FROM: GW Solutions Inc.

TO: Julie Pisani

DATE: May 15, 2017

SUBJECT: Update on the project - Surface Water and Groundwater Interaction in the Englishman River

1 BACKGROUND

GW Solutions has been working with the Mid Vancouver Island Habitat Enhancement Society (MVIHES) to better understand the interactions between surface water and groundwater in the Englishman River (ER) Watershed. The project has been divided into two phases: Phase 1 (completed) focused on overburden aquifers (sand and gravel) along the ER (below 16.5 km – measured from the estuary), and included an assessment of the water flux between the aquifers and the river; and, Phase 2 (in progress) which focuses on understanding the role of bedrock in the groundwater system of the ER Watershed. Community involvement and aquifer monitoring were the driving factors behind these two phases of the project.

2 OBJECTIVES

The Regional District of Nanaimo (RDN) has funded the interpretation and update of the ongoing Phase 2. GW Solutions has been retained to update the data with the following objectives:

- To integrate the recently downloaded loggers' data (both bedrock wells and surface water) into the historical information;
- To draft this document summarizing the results and providing an interpretation of the data; and
- To prepare and deliver a presentation to the Englishman River Watershed residents.

3 DATA UPDATE AND INTEGRATION TO THE HISTORICAL INFORMATION

In December 2016, GW Solutions received data logger information from ten bedrock wells and from five surface water monitoring stations. The historical and recent data have been integrated using Tableau, which is a software used to display and analyze large and complex data sets.

Table 1 shows the available data for the Englishman River Watershed project. There are 13 overburden wells (private/volunteer) with available water level data from 2009 to 2014, and 13 bedrock wells (private/volunteer) for which water levels have been monitored from 2009 to present.

In addition, there are 17 provincial observation wells included in the ER Project database from which only one is completed in bedrock (OW287); two wells do not have historical water level data.

The database includes six surface water monitoring stations from which one corresponds to the Water Survey Canada station (ID 08HB002, name: ENGLISHMAN RIVER NEAR PARKSVILLE). This federal station has been monitoring discharge since 1913 and water levels since 2011. The remaining five stations where installed as part of the Englishman River Project, Phase 2. There are two sets of available information for these recently installed stations: the first set covers data from May to October 2015 and the second set covers date from July to October 2016.

We have also compiled precipitation information from two Water Survey Canada stations: Station ID 157 (COOMBS) covers data from 1984 to 2006, and station ID 45627 (QUALICUM BEACH AIRPORT) covers data from 2007 to 2017.

The locations of all the monitoring stations for the Englishman River Watershed project are displayed in Figure 1. Figure 2 to 5 show the location of each type of well (private/volunteer, provincial observation wells, surface water stations, and precipitation gauges).

4 RESULTS

4.1 Water Levels

Both depth-to-water for wells and water level for surface water stations were converted to water elevation (referring to mean sea level) using ground elevation from a survey completed in Phase 1 and from the Digital Elevation Model (30 m x 30 m) from Natural Resources Canada (NRCAN).

Water levels are monitored every six hours in the wells and every hour in the surface water stations. Plots of groundwater elevation vs time, including daily total precipitation for all the private/volunteer bedrock wells, are presented in Appendix 1. To present cleaner water level information and to avoid the effects of pumping, data has been filtered to only show water levels measured at 4am.

Table 2 summarizes the main features of the historical water level for the private/volunteer bedrock wells; minimum water levels are recorded from August to October and maximum water levels are recorded from December to March. The low and high water levels coincide with the months of minimum and maximum precipitation. Figure 9 shows the total monthly precipitation from 2009 to 2016.

The groundwater fluctuation can be grouped into three categories: four wells with a groundwater fluctuation less than 1.5 m (ERR Deep, Grieg, Margot, Matthew Deep), three wells with a groundwater fluctuation between 1.5 m and 2 m (Bellevue, Leffler, and Martindale) and two wells with a groundwater fluctuation greater than 2 m (Lana and Lt. Mountain). Larger groundwater fluctuations are expected in bedrock wells located in a recharge zone with usually higher water elevations which may be the case of Lana and Lt. Mountain wells. Additionally, the Lana well has been completed in a deep fracture bedrock aquifer with water levels ranging from 70 to 100 m below ground. The water level of the Lana well is the deepest of all the wells within the ER project.

Based on the short monitoring period of the private/volunteer bedrock wells, two wells (Bellevue and Matthew Deep) reported a decreasing groundwater level trend and one well showed an increasing trend (ERR Deep). Most of the private/volunteer bedrock wells have less than four years of data; however, at least five years of continuous monitoring data is required to conclude if the noticed trends are due to climate factors (precipitation), connection to the surface water bodies (surface water-groundwater interaction), urbanization factors (reduced recharge areas due to impermeabilization of surfaces), or aquifer over-pumping (presence of other pumping wells).

Appendix 2 shows the monthly box and whisker summary diagram for all the private/volunteer bedrock wells. The whiskers represent the minimum and maximum values recorded and the box represents the values between the 25% and 75% percentiles, with the median illustrated by the light /dark boundary in the box.

4.2 Flows at the Surface Water Stations

Figure 8 displays the monthly discharge boxplot for the federal surface water station (ID 08HB002). The lowest flows are recorded in July through September with an average median monthly flow (data from 2009 to 2016) of 1.9 m^3/s. The maximum average median monthly flow is in November with a value of 19.2 m^3/s which represents 10 times the lowest average median monthly flow. The discharge rate for station 08HB002 follows the precipitation frequency as showed in Figure 9, with the lowest precipitation occurring between June and September.

Figure 10 and Figure 11 show the discharge monitoring results for the six surface water stations along the Englishman River. US and DS refers to “upstream” and “downstream”, respectively. Stations have been located upstream and downstream of the ER Falls because we wanted to know if the faults intersecting the ER were either contributing water or withdrawing water. The selection of the two stations, both located upstream of the South ER confluence, was based on the same rationale.

Very little precipitation was recorded between May 19 to August 28, 2015 and July 06 to August 30, 2016. Figure 12 shows the daily average discharge for each station considering these two data ranges (May-August 2015 and July-August 2016).

Similar trends are observed for both years where the flow at the Control site (26.1 km upstream from shore) is the lowest.

There is an average increase of flow of 24% from the Control site to the US Falls site; this may be partiality due to the contribution of many tributaries (including Moriarty Creek) to the ER.

Between US Falls and DS Hatchery stations the flow drops by approximately 6%; this suggests the ER loses water, thus recharging the fractured bedrock aquifer.

Finally, there is a substantial increase in flow at the mouth of the Englishman River Watershed (08HB002). For instance, between DS Hatchery, located 8.0 km upstream from shore, and 08HB002 (1.7 km from shore) there is an increase of flow of 29% (average of both years). This increase in flow is likely due to groundwater contribution to the ER and the flow from its tributaries.

5 CONCLUSIONS

Based on the work completed, GW Solutions draws the following conclusions:

- The lowest groundwater levels in the private/volunteer bedrock wells were recorded from August to October and the highest water levels were recorded from December to March.
- Groundwater fluctuation in the private/volunteer bedrock wells varies from 0.2 m to 11 m. Seven wells have groundwater fluctuation less than 2 m and only two wells have groundwater fluctuation between 6 m to 11 m.
- Most of the bedrock wells depict a stable groundwater elevation trend; however, there are two wells where a decreasing trend and one well where an increasing trend has been observed.
- Considering 2009-2016 flow data for the federal surface water station (08HB002), the following comments can be made:
    - The lowest flow occurs from July to September with an average median daily flow of 1.9 m^3/s;
    - The highest flow occurs in November with an average median daily flow of 19 m^3/s;
    - The discharge pattern follows the frequency and rate of the precipitation;
    - During the driest periods, May to August, there is a considerable increase in flow in the ER in its last 8 km; this results from the contribution of both groundwater and flow from tributaries.

- Considering the surface water elevation and flow data, the following observations can be made:
  - The major faults located between US Falls and DS Hatchery may be acting as sinks of groundwater because the flow appears to decrease along that section of the river. Figure 6 and Figure 7 show the detailed location of US/DS Falls and US/DS Hatchery sites, respectively.
  - During dry periods, between the Control site (located approximately 26.1 km from the estuary) and the WSC station (08HB002) located at the orange bridge (1.7 km from estuary), flow increases by approximately 30%.

6 RECOMMENDATIONS

Following this completed review, GW Solutions makes the following recommendations:

- Continue collecting information of all the private/volunteer bedrock wells and the surface water stations.
- Some wells require a more detailed analysis because of the observed trends or reported data: a) the well labelled as “ERR Deep” where groundwater levels indicate an increasing trend; this well is located less than 130 m from the ER, and b) the well labelled ‘’Lana” which presents the largest amplitude of fluctuation of the groundwater level.
- Re-start water level monitoring in the well labelled as Matthew Shallow (completed in an overburden aquifer). At this location, the groundwater elevation of the nearby bedrock well labelled as Matthew Deep is approximately 6 m higher, indicative of an upward groundwater flow from bedrock to the overburden aquifer.
- Integrate all the water quality information collected over the years into the Tableau data frame.
- Analytical models have been used for most of the estimations completed in this project (Phase 1 and Phase 2); however, analytical models are based on many assumptions and simplifications (idealizations). Sufficient data has been collected to date to support the completion of numerical model that may more accurately define the groundwater-surface water interaction regime. GW Solutions recommends considering the completion of a surface water-groundwater interaction numerical model for the 40 km long Englishman River. The model

should include: a detailed 3D conceptual model for the whole watershed, water level data, flow data, aquifer properties information, surface water monitoring information data, recharge data, and water use/consumption information. The main outputs from the numerical model will be: groundwater flux estimations along the River including, definition of losing/gaining sections, groundwater flow direction in the different aquifers of the Englishman River Watershed, grid distribution of recharge across the entire watershed, calibration of aquifer properties for the different set of aquifers, sensitivity analysis of water levels including the analysis of climate factors, groundwater usage, connection to surface water bodies, and urbanization.

Table 1. Data available within the Tableau data frame for the Englishman River Watershed

Monitoring group	No	Station ID	Data available from	Data available to	Data type
Precipitation	1	Precipitation	1/1/1984	12/31/2017	Total daily precipitation
Surface water stations	1	08HB002	1/1/1980	4/25/2017	Level and discharge
	2	Control	5/20/2015	10/7/2016	Level and discharge
	3	DS Falls	5/29/2015	10/11/2016	Level and discharge
	4	DS Hatchery	5/19/2015	10/11/2016	Level and discharge
	5	US Falls	6/12/2015	10/11/2016	Level and discharge
	6	US Hatchery	5/29/2015	10/11/2016	Level and discharge
Bedrock wells (Private/volunteer)	1	Bellevue	12/12/2013	11/18/2016	Water level
	2	Benzon	8/17/2009	8/12/2010	Water level
	3	ERR Deep	7/17/2013	11/23/2016	Water level
	4	ERR Shallow	7/17/2013	3/18/2014	Water level
	5	Fisher	7/5/2013	11/18/2016	Water level
	6	Grieg	6/25/2013	11/17/2016	Water level
	7	Lana	12/11/2013	2/16/2016	Water level
	8	Leffler	6/25/2013	11/23/2016	Water level
	9	Lt. Mountain	8/30/2010	11/18/2016	Water level
	10	Margot	8/17/2009	11/23/2016	Water level
	11	Martindale	10/24/2011	11/17/2016	Water level
	12	Matthew Deep	2/11/2014	11/23/2016	Water level
	13	Peterson	6/25/2013	1/31/2014	Water level
Overburden wells (Private/volunteer)	1	Butler	8/30/2010	1/31/2014	Water level
	2	Errington	8/17/2009	6/25/2013	Water level
	3	Fire Centre	9/30/2010	1/31/2014	Water level
	4	Highway Scale	8/30/2010	1/31/2014	Water level
	5	IT Yard	9/30/2010	2/11/2014	Water level

Monitoring group	No	Station ID	Data available from	Data available to	Data type
	6	Maple	8/30/2010	12/12/2013	Water level
	7	Matthew Shallow	8/12/2010	12/11/2013	Water level
	8	Paradise	8/17/2009	12/11/2013	Water level
	9	Rascal	7/11/2011	6/25/2013	Water level
	10	Rathrevor Maint Yd	9/24/2010	1/31/2014	Water level
	11	Rathrevor Nature House	9/24/2010	6/25/2013	Water level
	12	TH4	3/22/2011	6/25/2013	Water level
	13	Wildgreen	8/17/2009	7/22/2011	Water level
Provincial bedrock obs. wells	1	OW287	3/12/1984	4/11/2017	Water level
Provincial overburden obs. wells	1	OW231	No data	No data	
	2	OW235	No data	No data	
	3	OW295	11/26/1986	4/11/2017	Water level
	4	OW303	9/8/1988	1/23/2017	Water level
	5	OW304	10/3/1988	2/1/2017	Water level
	6	OW313	1/8/1992	12/9/1992	Water level
	7	OW314	1/25/1992	4/11/2017	Water level
	8	OW321	12/15/1992	1/23/2017	Water level
	9	OW392	3/29/2011	4/11/2017	Water level
	10	OW393	3/29/2011	4/11/2017	Water level
	11	OW395	4/20/2012	12/8/2016	Water level
	12	OW396	4/27/2012	1/9/2017	Water level
	13	OW398	2/19/2013	1/23/2017	Water level
	14	OW424	1/4/2013	4/11/2017	Water level
	15	OW433	9/3/2013	1/23/2017	Water level
	16	OW434	4/3/2013	1/23/2017	Water level

Table 2. Summary of main observations of historical groundwater elevation for the private/volunteer bedrock wells

No	Station ID	Data range	Trend	Month maximum gw level	Month minimum gw level	Average minimum gw elevation (masl)	Average maximum gw elevation (masl)	Average gw fluctuation (m)	Comment
1	Bellevue	2013-2016	Decreasing	March	August	115.99	117.69	1.70	
2	Benzon	2009-2010							Not enough data
3	ERR Deep	2013-2016	Increasing	March	September	54.61	54.81	0.20	
4	ERR Shallow	2013-2014							Not enough data
5	Fisher	2013-2016							Not enough data
6	Grieg	2013-2016	Stable	March	September	3.19	3.67	0.48	
7	Lana	2013-2016	Stable	February	October	53.14	64.06	10.92	
8	Leffler	2013-2016	Stable	February	October	111.56	113.07	1.51	Decreasing in 2016
9	Lt. Mountain	2010-2016	Stable	December-March	September	123.96	130.36	6.40	Increasing in 2016
10	Margot	2009-2016	Stable	May	September-October	53.76	54.41	0.65	
11	Martindale	2011-2016	Stable	March	August	13.28	15.23	1.95	
12	Matthew Deep	2014-2016	Decreasing	March	September-October	96.73	97.36	0.63	Slightly decreasing trend
13	Peterson	2013-2014			October				Not enough data

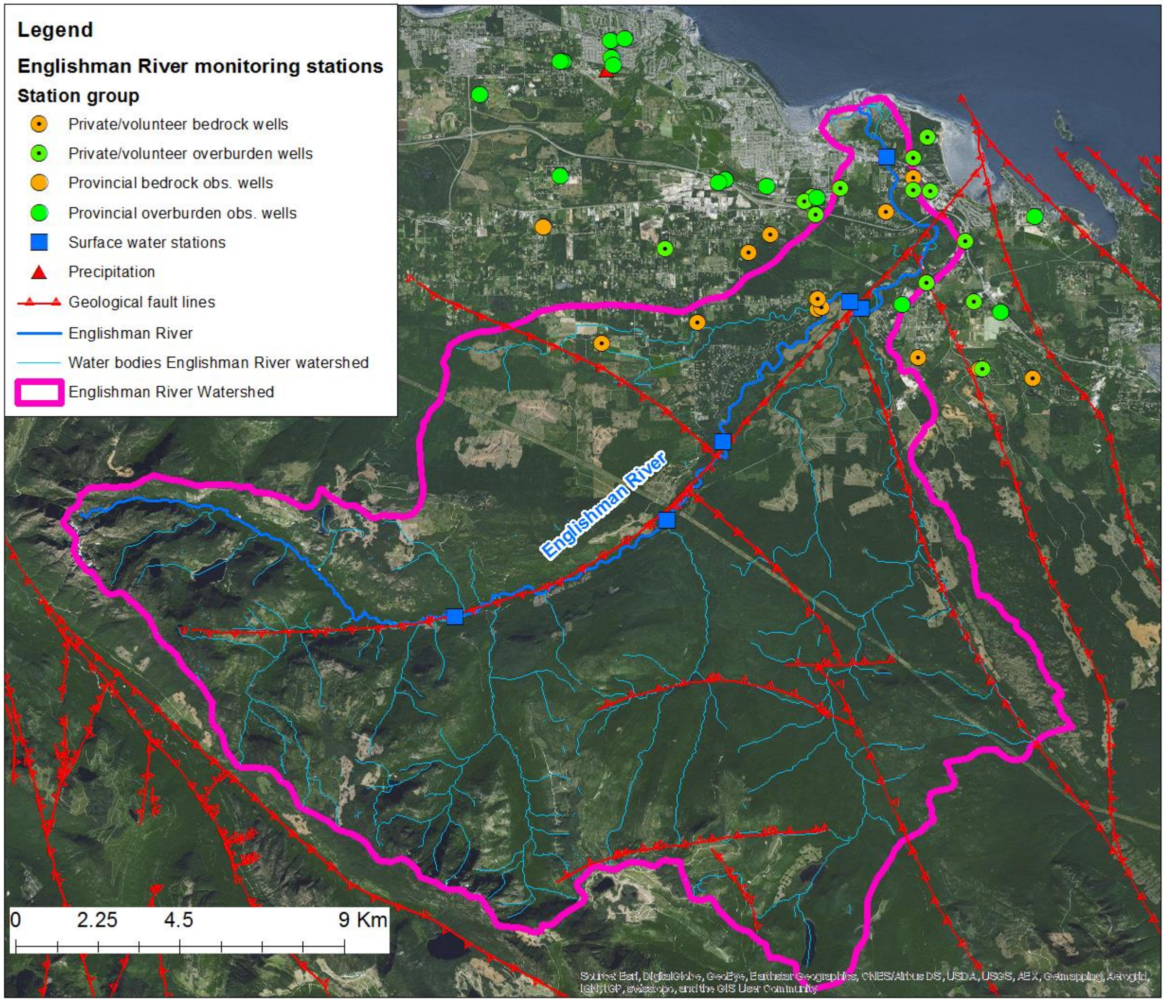

Figure 1. Location of all the monitoring stations included in the Tableau data frame

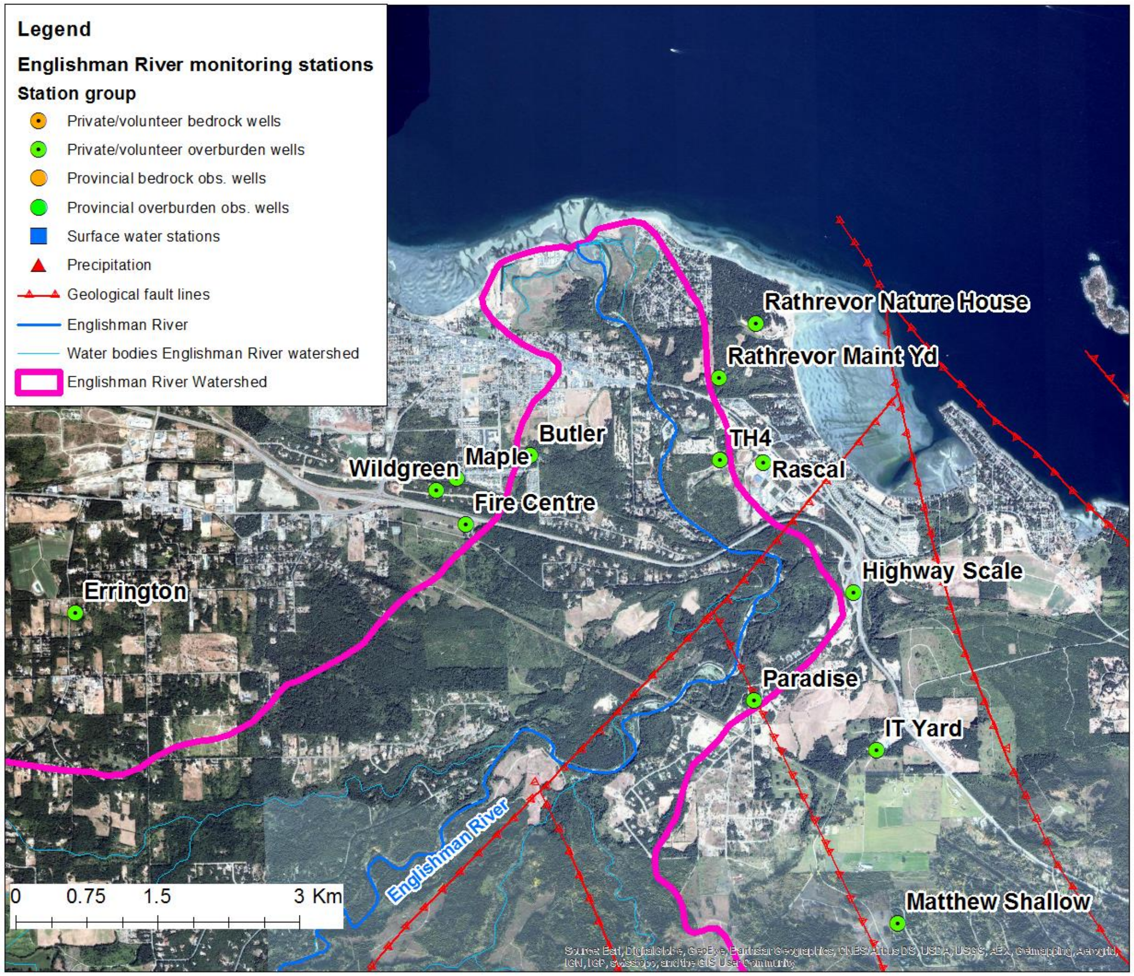

Figure 2. Location of the private/volunteer overburden wells

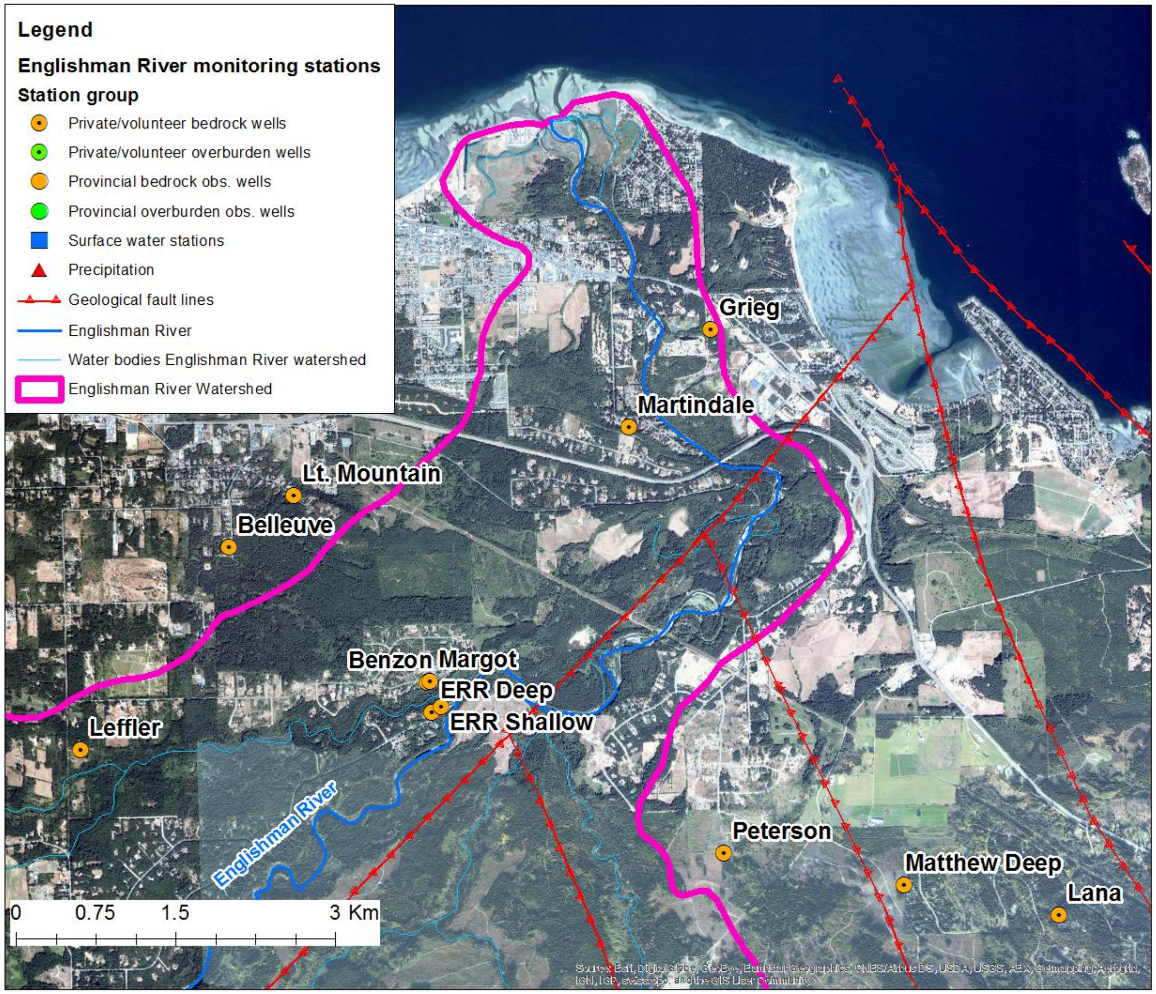

Figure 3. Location of the private/volunteer bedrock wells

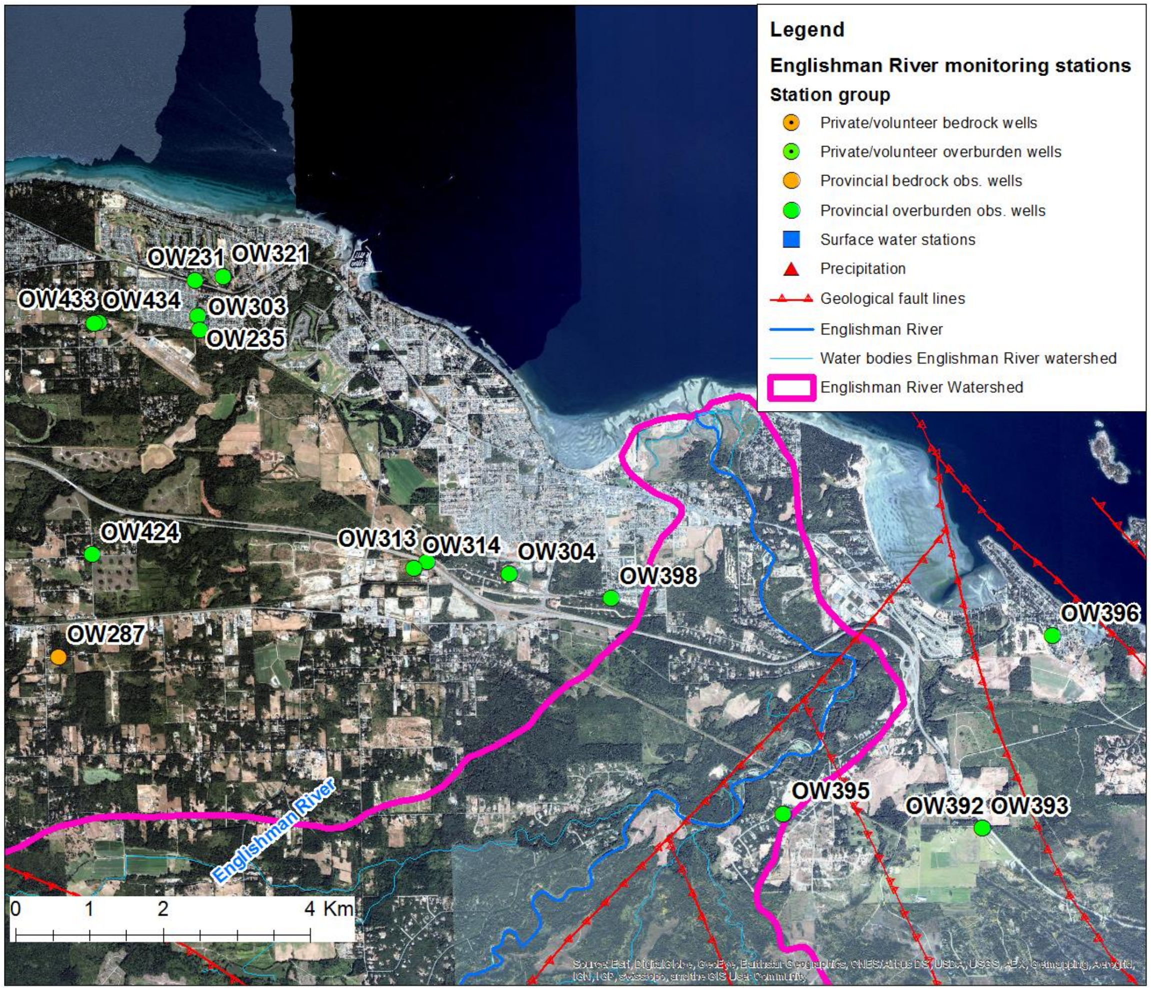

Figure 4. Location of the provincial observation wells both for bedrock and overburden aquifers

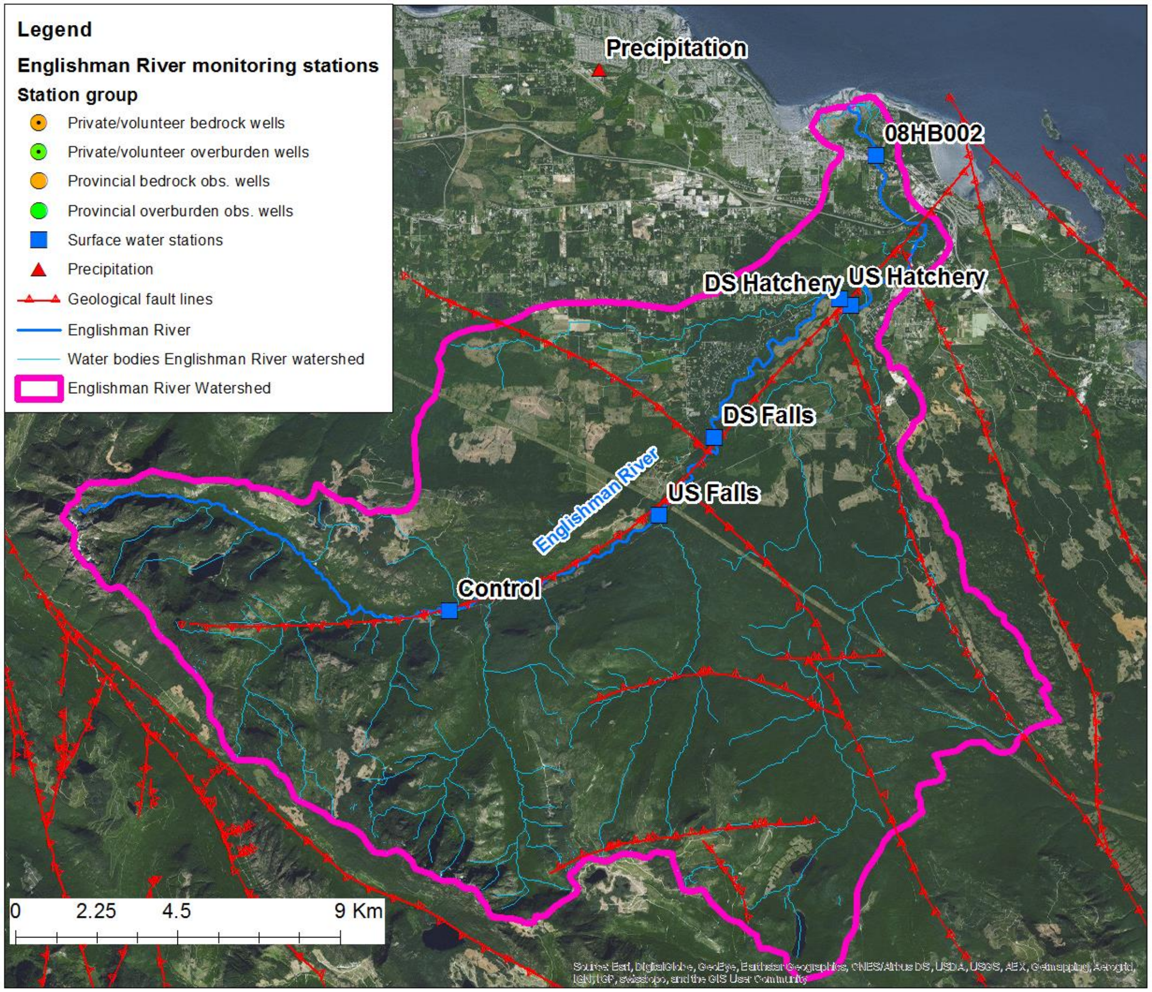

Figure 5. Location of surface water monitoring stations including the precipitation station

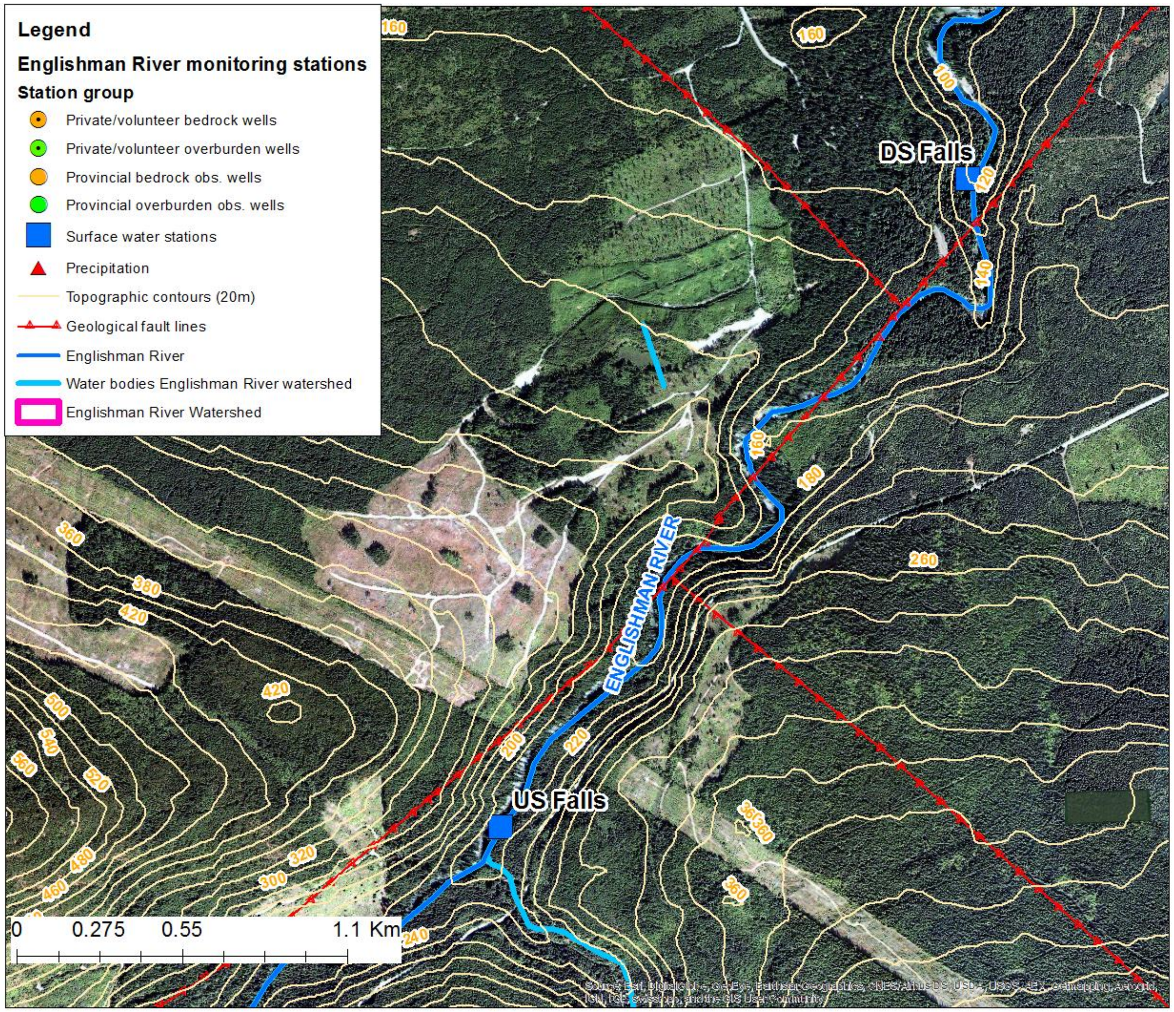

Figure 6. Detailed location of the US/DS Falls surface water stations

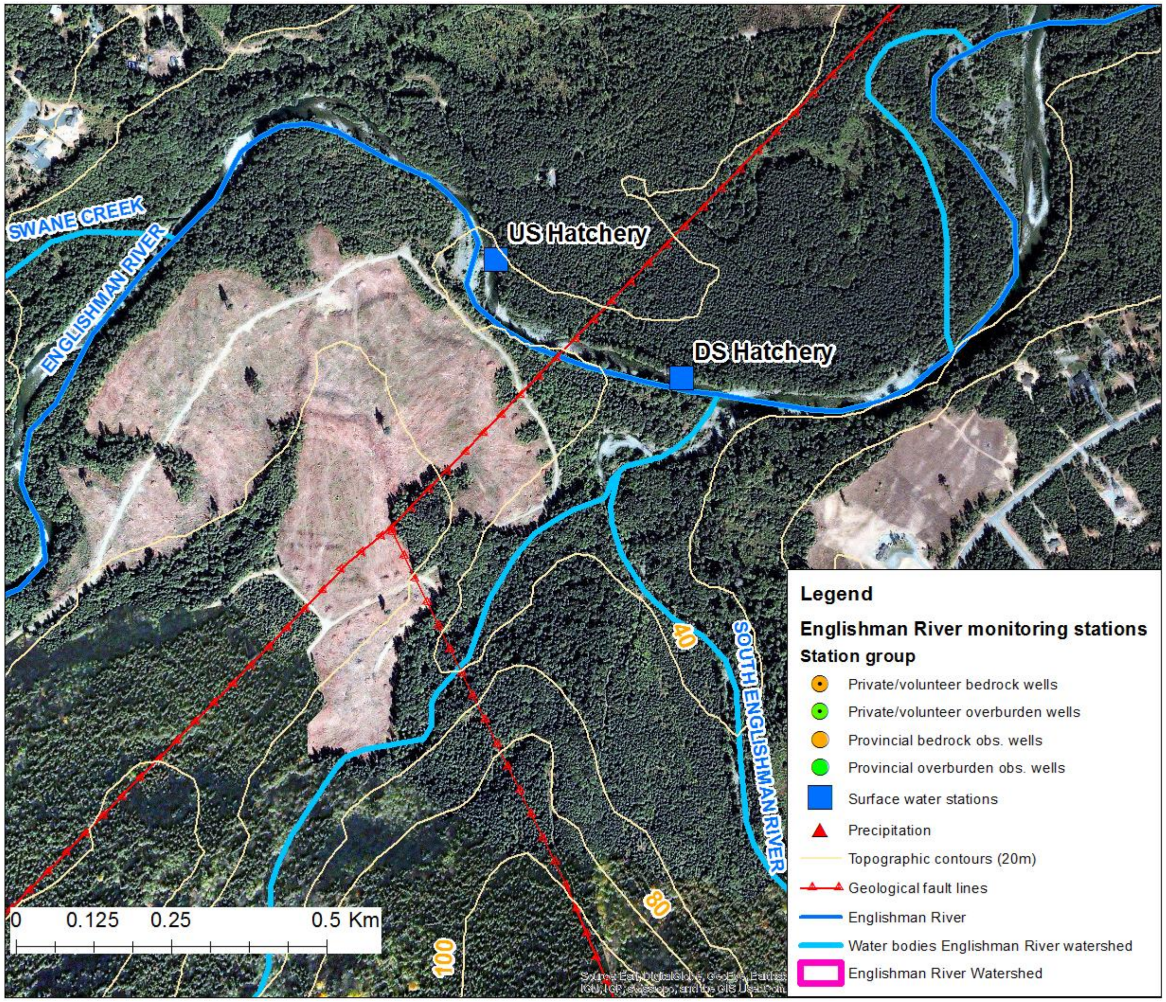

Figure 7. Detailed location of the US/DS Hatchery surface water stations

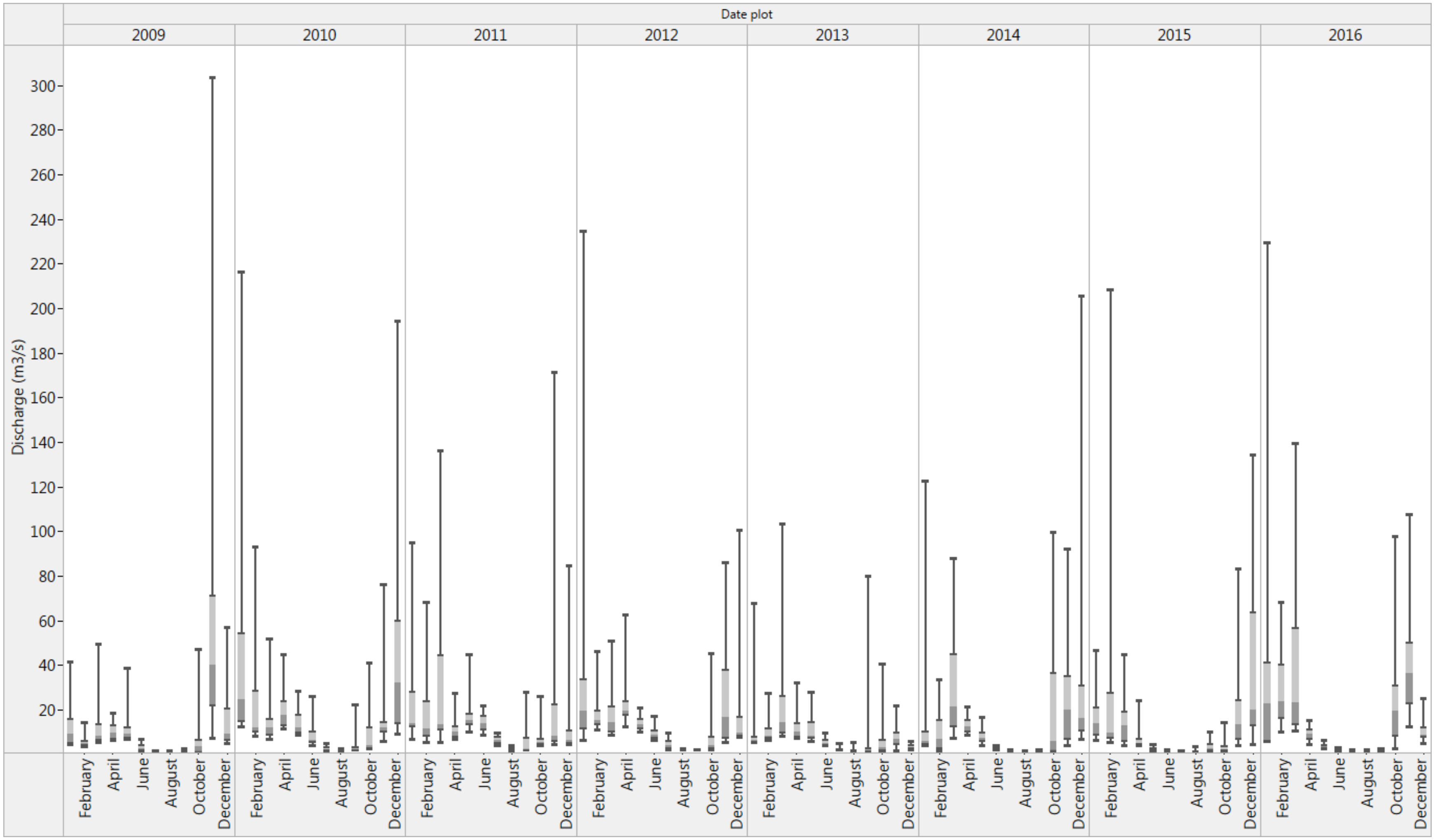

Figure 8. Monthly box and whisker diagram for the federal surface water station 08HB002

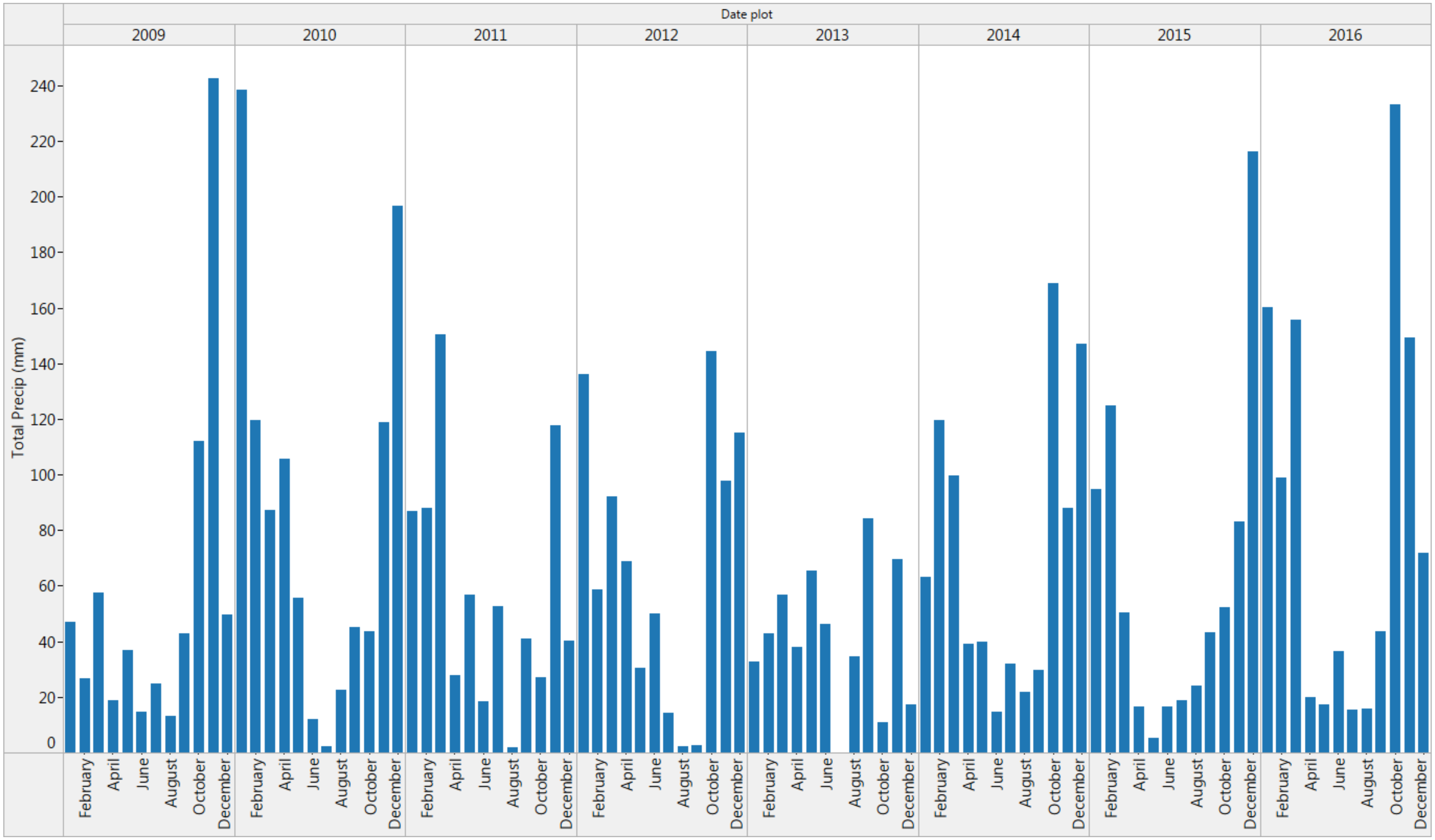

Figure 9. Monthly Total precipitation from 2009 to 2016

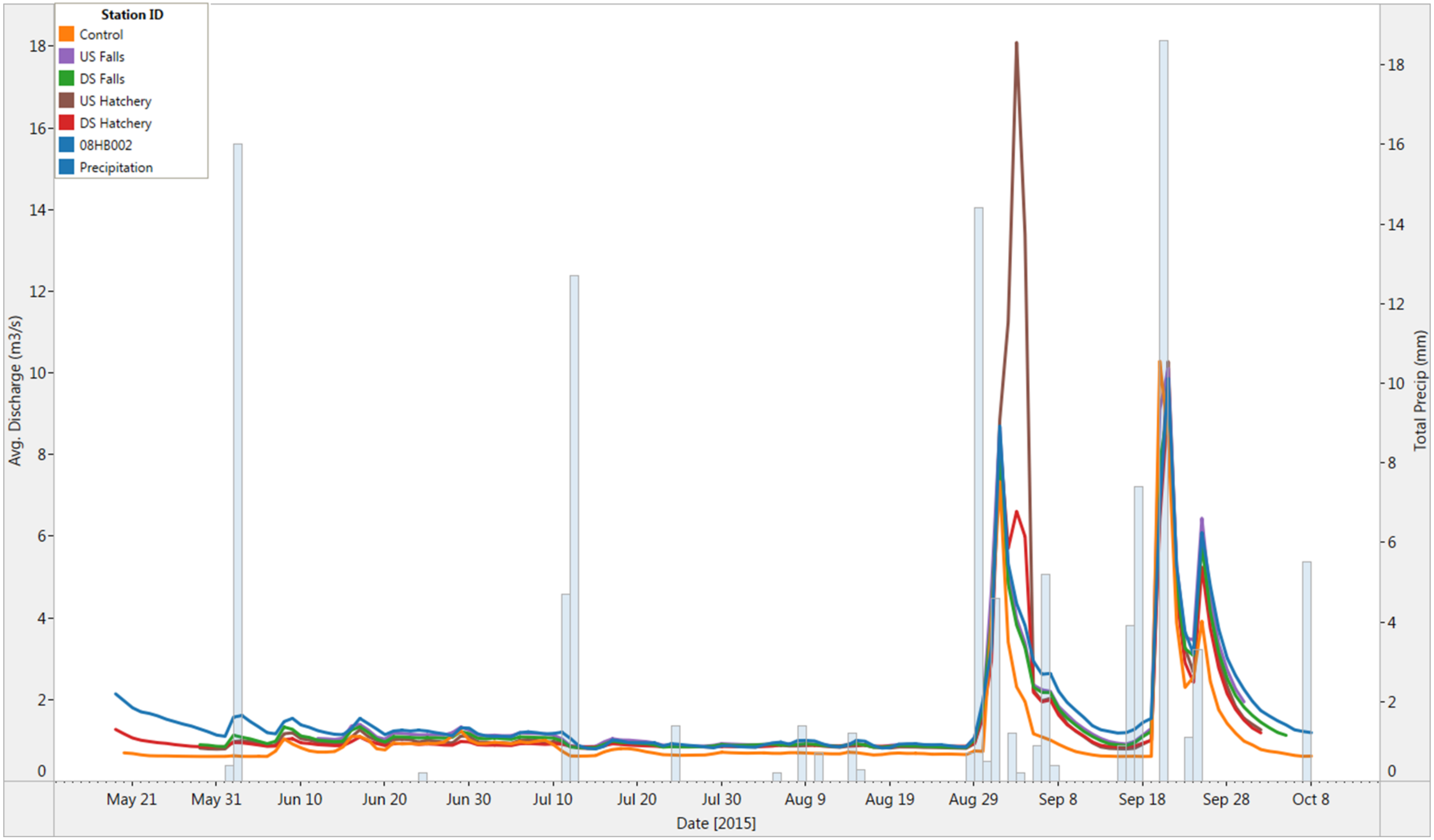

Figure 10. Average daily discharge for the six surface water monitoring stations from May to October 2015

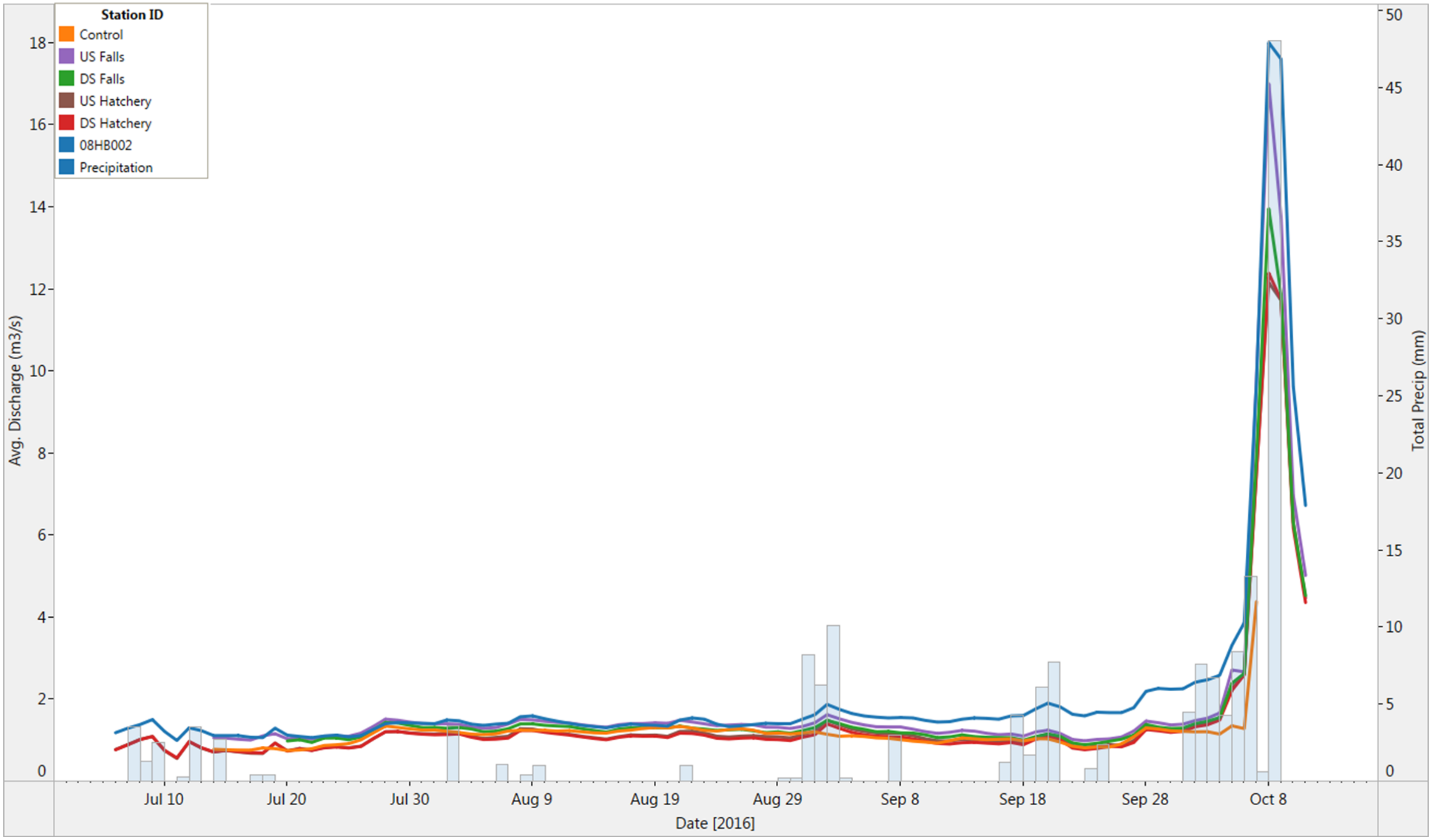

Figure 11. Average daily discharge for the six surface water monitoring stations from July to October 2016

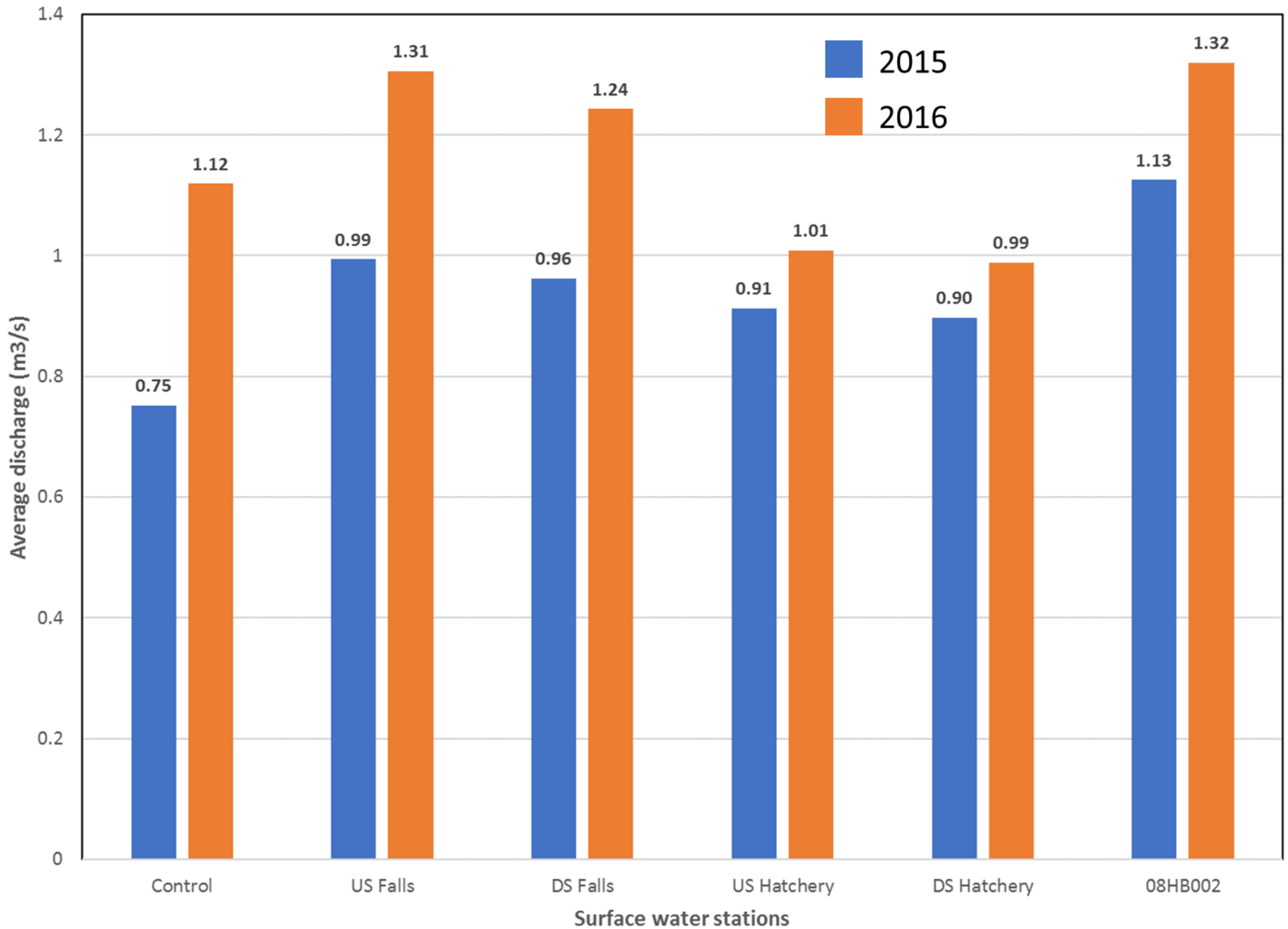

Figure 12. Comparison for 2015 and 2016 average daily discharge for each surface monitoring station

7 CLOSURE AND LIMITATIONS

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The findings and conclusions documented in this document have been prepared for the specific application to this project, and have been developed in a manner consistent with that level of care normally exercised by hydrogeologists currently practicing under similar conditions in the jurisdiction.

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The produced graphs, images, and maps, have been generated to visualize results and assist in presenting information in a spatial and temporal context. The conclusions and recommendations presented in this document are based on the review of information available at the time the work was completed, and within the time and budget limitations of the scope of work.

The RDN may rely on the information contained in this memorandum subject to the above limitations.

Yours truly,

GW Solutions Inc.

PROFESSIONAL PROVINCE OF G. R. WENDLING BRITISH COLUMBIA ENGINEER

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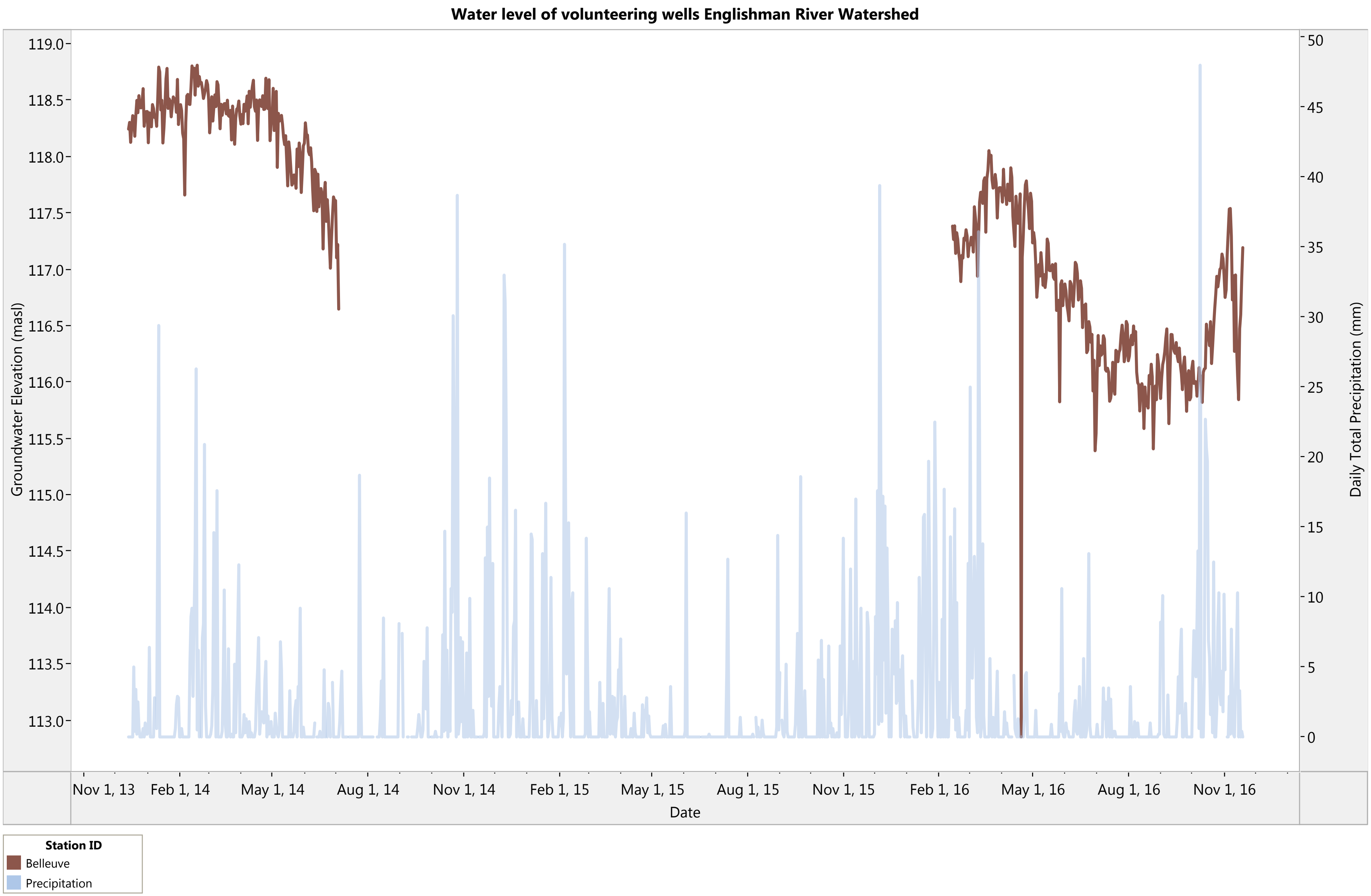
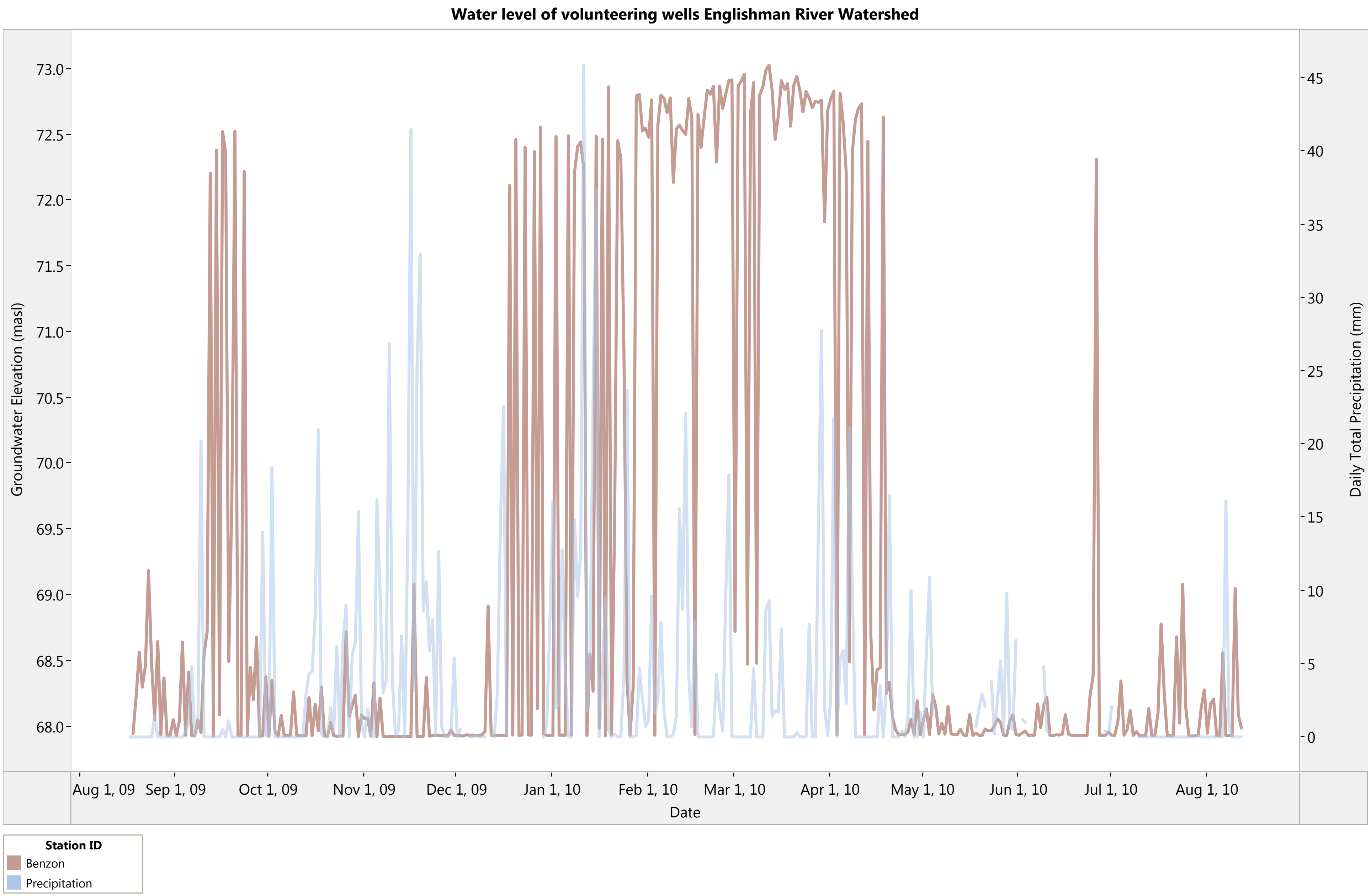
Senior hydrogeologist (President)

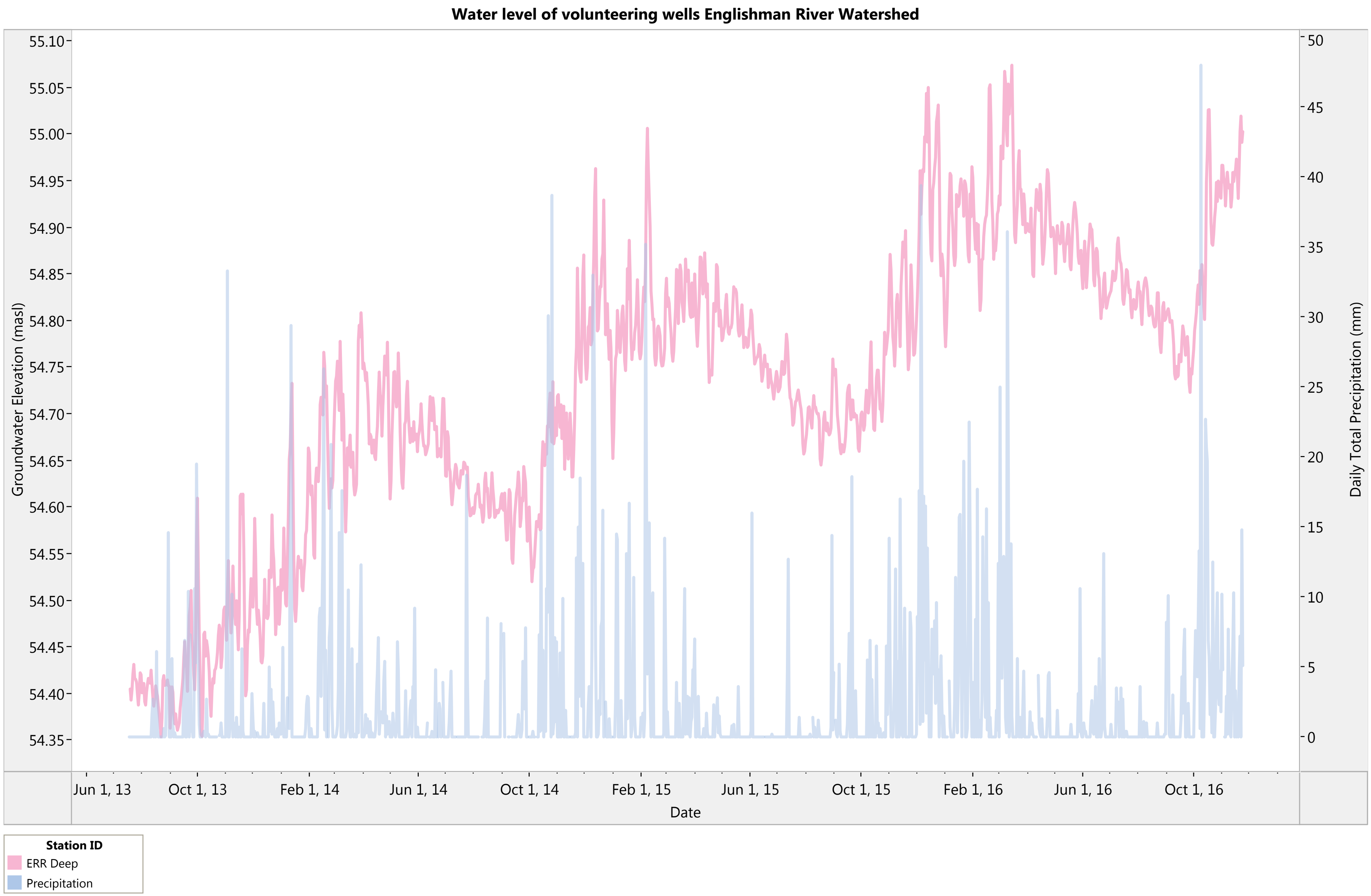
APPENDIX 1

Historical water level for private/volunteer bedrock wells

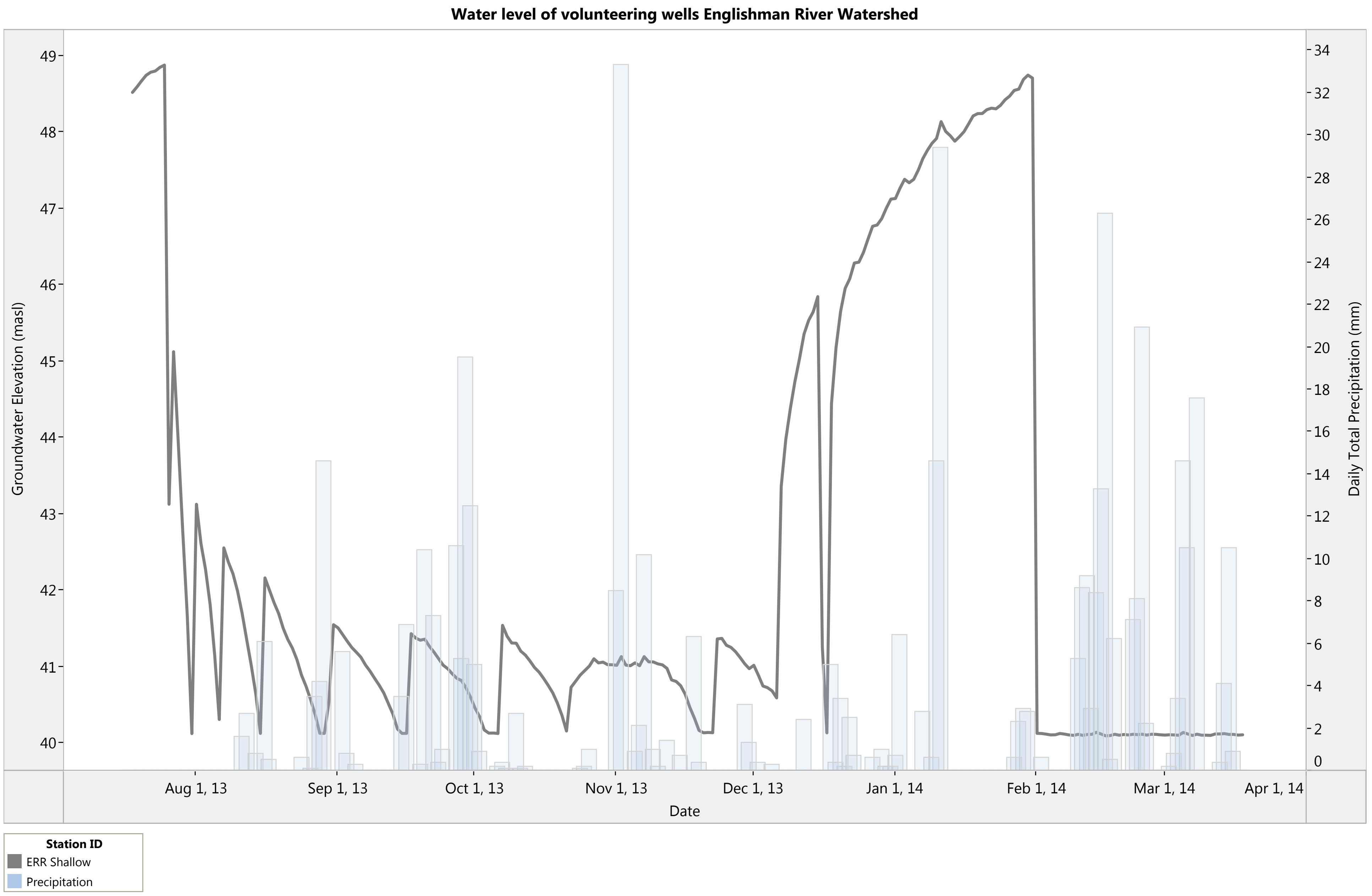

Water level of volunteering wells Englishman River Watershed
Groundwater Elevation (masl)
119.0
118.5
118.0
117.5
117.0
116.5
116.0
115.5
115.0
114.5
114.0
113.5
113.0
Daily Total Precipitation (mm)
50
45
40
35
30
25
20
15
10
5
0
Nov 1, 13
Feb 1, 14
May 1, 14
Aug 1, 14
Nov 1, 14
Feb 1, 15
May 1, 15
Aug 1, 15
Nov 1, 15
Feb 1, 16
May 1, 16
Aug 1, 16
Nov 1, 16
Date
Station ID
Belleuve
Precipitation



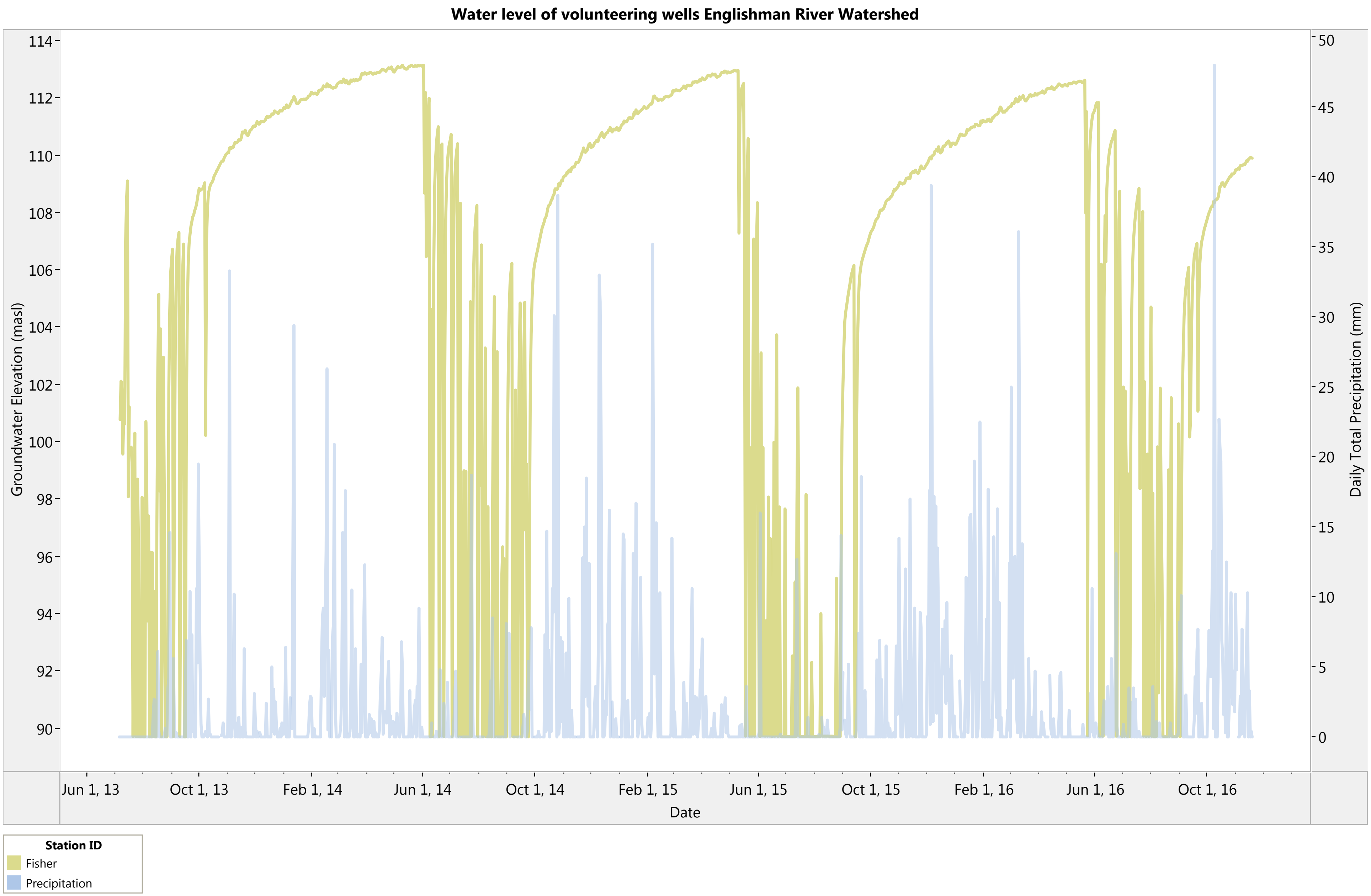
Water level of volunteering wells Englishman River Watershed
Groundwater Elevation (masl)
73.0
72.5
72.0
71.5
71.0
70.5
70.0
69.5
69.0
68.5
68.0
Daily Total Precipitation (mm)
45
40
35
30
25
20
15
10
5
0
Aug 1, 09
Sep 1, 09
Oct 1, 09
Nov 1, 09
Dec 1, 09
Jan 1, 10
Feb 1, 10
Mar 1, 10
Apr 1, 10
May 1, 10
Jun 1, 10
Jul 1, 10
Aug 1, 10
Date
Station ID
Benzon
Precipitation



Water level of volunteering wells Englishman River Watershed
Groundwater Elevation (masl)
55.10
55.05
55.00
54.95
54.90
54.85
54.80
54.75
54.70
54.65
54.60
54.55
54.50
54.45
54.40
54.35
Daily Total Precipitation (mm)
50
45
40
35
30
25
20
15
10
5
0
Jun 1, 13
Oct 1, 13
Feb 1, 14
Jun 1, 14
Oct 1, 14
Feb 1, 15
Jun 1, 15
Oct 1, 15
Feb 1, 16
Jun 1, 16
Oct 1, 16
Date
Station ID
ERR Deep
Precipitation



Water level of volunteering wells Englishman River Watershed
Groundwater Elevation (masl)
Daily Total Precipitation (mm)
49
48
47
46
45
44
43
42
41
40
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Aug 1, 13
Sep 1, 13
Oct 1, 13
Nov 1, 13
Dec 1, 13
Jan 1, 14
Feb 1, 14
Mar 1, 14
Apr 1, 14
Date
Station ID
ERR Shallow
Precipitation



Water level of volunteering wells Englishman River Watershed
Groundwater Elevation (masl)
Daily Total Precipitation (mm)
114
112
110
108
106
104
102
100
98
96
94
92
90
50
45
40
35
30
25
20
15
10
5
0
Jun 1, 13
Oct 1, 13
Feb 1, 14
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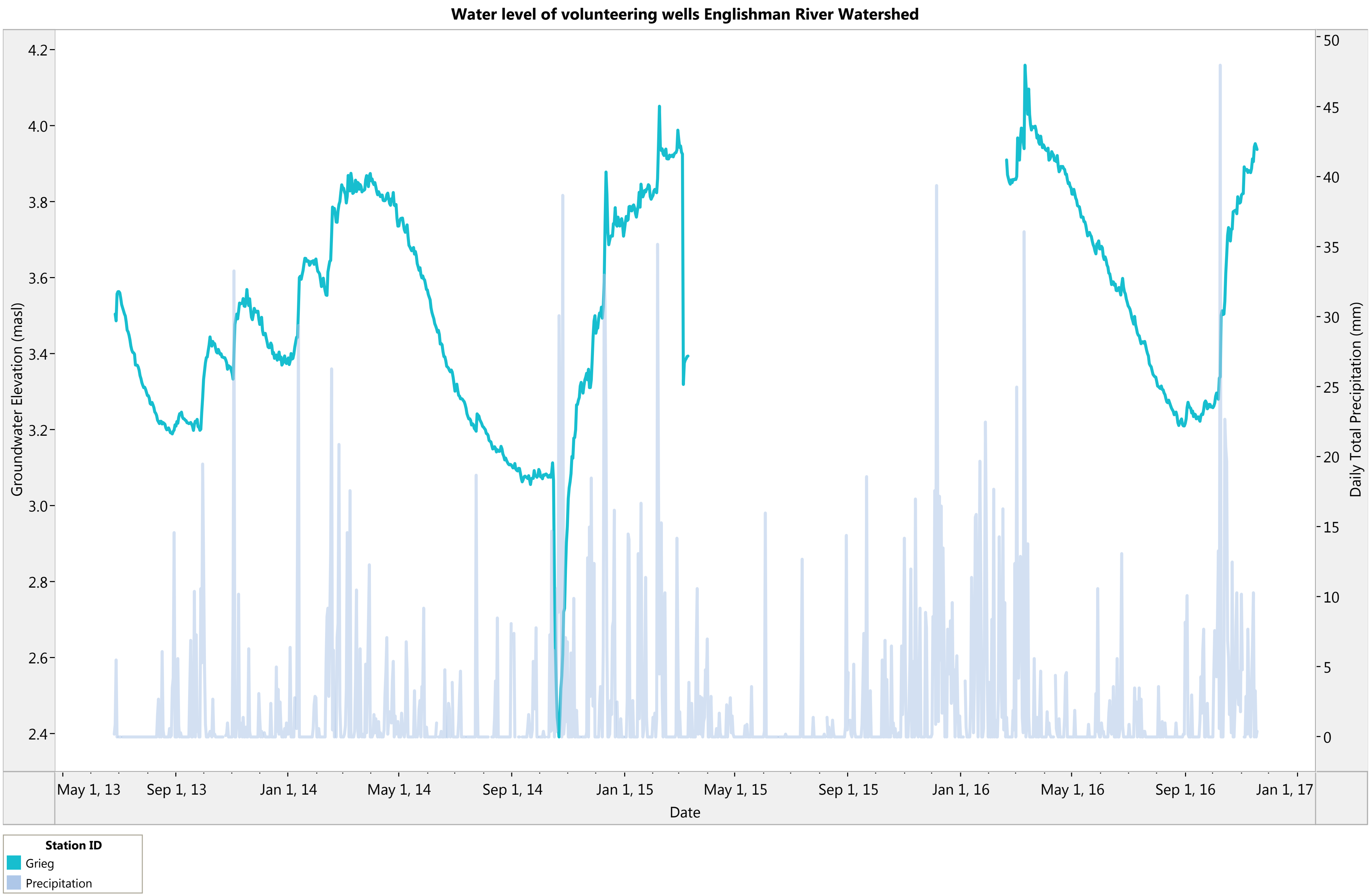
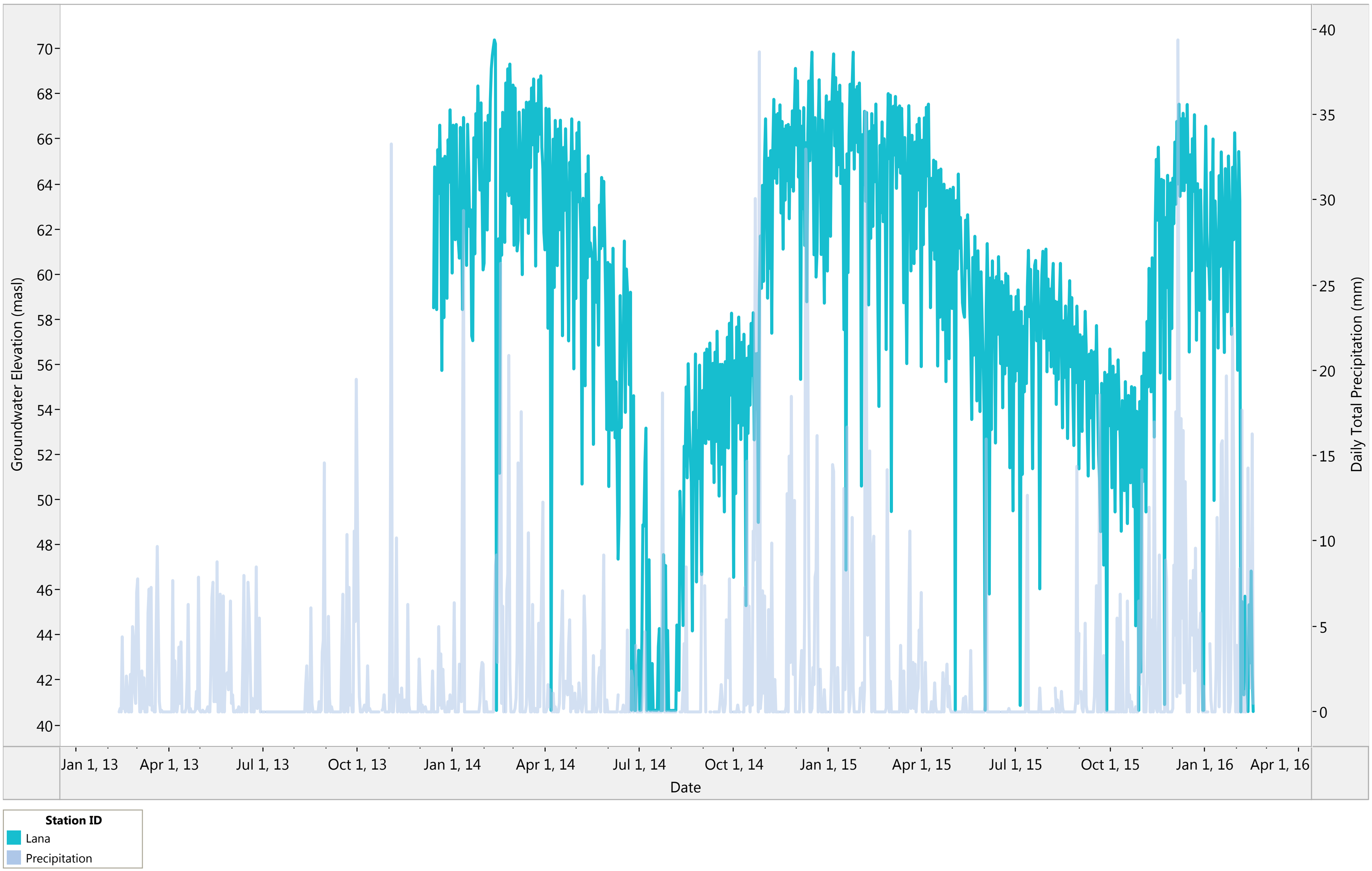
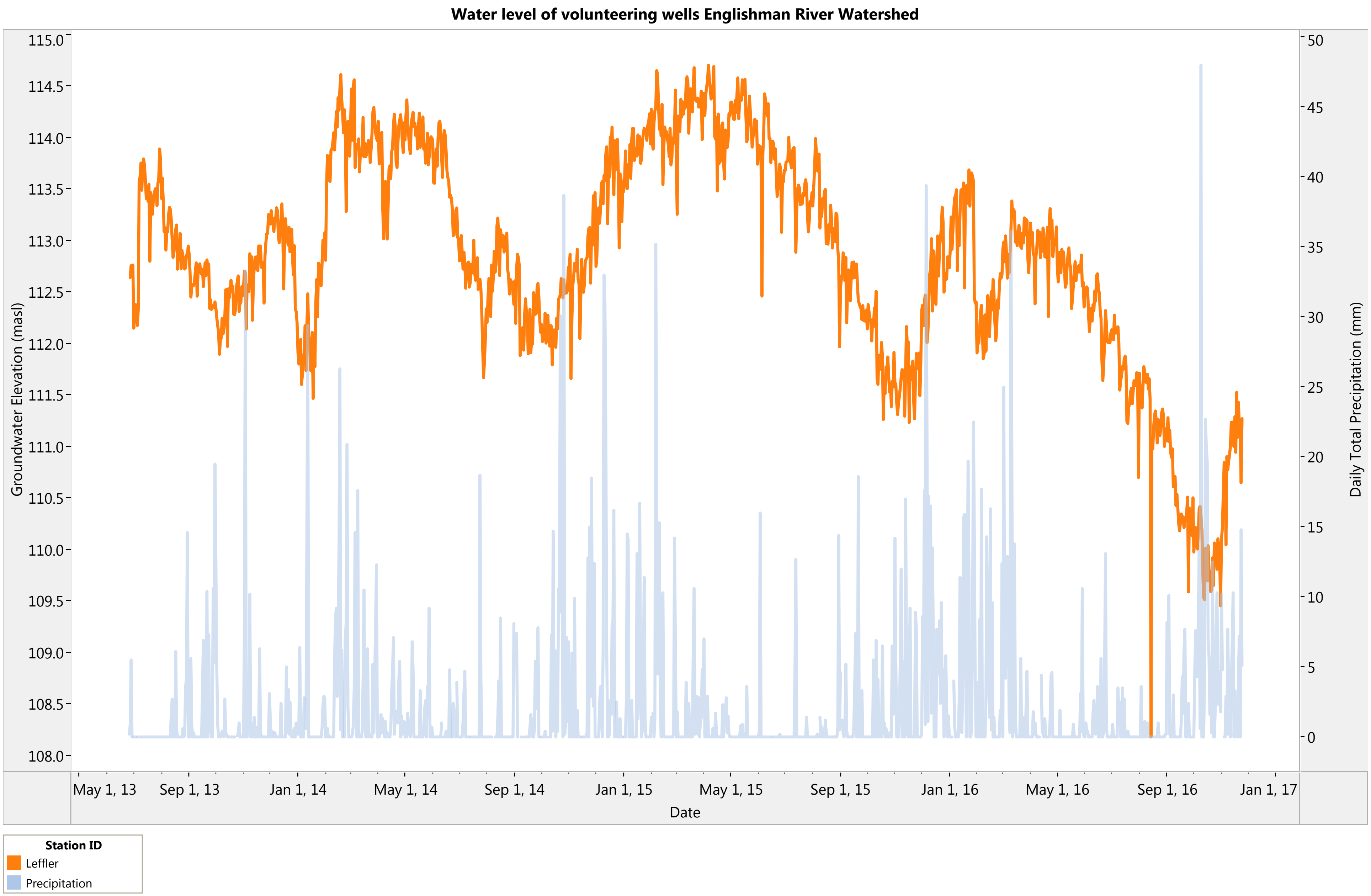
Date
Station ID
Fisher
Precipitation

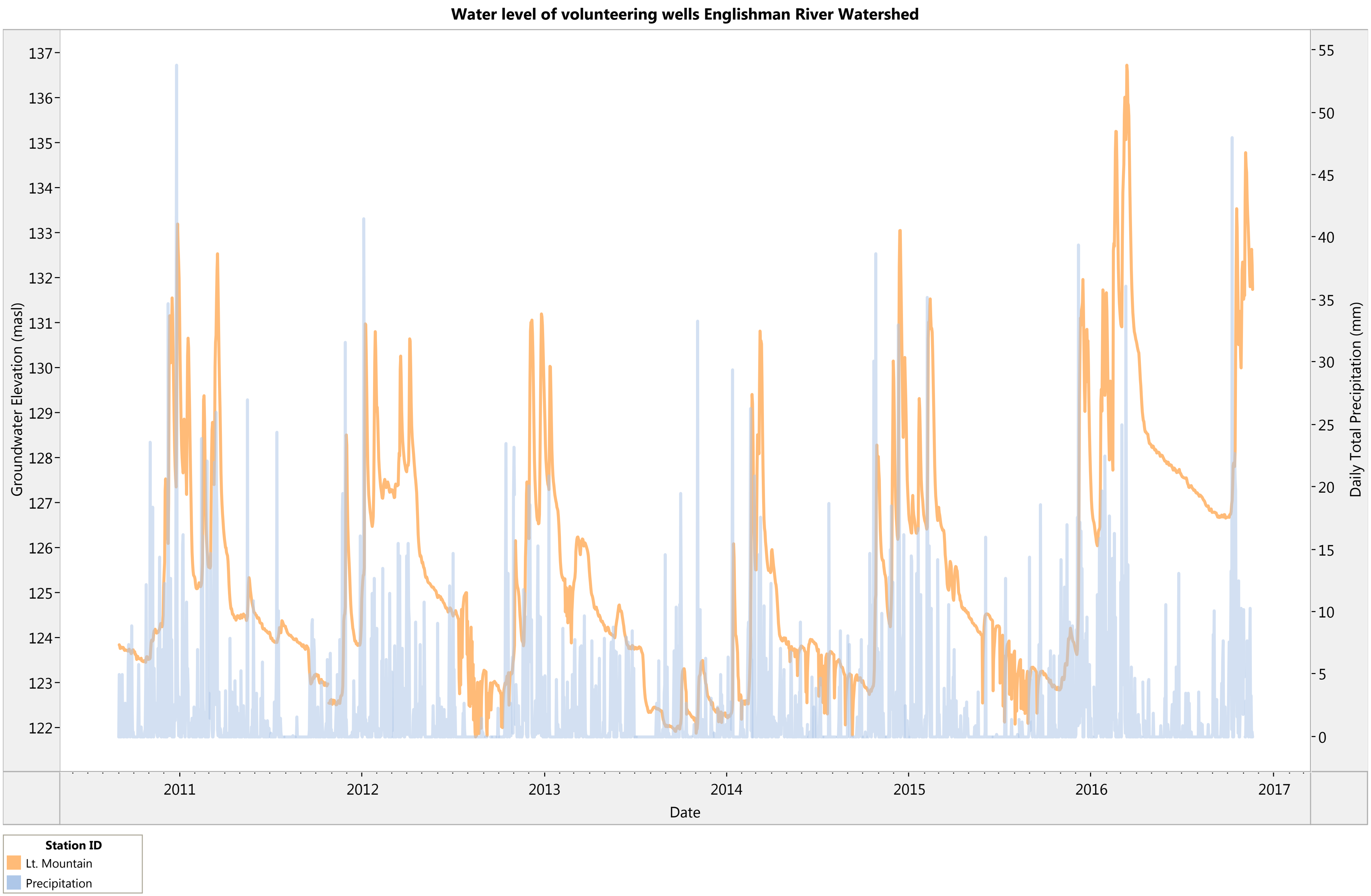


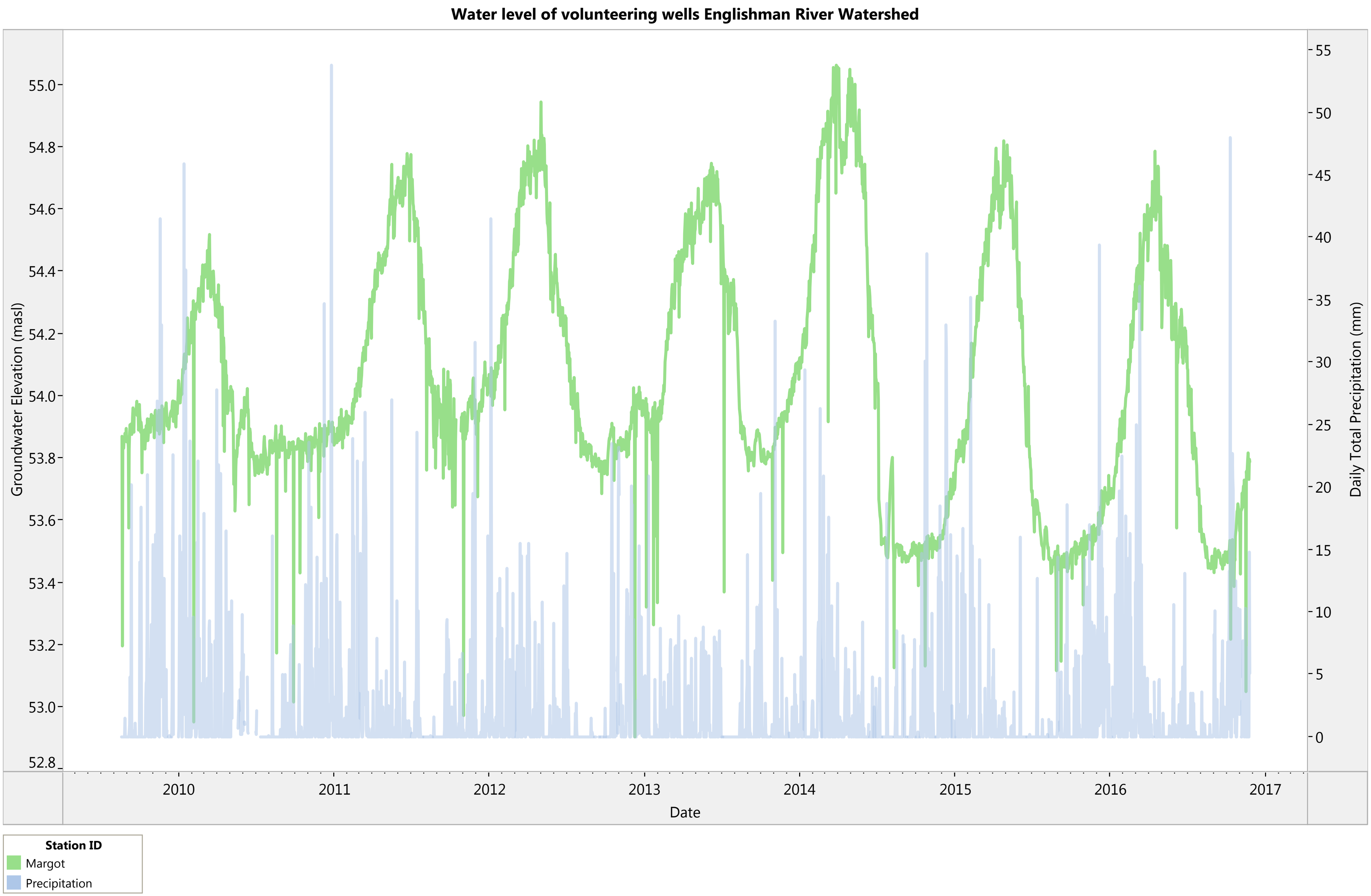
Water level of volunteering wells Englishman River Watershed
Groundwater Elevation (masl)
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
Daily Total Precipitation (mm)
50
45
40
35
30
25
20
15
10
5
0
May 1, 13
Sep 1, 13
Jan 1, 14
May 1, 14
Sep 1, 14
Jan 1, 15
May 1, 15
Sep 1, 15
Jan 1, 16
May 1, 16
Sep 1, 16
Jan 1, 17
Date
Station ID
Grieg
Precipitation

Water level of volunteering wells Englishman River Watershed

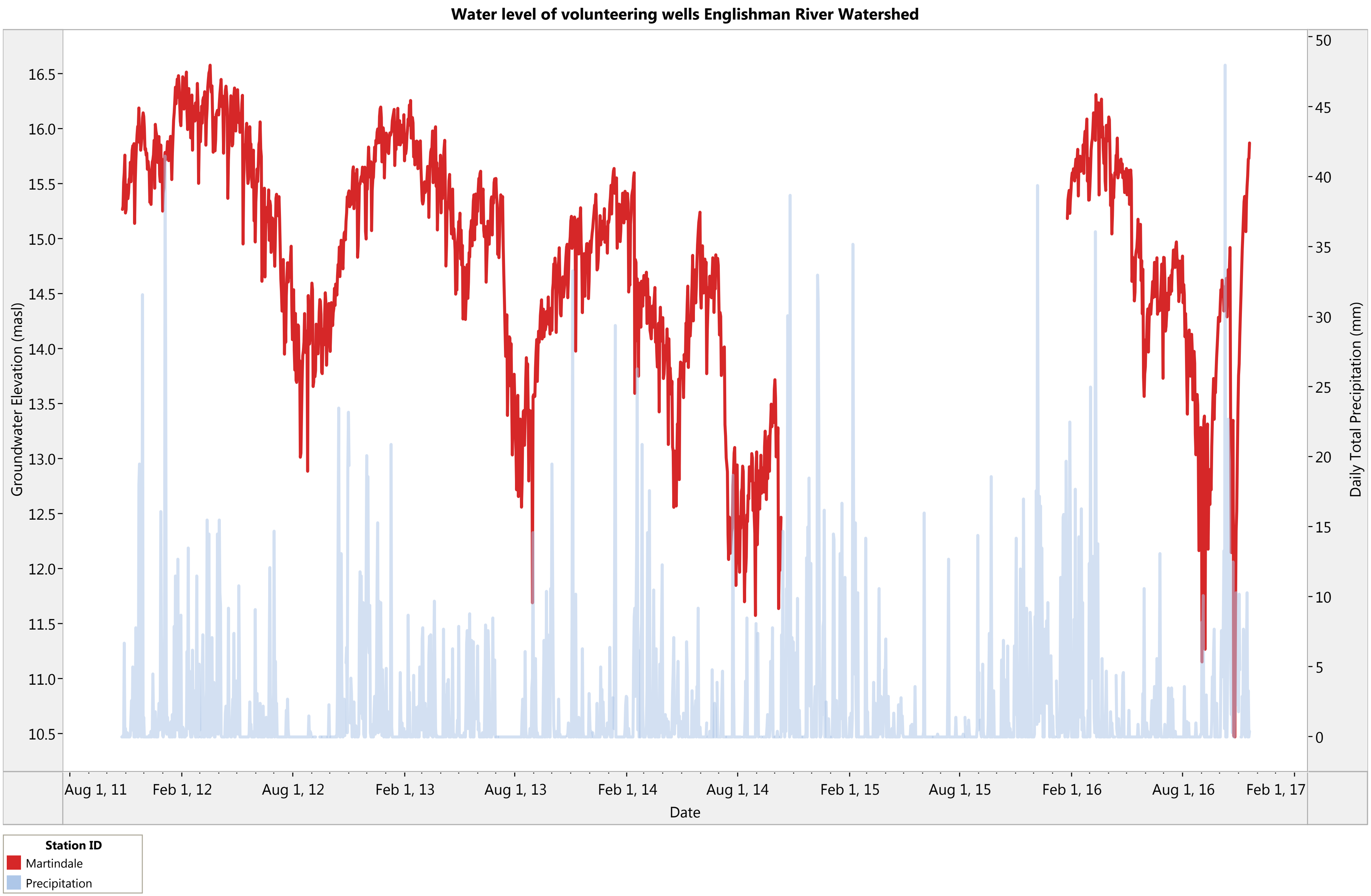



Water level of volunteering wells Englishman River Watershed
Groundwater Elevation (masl)
115.0
114.5
114.0
113.5
113.0
112.5
112.0
111.5
111.0
110.5
110.0
109.5
109.0
108.5
108.0
Daily Total Precipitation (mm)
50
45
40
35
30
25
20
15
10
5
0
May 1, 13
Sep 1, 13
Jan 1, 14
May 1, 14
Sep 1, 14
Jan 1, 15
May 1, 15
Sep 1, 15
Jan 1, 16
May 1, 16
Sep 1, 16
Jan 1, 17
Date
Station ID
Leffler
Precipitation

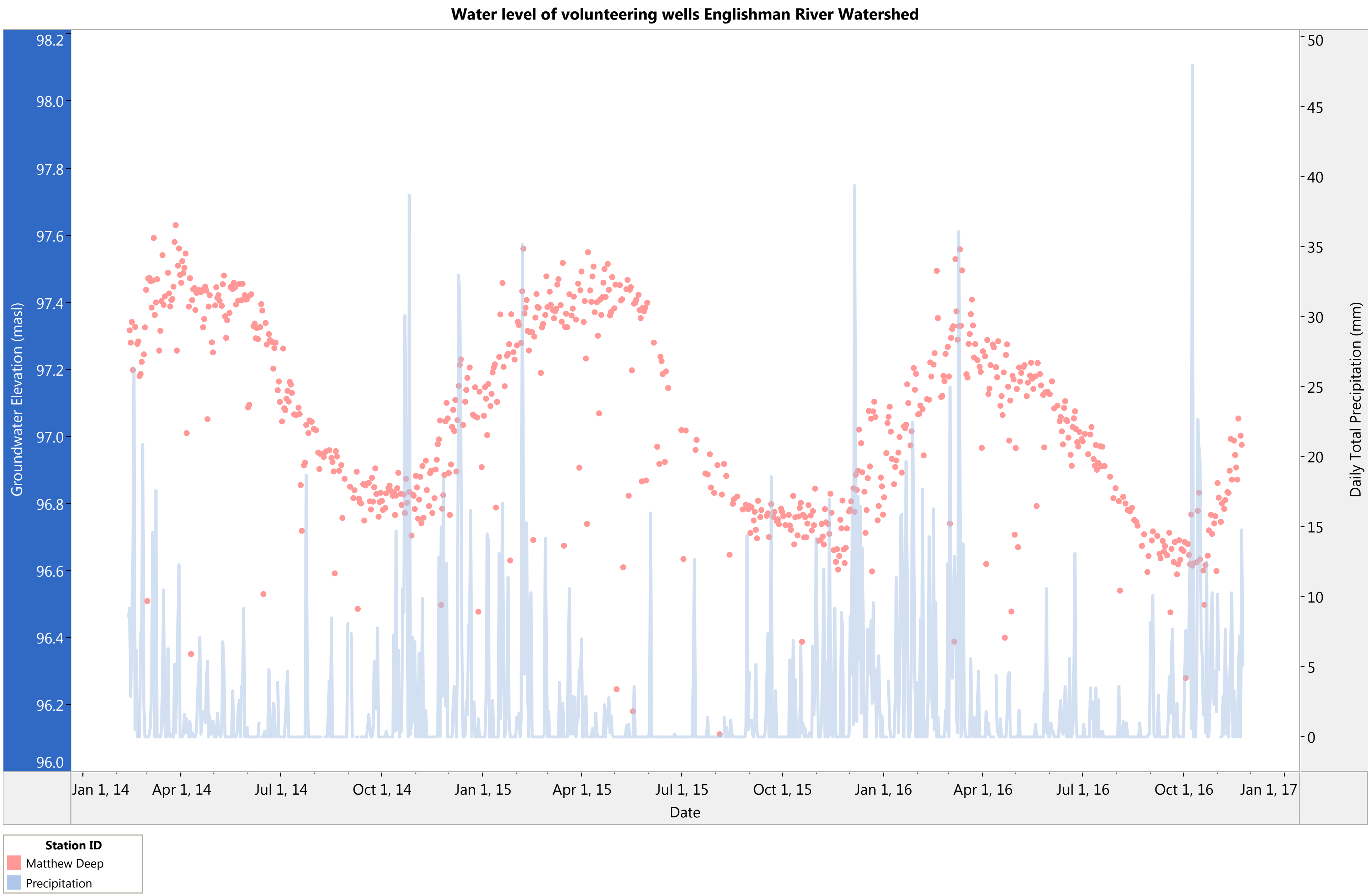

Water level of volunteering wells Englishman River Watershed
Groundwater Elevation (masl)
137
136
135
134
133
132
131
130
129
128
127
126
125
124
123
122
Daily Total Precipitation (mm)
55
50
45
40
35
30
25
20
15
10
5
0
2011
2012
2013
2014
2015
2016
2017
Date
Station ID
Lt. Mountain
Precipitation



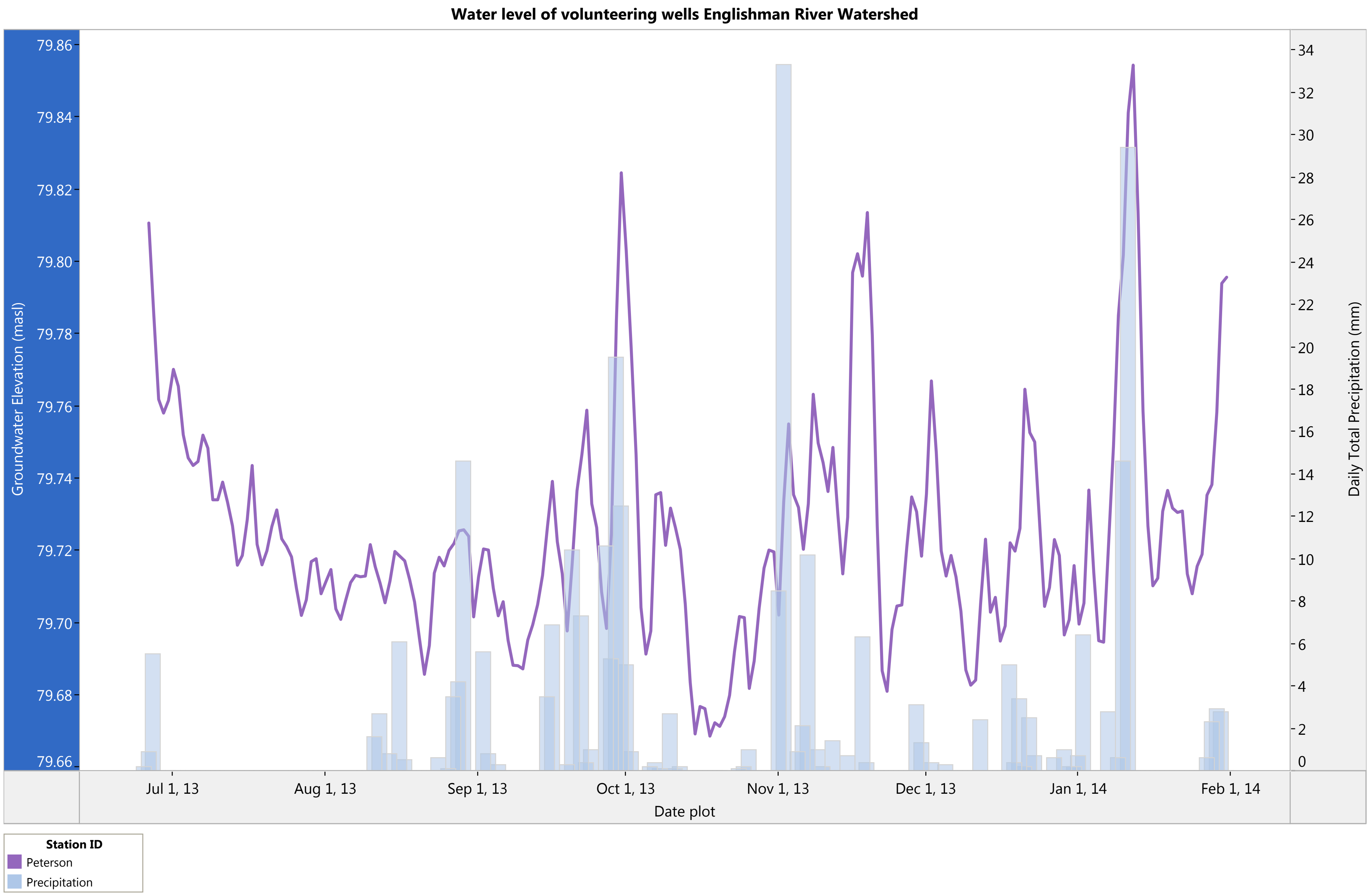
Water level of volunteering wells Englishman River Watershed
Groundwater Elevation (masl)
55.0
54.8
54.6
54.4
54.2
54.0
53.8
53.6
53.4
53.2
53.0
52.8
Daily Total Precipitation (mm)
55
50
45
40
35
30
25
20
15
10
5
0
2010
2011
2012
2013
2014
2015
2016
2017
Date
Station ID
Margot
Precipitation



Water level of volunteering wells Englishman River Watershed
Groundwater Elevation (masl)
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
Daily Total Precipitation (mm)
50
45
40
35
30
25
20
15
10
5
0
Aug 1, 11
Feb 1, 12
Aug 1, 12
Feb 1, 13
Aug 1, 13
Feb 1, 14
Aug 1, 14
Feb 1, 15
Aug 1, 15
Feb 1, 16
Aug 1, 16
Feb 1, 17
Date
Station ID
Martindale
Precipitation

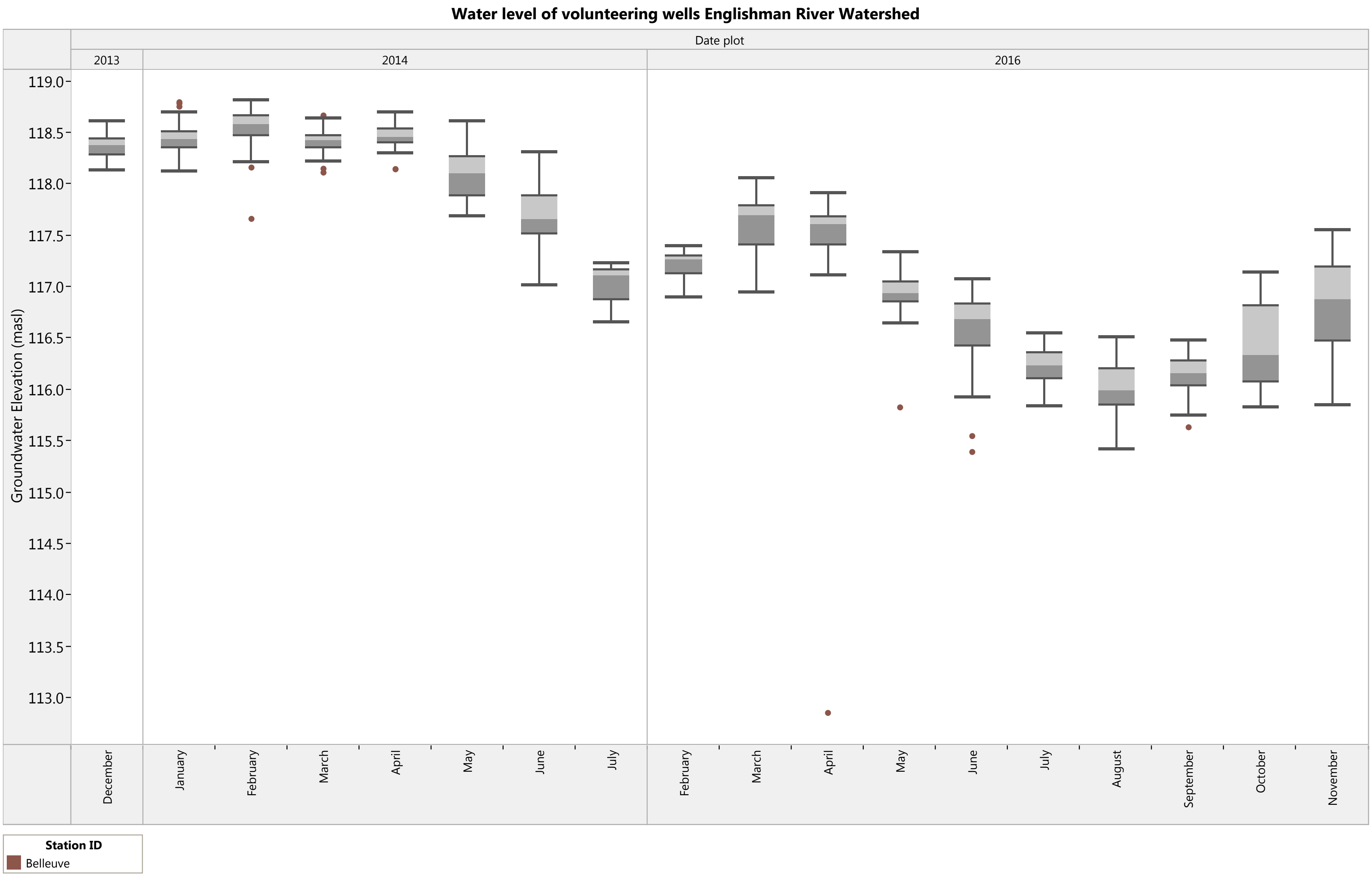


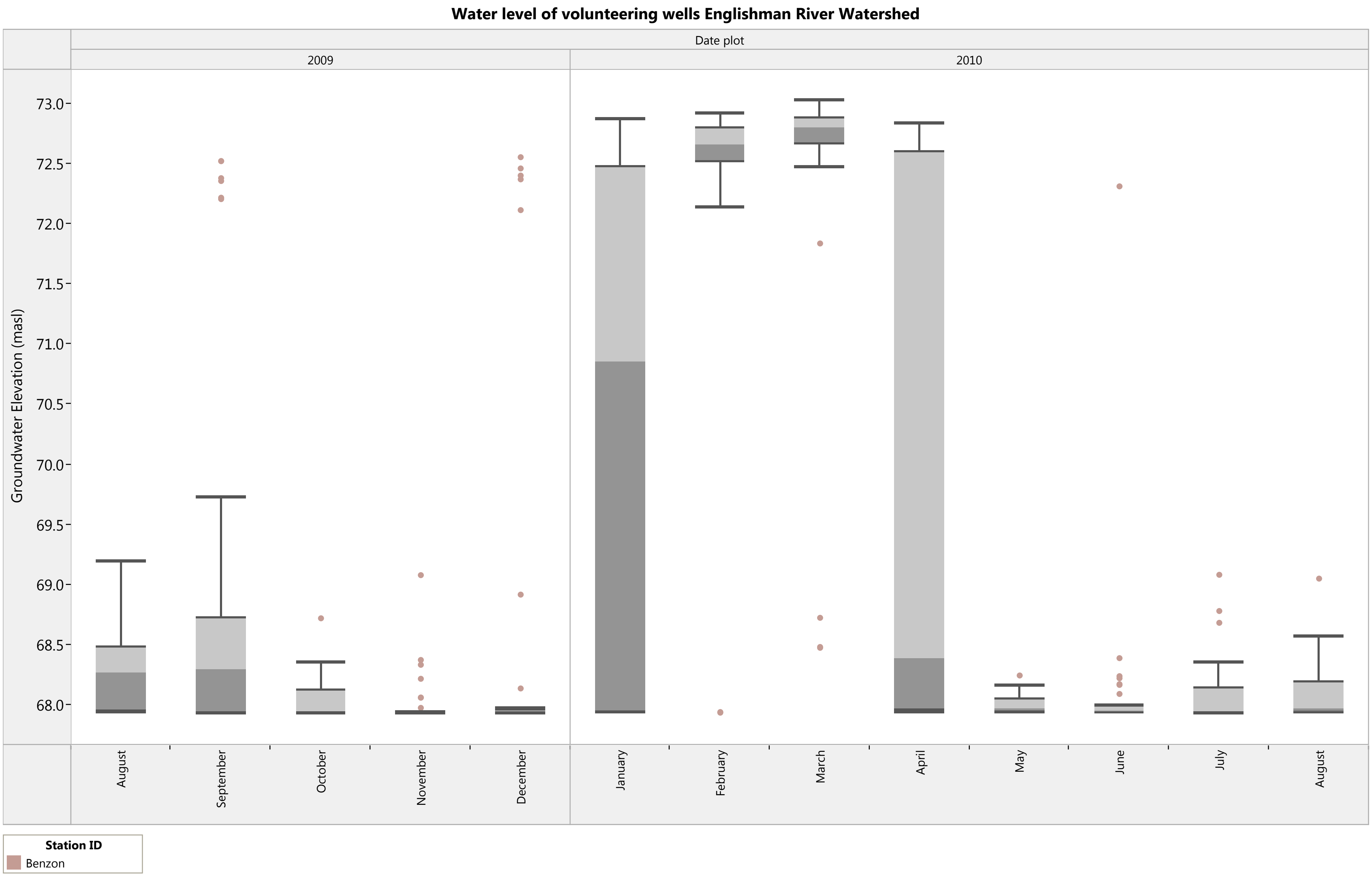
Water level of volunteering wells Englishman River Watershed
98.2
98.0
97.8
97.6
97.4
97.2
97.0
96.8
96.6
96.4
96.2
96.0
Groundwater Elevation (masl)
50
45
40
35
30
25
20
15
10
5
0
Daily Total Precipitation (mm)
Jan 1, 14
Apr 1, 14
Jul 1, 14
Oct 1, 14
Jan 1, 15
Apr 1, 15
Jul 1, 15
Oct 1, 15
Jan 1, 16
Apr 1, 16
Jul 1, 16
Oct 1, 16
Jan 1, 17
Date
Station ID
Matthew Deep
Precipitation

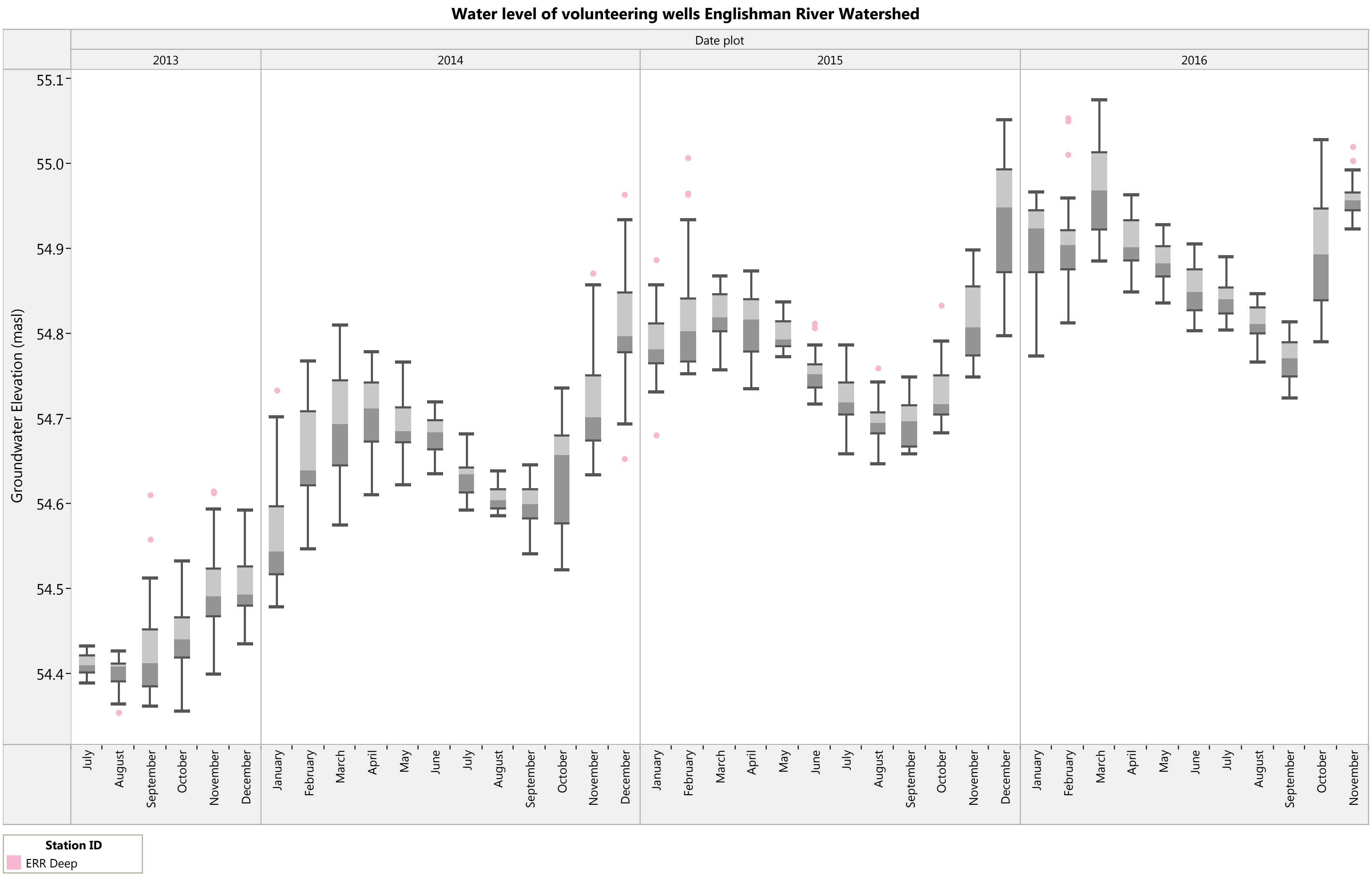

Water level of volunteering wells Englishman River Watershed
Groundwater Elevation (masl)
79.86
79.84
79.82
79.80
79.78
79.76
79.74
79.72
79.70
79.68
79.66
Daily Total Precipitation (mm)
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Jul 1, 13
Aug 1, 13
Sep 1, 13
Oct 1, 13
Nov 1, 13
Dec 1, 13
Jan 1, 14
Feb 1, 14
Date plot
Station ID
Peterson
Precipitation

APPENDIX 2

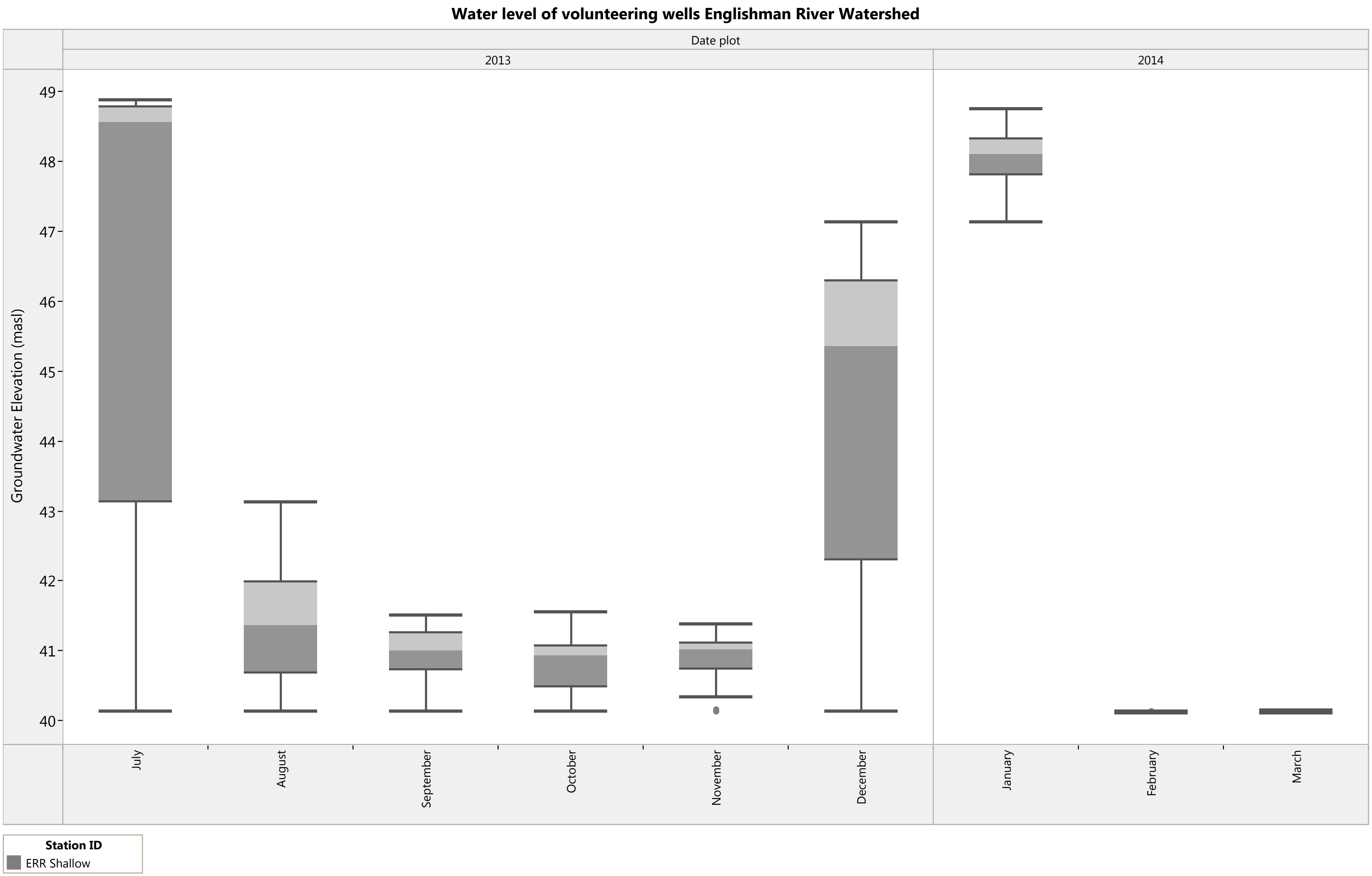
Box and whiskers diagrams for the private/volunteer bedrock wells


Water level of volunteering wells Englishman River Watershed
Date plot
2013
2014
2016
Groundwater Elevation (masl)
119.0
118.5
118.0
117.5
117.0
116.5
116.0
115.5
115.0
114.5
114.0
113.5
113.0
December
January
February
March
April
May
June
July
February
March
April
May
June
July
August
September
October
November
Station ID
Belleuve

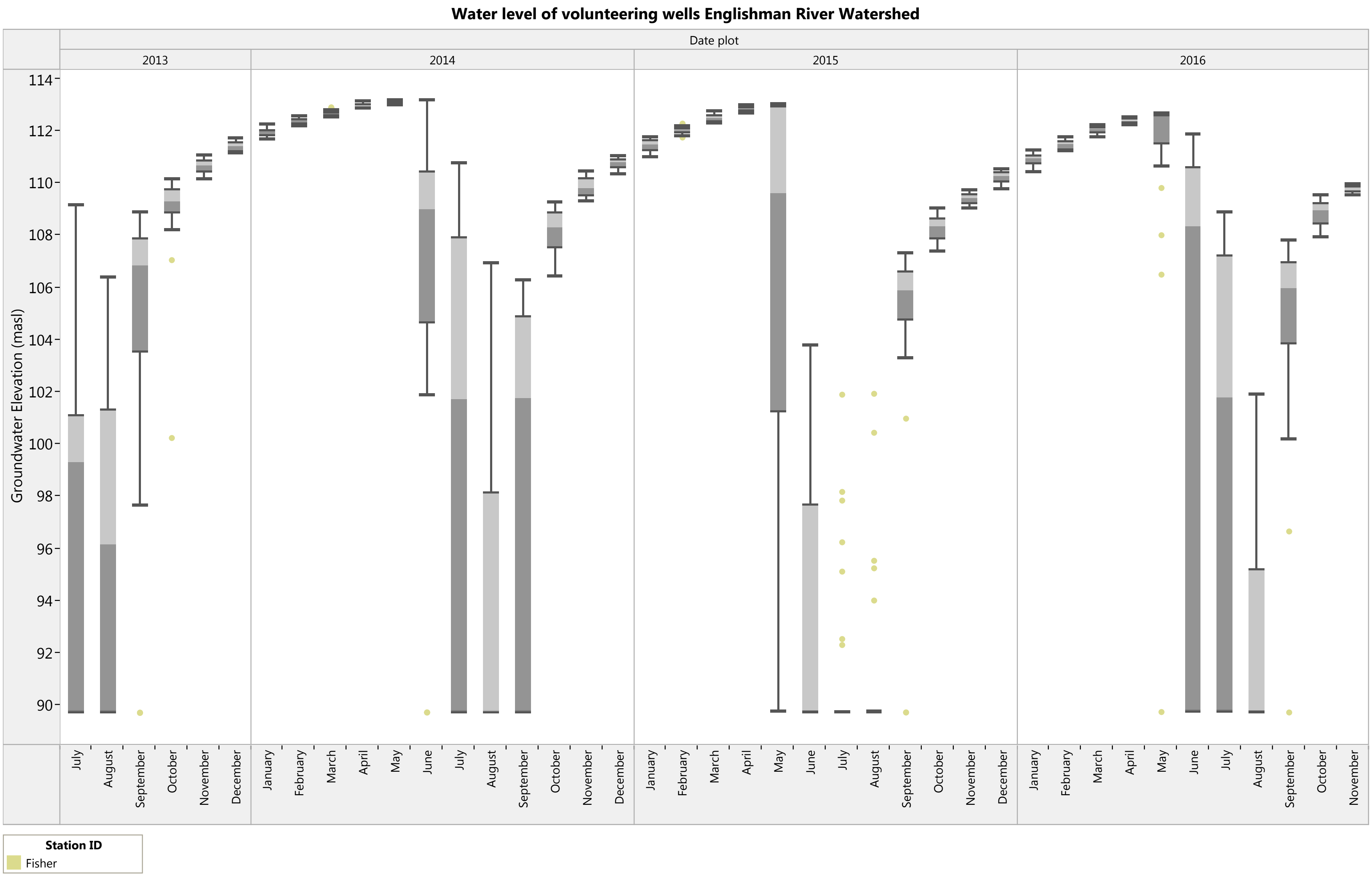

Water level of volunteering wells Englishman River Watershed
Date plot
2009
2010
Groundwater Elevation (masl)
73.0
72.5
72.0
71.5
71.0
70.5
70.0
69.5
69.0
68.5
68.0
August
September
October
November
December
January
February
March
April
May
June
July
August
Station ID
Benzon



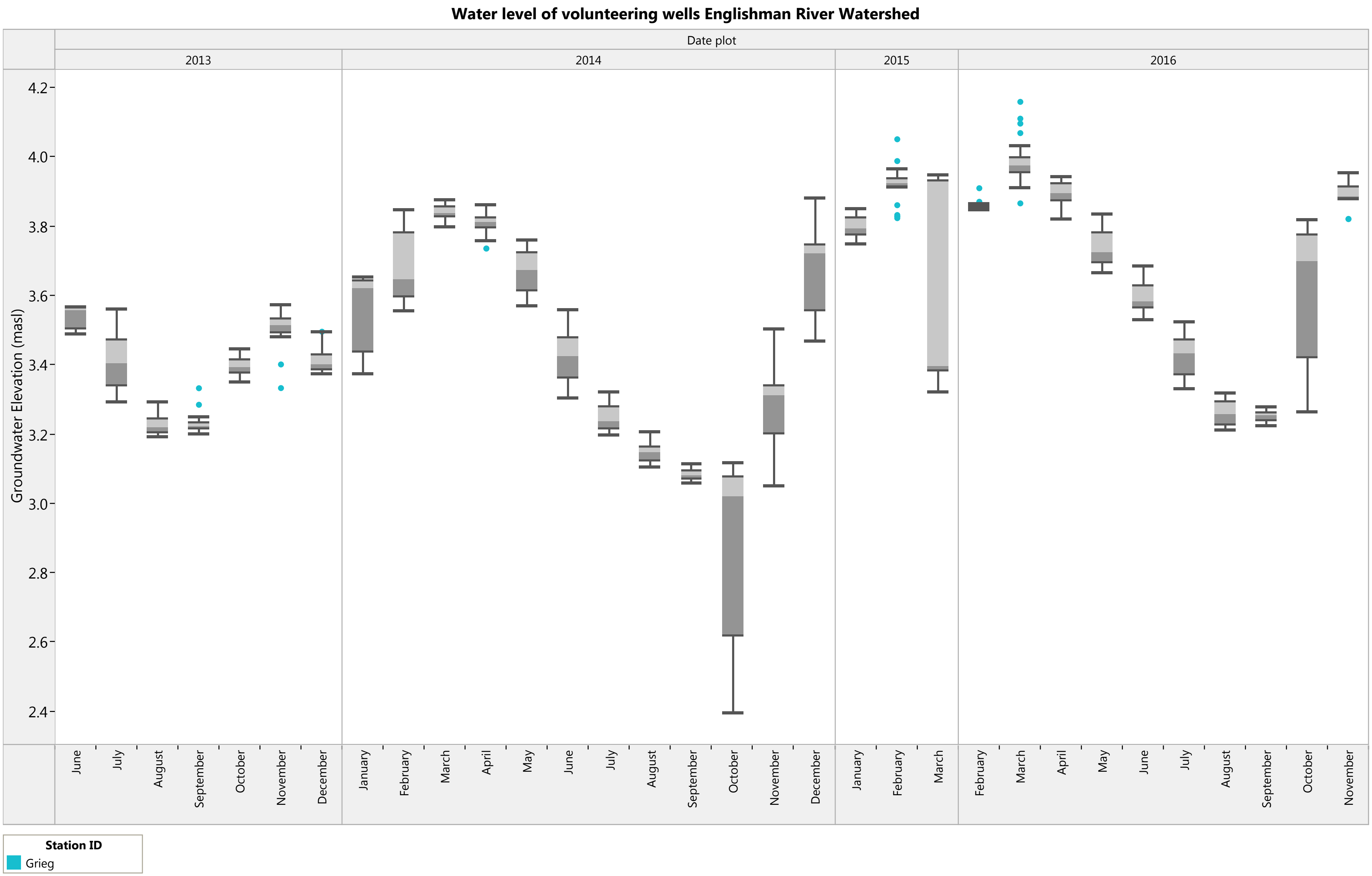
Water level of volunteering wells Englishman River Watershed
Date plot
2013
2014
2015
2016
Groundwater Elevation (masl)
55.1
55.0
54.9
54.8
54.7
54.6
54.5
54.4
July
August
September
October
November
December
January
February
March
April
May
June
Station ID
ERR Deep



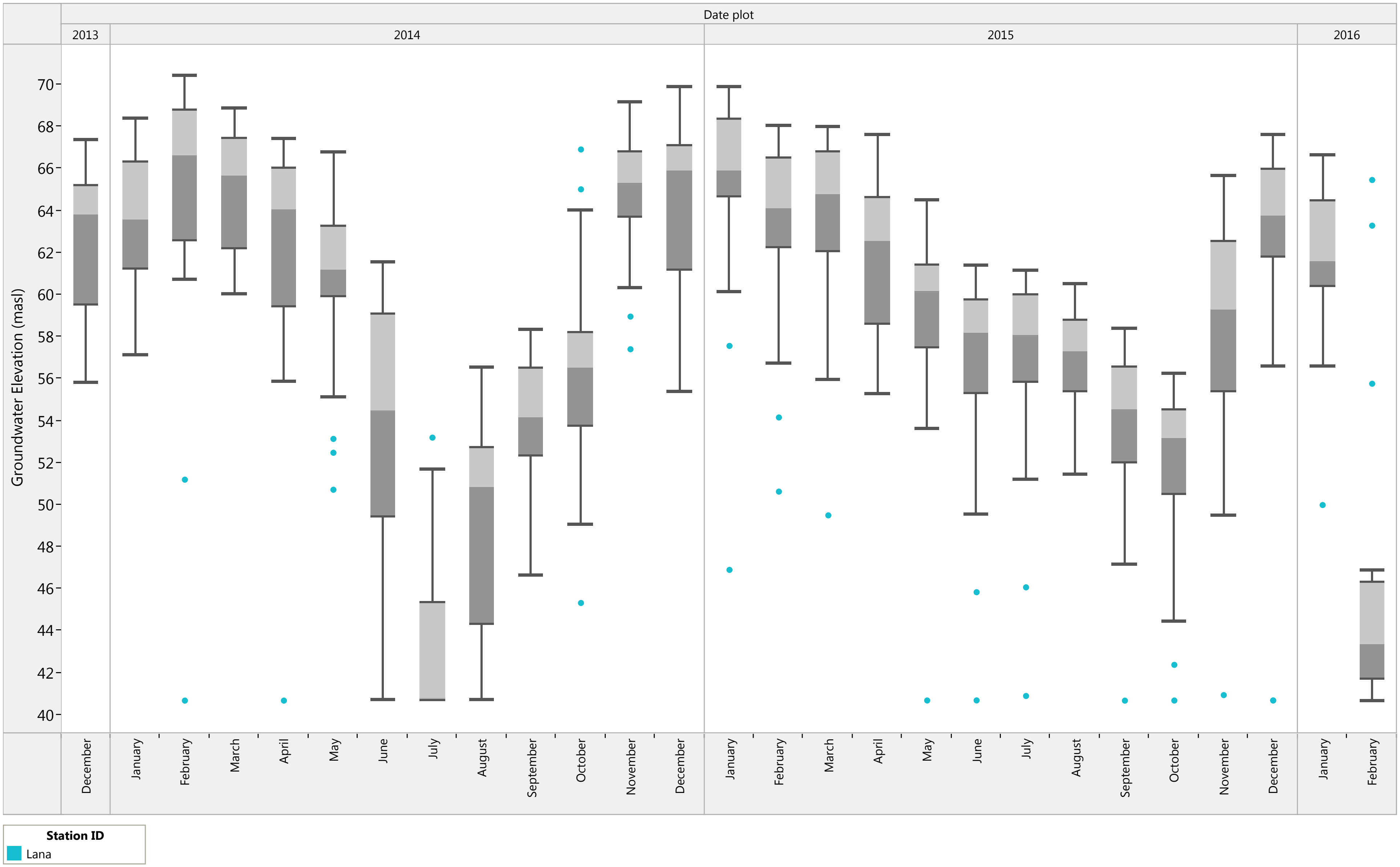
Water level of volunteering wells Englishman River Watershed
Date plot
2013
2014
Groundwater Elevation (masl)
49
48
47
46
45
44
43
42
41
40
July
August
September
October
November
December
January
February
March
Station ID
ERR Shallow

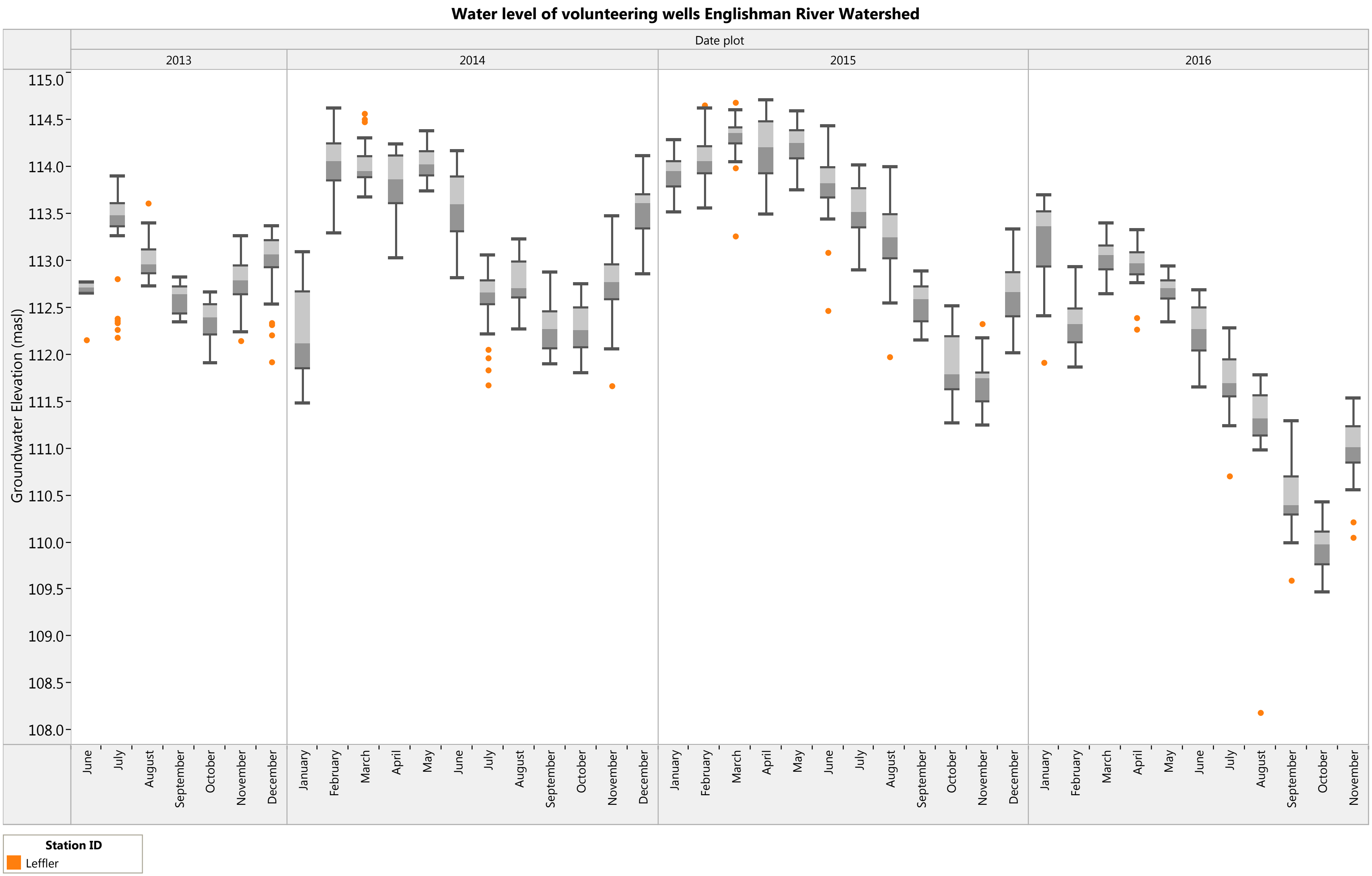


Water level of volunteering wells Englishman River Watershed
Date plot
2013
2014
2015
2016
Groundwater Elevation (masl)
114
112
110
108
106
104
102
100
98
96
94
92
90
July
August
September
October
November
December
January
February
March
April
May
June
Station ID
Fisher

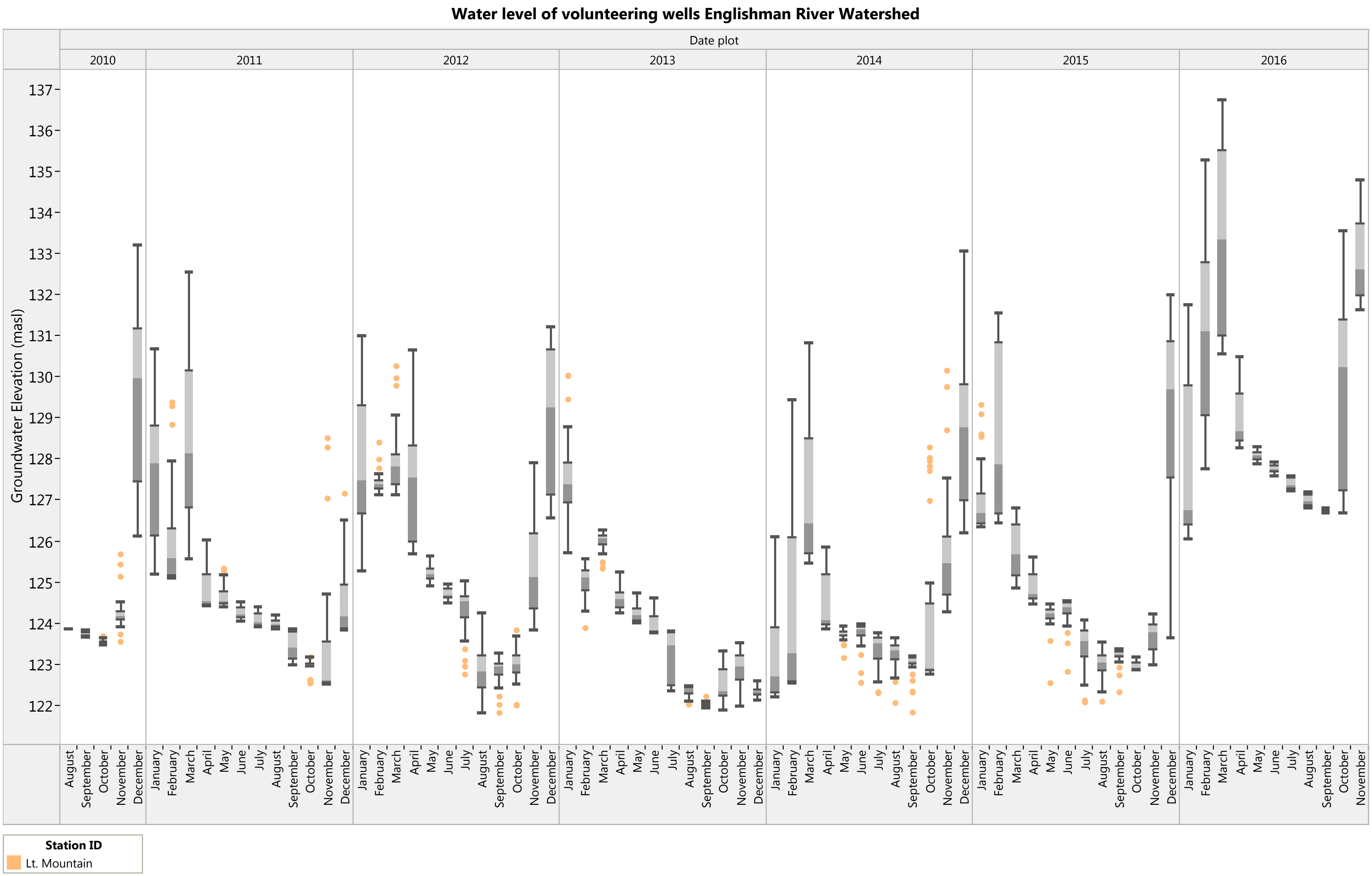

Water level of volunteering wells Englishman River Watershed
Date plot
2013
2014
2015
2016
Groundwater Elevation (masl)
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
June
July
August
September
October
November
December
January
February
March
April
May
June
July
August
September
October
November
December
January
February
March
February
March
April
May
June
July
August
September
October
November
Station ID
Grieg

Water level of volunteering wells Englishman River Watershed

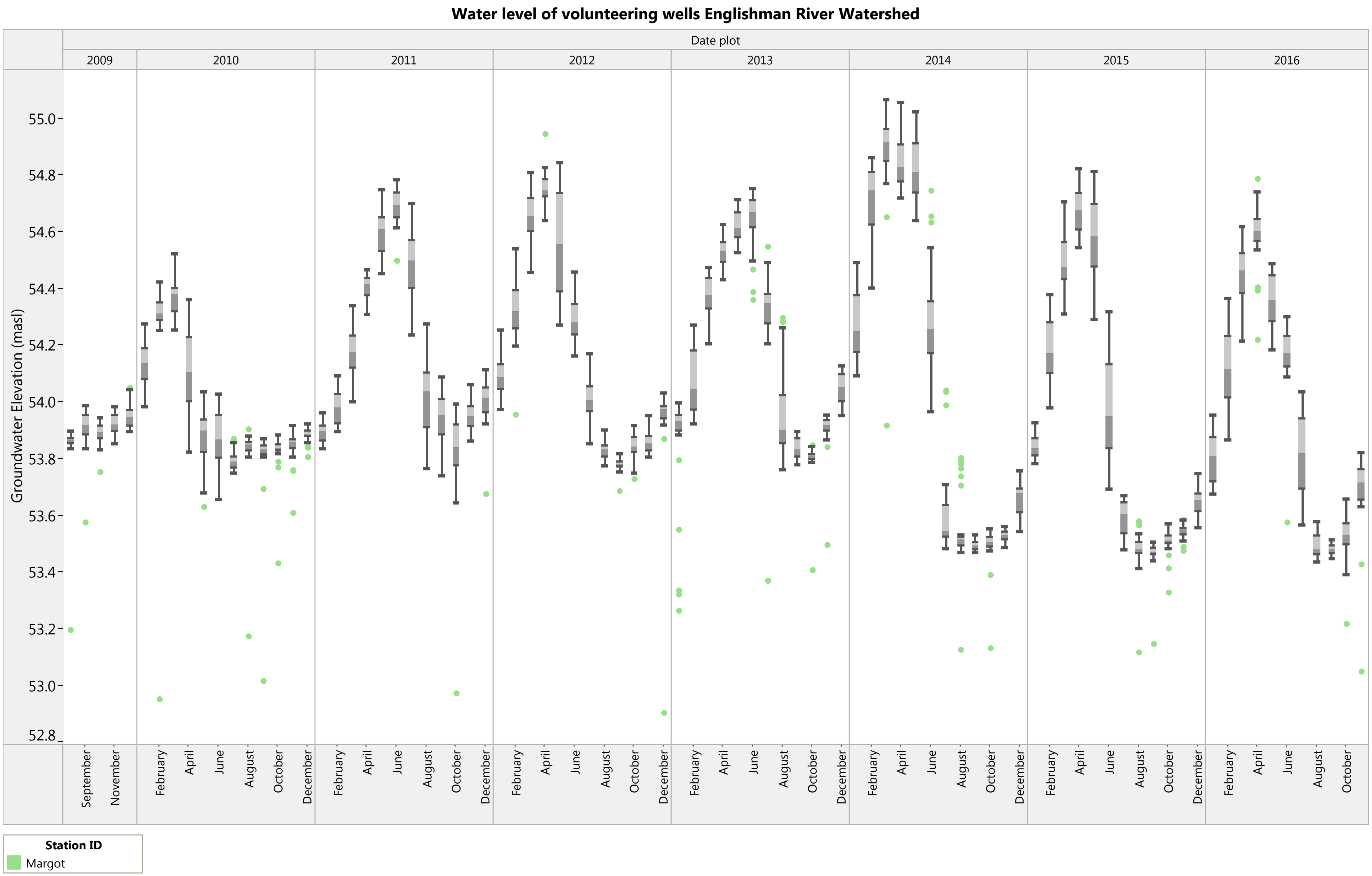




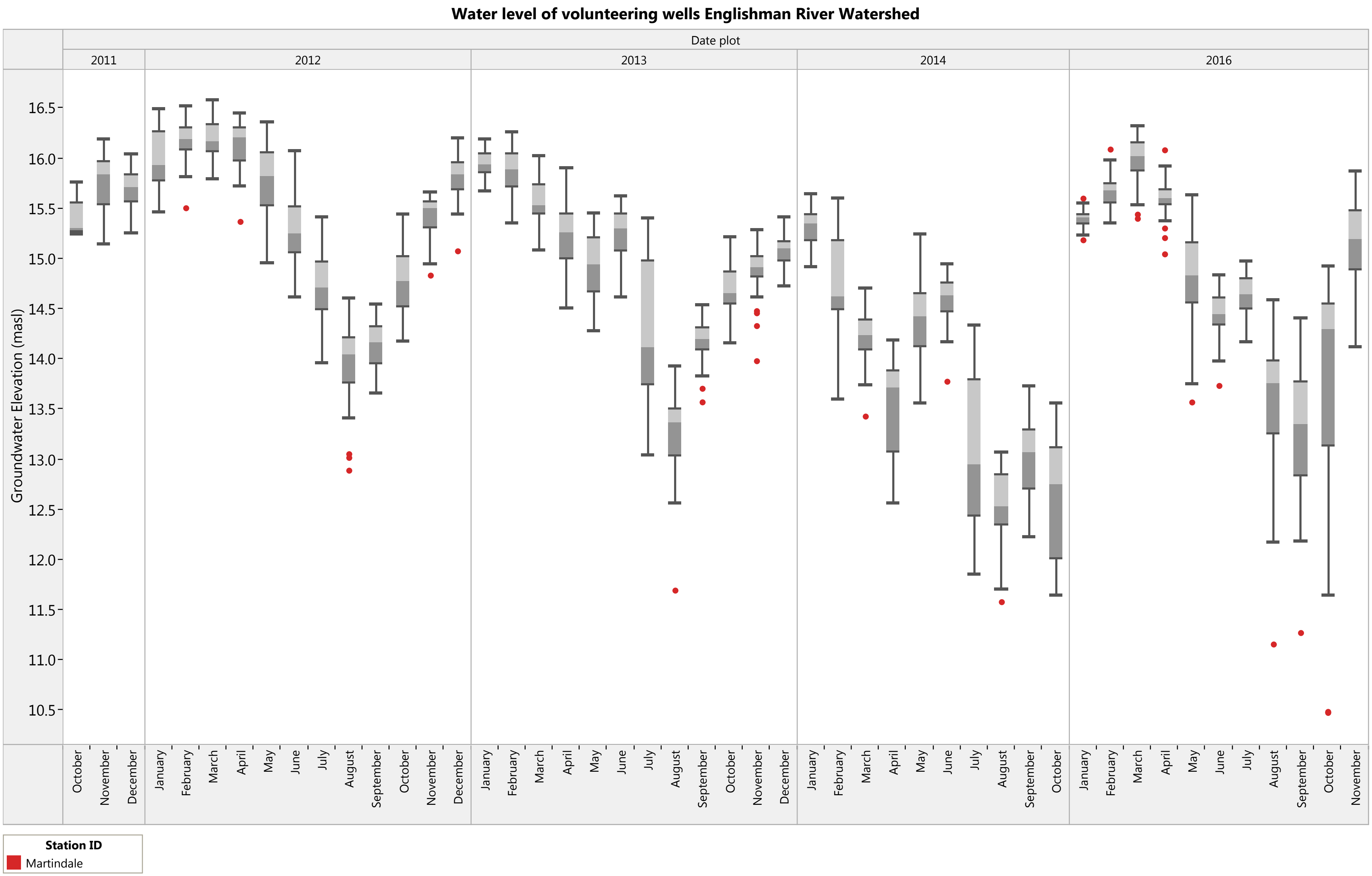
Water level of volunteering wells Englishman River Watershed
Date plot
2013
2014
2015
2016
Groundwater Elevation (masl)
115.0
114.5
114.0
113.5
113.0
112.5
112.0
111.5
111.0
110.5
110.0
109.5
109.0
108.5
108.0
June
July
August
September
October
November
December
January
February
March
April
May
Station ID
Leffler

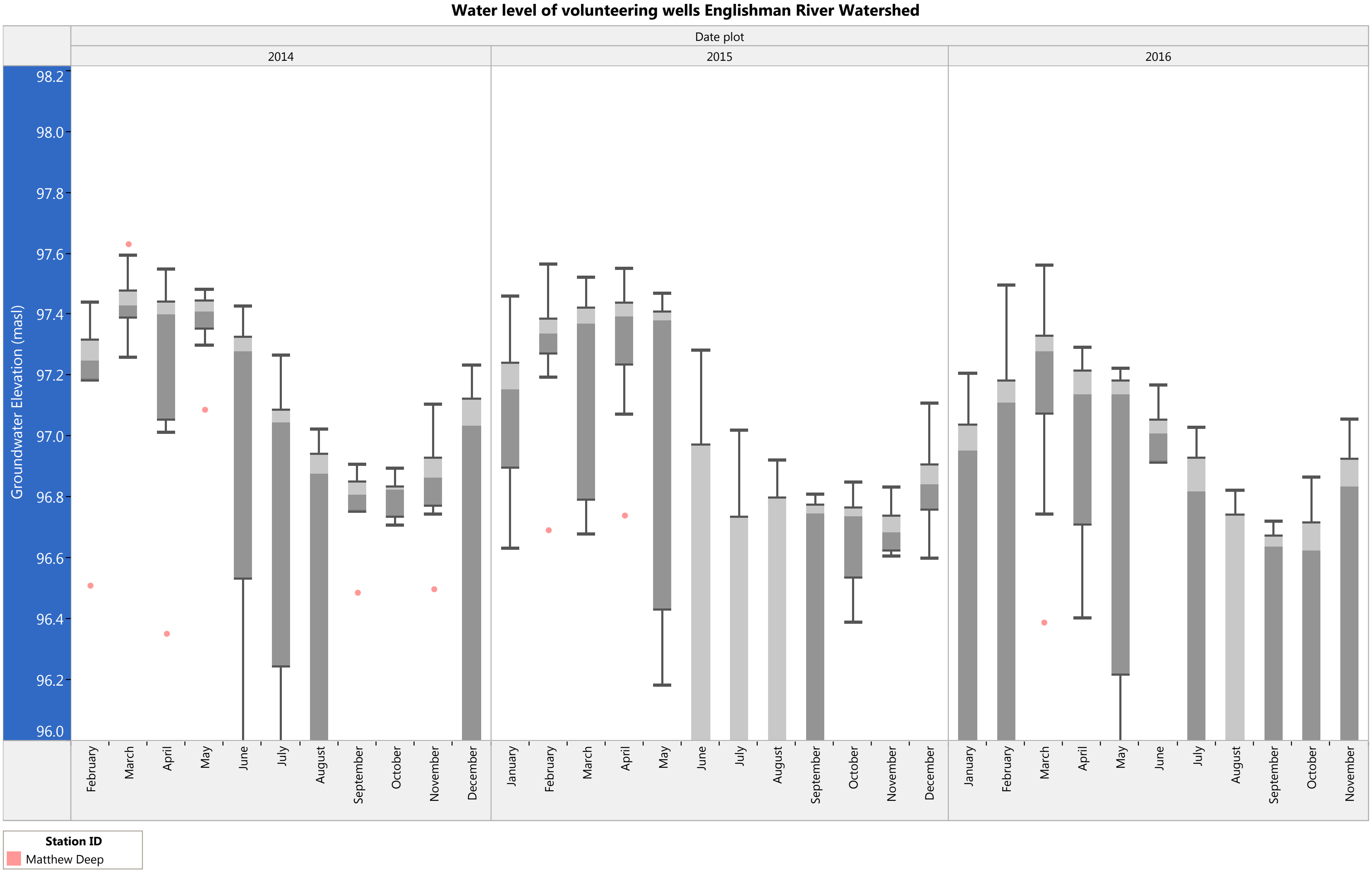


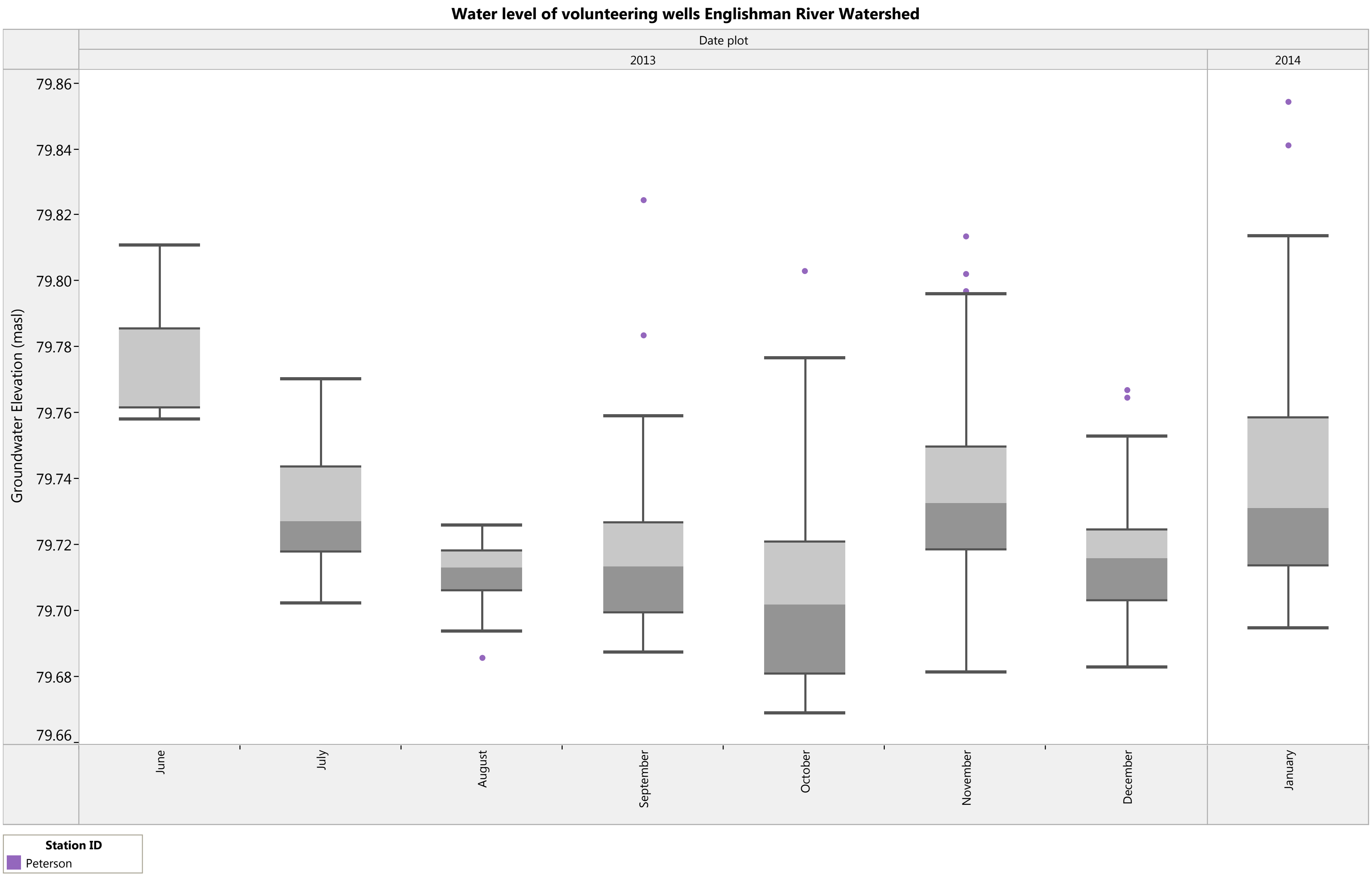
Water level of volunteering wells Englishman River Watershed
Date plot
2010
2011
2012
2013
2014
2015
2016
Groundwater Elevation (masl)
137
136
135
134
133
132
131
130
129
128
127
126
125
124
123
122
August
September
October
November
December
January
February
March
April
May
June
July
Station ID
Lt. Mountain



Water level of volunteering wells Englishman River Watershed
Date plot
2009
2010
2011
2012
2013
2014
2015
2016
Groundwater Elevation (masl)
55.0
54.8
54.6
54.4
54.2
54.0
53.8
53.6
53.4
53.2
53.0
52.8
September
November
February
April
June
August
October
December
Station ID
Margot


Water level of volunteering wells Englishman River Watershed
Date plot
2011
2012
2013
2014
2016
Groundwater Elevation (masl)
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
October
November
December
January
February
March
April
May
June
July
August
September
Station ID
Martindale


Water level of volunteering wells Englishman River Watershed
Date plot
2014
2015
2016
Groundwater Elevation (masl)
98.2
98.0
97.8
97.6
97.4
97.2
97.0
96.8
96.6
96.4
96.2
96.0
February
March
April
May
June
July
August
September
October
November
December
January
February
March
April
May
June
July
August
September
October
November
December
January
February
March
April
May
June
July
August
September
October
November
Station ID
Matthew Deep


Water level of volunteering wells Englishman River Watershed
Date plot
2013
2014
Groundwater Elevation (masl)
79.86
79.84
79.82
79.80
79.78
79.76
79.74
79.72
79.70
79.68
79.66
June
July
August
September
October
November
December
January
Station ID
Peterson