CENTENNIAL COAL
SPRINGVALE
2021 ANNUAL REVIEW

March 2022

Annual Review Title Block

Name of Operation	Springvale Colliery
Name of Operator	Springvale Coal Pty Limited
Project Approval #	SSD 5594
Name of holder	Centennial Springvale Pty Limited
Mining Lease #	ML1303, ML 1323, ML 1326, part ML 1424, ML 1537, ML 1588, ML 1670, ML 1727, MLA 445, MLA 497, CL 377, MPL 314, EL 6974, AUTH 460
Name of Holder of Mining Lease	Centennial Springvale Pty Ltd and Boulder Mining Pty Ltd
Water License #	10WA118719 (WAL 36383) 10BL603519 (WAL 36383) 10BL602017 (WAL 36443) 10BL601863 (WAL 36446)
Name of Holder of Water License	Centennial Springvale Pty Ltd
MOP/RMP Start Date	June 2018
MOP/RMP End Date	May 2025
Annual Review Start Date	1 January 2021
Annual Review End Date	31 December 2021

I, MICHAEL CLARK certify that this audit report is a true and accurate record of the compliance status of Centennial Springvale for the period 1 January to 31 December 2021 and that I am authorised to make this statement on behalf of Springvale Pty Ltd.

Note:

a) *The Annual Review is an 'environmental audit' for the purposes of s122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion) in an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000.*

b) *The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (intention to defraud by false or misleading statement – maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents –maximum penalty 2 years imprisonment or $22,000,or both).*

Name of Authorised Reporting Officer	MICHAEL CLARK
Title of Authorised Reporting Officer	Director
Signature of Authorised Reporting Officer	
Date	28/3/22

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Appendix No.	Appendix Name
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5	Noise Monitoring Results
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7	Complaint Register

1 STATEMENT OF COMPLIANCE

Table 1-1Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	
SSD 5594	No
EPBC 2011/5949	Yes
EPBC 2013/6881	Yes
SMP LW 411-418 (04/1673)	Yes
ML 1303	Yes
ML 1323	Yes
ML 1326	Yes
ML 1424 (part)	Yes
ML 1537	Yes
ML 1588	Yes
ML 1670	Yes
ML1727	Yes
CL 377	Yes
MPL 314	Yes
EL 6974	Yes
AUTH 460	Yes
EPL 3607	Yes
WAL 36383	No
WAL 36443	Yes
WAL 36446	Yes

Table 1-2 2021 Non-Compliances

Relevant Approval	Condition #	Condition summary	Compliance Status	Comment	Where Addressed in Annual Review
SSD5594	Schedule 3 Condition 4 and 5	Swamp Offset Bonds	Non-Compliant	LW419 Bond	Section 11
WAL 36383	2	Share component	Non-Compliant	Over extraction of share component	Section 11

Note: Compliance Status Key for Table 1-2

Risk Level	Colour Code	Description
High	Non-Compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium	Non-Compliant	Non-compliance with: • Potential for serious environmental consequences, but is unlikely to occur; or • Potential for moderate environmental consequences, but is likely to occur
Low	Non-Compliant	Non-compliance with: • Potential for moderate environmental consequences, but is unlikely to occur; or • Potential for low environmental consequences, but is likely to occur
Administrative	Non-Compliant	Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g. submitting a report to government later than required under approval conditions)

2 INTRODUCTION

Springvale Mine is an existing underground coal mine producing high quality thermal coal which is supplied to both domestic and international markets. It is located 15 kilometres to the northwest of the regional city of Lithgow and 120 kilometres west-northwest of Sydney in New South Wales (NSW).

Development Consent for Springvale was approved on 21 September 2015 by the Department of Planning, Industry and Environment (DPIE) as State Significant Development (SSD) 5594. The consent allows extraction of 5.5 million tonnes of run-of-mine (ROM) coal per calendar year until 2028. The consent has been modified on 3 occasions.

All mining operations are conducted in accordance with SSD 5594 (as modified), Approval Decisions under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), and in accordance with approvals granted under the Mining Act.

2.1 Scope

This Annual Review (AR) details the compliance, environmental management performance, and community engagement activities of Springvale over the Period 1 January 2021 to 31 December 2021. The AR has been prepared in accordance with the *Annual Review Guideline* (DPIE 2015), and satisfies

- Schedule 4, Condition 27 of SSD 5594
- Schedule 6, Condition 12 of SSD 5594
- Reporting requirements of mining tenements
- Reporting requirements of Extraction Plans

2.2 Mine Contacts

The contact details for the personnel responsible for environmental management and community relations at Springvale are provided in Table 2-1. The Springvale Enquiry and Complaint Line is (02) 63501 640.

Table 2-1Springvale Environmental Contact Details

Name	Position	Phone
Dennis Wallace	Mine Manager	T: (02) 6350 1613
		E: dennis.wallace@centennialcoal.com.au
Natalie Gardiner	Environment & Community Coordinator	T: (02) 6350 1672
		E: natalie.gardiner@centennialcoal.com.au

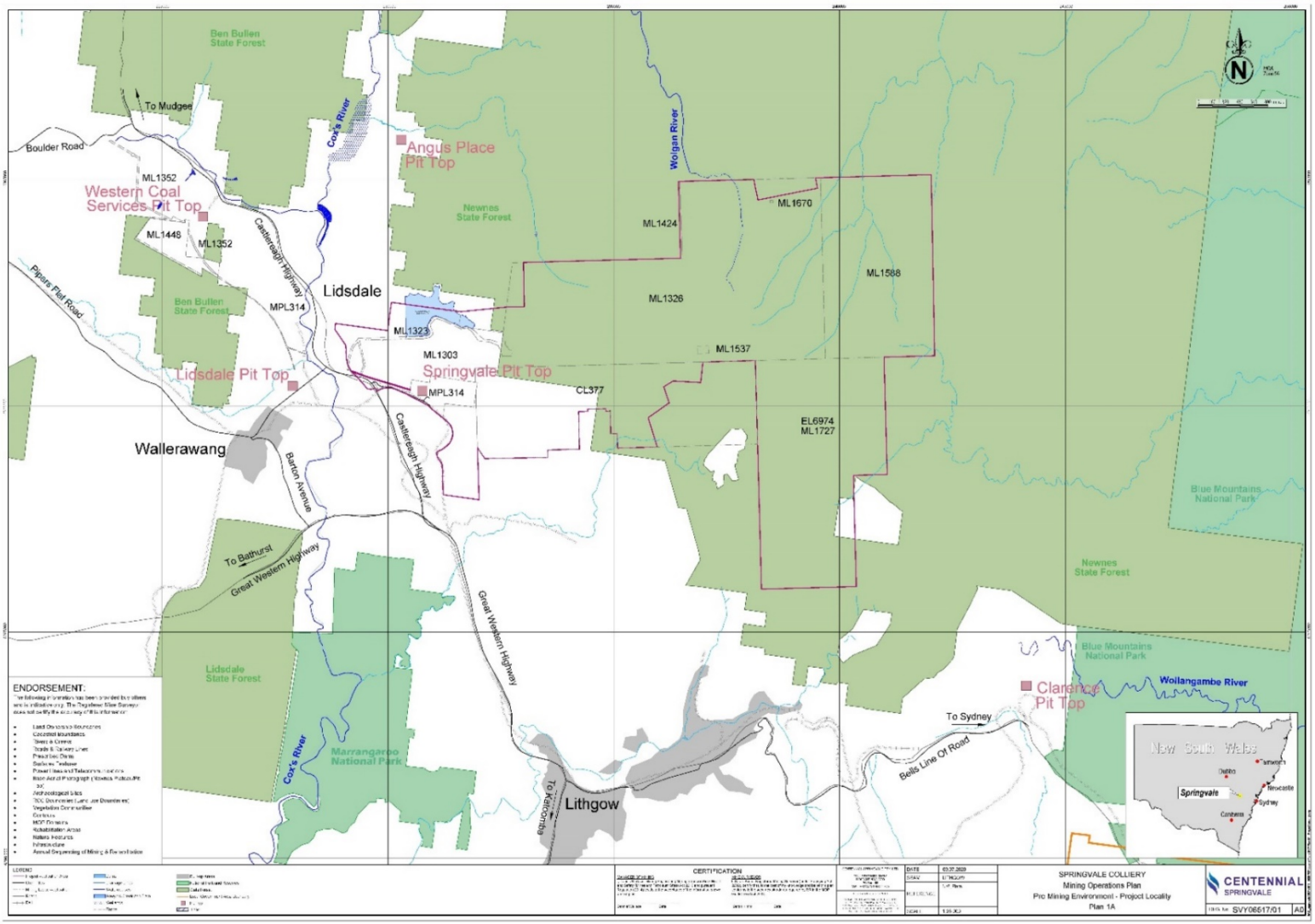


Figure 2-1 Development Consent Boundary

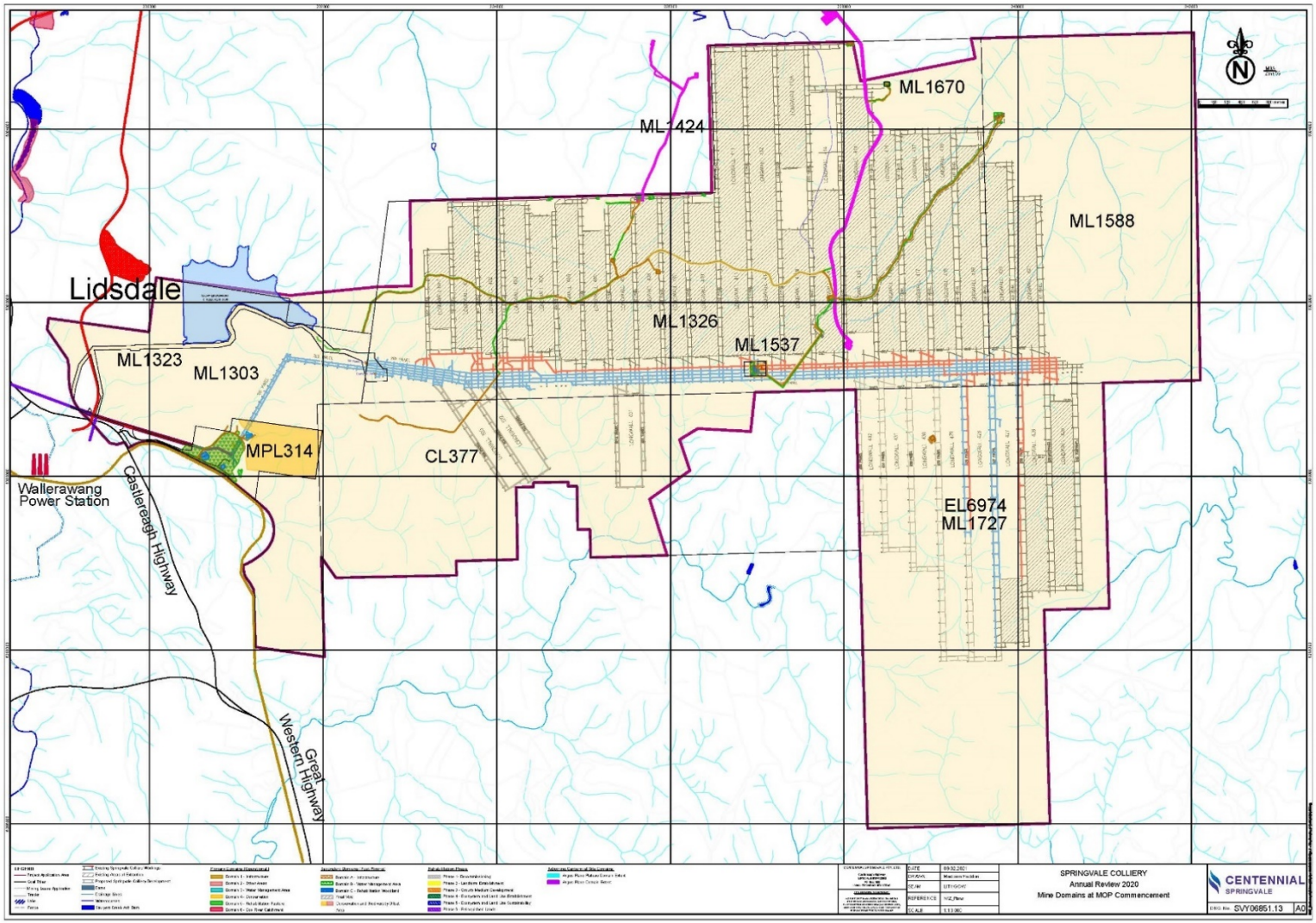


Figure 2-2 Mining Lease Boundaries

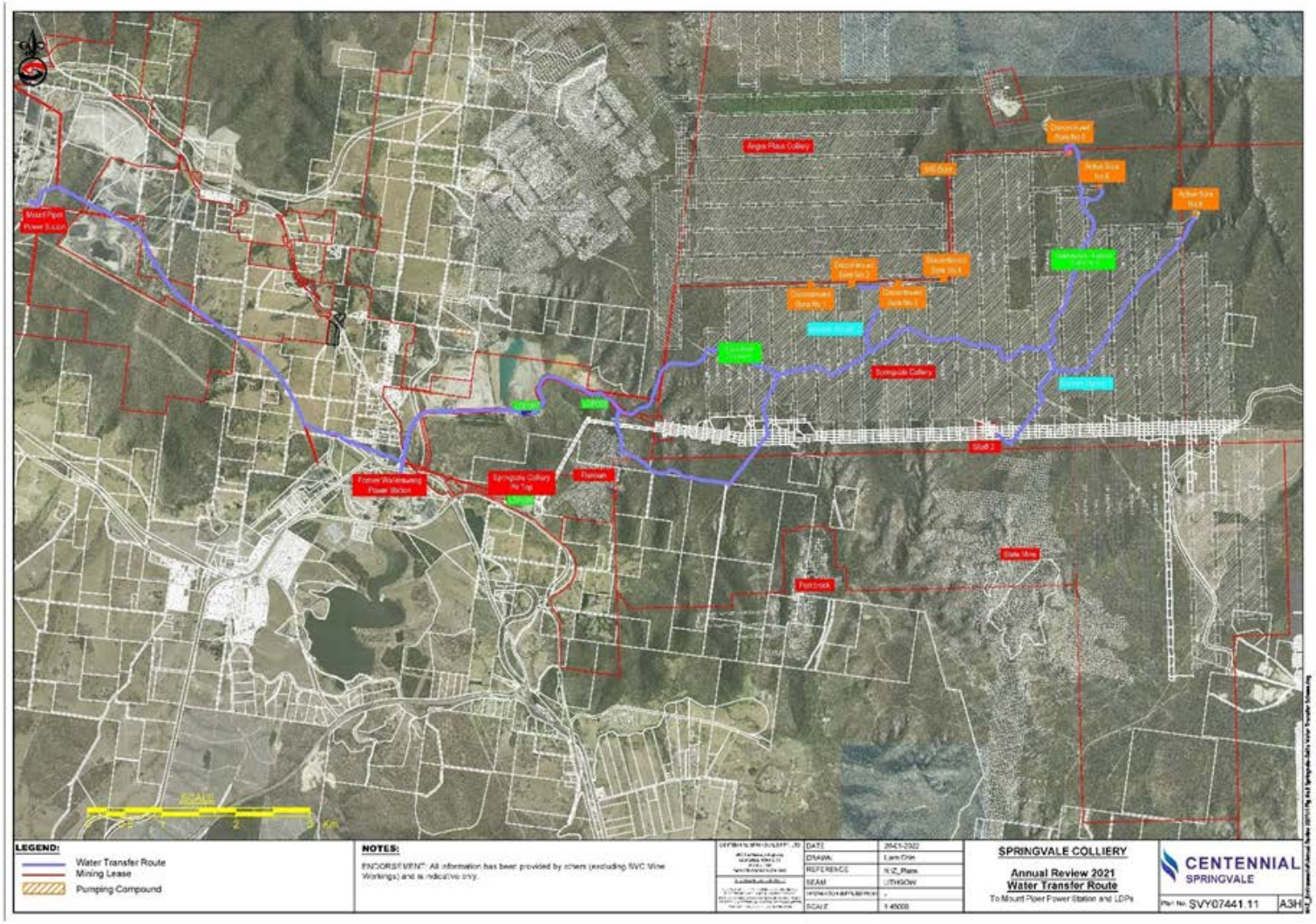


Figure 2-3 Newnes Plateau Operational Disturbance

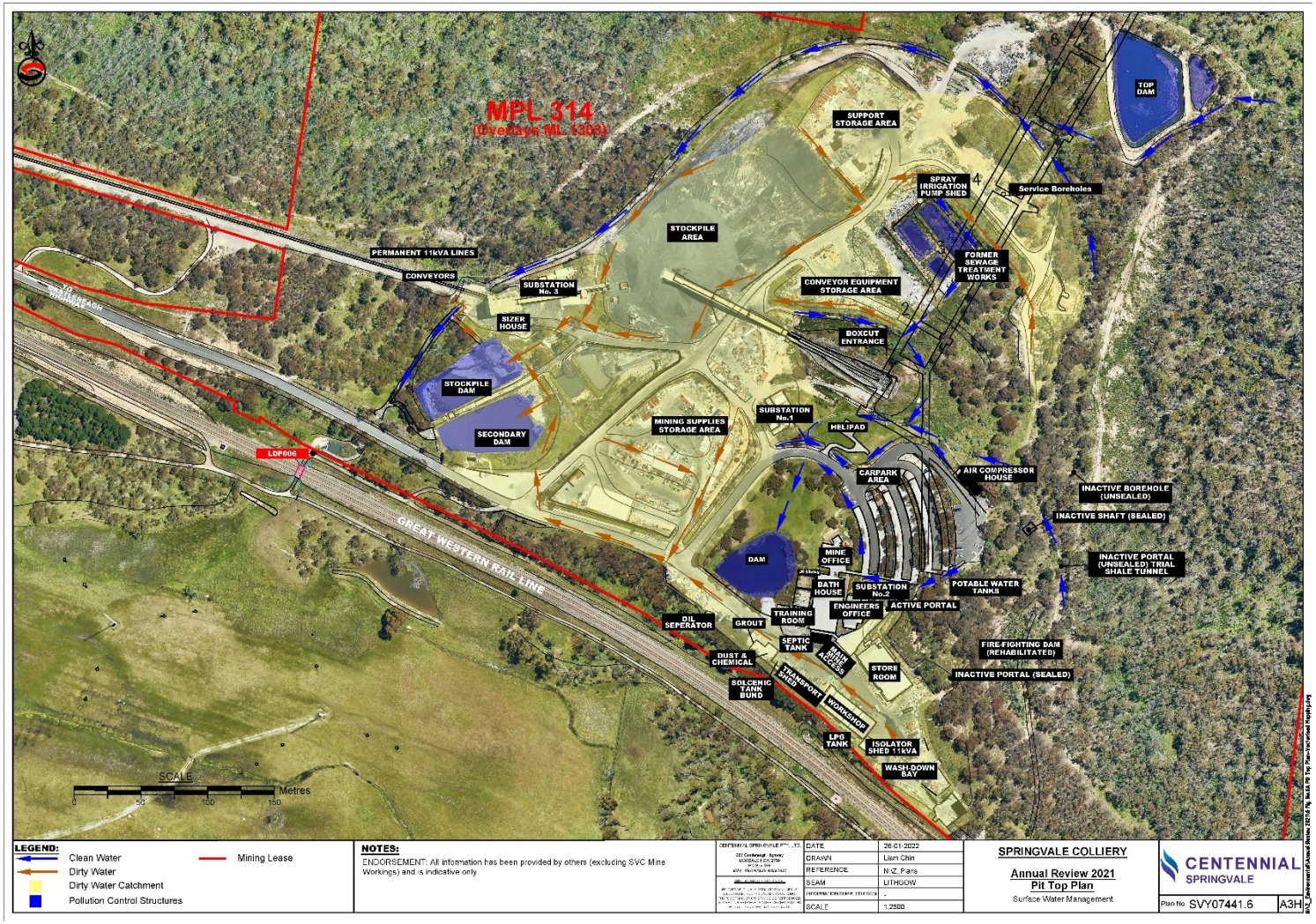


Figure 2-4 Springvale Pit Top Operational Disturbance

3 APPROVALS

Development Consent SSD 5594 was granted to Springvale on the 21st of September 2015. This consent supersedes the former Development Consent DA 11/92.

In accordance with Schedule 2, Condition 10 of SSD 5594, DA 11/92 was required to be surrendered by the 21st of September 2016. A legislative amendment has been proposed by the Department to manage the difficulties with the surrender of consents across multiple landholdings. The current extension to the surrender of consents is until 19 September 2023. All development and activities at Springvale from the 21st of September 2016 will be undertaken in accordance with SSD 5594 and DA 11/92 will not be relied upon to undertake development or activities beyond those encompassed by SSD 5594.

SSD 5594 has been modified on 3 occasions:

- Modification 1 was approved on 19 April 2017 to allow for 450 fte personnel, ROM production of 5.5Mtpa and a stockpile capacity of 200,000 tonnes

- Modification 2 was approved on 19 June 2017 and relates to the development consent granted for the Springvale Water Treatment Project (SSD-7592) in that it was required to defer the salinity limits until the SWTP is constructed and operational.

- Modification 3 was approved by the Director – Resource Assessments on 2 June 2021 to allow for the management of newly identified Aboriginal cultural heritage sites.

In addition to SSD 5594, Springvale operates in accordance with two federal approvals under the EPBC Act granted by the Department of Energy and Environment (former Department of Environment, former Department of Sustainability, Environment, Water, Population and Communities). Approval EPBC 2011/5949 was granted on the 14th of March 2012 and allows Springvale to extract coal from Longwalls 415 – 417. A second approval (EPBC 2013/6881) was issued on the 15th of October 2015 to allow secondary extraction associated with the Springvale Mine Extension Project SSD 5594.

Key approvals held by Springvale are presented in Table 3-1.

Table 3-1 Key Approvals held by Springvale

Approval	Description	Expiry Date	Change to Approval during Reporting Period
Project Approval – NSW Department to Planning, Industry and Environment			
SSD 5594	Springvale Mine Extension Project	31 December 2028	Yes
EPBC Approval – Commonwealth Department of Agriculture, Water and the Environment			
EPBC 2011/5949	Mining of Longwalls 415 – 417.	19 March 2032	No
EPBC 2013/6881	Mining associated with the Springvale Mine Extension Project.	8 October 2035	No
Mining Operation Plan – NSW Department of Regional NSW –Resources Regulator			
Mining Operations Plan	Operation of Springvale Colliery	31 May 2025	Yes
Environmental Protection Licence – NSW Environment Protection Agency			
EPL 3607	Springvale Colliery	Renewed Annually	No

The following changes occurred during the reporting period:

- SSD 5594 Modification 3 allowed for the management of newly identified Aboriginal cultural heritage sites.
- MOP Amendment B was an administrative update to align subsidence management processes to Longwalls 428-432 Extraction Plan. It also addressed the consent modification (MOD 3) which occurred in the reporting period.

3.1.1 Mining Tenements

Mining operation and exploration activities granted under the Mining Act are presented in Table 3-2.

Table 3-2 Mining Tenements associated with Springvale

Lease	Grant Date	Expiry Date
ML 1303	15 December 1992	15 December 2034
ML 1323#	3 August 1993	3 August 2035
ML 1326	28 September 1993	18 August 2024
ML 1424 (part)	18 August 2003	18 August 2024
ML 1537	15 June 2003	15 June 2024
ML 1588	19 June 2006	19 June 2027
ML 1670	17 February 2012	17 February 2033
ML 1727	4 February 2016	4 February 2037
MLA 445^	-	-
MLA 497^	-	-
CL 377	24 February 1992	9 March 2025
MPL 314	3 August 1993	3 August 2035
EL 6974	11 December 2007	13 December 2017*
AUTH 460	7 July 1992	6 June 2020

^ MLA 445, and MLA 497 were submitted 22 October 2012 and 28 May 2015, respectively. Both applications are still being processed.

* EL6974 renewal lodged 3 November 2017. Renewal Pending.

ML 1323 part cancellation was submitted to the department 10th May 2016 to update the mining lease boundary. Approval took effect 2nd December 2020. The part cancellation is outside the consent boundary for SSD5594.

3.1.2 Extraction Plans

Extraction Plans approved under since the consent was granted include:

- Longwall 419
- Longwall 420-422
- Longwall 424-427

During the reporting period Springvale prepared and submitted the Longwall 428-432 Extraction Plan. At the end of the reporting period the Extraction Plan was being assessed by both DPIE and DAWE.

3.1.3 Other Approvals

Springvale has established a Level 3 Occupation Permit with the Forestry Corporation of NSW (FCNSW) to operate under the forest and to build infrastructure and other surface facilities. The permit allows for infrastructure construction and ongoing maintenance on the surface to support below ground operations, including ventilation, dewatering and electricity supply infrastructure. This expires in February 2023.

Springvale also holds several Section 95 Certificates and Threatened Species Licenses as issued by OEH. These are presented in Table 3-3.

Table 3-3 BCD Approvals held by Springvale

Licence	Expiry
Section 95 Certificate Document No C0000077	30 June 2024
Threatened Species Licence Document No C0006077	31 December 2028
Threatened Species Licence Document No C0006298	31 December 2028
Threatened Species Licence Document No C0006026	31 December 2028
Threatened Species Licence Document No C0003184	22 June 2023
Threatened Species Licence Document No C0005809	31 December 2023
Threatened Species Licence Document No C0006026	31 December 2028
Threatened Species Licence Document No C0006096	31 December 2028
Threatened Species Licence Document No C0006185	31 December 2028
Threatened Species Licence Document No C0006242	31 December 2028
Threatened Species Licence Document No C0003546	9 April 2023
Threatened Species Licence Document No C0003839	12 July 2028
Threatened Species Licence Document No C0003684	31 December 2028
Threatened Species Licence Document No C0006265	31 December 2024
Threatened Species Licence Document No C0004842	31 December 2028

3.2 ANNUAL REPORTING

Table 3-4 provides a checklist of reporting requirements and performance conditions addressed within the Annual Review.

Table 3-4 Annual Review Requirements

Approval	Condition No	Requirement	Where addressed in Annual Review
Development Consent SSD 5594	Schedule 6 Condition 12	By the end of March each year, or as otherwise agreed by the Secretary, the Applicant shall review the environmental performance of the development to the satisfaction of the Secretary. This review must:	Noted
		(a) describe the development (including any rehabilitation) that was carried out in the past calendar year, and the development that is proposed to be carried out over the current calendar year;	Section 8
		(b) include a comprehensive review of the monitoring results and complaints records of the development over the past calendar year, which includes a comparison of these results against the: i. relevant statutory requirements, limits or performance measures/criteria. ii. requirements of any plan or program required under this consent; iii. monitoring results of previous years; and relevant predictions in the EIS;	Section 6 & 7
		(c) identify any non-compliance over the past calendar year, and describe what actions were (or are being) taken to ensure compliance;	Section 11
		(d) identify any trends in the monitoring data over the life of the development;	Section 6 & 7
		(e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and	Section 6 & 7
		(f) describe what measures will be implemented over the current calendar year to improve the environmental performance of the development.	Section 6 & 7
Development Consent SSD 5594	Schedule 4 Condition 27c	Monitor and Report on the effectiveness of the waste minimisation and management measures in the Annual Review	Section 6.8.2
Development Consent SSD 5594	Schedule 3 Condition 10	Six monthly environmental reporting in accordance with the Draft Guidelines for the Preparation of Extraction Plans V5 (DPE 2015)	Section 6 & 7
CL 377 ML1326 ML1424 ML1537 ML 1588	Condition 3	ANNUAL ENVIRONMENTAL MANAGEMENT REPORT (AEMR) Within 12 months of the commencement of mining operations and thereafter annually or, at such other times as may be allowed by the Director-General, the lease holder must lodge an Annual Environmental Management Report (AEMR) with the Director-General.	Noted

Approval	Condition No	Requirement	Where addressed in Annual Review
		1) The AEMR must be prepared in accordance with the Director-General's guidelines current at the time of reporting and contain a review and forecast of performance for the preceding and ensuing twelve months in terms of a) the accepted Mining Operations Plan; b) development consent requirements and conditions; c) Environment Protection Authority and Department of Land and Water Conservation licences and approvals; d) any other statutory environmental requirements; e) details of any variations to environmental approvals applicable to the lease area. and where relevant, progress towards final rehabilitation objectives.	Section 6 & 7
		After considering an AEMR the Director-General may, by notice in writing, direct the lease holder to undertake operations, remedial actions or supplementary studies in the manner and within the period specified in the notice to ensure that operations on the lease area are conducted in accordance with sound mining and environmental practice.	Noted
		The lease holder shall, as and when directed by the Minister, co-operate with the Director-General to conduct and facilitate review of the AEMR involving other government agencies.	Noted
ML1303 ML1323 ML1727 MPL 314	Condition 3 (f)	The lease holder must prepare a Rehabilitation Report to the satisfaction of the Minister. The report must: (i) Provided a detailed review of the progress of rehabilitation against the performance measures and criteria established in the approved MOP. (ii) Be submitted annually on the grant anniversary date (or at such other times as agreed by the Minister); and Be prepared in accordance with any relevant annual reporting guidelines published on the Department's website.	Section 8
ML 1670	Condition 4	(a) The lease holder must lodge Environment Management Reports (EMR) with the Director-General annually or at dates otherwise directed by the Director-general. (b) The EMR must: i) Report against non-compliance with the MOP; ii) Report on progress in respect of rehabilitation completion criteria; iii) Report on the extent of compliance with regulatory requirements; and Have regard to any relevant guidelines adopted by the Director-General.	Section 8
LW419 Extraction Plan LW420-422 Extraction Plan LW424-427 Extraction Plan	Section 6.1.3 Section 7.1.3 Section 7.1.2	Annual Review The Annual Review is completed in accordance with the post-approval requirements for State significant mining developments Annual Review Guidelines (2015) as required by the Department of Planning and Environment, incorporating the reporting requirements of the Department of Resources and Energy. The Annual Review will include information on operational activities, environmental performance and non-conformances and complaints received. This report is made available on the Centennial Coal website.	Section 6 & 7

4 OPERATIONS SUMMARY

Details of production and associated waste generated by the site for the report period and next reporting period is provided in Table 4-1.

Table 4-1:Production Summary & Forecast

Material	Approved Limit (and source)	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Next Reporting Period (Forecast)
Waste Rock/ Overburden	NIL	Not Applicable	Not Applicable	Not Applicable
ROM Coal	5.5 million tonnes per calendar yr. (Source: SSD5594 S2 C6)	2.939530 Mt	2.093013	3.002476
Coarse reject	NIL	Not Applicable	Not Applicable	Not Applicable
Fine reject (Tailings)	NIL	Not Applicable	Not Applicable	Not Applicable
Saleable product	NIL	Not Applicable	Not Applicable	Not Applicable

There are no inconsistences between approved limits and actual production.

4.1 MINING OPERATIONS

During the reporting period development was undertaken in 428 panel and secondary extraction in Longwall 427. Mine production in 2021 is shown in Figure 4-1.

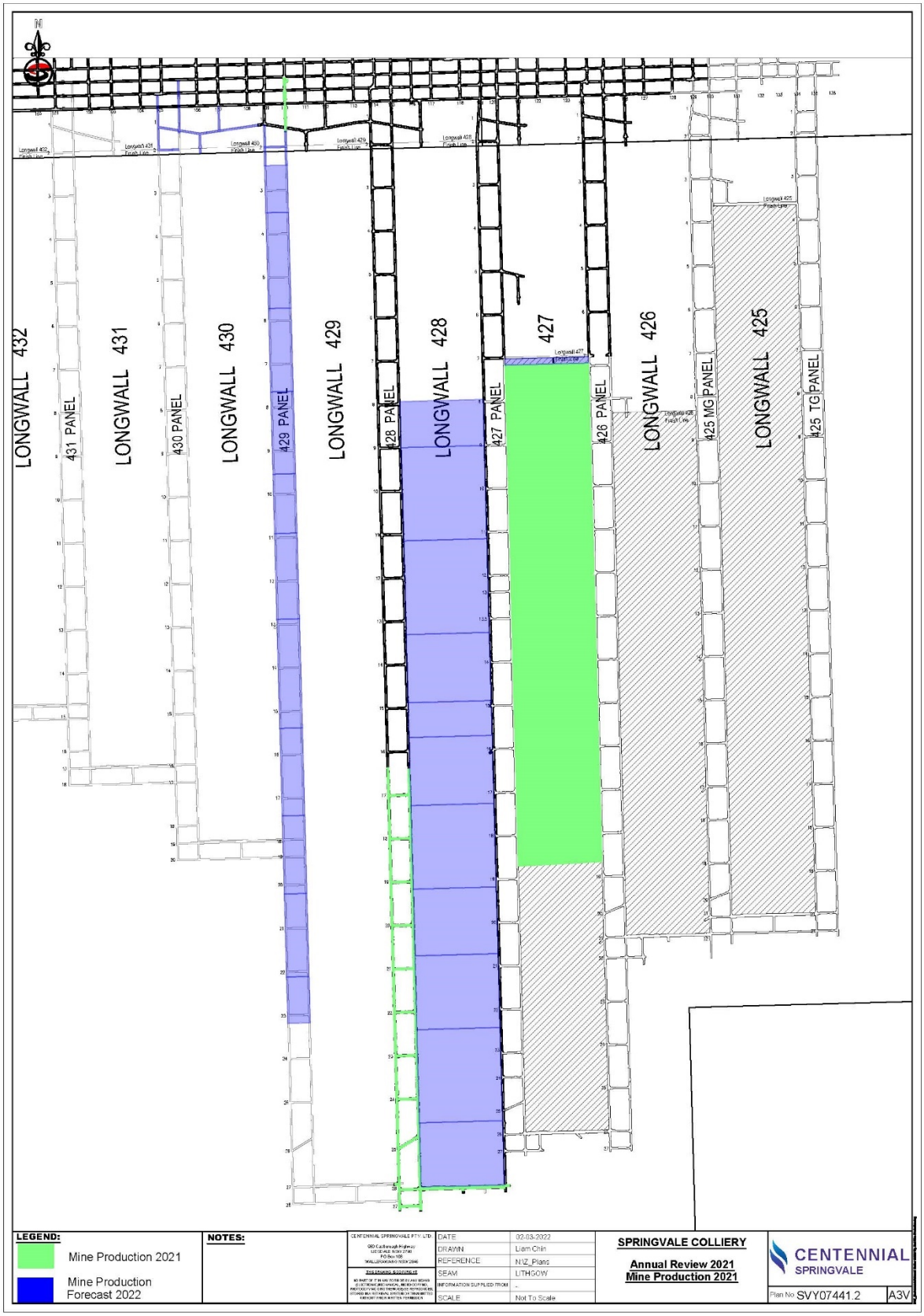


Figure 4-1 2021 Mine Production

4.2 OTHER OPERATIONS

Details of other operations relevant to Springvale is provided in Table 4-2.

Table 4-2: Operations Summary

	Approved Limit (and source)	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Comment (if applicable)
Hours of operation	24 hours a day, 7 days a week (Source: SSD5594 S2 C7)	24 hours a day, 7 days a week	24 hours a day, 7 days a week	No change
Transport (rail)	NIL	Not Applicable	Not Applicable	Not Applicable
Transport (road)	50,000 tonnes of ROM Coal per calendar year (Source: SSD 5594 S2 C8)	0t	0t	Within approved limits

There were no inconsistencies between the approved limit and actual production for the reporting period.

4.3 LAND DISTURBANCE

During the reporting period land disturbance was limited to the installation of monitoring equipment (groundwater and subsidence lines) in accordance with TS licence and occupation permit requirements. Cumulative land disturbances are discussed in Section 8.1.

4.4 EXPLORATION

Springvale is currently undertaking one exploration project, however in the current reporting period no further works were undertaken. The project aims to confirm the coal seam barrier between the proposed Springvale Mine workings and old flooded State Mine workings. The Project Area is located within Mining Lease ML1727 and the Exploration Licence area EL6974.

Exploration is planned to continue in 2022 at one Surface to Seam (SIS) exploration sites on the Newnes Plateau. The location of the proposed sites are presented in Plan A in Appendix 1.

4.5 CONSTRUCTION

There was no construction or demolition during the reporting period. There is no construction or demolition planned for 2022.

4.6 NEXT REPORTING PERIOD

In the next reporting period Springvale will complete Longwall 427 and commence Longwall 428. First working for future longwalls are planned to continue in accordance with the approved mine layout.

5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

Table 5-1 summarises the outcomes of the 2020 Annual Review, including actions issued by Regulators and actions addressed by Springvale.

Table 5-1: Actions from Previous Annual Review

Action Required	Requested By	Action Taken	Where addressed in Annual Review
Website publication within 1 month of 23/4/2021	DPIE	The Annual review was published on the Centennial website 16/4/2021	Not applicable

5.1 Site Inspections

During the reporting period DPIE undertook an inspection of both the Pit top and the Newnes Plateau Infrastructure sites on 14 April 2021. The Resource Regulator undertook an inspection on the Newnes Plateau on 18 May 2021. Additionally, DPIE and the IMP have undertaken site inspections on 25 March 2021 and 20 October 2021 as part of the consultation process for the Extraction Plan.

6 ENVIRONMENTAL PERFORMANCE

Springvale implements an Environmental Management Strategy, including management plans, procedures and monitoring programs that provide a framework for managing environment and community risks and impacts. To measure compliance with site approvals and licences, Springvale undertake a comprehensive monitoring program.

This section provides a summary of environmental performance in the reporting period, including:

- Section 6.1 – Meteorological Summary
- Section 6.2 – Noise
- Section 6.3 – Air Quality
- Section 6.4 – Biodiversity
- Section 6.5 – Heritage
- Section 6.6 – Blasting
- Section 6.7- Other Aspects

The environmental performance for water, rehabilitation and community aspects are reported in Sections 7.0, 8.0, 9.0 and 10.0 respectively.

Within Each Extraction Plan, Springvale has developed Trigger Action Response Plans (TARPs) using the performance indicators for subsidence impacts relevant to each component Management Plan. The TARP provides a process of tiered/escalating trigger levels for contingency measures should measurements and impacts be greater than predicted/approved. Relevant monitoring sections summarise the triggers reported during the reporting period. The Extraction Plan should be referred to for additional detail.

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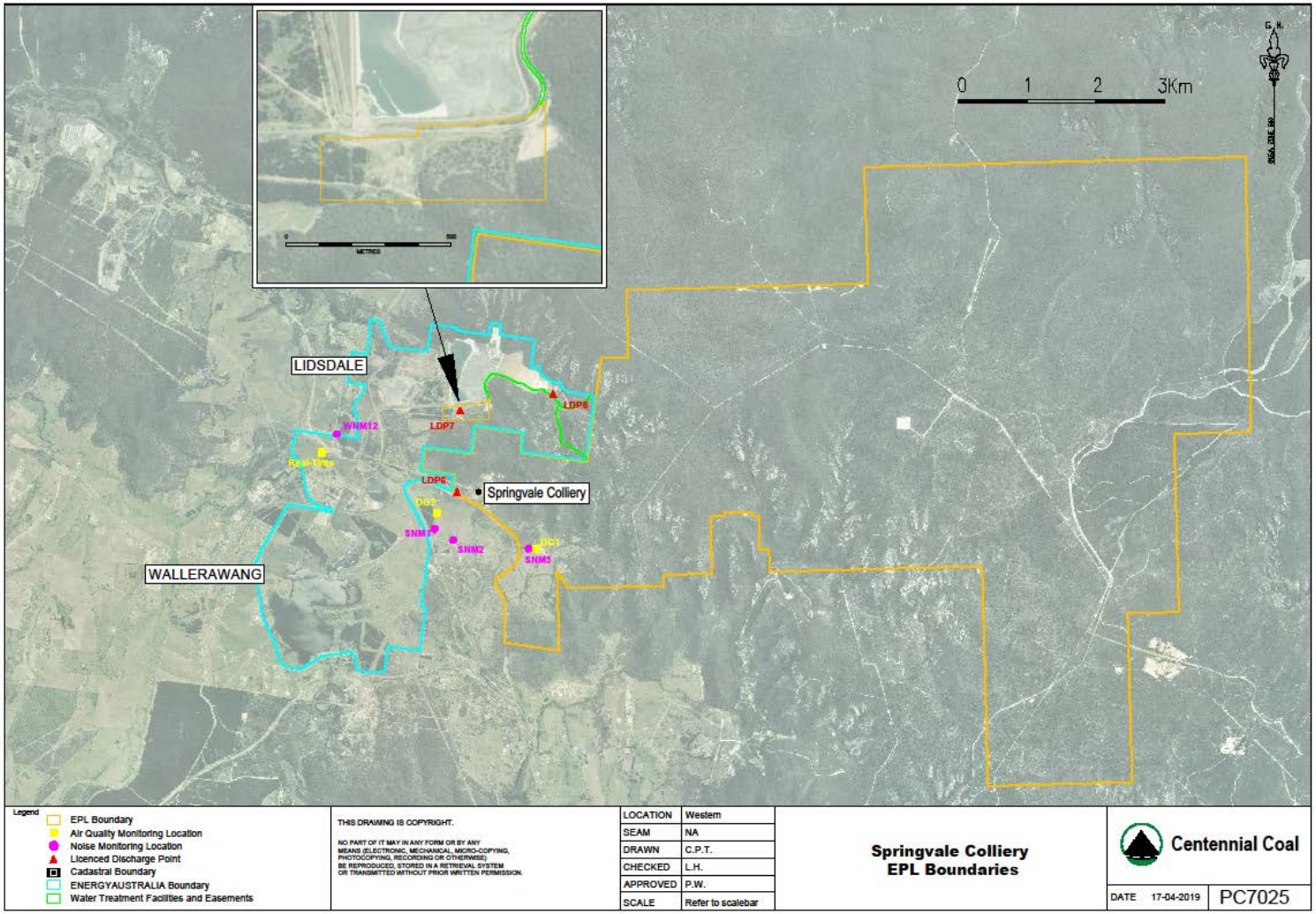


Figure 6-1 Springvale Operational Monitoring Locations

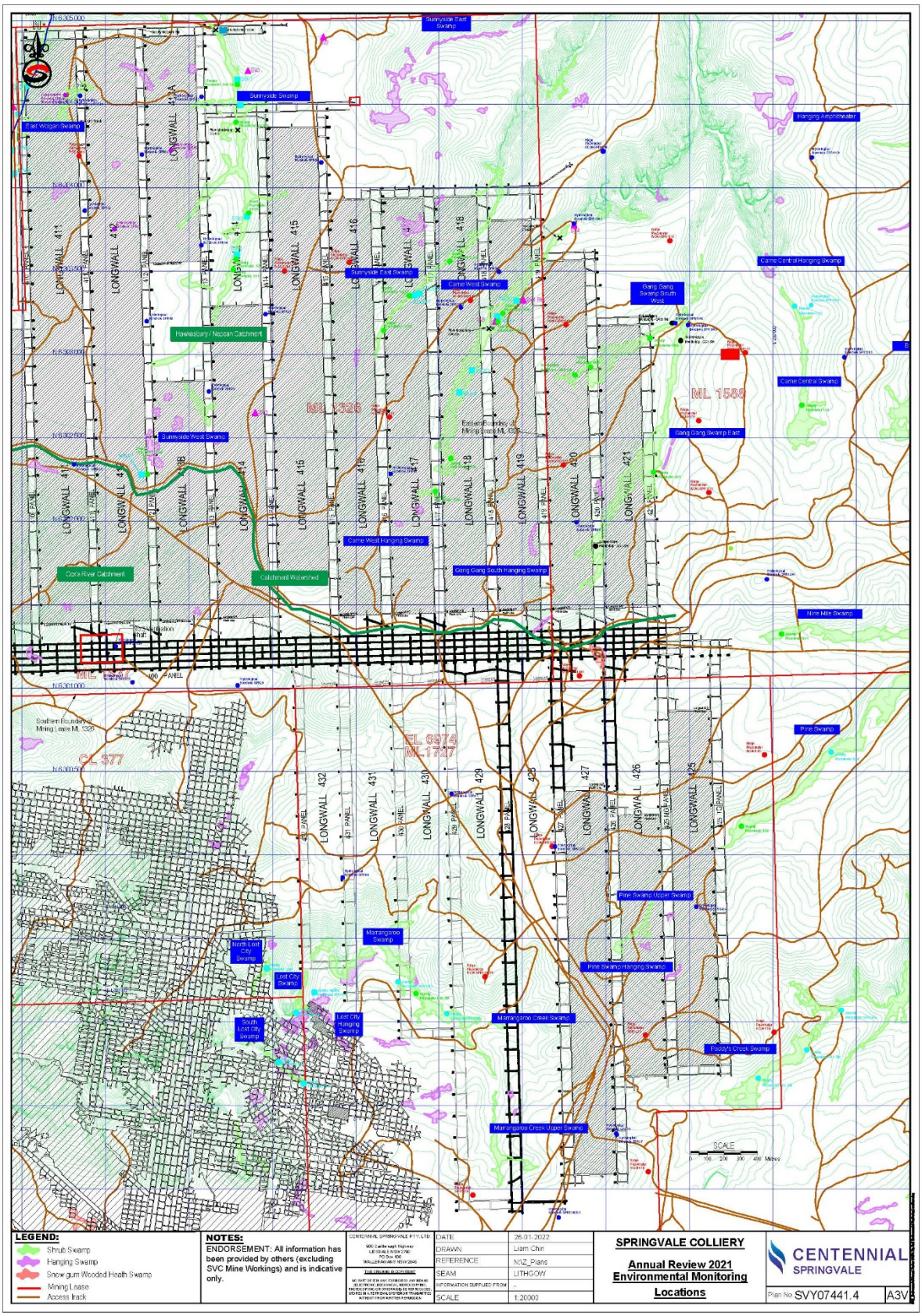


Figure 6-2 Springvale Extraction Plan Monitoring Locations

6.1 METEROLOGICAL SUMMARY

6.1.1 Environmental Management

Metrological monitoring is undertaken at an Automatic Weather station in accordance with SSD 5594 and EPL requirements.

A summary of meteorological data collected from Springvale Colliery during 2021 is presented in Table 6.1.

Table 6-1 Metrological Conditions

Month	Rainfall (mm)	Cumulative rainfall (mm)	Min Temperature @2m	Max Temperature @2m
January 2021	56.8	56.8	5.83	33.78
February 2021	86.6	143.4	7.21	28.94
March 2021	148.6	292	2.64	28.66
April 2021	1.8	293.8	2.51	18.69
May 2021	38.4	332.2	-4.7	19.66
June 2021	46.20	378.4	-4.64	16.2
July 2021	52.2	430.6	-7.63	17
August 2021	74.6	505.2	-5.32	19.71
September 2021	46.0	551.2	-4.23	21.22
October 2021	47.4	598.6	-0.41	27.15
November 2021	166.0	764.6	3.05	23.11
December 2021	75.4	840	3.93	29.55

The minimum temperature recorded on-site during the reporting period was -7.63°C in July and the maximum temperature recorded was 33.78°C in January.

Annual temperature and rainfall are presented in Figure 6-3. Total annual rainfall decreased by 77 mm from 917mm in 2020 to 840 mm in 2021.

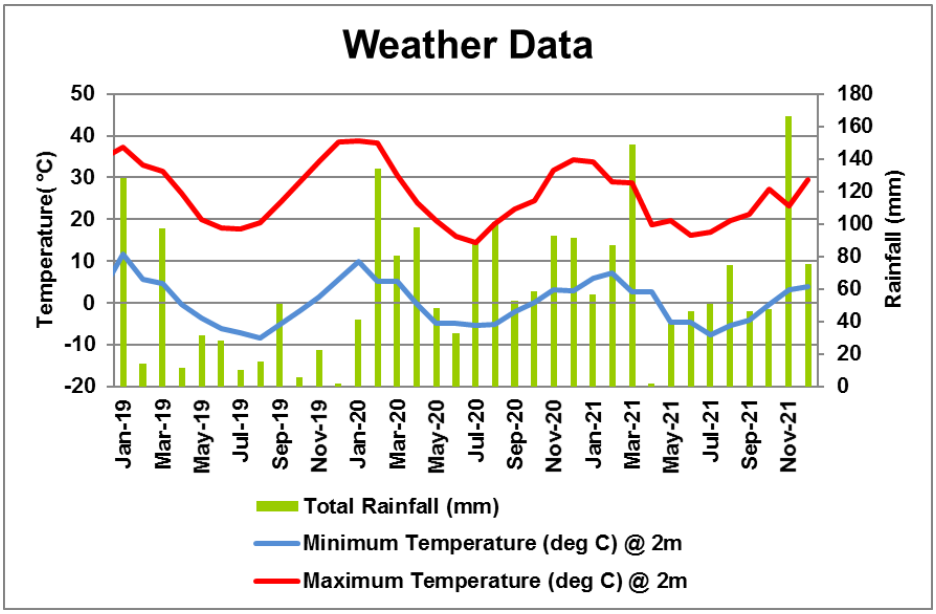


Figure 6-3 Annual temperature and Rainfall

An annual wind velocity and direction wind rose is presented in Figure 6-4. Both parameters are generally consistent with 2020 averages, with the average daily wind speed being 1.30m/sec and the predominant wind direction east north easterly.

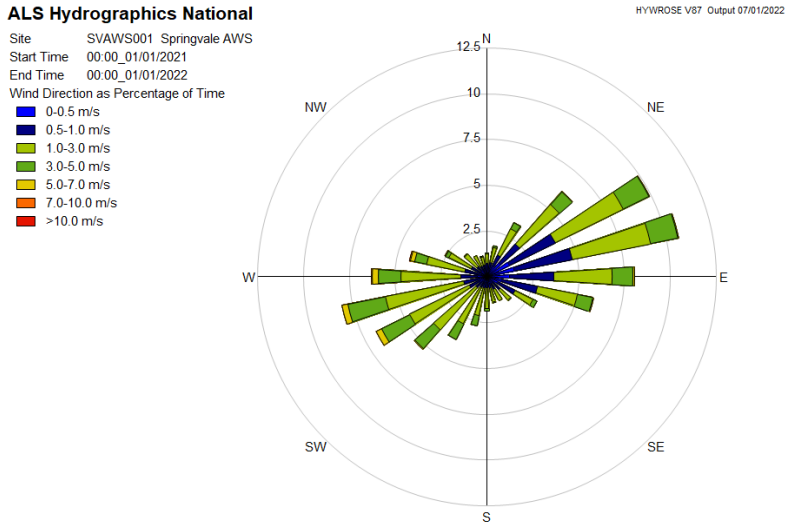


Figure 6-4 Annual Wind Rose

6.2 NOISE

6.2.1 Environmental Management

Springvale manages noise in accordance with the Western Region Noise Management Plan (WRNMP) dated February 2021. This plan was approved by DPIE 7 September 2021.

The following sources of noise identified in the NMP are relevant for Springvale Mine operations:

- Operation of mobile equipment – e.g. trucks, dozers, loaders
- Coal handling/processing plant – e.g. conveyors, washery, screens and hopper filling
- Coal transporting activities – e.g. overland conveyors, haul trucks
- Ventilation fans.

Key Noise mitigation measures for Springvale Mine operations are:

- Maintaining all plant and equipment to manufacturers specifications (ongoing).
- Operate mobile plant in a quiet, efficient manner and regular training of operators (ongoing).
- Installation of frequency modulated reversing alarms or “quakers” on mobile plant to replace reversing alarms (complete).
- Installing acoustic enclosures around processing plants (ongoing as required to ensure compliance).
- Switching off vehicles and plant when not in use (ongoing).

Additional noise management measures are outlined in the WRNMP.

6.2.2 Environmental Performance

Noise Criteria

Schedule 4 Condition 2 of SSD 5594 provides noise criteria for 3 identified locations.

Condition L4.1 of EPL 3607 specifies noise limits at the same locations. These are presented in Table 6-2.

Table 6-2 Noise Criteria

Receiver ID	Day LAeq (15 min)	Evening LAeq (15 min)	Night LAeq (15 min)	Night LA1 (1min)
S1	44	44	42	52
S2	43	43	43	53
S3	35	35	35	60
All other privately owned land	35	35	35	45

Springvale Mine is currently operating in compliance with the short-term noise monitoring program.

Attended Noise Monitoring

Monthly attended noise surveys have been undertaken at 5 locations which have been selected to be representative of identified receiver locations. These locations were shown in Figure 6-1. Results for day, evening and night are presented in Table 6-3 to Table 6-6.

Table 6-3 2021 Day (LAeq (15 minute) dBA)

EPL Location	Project Approval Location	Q1	Q2	Q3	Q4	Criteria Limit
EPL ID No. 3	S1	~36	<37	<30	Inaudible	44
EPL ID No. 4	S2	~36	<36	<30	Inaudible	43
Not Applicable	S3	Inaudible	Inaudible	Inaudible	Inaudible	35
EPL ID No. 5	S4	Inaudible	Inaudible	32	Inaudible	35
Not Applicable	S5	Inaudible	Inaudible	<30	Inaudible	35

Table 6-4 2021 Evening (LAeq (15 minute) dBA) Results

EPL Location	Project Approval Location	Q1	Q2	Q3	Q4	Criteria Limit
EPL ID No. 3	S1	41	41	<30	<36	44
EPL ID No. 4	S2	40	40	33	36	43
Not Applicable	S3	Inaudible	Inaudible	Inaudible	Inaudible	35
EPL ID No. 5	S4	<27	<33	<30	<33	35
Not Applicable	S5	<30	<30	<30	<30	35

Table 6-5 2021 Night (LAeq (15 minute) dBA) Results

EPL Location	Project Approval Location	Q1	Q2	Q3	Q4	Criteria Limit
EPL ID No. 3	S1	39	41	35	41	42
EPL ID No. 4	S2	44*	44*	37	44*	43
Not Applicable	S3	Inaudible	Inaudible	Inaudible	Inaudible	35
EPL ID No. 5	S4	~28	<28	<30	<30	35
Not Applicable	S5	<33	<30	31	<30	35

* Within 2dB tolerance as per Section 11.1.3 of the NSW Industrial Noise Policy (INP). A development will be deemed to be in non-compliance with a noise consent or licence if the monitored noise level is more than 2dB above the statutory noise limit specified in the consent or licence condition.

Table 6-6 2021 Night (LA1 (1 minute) dBA) Results

EPL Location	Project Approval Location	Q1	Q2	Q3	Q4	Criteria Limit
EPL ID No. 3	S1	49	51	43	48	52
EPL ID No. 4	S2	54*	48	46	54*	53
Not Applicable	S3	Inaudible	Inaudible	Inaudible	Inaudible	60
EPL ID No. 5	S4	<30	<33	34	<35	45
Not Applicable	S5	38	<30	38	33	45

* Within 2dB tolerance as per Section 11.1.3 of the NSW Industrial Noise Policy (INP). A development will be deemed to be in non-compliance with a noise consent or licence if the monitored noise level is more than 2dB above the statutory noise limit specified in the consent or licence condition.

Results are presented graphically in Appendix 4.

6.2.3 Comparison Against Predictions

Construction Noise

The predicted construction noise levels are significantly below the construction noise goals at the nearest sensitive receiver and therefore the potential construction noise impacts of the Project are negligible. There were no construction activities undertaken during the reporting period.

Operational Noise

The consequence of the implementation of the Project mitigation measures will be the reduction in the historic noise exceedances for residential receivers along Springvale Lane.

Noise modelling has indicated that noise emissions associated with the Project are predicted to exceed the project specific intrusive and amenity noise levels by up to 4 dBA during the night-time period under adverse meteorological conditions.

6.2.4 Long Terms Analysis

Long term trends are summarised in the Table 6.7.

Table 6-7 Long Term Attended Noise Monitoring trends

Criteria aspect	2017	2018	2019	2020	2021
No Exceedances of Day LAeq (15 min)	1	0	0	0	0
No Exceedances of Evening LAeq (15 min)	0	0	0	0	0
No Exceedances of Night LAeq (15 min)	2	2	0	0	0
No Exceedances of Night LA1 (1min)	2	2	0	0	0

6.2.5 Implemented / Proposed Improvements

Noise management controls are considered effective based upon compliance with the noise criteria. Springvale will continue to implement the WRNMP. Springvale will review and revise, if necessary the WRNMP in accordance with Schedule 6 Condition 6.

6.2.6 Acquisition

There have been no requests received or actions undertaken during the reporting period.

6.3 AIR QUALITY

Springvale manages air quality in accordance with the Western Region Air Quality and Greenhouse Gas Management Plan (WRAQMP) dated April 2021. This plan was approved by DPIE 10 May 2021.

The following identified sources of dust emissions in the WRAQMP are relevant Springvale Mine operations:

- Wind erosion from coal stockpiles
- Wind erosion from disturbed areas and coal stockpiles
- Wheel generated dust from vehicle movements
- Fugitive emissions from coal handling and processing Fugitive emissions through mine ventilation fans as a result of underground mining operations;
- Coal transporting activities; and
- Operation of mobile equipment.

Key dust mitigation measures for Springvale Mine operations are:

- Signage to display speed limits on all unsealed roads in the surface facilities area;
- Water sprays on unsealed areas during use or windy conditions; and

- Water sprays (sprinkler system) on the coal product stockpile as required.

6.3.1 Environmental Management

Air Quality Criteria

The criteria for the project are shown in Table 6-8 to Table 6-10.

Table 6-8 Long term criteria for deposited dust

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

Table 6-9 Long term criteria for particulate matter

Pollutant	Averaging period	Criterion
Total suspended particulate (TSP) matter	Annual	90 µg/m^3
Particulate matter < 10 µm (PM10)	Annual	25 µg/m^3

Table 6-10 Short term criteria for particulate matter

Pollutant	Averaging period	Criterion
Particulate matter < 10 µm (PM10)	24 hour	50 µg/m^3

Springvale undertakes air quality monitoring in accordance with the short-term program detailed in the WRAQMP. The air quality monitoring locations are shown in Figure 6-1. This includes both depositional dust gauges and a collocated PM_{10} and TSP High Volume air sampler. The real time dust monitor proposed under the long-term program is in operation and data has been reported in the Lidsdale Siding Annual Review.

6.3.2 Environmental Performance

Dust Deposition

The annual deposition dust results are presented in Table 6-11.

Table 6-11 2021 results for deposited dust

Dust Gauge	Min	Mean	Max
DG 1	0.21	0.74	1.28
DG 2	<0.1	0.53	1.61

The annual averages for deposited dust are within of below the predicted ranges and remain complaint with the limits in the project approval and EPL.

PM10 and TSP

The annual particulate matter results are summarised in Table 6-12.

Table 6-12 2021 results particulate matter

	Criteria	Maximum (µg/m^3)	Mean (µg/m^3)
24hr PM10 (short term)	50	22.5	6.04
PM10 (long term)	25		
TSP	90	36	12.51

The annual averages for PM10 and TSP are below the predicted ranges and remain compliant with the limits in the project approval.

Air quality results are presented graphically in Appendix 2.

6.3.3 Comparison against Predictions

As outlined in SSD 5594, dust levels from the Project are predicted to meet relevant air quality criteria for TSP, PM10and depositional dust.

6.3.4 Long Terms Analysis

The annual average long-term trends are summarised in the tables below.

Table 6-13 Long term trends for deposited dust

	2017	2018	2019	2020	2021
Annual Mean DG 1	1.27	1.86	1.49	1.53	0.72
Annual Mean DG 2	0.71	1.04	1.55	1.44	0.51

Table 6-14 Long term trends for HVAS

	2017	2018	2019	2020	2021
Annual Mean PM10	8	10	11.41*	9	6.04
Annual Mean TSP	17	20	24.18*	20	12.51

*As per note D of Schedule 4 Condition 5, the criteria exclude extraordinary events such as such fires. Data from 20 November 2019 to the end of the reporting period has therefore been excluded due to the Gosper Fire.

6.3.5 Implemented / Proposed Improvements

Dust emission controls are considered effective based upon compliance with the air quality criteria. Springvale will continue to implement the WRAQMP. Springvale will review and revise, if necessary the WRAQMP in accordance with Schedule 6 Condition 6.

6.4 BIODIVERSITY

6.4.1 Environmental Management

The Western Region Biodiversity Management Plan has been prepared to address the requirements of SSD 5594 Schedule 4 Condition 18 however the plan has not been approved by DPIE. The Western Region Biodiversity Management Plan was re-submitted on 30 September 2021. After receiving feedback from DPIE in October 2021 further consultation is proposed with relevant stakeholders in 2022 with re-submission by 30 April 2022.

Springvale also implements Biodiversity Management Plans and Swamp Monitoring Programs under approved Extraction Plans in accordance with SSD 5594 Schedule 4 Condition 10h(iv). As there was no construction during the reporting period, this section of the Annual Review focuses on the active extraction area of the mine.

6.4.2 Flora Monitoring

The following sections present a comparison against the performance measures in the TARP as applicable to different SMP and Extraction Plans approved by the operation.

The Temperate Highland Peat Swamps on Sandstone (THPSS) Monitoring and Management Plan (MMP) prescribes the requirements for monitoring the effects of mining on areas of THPSS. Flora monitoring for THPSS MMPs LWs 415 – 417 and LW 418 are methodologically identical.

The Swamp Monitoring Programs prepared as component of the Extraction Plans prescribe the requirements for monitoring the effects of mining on areas of THPSS. Flora monitoring for LW 419, LWs 420 – 422 and LWs 424 - 427 are methodologically identical but apply to different swamps with varying baseline and trigger levels.

A summary of impact swamps by longwall area as relevant to SSD 5594 is presented in Table 6-15. The Trigger analysis relevant to each Extraction Area approval is presented in Table 6-16 to 6-19.

Table 6-15 Summary of Impact Swamp by Longwall Area

Relevant Longwall	LW 418-419	LW 420-422	LW 422-427
Impact Swamps	West Carne; and Sunnyside East.	Carne West Gang Gang; and Nine Mile	Gang Gang East; Nine Mile Marrangaroo; Paddy's Creek; and Pine.

Table 6-16 SMP 418

Performance Indicator	Parameter Measured	Trigger Level*	Summer 2020/21	Autumn 2021	Winter 2021	Spring 2021
Change in species assemblage	Change in diversity of native species	A change in the number of species of greater than 30 % for a given site within a three year period.	Two impact sites (WC01 and WC02) showed a repeat trigger for species richness. Three reference sites exceeded the upper trigger level (TRI02, TG01 and BS01). For TG01, this was a first time exceedance.	Three impact sites recorded upper trigger level exceedances (WC01, WC02 and WC04) and one impact site recording a lower trigger level exceedance (WC03). Three reference sites exceeded the upper trigger level (TG01, TRI02 and BS01). One reference site excluded from analysis was also below the lower trigger (UGE01).	Two impact sites recorded lower trigger exceedances (WC02 and WC03) and one impact site recorded an upper trigger exceedance (WC04). Three reference sites recorded upper trigger level exceedances (TG01, TRI02 BS01). One site excluded from analysis recorded a lower trigger exceedance (UGE01).	A recurring lower trigger exceedance for species richness was recorded at impact site WC01. An upper trigger exceedance was recorded at impact site WC04. Upper trigger exceedances were also recorded at three reference sites (TG01, TRI02 and BS01). One site excluded from analysis recorded a lower trigger exceedance (CCS01).
	Recruitment of eucalypt species	An increase in eucalypts in an impact site compared to reference sites of more than three individual plants within a one year period.	Four impact sites recorded a recurring trigger from previous surveys (WC01, WC02, WC04 and SSE01). Two sites excluded from analysis also exceeded trigger levels (LGG01 and UGE01).	Four impact sites recorded a recurring trigger from previous surveys (WC01, WC02, WC04 and SSE01). One site excluded from analysis also exceeded trigger levels (LGG01).	Four impact sites recorded a recurring trigger from previous surveys (WC01, WC02, WC04 and SSE01). One reference site recorded a new trigger exceedance (TRI02). One site excluded from analysis also recorded a recurring trigger (LGG01).	Four impact sites recorded a reoccurring trigger in spring 2021 (WC01, WC02, WC04 and SSE01). One site excluded from analysis also recorded a recurring trigger (LGG01).
Change in condition	Condition of key species	A decline in condition score at an impact site of more than 1.5 compared to the average condition score at un-impacted sites within a one year period.	Four impact sites showed a recurring and worsening decline in condition beyond the trigger level for Gleichenia dicarpa (WC01, WC02, WC03 and WC04), and one impact site for Baumea rubiginosa (WC04).	Four impact sites showed a recurring and worsening decline in condition beyond the trigger level for Gleichenia dicarpa (WC01, WC02, WC03 and WC04), and one impact site for Baumea rubiginosa (WC04).	Four impact sites recorded a recurring trigger for condition of Gleichenia dicarpa (WC01, WC02, WC03 and WC04). Three impact sites recorded a recurring trigger for condition of Baumea rubiginosa (WC01, WC03 and WC04).	A recurring trigger level decrease in condition for Gleichenia dicarpa was observed in WC01, WC02, WC03, and WC04. A recurring trigger level decrease in condition for Baumea rubiginosa was observed in WC01, WC02, WC03 and WC04.
	Non-live ground cover	An increase of bare ground of more than 100m^2 in a site within a three year period.	Five impact sites maintained a recurring exceedance of trigger level for non-live ground cover (WC01, WC02, WC03, WC04 and SSE01). Two sites excluded from analysis also exceeded trigger levels (LGG01 and UGE01).	Five impact sites maintained a recurring exceedance of trigger level for non-live ground cover (WC01, WC02, WC03, WC04 and SSE01). Two sites excluded from analysis also exceeded trigger levels (LGG01 and UGE01).	All Five impact sites recorded a recuring trigger exceedance for non-live ground cover (WC01, WC02, WC03, WC04 and SSE01). One site excluded from analysis exceeded trigger levels (UGE01).	Five impact sites maintained a recurring exceedance of trigger level for non-live ground cover (WC01, WC02, WC03, WC04 and SSE01). Two sites excluded from analysis also exceeded trigger levels (LGG01 and UGE01).
	Non-native weeds	An increase in non-native weed species of more than 4 in a monitoring site (each having a cover of greater than 5%) compared to the average number in reference sites within a one year period.	No sites showed an increase in weed species beyond the trigger level.	No sites showed an increase in weed species beyond the trigger level.	No sites showed an increase in weed species beyond the trigger level.	No sites showed an increase in weed species beyond the trigger level.

Table 6-17 Extraction Plan 419

Performance Indicators	Trigger Level	Measure	Summer 2020/21	Autumn 2021	Winter 2021	Spring 2021
Shrub Swamps						
Negligible change to the shallow groundwater regime when compared with control swamps	A 10% increase of dry habitat or a 10% increase in damp habitat as a proportion of total vegetation cover	Increase in proportion of vegetation classified as terrestrial dry (Tdr) or terrestrial damp (Tda).	NA*	NA*	NA*	• West Carne • East Gang Gang • West Gang Gang • Sunnyside East
Negligible erosion of the surface of the swamp	Signs of ponding or scouring	Observed signs of ponding/scouring	-	-	-	-
Negligible change in the size of the swamp	A reduction of more than 20%	Increase in non-live (Mean Area (SAVI<0.12) in ha;	• West Carne • East Gang Gang • West Gang Gang • East Sunnyside	• West Carne • East Gang Gang • West Gang Gang • East Sunnyside • Tristar	Not completed due to Covid-19 restrictions impacting pilots.	• West Carne • East Gang Gang • West Gang Gang
Negligible change in the ecosystem functionality of the swamp	A floristic change that can be correlated with a hydrological change.	Change in non-veg cover per quadrat;	NA*	NA*	NA*	• West Carne • East Gang Gang • West Gang Gang • Sunnyside East • Barrier • Firetail • Tristar Twin Gully
		Proportion of live green cover;	NA*	NA*	NA*	• West Carne • East Gang Gang • West Gang Gang • Sunnyside East • Barrier • Firetail • Tristar Twin Gully
		Eucalypt Recruitment	NA*	NA*	NA*	• West Carne • East Gang Gang • West Gang Gang • Sunnyside East • Tristar Twin Gully
Negligible change to the composition or distribution of species within the swamp	If any other performance indicator is exceeded and can be correlated with a change in hydrology	Proportion of amphibious plant species of the total vegetation cover	NA*	NA*	NA*	• West Carne • East Gang Gang • West Gang Gang Sunnyside East
		Proportion of terrestrial dry species of the total vegetation cover;	NA*	NA*	NA*	• West Carne • East Gang Gang • West Gang Gang Sunnyside East

Performance Indicators	Trigger Level	Measure	Summer 2020/21	Autumn 2021	Winter 2021	Spring 2021
		Proportion of Terrestrial Damp Species of the Total Vegetation Cover	NA*	NA*	NA*	-
Negligible change to the structural integrity of the bedrock base or any controlling rockbar/s of the swamp	No significant fracturing, where fracturing is identified visually if the structural damage is exposed.	Observed and reported signs of fracturing	-	-	-	-
Hanging Swamps						
Negligible change in the size of the swamp	A reduction of more than 20%	Increase in non-live (Mean Area (SAVI<0.12) in ha;	• East Sunnyside HS	• East Sunnyside HS • West Carne HS	Not completed due to Covid-19 restrictions impacting pilots.	-
Negligible change in the ecosystem functionality of the swamp	A floristic change that can be correlated with a hydrological change.	Change in non-veg cover per quadrat;	NA*	NA*	NA*	• East Sunnyside 1 • East Sunnyside 2 • East Sunnyside 3 • Firetail HS • Twin Gully HS
		Proportion of live green cover;	NA*	NA*	NA*	• East Sunnyside 1 • East Sunnyside 2 • East Sunnyside 3 • Firetail HS Twin Gully HS
		Eucalypt Recruitment	NA*	NA*	NA*	• East Sunnyside 1 • East Sunnyside 2 • East Sunnyside 3 • Firetail HS
Negligible change to the composition or distribution of species within the swamp	If any other performance indicator is exceeded and can be correlated with a change in hydrology	Proportion of amphibious plant species of the total vegetation cover	NA*	NA*	NA*	• East Sunnyside 2 • East Sunnyside 3
		Proportion of terrestrial dry species of the total vegetation cover;	NA*	NA*	NA*	• East Sunnyside 1 • East Sunnyside 2 • East Sunnyside 3
		Proportion of Terrestrial Damp Species of the Total Vegetation Cover	NA*	NA*	NA*	• Twin Gully HS

* Not applicable for Seasonal Remote Sensing analysis. See Annual (Spring) Monitoring

Table 6-18 Extraction Plan 420-422

Performance Indicators	Trigger Level	Measure	Summer 2020/21	Autumn 2021	Winter 2021	Spring 2021
Shrub Swamps						
Negligible change to the shallow groundwater regime when compared with control swamps	A 10% increase of dry habitat or a 10% increase in damp habitat as a proportion of total vegetation cover	Increase in proportion of vegetation classified as terrestrial dry (Tdr) or terrestrial damp (Tda)	NA*	NA*	NA*	-
Negligible erosion of the surface of the swamp	Signs of ponding or scouring	Observed signs of ponding/scouring	-	-	-	-
Negligible change in the size of the swamp	A reduction of more than 20%	Increase in non-live (Mean Area (SAVI<0.12) in ha	-	• East Gang Gang • East Sunnyside • Nine Mile • Tristar • West Carne • West Gang Gang	Not completed due to Covid-19 restrictions impacting pilots.	-
Negligible change in the ecosystem functionality of the swamp	A floristic change that can be correlated with a hydrological change.	Change in non-veg cover per quadrat;	NA*	NA*	NA*	• Barrier • Best • Firetail • Tristar • Twin Gully • Nine Mile
		Proportion of live green cover	NA*	NA*	NA*	• Barrier • Best • Firetail • Tristar • Twin Gully
		Eucalypt Recruitment	NA*	NA*	NA*	• Best • Tristar
Negligible change to the composition or distribution of species within the swamp	If any other performance indicator is exceeded and can be correlated with a change in hydrology	Proportion of amphibious plant species of the total vegetation cover	NA*	NA*	NA*	-
		Proportion of terrestrial dry species of the total vegetation cover	NA*	NA*	NA*	-
		Proportion of Terrestrial Damp Species of the Total Vegetation Cover	NA*	NA*	NA*	-
Negligible change to the structural integrity of the bedrock base or any controlling rockbar/s of the swamp	No significant fracturing, where fracturing is identified visually if the structural damage is exposed	Observed and reported signs of fracturing	-	-	-	-
Hanging Swamp						
Negligible change in the size of the swamp	A reduction of more than 20%	Increase in non-live (Mean Area (SAVI<0.12) in ha	-	• East Sunnyside HS • West Carne HS	Not completed due to Covid-19 restrictions impacting pilots.	-
Negligible change in the ecosystem functionality of the swamp	A floristic change that can be correlated with a hydrological change	Change in non-veg cover per quadrat	NA*	NA*	NA*	• Firetail Hanging • Twin Gully Hanging
		Proportion of live green cover	NA*	NA*	NA*	• Firetail Hanging • Twin Gully Hanging
		Eucalypt Recruitment	NA*	NA*	NA*	-
		Proportion of amphibious plant species of the total vegetation cover	NA*	NA*	NA*	-

Performance Indicators	Trigger Level	Measure	Summer 2020/21	Autumn 2021	Winter 2021	Spring 2021
Negligible change to the composition or distribution of species within the swamp	If any other performance indicator is exceeded and can be correlated with a change in hydrology	Proportion of terrestrial dry species of the total vegetation cover	NA*	NA*	NA*	-
		Proportion of Terrestrial Damp Species of the Total Vegetation Cover	NA*	NA*	NA*	• Twin Gully Hanging
		Proportion of Terrestrial Damp Species of the Total Vegetation Cover	NA*	NA*	NA*	

* Not applicable for Seasonal Remote Sensing analysis. See Annual (Spring) Monitoring

Table 6-19 Extraction Plan 424-427

Performance Measure	Performance Indicator	Preliminary Trigger	Trigger	Summer 2020/21	Autumn 2021	Winter 2021	Spring 2021
Negligible change to the shallow groundwater regime when compared with control swamps	Groundwater levels remain within 95th percentile of pre-mining groundwater depth for more than 7 consecutive days.	Evidence of a reduction in water table depth or stability, due to underground mining, from piezometers located in impact sites	Groundwater depth in any piezometer exceeds the 95th percentile pre-mining groundwater depth for more than 7 consecutive days	**	**	**	**
		A statistically significant reduction in the abundance of native wetland species in an impacted swamp relative to the previous survey	A statistically significant reduction in the abundance of native wetland species in an impacted swamp when compared to control swamps.	NA*	NA*	NA*	• East Gang Gang
		Increased establishment of eucalypt and/or pine seedlings (≤1m in height)[2]	30% increase in frequency of eucalypt and/or pine seedlings (≤1m in height)	NA*	NA*	NA*	• Barrier • Best • Firetail • Tristar • Twin Gully • Firetail HS • Twin Gully HS • Pine • Marrangaroo • Paddys Creek • Pine HS
Negligible erosion of the surface of the swamp	Evidence of natural recruitment comprising characteristic swamp plant species within patches of nonvegetative cover. Characteristic swamp species are defined as terrestrial damp habitat (Tda) or amphibious (A) species[3]	Signs of ponding, surface deformation and/ or scouring with corresponding loss of vegetation cover	20% increase in the extent of non-vegetated area (excluding areas covered by standing water)	• Marangaroo • Paddys Creek • Pine HS • East Gang Gang	• East Gang Gang • Marangaroo • Nine Mile • Paddys Creek • Pine • Pine HS • Tristar	Not completed due to Covid-19 restrictions impacting pilots.	-
		10% increase in the extent of non-vegetated area (excluding areas covered by standing water) relative to the previous survey	A single patch of non-vegetative cover greater than 400 m^2 doubles in size compared to baseline data				
Negligible change in the size of the swamp	Swamp boundaries remain within the variation observed throughout the baseline monitoring period. The live green vegetated area within a swamp boundary remains within the variation observed throughout the baseline monitoring period for the corresponding season.	Physical contraction in swamp boundary of 5% or more in any reportable monitoring and/ or Plant health of characteristic swamp species reduces in an impact swamp by >5% relative to the same season in the previous year (i.e. 5% or more increase in SANDVI scores below 0.15)	Significant contraction in swamp boundary when compared to baseline conditions and variance observed in control swamps and/ or Significant loss in photosynthetic activity at a swamp scale compared with baseline conditions	• Marangaroo • Paddys Creek • Pine HS • East Gang Gang	• East Gang Gang • Marangaroo • Nine Mile • Paddys Creek • Pine • Pine HS • Tristar	Not completed due to Covid-19 restrictions impacting pilots.	-
Negligible change in the ecosystem functionality of the swamp	The population size and/ or spatial occurrence of key swamp obligate species[6] remains stable at the swamp scale	A statistically significant reduction in population size and/ or spatial occurrence of a key swamp obligate species in an impacted swamp relative to the previous survey	A statistically significant reduction in population size and/ or spatial occurrence of a key swamp obligate species in an impacted swamp relative to control swamps.				• East Gang Gang (Amphibious flora, BMWS, Giant Dragonfly, Boronia) • Paddys Creek (Boronia)

Performance Measure	Performance Indicator	Preliminary Trigger	Trigger	Summer 2020/21	Autumn 2021	Winter 2021	Spring 2021
	The population size and/ or spatial occurrence of key swamp obligate species[6] remains stable at the swamp scale	Increased establishment of eucalypt and/or pine seedlings (≤1m in height)	30% increase in frequency of eucalypt and/or pine seedlings (≤1m in height)	NA*	NA*	NA*	• Barrier • Best • Firetail • Tristar • Twin Gully • Firetail HS • Twin Gully HS • Pine • Marrangaroo • Paddys Creek Pine HS
		A 10% increase in terrestrial dry habitat (Tdr) vegetation as a proportion of total vegetation cover in an impacted swamp relative to the previous survey	Statistically significant increase in terrestrial dry habitat (Tdr) vegetation as a proportion of total vegetation cover in an impacted swamp relative to control swamps.	NA*	NA*	NA*	
Negligible change to the composition or distribution of species within the swamp	The proportion of amphibious (A) vegetation remains within the variability measured during the baseline period	A 10% decrease in amphibious (A) species over as a proportion of total vegetation cover in an impact swamp relative to the previous survey[7]	Statistically significant[1] decrease in amphibious (A) species cover as a proportion of total vegetation cover in an impacted swamp relative to control swamps	NA*	NA*	NA*	• Barrier • Tristar • Twin Gully • Twin Gully HS • East Gang Gang
	The proportion of terrestrial damp habitat (Tda) vegetation remains within the variability measures during the baseline period	A 10% change in terrestrial damp habitat (Tda) species cover as a proportion of total vegetation cover in an impact swamp relative to the previous survey	Statistically significant[1] change (increase or decrease) in Tda vegetation as a proportion of total vegetation in an impacted swamp relative to control swamps	NA*	NA*	NA*	• Twin Gully HS
	The proportion of terrestrial dry habitat (Tdr) vegetation remains within the variability measured during the baseline period	A 10% increase in terrestrial dry habitat (Tdr) vegetation as a proportion of total vegetation cover in an impacted swamp relative to the previous survey	Statistically significant increase in terrestrial dry habitat (Tdr) vegetation as a proportion of total vegetation in an impacted swamp relative to control swamps	NA*	NA*	NA*	• East Gang Gang
	No increase in exotic vegetation cover	10% increase in the extent of exotic vegetation cover relative to the previous survey[7]	A statistically significant increase exotic vegetation as a proportion of total vegetation cover for an impact swamp compared to control swamp	NA*	NA*	NA*	• Tristar • Twin Gully • Pine • Marrangaroo • Paddys Creek
	No increased establishment of eucalypt and/or pine seedlings (≤1m in height)	10% increase in the establishment of eucalypt and/or pine seedlings (≤1m in height) relative to the previous survey	30% increase in frequency of eucalypt and/or pine seedlings (≤1m in height)	NA*	NA*	NA*	• Barrier • Best • Firetail • Tristar • Twin Gully • Firetail HS • Twin Gully HS • Pine • Marrangaroo • Paddys Creek • Pine HS

Performance Measure	Performance Indicator	Preliminary Trigger	Trigger	Summer 2020/21	Autumn 2021	Winter 2021	Spring 2021
Negligible change to the structural integrity of the bedrock base or any controlling rockbar/s of the swamp	Measured subsidence does not exceed predictions. No visual cracking or peat slumping that was not present prior to mining	Measured subsidence exceeds predictions. Visual cracking or peat slumping notable (not present prior to mining)	Measured subsidence in excess of predictions (>125% of predicted levels) Visual cracking >50mm in width and 10m in length (not present prior to mining) Peat slumping >0.5m depth and >20m^2 relative to adjacent swamp surface (not present prior to mining)	-	-	-	-

* Not applicable for Seasonal Remote Sensing analysis. See Annual (Spring) Monitoring

** See Groundwater Resul

Flora Summary

Between October 2019 and February 2020, the Gospers Mountain fire burnt through Newnes Plateau and surrounding areas, including the monitoring locations for LW424-427, LW420-422 and LW419. As a result of the fire, a significant proportion of the vegetation within these monitoring locations experienced intense burning, and degradation of the surrounding vegetation. The results in the tables above show an uncharacteristically high proportion of trigger levels exceeded for both SAVI analysis and annual monitoring results (from Annual Transects) in 2021. This result is expected, due to the intensity of the burn across all swamps within the monitoring area.

Of particular note is the proportion of live cover and non-vegetated cover, despite partial recovery in many swamps. Exceedances recorded across all swamps are considered a reflection of the recovery rates of vegetation within each swamp, as full recovery from fire can take years or even decades.

Results from 2021 indicate a further increase in Eucalypt recruitment since the 2020 annual monitoring. Eucalypt recruitment is common in the post fire environment; however, survival within THPSS will depend on ongoing habitat suitability (e.g., moisture, effects of cold air drainage, extent and depth of peat).

Triggers

Flora Summer

The 'LW424-427 Seasonal Swamp Monitoring Report' for Summer 2020/2021 provided evidence of continuing triggers at Paddy's Creek and East Gang Gang Shrub Swamps, and Pine Hanging Swamp for non-live vegetation cover at swamp scale (SAVI<0.12). The exceedance of floristic indictors was reported to the Department in accordance with the Swamp Monitoring Program. The initial notification was provided to the Department 8 July 2021.

As outlined in the investigation report submitted 1 September 2021, the investigation concluded that at both control and impact swamps the non-live vegetation cover increase is notably in the impact swamps. The confounding factors of drought conditions lowering the groundwater and surface water levels combined with repeated fire make it difficult to attribute the decline in THPSS to undermining impacts alone.

Flora Autumn

The 'LW424-427 Seasonal Swamp Monitoring Report' (RPS, 31 August 2021) for Autumn 2021 provided evidence of new triggers at Marrangaroo and Nine Mile Swamps for non-live vegetation cover at the swamp scale (SAVI<0.12). The exceedance of floristic indictors was reported to the Department in accordance with the Swamp Monitoring Program. The initial notification was provided 1 September 2021.

The investigation outcomes were the same as noted for the Flora Summer trigger, the current program being appropriate for monitoring changes to the area in the future. This response was outlined in the investigation report submitted to the Department 25 October 2021.

Other Notifications

On 12 August 2021 Springvale advised the Department that Winter Flora monitoring could not be undertaken due to NSW COVID restrictions affecting access from the contracted company

based in South Australia. In accordance with the correspondence received from the Department dated 17 August 2021 the missed monitoring event is noted in the Annual Review.

6.4.3 Giant Dragonfly

The Giant Dragonfly Research and Management Program forms a component of the Biodiversity Management Plan which exists as a component of the Extraction Plan.

The 2020/2021 monitoring period observations indicate that the Giant Dragonfly is now absent from Carne West, Gang Gang East and Gang Gang West. The Giant Dragonfly was observed in the remaining impact swamps (Marrangaroo, Nine Mile, Pine and Paddy's Creek) where habitat conditions were intact. On a habitat hectare basis, there appears to be little difference in observations rates between these swamps and two of the three control swamps (i.e. Barrier and Firetail). The very high observation rate recorded in Best Swamp could reflect a pulse breeding event that may otherwise be observed in other swamps over time.

Other notable findings include:

- Soil moisture measures may represent an important indirect rapid predictor of habitat condition. Further consideration of this measure allied with other indirect measures should be investigated as a useful measure of habitat occupancy; and
- Increase larval activity is evident in the post fire environment and is potentially an indication of recovery

eDNA survey results are yet to be received for reasons relating to laboratory access (i.e. COVID limitations). Once received, the data obtained from these surveys will be provided and will aid in further interrogation of species absence in Carne West, Gang Gang East and Gang Gang West Swamps.

6.4.4 Blue Mountains Water Skink

Monitoring of the Blue Mountains Water Skink (BMWS) is undertaken in accordance with the BMWS Research and Management Program dated October 2015 which was approved by the former Department of Environment (now DAWE) on 27 November 2015. The BMWS Research and Management Program satisfy Condition 13 of EPBC 2013/6881. An interrelationship exists between this program and the Swamp and Biodiversity Management Plan prepared under SSD 5594 Schedule 3 Condition 10.

Key findings from the 2020/2021 monitoring period were that there were fewer skink captures in predicted impact swamps than reference swamps. This occurred for both the Spatial and Population Monitoring Programs. Noteworthy results were:

- Several BMWS captures in most reference swamps (i.e. Firetail, Best, Dinner Gully and Barrier). There were no captures in Central Carne;
- Several BMWS captures in Paddy's Creek Swamp, which is a predicted impact swamp;
- Two BMWS captures in Marrangaroo Swamp, which is generally consistent with prior monitoring events. Past and ongoing low captures in this swamp are likely attributed to frequent fire history;
- One BMWS individual caught twice in Carne West swamp (this site yielded zero BMWS captures in the 2019-20 period compared to 13 in the 2018-19 and 40 in the 2017-18 monitoring periods);
- Zero captures in Nine Mile Swamp. So far, the low year on year skink captures in this swamp indicate no clear trends in habitat occupancy or population size; and
- Zero captures in Pine Swamp. BMWS have never been caught in this swamp. Floristic composition indicates that BMWS are naturally absent from this swamp.

Future research directions remain focused on more accurately understanding BMWS population variability and habitat requirements for future management directions.

On 7 September 2020, Springvale notified the Department of the detection of a trigger in Carne West, Gang-Gang East and Gang Gang Swamp in accordance with the requirements of the Biodiversity and Swamp Monitoring Programs which are components of the Extraction Plan. No new Triggers were evident in the reporting period.

6.4.5 Swamp Aquatic Ecology

Aquatic ecology monitoring is undertaken on the Newnes Plateau in accordance with the Biodiversity Management Plans approved under the Extraction Plan. Monitoring location sites are summarised in Table 6-20.

Table 6-20 Aquatic Monitoring Locations on Newnes Plateau

Site	Site type	Catchment area	Description
CC1	Undermined	Carne Creek	Located downstream of Sunnyside East Swamp.
CC2	Undermined	Carne Creek	Located at the downstream end of Carne West Swamp.
CC3	Undermined	Carne Creek	Located at the downstream end of Gang Gang Swamp, below the confluence of two swamp flow channels.
CC4	Reference	Carne Creek	Located at the downstream end of a hanging swamp adjacent to Barrier Swamp.
CC5	Undermined	Carne Creek	Located below confluence of upper catchment tributaries draining CC1 and CC2-CC3.
BCN2	Undermined	Bungleboori Creek (Nine Mile Creek)	Located on the northern unnamed drainage to Bungleboori Creek tributary that drains Pine Swamp.
MC1	Future mining	Marrangaroo Creek	Located in upper Marrangaroo Creek.
PC1	Undermined	Paddys Creek	Located midway along Paddys Creek below two swamps.

In autumn 2021, CC3 was dry, so water, sediment and macroinvertebrate samples were not able to be collected. In autumn 2021 at CC2, and in spring 2021 at CC2 and CC3, there was insufficient water for the collection of macroinvertebrate samples, though water and sediment samples were able to be collected.

In autumn 2021, taxa richness was highest at CC5 and BCN2 (Figure 6.5). In spring 2021, taxa richness was highest at PC1, followed by CC1, while taxa richness at CC5 and BCN2 remained consistent with autumn results. Taxa richness results were lower at CC4 and MC1 than the long-term median result in both seasons, while results at CC1 and PC1 were also well below median results in autumn, but had recovered to be similar to medians by spring 2021.

EPT richness was highest at CC1 and CC5, where six or seven EPT taxa were collected during the two sampling events (Figure 6.6). These results were similar to the long-term median at CC1, and slightly below the long-term median at CC5. EPT richness was most variable between sampling events at BCN2, where three EPT taxa were collected in autumn, but only one EPT taxon was collected in spring. These results were both below the long-term median. EPT richness was also low at MC1, where two EPT taxa were collected during both sampling events, which is below the median of five EPT taxa. EPT richness at both CC4 and PC1 was consistent between seasons with four to five EPT taxa collected, and were just below median results.

SIGNAL-2 results were high at Carne Creek sites in 2021, with these results all similar to the historical median results excepting the spring result at CC4 (Figure 6.7). SIGNAL-2 results at BCN2 in 2021 were comparatively very low, with results indicating a dominance of tolerant taxa at this site that was not observed at any other site. Although the historical median of SIGNAL-2 scores was lowest at BCN2 of all sites, the results observed in autumn and spring 2021 were well below this median, showing further loss of sensitive macroinvertebrate families. As with the result at CC4, SIGNAL-2 scores at MC1 and PC1 were also higher in autumn than spring. SIGNAL-2 at MC1 in both seasons and PC1 in spring was slightly below results from Carne Creek sites, whereas in autumn, SIGNAL-2 at PC1 was the highest recorded after CC5.

Water quality was similar at all sites, with clear, fresh water of low salinity and a very dilute ionic composition. There were several toxicants observed in concentrations above the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG DGVs) , which indicates the potential for biological effects. Concentrations of dissolved aluminium were elevated above the ANZG DGV at all sites except MC1 during at least one sampling event, while the dissolved copper and zinc concentrations were elevated above the DGV at CC4 in spring 2021 only. There were also exceedances of dissolved cobalt and zinc at CC2 in autumn, and cobalt at CC3 in spring, though these sites did not contain sufficient water for the collection of macroinvertebrate samples. These dissolved metals could be naturally elevated in the catchments and some of the metals could be associated with the 2019 Gospers Mountain Bushfire. Bushfires often lead to increased concentrations of metals including copper and zinc. There were no exceedances of the ANZG DGVs for sediment quality, and therefore, no expected impacts to macroinvertebrate communities based on sediment toxicity.

Overall, the macroinvertebrate results indicated that the best community health was at CC5, with high macroinvertebrate diversity, high EPT richness and high SIGNAL-2 scores, and consistent results in both autumn and spring 2021. The macroinvertebrate community at BCN2 was dominated by tolerant taxa, relative to the other swamp sites. The aquatic habitat at BCN2 was very different to that observed at all other swamp sites. This site is a wide, deep, marshy pool with no flow, and a silty substrate, containing macrophytes and submerged grasses. In contrast, Carne Creek sites, MC1 and PC1 are all narrow channels with shallow, flowing water, and a rocky or sandy substrate. Given the similar water and sediment quality observed at all sites in 2021, these habitat differences at BCN2 likely explain the poorer results for macroinvertebrate sensitivity metrics at this site. As the macroinvertebrate sensitivity indices at BCN2, and other undermined sites CC1, CC5 and PC1, were below the long-term median calculated on pre-mining macroinvertebrate data, impacts due to subsidence cannot be ruled out. However, there was a similar decline at MC1 and CC4 that are not undermined. The potential impact of Springvale Mine will be explored further in the annual report following review of the 2021 groundwater report.

The macroinvertebrate communities at sites CC4 and MC1 displayed some impairment in 2021 compared to results from other sites. High volumes of rainfall in 2021 meant that flow was fast through the narrow channels of these sites, which reduced the availability of slow flowing edge habitat for macroinvertebrate families that prefer still or slow-flowing waters. This may have contributed to the impairment observed in diversity metrics at these sites compared with historical results and results from other sites in 2021. CC4 is a reference site with no underground mining and, therefore, no potential impacts from Springvale Mine operations. Secondary workings have not yet been undertaken in longwall 431 and 430, located near MC1 and, therefore, impacts from Springvale Mine operations on the macroinvertebrate community at this site are unlikely.

The swamp sites were badly affected by the Gospers Mountain bushfire in late 2019. There was notable recovery of damaged vegetation at all sites during 2021, particularly of groundcover vegetation including grasses and ferns. This regrowth has contributed to an increase in the amount of trailing vegetation as instream habitat recorded in 2021 as compared to 2020, which was true for all sites except the marshy site BCN2, which had been less impacted by fire than all other sites. This may have contributed to improvements observed in macroinvertebrate results in 2021 compared to 2020 results, particularly at CC1 and CC5 where regrowth of groundcover has been most substantial. Sampling in 2022 will allow for further determination of any recovery in the macroinvertebrate communities that is due to vegetation and instream habitat regeneration.

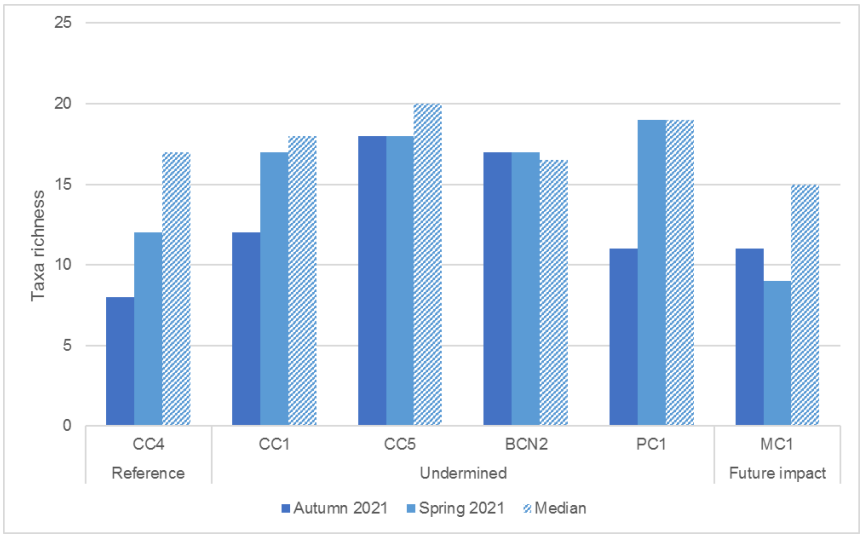


Figure 6-5 Taxa richness in Newnes Plateau swamp site samples, autumn and spring 2021

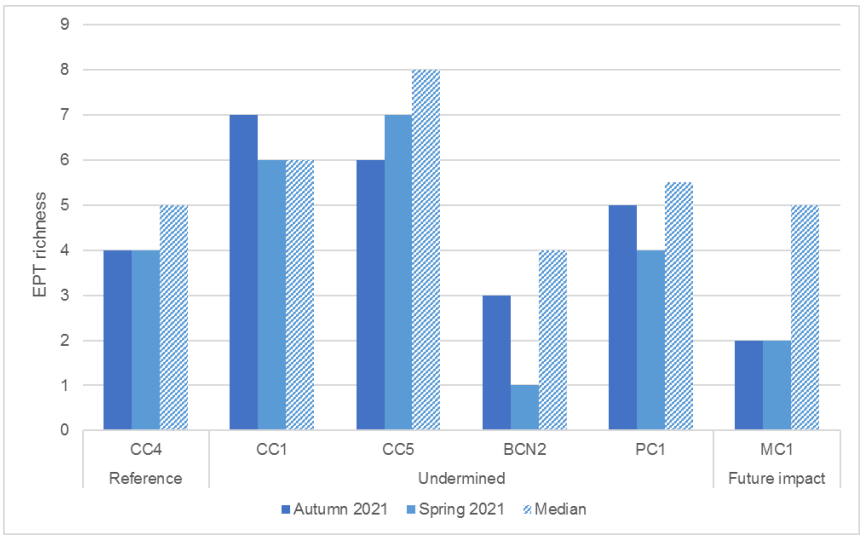


Figure 6-6 EPT richness in Newnes Plateau swamp site samples, autumn and spring 2021

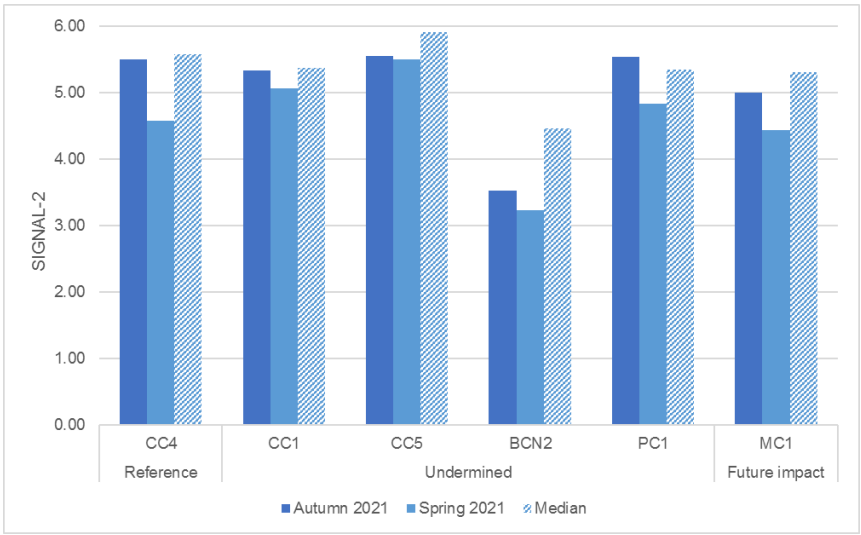


Figure 6-7 SIGNAL-2 in Newnes Plateau swamp site samples, autumn and spring 2021

6.4.6 Coxs River Land Management

Springvale implements a Catchment Improvement and Land Management Plan (CILMP) dated October 2017. This plan was approved by DPIE 8 March 2018.

The CILMP project site comprises two broad management areas (Riparian Management Area and Land Management Area) across three discrete component sites that occur along the upper Coxs River. The locations are shown in Figure 6-8.

The work plan is currently being undertaken by a bush regeneration specialist (The Bush Doctor). The status of management works is presented in Table 6-21.

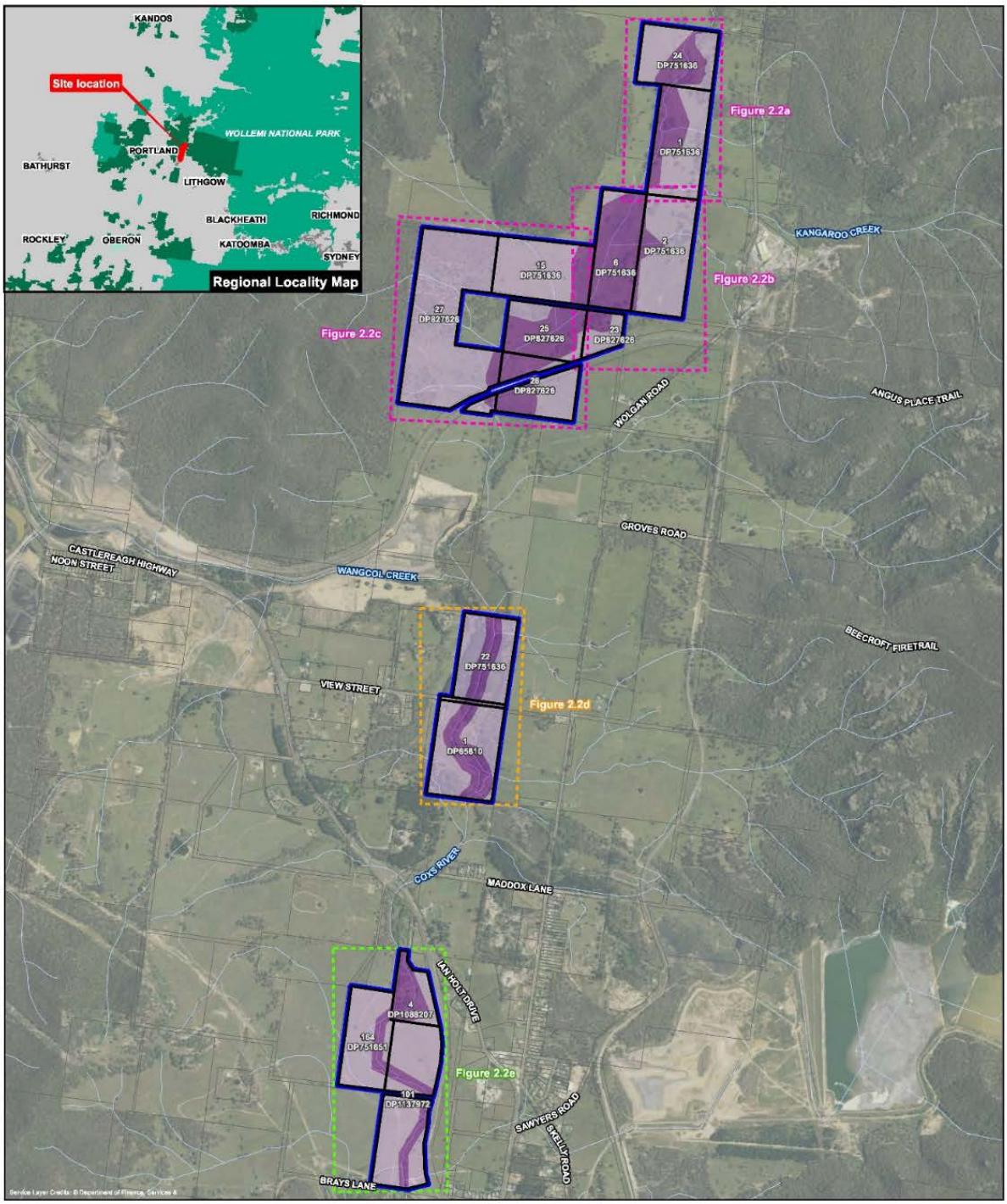


Figure 6-8 Coxs River Land Improvement Management Site Location

Table 6-21 Management Activities

Site	Management Works	Status	Year Complete
CILMP North	Fence Installation	New fencing installed on the eastern side 2020 is in good condition. Cattle are still accessing the riparian management area, the western side fence of the large typha fen is not sufficient to keep cattle out.	2020
	Cattle crossing stabilisation and bank stabilisation and flows control	Rescheduled- Unable to get machinery on site to carry out these works.	Not complete
	Environmental and noxious weed control	Ongoing.	2021
	Revegetation: shrub/canopy mid-upper banks	Scheduled Spring 2022	Not complete
	Revegetation: instream/bank stabilisation	Instream erosion control planned 2022.	Not complete
	Revegetation: Revegetation watering and maintenance	Commencing Spring 2022	2021
	Mountain Hollow Grassy Fen re-wetting	Instream erosion control planned for 2022. This work has been re-scheduled, for the past 6 months the site has not been accessible to vehicles due to the wet conditions and surface water.	Not complete
CILMP Central	Environmental and noxious weed control	Ongoing.	2021
	Revegetation: shrub/canopy mid-upper banks	Scheduled Spring 2022	Not complete
	Revegetation: Revegetation Watering and Maintenance	Scheduled 2022	Not complete
CILMP South	Fence Installation	Fence in good condition.	2020

Site	Management Works	Status	Year Complete
	Environmental and Noxious Weed Control	Ongoing. In maintenance stage. Seed production has been halted on priority weeds.	2021
	Bank Stabilisation and Flow Controls	Review Scheduled	Not complete
	Revegetation: shrub/canopy mid-upper banks	Review Scheduled	Not complete
	Revegetation: In-stream/bank stabilisation	Review Scheduled; instream growth of macrophytes has increased with silt deposits being colonised by sedges and rushes. The need to plant should be reviewed. Carex and juncus species naturally regenerating on the edge of the Coxs River. Blechnum fern growing on the river bank, frequently observed along the river.	Not complete
	Revegetation: Revegetation watering and maintenance	Forestry tubestock planted supplied by Lithgow community nursery.	2021

Key work management activities and observations are presented in Table 6-22.

Table 6-22 Photographs of CILMP Sites in 2021

Site Photograph	Description
	Tree Planting at CILMP South
	Carex and juncus species naturally regenerating on the edge of the Coxs River.
	Blechnum fern growing on the river bank, frequently observed along the river.

6.4.7 Biodiversity Offset Strategy

The Western Region Biodiversity Offset Strategy (WRBOS) was approved by the NSW Department of Planning, Industry and Environment (DPIE) on 27 January 2021. The WRBOS satisfied conditions of consent for Angus Place Colliery, Clarence Colliery, Springvale Mine and Western Coal Services site. Figure 6-9 shows the Biodiversity Offsets for the Western Region.

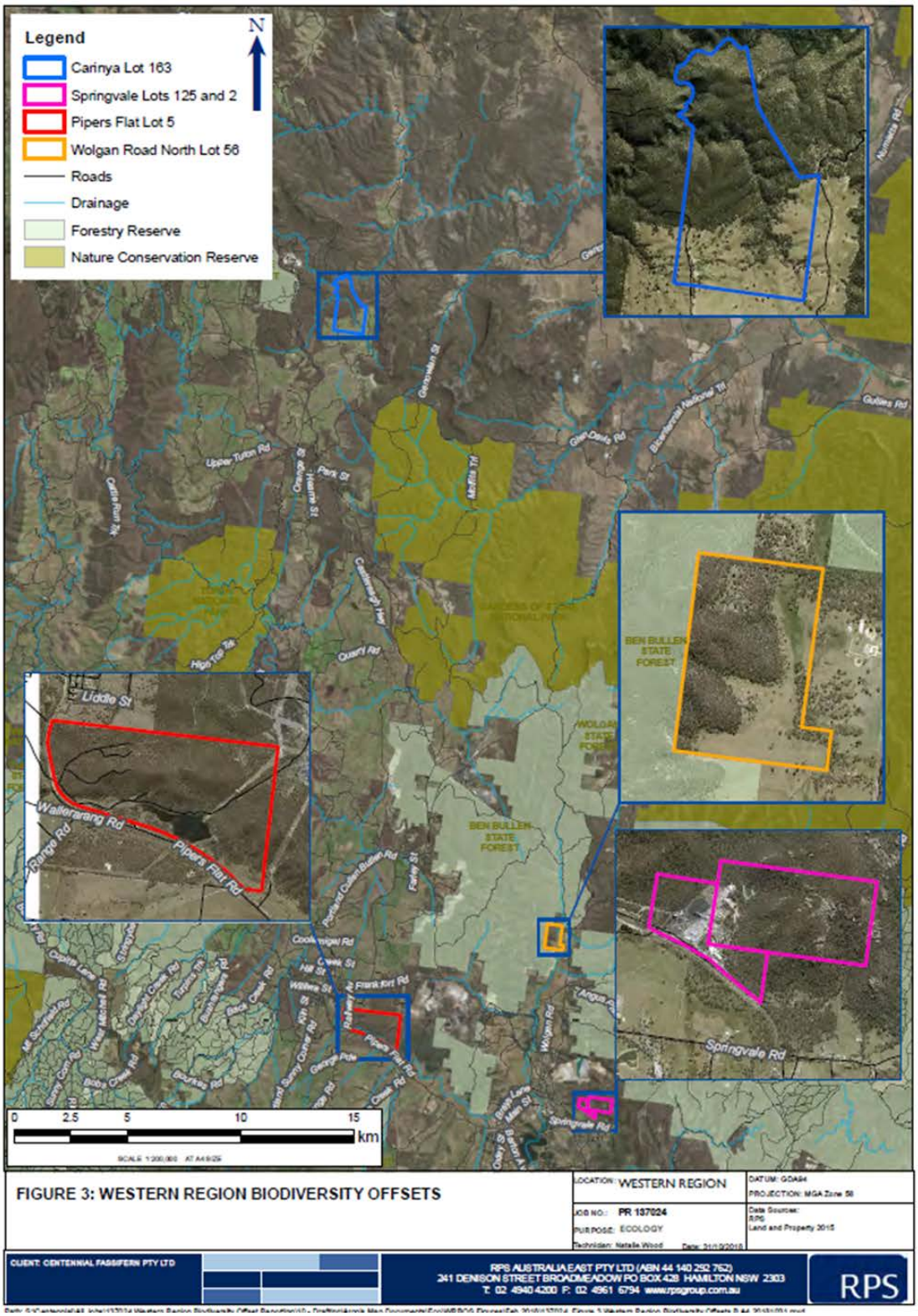


Figure 6-9 Western Region Biodiversity Offset Sites

In 2021 management activities have focused on weed management. Variation in species presents exists across the sites however Scotch Thistle, Fleabane, Ink Weed, Blackberry and Briar Rose have been treated. Planting of seeds collected at Wolgan Road Lot 56 occurred in the reporting period. Springvale submits Annual Management Reports to BCT for these sites to address reporting requirements for the sites.

6.5 SUBSIDENCE

6.5.1 Environmental Management

Subsidence monitoring programs are developed and approved for each Extraction Plan. The Extraction Plan for Longwalls 424-427 was approved by DPIE in 2018. Subsidence effects from mining Longwall 424 to Longwall 427 were managed in accordance with the Extraction Plan.

The Extraction Plan provides for six-monthly reporting in accordance with the Extraction Plan Guidelines. A Six-monthly report is prepared and provided to the relevant stakeholders and agencies in September annually. The following six-month period is included in the Annual Review which is submitted in March annually.

Results pertaining to the Subsidence Monitoring Program are presented in this section of the Annual Review. Monitoring summaries associated with water, biodiversity and heritage are presented in relevant sections.

6.5.2 Environmental Performance

Performance Measures

Subsidence performance measures outlined within SSD 5594 are presented in Table 6-23 and 6-24.

Table 6-23 Natural and Heritage Subsidence Impact Performance Measures

Table 1: Subsidence Impact Performance Measures – Natural and Heritage Features, etc

Water Resources	***Performance Measure***
Wolgan River, and other watercourses located outside the site	Negligible subsidence impacts or environmental consequences including • *negligible* diversion of flows or changes in the natural drainage behaviour of pools; • *negligible* reduction in water quality; • *negligible* increase in bank erosion or sediment load.
Carne Creek, Marrangaroo Creek and Paddys Creek	No greater subsidence impacts or environmental consequences than predicted in the EIS
All other watercourses	No greater subsidence impacts or environmental consequences than predicted in the EIS
Swamps	
Shrub swamps: Sunnyside and Nine Mile	Negligible environmental consequences including: • *negligible* change to the shallow groundwater regime when compared with control swamps; • *negligible* erosion of the surface of the swamp; • *negligible* change in the size of the swamp; • *negligible* change in the ecosystem functionality of the swamp; • *negligible* change to the composition or distribution of species within the swamp; and • *negligible* change to the structural integrity of the bedrock base or any controlling rockbar/s of the swamp.
Hanging swamps	Negligible environmental consequences including: • *negligible* change in the size of the swamp; • *negligible* change in the ecosystem functionality of the swamp; and • *negligible* change to the composition or distribution of species within the swamp.
Land	
Cliffs, minor cliffs, steep slopes and pagoda formations	No greater subsidence impacts or environmental consequences than predicted in the EIS.
Biodiversity	
Threatened species, populations or their habitats and EECs (except Sunnyside East, Carne West, Gang Gang South West, Gang Gang East, Pine, Pine Upper, Paddys, Marangaroo Creek and Marrangaroo Creek Upper Swamps)	Negligible environmental consequences.
Heritage Features	
Aboriginal heritage sites identified in Appendix 6 (except sites 45-1-0002, 45-1-0005, 45-1-2805, and 45-1-0065)	Negligible subsidence impact or environmental consequences.
Aboriginal heritage sites 45-1-0002, 45-1-0005, 45-1-2805, and 45-1-0065	No greater subsidence impact or environmental consequences than predicted in the EIS.
Historic heritage sites	Negligible subsidence impact or environmental consequences.
Mine workings	
First workings beneath any feature where performance measures in this table require negligible subsidence impact or environmental consequences. First workings within a 26.5 degree angle of draw of cliffs.	To remain long-term stable and non-subsiding
Second workings	To be carried out only in accordance with an approved Extraction Plan

Table 6-24 Built Features Subsidence Impact Performance Measures

Table 2: Subsidence Impact Performance Measures

Built Features	*Performance Measures*
Key public infrastructure: Lithgow Water Supply Dam	No damage or additional risk.
Power transmission lines and associated towers, unsealed roads and road culverts, fire trails, other public infrastructure, fences and other built features	Always safe. Serviceability should be maintained wherever practicable. Loss of serviceability must be fully compensated. Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.
Public safety	
Public Safety	Negligible additional risk

Survey Results

During the 2021 reporting period, coal was extracted from longwall (LW) 427. LW427 commenced on the 28th September 2020 and will be completed in January 2022 with an estimated total chainage of 2321m (finish chainage 650m).

The following table presents the results for the subsidence lines surveyed during the reporting period against the relevant trigger values. No anomalous surface movements were detected during the reporting period that warranted investigation.

Table 6-25 Subsidence Surveys for LW427

Subsidence Line	Survey date	Subsidence (m)		Tilt (mm/meter)		Strain (mm/meter)		Was trigger value exceeded?
		Max Result	Trigger value	Max Result	Trigger value	Max Result	Trigger value	
MCS	27/1/2021	-0.022	-0.5	-0.8	-4.5	-0.06	-0.08	No
AA	10/5/2021 18/10/2021	-0.814	-1.15	-15.2	-7	8.1	9	Yes
Z	3/11/2021	-0.381	-1.15	-5.5	-7	-7	-7	No
Zx	5/11/2021	-0.044	-1.15	-1.2	-7	-2.1	-7	No
NMS	29/7/2020	-0.001	-0.020	-0.1	-0.5	-0.9	-1	No
PCS	30/7/2020	-0.122	-0.150	-0.8	-3	-0.7	-5	No
PS	29/7/2020	-0.000	-0.020	-0.2	-7	-0.6	-1.4	No
GGSW	23/9/2021	-0.762	-1.25	-3.8	-9	-1.8	-9	No
GGE	22/9/2021	-0.683	-1.15	-7.1	-9	-3.8	-9	No
GG	24/9/2021	-0.090	-1.25	-0.5	-9	-1.4	-9	No
X	24/9/2021	-0.642	-1.15	-6	-9	-3.8	-9	No
B	11/11/2021	-0.993	-1.15	-6.1	-9	-10.7	-9	No
BB	17/11/2021	-0.638	-1.15	-4.4	-9	-2.0	-9	No

Subsidence Monitoring Line location are shown in Appendix 1 Plan 9.

Trigger Review

During the resurvey of AA Line in May 2021 an anomalous tilt measurement was recorded at AA71 to AA72. The subsidence level recorded at AA71 & AA72 was within the maximum predicted total vertical subsidence however the tilt measurement was over the maximum predicted total tilt. An investigation was conducted in accordance with the Longwall 424-427 Extraction Plan.

The investigation concluded the behaviour was not observed over entire length of the line (isolated peg) rather than movement within swamp. This is supported by monitoring data obtained from surrounding pegs shown in Figure 6-10 to Figure 6-12. The likely cause for the anomaly is that AA71 has been moved. The level on AA71 is out of step with AA70 & AA72 by approximately 100mm which suggests it may have been tampered with. There aren't any visible changes to the surface in the Pine Upper Swamp and there are no potential Impacts on the THPSS EC resulting from the erroneous data point.

In accordance with the management plan, the trigger type is classified as a "data error" which does not require notification.

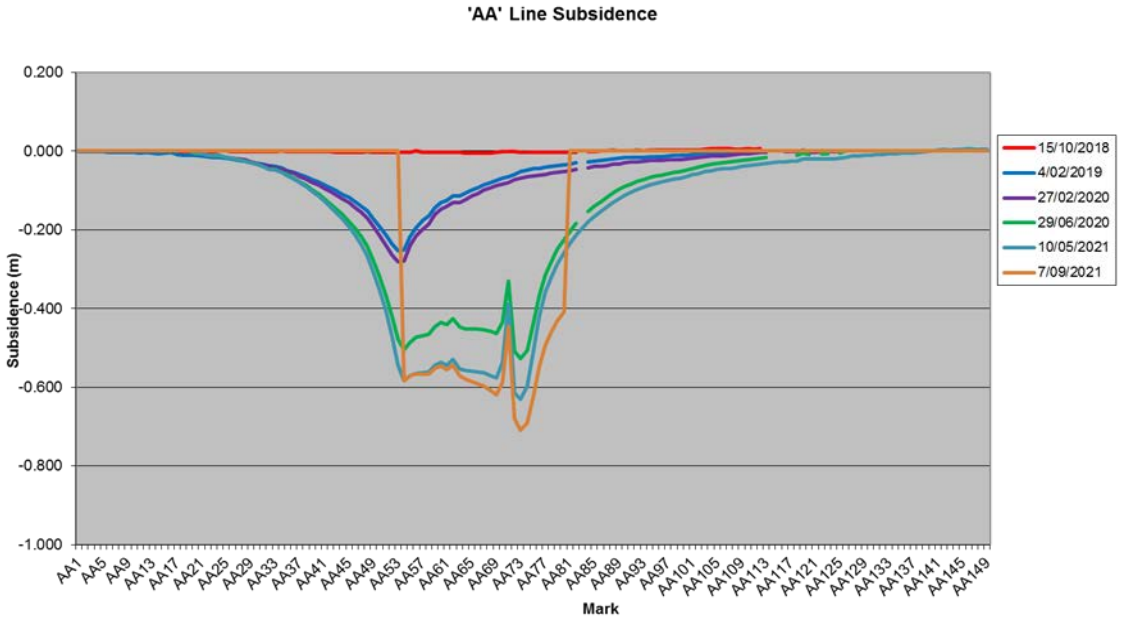


Figure 6-10 AA Line Subsidence Results

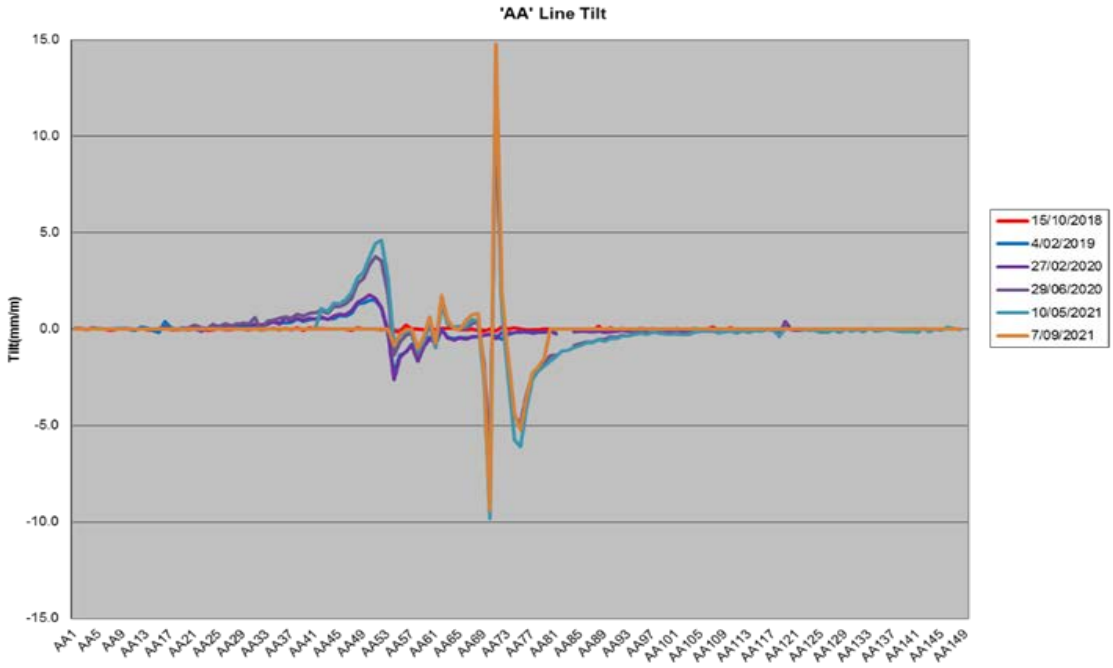


Figure 6-11 AA Line Tilt Results

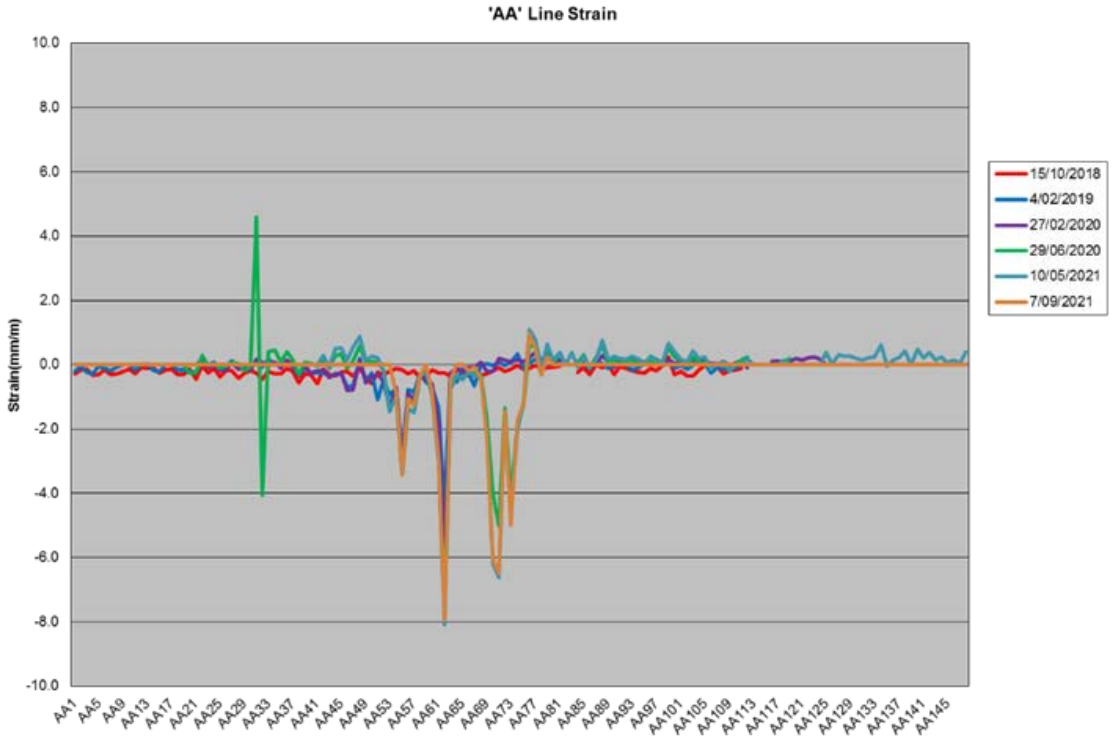


Figure 6-12 AA Line Strains

6.5.3 Comparison against Predictions

As part of the Extraction Plan process, a subsidence review is conducted. This section compares the results to the EIS predications and individual extraction plans shall be referred to for additional information.

The maximum total subsidence, after the completion of all the proposed longwalls is 1650 mm which represents approximately 52% of the 3.2 m maximum extraction height. The predicted

total tilt is 25 mm/m (i.e. 2.5%), which represents a change in grade of 1 in 40. The maximum predicted total curvatures are 0.60 km-1 hogging and 0.60 km-1 sagging, which represent minimum radii of curvature of 1.7 kilometres and 1.7 kilometres, respectively. Non-conventional subsidence has been predicted, in brackets, for subsidence above lineaments.

Table 6-26 Maximum predicated Total Conventional Subsidence

Longwall	Subsidence (mm)	Tilt (mm/m)	Hogging Curvature (km-1)	Sagging Curvature (km-1)
LW416 to LW423	1,200 (1,450)	10	0.15	0.20
LW424 to LW432	1,350 (1,650)	13	0.20	0.35
LW501	1,350	25	0.60	0.60
LW502 and LW503	1,650	25	0.60	0.60

Springvale has not exceeded the predicted subsidence levels during extraction of longwalls associated with the project.

6.6 HERITAGE

6.6.1 Environmental Management

Springvale manages Aboriginal heritage in accordance with the Western Region Aboriginal Cultural Heritage Management Plan dated September 2021. This plan was approved by DPIE on 14 October 2021.

Springvale manages European heritage in accordance with the Historic Heritage Management Plan dated June 2018. This was approved by DPIE on 4 July 2018.

The management of heritage items is also included within each Extraction Plan.

6.6.2 Environmental Performance

Indigenous Heritage

There are no indigenous heritage items located within the Springvale Operational Site.

The LW 424 – 427 Extraction Plan Area contains a total of eight Aboriginal registered sites; AHIMS 45-1- 2669 (artefact scatter), 45-1-0185 (artefact scatter), 45-1-0184 (artefact scatter), 45-1-0005 (grinding grooves), 45-1-0002 (grinding grooves), 45-1-0065 (shelter with grinding grooves and deposit); AHIMS 45-1- 2796 (artefact scatter), and AHIMS 45-1-2805 (grinding grooves).

Modification 3 triggered additional survey for site AHIMS 45-1-2805. Baseline Photogrammetry was conducted on 10 February 2021 and a 3D model has been generated through photography.



Figure 6-13 Example of Photogrammetry of AIHMS 45-1-2805

The site was not extracted beneath during the reporting period and no impacts have been observed. Phase 2 inspection has not been triggered in accordance with the methodology outlined in the Managements Plan.

European Heritage

There are no heritage items in the Springvale Lease Boundary which are listed on the Commonwealth Heritage Register, on the NSW State Heritage Register (SHR), or the s170 registers (state owned items), as searched on 7 Jan 2016. There are no unlisted heritage items in the Springvale Lease Boundary.

There are three heritage items listed in the Lithgow City Council LEP Schedule 5 – Environmental Heritage in the Springvale Lease Boundary. One site is located within the LW 424-427 Extraction Plan Area. There have been no inspections required during the reporting period.

Table 6-27 European Inspections

Site	Inspections Undertaken	Findings During Reporting Period
Wolgan Valley Railway (Newnes to Zig Zag) I245	Phase 1 (baseline) – 17 July 2018	Phase 1 – No heritage items identified and no damage to the railway route was identified.

Extraction of Longwall 427 is not complete therefore Phase 2 inspections have not been triggered by the monitoring program.

6.6.3 Comparison against Predictions

The revised subsidence review prepared for for Modification 3 of SSD 554 provides subsidence predictions for all sites (Aboriginal and European), providing maximum predicted tilt, curvature and strain with predicted values based on the EIS layout (MSEC 2020).

The revised assessment predicted sagging curvature slightly increased for the artefact site 45-1-2669, however the predicted hogging curvature for this site decreased. The potential for surface cracking in this location does not change. It is unlikely that the artefact scatter sites would experience adverse impacts due to surface cracking. It is also unlikely that the grinding groove sites, and rock shelter would experience adverse impacts due to their distances from the longwalls.

There has been no impact as a result of mining operations observed to indigenous or European heritage.

6.6.4 Implemented / Proposed Improvements

Springvale will continue to monitor and implement mitigation and management measures (as triggered) to ensure inadvertent harm to sites can be avoided.

The Western Region Heritage Committee Meetings were held in May and November 2021.

The land disturbance due diligence process implemented by the site is considered appropriate for the management of heritage items

6.7 BLASTING

There was no blasting carried out at the Springvale site in 2021.

6.8 OTHER MATTERS

6.8.1 Bushfire

There were no bushfires during the reporting period.

6.8.2 Waste

In accordance with Schedule 3 Condition 27 the following paragraphs describe waste management and minimisation practices at Springvale.

General waste is disposed of to landfill by licensed waste contractors. Recyclable materials, for example, plastic, paper and cardboard products, are recycled whenever possible at the site. Oil drums and filters are recycled with other waste metals and are removed from site by a metal recycling company. Waste oil collected in the workshop is stored in an underground collection sump before being removed off site by a licensed contractor for recycling.

Of the total waste collected at Springvale in 2021, 271.469 Tonnes (24.20%) was recycled including steel, timber, liquid waste, oils, paper and cardboard, filters grease, oily rags and oil filters. This compares with a recycling result of 275.075 Tonnes (24.98%) in 2020.

6.8.3 Greenhouse Gas

Greenhouse data applicable to Springvale is presented in Appendix 2.

7 WATER

7.1 WATER MANAGEMENT

Springvale manages water in accordance with the Water Management Plan dated March 2020. This plan was approved by DPIE on 19 February 2021. Springvale also implements management and monitoring programs approved under Extraction Plans.

7.1.1 Water Licenses

Table 7-1 presents water take against water licences for Springvale on the water reporting year (1st of July to the 30th of June) not calendar year.

Table 7-1 Water Licence Summary

WAL Number	Works Approvals	Water Sharing Plan, source and management zone (as applicable)	Entitlement (ML)	Passive take/flows (ML)	Active pumping (ML)	TOTAL (ML)
WAL 36383	10WA118719 – Bore 6 and 8	Sydney Basin Richmond Groundwater Source	5,958+1000 traded from WAL36479 Total 6958	N/A	6905.2	6905.2
WAL36449	10WA118719– Bore 6 and 8		2523		1010.7	1010.7
WAL 36446	10WA118752 – 24C/T to 8ML Dam	Sydney Basin Coxs River Groundwater Source	3,300	N/A	1126.7	1126.7
WAL 36443	10WA118754 – 85 C/T Pump Station		585	N/A	0	0

Note: Volume is reported in annual megalitres (ML)

From the information presented in Table 7-1, it is acknowledged that WAL 36383 exceeded its normal volume of 5958 ML in the water year 2020/2021, with approximately 947.2 ML extracted more than the allocation limit. The exceedance of the WAL occurred due to operational requirements to dewater the majority of underground water via Bore 6 and 8 (accounted from within the Richmond Groundwater Source) rather than being able to utilise the FBT dewatering system (accounted from within the Coxs River Groundwater Source).

The over extraction was forecast by the Springvale Mine and subsequently, points of extraction at Angus Place were reduced to account for the over extraction. However, additional allocation was still required at the end of the water reporting year therefore this has been included as a non-compliance.

Prior to the end of the Annual Review reporting period, the required additional allocation was traded from unused proportion from Clarence Colliery and was approximately 1500 ML. This combined sharing of the WALs across the three operations enabled a compliant water account for the year. In the second half of 2021, a permanent connection of water rights between all operations located in the Sydney Basin Richmond Groundwater Source was completed.

Bore Quality

The water quality of extracted water is presented in Table 7-2.

Table 7-2 Bore 6 and Bore 8 groundwater quality

Monitoring ID	Data Range	Analyte	Units	Minimum	Median	Maximum
Bore 6	4/09/2009 - present	pH	Units	6.8	7.4	7.9
		EC	µS/cm	867	1,160	1,865
		Fe	mg/L	0.05	0.54	3.47
Bore 8	15/01/2013 - present	pH	Units	5.5	7.5	7.9
		EC	µS/cm	228	1,155	1,357
		Fe	mg/L	0.05	0.05	2.12

Extracted water is now transferred to the Springvale Water Treatment Plant for re-use by Mt Piper Power Station.

7.1.2 Water Balance

A site water balance model was initially developed for Springvale Mine as part of the Springvale Mine Extension Project to quantify transfers within the site under existing and future operational conditions using various rainfall patterns. Figure 7-1 presents an overview of the sites water management system.

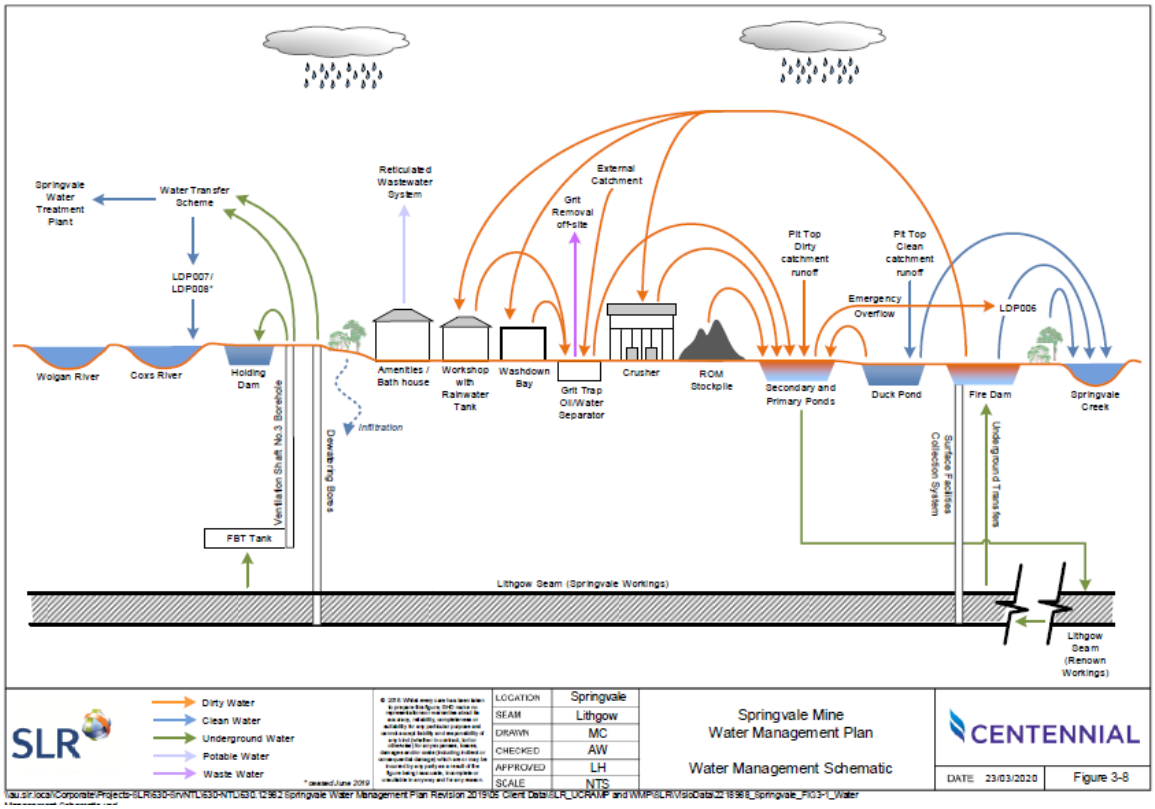


Figure 7-1 Water Balance Schematic

Table 7-3 presents output elements of the water balance in 2021 against the 2020 Springvale Water Management Plan predications and forecasts.

Table 7-3 Water Balance Review

Output element	Previous Conditions (2020)	Reporting Period Conditions (2021)	Predicted Conditions (2025)
Discharge through LDP006	641 ML/year	198 ML/year	589 ML/year
Transfer to the Springvale Water Treatment Plant	7,423 ML/year	8480.5 ML/year	9,420 ML/year

Discharges through LDP006 are below the modelled vales. Values for water extracted are consistent with modelled values.

7.1.3 Groundwater Model Update

Springvale engages JBS&G to undertake groundwater model updates. JBS&G have provided updates to the IMP and DPIE on Swamp and Groundwater modelling for Springvale during the reporting period.

The August 2021Review presented the latest observations in groundwater elevations and mine dewatering rates were integrated into the existing calibration dataset and were used to validate the model performance.

The comparison of observations with modelled groundwater elevations at the selected swamps in the vicinity of Springvale Mine is consistent. In addition, it is demonstrated that the model remains reasonably consistent in its prediction of the mine dewatering rate.

7.2 SURFACE OPERATIONS

7.2.1 Environmental Management

The surface water management systems at the pit top relies on the separation of clean and dirty water and the effective management of water through collection, treatment, and discharge. This is managed through several separate water systems including surface water dams and/or settling ponds, and clean water diversion channels.

Mine inflows, encountered during mining operations, require to be managed so that water levels can be kept at safe levels underground, and therefore operational risks can be reduced. Both clean and dirty water are generated underground. Clean water is water make from the goaf areas that do not experience machine movements. Dirty water comprises water that run along roadways and mine inflows from production panels. The dirty water is collected into portable staging tanks and pumped into the existing workings for the sediment to settle out before being diverted to the clean water system for transfer to the surface.

7.2.2 Environmental Performance

Water Quality- Licensed Discharge Points

Surface water monitoring is undertaken in accordance with EPL 3607. Water quality results for LDP006 (formally LDP001) are presented in Table 7-4. The Springvale Water Treatment Project (SWTP) is operational with discharge ceased at LDP007 on the 30th June 2019.

Table 7-4 LDP006 Water Quality Results

Pollutant	Unit of measure	2021 Lowest sample value	2021 Mean of sample	2021 Highest sample value	EPL Limit	2020 Mean
Conductivity	microsiemens per centimetre (µS/cm)	226	810.39	961	NA	905.16
Filterable iron	milligrams per litre (mg/L)	<0.05	0.02	0.41	NA	0.035
Filterable manganese	milligrams per litre (mg/L)	<0.001	0.01	0.02	NA	0.0184
Oil and Grease	milligrams per litre (mg/L)	<5	<5	<5	10	<5
pH	pH	6.90	8.19	8.80	6.5-9.0	7.94

Pollutant	Unit of measure	2021 Lowest sample value	2021 Mean of sample	2021 Highest sample value	EPL Limit	2020 Mean
Total suspended solids	milligrams per litre (mg/L)	<5	5.90	30	30	5.3
Turbidity	Nephelometric turbidity units (NTU)	2.5	11.93	49	50	12.26

Results obtained in the reporting demonstrates compliance with the EPL limits.

Results are presented graphically in Appendix 3.

Water Volume

Daily discharge volumes are measured against EPL 3607 volume limits in accordance with EPL 3607 Annual discharge volumes are outlined in Table 7-5.

Table 7-5 Water Volume

Licensed Discharge Point	2021 Lowest sample value	2021 Mean of sample	2021 Highest sample value	EPL Limit
LDP006 (formally LDP001)	0	546.7287	4409.672	10,000kl / day
LDP007 (formally LDP009)	No discharge			
LDP008 (formally LDP010)	No discharge			

Results obtained in the reporting demonstrates compliance with the EPL limits.

Results are presented graphically in Appendix 3.

Coxs River Catchment

Springvale also manages water in accordance with the Upper Coxs River Action and Monitoring Plan dated March 2020. This plan was approved by DPIE on 7 March 2020.

Since the commencement of the UCRAMP, significant changes to catchment water management have occurred that have reduced the volume of mine water discharges to the Coxs River. Specific to Springvale:

1. Until June 2019, Springvale Mine discharged up to 30 ML/day from LDP007 (formerly LDP009) to the Coxs River via Sawyers Swamp Creek. Since June 2019, mine water is treated in the SWTP and transferred to Mount Piper Power Station for beneficial reuse.

2. Discharge of surface water runoff occurs through LDP006 (formerly LDP001) to the Coxs River via Springvale Creek in accordance with EPL 3607. During the study period the average daily discharge was less than 1 ML/day, and the maximum daily discharge was 4.4 ML/day.

The salinity levels in the Coxs River was a key objective for the Plan. Electrical Conductivity (EC) in the Coxs River is continuously monitored at stream gauge 202154, and sampling is undertaken downstream of the former discharge point. Results are presented in Figure 7-2.

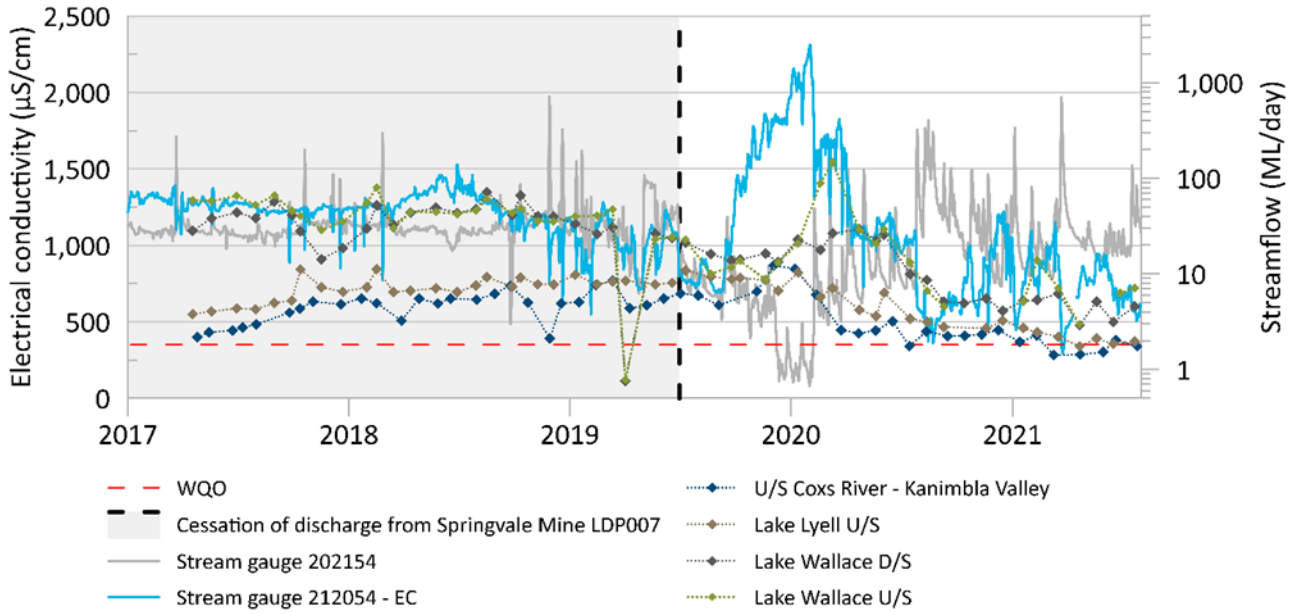


Figure 7-2 Regional EC Levels 2017-2021

From the beginning of 2017 to the cessation of discharge in June 2019, average EC in the Coxs River was 1,200 µS/cm, with little variation over time.

The dry period of very low streamflow following the cessation of discharge in June 2019 triggered a temporary increase in EC, probably due to high evaporation rates and low streamflows during summer. At the beginning of 2020, a period of high rainfall began, and a freshening effect is apparent, with EC consistently below 1,000 µS/cm. The trend has continued to decline in 2021.

Aquatic Ecology

Aquatic ecology monitoring is undertaken as a component of the Upper Coxs River Action and Monitoring Plan. Monitoring Sites associates with Springvale are presented in Table 7-6.

Table 7-6 Aquatic Ecology Monitoring Sites

Site	Description	Site Type
Sawyers Swamp Creek		
SSCup	Upstream reference site in Sawyers Swamp Creek, located upstream of Sawyers Swamp Creek Ash Dam.	Background
DP9dn	Located downstream of Springvale LDP7 (inactive) within offline drainage channel receiving runoff from Sawyers Swamp Creek.	Impact
Springvale Creek		
MC2	Located on Marrangaroo Creek. Replacement background site for SCup.	Background
SCdn	Downstream from Springvale Mine pit top located at the railway crossing 200 m upstream of the Castlereagh Highway.	Impact

Site	Description	Site Type
Coxs River		
CR0	Upstream of all Centennial LDPs	Background
CR1	Upstream of all Centennial LDPs	Background
CR3	Located downstream of Wangcol Creek and upstream of Sawyers Swamp Creek confluence.	Upstream
CR4	Located at the Maddox Lane road crossing downstream of Angus Place LDP1 (decommissioned), Springvale LDP7 (inactive) and SCS LDP1.	Impact
CR5	Located at the Main Street road crossing downstream of Angus Place LDP1 (decommissioned), Springvale LDP7 (inactive), SCS LDP1 and Lidsdale LDP4. Upstream of Springvale LDP6.	Impact
CR6	Coxs River directly downstream of Lake Wallace, on the downstream side of Rocky Waterhole Drive. Downstream of all Centennial LDPs.	Recovery
CR7	Located in the Marrangaroo National Park approximately 5 km downstream of the Lake Wallace dam wall.	Recovery

Sawyers Swamp Creek

Taxa richness results in Sawyers Swamp Creek in autumn 2021 were comparable between sites upstream of the former discharge point LDP7 (SSCup), and downstream of LDP7 (DP9dn) (Figure 7.3). In spring 2021, however, taxa richness was much lower at impact site DP9dn, with approximately twice as many taxa collected from background site SSCup than DP9dn. All taxa richness results in Sawyers Swamp Creek in 2021 were above the long-term SSCup median, except for the spring results from DP9dn.

EPT richness results were higher during both sampling events at impact site DP9dn than at background site SSCup, and EPT richness results at both sites were higher during autumn than spring (Figure 7.4). Despite high taxa richness result at SSCup in spring, EPT richness in these samples was the lowest of all sites, indicating that the taxa present were pollution tolerant. All results except for one replicate from SSCup in spring were above the long-term median result.

SIGNAL-2 results in autumn 2021 were consistent between sites and replicates (Figure 7.5), with all scores within the range from 4.18 to 4.23. In spring 2021, results were less consistent between replicates at both sites, ranging from 4.00 in one replicate at both sites, to 4.53 (SSCup) and 4.63 (DP9dn). All results in 2021 were above the long-term median.

Licensed discharges from LDP7 ceased during 2019 and, therefore, any differences in macroinvertebrate community health between Sawyers Swamp Creek sites, are not due to LDP7 discharges. Analysis of water quality results identified concentrations of dissolved aluminium, cobalt and zinc which were present at concentrations that could affect aquatic biota in both autumn and spring 2021 (ANZG 2018). These metals were elevated at the background site SSCup as well as at impact site DP9dn in lower concentrations, indicating influences in the catchment unrelated to LDP7 discharges.

In 2021, macroinvertebrate community health in the Coxs River downstream of the Sawyers Swamp Creek confluence (at CR4) was similar to that of the upstream site CR3, with comparable results for taxa richness, EPT richness and SIGNAL-2 in both autumn and spring (Figure 7.9 to Figure 7.11). The exception was taxa richness at CR4 in autumn 2021, which was lower than the taxa richness at CR3, although, the opposite pattern was observed in spring. These results indicate that there has not been a notable negative impact on macroinvertebrate communities in the Coxs River due to the influence of Sawyers Swamp Creek in 2021.

Springvale Creek

In autumn 2021, taxa richness was higher at impact site SCdn than at background site MC2 (Figure 7.6). In spring 2021, taxa richness results showed variability between the replicates, but were identical between sites. In 2021, taxa richness was equal to or higher than the long-term median in one replicate from SCdn during both sampling events, and one replicate from MC2 in spring 2021 only.

EPT richness results were comparable between sites and seasons in 2021, with all samples containing between four and six EPT taxa (Figure 4.5). All samples contained Ephemeroptera, Plecoptera and Trichoptera taxa, and the EPT richness of all samples was equal to or higher than the long-term median. SIGNAL-2 scores were higher at MC2 than SCdn during both sampling events, though all results at both sites were higher than the long-term SCup/MC2 median (Figure 7.8).

Water quality results indicated that the ionic composition of water was very different at SCdn compared to the dilute water observed at MC2. Despite this, there were no toxicants observed in any concentration known to cause biological effects at either site in 2021 (ANZG 2018). Sediment quality indicated elevated concentrations of several metals at SCdn compared with background conditions, including nickel and zinc, which were observed in concentrations that may cause biological effects during both seasons. Further analysis of discharge volumes and quality from LDP6 will be provided in the UCRC aquatic ecology monitoring 2021 annual report (GHD 2021) which will investigate whether the sediment guideline value exceedances in Springvale Creek are likely to be attributable to discharges from LDP6.

In 2020, the macroinvertebrate community health in the Coxs River downstream of the Springvale Creek confluence (at CR6) was in a poorer condition than the site immediately upstream of the Springvale Creek confluence (at CR5), with lower levels of all metrics at CR6 (Figure 7.9 to Figure 7.11). The difference was most marked in spring 2021, when taxa richness and EPT richness at CR6 were particularly low. Given the generally improved water quality observed at CR6 compared to CR5, these differences in the macroinvertebrate community are likely to be due to the scouring influence at CR6 caused by the Lake Wallace impoundment and spillway immediately upstream of CR6. At recovery site CR7, located approximately 5 km downstream of the spillway, taxa richness, EPT richness and SIGNAL-2 was generally consistent with or higher than the long-term CR5 median in both autumn and spring 2021. Given the high sensitivity of the macroinvertebrate community at CR7 relative to the background sites, there is no evidence of cumulative impacts from the Centennial operations on aquatic ecosystem health of the UCRC.

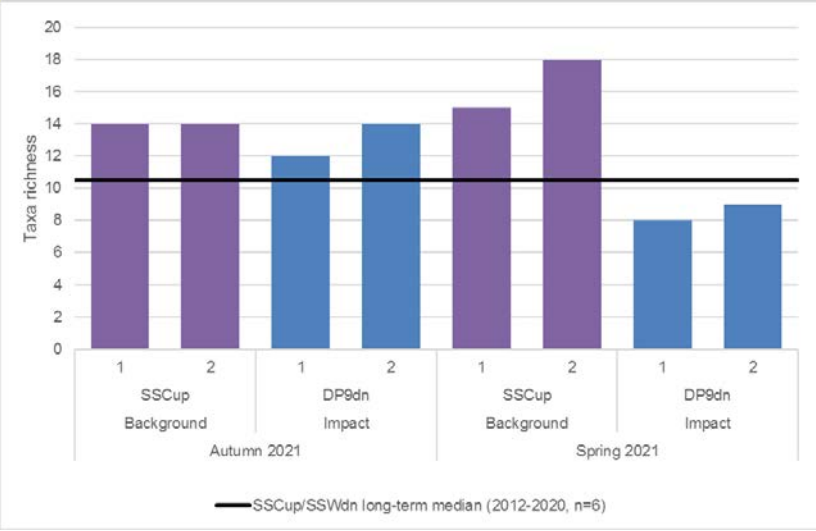


Figure 7-3 Taxa richness in Sawyers Swamp Creek samples in 2021

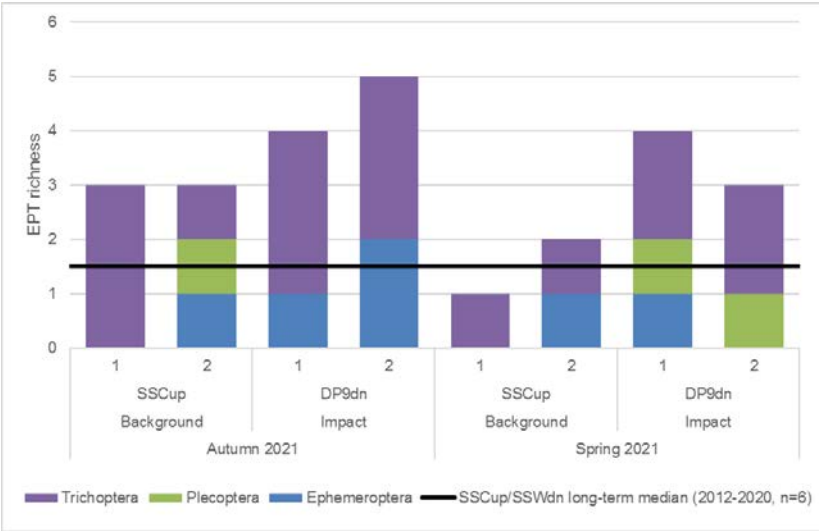


Figure 7-4EPT richness in Sawyers Swamp Creek samples in 2021

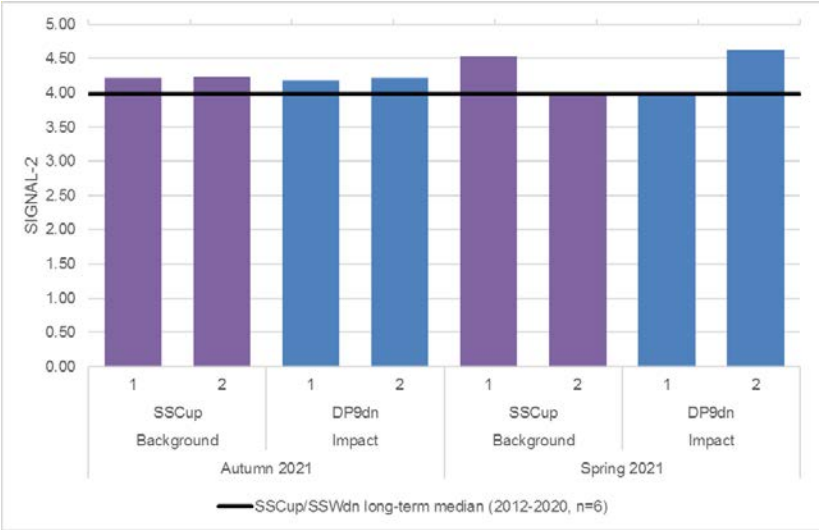


Figure 7-5SIGNAL-2 in Sawyers Swamp Creek samples in 2021

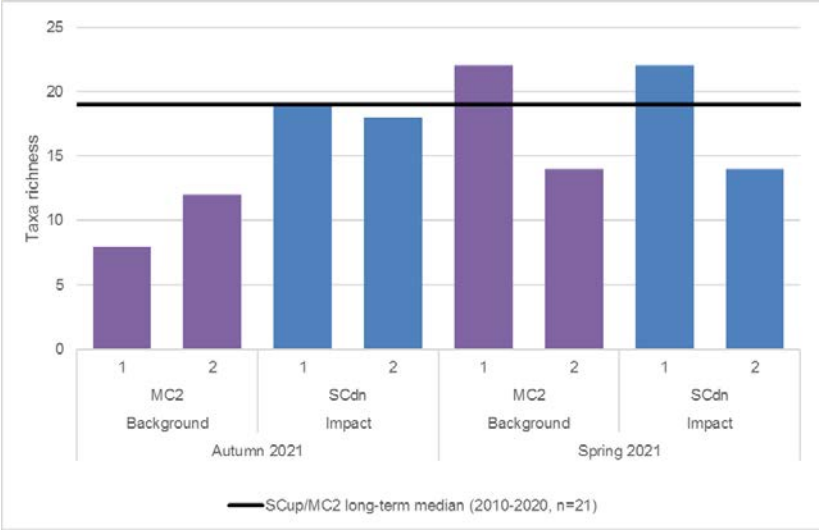


Figure 7-6 Taxa richness in Springvale Creek samples in 2021

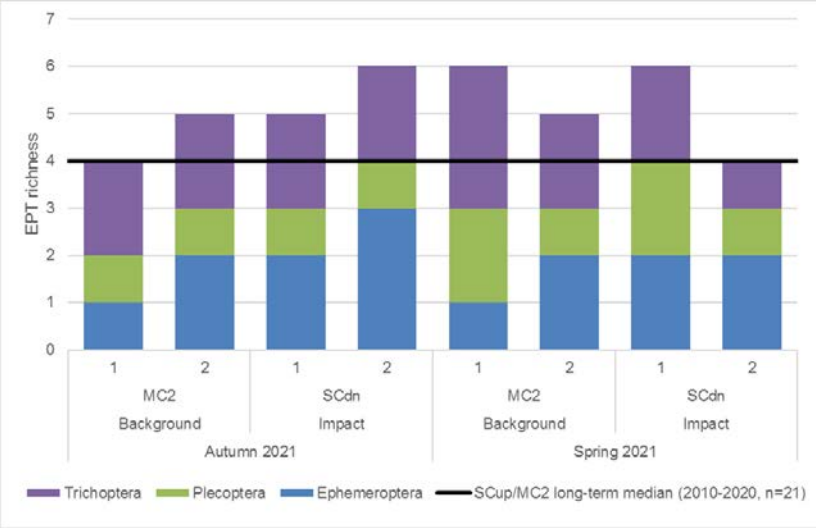


Figure 7-7EPT richness in Springvale Creek samples in 2021

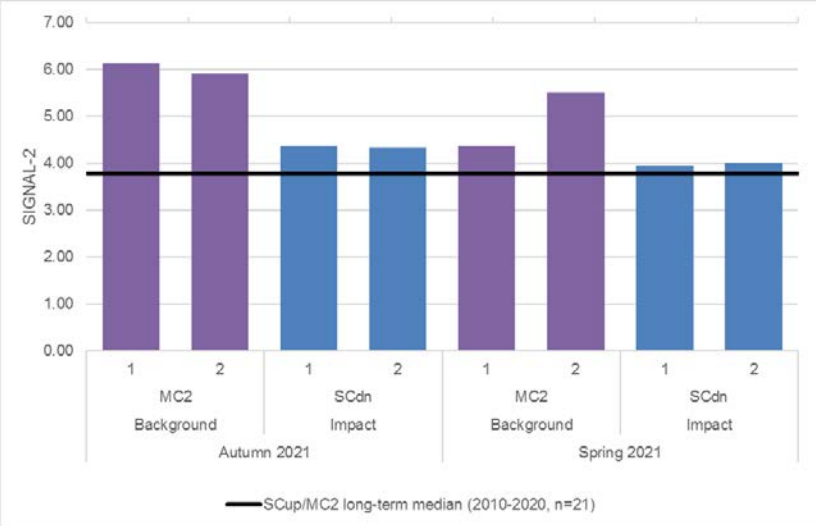


Figure 7-8 SIGNAL-2 in Springvale Creek samples in 2021

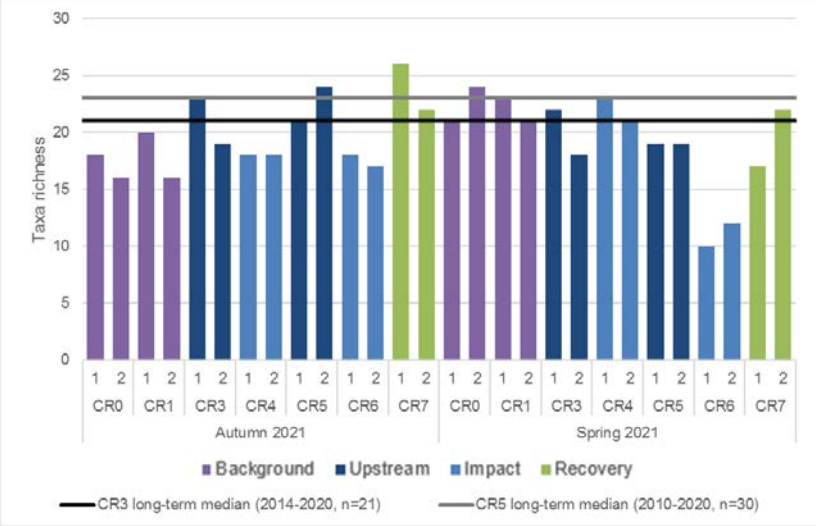


Figure 7-9 Taxa richness in Coxs River samples associated with Springvale Mine in 2021

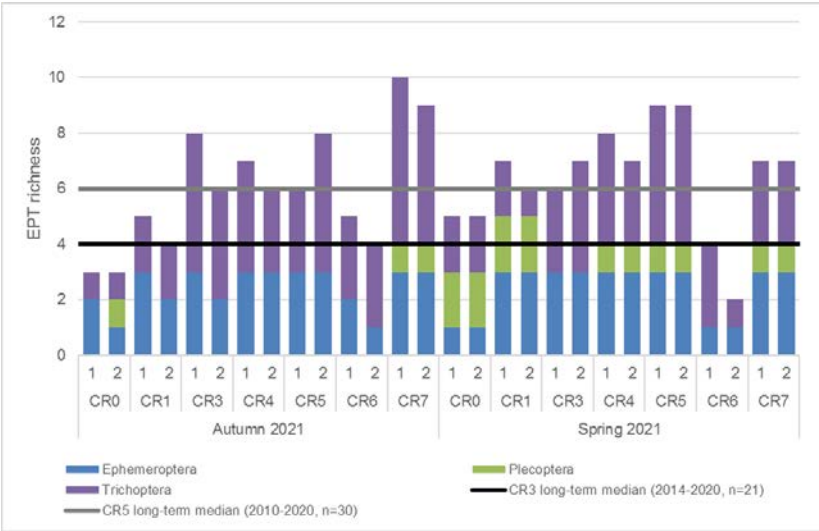


Figure 7-10 EPT richness in Coxs River samples associated with Springvale Mine in 2021

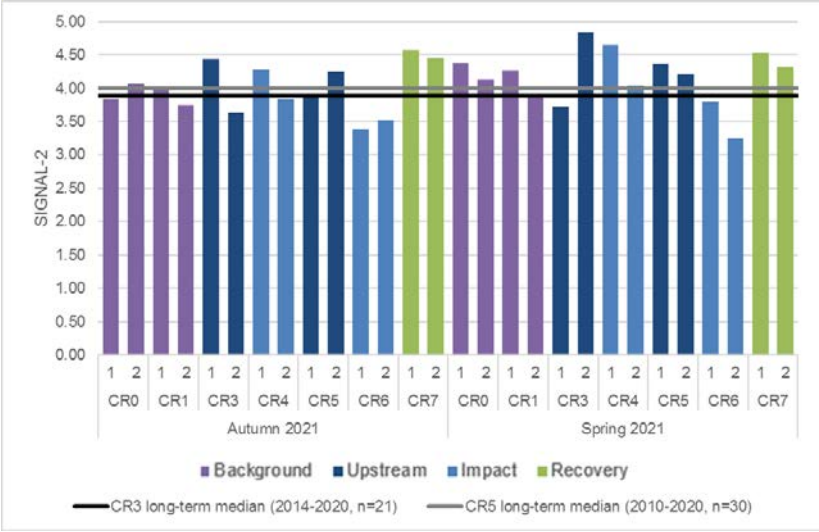


Figure 7-11SIGNAL-2 in Coxs River samples associated with Springvale Mine in 2021

7.2.3 Comparison against Predictions

The following summarises predications for riparian habitats for 424-427 as outlined in the subsidence assessment for the project and longwall 424-427.

The predicted post mining grades along the drainage lines are similar to the natural grades. Therefore, it is not expected that there would be any significant adverse changes in ponding or scouring resulting from the proposed mining. There may be some very minor localised areas which could experience small increases in the levels of ponding, where the natural gradients are low immediately upstream of the longwall chain pillars.

It is expected that fracturing of the bedrock would occur beneath some sections of the drainage lines which are located directly above the proposed longwalls. There may be some diversion of surface water flows into the dilated strata beneath the beds of drainage lines that contain exposed bedrock. However, it is unlikely that there would be any net loss of water from the catchment, however, as any diverted surface water is likely to re-emerge into the catchment further downstream. Past mining has shown these impacts to be minor, localised and isolated, and consequently are unlikely to impact upon flora or fauna species that may occur therein.

Results obtained in the reporting period are consistent with these predictions.

7.3 WATER MANAGEMENT IN EXTRACTION PLANS

7.3.1 Environmental Management

Subsidence from longwall mining can cause changes to the hydrogeological regime. The monitoring program targets the Newnes Plateau Shrub Swamps (NPSS), perched groundwater system, shallow groundwater system and the deep groundwater system through a combination of, routine surface water monitoring, standpipe piezometers and vibrating wire piezometers (VWPs). Impacts are assessed against performance triggers to identify when observed variances in groundwater levels, soil moisture and water quality exceed natural ranges.

Springvale is currently mining Longwall 427 which is covered under the Longwall 424-427 Extraction Plan. This Extraction Plan was approved by DPIE on 27 July 2018, with the Biodiversity Management Plan, Water Management Plan and Swamp Monitoring Program (SMP). Appendix 4 presents a comprehensive review of results including figures for the data

It is important to note an interrelationship exists between the Swamp, Biodiversity, Subsidence and Water Monitoring Programs/Management Plans. Springvale has prepared the Longwall 428-432 Extraction Plan which distinguishes the monitoring sites and aligns the monitoring methodologies for 415-432 to address the approval requirements for SSD 5594.

The following table identifies the impact and reference swamps outlined in the 424-427 Extraction Plan. The 424-427 Extraction Plan is available on the Centennial Website and shall be referred to for additional detail.

Table 7-7 Longwall 424-427 Impact and Reference Swamp Summary

Impact Sites	Reference Sites
Shrub Swamps (MU50)	
Pine Swamp Marrangaroo Creek Swamp Pine Swamp Upper Paddy's Creek Swamp; Gang Gang Swamp East; and Bungleboori / Nine Mile Swamp.	Barrier Swamp Carne Central Swamp*; Best Swamp; Firetail Swamp; Twin Gully Swamp; and TriStar Swamp.
Hanging Swamps (MU51)	
Hanging swamps at the head of Pine Swamp Hanging swamps north of base of Paddys Creek Swamp.	Firetail Hanging Swamp, Amphitheatre Hanging Swamps Twin Gully Hanging Swamp, and TriStar Hanging Swamp.

*Carne Central is not identified as a control site in the 428-432 Extraction Plan

7.3.2 Environmental Performance

Swamp and creek flow monitoring is undertaken manually. The 2021 flow and water quality summary is presented in Table 7-8 and 7-9 respectively.

Table 7-8 Swamp Surface Water Flows and Quality

Analyte	2021 comment
Carne Swamp	
pH	Three consecutive exceedances of the lower pH trigger from November to December. Single exceedance of upper pH limit in August. Swamp. Trends show greater variance compared to historical data.
EC	Numerous consecutive exceedances in the first half of the year. Declining trend since the bushfires/drought from 2020.
Fe	Single exceedance in November. Generally stable trend below detection limit.
Mn	Two non-consecutive exceedances in January and February. Declining trend since the bushfires/drought from 2020.
TSS	Generally stable trend.
Flow	Water level too low for flow monitoring or pooled water.
Gang Gang South West	
pH	Generally stable.
EC	Multiple exceedances separated by dry conditions.
Fe	Single exceedance in April.
Mn	Multiple exceedances separated by dry conditions.
TSS	Two exceedances in April and December.
Flow	High flow rate recorded in March. Generally dry or pooled/low flow conditions.
Gang Gang East	
pH	Generally stable. Trending with a lower average than historical data.
EC	Multiple exceedances separated by dry conditions.
Fe	Stable. At and below detection limits.
Mn	Multiple exceedances separated by dry conditions.
TSS	Stable.
Flow	High flow rate recorded in March. Generally dry or pooled/low flow conditions.
Marangaroo Swamp	
pH	Two non-consecutive exceedances of the upper pH trigger in September and October. Slightly increasing trend.
EC	Single exceedance in January. Generally stable trend.
Fe	Fluctuating with seasonal variance.
Mn	Fluctuating with seasonal variance.
TSS	Generally stable.
Flow	Generally stable. High flow recorded in March.
9 Mile Swamp	
pH	Single exceedance of the upper pH limit in July. Slight increasing trend.
EC	Single exceedance in July. Slight decreasing trend.
Fe	Stable.
Mn	Single exceedance in May. Fluctuating with seasonal variance.
TSS	Stable trend.
Flow	High flow recorded in March. Generally, water level too low for flow monitoring.

Table 7-9 Creek Surface Water Flows and Quality

Analyte	2021 comment
Carne West	
pH	Generally stable trend. Two exceedances of the lower trigger in January. Two exceedances of the lower trigger in November and December (ie 4 consecutive exceedances during 4 monitoring events in November and December).
EC	Slight declining trend.
TSS	Generally stable trend. One exceedance in March.
Flow	Water level too low for flow monitoring.
Gang Gang	
pH	Single exceedance of the lower pH trigger in February. Generally stable trend.
EC	Slight declining trend.
TSS	Generally stable trend.
Flow	Water level too low for flow monitoring.
Marrangaroo Creek	
pH	Exceeded the upper and lower pH limit in October and December respectively.
EC	Generally stable trend.
TSS	Multiple exceedances in October and December separated by dry conditions.
Flow	Generally dry or too low for flow monitoring.
Paddys Creek	
pH	Single exceedance of the lower pH limit in March.
EC	Generally stable trend. High value in November.
TSS	Generally stable trend.
Flow	High flow in March. Generally stable trend.
Pine/9 Mile Swamp	
pH	Single exceedance of the lower pH limit in February. Slight increasing trend.
EC	Single exceedance in June. Slight decreasing trend.
TSS	Generally stable trend.
Flow	Flows recorded in November and December. Generally too low for flow monitoring.

During the reporting period there were no triggers identified in relation to surface water.

Swamp piezometers

Groundwater levels are monitored daily by groundwater level loggers in 17 NPSS, with a total of 47 swamp piezometers and 19 perched piezometers. Results in the reporting period are presented in Table 7-10.

Table 7-10 Swamp Piezometer trends

Monitoring ID	2021 Comment
Barrier Swamp	
BA1	Stable – fluctuating with rainfall
BA2	Stable – fluctuating with rainfall
BA3	Stable – fluctuating with rainfall
Best Swamp	

Monitoring ID	2021 Comment
BE1	Stable – fluctuating with daily Cumulative Rainfall Deficit (CRD)
BE2	Stable – fluctuating with daily CRD
Carne Central	
CC1	Increasing trend – fluctuating with daily CRD
CC2	Increasing trend – fluctuating with daily CRD
Fire Tail	
FS1	Stable – fluctuating with daily CRD
FS2	Logger removed/stolen in February and replaced in April. Stable – fluctuating with daily CRD.
Twin Gully	
TG1	Stable – fluctuating with daily CRD
TG2	Stable – fluctuating with daily CRD
Tristar	
TS1	Shows a subdued and delayed response to daily CRD. Large increase in groundwater levels in March, September, and November due to rainfall events. Shows an increasing trend from March.
TS2	Shows a subdued and delayed response to daily CRD with an overall increasing trend from August.
TS3	Stable – fluctuating with daily CRD
East Wolgan	
WE1	Responded to rainfall events with short peaks in groundwater levels but was dry between events. Large increase in groundwater level in March due to rainfall. Jump in groundwater level from October is due to adjusting barometric correction.
WE2	Mostly dry but briefly responded to rainfall events in March, August and November with short peaks in groundwater levels. Jump in groundwater level from October is due to adjusting barometric correction.
Sunnyside West	
SW1	Trending with daily CRD. Increasing trend from June
Sunnyside	
SS1	Stable – consistent with historical observations
SS2	Stable – consistent with historical observations
SS3	Stable – consistent with historical observations. Logger battery depleted in September and needs replacement.
SS4	Stable – consistent with historical observations. Logger battery depleted in April and replaced in October.
SS5	Stable – consistent with historical observations
Sunnyside East	
SSE1	Damaged by bushfire – decommissioned
SSE2	Mostly dry – response to rainfall in March with a short sharp rise in groundwater level
SSE3	Mostly dry – showed a very minor response to rainfall in November
Carne West	
CW1	Mostly dry - showed a very minor response to rainfall in March
CW2	Mostly dry – response to rainfall in March with a short sharp rise in groundwater level
CW3	Mostly dry – response to rainfall in March with a large sharp rise in groundwater level which slowly receded over 1 month
CW4	Mostly dry – response to rainfall in March with a short sharp rise in groundwater level
Junction	
JS1	Piezometer damaged by road grading in February – decommissioned

Monitoring ID	2021 Comment
JS2	Trending with daily CRD. Increasing trend from March
JS3	Trending with daily CRD. Increasing trend from March
Gang Gang West	
GW1	Responded to rainfall events in February, March, May, August, November and December with sharp rises in groundwater levels that receded over days to weeks depending on the intensity of the rainfall event. Between rainfall events up to November the piezometer was dry. From November to mid-December, the piezometers sustained a groundwater level due to consistent rainfall.
GW2	Damaged by bushfire – decommissioned
GW3	Responded to rainfall events in February, March, August and November with sharp rises in groundwater levels that quickly receded over several days depending on the intensity of the rainfall event.
GW4	Responded to rainfall events in February, March, November and December with sharp rises in groundwater levels that slowly receded over days to weeks depending on the intensity of the rainfall event. Between rainfall events between January to November the piezometer was dry. From November onwards, the piezometer has sustained a groundwater level due to consistent rainfall.
Gang Gang	
GG1	The piezometer has trended with rainfall. Groundwater levels rise quickly following rainfall and slowly recede over several weeks. Shows a sustained groundwater level from March due to consistent rainfall during 2021 but the trend is not consistent with historical pre-mining observations.
GG2	Responded to rainfall events in February, March, August and November with sharp rises in groundwater levels that quickly receded over several days.
GG3	Shows a similar trend to GG1 but was dry between rainfall events in January, February, March, May, July, August, and October. Groundwater levels rise quickly following rainfall and slowly recede over several weeks. Shows a sustained groundwater level since November due to consistent rainfall but the trend is not consistent with historical pre-mining observations.
Pine	
BS2	Responded to rainfall events in January, February, March and May with sharp rises in groundwater level. The rainfall event in March shows the groundwater level slowly receding over approximately 2.5 months. The piezometer remained dry from June to December.
BS3	Stable – consistent with historical observations
BS4 (PSS)	Stable – consistent with historical observations
Nine Mile	
BS1	Stable – shows a gradual increasing trend
BS5 (NMSS)	Trending with daily CRD. Shows an increasing trend from January to December.
Marrangaroo	
MS1	Stable – some data gaps due to improper replacement of the level logger following quality monitoring events.
MS2	Stable – fluctuating with daily CRD. Some data gaps due to improper replacement of the level logger following quality monitoring events.
MS3	Stable – some data gaps due to improper replacement of the level logger following quality monitoring events.
Lost City	

Monitoring ID	2021 Comment
LCS1	Gradual declining trend since installation. Sudden drop in groundwater level in October due to placement of the logger following the October monitoring event.
LCS2	Stable
LC1	Stable - Sudden drop in groundwater level in September due to placement of the logger following the September monitoring event
LCN1	Stable – Fluctuating with daily CRD
Paddys Creek	
PC1	Stable – fluctuating with rainfall
PC2	Stable – fluctuating with rainfall

Swamp Groundwater Quality

pH, salinity and filtered iron are identified in the SMP as key parameters to identify mining impacts. Table 7-11 presents results relevant to impact sites during the reporting period.

Table 7-11 2021 Swamp groundwater quality trends

Monitoring ID	Analyte	2021 Comment
Sunnyside Swamp		
SS1	pH	No baseline trigger value applicable at this site. A high pH value observed in August. Trend is within historical limits.
	EC	Generally stable trend.
	Fe	Generally stable trend with small peaks around the wetter periods.
SS3	pH	Trend is within historical limits.
	EC	Generally stable trend.
	Fe	Generally stable trend.
SS4	pH	No baseline trigger value applicable at this site. A high pH value observed in August. Trend is within historical limits.
	EC	Generally stable trend.
	Fe	Generally stable trend.
SS5	pH	No baseline trigger value applicable at this site. A high pH value observed in August. Trend is within historical limits.
	EC	Generally stable trend.
	Fe	Fluctuating trends with seasonal variance around the wetter months.
Pine Swamp		
BS3	pH	Trends within historical limits.
	EC	Trends within historical limits. Minor non-consecutive elevated EC in February and July.

Monitoring ID	Analyte	2021 Comment
	Fe	Fluctuating trends with seasonal variance around the wetter months.
PSS	pH	Trends within historical limits.
	EC	Trends within historical limits.
	Fe	Fluctuating trends with seasonal variance around the wetter months.
Nine Mile Swamp		
BS1	pH	Generally stable trend.
	EC	Generally stable trend. Slightly elevated concentrations in February and July below short-term trigger.
	Fe	Fluctuating trends with seasonal variance around the wetter months.
NMSS	pH	Generally stable trend.
	EC	Generally stable trend.
	Fe	Fluctuating trends with seasonal variance around the wetter months.
Marrangaroo Swamp		
MS1	pH	Two non-consecutive exceedance of the lower pH limit in May and October. Trends show less stability compared to historical data.
	EC	Generally stable trend.
	Fe	Fluctuating trends with seasonal variance around the wetter months.
MS2	pH	Trends show less stability compared to historical data.
	EC	Generally stable trend.
	Fe	Fluctuating trends with seasonal variance around the wetter months. Highest recorded concentration observed in March but is within natural variability.
Paddys Creek Swamp		
PC1	pH	Trends within historical limits.
	EC	Generally stable trend.
	Fe	Generally stable trend.
PC2	pH	Trends within historical limits.
	EC	Generally stable trend.
	Fe	Generally stable trend.

As supported by groundwater level data, the following sites were dry: SSE1, SSE2, SSE3, CW1. CW2, GW1, GW2, GG1 and BS2.

Trigger Review

The Department was notified on 23 August 2021 of a potential groundwater level decline at MS2 based on manual data measurement (not the continuous logger). An investigation was undertaken and findings reported to the Department on 13 October 2021. The investigation concluded that the cause of the groundwater level exceedance was due to operator error while collecting routine groundwater level measurements.

Marrangaroo Swamp has therefore had no triggers and remains unimpacted from the mining operations at Springvale at the end of the reporting period.

Shallow Aquifer Piezometers

Groundwater levels in the shallow groundwater system (Burralow Formation and Bankswall Sandstone) are measured daily by level loggers at 19 shallow aquifer piezometers. Results are presented in Table 7-12.

Table 7-12 Shallow Aquifer 2021 Trends

Monitoring ID (Associated Swamp)	2021 Comment
SPR1601 (Carne West)	Stable – fluctuating with intense rainfall events
SPR1602 (Gang Gang West)	Stable – subdued response to daily CRD
SPR1603 (Gang Gang)	Stable – slight increasing trend consistent with daily CRD
SPR1604 (Carne Central)	Stable – increasing trend from January to December
SPR1605 (Pine/Nine Mile)	Stable – slight increasing trend from January to December
SPR1606 (Paddys Creek)	Stable – slight increasing trend from January to December
SPR1607 (Marrangaroo)	Stable – slight increasing trend from January to December
SPR1608 (Barrier)	Stable – slight increasing trend from January to December
SPR1611 (Fire Tail)	Stable – slight increasing trend from January to December
SPR1612 (Best)	Stable – slight increasing trend from January to December
SPR1613S (Lost City)	Stable
SPR1613D (Lost City)	Stable – groundwater level increased following rainfall in November
LCY2101 (Lost City)	Stable – Slight increasing trend since level logger installation in October

Monitoring ID (Associated Swamp)	2021 Comment
PLM2101 (Plum)	Fluctuating with daily CRD. Increasing trend since level logger installation in October
PLM2102 (Plum)	Stable – Slight increasing trend since level logger installation in October
WB12101 (Wishbone)	Stable – fluctuating with daily CRD
WB12102 (Wishbone)	Dry
WB32101 (Wishbone)	Fluctuating with daily CRD. Increasing trend since level logger installation in October
WB32102 (Wishbone)	Stable

There are were no triggers during the reporting period.

Soil Moisture

Soil moisture is measured daily by 33 soil moisture loggers at 15 NPSS. Results are presented in Table 7-13.

Table 7-13 2021 Soil Moisture Trends

Monitoring ID	Comment
BA1SM	10 cm sensor mostly dry with an increase in moisture from December. Increase in moisture at the 20 cm sensor corresponding consistent rainfall during 2021. Remaining sensors show gradual increasing trends and were fully saturated.
BA2SM	Increasing trends in all sensors. Sensors were fully saturated.
BA3SM	Increasing trends in all sensors. Sensors were fully saturated.
BE1SM	Sensors 10 to 50 cm fluctuating with rainfall. Remaining sensors were fully saturated and show slight increasing trends.
BE2SM	Sensors 10 to 50 cm fluctuating with rainfall. Remaining sensors were fully saturated and show slight increasing trends.
BS1	Sensors 10 to 30 cm fluctuated with rainfall and groundwater levels. Remaining sensors were fully saturated and show an increasing trend.
BS2	Sensors 10 to 50 cm corresponded with rainfall events with moisture levels ranging between 5 to 20%. Remaining sensors also corresponded with rainfall and show a gradual increasing trend with moisture levels ranging between 35 to 50%.
BS3	Sensors 10 and 20 cm show an increasing trend. Remaining sensors also show an increasing trend and were fully saturated.
BS4 (PSS)	Sensors 10 to 30 cm show gradual increasing trends which fluctuate with changes in groundwater levels. Remaining sensors show an increasing trend and were fully saturated.
BS5 (NMSS)	Sensors 10 and 20 cm are above ground. Sensor 30 cm fluctuated with rainfall and sensor 40 cm fluctuated with groundwater levels. Remaining sensors show a gradual increasing trend and were fully saturated.
CC1SM	Sensors 10 to 40 cm show increasing trends, becoming fully saturated from May. Remaining sensors show a gradual increasing trend and were fully saturated.
CC2SM	10 cm sensor fluctuated with rainfall. Sensors 20 to 60 cm fluctuated with groundwater levels and show an increasing trend. Remaining sensors show gradual increasing trends and were fully saturated.

Monitoring ID	Comment
CW1SM	Sensor 10 and 20 cm are above surface. Remaining sensors fluctuated with rainfall and show a gradual increasing trend with moisture levels ranging between 5 to 25%.
CW4SM	Sensors fluctuated with rainfall with moisture ranging between 5 to 20%.
FS1SM	Sensors 10 to 40 cm fluctuated with rainfall and show an increasing trend. Remaining sensors show gradual increasing trends and were fully saturated.
FS2SM	All sensors correspond with rainfall and show increasing trends.
GG2SM	Sensors 10 to 30 cm show low moisture of less than 10% with increasing response to rainfall with depth. Remaining sensors fluctuated with rainfall with moisture ranging between 15 to 35%.
GG3SM	Sensors 10 to 40 cm were dry. Remaining sensors fluctuated with rainfall with moisture levels ranging between 10 to 70%.
GW1SM	Sensors 10 to 20 cm were dry. Remaining sensors fluctuated with rainfall with moisture levels ranging between 5 to 80%.
GW3SM	Sensor 10 cm was dry. Remaining sensors fluctuated with rainfall with moisture levels ranging between 5 to 60%.
LC1SM	All sensors were saturated. Decreasing trends from sensors 30 to 120 cm.
LCN1SM	Sensors 10 to 20 cm fluctuated with rainfall and show an increasing trend. Remaining sensors show increasing trends and were fully saturated.
LCS1SM	All sensors were saturated. Decreasing trends in sensors 20 to 80 cm. Sensors 90 to 120 cm show gradual increasing trends.
LC2SM	Sensors 10 to 30 cm show increasing trends. Remaining sensors show decreasing trends. Fully saturated from 50 to 120 cm.
MS1SM	All sensors show increasing trends. Fully saturated from 60 to 120 cm.
MS2SM	Sensors 10 to 30 cm show increasing trends. Remaining sensors show gradual increasing trends and were fully saturated.
MS3SM	Sensors 10 to 30 cm show increasing trends. Remaining sensors show gradual increasing trends and were fully saturated.
PC1SM	Sensors 10 and 20 cm are above ground. Remaining sensors show increasing trends and were fully saturated.
PC2SM	All sensors are fully saturated and show increasing trends.
TG1SM	Sensor 10 and 20 cm show increasing trends. Remaining sensors show gradual increasing trends and are fully saturated.
TG2SM	Sensor 10 and 20 cm show increasing trends. Remaining sensors show gradual increasing trends and are fully saturated.
TS2SM	Sensors 10 to 30 cm trend with rainfall and ranged between 5 to 20% moisture up until November where they increased to 30 to 70% due to rainfall. Sensors 40 to 80 cm have been trending with groundwater levels. Remaining sensors show gradual increasing trends and were fully saturated.
TS3SM	Sensors 10 and 20 cm show increasing trends. Sensor 70 cm shows increasing moisture up to June where it stabilised to a similar trend and moisture to sensors 100 cm. Remaining sensors show gradual increasing trends and were fully saturated.

There were no triggers during the reporting period.

Standpipe piezometer

The following table identifies the impact and reference shallow water aquifer sites outlined in the 424-427 Extraction Plan Swamp Monitoring Program (SMP). The 424-427 Extraction Plan is available on the Centennial Website and should be referred to for additional detail.

Table 7-14 LW424-427 Extraction Plan Standpipe piezometer Monitoring Sites

Impact	Reference
SPR1108 SPR1211 SPR1301	AP5PR AP1105

Results for the reporting period are presented in Table 7-15.

Table 7-15 Standpipe piezometer trends

Monitoring ID	2021 Comments
AP5PR	Stable
AP1105	Stable
RSE	Stable
RSS	Response to large rainfall events in March, August, November and December with short sharp rises in groundwater levels that receded over several days. Gradual increasing trend from January to December.
SPR1101	Damaged by subsidence - decommissioned
SPR1104	Dry
SPR1106	Stable – gradual increasing trend from June to December that is consistent with daily CRD trend
SPR1107	Stable
SPR1108	Stable – gradual increasing trend from January to December
SPR1109	Stable – slight increasing trend from January to December
SPR1110	Dry
SPR1111	Stable
SPR1112	Stable – minor response to rainfall in March, November and December. Slight increasing trend from January to December
SPR1113	Stable – slight increasing trend from January to December
SPR1210	Vandalised – replaced by SPR1210R
SPR1210R	Stable – very slight increasing trend from January to December. LW427 was within 600 m from September to November
SPR1211	Damaged by subsidence - decommissioned
SPR1301	Stable
SPR1401	Stable – very slight increasing trend from January to December
SPR1402	Vandalised - decommissioned
SPR1403	Damaged by bushfire - decommissioned
SPR1806	Stable – very slight decreasing trend from January to December
SPR1807	Dry
SPR1808	Stable – decreasing trend from January to December. Data gap in December due to the piezometer being struck by lightning

Shallow groundwater quality

pH, salinity and filtered iron are identified in the SMP as key parameters to identify mining impacts. The following presents results relevant to impact sites during the reporting period.

Table 7-16 2021 Shallow groundwater Quality trends

Monitoring ID	Analyte	2021 water quality comment
SPR1108	pH	Stable.
	EC	Stable.
	Fe	Stable. Below detection limit.
SPR1211	pH	Stable.
	EC	Stable.
	Fe	Single elevated value in June but below trigger.
SPR1301	pH	Exceedance of upper pH trigger. Elevated pH attributed to grout contamination and is not representative of natural conditions.
	EC	Exceedance of EC trigger. Elevated concentration attributed to grout contamination and is not representative of natural conditions.
	Fe	Stable. Below detection limit.

Vibrating wire piezometers

Vibrating wire piezometers form a component of the Extraction Plan Longwall 424-427 Water Management Plan. No trigger levels are defined for vibrating wire piezometers and impacts are analysed with consideration to ridge, swamp and shallow aquifers located in proximity to sites.

Pore pressures in the shallow and deep groundwater systems are monitored daily by 13 multi-level vibrating wire piezometer (VWP) arrays. Results are presented in Table 7-17.

Table 7-17 Vibrating Wire groundwater trends

Monitoring ID	Sensor depth (mbgl)[1]	2021 Comment
SPR37	110, 135, *165,* 187, 260, *320, 350*, 405	Fluctuations in piezometer #8 are erroneous logger readings but the piezometer is stable. Remaining piezometers are stable.
SPR38	*80 (#1),* 100 (#2), 135 (#3), 190 (#4), *230 (#5), 300 (#6), 355 (#7), 370 (#8)*	Piezometers #6, #7 and #8 have been damaged by subsidence. Piezometers #1 and #5 have malfunctioned. Piezometers #2, #3 and #4 show a slight declining trend.

Monitoring ID	Sensor depth (mbgl)[1]	2021 Comment
SPR1208	*90, 130, 226, 303, 330, 380, 411, 421*	Damaged by bushfire – decommissioned.
SPR1210	76 (#7), 160 (#6), 224 (#5), 308 (#4), 326 (#3), 376 (#2), 388 (#1)	Depressurisation responses observed in piezometers #1 to #6 due to the passing of LW427. Piezometers #7 remains stable.
SPR1302	200 (#6), 271 (#5), 310 (#3), 370 (#2), 390 (#1)	Depressurisation responses in piezometers #1 and #2 during September due to commencement of first workings for LW428. Remaining piezometers were stable.
SPR1804	*345, 291, 217, 118, 69, 38*	Undermined by LW425 – decommissioned
AP10PR	343, 327, 300, *270*, 248, 205, 150, 103, 60	All piezometers were stable

Triggers

SPR 1301

Springvale notified the Department of a groundwater level trigger at SPR1301T on 13 May 2021. An investigation was conducted and concluded that the trigger observed in the post-mining period was due to a subdued and delayed response to climatic conditions as similar responses were observed at reference sites. The trigger was coincidental with a declining rainfall trend. The investigation report was provided to the Department on 25 June 2021.

7.3.3 Comparison against Predictions

The initial predictions for Longwalls 424 – 427 were completed by MSEC (2013) for the Springvale Mine Extension Project EIS. To support the Longwall 424-427 Extraction Plan, the Subsidence Predictions and Impact Assessments for the Natural and Built Features in Support of the Extraction Plan for Longwalls 424 to 427 in the Lithgow Seam (MSEC, 2018) was prepared as a revised subsidence assessment for Longwalls 424 – 427.

There is an interrelationship between the conditions of approval and impacts predicated in the subsidence assessments which form a component of the Extraction Plan. To ensure information is not misrepresented in the Annual Review Summary, both the Approval and Extraction Plans available on the website shall be referred for detail on the predications for the Project.

8 REHABILITATION

Springvale manages rehabilitation in accordance with the Mining Operations Plan (MOP). MOP Amendment B was approved by Resources Regulator on 21 October 2021.The MOP has been prepared to satisfy the requirements of Schedule 4 Condition 32 of the SSD 5594.

8.1 Mining and Rehabilitation Status

Springvale adopts a progressive approach to rehabilitation which reduces and mitigates potential environmental impacts. Progressive rehabilitation at Springvale has mainly been associated with infrastructure corridors following the trenching of services. No major rehabilitation of the pit top and Newnes Plateau infrastructure is anticipated until site closure.

During the reporting period, minor disturbance activities were undertaken. These were associated with the installation of monitoring equipment required to be installed for the extraction plan. This disturbance was minor in nature and cannot be quantified. As outlined in Table 8-1, there was no reportable disturbance or rehabilitation in 2021.

Table 8-1Disturbance and Rehabilitation during the Reporting Period

Disturbance	Rehabilitation
	0

The status of disturbance and rehabilitation for Springvale (SSD-5594) and the SWTP (SSD-7592) as at the end of 2021 is presented in Table 8-2 and Figure 8-1.

In 2020 Annual Review, it was forecast that the 3 drill sites will be rehabilitated at the completion of the SIS drill program in 2021. The third SIS hole was not completed in 2021 and therefore changes in rehabilitation status reflects the activity now predicated in 2022.

Table 8-2Rehabilitation Status

Mine Area Type	Approval	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Next Reporting Period (Forecast)
		Year 2020 (ha)	Year 2021 (ha)	Year 2022 (ha)
A. Total mine footprint[1]	Springvale	43.4	43.4	44.2
	SWTP	7.7	7.7	7.7
B. Total active disturbance[2]	Springvale	36.3	36.3	37.1
	SWTP	5.8	5.8	5.8
C. Land being prepared for rehabilitation[3]	Springvale	-	-	-
	SWTP	-	-	-
D. Land under active rehabilitation[4]	Springvale	7.1	7.1	8.5
	SWTP	1.9	1.9	1.9
E. Completed rehabilitation[5]	Springvale	0	0	0
	SWTP	0	0	0

[1] **Total Mine Footprint:** includes all areas within a mining lease that either have at some point in time or continue to pose a rehabilitation liability due to mining and associated activities. As such it is the sum of total active disturbance, decommissioning, landform establishment, growth medium development, ecosystem establishment, ecosystem development and relinquished lands (as defined in the DRE MOP/RMP Guidelines). Please note that subsidence remediation areas are excluded.
[2] **Total Active Disturbance:** includes all areas requiring rehabilitation
[3] **Land being prepared for rehabilitation:** includes the sum of mine disturbed land that is under the following rehabilitation phases – decommissioning, landform establishment and growth medium development (as defined in DRE MOP/RMP Guidelines)
[4] **Land under active rehabilitation:** includes areas under rehabilitation and being managed to achieve relinquishment – includes 'ecosystem and land use establishment' and 'ecosystem and land use sustainability (as defined under the DRE MOP/RMP Guidelines)
[5] **Total Mine Footprint:** includes all areas within a mining lease that either have at some point in time or continue to pose a rehabilitation liability due to mining and associated activities. As such it is the sum of total active disturbance, decommissioning, landform establishment, growth medium development, ecosystem establishment, ecosystem development and relinquished lands (as defined in the DRE MOP/RMP Guidelines). Please note that subsidence remediation areas are excluded.
[5] **Total Active Disturbance:** includes all areas requiring rehabilitation
[5] **Land being prepared for rehabilitation:** includes the sum of mine disturbed land that is under the following rehabilitation phases – decommissioning, landform establishment and growth medium development (as defined in DRE MOP/RMP Guidelines)
[5] **Land under active rehabilitation:** includes areas under rehabilitation and being managed to achieve relinquishment – includes 'ecosystem and land use establishment' and 'ecosystem and land use sustainability (as defined under the DRE MOP/RMP Guidelines)
[5] **Completed rehabilitation**: requires formal sign off from DRE that the area has successfully net the rehabilitation land use objectives or completion criteria

*Springvale and SWTP GIS data for 2019 was refined to address previous inconsistencies. Areas for 2018 have not been updated for Springvale as the snapshot of disturbance was based upon end of 2019. SWTP disturbance and rehabilitation for 2018 has been captured based upon data and timing of completed activities.

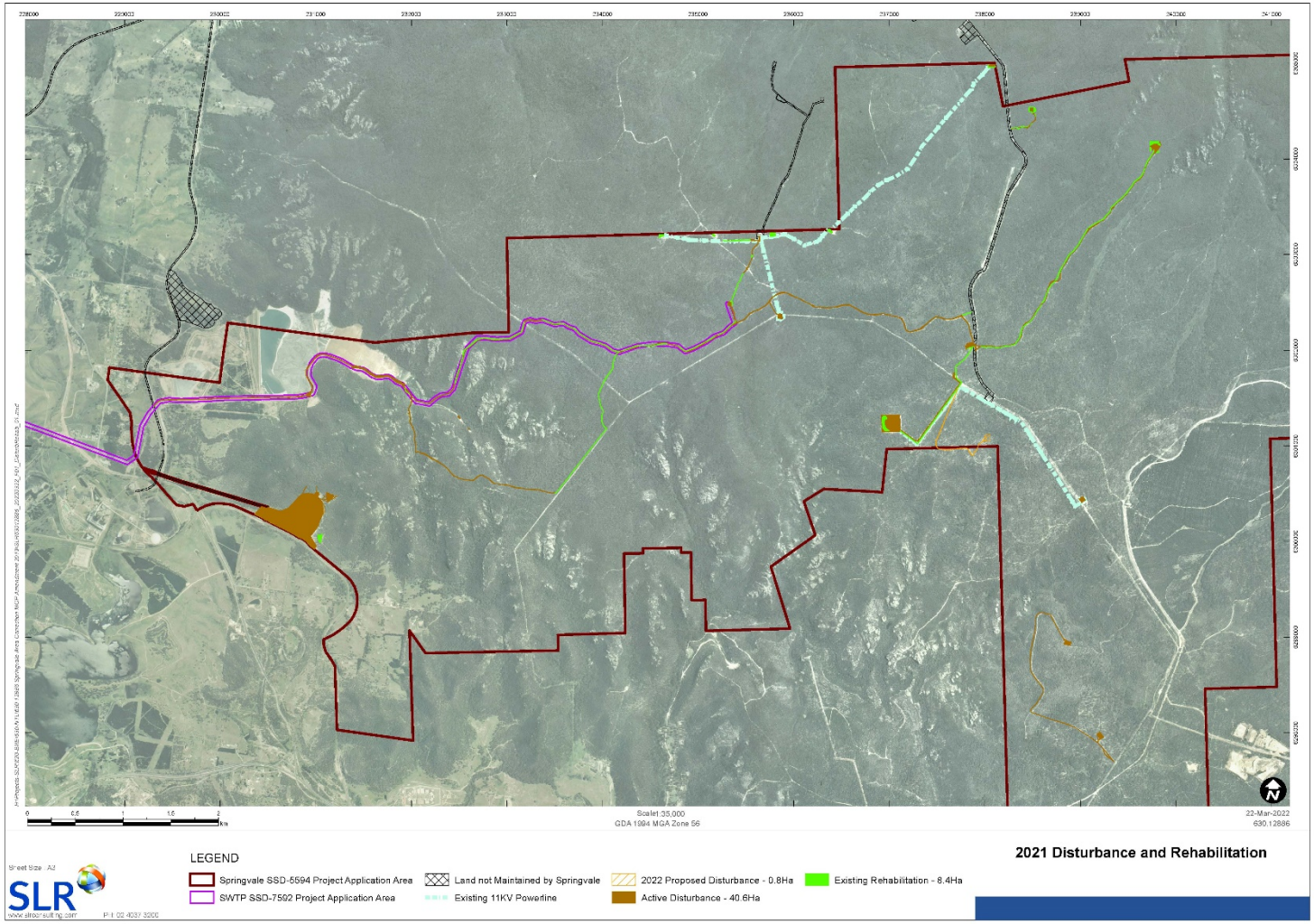


Figure 8-1 Disturbance and Rehabilitation as at 31 December 2021

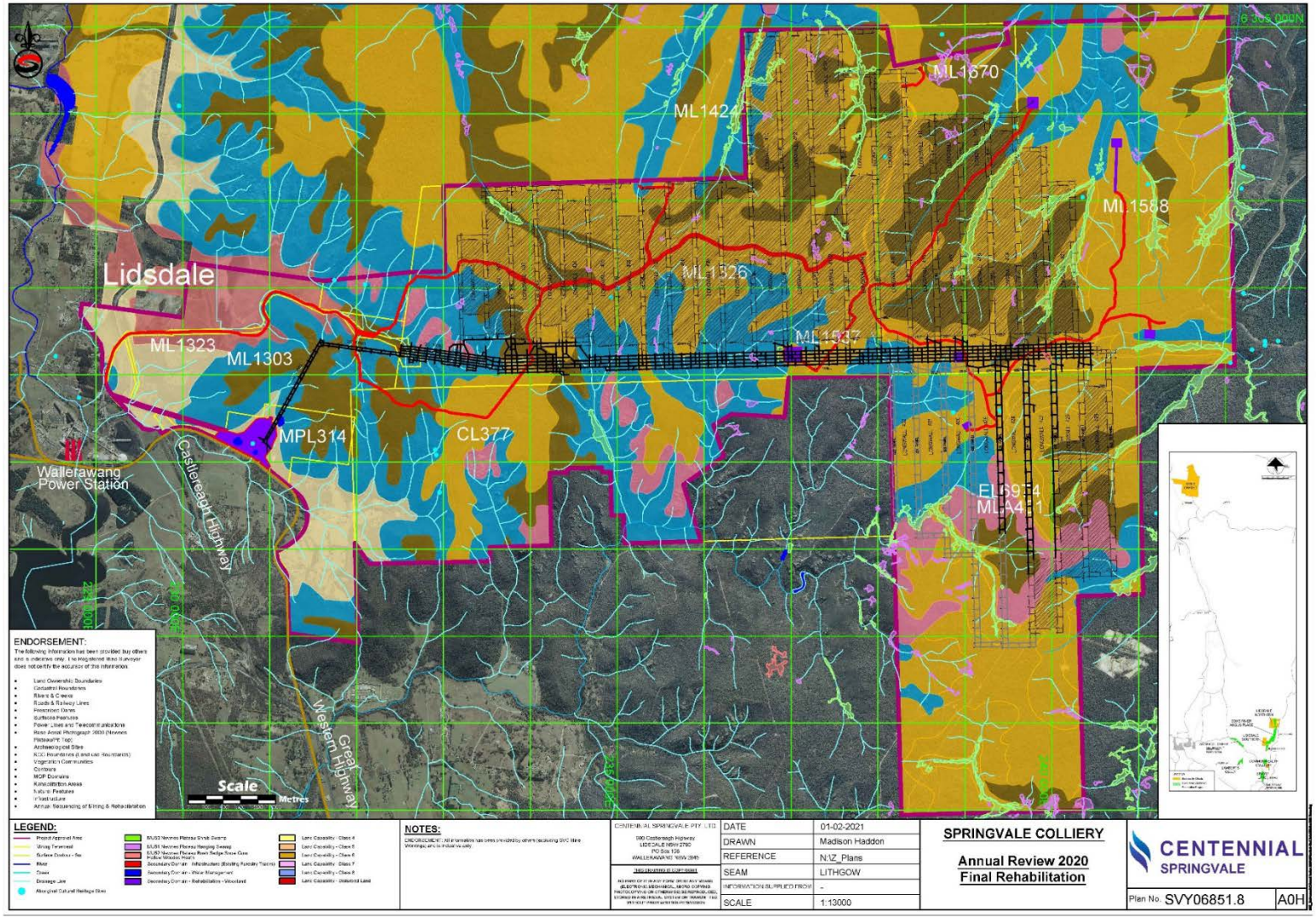


Figure 8-2 Final Rehabilitation

8.2 Rehabilitation Monitoring

Springvale undertakes rehabilitation monitoring in accordance with the MOP. The focus of the rehabilitation monitoring program is to document the progress of vegetation and soil function at each monitoring site in reaching ecosystem health, structure, and composition indicators consistent with control monitoring sites.

8.2.1 Landscape Function Analysis

8.2.1.1 Landscape Organisation Indices

The 2021 results indicate increases across all sites including four rehabilitation sites scoring 1.00 (SPR 1, SPR 2, SPR 3 and SPR 8). An increase is also evident within the landscape organisation index at all three control sites, with a mean index of 0.99.

Mean landscape organisation index scores across both rehabilitation and controls are the highest recorded since the baseline survey in 2015.

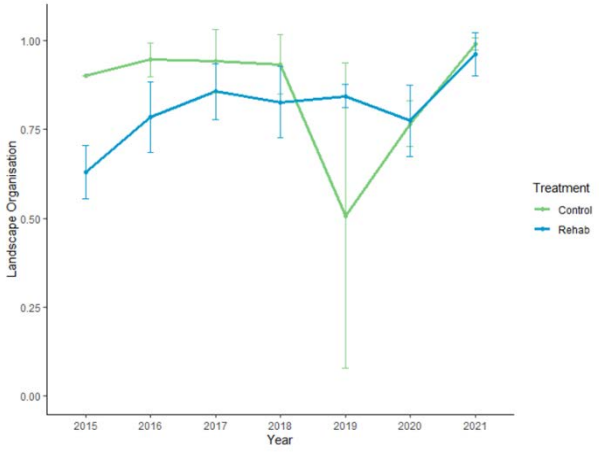


Figure 8-3LFA- Mean landscape Organisation Index (2015-2021)

8.2.1.2 Soil Stability

Soil stability has remained relatively stable across the rehabilitation sites, with mean stability falling slightly between spring 2020 and spring 2021 (59 % to 58 %).This decline continues on from a slight decrease in the preceding year (autumn – spring 2020) (63 % to 59 %).

Whilst all rehabilitation sites have recorded stable and moderate to high levels of soil stability (55 % to 62 %), all are below the current mean stability index for the control sites (70.9%).

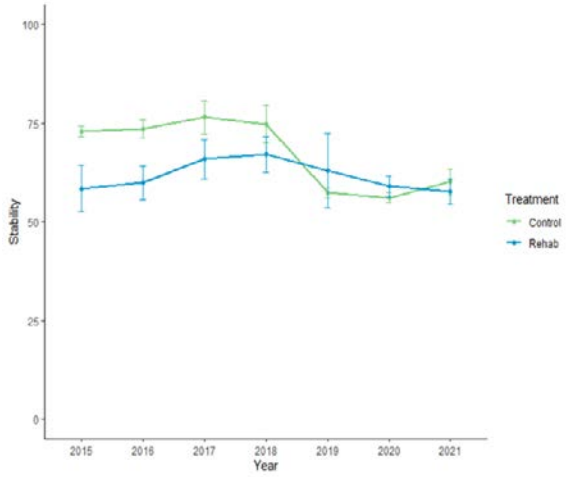


Figure 8-4 LFA Mean Stability (2015-2021)

8.2.1.3 Infiltration

The infiltration index has increased from 37 % to 42 % over the monitoring period. The latest mean infiltration index for rehabilitation sites (42 %) sits above the 5-year mean (39%).The mean of the control sites are similar to the mean of rehabilitation sites indicating a consistency of recovery for both the control and rehabilitation sites.

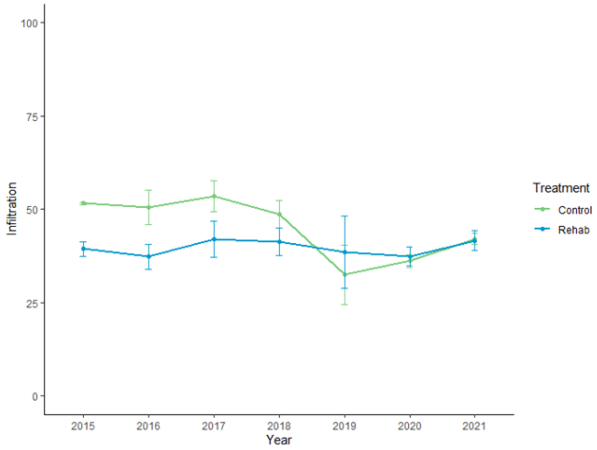


Figure 8-5LFA Mean Infiltration(2015-2022)

8.2.1.4 Nutrient Recycling

The current results for nutrient cycling index for rehabilitation sites remain relatively similar to previous years. This trend has continued into 2021, with an increase (of 4 %) in the mean index to 34 %. This increase is higher than the 5-year (2015- 2020) average nutrient cycling index for rehabilitation sites (32 %), therefore it is showing a steady increase over time, most likely a result of the larger number of plants growing and decomposing across the sites.

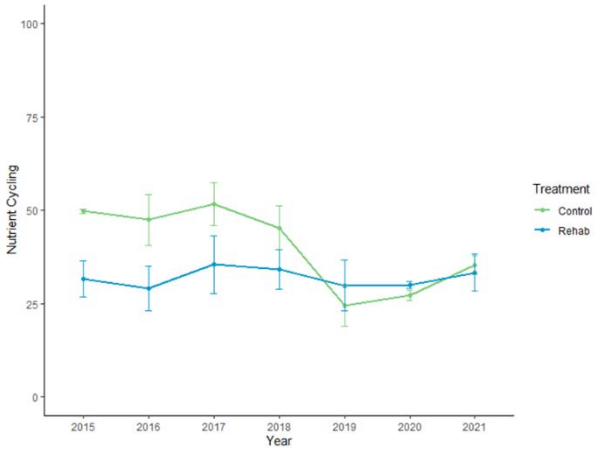


Figure 8-6 LFA Mean Nutrient Cycling

8.2.2 Vegetation Assessment

A summary of the vegetation assessment is provided below:

- Plant diversity has increased across most rehabilitation and control sites at both the Pit Top Area and on the Newnes Plateau. Minor decreases in native plant diversity were recorded at SPR 5 and SPR 1.
- Native over-storey cover increased at all rehabilitation and control site across the Pit Top and on the Newnes Plateau.
- Mid-storey cover increased across most sites rehabilitation and control sites, although cover scores were lower for sites SPR 6, SPR 8 and SPR 9 (Newnes Plateau) and SPR 1 (Pit Top).
- Native grass cover scores were higher for most monitoring sites. Lower native grass cover scores were recorded at SPR 7 (Newnes Plateau) and SPR 1 (Pit Top).
- Native shrub cover scores were higher across the Pit Top but were mixed across the Newnes Plateau sites. Lower shrub cover scores were recorded at SPR 3, SPR 6 and SPR 7.
- Native groundcover 'other' (i.e. forbs, ferns, rushes and sedges) scores were lower at both Pit Top sites. Scores for native groundcover 'other' varied across the Newnes Plateau sites, with lower scores recorded at SPR 5 (control) and SPR 6 (rehabilitation).

8.2.3 Fauna Species and Habitat

A total of 14 fauna species, comprising 13 birds and one mammal, were observed within and near the rehabilitation sites during the field survey. No threatened fauna species were observed during the 2021 survey. A slight reduction in the number of species recorded in 2021 this may be due to seasonal changes and time of year or weather conditions per day.

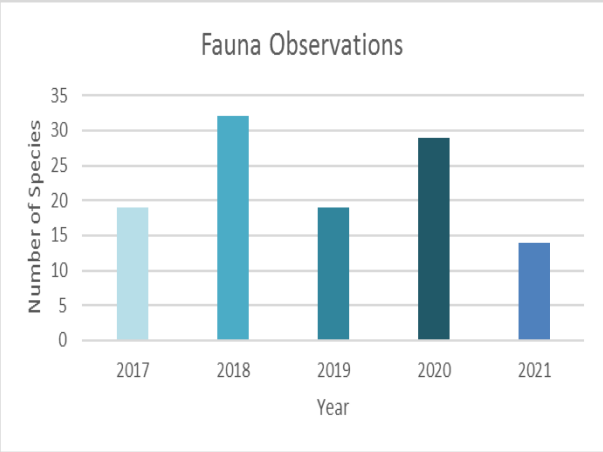


Figure 8-7Fauna Biodiversity (2017-2021)

8.2.4 Erosion

No evidence of rilling or sheet erosion was observed at any of the rehabilitation sites. This is likely to be due to the hard-setting qualities of the soil, the presence of native vegetation and the abundance of woody debris (burnt and unburnt).

8.2.5 MOP Performance Criteria Assessment

The results show that the rehabilitation sites have met the majority of their completion criteria, with the exception of some rehabilitation objectives that relate to 'Ecosystem health, structure and composition'. Results are presented in Appendix 6.

8.3 Rehabilitation Works

The East Wolgan Swamp was rehabilitated in accordance with the s95 Certificate issued by OEH with major works completed through 2014 by The Bush Doctor. The Bush Doctor is a swamp rehabilitation specialist.

Annual reports have been supplied to BCD in accordance with s95 certificate requirements.

The December 2019 bushfire had a dramatic impact on the swamp, consuming all green plant material and much of the organic cover across the surface of the rehabilitated section of East Wolgan Swamp including jute rolls, jute matting and brush matting. Springvale will continue to monitor and report on the vegetation recovery post bushfire to determine the recovery of the swamp.

8.4 Actions During Next period

During 2022 Centennial will pursue consultation and approval of the Western Region Biodiversity Management Plan. Implementation of the Coxs River management plan and the Biodiversity Management Plan will continue in 2022.

9 COMMUNITY CONSULTATION

Springvale consults with the community through forums such as, the Centennial Western Region Community Consultative Committee and community organised events.

Meetings of the Centennial Western Region Community Consultative Committee (CCC) were held

- 17 February 2021
- May 2021 (Presentation distributed only)
- 18 August 2021
- 17 November 2021

Some meetings were conducted using online forums (Microsoft teams to adhere to covid-19 requirements).

Representatives of the appointed community representatives, relevant government organisations and company representatives attended the meetings. A detailed presentation was provided to attendees at each CCC meeting on the operational activities at the site.

Key agenda items discussed in 2021 included the Longwall 428-432 Extraction plan approvals and associated monitoring installations requirements, and Modification 3. Environmental monitoring results inclusive of triggers were discussed. Specific presentations were delivered on the Coxs River Land Improvement Management Plan and projects being completed which deliver work, industry and community benefits.

9.1 COMMUNITY SPONSORSHIP

The Springvale continues to support the local community through various sponsorship avenues to the following community activities, groups and associations in 2021, including:

- 1 The Westpac Rescue Helicopter Service
- 2 Lithgow City Council for LithGlow and Halloween
- 3 Mingaan Wiradjuri Aboriginal Corporation for NADOIC Week.

In accordance with Schedule 2 Condition 15, in March 2021 Springvale paid the Lithgow City Council the community contribution for 2020 based on saleable tonnes for the year. This was calculated at approximately $76K.

9.2 COMMUNITY COMPLAINTS

In accordance with Schedule 5, Condition 15, Springvale Pty Ltd is required to make a complaint register available monthly on the Centennial website. The complaint register is presented in Appendix 7. Long terms trends in complaints are presented in Table 9-1.

Table 9-1 Record of annual community complaints for 2017 to 2021

Community Complaints						
Year	**Air**	**Water**	**Noise**	**Waste**	**Other**	**Total**
2017	0	0	4	0	0	4
2018	0	0		0	1	1
2019	0	0	1	0	0	1
2020	0	0	0	0	0	0
2021	0	0	0	0	0	0

There have been no community complaints at Springvale during the reporting period

10 INDEPENDENT ENVIRONMENTAL AUDIT

Schedule 5, Condition 13 of SSD 5594 requires Springvale to commission an IEA prior to 30 June 2016 and every 3 year thereafter. An Independent Audit was last conducted by MCW Environmental in 2019 with the final audit report submitted to DPE in November 2019.

Table 10.1 provides an update on the audit recommendations and opportunities for improvement.

Table 10-1 Independent audit actions and progress

Audit Reference	Action	Status	Summary
OFI-2019-002	Ensure documents made available on the website are kept up to date and that redundant and/or draft versions are removed.	Complete	Compliance database action amended to identify changes in documents required to be available on the website.
OFI-2019-003	Update the noise management procedure (SV-STD-2172) to include process for identifying when weather forecasts anticipate meteorological conditions where noise limits do not apply and associated mitigation measures to be implemented during these conditions.	Complete	Springvale is currently trialling a real time weather alarm system for CHP activity management. The Site procedure has been updated to reflect this change.
OFI-2019-004	Centennial Springvale to monitor noise levels from	Complete	Noise monitoring investigation undertaken

Audit Reference	Action	Status	Summary
	dozer activities once full production levels are reached, and address issues if they arise.		quarterly. No non-compliances recorded.
OFI-2019-005	Implement recommendations from Advitech Low Frequency Noise report 2017, relevant to SSD5594.	Complete	There are no outstanding Low Frequency Noise issued for Springvale to address which are relevant to SSD5594.
OFI-2019-006	Report on progress and outcomes of the Low Frequency Noise Investigations in the Annual Review	Complete	LFN outcomes reported on in 2020 annual review.
OFI-2019-007	Include site specific detail in the WRAQGHGMP in relation to the GHG reduction strategies in place to deliver the 25% reduction target.	Ongoing	GHG reductions are part of a companywide project.
OFI-2019-008	Implement a system to track onsite reductions in emissions to demonstrate compliance with the 25% reduction.	Ongoing	GHG reductions are part of a companywide project
OFI-2019-009	Centennial Springvale to continue to communicate with DPE regarding progressing the approval of the Upper Coxs River Action and Monitoring Plan	Complete	DPIE approval received 07/05/2020.
OFI-2019-010	Centennial Springvale to continue to communicate with DPIE regarding progressing the approval of the Water Management Plan.	Complete	DPIE approval received 19/02/2021.
OFI-2019-011	Centennial Springvale to continue to communicate with DPIE regarding progressing the approval of the Biodiversity Management Plan.	Ongoing	Centennial resubmitted the Western Regions Biodiversity Management Plan on 30 September 2021. The Department responded to the submission on 18 October 2021. Centennial is implementing the Department's request to revise the Western Region Biodiversity Management Plan (BMP), inclusive of undertaking contemporary consultation with agencies.

Audit Reference	Action	Status	Summary
			The Department has requested that the revised BMP be submitted 30 April 2022.
OFI-2019-012	Centennial Springvale to further consider their responsibilities in respect to the maintenance of the access road to Sunnyside Swamp and consult with FCNSW as to what their expectations are to rehabilitation.	Ongoing	Springvale has continued to work collaboratively with FCNSW on road maintenance activities. Ensuring that the surface of the roads are free draining whilst maintaining appropriate erosion controls. Formed roads and fire trials are priority.
OFI-2019-013	Centennial Springvale to ensure that the conditions of the MOP approval are included in the next MOP amendment.	Complete	The MOP approval conditions are included in section 1.2.5 of the MOP. The MOP was approved 29/09/2020.
OFI-2019-014	Centennial Springvale to communicate with DPIE regarding progressing the approval of the Environmental Management Strategy.	Complete	The latest version Environmental Management Strategy was approved on 14/4/2020.
OFI-2019-015(a)	Update the periodic review schedule for the management plans to ensure compliance with SSD5594 CoA S6-6.	Complete	All management plans to be reviewed within 3 months of the submission of the annual review and immediately following an incident.
OFI-2019-015(b)	If low community member attendance occurs in future meetings, it is suggested that additional members of the community are invited to participate in the CCC.	Complete	Discussion point included in CCC 20/11/19 meeting regarding current community membership level and suggestion that additional members are invited to participate in the CCC if triggered. Attendance will continue to be monitored.
OFI-2019-016	Ensure all incidents and non-compliances are included in the annual review for the respective reporting period.	Complete	All incidences and non-compliances are reported in Annual Reviews.
OFI-2019-017	Ensure documents are made available on the website are kept up to date and that redundant and/or draft versions are removed.	Complete	Compliance database action created for yearly audit of website documents.
OFI-2019-018	Springvale are encouraged to identify opportunities to	Ongoing	Housekeeping initiatives developed since the audit

Audit Reference	Action	Status	Summary
	continually improve the management of coal residues on site and to improve general housekeeping standards across the pit top.		include signage, maintenance procedures, stock movement monitoring process (spray paint). Housekeeping practices will continue to be managed.
OFI-2019-019	Continue to investigate and implement measures to reduce dust generation from tacking dirt around the pit top areas.	Complete	The Dust levels at Springvale are <2g/month. Springvale utilise a water truck and road sweeping as required.
OFI-2019-020(a)	There is an opportunity to review the naming of the dams within the Springvale pit top to ensure consistency across EPL documentation. During the next EPL variation update the dam referred to in this condition to reflect P1.3.	Complete	The naming of the dams has been addressed in the most recent Water management plan approved 19/02/2021.
OFI-2019-020(b)	It is noted that the sediment dam in this condition is referred to as Dam 3 in EPL p1.3 and “primary and secondary dams” in the water management plan.	Noted.	
OFI-2019-021	Centennial Springvale to review and update the water management plan and associated schematics to include the sediment dam located at LDP006 and to correctly represent drainage from the Fire Dam to the correct off site discharge point.	Complete	The schematics have been updated in the Water management plan approved 19/02/2021.
OFI-2019-022	Centennial Springvale to investigate opportunities other than the website to publicise the community information hotline.	Complete	Letterbox drop leaflet was prepared and distributed on 02/03/2020 to residents of Springvale Lane detailing the community complaint/enquiry hotline number for Springvale.
OFI-2019-023	Centennial Springvale to develop an incident checklist as part of the PIRMP that includes the initial phone call and follow up notification requirements of EPL3607.	Complete	Section 6.2 of PIRMP details actions required relating to the notification requirements to EPA as per EPL3607.

Audit Reference	Action	Status	Summary
OFI-2019-024	Centennial Springvale to further investigate operations within the Warragamba Outer Catchment Area to confirm compliance with this condition.	Complete	Springvale was obtained specialist advice in regard to the Warragamba Outer Catchment Area to confirm compliance with this condition.
OFI-2019-026	Upload a copy of the Extraction Plan LW424-427 Powerline Management Plan to the Centennial website.	Complete	Uploaded to the website.
REC-2019-001	Consult with Lithgow City Council regarding the surrender of DA 461/02 in accordance with Section 104A of the EP&A Act.	Complete	LCC approved the surrender of DA 461/02 on 12 November 2020
REC-2019-002	Put processes in place to ensure payments to LCC are made prior to the required 31 March annually.	Complete	Compliance database action modified to allow payment completion of voluntary payment as per consent by 31 March annually.
REC-2019-003	That DPIE seek clarification from the IMP on their assessment of compliance with the performance measures defined in Condition S3-1.	Noted.	
REC-2019-004	A compliance section that includes assessment and reporting of compliance with the performance measures in condition S3-1 should be included in the relevant reports developed for the 6 monthly extraction plan reports and annual reviews. This should include an assessment of the performance measures for potential impacts to water resources due to reduced water levels in swamps	Complete	As outlined in Volume 1 of the Extraction Plan, to establish compliance with the performance measures as outlined in Condition 3-1 , Springvale has developed a monitoring program and associated TARPs. The TARPS specified in each component extraction plan management plan are incorporated into a master TARP. Section 4 of the 6 monthly Extraction Plan Report reports on TARP triggers in the current extraction plan area with a detailed summary incorporated in section 6 of the document. TARP exceedances are similarly documented in the Annual Review.
REC-2019-005	That monitoring reports include the latest research and understanding	Complete	Annual review and six-monthly extraction plan report environmental performance

Audit Reference	Action	Status	Summary
	regarding subsidence/mining impacts on swamps, particularly where the reports are public documents.		section includes reference triggers reported during the reporting period.
REC-2019-006	That Centennial Springvale, DPIE and relevant agencies continue to develop suitable offset/strategies to address impacts that have occurred in swamps.	Ongoing	Centennial is continuing to work with DPIE and other agencies to finalise offset strategies. At the end of December 2021, the revised offset strategy was under assessment.
REC-2019-007	That Centennial Springvale complete and submit a revised Swamp offset package for determining offset liabilities.	Ongoing	Centennial is continuing to work with DPIE and other agencies to finalise offset strategies. At the end of December 2021, the revised offset strategy was under assessment.
REC-2019-008	Ensure consultation section of the component management plans (generally section 10) reflects the consultation undertaken for that plan and with the agencies identified in SSD5594.	Complete	Consultation is undertaken with relevant stakeholders during management plan preparation.
REC-2019-011	Ensure that the sediment and erosion control structures at Centennial Springvale sites on Newnes Plateau are compliant with all aspects of the Managing Urban Stormwater: Soils and Construction.	Complete	Sediment and erosion controls are inspected and maintained as required.
REC-2019-012	Investigate the opportunity to construct a clean water diversion at Bore 8.	Complete	The construction of the Bore 8 erosion and sediment controls reviewed against the approved Bore 8 project management plan.
REC-2019-013	Update the EMS to include a register of any strategies, plans and programs approved under the conditions of SSD5594.	Complete	Summary table included in the EMS outlining the approval status of plans under SSD5594. The latest version Environmental Management Strategy was approved on 14/4/2020.

Audit Reference	Action	Status	Summary
REC-2019-014	Update EMS to include clear plan depicting all monitoring required to be carried out under the conditions of this consent.	Complete	Monitoring locations are clearly presented in the latest version Environmental Management Strategy was approved on 14/4/2020
REC-2019-015	Ensure notification and submission of the written reports are provided to the DPIE and other relevant agencies within the required timeframe.	Complete	The PIRMP includes notification to DPIE (and other relevant agencies) on incident relating to an exceedance of performance measures or material harm.
REC-2019-016	Ensure that March 2019 noise monitoring results received from SLR in April 2019 are reported in the next monthly environmental report.	Complete	March 2019 noise monitoring reported in March 2019 Monthly EPL Monitoring report.
REC-2019-017	Put process in place to ensure that monitoring occurs within the required timeframe.	Complete	Expectations of ALS regarding failure to monitor as per the agreed scope of work discussed and agreed upon.
REC-2019-018	Put process in place to ensure that the Annual Exploration Report is provided to the Resources Regulator within the required time frame.	Complete	Compliance database action created to ensure timely submission.
REC-2019-019	Review UCRAMP following updates to the Springvale Water Management Plan to ensure consistency between these documents.	Complete	The water management plan was reviewed with consideration to the UCRAMP. UCRAMP was approved 7/05/2020.

11 INCIDENTS AND NON-COMPLIANCES DURING THE REPORTING PERIOD

This section refers to non-compliances and incidents reported during the reporting period. IEA period non-compliances have been discussed in Section 10. In 2021 there were no non-compliance or incidents reported.

Table 11-1 Bond Non-Compliance

Overview of incident/non-compliance	Schedule 3 Condition 4 and 5 require Bonds to be in place for Swamps predicted to be affected by undermining.
Description of Incident/non-compliance	The bond previously held by the Department in compliance with the approval expired on 30 June 2021 and has not been replaced. The Bond payment is associated with condition of approval for Longwall 419 Extraction Plan. Bonds do remain current for other Swamps and Extractions plans required under SSD 5594.
Action taken	Centennial requested an extension until 27 February 2022 to supply outstanding bonds for Springvale Mine on 26 November 2021.On 25 February 2022 Centennial has advised that this extension request was not approved. Meetings have been held between DPIE and Centennial in relation to the payment strategy for the bonds.
Current Status of Actions	Centennial is currently undertaking further discussions with DPIE in relation to the payment of bonds.

Table 11-2 WAL Non-Compliance

Overview of incident/non-compliance	WAL 36383 Exceedance of water extraction for the 2020/2021 water year.
Description of Incident/non-compliance	30/6/2021
Action taken	Administrative modifications to WALS were initiated in 2018 and a licence application was submitted to Water NSW to share extraction across multiple WALS.
Current Status of Actions	Prior to the end of the Annual Review reporting period, the required additional allocation was traded from unused proportion from Clarence Colliery and was approximately 1500 ML. This combined sharing of the WALs across the three operations enabled a compliant water account for the next water year. In the second half of 2021, a permeant connection of water rights between all operations located in the Sydney Basin Richmond Groundwater Source was completed.

A summary of incident and regulatory action is presented in the following table.

Table 11-3Summary of Reportable Incidents and Regulatory Actions

Compliance Type	Agency(ies)	Number
Incidents	0	0
Caution Notices	0	0
Warning Letters	0	0
Penalty Notices	0	0
Prosecutions	0	0

Note: This table includes actions taken by DPE, DRG, Resources Regulator and the EPA during the reporting period.

12 ACTIVITES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

Table 12.1 presents activities that are currently planned for the next reporting period, including

Table 12-1 Forecast Operations for 2022

Improvement Actions
• Extraction Plan 428-432 Approval and Implementation • Installation of additional monitoring equipment associated with 428-432 Extraction Plan Area • Independent Audit preparation and completion • SIS drilling program • Continue to undertake land management works at Coxs River and biodiversity offset sites
Management Plan Revisions
• Western Region Biodiversity Management Plan
Condition Triggers
• Undertake revisions to Management plans within 3 months of IEA and Annual Review Submission

It is noted that changes to production activities may trigger changes to planned activities.

13 REFERENCES

ACIRL (2021) January to December 2021Monitoring Reports

EMM (2022) Annual Environment Monitoring Review 2021

EMM (2021) Upper Coxs River Action and Monitoring Plan

GHD (2022) Newnes Plateau Swamps- Aquatic Ecology Summary

GHD (2022) UCR Aquatic Ecology Site Summaries from 2021 monitoring

JR Richards (2021) Total Waste Management Report Springvale

RPS (2021) Blue Mountains Water Skink Research and Management program Annual Report 2020-21 Monitoring Report.

RPS (2022) Giant DragonFly Research and Monitoring Program Summer 2020-2021 Monitoring Report for LW 419-427

RPS (2021) Springvale Swamp Biodiversity 2021 Annual Monitoring result Summary for Lws 415-+417, LW 418, LW 419, LWS 420-422 and LWs 424-427

SLR Rehab (2021) Springvale Colliery Annual rehabilitation Monitoring Report

SLR Noise (2021) Quarterly Noise Monitoring R42 to R45

The Bush Doctor (2021) Centennial Annual Work Report Coxs River 2021

Appendices

Appendix 1:

Plans

awang
Wolgan Road
Commonwealth
Cal
Newcom
Angus Place
ML1670
ML1424
ML1588
Springvale Mine
ML1326
ML1537
Kerosenevale Open Cuts
ML1323
ML1303
Renown
MPL314
Springvale Pit Top
Wallerawang Power Stn
CL377
State Mine
Fernbrook
EL6974
ML1727
Clarence
Steelworks
New State Mine
Hermitage
N

SCALE

0 1 2 3 4 Km

LEGEND:

- Current Workings
- Proposed First Workings
- Mining Leases

NOTES:

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REFERENCE	N:\Z_Plans
SEAM	LITHGOW
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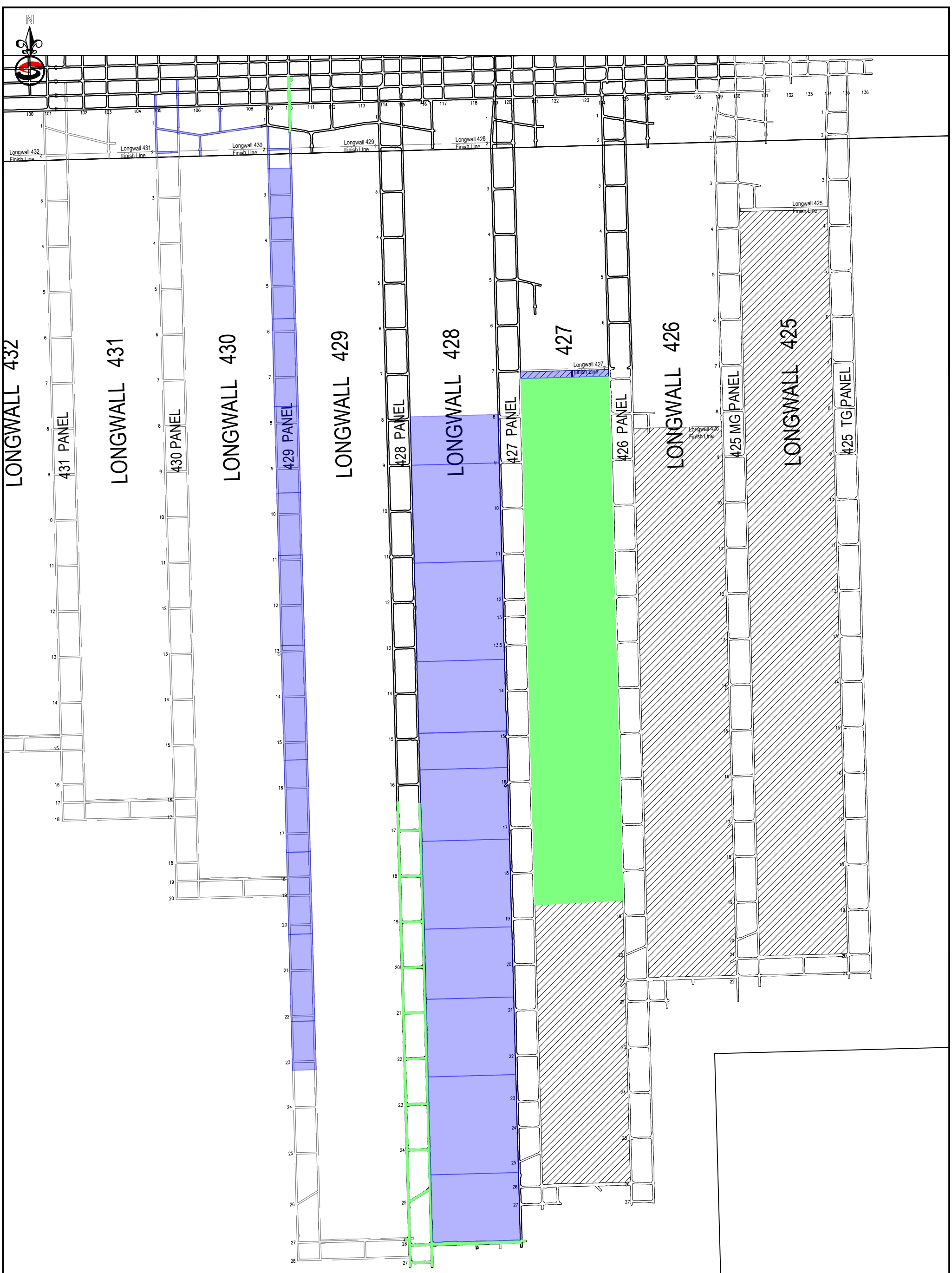
SPRINGVALE COLLIERY

Regional Location Plan

CENTENNIAL SPRINGVALE

Plan No. SVY07441.1 A3H

N:\Z_Environmental\Annual Review 20/21\1 Fig No 1 Regional Location Plan.dwg



LEGEND:

- Mine Production 2021
- Mine Production Forecast 2022

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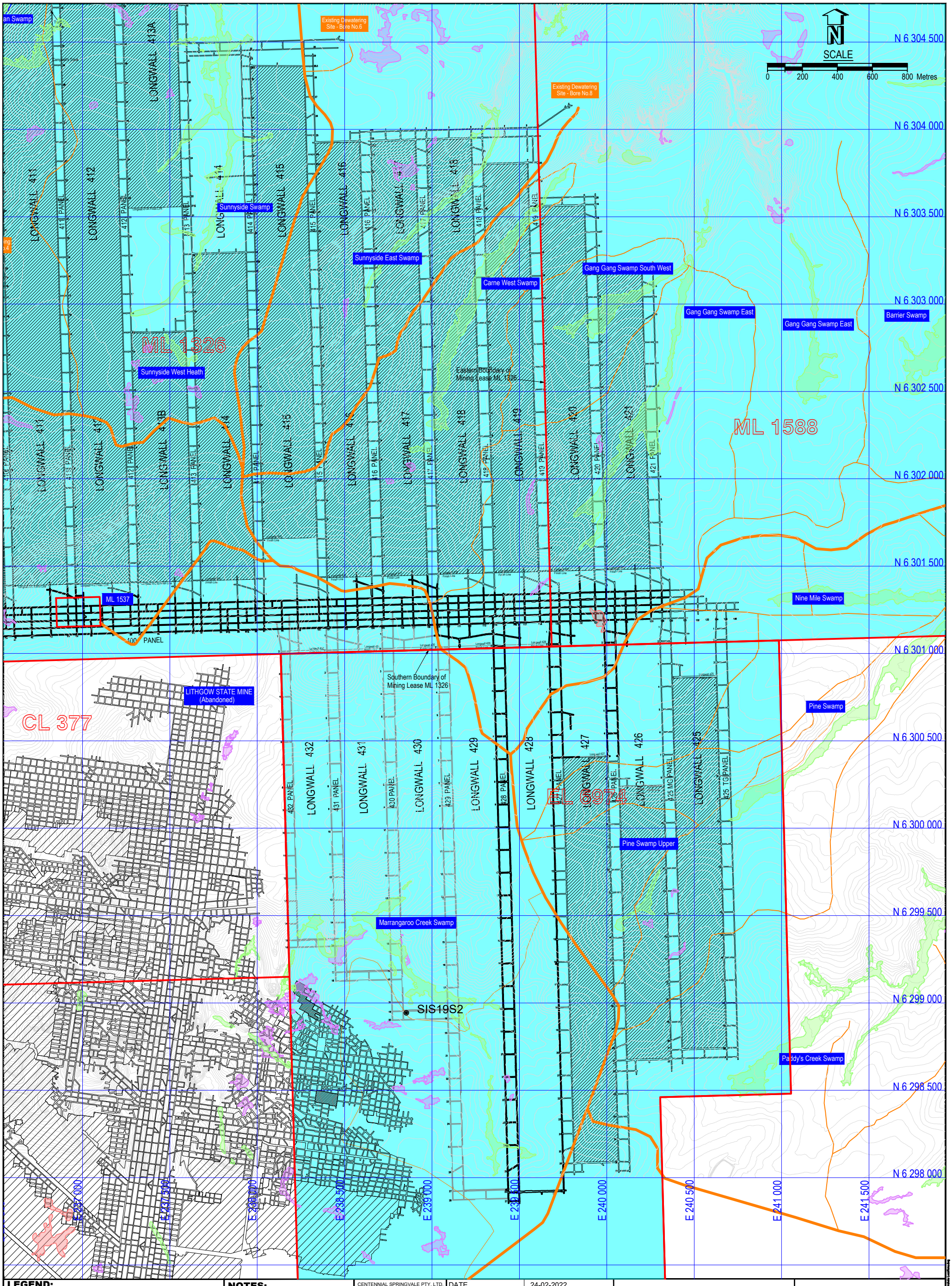
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SCALE	Not To Scale

SPRINGVALE COLLIERY

Annual Review 2021
Mine Production 2021

CENTENNIAL SPRINGVALE

Plan No. SVY07441.2 A3V



LEGEND:

- Shrub Swamp
- Hanging Swamp
- Snow gum Wooded Heath Swamp
- Exploration License EL6974
- Monitoring Boreholes Completed 2021
- Mining Lease
- Access track

NOTES:

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No exploration was conducted during 2021.

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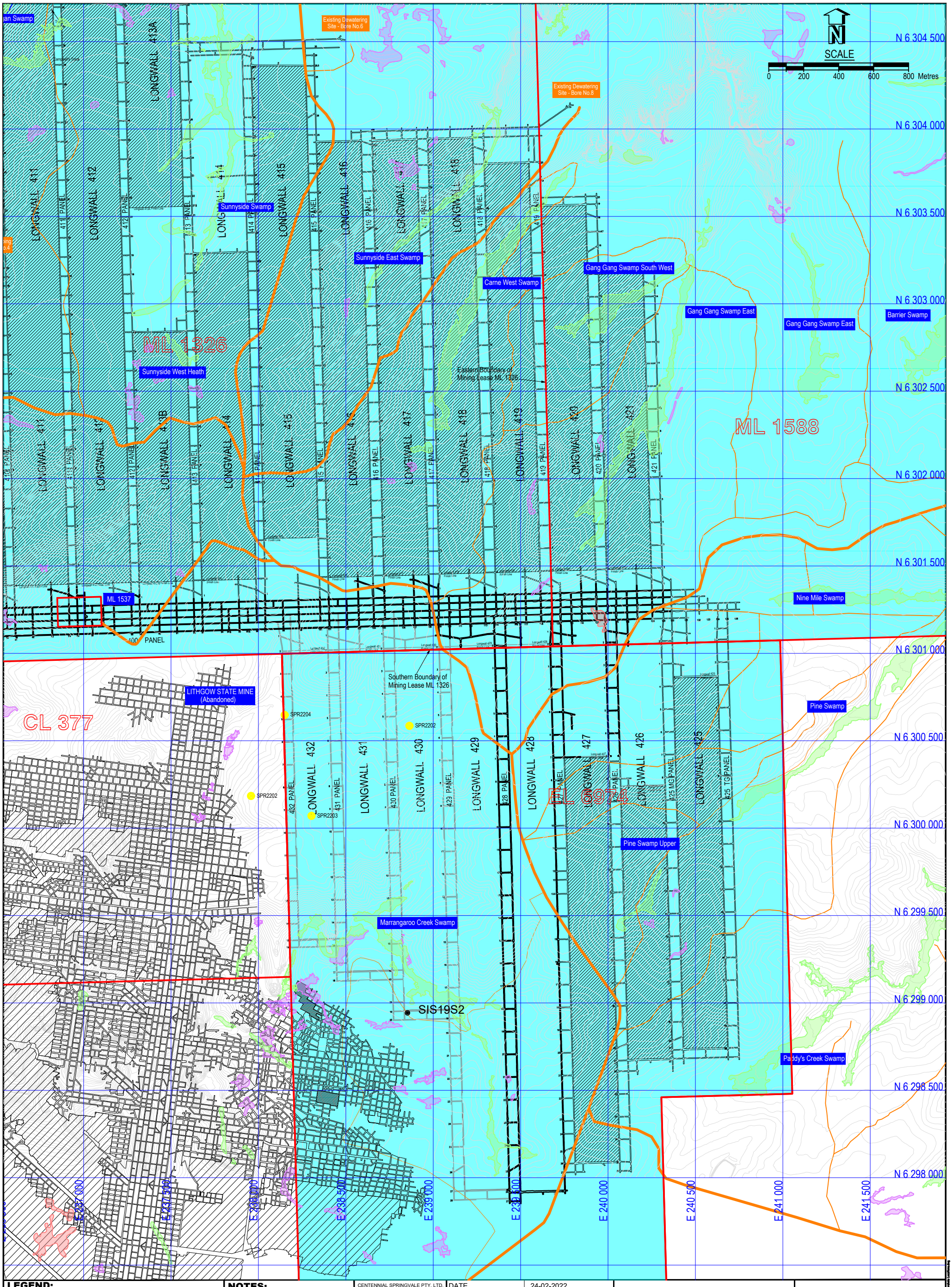
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DRAWN	Liam Chin
REFERENCE	N:\Z_Plans
SEAM	LITHGOW
INFORMATION SUPPLIED FROM	Mine Geologist
SCALE	1:20000

SPRINGVALE COLLIERY

Annual Review 2021
2021 Completed Boreholes

CENTENNIAL SPRINGVALE

Plan No. SVY07441.3A | A3V



LEGEND:

- Shrub Swamp
- Hanging Swamp
- Snow gum Wooded Heath Swamp
- Exploration License EL6974
- Exploration Boreholes Proposed 2022
- Mining Lease
- Access track

NOTES:

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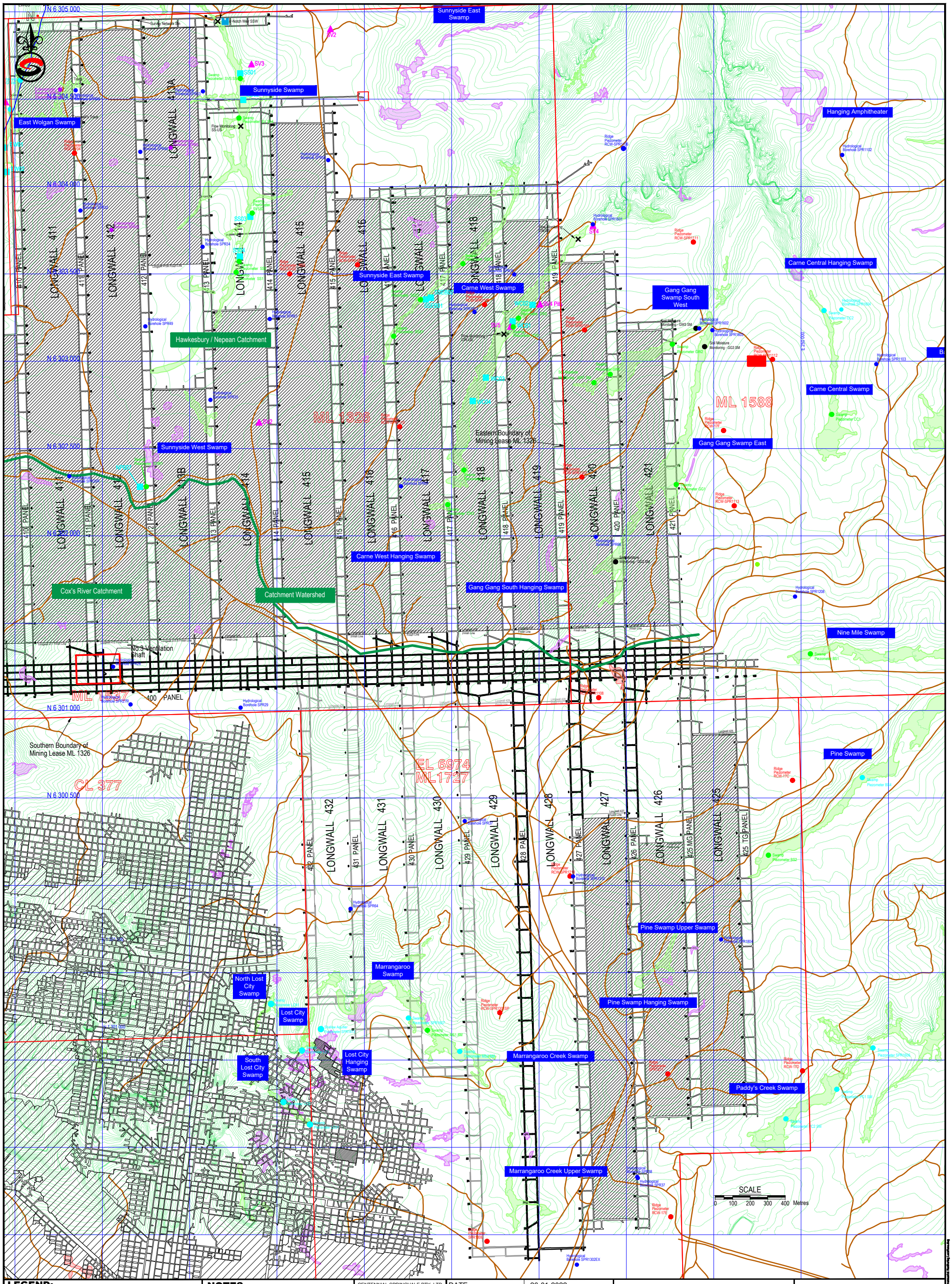
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SEAM	LITHGOW
INFORMATION SUPPLIED FROM	Mine Geologist
SCALE	1:20000

SPRINGVALE COLLIERY

Annual Review 2021
2022 Proposed Boreholes

CENTENNIAL SPRINGVALE

Plan No. SVY07441.3B A3V



LEGEND:

- Shrub Swamp
- Hanging Swamp
- Snow gum Wooded Heath Swamp
- Mining Lease
- Access track

NOTES:

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SCALE	1:20000

SPRINGVALE COLLIERY

Annual Review 2021
Environmental Monitoring Locations

CENTENNIAL SPRINGVALE

Plan No. SVY07441.4 | A3V

Place Dewatering Site

Existing Dewatering Site - Bore No.6

Existing Dewatering Site - Bore No.8

MLA 448

ML 1588

Rehabilitated Pumping Bore No.1

Rehabilitated Pumping Bore No.2

Discontinued Pumping Bore No.3

Rehabilitated Pumping Bore No.4

Booster Station 2

Booster Station 1

CCL 704

CL 377

ML 6974
ML1727

SIS01

SIS02

Discontinued Pit Top Fire Dam

DENDROWN COLLIERY

LONGWALL 401 … LONGWALL 432

200 PANEL

300 PANEL

100 PANEL

LEGEND:

- Newnes State Forest
- Longwall Extraction
- 11KV Powerline Path
- Mining Lease
- Formed Track
- Water Transfer Pipeline
- Rehabilitated Areas prior to 2021
- Active Infrastructure Area
- Proposed Rehabilitation Areas 2022

NOTES:

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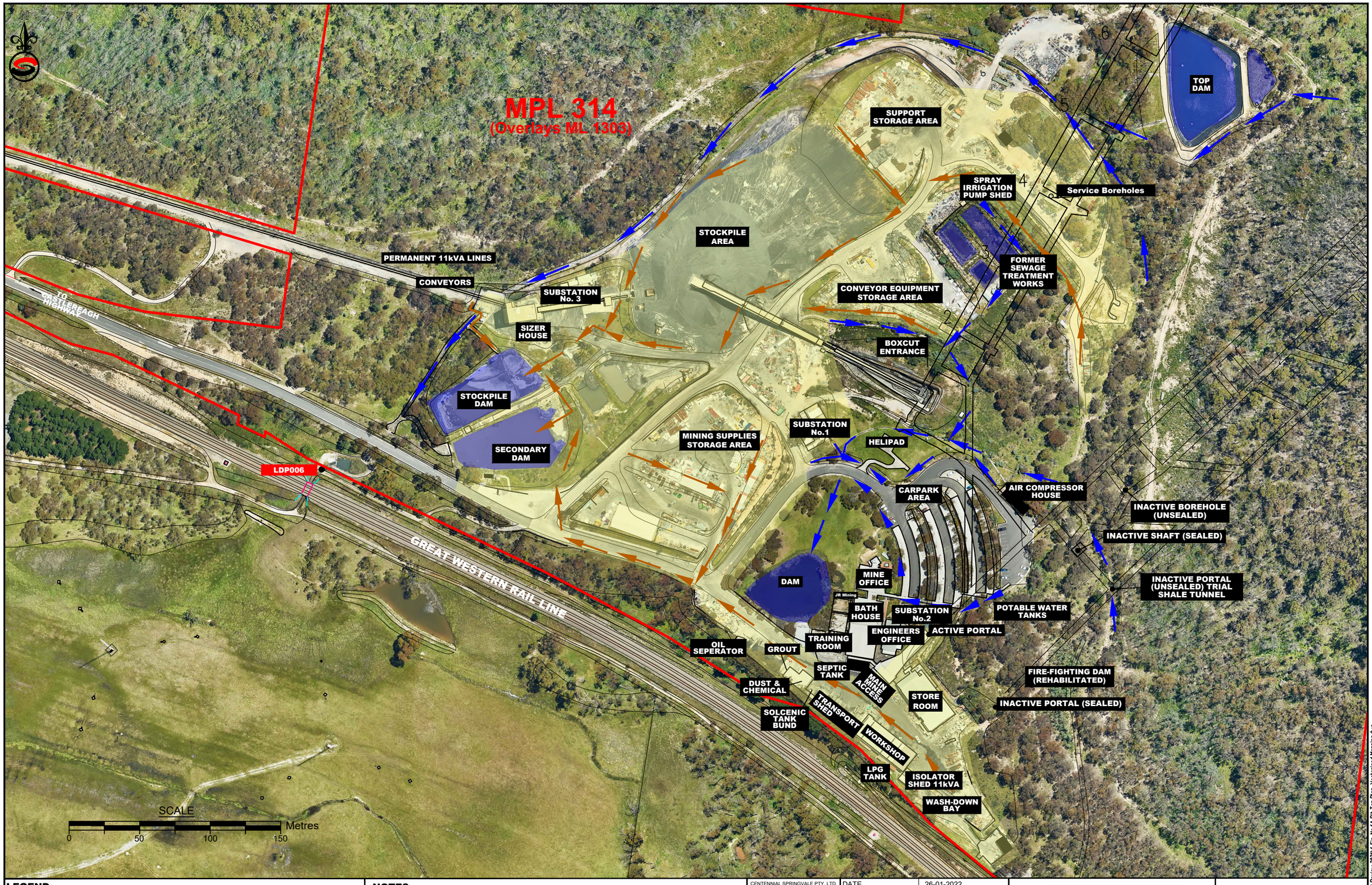
SPRINGVALE COLLIERY

Annual Review 2021
Proposed Rehabilitation 2022
Newnes Plateau

CENTENNIAL SPRINGVALE

Plan No. SVY07441.5 A3H

N:\Z_Environmental\Annual Review 2021\5 Plan No.5-Proposed Rehabilitation.dwg



LEGEND:

- Clean Water
- Dirty Water
- Dirty Water Catchment
- Pollution Control Structures
- Mining Lease

NOTES:

ENDORSEMENT: All information has been provided by others (excluding SVC Mine Workings) and is indicative only.

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SPRINGVALE COLLIERY

Annual Review 2021
Pit Top Plan
Surface Water Management

CENTENNIAL SPRINGVALE

Plan No. SVY07441.6 | A3H

N:\Z_Environmental\Annual Review 2021\6 Fig. No.6A Pit Top Plan-Vectorised Mapping.dwg



LEGEND:

Mining Lease

NOTES:

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SPRINGVALE COLLIERY

Annual Report 2021
Pit Top Plan - Aerial Photograph

CENTENNIAL SPRINGVALE

Plan No. SVY07441.7 A3V

6 305 000N

6 300 000N

6 295 000N

230 000E

235 000E

240 000E

ML1424

ML1670

ML1588

ML1326

ML1537

Lidsdale

ML1323

ML1303

MPL314

CL377

EL6974
MLA451

Former Wallerawang Power Station

Castlereagh Highway

Great Western Highway

Scale
Metres
0 200 400 600 800 1000

ENDORSEMENT:

The following information has been provided buy others and is indicative only. The Registered Mine Surveyor does not certify the accuracy of this information:

- Land Ownership Boundaries
- Cadastral Boundaries
- Rivers & Creeks
- Roads & Railway Lines
- Prescribed Dams
- Surfaces Features
- Power Lines and Telecommunications
- Base Aerial Photograph 2009 (Newnes Plateau/Pit Top)
- Archaeological Sites
- RCC Boundaries (Land use Boundaries)
- Vegetation Communities
- Contours
- MOP Domains
- Rehabilitation Areas
- Natural Features
- Infrastructure
- Annual Sequencing of Mining & Rehabilatation

LEGEND:

- Project Approval Area
- Mining Tenement
- Surface Contour - 5m
- River
- Creek
- Drainage Line
- Aboriginal Cultural Heritage Sites
- MU50 Newnes Plateau Shrub Swamp
- MU51 Newnes Plateau Hanging Swamp
- MU52 Newnes Plateau Rush Sedge Snow Gum Hollow Wooded Heath
- Secondary Domain - Infrastructure (Existing Forestry Tracks)
- Secondary Domain - Water Management
- Secondary Domain - Rehabilitation - Woodland
- Land Capability - Class 4
- Land Capability - Class 5
- Land Capability - Class 6
- Land Capability - Class 7
- Land Capability - Class 8
- Land Capability - Disturbed Land

NOTES:

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SPRINGVALE COLLIERY

Annual Review 2021
Final Rehabilitation

CENTENNIAL SPRINGVALE

Plan No. SVY07441.8 A0H

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Springvale

State Mine

Clarence

ML 1588

ML 1326

ML 1537

EL 6974
ML1727

CL 377

"FF-L" ROCK OUTCROPS

"CWS" ROCK FACE

"CCS" ROCK FACE

"X" LINE

"GG" LINE

"NMS" LINE

"PS" LINE

"Z" LINE

"ZX" LINE

"AA" LINE

"MCS1" LINE

"MCS2" LINE

"MCS" LINE

"PCS" LINE

POWERLINES

SPRINGVALE TINV POWERLINE

LEGEND:

- SMP Monitored Subsidence Line
- SMP Proposed Subsidence Line
- Powerlines
- Shrub Swamp
- Hanging Swamp
- Snow Gum Wooded Heath Swamp

NOTES:

ENDORSEMENT: All information has been provided by others (excluding SVC Mine Workings) and is indicative only.
Northern Subsidence Lines are planned to be decommissioned in 2022.

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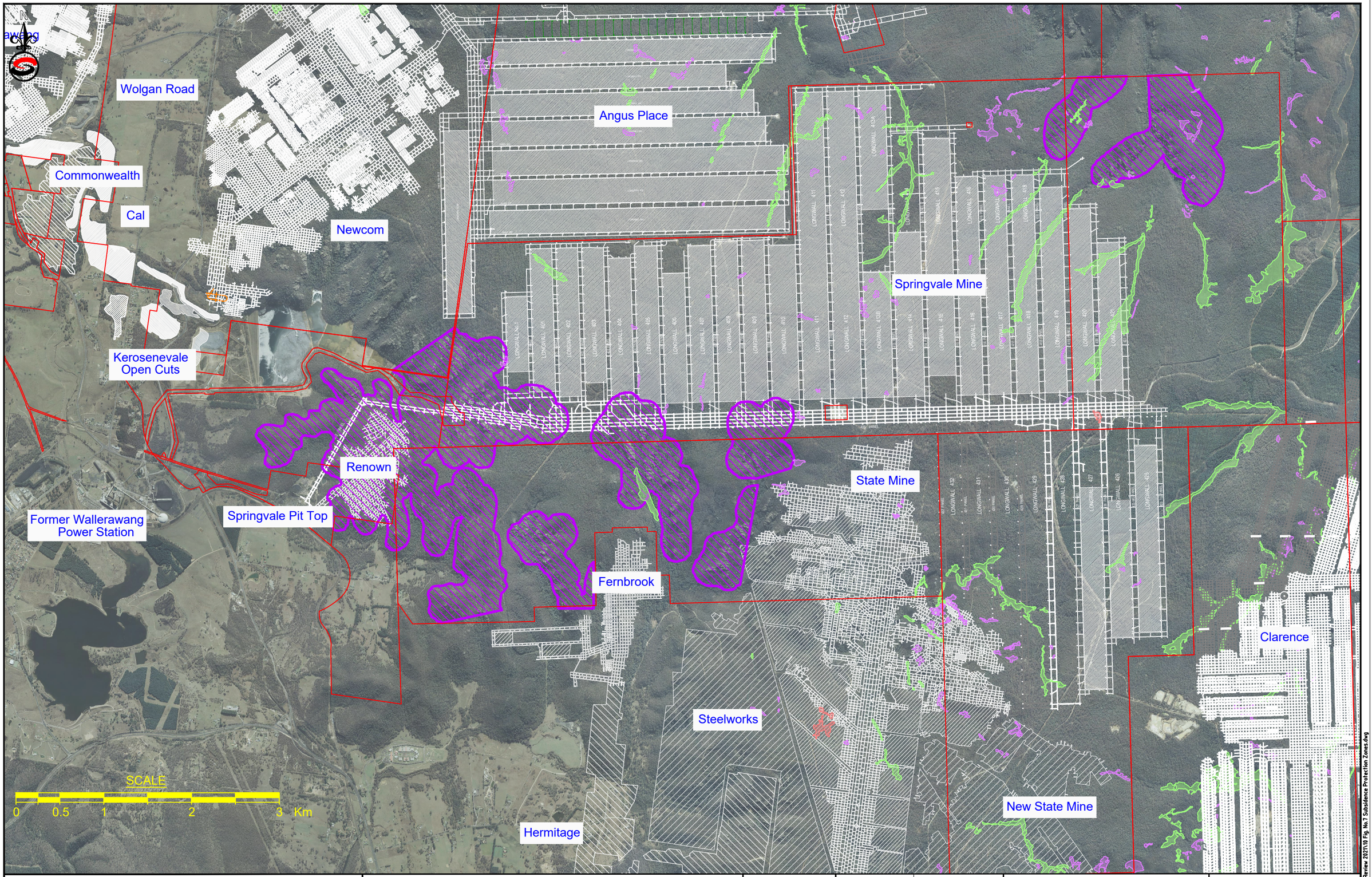
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SCALE	1:20000

SPRINGVALE COLLIERY

Annual Review 2021
Subsidence Monitoring

CENTENNIAL SPRINGVALE

Plan No. SVY07441.9 | A3V



LEGEND:

- Subsidence Protection Zone
- Shrub Swamp
- Hanging Swamp
- Snow Gum Wooded Heath Swamp
- Mining Lease

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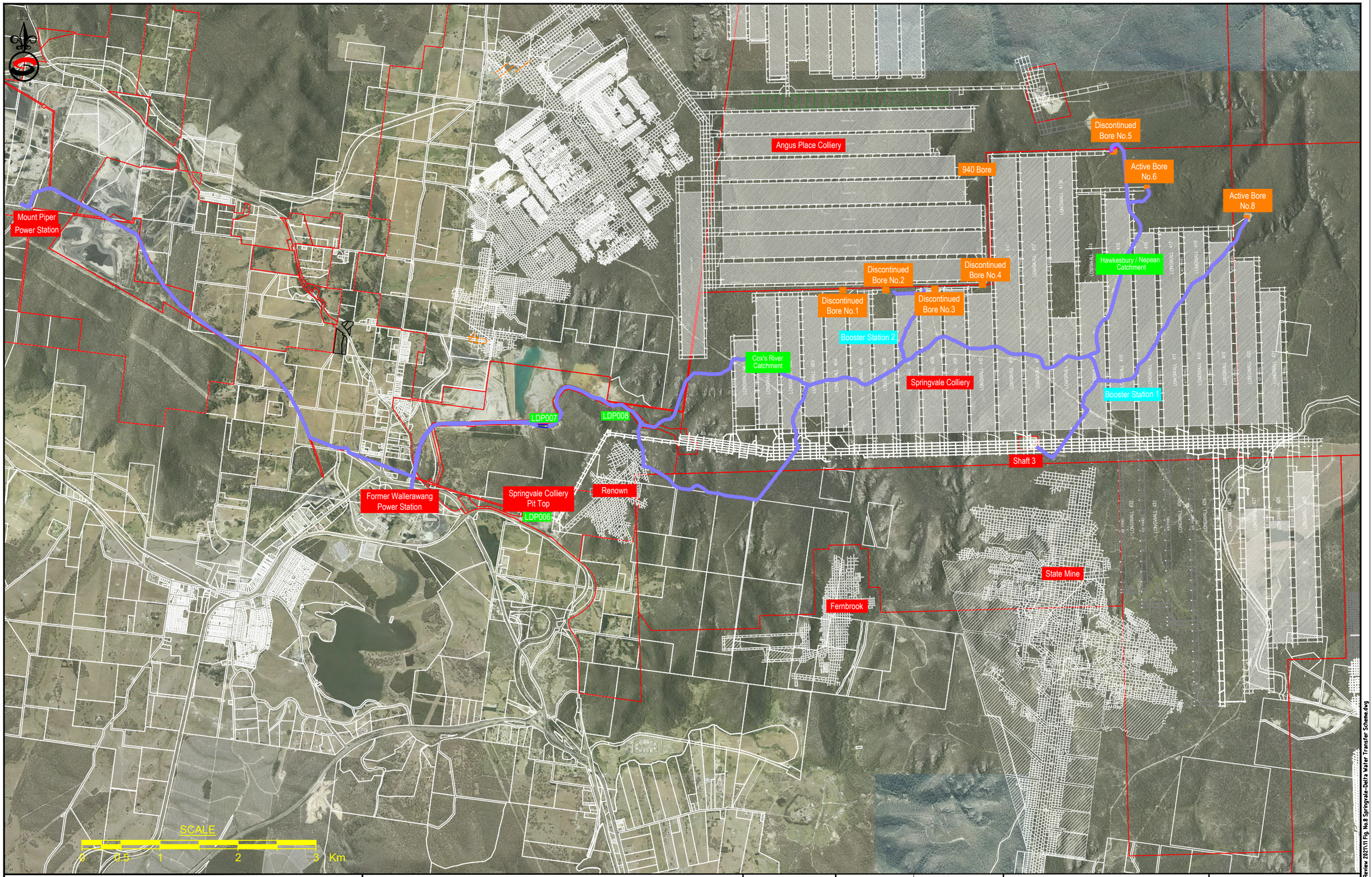
SPRINGVALE COLLIERY

Annual Review 2021
Subsidence Protection Zones

CENTENNIAL SPRINGVALE

Plan No. SVY07441.10 A3H

N:\Z_Environmental\Annual Review 2021\10 Fig No.7 Subsidence Protection Zones.dwg



LEGEND:

- Water Transfer Route
- Mining Lease
- Pumping Compound

NOTES:

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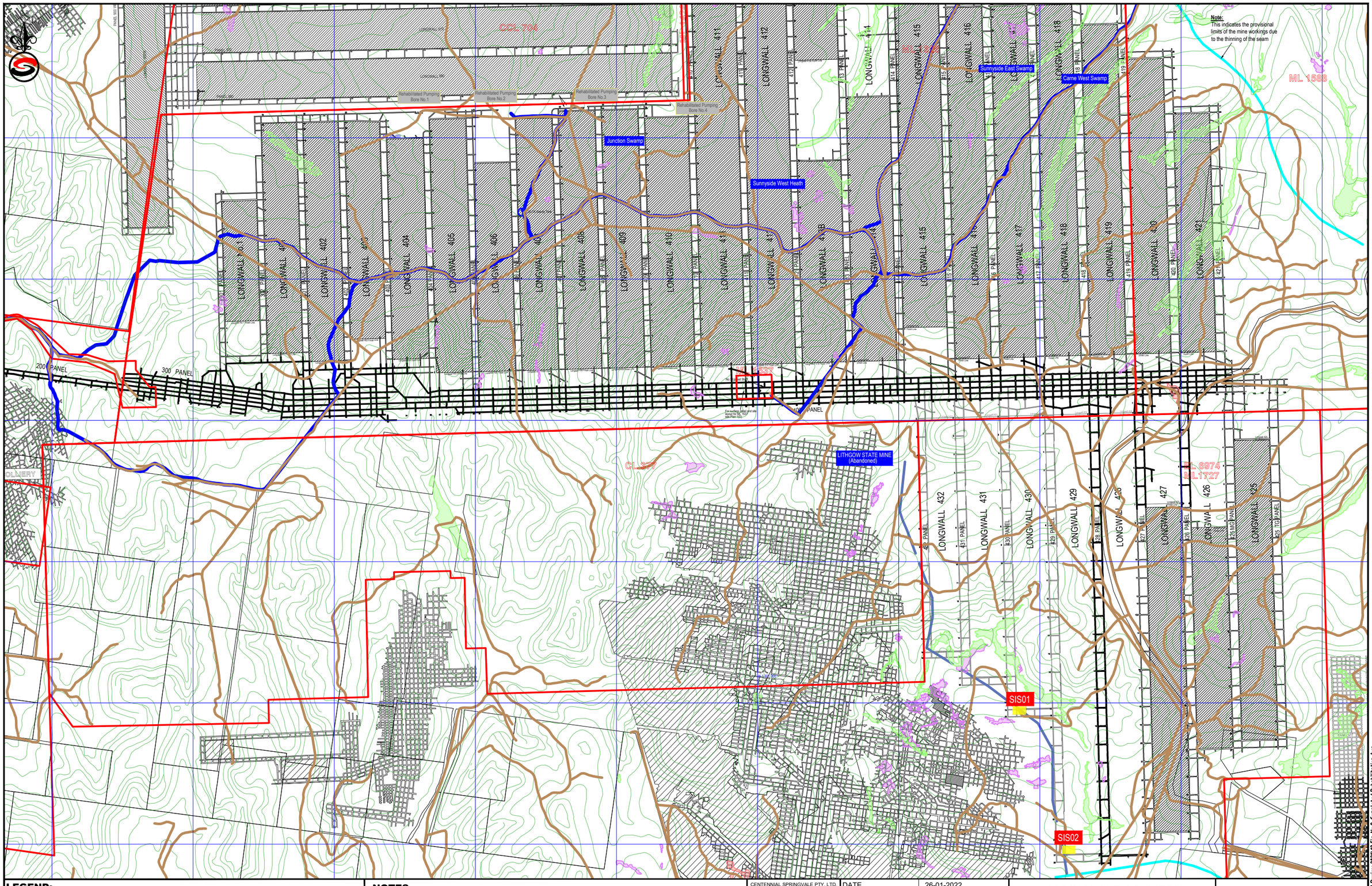
Annual Review 2021
Water Transfer Route

To Mount Piper Power Station and LDPs.

CENTENNIAL SPRINGVALE

Plan No. SVY07441.11 A3H

N:\Z_Environmental\Annual Review 2021\11 Fig. No.8 Springvale-Delta Water Transfer Scheme.dwg



Note:
This indicates the provisional limits of the mine workings due to the thinning of the seam

LEGEND:

- Longwall Extraction
- Water Transfer Pipeline
- Mining Lease
- Formed Track
- Surface Contour
- Non Rehabilitated Sites
- Shrub Swamp
- Hanging Swamp
- Snow Gum Wooded Heath Swamp

NOTES:

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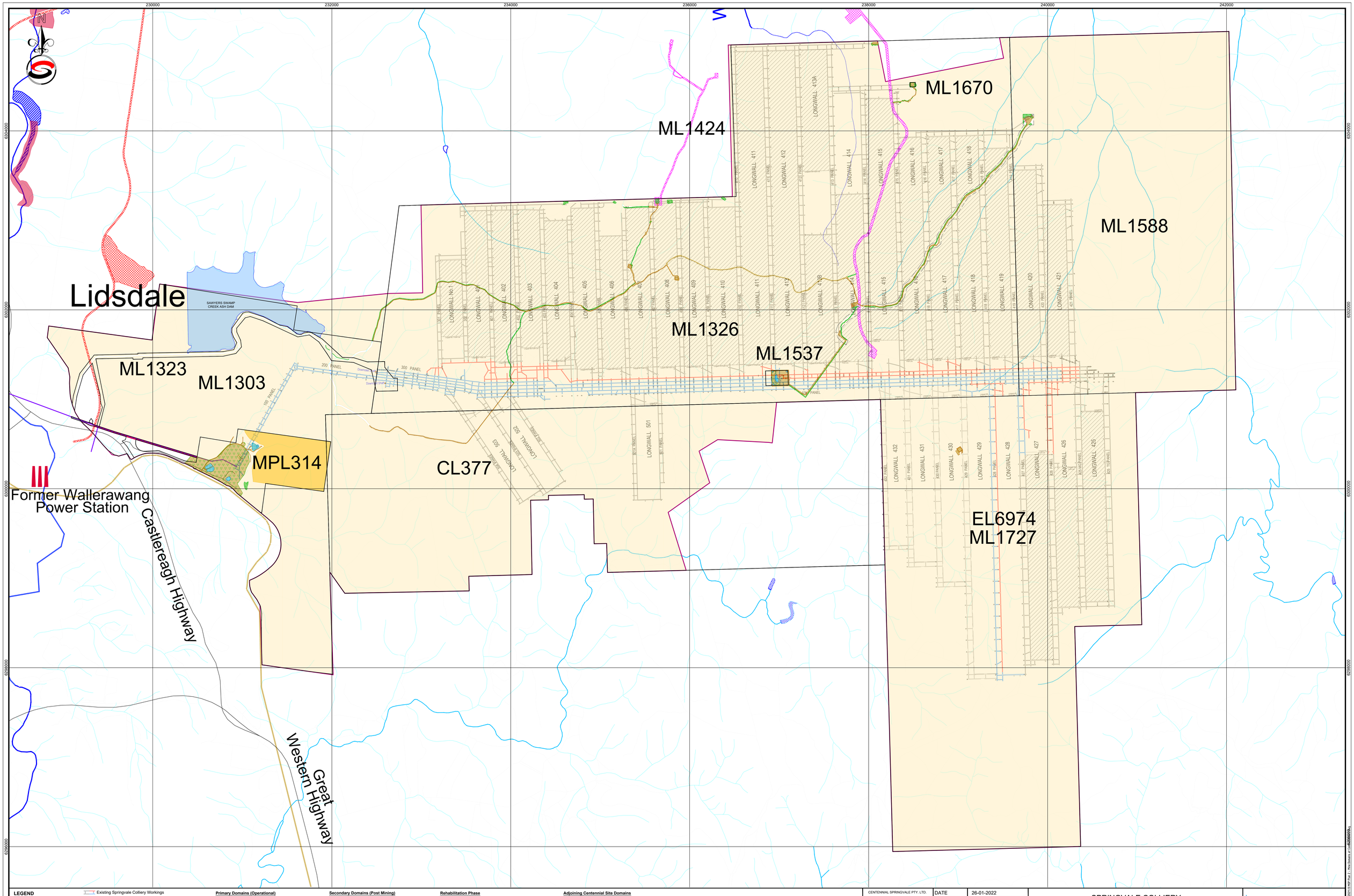
Annual Review 2021
Completed Rehabilitation 2021

Newnes Plateau

CENTENNIAL SPRINGVALE

Plan No. SVY07441.12 A3H

N:\Z_Environment\Annual Review 2021\12 Fig. No.5-Completed Rehabilitation.dwg



LEGEND

- Project Application Area
- Coal Titles
- Mining Lease Application
- Tracks
- Lake
- Fence
- Existing Springvale Colliery Workings
- Existing Areas of Extraction
- Proposed Springvale Colliery Development
- Dams
- Drainage Lines
- Watercourses
- Sawyers Creek Ash Dam

Primary Domains (Operational)

- Domain 1 - Infrastructure
- Domain 2 - Other Areas
- Domain 3 - Water Management Area
- Domain 4 - Conservation
- Domain 5 - Rehabilitation Pasture
- Domain 6 - Cox River Catchment

Secondary Domains (Post Mining)

- Domain A - Infrastructure
- Domain B - Water Management Area
- Domain C - Rehabilitation Woodland
- Final Void
- Conservation and Biodiversity Offset Area

Rehabilitation Phase

- Phase 1- Decommissioning
- Phase 2 - Landform Establishment
- Phase 3 - Growth Medium Development
- Phase 4 - Ecosystem and Land Use Establishment
- Phase 5 - Ecosystem and Land Use Sustainability
- Phase 6 - Relinquished Lands

Adjoining Centennial Site Domains

- Angus Place Plateau Domain Extent
- Angus Place Domain Extent

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SPRINGVALE COLLIERY
Annual Review 2021
Mine Domains at MOP Commencement

CENTENNIAL SPRINGVALE

DRG. No. SVY07441.13 | A0

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Appendix 2:

Air Quality and Greenhouse Gas Monitoring Results

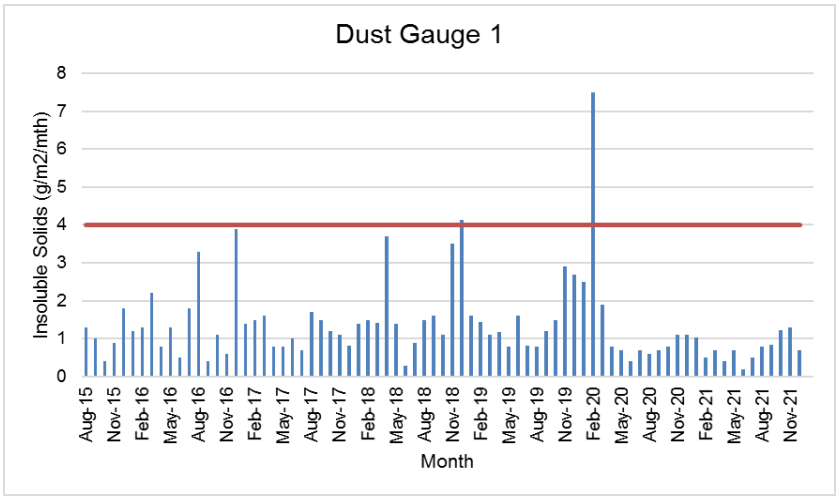


Figure 1A-1- Dust Gauge 1 results 2015-2022

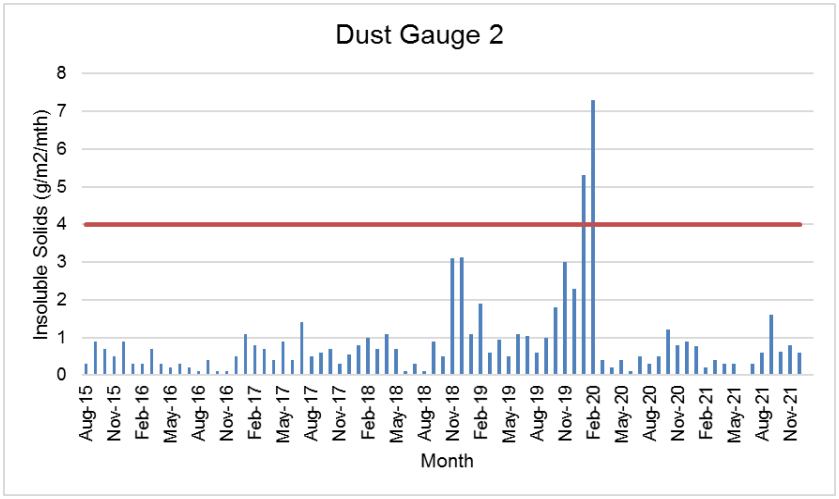


Figure 1A-2- Dust Gauge 2 results 2015-2022

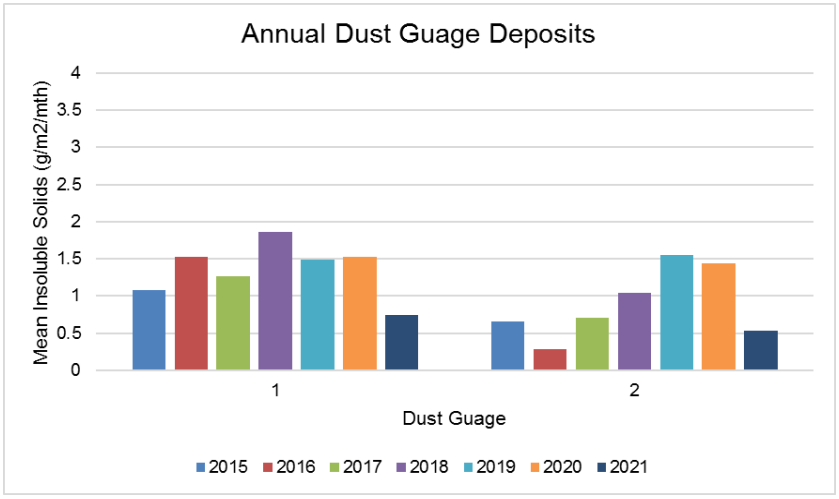


Figure 1A-3- Annual Dust Gauge results 2015-2022

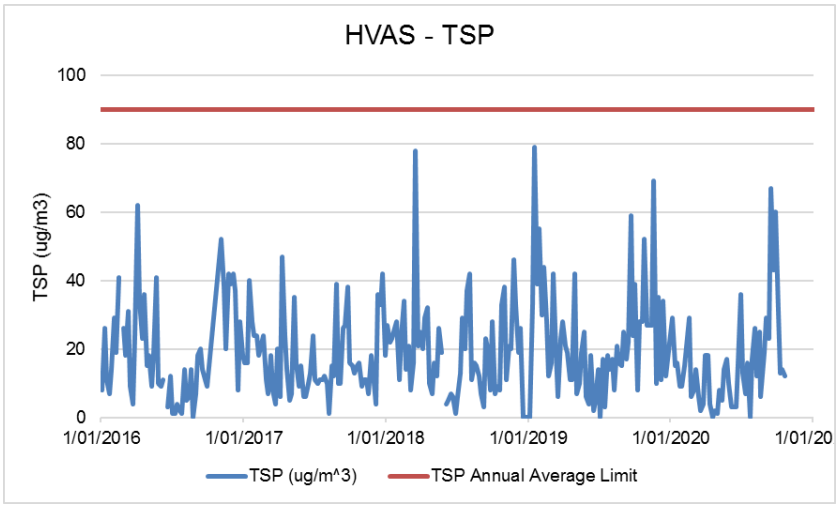


Figure 1A4—TSP Results 2016-2022

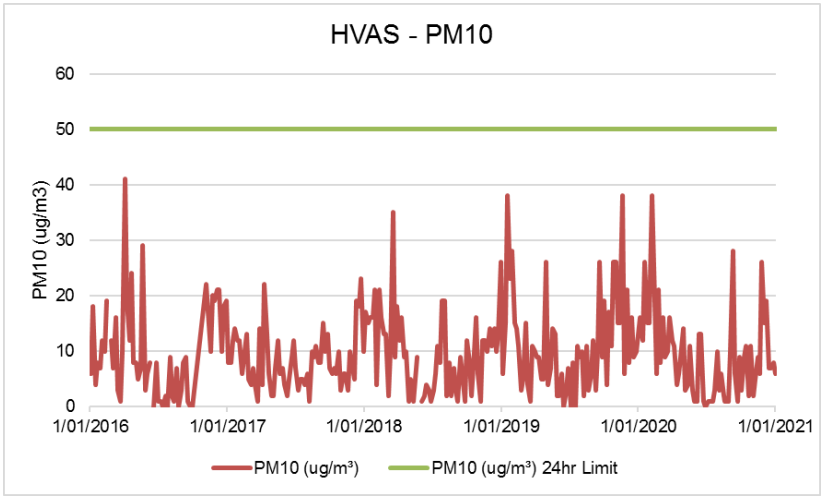


Figure 1A5—PM10 Results 2016-2022

Greenhouse Gas

Greenhouse gas emissions are calculated for the financial year from emission sources at Springvale Table E 1 provides a greenhouse gas emissions summary for the 2019/20 financial year.

Table 1A-1: Total GHG emissions from Springvale*

Emissions Summary (CO_2-Et) July 2019 to June 2020	Total
Total Energy Consumption (GJ)	135,158
Scope 1 Emissions CO2eT Total	363,860
Scope 2 Emissions CO2eT Total	25,209
Scope 1 & Scope 2 Emissions CO2eT Total	389,069

*This Includes Data from the Springvale Western Coal Services Operation

Appendix 3:

LDP Results

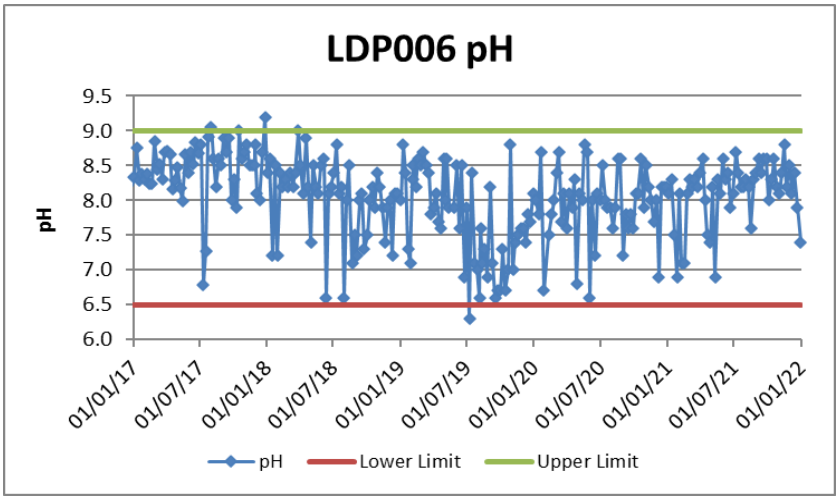


Figure 3A-1- LDP001 pH 2017-2022

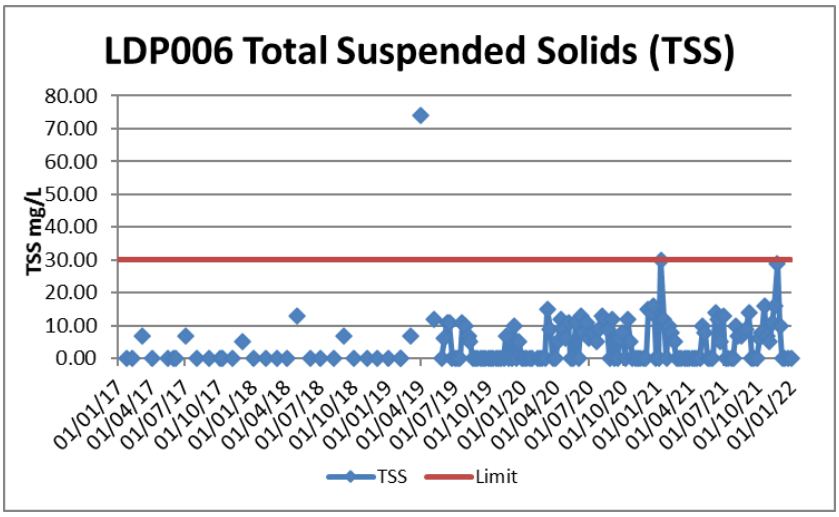


Figure 3A-2- LDP001 TSS 2017-2022

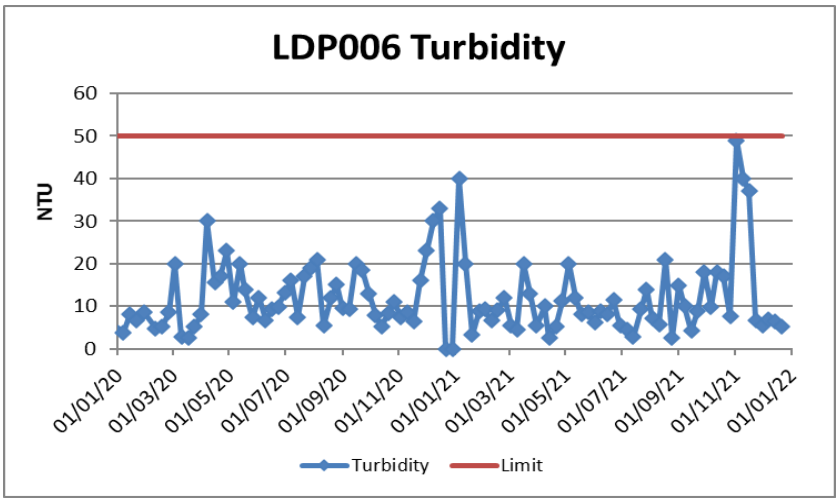


Figure 3A-3- LDP001 Turbidity 2017-2022

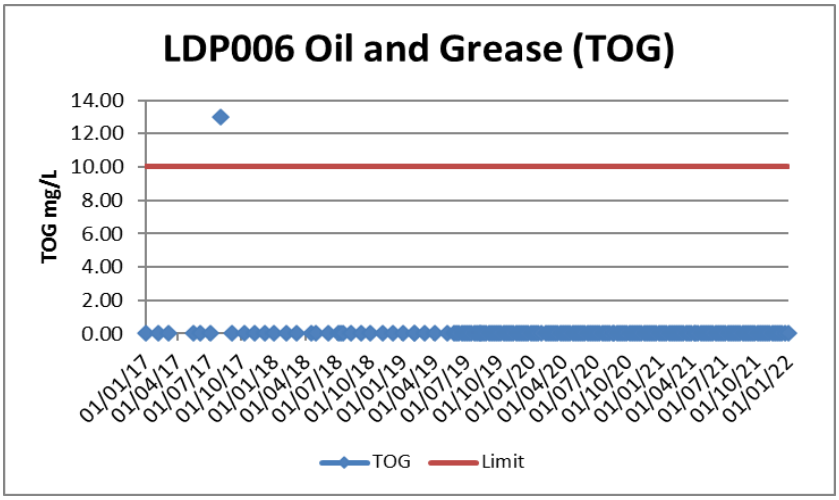


Figure 3A-4- LDP001 TOG 2017-2022

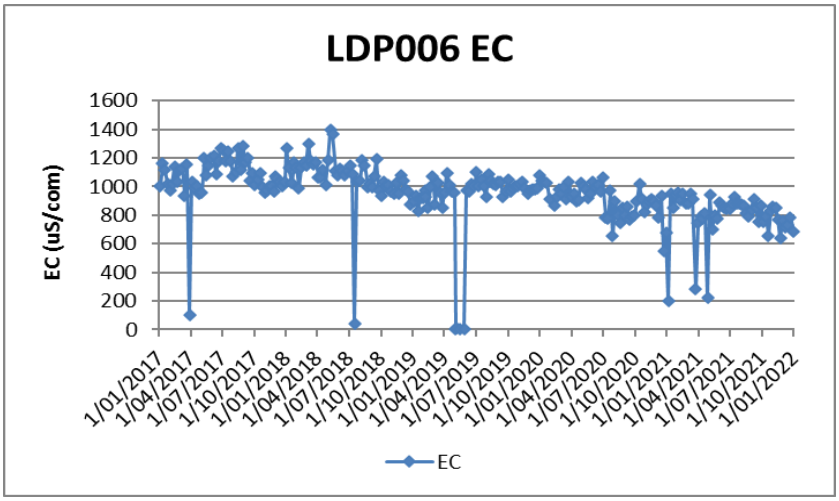


Figure 3A-5- LDP001 EC 2017-2022

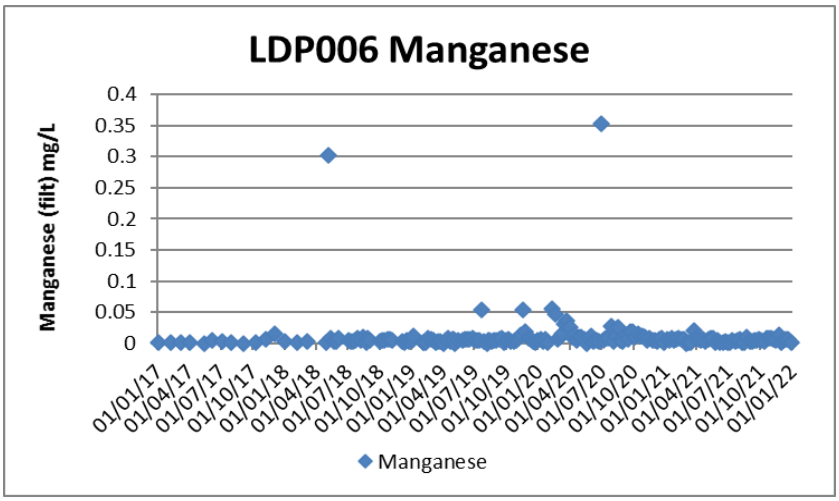


Figure 3A-5- LDP001 Manganese 2017-2022

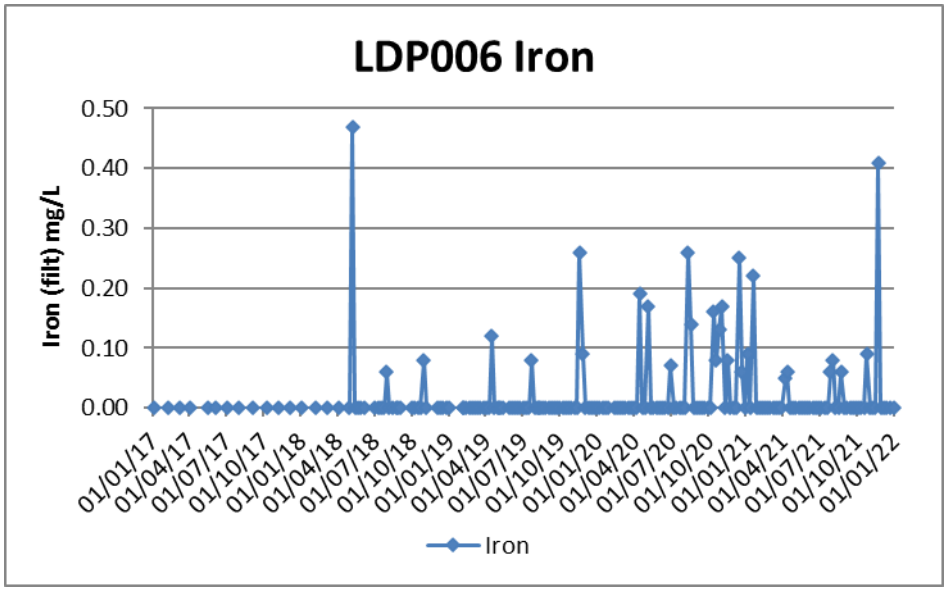


Figure 3A-6- LDP001 Iron 2017-2022

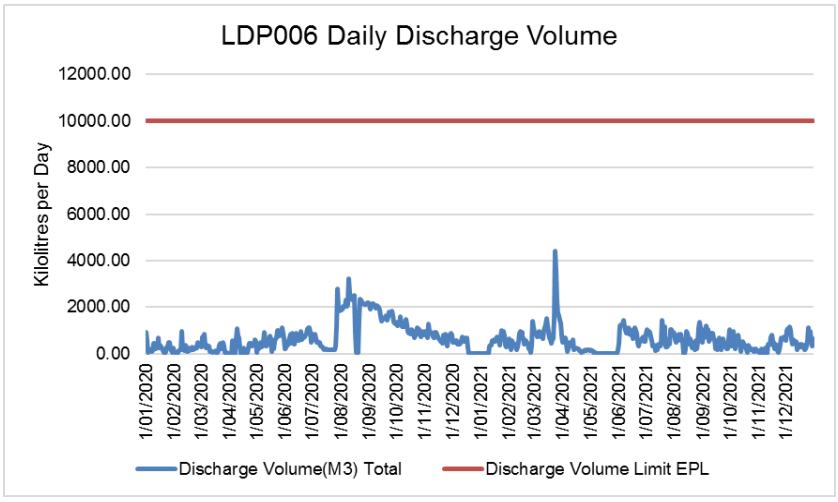


Figure 3A-6- LDP001 Volume 2020-2022

Appendix 4:

Annual Groundwater and Surface Water Monitoring Report

Annual Environmental Monitoring Review (AEMR)

1 January 2021 to 31 December 2021 surface and groundwater AEMR

Prepared for Springvale Coal Pty Ltd
March 2022



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Annual Environmental Monitoring Review (AEMR)

1 January 2021 to 31 December 2021 surface and groundwater AEMR

Report Number

E210603SV RP#3

Client

Springvale Coal Pty Ltd

Date

15 March 2022

Version

v3 Final

Prepared by



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15 March 2022

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This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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1 Introduction

Underground coal mining commenced at Springvale Coal Pty Ltd (Springvale) in 1995 following the granting of Development Consent (DA 11/92) on 27 July 1992, pursuant to Section 101 under Part 4 of the NSW *Environmental Planning and Assessment Act* 1979 (EP&A Act). DA11/92 was modified on four occasions. Development Consent SSD-5594 was granted on 21 September 2015 allowing the ongoing operation of Springvale for a further 13 years.

Current mining operates under a Water Management Plan (WMP) (Centennial 2018b); a subplan of the overarching Extraction Plan for Long Wall (LW) 424 to 427. The WMP outlines Springvale's management approach for the swamp areas in and around Springvale (refer to Swamp Management Plan (SMP) (Centennial 2018a)).

The SMP and WMP detail intensive monitoring programmes that have been implemented to monitor potential impacts from underground mining on the groundwater regime, and in particular the Newnes Plateau Shrub Swamps (NPSS) and Newnes Plateau Hanging Swamps (NPHS). The greater monitoring programme incorporates NPSS and groundwater monitoring locations above both the Springvale underground operations and the adjacent Angus Place Colliery.

This report discussed observed anomalies and possible mining-induced groundwater-related impacts during the reporting period (January 2021 to December 2021). Any observed impacts that exceed trigger levels set out in the WMP and SMP are also identified so that appropriate management or engineering solutions may be implemented.

2 Existing environment

2.1 Rainfall data

Daily rainfall is measured at the Bureau of Meteorology (BoM) rain gauge at Maddox Lane, Lidsdale (BoM Station No. 063132) and the Springvale owned Newnes Plateau Prison Farm Rain Gauge. Rainfall data is summarised in Table 2.1. Comparative analysis of the two weather stations has been presented below due to the disparate weather patterns occurring across the region, influenced by topography.

The daily cumulative rainfall deviation (CRD) from daily mean rainfall for Newnes Plateau is shown on Figure 2.1. Above average rainfall has been observed since February 2020 following a period of below average rainfall since October 2016. Above average rainfall continued into 2021 with cumulative total rainfall for the Newnes Plateau and Lidsdale above their respective average annual long-term averages (Table 2.1).

Table 2.1 January to December 2021 rainfall summary

Month	Long term average rainfall (mm)		2021 observed rainfall (mm)	
	Newnes Plateau[1]	Lidsdale[2]	Newnes Plateau	Lidsdale
January	85.4	85.1	63.6	82.8
February	124.1	77.0	115.2	87.4
March	108.4	68.8	116.6	154.0
April	58.9	42.5	7.4	0.6
May	42.0	47.5	31.6	25.2
June	73.5	49.6	61.6	51.8
July	53.7	50.0	60.0	60.6
August	58.6	63.4	94.2	81.4
September	54.8	52.9	70.8	43.2
October	77.5	66.9	53.6	53.2
November	103.3	73.5	178.6	172.4
December	89.0	73.5	125.2	63.0
Total	**929.1**	**750.7**	**978.4**	**875.6**

Notes: 1. 20 August 1998 to 31 December 2021; 2. 1 August 1959 to 31 December 2021.

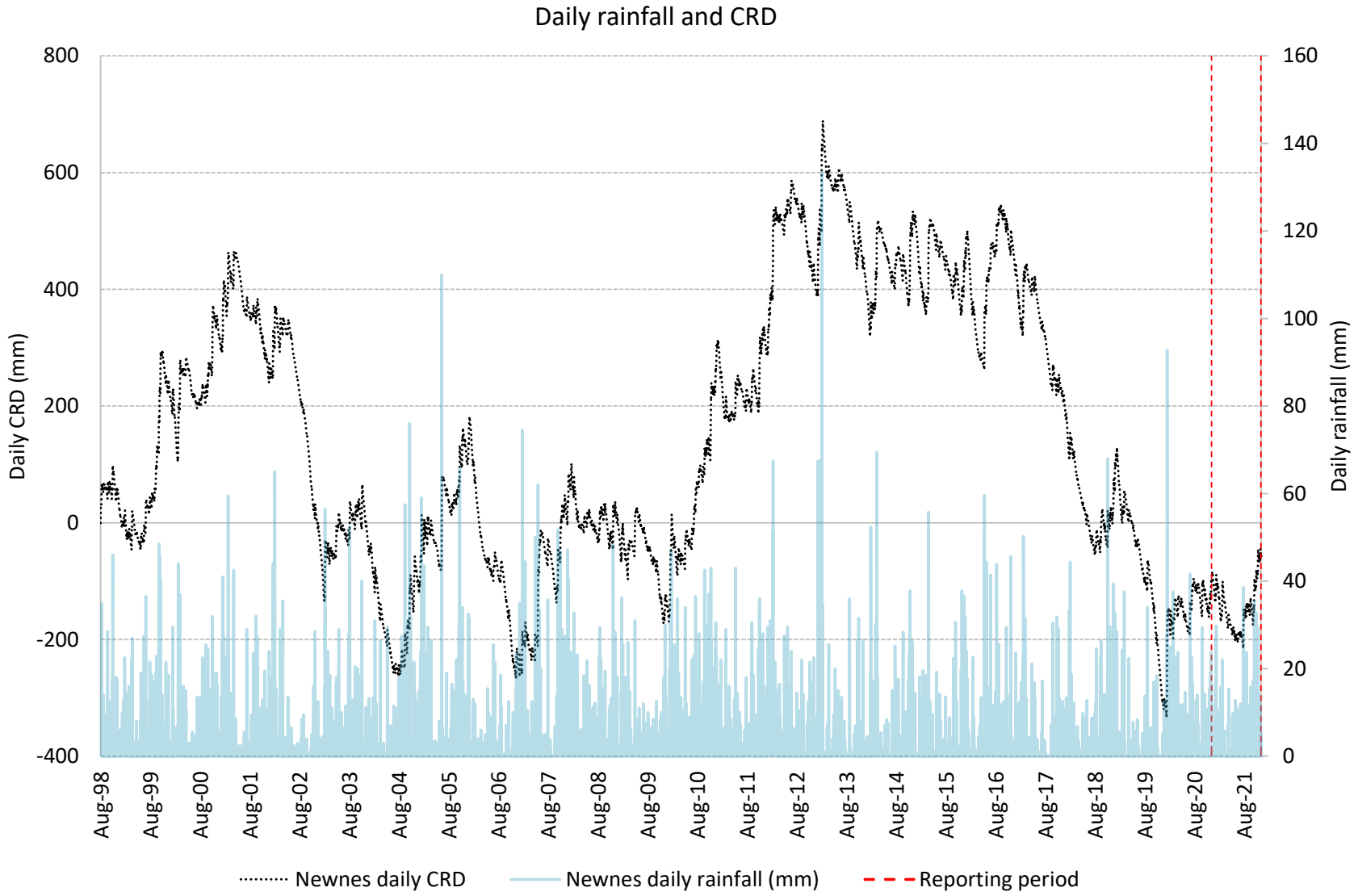


Figure 2.1 **Daily cumulative rainfall deviation (CRD) from the daily rainfall mean – August 1998 to December 2021**

2.2 Hydrogeology

The hydrogeology complexities of the Springvale local area have been well research over time. The groundwater systems interacting with the Springvale Mine have been conceptualised (McHugh 2014) and for simplicity, are divided into three distinct groundwater systems:

- perched groundwater system;
- a shallow regional groundwater system, ranging from unconfined to semi-confined; and
- a deep confined groundwater system which includes the Lithgow coal seam.

2.2.1 Perched groundwater system – Burralow Formation

The perched groundwater system comprises multiple discontinuous perched localised flow bands. The perched groundwater system is recharged by excess rainfall. The presence of six distinct fine-grained claystone and siltstone units (YS1 to YS6) act as aquitards, or semi permeable layers, which impede rainfall percolation to the shallow groundwater system, associated with the Banks Wall Sandstone.

The NPSS and NPHS, listed as an Endangered Ecological Community (EEC) under the Environmental Protection and Biodiversity Conservation (EPBC) Act 1999, coincide with the lithographic and topographic occurrence of aquitards in the Burralow Formation (McHugh 2014).

2.2.2 Shallow groundwater system – Banks Wall Sandstone

The shallow groundwater system is a regional system in the Banks Wall Sandstone (Narrabeen Group) and generally extends to a depth of up to 200 m below ground level (BGL). The shallow groundwater systems is hydraulically separated from the perched groundwater system.

The shallow groundwater system is recharged by rainfall, overlying watercourses where it outcrops in incised gullies, and by minor vertical leakage from the perched groundwater system. Regional recharge potentially occurs in areas of outcrop and sub-crop to the west and southwest of the study area (Jacobs 2019). Local discharge is inferred to occur in incised gullies that intercept the water table with some swamps coinciding with this occurrence (McHugh 2014). Regional discharge is inferred to occur to the north-east, where units outcrop in the scarp of the plateau.

Groundwater flow occurs primarily by interconnective fracturing, bedding planes and structural features such as lineaments and faults with some primary/pore porosity. The fracture system is the primary control of groundwater flow as the rock matrix has low permeability. The general groundwater flow direction is toward the north-east, which is consistent with the dip of the strata.

At the base of the shallow groundwater system is the Mount York Claystone (MYC). This unit comprises a sequence of shale and claystones that form an aquitard which influences vertical connectivity between the shallow and deep groundwater systems.

2.2.3 Deep groundwater system

The deep groundwater system, associated with the Burra-moko Head Sandstone, Caley Formation and Illawarra Coal Measures, is up to 200 m in thickness and is located below the MYC. Groundwater flow occurs primarily via interconnective fracturing, bedding planes, cleated coal seams and structural features such as lineaments and faults. The fracture system is the primary control of groundwater flow as the rock matrix has low permeability.

The general groundwater flow direction in the deep groundwater system is towards the north-east, which is consistent with the dip of the strata. Regional recharge potentially occurs in areas of outcrop/sub-crop to the west and south-west of the study area by rainfall, overlying watercourses, dams and minor leakage from the shallow groundwater system. Groundwater discharge is inferred to occur to the north-east, where the units outcrop in the scarp of the plateau.

2.3 Drainage and catchments

Springvale is in the catchments of the Coxs River and Wolgan River. Drainages off the plateau are often deeply incised in their lower reaches, incorporating numerous cliff lines and pagodas bordering the valley flanks. In the upper catchment areas, drainage lines are typically poorly defined to non-existent with overland sheet flow being the typical mode of discharge during rainfall events.

2.4 Surface water and groundwater interaction

The dominant surface water and groundwater interactions on the Newnes Plateau involve recharge to shallow groundwater and groundwater discharge to surface water (Jacobs 2019).

Surface water leakage to shallow groundwater occurs from overlying watercourses. Groundwater discharge to surface water occurs as seepages and drips from exposed faces of cliff lines or exposed bedrock in drainage lines, and as seepage from sub-cropping bedrock to regolith or residual soil profiles on valley flanks and valley floors (Jacobs 2019). Where sufficient seepage occurs, the seepages may support the development of NPHS or NPSS.

Groundwater seepage may contribute to stream baseflow either directly as discharge to drainage lines in the valley floor, or indirectly as a contribution to catchment subsurface flow (Jacobs 2019).

2.5 Mining progress

LW 427 operations commenced on 28 September 2020 and was being mined during the reporting period. Appendix A shows the historical progression of long wall mining at Springvale.

3 Monitoring program

3.1 Monitoring locations

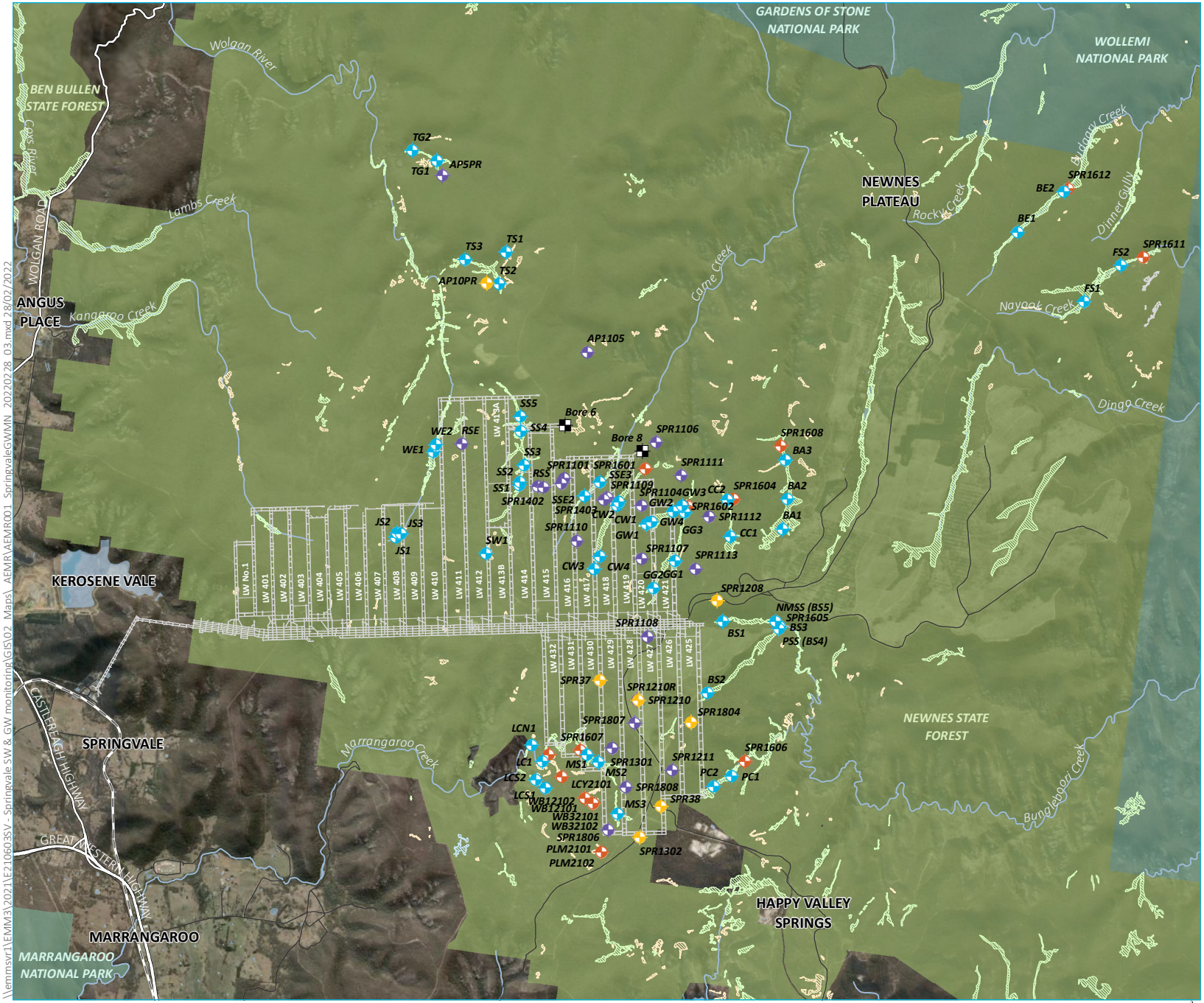
The WMP and SMP monitoring programs prescribe the collection of surface water and groundwater monitoring data to assess potential mining-related impacts on groundwater and surface water, and to assist in the development of management strategies. The programs focus on obtaining data adjacent to and in the NPSS and NPHS.

Subsidence from longwall mining can cause changes to the hydrogeological regime. The monitoring program targets the NPSS, perched groundwater system, shallow groundwater system and the deep groundwater system through a combination of, routine surface water monitoring, standpipe piezometers and vibrating wire piezometers (VWPs). Impacts are assessed against performance triggers to identify when observed variances in groundwater levels, soil moisture and water quality exceed natural ranges.

The following details the Springvale surface water and groundwater monitoring network:

- Groundwater levels are monitored daily by groundwater level loggers in 17 NPSS, with a total of 47 swamp piezometers and 19 perched piezometers. Manual (ie dip) groundwater level measurements are undertaken monthly and level loggers are downloaded monthly.
- Soil moisture is measured daily by 33 soil moisture loggers at 15 NPSS. Soil moisture loggers are downloaded monthly.
- Groundwater levels in the shallow groundwater system (Burralow Formation and Bankswall Sandstone) are measured daily by level loggers at 20 standpipe piezometers. Manual groundwater level measurements are obtained monthly and level loggers are downloaded monthly.
- Pore pressures in the shallow and deep groundwater systems are monitored daily by 13 multi-level vibrating wire piezometer (VWP) arrays. VWP loggers are downloaded monthly.
- Surface water samples are obtained from 11 locations on a fortnightly basis and monthly at 16 locations.
- Swamp and creek flows are manually gauged on a fortnightly basis at 27 locations.
- Groundwater samples are obtained from 14 swamp piezometers on a monthly basis and quarterly at 19 ridge piezometers.
- A weather station is installed at the Newnes Prison Farm. Weather data is also obtained from the BoM-operated rain gauge at Maddox Lane, Lidsdale (BoM Station No. 063132).

The locations of the groundwater and surface water monitoring sites are shown on Figure 3.1 and 3.2. Details of the monitoring sites are summarised in Appendix B.



KEY

- Underground mine workings
- Rail line
- Major road
- Minor road
- Named watercourse
- Waterbody
- NPWS reserve
- State forest

Groundwater monitoring network

- Dewatering bore
- Vibrating wire piezometer
- Swamp piezometer
- Standpipe piezometer
- Perched piezometer

Temperate Highland Peat Swamps on Sandstone EEC

- Hanging
- Shrub
- Snow
- TBC

Source: EMM (2022); Centennial Coal (2022); DFSI (2020, 2021); ESRI (2022); Jacobs (2021); GA (2011)

0 2.5 5 km

GDA2020 MGA Zone 56

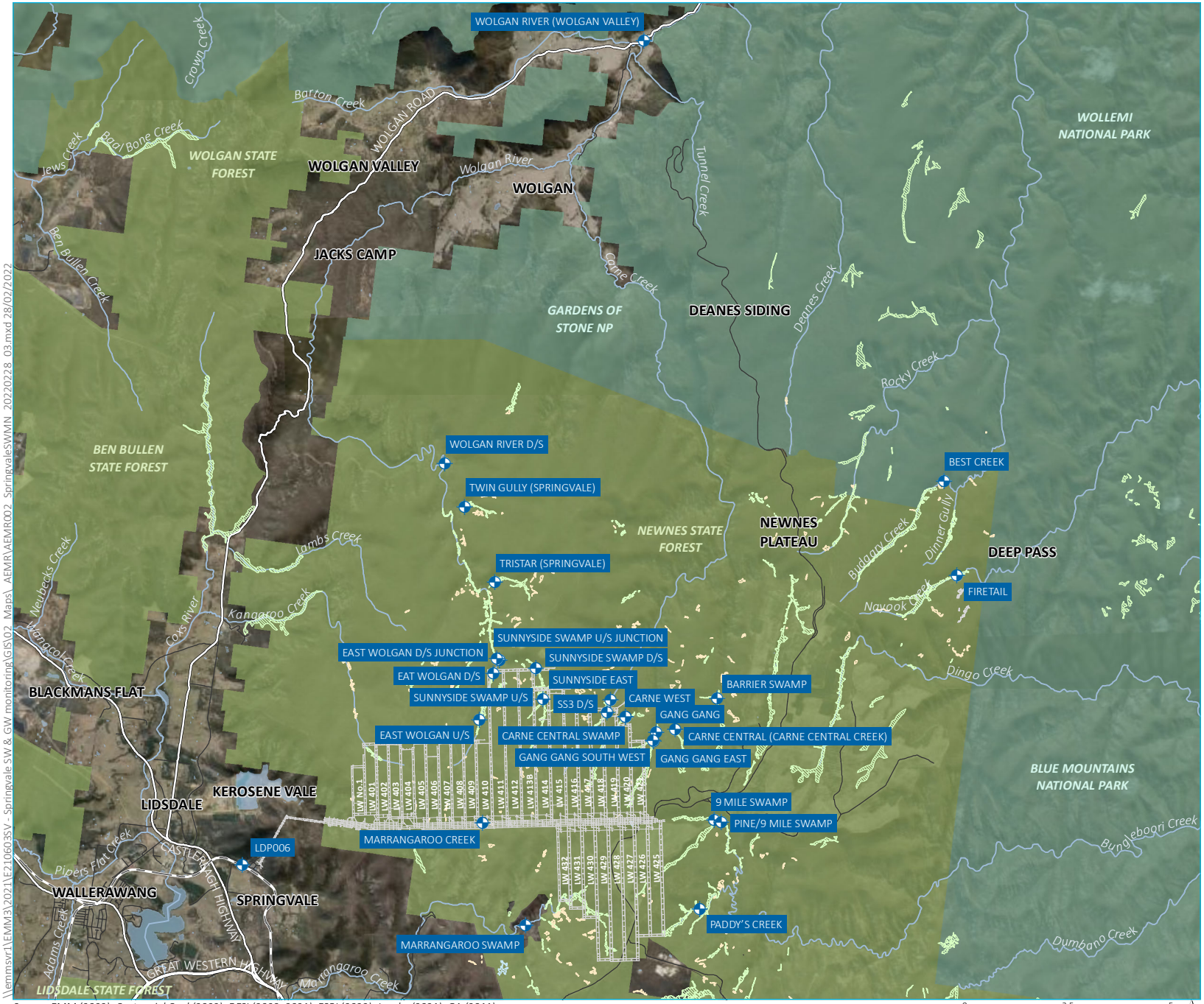
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Springvale groundwater monitoring network

Springvale Coal Pty Ltd
Annual Environmental Monitoring Review (AEMR)
Figure 3.1

EMM
creating opportunities



KEY

- Surface water monitoring network
- Underground mine workings
- Rail line
- Major road
- Minor road
- Named watercourse
- Waterbody
- NPWS reserve
- State forest

Temperate Highland Peat Swamps on Sandstone EEC

- Hanging
- Shrub
- Snow
- TBC

Source: EMM (2022); Centennial Coal (2022); DFSI (2020, 2021); ESRI (2022); Jacobs (2021); GA (2011)

0 2.5 5 km

GDA2020 MGA Zone 56

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Springvale surface water monitoring network

Springvale Coal Pty Ltd
Annual Environmental Monitoring Review (AEMR)
Figure 3.2

EMM creating opportunities

3.2 Performance measurement

The SMP includes details relating to surface water and groundwater trigger levels for swamp piezometers, standpipe piezometers and surface water monitoring sites within the LW 424 to 427 trigger investigation area (TIA).

There are two types of monitoring sites that form the basis of the SMP:

1. Impact sites located within the LW 424 to 427 TIA.

2. Reference sites located outside of the LW 424 to 427 TIA and distant from active mining. Reference sites have similar climatic, geological, hydrogeological, hydrological, and vegetative conditions to impact piezometers and are used to help discern natural and anthropogenic impacts at impact sites.

The trigger investigation area (TIA) is defined as a 600 m buffer zone around the active longwall mining face. When an impact site falls within the TIA, the pre-mining period of data collection ends, and the pre-mining trigger level is set. If an impact site is within 2 km of an undermined significant lineament, the pre-mining period of data collection ends, and pre-mining trigger levels are set. Groundwater level data collected once an impact site is within the TIA or within 2 km of an intercepted significant lineament is referred to as *post-mining data*. Post mining data from impact piezometers are compared to triggers levels and reference sites to determine whether anomalous results have been observed at impact sites.

3.3 Trigger criteria

Performance triggers are used to identify exceedances in groundwater levels and quality that may be due to mining. However, these conclusions can only be drawn through detailed investigation as detailed in the SMP and WMP.

This report focuses on short term changes, as detailed in the SMP, to identify any potential impacts in groundwater levels and quality during the reporting period and provides suggestions for any further investigation. The performance indicators for monitoring sites as per the SMP and WMP are shown in Table 3.1.

Table 3.1 Springvale management plan performance criteria

Swamp management plan (SMP) short-term performance criteria		
Groundwater levels	Swamp piezometers	If the measured water levels are less than the baseline pre-mining 95th percentile for more than seven days.
	Perched piezometers	Insufficient pre-mining baseline data to establish triggers for impact sites.
	Standpipe piezometers	If the seven-day moving average water levels are less than the pre-mining 5th percentile for more than 1 month.
	VWP	There are no trigger levels for VWPs. VWPs are used as a proxy for possible impacts to ridge and swamp piezometers and to monitor for potential connective cracking to the shallow groundwater system (above the MYC).
Groundwater quality	Swamp piezometers	If the observations for pH, electrical conductivity (EC) and dissolved iron (Fe) exceed the pre-mining baseline 80th percentile by two standard deviations for more than two months.
	Perched piezometers	Insufficient pre-mining baseline data to establish triggers.

Table 3.1 Springvale management plan performance criteria

Swamp management plan (SMP) short-term performance criteria		
	Standpipe piezometers	if the following parameter measurements/values are exceeded: • pH less than or equal to 2.73 or greater than or equal to 7.87 • Electrical conductivity greater than or equal to 100 µS/cm • Dissolved iron greater than or equal to 1 mg/L
Surface water	Swamp flows	If the observations for pH, EC, Fe, dissolved manganese (Mn), and total suspended solids (TSS) exceed the pre-mining baseline 80th percentile by two standard deviations for more than two months.
Water Management Plan performance criteria		
Surface water	Stream flows	Parameters at downstream monitoring location is greater than 80th percentile at reference site (greatest observation of all reference sites) for three consecutive monitoring events: • TSS: 97 mg/L • pH: 4.7 and 8 • EC: 174 µS/cm.

4 Groundwater level monitoring

Groundwater level trigger investigations, as defined in the SMP, completed during the reporting period are briefly summarised in Table 4.1. Investigations determined the triggers were not caused by mining.

Table 4.1 Groundwater level trigger investigations completed during the reporting period

Monitoring ID	Type	Comment	Submitted to the department?
MS2	Swamp piezometer	The investigation concluded that the cause of the groundwater level exceedance was due to operator error while collecting routine groundwater level measurements.	Yes
SPR1301	Standpipe piezometer	The investigation concluded that the trigger observed in the post-mining period was due to a subdued and delayed response to climatic conditions as similar responses were observed at reference sites. The trigger was coincidental with a declining rainfall trend.	Yes

4.1 Swamp piezometers

Short term triggers (see Section 3.2) have been reviewed against swamp groundwater levels during the reporting period. No short-term triggers, besides MS2 (see Table 4.1), have been recorded during the reporting period.

Hydrographs for reference and impact swamp piezometers are shown in Figure 4.1 to Figure 4.19. Comments on groundwater level trends during the reporting period are shown on Table 4.2. A summary of historical observations prior to the reporting period can be found in Appendix C.

Table 4.2 Swamp piezometer groundwater level trend summary

Swamp	Monitoring ID	Site type as per SMP	Mined status	Comment
Barrier Swamp	BA1	Reference	NA	Stable – fluctuating with rainfall
	BA2			Stable – fluctuating with rainfall
	BA3			Stable – fluctuating with rainfall
Best Swamp	BE1	Reference	NA	Stable – fluctuating with daily CRD
	BE2			Stable – fluctuating with daily CRD
Carne Central	CC1	Reference	NA	Increasing trend – fluctuating with daily CRD
	CC2			Increasing trend – fluctuating with daily CRD
Fire Tail	FS1	Reference	NA	Stable – fluctuating with daily CRD
	FS2			Logger removed/stolen in February and replaced in April. Stable – fluctuating with daily CRD.
Twin Gully	TG1	Reference	NA	Stable – fluctuating with daily CRD
	TG2			Stable – fluctuating with daily CRD

Table 4.2 Swamp piezometer groundwater level trend summary

Swamp	Monitoring ID	Site type as per SMP	Mined status	Comment
Tristar	TS1	Reference	NA	Shows a subdued and delayed response to daily CRD. Large increase in groundwater levels in March, September, and November due to rainfall events. Shows an increasing trend from March.
	TS2			Shows a subdued and delayed response to daily CRD with an overall increasing trend from August.
	TS3			Stable – fluctuating with daily CRD
East Wolgan	WE1	Impact	Adjacent LW411	Responded to rainfall events with short peaks in groundwater levels but was dry between events. Large increase in groundwater level in March due to rainfall. Jump in groundwater level from October is due to adjusting barometric correction.
	WE2			Mostly dry but briefly responded to rainfall events in March, August and November with short peaks in groundwater levels. Jump in groundwater level from October is due to adjusting barometric correction.
Sunnyside West	SW1	Impact	LW413B/414	Trending with daily CRD. Increasing trend from June
Sunnyside	SS1	Impact	NA	Stable – consistent with historical observations
	SS2			Stable – consistent with historical observations
	SS3			Stable – consistent with historical observations. Logger battery depleted in September and needs replacement.
	SS4			Stable – consistent with historical observations. Logger battery depleted in April and replaced in October.
	SS5			Stable – consistent with historical observations
Sunnyside East	SSE1	Impact	LW417	Damaged by bushfire – decommissioned
	SSE2			Mostly dry – response to rainfall in March with a short sharp rise in groundwater level
	SSE3			Mostly dry – showed a very minor response to rainfall in November
Carne West	CW1	Impact	LW419	Mostly dry - showed a very minor response to rainfall in March
	CW2			Mostly dry – response to rainfall in March with a short sharp rise in groundwater level
	CW3		LW417	Mostly dry – response to rainfall in March with a large sharp rise in groundwater level which slowly receded over 1 month
	CW4			Mostly dry – response to rainfall in March with a short sharp rise in groundwater level
Junction	JS1	Impact	LW408	Piezometer damaged by road grading in February – decommissioned
	JS2			Trending with daily CRD. Increasing trend from March
	JS3			Trending with daily CRD. Increasing trend from March

Table 4.2 Swamp piezometer groundwater level trend summary

Swamp	Monitoring ID	Site type as per SMP	Mined status	Comment
Gang Gang West	GW1	Impact	LW420	Responded to rainfall events in February, March, May, August, November and December with sharp rises in groundwater levels that receded over days to weeks depending on the intensity of the rainfall event. Between rainfall events up to November the piezometer was dry. From November to mid-December, the piezometers sustained a groundwater level due to consistent rainfall.
	GW2			Damaged by bushfire – decommissioned
	GW3			Responded to rainfall events in February, March, August and November with sharp rises in groundwater levels that quickly receded over several days depending on the intensity of the rainfall event.
	GW4			Responded to rainfall events in February, March, November and December with sharp rises in groundwater levels that slowly receded over days to weeks depending on the intensity of the rainfall event. Between rainfall events between January to November the piezometer was dry. From November onwards, the piezometer has sustained a groundwater level due to consistent rainfall.
Gang Gang	GG1	Impact	LW420	The piezometer has trended with rainfall. Groundwater levels rise quickly following rainfall and slowly recede over several weeks. Shows a sustained groundwater level from March due to consistent rainfall during 2021 but the trend is not consistent with historical pre-mining observations.
	GG2			Responded to rainfall events in February, March, August and November with sharp rises in groundwater levels that quickly receded over several days.
	GG3			Shows a similar trend to GG1 but was dry between rainfall events in January, February, March, May, July, August, and October. Groundwater levels rise quickly following rainfall and slowly recede over several weeks. Shows a sustained groundwater level since November due to consistent rainfall but the trend is not consistent with historical pre-mining observations.
Pine	BS2	Impact	LW425	Responded to rainfall events in January, February, March and May with sharp rises in groundwater level. The rainfall event in March shows the groundwater level slowly receding over approximately 2.5 months. The piezometer remained dry from June to December.
	BS3			Stable – consistent with historical observations
	BS4 (PSS)			Stable – consistent with historical observations
Nine Mile	BS1	Impact	NA	Stable – shows a gradual increasing trend
	BS5 (NMSS)			Trending with daily CRD. Shows an increasing trend from January to December.
Marrangaroo	MS1	Impact	NA	Stable – some data gaps due to improper replacement of the level logger following quality monitoring events.
	MS2			Stable – fluctuating with daily CRD. Some data gaps due to improper replacement of the level logger following quality monitoring events.
	MS3			Stable – some data gaps due to improper replacement of the level logger following quality monitoring events.

Table 4.2 Swamp piezometer groundwater level trend summary

Swamp	Monitoring ID	Site type as per SMP	Mined status	Comment
Lost City	LCS1	Impact	NA	Gradual declining trend since installation. Sudden drop in groundwater level in October due to placement of the logger following the October monitoring event.
	LCS2			Stable
	LC1			Stable - Sudden drop in groundwater level in September due to placement of the logger following the September monitoring event
	LCN1			Stable – Fluctuating with daily CRD
Paddys Creek	PC1	Impact	NA	Stable – fluctuating with rainfall
	PC2			Stable – fluctuating with rainfall

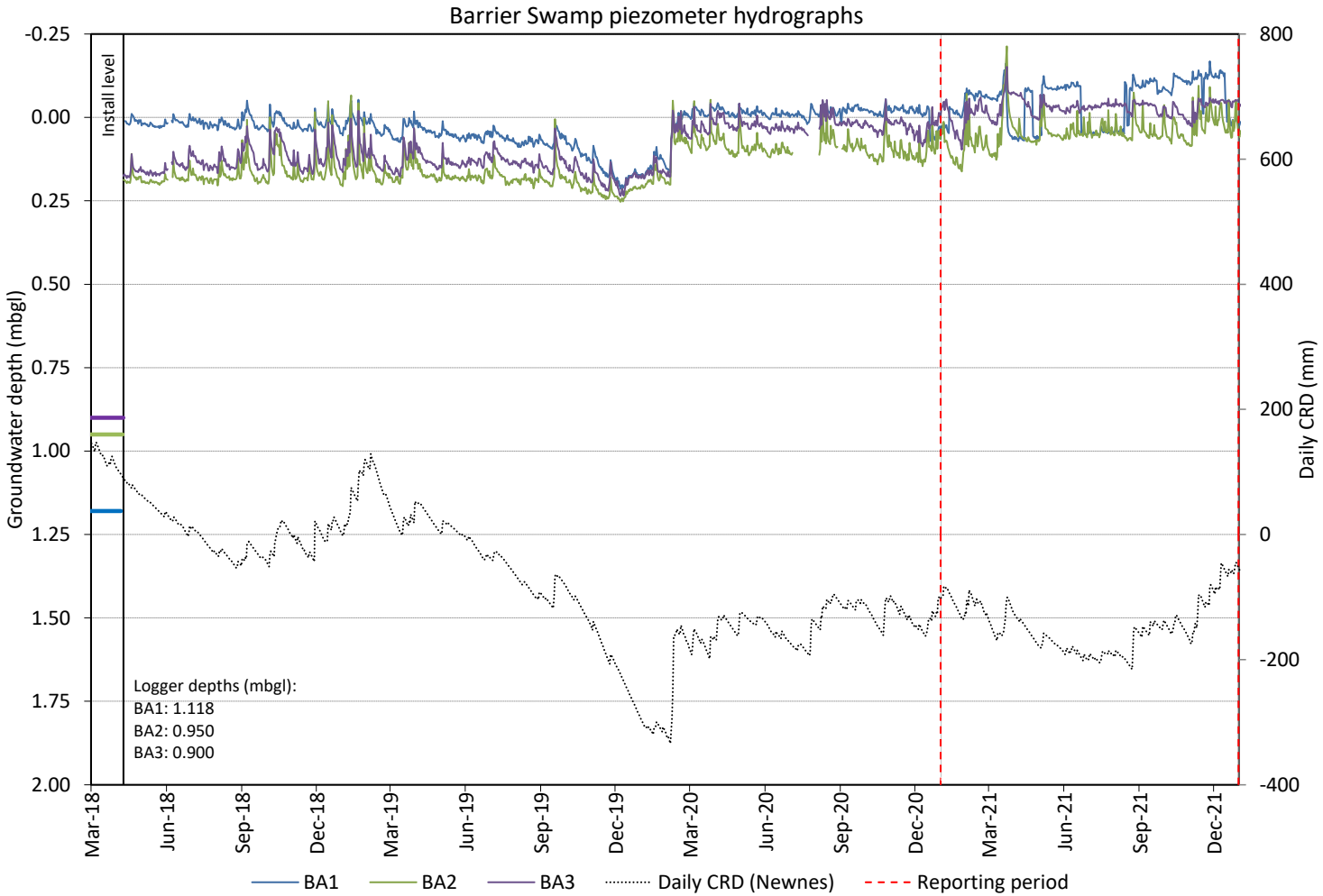


Figure 4.1 **Barrier Swamp hydrograph**

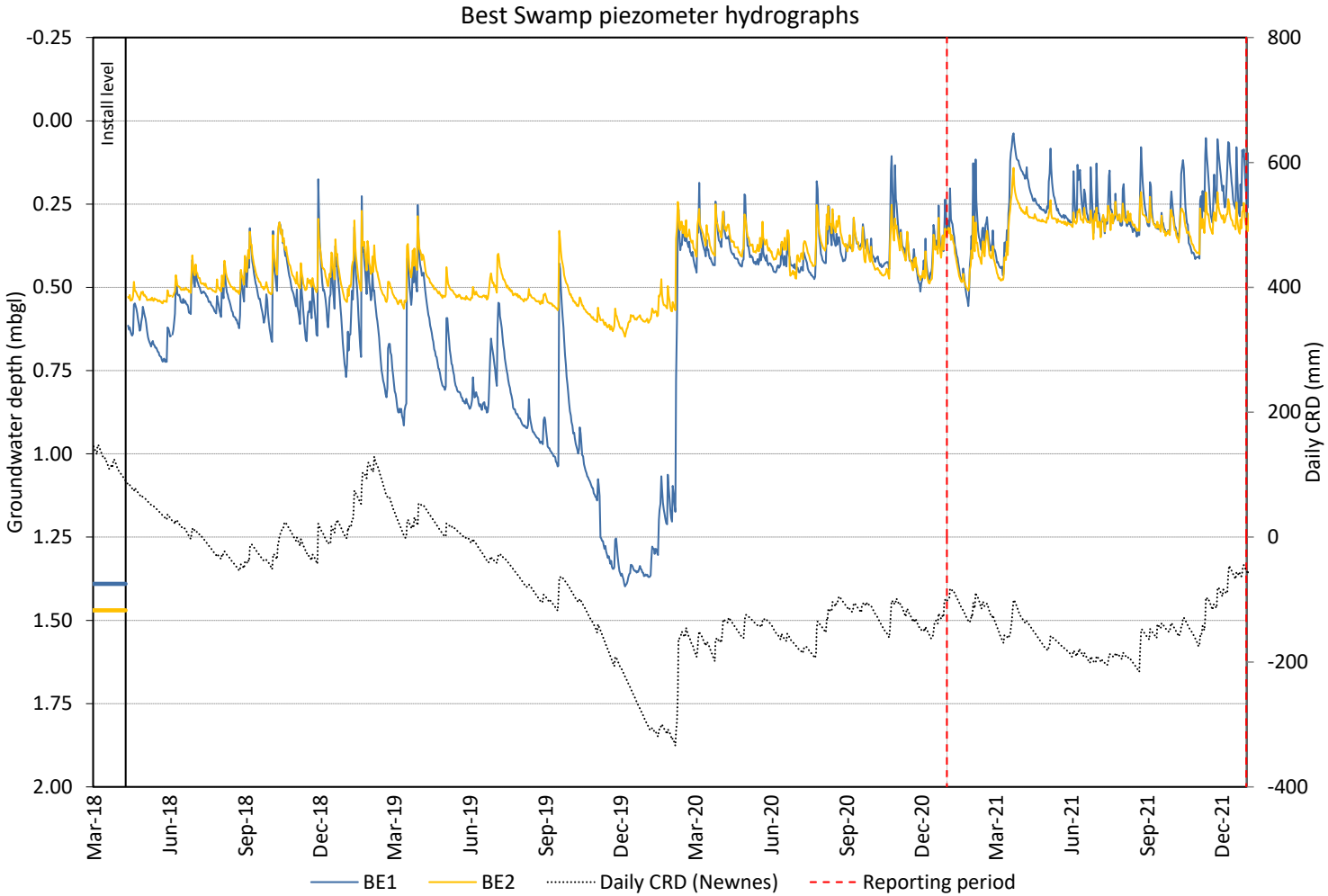


Figure 4.2 **Best Swamp hydrograph**

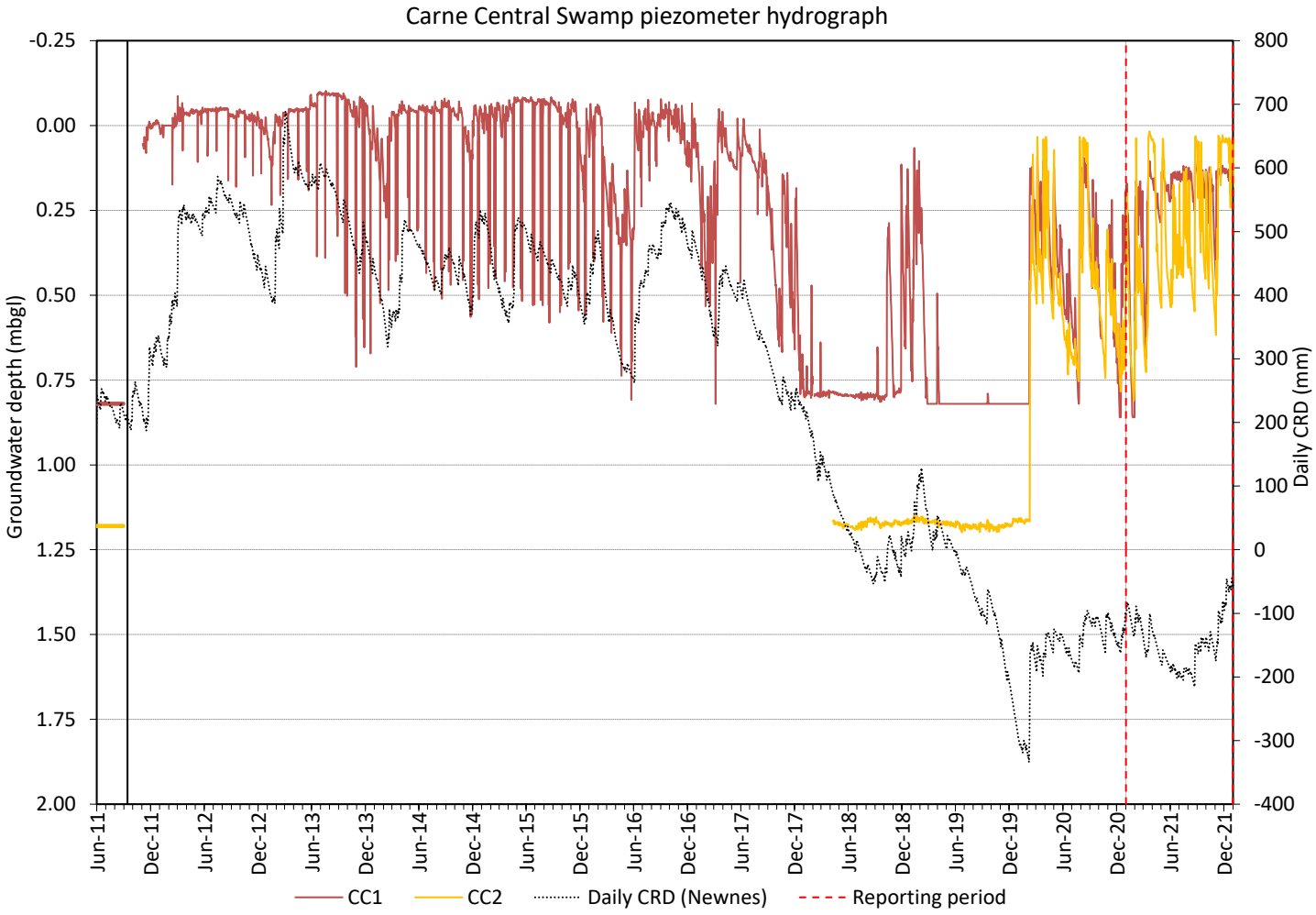


Figure 4.3 Carne Central Swamp hydrograph

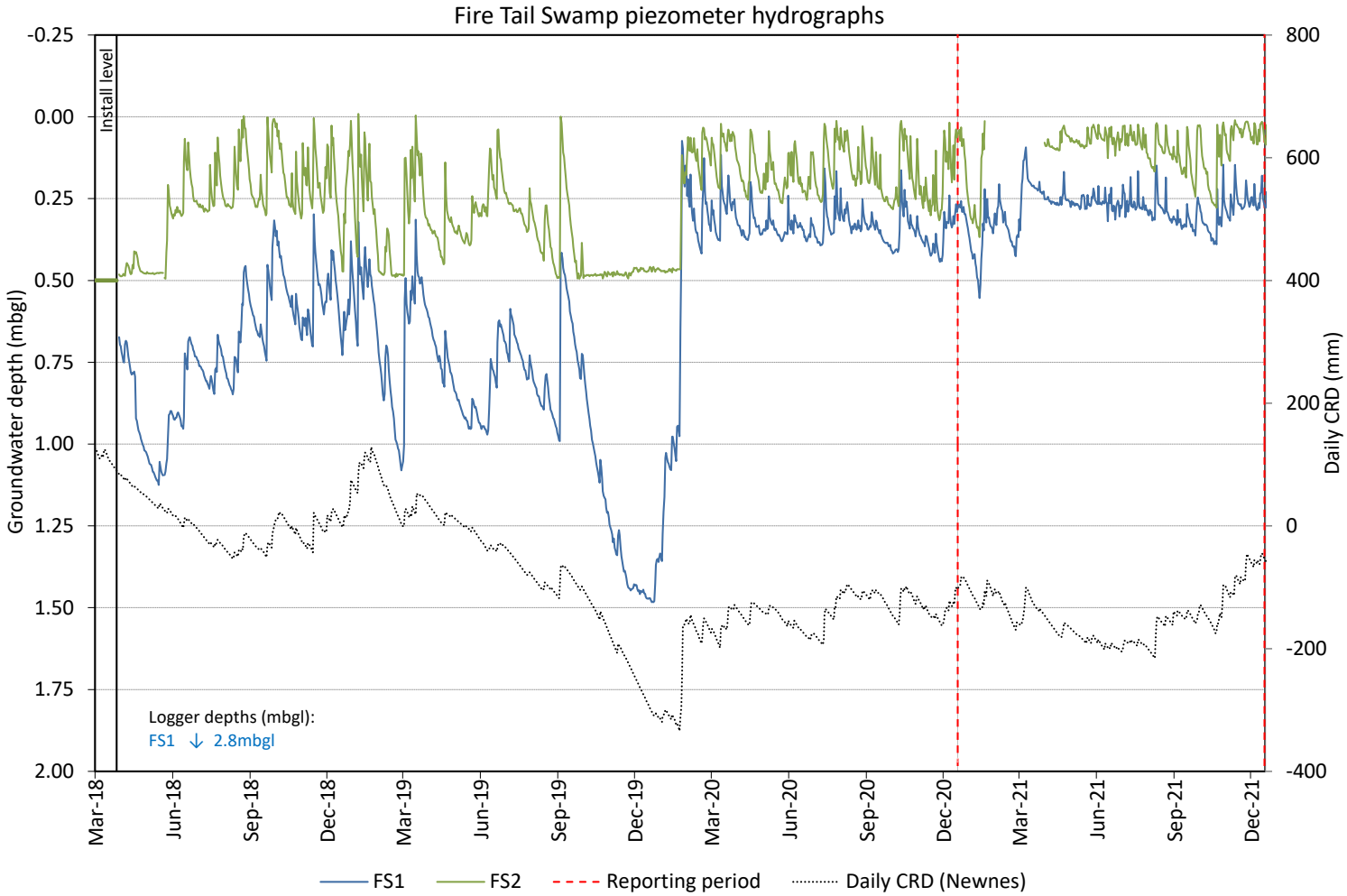


Figure 4.4 Fire Tail Swamp hydrogaph

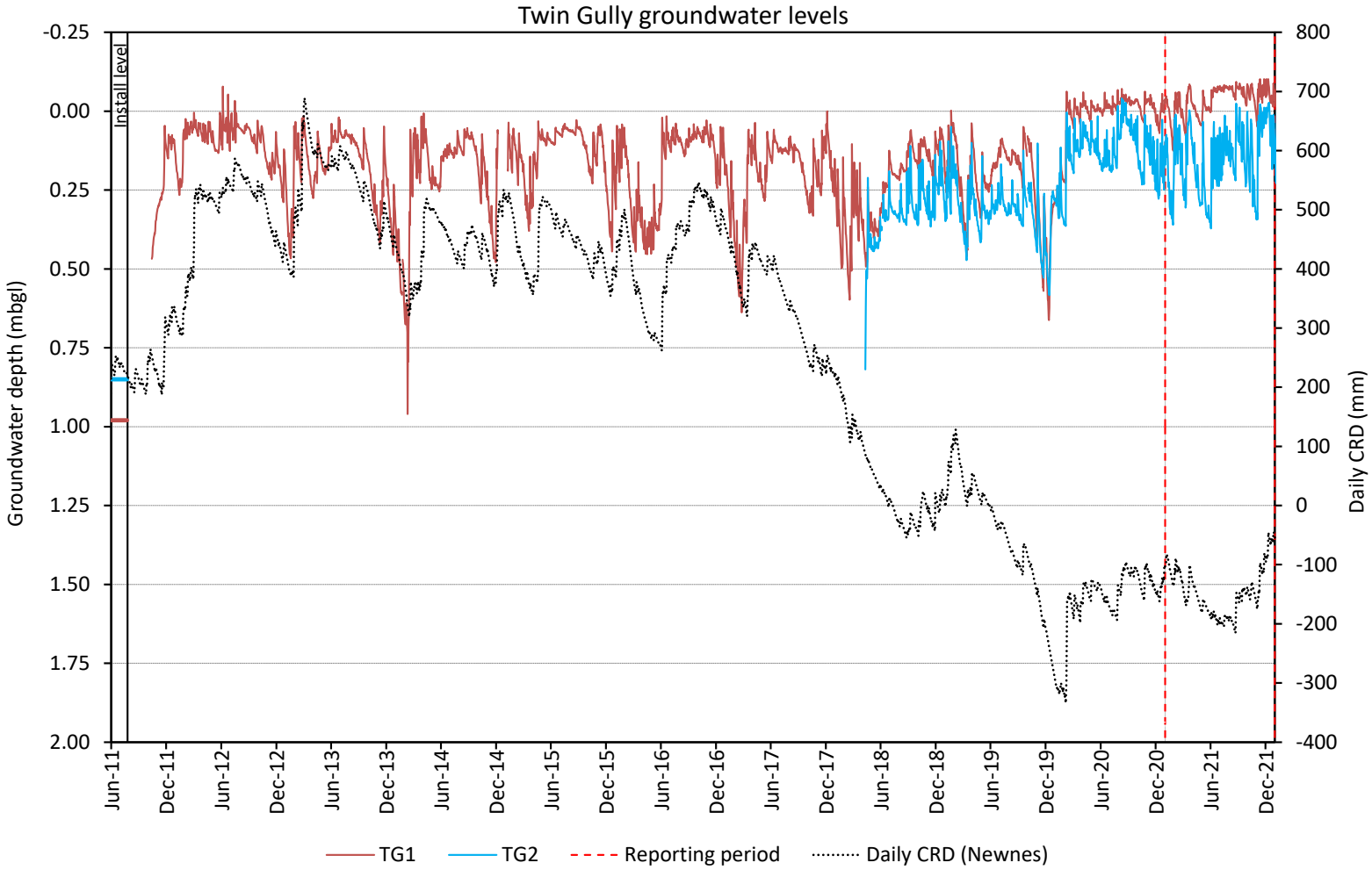


Figure 4.5 **Twin Gully Swamp hydrograph**

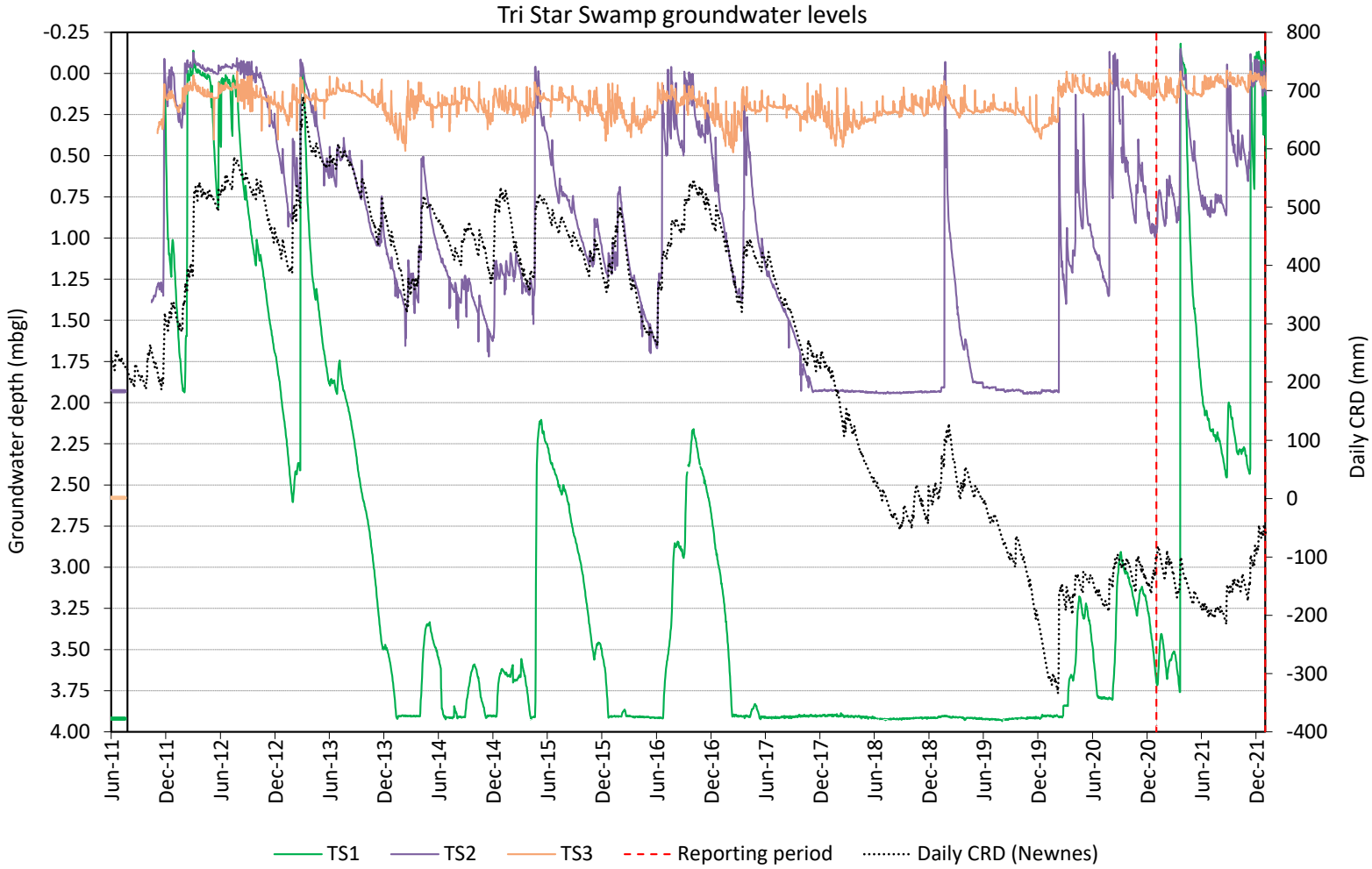


Figure 4.6 **Tristar Swamp hydrograph**

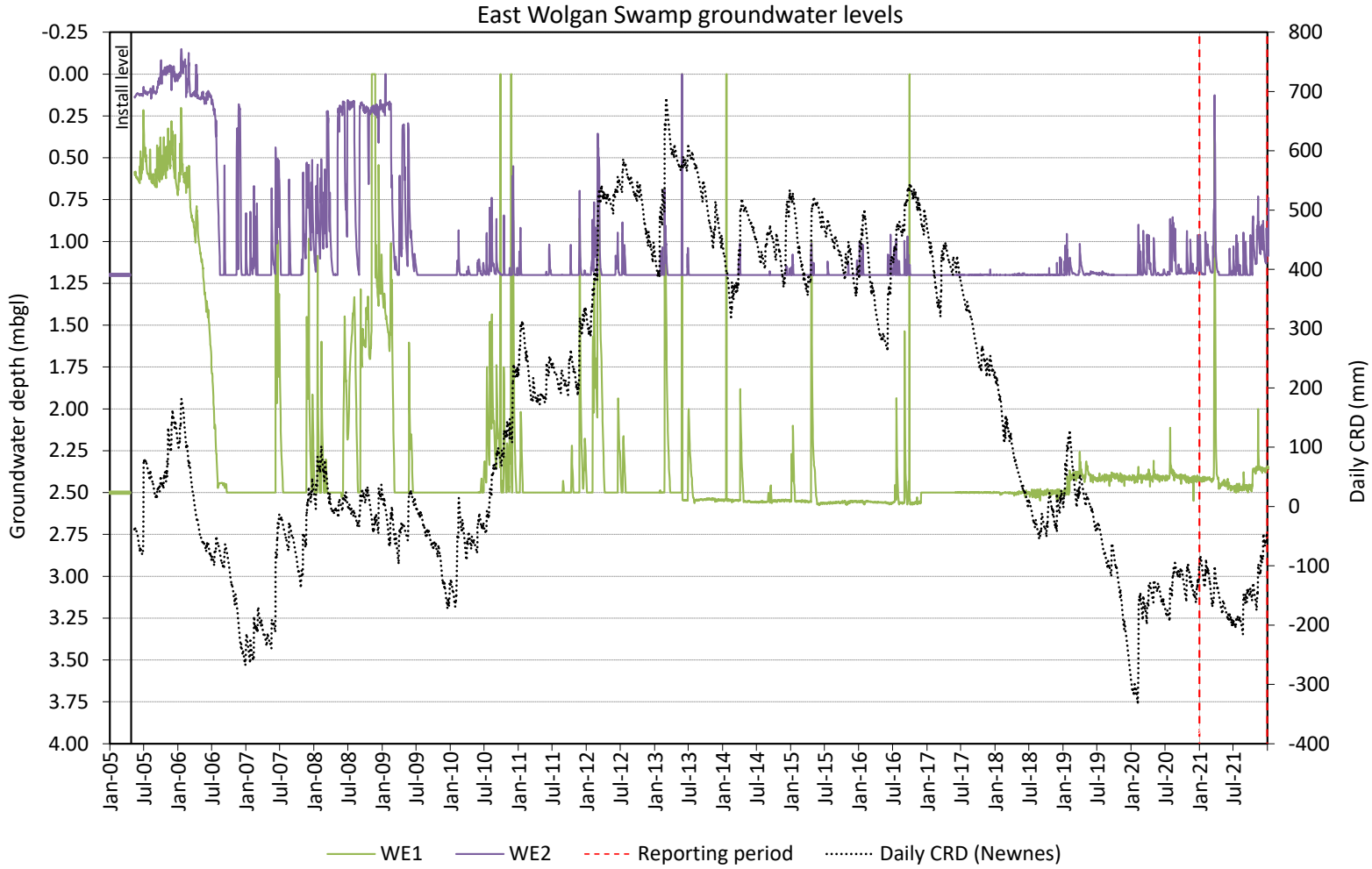


Figure 4.7 **East Wolgan Swamp hydrograph**

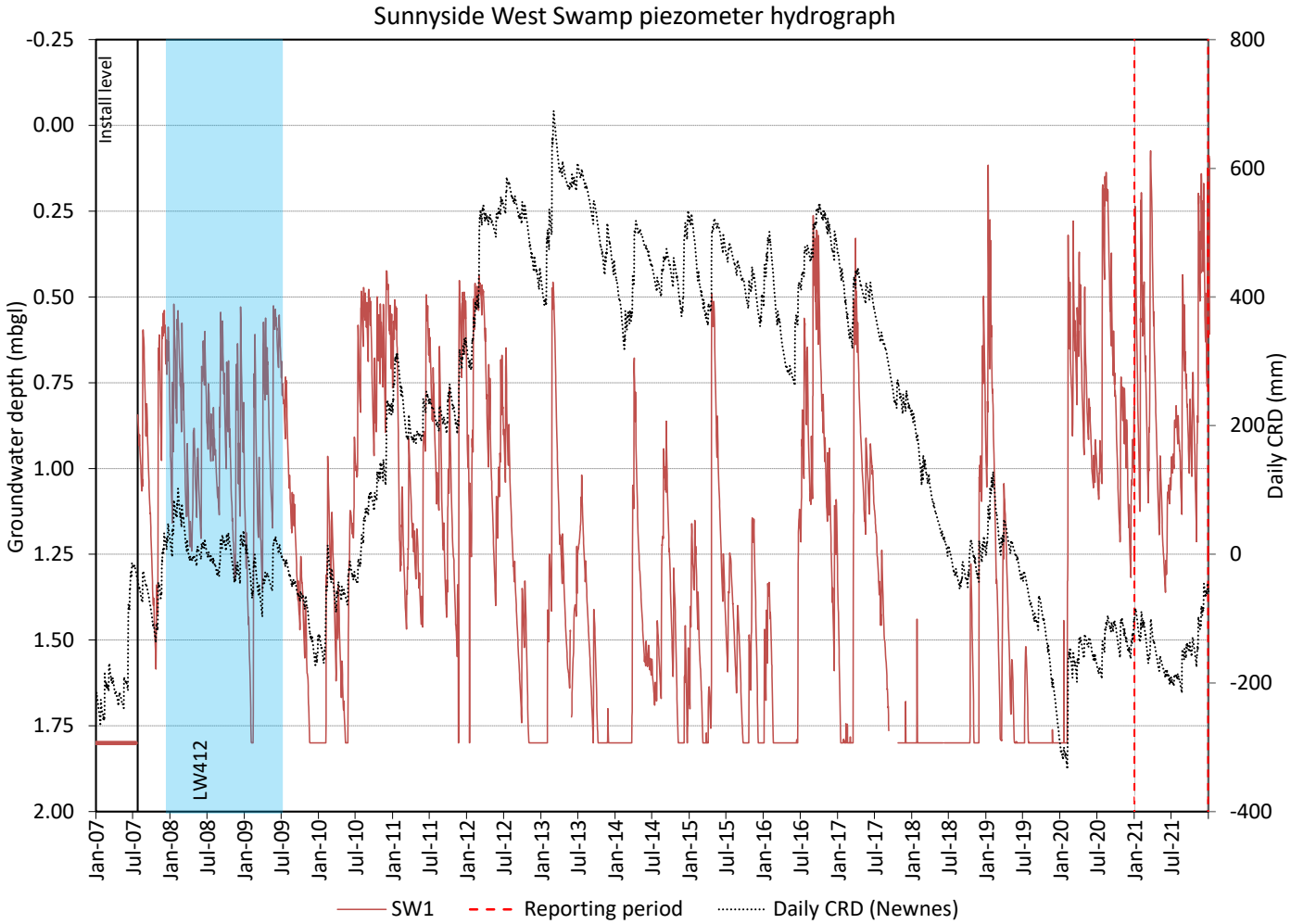


Figure 4.8 Sunnyside West Swamp hydrograph

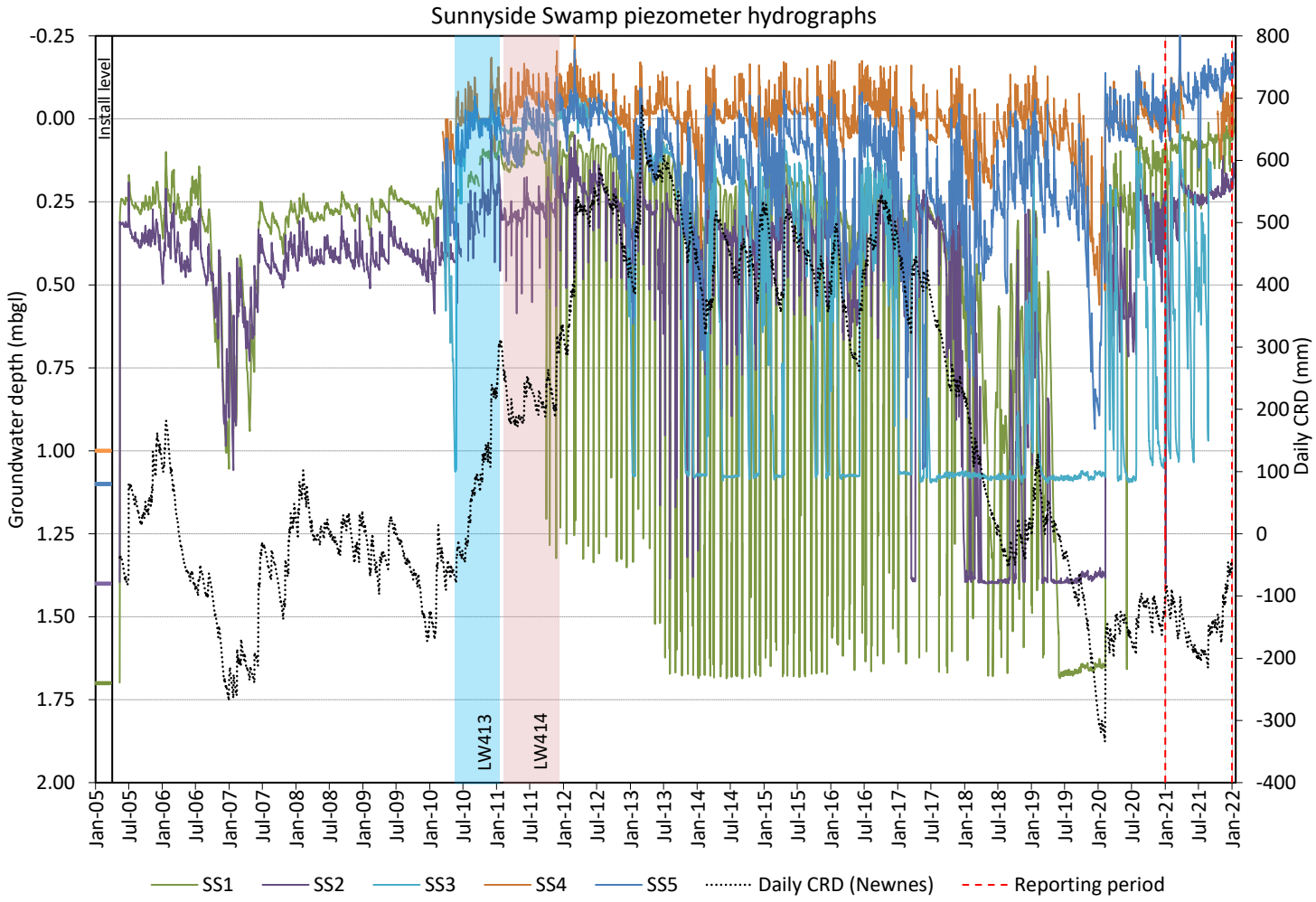


Figure 4.9 Sunnyside Swamp hydrograph

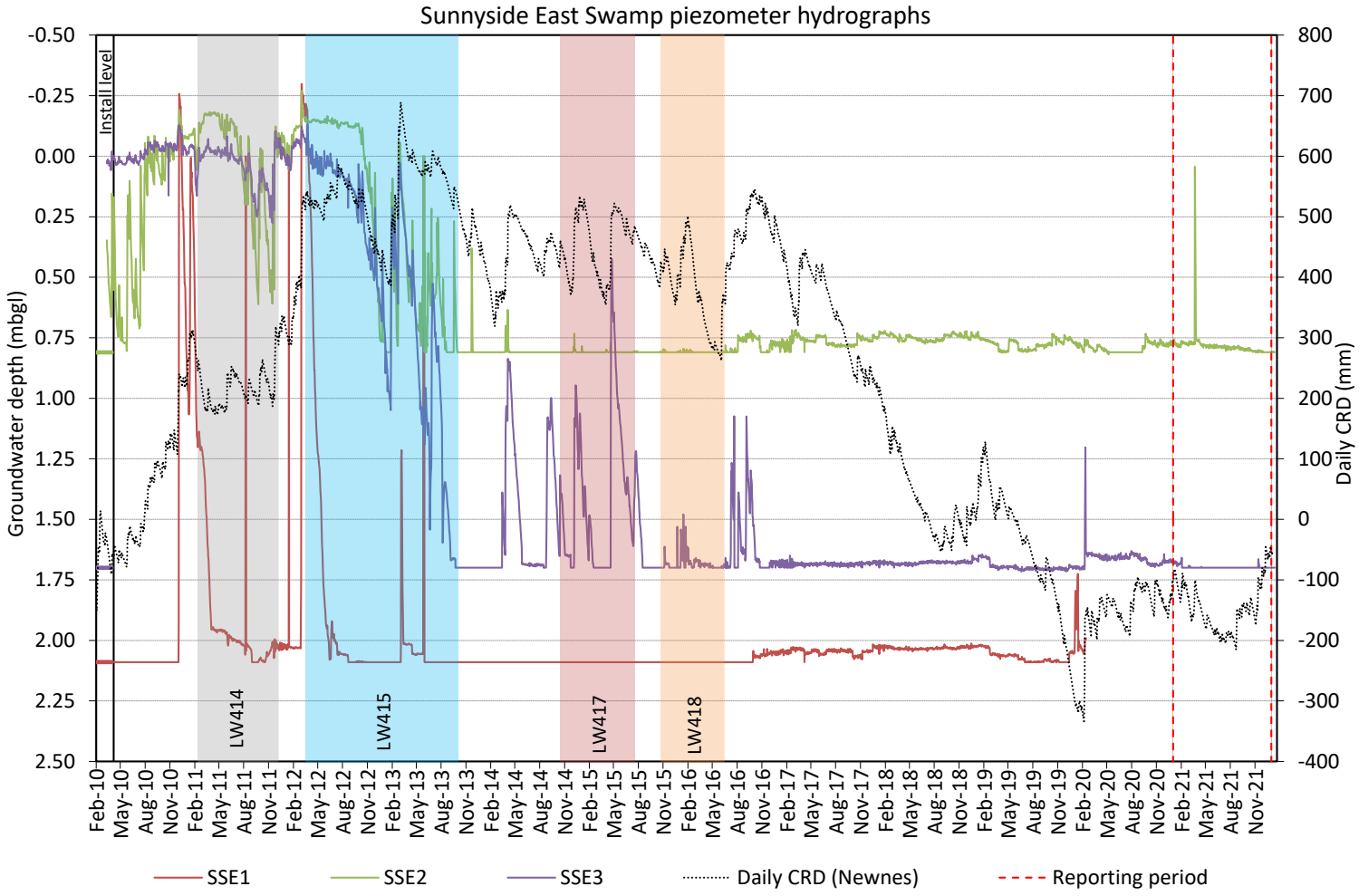


Figure 4.10 **Sunnyside East Swamp hydrograph**

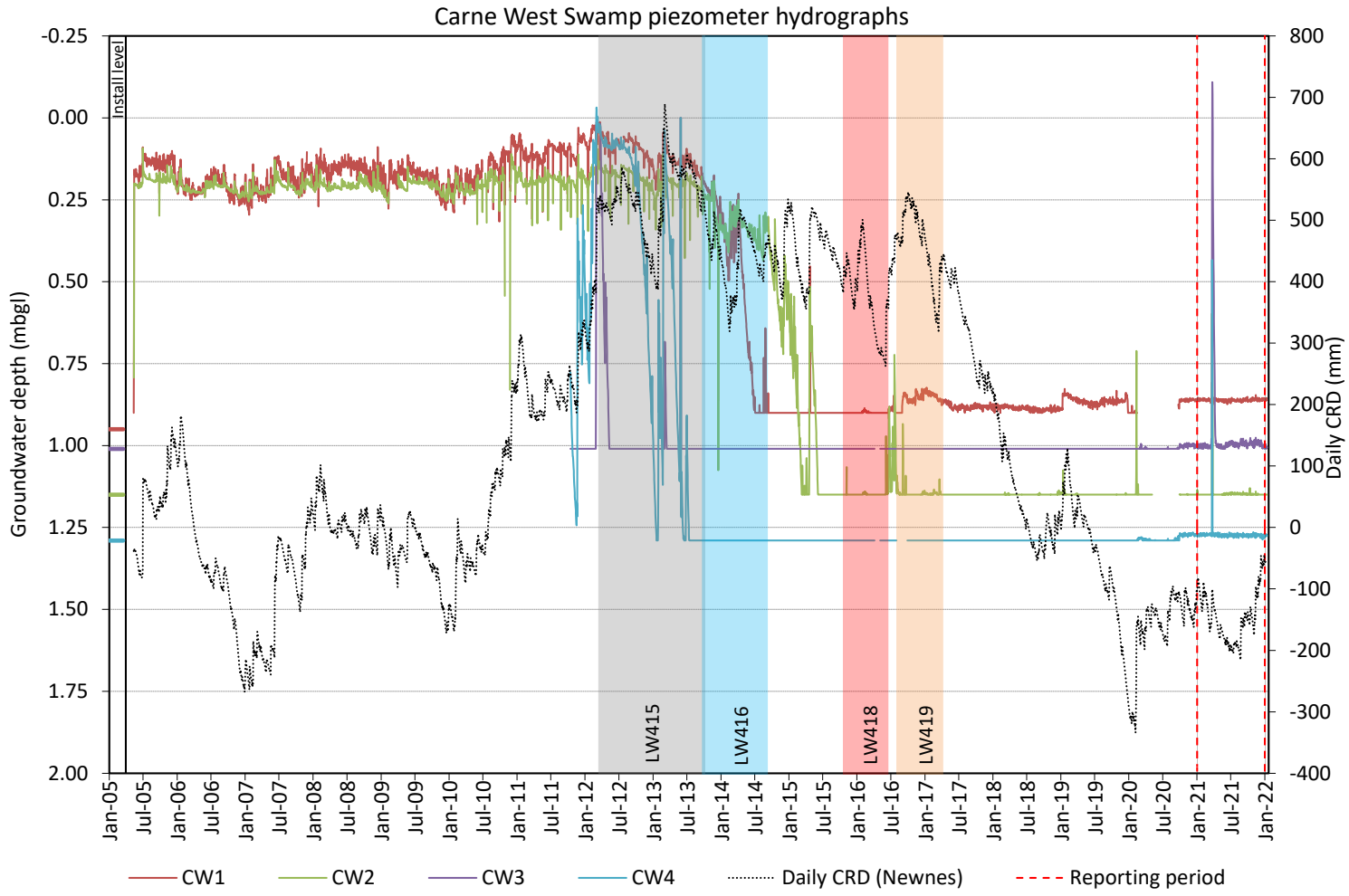


Figure 4.11 Carne West Swamp hydrograph

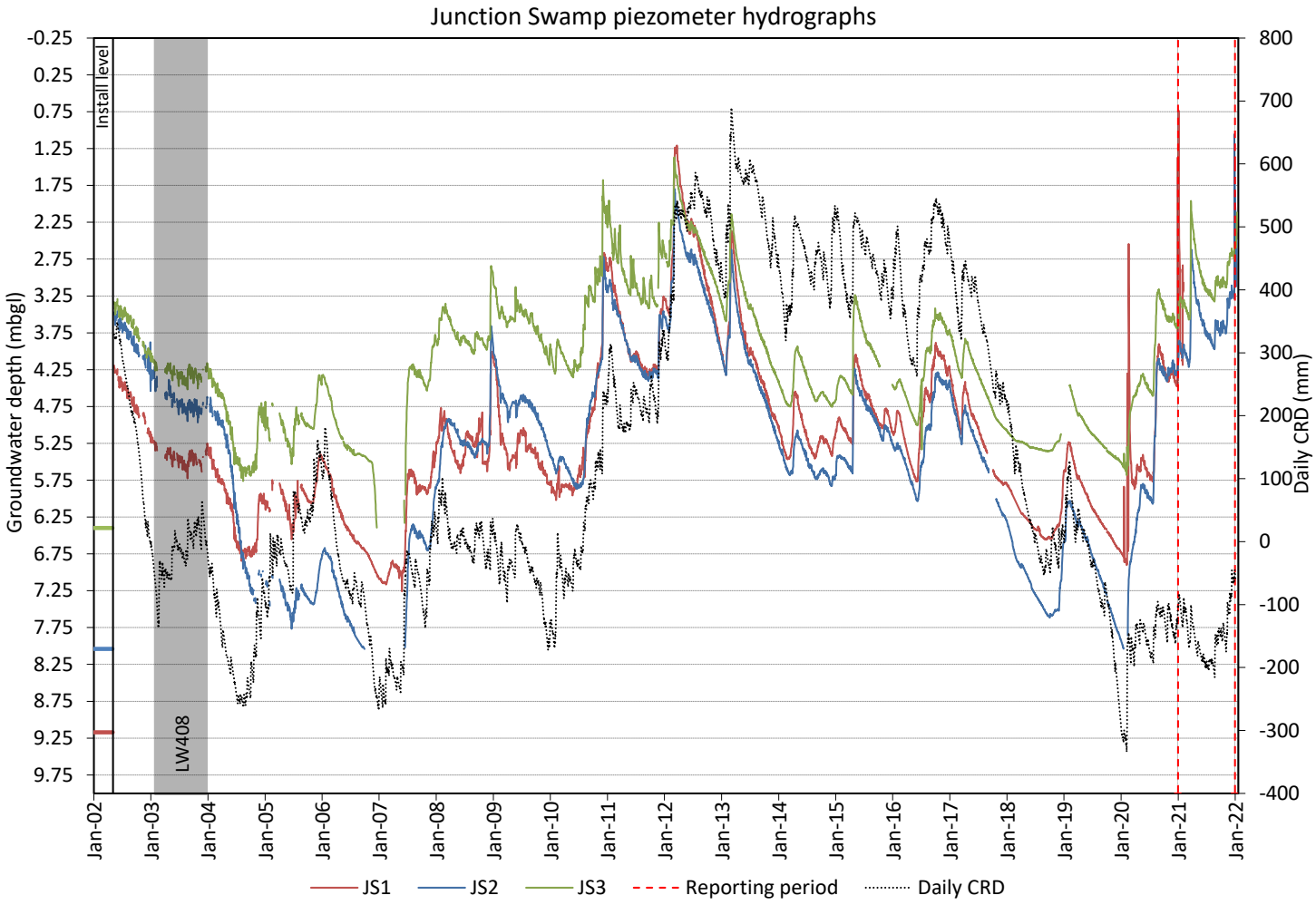


Figure 4.12 Junction Swamp hydrograph

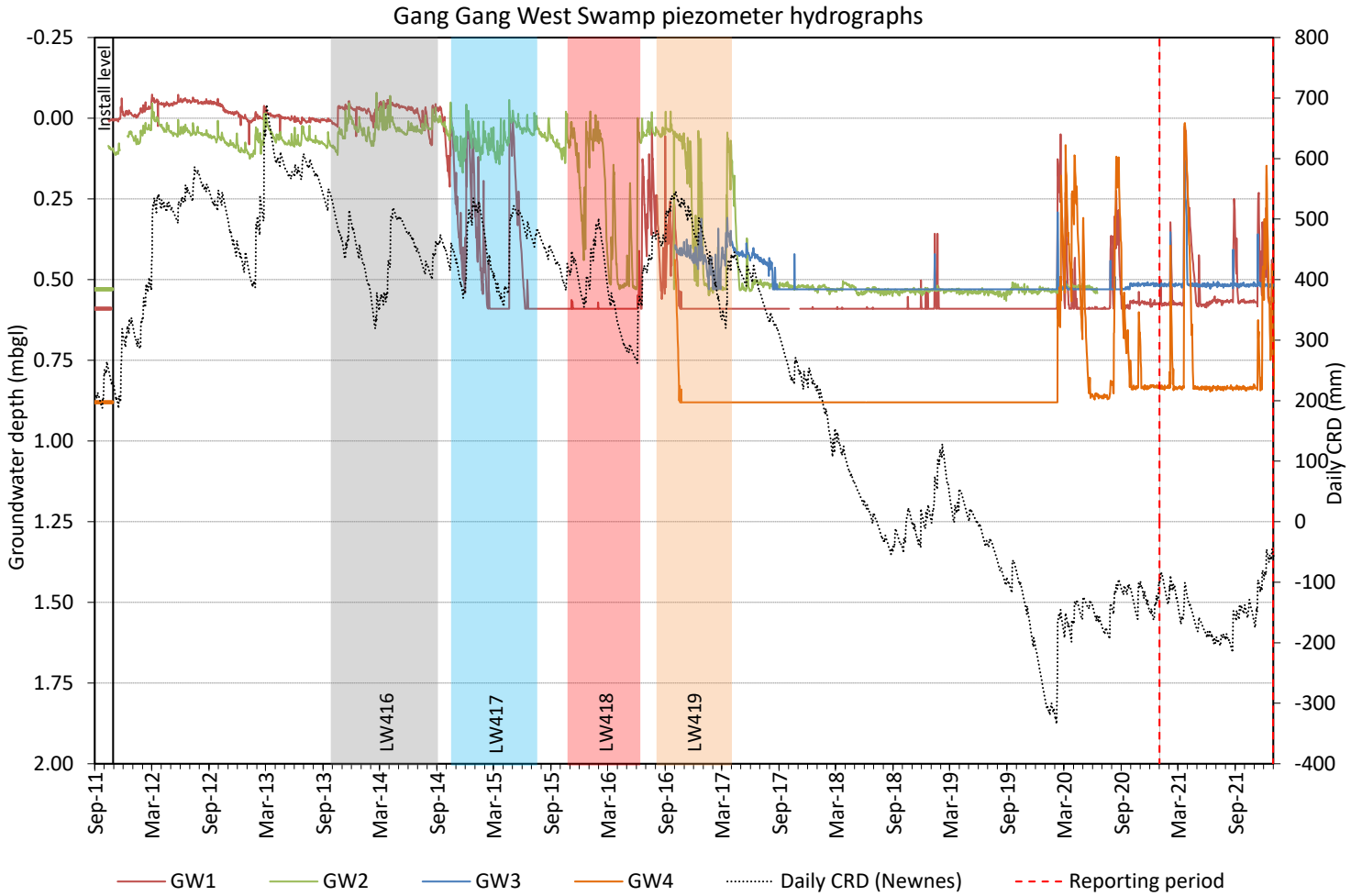


Figure 4.13 **Gang Gang West Swamp hydrograph**

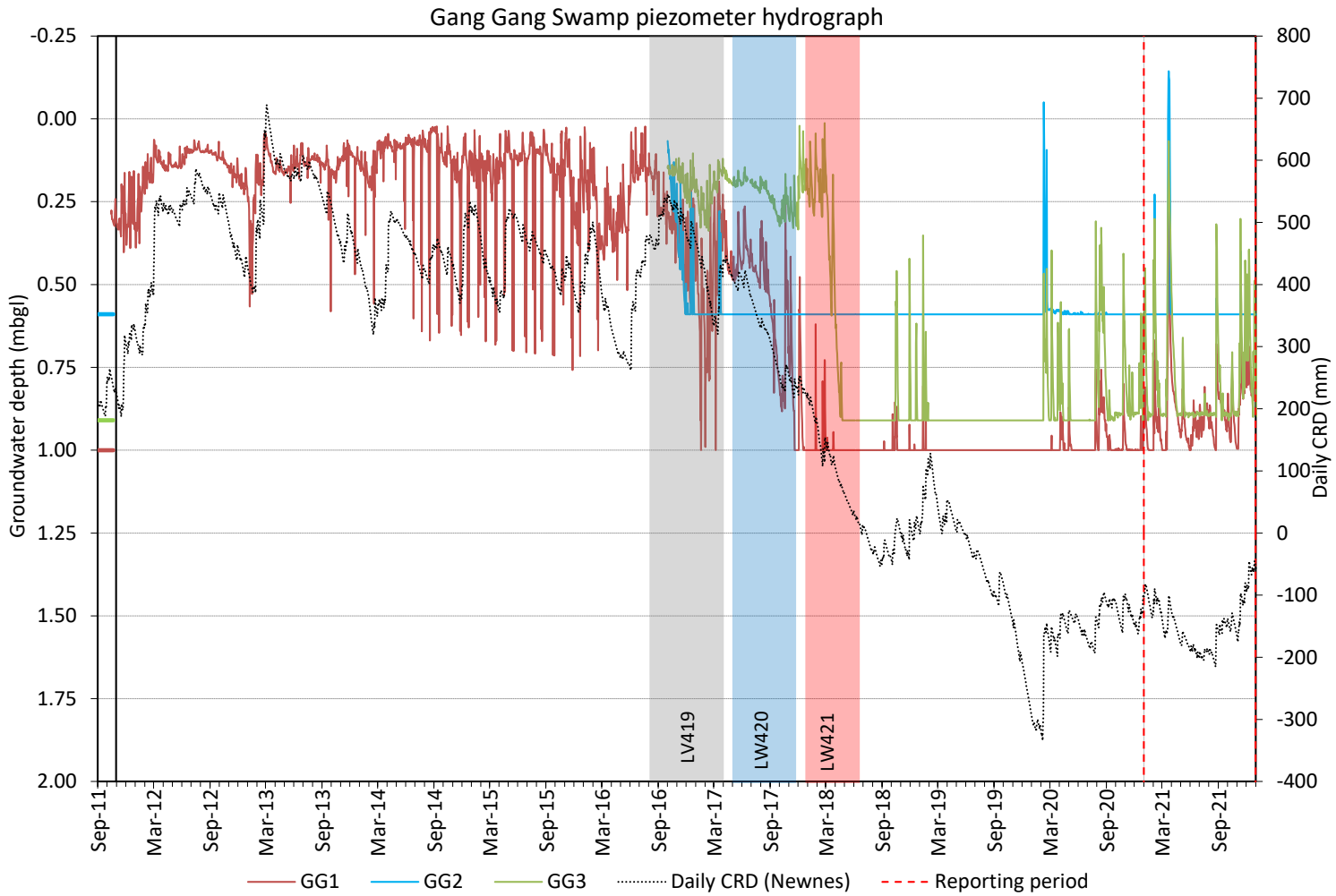


Figure 4.14 Gang Gang Swamp hydrograph

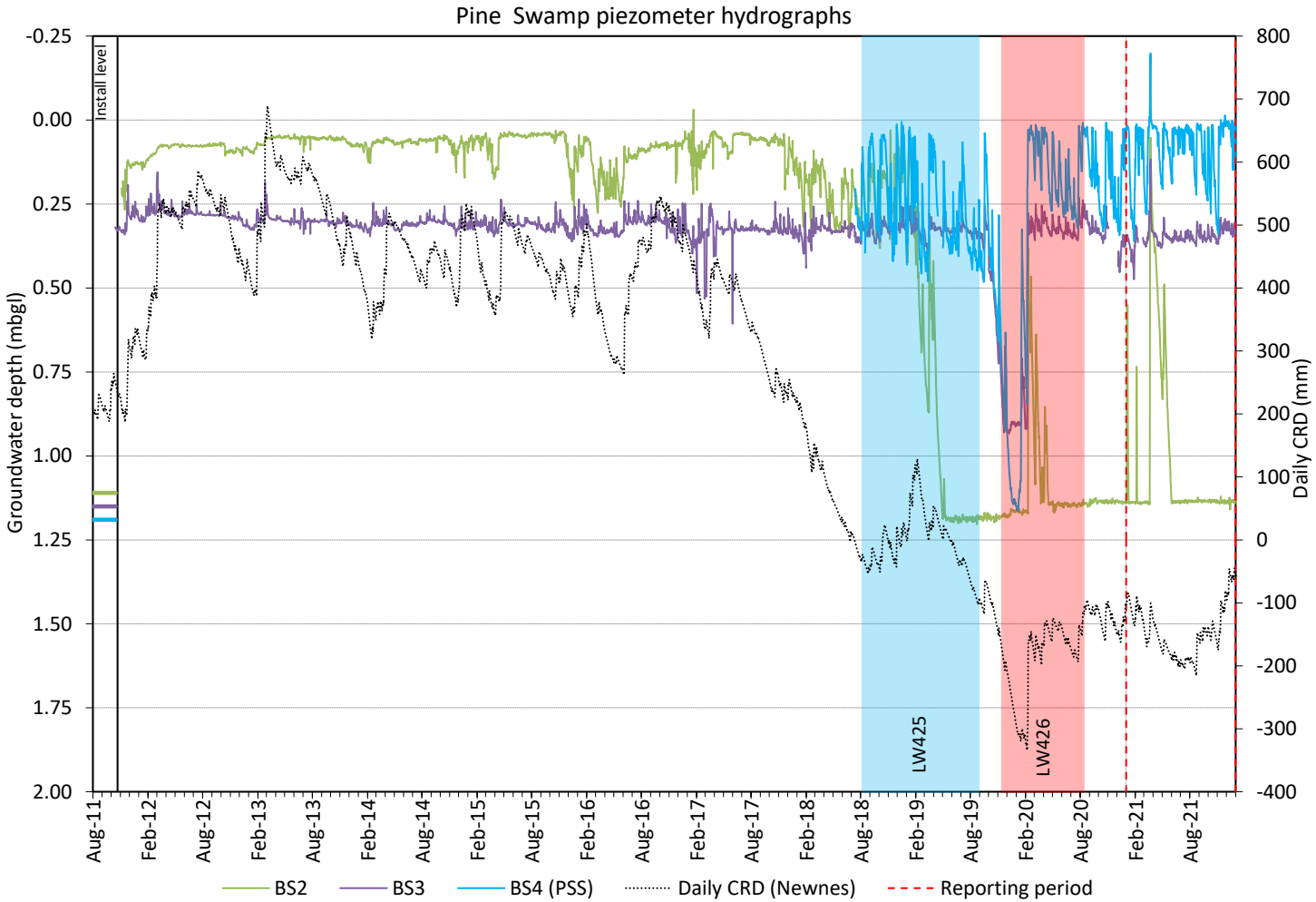


Figure 4.15 Pine Swamp hydrograph

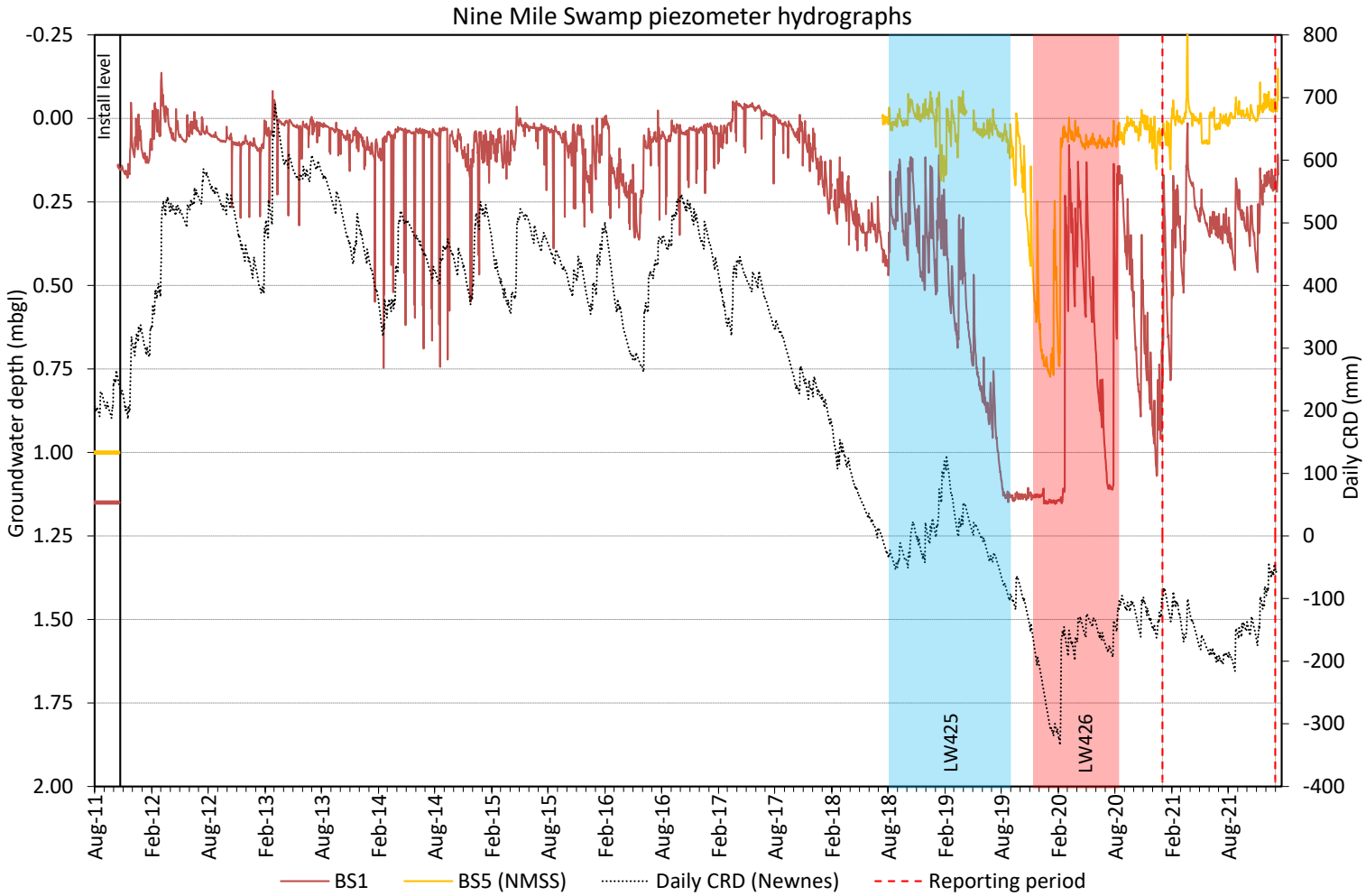


Figure 4.16 Nine Mile Swamp hydrographs

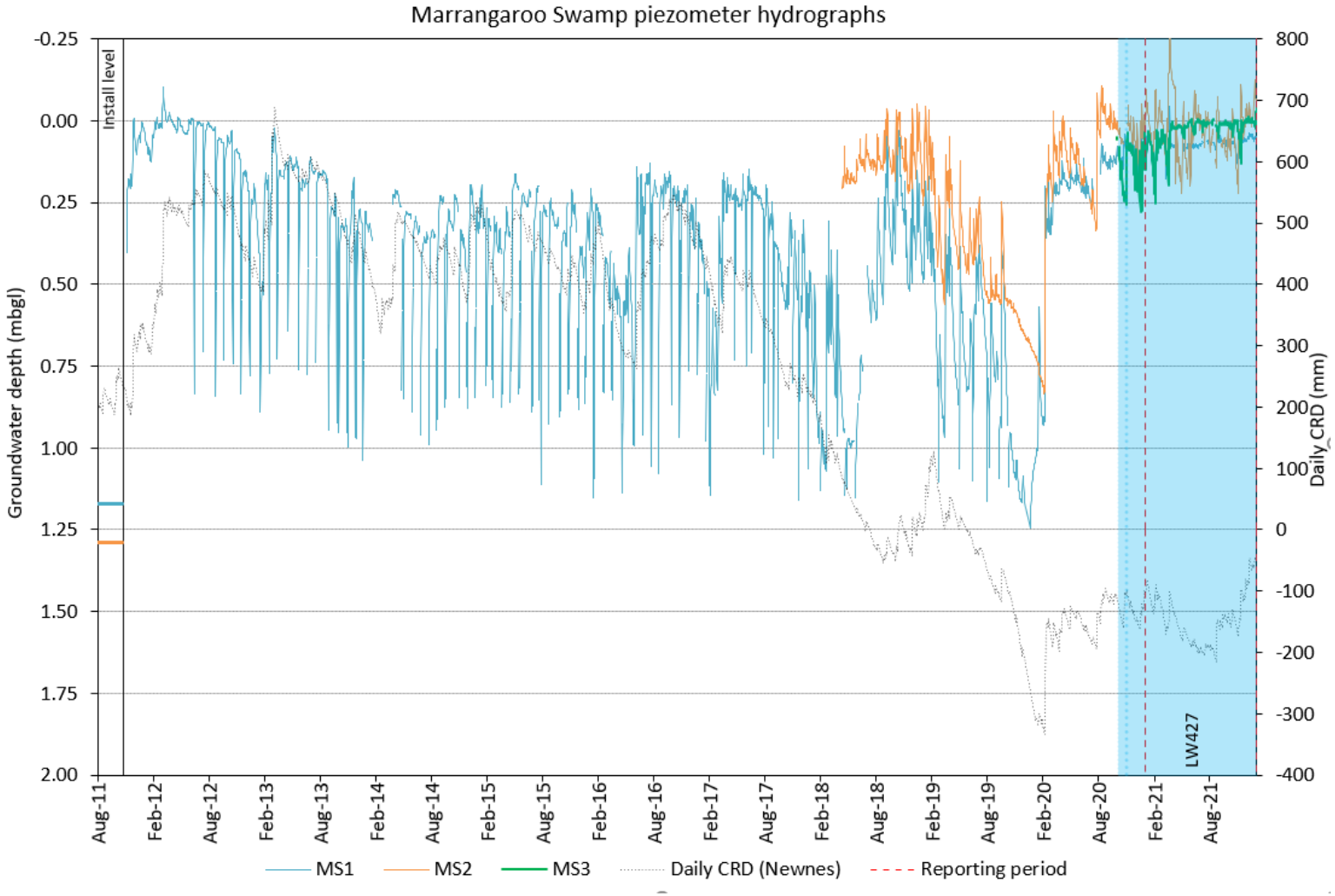


Figure 4.17 Marrangaroo Swamp hydrograph

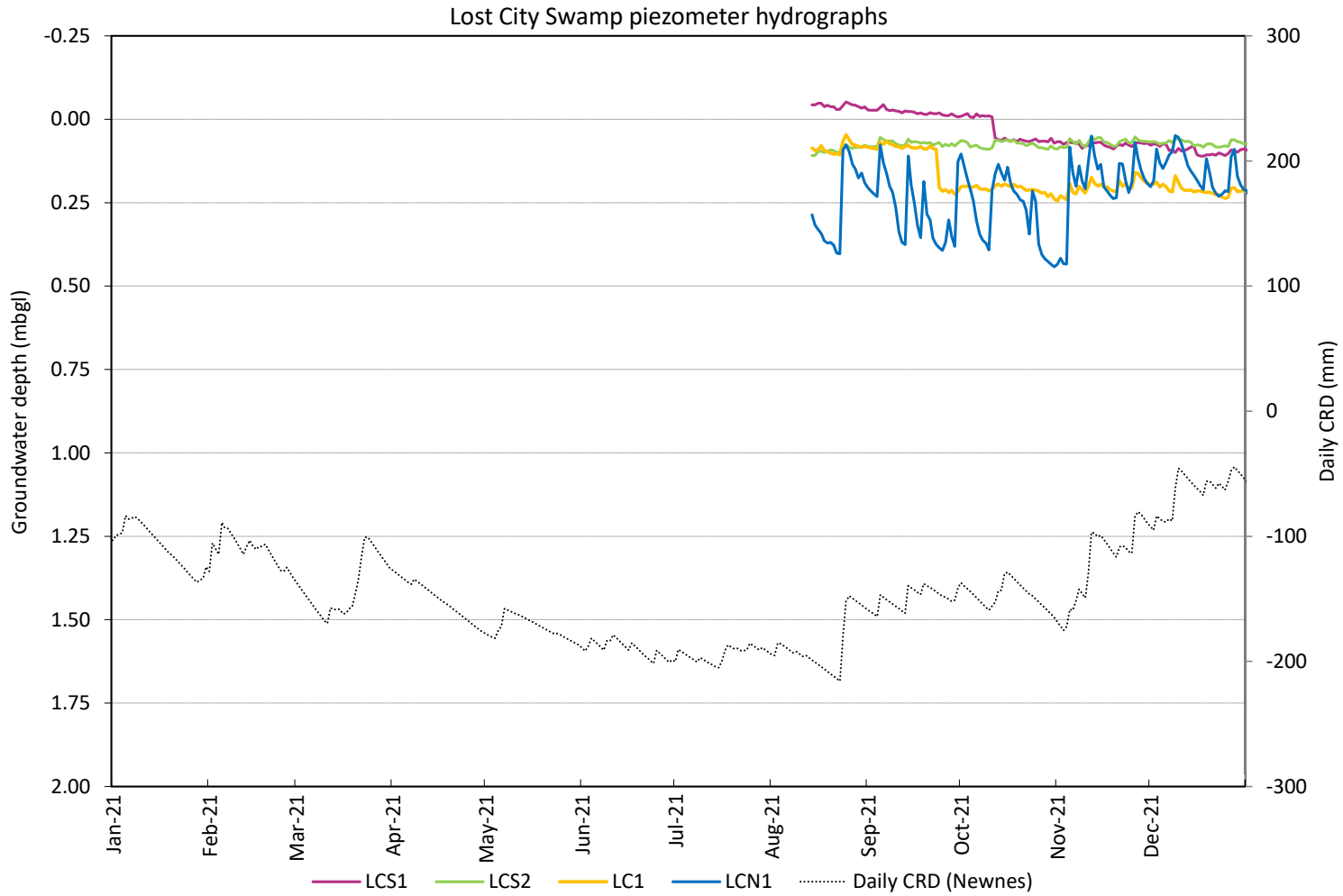


Figure 4.18 Lost City Swamp hydrographs

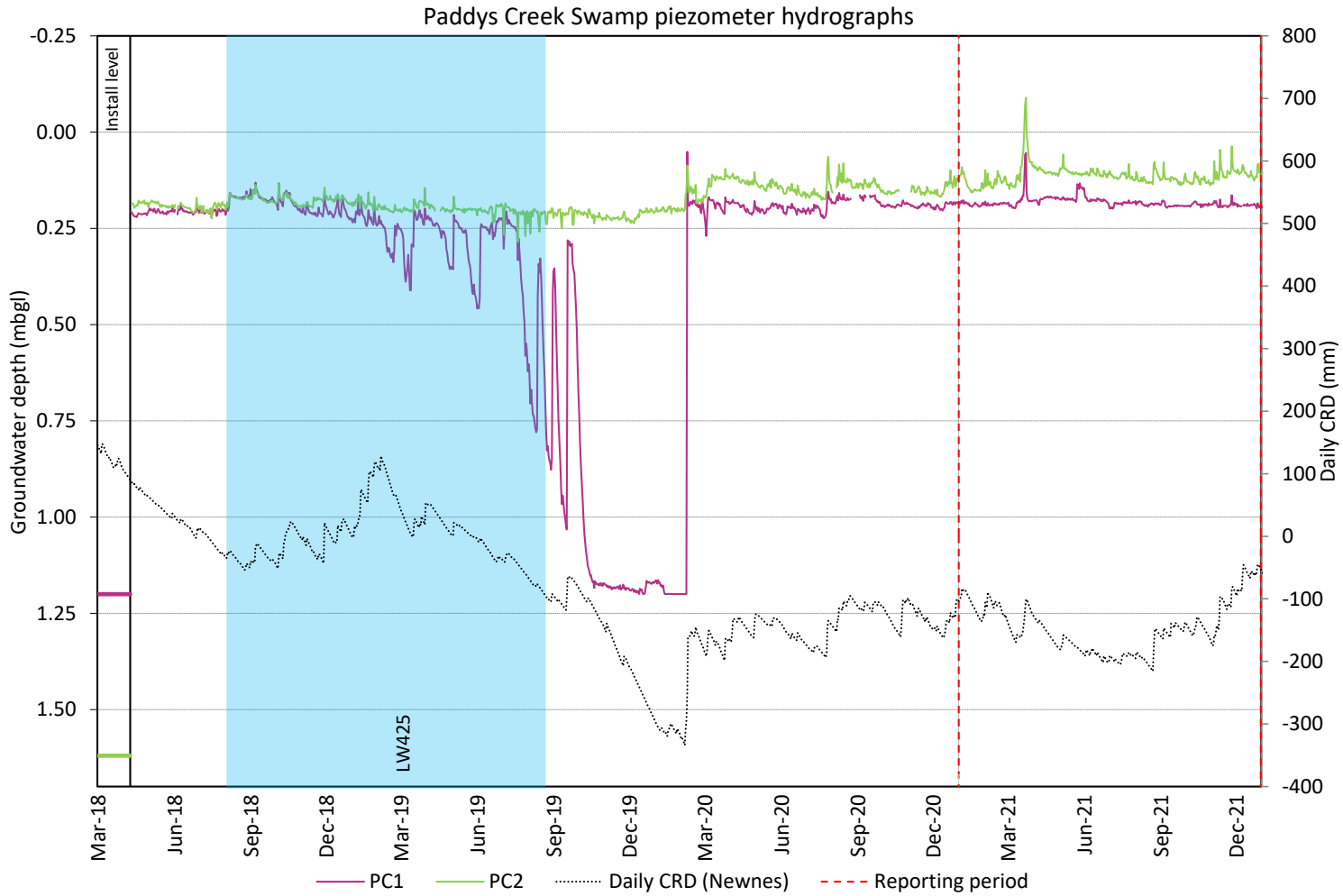


Figure 4.19 Paddys Creek hydrograph

4.2 Perched groundwater system

Groundwater level triggers have not been developed for perched piezometers due to insufficient pre-mining baseline data.

Hydrographs for reference and impact swamp piezometers are shown in Figure 4.20. Comments on groundwater level trends during the reporting period are shown on Table 4.3.

Table 4.3 Perched piezometer groundwater level trend summary

Monitoring ID	Associated Swamp	Site type	Comment
SPR1601	Carne West	Impact	Stable – fluctuating with intense rainfall events
SPR1602	Gang Gang West	Impact	Stable – subdued response to daily CRD
SPR1603	Gang Gang	Impact	Stable – slight increasing trend consistent with daily CRD
SPR1604	Carne Central	Impact	Stable – increasing trend from January to December
SPR1605	Pine/Nine Mile	Impact	Stable – slight increasing trend from January to December
SPR1606	Paddys Creek	Impact	Stable – slight increasing trend from January to December
SPR1607	Marrangaroo	Impact	Stable – slight increasing trend from January to December
SPR1608	Barrier	Reference	Stable – slight increasing trend from January to December
SPR1609	Tri Star	NA	No piezometer installed
SPR1610	Twin Gully	NA	No piezometer installed
SPR1611	Fire Tail	Reference	Stable – slight increasing trend from January to December
SPR1612	Best	Reference	Stable – slight increasing trend from January to December
SPR1613S	Lost City	NA	Stable
SPR1613D	Lost City	NA	Stable – groundwater level increased following rainfall in November
LCY2101	Lost City	NA	Stable – Slight increasing trend since level logger installation in October
PLM2101	Plum	NA	Fluctuating with daily CRD. Increasing trend since level logger installation in October
PLM2102	Plum	NA	Stable – Slight increasing trend since level logger installation in October
WB12101	Wishbone	NA	Stable – fluctuating with daily CRD
WB12102	Wishbone	NA	Dry
WB32101	Wishbone	NA	Fluctuating with daily CRD. Increasing trend since level logger installation in October
WB32102	Wishbone	NA	Stable

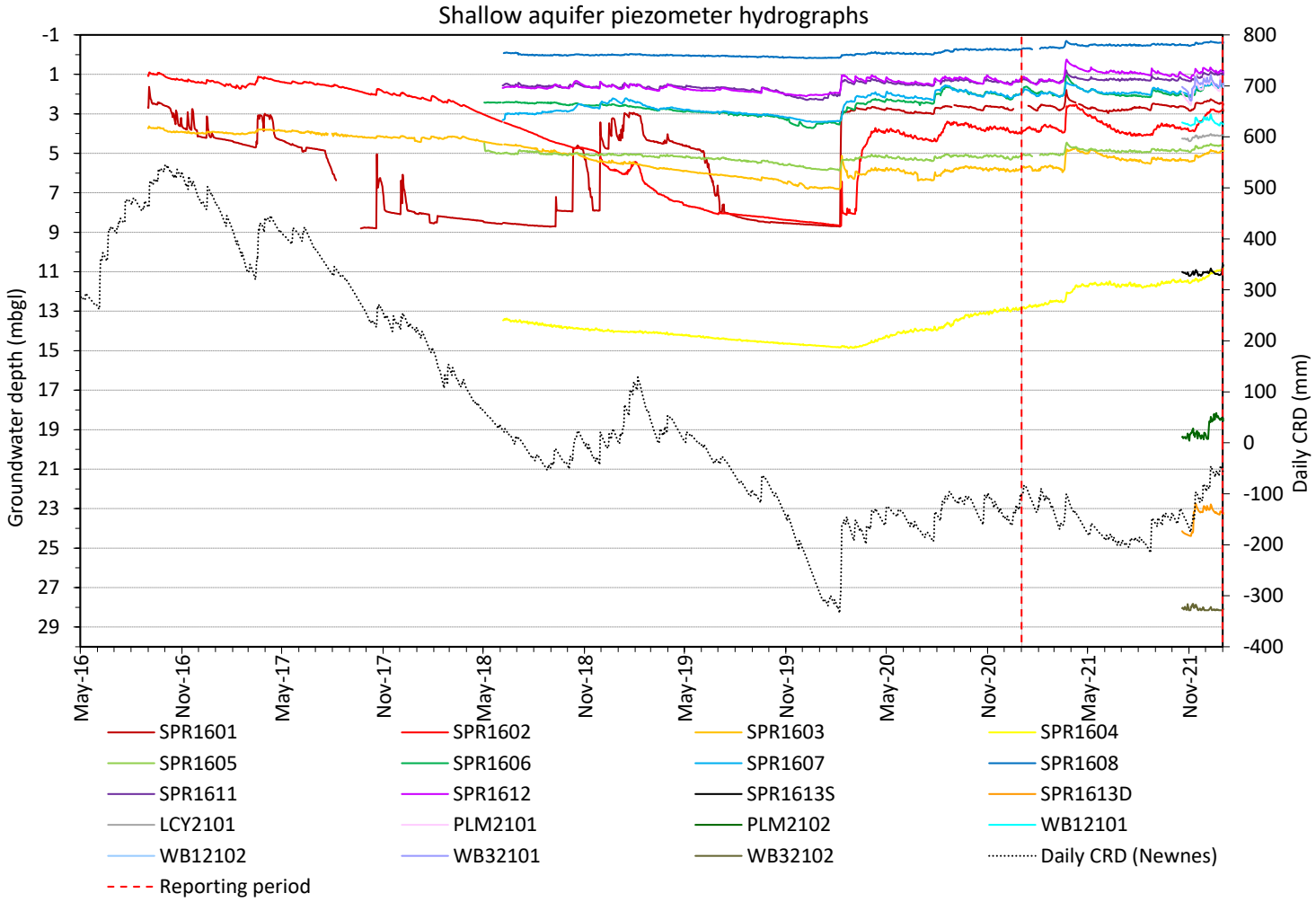


Figure 4.20 Perched standpipe hydrographs

4.3 Shallow groundwater system

Short term triggers (see Section 3.2) have been reviewed against standpipe piezometers during the reporting period. No short-term triggers, besides SPR1301 (see Table 4.1), have been recorded during the reporting period.

Hydrographs for reference and impact standpipe piezometers are shown in Figure 4.21. Comments on groundwater level trends during the reporting period are shown on Table 4.4.

Table 4.4 Standpipe piezometer groundwater level trend summary

Monitoring ID	Site type	Mined status	Comments
AP5PR	Reference	NA	Stable
AP1105	Reference	NA	Stable
RSE	Impact	LW411	Stable
RSS	Impact	LW415	Response to large rainfall events in March, August, November and December with short sharp rises in groundwater levels that receded over several days. Gradual increasing trend from January to December.
SPR1101	Impact	LW416	Damaged by subsidence - decommissioned
SPR1104	Impact	LW420	Dry
SPR1106	Impact	NA	Stable – gradual increasing trend from June to December that is consistent with daily CRD trend
SPR1107	Impact	LW420	Stable
SPR1108	Impact	LW427	Stable – gradual increasing trend from January to December
SPR1109	Impact	LW418	Stable – slight increasing trend from January to December
SPR1110	Impact	LW417	Dry
SPR1111	Impact	NA	Stable
SPR1112	Impact	NA	Stable – minor response to rainfall in March, November and December. Slight increasing trend from January to December
SPR1113	Impact	NA	Stable – slight increasing trend from January to December
SPR1210	Impact	LW428	Vandalised – replaced by SPR1210R
SPR1210R	Impact	LW428	Stable – very slight increasing trend from January to December. LW427 was within 600 m from September to November
SPR1211	Impact	LW426	Damaged by subsidence - decommissioned
SPR1301	Impact	NA	Stable
SPR1401	Impact	NA	Stable – very slight increasing trend from January to December
SPR1402	Impact	NA	Vandalised - decommissioned
SPR1403	Impact	NA	Damaged by bushfire - decommissioned
SPR1806	6 December 2019	NA	Stable – very slight decreasing trend from January to December
SPR1807	5 July 2019	NA	Dry
SPR1808	3 July 2019	NA	Stable – decreasing trend from January to December. Data gap in December due to the piezometer being struck by lightning

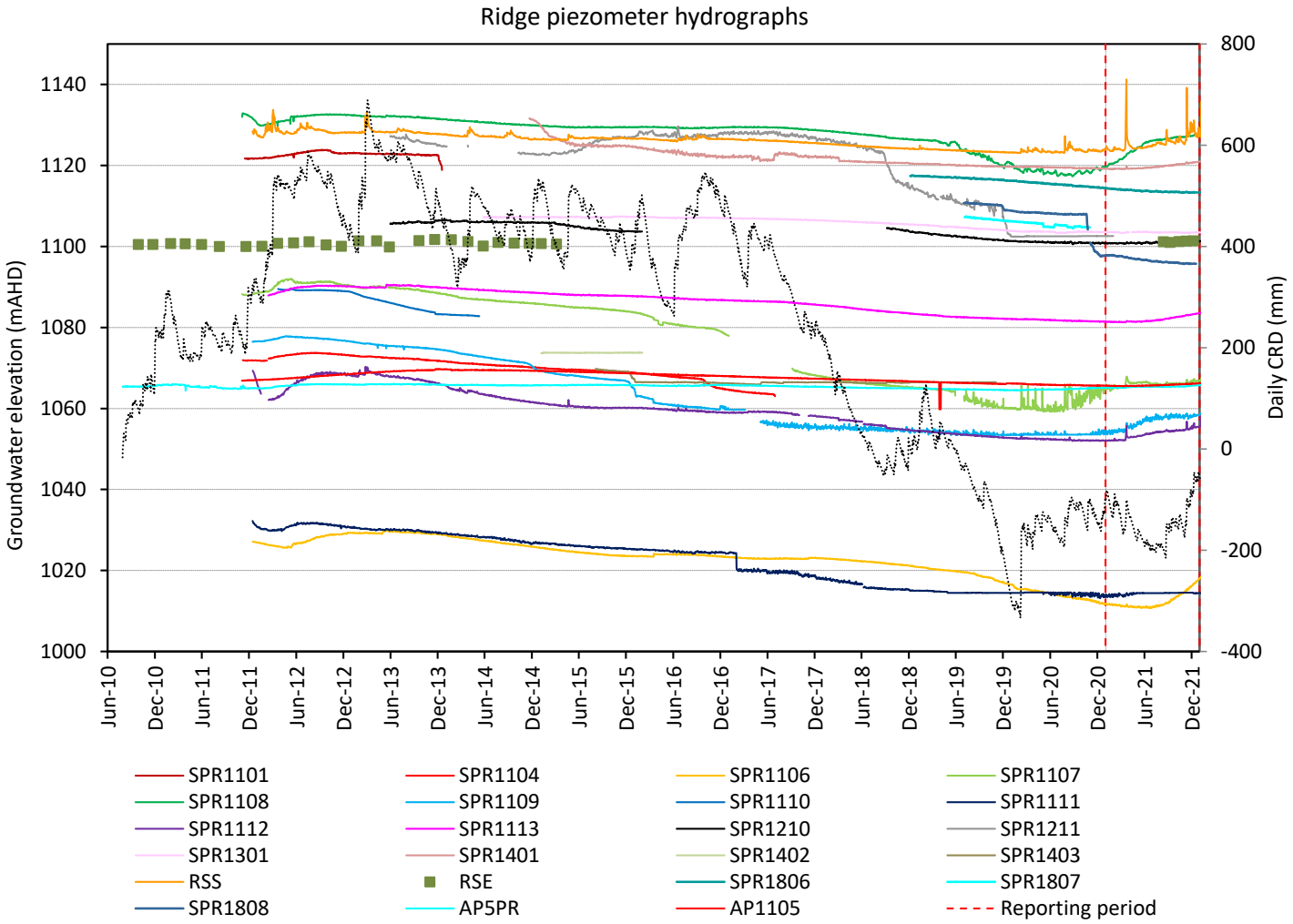


Figure 4.21 Standpipe piezometer hydrographs

4.4 Vibrating wire piezometers

There are no trigger levels for VWPs in the WMP or SMP. VWPs are used as a proxy for possible impacts to ridge and swamp piezometers and to monitor for potential connective cracking to the perched and shallow groundwater sources (above the MYC). No depressurisation of VWP above the MYC, besides SPR1210 (see Table 4.1), have been recorded during the reporting period.

Multi-level VWPs arrays have been installed in boreholes across the mining lease area to monitor piezometric pore pressures in the shallow and deep groundwater systems described in Section 2. Most of the VWPs are located in the vicinity of the current workings at Springvale Mine, in the area that is being currently mined, or will be mined in the future.

Table 4.5 Vibrating wire piezometer piezometric head trend summary

Monitoring ID	Sensor depth (mbgl)[1]	Comment
SPR37	110, 135, ***165,*** 187, 260, ***320, 350***, 405	Fluctuations in piezometer #8 are erroneous logger readings but the piezometer is stable. Remaining piezometers are stable.
SPR38	***80 (#1),*** 100 (#2), 135 (#3), 190 (#4), ***230 (#5), 300 (#6), 355 (#7), 370 (#8)***	Piezometers #6, #7 and #8 have been damaged by subsidence. Piezometers #1 and #5 have malfunctioned. Piezometers #2, #3 and #4 show a slight declining trend.
SPR1208	***90, 130, 226, 303, 330, 380, 411, 421***	Damaged by bushfire – decommissioned
SPR1210	76 (#7), 160 (#6), 224 (#5), 308 (#4), 326 (#3), 376 (#2), 388 (#1)	Depressurisation responses observed in piezometers #1 to #6 due to the passing of LW427. Piezometers #7 remains stable.
SPR1302	200 (#6), 271 (#5), 310 (#3), 370 (#2), 390 (#1)	Depressurisation responses in piezometers #1 and #2 during September due to commencement of first workings for LW428. Remaining piezometers were stable.
SPR1804	***345, 291, 217, 118, 69, 38***	Undermined by LW425 – decommissioned
AP10PR	343, 327, 300, ***270***, 248, 205, 150, 103, 60	All piezometers were stable

Notes: 1. Piezometers italicised and bold are not functional; mbgl – metres below ground level.

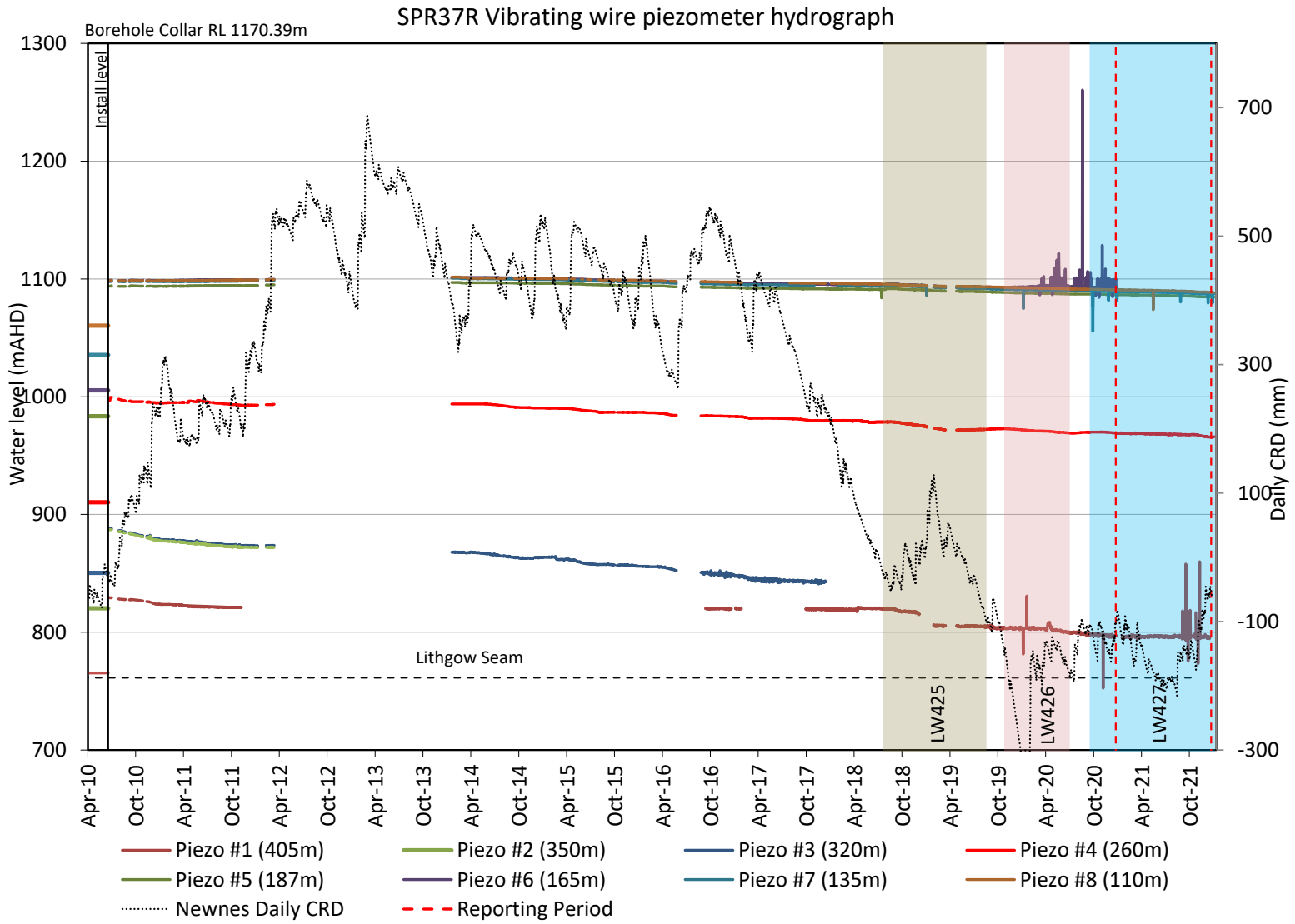


Figure 4.22 SPR37R hydrograph

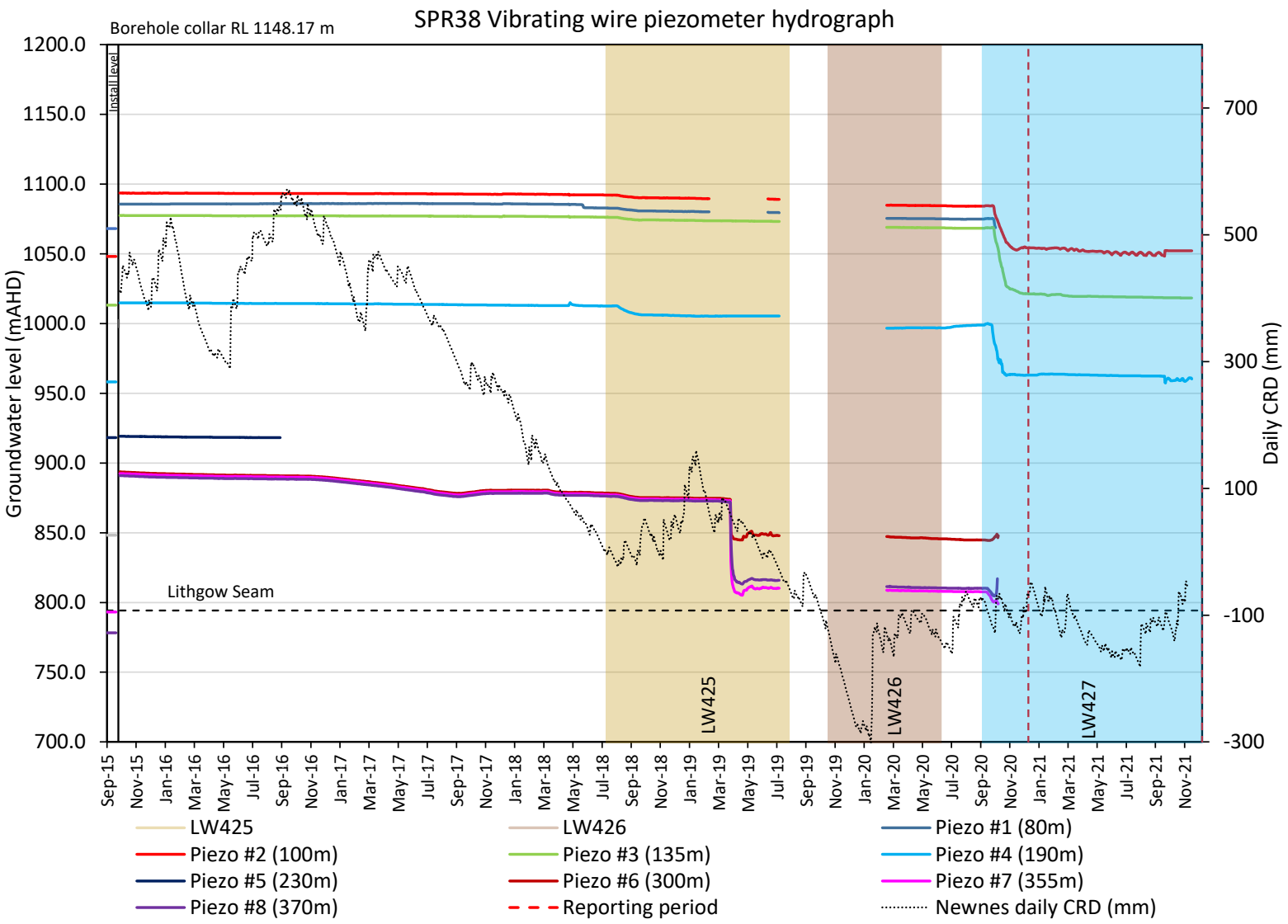


Figure 4.23 SPR38 hydrograph

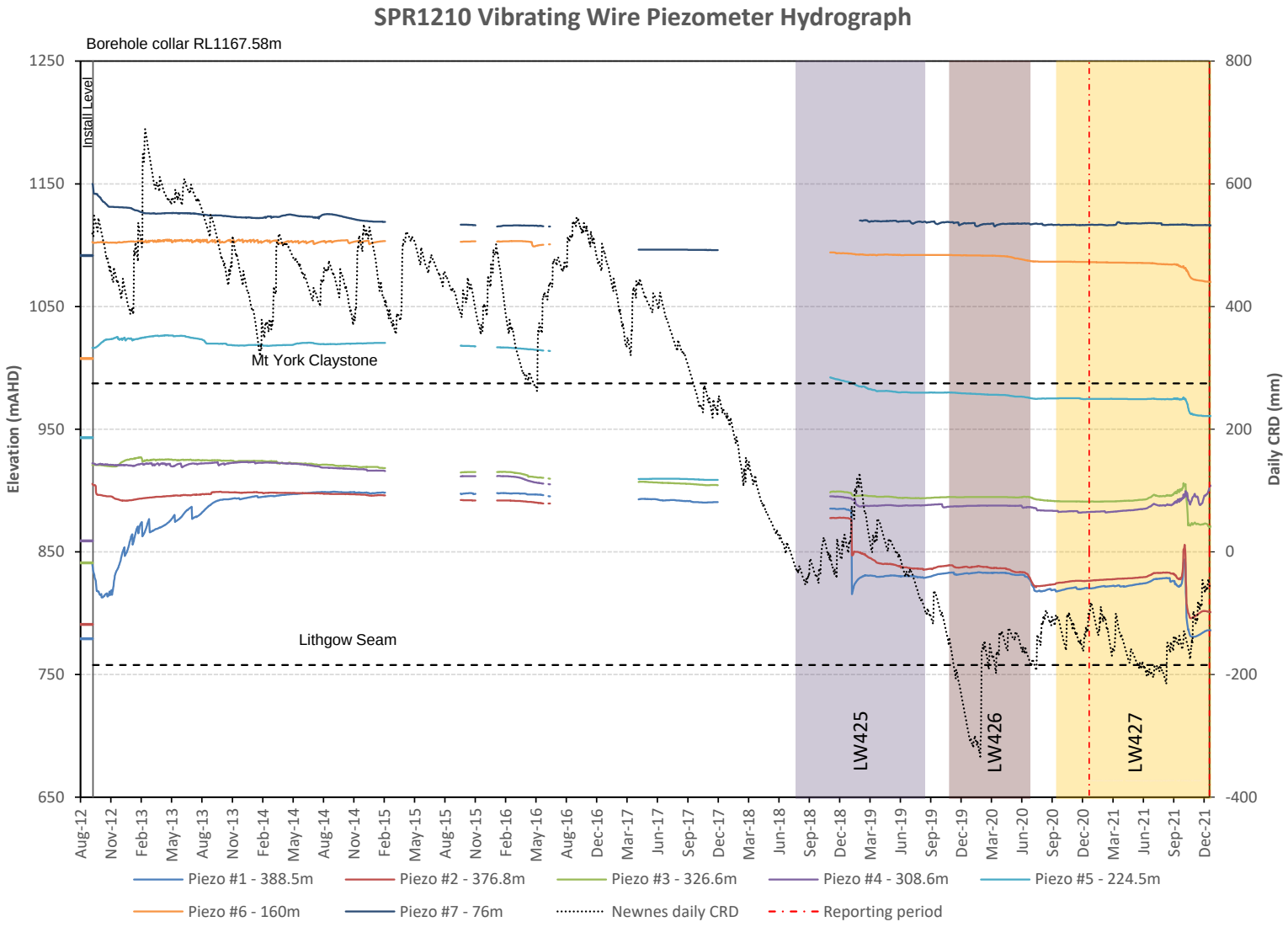


Figure 4.24 SPR1210 hydrograph

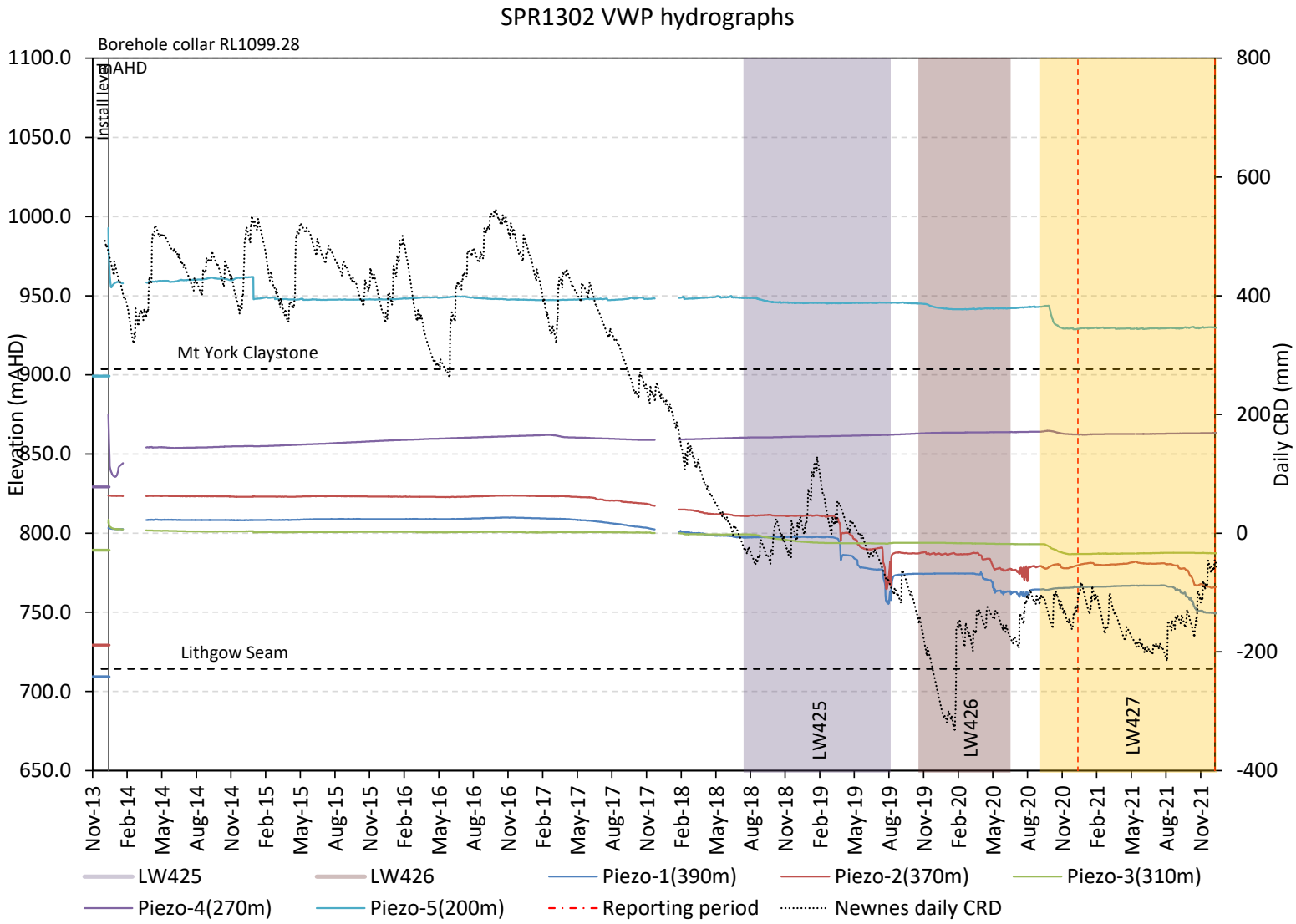


Figure 4.25 SPR1302 hydrograph

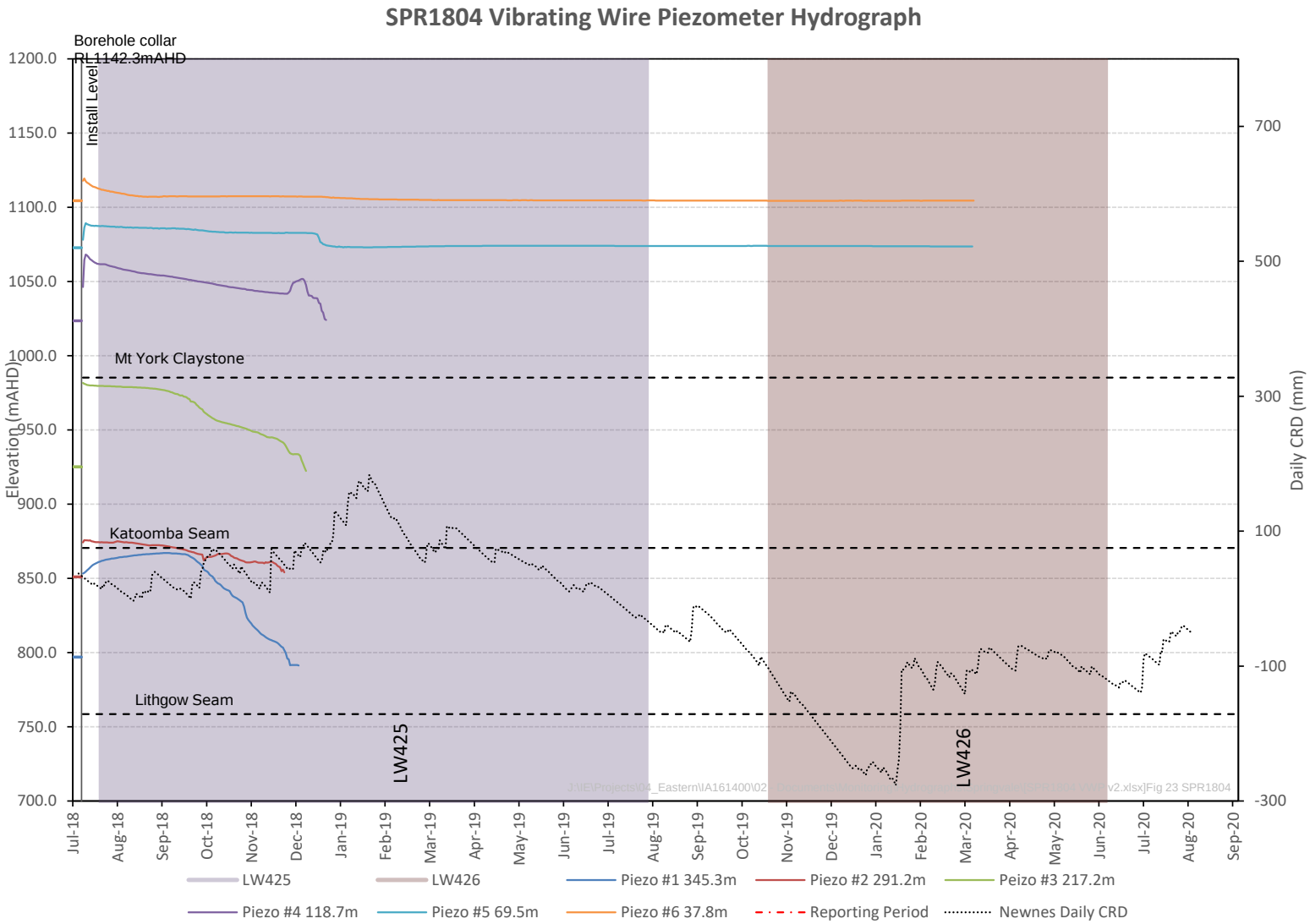


Figure 4.26 SPR1804 hydrograph

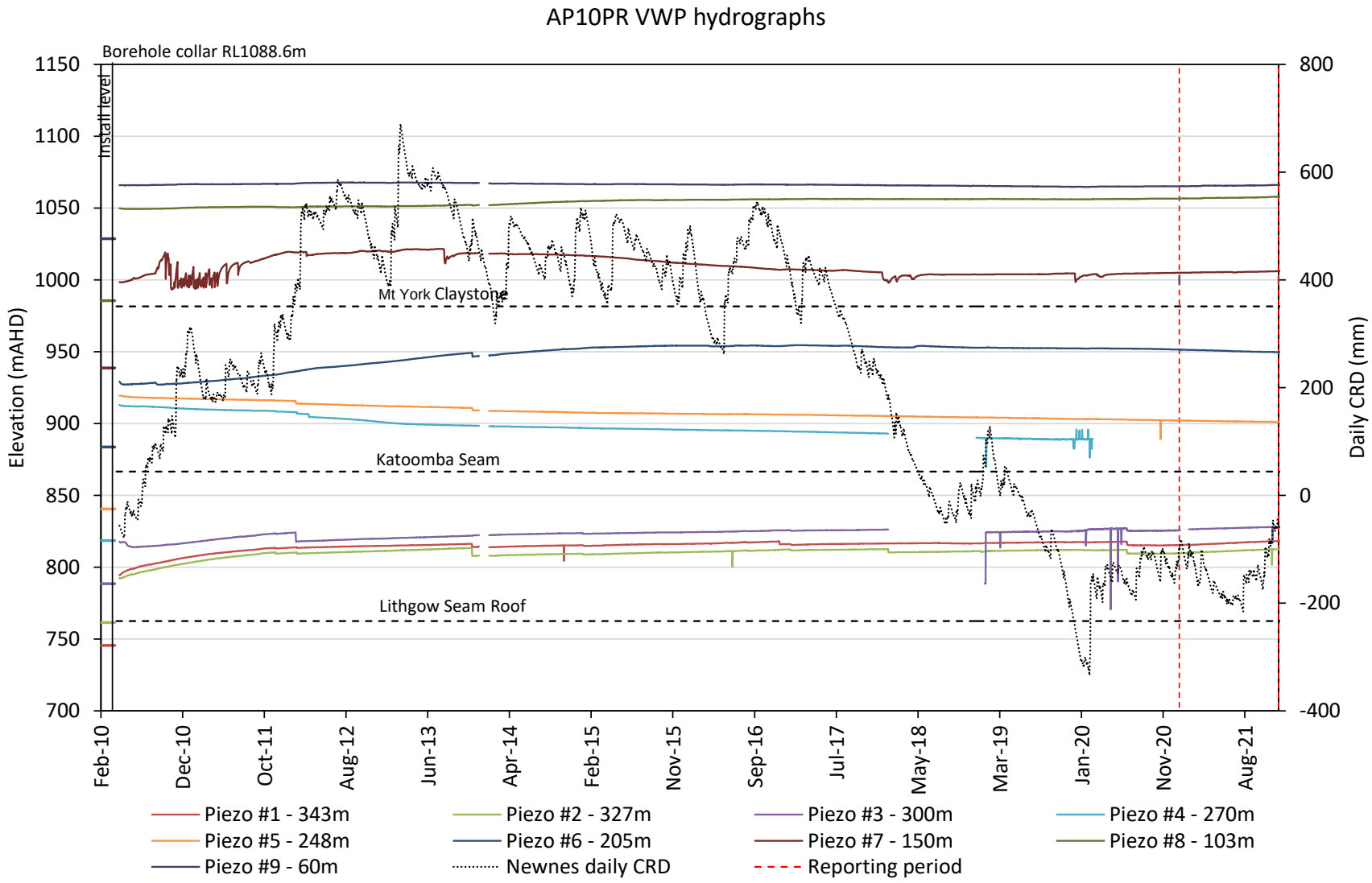


Figure 4.27 AP10PR hydrograph

5 Soil moisture monitoring

Soil moisture probes were installed to provide a means to continue monitoring swamp conditions if swamp groundwater levels decline.

Twenty-four soil moisture probes across various swamps were installed between July and October 2018. The soil moisture systems were damaged in the 2020 Gospers Mountain bushfire and were subsequently reinstated in September 2020.

Table 5.1 comments on the soil moisture trends. Time series for soil moisture sites are shown in Appendix D.

Table 5.1 Soil moisture monitoring trend summary

Monitoring ID	Comment
BA1SM	10 cm sensor mostly dry with an increase in moisture from December. Increase in moisture at the 20 cm sensor corresponding consistent rainfall during 2021. Remaining sensors show gradual increasing trends and were fully saturated.
BA2SM	Increasing trends in all sensors. Sensors were fully saturated.
BA3SM	Increasing trends in all sensors. Sensors were fully saturated.
BE1SM	Sensors 10 to 50 cm fluctuating with rainfall. Remaining sensors were fully saturated and show slight increasing trends.
BE2SM	Sensors 10 to 50 cm fluctuating with rainfall. Remaining sensors were fully saturated and show slight increasing trends.
BS1	Sensors 10 to 30 cm fluctuated with rainfall and groundwater levels. Remaining sensors were fully saturated and show an increasing trend.
BS2	Sensors 10 to 50 cm corresponded with rainfall events with moisture levels ranging between 5 to 20%. Remaining sensors also corresponded with rainfall and show a gradual increasing trend with moisture levels ranging between 35 to 50%.
BS3	Sensors 10 and 20 cm show an increasing trend. Remaining sensors also show an increasing trend and were fully saturated.
BS4 (PSS)	Sensors 10 to 30 cm show gradual increasing trends which fluctuate with changes in groundwater levels. Remaining sensors show an increasing trend and were fully saturated.
BS5 (NMSS)	Sensors 10 and 20 cm are above ground. Sensor 30 cm fluctuated with rainfall and sensor 40 cm fluctuated with groundwater levels. Remaining sensors show a gradual increasing trend and were fully saturated.
CC1SM	Sensors 10 to 40 cm show increasing trends, becoming fully saturated from May. Remaining sensors show a gradual increasing trend and were fully saturated.
CC2SM	10 cm sensor fluctuated with rainfall. Sensors 20 to 60 cm fluctuated with groundwater levels and show an increasing trend. Remaining sensors show gradual increasing trends and were fully saturated.
CW1SM	Sensor 10 and 20 cm are above surface. Remaining sensors fluctuated with rainfall and show a gradual increasing trend with moisture levels ranging between 5 to 25%.
CW4SM	Sensors fluctuated with rainfall with moisture ranging between 5 to 20%.
FS1SM	Sensors 10 to 40 cm fluctuated with rainfall and show an increasing trend. Remaining sensors show gradual increasing trends and were fully saturated.
FS2SM	All sensors correspond with rainfall and show increasing trends.
GG2SM	Sensors 10 to 30 cm show low moisture of less than 10% with increasing response to rainfall with depth. Remaining sensors fluctuated with rainfall with moisture ranging between 15 to 35%.

Table 5.1 Soil moisture monitoring trend summary

Monitoring ID	Comment
GG3SM	Sensors 10 to 40 cm were dry. Remaining sensors fluctuated with rainfall with moisture levels ranging between 10 to 70%.
GW1SM	Sensors 10 to 20 cm were dry. Remaining sensors fluctuated with rainfall with moisture levels ranging between 5 to 80%.
GW3SM	Sensor 10 cm was dry. Remaining sensors fluctuated with rainfall with moisture levels ranging between 5 to 60%.
LC1SM	All sensors were saturated. Decreasing trends from sensors 30 to 120 cm.
LCN1SM	Sensors 10 to 20 cm fluctuated with rainfall and show an increasing trend. Remaining sensors show increasing trends and were fully saturated.
LCS1SM	All sensors were saturated. Decreasing trends in sensors 20 to 80 cm. Sensors 90 to 120 cm show gradual increasing trends.
LC2SM	Sensors 10 to 30 cm show increasing trends. Remaining sensors show decreasing trends. Fully saturated from 50 to 120 cm.
MS1SM	All sensors show increasing trends. Fully saturated from 60 to 120 cm.
MS2SM	Sensors 10 to 30 cm show increasing trends. Remaining sensors show gradual increasing trends and were fully saturated.
MS3SM	Sensors 10 to 30 cm show increasing trends. Remaining sensors show gradual increasing trends and were fully saturated.
PC1SM	Sensors 10 and 20 cm are above ground. Remaining sensors show increasing trends and were fully saturated.
PC2SM	All sensors are fully saturated and show increasing trends.
TG1SM	Sensor 10 and 20 cm show increasing trends. Remaining sensors show gradual increasing trends and are fully saturated.
TG2SM	Sensor 10 and 20 cm show increasing trends. Remaining sensors show gradual increasing trends and are fully saturated.
TS2SM	Sensors 10 to 30 cm trend with rainfall and ranged between 5 to 20% moisture up until November where they increased to 30 to 70% due to rainfall. Sensors 40 to 80 cm have been trending with groundwater levels. Remaining sensors show gradual increasing trends and were fully saturated.
TS3SM	Sensors 10 and 20 cm show increasing trends. Sensor 70 cm shows increasing moisture up to June where it stabilised to a similar trend and moisture to sensors 100 cm. Remaining sensors show gradual increasing trends and were fully saturated.

6 Swamp groundwater quality (SMP)

A suite of water quality parameters is monitored including field parameters (pH, temperature, electrical conductivity (EC), Eh, dissolved oxygen, TDS), major ions and trace ions. However, as per the SMP, the focus is on the following key parameters to identify potential mining impacts.

- pH;
- salinity (EC); and
- filtered iron.

Groundwater quality is monitored across the plateau at the locations shown on Figure 3.1. The timeseries for long term water quality trends are shown in Appendix G and tabulated statistics are shown in Appendix F.

Section 6.1 and Section 6.2 summarise the trends of key groundwater quality parameters at reference and impact sites, and reviews the swamp piezometers compliance status against respective site-specific trigger values outlined in Table 3.1 and Appendix F. Identified triggers have been italicised in ***bold***.

6.1 Reference sites

6.1.1 Barrier Swamp

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.1 Barrier Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
BA1	18/03/2018 – present	Monthly	pH	pH had a single exceedance in short term trigger in September. The exceedance was similarly observed at the other Reference Swamp piezometers.
	18/03/2018 – present	Monthly	EC	Stable trend.
	18/03/2018 – present	Monthly	Fe	Stable trend.
BA2	18/03/2018 – present	Monthly	pH	pH had a single exceedance in the upper short term trigger in September. The exceedance was similarly observed at the other Reference Swamp piezometers.
	18/03/2018 – present	Monthly	EC	Slightly declining trend.
	18/03/2018 – present	Monthly	Fe	Minor fluctuations.

Table 6.1 Barrier Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
BA3	18/03/2018 – present	Monthly	pH	pH had a single exceedance in the upper short term trigger in September. The exceedance was similarly observed at the other Reference Swamp piezometers.
	18/03/2018 – present	Monthly	EC	Slightly declining trend.
	18/03/2018 – present	Monthly	Fe	Minor fluctuations with rainfall. Single exceedance in March.

6.1.2 Best Swamp

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.2 Best Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
BE1	18/03/2018 – present	Monthly	pH	pH had a single exceedance in the upper short term trigger in September. The exceedance was similarly observed at the other Reference Swamp piezometers.
	18/03/2018 – present	Monthly	EC	Generally stable trend.
	18/03/2018 – present	Monthly	Fe	Fluctuating concentrations.
BE2	18/03/2018 – present	Monthly	pH	pH had a single exceedance in short term trigger in September. The exceedance was similarly observed at the other Reference Swamp piezometers.
	18/03/2018 – present	Monthly	EC	Generally stable trend.
	18/03/2018 – present	Monthly	Fe	Single exceedance in March. Generally low concentrations below the limit of reporting.

6.1.4 Carne Central Swamp

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.3 Carne Central Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
CC1	12/06/2012 - present	Monthly	pH	Two non-consecutive exceedances of the lower pH short term trigger in June and November. Trend shows greater variability compared to historical data.
	12/06/2012 - present	Monthly	EC	Generally stable. Lower average conductivity compared to historical data.
	12/06/2012 - present	Monthly	Fe	Stable trends. Lower average concentration compared to historical data.
CC2	8/07/2019 - present	Monthly	pH	Limited data collected during reporting period.
	8/07/2019 - present	Monthly	EC	Limited data collected during reporting period.
	8/07/2019 - present	Monthly	Fe	Limited data collected during reporting period.

6.1.5 Firetail Swamp

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.4 Firetail Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
FS1	18/03/2018 – present	Monthly	pH	Exceedance of the upper trigger in September.
	18/03/2018 – present	Monthly	EC	Fluctuations within historical limits.
	18/03/2018 – present	Monthly	Fe	Fluctuations within historical limits.
FS2	29/05/2019 - present	Monthly	pH	Limited data collected during reporting period.
	29/05/2019 - present	Monthly	EC	Limited data collected during reporting period. Lower average concentration compared to historical data.
	29/05/2019 - present	Monthly	Fe	Limited data collected during reporting period. Peaked concentration in December.

6.1.6 Twin Gully Swamp

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.5 Twin Gully Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
TG1	15/10/2012 - present	Monthly	pH	Single exceedance of the upper pH limit in August. Generally stable trend within historical limits.
	15/10/2012 - present	Monthly	EC	Generally stable within historical limits.
	15/10/2012 - present	Monthly	Fe	Single exceedance in December. Fluctuating trend with seasonal variance around the wetter months.
TG2	19/11/2018 - present	Monthly	pH	Generally stable trend. One outlier of low pH in September.
	19/11/2018 - present	Monthly	EC	Generally stable within historical limits.
	19/11/2018 - present	Monthly	Fe	Single exceedance in March. Fluctuating trend with seasonal variance around the wetter months.

6.1.7 Tristar Swamp

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.6 Tristar Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
TS1	12/06/2014 - present	Monthly	pH	Limited data collected during reporting period.
	12/06/2014 - present	Monthly	EC	Limited data collected during reporting period.
	12/06/2014 - present	Monthly	Fe	Limited data collected during reporting period.
TS2	16/10/2012 - present	Monthly	pH	No data collected.
	16/10/2012 - present	Monthly	EC	No data collected.
	16/10/2012 - present	Monthly	Fe	No data collected.
TS3	17/10/2012 - present	Monthly	pH	Single exceedance of the upper pH limit in August. Generally stable trend within historical limits.
	17/10/2012 - present	Monthly	EC	Generally stable trend within historical limits

Table 6.6 Tristar Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
	17/10/2012 - present	Monthly	Fe	Fluctuating trend with seasonal variance around the wetter months.

6.2 Impact sites

6.2.1 Sunnyside Swamp

Sunnyside Swamp is an impact swamp overlying LW413-LW414. Water quality sampling occurred after mining began in LW413-LW414 and subsequently there is no baseline pre-mining data and no triggers defined.

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.7 Sunnyside Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
SS1	22/02/2011 - present	Monthly	pH	No baseline trigger value applicable at this site. A high pH value observed in August. Trend is within historical limits.
		Monthly	EC	Generally stable trend.
		Monthly	Fe	Generally stable trend with small peaks around the wetter periods.
SS3	22/02/2011 - present	Monthly	pH	Trend is within historical limits.
		Monthly	EC	Generally stable trend.
		Monthly	Fe	Generally stable trend.
SS4	22/02/2011 - present	Monthly	pH	No baseline trigger value applicable at this site. A high pH value observed in August. Trend is within historical limits.
		Monthly	EC	Generally stable trend.
		Monthly	Fe	Generally stable trend.
SS5	22/02/2011 - present	Monthly	pH	No baseline trigger value applicable at this site. A high pH value observed in August. Trend is within historical limits.
		Monthly	EC	Generally stable trend.
		Monthly	Fe	Fluctuating trends with seasonal variance around the wetter months.

6.2.2 Sunnyside East Swamp

Sunnyside East Swamp is an impact swamp that overlies LW416-LW418. It has been predominately dry since mid-2013 and limited samples have been collected since 2017 due to dry conditions.

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.8 Sunnyside East Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
SSE1	11/03/2013 - present	Monthly	pH	Dry
		Monthly	EC	Dry
		Monthly	Fe	Dry
SSE2	12/06/2012 - present	Monthly	pH	Dry
		Monthly	EC	Dry
		Monthly	Fe	Dry
SSE3	22/02/2011 - present	Monthly	pH	Dry
		Monthly	EC	Dry
		Monthly	Fe	Dry

6.2.3 Carne West Swamp

Carne West is an impact swamp that overlies LW417 – LW419. It has been predominately dry since 2014.

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.9 Carne West Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
CW1	22/02/2011 - present	Monthly	pH	Dry
		Monthly	EC	Dry
		Monthly	Fe	Dry
CW2	22/02/2011 - present	Monthly	pH	Dry
		Monthly	EC	Dry
		Monthly	Fe	Dry

6.2.4 Gang Gang West Swamp

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.10 Gang Gang West Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
GW1	13/12/2012 - present	Monthly	pH	Dry
		Monthly	EC	Dry
		Monthly	Fe	Dry
GW2	16/10/2012 - present	Monthly	pH	Dry
		Monthly	EC	Dry
		Monthly	Fe	Dry

6.2.5 Gang Gang Swamp

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.11 Gang Gang Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
GG1	16/10/2012 - present	Monthly	pH	Dry
		Monthly	EC	Dry
		Monthly	Fe	Dry

6.2.6 Pine Swamp

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.12 Pine Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
BS2	15/10/2012 - present	Monthly	pH	Dry
		Monthly	EC	Dry
		Monthly	Fe	Dry
BS3	15/10/2012 - present	Monthly	pH	Trends within historical limits.
		Monthly	EC	Trends within historical limits. Minor non-consecutive elevated EC in February and July.
		Monthly	Fe	Fluctuating trends with seasonal variance around the wetter months.
PSS	18/02/2018 - present	Monthly	pH	Trends within historical limits.
		Monthly	EC	Trends within historical limits.

Table 6.12 Pine Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
		Monthly	Fe	Fluctuating trends with seasonal variance around the wetter months.

6.2.7 Nine Mile Swamp

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.13 Nine Mile Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
BS1	16/10/2012 - present	Monthly	pH	Generally stable trend.
		Monthly	EC	Generally stable trend. Slightly elevated concentrations in February and July below short-term trigger.
		Monthly	Fe	Fluctuating trends with seasonal variance around the wetter months.
NMSS	18/02/2018 - present	Monthly	pH	Generally stable trend.
		Monthly	EC	Generally stable trend.
		Monthly	Fe	Fluctuating trends with seasonal variance around the wetter months.

6.2.8 Marrangaroo Swamp

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.14 Marrangaroo Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
MS1	12/06/2012 - present	Monthly	pH	Two non-consecutive exceedance of the lower pH limit in May and October. Trends show less stability compared to historical data.
		Monthly	EC	Generally stable trend.
		Monthly	Fe	Fluctuating trends with seasonal variance around the wetter months.
MS2	19/11/2018 - present	Monthly	pH	Trends show less stability compared to historical data.
		Monthly	EC	Generally stable trend.
		Monthly	Fe	Fluctuating trends with seasonal variance around the wetter months. Highest recorded concentration observed in March but is within natural variability.

6.2.9 Paddys Creek Swamp

Refer to Appendix E for water quality timeseries and Appendix F for tabulated data.

Table 6.15 Paddys Creek Swamp groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
PC1	18/02/2018 - present	Monthly	pH	Trends within historical limits.
		Monthly	EC	Generally stable trend.
		Monthly	Fe	Generally stable trend.
PC2	18/02/2018 - present	Monthly	pH	Trends within historical limits.
		Monthly	EC	Generally stable trend.
		Monthly	Fe	Generally stable trend.

7 Shallow groundwater system – groundwater quality (SMP)

A suite of water quality parameters is monitored including field parameters (pH, temperature, EC, Eh, dissolved oxygen, TDS), major ions and trace ions. However, as per the SMP, the focus is on the following key parameters to identify potential mining impacts.

- pH;
- salinity (EC); and
- filtered iron.

Groundwater quality is monitored across the plateau at the locations shown on Figure 3.1. The timeseries for long term water quality trends are shown in Appendix G and tabulated statistics are shown in Appendix F.

Section 7 summarises the trends of key groundwater quality parameters at reference and impact sites, and reviews the standpipes piezometers compliance status against respective site-specific trigger values outlined in Table 3.1 and Appendix F. Identified triggers have been italicised in ***bold***.

Table 7.1 Shallow groundwater system quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
AP9PR	17/03/2016 - present	Quarterly	pH	Stable.
		Quarterly	EC	Stable.
		Quarterly	Fe	Stable. Below detection limit.
AP8PR	17/03/2016 - present	Quarterly	pH	Stable.
		Quarterly	EC	Stable.
		Quarterly	Fe	Stable. Below detection limit.
AP5PR	17/03/2016 - present	Quarterly	pH	Stable.
		Quarterly	EC	Stable.
		Quarterly	Fe	Stable. Below detection limit.
AP4PR	17/03/2016 - present	Quarterly	pH	Stable.
		Quarterly	EC	Stable.
		Quarterly	Fe	Stable. Below detection limit.
AP1204	17/03/2016 - present	Quarterly	pH	Stable.
		Quarterly	EC	Stable.
		Quarterly	Fe	Stable. Below detection limit.
AP1105	4/12/2018 - present	Quarterly	pH	Stable.
		Quarterly	EC	Stable.

Table 7.1 Shallow groundwater system quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
		Quarterly	Fe	Stable. Below detection limit.
SPR1113	17/03/2016 - present	Quarterly	pH	Stable.
		Quarterly	EC	Stable.
		Quarterly	Fe	Stable. Below detection limit.
SPR1401	17/03/2016 - present	Quarterly	pH	Stable.
		Quarterly	EC	Stable.
		Quarterly	Fe	Stable. Below detection limit.
SPR1109	18/03/2016 – 30/11/2016	Not sampled	pH	Damaged by subsidence.
		Not sampled	EC	Damaged by subsidence.
		Not sampled	Fe	Damaged by subsidence.
SPR1106	18/03/2016 – present	Quarterly	pH	Stable.
		Quarterly	EC	Stable.
		Quarterly	Fe	Stable. Below detection limit.
SPR1104	17/03/2016 – 2/06/2016	Quarterly	pH	Dry.
		Quarterly	EC	Dry.
		Quarterly	Fe	Dry.
SPR1111	17/03/2016 - present	Quarterly	pH	Declining trend.
		Quarterly	EC	Stable.
		Quarterly	Fe	Stable. Below detection limit.
SPR1107	17/03/2016 – 30/08/2016	Not sampled	pH	Damaged by subsidence.
		Not sampled	EC	Damaged by subsidence.
		Not sampled	Fe	Damaged by subsidence.
SPR1108	17/03/2016 - present	Quarterly	pH	Stable.
		Quarterly	EC	Stable.
		Quarterly	Fe	Stable. Below detection limit.
SPR1112	17/03/2016 - present	Quarterly	pH	Stable.
		Quarterly	EC	Stable.
		Quarterly	Fe	Single elevated value in June but below trigger.
SPR1210	5/03/2019 – 28/05/2019	Quarterly	pH	Too low and muddy to sample.
		Quarterly	EC	Too low and muddy to sample.

Table 7.1 Shallow groundwater system quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
		Quarterly	Fe	Too low and muddy to sample.
SPR1211	4/12/2018 – 12/09/2019	Not sampled	pH	Damaged by subsidence.
		Not sampled	EC	Damaged by subsidence.
		Not sampled	Fe	Damaged by subsidence.
SPR1301	4/12/2018 - present	Quarterly	pH	Exceedance of upper pH trigger. Elevated pH attributed to grout contamination and is not representative of natural conditions.
		Quarterly	EC	Exceedance of EC trigger. Elevated concentration attributed to grout contamination and is not representative of natural conditions.
		Quarterly	Fe	Stable. Below detection limit.
RSS	17/03/2016 - present	Quarterly	pH	Stable.
		Quarterly	EC	Elevated compared to historical data but below trigger limit.
		Quarterly	Fe	Stable. Below detection limit.

8 Bore 6 and Bore 8

This section summarises the trends of key groundwater quality parameters and reviews compliance status. Bores 6 and 8 are dewatering wells that provides indicative water quality of mine inflows, but it was also be influenced by underground activities. Refer to Appendix E for water quality timeseries.

Table 8.1 Bore 6 and Bore 8 groundwater quality summary

Monitoring ID	Date range	Frequency	Analyte	Units	Minimum	Median	Maximum
Bore 6	4/09/2009 - present	Weekly	pH	Units	6.8	7.4	7.9
			EC	µS/cm	867	1,160	1,865
			Fe	mg/L	0.05	0.54	3.47
Bore 8	15/01/2013 - present	Weekly	pH	Units	5.5	7.5	7.9
			EC	µS/cm	228	1,155	1,357
			Fe	mg/L	0.05	0.05	2.12

9 Surface water quality (SMP)

A suite of quality parameters is monitored including field parameters (pH, temperature, EC, Eh, dissolved oxygen, TDS), major ions and trace ions. However, as per the SMP, the focus is on the following key parameters to identify potential mining impacts.

- pH;
- salinity (EC);
- filtered iron;
- filtered manganese; and
- total suspense solids (TSS).

Surface water quality is monitored across the plateau at the locations shown on Figure 3.2. The timeseries for long term water quality trends are shown in Appendix G and tabulated statistics are shown in Appendix H.

Section 9.1 and Section 9.2 summarise the trends of key surface water quality parameters at reference and impact sites, and reviews the sites compliance status against respective site-specific trigger values outlined in Table 3.1 and Appendix H. Identified triggers have been italicised in ***bold***.

9.1 Reference sites

9.1.1 Barrier Swamp

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 9.1 Barrier Swamp surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Barrier Swamp	27/09/2016 - present	Fortnightly/ Monthly	pH	Single exceedance in the upper pH limit in July.
			EC	Slight decreasing trend.
			Fe	Single exceedance in March. Fluctuating with seasonal variance.
			Mn	Generally stable.
			TSS	Single exceedance in May. Highly variable.
			Flow	Generally stable.

9.1.2 Best Creek

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 9.2 Best Creek surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Best Creek	24/11/2017 - present	Fortnightly/ Monthly	pH	Fluctuating within trigger limits.
			EC	Three non-consecutive exceedances in March, August and September.
			Fe	Fluctuating with seasonal variance.
			Mn	Fluctuating with seasonal variance.
			TSS	Generally stable.
			Flow	Stable.

9.1.3 Carne Central Swamp

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 9.3 Carne Central Swamp surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Carne Central Swamp	27/09/2016 - present	Fortnightly/ Monthly	pH	Generally stable.
			EC	Two non-consecutive exceedances in January and June. Generally stable.
			Fe	Single exceedance in May. Generally stable below detection limits.
			Mn	Fluctuating with seasonal variance.
			TSS	Single exceedance in June.
			Flow	Limited flow data. One reading in March.

9.1.4 Firetail Swamp

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 9.4 Firetail surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Firetail	24/11/2017 - present	Fortnightly/ Monthly	pH	Generally stable.
			EC	Single exceedance in September. Generally stable.
			Fe	Single exceedance in October. Fluctuating with seasonal variance.
			Mn	Generally stable.
			TSS	Stable.
			Flow	Generally stable. Higher flows recorded in March.

9.2 Impact sites

9.2.1 Carne Swamp

pH and electrical conductivity have exceeded the trigger threshold detailed in Section 3.3 and requires investigation as per the SMP.

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 9.5 Carne Swamp surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Carne Swamp	5/01/2005 - present	Fortnightly/ Monthly	pH	Three consecutive exceedances of the lower pH trigger from November to December. Single exceedance of upper pH limit in August. Swamp. Trends show greater variance compared to historical data.
			EC	Numerous consecutive exceedances in the first half of the year. Declining trend since the bushfires/drought from 2020.
			Fe	Single exceedance in November. Generally stable trend below detection limit.
			Mn	Two non-consecutive exceedances in January and February. Declining trend since the bushfires/drought from 2020.
			TSS	Generally stable trend.
			Flow	Water level too low for flow monitoring or pooled water.

9.2.2 Gang Gang South West

Gang Gang South West has been intermittently dry through the reporting period.

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 9.6 Gang Gang South West surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Gang Gang South West	27/09/2016 - present	Fortnightly/ Monthly	pH	Generally stable.
			EC	Multiple exceedances separated by dry conditions.
			Fe	Single exceedance in April.
			Mn	Multiple exceedances separated by dry conditions.
			TSS	Two exceedances in April and December.
			Flow	High flow rate recorded in March. Generally dry or pooled/low flow conditions.

9.2.3 Gang Gang East

Gang Gang East has been intermittently dry through the reporting period.

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 9.7 Gang Gang East surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Gang Gang East	27/09/2016 - present	Fortnightly/ Monthly	pH	Generally stable. Trending with a lower average than historical data.
			EC	Multiple exceedances separated by dry conditions.
			Fe	Stable. At and below detection limits.
			Mn	Multiple exceedances separated by dry conditions.
			TSS	Stable.
			Flow	High flow rate recorded in March. Generally dry or pooled/low flow conditions.

9.2.4 Marrangaroo Swamp

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 9.8 Marrangaroo Swamp surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Marangaroo Swamp	24/11/2017 - present	Fortnightly/ Monthly	pH	Two non-consecutive exceedances of the upper pH trigger in September and October. Slightly increasing trend.
			EC	Single exceedance in January. Generally stable trend.
			Fe	Fluctuating with seasonal variance.
			Mn	Fluctuating with seasonal variance.
			TSS	Generally stable.
			Flow	Generally stable. High flow recorded in March.

9.2.5 Nine Mile Swamp

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 9.9 Nine Mile Swamp surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
9 Mile Swamp	27/11/2017 - present	Fortnightly/ Monthly	pH	Single exceedance of the upper pH limit in July. Slight increasing trend.
			EC	Single exceedance in July. Slight decreasing trend.
			Fe	Stable.
			Mn	Single exceedance in May. Fluctuating with seasonal variance.
			TSS	Stable trend.
			Flow	High flow recorded in March. Generally, water level too low for flow monitoring.

9.2.6 Sunnyside

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 9.10 Sunnyside Swamp surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Sunnyside U/S Junction	31/03/2006 - present	Fortnightly/ Monthly	pH	Single exceedance in the upper pH limit in October. Generally stable.
			EC	Single exceedance in October. Generally stable trend
			Fe	Generally stable trend.
			Mn	Single exceedance in December.
			TSS	Generally stable trend.
			Flow	Generally stable trend.
Sunnyside Swamp Upstream	24/05/2005 - present	Fortnightly/ Monthly	pH	Two non-consecutive exceedances in the upper pH limit in August and October.
			EC	Generally stable trend.
			Fe	Single exceedance in December.
			Mn	Single exceedance in December.
			TSS	High value in July, likely to be erroneous.
			Flow	Water level pooled or too low for flow monitoring.
Sunnyside Swamp Downstream	24/05/2005 - present	Fortnightly/ Monthly	pH	Single exceedance in the upper pH limit in August. Generally stable trend.
			EC	Generally stable trend.
			Fe	Single exceedance in April. Generally stable trend.
			Mn	Generally stable trend.
			TSS	High value in February. Generally stable trend.
			Flow	Generally stable trend.

9.2.7 Sunnyside East

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 9.11 Sunnyside East surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
SS3 D/S	10/06/2010 - present	Fortnightly/ Monthly	pH	Dry
			EC	Dry
			Fe	Dry
			Mn	Dry
			TSS	Dry

Table 9.11 Sunnyside East surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
			Flow	Dry

9.2.8 East Wolgan

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 9.12 East Wolgan surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
East Wolgan Upstream	8/04/2005 - present	Fortnightly/ Monthly	pH	One sample in March. Generally dry.
			EC	One sample in March. Generally dry.
			Fe	One sample in March. Generally dry.
			Mn	One sample in March. Generally dry.
			TSS	One sample in March. Generally dry.
			Flow	Too low to sample. Generally dry.
East Wolgan Downstream	8/04/2005 - present	Fortnightly/ Monthly	pH	Limited samples collected in March and November. Generally dry.
			EC	Limited samples collected in March and November. Generally dry.
			Fe	Limited samples collected in March and November. Generally dry.
			Mn	Limited samples collected in March and November. Generally dry.
			TSS	Limited samples collected in March and November. Generally dry.
			Flow	Limited samples collected in March and November. Generally dry.
East Wolgan DS Junction	8/04/2005 - present	Fortnightly/ Monthly	pH	Single exceedance in upper pH limit in May.
			EC	Generally stable trend.
			Fe	Generally stable trend with seasonal variance.
			Mn	Single exceedance in November. Generally stable trend.
			TSS	Generally stable trend.
			Flow	Generally stable trend.

10 Surface water quality (WMP)

A suite of quality parameters is monitored including field parameters (pH, temperature, EC, Eh, dissolved oxygen, TDS), major ions and trace ions. However, as per the WMP, the focus is on the following key parameters to identify potential mining impacts.

- pH;
- salinity (EC); and
- total suspense solids (TSS).

Surface water quality is monitored across the plateau at the locations shown on Figure 3.2. The timeseries for long term water quality trends are shown in Appendix G and tabulated statistics are shown in Appendix H.

Section 10 summarises the trends of key surface water quality parameters at reference and impact sites, and reviews the sites compliance status against respective site-specific trigger values outlined in Table 3.1 and Appendix H. Identified triggers have been italicised in ***bold***.

10.1 Reference sites

10.1.1 Carne Central

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 10.1 Carne Central surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Carne Central	21/03/2016 - present	Fortnightly/ Monthly	pH	Trends within historical limits.
Carne Central	21/03/2016 - present	Fortnightly/ Monthly	EC	Slightly declining trend.
Carne Central	21/03/2016 - present	Fortnightly/ Monthly	TSS	Single exceedance in June. Generally stable.
Carne Central	21/03/2016 - present	Fortnightly/ Monthly	Flow	Generally, water level too low to sample.

10.1.2 Tristar Swamp

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 10.2 Tristar surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Tristar (Springvale site)	2/11/2016 - present	Fortnightly/ Monthly	pH	Generally stable trend.
Tristar (Springvale site)	2/11/2016 - present	Fortnightly/ Monthly	EC	Generally stable trend.
Tristar (Springvale site)	2/11/2016 - present	Fortnightly/ Monthly	TSS	Generally stable trend.
Tristar (Springvale site)	2/11/2016 - present	Fortnightly/ Monthly	Flow	High flow recorded in December Generally stable trend.

10.1.3 Twin Gully

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 10.3 Twin Gully surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Twin Gully (Springvale site)	2/11/2016 - present	Fortnightly/ Monthly	pH	Single exceedance in upper pH limit in August. Generally stable trend.
Twin Gully (Springvale site)	2/11/2016 - present	Fortnightly/ Monthly	EC	Three non-consecutive exceedances in February, June and August.
Twin Gully (Springvale site)	2/11/2016 - present	Fortnightly/ Monthly	TSS	Single exceedance in May. Generally stable trend.
Twin Gully (Springvale site)	2/11/2016 - present	Fortnightly/ Monthly	Flow	Generally stable trend. High flow recorded in December.

10.1.4 Wolgan River

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 10.4 Wolgan River surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Wolgan River Downstream	4/01/2002 - present	Fortnightly/ Monthly	pH	Generally stable trend.
Wolgan River Downstream	4/01/2002 - present	Fortnightly/ Monthly	EC	Generally stable trend.
Wolgan River Downstream	4/01/2002 - present	Fortnightly/ Monthly	TSS	Two exceedances in February and April. Generally stable trend.
Wolgan River Downstream	4/02/2008 - present	Fortnightly/ Monthly	Flow	High flow recorded in March. Generally stable trend.
Wolgan River (Wolgan Valley)	30/04/2018 - present	Fortnightly/ Monthly	pH	Two non-consecutive exceedances of the lower pH limit in September and November.
Wolgan River (Wolgan Valley)	30/04/2018 - present	Fortnightly/ Monthly	EC	Generally stable trend.
Wolgan River (Wolgan Valley)	30/04/2018 - present	Fortnightly/ Monthly	TSS	Generally stable trend.
Wolgan River (Wolgan Valley)	30/04/2018 - present	Fortnightly/ Monthly	Flow	High flow recorded in April. Generally stable trend.

10.2 Impact sites

10.2.1 Carne West

pH has exceeded the trigger threshold detailed in Section 3.3 and requires investigation as per the WMP. No pre-mining data is available for Carne West.

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 10.5 Carne West surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Carne West	12/07/2016 - present	Fortnightly/ Monthly	***pH***	Generally stable trend. Two exceedances of the lower trigger in January. Two exceedances of the lower trigger in November and December (ie 4 consecutive exceedances during 4 monitoring events in November and December).
Carne West	12/07/2016 - present	Fortnightly/ Monthly	EC	Slight declining trend.
Carne West	12/07/2016 - present	Fortnightly/ Monthly	TSS	Generally stable trend. One exceedance in March.
Carne West	12/07/2016 - present	Fortnightly/ Monthly	Flow	Water level too low for flow monitoring.

10.2.2 Gang Gang

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 10.6 Gang Gang surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Gang Gang	21/3/2016 - present	Fortnightly/ Monthly	pH	Single exceedance of the lower pH trigger in February. Generally stable trend.
Gang Gang	21/3/2016 - present	Fortnightly/ Monthly	EC	Slight declining trend.
Gang Gang	21/3/2016 - present	Fortnightly/ Monthly	TSS	Generally stable trend.
Gang Gang	21/3/2016 - present	Fortnightly/ Monthly	Flow	Water level too low for flow monitoring.

10.2.3 Marrangaroo Creek

Marrangaroo creek was intermittently dry during the 2021 reporting period. Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 10.7 Marrangaroo Creek surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Marrangaroo Creek	30/01/2014 - present	Fortnightly/ Monthly	pH	Exceeded the upper and lower pH limit in October and December respectively.
Marrangaroo Creek	30/01/2014 - present	Fortnightly/ Monthly	EC	Generally stable trend.
Marrangaroo Creek	30/01/2014 - present	Fortnightly/ Monthly	TSS	Multiple exceedances in October and December separated by dry conditions.
Marrangaroo Creek	30/01/2014 - present	Fortnightly/ Monthly	Flow	Generally dry or too low for flow monitoring.

10.2.4 Paddys Creek

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 10.8 Paddys Creek surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Paddys Creek	24/11/2017 - present	Fortnightly/ Monthly	pH	Single exceedance of the lower pH limit in March.
Paddys Creek	24/11/2017 - present	Fortnightly/ Monthly	EC	Generally stable trend. High value in November.
Paddys Creek	24/11/2017 - present	Fortnightly/ Monthly	TSS	Generally stable trend.
Paddys Creek	24/11/2017 - present	Fortnightly/ Monthly	Flow	High flow in March. Generally stable trend.

10.2.5 Pine/Nine Mile Swamp

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 10.9 Pine/Nine Mile Swamp surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Pine/9 Mile Swamp	27/11/2017 - present	Fortnightly/ Monthly	pH	Single exceedance of the lower pH limit in February. Slight increasing trend.
Pine/9 Mile Swamp	27/11/2017 - present	Fortnightly/ Monthly	EC	Single exceedance in June. Slight decreasing trend.
Pine/9 Mile Swamp	27/11/2017 - present	Fortnightly/ Monthly	TSS	Generally stable trend.
Pine/9 Mile Swamp	27/11/2017 - present	Fortnightly/ Monthly	Flow	Flows recorded in November and December. Generally, too low for flow monitoring.

10.2.6 Sunnyside East

Refer to Appendix G for water quality timeseries and Appendix H for tabulated data.

Table 10.10 Sunnyside East surface water quality summary

Monitoring ID	Date range	Frequency	Analyte	2021 water quality comment
Sunnyside East	21/03/2016 - present	Fortnightly/ Monthly	pH	Five non-consecutive exceedances of the lower pH limit across the reporting period.
Sunnyside East	21/03/2016 - present	Fortnightly/ Monthly	EC	Two exceedances in April and November. Slight declining trend.
Sunnyside East	21/03/2016 - present	Fortnightly/ Monthly	TSS	High value in July. Generally stable trend.
Sunnyside East	21/03/2016 - present	Fortnightly/ Monthly	Flow	Too low for flow monitoring.

11 Conclusions

This report has reviewed groundwater level, quality and surface water quality data for the reporting period 1 January to 31 December 2021. The following summarises the thew key outcomes of this review in accordance with the WMP and SMP:

- Swamps – groundwater levels remain stable at swamps piezometers that have not been previously impacted by mining.
- Perched groundwater system - groundwater levels in perched piezometers show an increasing trend in groundwater levels consistent with prevailing climatic conditions. Perched piezometers that have been impacted by mining, or installed post mining, show similar groundwater trends to reference sites or historical observations.
- Shallow groundwater system - groundwater levels in perched piezometers that have not been directly impacted by mining, show an increasing trend consistent with increasing rainfall.
- Deep groundwater system – VWPs located adjacent to longwalls show typical depressurisation responses due to subsidence. Depressurisation has been observed in one piezometer above the MYC due to LW 427 activities, but no impact has been observed at nearby swamp, perched or standpipe piezometers.
- Swamp groundwater quality (SMP) – no triggers identified during the reporting period.
- Shallow groundwater system quality (SMP) – no triggers identified during the reporting period.
- Surface water quality (SMP) – EC at Carne Swamp surface water monitoring site has exceeded the trigger thresholds detailed in the SMP by exceeding the upper threshold for more than two consecutive months. An investigation into the exceedances is required. No other triggers have been identified.
- Surface water quality (WMP) – pH at Carne West surface water monitoring site has exceeded the trigger criteria detailed in the WMP by exceeding the lower threshold for more than three consecutive monitoring events. An investigation into the exceedances is required. No other triggers have been identified.

References

Centennial (2018a) Swamp Monitoring Program for LW424 to LW 427, Springvale Mine, May 2018.

Centennial (2018b) Water Management Plan of Extraction plan for LW424-427, Springvale Mine, May 2018.

Jacobs (2019) Groundwater Impact Assessment, Angus place Amended Project, prepared by Jacobs Group (Australia) Pty Ltd for Centennial Angus Place Pty Ltd, October 2019.

McHugh (2014) The geology of the shrub swamps within Angus place, Springvale and the Springvale Mine extension project areas, prepared by E.A.McHugh Geological and Petrographic Services for Centennial Coal Pty Ltd, September 2014.

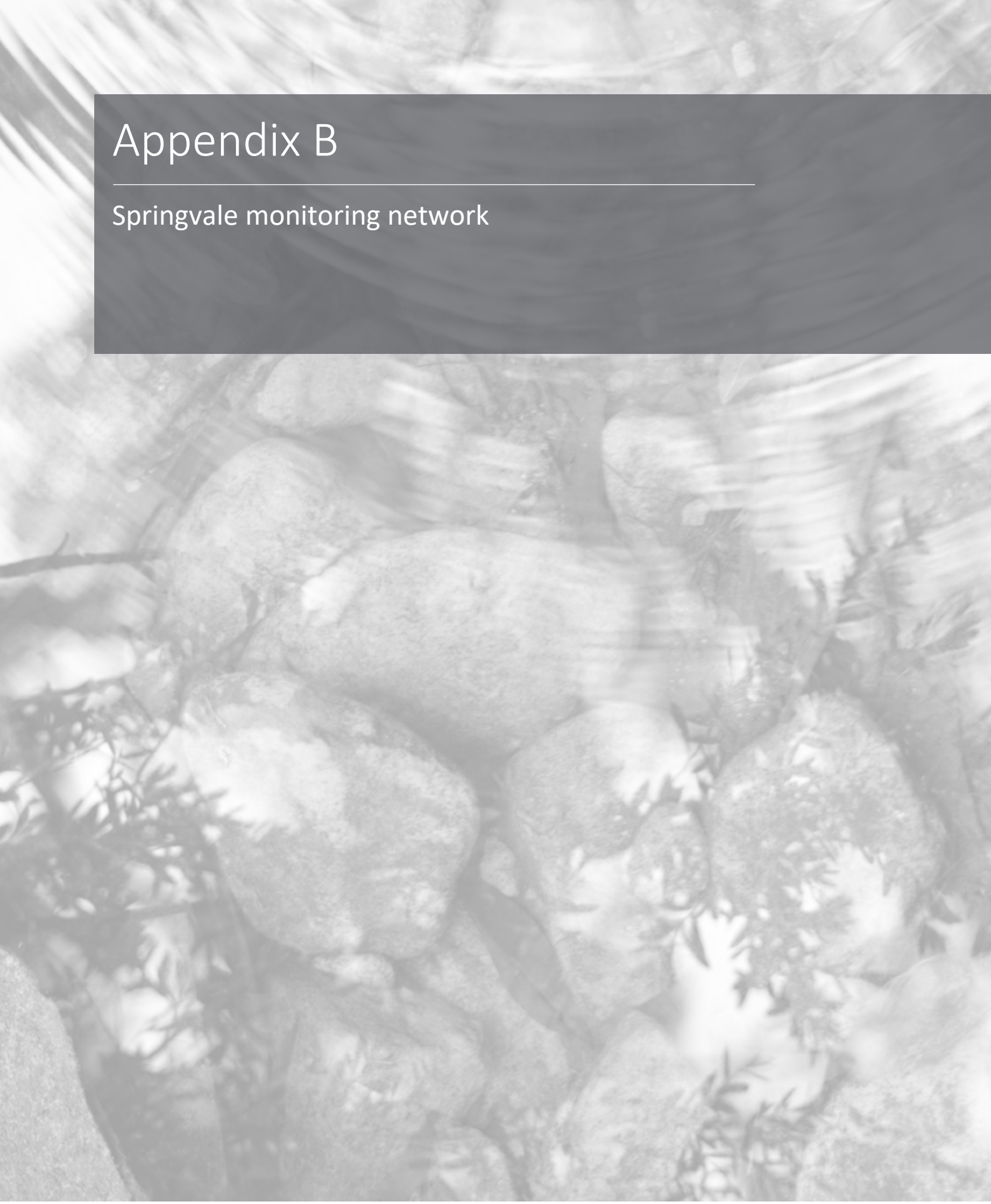


Appendix A

Historical longwall progression

Table A.1 Springvale mining progress

Longwall	Start	Finish
No 1	March 1995	January 1996
401	March/April 1996	January/February 1997
402	February/March 1997	November/Dececmber 1997
403	January/February 1998	November/December 1998
404	January/February 1999	February/March 2000
405	10 April 2000	26 March 2001
406	27 May 2001	23 January 2002
407	28 March 2002	9 January 2003
408	20 February 2003	18 December 2003
409	18 February 2004	10 December 2004
410	9 February 2005	19 January 2006
411	10 March 2006	26 October 2007
412	14 December 2007	22 June 2009
413A	7 August 2009	1 April 2010
413B	20 May 2010	29 December 2010
414	11 February 2011	21 November 2011
415	15 March 2012	17 September 2013
416	24 September 2013	19 August 2014
417	11 October 2014	4 July 2015
418	22 October 2015	30 May 2016
419	2 August 2016	18 March 2017
420	29 April 2017	9 November 2017
421	23 December 2017	15 June 2018
425	2 August 2018	16 August 2019
426	22 November 2019	31 July 2020
427	28 September 2020	January 2022



Appendix B

Springvale monitoring network

Table B.1 Springvale swamp monitoring network

Site	Monitoring ID	Easting (GDA94)	Northing (GDA94)	Target	Comments
Barrier Swamp	BA1	242024	6302814	Swamp water level + Soil moisture + Quality	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly • Perched groundwater quality monthly
	BA2	242099	6303297	Swamp water level + Soil moisture + Quality	
	BA3	242070	6303923	Swamp water level + Soil moisture + Quality	
	SPR1608	241991	6304157	Perched groundwater system	
	Barrier Swamp	242026	6304243	Surface water quality	
Best Swamp	BE1	245818	6307614	Swamp water level + Soil moisture + Quality	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly • Perched groundwater quality monthly
	BE2	246565	6308274	Swamp water level + Soil moisture + Quality	
	SPR1612	246637	6308319	Perched groundwater system	
	Best Creek	247523	6309517	Surface water quality	
Carne Central Swamp	CC1	241175	6302695	Swamp water level + Soil moisture + Quality	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly • Perched groundwater quality monthly
	CC2	241131	6303290	Swamp water level + Soil moisture + Quality	
	SPR1604	241231	6303296	Perched groundwater system	
	Carne Central Swamp	239810	6303794	Surface water quality	
	Carne Central (Carne Central Creek)	241008	6303476	Surface water quality	
Carne West Swamp	CW1	239350	6303195	Swamp water level + Soil moisture + Quality	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly • Perched groundwater quality monthly
	CW2	239379	6303249	Swamp water level + Quality	
	CW3	238982	6302173	Swamp water level	
	CW4	239075	6302375	Swamp water level + Soil moisture	
	SPR1601	239808	6303789	Perched groundwater system	
	Carne West	239809	6303794	Swamp water level	

Table B.1 Springvale swamp monitoring network

Site	Monitoring ID	Easting (GDA94)	Northing (GDA94)	Target	Comments
Firetail Swamp	FS1	246893	6306485	Swamp water level + Soil moisture + Quality	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly • Perched groundwater quality monthly
	FS2	247489	6307074	Swamp water level + Soil moisture + Quality	
	SPR1611	247843	6307206	Perched groundwater system	
	Firetail	247829	6307217	Surface water quality	
Gang Gang Swamp	GG1	240283	6302299	Swamp water level + Quality	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly • Perched groundwater quality monthly
	GG2	239937	6301850	Swamp water level + Soil moisture	
	GG3	240449	6303084	Swamp water level + Soil moisture	
	SPR1603	240491	6303177	Perched groundwater system	
	Gang Gang East	240486	6303211	Surface water quality	
	Gang Gang	240553	6303429	Surface water quality	
Gang Gang West Swamp	GW1	239820	6302891	Swamp water level + Soil moisture + Quality	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly • Perched groundwater quality monthly
	GW2	240258	6303093	Swamp water level + Quality	
	GW3	240397	6303190	Swamp water level + Soil moisture	
	GW4	239906	6302926	Swamp water level	
	SPR1602	240414	6303186	Perched groundwater system	
	Gang Gang South West	240467	6303220	Surface water quality	
Junction Swamp	JS1	235774	6302686	Swamp water level	
	JS2	235800	6302753	Swamp water level	
	JS3	235857	6302737	Swamp water level	
Lost City Swamp	LCN1	237966	6299321	Swamp water level + soil moisture	Baseline data collection

Table B.1 Springvale swamp monitoring network

Site	Monitoring ID	Easting (GDA94)	Northing (GDA94)	Target	Comments
	LC1	238146	6299054	Swamp water level + soil moisture	
	LCS1	238188	6298631	Swamp water level + soil moisture	
	LCS2	238037	6298759	Swamp water level + soil moisture	
	LCY2101	238460	6298816	Perched groundwater system	
	SPR1613S	238246	6299175	Perched groundwater system	
	SPR1613D	238246	6299175	Perched groundwater system	
Marrangaroo Swamp	MS1	238861	6299170	Swamp water level + Soil moisture + Quality	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly • Perched groundwater quality monthly
	MS2	239046	6299049	Swamp water level + Soil moisture + Quality	
	SPR1607	238751	6299241	Perched groundwater system	
	Marrangaroo Swamp	237378	6298734	Surface water quality	
	Marrangaroo Creek	236347	6301221	Surface water quality	
Paddys Creek Swamp	PC1	241204	6298832	Swamp water level + Soil moisture + Quality	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly • Perched groundwater quality monthly
	PC2	240913	6298663	Swamp water level + Soil moisture + Quality	
	SPR1606	241416	6299066	Perched groundwater system	
	Paddy's Creek	241601	6299127	Surface water quality	
Pine/9 Mile Swamp	BS1 (Nine Mile)	241053	6301325	Swamp water level + Soil moisture + Quality	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly • Perched groundwater quality monthly
	BS2 (Pine)	240813	6300172	Swamp water level + Soil moisture + Quality	
	BS3 (Pine)	241980	6301243	Swamp water level + Soil moisture + Quality	
	PSS (BS4) (Pine confluence)	241959	6301202	Swamp water level + Soil moisture + Quality	
	NMSS (BS5) (Nine Mile confluence)	241913	6301328	Swamp water level + Soil moisture + Quality	

Table B.1 Springvale swamp monitoring network

Site	Monitoring ID	Easting (GDA94)	Northing (GDA94)	Target	Comments
	SPR1605	241965	6301250	Perched groundwater system	
	9 Mile Swamp	241955	6301301	Surface water quality	
	Pine/9 Mile swamp	242130	6301240	Surface water quality	
Plum Swamp	PLM2101	239095	6297595	Perched groundwater system	Baseline data collection
	PLM2102	239095	6297595	Perched groundwater system	
Sunnyside Swamp	SS1	237770	6303520	Swamp water level + Quality	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly
	SS2	237780	6303573	Swamp water level	
	SS3	237844	6303844	Swamp water level + Quality	
	SS4	237791	6304398	Swamp water level + Quality	
	SS5	237787	6304631	Swamp water level + Quality	
	Sunnyside Swamp Upstream	237809	6304220	Surface water quality	
	Sunnyside Swamp Downstream	237637	6304967	Surface water quality	
	Sunnyside Swamp Upstream Junction	236752	6305174	Surface water quality	
Sunnyside East Swamp	SSE2	238825	6303351	Swamp water level + Quality	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly
	SSE3	239075	6303566	Swamp water level + Quality	
	SS3 D/S (Sunnyside East Downstream)	239363	6303908	Surface water quality	
	Sunnyside East	239442	6304205	Surface water quality	
Sunnyside West Swamp	SW1	237230	6302421	Swamp water level	
Tristar Swamp	TS1	237555	6307286	Swamp water level + Quality	• Surface water quality monthly • Flows fortnightly
	TS2	237446	6306779	Swamp water level + Soil moisture + Quality	

Table B.1 Springvale swamp monitoring network

Site	Monitoring ID	Easting (GDA94)	Northing (GDA94)	Target	Comments
	TS3	236897	6307163	Swamp water level + Soil moisture + Quality	• Swamp groundwater quality monthly
	Tristar (Springvale)	236644	6307057	Surface water quality	
Twin Gully Swamp	TG1	236436	6308767	Swamp water level + Soil moisture + Quality	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly
	TG2	236043	6308932	Swamp water level + Soil moisture + Quality	
	Twin Gully (Springvale)	235912	6308894	Surface water quality	
Wishbone Swamp	WB12101	238830	6298471	Perched groundwater system	Baseline data collection
	WB12102	238830	6298471	Perched groundwater system	
	WB32101	238957	6298378	Perched groundwater system	
	WB32102	238957	6298378	Perched groundwater system	
Wolgan East Swamp	WE1	236387	6304057	Swamp water level	• Surface water quality monthly • Flows fortnightly • Swamp groundwater quality monthly
	WE2	236419	6304178	Swamp water level	
	East Wolgan Upstream	236262	6303726	Surface water quality	
	Eat Wolgan Downstream	236606	6304856	Surface water quality	
	East Wolgan Downstream Junction	236684	6305200	Surface water quality	
Wolgan River	Wolgan River (Wolgan Valley)	240256	6320189	Springvale water quality site	• Surface water quality monthly • Flows monthly
	Wolgan river Downstream	235432	6309941	Springvale water quality site	• Groundwater quality weekly
Springvale discharge points	Bore 6	238507	6304494	Springvale water quality site	
	Bore 8	239763	6304072	Springvale water quality site	
	LDP006	230519	6300198	Springvale water quality site	

Table B.2 Springvale shallow groundwater system monitoring network

Monitoring ID	Easting (GDA94)	Northing (GDA94)	Depth (mbgl)	Target	Comments
AP5PR	236529	6308528	94.0	Banks Wall sandstone	Groundwater quality sampled quarterly
AP1105	238865	6305671	75.7	Banks Wall sandstone	
RSE	236840	6304191	49.8	Burralow Formation	Manually measured
RSS	238072	6303500	43.9	Burralow Formation	Groundwater quality sampled quarterly
SPR1101	238498	6303632	47.4	Burralow Formation	Damaged by subsidence
SPR1104	239747	6303190	47.0	Banks Wall sandstone	Groundwater quality sampled quarterly
SPR1106	239983	6304218	86.2	Banks Wall sandstone	
SPR1107	239745	6302337	55.6	Burralow Formation	Damaged by subsidence
SPR1108	239841	6301074	76.1	Burralow Formation	Damaged by subsidence
SPR1109	239188	6303324	60.1	Burralow Formation	Groundwater quality sampled quarterly
SPR1110	238702	6302625	65.8	Banks Wall sandstone	
SPR1111	240383	6303682	60.9	Banks Wall sandstone	
SPR1112	240836	6303010	50.0	Burralow Formation	
SPR1113	240617	6302172	60.6	Burralow Formation	
SPR1210	240965	6301652	131.2	Burralow Formation	
SPR1210R	239694	6300050	70.0	Burralow Formation	

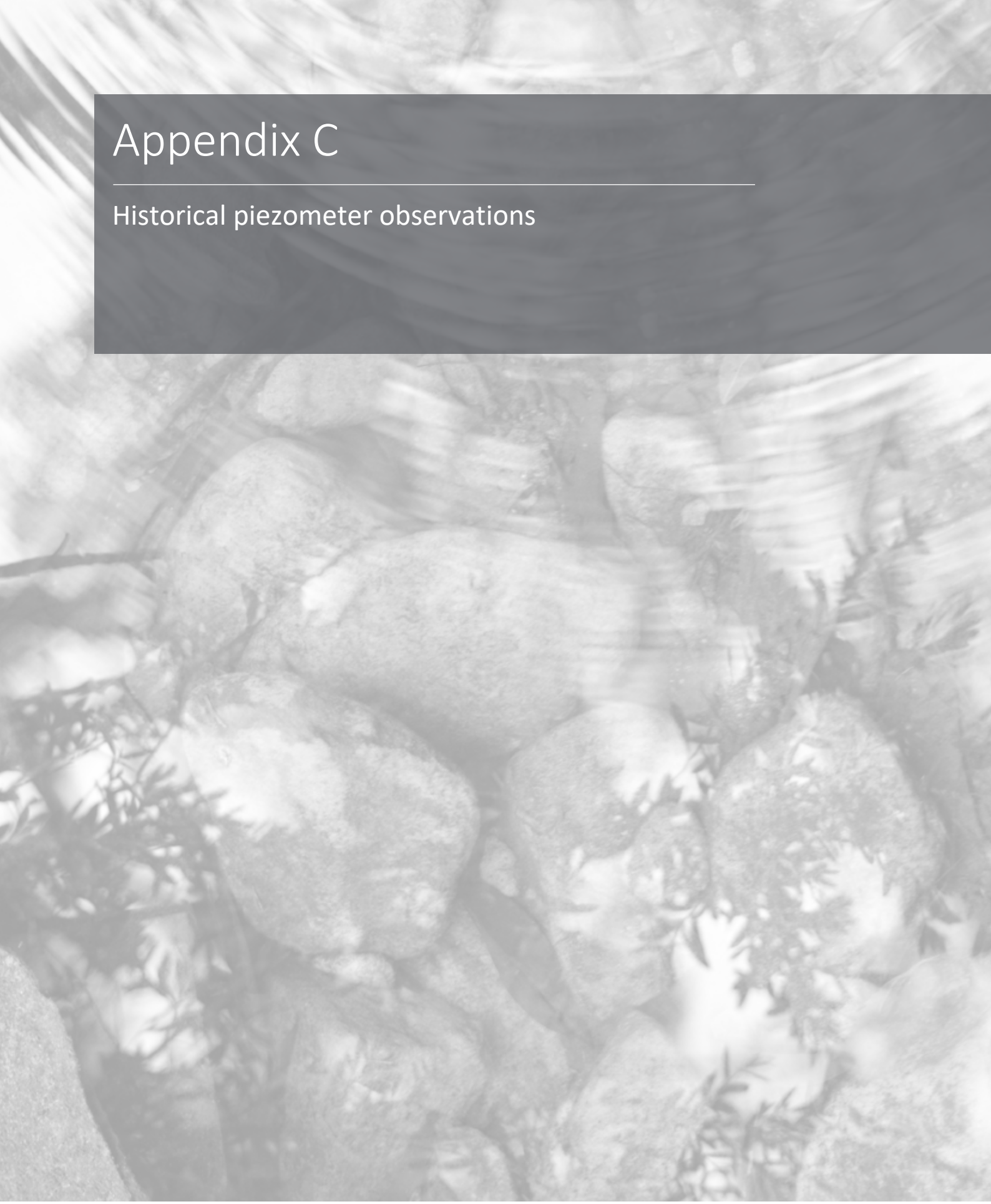
Table B.2 Springvale shallow groundwater system monitoring network

Monitoring ID	Easting (GDA94)	Northing (GDA94)	Depth (mbgl)	Target	Comments
SPR1211	240237	6298920	133.8	Banks Wall sandstone	Damaged by subsidence
SPR1301	239275	6299271	86.7	Banks Wall sandstone	Groundwater quality sampled quarterly
SPR1401	239716	6297828	46.6	Burralow Formation	
SPR1402	238453	6303547	92.9	Burralow Formation	Vandalised
SPR1403	238163	6303489	51.1	Burralow Formation	Damaged by bushfire
SPR1806	239202	6297962	57.2	Burralow Formation	Groundwater quality sampled quarterly
SPR1807	239628	6299681	73.5	Burralow Formation	
SPR1808	239495	6298643	62.6	Burralow Formation	

Table B.3 Springvale vibrating wire monitoring network

Monitoring ID	Easting (GDA94)	Northing (GDA94)	Target aquifers	Target depths	Comments
SPR37	239078	6300367	AQ4, AQ4 , AQ3, AQ3, semi permeable layer, AQ1, AQ1	110, 135, ***165,*** 187, 260, ***320, 350***, 405	
SPR38	240061	6298330	AQ4, AQ4, AQ4, AQ3, AQ3, semi permeable layer, AQ1, AQ1	80, 100, 135, 190, 230, ***300, 355, 370***	Lower sensors damaged by subsidence
SPR1208	240965	6301652	AQ4, AQ4, AQ3, AQ3, AQ2, AQ1, AQ1, AQ1	***90, 130, 226, 303, 330, 380, 411, 421***	Damaged by bushfire
SPR1210	239694	6300050	AQ6, AQ4, AQ3, SP2, AQ2, AQ1	76, 160, 224, 308, 326, 376, 388	
SPR1302	239716	6297828	Lithgow seam, AQ1, AQ2, AQ3, AQ3	390, 370, 310, 271, 200	
SPR1804	240542	6299690	AQ1, AQ2, AQ3, AQ4, AQ5, AQ6	***345, 291, 217, 118, 69, 38***	Damaged by subsidence
AP10PR	237246	6306781	AQ1, AQ1, SP1, AQ2, AQ3, AQ3, AQ4, AQ4	343, 327, 300, ***270***, 248, 205, 150, 103, 60	

Notes: Bold and italicised numbers indicate sensors that are faulty or disconnected.



Appendix C

Historical piezometer observations

Table C.1 Swamp groundwater level history

Swamp name	Piezometers	Swamp characteristics and mining history
Barrier Swamp	BA1 BA2 BA3 SPR1608	There are three piezometers installed in Barrier Swamp and the perched groundwater system is monitored by SPR1608. Groundwater at Barrier swamp is primarily fed by the outcropping of the YS4 ply which runs parallel to the length of the swamp. The swamp terminates downstream intersecting with the YS5, YS5a and YS6 plies. From bore logs, the surface peat layer is typically 0.3 m to 0.6 m thick, under which lies a clayey sand or sand that transitions into a weather sandstone. Barrier Swamp is a water logged swamp that exhibits stable water levels with consistent groundwater base flow contribution. Water levels at the three piezometers reflect the general trends of the CRD curve and respond to rainfall events in relative agreement.
Best Swamp	BE1 BE2 SPR1612	There are two piezometers installed in Best Swamp and the perched groundwater system is monitored by SPR1612. The profile is varied with the peat layer in the upstream section at BE1 approximately 0.7 m thick and at BE2 it is 0.3 m thick. At BE1 beneath the peat is a think 0.2 m layer of clayey sand that transitions in to a 0.5 m thick weathered sandstone soil that terminates on bedrock. At BE2 beneath the peat is a 0.2 m later of sand, then a 0.4 m layer of clayey sand with bands of clay, then a 0.6 m thick weathered sandstone soil than terminates on bedrock. Best Swamp is a waterlogged swamp with water levels strongly correlated to the CRD curve particularly upstream at BE1. The declining water levels since installation to January 2020 reflect the below average rainfall conditions since 2016.
Carne Central Swamp	CC1 CC2 SPR1604	There are two piezometers installed in Carne Central Swamp and the perched groundwater system is monitored by SPR1604. The swamp is fed by outcropping of the YS4 ply in the upstream section near CC1 and YS5 ply near CC2. Further downstream Carne Central hanging swamp is supported outcropping of the YS5, YS5a and YS6 plies near the cliff edge. The upstream section at CC1 has a 0.2 m of root mat followed by a 0.2 m of sandy clay, then by a 0.5 m later of clayey sands and terminates on weathered sandstone bedrock at 0.95 m. the downstream section at CC2 is characterised by a 0.3 m surface peat layer followed by a 0.3 m clayey sand layer followed by a 0.2 m sandy clay layer that transitions into a weathered sandstone profile (0.4 m thick). The clay layers within the swamp profile are likely related to the outcropping plies. Carne Central swamp is a reference swamp with water levels strongly correlating to the CRD curve. The sharp drawdowns observed in the hydrograph are sampling spikes caused by bore purging. The declining water levels from 2016 to early 2020 at CC1 reflect the drought conditions experienced on the plateau. During this time, Carne Central Swamp has transitioned from a permanently waterlogged swamp into a periodically waterlogged swamp. Following the above average rainfall conditions since February 2020 waterlogged conditions were once again observed at the swamp.
Firetail Swamp	FS1 FS2 SPR1611	There are two piezometers installed in Fire Tail Swamp and the perched groundwater system is monitored by SPR1611. The profile at FS1 is relatively deep at 2.9 m with a 0.4m surface peat layer, followed by a 2.5 m layer of clayey sands with two 0.2 m bands of clay between 1 m and 1.5 m depth, and terminating on bedrock. The profile at FS2 is relatively shallow at 0.5 m deep with a 0.3 m surface peat layer followed by a think 0.1m sandy layer that transitions into the weathered sandstone bedrock. Fire Tail Swamp is a reference swamp located out of the extraction area. Water levels at FS1 located upgradient, fluctuate readily and appear to be influenced by rainfall variation. FS2 is observed to have a baseflow contribution that keeps the swamp waterlogged.

Table C.1 Swamp groundwater level history

Swamp name	Piezometers	Swamp characteristics and mining history
Twin Gully	TG1 TG2	There are two piezometers installed in Twin Gully Swamp. Twin Gully lies predominantly over the Banks Wall sandstone and commences between the YS5 and YS6 plies where hanging swamps are observed. On the southern side of the swamp, a hanging swamp outcrops from the YS6 ply where there is a permanent pool of water. Twin Gully Swamp is highly channelized with free-flowing surface water. The swamp is characterised by a surface peat layer above a sandy/weathered sandstone profile. TG1 is located on the edge of the swamp and there is only a think root mat layer, whereas TG2, which is located within the swamp, there is a 0.3m peat layer. The depth of the swamp varies from 0.9 m to greater than 1.1 m. It is noted the total depth from the bore log of TG1 is not representative as drilling was terminated prior to refusal on bedrock due to collapse of the borehole. Water levels are correlated to the CRD curve and the trends between TG1 and TG2 are very similar. Long term water level trends at Twin Gully are relatively stable. This suggests there is a large groundwater baseflow contribution to the swamp that maintains waterlogged conditions.
Tristar Swamp	TS1 TS2 TS3	The swamp consists of two arms that converge in the main swamp valley. The swamp commences below YS5. Tristar. Two substantial hanging swamps coincide with the location of YS5 above the upper reaches of the two arms of the swamp. A large proportion of the swamp is situated within the Banks Wall Sandstone. The swamp is characterised by a peaty/highly organic surface soil layer that ranges from 0.3 m to 1.1 m, and a sandy profile that extends to the weathered sandstone bedrock. The valley walls are steep, and the swamp is highly channelised with free-flowing surface water observed down gradient at TS3. The swamp profile is very deep compared to other swamp on the plateau with the bedrock encountered 3.95 m below ground level at TS1 and hole termination beyond 2 m due to collapse at TS2. The swamp at TS1 is rainfall dependent with water levels only observed during periods of prolonged above average rainfalls. The swamp at TS2 is strongly influenced by the prevailing rainfall conditions closely following the CRD curve. The swamp at TS3 is permanently waterlogged with evidence of a strong groundwater contribution. Water levels remained stable at TS3 through the drought from 2016 and rainfall events do not significantly influence water levels compared toTS1 and TS2.
East Wolgan Swamp	WE1 WE2	The swamp intercepts the YS4 ply that runs along the length of the swamp. The bore logs show the depth of the swamp at WE1 is 2.8m with a 0.5m surface peat layer, followed by a 0.8m sand layer, followed by a 1.5m clayey sand layer and terminating on sandstone bedrock. At WE2, a 1m thick peat layer is present, followed by a 0.3m clayey sand layer and terminates on sunstone bedrock. Wolgan East Swamp was within the Angle of Draw of Springvale Longwall 411 in July 2006 and undermined by Angus Place Longwall 960 in August and September 2011. It was also used as an emergency licenced discharge point (LDP004) for Springvale from 2005 to 2009. Water levels in East Wolgan are believed to be rainfall dependent with little groundwater contribution. The elevated water levels on the hydrograph apparent during 2005, 2006, 2008 and early 2009 are due to the upstream discharge from LDP004. It is difficult to characterise the swamp's natural water level behaviour prior to 2005 because the swamp was subject to mine water discharge at the time of installation and was soon passed by LW411.
Sunnyside West Swamp	SW1	The swamp is located south west, upgradient of Sunnyside Swamp. Sunnyside West swamp is a shrub swamp lying on a local high point with no visible surface water. The bore log shows there is a 0.4 m peat layer above a 1.1 m clayey sand layer, and below that a 0.5 m silty clay and terminates at 2 m on siltstone. The groundwater is likely from the perched aquifer/sub surface flow from above the YS1 ply. Sunnyside West Swamp was undermined by LW412 which commenced in December 2007. It is difficult to assess the pre-mining hydrogeological conditions of the swamp as the baseline period is short. Water levels are highly variable and correlate to periods of above average rainfall.

Table C.1 Swamp groundwater level history

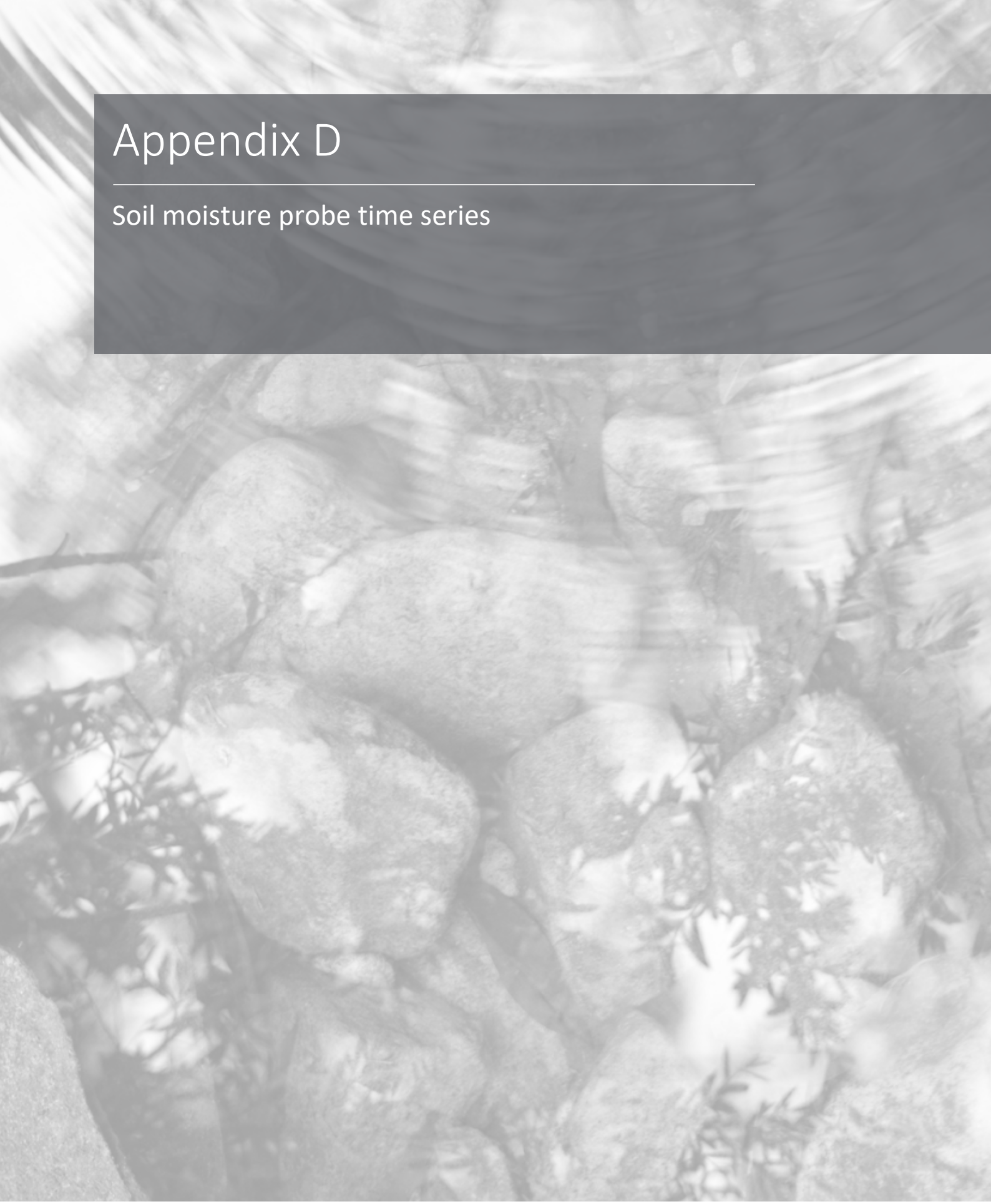
Swamp name	Piezometers	Swamp characteristics and mining history
Sunnyside Swamp	SS1 SS2 SS3 SS4 SS5	Sunnyside Swamp generally commences below YS2, however the western branch (containing SS3) commences between YS1 and YS2. The swamp likely receives seepage contribution from above the YS2 to YS4 plies. Sunnyside swamp has not been undermined but was within 600 m of LW413 and LW414. No mining impacts have been observed. Drawdown from groundwater sampling is evident in some piezometers. Sunnyside Swamp has been a permanently waterlogged swamp until the drought between 2016 to 2020, where the upper reaches of the swamp at SS1, SS2 and SS3 were observed to become dry. Waterlogging resumed following above average rainfall from February 2020.
Sunnyside East Swamp	SSE1 SSE2 SSE3	Groundwater seepage is likely from the YS4 ply where it outcrops above the edges of the swamp. The swamp alignment coincides with a significant lineament that trends parallel with the Deanes Creek Lineament Zone. Sunnyside East Swamp profile is relatively deep compared to other swamps on the plateau with logs suggesting depths of approximately 1.8 m to 2.3 m. The swamp profile is characterised by a surface layer of peat with depths of 0.2 m to 0.4 m, below that a clayey sand layer with thicknesses of 1.0 m to 1.5 m, below that a think interface approximately 0.2 m to 0.4 m between the swamp and the underlying bedrock. This interface is a sandy gravel in the upgradient section and a silty clay in the downgradient section. It is noted that SSE2, which monitors the middle section, may not provide a full representation of the swamp as the installation reached refusal on tree roots and did not go all the way to the bedrock. Sunnyside swamp water level impacts were first observed towards the end of LW414 when it intersected with the lineament underlying the swamp. Water levels made a subsequent recovery but when the Deanes Creek lineament was undermined by LW415, changes to the groundwater regime were observed. The swamp was dry by the time LW417 and LW418 directly undermined the swamp.
Carne West Swamp	CW1 CW2 CW3 CW4 SPR1601	The hanging swamp upstream of Carne West coincides with the outcropping of the YS2 ply and the swamp terminates downstream of YS5. Carne West likely receives groundwater input from above the YS3 and YS4 plies, and to a lesser extent YS5 plies. CW1 and CW2 are installed below the YS4 ply. CW3 is installed above and the YS3 ply and CW4 is installed above the YS4 ply. SPR1601 is installed above YS6. The swamp alignment also coincides with the regional Deanes Creek lineament structural zone. Data from the four swamp bore logs were used to characterise the swamp. There is a 0.4 to 0.8 m peat layer, and below that a layer of sand/gravelly sand that transitions into the weathered bedrock. At CW3 there is a clay presence that is likely related to the YS3 ply. The depth of the swamp varies from 1 to 1.5 m. The first indications of impact at Carne West swamp were observed in September 2013 towards the completion of LW415 when it approached the Deanes Creek lineament. The significant water level decline was more apparent by September 2014 when the lineament was once again approached by LW416. By the time Carne West was directly undermined by LW418 and LW419, the swamp had become dry.
Junction Swamp	JS1 JS2 JS3	Three piezometers were installed in the Burralow Formation using a drill rig. The profile consists of a thin topsoil with a clayey sand layer than transitions into the sandstone bedrock. At JS1, YS1 ply is present at the base of the borehole. Since installation in May 2002, water levels at JS1, JS2 and JS3 show a strong correlation with rainfall and CRD except for the period when LW408 was extracted from February 2003 to December 2003. During this period water levels were out on sync with the CRD and remained stable to slightly declining despite increasing CRD.

Table C.1 Swamp groundwater level history

Swamp name	Piezometers	Swamp characteristics and mining history
Gang Gang West Swamp	GW1 GW2 GW3 GW4 SPR1602	The upper reach of the swamp starts just above the YS4 ply and the swamp terminates on the YS5 ply. A lineament is mapped along the length of the swamp and is correlated to the Deanes Creek lineament. Data from GW1 and GW2 bore logs and the GW3 soil analysis were used to characterize the swamp profile. The top layer comprises of a highly organic sandy clay/peat about 0.3 m thick. Below this is a layer of sand that transitions into the weathered sandstone bedrock. Mining impacts were observed in the upper reaches at GW1 in August 2014 toward the completion of LW416 as it intersected the Deanes Creek lineament. The subsequent longwalls saw increasing changes due to decreasing groundwater baseflow contribution. By the time the swamp was directly undermined by LW420, the swamp had become dry.
Gang Gang Swamp	GG1 GG2 GG3	Gang swamp intercepts YS2 to YS5 plies. A lineament is mapped along the length of the swamp and is correlated to the Deanes Creek lineament. Data from the GG1 bore log and the soil analysis from GG2 and GG3 were used to characterise the swamp profile. The swamp is characterised by a thin shallow organic peat/clay layer less than 0.3 m; overlying a sandy gravel and weathered sandstone bedrock. In some areas, e.g. at GG2, a very fine sand/clay layer approximately 20cm thick is observed at the interface between the bedrock. Gang Water level declines were first observed at GG1 in August 2016 during the extraction of LW419. GG2 and GG3 were installed October 2016 and only capture the respective declines. In August 2017, GG1 displayed a rapid decline in water levels as LW420 advanced. Downgradient at GG3, water levels remained elevated until February 2018 until LW421 undermined the swamp. Gang Gang Swamp remained predominately dry after April 2018 with brief responses to prolonged periods of above average rainfall.
Pine Swamp	BS2 BS3 BS4 SPR1605	There are three piezometers installed in Pine Swamp and the perched groundwater system is monitored by SPR1605. Pine Swamp intercepts the YS2 and YS3 plie in the upper reaches, with the confluence with Nine Mile Swamp occurring below the YS4 ply. A mapped lineament coincides with the strike of the swamp. The top layer consists of a clayey sand/sand with high organics approximately 0.8 m to 1 m in thickness. At BS4, a thin 0. 2 m peat layer is present above this layer. There is a thin sand interface approximately 0.2 m thick above the weathered sandstone bedrock but at BS4 this interface is slightly thicker at 0.4 m. At BS4 where the YS4 ply runs parallel to the swamp and a clay band is observed beneath the peat layer. Pine Swamp has been a historically waterlogged swamp with stable water level trends that suggest a significant component of groundwater contribution. In February 2019, when the upper reaches of the swamp were undermined LW425, water levels in the upper reaches rapidly declined and BS2 became dry three months later in May 2019. Downgradient at BS3 and BS4, water levels began to show indications of decline in mid-2019 and commencing rapid decline in October 2019. Since February 2020, the above average rainfalls have caused water levels return to pre-mining conditions in the lower reaches of the swamp at BS3 and BS4. However, in the upper reaches at BS2 the brief water level increases suggest an altered groundwater regime with the primary contribution now from precipitation.

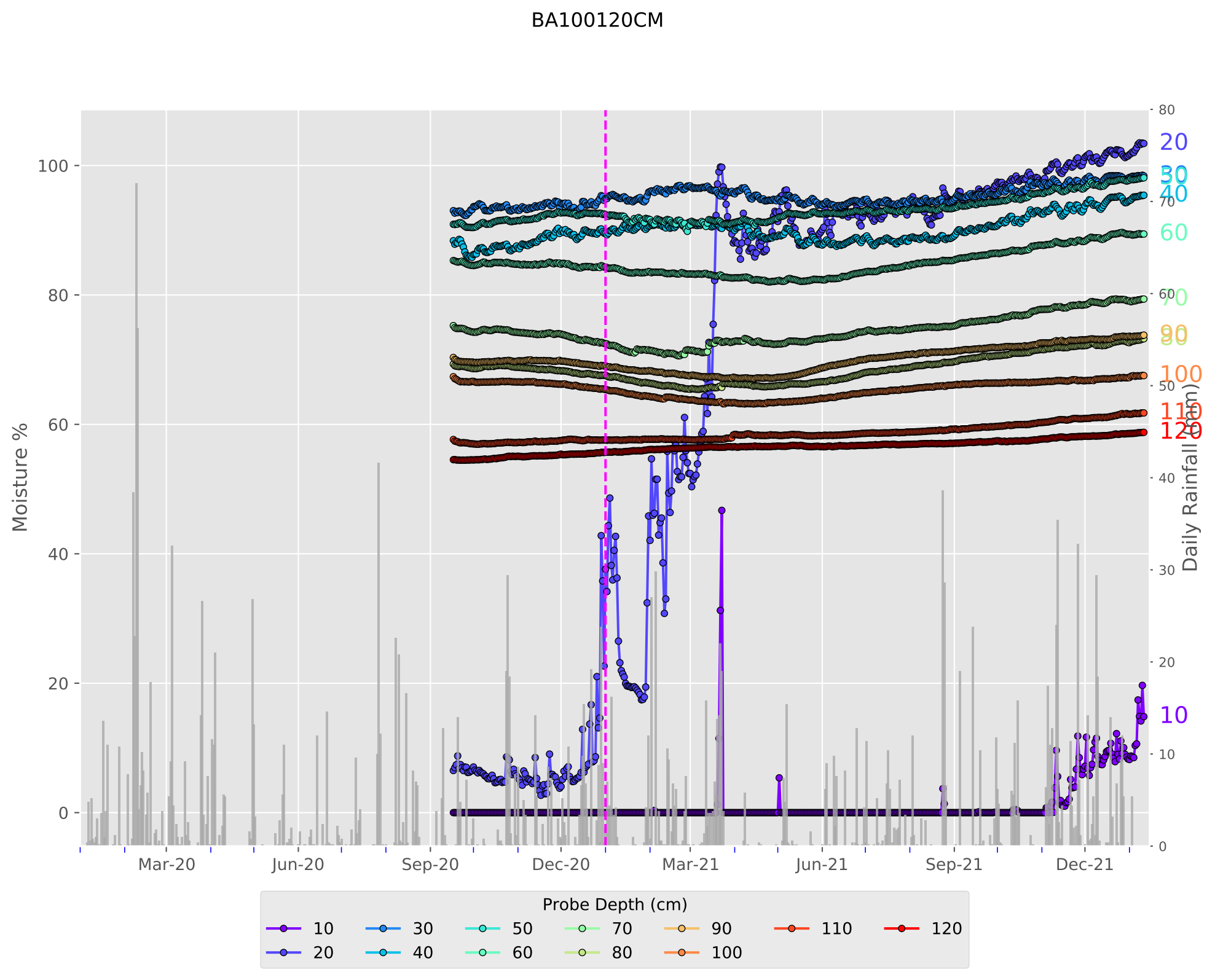
Table C.1 Swamp groundwater level history

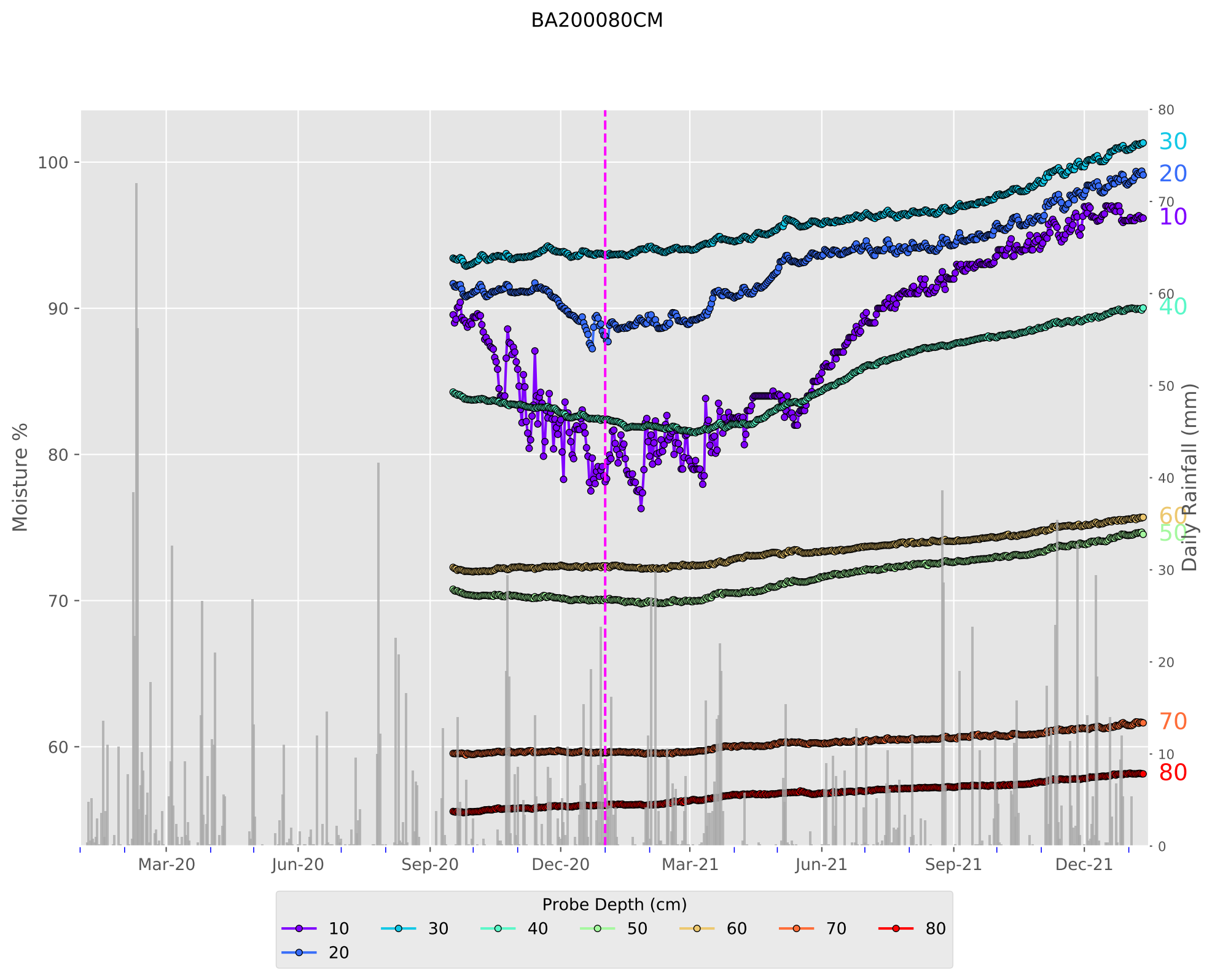
Swamp name	Piezometers	Swamp characteristics and mining history
Nine Mile Swamp	BS1 BS5 SPR1605	The YS3 ply runs parallel to the length of the swamp and the confluence with Pine Swamp occurs around the YS4 outcrop. Pine Swamp receives groundwater seepages from YS2 to YS4 plies. There is a major NNE-SSW fault zone in this area that intersects with both LW425, LW426 and Pine and Nine Mile Swamps. The swamp profile is varied. In the upstream section, the bore log at BS1 does not penetrate the full depth of the swamp due to refusal on caving at 1.1 m. This top layer consists of a highly organic clay. In the downstream section at BS5 there is a 0.4 m peat top layer that transitions into a peaty clay layer (0.3 m thick) and below that is a 0.3 m thick layer of gravelly sand that terminates on weathered sandstone bedrock at 1 m. Nine Mile swamp is a historically waterlogged swamp with relatively stable water levels. Drawdown from groundwater sampling is evident. From mid-2017 water levels at BS1 began declined in response to drought in 2016. The water level decline at BS1 was accelerated during the extraction of LW425 (800 m from BS1) and in February 2019 when the longwall passed through the Pine Swamp lineament. Towards the end of extraction of LW425, when the mining face was approximately 600m away from Nine Mile Swamp, BS1 went dry and BS5 was observed to decline rapidly. The rains in February 2020 recharged water levels at Nine Mile Swamp. BS5 water levels returned to historic levels and have remained stable. Water levels at BS1 have also recovered but appear to respond to rainfall more readily than previously observed.
Marrangaroo Swamp	MS1 MS2 SPR1607	The Marrangaroo Swamp overlies YS3 to YS6 plies along its length. The bore logs indicate the swamp depth is approximately 1.3 m to 1.5 m. A 0.3 m peat layer is only present in the upper segment (MS2 and MS3) of the swamp. The swamp has a sandy profile above a weathered sandstone bedrock. Bore logs indicate the presence of a clayey layer in the order of 0.5 m to 0.6 m thickness at swamp piezometers. Marrangaroo Swamp is a waterlogged swamp and historical records show a strong correlation between water levels and CRD. The three swamp piezometers display similar water level fluctuations. The continued below average rainfall since mid-2016 resulted in declining swamp water levels. Marrangaroo Swamp hydrograph displayed less stability as the groundwater contribution lessened from YS plies. In February 2020, the above average rainfalls recharged the swamps to pre-drought water levels where they have since remained stable. Mining has not occurred within the vicinity of Marrangaroo Swamp but planned longwalls 428 to 432 underlie the swamp.
Paddys Creek Swamp	PC1 PC2 SPR1606	There are two piezometers installed in Paddy's Creek Swamp and the perched groundwater system is monitored by SPR1606. The swamp overlies YS4 to YS6 plies along its length. The bore logs indicate the swamp depth is approximately 1.2 m to 1.6 m. The swamp is characterised by a 0.3 m peat layer followed by a clayey sand before refusing on weathered bedrock. Paddys Creek Swamp is located to the south east of LW425. Although the longwall did not directly undermine the swamp, it was within 600 m. Water levels downstream at PC1 began to decline in late 2018 despite an increasing rainfall. Water level declines at PC1 were likely influenced by below average rainfall as groundwater levels have recovered following above rainfall from February 2020. Water levels at PC2 (upstream) remained stable throughout this time.

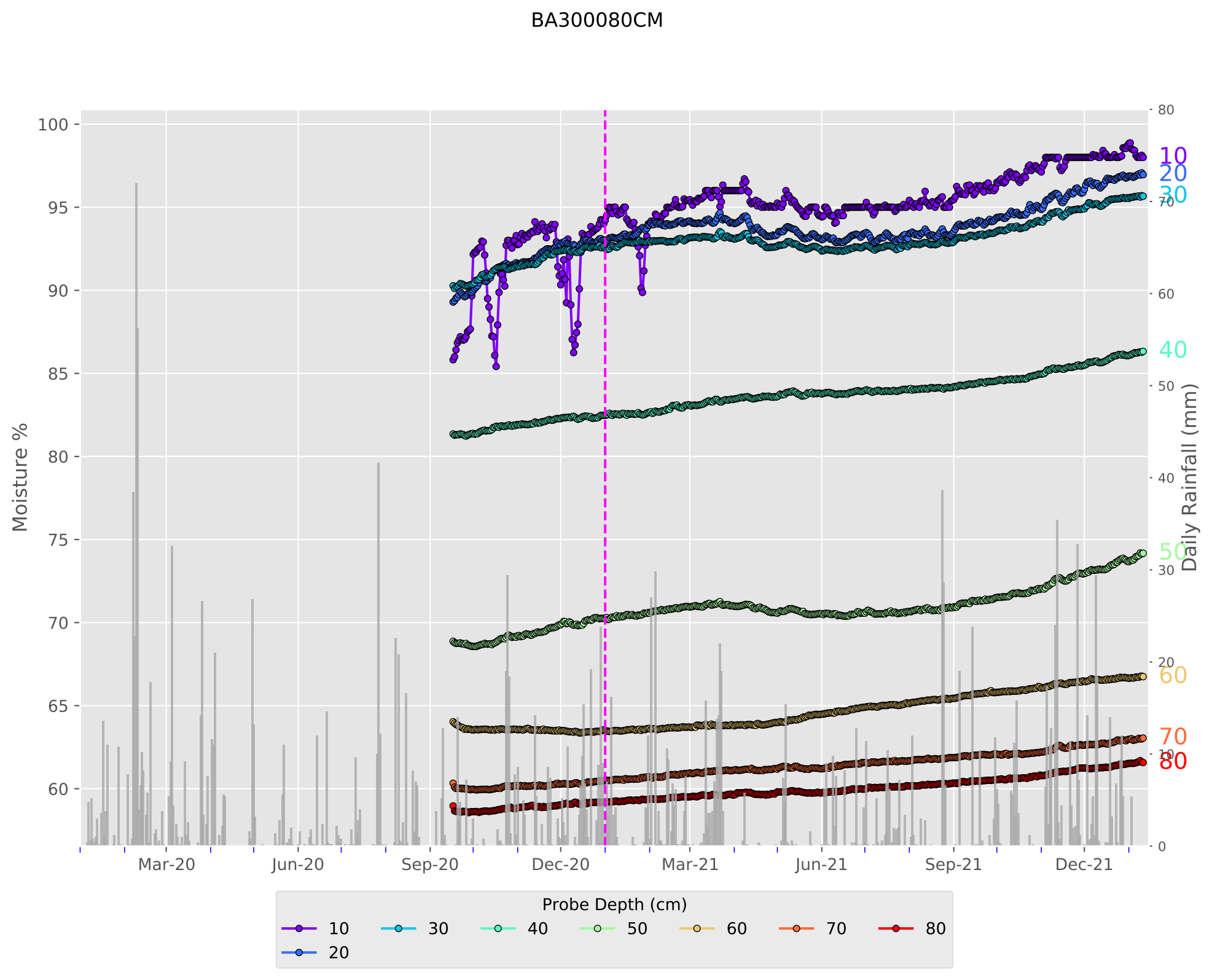


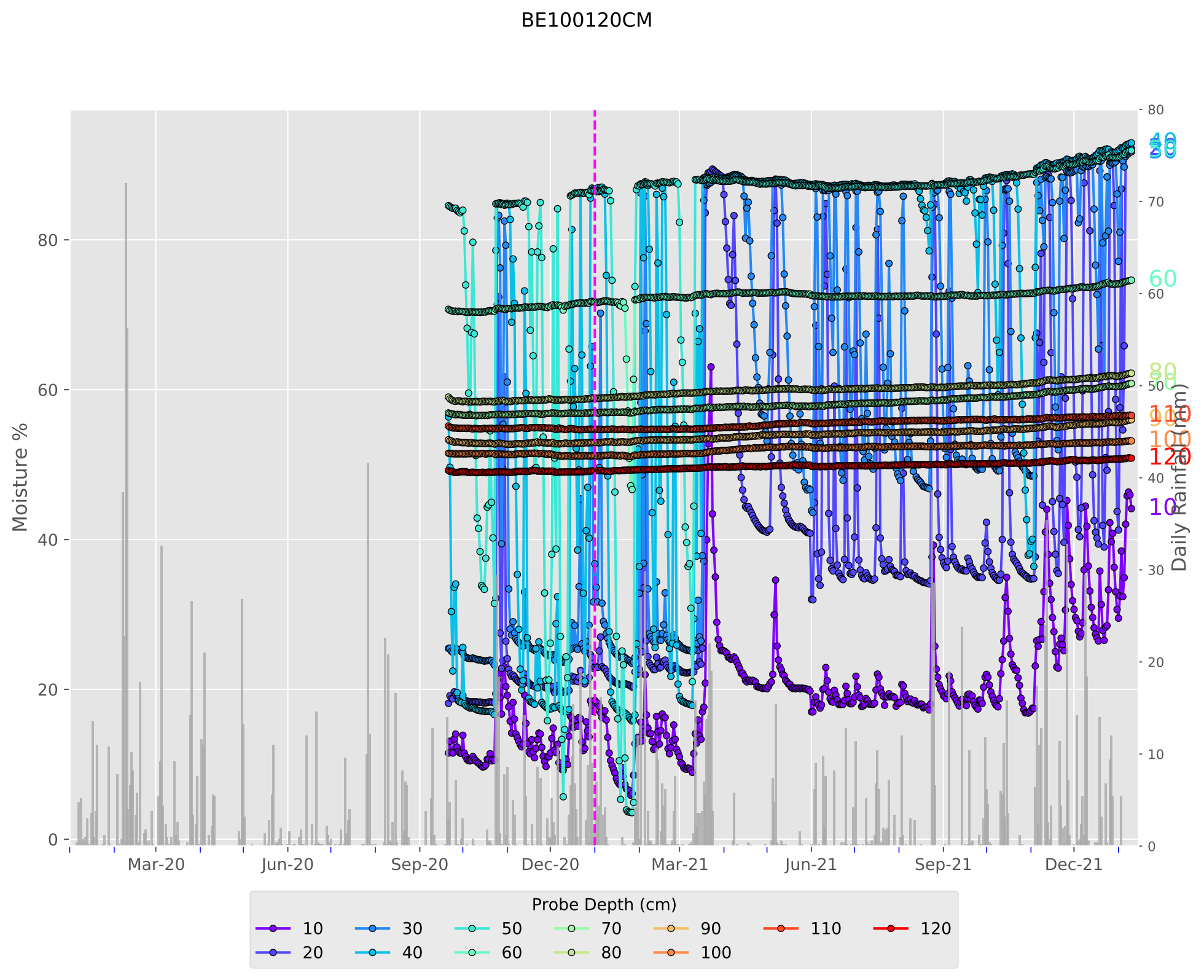
Appendix D

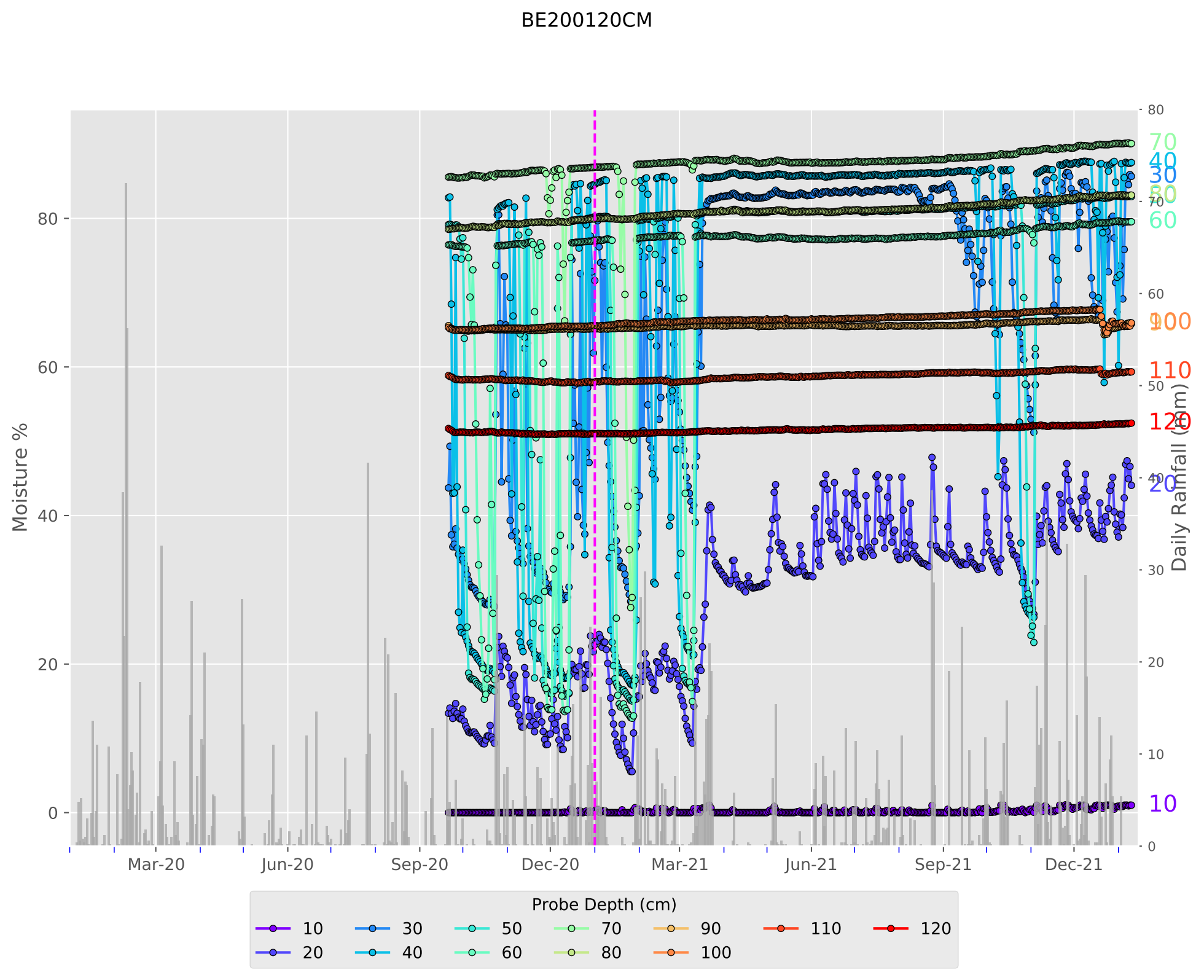
Soil moisture probe time series

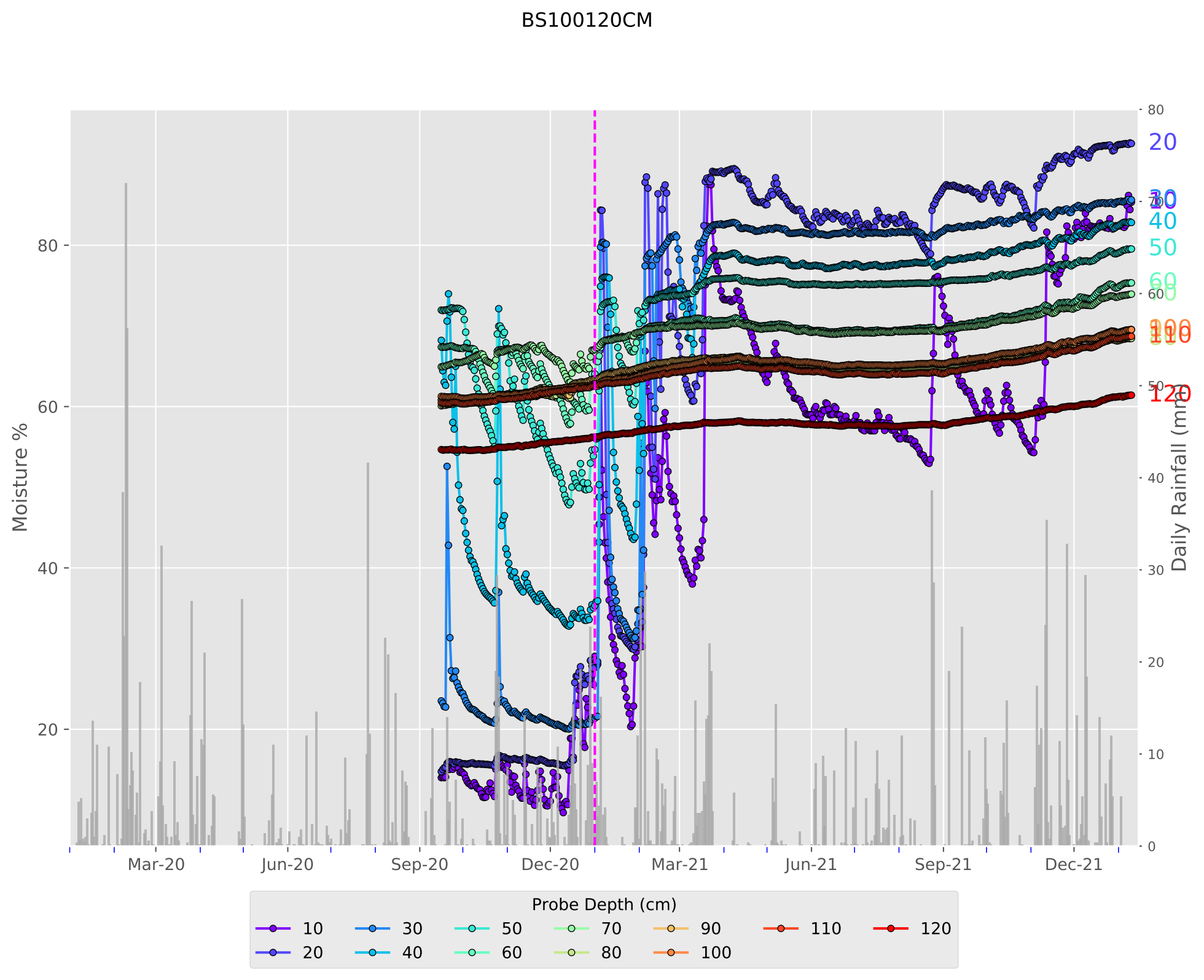

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60
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0
80
70
60
50
40
30
20
10
0
20
30
40
60
70
80
90
100
110
120
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

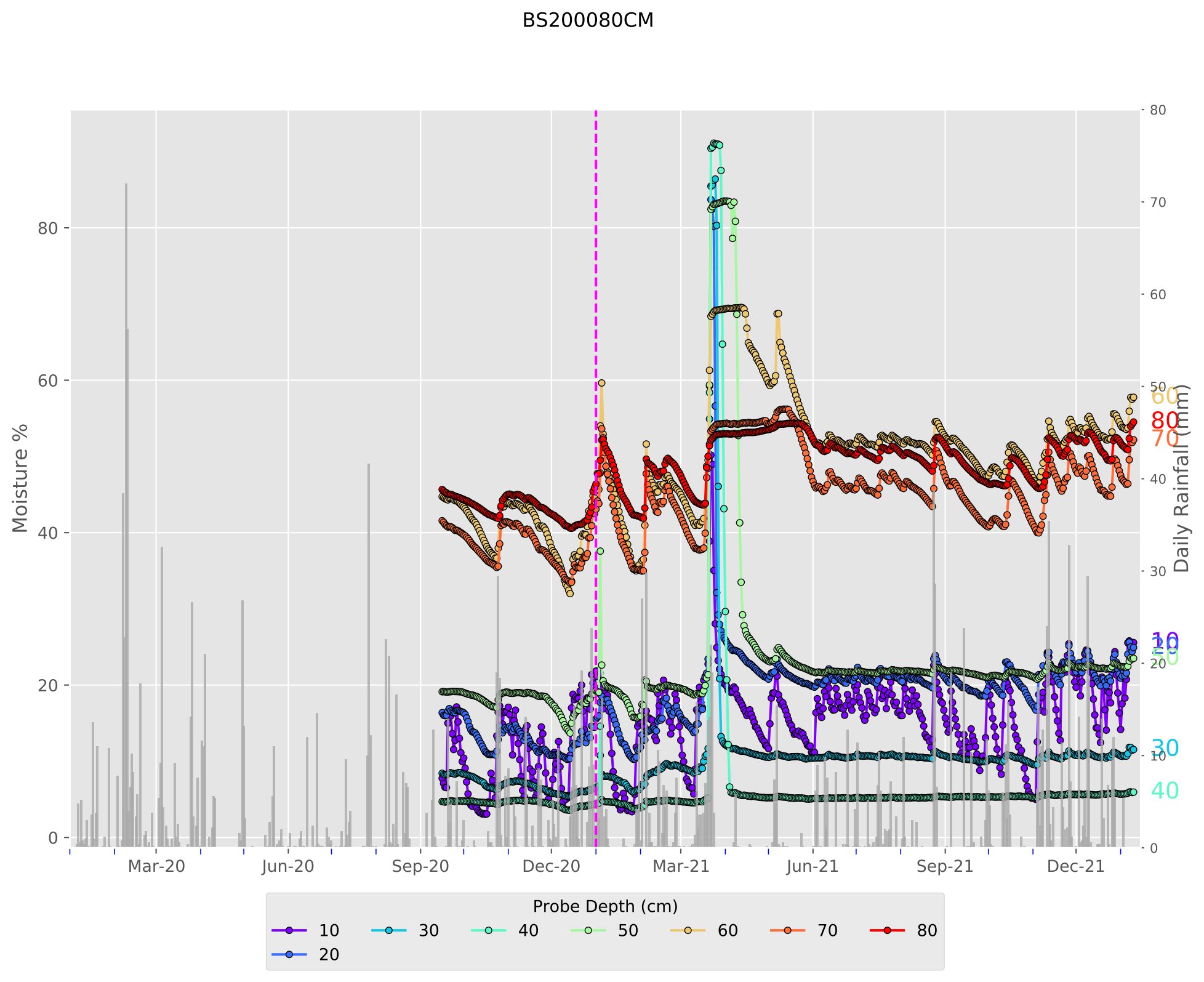

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40
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0
30
20
10
40
60
50
70
80
Mar-20
Jun-20
Sep-20
Dec-20
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Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
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50
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70
80

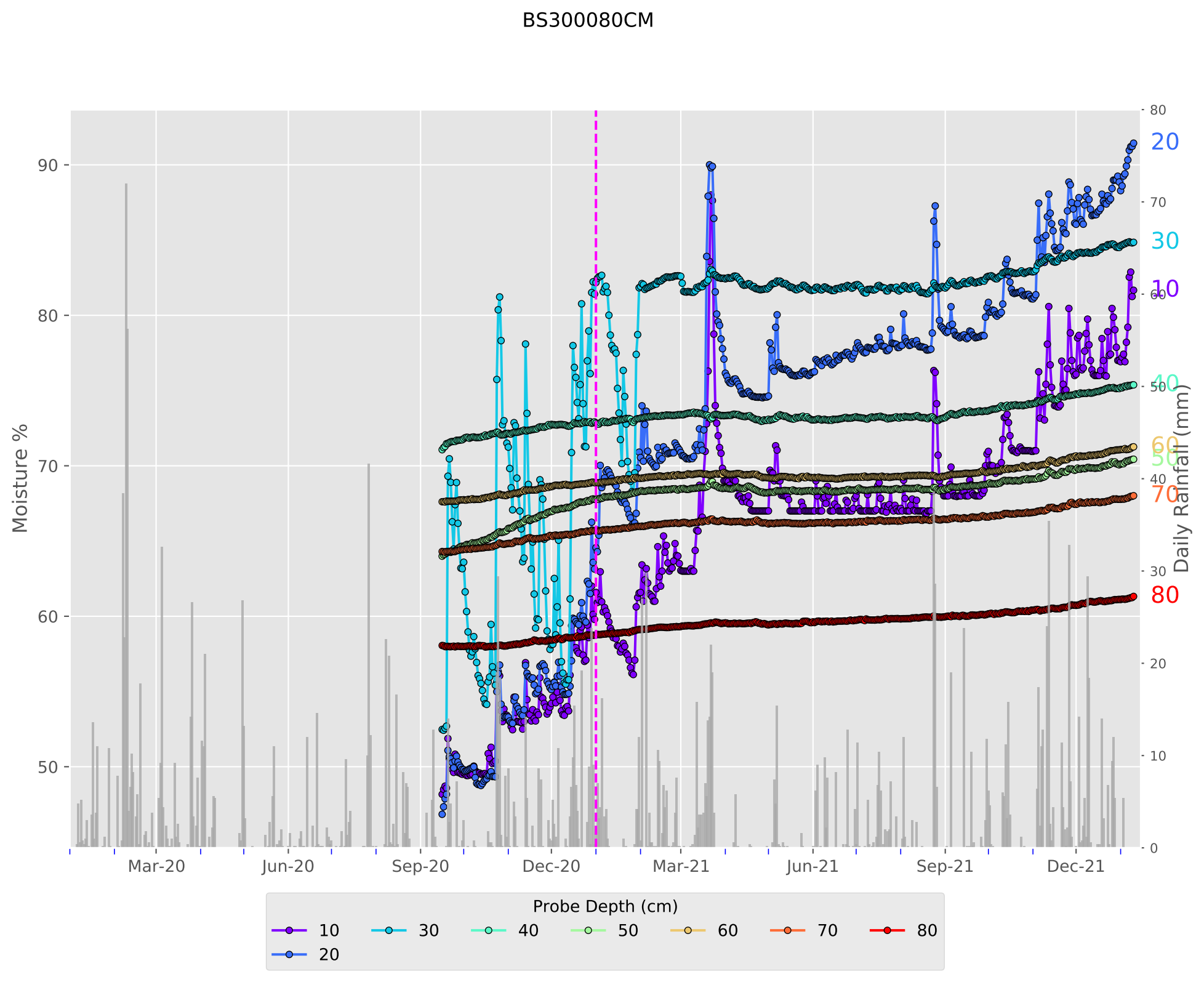

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Moisture %
Daily Rainfall (mm)
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60
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30
20
10
0
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
10
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80
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70
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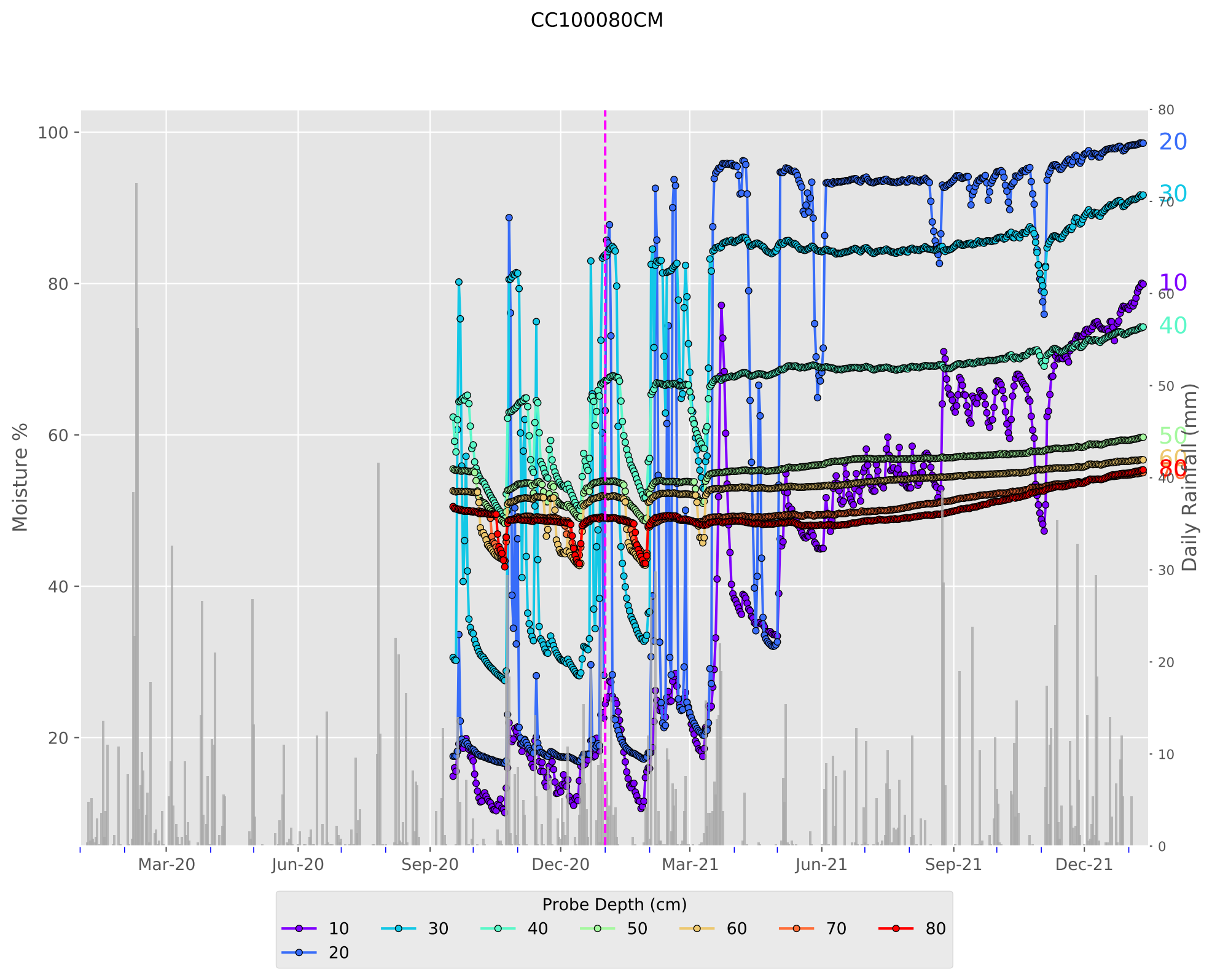

BE100120CM
Moisture %
Daily Rainfall (mm)
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20
40
60
80
0
10
20
30
40
50
60
70
80
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

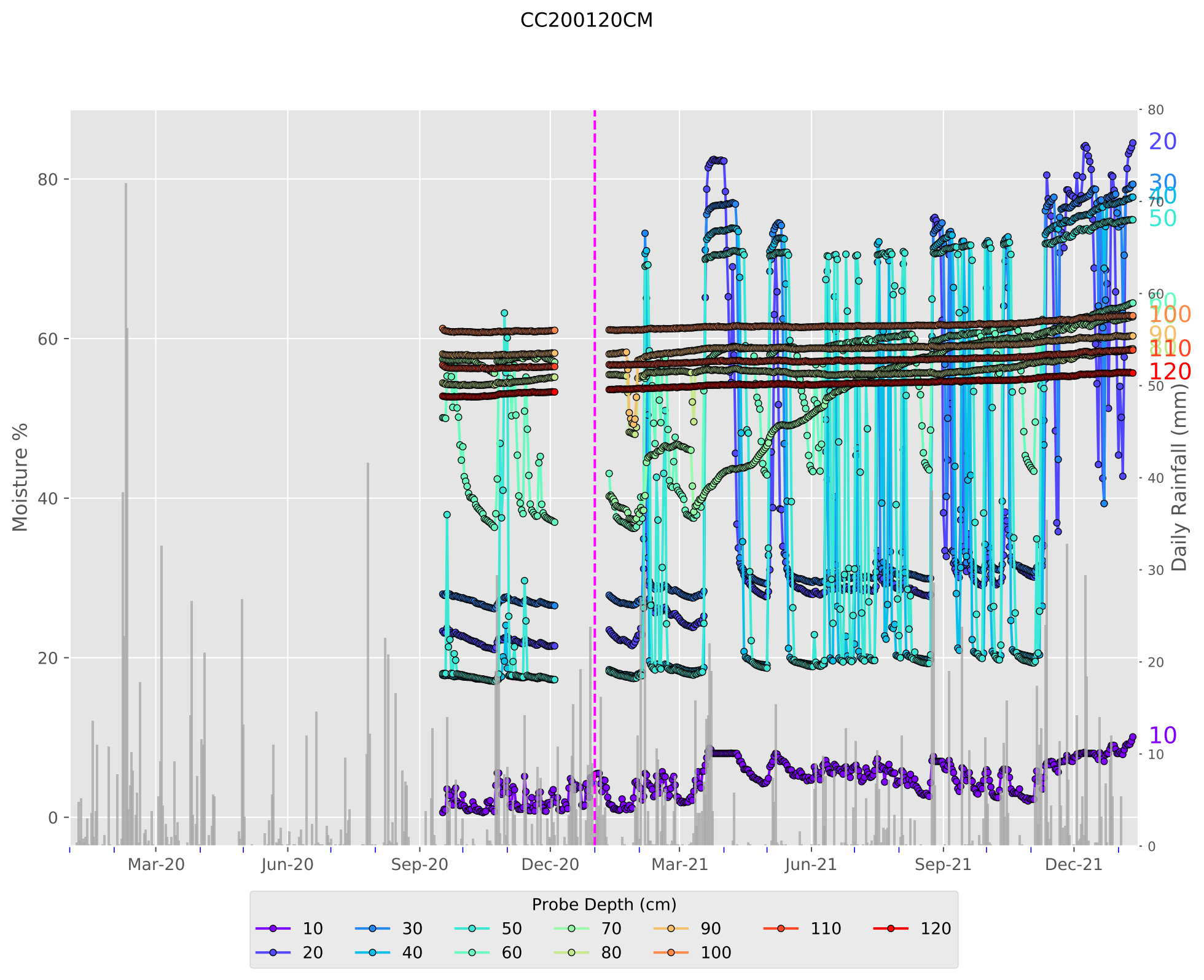

BE200120CM
Moisture %
Daily Rainfall (cm)
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20
40
60
80
0
10
20
30
40
50
60
70
80
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
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90
100
110
120

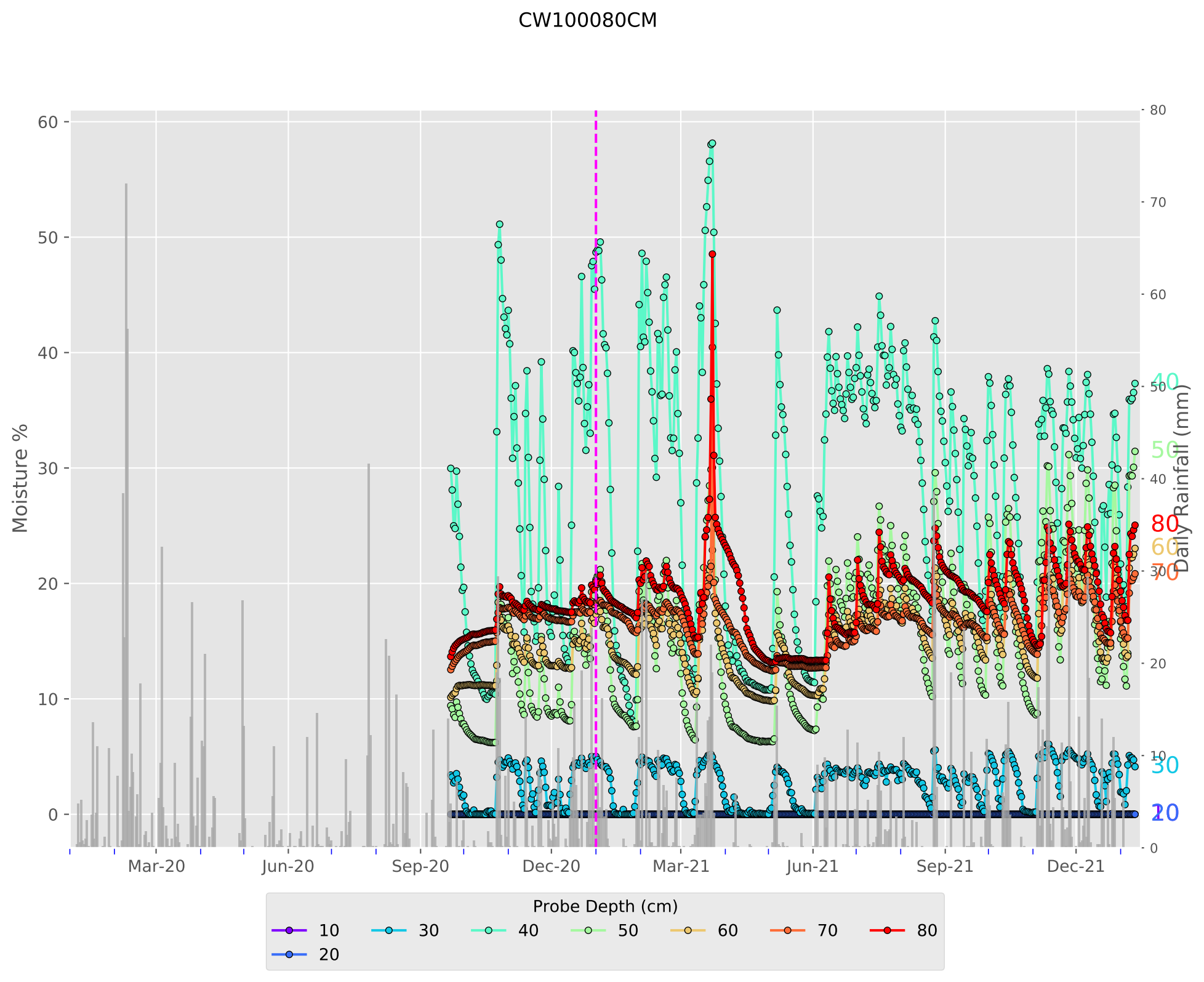

BS100120CM
Moisture %
Daily Rainfall (mm)
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

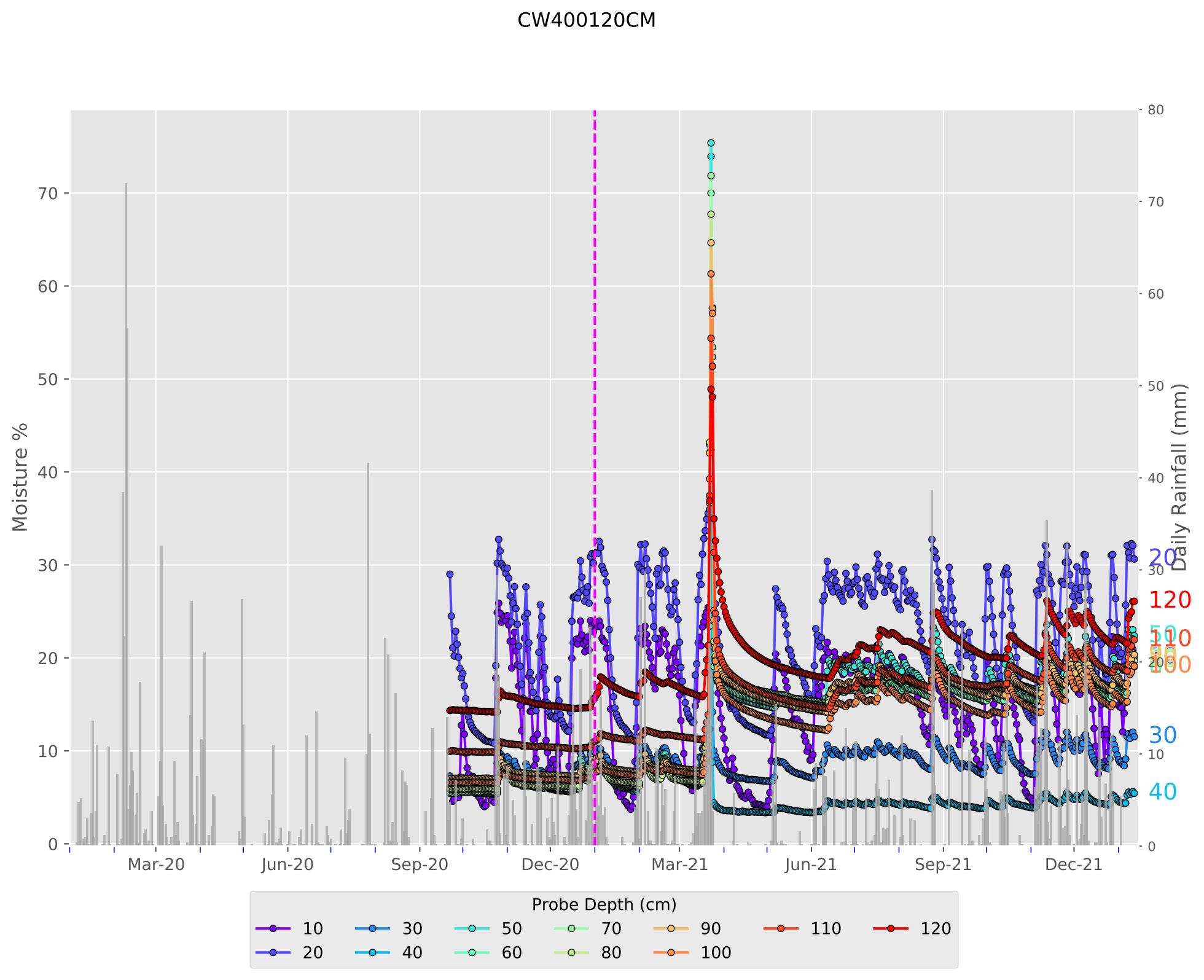

BS200080CM
Moisture %
Daily Rainfall (mm)
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20
40
60
80
0
10
20
30
40
50
60
70
80
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80

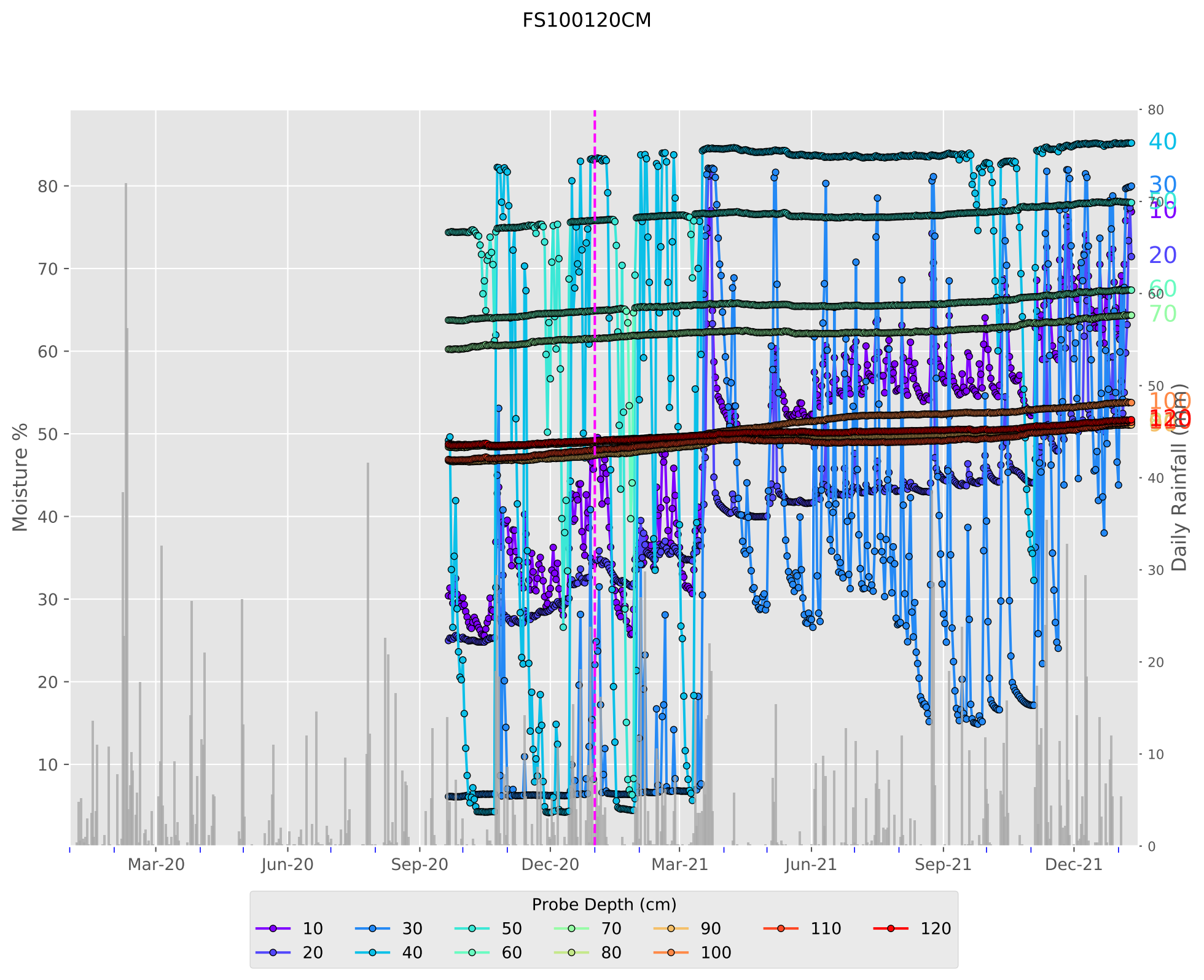

BS300080CM
Moisture %
Daily Rainfall (mm)
90
80
70
60
50
80
70
60
50
40
30
20
10
0
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
20
30
10
40
60
50
70
80
Probe Depth (cm)
10
30
40
50
60
70
80
20

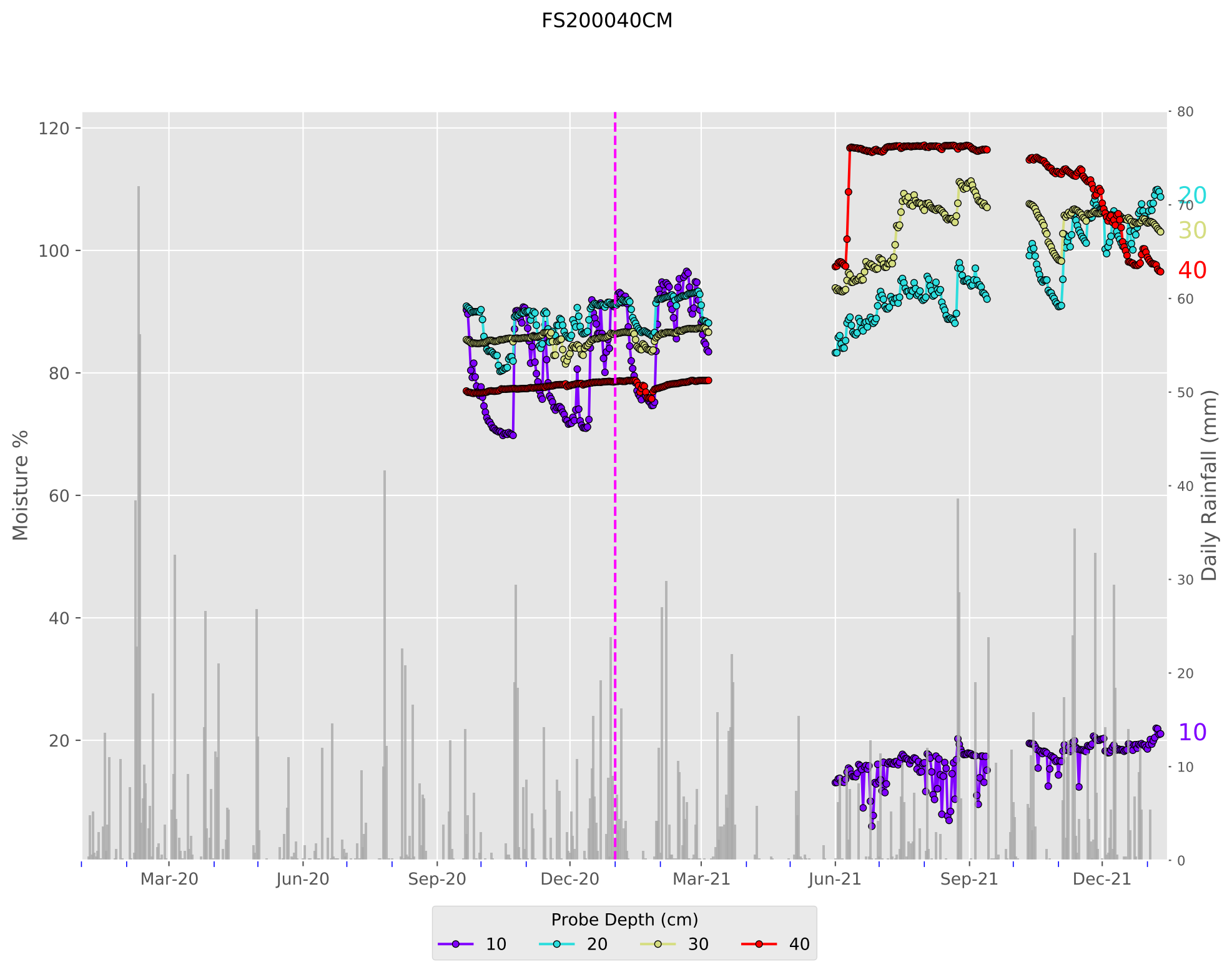

CC100080CM
Moisture %
Daily Rainfall (mm)
100
80
60
40
20
80
70
60
50
40
30
20
10
0
20
30
10
40
50
60
70
80
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
30
40
50
60
70
80
20

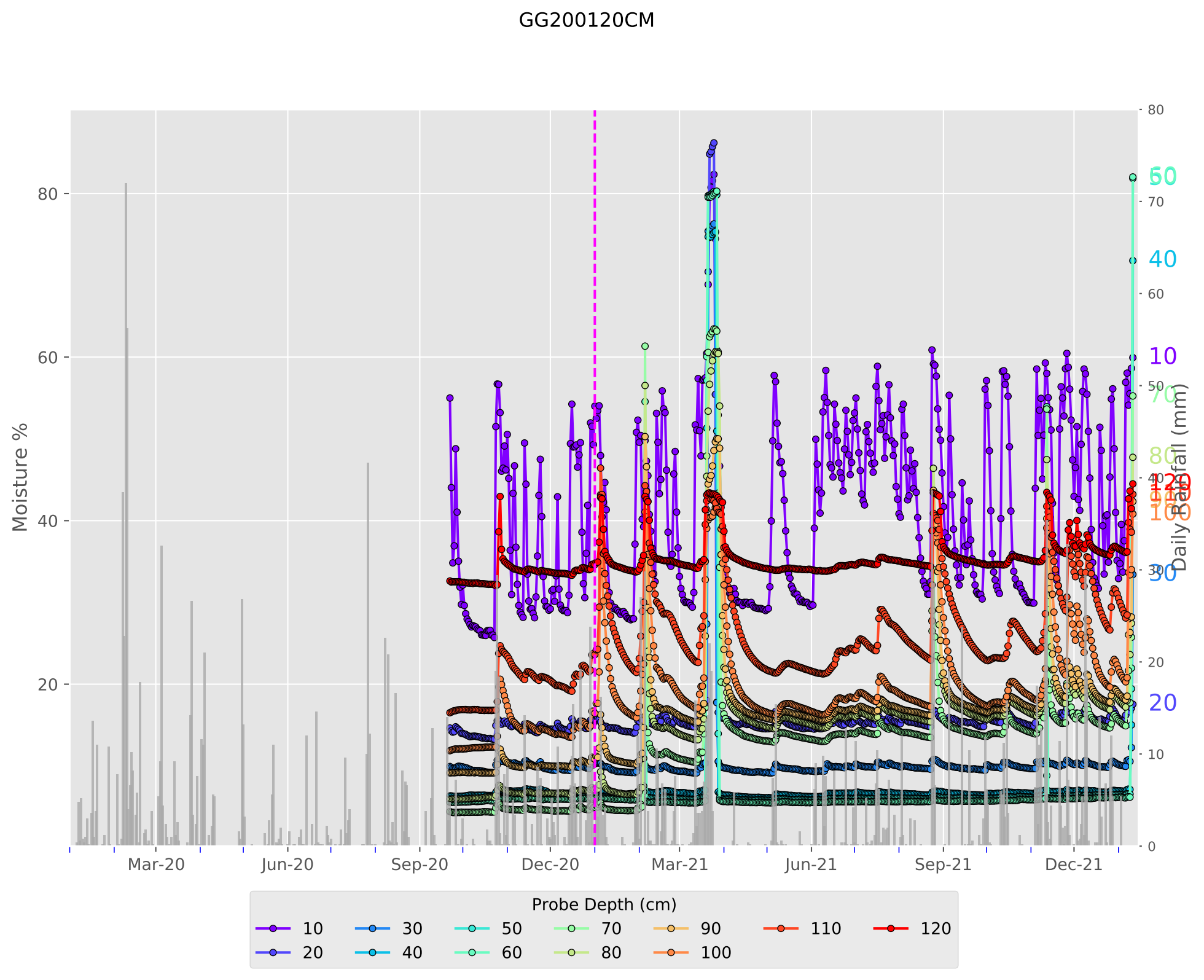

CC200120CM
Moisture %
Daily Rainfall (mm)
0
20
40
60
80
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

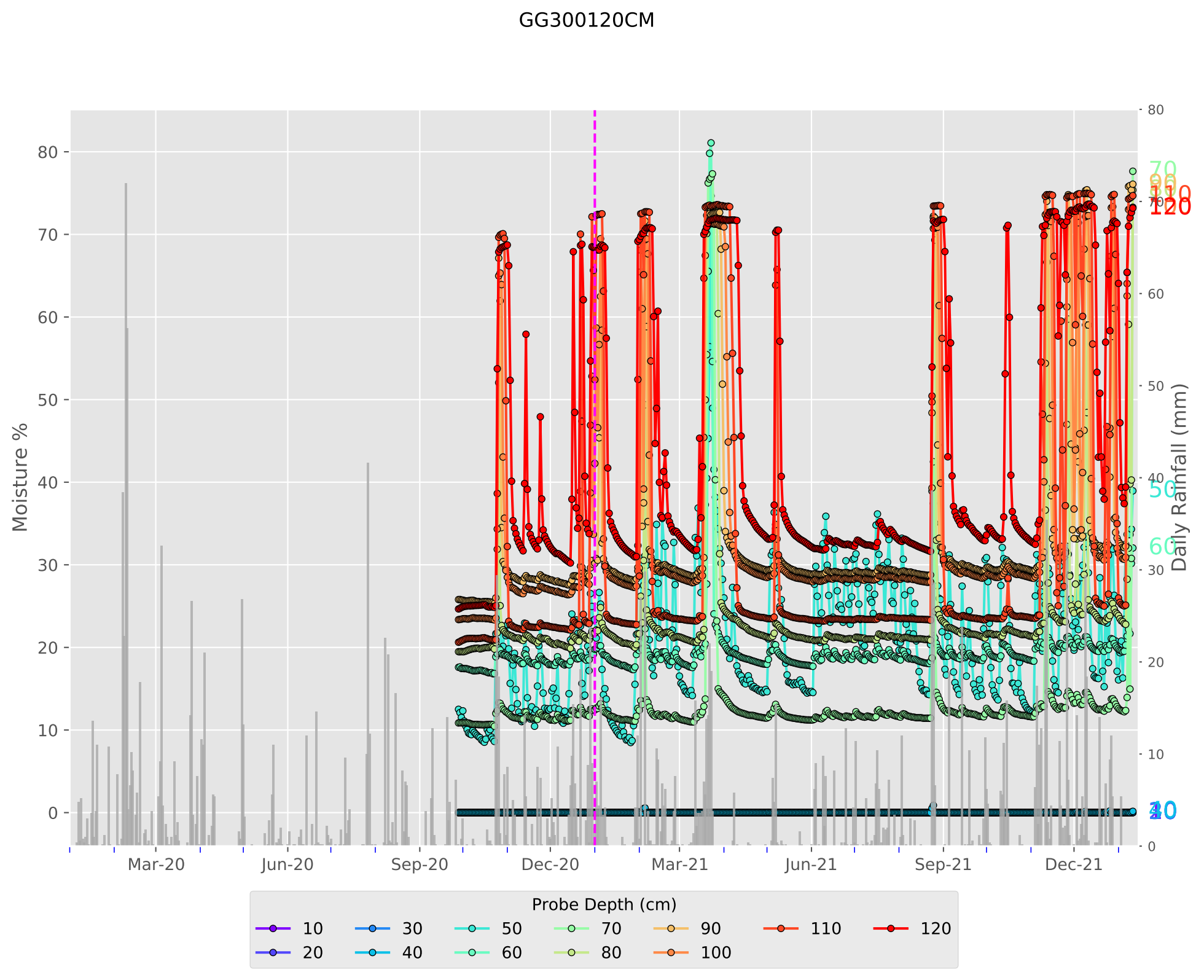

CW100080CM
Moisture %
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80

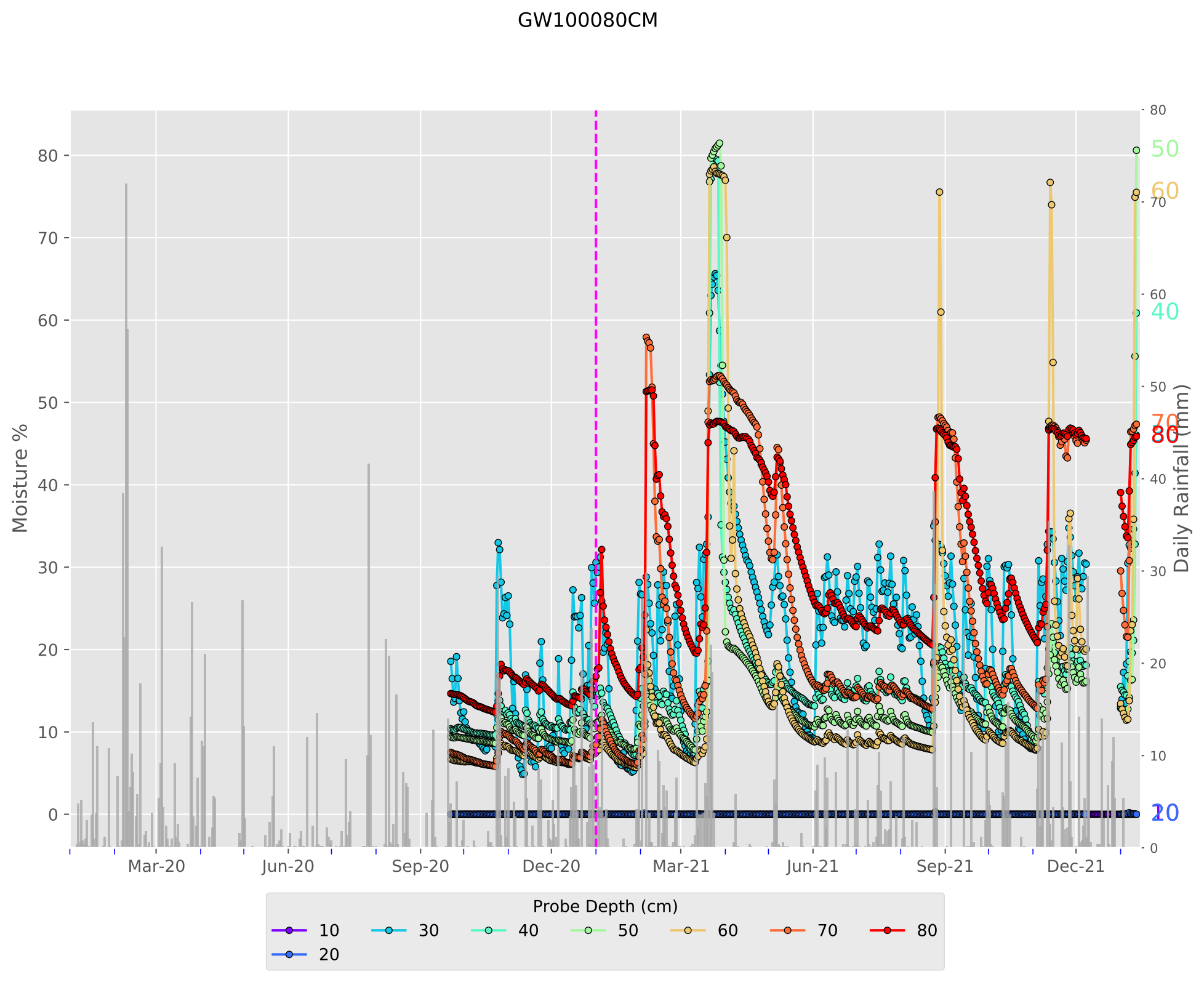

CW400120CM
Moisture %
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

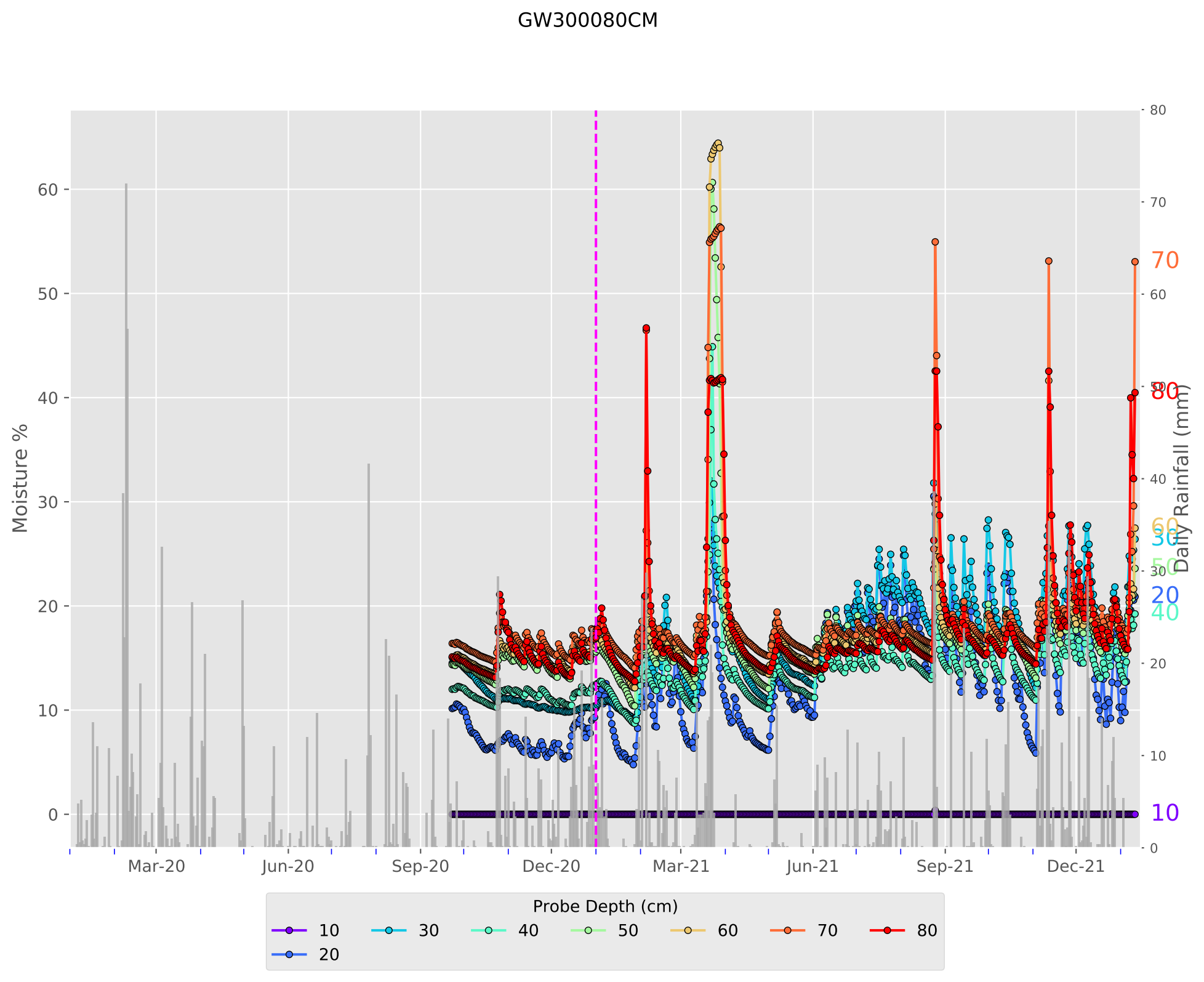

FS100120CM
Moisture %
Daily Rainfall (mm)
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

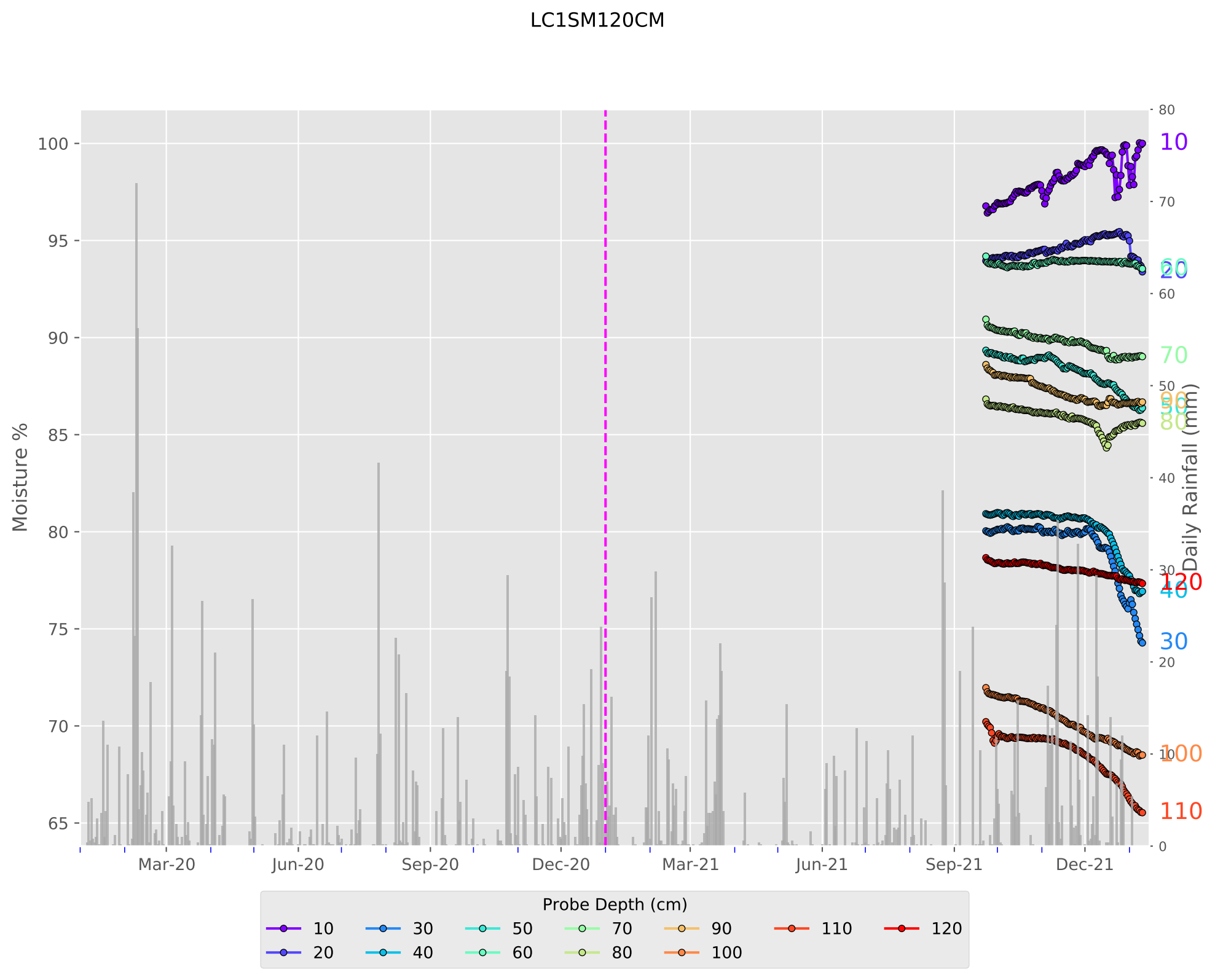

FS200040CM
Moisture %
Daily Rainfall (mm)
120
100
80
60
40
20
80
70
60
50
40
30
20
10
0
20
30
40
10
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40

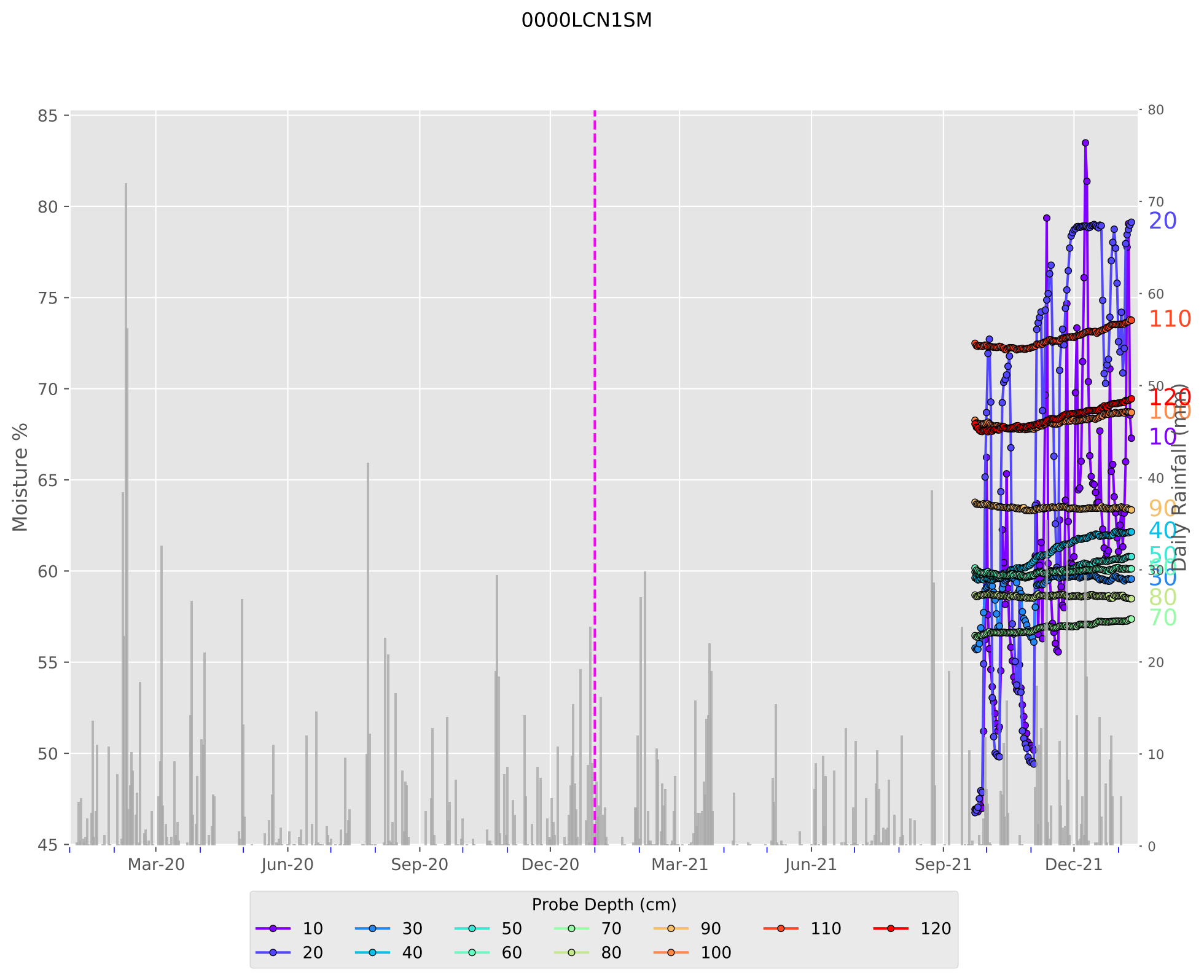

GG200120CM
Moisture %
Daily Rainfall (mm)
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

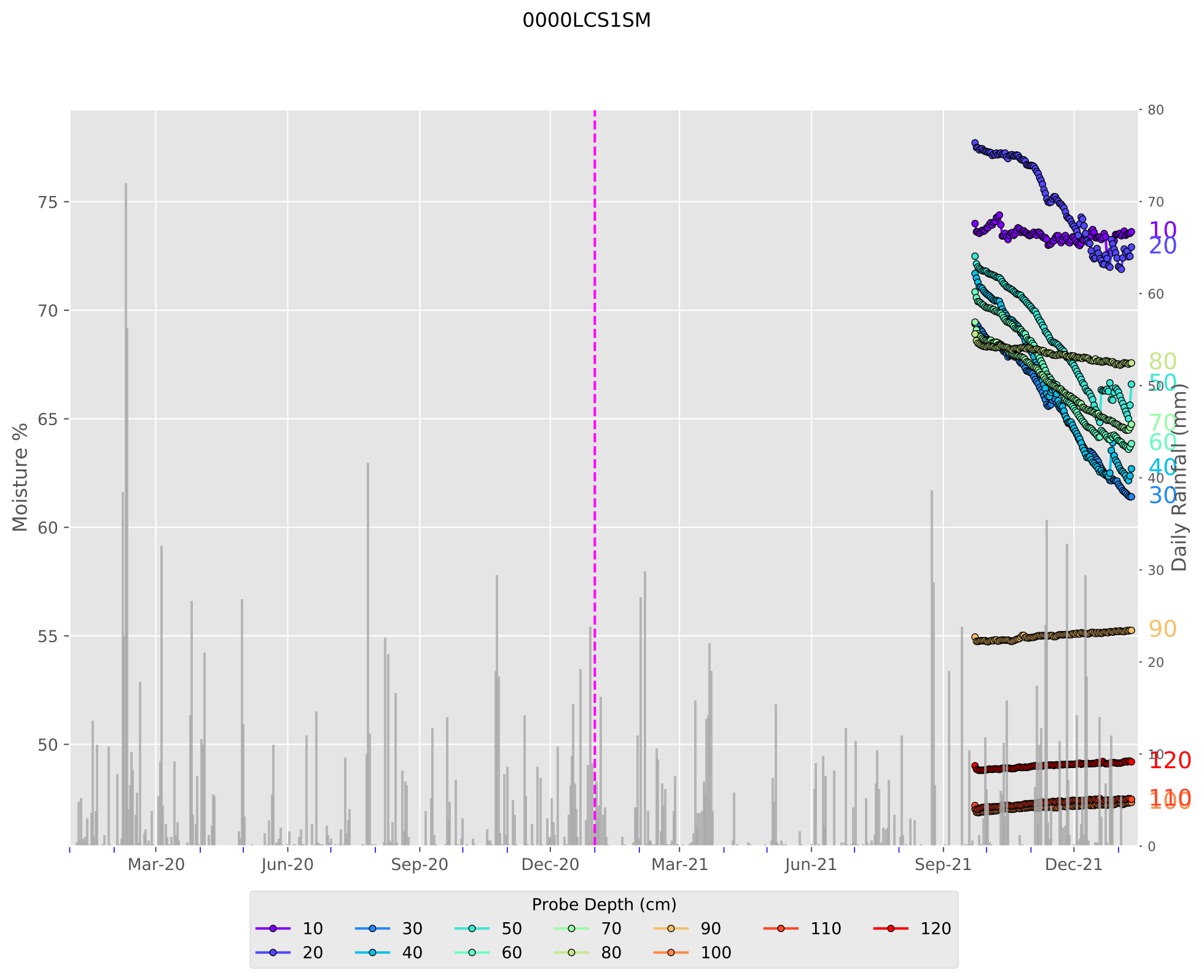

GG300120CM
Moisture %
Daily Rainfall (mm)
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

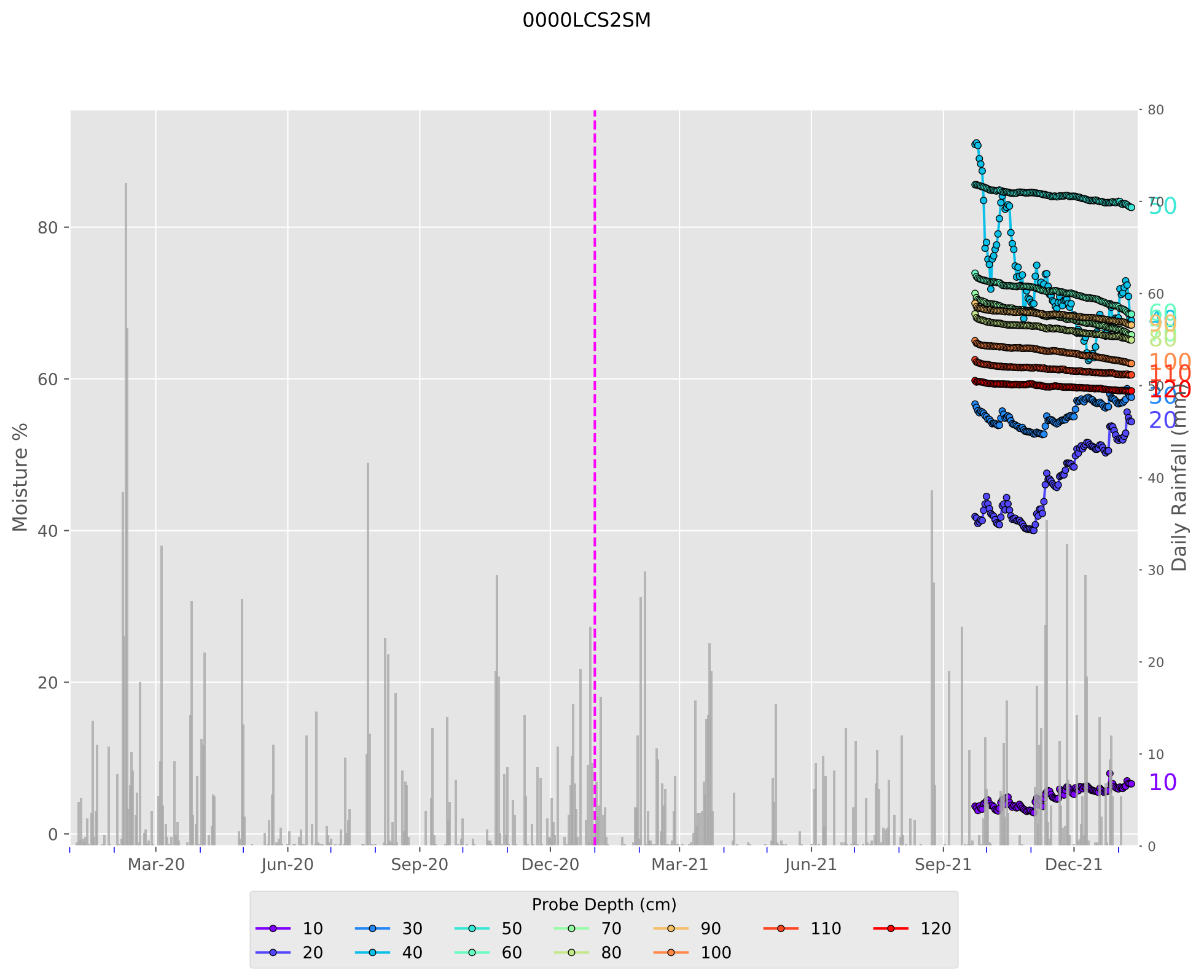

GW100080CM
Moisture %
Daily Rainfall (mm)
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80

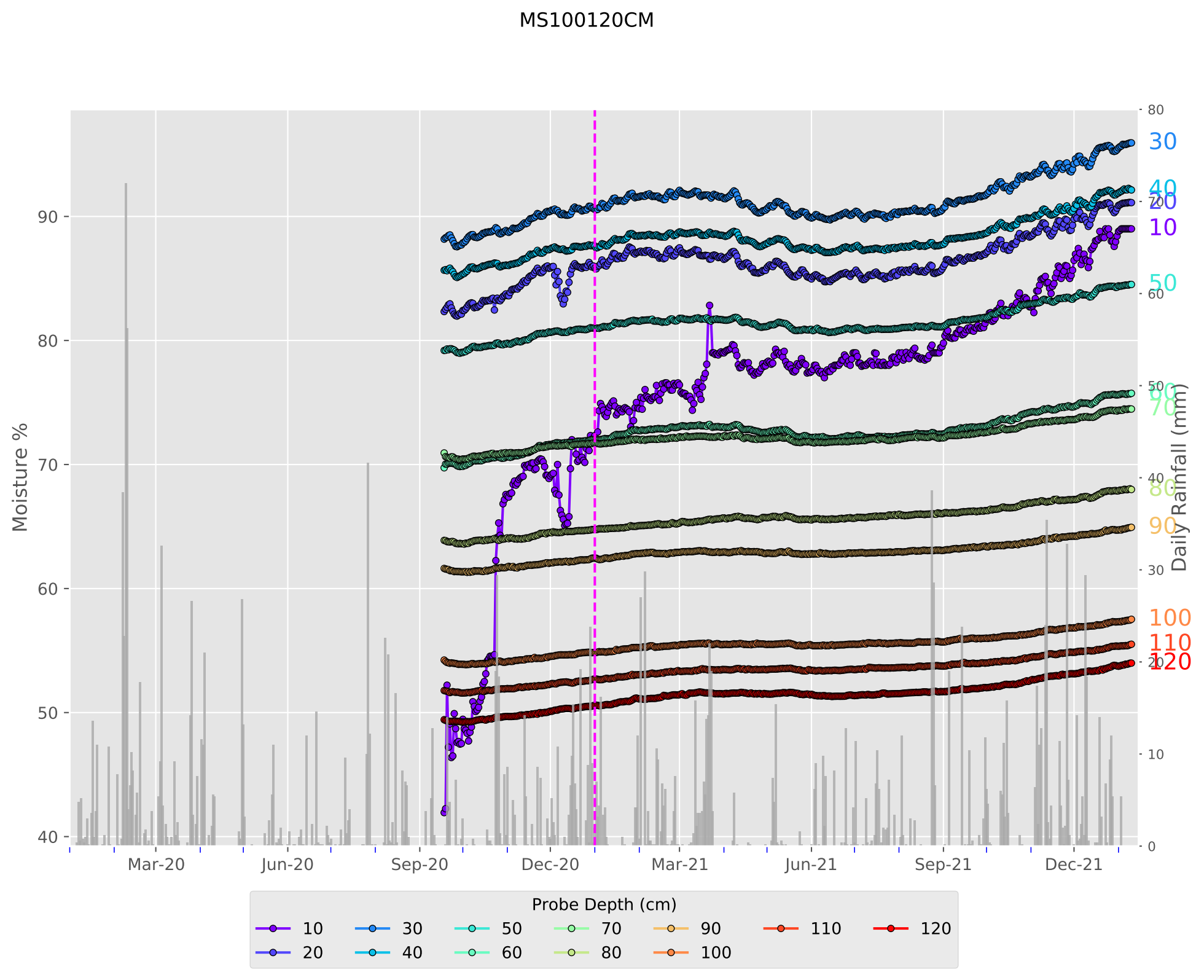

GW300080CM
Moisture %
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80

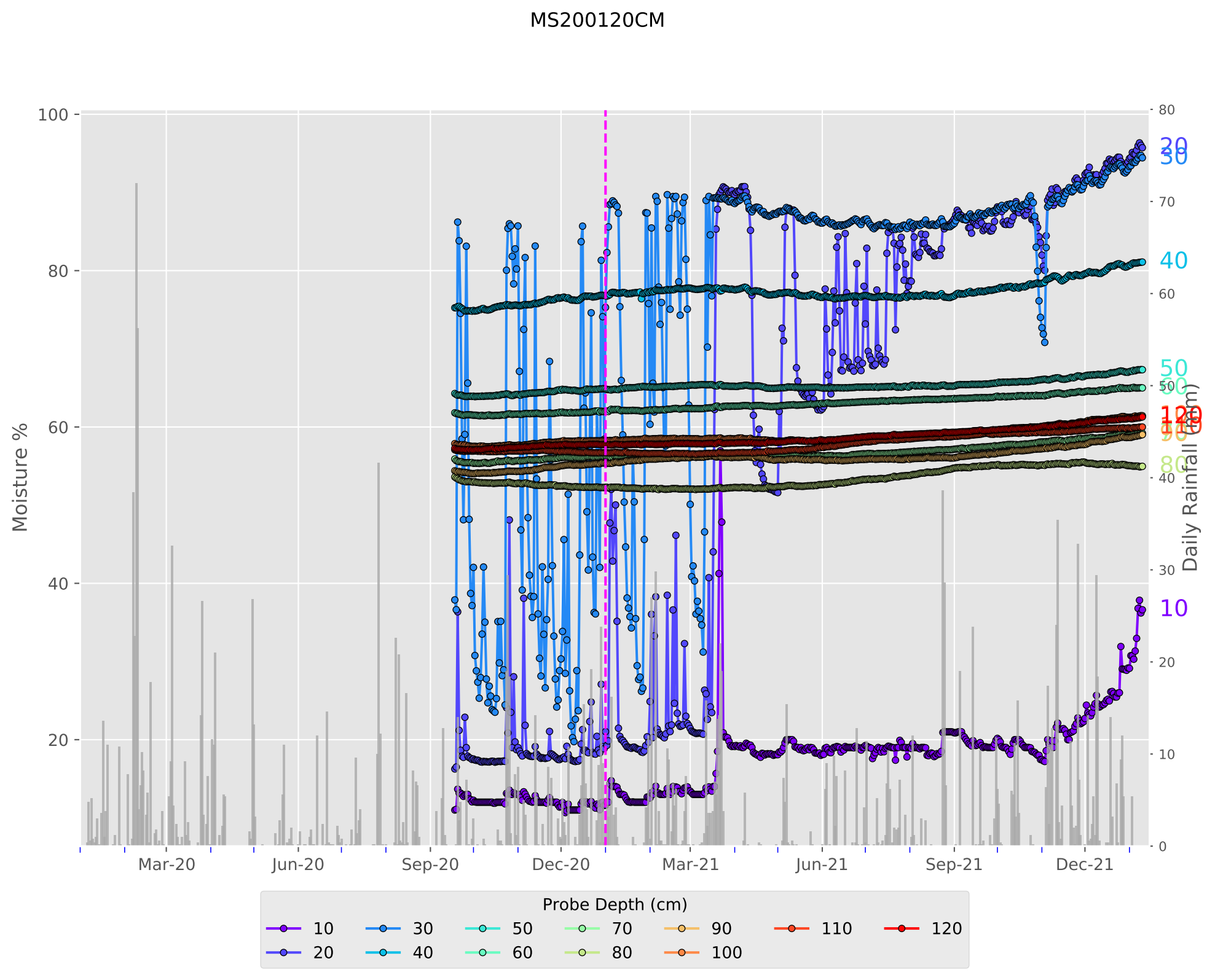

LC1SM120CM
Moisture %
Daily Rainfall (mm)
100
95
90
85
80
75
70
65
80
70
60
50
40
30
20
10
0
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
10
20
30
40
50
60
70
80
90
100
110
120
Probe Depth (cm)

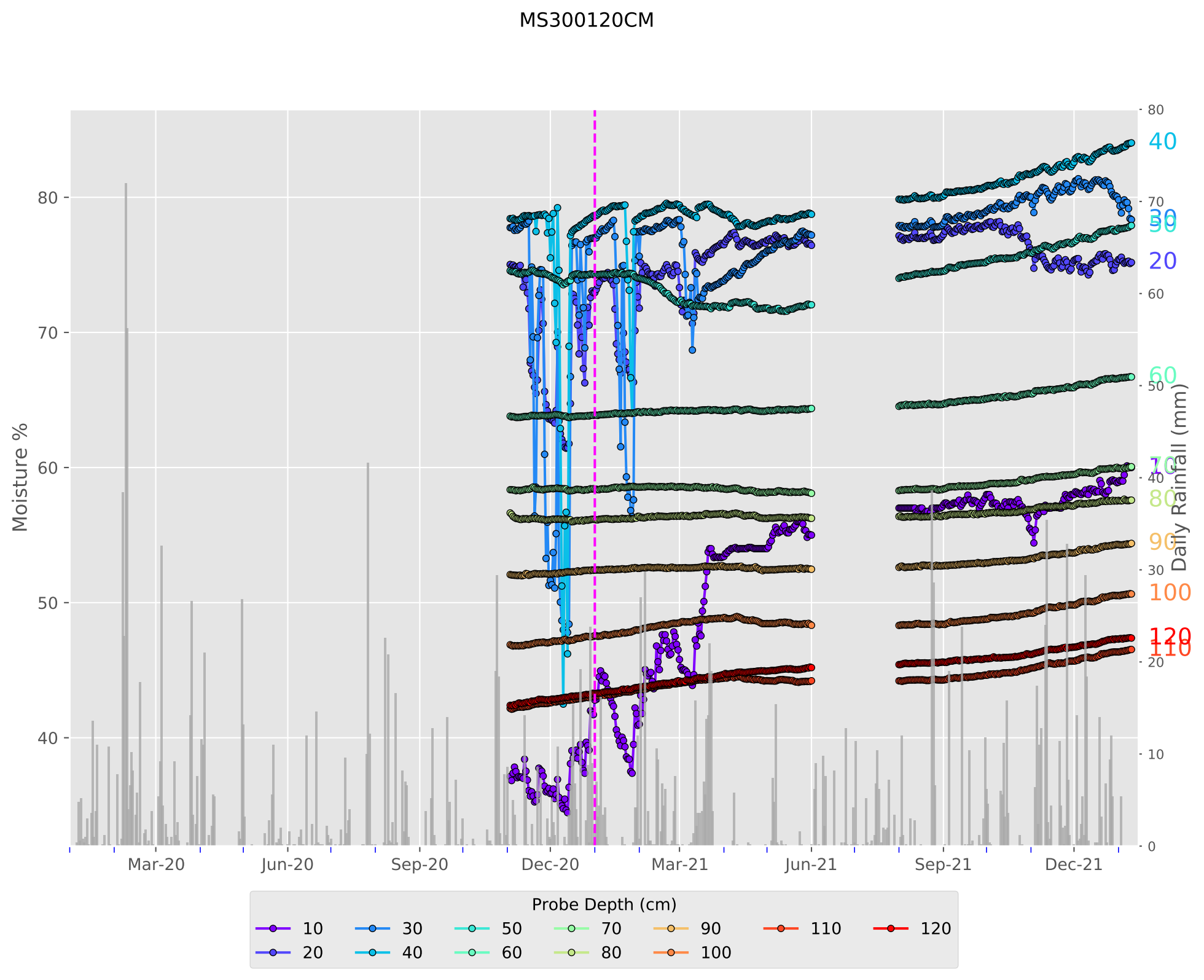

0000LCN1SM
Moisture %
Daily Rainfall (mm)
85
80
75
70
65
60
55
50
45
80
70
60
50
40
30
20
10
0
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

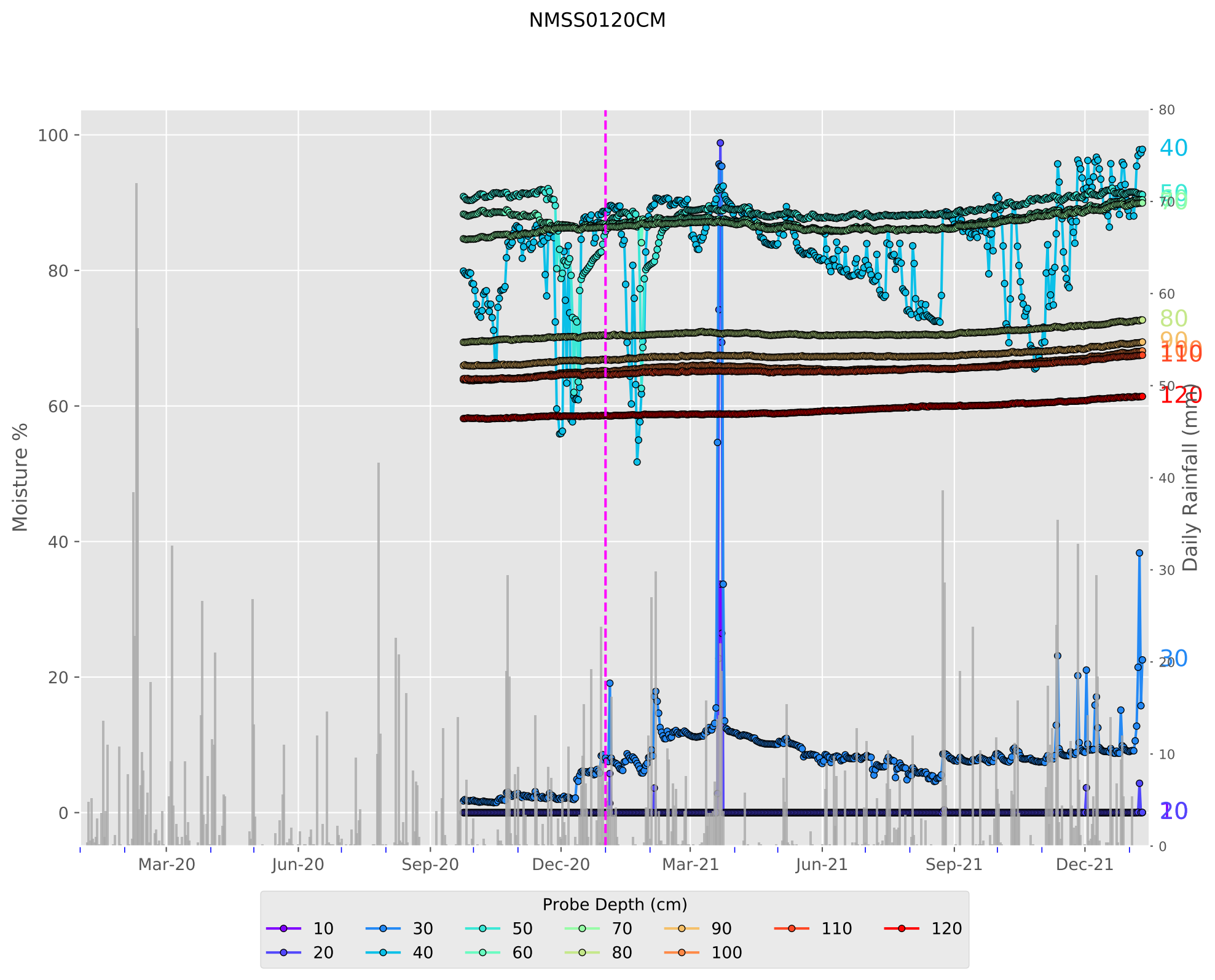

0000LCS1SM
Moisture %
Daily Rainfall (mm)
75
70
65
60
55
50
80
70
60
50
40
30
20
10
0
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

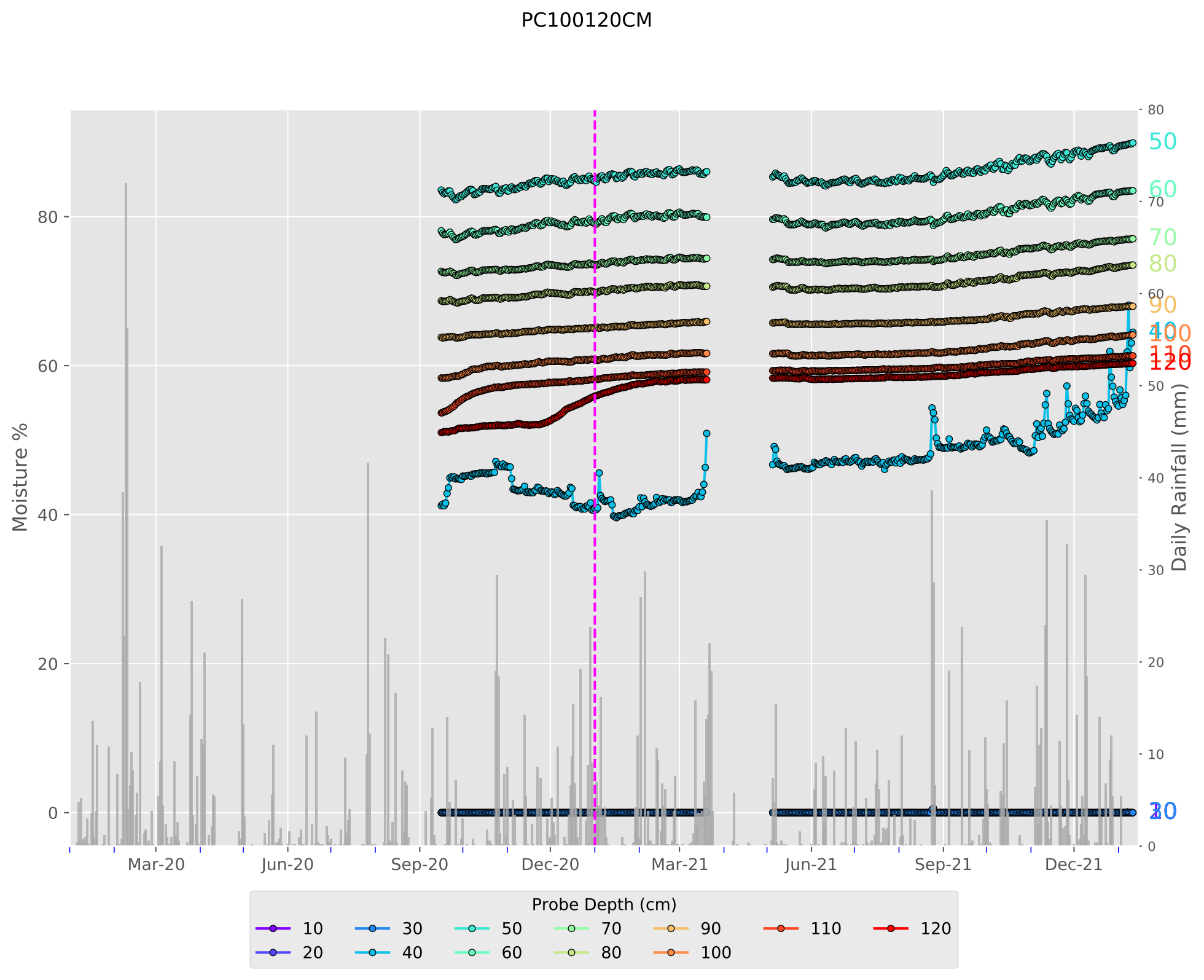

0000LCS2SM
Moisture %
Daily Rainfall (mm)
0
20
40
60
80
0
10
20
30
40
50
60
70
80
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

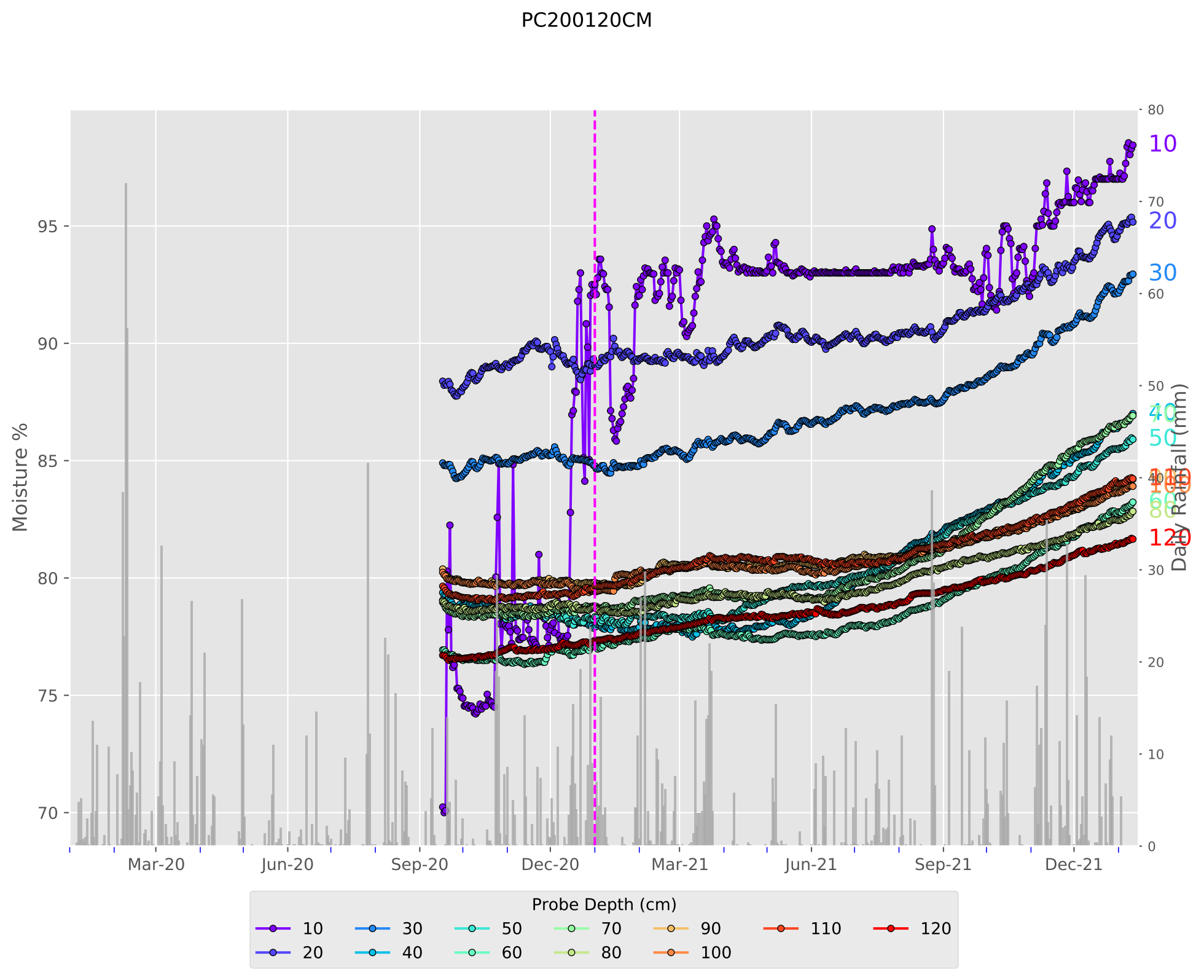

MS100120CM
Moisture %
Daily Rainfall (mm)
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

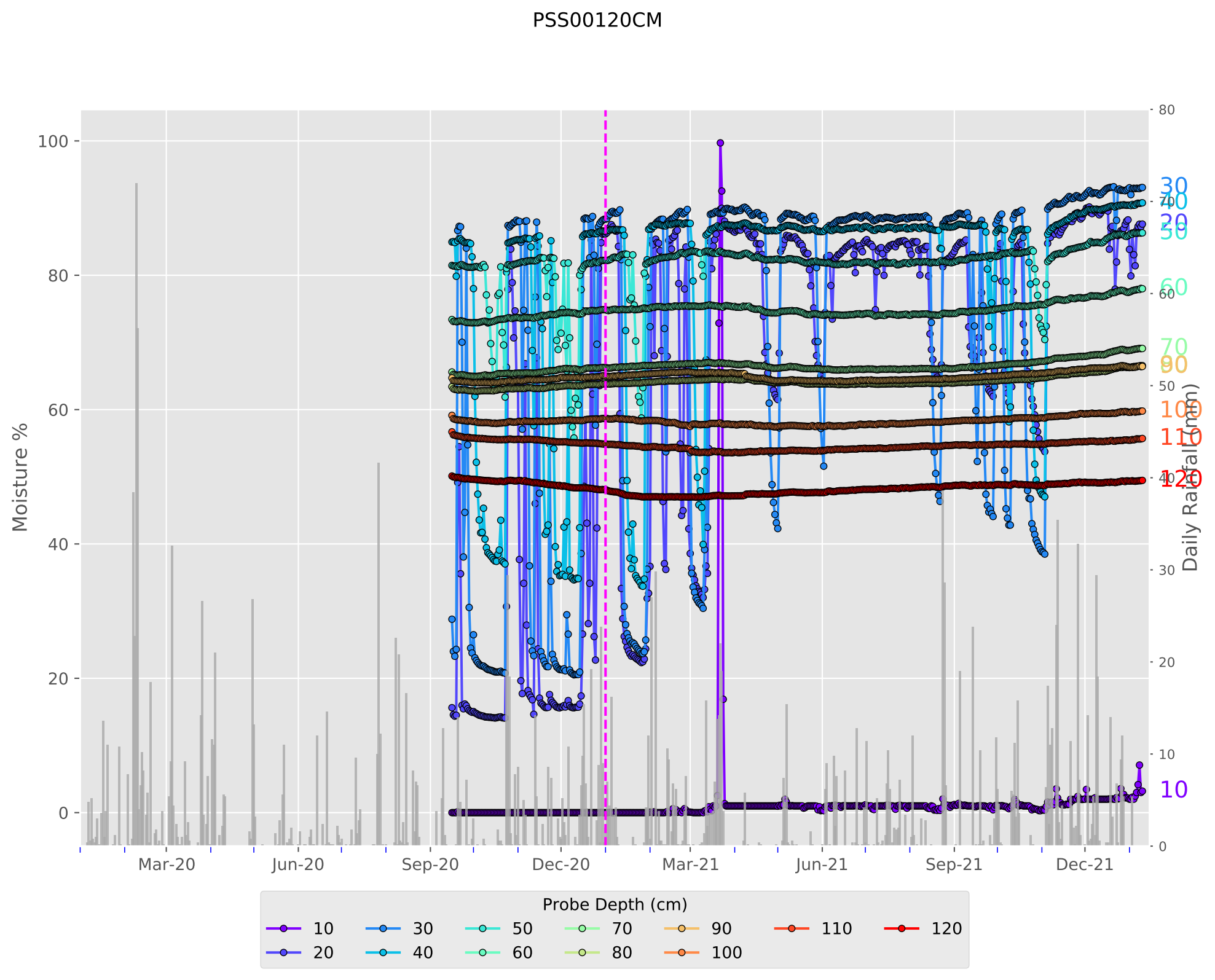

MS200120CM
Moisture %
Daily Rainfall (mm)
100
80
60
40
20
80
70
60
50
40
30
20
10
0
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

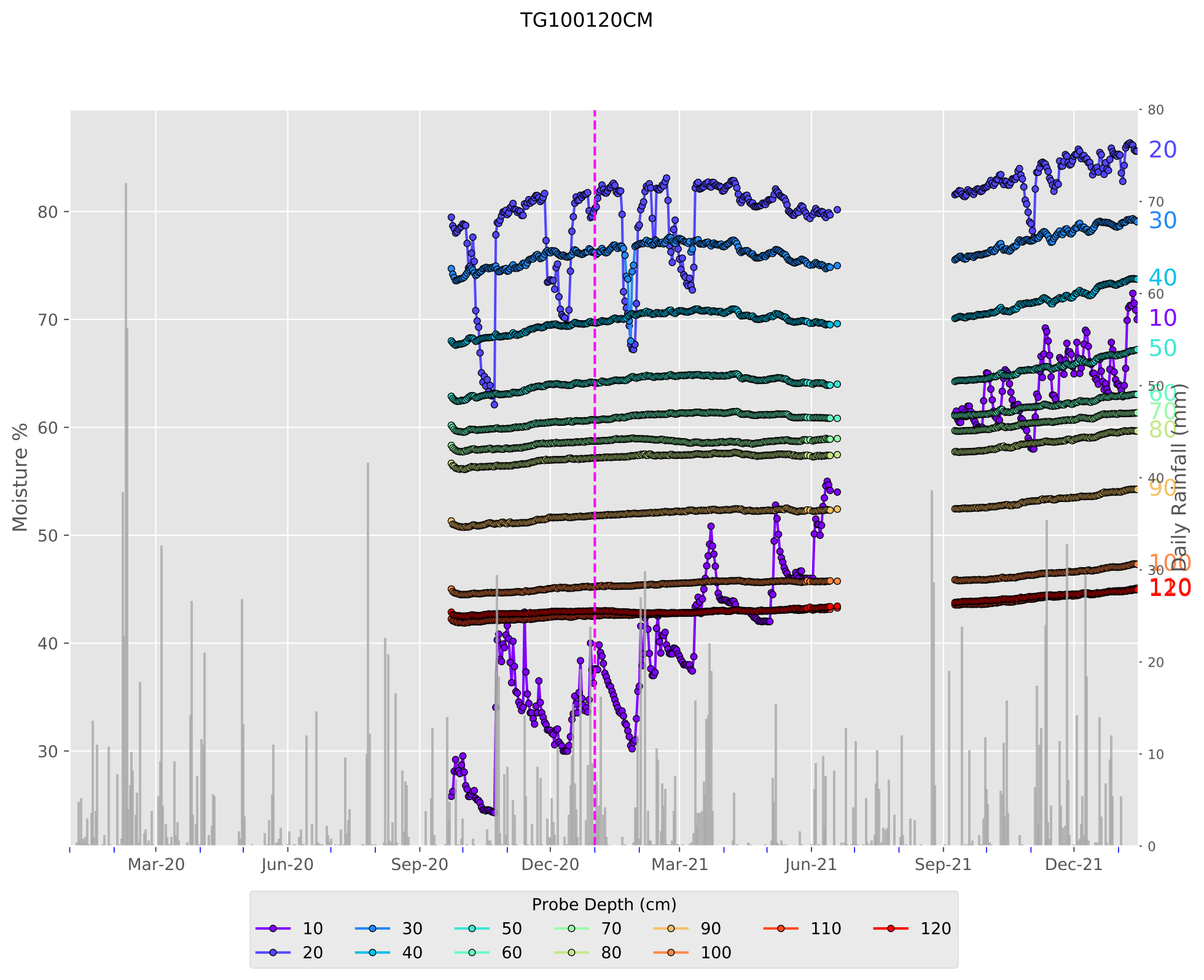

MS300120CM
Moisture %
Daily Rainfall (mm)
80
70
60
50
40
30
20
10
0
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

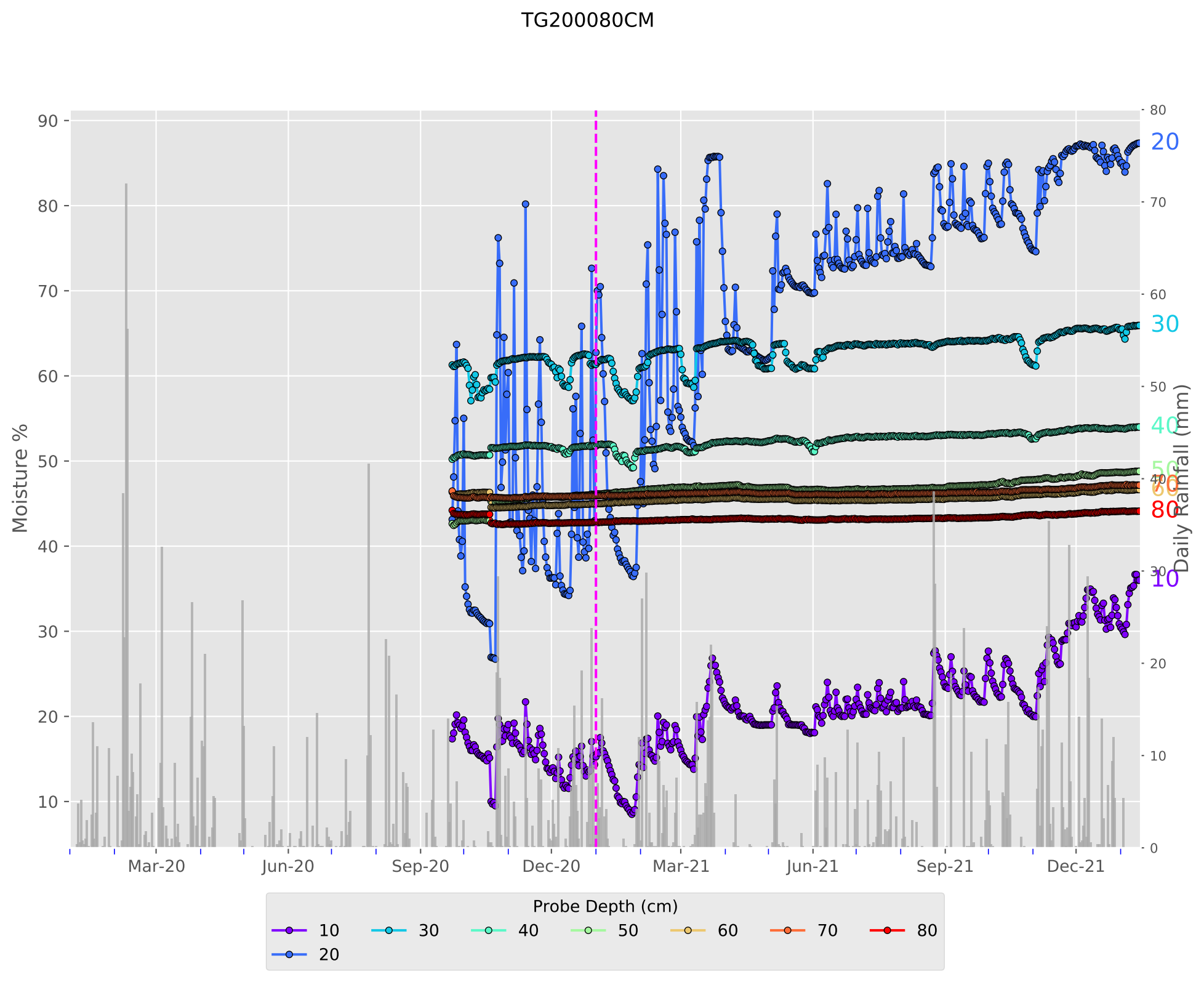

NMSS0120CM
Moisture %
Daily Rainfall (mm)
100
80
60
40
20
0
80
70
60
50
40
30
20
10
0
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

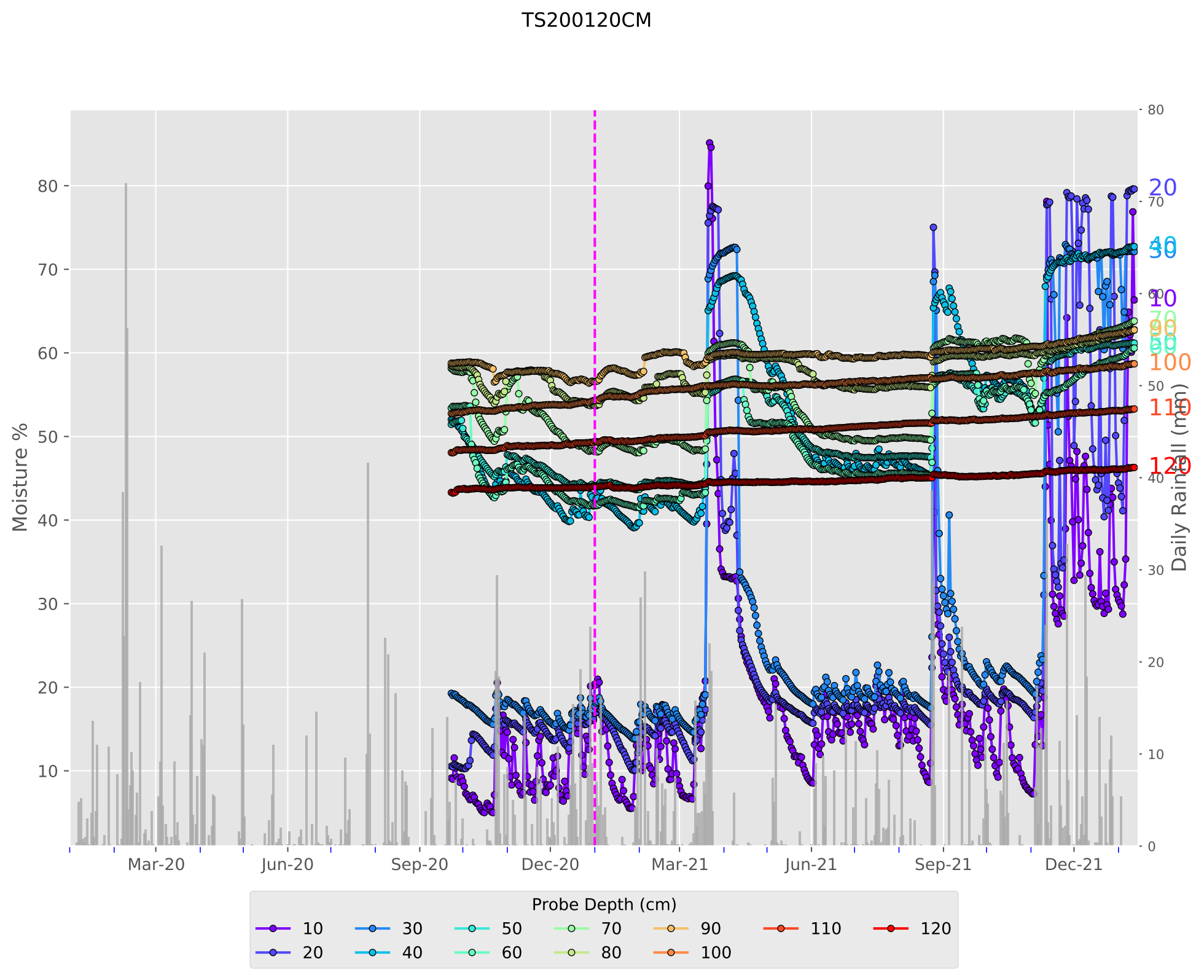

PC100120CM
Moisture %
Daily Rainfall (mm)
0
20
40
60
80
0
10
20
30
40
50
60
70
80
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

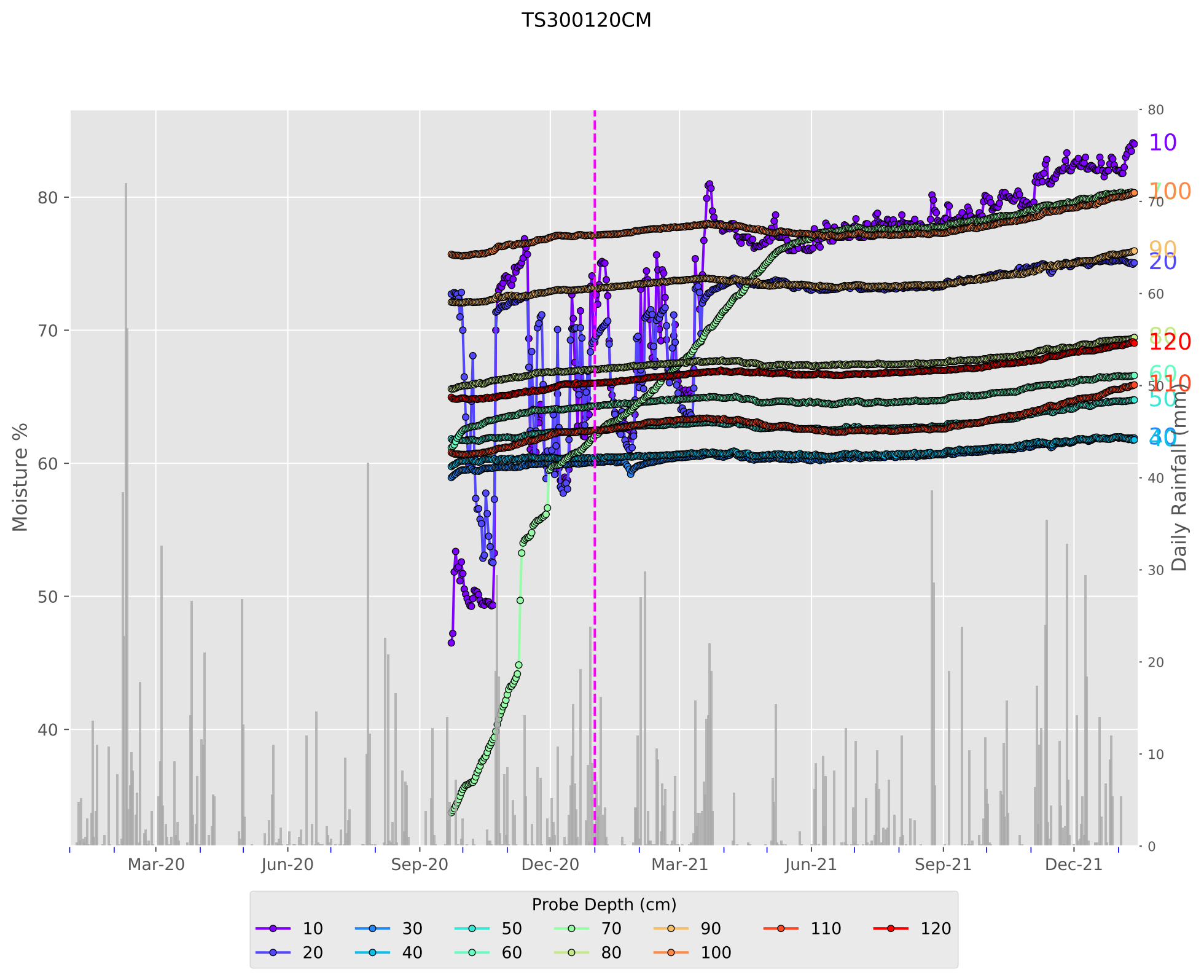

PC200120CM
Moisture %
95
90
85
80
75
70
Daily Rainfall (mm)
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60
80
100
120
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

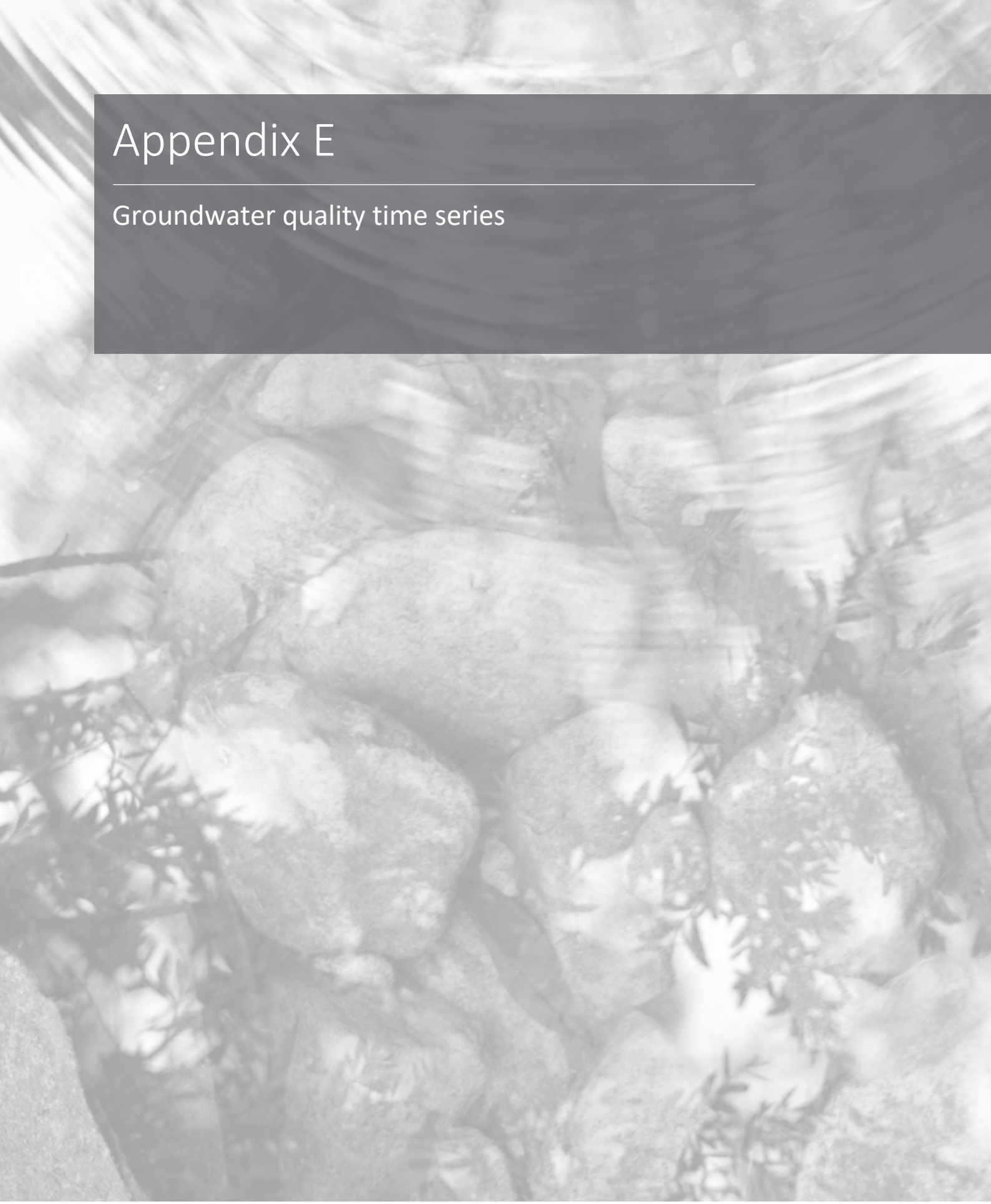

PSS00120CM
Moisture %
Daily Rainfall (mm)
100
80
60
40
20
0
80
60
50
40
30
20
10
0
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120


TG100120CM
Moisture %
Daily Rainfall (mm)
80
70
60
50
40
30
20
10
0
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120


TG200080CM
Moisture %
Daily Rainfall (mm)
90
80
70
60
50
40
30
20
10
0
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80

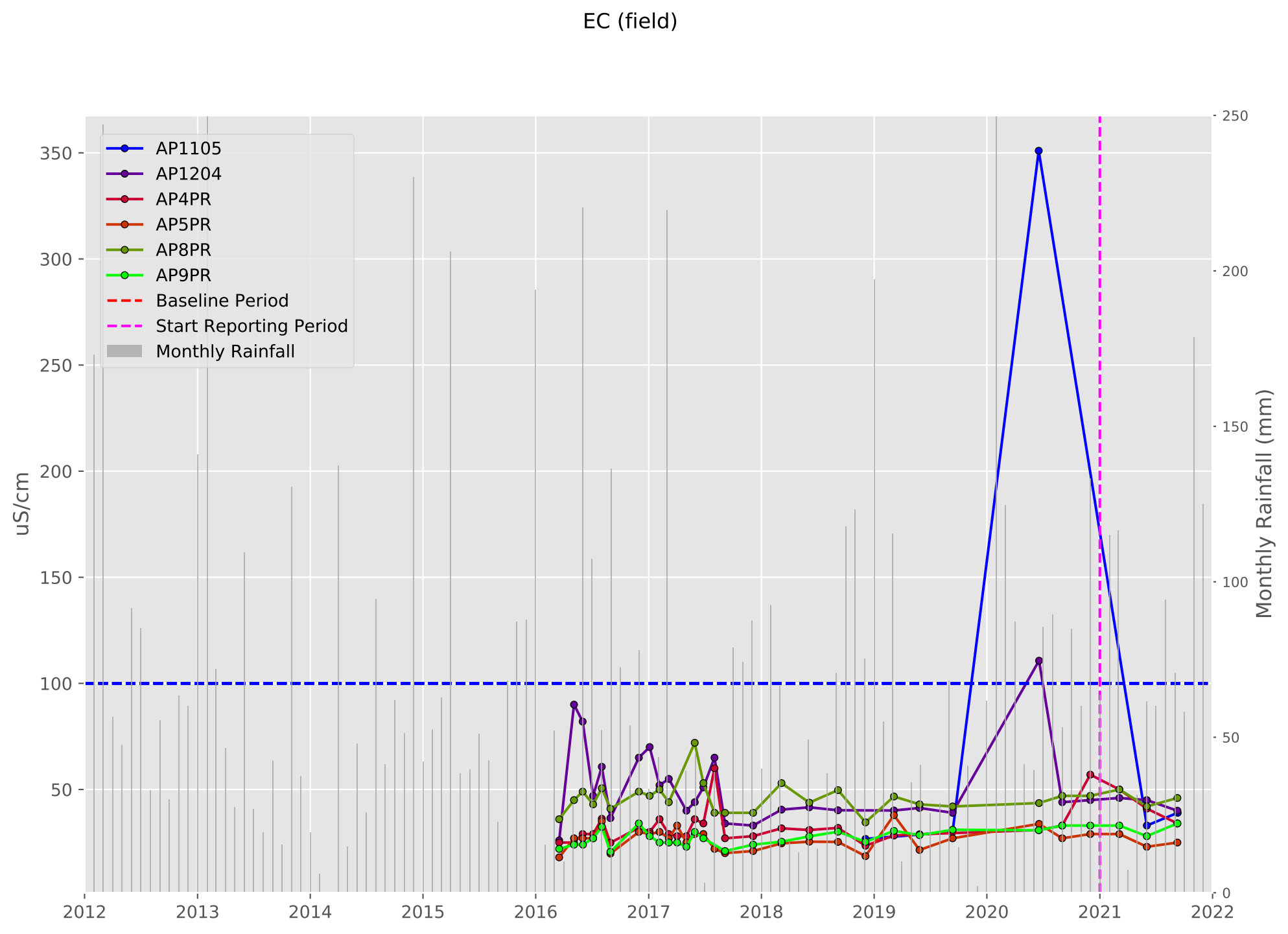

TS200120CM
Moisture %
Daily Rainfall (mm)
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

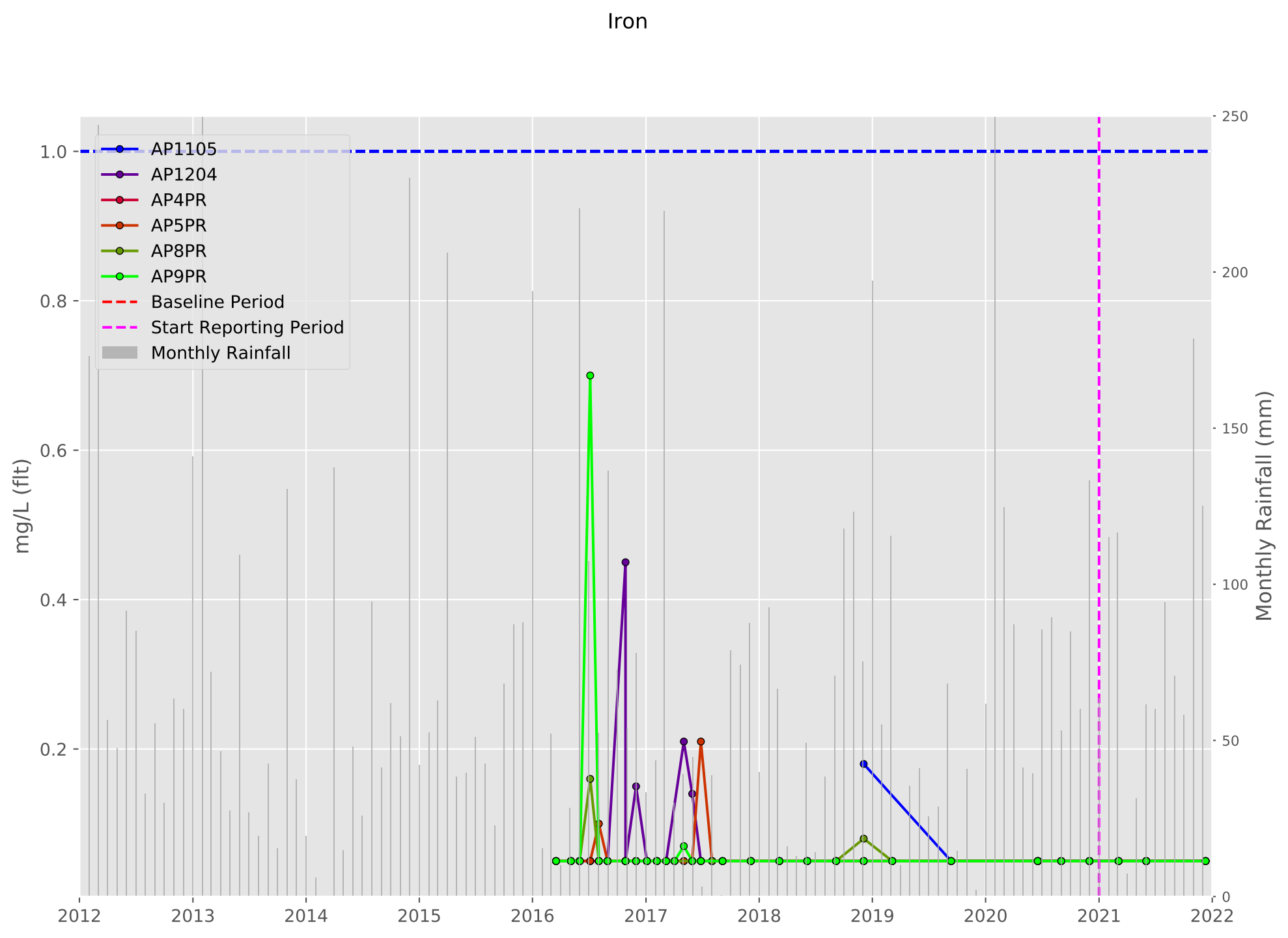

TS300120CM
Moisture %
Daily Rainfall (mm)
80
70
60
50
40
30
20
10
0
Mar-20
Jun-20
Sep-20
Dec-20
Mar-21
Jun-21
Sep-21
Dec-21
Probe Depth (cm)
10
20
30
40
50
60
70
80
90
100
110
120

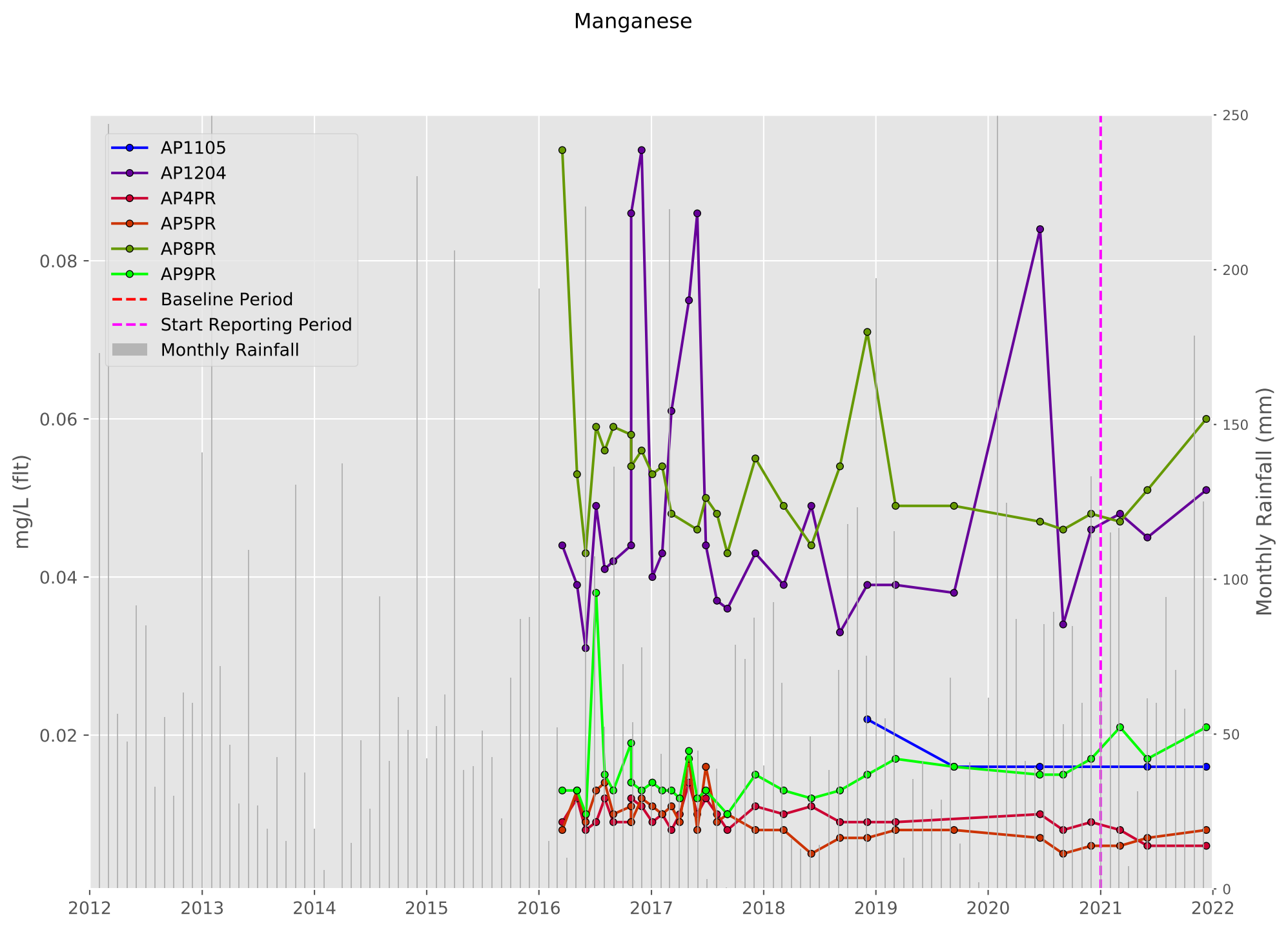


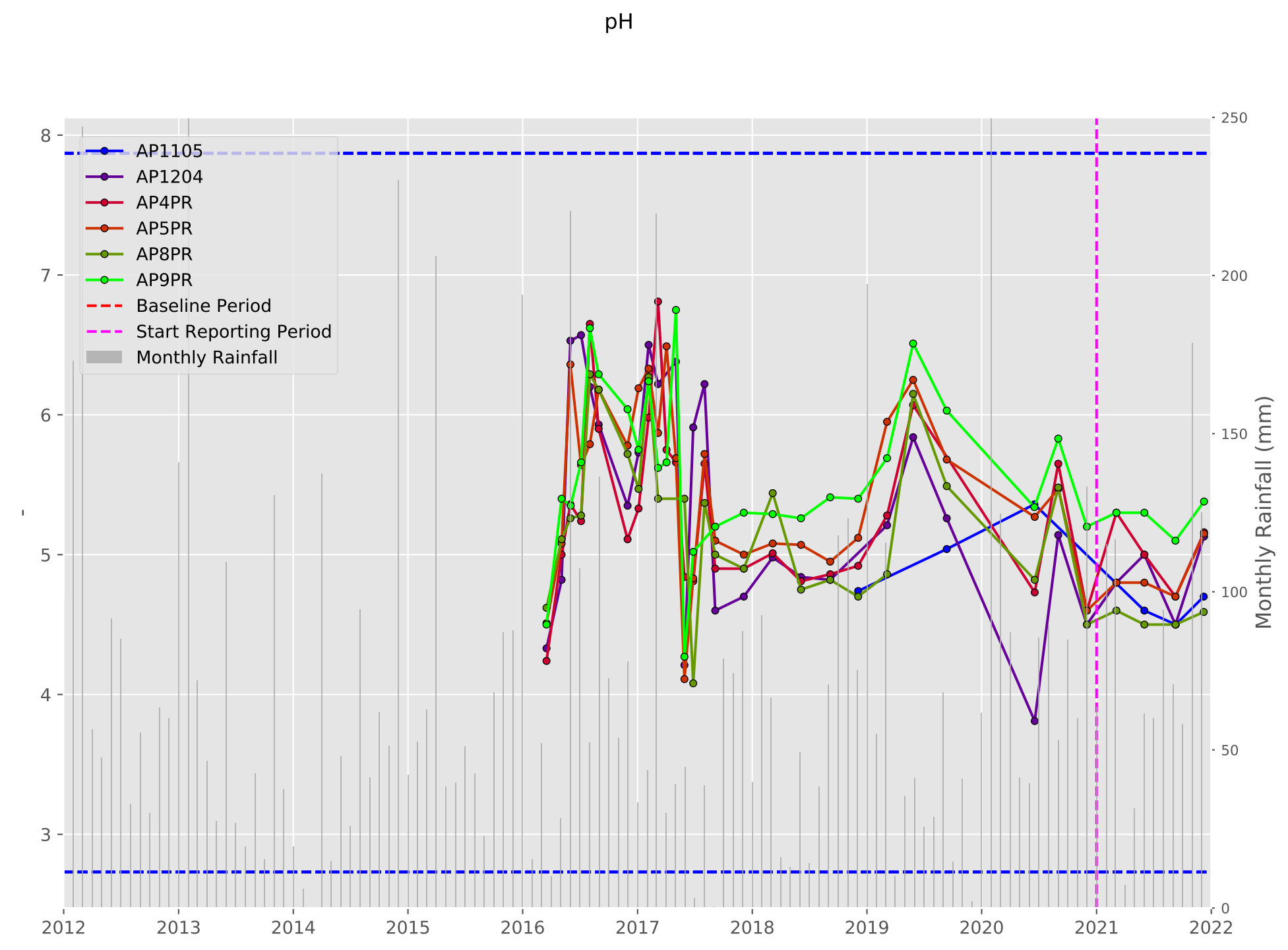
Appendix E

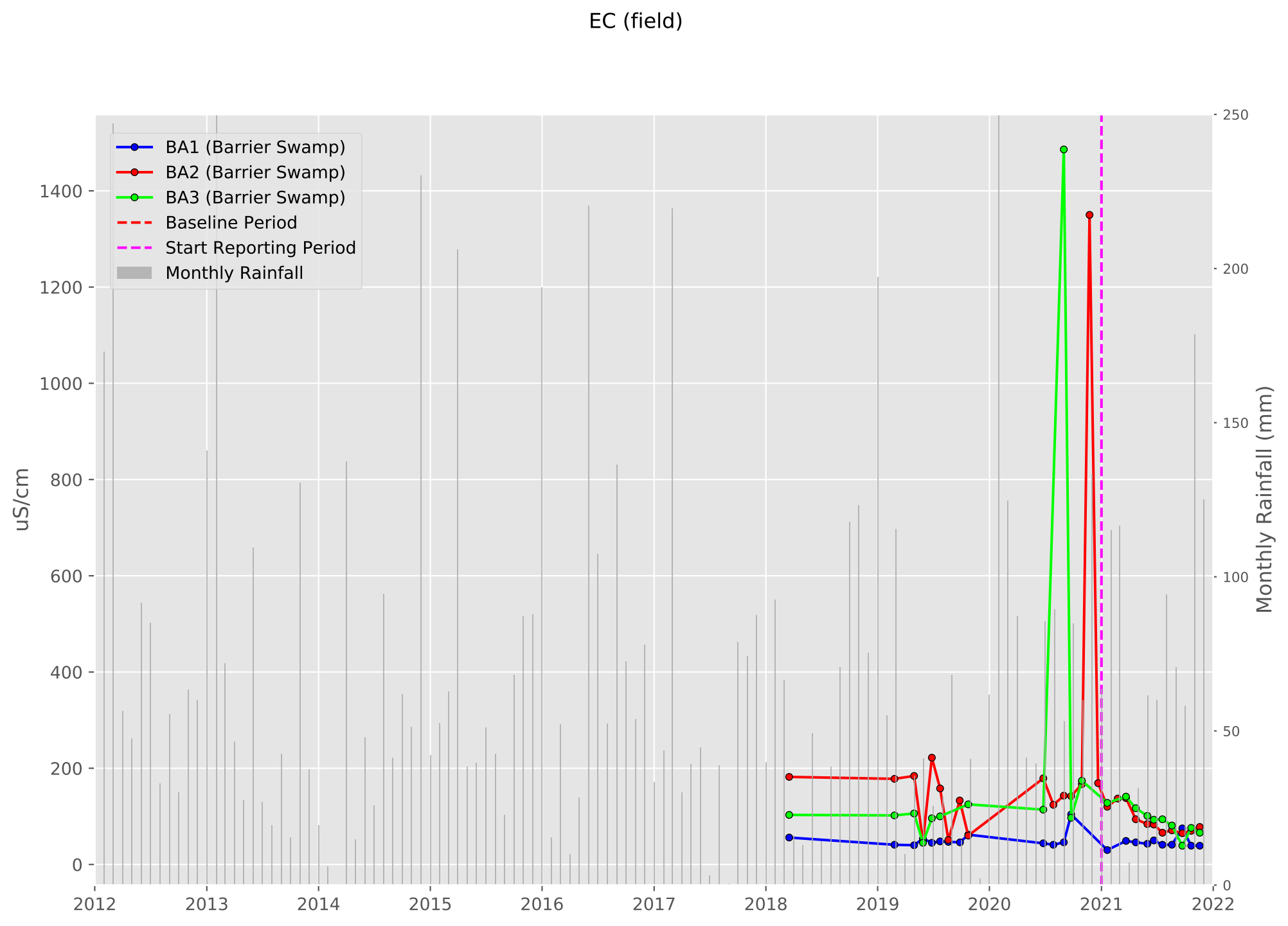
Groundwater quality time series

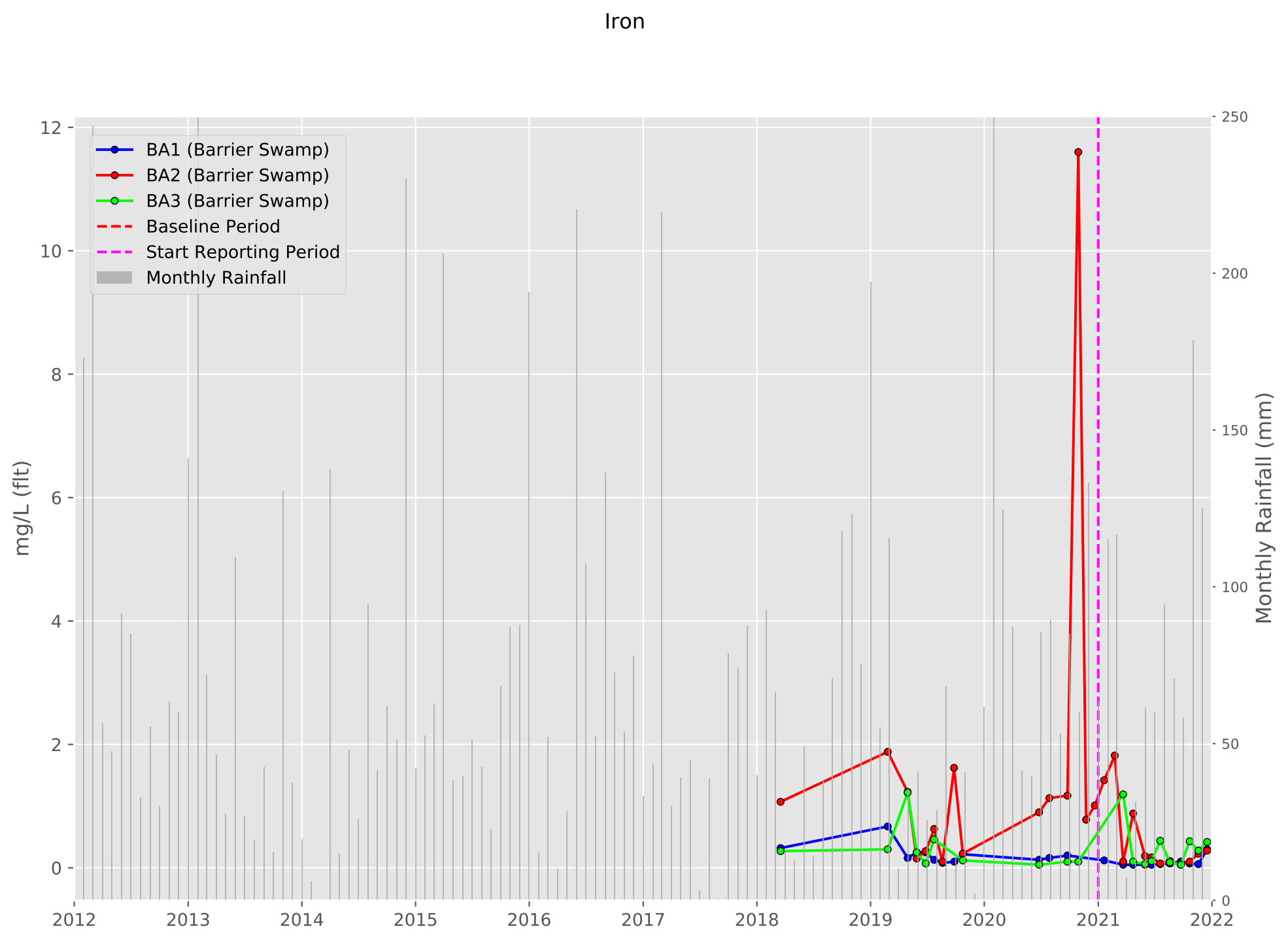

EC (field)
AP1105
AP1204
AP4PR
AP5PR
AP8PR
AP9PR
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
350
300
250
200
150
100
50
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

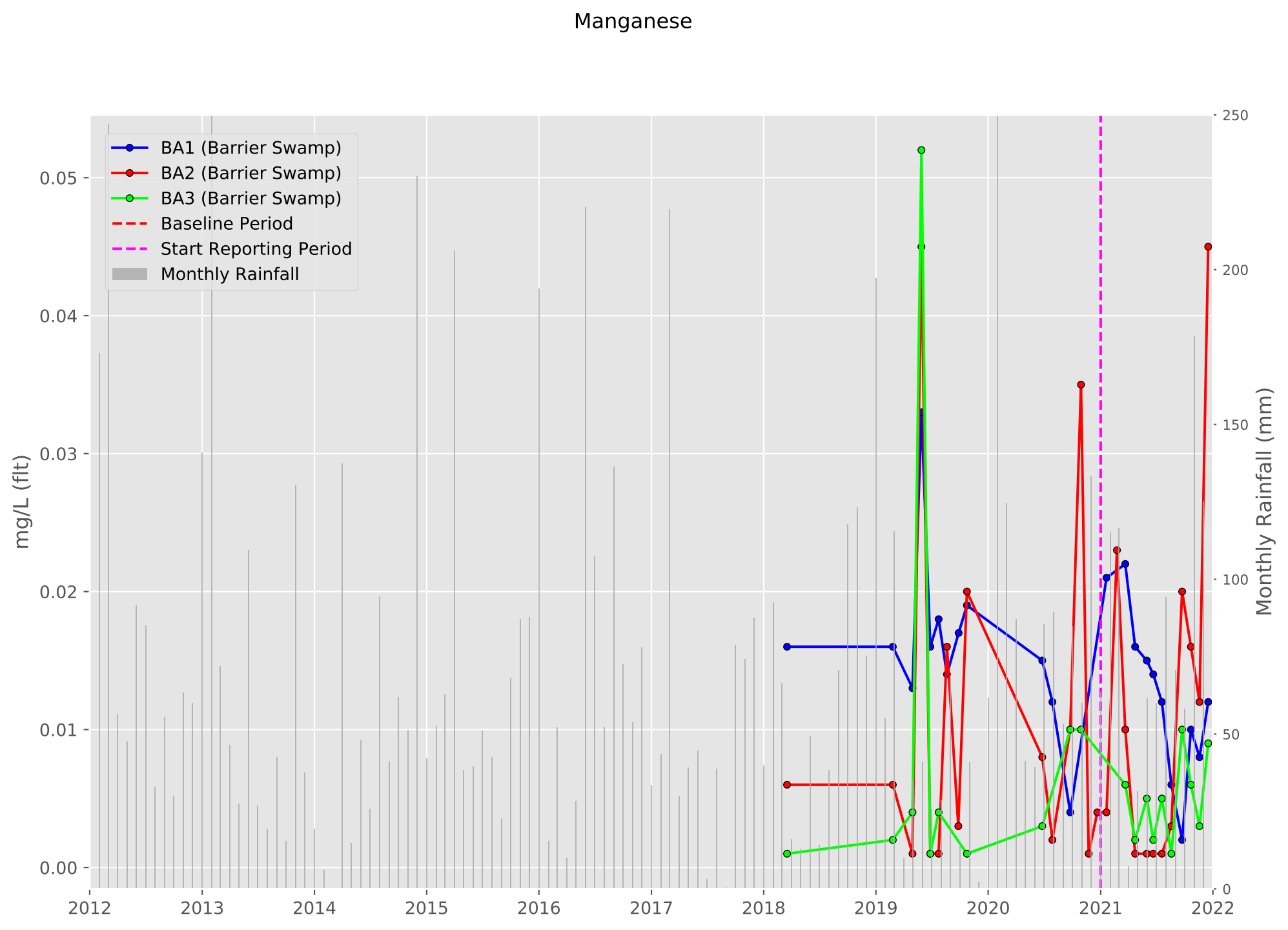

Iron
AP1105
AP1204
AP4PR
AP5PR
AP8PR
AP9PR
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
1.0
0.8
0.6
0.4
0.2
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

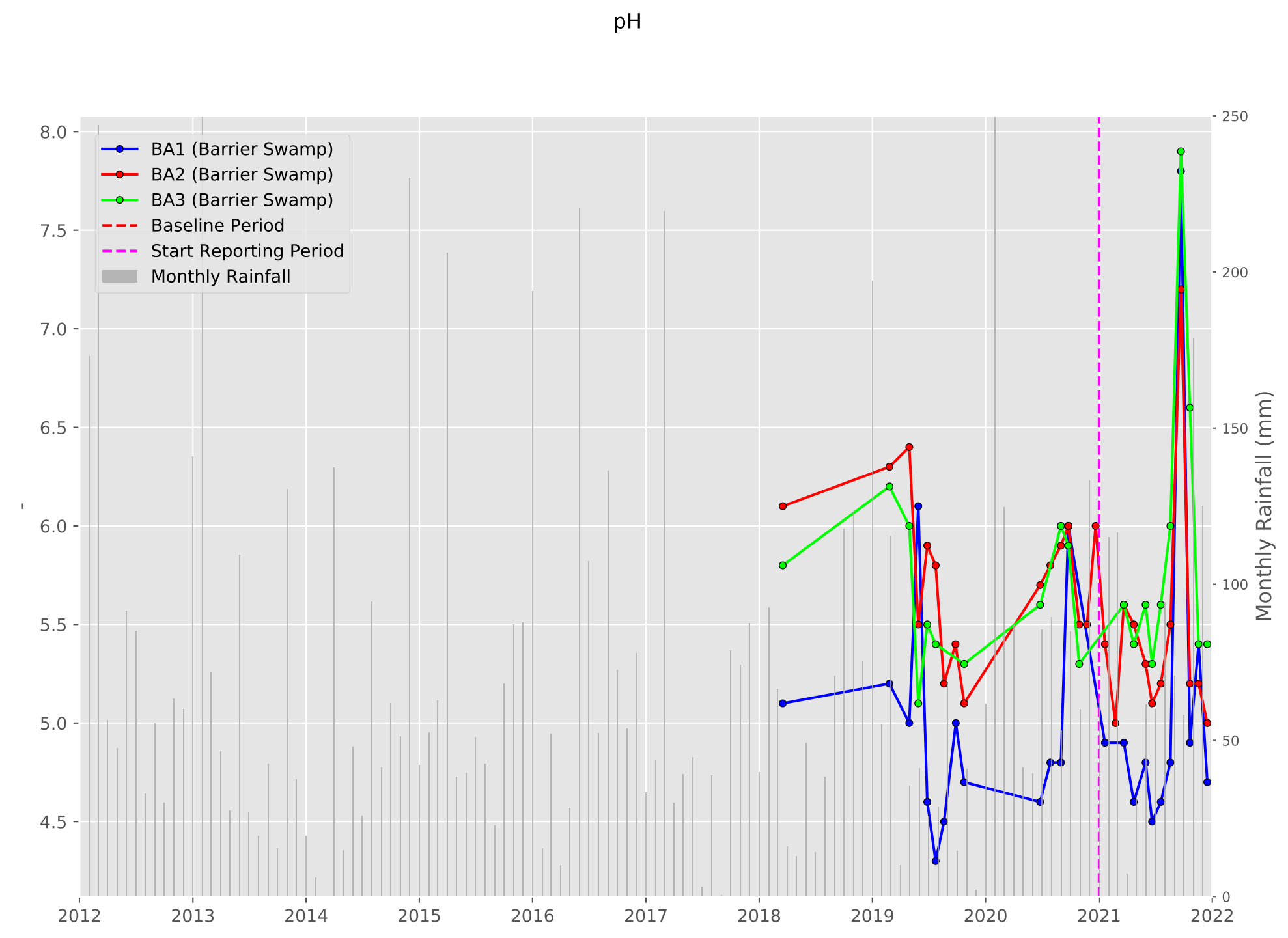

Manganese
AP1105
AP1204
AP4PR
AP5PR
AP8PR
AP9PR
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.02
0.04
0.06
0.08
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

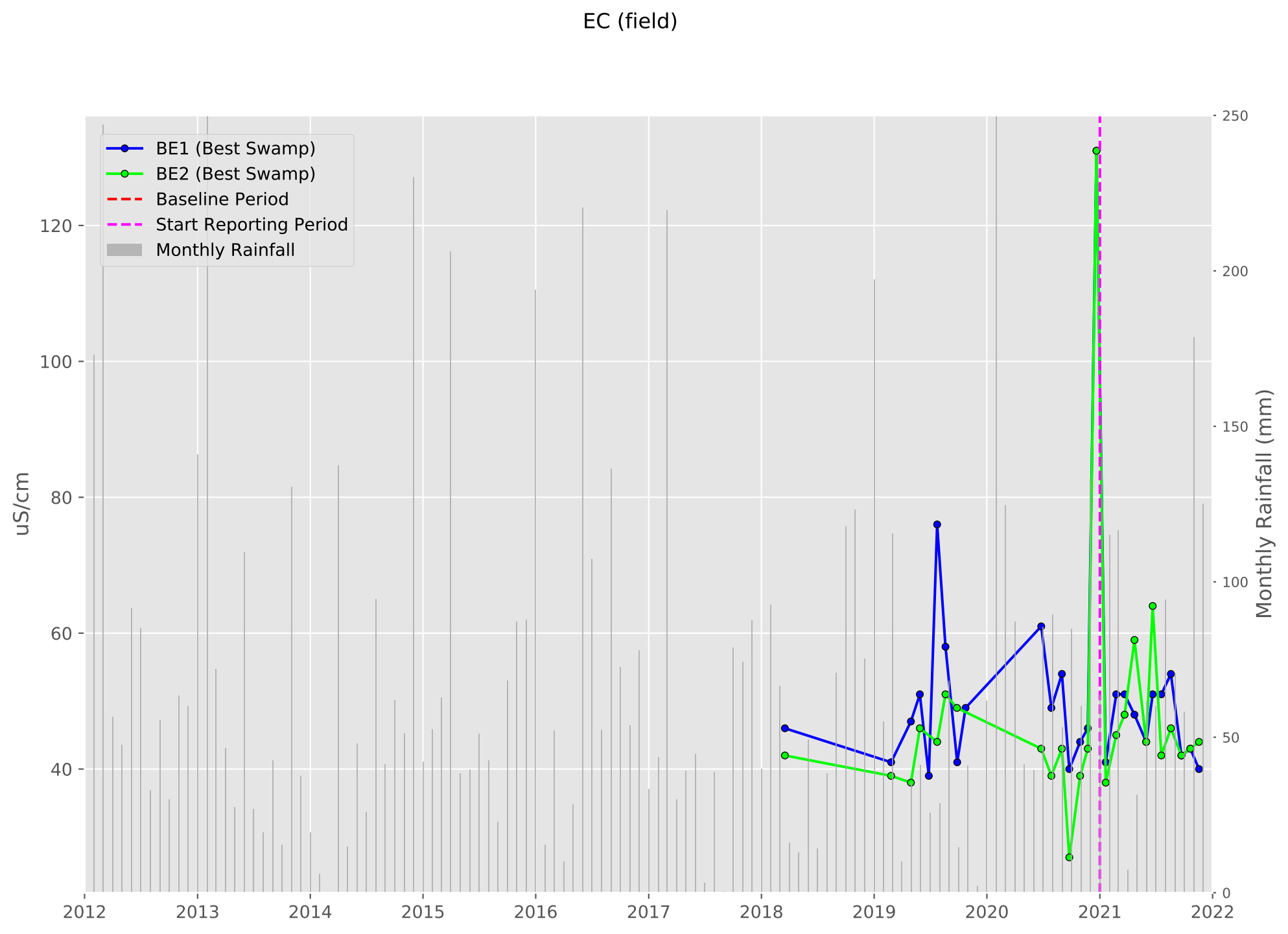

pH
AP1105
AP1204
AP4PR
AP5PR
AP8PR
AP9PR
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

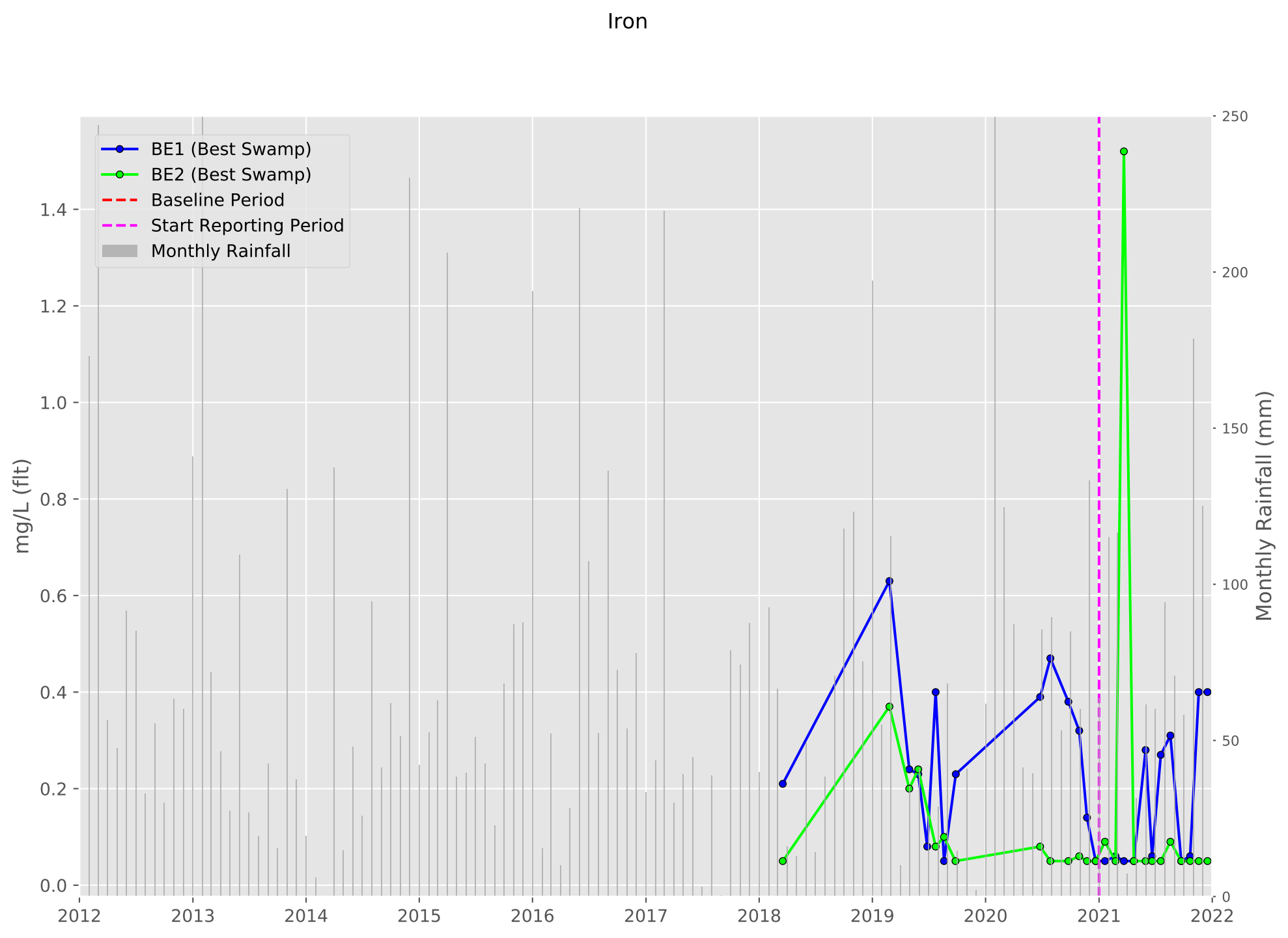

EC (field)
BA1 (Barrier Swamp)
BA2 (Barrier Swamp)
BA3 (Barrier Swamp)
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
200
400
600
800
1000
1200
1400
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

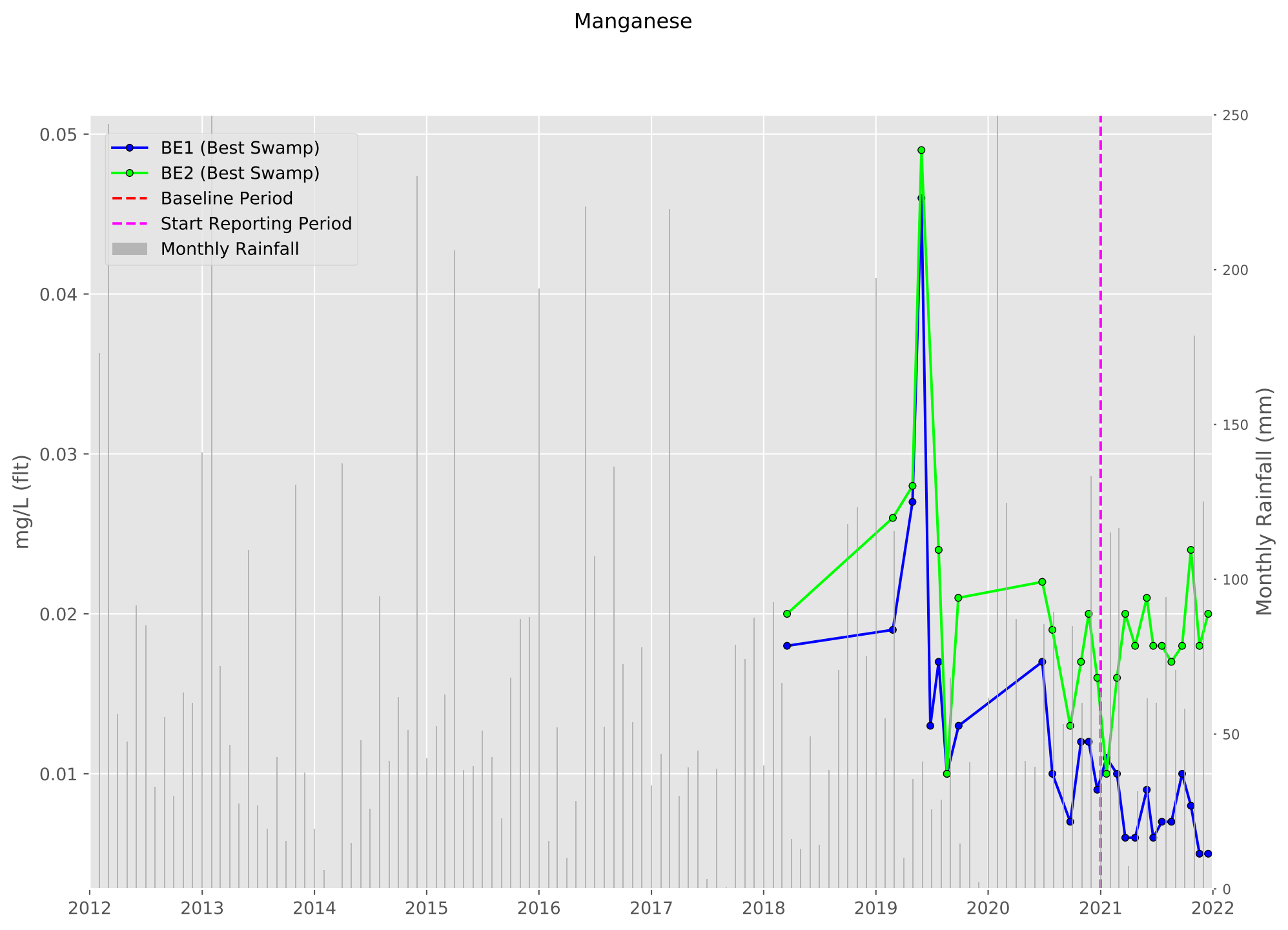

Iron
BA1 (Barrier Swamp)
BA2 (Barrier Swamp)
BA3 (Barrier Swamp)
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
2
4
6
8
10
12
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

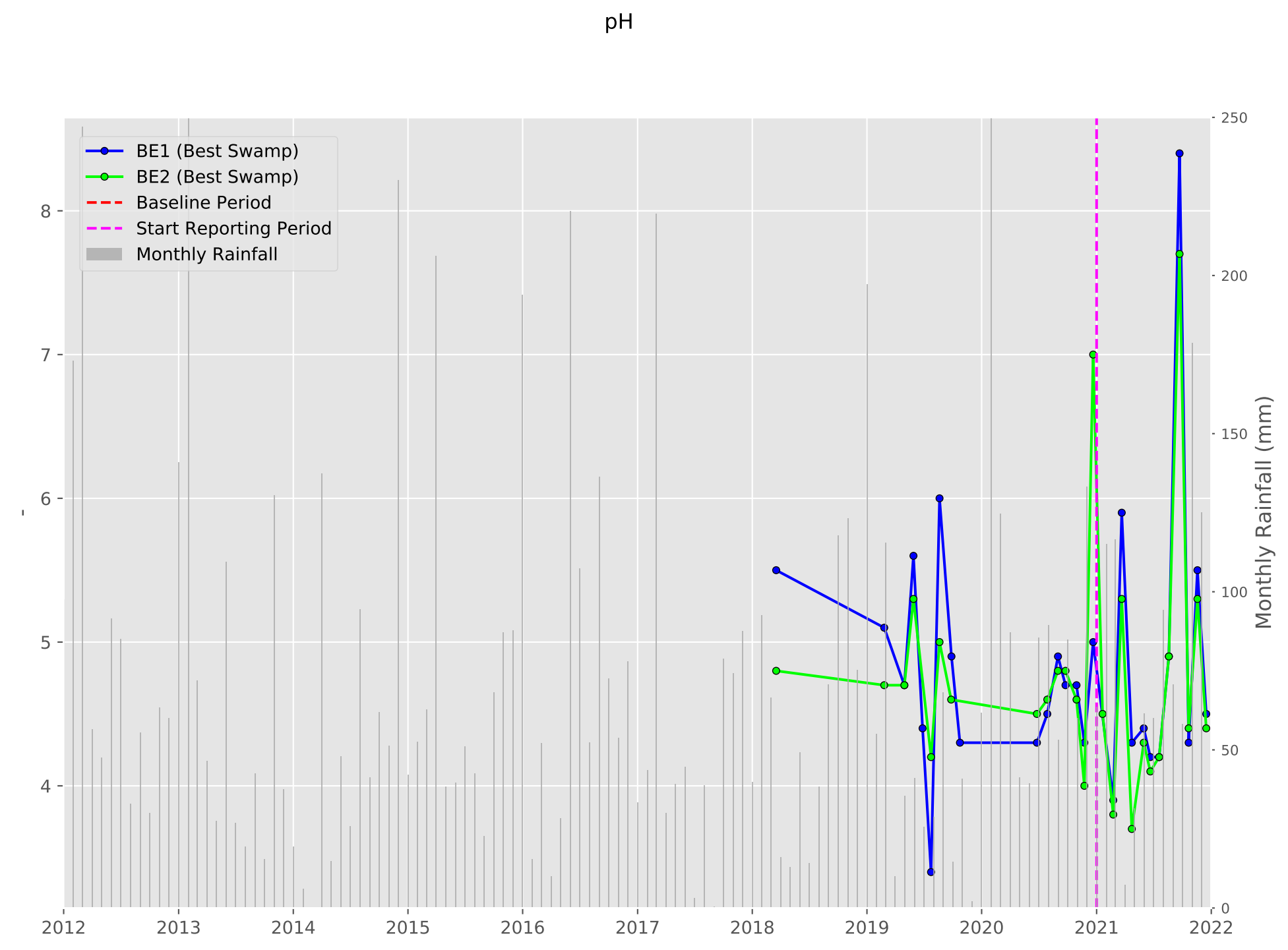

Manganese
BA1 (Barrier Swamp)
BA2 (Barrier Swamp)
BA3 (Barrier Swamp)
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.01
0.02
0.03
0.04
0.05
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


pH
BA1 (Barrier Swamp)
BA2 (Barrier Swamp)
BA3 (Barrier Swamp)
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

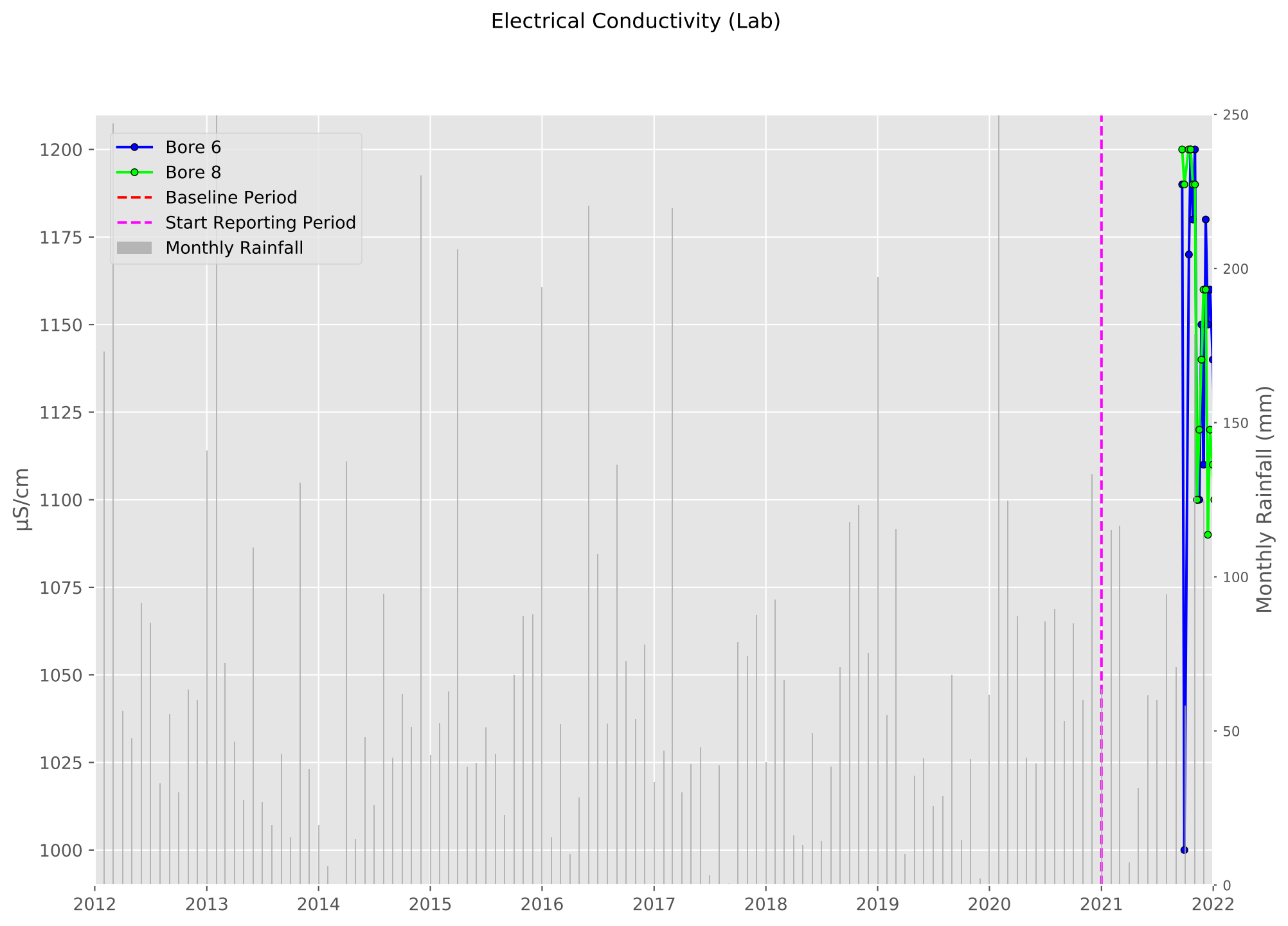

EC (field)
BE1 (Best Swamp)
BE2 (Best Swamp)
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
120
100
80
60
40
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

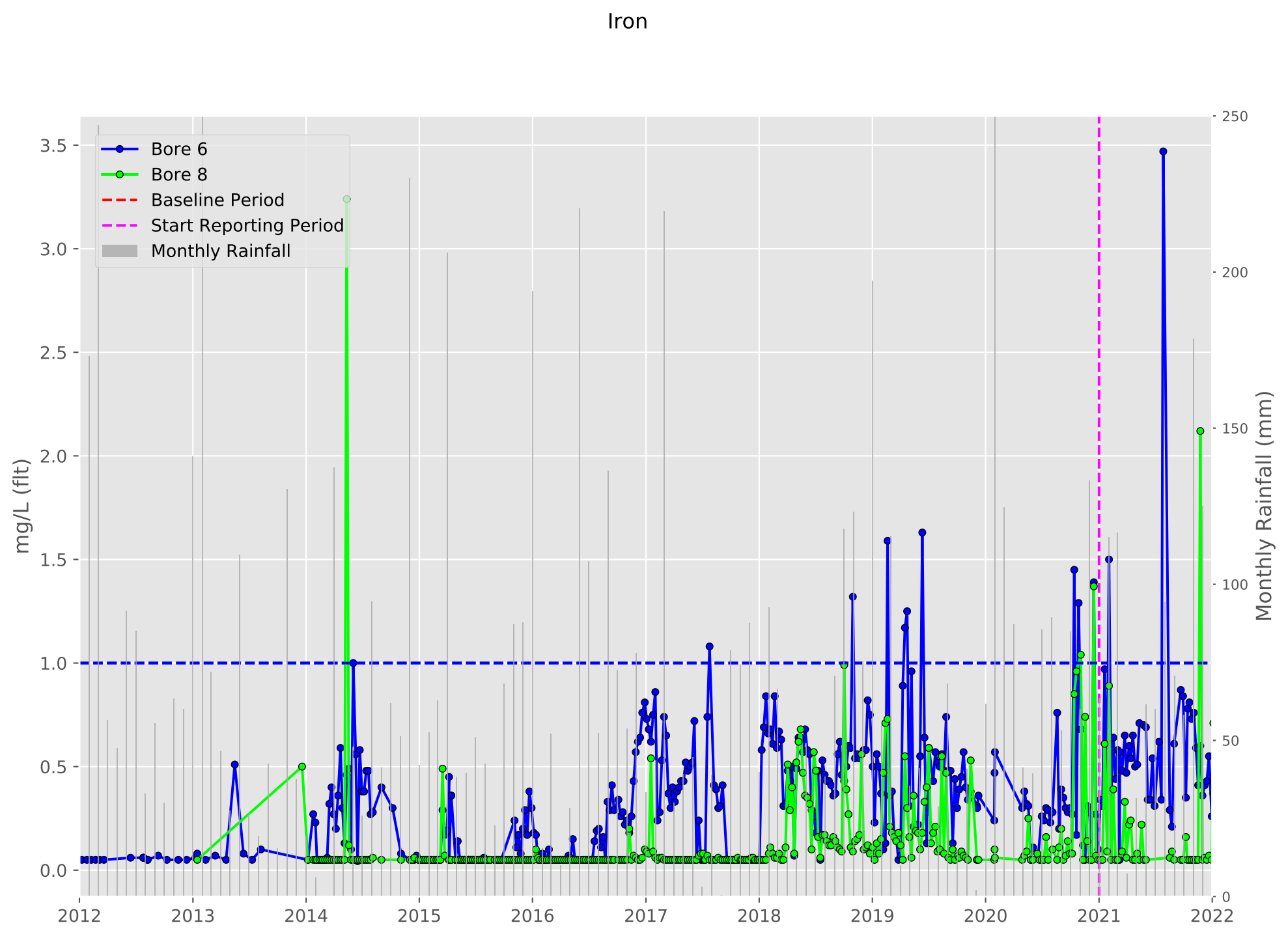

Iron
BE1 (Best Swamp)
BE2 (Best Swamp)
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

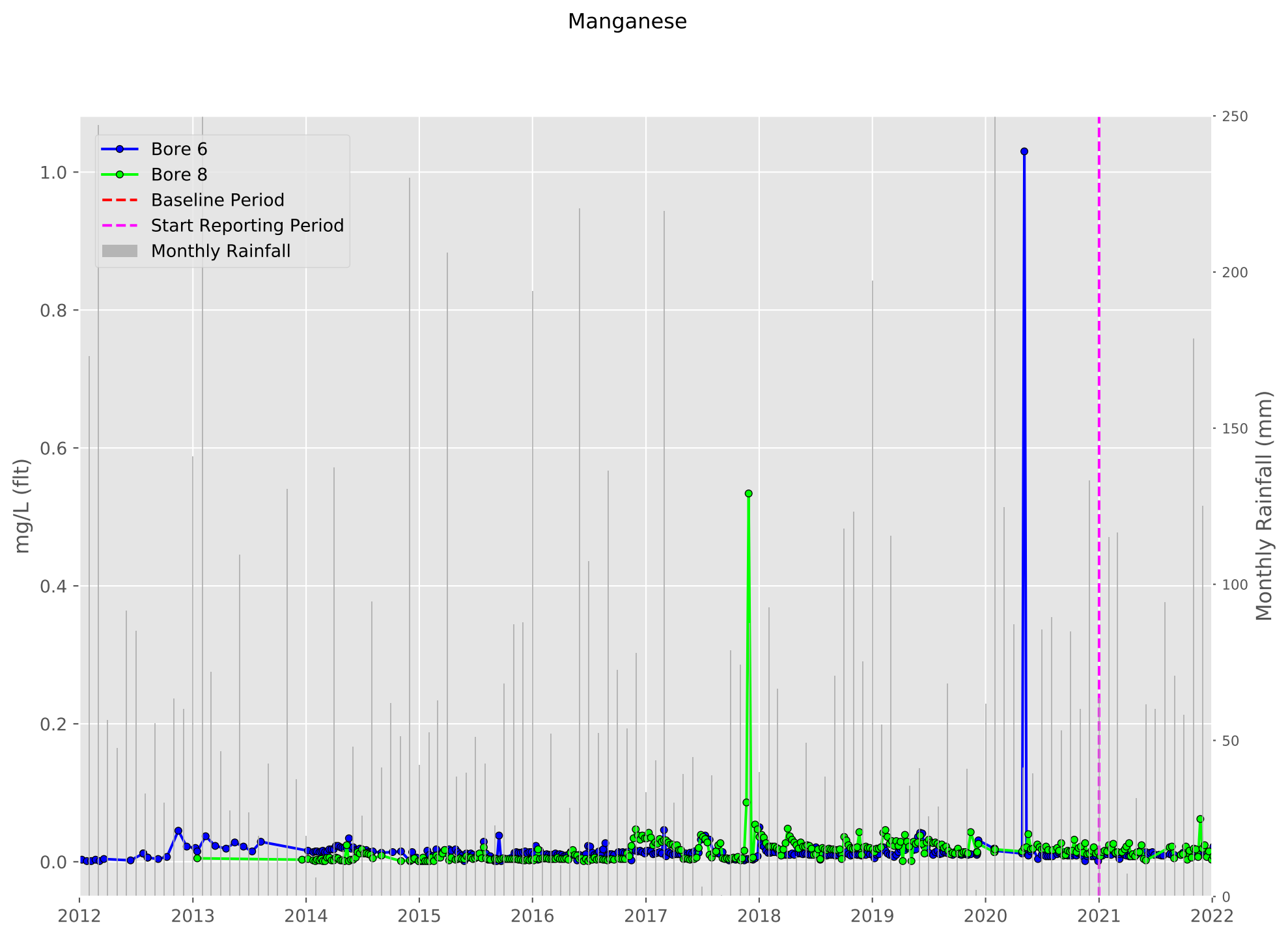

Manganese
BE1 (Best Swamp)
BE2 (Best Swamp)
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.05
0.04
0.03
0.02
0.01
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

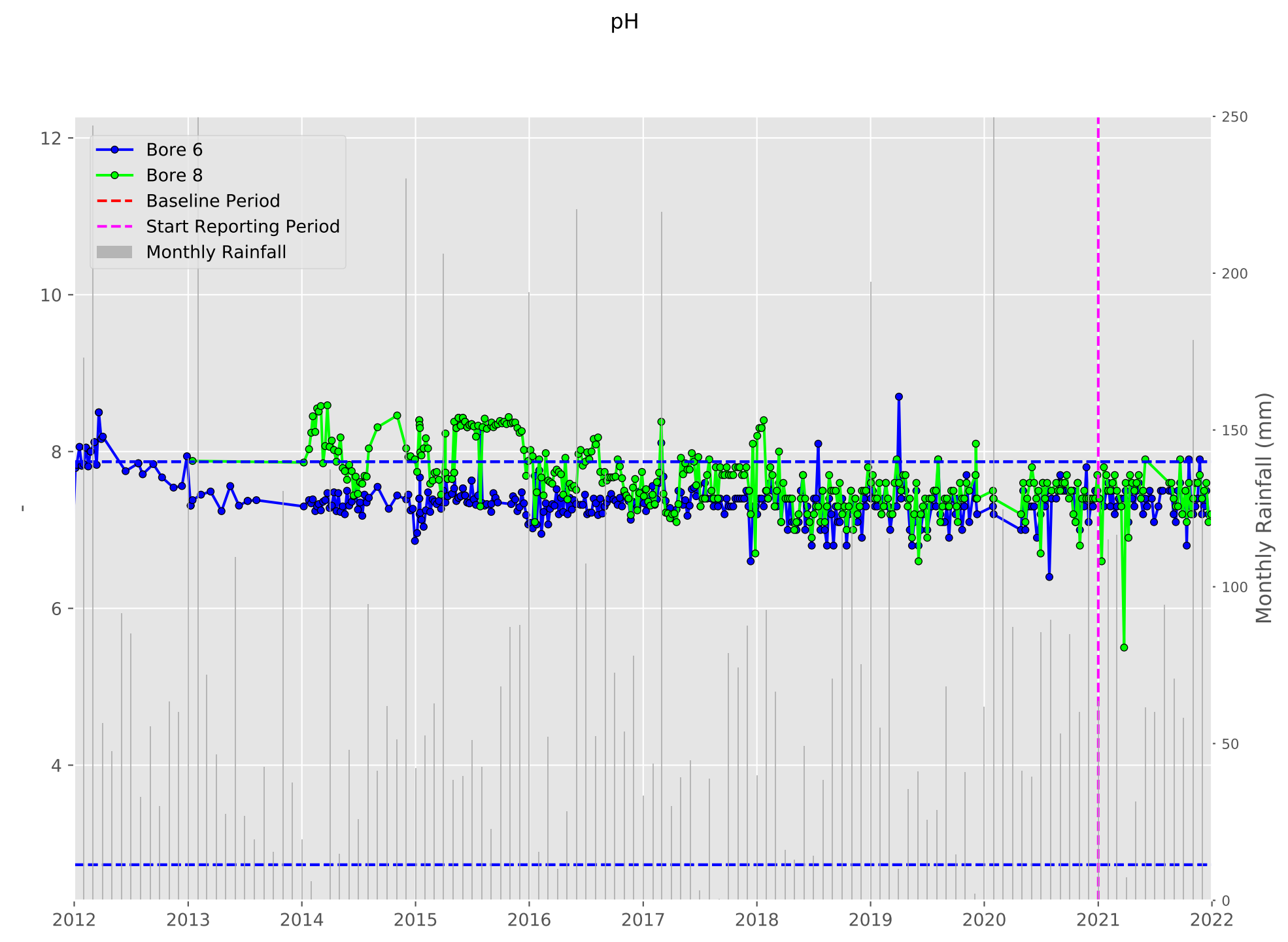

pH
BE1 (Best Swamp)
BE2 (Best Swamp)
Baseline Period
Start Reporting Period
Monthly Rainfall
-
8
7
6
5
4
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


EC (field)
Bore 6
Bore 8
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
500
1000
1500
2000
2500
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

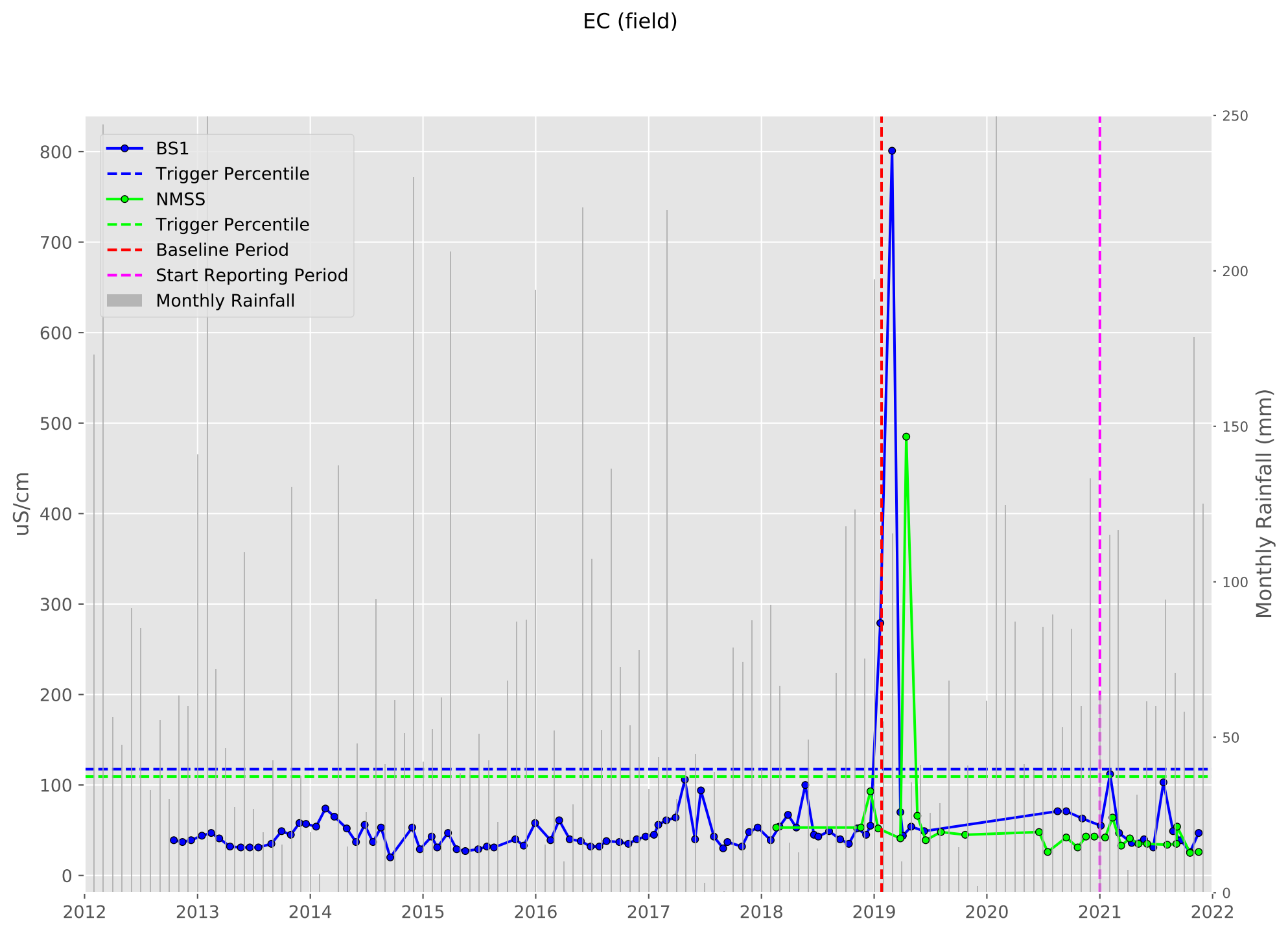

Electrical Conductivity (Lab)
Bore 6
Bore 8
Baseline Period
Start Reporting Period
Monthly Rainfall
µS/cm
Monthly Rainfall (mm)
1200
1175
1150
1125
1100
1075
1050
1025
1000
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

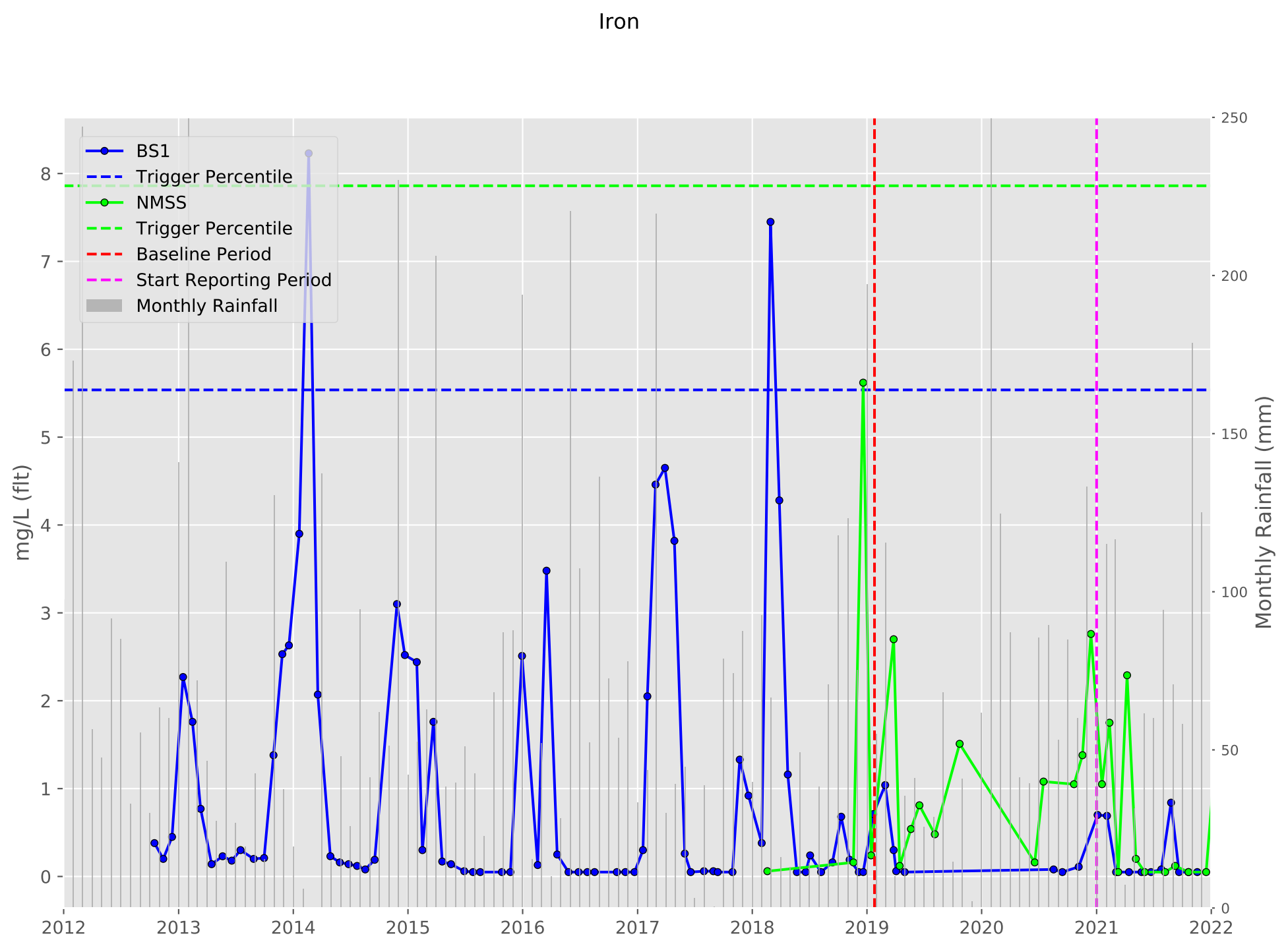

Iron
Bore 6
Bore 8
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

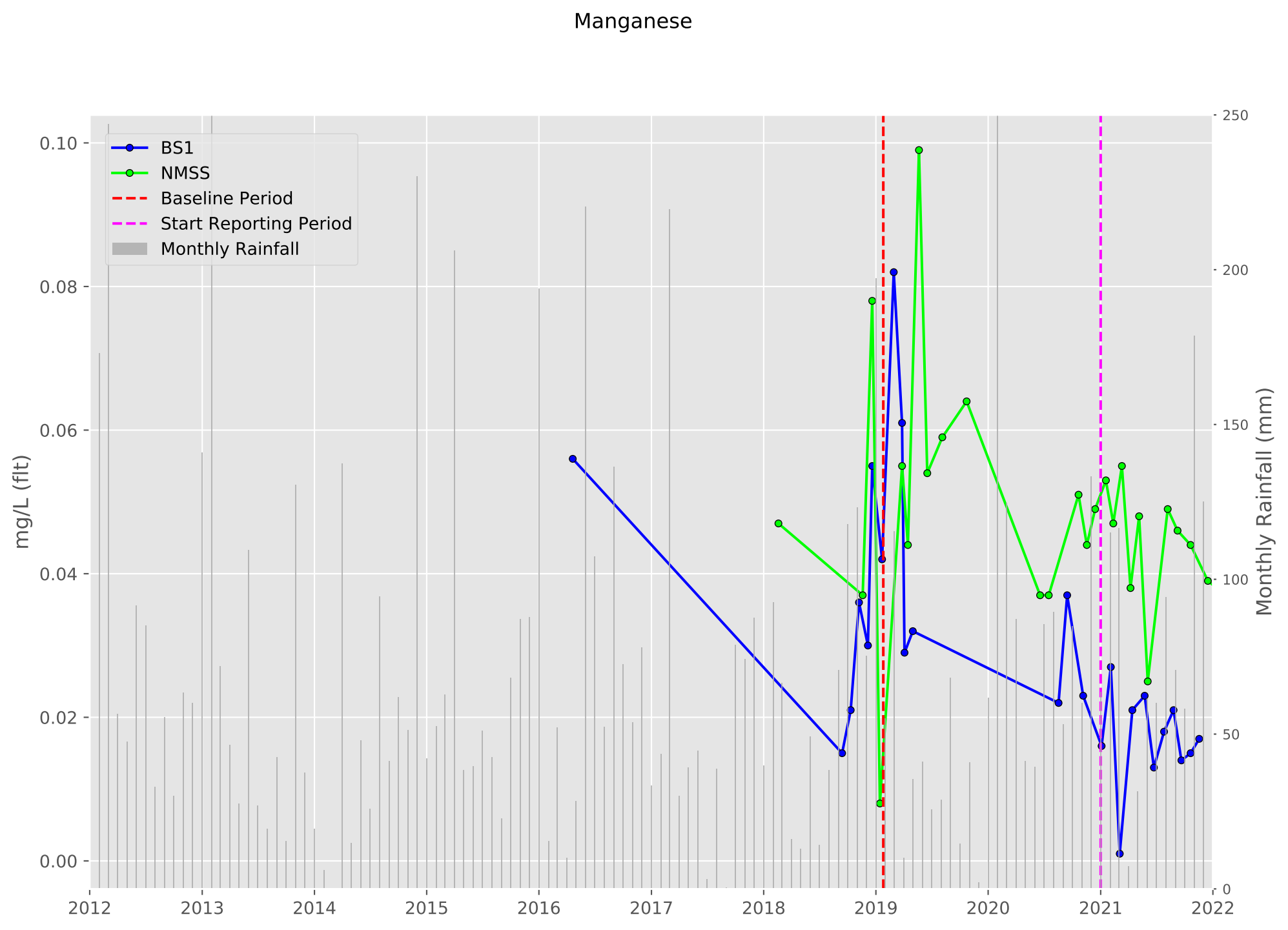

Manganese
Bore 6
Bore 8
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

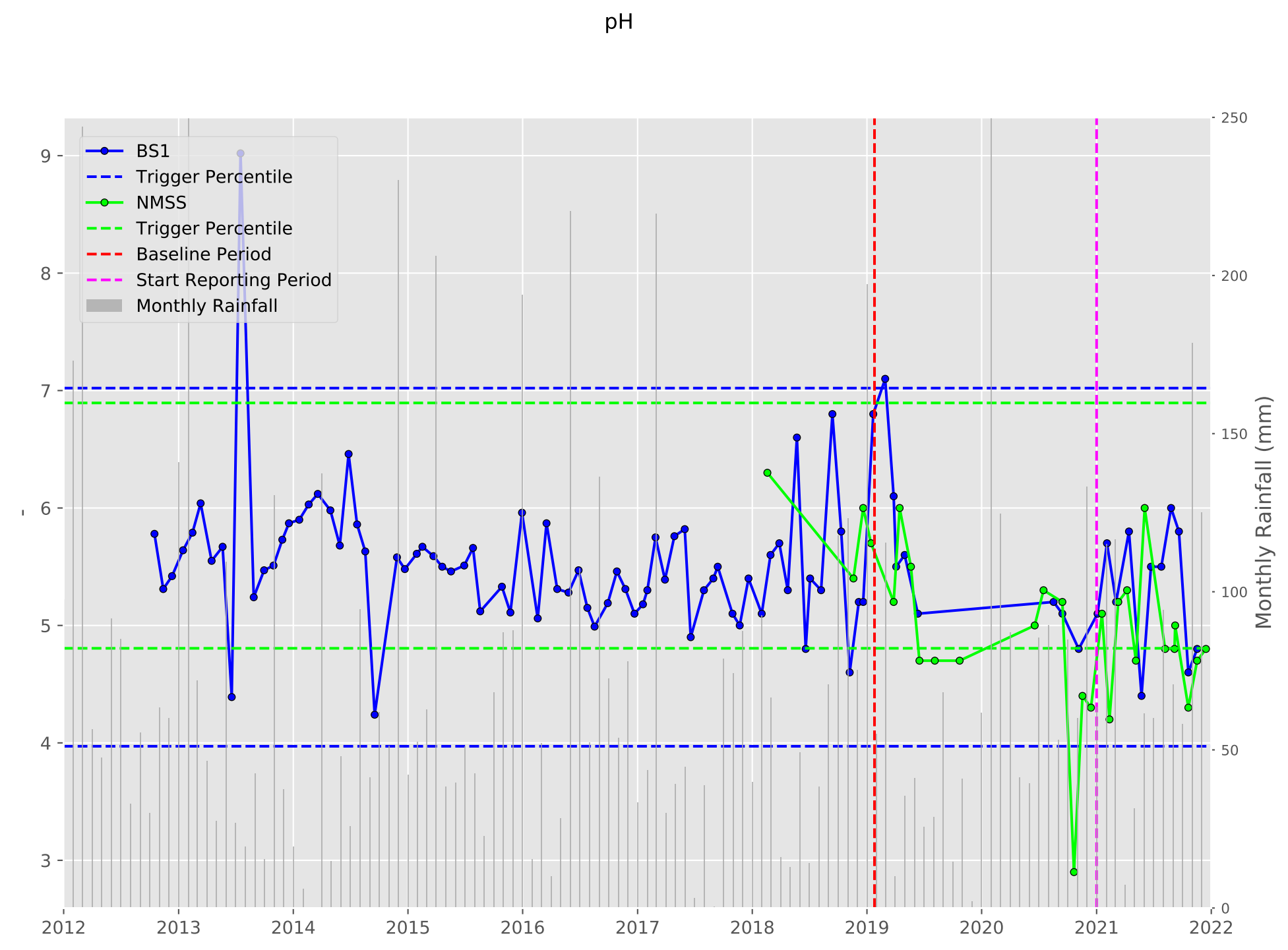

pH
Bore 6
Bore 8
Baseline Period
Start Reporting Period
Monthly Rainfall
12
10
8
6
4
-
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

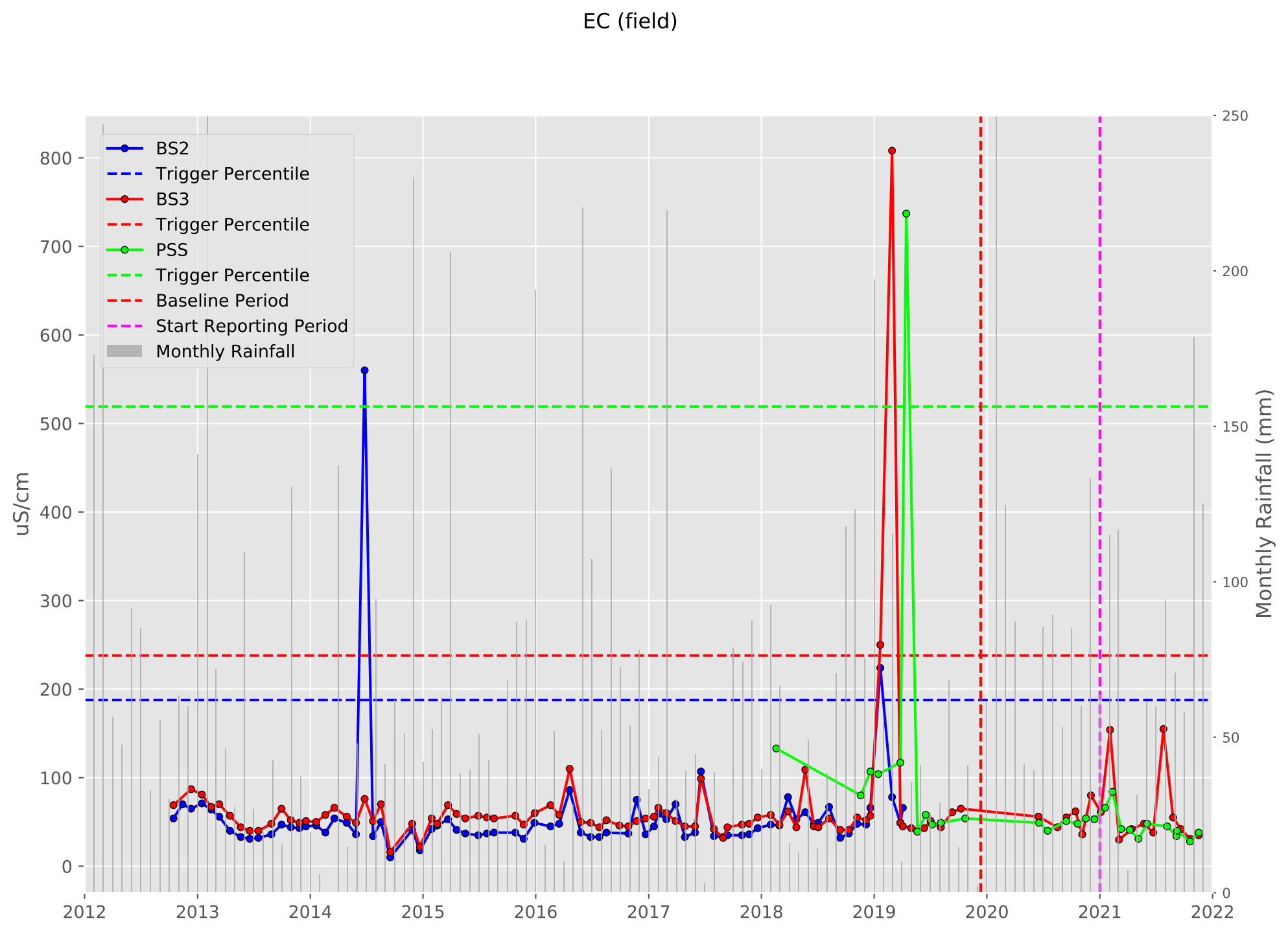

TSS
Bore 6
Bore 8
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0
500
1000
1500
2000
2500
3000
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

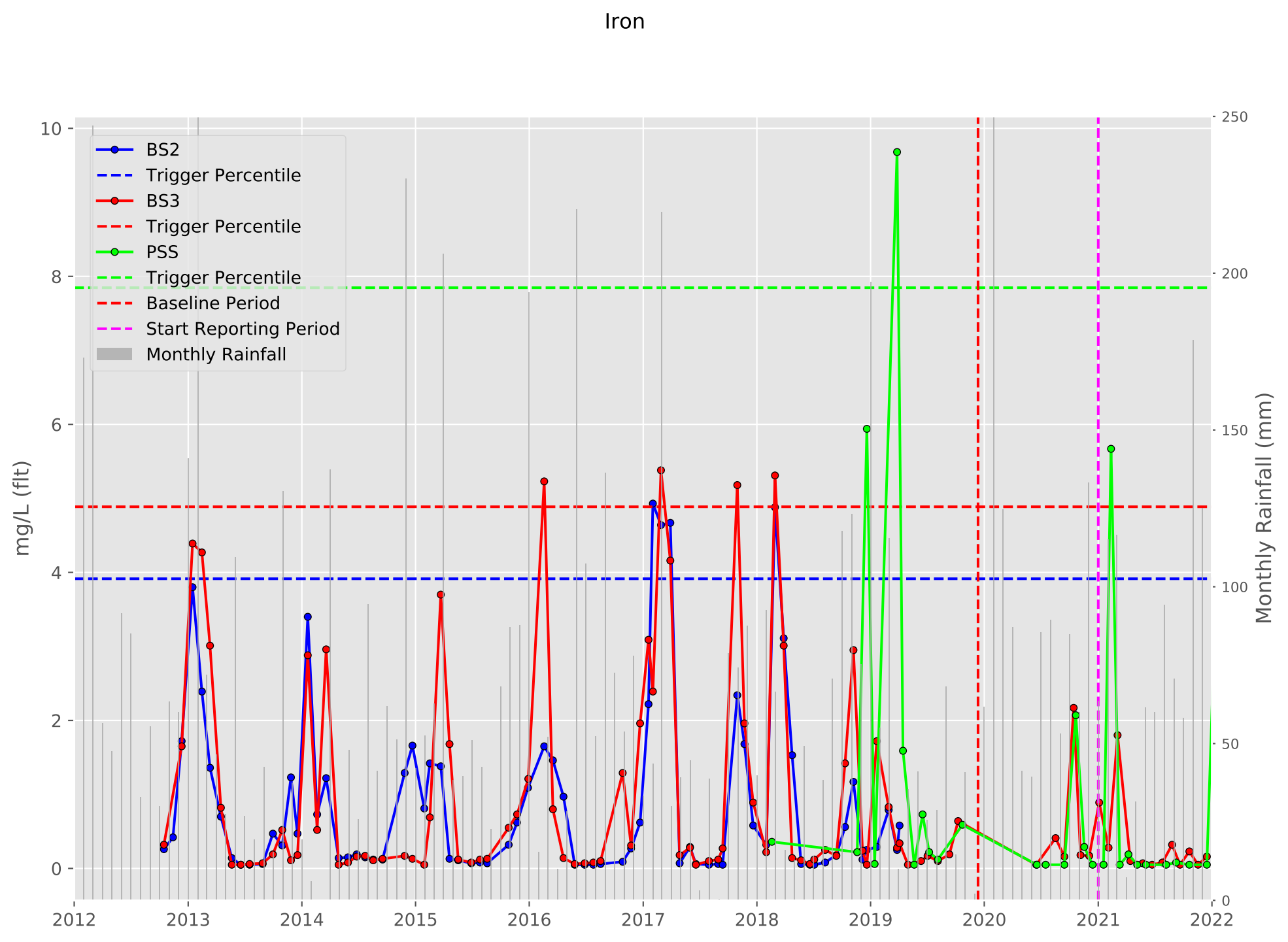

EC (field)
BS1
Trigger Percentile
NMSS
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
100
200
300
400
500
600
700
800
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

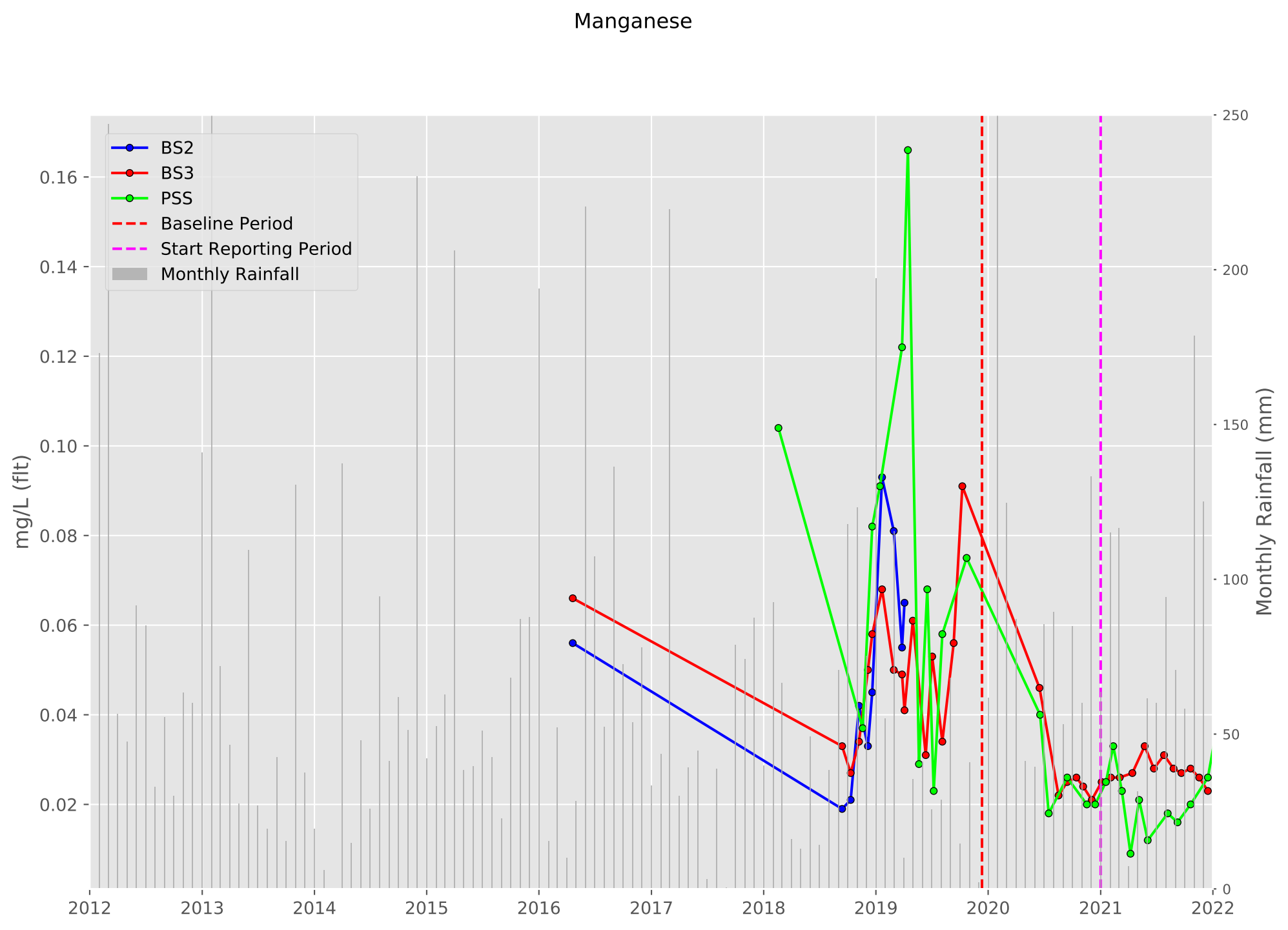

Iron
BS1
Trigger Percentile
NMSS
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
1
2
3
4
5
6
7
8
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

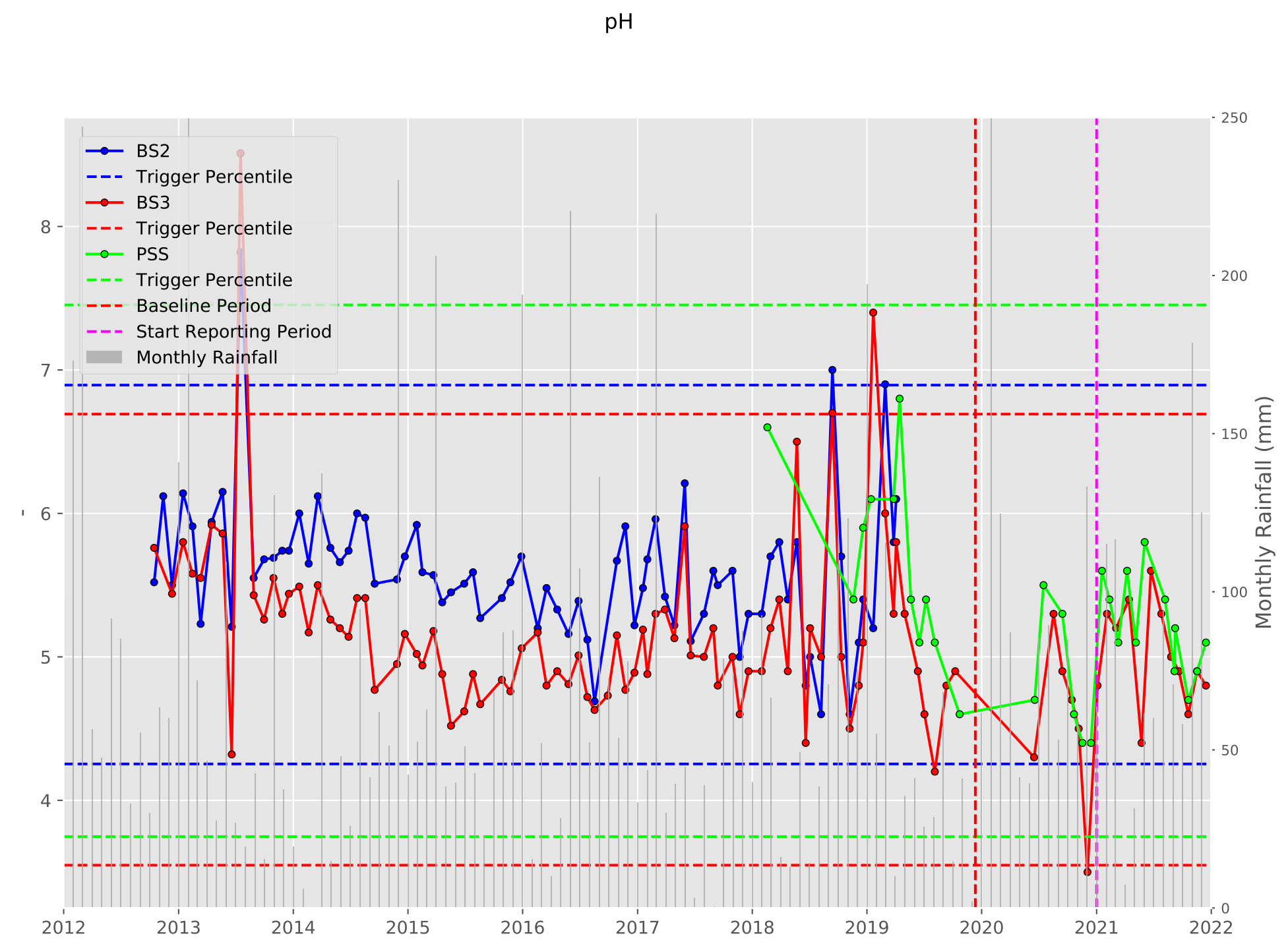

Manganese
BS1
NMSS
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.02
0.04
0.06
0.08
0.10
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

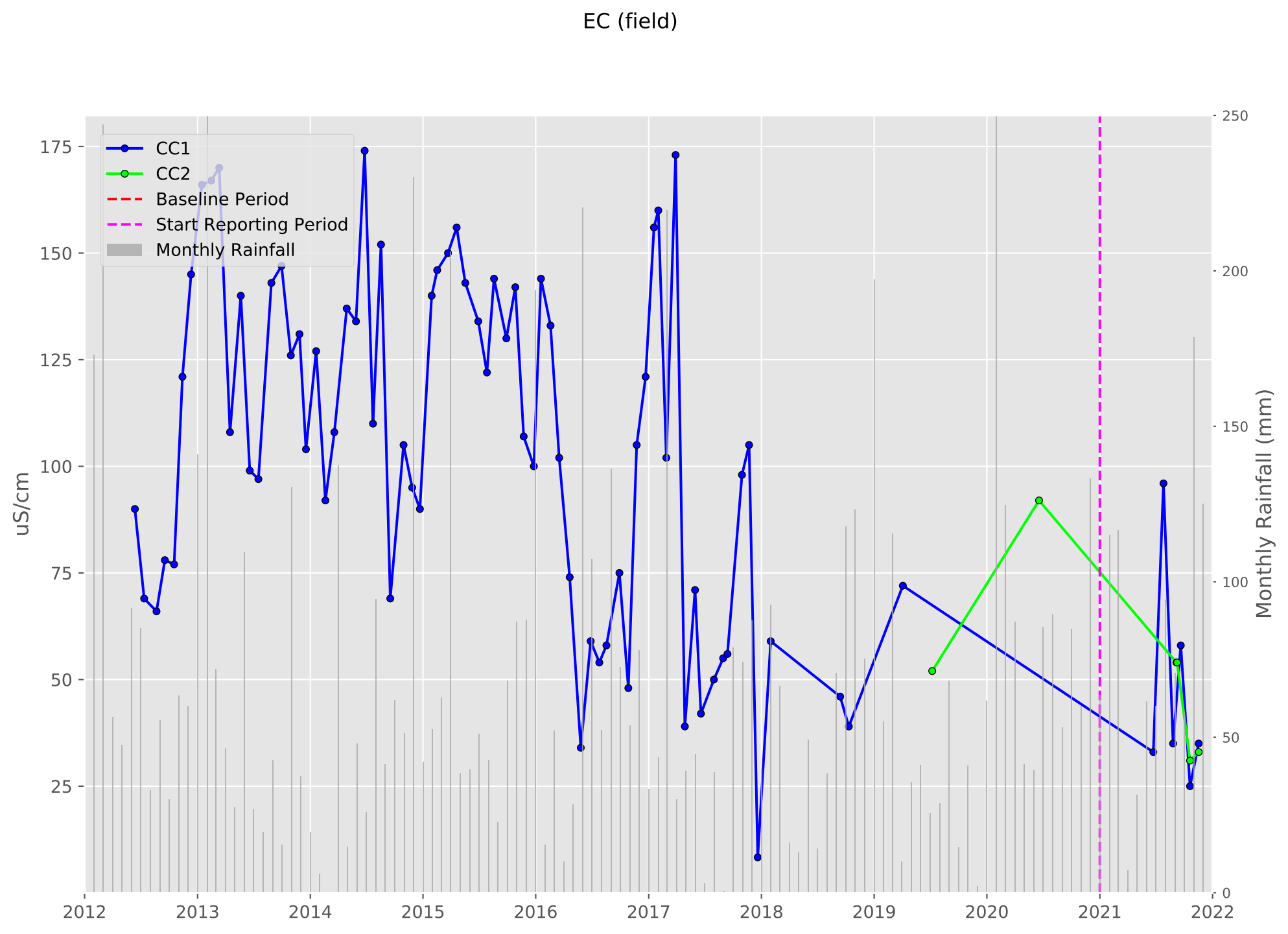

pH
BS1
Trigger Percentile
NMSS
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
9
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

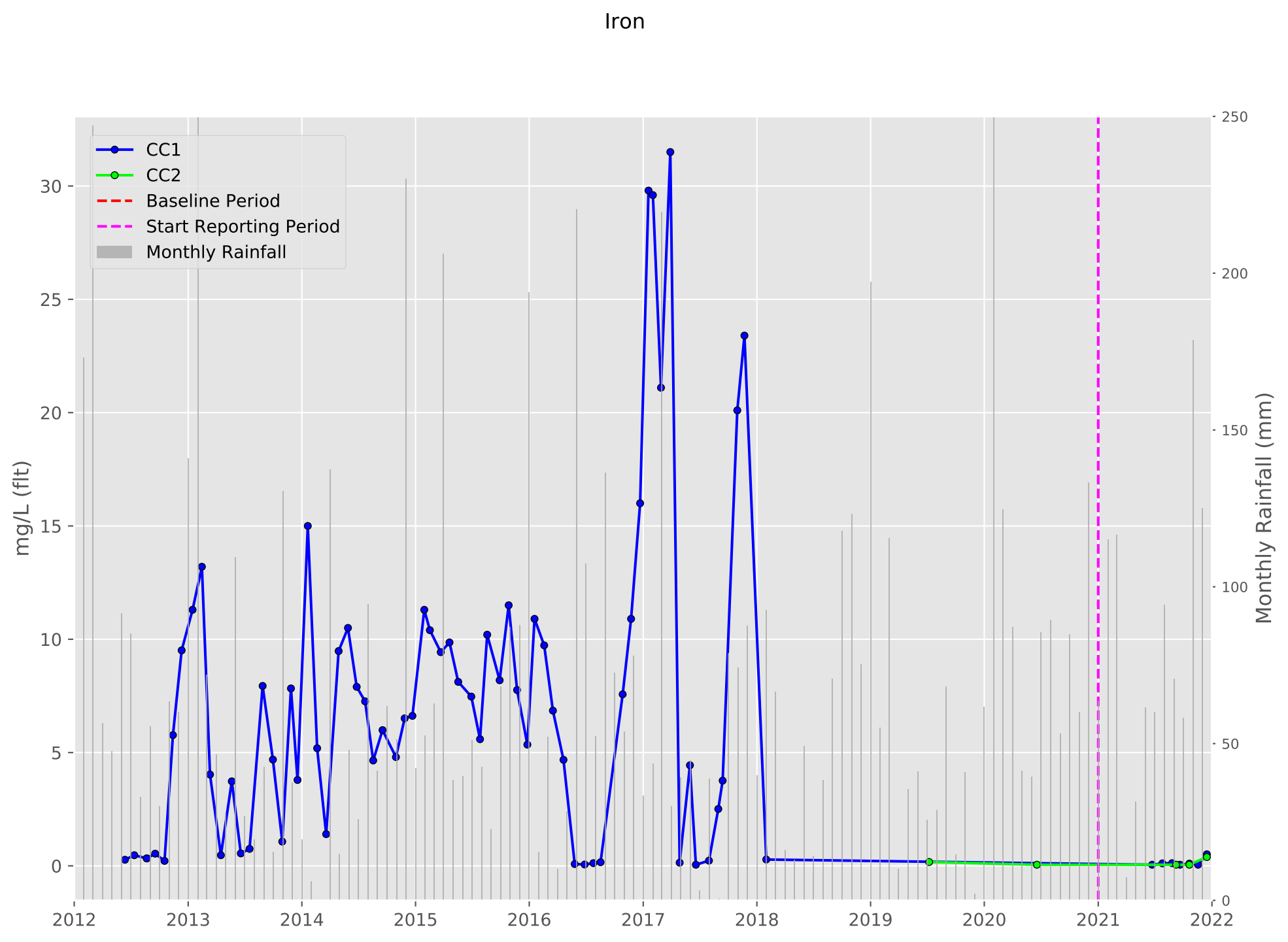

EC (field)
BS2
Trigger Percentile
BS3
Trigger Percentile
PSS
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
100
200
300
400
500
600
700
800
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

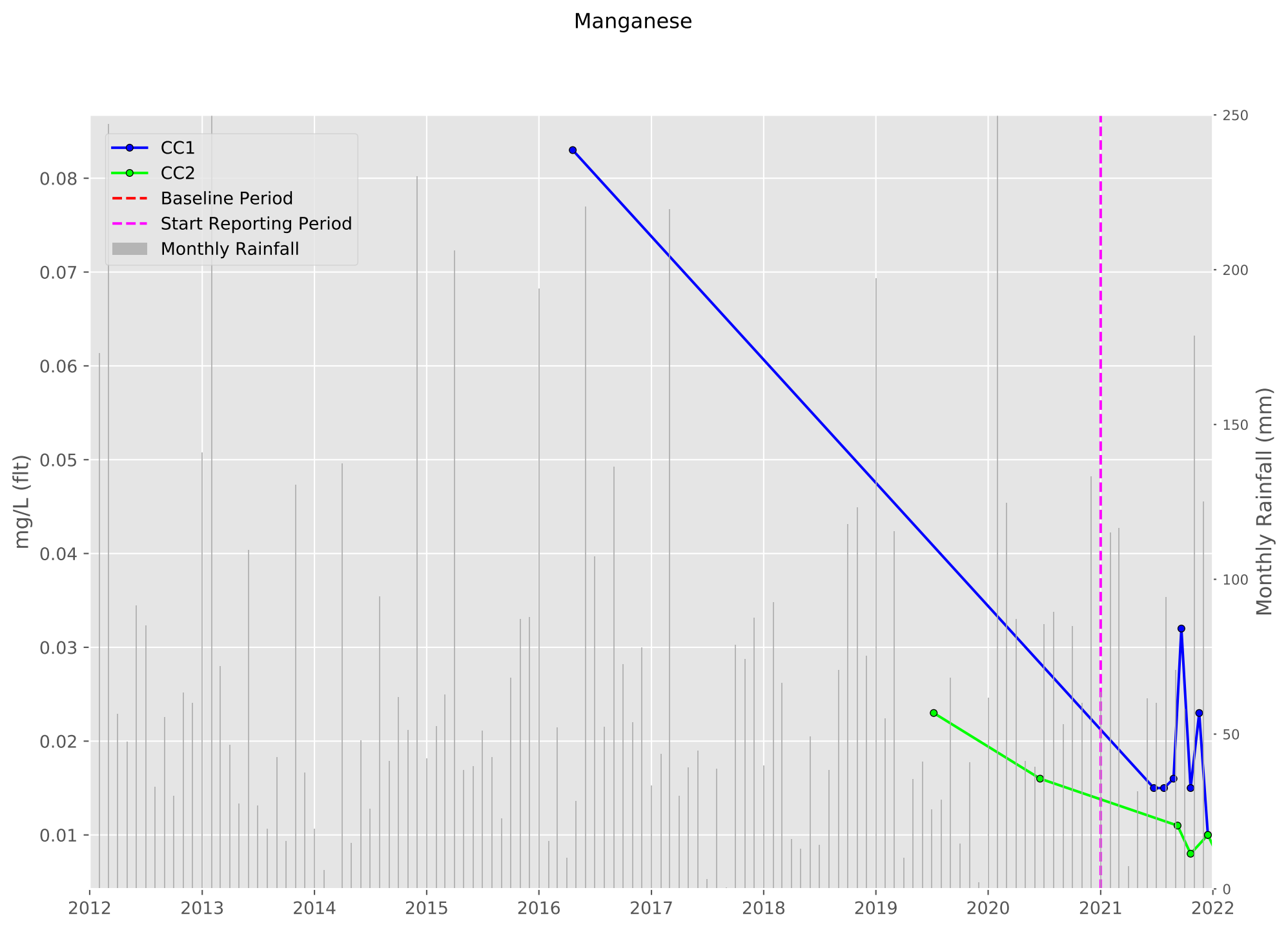

Iron
BS2
Trigger Percentile
BS3
Trigger Percentile
PSS
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
2
4
6
8
10
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

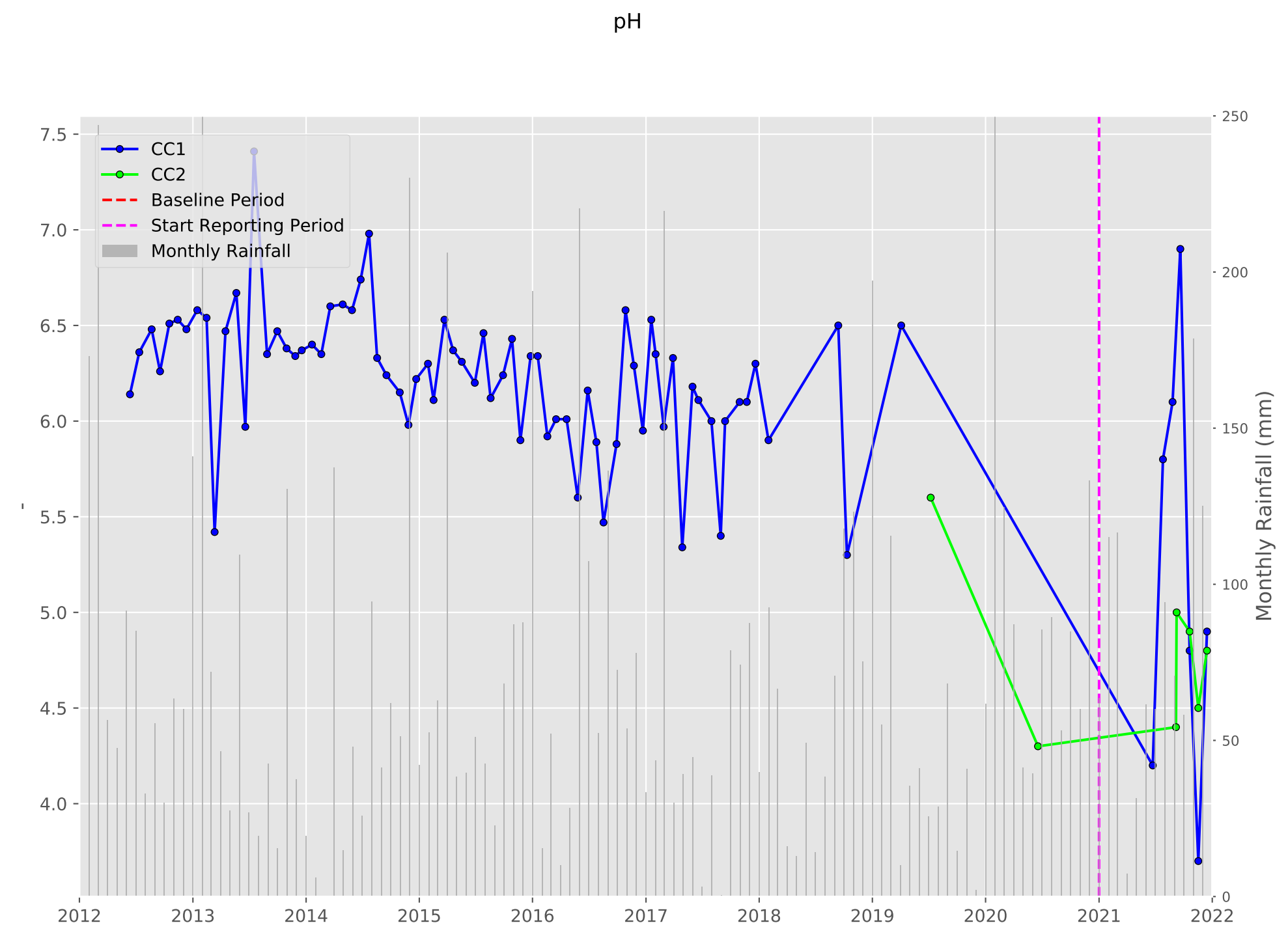

Manganese
BS2
BS3
PSS
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

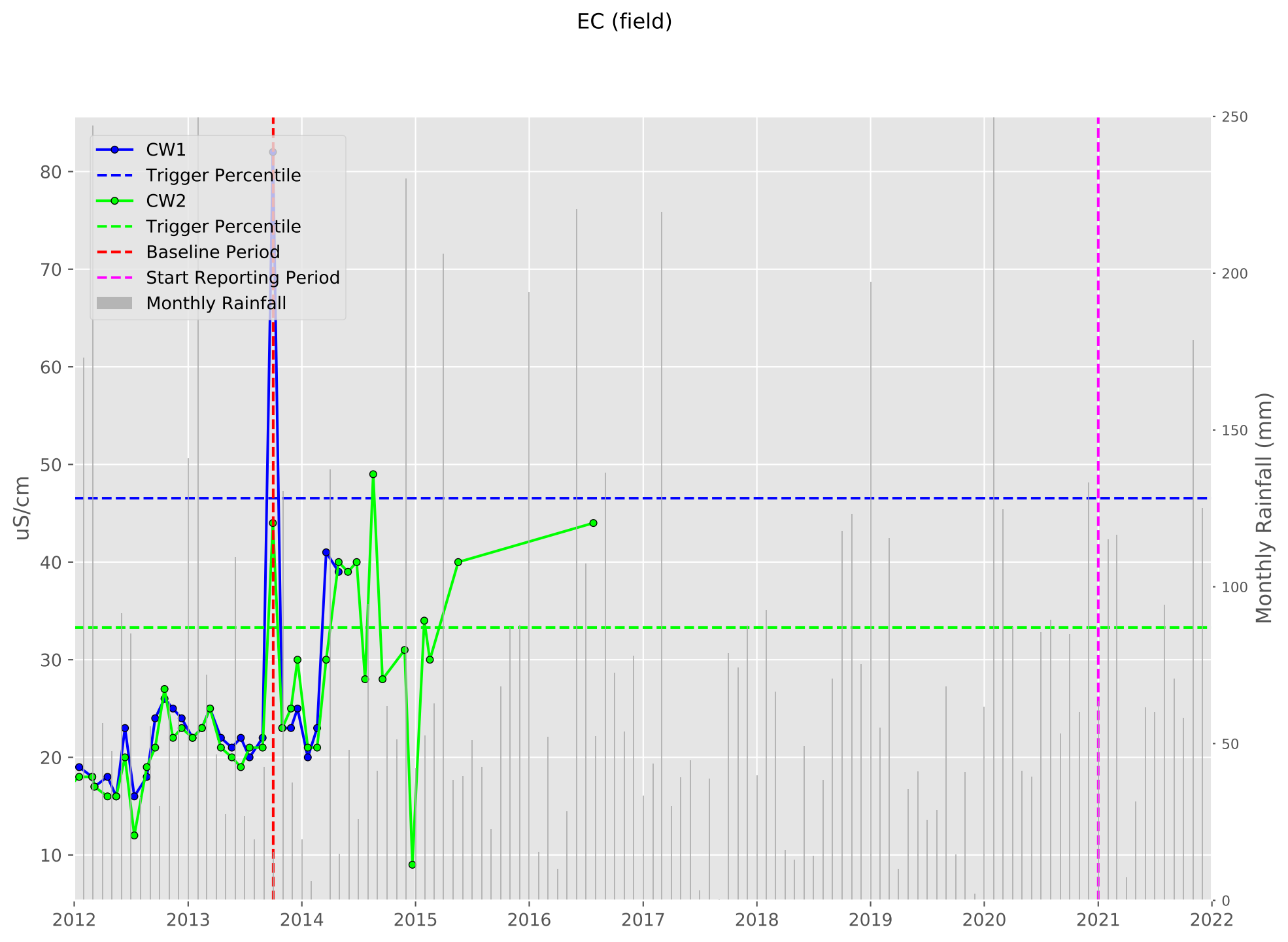

pH
BS2
Trigger Percentile
BS3
Trigger Percentile
PSS
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
8
7
6
5
4
-
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

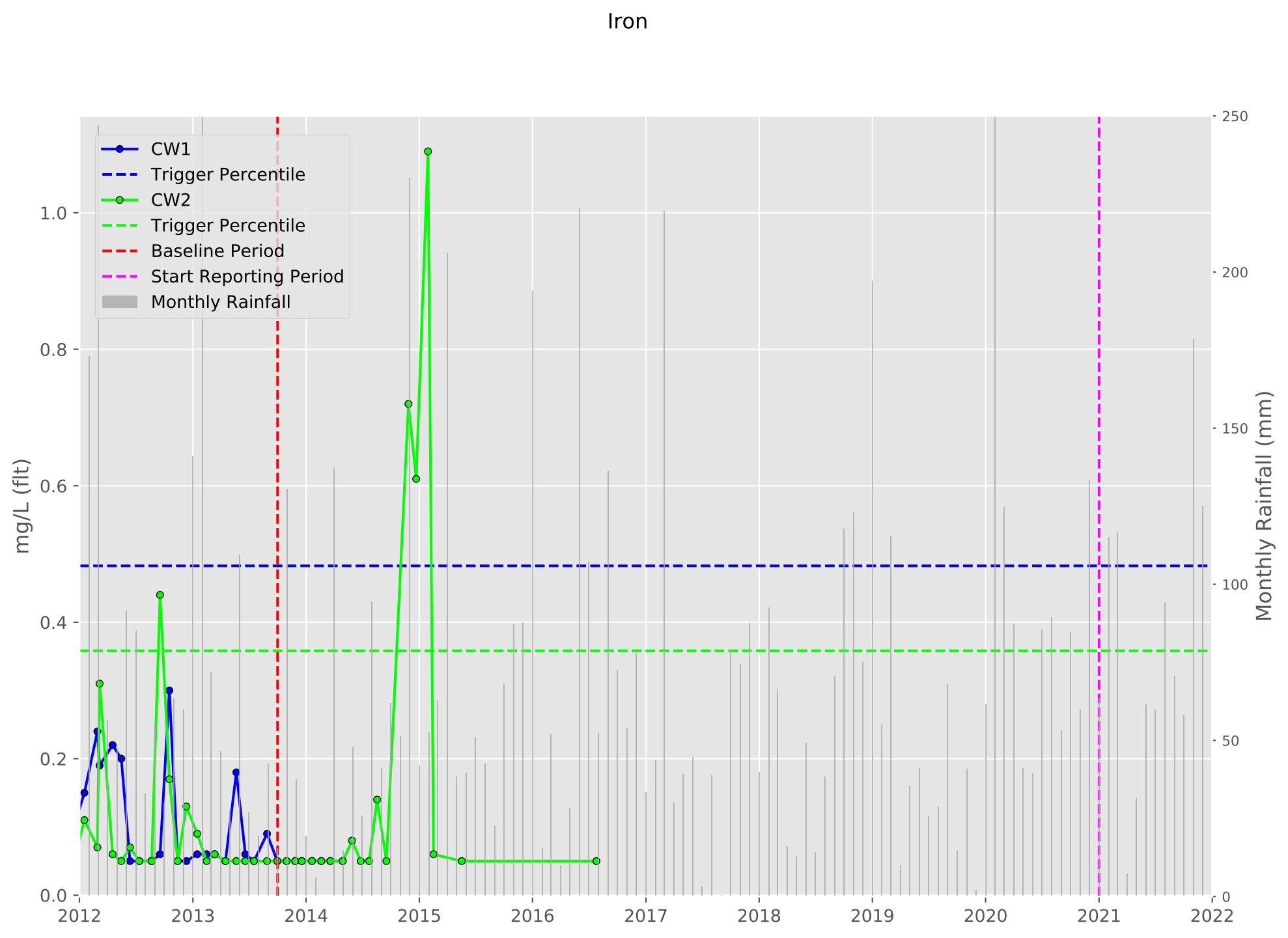

EC (field)
CC1
CC2
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
175
150
125
100
75
50
25
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

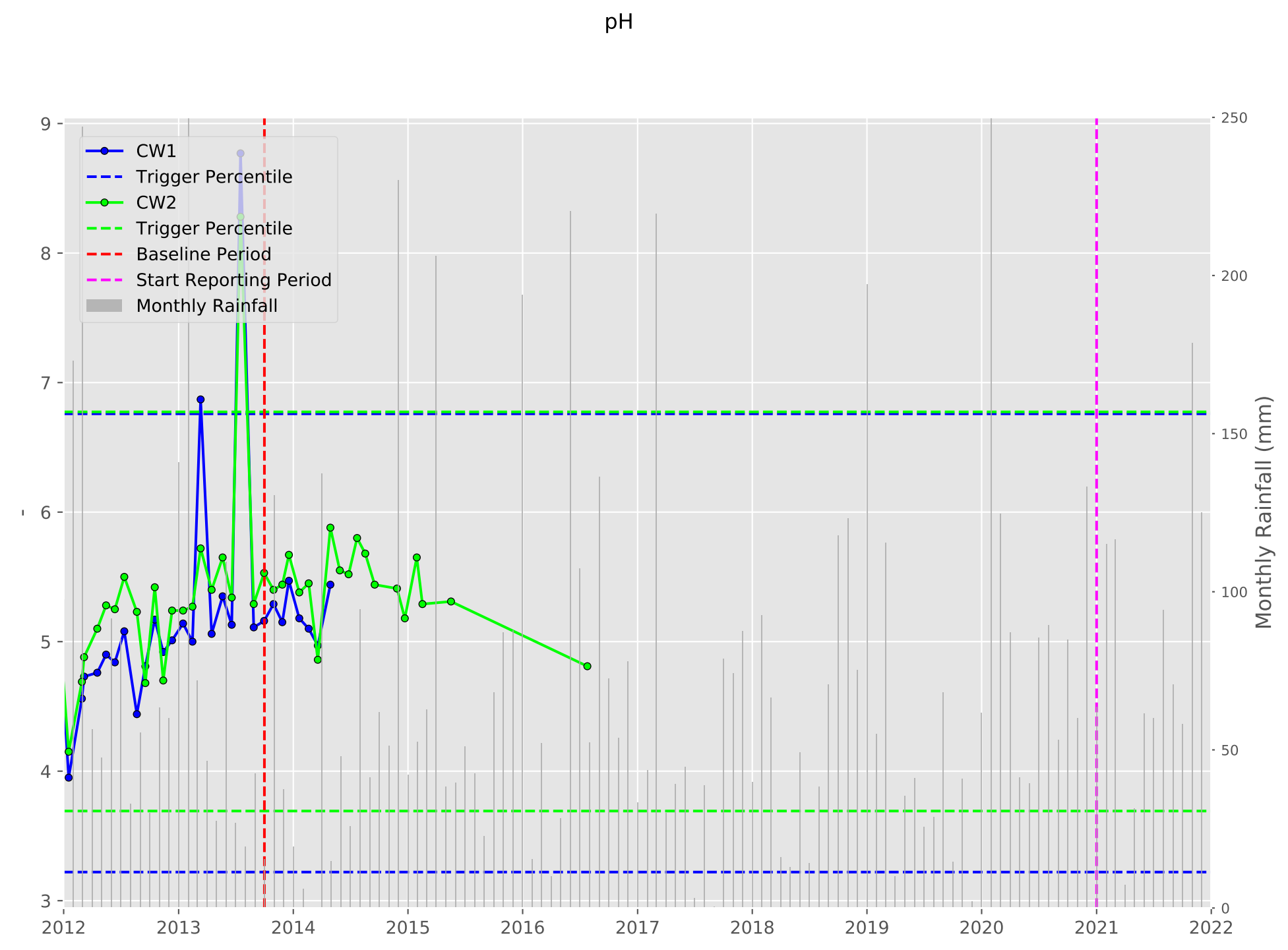

Iron
CC1
CC2
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
5
10
15
20
25
30
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

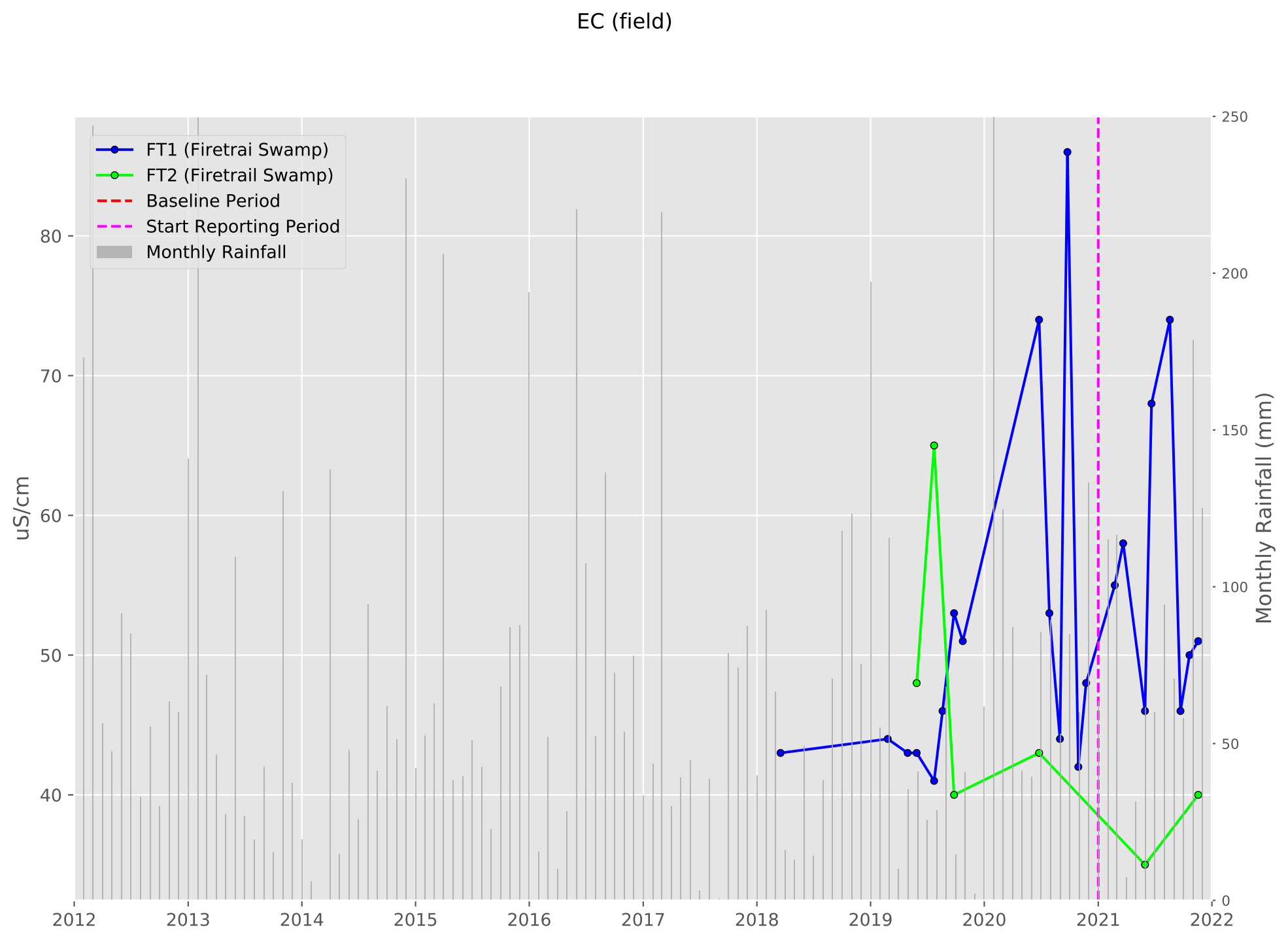

Manganese
CC1
CC2
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

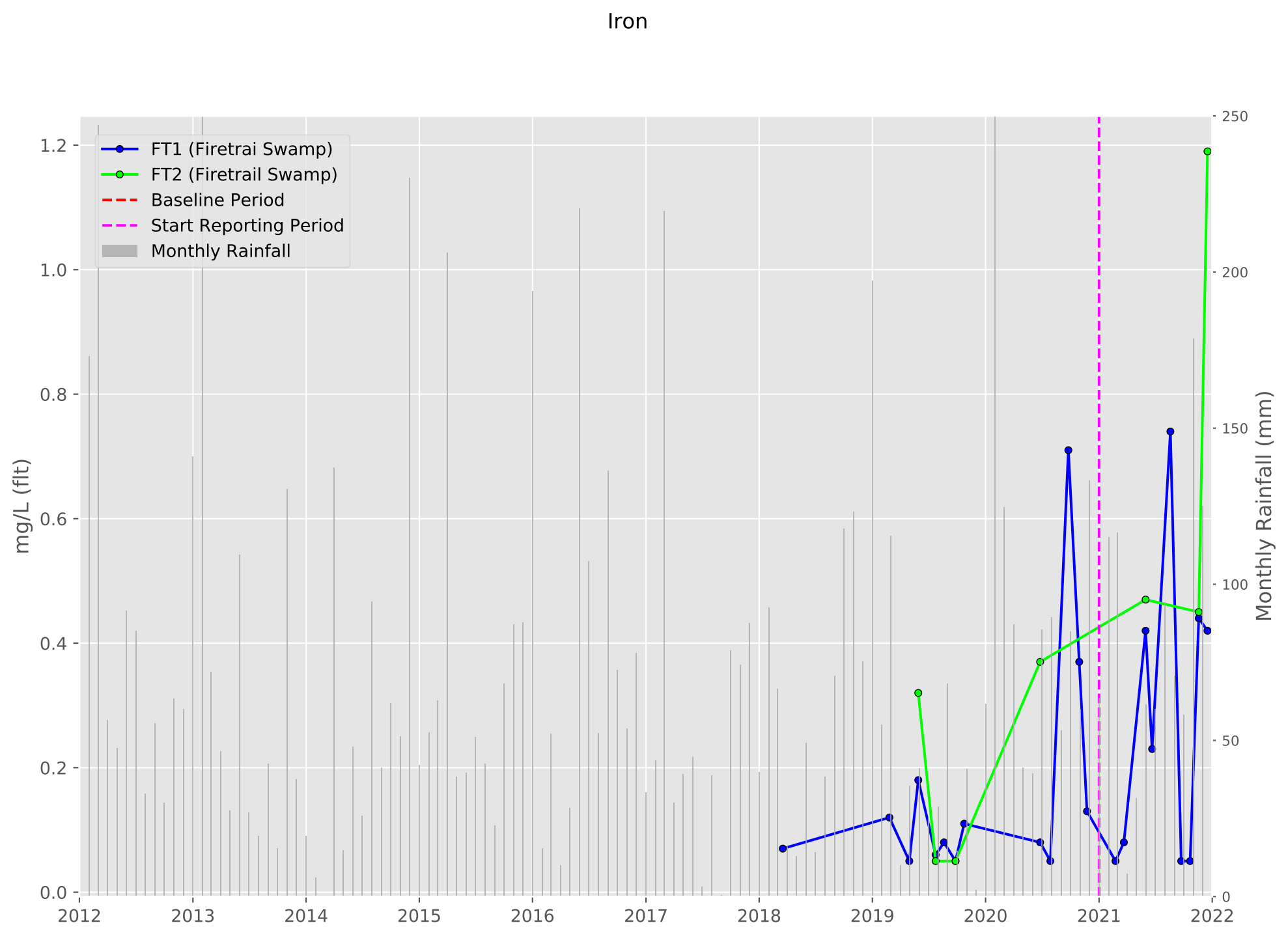

pH
CC1
CC2
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

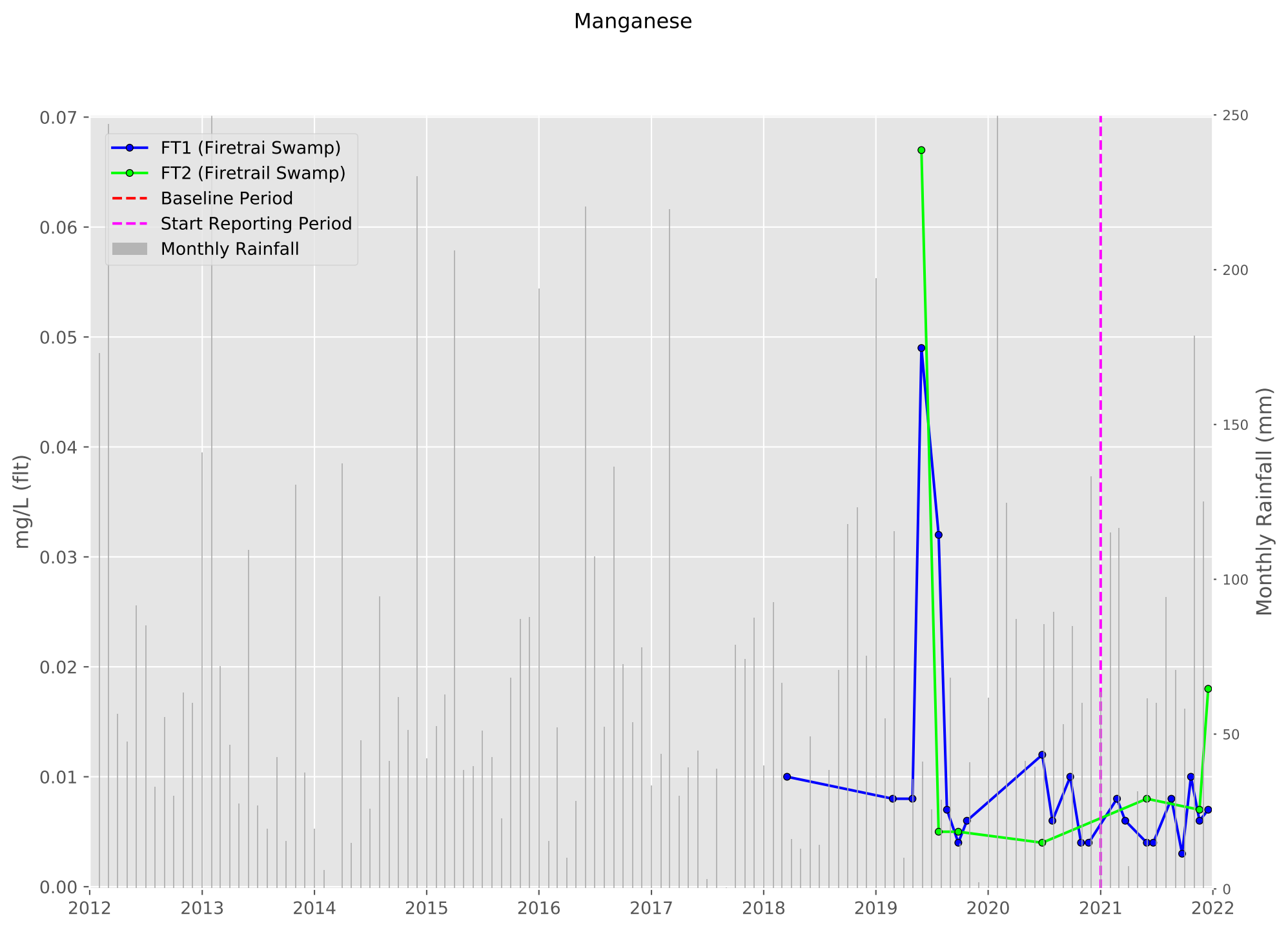

EC (field)
CW1
Trigger Percentile
CW2
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
10
20
30
40
50
60
70
80
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

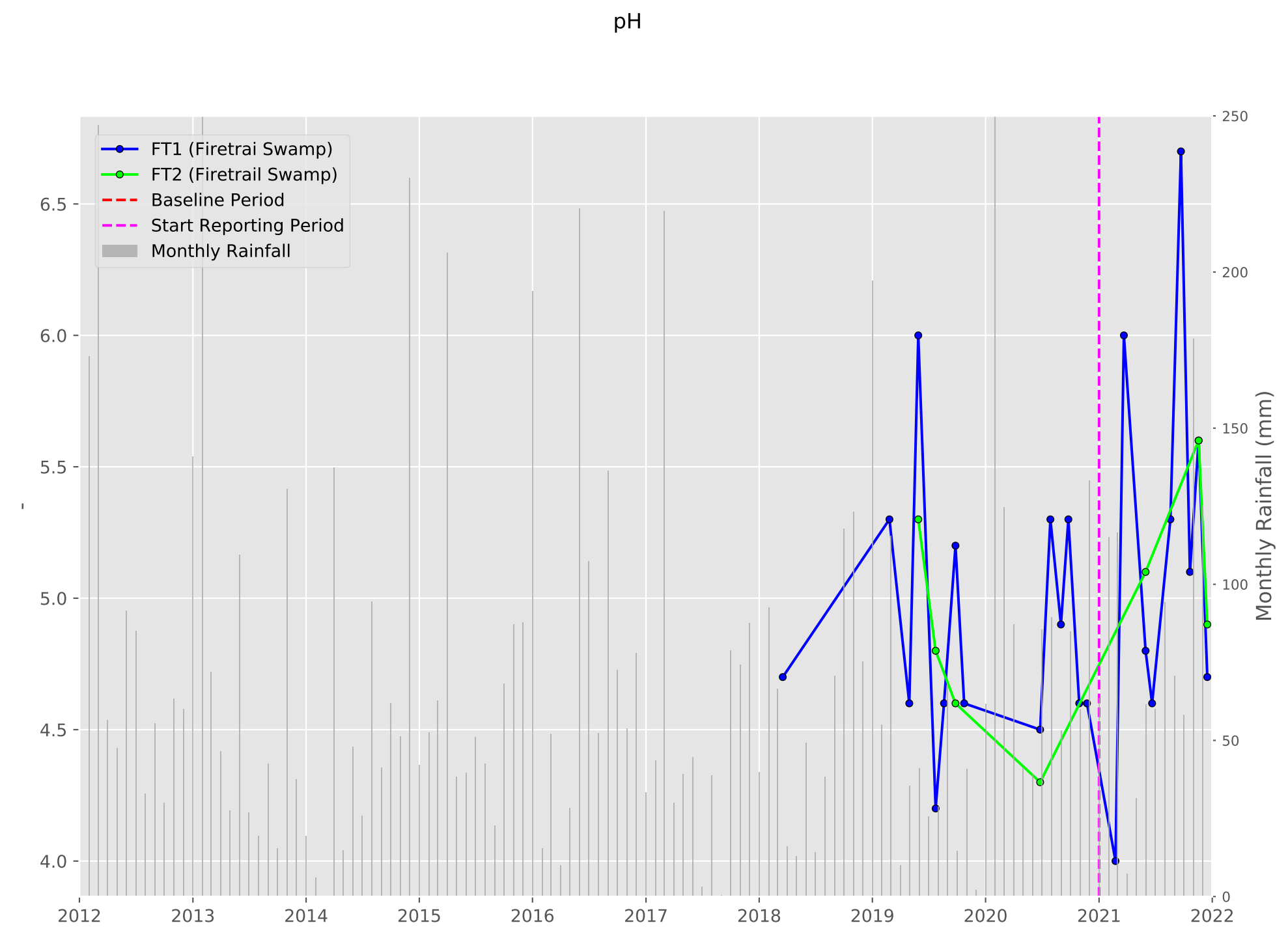

Iron
CW1
Trigger Percentile
CW2
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

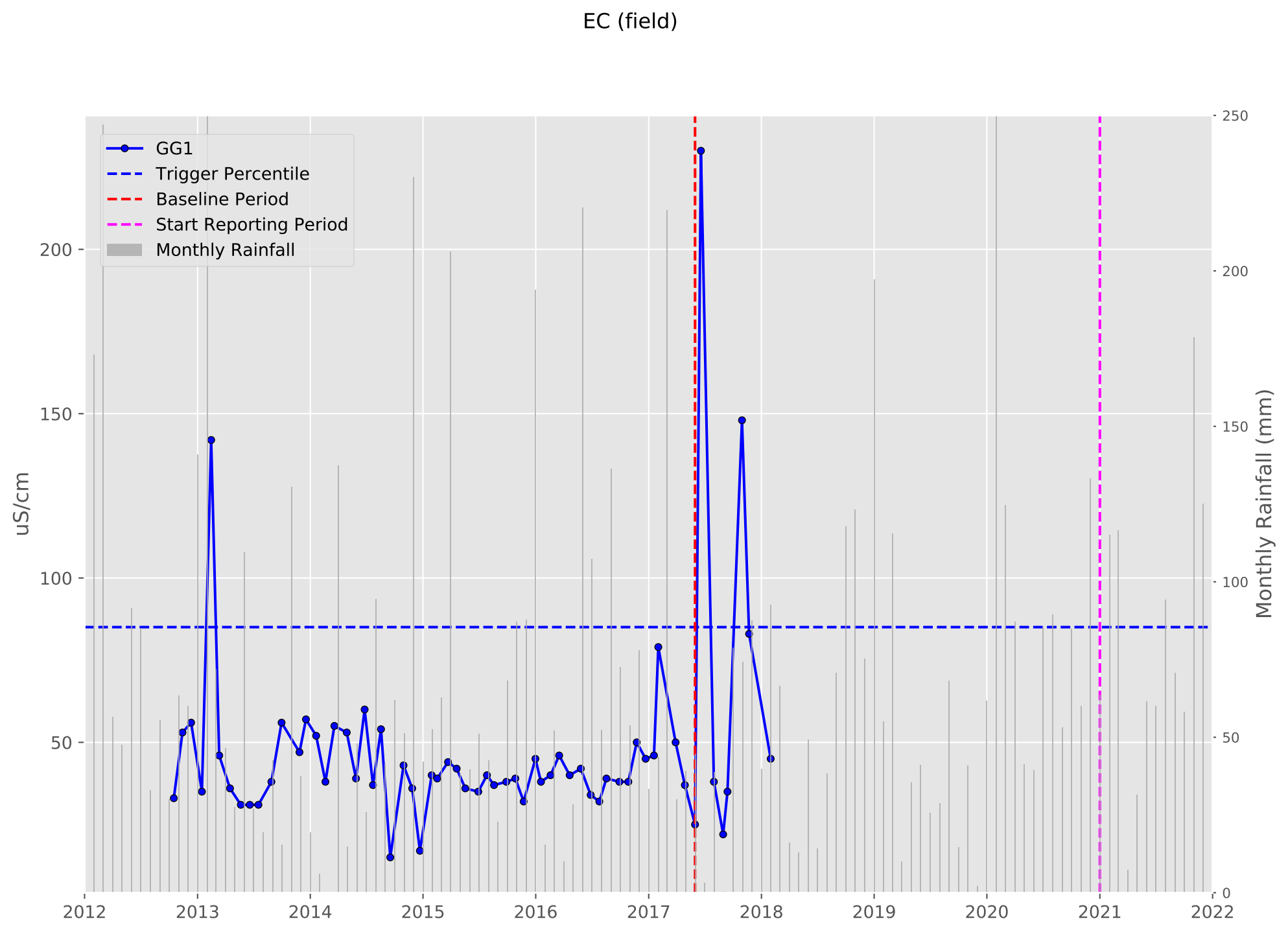

pH
CW1
Trigger Percentile
CW2
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
9
8
7
6
5
4
3
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

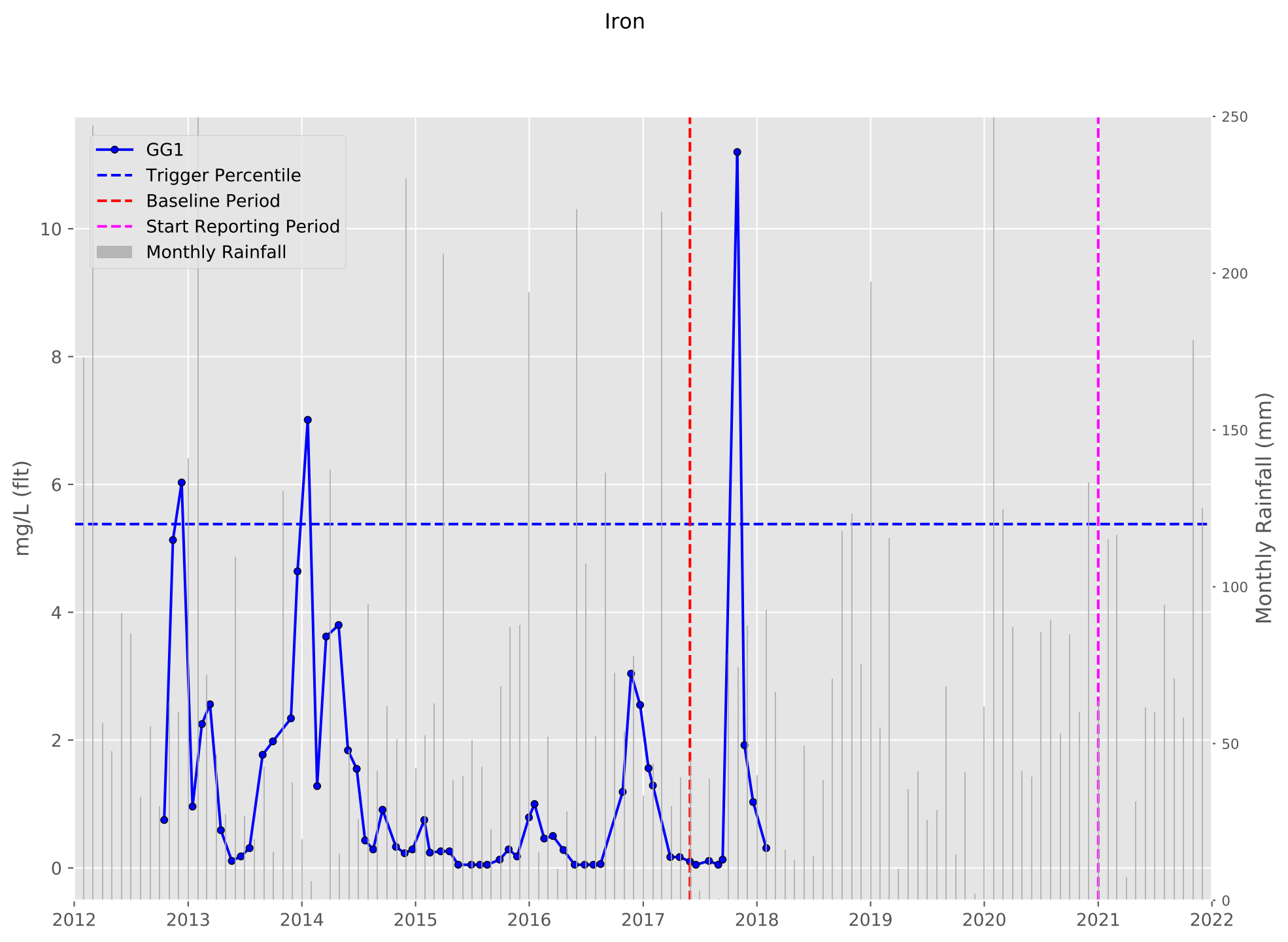

EC (field)
FT1 (Firetrai Swamp)
FT2 (Firetrail Swamp)
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
40
50
60
70
80
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

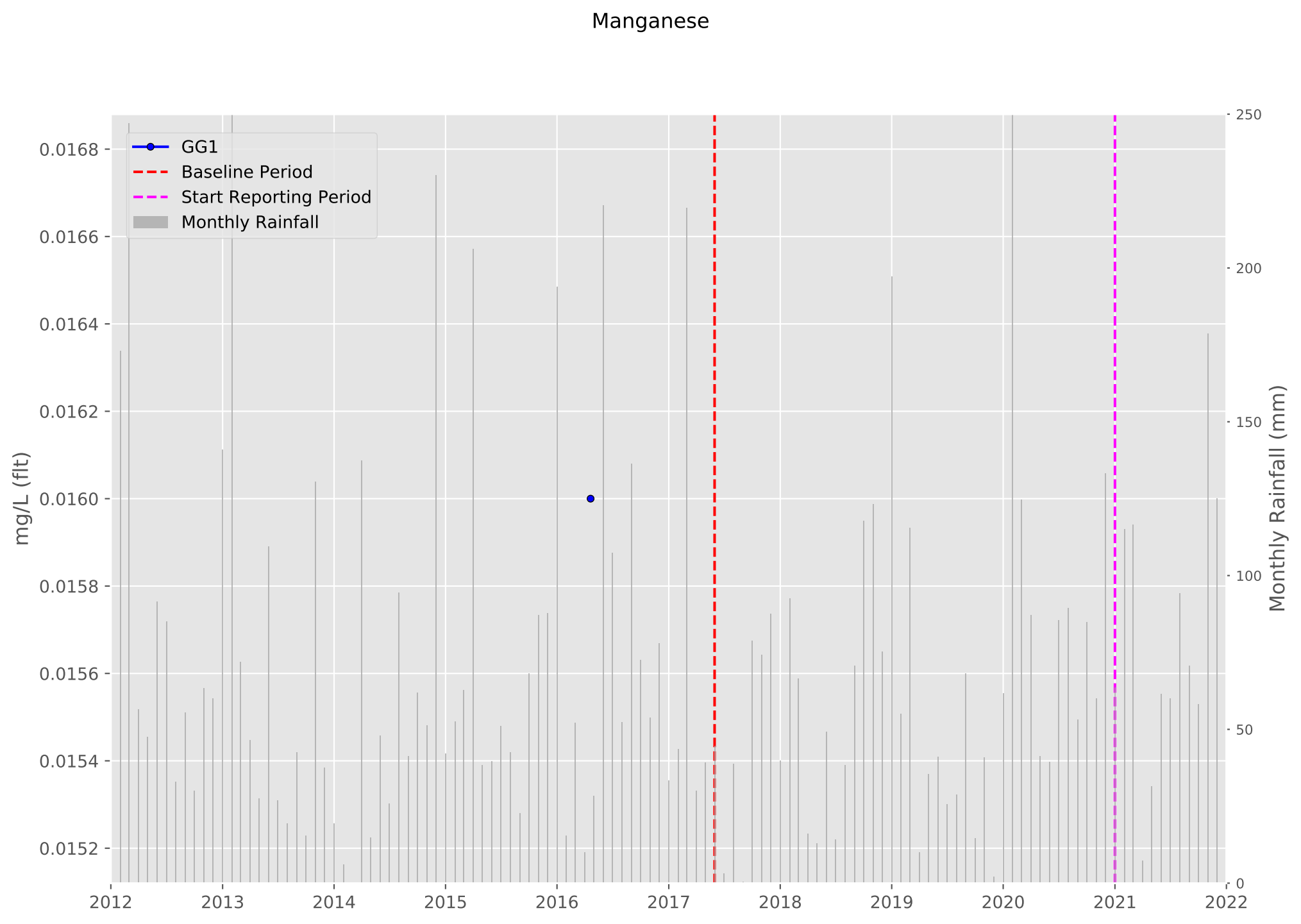

Iron
FT1 (Firetrai Swamp)
FT2 (Firetrail Swamp)
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

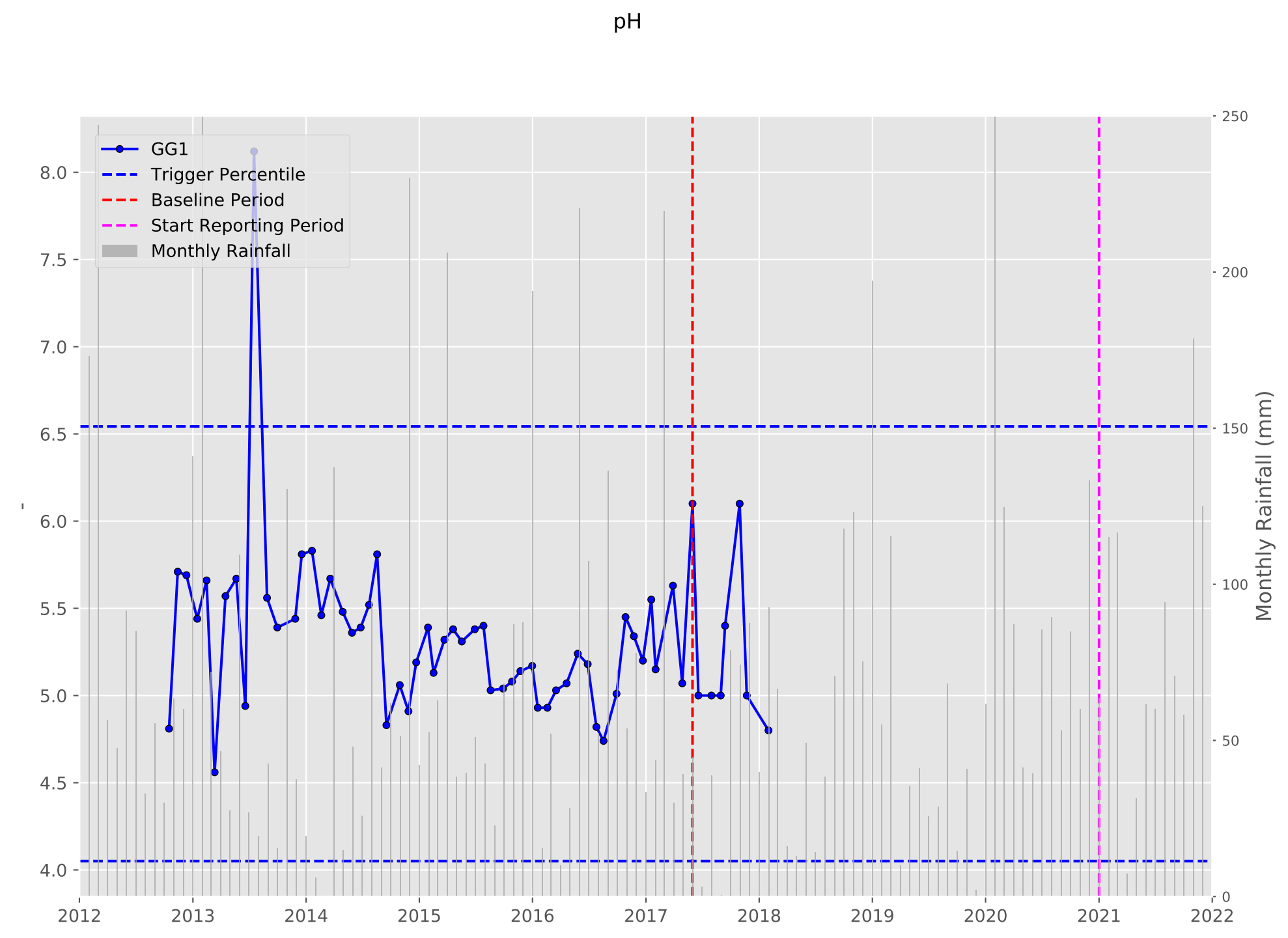

Manganese
FT1 (Firetrai Swamp)
FT2 (Firetrail Swamp)
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

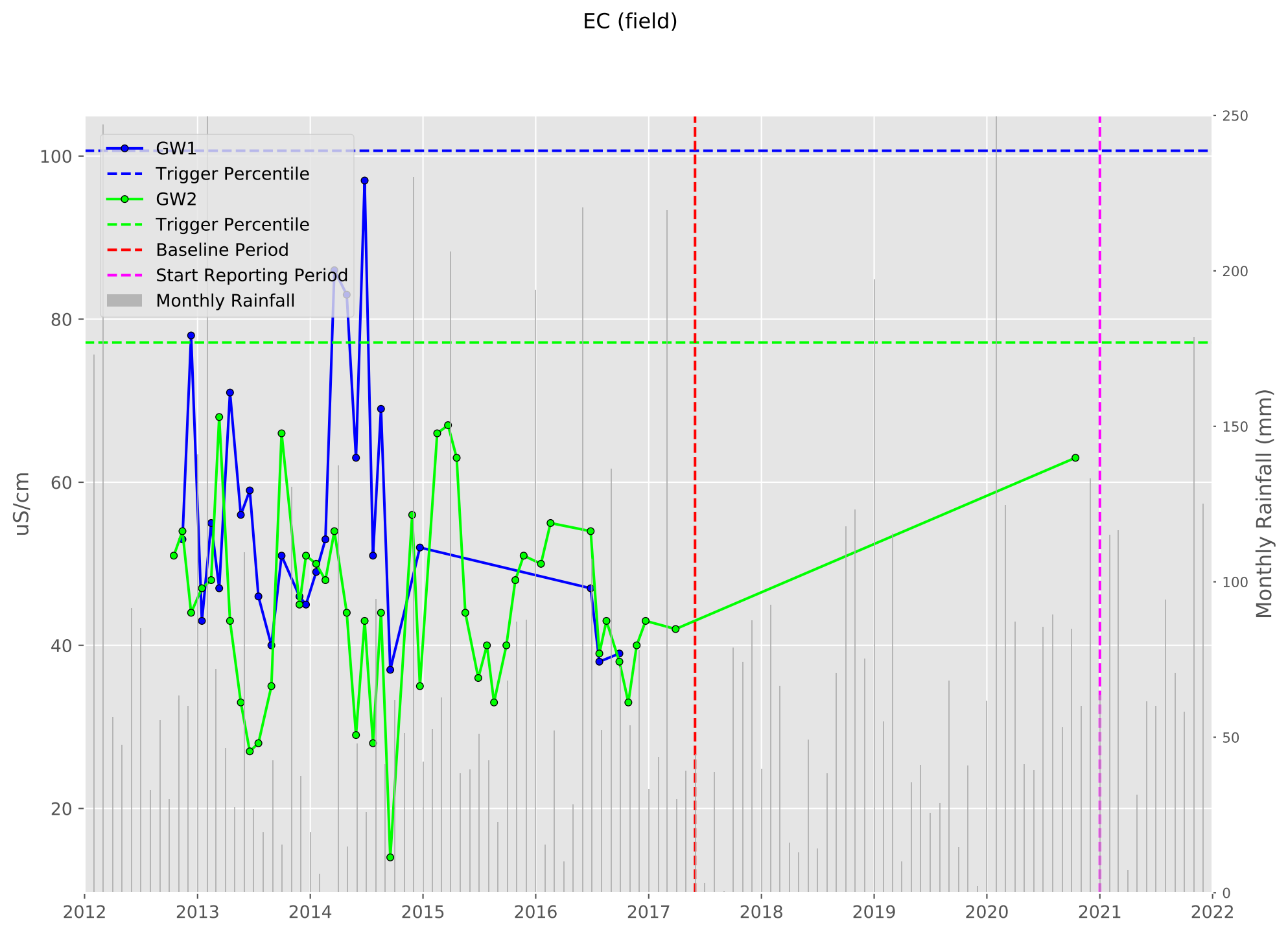

pH
FT1 (Firetrai Swamp)
FT2 (Firetrail Swamp)
Baseline Period
Start Reporting Period
Monthly Rainfall
-
6.5
6.0
5.5
5.0
4.5
4.0
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

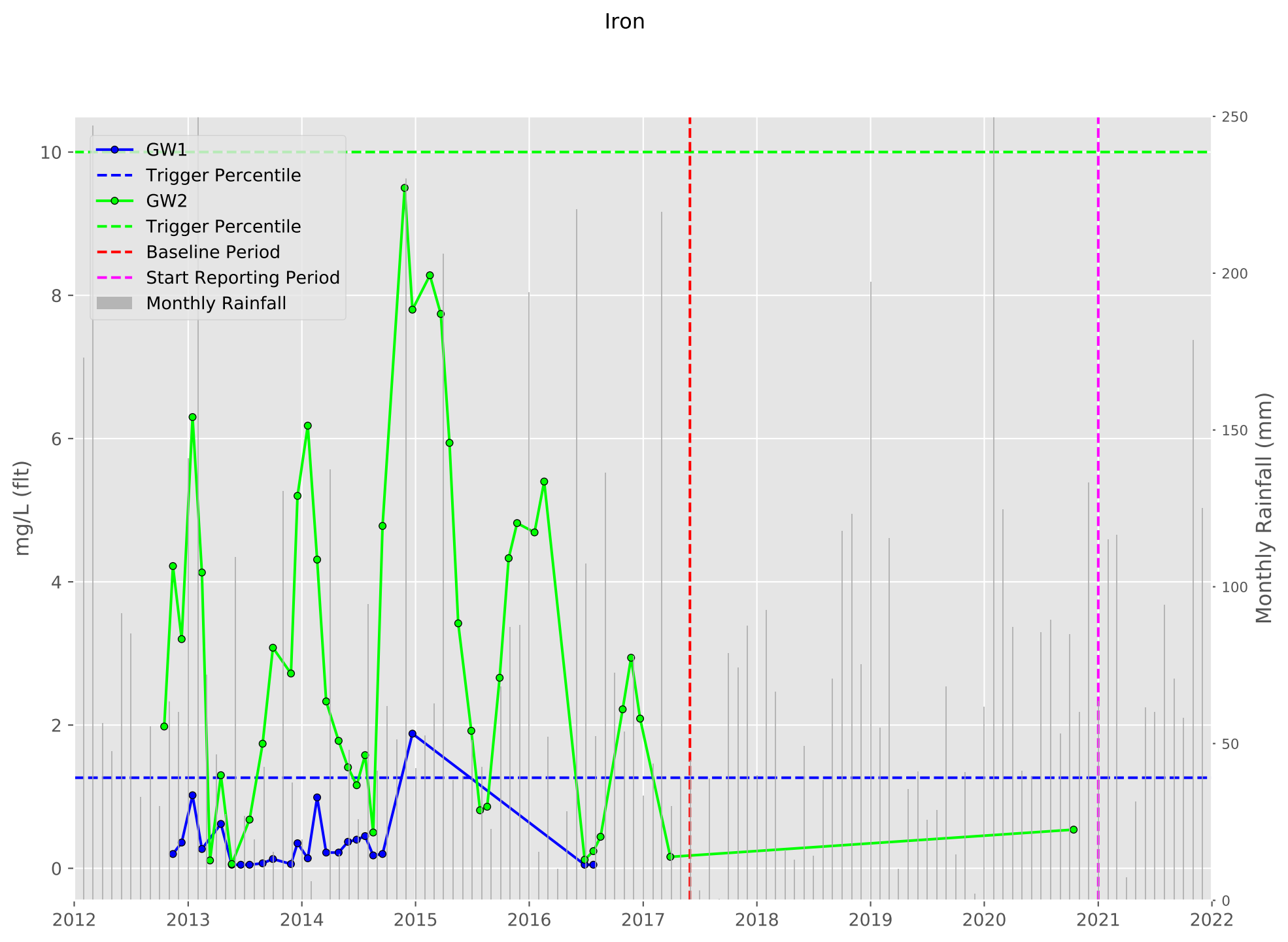

EC (field)
GG1
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

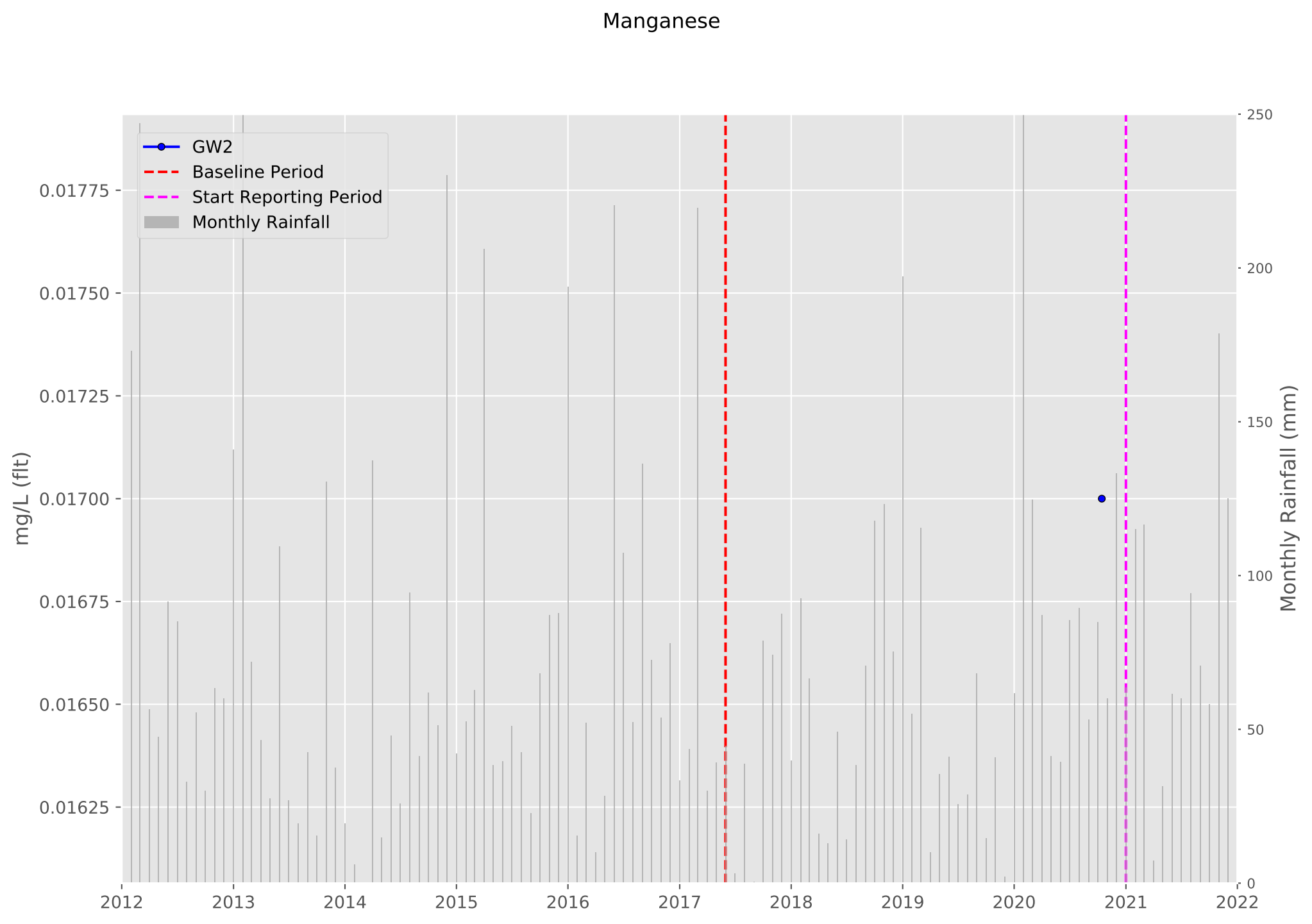

Iron
GG1
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
2
4
6
8
10
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

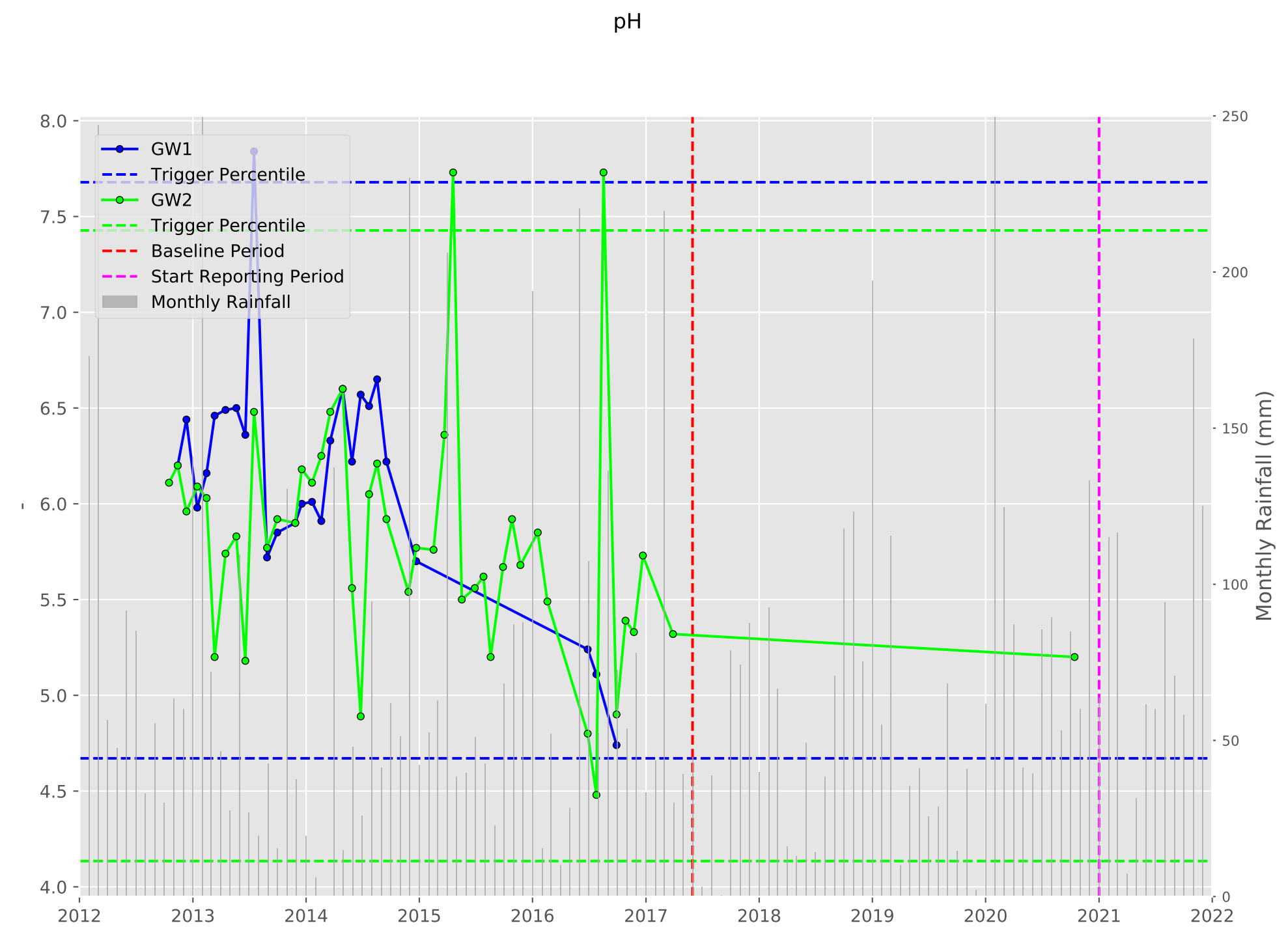

Manganese
GG1
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0168
0.0166
0.0164
0.0162
0.0160
0.0158
0.0156
0.0154
0.0152
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

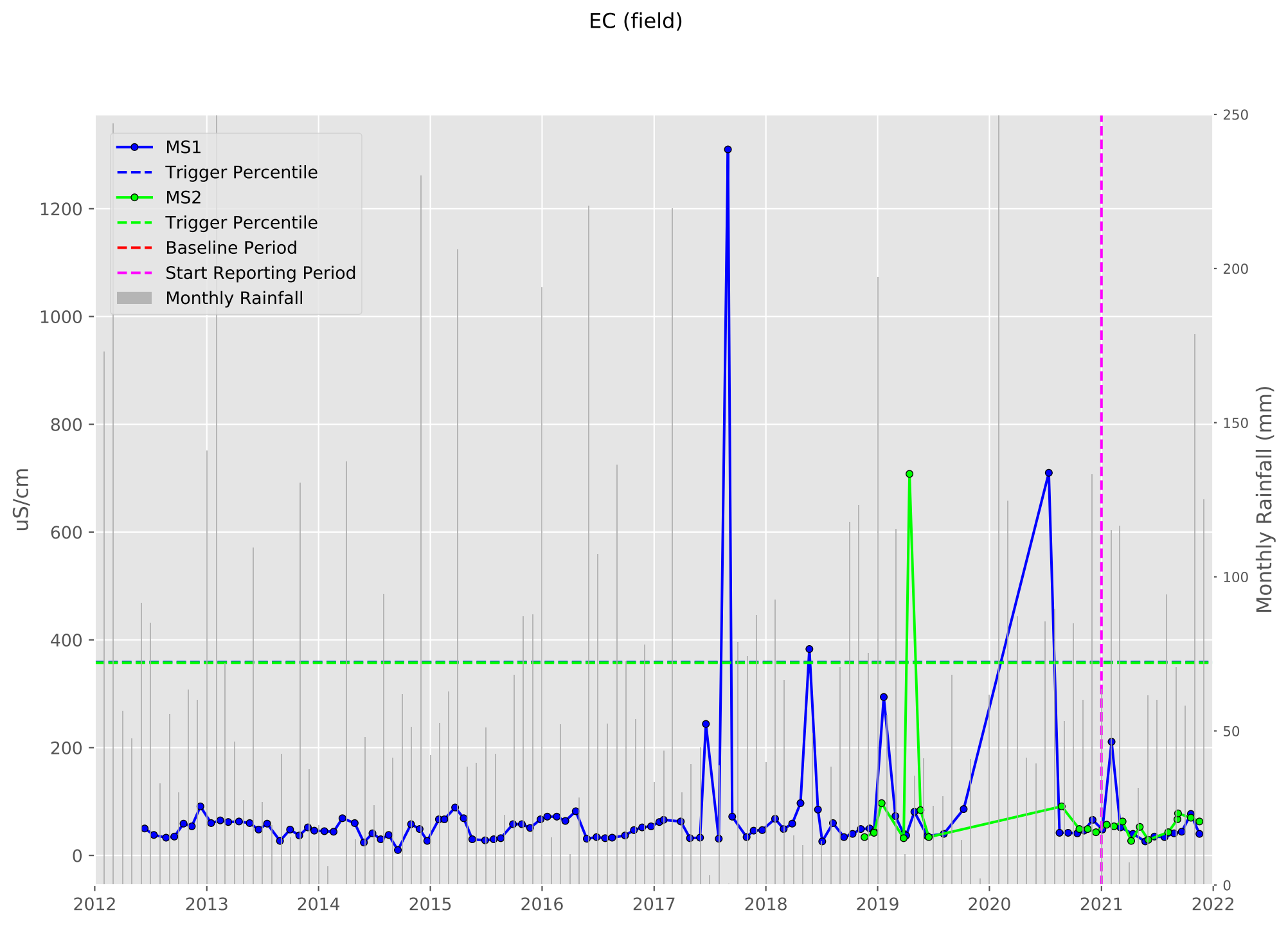

pH
GG1
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
-
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

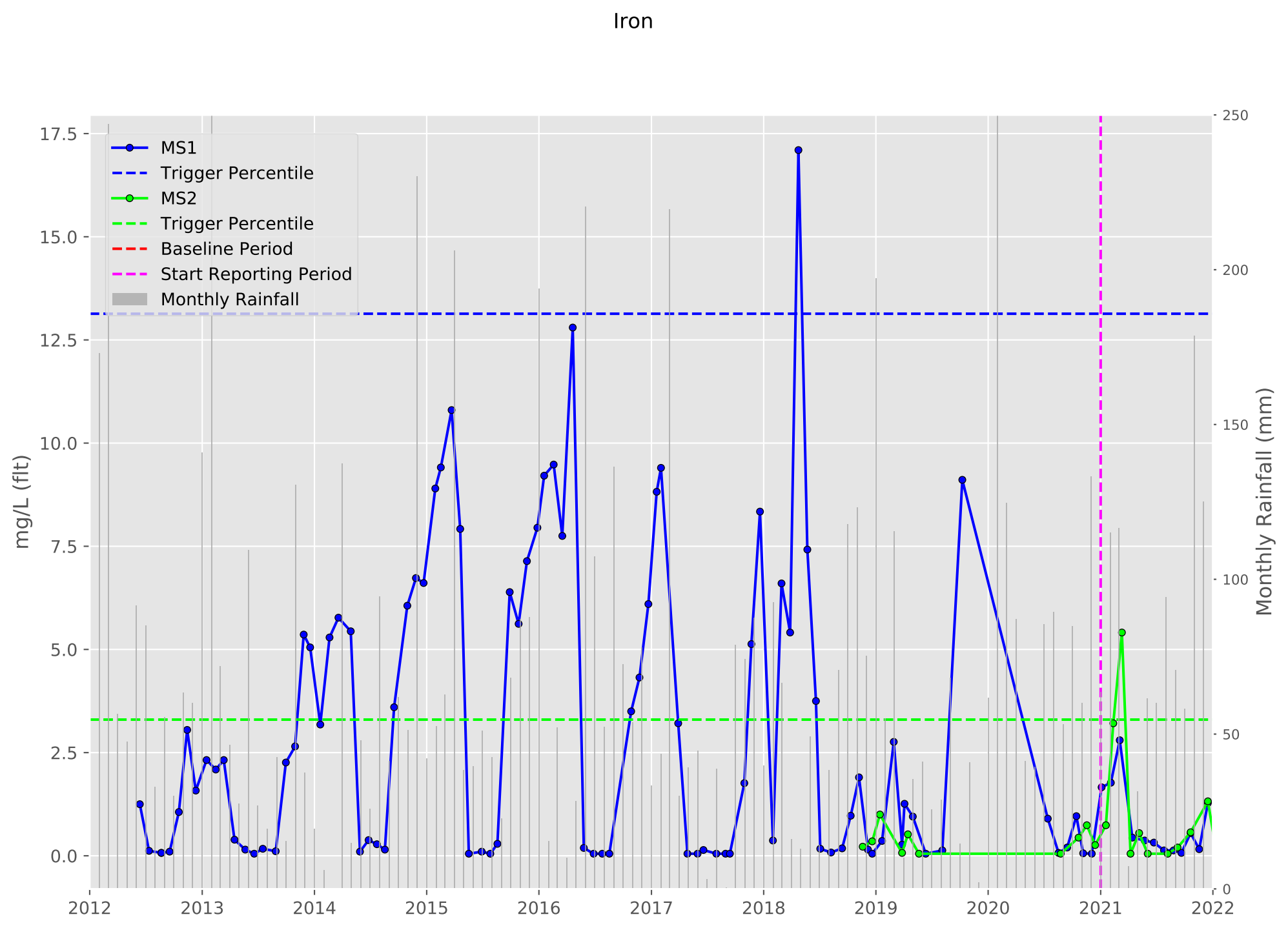

EC (field)
GW1
Trigger Percentile
GW2
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
100
80
60
40
20
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


Iron
GW1
Trigger Percentile
GW2
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
2
4
6
8
10
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

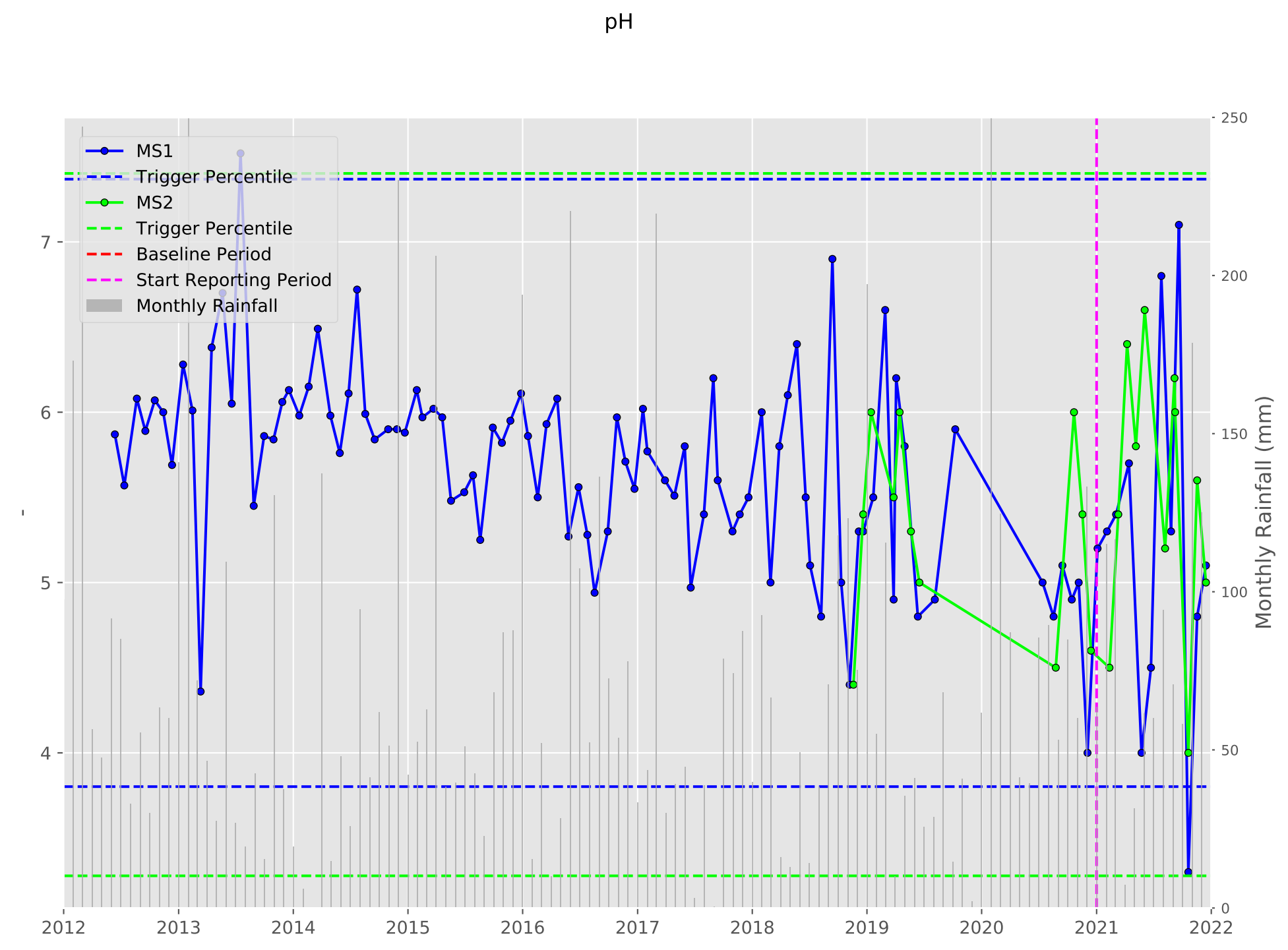

Manganese
GW2
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
0.01775
0.01750
0.01725
0.01700
0.01675
0.01650
0.01625
Monthly Rainfall (mm)
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

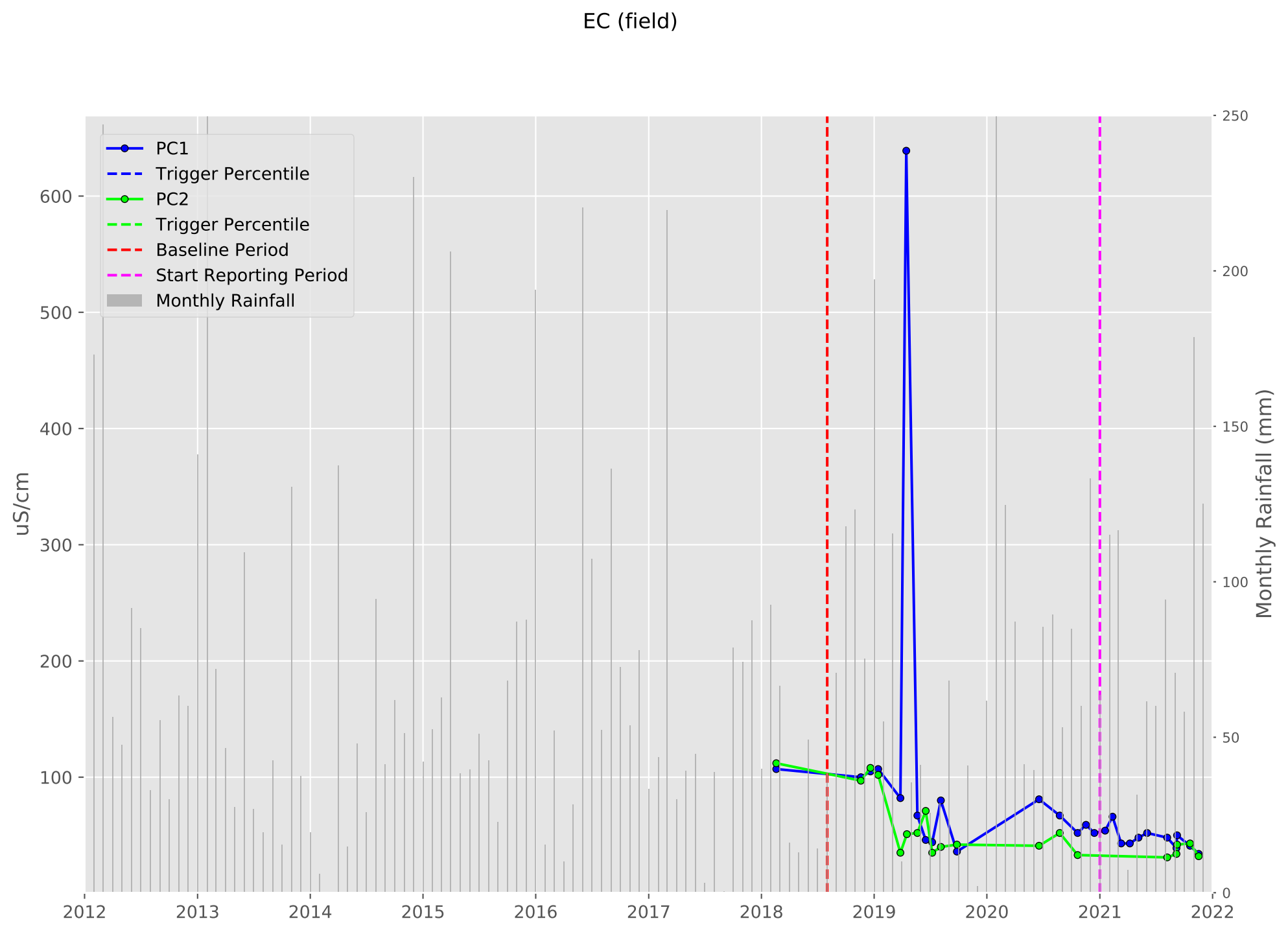

pH
GW1
Trigger Percentile
GW2
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

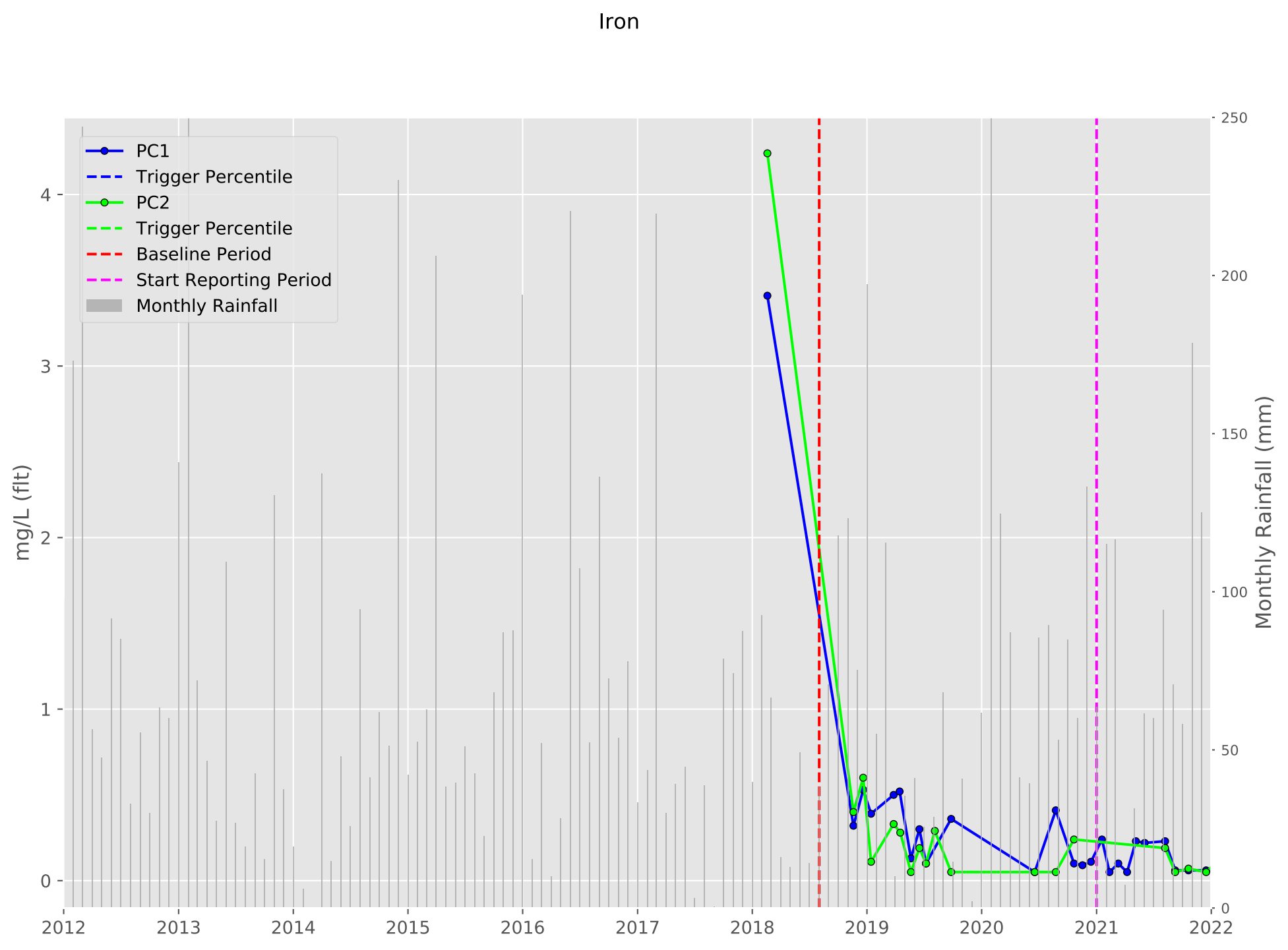

EC (field)
MS1
Trigger Percentile
MS2
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
200
400
600
800
1000
1200
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

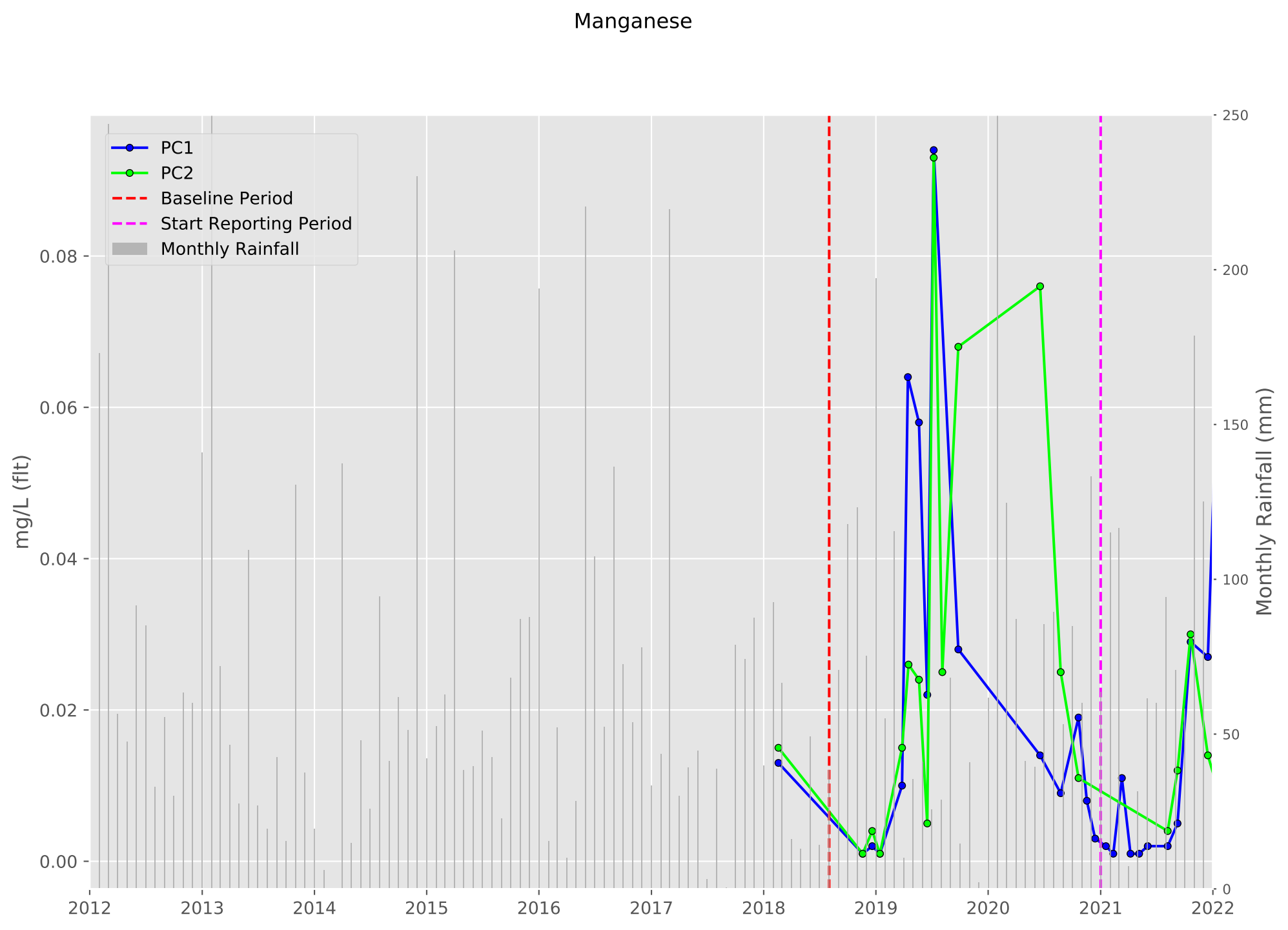

Iron
MS1
Trigger Percentile
MS2
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

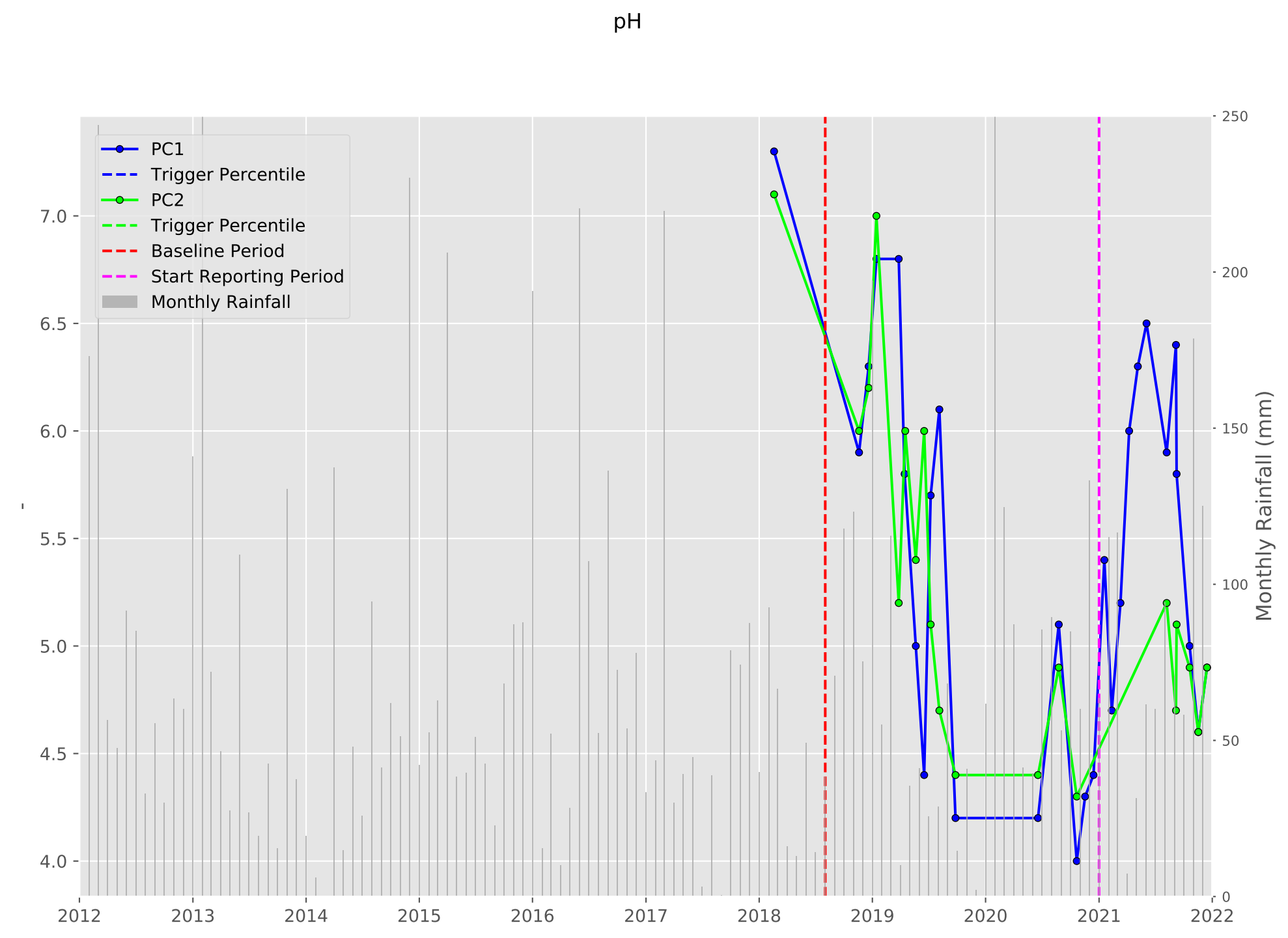

Manganese
MS1
MS2
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.02
0.04
0.06
0.08
0.10
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

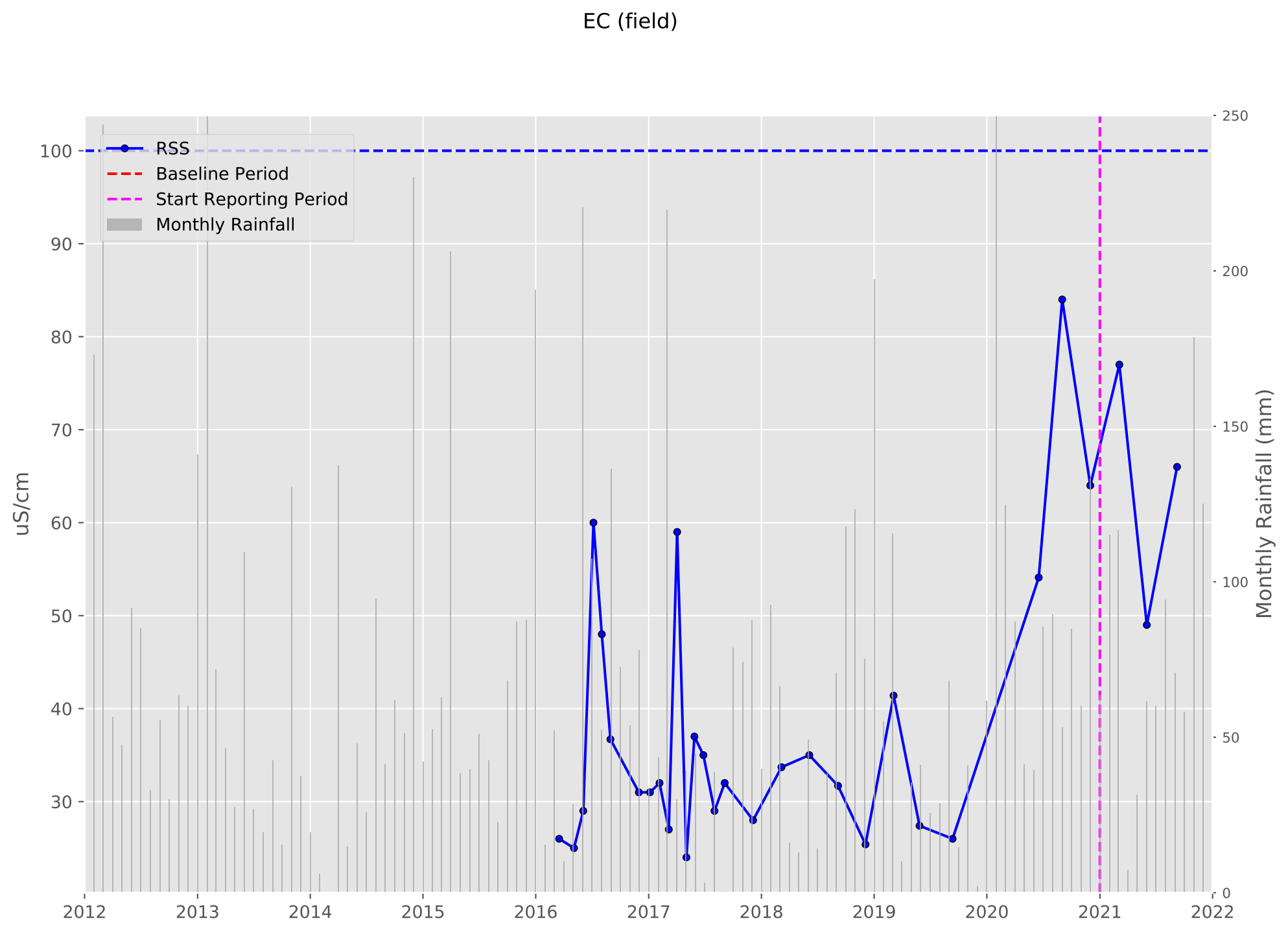

pH
MS1
Trigger Percentile
MS2
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
7
6
5
4
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

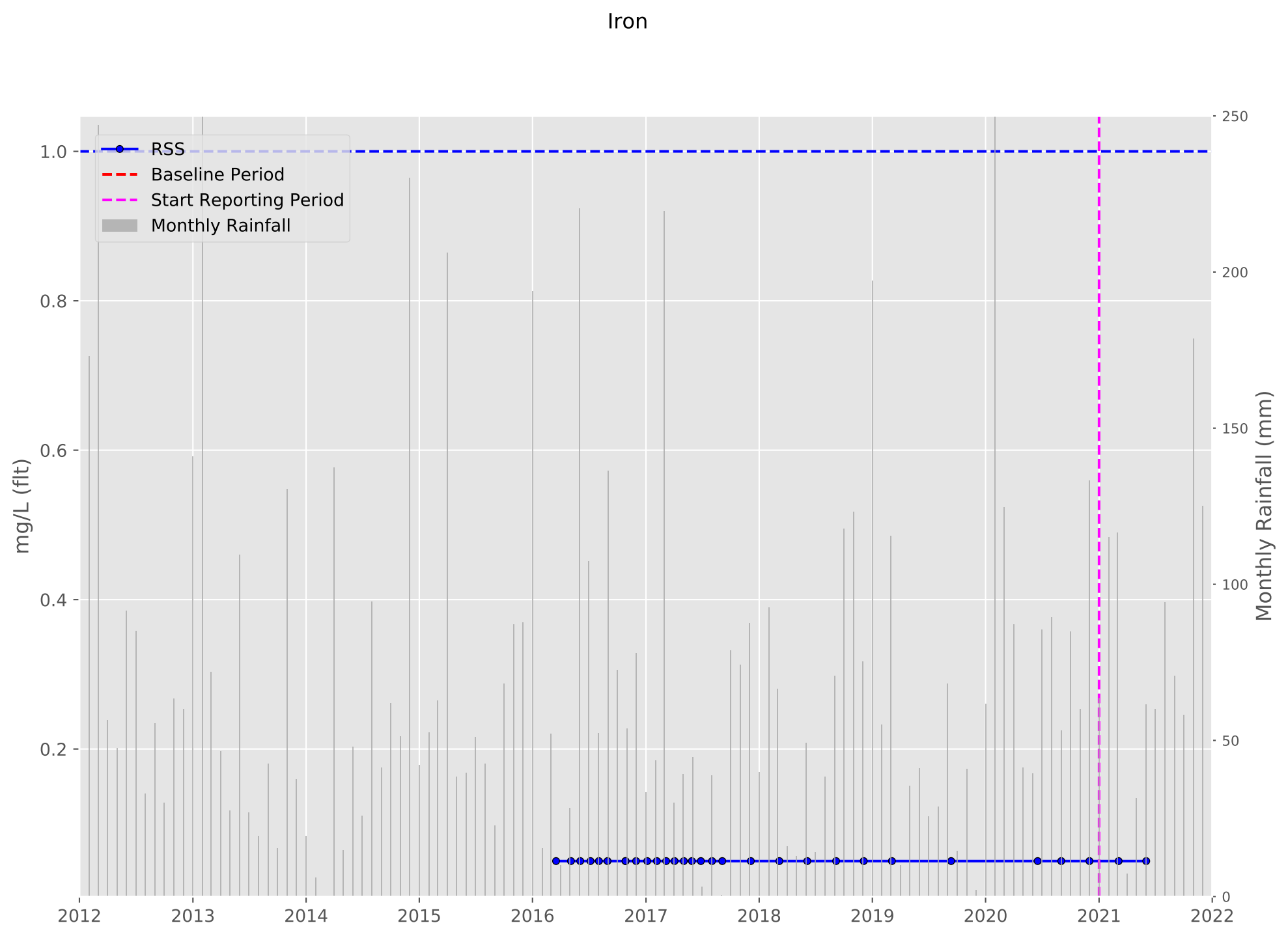

EC (field)
PC1
Trigger Percentile
PC2
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
100
200
300
400
500
600
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

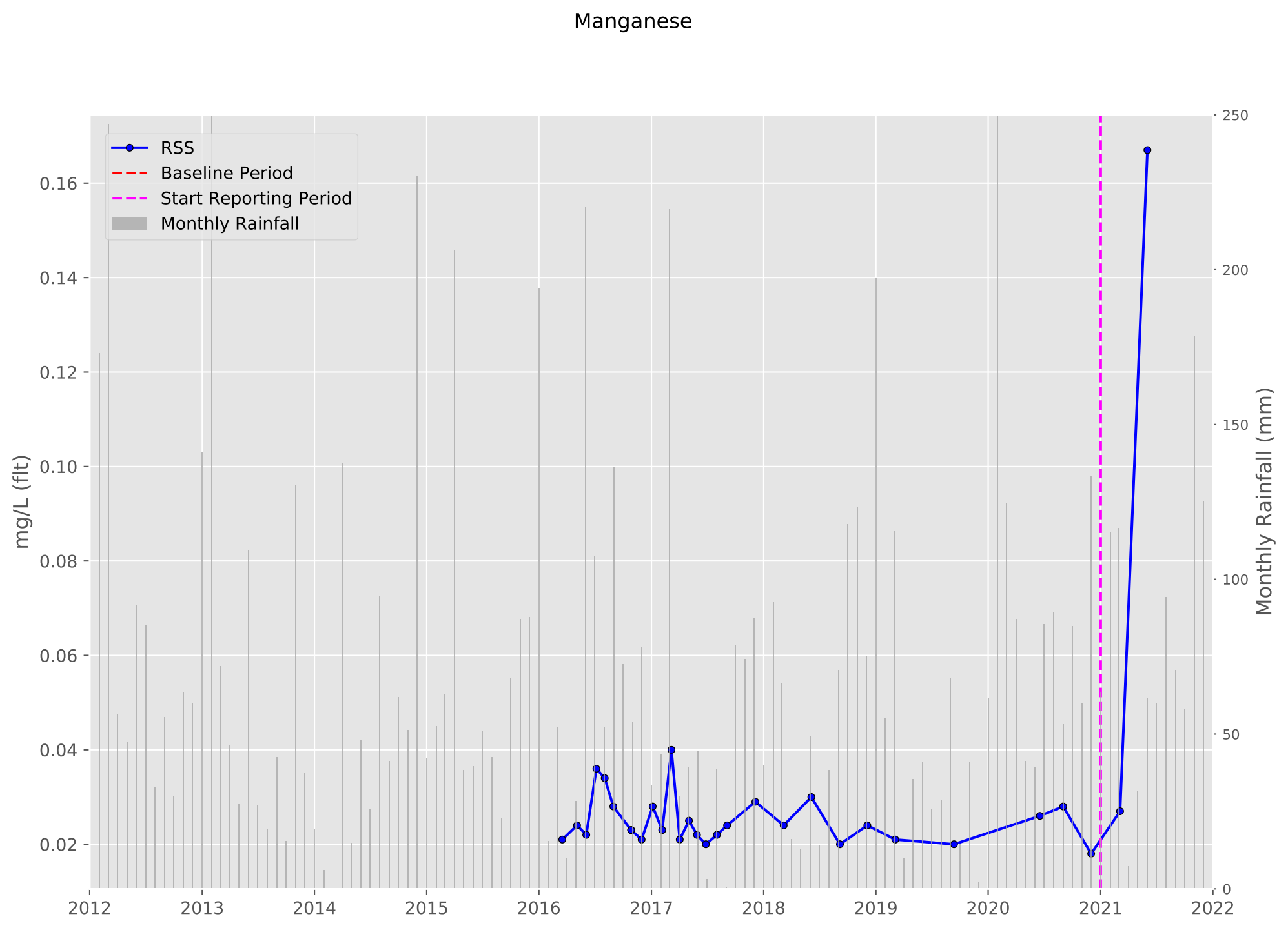

Iron
PC1
Trigger Percentile
PC2
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
1
2
3
4
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

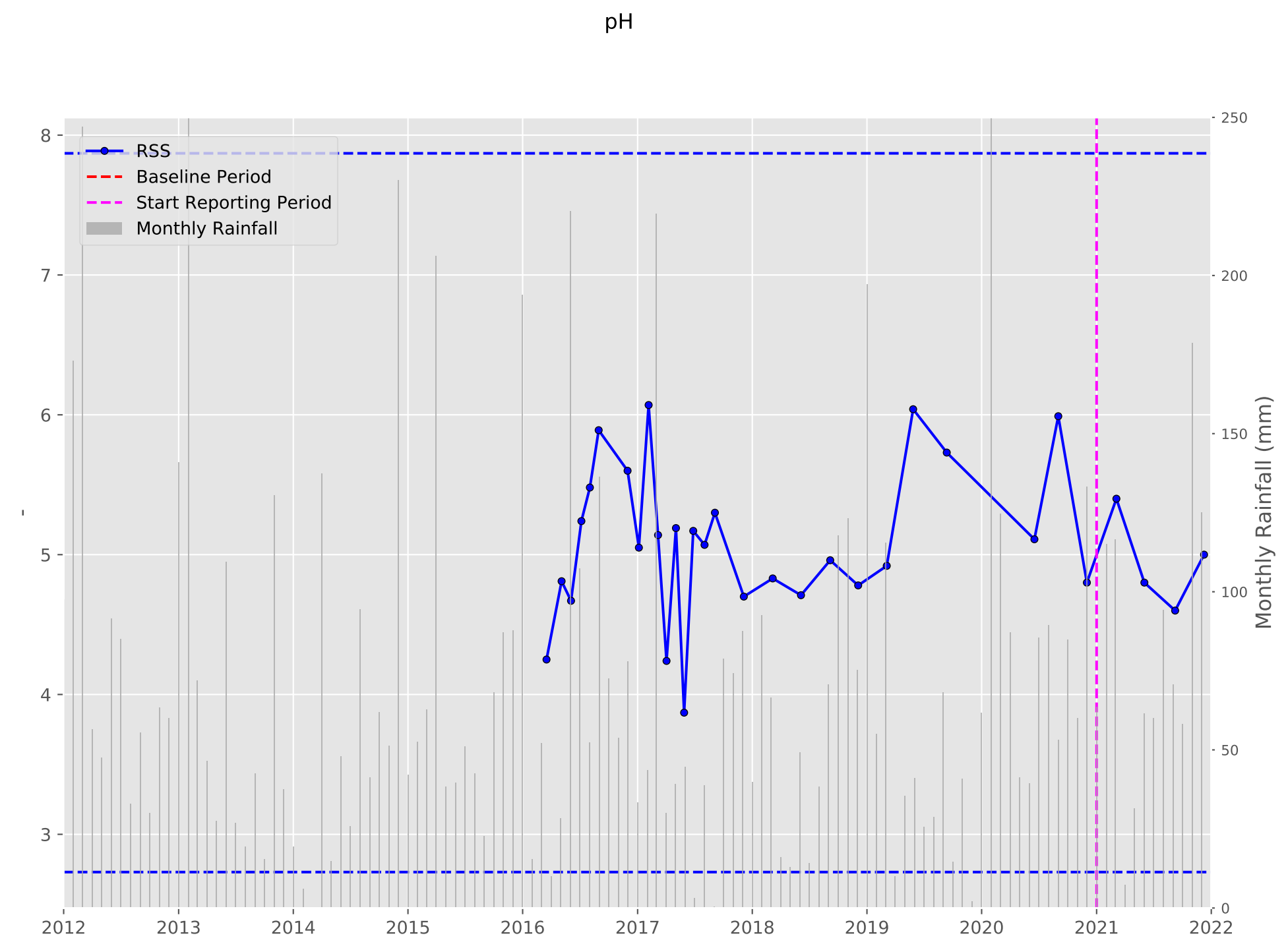

Manganese
PC1
PC2
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.02
0.04
0.06
0.08
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

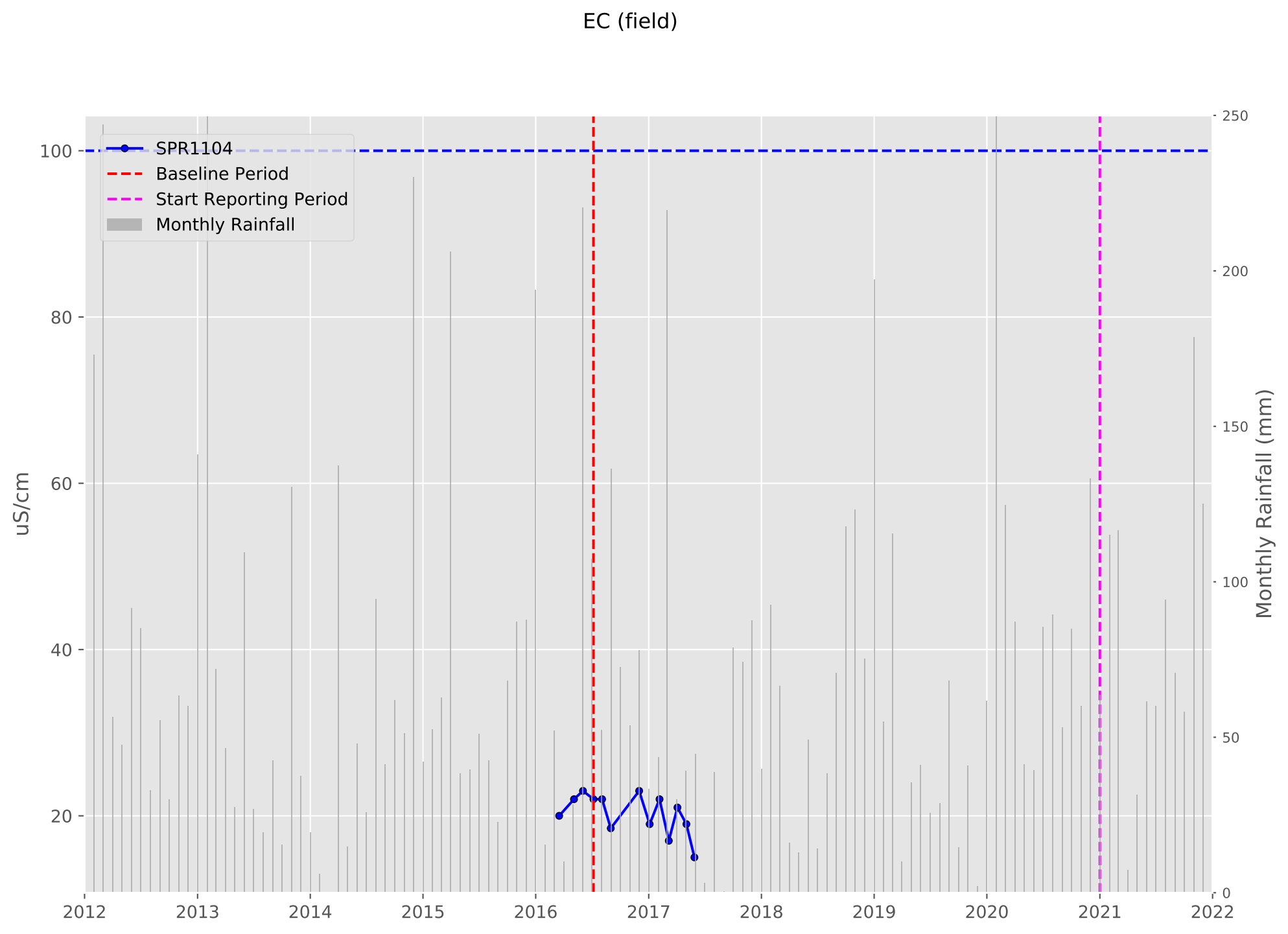

pH
PC1
Trigger Percentile
PC2
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

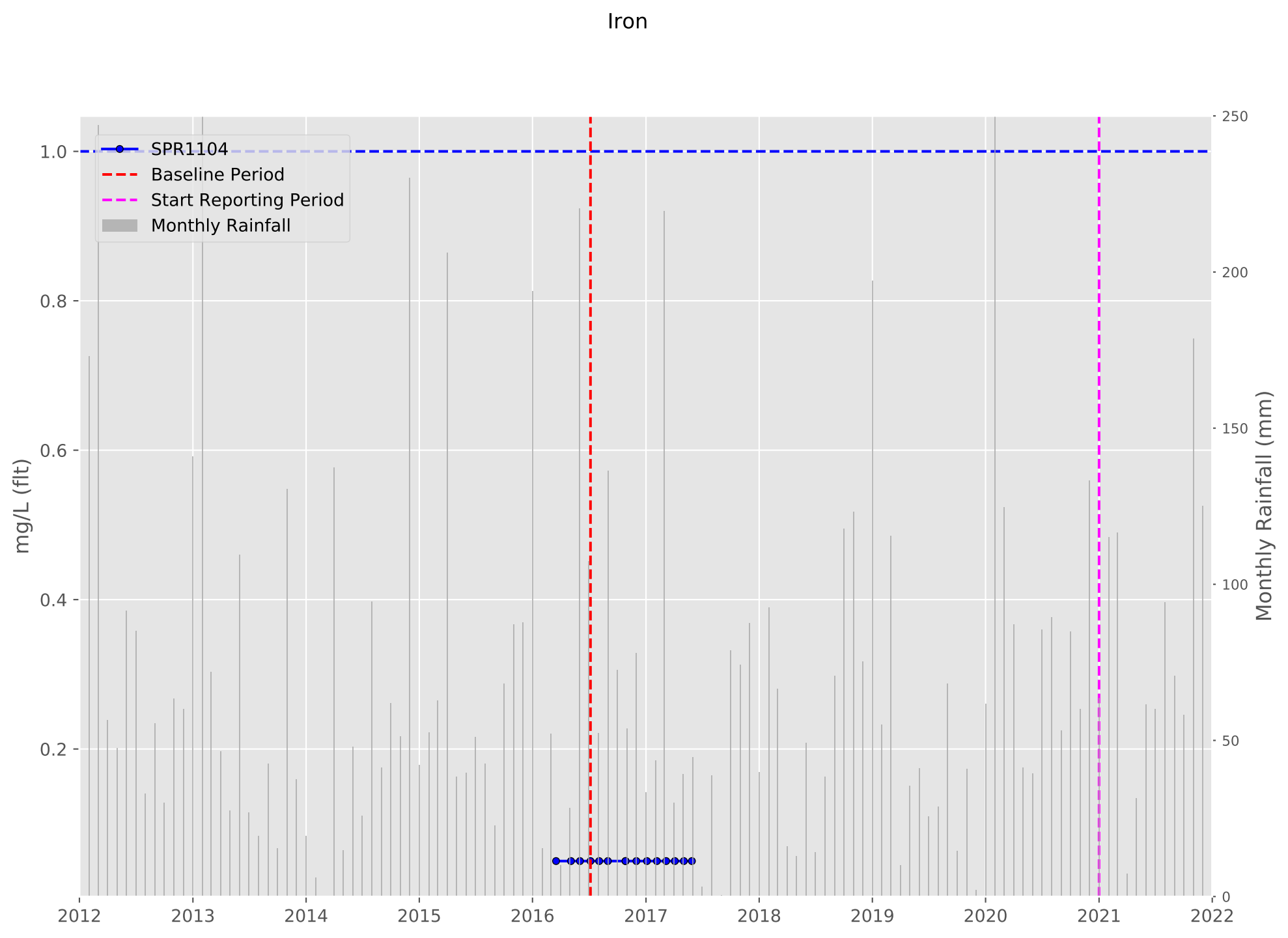

EC (field)
RSS
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
100
90
80
70
60
50
40
30
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

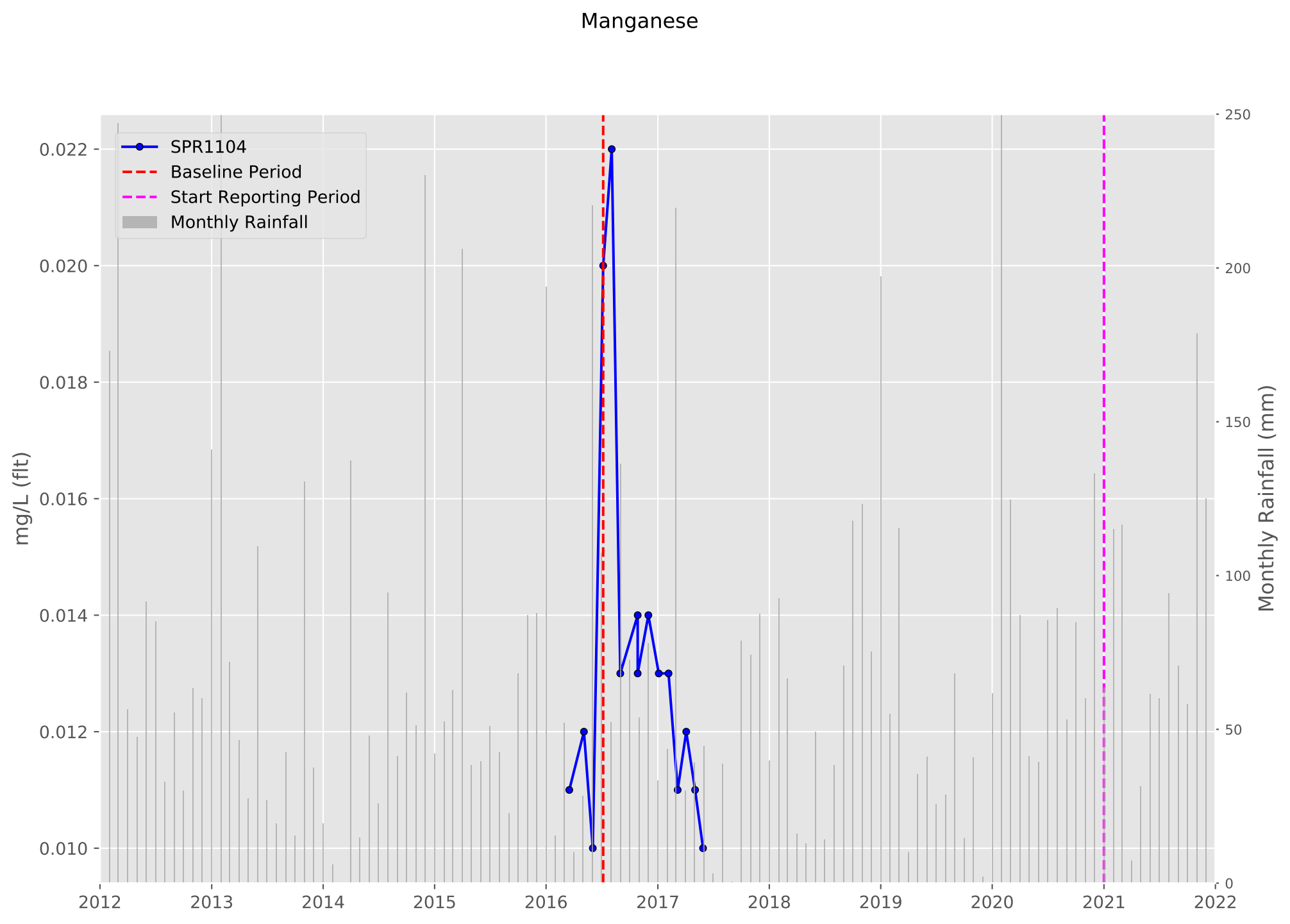

Iron
RSS
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
1.0
0.8
0.6
0.4
0.2
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

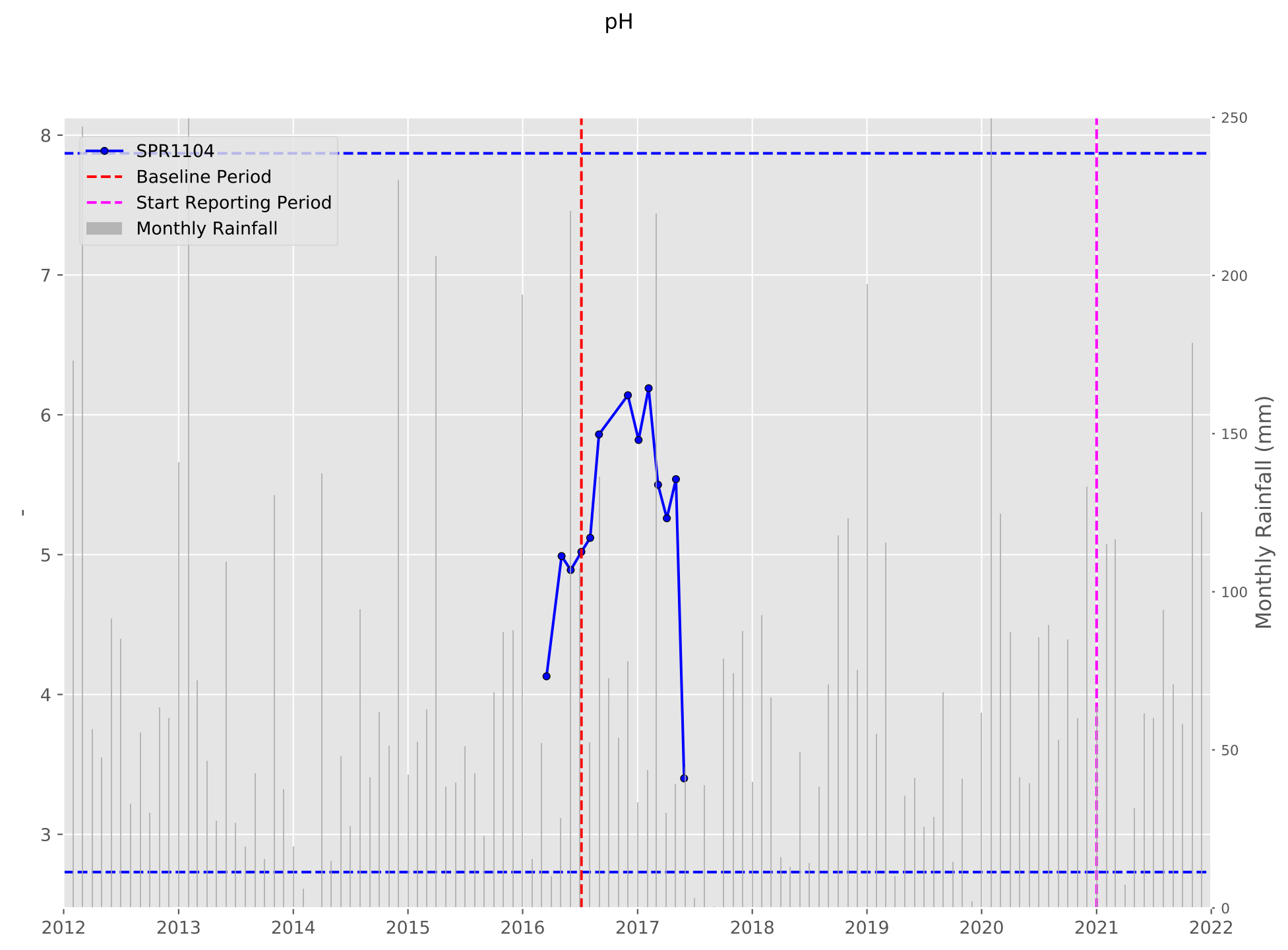

Manganese
RSS
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

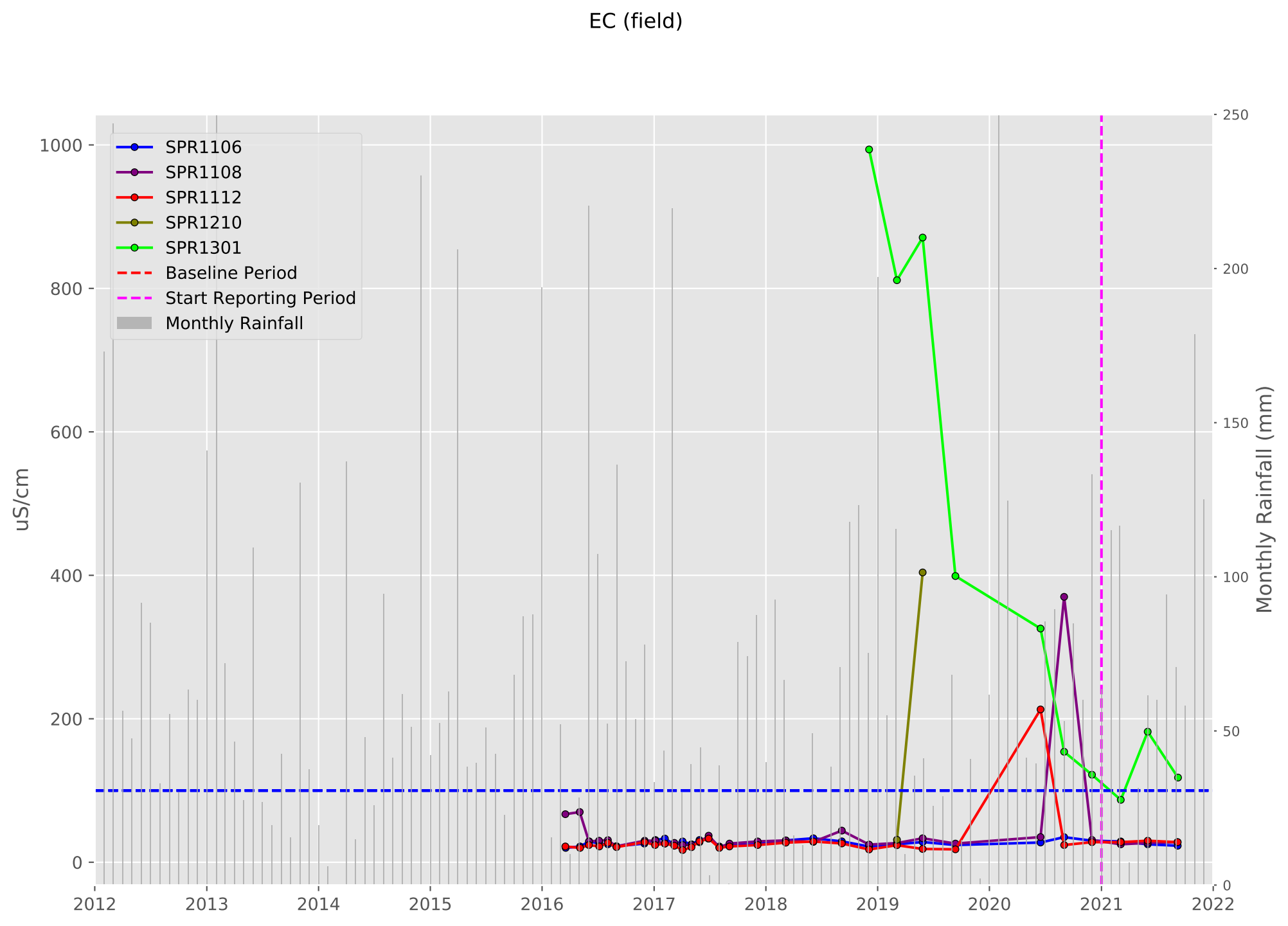

pH
RSS
Baseline Period
Start Reporting Period
Monthly Rainfall
8
7
6
5
4
3
-
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

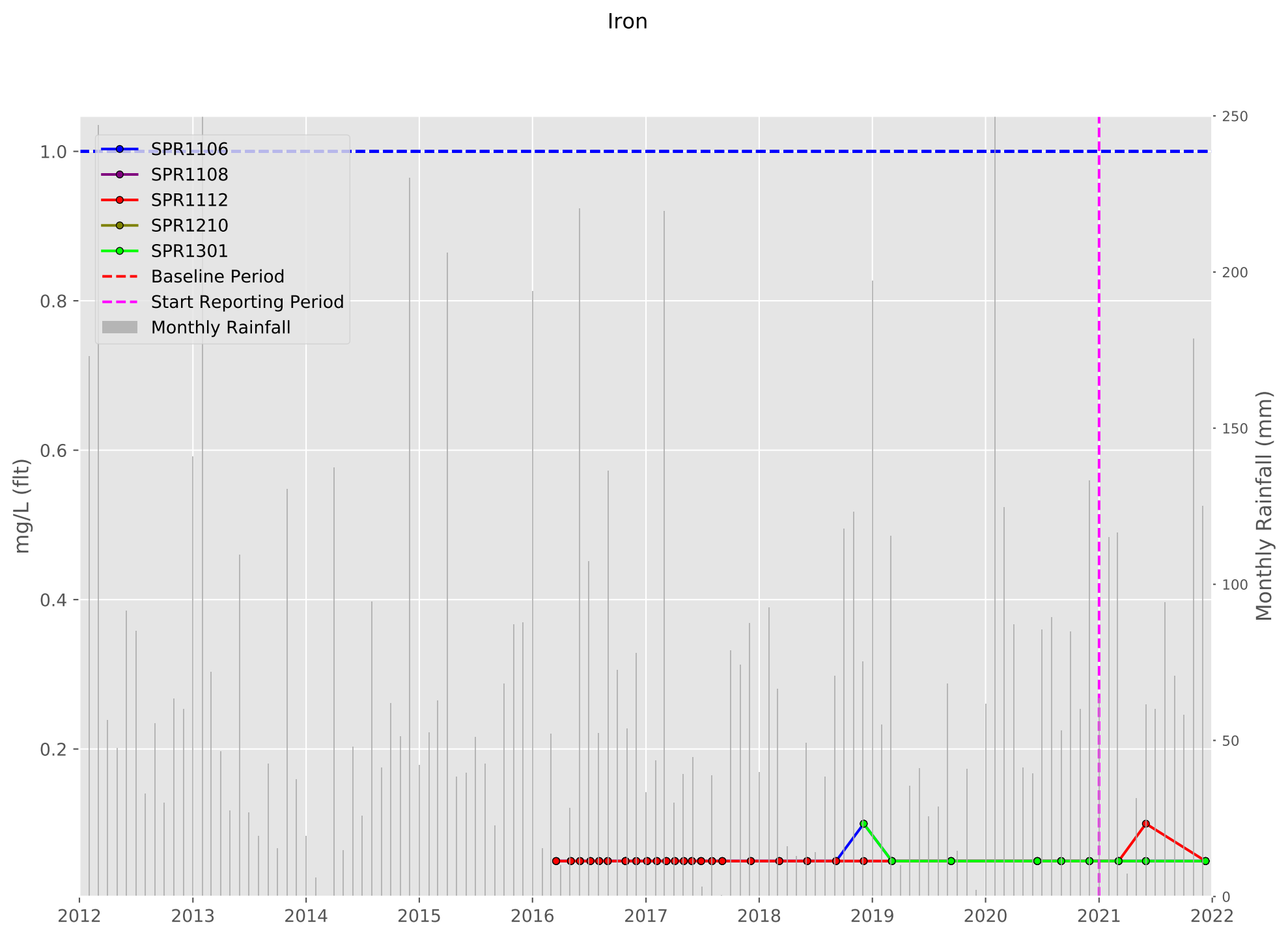

EC (field)
SPR1104
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
100
80
60
40
20
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

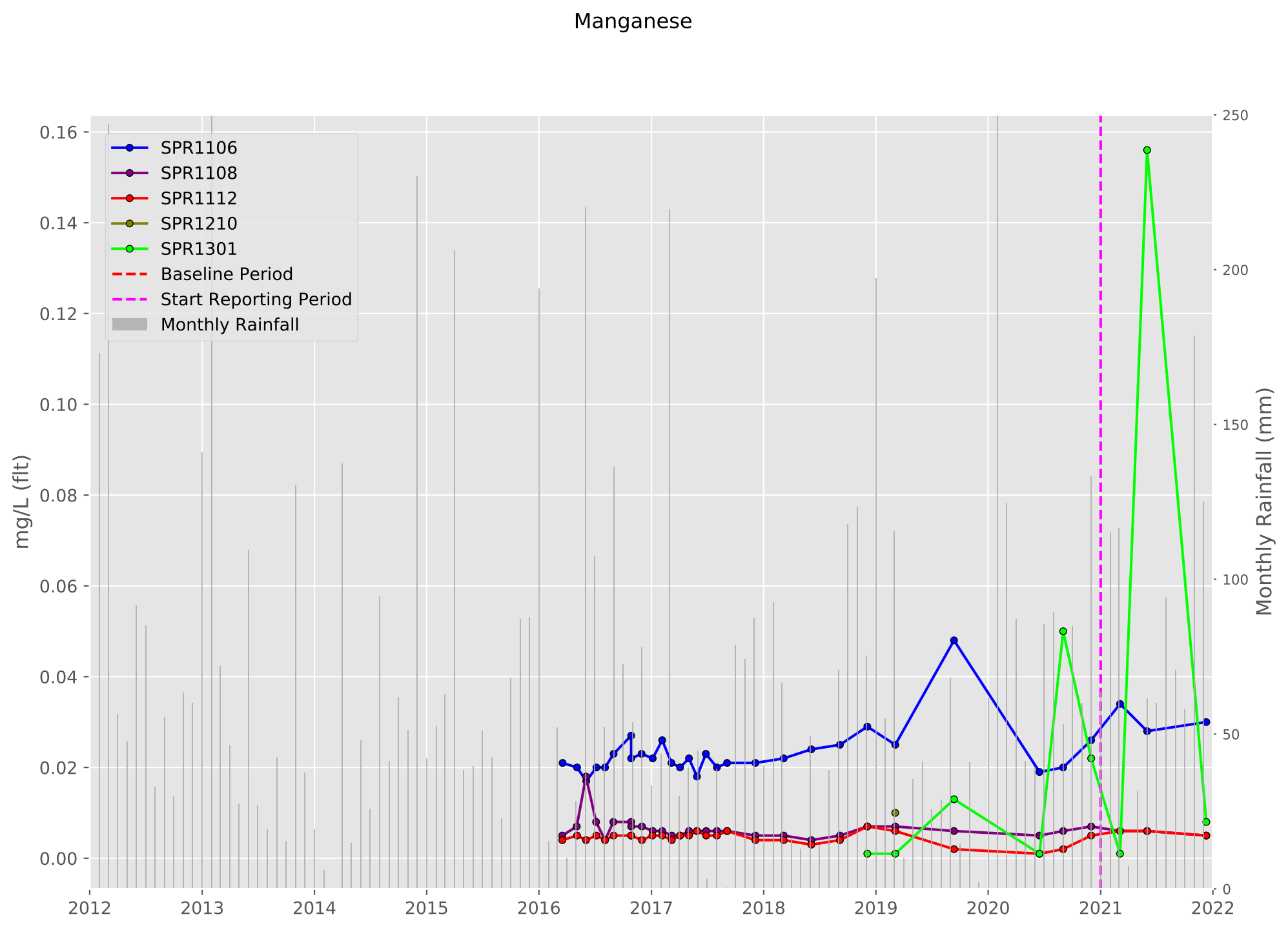

Iron
SPR1104
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
1.0
0.8
0.6
0.4
0.2
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

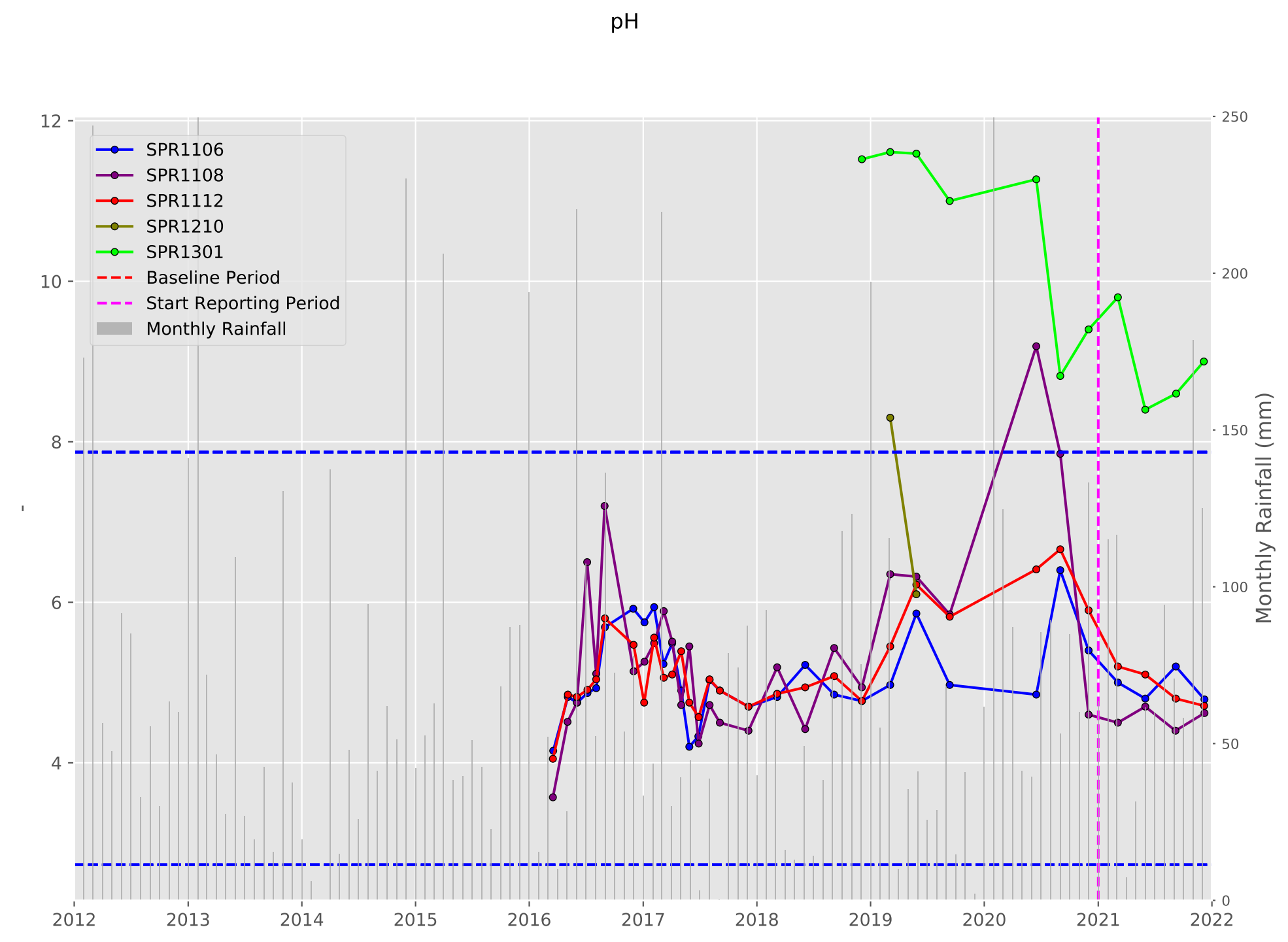

Manganese
SPR1104
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.022
0.020
0.018
0.016
0.014
0.012
0.010
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

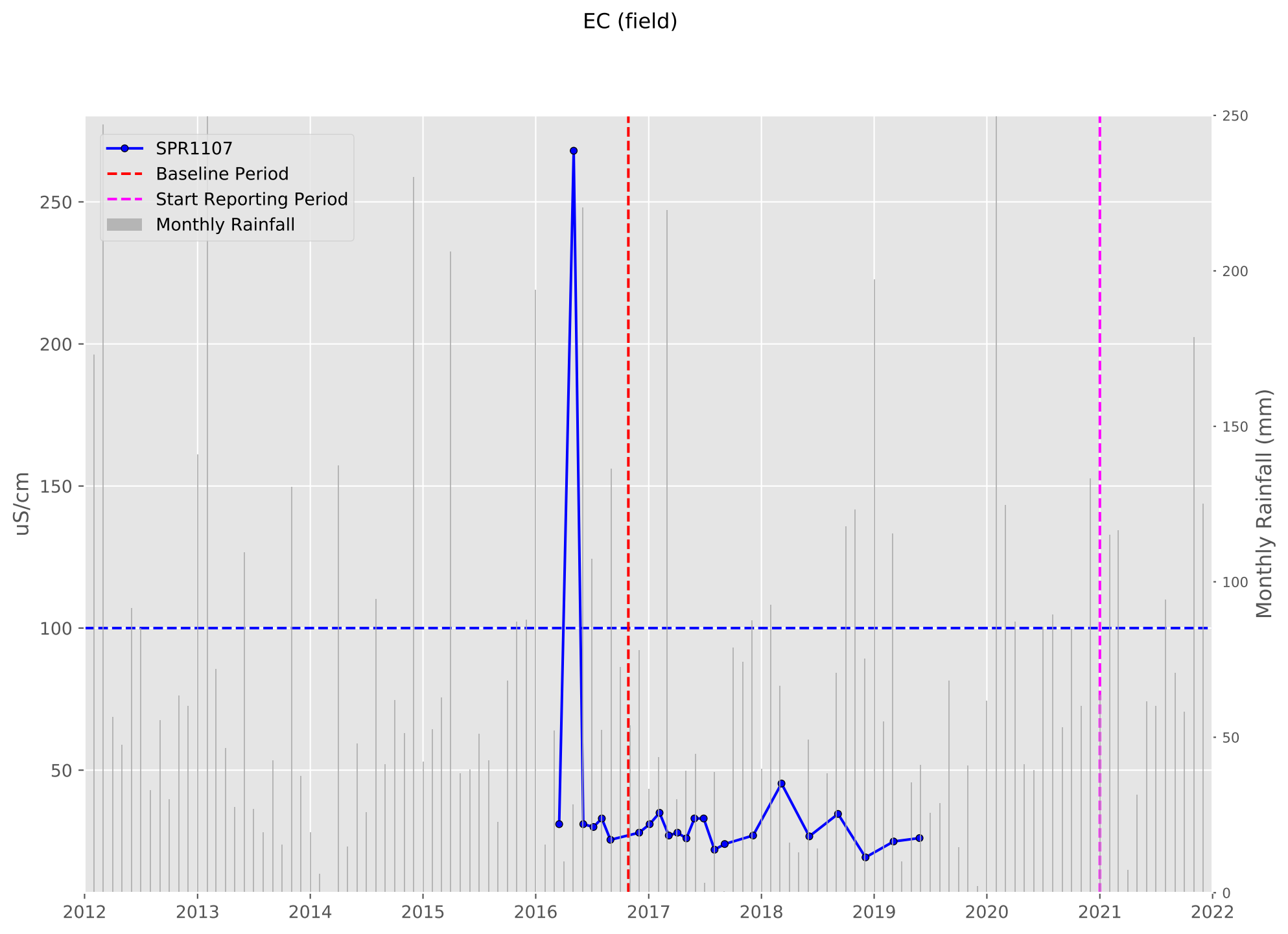

pH
SPR1104
Baseline Period
Start Reporting Period
Monthly Rainfall
8
7
6
5
4
3
-
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


EC (field)
SPR1106
SPR1108
SPR1112
SPR1210
SPR1301
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
200
400
600
800
1000
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

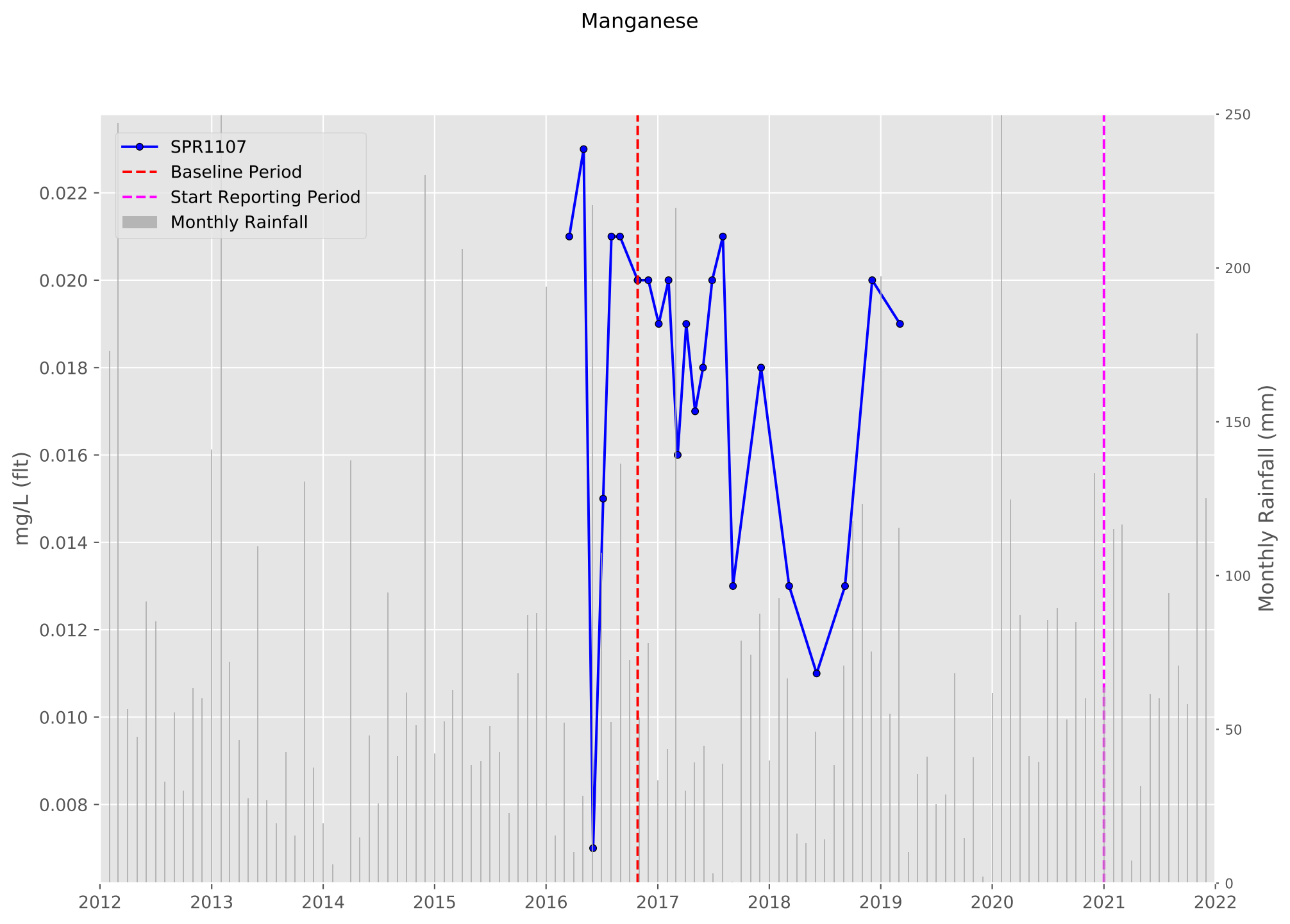

Iron
SPR1106
SPR1108
SPR1112
SPR1210
SPR1301
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
1.0
0.8
0.6
0.4
0.2
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

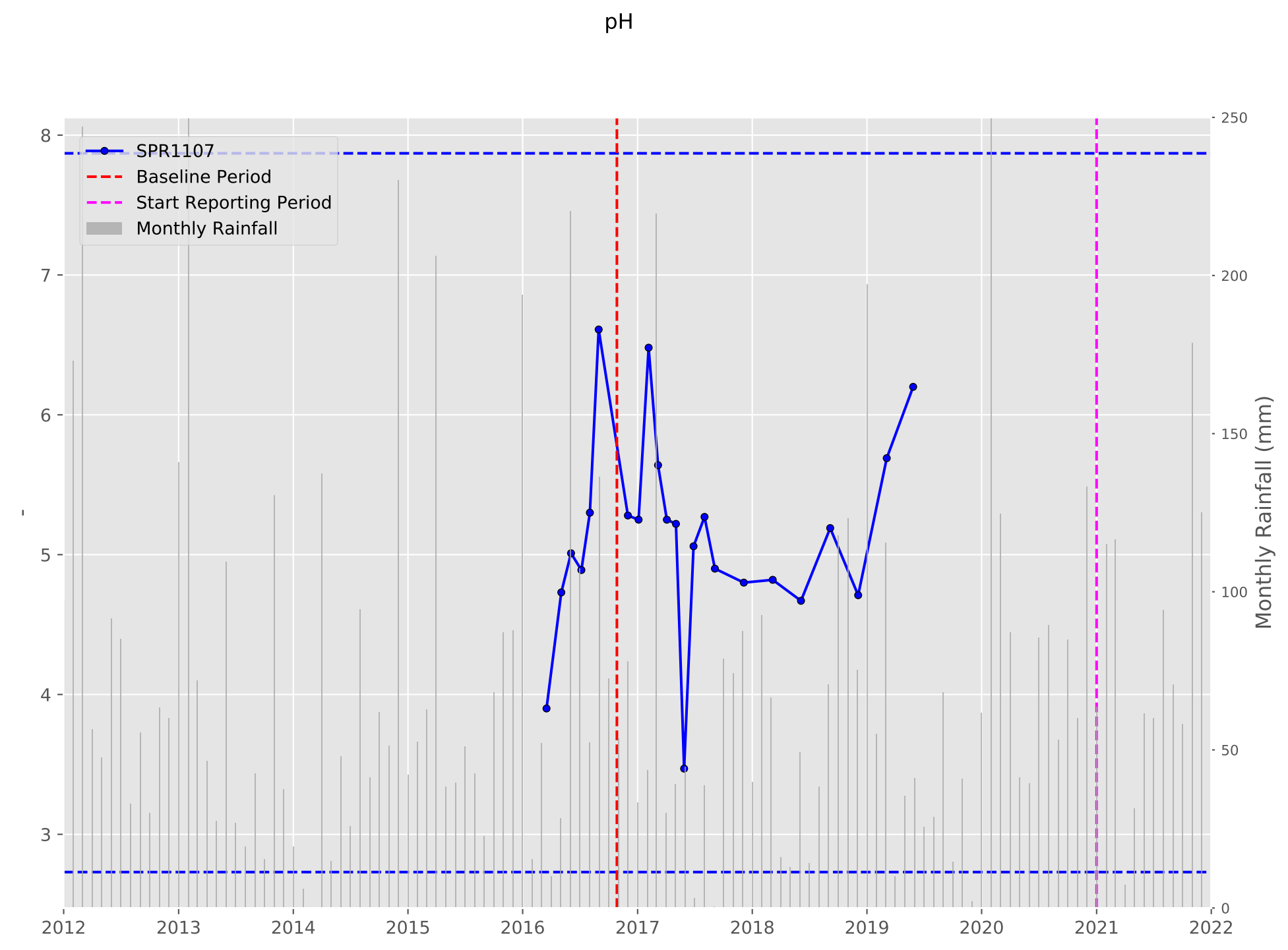

Manganese
SPR1106
SPR1108
SPR1112
SPR1210
SPR1301
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

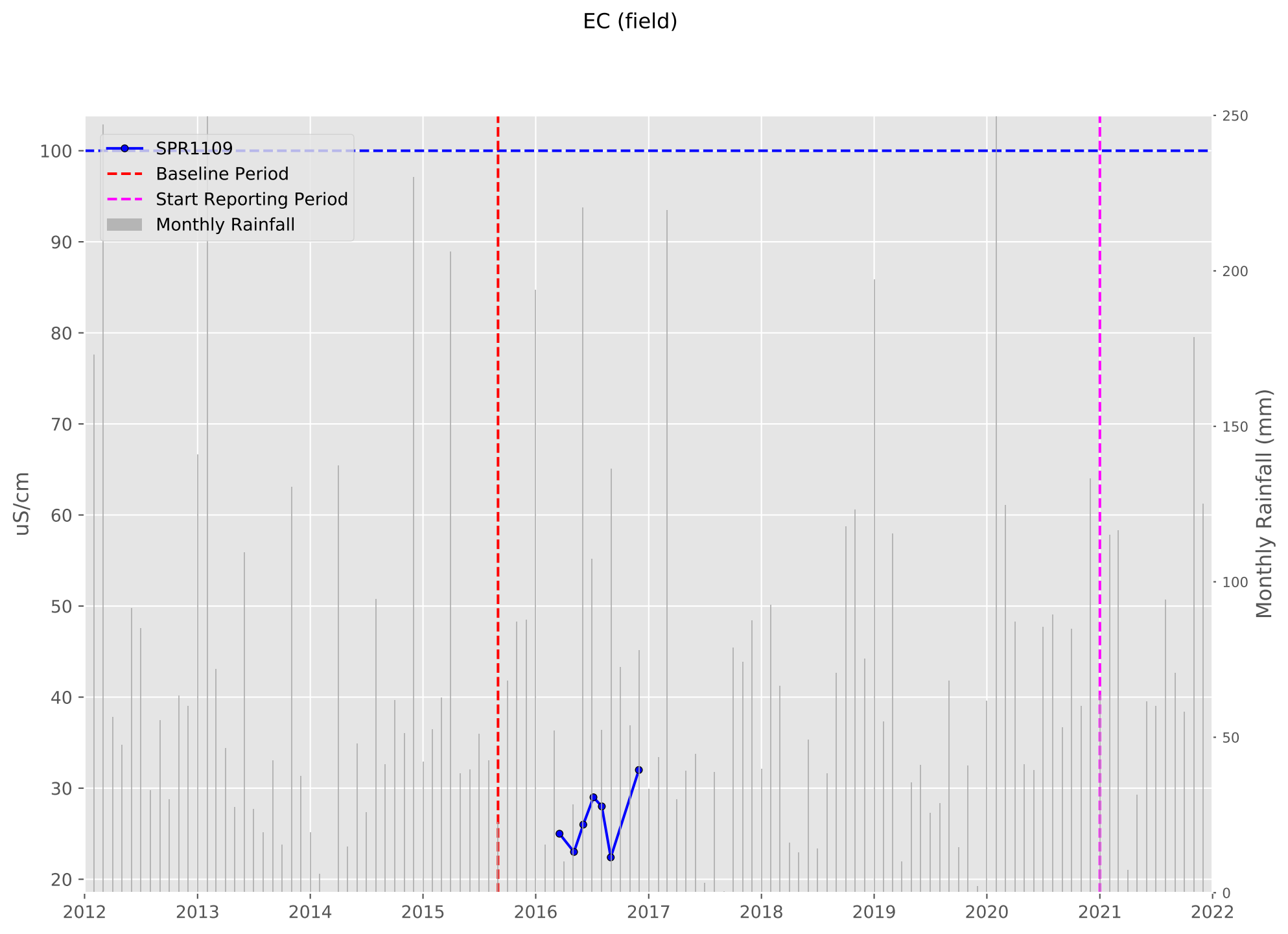

pH
SPR1106
SPR1108
SPR1112
SPR1210
SPR1301
Baseline Period
Start Reporting Period
Monthly Rainfall
12
10
8
6
4
-
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

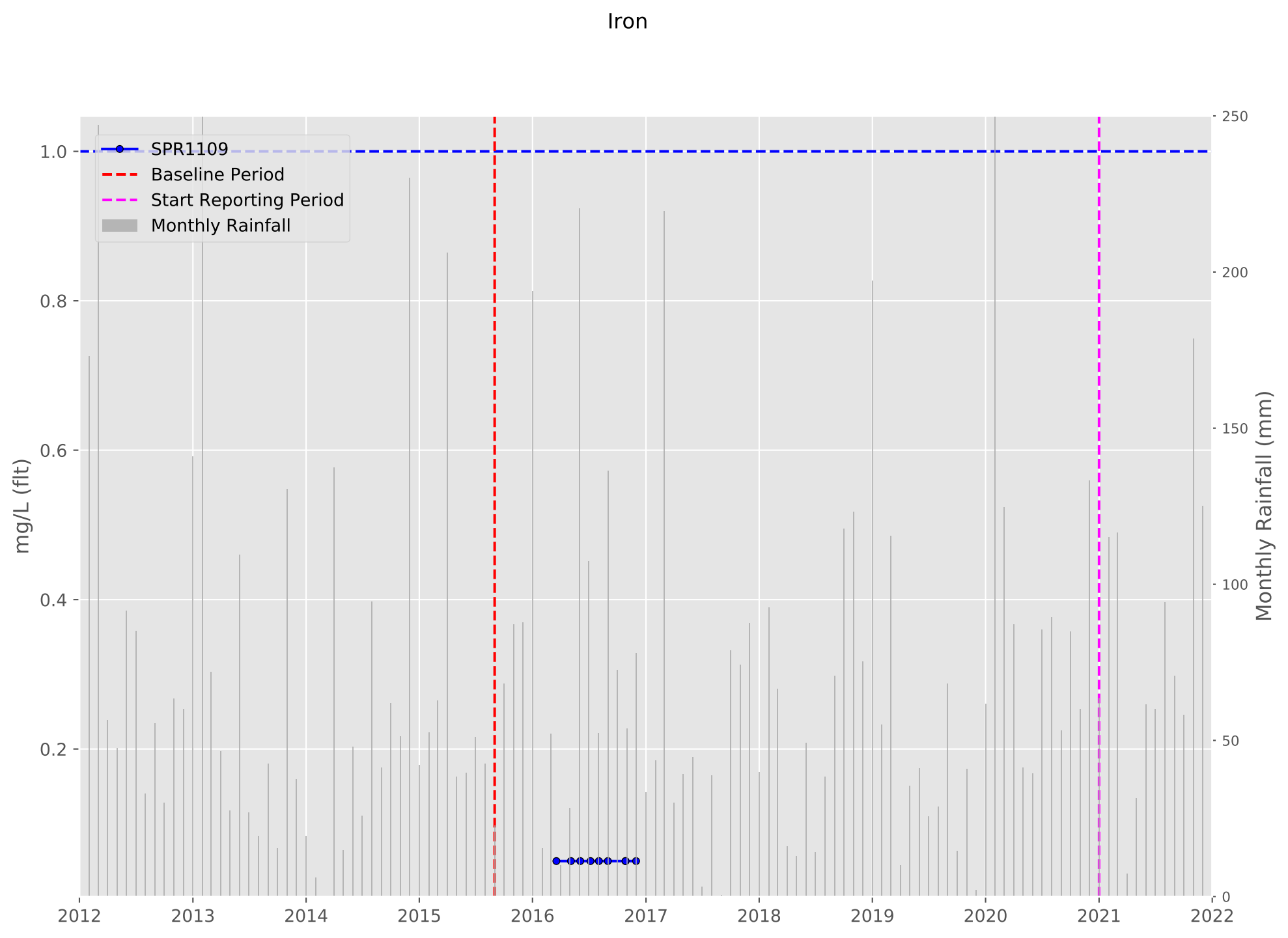

EC (field)
SPR1107
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

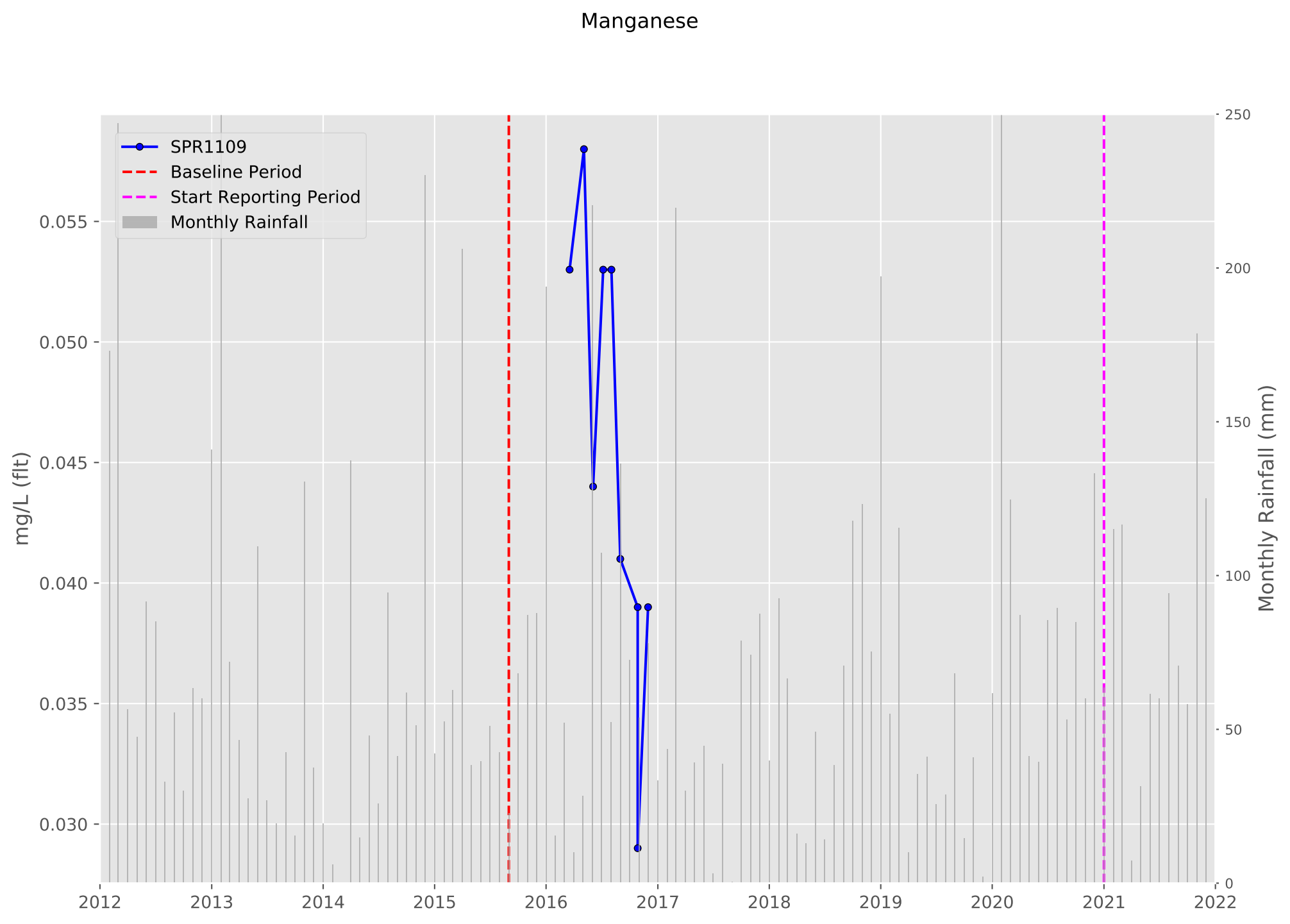

Iron
SPR1107
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
1.0
0.8
0.6
0.4
0.2
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

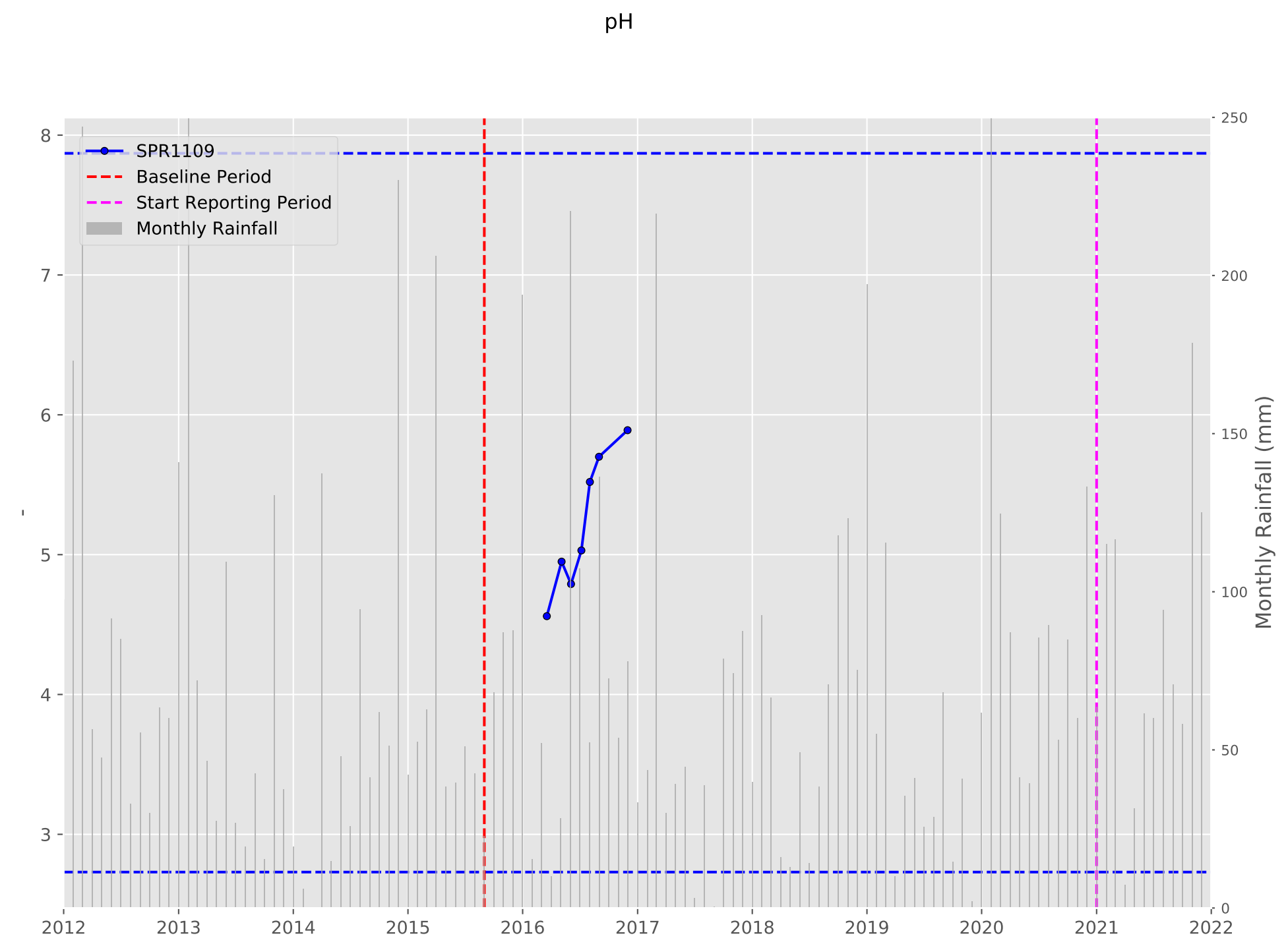

Manganese
SPR1107
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.022
0.020
0.018
0.016
0.014
0.012
0.010
0.008
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

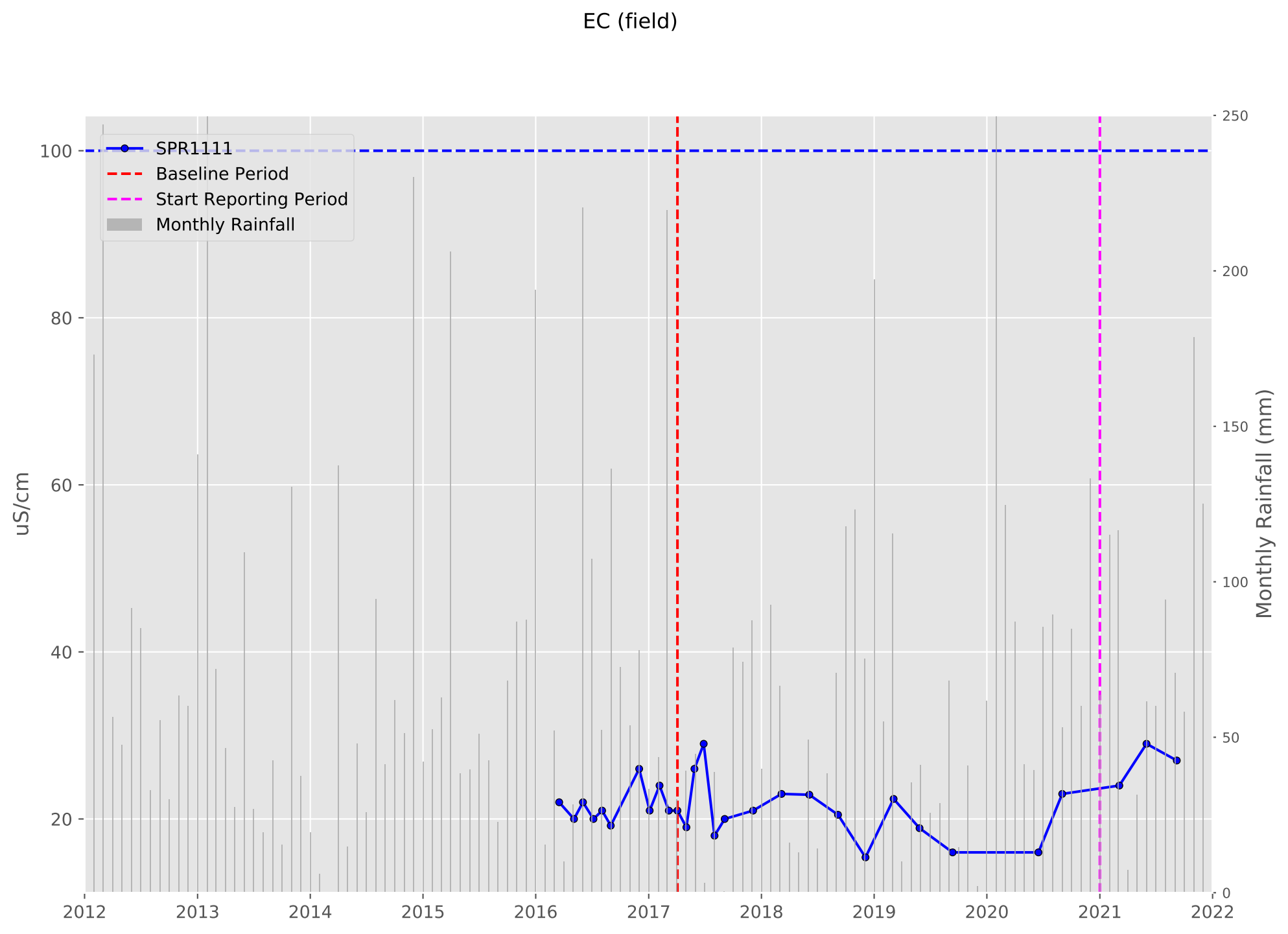

pH
SPR1107
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

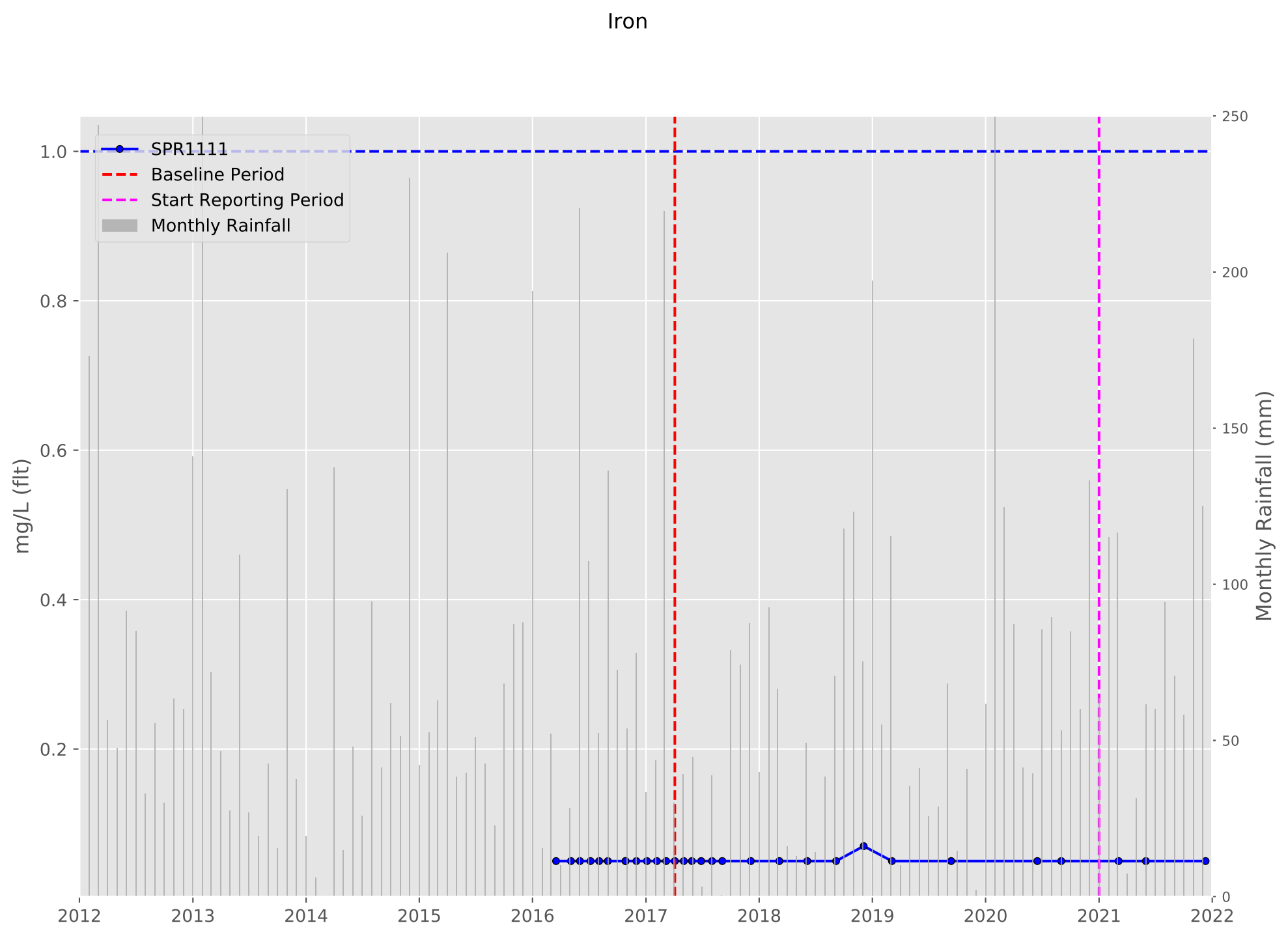

EC (field)
SPR1109
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
100
90
80
70
60
50
40
30
20
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

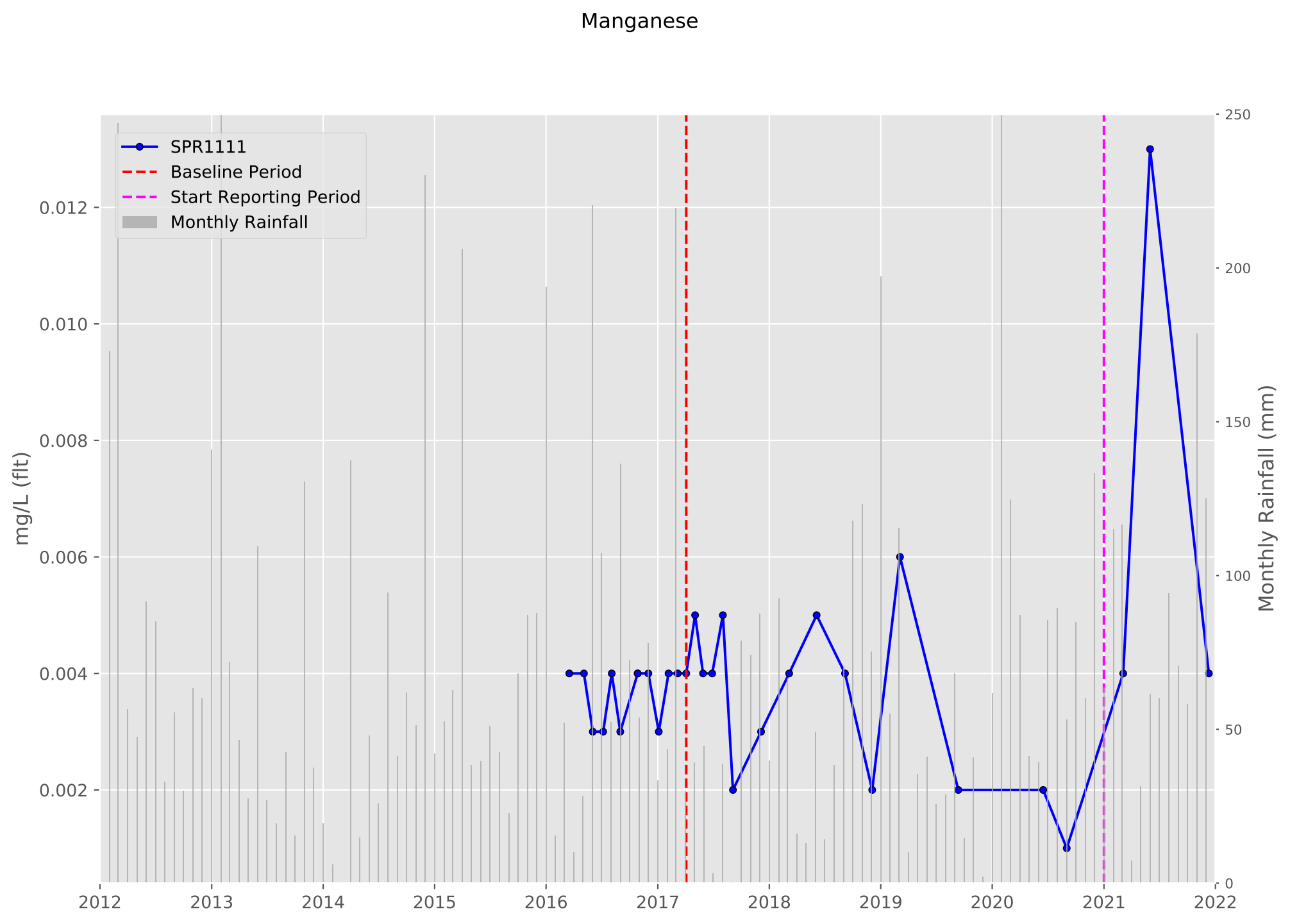

Iron
SPR1109
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
1.0
0.8
0.6
0.4
0.2
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

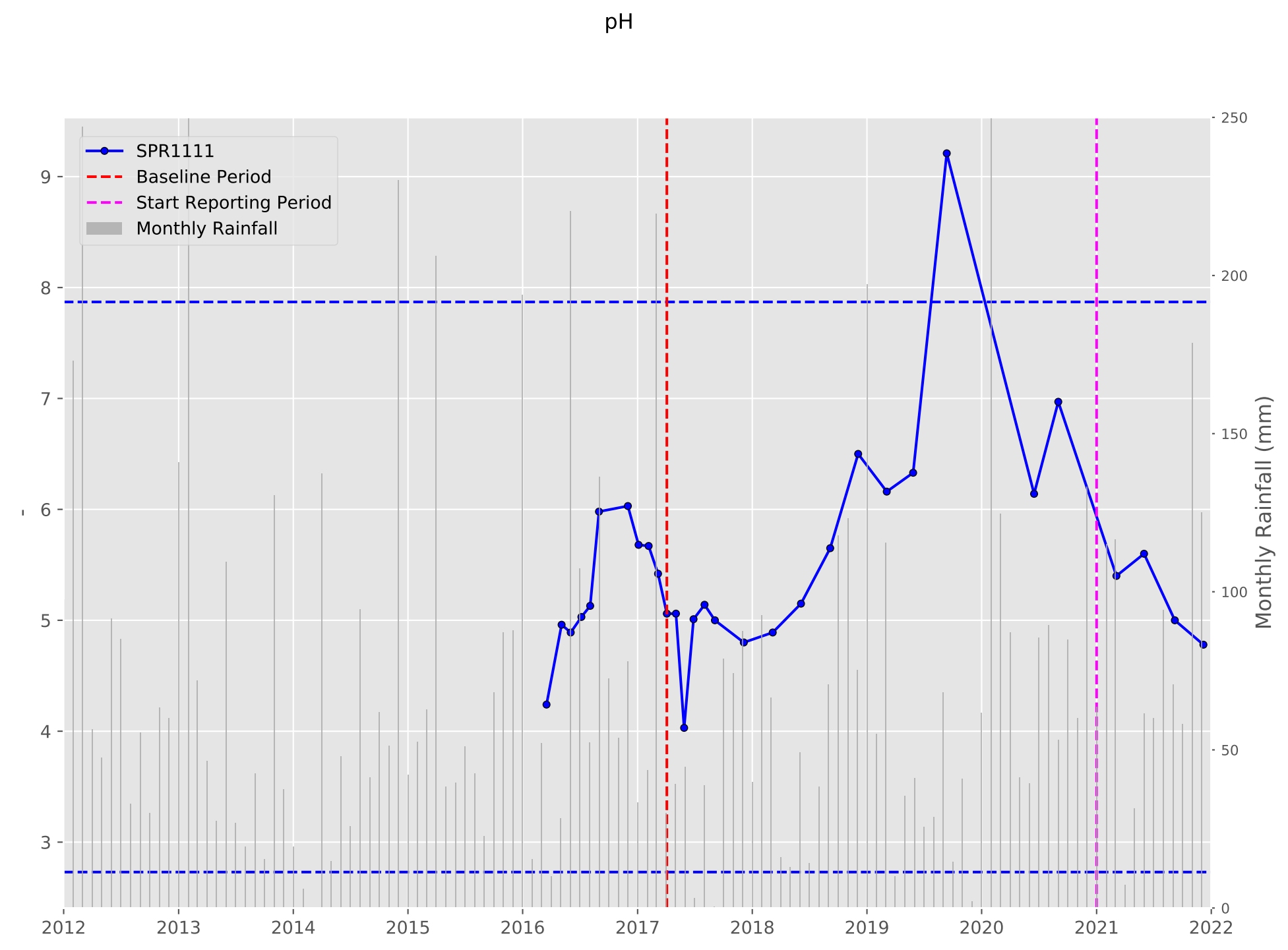

Manganese
SPR1109
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.055
0.050
0.045
0.040
0.035
0.030
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

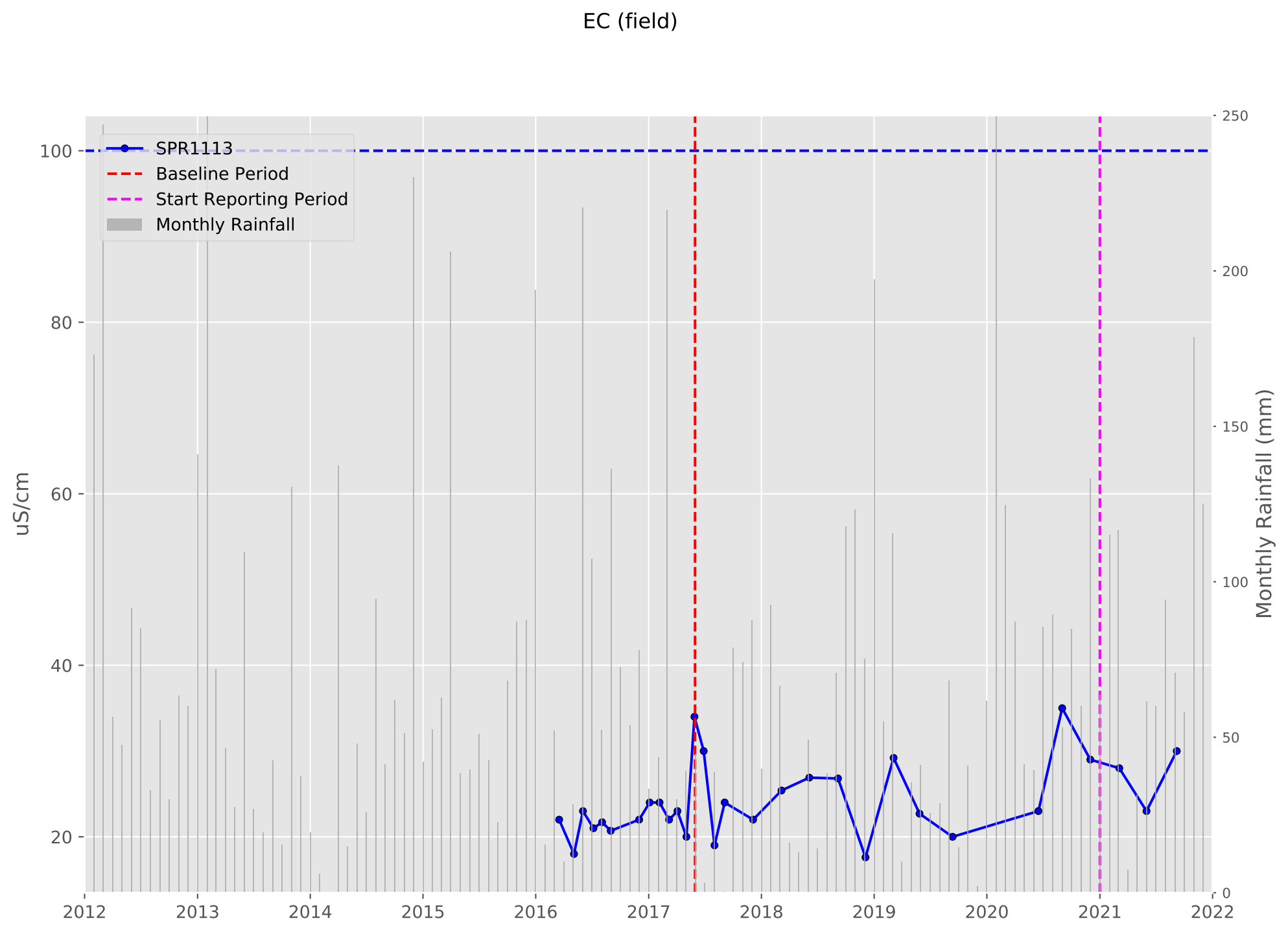

pH
SPR1109
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

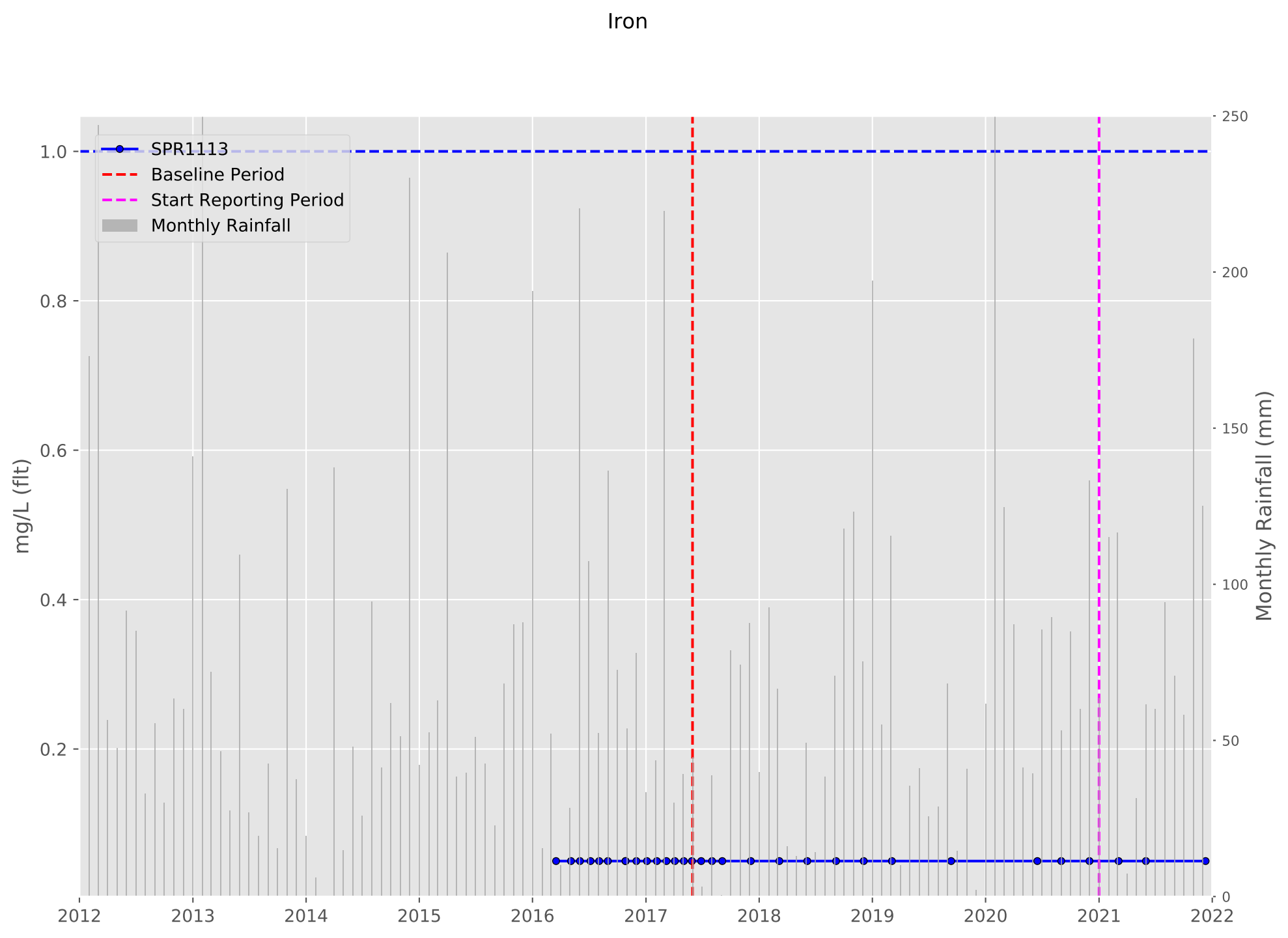

EC (field)
SPR1111
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
100
80
60
40
20
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

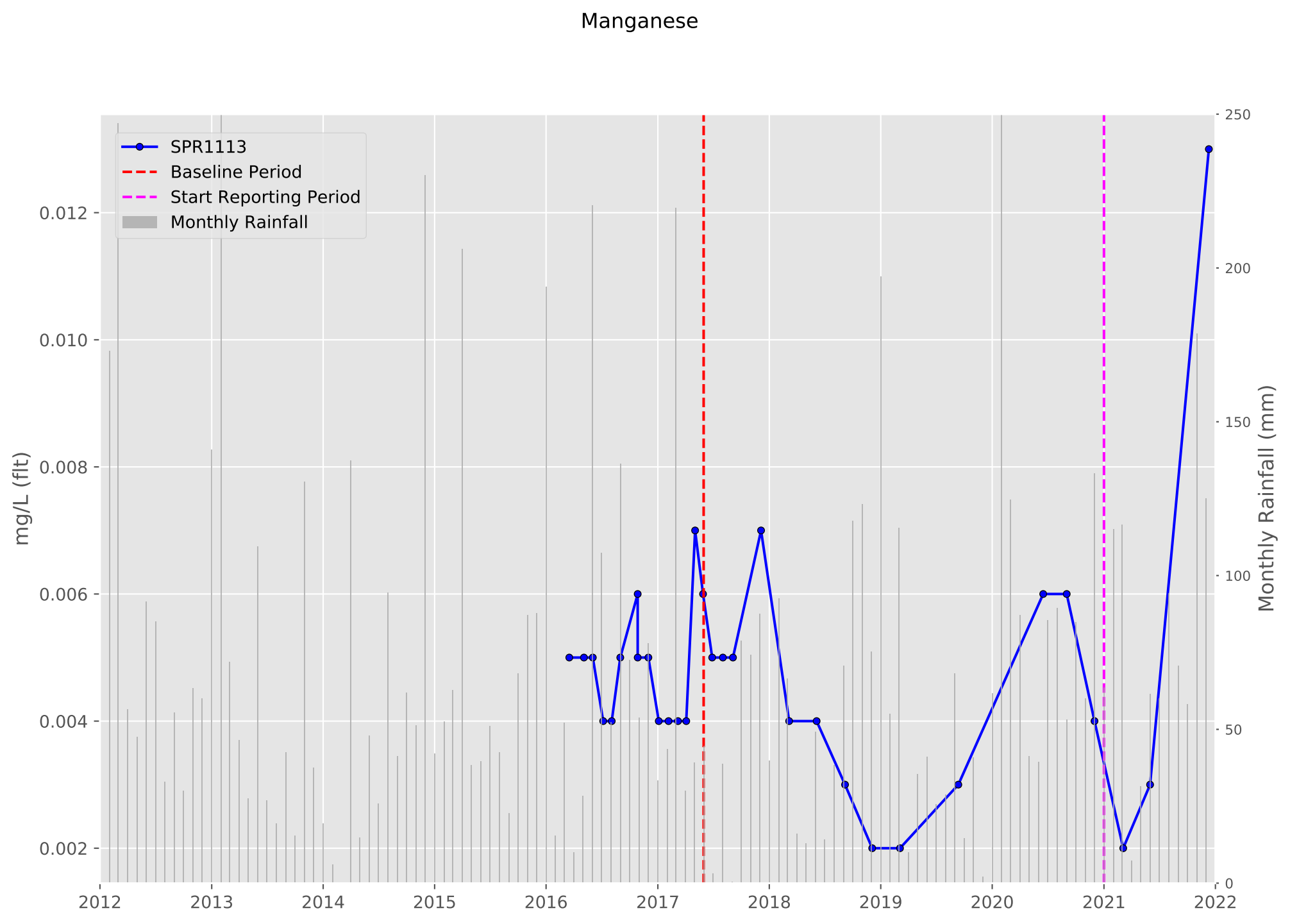

Iron
SPR1111
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
1.0
0.8
0.6
0.4
0.2
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

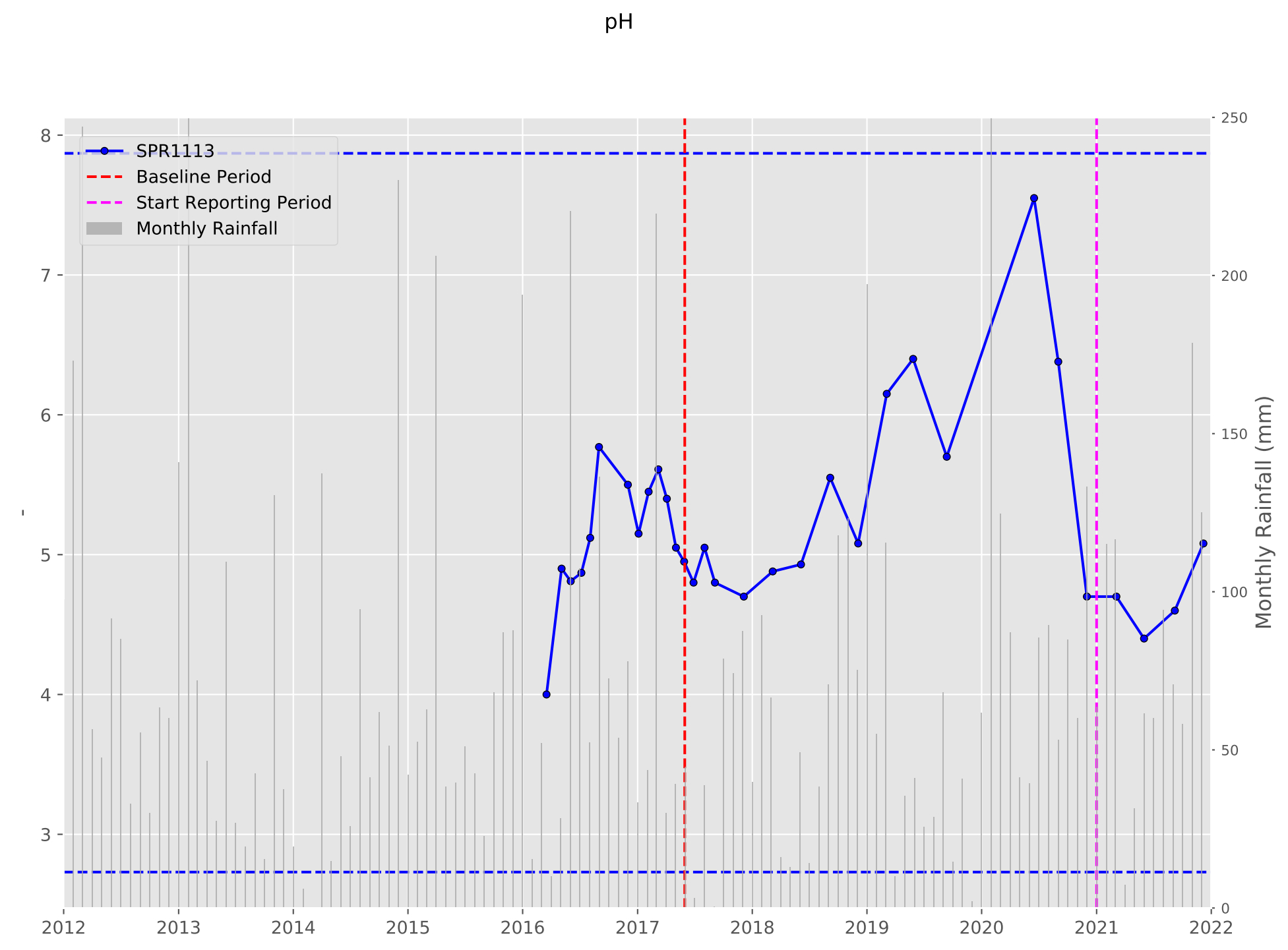

Manganese
SPR1111
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.012
0.010
0.008
0.006
0.004
0.002
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

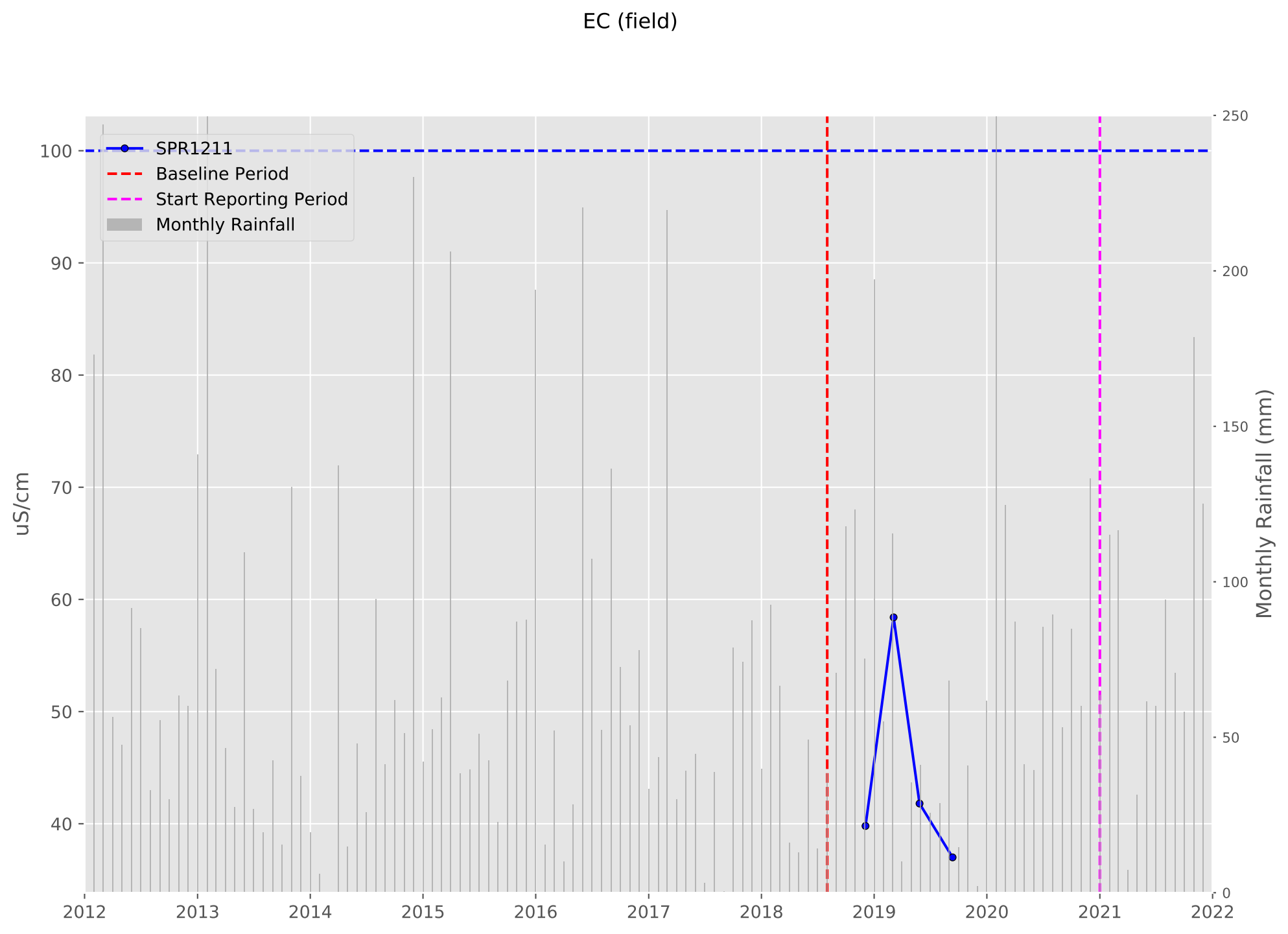

pH
SPR1111
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
9
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


EC (field)
SPR1113
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
100
80
60
40
20
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

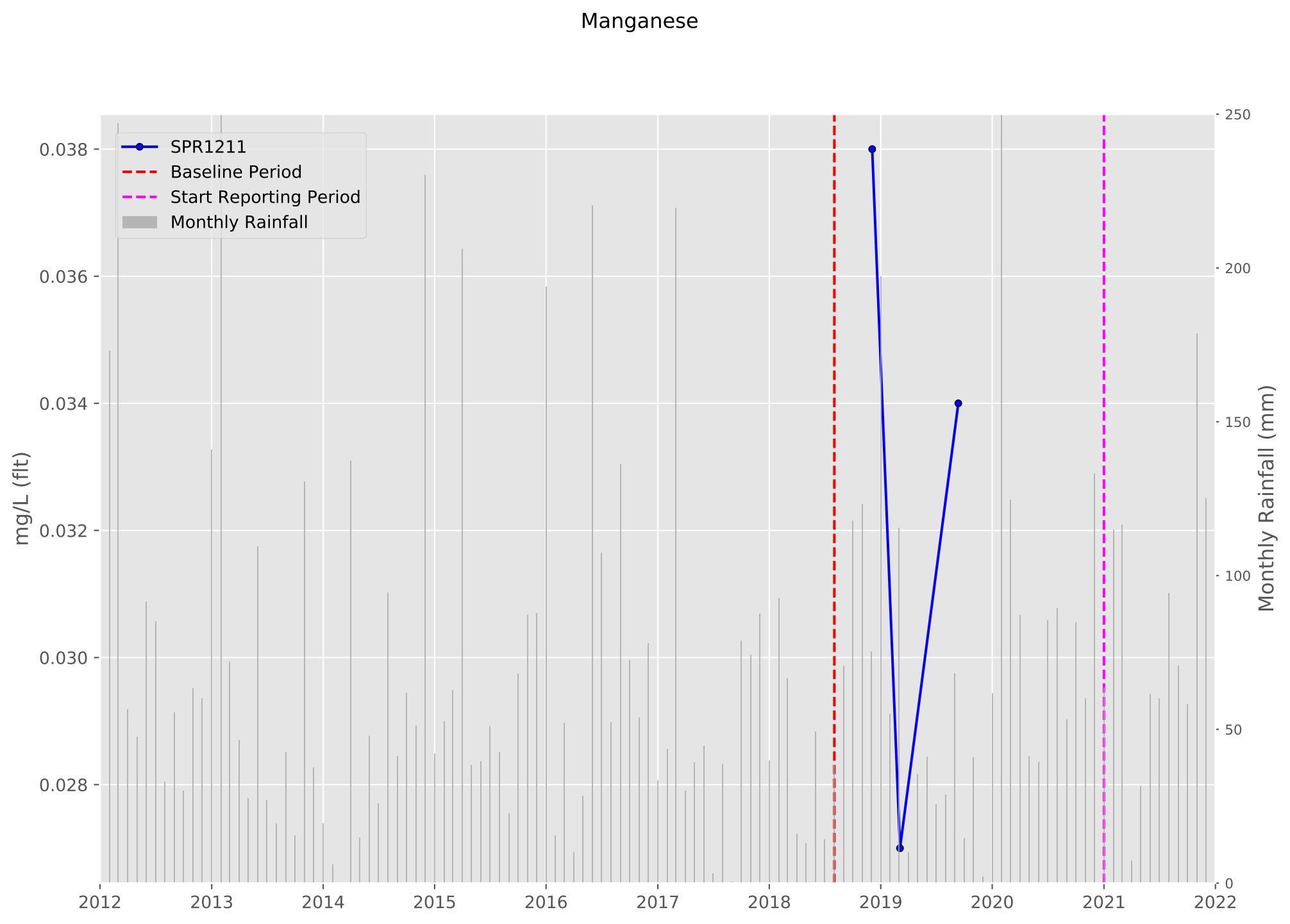

Iron
SPR1113
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
1.0
0.8
0.6
0.4
0.2
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

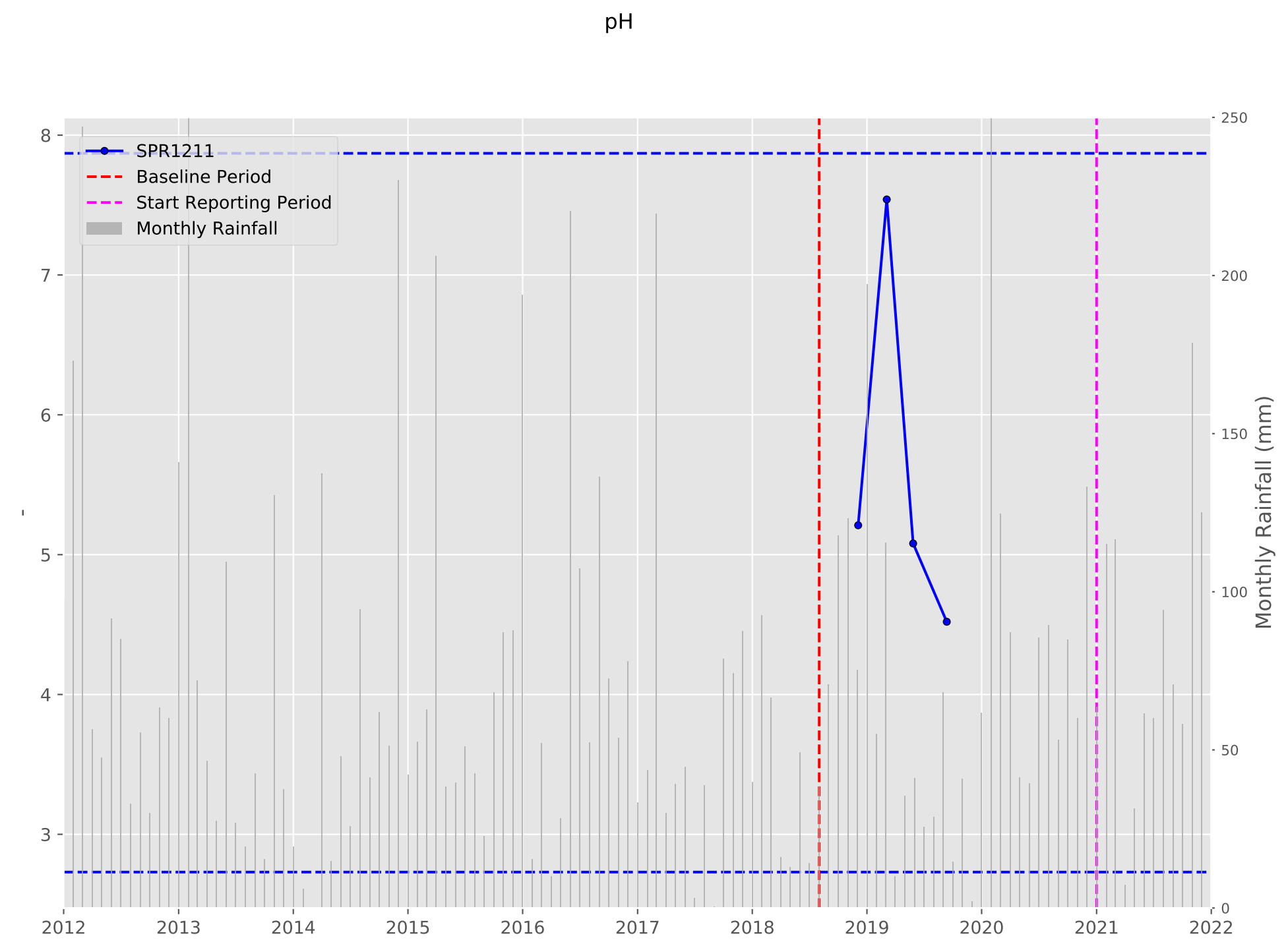

Manganese
SPR1113
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.002
0.004
0.006
0.008
0.010
0.012
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

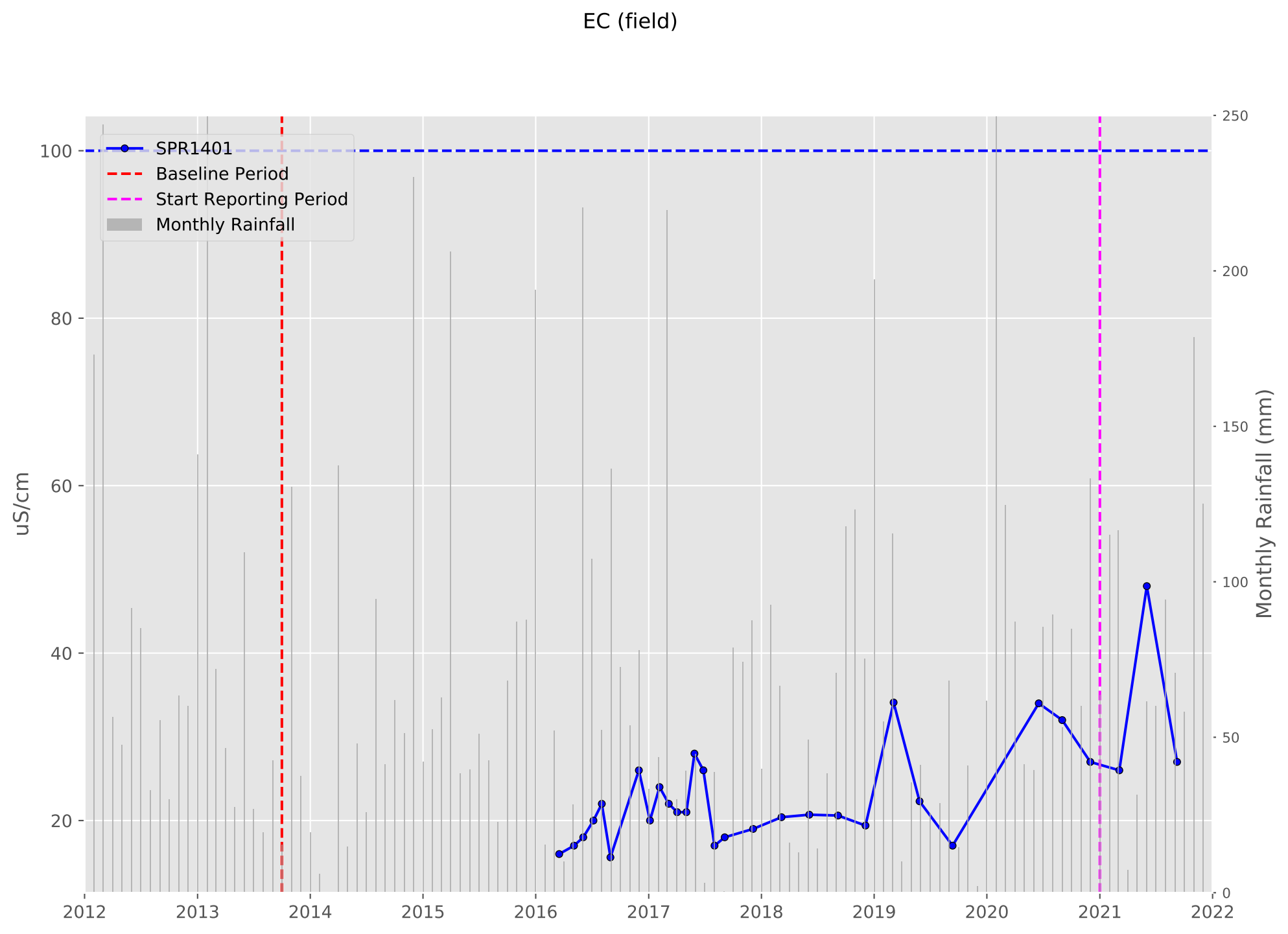

pH
SPR1113
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

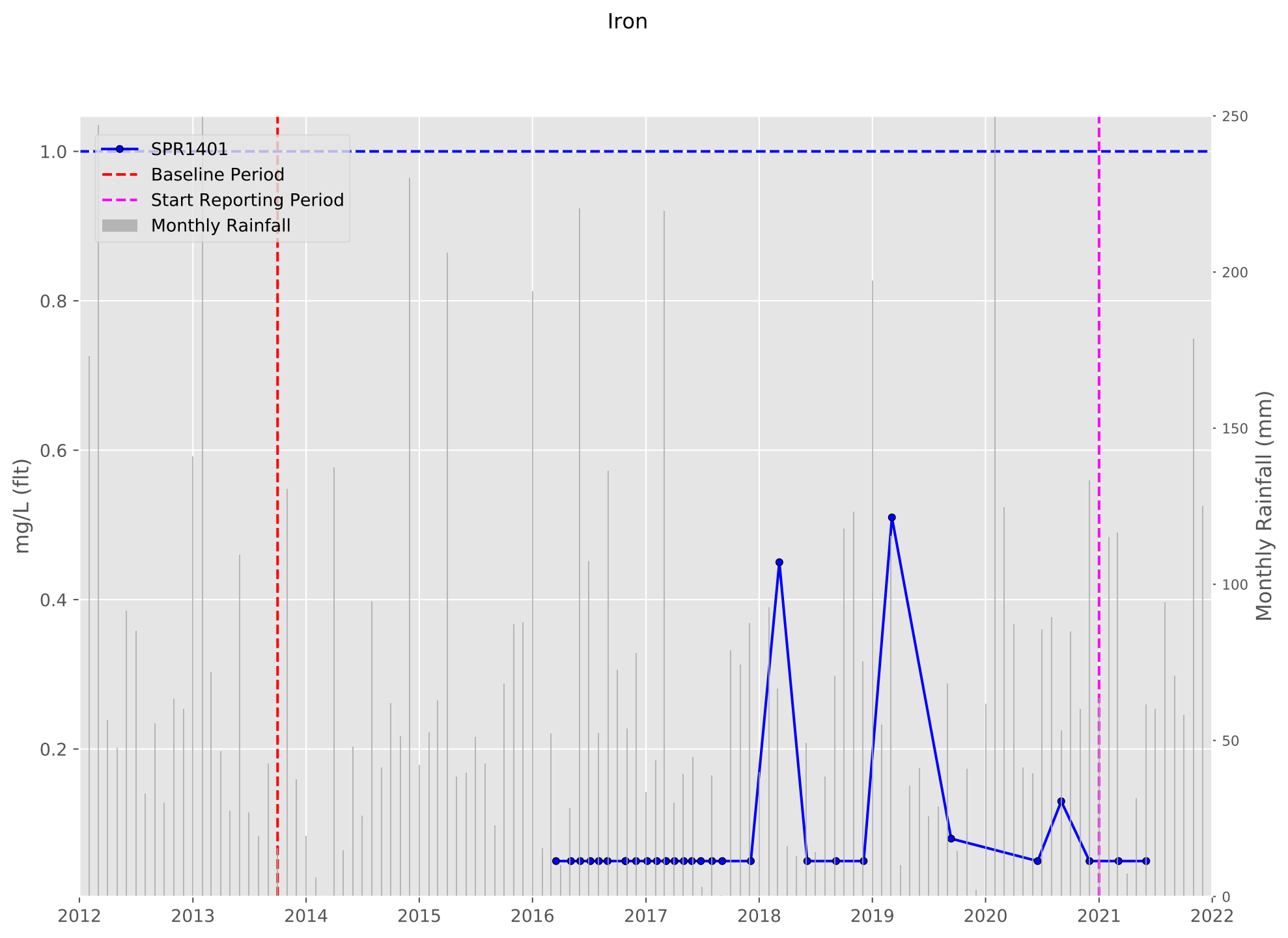

EC (field)
SPR1211
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
100
90
80
70
60
50
40
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

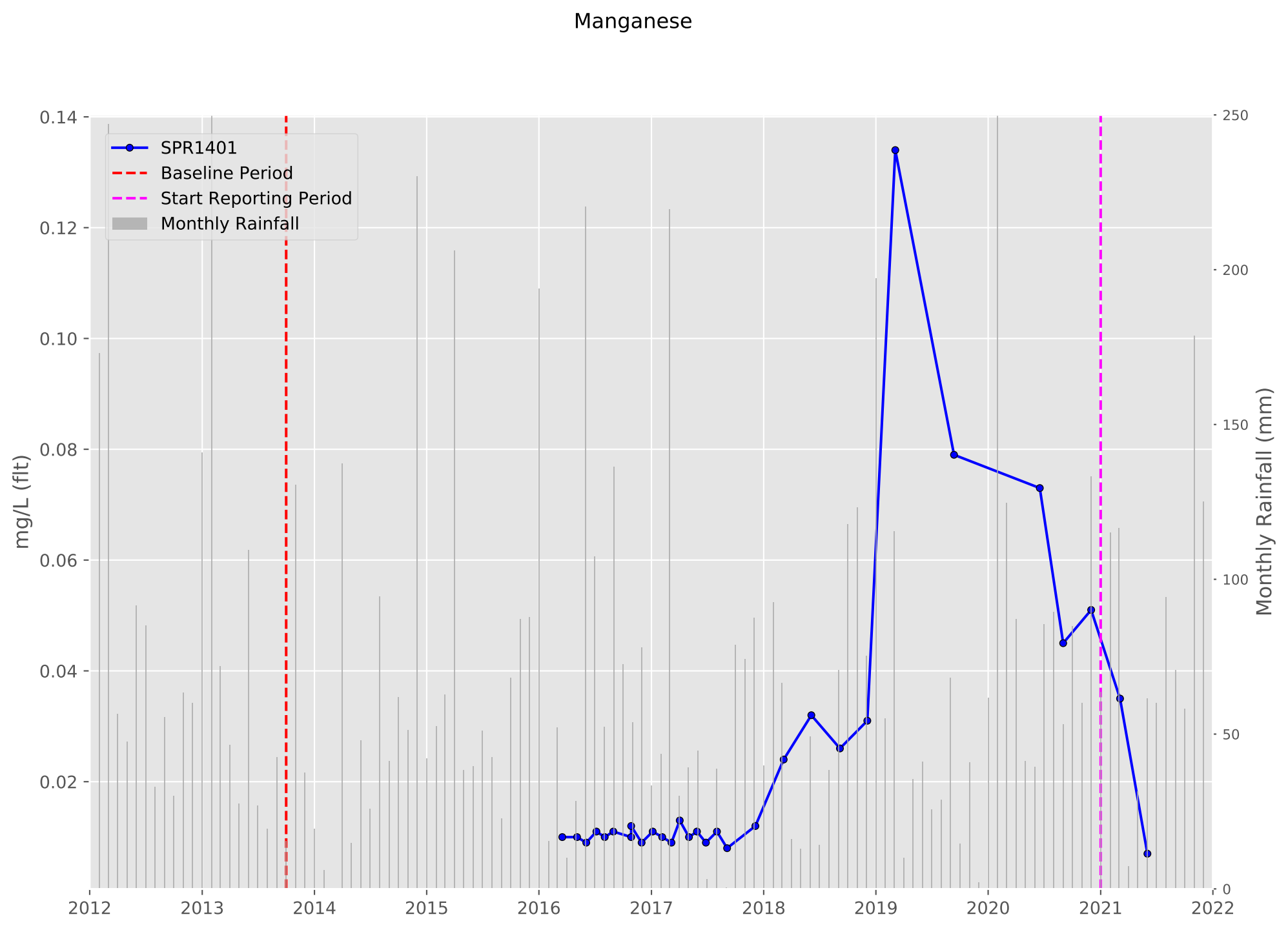

Iron
SPR1211
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
1.0
0.8
0.6
0.4
0.2
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

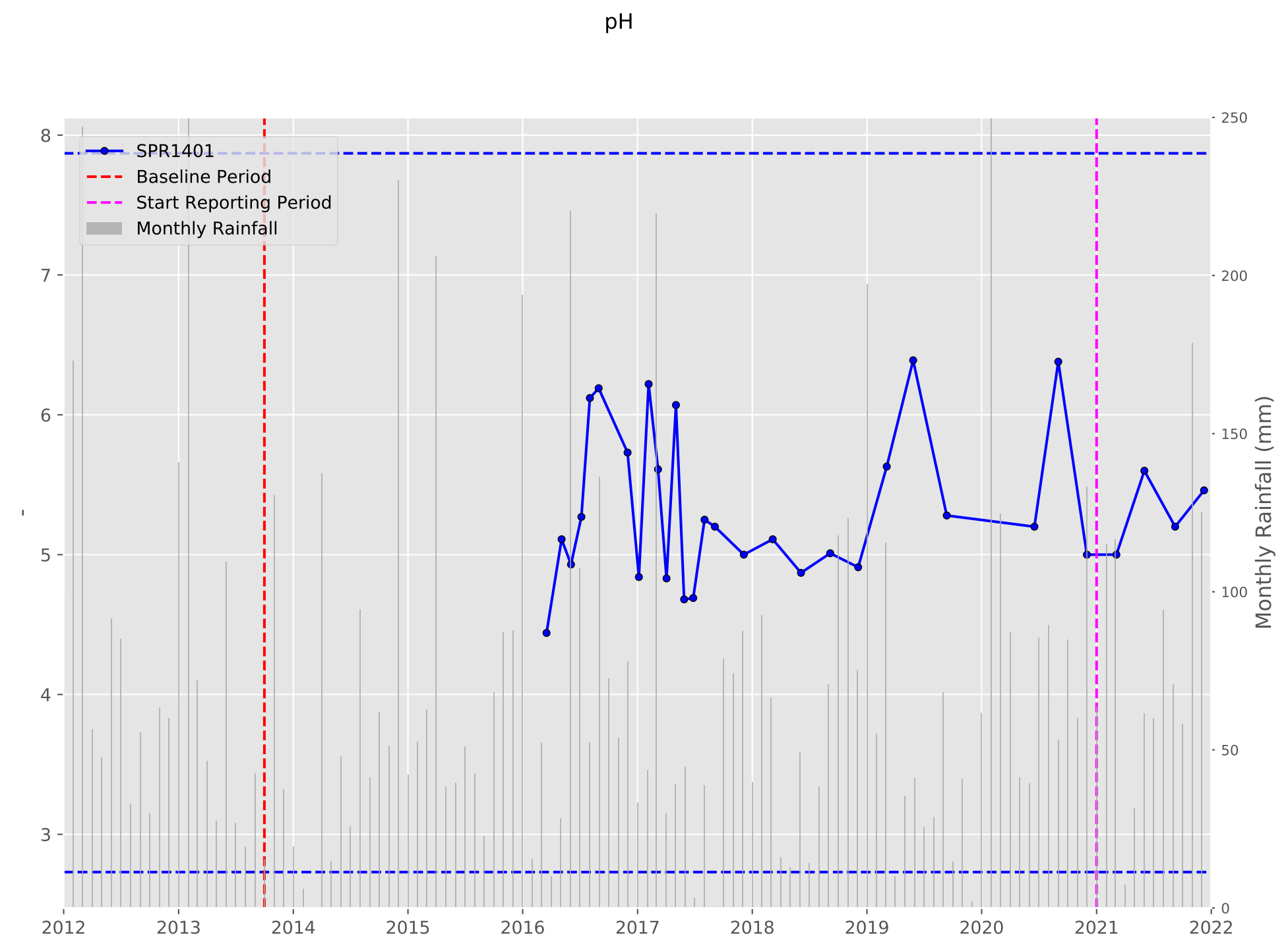

Manganese
SPR1211
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.038
0.036
0.034
0.032
0.030
0.028
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

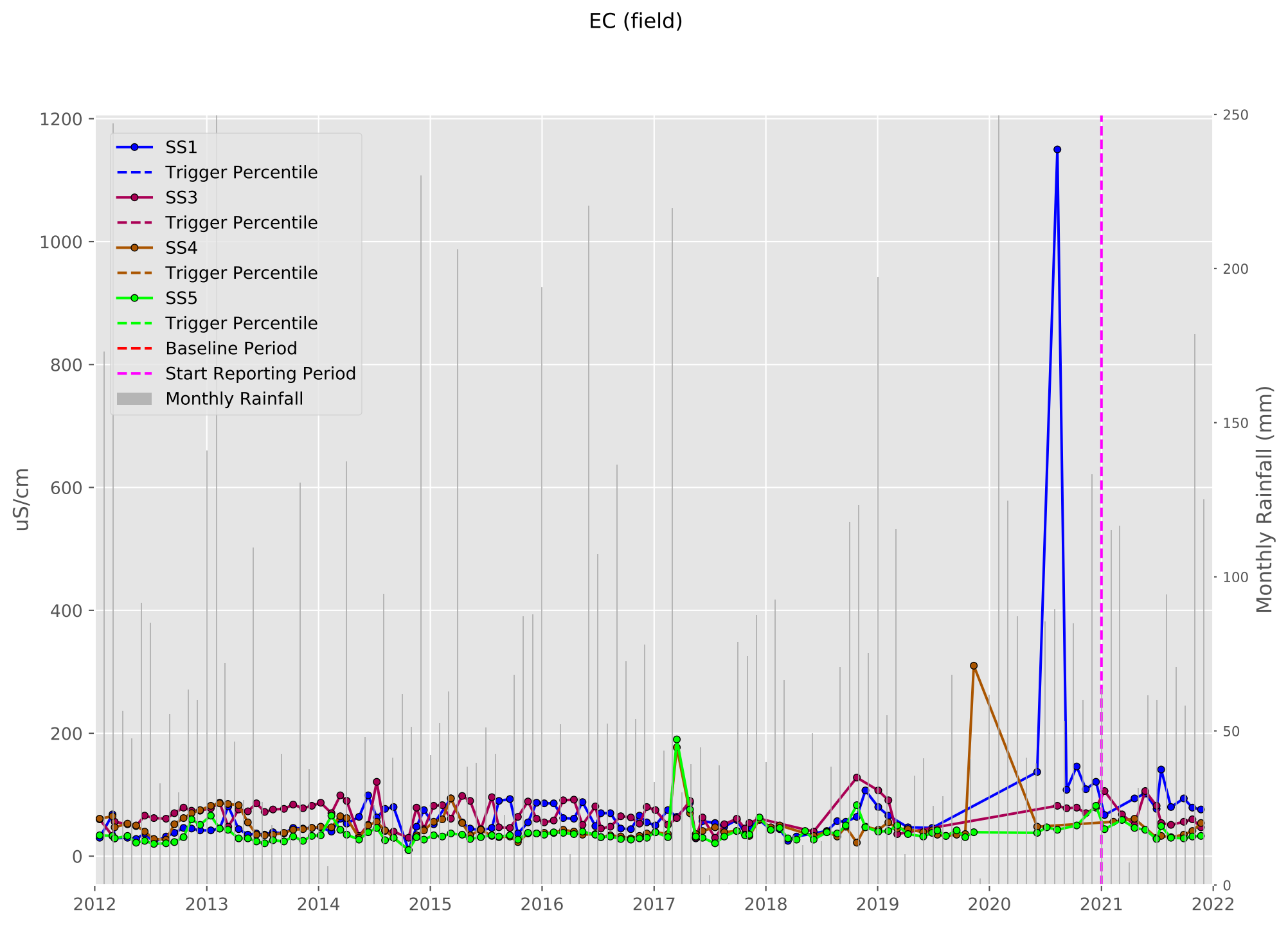

pH
SPR1211
Baseline Period
Start Reporting Period
Monthly Rainfall
8
7
6
5
4
3
-
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

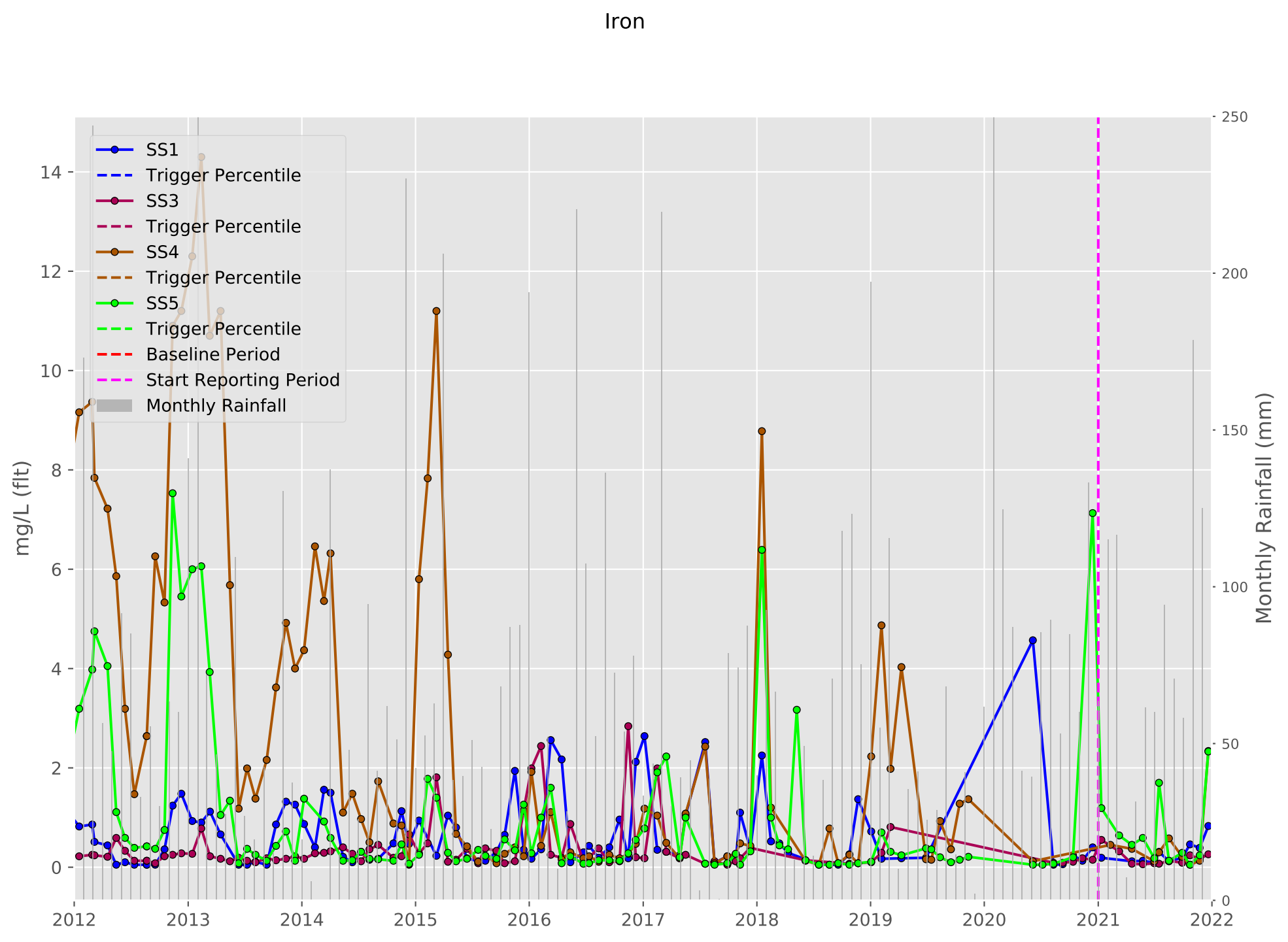

EC (field)
SPR1401
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
100
80
60
40
20
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

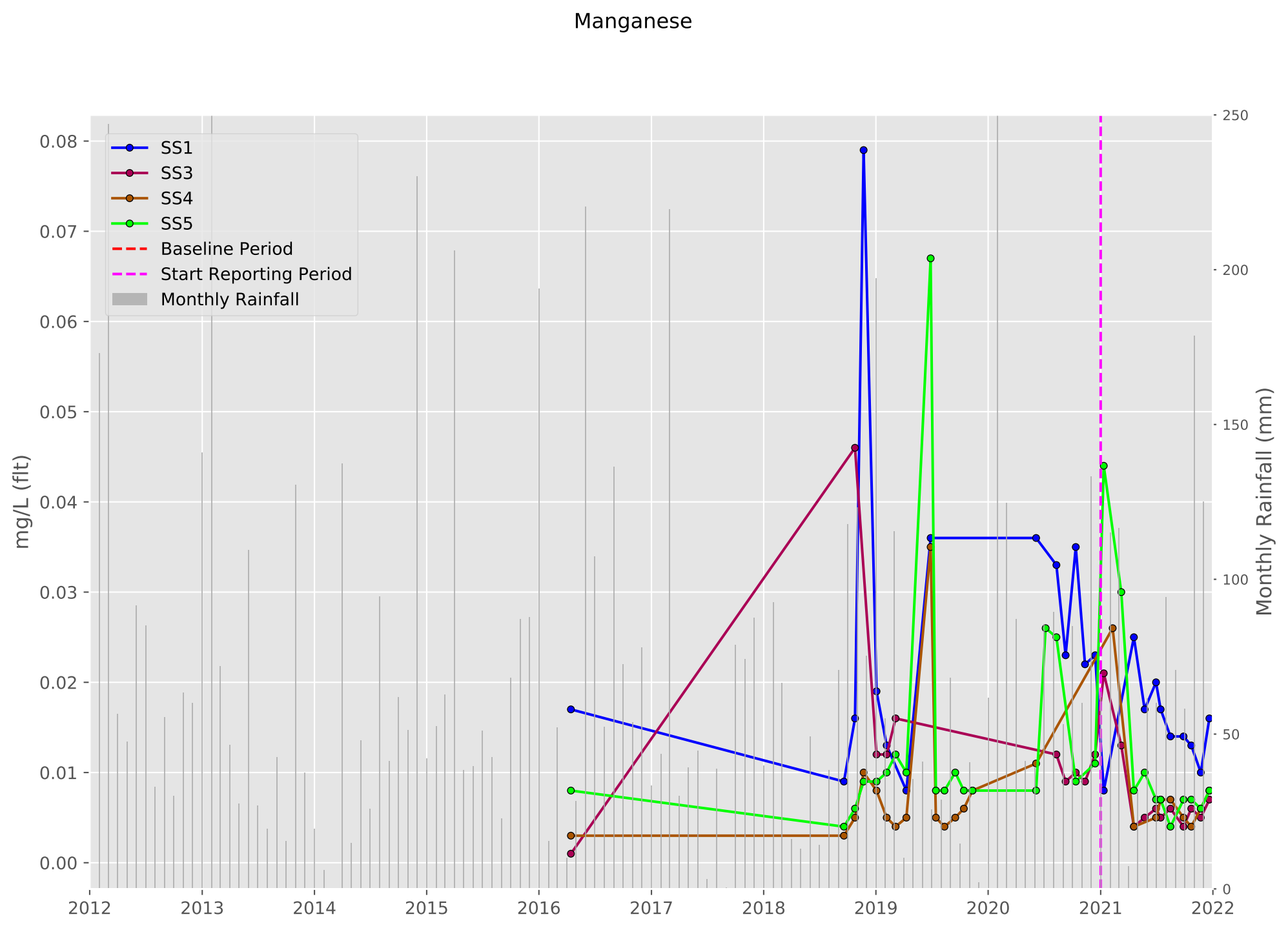

Iron
SPR1401
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
1.0
0.8
0.6
0.4
0.2
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

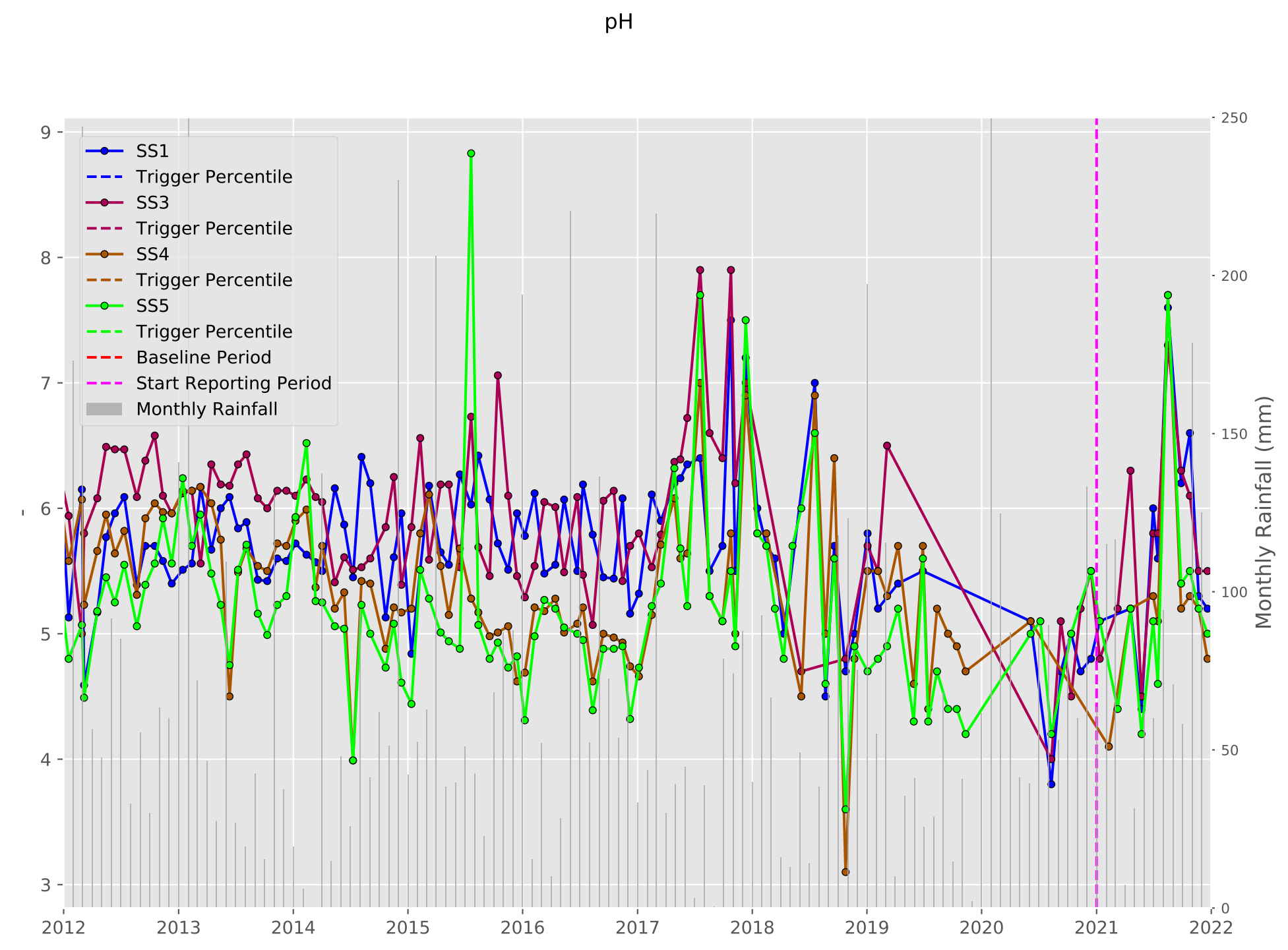

Manganese
SPR1401
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

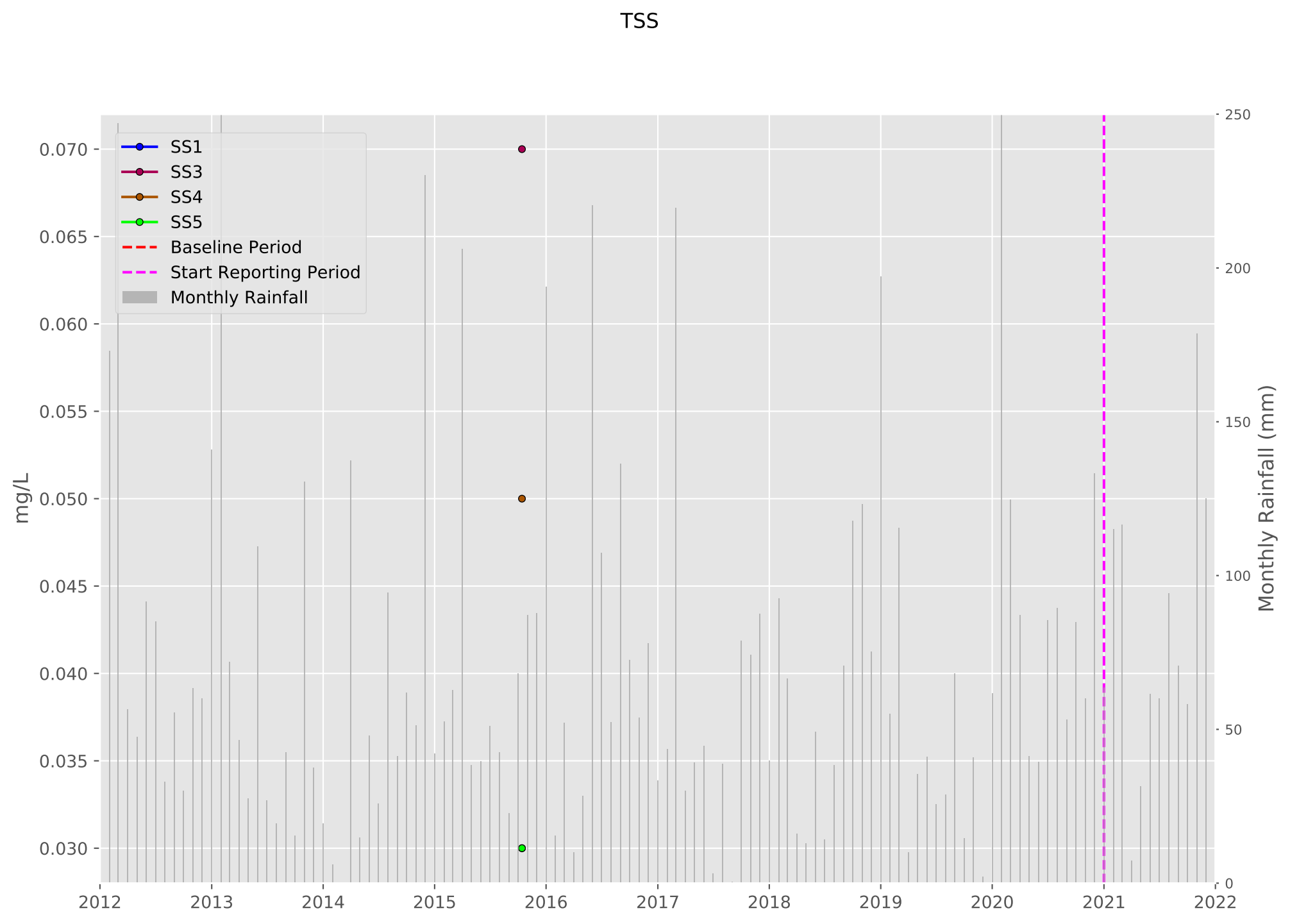

pH
SPR1401
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

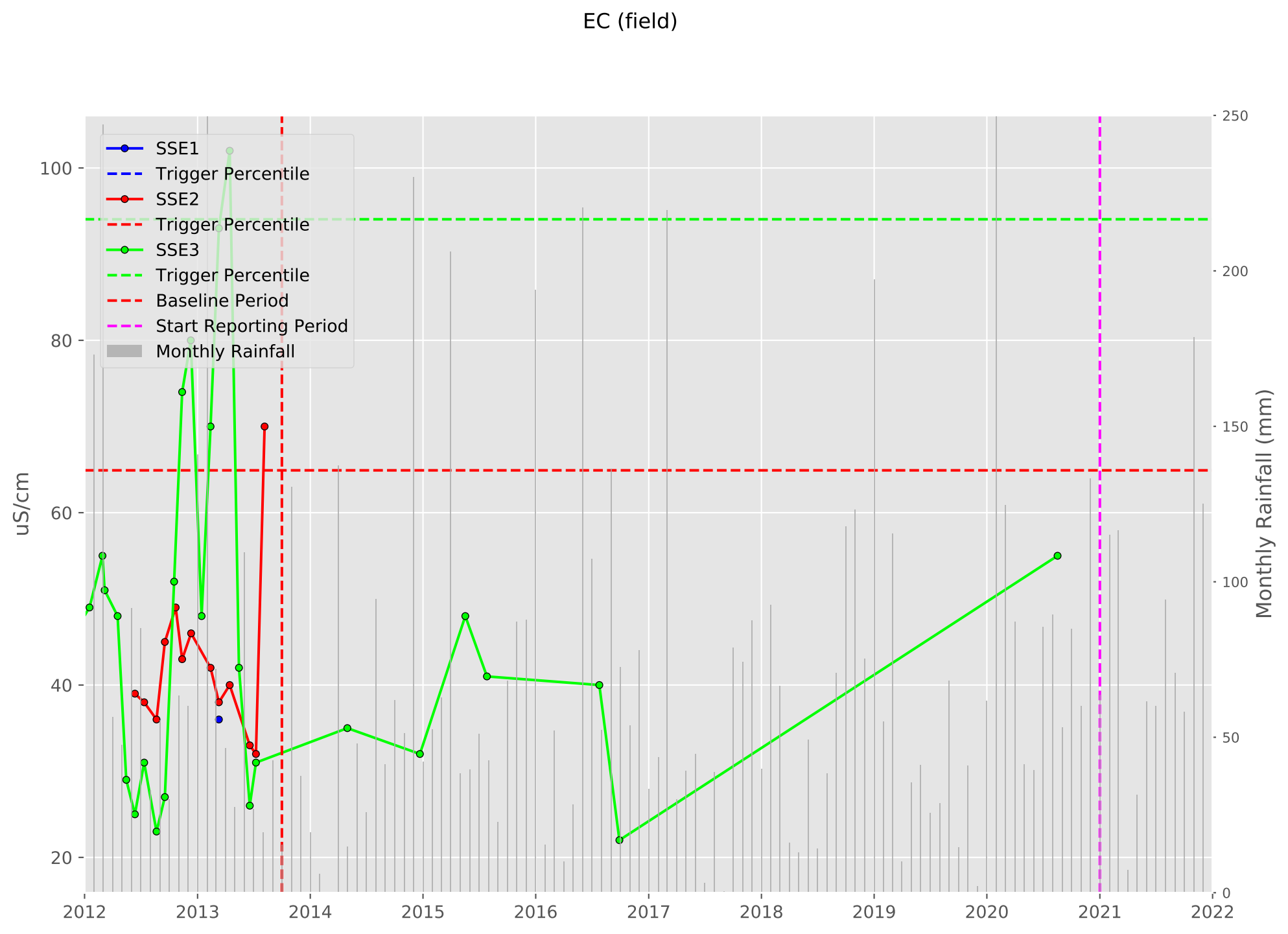

EC (field)
SS1
Trigger Percentile
SS3
Trigger Percentile
SS4
Trigger Percentile
SS5
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
200
400
600
800
1000
1200
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

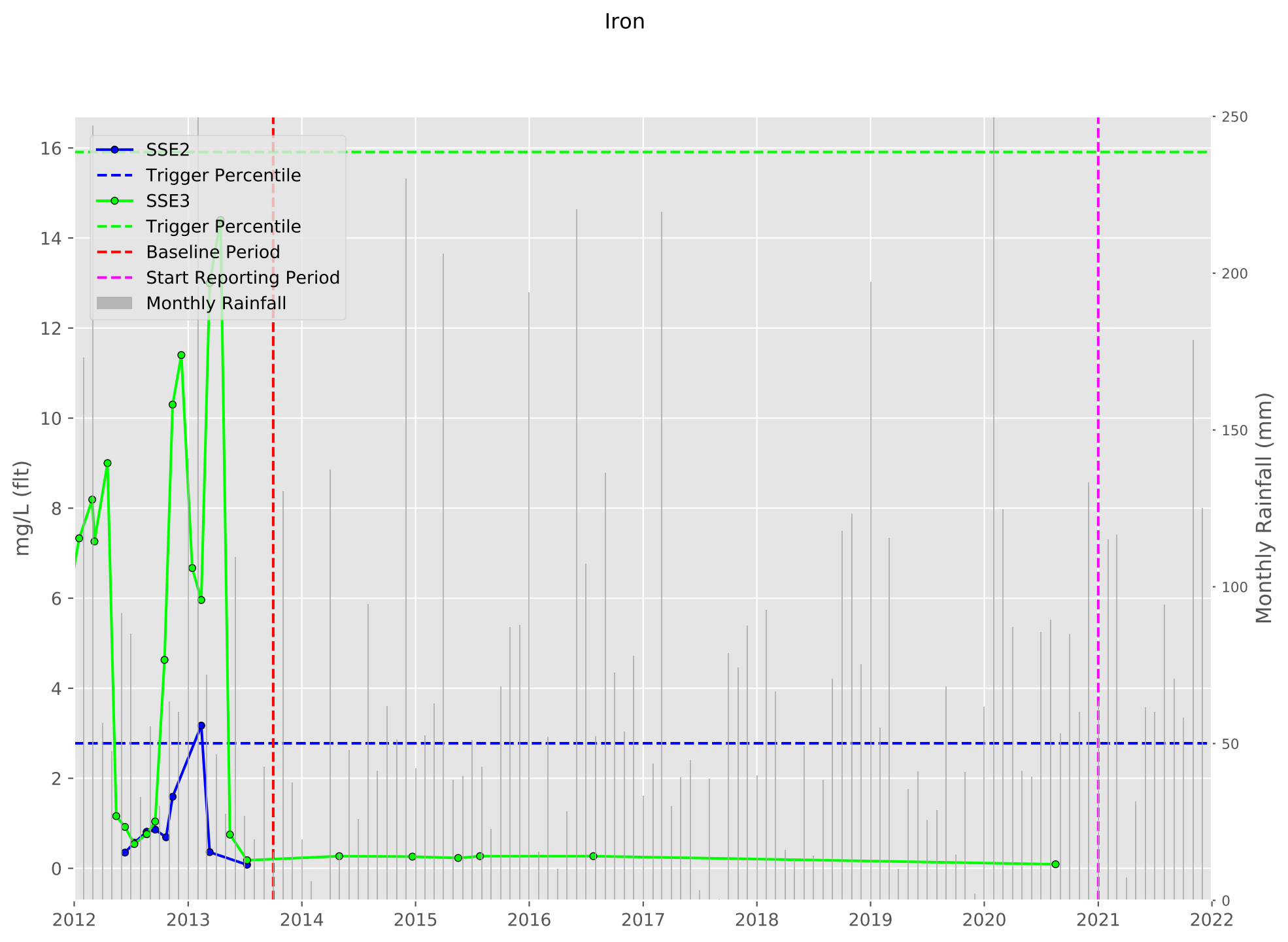

Iron
SS1
Trigger Percentile
SS3
Trigger Percentile
SS4
Trigger Percentile
SS5
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
2
4
6
8
10
12
14
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

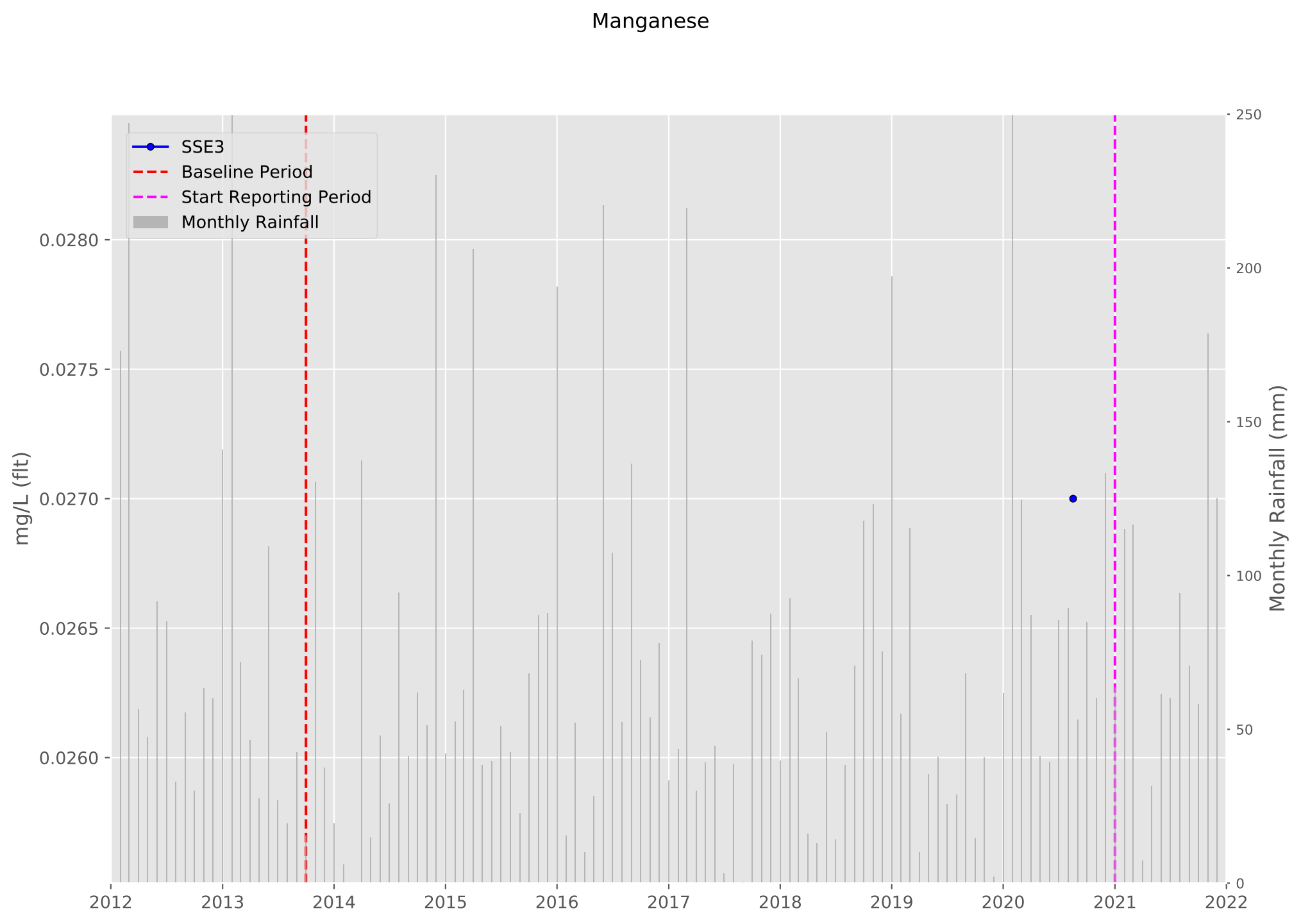

Manganese
SS1
SS3
SS4
SS5
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


pH
SS1
Trigger Percentile
SS3
Trigger Percentile
SS4
Trigger Percentile
SS5
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
9
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

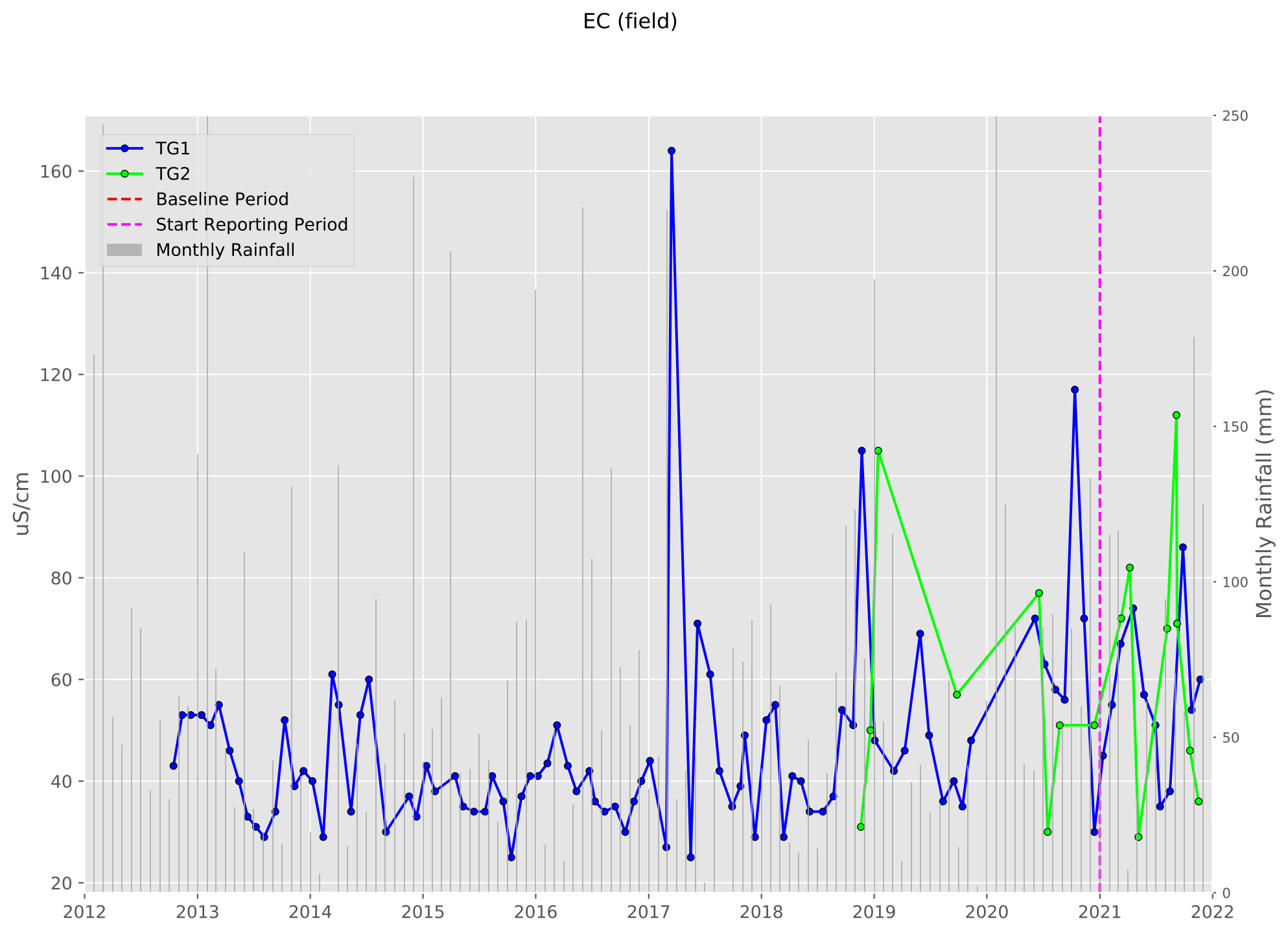

TSS
SS1
SS3
SS4
SS5
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0.070
0.065
0.060
0.055
0.050
0.045
0.040
0.035
0.030
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

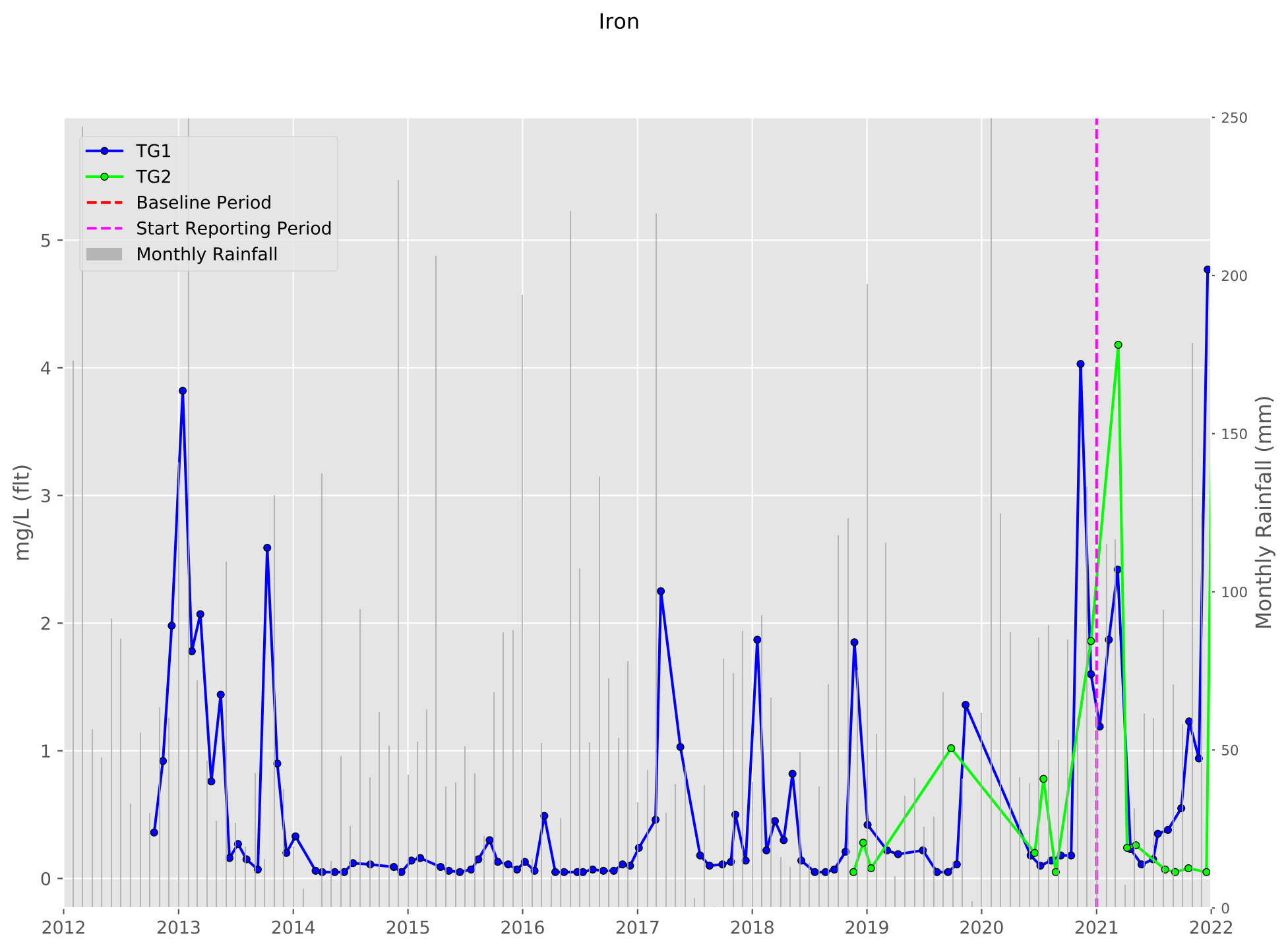

EC (field)
SSE1
Trigger Percentile
SSE2
Trigger Percentile
SSE3
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
100
80
60
40
20
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

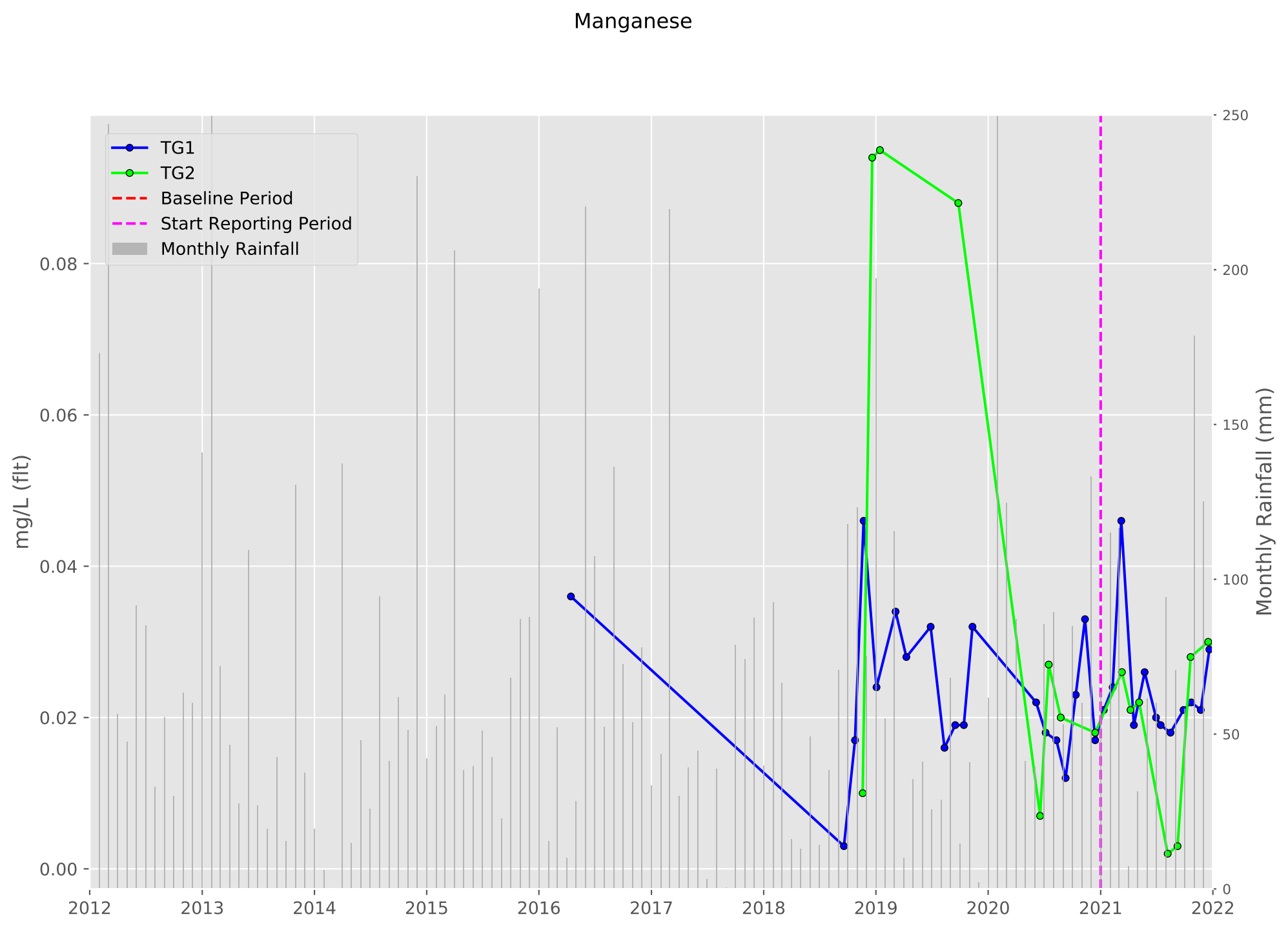

Iron
SSE2
Trigger Percentile
SSE3
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
2
4
6
8
10
12
14
16
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

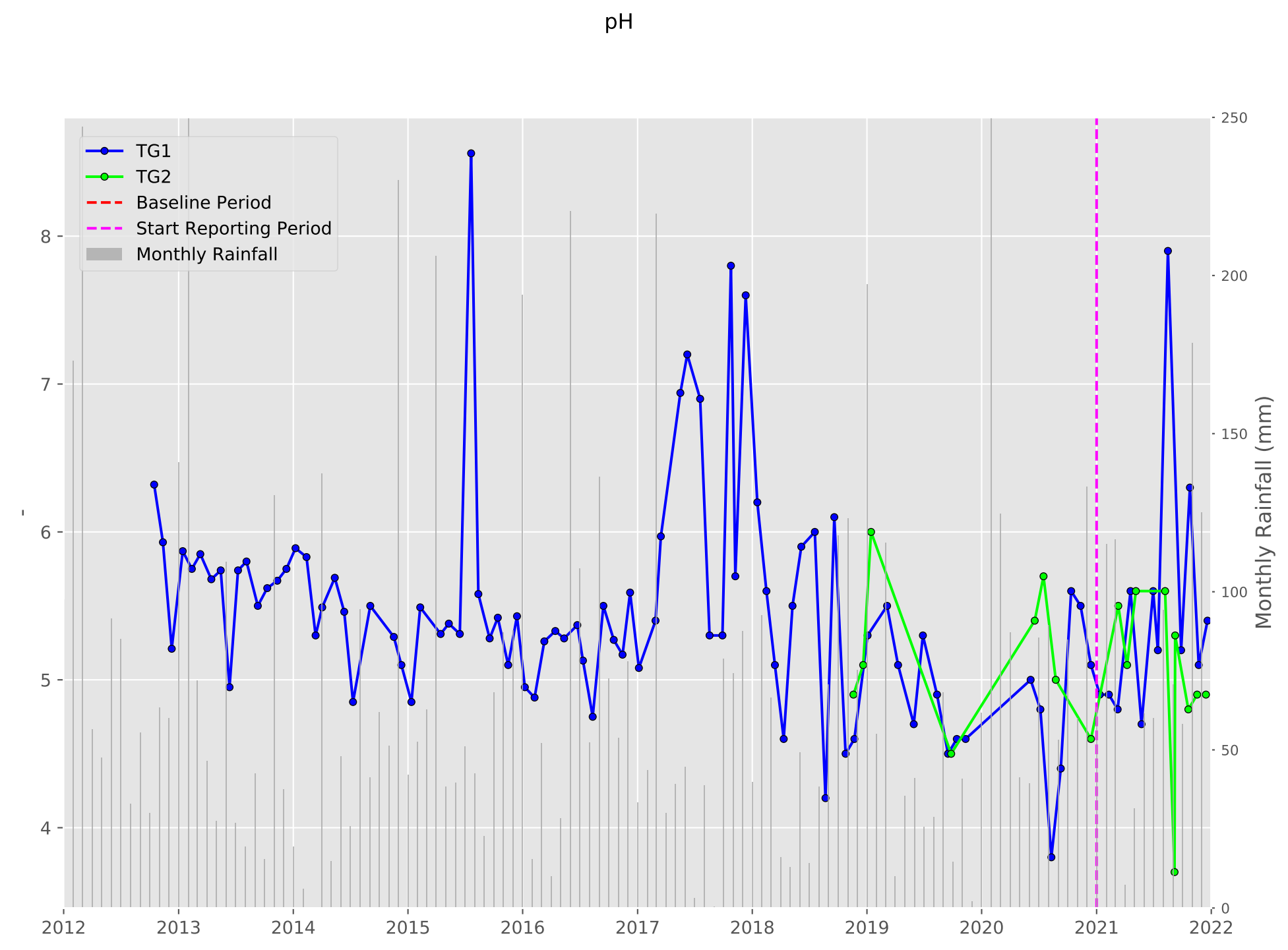

Manganese
SSE3
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0280
0.0275
0.0270
0.0265
0.0260
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

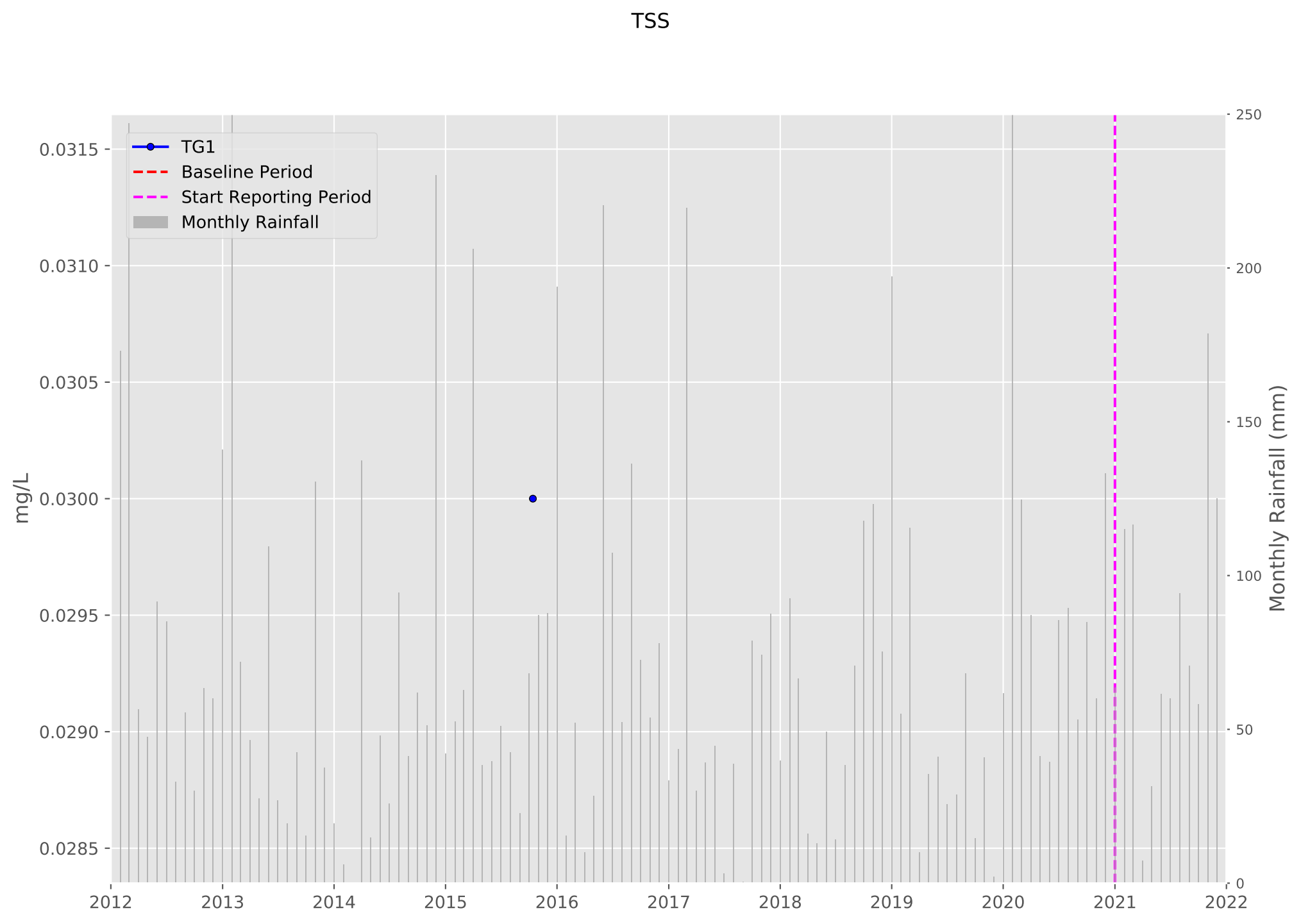

pH
SSE1
Trigger Percentile
SSE2
Trigger Percentile
SSE3
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
7.5
7.0
6.5
6.0
5.5
5.0
-
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

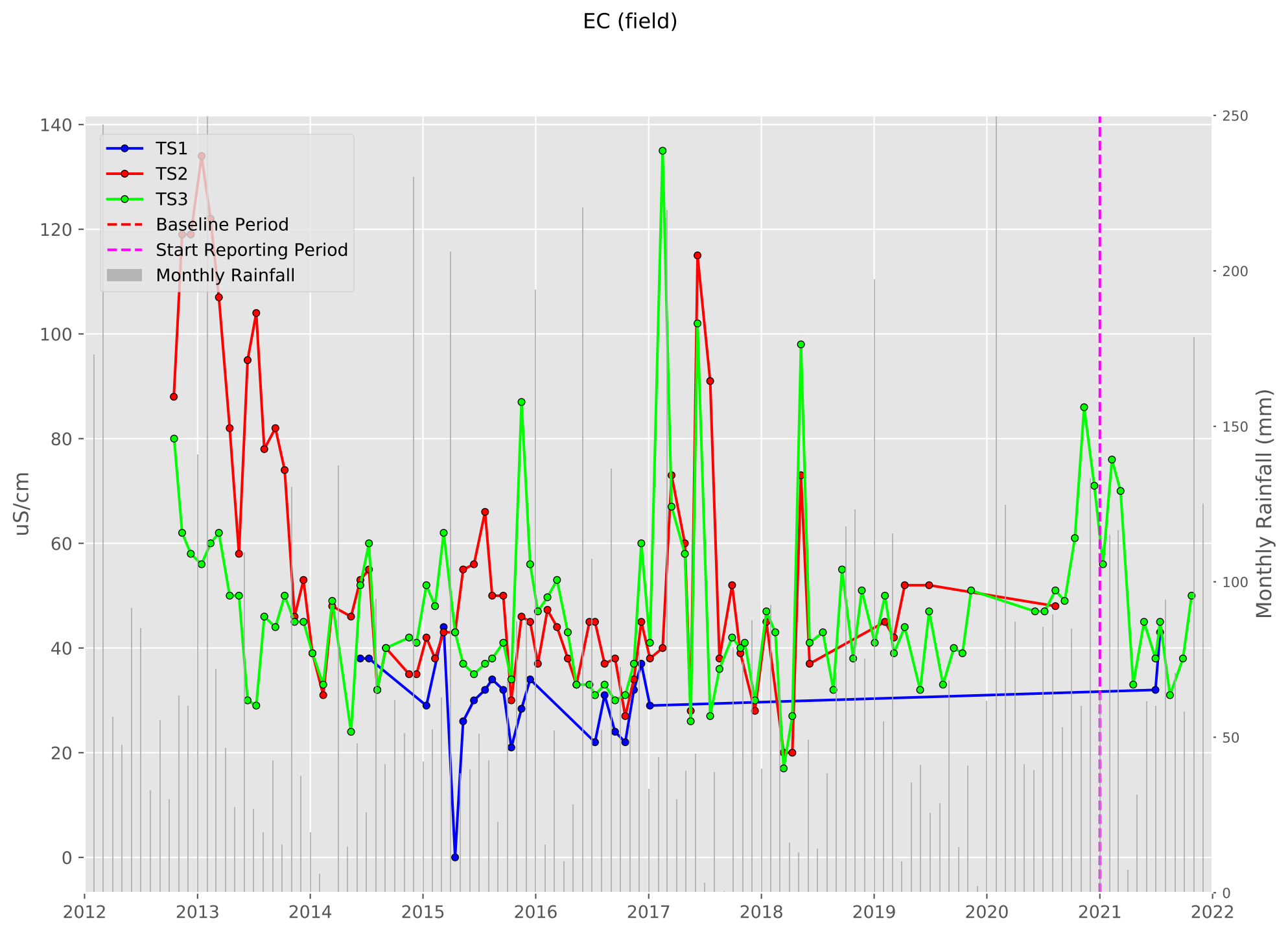

EC (field)
TG1
TG2
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
20
40
60
80
100
120
140
160
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

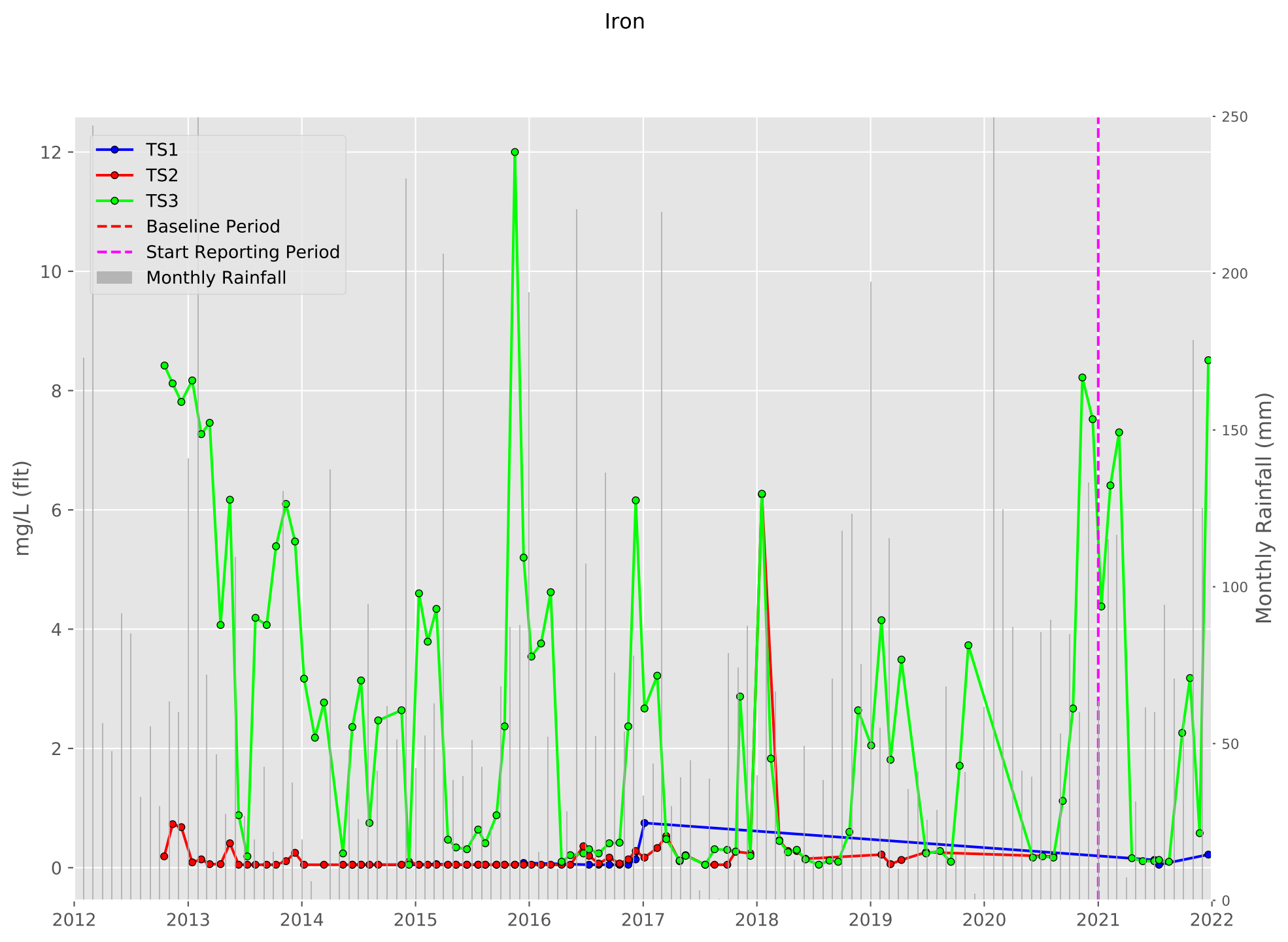

Iron
TG1
TG2
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
1
2
3
4
5
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

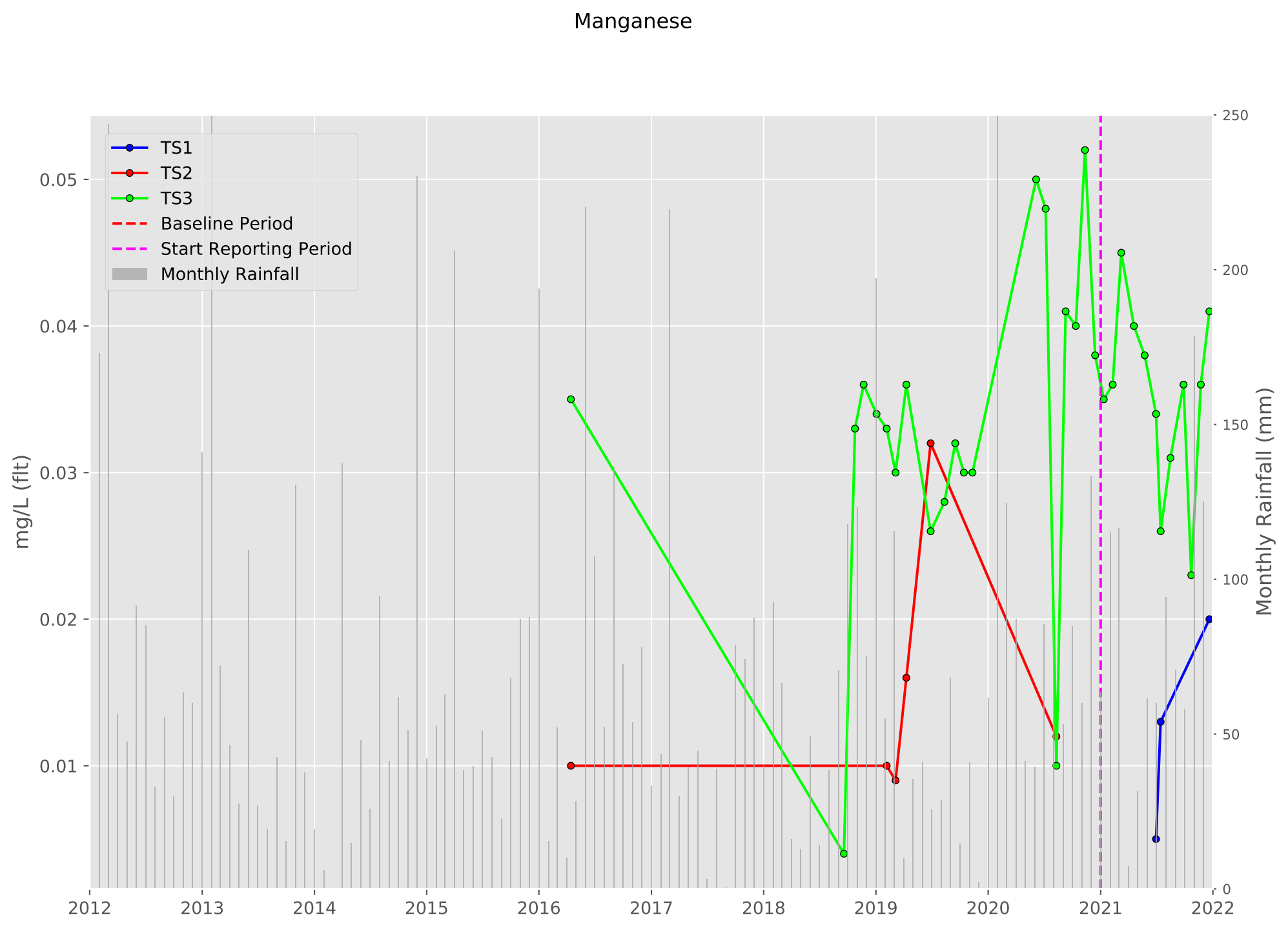

Manganese
TG1
TG2
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.02
0.04
0.06
0.08
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

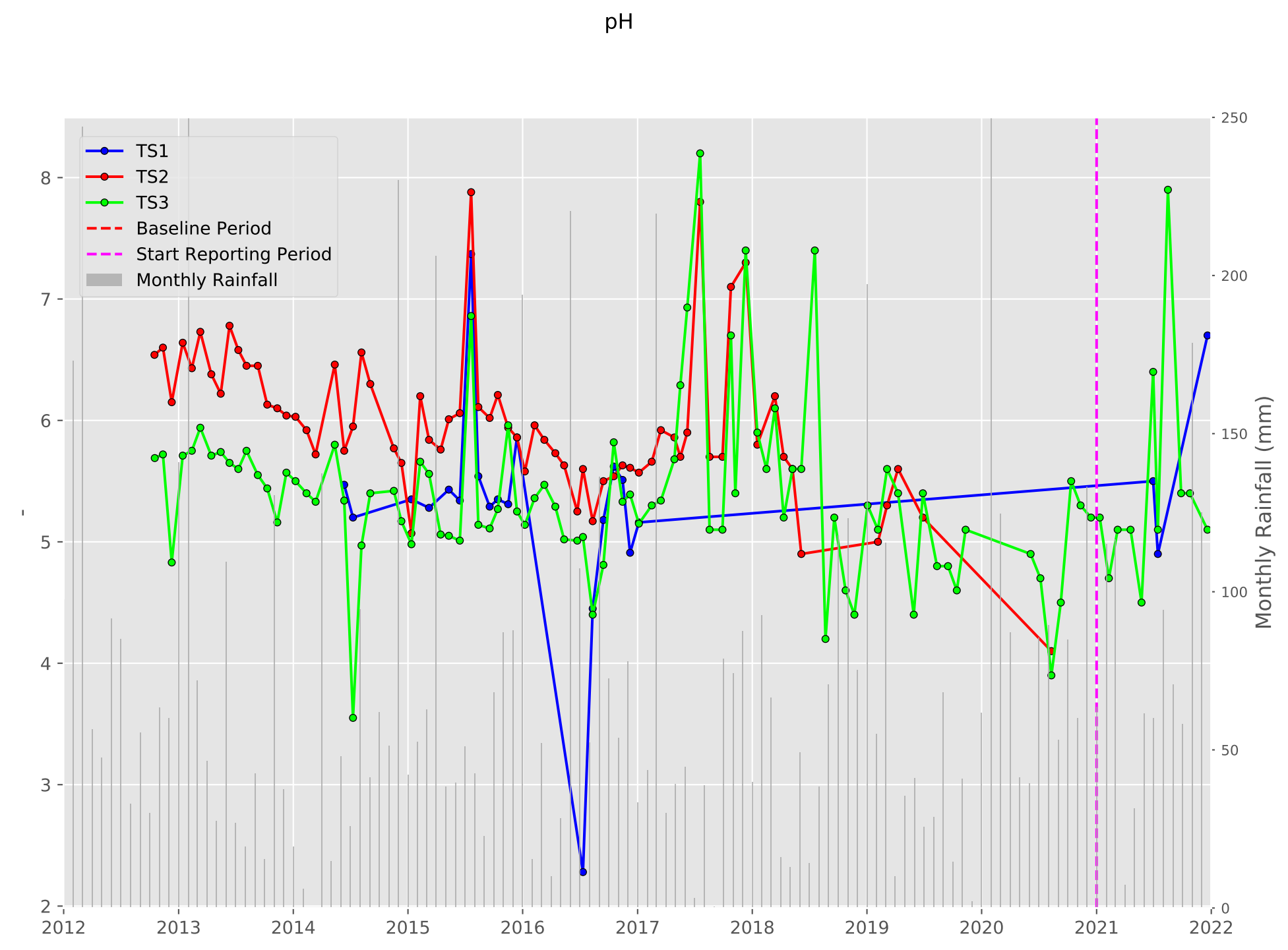

pH
TG1
TG2
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8
7
6
5
4
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

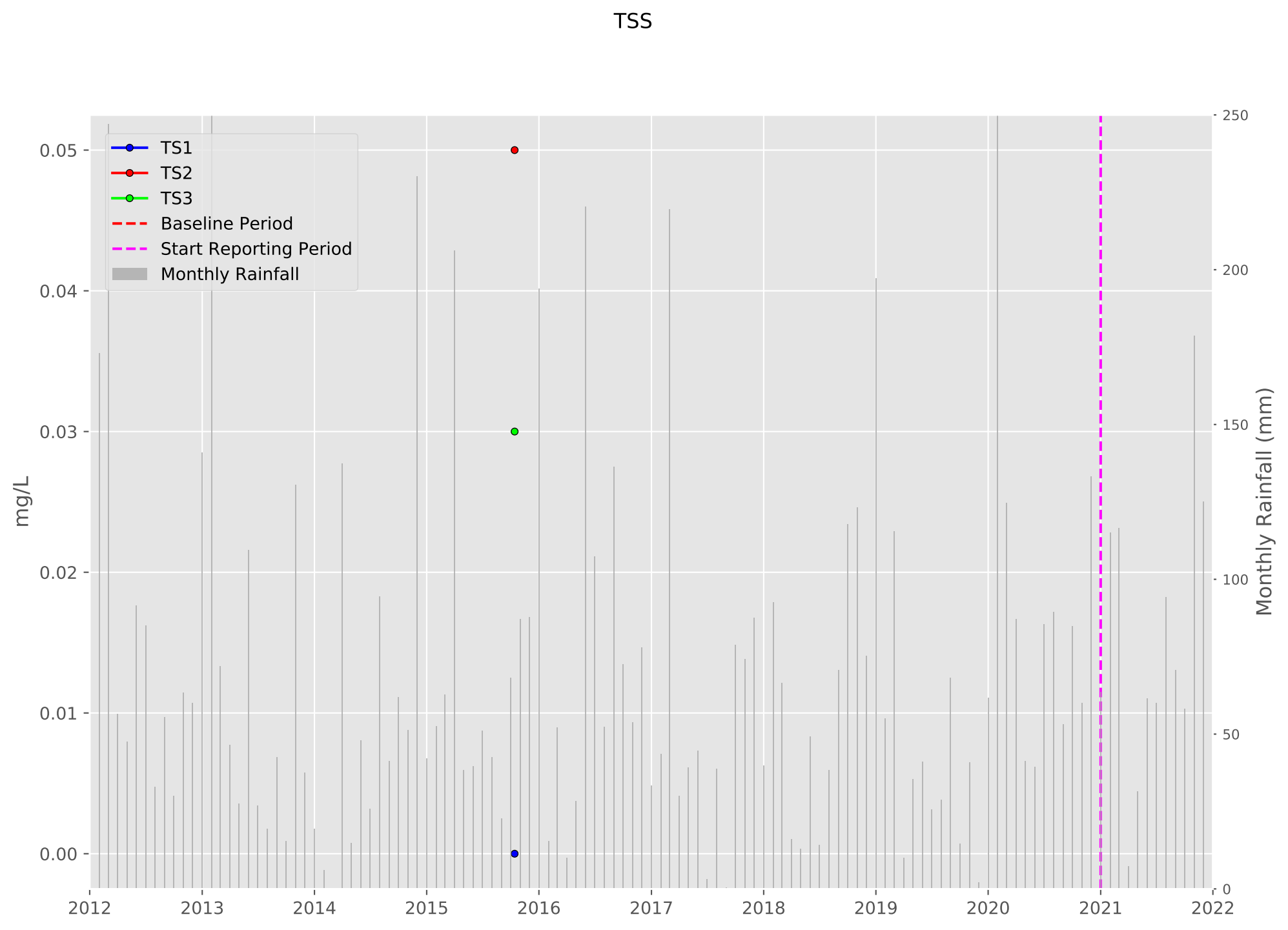

TSS
TG1
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0.0315
0.0310
0.0305
0.0300
0.0295
0.0290
0.0285
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


EC (field)
TS1
TS2
TS3
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
20
40
60
80
100
120
140
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


Iron
TS1
TS2
TS3
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
2
4
6
8
10
12
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


Manganese
TS1
TS2
TS3
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.05
0.04
0.03
0.02
0.01
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


pH
TS1
TS2
TS3
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8
7
6
5
4
3
2
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


TSS
TS1
TS2
TS3
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0.05
0.04
0.03
0.02
0.01
0.00
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022



Appendix F

Groundwater quality statistics

Table F.1 Swamp piezometer groundwater quality statistics (SMP)

	Pre-mining statistics							Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Unit**	**count**	**20th %ile - 2×StDev**	**80th %ile + 2×StDev**	**Exceedance**	**Min**	**Median**	**Max**
CW1	22/02/11	30/09/13	pH	Units	32	3.22	6.76	FALSE	Dry	Dry	Dry
CW1	22/02/11	30/09/13	EC (field)	µS/cm	32	NA	46.54	FALSE	Dry	Dry	Dry
CW1	22/02/11	30/09/13	Iron	mg/L	33	NA	0.48	FALSE	Dry	Dry	Dry
CW2	22/02/11	30/09/13	pH	Units	32	3.69	6.77	FALSE	Dry	Dry	Dry
CW2	22/02/11	30/09/13	EC (field)	µS/cm	32	NA	33.30	FALSE	Dry	Dry	Dry
CW2	22/02/11	30/09/13	Iron	mg/L	33	NA	0.36	FALSE	Dry	Dry	Dry
GG1	16/10/12	28/04/17	pH	Units	54	4.05	6.54	FALSE	Dry	Dry	Dry
GG1	16/10/12	28/04/17	EC (field)	µS/cm	54	NA	85.06	FALSE	Dry	Dry	Dry
GG1	16/10/12	28/04/17	Iron	mg/L	53	NA	5.38	FALSE	Dry	Dry	Dry
GW1	13/11/12	28/09/16	pH	Units	26	4.67	7.68	FALSE	Dry	Dry	Dry
GW1	13/11/12	28/09/16	EC (field)	µS/cm	26	NA	100.65	FALSE	Dry	Dry	Dry
GW1	13/11/12	25/07/16	Iron	mg/L	24	NA	1.26	FALSE	Dry	Dry	Dry
GW2	16/10/12	29/03/17	pH	Units	45	4.13	7.43	FALSE	Dry	Dry	Dry
GW2	16/10/12	29/03/17	EC (field)	µS/cm	45	NA	77.14	FALSE	Dry	Dry	Dry
GW2	16/10/12	29/03/17	Iron	mg/L	43	NA	10.00	FALSE	Dry	Dry	Dry
MS1	12/06/12	15/12/21	pH	Units	106	3.80	7.37	**TRUE**	3.3	5.25	7.1
MS1	12/06/12	17/11/21	EC (field)	µS/cm	105	NA	358.67	FALSE	26	41	211
MS1	12/06/12	15/12/21	Iron	mg/L	106	NA	13.13	FALSE	0.07	0.405	2.8

Table F.1 Swamp piezometer groundwater quality statistics (SMP)

	Pre-mining statistics							Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Unit**	**count**	**20th %ile - 2×StDev**	**80th %ile + 2×StDev**	**Exceedance**	**Min**	**Median**	**Max**
MS2	19/11/18	15/12/21	pH	Units	22	3.28	7.40	FALSE	4	5.6	6.6
MS2	19/11/18	17/11/21	EC (field)	µS/cm	22	NA	357.60	FALSE	27	57	78
MS2	19/11/18	13/01/22	Iron	mg/L	21	NA	3.30	**TRUE**	0.05	0.55	5.41
BS1	16/10/12	21/01/19	pH	Units	75	3.97	7.02	FALSE	4.4	5.5	6
BS1	16/10/12	21/01/19	EC (field)	µS/cm	75	NA	117.52	FALSE	26	47	112
BS1	16/10/12	21/01/19	Iron	mg/L	74	NA	5.54	FALSE	0.05	0.05	0.84
NMSS	18/02/18	14/01/19	pH	Units	4	4.81	6.89	FALSE	4.2	4.8	6
NMSS	18/02/18	14/01/19	EC (field)	µS/cm	4	NA	109.34	FALSE	25	35	64
NMSS	18/02/18	14/01/19	Iron	mg/L	4	NA	7.86	FALSE	0.05	0.12	2.29
PC1	18/02/18	18/02/18	pH	Units	1			FALSE	4.6	5.6	6.5
PC1	18/02/18	18/02/18	EC (field)	µS/cm	1			FALSE	34	48	66
PC1	18/02/18	18/02/18	Iron	mg/L	1			FALSE	0.05	0.06	0.24
PC2	18/02/18	18/02/18	pH	Units	1			FALSE	4.6	4.9	5.2
PC2	18/02/18	18/02/18	EC (field)	µS/cm	1			FALSE	31	34	43
PC2	18/02/18	18/02/18	Iron	mg/L	1			FALSE	0.05	0.07	0.19
BS2	15/10/12	4/04/19	pH	Units	77	4.25	6.89	FALSE	Dry	Dry	Dry
BS2	15/10/12	4/04/19	EC (field)	µS/cm	77	NA	187.68	FALSE	Dry	Dry	Dry
BS2	15/10/12	4/04/19	Iron	mg/L	77	NA	3.91	FALSE	Dry	Dry	Dry

Table F.1 Swamp piezometer groundwater quality statistics (SMP)

	Pre-mining statistics							Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Unit**	**count**	**20th %ile - 2×StDev**	**80th %ile + 2×StDev**	**Exceedance**	**Min**	**Median**	**Max**
BS3	15/10/12	9/10/19	pH	Units	83	3.55	6.69	FALSE	4.4	4.95	5.6
BS3	15/10/12	9/10/19	EC (field)	µS/cm	83	NA	237.95	FALSE	30	42	155
BS3	15/10/12	9/10/19	Iron	mg/L	82	NA	4.89	FALSE	0.05	0.13	1.8
PSS	18/02/18	23/10/19	pH	Units	11	3.75	7.45	FALSE	4.7	5.15	5.8
PSS	18/02/18	23/10/19	EC (field)	µS/cm	11	NA	519.10	FALSE	28	41	84
PSS	18/02/18	23/10/19	Iron	mg/L	11	NA	7.85	FALSE	0.05	0.05	5.67
BA1	18/03/18	16/12/21	pH	Units	24	3.14	6.60	**TRUE**	4.5	4.8	7.8
BA1	18/03/18	18/11/21	EC (field)	µS/cm	23	NA	82.41	FALSE	30	42	75
BA1	18/03/18	16/12/21	Iron	mg/L	23	NA	0.52	FALSE	0.05	0.06	0.3
BA2	18/03/18	16/12/21	pH	Units	28	4.21	6.95	**TRUE**	5	5.25	7.2
BA2	18/03/18	18/11/21	EC (field)	µS/cm	27	NA	659.30	FALSE	65	83	138
BA2	18/03/18	16/12/21	Iron	mg/L	27	NA	5.58	FALSE	0.05	0.18	1.82
BA3	18/03/18	16/12/21	pH	Units	21	4.18	7.22	**TRUE**	5.3	5.6	7.9
BA3	18/03/18	18/11/21	EC (field)	µS/cm	21	NA	732.92	FALSE	39	93.5	141
BA3	18/03/18	16/12/21	Iron	mg/L	20	NA	1.11	**TRUE**	0.05	0.195	1.19
BE1	18/03/18	16/12/21	pH	Units	27	2.44	7.28	**TRUE**	3.9	4.4	8.4
BE1	18/03/18	18/11/21	EC (field)	µS/cm	27	NA	88.92	FALSE	40	48	54
BE1	18/03/18	16/12/21	Iron	mg/L	26	NA	0.72	FALSE	0.05	0.06	0.4

Table F.1 Swamp piezometer groundwater quality statistics (SMP)

	Pre-mining statistics							Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Unit**	**count**	**20th %ile - 2×StDev**	**80th %ile + 2×StDev**	**Exceedance**	**Min**	**Median**	**Max**
BE2	18/03/18	16/12/21	pH	Units	26	2.46	6.74	**TRUE**	3.7	4.4	7.7
BE2	18/03/18	18/11/21	EC (field)	µS/cm	25	NA	85.68	FALSE	38	44	64
BE2	18/03/18	16/12/21	Iron	mg/L	25	NA	0.69	**TRUE**	0.05	0.05	1.52
CC1	12/06/12	15/12/21	pH	Units	79	4.83	7.60	FALSE	3.7	4.9	6.9
CC1	12/06/12	17/11/21	EC (field)	µS/cm	78	NA	227.91	FALSE	25	35	96
CC1	12/06/12	15/12/21	Iron	mg/L	75	NA	24.88	FALSE	0.05	0.1	0.51
CC2	8/07/19	15/12/21	pH	Units	7	3.53	5.87	FALSE	4.4	4.8	5
CC2	8/07/19	17/11/21	EC (field)	µS/cm	6	NA	97.88	FALSE	31	43.5	54
CC2	8/07/19	15/12/21	Iron	mg/L	5	NA	0.51	FALSE	0.05	0.215	0.39
FT1	18/03/18	16/12/21	pH	Units	23	3.34	6.56	**TRUE**	4	5.1	6.7
FT1	18/03/18	18/11/21	EC (field)	µS/cm	22	NA	81.85	FALSE	46	53	74
FT1	18/03/18	16/12/21	Iron	mg/L	22	NA	0.84	FALSE	0.05	0.23	0.74
FT2	29/05/19	16/12/21	pH	Units	7	3.77	6.13	FALSE	4.9	5.1	5.6
FT2	29/05/19	18/11/21	EC (field)	µS/cm	6	NA	69.22	FALSE	35	37.5	40
FT2	29/05/19	16/12/21	Iron	mg/L	7	NA	1.23	FALSE	0.45	0.47	1.19
TS1	12/06/14	20/12/21	pH	Units	22	3.36	7.34	FALSE	4.9	5.5	6.7
TS1	12/06/14	15/07/21	EC (field)	µS/cm	22	NA	54.69	FALSE	32	37.5	43
TS1	12/06/14	20/12/21	Iron	mg/L	22	NA	0.38	FALSE	0.05	0.13	0.22

Table F.1 Swamp piezometer groundwater quality statistics (SMP)

	Pre-mining statistics							Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Unit**	**count**	**20th %ile - 2×StDev**	**80th %ile + 2×StDev**	**Exceedance**	**Min**	**Median**	**Max**
TS2	16/10/12	10/08/20	pH	Units	70	4.38	7.65	FALSE	Not sampled		
TS2	16/10/12	10/08/20	EC (field)	µS/cm	70	NA	126.02	FALSE	Not sampled		
TS2	16/10/12	10/08/20	Iron	mg/L	68	NA	1.76	FALSE	Not sampled		
TS3	17/10/12	20/12/21	pH	Units	100	3.57	7.15	**TRUE**	4.5	5.1	7.9
TS3	17/10/12	25/10/21	EC (field)	µS/cm	99	NA	91.16	FALSE	31	45	76
TS3	17/10/12	20/12/21	Iron	mg/L	99	NA	10.11	FALSE	0.1	1.42	8.51
TG1	15/10/12	20/12/21	pH	Units	98	3.41	7.29	**TRUE**	4.7	5.2	7.9
TG1	15/10/12	22/11/21	EC (field)	µS/cm	97	NA	94.08	FALSE	35	55	86
TG1	15/10/12	20/12/21	Iron	mg/L	95	NA	2.75	**TRUE**	0.11	0.745	4.77
TG2	19/11/18	15/12/21	pH	Units	17	3.73	6.67	FALSE	3.7	5.1	5.6
TG2	19/11/18	17/11/21	EC (field)	µS/cm	16	NA	127.61	FALSE	29	70.5	112
TG2	19/11/18	16/12/21	Iron	mg/L	15	NA	3.04	**TRUE**	0.05	0.16	5.68
SSE1	11/03/13	11/03/13	pH	Units	1	No pre-mining data		FALSE	Decommissioned		
SSE1	11/03/13	11/03/13	EC (field)	µS/cm	1			FALSE	Decommissioned		
SSE1	11/03/13	11/03/13	Iron	mg/L	1			FALSE	Decommissioned		
SSE2	12/06/12	6/08/13	pH	Units	13	4.80	6.03	FALSE	Dry		
SSE2	12/06/12	6/08/13	EC (field)	µS/cm	13	NA	64.91	FALSE	Dry		
SSE2	12/06/12	9/07/13	Iron	mg/L	10	NA	2.78	FALSE	Dry		

Table F.1 Swamp piezometer groundwater quality statistics (SMP)

	Pre-mining statistics							Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Unit**	**count**	**20th %ile - 2×StDev**	**80th %ile + 2×StDev**	**Exceedance**	**Min**	**Median**	**Max**
SSE3	22/02/11	9/07/13	pH	Units	30	4.72	6.70	FALSE	Dry		
SSE3	22/02/11	9/07/13	EC (field)	µS/cm	30	NA	94.05	FALSE	Dry		
SSE3	22/02/11	9/07/13	Iron	mg/L	30	NA	15.91	FALSE	Dry		
SS1	22/02/11	20/12/21	pH	Units	111	4.11	7.38	**TRUE**	4.4	5.45	7.6
SS1	22/02/11	22/11/21	EC (field)	µS/cm	110	NA	294.23	FALSE	67	80	141
SS1	22/02/11	20/12/21	Iron	mg/L	110	NA	2.37	FALSE	0.09	0.19	0.83
SS3	22/02/11	20/12/21	pH	Units	104	4.23	7.73	FALSE	4.5	5.8	7.3
SS3	22/02/11	22/11/21	EC (field)	µS/cm	103	NA	123.50	FALSE	47	58	106
SS3	22/02/11	20/12/21	Iron	mg/L	104	NA	1.34	FALSE	0.06	0.13	0.55
SS4	22/02/11	20/12/21	pH	Units	112	3.75	7.16	**TRUE**	4.1	5.2	7.7
SS4	22/02/11	22/11/21	EC (field)	µS/cm	111	NA	123.74	FALSE	30	38	61
SS4	22/02/11	20/12/21	Iron	mg/L	111	NA	13.82	FALSE	0.05	0.3	2.34
SS5	22/02/11	20/12/21	pH	Units	121	3.36	6.99	**TRUE**	4.2	5.1	7.7
SS5	22/02/11	22/11/21	EC (field)	µS/cm	120	NA	79.86	FALSE	28	38	59
SS5	22/02/11	20/12/21	Iron	mg/L	119	NA	4.81	FALSE	0.05	0.45	2.33

Table F.2 Standpipe piezometer groundwater quality statistics (SMP)

	Pre-mining statistics						Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Units**	**count**	**SMP Trigger**	**Exceedance**	**Min**	**Median**	**Max**
AP9PR	17/03/16	9/12/21	pH	units	30	2.73 - 7.87	FALSE	5.1	5.3	5.38
AP9PR	17/03/16	9/09/21	EC (field)	µS/cm	29	100	FALSE	28	33	34
AP9PR	17/03/16	10/12/21	Iron	mg/L	30	1	FALSE	0.05	0.05	0.05
AP8PR	17/03/16	8/12/21	pH	units	29	2.73 - 7.87	FALSE	4.5	4.545	4.6
AP8PR	17/03/16	9/09/21	EC (field)	µS/cm	28	100	FALSE	42	46	50
AP8PR	17/03/16	10/12/21	Iron	mg/L	29	1	FALSE	0.05	0.05	0.05
AP5PR	17/03/16	9/12/21	pH	units	31	2.73 - 7.87	FALSE	4.7	4.8	5.15
AP5PR	17/03/16	9/09/21	EC (field)	µS/cm	30	100	FALSE	23	25	29
AP5PR	17/03/16	10/12/21	Iron	mg/L	31	1	FALSE	0.05	0.05	0.05
AP4PR	17/03/16	9/12/21	pH	units	30	2.73 - 7.87	FALSE	4.7	5.08	5.3
AP4PR	17/03/16	9/09/21	EC (field)	µS/cm	29	100	FALSE	34	41	50
AP4PR	17/03/16	10/12/21	Iron	mg/L	30	1	FALSE	0.05	0.05	0.05
AP1204	17/03/16	9/12/21	pH	units	29	2.73 - 7.87	FALSE	4.5	4.9	5.13
AP1204	17/03/16	9/09/21	EC (field)	µS/cm	28	100	FALSE	40	45	46
AP1204	17/03/16	10/12/21	Iron	mg/L	30	1	FALSE	0.05	0.05	0.05
AP1105	4/12/18	8/12/21	pH	units	6	2.73 - 7.87	FALSE	4.5	4.6	4.7
AP1105	4/12/18	10/09/21	EC (field)	µS/cm	5	100	FALSE	33	36	39
AP1105	4/12/18	10/12/21	Iron	mg/L	5	1	FALSE	0.05	0.05	0.05

Table F.2 Standpipe piezometer groundwater quality statistics (SMP)

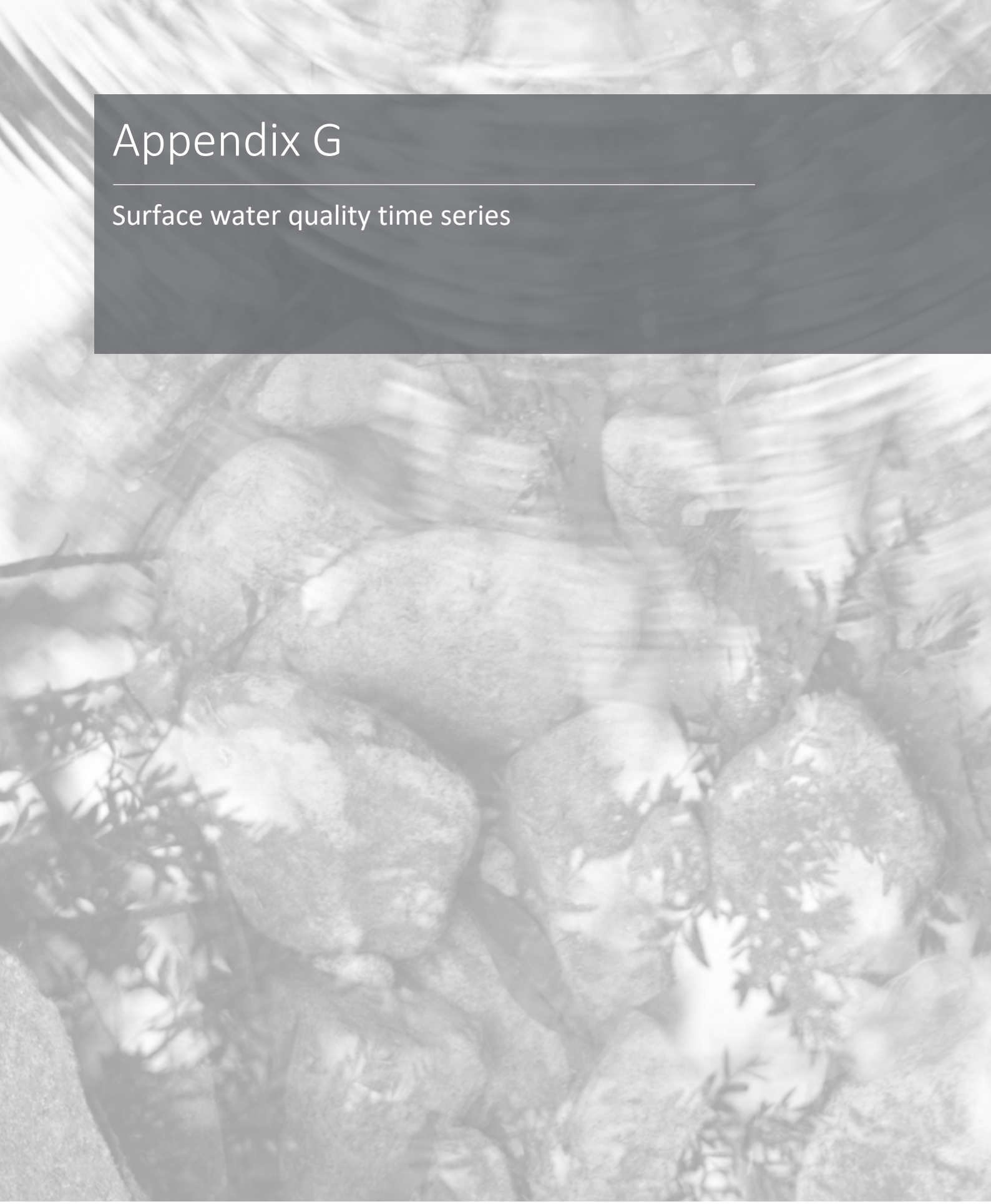
	Pre-mining statistics						Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Units**	**count**	**SMP Trigger**	**Exceedance**	**Min**	**Median**	**Max**
RSS	17/03/16	9/12/21	pH	units	31	2.73 - 7.87	FALSE	4.6	4.9	5.4
RSS	17/03/16	8/09/21	EC (field)	µS/cm	30	100	FALSE	49	66	77
RSS	17/03/16	2/06/21	Iron	mg/L	30	1	FALSE	0.05	0.05	0.05
SPR1104	17/03/16	2/06/16	pH	units	3	2.73 - 7.87	FALSE	Dry		
SPR1104	17/03/16	2/06/16	EC (field)	µS/cm	3	100	FALSE	Dry		
SPR1104	17/03/16	2/06/16	Iron	mg/L	3	1	FALSE	Dry		
SPR1106	18/03/16	8/12/21	pH	units	31	2.73 - 7.87	FALSE	4.79	4.9	5.2
SPR1106	18/03/16	7/09/21	EC (field)	µS/cm	30	100	FALSE	23	25	29
SPR1106	18/03/16	10/12/21	Iron	mg/L	31	1	FALSE	0.05	0.05	0.05
SPR1108	17/03/16	21/02/17	pH	units	9	2.73 - 7.87	FALSE	4.4	4.56	4.7
SPR1108	17/03/16	21/02/17	EC (field)	µS/cm	9	100	FALSE	25	27	28
SPR1108	17/03/16	21/02/17	Iron	mg/L	10	1	FALSE	0.05	0.05	0.05
SPR1112	17/03/16	7/12/21	pH	units	31	2.73 - 7.87	FALSE	4.71	4.95	5.2
SPR1112	17/03/16	7/09/21	EC (field)	µS/cm	30	100	FALSE	28	28	30
SPR1112	17/03/16	10/12/21	Iron	mg/L	31	1	FALSE	0.05	0.05	0.1
SPR1210	5/03/19	28/05/19	pH	units	2	2.73 - 7.87	FALSE	Water level too low to sample		
SPR1210	5/03/19	28/05/19	EC (field)	µS/cm	2	100	FALSE	Water level too low to sample		
SPR1210	5/03/19	5/03/19	Iron	mg/L	1	1	FALSE	Water level too low to sample		

Table F.2 Standpipe piezometer groundwater quality statistics (SMP)

	Pre-mining statistics						Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Units**	**count**	**SMP Trigger**	**Exceedance**	**Min**	**Median**	**Max**
SPR1301	4/12/18	5/02/21	pH	units	7	2.73 - 7.87	**TRUE**	8.4	8.8	9.8
SPR1301	4/12/18	5/02/21	EC (field)	µS/cm	7	100	**TRUE**	87	118	182
SPR1301	4/12/18	5/02/21	Iron	mg/L	9	1	FALSE	0.05	0.05	0.05
SPR1107	17/03/16	30/08/16	pH	units	6	2.73 - 7.87	FALSE	Damaged by subsidence		
SPR1107	17/03/16	30/08/16	EC (field)	µS/cm	6	100	FALSE	Damaged by subsidence		
SPR1107	17/03/16	30/08/16	Iron	mg/L	6	1	FALSE	Damaged by subsidence		
SPR1109	18/03/16	30/11/16	pH	units	7	2.73 - 7.87	FALSE	Damaged by subsidence		
SPR1109	18/03/16	30/11/16	EC (field)	µS/cm	7	100	FALSE	Damaged by subsidence		
SPR1109	18/03/16	30/11/16	Iron	mg/L	9	1	FALSE	Damaged by subsidence		
SPR1111	17/03/16	7/03/17	pH	units	10	2.73 - 7.87	FALSE	4.78	5.2	5.6
SPR1111	17/03/16	7/03/17	EC (field)	µS/cm	10	100	FALSE	24	27	29
SPR1111	17/03/16	7/03/17	Iron	mg/L	12	1	FALSE	0.05	0.05	0.05
SPR1113	17/03/16	29/05/17	pH	units	13	2.73 - 7.87	FALSE	4.4	4.65	5.08
SPR1113	17/03/16	29/05/17	EC (field)	µS/cm	13	100	FALSE	23	28	30
SPR1113	17/03/16	29/05/17	Iron	mg/L	15	1	FALSE	0.05	0.05	0.05
SPR1211	4/12/18	12/09/19	pH	units	4	2.73 - 7.87	FALSE	Decommissioned		
SPR1211	4/12/18	12/09/19	EC (field)	µS/cm	4	100	FALSE	Decommissioned		
SPR1211	4/12/18	12/09/19	Iron	mg/L	3	1	FALSE	Decommissioned		

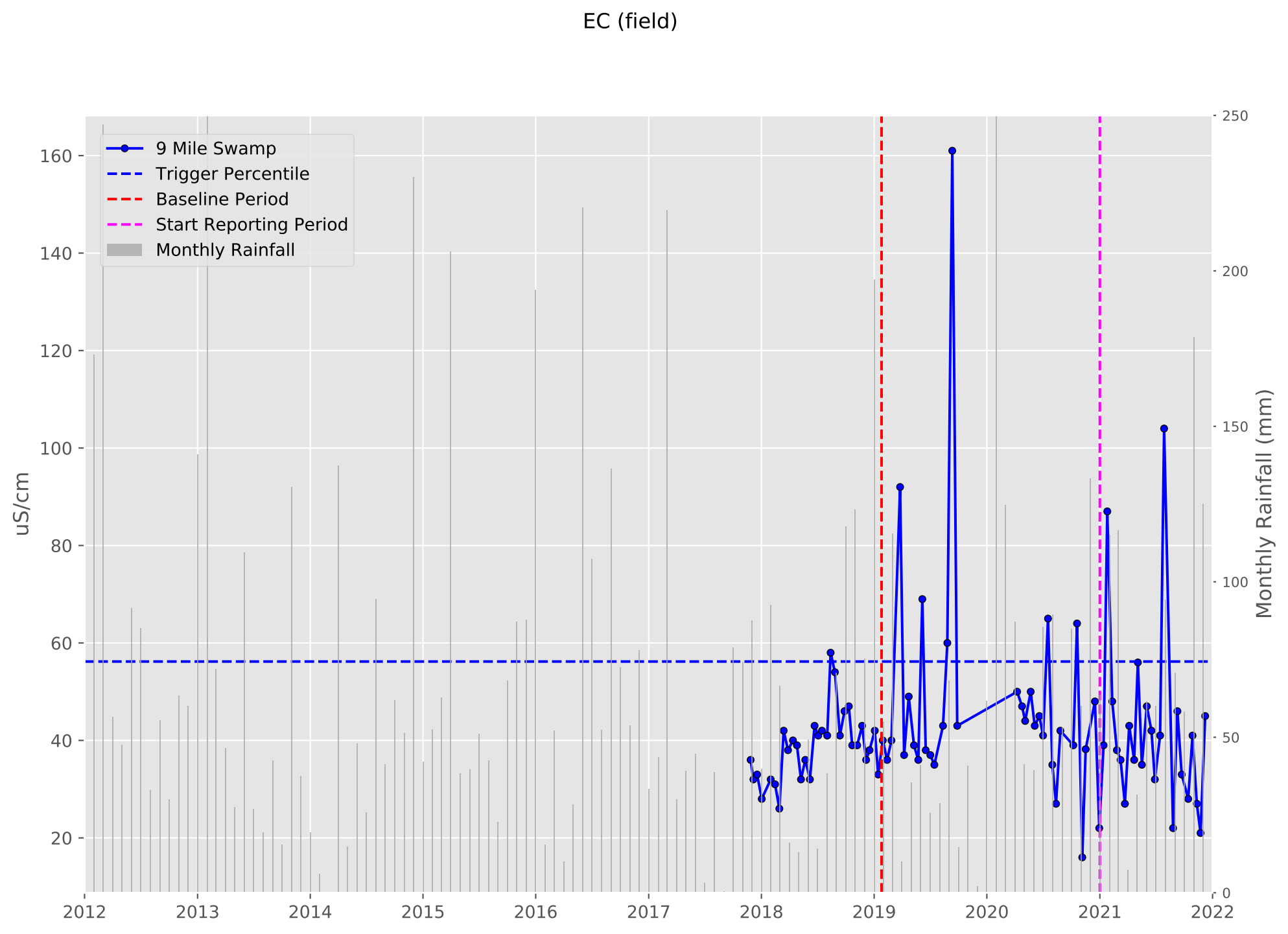
Table F.2 Standpipe piezometer groundwater quality statistics (SMP)

	Pre-mining statistics						Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Units**	**count**	**SMP Trigger**	**Exceedance**	**Min**	**Median**	**Max**
SPR1401	17/03/16	9/12/21	pH	units	31	2.73 - 7.87	FALSE	5	5.33	5.6
SPR1401	17/03/16	8/09/21	EC (field)	µS/cm	30	100	FALSE	26	27	48
SPR1401	17/03/16	2/06/21	Iron	mg/L	30	1	FALSE	0.05	0.05	0.05

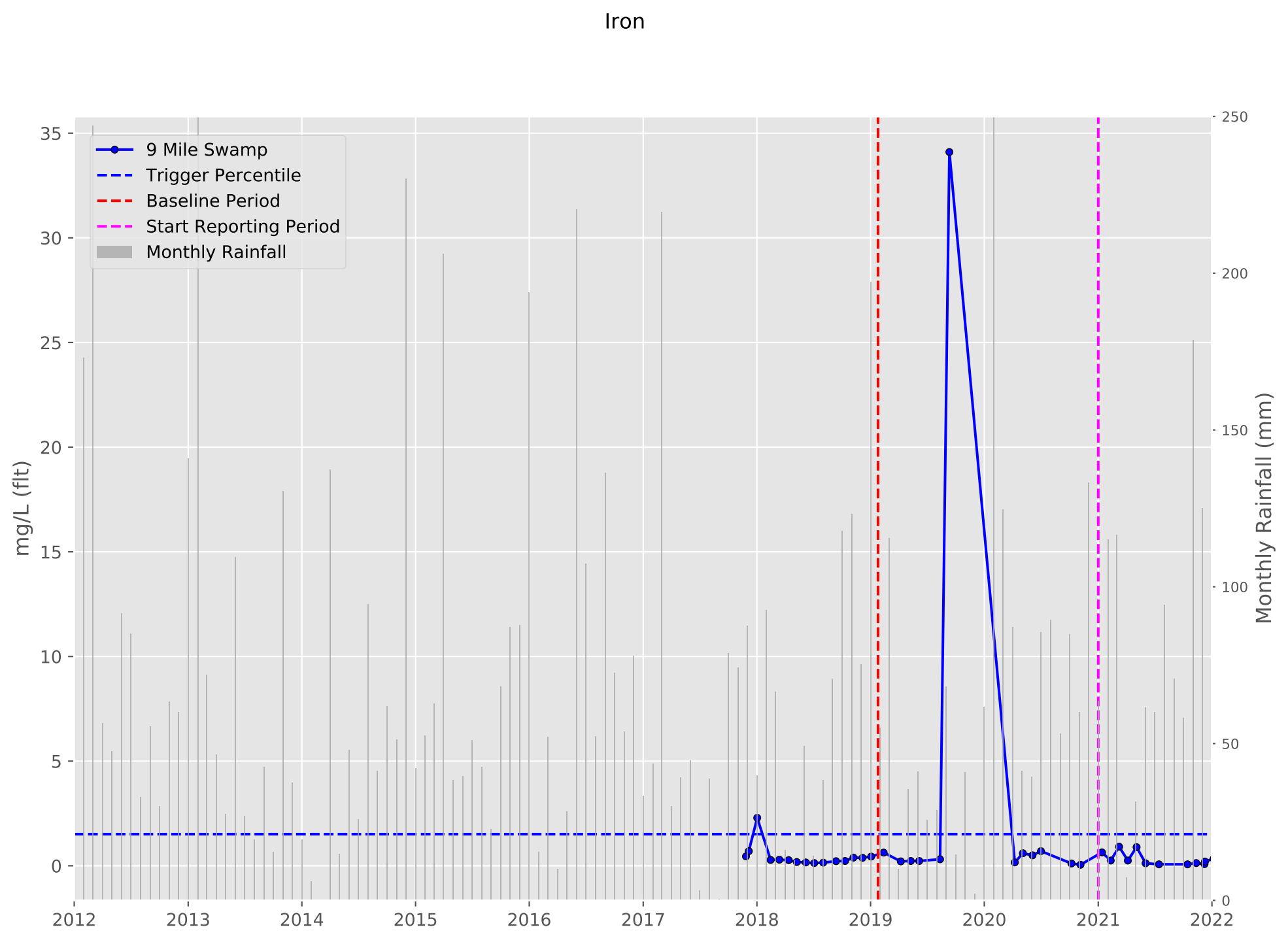


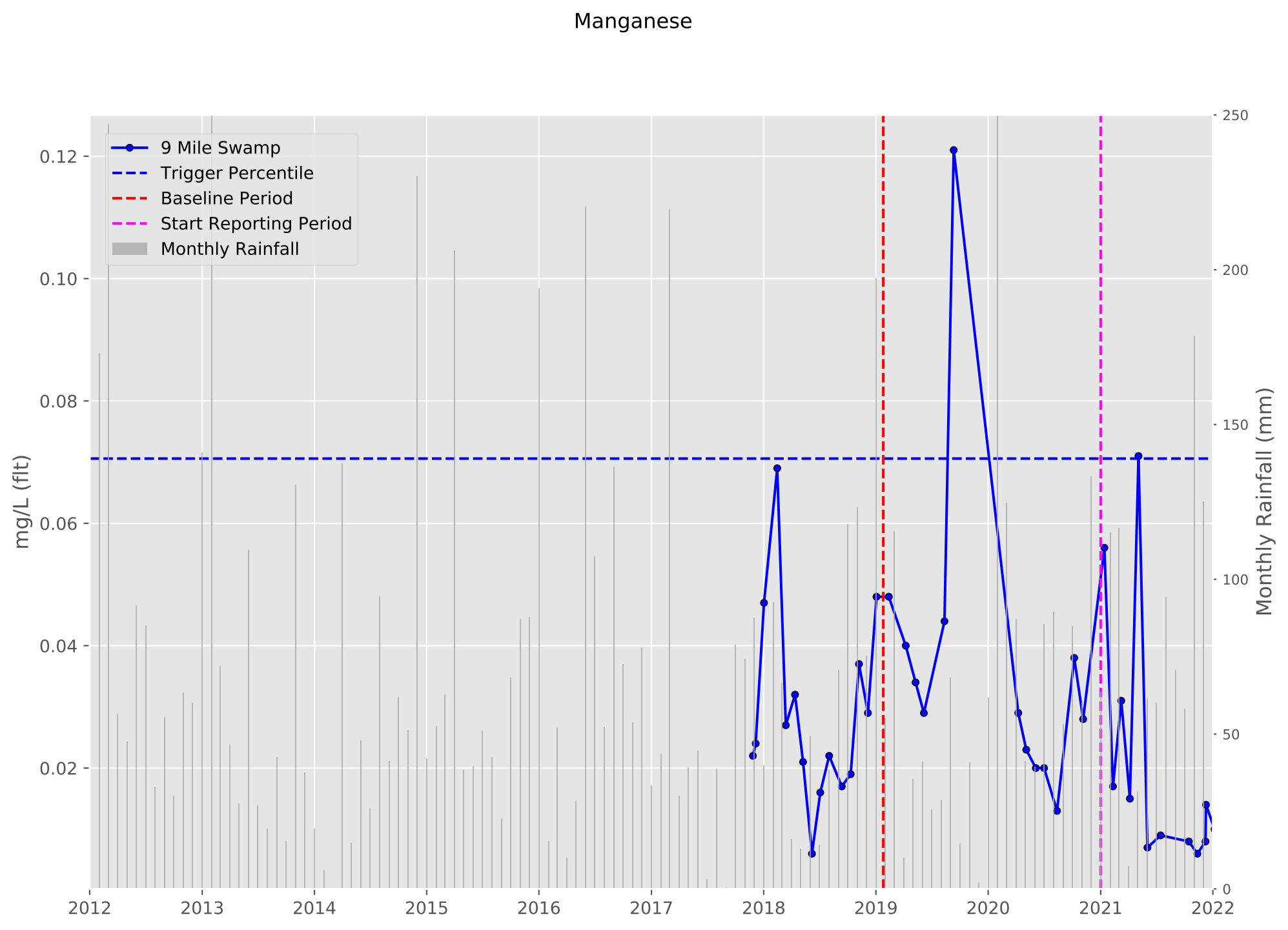
Appendix G

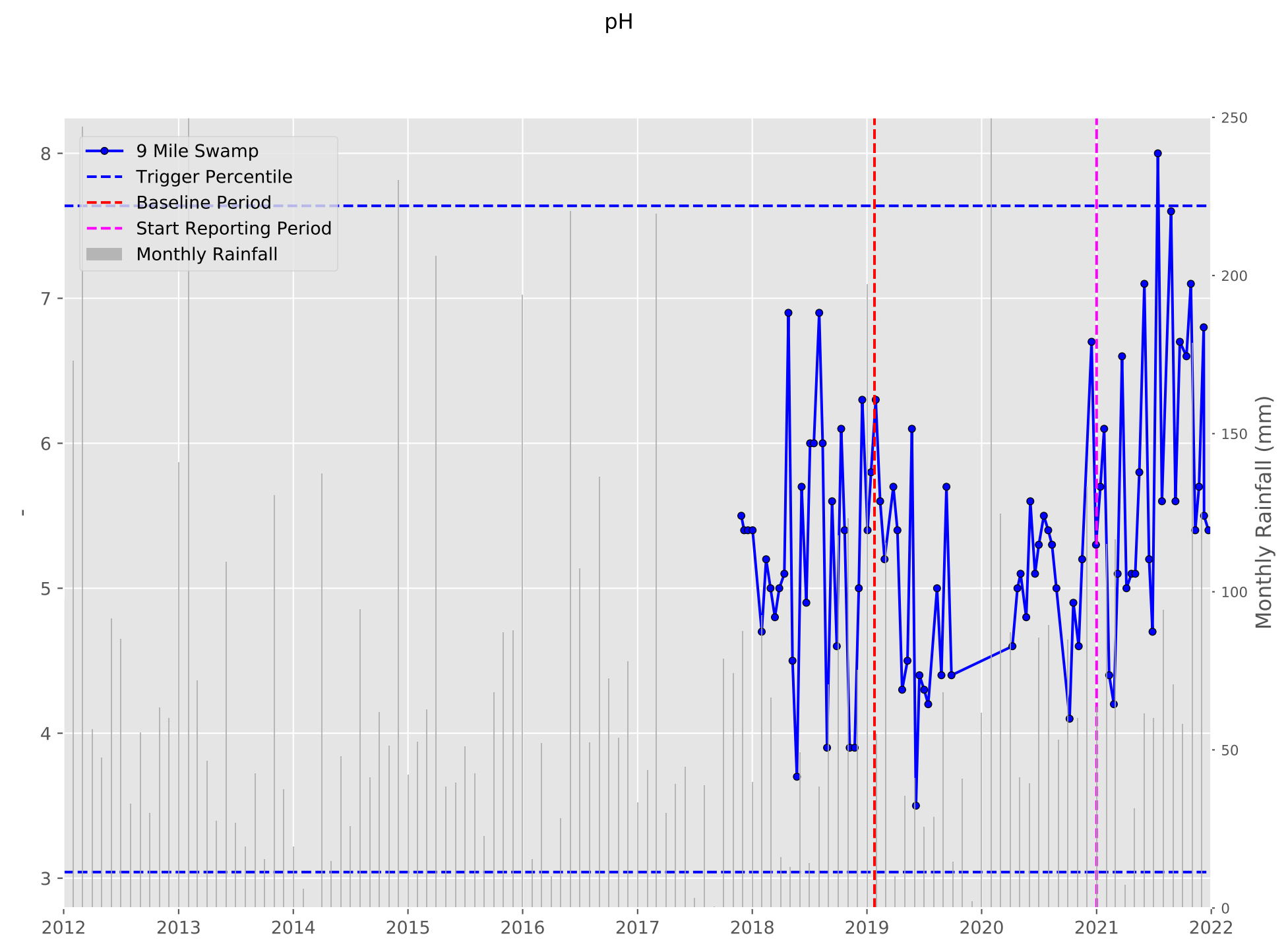
Surface water quality time series

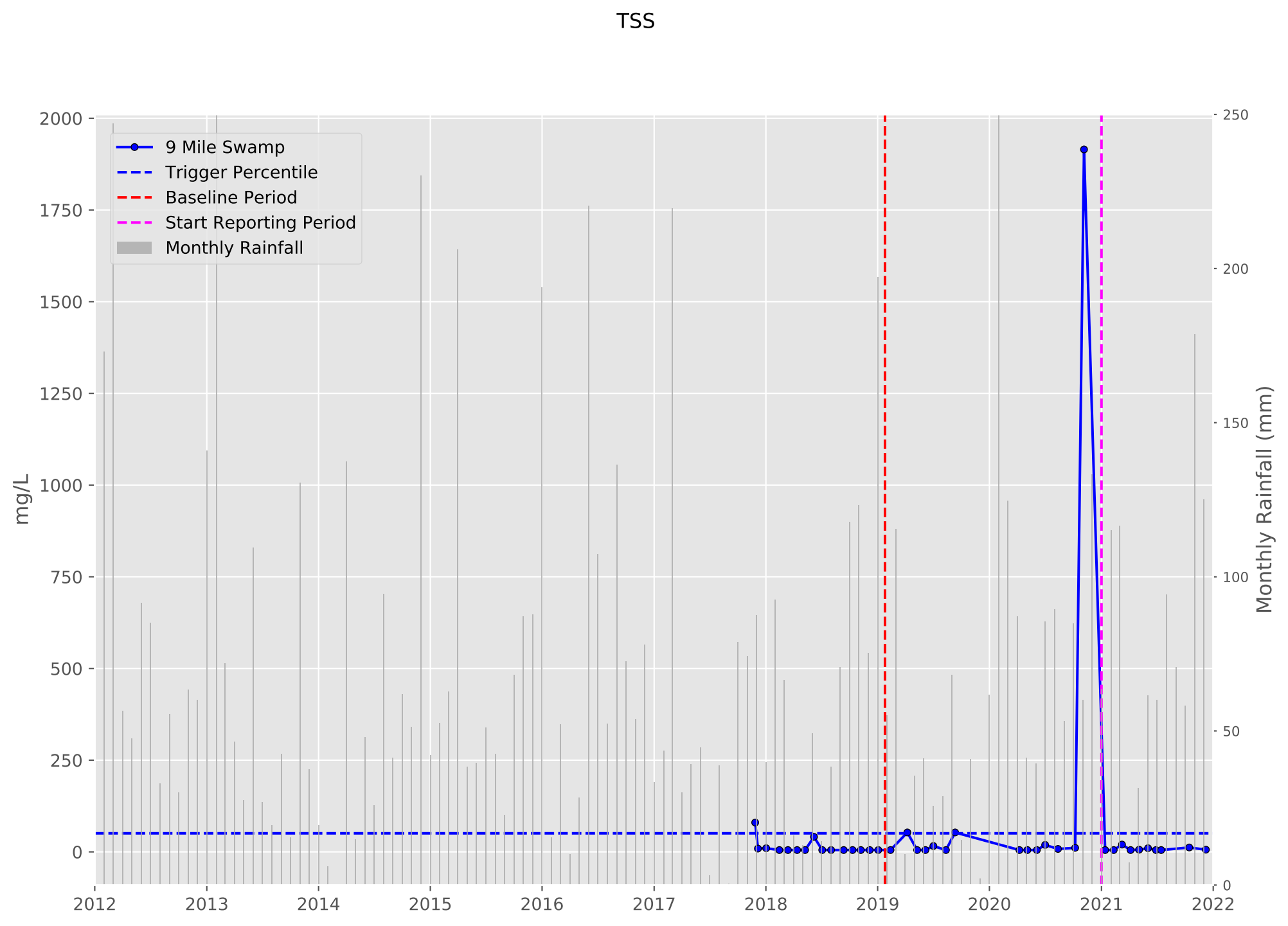

EC (field)
9 Mile Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
160
140
120
100
80
60
40
20
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

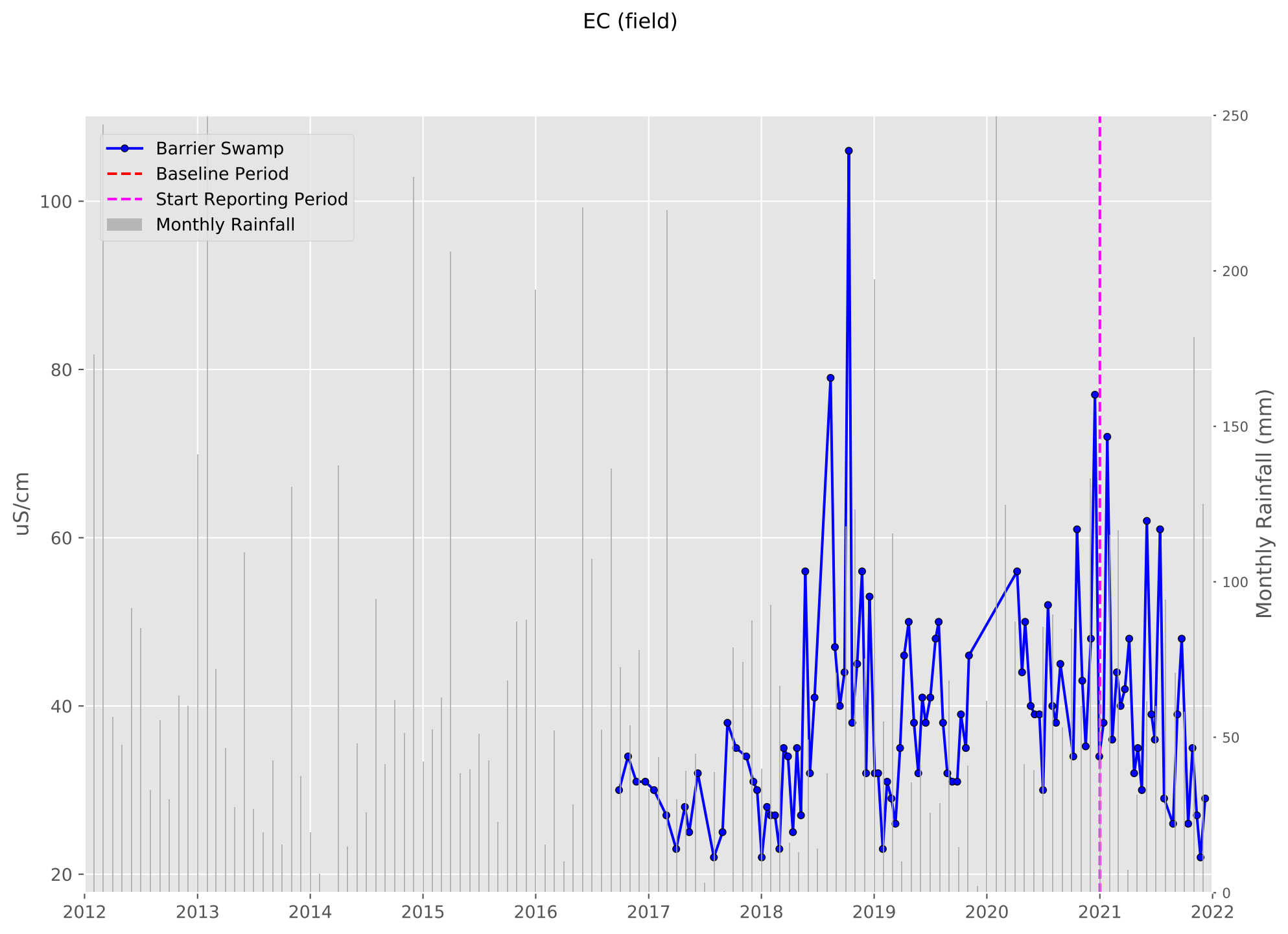

Flow Rate
9 Mile Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
80000
60000
40000
20000
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

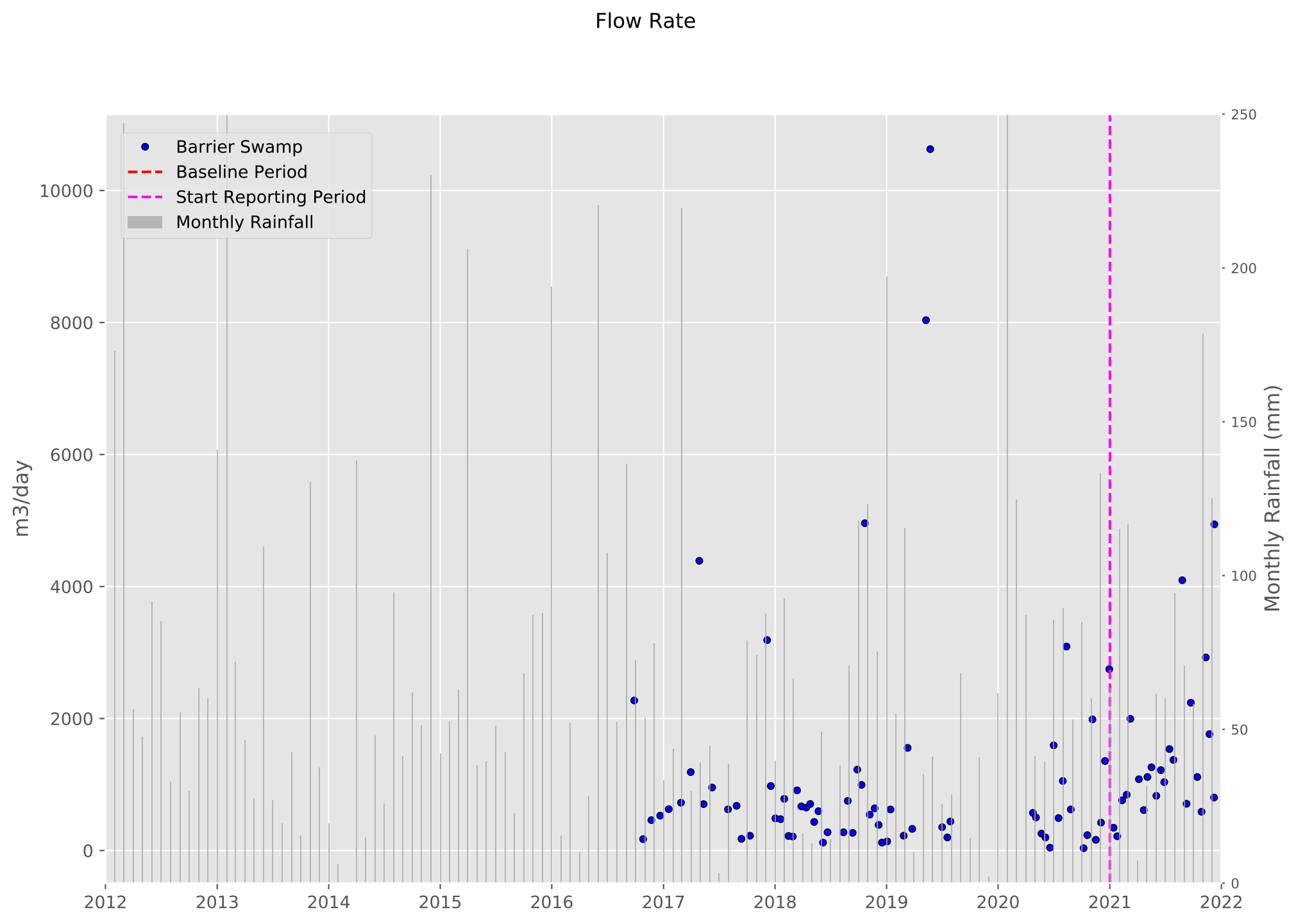

Iron
9 Mile Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
5
10
15
20
25
30
35
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

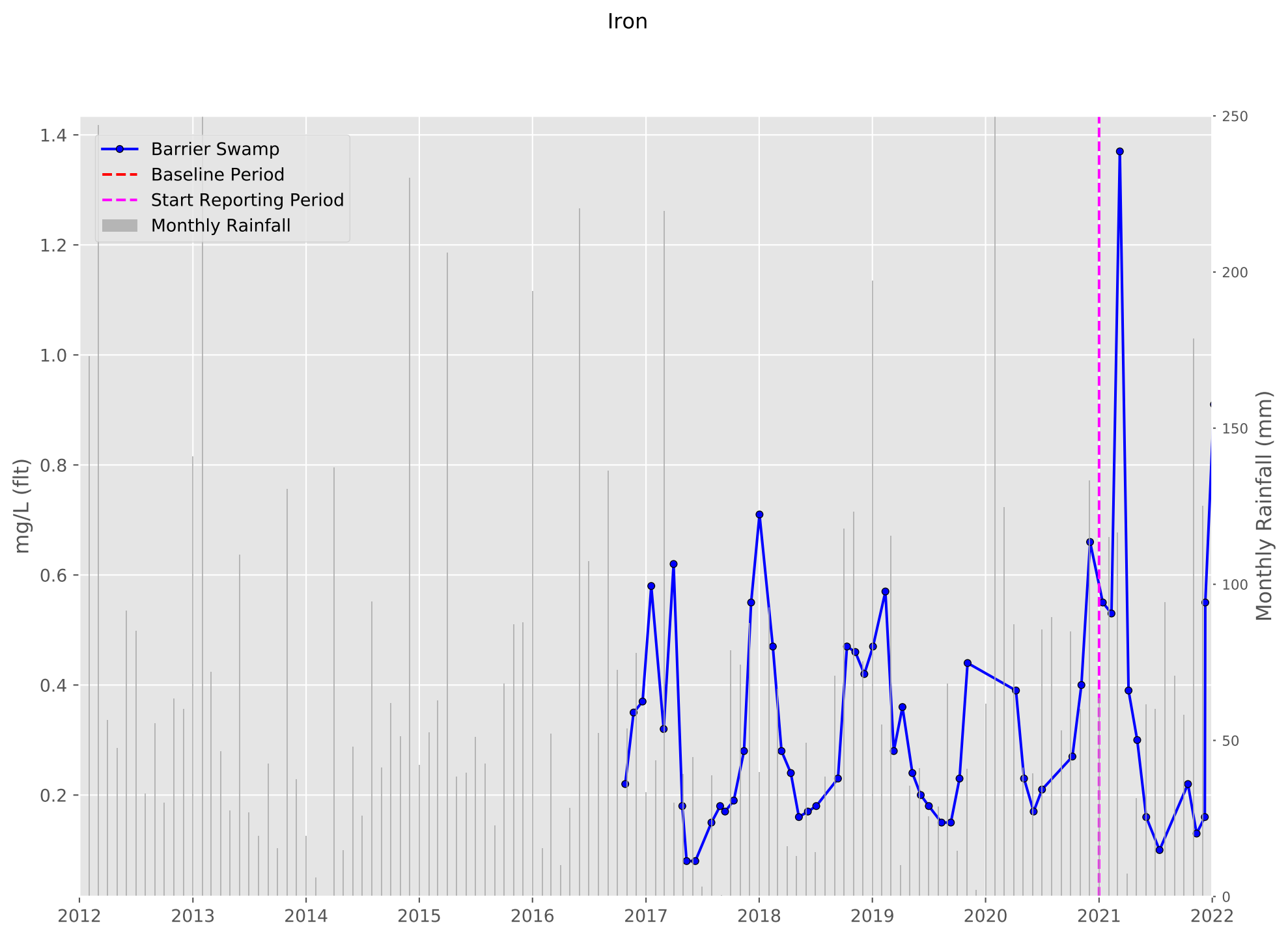

Manganese
9 Mile Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.12
0.10
0.08
0.06
0.04
0.02
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

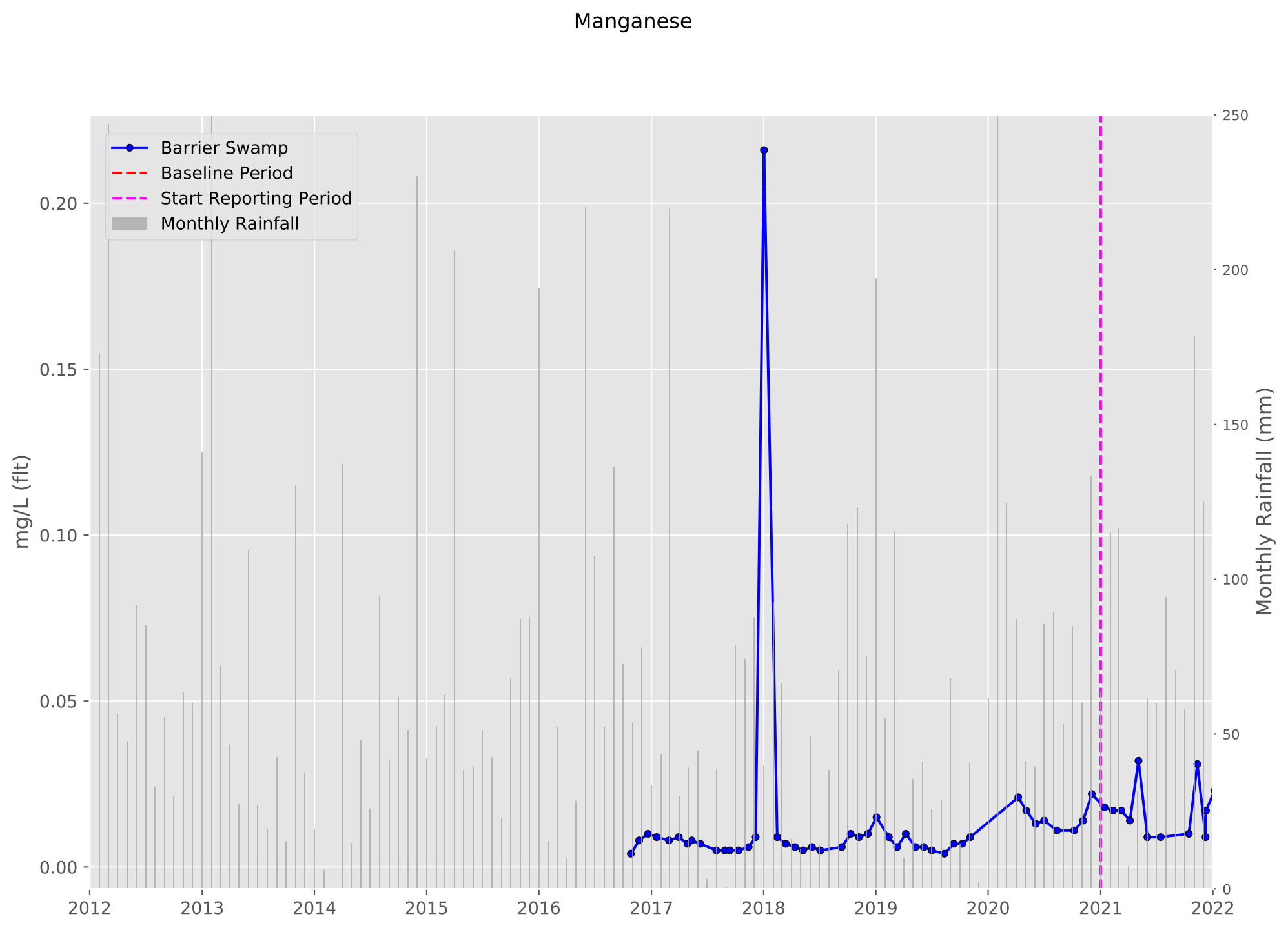

pH
9 Mile Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

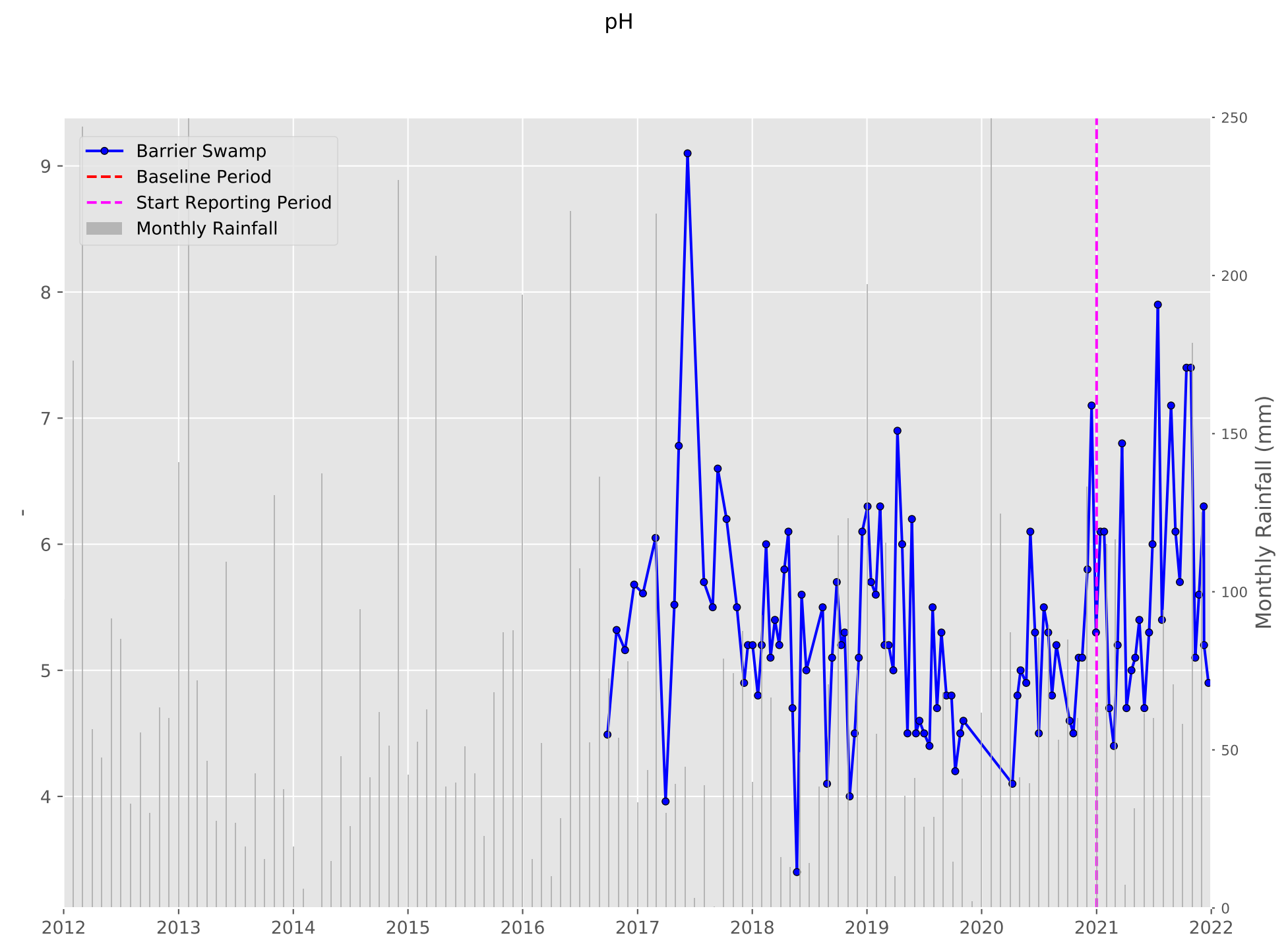

TSS
9 Mile Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
2000
1750
1500
1250
1000
750
500
250
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

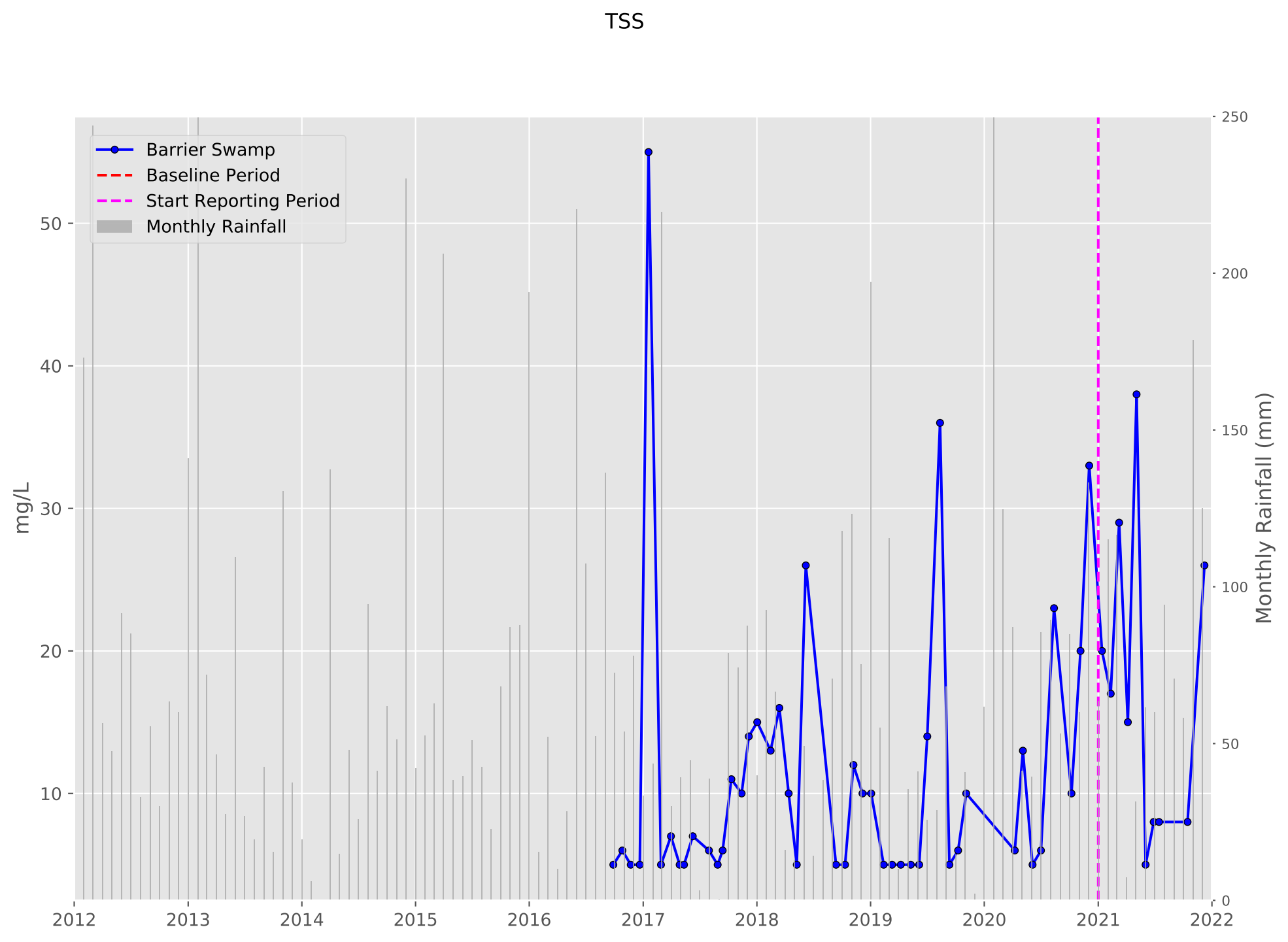

EC (field)
Barrier Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
20
40
60
80
100
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

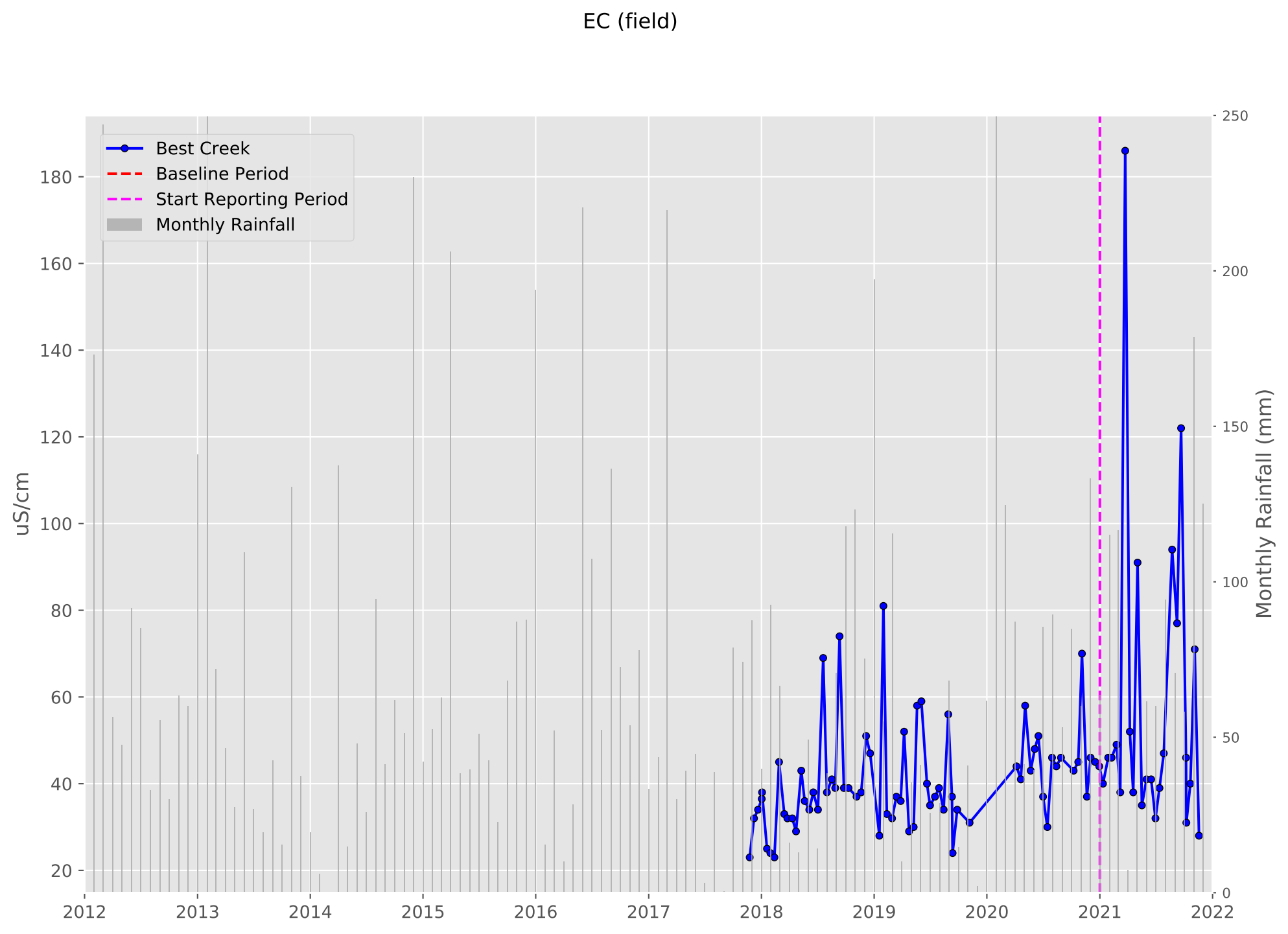

Flow Rate
Barrier Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
10000
8000
6000
4000
2000
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


Iron
Barrier Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

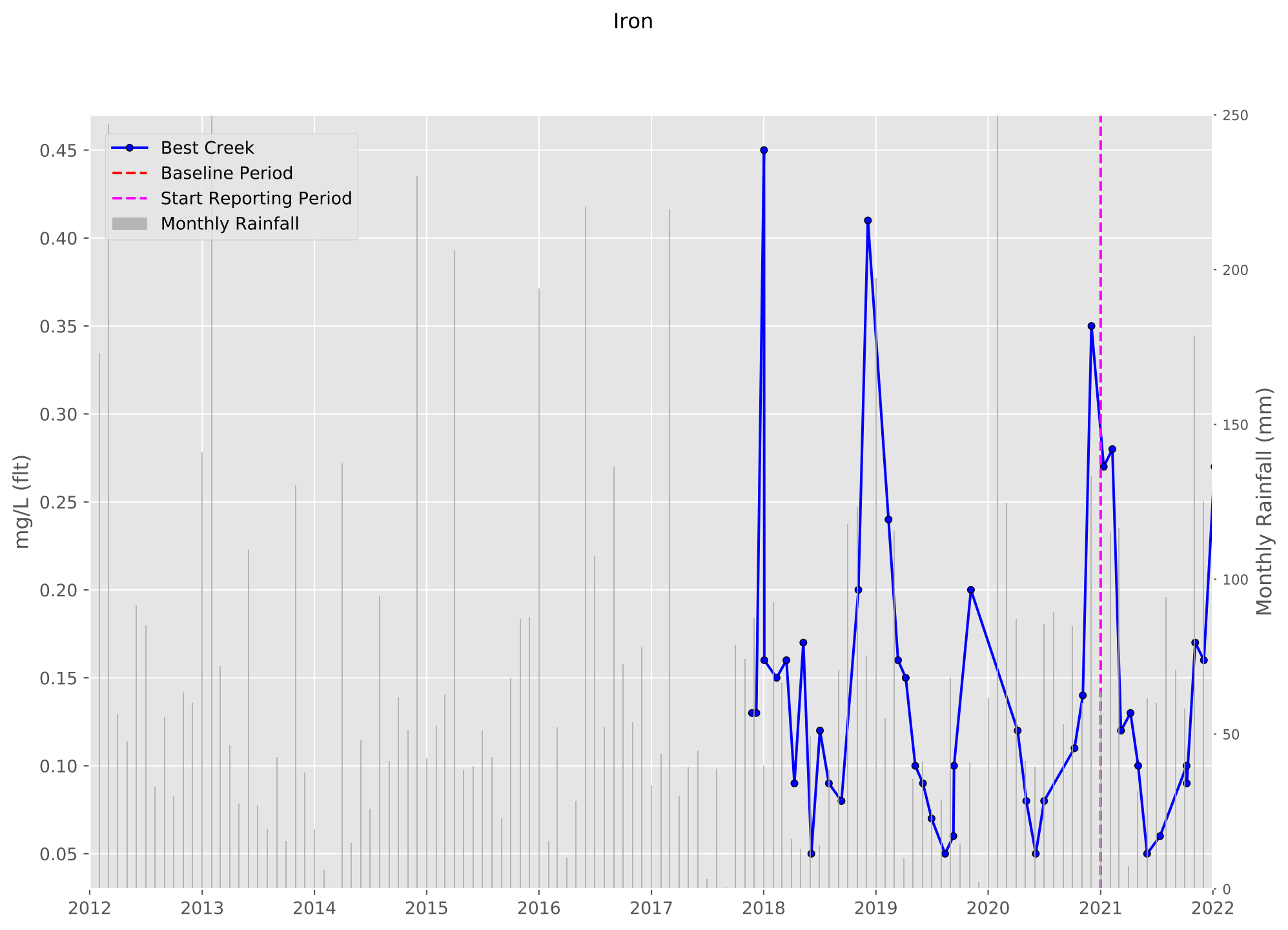

Manganese
Barrier Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.05
0.10
0.15
0.20
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

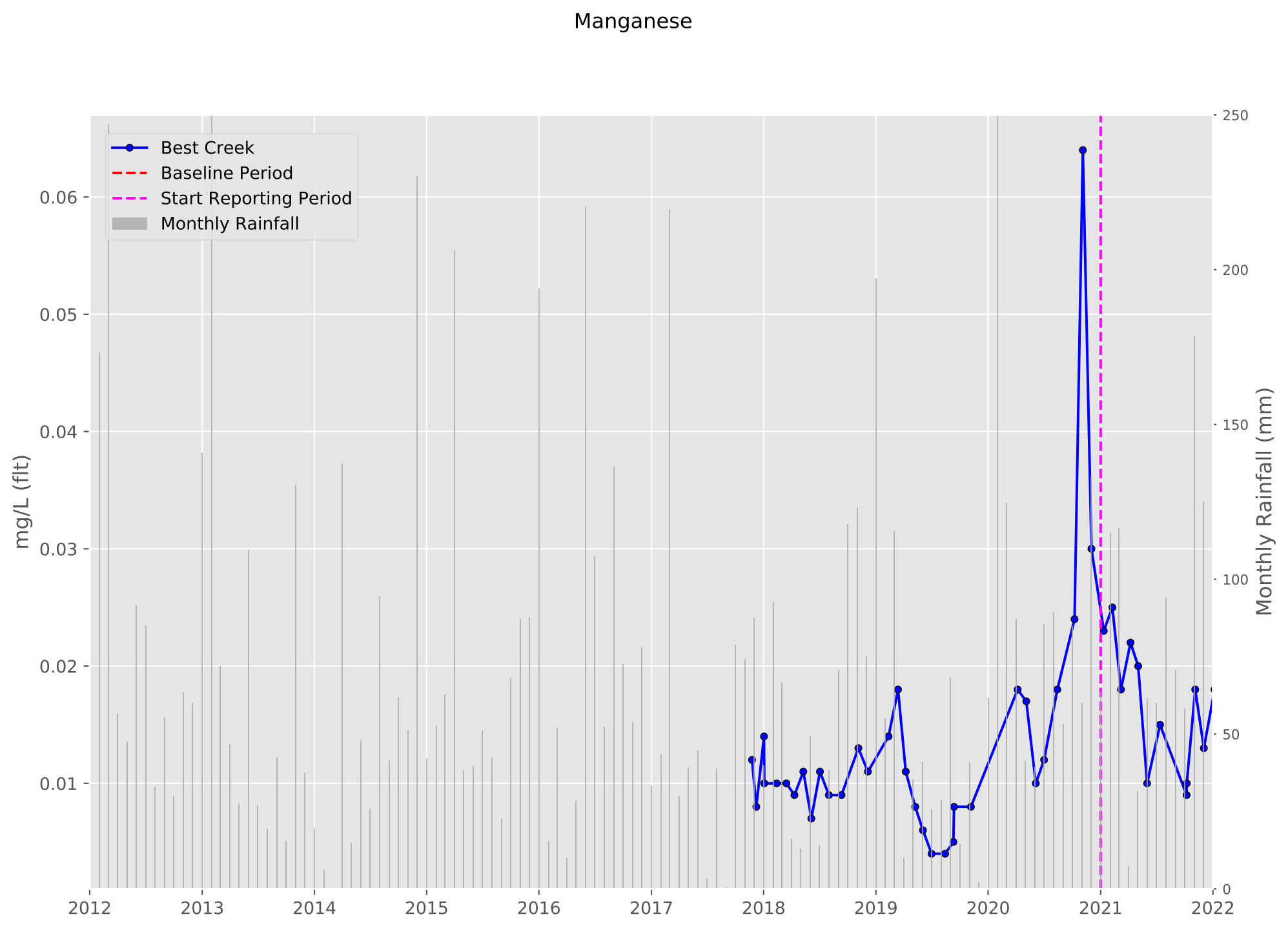

pH
Barrier Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
9
8
7
6
5
4
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

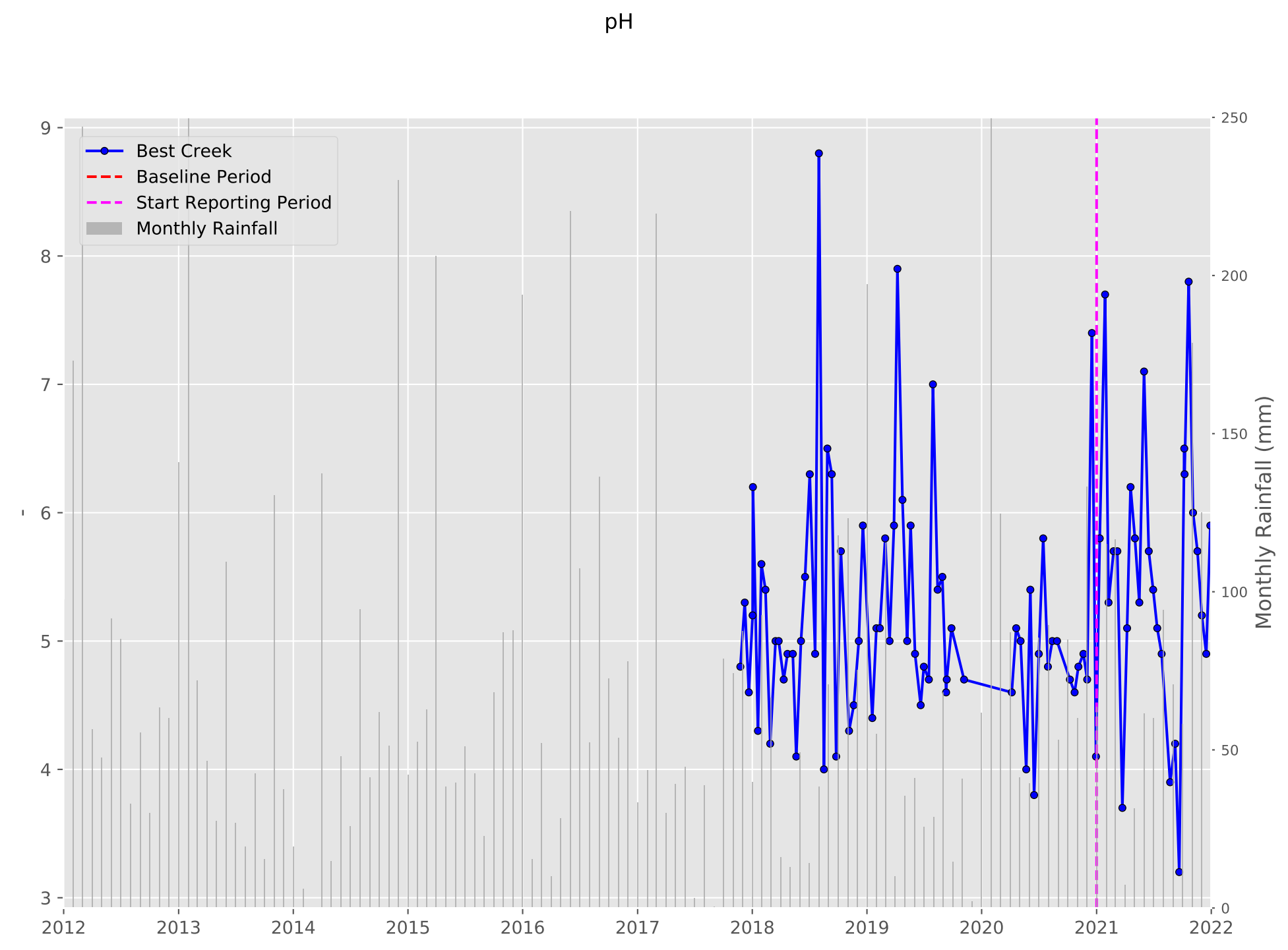

TSS
Barrier Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
10
20
30
40
50
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

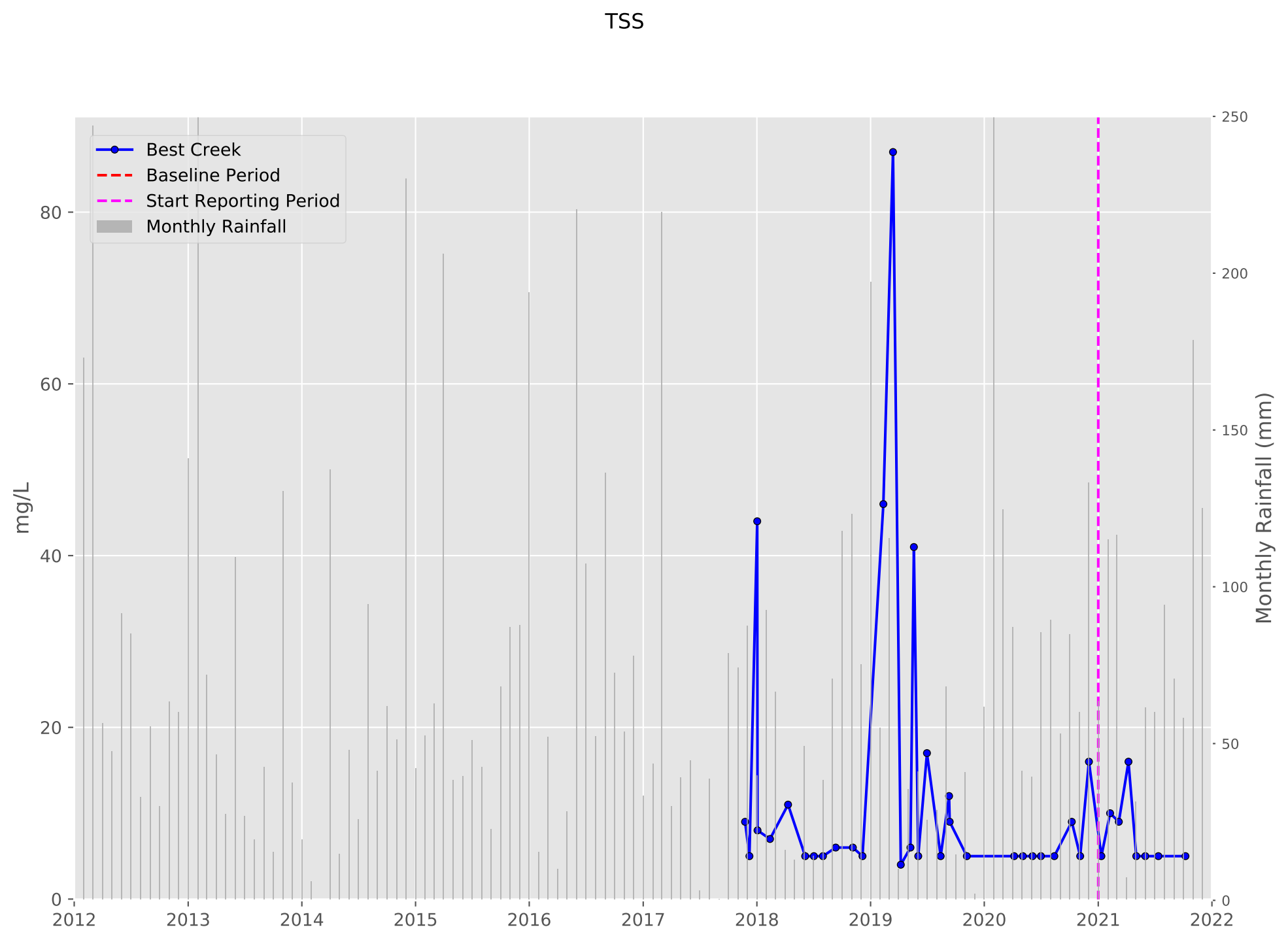

EC (field)
Best Creek
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
20
40
60
80
100
120
140
160
180
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

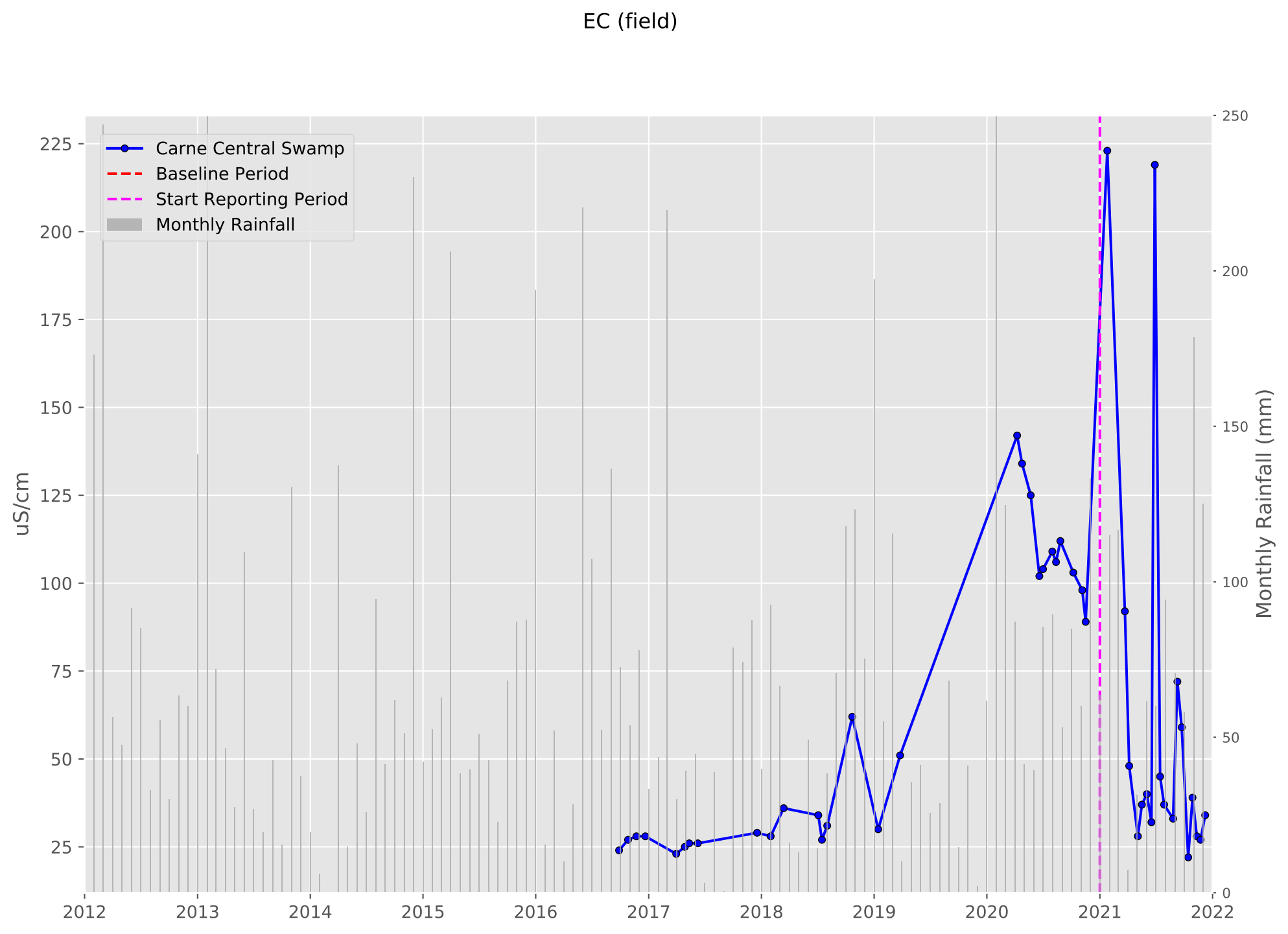

Flow Rate
Best Creek
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
14000
12000
10000
8000
6000
4000
2000
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

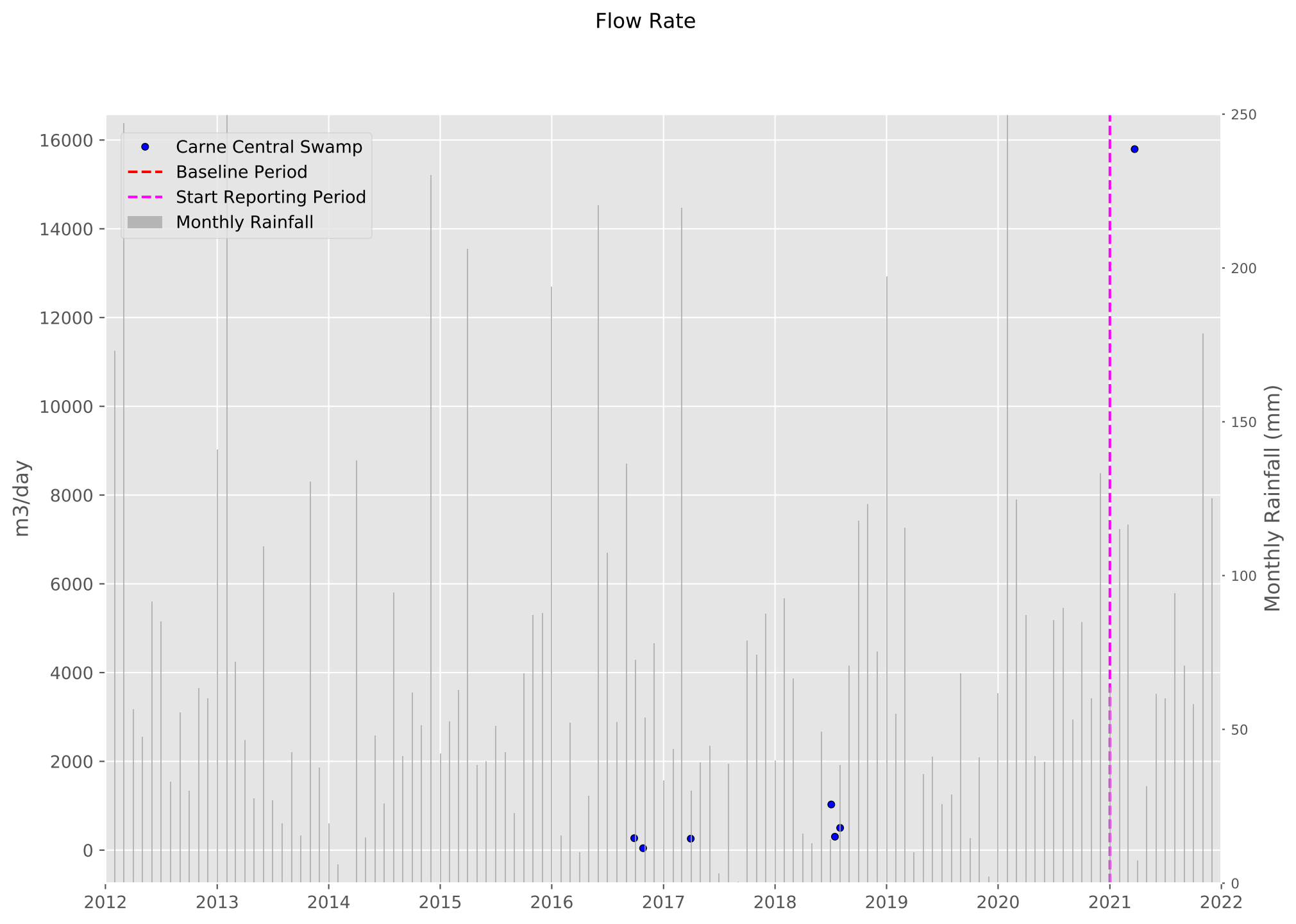

Iron
Best Creek
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

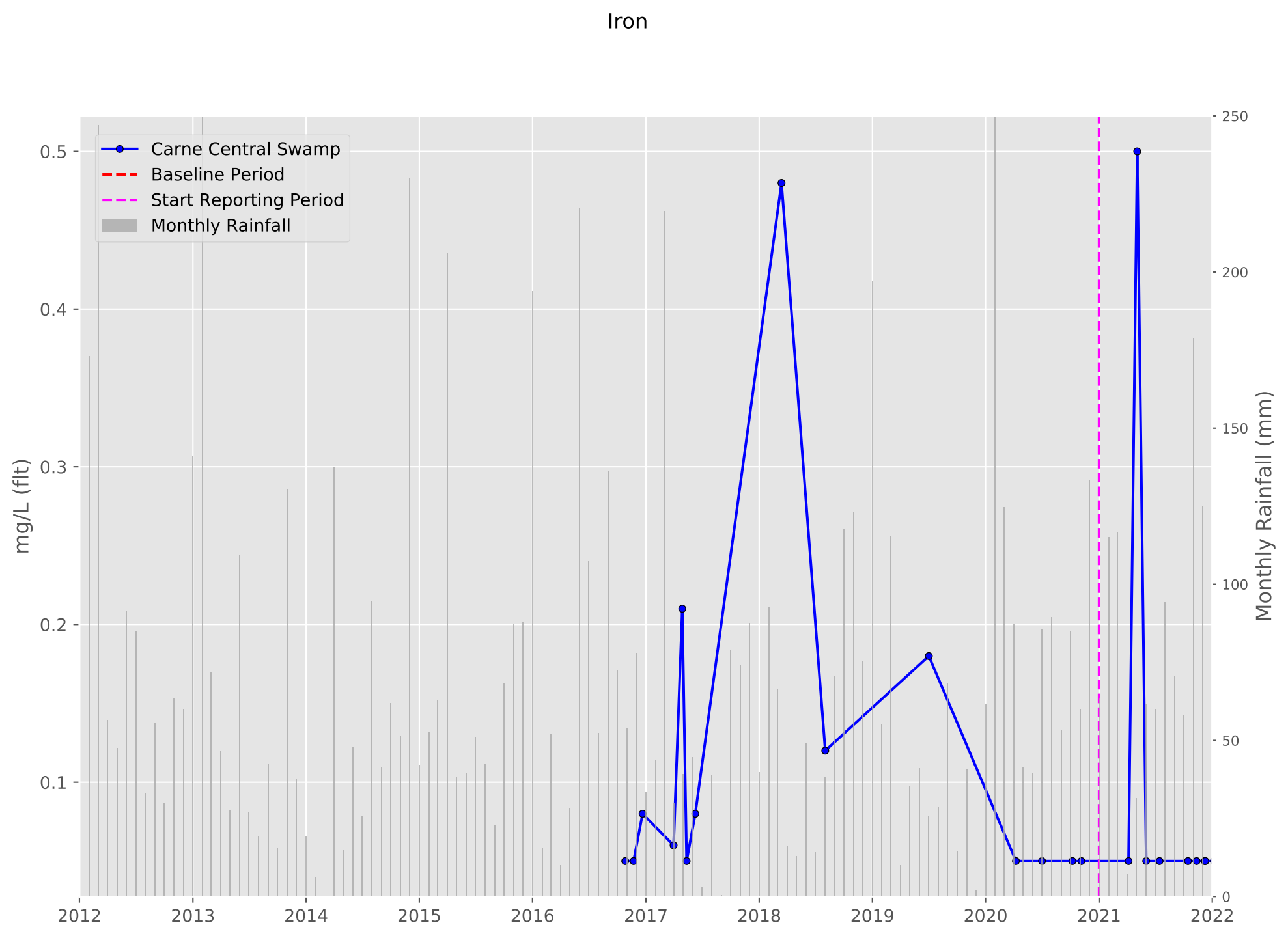

Manganese
Best Creek
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.01
0.02
0.03
0.04
0.05
0.06
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

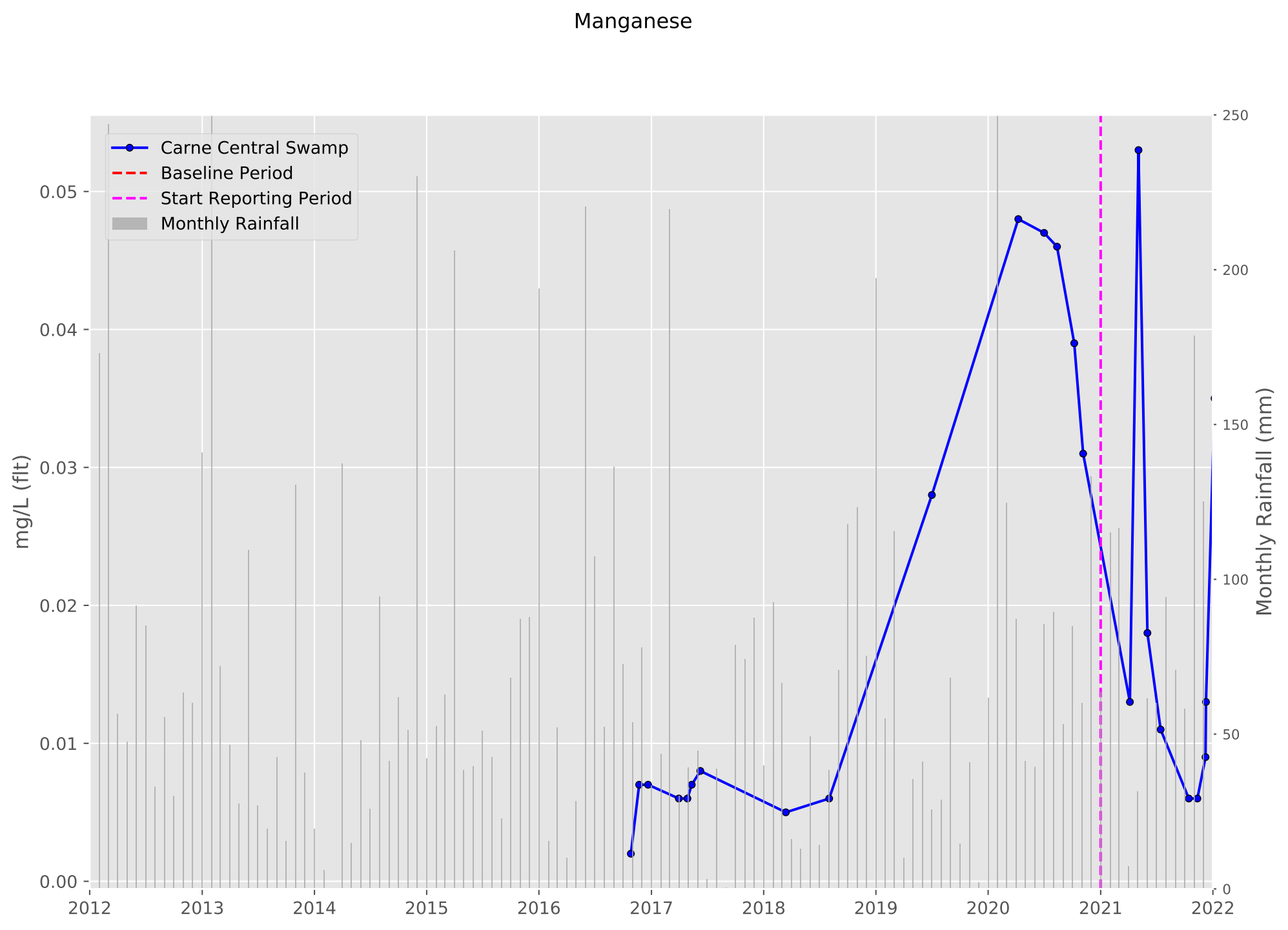

pH
Best Creek
Baseline Period
Start Reporting Period
Monthly Rainfall
9
8
7
6
5
4
3
-
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

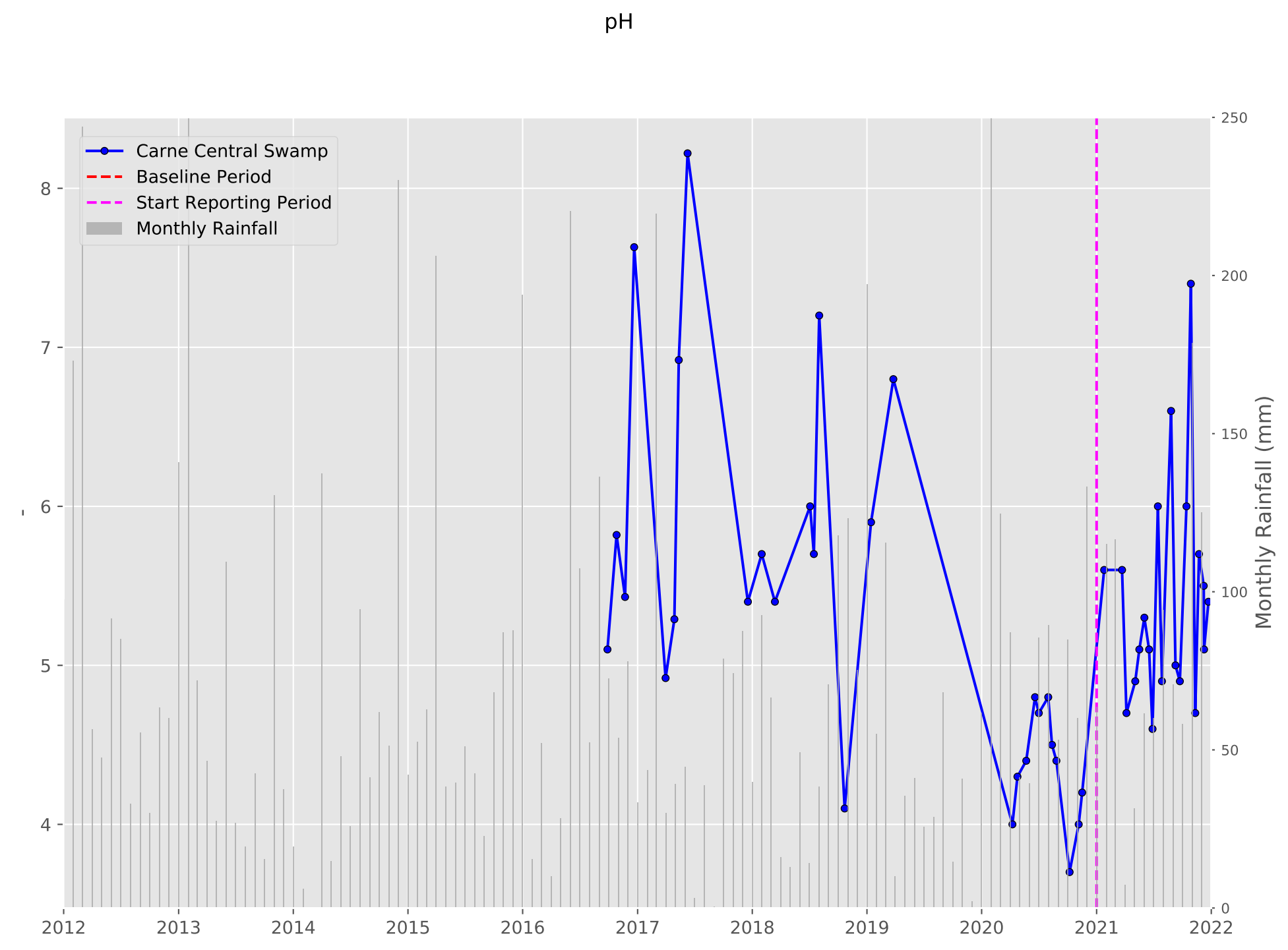

TSS
Best Creek
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0
20
40
60
80
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

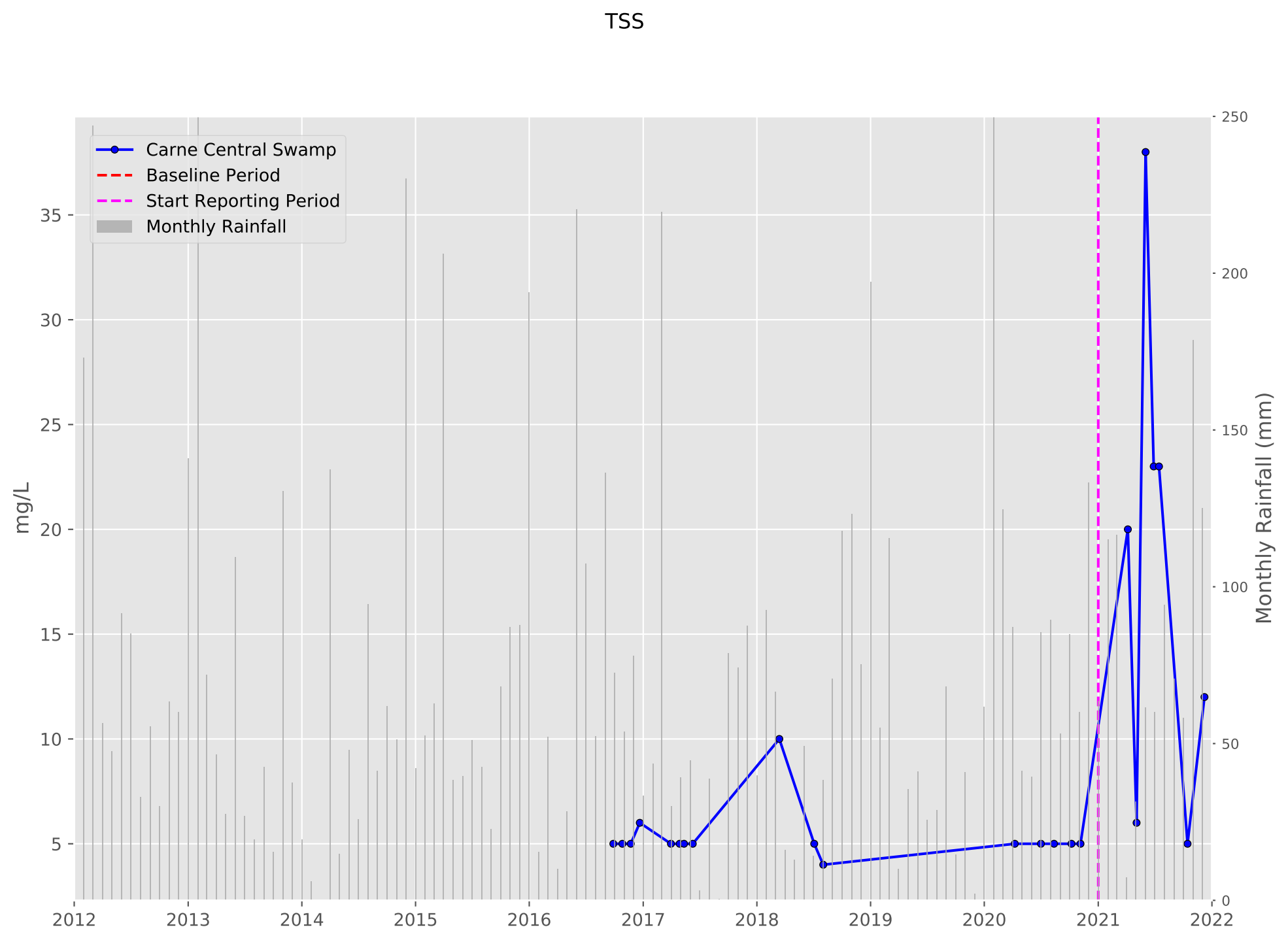

EC (field)
Carne Central Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
225
200
175
150
125
100
75
50
25
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

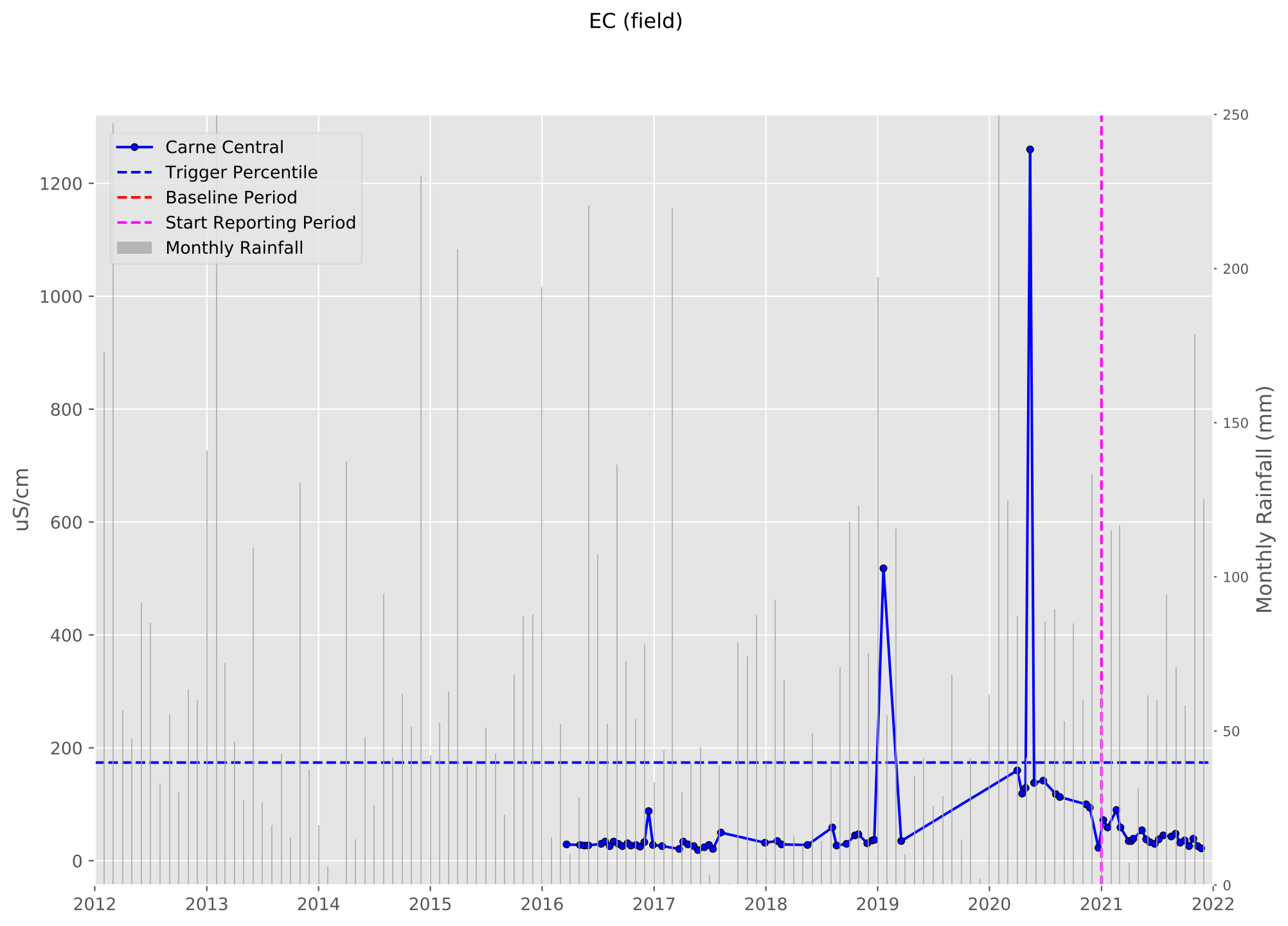

Flow Rate
Carne Central Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
16000
14000
12000
10000
8000
6000
4000
2000
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

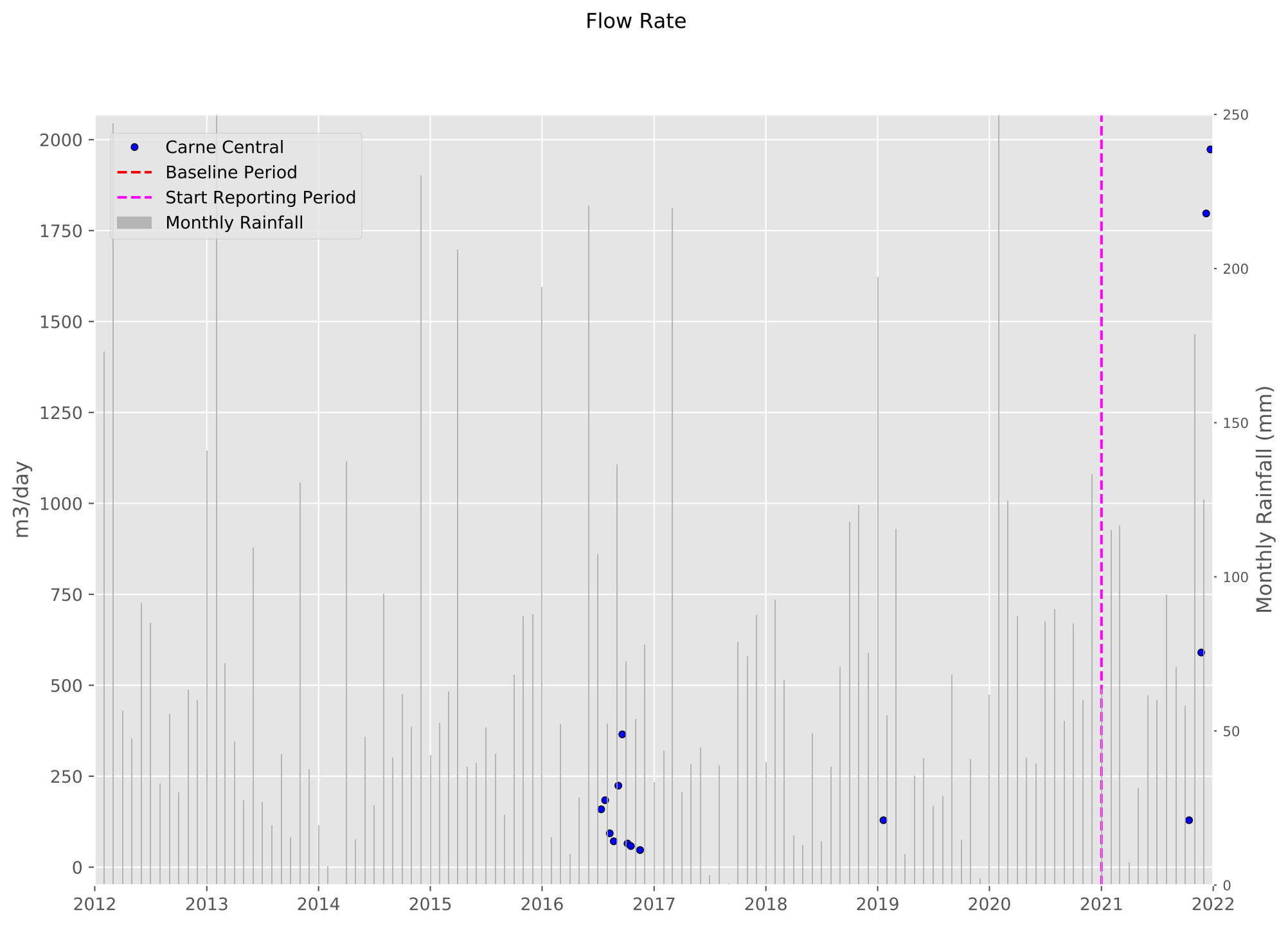

Iron
Carne Central Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.1
0.2
0.3
0.4
0.5
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

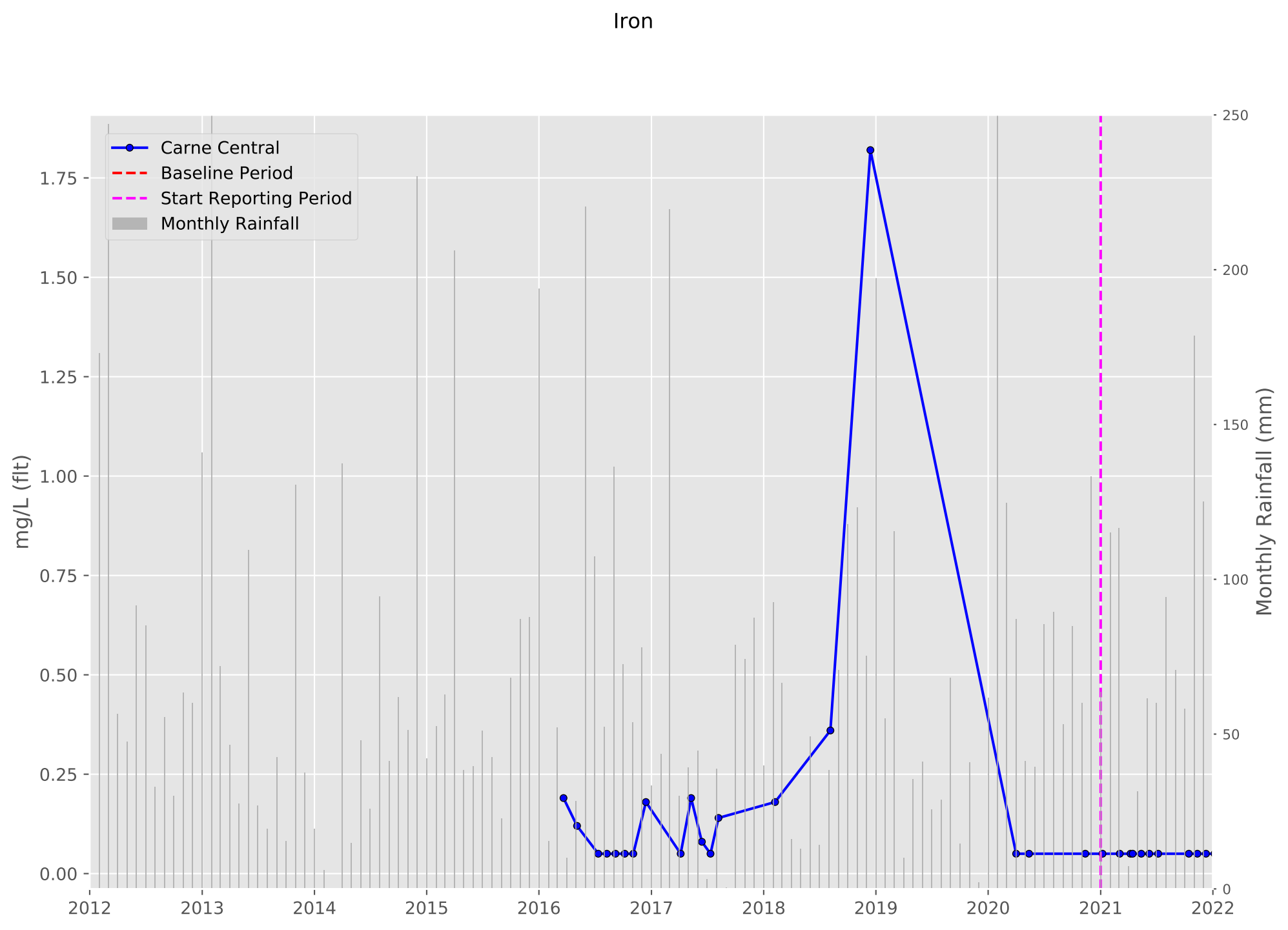

Manganese
Carne Central Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.01
0.02
0.03
0.04
0.05
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

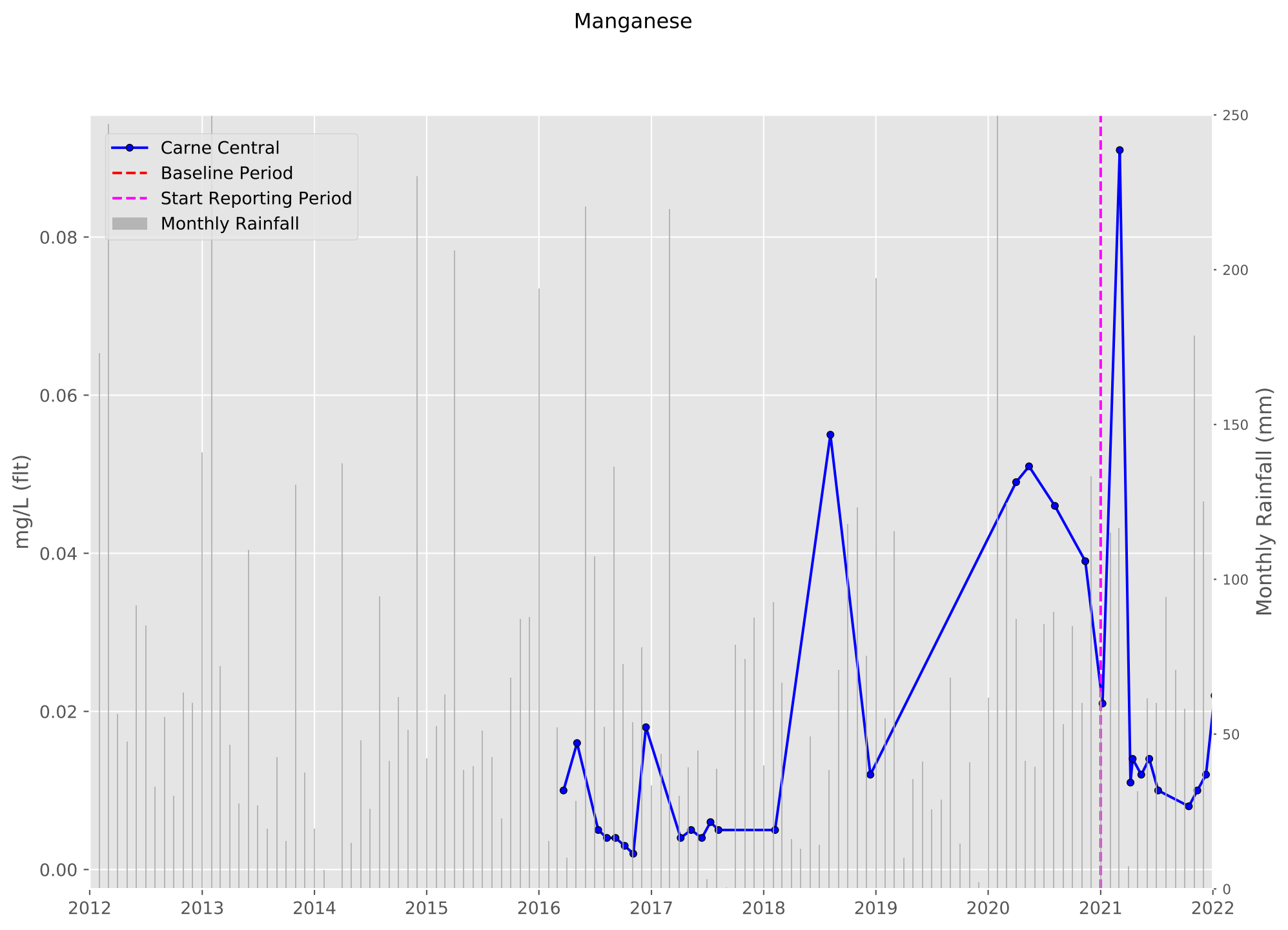

pH
Carne Central Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
8
7
6
5
4
-
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

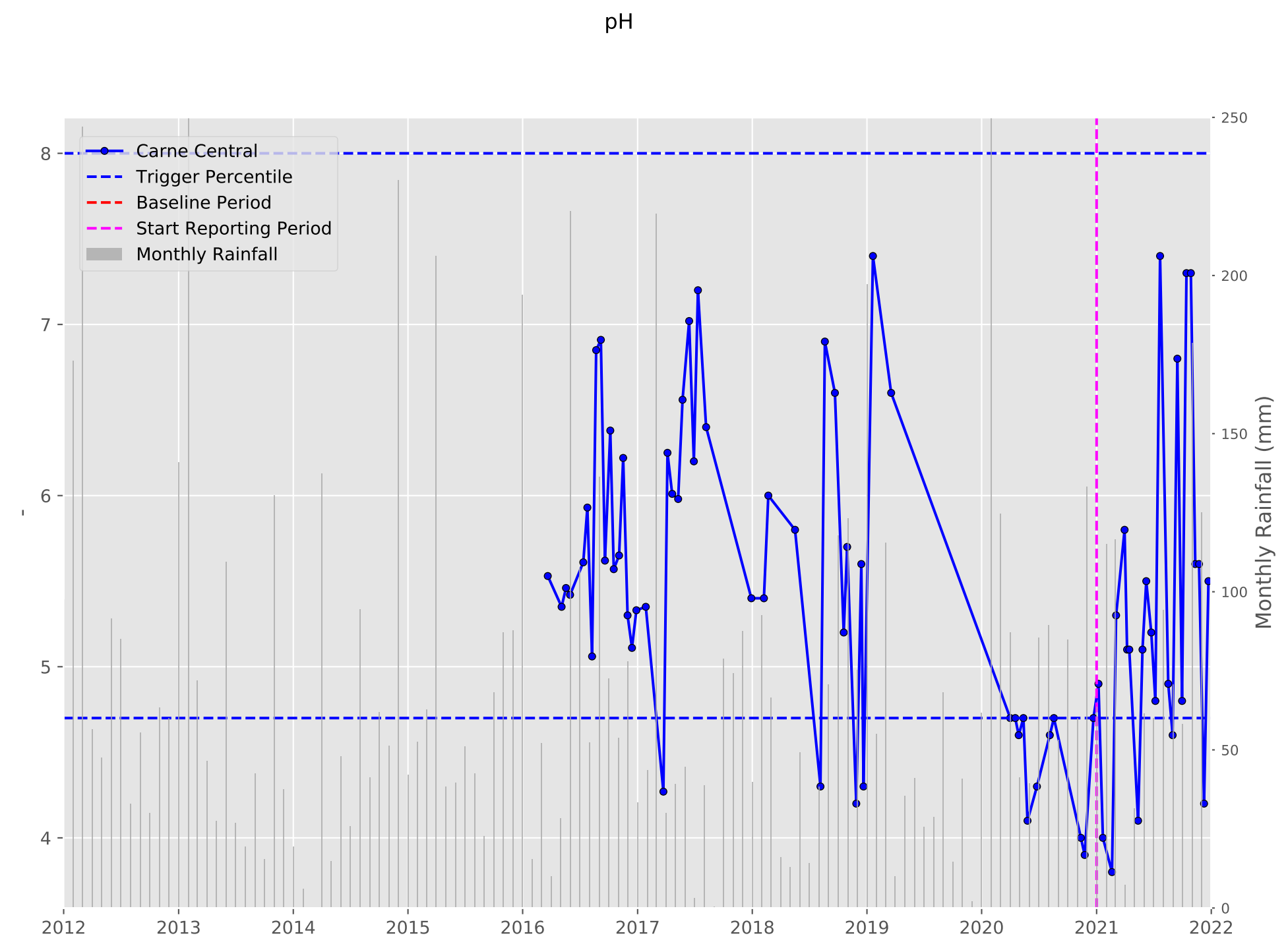

TSS
Carne Central Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0
5
10
15
20
25
30
35
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

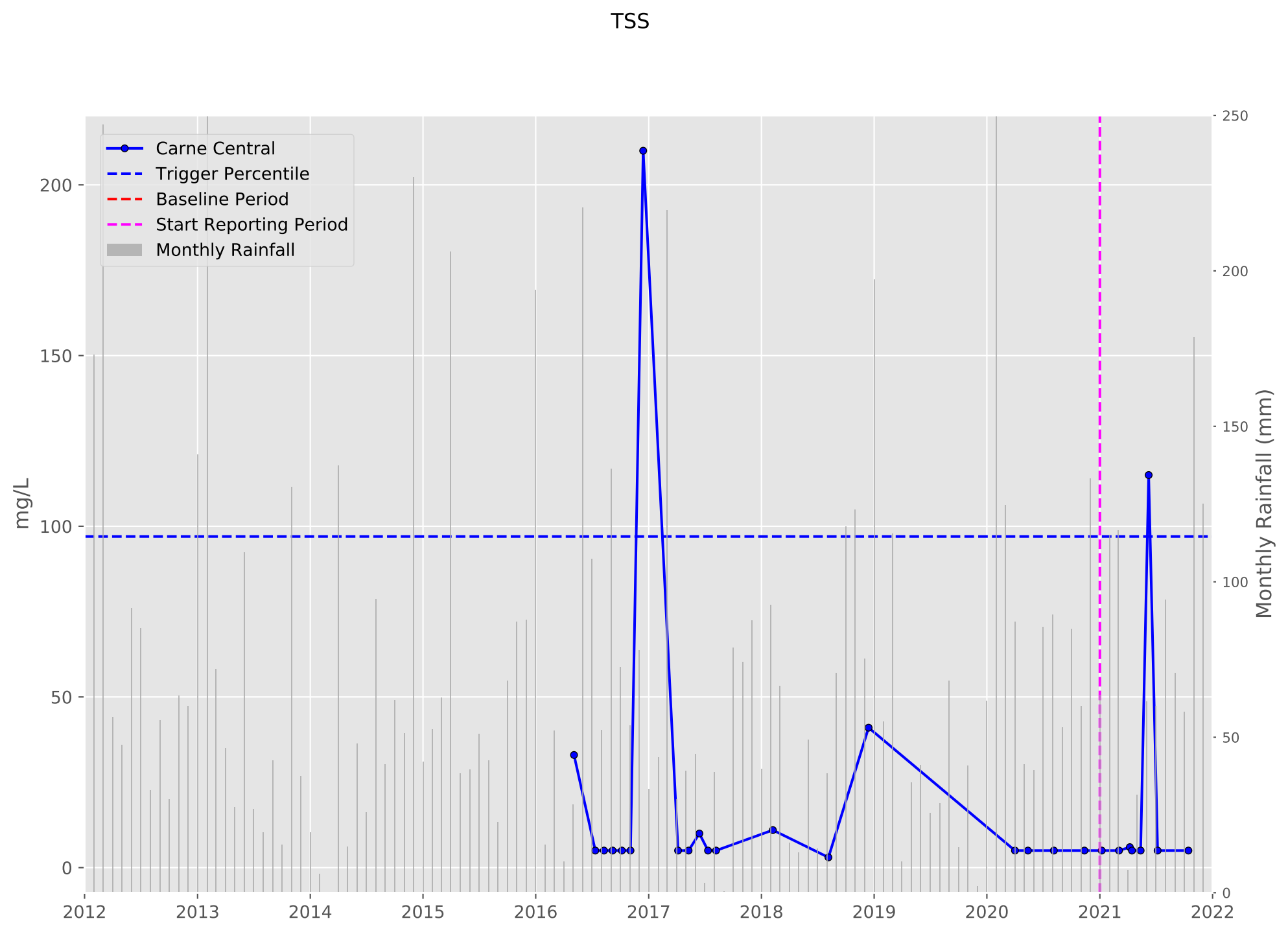

EC (field)
Carne Central
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
200
400
600
800
1000
1200
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

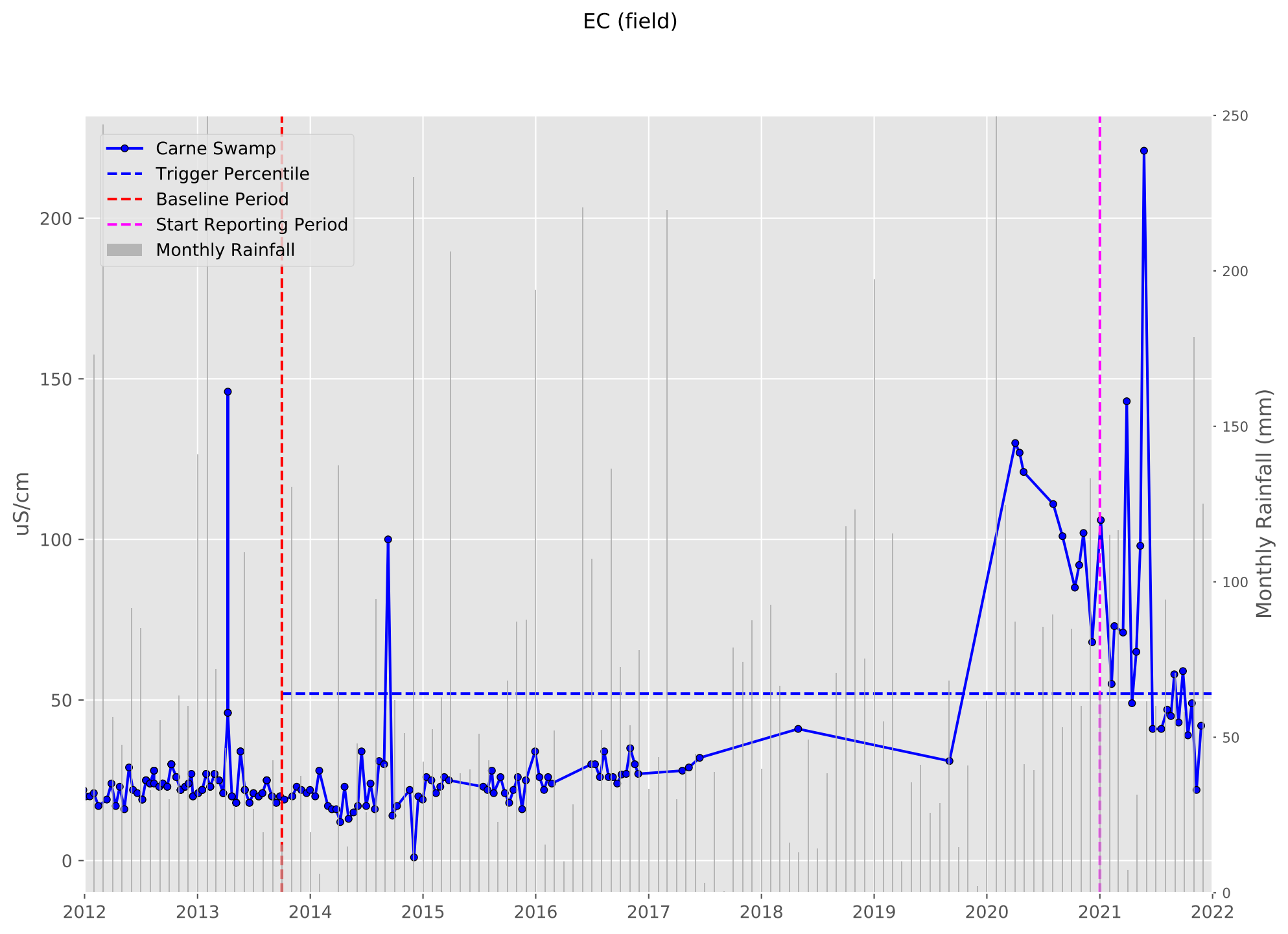

Flow Rate
Carne Central
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
2000
1750
1500
1250
1000
750
500
250
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

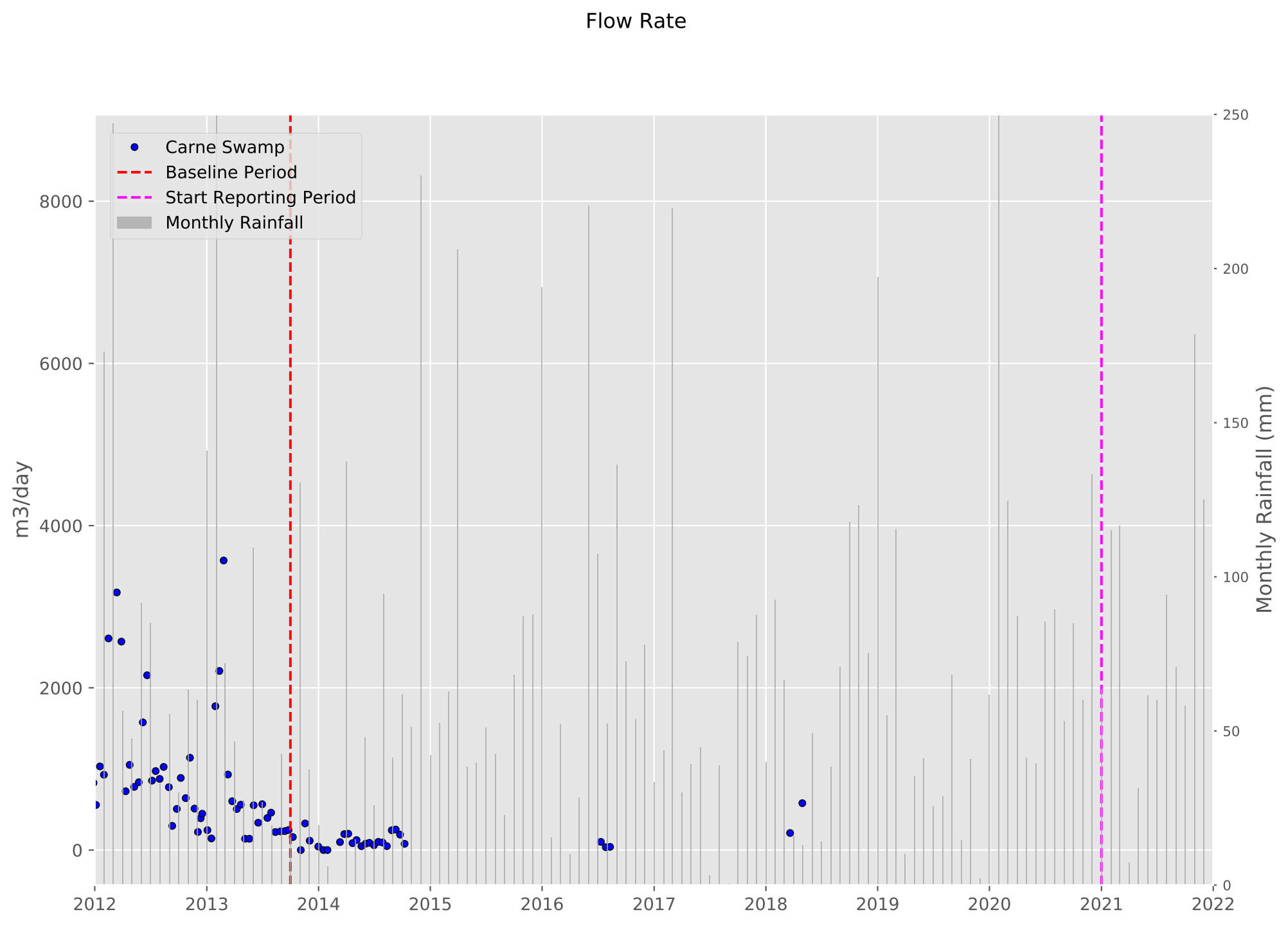

Iron
Carne Central
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

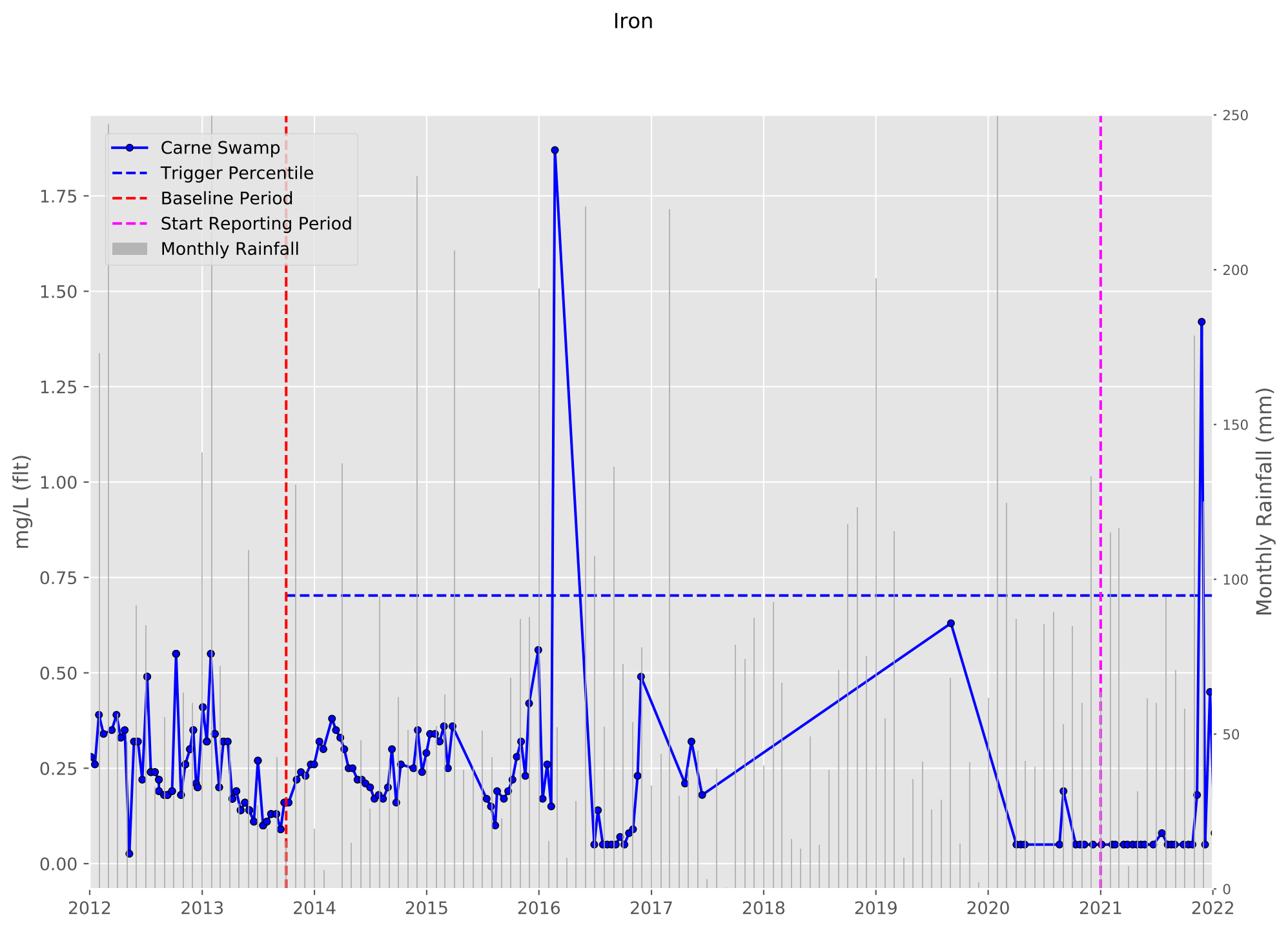

Manganese
Carne Central
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.02
0.04
0.06
0.08
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

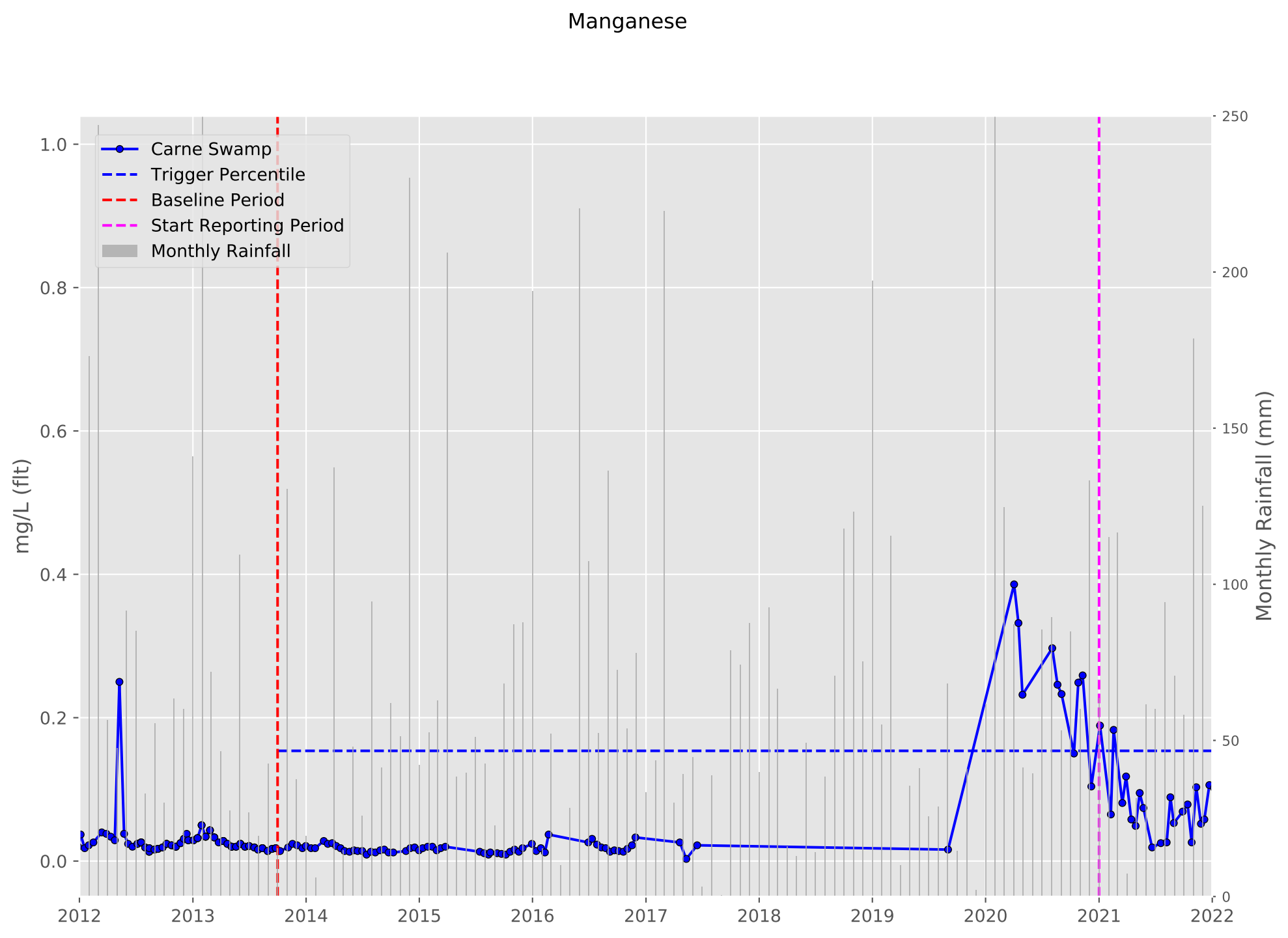

pH
Carne Central
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8
7
6
5
4
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

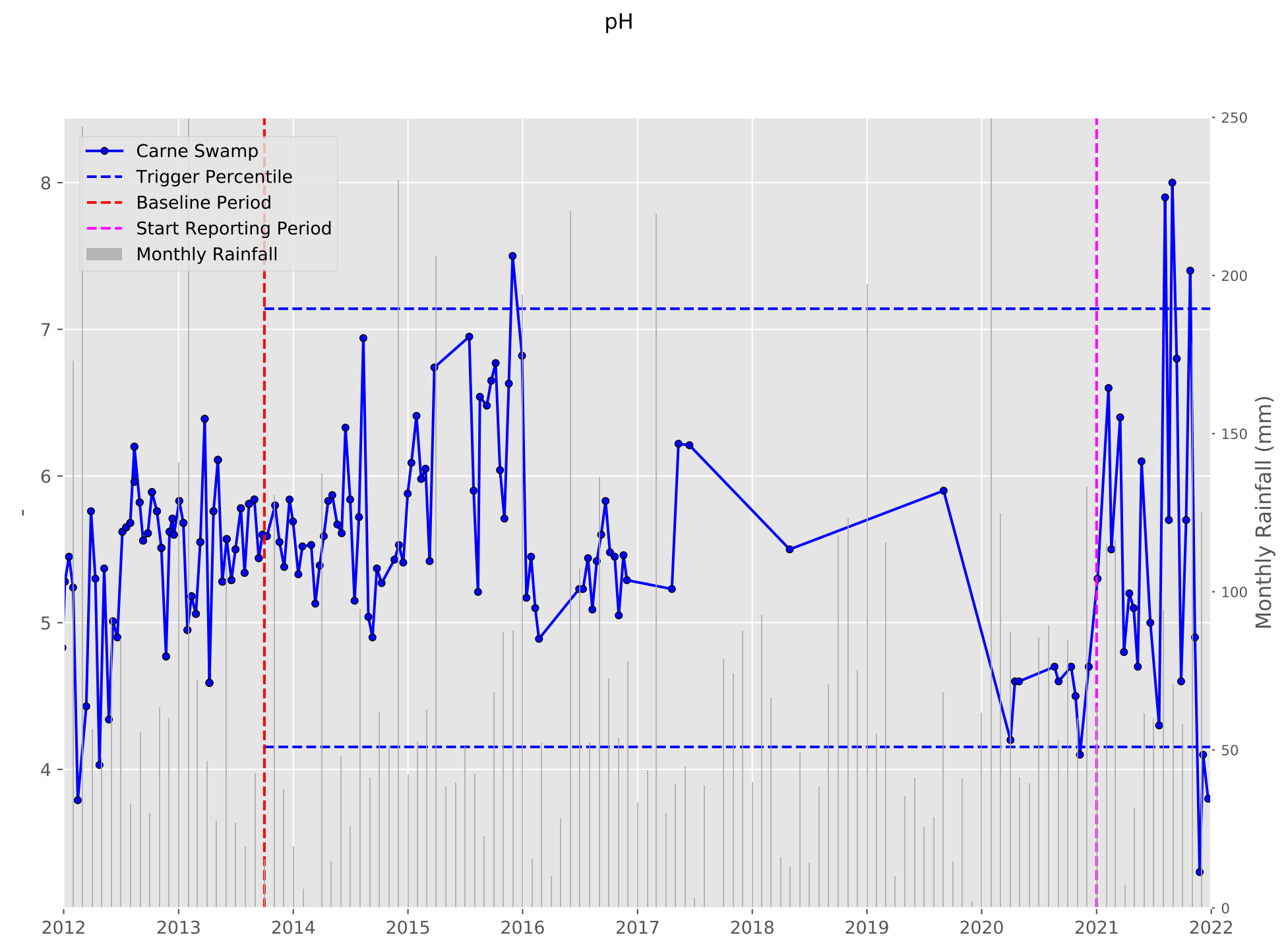

TSS
Carne Central
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

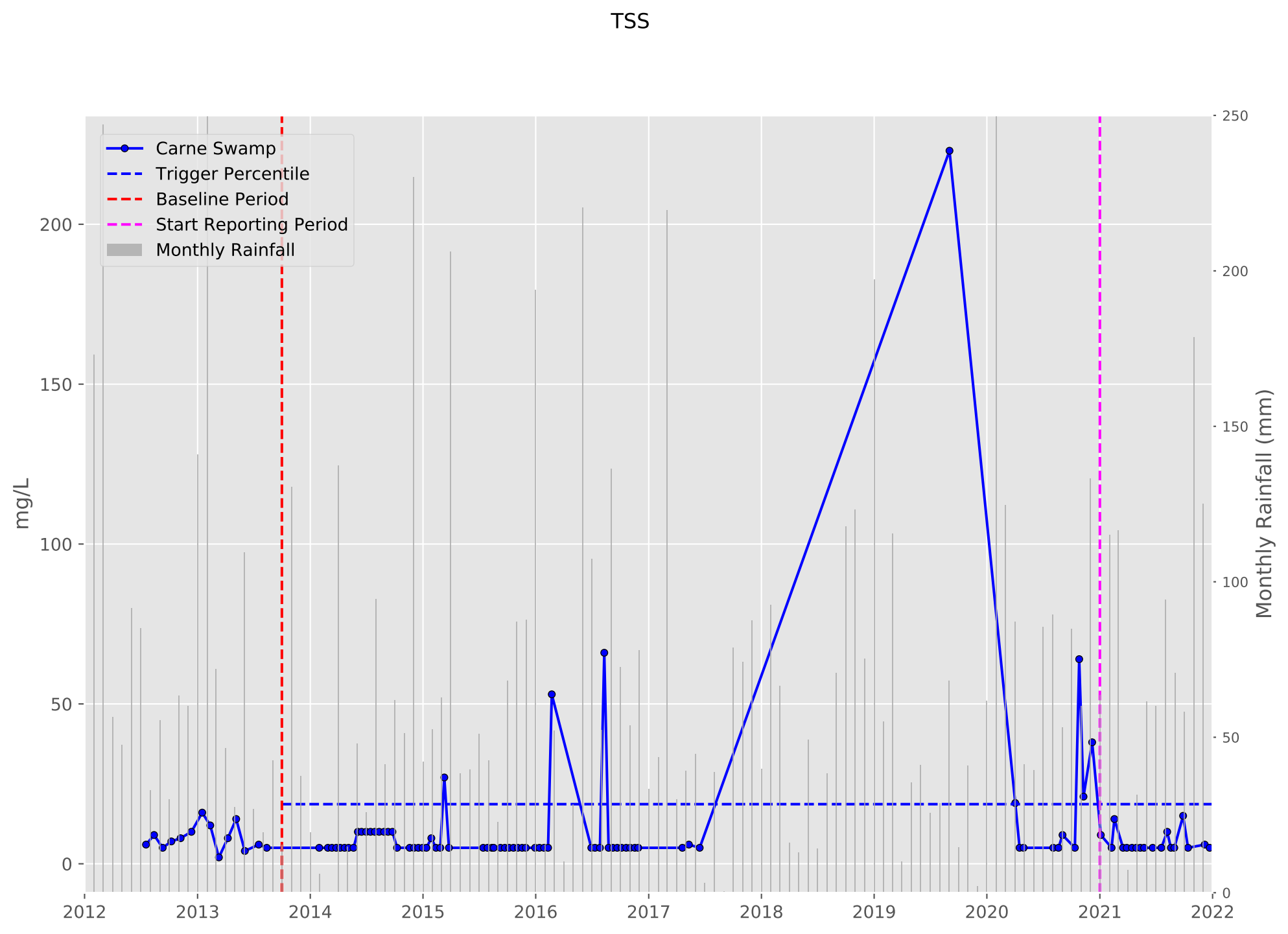

EC (field)
Carne Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

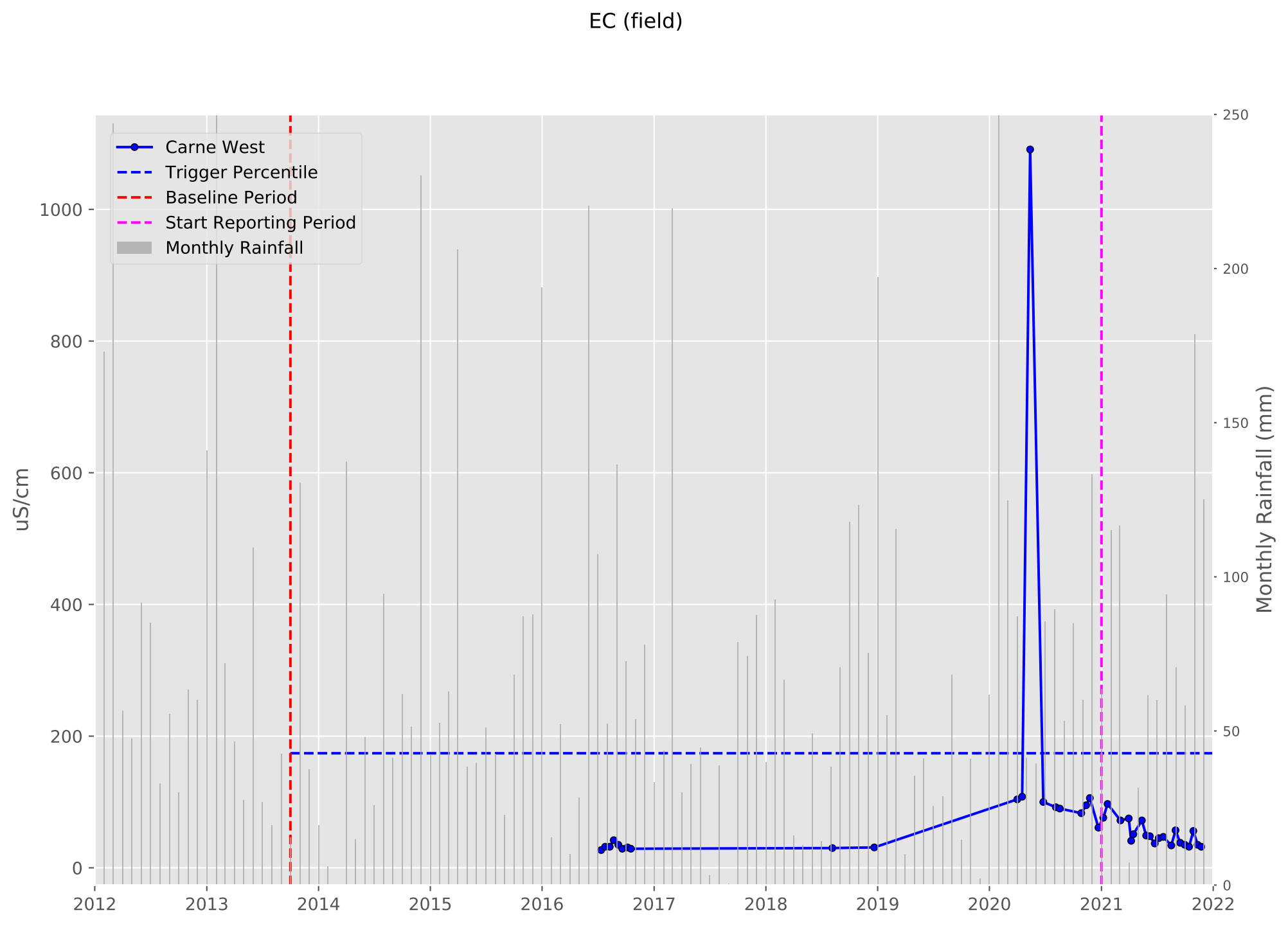

Flow Rate
Carne Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
0
2000
4000
6000
8000
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

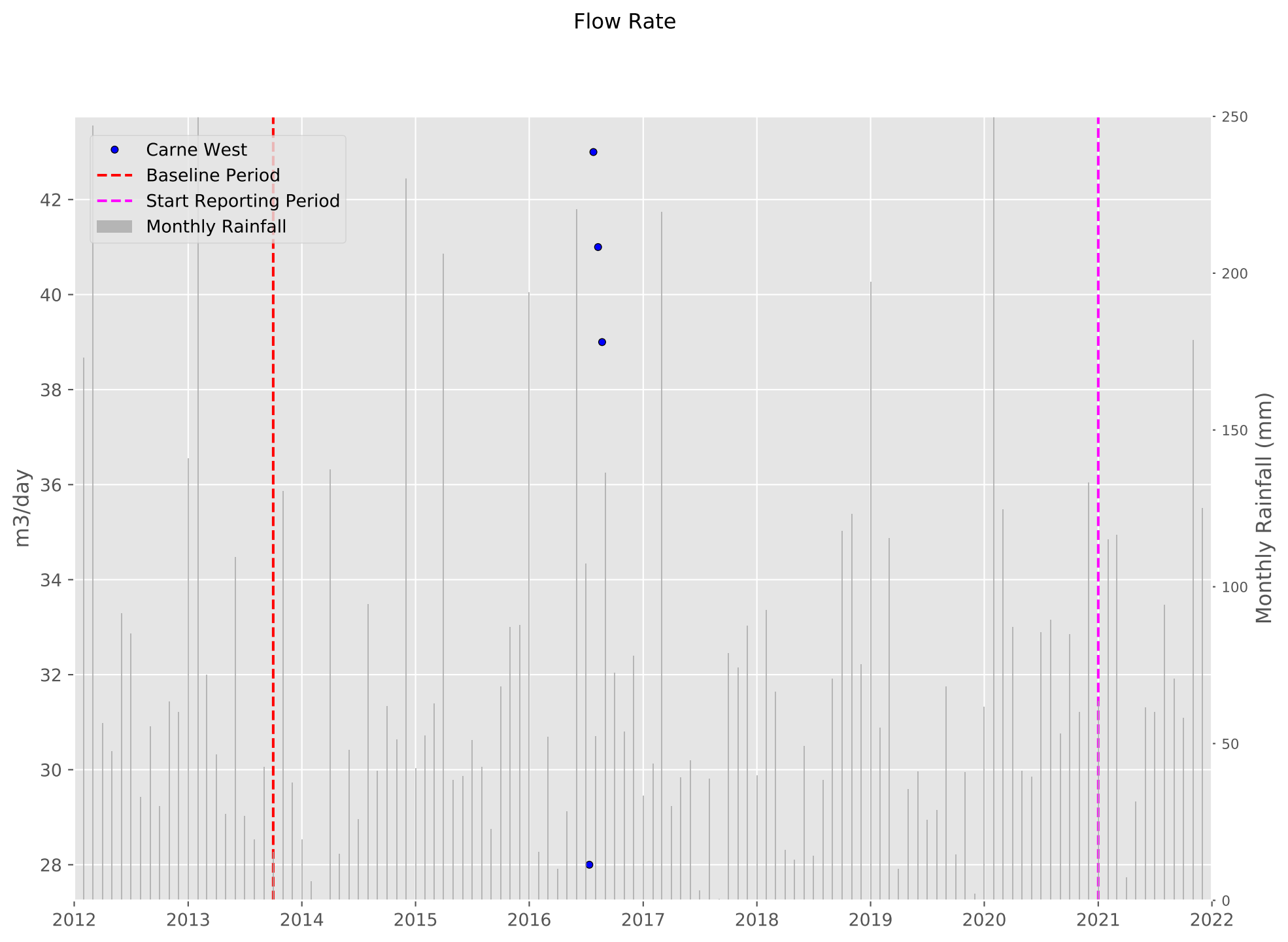

Iron
Carne Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

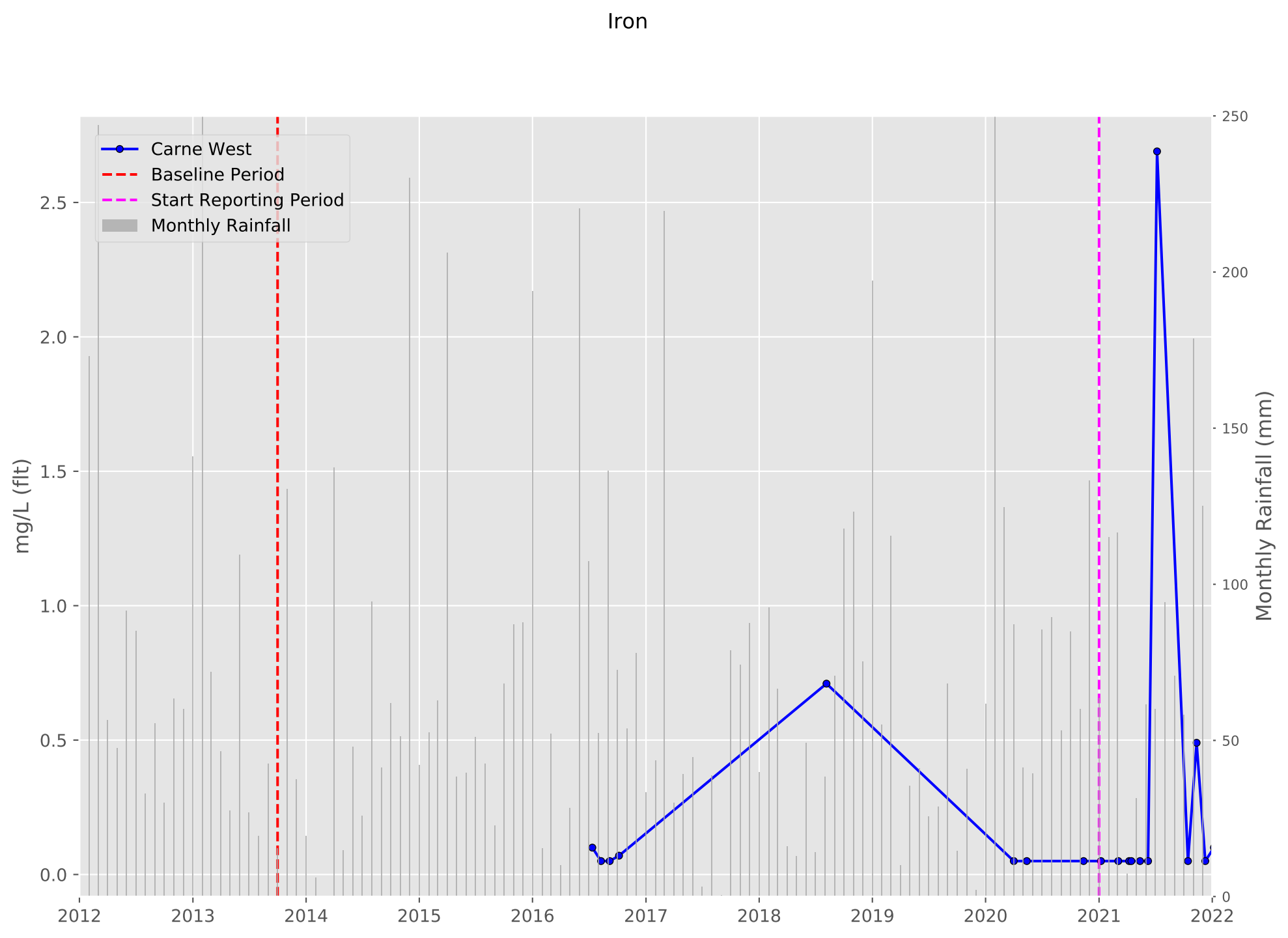

Manganese
Carne Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
1.0
0.8
0.6
0.4
0.2
0.0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


pH
Carne Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
8
7
6
5
4
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

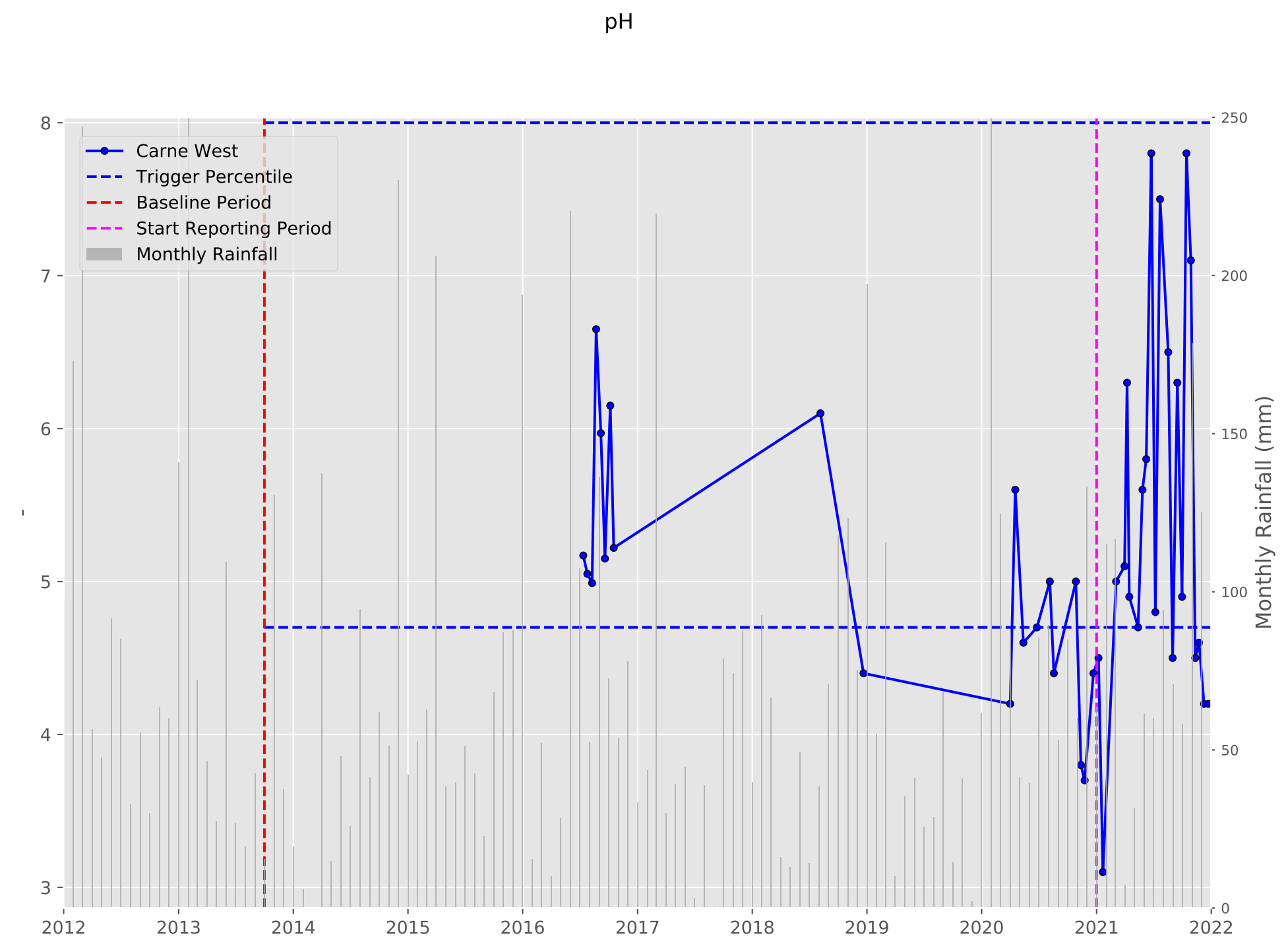

TSS
Carne Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

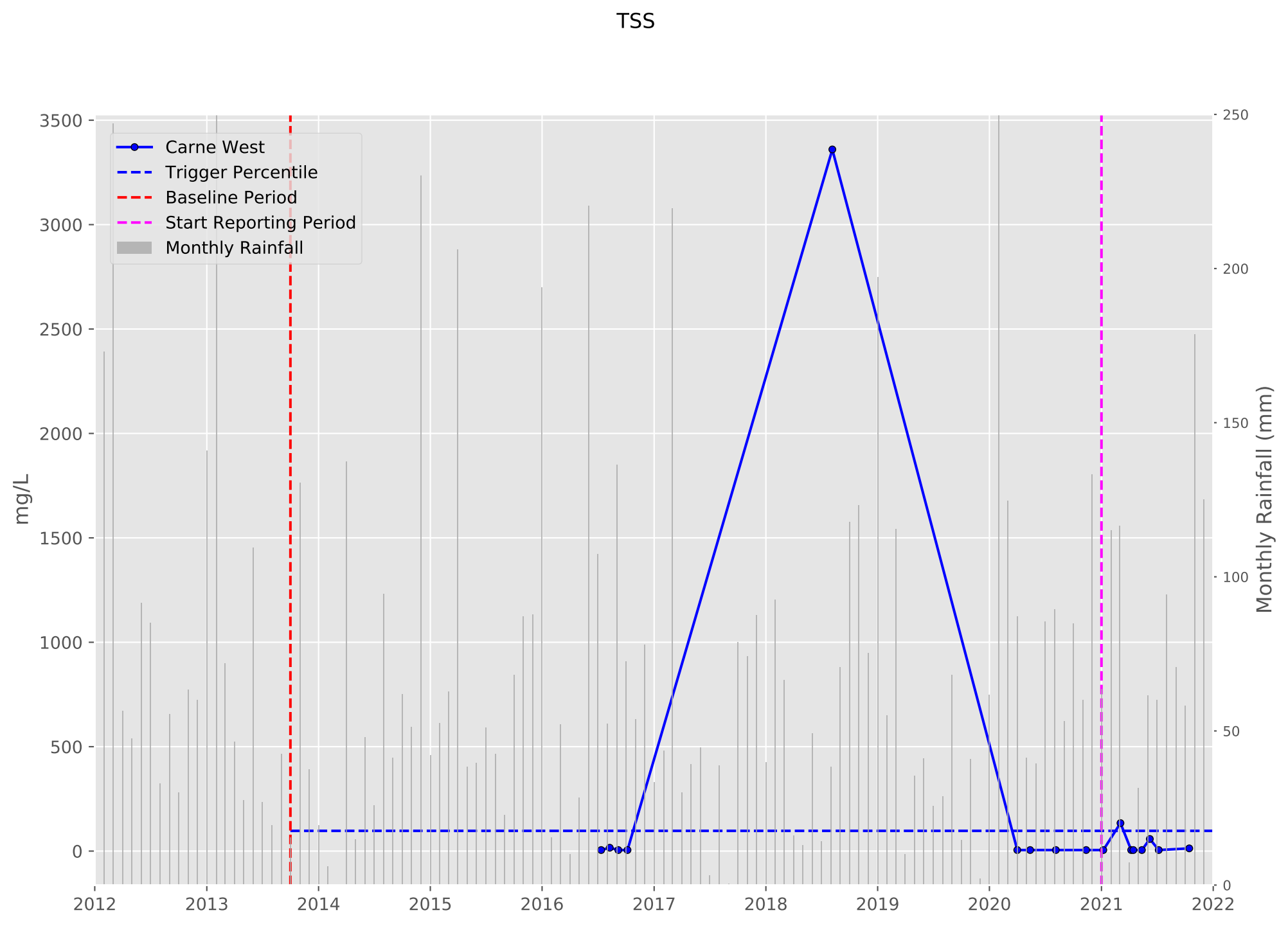

EC (field)
Carne West
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
200
400
600
800
1000
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

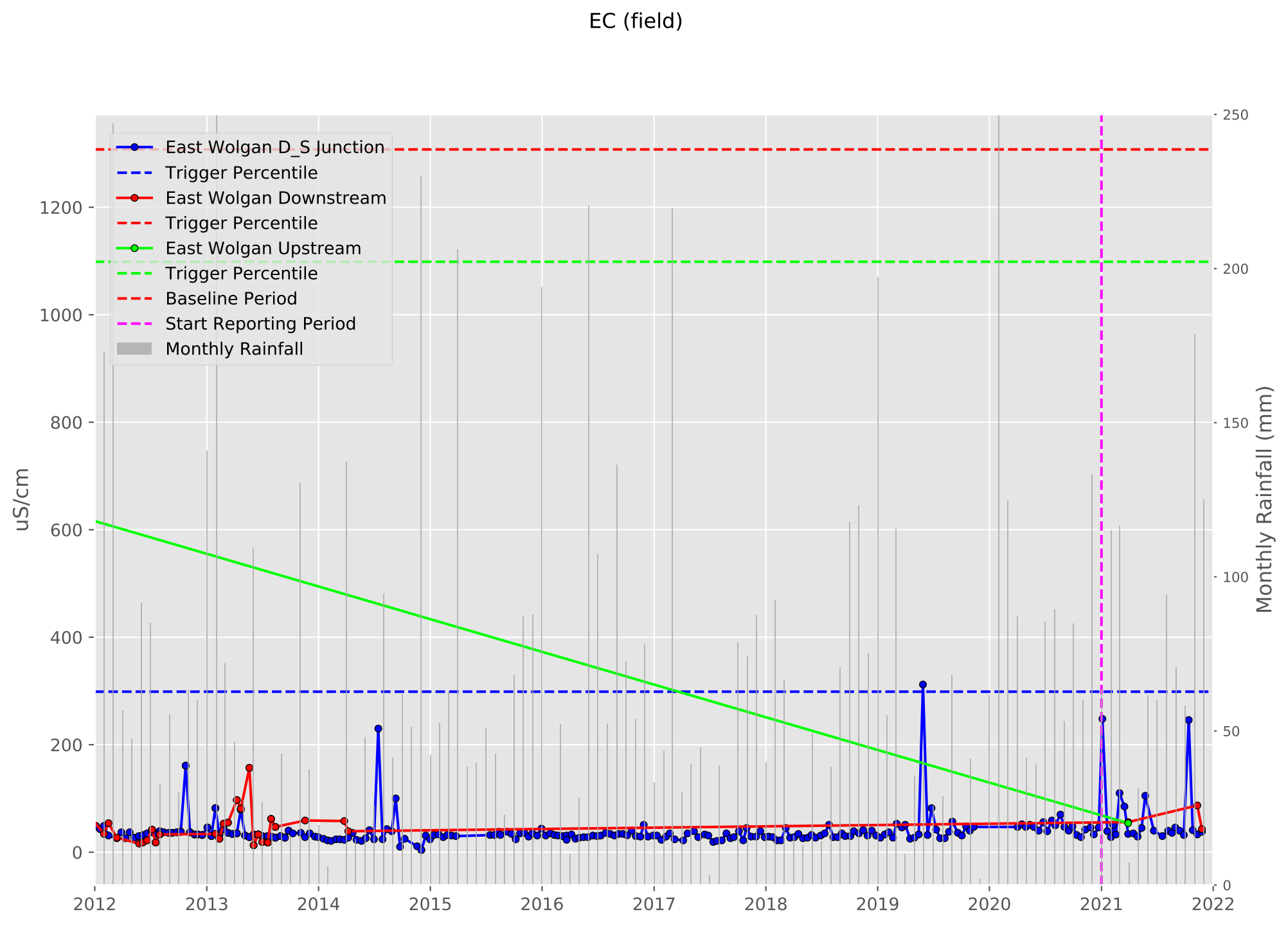

Flow Rate
Carne West
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
42
40
38
36
34
32
30
28
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

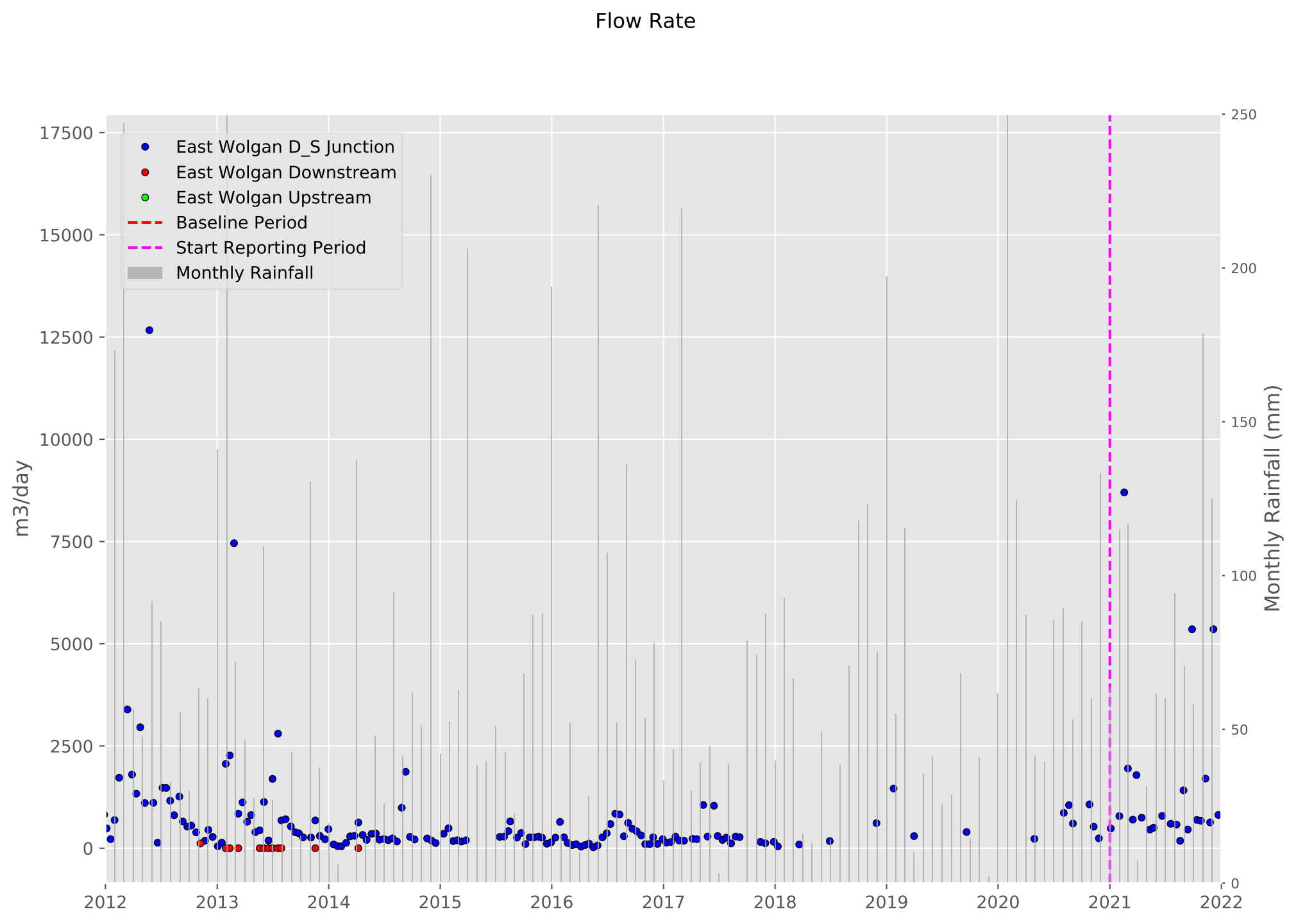

Iron
Carne West
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0
0.5
1.0
1.5
2.0
2.5
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

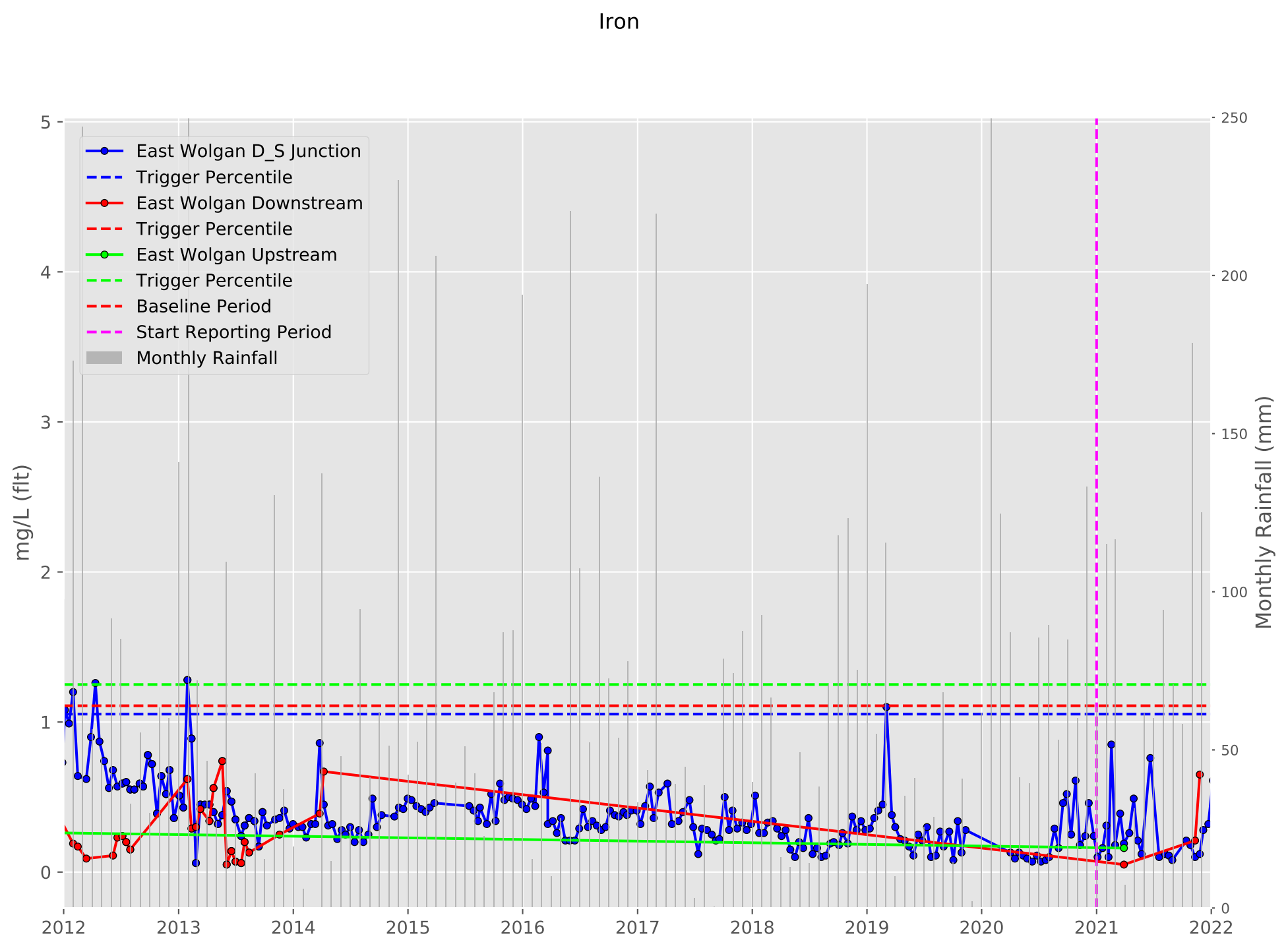

Manganese
Carne West
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.20
0.15
0.10
0.05
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

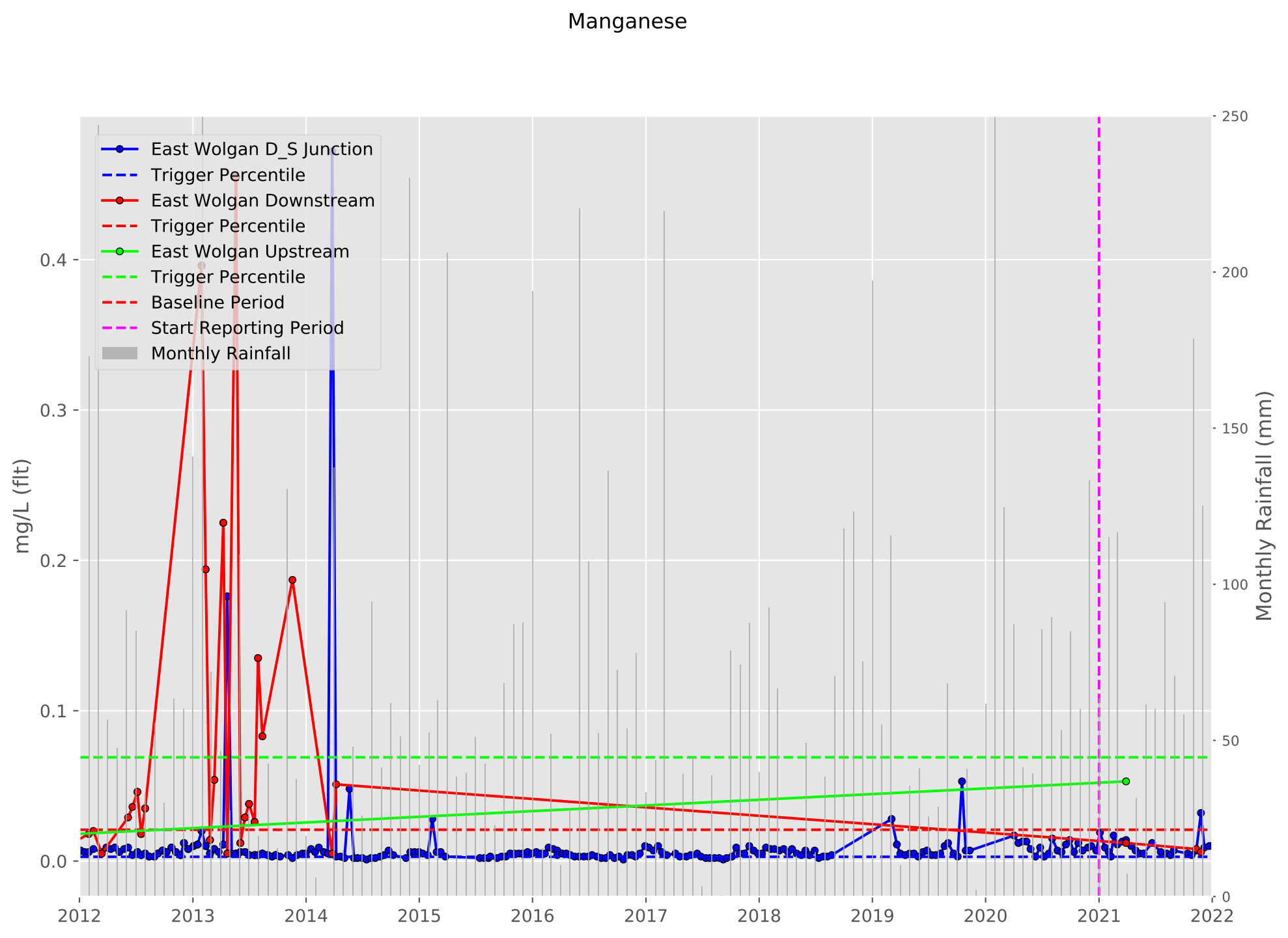

pH
Carne West
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

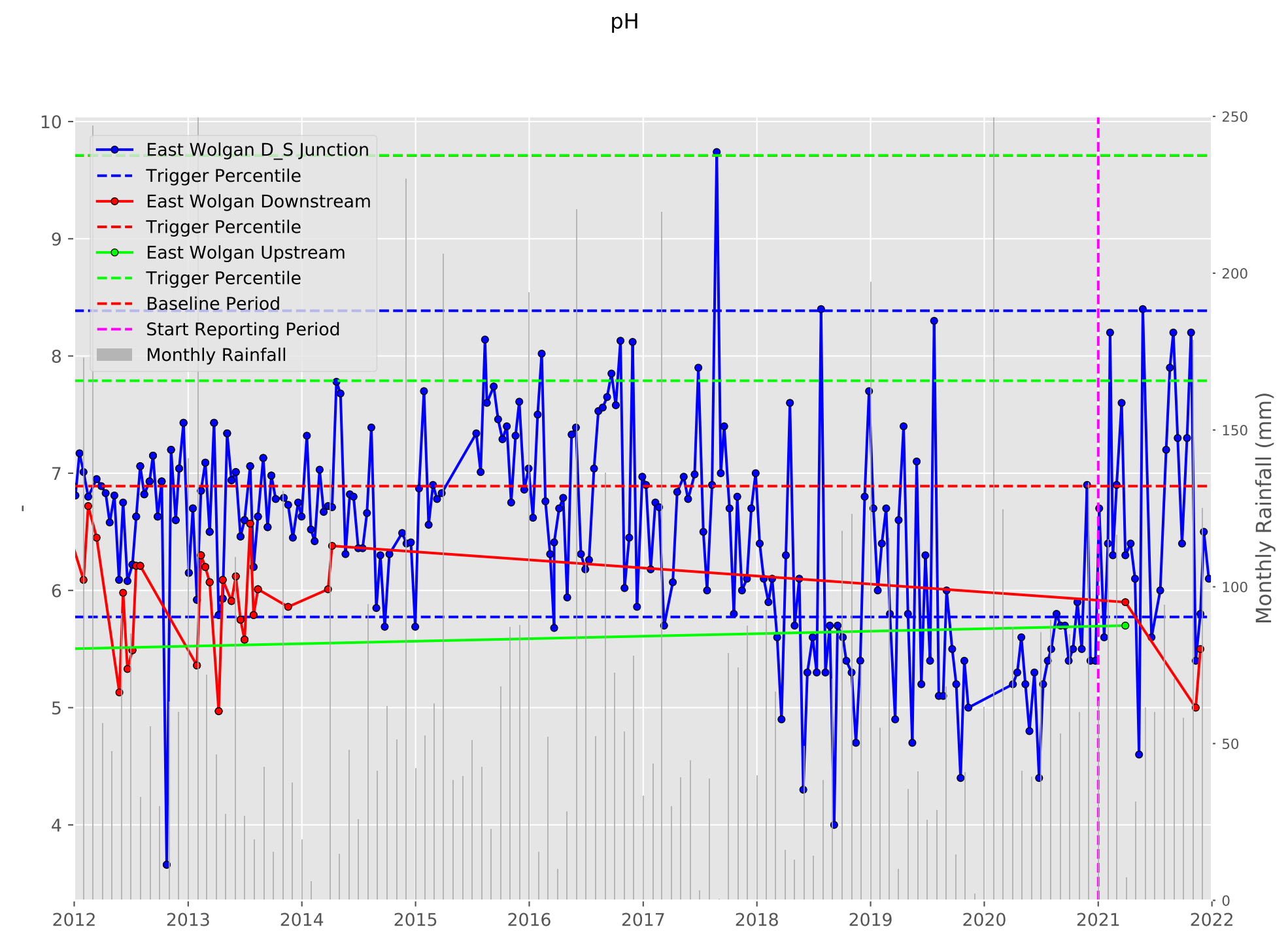

TSS
Carne West
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
3500
3000
2500
2000
1500
1000
500
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

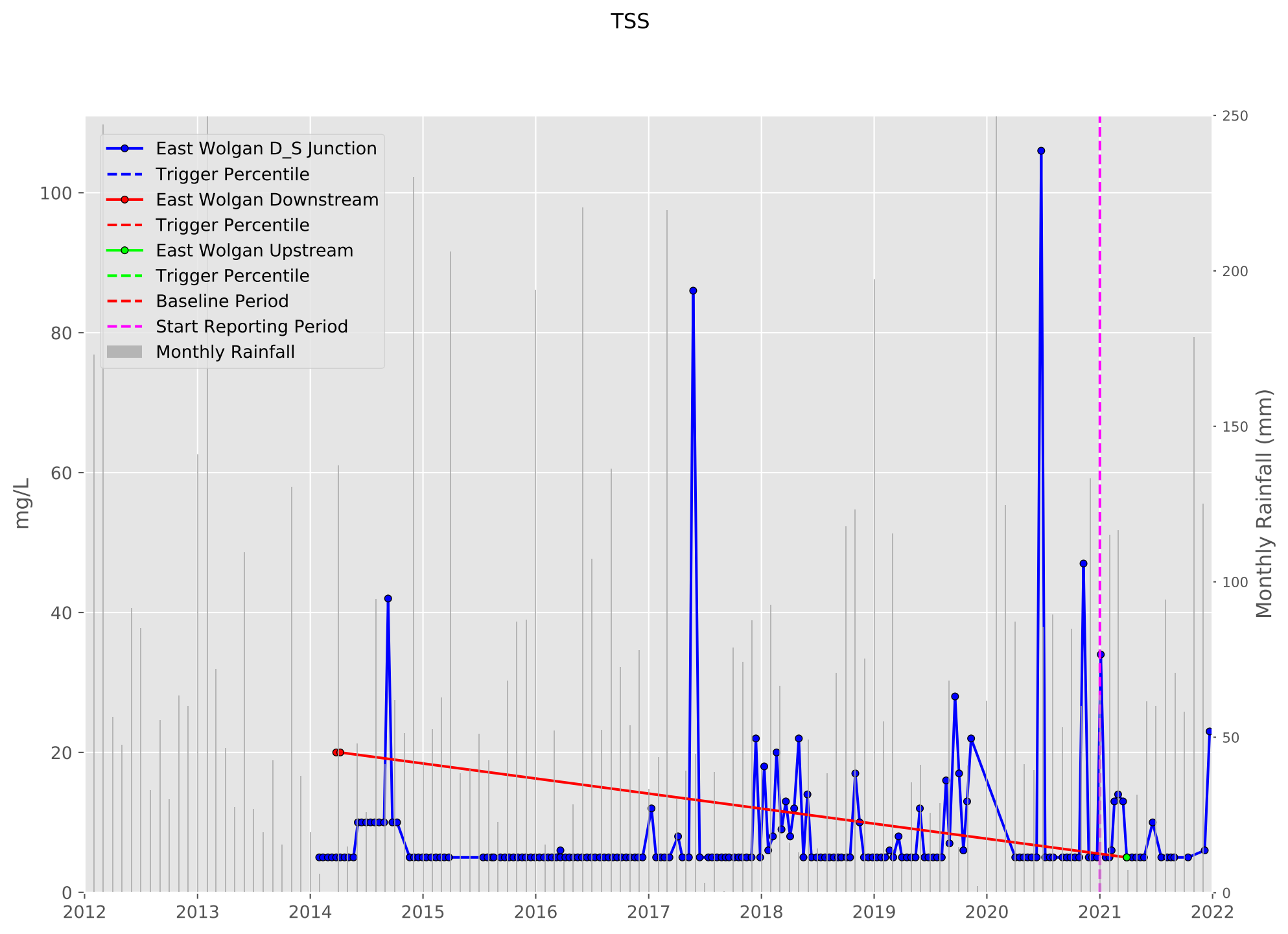

EC (field)
East Wolgan D_S Junction
Trigger Percentile
East Wolgan Downstream
Trigger Percentile
East Wolgan Upstream
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
200
400
600
800
1000
1200
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

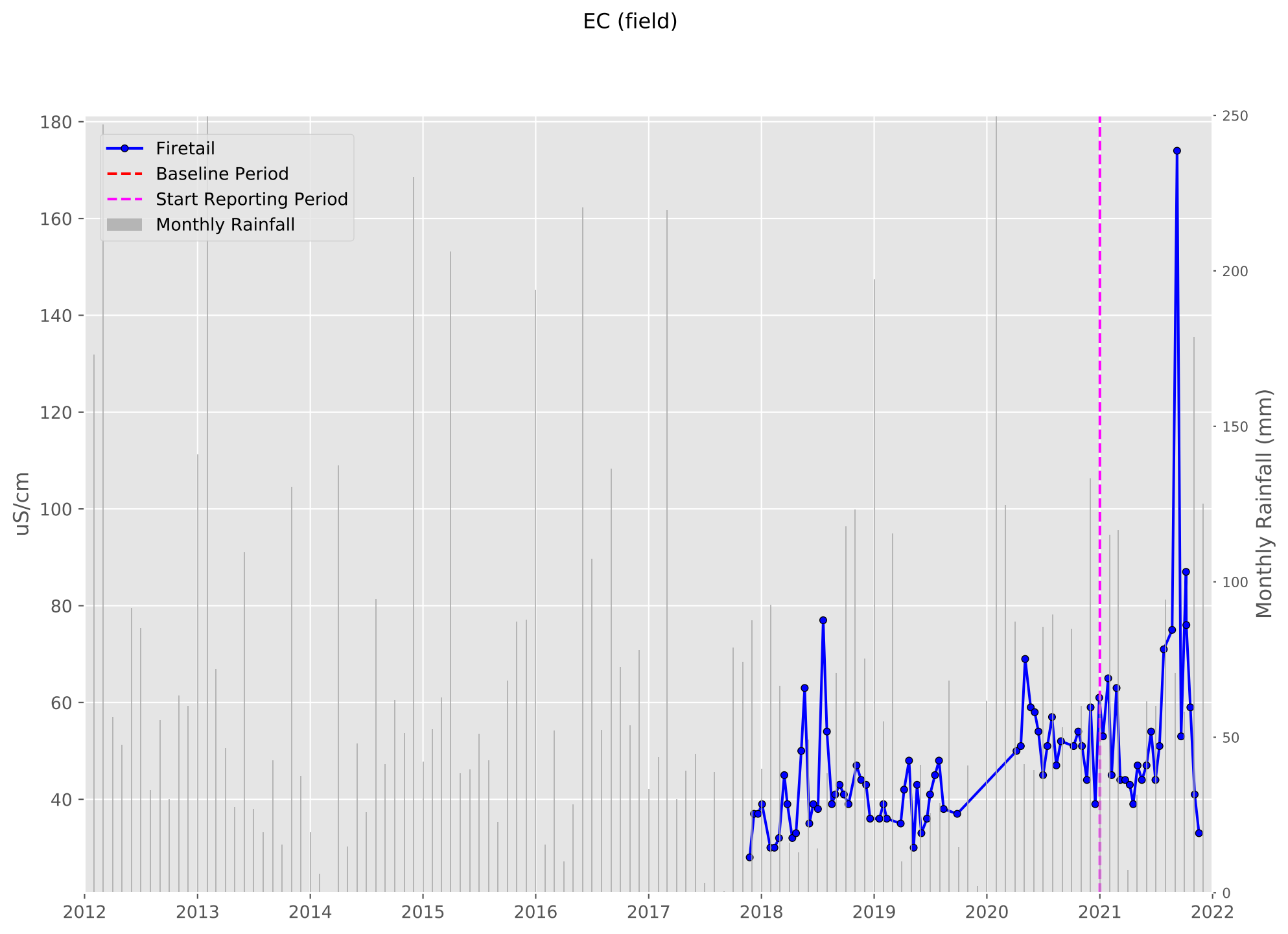

Flow Rate
East Wolgan D_S Junction
East Wolgan Downstream
East Wolgan Upstream
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
17500
15000
12500
10000
7500
5000
2500
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

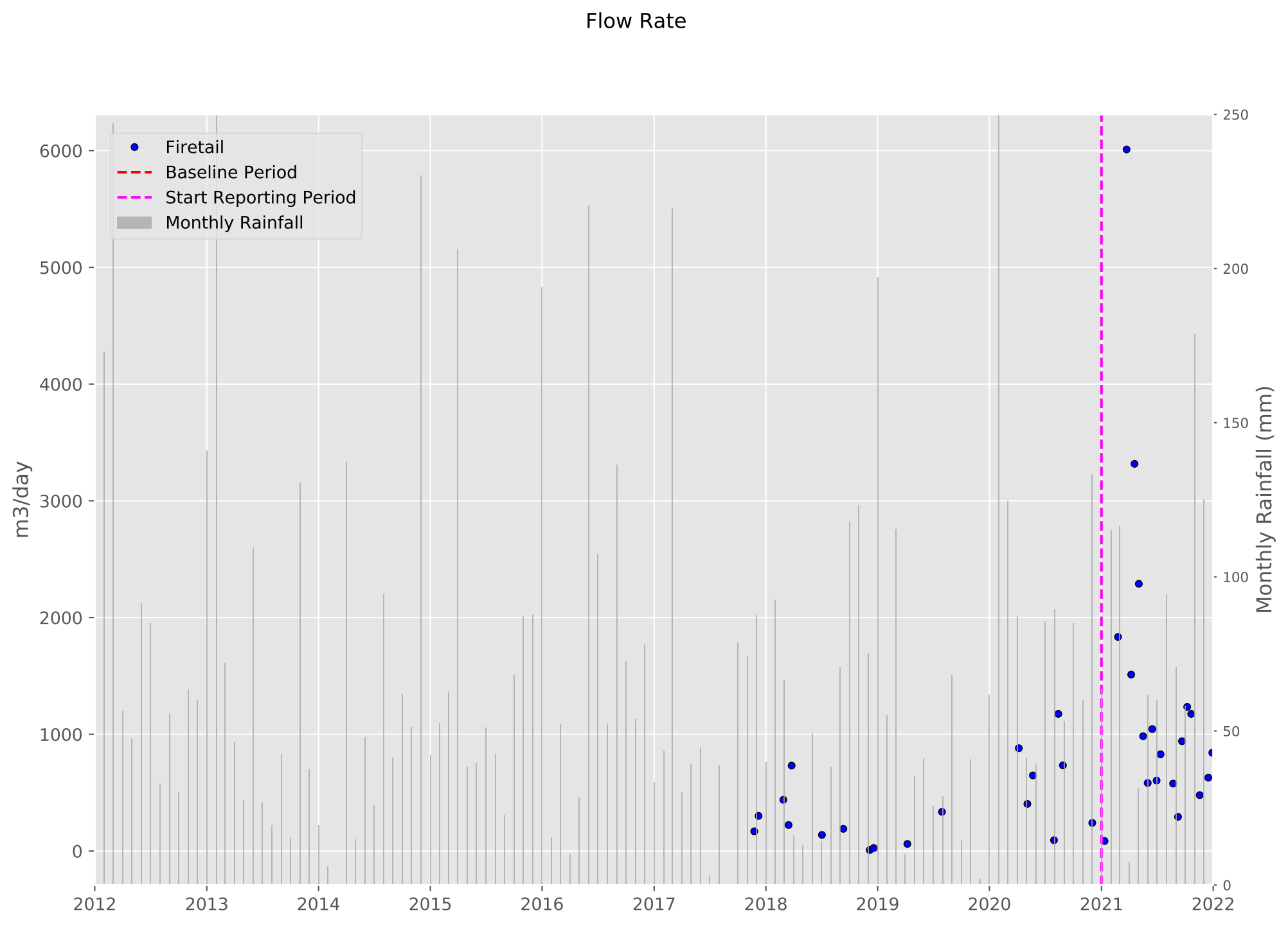

Iron
East Wolgan D_S Junction
Trigger Percentile
East Wolgan Downstream
Trigger Percentile
East Wolgan Upstream
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
1
2
3
4
5
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

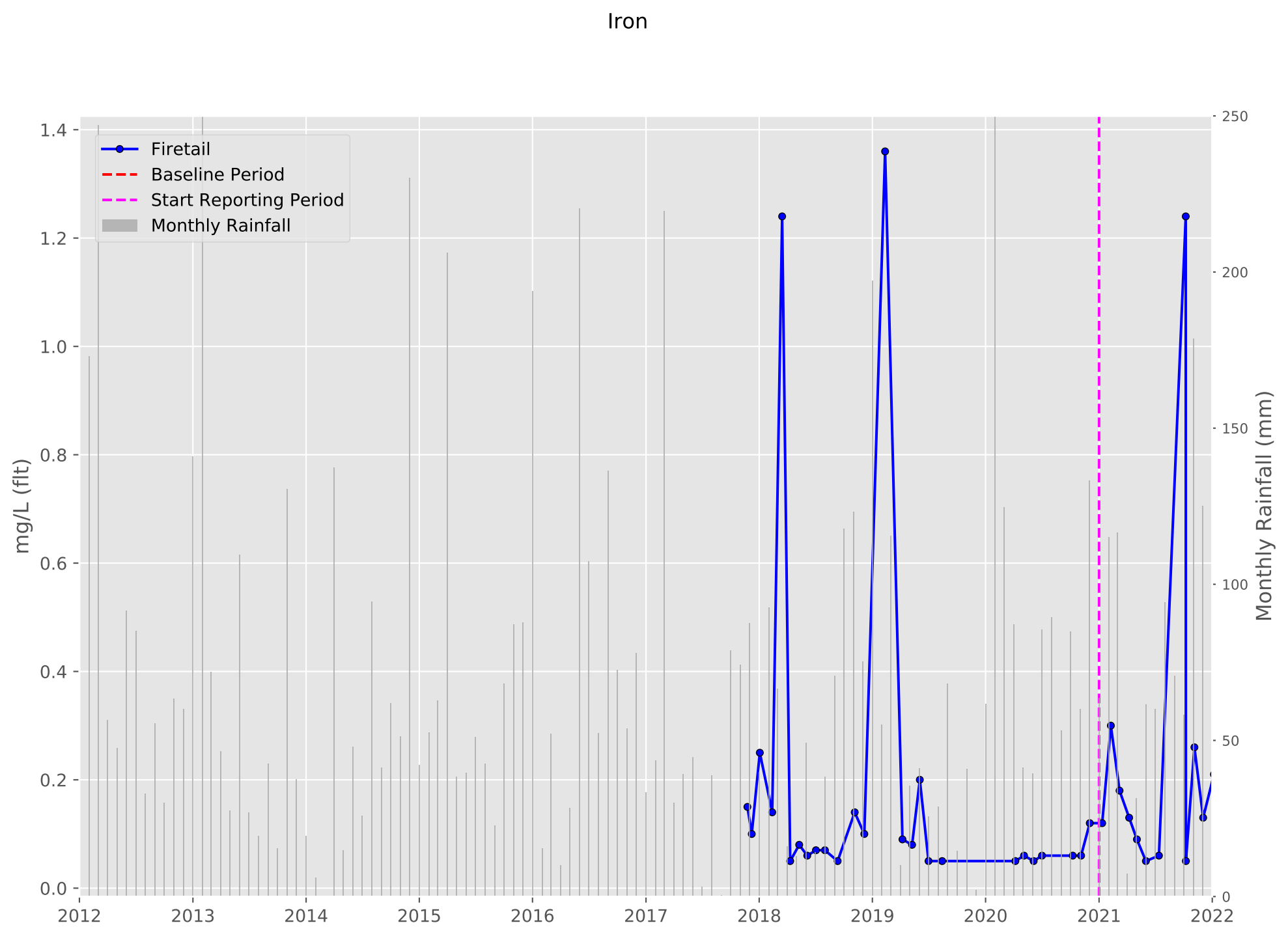

Manganese
East Wolgan D_S Junction
Trigger Percentile
East Wolgan Downstream
Trigger Percentile
East Wolgan Upstream
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0
0.1
0.2
0.3
0.4
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

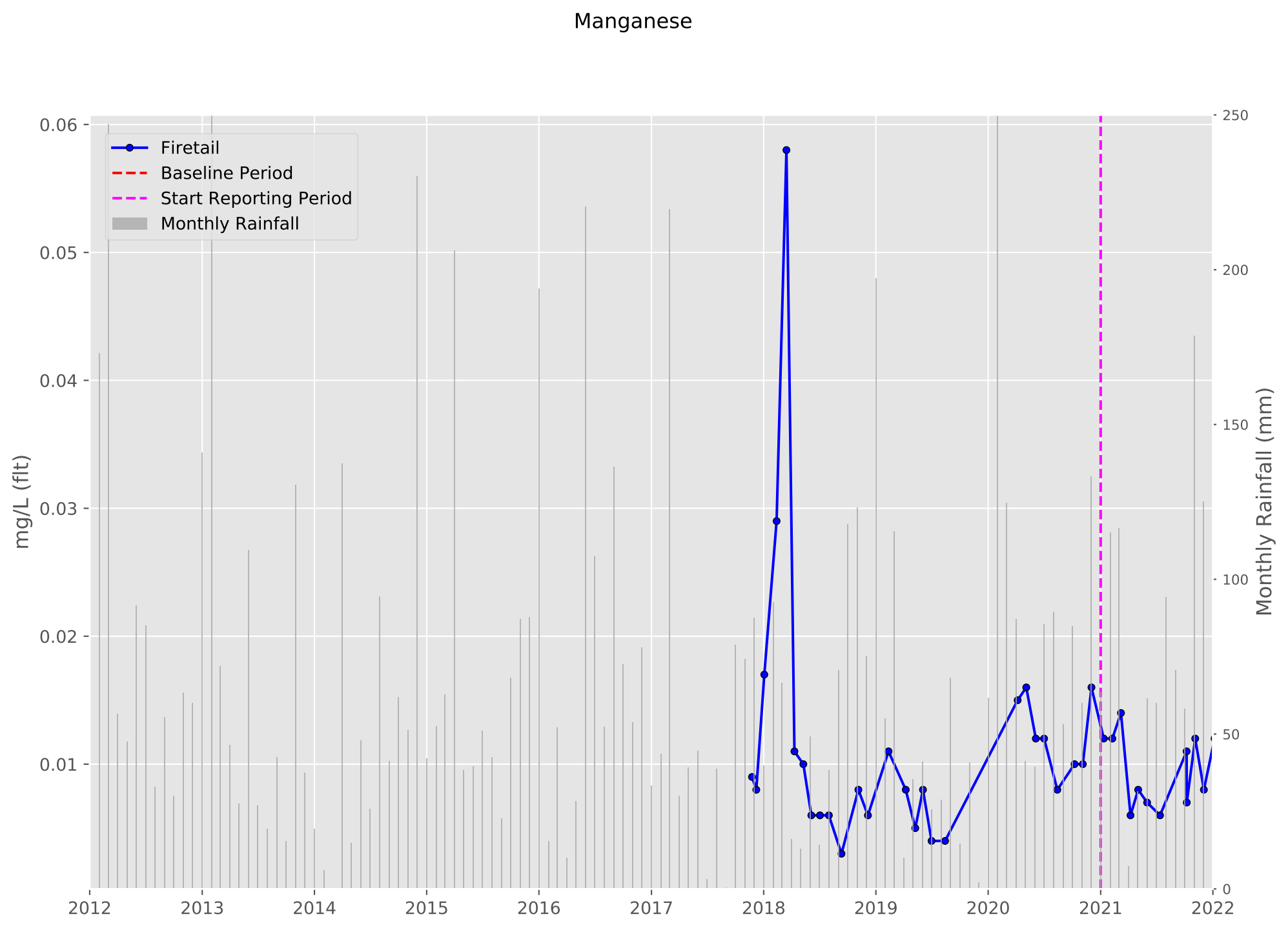

pH
East Wolgan D_S Junction
Trigger Percentile
East Wolgan Downstream
Trigger Percentile
East Wolgan Upstream
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
10
9
8
7
6
5
4
-
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

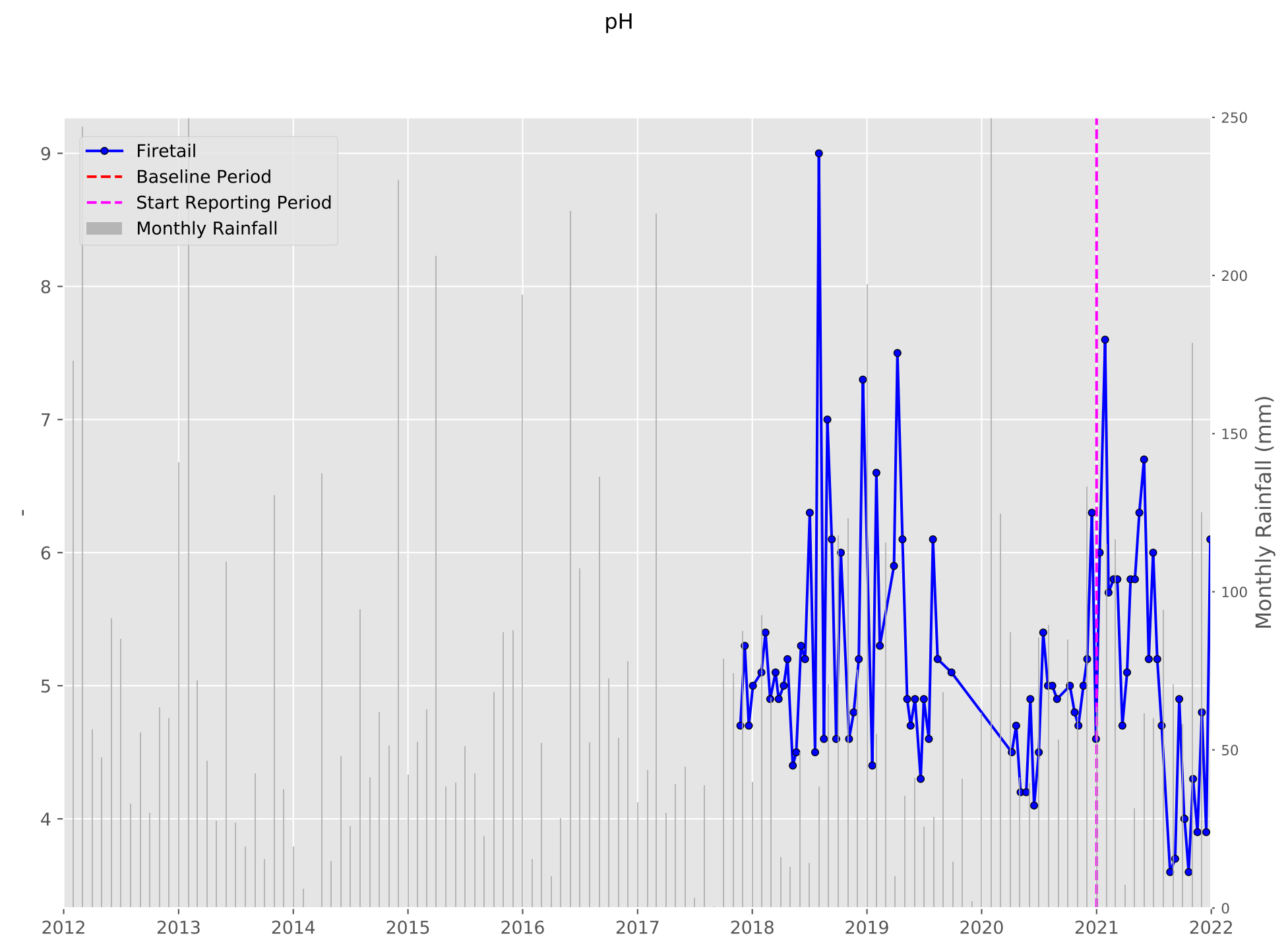

TSS
East Wolgan D_S Junction
Trigger Percentile
East Wolgan Downstream
Trigger Percentile
East Wolgan Upstream
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0
20
40
60
80
100
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

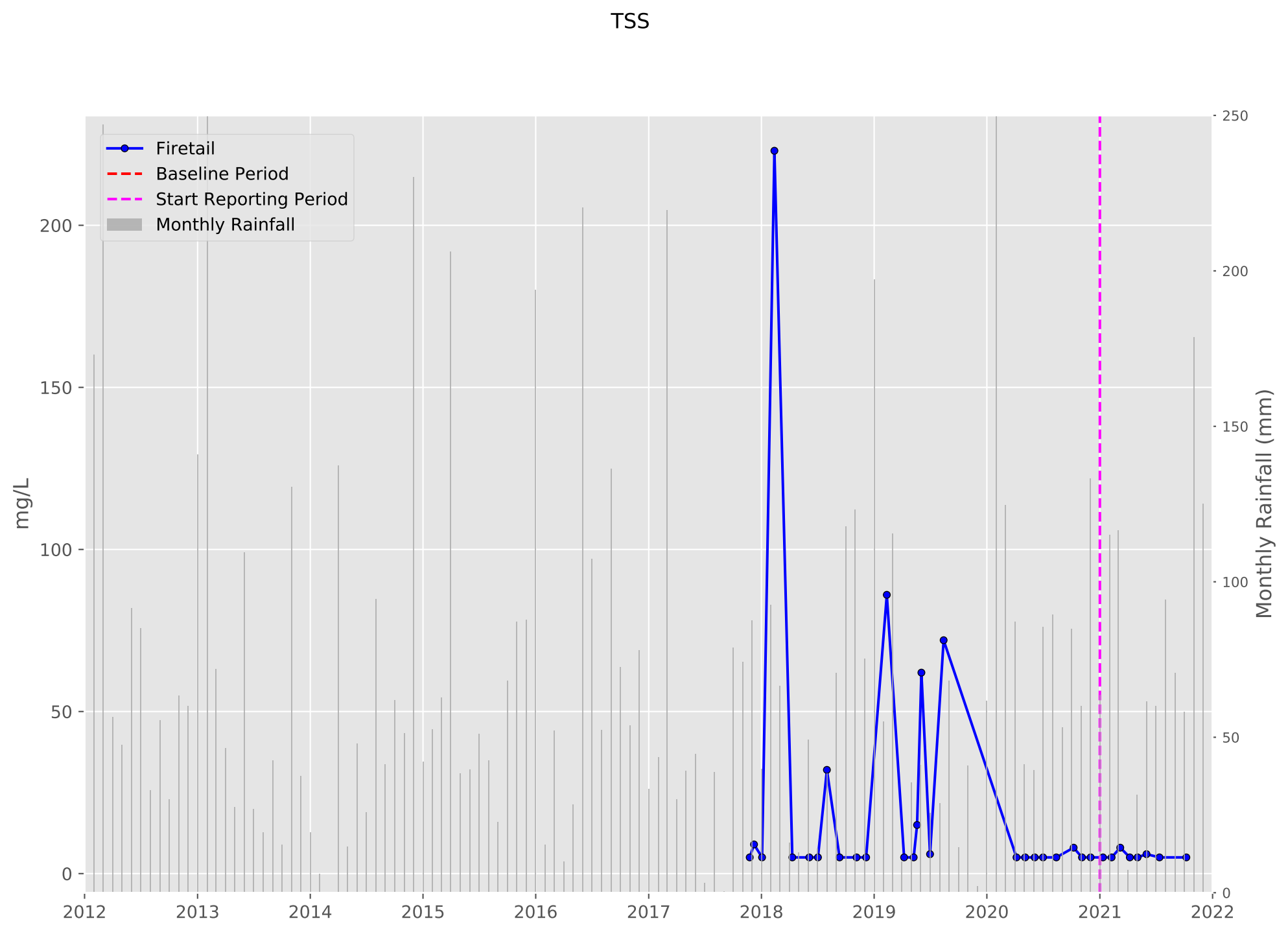

EC (field)
Firetail
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
180
160
140
120
100
80
60
40
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

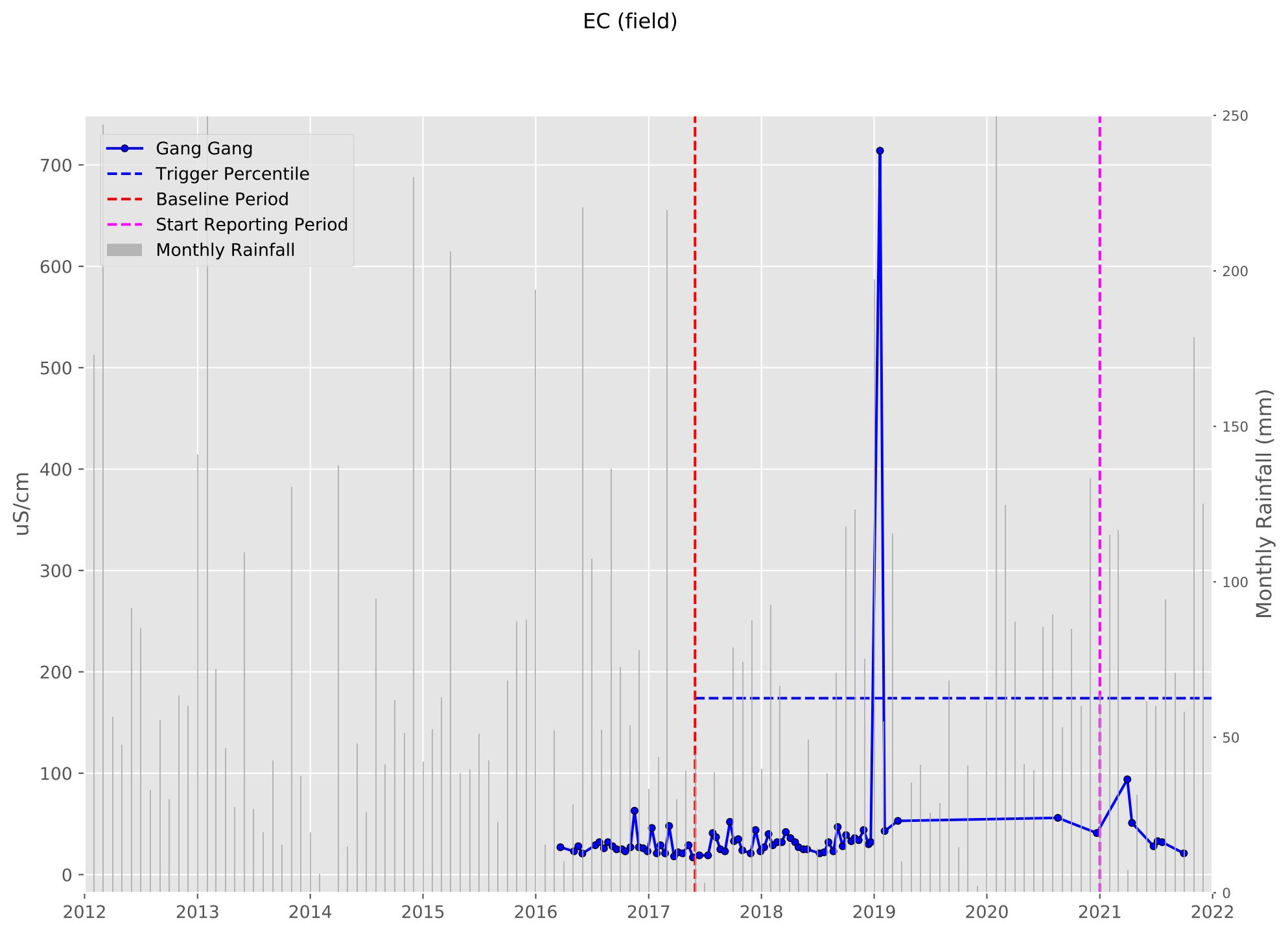

Flow Rate
Firetail
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
6000
5000
4000
3000
2000
1000
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


Iron
Firetail
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

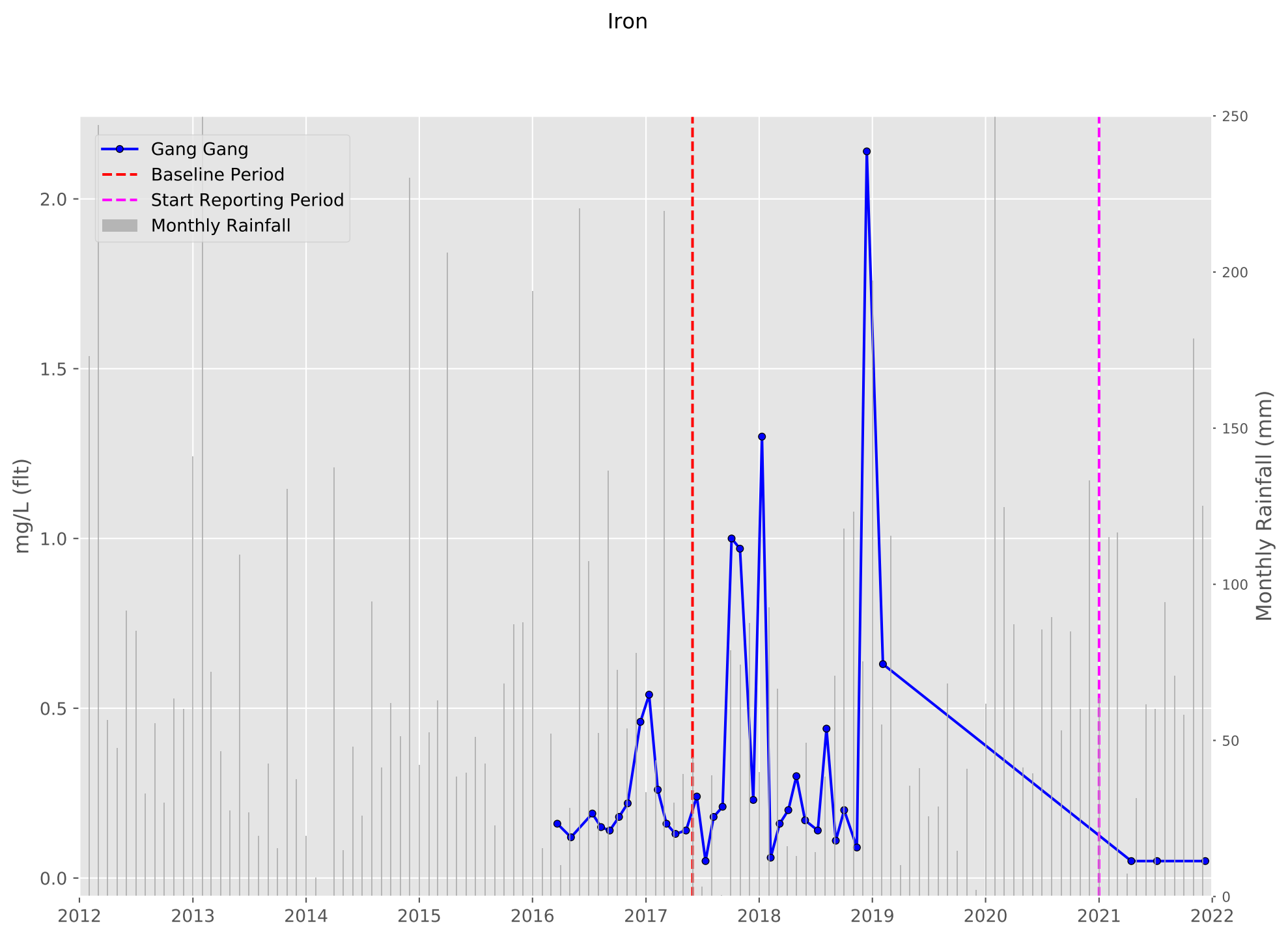

Manganese
Firetail
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.06
0.05
0.04
0.03
0.02
0.01
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

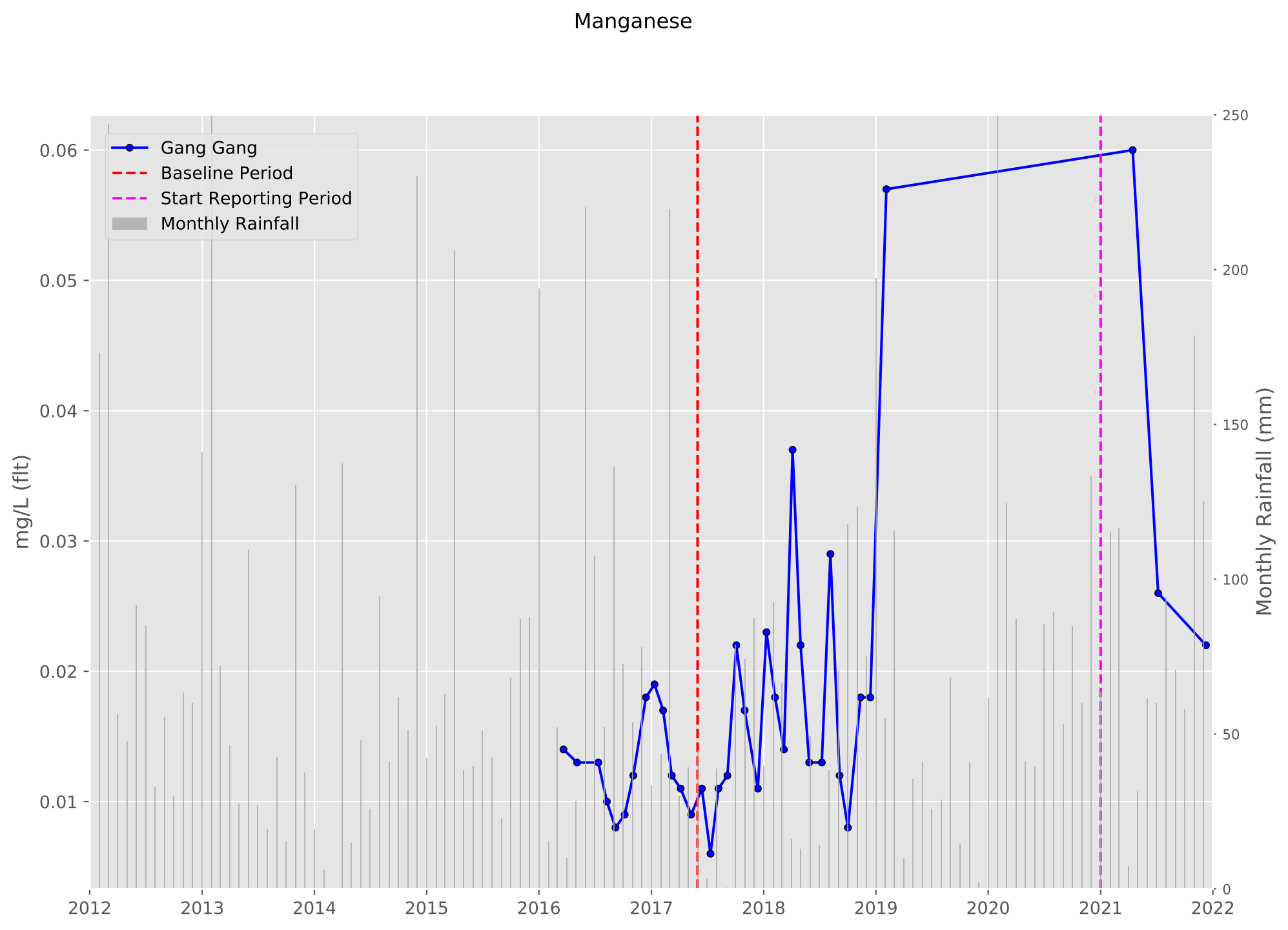

pH
Firetail
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
9
8
7
6
5
4
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

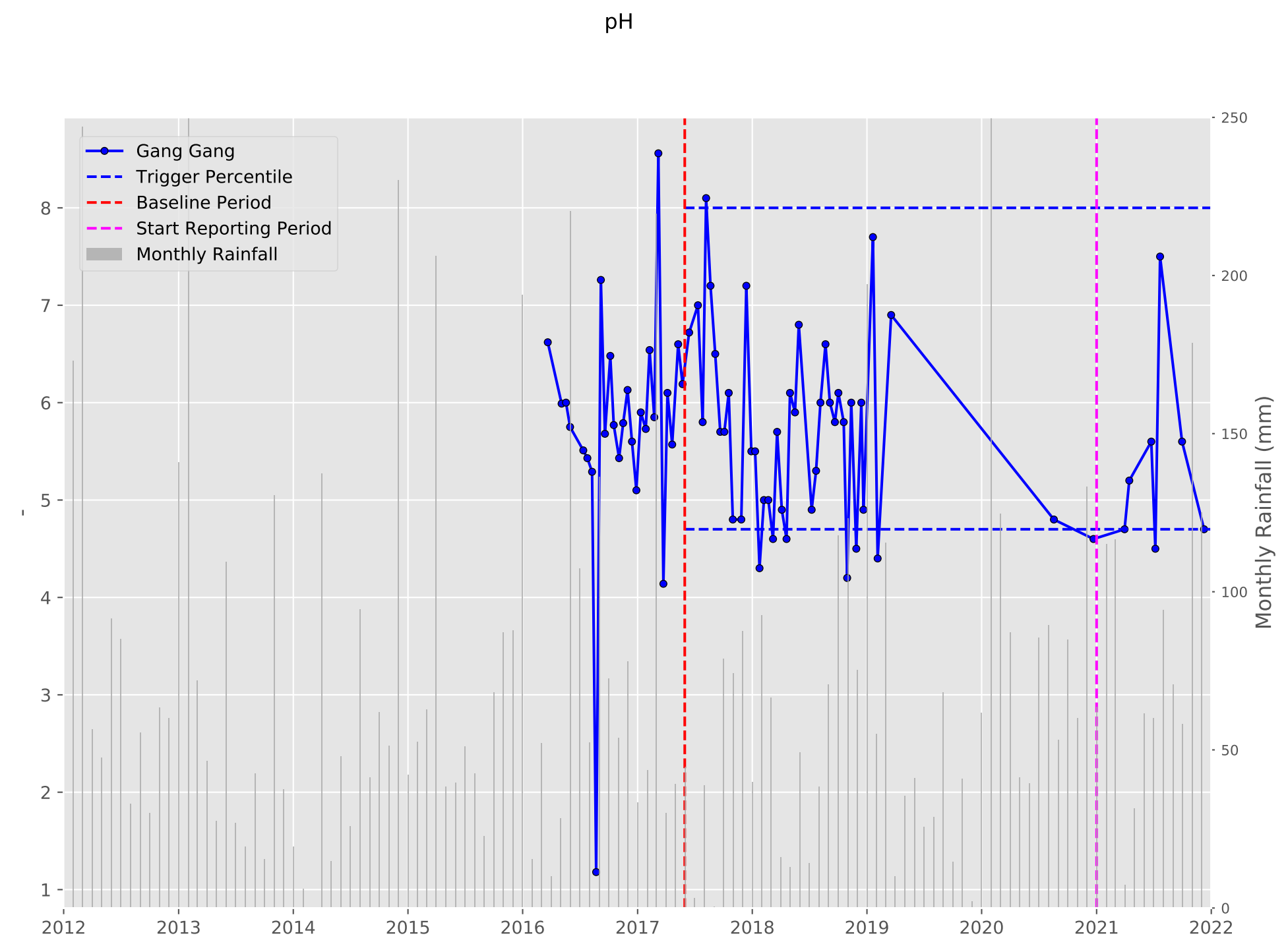

TSS
Firetail
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

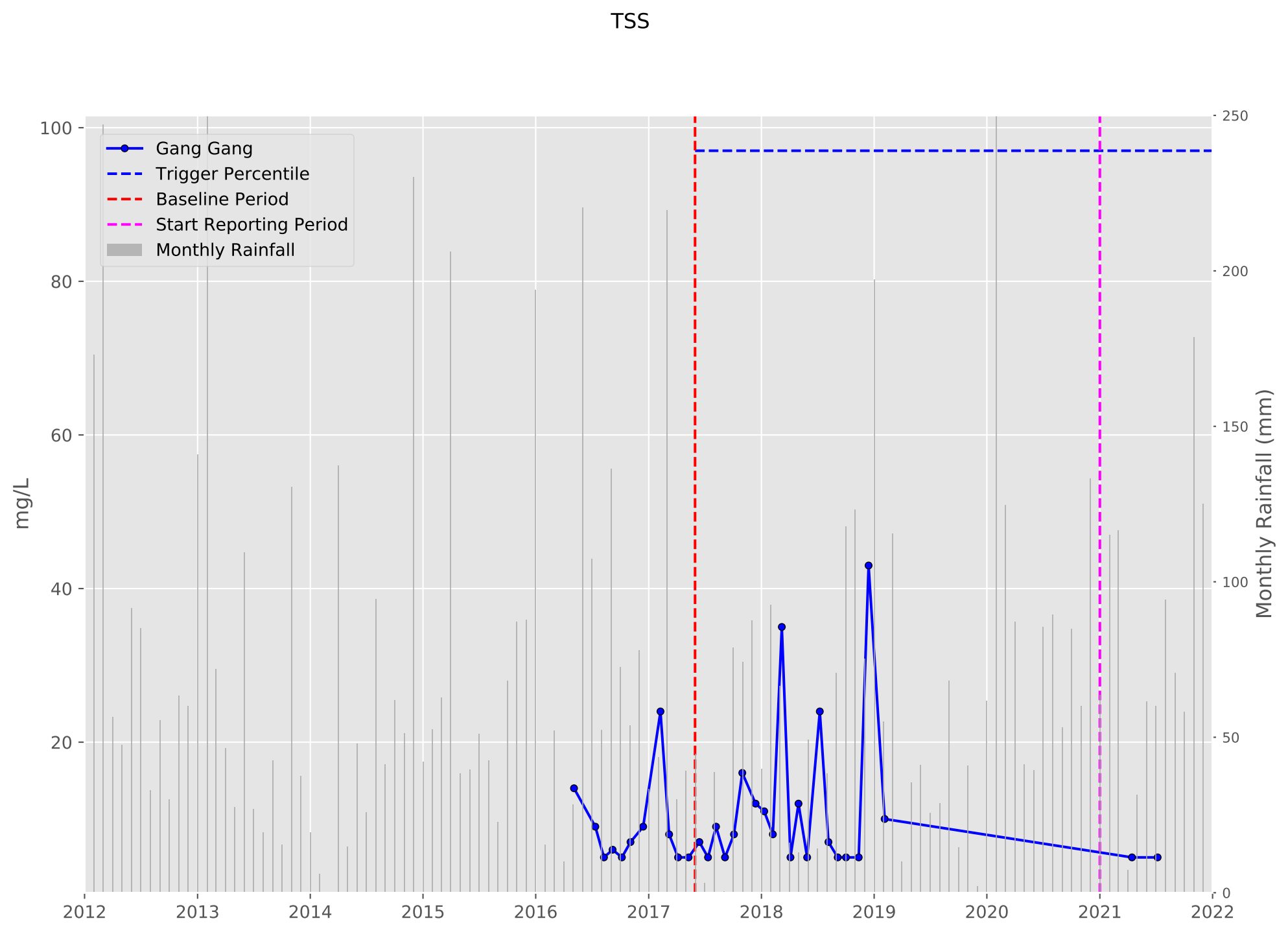

EC (field)
Gang Gang
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
100
200
300
400
500
600
700
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

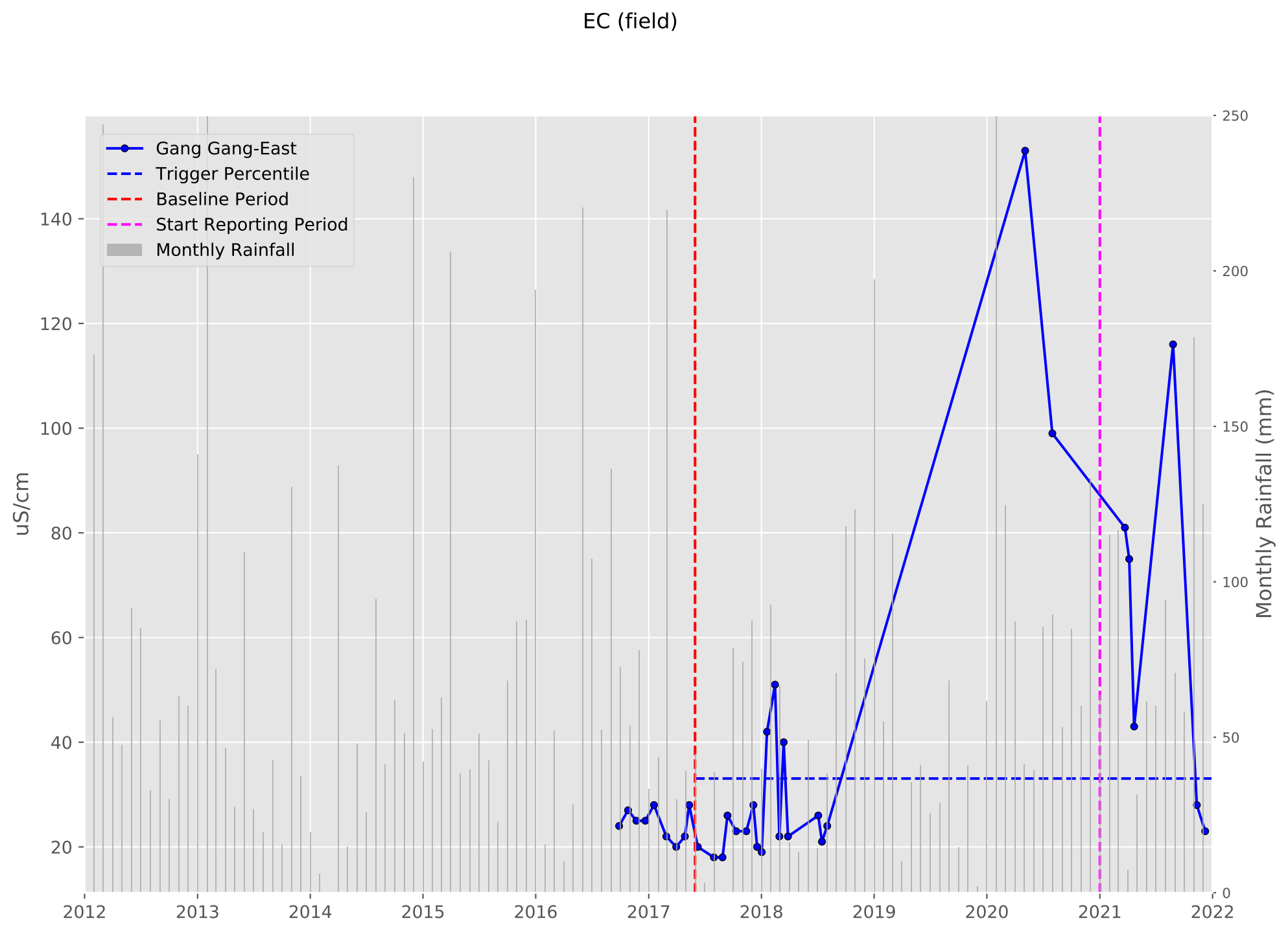

Flow Rate
Gang Gang
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
1000
800
600
400
200
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

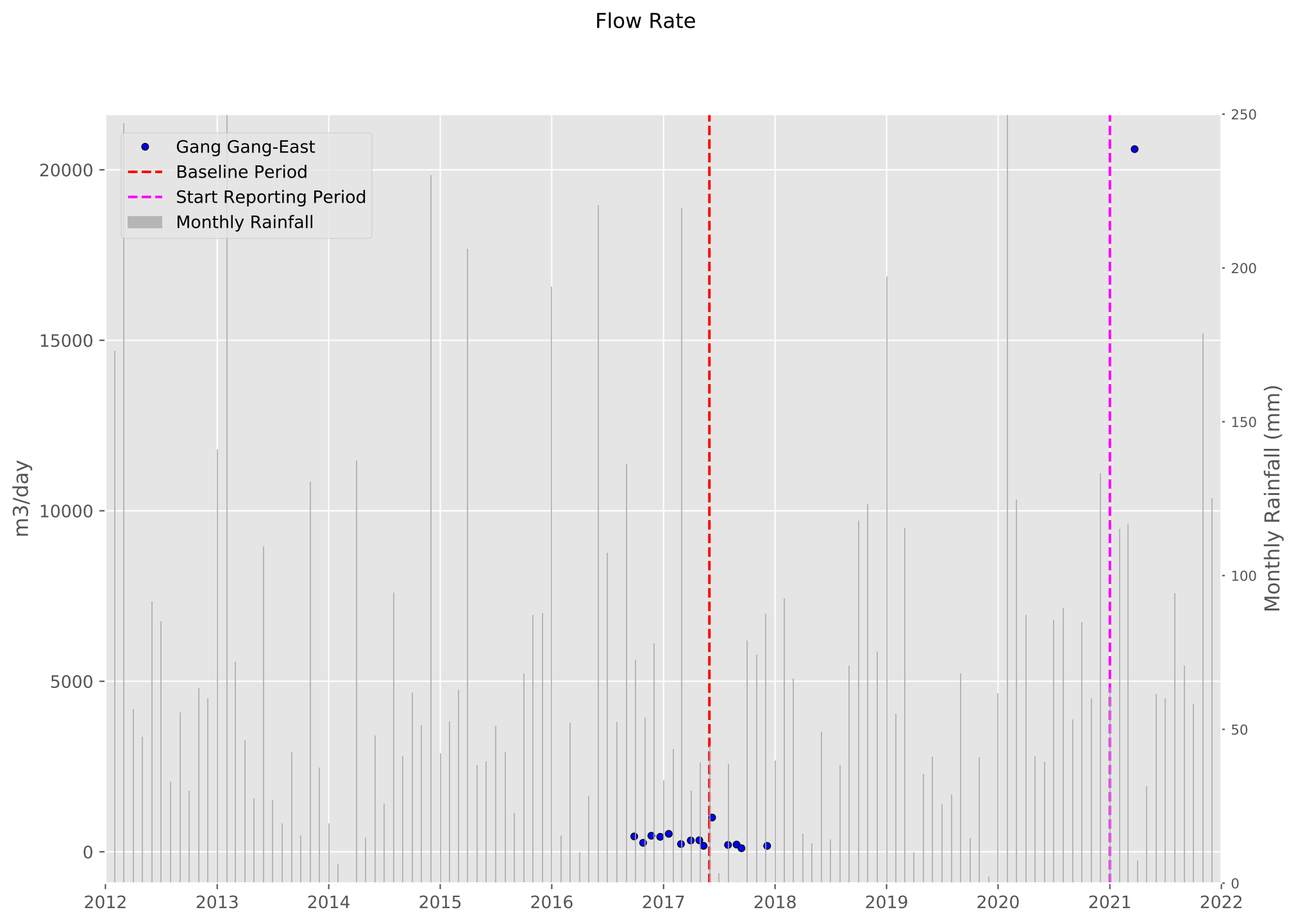

Iron
Gang Gang
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0
0.5
1.0
1.5
2.0
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

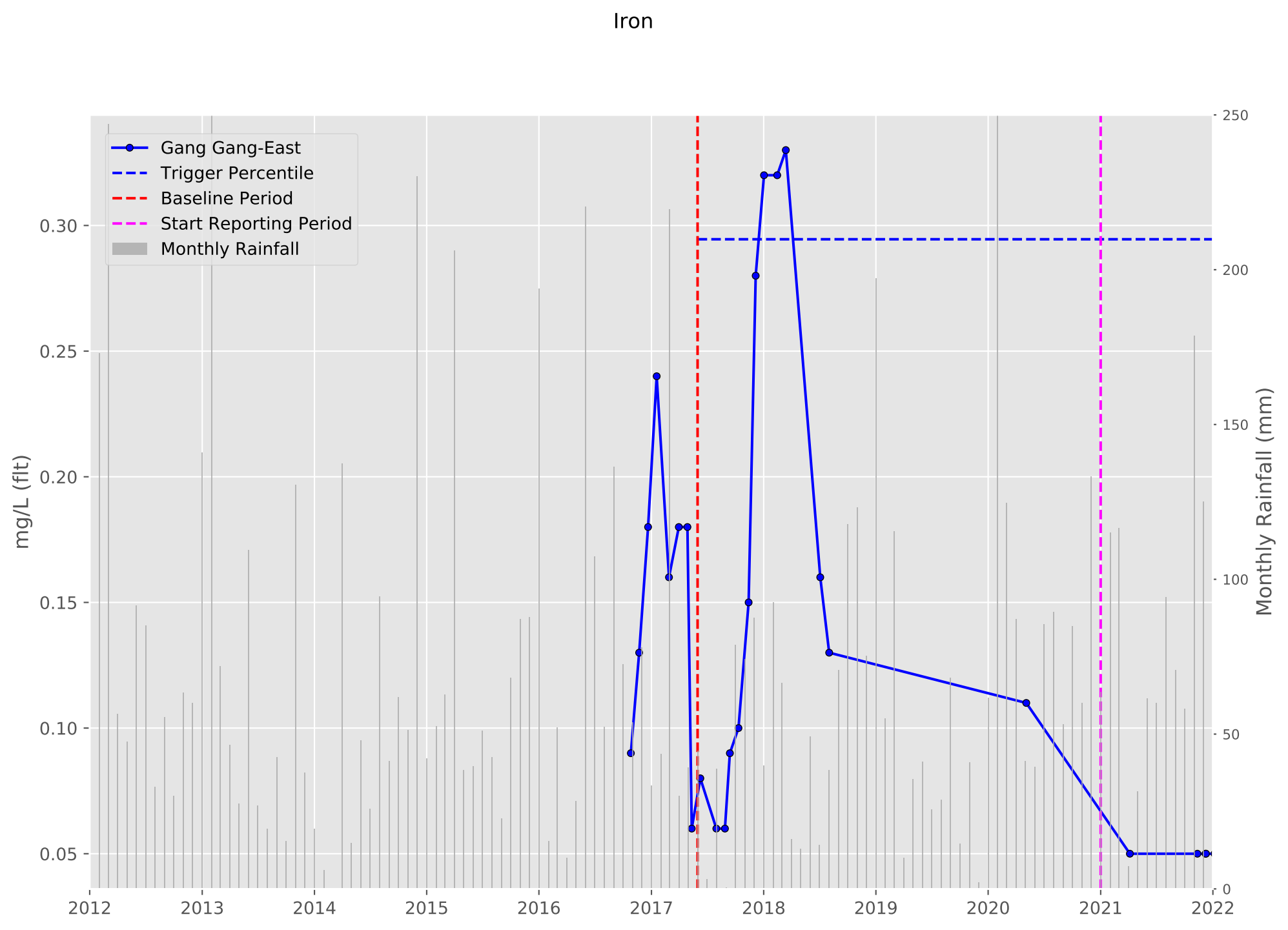

Manganese
Gang Gang
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.06
0.05
0.04
0.03
0.02
0.01
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

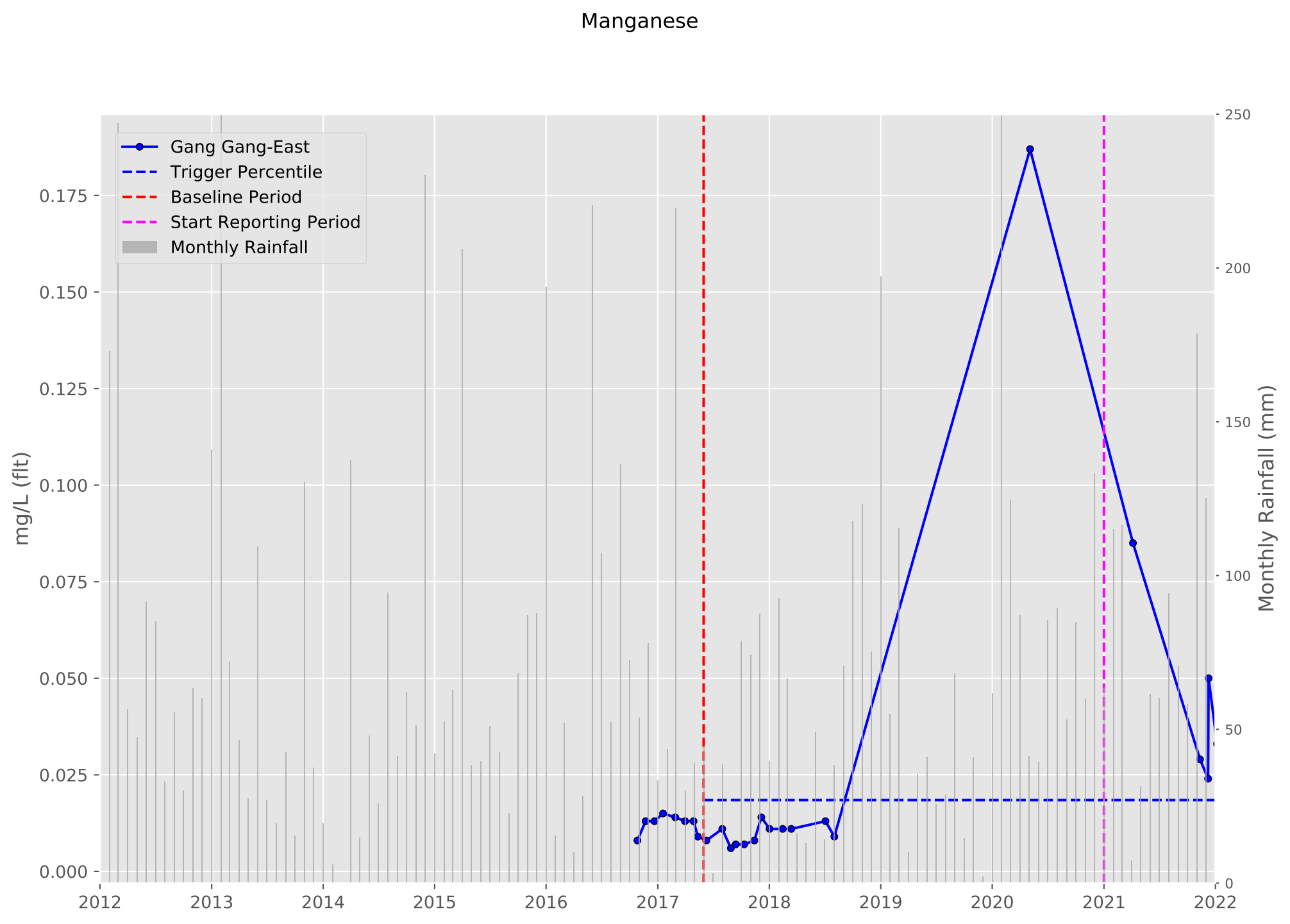

pH
Gang Gang
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
1
2
3
4
5
6
7
8
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

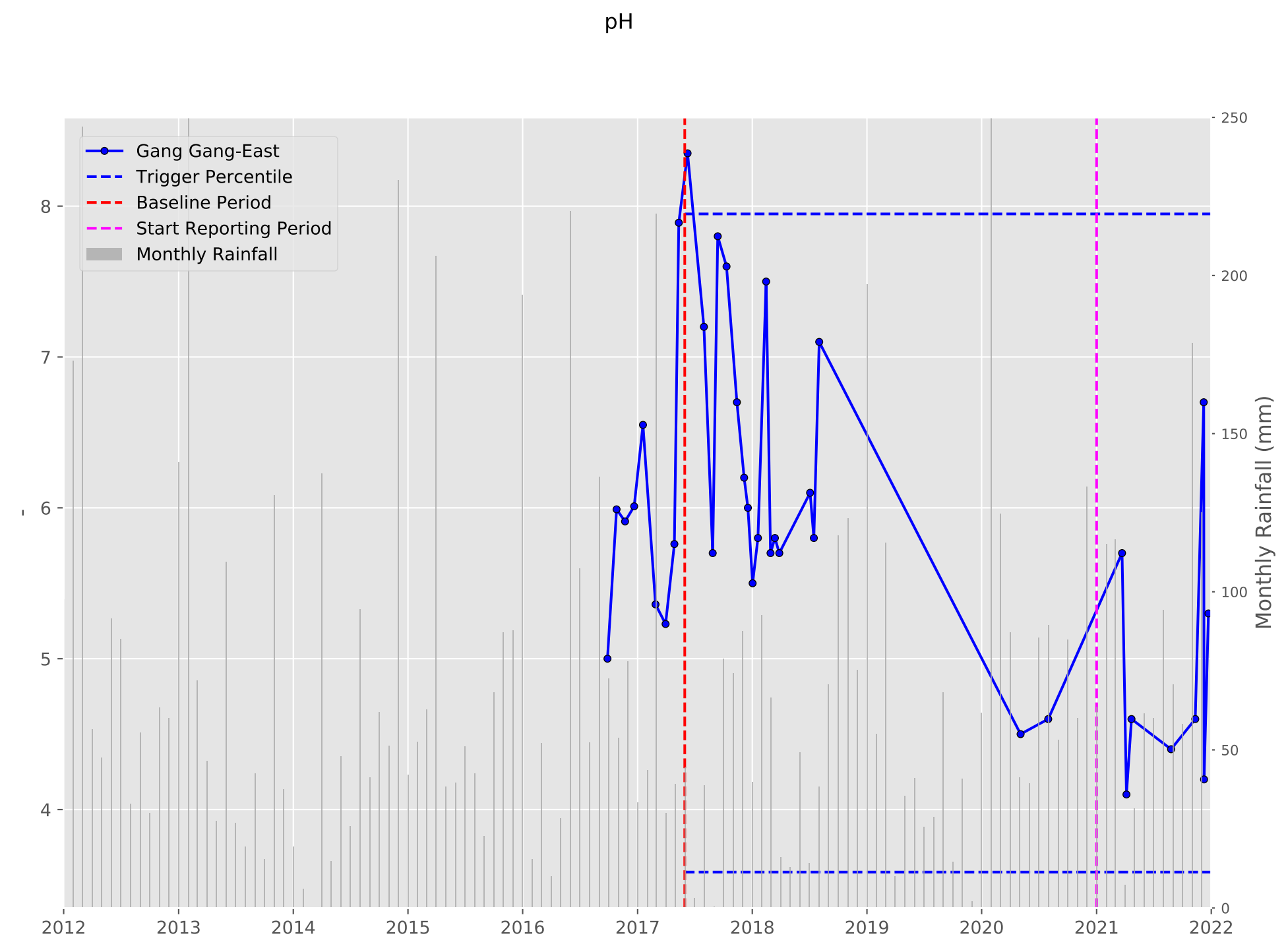

TSS
Gang Gang
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
100
80
60
40
20
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

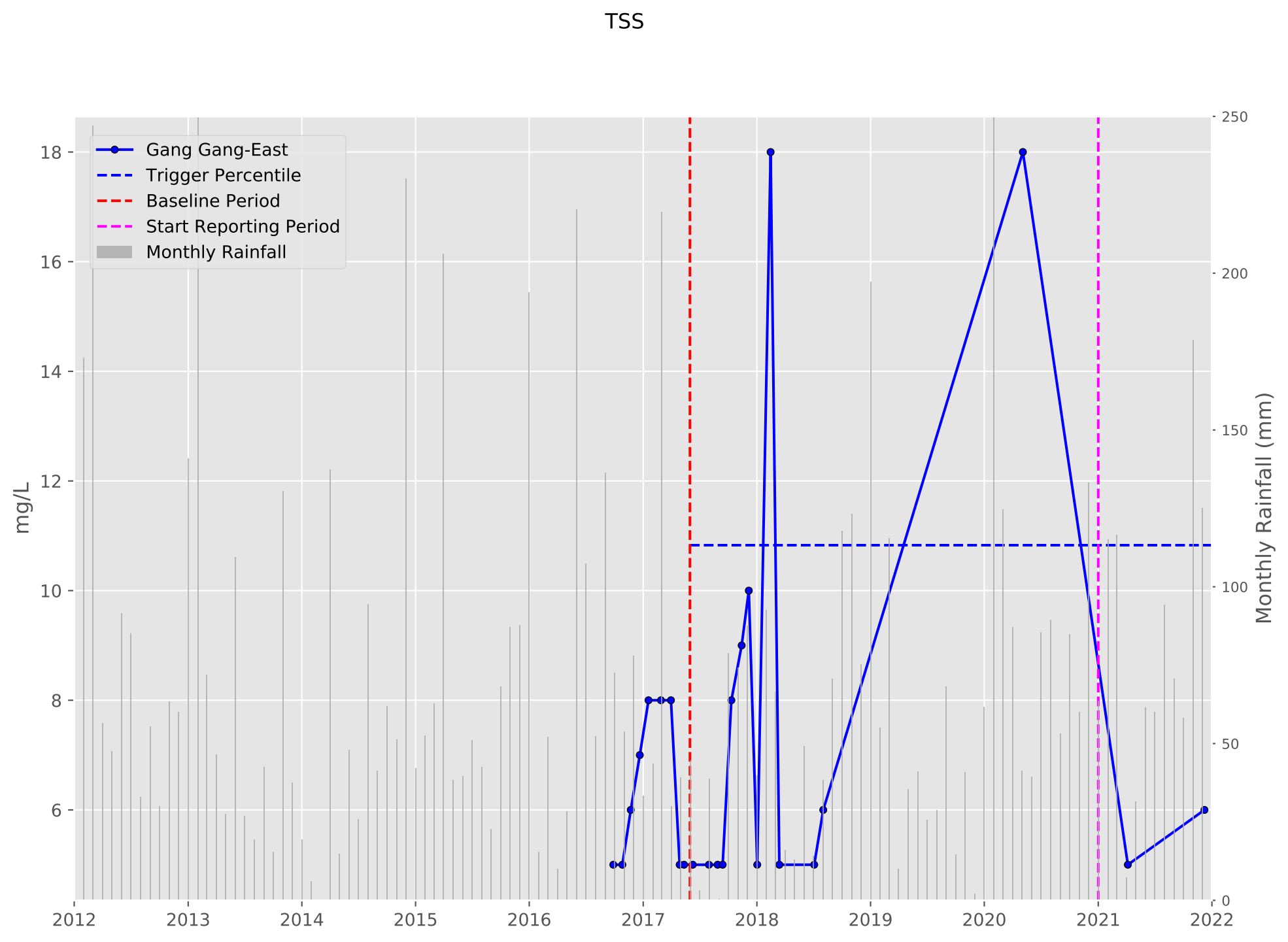

EC (field)
Gang Gang-East
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
20
40
60
80
100
120
140
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

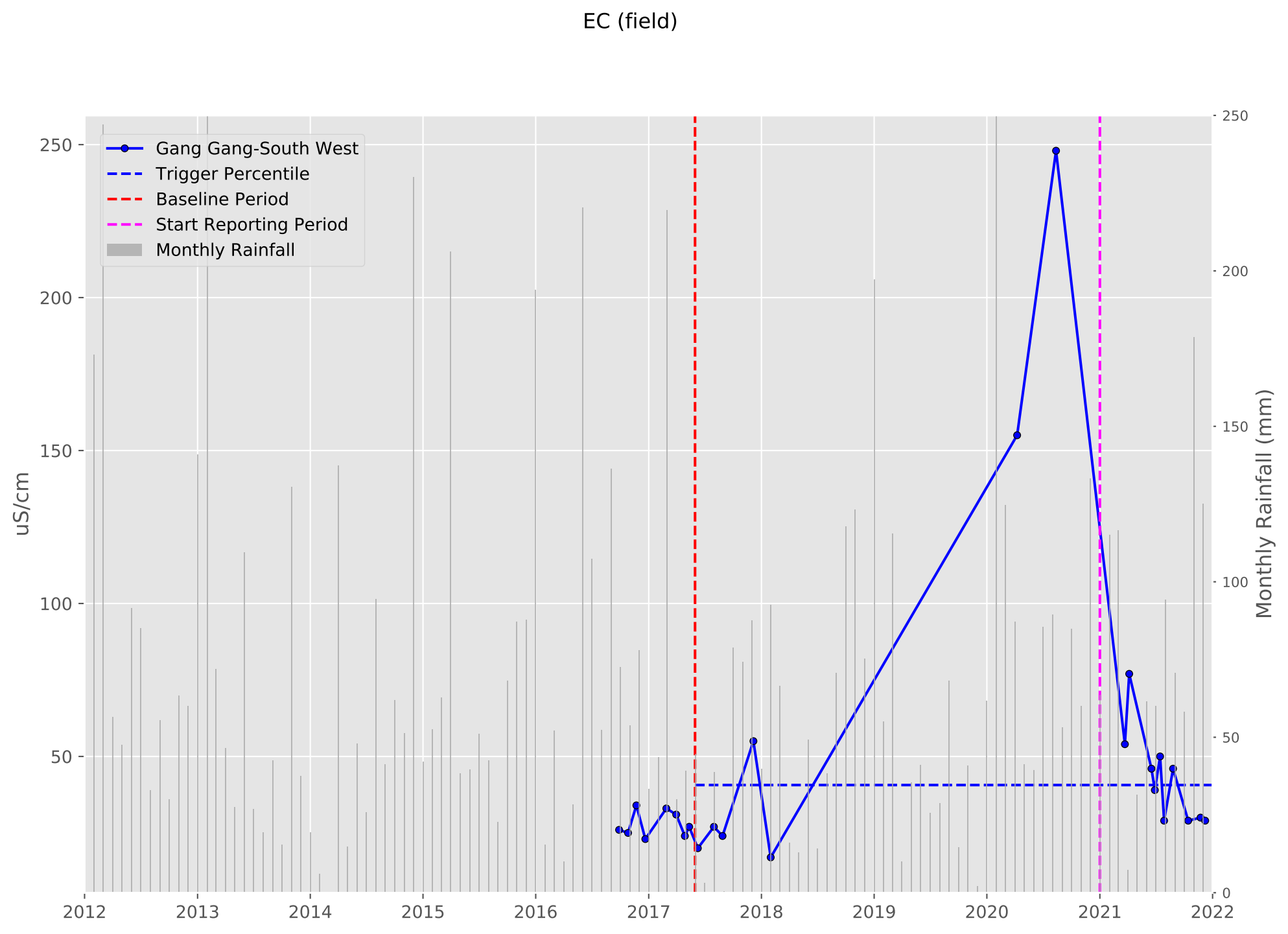

Flow Rate
Gang Gang-East
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
0
5000
10000
15000
20000
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

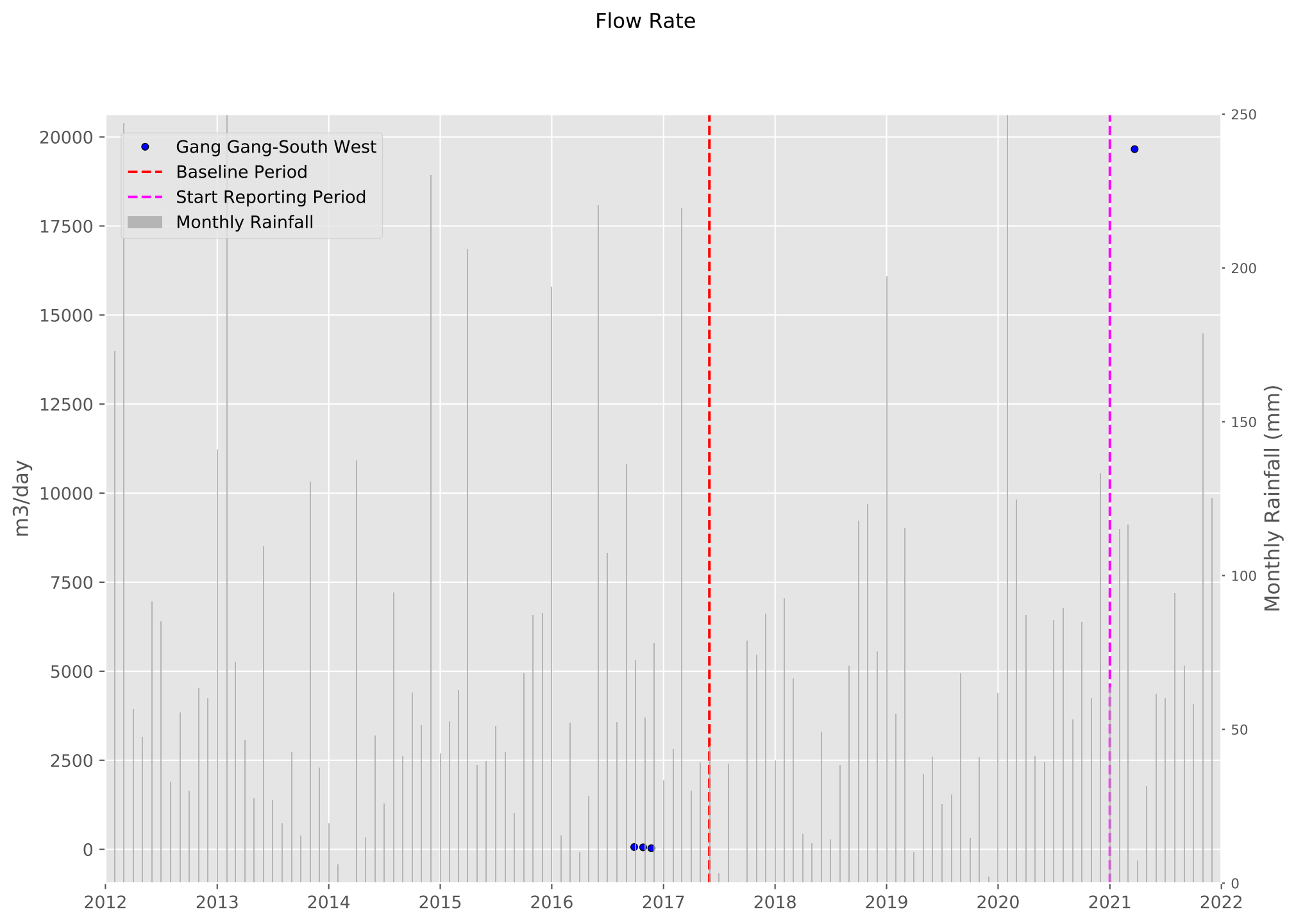

Iron
Gang Gang-East
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.05
0.10
0.15
0.20
0.25
0.30
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

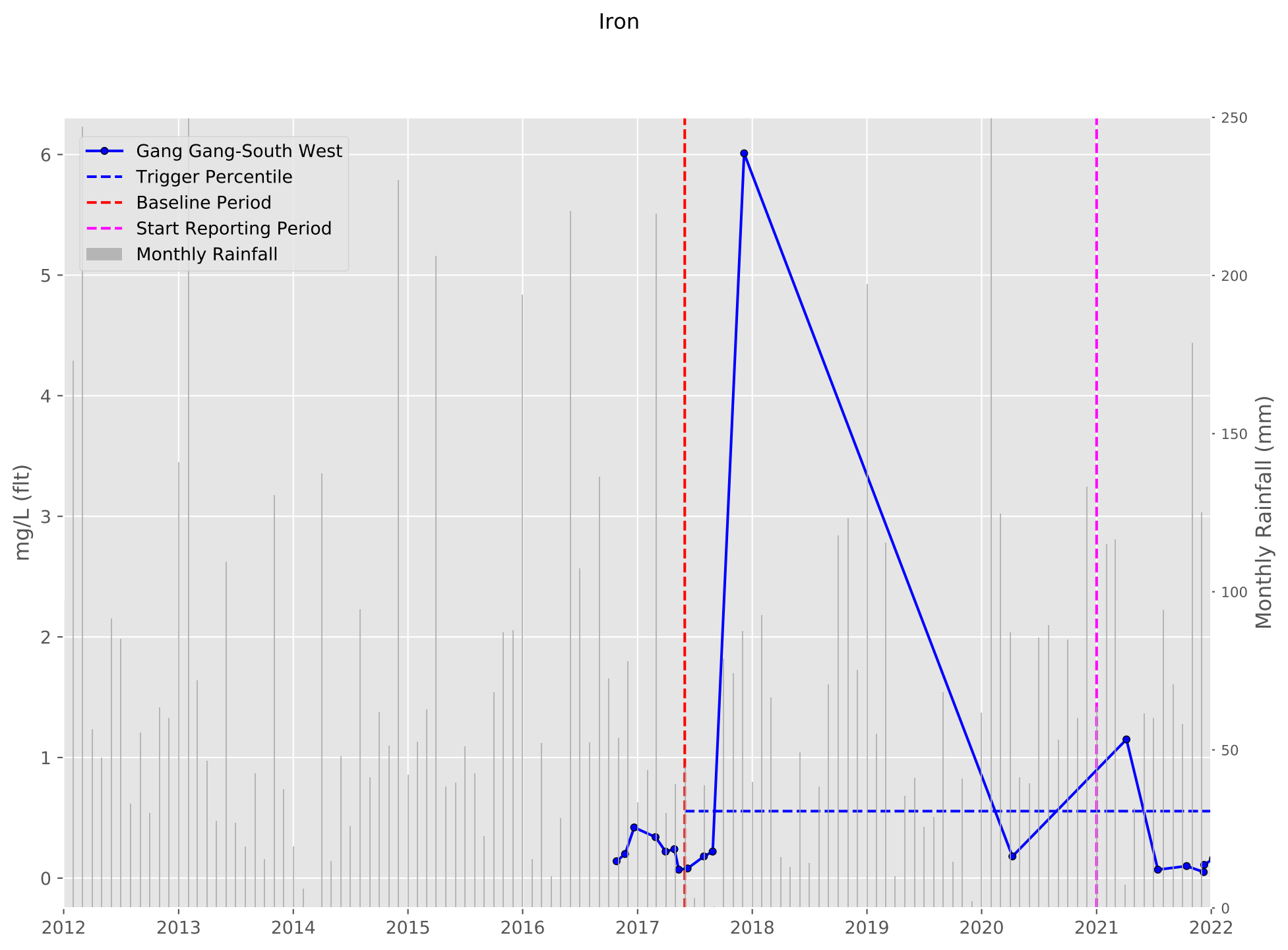

Manganese
Gang Gang-East
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.175
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

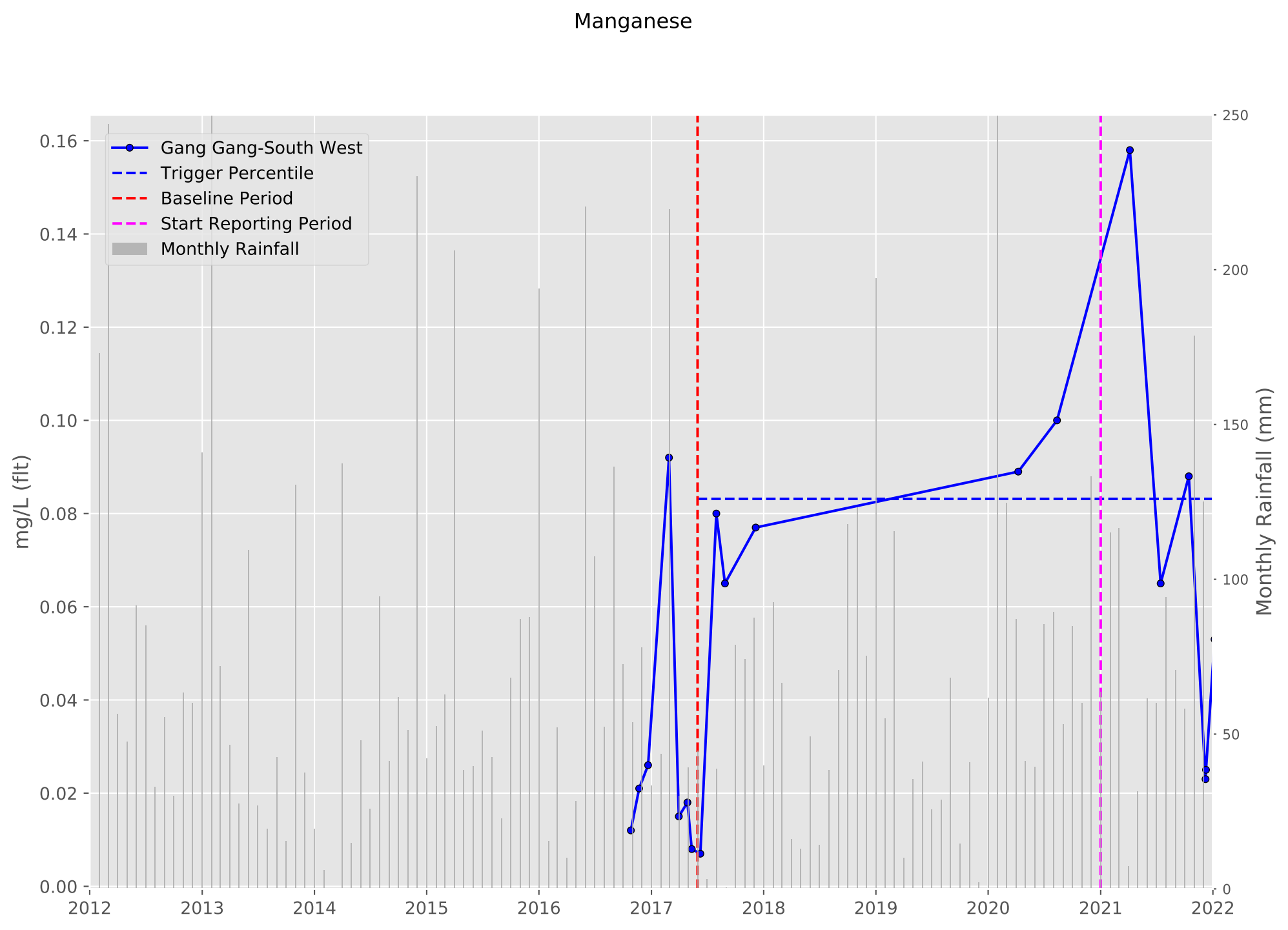

pH
Gang Gang-East
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8
7
6
5
4
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

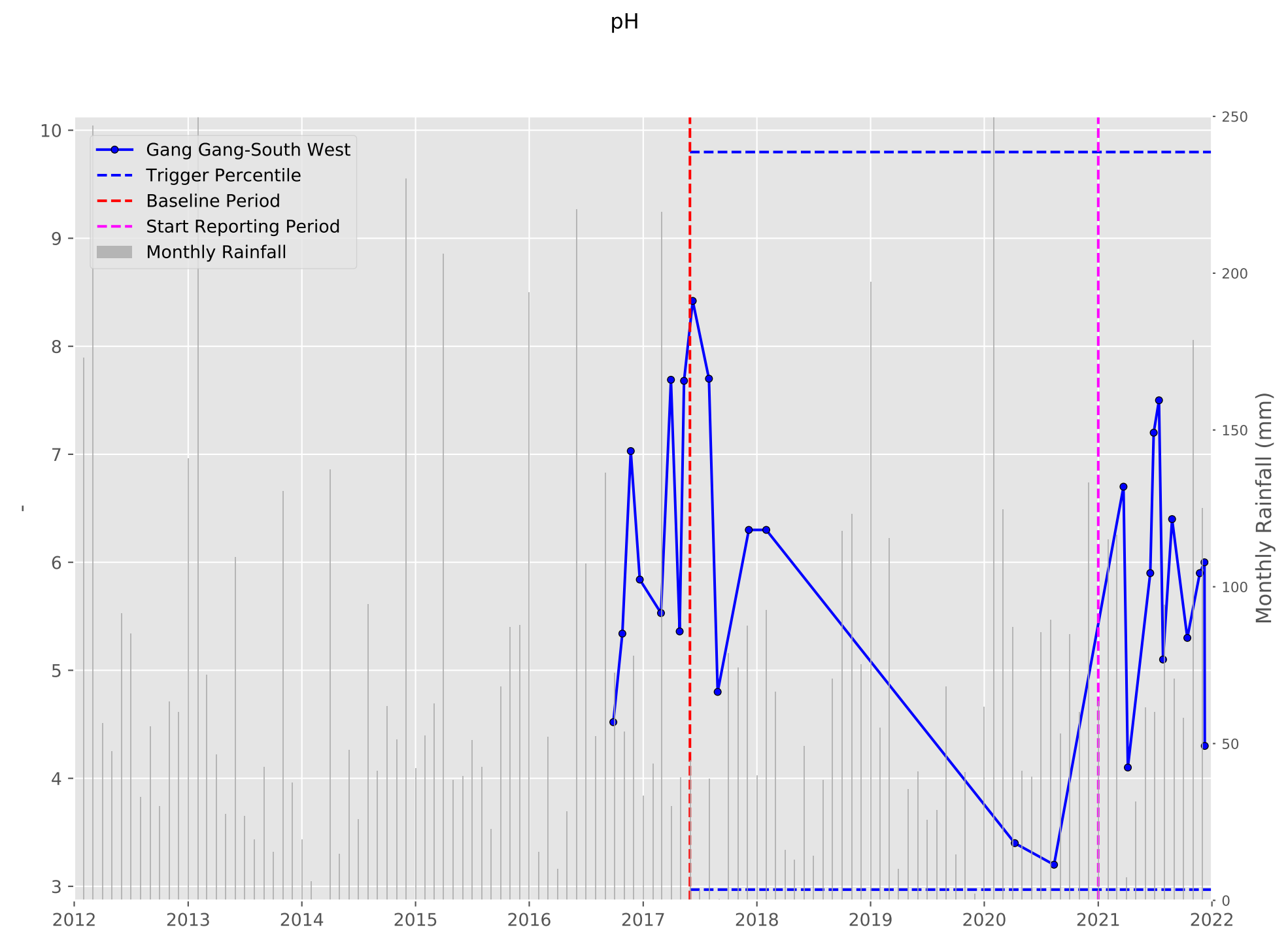

TSS
Gang Gang-East
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
18
16
14
12
10
8
6
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

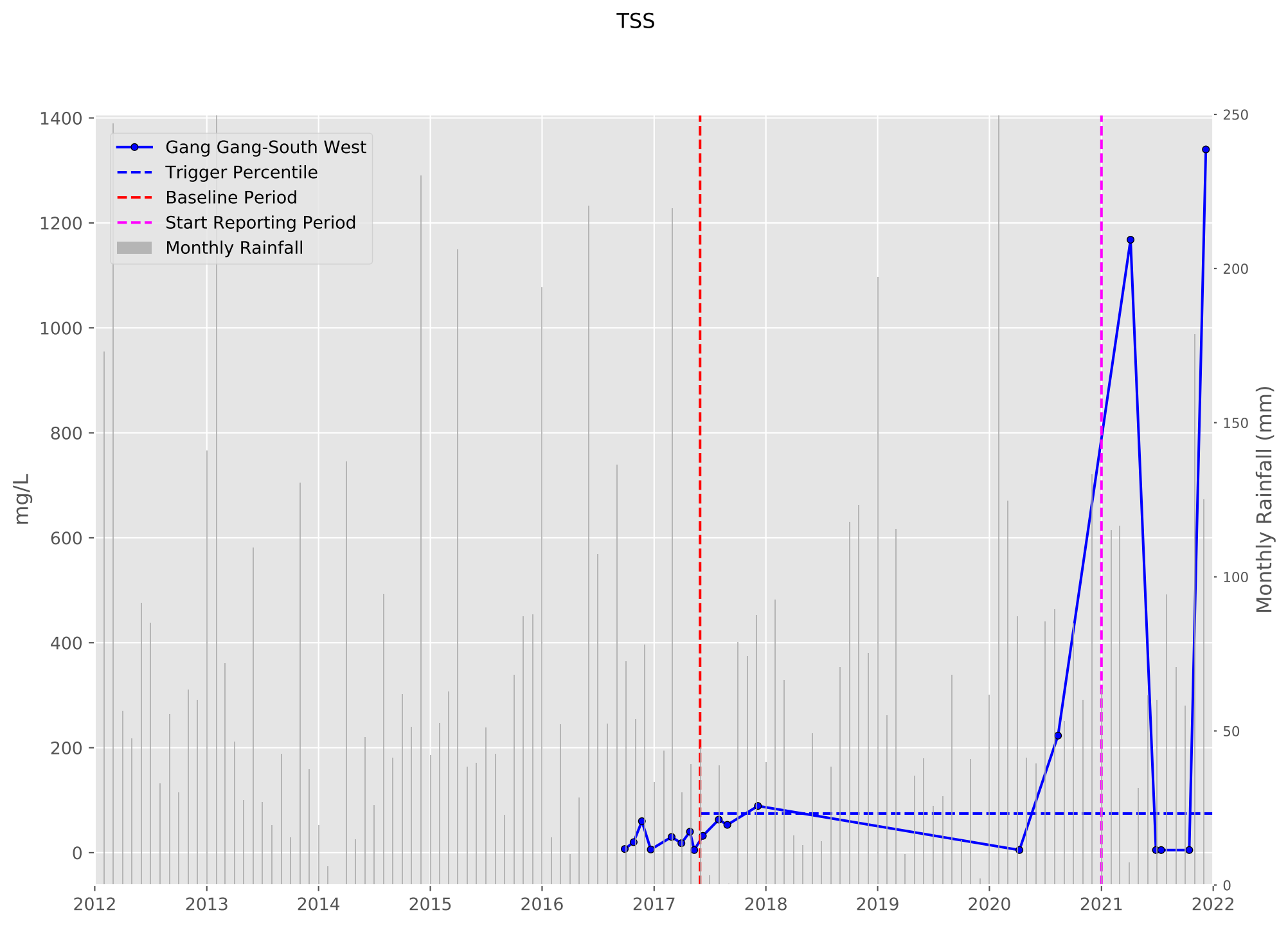

EC (field)
Gang Gang-South West
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

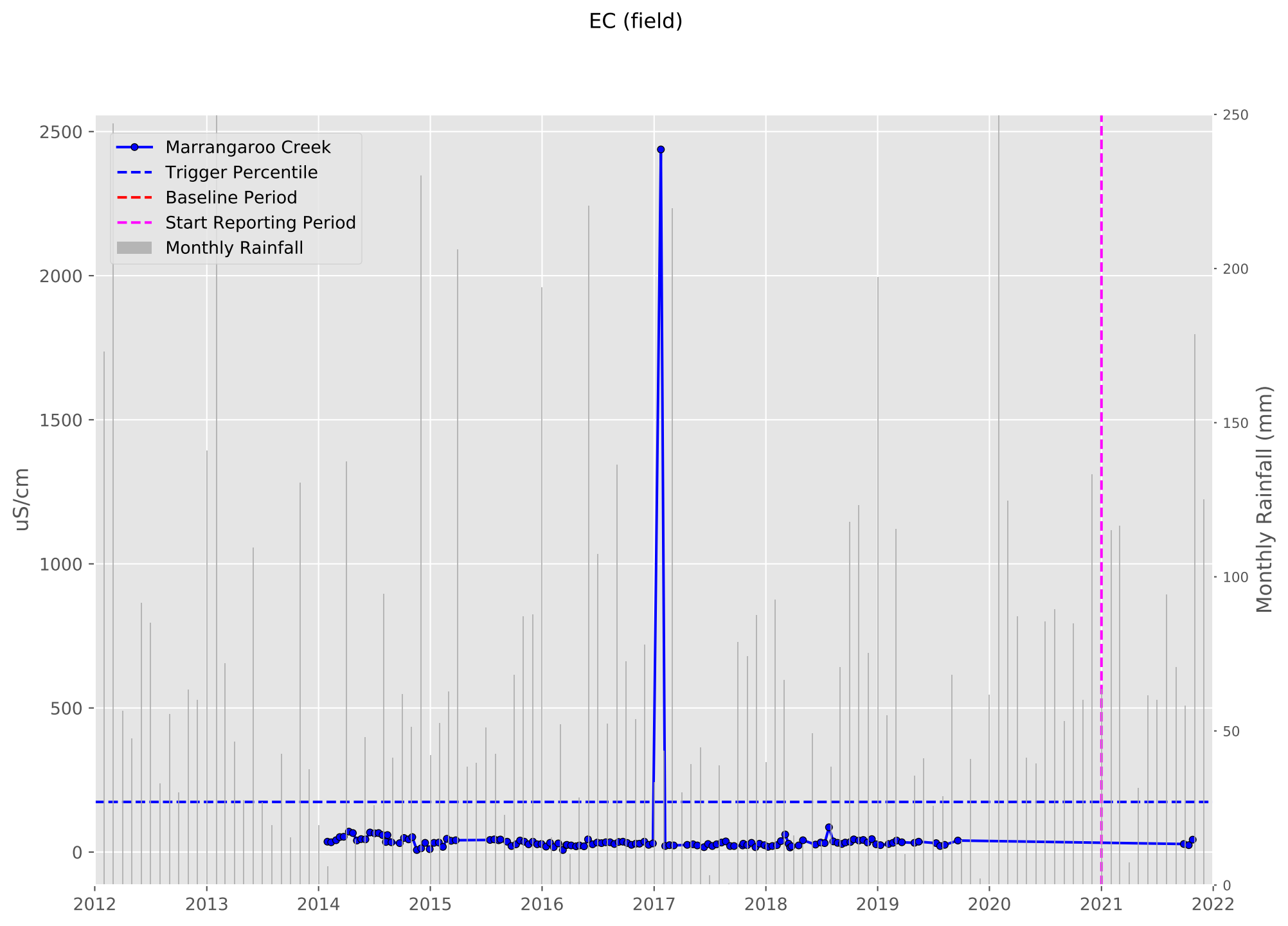

Flow Rate
Gang Gang-South West
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
20000
17500
15000
12500
10000
7500
5000
2500
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

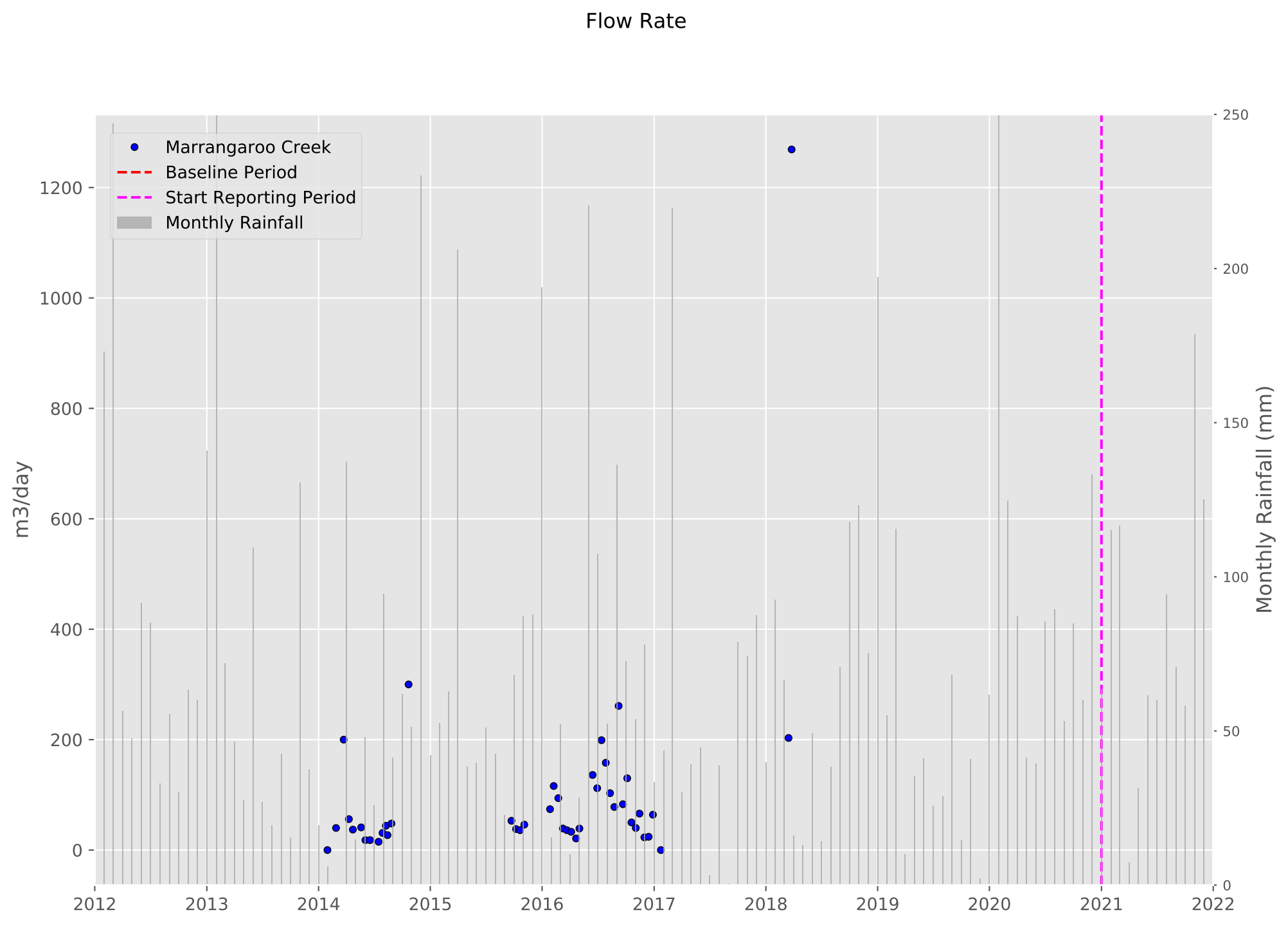

Iron
Gang Gang-South West
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
1
2
3
4
5
6
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

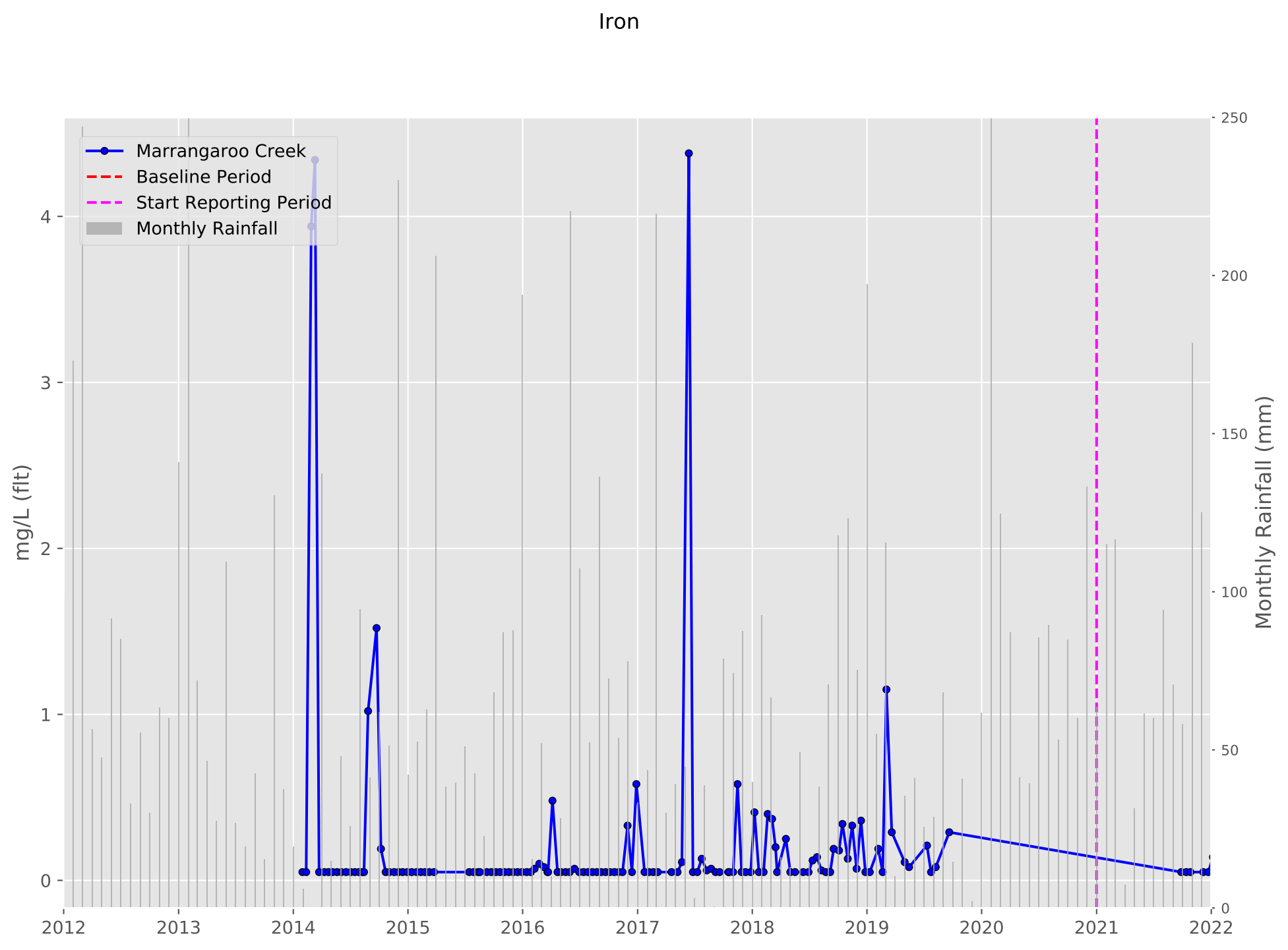

Manganese
Gang Gang-South West
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

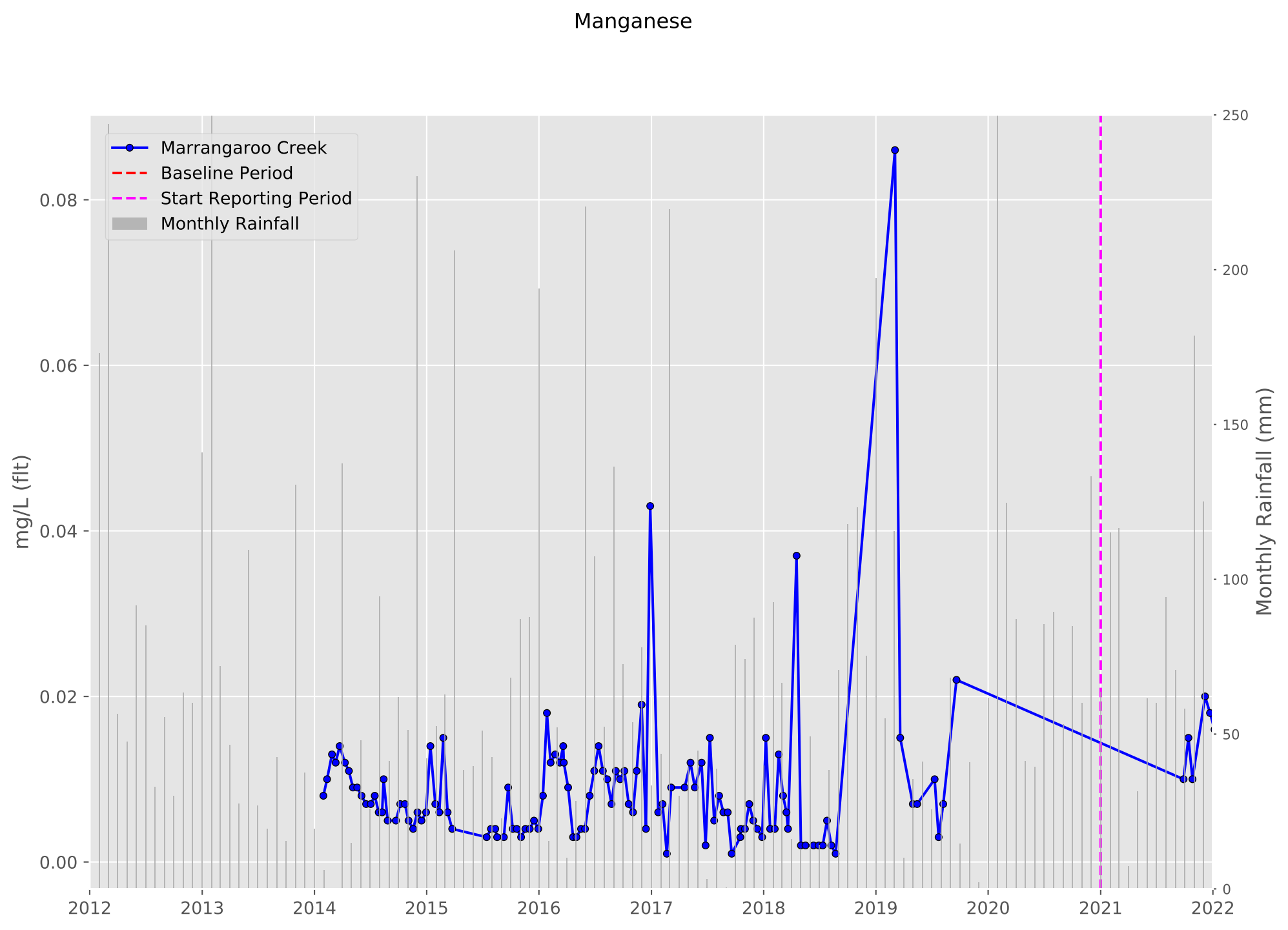

pH
Gang Gang-South West
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
10
9
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

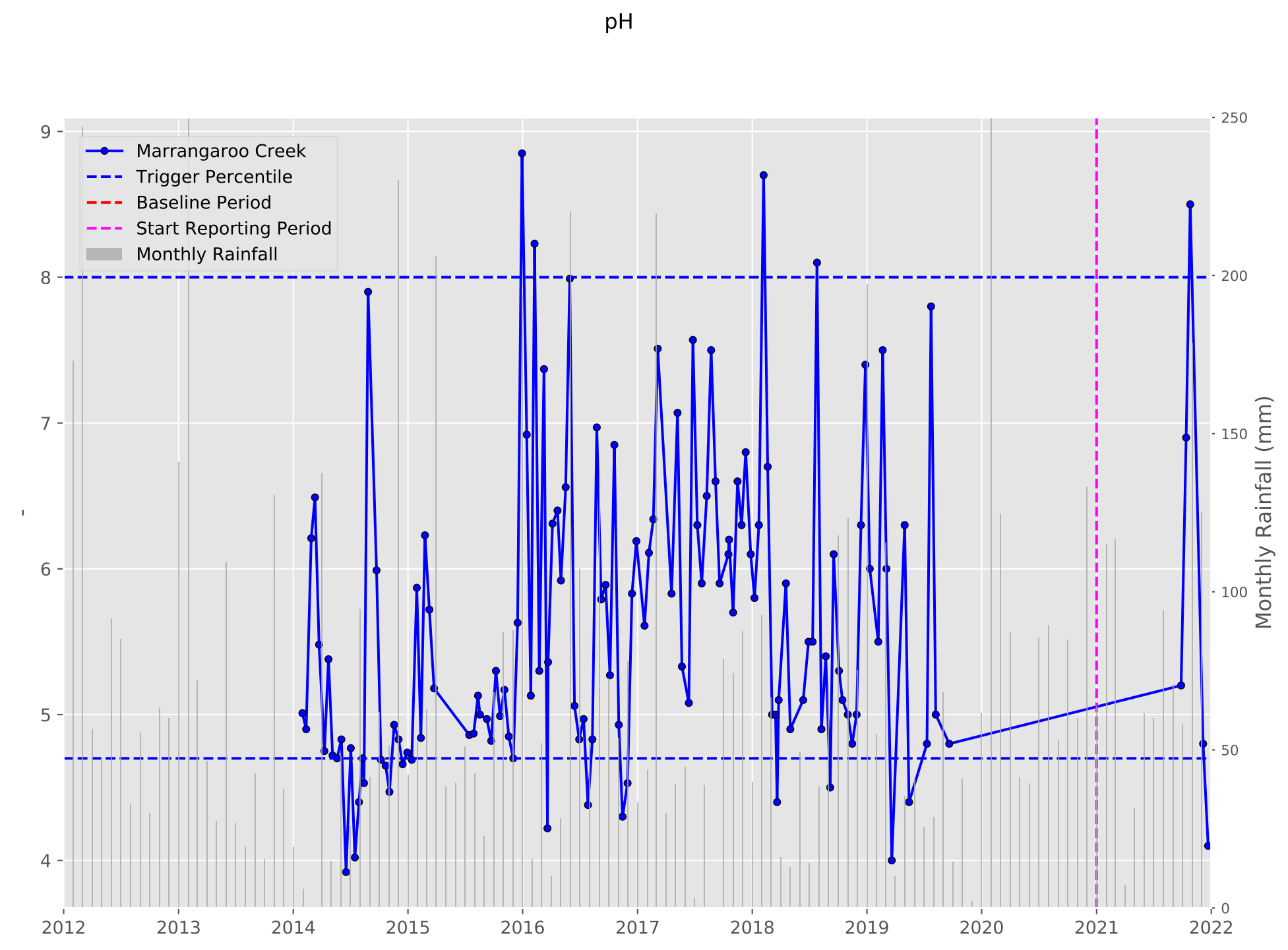

TSS
Gang Gang-South West
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
1400
1200
1000
800
600
400
200
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

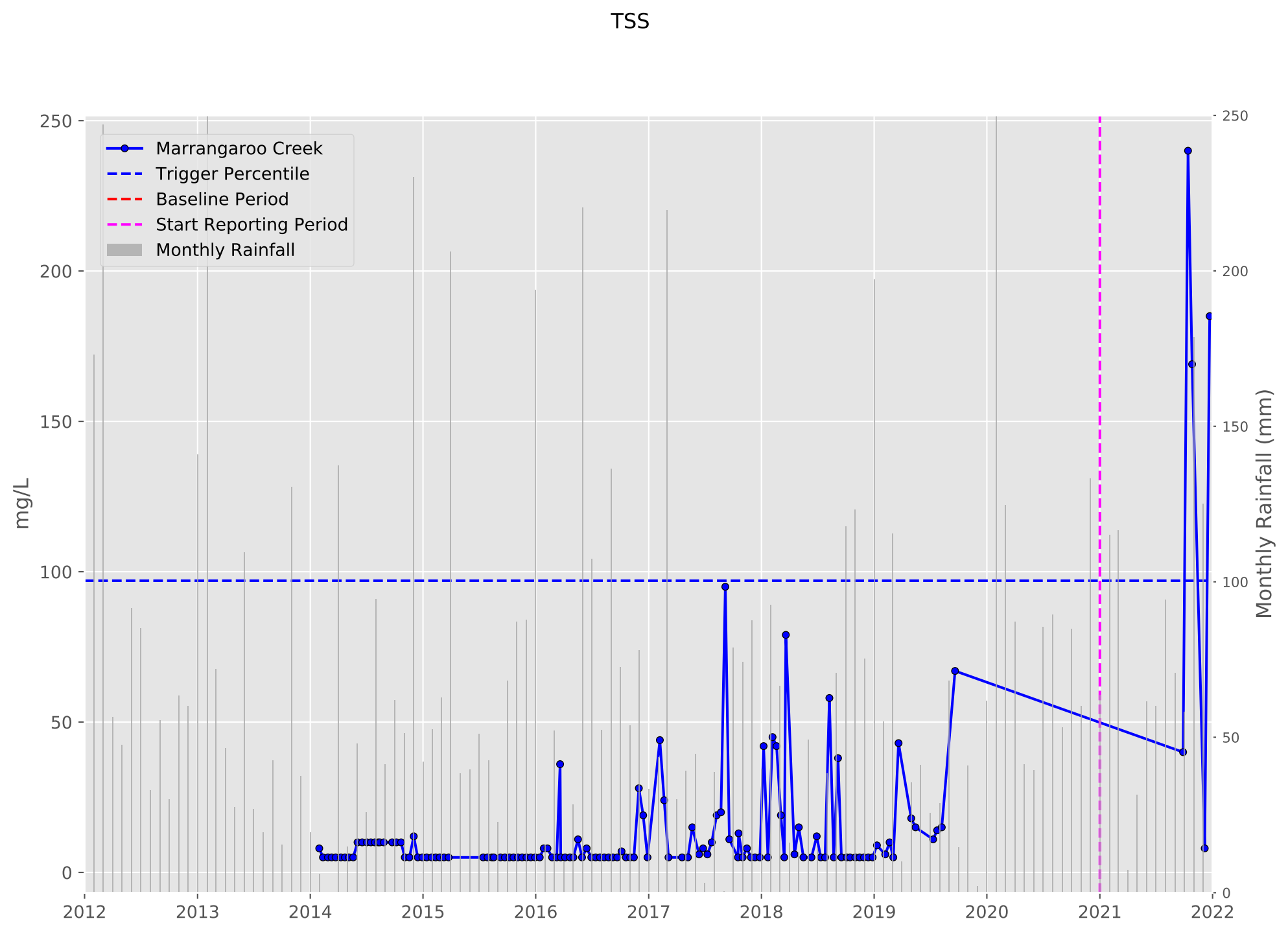

EC (field)
Marrangaroo Creek
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
2500
2000
1500
1000
500
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

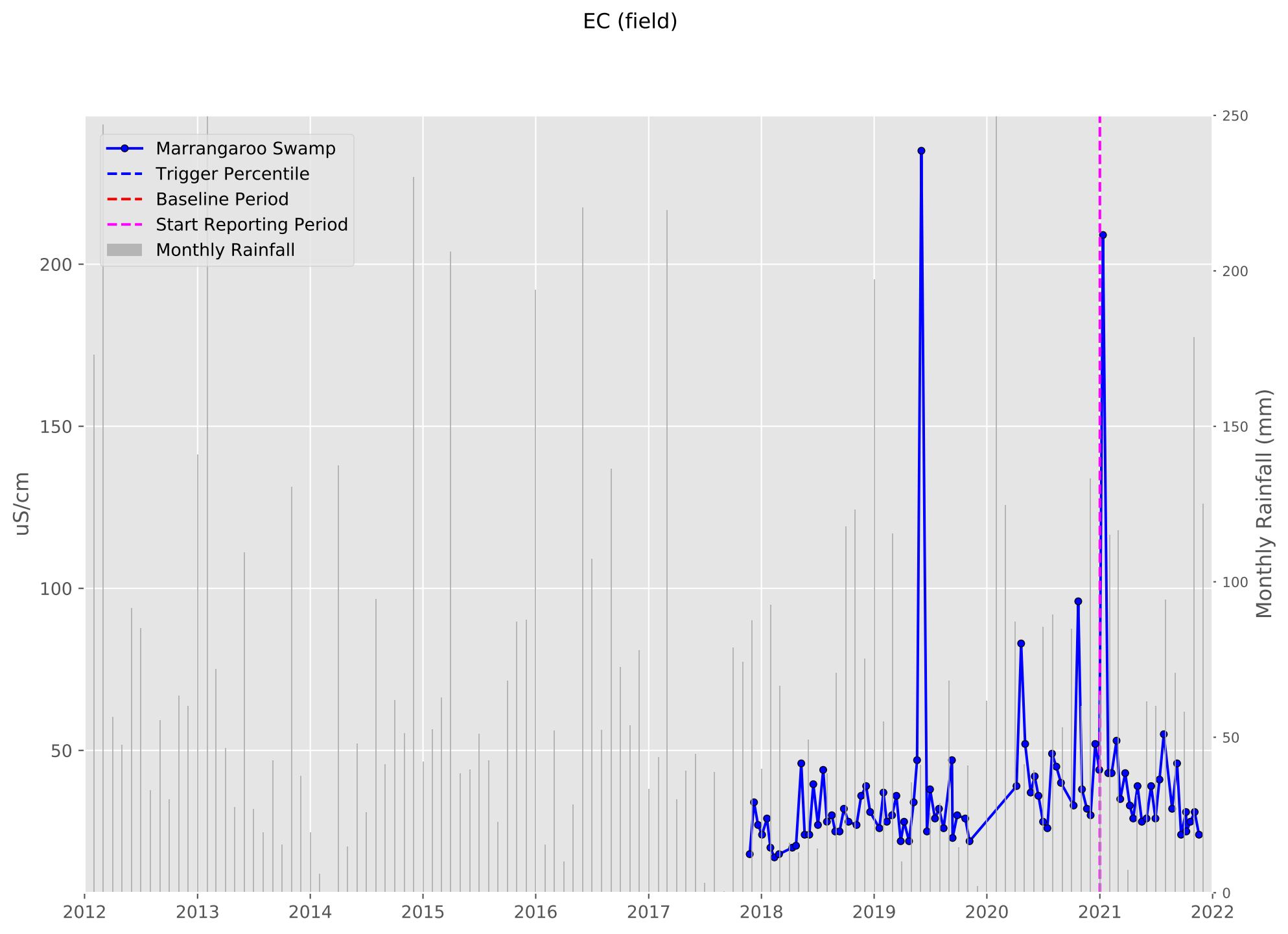

Flow Rate
Marrangaroo Creek
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
0
200
400
600
800
1000
1200
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

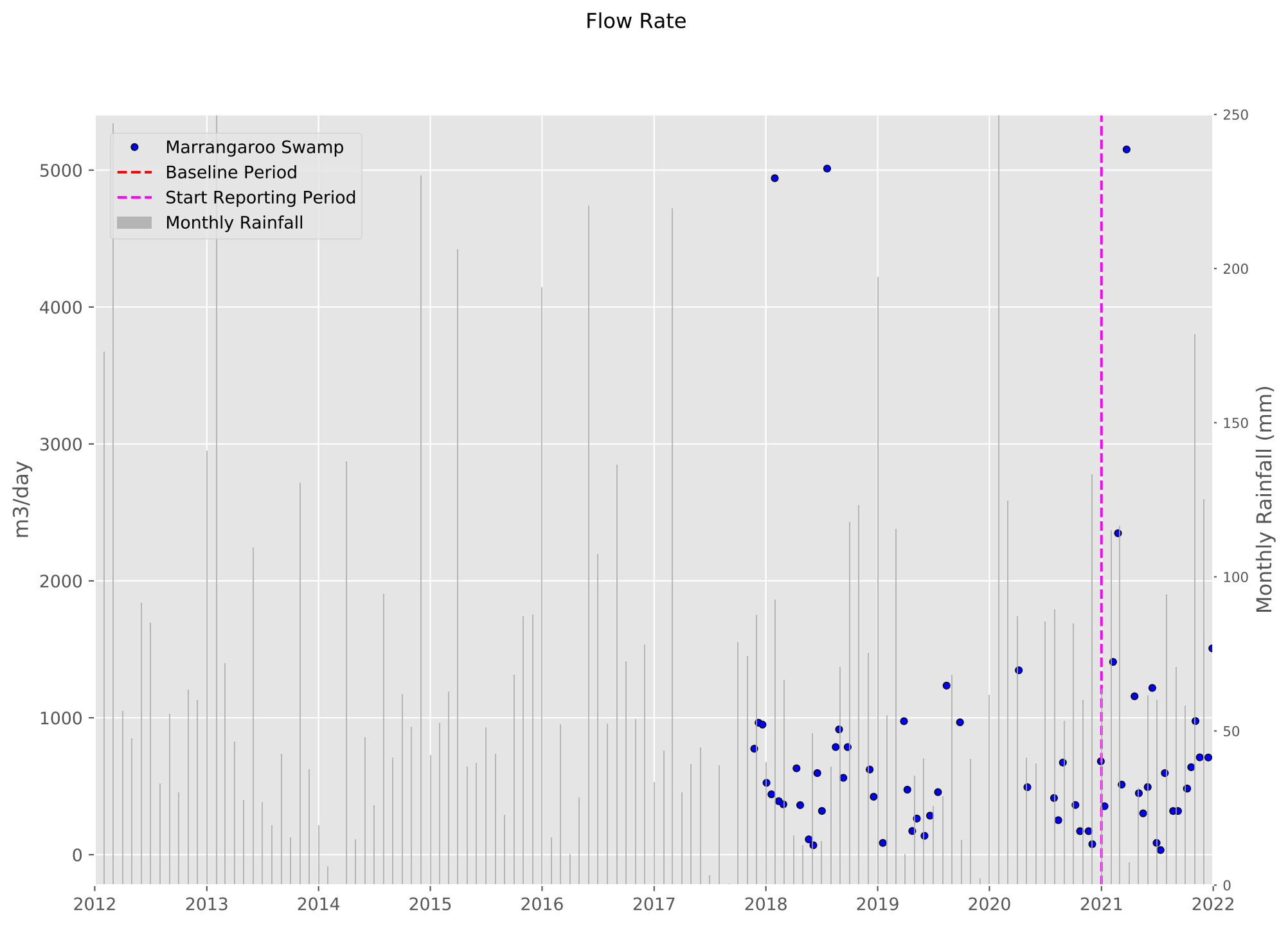

Iron
Marrangaroo Creek
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
1
2
3
4
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

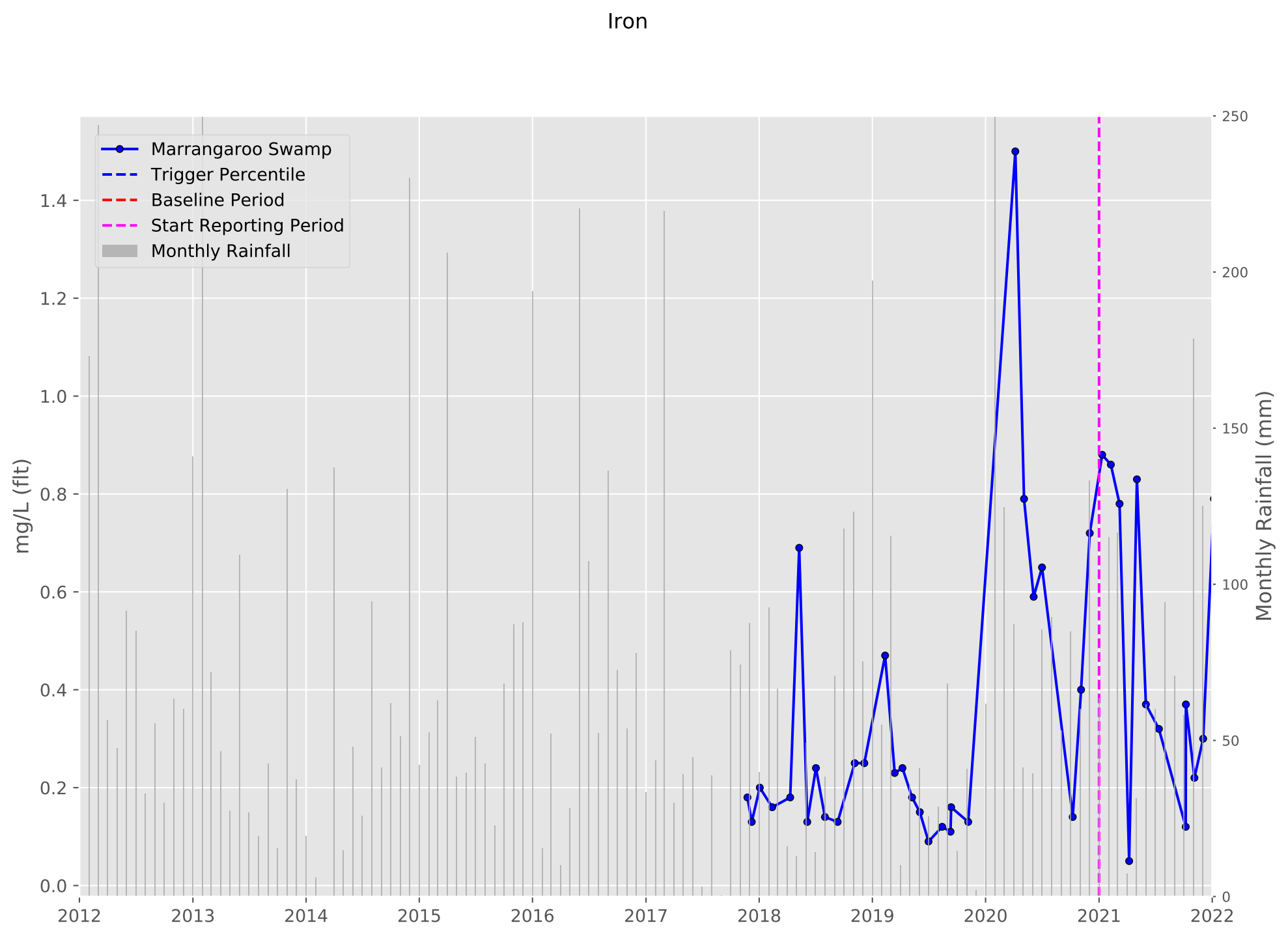

Manganese
Marrangaroo Creek
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.00
0.02
0.04
0.06
0.08
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

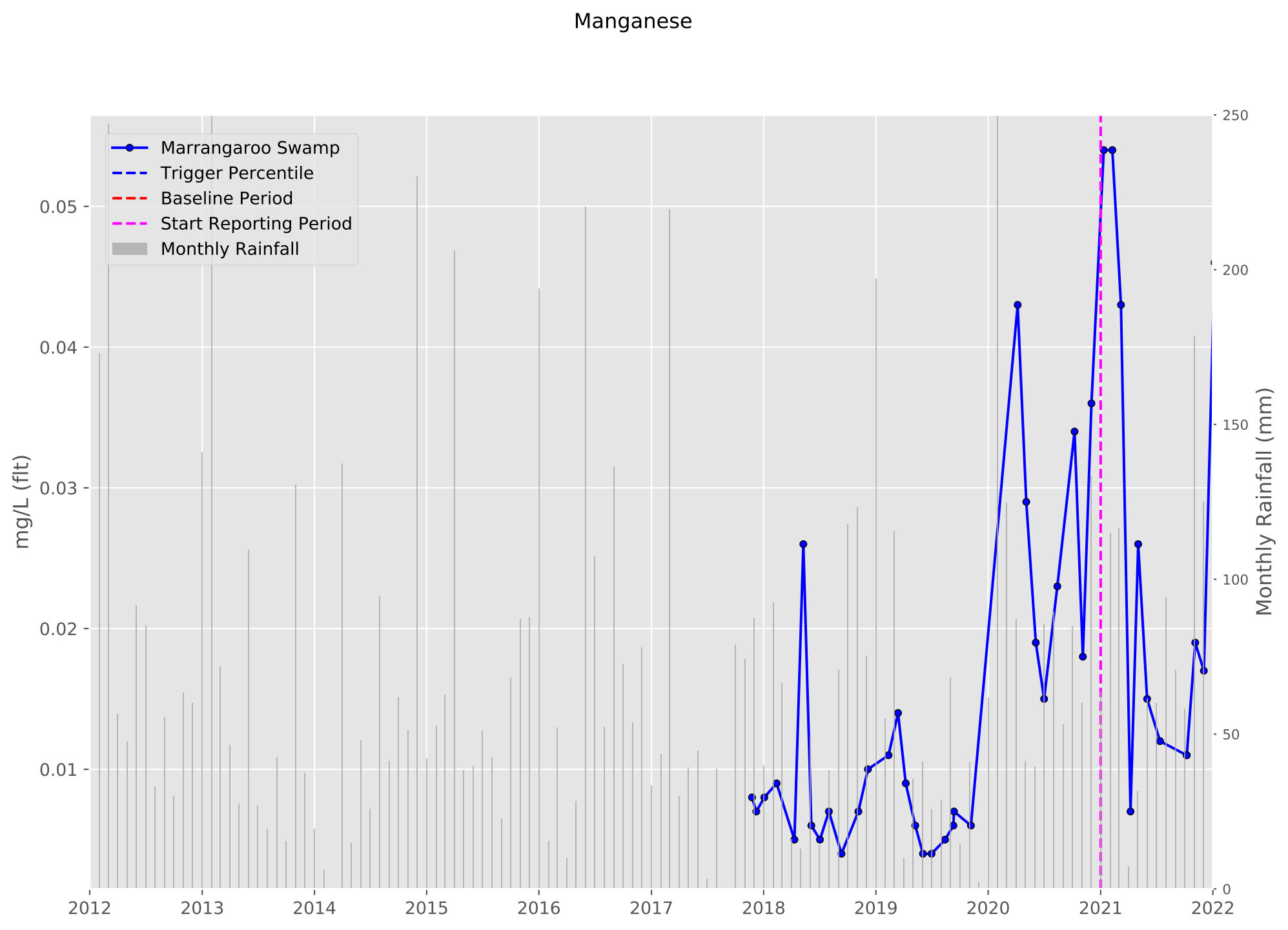

pH
Marrangaroo Creek
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
9
8
7
6
5
4
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

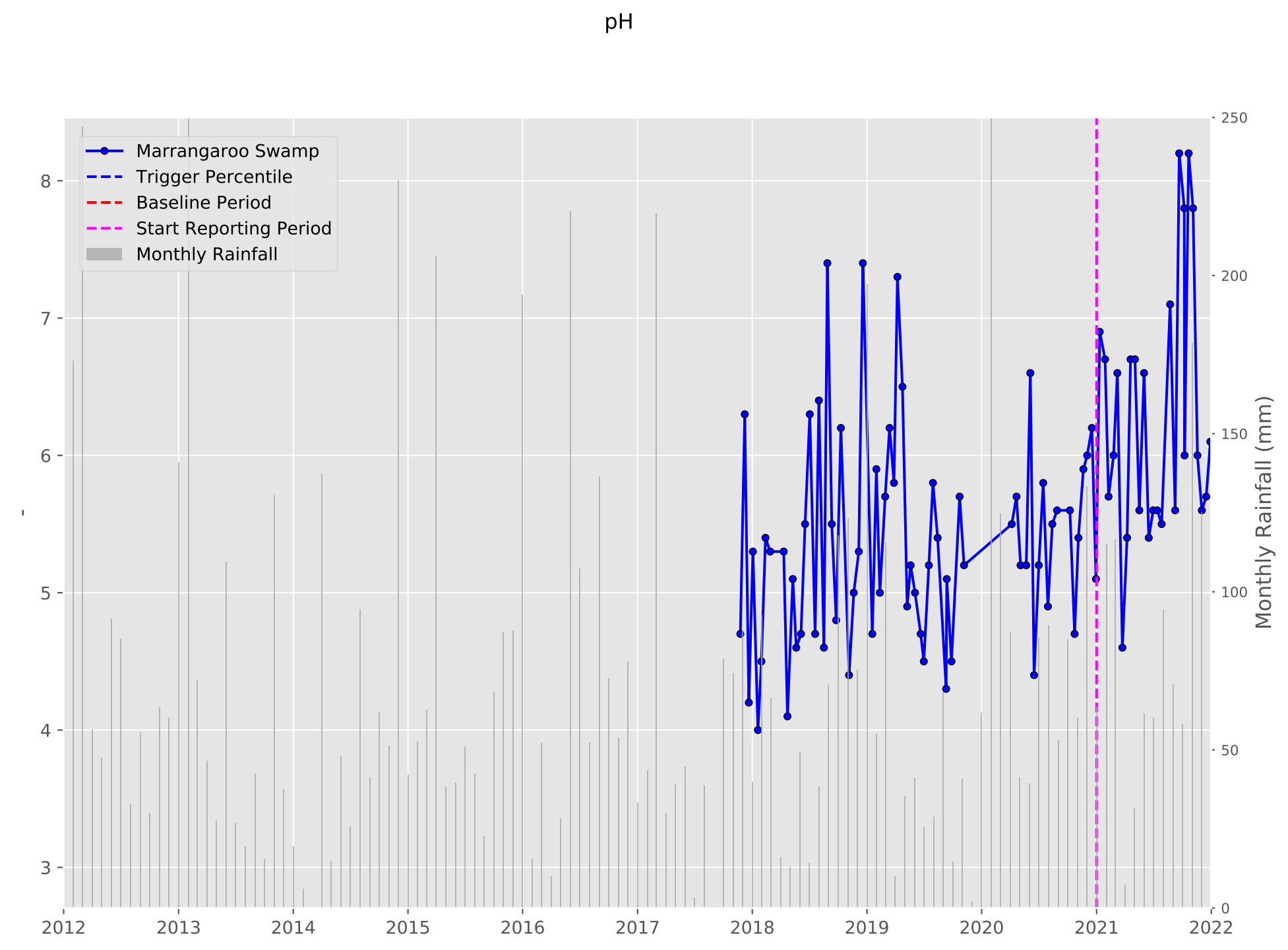

TSS
Marrangaroo Creek
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

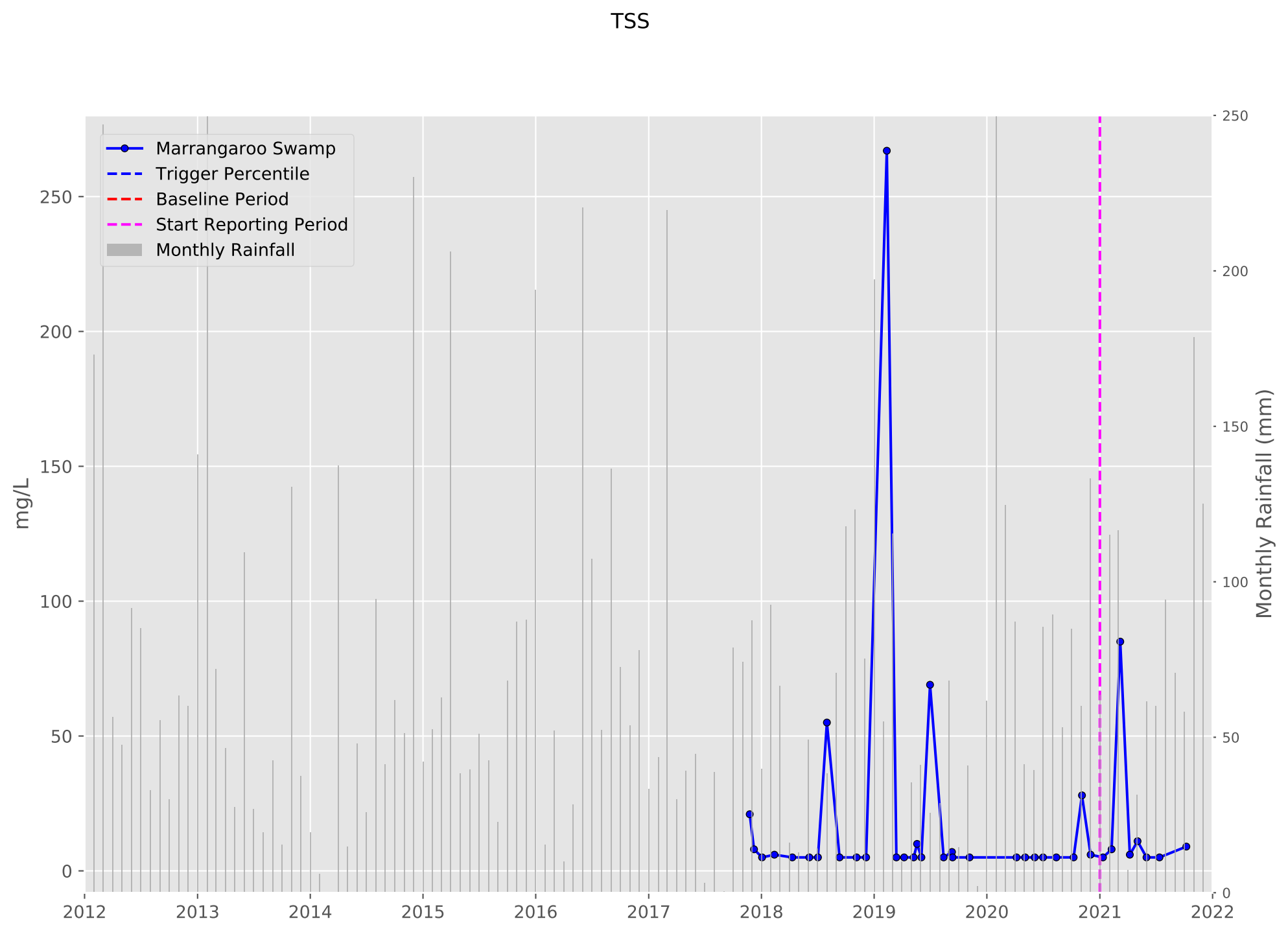

EC (field)
Marrangaroo Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

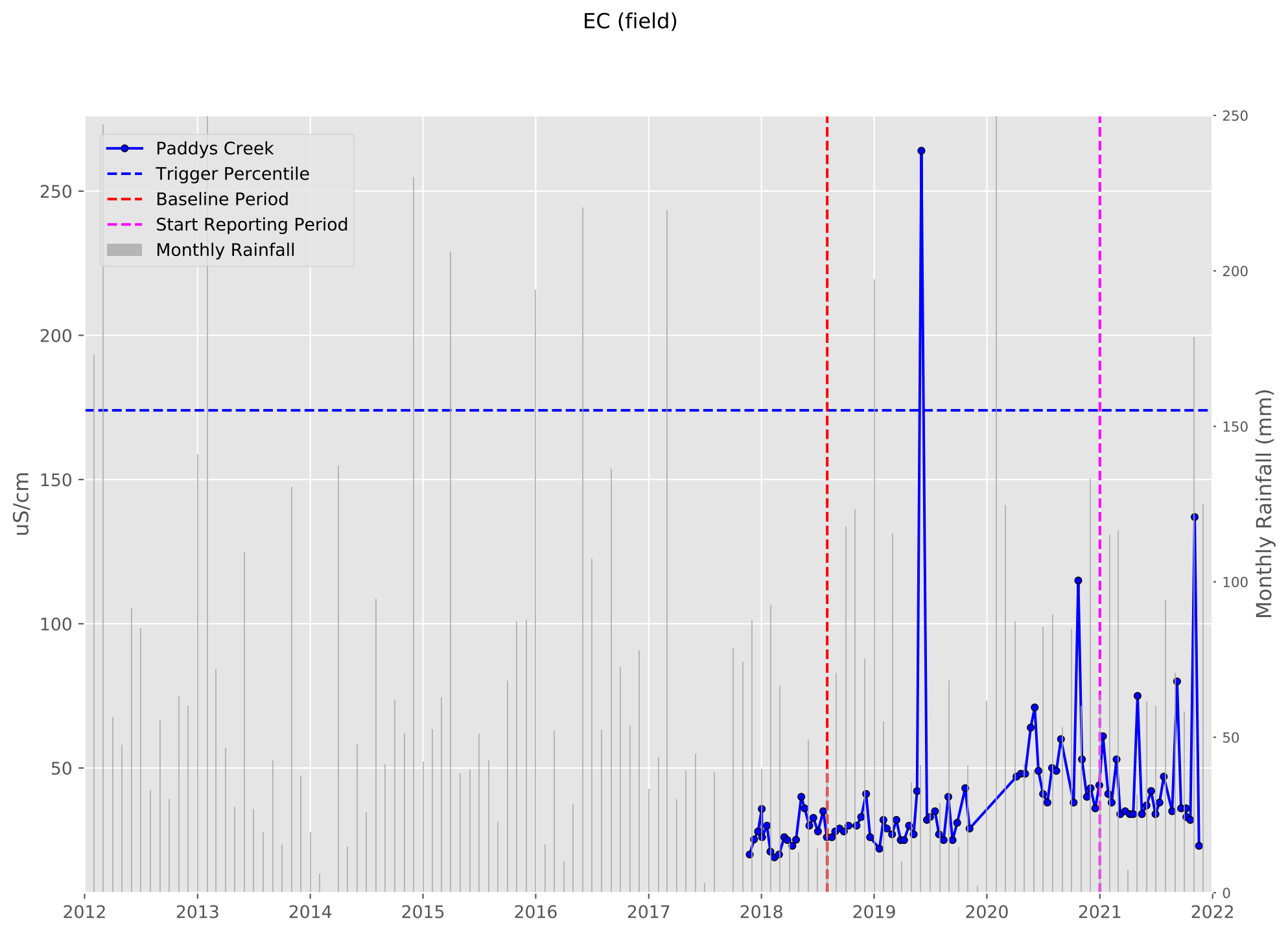

Flow Rate
Marrangaroo Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
0
1000
2000
3000
4000
5000
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

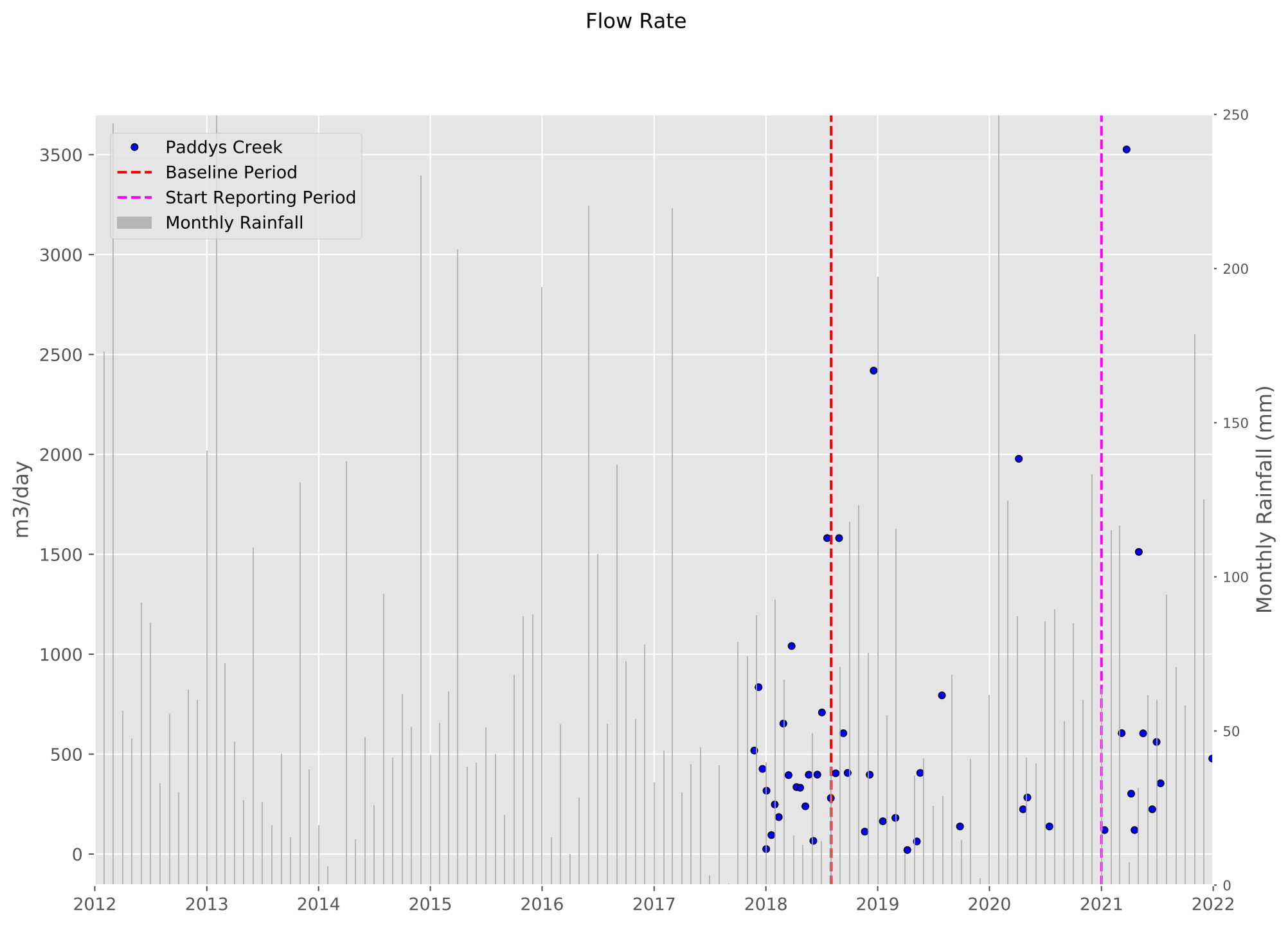

Iron
Marrangaroo Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

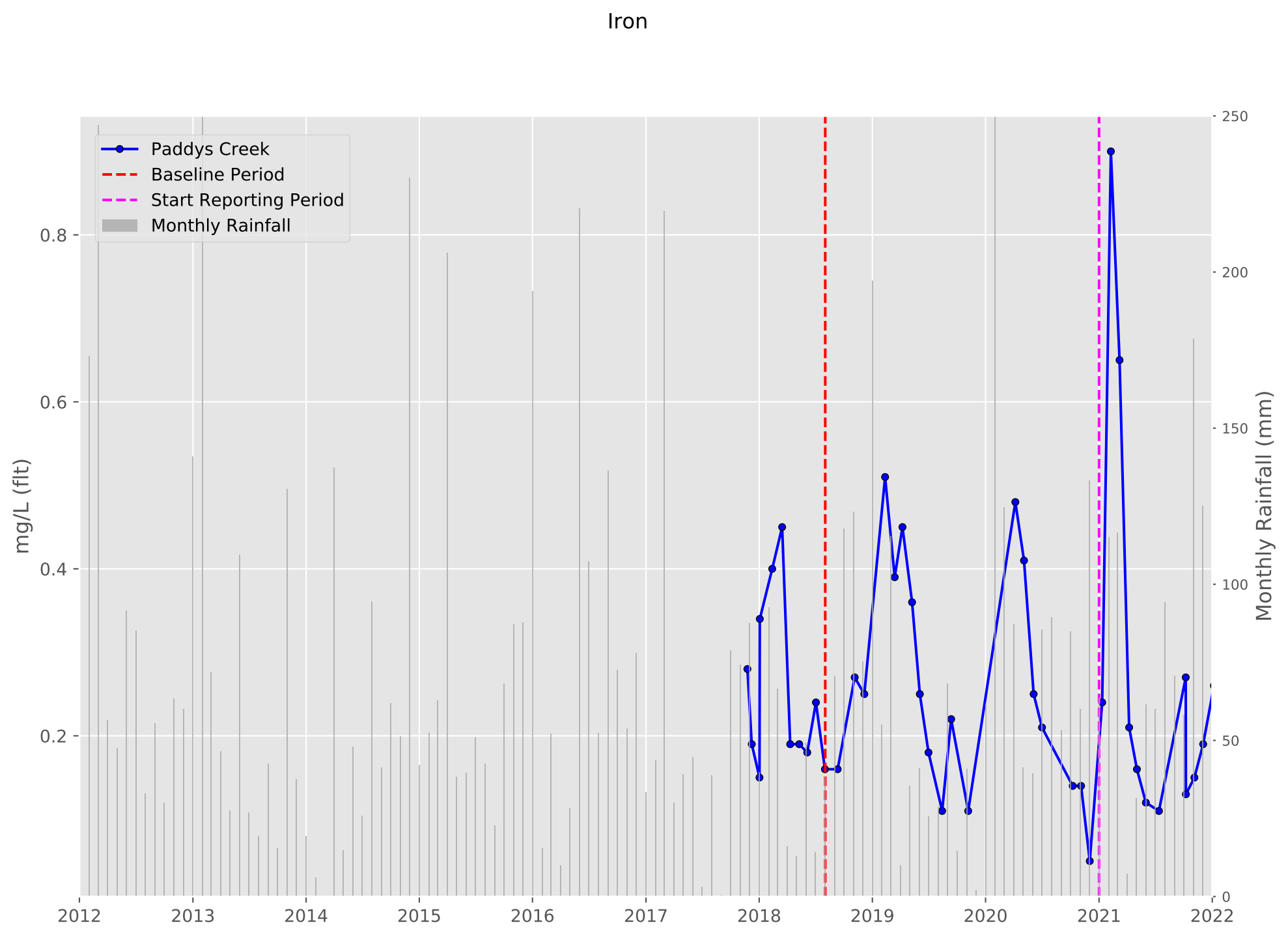

Manganese
Marrangaroo Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.01
0.02
0.03
0.04
0.05
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

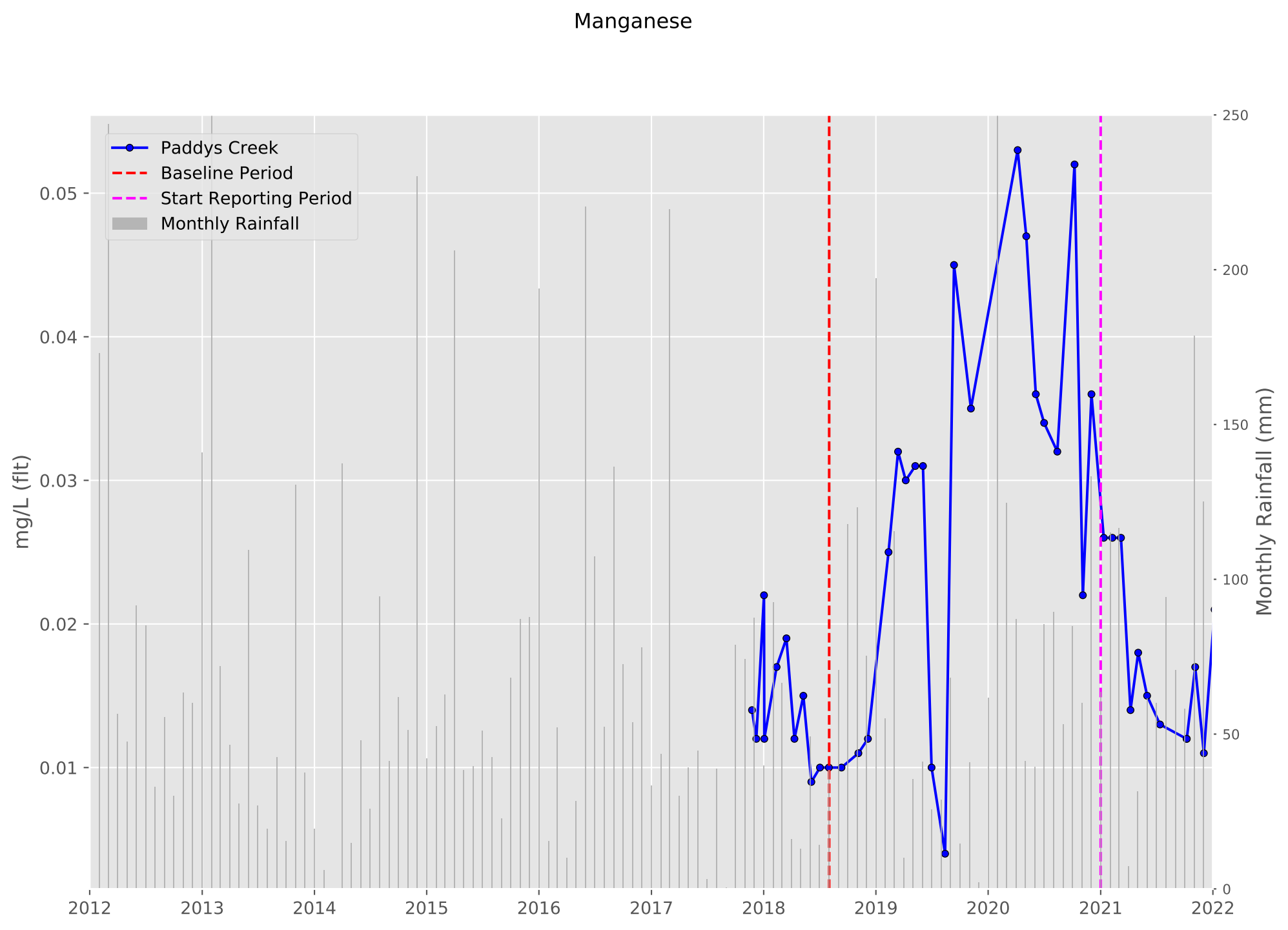

pH
Marrangaroo Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

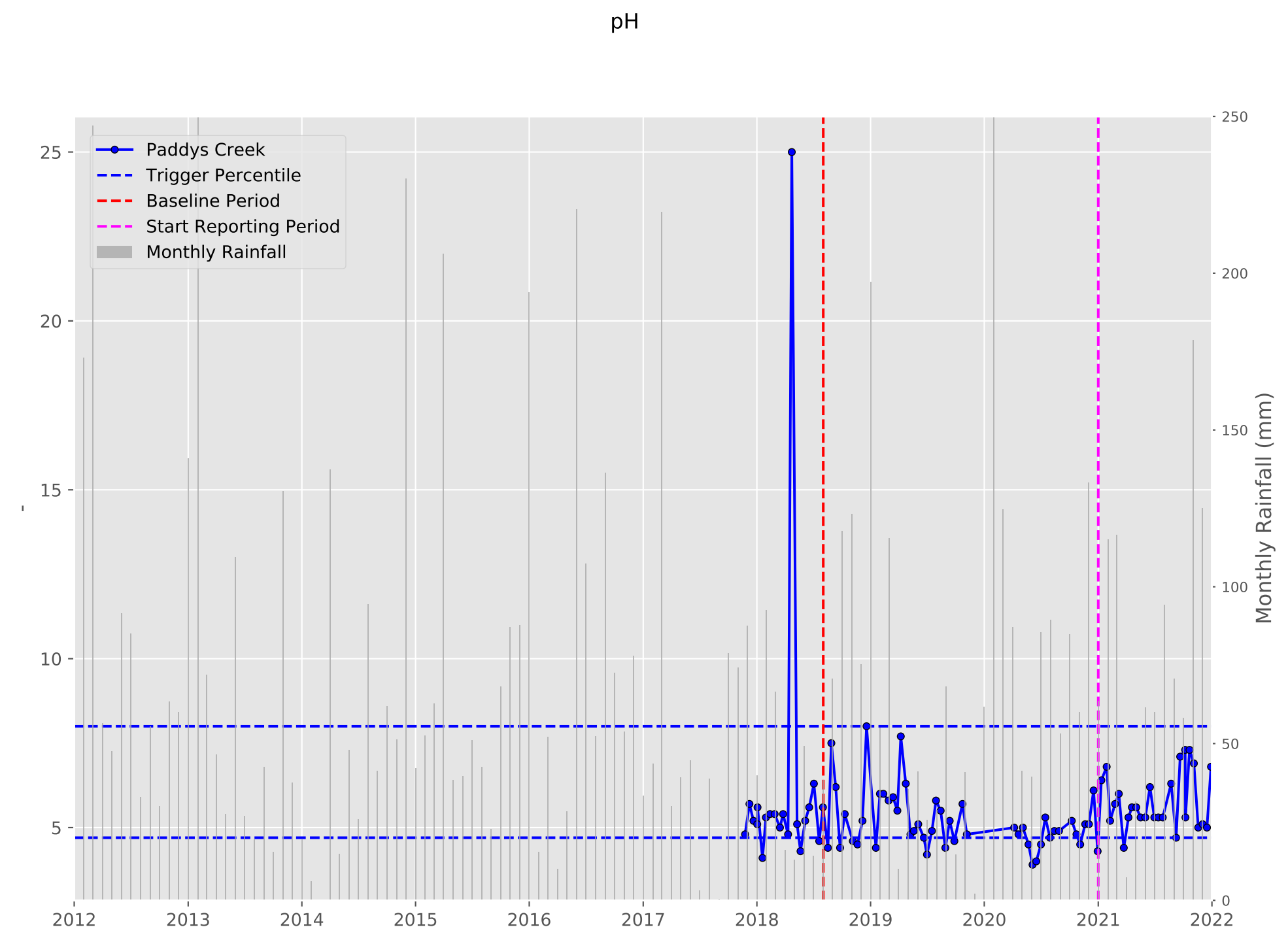

TSS
Marrangaroo Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

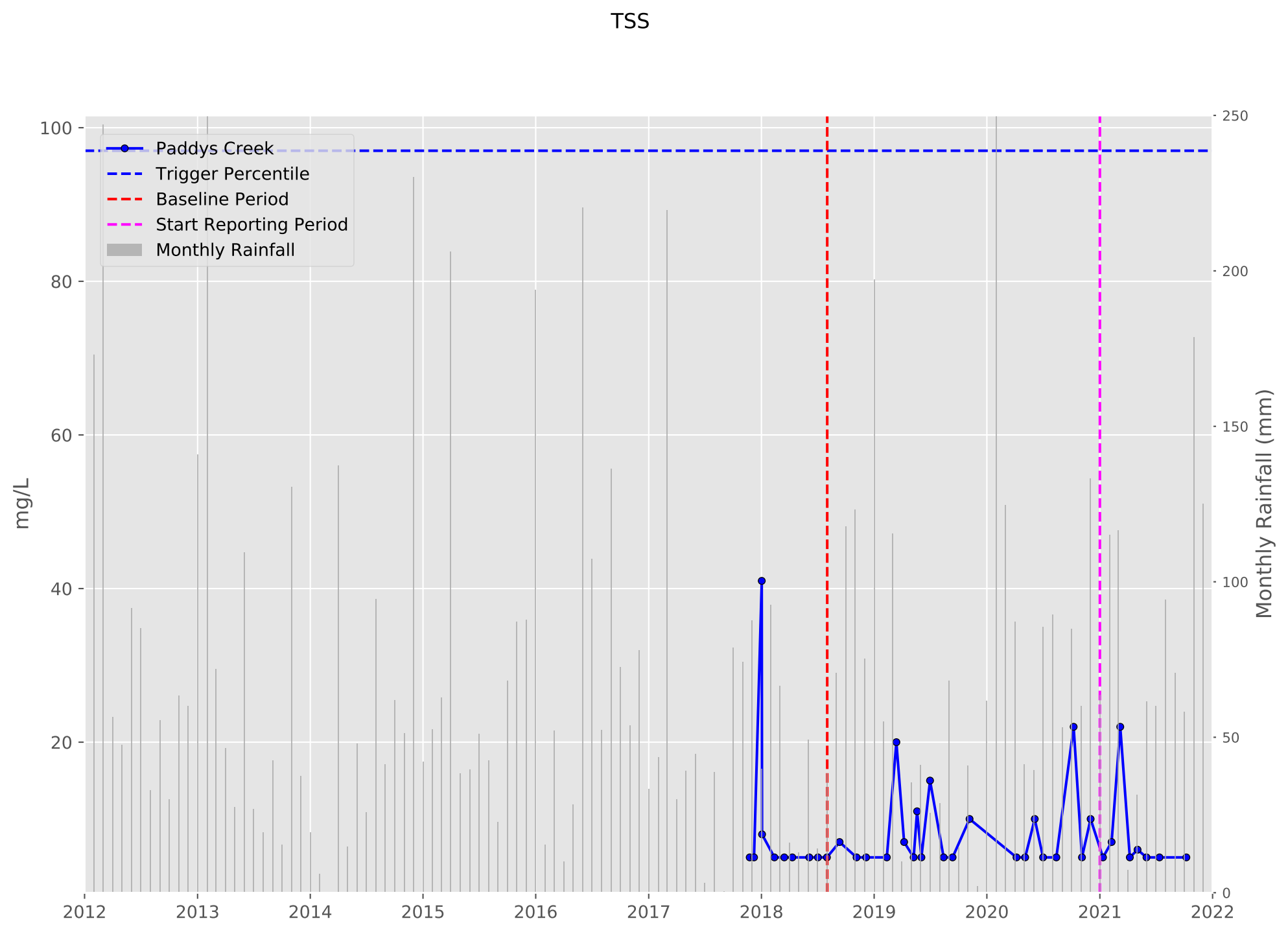

EC (field)
Paddys Creek
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

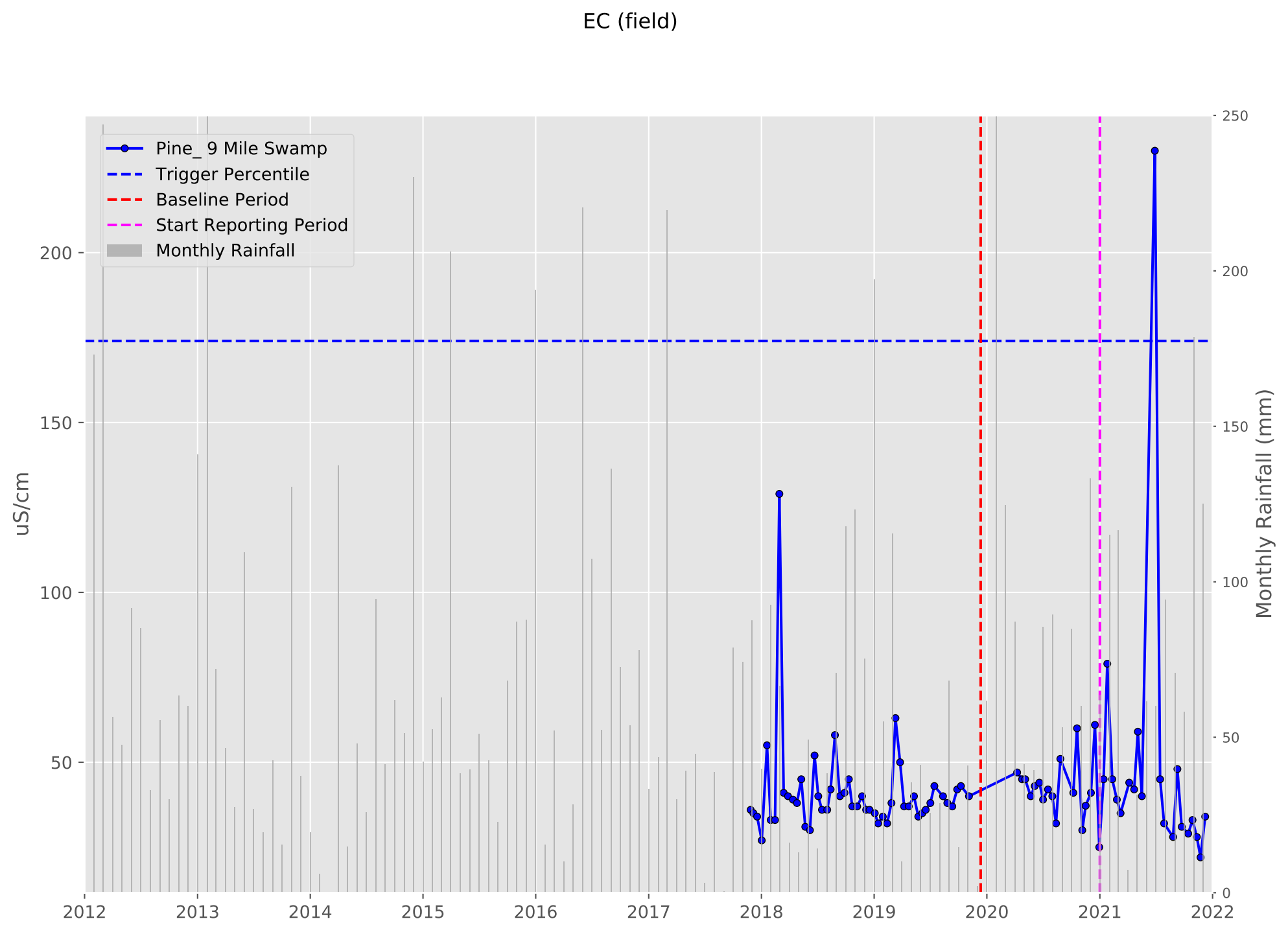

Flow Rate
Paddys Creek
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
0
500
1000
1500
2000
2500
3000
3500
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

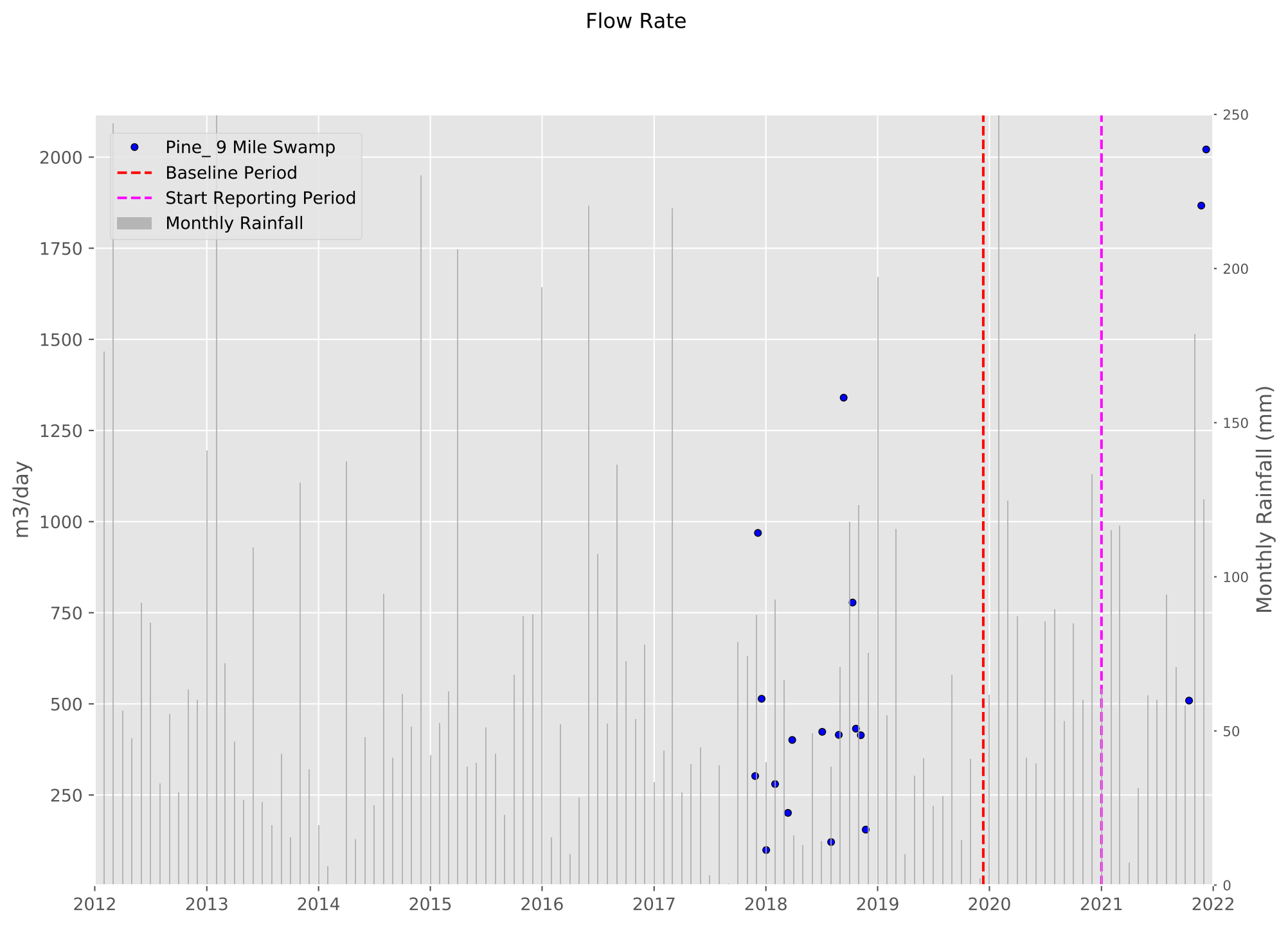

Iron
Paddys Creek
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.2
0.4
0.6
0.8
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

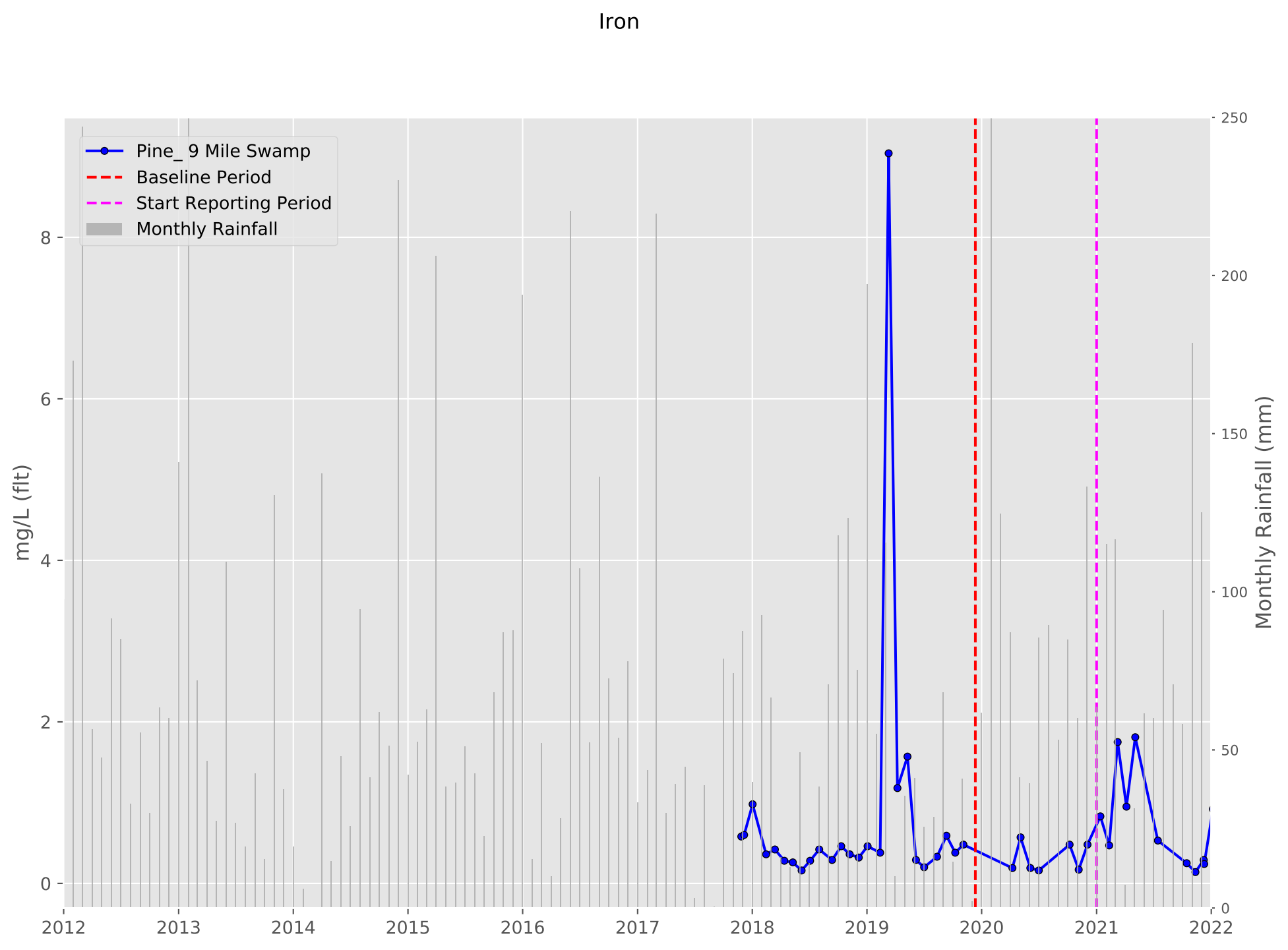

Manganese
Paddys Creek
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.01
0.02
0.03
0.04
0.05
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

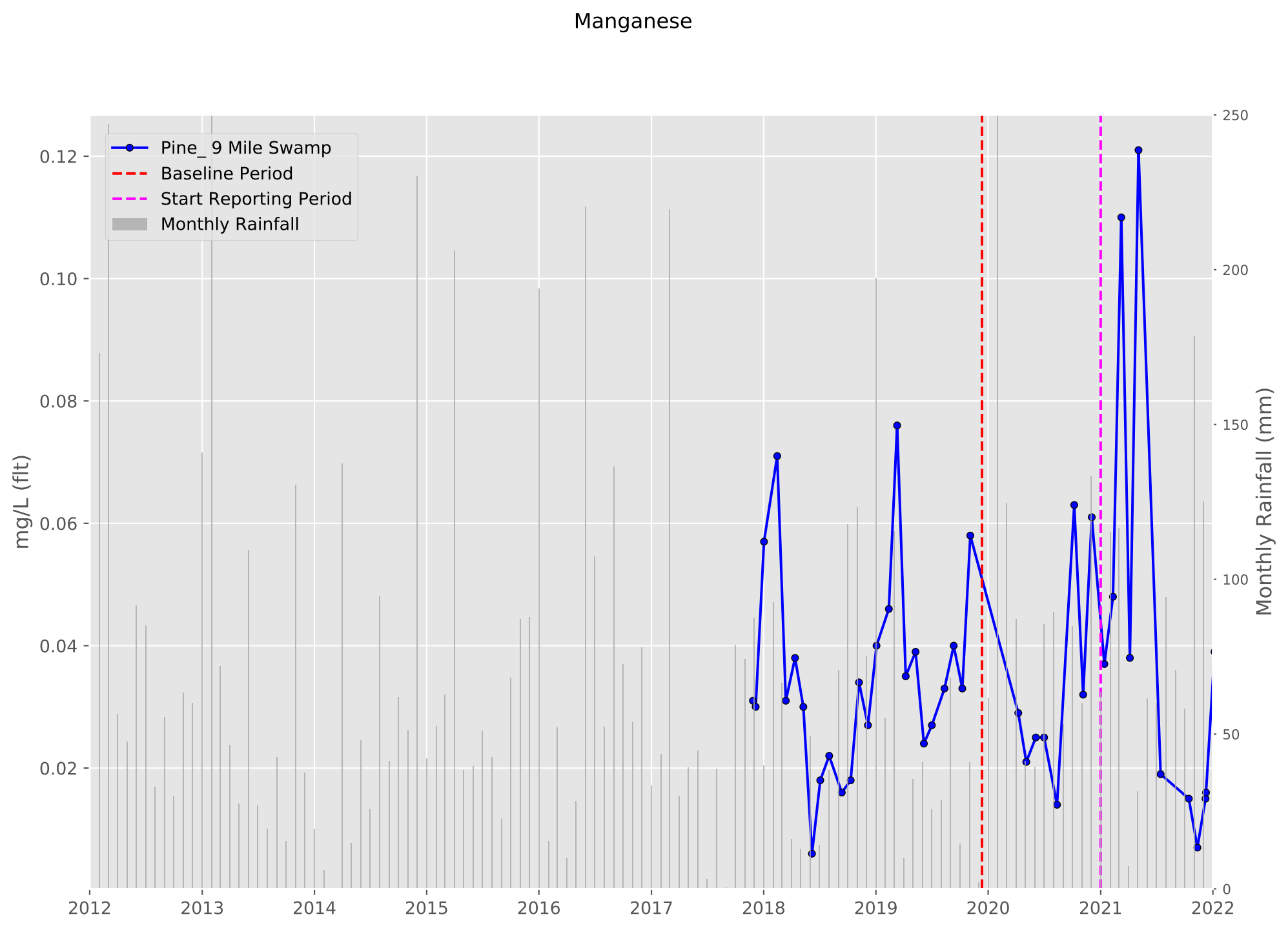

pH
Paddys Creek
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
25
20
15
10
5
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

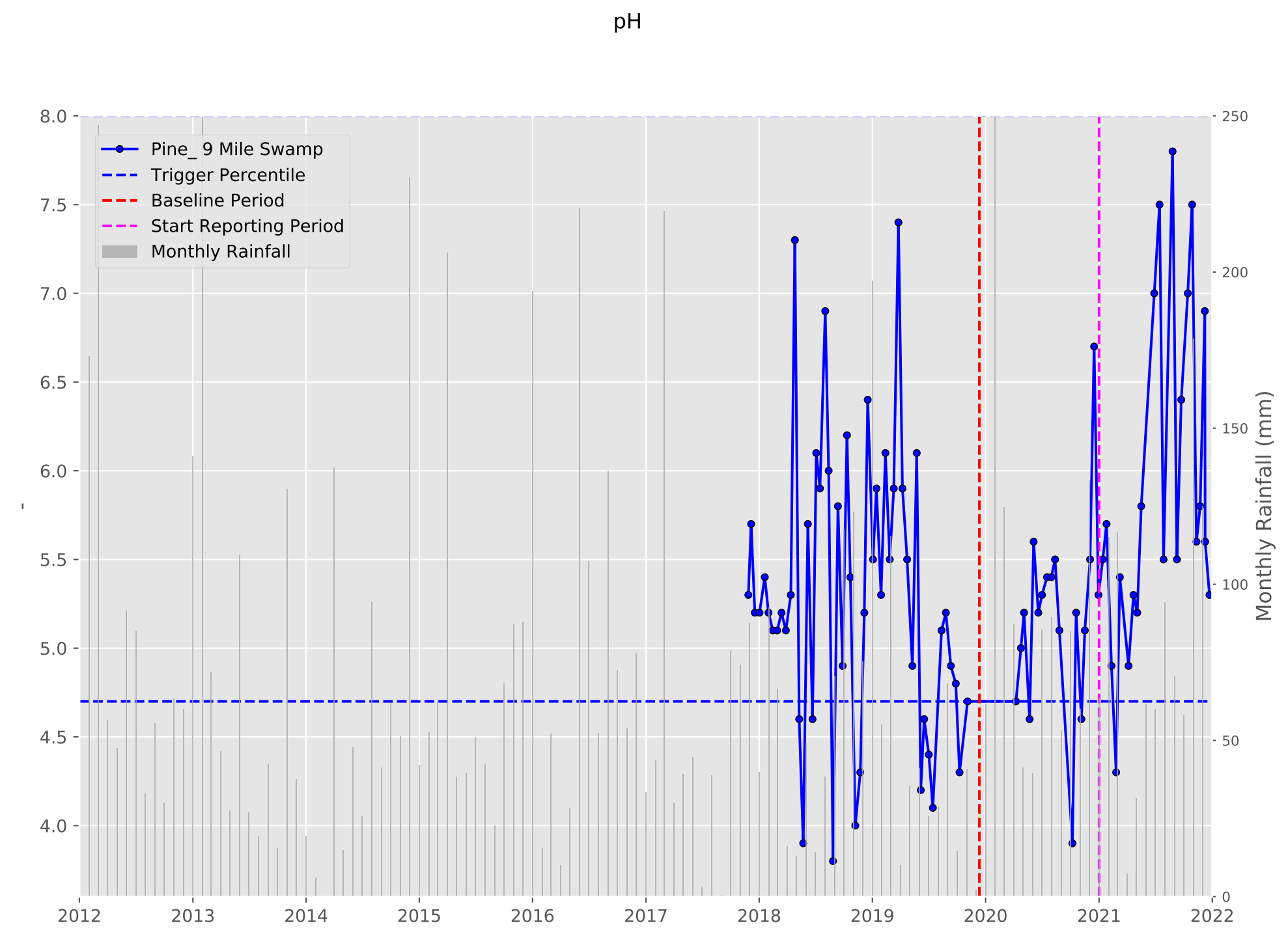

TSS
Paddys Creek
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
100
80
60
40
20
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

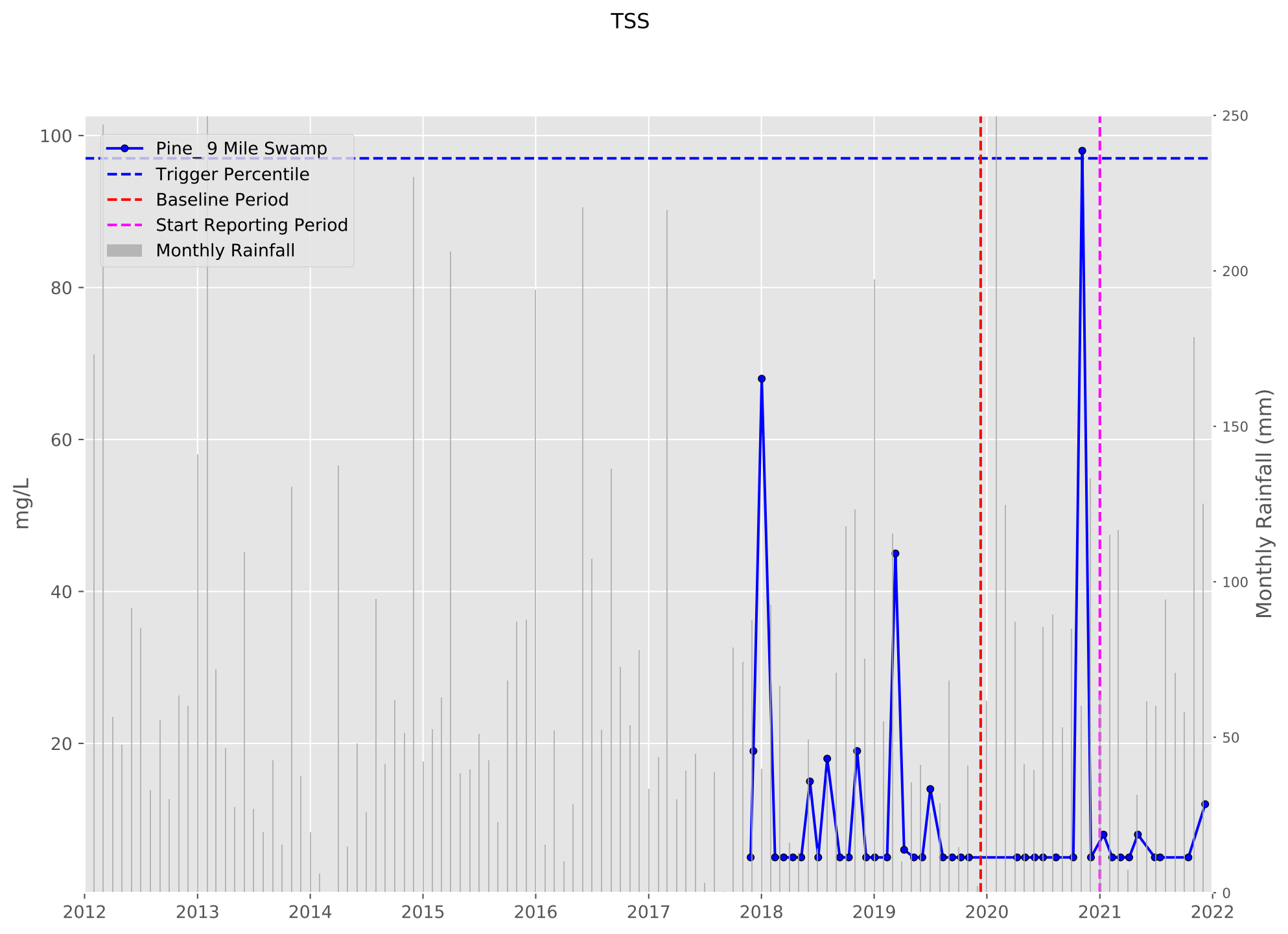

EC (field)
Pine_ 9 Mile Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

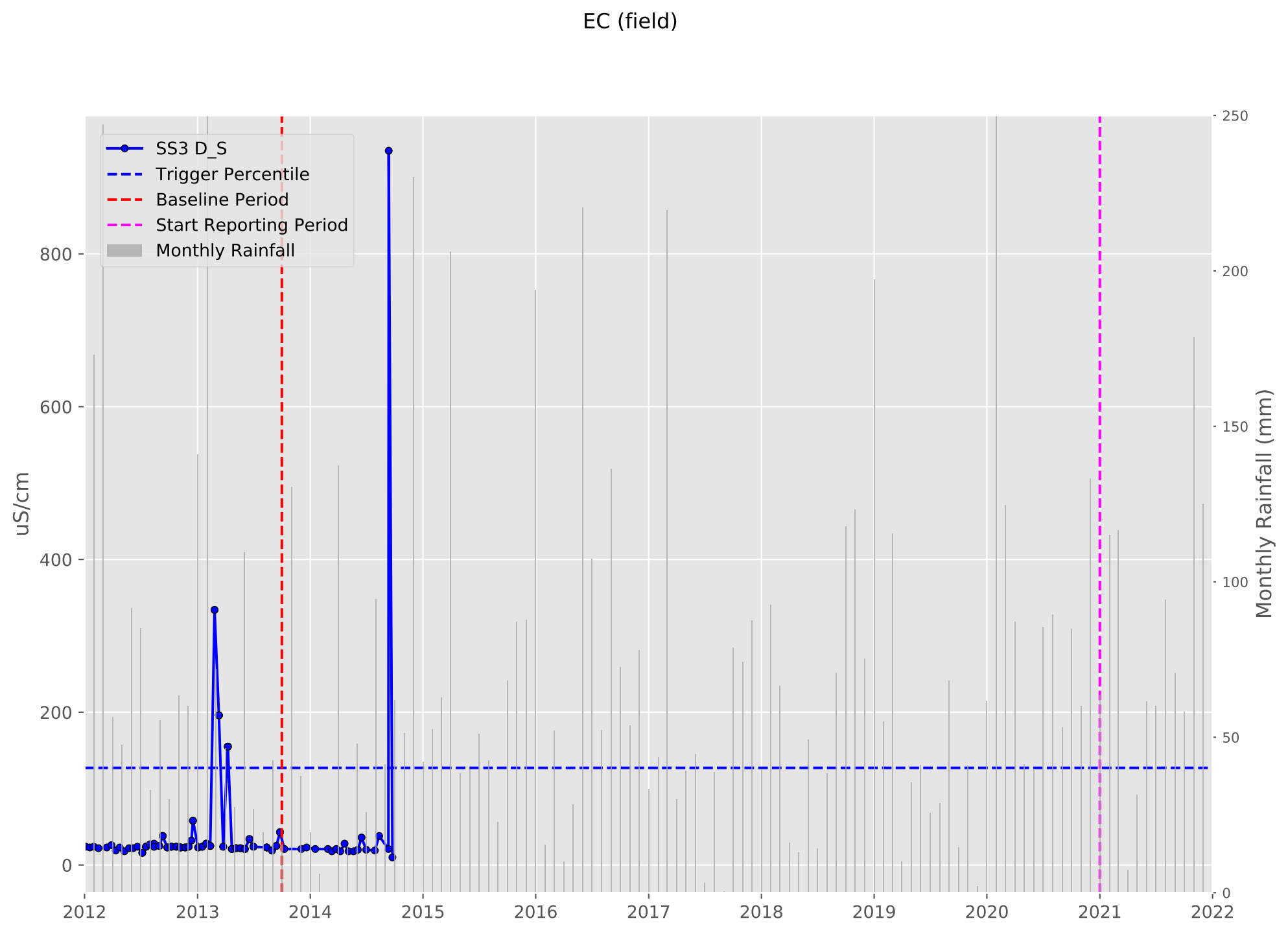

Flow Rate
Pine_ 9 Mile Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
2000
1750
1500
1250
1000
750
500
250
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

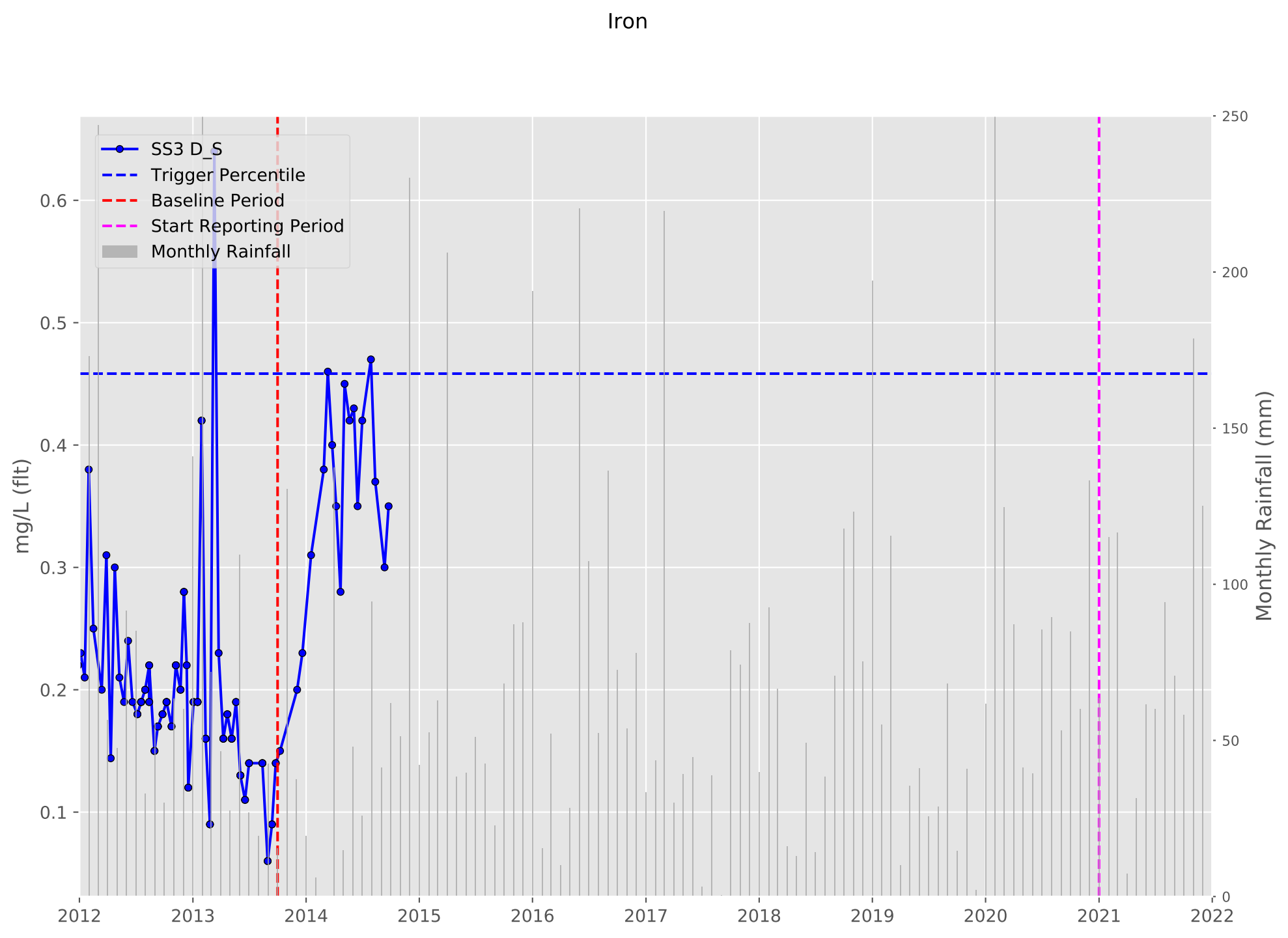

Iron
Pine_ 9 Mile Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
2
4
6
8
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

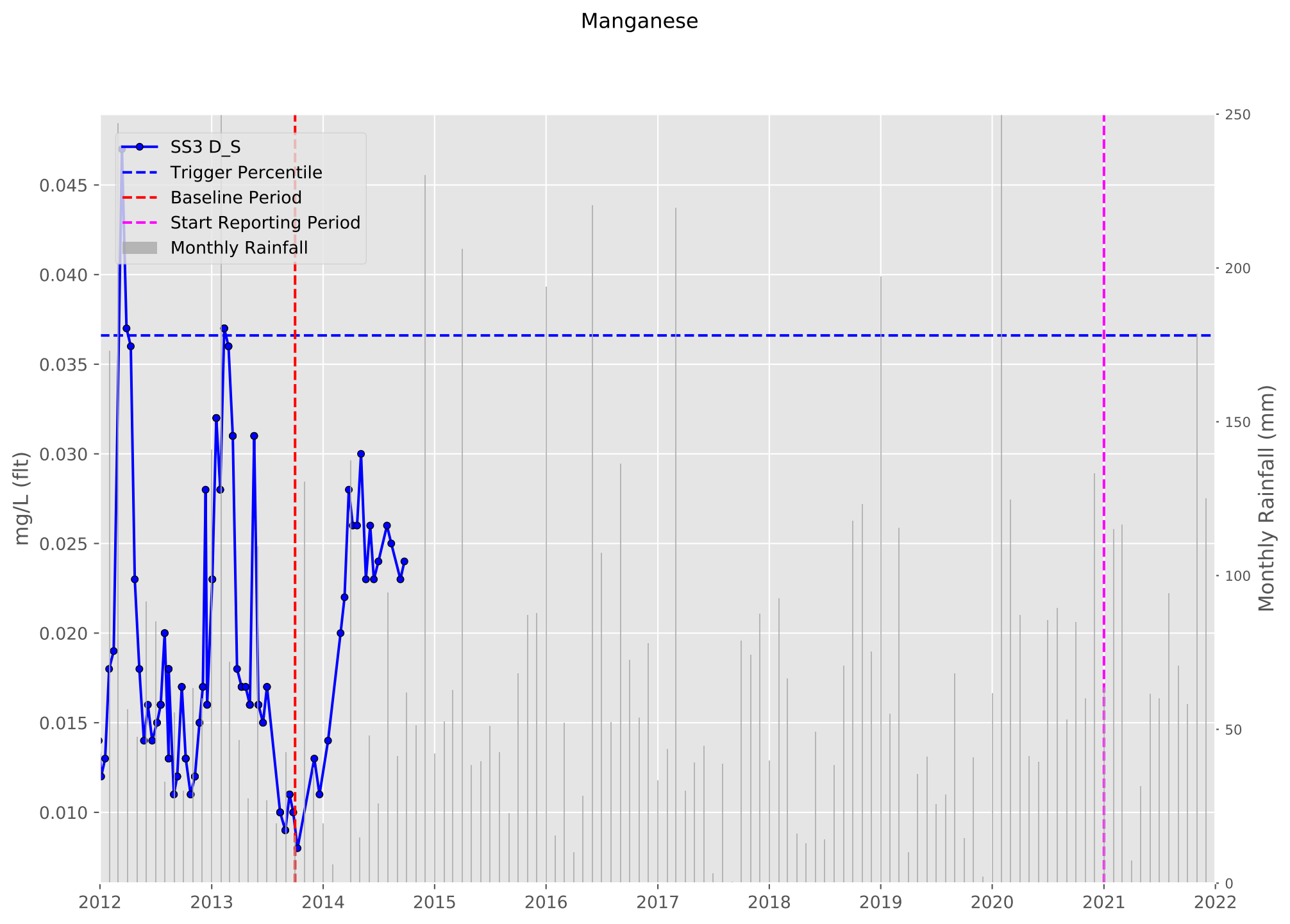

Manganese
Pine_ 9 Mile Swamp
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.12
0.10
0.08
0.06
0.04
0.02
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

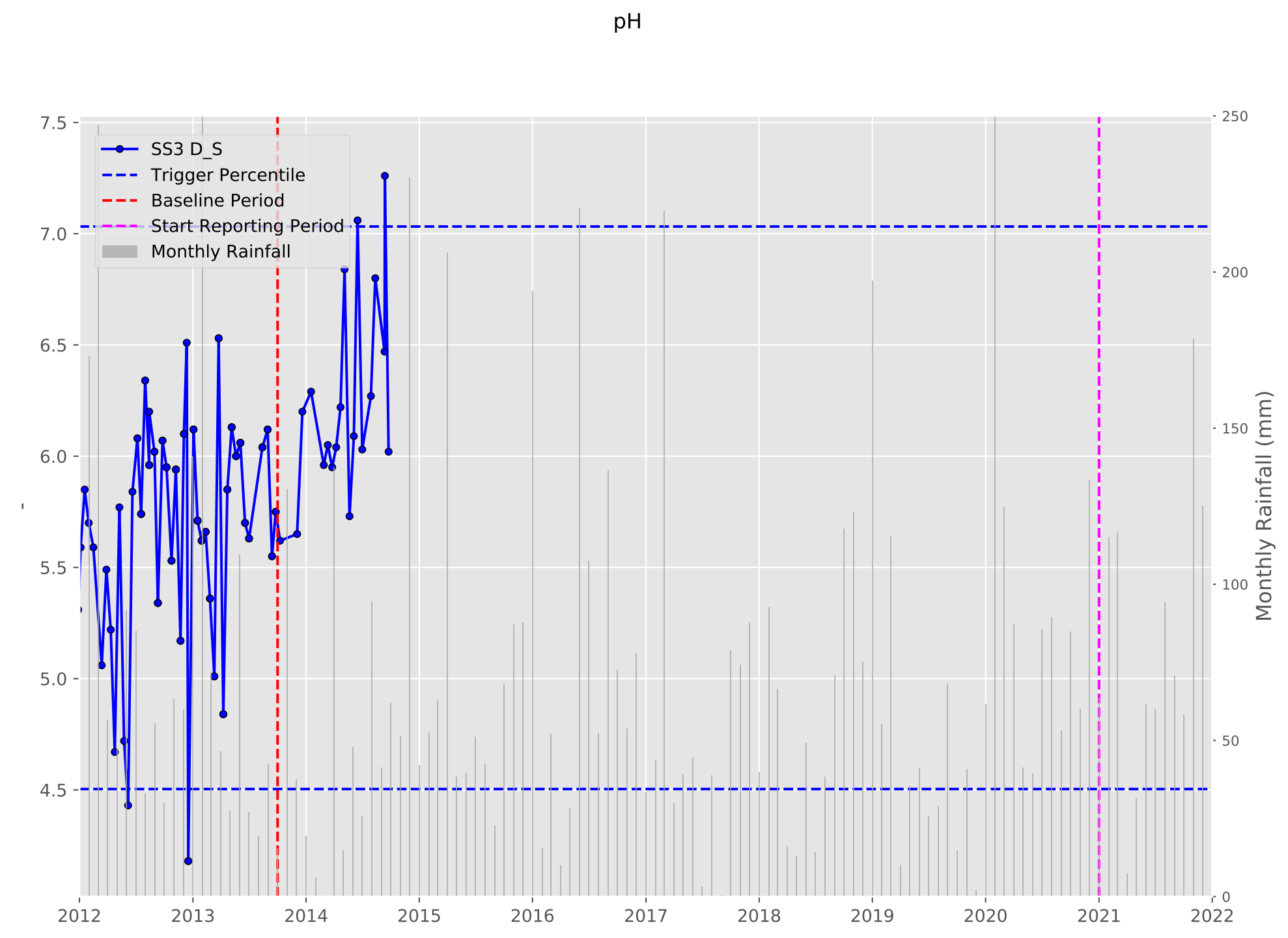

pH
Pine_ 9 Mile Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
-
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

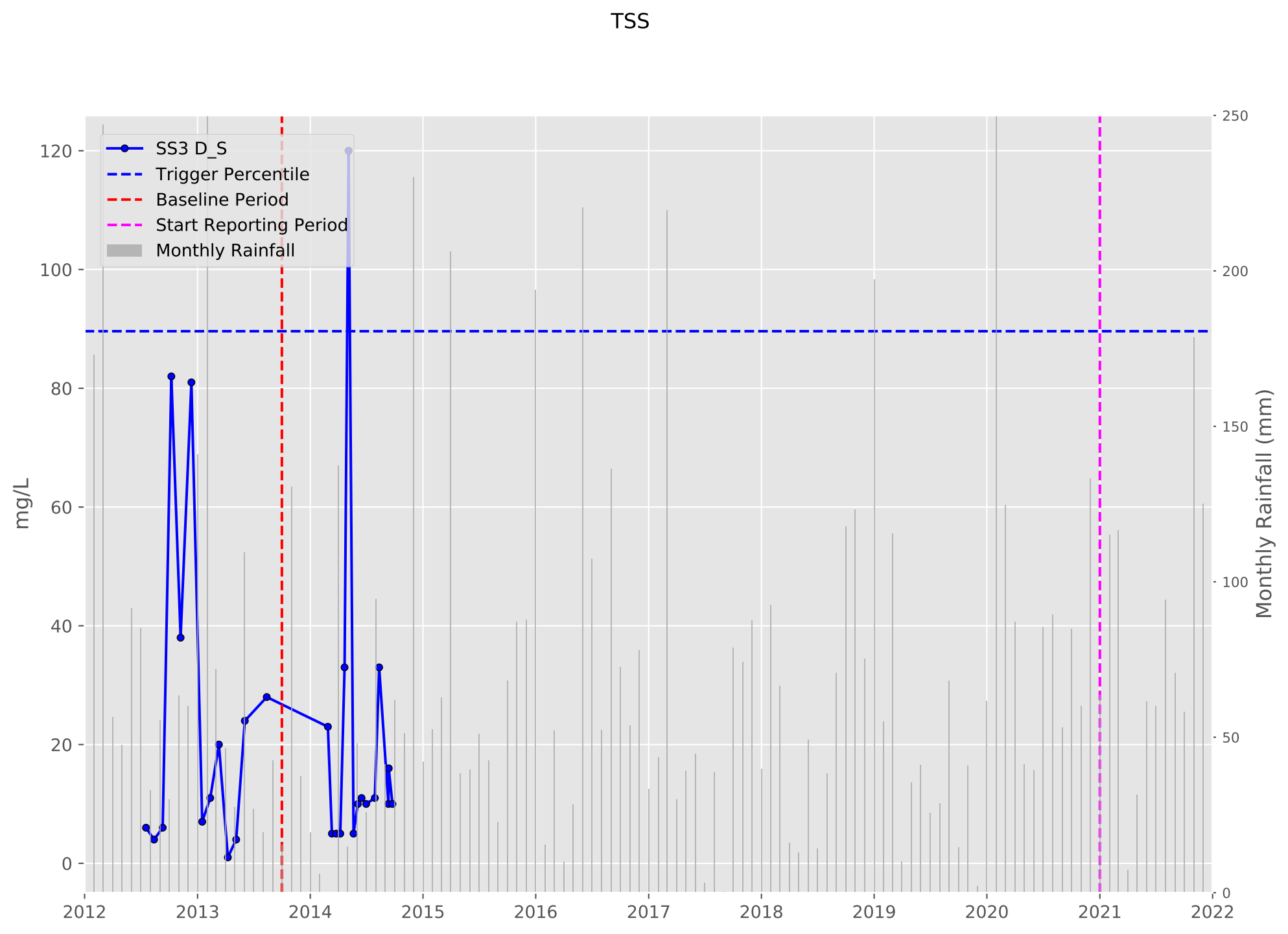

TSS
Pine_ 9 Mile Swamp
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
100
80
60
40
20
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

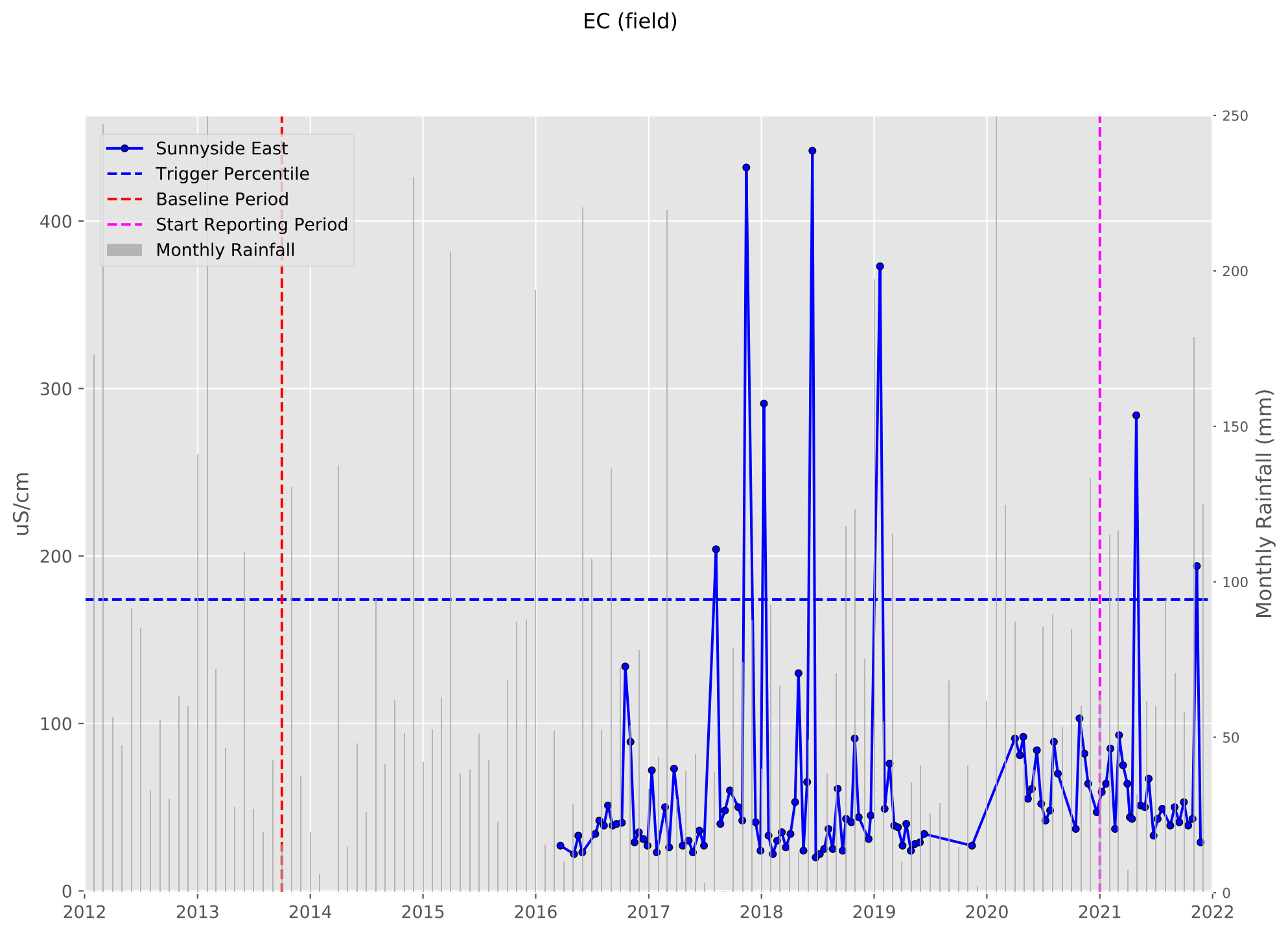

EC (field)
SS3 D_S
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
200
400
600
800
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

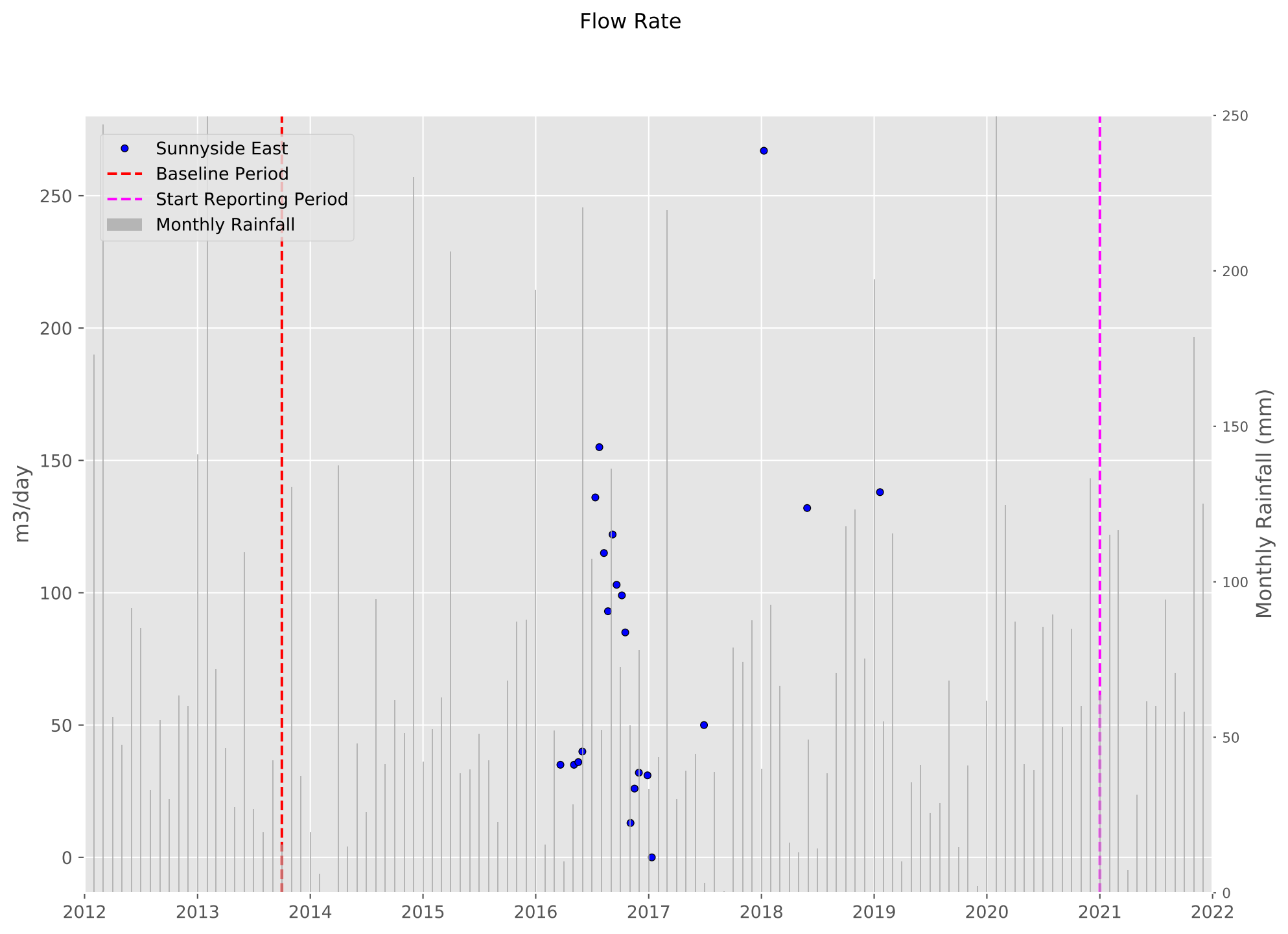

Iron
SS3 D_S
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.1
0.2
0.3
0.4
0.5
0.6
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

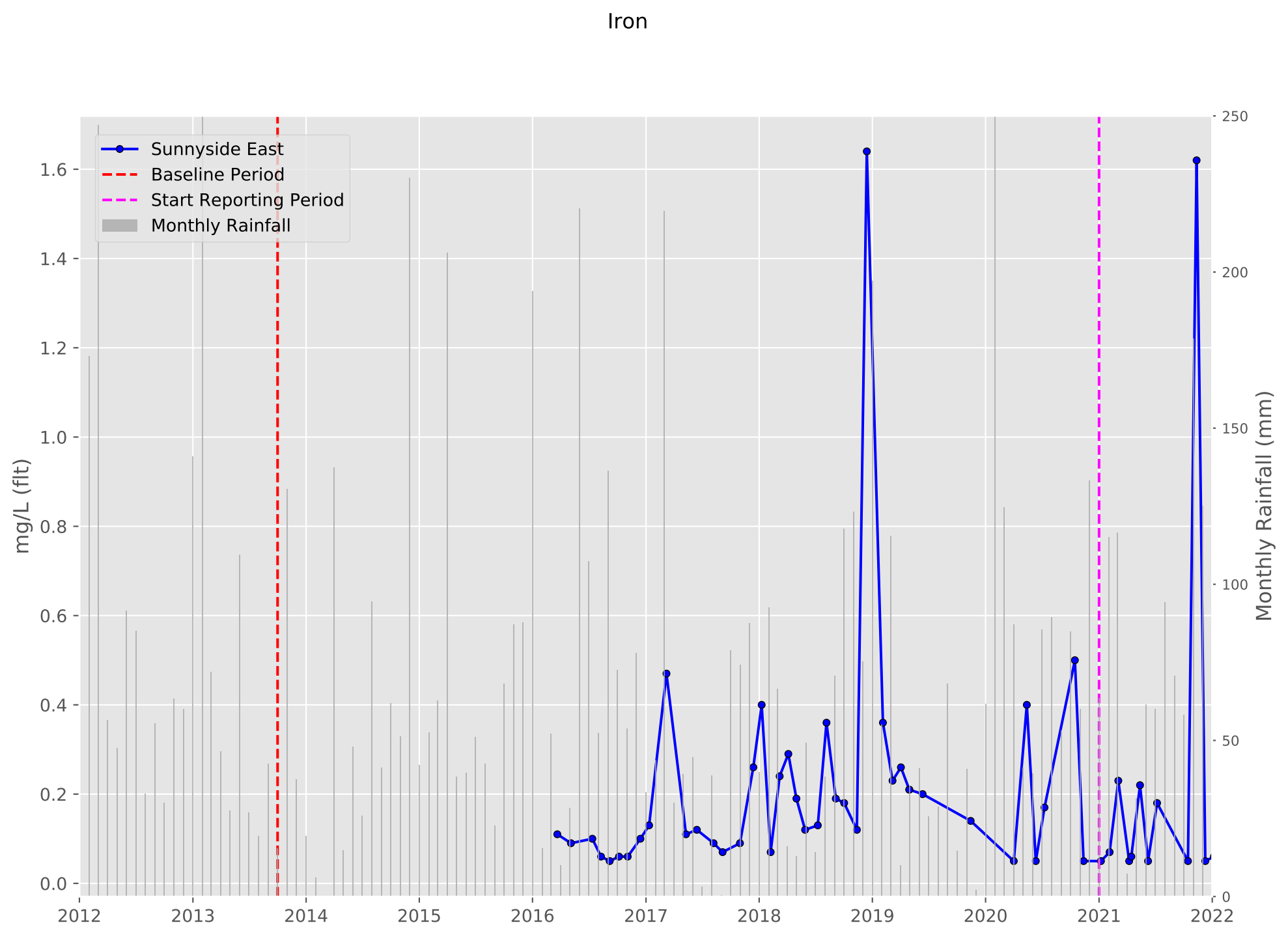

Manganese
SS3 D_S
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

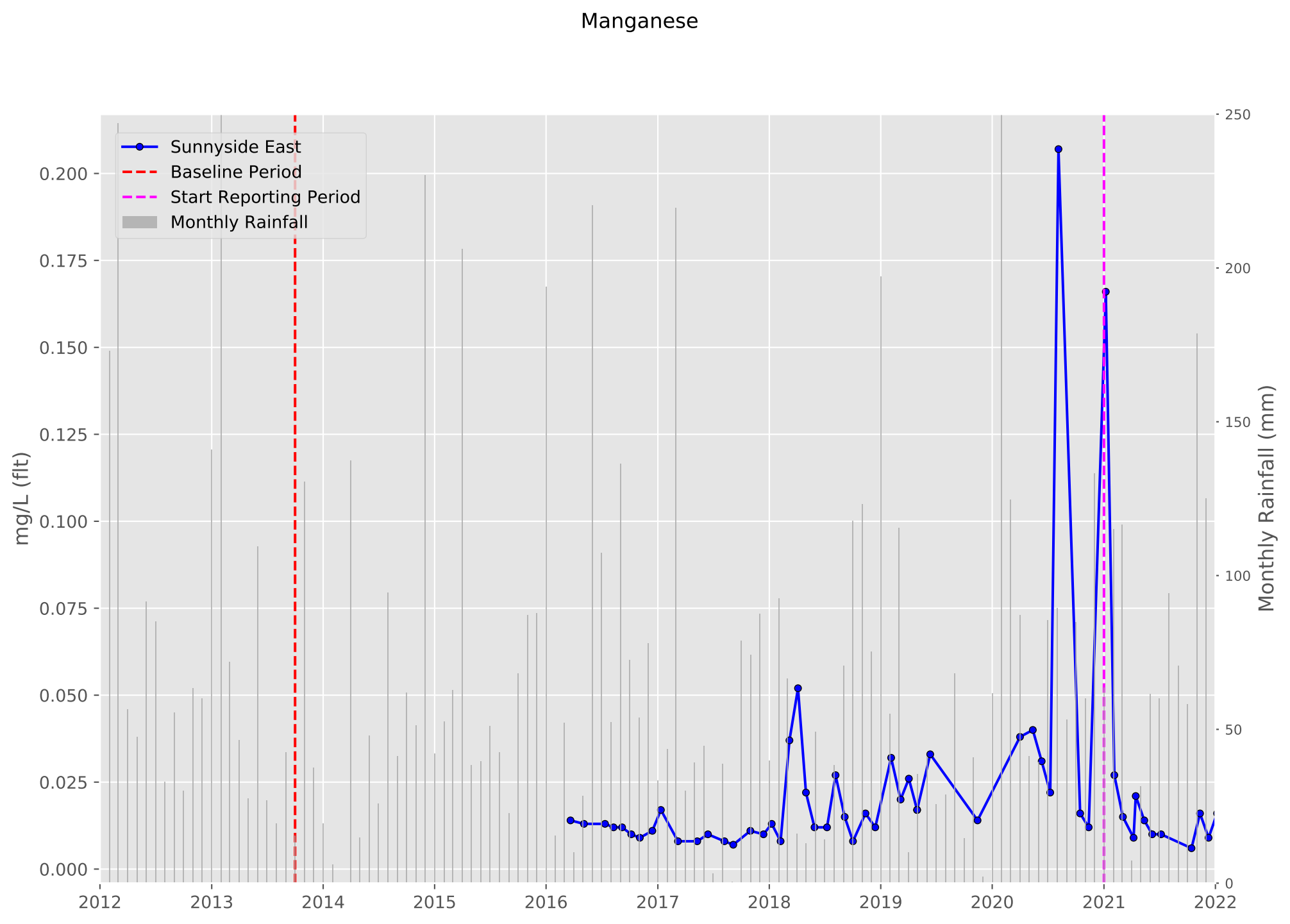

pH
SS3 D_S
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
7.5
7.0
6.5
6.0
5.5
5.0
4.5
-
250
200
150
100
50
0
Monthly Rainfall (mm)
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

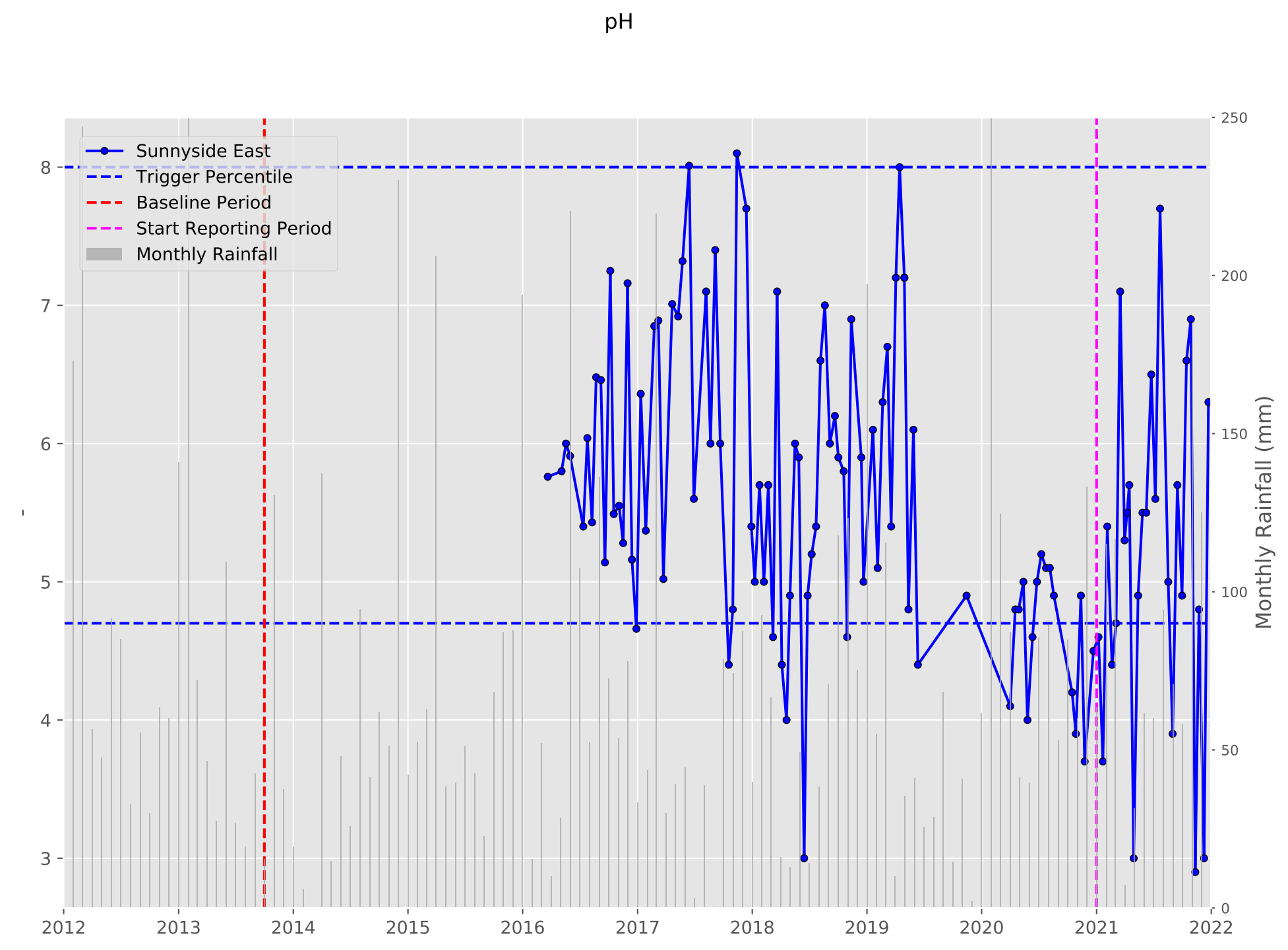

TSS
SS3 D_S
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0
20
40
60
80
100
120
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

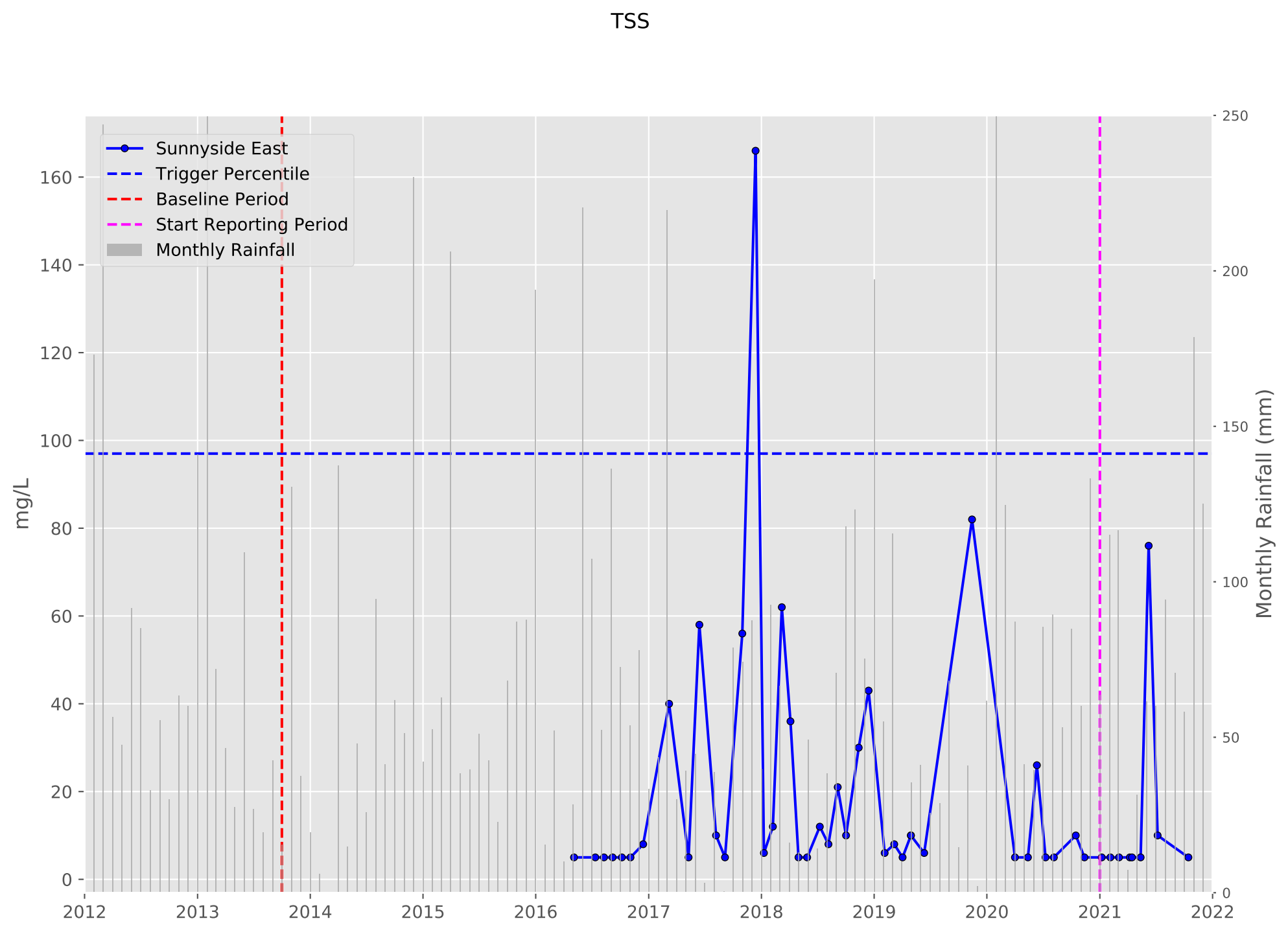

EC (field)
Sunnyside East
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
100
200
300
400
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

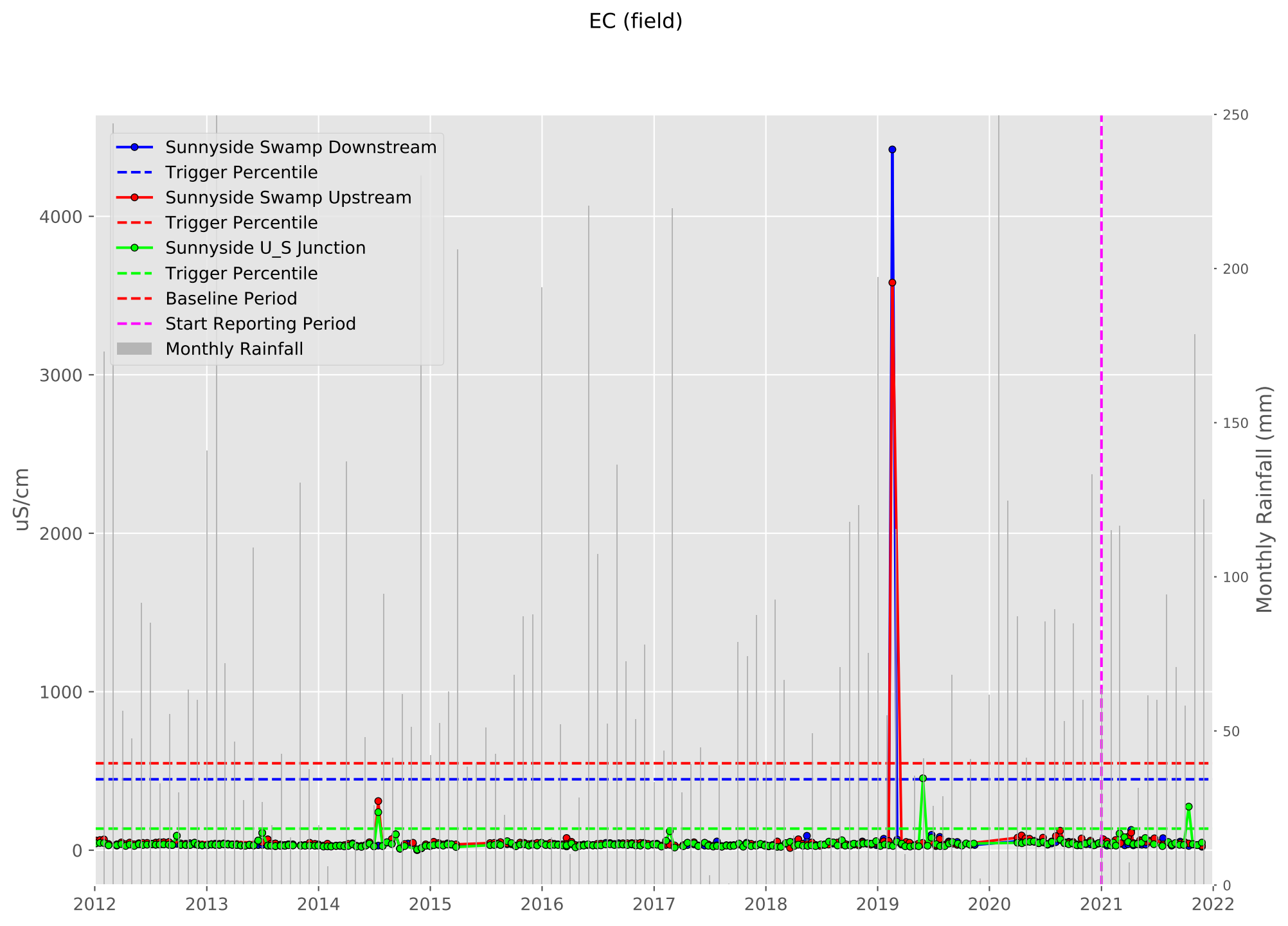

Flow Rate
Sunnyside East
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

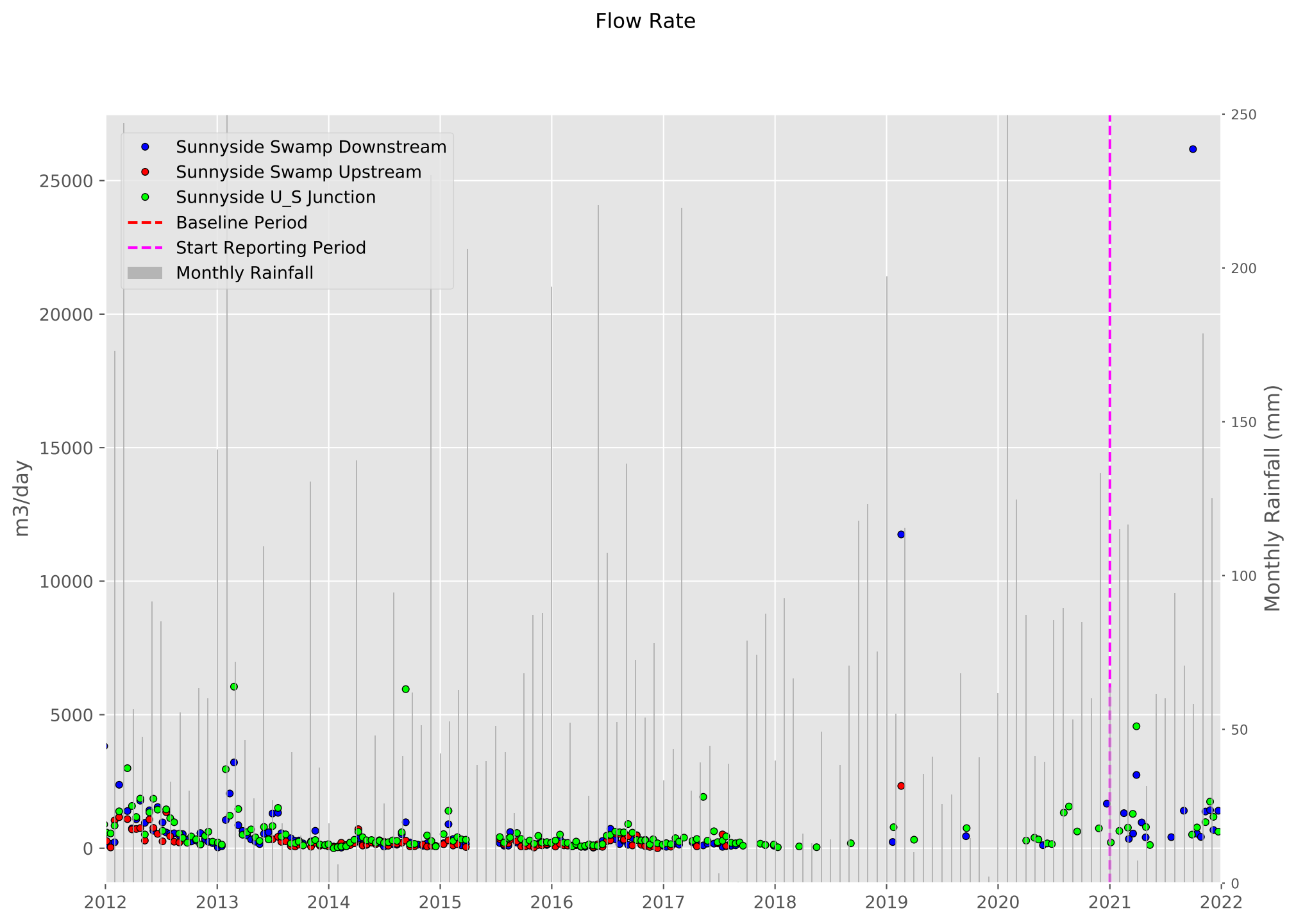

Iron
Sunnyside East
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

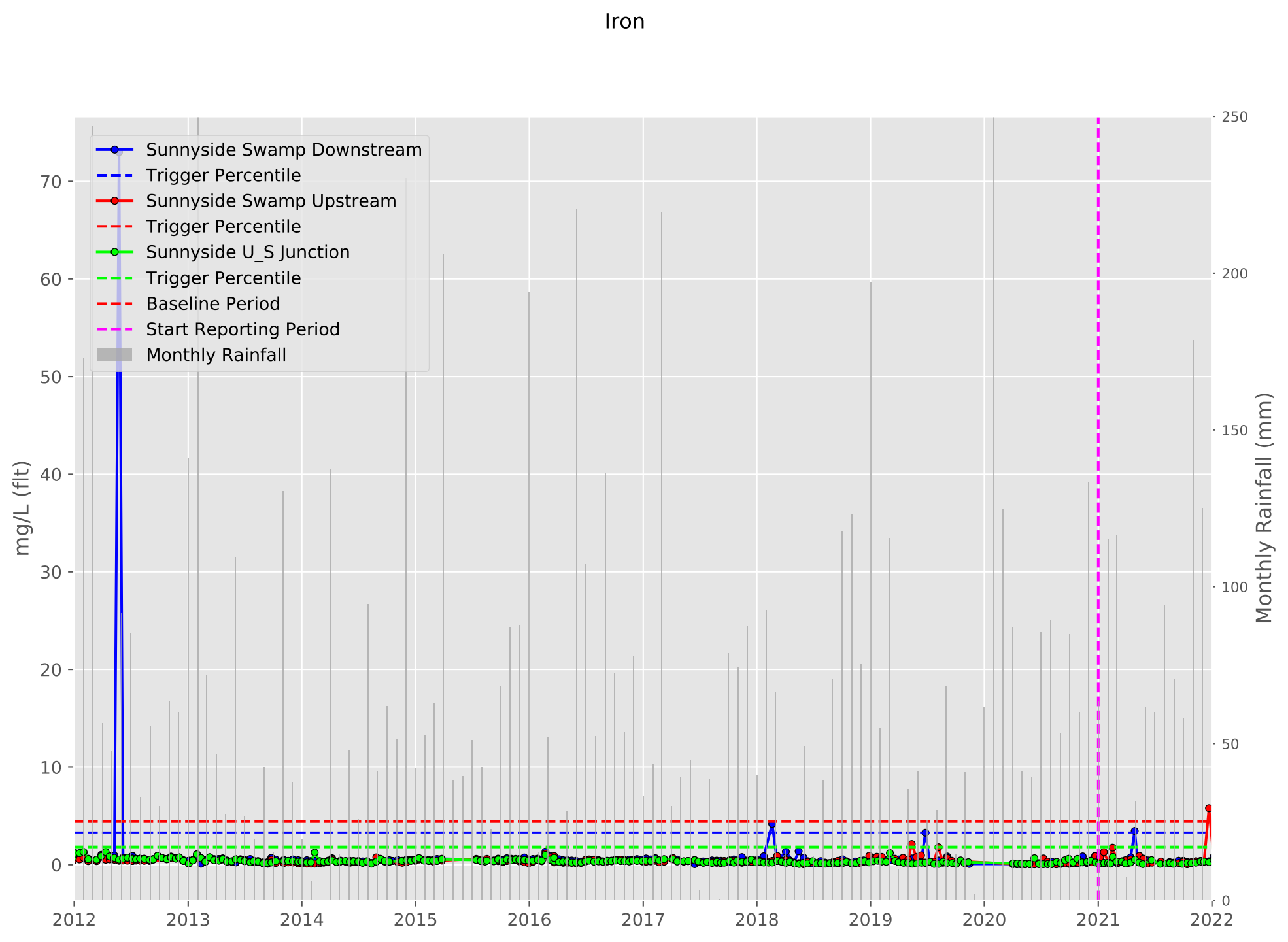

Manganese
Sunnyside East
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.175
0.200
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

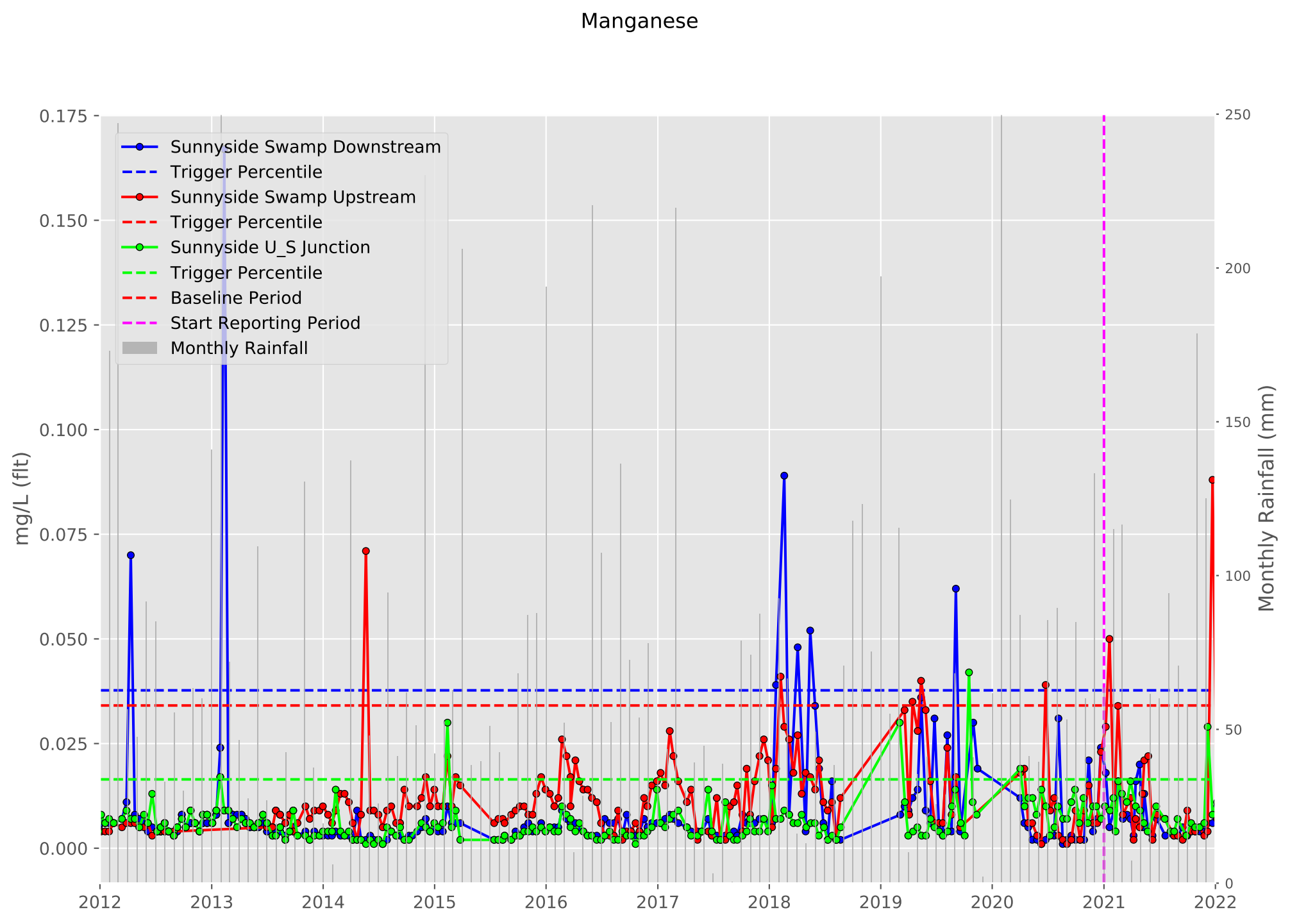

pH
Sunnyside East
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

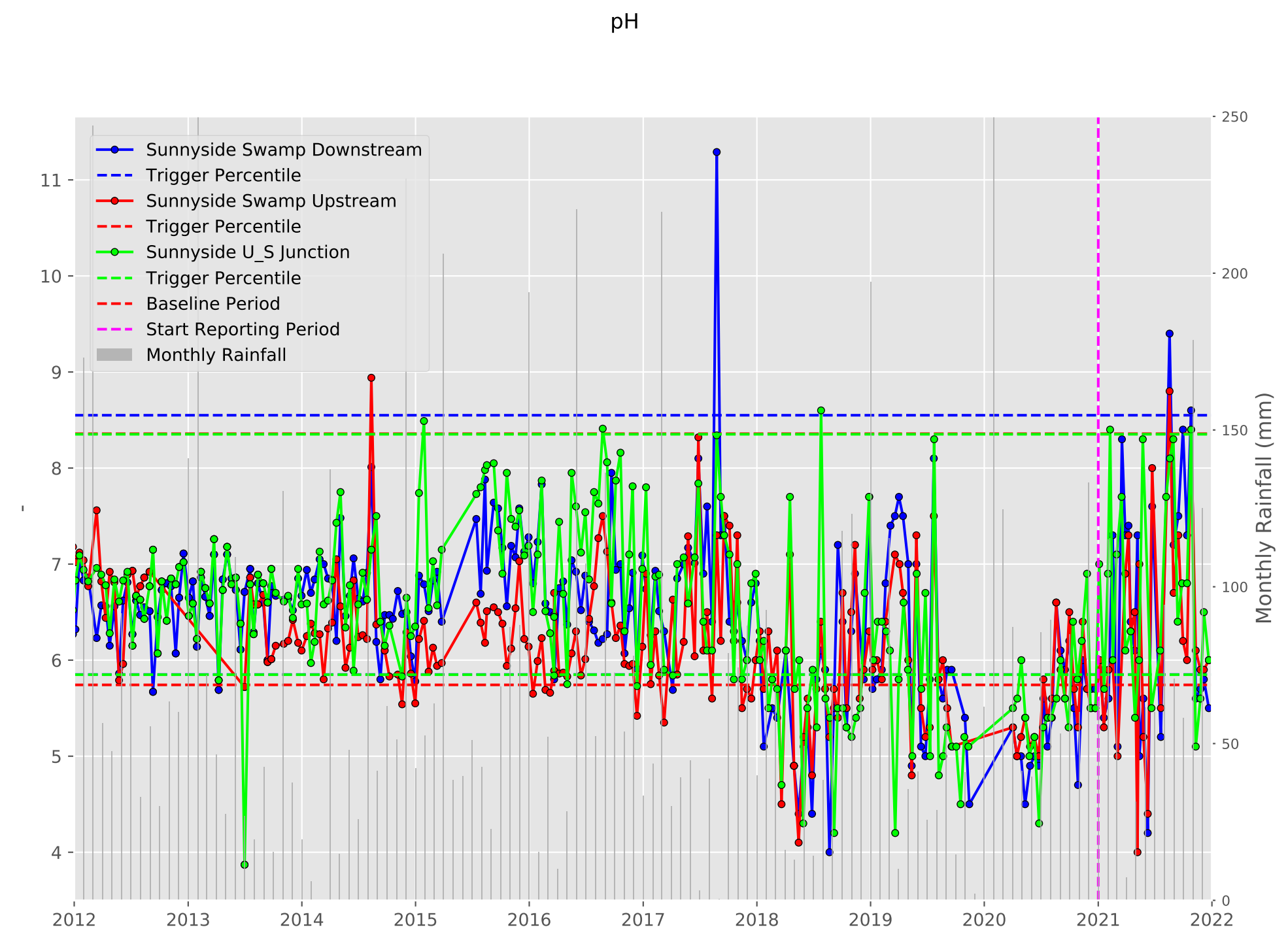

TSS
Sunnyside East
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0
20
40
60
80
100
120
140
160
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

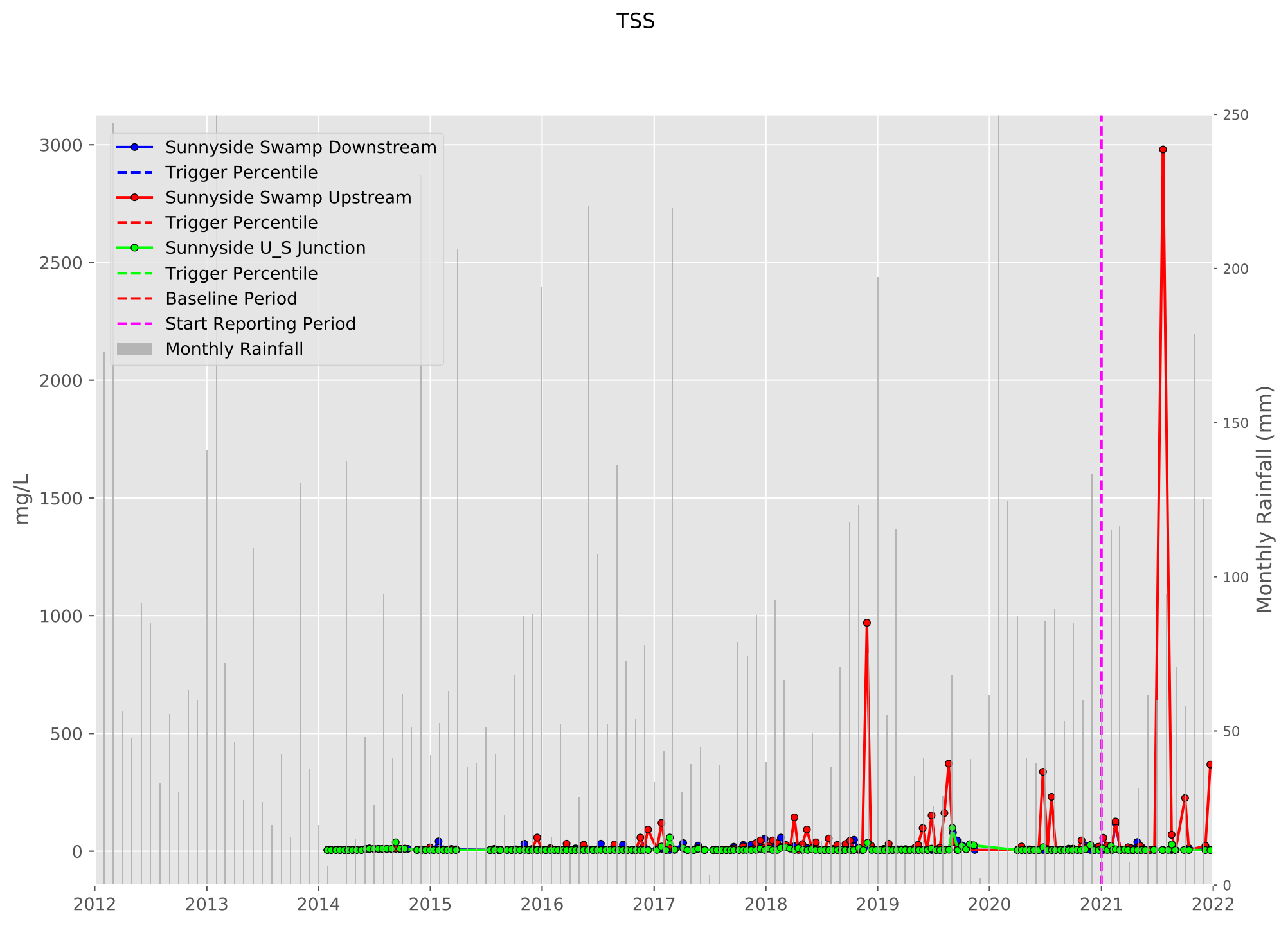

EC (field)
Sunnyside Swamp Downstream
Trigger Percentile
Sunnyside Swamp Upstream
Trigger Percentile
Sunnyside U_S Junction
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
1000
2000
3000
4000
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

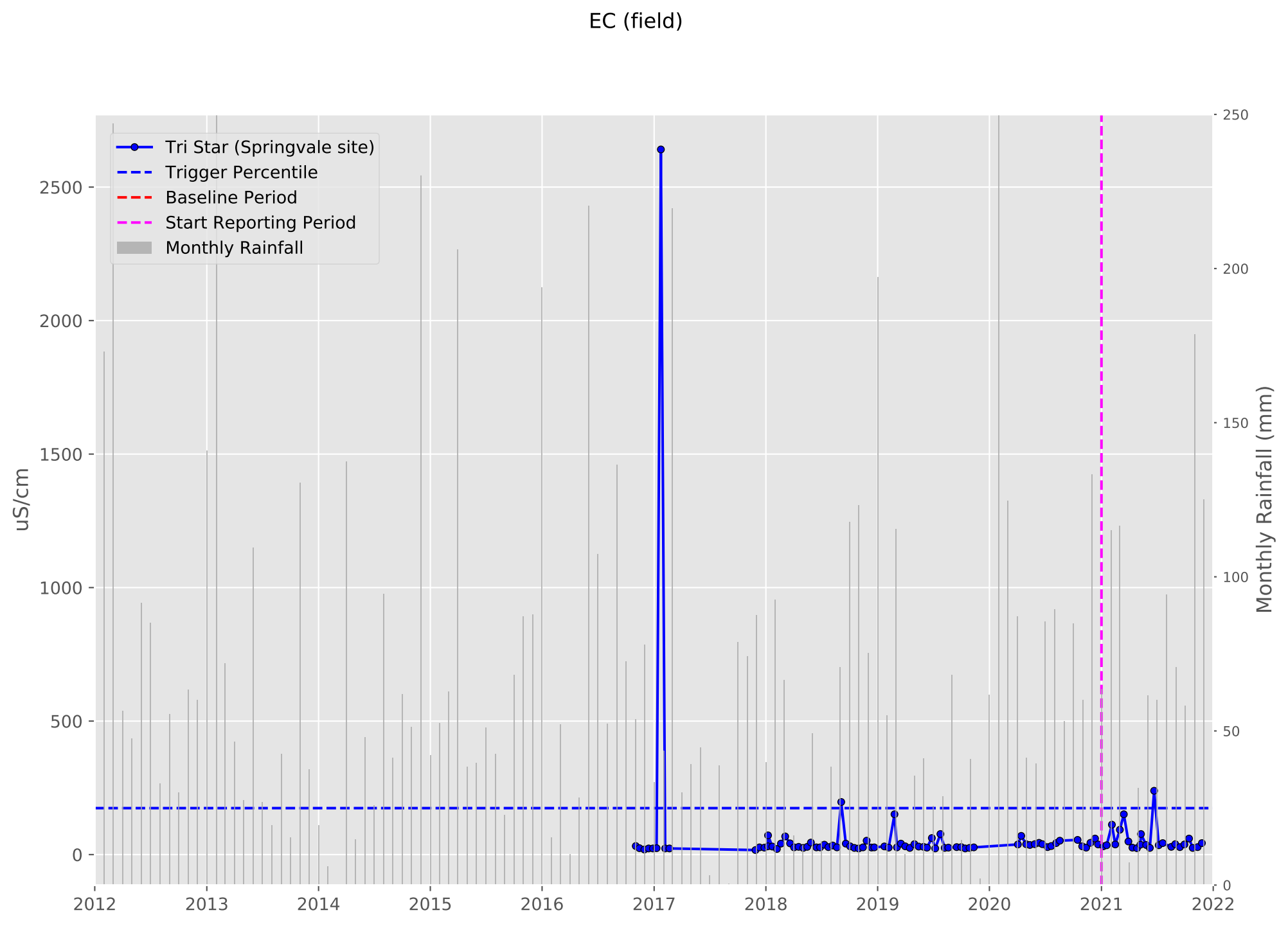

Flow Rate
Sunnyside Swamp Downstream
Sunnyside Swamp Upstream
Sunnyside U_S Junction
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
25000
20000
15000
10000
5000
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

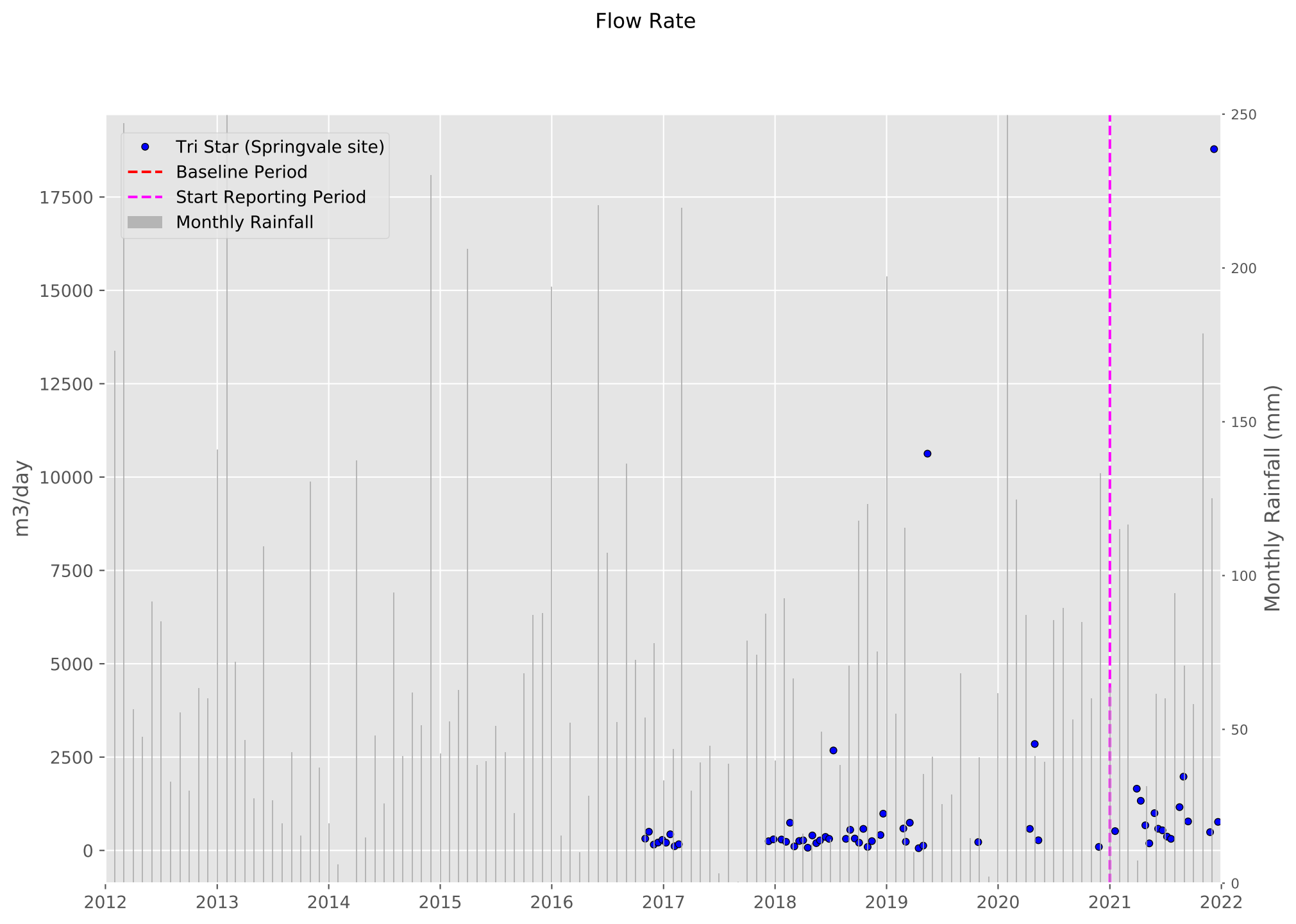

Iron
Sunnyside Swamp Downstream
Trigger Percentile
Sunnyside Swamp Upstream
Trigger Percentile
Sunnyside U_S Junction
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
10
20
30
40
50
60
70
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

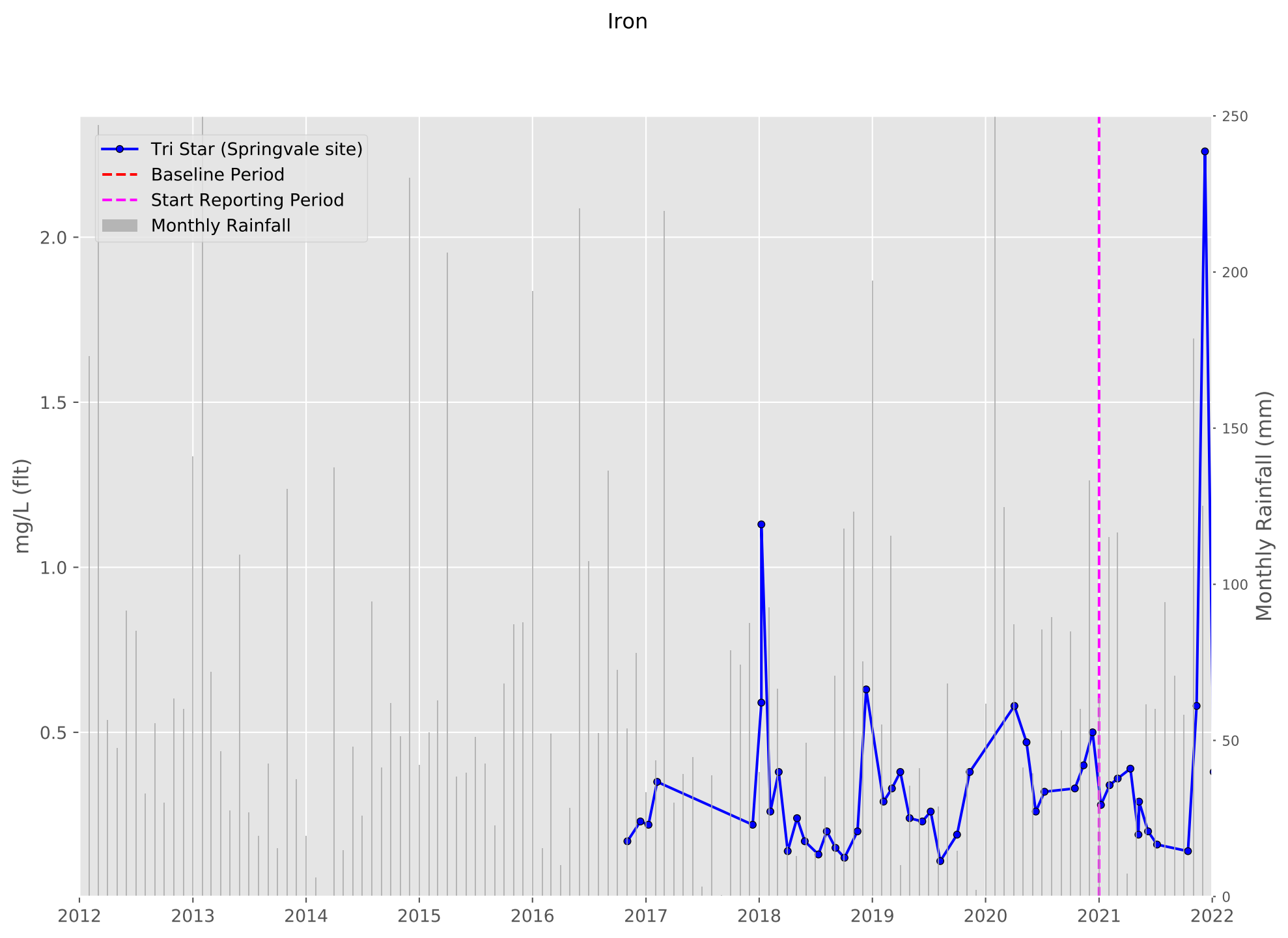

Manganese
Sunnyside Swamp Downstream
Trigger Percentile
Sunnyside Swamp Upstream
Trigger Percentile
Sunnyside U_S Junction
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

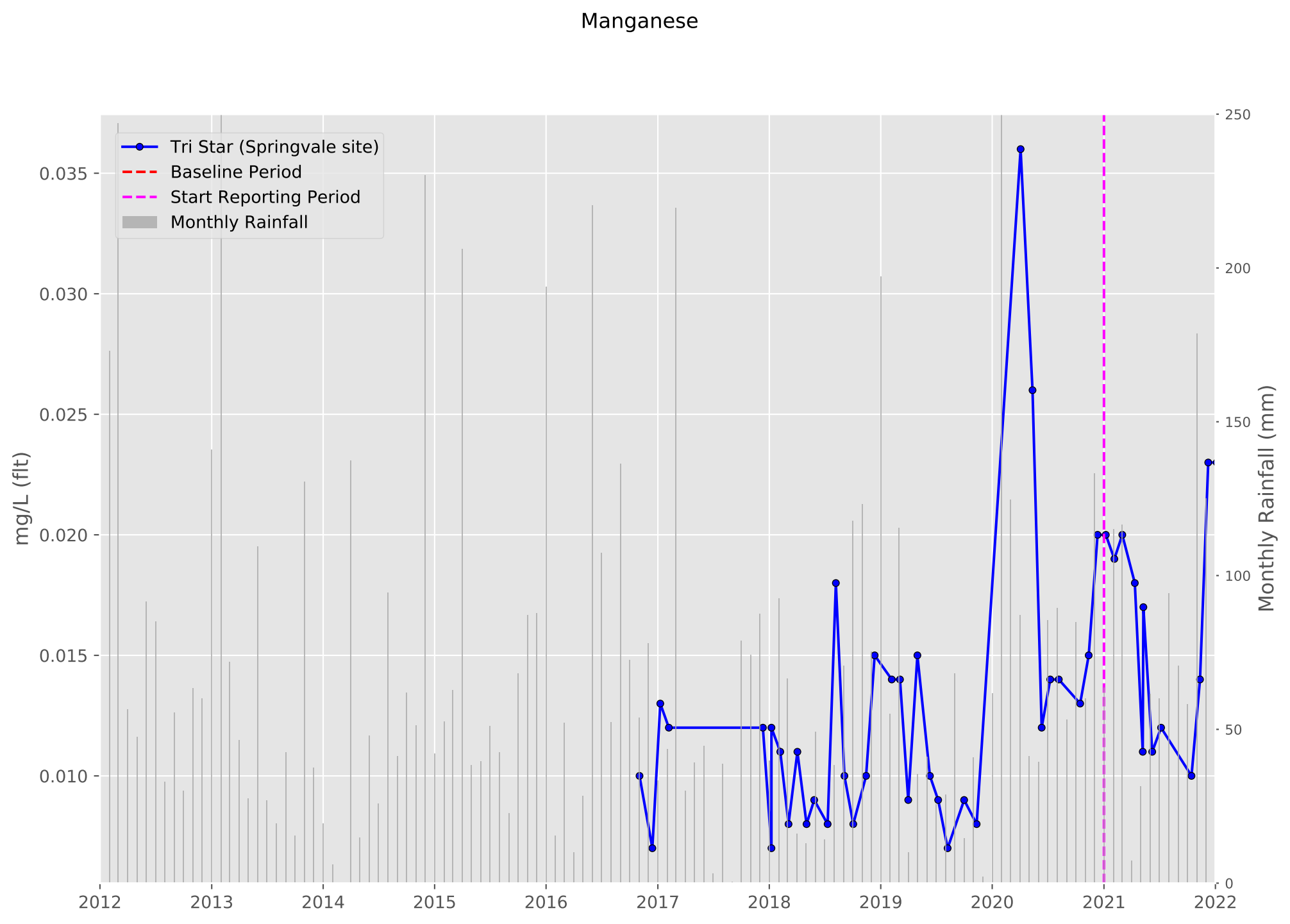

pH
Sunnyside Swamp Downstream
Trigger Percentile
Sunnyside Swamp Upstream
Trigger Percentile
Sunnyside U_S Junction
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
11
10
9
8
7
6
5
4
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

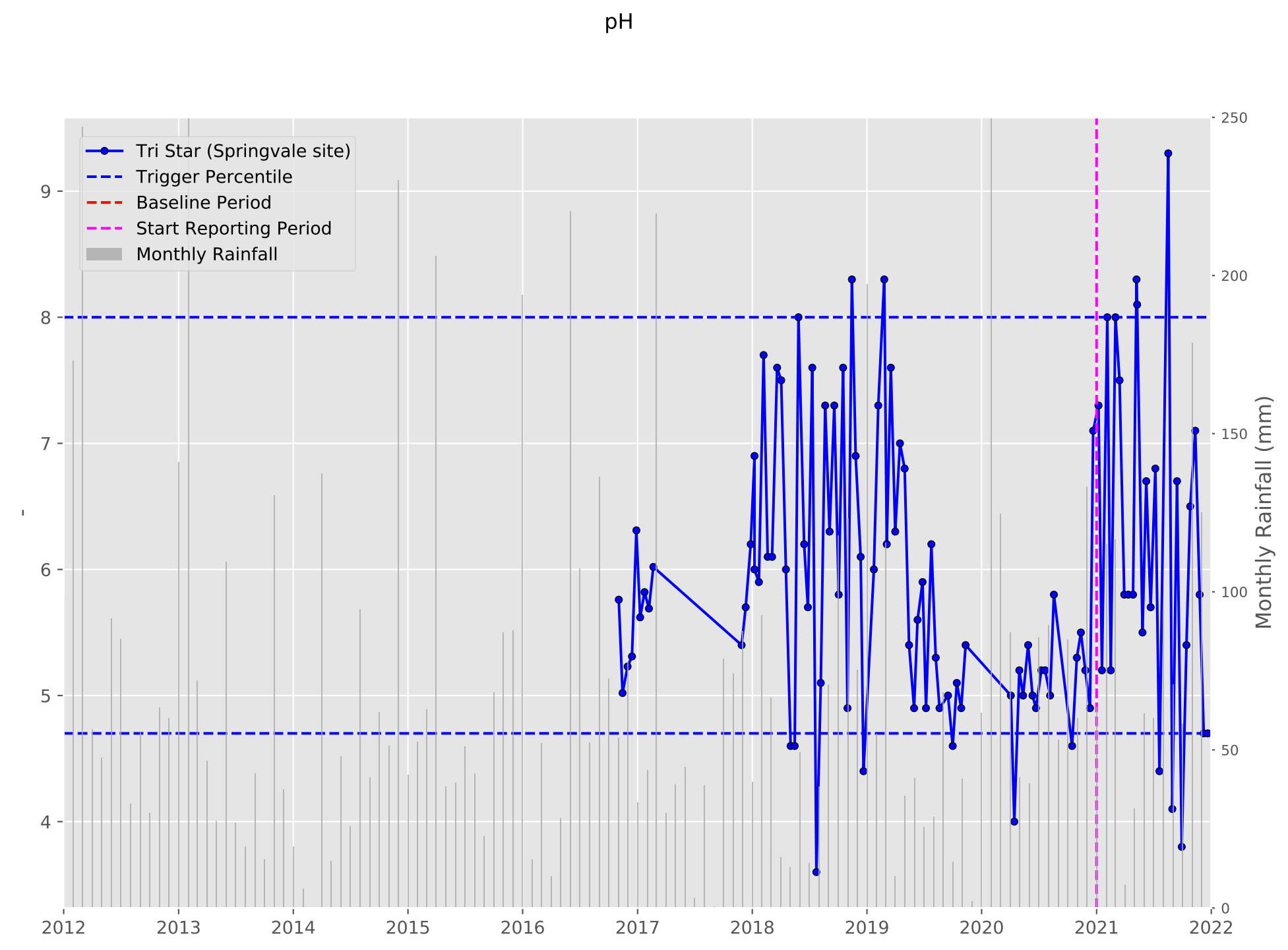

TSS
Sunnyside Swamp Downstream
Trigger Percentile
Sunnyside Swamp Upstream
Trigger Percentile
Sunnyside U_S Junction
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
3000
2500
2000
1500
1000
500
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

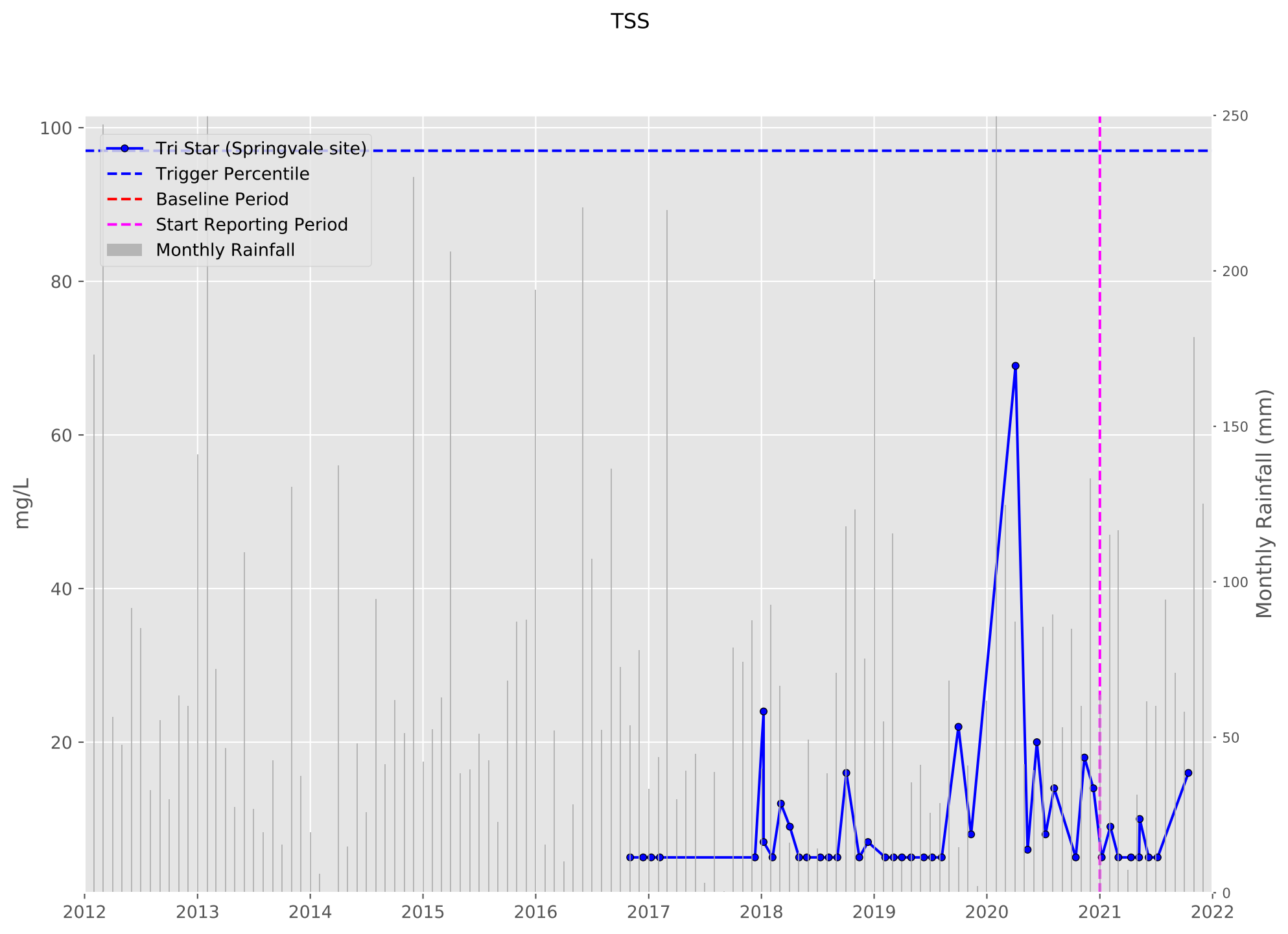

EC (field)
Tri Star (Springvale site)
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
500
1000
1500
2000
2500
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

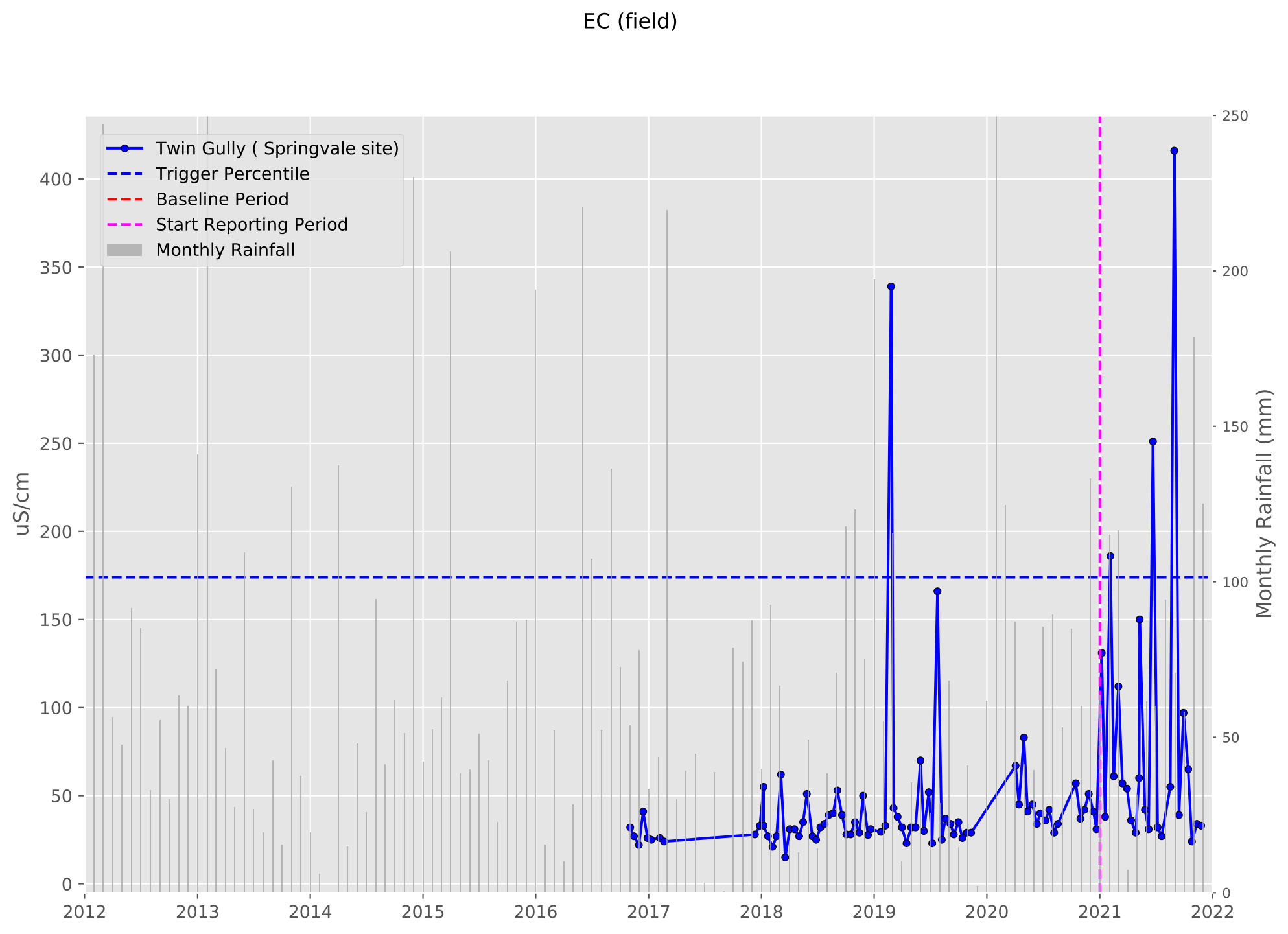

Flow Rate
Tri Star (Springvale site)
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
17500
15000
12500
10000
7500
5000
2500
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

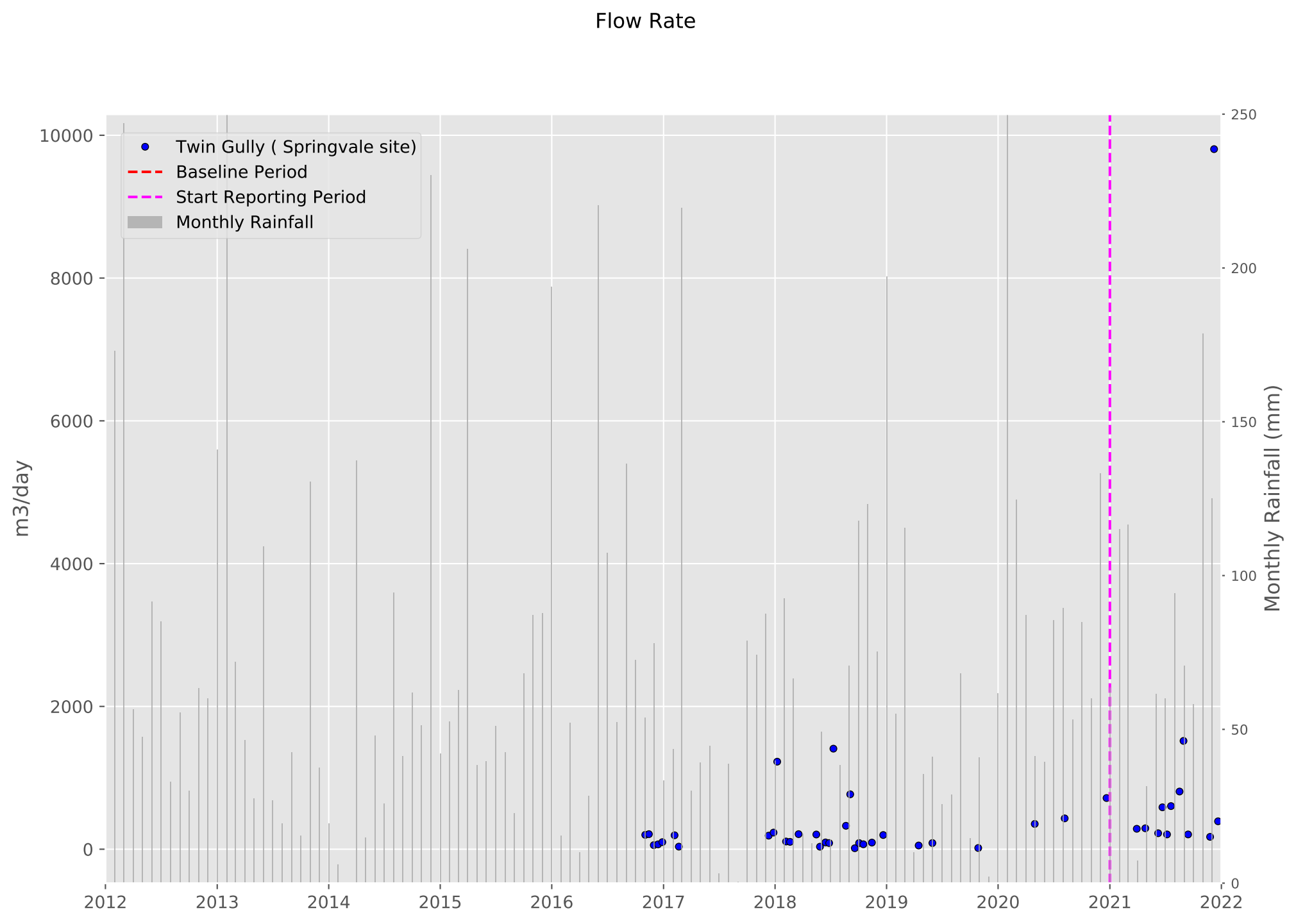

Iron
Tri Star (Springvale site)
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.5
1.0
1.5
2.0
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

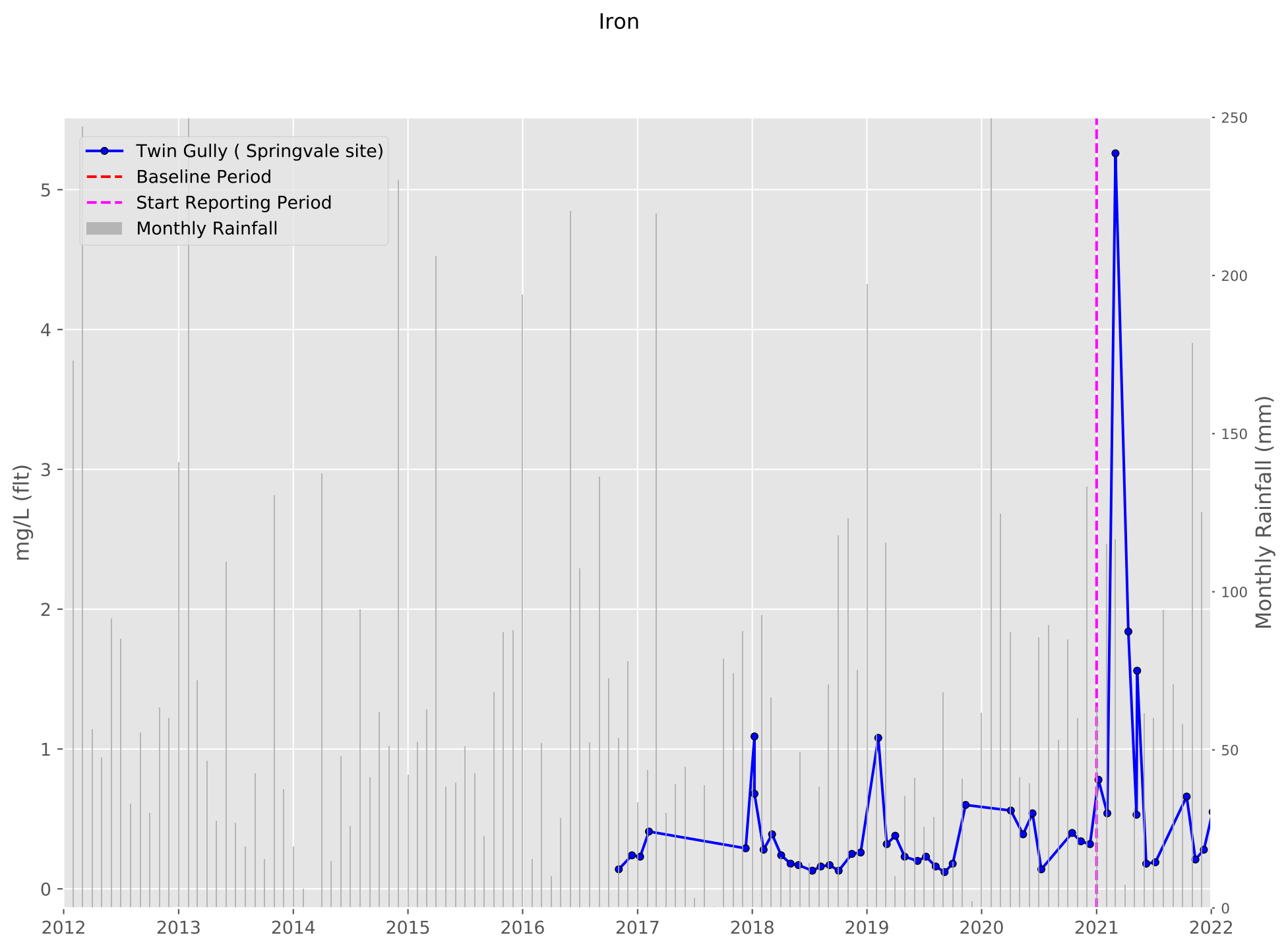

Manganese
Tri Star (Springvale site)
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.035
0.030
0.025
0.020
0.015
0.010
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

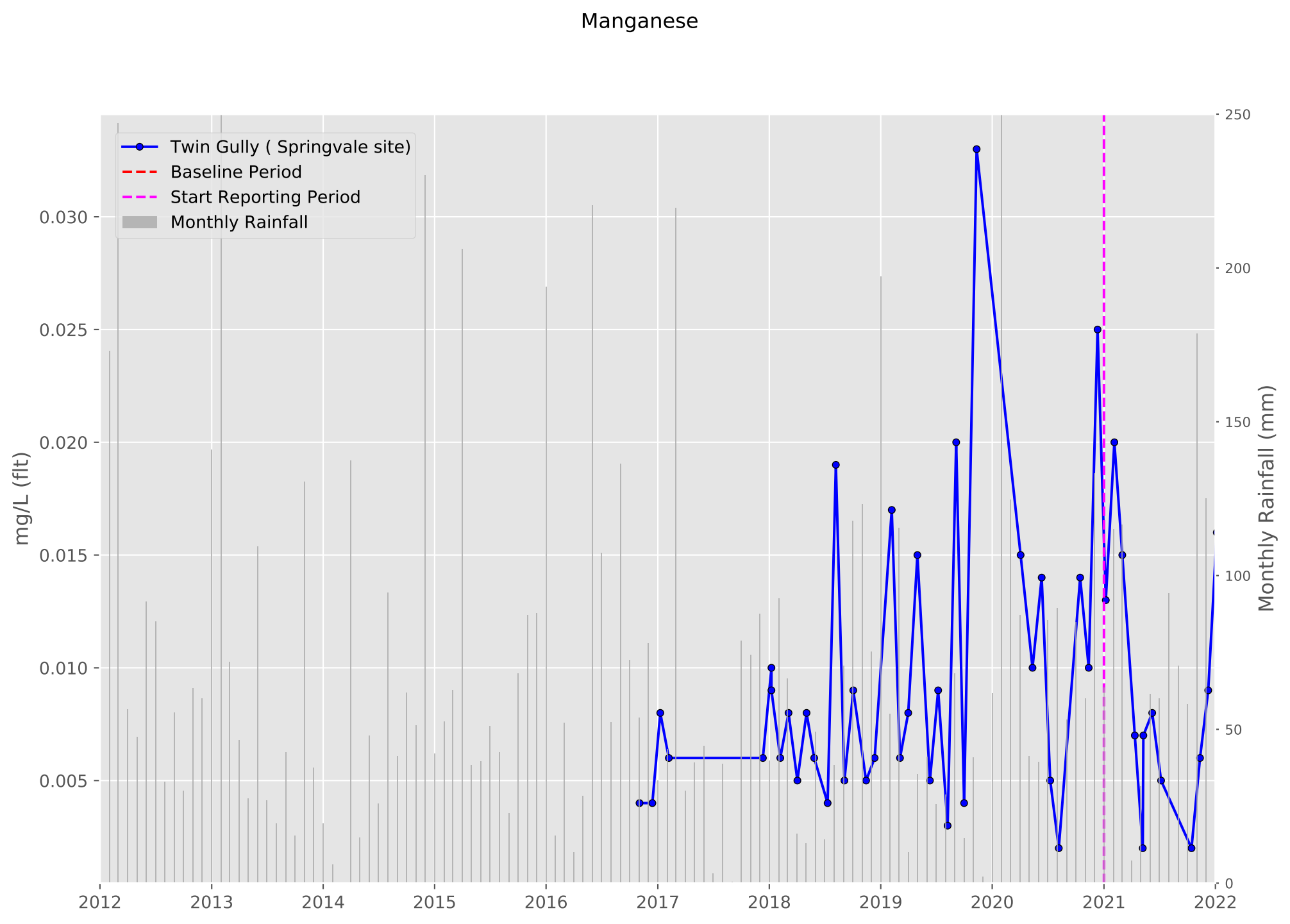

pH
Tri Star (Springvale site)
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
9
8
7
6
5
4
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

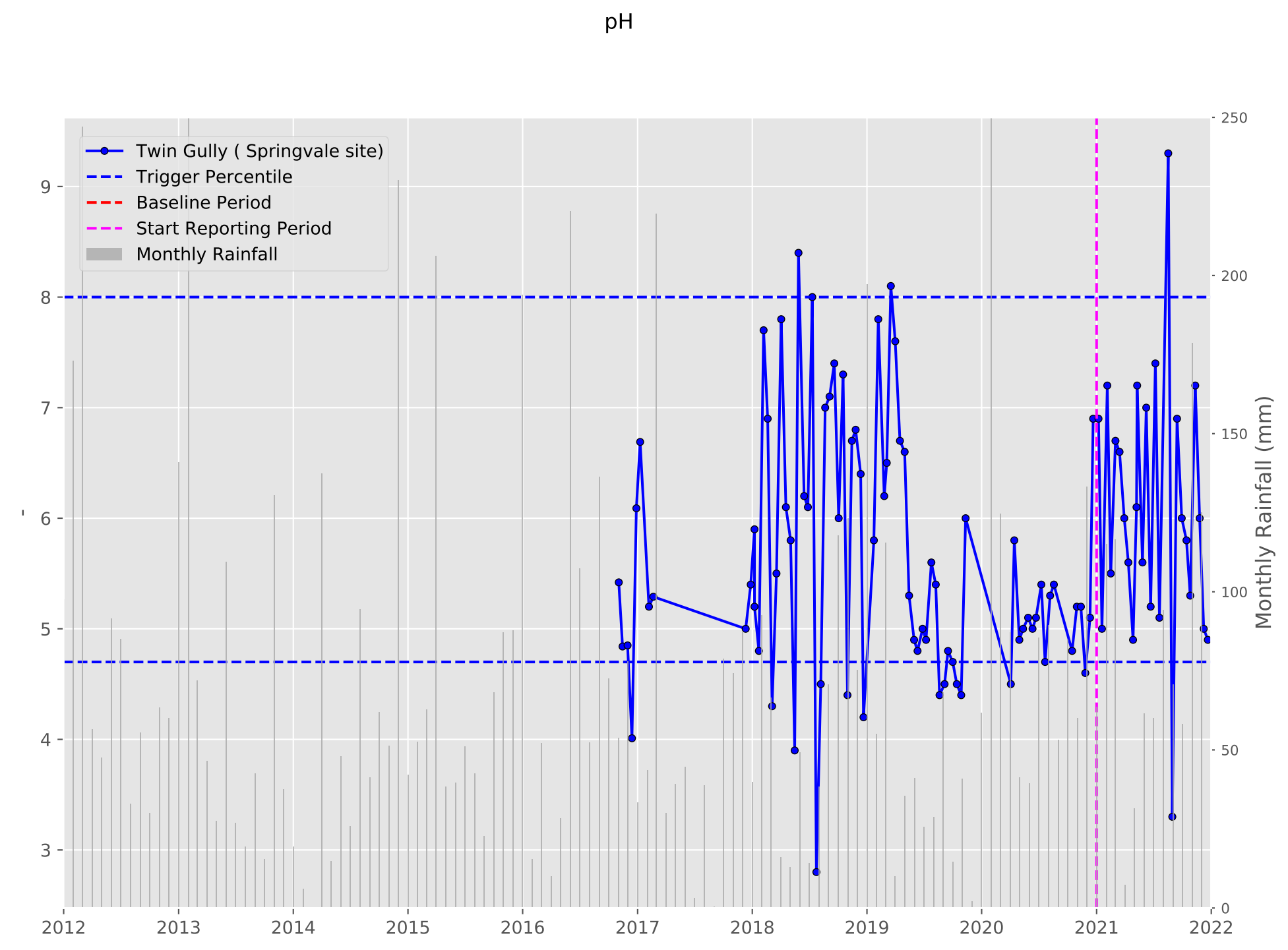

TSS
Tri Star (Springvale site)
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
100
80
60
40
20
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

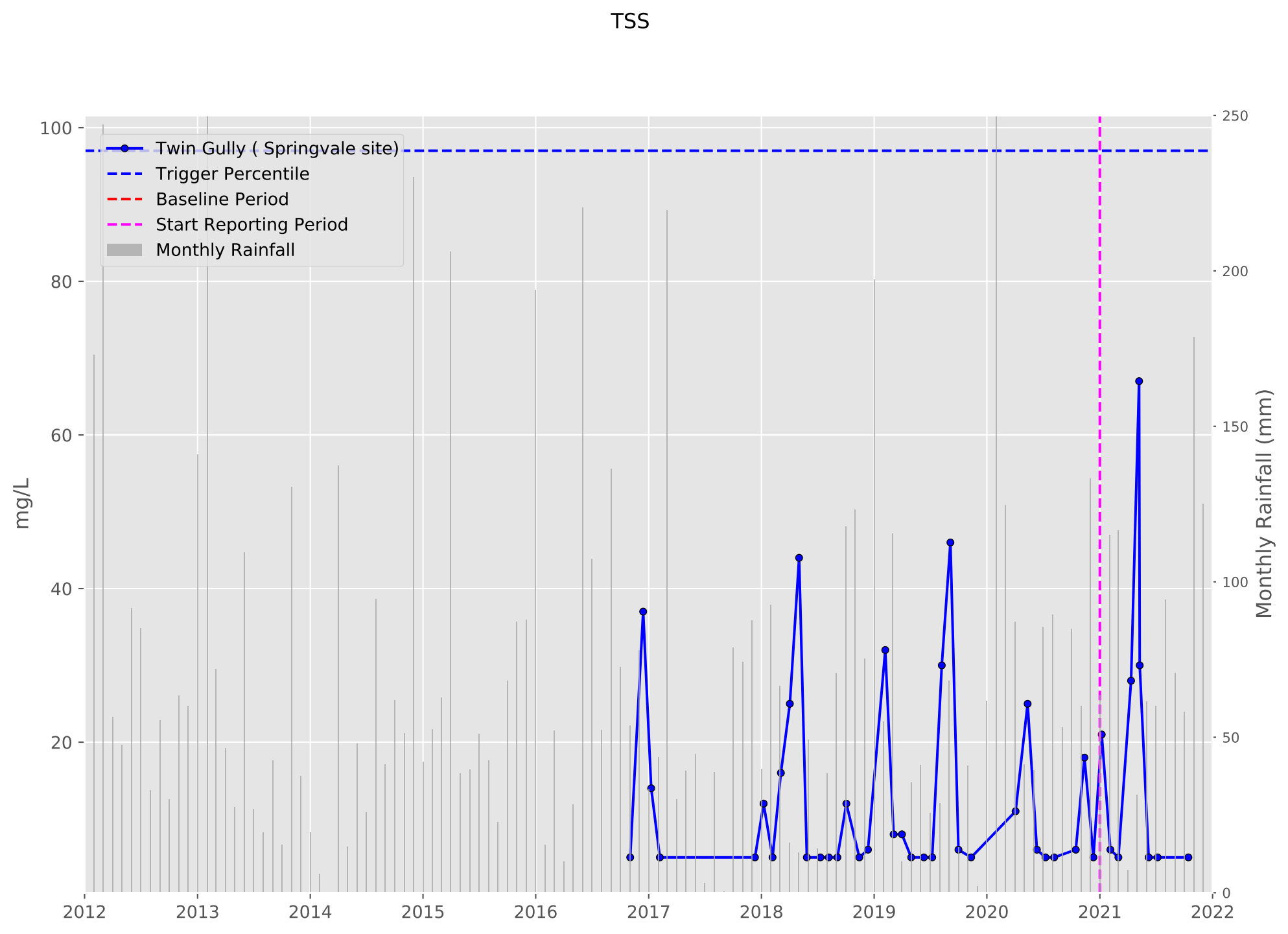

EC (field)
Twin Gully (Springvale site)
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
0
50
100
150
200
250
300
350
400
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

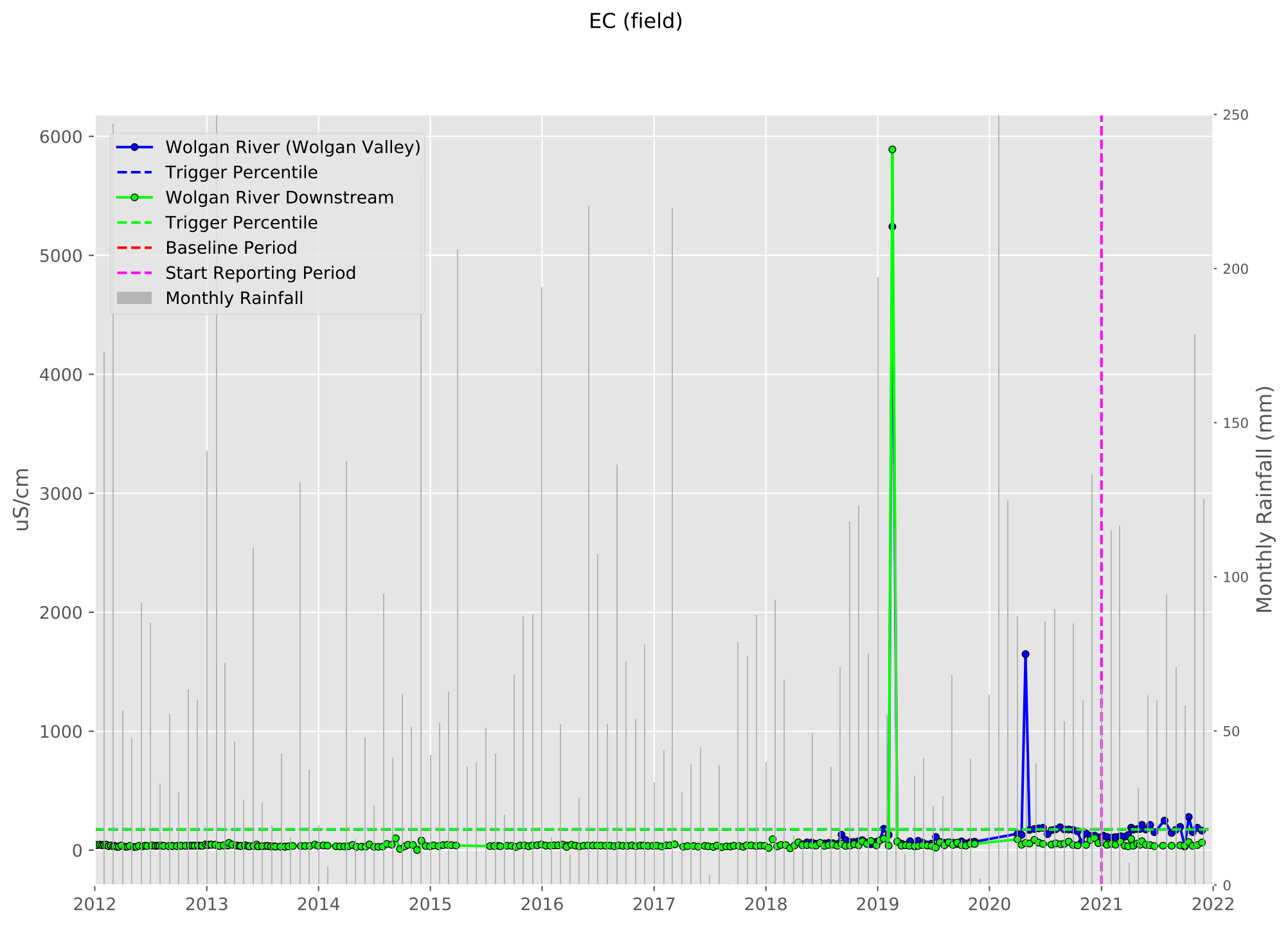

Flow Rate
Twin Gully (Springvale site)
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
10000
8000
6000
4000
2000
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

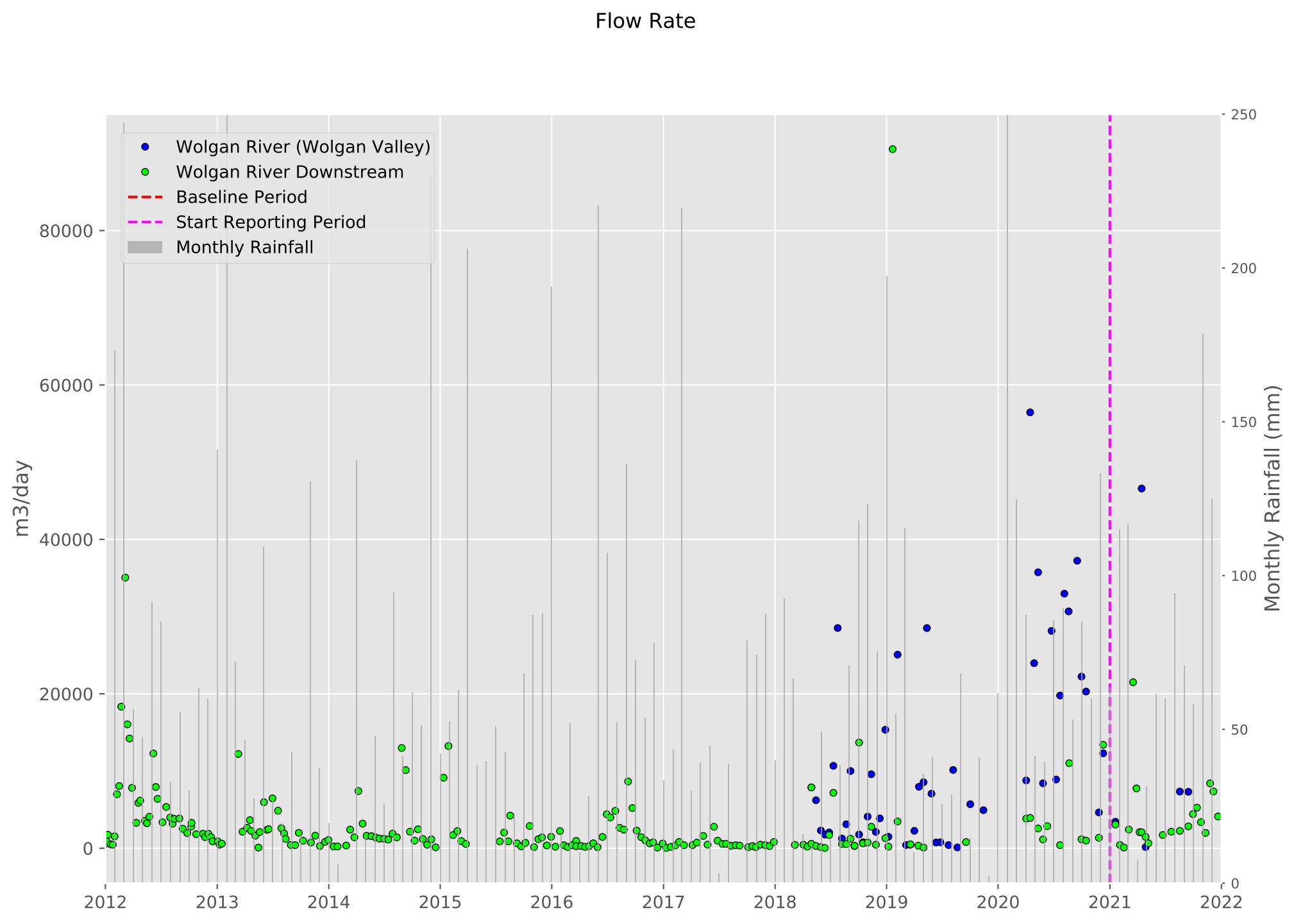

Iron
Twin Gully (Springvale site)
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0
1
2
3
4
5
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

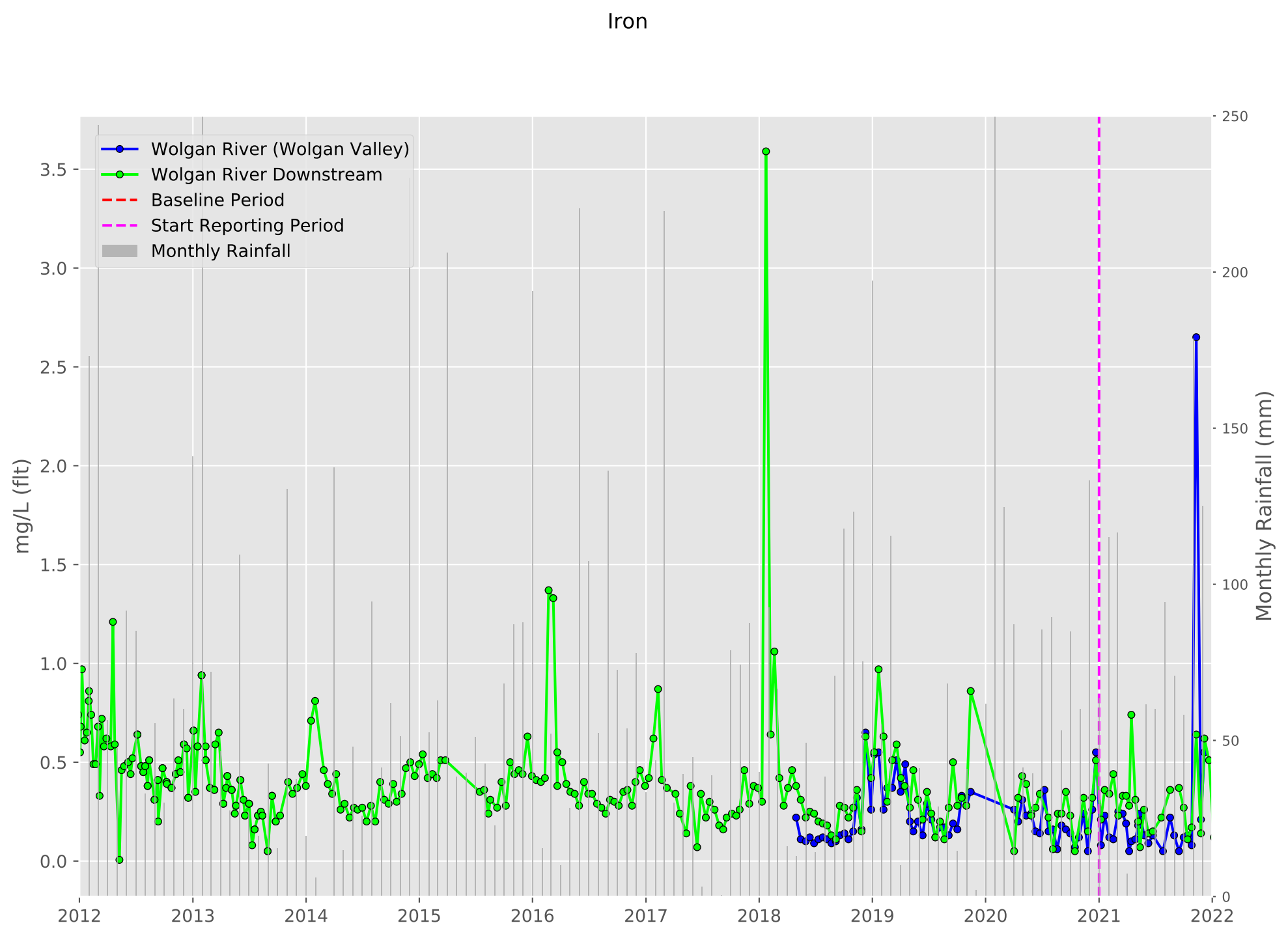

Manganese
Twin Gully (Springvale site)
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.030
0.025
0.020
0.015
0.010
0.005
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

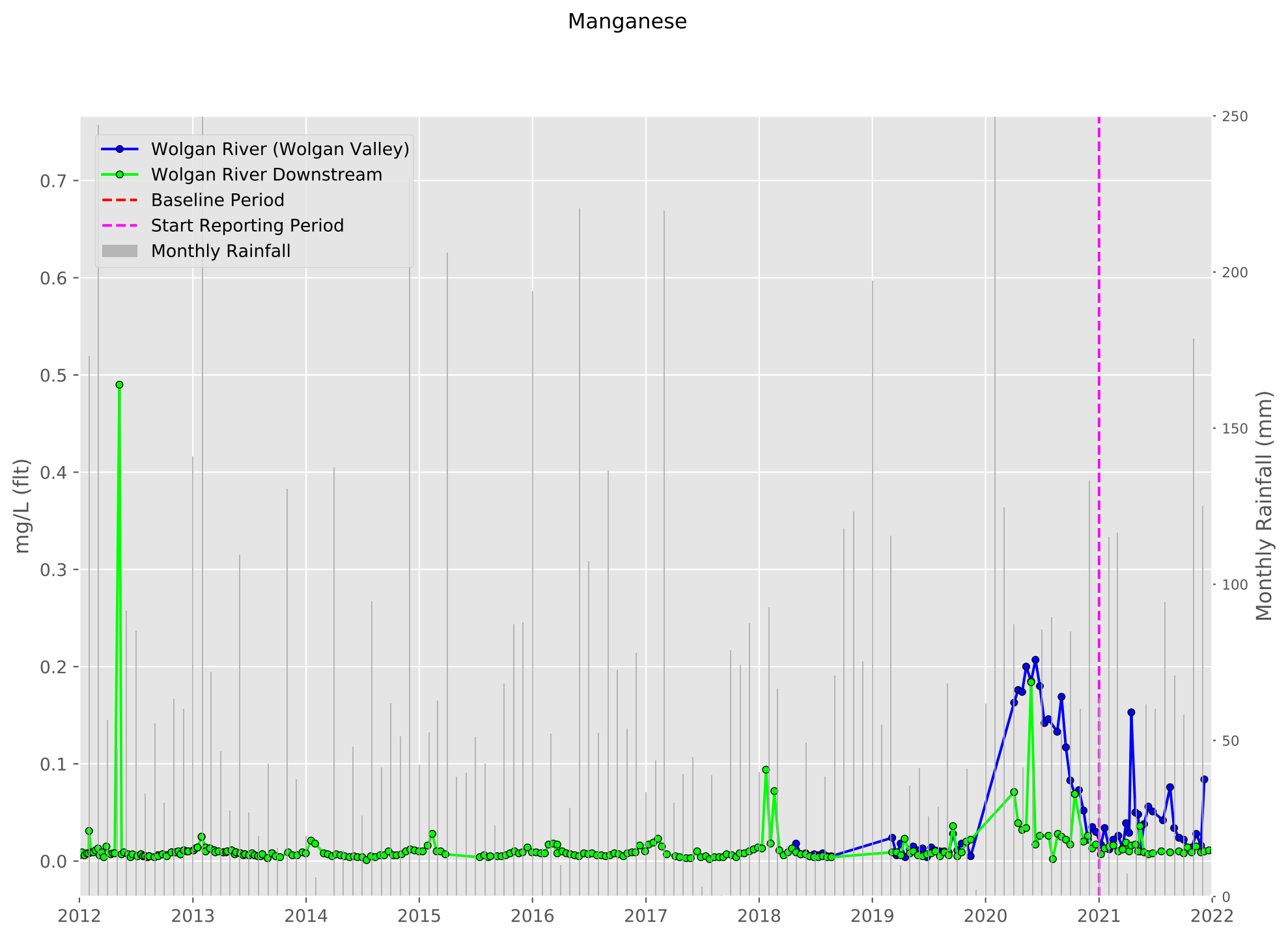

pH
Twin Gully (Springvale site)
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
9
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

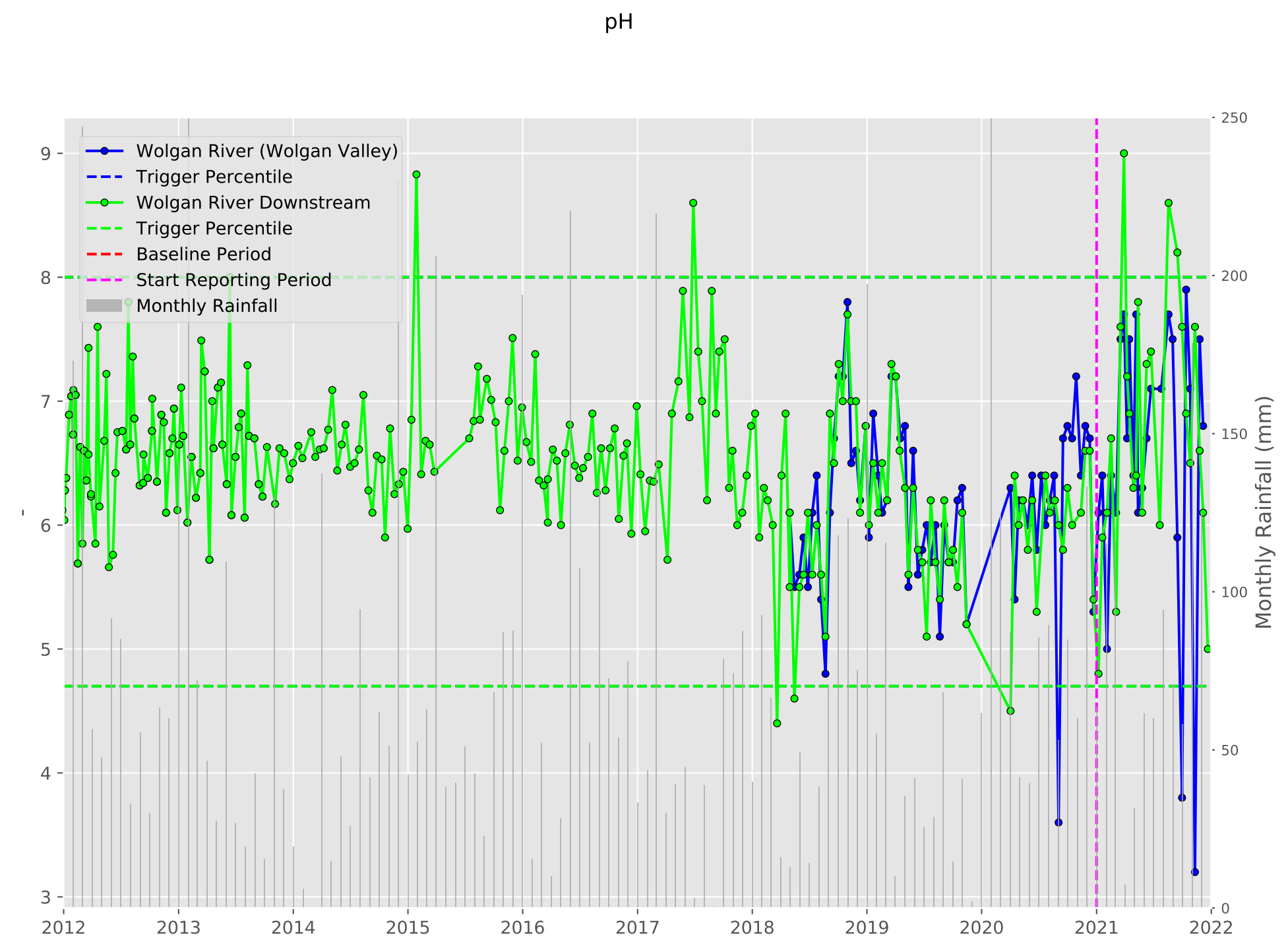

TSS
Twin Gully (Springvale site)
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
100
80
60
40
20
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

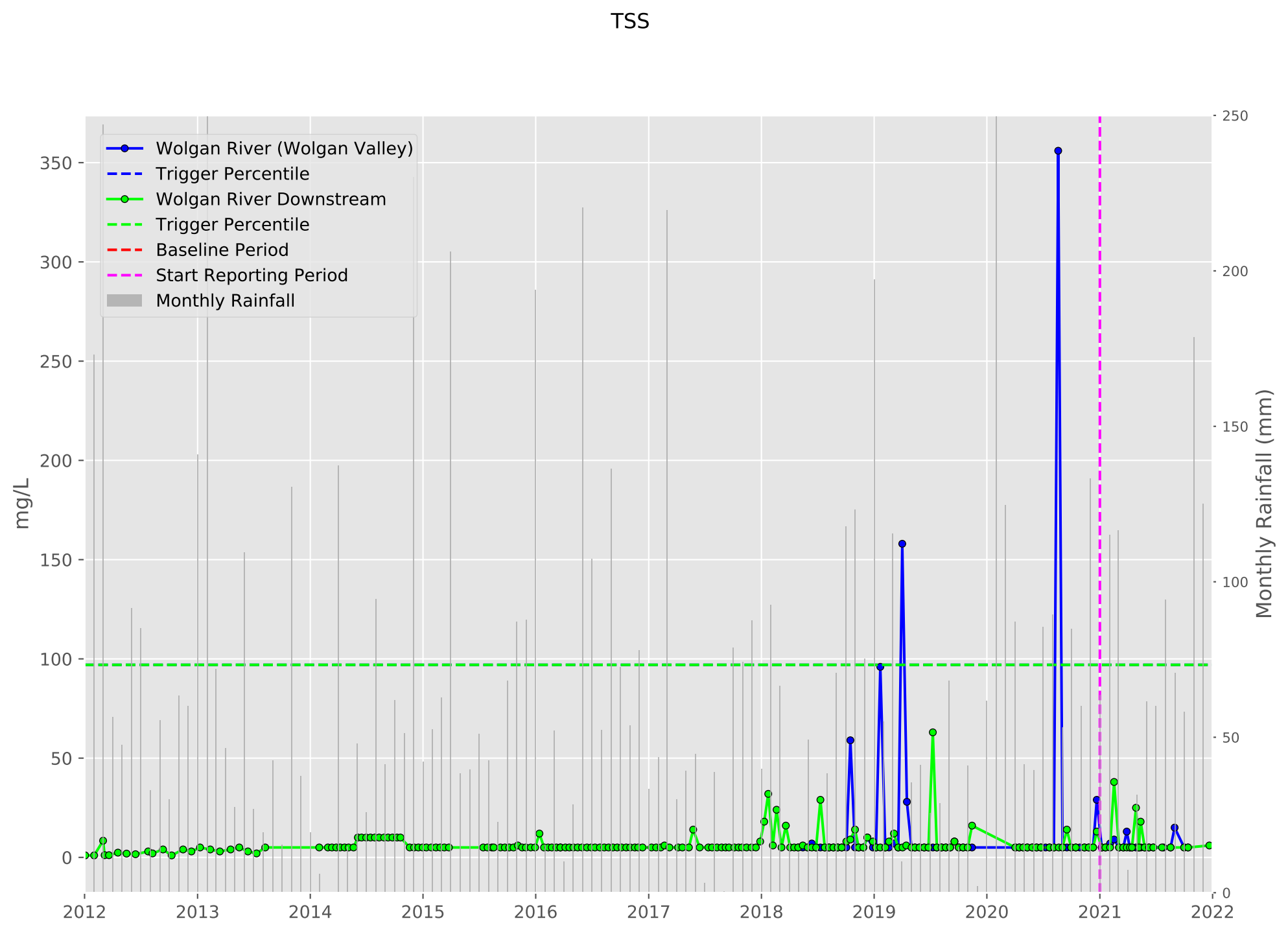

EC (field)
Wolgan River (Wolgan Valley)
Trigger Percentile
Wolgan River Downstream
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
uS/cm
Monthly Rainfall (mm)
6000
5000
4000
3000
2000
1000
0
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

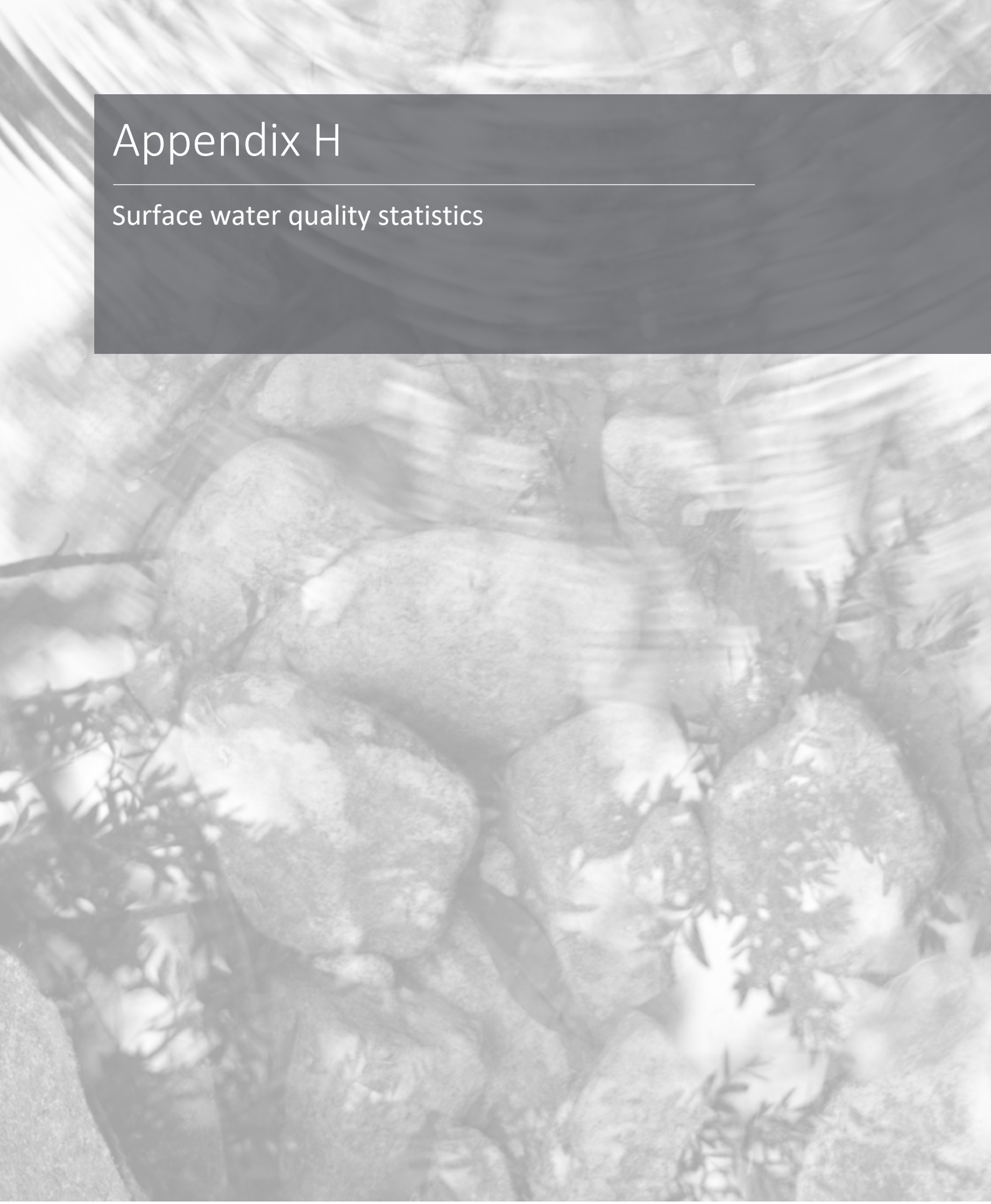

Flow Rate
Wolgan River (Wolgan Valley)
Wolgan River Downstream
Baseline Period
Start Reporting Period
Monthly Rainfall
m3/day
Monthly Rainfall (mm)
0
20000
40000
60000
80000
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


Iron
Wolgan River (Wolgan Valley)
Wolgan River Downstream
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


Manganese
Wolgan River (Wolgan Valley)
Wolgan River Downstream
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L (flt)
Monthly Rainfall (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


pH
Wolgan River (Wolgan Valley)
Trigger Percentile
Wolgan River Downstream
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
-
Monthly Rainfall (mm)
9
8
7
6
5
4
3
250
200
150
100
50
0
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


TSS
Wolgan River (Wolgan Valley)
Trigger Percentile
Wolgan River Downstream
Trigger Percentile
Baseline Period
Start Reporting Period
Monthly Rainfall
mg/L
Monthly Rainfall (mm)
0
50
100
150
200
250
300
350
0
50
100
150
200
250
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022



Appendix H

Surface water quality statistics

Table H.1 Swamp surface water quality statistics (SMP)

	Pre-mining statistics							Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Unit**	**count**	**20th %ile - 2×StDev**	**80th %ile + 2×StDev**	**Exceedance**	**Min**	**Median**	**Max**
Carne Swamp	5/01/05	25/09/13	pH	units	263	4.15	7.14	**TRUE**	3.3	5.25	8
Carne Swamp	5/01/05	25/09/13	EC (field)	µS/cm	263	NA	51.99	**TRUE**	22	52	221
Carne Swamp	5/01/05	25/09/13	Iron	mg/L	263	NA	0.70	**TRUE**	0.05	0.05	1.42
Carne Swamp	5/01/05	25/09/13	Manganese	mg/L	263	NA	0.15	**TRUE**	0.019	0.0715	0.189
Carne Swamp	18/07/12	13/08/13	TSS	mg/L	14	NA	18.64	FALSE	5	5	15
Carne Swamp	4/02/08	25/09/13	Flow Rate	kL/day	142	NA	NA	FALSE	Too low to measure		
East Wolgan Upstream	8/04/05	11/04/06	pH	units	25	7.79	9.71	FALSE	5.7	5.7	5.7
East Wolgan Upstream	8/04/05	11/04/06	EC (field)	µS/cm	25	NA	1098.55	FALSE	54	54	54
East Wolgan Upstream	8/04/05	11/04/06	Iron	mg/L	25	NA	1.25	FALSE	0.16	0.16	0.16
East Wolgan Upstream	8/04/05	11/04/06	Manganese	mg/L	25	NA	0.07	FALSE	0.053	0.053	0.053
East Wolgan Upstream	8/04/05	11/04/06	TSS	mg/L	0	No pre-mining data		FALSE	5	5	5
East Wolgan Upstream	8/04/05	11/04/06	Flow Rate	kL/day	0			FALSE	Too low to measure		
East Wolgan Downstream	8/04/05	24/04/06	pH	units	28	6.89	9.71	FALSE	5	5.5	5.9
East Wolgan Downstream	8/04/05	24/04/06	EC (field)	µS/cm	28	NA	1307.51	FALSE	43	56	87
East Wolgan Downstream	8/04/05	24/04/06	Iron	mg/L	27	NA	1.11	FALSE	0.05	0.21	0.65
East Wolgan Downstream	8/04/05	24/04/06	Manganese	mg/L	27	NA	0.02	FALSE	0.006	0.008	0.012
East Wolgan Downstream	8/04/05	24/04/06	TSS	mg/L	0	NA		FALSE	5	5	5
East Wolgan Downstream	8/04/05	24/04/06	Flow Rate	kL/day	0	NA		FALSE	Too low to measure		

Table H.1 Swamp surface water quality statistics (SMP)

	Pre-mining statistics							Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Unit**	**count**	**20th %ile - 2×StDev**	**80th %ile + 2×StDev**	**Exceedance**	**Min**	**Median**	**Max**
East Wolgan D_S Junction	22/04/78	21/06/06	pH	units	8	5.77	8.39	**TRUE**	4.6	6.4	8.4
East Wolgan D_S Junction	22/04/78	21/06/06	EC (field)	µS/cm	8	NA	298.67	FALSE	28	40	248
East Wolgan D_S Junction	22/04/78	21/06/06	Iron	mg/L	8	NA	1.05	FALSE	0.08	0.185	0.85
East Wolgan D_S Junction	22/04/78	21/06/06	Manganese	mg/L	8	NA	0.003	**TRUE**	0.003	0.008	0.032
East Wolgan D_S Junction	22/04/78	21/06/06	TSS	mg/L	0	No pre-mining data		FALSE	5	5	34
East Wolgan D_S Junction	22/04/78	21/06/06	Flow Rate	kL/day	0	No pre-mining data		FALSE	181	722.5	8701
Gang Gang-East	27/09/16	12/05/17	pH	units	9	3.59	7.95	FALSE	4.1	4.6	6.7
Gang Gang-East	27/09/16	12/05/17	EC (field)	µS/cm	9	NA	33.07	**TRUE**	23	59	116
Gang Gang-East	26/10/16	12/05/17	Iron	mg/L	8	NA	0.29	FALSE	0.05	0.05	0.05
Gang Gang-East	26/10/16	12/05/17	Manganese	mg/L	8	NA	0.02	**TRUE**	0.024	0.033	0.085
Gang Gang-East	27/09/16	12/05/17	TSS	mg/L	9	NA	10.83	FALSE	5	5.5	6
Gang Gang-East	27/09/16	12/05/17	Flow Rate	kL/day	9	NA	NA	**TRUE**	20606	20606	20606
Gang Gang-South West	27/09/16	12/05/17	pH	units	8	2.97	9.80	FALSE	4.1	5.9	7.5
Gang Gang-South West	27/09/16	12/05/17	EC (field)	µS/cm	8	NA	40.65	**TRUE**	29	42.5	77
Gang Gang-South West	26/10/16	12/05/17	Iron	mg/L	7	NA	0.56	**TRUE**	0.05	0.105	1.15
Gang Gang-South West	26/10/16	12/05/17	Manganese	mg/L	7	NA	0.08	**TRUE**	0.023	0.059	0.158
Gang Gang-South West	27/09/16	12/05/17	TSS	mg/L	8	NA	74.62	**TRUE**	5	5	1340
Gang Gang-South West	27/09/16	22/11/16	Flow Rate	kL/day	3	NA	NA	**TRUE**	19658	19658	19658

Table H.1 Swamp surface water quality statistics (SMP)

	Pre-mining statistics							Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Unit**	**count**	**20th %ile - 2×StDev**	**80th %ile + 2×StDev**	**Exceedance**	**Min**	**Median**	**Max**
Marrangaroo Swamp	24/11/17	29/12/21	pH	units	91	2.97	8.13	**TRUE**	4.6	6	8.2
Marrangaroo Swamp	24/11/17	18/11/21	EC (field)	µS/cm	88	NA	104.57	**TRUE**	24	33	209
Marrangaroo Swamp	24/11/17	6/01/22	Iron	mg/L	41	NA	1.32	FALSE	0.05	0.37	0.88
Marrangaroo Swamp	24/11/17	6/01/22	Manganese	mg/L	42	NA	0.05	FALSE	0.007	0.018	0.054
Marrangaroo Swamp	24/11/17	8/10/21	TSS	mg/L	38	NA	99.88	FALSE	5	7	85
Marrangaroo Swamp	24/11/17	29/12/21	Flow Rate	kL/day	63	NA	NA	**TRUE**	34	554	5151
9 Mile Swamp	27/11/17	14/01/19	pH	units	30	3.04	7.64	**TRUE**	4.2	5.6	8
9 Mile Swamp	27/11/17	14/01/19	EC (field)	µS/cm	30	NA	56.19	**TRUE**	21	39	104
9 Mile Swamp	27/11/17	3/01/19	Iron	mg/L	15	NA	1.51	FALSE	0.07	0.225	0.91
9 Mile Swamp	27/11/17	3/01/19	Manganese	mg/L	15	NA	0.07	**TRUE**	0.006	0.012	0.071
9 Mile Swamp	27/11/17	3/01/19	TSS	mg/L	15	NA	50.61	FALSE	5	5.5	20
9 Mile Swamp	27/11/17	28/03/18	Flow Rate	kL/day	5	NA	NA	**TRUE**	94392	94392	94392
Barrier Swamp	27/09/16	23/12/21	pH	units	106	2.95	7.80	**TRUE**	4.4	5.4	7.9
Barrier Swamp	27/09/16	8/12/21	EC (field)	µS/cm	104	NA	72.30	FALSE	22	36	72
Barrier Swamp	26/10/16	6/01/22	Iron	mg/L	56	NA	0.93	**TRUE**	0.1	0.345	1.37
Barrier Swamp	26/10/16	6/01/22	Manganese	mg/L	57	NA	0.07	FALSE	0.009	0.017	0.032
Barrier Swamp	27/09/16	8/12/21	TSS	mg/L	55	NA	36.86	**TRUE**	5	16	38
Barrier Swamp	27/09/16	9/12/21	Flow Rate	kL/day	89	NA	NA	**TRUE**	216	1114	4942

Table H.1 Swamp surface water quality statistics (SMP)

	Pre-mining statistics							Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Unit**	**count**	**20th %ile - 2×StDev**	**80th %ile + 2×StDev**	**Exceedance**	**Min**	**Median**	**Max**
Best Creek	24/11/17	29/12/21	pH	units	94	2.67	7.83	FALSE	3.2	5.7	7.8
Best Creek	24/11/17	18/11/21	EC (field)	µS/cm	91	NA	93.02	**TRUE**	28	46	186
Best Creek	24/11/17	6/01/22	Iron	mg/L	43	NA	0.37	FALSE	0.05	0.125	0.28
Best Creek	24/11/17	6/01/22	Manganese	mg/L	44	NA	0.04	FALSE	0.009	0.018	0.025
Best Creek	24/11/17	8/10/21	TSS	mg/L	39	NA	43.66	FALSE	5	5	16
Best Creek	24/11/17	29/12/21	Flow Rate	kL/day	57	NA	NA	**TRUE**	77	907	6345
Carne Central Swamp	27/09/16	23/12/21	pH	units	48	2.66	7.94	FALSE	4.6	5.2	7.4
Carne Central Swamp	27/09/16	8/12/21	EC (field)	µS/cm	46	NA	201.32	**TRUE**	22	38	223
Carne Central Swamp	26/10/16	6/01/22	Iron	mg/L	23	NA	0.36	**TRUE**	0.05	0.05	0.5
Carne Central Swamp	26/10/16	6/01/22	Manganese	mg/L	24	NA	0.07	FALSE	0.006	0.013	0.053
Carne Central Swamp	27/09/16	8/12/21	TSS	mg/L	23	NA	28.41	**TRUE**	5	20	38
Carne Central Swamp	27/09/16	23/03/21	Flow Rate	kL/day	7	NA	NA	**TRUE**	15795	15795	15795
Firetail	24/11/17	29/12/21	pH	units	86	2.62	7.78	FALSE	3.6	5.15	7.6
Firetail	24/11/17	18/11/21	EC (field)	µS/cm	83	NA	90.68	**TRUE**	33	51	174
Firetail	24/11/17	6/01/22	Iron	mg/L	38	NA	0.85	**TRUE**	0.05	0.13	1.24
Firetail	24/11/17	6/01/22	Manganese	mg/L	39	NA	0.03	FALSE	0.006	0.0095	0.014
Firetail	24/11/17	8/10/21	TSS	mg/L	34	NA	90.89	FALSE	5	5	8
Firetail	24/11/17	29/12/21	Flow Rate	kL/day	37	NA	NA	**TRUE**	86	941	6010

Table H.1 Swamp surface water quality statistics (SMP)

	Pre-mining statistics							Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Unit**	**count**	**20th %ile - 2×StDev**	**80th %ile + 2×StDev**	**Exceedance**	**Min**	**Median**	**Max**
SS3 D_S	10/06/10	25/09/13	pH	units	128	4.50	7.03	FALSE			
SS3 D_S	10/06/10	25/09/13	EC (field)	µS/cm	128	NA	127.19	FALSE			
SS3 D_S	10/06/10	25/09/13	Iron	mg/L	127	NA	0.46	FALSE	Dry		
SS3 D_S	10/06/10	25/09/13	Manganese	mg/L	127	NA	0.04	FALSE			
SS3 D_S	18/07/12	13/08/13	TSS	mg/L	13	NA	89.61	FALSE			
Sunnyside U_S Junction	31/03/06	22/08/09	pH	units	76	5.85	8.35	**TRUE**	5.1	6.5	8.4
Sunnyside U_S Junction	31/03/06	22/08/09	EC (field)	µS/cm	76	NA	136.21	**TRUE**	26	39	275
Sunnyside U_S Junction	31/03/06	22/08/09	Iron	mg/L	76	NA	1.82	FALSE	0.07	0.2	0.8
Sunnyside U_S Junction	31/03/06	22/08/09	Manganese	mg/L	76	NA	0.02	**TRUE**	0.003	0.008	0.029
Sunnyside U_S Junction	31/03/06	22/08/09	TSS	mg/L	0	No pre-mining data		FALSE	5	5	29
Sunnyside U_S Junction	21/02/08	22/08/09	Flow Rate	kL/day	36	NA	NA	**TRUE**	120	777	4566
Sunnyside Swamp Upstream	24/05/05	19/08/09	pH	units	87	5.74	8.36	**TRUE**	4	6	8.8
Sunnyside Swamp Upstream	24/05/05	19/08/09	EC (field)	µS/cm	87	NA	548.61	FALSE	28	45	111
Sunnyside Swamp Upstream	24/05/05	19/08/09	Iron	mg/L	87	NA	4.42	**TRUE**	0.05	0.325	5.79
Sunnyside Swamp Upstream	24/05/05	19/08/09	Manganese	mg/L	87	NA	0.03	**TRUE**	0.002	0.007	0.088
Sunnyside Swamp Upstream	24/05/05	19/08/09	TSS	mg/L	0	No pre-mining data		FALSE	5	13	2980
Sunnyside Swamp Upstream	4/02/08	19/08/09	Flow Rate	kL/day	37	NA	NA	FALSE	Too low to measure		
Sunnyside Swamp Downstream	24/05/05	19/08/09	pH	units	104	5.85	8.55	**TRUE**	4.2	6.25	9.4

Table H.1 Swamp surface water quality statistics (SMP)

	Pre-mining statistics							Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**Unit**	**count**	**20th %ile - 2×StDev**	**80th %ile + 2×StDev**	**Exceedance**	**Min**	**Median**	**Max**
Sunnyside Swamp Downstream	24/05/05	19/08/09	EC (field)	µS/cm	104	NA	447.61	FALSE	22	38	128
Sunnyside Swamp Downstream	24/05/05	19/08/09	Iron	mg/L	102	NA	3.28	**TRUE**	0.15	0.35	3.46
Sunnyside Swamp Downstream	24/05/05	19/08/09	Manganese	mg/L	101	NA	0.04	FALSE	0.003	0.005	0.02
Sunnyside Swamp Downstream	24/05/05	19/08/09	TSS	mg/L	0	No pre-mining data		FALSE	5	5	118
Sunnyside Swamp Downstream	4/02/08	19/08/09	Flow Rate	kL/day	37	NA	NA	**TRUE**	347	965	26179

Table H.2 Surface water quality statistics (WMP)

	Pre-mining statistics					Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**count**	**WMP trigger**	**Exceedance**	**Min**	**Median**	**Max**
Carne West	No pre-mining data		pH	0	4.7 - 8.0	**TRUE**	3.1	4.95	7.8
Carne West			EC (field)	0	174	FALSE	32	47.5	97
Carne West			TSS	0	97	**TRUE**	5	5	134
Carne West			Flow Rate	0	NA	FALSE	Too low to measure		
Gang Gang	21/03/16	24/05/17	pH	27	4.7 - 8.0	FALSE	4.5	5.2	7.5
Gang Gang	21/03/16	24/05/17	EC (field)	27	174	TRUE	21	32.5	94
Gang Gang	4/05/16	10/05/17	TSS	11	97	FALSE	5	5	5
Gang Gang	21/03/16	24/05/17	Flow Rate	26	NA	FALSE	Too low to measure		
Marrangaroo Creek	30/01/14	22/12/21	pH	134	4.7 - 8.0	FALSE	4.1	5.2	8.5
Marrangaroo Creek	30/01/14	26/10/21	EC (field)	132	174	FALSE	24	28	43
Marrangaroo Creek	30/01/14	22/12/21	TSS	133	97	TRUE	8	169	240
Marrangaroo Creek	30/01/14	26/03/18	Flow Rate	44	NA	FALSE	Too low to measure		
Paddys Creek	24/11/17	1/08/18	pH	19	4.7 - 8.0	**TRUE**	4.4	5.45	7.3
Paddys Creek	24/11/17	1/08/18	EC (field)	20	174	**TRUE**	23	36	137
Paddys Creek	24/11/17	1/08/18	TSS	10	97	FALSE	5	5	22
Paddys Creek	24/11/17	1/08/18	Flow Rate	20	NA	TRUE	120	478	3526
Pine_ 9 Mile Swamp	27/11/17	14/01/19	pH	31	4.7 - 8.0	TRUE	4.3	5.6	7.8
Pine_ 9 Mile Swamp	27/11/17	14/01/19	EC (field)	31	174	TRUE	22	39.5	230

Table H.2 Surface water quality statistics (WMP)

	Pre-mining statistics					Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**count**	**WMP trigger**	**Exceedance**	**Min**	**Median**	**Max**
Pine_ 9 Mile Swamp	27/11/17	3/01/19	TSS	15	97	FALSE	5	5	12
Pine_ 9 Mile Swamp	27/11/17	23/11/18	Flow Rate	15	NA	TRUE	509	1867	2021
Carne Central	21/03/16	23/12/21	pH	75	4.7 - 8.0	FALSE	3.8	5.1	7.4
Carne Central	21/03/16	23/11/21	EC (field)	73	174	FALSE	22	38	90
Carne Central	4/05/16	14/10/21	TSS	27	97	TRUE	5	5	115
Carne Central	12/07/16	23/12/21	Flow Rate	14	NA	TRUE	129	1193.5	1973
Tri Star (Springvale site)	2/11/16	21/12/21	pH	103	4.7 - 8.0	FALSE	3.8	5.8	9.3
Tri Star (Springvale site)	2/11/16	25/11/21	EC (field)	101	174	**TRUE**	24	37.5	239
Tri Star (Springvale site)	2/11/16	14/10/21	TSS	44	97	FALSE	5	5	16
Tri Star (Springvale site)	2/11/16	21/12/21	Flow Rate	60	NA	**TRUE**	190	719	18783
Twin Gully (Springvale site)	2/11/16	21/12/21	pH	102	4.7 - 8.0	**TRUE**	3.3	6	9.3
Twin Gully (Springvale site)	2/11/16	25/11/21	EC (field)	100	174	**TRUE**	24	54.5	416
Twin Gully (Springvale site)	2/11/16	14/10/21	TSS	45	97	**TRUE**	5	6	67
Twin Gully (Springvale site)	2/11/16	21/12/21	Flow Rate	43	NA	**TRUE**	173	342	9806
Wolgan River Downstream	4/01/02	21/12/21	pH	898	4.7 - 8.0	**TRUE**	4.8	6.7	9
Wolgan River Downstream	4/01/02	25/11/21	EC (field)	895	174	FALSE	32	45	94
Wolgan River Downstream	4/01/02	21/12/21	TSS	326	97	FALSE	5	5	38
Wolgan River Downstream	4/02/08	21/12/21	Flow Rate	325	NA	**TRUE**	86	2416	21496

Table H.2 Surface water quality statistics (WMP)

	Pre-mining statistics					Reporting period statistics (31 Jan to 31 Dec 2021)			
Monitoring ID	**Start**	**Finish**	**analyte**	**count**	**WMP trigger**	**Exceedance**	**Min**	**Median**	**Max**
Wolgan River (Wolgan Valley)	30/04/18	6/12/21	pH	86	4.7 - 8.0	FALSE	3.2	6.7	7.9
Wolgan River (Wolgan Valley)	30/04/18	25/11/21	EC (field)	85	174	FALSE	30	167	279
Wolgan River (Wolgan Valley)	30/04/18	13/10/21	TSS	81	97	FALSE	5	5	15
Wolgan River (Wolgan Valley)	30/04/18	15/09/21	Flow Rate	54	NA	FALSE	144	7309	46586
Sunnyside East	No pre-mining data		pH	0	4.7 - 8.0	FALSE	2.9	5.35	7.7
Sunnyside East			EC (field)	0	174	FALSE	29	50	284
Sunnyside East			TSS	0	97	FALSE	5	5	76
Sunnyside East			Flow Rate	0	NA	FALSE	Too low to measure		





Appendix 5:

Noise Monitoring Results

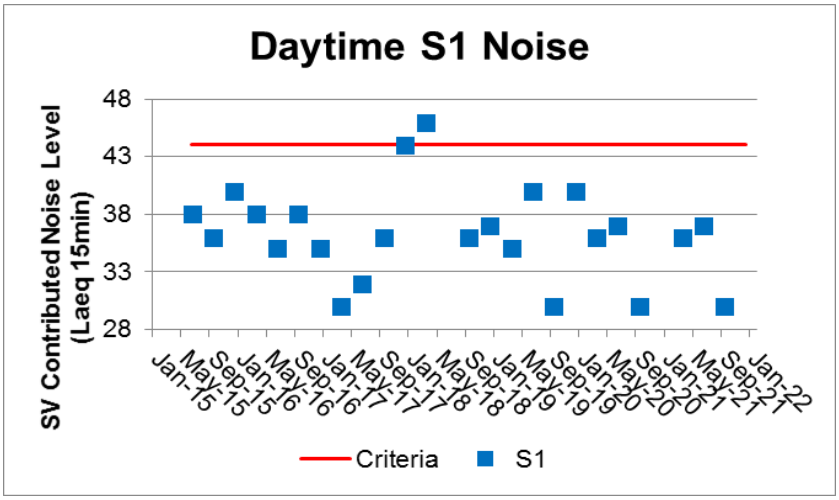


Figure 2A-1 Day S1 Noise LAeq15min Results

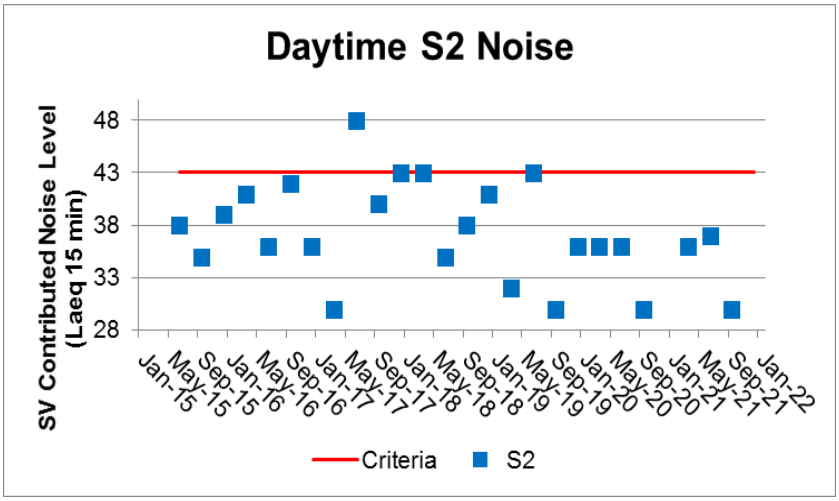


Figure 2A-2 Day S2 Noise LAeq 15min Results

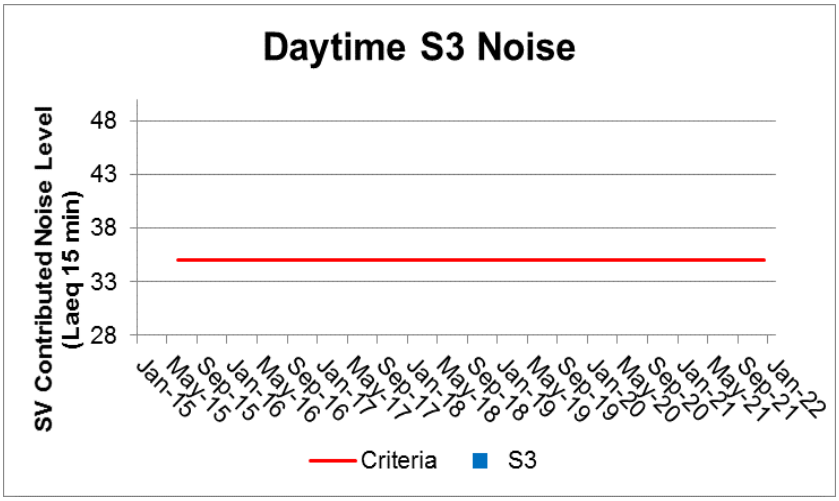


Figure 2A-3 Day S3 Noise LAeq15min Results

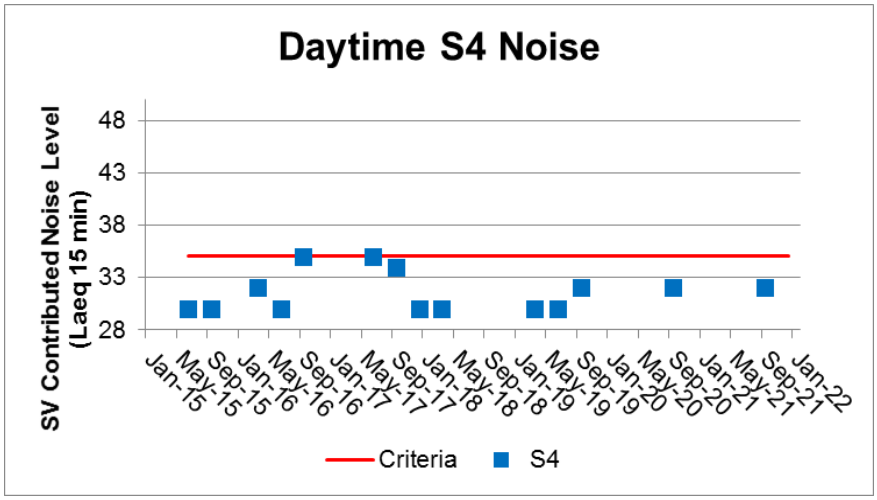


Figure 2A-4 Day S4 Noise LAeq15min Results

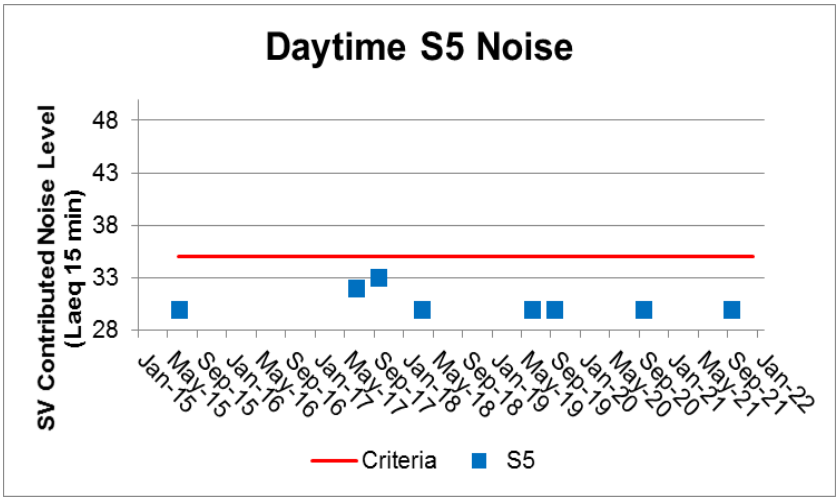


Figure 2A-5 Day S5 Noise LAeq15min Results

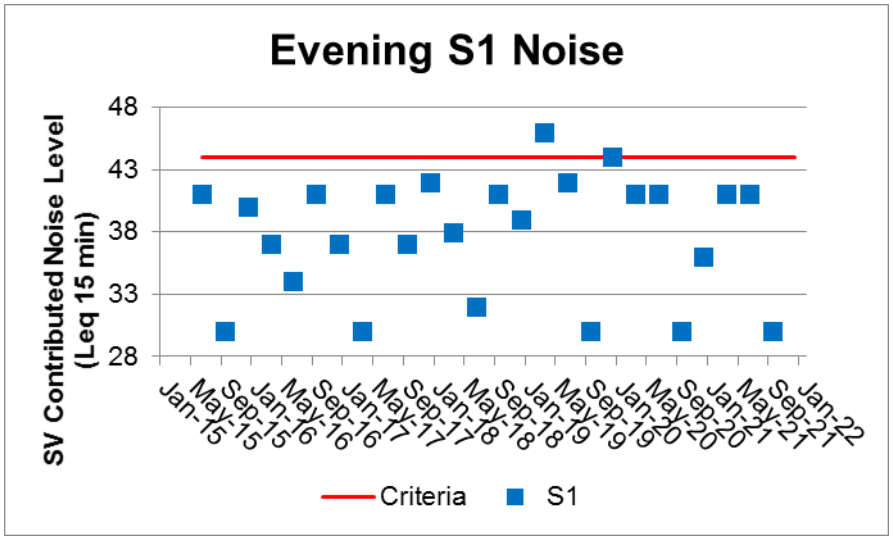


Figure 2A-6 Evening S1 Noise LAeq15min Results

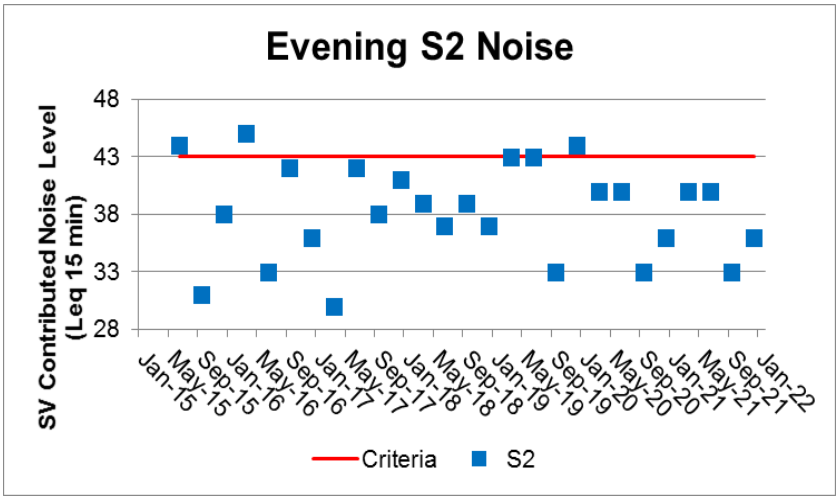


Figure 2A-7 Evening S2 Noise LAeq15min Results

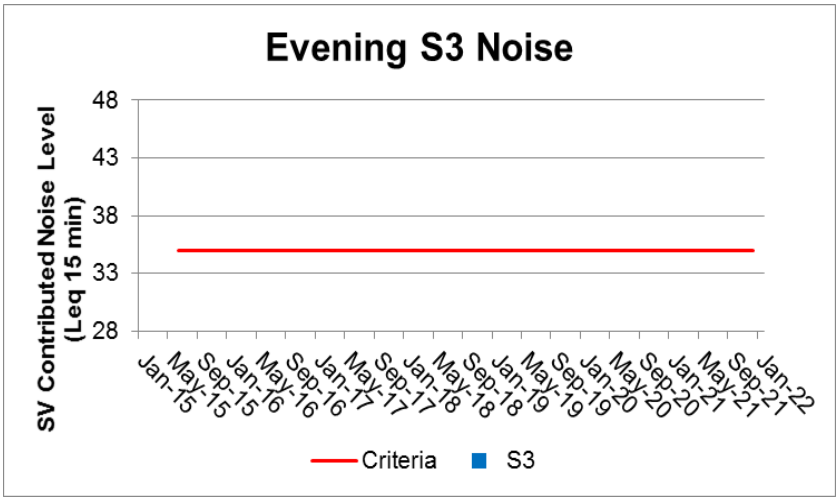


Figure 2A-8 Evening S3 Noise LAeq15min Results

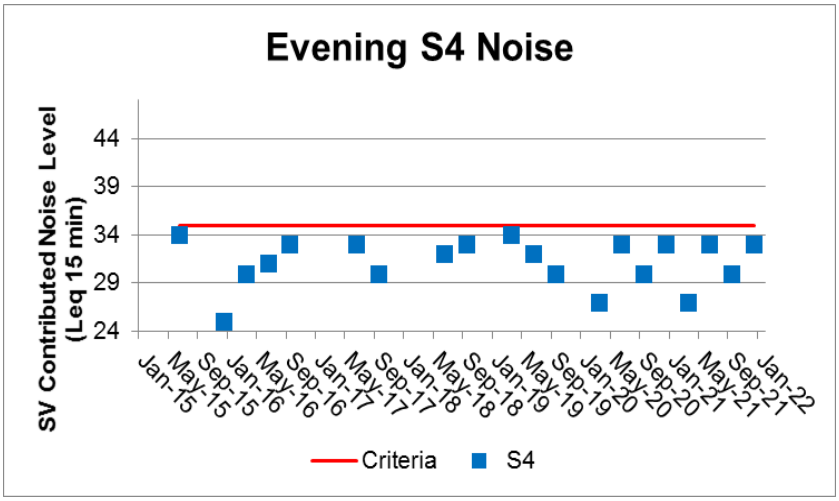


Figure 2A-9 Evening S4 Noise LAeq15min Results

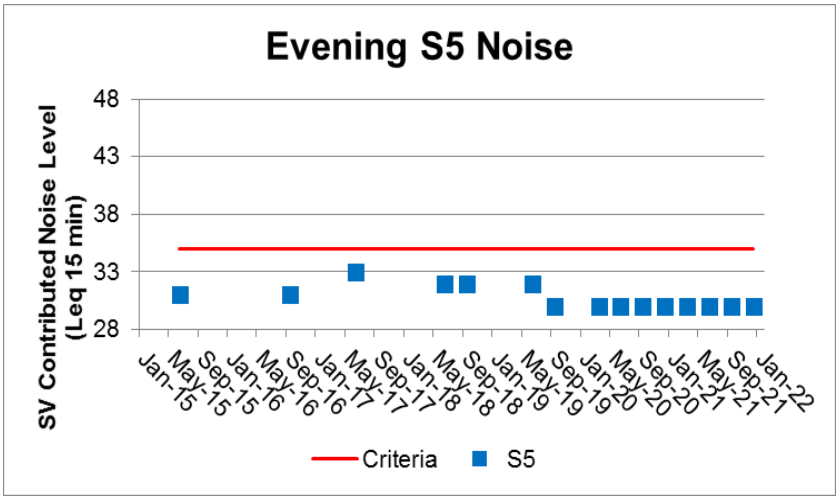


Figure 2A-10 Evening S5 Noise LAeq15min Results

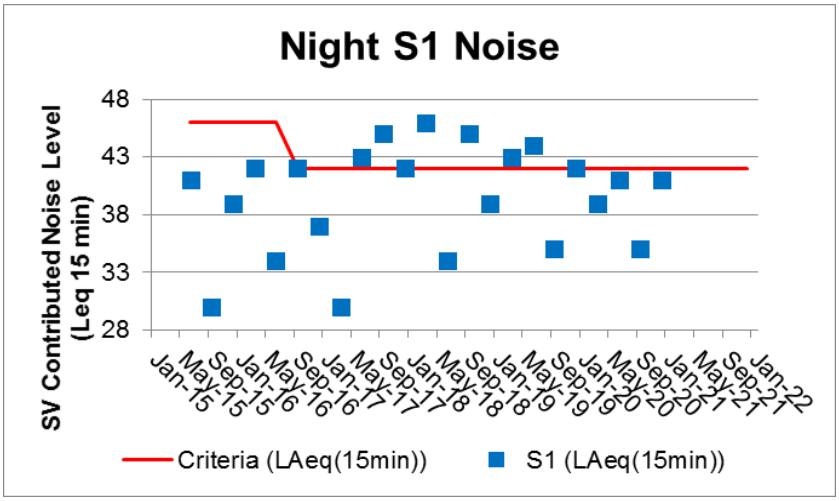


Figure 2A-11 Night S1 Noise LAeq15min Results

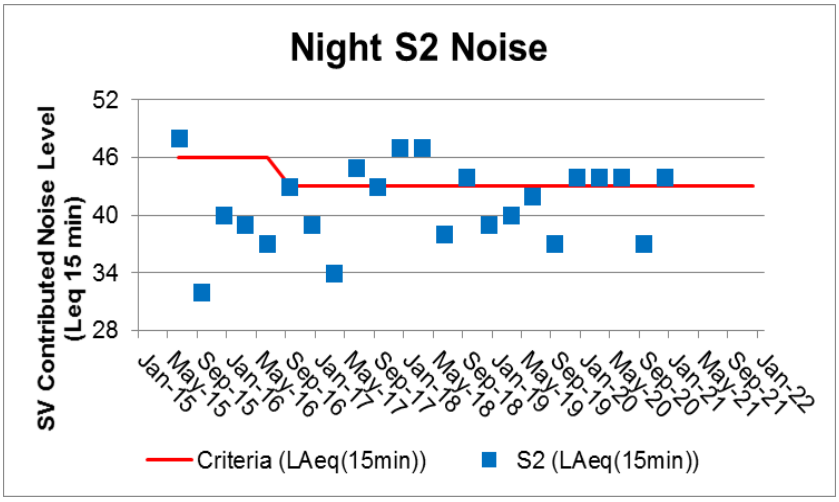


Figure 2A-12 Night S2 Noise LAeq15min Results

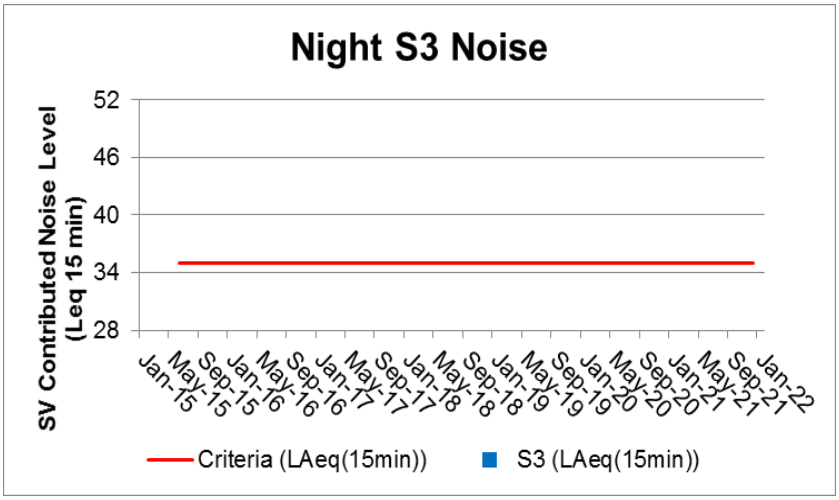


Figure 2A-13 Night S3 Noise LAeq15min Results

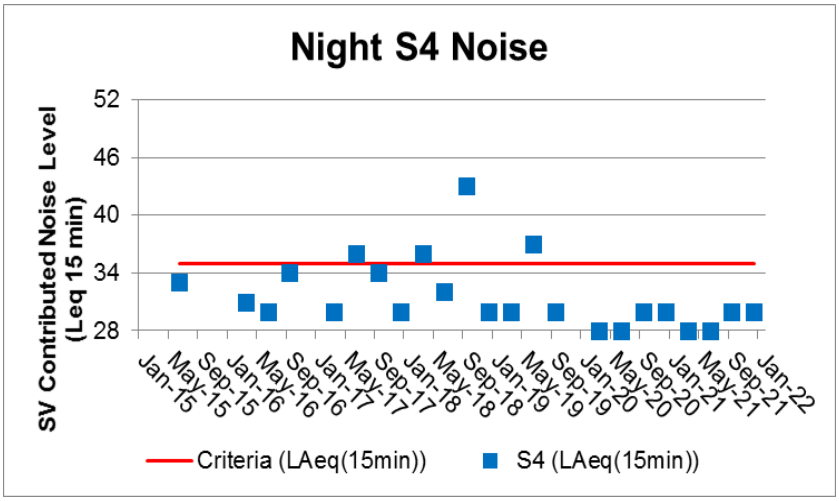


Figure 2A-14 Night S4Noise LAeq15min Results

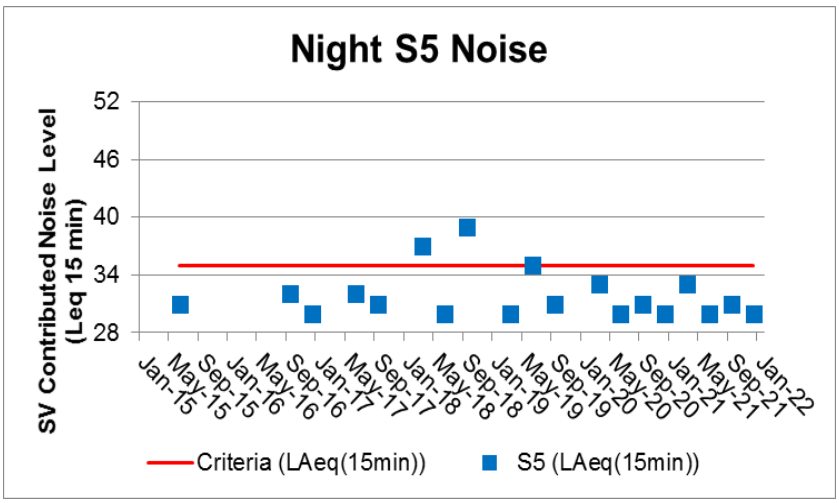


Figure 2A-15 Night S5 Noise LAeq15min Results

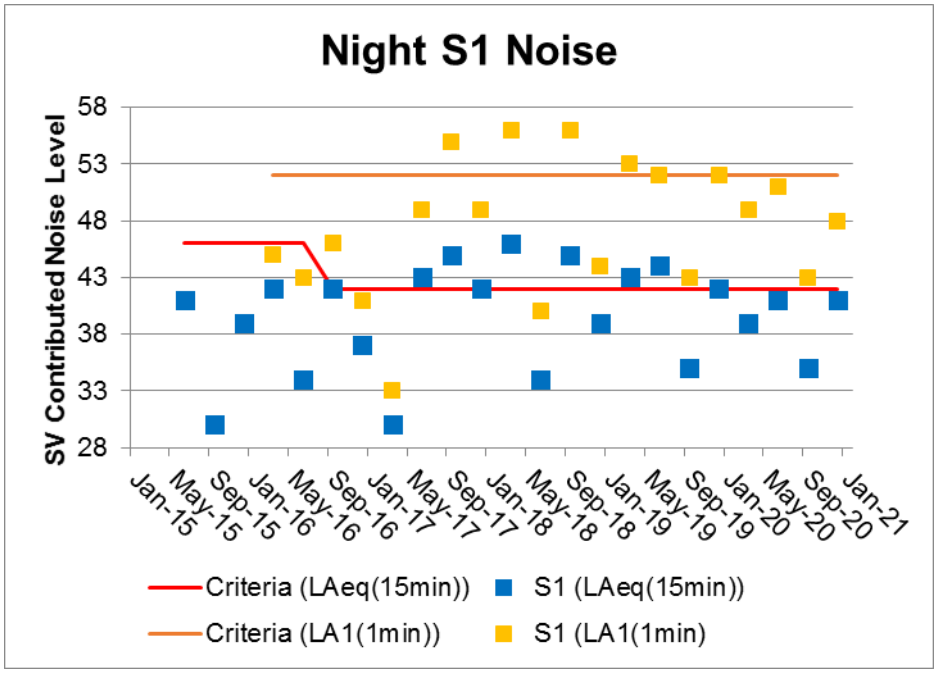


Figure 2A-15 Night S1 Noise LAeq1min Results

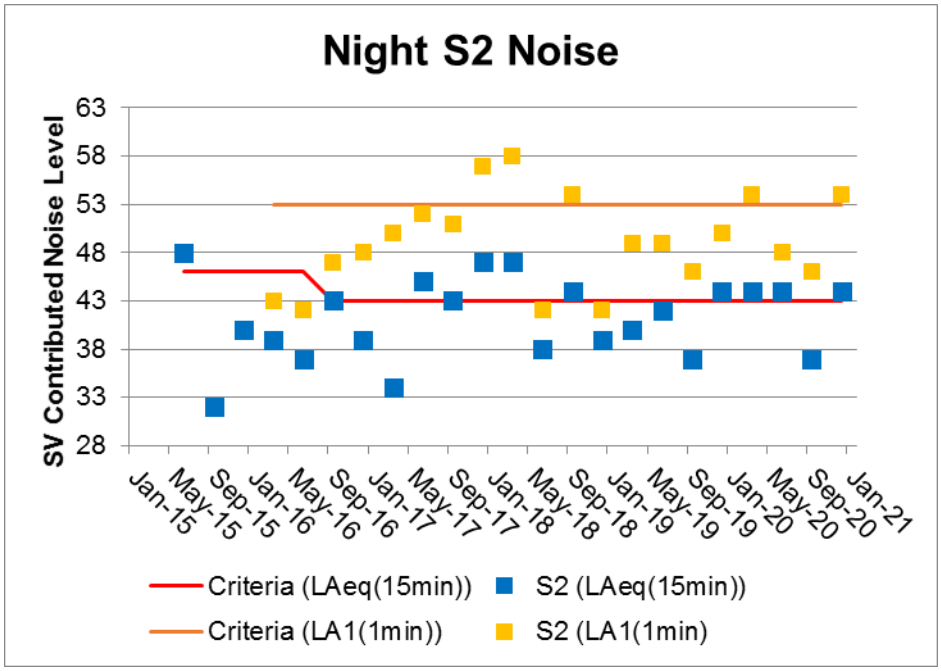


Figure 2A-15 Night S2 Noise LAeq1min Results

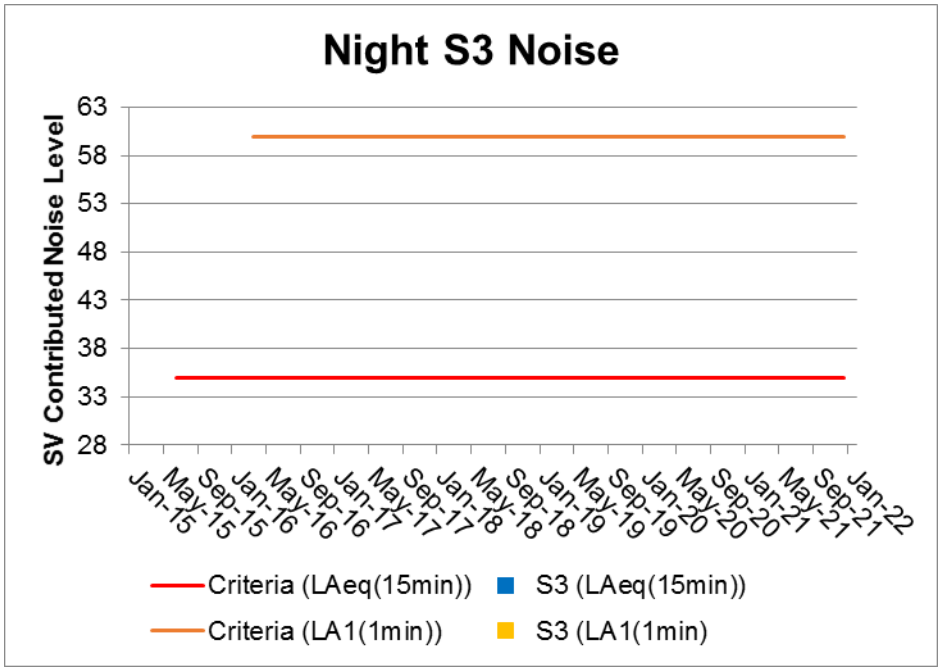


Figure 2A-15 Night S3 Noise LAeq1min Results

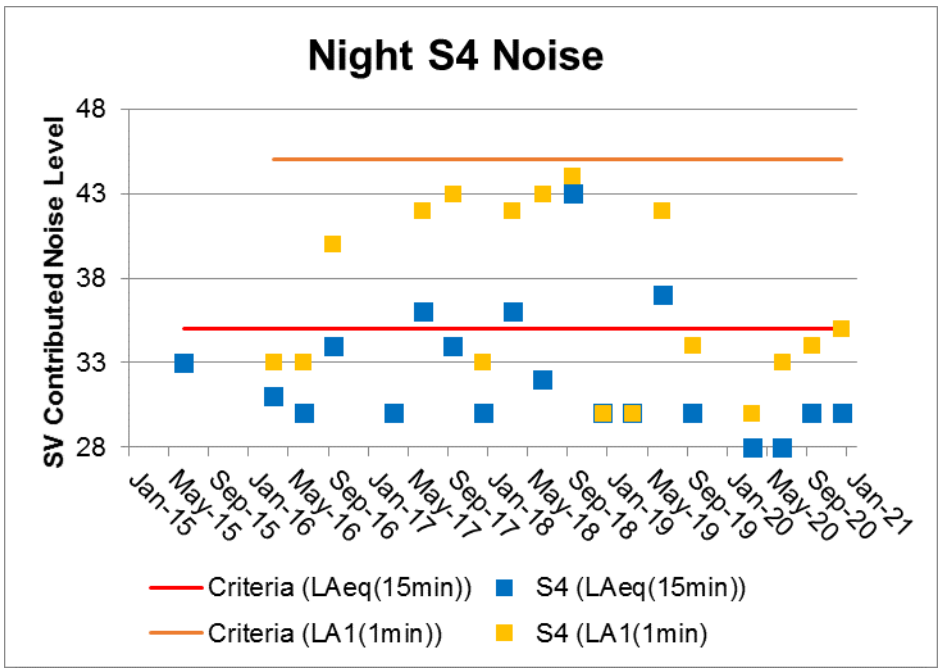


Figure 2A-15 Night S4 Noise LAeq1min Results

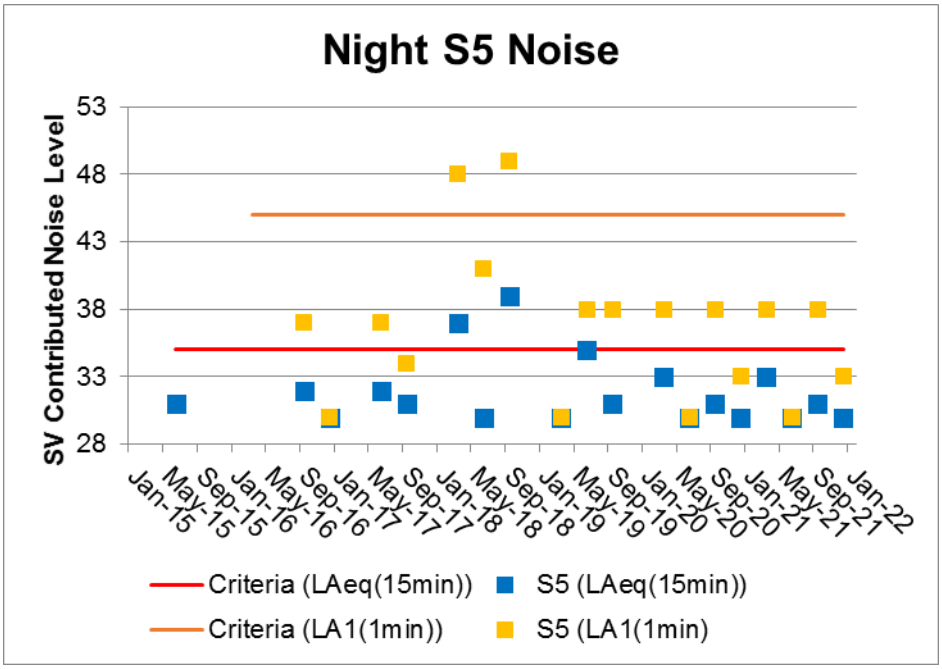


Figure 2A-15 Night S5 Noise LAeq1min Results

Appendix 6:

MOP Performance Criteria Assessment

Table 6A-1 Summary: Monitoring results and achievement of relevant performance indicators and completion criteria (Green = criteria achieved, Orange = criteria progressing but not achieved, Red= criteria not achieved)

Rehabilitation Phase (MOP)	Rehabilitation objectives	Performance indicator	Completion Criteria	Sub criteria	Ecosystem measure	Unit of measure	SPR 1	SPR 2	SPR 3	SPR 4	SPR 5	SPR 6	SPR 7	SPR 8	SPR 9
							Rehab	Rehab	Rehab	**Control**	**Control**	Rehab	Rehab	Rehab	**Control**
Phase 1: De-commissioning Development	All sites are in natural state with no hazardous or contaminated materials remaining.	Absence of hazardous material (including carbonaceous materials)	All hazardous materials and contaminated materials removed	N/A	Physical inspection of sites	y/n	Yes	Yes	Yes	N/A Control Site	N/A Control Site	Yes	Yes	Yes	N/A Control Site
Phase 2: Landform Establishment	Landforms are stable and non-polluting	Erosion control	No active erosion present	N/A	Inspection for areas of active erosion. Landscape Function Analysis – Rill assessment (if required)	m^2	None	None	None	N/A Control Site	N/A Control Site	None	None	None	N/A Control Site
			Erosion control structures have been installed.	N/A	Inspection for control structures	y/n	Yes	Yes	Yes	N/A Control Site	N/A Control Site	Yes	Yes	Yes	N/A Control Site
		Suitable gradient	Slope (<14°)	N/A	Gradient assessment of sites	Degrees	12°	5°	4°	11°	4°	2°	5°	10°	1°

Rehabilitation Phase (MOP)	Rehabilitation objectives	Performance indicator	Completion Criteria	Sub criteria	Ecosystem measure	Unit of measure	SPR 1	SPR 2	SPR 3	SPR 4	SPR 5	SPR 6	SPR 7	SPR 8	SPR 9
		Stable landform	Final landform is consistent with surrounding landforms	N/A	Inspection of site and surroundings	y/n	Yes	Yes	Yes	N/A Control Site	N/A Control Site	Yes	Yes	Yes	N/A Control Site
	Drainage structures are performing as designed	Surface water drainage	Landform is stable and contour banks and diversion drains into appropriate areas	N/A	Inspection of site and surroundings	y/n	Yes	Yes	Yes	N/A Control Site	N/A Control Site	Yes	Yes	Yes	N/A Control Site
Phase 3: Growth Medium	Land and Soil Capability Class 5	Suitable topsoil present and no stockpiles	Suitable growth medium available – no stockpiles present	N/A	Inspection of site and topsoil	y/n	Yes	Yes	Yes	N/A Control Site	N/A Control Site	Yes	Yes	Yes	N/A Control Site
Phase 4: Ecosystem Establishment	Ecosystem health, structure & composition satisfying completion criteria	Species Selection	A mixture of native trees, shrubs and grasses representative of regionally	The diversity of shrubs and juvenile trees is comparable to that of	BioBanking Native plant species richness (total)	Total species Pit Top Sites representing **PCT 728**	29			34					

Rehabilitation Phase (MOP)	Rehabilitation objectives	Performance indicator	Completion Criteria	Sub criteria	Ecosystem measure	Unit of measure	SPR 1	SPR 2	SPR 3	SPR 4	SPR 5	SPR 6	SPR 7	SPR 8	SPR 9
			occurring woodland is present.	the control sites		Total species Newnes Plateau Sites representing **PCT 1789**		37	40		38	33	32	40	27
			<15 % weeds present in monitoring sites.	Exotic plant cover is comparable to that of the control sites	Exotic plant cover	%	0%	0%	1%	0%	0%	1%	10%	0%	0%
	Ecosystem health, structure & composition satisfying completion criteria	Sustainability / Nutrient Cycling	Landform is ecologically functional and performing as designed.	Ability of the site to retain resources is comparable to that of the control sites	LFA Landscape organisation index	0-1	0.88	0.74	0.88	0.73	0.73	0.61	0.77	0.77	0.84
				Infiltration is comparable with control sites	LFA infiltration index	%	39.94	41.05	35.67	36	34.56	35.02	37.53	55.68	37.97
				Nutrient cycling is comparable with control sites	LFA nutrient cycling index	%	30.50	30.51	28.42	25.63	28.23	31.01	29.64	29.93	27.83

Rehabilitation Phase (MOP)	Rehabilitation objectives	Performance indicator	Completion Criteria	Sub criteria	Ecosystem measure	Unit of measure	SPR 1	SPR 2	SPR 3	SPR 4	SPR 5	SPR 6	SPR 7	SPR 8	SPR 9
			Flora species reproducing. Evidence of second generation.	Succession of plants comparable with control sites	N/A	y/n	Yes	Yes	Yes	N/A Control Site	N/A Control Site	Yes	Yes	Yes	N/A Control Site
		Stable landform	Landform is stable and functioning as intended	Indication of the sites stability and that it is comparable to that of the control sites	LFA Stability index	%	59.48	54.8	58.84	57.39	54.84	62.68	60.65	57.4	56.33
		Development of Woodland Habitat, Vegetation health, Vegetation structure		Native over-storey cover is comparable to that of the control sites	Native over-storey cover (%) (BioBanking)	%	7.8	15.2	5.2	14.9	22.2	35	7	13.5	22.5
				Native mid-storey cover is comparable to that of the control sites	Native mid-storey cover (%) (BioBanking)	%	0.8	0	3.5	1.9	7.3	7.5	7	0.5	3.5
				Groundcover of native grasses is comparable to that of the control sites	Native groundcover (grasses) (BioBanking)	%	48	14	18	16	36	3.5	16	26	52

Rehabilitation Phase (MOP)	Rehabilitation objectives	Performance indicator	Completion Criteria	Sub criteria	Ecosystem measure	Unit of measure	SPR 1	SPR 2	SPR 3	SPR 4	SPR 5	SPR 6	SPR 7	SPR 8	SPR 9
				Groundcover of native shrubs is comparable with remnant vegetation	Native groundcover (shrubs) (%) (BioBanking)	%	32	12	26	54	36	32	16	28	16
	Ecosystem health, structure & composition satisfying completion criteria			Native groundcover 'other' is comparable to that of the control sites	Native groundcover (other) (%) (BioBanking)	%	4	58	56	42	18	24	36	50	12
				Regeneration of over-storey species is comparable to that of the control sites	Over-storey regeneration (BioBanking)	0-1	1	1	1	1	1	1	1	1	1
				Abundance of hollow logs is comparable to that of the control sites	Total length of fallen logs (BioBanking)	m	0	3	90	0	27	32	31	23	48

Rehabilitation Phase (MOP)	Rehabilitation objectives	Performance indicator	Completion Criteria	Sub criteria	Ecosystem measure	Unit of measure	SPR 1	SPR 2	SPR 3	SPR 4	SPR 5	SPR 6	SPR 7	SPR 8	SPR 9
		Functional Indicators	Presence of vertebrate and invertebrate species from broad range of groups.	Vertebrate and invertebrate species comparable with control sites and surrounding environment.	Inspection of sites and surrounding environment.	y/n	Yes	Yes	Yes	N/A Control Site	N/A Control Site	Yes	Yes	Yes	N/A Control Site
		Habitat	Typical food and water sources required by vertebrates & invertebrates are present.	Food and water sources available or comparable to control sites.	Inspection of sites.	y/n	Yes	Yes	Yes	N/A Control Site	N/A Control Site	Yes	Yes	Yes	N/A Control Site
		Land Use	Rehabilitated sites can meet designated land uses without further management inputs.	Regeneration and ecosystem development occurring naturally	Inspection of sites and analysis of LFA and BioBanking results.	y/n	Yes	Yes	Yes	N/A Control Site	N/A Control Site	Yes	Yes	Yes	N/A Control Site
			Less than 20 % bare ground.	N/A	BioBanking results	%	24	0	0	4	4	4	10	0	2

Rehabilitation Phase (MOP)	Rehabilitation objectives	Performance indicator	Completion Criteria	Sub criteria	Ecosystem measure	Unit of measure	SPR 1	SPR 2	SPR 3	SPR 4	SPR 5	SPR 6	SPR 7	SPR 8	SPR 9
			Total woody species richness differs 10 – 20 % from control sites	N/A	BioBanking results	y/n	Yes	Yes	Yes	N/A Control Site	N/A Control Site	Yes	Yes	Yes	N/A Control Site

Appendix 6:

Complaint Register

As required under Schedule 6, Condition 15 of Springvale Mine's Consent (SSD_5594) a complaints register must be updated on a monthly basis. The monthly EPL Monitoring Report uploaded on the Centennial Coal website also includes a community complaints section. This register will be updated monthly as triggered by a complaint to form a log. The following lists community complaints received since the Consent grant date.

Date	Complaint/Enquiry	Method	Description	Investigation/Cause	Springvale Response
28/09/2015	Complaint	Phone	A complaint was made to the colliery regarding a vehicle entering the highway from the mine access road at 5:30am on the 28/9. It is unknown whether the vehicle has come from the colliery.	Failure to abide by road rules and failure to abide by road signage.	Springvale apologised to the complainant and explained such behaviour was not condoned and should be reported to authorities. The mine committed to logging the incident as a complaint although it is a public road and it was not known whether the vehicle has come from the colliery. A toolbox talk was issued to the workforce in relation to road safety.
23/10/2016	Complaint	Phone	Resident called Springvale Coal Services (SCS) Control Room to lodge a noise complaint regarding the empty haul trucks travelling from SCS to Springvale Mine.	Springvale Mine is temporarily hauling ROM coal to Springvale Coal Services (SCS) via the Castlereagh Highway. The complaint was regarding the speed and noise (tail gates not secured properly) of the returning empty trucks travelling along the Highway to Springvale Mine.	Centennial representative contacted complainant on 23/10. The following actions were implemented: • Minimise truck movements and truck speed leaving SCS to 80kmph. • Check tailgates on trucks are fastened. • Limit truck movements to weekdays where possible. • Notify complainant if weekend hauling is planned. Complainant was advised of actions to be implemented. 1/11 – Agreed to cease truck movements on weekends.
24/02/2017	Complaint	Phone	A complaint was received in relation to noise generated from the haulage of coal	Springvale Mine is temporarily hauling ROM coal to Springvale Coal	The following actions had been implemented for the duration of hauling: • Minimise truck movements and truck speed leaving SCS.

Date	Complaint/Enquiry	Method	Description	Investigation/Cause	Springvale Response
			along the Castlereagh Highway at Blackman's Flat. The complainant stated that: • The haulage of coal should be undertaken via the existing conveyor infrastructure and additional private haul road links should be constructed if this activity is to continue; • The trucks with trailers are the noisiest on the return journey along Blackman's Flat due to increased noise generated from the uneven road surface; • The haulage of coal along public roads results in more regular truck movements and therefore has an increased noise and amenity impact.	Services (SCS) via the Castlereagh Highway.	• Check tailgates on trucks are fastened. • Truck movements only to occur on weekdays. Complainant acknowledged actions being taken by Springvale to reduce impacts. Hauling is being undertaken in accordance with Springvale SSD_5594.
14/05/2017	Complaint	Email	Springvale received an email from the EPA advising that they had received a complaint to the Environment Line	Likely cause of noise is Springvale stockpile dozer/s. Analysis of noise monitor (situated at Springvale	CHP Supervisor was notified of the noise complaint received and subsequently spoke with dozer operators regarding the complaint and control measures to be adhered to while operating. A subsequent

Date	Complaint/Enquiry	Method	Description	Investigation/Cause	Springvale Response
			regarding noise potentially associated with pit-top activities at Springvale. Relevant components from the complaint made to EPA are below. "The caller has been woken at around 6am for three out of the past four Sundays by noise from the Springvale Colliery. The caller indicates that they believe that the noise is associated with machinery known as the coal pusher. The caller resides about 2km away. The caller notes that this work has often been done at other times of the day and night which are not a big problem, but that early on a Sunday morning is quite disturbing. The caller suggests that if the work could commence from 8am it would significantly reduce the impact on their household".	pit-top) showed that there were elevated noise levels from the stockpile dozer on the identified Sunday mornings. Weather conditions during these times also indicated a potential inversion which would have exacerbated any noise levels.	Toolbox Talk was issued to the dozer operators. The focus of the discussion and Toolbox Talk was proactive management and reducing noise in the morning when noise enhancing conditions may be occurring. Noise management of the stockpile dozer remains ongoing.
04/06/2017	Complaint	Phone	Springvale received a phone call from the EPA advising that they had received a complaint regarding noise potentially associated	Likely noise source is stockpile dozer/s. Weather conditions during these times also indicated a potential inversion which would	The dozer has been inspected by Westrac technicians and a guard removed that is thought to be increasing the noise levels while it is operating. Further investigation and management of the stockpile dozer is ongoing.

Date	Complaint/Enquiry	Method	Description	Investigation/Cause	Springvale Response
			with pit-top activities at Springvale. Relevant components from the complaint made to EPA are below. “Dozer operation was audible at Skelly Road at 6am on a Sunday morning. Noise levels were fine the previous couple of weekends but were once again obtrusive at 6am Sunday 4 June 2016”.	have exacerbated any noise levels.	
29/07/2017	Complaint	Email	Springvale received an email from the EPA advising that they had received a complaint to the Environment Line. Details of complaint made to EPA are below: “Machinery noise coming from mining equipment at Centennial Coal Springvale. The noise lasted 2 hours on 28/07/2017 from 23.30”.	Likely cause of machinery noise is stockpile dozer/s. Analysis of weather conditions indicated still conditions between 23:30 - 01:30 - wind velocity recorded 0m/s. Atmospheric conditions indicated potential inversion during preceding and during the complaint time. Weather conditions and current stockpile dozer operations both likely factors in noise levels causing complaint.	Springvale has already undertaken the following actions in relation to noise management: • Toolbox Talk issued to dozer operators. • Dozers inspected by Westrac technicians. • Guard on dozer, thought to be exacerbating noise levels, removed. • Re-commissioning of real time monitor. Springvale are investigating further opportunities to manage/mitigate noise. Additional actions underway include: • Additional noise monitoring to correlate noise sources and assess potential for managing noise sources at high risk times. • Investigation of noise attenuation engineering solutions for dozers.

Date	Complaint/Enquiry	Method	Description	Investigation/Cause	Springvale Response
11/05/2018	Complaint	Email	Complaint received from resident stating that their complaints are not being recorded at the Springvale Community Consultative Committee (CCC).	Following a review of the Community Complaints Register it is confirmed that all complaints received in relation to Springvale are registered in the Springvale Community Complaints Register. On review of the Springvale CCC presentations, it is found that one complaint (received 23/10/2016) was not recorded in the CCC presentation. All other complaints had been recorded in CCC presentations.	Springvale will continue to record complaints in the Community Complaints Register and report any complaints received to the CCC.
01/08/2019	Complaint	Phone	Springvale received a phone call from a resident with noise concern from the operation.	Monitoring to be undertaken to determine the plant or activity or metro conditions which are causing the resident concern.	Discussions with Group Manager of Stakeholder Engagement and resident have occurred. Consultant engaged for monitoring and future actions will be driven from the investigation findings



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