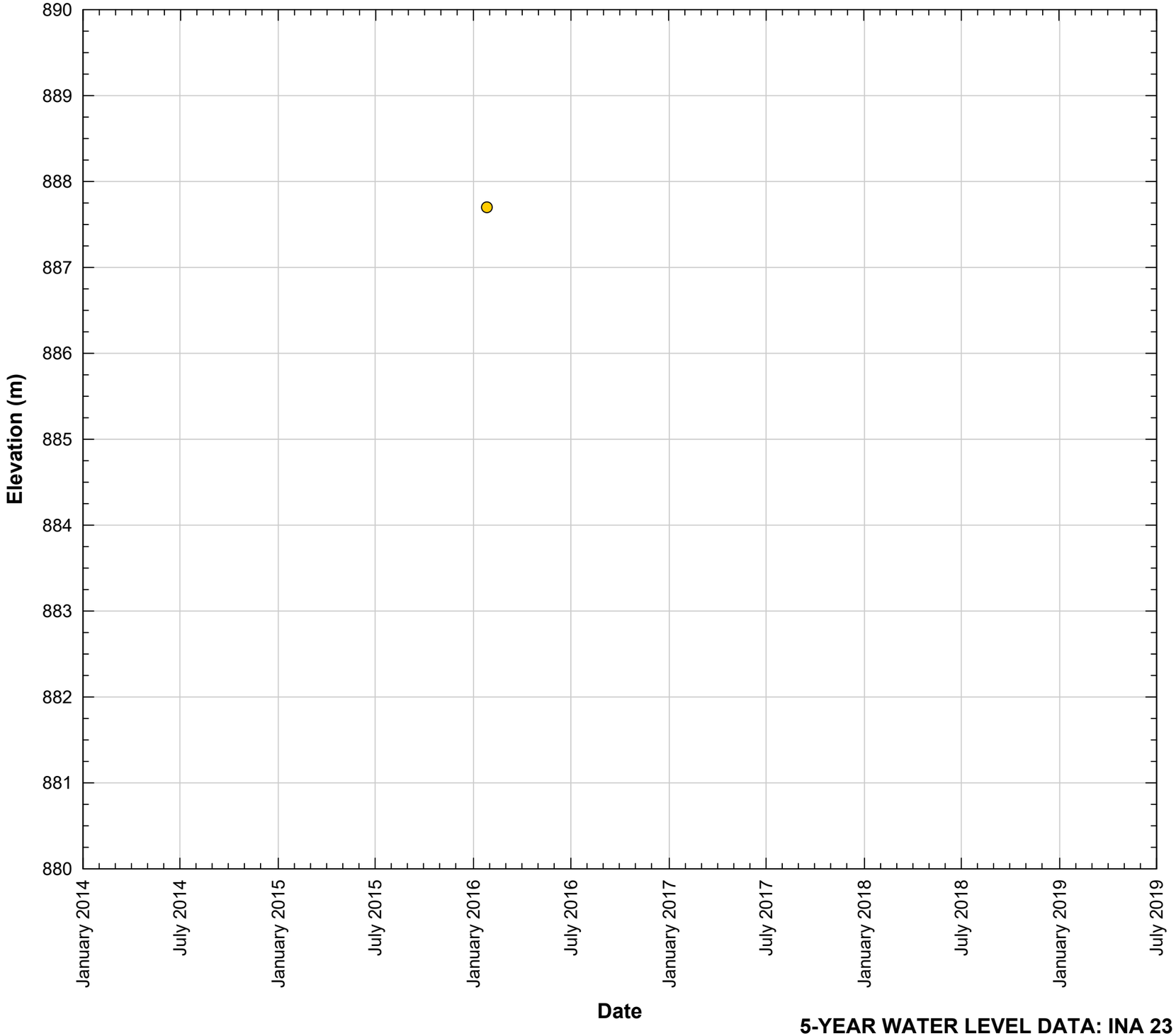




INA 22			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/7/2008	12/13/2018	Monthly

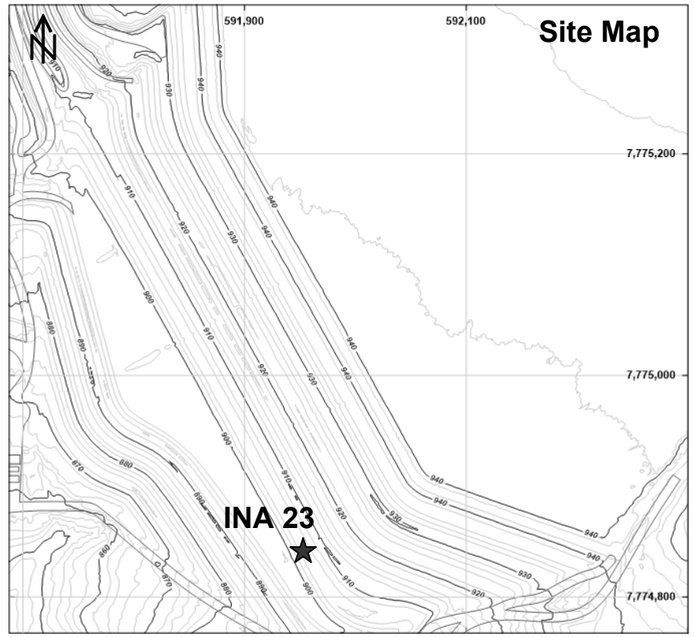
5-YEAR WATER LEVEL DATA: INA 22

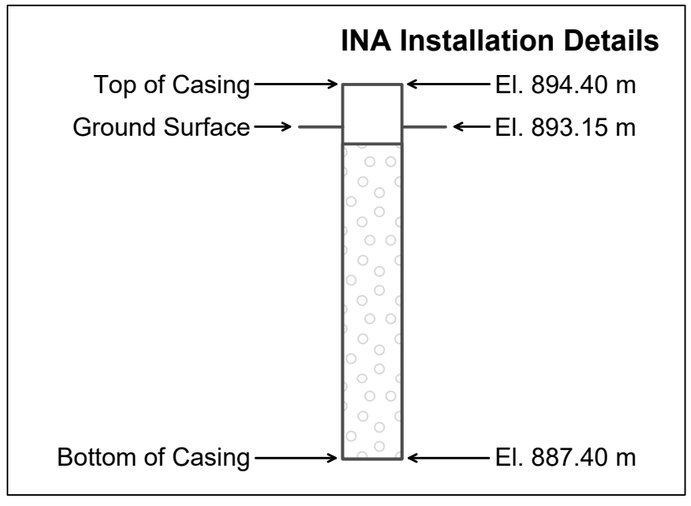
FIGURE 6-20



5-YEAR WATER LEVEL DATA: INA 23

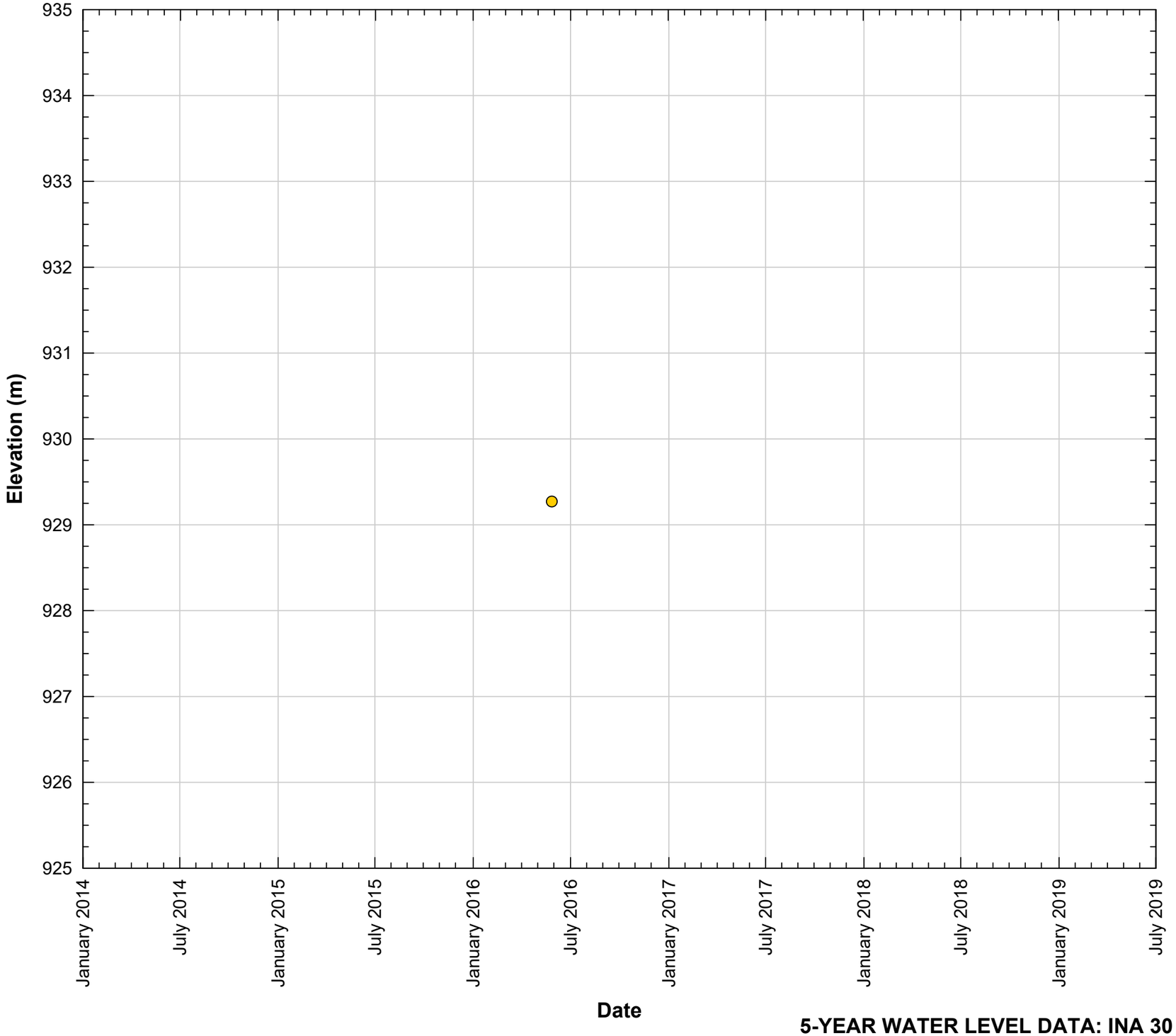
FIGURE 6-21

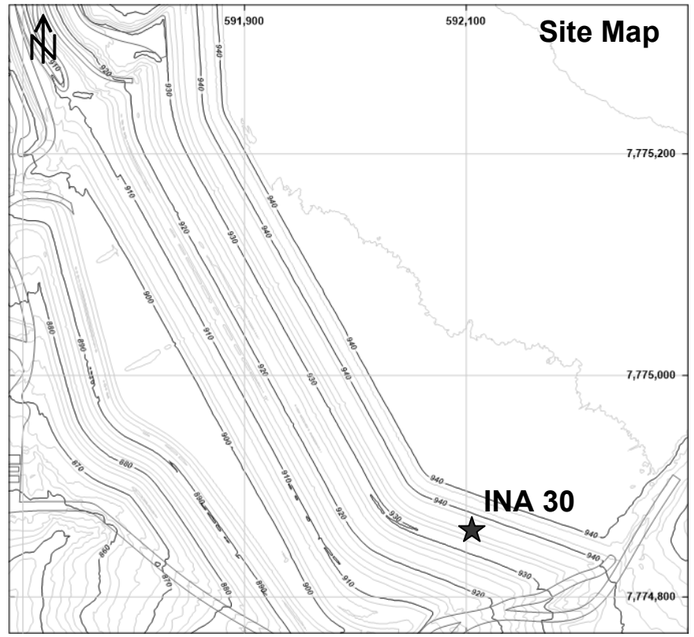


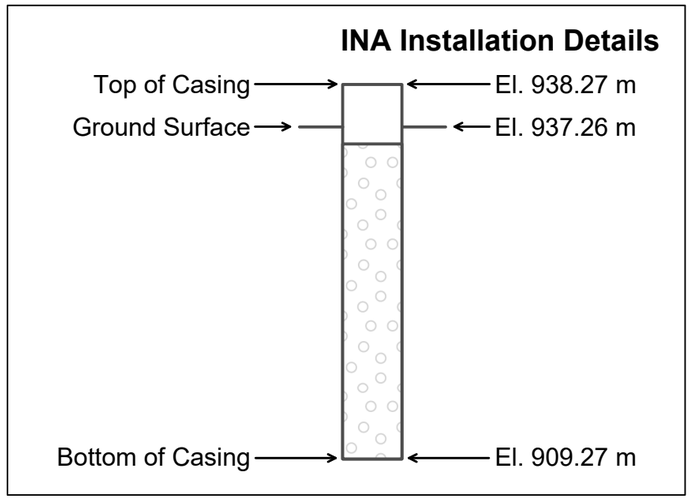


INA 23			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/7/2008	12/13/2018	Monthly

5-Year Water Level Data: INA 30



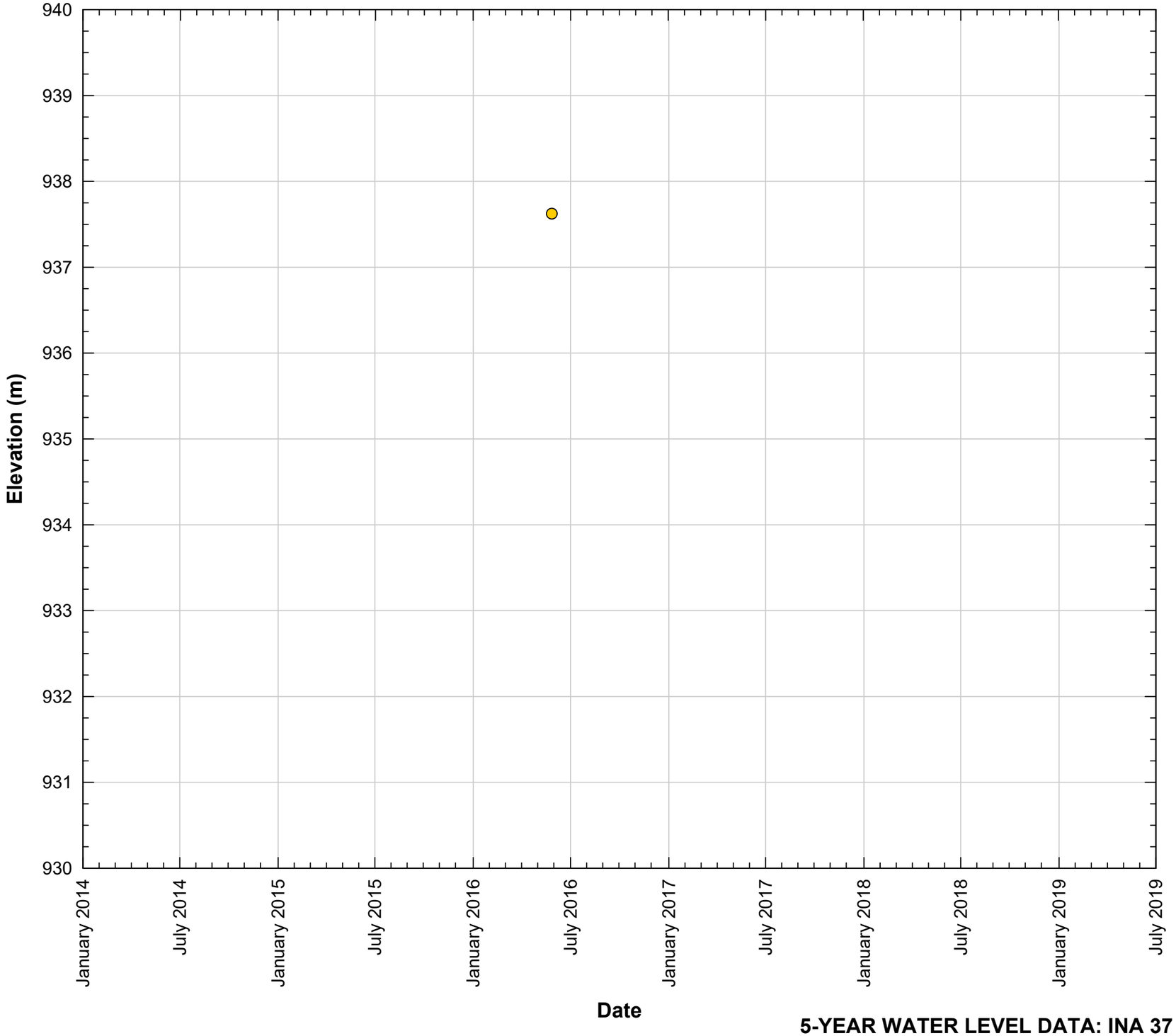




INA 30			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/7/2008	11/27/2018	Monthly

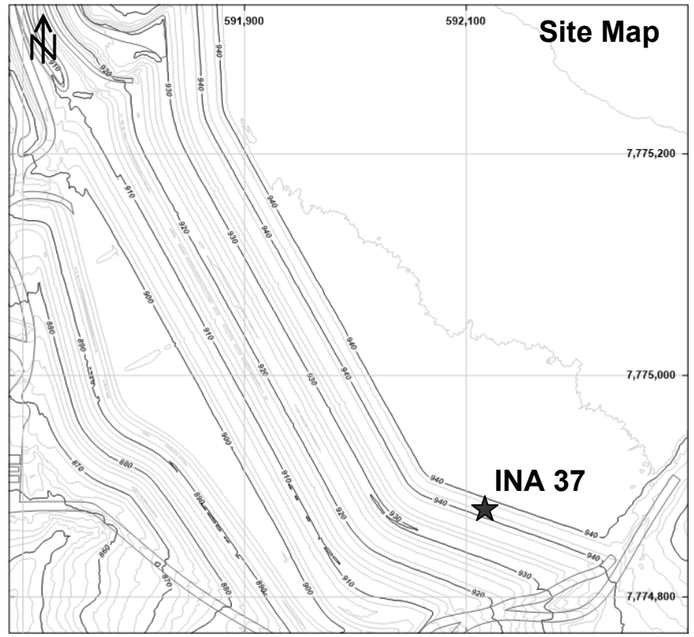
5-YEAR WATER LEVEL DATA: INA 30

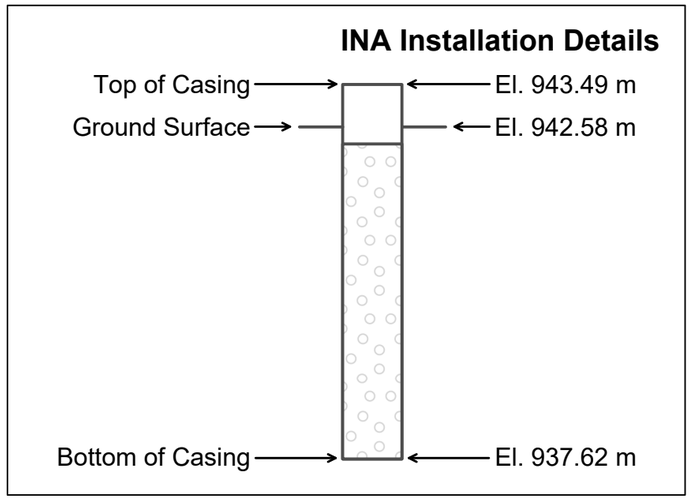
FIGURE 6-22



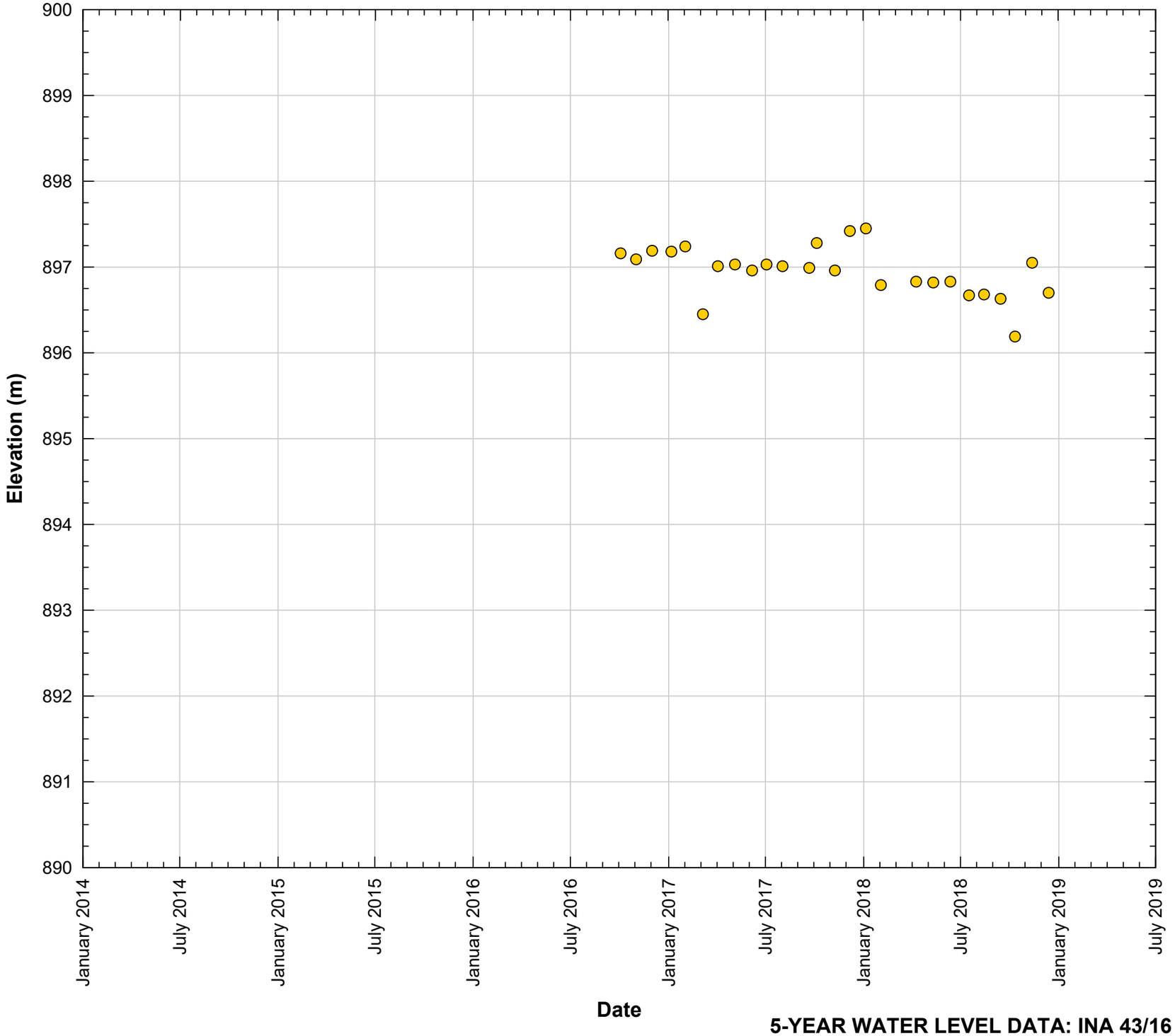
5-YEAR WATER LEVEL DATA: INA 37

FIGURE 6-23



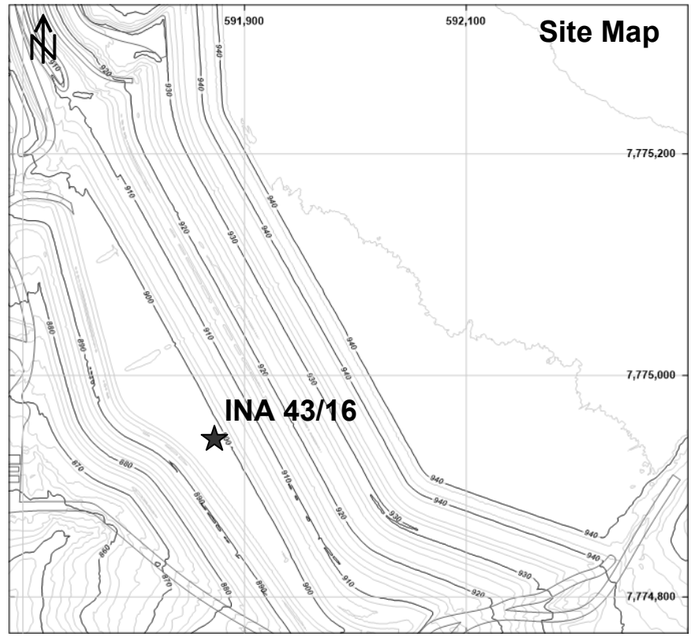


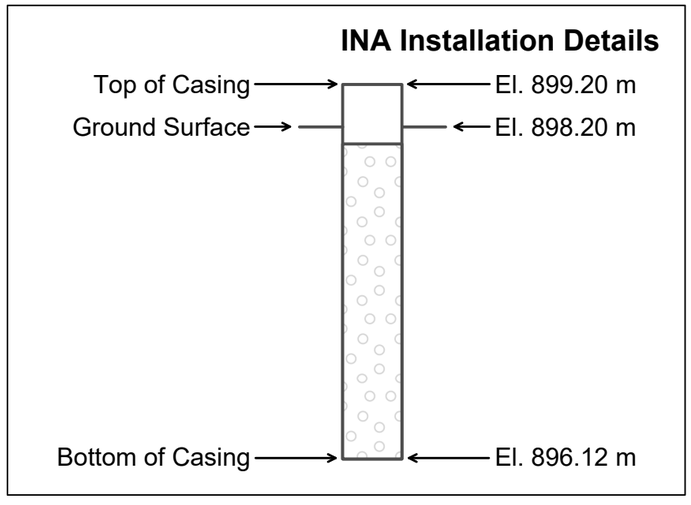
INA 37			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/29/2014	11/27/2018	Monthly



5-YEAR WATER LEVEL DATA: INA 43/16

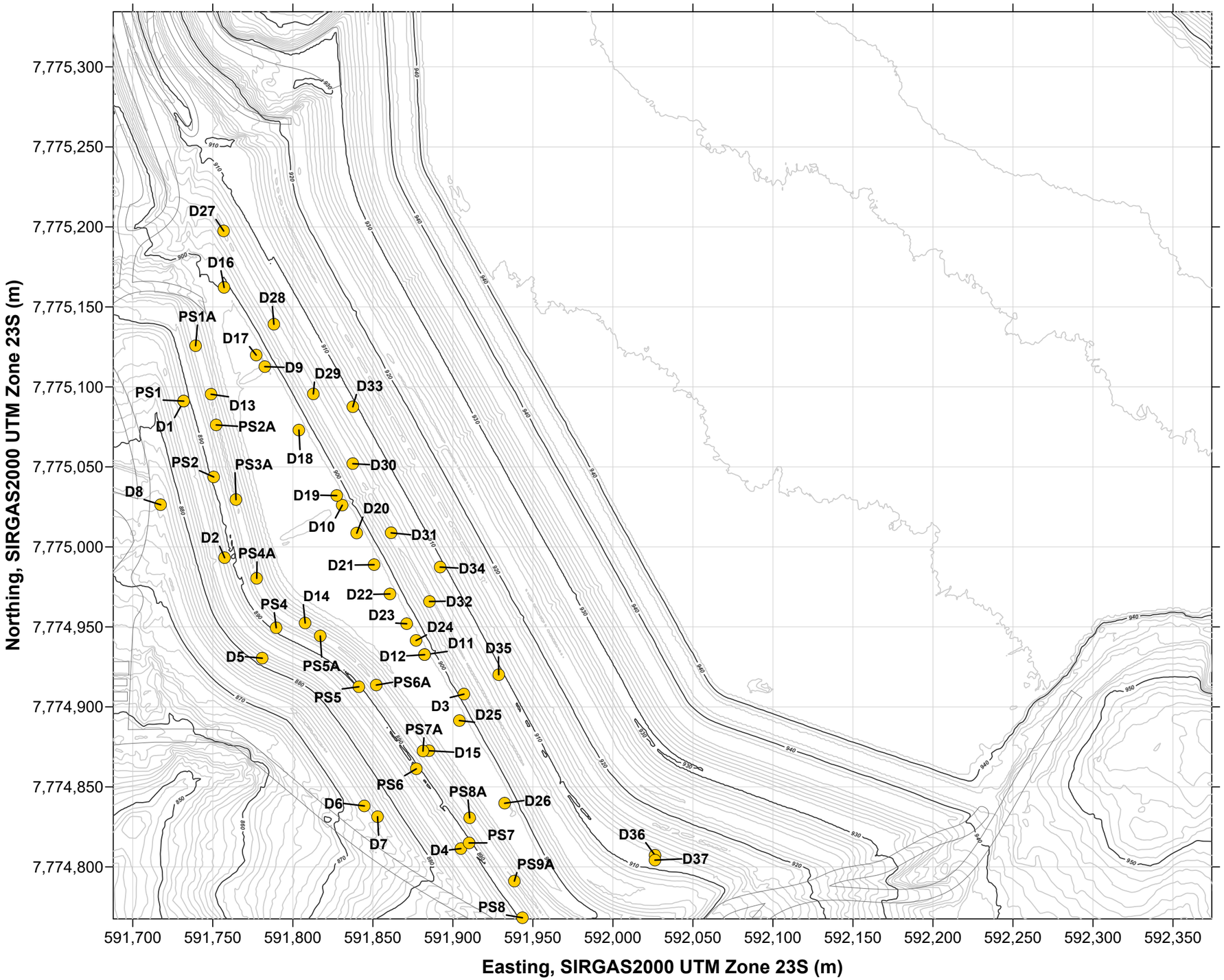
FIGURE 6-24





INA 43/16			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	10/3/2016	12/13/2018	Monthly

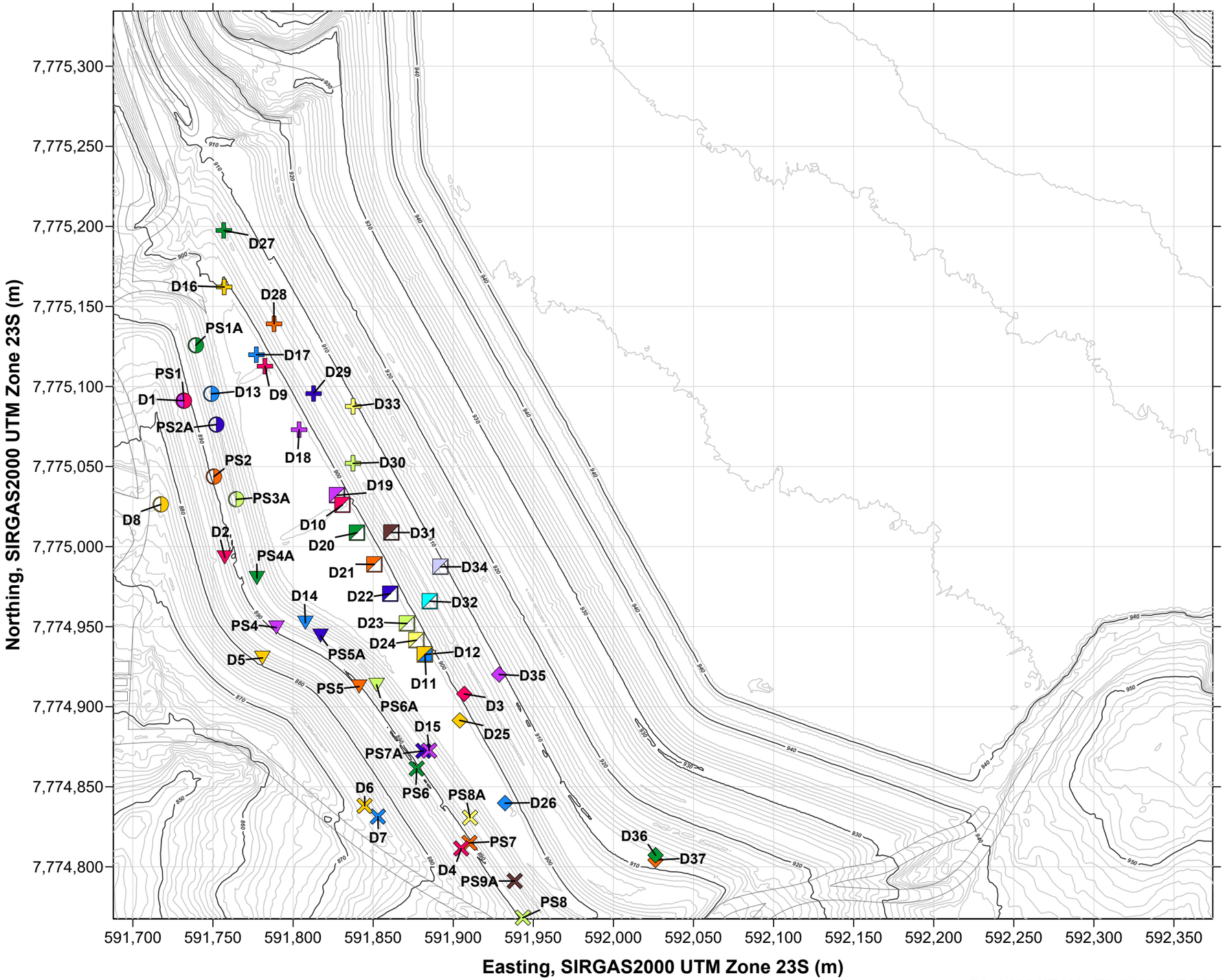
PLAN VIEW: FLOW METERS (DRAINS)



Note:
1. Horizontal datum is SIRGAS2000 UTM Zone 23S in meters, Vertical datum is Mean Sea Level in meters.

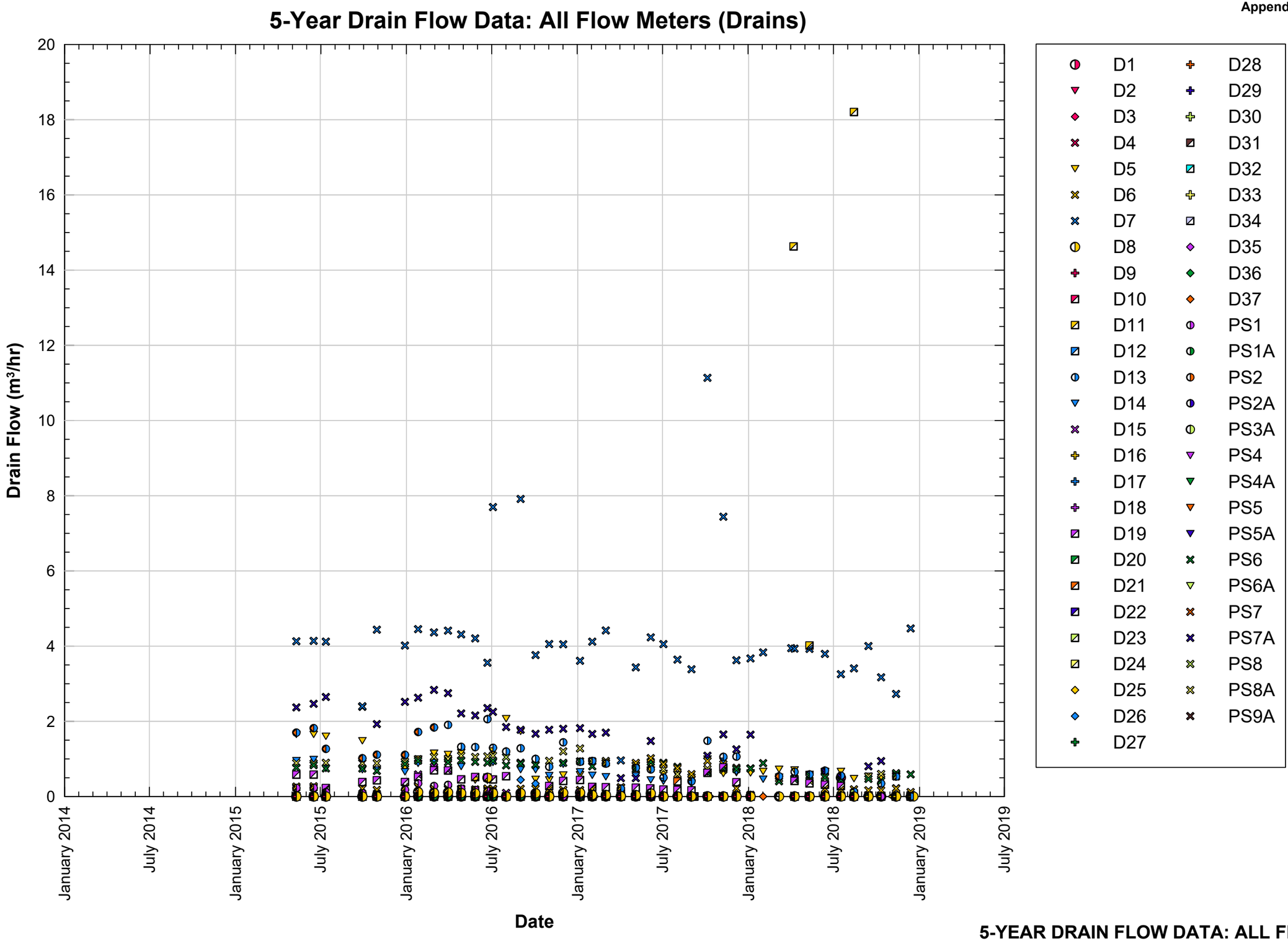
PLAN VIEW: FLOW METERS (DRAINS)
FIGURE 7-1

PLAN VIEW: FLOW METERS (DRAINS) GROUPED BY LOCATION ON DAM I



Note:
1. Horizontal datum is SIRGAS2000 UTM Zone 23S in meters, Vertical datum is Mean Sea Level in meters.

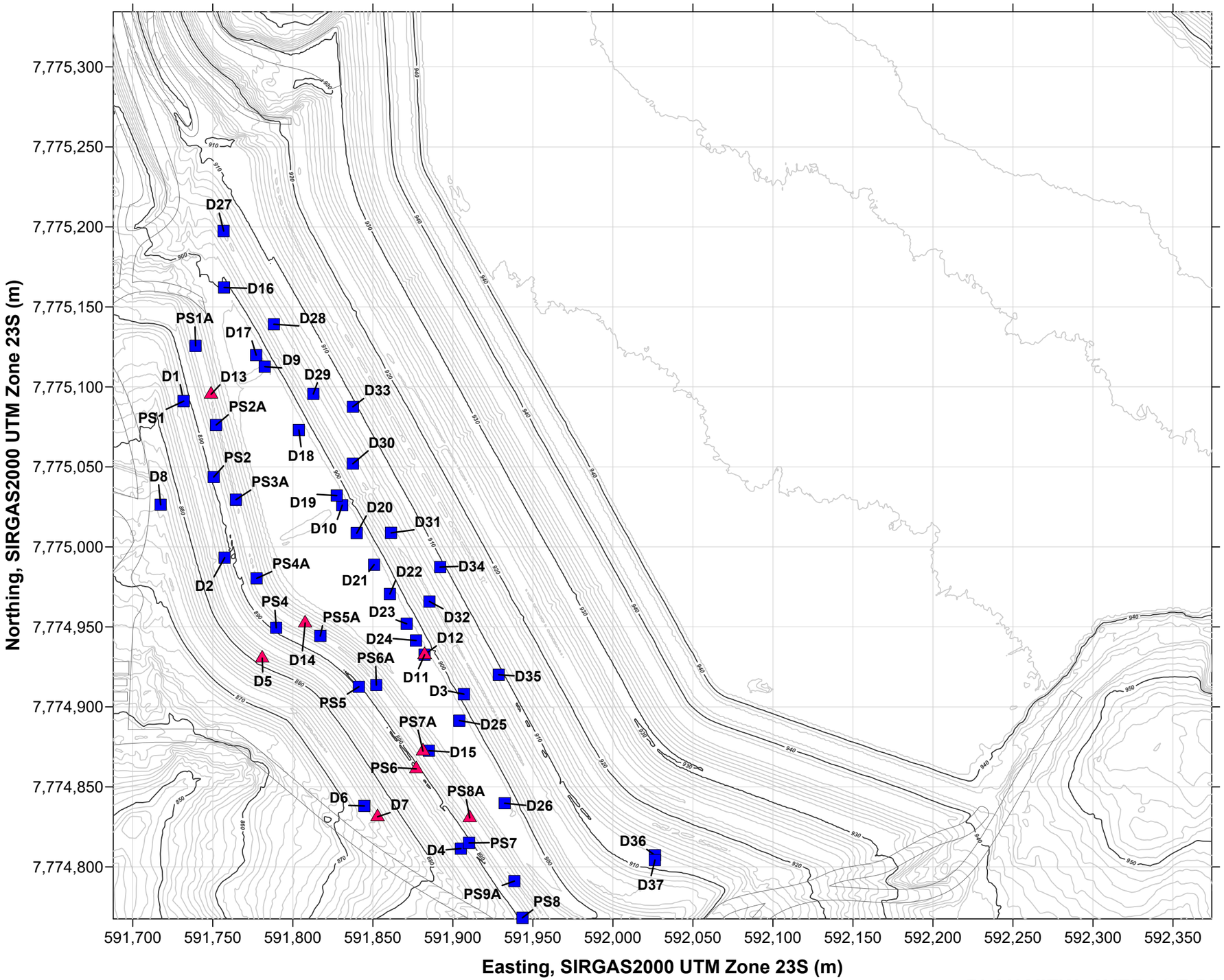
PLAN VIEW: FLOW METERS (DRAINS) GROUPED BY LOCATION ON DAM I
FIGURE 7-2A



5-YEAR DRAIN FLOW DATA: ALL FLOW METERS (DRAINS)

FIGURE 7-2B

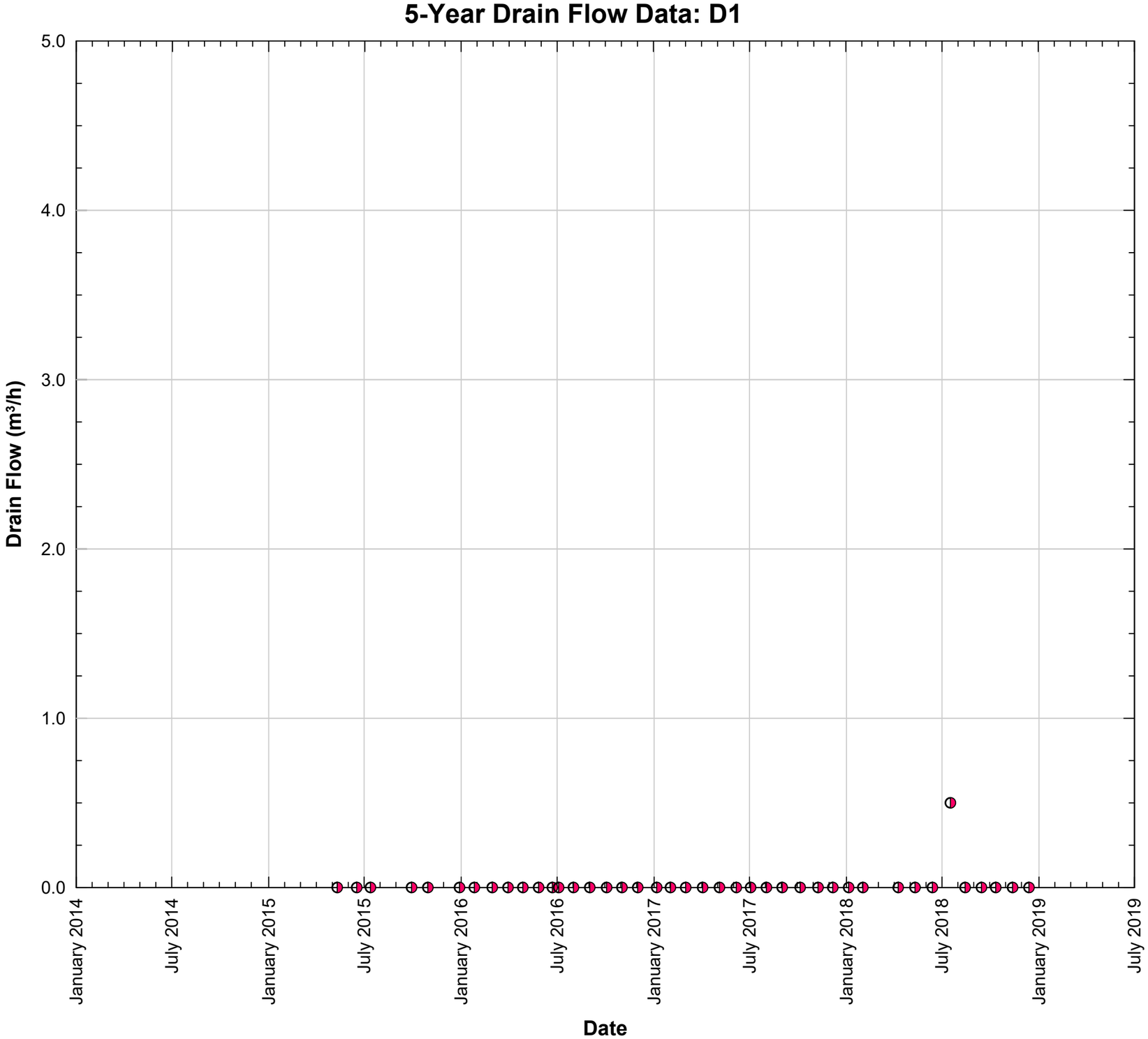
PLAN VIEW: AVERAGE DRAIN FLOW READING BETWEEN 2014 AND 2019

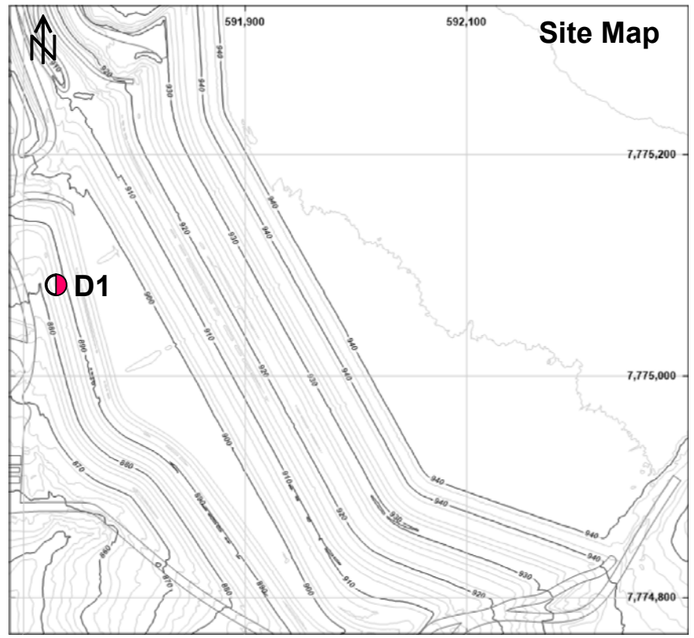


Symbol	Average Reading Between 2014 and 2019
▲	Greater than 0.5 m^3/hr
■	Less than 0.5 m^3/hr

Note:
1. Horizontal datum is SIRGAS2000 UTM Zone 23S in meters, Vertical datum is Mean Sea Level in meters.

PLAN VIEW: AVERAGE DRAIN FLOW READING BETWEEN 2014 AND 2019
FIGURE 7-3

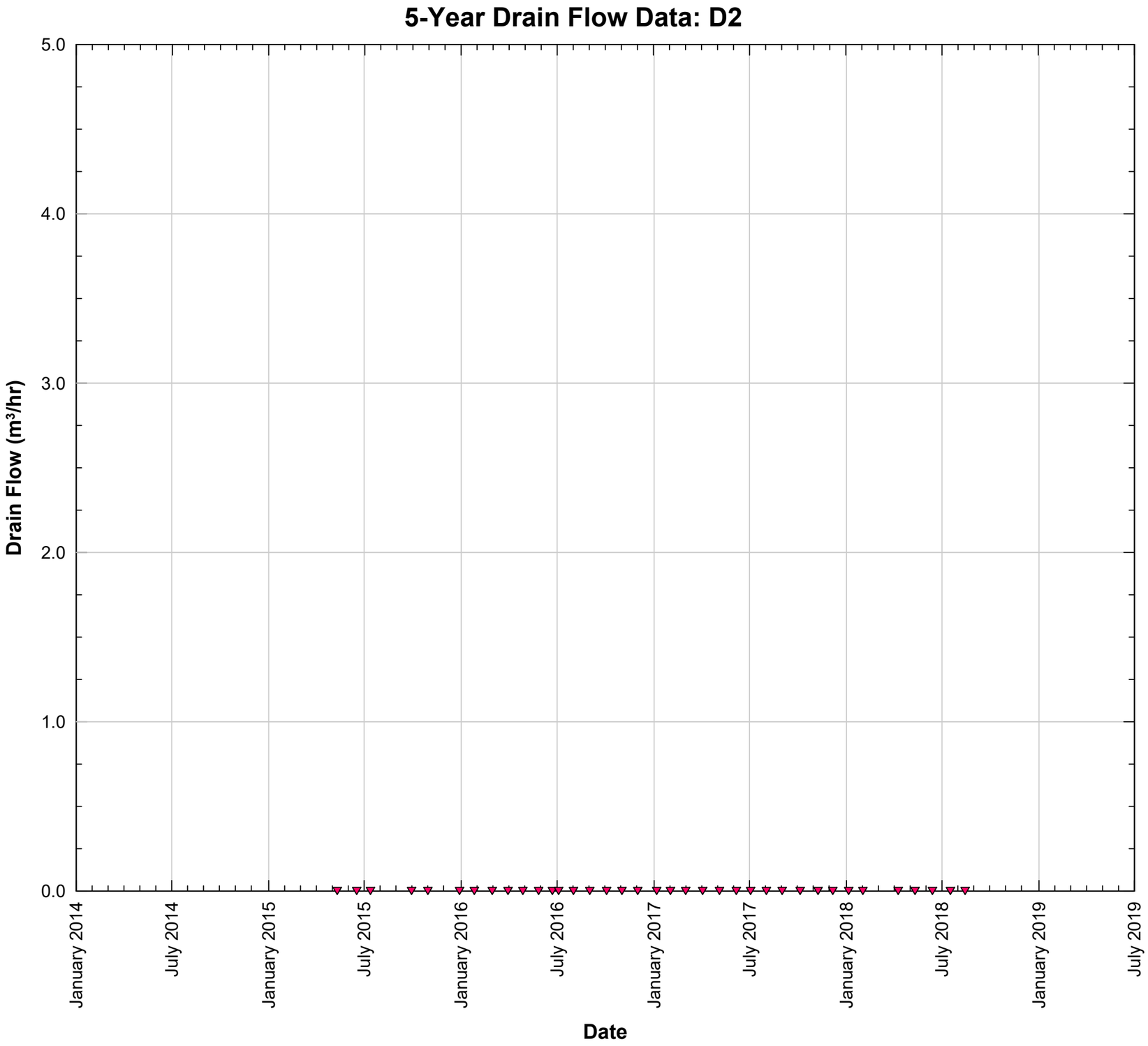


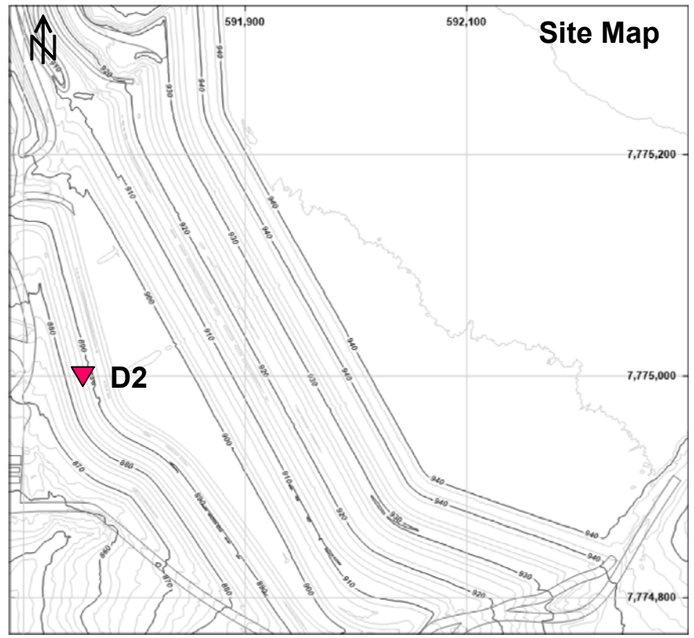


D1			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: D1

FIGURE 7-4

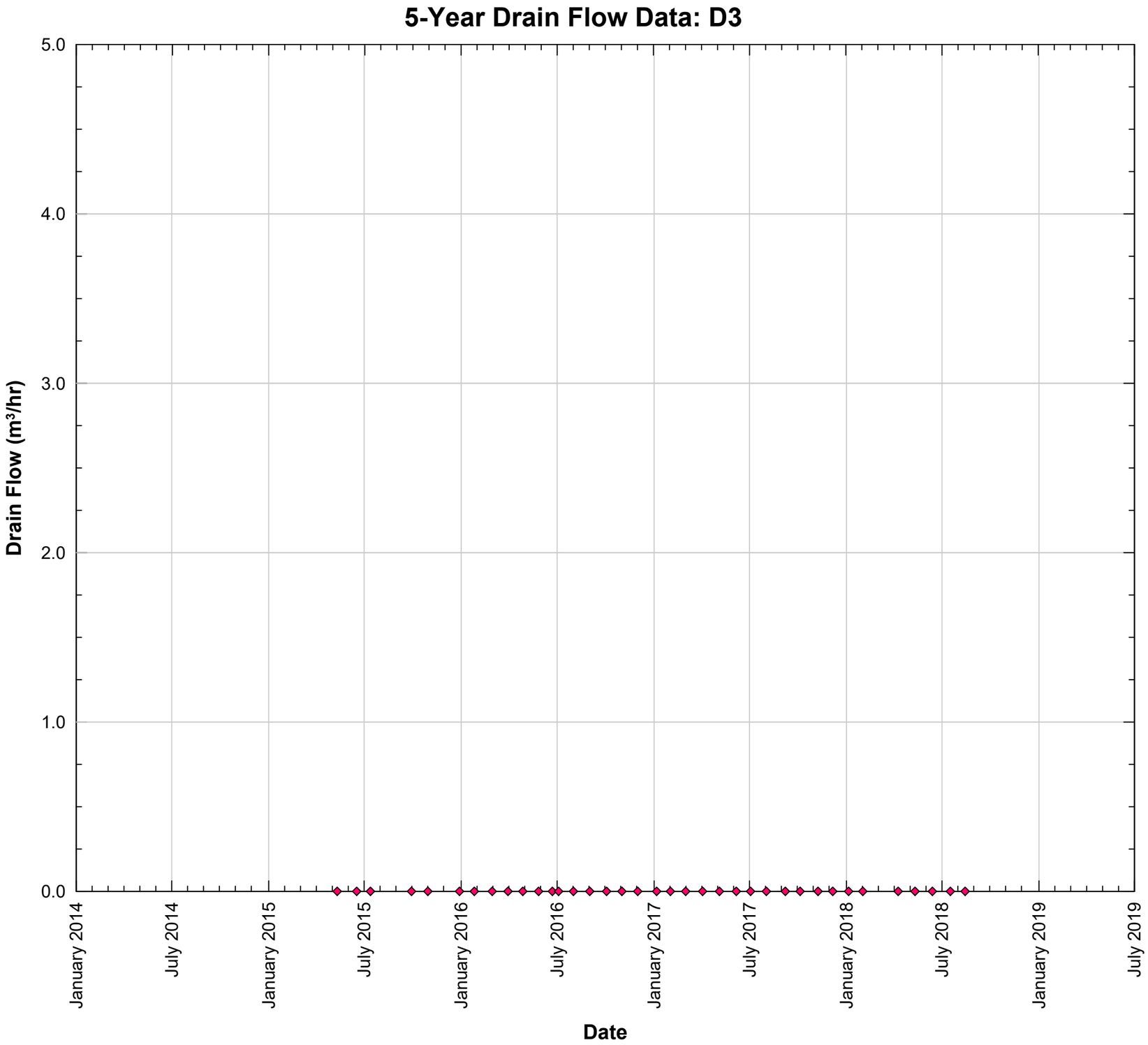


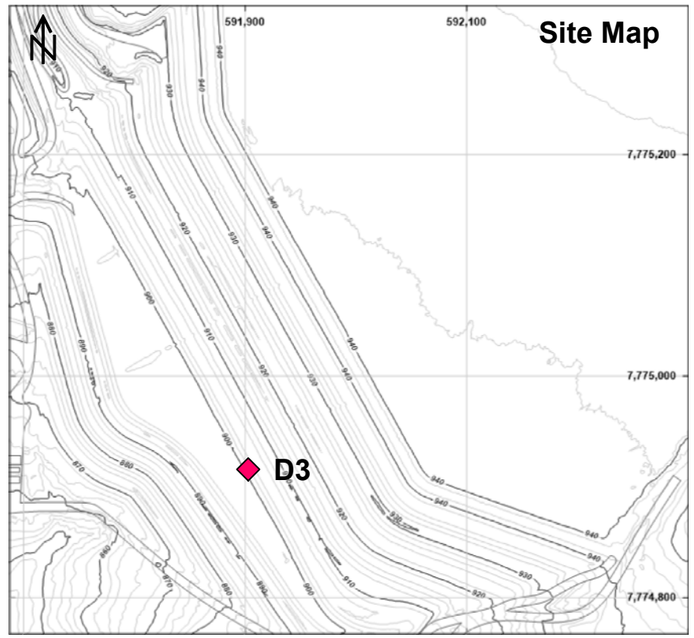


D2			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	8/14/2018	Monthly

5-YEAR DRAIN FLOW DATA: D2

FIGURE 7-5

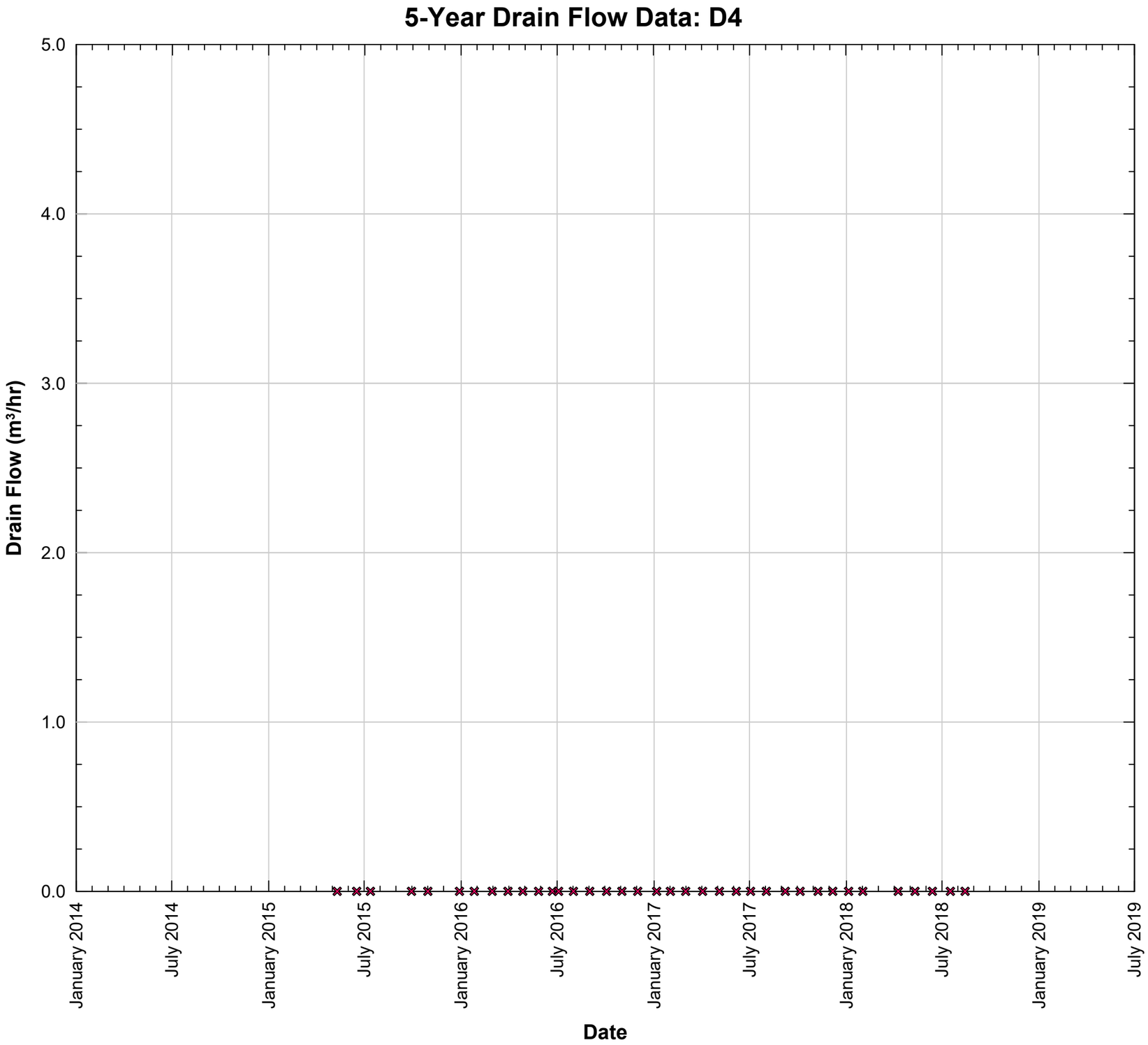


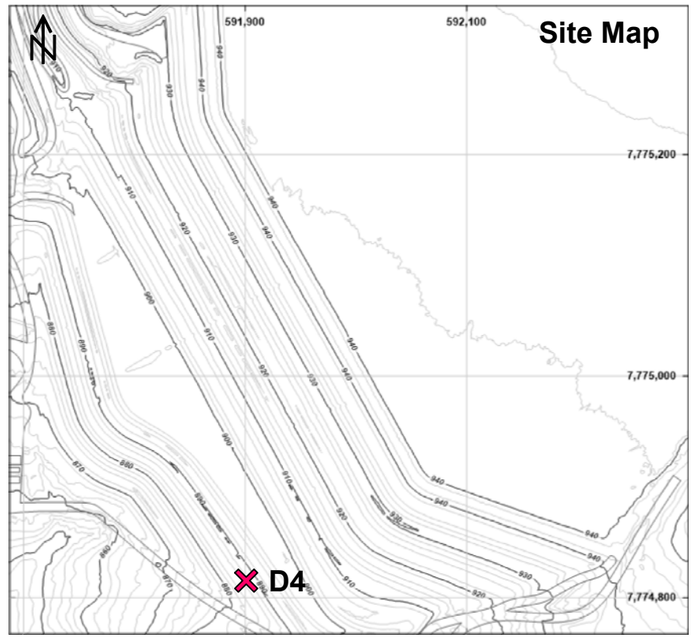


D3			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	8/14/2018	Monthly

5-YEAR DRAIN FLOW DATA: D3

FIGURE 7-6

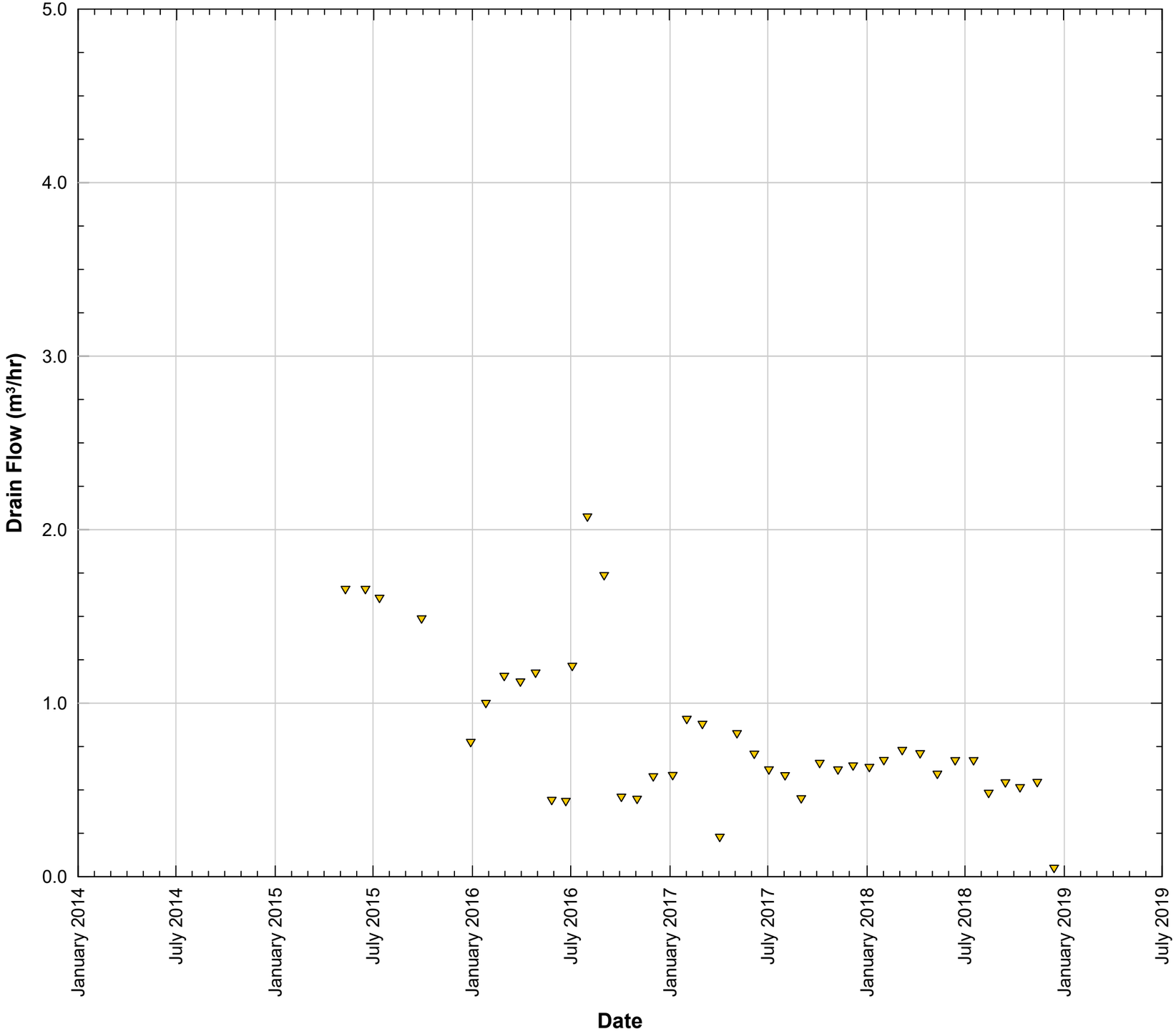


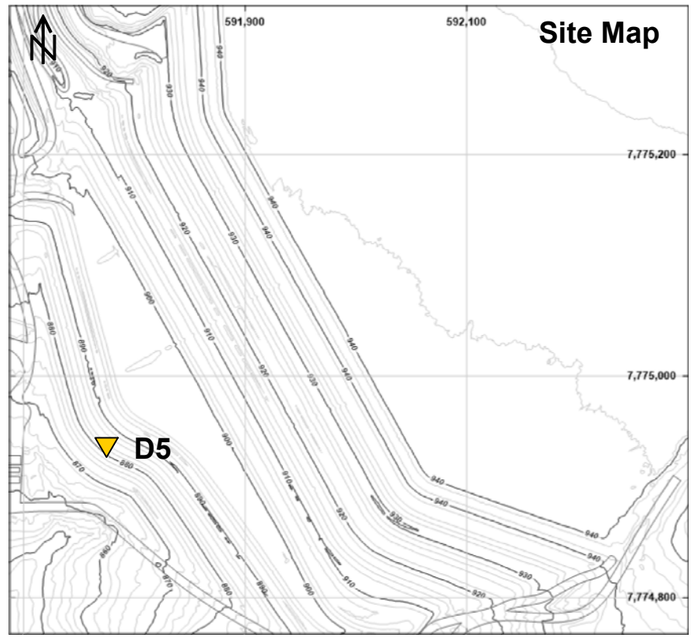


D4			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	8/14/2018	Monthly

5-YEAR DRAIN FLOW DATA: D4
FIGURE 7-7

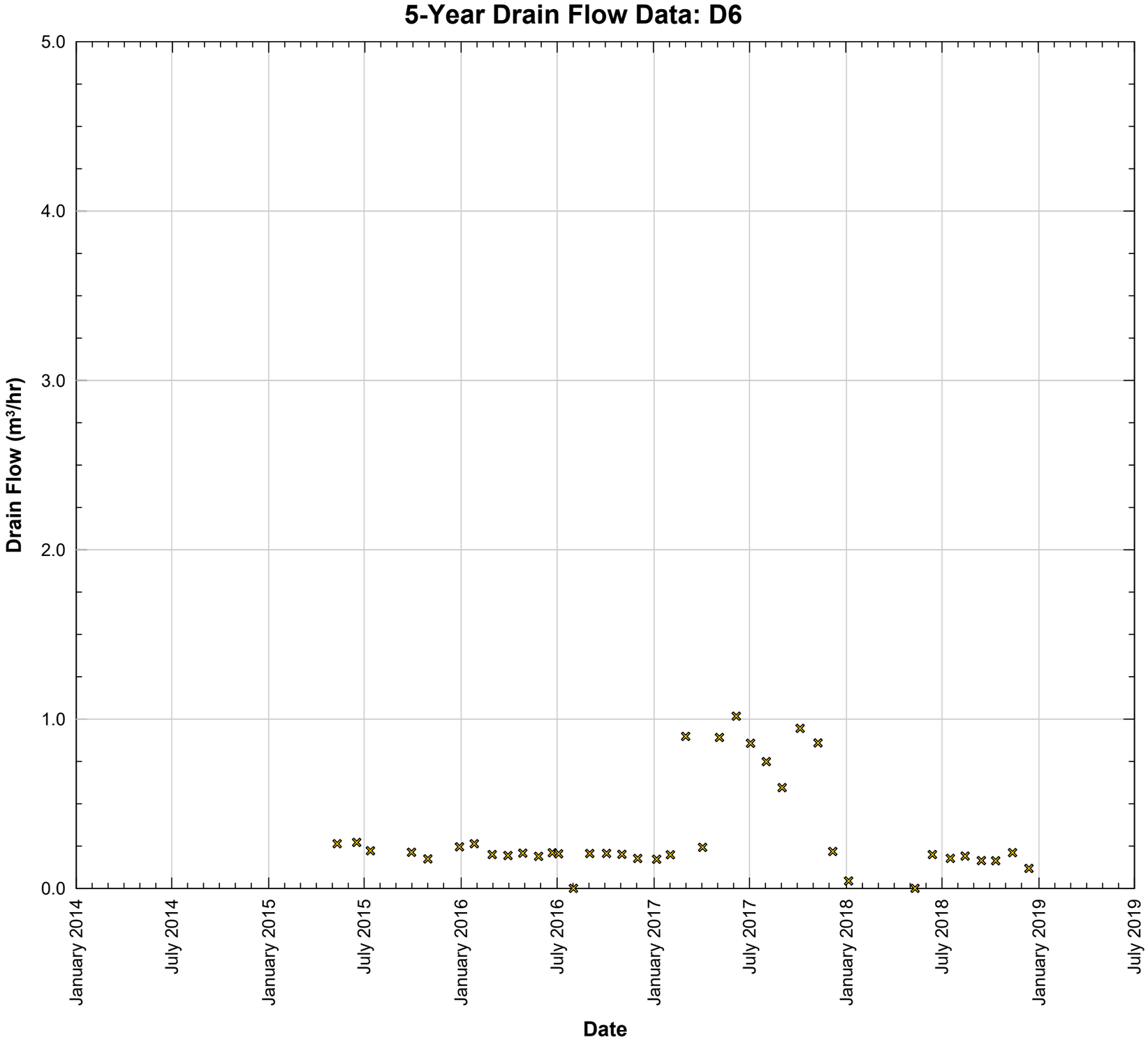
5-Year Drain Flow Data: D5

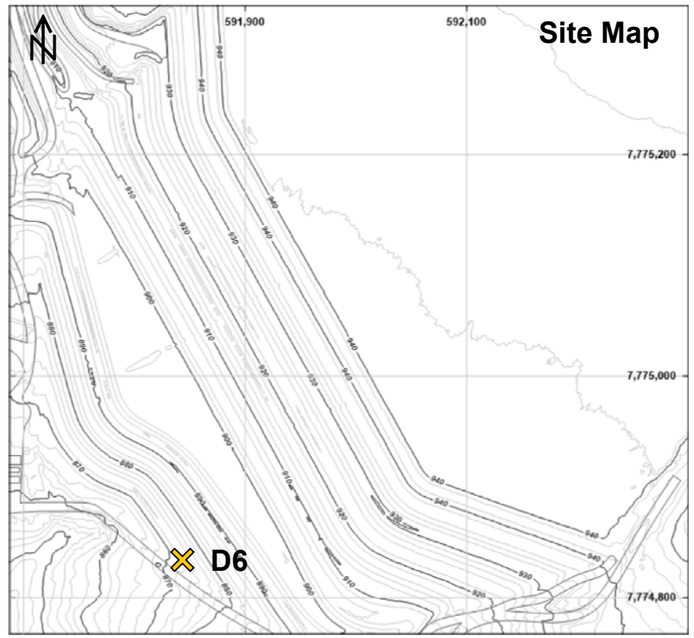




D5			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

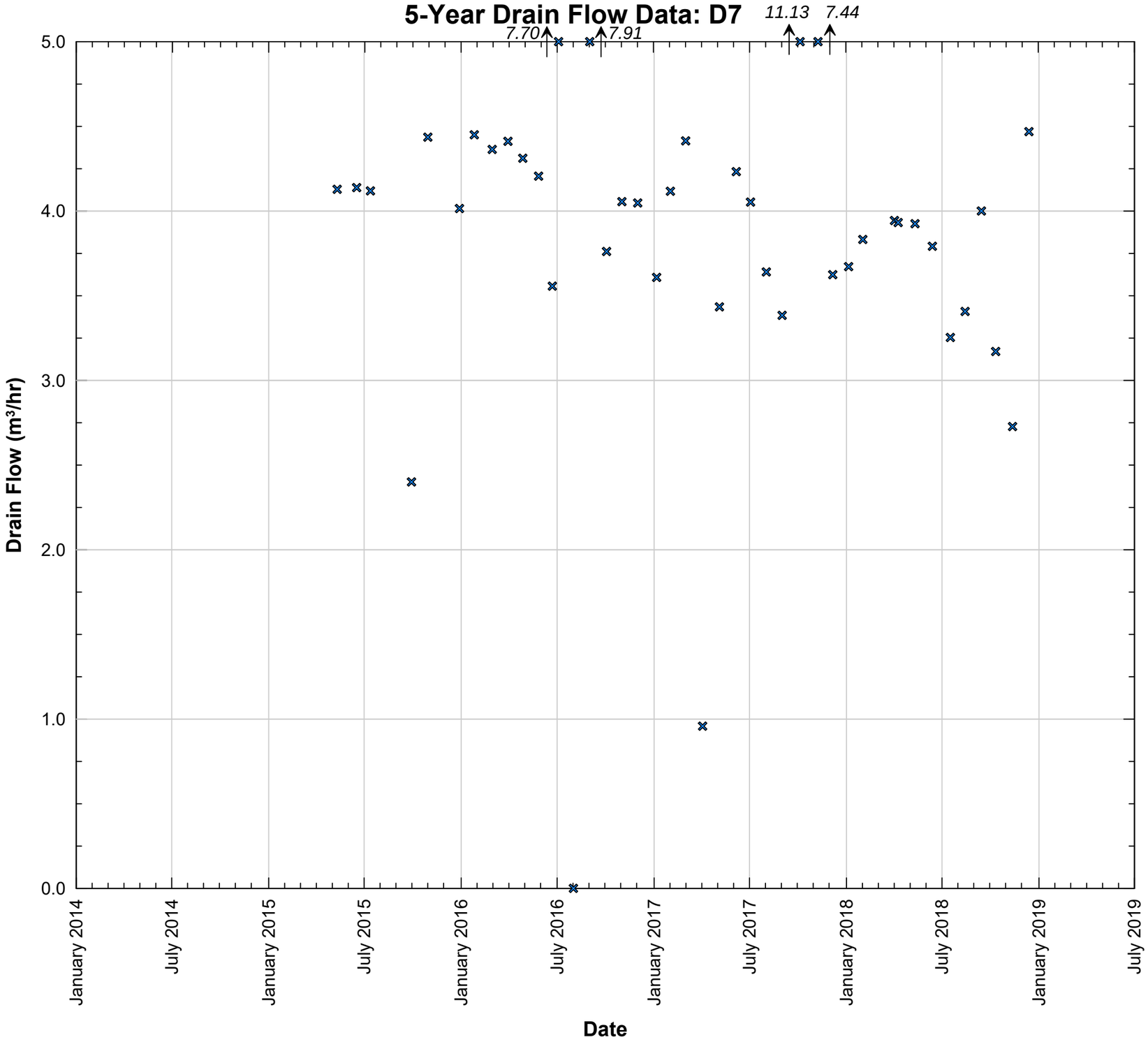
5-YEAR DRAIN FLOW DATA: D5
FIGURE 7-8

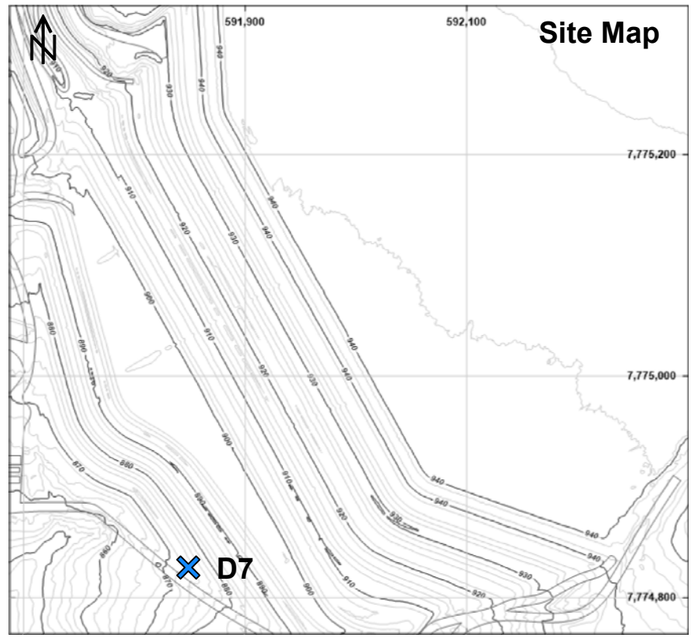




D6			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

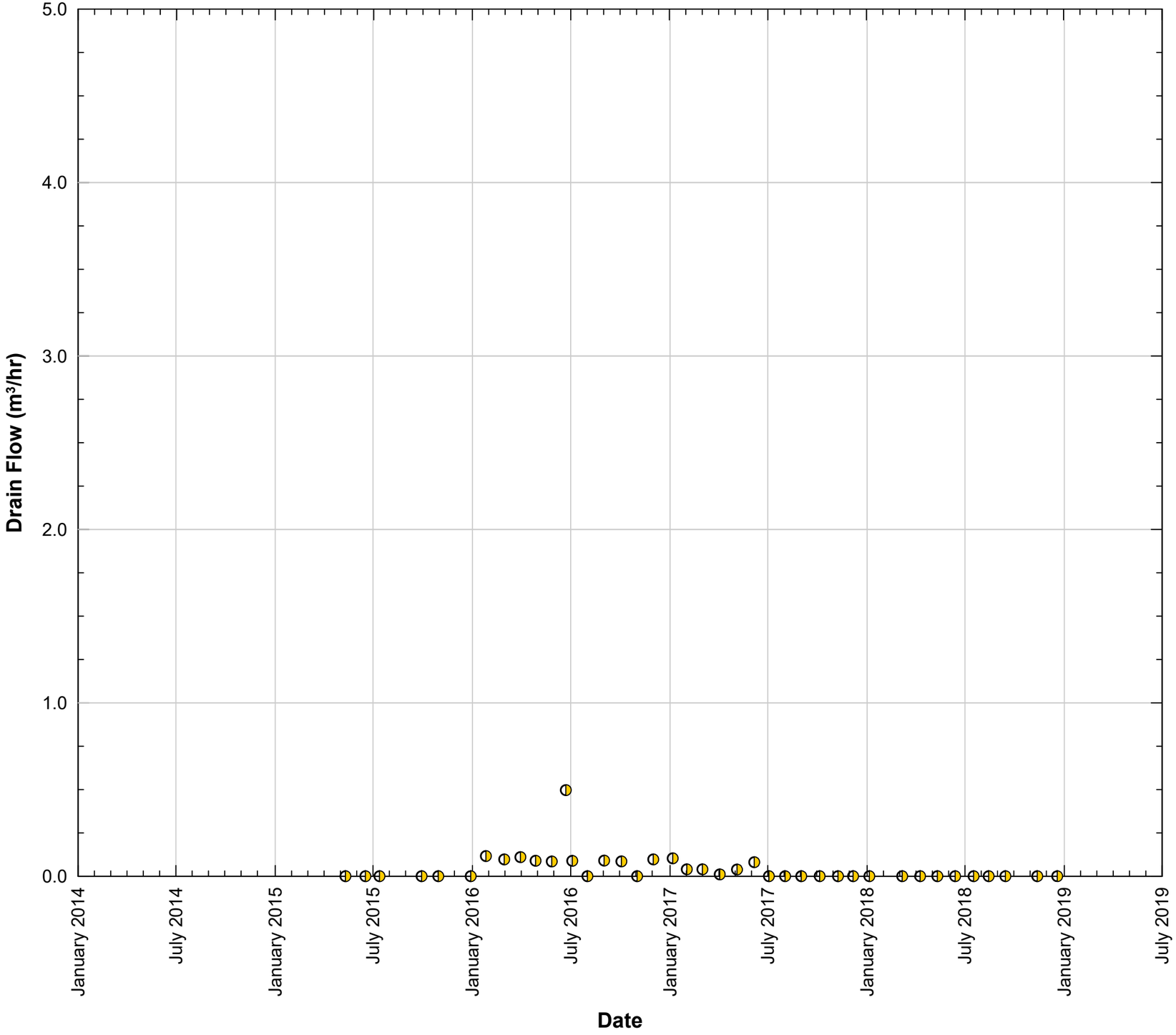
5-YEAR DRAIN FLOW DATA: D6
FIGURE 7-9

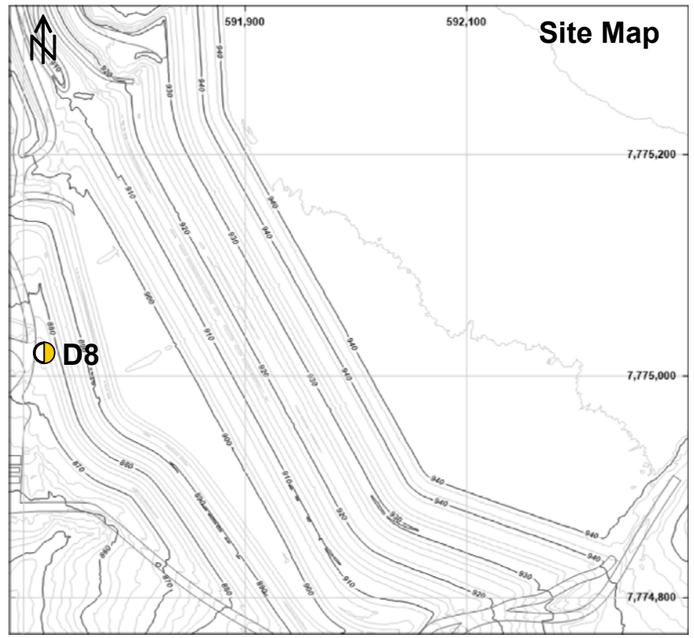




D7			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: D7
FIGURE 7-10

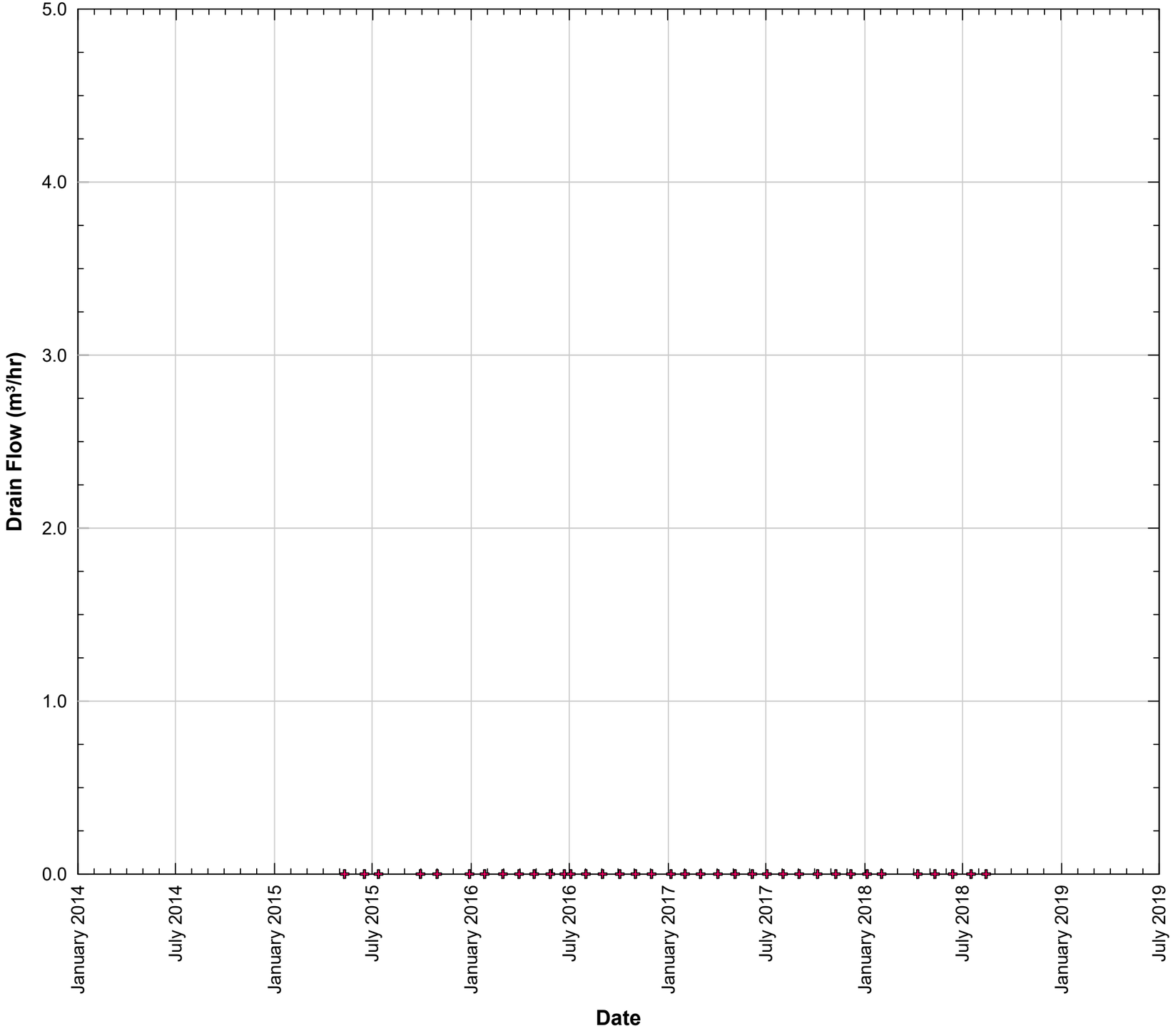


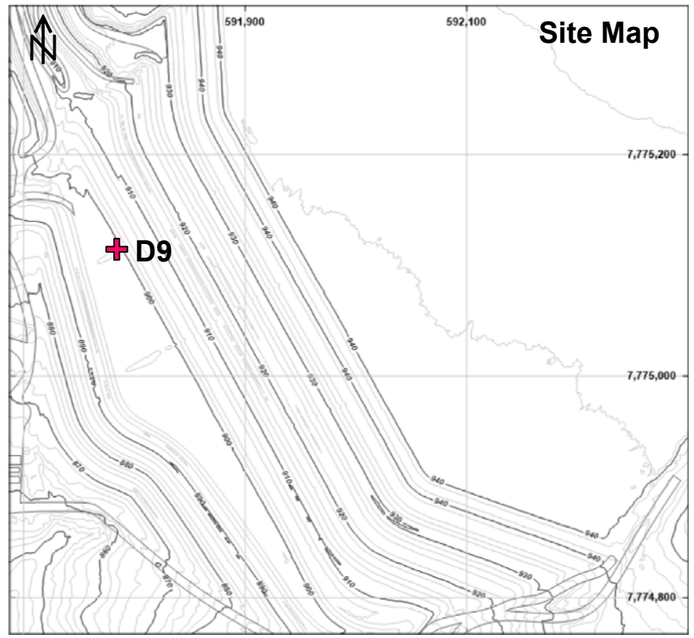


D8			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/19/2018	Monthly

5-YEAR DRAIN FLOW DATA: D8

FIGURE 7-11

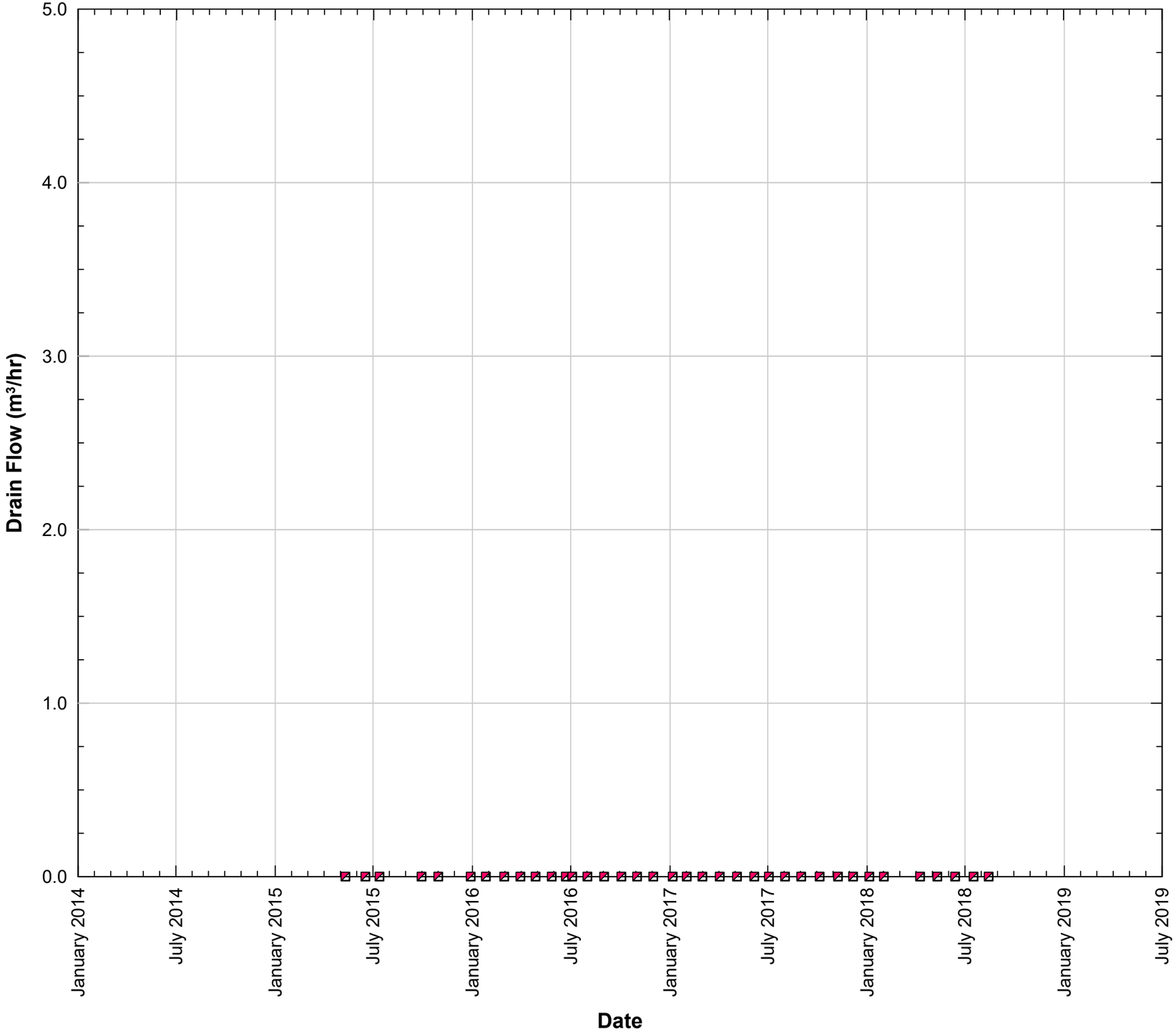


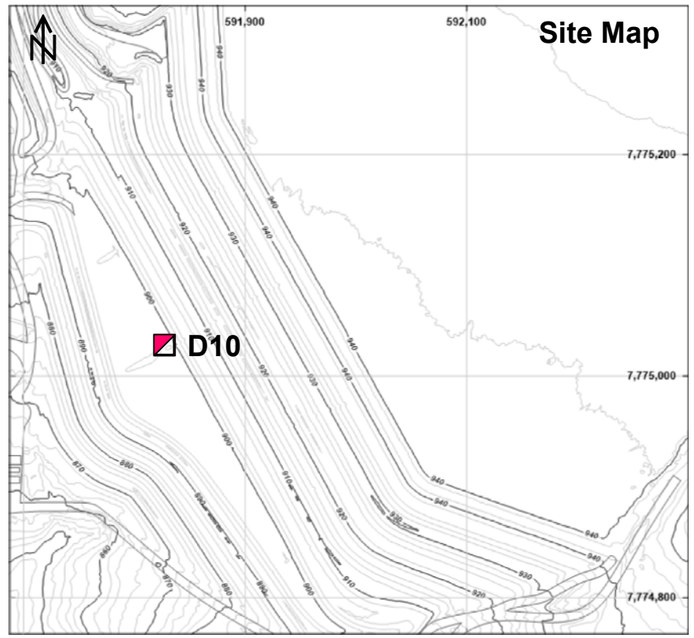


D9			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	8/14/2018	Monthly

5-YEAR DRAIN FLOW DATA: D9

FIGURE 7-12

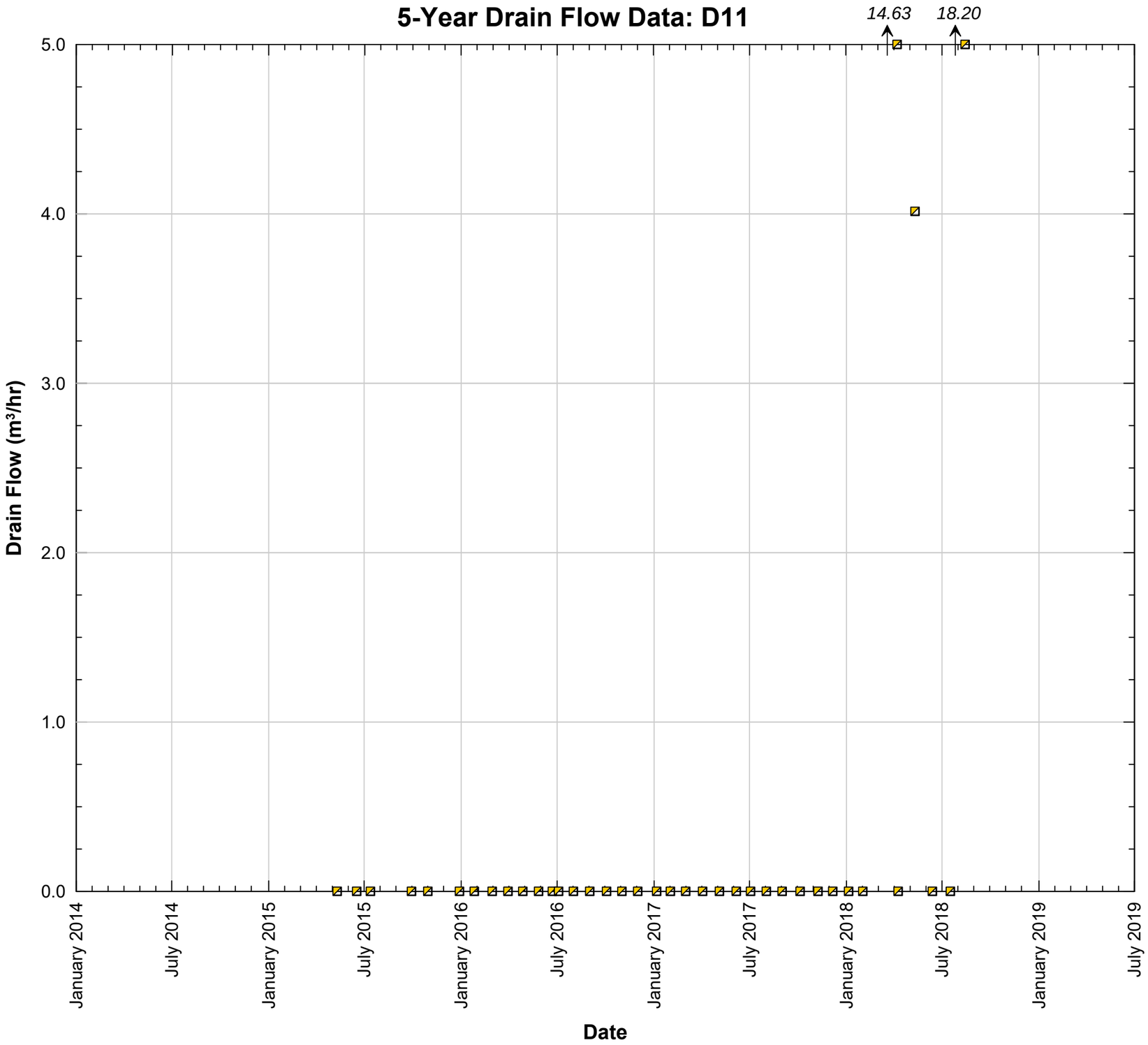


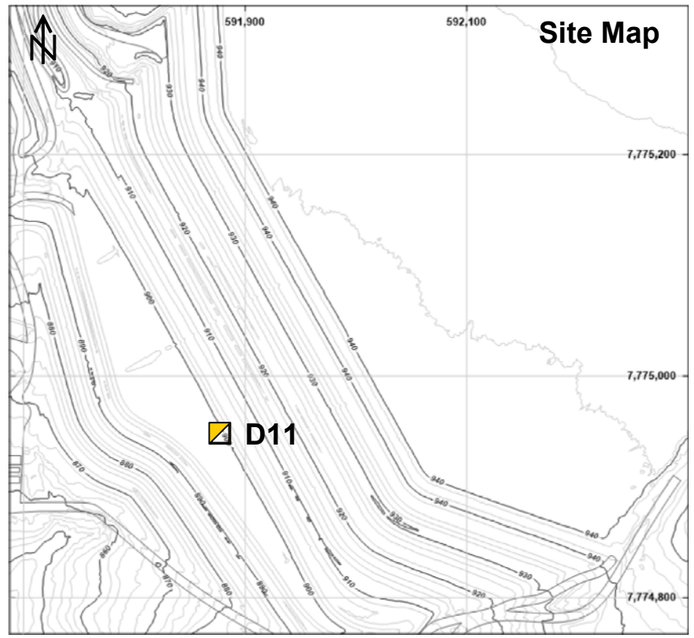


D10			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	8/14/2018	Monthly

5-YEAR DRAIN FLOW DATA: D10

FIGURE 7-13

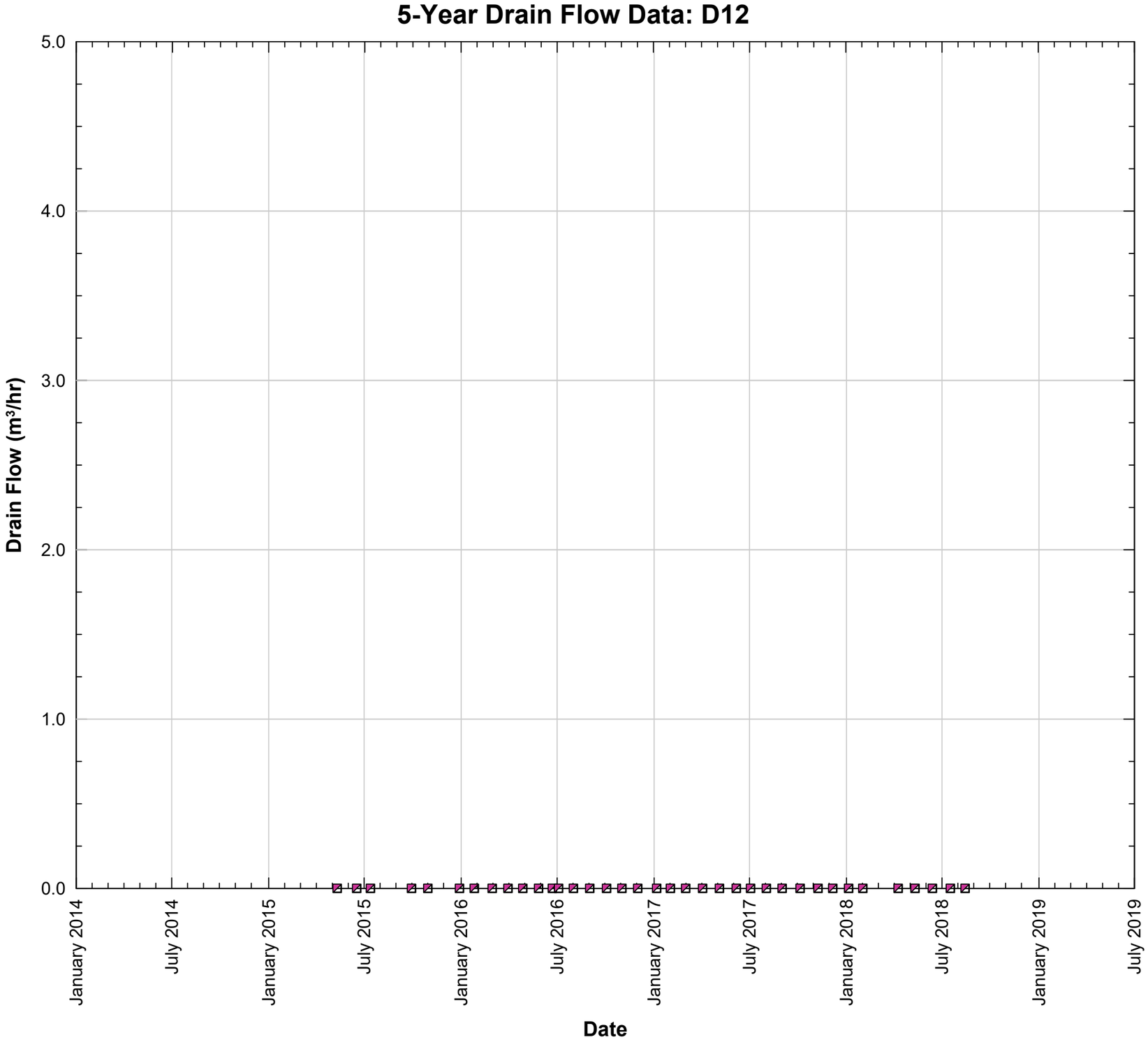


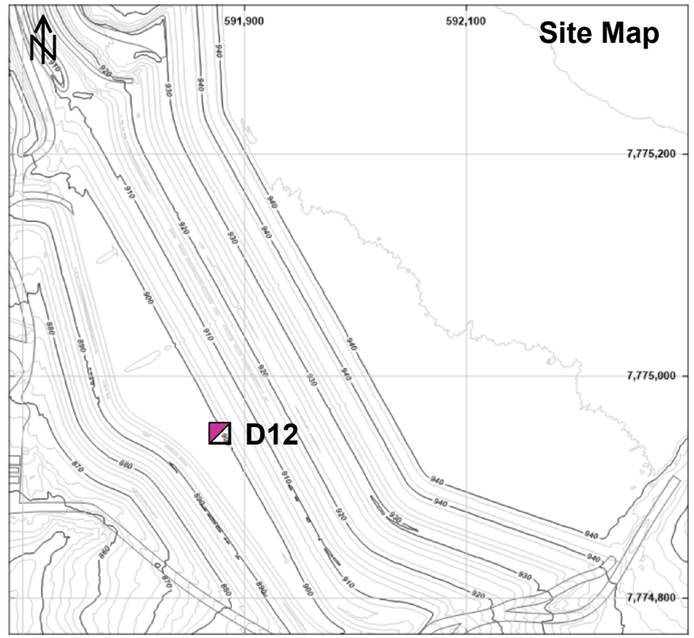


D11			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	8/14/2018	Monthly

5-YEAR DRAIN FLOW DATA: D11

FIGURE 7-14

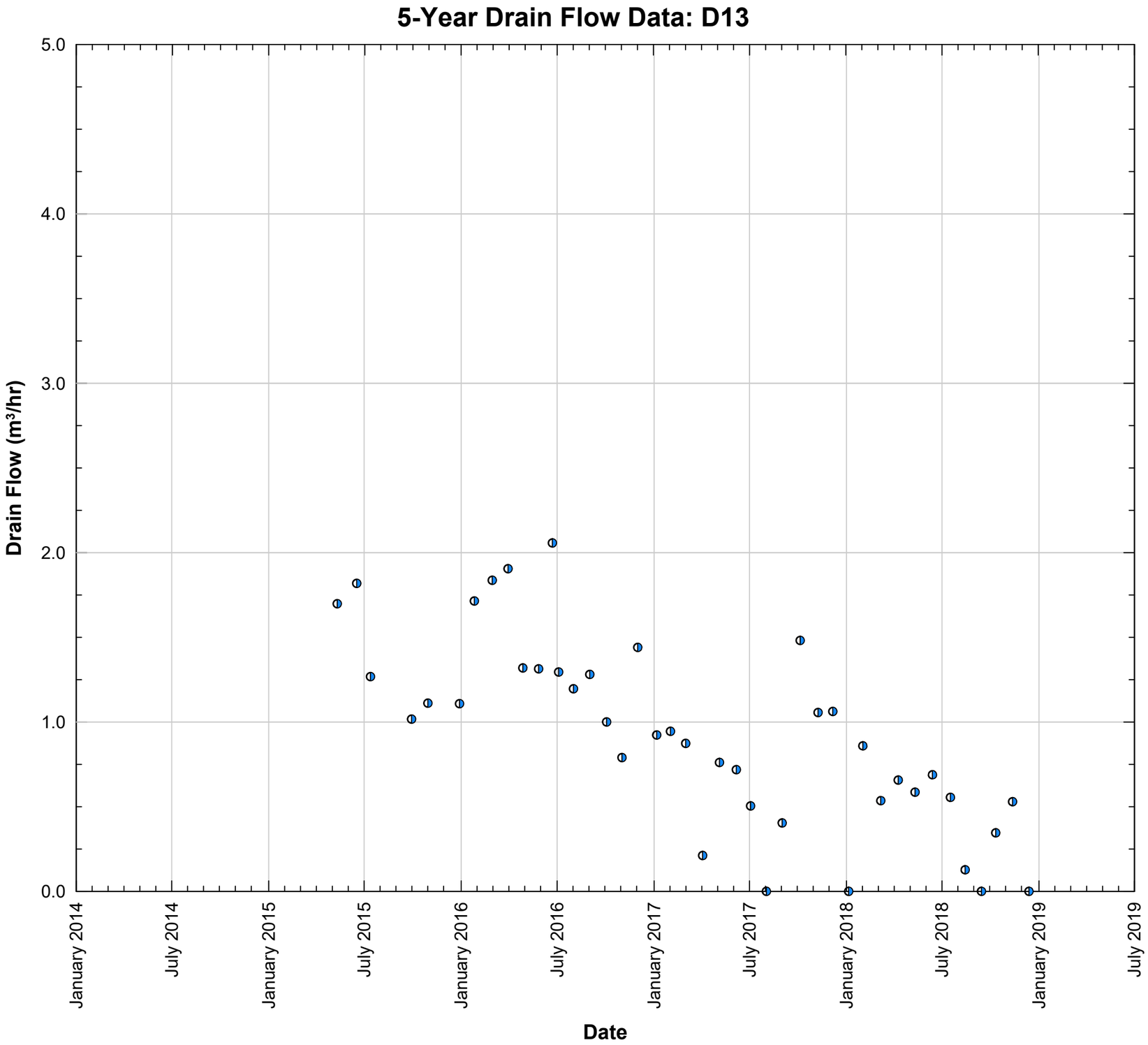


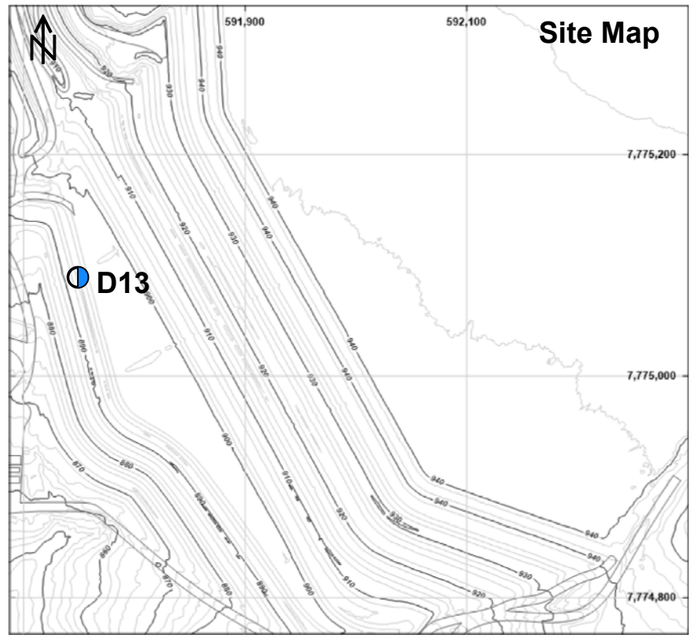


D12			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	8/14/2018	Monthly

5-YEAR DRAIN FLOW DATA: D12

FIGURE 7-15

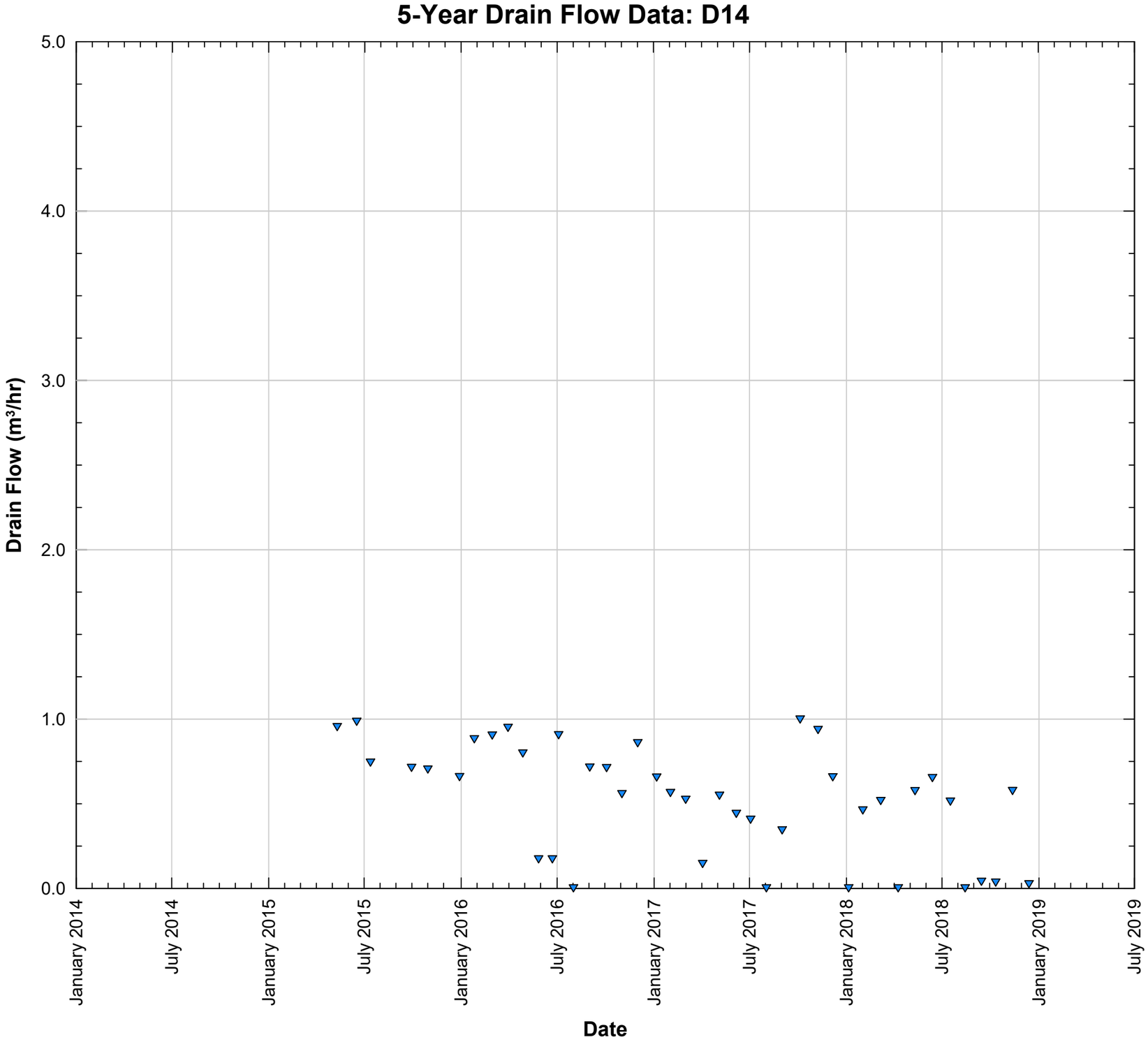


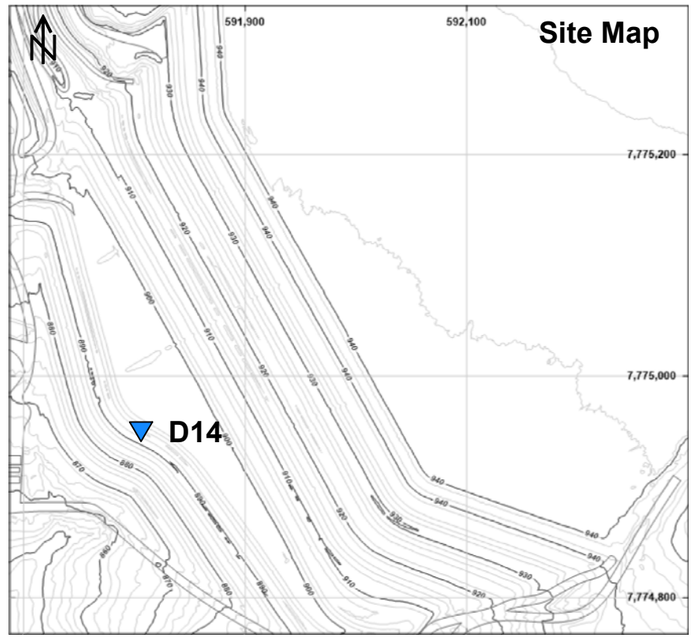


D13			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/19/2018	Monthly

5-YEAR DRAIN FLOW DATA: D13

FIGURE 7-16

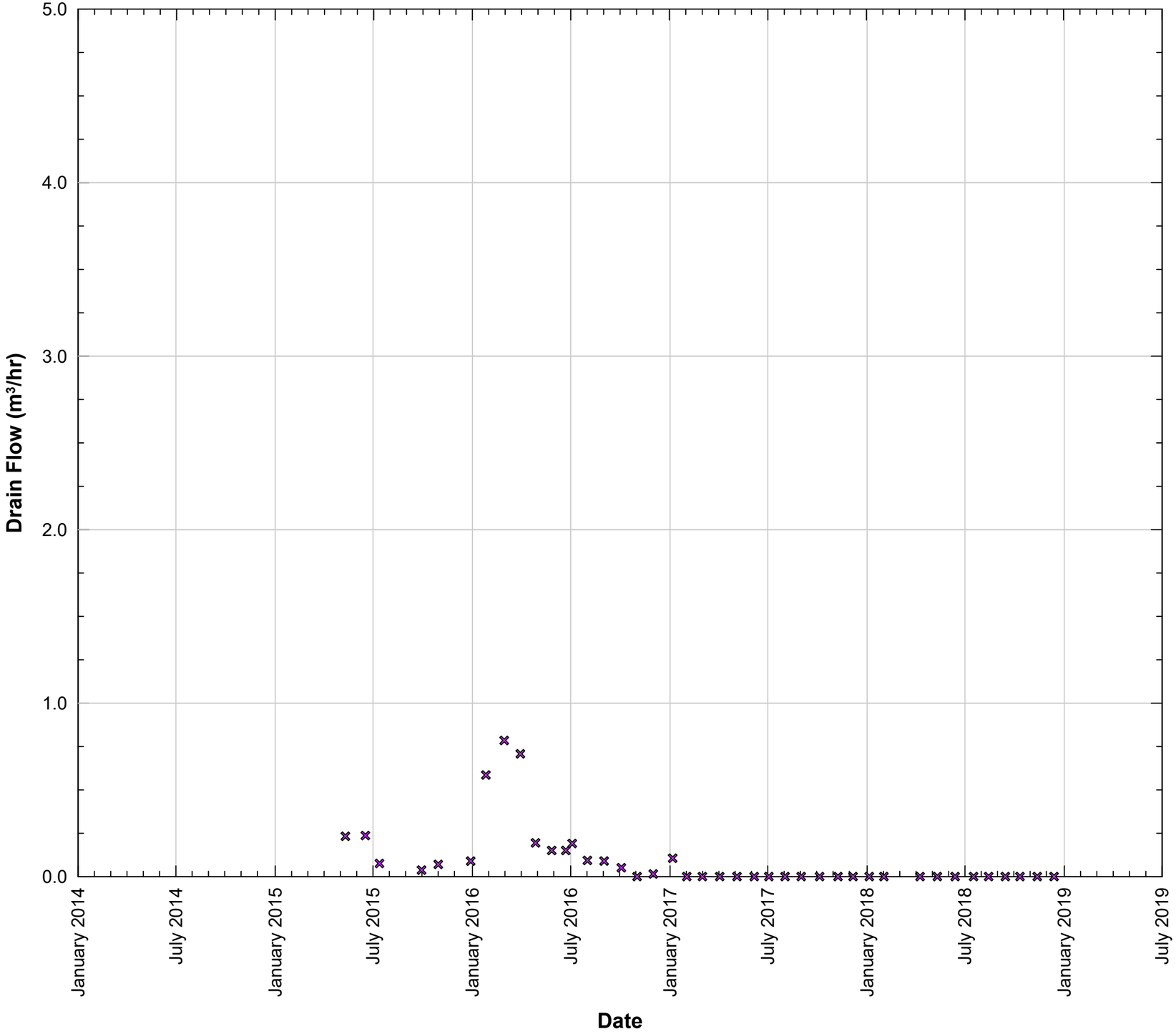


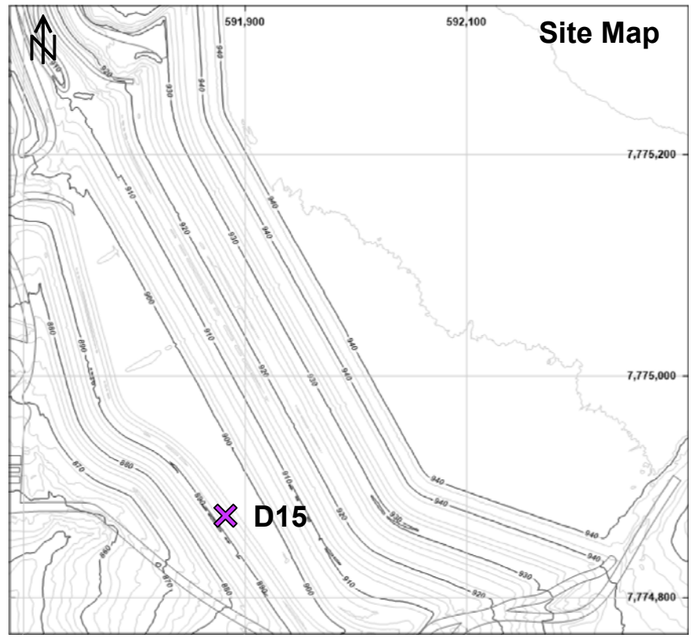


D14			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: D14

FIGURE 7-17

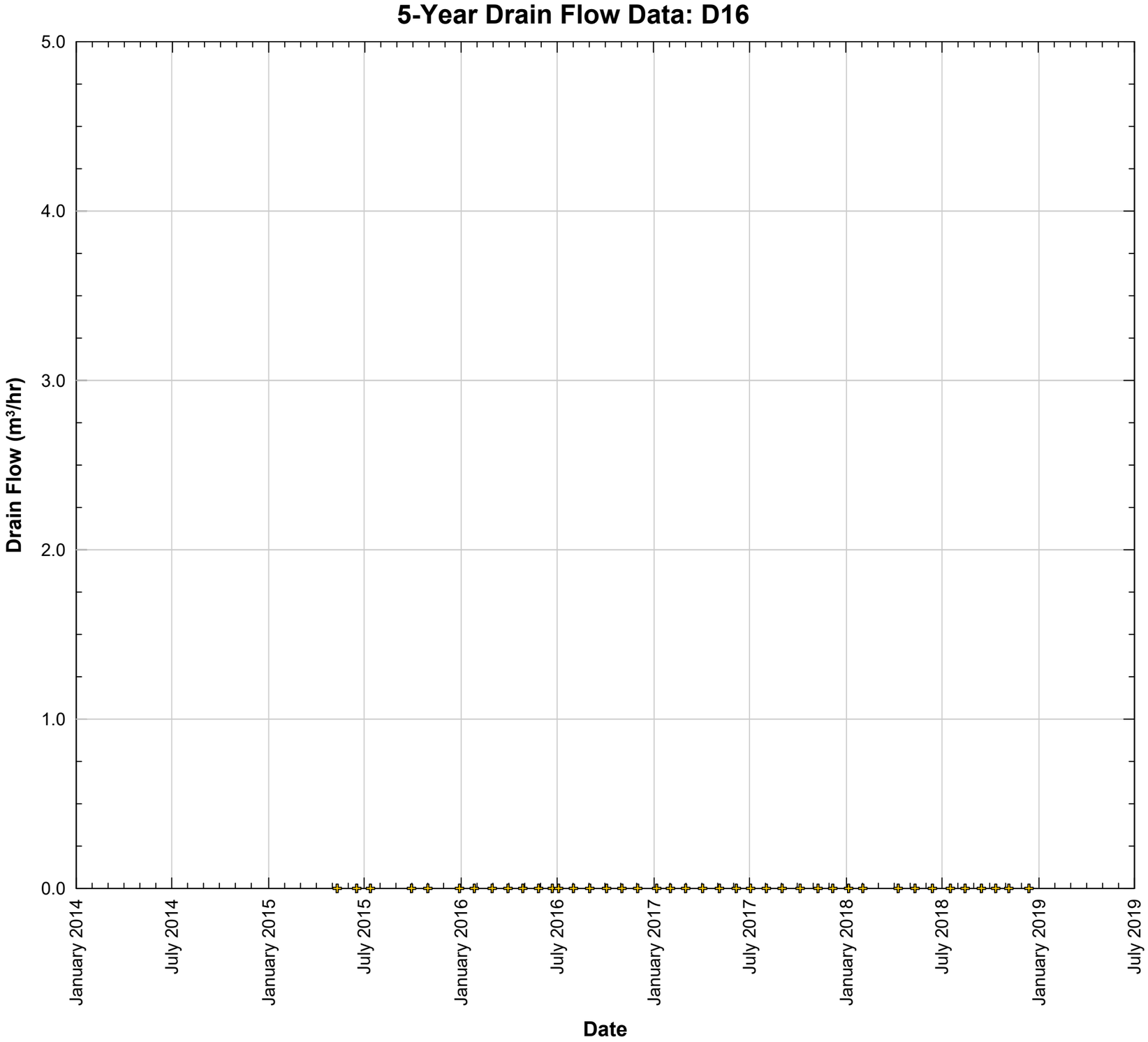


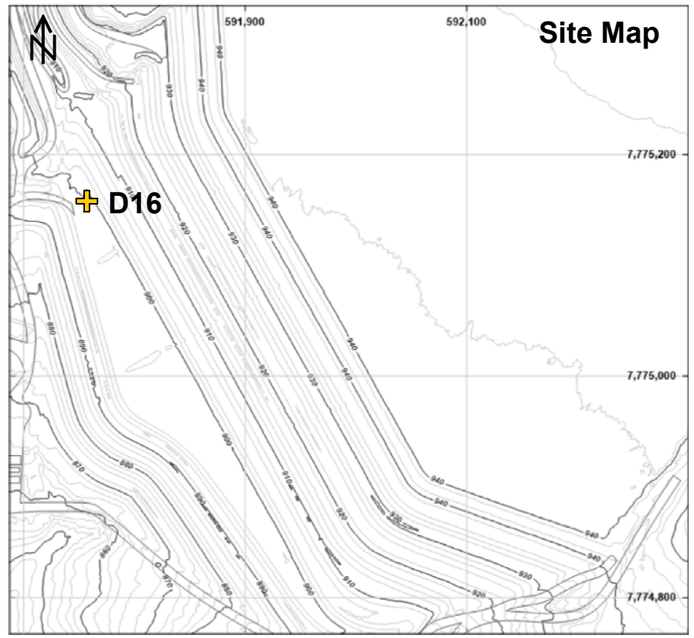


D15			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: D15

FIGURE 7-18

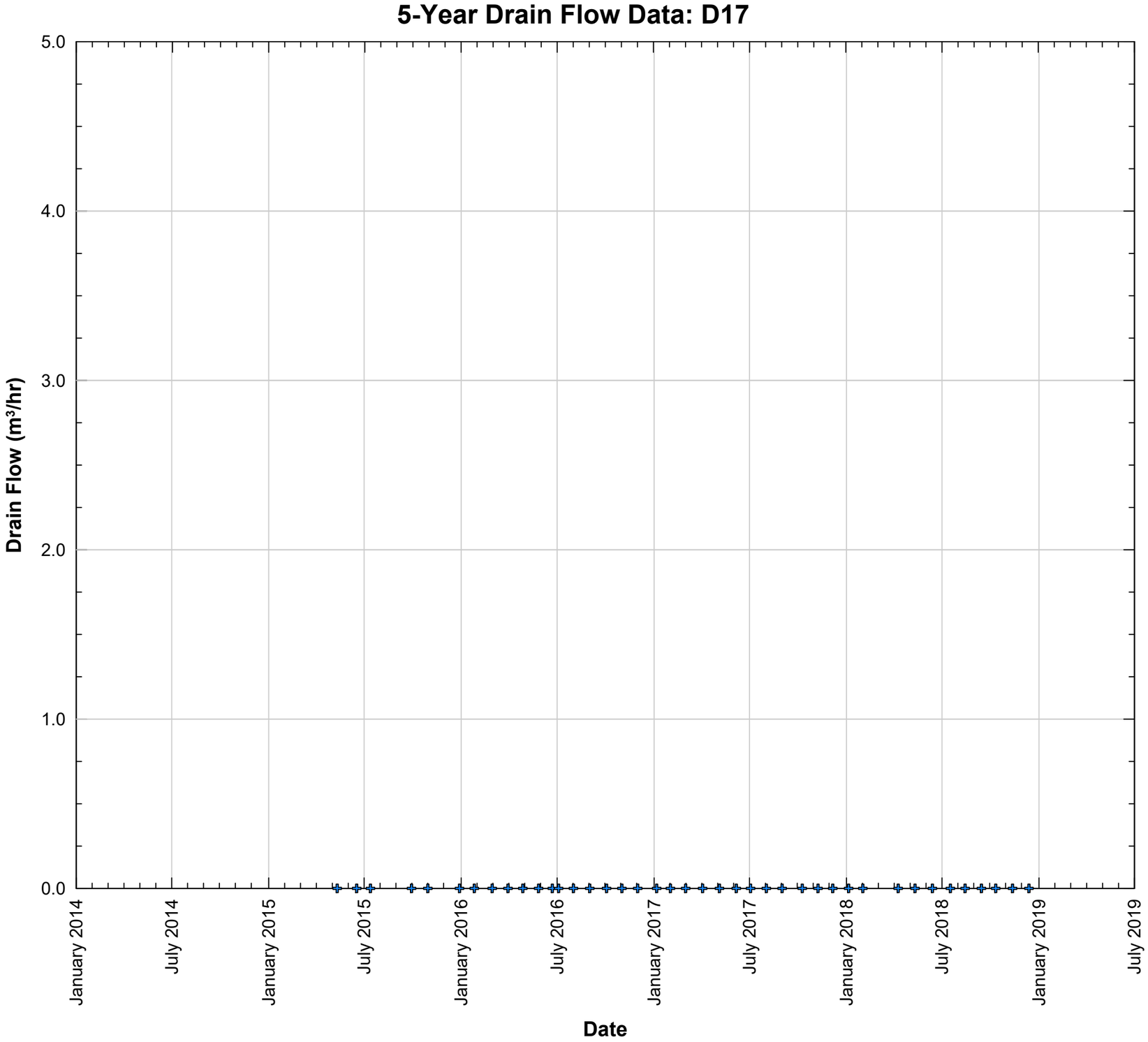


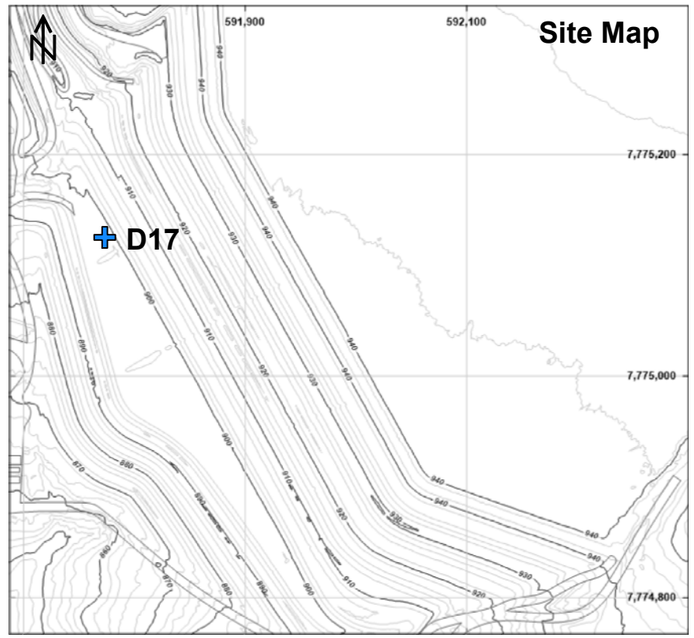


D16			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: D16

FIGURE 7-19



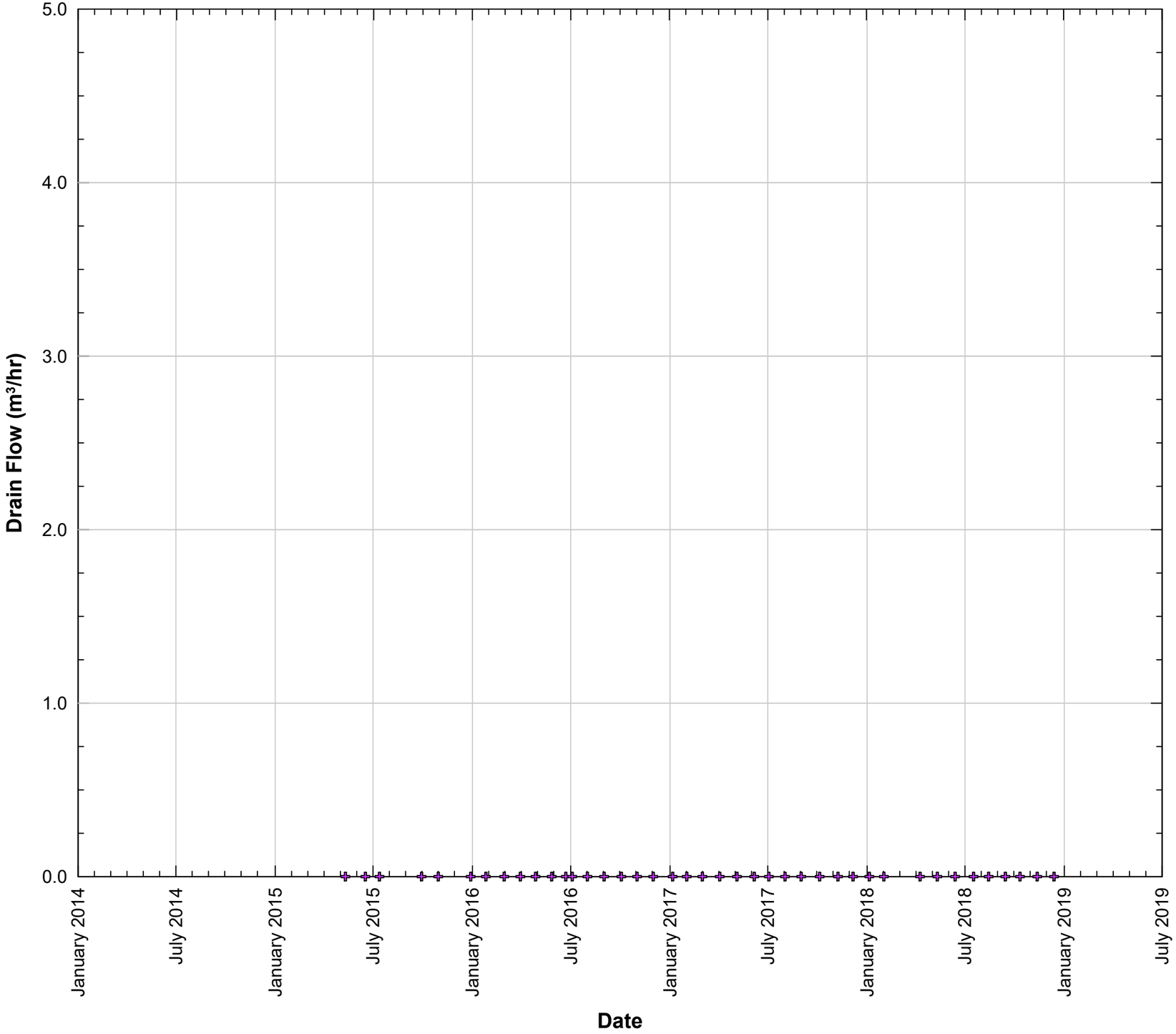


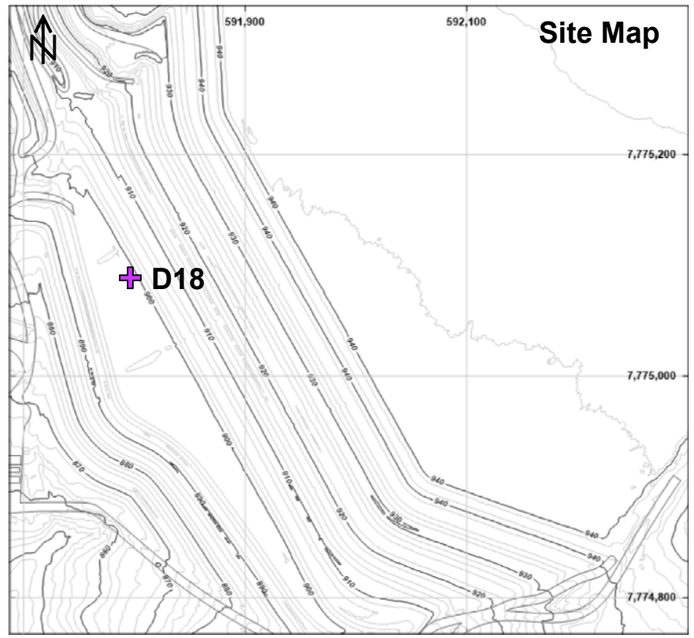
D17			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: D17

FIGURE 7-20

5-Year Drain Flow Data: D18

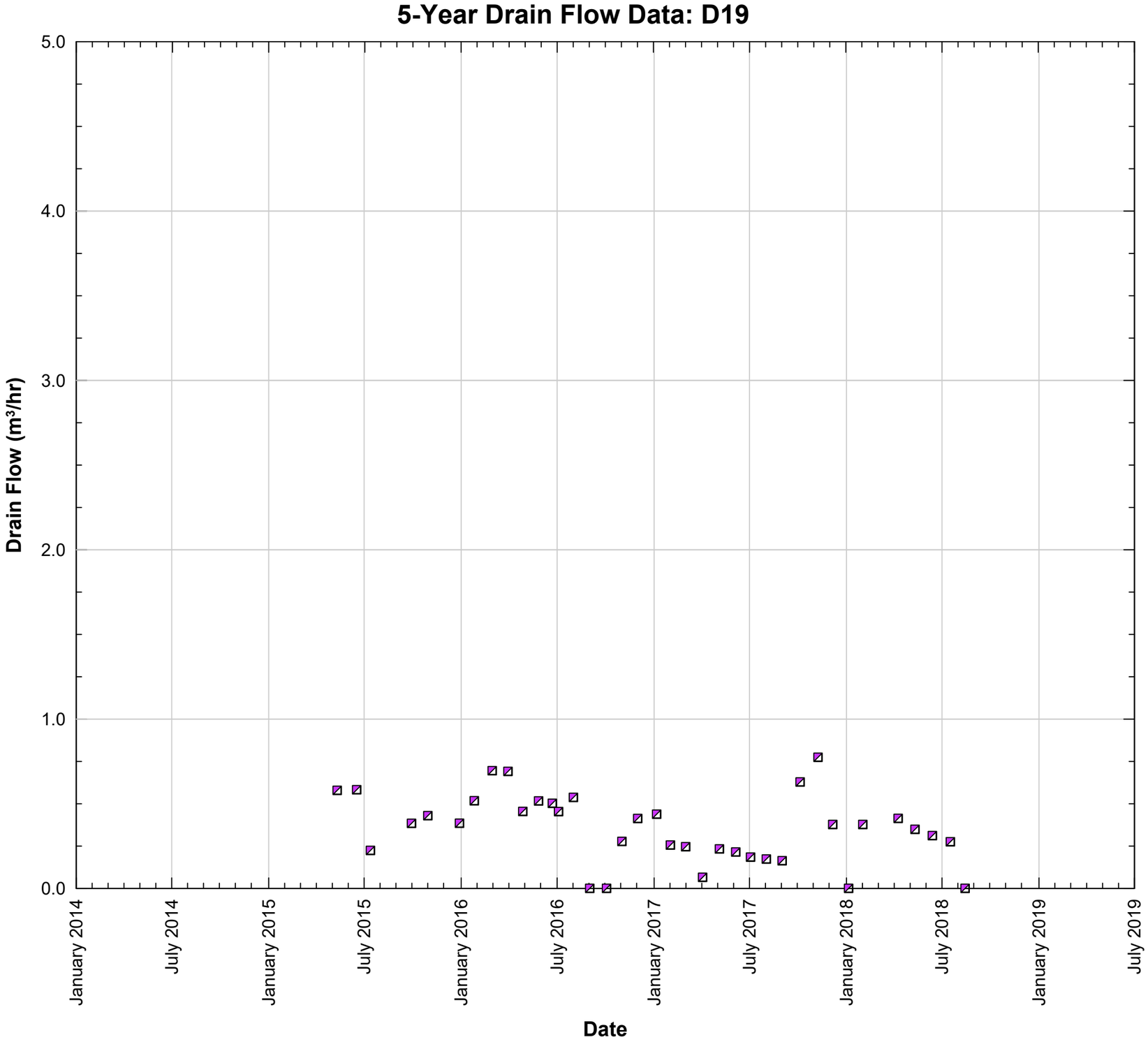


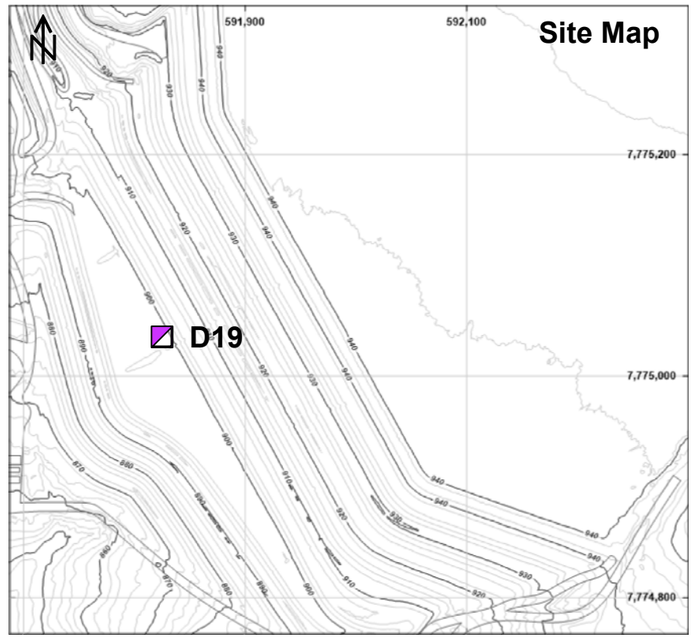


D18			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: D18

FIGURE 7-21

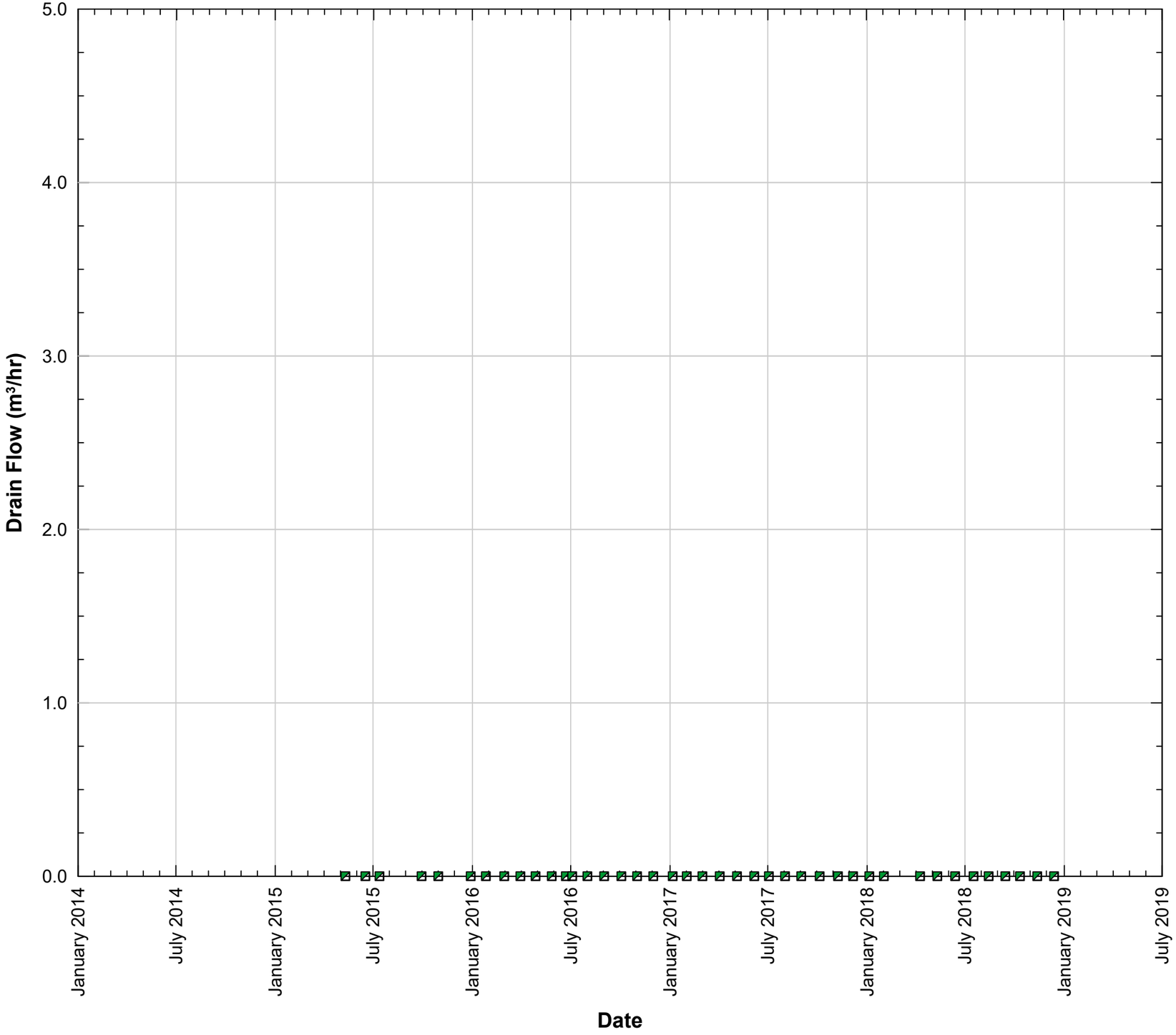


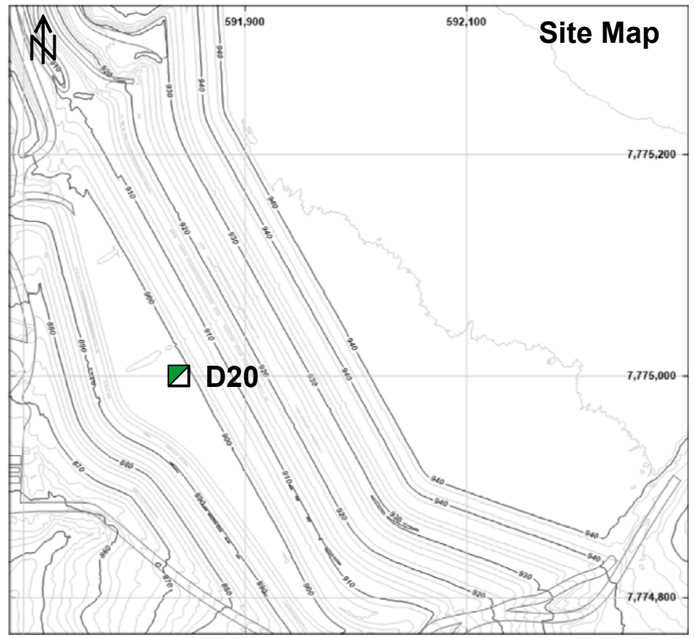


D19			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	8/14/2018	Monthly

5-YEAR DRAIN FLOW DATA: D19

FIGURE 7-22

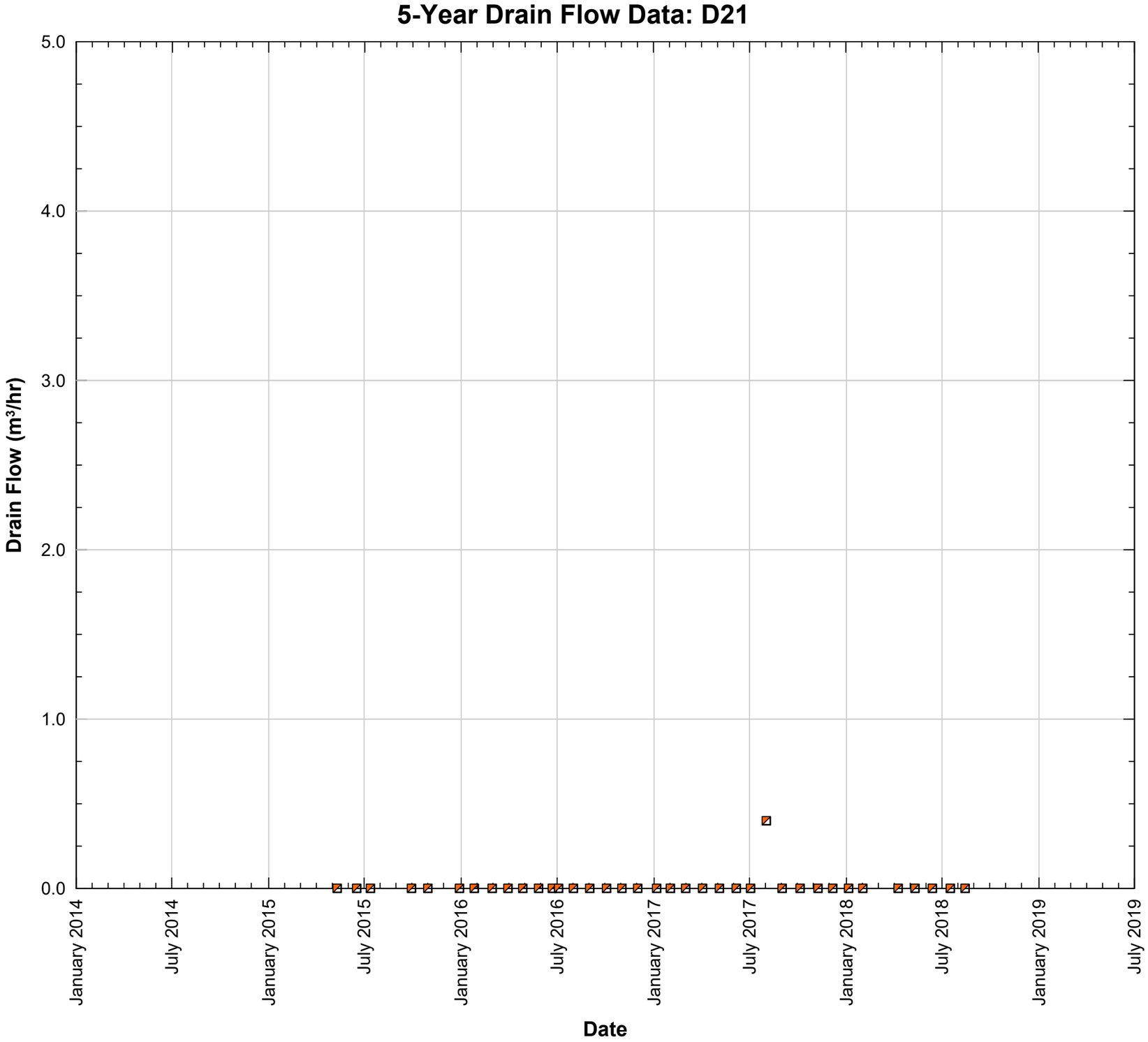


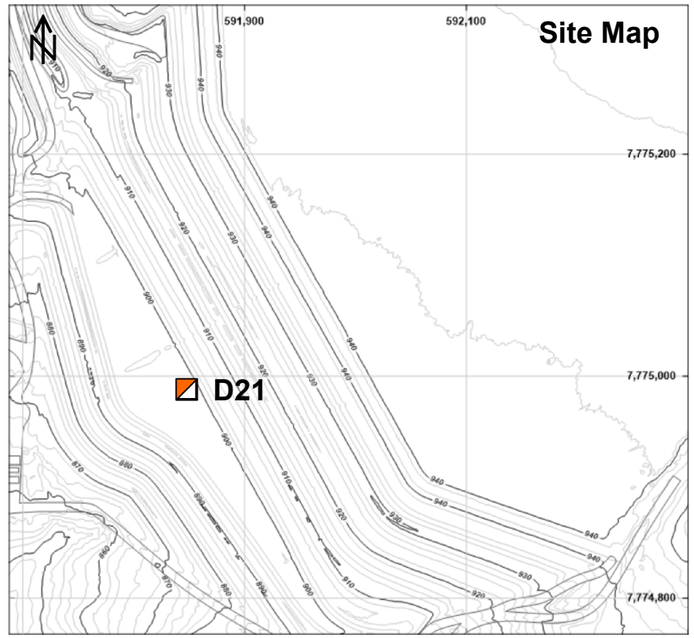


D20			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: D20

FIGURE 7-23

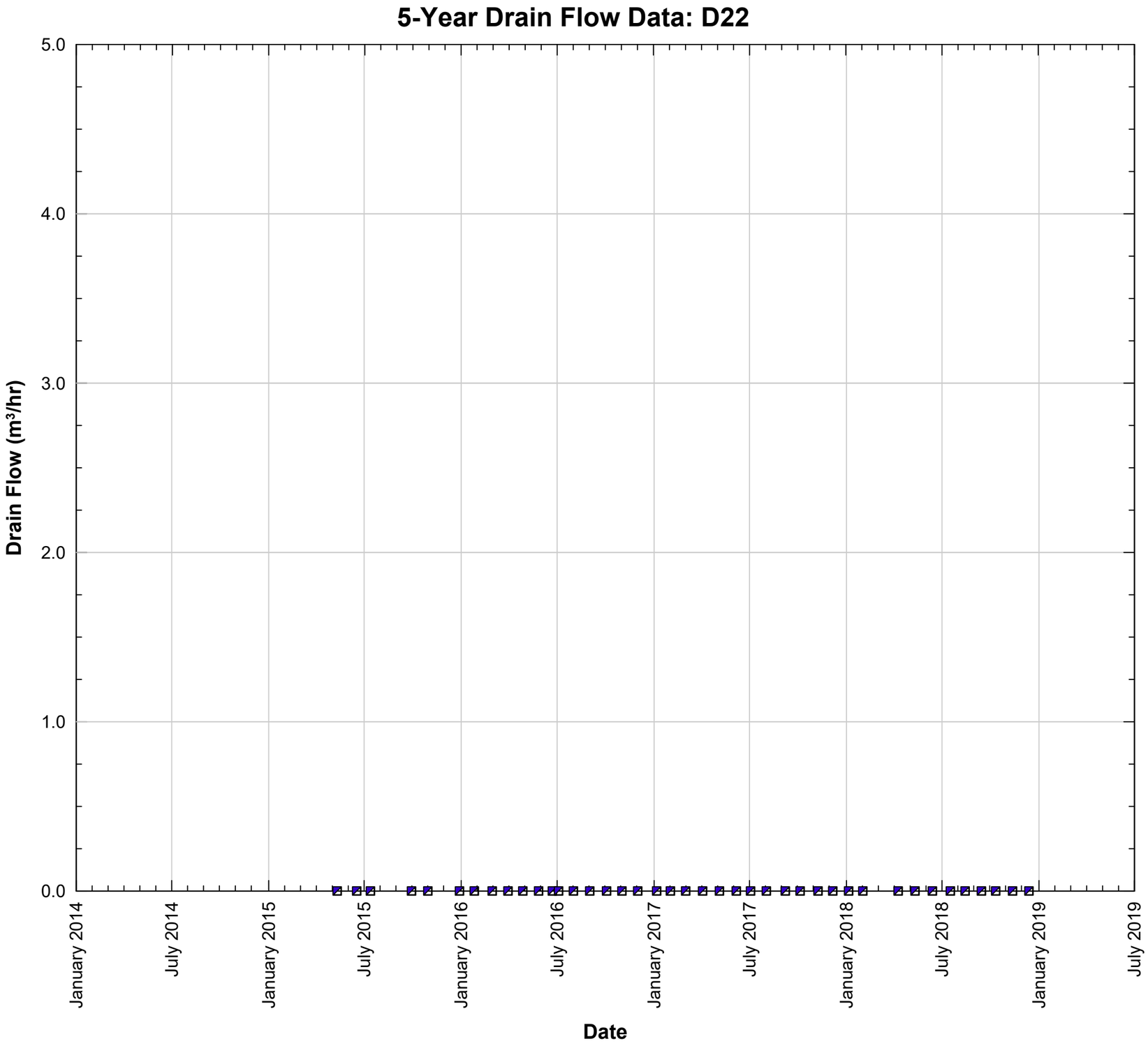


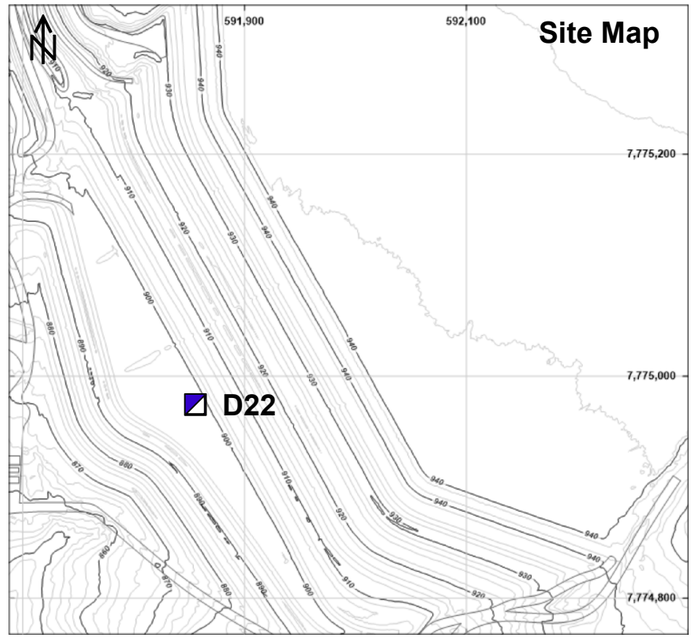


D21			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	8/14/2018	Monthly

5-YEAR DRAIN FLOW DATA: D21

FIGURE 7-24

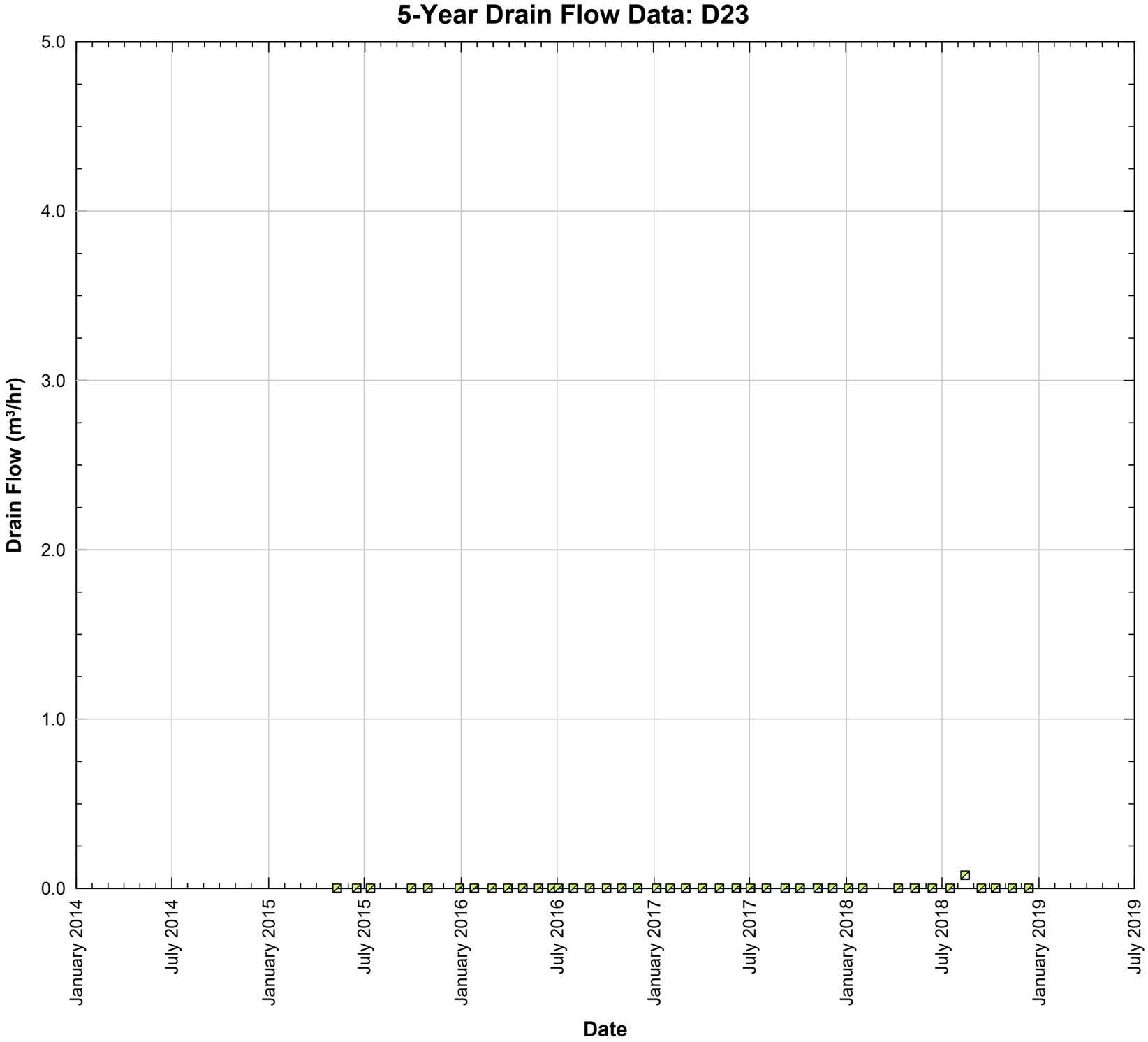


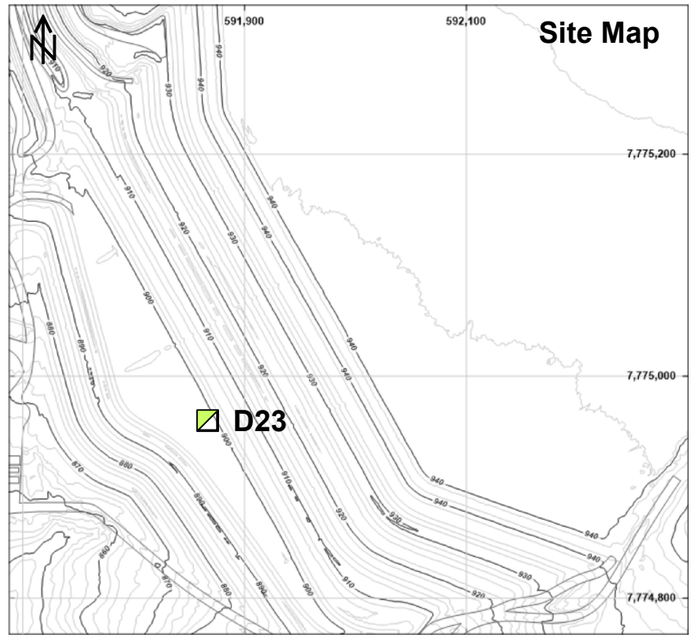


D22			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: D22

FIGURE 7-25

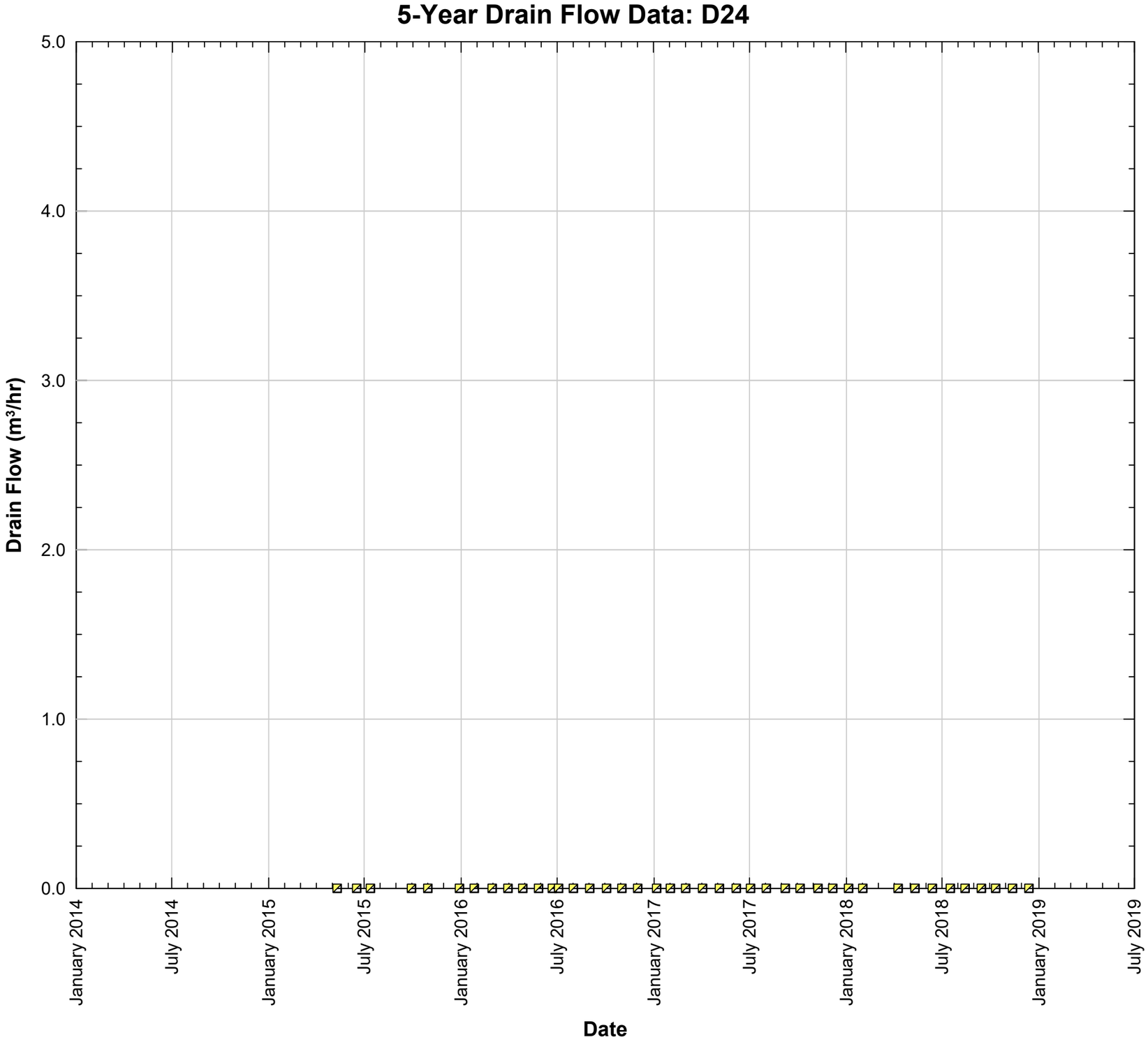


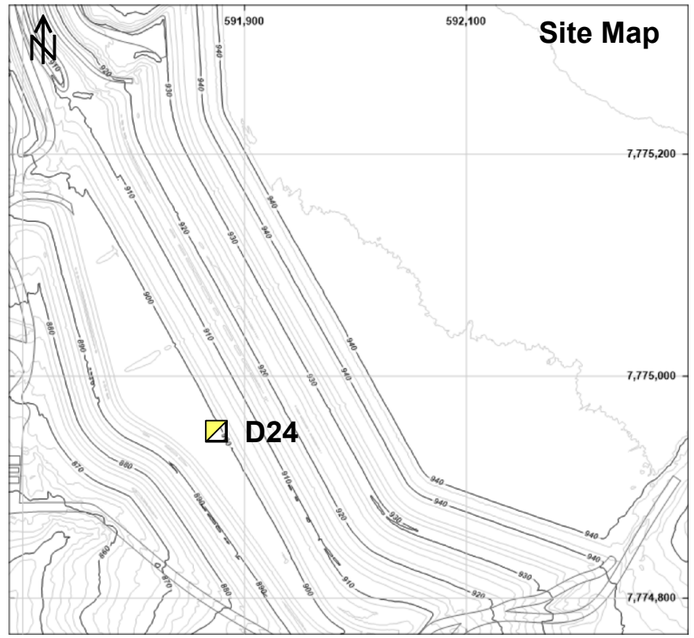


D23			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: D23

FIGURE 7-26

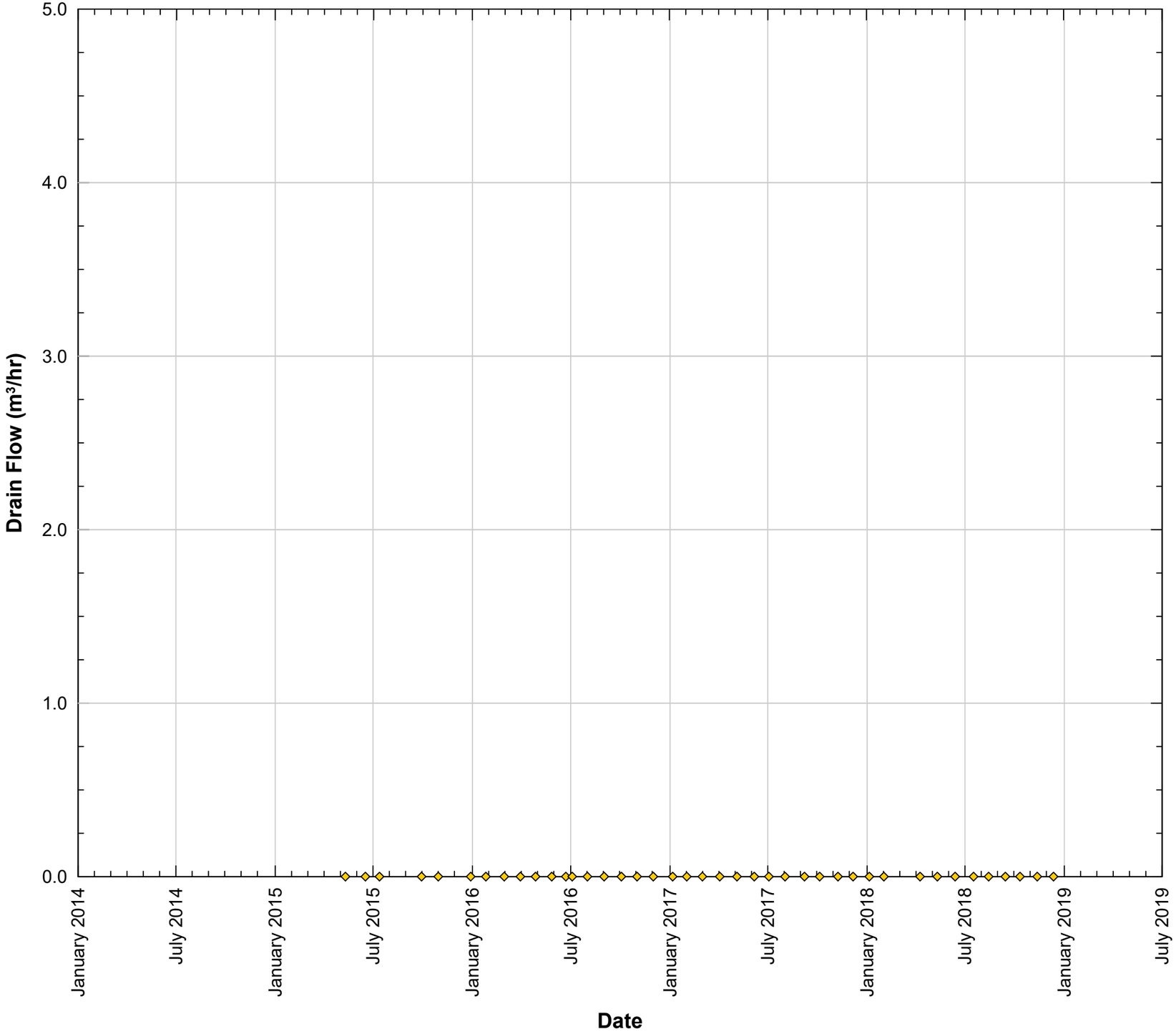


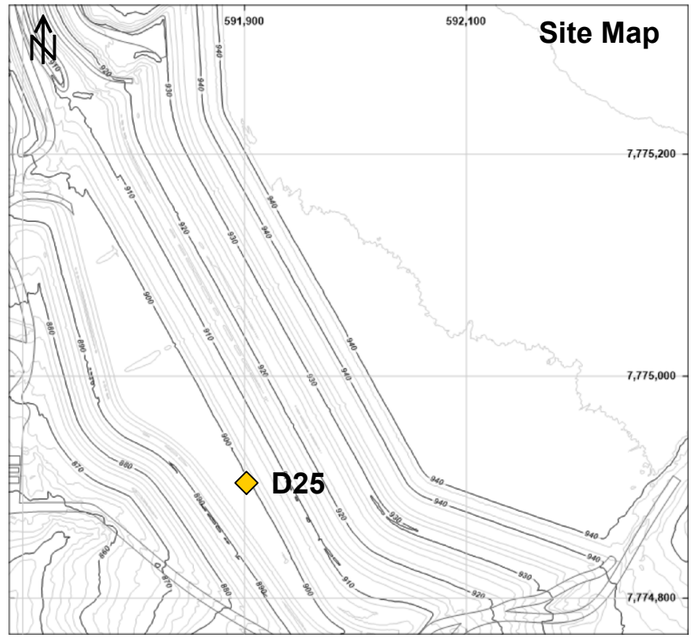


D24			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: D24

FIGURE 7-27



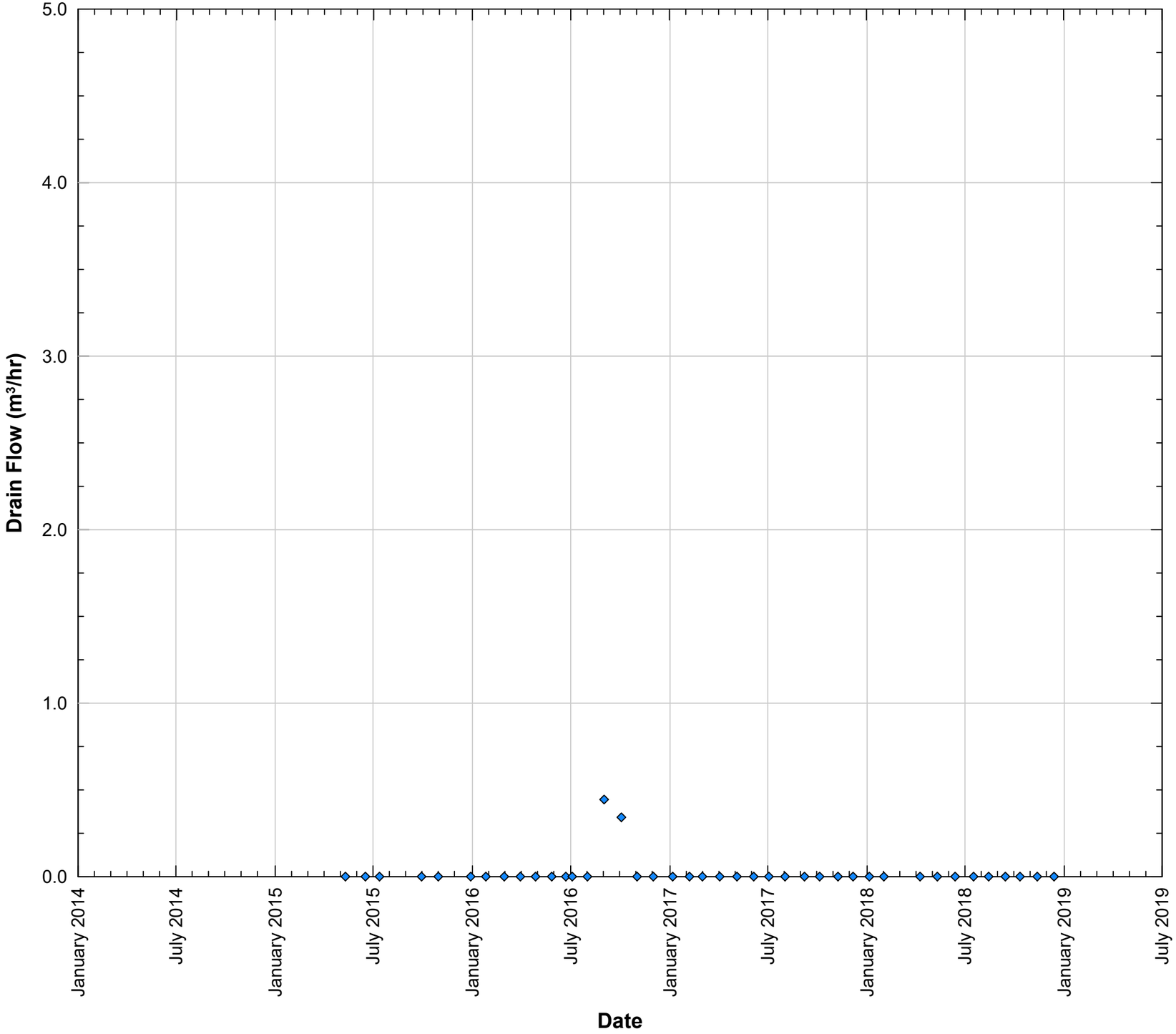


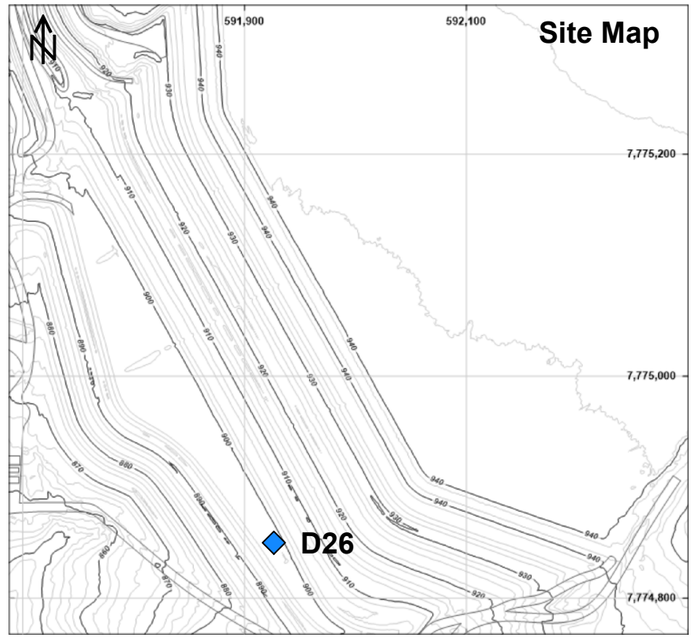
D25			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	12/12/2018	Monthly

5-YEAR DRAIN FLOW DATA: D25

FIGURE 7-28

5-Year Drain Flow Data: D26

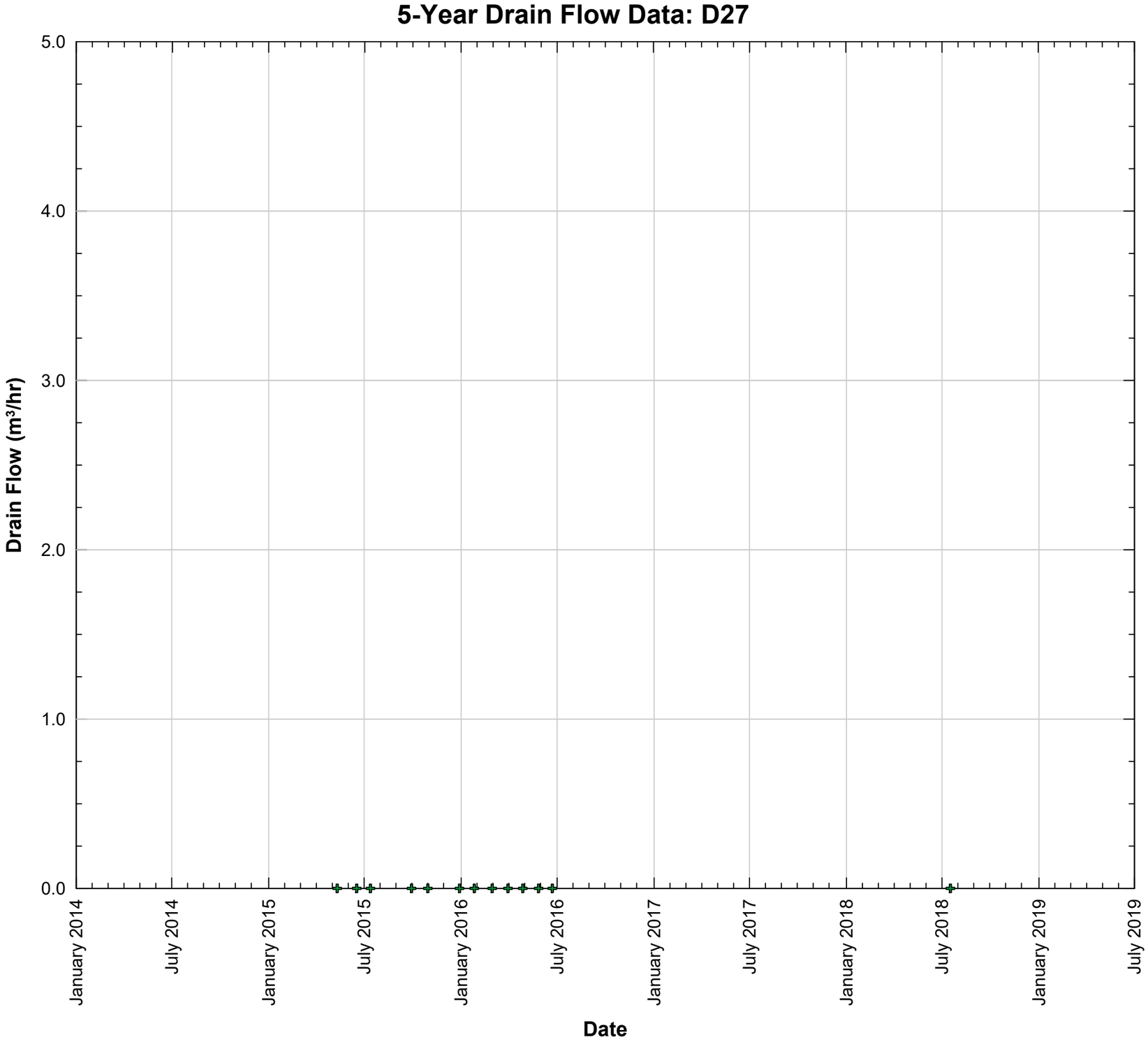


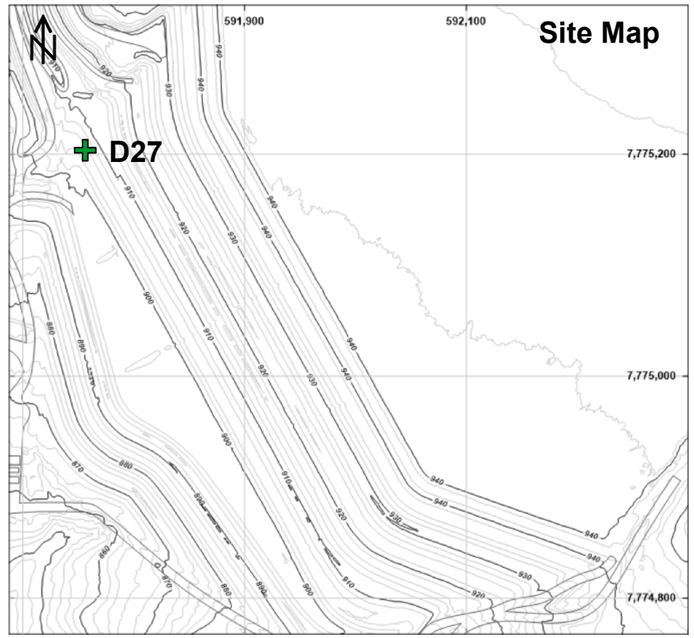


D26			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: D26

FIGURE 7-29

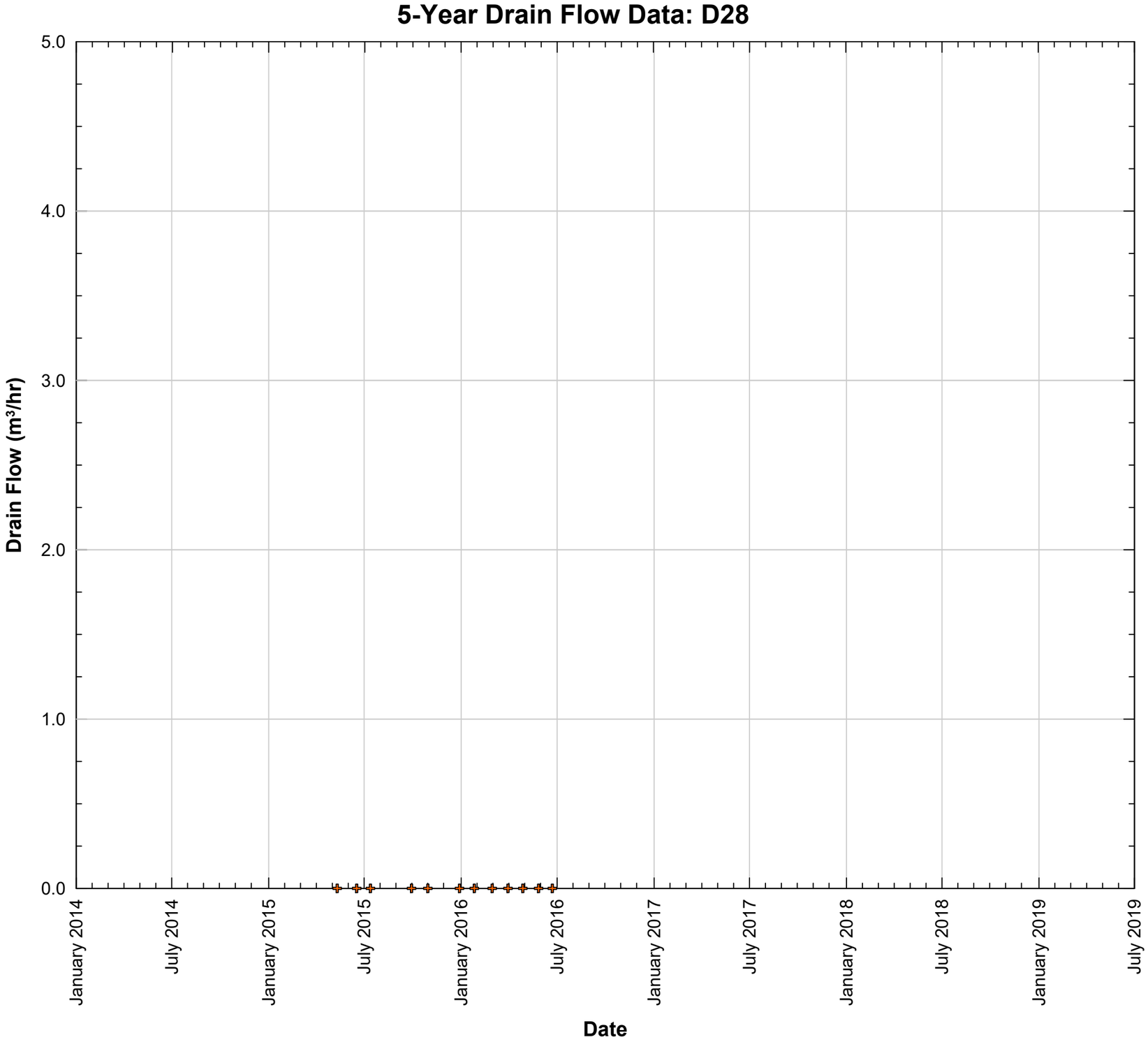


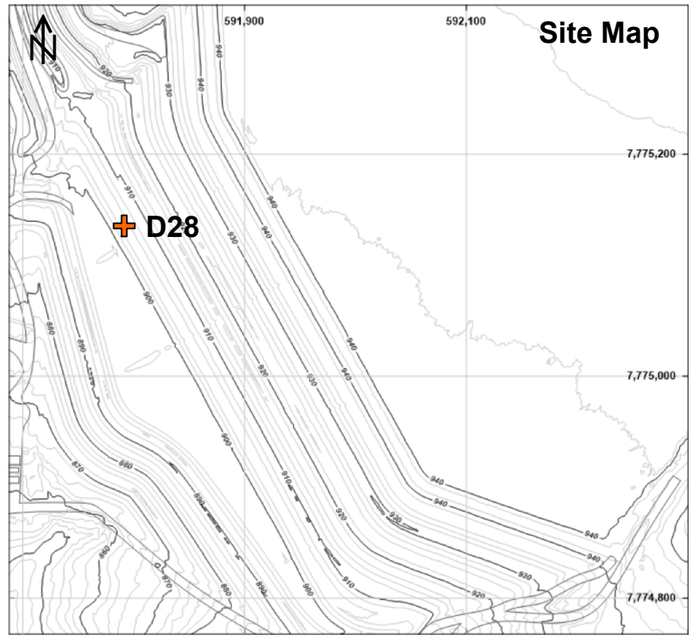


D27			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	7/17/2018	Monthly

5-YEAR DRAIN FLOW DATA: D27

FIGURE 7-30

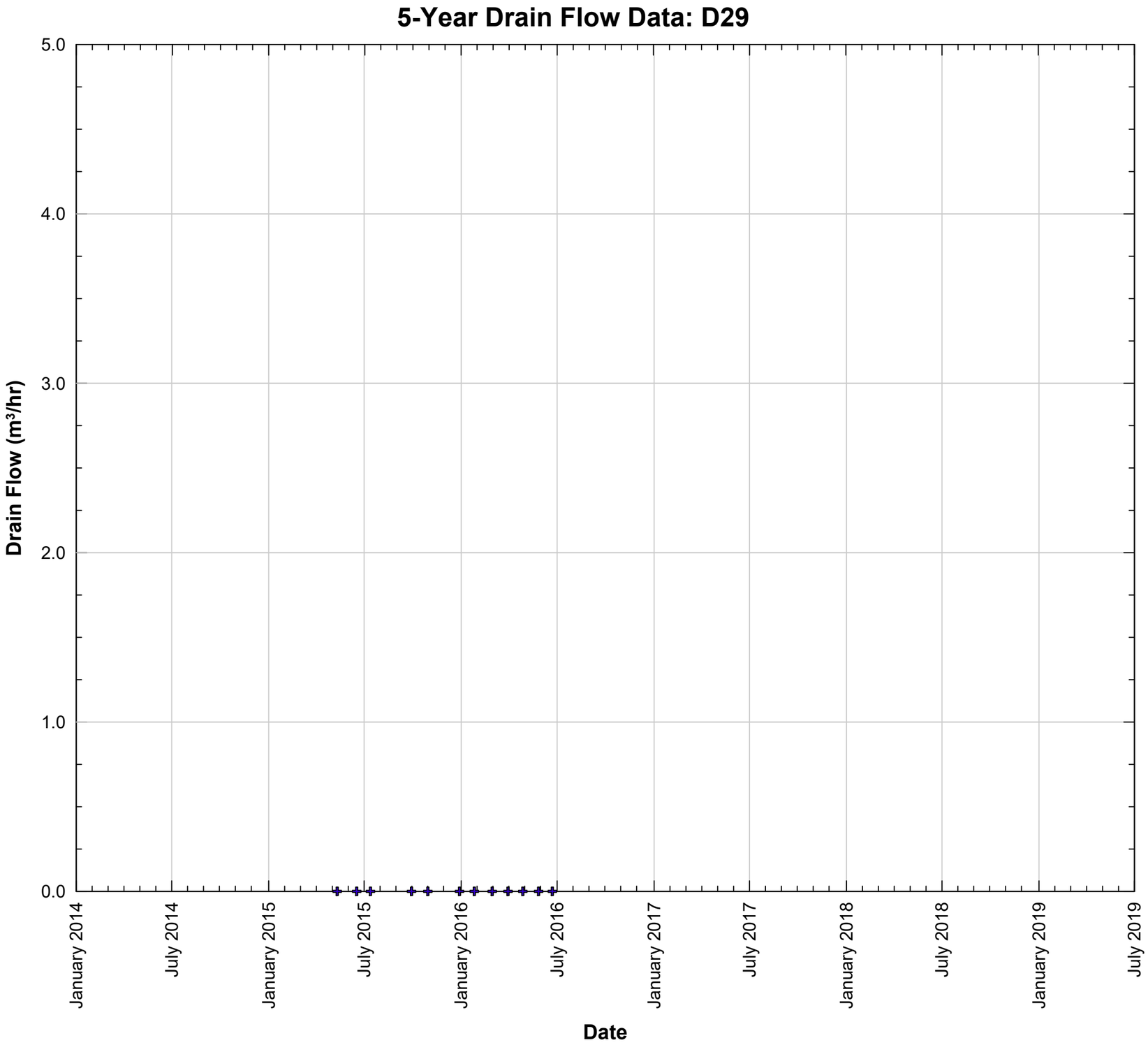


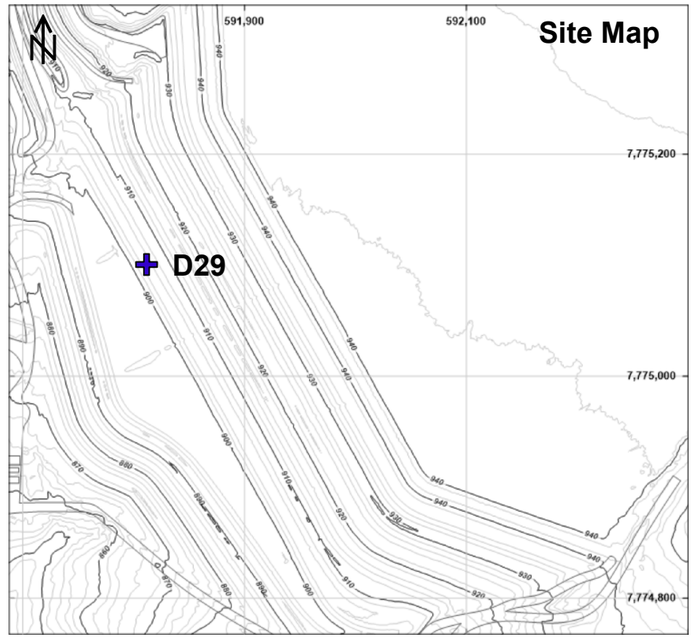


D28			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	6/22/2016	Monthly

5-YEAR DRAIN FLOW DATA: D28

FIGURE 7-31

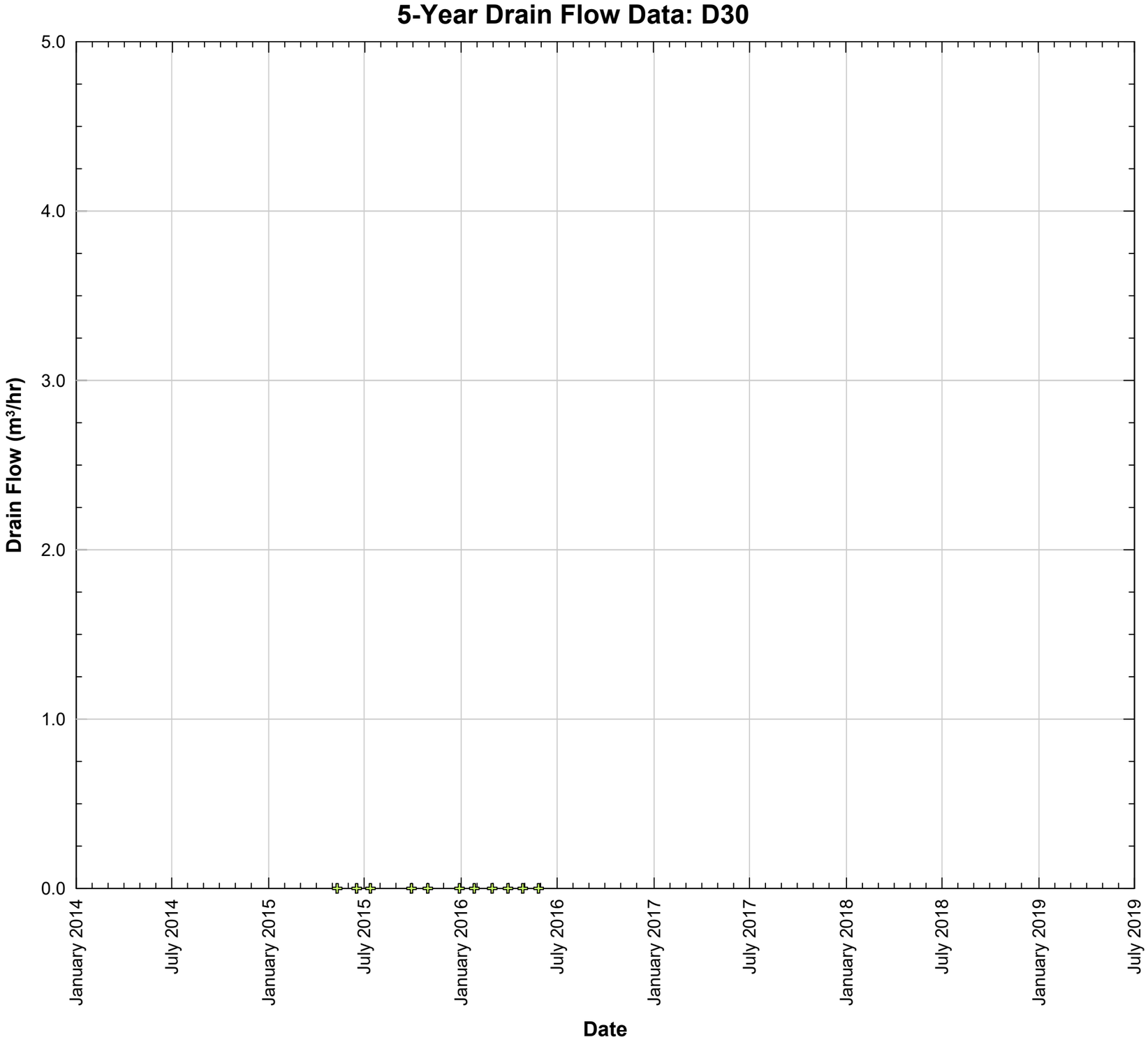


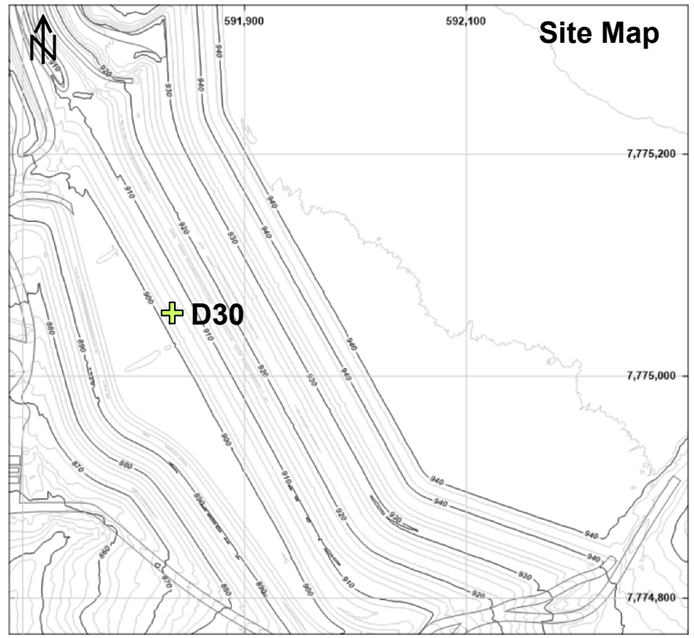


D29			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	6/22/2016	Monthly

5-YEAR DRAIN FLOW DATA: D29

FIGURE 7-32

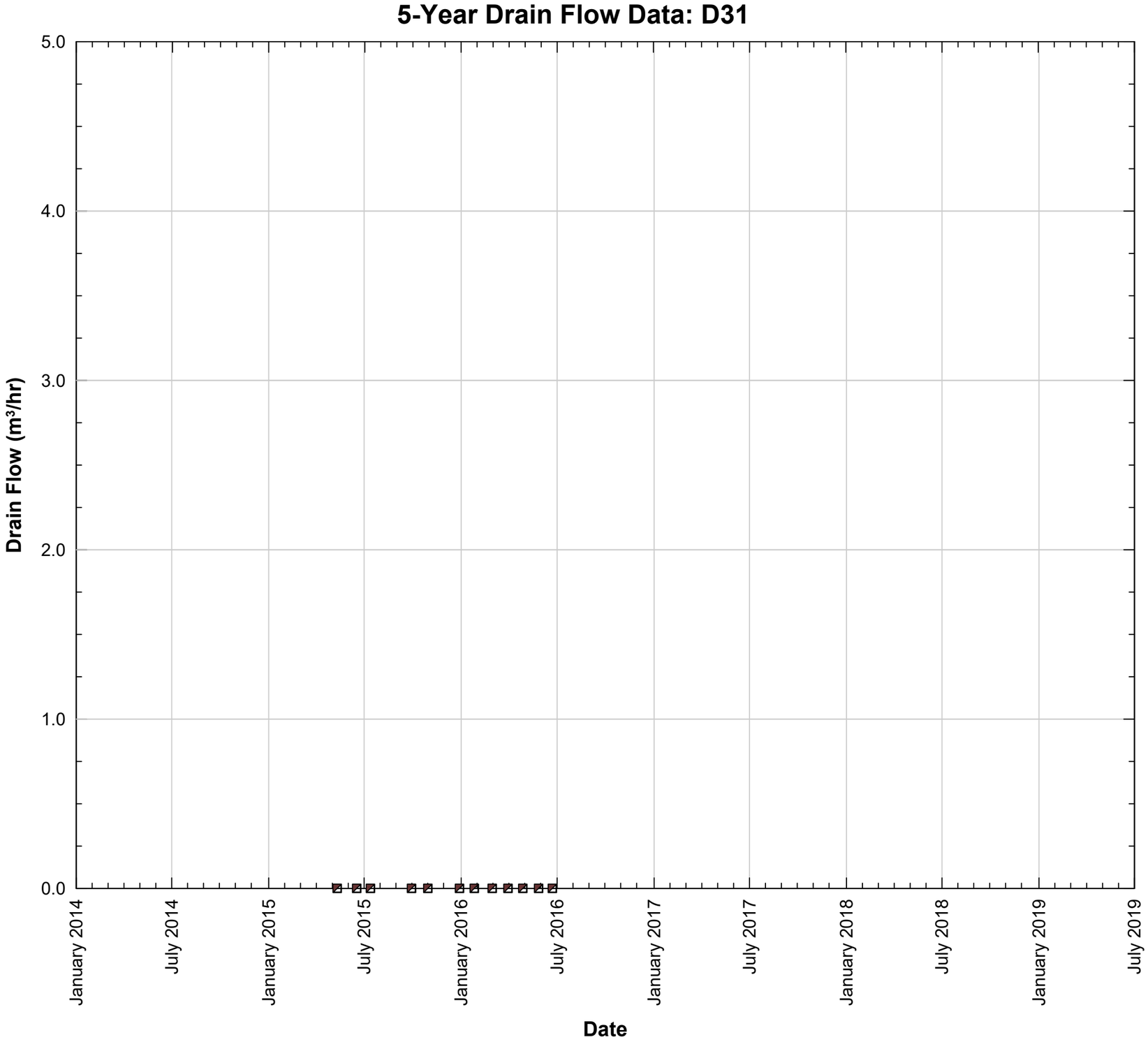


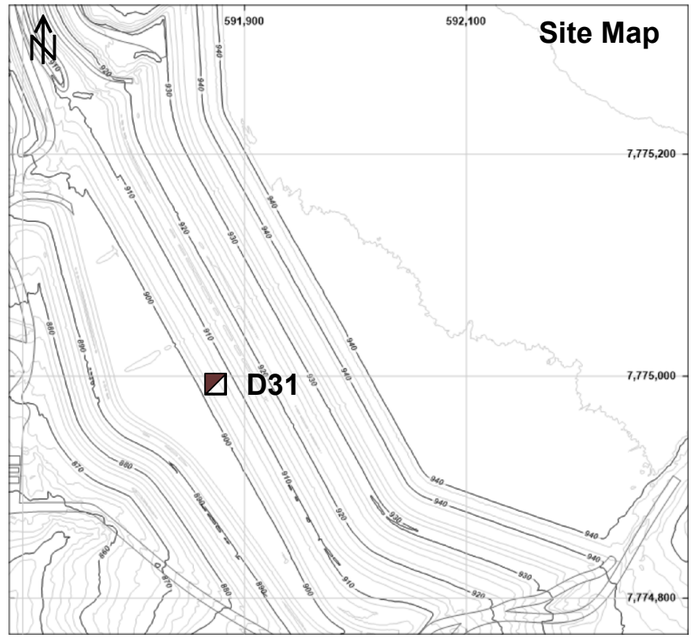


D30			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	5/27/2016	Monthly

5-YEAR DRAIN FLOW DATA: D30

FIGURE 7-33

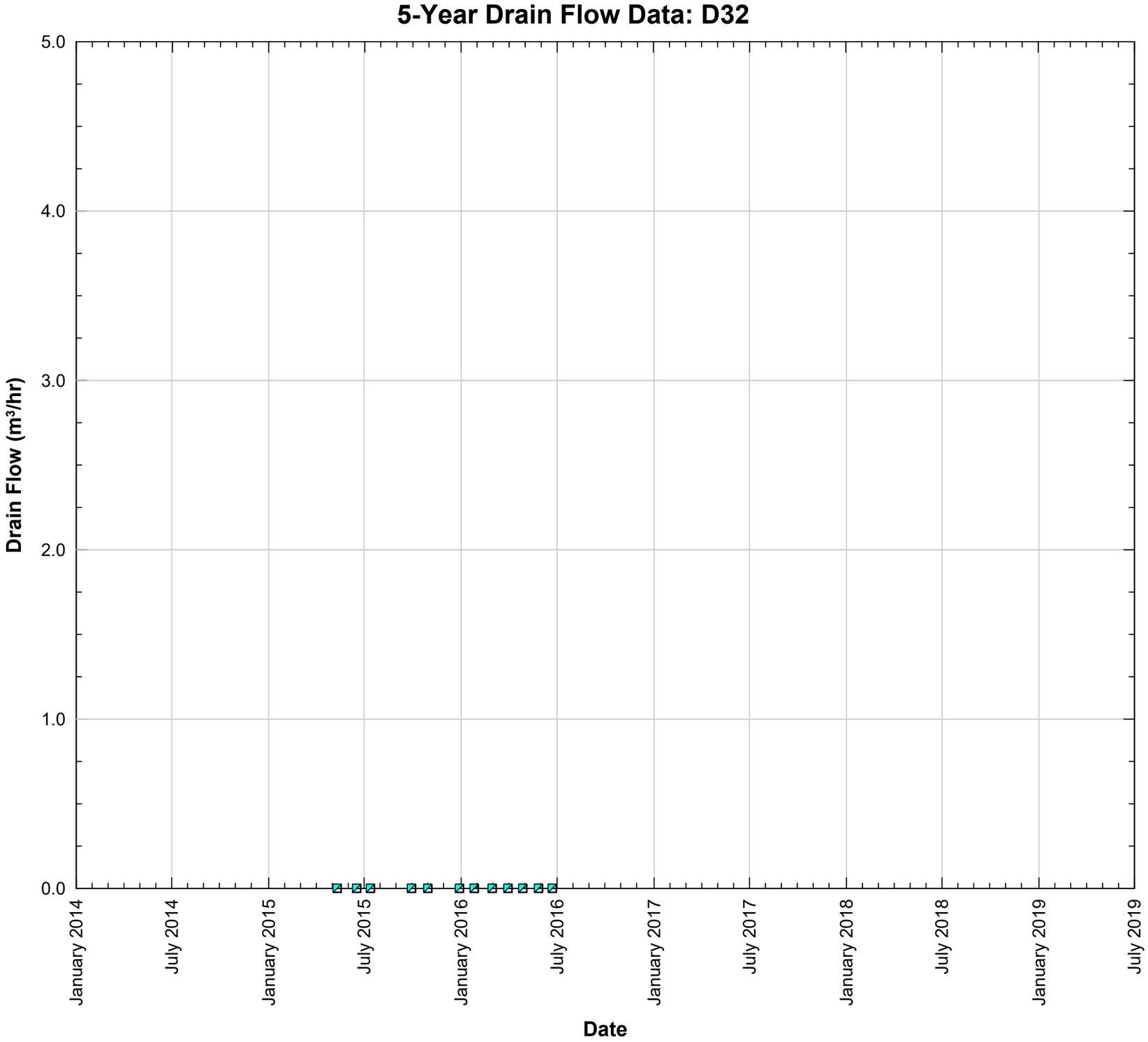


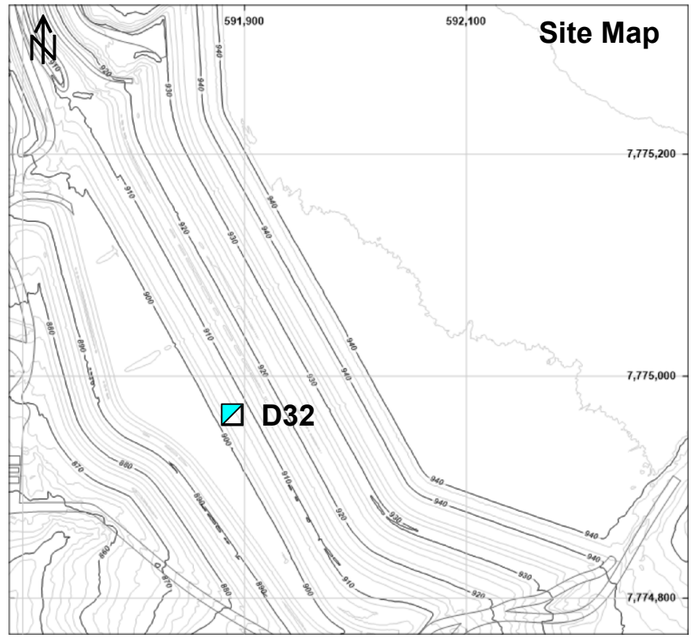


D31			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	6/22/2016	Monthly

5-YEAR DRAIN FLOW DATA: D31

FIGURE 7-34

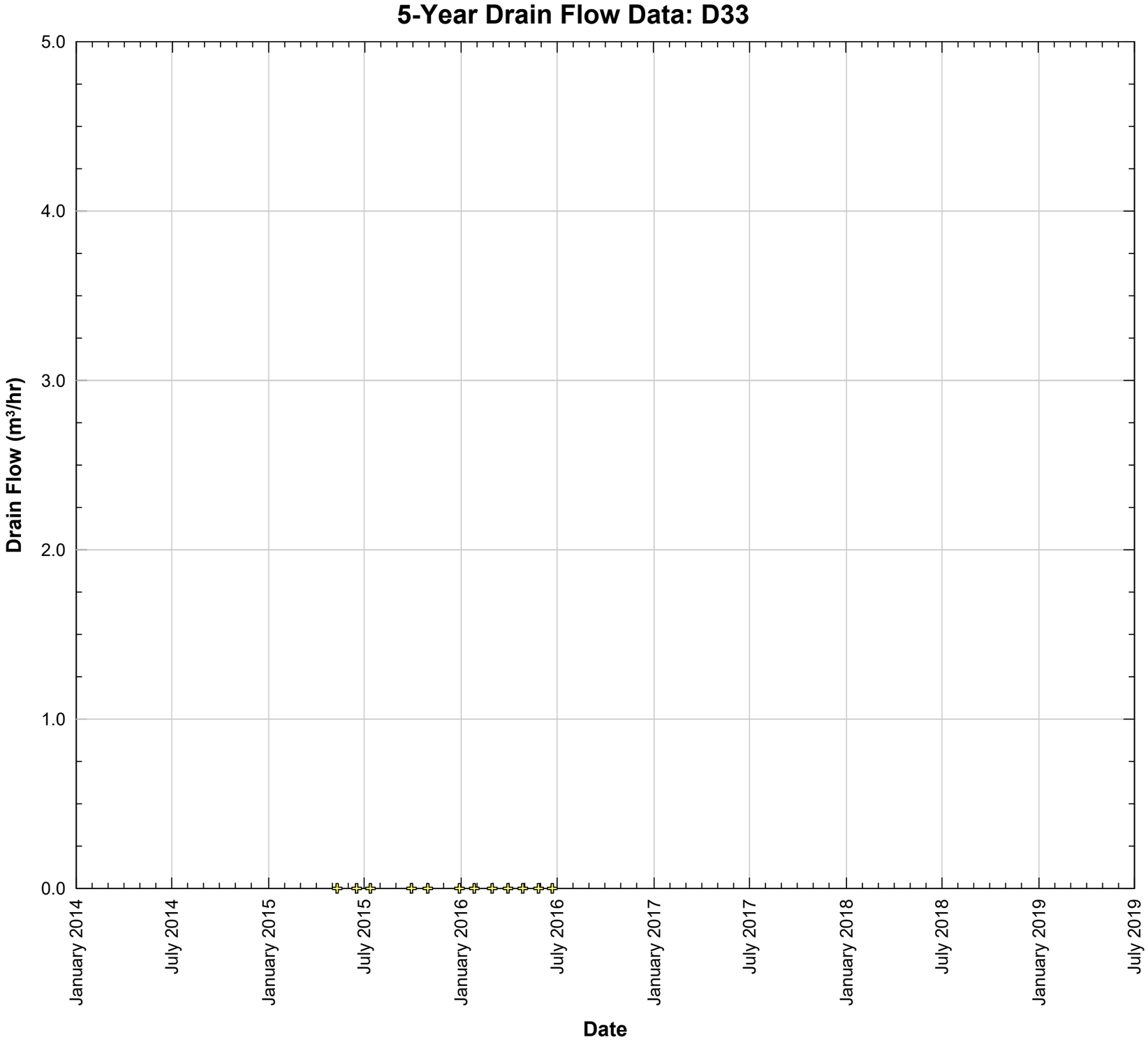


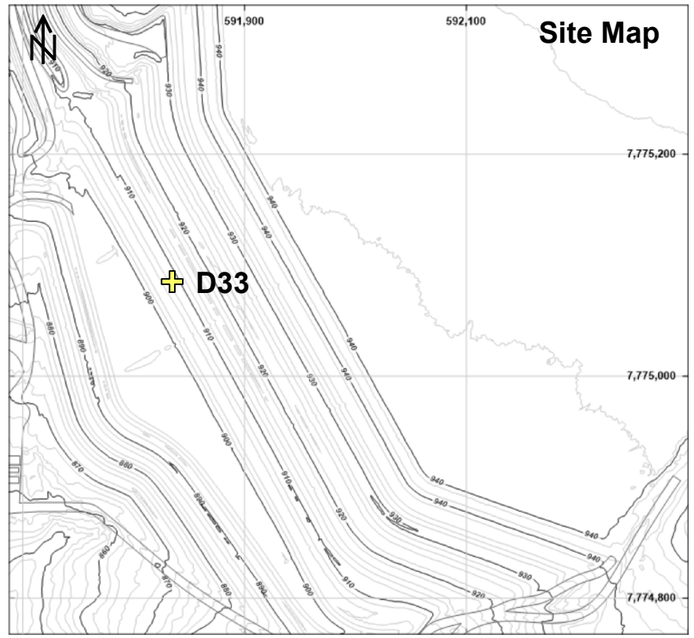


D32			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	6/22/2016	Monthly

5-YEAR DRAIN FLOW DATA: D32

FIGURE 7-35

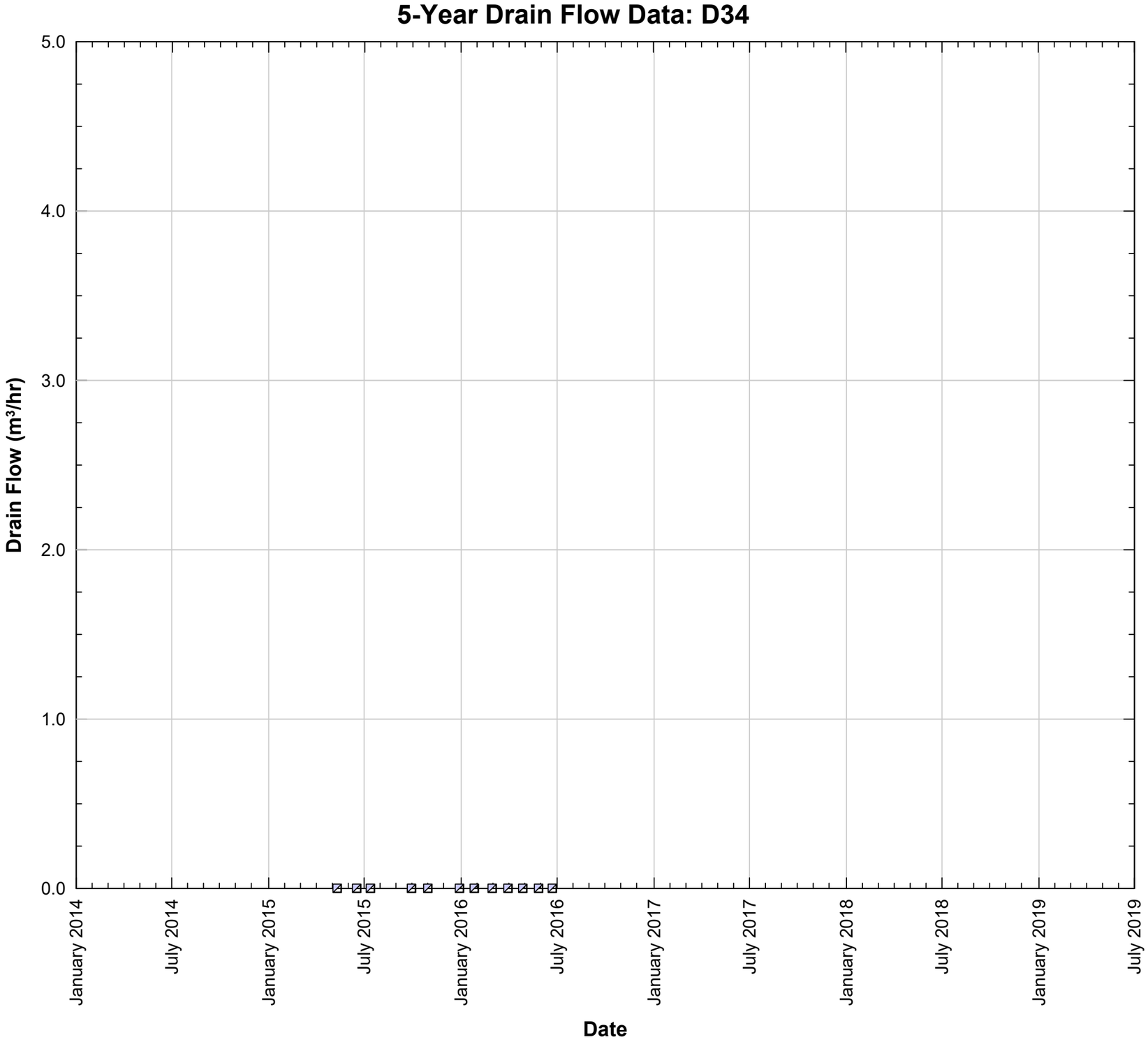


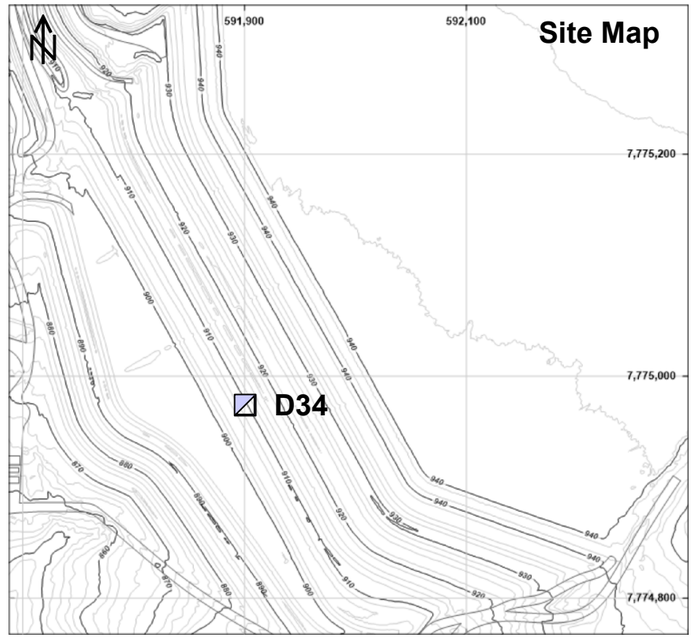


D33			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	6/22/2016	Monthly

5-YEAR DRAIN FLOW DATA: D33

FIGURE 7-36

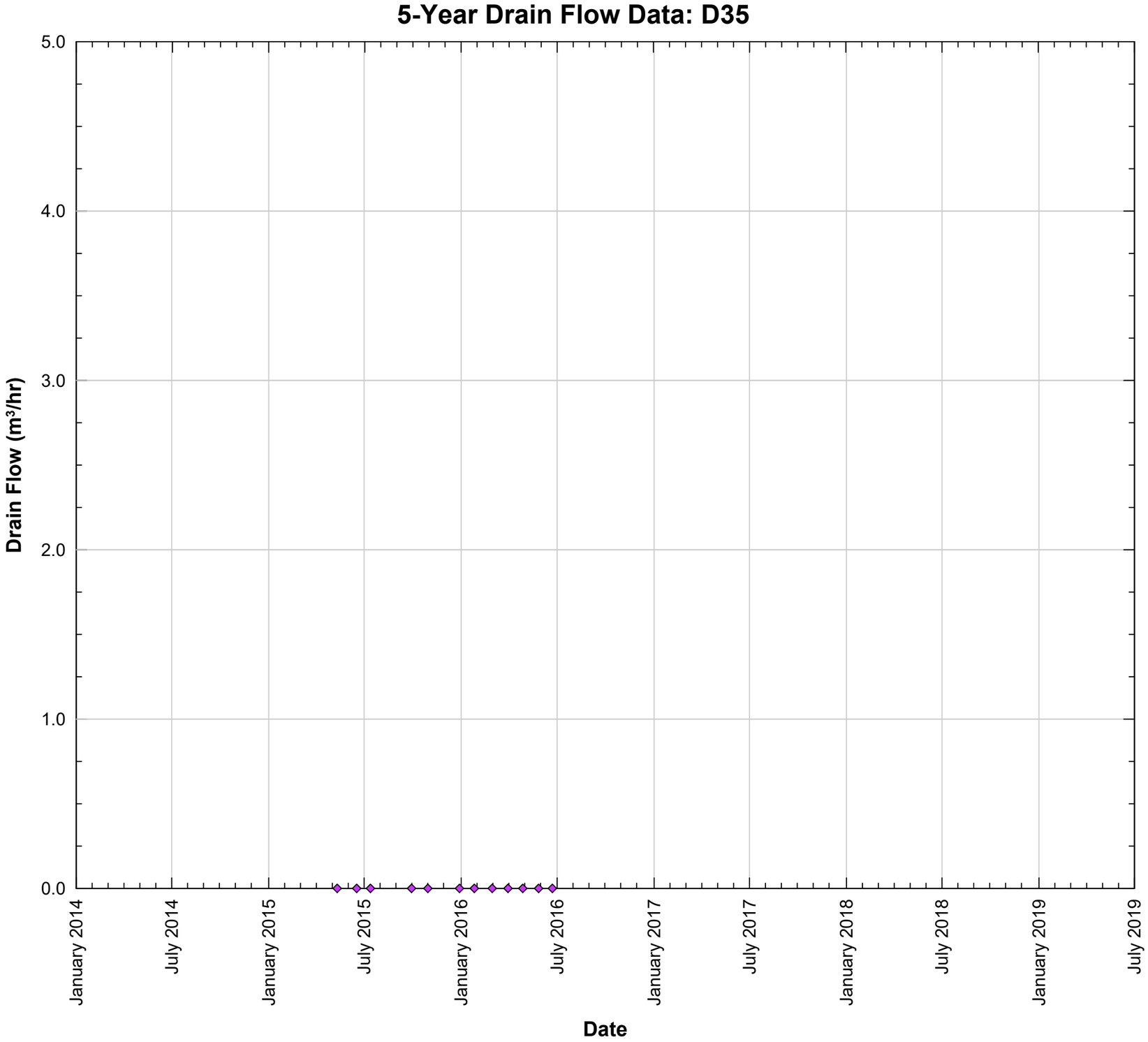


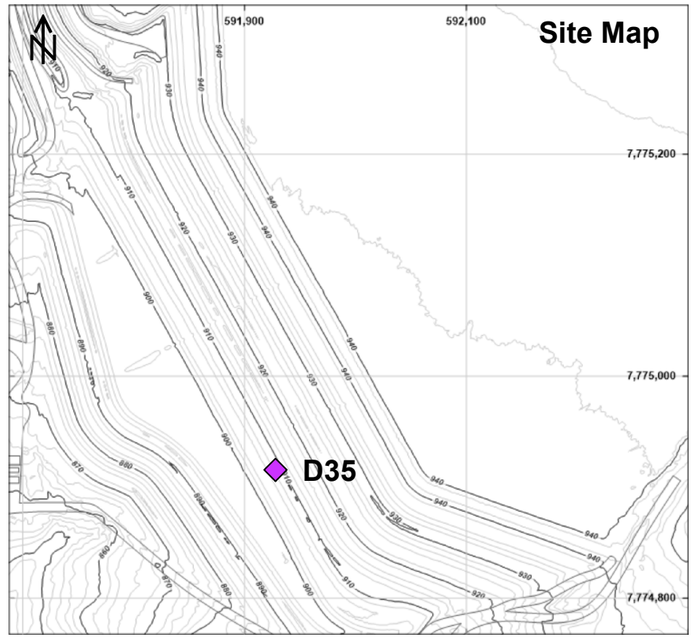


D34			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	6/22/2016	Monthly

5-YEAR DRAIN FLOW DATA: D34

FIGURE 7-37

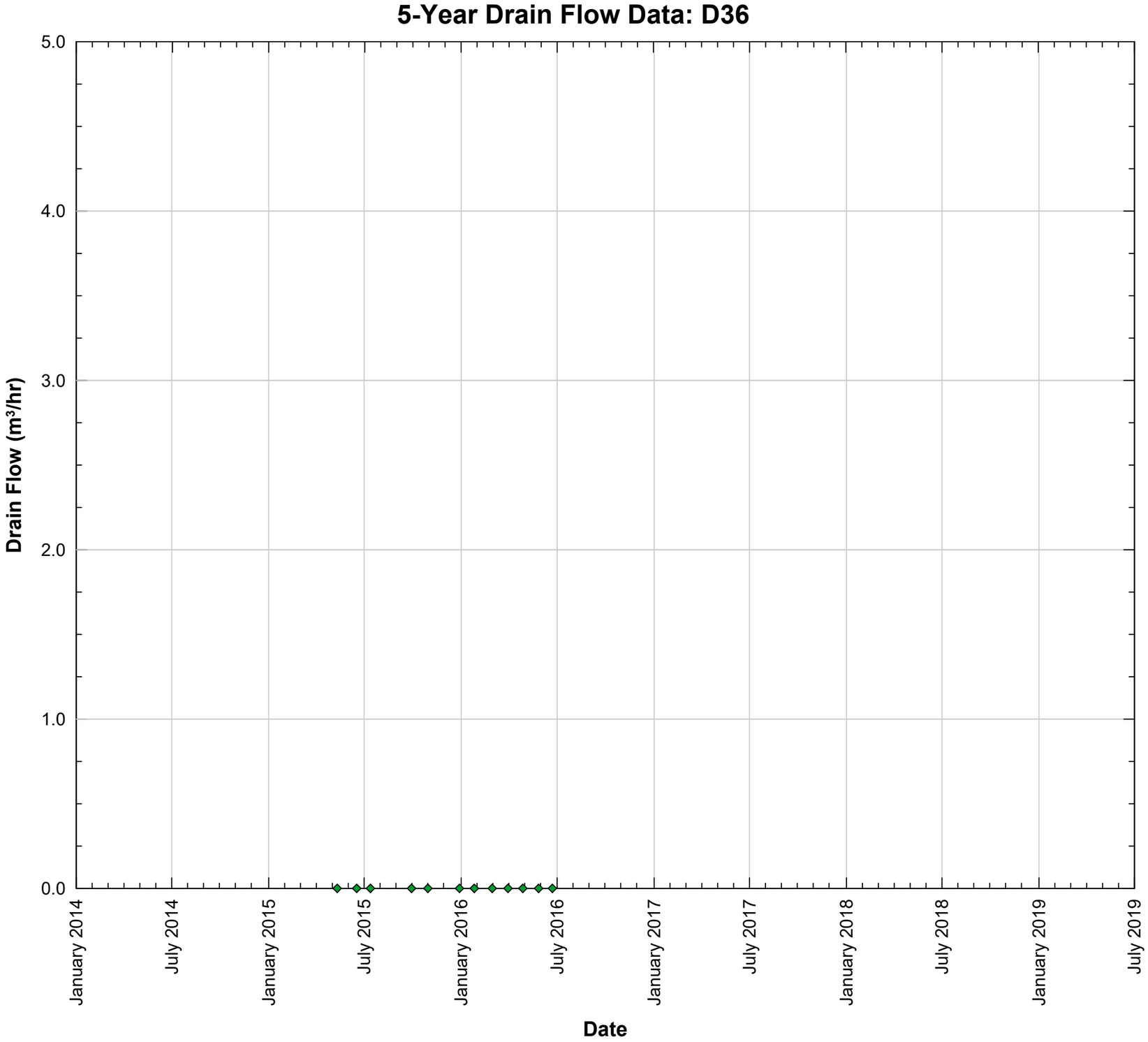


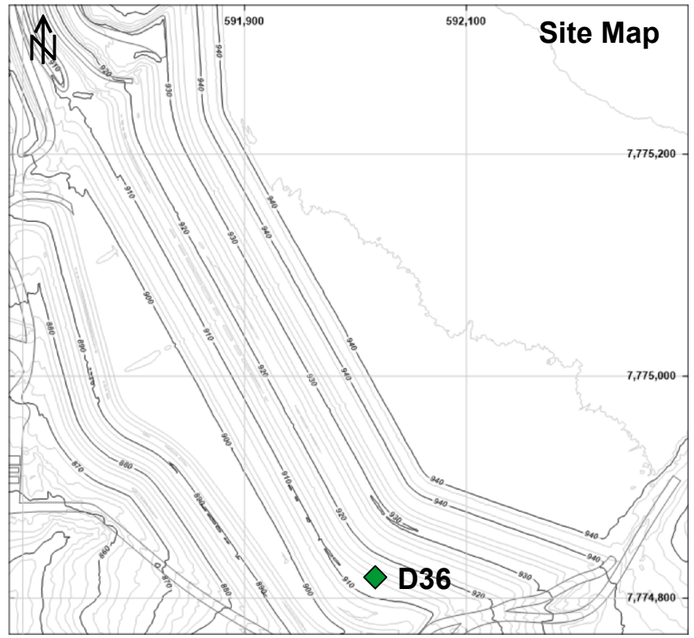


D35			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	6/22/2016	Monthly

5-YEAR DRAIN FLOW DATA: D35

FIGURE 7-38

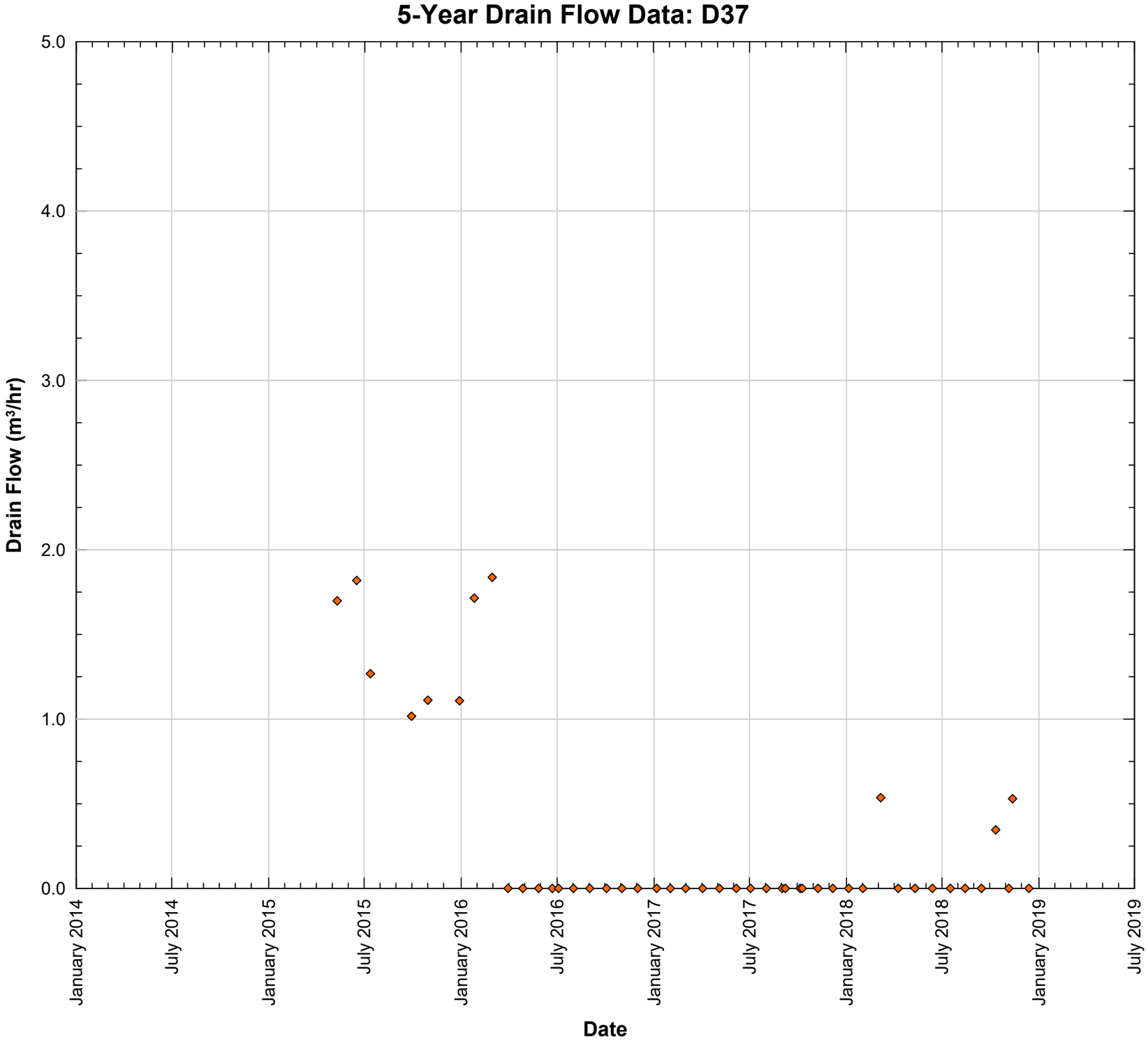


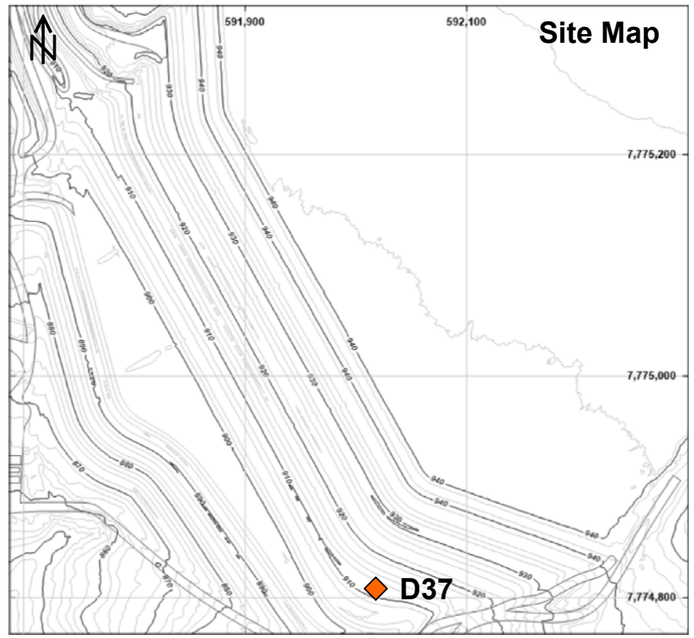


D36			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	6/22/2016	Monthly

5-YEAR DRAIN FLOW DATA: D36

FIGURE 7-39

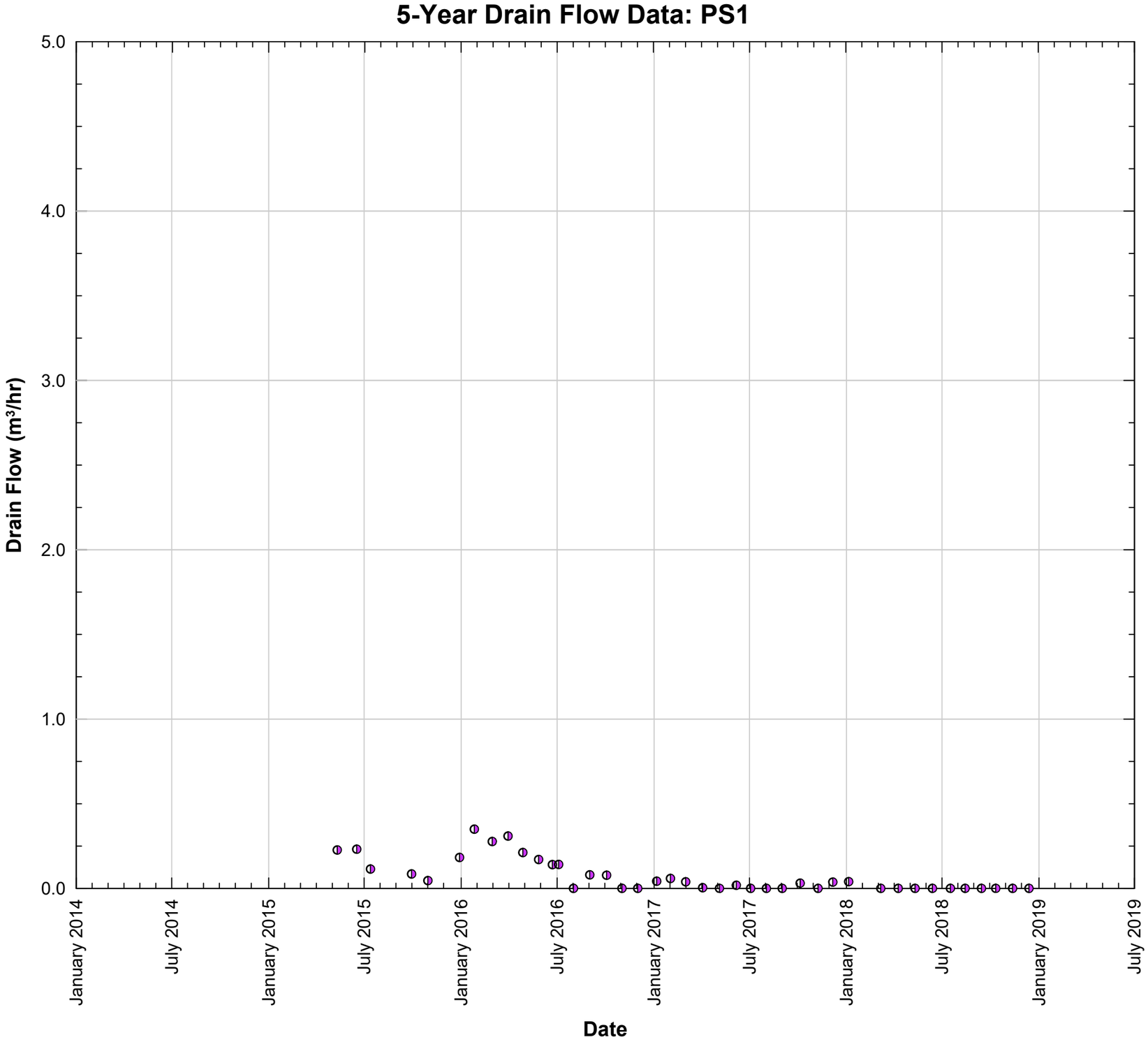


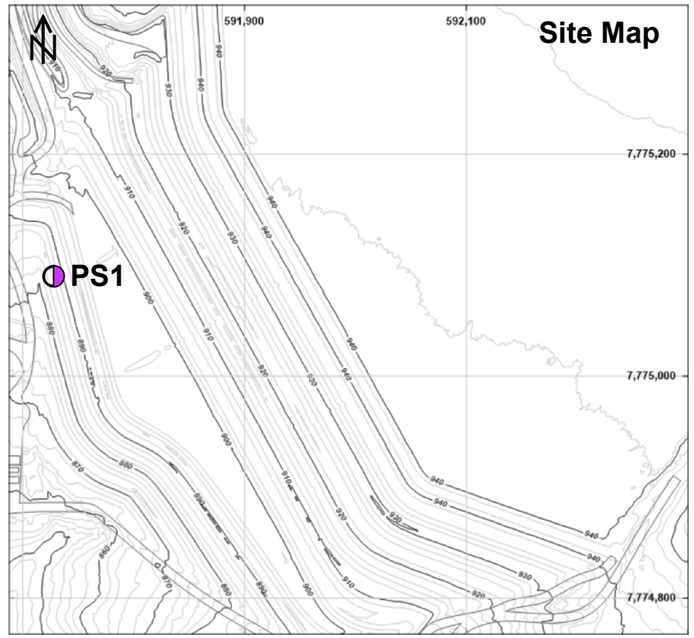


D37			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/1/2004	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: D37

FIGURE 7-40

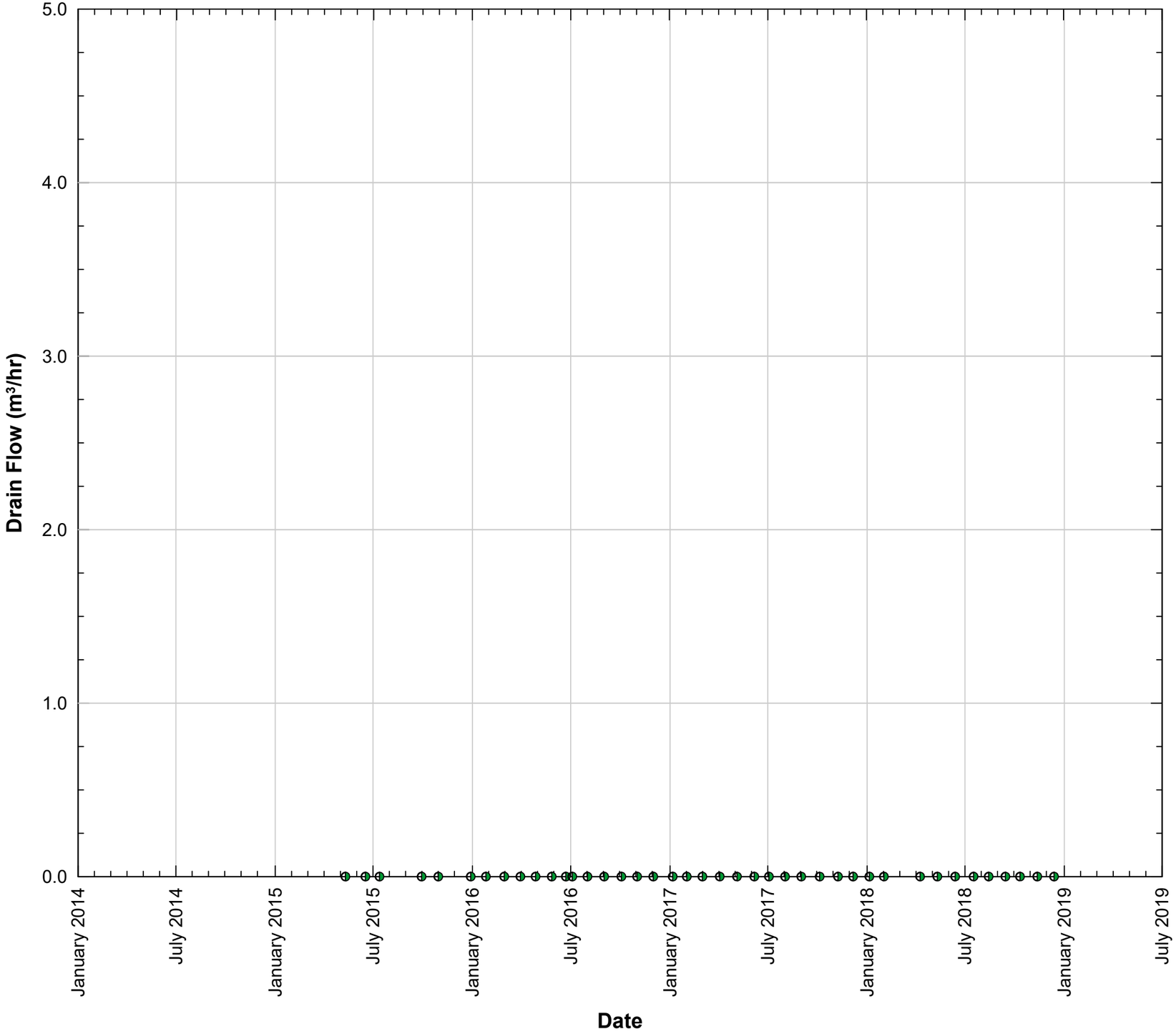


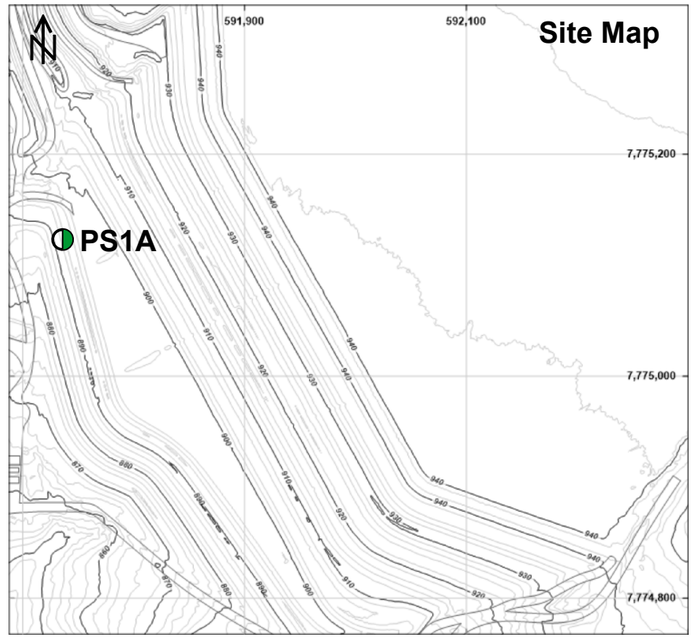


PS1			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS1

FIGURE 7-41

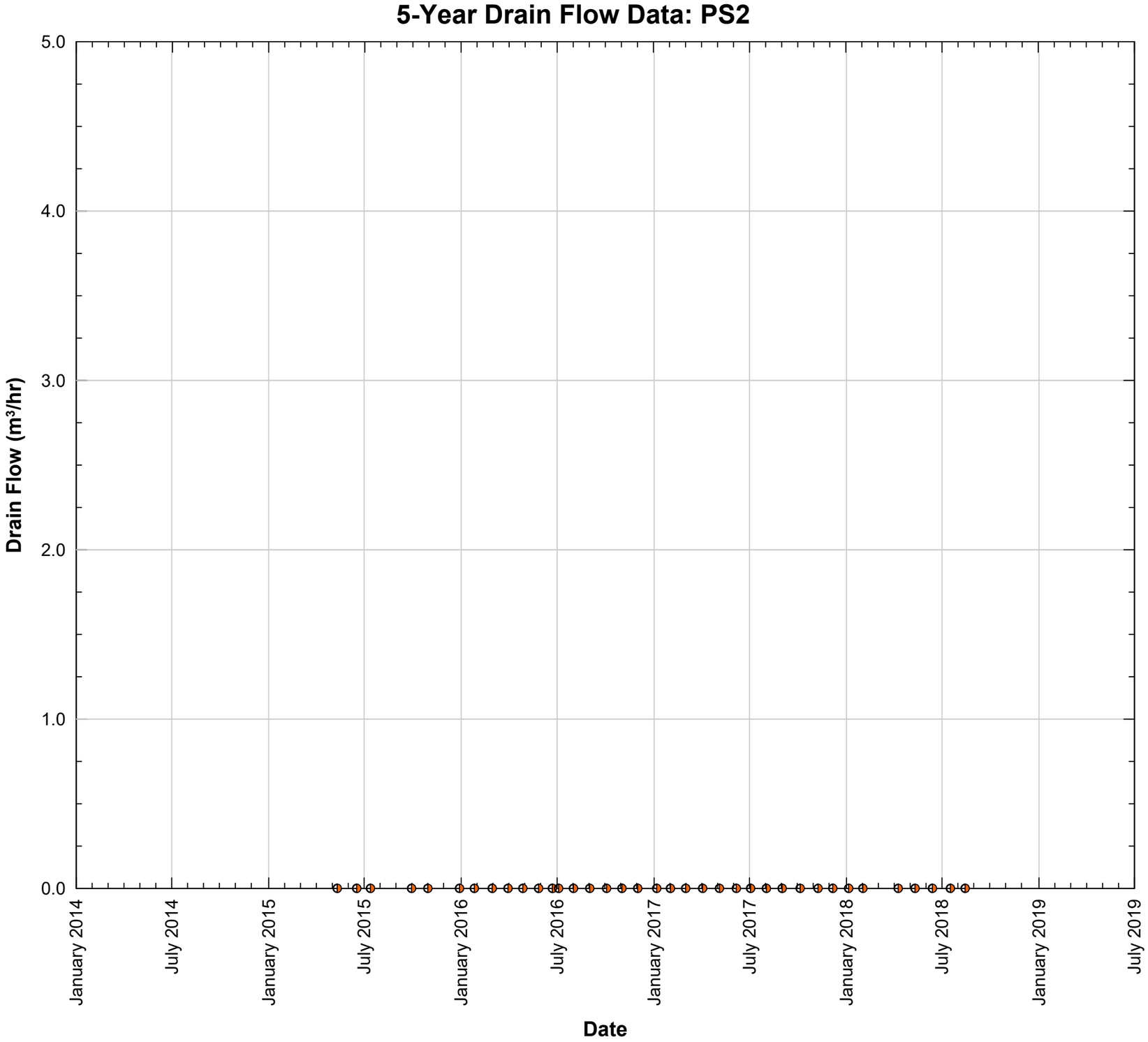


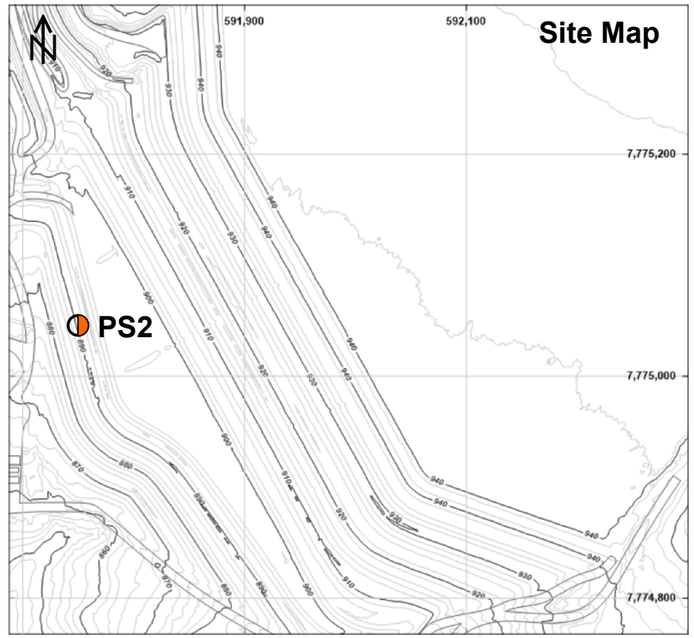


PS1A			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS1A

FIGURE 7-42

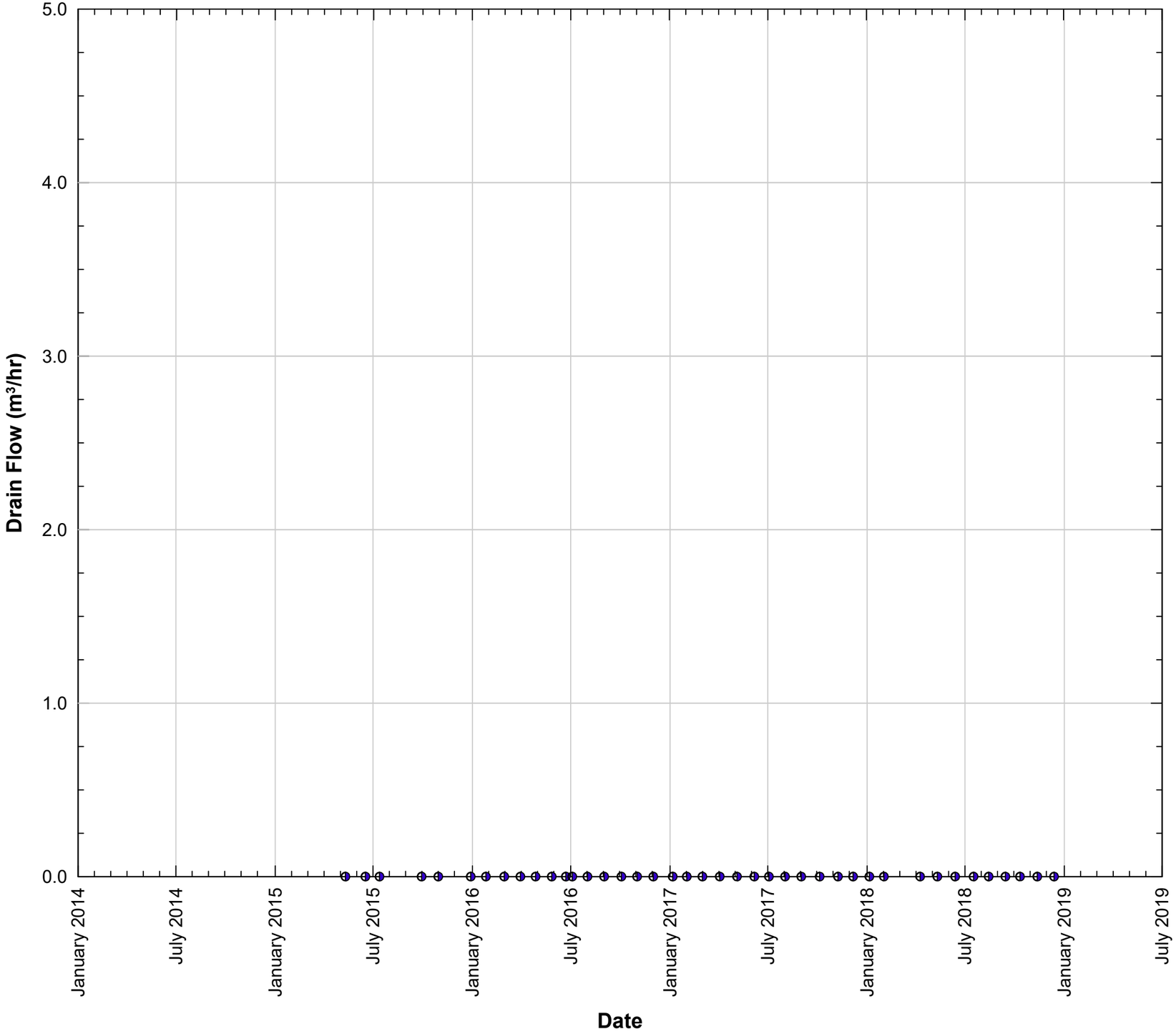


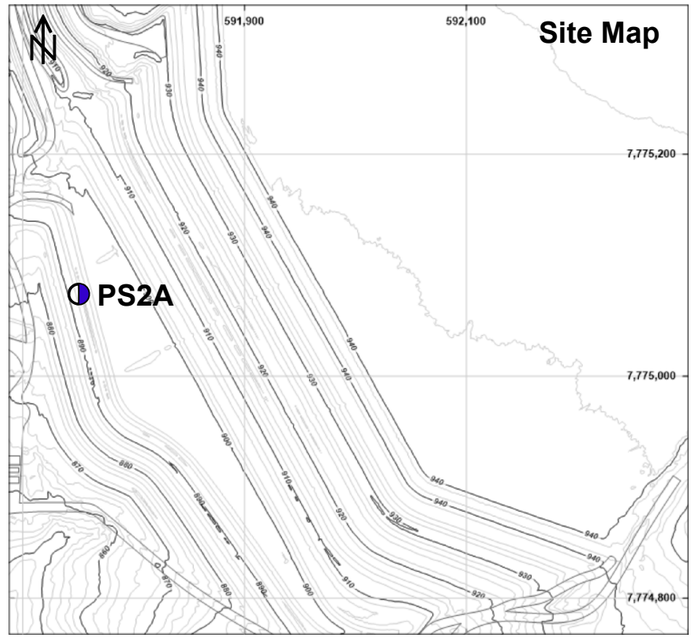


PS2			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	8/14/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS2

FIGURE 7-43

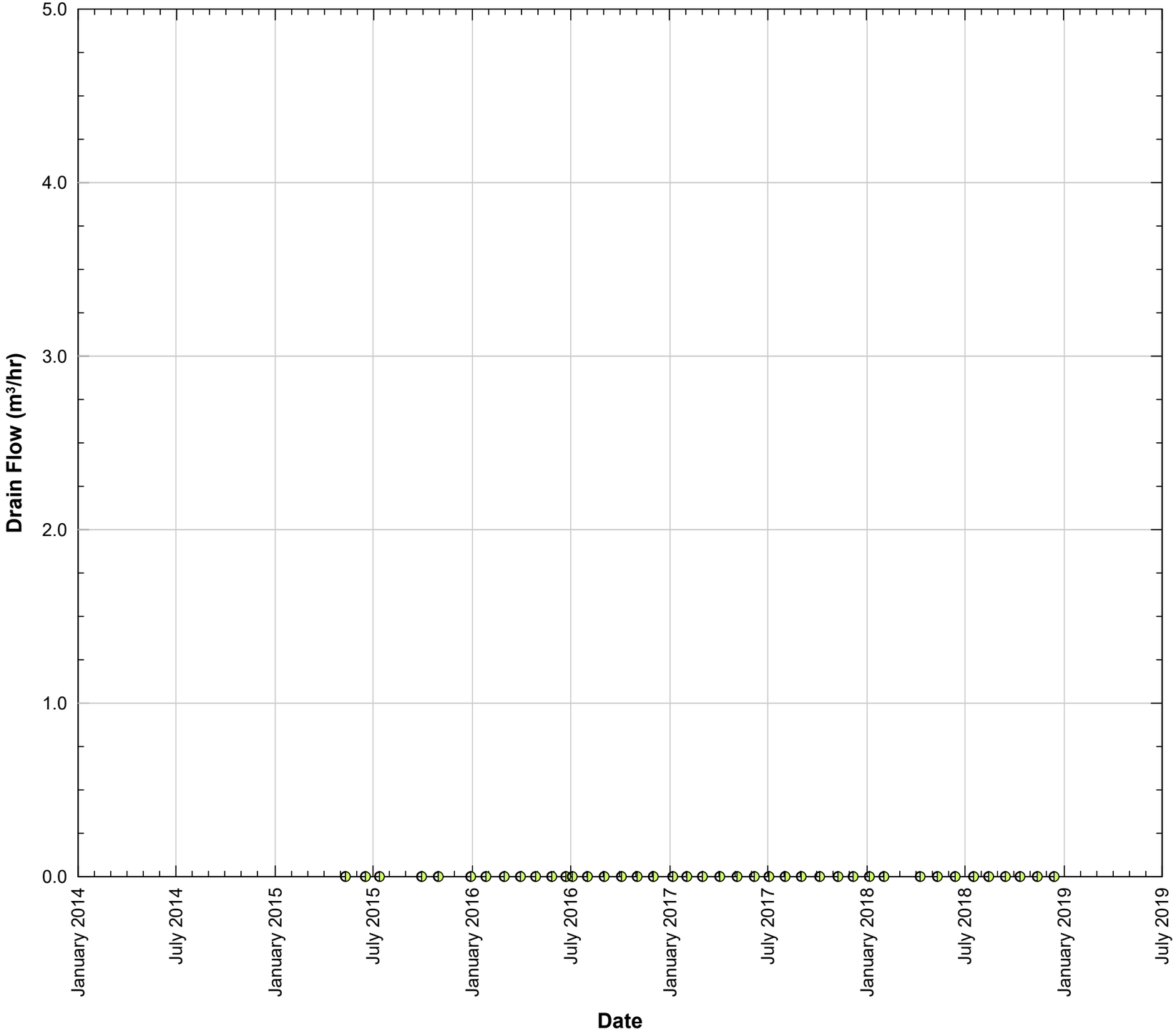


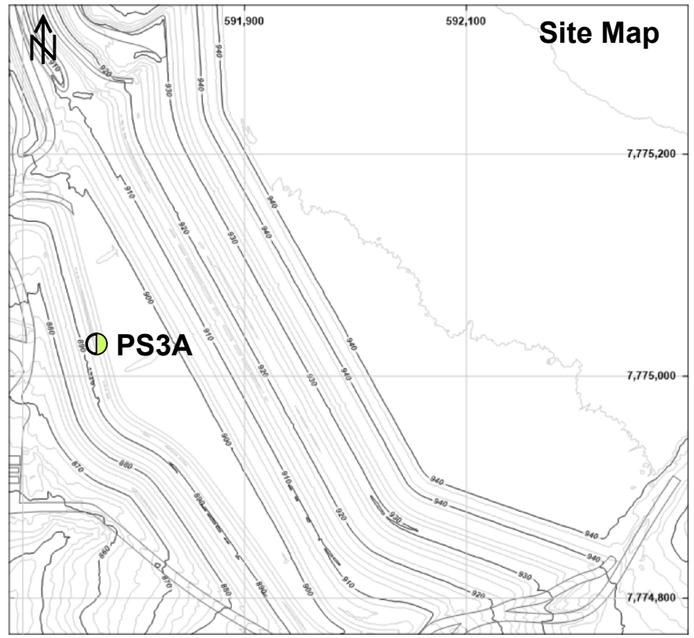


PS2A			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS2A

FIGURE 7-44

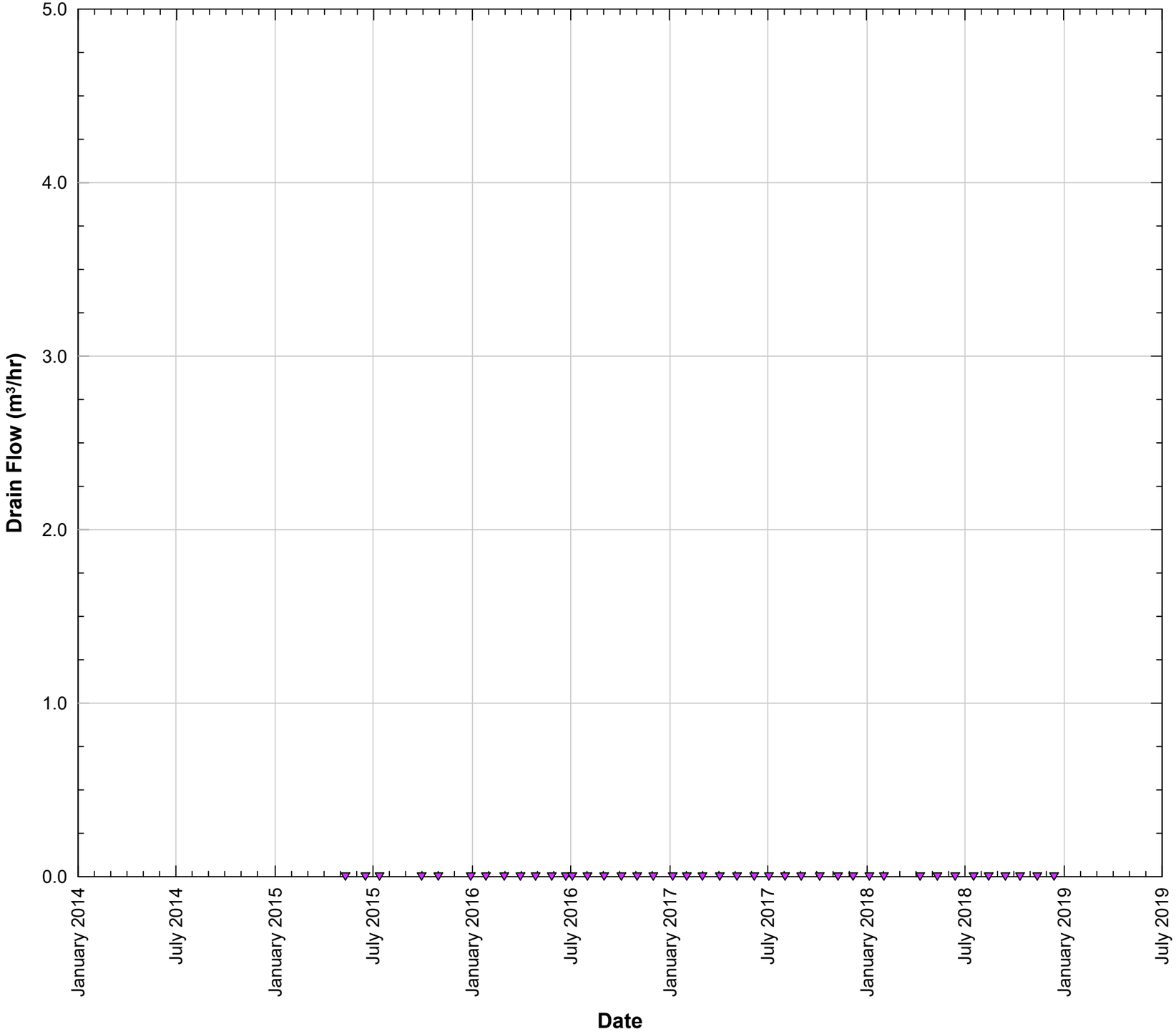


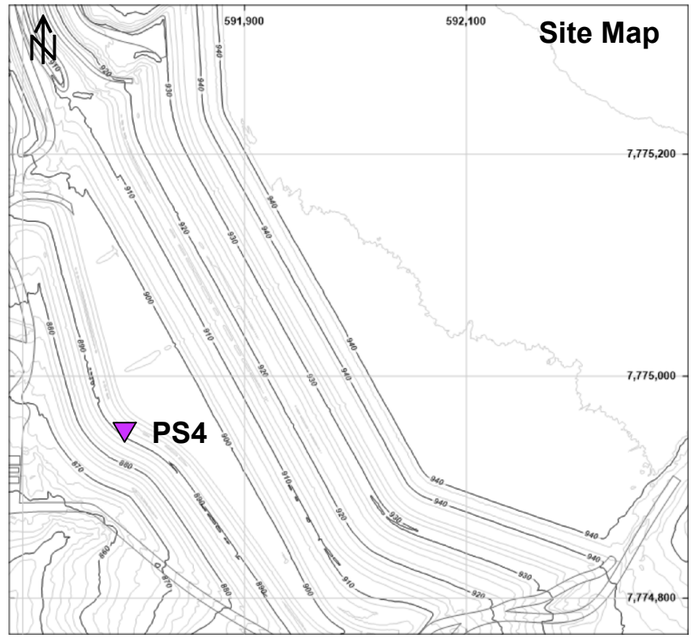


PS3A			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS3A

FIGURE 7-45

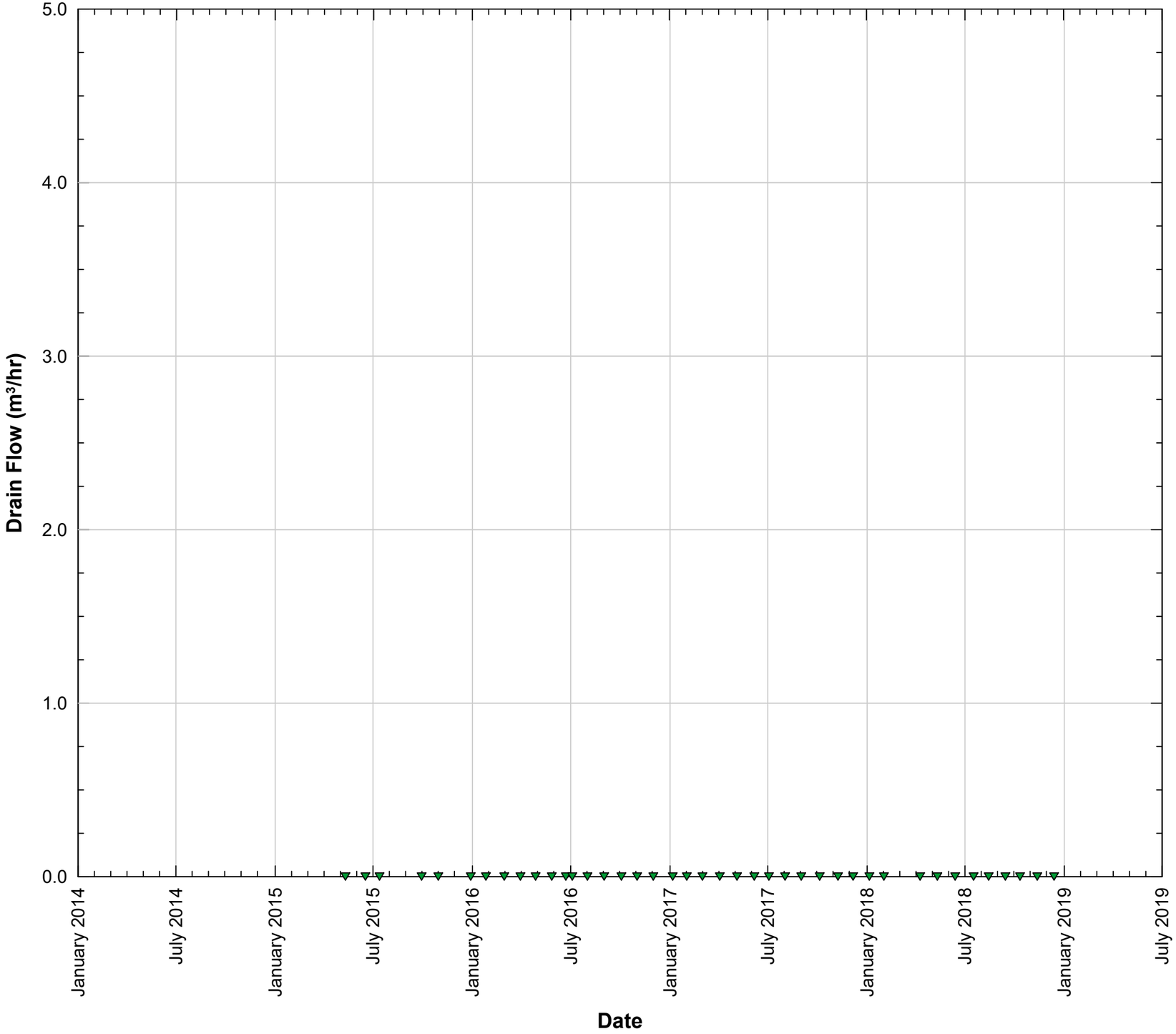


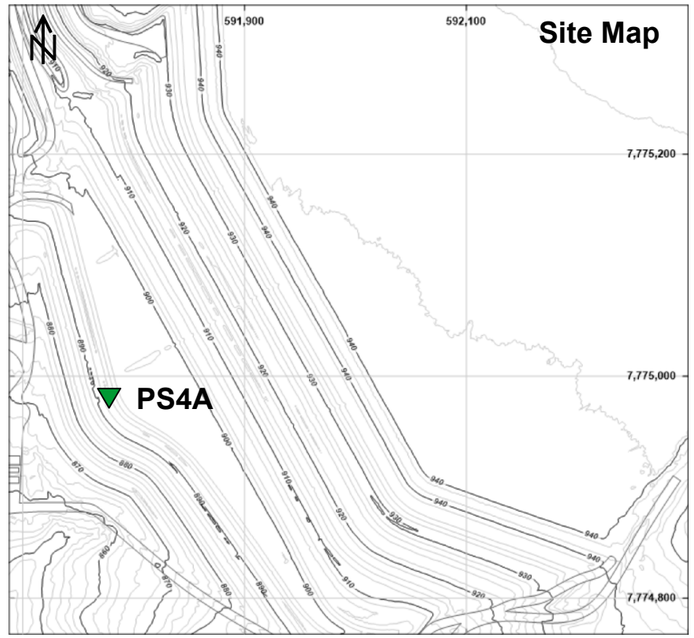


PS4			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS4

FIGURE 7-46

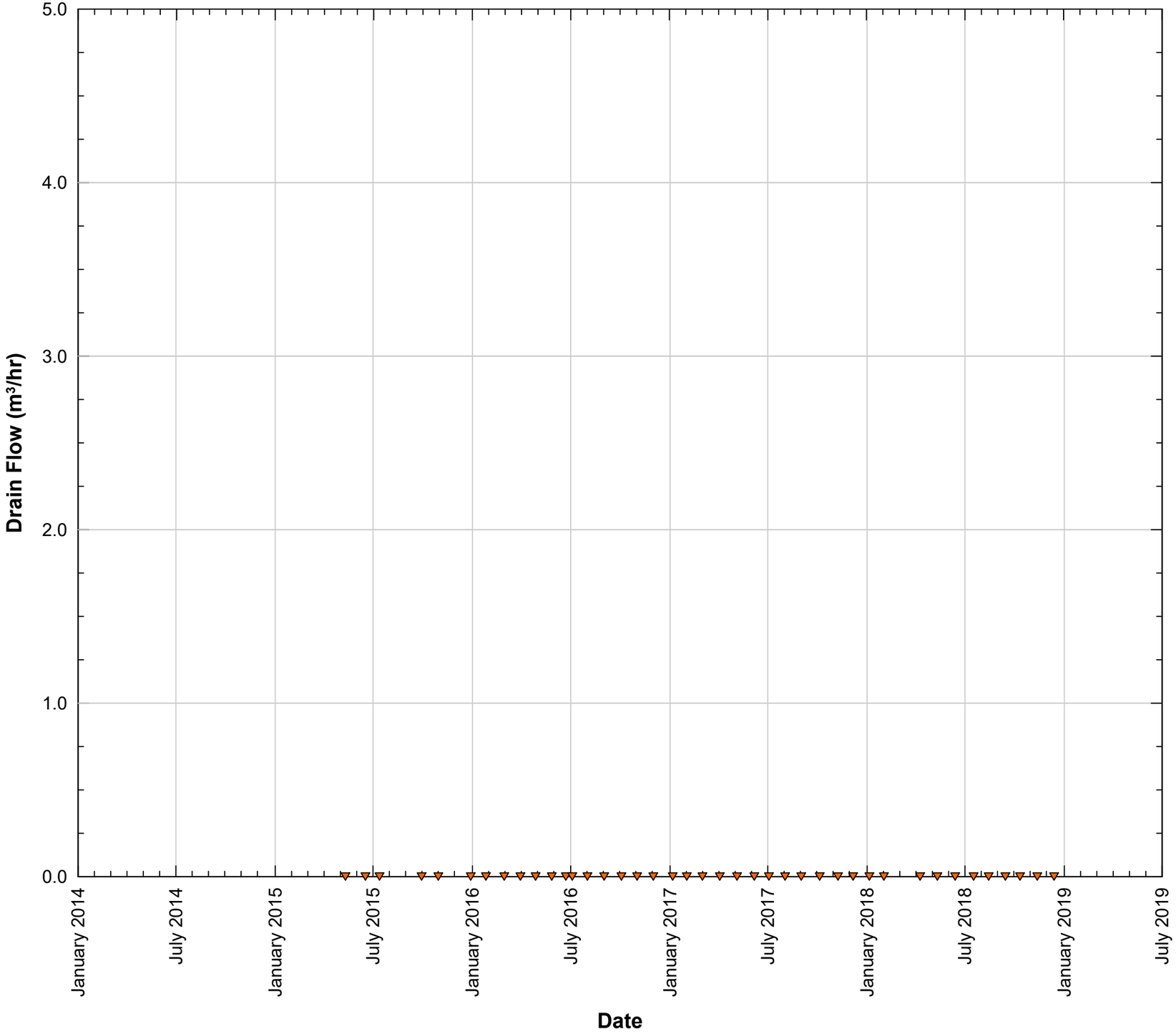


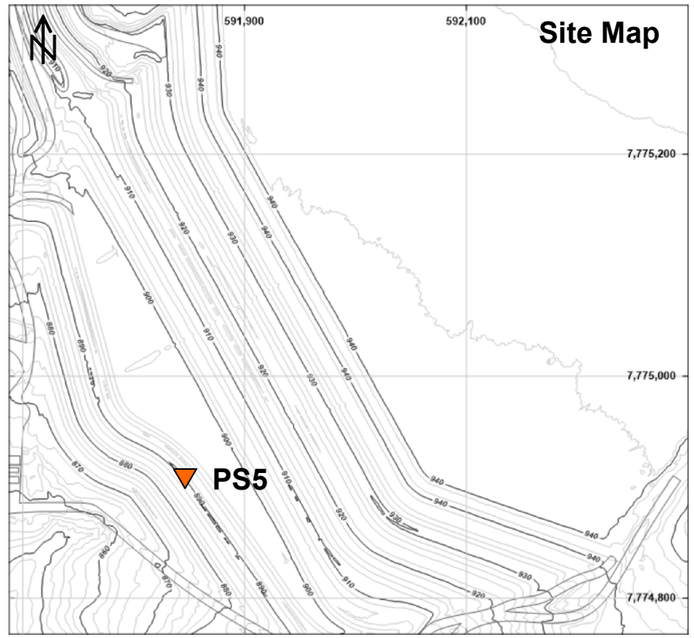


PS4A			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS4A

FIGURE 7-47

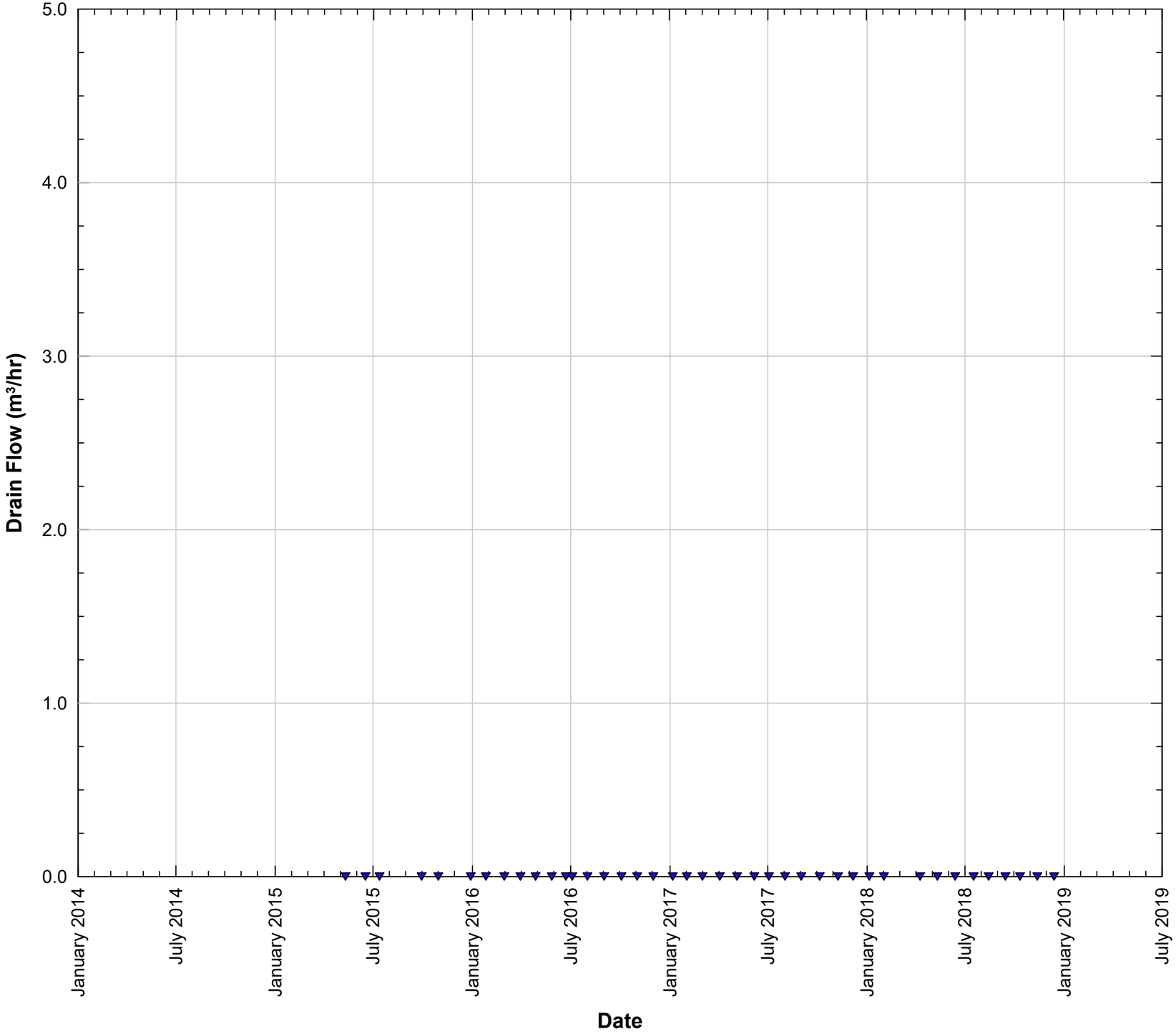


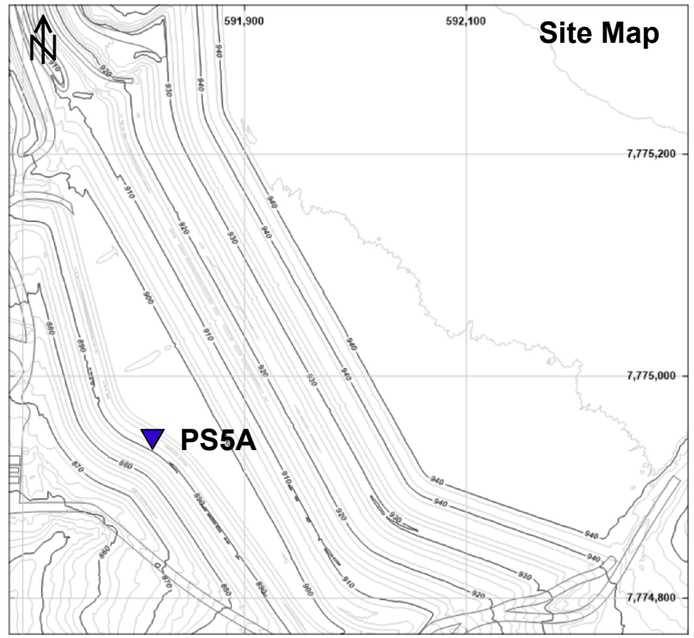


PS5			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS5

FIGURE 7-48

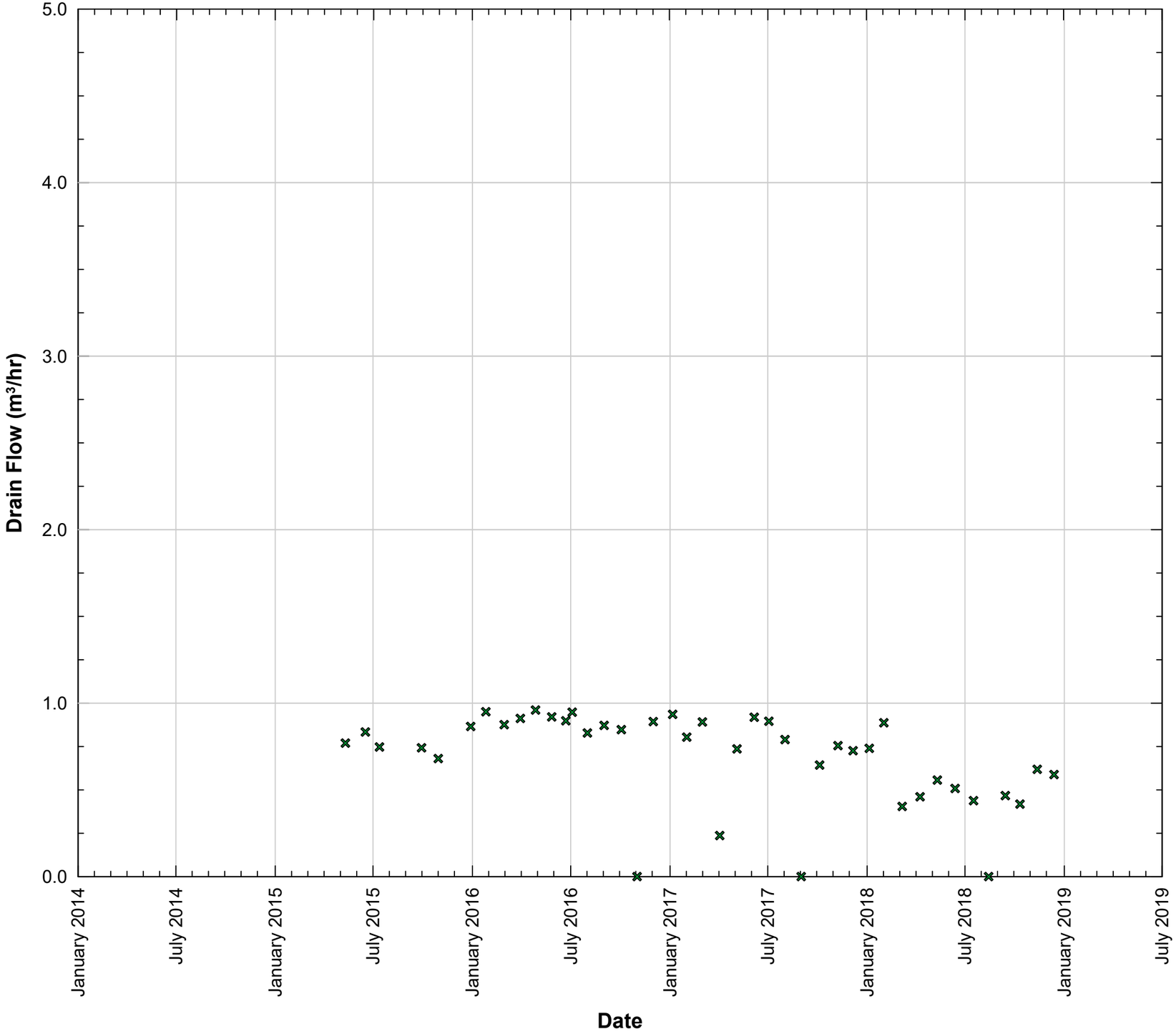


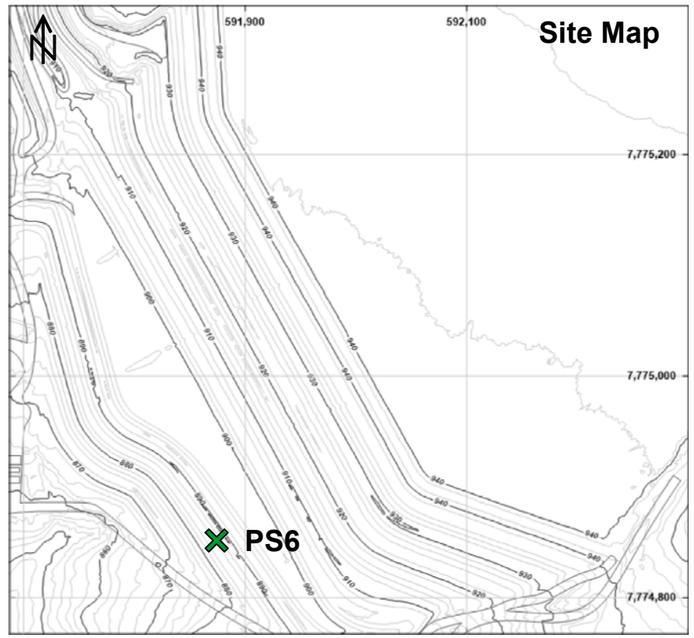


PS5A			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS5A

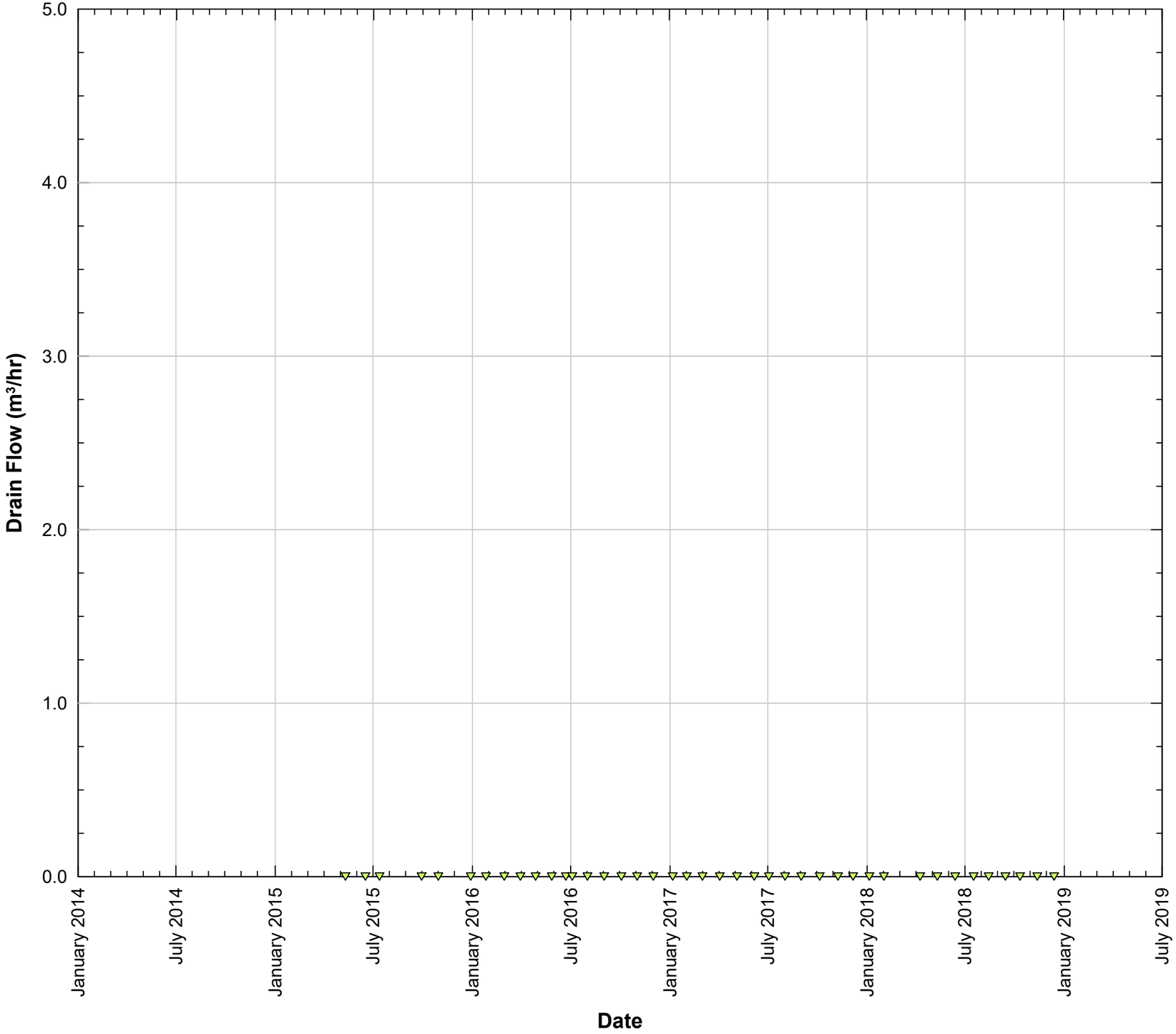
FIGURE 7-49

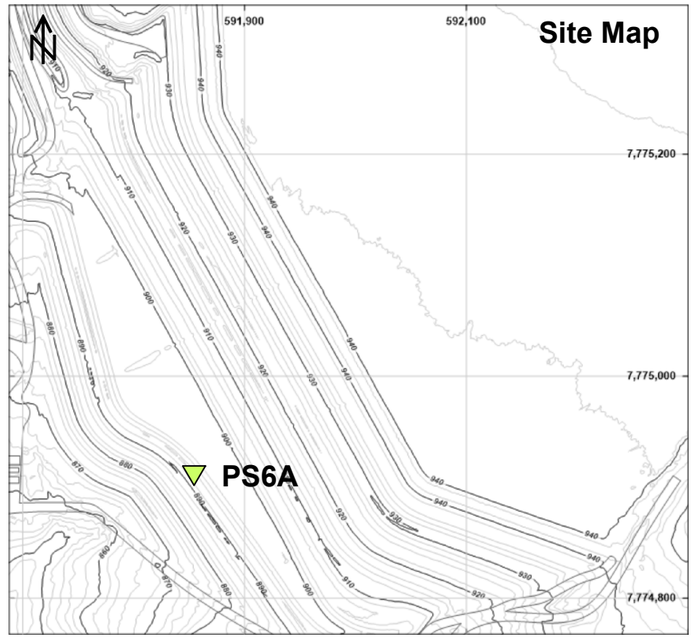




PS6			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS6
FIGURE 7-50

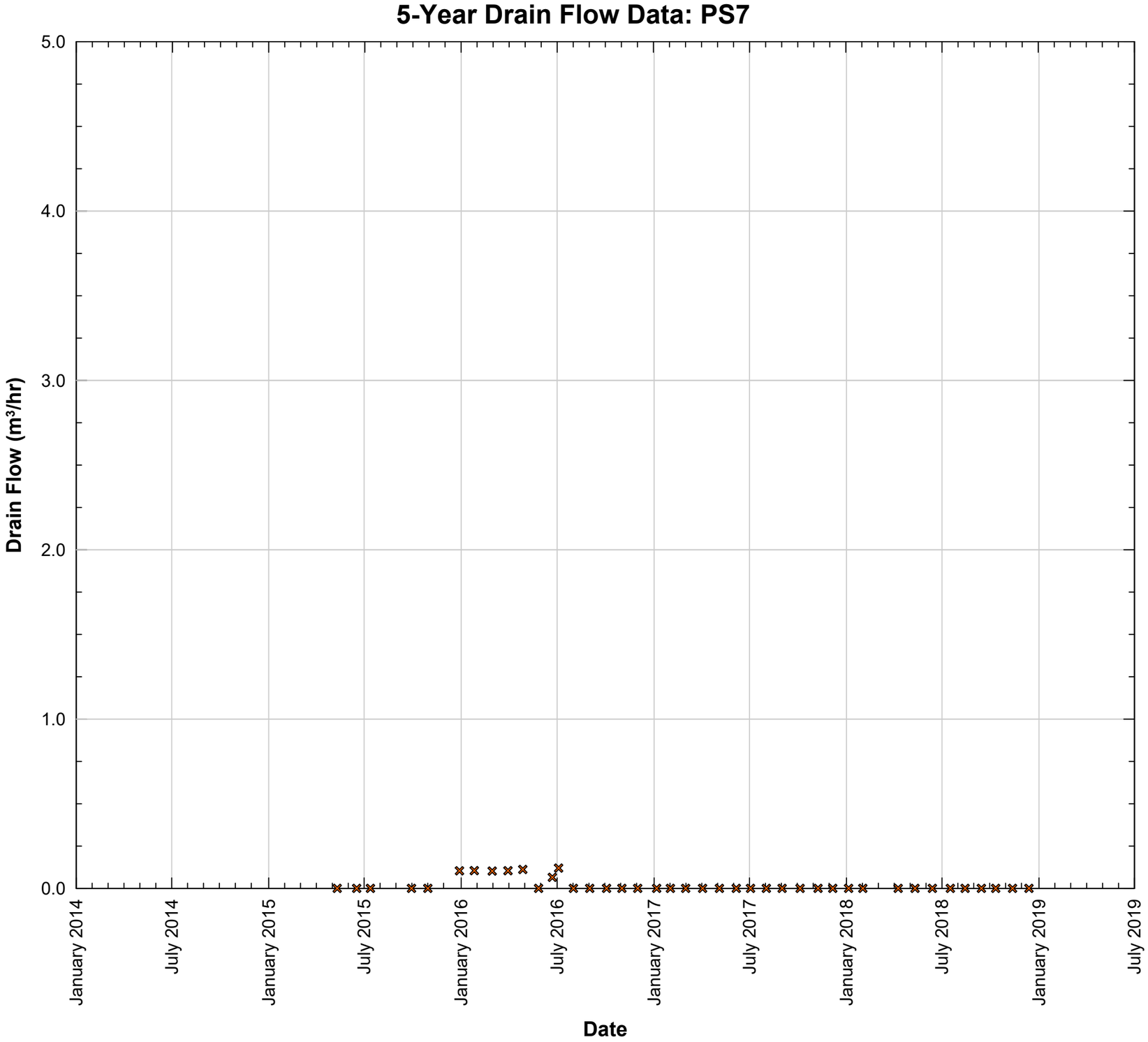


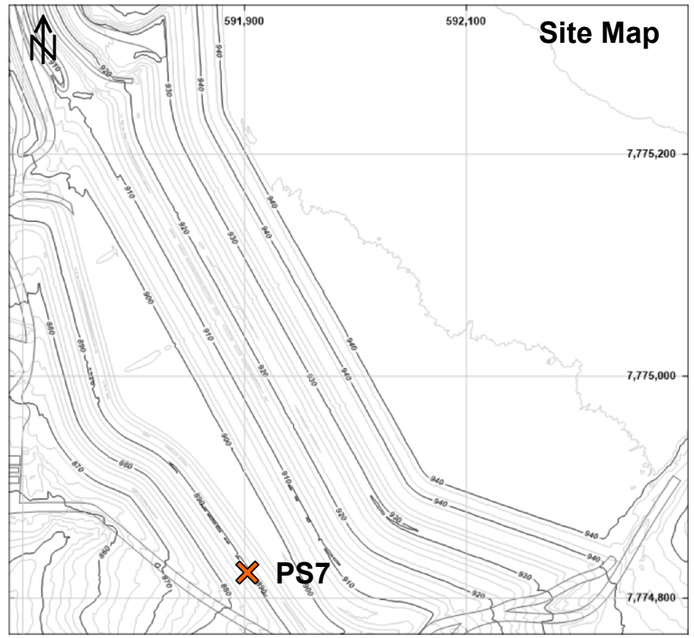


PS6A			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS6A

FIGURE 7-51

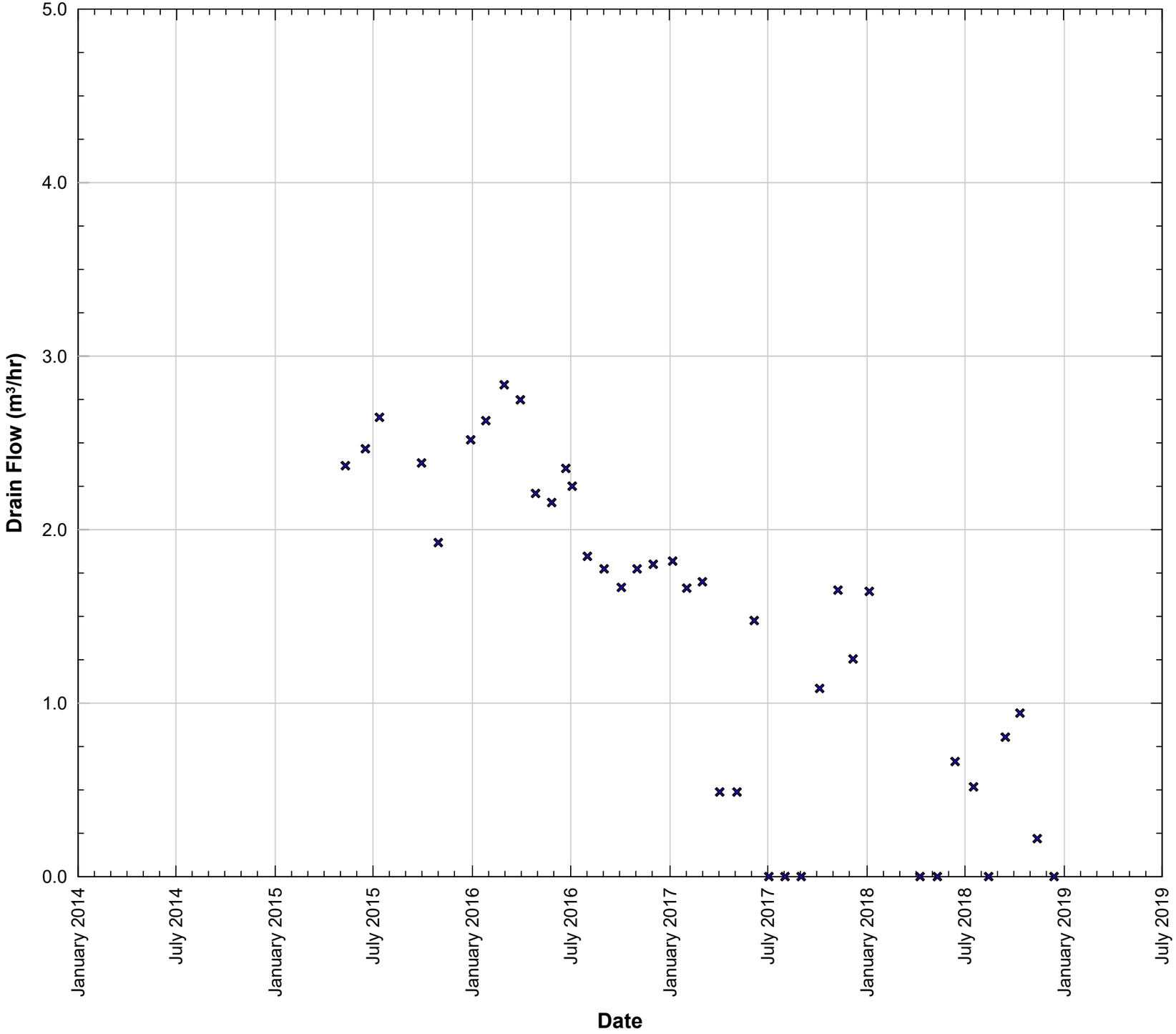


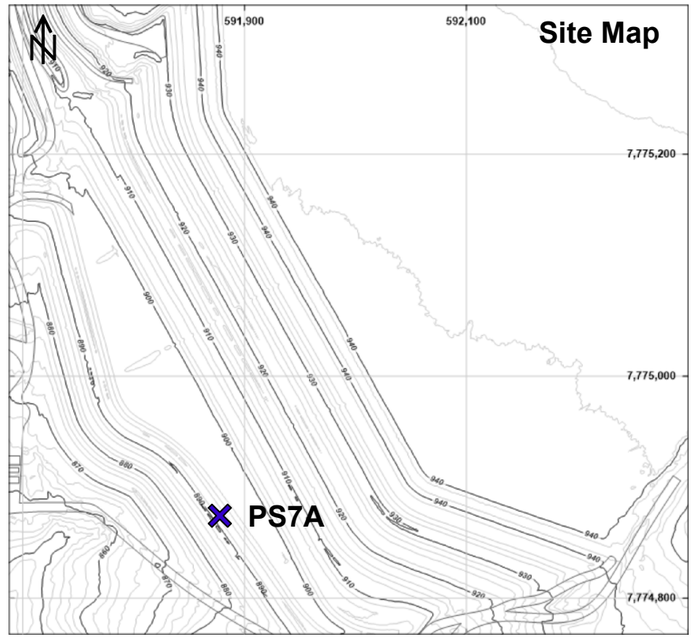


PS7			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS7

FIGURE 7-52

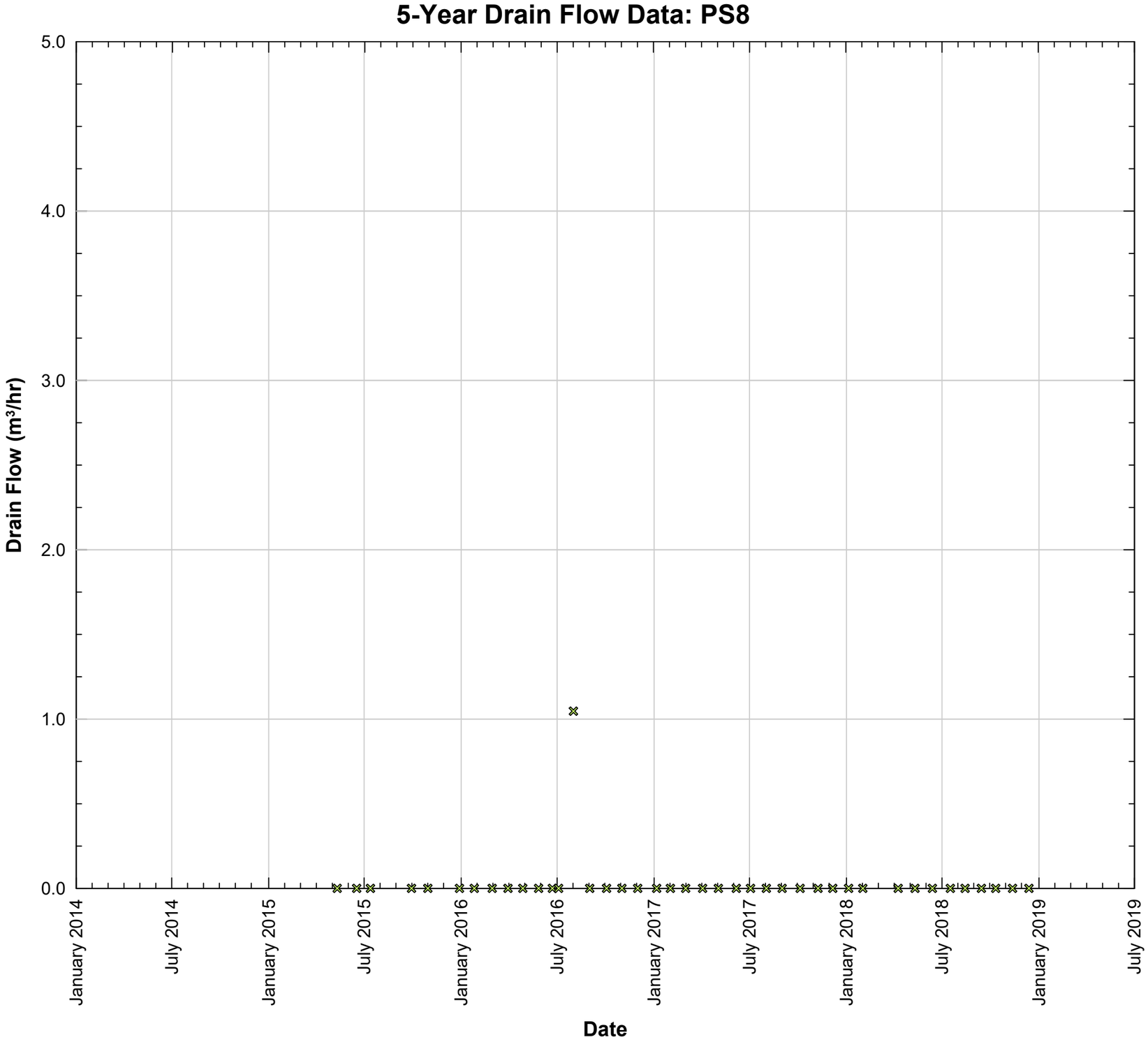


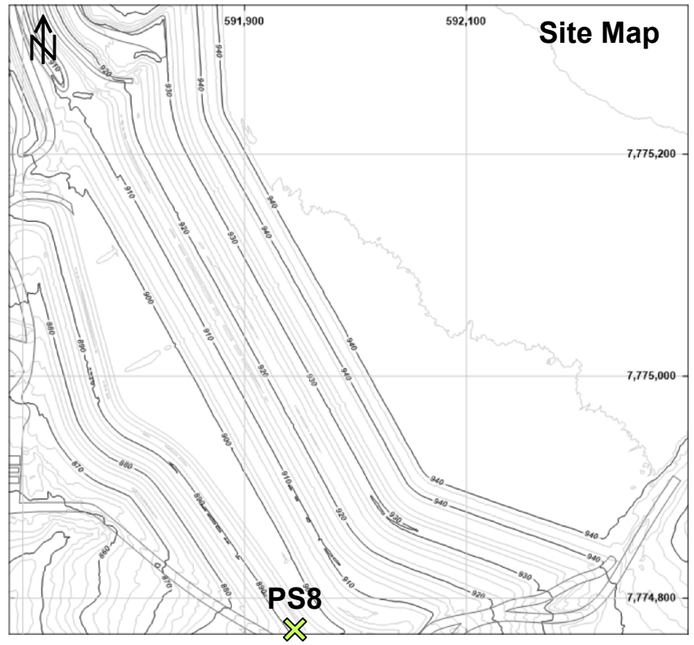


PS7A			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS7A

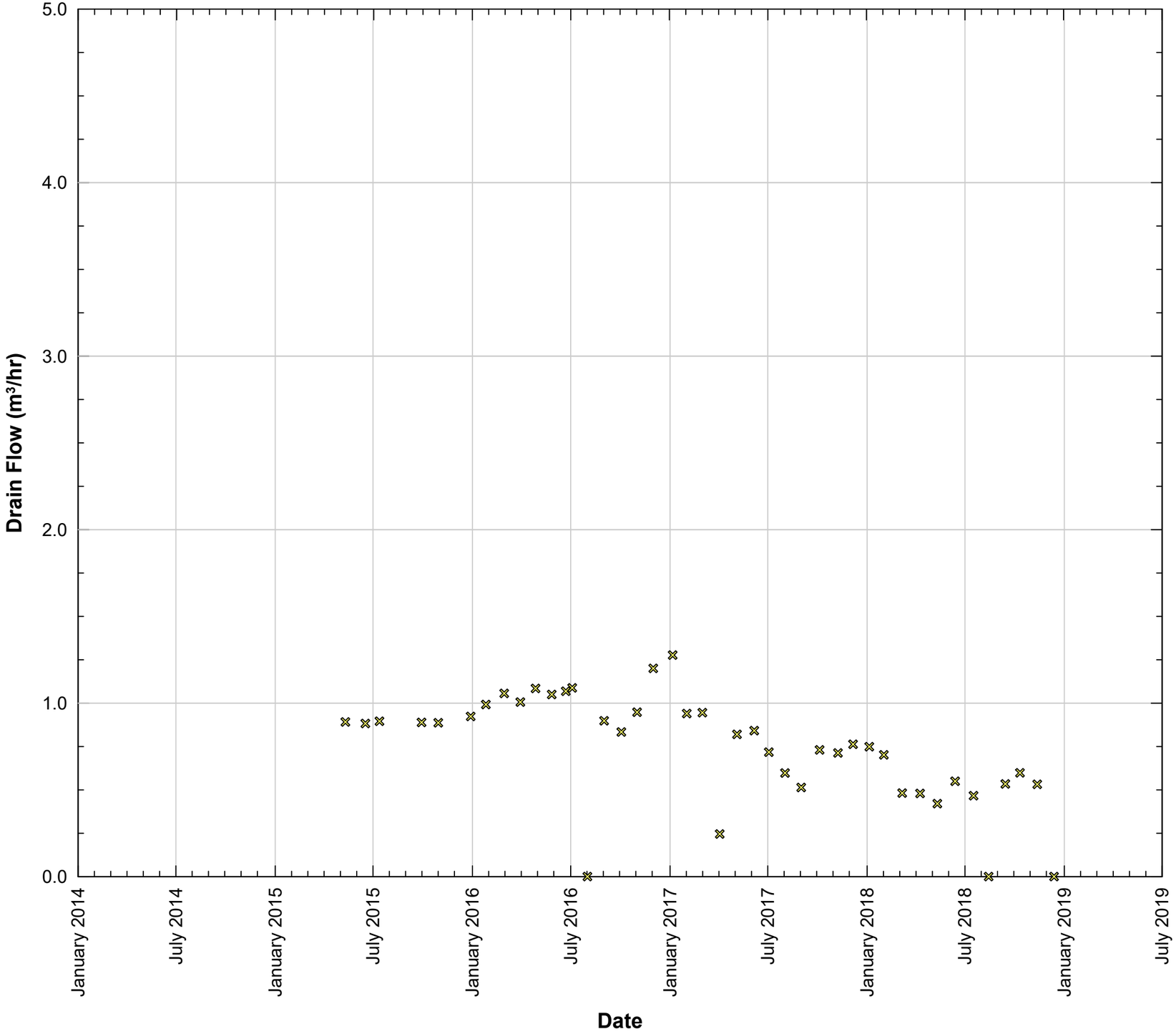
FIGURE 7-53

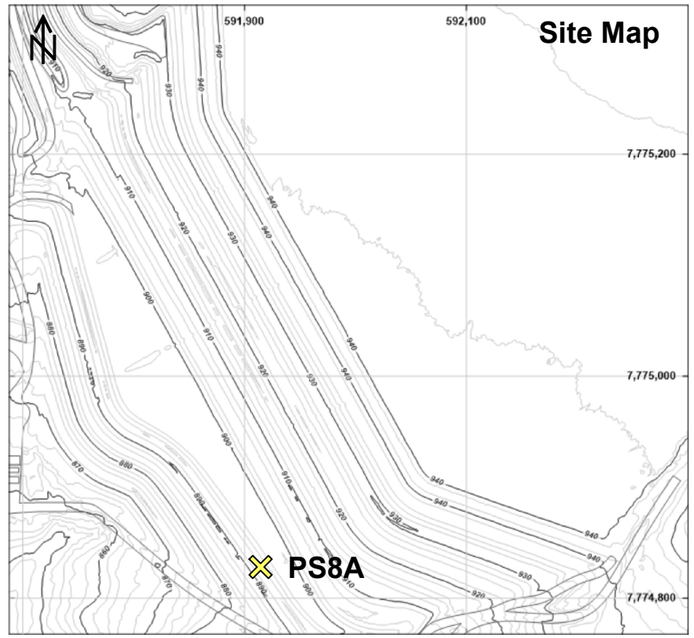




PS8			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS8
FIGURE 7-54

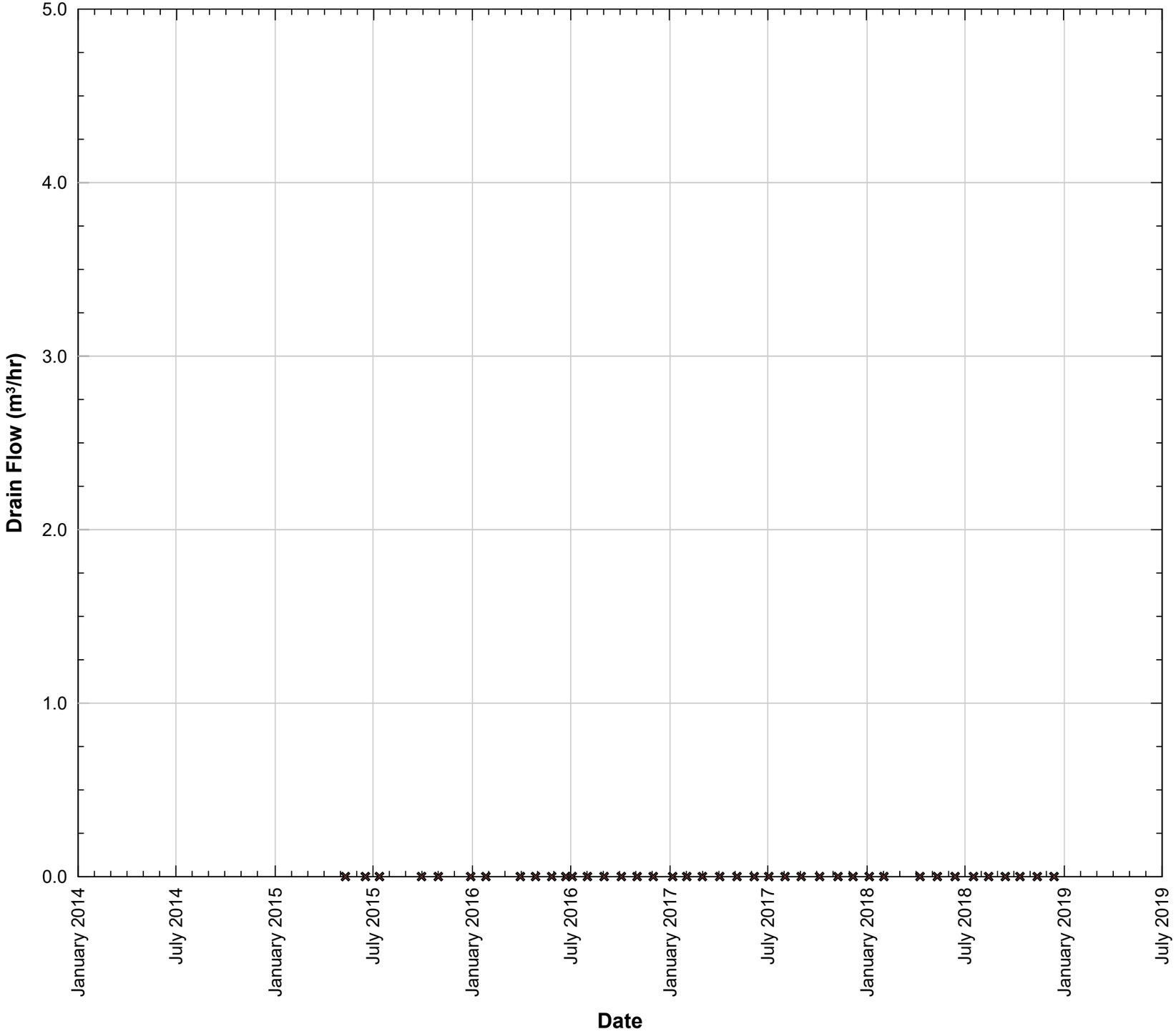


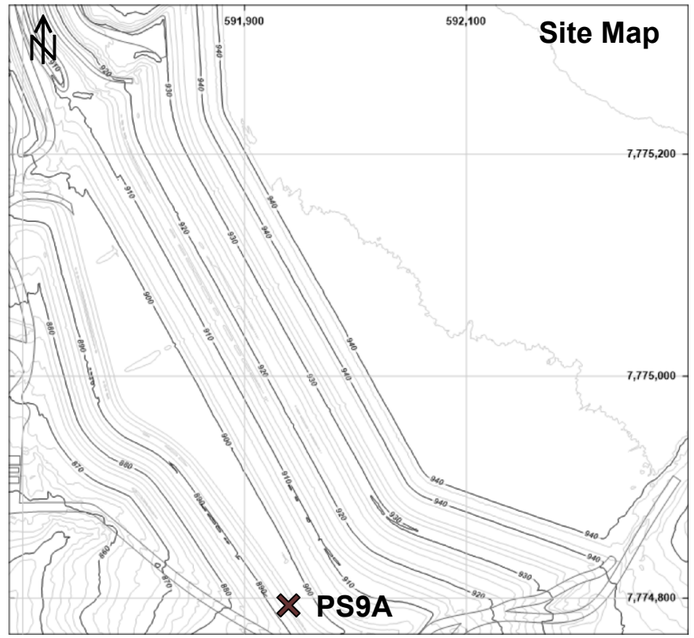


PS8A			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS8A

FIGURE 7-55

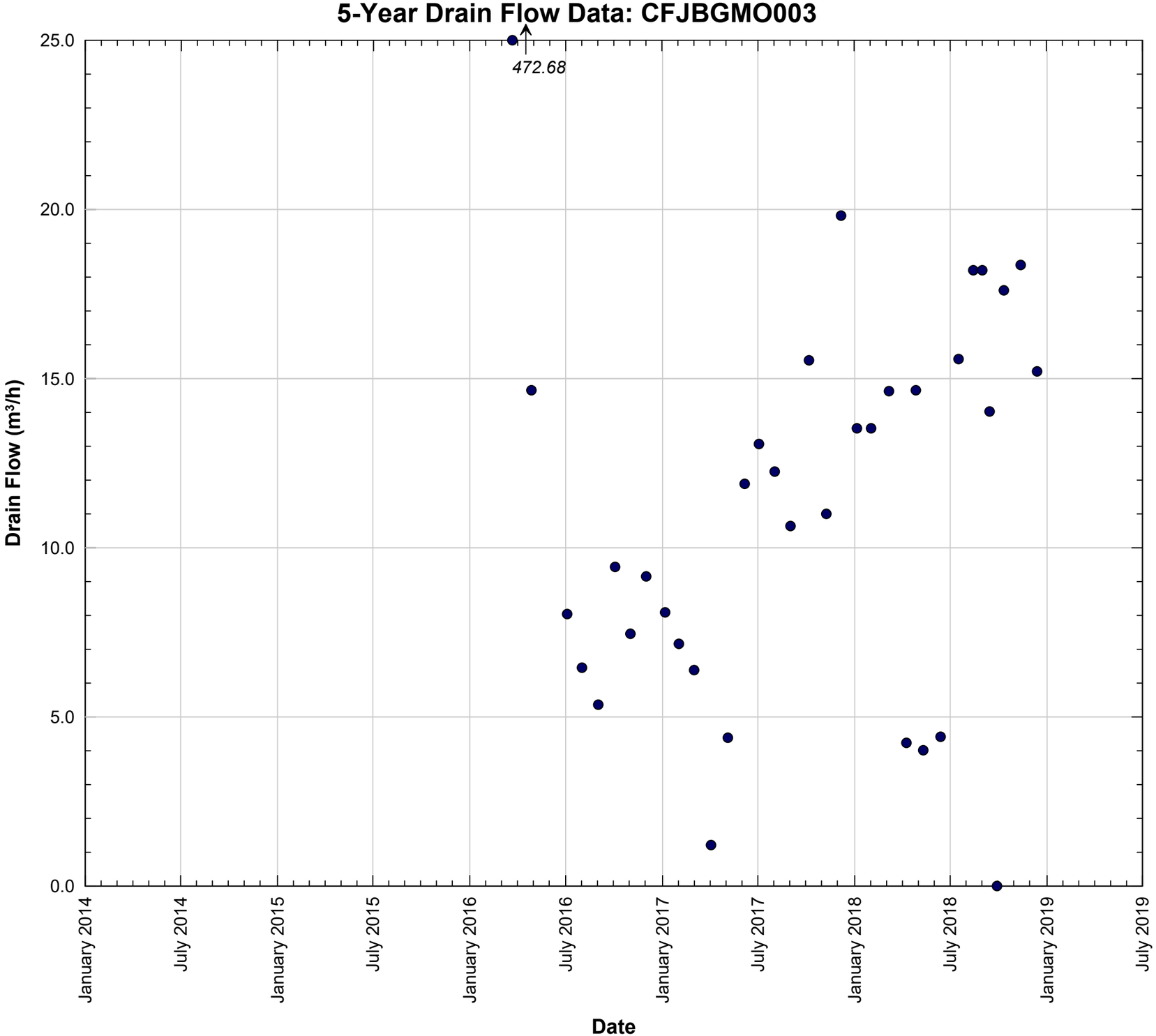


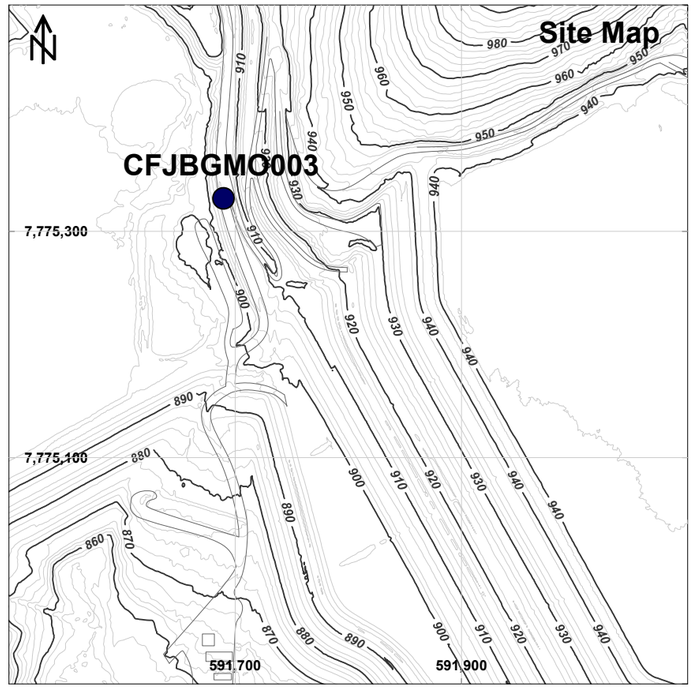


PS9A			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	4/1/1996	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: PS9A

FIGURE 7-56



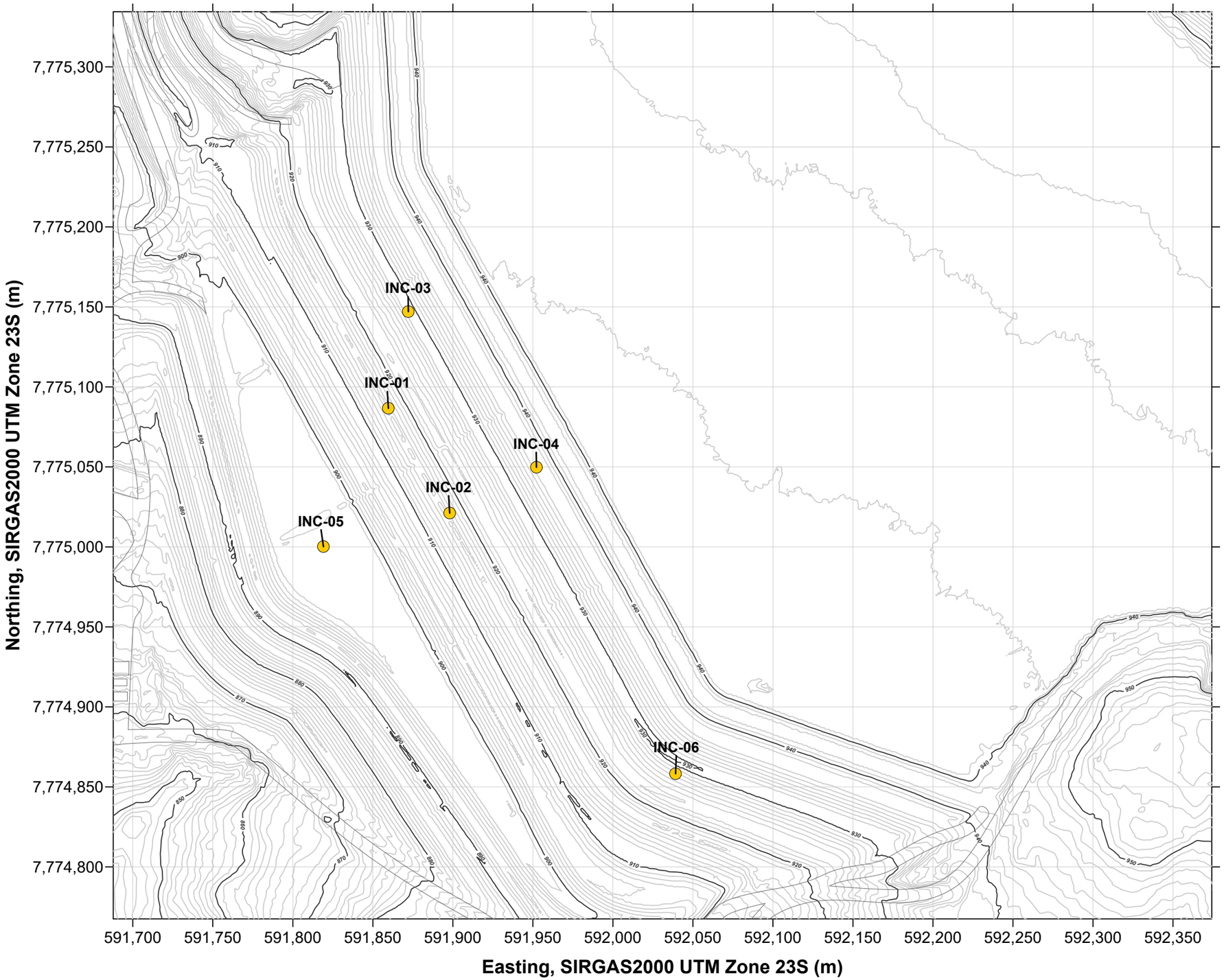


CFJBGMO003			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	1/4/2013	12/13/2018	Monthly

5-YEAR DRAIN FLOW DATA: CFJBGMO003

FIGURE 7-57

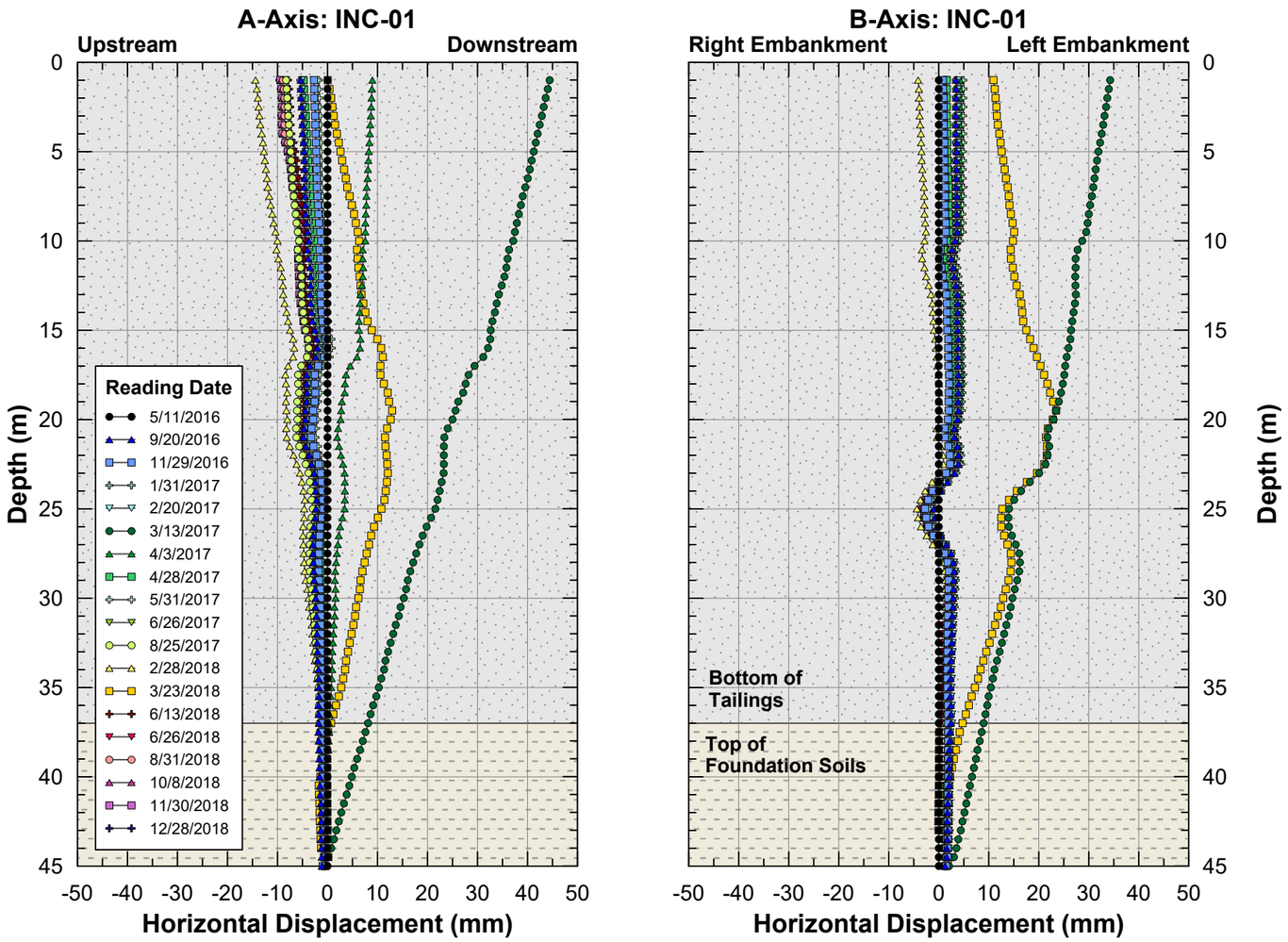
PLAN VIEW: INCLINOMETERS

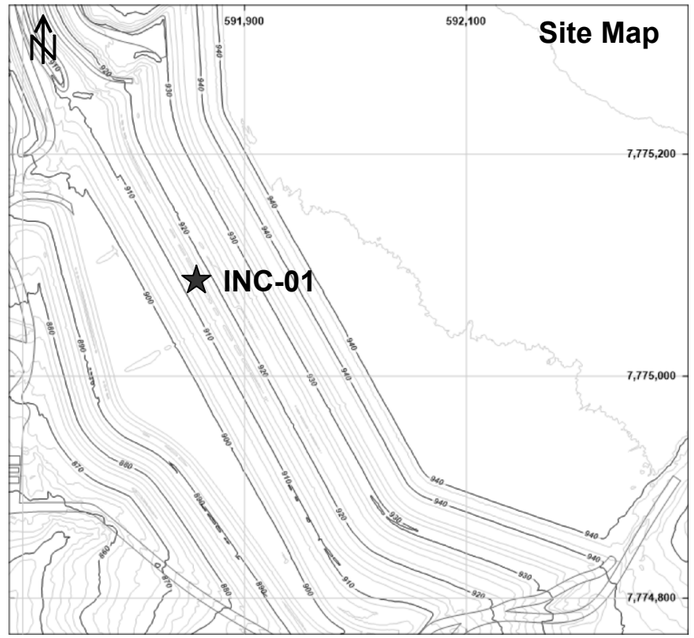


Note:
1. Horizontal datum is SIRGAS2000 UTM Zone 23S in meters, Vertical datum is Mean Sea Level in meters.

PLAN VIEW: INCLINOMETERS
FIGURE 8-1

VARIATION OF HORIZONTAL DISPLACEMENT WITH DEPTH: INC-01



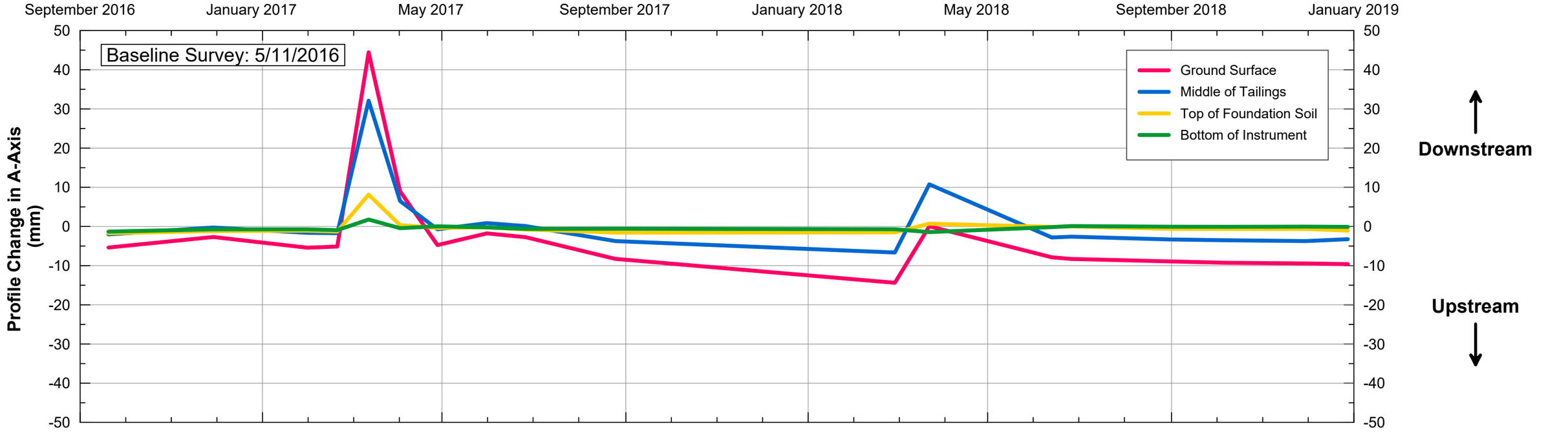


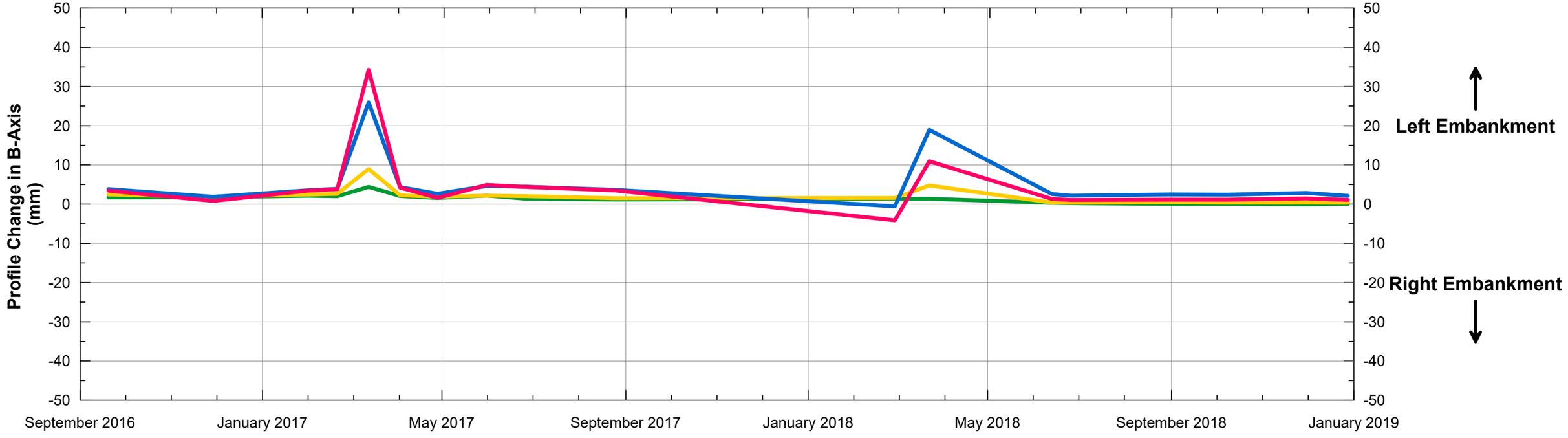
INC-01			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	5/11/2016	12/28/2018	Monthly

Note:
1. Baseline survey: 5/11/2016.

VARIATION OF HORIZONTAL DISPLACEMENT WITH DEPTH: INC-01
FIGURE 8-2

SLOPE INCLINOMETER DATA HISTORY (HORIZONTAL DISPLACEMENT): INC-01

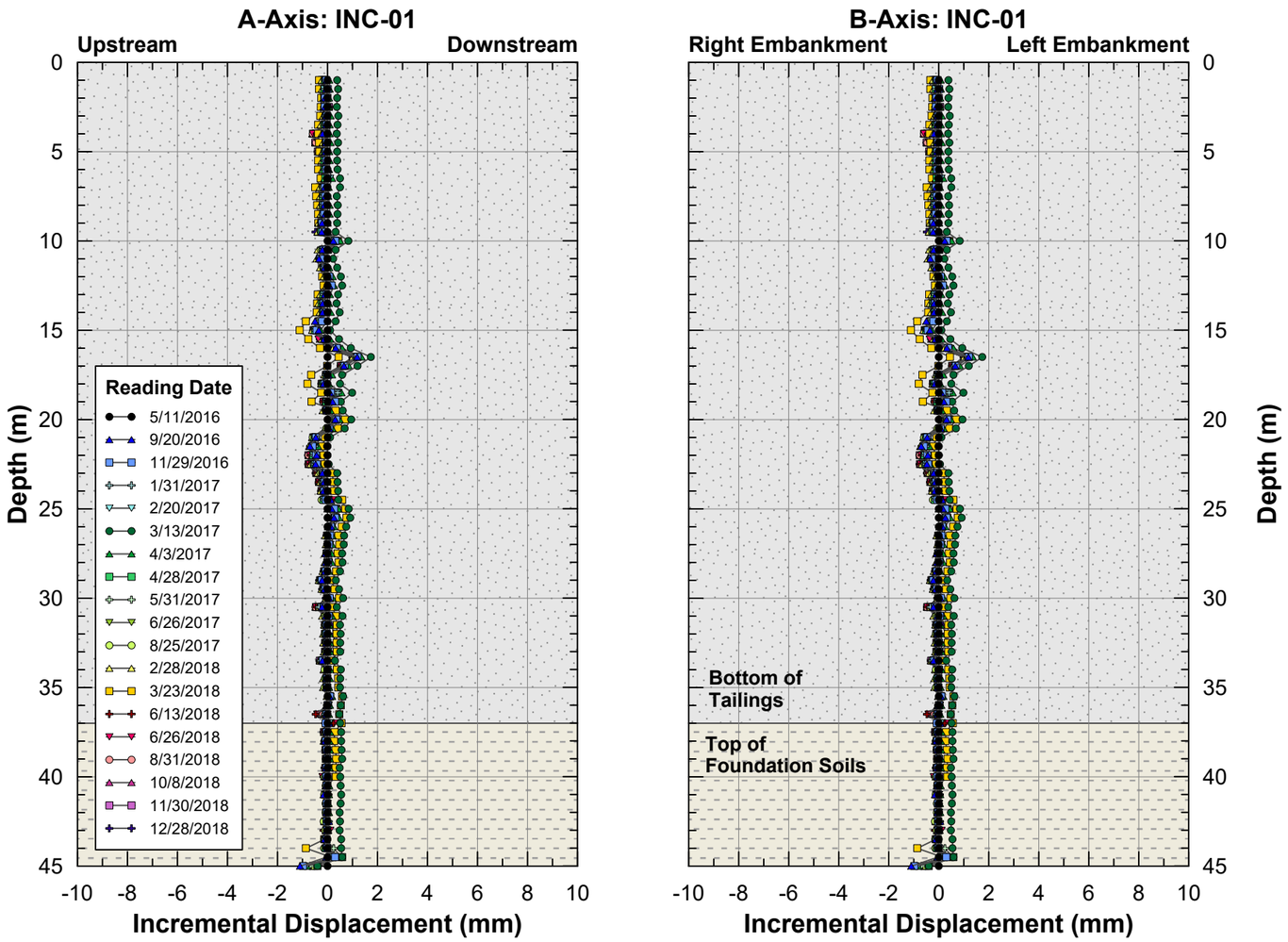


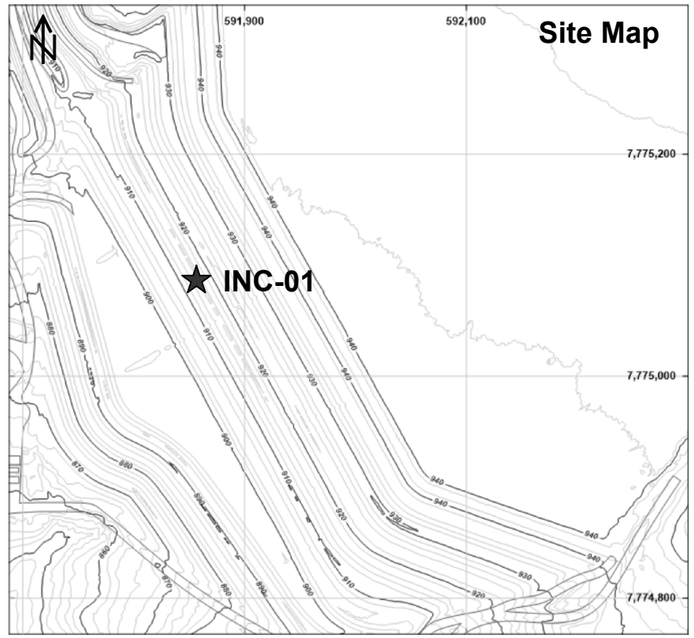


SLOPE INCLINOMETER DATA HISTORY (HORIZONTAL DISPLACEMENT): INC-01

FIGURE 8-3

VARIATION OF INCREMENTAL DISPLACEMENT WITH DEPTH: INC-01



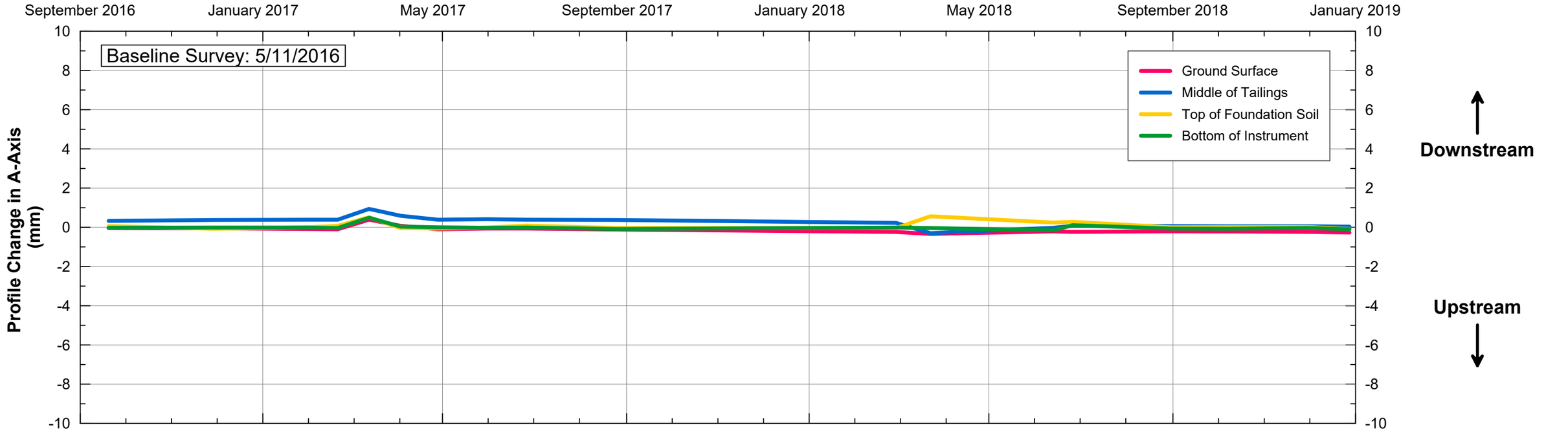


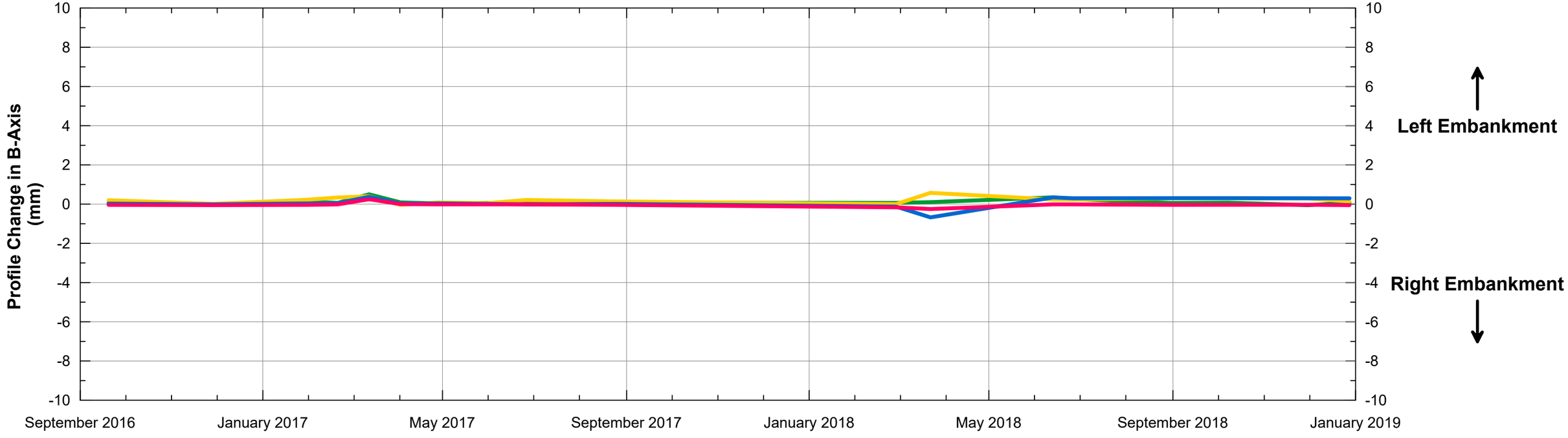
INC-01			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	5/11/2016	12/28/2018	Monthly

Note:
1. Baseline survey: 5/11/2016.

VARIATION OF INCREMENTAL DISPLACEMENT WITH DEPTH: INC-01
FIGURE 8-4

SLOPE INCLINOMETER DATA HISTORY (INCREMENTAL DISPLACEMENT): INC-01

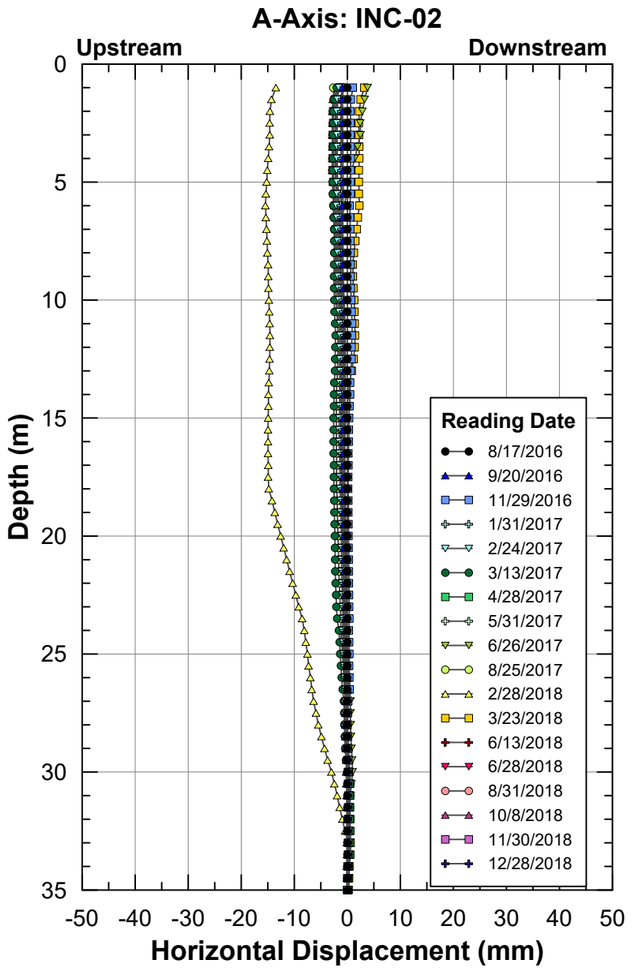


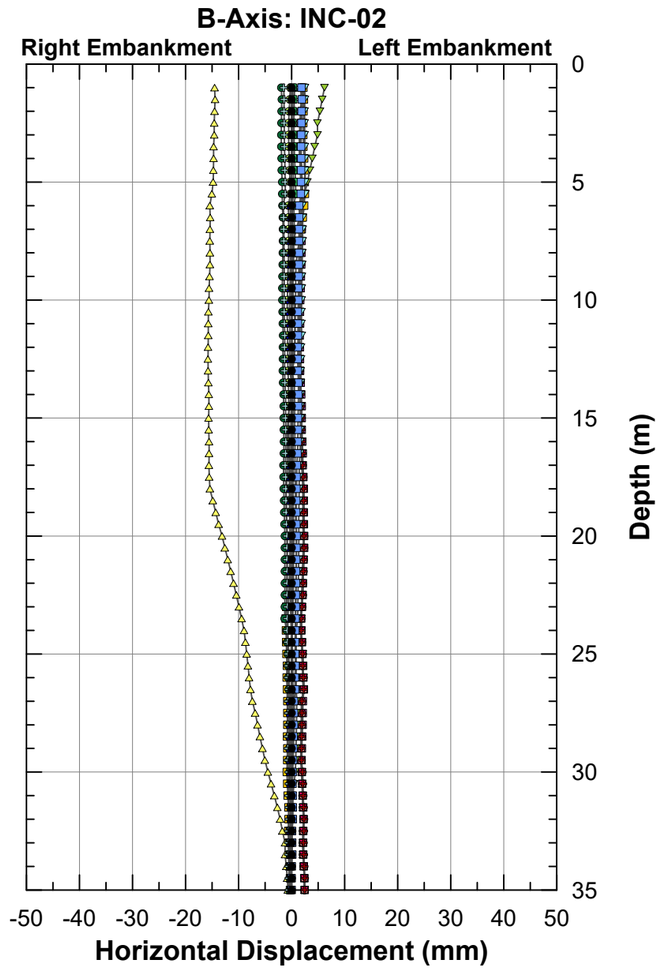


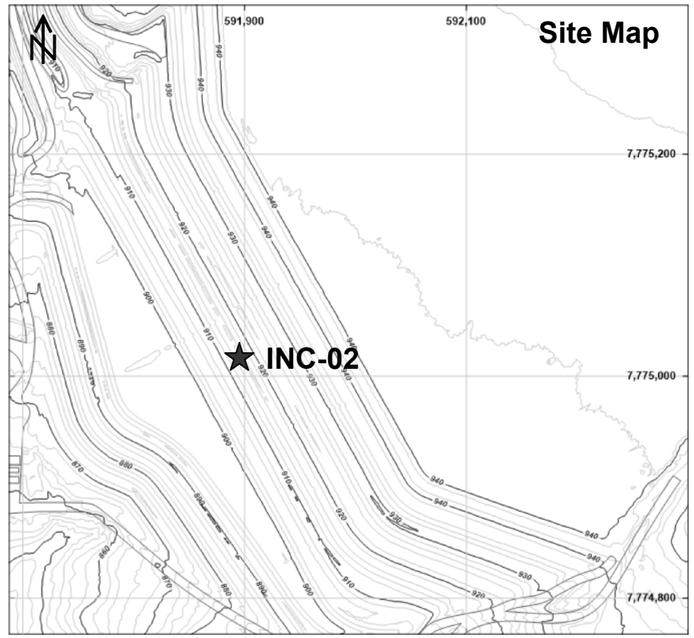
SLOPE INCLINOMETER DATA HISTORY (INCREMENTAL DISPLACEMENT): INC-01

FIGURE 8-5

VARIATION OF HORIZONTAL DISPLACEMENT WITH DEPTH: INC-02





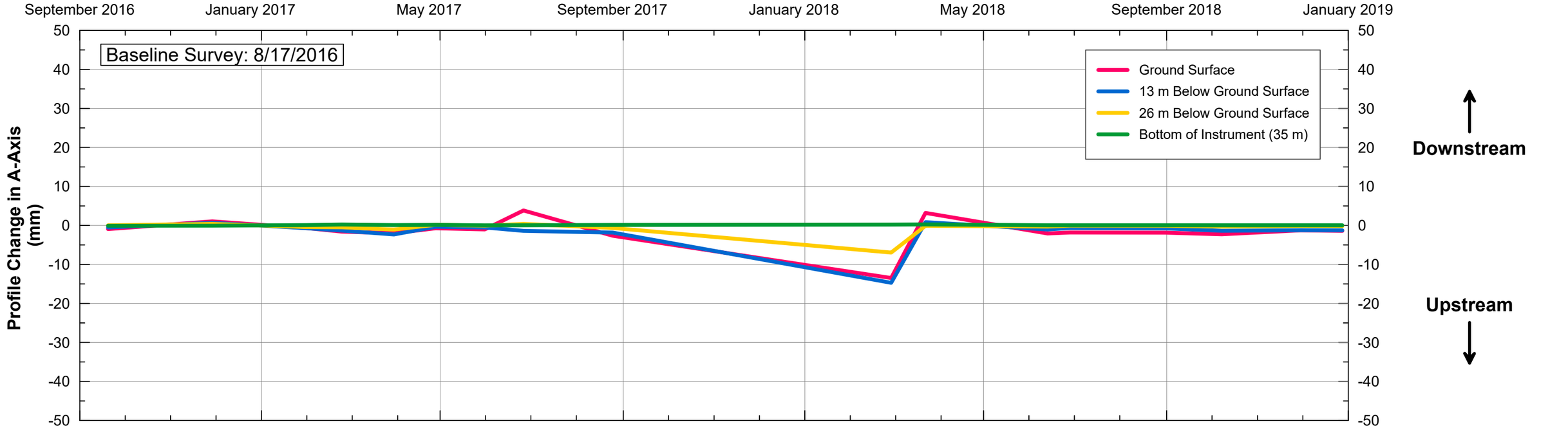


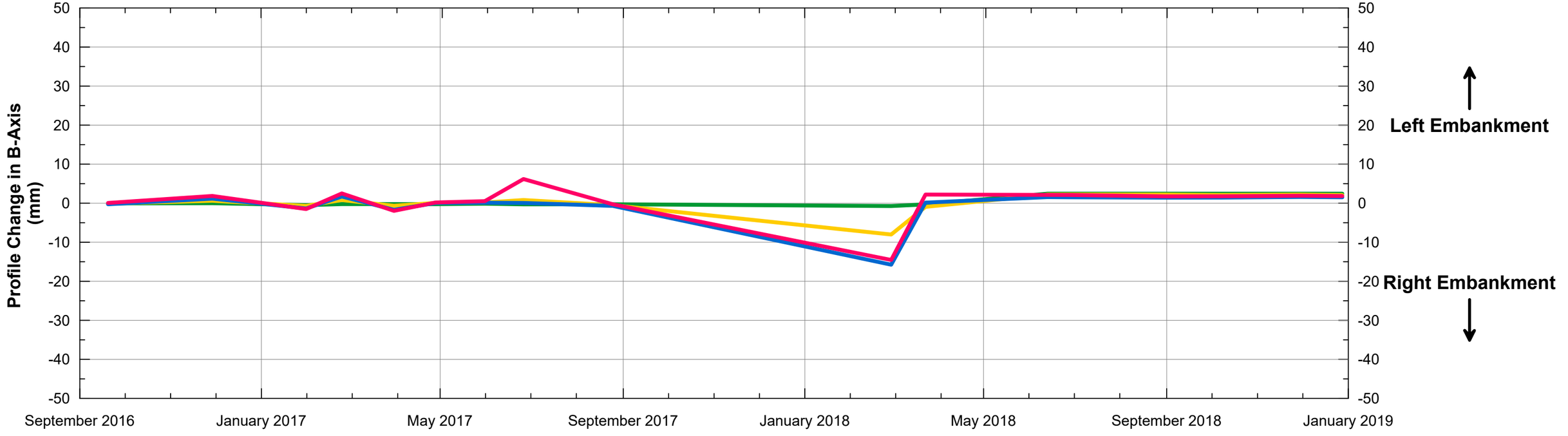
INC-02			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	8/17/2016	12/28/2018	Monthly

Notes:
1. Baseline survey: 8/17/2016.
2. No stratigraphic information was available for INC-02.

VARIATION OF HORIZONTAL DISPLACEMENT WITH DEPTH: INC-02
FIGURE 8-6

SLOPE INCLINOMETER DATA HISTORY (HORIZONTAL DISPLACEMENT): INC-02

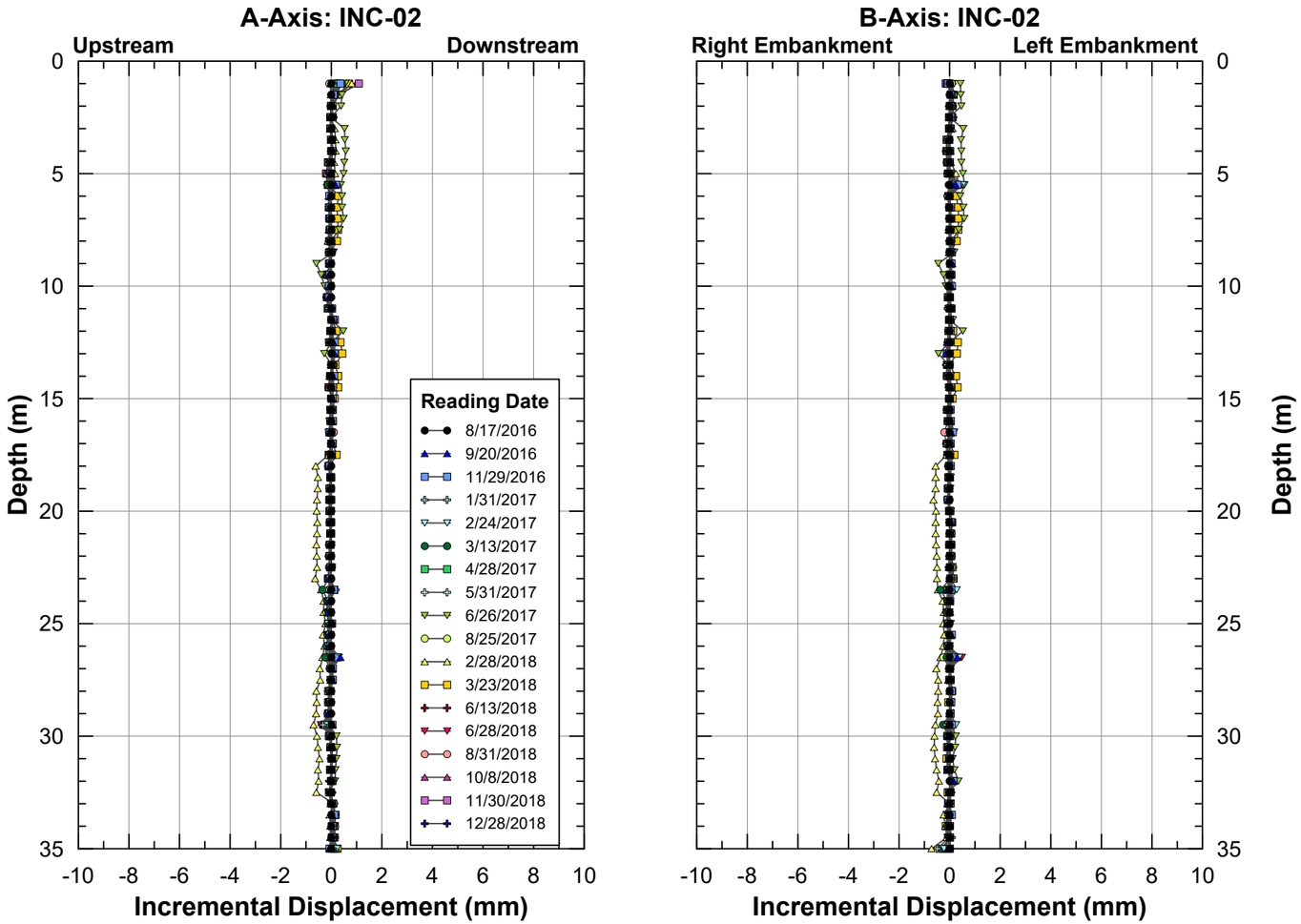


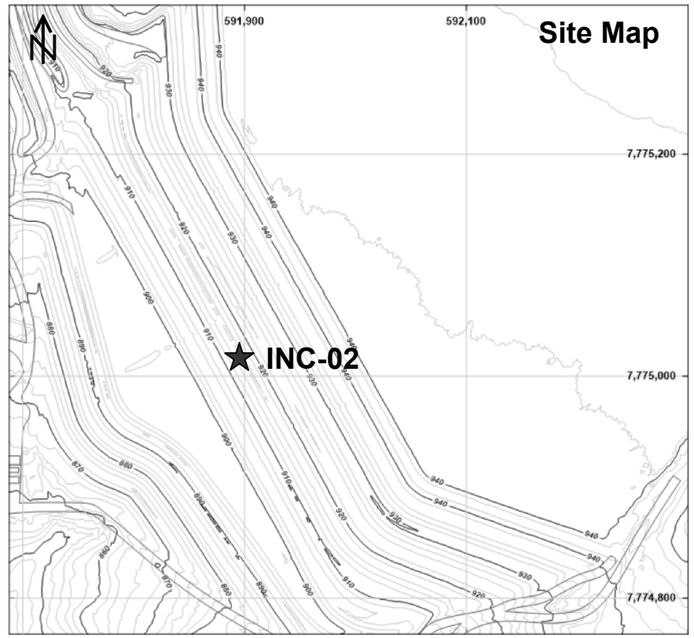


SLOPE INCLINOMETER DATA HISTORY (HORIZONTAL DISPLACEMENT): INC-02

FIGURE 8-7

VARIATION OF INCREMENTAL DISPLACEMENT WITH DEPTH: INC-02



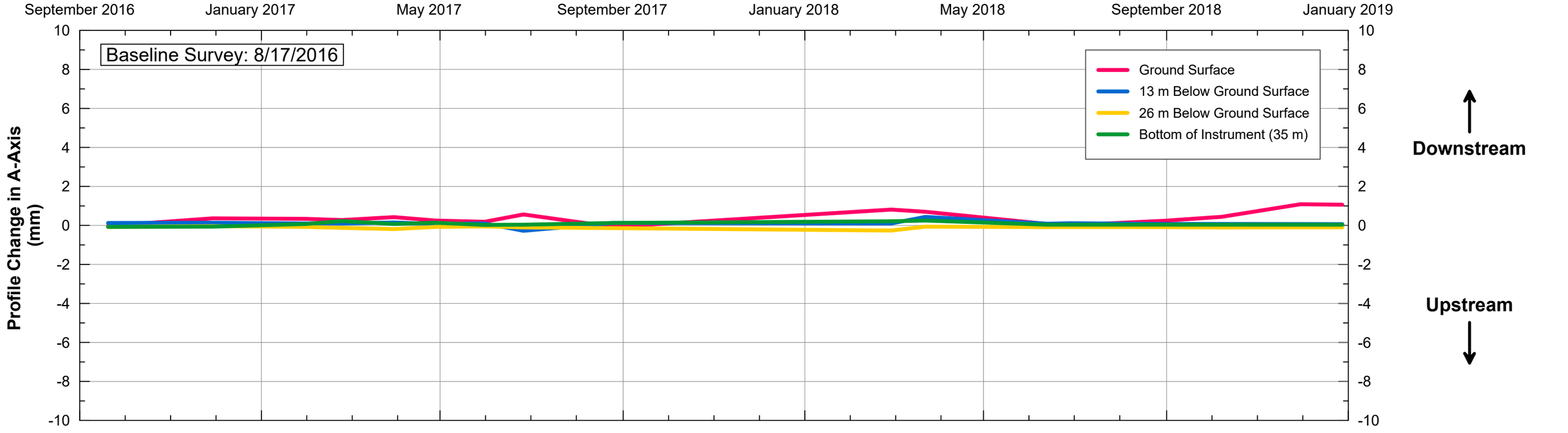


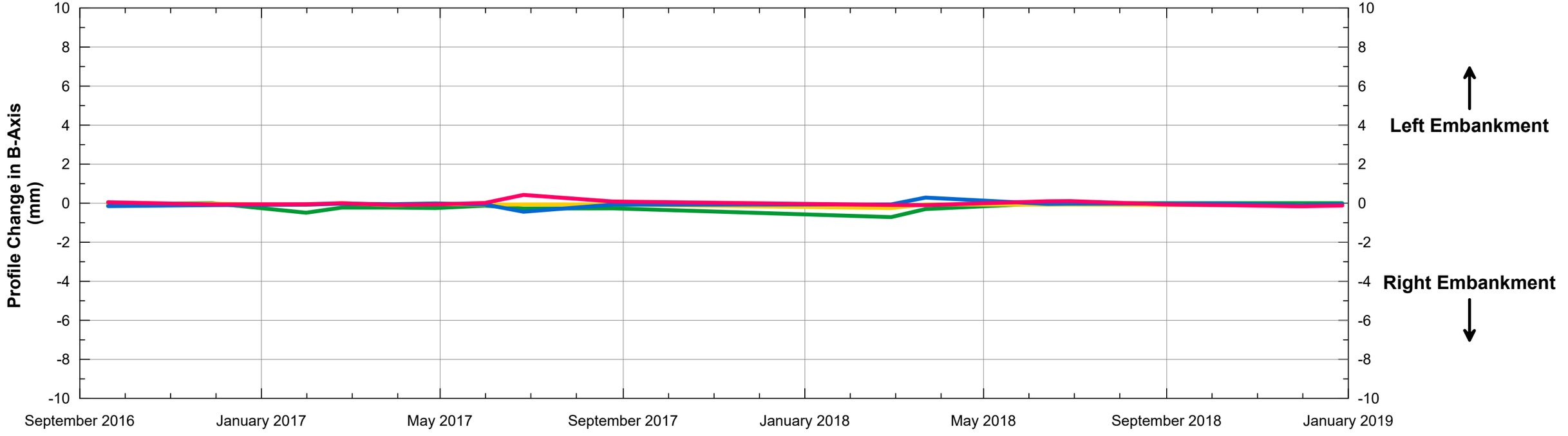
INC-02			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	8/17/2016	12/28/2018	Monthly

Notes:
1. Baseline survey: 8/17/2016.
2. No stratigraphic information was available for INC-02.

VARIATION OF INCREMENTAL DISPLACEMENT WITH DEPTH: INC-02
FIGURE 8-8

SLOPE INCLINOMETER DATA HISTORY (INCREMENTAL DISPLACEMENT): INC-02

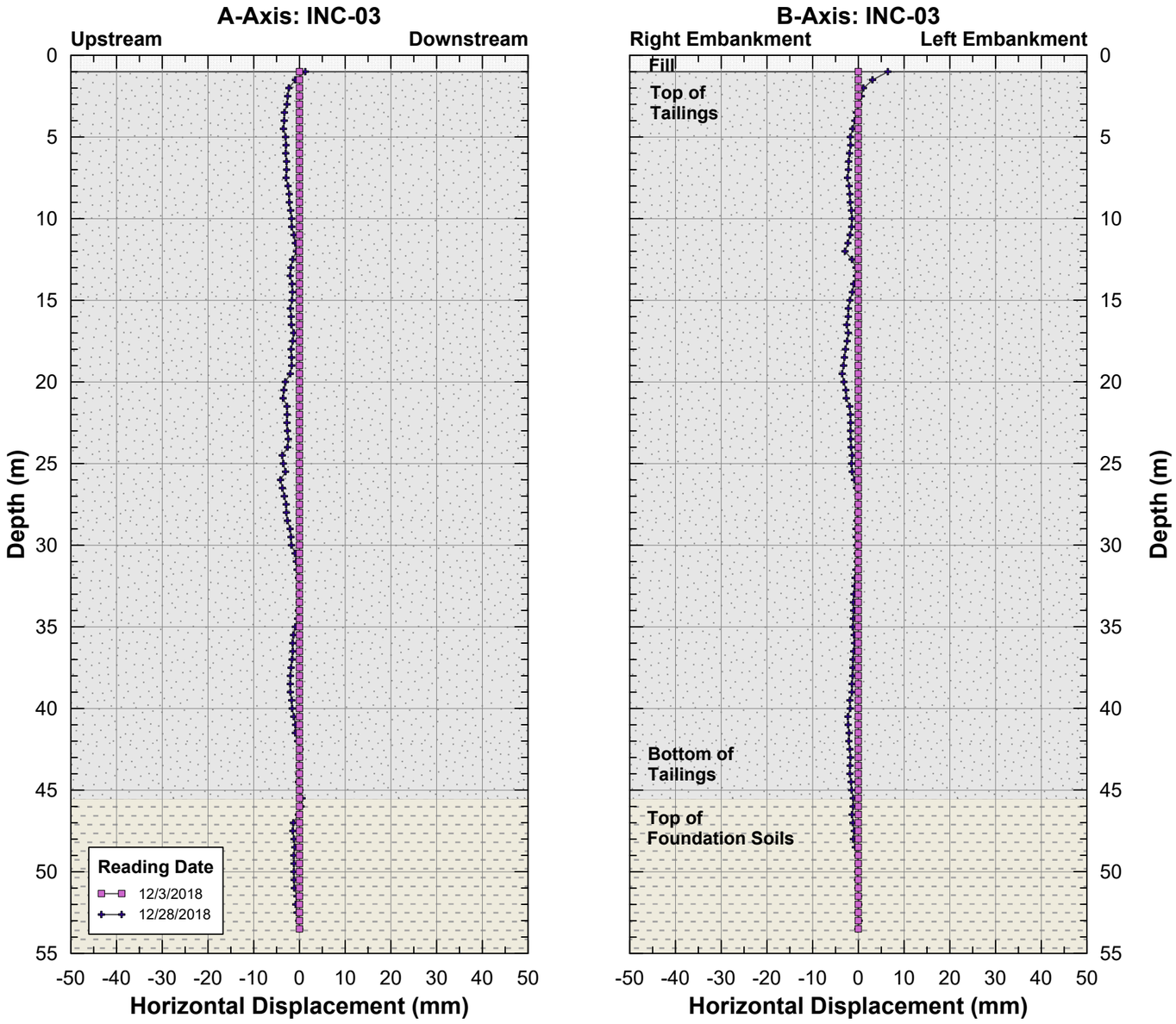


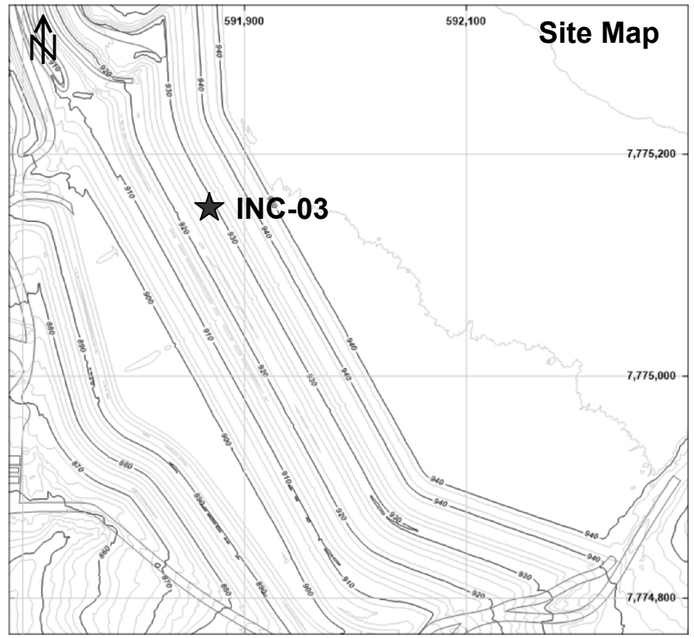


SLOPE INCLINOMETER DATA HISTORY (INCREMENTAL DISPLACEMENT): INC-02

FIGURE 8-9

VARIATION OF HORIZONTAL DISPLACEMENT WITH DEPTH: INC-03



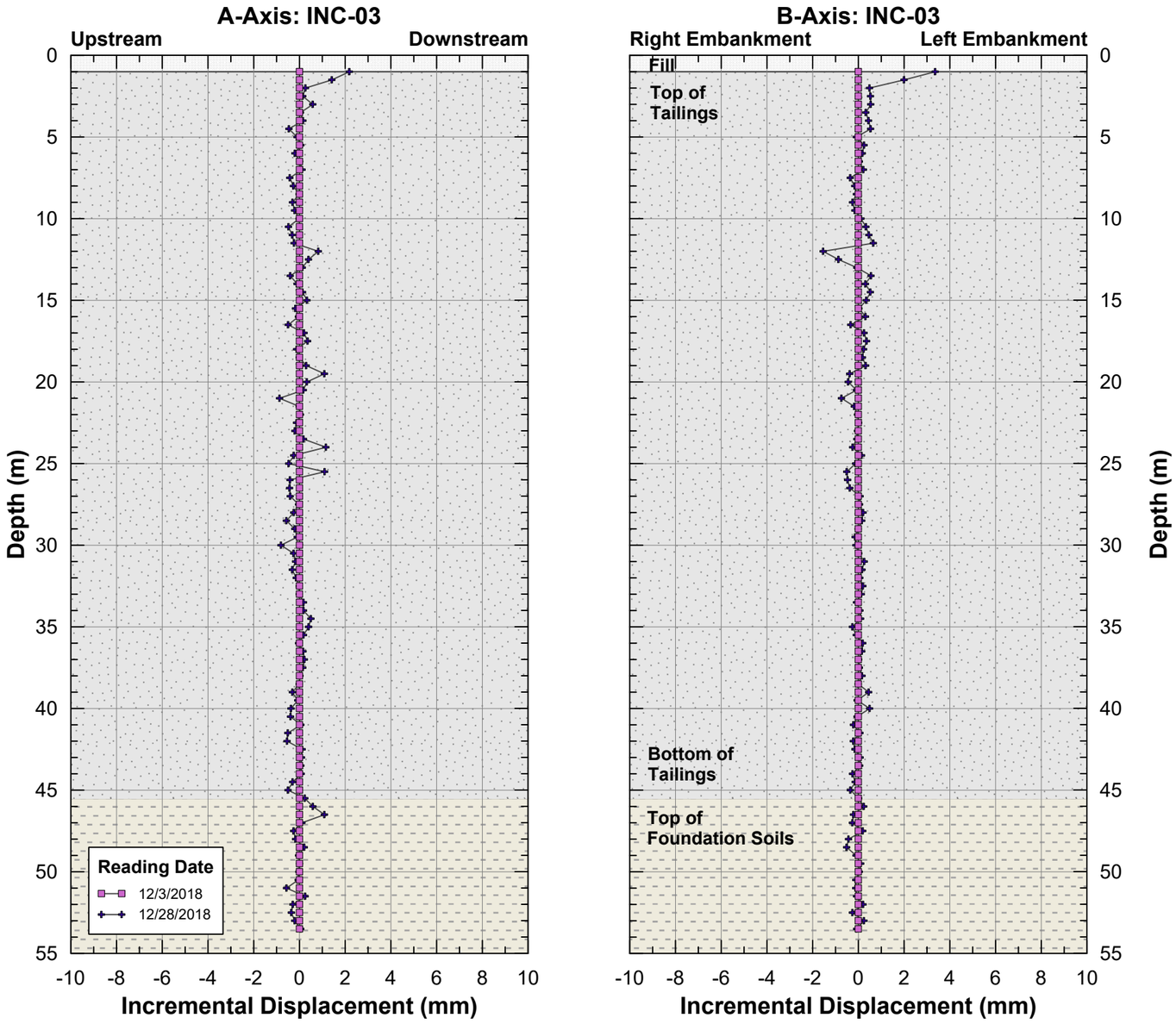


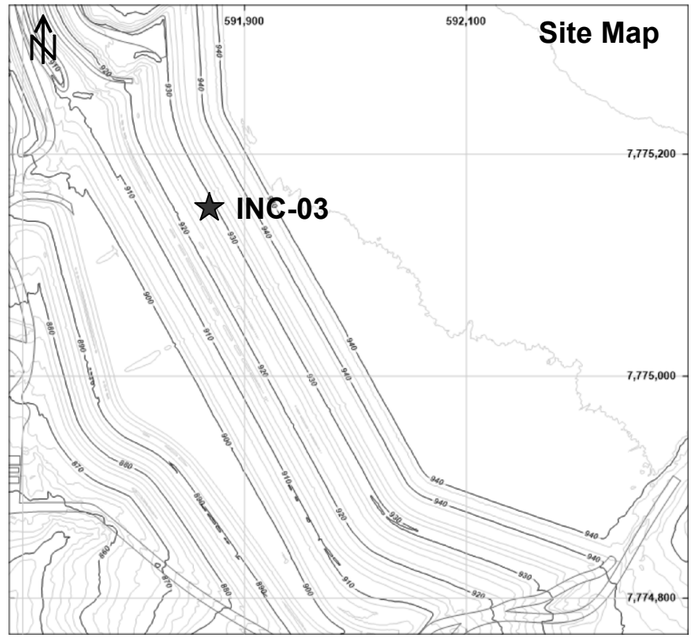
INC-03			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	12/3/2018	12/27/2018	Once

Note:
1. Baseline survey: 12/3/2018.

VARIATION OF HORIZONTAL DISPLACEMENT WITH DEPTH: INC-03
FIGURE 8-10

VARIATION OF INCREMENTAL DISPLACEMENT WITH DEPTH: INC-03



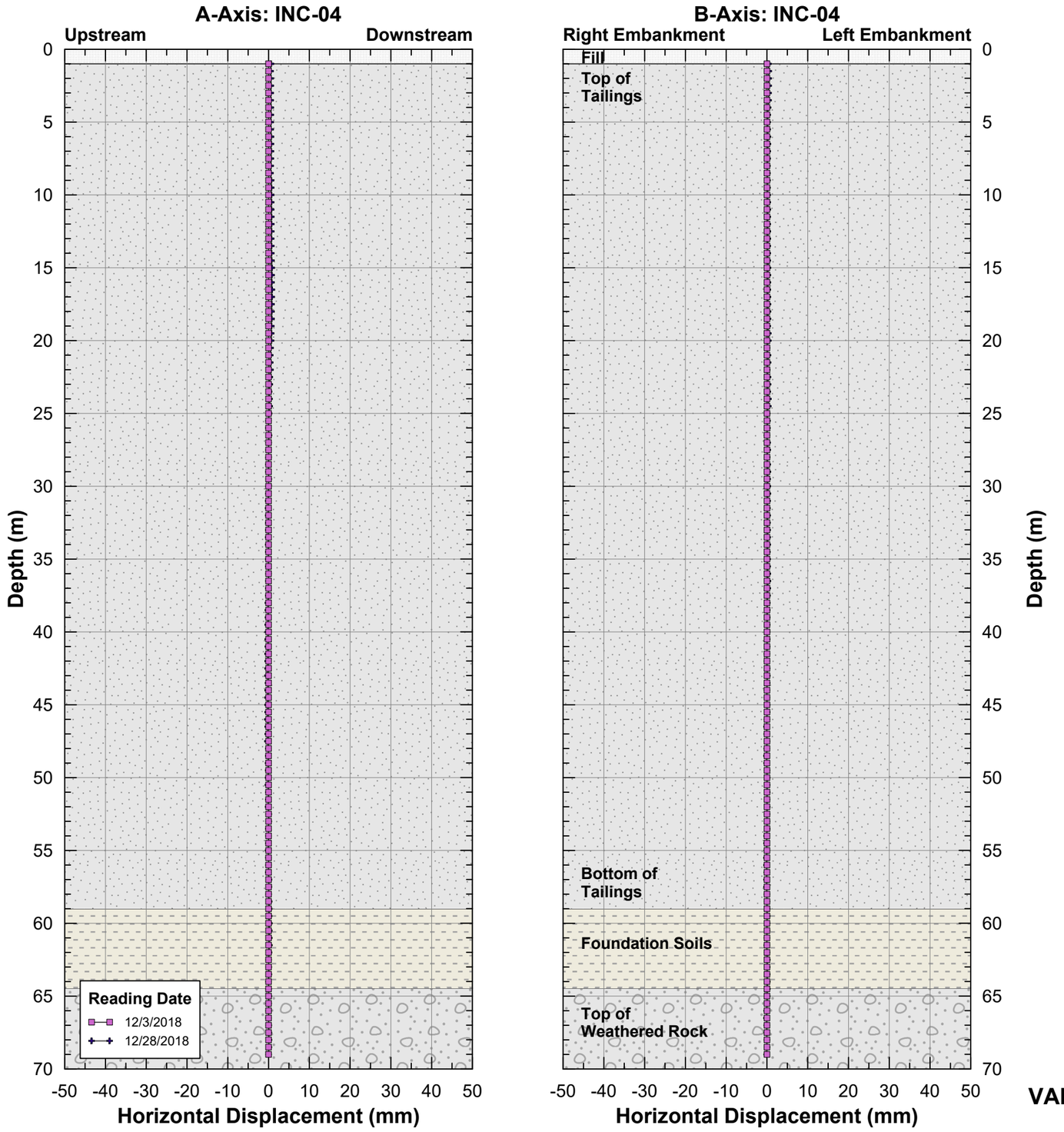


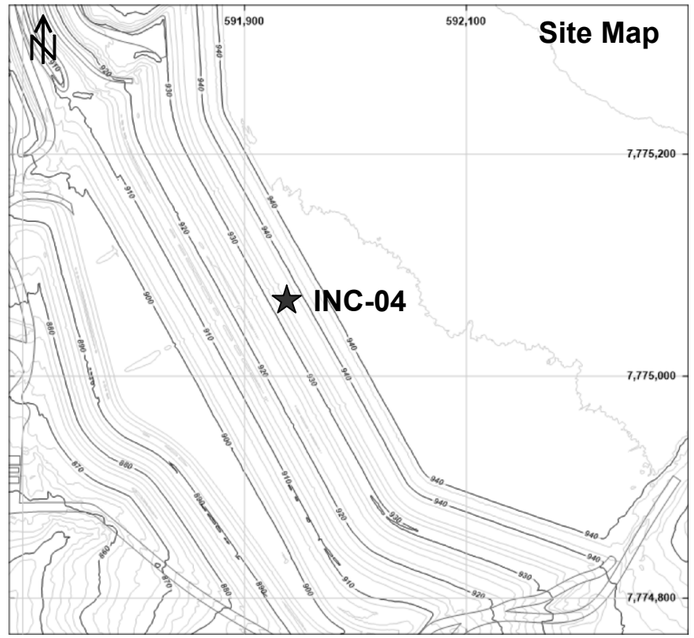
INC-03			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	12/3/2018	12/27/2018	Once

Note:
1. Baseline survey: 12/3/2018.

VARIATION OF INCREMENTAL DISPLACEMENT WITH DEPTH: INC-03
FIGURE 8-11

VARIATION OF HORIZONTAL DISPLACEMENT WITH DEPTH: INC-04



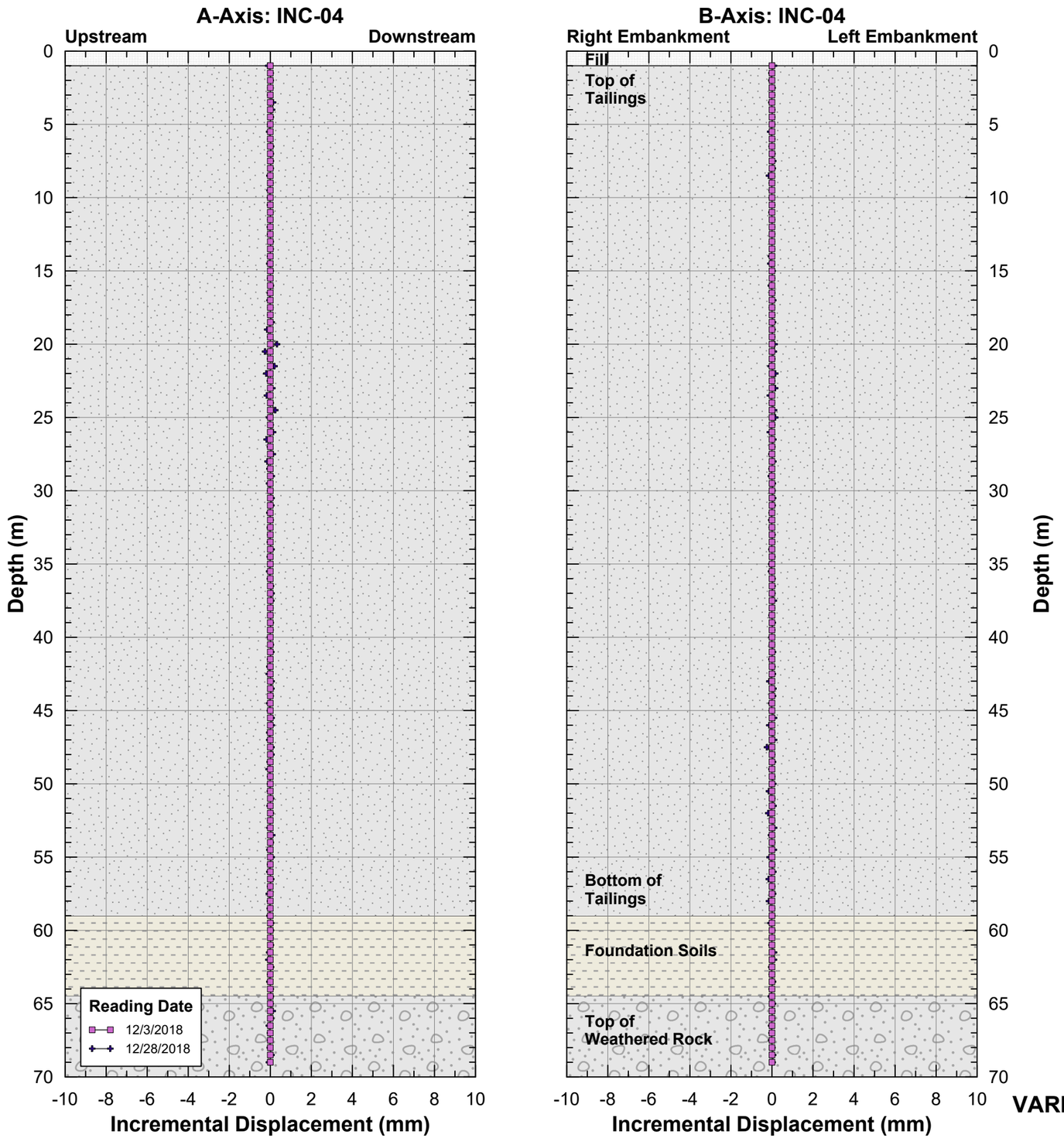


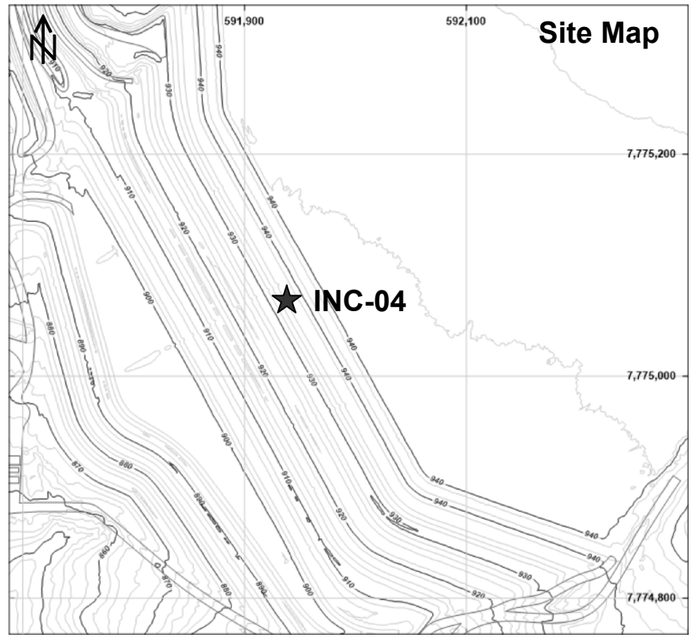
INC-04			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	12/3/2018	12/27/2018	Once

Note:
1. Baseline survey: 12/3/2016.

VARIATION OF HORIZONTAL DISPLACEMENT WITH DEPTH: INC-04
FIGURE 8-12

VARIATION OF INCREMENTAL DISPLACEMENT WITH DEPTH: INC-04



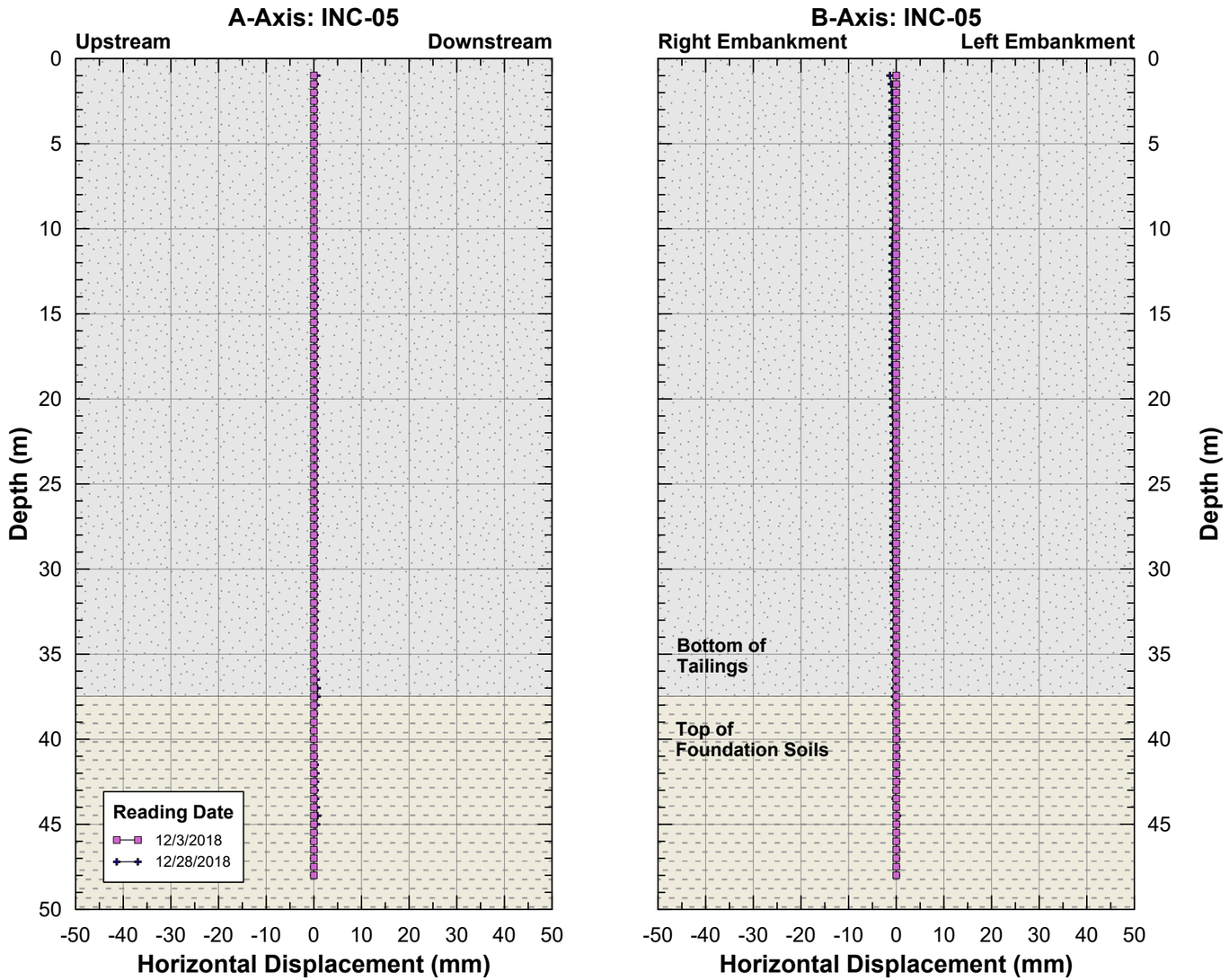


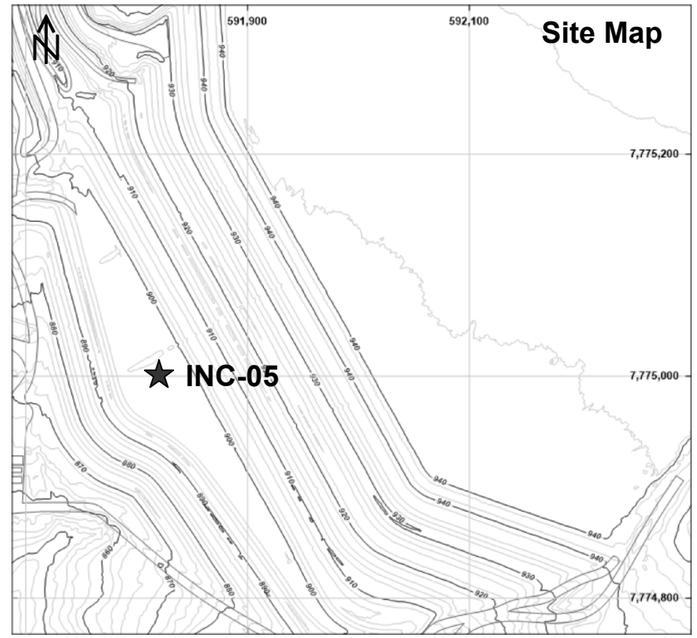
INC-04			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	12/3/2018	12/27/2018	Once

Note:
1. Baseline survey: 12/3/2016.

VARIATION OF INCREMENTAL DISPLACEMENT WITH DEPTH: INC-04
FIGURE 8-13

VARIATION OF HORIZONTAL DISPLACEMENT WITH DEPTH: INC-05



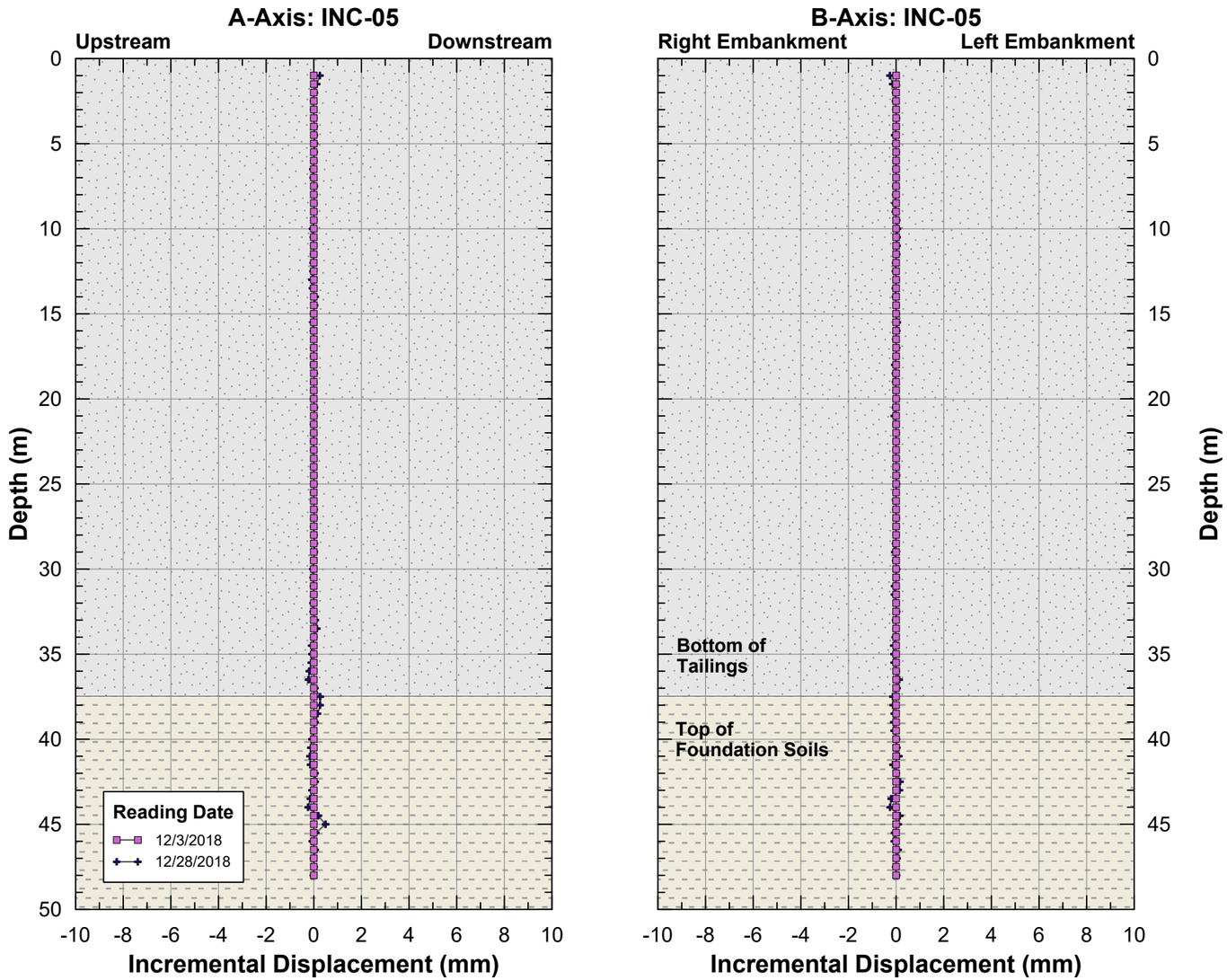


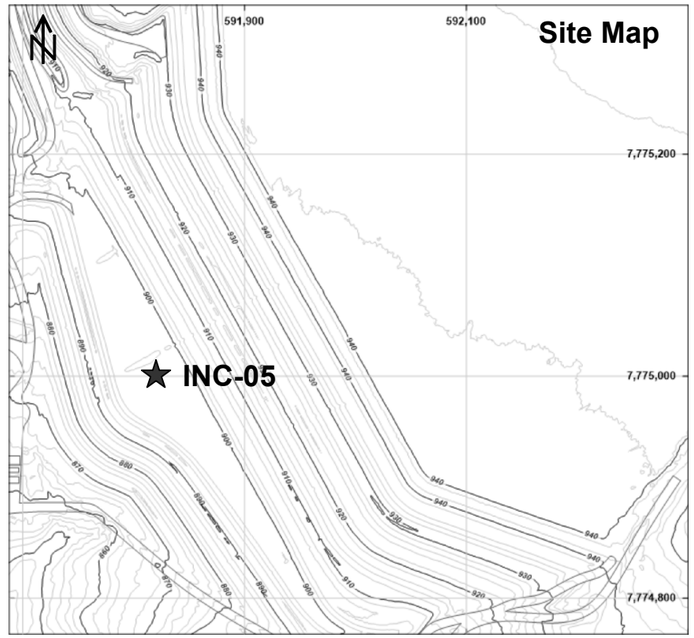
INC-05			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	12/3/2018	12/27/2018	Once

Note:
1. Baseline survey: 12/3/2018.

VARIATION OF HORIZONTAL DISPLACEMENT WITH DEPTH: INC-05
FIGURE 8-14

VARIATION OF INCREMENTAL DISPLACEMENT WITH DEPTH: INC-05



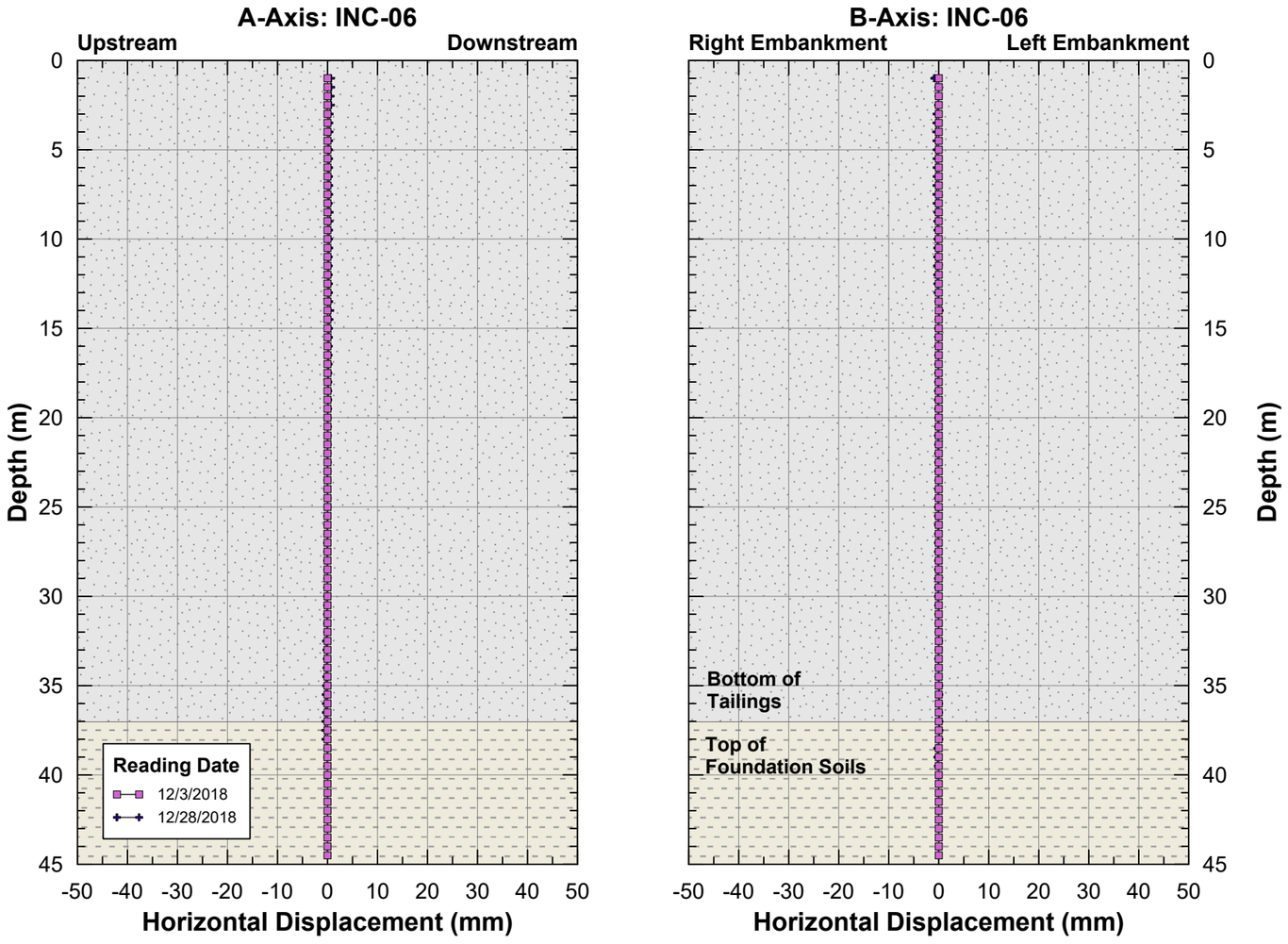


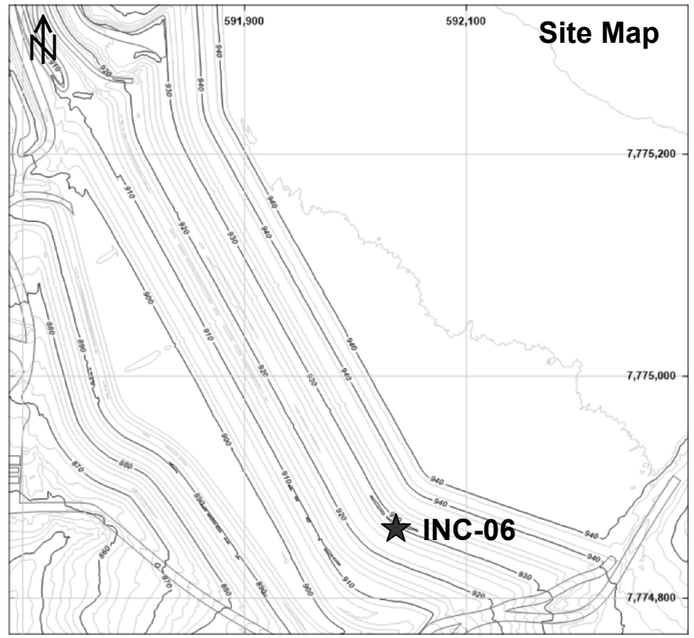
INC-05			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	12/3/2018	12/27/2018	Once

Note:
1. Baseline survey: 12/3/2018.

VARIATION OF INCREMENTAL DISPLACEMENT WITH DEPTH: INC-05
FIGURE 8-15

VARIATION OF HORIZONTAL DISPLACEMENT WITH DEPTH: INC-06



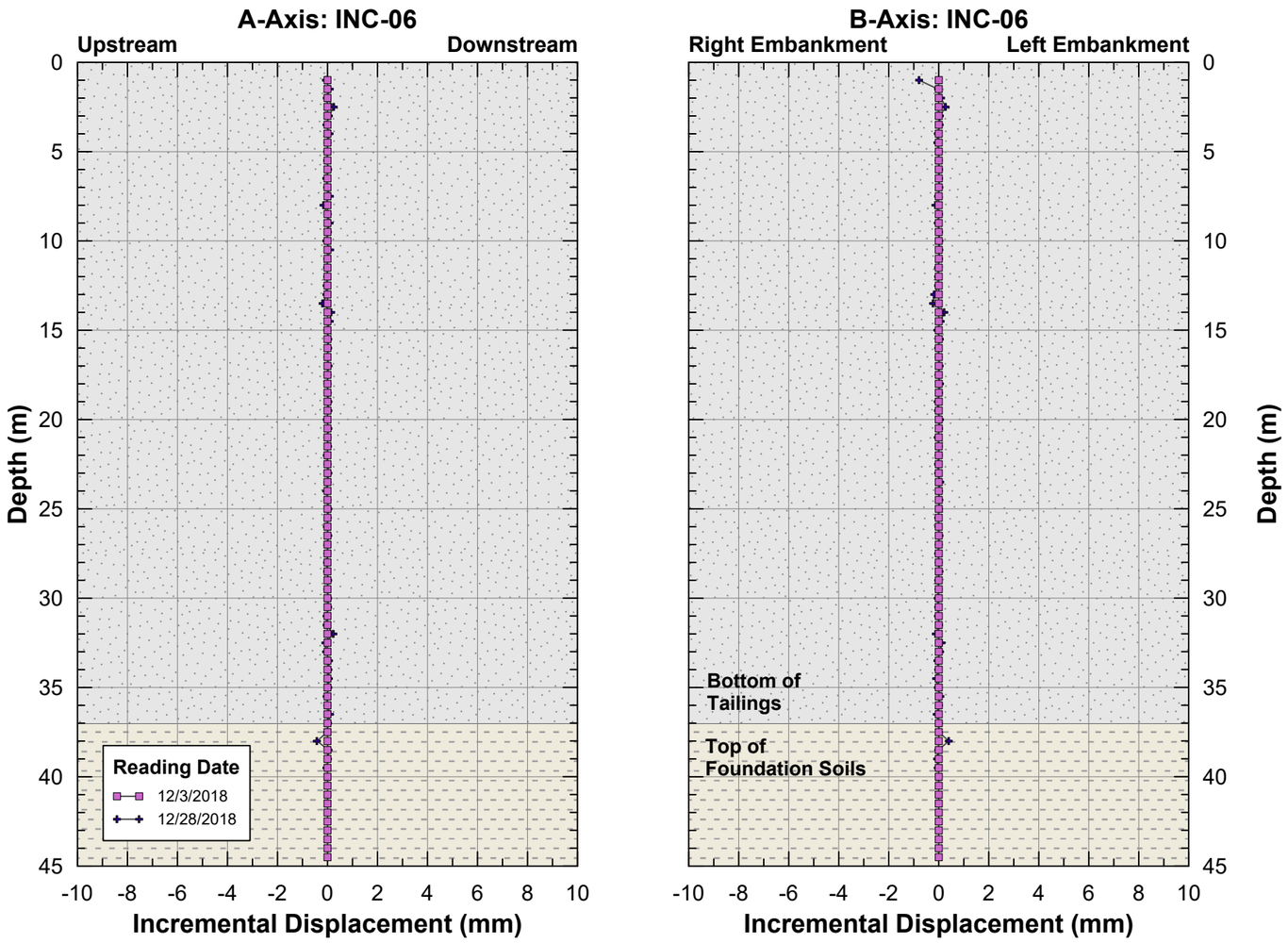


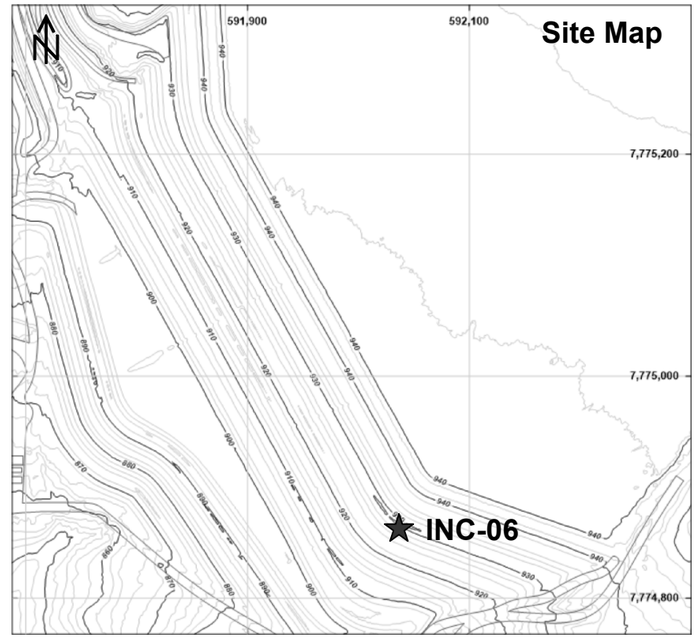
INC-06			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	12/3/2018	12/27/2018	Once

Note:
1. Baseline survey: 12/3/2016.

VARIATION OF HORIZONTAL DISPLACEMENT WITH DEPTH: INC-06
FIGURE 8-16

VARIATION OF INCREMENTAL DISPLACEMENT WITH DEPTH: INC-06



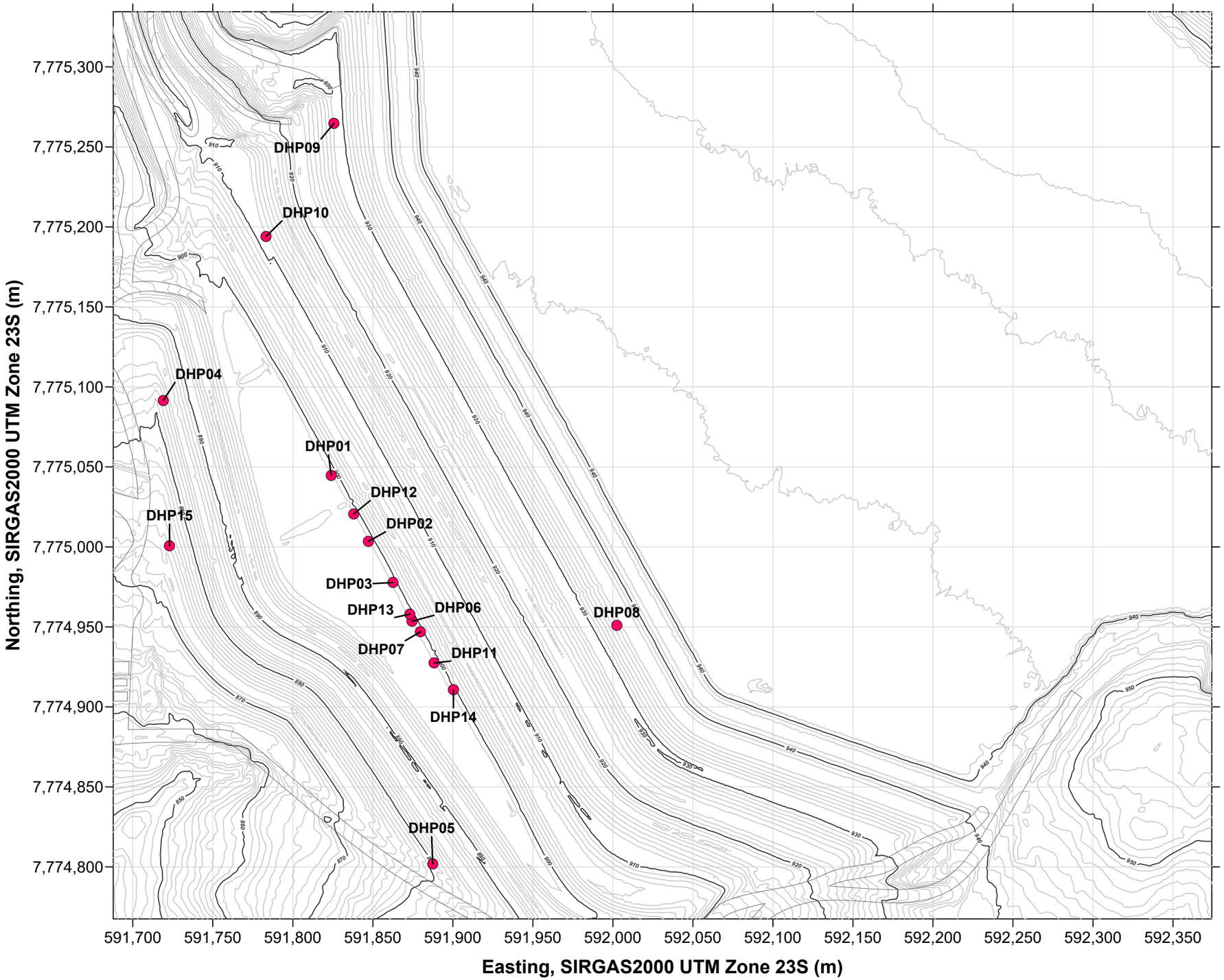


INC-06			
Measurement	**From**	**To**	**Average Frequency of Reading**
Manual Reading	12/3/2018	12/27/2018	Once

Note:
1. Baseline survey: 12/3/2016.

VARIATION OF INCREMENTAL DISPLACEMENT WITH DEPTH: INC-06
FIGURE 8-17

PLAN VIEW:DEEP HORIZONTAL DRAINS ("DHPs")



Notes:
2. Horizontal datum is SIRGAS2000 UTM Zone 23S in meters, Vertical datum is Mean Sea Level in meters.
3. DHP06 and DHP15 were not installed, drilled explorations backfilled with sand and grout.

PLAN VIEW: DEEP HORIZONTAL DRAINS ("DHPs")
FIGURE 9-1

Appendix C

Annex 2 – Tables

December 2019

LIST OF TABLES

Table 2-1 - Installation Summary of Rain Gauges
Report of the Expert Panel on the Technical Causes of the Failure of Feijão Dam I
Appendix C – Historical Instrumentation Data

Field Code	Geotec III Code	Latitude (UTM SAD69)	Longitude (UTM SAD69)	Latitude (UTM SIRGAS2000)	Longitude (UTM SIRGAS2000)	Elevation (m)	Status (Active / Inactive)	Period of Available Measurements		Monitoring Frequency	Notes
								Start	End		
PE / PLUV 02	CFJPL001	7,776,099.84	591,489.68	7,776,054.71	591,444.98	885.00	Inactive	2004-01-01	2008-11-02	Daily	Office Rain Gauge
PLUV 01	CFJPL002	7,773,594.20	591,858.50	7,773,549.06	591,813.80	816.80	Active	2006-01-01	2019-01-15	Daily	Near the Laboratory
Rain Gauge Dam 6 / PLUV 03	CFJPL003	7,775,138.00	591,560.00	7,775,092.87	591,515.30	885.00	Inactive	2011-01-01	2014-04-27	Daily	Dam VI
F11-BJC	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	Active	2015-04-18	2019-01-25	Hourly	Located near the CPX mine (2)
F18-BFE-01	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	Active	2017-03-02	2019-01-25	Hourly	Located near Feijão/Jangada mine(2)
INMET Ibirité	N.I.	7,784,731.99	603,411.92	7,784,686.87	603,367.24	1199.00	Active	2008-06-06	2019-01-25	Hourly	-

Notes: 1. N.I. - No Information availale.
2. Weather Stations monitored by Vale S.A.

Table 3-1 - Installation Summary of Weather Stations Report of the Expert Panel on the Technical Causes of the Failure of Feijão Dam I Appendix C – Historical Instrumentation Data											
Field Code	**Geotec III Code**	**Latitude (UTM SAD69)**	**Longitude (UTM SAD69)**	**Latitude (UTM SIRGAS2000)**	**Longitude (UTM SIRGAS2000)**	**Elevation (m)**	**Status (Active / Inactive)**	**Period of Available Measurements (YYYY-MM-DD)**		**Monitoring Frequency**	**Notes**
								Start	**End**		
F11-BJC	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	Active	2015-04-18	2019-01-25	Hourly	Located near the CPX mine [(2)]
F18-BFE-01	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	Active	2017-03-02	2019-01-25	Hourly	Located near Feijão/Jangada mine[(2)]
INMET Ibirité	N.I.	7,784,731.99	603,411.92	7,784,686.87	603,367.24	1199.00	Active	2008-06-06	2019-01-25	Hourly	-

Note: 1. N.I. - No Information availale.

2. Weather Stations monitored by Vale S.A.

Table 4-1 - Installation Summary of Reservoir Gauges Report of the Expert Panel on the Technical Causes of the Failure of Feijão Dam I Appendix C – Historical Instrumentation Data											
Field Code	**Geotec III Code**	**Latitude (UTM SAD69)**	**Longitude (UTM SAD69)**	**Latitude (UTM SIRGAS2000)**	**Longitude (UTM SIRGAS2000)**	**Top Elevation (m)**	**Bottom Elevation (m)**	**Status (Active / Inactive)**	**Monitoring Frequency**	**Period of Available Measurements**	
										Start	**End**
N.I.	CFJB1RR001	7,775,464.00	592,116.00	7,775,418.87	592,071.30	937.00	930.00	Active	Daily[2], Every other Day[3], Weekly[4], Monthly[5]	2005-06-29	2017-07-03

Notes:
1. N.I. - No Information availale.
2. From June 2005 to Steptember 2006
3. From January 2007 to April 2007
4. April 2007 to March 2008
5. From April 2008 to July 2017

Table 5-1 - Installation Summary of Piezometers

Report of the Expert Panel on the Technical Causes of the Failure of Feijão Dam I

Appendix C – Historical Instrumentation Data

Field Code	Geotec III Code	Latitude (UTM SAD69)	Longitude (UTM SAD69)	Latitude (UTM SIRGAS2000)	Longitude (UTM SIRGAS2000)	Surface Elevation (m)	Installation Date (YYYY-MM-DD)	Instrument Sub-type (Casagrande / Vibrating Wire)	Status (Active / Inactive / Inoperative)	Instrument Automated (Yes / No)	Material Type within Location of Screen Interval	Top Elevation of Casing (m)	Bottom Elevation of Casing (m)	Length of Casing (m)	Tube Diameter (inches)	Top Elevation of Screen (m)	Base Elevation of Screen (m)	Length of Screen Interval (m)	Installed Elevation of Pressure Transducer (m)	Alert Level (m)	Emergency Level (m)	Raising ID	Notes [2]	Period of Available Measurements (YYYY-MM-DD)	
																								Start	End
PZ-1C	CFJB1PZ001	7,774,912.83	591,824.36	7,774,867.70	591,779.66	860.10	N.I.	Casagrande	Inactive	No	Embankment	860.10	856.06	4.04	N.I.	N.I.	N.I.	N.I.	N.I.	861	861	First	-	1996-04-30	2010-11-30
PZ-17C	CFJB1PZ002	7,775,187.58	591,854.50	7,775,142.44	591,809.80	910.42	1999-07-19	Casagrande	Active	Yes	Tailings	910.60	900.58	10.02	1.50	901.08	900.58	0.50	900.66	904.5	904.5	Fifth	Stable Readings	1999-08-21	2019-01-25
PZ-18C	CFJB1PZ003	7,775,184.33	591,849.01	7,775,139.20	591,804.31	909.09	1999-07-19	Casagrande	Active	Yes	Tailings	909.50	898.64	10.86	1.50	899.14	898.64	0.50	899.10	N.I.	N.I.	Fifth	Stable Readings	1999-08-21	2019-01-25
PZ-19C	CFJB1PZ004	7,775,176.72	591,834.79	7,775,131.59	591,790.09	904.91	N.I.	Casagrande	Inactive	No	Tailings	904.91	887.73	17.18	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	Fourth	-	1999-08-21	2011-04-27
PZ-19C-1	CFJB1PZ005	7,775,178.31	591,833.94	7,775,133.18	591,789.24	904.01	2005-04-09	Casagrande	Active	Yes	Tailings	904.47	887.29	17.18	1.50	887.79	887.29	0.50	854.86	N.I.	N.I.	Fourth	Stable Readings	2005-05-16	2019-01-25
PZ-2C	CFJB1PZ006	7,774,928.16	591,842.99	7,774,883.02	591,798.28	869.09	2003-07-13	Casagrande	Active	Yes	Starter Dike	869.59	855.09	14.50	1.25	855.59	855.09	0.50	854.15	865	868	First	Stable Readings	2004-01-12	2018-12-08
PZ-20C	CFJB1PZ007	7,775,121.45	591,884.40	7,775,076.31	591,839.70	909.83	1999-07-19	Casagrande	Active	No	Tailings	909.57	900.67	8.90	0.75	901.17	900.67	0.50	N.I.	N.I.	N.I.	Fifth	Dry since Jul-2016	1999-08-21	2018-08-31
PZ-21C	CFJB1PZ008	7,775,074.04	591,916.29	7,775,028.91	591,871.59	910.31	1999-07-19	Casagrande	Active	Yes	Tailings	910.92	901.18	9.74	0.75	901.68	901.18	0.50	901.40	N.I.	N.I.	Fifth	Stable Readings	1999-08-21	2019-01-25
PZ-22C	CFJB1PZ009	7,775,063.58	591,898.30	7,775,018.44	591,853.60	904.66	2008-07-09	Casagrande	Active	Yes	Tailings	905.12	894.04	11.09	0.75	894.53	894.04	0.49	894.79	N.I.	N.I.	Fourth	Stable Readings	1999-08-21	2019-01-25
PZ-22C-1	CFJB1PZ010	7,775,064.49	591,897.94	7,775,019.36	591,853.24	904.58	2004-09-19	Casagrande	Active	Yes	Tailings	905.46	893.22	12.24	0.75	893.72	893.22	0.50	893.33	N.I.	N.I.	Fourth	Stable Readings	2004-01-12	2019-01-25
PZ-23C	CFJB1PZ011	7,775,013.31	591,951.32	7,774,968.18	591,906.62	911.07	1999-07-19	Casagrande	Active	Yes	Tailings	911.55	899.04	22.51	0.75	899.54	899.04	0.50	899.16	N.I.	N.I.	Fifth	Stable Readings	1999-08-21	2019-01-25
PZ-24C	CFJB1PZ012	7,775,003.52	591,931.45	7,774,958.39	591,886.75	904.85	1999-07-19	Casagrande	Active	Yes	Tailings	905.29	884.26	21.03	0.75	884.76	884.26	0.50	884.89	N.I.	N.I.	Fourth	Stable Readings	1999-08-21	2019-01-25
PZ-25C	CFJB1PZ013	7,774,891.41	592,018.61	7,774,846.27	591,973.91	911.08	1999-07-19	Casagrande	Active	Yes	Tailings	911.53	901.28	10.25	0.75	901.78	901.28	0.50	901.59	N.I.	N.I.	Fifth	Stable Readings	2000-02-12	2019-01-25
PZ-26C	CFJB1PZ014	7,774,879.10	591,999.63	7,774,833.97	591,954.93	905.32	1999-07-19	Casagrande	Active	Yes	Tailings	905.76	894.77	10.99	0.75	895.27	894.77	0.50	895.27	N.I.	N.I.	Fourth	Stable Readings	1999-08-21	2019-01-25
PZ-27C	CFJB1PZ015	7,775,193.89	591,866.15	7,775,148.75	591,821.44	915.76	2008-07-09	Casagrande	Active	No	Embankment	916.07	909.88	6.19	0.75	910.38	909.88	0.50	N.I.	N.I.	N.I.	Sixth	Dry since Dec-2016	2000-09-12	2006-10-13
PZ-28C	CFJB1PZ016	7,775,196.25	591,870.61	7,775,151.11	591,825.91	916.77	2000-07-19	Casagrande	Active	Yes	Embankment	917.42	906.78	10.64	0.75	907.28	906.78	0.50	906.29	N.I.	N.I.	Sixth	Stable Readings in 2017	2000-09-12	2019-01-25
PZ-29C	CFJB1PZ017	7,775,152.57	591,889.26	7,775,107.44	591,844.56	915.84	2000-07-19	Casagrande	Active	No	Embankment	916.10	910.05	6.05	0.75	910.55	910.05	0.50	N.I.	N.I.	N.I.	Sixth	Dry since Jan-2012	2000-08-12	2009-11-18
PZ-30C	CFJB1PZ018	7,775,154.89	591,893.62	7,775,109.75	591,848.92	916.93	2000-07-19	Casagrande	Active	Yes	Embankment	917.55	906.81	10.74	0.75	907.33	906.83	0.50	906.23	N.I.	N.I.	Sixth	-	2000-08-12	2019-01-25
PZ-31C	CFJB1PZ019	7,775,083.41	591,927.56	7,775,038.28	591,882.86	916.01	N.I.	Casagrande	Inoperative	No	Embankment	916.01	910.26	5.75	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	Sixth	-	2000-12-12	2000-12-12
PZ-32C	CFJB1PZ020	7,775,086.06	591,911.95	7,775,040.93	591,867.25	917.08	2000-07-19	Casagrande	Active	No	Embankment	917.70	906.80	10.90	0.75	907.30	906.80	0.50	N.I.	N.I.	N.I.	Sixth	Dry since Aug-2012	2000-08-12	2012-07-26
PZ-33C	CFJB1PZ021	7,775,019.15	591,963.16	7,774,974.02	591,918.46	916.23	2000-07-19	Casagrande	Active	No	Embankment	916.47	909.99	6.48	0.75	910.49	909.99	0.50	N.I.	N.I.	N.I.	Sixth	Dry since Feb-2012	2000-10-12	2019-01-18
PZ-34C	CFJB1PZ022	7,775,021.64	591,967.58	7,774,976.50	591,922.88	917.30	2000-07-19	Casagrande	Active	No	Tailings	917.95	907.13	10.82	0.75	907.63	907.13	0.50	N.I.	N.I.	N.I.	Sixth	Dry since Aug-2013	2005-03-11	2013-07-23
PZ-35C	CFJB1PZ023	7,774,898.95	592,030.37	7,774,853.81	591,985.66	916.55	2000-07-19	Casagrande	Active	No	Embankment	916.86	910.47	6.39	0.75	910.97	910.47	0.50	N.I.	N.I.	N.I.	Sixth	Dry since Feb-2012	2002-12-12	2009-11-18
PZ-36C	CFJB1PZ024	7,774,901.70	592,034.55	7,774,856.57	591,989.85	917.38	2000-07-19	Casagrande	Active	No	Tailings	918.00	907.77	10.23	0.75	908.27	907.77	0.50	N.I.	N.I.	N.I.	Sixth	Dry since Aug-2012	2000-08-12	2012-07-26
PZ-37C	CFJB1PZ025	7,775,202.56	591,882.02	7,775,157.43	591,837.32	921.89	2002-10-19	Casagrande	Active	No	Embankment	922.21	916.14	6.07	0.75	916.64	916.14	0.50	N.I.	N.I.	N.I.	Seventh	Dry since Feb-2012	2009-11-18	2009-11-18
PZ-38C	CFJB1PZ026	7,775,204.45	591,885.53	7,775,159.32	591,840.83	921.20	N.I.	Casagrande	Inactive	No	Tailings	921.20	913.95	7.25	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	Seventh	Dry since Feb-2012	2002-11-06	2004-03-12
PZ-39C	CFJB1PZ027	7,775,160.93	591,905.20	7,775,115.79	591,860.50	922.08	2002-10-19	Casagrande	Active	No	Embankment	922.42	916.31	6.11	0.75	916.81	916.31	0.50	N.I.	N.I.	N.I.	Seventh	Dry since Aug-2012	2002-11-06	2009-11-18
PZ-40C	CFJB1PZ028	7,775,162.70	591,908.80	7,775,117.56	591,864.10	922.23	2002-10-19	Casagrande	Active	No	Tailings	922.41	913.80	8.61	0.75	914.30	913.80	0.50	N.I.	N.I.	N.I.	Seventh	-	2005-05-16	2012-07-26
PZ-41C	CFJB1PZ029	7,775,091.71	591,943.73	7,775,046.58	591,899.03	922.37	2002-10-19	Casagrande	Active	No	Embankment	922.67	916.72	5.95	0.75	917.22	916.72	0.50	N.I.	N.I.	N.I.	Seventh	Dry since Feb-2012	2009-11-18	2009-11-18
PZ-42C	CFJB1PZ030	7,775,093.46	591,947.27	7,775,048.33	591,902.57	922.49	2002-10-19	Casagrande	Active	No	Tailings	922.66	913.56	9.10	0.75	914.06	913.56	0.50	N.I.	N.I.	N.I.	Seventh	Dry since Jun-2012	2002-11-06	2012-05-18
PZ-43C	CFJB1PZ031	7,775,027.07	591,979.53	7,774,981.94	591,934.83	922.46	2002-10-19	Casagrande	Active	No	Embankment	922.94	917.61	5.33	0.75	918.11	917.61	0.50	N.I.	N.I.	N.I.	Seventh	Dry since Feb-2012	2009-11-18	2009-11-18
PZ-44C	CFJB1PZ032	7,775,028.71	591,986.43	7,774,983.57	591,941.73	922.54	2010-02-03	Casagrande	Active	No	Tailings	922.84	914.42	8.42	0.75	914.92	914.42	0.50	N.I.	N.I.	N.I.	Seventh	Instrument not located since Jun-2017	2002-11-06	2018-08-14
PZ-45C	CFJB1PZ033	7,774,909.29	592,045.88	7,774,864.16	592,001.18	922.75	N.I.	Casagrande	Inactive	No	Embankment	922.75	917.83	4.92	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.	Seventh	-	N.I.	N.I.
PZ-45C-1	CFJB1PZ034	7,774,909.30	592,045.88	7,774,864.17	592,001.18	922.75	2005-04-19	Casagrande	Active	No	Embankment	923.34	917.83	5.51	0.75	918.33	917.83	0.50	N.I.	N.I.	N.I.	Seventh	-	2005-06-16	2009-11-18
PZ-46C	CFJB1PZ035	7,774,911.49	592,049.32	7,774,866.36	592,004.62	922.99	2002-10-19	Casagrande	Active	No	Tailings	923.31	914.81	8.50	0.75	915.31	914.81	0.50	N.I.	N.I.	N.I.	Seventh	Dry since Jan-2012	2002-11-06	2009-11-18
PZ-47C	CFJB1PZ036	7,775,215.95	591,905.63	7,775,170.82	591,860.93	929.20	2005-04-15	Casagrande	Active	Yes	Tailings	929.91	909.73	20.18	0.75	910.23	909.73	0.50	909.08	N.I.	N.I.	Eighth	Stable Readings	2005-03-28	2018-12-08
PZ-48C	CFJB1PZ037	7,775,174.20	591,928.98	7,775,129.06	591,884.28	929.30	2005-04-15	Casagrande	Active	Yes	Tailings	929.30	908.90	20.40	0.75	909.40	908.90	0.50	908.71	N.I.	N.I.	Eighth	Stable Readings in 2017	2004-01-12	2019-01-25
PZ-49C	CFJB1PZ038	7,775,104.82	591,967.35	7,775,059.69	591,922.65	929.58	2005-04-15	Casagrande	Active	Yes	Tailings	930.24	910.52	19.72	0.75	911.02	910.52	0.50	910.67	N.I.	N.I.	Eighth	Stable Readings	2005-03-28	2019-01-25
PZ-50C	CFJB1PZ039	7,775,040.03	592,003.45	7,774,994.90	591,958.75	929.66	2005-04-15	Casagrande	Active	No	Tailings	930.32	909.12	21.20	0.75	909.62	909.12	0.50	N.I.	N.I.	N.I.	Eighth	Practically Dry	2005-03-28	2016-06-28
PZ-51C	CFJB1PZ040	7,774,924.57	592,069.15	7,774,879.44	592,024.45	929.80	2005-04-15	Casagrande	Active	Yes	Tailings	930.50	910.20	20.30	0.75	910.70	910.20	0.50	910.49	N.I.	N.I.	Eighth	Stable Readings	1996-11-17	2019-01-25
PZ-52C	CFJB1PZ041	7,775,213.69	591,901.80	7,775,168.56	591,857.09	929.36	2011-12-31	Casagrande	Active	No	Embankment	930.08	923.53	6.55	0.75	924.03	923.53	0.50	N.I.	N.I.	N.I.	Eighth	Dry since Feb-2012	N.I.	N.I.
PZ-53C	CFJB1PZ042	7,775,102.82	591,963.97	7,775,057.68	591,919.27	929.56	2005-04-15	Casagrande	Active	No	Embankment	930.37	923.84	6.53	0.75	924.34	923.84	0.50	N.I.	N.I.	N.I.	Eighth	Dry since Jan-2012	2009-11-18	2009-11-18
PZ-54C	CFJB1PZ043	7,774,921.57	592,065.77	7,774,876.43	592,021.07	929.95	2005-04-15	Casagrande	Active	No	Embankment	930.71	924.12	6.59	0.75	924.62	924.12	0.50	N.I.	N.I.	N.I.	Eighth	-	N.I.	N.I.
PZC-19B	CFJB1PZ044	7,774,938.75	591,847.95	7,774,893.61	591,803.25	871.27	2006-02-12	Casagrande	Active	Yes	Starter Dike	872.27	858.27	14.00	0.75	859.77	858.27	1.50	858.29	N.I.	N.I.	First	Stable Readings	2006-02-13	2019-01-25
PZC-19C	CFJB1PZ045	7,774,935.57	591,850.32	7,774,890.44	591,805.62	871.27	2006-02-12	Casagrande	Active	Yes	Foundation Soil	872.27	853.27	19.00	1.00	854.77	853.27	1.50	853.35	N.I.	N.I.	First	Stable Readings	2006-02-13	2019-01-25
PZC-20B	CFJB1PZ046	7,774,957.90	591,809.02	7,774,912.76	591,764.32	871.88	2006-02-12	Casagrande	Active	No	Starter Dike	872.88	861.88	11.00	1.00	863.38	861.88	1.50	N.I.	N.I.	N.I.	First	Dry since Jan-2012	2009-11-04	2009-12-01
PZC-20C	CFJB1PZ047	7,774,955.73	591,812.30	7,774,910.60	591,767.60	871.95	2006-02-12	Casagrande	Active	Yes	Starter Dike	872.95	856.95	16.00	1.00	858.45	856.95	1.50	858.32	918	919	First	Stable Readings	2006-02-13	2018-11-07
PZC-21	CFJB1PZ048	7,775,162.42	591,783.78	7,775,117.29	591,739.08	893.68	2006-10-09	Casagrande	Active	Yes	Foundation Soil	894.87	878.62	16.25	0.75	880.12	878.62	1.50	878.76	N.I.	N.I.	Third	Stable Readings	2007-04-24	2019-01-25
PZC-22	CFJB1PZ049	7,775,103.87	591,812.23	7,775,058.73	591,767.53	898.69	2006-10-04	Casagrande	Active	Yes	Tailings	899.69	883.49	16.20	0.75	884.99	883.49	1.50	884.43	N.I.	N.I.	Third	Stable Readings	2007-04-24	2019-01-25
PZC-23	CFJB1PZ050	7,775,107.01	591,811.45	7,775,061.88	591,766.75	898.64	2006-10-09	Casagrande	Active	Yes	Tailings	899.62	877.87	21.75	0.75	879.37	877.87	1.50	877.95	N.I.	N.I.	Third	Stable Readings	2007-04-24	2019-01-25
PZC-24	CFJB1PZ051	7,775,097.68	591,790.47	7,775,052.55	591,745.77	889.93	2006-10-10	Casagrande	Active	Yes	Starter Dike	891.01	875.11	15.90	0.75	876.61	875.11	1.50	875.22	N.I.	N.I.	Second	Stable Readings	2007-04-24	2019-01-25
PZC-25	CFJB1PZ052	7,774,854.07	591,939.48	7,774,808.94	591,894.78	885.28	2006-10-10	Casagrande	Active	No	Foundation Soil	886.29	874.09	12.20	0.75	875.59	874.09	1.50	N.I.	N.I.	N.I.	First	Dry since Mar-2013	2008-01-07	2013-01-23
PZF-1	CFJB1PZ053	7,775,154.57	591,762.49	7,775,109.44	591,717.79	885.23	1996-04-19	Casagrande	Active	No	Foundation Soil	886.13	877.11	9.02	0.75	877.61	877.11	0.50	N.I.	886	886	First	Dry since Aug-2016	1998-11-06	2016-07-04
PZF-11	CFJB1PZ054	7,775,905.88	591,552.97	7,775,860.75	591,508.27	862.96	N.I.	Casagrande	Inactive	No	Foundation Soil	863.16	852.22	10.94	N.I.	852.72	852.22	0.50	N.I.	861	861	First	-	1996-04-30	2003-11-12
PZF-11-1	CFJB1PZ055	7,774,921.09	591,834.29	7,774,875.96	591,789.59	863.16	N.I.	Casagrande	Inactive	No	N.I.	863.16	851.86	11.30	N.I.	N.I.	N.I.	N.I.	N.I.	861	861	First	-	2004-01-12	2013-01-23
PZF-13	CFJB1PZ056	7,774,932.93	591,848.20	7,774,887.80	591,803.50	871.46	1996-04-19	Casagrande	Active	Yes	Starter Dike	872.06	852.54	19.52	0.75	853.04	852.54	0.50	853.45	866	868.1	First	Stable Readings	1996-04-30	2019-01-25
PZF-19	CFJB1PZ057	7,774,852.04	591,941.13	7,774,806.91	591,896.43	885.06	1996-04-19	Casagrande	Active	No	Starter Dike	885.71	878.71	7.00	0.75	879.21	878.71	0.50	N.I.	N.I.	N.I.	First	Dry since Jan-2012	2009-11-04	2009-12-01
PZF-23	CFJB1PZ058	7,774,878.85	591,893.59	7,774,833.71	591,848.88	873.94	1996-04-19	Casagrande	Active	Yes	Foundation Soil	874.42	863.65	10.77	0.75	864.15	863.65	0.50	864.69	N.I.	N.I.	First	Stable Readings	1996-04-30	2019-01-25
PZF-5	CFJB1PZ059	7,775,074.96	591,762.35	7,775,029.83	591,717.65	875.39	1996-04-19	Casagrande	Active	No	Foundation Soil	875.89	869.10	6.79	0.75	869.60	869.10	0.50	N.I.	873.5	874.5	First	Dry since Jan-2012	1996-04-30	2018-10-11
PZM-6	CFJB1PZ060	7,775,029.22	591,765.18	7,774,984.09	591,720.48	871.68	1996-04-19	Casagrande	Active	No	Right Shoulder	872.28	864.59	7.69	0.75	865.09	864.59	0.50	N.I.	868	868	First	Dry since Jan-2012	N.I.	N.I.
PZM-10	CFJB1PZ061	7,775,046.90	591,826.62	7,775,001.76	591,781.92	898.69	1996-04-19	Casagrande	Active	No	Tailings	898.96	889.95	9.01	1.50	890.45	889.95	0.50	N.I.	895.4	N.I.	Third	Dry since Jan-2012	2009-11-04	2009-12-01
PZM-14	CFJB1PZ062	7,774,941.12	591,859.26	7,774,895.99	591,814.56	877.06	1996-04-19	Casagrande	Active	No	Starter Dike	877.24	860.06	17.18	0.75	860.56	860.06	0.50	N.I.	870	N.I.	First	Dry since Jan-2012	1996-04-30	2009-11-18
PZM-15	CFJB1PZ063	7,774,950.83	591,872.01	7,774,905.70	591,827.31	884.90	1996-04-19	Casagrande	Active	Yes	Tailings	885.37	872.88	12.49	0.75	873.38	872.88	0.50	873.15	877	N.I.	First	Stable Readings	1996-04-30	2019-01-25
PZM-16	CFJB1PZ064	7,774,979.40	591,828.66	7,774,934.27	591,783.95	884.90	1996-04-19	Casagrande	Active	Yes	Embankment	885.36	872.79	12.57	0.75	873.29	872.79	0.50	873.38	N.I.	N.I.	First	Stable Readings	1996-04-30	2019-01-25

Table 5-1 - Installation Summary of Piezometers

Report of the Expert Panel on the Technical Causes of the Failure of Feijão Dam I

Appendix C – Historical Instrumentation Data

Field Code	Geotec III Code	Latitude (UTM SAD69)	Longitude (UTM SAD69)	Latitude (UTM SIRGAS2000)	Longitude (UTM SIRGAS2000)	Surface Elevation (m)	Installation Date (YYYY-MM-DD)	Instrument Sub-type (Casagrande / Vibrating Wire)	Status (Active / Inactive / Inoperative)	Instrument Automated (Yes / No)	Material Type within Location of Screen Interval	Top Elevation of Casing (m)	Bottom Elevation of Casing (m)	Length of Casing (m)	Tube Diameter (inches)	Top Elevation of Screen (m)	Base Elevation of Screen (m)	Length of Screen Interval (m)	Installed Elevation of Pressure Transducer (m)	Alert Level (m)	Emergency Level (m)	Raising ID	Notes [2]	Period of Available Measurements (YYYY-MM-DD)	
																								Start	End
PZM-17	CFJB1PZ065	7,774,964.25	591,889.80	7,774,919.12	591,845.10	893.42	1996-04-19	Casagrande	Active	Yes	Tailings	893.95	871.90	22.05	0.75	872.40	871.90	0.50	872.99	890	N.I.	Third	Stable Readings	1996-04-30	2019-01-25
PZM-2	CFJB1PZ066	7,775,157.81	591,774.29	7,775,112.67	591,729.59	890.00	1996-04-19	Casagrande	Active	No	Starter Dike	890.80	880.74	10.06	0.75	881.24	880.74	0.50	N.I.	888	N.I.	Second	Dry since Mar-2012	1999-08-21	2009-11-18
PZM-20	CFJB1PZ067	7,774,859.08	591,951.31	7,774,813.94	591,906.61	890.00	1996-04-19	Casagrande	Active	Yes	Starter Dike	889.85	882.35	7.50	0.75	882.85	882.35	0.50	882.57	886	N.I.	Second	Stable Readings	1996-04-30	2018-09-14
PZM-22	CFJB1PZ068	7,774,872.06	591,973.56	7,774,826.92	591,928.86	898.30	1996-04-19	Casagrande	Active	No	Tailings	898.62	889.84	8.78	0.75	890.61	890.11	0.50	N.I.	896	N.I.	Third	Practically Dry	2000-11-12	2018-09-14
PZM-4	CFJB1PZ069	7,775,164.01	591,796.83	7,775,118.88	591,752.13	899.25	N.I.	Casagrande	Inactive	No	Tailings	899.25	890.06	9.19	N.I.	N.I.	N.I.	N.I.	N.I.	895	N.I.	Fourth	-	1996-07-30	2008-04-28
PZM-7	CFJB1PZ070	7,775,038.46	591,793.25	7,774,993.33	591,748.55	885.10	1996-04-19	Casagrande	Active	Yes	Embankment	885.94	873.11	12.82	0.75	873.61	873.11	0.50	873.91	891	N.I.	First	Stable Readings	1996-04-30	2019-01-25
PZM-9	CFJB1PZ071	7,775,043.30	591,814.61	7,774,998.17	591,769.91	893.41	1996-04-19	Casagrande	Active	Yes	Tailings	893.73	871.11	22.62	0.75	871.61	871.11	0.50	871.38	890.1	N.I.	Third	Stable Readings	1996-05-30	2019-01-25
PZC-26	CFJB1PZ072	7,775,290.08	591,894.93	7,775,244.94	591,850.23	937.18	2007-09-24	Casagrande	Active	No	Tailings	938.15	925.15	13.00	1.50	926.65	925.15	1.50	N.I.	N.I.	N.I.	Ninth	Dry since Jan-2012	2009-11-04	2009-12-01
PZC-27	CFJB1PZ073	7,775,226.01	591,921.30	7,775,180.88	591,876.60	937.26	2007-09-19	Casagrande	Active	No	Tailings	938.22	925.22	13.00	1.50	926.72	925.22	1.50	N.I.	N.I.	N.I.	Ninth	Dry since Jan-2012	2009-11-04	2009-12-01
PZC-28	CFJB1PZ074	7,775,048.81	592,019.31	7,775,003.67	591,974.61	937.20	2007-09-18	Casagrande	Active	No	Tailings	938.29	931.14	13.00	1.50	932.64	931.14	1.50	N.I.	N.I.	N.I.	Ninth	Dry since Sep-2012	2009-02-26	2012-08-24
PZC-29	CFJB1PZ075	7,775,114.55	591,983.09	7,775,069.42	591,938.39	937.27	2007-09-20	Casagrande	Active	No	Tailings	938.40	925.40	13.00	1.50	926.90	925.40	1.50	N.I.	N.I.	N.I.	Ninth	Dry since Nov-2012	2008-11-30	2012-09-19
PZC-30	CFJB1PZ076	7,775,049.76	592,018.75	7,775,004.62	591,974.05	937.21	2007-09-17	Casagrande	Active	No	Tailings	938.30	925.30	13.00	1.00	926.80	925.30	1.50	N.I.	N.I.	N.I.	Ninth	Dry since Aug-2012	2009-02-26	2012-07-26
PZC-31	CFJB1PZ077	7,774,935.41	592,084.51	7,774,890.28	592,039.81	937.18	2007-09-13	Casagrande	Active	No	Tailings	938.20	925.20	13.00	0.00	926.70	925.20	1.50	N.I.	N.I.	N.I.	Ninth	Dry since Jun-2012	2009-11-04	2012-05-18
PZC-32	CFJB1PZ078	7,774,905.92	592,150.96	7,774,860.78	592,106.26	937.26	2007-09-12	Casagrande	Active	No	Tailings	938.24	925.24	13.00	1.50	926.74	925.24	1.50	N.I.	N.I.	N.I.	Ninth	Dry since Sep-2014	2008-01-07	2012-08-24
PZ-3C	CFJB1PZ079	7,774,943.18	591,861.78	7,774,898.05	591,817.08	878.31	1996-04-19	Casagrande	Active	Yes	Starter Dike	879.38	857.89	21.49	0.75	858.39	857.89	0.50	857.01	871	N.I.	First	-	1996-04-30	2019-01-25
PZ-11C	CFJB1PZ080	7,775,082.03	591,752.53	7,775,036.90	591,707.83	875.40	1996-04-19	Casagrande	Active	No	Right Shoulder	876.29	853.23	23.06	0.75	853.73	853.23	0.50	N.I.	873.5	N.I.	First	-	1996-04-30	2018-09-14
PZ-12C	CFJB1PZ081	7,775,090.89	591,775.42	7,775,045.76	591,730.72	882.94	1996-04-19	Casagrande	Active	Yes	Foundation Soil	883.77	860.82	22.95	0.75	861.32	860.82	0.50	861.36	880.5	N.I.	First	Stable Readings	1996-04-30	2019-01-25
PZ-13C	CFJB1PZ082	7,775,100.22	591,800.13	7,775,055.09	591,755.43	893.52	1996-04-19	Casagrande	Active	Yes	Tailings	894.59	871.17	23.42	0.75	871.67	871.17	0.50	871.56	892	N.I.	Third	Stable Readings	1996-04-30	2019-01-25
PZ-14C-1	CFJB1PZ083	7,775,107.78	591,822.26	7,775,062.65	591,777.56	898.22	N.I.	Casagrande	Inactive	No	N.I.	898.22	874.15	24.07	N.I.	N.I.	N.I.	N.I.	N.I.	898	N.I.	Third	-	2004-01-12	2010-06-29
PZ-4C	CFJB1PZ084	7,774,958.19	591,880.98	7,774,913.06	591,836.27	889.54	1996-04-19	Casagrande	Active	Yes	Starter Dike	890.58	861.15	29.43	0.75	861.65	861.15	0.50	861.18	881.4	N.I.	Second	Stable Readings	1996-04-30	2019-01-25
PZ-5C	CFJB1PZ085	7,774,975.53	591,903.53	7,774,930.39	591,858.83	898.68	1996-04-19	Casagrande	Active	No	Foundation Soil	899.55	862.01	37.54	0.75	862.51	862.01	0.50	N.I.	892	N.I.	Third	-	1996-04-30	2018-10-11
PZ-6C	CFJB1PZ086	7,774,988.50	591,919.89	7,774,943.37	591,875.19	898.24	1996-04-19	Casagrande	Active	Yes	Tailings	899.14	861.39	37.75	0.75	861.89	861.39	0.50	862.50	870	N.I.	Third	Stable Readings	1996-04-30	2019-01-25
PZC-33	CFJB1PZ087	7,775,290.39	591,907.76	7,775,245.26	591,863.06	940.15	2013-04-28	Casagrande	Active	No	Embankment	941.18	935.44	5.74	1.00	935.94	935.44	0.50	N.I.	N.I.	N.I.	Ninth	Dry since Jan-2012	N.I.	N.I.
PZC-34	CFJB1PZ088	7,775,231.95	591,934.30	7,775,186.82	591,889.59	940.26	2013-04-28	Casagrande	Active	No	Tailings	941.26	935.56	5.70	1.00	936.06	935.56	0.50	N.I.	N.I.	N.I.	Ninth	Dry since Apr-2012	N.I.	N.I.
PZC-35	CFJB1PZ089	7,775,189.95	591,957.82	7,775,144.82	591,913.12	940.20	2013-04-28	Casagrande	Active	No	Embankment	941.16	935.43	5.73	1.00	935.93	935.43	0.50	N.I.	N.I.	N.I.	Ninth	Dry since Apr-2014	2017-02-15	2017-02-15
PZC-36	CFJB1PZ090	7,775,121.51	591,995.80	7,775,076.38	591,951.09	940.20	2013-04-28	Casagrande	Active	No	Embankment	941.20	935.51	5.69	1.00	936.01	935.51	0.50	N.I.	N.I.	N.I.	Ninth	Dry since Apr-2014	N.I.	N.I.
PZC-37	CFJB1PZ091	7,775,055.87	592,032.01	7,775,010.73	591,987.31	939.91	2013-05-01	Casagrande	Active	No	Embankment	940.98	935.29	5.69	1.00	935.79	935.29	0.50	N.I.	N.I.	N.I.	Ninth	Dry since Mar-2017	2015-03-26	2017-02-15
PZC-38	CFJB1PZ092	7,774,942.57	592,098.05	7,774,897.44	592,053.35	940.11	2013-05-02	Casagrande	Active	No	Embankment	941.00	935.33	5.67	1.00	935.83	935.33	0.50	N.I.	N.I.	N.I.	Ninth	Dry since Apr-2014	N.I.	N.I.
PZC-39	CFJB1PZ093	7,774,918.74	592,157.24	7,774,873.61	592,112.54	940.11	2013-05-05	Casagrande	Active	No	Embankment	941.04	935.34	5.70	1.00	935.84	935.34	0.50	N.I.	N.I.	N.I.	Ninth	Dry since Apr-2014	N.I.	N.I.
PZC-40	CFJB1PZ094	7,774,888.93	592,240.27	7,774,843.80	592,195.57	940.21	2013-05-06	Casagrande	Active	No	Embankment	941.22	935.48	5.74	1.00	935.98	935.48	0.50	N.I.	N.I.	N.I.	Ninth	Dry since Apr-2014	N.I.	N.I.
PZC-41	CFJB1PZ095	7,774,969.62	591,806.67	7,774,924.49	591,761.97	901.57	2016-06-19	Casagrande	Active	Yes	Foundation Soil	902.57	871.16	31.41	1.00	872.16	871.16	1.00	871.53	N.I.	N.I.	First	Stable Readings	2016-06-20	2019-01-25
PZC-42	CFJB1PZ096	7,774,896.46	591,882.66	7,774,851.33	591,837.96	898.91	2016-06-19	Casagrande	Active	Yes	Foundation Soil	899.91	868.41	31.50	1.00	869.41	868.41	1.00	868.82	N.I.	N.I.	First	Stable Readings	2016-06-20	2019-01-25
PZC-43	CFJB1PZ097	7,774,874.89	591,786.66	7,774,829.76	591,741.96	864.43	2016-06-19	Casagrande	Active	Yes	Downstream	865.43	844.35	21.08	1.00	845.35	844.35	1.00	845.07	N.I.	N.I.	Downstream	Stable Reading - 858.2	2016-06-20	2019-01-18
PZC-44	CFJB1PZ098	7,774,854.03	591,811.89	7,774,808.90	591,767.19	866.42	2016-06-19	Casagrande	Active	Yes	Downstream	867.42	843.21	24.21	1.00	844.21	843.21	1.00	843.35	N.I.	N.I.	Downstream	Stable Reading - 861.5	2016-06-20	2019-01-25
PZC-45	CFJB1PZ099	7,774,895.82	591,755.51	7,774,850.69	591,710.81	865.93	2016-06-19	Casagrande	Active	Yes	Downstream	866.93	845.44	21.49	1.00	846.44	845.44	1.00	845.47	N.I.	N.I.	Downstream	Stable Reading - 858.3	2016-06-20	2018-12-08
PZC-46	CFJB1PZ100	7,774,868.93	591,758.05	7,774,823.80	591,713.35	855.63	2016-06-19	Casagrande	Active	Yes	Downstream	856.63	837.67	18.96	1.00	838.57	837.57	1.00	836.82	N.I.	N.I.	Downstream	Stable Reading - 854.4	2016-06-20	2019-01-25
PZC-47	CFJB1PZ101	7,774,876.01	591,741.70	7,774,830.88	591,697.00	858.34	2016-06-19	Casagrande	Active	Yes	Downstream	858.34	840.38	17.96	1.00	841.38	840.38	1.00	840.64	N.I.	N.I.	Downstream	Stable Reading - 853.5	2016-06-20	2019-01-25
PZC-16.6A	CFJB1PZ102	7,775,131.19	591,897.75	7,775,086.05	591,853.04	909.48	2016-09-08	Casagrande	Active	Yes	Tailings	910.48	889.48	21.00	0.75	890.48	889.48	1.00	890.83	N.I.	N.I.	Sixth	Stable Readings	2018-09-26	2018-12-08
PZC-16.7	CFJB1PZ103	7,775,126.07	591,866.18	7,775,080.93	591,821.48	904.77	2016-09-08	Casagrande	Active	Yes	Tailings	905.77	883.77	22.00	0.75	884.77	883.77	1.00	883.07	N.I.	N.I.	Fourth	Stable Readings	2018-09-26	2019-01-25
PZE-08	N.I.	7,775,052.39	591,926.61	7,775,007.26	591,881.91	930.00	2019-01-11	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	76.00	3.80	N.I.	N.I.	N.I.	906.00	N.I.	N.I.	N.I.	-	2019-01-11	2019-01-18
PZE-09	N.I.	7,775,052.39	591,926.61	7,775,007.26	591,881.91	930.00	2019-01-11	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	76.00	3.80	N.I.	N.I.	N.I.	900.00	N.I.	N.I.	N.I.	-	2019-01-11	2019-01-18
PZE-11	N.I.	7,775,052.39	591,926.61	7,775,007.26	591,881.91	930.00	2019-01-11	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	76.00	3.80	N.I.	N.I.	N.I.	886.50	N.I.	N.I.	N.I.	-	2019-01-11	2019-01-18
PZE-12	N.I.	7,775,052.39	591,926.61	7,775,007.26	591,881.91	930.00	2019-01-11	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	76.00	3.80	N.I.	N.I.	N.I.	879.00	N.I.	N.I.	N.I.	-	2019-01-11	2019-01-18
PZE-13	N.I.	7,775,052.39	591,926.61	7,775,007.26	591,881.91	930.00	2019-01-11	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	76.00	3.80	N.I.	N.I.	N.I.	871.00	N.I.	N.I.	N.I.	-	2019-01-11	2019-01-18
PZE-14	N.I.	7,775,052.39	591,926.61	7,775,007.26	591,881.91	930.00	2019-01-11	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	76.00	3.80	N.I.	N.I.	N.I.	854.50	N.I.	N.I.	N.I.	-	2019-01-11	2019-01-18
PZE-15	N.I.	7,775,025.08	591,853.24	7,774,979.95	591,808.54	904.00	2018-12-20	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	51.37	3.80	N.I.	N.I.	N.I.	890.00	N.I.	N.I.	N.I.	-	2018-12-19	2019-01-18
PZE-16	N.I.	7,775,025.08	591,853.24	7,774,979.95	591,808.54	904.00	2018-12-20	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	51.37	3.80	N.I.	N.I.	N.I.	886.00	N.I.	N.I.	N.I.	-	2018-12-19	2019-01-18
PZE-17	N.I.	7,775,025.08	591,853.24	7,774,979.95	591,808.54	904.00	2018-12-20	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	51.37	3.80	N.I.	N.I.	N.I.	880.00	N.I.	N.I.	N.I.	-	2018-12-19	2019-01-18
PZE-18	N.I.	7,775,025.08	591,853.24	7,774,979.95	591,808.54	904.00	2018-12-20	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	51.37	3.80	N.I.	N.I.	N.I.	866.50	N.I.	N.I.	N.I.	-	2018-12-19	2019-01-18
PZE-19	N.I.	7,775,025.08	591,853.24	7,774,979.95	591,808.54	904.00	2018-12-20	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	51.37	3.80	N.I.	N.I.	N.I.	853.00	N.I.	N.I.	N.I.	-	2018-12-19	2019-01-18
PZE-20	N.I.	7,775,016.32	591,794.72	7,774,971.19	591,750.02	898.56	2018-11-29	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	41.50	3.80	N.I.	N.I.	N.I.	875.57	N.I.	N.I.	N.I.	-	2018-11-29	2019-01-18
PZE-20A	N.I.	7,775,016.32	591,794.72	7,774,971.19	591,750.02	898.56	2018-11-29	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	41.50	3.80	N.I.	N.I.	N.I.	890.56	N.I.	N.I.	N.I.	-	2018-11-29	2019-01-18
PZE-21	N.I.	7,775,016.32	591,794.72	7,774,971.19	591,750.02	898.56	2018-11-29	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	41.50	3.80	N.I.	N.I.	N.I.	868.60	N.I.	N.I.	N.I.	-	2018-11-29	2019-01-18
PZE-22	N.I.	7,775,016.32	591,794.72	7,774,971.19	591,750.02	898.56	2018-11-29	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	41.50	3.80	N.I.	N.I.	N.I.	858.63	N.I.	N.I.	N.I.	-	2018-11-29	2019-01-18
PZE-36	N.I.	7,774,957.82	591,888.78	7,774,912.69	591,913.12	904.00	2018-11-26	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	50.50	3.80	N.I.	N.I.	N.I.	874.20	N.I.	N.I.	N.I.	-	2018-11-28	2019-01-18
PZE-37	N.I.	7,774,957.82	591,888.78	7,774,912.69	591,913.12	904.00	2018-11-26	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	50.50	3.80	N.I.	N.I.	N.I.	869.70	N.I.	N.I.	N.I.	-	2018-11-28	2019-01-18
PZE-38	N.I.	7,774,957.82	591,888.78	7,774,912.69	591,913.12	904.00	2018-11-26	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	50.50	3.80	N.I.	N.I.	N.I.	854.20	N.I.	N.I.	N.I.	-	2018-11-28	2019-01-18
PZE-39	N.I.	7,774,957.82	591,888.78	7,774,912.69	591,913.12	904.00	2018-12-04	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	35.00	3.80	N.I.	N.I.	N.I.	869.70	N.I.	N.I.	N.I.	-	2018-12-04	2019-01-18
PZE-40	N.I.	7,774,957.82	591,888.78	7,774,912.69	591,913.12	904.00	2018-12-04	Vibrating Wire	Active	Yes	N.I.	N.I.	N.I.	50.50	3.80	N.I.	N.I.	N.I.	854.20	N.I.	N.I.	N.I.	-	2018-11-30	2019-01-18

Note: 1. N.I. - No Information available.

2. Notes transcribed from Geotechnical Evaluation of Instrumentation at Dam I (Fugro 2018)

Table 6-1 - Installation Summary of Water Level Indicators
Report of the Expert Panel on the Technical Causes of the Failure of Feijão Dam I
Appendix C – Historical Instrumentation Data

Field Code	Geotec III Code	Latitude (UTM SAD69)	Longitude (UTM SAD69)	Latitude (UTM SIRGAS2000)	Longitude (UTM SIRGAS2000)	Surface Elevation (m)	Installation Date (YYYY-MM-DD)	Status (Active / Inactive)	Material Type within Location of Screen Interval	Top Elevation of Casing (m)	Bottom Elevation of Casing (m)	Tube Diameter (inches)	Length of Casing (m)	Alert Level (m)	Emergency Level (m)	Raising ID	Notes [2]	Period of Available Measurements (YYYY-MM-DD)	
																		Start	End
MNA 1C	CFJB1NA001	7,774,912.74	591,824.23	7,774,867.61	591,779.53	860.99	N.I.	Inactive	Tailings	861.99	861.11	N.I.	0.88	N.I.	N.I.	First	-	2007-12-27	2008-01-28
MNA 14C	CFJB1NA002	7,775,108.49	591,822.16	7,775,063.36	591,777.46	898.69	N.I.	Inactive	N.I.	899.69	874.79	N.I.	24.90	N.I.	N.I.	Third	-	1996-04-30	2005-08-25
PZ 16C	CFJB1NA009	7,775,126.80	591,867.16	7,775,081.67	591,822.46	904.40	N.I.	Inactive	N.I.	905.40	876.50	N.I.	28.90	N.I.	N.I.	Fourth	-	1996-04-30	1999-06-18
INA 01	CFJB1NA014	7,775,192.34	591,867.46	7,775,147.21	591,822.76	915.40	2005-10-17	Active	Tailings	916.52	895.72	1.50	20.80	915.52	N.I.	Sixth	Stable Readings	2006-01-12	2018-11-27
INA 02	CFJB1NA015	7,775,152.23	591,889.60	7,775,107.09	591,844.90	915.46	2005-10-18	Active	Tailings	916.65	895.60	1.50	21.05	N.I.	N.I.	Sixth	Stable Readings	2006-01-12	2018-12-04
INA 03	CFJB1NA016	7,775,127.79	591,865.23	7,775,082.66	591,820.53	904.15	2005-12-18	Active	Tailings	905.38	884.88	1.50	20.50	904.78	904.78	Fourth	Stable Readings	2005-12-25	2019-01-18
INA 05	CFJB1NA017	7,775,083.01	591,928.14	7,775,037.87	591,883.44	915.63	2005-12-22	Active	Tailings	916.83	896.01	1.50	20.82	N.I.	N.I.	Sixth	Stable Readings	2005-12-25	2019-01-18
INA 06	CFJB1NA018	7,775,057.77	591,883.37	7,775,012.64	591,838.67	897.73	2005-11-22	Active	Tailings	898.88	878.08	1.50	20.80	N.I.	N.I.	Third	-	2006-01-12	2018-12-13
INA 07	CFJB1NA019	7,775,026.10	591,979.85	7,774,980.96	591,935.15	922.00	2005-10-27	Active	Tailings	922.32	901.27	1.50	21.05	921.52	921.52	Seventh	Stable Readings	2006-01-12	2019-01-18
INA 08	CFJB1NA020	7,774,993.16	591,918.49	7,774,948.03	591,873.79	898.04	2005-10-24	Active	Tailings	899.19	878.11	1.50	21.08	898.29	898.29	Third	Stable Readings	2005-12-25	2018-12-13
INA 09	CFJB1NA021	7,774,909.28	592,045.45	7,774,864.14	592,000.75	922.40	2005-12-27	Active	Tailings	923.64	902.64	1.50	21.00	N.I.	N.I.	Seventh	Stable Readings	2006-01-12	2018-11-27
INA 10	CFJB1NA022	7,774,881.42	592,003.19	7,774,836.29	591,958.49	906.32	2005-11-28	Active	Tailings/Foundation Soil	906.32	885.41	1.50	20.91	N.I.	N.I.	Fourth	Stable Readings	2006-01-12	2018-11-27
INA 11	CFJB1NA023	7,775,286.48	591,850.42	7,775,241.35	591,805.72	920.86	2005-11-14	Active	Embankment	922.09	906.09	1.50	16.00	920.09	920.09	Seventh	Stable Readings	2005-11-30	2018-11-27
INA 12	CFJB1NA024	7,775,285.02	591,830.08	7,775,239.89	591,785.38	915.55	2005-11-07	Active	Embankment	916.81	905.91	1.50	10.90	914.82	N.I.	Sixth	Dry since Nov-2016	2006-01-12	2018-11-27
INA 13	CFJB1NA025	7,774,885.41	592,142.91	7,774,840.28	592,098.21	930.36	2005-12-09	Active	Embankment	931.40	910.33	1.50	21.07	N.I.	N.I.	Eighth	-	2005-12-25	2018-07-25
INA 14	CFJB1NA026	7,774,868.37	592,136.58	7,774,823.24	592,091.88	923.26	2005-11-30	Active	Embankment	924.27	913.22	1.50	11.05	N.I.	N.I.	Seventh	-	2006-01-12	2018-11-27
INA 17	CFJB1NA027	7,774,933.12	592,083.27	7,774,887.99	592,038.57	897.73	2005-12-19	Active	Embankment	898.89	876.44	1.50	22.45	897.45	N.I.	Third	-	2005-12-25	2018-11-27
INA 21	CFJB1NA028	7,775,005.34	591,930.82	7,774,960.21	591,886.12	904.62	2006-10-13	Active	Tailings	905.62	884.42	1.50	21.20	897.50	902.00	Fourth	Stable Readings	2008-01-07	2019-01-18
INA 22	CFJB1NA029	7,775,100.60	591,789.78	7,775,055.46	591,745.08	890.01	2006-10-10	Active	Tailings/Embankment	890.87	884.26	1.50	6.61	886.15	885.80	Second	-	2008-01-07	2018-12-13
INA 23	CFJB1NA030	7,774,868.01	591,957.89	7,774,822.87	591,913.19	893.15	2006-10-10	Active	Tailings/Embankment	894.40	887.40	1.50	7.00	N.I.	N.I.	Third	Dry since Feb-2016	2008-01-07	2018-12-13
INA 24	CFJB1NA031	7,775,289.10	591,894.96	7,775,243.96	591,850.26	937.19	2007-09-24	Active	Embankment	938.14	929.14	1.50	9.00	N.I.	N.I.	Ninth	Dry since Jan-2012	2008-01-07	2018-11-27
INA 25	CFJB1NA032	7,775,225.05	591,921.80	7,775,179.92	591,877.10	937.25	2007-09-19	Active	Tailings/Embankment	938.21	929.21	1.50	9.00	N.I.	N.I.	Ninth	Dry since Jan-2012	2008-01-07	2018-11-27
INA 26	CFJB1NA033	7,775,183.23	591,944.95	7,775,138.10	591,900.25	937.28	2007-09-18	Active	Embankment	938.33	929.33	1.50	9.00	N.I.	N.I.	Ninth	Dry since Jan-2012	2008-01-07	2018-11-27
INA 27	CFJB1NA034	7,775,113.71	591,983.53	7,775,068.58	591,938.83	937.29	2007-09-20	Active	Embankment	938.37	929.37	1.50	9.00	N.I.	N.I.	Ninth	Dry since Jan-2012	2008-01-07	2018-11-27
INA 28	CFJB1NA035	7,775,048.81	592,019.31	7,775,003.67	591,974.61	937.20	2007-09-17	Active	Embankment	938.28	929.28	1.50	9.00	N.I.	N.I.	Ninth	Dry since Jan-2012	2008-01-07	2018-11-27
INA 29	CFJB1NA036	7,774,934.70	592,085.12	7,774,889.57	592,040.42	937.19	2007-09-12	Active	Embankment	938.22	929.22	1.50	9.00	N.I.	N.I.	Ninth	Dry since Jan-2012	2008-01-07	2018-11-27
INA 30	CFJB1NA037	7,774,906.52	592,150.12	7,774,861.39	592,105.42	937.26	2007-09-11	Active	Embankment	938.27	929.27	1.50	9.00	N.I.	N.I.	Ninth	-	2008-01-07	2018-11-27
INA 31	CFJB1NA038	7,775,290.71	591,914.30	7,775,245.58	591,869.60	942.57	2013-04-14	Active	Embankment	943.52	937.78	1.00	5.74	N.I.	N.I.	Tenth	Dry since Jan-2012	2014-04-29	2018-11-27
INA 32	CFJB1NA039	7,775,235.41	591,940.15	7,775,190.28	591,895.45	942.52	2013-04-15	Active	Embankment	943.42	937.68	1.00	5.74	N.I.	N.I.	Tenth	Dry since Jan-2012	2014-04-29	2018-11-27
INA 33	CFJB1NA040	7,775,193.15	591,963.72	7,775,148.01	591,919.02	942.55	2013-04-16	Active	Embankment	943.53	937.66	1.00	5.87	N.I.	N.I.	Tenth	Dry since Apr-2012	2014-04-29	2018-11-27
INA 34	CFJB1NA041	7,775,123.87	592,002.00	7,775,078.74	591,957.30	942.61	2013-04-17	Active	Embankment	943.52	937.65	1.00	5.87	N.I.	N.I.	Tenth	Dry since Apr-2012	2014-04-29	2018-11-27
INA 35	CFJB1NA042	7,775,058.64	592,037.99	7,775,013.51	591,993.29	942.53	2013-04-18	Active	Embankment	943.44	937.55	1.00	5.89	N.I.	N.I.	Tenth	Dry since Apr-2012	2014-04-29	2018-11-27
INA 36	CFJB1NA043	7,774,946.41	592,103.72	7,774,901.28	592,059.02	942.58	2013-04-21	Active	Embankment	943.50	937.64	1.00	5.86	N.I.	N.I.	Tenth	Dry since Apr-2012	2014-04-29	2018-11-27
INA 37	CFJB1NA044	7,774,924.80	592,159.33	7,774,879.67	592,114.63	942.58	2013-04-22	Active	Embankment	943.49	937.62	1.00	5.87	N.I.	N.I.	Tenth	-	2014-04-29	2018-11-27
INA 38	CFJB1NA045	7,774,895.01	592,242.80	7,774,849.87	592,198.09	942.66	2013-04-23	Active	Embankment	943.55	937.83	1.00	5.72	N.I.	N.I.	Tenth	Dry since Apr-2012	2014-04-29	2018-11-27
INA 39/16	CFJB1NA046	7,775,122.25	591,774.68	7,775,077.12	591,729.98	897.81	2016-06-19	Active	Starter Dike	898.81	893.29	1.00	5.52	N.I.	N.I.	Second	Dry since Jun-2016	2016-10-03	2018-12-13
INA 40/16	CFJB1NA047	7,775,071.12	591,801.84	7,775,025.99	591,757.14	898.00	2016-06-19	Active	Embankment	899.00	895.71	1.00	3.29	N.I.	N.I.	Third	Stable Readings	2016-10-03	2018-12-13
INA 41/16	CFJB1NA048	7,775,007.24	591,838.57	7,774,962.11	591,793.87	898.37	2016-06-19	Active	Embankment	899.37	895.90	1.00	3.47	N.I.	N.I.	Third	Stable Readings	2016-10-03	2018-12-13
INA 42/16	CFJB1NA049	7,774,824.29	591,940.82	7,774,779.16	591,896.12	898.51	2016-06-19	Active	Left Shoulder	899.51	893.51	1.00	6.00	N.I.	N.I.	Third	Stable Readings	2016-10-03	2018-12-13
INA 43/16	CFJB1NA050	7,774,987.14	591,916.65	7,774,942.01	591,871.95	898.20	2016-06-19	Active	Tailings	899.20	896.12	1.00	3.08	N.I.	N.I.	Third	Stable Readings	2016-10-03	2018-12-13
INA 16.2	CFJB1NA051	7,775,070.23	591,897.75	7,775,025.10	591,853.04	904.96	2016-06-09	Active	Tailings	905.96	885.00	0.75	20.96	N.I.	N.I.	Fourth	Stable Readings	2017-01-19	2019-01-18
INA 16.1	N.I.	7,775,184.26	591,949.10	7,775,139.13	591,904.40	937.24	2016-09-08	Active	Tailings	938.24	909.11	0.75	29.13	N.I.	N.I.	Ninth	Stable Readings	2017-01-19	2018-11-27
INA 16.4	N.I.	7,775,110.21	591,826.58	7,775,065.07	591,781.88	898.42	2016-09-06	Active	Tailings	899.42	880.31	0.75	19.11	N.I.	N.I.	Third	-	2017-01-06	2018-11-27

Table 6-1 - Installation Summary of Water Level Indicators
Report of the Expert Panel on the Technical Causes of the Failure of Feijão Dam I
Appendix C – Historical Instrumentation Data

Field Code	Geotec III Code	Latitude (UTM SAD69)	Longitude (UTM SAD69)	Latitude (UTM SIRGAS2000)	Longitude (UTM SIRGAS2000)	Surface Elevation (m)	Installation Date (YYYY-MM-DD)	Status (Active / Inactive)	Material Type within Location of Screen Interval	Top Elevation of Casing (m)	Bottom Elevation of Casing (m)	Tube Diameter (inches)	Length of Casing (m)	Alert Level (m)	Emergency Level (m)	Raising ID	Notes [2]	Period of Available Measurements (YYYY-MM-DD)	
																		Start	End
INA 16.5	N.I.	7,775,023.00	591,943.88	7,774,977.86	591,899.18	909.65	2016-09-06	Active	Tailings	910.65	890.11	0.75	20.54	N.I.	N.I.	Fifth	Stable Readings	2017-01-19	2019-01-18
INA 04	N.I.	7,775,185.31	591,940.52	7,775,140.17	591,895.82	926.79	N.I.	Inactive	N.I.	927.79	907.59	N.I.	20.20	N.I.	N.I.	Eighth	-	2005-12-25	2006-04-29
INA 15	N.I.	7,775,050.75	592,017.36	7,775,005.61	591,972.66	926.30	N.I.	Inactive	N.I.	927.30	907.20	N.I.	20.10	N.I.	N.I.	Eighth	-	2005-12-25	2006-04-29
INA 16	N.I.	7,774,937.74	592,083.44	7,774,892.60	592,038.74	926.25	N.I.	Inactive	N.I.	927.25	907.15	N.I.	20.10	N.I.	N.I.	Eighth	-	2005-12-25	2006-04-29
INA 18	N.I.	7,775,116.66	591,979.51	7,775,071.52	591,934.81	926.11	N.I.	Inactive	N.I.	927.11	906.58	N.I.	20.53	N.I.	N.I.	Eighth	-	2005-12-25	2006-04-29
INA 19A	N.I.	7,774,930.66	591,851.26	7,774,885.53	591,806.56	871.53	N.I.	Inactive	Starter Dike	872.50	865.90	0.75	6.60	N.I.	N.I.	First	Stable Readings	2006-03-01	2006-04-29
INA 20A	N.I.	7,774,972.76	591,791.57	7,774,927.63	591,746.87	872.00	N.I.	Inactive	Starter Dike	873.00	866.00	N.I.	7.00	N.I.	N.I.	First	-	2006-03-01	2006-04-29

Notes: 1. N.I. - No Information available.

2. Notes transcribed from Geotechnical Evaluation of Instrumentation at Dam I (Fugro 2018)

Table 7-1 - Installation Summary of Flow Meters (Drains)
Report of the Expert Panel on the Technical Causes of the Failure of Feijão Dam I
Appendix C – Historical Instrumentation Data

Field Code	Geotec III Code	Previous Code	Latitude (UTM SAD69)	Longitude (UTM SAD69)	Latitude (UTM SIRGAS2000)	Longitude (UTM SIRGAS2000)	Surface Elevation (m)	Installation Date (YYYY-MM-DD)	Instrument Sub-type (Triangular / Direct)	Raising ID	Notes [2]	Period of Available Measurements	
												Start	End
D1 / DH36	CFJB1MI001	FEIBR1MV001	7,775,136.24	591,776.52	7,775,091.11	591,731.82	888.25	1993-06-01	Triangular	Third	Dry since May 2015	1996-04-01	2018-12-13
D10	CFJB1MI002	FEIBR1MV002	7,775,071.19	591,875.59	7,775,026.06	591,830.88	897.28	1995-06-01	Triangular	Fourth	Dry since May 2015	1996-04-01	2018-08-14
D11	CFJB1MI003	FEIBR1MV003	7,774,977.76	591,927.04	7,774,932.63	591,882.34	897.63	1995-06-01	Triangular	Fourth	Dry since May 2015	1996-04-01	2018-08-14
D12	CFJB1MI004	FEIBR1MV004	7,774,977.76	591,927.04	7,774,932.63	591,882.34	897.63	1995-06-01	Triangular	Fourth	Dry since May 2015	2004-01-01	2018-08-14
D13	CFJB1MI005	FEIBR1MV005	7,775,140.54	591,793.64	7,775,095.41	591,748.94	894.80	1993-06-01	Triangular	Third	Presents mesurable flowrates	2004-01-01	2018-12-13
D14	CFJB1MI006	FEIBR1MV006	7,774,997.55	591,852.40	7,774,952.42	591,807.69	894.96	1993-06-01	Triangular	Third	Presents mesurable flowrates	2004-01-01	2018-12-13
D15	CFJB1MI007	FEIBR1MV007	7,774,917.73	591,929.74	7,774,872.59	591,885.04	894.80	1993-06-01	Triangular	Third	Dry since February 2017	2004-01-01	2018-12-13
D16	CFJB1MI008	FEIBR1MV008	7,775,207.26	591,801.75	7,775,162.12	591,757.05	898.98	1995-06-01	Triangular	Fourth	Dry since May 2015	2004-01-01	2018-12-13
D17	CFJB1MI009	FEIBR1MV009	7,775,164.98	591,821.82	7,775,119.85	591,777.12	897.38	1993-06-01	Triangular	Third	Dry since May 2015	2004-01-01	2018-12-13
D18	CFJB1MI010	FEIBR1MV010	7,775,118.14	591,848.51	7,775,073.01	591,803.81	898.08	1995-06-01	Triangular	Fourth	Dry since May 2015	2004-01-01	2018-12-13
D19	CFJB1MI011	FEIBR1MV011	7,775,077.21	591,872.13	7,775,032.08	591,827.43	897.57	1995-06-01	Triangular	Fourth	Presents mesurable flowrates	2004-01-01	2018-08-14
D2	CFJB1MI012	FEIBR1MV012	7,775,038.37	591,802.09	7,774,993.24	591,757.39	887.62	1993-06-01	Triangular	Third	Dry since May 2015	1996-04-01	2018-08-14
D20	CFJB1MI013	FEIBR1MV013	7,775,053.76	591,884.62	7,775,008.62	591,839.92	897.72	1995-06-01	Triangular	Fourth	Dry since May 2015	2004-01-01	2018-12-13
D21	CFJB1MI014	FEIBR1MV014	7,775,033.98	591,895.50	7,774,988.85	591,850.80	897.89	1995-06-01	Triangular	Fourth	Dry since May 2015	2004-01-01	2018-08-14
D22	CFJB1MI015	FEIBR1MV015	7,775,015.71	591,905.39	7,774,970.58	591,860.69	897.97	1995-06-01	Triangular	Fourth	Dry since May 2015	2004-01-01	2018-12-13
D23	CFJB1MI016	FEIBR1MV016	7,774,997.11	591,915.86	7,774,951.98	591,871.16	898.04	1995-06-01	Triangular	Fourth	Dry since May 2015	2004-01-01	2018-12-13
D24	CFJB1MI017	FEIBR1MV017	7,774,986.64	591,921.72	7,774,941.51	591,877.02	898.01	1995-06-01	Triangular	Fourth	Dry since May 2015	2004-01-01	2018-12-13
D25	CFJB1MI018	FEIBR1MV018	7,774,936.58	591,948.80	7,774,891.45	591,904.10	897.99	1995-06-01	Triangular	Fourth	Dry since May 2015	2004-01-01	2018-12-12
D26	CFJB1MI019	FEIBR1MV019	7,774,884.92	591,977.06	7,774,839.79	591,932.36	897.72	1995-06-01	Triangular	Fourth	Dry since November 2016	2004-01-01	2018-12-13
D27	CFJB1MI020	FEIBR1MV020	7,775,242.57	591,801.49	7,775,197.44	591,756.79	904.31	1998-06-01	Triangular	Fifth	Dry since May 2015	2004-01-01	2018-07-17
D28	CFJB1MI021	FEIBR1MV021	7,775,184.26	591,832.87	7,775,139.13	591,788.17	904.13	1998-06-01	Triangular	Fifth	Dry since May 2015	2004-01-01	2016-06-22
D29	CFJB1MI022	FEIBR1MV022	7,775,140.72	591,857.52	7,775,095.59	591,812.82	904.22	1998-01-01	Triangular	Fifth	Dry since May 2015	2004-01-01	2016-06-22
D3	CFJB1MI023	FEIBR1MV023	7,774,953.11	591,951.60	7,774,907.98	591,906.90	887.98	1993-06-01	Triangular	Third	Dry since May 2015	1996-04-01	2018-08-14
D30	CFJB1MI024	FEIBR1MV024	7,775,097.15	591,882.19	7,775,052.02	591,837.48	904.30	1998-01-01	Triangular	Fifth	Dry since May 2015	2004-01-01	2016-05-27
D31	CFJB1MI025	FEIBR1MV025	7,775,053.92	591,906.13	7,775,008.79	591,861.42	904.29	1998-01-01	Triangular	Fifth	Dry since May 2015	2004-01-01	2016-06-22
D32	CFJB1MI026	FEIBR1MV026	7,775,010.99	591,930.11	7,774,965.85	591,885.40	904.54	1998-01-01	Triangular	Fifth	Dry since May 2015	2004-01-01	2016-06-22
D33	CFJB1MI027	FEIBR1MV027	7,775,132.72	591,882.22	7,775,087.58	591,837.52	909.08	2000-01-01	Triangular	Sixth	Dry since May 2015	2004-01-01	2016-06-22
D34	CFJB1MI028	FEIBR1MV028	7,775,032.49	591,936.77	7,774,987.36	591,892.07	909.15	2000-01-01	Triangular	Sixth	Dry since May 2015	2004-01-01	2016-06-22

Table 7-1 - Installation Summary of Flow Meters (Drains)
Report of the Expert Panel on the Technical Causes of the Failure of Feijão Dam I
Appendix C – Historical Instrumentation Data

Field Code	Geotec III Code	Previous Code	Latitude (UTM SAD69)	Longitude (UTM SAD69)	Latitude (UTM SIRGAS2000)	Longitude (UTM SIRGAS2000)	Surface Elevation (m)	Installation Date (YYYY-MM-DD)	Instrument Sub-type (Triangular / Direct)	Raising ID	Notes [2]	Period of Available Measurements	
												Start	End
D35	CFJB1MI029	FEIBR1MV029	7,774,965.24	591,973.37	7,774,920.10	591,928.67	909.56	2000-01-01	Triangular	Sixth	Dry since May 2015	2004-01-01	2016-06-22
D36	CFJB1MI030	FEIBR1MV030	7,774,852.35	592,071.04	7,774,807.22	592,026.34	910.11	2000-01-01	Triangular	Sixth	Dry since May 2015	2004-01-01	2016-06-22
D37	CFJB1MI031	FEIBR1MV031	7,774,849.36	592,070.98	7,774,804.22	592,026.28	910.17	2000-01-01	Triangular	Sixth	Dry since May 2015	2004-01-01	2018-12-13
D4	CFJB1MI032	FEIBR1MV032	7,774,856.57	591,949.70	7,774,811.44	591,905.00	887.94	1993-06-01	Triangular	Third	Dry since May 2015	1996-04-01	2018-08-14
D5	CFJB1MI033	FEIBR1MV033	7,774,975.61	591,825.58	7,774,930.47	591,780.88	882.04	1990-06-01	Triangular	Second	Presents mesurable flowrates	1996-04-01	2018-12-13
D6	CFJB1MI034	FEIBR1MV034	7,774,883.23	591,889.39	7,774,838.09	591,844.69	872.87	1990-06-01	Triangular	Second	Presents mesurable flowrates	1996-04-01	2018-12-13
D7	CFJB1MI035	FEIBR1MV035	7,774,876.48	591,897.67	7,774,831.35	591,852.97	874.10	1990-06-01	Triangular	Second	Presents mesurable flowrates	1996-04-01	2018-12-13
D8	CFJB1MI036	FEIBR1MV036	7,775,071.47	591,762.10	7,775,026.34	591,717.40	875.15	1990-06-01	Triangular	Second	Dry in July 2017	1996-04-01	2018-12-19
D9	CFJB1MI037	FEIBR1MV037	7,775,157.77	591,827.20	7,775,112.64	591,782.50	896.90	1995-06-01	Triangular	Fourth	Dry since May 2015	1996-04-01	2018-08-14
PS1	CFJB1MI038	FEIBR1MV038	7,775,136.24	591,776.52	7,775,091.11	591,731.82	890.26	1993-01-01	Triangular	Third	Dry in July 2017	1996-04-01	2018-12-13
PS1A	CFJB1MI039	FEIBR1MV039	7,775,170.85	591,783.96	7,775,125.72	591,739.26	893.69	1993-06-01	Triangular	Third	Dry since May 2015	1996-04-01	2018-12-13
PS2	CFJB1MI040	FEIBR1MV040	7,775,088.83	591,795.25	7,775,043.70	591,750.55	889.88	1993-06-01	Triangular	Third	Dry since May 2015	1996-04-01	2018-08-14
PS2A	CFJB1MI041	FEIBR1MV041	7,775,121.34	591,796.82	7,775,076.21	591,752.12	893.38	1993-06-01	Triangular	Third	Dry since May 2015	1996-04-01	2018-12-13
PS3A	CFJB1MI042	FEIBR1MV042	7,775,074.65	591,809.17	7,775,029.52	591,764.47	893.37	1993-06-01	Triangular	Third	Dry since May 2015	1996-04-01	2018-12-13
PS4	CFJB1MI043	FEIBR1MV043	7,774,994.58	591,834.32	7,774,949.45	591,789.62	890.88	1993-06-01	Triangular	Third	Dry since May 2015	1996-04-01	2018-12-13
PS4A	CFJB1MI044	FEIBR1MV044	7,775,025.44	591,822.12	7,774,980.31	591,777.42	893.40	1993-06-01	Triangular	Third	Dry since May 2015	1996-04-01	2018-12-13
PS5	CFJB1MI045	FEIBR1MV045	7,774,957.71	591,885.97	7,774,912.57	591,841.26	889.90	1993-06-01	Triangular	Third	Dry since May 2015	1996-04-01	2018-12-13
PS5A	CFJB1MI046	FEIBR1MV046	7,774,989.46	591,861.86	7,774,944.33	591,817.16	893.44	1993-06-01	Triangular	Third	Dry since May 2015	1996-04-01	2018-12-13
PS6	CFJB1MI047	FEIBR1MV047	7,774,906.43	591,921.88	7,774,861.30	591,877.18	889.56	1993-06-01	Triangular	Third	Presents mesurable flowrates	1996-04-01	2018-12-13
PS6A	CFJB1MI048	FEIBR1MV048	7,774,958.77	591,896.88	7,774,913.64	591,852.18	893.35	1993-06-01	Triangular	Third	Dry since May 2015	1996-04-01	2018-12-13
PS7	CFJB1MI049	FEIBR1MV049	7,774,860.08	591,954.86	7,774,814.94	591,910.16	889.79	1993-06-01	Triangular	Third	Dry since August 2016	1996-04-01	2018-12-13
PS7A	CFJB1MI050	FEIBR1MV050	7,774,917.52	591,926.05	7,774,872.39	591,881.35	893.14	1993-06-01	Triangular	Third	Dry in July 2017	1996-04-01	2018-12-13
PS8	CFJB1MI051	FEIBR1MV051	7,774,813.35	591,988.17	7,774,768.21	591,943.46	890.35	1993-06-01	Triangular	Third	Dry in September 2016	1996-04-01	2018-12-13
PS8A	CFJB1MI052	N.I.	7,774,875.79	591,955.25	7,774,830.65	591,910.55	893.11	1993-06-01	Triangular	Third	Presents mesurable flowrates	1996-04-01	2018-12-13
PS9A	CFJB1MI053	N.I.	7,774,836.26	591,983.13	7,774,791.13	591,938.43	893.46	1993-06-01	Triangular	Third	Dry since March 2016	1996-04-01	2018-12-13
N.I.	CFJBGMO003	N.I.	7,775,382.00	591,684.00	7,775,336.87	591,639.30	898.00	2016-11-03	Direct	Third	-	2013-01-04	2018-12-13

Note: 1. N.I. - No Information available.

2. Notes transcribed from Geotechnical Evaluation of Instrumentation at Dam I (Fugro 2018)

Table 8-1 - Installation Summary of Inclinometers
Report of the Expert Panel on the Technical Causes of the Failure of Feijão Dam I
Appendix C – Historical Instrumentation Data

Field Code	Geotec III Code	Latitude (UTM SAD69)	Longitude (UTM SAD69)	Latitude (UTM SIRGAS2000)	Longitude (UTM SIRGAS2000)	Surface Elevation (m)	Length (m)	Installation Date (YYYY-MM-DD)	Baseline Measurement Date	Period of Available Measurements	
										Start	End
INC-01	N.I.	7,775,131.76	591,859.69	7,775,086.62	591,814.99	905.50	45.00	N.I.	2016-05-11	2016-05-11	2018-12-28
INC-02	N.I.	7,775,066.27	591,898.02	7,775,021.13	591,853.32	905.50	35.00	N.I.	2016-08-17	2016-08-17	2018-12-28
INC-03	N.I.	7,775,192.14	591,872.17	7,775,147.01	591,827.47	923.00	53.50	2018-11-05	2018-12-03	2018-12-03	2018-12-27
INC-04	N.I.	7,775,094.89	591,952.24	7,775,049.76	591,907.54	923.60	69.00	2018-10-10	2018-12-03	2018-12-03	2018-12-27
INC-05	N.I.	7,775,045.30	591,819.13	7,775,000.17	591,774.43	895.10	48.00	2018-10-22	2018-12-03	2018-12-03	2018-12-28
INC-06	N.I.	7,774,903.36	592,039.16	7,774,858.23	591,994.46	923.00	44.50	2018-11-13	2018-12-03	2018-12-03	2018-12-28

Notes: 1. N.I. - No Information availale.

Table 9-1 - Installation Summary of Deep Horizontal Drains ("DHPs")
Report of the Expert Panel on the Technical Causes of the Failure of Feijão Dam I
Appendix C – Historical Instrumentation Data

Field Code	Latitude (UTM SAD69)	Longitude (UTM SAD69)	Latitude (UTM SIRGAS2000)	Longitude (UTM SIRGAS2000)	Surface Elevation (m)	Installation Dates		Pipe Diameter (inches)	Total Drain Length (m)	Non-perforated Pipe Length (m)	Drainage Cell (Perforated Pipe) Length (m)	Length of Grouting (m)	Weight of Sand Used (kg)	Slope (degrees)	Measurement Available (Yes / No)	Initial Water Flow		Period of Available Measurements (YYYY-MM-DD)	
						Start	End									(l/s)	(m3/h)	Start	End
DHP01	7775089.802	591868.708	7,775,044.67	591,824.01	898.57	2018-02-22	2018-03-05	2.00	34.00	4.00	30	3.00	625.00	+5	Yes	0.02	0.07	2018-05-18	2018-12-13
DHP02	7775048.575	591891.954	7,775,003.44	591,847.25	898.49	2018-03-12	2018-03-23	2.00	42.00	4.00	38	3.00	400.00	+5	Yes	No initial water flow		2018-05-18	2018-12-13
DHP03	7775022.871	591907.326	7,774,977.74	591,862.63	898.98	2018-03-26	2018-03-28	2.00	60.00	4.00	56	0.00	0.00	+5	Yes	0.09	0.33	2018-05-18	2018-12-13
DHP04	7775136.591	591763.758	7,775,091.46	591,719.06	882.43	2018-04-09	2018-04-09	2.00	25.00	4.00	21	3.00	275.00	+5	Yes	0.02	0.07	2018-05-18	2018-12-13
DHP05	7774846.952	591932.155	7,774,801.82	591,887.45	880.05	2018-04-12	2018-04-12	2.00	42.00	4.00	28	3.00	300.00	+5	Yes	0.24	0.86	2018-05-18	2018-05-18
DHP06 [1]	7774998.670	591919.180	7,774,953.54	591,874.48	910.34[4]	2018-04-16	2018-04-19	N.I.	N.I.	N.I.	N.I.	3.00	300.00	+5	No	No initial water flow		N.I.	N.I.
DHP07	7774992.062	591924.451	7,774,946.93	591,879.75	899.16	2018-04-20	2018-04-23	2.00	32.00	4.00	28.00	3.00	250.00	+5	Yes	No initial water flow		2018-05-18	2018-12-13
DHP08	7774996.070	592047.150	7,774,950.94	592,002.45	941.00[4]	2018-04-24	2018-04-25	2.00	42.00	4.00	38.00	3.00	450.00	+5	No	No initial water flow		N.I.	N.I.
DHP09	7775309.790	591870.350	7,775,264.66	591,825.65	944.00[4]	2018-04-26	2018-04-27	2.00	40.00	2.00	37.00	3.00	500.00	+5	No	No initial water flow		N.I.	N.I.
DHP10	7775239.130	591827.950	7,775,194.00	591,783.25	919.81[4]	2018-05-02	2018-05-03	2.00	50.00	4.00	46.00	3.00	525.00	+5	No	No initial water flow		N.I.	N.I.
DHP11	7774972.628	591932.997	7,774,927.50	591,888.30	898.81	2018-05-04	2018-05-08	2.00	78.00	6.00	72.00	3.00	550.00	+5	Yes	0.32	1.17	2018-05-18	2018-12-13
DHP12	7775065.704	591882.787	7,775,020.57	591,838.09	898.55	2018-05-10	2018-05-15	2.00	69.00	6.00	63.00	3.00	625.00	+5	Yes	0.41	1.48	2018-05-18	2018-12-13
DHP13	7775003.084	591917.837	7,774,957.95	591,873.14	899.06	2018-05-16	2018-05-17	2.00	70.00	6.00	64.00	3.00	575.00	+5	Yes	0.11	0.39	2018-06-13	2018-12-13
DHP14	7774955.847	591945.063	7,774,910.71	591,900.36	899.28	2018-06-07	2018-06-08	2.00	82.00	6.00	76.00	N.I.	650.00	0	Yes	N.I.		2018-06-13	2018-12-13
DHP15 [1],[3]	7775045.784	591767.640	7,775,000.65	591,722.94	873.79	2018-06-11	2018-06-13	2.00	61.00	6.00	55.00	N.I.	N.I.	0	Yes	N.I.		2018-07-17	2018-12-13

Notes:
1. DHPs not installed, drilled explorations backfilled with sand and grout.
2. N.I. - No Information.
3. DHP15 was not completed, but flow measurements were recorded for this location as presented in Table 9-2. No information is available regarding the details of any device at the DHP15 location

Table 9-2 - Measurement Data Summary of Deep Horizontal Drains ("DHPs")
Report of the Expert Panel on the Technical Causes of the Failure of Feijão Dam I
Appendix C – Historical Instrumentation Data

DHP Location	Drain Flow (m^3/h)					
	2018-05-18	**2018-06-13**	**2018-07-17**	**2018-10-11**	**2018-11-12**	**2018-12-13**
DHP01	0.069	Dry	0.020	0.019	0.019	0.019
DHP02	Damaged	Damaged	Damaged	Damaged	Damaged	Damaged
DHP03	0.331	Dry	0.183	0.157	0.155	0.155
DHP04	0.067	0.203	0.056	0.033	0.033	0.033
DHP05	0.857	N.I.	N.I.	N.I.	N.I.	N.I.
DHP07	Dry	Dry	Dry	Dry	Dry	Dry
DHP11	1.166	0.906	0.893	0.814	0.795	0.795
DHP12	1.477	1.163	1.071	0.602	0.892	0.900
DHP13	N.I.	0.135	0.143	0.087	0.087	0.092
DHP14	N.I.	1.456	1.052	0.910	0.769	0.629
DHP15	N.I.	N.I.	0.013	0.012	0.011	N.I.

Notes:

1. N.I. - No Information.