Chapter	Page	Section	Line/Table/ Figure #	Comment	
4	19	4.2	513-514	"Here are two illustrative examples of an appropriate use of well replacement…" … "Example 2: Replacement of a 1,000-gpm agricultural well that will be properly decommissioned with a new 2,000-gpm capacity agricultural well is permissible with the explicit condition that the 10-year average total net groundwater extraction within the combined area serviced by the old and the new well does not exceed the average groundwater extraction over the most recent 10-years." Since groundwater use is mostly unmetered (much less publicly accessible), how would this be tracked or enforced?	TC-058
4	23	4.2	659-667	The proposed monitoring of irrigation efficiency omits a key tool– metering of water use. Without metering, how can we know if the efficiency projects are actually working?	TC-059
4	23	4.2	659-667	The proposed monitoring of irrigation efficiency lists "Assessment of the increase in irrigation efficiency, with particular emphasis on assessing the reduction or changes in consumptive water use (evaporation, evapotranspiration) based on equipment specification, scientific literature, or field experiments." Doesn't efficiency usually not affect consumptive water use but instead just change recharge (that's how it is represented in the SVIHM, right?). What is the physical basis for thinking efficiency would affect consumptive use for crops like pasture and alfalfa that have low-lying continuous canopy cover (i.e., in contrast to orchards or row crops like tomatoes where efficient delivery systems like drip irrigation could reduce evaporation from bare soil)?	TC-060
4	25	4.2	668	"Juniper Removal: The GSA, USGS and other agencies and private stakeholders will remove excess juniper within the watershed to improve groundwater levels." While it is conceptually possible to increase water yield for some number of years following juniper removal, it is difficult to actually implement at a watershed scale and maintain it over time. Furthermore, juniper removal will not necessarily increase water yield in all climates, so local conditions should be evaluated (Niemeyer et al. 2017). Such projects should be considered within a holistic management framework that re-establishes historical fire regimes and does not focus solely on water yield. Maintenance would be needed because the benefits of one-time removal projects are likely to be short-lived (Fogarty et al. 2021). References: Fogarty, D. T., de Vries, C., Bielski, C., & Twidwell, D. (2021). Rapid Re-encroachment by Juniperus virginiana After a Single Restoration Treatment. Rangeland Ecology & Management, 78, 112–116. https://doi.org/10.1016/j.rama.2021.06.002. Niemeyer, R. J., Link, T. E., Heinse, R., & Seyfried, M. S. (2017). Climate moderates potential shifts in streamflow from changes in pinyon-juniper woodland cover across the western U.S. Hydrological Processes, 31(20), 3489–3503. https://doi.org/10.1002/hyp.11264	TC-061

Chapter	Page	Section	Line/Table/ Figure #	Comment	
4	30	4.3	895	Given that there is already a dam in place that captures winter runoff from the upper Shasta River watershed, we oppose the Managed Aquifer Recharge (MAR) or In-Lieu Recharge (ILR) PMA. Dwinnell Dam already reduces winter and spring flows enough that there are not sufficient high flows to maintain natural geomorphic processes in the Shasta River. There is no "extra" water in the Shasta River that can be used to recharge groundwater. The way to improve groundwater conditions is demand reduction.	TC-062
4	32	4.3	954	We support the Strategic Groundwater Pumping Curtailment PMA.	TC-063
App 2-E	10			We did not receive this appendix with the model documentation until September 13, so did not have time to review it in detail. Many sections of it appear to only be partially complete. We look forward to reviewing this when it is complete.	TC-064
App 2-I	8			How do the total evapotranspiration of applied water (ETaw) and precipitation (ETpr) values calculated in this report compare with previous estimates such as from CDWR Land and Water Use Estimates (https://water.ca.gov/Programs/Water-Use-And-Efficiency/Land-And-Water-Use/Agricultural-Land-And-Water-Use-Estimates), and/or the remote-sensing based Baldocchi et al. (2019)? Full citation: Baldocchi, D., Dralle, D., Jiang, C., & Ryu, Y. (2019). How Much Water Is Evaporated Across California? A Multiyear Assessment Using a Biophysical Model Forced With Satellite Remote Sensing Data. Water Resources Research, 55(4), 2722–2741. https://doi.org/10.1029/2018WR023884	TC-065
App 3-A	10		Table 2	Why are flow gages not listed in the Table 2 Data Gap Prioritization? Shouldn't measuring the flow rates of the largest springs (i.e., Big Springs, Little Springs, etc.) be the highest priority? We do not understand how it will be possible to calibrate groundwater model without having data for these springs.	TC-066
App 3-A	11		Table 2	The groundwater extraction row of Table 2 says "No strategy has been defined yet to fill this data gap. Only voluntary measures are being considered to gathered extraction data." This is disappointing. How can groundwater be effectively managed without data about how much groundwater is being pumped?	TC-067

Quartz Valley Indian Reservation

September 22, 2021

To: Siskiyou County Flood Control and Water Conservation District

From: Quartz Valley Indian Community

RE: Scott River Groundwater Sustainability Plan Comments

Chairman Kobseff,

We thank you this opportunity to provide comments on the Scott Valley Groundwater Sustainability Plan (GSP). The Quartz Valley Indian Community (QVIC) sees this process enacted by the Sustainable Groundwater Management Act (SGMA) as an important and necessary step towards ecological balance in the Scott River system. The demands of drinking water, agriculture and the environment have been competing for decades and drought conditions of recent years are exacerbating this issue.

As you are aware, the QVIC was granted a seat on the Scott Groundwater Advisory Committee (SGAC). Our staff was an active participant throughout the entire process reviewing materials and providing verbal and written comments. We feel that many of these comments were not adequately addressed in the development of the current draft of the GSP. SGMA was enacted to be a collaborative process and we were hopeful that this would be a first step in working with our neighbors to develop a GSP that could meet all the needs of the Scott community. We never expected that the SGMA process would resolve all the water problems in the valley, in part because SGMA only applies to a subset of groundwater users (i.e., those not already covered by the existing water rights adjudications) and does not apply to surface water users. However, we are disappointed that the GSP did not propose more ambitious steps towards addressing the critical lack of instream flows in the river during summer and fall. Instead of providing long-term solutions, the GSP seems primarily aimed at continuing the status quo, with only slight improvements proposed. We can envision a future in which fish have the water they need to survive, and farmers and ranchers have secure access to the water needed for their operations; however, the GSP does not do enough to bring that vision closer to becoming reality. Many of the comments herein have already been stated throughout the development of the GSP, we also had an additional technical review from our consultants during this public comment period. QVIC-001

The technical review has revealed a concerning weakness in the model, particularly in October and November when the groundwater basin is transitioning between draining and filling, those details are included herein. This is most concerning to the Tribe since this is when our salmon are in the Scott system trying to access as much habitat as possible to spawn. We feel that these modeling weaknesses could be refined and alleviated through a more robust monitoring program throughout the valley. On the ground information, through data collection and sharing, will be necessary to build our trust in the accuracy of the model being used to manage the Scott system. QVIC-002

A significant legal analysis of the GSP was provided to QVIC by the Karuk Tribe, and we have included those comments herein. These legal issues have created uncertainty in the development of the GSP and we feel, had they been resolved early on, a better GSP could have been produced.

We hope these comments are useful and can lead to a final draft that is working toward restoration and a water management strategy that is effective at meeting the needs the Scott River basin.

Administration: 530-468-5907 Fax: 530-468-5908

13601 Quartz Valley Road, Fort Jones, CA 96032

We have also attached a Technical Memorandum developed by our consultants on the Shasta GSP. Many of the same legal questions apply to the Shasta GSP as well. Although QVIC staff were focused on the Scott GSP development, the Tribe has ancestral lands in the Shasta basin and development of a solid GSP is just as important there as in the Scott River basin to QVIC membership. QVIC-003

Thank you and please contact my staff lead, Crystal Robinson, Environmental Director crystal.robinson@qvir-nsn.gov, if you have any technical questions or follow up to these comments.

Sincerely,

Harold Bennett, Tribal Chairman
Quartz Valley Indian Reservation

Attachment C – Shasta Valley Groundwater Sustainability Plan Comment and Comment Response Matrix

Author	CIN	Group	Sub-Category	Description	Code/Regulation	Chapter	Page	Section	Line/ Table/ Fig #	Comment	Response / Recommended Action
Ginger Sammito	GS-001	C	DW	Domestic Well Definition		2	8	1.1.1	151-153	Need to define what constitute a domestic well upper bound. Is it 450 gpm? 100gpm?	A domestic well is defined by a well that pumps potable groundwater for personal use.
Ginger Sammito	GS-002	C	HM	Specific Edit to Plan Requested		2	35	2.2.1.2	figure#8	Graph depicts data up to 2005 yet verbiage states 2020	Edit complete.
Ginger Sammito	GS-003	C	HM	Specific Edit to Plan Requested		2	39	2.2.1.2	Figure #12	Need to define xxx place holders. Probably just overlooked	Figure was updated.
Ginger Sammito	GS-004	C	WI	Well Pumping Reporting		3	7	3.3	178-188	What about large capacity well which are on large generators and do not have a large land base case in point is APN: 019-661-410-000 which has a 2,500-gallon capacity well on 4.06 acres.	Volunteers with this well type is welcome to voluntarily report their usage. There is also a PMA on volunatry well metering in Chapter 4.
Ginger Sammito	GS-005	C	MN	Specific Edit to Plan Requested- Groundwater Monitoring Figure		3	9,10		Figure 1,2	x-axis needs to be cleaned up. Maybe just being/end value	The figures have been updated.
Ginger Sammito	GS-006	C	GL	Specific Edit to Plan Requested- Chronic Lowering of Groundwater Levels		3	35	3.4.1.1	599-605	Excessive number is ambiguous statement. What number determined excessive?	See MCR "SGMA"
Ginger Sammito	GS-007	C	IS	Specific Edit to Plan Requested		3		3.4.3.2	Table 7	What is the significance defined by the asterisk next to the values? Maybe just need a statement here.	Edit complete.
Ginger Sammito	GS-008	C	WR	Specific Edit to Plan Requested		4	4	4.1	153	A permit is required for extraction within and outside basin now	See Section 2.1.4.3.
Ginger Sammito	GS-009	C	TR	Data Access, Transparency		4	14	4.2	335	The only way to acquire valid data is to house the well drillers report within this county so the information will be readily available to SGMA	Noted
California Trout	CT-001	C	GL	Specific Edit to Plan Requested		ES	3	ES-1	98	Available for the Basin dates back to eat least (typo)	Edit complete.
California Trout	CT-002	C	GL	Specific Edit to Plan Requested		ES	3	ES-1	101	What is Error! Reference source not found?	Edit complete.
California Trout	CT-003	C	GE	Specific Edit to Plan Requested		2	4	2.1.1	91	cover ~~a~~ the northern (typo)	GSP text corrected.
California Trout	CT-004	C	BR	Public Trust Doctrine, Interconnected Surface Water		2	12	2.1.2	162	This section never mentions the Public Trust Doctrine despite the GSP acknowledging that groundwater and surface water in the basin are interconnected (line 110)	See MCR "Public Trust"
California Trout	CT-005	C	WB	Data Uncertainty- Illegal Cannabis		2	28	2.1.4.2	695-697	"[t]here is not substantial enough data to include groundwater use estimates from illegal cannabis production in the overall and future water budgets." → How can the GSA ensure accurate water budgets if it excludes this potentially significant, albeit illegal, use of groundwater?	The commenter acknowledges that illegal cannabis production is only potentially significant highlighting the uncertainty in quantifying the groundwater use. Adding a groundwater use term for illegal cannabis production in the groundwater model would introduce more uncertainty into the model results because there is no conclusive data yet on illegal cannabis production, thus including this groundwater use may create a less accurate water budget. This is a data gap as the groundwater use term for illegal cannabis cannot be accurately calculated without further investigation of the location, areal extent, and timing of illegal cannabis production, in addition to where they are sourcing their water; this data gap that will require more data to be collected for more precise estimates of illegal cannabis production groundwater pumping. Preliminary approximate estimates of cannabis production in the basin indicated an upper limit increase of approximately 30% in agricultural pumping with a lower estimate of approximately 10% in agricultural pumping.

California Trout	CT-006	C	HM	Request for Clarification; see GS-003		2	39	2.2.1.2	Figure 12	Is this the updated figure?	The figures were updated to match the previously used time span of 1984-2021
California Trout	CT-007	C	GE	Specific Edit to Plan Requested		2	63	2.2.1.4	1336	"soil groups are described in Table (XXX)" → what table does this refer to?	The four main hydrologic soil groups were described in detail in the text thus the table is not necessary and mention of the table was removed.
California Trout	CT-008	B	BR	Public Trust Doctrine, Interconnected Surface Water		2	105	2.2.2.6	2052-2054	"the Shasta River surface water network contains many miles of stream channel that are connected to groundwater. The Shasta River and its major tributaries are all considered part of the interconnected surface water system in the Basin." Given this statement, the GSP needs to include Public Trust considerations, as the public trust doctrine applies to the management of groundwater that impacts a public trust resource (here, the Shasta River).	See MCR "Public Trust"
California Trout	CT-009	C	MN	Specific Edit to Plan Requested		3	6	3.3	134	Per 23 C.C.R. § 354.34(b)(1-4)	Edit complete.
California Trout	CT-010	C	MN	Specific Edit to Plan Requested		3	6	3.3	152	Section 351(l)	Edit complete.
California Trout	CT-011	C	MN	Data Gaps, Water Pumping		3	7	3.3	179-180	"Owners and/or operators of groundwater wells, meeting a certain criteria, are *encouraged* to report pumping volumes" (emphasis added) → what is landowners do not want to share information?	At this time, the GSA has elected to use a voluntary program for groundwater extraction reporting. For the next five years, the GSA will conduct public outreach to encourage voluntary participation. This may be revisited in the 5-year update.
California Trout	CT-012	C	MN	Monitoring Network- schedule		3	30	3.3.4.2	511	Why will this take 10 years?	Edit complete.
California Trout	CT-013	C	WQ	Groundwater Quality					1138-1139	"Arsenic, boron, iron, manganese, and pH do not have an SMC because they are naturally occurring." → what if groundwater pumping increases the concentration of these constituents?	See MCR "Water Quality"
California Trout	CT-014	C	PM	PMAs, Public Trust Doctrine		4		4.1	Table 4.1	General thoughts about PMAs: - Most of the tier 1 actions rely on another entity acting - If the restriction of groundwater pumping is in Tier 3, it will likely not be implemented soon enough to improve conditions. This triggers public trust doctrine concerns.	See MCR "Public Trust"
California Trout	CT-015	C	PM	PMA Implementation		5	10	5.1.2	299-337	Concerning that the only concrete action the GSA commits to is "coordination." What is the GSA's strategy for implementing this GSP?	Text has been added to Chapter 5 to flesh out how the GSP will be implemented.
California Department of Fish and Wildlife	CDFW-001	A	BR	GDEs, Environmental Beneficial Users, Public Trust Doctrine						The Department has significant concerns about potential impacts of groundwater pumping on GDEs and interconnected surface waters (ISWs), including ecosystems on Department-owned and managed lands within SGMA regulated basins. The Department owns the Shasta Valley Wildlife Area, on Little Shasta River, and Big Springs Wildlife Area within the Big Springs complex of the headwaters of Shasta River. The Department urges the GSA to plan for and engage in responsible groundwater management that minimizes or avoids these impacts to the maximum extent feasible as required under applicable provisions of SGMA and the Public Trust Doctrine.	See MCR "GDE" and "Public Trust Doctrine"
California Department of Fish and Wildlife	CDFW-002	C	GD	GDE- vegetation	23 CCR §§ 354.10(a), 354.26(b)(3), 354.28(b)(4), 354.34(b)(2), and 354.34(f)(3)	2			Table 7	The Draft GSP species prioritized for management were identified as "riparian vegetation," which is a vegetation type, not an ecosystem or species.	The language has been updated for clarity.
California Department of Fish and Wildlife	CDFW-003	A	GD	Identification of Environmental Beneficial Users	23 CCR §§ 354.10(a), 354.26(b)(3), 354.28(b)(4), 354.34(b)(2), and 354.34(f)(3)	2			Table 7	While this column identified salmonids as a species prioritized for management, the Draft GSP did not provide objectives that would be anticipated to support salmonids. Instead, the GSP provided objectives intended to minimize sediment erosion into streams where bank swallows exist that depend on erosion for their management. This choice of objectives suggests that the Draft GSP does not recognize the unique life histories of these species that may give rise to differences in management needs between salmonids and other species.	See MCR "GDE"

California Department of Fish and Wildlife	CDFW-004	A	BR	Identification of Environmental Beneficial Users, Endangered Species	23 CCR §§ 354.10(a), 354.26(b)(3), 354.28(b)(4), 354.34(b)(2), and 354.34(f)(3)					In addition, many species, including special-status species, that are known to depend on or may be vulnerable to groundwater fluctuations were not identified in the first column. These include bank swallow, foothill yellow legged frog, western pond turtle, greater sandhill crane and willow flycatcher to name a few. The Draft GSP does not indicate where these species are found in the basin and how these individual species could be impacted by groundwater.	See MCR GDE
California Department of Fish and Wildlife	CDFW-005	A	GD	GDE Classification Methodology	Water Code § 10727.4(l); 23 CCR § 354.16(g)					the Draft GSP does not provide sufficient detail when describing the methods used for GDE classification and mapping included in the Draft GSP and rationale for the methods used. The Draft GSP mentions tabletop methods of using existing mapping tools, root depth to groundwater modeling and other tools for identifying GDEs. However, it also fails to include Advisory Committee input or field verification of the identified GDEs. Without these means of verification, the Department cannot evaluate or comment on the accuracy of the GSP's GDE classification or mapping. The Department recommends that GDE mapping is informed by science-based vegetation classification or similar methods, such as the Department's Survey of California Vegetation Classification and Mapping Standards.The Draft GSP's classification and mapping should be revised if necessary after utilizing these methods. Classification and mapping methods should be thoroughly described so that GDE classification and mapping can be verified by stakeholders or repeated during future GSP updates and effectiveness monitoring.	See MCR GDE
California Department of Fish and Wildlife	CDFW-006	B	HM	Identification of Aquifers and Aquitards	23 CCR §354.14 (b)(4)(B) and (C)					The GSP does not properly identify and characterize the principal aquifers and aquitards within the Basin as required by applicable SGMA regulations. The Draft GSP provides a regional description of the aquifer system(s) within the Basin without specifying the principal aquifer system is collectively within the basin. It would be helpful to identify the principal aquifer system within the Basin, and characterize the vertical and lateral extent of these assemblages in relation to one another. The Draft GSP should characterize associated aquifer parameters (i.e., hydraulic connectivity and specific yield/storativity) where each of the forementioned aquifer assemblages are located, and characterize or define the lateral and vertical extent of existing aquitards/confining layers within the Basin.	See MCR Aquifer System
California Department of Fish and Wildlife	CDFW-007	C	HM	Accuracy of the Hydrogeologic Model	23 CCR §354.14 (b)(3).					In addition, the Department's understanding is that the Draft GSP does not clearly identify a definable bottom of the Basin as required by applicable SGMA regulations. The Draft GSP provides a discussion of the geologic units from oldest to youngest within the Basin but does not identify a definable base between the alluvial material and deeper hard rock material in the Basin.	The HCM is appropriate and properly reflects uncertainty about the depth of the groundwater basin. Due to the volcanic nature of Shasta Valley many uncertainties surround Basin characterization. The Department of Water Resources is conducting airborne electromagnetic (AEM) surveys throughout California to assist implementing SGMA, which may improve some uncertainties in the HCM. At this time the GSP will focus on the critical data gaps listed in Appendix 3-A. Any future studies to improve the HCM will depend on partnerships with other agencies.
California Department of Fish and Wildlife	CDFW-008	B	HM	Accuracy of the Hydrogeologic Model- Groundwater Elevation Countours						The Draft GSP needs to provide groundwater level elevation contour maps depicting the groundwater table or potentiometric surface associated with current seasonal highs and seasonal lows and hydraulic gradients between principal aquifers.	See MCR Aquifer System
California Department of Fish and Wildlife	CDFW-009	C	HM	Accuracy of the Hydrogeologic Model						Different sections of the Draft GSP provide varying yields for Pluto's Cave, ranging from 1,000-4,000 gallons per minute. The Draft GSP should be consistent in its description of yields. If a range is used for this location or other springs in the Basin, it should not have a large range of variation.	The big range may stem from seasonal variations. Spring monitoring in Big Springs also exhibit a large variation in yields.

California Department of Fish and Wildlife	CDFW-010	C	HM	Accuracy of the Hydrogeologic Model						In addition, the source of recharge for the springs should be identified if known. The Department suspects the source of the recharge for the springs is likely snowmelt. It would be beneficial if this could be confirmed and included in the Draft GSP.	Isotope data is being analyzed at Lawrence Livermore National Laboratory regarding the source of spring recharge. Results are expected in 2022. See MRC "General Data Gaps".
California Department of Fish and Wildlife	CDFW-011	C	HM	Accuracy of the Hydrogeologic Model						Similarly, for extractions, it would be helpful to describe the points of diversion of surface water in text and with a map, including extractions from water districts and municipalities.	We are working with the watermaster to resolve possible privacy concerns.
California Department of Fish and Wildlife	CDFW-012	B	HM	Accuracy of the Hydrogeologic Model- Groundwater Elevation Contours	23 CCR §354.16 (a)(1)					The Department was unable to locate groundwater elevation contour maps that complies with applicable SGMA regulations that require characterization of the current seasonal highs and lows of the principal aquifer within the Basin. The referenced appendices include a set of presentation slides. The Department recommends supplementing these slides with discussion of the model inputs and associated literature cited to provide a greater understanding of the model and facilitate evaluation of compliance with applicable SGMA requirements.	See MCR Aquifer System
California Department of Fish and Wildlife	CDFW-013	A	GE	Meeting SGMA Requirements	23 CCR § 354.22 et seq.; Water Code §§ 10721(x)(6) and 10727.2(b)					The Draft GSP concludes that sustainability will be achieved by 2042 and undesirable results will be avoided, but the Department has concerns about the analysis and data underlying these conclusions. The goal of sustainability cannot be achieved by 2042 without an accurate water budget and clearly-defined sustainable management criteria, including minimum thresholds and measurable objectives,	See MCR General Data Gaps
California Department of Fish and Wildlife	CDFW-014	A	IS	ISW Depletion- Modeling and Minimum Threshold	23 CCR § 354.28(c)(6)					If a numerical groundwater-surface water model is not used to quantify surface water depletion, the GSP must identify and describe an equally effective method, tool, or analytical model to be used for this purpose. The Draft GSP does not meet these requirements because it does not set minimum thresholds based on the rate or volume of surface water depletions caused by groundwater use, and it does not utilize a basin-wide groundwater-surface water model or equally effective method, tool, or model to quantify such depletions.	See MCR ISW
California Department of Fish and Wildlife	CDFW-015	A	IS	ISW Depletion- SMC Calculation	23 CCR § 354.28(c)(6)					In the Draft GSP, sustainable management criteria related to depletions of interconnected surface water have not been clearly defined. The GSP claims to have considered measured groundwater contributions and the protection of GDEs through equations and numbers identifying the minimum thresholds and measurable objectives. Based on the limited explanation and justification in the GSP, the Department does not understand how the equations and numbers will ensure adequate protection of fish and wildlife resources and habitat. These equations and general numbers do not clearly articulate how they will affect beneficial users' needs or how data gaps in the understanding of the basin have been addressed. The numbers and equations do not relate to flows needed to support species and habitat, and the equations do not appear to produce specific quantitative metrics protective of resource needs.	See MCR ISW and GDE
California Department of Fish and Wildlife	CDFW-016	A	IS	ISW Depletion- SMCs	23 CCR § 354.28(c)(6)					While interim milestones are provided, it is unclear how they will provide a "reasonable path" to achieving sustainability because they are also framed in terms of equations and percentages without relation to a specific value to ensure sustainability.	See MCR ISW
California Department of Fish and Wildlife	CDFW-017	A	IS	ISW Depletion- Omission of Data	23 CCR § 354.28(c)(6)					The Department is also concerned that the analysis omits Upper Little Shasta River and fails to account for the fact that the stream annually disconnects.	See MCR ISW
California Department of Fish and Wildlife	CDFW-018	A	IS	ISW Depletion- SMCs	23 CCR § 354.28(c)(6)					The Department requests revisions to the draft GSP to clarify how the sustainable management criteria were developed, how these criteria relate to the relevant sustainability indicators and how the criteria may affect the interests of beneficial users.	See MCR ISW

California Department of Fish and Wildlife	CDFW-019	A	IS	ISW Depletion-Accounting for Fully Allocated Stream System Designation	Water Right Order 98-08					The Draft GSP's sustainability criteria also fail to account for the fact that the State Water Resources Control Board (SWRCB) has declared Shasta River a fully appropriated stream system (FASS) during part of the year, meaning insufficient supply is available for new water right applications at this time (Water Right Order 98-08). The FASS determination was based on numerous water rights decisions and orders that determined that allocated water likely exceeds available supplies from May 1 to October 31 each year (i.e., supplies are likely over-allocated at this time). The Draft GSP anticipates that surface water users and the Scott Valley and Shasta Valley Watermaster District (SSWD) will be able to maintain sufficient flows instream. However, given likely over-allocation and potential surface water depletions from groundwater pumping, which the GSA has not analyzed adequately, this assumption may not be realistic.	See MCR "ISW"
California Department of Fish and Wildlife	CDFW-020	B	IS	ISW Depletion-Setting Thresholds						The GSA should not wait for additional California Water Action Plan deliverables for the Shasta River before determining and implementing "sufficient flows for salmonid species within the Shasta River." The Department has provided best available science that can be used to answer this question now rather than referring to an "aspirational watershed goal." Please see the Department's previous April 28, 2020, letter for details on this best available science and the needs of other special-status species that require attention beyond salmonids.	See MCR "GDE" and "ISW"
California Department of Fish and Wildlife	CDFW-021	B	WB	Water Budget-Estimating Extraction	23 CCR § 354.18 (e)					The Draft GSP indicates no extraction information was available for wells within the Basin at the time of preparing the model. The Draft GSP does not discuss the utilization of evapotranspiration (ET) estimates to determine rates of aquifer pumping specific to crop type to quantify groundwater extraction values for development of the water budget. The Department understands that this method may be the best available science at present but suggests that the GSA consider remedying the issues regarding lack of accurate well information and groundwater usage data sets needed to adequately characterize groundwater levels and groundwater in storage within the Basin.	Thank you for this comment. As GSP implementation proceeds, the GSA intends to work to improve information about and understanding of the Basin, and plans to utilize the best available information and science to characterize groundwater conditions and usage. Over time, it is anticipated that this will include more detailed and accurate well information and groundwater usage data sets. Needs for collecting pumping data are identified in GSP Chapter 3 (Section 3.3, Lines 178-193; Appendix 3-A), and initial plans for collecting and reporting pumping data are included in GSP Chapter 4 (Section 4.2, Lines 671-687). Groundwater pumping data will be gathered and reported in GSP annual reports and periodic evaluations, as they are available. Appendix 2-I discusses the method of satellite imagery used with potential evapotranspiration to estimate Applied Water which is used to estimate the groundwater extracted on agricultural lands. Increased groundwater level and stream monitoring is planned for the next five years to improve model representation and would benefit from groundwater extraction monitoring as well but would require additional funding to fill this data gap as extraction metering comes at a higher cost.

California Department of Fish and Wildlife	CDFW-022	A	HM	Hydrogeologic Model and Water Budget- Specific Yield and Irrigation Efficiency		2				The Department recommends revisiting the sections regarding specific yield and irrigation efficiency improvement projects to clearly identity how the SVIHM and water budget demonstrate a sustainable use of groundwater for all beneficial users. The Draft GSP needs to include a clearer explanation of the connection between groundwater that goes to surface water runoff and groundwater infiltration, or evaporation. Based on the information provided in the Draft GSP, it is difficult to understand these components of the SVIHM and water budget, the potential relationship with the surface water in GDEs, and how groundwater will impact species throughout the year. Once the GSA clarifies its understanding of these issues, the water budget should be adjusted accordingly and the Draft GSP should identify sustainable management criteria that prevent adverse impacts to beneficial users, such as dewatering of GDEs, and strive for long term groundwater sustainability with PMAs.	This comment uses an incorrect name for the Basin numerical model. It is called the Shasta Watershed Groundwater Model (SWGM). See MCR "Sustainable Yield", "Water Budgets", "ISW", and "GDE".
California Department of Fish and Wildlife	CDFW-023	C	PM	PMAs- Water Conservation						The GSA should also consider developing PMAs that promote more efficient water use through water conservation where feasible.	More efficient water use through water conservation is an innate characteristic of many PMAs such as "Irrigation Efficiency Improvements". See MCR "PMA Selection Criteria"
California Department of Fish and Wildlife	CDFW-024	C	MN	Groundwater Monitoring Network- Well Identification	23 CCR § 354.34(c)(6)(D)	3			Table 2	Chapter 3, Table 2 identifies wells designated for potential inclusion in the groundwater level monitoring and storage monitoring network as Representative Monitoring Points (RMPs); however, the map provided for these wells does not provide any designation (well identification) for the points shown on the map. The Draft GSP should include the well ID and associated information needed to assist in the evaluation of the proposed observation point for its potential to accurately characterize groundwater occurrence at that location. As reference, the data set should include the ground surface elevations for each well, reference point elevations for water level measurements, and important well construction information (i.e., well screen perforation intervals).	Table 2 already included well identification that matched the mapped points, and characterization information including well screen intervals. The table has been updated with additional well ID numbers, which can all be referenced on CASGEM.
California Department of Fish and Wildlife	CDFW-025	A	MN	Data Gaps in Model, impacts to Environmental Beneficial Users	23 CCR § 355.4(b)(2)					The Draft GSP does not contain a basin-wide groundwater-surface water model, analysis of the surface water depletion rate, or basin-wide groundwater monitoring, all of which are necessary to assess potential surface water depletions and impacts to beneficial surface water users, including Chinook Salmon, Coho Salmon, and Pacific Lamprey.	See MCR ISW
California Department of Fish and Wildlife	CDFW-026	A	IS	Instream Flows- Data Gaps	23 CCR § 355.4(b)(2)					The GSP also lacks quantitative criteria for instream flows (discussed more fully below), which are needed to assess compliance with SGMA and avoid significant and unreasonable depletions of ISW.	See MCR "ISW"
California Department of Fish and Wildlife	CDFW-027	A	GE	Compliance with SGMA- Uncertainties in Data	23 CCR § 355.4(b)(2)					the Draft GSP must set forth a reasonable pathway and timeline for addressing these data gaps and developing sustainable management criteria as required under SGMA, supplementing with models and other data if needed to address uncertainties in basin-specific data.	See MCR General Data Gaps
California Department of Fish and Wildlife	CDFW-028	B	GD	Environmental Benefical Users- Setting SMCs	23 CCR §§ 354.24, 354.26, and 354.28					After conducting the necessary analysis and establishing appropriate criteria, the Draft GSP should be updated to consider and avoid any unreasonable adverse impacts to beneficial users anticipated to result from such depletions. GSP characterizes instream flows as “aspirational watershed goals” within sustainable management criteria. This characterization ignores the plain language of SGMA, which clearly indicates sustainable management criteria and objectives must be developed to avoid undesirable results within the planning and implementation horizon.	See MCR "ISW"
California Department of Fish and Wildlife	CDFW-029	B	HM	Omission of Data	23 CCR § 355.4(b)(1)					the GSP lacks consideration of current versus historic surface water extractions, agriculture ditch losses and gains, new or improved wells in the basin, and local springs that feed into Shasta River.	See MCR General Data Gaps and ISW
California Department of Fish and Wildlife	CDFW-030	B	HM	Omission of Data	23 CCR § 355.4(b)(1)					the GSP fails to analyze data from Little Shasta River, a tributary of Shasta River, and may exclude smaller tributaries that regularly disconnect, including Willow and Whitney Creeks. These deficiencies in the analysis suggests the model may not be considering all relevant groundwater pumping and related impacts in the basin.	See MCR ISW

California Department of Fish and Wildlife	CDFW-031	B	MN	Monitoring Network Data Gaps						Since SGMA requires sustainable management of the entire basin, the sustainable management criteria must take a basin-wide approach. The GSA should identify the data gaps, set basin-wide sustainable management criteria, and identify how the GSA will achieve a robust monitoring system to capture accurate information on these portions of the basin or use existing data to accurately model these portions and assess impacts.	See MCR General Data Gaps
California Department of Fish and Wildlife	CDFW-032	A	PM	PMAs- Implementation Schedule	23 CCR § 355.4(b)(5)					GSPs must include projects and management actions that are feasible and likely to prevent undesirable results and ensure that the basin is operated within its sustainable yield. The Department encourages and will make best efforts to support PMAs anticipated to address both immediate and long-term fish and wildlife resource needs. Not recognizing the role of the GSA to ensure sustainable management and deferring nearly all PMAs through an “integrative and collaborative approach” will make it difficult to achieve sustainability even by 2042 as contemplated under SGMA. The Department encourages the GSA to start working on PMAs like the reservoirs sooner than described.	Further discussion of PMA implementation has been added to Chapter 5.
California Department of Fish and Wildlife	CDFW-033	A	BR	Public Trust Doctrine, GDEs	National Audubon Society v. Alpine County Superior Court (1983) 33 Cal. 3d 419, 446					It is not clear that the GSA has undertaken the analysis and consideration required under the Public Trust Doctrine to support its proposed PMAs and management criteria. Under Audubon and Environmental Law Foundation, the GSA must conduct a robust analysis that considers the needs of public trust resources and impacts to those resources due to the proposed groundwater management practices, and that clearly explains why protection of public trust resources is infeasible due to inconsistency with the public interest. As explained above, the GSA has yet to resolve significant data gaps relevant to the surface water depletion rate, basin-wide groundwater levels, and the presence and needs of GDEs and beneficial users of interconnected surface waters. These issues must be addressed to ensure appropriate consideration of the needs of public trust resources as required under the Public Trust Doctrine.	See MCR "Public Trust", "ISW", "GDE", "General Data Gaps"
California Department of Fish and Wildlife	CDFW-034	B	PM	PMAs- Selecting PMAs in light of Public Trust						Based on an accurate understanding of public trust resource needs and impacts, the GSA will need to assess a range of potential protective measures to address impacts of groundwater extractions. These measures may need to go beyond the PMAs identified in the Draft GSP and may include pumping limits or alternative supply options to address existing, new, and expanded extractions. Given overallocation and ongoing drought, it is critical to plan for such eventualities in the Draft GSP. Before rejecting such measures, the GSA will need to engage in a balancing of competing interests that shows that protecting species and habitat though contingent pumping limits, use of supply alternatives, or equivalent protective measures would be infeasible.	See MCR "Public Trust"
California Department of Fish and Wildlife	CDFW-035	A	BR	PMAs- Impact on Endangered Species						the GSA should consider the implications of its GSP development and implementation on species listed under the California Endangered Species Act (CESA). As previously identified in our April 28, 2020 letter, the highest priority recovery actions for protection of CESA threatened Coho Salmon include increasing instream flows, increasing cold water input in the Upper Shasta basin, reducing overall water temperature, increasing dissolved oxygen, and reducing warm tailwater inputs to the stream. The current Draft GSP does not support all beneficial users including aquatic species like salmonids by not accounting for their needs in the sustainable management criteria and deferring the PMAs to a future date.	See MCR "Public Trust"

California Department of Fish and Wildlife	CDFW-036	B	GD	Environmental Beneficial Users- Modeling						the North Coast Regional Water Quality Control Board (Regional Water Board) provided a recommendation for an increase of 45 cubic feet per second (CFS) of cold water from the Big Springs Complex into the Shasta River. (Regional Water Board, 2006. Staff Report for the Action Plan for the Shasta River Watershed Temperature and Dissolved Oxygen Total Maximum Daily Loads. Chapter 6. Temperature TMDL.) According to their modeling analysis, this cold water is the most beneficial flow contribution in the Shasta River with respect to temperature and is critical for temperature TMDL compliance and support of the most sensitive beneficial uses the Regional Water Board identified in their analysis, which include cold freshwater habitat and spawning, reproduction, and/or early development of aquatic species. The Total Maximum Daily Load (TMDL) analysis provides clear evidence that these beneficial uses depend on supporting conditions provided by the recommended increase in cold groundwater, which in turn supports groundwater dependent ecosystems. These ecosystems may be currently threatened by unsustainable groundwater use.	See MCR "ISW"
California Department of Fish and Wildlife	CDFW-037	B	GD	Environmental Beneficial Users- Public Trust Doctrine						the Temperature TMDL assigns load allocations for riparian shade and riparian areas are inherently groundwater dependent ecosystems. Actions may need to go beyond SGMA minimum requirements to meet Public Trust Doctrine requirements.	See MCR "Public Trust Doctrine"
California Department of Fish and Wildlife	CDFW-038	A	BR	PMA Schedule in light of Public Trust and ESA						The GSA has also suggested that it will defer PMAs for protection of Public Trust resources and CESA-listed species. Delaying these actions is not likely to ensure protection of public trust resources, particularly since ongoing groundwater pumping is causing significant adverse impacts to those resources. The GSA's proposal to spend the next 5 years increasing monitoring and fleshing out the outstanding sections of the GSP unduly delays tangible actions needed in the immediate term for protection of public trust resources.	See MCR "Public Trust Doctrine"
California Department of Fish and Wildlife	CDFW-039	A	BR	State Water Board Emergency Regs	23 CCR § 354.28(b)(5), 8/17/2021 SWRCB Emergency Regs					Per SGMA regulations, GSP minimum thresholds must be consistent with existing regulatory standards absent clear justification for differences. Emergency regulations approved by SWRCB on August 17, 2021, and effective on August 30, 2021, set forth minimum instream flows needed to avoid extirpation of certain fish species in the Scott and Shasta rivers during the current drought emergency. Per the SWRCB's Informative Digest, these emergency regulations are intended to preserve minimum instream flows for migration, rearing, and spawning of fall-run Chinook and SONCC coho salmon in the Scott and Shasta rivers during the current drought emergency. (pp. 21-22.) These regulations must be accounted for in the draft GSPs for the Scott and Shasta basins.	See MCR "Emergency Regulations"
California Department of Fish and Wildlife	CDFW-040	A	BR	Public Trust Doctrine- Instream Flows	8/17/2021 SWRCB Emergency Regs					The Public Trust Doctrine requires the GSA to manage groundwater pumping in the basin to ensure instream flows in interconnected surface waters (e.g., the Scott and Shasta rivers) are maintained at levels that fully support all life stages of all fish species during all seasons and water year types when feasible. In certain seasons and water year types, this may require maintenance of additional flow beyond the minimum instream flows set forth in the SWRCB emergency regulations.	See MCR "Emergency Regulations"
Scott Valley and Shasta Valley Watermaster District	SSWD-001	C	WR	Specific Edit to Plan Requested: Water Resources		2	14	2.1.2.2	Line 233	Recommend: Amend to specify that "during dry seasons, groundwater springs in the Big Springs Complex provide an estimated 95 percent of baseflow to the lower Shasta River via the Big Springs Creek tributary" (Nichols et al, 2010).	Edit Complete.
Scott Valley and Shasta Valley Watermaster District	SSWD-002	C	SB	Specific Edit to Plan Requested		2	19-20	2.1.2.12	449	Recommend: list BSID and MWCD separately, to identify them as the only irrigation districts that divert groundwater. Comment: If the descriptions of SWRA and GID are to remain in the plan, need to make clear that these are adjudicated surface water users that are not subject to SGMA.	Edit Complete.

Scott Valley and Shasta Valley Watermaster District	SSWD-003	C	WR	Specific Edit to Plan Requested: Water Rights		2	20	2.1.2.12	450	Correction Needed: BSID abandoned 25 of 30 cfs priority 24 from Big Springs Lake in a letter dated 6/18/1987 to DWR. BSID then abandoned the remaining 5cfs in a letter dated 12/17/1996 to DWR. Therefore, BSID has no active water rights from Big Springs Lake.	Edit Complete.
Scott Valley and Shasta Valley Watermaster District	SSWD-004	C	WR	Specific Edit to Plan Requested		2	20	2.1.2.12	451	Question: what entity will manage BSID's groundwater diversion?	Groundwater diversions are under the GSA's jurisdiction.
Scott Valley and Shasta Valley Watermaster District	SSWD-005	C	WR	Specific Edit to Plan Requested		2	20	2.1.2.12	454	Correction needed: Please clarify that BSID does not divert surface water. Is the "surface water management" described here referring to their delivery system?	Edit Complete.
Scott Valley and Shasta Valley Watermaster District	SSWD-006	C	WR	Specific Edit to Plan Requested: Water Rights		2	20	2.1.2.12	456-462	Correction needed: Please clarify that GID has surface water rights via the Shasta River Decree that are not subject to SGMA. Question: how/why will GID surface water management be incorporated into the GSP?	Edit Complete.
Scott Valley and Shasta Valley Watermaster District	SSWD-007	C	WR	Specific Edit to Plan Requested: Water Rights		2	20	2.1.2.12	472-476	Correction needed: Please clarify that SWRA has surface water rights via the Shasta River Decree that are not subject to SGMA. Question: how/why will SWRA surface water management be incorporated into the GSP?	Edit Complete.
Scott Valley and Shasta Valley Watermaster District	SSWD-008	C	GE	Specific Edit to Plan Requested		2	23	2.1.2.16	519-530	Comment: Thank you for editing this section from the previous draft. Lines 519-530 are now largely duplicative to lines 531-566, and could be deleted.	Text was updated to reduce duplication.
Scott Valley and Shasta Valley Watermaster District	SSWD-009	C	WR	Specific Edit to Plan Requested		2	24	2.1.2.16	567-568	Comment: SSWD may be prohibited from providing this level of diversion detail due to privacy regulations. However, we can consult with legal counsel as to what type of aggregate data we could provide.	Noted.
Scott Valley and Shasta Valley Watermaster District	SSWD-010	C	WR	Specific Edit to Plan Requested		2	78	2.2.1.5	1466-1468	Comment: This statement is not accurate. Please provide supporting documentation for the Willis source.	Removed sentence and provided documentation of the Willis source in the reference section.
Scott Valley and Shasta Valley Watermaster District	SSWD-011	C	WR	Specific Edit to Plan Requested: Water Resources		2	107	2.2.2.6	2087	Recommend: Since Big Springs accounts for 95% of lower Shasta River baseflow during the irrigation season, please pursue research to address this data gap first, rather than the current research focus along the Little Shasta River.	The GSP has been updated to address this comment. See MCR "ISW".
Scott Valley and Shasta Valley Watermaster District	SSWD-012	C	IS	Specific Edit to Plan Requested: Water Resources		2	116	2.2.2.6	2209	Correction needed: No surface irrigation diversions were occurring at the time of this study. Please edit this sentence to reflect this fact.	Edit Complete.
Scott Valley and Shasta Valley Watermaster District	SSWD-013	C	MN	Monitoring Networks- ISW Data	Water Code § 10721(x)(1)- 93 (6)	3	6	3.3	All	Comment: SSWD can assist in collecting data that will inform the "Depletions of Interconnected Surface Water (ISW)" component of the GSP. SSWD has a particular interest in addressing the SGMA undesirable result of "depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water"	Noted.
Scott Valley and Shasta Valley Watermaster District	SSWD-014	B	MN	Monitoring Network- ISW Data		3	14-17	3.3	Table 1	Recommend: Highly recommend adding ISW monitoring sites near known groundwater pumping locations.	See MCR ISW
Scott Valley and Shasta Valley Watermaster District	SSWD-015	B	IS	ISW System Data		3	26	3.3.4.1	436	STRONGLY RECOMMEND: Need to evaluate groundwater contributions to the Shasta River year-round, or at least before, during, and after irrigation season.	See MCR ISW
Scott Valley and Shasta Valley Watermaster District	SSWD-016	C	IS	ISW Depletion		3	29	3.3.4.1	474	Recommend: SPU gage has value as indicator of surface water depletions, particularly immediately before and after the majority of groundwater pumps turn on in the spring.	SPU gage will be included in the planned expansion of the ISW monitoring network. See Section 3.3.4.2.

Scott Valley and Shasta Valley Watermaster District	SSWD-017	C	IS	ISW Depletion: Monitoring Network		3	30	3.3.4.2	504	Recommend: SPU is currently maintained by DWR and has been since 2013. Please include the data from this gage.	The SPU gage will be included in the future monitoring network, in the proposed expansion discussed in Section 3.3.4.2.
Scott Valley and Shasta Valley Watermaster District	SSWD-018	C	IS	ISW Depletion: Monitoring Network Schedule		3	31	3.3.4.3	513	Recommend: Monitoring needs to occur prior to groundwater pumps turning on in the spring, in order to capture data to help determine how much groundwater pumping is depleting surface flows in the lower Shasta River.	Edit complete. Monitoring will occur through the entire year.
Scott Valley and Shasta Valley Watermaster District	SSWD-019	C	IS	ISW Depletion: Monitoring Network Schedule		3	31	3.3.4.3	522	Recommend: If groundwater level sampling only occurs twice per year, it should be done pre and post irrigation season.	Edit complete.
Scott Valley and Shasta Valley Watermaster District	SSWD-020	C	IS	Request for Clarification: ISW Depletion		3	42	3.4.3.2	791	Question: What are the identified reaches for ISW? Again, any useful ISW measurements need to be taken prior to, during, and after irrigation season.	For the current iteration of the ISW SMCs, the only reach for which we can define baseflow is part of the main Shasta River. The goal for the 5-year GSP update is to fill data gaps and upgrade the Shasta Watershed Groundwater Model (SWGM) to examine the entire ISW network (see ISW map in Section 2.2.2.6) to define surface water depletion due to groundwater pumping.
Scott Valley and Shasta Valley Watermaster District	SSWD-021	B	IS	ISW Depletion: Minimum Threshold		3	42	3.4.3.2	807-812	Comment: Computing baseflows at SRM using this formula for gaging minimum thresholds during the irrigation season on a real-time basis can be very cumbersome and inaccurate due to all the variables involved including the large number of adjudicated and riparian surface water diversions between Dwinnell Reservoir and SRM, unknown surface and subsurface return flows from irrigation as well as the large flow travel time between these two sites which is estimated at about 18 hours at lower flows. For this method to be reliable, the flow at the upstream and downstream gages and the surface water and ground water diversions would have to be in a steady state at least 18 hours before the measurements as well as during the measurements. The watermaster would also need permission from the riparian diverters to measure their diversions along with the adjudicated diversions within a given day. Even so, this method does not account for the depletion of surface water due to ground water diversions. Given all the variables involved, SSWD recommends that minimum thresholds be determined for SPU and real-time baseflows be computed using the SPU gage instead of SRM. When baseflows are approaching minimum thresholds, only a few surface water diversions will be occurring between Dwinnell Reservoir and SPU, no riparian diversions exist, the flow travel time is only about 6 hours and as the available flow data for SPU indicates, the baseflow at this gage equals near 100% of the inflow to the Lower Shasta during low flow periods and the actual flow at this gage would be close to the baseflow.	See MCR ISW
Scott Valley and Shasta Valley Watermaster District	SSWD-022	C	IS	Specific Edit to Plan Requested: ISW Data		3	43	3.4.3.2	Table 7	Correction needed: The SRM mean daily flow values for 2016 and 2017 in Table 7 do not agree with the USGS final data. These values should be 40.6, 48.8, 65.6, 67.4, 71.4 and 75.0 cfs, respectively. The flow values for 2018 – 2020 agree with the final data. Also, it appears that the terms “Baseflow” and “Groundwater Contributions” as used in Table 7 and Figure 10 are the same values, but this is confusing.	The values given by the reviewer match the data found on the USGS website for mean daily flow for SRM, Table 7 and the associated calculations have been updated to reflect this. The GSP text was updated to only use the term Groundwater Contributions as it was more prevasive in the text.
Scott Valley and Shasta Valley Watermaster District	SSWD-023	A	IS	ISW Depletion: Minimum Threshold		3	45	3.4.3.4	Table 8	Recommend: SSWD recommends that the preliminary minimum threshold for baseflow be set at 115 cfs instead of 100 cfs and a trigger be set at 130 cfs instead of 115 cfs at SRM and that these values do not change depending on the year type.	See MCR ISW

Scott Valley and Shasta Valley Watermaster District	SSWD-024	A	IS	ISW Depletion: Minimum Threshold		3	45	3.4.3.3	849	Recommend: using 115 as the minimum threshold. This is consistent with the recent SWB Emergency Drought Regulation. If the SGMA process doesn't address drought conditions, the SWB likely will. Note: The recent SWB Emergency Drought Regulation included a schedule of water right priorities for both surface water and groundwater users. It would behoove the SGMA Team to include this in the GSP.	See MCR ISW
Scott Valley and Shasta Valley Watermaster District	SSWD-025	C	MN	Specific Edit to Plan Requested: Monitoring Network		3	47	3.4.3.6	932	Recommend: CDFW will be installing a stream gage in Big Springs Creek, which is a major ISW area. Recommend including this gage into the monitoring network to provide real-time continuous flow data.	The stream gage in Big Springs Creek will be included in the future monitoring network, in the proposed expansion discussed in Section 3.3.4.2.
Scott Valley and Shasta Valley Watermaster District	SSWD-026	C	PM	Specific Edit to Plan Requested: PMAs		4	6	4.1	Table 4.1	Correction needed: on Watermaster Tier 1: Please add first sentence: "Implements Shasta River Decree." Then, please replace "enforce" with "assists in managing."	Edit Complete
Scott Valley and Shasta Valley Watermaster District	SSWD-027	B	PM	PMAs		4	10	4.1	Table 4.1	Recommend: adding Tier 3 project titled "Coordinated Shasta Valley Irrigation Management," as a voluntary locally-led initiative amongst all water users to rotate diversions and employ other tools to keep more water instream and avoid additional regulations. Potentially led by SSWD or RCD.	PMA added to Chapter 4.
Scott Valley and Shasta Valley Watermaster District	SSWD-028	A	PM	PMAs: Permitting		4	11	4.2	304	Recommend: For new well permits, add a restriction of how close to surface water the well can be placed, based on modeling of if surface water will be depleted by well pumping.	See MCR "5-year Update"
Scott Valley and Shasta Valley Watermaster District	SSWD-029	A	PM	PMAs: Permitting		4	19	4.2	501	Same recommendation as above.	See MCR "5-year Update"
David Webb for Friends of the Shasta River	FOSR-001	C	OR	Draft GSP Public Comment Period						We would like to have it noted that we are filing under protest, in that the entire document has not been available for the entire 45 days, and that some of it is still not available, hence we were not able to review either all that has been posted, nor the entire document since some is not posted at all. At eh same time, we do recognize that DWR seems to not be willing to allow additional time for completion and proper review.	Noted
David Webb for Friends of the Shasta River	FOSR-002	C	SB	Specific Edit to Plan Reqeusted: Land Use		2	8		1	The numbers appear to be for the entire watershed. They should be subsetted out for the management area only.	Comment noted and numbers are being reviewed.
David Webb for Friends of the Shasta River	FOSR-003	C	SB	Specific Edit to Plan Reqeusted: Land Use		2	9		3	Unclear what the X and Y axes are. There should be a link to an electronic version that can be downloaded and viewed at such a scale as to be meaningful	See MCR "Data System". The axis are latitude and longitude in the projection NAD 83 / California Albers (EPSG:3310).
David Webb for Friends of the Shasta River	FOSR-004	C	WR	Specific Edit to Plan Reqeusted: Water Rights		2	20		450-4	Check with Lisa Faris, but I think BSID has formally abandoned its right to Big Springs as a water source	Edit Complete.
David Webb for Friends of the Shasta River	FOSR-005	C	WR	Specific Edit to Plan Reqeusted: Water Rights		2	20		466	MWCD has a storage right to 35,000 af from the Shasta and ~14,000 af from Parks Creek, with no restriction on flow from the Shasta, and 150 cfs max from Parks Creek. And you should be more explicit about their gw usage since it has already been the target of an interference lawsuit. They pump gw from both the Pacy Wells and the Flying L pumps, and until the last few years their canal leaked to groundwater 20-30 cfs constantly when running full, which is now gone as a result of public funding for canal lining. Also MWCD has blocked public access to any of the data from the gauges below the dam, so they may not be worth mentioning.	Comment noted and numbers are being reviewed.
David Webb for Friends of the Shasta River	FOSR-006	C	WR	Specific Edit to Plan Reqeusted: Water Resources		2	22		494	I don't think the SVRCD has had funding for operation of the Yreka Creek gauge for some years. Better check.	Maintenance of stream gages will be included in implementation projects.
David Webb for Friends of the Shasta River	FOSR-007	C	WR	Specific Edit to Plan Reqeusted: Water Resources		2	23-4		519-68	This contains internal inconsistencies and errors, is overly long. Needs to be completely rewritten	This section was rewritten to correct restatements, it was originally edited with suggestions form the Shasta Valley Watermaster.

David Webb for Friends of the Shasta River	FOSR-008	C	SB	Specific Edit to Plan Reqeusted: Basin Setting		2	26		637-45	2014 data should be updated from current county records. Additionally, note should be made that the reduced property tax income to the county has not been offset by state subvention funds since 2009.	Noted.
David Webb for Friends of the Shasta River	FOSR-009	C	WI	Specific Edit to Plan Reqeusted: Permitting		2			650-658	This sections should include information on the impacts of the recently lost lawsuit where the county is now required to do CEQA analysis on new well permits, providing a basis for future gw demand management.	Noted.
David Webb for Friends of the Shasta River	FOSR-010	B	WR	Specific Edit to Plan Reqeusted: Water Resources		2	27-28		660-701	This illegal use needs to be put into perspective, with the range of water usage estimates converted to estimated acre feet, with comparison to other agricultural uses of groundwater in the Shasta Valley. The county is already under fire for claimed racist treatment of illegal growers. Not adding this perspective adds to that issue.	Water usage by the illegal cannabis community within Shasta Valley unknown. Agricultural usage of groundwater is also uncertain due to the lack of well metering. Voluntary reporting of groundwater extraction to the GSA (see PMA in Chapter 4) is the best path towards comparing groundwater usage by legal and illegal growers.
David Webb for Friends of the Shasta River	FOSR-011	C	SB	Specific Edit to Plan Reqeusted: Basin Setting		2	28		712-19	This could be a whole lot clearer. Rewrite please	Legal language must remain unchanged. No edit completed.
David Webb for Friends of the Shasta River	FOSR-012	C	WR	Specific Edit to Plan Reqeusted: Water Resources		2	29		726-7	This ignores the de facto replenishment from the extensive network of irrigation ditches. And it should be noted that public funding is steadily reducing that recharge through payments for pipelines and canal lining, both of which need to be factored into availability calculations going forwards from baseline years.	Recharge from irrigation ditches are discussed elsewhere in the GSP. See MCR "ISW".
David Webb for Friends of the Shasta River	FOSR-013	C	WR	Specific Edit to Plan Reqeusted: Water Resources		2	30		738-69	You really should mention the lahar forming the bulk of the flat portion of the Shasta Valley, and much of the gw basin, and which is responsible for forcing water in Pluto's cave basalt to surface as springs.	The existing chapter presents the known geology of Shasta Valley and the basis of the Shasta Watershed Groundwater Model (SWGM). See MCR "HCM".
David Webb for Friends of the Shasta River	FOSR-014	C	WR	Specific Edit to Plan Reqeusted: Water Resources		2	35		Fig 8	Text of caption does not quite match illustration	The figure will be updated in the GSP to reflect the text as the period of historical interest is 1983-2020 as it relates to the model.
David Webb for Friends of the Shasta River	FOSR-015	C	WR	Specific Edit to Plan Reqeusted: Water Resources		2	43-4		814-	Completely ignoring the lahar filling the Shasta Valley presents a very outmoded interpretation of surficial geology. See USGS Bulletin 1861	The existing chapter presents the known geology of Shasta Valley and the basis of the Shasta Watershed Groundwater Model (SWGM). See MCR "HCM".
David Webb for Friends of the Shasta River	FOSR-016	C	WR	Specific Edit to Plan Reqeusted: Water Resources		2	44		819-21	It should be clearly noted that the Hornbrook formation does not yield potable or agriculturally useful water and serves as the lower extent of usable aquifer space	This is addressed elsewhere in the GSP.
David Webb for Friends of the Shasta River	FOSR-017	C	WR	Specific Edit to Plan Reqeusted: Water Resources		2	48-9		975-980	This needs to be re-written so as to be meaningful to the ordinary reader	The text was updated to use more common language and include examples of the geologic description.
David Webb for Friends of the Shasta River	FOSR-018	C	GE	Specific Edit to Plan Reqeusted: Basin Setting		2	78		1480	Range of data years not correct.	The data availability periods were updated according to the USGS website of 1911-2021 and 1933-2021 for SRM and SRY respectively.
David Webb for Friends of the Shasta River	FOSR-019	C	GL	Groundwater Levels		2	85		1586-94	For proper understanding, merely saying gw levels are stable doesn't impart the most important pieces of the picture. More accurate would be to say something along the lines that overall, full recharge occurs by the spring of each year, but because measurement are taken only spring and fall nothing is known about the timing or maximum depth of summer drawdown as it may be changing over time.	Edit complete.
David Webb for Friends of the Shasta River	FOSR-020	C	GD	Groundwater Level Impact to GDEs		2	86		1615-6	It is also important for domestic uses which must be noted here. Additionally, the importance for fish should be further highlighted with the need for gw levels to be sufficiently high to sustain cold gw discharges in the stream bed and from springs feeding the river. Without that discharge no cold water fish habitat will survive, and its maintenance will necessarily serve to guide future gw management	Edit complete.
David Webb for Friends of the Shasta River	FOSR-021	C	GS	Specific Edit to Plan Requested: Groundwater Storage		2	86		1621-2	Reference is made to section 2.3, which doesn't seem to exist. Why not go into gw storage here along with the following maps, rather than making a reader jump around?	Section 2.2.1 is presenting the scientific basis of the hydrogeologic model and an overall storage estimate has not been done for the Shasta Valley groundwater basin. Section 2.2.3 presents the results of the Shasta Watershed Groundwater Model (SWGM), which estimates the storage.

David Webb for Friends of the Shasta River	FOSR-022	C	GL	Specific Edit to Plan Requested: Mapping		2	87-91		figs	These figs would be improved if you added the east-west roads--HY 3, A-12, Louie Rd and Jackson Ranch Road.	No action as adding roads would make reading the contour lines more difficult.
David Webb for Friends of the Shasta River	FOSR-023	C	GL	Specific Edit to Plan Requested: Mapping		2	87		Fig 35	Elevations throughout should be converted to MSL also with a 2nd map set to show that, since surface elevation is highly variable, hence depth to water is largely meaningless, especially without surface elevation..	Depth to water is meaningful for discussions of GDEs and ISWs. A map with MSL has been added.
David Webb for Friends of the Shasta River	FOSR-024	B	WQ	Groundwater Quality		2	93		1627 ff	Mention in this background section needs to be made of the absolutely crucial role gw discharge to surface water plays on surface water quality in terms of temperature, and while gw temperature isn't going to change, reduction in gw discharge will/has negatively impacted surface water quality and placed an possibly insurmountable burden on surface water users in terms of meeting TMDL goals without integrating gw depletion into TMDL targeted efforts.	See MCR "Surface Water Temperature"
David Webb for Friends of the Shasta River	FOSR-025	B	WQ	Groundwater Quality		2	94 ff		1668 ff	You fail to provide any insight into the marked degradation in water quality resulting from extraction from the Hornbrook formation vs. overlying sediments. That degradation effectively makes the Hornbrook unsuitable for any current uses and limits water availability in the basin to those sediments overlying it only.	See MCR "References"
David Webb for Friends of the Shasta River	FOSR-026	A	WQ	Groundwater Quality Monitoring Networks		2	94		1675-77	In this section it is not clear, but it appears that what may have been done is approach the contamination question backwards--taking existing wells and using them as the basis for a monitoring plan. A proper approach would be to first determine what areas and constituents needed to be monitored, then looking to see if any existing wells were located where needed. If so, their usage would be appropriate Limiting investigations to only existing wells is completely faulty and needs to be done properly.	Development of the monitoring network was based on: - the list of consitutents of concern developed in Chapter 2.2.2.3 and Appendix 2-B - wells within the Basin with historical data and reliable monitoring programs.
David Webb for Friends of the Shasta River	FOSR-027	C	GE	Specific Edit to Plan Requested		2	95		1718	Refers to Appendix 2-b, which is the correct title as posted, but the document itself is called Appendix C in the headers and title sheet.	The title and headers in Appendix 2-B will be updated to reflect that it is in Appendix 2-B
David Webb for Friends of the Shasta River	FOSR-028	B	IS	Identification of ISW Systems		2	105		2055-59	Surface diversion has an arguably greater impact on flow most of the year than any of the natural factors except winter floods. As such, to keep flow variation in perspective, irrigation diversion absolutely must be pointed out here as taking 90% or more of the total natural flow at times in nearly all summers, overwhelming other factors.	The GSP states that the Shasta River system has the five functional flow elements and not that they control the flow, precipitation and runoff significantly control streamflow but they are not explicitly stated here rather they are discussed in Section 2.2.1.5 Hydrology along with surface diversions. This section is on Interconnected Surface Water looks at the influence of groundwater conditions on streamflow thus it mentions Big Springs as a groundwater influence.
David Webb for Friends of the Shasta River	FOSR-029	B	IS	Identification of ISW Systems: Transects		2	108		2095-8	Data was presented to the consultants by representatives of the water master district strongly indicating that in 2020 considerable losses of surface water to groundwater was occurring between the CDEC gauges SPU and SRM. While not part of any planned study, the implications and magnitude are too great not to be mentioned here. Also important is that the apparent placement of the SRU transect near the apparent confluence of Julien Creek may have inadvertently left it influenced by stream underflow from Julien creek and its near-stream associated springs to the west of the Montague Grenada Road. As such, its findings should be clearly explained as not necessarily representative of any other portion of the river, and the data from between SPU and SRM should be included here to offset any misperceptions.	See MCR "ISW"
David Webb for Friends of the Shasta River	FOSR-030	C	IS	Identification of ISW Systems: Transects		2	110		Fig 46	Need a more detailed location of transects please.	See updated map in Chapter 3. Exact locations are kept private within the GSA due to agreements with participating landowners.

David Webb for Friends of the Shasta River	FOSR-031	B	GD	Identification of GDEs		2	120 ff, 126,	2.2.2.7	2230, 2331-3	The GDE screening use of DWR's identified irrigated areas in an effort to exclude man-made wet areas yields faulty results in that (in the words of UC Extension agent Dan Drake describing one such area in particular) there are irrigated areas of natural wetland which he described as " an irrigated swamp". That situation of rising groundwater creating small to large wetlands is relatively common in the Shasta Valley with its confused surface and subsurface geology, and the impossibility of fine-tuning flood irrigation to not irrigate such wet areas if the surrounding areas below the ditches need irrigation. Failing to identify and capture the seeps, springs, and wetlands effectively eliminates many early-warnings of declining groundwater, and will ultimately result in decreased surface flows. Many such areas are also irrigated, or surrounded by irrigated lands, making them impossible to identify by DWR. There needs to be further study, perhaps along the lines of performing remote sensing of leaf moisture content in the Fall of the year well after irrigation has ceased to identify areas with leaf moisture levels higher than surrounding areas, regardless of whether irrigation ditches are present near-by or not. Large areas meeting this description can be found south of the Parks Creek crossing of HY 99 and north of the Edgewood Exit , north of the Hy 3 crossing of the Shasta River, South of the Montague-Grenada Road Crossing, and along a broad swath of the little Shasta west of Harry Cash Road and East of Montague, and elsewhere. In addition, the tiny maps in the document do not allow review of any specific areas for inclusion or exclusion and are useless eye candy. GIS data needs to be posted and accessible and also detailed PDF maps so the general public can draw proper conclusions.	See MCR GDE
David Webb for Friends of the Shasta River	FOSR-032	B	GD	Identification of GDEs: Depth to Groundwater		2	130 ff		2394-2400	This appears to be saying that an acceptable depth to gw will be at the extreme end of the maximum depth of willow rooting, or even beyond. That provides no margin of error for climatic fluctuations, and ignores the necessity of water reaching the surface in order to allow seedling propagation. If this is correct, it is not at all conservative and needs to be reduced to some mid depth value for dry years, and near surface for wet years. The same applies further on for other gw dependent species also. If this is incorrect, the topic needs additional clarification please.	See MCR GDE
David Webb for Friends of the Shasta River	FOSR-033	B	GD	Identification of GDEs: Depth to Groundwater		2	133-3		2412-2433, fig 58	Given the unique geology of much of the Shasta Valley, there needs to be some sort of validation that "*These grid or raster geospatial datasets were developed 2428 by interpolating between statistical representations of observed groundwater elevations for each three-year rolling period using data obtained from the California Statewide Groundwater Elevation Monitoring (CASGEM) Program using the well-establish kriging method*" can in fact be accurately used to interpolate between known points. Common methods won't always work in uncommon situations, and there is no discussion/documentation of their applicability in an area dominated by the largest volcanic lahar on the planet and with large areas of volcanic deposits which collectively funnel groundwater to the surface or restrict it below the surface in ways not consistent with conditions found in purely alluvial areas. See also lines 2679-82 in Chapter 2 confirming this complexity. Finally, depth to gw seems to be a relatively useless metric in an area of highly varying surface elevation, again as different from typically fully alluvial areas. All gw data should be also presented in height relative to mean sea level.	Noted.

David Webb for Friends of the Shasta River	FOSR-034	B	GD	Identification of GDEs: Depth to Groundwater		2	135		2434-2437	The processes described seem reasonable, assuming the data is accurate, but in fact it necessarily relies on multiple layers of approximations. As far as I know, elevation for most of the Shasta Valley is only available as 30 m digital elevation models (DEMs), making comparisons of measured depth to gw at one well location impossible to compare to depth to water at another potential GDE location, since the electronic surface elevations are not nearly sufficiently accurate at the elevations involved. As with the rest of the document, there isn't sufficient time to adequately research this other than to bring it up as an apparent problem. While the normal accuracy of 30 M DEM's is stated as "3.04 meters." It is followed by the following caveat "It is important to note that the vertical accuracy actually varies significantly across the U.S". Given the target depth for willow roots of 13', or 4 meters, there is ample room for mis-classification of all species.	Noted.
David Webb for Friends of the Shasta River	FOSR-035	C	GD	Identification of GDEs		2	136		2504-09	This paragraph claims the analysis (described in our prior comment above) describes "the maximum possible extent" of vegetated GDEs. As stated above, surface elevation data appears to be inadequate to support the analysis used, and hence the conclusion stated. It goes on to note that it is not a definitive determination, but the plan includes no sub sample analysis type project proposal to validate its accuracy, and instead will leave unknown acres unprotected.	The GSA acknowledges the data gaps in the GDE analysis in Section 2.2.2.7 and outlines how to address them in Appendix 3-A and Chapter 5. Additional text has been added to Section 2.2.2.7 and Appendix 3-A for clarity and an additional management action "Groundwater Dependent Ecosystem Data Gaps" has been added to Chapter 4. The GSA looks forward to working with CDFW and other agencies to fill these data gaps of local habitat in Shasta Valley in the next 5 years for the next GSP update.
David Webb for Friends of the Shasta River	FOSR-036	A	WB	Accuracy of Water Budget		2	138-9		2513-4, fig 60 and 61	Sufficient data is not provided in appendix 2E as here stated. We have asked for numeric data used to produce the two figures, and the sources of that data and have received no response as of 9/26. This appears to be the validation period for the model, and a cursory look suggests multiple problems with the data assumptions built into the figures. Those problems cannot be evaluated without the above information. Included are: A static leakage value from canals despite ongoing canal lining, seemingly static lake leakage into gw, despite variable lake elevations and consequent leakage, increasing gw leakage into streams over time, despite expanding gw usage, and apparently unrelated to water year type, and no change in streams leaking into gw, despite presentation of data suggesting just that in the course of plan development..	See MCR Water Budgets

David Webb for Friends of the Shasta River	FOSR-037	A	WB	Accuracy of Water Budget		2	143-5	2.2.3.2, 2.2.3.3	Tables 13-18, 2637-2656	Collectively these pages and lines describe values used in depicting annual water budgets for a ~20 year period from 1991-2018. No source of the data values sued is provided. No explanation is given for how the values are prorated for the various water years, The absence of this sources and methods information makes proper review and commenting on all terms impossible. Other published data strongly suggests significant inaccuracies exist in the numbers used. This information was presumably used to calibrate and validate the model outputs. If so, the model itself needs to be re-configured: As an example, Appendix 2-B page 23 includes a map of the longer leaky ditches within the watershed. Looking at just one of those explicitly identified ditches--the Montague Water Conservation District Main Canal--A study by Willis and Deas in 2010 for the Montague Water Conservation District (District) determined that the canal lost 28 cfs on a continuous basis when running at capacity. That quantity over a 180 day irrigation season equates to 10.1 TAF. In table 13 and 14, the maximum value for canal leakage to gw for the entire GW basin and watershed both is listed as 10 TAF, less than the measured leakage from this one ditch alone, let along all the other major and minor ditches throughout the watershed. To offset this error, some other factor(s) must be proportionally smaller than what is real, and a model built to target those inaccurate numbers will necessarily predict poorly. The other values shown are not so easily disputed in the absence of more source information, but would seem to be equally suspect. This error is compounded by the District's ongoing efforts to eliminate that leakage, and they currently have ~ $4 million in public grant funds to complete the lining of the canal, with an obvious impact on gw supply. Nowhere does the model make mention of subtracting an appropriate amount of recharge to compensate for this loss. Instead it calls for spending more public money to duplicate the effect of leaky ditches with MAR type projects. A proper plan should address this. It is also worth noting that the District doesn't necessarily operate for a full irrigation season in a dry year, nor does the Grenada Irrigation District, which also utilizes an unlined canal reported in their own documents as losing as much as 12 cfs when full, making for what should be a dynamic amount of canal leakage to gw value in the water budget, while the chart shows it as essentially straight line amount through all water year types. It appears that numbers have been over simplified with unknown consequences.	Thank you for this comment. It will be taken into consideration for revisions in the final GSP and for improvements to the model during GSP implementation. As referenced in the draft GSP (Chapter 2), comprehensive documentation of the water budget development process and the model is included in Appendix 2-E and is not included in this section of GSP.
David Webb for Friends of the Shasta River	FOSR-038	C	WB	Specific Edit to Plan Requested		2	145		2605-7	The word "enhanced" while technically correct, presents the opposite feeling than what is needed to characterize conditions. Exacerbated would be a better word.	Text updated.
David Webb for Friends of the Shasta River	FOSR-039	C	WB	Water Budget-Estimating Extraction		2	146		2708-10	The reduction in discharge isn't caused solely by the absence of natural recharge, but is also reduced by GW pumping. Since this is a plan leading to management of gw usage, its impacts should never be ignored.	A PMA has been added to address data gaps in the interconnected surface water, which includes collecting data on canal diversions and leekage.
David Webb for Friends of the Shasta River	FOSR-040	C	WB	Water Budget		2	146		2717-8	This sentence should include not just reduction in precipitation , but also reduction in anthropogenic recharged, as from ditch and canal lining, projects which should include offsetting measures if publicly funded.	GSP text revised to include anthropogenic recharge changes impacting water table slope.
David Webb for Friends of the Shasta River	FOSR-041	B	WB	Water Budget		2	146		2722-4	The claim that climatic reductions in recharge will not cause overdraft is not supported by the identified consequences in these sentences--all of these are undesirable effects. GW usage and hence what constitutes overdraft is going to shift in harmony with gw supply in order not to cause a diminishment of surface flows.	See MCR Overdraft
David Webb for Friends of the Shasta River	FOSR-042	B	WB	Water Budget		2	146		2724-2726	This concept is not given proper adherence elsewhere in the document when talking about monitoring--The amount of decline in gw levels is going to be apparently related to a great degree to the underground flow rate/underground porosity. Nowhere is that factor captured in changes in gw elevation standards proposed. I.e. all wells are treated as equal in terms of % decline before requiring management action..	See Section 2.2 and Appendix 2-A and 2-E.
David Webb for Friends of the Shasta River	FOSR-043	B	WB	Specific Edit Requested		2	148		2797-8	No factual basis is provided for this assertion. It should be removed here and elsewhere.	See MCR "Overdraft"
David Webb for Friends of the Shasta River	FOSR-044	C	GE	Specific Edit Requested		2	150		Fig 66	This is too small to be useful. It needs to be available full sized electronically. The apparent if slight increase in discharge of gw into streams needs to be explained. Nowhere has that been done.	The water budgets will be individually plotted in the GSP rather than in a plot grid.

David Webb for Friends of the Shasta River	FOSR-045	B	GD	Ecological Beneficial Users		2	151		2826-8	Her and elsewhere this plan fails to recognize the critical role of gw in supplying cold water to the system, and the fact that existing usage levels are already significantly diminishing that cold inflow, jeopardizing attainment of the TMDL, further endangering coho salmon, and putting Fall Chinook salmon more at risk.	See MCR "Surface Water Temperature"
David Webb for Friends of the Shasta River	FOSR-046	B	WB	Sustainable Yield		2			2826-8	The claim that the sustained yield for the Shasta Valley is 42-45 TAF/year hasn't been substantiated anywhere. AS such it is an unsubstantiated assertion here and absolutely needs to have its basis fully documented. That volume translates to 115-125 net CFS on a continuous basis for a 6 month growing season. That translates to 10,500-11,250 acres cropped with 4' of water per acre. In 2010 DWR estimated that approximately 10,200 acres were irrigated with just GW, an additional 1,230 acres were irrigated with a combination of surface and ground water, and no accounting was made of domestic use. At best there is no room for further expansion and that should be clearly noted. Also domestic use and illegal use needs to be factored in, along with planned reductions in gw irrigated acreages as recharge from canals is eliminated over time. We appear to have actually to have exceeded supply already, assuming that 115-125 cfs is even sustainable, which remaining instream flows say absolutely is not..	See MCR Sustainable Yield
David Webb for Friends of the Shasta River	FOSR-047	A	BR	Human Right to Water		2	151		2816-2822	While the assertion that the basin is not in overdraft, the previous comments suggests we are right on the edge. Beyond that, the experience of people whose wells have gone dry suggests that the out dated definition that looks only at long term ability to regain a spring-time gw level completely fails to protect gw users in mid summer if heavy irrigation use draws down summer levels below well depths, yet winter precipitation and soil porosity is still sufficient to allow full recharge. Hiding behind this interpretation does the citizens of the county no good, and only highlights the failure of the count to allow designating special management areas to address those areas experiencing summer water shortages. Reliance on this definition is a violation of state policy " *It is the policy of the State of California that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes"*	See MCR Overdraft
David Webb for Friends of the Shasta River	FOSR-048	C	MN	Specific Edit to Plan Requested		3	6		155	Appendix Z should read Appendix 3-A	Edit Complete
David Webb for Friends of the Shasta River	FOSR-049	C	MN	Monitoring Network PMAs		3	7		167-74	It would seem prudent to have these needed study items consolidated into a master PMA list to facilitate future funding.	See Chapter 4 for new PMAs that address these data gaps.
David Webb for Friends of the Shasta River	FOSR-050	B	MN	Monitoring Network- Data Gaps		3	7		178-93	If the collection of the indicated data is needed, then there needs to be a fall-back approach identified to be utilized when/if voluntary measures fail to yield needed results. More detail is needed in terms of where the identified data is needed, at what well density, etc.	See MCR General Data Gaps
David Webb for Friends of the Shasta River	FOSR-051	C	MN	Specific Edit to Plan Requested- Mapping		3	8-11		maps	These maps are somewhat redundant, are too small to convey much useful information, and there is an excess of white space. The maps could be larger, and have key roads on them for helping know what is where.	Edit Complete
David Webb for Friends of the Shasta River	FOSR-052	B	PM	Monitoring Network PMAs		3	12		221-5	PMAs should be recognized as being made up of both actions taken, and actions avoided/not taken. The county has made it clear that any actions that will reduce existing gw usage are going to be stringently avoided--an example of actions deliberately not taken. Monitoring wells should be adequately distributed in areas where those actions avoided are likely to have undesirable impacts to adjoining gw users and or ISW.	See MCR General Data Gaps
David Webb for Friends of the Shasta River	FOSR-053	C	MN	Monitoring Network PMAs		3	12		236-7	This sentence imparts no useful information. If it is supposed to be saying something it needs to be written.	Edit Complete

David Webb for Friends of the Shasta River	FOSR-054	B	MN	Monitoring Network PMAs		3			246-50	Activities on the West side of the River need to be tracked and monitored separately from those on the East side. Likewise Pluto's Cave Basalt really needs its own monitoring plan with triggers and actions.	The GSA has elected to not use management areas at this time.
David Webb for Friends of the Shasta River	FOSR-055	B	DW	Domestic Well Failure		3	12		256-8	While they may lack numeric data for depth to water over multi-years, the fact that domestic wells near A-12 are going dry should be treated as a long term trend if the owners can indicate that in past years no such problems existed and as a result of declining water levels, now they do. With luck some or all of them will have a reliable depth to water at the time of drilling, to be compared to current problematic depths, providing an indication of long term trends.	The GSA needs qualitative data and documentation of dry domestic wells. Affected well users should report their dry well to the state or GSA and/or provide water level data to the GSA.
David Webb for Friends of the Shasta River	FOSR-056	B	MN	Monitoring Network PMAs		3	18		281-4	It would seem prudent to add to the list of projects the securing of extra well loggers to be standing by so that wells deemed potentially needed can be monitored on a preliminary basis and/or added immediately should they prove to be essential to proper management. they would also be good to have in the event of logger failure.	See Chapter 4 and 5.
David Webb for Friends of the Shasta River	FOSR-057	C	MN	Monitoring Network PMAs		3	18		286-7	Given the importance of the wells supplying Lake Shastina, it seems like they should be immediately added to the monitoring network if the CSD is willing. Specific outreach to them is in order.	The initial groundwater level monitoring network is based on the DWR-funded CASGEM well network, which does not include any wells near Lake Shastina. Additional wells may be added to the monitoring network for the 5-year GSP update, such as near Lake Shastina.
David Webb for Friends of the Shasta River	FOSR-058	C	MN	Monitoring Network-Groundwater Levels		3	18		288-90	It seems likely that DWR guidance for well density is poorly suited to a volcanic area such as the Shasta Valley, with its convoluted and confused geology and hence hydrology. that should be clearly noted so as to allow finding funding for a greatly expanded monitoring network.	PMAs have been added to Chapter 4 to expand the current monitoring works. Monitoring networks will be expanded based on the data gap appendix (Appendix 3-A) and modeling needs.
David Webb for Friends of the Shasta River	FOSR-059	B	MN	Monitoring Network Schedule, Domestic Wells		3	22		305-8	2x annual monitoring may be good enough for some purposes, but protection of domestic wells in a meaningful fashion requires near-real time monitoring during critical periods. There should be a separate focus on meeting domestic needs in near real time, with monitoring, triggers and actions defined.	See MCR General Data Gaps
David Webb for Friends of the Shasta River	FOSR-060	B	MN	Monitoring Network Groundwater Storage		3	22		318-21	It appears that the SWGM cannot provide a numeric value for Storage as the text here states, but only an indication of whether it is increasing or decreasing or staying the same based on gw elevation. Is this correct? If so the language needs to be corrected. If not, additional information needs to be included in Appendix 2-E to explain how a model utilizing cross section data with an unknown boundary between usable water bearing strata and the Hornbrook formation, with seemingly no data known for subsurface porosity, and gw levels at the edge of the river varying from above and below stream water level, is able to estimate volume of groundwater. Perhaps an illustration.	See MCR HCM
David Webb for Friends of the Shasta River	FOSR-061	B	WI	Well Inventory		3	23		363-6	Developing a plan based solely on what is available free or cheap seems arbitrary at best. It would be more appropriate to first develop an ideal plan, then see what if any existing wells approximate it. After that others need to be secured. Having such a plan should facilitate securing funding for additional wells.	See MCR General Data Gaps
David Webb for Friends of the Shasta River	FOSR-062	B	WI	Monitoring Network- Data Validation, Well Inventory		3	24		366-7	This speaks to the need for equipment, specifically a down-hole camera to be used to capture screening details. Use of it might also help to further validate well logs, and cause those not accurate to be discarded from use.	See Chapter 4
David Webb for Friends of the Shasta River	FOSR-063	B	WI	Monitoring Network- Data Validation		3	24		367-8	USGS examined 21,400 well logs (as reported in USGS Bulletin 1766) in eh Central Valley, and found that only 590 of them had sufficient information on screening and water depths to be usable in assessing gw availability in the Central Valley--2.8%. We should expect no better here. A program needs to be established and funded where-by a trained geologist accompanies drillers to perform well logging in key areas when wells are being drilled there, along with a down hole camera to capture and/or validate well log information or add to it.	See Chapter 4

David Webb for Friends of the Shasta River	FOSR-064	C	MN	Monitoring Network: Well Characteristics		3	24		381-2	Does it matter if a well to take a water sample from is domestic or Ag? Might other parameters matter more especially water source depth and proximity to known or suspected sources of Water Quality problems?	The monitoring network must be representative of all users (municipal, agricultural, domestic), land use, and water bearing formations. The lack of domestic wells and agricultural wells is a large data gap. Firstly, wells used for different uses generally tap into different water bearing formations (ie., domestic wells tap into shallow groundwater and agricultural tend to drill much deeper wells). Secondly, monitored domestic wells would assist in documentation and management if wells go dry.
David Webb for Friends of the Shasta River	FOSR-065	B	MN	Monitoring Network PMAs		3	27		397	It seems as if a plan should have sequential steps evaluated for relevance via the prioritization process, then organized into a table, making it clear that each is an essential step that is part of a well organized plan. This SGMA plan is long on explanation, which is good, but short on identified and organized action items. That really needs to be fixed. Here, there needs to be an action item explicitly committing to doing something specific with regards to adding more wells and/or drilling dedicated wells, or at least a process for deciding those details.	See MCR General Data Gaps
David Webb for Friends of the Shasta River	FOSR-066	C	WI	Monitoring Network: Well Characteristics		3	27		408-10	Section 3.3.4.1 really doesn't provide any enlightenment on where and how and how many additional wells will be selected.	Edit Complete
David Webb for Friends of the Shasta River	FOSR-067	C	GE	Specific Edit to Plan Requested		3	29		Fig 6	Description does not match illustration. Illustration needs to be made clear--is it hypothetical for the Shasta Valley, or data based? Does the table refer to the 70 cfs discharge or 35 cfs?	Edit Complete
David Webb for Friends of the Shasta River	FOSR-068	B	MN	Monitoring Network Impacts on GDEs, Environmental Beneficial Users		3	29-30		487-95	While this methodology could be able to work well given proper targets, there seem to be unrecognized issues that need to be resolved before it can hope to be reliable. First, aquatic organisms do not live on 2 year averages, or any other long term metrics. They live or die in the moment, depending on river flow, temperature, and dissolved oxygen levels. Properly protecting GDEs and ISW will require a real time monitoring and response process, not one apparently intending to look at 2 years of data prior to taking anything seriously, and even then perhaps not acting on those observations other than study them more. As a "Plan" this needs to recognize that reality and specify triggers and actions to be taken. Secondly, , many diverters, either by choice or at the direction of the water master do not divert their full water right continuously. Somehow that needs to be captured in a real time basis. At present that is not possible and needs to be created ASAP so as to utilize the full 5 year window. Third, from 20+ years of working with irrigators, developing irrigation efficiency studies, and educating myself on irrigation practices, it is painfully obvious that no one is 100% efficient. 50% is as good as is normally encountered. Persons with difficult to irrigate ground, or excessive water rights can do even worse. The excess water they apply is not consumed, and in instead generally finds its way back to the river, either very quickly as surface tailwater, or a little more slowly as subsurface return flow. The rapidity of those process can be visualized by the response of the river at the end of the irrigation season when the river rapidly rises to a static flow, but doesn't rise up then decline as diversion ceases and tailwater continues to supplement natural flow. Having the water master inform you of the gross diversion Q every 2 weeks is of little or no value in terms of determining surface depletion or meeting the minute by minute needs of aquatic systems. Somehow you will have to arrive at a real time value for ET in order to be able to know what the depletion is from surface diversion. Finally, as a general observation the SPU gauge seems far more useful as an index of GW discharge to the stream from nearly all sources than would a complicated process of trying to work out a water balance with multiple users doing unpredictable things as the whim strikes them.	See MCR ISW

David Webb for Friends of the Shasta River	FOSR-069	B	MN	Monitoring Network: Locations		3	30		Table 4	SV02 seems to be oddly placed to monitor GW levels for anywhere except very close to where it exactly is. I have seen no explanation as to why this location was chosen--it appears to have been arbitrarily selected on some other basis other than functionality. It is completely unclear how it can be expected to be representative of GW levels anywhere else, especially in areas where GW is discharging to the stream. Review of data from SRM and SRY suggest that about 5-10 cfs is added to stream flow between SRM and SRY in the absence of precip., suggesting that GW is of little significance between those two stations, especially when compared to the 70-150 cfs that discharges tot eh river upstream of SPU, where monitoring of gw levels would seemingly be far more useful. This site either needs to be fully justified vs. other potential sites, or some other site(s) than can be justified chosen. Given the acknowledges uncertainty of how best to properly manage gw in the absence of adequate information, it would seem far more sensible to monitor multiple sites in the expectation that one will be unpredictably better than he others, rather than arbitrarily settle on one location and hope for the best while waiting for 5 years to discover no useful information was gained. These observations are supported by lines 871-5 in this document, ch 3.	See MCR GDE
David Webb for Friends of the Shasta River	FOSR-070	B	MN	Monitoring Network Data Gaps		3	30		509-11	While a target of 2032 may or may not be reasonable, I have not seen any specific steps identified that will make addressing the details of the Little Shasta any easier or more doable in 2032 than it is now. Data gaps, along with proposed steps that need to be taken to fill them need to be identified, along with a timeline for accomplishing them.	See MCR ISW
David Webb for Friends of the Shasta River	FOSR-071	B	MN	Monitoring Network Data Validation		3	31		513-521	The validity of this approach isn't immediately apparent, and needs to be more fully developed and explained especially with regards tot eh rationales used. In >30 years of driving I-5 over Parks Creek, and always driving in the fast lane when going across the Parks creek bridge so as to be able to see the creek where it crossed the Mills ranch low water crossing under I-5. In all those years, I have never seen a no flow condition other than this summer. I question if it should be adopted at the expected target prior to initiation of monitoring. Both Parks Creek has spring flows both above and below the "dry reach", flow that is in large part diverted. Again, I am not sure exactly what is being tracked by this process. The Little Shasta has substantial flow upstream of the dry reach, again diverted, and possibly about to be supplemented by 1707 water from the Hart Ranch. Again, just how this process yields useful information isn't clear.	See MCR ISW
David Webb for Friends of the Shasta River	FOSR-072	C	MN	Monitoring Network Schedule		3	31		522-3	These two sentences seem contradictory--will the monitoring be continuous or 2x annually?	Edit Complete
David Webb for Friends of the Shasta River	FOSR-073	C	GL	Specific Edit to Plan Requested: Groundwater Level		3	35		599-605	"Excessive" needs to be defined or described, as does "adverse". Without definition this section is meaningless.	See MCR "SGMA"
David Webb for Friends of the Shasta River	FOSR-074	A	DW	Domestic Well Failure		3	36		614-5	Selecting as a target the drying up of domestic wells as an acceptable and anticipated outcome when it could be prevented by proper management and sharing of eh GW resource is not acceptable as a planned approach. I hope the people likely to be affected are outraged. Will your recommend red tagging homes with no water supply for that portion of the summer when there is none?	The minimum threshold for water level does not allow for water levels to decline below historic water levels except for a small margin to provide some operational flexibility. This will minimize the impact of well outages.

David Webb for Friends of the Shasta River	FOSR-075	A	GL	Groundwater Elevation Minimum Threshold		3	36		638-42	This 75th percentile and 10% buffer seems to be completely arbitrary, with no basis for determining if it is protective of all uses. Additionally, it appears that it would allow pockets of severe impacts to the functionality of most wells, as long as elsewhere in the watershed things were doing better enough to meet the 75th percentile overall. Given the complicated geologic conditions and substantial unknowns, this doesn't seem like an acceptable approach. Something more protective of domestic users along with GDEs and ISW needs to be selected, especially for the first 5 years. It needs to be recognized that all existing wells almost certainly have been adequate for meeting domestic needs for all years since they were drilled, until the last 2 years. That potentially decades long history shouldn't be ignored, just because a depth to water value is unknown. It is known that the depth to water was above the level of the pump until excessive extraction relative to supply occurred in 2020 and/or 2021.	See MCR "ISW" and "Well Outtage Appendix"
David Webb for Friends of the Shasta River	FOSR-076	C	IS	Specific Edit to Plan Requested		3	40		720-21	The Shasta River jumps up within 2-3 days of the cessation of most irrigation on or before October 1, regardless of any precip. That flow is a direct measure of the then-impaired gw discharge to the stream. This sentence appears to belong in the Scott watershed, not the Shasta	Edit complete
David Webb for Friends of the Shasta River	FOSR-077	C	IS	Specific Edit to Plan Requested		3	40		723	This sentence appears to refer to the Scott River also.	Edit complete
David Webb for Friends of the Shasta River	FOSR-078	C	IS	Specific Edit to Plan Requested		3	40		727-28	This sentence appears to refer to the Scott River also.	Edit complete
David Webb for Friends of the Shasta River	FOSR-079	A	IS	ISW Depletion-Impact to Environmental Beneficial Users		3	41		751-2	It needs to be noted that adverse impacts happen to junior water users in all or essentially all water year types (i.e. GID always gets curtailed sooner or later each summer). That is easy to document. Equally important, aquatic organisms are negatively impacted each year as a result of low flows, excessive temperatures, low levels of dissolved oxygen and passage barriers. The presence of those impairments should be sufficient to define a gw dependent ecosystem as in chronic overdraft during each summer and Fall. there is certainly no need to wait for 2 years in a row of some other impacts to make that determination. This has been the case since 1916.	See MCR ISW and GDE
David Webb for Friends of the Shasta River	FOSR-080	B	IS	ISW Depletion-Impact to Environmental Beneficial Users		3	42		796-801	The multiple deficiencies of this approach were described above.	See MCR ISW and GDE
David Webb for Friends of the Shasta River	FOSR-081	B	IS	ISW Depletion-Impact to Environmental Beneficial Users		3	45		842	Artificially imposing the "Fall Minimum" (plus buffer?) as an acceptable target is likely to result in reproductive failure when GDE plants generally need surface water for seed germination, followed by a slow decline in water level below the surface. This will potentially yield the same results as are seen in the Shasta River at eh beginning of the irrigation season when water levels unnaturally drop in advance of the release of willow seeds, effectively eliminating natural recruitment.	See MCR ISW and GDE
David Webb for Friends of the Shasta River	FOSR-082	B	IS	ISW Depletion-Impact to Environmental Beneficial Users		3	45		844-5	It seems unlikely that satellite imagery will be able to discern the above reproductive failure, but will instead track the presence of mature over story plants until they get old and die, with nothing to replace them. By that point cause and effect are likely to be unlinked in people's minds.	See MCR ISW and GDE
David Webb for Friends of the Shasta River	FOSR-083	A	IS	ISW Depletion-Impact to Environmental Beneficial Users		3	45		849	Again, selecting 100 cfs as the MT appears to be entirely arbitrary, especially given that Figure 10 shows that flows that low only occurred in one unusually dry year since 2010. At this point, there would seem to be sufficient data to select targets based on average conditions or past water year types for which we have data, pending the collection of more data, not the lowest number available. Setting a low number will only provide an opportunity to allow additional gw development to take place while the next 5 years pass, assuming they are normal water years and not a continuation of drought. Adding to the existing overdraft condition will only make future management harder. In the face of considerable uncertainty, a conservative approach should be taken.	See MCR ISW

David Webb for Friends of the Shasta River	FOSR-084	C	IS	Request for Clarification		3	45		856-7	To be useful, it is necessary to know the surface elevation of the river closest to this well--what is it vs. the MSL elevation of the water target in this well?	GDEs are dependent on groundwater levels, not river levels. No editing has been done.
David Webb for Friends of the Shasta River	FOSR-085	C	IS	ISW Depletion-Impact to Environmental Beneficial Users		3	45		857	This depth to water appears to preclude the establishment or survival of any GDE native to the Shasta Valley. Please explain how that relates to line 855.	Edit complete. The well is not directly measuring groundwater levels within the GDE, just nearby groundwater levels. It is a proxy groundwater well, where the minimum threshold is based on its historical record. The monitoring network does not currently have shallow wells to directly measure groundwater levels within GDEs.
David Webb for Friends of the Shasta River	FOSR-086	A	IS	ISW Depletion-Impact to Environmental Beneficial Users		3	45		Table 8	Suddenly this table says the MT can now be 80cfs (20% less than 100 cfs). Nowhere is that mentioned nor justified. 100 cfs is already unreasonably low. This is bait and switch. If a 20% buffer is needed, then the MT should be set 20% higher than any acceptable minimum, or 125 cfs.	See MCR ISW
David Webb for Friends of the Shasta River	FOSR-087	C	IS	ISW Depletion-Impact to Environmental Beneficial Users		3	45		864-8	The importance of these lines is not clear and they need to be better explained. Historic data needs to be supplied for this well to allow the numbers presented to be evaluated.	Well data is presented in Appendix 2-C.
David Webb for Friends of the Shasta River	FOSR-088	B	WQ	Water Quality Monitoring		3	49		1003-4	No adequate justification is provided for limiting water quality tracking to these tow constituents only. In addition, language in lines 1073-5 acknowledges that subsurface gw flows in any direction are possible in the presence of heavy gw pumping, potentially mobilizing naturally occurring contaminants from where they are naturally found to areas where they won't be expected nor looked for. Less frequent but periodic monitoring is needed to provide indications of this should it begin to occur.	See MCR Water Quality
David Webb for Friends of the Shasta River	FOSR-089	C	WQ	Request for Clarification: Harter Reference Document		3	51		1096-7	I have looked through the Harter reference, and can find no justification for the statement here to the effect that Shasta Valley CAFO stocking densities are not of concern. As such, that assertion is not supported by any facts and must be seen as arbitrary. Please provide a page number if I am mistaken.	The text was updated to indicate that currently it is unkown whether animal farms are of concern, but that monitoring wells at dairies in Shasta Valley will help determine if there is concern and will be included in the GSP update.
David Webb for Friends of the Shasta River	FOSR-090	C	GE	Request for Clarification: USGS Reference Document		3	61		1349-51	I was unable to find any such reference document. Please provide a proper link and/or title	The link to the reference document is correct.
David Webb for Friends of the Shasta River	FOSR-091	C	GA	Role of GSA		4	2		60-3	The GSA should be explicitly identified as having responsibility for commenting both in favor and opposed to activities, both those brought to it for endorsement, and other publicly funded activities that further or retard GWMP goals	The GSA will act as the groundwater agency for the county.
David Webb for Friends of the Shasta River	FOSR-092	C	GE	Role of GSA		4			80-5	The plan fails to live up to this goal, particularly in regards to its failure to in any way acknowledge or address the absolutely essential role discharged groundwater plays in providing cold water refugia and in overall water temperature protection.	See MCR "Surface Water Temperature"
David Webb for Friends of the Shasta River	FOSR-093	C	GA	Role of GSA		4			88-9	Again, as a responsible management agency the GSA should be prepared to speak up to both support <u>and oppose</u> future proposed activities. Merely staying silent on detrimental projects isn't acceptable.	The GSA will act as the groundwater agency for the county.
David Webb for Friends of the Shasta River	FOSR-094	A	PM	PMA Selection Criteria		4			131-3	I have not seen criteria for rejection of any project, just higher or lower scores, with no suggested threshold for rejection either as inadequately beneficial vs. cost, or likely to cause harm. That leaves the door open for "smokescreen" and "sweetheart" projects	See PMA Selection Criteria
David Webb for Friends of the Shasta River	FOSR-095	A	PM	PMA Selection Criteria		4	9		Table, row 2	In addition to leasing, higher priority should be given to permanent purchase of water. Leasing is appropriate for temporary situations. These issues are not temporary.	See PMA Selection Criteria

David Webb for Friends of the Shasta River	FOSR-096	A	PM	PMA Selection Criteria		4	9		Table, row 3	"irrigation efficiency" should never be given blanket endorsement--such projects often lead to an expanded irrigation footprint, reduction in anthropogenic recharge, and the transfer of "saved" water to more upstream junior users. Where mentioned language should include something along the lines of "carefully vetted" irrigation efficiency projects "scrutinized to assure no unintended consequences result". Particular scrutiny should be given to NRCS projects, in that NRCS is legislatively constrained to looking at only "on farm" impacts for the project recipient, not community, basin wide or off farm unintended consequences.	See PMA Selection Criteria
David Webb for Friends of the Shasta River	FOSR-097	C	PM	PMAs: Project Feedback		4	10		Table, row 2	ILR sounds like a benign approach, but to the extent that it allows a diminution of gw discharge to the stream by replacing it with a similar volume of the mixed natural water and tailwater that constitutes current river flow, it undermines essential water quality needs and goals in terms of water temperature and potentially nutrient loading. It is often unlikely to be overall beneficial at meeting the combined water management goals the river must achieve from all regulatory agencies.	As part of the ILR implementation, there would be further assessment of potential benefits and challenges prior to full scale implementation.
David Webb for Friends of the Shasta River	FOSR-098	C	PM	PMAs: Project Feedback		4	10		Table, row 3	It is inappropriate to propose large physical project such as this without first doing a preliminary engineering study to document its likelihood of success. Nowhere is that essential first step proposed.	See MCR "PMA Selection Criteria".
David Webb for Friends of the Shasta River	FOSR-099	C	PM	PMAs: Project Feedback		4	10		Table, Row 4	This approach also needs to have a preliminary study and action plan in place well before any needed implementation so that actual implementation can be carried out in a fair and effective fashion, with minimal surprises or discussion-related delays. No such study and plan development is proposed anywhere, effectively preventing groundwater curtailment as a real option.	See MCR "PMA Selection Criteria".
David Webb for Friends of the Shasta River	FOSR-100	C	PM	PMAs: Project Feedback		4	11		211 ff	Significant portions of this project have been the subject of a Notice of Violation from the SWRCB for violation of state water law. It is an example of a (deliberately?) flawed examination of project details before investing money in preliminary studies, and/or the preparation of funding requests. Endorsing projects with illegal components undermines the credibility of the GSA and will impact the future effectiveness of it.	See MCR "PMA Selection Criteria"
David Webb for Friends of the Shasta River	FOSR-101	C	PM	PMAs: Project Feedback		4	12		225	This project needs to be expanded, especially in the area between river mile 15.5 and 31 that becomes a losing reach over the course of the summer under current gw usage conditions.	Thank you for this comment. Subject to funding availability, the GSA tentatively plans to expand this project to other locations in the Basin, including the one referenced in your comment.
David Webb for Friends of the Shasta River	FOSR-102	C	PM	Specific Edit to Plan Requested		4	12		236	As of 9/22 this appendix appears not to exist	The text has been edited to refer to the correct appendix.
David Webb for Friends of the Shasta River	FOSR-103	B	PM	PMAs: Project Feedback		4	13		264-73 ff	Needing to be added here are projects to perform preliminary engineering studies of most Tier 3 actions, to complete instream flow studies so as to quantify the availability of "excess water" for storage projects or MAR, to define likely benefits of proposed MAR experiment, funding for water acquisition, funding for well installation to fill data gaps, funding for hiring a qualified geologist to accompany well drillers to prepare reliable well logs, either local legislation requiring above geologist on wells, or incentive payment to landowner and driller for allowing geologist to log well while being drilled, funding or additional piezometer transects between rm 15.5 and 31, and elsewhere, studies to quantify accurately the recharge occurring from unlined ditches so as to respond appropriately as they become lined over time, studies to define underground transit times in various areas to set a foundation for evaluating recharge and water banking proposals,	See Chapter 4 and 5.
David Webb for Friends of the Shasta River	FOSR-104	C	PM	Specific Edit to Plan Requested		4	14		309	Add "canal leakage" to the list of recharge sources	Edit Complete
David Webb for Friends of the Shasta River	FOSR-105	C	PM	Specific Edit to Plan Requested		4	14		311	Replace "lead to" with "are indicative of"	Edit Complete

David Webb for Friends of the Shasta River	FOSR-106	B	PM	Environmental Beneficial Users		4	14		321-23	As noted elsewhere in the plan, gw usage has decreased the flows from Big Springs alone by approximately 1/2 (~60 cfs),, severely degrading the ability of the river to support groundwater dependent ecosystems, specifically cold water fish, or to support existing surface water users. This plan needs to acknowledge that failure to reverse, or partially reverse that impact will guarantee continued uncertainty and risk of litigation. Using as a stated goal the continuation of the current usage levels is not acceptable.	See MCR "ISW"
David Webb for Friends of the Shasta River	FOSR-107	A	PM	Groundwater Use Estimate		4	14		328-9	Comparing the 5 or 10 year average ET to the maximum ET observed between 2010 and 2020 will result in an increase in gw usage. It should be compared to the comparable average between 2010 and 2020;	Noted.
David Webb for Friends of the Shasta River	FOSR-108	B	PM	Groundwater Use Estimate		4	15		350	To meet this standard, it isn't sufficient to minimize future extraction. It will also be necessary to reduce current extraction proportionately to identifiable reductions in recharge. Specifically, 8 miles of publicly funded canal lining by the Montague Irrigation District slated for completion in 2021, and is intended to reduce gw recharge by approximately 28 cfs continuously, during all periods when the canal is running full. Estimates and modeling were based on a time frame when that leakage was customarily part of the working gw system. See further comments on the topic in Ch2 comments. Other individuals and entities are similarly taking steps that will reduce their recharge, with no effort within this plan to track, offset, or oppose the substantial and measurable losses.	It is unclear whether the additional 28 cfs delivered to Montagues Irrigation District will be recharged there or whether additional consumptive uses will be created (e.g., more acreage to be irrigated). The latter would constitute an undesirable expansion of net consumptive use in the basin.
David Webb for Friends of the Shasta River	FOSR-109	C	DW	Domestic Well Failure, Groundwater Levels		4	16		402	The unsubstantiated statement, that "Currently, there is no threat of chronically declining water levels in Shasta Valley" is not supported by any preventative measures yet in place to limit gw extraction to its current levels, let along levels that would not result in undesirable results. In fact numerous domestic users are finding that they are increasingly without water as a result of declining water levels that is becoming more problematic each year.	The minimum threshold for water level does not allow for water levels to decline below historic water levels except for a small margin to provide some operational flexibility. This will minimize the impact of well outages. PMAs will be used to prevent the minimum threshold to be exceeded.
David Webb for Friends of the Shasta River	FOSR-110	B	GE	Specific Edit to Plan Requested: References to Overdraft		4	16		403	The unsubstantiated statement "the basin is not in an overdraft condition" here and elsewhere is in direct contradiction to data documenting that Spring flows in summer, as measured at Big Springs, have declined by ~ 60 cfs. That loss of cold water both where measured in Big Springs, and presumably from other springs fed by the Pluto's Cave Basalt has directly and adversely affected the ability of the river to support its most iconic GDE species--salmon, both coho and Chinook. Additionally, the decrease in gw discharge to the surface has directly impacted junior water users who are increasingly frequently curtailed by the water master. The presence of one or more undesirable results is the definition of an overdraft condition., The Shasta River meets that definition. All statements claiming not to be in overdraft condition should be removed.	Not all undesirable results are related to overdraft conditions. Undesirable results related to all sustainable management criteria may occur even without overdraft.
David Webb for Friends of the Shasta River	FOSR-111	B	GE	References to Overdraft		4	16		416-7	The Shasta River is not a gaining stream at all times as a direct result o excessive gw pumping. Specifically, data has been presented to the project consultants by the water masters showing that the Shasta between River miles 15.5 and 31 became a losing reach by the end of the summer in 2020. Data for other years is not available, but since little has changed in terms of gw usage in 2020 vs. recent years, there is no reason to presume this has not been an ongoing condition. That data documenting the annual development of a losing reach in the river should be included as an appendix so the public can readily see and understand it, and support appropriate measures to address it.	See MCR "ISW"
David Webb for Friends of the Shasta River	FOSR-112	C	GE	Specific Edit to Plan Requested		4	17		427	Add the words "canal leakage" as another source of recharge.	Edit Complete
David Webb for Friends of the Shasta River	FOSR-113	C	PM	Managed Aquifer Recharge		4	17		436-7	The observation that gw levels slope from the basin margins towards eh Shasta River should color MAR concepts. MAR on the west side of the river (as is proposed herein elsewhere) will not benefit gw levels or users on the East side of the river, where identifiable shortages now exist. No explanation is provided as to why MAR is being proposed in this unfruitful area.	Locations for MAR has not yet been proposed and will be explored with a feasibility study, as discussed in Chapter 5.

David Webb for Friends of the Shasta River	FOSR-114	C	GE	Recharge		4	17		446-7	This statement conveniently ignores the other sources of recharge, specifically canal leakage and deep peculation from excess irrigation, reductions in both of which are currently and for years have been the focus of public and private pending.	Edit Complete
David Webb for Friends of the Shasta River	FOSR-115	C	GE	Reference to Overdraft		4	18		470-1	This statement ignores the SGMA use of the presence of one or more undesirable conditions as the indicator of overdraft, an error made throughout the document.	Not all undesirable results are related to overdraft conditions. Undesirable results related to all sustainable management criteria may occur even without overdraft.
David Webb for Friends of the Shasta River	FOSR-116	C	PM	PMAs- Climate Change		4	18		473-5	Merely stating the existence of diminishing amounts of precip. isn't enough. Where is the response to this fact? Instead throughout the document there is a concerted effort to continue the slowly expanding and demonstrably excessive usage of gw, and to ignore the developing climatic trend that calls out for a conservative approach until climatic conditions prove otherwise. That is not a plan. at best it is an ex That is not a plan. at best it is an excise in wishful thinking.	Future climate simulations under current land use conditions demonstrate that water levels are not in chronic overdraft.
David Webb for Friends of the Shasta River	FOSR-117	C	MU	Coordination with Land Use Zoning		4	19		511 ff	Reliance on zoning seems misplaced, particularly with the proposed urban "partners" within whose jurisdiction little or no gw usage for irrigation occurs. Why is there no mention of a moratorium on the issuance of new well drilling permits for wells >6" diameter or similar county level actions that would immediately halt gw usage expansion, but instead pointing to a long, cumbersome and difficult process not likely to occur?	This option has not been discussed as a PMA by the advisory committee.
David Webb for Friends of the Shasta River	FOSR-118	C	PM	Well Replacement PMA		4	19		518--box	Example 2--There is no existing nor proposed county staff position that will be monitoring agreements such as is described, nor is there a penalty nor other recourse if the agreement isn't adhered to. It is also unclear if this example agreement runs in perpetuity, or only for 10 years.	Chapter 5 has been expanded to outline, in more detail, the implementation plan.
David Webb for Friends of the Shasta River	FOSR-119	C	PM	Well Permitting		4	22		558-60	There should be an appropriate sharing of additional gw between gw users, surface users and GDEs.	Noted.
David Webb for Friends of the Shasta River	FOSR-120	C	PM	Specific Edit to Plan Requested		4	23		588-9	The plan should note where this baseline data is located, and how it was calculated so that it can be independently verified over time.	Noted.
David Webb for Friends of the Shasta River	FOSR-121	C	TR	Transparency, Multi-benefit, Inter-agency PMAs		4	24		635-6	Deliberately positioning the GSA to endorse someone's pet projects with little or no relevance to gw management is inappropriate. The GSA members have had many years of opportunity during which time they have frequently met with the specific "other agencies" responsible for such projects. This is a transparent effort to enhance the fundability of projects that should stand on their own, and not deplete gw related funding.	GSA implementation will require cooperation and collaboration between different agencies, particularly for grant funding. The GSA must also help protect groundwater dependent species (see Section 2.2.2.7) and species dependent on interconnected surface waters.
David Webb for Friends of the Shasta River	FOSR-122	C	PM	PMAs: Irrigation Efficiency Projects		4	24		641-4	Irrigation efficiency improvements cannot be given a blanket endorsement. Each needs to be individually assessed to determine all its effects. As already pointed out, recharge from leaking ditches is substantial, and is relied upon unknowingly by many gw users in the basin, as is deep percolation. Reduction in those avenues of recharge need to be offset by equivalent reduction in gw demand.	The complex interaction between groundwater, surface water, and canal usage will be assessed with the Shasta Valley Integrated Hydrologic Model.
David Webb for Friends of the Shasta River	FOSR-123	C	PM	PMAs: Juniper Removal Efficacy		4	25		669-70	Published University of California Extension Service research by Kuhn et. al. (*Juniper removal may not increase overall Klamath River Basin water yields*, California Agriculture, Volume 61, #4, 2007) suggests that gw benefits from this effort will be negligible. If it is undertaken as a gw management exercise, any benefits need to be documented by measured gw results, not by theoretical expectations.	See MCR "PMA Selection Criteria". The mentioned study and further research would be taken into account during the prioritization process.

David Webb for Friends of the Shasta River	FOSR-124	A	PM	Voluntary Reporting of Groundwater Pumping		4	25		674	Complete reliance on voluntary participation is at best disingenuous. There needs to be a fall-back method in place for when voluntary efforts are inadequate to generate needed data. Additionally, the existing well log based data base of existing wells is incomplete to an unknown degree. Without an accurate accounting of the total number of wells, evaluating the representative nature of any voluntary data will be impossible. There at minimum needs to be a method proposed for arriving at a count of total wells so that the representative nature and locations of any volunteered wells can be verified. One approach would be to secure from PP&L a total count of agricultural pump power drops, and subtracting from that the number of surface diversion pumps.	See MCR "PMA Selection Criteria". Additionally, a well inventory program is included as a PMA in Chapter 4.
David Webb for Friends of the Shasta River	FOSR-125	A	BR	Endangered Species Act, Streamflow		4	26		724-6	While stream flow augmentation by reducing diversions will yield desirable results, it cannot be overlooked that in addition to wet water ESA listed coho salmon require cold water, water already depleted by existing gw usage. Further planned depletion might well violate section 9 of the ESA. Given that, they cannot be accurately said to "effectively offset" an increase in gw usage.	See MCR "Surface Water Temperature"
David Webb for Friends of the Shasta River	FOSR-126	A	HM	Selecting Projects Using the Hydrogeologic Model: Water Quality and Instream Flows		4	27		766-9	Use of the SWHM model for project assessment alone is not consistent with claimed plans to work with other agencies in that it has apparently no water quality component, most importantly for assessing temperature impacts on large and small refugia areas. Neither does it attempt to address minimum instream flow requirements. Project evaluation needs to be more appropriately comprehensive focusing on not reducing the likelihood of attaining all other mandatory water related targets, and in spreading any burdens fairly.	See MCR "Surface Water Temperature", "Public Trust Doctrine", and "ISW"
David Webb for Friends of the Shasta River	FOSR-127	C	PM	Request for Clarification: Specific PMA		4	27		771 ff	As presented, this appears to be a construction project, without first performing proper feasibility and preliminary engineering studies to document availability of "excess water", reasonable locations and size, potential costs, residence time, and reasonably expected benefits. If it is intended to be a preliminary study, then it should clearly be described that way only, with no fore-ordained outcome in terms of a physical project to follow, as it is currently described. It is worth noting that no mention of a gw shortage for **existing** gw users in the area identified have been made known at the advisory committee meetings. Beyond a project specific preliminary investigation, there needs to be the completion of an instream flow study in order to document the availability of excess water with which to do recharge on a regular enough basis to be useful. Proposed ownership of the stored water needs to be identified, as does its planned disposition, and how this meshes with the Grenada Irrigation Districts plans to initiate reliance on groundwater in lieu of river water so as to avoid water master curtailments.	See MCR "PMA Selection Criteria".
David Webb for Friends of the Shasta River	FOSR-128	C	WR	Water Resources		4	28		792	There is no such thing in the Shasta Watershed as "excess winter runoff" in almost all years.	See MCR "PMA Selection Criteria"
David Webb for Friends of the Shasta River	FOSR-129	C	WR	Water Resources		4	31		931	In essentially all years there are no excess winter and spring flows in the Shasta River given the presence of Dwinnell Res. and diversions from the Little Shasta.	See MCR "PMA Selection Criteria"
David Webb for Friends of the Shasta River	FOSR-130	C	GE	Specific Edit to Plan Requested		4	31		944-5	This appendix doesn't seem to exist.	Edit Complete
David Webb for Friends of the Shasta River	FOSR-131	C	GE	Specific Edit to Plan Requested		4	33		1020	This appendix doesn't seem to exist.	Edit Complete
David Webb for Friends of the Shasta River	FOSR-132	C	WI	Well Logs		4	32		991-97	This information should be collected as part of a plan development project so as to be in place when needed. Existing well logs are known to be incomplete. An alternative count of production wells needs to be done, probably via securing from PP&L a count of irrigation power drops. That in turn would allow accurately assessing the level of incompleteness of the well log dataset.	The PMA "Well Inventory Program" will create a more complete well inventory.

David Webb for Friends of the Shasta River	FOSR-133	C	WI	Well Logs		4	34		1055 ff	A project intended to generate geologically accurate well logs needs to be initiated. It could consist of paying for a qualified geologist to accompany well drillers as they drill new wells, and/or should include the drilling of dedicated wells to better characterize the subsurface geology and water bearing strata. It might be necessary to include incentive	Well drilling regulations are controlled by the state and county governments. Currently all wells are drilled by a C-57 licensed operator and must follow the standards according to the local environmental health and the state well drilling standards. The Department of Water Resources is conducting airborne electromagnetic (AEM) surveys throughout California to assist implementing SGMA in high and medium priority SGMA basins. The AEM survey may clarify some HCM data gaps.
Nick Joslin	MSEC-001	B	BR	Public Trust Doctrine – Impacts to Resources						We believe that this current document, at its heart, will fail to address ongoing impacts to the public trust resources of the Shasta Valley. This plan de-emphasizes the fact that the Shasta River is in a perilous state due to agricultural diversions of surface water and over pumping of groundwater. The Shasta River, as is described many times in the draft document, is intimately connected to the ground water in the basin. The river is listed 303(d) impaired for both temperature and dissolved oxygen. Many past assessments have described a river system that is heavily impacted by irrigation diversion of surface water and groundwater extraction. This summer agricultural users nearly de-watered the river and one of the lowest flow events ever recorded resulted (3.5 cfs at the Yreka gage).	See MCR "Public Trust Doctrine", "ISW"
Nick Joslin	MSEC-002	A	GE	GSP Insufficient						We believe parts of this plan will serve to improperly establish baseline coverage of current practices, delay implementation of management actions, or even promote projects which could increase groundwater pumping. In doing so, the GSP seems to be designed to protect agricultural overreliance on groundwater in the Shasta River basin.	See MCR General Data Gaps
Nick Joslin	MSEC-003	A	IS	ISW Depletion – Water Budget						The GSP points towards an over reliance on future studies or future projects when it is evident that in order to consider groundwater sustainability in the Shasta Valley, one could simply consider only the agricultural water use during agricultural irrigation season. During the driest time of the year, agricultural use of interconnected surface water and groundwater vastly tips the water budget out of any semblance of sustainable. Once the irrigation season ends, groundwater recharge is rapid.	See MCR ISW
Nick Joslin	MSEC-004	C	GE	Public Trust, Impacts to Environmental Beneficial Users, Role of Agriculture						As this region has continued to experience more "very dry" years, it has become more and more apparent that there is simply not enough water during the summer months to support current agricultural users, protect the public trust resources, and maintain suitable aquatic habitat for native salmonids. The county remains averse to addressing the current conditions, minimizing the evidence that agricultural groundwater use plays an increasing role in pushing the Shasta Valley further from groundwater sustainability.	Noted.
Nick Joslin	MSEC-005	A	PM	PMAs, Increasing Water Use						We assert that generic projects in the preliminary list of PMA's aimed at "irrigation efficiency" or "flow management strategies/plans" (SHA's) will simply allow increased water consumption and expansion of irrigated acreages. None of these theoretical projects puts more water in the river or ground; they would simply ratify extractive water uses under a banner of "beneficial" use.	Sustainable water use will require a combination of project and managment actions, as defined in Chapter 4.
Nick Joslin	MSEC-006	C	DC	Environmental Justice						This GSP does little to acknowledge the shifting considerations being made throughout state code which serve to address issues of racial and environmental justice (see SWRCB Racial Equity Initiative and the CA Fish and Game Commission working on an equity resolution and initiative). We have reached a critical moment in the evolving state regulatory structure where we must not only acknowledge the systemic tribal, racial, and environmental harms and injustices that have been propagated through land and water use laws, but we must now act to cease such harms. As such, by not addressing this, the plan will act to extend the historic "beneficial" use of water in Shasta Basin to grow food for cattle and only secondarily extend considerations to the environment or disadvantaged communities.	Noted.

Nick Joslin	MSEC-007	C	GA	Financing Cattle Industry						With respect to developing, installing, and maintaining a modern monitoring system, we are troubled to see a shift in financing away from groundwater users and towards some notion that the whole county “benefits” from the cattle industry’s continued overreliance on groundwater extraction.	Noted.
Nick Joslin	MSEC-008	C	GA	Financing- Taxes						We do not think any taxpayers who reside outside of a specific basin should be asked to pay for any basin-specific monitoring network (tax increase).	This is a correct statement. Only groundwater users under GSA jurisdiction would be subject to any GSA related fees.
Nick Joslin	MSEC-009	C	TR	Transparency- Monitoring Equipment						We believe that all monitoring equipment paid for with taxpayer money should be available in real time to the public.	See MCR "Data System"
Nick Joslin	MSEC-010	A	WI	Well Metering						We believe that agricultural wells should be required to be metered for accuracy in reporting.	See MCR "5-year Update"
Salmonid Restoration Federation	SRF-001	B	GE	Streamflow Depletion, Well Regulation						Groundwater extraction from areas where wells can be regulated under SGMA are just one of these causes of flow depletion. Therefore, GSPs are not responsible for reversing the streamflow depletion caused by surface diversions or groundwater outside SGMA jurisdiction (e.g., wells near the mainstem Scott River, in the zone subject to surface water adjudication). However, the draft GSPs do not meet the SGMA requirements for addressing the impacts of groundwater extraction from wells inside SGMA jurisdiction.	Noted.
Salmonid Restoration Federation	SRF-002	A	IS	ISW Depletion Thresholds						SGMA requires that a GSP define minimum thresholds for streamflow depletion that cause adverse impacts on beneficial uses of the surface water, and then propose actions to ensure that such thresholds are avoided. Instead, the Scott Valley GSP does that process backwards, first defining actions that are easily achievable by groundwater users and then setting the minimum thresholds based on that. There is no consideration of the actual effects of streamflow depletion on surface water beneficial uses. This approach does not meet SGMA requirements.	This comment refers to the Scott Valley GSP and not the Shasta Valley GSP.
Salmonid Restoration Federation	SRF-003	B	MN	Data Gaps, Transparency						There is currently a lack of basic information such as the amount of groundwater extracted. Neither the Scott or Shasta GSP require metering of groundwater extraction, nor public sharing of groundwater elevation data in a form that is transparent and verifiable (i.e., sharing the actual raw data rather than summaries). Without metering and data sharing, GSP policies such as “Avoiding Significant Increase of Total Net Groundwater Use from the Basin” are illusory and easy to game.	See MCR "5-year Update"
Salmonid Restoration Federation	SRF-004	A	GE	Well Metering, Construction						In the absence of universal metering, the only other way to ensure avoiding increases in net groundwater use would be to not allow new well construction and not allow irrigation in areas not currently irrigated; however, the GSPs contain no such prohibition.	See MCR "5-year Update"
Shasta Headwaters	SH-001	C	GE	Tone of GSP						In general, the draft plan underestimates the Shasta River’s immense natural values, and it understates its historical significance to the third most productive salmon-supporting river in the contiguous western United States, and largest river restoration project in the nation/world. The plan should convey a tone of pride, honor, and duty to protect and restore the remarkable natural heritage of the Shasta River. By framing the task at hand through a solution-oriented lens, the plan should clarify that a thriving, charged, salmon-laden Shasta River is the ultimate indicator of sustainable groundwater management throughout the valley.	See MCR "GDE", "ISW", and "General Data Gaps"
Shasta Headwaters	SH-002	C	WR	Specific Edit to Plan Requested: Hydrogeology				2.2.1.1.	784	At the end of section 2.2.1.1 after line 784, emphasize how the valley’s hydrogeology including its shallow grade, unique mineral deposits/chemical composition, and continual copious inputs of cold, clean, glacial-fed spring water made Shasta River prime salmon habitat, that historically boasted a significant majority percentage of salmon returning to spawn in the Klamath River system.	Language added.
Shasta Headwaters	SH-003	C	BR	Specific Edit to Plan Requested: Broader Regulation						Such hydrological conditions were guaranteed by consistent winter snowpack that is diminishing under current and projected warming. Please highlight how state and local water policy reform is necessary to adjust current practices to prospects of natural recharge, now and in the near future.	Language added.

Shasta Headwaters	SH-004	B	WB	Reference to Overdraft						During one of the GSA sub-committee meetings, I inquired that since the ground-to-surface water interconnection is established, and it's common for the Shasta River to flow at a tiny fraction of its naturally occurring volume, how can the basin not be overdrafted? The team provided a lengthy explanation that sounded like technically, the basin may not be in overdraft. But practically speaking, a month later the state issued emergency drought curtailments to irrigators throughout the basin for the first time ever. If the basin is not in a state of overdraft, while the river that defines the basin is routinely getting dewatered, perhaps we need to redefine overdraft? I was unable to find an explanation of what constitutes overdraft in the draft plan. Please point me toward it, or include it as point of discussion/clarification .	See MCR Overdraft
Shasta Headwaters	SH-005	C	PO	Public Outreach and Engagement						The plan also underestimates the power of coordinated, widespread, voluntary conservation efforts, grassroots stewardship, and community buy-in. We urge you to include more meaningful opportunities for public interest representation, as well as Tribal leadership	Languge added in new PMA.
Shasta Headwaters	SH-006	B	MN	Monitoring Network: Transparency, Accessibility						We recommend establishing a monitoring network and making important water information available to the public	The GSA has established a monitoring network, as described in Chapter 3, however some data may need to remain private to the GSA due to privacy concerns from private well owners.
Shasta Headwaters	SH-007	C	PM	Specific Edit to Plan Requested: Add Specific PMAs						Include residential, municipal, and small agricultural water conservation education to the list of Tier I or II PMA's.	Languge added in new PMA.
Shasta Headwaters	SH-008	B	PM	PMA Selection Criteria, Stakeholder Engagement						Incorporate a mechanism for generating diverse stakeholder consensus on PMA prioritization and implementation.	Noted. Planned outreach during the implementation phase of the plan is described in Chapter 5.
Shasta Headwaters	SH-009	C	GE	Specific Edit to Plan Requested					Table 1	Include Friends of Shasta River in the Table 1 list of Shasta Valley Stakeholder Groups as an environmental organization or local NGO.	Edit Complete.
Shasta Headwaters	SH-010	A	DC	Fund Tribal and NGO Participation						Provide financial support for Tribal and/or environmental stakeholder leadership during plan implementation and maintenance.	Comment noted. Outreach activities are included in the implementation plan.
Shasta Headwaters	SH-011	B	MN	Monitoring Network: Data Gaps						In addition to bridging data gaps, we urge the GSA to pay more attention to making better use of data we do have, and synthesize the many avenues of watershed data monitoring into a comprehensive, user-friendly, consistent data management system.	See MCR "Data System"
Shasta Headwaters	SH-012	B	PM	Coordinate PMA Implementation Across Subbasins						Coordinate PMA implementation among the four basins; Shasta, Scott, Butte, Tule Lake.	PMAs will be coordinated as needed.
Shasta Headwaters	SH-013	B	GE	Consolidate Resource Agencies						Consolidate resources – combine the multiple water conservation/irrigation/service districts into one comprehensive Shasta River watershed authority.	Noted. No edit made.
Shasta Headwaters	SH-014	B	MN	Coordinate Monitoring with other State and Regional Programs						Coordinate data monitoring and plan performance between GSA's and Integrated Regional Water Management (IRWM) groups operating in Siskiyou County. Specifically, the North Coast Resource Partnership and the Upper Sacramento Regional Water Action Group (RWAG).	Data monitoring and GSP implementation will be coordinated with relevent and willing agencies.
Shasta Headwaters	SH-015	C	PM	Specific Edit to Plan Requested: Add Monitoring to PMA						In the "upslope water yield projects' category, include a mechanism for monitoring non-beneficial, industrial extraction.	See MCR "PMA Selection Criteria"
Shasta Headwaters	SH-016	C	PM	Specific Edit to Plan Requested: Edit PMA						Include incentives for switching to less water-intensive crops, and adopting regenerative agricultural practices in Tier I or Tier II PMA's	Language added to PMA " Irrigation Efficiency Improvements"

Shasta Headwaters	SH-017	B	MN	Monitoring Unregulated Groundwater Use						Identify periodic updates of Bulletin 118 as an opportunity to mandate monitoring of unregulated groundwater upstream.	The Shasta River groundwater basin has already undergone a revision and border expansion. The GSA only has authority within the Shasta River groundwater basin and groundwater extraction outside its authority will be addressed by the County as needed.
Shasta Headwaters	SH-018	A	WR	Revise Water Rights and Management Policies						Revisit and revise overly-complicated, fragmented, outdated, profit-motivated water management policies, and over-allocated water rights.	Noted. No edit made.
Shasta Headwaters	SH-019	C	GE	Uneven Regulatory Policies						Over-regulating small business, while under-regulating big business thereby pitting farmers against fish, while industrial users deplete dwindling supplies.	Noted. No edit made.
Shasta Headwaters	SH-020	B	GE	Permitting Process						Streamline permit processes and provide incentives for the deconstruction of impoundments that are not subject to FERC, but have outlived their useful lives .	Noted. No edit made.
Shasta Headwaters	SH-021	A	PM	Awarding Grant Funds to PMAs						GSP's should allocate a substantial percentage of SGMA grant funds to management actions that reward behavioral alternatives to wasteful water use, across sectors.	See MCR "PMA Selection Criteria"
Shasta Headwaters	SH-022	C	GE	Achieving Goals of SGMA						In order for GSA's to achieve desired results, stakeholders must do more than meter wells and monitor groundwater elevation. We must learn to appreciate ecosystem services, limit consumptive uses that primarily benefit private interests, invest downstream stakeholders in protecting supplies upstream, restore biodiversity habitat, and heed traditional ecological knowledge.	Noted. No edit made.
Shasta Headwaters	SH-023	C	PO	Community buy-in						we are concerned that without sufficient community buy-in and effective diverse stakeholder participation, GSP's will primarily serve to allocate corporate welfare to large land-owners, and continue current "regulatory" trends that broaden economic disparities and favor private over public interests.	Noted. Planned outreach during the implementation phase of the plan is described in Chapter 5.
National Marine Fisheries Service	NMFS-001	B	OR	Comment Response and Summary						We previously commented on draft Chapters 3 of the SV GSP . However, many of those comments do not appear to have been considered by the SV GSA, so we have reiterated them in this letter. In the future, we recommend the SR GSA compile a publicly available summary of comments received on the SV GSP, along with the GSA's response to each comment.	This will be done for the current group of public comments.
National Marine Fisheries Service	NMFS-002	B	MN	Monitoring Network – Data Gaps			16		Figure 1	Page 16, Figure 1: The chosen monitoring wells are generally located too far from waterways to adequately analyze and monitor streamflow depletion. We recommend the SR GSA develop a plan for installing paired streamflow gauges and groundwater monitoring wells located in close proximity to each other. These monitoring points should be strategically located throughout the basin where potential streamflow depletion impacts are likely occurring.	See MCR Data Gaps - ISW
National Marine Fisheries Service	NMFS-003	B	MN	Monitoring Network – Data Gaps			25		426	Page 25, line 426: The draft GSP proposes monitoring groundwater contributions to the Shasta River during the "irrigation season", yet does not explain why monitoring is limited to this season only. Streamflow depletion does not usually occur instantaneously with the causative groundwater pumping, but can instead be delayed by days, weeks, months or years (Barlow and Leake 2012). For instance, groundwater pumping during the irrigation season could deplete streamflow when adult coho salmon are migrating in December, well after the irrigation season. To account for this temporal variability, streamflow depletion and augmentation monitoring should occur year-round.	See MCR ISW
National Marine Fisheries Service	NMFS-004	B	IS	Monitoring Network – Data Gaps			25		439	Page 25, line 439: The proposed protocol for monitoring interconnected surface water dynamics pairs streamflow gauging data collected at 15 minute intervals with bi-monthly surface water diversion data. The low frequency with which surface water diversion data is collected may hinder the intended analysis; we suggest gathering data on surface water diversions more frequently to alleviate this concern.	See MCR ISW
National Marine Fisheries Service	NMFS-005	B	MN	Monitoring Network – Data Gaps			25		Table 4	Page 25, Table 4: As alluded to above, a grand total of four monitoring locations within the Shasta Valley is likely insufficient to characterize interconnected surface water dynamics.	See MCR Data Gaps - ISW

National Marine Fisheries Service	NMFS-006	B	MN	Monitoring Network – Data Gaps			25		449	Page 25, line 449: Waiting until the 2032 GSP update to begin monitoring the upper Little Shasta River watershed is not appropriate, given that a 2032 start date leaves just 10 years to address streamflow depletion impacts prior to the SGMA deadline for achieving sustainable groundwater management. The SR GSA should design a plan now to gather the required data so that significant progress can be achieved at the first 5-year check-in in 2027.	See MCR ISW
National Marine Fisheries Service	NMFS-007	B	GD	Groundwater Dependent Ecosystems			35		663	Page 35, line 663: The draft GSP lists potential impacts resulting from streamflow depletion as diminished agricultural surface water diversions, and inadequate flows to support riparian health and ecosystems. The list should also include impacts to ESA-listed salmonids and their habitat that depend on significant groundwater accretion to maintain habitat suitability.	Edit complete. The referenced page and line number is incorrect so edits were done based on best professional judgement.
National Marine Fisheries Service	NMFS-008	B	GE	Request for Clarification			35		676	Page 35, line 676: Growth in groundwater demand that changes the distribution of pumping and volume pumped cannot be characterized as “unforeseen”, since the GSA is responsible for managing current and future groundwater extraction, and SGMA gives broad power to GSAs to accomplish that task.	Edit complete. The referenced page and line number is incorrect so edits were done based on best professional judgement.
National Marine Fisheries Service	NMFS-009	B	GD	Environmental Beneficial Users			36		694	Page 36, line 694: The draft chapter forgoes developing a groundwater/surface water analytical model as required under SGMA, and instead proposes using an analysis that uses the location, quantity and timing of interconnected surface water. The analysis focuses on the months of July through September based upon the lack of surface water input at that time of year. However, streamflow depletion impacts to beneficial uses of surface water, and specifically ESA-listed salmonids and their habitat, is not restricted to that time period. For instance, juvenile coho salmon migrate out of the Shasta River watershed during the spring months, well before July, and rearing juvenile coho salmon and steelhead inhabit the Shasta River throughout the year. Furthermore, the streamflow depletion response to groundwater pumping is not likely instantaneous, but can vary from days to months or years depending on factors such as aquifer composition, pumping depth, and other factors. NMFS recommends the SR GSA develop an integrated surface water/groundwater analytical model considering the inherent complexity of Shasta River hydrogeology.	See MCR ISW
National Marine Fisheries Service	NMFS-010	B	IS	Request for Clarification			36		704	Page 36, line 704: For computing groundwater contributions during the irrigation season, riparian diversions are estimated at 20 cfs throughout the growing season. However, the following sentence states that riparian diverters do not continuously divert flow. The plans approach is to use a 2/3 of the 20 cfs estimate. How was this estimate determined?	See MCR "ISW"
National Marine Fisheries Service	NMFS-011	B	IS	Request for Clarification			37		top paragraph	Page 37, top paragraph: Another uncertainty that requires acknowledgement is the sparse gauging network proposed for the “water balance” analysis. Using just two surface water gauges to characterize discharge within the groundwater basin is clearly inadequate for a number of reasons. For instance, both gauges are located on the mainstem Shasta River, with none located on tributary reaches. Also, the two existing gauges are separated by approximately 10 miles of river channel. Finally, the proposed addition of a future monitoring site (SPU on Figure 3) between the two gauges, while a worthwhile effort, does not address the lack of tributary gauges.	See MCR ISW
National Marine Fisheries Service	NMFS-012	B	GD	Request for Clarification			39		743	Page 39, Line 743: There appears to be no justification given as to how a minimum threshold of 100 cfs of average monthly groundwater contribution avoids significant and unreasonable impacts to surface water beneficial uses caused by groundwater pumping. NMFS recommends the SR GSA include this justification.	See MCR ISW
National Marine Fisheries Service	NMFS-013	B	HM	Modeling Insufficient			39		754	Page 39, line 754: As discussed earlier, focusing sustainable management criteria on the irrigation season is unlikely to adequately account for the spatial and temporal scale of groundwater/surface water interaction within the Shasta River basin. A groundwater/surface water analytical model is the appropriate tool for this type of analysis.	See MCR ISW
National Marine Fisheries Service	NMFS-014	B	GE	Request for Clarification						How is the CDFW Water Action Plan streamflow prescriptions going to be worked into the GSAs streamflow depletion SMCs?”	See MCR "ISW"

NGO Consortium	NGO-001	C	DC	Identification and Mapping of DACs						The GSP states that there are five DACs in the basin, but these areas are not mapped and the population is not provided. Provide a map of the DACs in the basin. The DWR DAC mapping tool can be used for this purpose. Include the population of each DAC in the GSP text or on the map.	One map showing DACs and SDACs has been added to Chapter 2. The population of each community is listed at the beginning of Section 2.1.1.
NGO Consortium	NGO-002	C	DW	Domestic Well Mapping						The GSP provides a map of domestic well density in Figure 4, but fails to provide depth of these wells (such as minimum well depth, average well depth, or depth range) within the basin. Include a map showing domestic well locations and average well depth across the basin	Average depths and other information about domestic wells is provided in Appendix 3-C.
NGO Consortium	NGO-003	B	DC	Mapping of DAC and groundwater users						The GSP fails to identify the population dependent on groundwater as their source of drinking water in the basin. Specifics are not provided on how much each DAC community relies on a particular water supply (e.g., what percentage is supplied by groundwater). Identify the sources of drinking water for DAC members, including an estimate of how many people rely on groundwater (e.g., domestic wells, state small water systems, and public water systems).	Added a sentence about SDAC and DAC dependence on groundwater as a source of drinking water. Details on populations in these communities are already discussed.
NGO Consortium	NGO-004	A	IS	ISW Mapping						The identification of Interconnected Surface Waters (ISWs) is insufficient, due to lack of supporting information provided for the ISW analysis. To assess ISWs, the plan relied on previous reports by Shasta Valley Resource Conservation District (SVRCD) and an on-going transect study for the Little Shasta River and Shasta River to determine the direction of flow exchange. The transect study commenced in May 2020. The GSP states (p. 2-105): "The Shasta River and its major tributaries are all considered part of the interconnected surface water system in the Basin." Figure 43 maps streams in the basin, but only shows Shasta River and Little Shasta River as being interconnected. No other data is presented in this section of the GSP, including depth-to-groundwater data and well locations.	See MCR ISW
NGO Consortium	NGO-005	B	IS	Groundwater Elevation and ISW Data						Describe available groundwater elevation data and stream flow data in the basin. ISWs are best analyzed using depth-to-groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought), to determine the range of depth and capture the variability in environmental conditions inherent in California's climate.	See MCR ISW
NGO Consortium	NGO-006	B	IS	Groundwater Contour Maps						Overlay the stream reaches shown on Figure 43 with depth-to-groundwater contour maps to illustrate groundwater depths and the groundwater gradient near the stream reaches. Show the location of groundwater wells in the basin.	Maps have been added with groundwater gradients from 2015. Groundwater contour maps added to Appendix 2-C also have plotted rivers and streams.
NGO Consortium	NGO-007	B	IS	Groundwater Contour Maps						For the depth-to-groundwater contour maps, use the best practices presented in Attachment D. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this layer from land surface elevations from a Digital Elevation Model (DEM) to estimate depth-to-groundwater contours across the landscape. This will provide accurate contours of depth to groundwater along streams and other land surface depressions where GDEs are commonly found.	The recommended approach in this comment cannot be done due to existing data gaps. See MCR "General Data Gaps".
NGO Consortium	NGO-008	C	IS	ISW Data Gaps						On the stream reaches map (Figure 43), consider any segments with data gaps as potential ISWs and clearly mark them as such on the map.	Edit Complete
NGO Consortium	NGO-009	B	IS	ISW Data Gaps						Describe data gaps for the ISW analysis. Reconcile these data gaps with specific measures (shallow monitoring wells, stream gauges, and nested/clustered wells) along surface water features in the Monitoring Network section of the GSP.	See MCR Data Gaps - ISW

NGO Consortium	NGO-010	A	GD	Identification of GDEs						The identification of Groundwater Dependent Ecosystems (GDEs) is **insufficient**, due to lack of clarity around the monitoring well data (well location and screen depth) used to map groundwater elevations and depth to groundwater. The GSP references TNC Best Practices for using the NC Dataset (2019) as the approach used to map depth to groundwater, using the difference between land surface elevation and interpolated groundwater elevation above mean sea level. However, the GSP does not further describe the monitoring well data (well location and screen depth) used to create the depth-to-groundwater maps presented in Appendix 2-H.	See MCR GDE
NGO Consortium	NGO-011	B	GD	Identification of GDEs						NC dataset polygons were incorrectly removed in areas adjacent to irrigated fields due to the presence of surface water. However, this removal criteria is flawed since GDEs, in addition to groundwater, can rely on multiple water sources – including shallow groundwater receiving inputs from irrigation return flow from nearby irrigated fields – simultaneously and at different temporal/spatial scales. NC dataset polygons adjacent to irrigated land can still potentially be reliant on shallow groundwater aquifers, and therefore should not be removed solely based on their proximity to irrigated fields. If insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons as “Potential GDEs” in the GSP until data gaps are reconciled in the monitoring network.	See MCR GDE
NGO Consortium	NGO-012	B	GD	Identification of GDEs						NC dataset polygons were incorrectly removed based on the amount of time that they access groundwater. As presented in the GSP, assumed GDEs have access to groundwater >50% of time and assumed non-GDEs have access to groundwater <50% of the time. However, NC dataset polygons should not be assumed to be disconnected if there is any connection to groundwater (regardless of temporal percentage). Many GDEs often simultaneously rely on multiple sources of water (i.e., both groundwater and surface water), or shift their reliance on different sources on an interannual or inter-seasonal basis. Use depth-to-groundwater data from multiple seasons and water year types to verify whether polygons in the NC Dataset are supported by groundwater, instead of the incorrect criteria mentioned above (presence of irrigation water or less than 50% time connected to groundwater). Instead of using groundwater elevation data from 2011 - 2020, we recommend the pre-SGMA baseline period of 2005 - 2015.	See MCR GDE
NGO Consortium	NGO-013	B	GD	Identification of GDEs						On the depth-to-groundwater level maps presented in Appendix 2-H, include the location of groundwater monitoring wells used to produce the maps. Discuss screening depth of monitoring wells and ensure they are monitoring the shallow principal aquifer. Change the vertical scale such that shallow groundwater elevations are presented more clearly. For example, change the largest depth on the scale to a depth of 100 or 200 feet (instead of 3000 feet). The manner in which the depths are presented make it very difficult to distinguish between depths ranging from 0-100 feet, which is the depth range pertinent to GDEs.	See Appendix 2-C for better contour maps. The GDE analysis was prelimary until data gap are filled. See MCR "GDE".
NGO Consortium	NGO-014	B	WB	Water Budget-Accounting for GDEs						The water budget did not explicitly include the current, historical, and projected demands of native vegetation. The omission of explicit water demands for native vegetation is problematic because key environmental uses of groundwater are not being accounted for as water supply decisions are made using this budget, nor will they likely be considered in project and management actions. Quantify and present all water use sector demands in the historical, current, and projected water budgets with individual line items for each water use sector, including native vegetation.	The soil water balance in Appendix 2-I includes agricultural, native and urban water use as stated in the introduction, however, the native and urban water uses were not presented as the primary focus was on agriculture water use due to it's higher impact on groundwater. The addition of water budget plots including native, urban and agricultural water use will be considered in the GSP update for Appendix 2-I.

NGO Consortium	NGO-015	C	WB	Identification of Wetlands						Managed wetlands are not mentioned in the GSP, so it is not known whether or not they are present in the basin. State whether or not there are managed wetlands in the basin. If there are, ensure that their groundwater demands are included as separate line items in the historical, current, and projected water budgets.	The GSA is unaware of any managed wetlands in Shasta Valley, per the SGMA definition. Early phases of implementation will include confirming no managed wetlands currently exist with the Basin.
NGO Consortium	NGO-016	B	PO	Targeted Stakeholder Outreach						The opportunities for public involvement and engagement are described in very general terms. They include attendance at public meetings, stakeholder email list, and updates to the GSP website. There is no specific outreach described for members of the DAC communities or domestic well owners. In the Stakeholder Communication and Engagement Plan, describe active and targeted outreach to engage DAC members, domestic well owners, and environmental stakeholders throughout the GSP development and implementation phases. Refer to Attachment B for specific recommendations on how to actively engage stakeholders during all phases of the GSP process	Targeted outreach was not conducted to specific DACs but a large portion of the GSP area is classified as SDAC or DAC and thus outreach to the entire basin area was intended to cover those communities. See Chapter 1 for additional information.
NGO Consortium	NGO-017	B	PO	Targeted Stakeholder Outreach						The Stakeholder Communication and Engagement Plan does not include a plan for continual opportunities for engagement through the *implementation* phase of the GSP for DACs, domestic well owners, and environmental stakeholders.	Noted. Planned outreach during the implementation phase of the plan is described in Chapter 5.
NGO Consortium	NGO-018	C	GL	Groundwater Level Minimum Threshold						For chronic lowering of groundwater levels, the GSP does not sufficiently describe or analyze direct or indirect impacts on domestic drinking water wells, DACs, or tribes when defining undesirable results. Describe direct and indirect impacts on DACs, drinking water users, and tribes when describing undesirable results for chronic lowering of groundwater levels.	Average depths and other information about domestic wells is provided in Appendix 3-C. The entire Basin is considered a DAC or SDAC so the exisiting discussion is valid. The Karuk Tribe land in the northwestern corner of the Basin uses City of Yreka municipal water. The potential unreasonable results from reaching the groundwater level minimum threshold is presented in Appendix 3-C. The associated language in Chapter 3 has been updated with the results of the analysis.
NGO Consortium	NGO-019	C	GL	Groundwater Level Minimum Threshold						The GSP does not sufficiently describe how the existing minimum threshold groundwater levels are consistent with avoiding undesirable results in the basin. Consider and evaluate the impacts of selected minimum thresholds and measurable objectives on DACs, drinking water users, and tribes within the basin. Further describe the impact of passing the minimum threshold for these users. For example, provide the number of domestic wells that would be de-watered at the minimum threshold.	The entire Basin is considered a DAC or SDAC so the exisiting discussion is valid. The Karuk Tribe land in the northwestern corner of the Basin uses City of Yreka municipal water. The potential unreasonable results from reaching the groundwater level minimum threshold is presented in Appendix 3-C. The associated language in Chapter 3 has been updated with the results of the new analysis.
NGO Consortium	NGO-020	B	WQ	Constituents of Concern	23 CCR §354.34(c)(4)					For degraded water quality, minimum thresholds for two constituents of concern (COCs), nitrate and specific conductivity, are set at the maximum contaminant levels (MCLs). However, the GSP does not set SMC for the other COCs in the basin (benzene, arsenic, boron, iron, manganese, and pH). The GSP states on p. 3-49 that because benzene is already being monitored and managed by the Regional Board through the Leaking Underground Storage Tank (LUST) program, SMC are not needed. The GSP states that since arsenic, boron, iron, manganese, and pH are naturally occurring, SMC are not needed. However, SMC should be established for all COCs in the basin, in addition to coordinating with water quality regulatory programs. Naturally occurring COCs can be exacerbated as a result of groundwater use or groundwater management within the basin. Set minimum thresholds and measurable objectives for water quality constituents within the basin including naturally occurring constituents that can be exacerbated as a result of groundwater use or groundwater management. Ensure they align with drinking water standards.	See MCR Water Quality

NGO Consortium	NGO-021	B	WQ	Impact of Water Quality on DACs			3-50			To determine undesirable results for water quality, the GSP performs a statistical analysis that describes the undesirable result as follows (p. 3-50): “This quantitative measure assures that water quality remains constant and does not increase by more than 15% per year, on average over ten years, in more than 25% of wells in the monitoring network. It also assures that water quality does not exceed maximum thresholds for concentration, MT, in more than 25% of wells in the monitoring network.” The GSP does not, however, discuss impacts on drinking water users, DACs, or tribes when defining this undesirable result, such as describing how many domestic wells would be impacted by degraded water quality. Describe direct and indirect impacts on DACs, drinking water users, and tribes when defining undesirable results for degraded water quality. For specific guidance on how to consider these users, refer to “Guide to Protecting Water Quality Under the Sustainable Groundwater Management Act.” Evaluate the cumulative or indirect impacts of proposed minimum thresholds for degraded water quality on DACs, drinking water users, and tribes.	The entire Basin is considered a DAC or SDAC so the exisiting discussion is valid. The Karuk Tribe land in the northwestern corner of the Basin uses City of Yreka municipal water. The water quality minium threshold is set to the same standards as surface water quality. The potential unreasonable results from reaching the water quality minimum threshold is equivalent to violation of surface water quality standards, which is potential harm to human health. However the GSA aims to keep the Basin within the measureable objective (MO), which is to keep water quality within the historical range. Issues with water quality (ie., violations of the MO) will be coordinated between the GSA and the Regional Water Quality Control Board. PMAs might be activated.
NGO Consortium	NGO-022	C	GD	Specific Edit to Plan Requested			3-44			The GSP states (p. 3-44): “Though SMCs for GDEs are not required by SGMA, the minimum thresholds for SV02 will be set to protect beneficial users such as GDEs and set at the Fall minimum.” The GSP further states (p. 3-45): “Based on the 7 year history of data recorded in the CASGEM system for SV02, the MT for SV02 will be set at 31 feet below ground surface for the Fall measurement.” The seven year period for which data is available is not provided in the GSP.	The data is provided in Appendix 2-C.
NGO Consortium	NGO-023	B	GL	Chronic Lowering of Groundwater Level- GDEs	23 CCR §354.26(b)(3), and §354.28(b)(4)					Furthermore, the GSP does not discuss or analyze the potential impacts to GDEs based on the proposed minimum threshold. If minimum thresholds are set to historic low groundwater levels (or lower) and the basin is allowed to operate at or close to those levels over many years, there is a risk of causing catastrophic damage to ecosystems that are more adverse than what was occurring at the height of the 2012-2016 drought. This is because California ecosystems, which are adapted to our Mediterranean climate, have some drought strategies that they can utilize to deal with short-term water stress. However, if the drought conditions are prolonged, the ecosystem can collapse. When defining undesirable results for chronic lowering of groundwater levels, provide specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact to GDEs. Undesirable results to environmental users occur when ‘significant and unreasonable’ effects on beneficial users are caused by one of the sustainability indicators (i.e., chronic lowering of groundwater levels, degraded water quality, or depletion of interconnected surface water). Thus, potential impacts on environmental beneficial uses and users need to be considered when defining undesirable results in the basin. Defining undesirable results is the crucial first step before the minimum thresholds	See MCR Water Quality
NGO Consortium	NGO-024	C	IS	ISW Depletion Minimum Threshold			3-45			The minimum threshold for depletion of ISW is set to 100 cubic feet per second (cfs). The GSP states (p 3-45): “Based on the limited 5-year history of measurements for the groundwater contributions SMC, a preliminary Minimum Threshold will be set at 100 CFS of average monthly groundwater contributions.” Based on discussion in the GSP, it is not clear how this value is derived and how it relates to beneficial users.	See MCR "ISW"

NGO Consortium	NGO-025	B	IS	ISW Depletion Minimum Threshold	23 CCR §354.28(c)(6)					Furthermore, the GSP makes no attempt to evaluate the impacts of the proposed minimum threshold on environmental beneficial users of surface water. The GSP does not explain how the chosen minimum thresholds and measurable objectives avoid significant and unreasonable effects on surface water beneficial users in the basin, such as increased mortality and inability to perform key life processes (e.g., reproduction, migration). When defining undesirable results for depletion of interconnected surface water, include a description of potential impacts on instream habitats within ISWs when defining minimum thresholds in the basin. The GSP should confirm that minimum thresholds for ISWs avoid adverse impacts to environmental beneficial users of interconnected surface waters as these environmental users could be left unprotected by the GSP. These recommendations apply especially to environmental beneficial users that are already protected under pre-existing state or federal law	See MCR ISW
NGO Consortium	NGO-026	A	WB	Sustainable Yield			2-151			the GSP does not calculate a sustainable yield based on the projected water budget with climate change incorporated, but instead states that the sustainable yield will vary over time as new project and management actions are added. The GSP states (p. 2-151): "The sustainable yield is not a number that is constant over time, as future conditions may decrease or increase the amount of groundwater that can be withdrawn without causing undesirable results." If sustainable yield is not calculated, then there is also increased uncertainty in virtually every subsequent calculation used to plan for projects, derive measurable objectives, and set minimum thresholds. Plans that do not explicitly calculate sustainable yield may underestimate future impacts on vulnerable beneficial users of groundwater such as ecosystems, DACs, domestic well owners, and tribes. Estimate sustainable yield based on the projected water budget with climate change incorporated, to inform the basis for development of projects and management actions.	See MCR "Sustainable Yield"
NGO Consortium	NGO-027	C	PM	PMAs- Incorporate Climate Change						Incorporate climate change scenarios into projects and management actions.	The future climate models were prepared by DWR and used in accordance with DWR guidance.
NGO Consortium	NGO-028	A	MN	Monitoring Netowrk- Add Representative Monitoring Points	23 CCR §354.34(b)(2)					The consideration of beneficial users when establishing monitoring networks is insufficient, due to lack of specific plans to increase the Representative Monitoring Points (RMPs) in the monitoring network that represent water quality conditions and shallow groundwater elevations around DACs, domestic wells, GDEs, and ISWs. Beneficial users of groundwater may remain unprotected by the GSP without adequate monitoring and identification of data gaps in the shallow aquifer. The Plan therefore fails to meet SGMA's requirements for the monitoring network. The GSP does not provide specific plans, well locations shown on a map, or a timeline to fill the data gaps. the additional RMPs should be included in the GSP now, instead of included in the 5-year GSP update. Without a map of proposed new monitoring well locations, a determination cannot be made regarding the adequacy of the monitoring network for sustainability indicators going forward into the GSP implementation phase.	Current GSP has been approved by the stakeholder committee and meets regulatory requirements. The current GSP has identified these data gaps (Appendix 3-A), PMAs to address these data gaps, and is consistent with regulations, communications by DWR, and DWR approved GSPs. In response to the public comment period, additional PMAs and language regarding data gap processes have been added to the GSP.
NGO Consortium	NGO-029	B	MN	Monitoring Network- Mapping						Provide maps that overlay current and proposed monitoring well locations with the locations of DACs, domestic wells, GDEs, and ISWs to clearly identify potentially impacted areas.	The GDE and ISW analysis are considered preliminary until identified data gaps are filled. This map will be created when data gaps are addressed. See MCR "GDE" and "ISW".

NGO Consortium	NGO-030	B	MN	Monitoring Network- Add Representative Monitoring Points						Increase the number of representative monitoring points (RMPs) across the basin as needed to adequately monitor all groundwater condition indicators. Prioritize proximity to GDEs and drinking water users when identifying new RMPs.	See MCR General Data Gaps
NGO Consortium	NGO-031	B	MN	Monitoring Network- Addressing Data Gaps						Provide specific plans to fill data gaps in the monitoring network. Evaluate how the gathered data will be used to identify and map GDEs and ISWs, and identify DACs and shallow domestic well users that are vulnerable to undesirable results.	See MCR General Data Gaps
NGO Consortium	NGO-032	C	MN	Using Monitoring Networks to Assess Impact to Water Users						Further describe the biological monitoring that will be used to assess the potential for significant and unreasonable impacts to GDEs or ISWs due to groundwater conditions in the basin. Appendix 3-A mentions the use of satellite images to evaluate the health of GDEs over time, however no further details are provided in the GSP.	See MCR "GDE" and "ISW"
NGO Consortium	NGO-033	B	PM	PMAs- DACs						The consideration of beneficial users when developing projects and management actions is insufficient, due to the failure to completely identify benefits or impacts of identified projects and management actions to beneficial users of groundwater such as DACs and drinking water users. does not discuss the manner in which DACs, drinking water users, and tribes may be benefitted or impacted by projects and management actions identified in the GSP. Therefore, potential project and management actions may not protect these beneficial users. For DACs, domestic well owners, and tribes, include a discussion of whether potential impacts to water quality from projects and management actions could occur and how the GSA plans to mitigate such impacts.	The entire Basin is considered a DAC or SDAC so the exisiting discussion is valid. The Karuk Tribe land in the northwestern corner of the Basin uses City of Yreka municipal water. See MCR "PMA Selection Criteria".
NGO Consortium	NGO-034	B	PM	Drinking Water Well Impact Mitigation Program for DACs and Domestic Well Users						For DACs and domestic well owners, include a drinking water well impact mitigation program to proactively monitor and protect drinking water wells through GSP implementation. Refer to Attachment B for specific recommendations on how to implement a drinking water well mitigation program.	We already follow the Appendix B recommendations for a drinking water well impact mitigation program. The key elements include (Section 2 of Appendix B): - Drinking water well monitoring program (see RMP for water level); - Adaptive management trigger system (see water level SMC, where the MO is in the "green light" and the minimum threshold in the "yellow light" zone, for which potential corrective actions have been identified (see PMAs that address: - Undertake an analysis to pinpoint the cause; - Undertake water quality testing for selected domestic and public supply wells; - Provide immediate support to groundwater users experiencing impacts; - Reassess pumping allocation and pumping patterns; - Consider restricting or limiting groundwater extraction near the impacted area.); - drinking water well impact model (Appendix 3-C of GSP); - public outreach and education (see PMAs); - development of mitigation measures, - identifying eligibility and access.
NGO Consortium	NGO-035	C	PM	Multi-benefit projects						Recharge ponds, reservoirs, and facilities for managed stormwater recharge can be designed as multiple-benefit projects to include elements that act functionally as wetlands and provide a benefit for wildlife and aquatic species. For guidance on how to integrate multi-benefit recharge projects into your GSP, refer to the “Multi-Benefit Recharge Project Methodology Guidance Document.”	See MCR "PMA Selection Criteria"

NGO Consortium	NGO-036	B	PM	PMAs- Incorporate Climate Change						Develop management actions that incorporate climate and water delivery uncertainties to address future water demand and prevent future undesirable results.	The future climate models were prepared by DWR and used in accordance with DWR guidance.
Karuk Tribe	Karuk-001	C	GE	References Other Comments						The Karuk Tribe supp011s and incorporates by reference the technical comments prepared by Riverbend Sciences on behalf of the Klamath Tribal Water Quality Consortium dated September 21, 2021 regarding review and comments on Public Draft Shasta Valley Groundwater Sustainability Plan. These comments are attached.	Noted.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-001	B	TR	Lack of Data Transparency						How will transparency and public access to data be incorporated into reporting and data sharing agreements? All data that is paid for with public money should be accessible to the public. All GSP reporting (i.e., annual and five-year review reports) should include electronic appendices with easily accessible data, so others could run their own analyses on the data.	The GSA will follow DWR guidelines for data and model transparency. Per DWR's modeling BMP document, "final model files used for decision making in the GSP should be packaged for release to the Department". We anticipate that model files will be uploadable with the GSP in digital format. Similarly, we anticipate that DWR will collect annual report data in digital format.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-002	B	AL	Well Metering, Lack of Data Transparency						We understand the political sensitivity of well metering, but how can groundwater be managed at a basinwide scale without metering? At least some subset of the wells should be mandated to be metered. Examples could include the largest wells, or new wells drilled after the passage of the SGMA legislation or after adoption of the Shasta Valley GSP. How can existing ordinances, such as the prohibition on the use of groundwater for cannabis production or the requirement for permits being needed for inter-basin transfers of groundwater, be enforced without the well metering? How can the effects of efficiency projects be verified without metering? The lack of metering requirements suggests a lack of transparency, which further suggests a lack of will to actually manage groundwater extraction.	See MCR "5-year Update"
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-003	B	BR	Water Management						Watermastering should be returned to the State of California, with well-organized publicly accessible records of diversions.	Noted.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-004	B	PM	GSP Terminology and Plans/Actions Inssuficiently Defined						The GSP full of things like that sound great like the “Avoiding Significant Increase of Total Net Groundwater Use from the Basin” project and management action (PMA), but when we look closely at the details we see that the wording is loosely defined so that it does not actually guarantee anything. Since all well metering is voluntary, how is it possible to verify this? If the GSP is to actually achieve the stated objectives, it needs more things that can actually be readily verified. Examples that we recommend include: No additional wells for new land use or additional cropping will be permitted in the basin. Only new wells intended to replace old wells and existing crops will be permitted, and these replacement wells will be metered. The intent here is to avoid net increase in groundwater use. Wells intended to replace stream diversions will not be permitted, even if there will be no additional net water usage (i.e., pumped groundwater will be used to replace surface water irrigation of existing crops). The intent here is to allow the SWRCB to ascertain and regulate surface water rights and stream and spring flows. The use of groundwater wells in place of stream or spring diversions simply moves the point of diversion and lessens the ability of the SWRCB to carry out its mission.	See MCR "PMA Selection Criteria" and "5-Year Update"

Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-005	B	MN	Monitoring Network – Lack of Available Funding to Implement						We generally agree with sites and parameters proposed in Section 3.3 Monitoring Networks, but we are extremely concerned that funding will not be available to actually implement the monitoring. The GSA has a responsibility to provide the funding needed to collect these data. Without the monitoring, critical data gaps will persist and it will be impossible to understand or properly manage the intricate Shasta Valley groundwater system.	See MCR General Data Gaps
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-006	B	IS	Modeling/Monitoring Insufficient –Interconnected Surface Waters						The monitoring plan proposes monthly monitoring of the springs, however, this is insufficient given the importance of these springs and the potential insights that high-resolution data could provide into the complex dynamics of Shasta Valley groundwater. At what time scales do the flow of these springs fluctuate (seasonal, weekly, daily, hourly, etc.) and what do these fluctuations appear to correspond with (e.g., Dwinnell reservoir levels, nearby groundwater pumps cycling on/off, flood irrigation, snowmelt, storm events, etc.)? How can we understand this without data? The two largest springs, Big Springs and Little Springs, are especially important. Other critically important springs that need continuous flow monitoring include Bridge Field Springs (on Shasta Springs Ranch, owned by Emmerson), Black Meadow Springs (on Shasta Springs Ranch, owned by Emmerson), Kettle Springs (on Shasta Springs Ranch, owned by Emmerson), and Hole in the Ground Spring. We noticed that Bridge Field Springs and Black Meadow Springs, were not included in the monitoring plan. We strongly urge that both these springs be added to the monitoring plan.	See MCR Data Gaps - ISW
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-007	A	IS	Minimum Threshold for IS Insufficient						The GSP proposed a Minimum Threshold (MT) for Interconnected Surface Water (ISW) of 100 cfs groundwater contributions, based on a water balance of the Shasta River reach between Dwinnell Dam and the USGS flow gage near Montague. The estimated diversions used in the water balance are highly uncertain and unreliable, derived from private watermaster records. The bounds of uncertainty on these diversion estimates are so large as to make them nearly useless as a decision-making tool. Rather than estimating groundwater contributions based on a highly uncertain water balance, we would much rather have the MT ISW be based on the sum of measured discharges from key individual springs (i.e., Big Springs, Little Springs, Bridge Field Springs, Black Meadow Springs, Kettle Springs, and Hole in the Ground Spring). While these individual springs do not represent the entirety of the groundwater contributions (i.e., there may be some diffuse contributions as well as additional smaller springs), data on the spring flows are required anyway for management and model calibration, and should provide a more reliable relative metric of groundwater contributions than the water balance. There are not yet much data yet on these spring flows, but measurements need to begin as soon as possible.	See MCR ISW

Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-008	B	IS	Interconnected Surface Water – GSP Does Not Account for Depletion of Surface Water Through Groundwater Pumping						We highlight this issue because at times the GSP document seems to not acknowledge this fundamental physical reality. For example, from Chapter 3, page 46: As explained in the previous section, the lack of historical and high-frequency groundwater elevation data in the Basin, spatial gaps in streamflow and spring measurements, and uncertainty in the historical and current data regarding surface water diversions and groundwater does not allow the development of a reliable estimate of stream depletion due to pumping. Acknowledging these uncertainties and existing data gaps, the GSA finds it inappropriate to define the interconnected surface water SMC at this stage using modeled results of stream depletion. Instead, the GSA proposes as adaptive approach that would help improve the SMC setting in the future using newly collected data while addressing SGMA requirements… What other long-term source of water is there for the wells (see Theis, 1940, The Sources of Water Derived from Wells)? It is important to strike "…does not allow the development of a reliable estimate of stream depletion due to pumping." and replace with something like " …makes current model predictions of location and timing of impacts uncertain."	See MCR ISW
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-009	B	HM	Modeling Insufficient – Streamflow Depletion						A primary reason given for this is lack of data. Our comment regarding this issue (Chapter 3, page 30) is: The text states "The goal is to use this approach for the first 5 years of implementation, collect more data, and at the GSP update provide a stream depletion approach based on more reliable results produced by the further calibrated SWGM." Two fundamental questions regarding groundwater development in the Shasta Valley are "What effect has past and present groundwater pumping had on surface-water flow in the Shasta River, tributaries, and springs in the Valley?" "What effect will future groundwater pumping have on surface-water resources in the Shasta Valley?" From the stated text, it seems that the Shasta Watershed Groundwater Model (SWGM) will not be used to answer these questions for at least 5 years. If the groundwater part of the model can be used to calculate water budget components as has already been done, why can't it be used to calculate streamflow depletions? Conversely, if the model can't be used to reliably calculate streamflow depletions, why can it be used to calculate water-budget components? Using a groundwater model, streamflow depletion from groundwater pumping is always determined using model-calculated water budget components. At this stage of development of the groundwater model, uncertainty in computed streamflow depletion will most likely be in the timing of the depletion, rather than the relative amounts that various surface-water features are affected. In five years, there will still be uncertainty in the timing of depletion, but perhaps that uncertainty will be lower. Nonetheless, a delay of five years in tackling fundamental questions seems to be ignoring the current value of the model. If key calculations were run and re-run as the model was being improved, then the modelers would learn the sensitivity of model results to changes in parameters.	See MCR ISW
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-010	B	HM	Modeling Insufficient – Climate Change						The GSP does include model runs for future climate change, these results are not presented in a coherent way that highlights the major challenges that climate change will pose to water management. A warming climate will cause a shift in precipitation form (less snow, more rain) that will in turn shift the seasonal timing of tributary surface flows into the valley. Regardless of what happens to total precipitation or total runoff, this change in precipitation form and runoff timing is a huge issue that water management is going to need to recon with.	See MCR Water Budgets

Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-011	C	HM	Specific Edit to Plan Requested		2	79	2.2.1.5	1500-1504	"Streamflow data from all available sources will be further assessed during hydrologic model development to identify important critical conditions. Data quantity and quality impact both selection of data to be used for calibration and interpretation of model performance during associated time periods. More weight is given to locations and time periods with higher quality data." This wording seems to suggest this work was not done as part of model calibration to date, but this appears incorrect, true? If so, it should be reworded in past tense.	The text was updated to properly reflect intial data assessment was completed for historical USGS streamflow gages, but as new streamflow data is being collected and as the model period is being extended to recent years more data assessment will be completed.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-012	B	SB	Specific Edit to Plan Requested		2	87-91	2.2.2.2	Figure 35-39	Based on the values this is, indeed, a depth to water map, but then it is not an "Elevation Map" as stated. It is a bit confusing as it appears to show cones of depressions in the far eastern and western areas, but as the land is sloping it is not clear how much these values reflect changes in land surface elevation versus water groundwater surface elevation. Why not present WL elevation maps and depth to water maps separately? In the latter case, it would be good to include a more detailed land surface elevation map than that provided in Figure 6 (which is in 2,000 foot increments).	The groundwater contour maps have been updated in Chapter 2 and additional maps have been added to Appendix 2-C.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-013	C	GE	Specific Edit to Plan Requested		2	17	2.2.2.6	2071	This is supposed to read "south to north" not "~~north to south~~", right?	The GSP text will be updated.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-014	B	IS	Modeling/Monitoring Insufficient – Interconnected Surface Waters		2	108	2.2.2.6	2124-2166	We assume these measurements will continue into the future and measurements obtained throughout the year. This is important because winter periods may prove best for understanding the ultimate degree of GS/SW interaction because of the lack of nearby irrigation pumping. In addition, a year-round analysis would provide a fuller picture of this interaction.	See MCR ISW
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-015	C	GE	Specific Edit to Plan Requested		2	111	2.2.2.6	2128	It is coinciding, so suggest following edit: "~~potentially coinciding~~" to "coincident".	The exact end of the irrigation season and cessation of upstream diversions are uncertain thus the use of potentially coincidinng.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-016	C	OR	Specific Edit to Plan Requested		2	133-134	2.2.2.7	2433, Figure 58	Why are these maps (Figure 58 and in Appendix 2-G) so different from Figures 35-39? Is it simply a matter of scale? Suggest replacing Figures 35-39 with these figures and including WL Elevation maps separately.	The GDE analysis (Figure 58 and Appendix 2-G) used groundwater level data in a three-year rolling average while Figures 35-39 represent seasonal highs and lows in a given year.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-017	C	GD	Specific Edit to Plan Requested		2	136-137	2.2.2.7	2506, Figure 59	Why is this survey considered a maximum and not a minimum possible extent? There are a lot of acknowledged generalizations in this section. We would think you'd want a relatively quick field check before dismissing all the "Assumed not a GDE" areas. In addition, as noted, perched zones were not captured in the analysis. Recommend that you include something like "Representative areas currently classed as 'Assumed not a GDE' will be reviewed in the field as part of future work".	Edit Complete
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-018	B	OR	Specific Edit to Plan Requested		2	138	2.2.3	Figure 60	This graph (or an additional one) should include change in storage through time.	The water budget figures will be updated to include change in storage.

Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-019	B	HM	Modeling/Monitoring – GDEs		2	138	2.2.3	Figure 60	It is important that groundwater ET be modeled explicitly in the GSFLOW model to better understand and illustrate the changes in amount and location of potential impacts to GDEs through time in areas of shallow water tables. We assume this was done. In any case, it is easy to do in MODFLOW by adding in an ET surface corresponding to ground surface with general groundwater ET extinction point rules. We assume there is a comparable simple way to do this in GSFLOW. This needs to be reported as part of the water budgets (Figures 60-61). This would be in addition to the analysis mentioned on page 141, which we don't fully understand – given groundwater ET changes as a function of WLs, how could it be calculated ahead of time and then used as input? We realize we may misunderstand this. Clarification in the text would be very useful.	Groundwater dependent ET will be included in the five year update of the model. It was not included in the current version of the model because historical groundwater levels throughout the Basin and over the entire simulation period are sufficiently deep that significant feedback to the land/soil subsystem are absent or negligible for purposes of estimating groundwater pumping. Water budgets of the annual evapotranspiration due to applied water and preciptitation can be found in Appendix 2-I.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-020	B	AL	Pumping Allocations		2	138	2.2.3	2521-2531	It appears that you deem domestic and public pumping to be inconsequential. We do not necessarily disagree, but an estimate of these values needs to be provided to substantiate this position.	Similar to most groundwater basins in California there was no measured groundwater pumping data of agricultural, domestic and publicy suppy uses. In the case of agriculture it has been established that applied water is a sufficient proxy for pumping estimates. [No action needed] See General Data Gaps
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-021	B	HM	Modeling/Monitoring – GSFLOW		2	141	2.2.3.1	2603-2609	It is important that the GSFLOW model be used to calculate groundwater ET because the water table fluctuates through time due to changing stresses. What is the benefit to calculating this outside the model and then using it as input?	There is insufficient data on shallow groundwater dynamics to determine the depth of influence of vegetation on groundwater thus ET was calculated prior to modeling. Recent data collection of shallow groundwater transects will aid in understanding the potential draw of shallow groundwater due to vegetation and allow for inclusion of ET into the model.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-022	C	GE	Specific Edit to Plan Requested		2	143	2.2.3.1	Table 15 & 16	Delete one of the "~~within the~~" in each, and in Table 16 we think you mean watershed boundary, not ~~Basin~~ boundary	Corrected Basin to Watershed and removed extra text of within the.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-023	B	GE	Specific Edit to Plan Requested		2	144	2.2.3.1	Table 18	Looks like Average and Maximum values are reversed for Agricultural Pumping, or one of the values is erroneous.	The script used to create the table will be checked and the table will be updated to fix this.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-024	C	GE	Specific Edit to Plan Requested		2	145	2.2.3.4	2695	"Winter rains and winter/spring runoff ~~fill~~recharge the aquifer system between October and April (Figure 23)." Replace ~~fill~~ with recharge. If it filled there wouldn't be many of the issues we are dealing with here.	GSP text changed from fill to recharge to clarify the meaning, the original use of fill was meant to indicate fill as an action of putting more water in a bucket and not completely filling a bucket.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-025	B	TR	Lack of Data Transparency		2	146	2.2.3.4	2731-2734	"The response of the groundwater discharge to the stream system will be delayed relative to the timing of the changes in pumping or recharge – by a few days if changes occur within a few tens or hundreds of feet of a stream, by weeks to months if they occur at larger distances from the stream." This statement requires proof. Assuming delay calculations were performed for the local aquifer they should be included somewhere in the document.	The GSP will be updated to include a citation on general stream-aquifer dynamics (Theis 1941) and the text will be updated stating the assumption that the dynamics would be under the same aquifer conditions.

Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-026	C	OR	Specific Edit to Plan Requested		2	151	2.2.4.2	Figure 67	"Baseline" line should be removed from graph and legend because it is confusing and same color as "Wet"	The figure was updated to remove baseline.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-027	C	OR	Specific Edit to Plan Requested		2	151	2.2.4.2	Figure 67	"Figure 67. Projected flow at the Shasta River near Yreka gage, in difference (cfs) from Baseline, for four future projected climate change scenarios" Perhaps we are mis-understanding what these scenarios are, but are extremely skeptical of any claims that the temperature-driven changes in precipitation form due to climate change (i.e., more rain and less snow) are not going to substantially decrease river flows in summer and fall, regardless of what happens to total annual amount of precipitation. The GSP should acknowledge these realities and then describe how the model predicts that this will seasonally change river flow and groundwater. The format of the graph makes it very difficult to see meaningful seasonal patterns. The y-axis scale that ranges from -2,000 to +12,000 cfs makes it impossible to see what is happening during low flows. Can you add a second panel that to graph so that the low-flow period is legible (maybe -100 to +100 cfs?)? Or maybe limit the months to just show April through October?	The GSP includes Figure 67 to show changes in both wet season and dry season streamflows in future climate scenarios, these scenarios are based on climate change factors provided by DWR, if improved climate change factor data becomes available it will be considered for model updates. The y-axis scale on the figure ranges from -500 to 1,000 cfs not -2,000 to 12,000 cfs. The goal of Figure 67 was to indicate the general trend in streamflow between the baseline and other climate scenarios as increasing or decreasing. More detailed analysis or visualization may be done by those interested when the Shasta Valley Integrated Hydrologic Model results will be made available with the submission of the final GSP.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-028	C	OR	Specific Edit to Plan Requested		2	151	2.2.5	2816-2818	Delete "~~Groundwater pumping has not caused significant and unreasonable conditions in the Basin during the last 20 years~~". The Basin has recognized problems and is a Medium Priority to the State and its why we are doing this SGMA Plan. You can say it's not in overdraft (continuously declining WLs), but that's it.	
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-029	C	OR	Specific Edit to Plan Requested		2	151	2.2.5	2827	Suggest: "…acre-feet per ~~year minus any future~~ reduction in…" to "…acre-feet per year. It may change in the future due to reduction in…"	
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-030	B	OR	GSP Terminology and Plans/Actions Inssuficiently Defined		2	152	2.2.5	2849-2857	It appears you are saying that the sustainable yield is less than the current value of pumping. The sustainable yield needs to be defined as part of this SGMA plan and then used as the management target. As it is currently worded in the document, there is apparently no lower limit to reductions in pumping.	See MCR Sustainable Yield
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-031	B	OR	GSP Terminology and Plans/Actions Inssuficiently Defined		3	5	3.2	114-116	The first sustainability goal listed is "Groundwater elevations and groundwater storage do not significantly decline below their historically measured range, protect the existing well infrastructure from outages, protect groundwater-dependent ecosystems, and avoid significant additional stream depletion due to groundwater pumping." There is not definition of what "significant" means, so we suggest removing that word. Without a definition, isn't this meaningless? It should probably either be percent (e.g., 1%) or volume?	See MCR "SGMA"
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-032	B	OR	GSP Terminology and Plans/Actions Inssuficiently Defined		3	5	3.2	123	In "Groundwater will continue to provide river baseflow as interconnected surface water with no ~~significant or unreasonable~~further reduction in volume." strike "~~significant or unreasonable~~" and replace with "further'. Without a definition, significant is too vague.	See MCR "SGMA"

Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-033	B	MN	Monitoring Network – Lack of Available Funding to Implement		3	6-33			We generally agree with sites and parameters proposed in Section 3.3 Monitoring Networks, but we are extremely concerned that funding will not be available to actually implement the monitoring. As described in our comments on Chapter 3, Section 3.3, pages 16-17, Table 1, we also recommend continuous flow monitoring of the springs, and adding two additional springs to the flow monitoring sites: Bridge Field Springs and Black Meadow Springs.	See MCR Data Gaps - ISW
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-034	B	MN	Monitoring Network – Network Insufficient		3	16-17	3.3	Table 1	From our perspective, monitoring the flow of the springs is the most important. The output of these springs is what sustains aquatic ecosystems and agriculture in the Shasta River. In addition, the ability to predict flow in these springs is the primary endpoint upon which we will judge the performance of the Shasta Watershed Groundwater Model. We need to understand how groundwater elevations and groundwater pumping affect the flow in these springs. The monitoring plan proposes monthly monitoring of the springs, however, this is insufficient given the importance of these springs and the potential insights that high-resolution data could provide into the complex dynamics of Shasta Valley groundwater. At what time scales do the flow of these springs fluctuate (seasonal, weekly, daily, hourly, etc.) and what do these fluctuations appear to correspond with (e.g., Dwinnell reservoir levels, nearby groundwater pumps cycling on/off, flood irrigation, snowmelt, storm events, etc.)? How can we understand this without data? The two largest springs, Big Springs and Little Springs, are especially important. Other critically important springs that need continuous flow monitoring include Bridge Field Springs (on Shasta Springs Ranch, owned by Emmerson), Black Meadow Springs (on Shasta Springs Ranch, owned by Emmerson), Kettle Springs (on Shasta Springs Ranch, owned by Emmerson), and Hole in the Ground Spring. We noticed that Bridge Field Springs and Black Meadow Springs were not included in the monitoring plan. We strongly urge that both these springs be added to the monitoring plan.	See MCR Data Gaps - ISW
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-035	C	GE	Specific Edit to Plan Requested		3	6	3.3	155	“A detailed discussion of potential data gaps, and strategies for resolving them, is included as <u>Appendix 3-A</u>~~Z~~”	Edit Complete
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-036	B	AL	Monitoring Network – Monitoring Plan Insufficient		3	25	3.3.3.1	Table 3	Specific conductivity can readily be obtained at the wellhead using a meter. We suggest taking annually when sampling for nitrate.	Comment noted, specific conductivity will be considered for testing during future groundwater sampling.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-037	B	GL	Well Inventory		3	28	3.3.4.1	458-472	Suggest using WLs from “permanent” stilling well in stream and WLs from two nearby adjacent piezometers at different depths to track changes in gradients through time.	See MCR Data Gaps - ISW

Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-038	B	OR	Specific Edit to Plan Requested		3	29	3.3.4.1	Figure 6	Should "gradient near Scott River" be changed to "gradient near Shasta River?" If you did mean this to be for the Scott River, then some discussion should be added to justify using conditions in the Scott Valley for analyses in the Shasta valley. Also, not all information is given in explaining the generation of 70 cfs of baseflow for a single water-level gradient. That gradient would have to apply to some length of the river. Is the baseflow number for the entire basin? And would one water-level gradient explain that number (70 cfs)? Normally the quantity would be given as "cfs per unit length of river," or "cfs for reach X," where reach X has some defined length.	The figure caption has been updated.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-039	C	OR	Specific Edit to Plan Requested		3	29	3.3.4.1	Figure 6 caption	This caption seems to be for a map figure, not for the schematic cross section shown.	Edit Complete
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-040	B	WB	Modeling Insufficient For Water Budget		3	30	3.3.4.1	490-492	The text states "*The goal is to use this approach for the first 5 years of implementation, collect more data, and at the GSP update provide a stream depletion approach based on more reliable results produced by the further calibrated SWGM*." Two fundamental questions regarding groundwater development in the Shasta Valley are "What effect has past and present groundwater pumping had on surface-water flow in the Shasta River, tributaries, and springs in the Valley?" "What effect will future groundwater pumping have on surface-water resources in the Shasta Valley?" From the stated text, it seems that the Shasta Watershed Groundwater Model (SWGM) will not be used to answer these questions for at least 5 years. If the groundwater part of the model can be used to calculate water budget components as has already been done, why can't it be used to calculate streamflow depletions? Conversely, if the model can't be used to reliably calculate streamflow depletions, why can it be used to calculate water-budget components? Using a groundwater model, streamflow depletion from groundwater pumping is always determined using model-calculated water budget components. At this stage of development of the groundwater model, uncertainty in computed streamflow depletion will most likely be in the timing of the depletion, rather than the relative amounts that various surface-water features are affected. In five years, there will still be uncertainty in the timing of depletion, but perhaps that uncertainty will be lower. Nonetheless, a delay of five years in tackling fundamental questions seems to be ignoring the current value of the model. If key calculations were run and re-run as the model was being improved, then the modelers would learn the sensitivity of model results to changes in parameters.	Sensitivity analysis is an important component of understanding the impact of parameters on model results, but for a sensitivity analysis to be useful it requires surface water and groundwater data sets with good spatial and temporal coverage, these are data gaps to be filled in the first five years, to discern how changes in model parameters impact the difference between simulated and observed values. The primary difference here is that the groundwater budgets are cumulative over the entire basin and watershed which allow for averaging out of discrepancies such as uncertainty in which reaches are gaining or losing which is critical in ISW, but provides sufficient understanding of the groundwater budget to understand the respective impact of various sources and sinks. Stream leakage from the aquifer to the stream occurs when groundwater levels are above the ground surface which is considered a loss from the groundwater system, if this loss did not occur to the stream leakage at a certain reach then it would result in an increase in groundwater outflow somewhere else in the domain such as near the drainage of the Shasta River from the watershed, thus there would not be a major change to the overall groundwater budget. In five years there will be sufficient groundwater and surface water level data to understand what groundwater conditions are near the river to calibrate model conditions to match these which will result in spatially accurate ISW, while stream gages will allow for potentially individually calibrating the streambed conductance to better quantify the rate of streambed depletion. [No action needed]
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-041	B	WI	Well Inventory		3	30	3.3.4.2	502-511	Suggest incorporating the in-stream stilling well and adjacent vertical gradient piezometers as future improvements	See MCR Data Gaps - ISW

Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-042	C	GE	Specific Edit to Plan Requested		3	30	3.3.4.2	Table 5	We are confused why the “Shasta River near Yreka (SRY)” is listed in the Table 5 “Future monitoring locations for monitoring” with the Agency listed “NA”? Isn’t that a long-term flow gage that has been operated for decades by the USGS?	Edit Complete
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-043	B	TR	Request for Clarification		3	35	3.4.1.1	607	“Surface diversions will be entered into the County data management system” Please describe whether or not these data will be publicly accessible. Data collected for demonstrating SGMA compliance should be publicly accessible	The GSA will follow DWR guidelines for data and model transparency.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-044	C	GE	Specific Edit to Plan Requested		3	36	3.4.1.2	641-642	Suggest change “the ~~historic low~~” to “<u>the historic smallest depth to groundwater</u>”	Edit Complete
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-045	A	PM	Request for Clarification		3	36-37	3.4.1.2-.3	641 Table 6 Fig 8	Why is MT set below historic low? This conflicts with previous statements of trying to reduce GW pumping and maintain or raise WLs (see Section 2.2.5)	The MT for groundwater levels is set slightly below the historical low to provide some buffer in the GSP to avoid breaking the MT in the first few years of plan implementation before PMAs are implemented to begin improving water levels and reduce groundwater pumping.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-046	C	OR	Specific Edit to Plan Requested		3	37	3.4.1.3	Table 6	“AT” is not in Acronym list.	
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-047	B	TR	Lack of Data Transparency		3	41	3.4.3.1	772-773	It is not at all clear why municipal water users are apparently de minimis. No data have been supplied to support this claim.	The GSP text is not classifying municipal water users as de minimis users, it was stating that the GSP's PMAs would not change the operations for municipal users.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-048	B	HM	Modeling		3	42	3.4.3.2	787-792	“The GSA will not be using a numerical groundwater-surface water model to evaluate ISW at this time. A temporary approach based on baseflow calculation will be used.” We strongly suggest using the model in parallel with the planned approach to better understand model behavior recalibration (as you note in 3.4.3.6).	See MCR ISW

Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-049	B	GL	Specific Edit to Plan Requested		3	43	3.4.3.2	Equation table 7	Some additional explanation would be helpful. First, mention somewhere that change in storage in the reach is assumed to be zero. We suggest changing "*SRM* is flow out of the USGS maintained SRM gage" to "*SRM* is flow at USGS maintained Shasta River near Montague (SRM) gage 11517000, located at the downstream end of the reach" A schematic with arrows for various components would help. More importantly, some sort of error analysis should be done to determine uncertainty in groundwater contributions. If an uncertainty can be estimated for each of the components of the water budgets, an analysis can be carried out to determine uncertainty in computed groundwater contributions.	See MCR "ISW"
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-050	B	TR	Lack of Data Transparency		3	42-44	3.4.3.2	784-832	A very important factor that does not appear to us to be mentioned in "Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives" is that there appears to be no accounting for return flows such as tailwater. If much of the irrigation along this reach of the river uses flood irrigation (i.e., in contrast to sprinklers), then isn't there a substantial quantity of tailwater that returns to the river from agricultural fields? If tailwater returns are not accounted for, then "baseflow" could be substantially overestimated in the methods described. While there are some records of tailwater quantities (i.e., from the SVRCD reports), it likely is not possible to estimate these quantities very accurately. But wouldn't it be better to at least make some educated guess about the percent of the diversions that return as tailwater (e.g., perhaps it is in the range of 10-50%) and include that in the calculation, instead of completing ignoring it? You are calling it "Groundwater Contributions" so, it should be your best estimate of groundwater. If you don't apply an adjustment for tailwater, then you should call it something else, like "Groundwater Contributions Plus Tailwater Returns," otherwise it is misleading. We do not have access to the all the reports and data sources cited in the chapter, so perhaps tailwater was indeed already accounted for and we are not aware of it, but from the descriptions provided in the GSP it appears that tailwater was ignored.	See MCR ISW
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-051	C	OR	Specific Edit to Plan Requested		3	43	3.4.3.2	821	We suggest changing "Riparian diverters are not measured" to "Riparian diverters are not measured, despite requirements to measure and report diversions under California Senate Bill 88"	The text remains unchanged because under California Senate Bill 88 requirements to measure and report diversions depends on other circumstances such as total amount diverted, water rights, and permitting.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-052	A	PM	Specific Edit to Plan Requested		3	45	3.4.3.4	846	The proposed Minimum Threshold (MT) for Interconnected Surface Water (ISW) is 100 cfs of groundwater contributions, based on a water balance of the Shasta River reach between Dwinnell Dam and the USGS flow gage near Montague. The estimated diversions used in the water balance are highly uncertain and unreliable, derived from private watermaster records. The bounds of uncertainty on these diversion estimates are so large as to make them nearly useless as a decision[1]making tool. Rather than estimating groundwater contributions based on a highly uncertain water balance (i.e., not the dramatic week to week fluctuations in Table 7), we would much rather have the MT ISW be based on the sum of measured discharges from key individual springs (i.e., Big Springs, Little Springs, Bridge Field Springs, Black Meadow Springs, Kettle Springs, and Hole in the Ground Spring). While these individual springs do not represent the entirety of the groundwater contributions (i.e., there may be some diffuse contributions as well as addition smaller springs), data on the spring flows are required for anyway for management and model calibration, and should provide a more reliable relative metric of groundwater contributions than the water balance. There are not yet much data yet on these spring flows, but measurements need to begin as soon as possible.	See MCR ISW

Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-053	C	OR	Specific Edit to Plan Requested		3	46-47	3.4.3.6	906-913	What other long-term source of water is there for the wells (see Theis, 1940, The Sources of Water Derived from Wells)? It is important to strike "…~~does not allow the development of a reliable estimate of stream depletion due to pumping.~~" and replace with something like " …makes current model predictions of location and timing of impacts uncertain."	Edit complete
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-054	B	PM	Request for Clarification		4	14	4.2	304	The "Avoiding Significant Increase of Total Net Groundwater Use from the Basin" PMA does not provide a definition of what "significant" means, so we suggest removing that word. Without a definition, isn't this PMA meaningless? It should probably either be percent (e.g., 1%) or volume? See related comment regarding Chapter 4, page 19, section 4.2, line 505-508.	See MCR "SGMA"
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-055	B	PM	Request for Clarification		4	14	4.2	326-331	We are unable to understand exactly what the "Avoiding Significant Increase of Total Net Groundwater Use from the Basin" PMA means, especially, this excerpt: "Due to the direct relationship between net groundwater use and ET, implementation of the MA is measured by comparing the most recent five- and ten-year running averages of agricultural and urban ET over both the Basin and watershed, to the maximum value of Basin ET measured in the 2010-2020 period, within the limits of measurement uncertainty." Can it be re-stated more clearly, such as, "The goal of this MA is for X not to exceed Y by Z percent?" Can you provide information on the limits of measurement uncertainty? What is the rationale for using the maximum as the basis for the comparison? Is the purpose of the running averages to smooth out climatic variation (i.e., is ET higher in wet years than dry years)? If there is substantial variation between water year types, then should the goal be different in different water year types? What about the contribution of surface water irrigation to ET? We anticipate that climate change will cause increased reliance on groundwater because surface water flows are going to recede earlier in the irrigation season (due less snowmelt), which could result in ET staying the same but groundwater extraction will increase and flows be lower, all without violating this MA.	The GSA may choose to use Basin ET in lieu of metering wells to ensure that consumptive water use in the Basin will not rise further. When chossing ET as a measure of groundwater consumptive use, future running average ET (more recent five-year period or the most recent 10=year period) cannot exceed the maximum annual observed ET in the 2010-2020 periods.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-056	C	GE	References Other Comments		4	15	4.2	341-343	"To be flexible in adjusting the limit on total net groundwater extraction if and where additional groundwater resources become available due to additional recharge dedicated to later extraction." Groundwater is already over-extracted, and there is not extra water available to use in enhancing recharge. See comments on Chapter 4, Section 4.3, page 30, line 895.	If no water is available for recharge and no MAR or ILR occurs, then total net groundwater extraction would not be expanded.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-057	C	OR	Request for Clarification		4	19	4.2	505-508	"The permitting program would ensure that construction of new extraction wells does not significantly expand current total net groundwater use in the Basin (to the degree that such expansion may cause the occurrence of undesirable results)." How are "undesirable results" defined? Please add a definition or citation here. See related comment regarding Chapter 4, page 14, section 4.2, line 304.	Undesirable results are defined in chapter 3
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-058	B	AL	Request for Clarification		4	19	4.2	513-514	"Here are two illustrative examples of an appropriate use of well replacement…" … "Example 2: Replacement of a 1,000-gpm agricultural well that will be properly decommissioned with a new 2,000-gpm capacity agricultural well is permissible with the explicit condition that the 10-year average total net groundwater extraction within the combined area serviced by the old and the new well does not exceed the average groundwater extraction over the most recent 10-years." Since groundwater use is mostly unmetered (much less publicly accessible), how would this be tracked or enforced?	The extraction could be measured with a flow meter, or by assessing changes in ET from lands that may be serviced by this well.

Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-059	B	AL	Request for Clarification		4	23	4.2	659-667	The proposed monitoring of irrigation efficiency omits a key tool– metering of water use. Without metering, how can we know if the efficiency projects are actually working?	See MCR "5-year Update"
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-060	B	GE	Request for Clarification		4	23	4.2	659-667	The proposed monitoring of irrigation efficiency lists "Assessment of the increase in irrigation efficiency, with particular emphasis on assessing the reduction or changes in consumptive water use (evaporation, evapotranspiration) based on equipment specification, scientific literature, or field experiments." Doesn't efficiency usually not affect consumptive water use but instead just change recharge (that's how it is represented in the SVIHM, right?). What is the physical basis for thinking efficiency would affect consumptive use for crops like pasture and alfalfa that have low[1]lying continuous canopy cover (i.e., in contrast to orchards or row crops like tomatoes where efficient delivery systems like drip irrigation could reduce evaporation from bare soil)?	This comment refers to the Scott Valley groundwater basin numerical model, when these comments are for the Shasta Valley Basin. However, the irrigation efficiency PMA has been updated for clarity to address this comment.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-061	B	GL	Groundwater Level Improvement Plan Insufficient		4	25	4.2	668	"Juniper Removal: The GSA, USGS and other agencies and private stakeholders will remove excess juniper within the watershed to improve groundwater levels." While it is conceptually possible to increase water yield for some number of years following juniper removal, it is difficult to actually implement at a watershed scale and maintain it over time. Furthermore, juniper removal will not necessarily increase water yield in all climates, so local conditions should be evaluated (Niemeyer et al. 2017). Such projects should be considered within a holistic management framework that re-establishes historical fire regimes and does not focus solely on water yield. Maintenance would be needed because the benefits of one-time removal projects are likely to be short-lived (Fogarty et al. 2021). References: Fogarty, D. T., de Vries, C., Bielski, C., & Twidwell, D. (2021). Rapid Re-encroachment by Juniperus virginiana After a Single Restoration Treatment. Rangeland Ecology & Management, 78, 112–116. https://doi.org/10.1016/j.rama.2021.06.002. Niemeyer, R. J., Link, T. E., Heinse, R., & Seyfried, M. S. (2017). Climate moderates potential shifts in streamflow from changes in pinyon-juniper woodland cover across the western U.S. Hydrological Processes, 31(20), 3489–3503. https://doi.org/10.1002/hyp.11264	Added the recommended text and references.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-062	A	PM	Alternative PMA Suggested		4	30	4.3	895	Given that there is already a dam in place that captures winter runoff from the upper Shasta River watershed, we oppose the Managed Aquifer Recharge (MAR) or In-Lieu Recharge (ILR) PMA. Dwinnell Dam already reduces winter and spring flows enough that there are not sufficient high flows to maintain natural geomorphic processes in the Shasta River. There is no "extra" water in the Shasta River that can be used to recharge groundwater. The way to improve groundwater conditions is demand reduction.	For the MAR and ILR PMA, the GSA will conduct a pilot study and discuss with the SWRCB regarding the diversion of water to evaluate the sustainabiltiy of water diversion. See MCR "PMA Selection Criteria".
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-063	C	GE	Projects and Management Actons		4	32	4.3	954	We support the Strategic Groundwater Pumping Curtailment PMA.	Noted. See MCR "PMA Selection Criteria".
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-064		GE	Modeling		App 2-E	10			We did not receive this appendix with the model documentation until September 13, so did not have time to review it in detail. Many sections of it appear to only be partially complete. We look forward to reviewing this when it is complete.	Model documentation is included in Appendix 2-E.

Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-065	B	OR	Request for Clarification		App 2-I	8			How do the total evapotranspiration of applied water (ETaw) and precipitation (ETpr) values calculated in this report compare with previous estimates such as from CDWR Land and Water Use Estimates (https://water.ca.gov/Programs/Water-Use-And-Efficiency/Land-And-Water[1]Use/Agricultural-Land-And-Water-Use-Estimates), and/or the remote-sensing based Baldocchi et al. (2019)? Full citation: Baldocchi, D., Dralle, D., Jiang, C., & Ryu, Y. (2019). How Much Water Is Evaporated Across California? A Multiyear Assessment Using a Biophysical Model Forced With Satellite Remote Sensing Data. Water Resources Research, 55(4), 2722–2741. https://doi.org/10.1029/2018WR023884	Thank you for this comment. The estimates of total evapotranspiration of applied water and precipitation were developed using best professional practices and sources of information cited in Appendix 2-I (Section 3), but a direct comparison to the other two sources of information cited here has not been completed at this time. This comparison will be taken into consideration for revisions for the final GSP and during GSP implementation, as each may provide a helpful point of reference and potential opportunity for improving estimates of evapotranspiration within the Basin.
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-066	B	OR	Request for Clarification		App 3-A	10		Table 2	Why are flow gages not listed in the Table 2 Data Gap Prioritization? Shouldn't measuring the flow rates of the largest springs (i.e., Big Springs, Little Springs, etc.) be the highest priority? We do not understand how it will be possible to calibrate groundwater model without having data for these springs.	See MCR Data Gaps - ISW
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-067	B	OR	Request for Clarification		App 3-A	11		Table 2	The groundwater extraction row of Table 2 says "No strategy has been defined yet to fill this data gap. Only voluntary measures are being considered to gathered extraction data." This is disappointing. How can groundwater be effectively managed without data about how much groundwater is being pumped?	See MCR General Data Gaps
Quartz Valley Indian Community	QVIC-001	B	PM	PMAs For Instream Flows Insufficient						However, we are disappointed that the GSP did not propose more ambitious steps towards addressing the critical lack of instream flows in the river during summer and fall.	See MCR "ISW"
Quartz Valley Indian Community	QVIC-002	B	HM	Modeling Insufficient						The technical review has revealed a concerning weakness in the model, particularly in October and November when the groundwater basin is transitioning between draining and filling, those details are included herein. This is most concerning to the Tribe since this is when our salmon are in the Scott system trying to access as much habitat as possible to spawn. We feel that these modeling weaknesses could be refined and alleviated through a more robust monitoring program throughout the valley.	See MCR Data Gaps - ISW
Quartz Valley Indian Community	QVIC-003	C	GE	References Other Comments						We have also attached a Technical Memorandum developed by our consultants on the Shasta GSP. Many of the same legal questions apply to the Shasta GSP as well. Although QVIC staff were focused on the Scott GSP development, the Tribe has ancestral lands in the Shasta basin and development of a solid GSP is just as important there as in the Scott River basin to QVJC membership.	Noted.

SHASTA VALLEY GROUNDWATER SUSTAINABILITY PLAN
PUBLIC COMMENT SUMMARY – MULTIPLE COMMENT RESPONSE

November 2021

Multiple Comment Response Directory Table

ID	Multiple Comment Response
ISW	Clarifying text has been added to Section 3.4.3.2., where the GSP identifies and describes an effective method for quantifying streamflow depletion on calculating Baseflow contribution. The methodology is used in lieu of an integrated hydrologic model, which is currently under development. In the interim, groundwater contributions to baseflow are held at historic levels to avoid new undesirable results. SGMA defines that depletion of ISW (354.16) is based on groundwater conditions occurring throughout the basin and not explicitly groundwater extraction or use. The GSP sets the minimum threshold (MT) based on the calculated baseflow contributions from groundwater which is a function of groundwater conditions in the basin. However, the Basin is expected to operate above the measurable objective (MO) at 145 CFS; the difference between the MO and MT is and should be treated as an operational buffer zone to prevent the Basin from approaching the MT. At this time a preliminary Minimum Threshold of 100 cfs of baseflow has been chosen by looking at the typical baseflow under recent conditions, which is limited by a short historical record that lacks sufficient drought year representation. The MT is set at 100 cfs and not higher (closer to 150 cfs in some years) to account for the lack of baseflow data during drought years that would result in lower baseflow contribution. This will prevent the MT from being passed under current conditions in a drought year. The Minimum Threshold may increase pending further discussion with the Watermaster and analysis of new groundwater and surface water monitoring data under a greater variety of water year types. This analysis can be completed prior to the scheduled 5-year GSP update, if new data from 2019-2021 is obtained. The GSA plans to collaborate with CDFW to develop in-stream flow requirements with the SWRCB to better protect environmental beneficial users. Fundamentally, the GSA currently lacks sufficient groundwater and surface water monitoring data and models to identify depletion of surface water specifically from groundwater pumping and appropriately calibrate the model. At this time there is insufficient groundwater and surface water monitoring data to distinguish what baseflow contribution occurs during periods of influence from groundwater pumping and what baseflow occurs during periods of no influence from groundwater pumping, however, baseflow is still a direct measure of ISW. The numerical groundwater-surface water model cannot be used for this calculation until the identified data gaps are filled. After the data gaps are addressed, the model can be calibrated to properly represent the flow exchange and evaluate groundwater contributions during the entire year. The focus of the 2027 GSP update is to address data gaps related to the Big Springs Complex, and the focus of the following GSP update will be the Little Shasta River and other Shasta River tributaries, dependent on funding. The UC Davis Center for Watershed Sciences (CWS) is in the process of developing an

ID	Multiple Comment Response
	in-stream flow assessment of the Little Shasta River (LSR) and have been sharing information that will support the GSP in eventually creating ISW criteria for the LSR as currently there is insufficient data to quantify streamflow depletions or more specifically streamflow depletions due to groundwater extraction. Due to these data gaps, the GSP also does not have detailed interim milestones for the ISW SMC. These will be developed during first five-year implementation period as additional data become available and the integrated hydrologic model becomes available for developing a more specific ISW SMC, including interim milestones. This may also include determining which reaches that could benefit from reduction in pumping or recharge projects during critical times of the year. The GSA acknowledges the data gaps in the ISW analysis in Section 2.2.2.6, outlines how to address them in Appendix 3-A, and discusses the implementation plan in Chapter 5. Additional text has been added to Section 2.2.2.6 and Appendix 3-A for clarity and an additional management action "Interconnected Surface Water Data Gaps" has been added to Chapter 4. A more detailed implementation for PMAs and data gaps has been added to Chapter 5. The GSA looks forward to working with CDFW and other relevant agencies to fill these data gaps of ISWs in Shasta Valley in the next 5 years for the next GSP update.
GDE	Section 2.2.2.7 lists all the protected species in Shasta Valley. The section provides Table 2.6, which lists all freshwater species with any federal and state level status, from endangered to watch list. This list of observed species within the Butte Valley groundwater basin was collected from the California Department of Fish and Wildlife (CDFW) Biogeographic Information and Observation System (BIOS) Viewer. Describing potential impacts on GDEs requires a better understanding of the location and nature of GDEs in the Basin. The location of species within the Basin requires local confirmation and fine-tuning of general online maps. The GDE monitoring network must be expanded; SV02 is currently the best and only groundwater well to monitor any subset of GDEs. The aim of the GSP is to protect existing GDEs. By setting the water level SMCs such that water level conditions during the baseline period (1991-2014) are preserved, these existing GDEs are sufficiently protected. Representative areas currently classed as 'Assumed not a GDE' will be reviewed in the field as part of future work and reanalyzed as data gaps are filled. The GSA acknowledges the data gaps in the GDE analysis in Section 2.2.2.7 and outlines how to address them in Appendix 3-A and Chapter 5. Additional text has been added to Section 2.2.2.7 and Appendix 3-A for clarity and an additional management action "Groundwater Dependent Ecosystem Data Gaps" has been added to Chapter 4. The GSA looks forward to working with

ID	Multiple Comment Response
	CDFW and other agencies to fill these data gaps of local habitat in Shasta Valley in the next 5 years for the next GSP update.
Water Budgets	A table with the data shown in Figures 60 and 61 in Chapter 2 is now included, presenting the historic groundwater basin and watershed water budgets. Tables 13-18 in Chapter 2 present summary statistics for the water budget, computed with SWGM. The model is currently calibrated for the period from 1990 to 2018 using twice annual water level data from DWR's CASGEM database plus local monthly data provided by The Nature Conservancy for few locations in the Basin. With new continuous water level monitoring now in place since 2019, and with additional data collection efforts to address data gaps identified in the GSP, future model calibration will provide the basis for improving the representation of the groundwater-surface water interface in the model, including canal leakage, lake seepage, and surface water depletion due to groundwater pumping. The future climate models were prepared by DWR and used in accordance with DWR guidance.
HCM	The entire Basin is considered one principal aquifer, with sub aquifers or water bearing formations reflected in the parametrization of the model. Text has been modified to make this clearer. Groundwater elevation maps are included in Section 2.2.2. Aquifer parameters are described in Chapter 2.2 and documentation of the Shasta Watershed Groundwater Model (SWGM) in Appendix 2-E. For purposes of the GSP, a representative groundwater monitoring program was developed across multiple water bearing formations, representative of the varied geology across the basin. The network encompasses both, alluvial formations and volcanic formations. Data do not currently exist to distinguish water level conditions in multiple overlying geologic units. Future nested piezometer well development should help determine vertical gradients between aquifers. The geologic model, based on well logs, defined different hydrogeologic formations. These were assigned appropriate hydraulic parameters based on geologic properties and further adjusted with model calibration. Unlike alluvial basins elsewhere in California, the principle aquifer in Shasta Valley is not the alluvium; rather it is a combination of the alluvium, volcanic debris and lava flows. A definable base is not presented in the HCM because a clear spatial definition of the contact between alluvium, volcanics, and bedrock is not available, especially where volcanic rocks are very thick. It is possible to calculate the approximate storage in the principle aquifer using groundwater elevation, expected (range of) values for formation specific yield, and formation thicknesses, but given the large uncertainty about the thickness

ID	Multiple Comment Response
	of the volcanics, our focus is on changes in groundwater storage rather than total groundwater storage. We note that water bearing formations may have variable yields throughout the basin due to changes in geologic structure, preferential flow paths (e.g. fractures), and groundwater conditions.
Data Gaps - ISW	SMCs for ISWs will be revisited during the next 5-year GSP update. The GSA acknowledges the data gaps in the ISW analysis in Section 2.2.2.6, outlines how to address them in Appendix 3-A, and discusses the implementation plan in Chapter 5. Additional text has been added to Section 2.2.2.6 and Appendix 3-A for clarify and an additional management action "Interconnected Surface Water Data Gaps" has been added to Chapter 4. A more detailed implementation for PMAs and data gaps has been added to Chapter 5. The GSA looks forward to working with CDFW and other relevant agencies to fill these data gaps of ISWs in Shasta Valley in the next 5 years for the next GSP update.
Data Gaps - GDE	See MCR GDE
Opinion	Noted.
Water Quality	The GSA only sets SMCs for two COCs but will continue to monitor other identified COCs for any increasing temporal and spatial trends. As shown in Appendix 2-B, benzene contamination is highly localized and is monitored and managed by the Regional Board through the Leaking Underground Storage Tank (LUST) program. The GSA feels that SMCs are not needed at this time for benzene but will continue to monitor trends. The GSA feels that an SMC is not needed for naturally occurring arsenic, boron, iron, manganese, and pH, but will continue to monitor the constituents for any future issues.
Public Trust	Case law does not support the assertion that the Public Trust Doctrine (PTD) requires a GSA generally, or a special act district acting in such capacity, to take specific actions with respect to public trust resources in the context of developing a GSP. Therefore, the consensus building of the Advisory Committee (AC) is a legitimate means of specifying an approach to considering the PTD, where the AC - consisting of a wide range of stakeholders - considered this MT to be a workable compromise between local economic interests, tribal interests, and environmental needs. The GSA operates under the SGMA and its associated regulations. SGMA clearly outlines a staged process to full compliance with the sustainability criteria by 2042. Furthermore, an extended implementation period for actions to protect public trust resources is not unprecedented: Several decades separate the Mono Lake court decision (National Audubon Society v. Superior Court (Supreme Court of California, 1983, 33 Cal.3d 419) from achieving its management (i.e., sustainability) goal, which has yet to be reached (https://www.monolake.org/learn/stateofthelake/). A short section on the PTD has been added to Chapter 2 - Section 2.1.2.6.

SHASTA VALLEY GROUNDWATER SUSTAINABILITY PLAN
PUBLIC COMMENT SUMMARY – MULTIPLE COMMENT RESPONSE

November 2021

ID	Multiple Comment Response
General Data Gaps	The GSA acknowledges existing data gaps in Chapter 3 and Appendix 3-A, proposes PMAs in Chapter 4, and discusses an implementation plan in Chapter 5. General data gaps include water levels from domestic wells and groundwater extraction. Based on existing and available data, the GSP contains an accurate water budget, clearly defined sustainable management criteria, including minimum thresholds. The GSP will be updated as needed when data gaps are filled but will be dependent on outside sources of funding. The current data gap in groundwater extraction does not limit effective groundwater management as estimating groundwater extraction based on land use is sufficient to quantify basin groundwater budgets that determine groundwater sustainability for the basin. Future voluntary collection of groundwater extraction will serve for modeled groundwater pumping validation and verification of the success of PMAs.
Overdraft	As defined in Bulletin 118, overdraft refers to a long-term trend in groundwater storage, not to short-term fluctuations in water levels that may seasonally lead to some undesirable results.
Sustainable Yield	The GSP is more conservative than a specific sustainable yield. Sustainable yield is a function of future climate and of project implementation. It may be less in the future than it is currently. The sustainable yield selected by the GSP is a formula that accounts for such changes. Prescribing a fixed sustainable yield is technically incorrect and practically insufficient to achieve long-term sustainability. The starting value of the sustainable yield is focused on the historic average of groundwater pumping which will translate into looking at the future averages of annual groundwater pumping rather than specific years. The undesirable results are prevented through the minimum threshold. The minimum threshold will be reached by implementation of PMAs that achieve the required level of reversal in streamflow depletion. To the degree that those PMAs require a future reduction in groundwater pumping, that amount of pump reduction must be subtracted from the sustainable yield, which was computed for the pre-2015 baseline period. By providing a definition of sustainable yield that is not a fixed number, but accounts for future PMAs in a well-prescribed protocol, the sustainable yield is specific and implicitly adjusts to the implementation of PMAs. The GSP's definition of sustainable yield avoids the possibility that a new pumper will claim the amount of pumping that was retired through a PMA elsewhere in the basin. This also provides for managed or in lieu aquifer recharge to not be added to the sustainable yield of the basin if that recharge is explicitly dedicated to the reversal of stream depletion. The approach is consistent with that, e.g., in overdrafted basins, where the sustainable yield, in some basins, is defined as the sustainable yield during the base period plus any future increases in managed aquifer recharge (a PMA).
Groundwater Storage	**Moved to HCM**
PMA Selection Criteria	Chapter 5 outlines how PMAs will be selected for prioritization during GSP implementation. Text has been added to Chapter 4.1 and Chapter 5 implementation schedule. After GSP adoption, the GSA will prioritize certain

ID	Multiple Comment Response
	PMAs for feasibility reviews and preliminary engineering studies. Based on review and study results, PMAs may move forward to implementation.
SGMA	The terms are part of SGMA language. The definitions of unreasonable results are explained in Chapter 3 for the different sustainability indicators.
5-year Update	At this time, the GSA has elected to use a voluntary program for groundwater extraction reporting. For the next five years, the GSA will conduct public outreach to encourage voluntary participation. This may be revisited in the 5-year update. Siskiyou County is currently considering a revised well drilling permit.
Surface Water Temperature	CCR 354.28(c)(4) explicitly refers to "contaminant plumes" and "supply wells", indicating that groundwater quality must be monitored ("Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin."). Furthermore, in interpreting this regulation, DWR's BMP 6 guidelines (https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-6-Sustainable-Management-Criteria-DRAFT_ay_19.pdf) provide no indication that surface water quality monitoring is required where and when baseflow conditions occur. With respect to surface water temperature, it is described as an undesirable result associated with low groundwater levels and storage, and insufficient baseflow.
Emergency Regulations	The SWRCB regulations at 23 CCR 875 et seq. identify "emergency minimum flows" and authorize the Division of Water Rights to curtail diversions where necessary to ensure Shasta River flows are not reduced below the emergency minimum flows. In this regard, the emergency minimum flows serve as a target to guide the Division of Water Rights in determining whether to curtail diversions. These minimum flows do not apply outside this context such that local water use, and planning decisions must attempt to achieve the emergency minimum flows. Further, SWRCB's action only pertains to extremely dry years and/or is anchored in a governor's drought emergency declaration. Some language on this topic has been added to Chapter 2.
References	This topic is already discussed in Chapter 2, based on existing scientific data. Additional statements must be supported by scientific references and documented data. If relevant references are missing from the GSP, please submit to the GSA during the next GSP update.
Well Outtage Appendix	A well outage analysis has been added to the GSP, in Appendix 3-C.

SHASTA VALLEY GROUNDWATER SUSTAINABILITY PLAN
PUBLIC COMMENT SUMMARY – MULTIPLE COMMENT RESPONSE

November 2021

ID	Multiple Comment Response
Data System	The GSA will follow DWR guidelines for data and model transparency. Per DWR's modeling BMP document, "final model files used for decision making in the GSP should be packaged for release to the Department". We anticipate that model files will be unloadable with the GSP in digital format. Similarly, we anticipate that DWR will collect annual report data in digital format.

Table Key:
AC = Advisory Committee
BMP = best management practice
CASGEM = California Statewide Groundwater Elevation Monitoring Program
CDFW = California Department of Fish and Wildlife
COC = Water Quality Constituent of Concern
DWR = Department of Water Resources
GDE = Groundwater Dependent Ecosystem
GSA = Groundwater Sustainability Agency
GSP = Groundwater Sustainability Plan
HCM = Hydrologic Conceptual Model
ISW = Interconnected Surface Water
MT = Minimum Threshold
PMA = Project and Management Action
PTD = Public Trust Doctrine
SGMA= Sustainable Groundwater Management ACt
SMC = Sustainable Management Criteria
SWGM = Shasta Watershed Groundwater Model
SWRCB = State Water Resource Control Board

Appendix 1-D Shasta Valley Tribal Comment Summary

Shasta Valley Groundwater Sustainability Plan

Tribal Comment Summary

January 2022

Prepared for:

Siskiyou County Flood Control and Water Conservation District

Prepared by:

Stantec Consulting Services, Inc.

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SHASTA VALLEY GROUNDWATER SUSTAINABILITY PLAN
TRIBAL COMMENT SUMMARY

January 2022

LIST OF TABLES

ABBREVIATIONS

Advisory Committee	Shasta Valley Groundwater Basin Advisory Committee
CIN	Comment Identification Number
District	Siskiyou County Flood Control and Water Conservation District
DWR	California Department of Water Resources
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
Matrix	Comment and Comment Response Matrix
MCR	Multiple Comment Response
MOU	Memorandum of Understanding
SGMA	Sustainable Groundwater Management Act of 2014
Summary	Tribal Comment Summary

ATTACHMENTS

Attachment A – Tribal Correspondence

Attachment B – Annotated Tribal Comment Letters Received on Draft Groundwater Sustainability Plan

Attachment C – Shasta Valley Groundwater Sustainability Plan Tribal Comment and Comment Response Matrix

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January 2022

1.0 INTRODUCTION

This Tribal Comment Summary (Summary) describes the process used by the Siskiyou County Flood Control and Water Conservation District (District) Groundwater Sustainability Agency (GSA) to solicit, review, and respond to Tribal comments on the Draft Shasta Valley Groundwater Sustainability Plan (GSP). This Appendix was developed pursuant to Section III Item vii of the Memorandum of Understanding (MOU) between the Karuk Tribe and the District.

The public review and notification processes were developed pursuant to the Sustainable Groundwater Management Act of 2014 (SGMA) and the California Department of Water Resources' (DWR) Groundwater Sustainability Plan Emergency Regulations, developed in May 2016.

This Summary serves to supplement Appendix 1-C – Comment Response Summary, which describes the process and tools used by the GSA to solicit, review, and respond to public comments on the Draft Shasta Valley GSP. To read more about the public review period and the process and tools used to respond to public comments, refer to Appendix 1-C.

This Summary is comprised of the following four sections:

- Section 1 – Introduction: Section 1 provides an overview of the purpose and structure of the document.
- Section 2 – Notice and Communication: Section 2 describes the method by which the GSA notified Tribes within the plan area of the proposed plan and the resulting government-to-government consultation between the County and the Karuk Tribe. The notification letters, requests for consultation, and consultation meeting summary are included as **Attachment A** to this Summary.
- Section 3 – Tribal Comments: Section 3 provides an overview of the comment letters received from Tribes on the Draft GSP during the public comment period. The comment letters in their entirety are included as **Attachment B** to this Summary. This section also summarizes how the GSA reviewed and responded to the Tribal comment letters received during the public comment period, which is discussed in detail in Appendix 1-C. A copy of the tool used to categorize and respond to comments is provided as **Attachment C** to this Summary.
- Section 4 – Outcomes from December 3, 2021 Government-to-Government Consultation Meeting: Section 4 describes the outcomes of the meeting between the Karuk Tribe and the District on December 3, 2021. A full account of the meeting is provided in the consultation meeting summary which is included in **Attachment A**.

2.0 NOTICE AND COMMUNICATION

The GSA notified Tribes within the GSP area of its intention to adopt the GSP on August 11, 2021, which was at least 90 days before adoption of the Final GSP on December 7, 2021. This notification included a letter sent the Yurok, Shasta Indian Nation, and Karuk Tribes. In addition to the letter, the public was notified about release of the Draft GSP via postings on the Siskiyou County website and a local Yreka newspaper.

The GSA received an informal request for government-to-government consultation from the Karuk Tribe on September 7, 2021. The GSA and Karuk attempted to coordinate a meeting prior to the close of the public comment period on September 26, 2021, however, they were not able to find a time given the short window of opportunity. Subsequently, the Karuk Tribe submitted a formal request for government-to-government consultation on September 20, pursuant to Section III Item v of the MOU between the District and the Tribe. The GSA and the Karuk Tribe held a government-to-government consultation on December 3, 2021. An example of the notification letter sent to the Tribes, copies of the Karuk Tribe's requests for consultation, and the December 3 Consultation Meeting Summary are included in **Attachment A** to this Summary.

3.0 TRIBAL COMMENTS

The GSA received three comment letters on the Draft GSP from Tribes during the public comment period—see **Table 1** below. Copies of the comment letters received are provided in **Attachment B** to this Summary.

Table 1. Submitted Comments

Commenter Name	Date Comment was Received
Karuk Tribe	9/24/2021
Klamath Tribal Water Quality Consortium	9/24/2021
Quartz Valley Indian Community	9/24/2021

The GSA reviewed and responded to Tribal comments using the same process and methodology as comments received from other members of the public. The process is summarized here and detailed in full in Appendix 1-C.

Following the close of the public comment period, the GSA reviewed each comment letter to identify individual comments on the Draft GSP. To organize and manage the review of issue-specific comments, staff created a database, or matrix, that allowed for the categorization, grouping, and response to comments.

Of the three letters received from Tribes, GSA staff identified a total of 71 issue-specific comments for review and response. Each comment was assigned an individual comment identification number and entered into the database referred to as the Shasta Valley GSP Comment and Comment Response Matrix (Matrix). GSA staff then used the Matrix to group technical or policy issues raised on the GSP, identify potential changes to the GSP to address comments, and develop comment responses. The portion of the Matrix pertaining specifically to Tribal comments is provided in **Attachment C** to this Summary. The full Matrix, which includes public comments and Tribal comments, is provided in Appendix 1-C.

Table 2 describes the types of information included in the Matrix.

Table 2. Shasta Valley Groundwater Sustainability Plan Comment and Comment Response Matrix Columns

Matrix Column	Column Description
Author	Name of agency or organization that signed or submitted the comment letter.
Comment Identification Number (CIN)	Unique identifier assigned to each comment received. A single comment letter may contain multiple individual comments, each with its own comment identification number.
Multiple Comment Response (MCR) number	Comments that were similar in scope were grouped together based on the GSP sections or content they discussed. Each group of comments were assigned an MCR number, identified here.
Group	Comment grouping to facilitate structured review by Advisory Committee and GSA staff.
Sub-Category	Topic within the Draft GSP that the comment identifies with, describes, or otherwise raises questions about.
Description	Short description of the main topic or issues raised in the comment.
Code/Regulation	The code or regulation cited in the comment, if referenced.
Location in GSP	The chapter, page, and line number in the Draft GSP cited in the comment, if referenced.
Comment	Copies of the comment text directly from the comment letter.
Response/Recommended Action	Response or recommended action to address the comment.
Response Location in GSP	Location in Draft GSP text changes were made in response to comment, if applicable.

Key:
GSA = Groundwater Sustainability Agency
GSP = Groundwater Sustainability Plan

Comments of a similar nature were assigned a “Multiple Comment Response” or MCR. An MCR is a single response that applies to multiple comments of a similar nature. Draft MCRs pertaining significant technical and policy comments were shared with the Advisory Committee in advance of the Comment Response Workshop on October 26. Based on feedback from the workshop, the MCRs were finalized and are included in **Attachment C** to this Summary. For more information about the workshop and the development of comment responses, see Appendix 1-C.

4.0 OUTCOMES FROM DECEMBER 3, 2021, GOVERNMENT-TO-GOVERNMENT CONSULTATION MEETING

The District and the Karuk Tribe agreed to several actions as a result of the government-to-government consultation held on December 3, 2021. First, GSA staff committed to providing a Tribal Comment Summary pursuant to the MOU. Second, the District agreed to amend the implementation chapter of the GSP to include specific language related to future coordination between the Tribe and the District. Third, both parties committed to future communication and collaboration with one another and agreed to meet in January 2022 as a first step, to outline the scope of the effort. As previously noted, a full account of the meeting and its agreements is provided in the Meeting Summary included in **Attachment A** to this Summary.

Attachment A – Tribal Correspondence

COUNTY OF SISKIYOU
Flood Control and Water Conservation District

P.O. Box 750 □ 1312 Fairlane Rd (530) 842-8005
Yreka, California 96097 FAX (530) 842-8013
www.co.siskiyou.ca.us Toll Free: 1-888-854-2000, ext. 8005

August 10, 2021
Attn: [Recipient]

Subject: Notice of Upcoming Hearing for Adoption of Groundwater Sustainability Plans

Dear [Recipient],

This letter is intended to provide the [Recipient] with notice of the Siskiyou County Flood Control and Water Conservation Districts (District) proposed adoption of a Groundwater Sustainability Plan (GSP) pursuant to California Water Code (CWC) section 10728.4. As required by the Sustainable Groundwater Management Act (SGMA) of 2014 (CWC §10720 et seq.), the District, acting as the Groundwater Sustainability Agency, must provide notice to a city or county within the area of the proposed GSP at least 90-days prior to holding a public hearing to adopt the GSP (CWC §10728.4).

The District has scheduled a public hearing to consider adoption of the Butte Valley, Shasta Valley and Scott River Valley GSP on December 7, 2021, at a time to be determined, during a meeting of the District, located in the Siskiyou County Board Chambers, 311 Fourth St, Yreka, CA 96097.

In accordance with CWC §10728.4, your city is eligible to request consultation with the District in advance of the public hearing. If you wish to consult with the District regarding the adoption of its GSP, please provide notice within 30 days of receipt of this letter.

You may also submit comments on the GSP during the scheduled public comment period. All relevant material, including instructions for commenting, can be found in a downloadable pdf format on the District's website at the following link: https://www.co.siskiyou.ca.us/naturalresources/page/sustainable-groundwater-management-act-sgma

If you have any questions, contact Matt Parker, Natural Resources Specialist at (530) 842-8019, or mparker@co.siskiyou.ca.us. This letter was approved by the Siskiyou County Board of Supervisors on August 10, 2021 by the following vote:

AYES: Director Criss, Kobseff, Valenzuela, Ogren and Haupt
NOES: None
ABSENT: None
ABSTAIN: None

Sincerely,

Ray A. Haupt, Chair
Siskiyou County Flood Control and Water Conservation District

Karuk Community Health Clinic
64236 Second Avenue
Post Office Box 316
Happy Camp, CA 96039
Phone: (530) 493-5257
Fax: (530) 493-5270

Karuk Tribe

Karuk Dental Clinic
64236 Second Avenue
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Happy Camp, CA 96039
Phone: (530) 493-2201
Fax: (530) 493-5364

Administrative Office
Phone: (530) 493-1600 • Fax: (530) 493-5322
64236 Second Avenue • Post Office Box 1016 • Happy Camp, CA 96039

September 7th, 2021

Ray Haupt, Chair
P.O. Box 750
1312 Fairlane Road
Yreka, CA 96097

RE: Government to Government Meeting Request; Comments Sustainable Groundwater Management Plan

Ayukîi Supervisor Haupt:

The Karuk Tribe appreciates the efforts of you and the County of Siskiyou to develop Sustainable Groundwater Management Plans for the Scott and Shasta Valleys. Groundwater use impacts stream flows and fisheries habitat critical to the survival of salmon, steelhead, lamprey and other species the Karuk rely on not only for our sustenance but our cultural identity as well. Therefore, we are very interested in the development of a Sustainable Groundwater Management Plan for the Scott and Shasta Valleys.

We are writing to request an informal consultation meeting pursuant to the Memorandum of Understanding (MOU) between the Siskiyou County Flood Control and Water Conservation District and the Karuk Tribe, Section III (v). the purpose of the meeting is to discuss the timeline for comments on the draft Sustainable Groundwater Management Plan and specific concerns with the Plan.

As per the MOU, we would like to convene two elected offices from the County and the Tribe along with pertinent staff. Current COVID protocols are such that an electronic teleconference would be most appropriate.

Barbara Snider is the Tribal Council executive secretary and can work with a designated counterpart from the County to arrange meeting details. Barbara can be contacted either via phone, (530) 493-1600 extension 2036, or email bsnider@karuk.us.

Yootva,

Russell "Buster" Attebery
Chairman

Enclosure: Memorandum of Understanding between the Siskiyou County Flood Control and Water Conservation District and the Karuk Tribe

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Karuk Dental Clinic
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Phone: (530) 493-2201
Fax: (530) 493-5364

October 20th, 2021

Ray Haupt, Chair
PO Box 750
1312 Fairlane Road
Yreka, CA 96097

RE: Government to Government Meeting Request

Ayukîi Supervisor Haupt:

On September 7, 2021, pursuant to section III. (v.) of the Memorandum of Understanding (MOU) between the Siskiyou County Flood Control District (District) and the Tribe signed in March of 2020, the Tribe transmitted a request for an informal consultation meeting to discuss "the timeline for comments on the draft [Scott and Shasta] Sustainable Groundwater Management Plans and specific concerns with the Plan."

District staff communicated by email that there were no available meeting times to meet our request prior to the deadline for comments on the draft Plans.

On September 24, 2021 the Tribe received a letter from the District offering to meet with the Karuk Tribe. However, one of our key issues was the deadline for comments. Because the District did not release all of the 600+ pages of technical information used to develop the draft Plans when the draft Plans were released, it was difficult for Tribal staff and consultants to prepare thorough comments. By failing to meet with the Tribe in a timely manner, the District provided no opportunity to resolve issues arising from the development of the Plans.

Because our issue was not addressed or resolved in a timely manner consistent with section III. (v.) of the MOU, the Karuk Tribal Council invites the District to participate in an official Government to Government consultation meeting that would include a majority of the Karuk Council and the District Board and held in accordance with the Ralph M. Brown Act pursuant to section III. (vi.) of the MOU. The meeting will be held virtually due to COVID-19, please have appropriate staff contact Executive Secretary Barbara Snider to schedule at 530-493-1600 ext2036 or bsnider@karuk.us

The agenda of this meeting shall include a discussion of the ground water crisis the Plans are supposed to address, the consequences of failing to address the groundwater crisis, and our specific concerns with the draft Plans. Any unresolved issues in addition to our already filed comments shall be documented and forwarded to the District Board in accordance with Section III (vii.) of the MOU.

Yôotva,

Russell "Buster" Attebery
Karuk Tribe Chairman

Siskiyou County Sustainable Groundwater Management
Facilitated Meeting: County of Siskiyou/Karuk Tribe
MEETING NOTES

Friday December 3, 2021
9:00 – 11:00 AM

Meeting Objective: Siskiyou County Flood Control District (County) to listen to and discuss Karuk Tribe's concerns regarding the timeline for comments on the draft Groundwater Sustainability Plans (GSPs) and specific concerns with the GSPs in Scott and Shasta Valleys.

Attendees:

Karuk Tribe	County of Siskiyou	SGMA Technical Team	Facilitation Support
Russell "Buster" Attebery	Michael Kobseff	Laura Foglia	Katie Duncan
Archie Super	Nancy Ogren	Thomas Harter	Marisa Perez-Reyes
Robert Super	Natalie Reed		
Elizabeth Bentley	Aaron Ferguson		
Arron Hockaday	Matt Parker		
Renee Stauffer	Elizabeth Nielsen		
Darrel Aubrey			
Joshua Saxon			
Grant Johnson			
Craig Tucker			
Earl Crosby			

Agenda:
1. Welcome and Introductions
2. Opening Statements
3. Summary of Karuk Comments on the GSPs
4. Next Steps, Closing Remarks

Meeting Summary

1. Welcome and Introductions

The Karuk Tribal Councilmembers made self-introductions. Supporting staff to the Karuk Tribe made self-introductions. The Siskiyou County Flood Control District Board Members made self-introductions, followed by GSA supporting staff. The technical team made self-introductions, followed by the Stantec facilitator and note-taker.

The Karuk Tribe relayed that Anecita Agustinez, Tribal Policy Advisor to the Department of Water Resources (DWR), had been invited to join the meeting and may enter, later in the call. The County requested a five-minute recess to confer amongst themselves, regarding Anecita's role in the meeting.

Note that the recess was ten minutes long. Anecita Agustinez entered the meeting during the recess.

The County reported back that they are not prepared to move forward with the consultation with a third-party present, given the non-public meeting setting. Chairman Russel Attebery of the Karuk Tribe countered that the Memorandum of Understanding (MOU) between the County and the Tribe permits the participation of DWR as a third-party facilitator (Section III, Item IV). ["The Parties agree that each Party may request DWR facilitation services to ensure the Parties continue working together."]. The County contested whether Anecita Agustinez's participation would fall under Section III, Item IV of the MOU.

Anecita Agustinez requested permission to make a statement, which was denied by the County.

The Facilitator asked the Karuk Tribe if they would be willing to move forward with the consultation without Anecita's participation. The Karuk Tribe requested a recess to discuss the request. The Facilitator released the group for a ten-minute recess.

After a ten-minute recess, the Karuk Tribe conveyed that they were willing to continue the meeting without Anecita Agustinez, but wanted their disappointment with the meeting condition to be noted. Craig Tucker requested the note-taker add that the meeting was convened by the Karuk Tribe.

Darrel Aubrey confirmed that the Tribe received the August 10 Notice of Intent to Adopt and subsequently filed a request to meet with the GSA, on September 7. Darrel confirmed that the Tribe would like the summary of this consultation meeting to be made publicly available.

2. Opening Statements

Chairman Attebery shared that although the Tribe and the County have not always seen eye-to-eye, the Tribe has adopted the perspective of approaching the County with kindness. The Tribe has sustainably managed the environment for thousands of years. Given the current climate crisis and drought, the Tribe wants to meet to help sustainably manage the water for both farmers and fish. At this time, the Karuk feel that the SGMA process is a flawed process, because they have not been able to provide input. Instead of forming a GSA that includes the Tribes, the County formed an Agency that excluded Tribal participation. The Karuk feel that the Scott and Shasta Plans do a disservice to the people, make things worse, and create more conflict.

Director Kobseff shared the County's intention to welcome the Tribe and to work out differences where they can. He recognized that they haven't seen eye-to-eye in the past but wants to have a dialogue. The GSA wants to end water conflict in the region. He shared that in his 15-year history working for the County, he's championed projects and policies that benefit fish. Director Ogren shared her respect for the Tribes and expressed hope that they can work together to solve problems.

3. Summary of Karuk Comments on the GSPs

Craig Tucker shared that he was around when SGMA was passed into law, noting that California is far behind the rest of the Western states in regulating groundwater. Craig shared that when the legislation was passed, he advocated for the GSAs to involve Tribes like the Karuk. He noted that although the Tribes have really tried to be involved in the GSA, it has been extremely difficult for the County and the Tribe to just sit down and have a conversation. Given the obstacles they encountered on the front-end of the SGMA process, they developed this MOU with the County. Unfortunately, in the Karuk's perspective, the MOU has not worked. The Final GSPs were just released yesterday and the County is holding a public hearing to adopt on Tuesday.

Craig highlighted that there is not a separate appendix to the GSPs to share Tribal comments and responses to comments, which was a negotiated item in the MOU (section III, item vii).

Another issue the Karuk have with the GSPs relates to the topic of in-stream flows and the failure to define undesirable results. The Karuk are concerned about whether the Plans will pass muster at DWR. Craig noted that the GSA may be on a trajectory to giving away their authority to manage groundwater locally, which would certainly displease the constituents of the County. He contested that the GSA have been seating the Tribe "at the kids table" by only including them on Advisory and Ad Hoc Committees, rather than providing a governing seat on the GSA Board.

Craig asked, point-blank, if the opportunity to fix problems with the Plans exists or if it is set in stone and immutable prior to adoption. Matt Parker replied that the timeline is tight; he directed the question to the technical team.

Thomas Harter shared that the Scott and Shasta GSPs are among the most progressive in the State, regarding interconnected surface waters. These Plans are at the first step- they have more data to collect and projects to develop as implementation begins. The Minimum Threshold balances the interests involved. From a technical perspective, these plans represent the best possible path forward at this point. Craig Tucker said he would “agree to disagree” on Thomas’s assertion about the Plans being among the most progressive. Craig believes that SGMA sets them on a trajectory toward Coho extinction, and the Chinook aren’t far behind. SGMA is based on one of the worst water years in recent history. It’s one piece of regulation, but it’s not the end-all. He believes the GSA is on a trajectory for total basin adjudication.

Darrel Aubrey noted that the “significant and unreasonable stream depletion” definition of undesirable results is not quantitative. The Tribe would like it to be quantitative. Thomas shared that the desirable outcome for stream depletion reversal is specific and measurable. The mandate under SGMA is to prevent new undesirable results, from the benchmark of 2014.

Councilmember Arron Hockaday of the Karuk Tribe shared his experience, walking the Scott River in July. The stream is discontinuous, leaving fish stranded in ponds. He urged the GSA to remember that when we talk about low flow conditions, we can live with it, but the fish cannot and one day they won’t be there anymore.

Thomas Harter asserted that the measurable objective and the broader watershed perspective and goal articulated in the GSPs clearly shares the priority of the protecting the fish. Thomas cited specifics from the revised version of the Plans that were published yesterday.

Craig Tucker asserted that the January 31 deadline is a policy deadline and that DWR might allow more time if the GSA requested it. GSA Legal Counsel, Aaron Ferguson, clarified that January 31 is a statutory deadline and cannot be changed. The Tribe suggested meeting with the GSA in January. Thomas explained that the process for uploading the Plans is complicated and they wouldn’t want to start after January 1.

Darrel Aubrey requested clarification about whether the public is meant to have time to review the updated Plans and provide comments prior to Tuesday’s hearing. Matt explained that the Plans are not officially open to comments right now and pointed to DWR’s public comment period, which will open after the Plans are adopted.

Josh Saxon revisited the question of whether the Tribal comments will be pulled into a separate appendix, per the MOU. Matt recognized the oversight and conveyed that he would work with the technical team to pull those comments into separate appendices.

Laura Foglia shared information about the conversations she’s had with DWR and CDFW. DWR encouraged the technical team to publish GSPs now, with the addition of explicit language to the Implementation sections of the GSPs that conveys that the GSA will coordinate with the Tribes and other agencies (like CDFW) immediately after the Plans are adopted. The Facilitator asked Laura to clarify whether that modification is already reflected in the Plans. Laura said it was not explicit in the Scott and Shasta Plans and that based on outcomes from this meeting, they could further revise the Plans.

Darrel Aubrey pointed out that it feels like the Tribe was set up to fail – the MOU sets out an order of events, starting with informal consultation, formal consultation, and finally the preparation of a memorandum. Legal Counsel Ferguson raised the question of what it means for the GSA and the Tribe to “resolve” an issue, per the MOU. County representatives suggested the Tribe should have initiated the consultation request earlier. Craig shared that they did try to accelerate the timeline. Matt noted that he attempted to initiate staff-to-staff consultation a year ago. Matt claimed he had an email from Karuk staff indicating that they were okay with the Plan. Craig expressed doubt about that. Chairman Attebery shared his frustration that the County canceled the September meeting because one Board representative couldn’t make it. He shared that it sends the message that the Tribe doesn’t deserve a seat at the table.

Darrel Aubrey voiced that there isn't any point in rehashing the past and the group should focus on moving forward. Director Ogren suggested the County approve the Plans because they are out of time but make a commitment to working together with the Karuk to make the Plans work to everyone's best interest. She commended the skill of the technical teams that are present today. She urged the group to focus on that.

Craig shared that the State has been a good partner to the Tribe, and they will be working with DWR to share their grievances with the Plans. Craig shared his impression that the County has neglected the value of having a large Tribe in their area and instead acted as though the Tribe were a curse. He added that the Tribe is the largest non-federal employer in the area, and he's surprised the County hasn't met with the Tribe all along. Building on Craig's point, Darrel suggested the Tribe and the County hold more regular meetings. Craig clarified that it's "easier to work with us than against us."

Councilmember Archie Super thanked Director Ogren for her statements and noted the importance of having data-driven counsel, like Craig Tucker. Councilmember Super shared that in the last year, they've been trying to meet with the County, and it hasn't happened. He shared that it sends the message that the County has an issue with the Tribe. If they do, he wants to talk about it. And if they don't, he wants to get together and try to make it work.

Chairman Attebery shared his agreement with Director Ogren's statement. He reminded the Board of when the Karuk stepped in to help the City of Montague with their water problem and the smaller agencies all thanked the Karuk for stepping in, but the County did not offer thanks and instead changed the subject to share their concern about whether the Tribe would sue them about fish. He offered his regret for bringing it up, but felt it was important to share the context. He shared additional information about the Tribe's commitment to the area.

Councilmember Hockaday shared a statement about the longevity of the farming community in the area and reiterated his belief that it's time for everyone to come together.

4. Next Steps, Closing Remarks

The Facilitator reflected that it sounds like there is a common desire to move forward. The specific solutions she has heard offered include:

- More frequent government-to-government meetings.
- Explicit language in the GSPs, or maybe a separate agreement, regarding future coordination.

The Facilitator asked the County whether they are interested in either of the solutions and solicited additional solutions.

Director Kobseff offered apologies that the County has been perceived as not agreeable to these meetings. He pushed back on the assertion that the County ever closed the door on a conversation. He drew a distinction between meeting and agreeing. One of his issues is he doesn't think SGMA can solve the fish issues; he suggested that must be addressed through a different regulatory framework. Director Kobseff mentioned an upstream storage project proposal the County submitted recently, which unfortunately was not awarded. He reiterated his commitment to working together to find solutions for fish.

Craig Tucker asked the County to meet the Tribe half-way. He expressed doubt that there is enough room upstream for additional storage, but they are willing to support the study or like-studies. In turn, the County needs to consider the Tribes' suggestions as well, such as demand reduction studies and actions to restore flows to the river, and that equal consideration is what has been lacking thus far.

Darrel Aubrey suggested that to avoid scheduling conflicts, coordination meetings should be scheduled at least one month in advance. The Facilitator spoke to the scheduling element- she proposed the group agree to quarterly meetings starting in January. Matt asked for clarification about whether DWR or

Stantec can support facilitation of such meetings, especially considering they may want to discuss environmental matters aside from SGMA.

The Facilitator noted that the agenda for those coordination meetings would need to be agreed upon in advance. The first meeting could include discussion of next steps related to SGMA. The first step is to set a meeting date. Facilitator could work with both parties to establish a joint agenda and set the duration of the meeting. That process would take place for each meeting occurrence.

Craig urged the Councilmembers and Supervisors to think bigger. The Tribe and the County are pretty far apart on fish-related issues. He noted the nexus with housing, healthcare, etc., and proposed the County and the Tribe need to find something they can "win" on. The Facilitator suggested the Directors should confer amongst themselves and suggested the group commit, by December 17, with proposals for the first meeting date, the frequency of the meetings, their scope, and associated expectations. The Facilitator will coordinate with Darrel and cc the Chairman.

The Facilitator summarized the action items from the meeting:

- The Tribal-specific comments will be pulled out, pursuant to the MOU. There will be a separate Tribal comment and response matrix and summary for both the Scott and Shasta Valley GSPs.
- The group committed to continued collaboration and coordination.
- The group discussed whether language should be added to the GSPs. The Facilitator noted that the Supervisors can provide direction to staff and the technical team to add that specific language as a condition to approval of the GSPs.
- Facilitator will coordinate with both parties to schedule a meeting for January 2022 and develop a joint agenda that reflects each party's intentions and priorities.

Director Kobseff thanked the Tribe for meeting with the County and apologized for the rough start. Director Ogren expressed her thanks and appreciation for their respect and patience as they move through this process.

Chairman Attebery expressed that it is not how you start the game, it's how you finish the game. He couldn't agree more with the others. Councilmember Hockaday asked Councilmember Archie Super to close in prayer. Councilmember Super offered a closing prayer of thanks.

The Facilitator adjourned the meeting.

Attachment B – Annotated Tribal Comment Letters Received on Draft Groundwater Sustainability Plan

Karuk Community Health Clinic
64236 Second Avenue
Post Office Box 316
Happy Camp, CA 96039
Phone: (530) 493-5257
Fax: (530) 493-5270

Karuk Tribe

Karuk Dental Clinic
64236 Second Avenue
Post Office Box 1016
Happy Camp, CA 96039
Phone: (530) 493-2201
Fax: (530) 493-5364

Administrative Office
Phone: (530) 493-1600 • Fax: (530) 493-5322
64236 Second Avenue • Post Office Box 1016 • Happy Camp, CA 96039

September 23, 2021

Ray Haupt, Chair
Siskiyou County Flood Control & Water Conservation District
P.O. Box 750
1312 Fairlane Road
Yreka Ca 96097

Re: Karuk Tribe Comments on Scott and Shasta Groundwater Sustainability Plans

Ayukîi Chairman Haupt:

The careful and sustainable management of our groundwater is critically important to ensuring Siskiyou County residents have ample water supplies to meet future drinking, agricultural, and environmental needs. For the Tribe, proper management of groundwater is a critical part of ensuring that the in-stream flow needs of fisheries are met today and into the future.

The Sustainable Groundwater Management Act (SGMA) was enacted to protect and sustainably manage California's groundwater resources. The Karuk Tribe continues to be disappointed and frustrated by the Siskiyou County's implementation of SGMA. Since 2017, requests to form a Groundwater Sustainability Agency that includes tribes have been ignored. Despite efforts to craft a Memorandum of Understanding to facilitate good faith communication and exchange of information, the County has largely ignored the Tribe's requests for government-to-government meetings and our input into the SGMA process.

This most recent comment period on the draft Groundwater Sustainability Plans for the Scott and Shasta are another example of the County's refusal to act in good faith with the Karuk Tribe or other entities. The County did not share all of the technical materials that support the documents to be reviewed in a timely manner. This resulted in Tribes, agencies, and others scrambling to perform a technical review on hundreds of pages of materials, draft comments, and get comments approved by governing councils or management in two weeks.

This process has been deeply flawed and mismanaged from the outset and does a disservice to the Tribes, non-tribal constituents, agricultural operators, fishermen, and others seeking certainty and resolution of the water resource conflicts in our region. In fact, because of the deep flaws in the process and the work product, its likely to create more uncertainty for everyone.

<u>Comments on the Scott Groundwater Sustainability Plan</u>

1. The GSP Fails to Properly Specify Undesirable Results, Minimum Thresholds and Measurable Objectives for the Interconnected Surface Waters Sustainability Goal

Despite the known impacts of low flows on protected species, the GSP fails to properly define undesirable results, minimum thresholds, and measurable objectives for the interconnected surface waters (ISW) sustainability indicator.

SGMA sets out a three-step process for defining these terms. The undesirable result is an "effect" caused by over pumping; here, the depletion of streamflow. (Wat. Code § 10721, def (x)(6); Cal. Code Regs. tit. 23, § 354.26.) The minimum threshold is the numeric value that determines when an effect becomes "undesirable," i.e. when it becomes "significant and unreasonable." (Wat. Code § 10721, def. (x); Cal. Code Regs. tit. 23, § 354. It must

> quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results....

(Cal. Code Regs., tit. 23, § 354.28, subd. (a).) With regard to depletions of interconnected surface water, the regulations require that the minimum threshold be defined as the "rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results." (*Id.* § 354.28, subd. (c)(6).) And the measurable objective represents numeric targets to achieve sustainability; that is, to avoid undesirable results by keeping the basin above the minimum threshold. (Cal. Code Regs. tit. 23, § 354.30.)

The GSP defines these terms for interconnected surface waters in a way that fails, as the statute requires, to tie the results of over pumping to concrete effects in the basin. The GSP distinguishes between a "SGMA undesirable result" and an "aspirational 'watershed goal.'" (GSP at 3.57-59.) The former is defined as "stream depletion that can be attributed to groundwater pumping outside of the adjudicated zone to the degree it leads to significant and unreasonable impacts on beneficial uses of surface water." (GSP at 3.57.) The minimum threshold is defined as the "the amount of stream depletion reversal achieved by one or an equivalent set of multiple minimum required PMAs to meet the intent of SGMA (no additional undesirable results), and Porter Cologne and the PTD (some reversal of existing undesirable results)."[1] (GSP at 3.60.) And the measurable objectives are defined by percentages of streamflow depletion reversed by PMAs. (GSP at 3.63-64.)

2. The Undesirable Result Definition is Tautological and Fails to Achieve Basin-Wide Sustainability as SGMA Requires

As part of achieving a basin's "sustainability goal," a GSP must "identify" "undesirable result[s]." (Wat. Code §§ 10721 subds. (u)-(x); 10727.2, subd. (b).) An "undesirable result" means an "effect[] caused by groundwater conditions throughout the basin." (Id. § 10721, subd. (x).) Undesirable results include "[d]epletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water." (Id. § 10721, subd. (x)(6).)

The GSP must define these "significant" and "unreasonable" effects. (Cal. Code Regs. tit. 23, § 354.26(a).) But the GSP's definition of "undesirable results" is a tautology. The GSP defines it as "significant and unreasonable stream depletion due to groundwater extraction from wells subject to SGMA (i.e., outside of the Adjudicated Zone)." (GSP at 3.59.) By including the terms "significant and unreasonable" in the definition, the GSP fails to provide a workable definition: an effect is defined as unreasonable if it is unreasonable. This is nonsensical and unworkable. In *Asociacion de Gente Unida por*

[1] The GSP finds that the ISW undesirable result existed prior to 2015 and thus the GSP need not address it under SGMA. (GSP at 3.55-56; Wat. Code § 10727.2.) This memo discusses this finding below.

el Agua v. Central Valley Regional Water Quality Control Board (2012) 210 Cal.App.4th 1255, 1280, the Court of Appeal disapproved a waste discharge requirement for dairy pollution where "the basis for concluding that any degradation of groundwater will be of maximum benefit to the people of California is that the Order states that it prohibits any further degradation of groundwater." The court found that this reasoning was "circular." (*Ibid.*) The same is true here.

What the GSP could have done, but did not do, is establish a streamflow target that is protective of beneficial uses in the Scott. It then could have determined the relative contributions of groundwater users inside and outside the adjudication along with surface users. It could then establish the needed reductions in use by all three categories of water users. Even though the GSA lacks authority over surface users and the adjudicated zone, the exercise would inform the amount that pumpers outside the zone need to reduce by to reach a satisfactory flow rate. And making these calculations would inform the County, the State Board, the Watermaster, and potentially the courts and other agencies about the scale and nature of needed actions. This approach would also comply with SGMA by quantifying the undesirable result and minimum threshold.

Starting with a streamflow target and working backwards is consistent with SGMA because the statute measures compliance at the basin scale. For instance, the "sustainability goal" means ensuring that the "applicable basin is operated within its sustainable yield." (Wat. Code § 10721, def. (u).) And an "undesirable result" means "one or more of the following effects caused by groundwater conditions occurring throughout the basin." (*Id.* def. (x).) And DWR evaluates GSPs to determine whether they are "likely to achieve the sustainability goal for the basin covered by the groundwater sustainability plan." (Wat. Code § 10733, subd. (b).) The regulations reiterate that undesirable results are "significant and unreasonable effects…occurring throughout the basin." (Cal. Code Regs. tit. 23, § 354.26(a).) Again, the regulations and the statute include the language "throughout the basin." If the legislature did not want to include consideration of effects in the adjudicated areas, it could have done so but did not. By focusing solely on pumping outside the adjudicated zone, the GSP fails to ensure, or even analyze what would be necessary to ensure that the basin as a whole reaches sustainability.

3. The Undesirable Result Is Not Quantified, in Violation of the SGMA Regulations

The SGMA regulations require the GSP to quantify the undesirable result:

> The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a **quantitative description** of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.

(Cal. Code Regs., tit. 23, § 354.26, subd. (b)(2) (emphasis added).) The description in the GSP is inadequate because it is not a "quantitative description." The regulations are clear that the result must be in the form of numbers tying minimum threshold exceedances to the significant and unreasonable effects. The GSP's description is entirely qualitative. In addition, the description lacks "criteria" for "when and where" groundwater conditions cause significant and unreasonable depletions. Again, SGMA and the regulations make crystal clear that the undesirable results analysis must be tied to physical conditions and physical locations, not solely a model output.

This violates the regulations.

4. The Reasonableness Analysis Fails to Consider Costs to Beneficial Users of Surface Waters

The GSP is required to determine whether the depletions of surface waters have "unreasonable impacts on beneficial users of surface waters." But instead of focusing its discussion on the harms to beneficial users, it focuses solely on the costs to groundwater users. This violates SGMA.

The GSP fails to properly consider the "unreasonableness" of stream depletions by failing to analyze not only of the costs of compliance but of the costs to the public, tribes, and commercial fisheries of the loss of fish populations—loss which may include the incalculable consequences of extinction or extirpation. For instance, courts have held that when setting water quality objectives under Water Code section 13241, the "Water Control Boards are charged with taking into account economic considerations, not merely costs of compliance with a permit. As noted, economic considerations also include, among other things, the costs of not addressing the problems of contaminated water." (*City of Duarte v. State Water Resources Control Board* (2021) 60 Cal.App.5th 258, 276.) The same is true here: determining whether an effect is reasonable requires looking at both costs to comply with any restrictions and also the costs to the public of over-extraction.

The GSP states: "In the context of assessing MTs for the ISW SMC, it is reasonable to only hold groundwater producers outside the adjudicated zone to a modest percentage of stream depletion reversal because any greater responsibility would unreasonably constrain groundwater users in the basin." (GSP at 3.58.) Later, the GSP purports to analyze "what is an "unreasonable" amount of stream depletion, which could be reframed as: what is a "reasonable" amount of avoided groundwater use?" (GSP at 3.59.) This is not the question the statute asks: SGMA requires the definition of significant and unreasonable effects to focus on the *results* of stream depletion, not the cost of avoiding it. (Wat. Code § 10721, def. (x); Cal. Code Regs. tit 23, § 354.26(a).) Any costs associated with any constraint on groundwater users has to be balanced against the effect of their actions on groundwater conditions. A reasonableness analysis that focuses entirely on costs to groundwater users is incomplete.

5. The Unreasonableness Analysis Ignores Legally Binding Streamflow Limits in the Scott River

The analysis also misses the fact that the State Board recently adopted emergency regulations setting flow levels (embodied in the CDFW drought minimum flows) below which extractions are deemed to be unreasonable. (See Wat. Code § 1058.5. (State Board authority to adopt emergency regulations to "prevent the waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion, of water"); Cal. Code Regs. tit. 23, § 875 et seq.) Rather than focusing on the cost of compliance, the GSP must revisit its significant and unreasonable analysis in light of the State Board's determination of what is "reasonable." It is within the State Board's authority to determine which uses are reasonable. (*Stanford Vina Ranch Irrigation Company v. State* (2020) 50 Cal.App.5th 976, 1002–1003 ("[T]he Board is charged with acting to prevent unreasonable and wasteful uses of water, regardless of the claim of right under which the water is diverted.").)

Nor does the fact that extraction has been continuing at these levels for the last several decades (a fraction of the time that the Karuk Tribe has existed in the Klamath basin) make over-extraction of groundwater reasonable. (Wat. Code § 100.5 ("conformity of a use, method of use, or method of diversion of water with local custom shall not be solely determinative of its reasonableness.") The GSP must account for the fact the State Board has now declared flows below the CDFW drought minimum flows to be unreasonable.

6. Minimum Thresholds Inadequately Defined

The GSP defines the minimum threshold for interconnected surface waters as "the amount of stream depletion reversal achieved by one or an equivalent set of multiple minimum required PMAs to meet the intent of SGMA (no additional undesirable results), and Porter Cologne and the PTD (some reversal of existing undesirable results)." (GSP at 3.60.) It goes on specify: "**average stream depletion reversal** of the implemented PMAs during September–November **must exceed 15% of the depletion caused by groundwater pumping from outside the adjudicated zone in 2042 and thereafter**..." (GSP at 3.60 (emphasis in original).) There are at least three problems with this. First, it is circular. Second, the 15% figure is arbitrary and unsupported by evidence. Last, it is not tied to a "monitoring site or representative monitoring site" as required by the regulations.

The minimum threshold is circular because it starts from the premise that the ILR/MAR scenario is all that need be done. The GSP states that Advisory Committee determined it was "reasonable" implement the MAR/ILR scenario of PMAs. (GSP at 3.60.) This involves flooding fields using excess flows in the winter and switching from groundwater to surface water irrigation using excess water in the spring. This scenario does not involve reducing pumping by groundwater users. Having determined the costs associated with the MAR/ILR scenario are reasonable, the GSP simply states that the streamflow associated with that scenario is the minimum threshold. (GSP at 3.61.) This depletion reduction figure is 15%.

By defining the minimum threshold as the results of simulated PMAs, the GSP creates a circle. It can define the undesirable result and achieve it without demonstrating any real-world impact on flows, fish, or the people that rely on them. This violates SGMA.

In addition, the 15% figure is completely lacking in evidence. An agency's action is invalid if it is "arbitrary, capricious, or without evidentiary support." (E.g. *Association of Irritated Residents v. San Joaquin Valley Unified Air Pollution Control Dist.* (2008) 168 Cal.App.4th 535, 542.)

While the GSP implies that it was discussed at the Advisory Committee meetings, there is no justification for why 15% was chosen, and not 50%, 100%, or 5%. Indeed, although the key driver of the GSP's MT analysis is the cost of the MAR/ILR scenario, the GSP *does not consider the cost of the scenario!* (GSP at 3.60-61, 4.27 ("Costs and funding for [the ILR/MAR] project have not yet been explored.") Here, the failure to consider the costs of the ILR/MAR scenario—which is the only basis for the selection of the 15% reduction figure—is arbitrary and capricious because it is not based on any evidence in the record.

Moreover, there is no analysis of the impacts of the 15% depletion reduction on the stream itself. Without this analysis, there is no way to know whether this level of reduction is "significant" or "unreasonable," no matter how the terms are defined. And this illustrates the problem with defining the minimum threshold in terms of a modeled output rather than, as required by the regulations, a value at a monitored site.

The "minimum thresholds" must "quantify groundwater conditions for each applicable sustainability indicator *at each monitoring site or representative monitoring site.*" (Cal. Code Regs., tit. 23, § 354.28(a), emphasis added.) Therefore, the definition of the undesirable result must be "quantitative" and must be tied to minimum threshold exceedances at *particular monitoring sites.*[2] In other words, the SGMA regulations require a GSP to express an undesirable result in terms of a real-world impact to a directly measured value, in this case, streamflow.

The SVIHM model will doubtless be a useful tool and provides invaluable insights into those parameters that cannot be directly measured. But it is not a "monitoring site." The GSP must include minimum thresholds that inform the GSA and the public when physical conditions in the basin have reached the point of being "significant and unreasonable" impacts on interconnected surface waters.

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[2] Section 352.4 of the regulations makes clear that a monitoring site is a physical location, not a model output. (Cal. Code Regs., tit. 23, § 352.4.)

7. Measurable Objectives are not Properly Defined

The GSP attempts to avoid the requirement to define the minimum threshold and measurable objectives in terms of stream flow by referring to section 354.30, subdivision (b) of the regulations. The GSP states, "Choosing the aspirational watershed goal itself as MO would not meet the requirement that quantification/measurement of streamflow depletion that is used to establish the minimum threshold, Section 3.3.5.1, must also [be] used to quantify the MO."[3] But this is precisely backwards. As discussed above, the minimum threshold must be defined with reference to a measured value at a monitoring site. And there is no requirement that the measured value be identical, only that the metrics and monitoring sites be the same. Again, SGMA is clear that measurable objectives, like minimum thresholds and undesirable results, be defined in terms of measurable stream flow, not as a portfolio of PMAs or solely as a model output.

8. The GSP Does not Consider the 2021 Emergency Regulations or the CDFW Drought Flows

On June 15. 2021, CDFW transmitted Minimum Flow Recommendations for the Scott and Shasta Rivers to the State Board.[4] The minimum flow recommendation largely tracks the USFS water right at the Fort Jones Gage, with deviations in September (33 cfs), November (60 cfs), and December (150 cfs.)

Based on these recommendations, the 2017 CDFW flow recommendations, and a Petition for Emergency Rulemaking filed by ELF and the Karuk Tribe on July 1, 2021, the State Board adopted emergency regulations setting minimum flows on the Scott and Shasta River in August 2021. (See Cal. Code Regs. Tit. 23, § 875 et seq.)

The emergency regulations establish the CDFW Minimum Flow Recommendations as the minimum permissible flows in the Scott River. (Cal. Code Regs. tit. 23, § 875(c)(1).) State Board staff is authorized to curtail diversions—both surface waters and groundwater—that reduce river flow below those levels. Curtailment orders have now gone out to diverters.

The GSP does not acknowledge either of these events. Rather, it states "However, neither the ESA, TMDL, or PTD specify mandatory targets, minimum thresholds, or specific project requirements." (GSP at 3.57) This statement is not true. The emergency regulation now sets a minimum flow for the Scott River. Thus, the goal of restoring adequate flows in the Scott is no longer "aspirational"—a minimum flow is now the law. The GSP must be revised to account for this.

9. The GSP Fails to Consider Undesirable Effects that Have Occurred After 2015

Water Code section 10727.2, subdivision (b)(4) states that a GSP "may, but is not required to, address undesirable results that occurred before, and have not been corrected by, January 1, 2015. Notwithstanding paragraphs (1) to (3), inclusive, a groundwater sustainability agency has discretion as to whether to set measurable objectives and the timeframes for achieving any objectives for undesirable results that occurred before, and have not been corrected by, January 1, 2015."

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[3] GSP, Chapter 3, at p. 53. The cited regulation states: "measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds." (Cal. Code Regs., tit. 23, § 354.30, subd. (b).)

[4] Available at https://www.waterboards.ca.gov/drought/scott_shasta_rivers/docs/swb_2021_shasta_scott_drought_emergency_final.pdf, accessed September 15, 2021.

The GSP says, "In Scott Valley, undesirable results associated with depletion of interconnected surface water that have occurred since January 1, 2015, had already existed for over thirty years prior as of 2015. No additional undesirable results have occurred since January 1, 2015 (Section 2.2.1.6). Additional future surface water depletion due to groundwater pumping will be avoided by rigorous controls set on maintaining current water level conditions (Section 3.4.1) and by avoiding significant additional consumptive water use in Scott Valley (see chapter 4)." (GSP at 3.55.)

This misstates the facts. It is clear that there is sufficient water in the Scott River system to sustain fish populations in almost every year. This is evident from the pre-1980 record showing that the river could sustain the USFS flow right and the CDFW recommended flows prior to the adjudication and the expansion of groundwater pumping. And it is clear from the information contained in the GSP that almost every year, precipitation is sufficient to bring flows up to a level that would support those flows for most of the year, absent irrigation. (See GSP at App. 4-A, at pp. 73-75.)

Therefore, the effects of stream depletion did not "exist" prior to 2015. Indeed, on January 1, 2015, the Scott River flowed at over 500 cfs, well above the CDFW-recommended 362 cfs.[5] The "undesirable result" for the purposes of SGMA is the disconnection and low flow in the river. (Wat. Code § 10721, def. (x)(6).) In the summer of 2015, growers made a choice to withdraw water from a full aquifer. And in 2015, just as in every prior summer, the County, the State Board, and other responsible agencies allowed the depletions to occur.

This does not mean that the undesirable result "existed." Courts have "long settled that separate, recurring invasions of the same right can each trigger their own statute of limitations." (*Aryeh v. Canon Business Solutions* (2013) 55 Cal.4th 1185, 1198.) This a similar situation: the stream depletions are not a continuous problem that occurred long ago and has not been corrected, like seawater intrusion or permanent subsidence. Depletions are discrete events that recur anew each year, but the GSP treats them as permanent. Indeed, the GSP claims that there is no chronic lowering of groundwater levels in the Scott. (GSP at 3.32.)

The GSP should be revised to make clear that the stream depletions did not "exist" prior to 2015 because each year they are caused again.

10. The GSA's Baseline Analysis Must Include Consideration of Other Laws

SGMA also does not absolve the County or the GSA of its duty to comply with other environmental laws. SGMA contains at least four explicit savings clauses making explicit that SGMA's requirements are in addition to, and do not replace, the requirements of other laws, including the Clean Water Act, the public trust doctrine, the state and federal Endangered Species Acts, or Fish and Game Code 5937, to name just a few.

SGMA's savings clauses include:

- "Nothing in this part, or in any groundwater management plan adopted pursuant to this part, determines or alters surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights." (§ 10720.5, subd. (b).)
- "A groundwater sustainability agency may exercise any of the powers described in this chapter in implementing this part, in addition to, and not as a limitation on, any existing authority . . . ." (§ 10725, subd. (a).)

[5] USGS Flow Meter Data available at https://nwis.waterdata.usgs.gov/ca/nwis/uv/?ts_id=16566&format=img_default&site_no=11519500&begin_date=20150101&end_date=20150101

- "This part is in addition to, and not a limitation on, the authority granted to a local agency under any other law." (§ 10726.8, subd. (a).)
- "Nothing in this part is a limitation on the authority of the [State Water Board], the [Department of Water Resources], or the State Department of Public Health." (§ 10726.8, subd. (c).)[6]

The GSP purports to consider other laws. But it does so in the context of doing as little as possible to comply with those laws. The GSP states that SGMA requires it to only not cause more undesirable results than "existed" in 2015 (e.g. GSP at 3.60). But it characterizes any "additional" reduction in pumping as in response to the public trust doctrine the Clean Water Act, not SGMA. As discussed above, the conclusion that SGMA does not require further reductions below the 2015 baseline is incorrect. The analysis of undesirable results and minimum thresholds needs to be revised to take into account the requirements of all other relevant laws.

For instance, the analysis of temperature impacts is insufficient. Groundwater extractions reduce cold-water inflows. (GSP at 2.25.) And this occurs not just in the August-November period, but throughout the year. And some of these cold pools may exist in tributaries that are not part of the adjudicated area, such as the East Fork.[7] These areas would thus be fully under the jurisdiction of SGMA. But the GSP does not model or account for cold water refugia, which are crucial for salmonid over-summering and rearing, especially for Coho. (GSP at 2.73.) The TMDL Action Plan reinforces that these thermal refugia are necessary for species recovery: "Where reaches of the Scott River and its tributaries are providing suitable freshwater salmonid habitat, including cold water refugia for coho and other salmonids, protection of these areas should be a priority for restoration efforts."[8]

The GSP's failure to model and consider impacts of groundwater extraction on this crucial habitat implicates the Clean Water Act, by failing to comply with the TMDL for temperature, and the Endangered Species Act, for failing to protect critical habitat. Moreover, temperature impacts are an "effect" that the GSP wholly fails to evaluate the significance and reasonableness of when defining the undesirable result and minimum thresholds for either water quality or interconnected surface waters.

The GSP should, at the very least, incorporate a plan to identify and protect these cold water refugia where they occur.

11. The GSP Fails to Consider Surface Water Quality

The GSP's identification of undesirable results for water quality is insufficient because it fails to consider groundwater extraction's impacts to surface water quality. SGMA provides that "[s]ignificant and unreasonable degraded water quality" is an undesirable effect required to be avoided (Wat. Code § 10721, subd. (x)(4), and SGMA does not limit this definition to degraded *groundwater* quality. But the GSP limits its discussion of the water quality undesirable result to groundwater quality. (GSP at 3.42) This limitation violates SGMA because it does not consider the significant effects that groundwater conditions have on surface water quality, namely, temperature—including cold water refugia. The GSP acknowledges that the Scott is listed as impaired for temperature under section 303(d) of the Clean Water Act. (GSP at 2.23) And extractions of groundwater affect flows and therefore temperature in the Scott. (GSP at 2.25.)

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[6] The "part" mentioned in each provision refers to Part 2.74 of the Water Code—that is, the entire Sustainable Groundwater Management Act. (§ 10720.)

[7] North Coast Regional Water Quality Control Board, Staff Report for the Action Plan for the Scott River Watershed Sediment and Temperature Total Maximum Daily Loads (2005) at p. 4-35.

[8] North Coast Regional Water Quality Control Board, Staff Report for the Action Plan for the Scott River Watershed Sediment and Temperature Total Maximum Daily Loads (2005) at p. 5-4.

The GSP must be revised to describe impacts to surface water temperature as an undesirable result and to develop minimum thresholds, measurable objectives, and projects and management actions to remedy the undesirable result.

12. Additional technical comments to be incorporated by reference

The Karuk Tribe supports and incorporates by reference the technical comments prepared by Riverbend Sciences on behalf of the Klamath Tribal Water Quality Consortium dated September 21, 2021 regarding review and comments on *Public Draft Scott Valley Groundwater Sustainability Plan.* These comments are attached.

Comments on the Shasta Groundwater Sustainability Plan

The Karuk Tribe supports and incorporates by reference the technical comments prepared by Riverbend Sciences on behalf of the Klamath Tribal Water Quality Consortium dated September 21, 2021 regarding review and comments on *Public Draft Shasta Valley Groundwater Sustainability Plan*. These comments are attached. Karuk-001

The Karuk Tribe hopes that the Groundwater Sustainability Agency/ Siskiyou County Flood Control & Water Conservation District will work to amend the draft plans based on the extensive feedback based on the legal and technical merits of the draft plans. The Karuk Tribes remains interested forging a collaborative relationship with the County despite the apparent lack of such interest by the County.

Yôotva,

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MEMORANDUM REPORT

To: Klamath Tribal Water Quality Consortium
From: Eli Asarian, Riverbend Sciences
Date: September 20, 2021
Re: Review and comments on *Public Draft Shasta Valley Groundwater Sustainability Plan*

The public draft of the "Shasta Valley Groundwater Sustainability Plan" was circulated for public comment by the Siskiyou County Flood Control & Water Conservation District in August, 2021. To assist the member Tribes of the Klamath Tribal Water Quality Consortium in the preparation of their comments, Riverbend Sciences and subcontractors have reviewed the document and prepared the comments provided here for the Tribes' use.

A) COMMENT OVERVIEW

We have reviewed the public draft of the Shasta Valley Groundwater Sustainability Plan (GSP) and wish to provide the following comments. Our comments are arranged into three sections: A) Comment overview in which we provide a summary of our most important big-picture comments, B) comments on specific sections of the GSP chapters using the comment form provided.

A summary of our big-picture comments is provided in the following bullets, which are then discussed in the paragraphs below:

- The GSP lacks transparency
- Many GSP actions and goals sound great but are loosely defined so do not actually achieve much
- The GSP's monitoring plan is good, but without sufficient funding it cannot be implemented, and critical data gaps will remain unfilled
- The Minimum Threshold for Interconnected Surface Water should use direct measurements of springs, not a water balance that relies heavily on highly uncertain diversion estimates
- Parts of the GSP do not acknowledge the hydrologic reality of the sources of water to a well
- Even if the model will not be used for sustainable management criteria, it is still informative to look at its predictions for streamflow depletion
- The GSP does not deal appropriately with climate change

The GSP lacks transparency

Collaborative management and transparency and core tenants of SGMA. How will transparency and public access to data be incorporated into reporting and data sharing agreements? All data that is paid for with public money should be accessible to the public. All GSP reporting (i.e., annual and five-year review reports) should include electronic appendices with easily accessible data, so others could run their own analyses on the data.

TC-001

We understand the political sensitivity of well metering, but how can groundwater be managed at a basinwide scale without metering? At least some subset of the wells should be mandated to be metered. Examples could include the largest wells, or new wells drilled after the passage of the SGMA legislation or after adoption of the Shasta Valley GSP. How can existing ordinances, such as the prohibition on the use of groundwater for cannabis production or the requirement for permits being needed for inter-basin transfers of groundwater, be enforced without the well metering? How can the effects of efficiency projects be verified without metering? The lack of metering requirements suggests a lack of transparency, which further suggests a lack of will to actually manage groundwater extraction.

TC-002

We also have serious concerns with the lack of transparency with the current Scott Valley and Shasta Valley Watermaster District program. Watermastering should be returned to the State of California, with well-organized publicly accessible records of diversions.

TC-003

Many GSP actions and goals sound great but are loosely defined so do not actually achieve much

The GSP full of things like that sound great like the "Avoiding Significant Increase of Total Net Groundwater Use from the Basin" project and management action (PMA), but when we look closely at the details we see that the wording is loosely defined so that it does not actually guarantee anything. Since all well metering is voluntary, how is it possible to verify this?

TC-004

If the GSP is to actually achieve the stated objectives, it needs more things that can actually be readily verified. Examples that we recommend include:

- No additional wells for new land use or additional cropping will be permitted in the basin. Only new wells intended to replace old wells and existing crops will be permitted, and these replacement wells will be metered. The intent here is to avoid net increase in groundwater use.
- Wells intended to replace stream diversions will not be permitted, even if there will be no additional net water usage (i.e., pumped groundwater will be used to replace surface water irrigation of existing crops). The intent here is to allow the SWRCB to ascertain and regulate surface water rights and stream and spring flows. The use of groundwater wells in place of stream or spring diversions simply moves the point of diversion and lessens the ability of the SWRCB to carry out its mission.

The GSP's monitoring plan is good, but without sufficient funding it cannot be implemented, and critical data gaps will remain unfilled

We generally agree with sites and parameters proposed in Section 3.3 Monitoring Networks, but we are extremely concerned that funding will not be available to actually implement the monitoring. The GSA has a responsibility to provide the funding needed to collect these data. Without the monitoring, critical data gaps will persist and it will be impossible to understand or properly manage the intricate Shasta Valley groundwater system.

TC-005

From our perspective, monitoring the flow of the springs is the most important. The output of these springs is what sustains aquatic ecosystems and agriculture in the Shasta River. In addition, the ability to predict flow in these springs is the primary endpoint upon which we will judge the performance of the Shasta Watershed Groundwater Model. We need to understand how groundwater elevations and groundwater pumping affect the flow in these springs. The monitoring plan proposes monthly monitoring of the springs, however, this is insufficient given the importance of these springs and the potential insights that high-resolution data could provide into the complex dynamics of Shasta Valley groundwater. At what time scales do the flow of these springs fluctuate (seasonal, weekly, daily, hourly, etc.) and what do these fluctuations appear to correspond with (e.g., Dwinnell reservoir levels, nearby groundwater pumps cycling on/off, flood irrigation, snowmelt, storm events, etc.)? How can we understand this without data? The two largest springs, Big Springs and Little Springs, are especially important. Other critically important springs that need continuous flow monitoring include Bridge Field Springs (on Shasta Springs Ranch, owned by Emmerson), Black Meadow Springs (on Shasta Springs Ranch, owned by Emmerson), Kettle Springs (on Shasta Springs Ranch, owned by Emmerson), and Hole in the Ground Spring. We noticed that Bridge Field Springs and Black Meadow Springs, were not included in the monitoring plan. We strongly urge that both these springs be added to the monitoring plan.

TC-006

The Minimum Threshold for Interconnected Surface Water should use direct measurements of springs, not a water balance that relies heavily on highly uncertain diversion estimates

The GSP proposed a Minimum Threshold (MT) for Interconnected Surface Water (ISW) of 100 cfs groundwater contributions, based on a water balance of the Shasta River reach between Dwinnell Dam and the USGS flow gage near Montague. The estimated diversions used in the water balance are highly uncertain and unreliable, derived from private watermaster records. The bounds of uncertainty on these diversion estimates are so large as to make them nearly useless as a decision-making tool. Rather than estimating groundwater contributions based on a highly uncertain water balance, we would much rather have the MT ISW be based on the sum of measured discharges from key individual springs (i.e., Big Springs, Little Springs, Bridge Field Springs, Black Meadow Springs, Kettle Springs, and Hole in the Ground Spring). While these individual springs do not represent the entirety of the groundwater contributions (i.e., there may be some diffuse contributions as well as additional smaller springs), data on the spring flows are required anyway for management and model calibration, and should provide a more reliable relative metric of groundwater contributions than the water balance. There are not yet much data yet on these spring flows, but measurements need to begin as soon as possible.

TC-007

Parts of the GSP do not acknowledge the hydrologic reality of the sources of water to a well

It is important to note that there are only three sources of water to a pumping well: 1) reductions in discharges from the system (e.g., discharges to streams and springs); 2) an increase in recharge to the system (capture of rejected recharge), and 3) change in storage (change in groundwater levels, which is only a temporary source of water and is not sustainable).

Because the Shasta work includes the entire watershed, item "2" would only result in robbing Peter to pay Paul – there is no net increase in yield when viewing the system as a whole. Item "3" is not important when looking at the long-term (sustainable) response of the system to pumping – it's only a matter of time before the impacts show up.

The point to be made here is that all groundwater pumping eventually comes at the expense of surface water systems (e.g., stream flow), the only real question is how long it will take for these depletion effects to reach the surface water systems. This delay is a function of distance from the stream and aquifer properties. It doesn't matter if the well is 10 feet or 10,000 feet from a surface water feature– the result will ultimately be impact to surface water features. This assumes that the basin does not simply go into overdraft, at which point there are no additional sources of surface water to deplete, or that they are already being depleted as rapidly as possibly given aquifer properties.

We highlight this issue because at times the GSP document seems to not acknowledge this fundamental physical reality. For example, from Chapter 3, page 46:

> As explained in the previous section, the lack of historical and high-frequency groundwater elevation data in the Basin, spatial gaps in streamflow and spring measurements, and uncertainty in the historical and current data regarding surface water diversions and groundwater does not allow the development of a reliable estimate of stream depletion due to pumping. Acknowledging these uncertainties and existing data gaps, the GSA finds it inappropriate to define the interconnected surface water SMC at this stage using modeled results of stream depletion. Instead, the GSA proposes as adaptive approach that would help improve the SMC setting in the future using newly collected data while addressing SGMA requirements…

TC-008

What other long-term source of water is there for the wells (see Theis, 1940, The Sources of Water Derived from Wells)? It is important to strike "…does not allow the development of a reliable estimate of stream depletion due to pumping." and replace with something like " …makes current model predictions of location and timing of impacts uncertain."

Even if the model will not be used for sustainable management criteria, it is still informative to look at its predictions for streamflow depletion

The GSP states that the model is not complete and therefore was not used for assessing sustainable management criteria. A primary reason given for this is lack of data. Our comment regarding this issue (Chapter 3, page 30) is:

> The text states "*The goal is to use this approach for the first 5 years of implementation, collect more data, and at the GSP update provide a stream depletion approach based on more reliable results produced by the further calibrated SWGM.*" Two fundamental questions regarding groundwater development in the Shasta Valley are "What effect has past and present groundwater

TC-009

pumping had on surface-water flow in the Shasta River, tributaries, and springs in the Valley?" "What effect will future groundwater pumping have on surface-water resources in the Shasta Valley?" From the stated text, it seems that the Shasta Watershed Groundwater Model (SWGM) will not be used to answer these questions for at least 5 years. If the groundwater part of the model can be used to calculate water budget components as has already been done, why can't it be used to calculate streamflow depletions? Conversely, if the model can't be used to reliably calculate streamflow depletions, why can it be used to calculate water-budget components? Using a groundwater model, streamflow depletion from groundwater pumping is always determined using model-calculated water budget components. At this stage of development of the groundwater model, uncertainty in computed streamflow depletion will most likely be in the timing of the depletion, rather than the relative amounts that various surface-water features are affected. In five years, there will still be uncertainty in the timing of depletion, but perhaps that uncertainty will be lower. Nonetheless, a delay of five years in tackling fundamental questions seems to be ignoring the current value of the model. If key calculations were run and re-run as the model was being improved, then the modelers would learn the sensitivity of model results to changes in parameters.

TC-009 contd.

We would add that the modeling process itself is an invaluable tool in gaining stakeholder buy-in on the local physical conditions and the model itself. This buy-in is especially important down the road when the model is used to make critical decisions. Letting stakeholders clearly see the difficulties in simplifying the system for input into the computer program and illustrating the uncertainties that arise from data gaps is invaluable as part of building trust. Unfortunately, this was not our experience on this project.

The GSP does not deal appropriately with climate change

The GSP appears to treat climate change as a check-the-box exercise rather than seriously grappling with what it will mean for groundwater management. The GSP does include model runs for future climate change, these results are not presented in a coherent way that highlights the major challenges that climate change will pose to water management. A warming climate will cause a shift in precipitation form (less snow, more rain) that will in turn shift the seasonal timing of tributary surface flows into the valley. Regardless of what happens to total precipitation or total runoff, this change in precipitation form and runoff timing is a huge issue that water management is going to need to recon with. Perhaps we missed it (and if so, we apologize), but we did not see evidence that the GSP recognizes the severity of the coming changes to climate, nor presents a coherent plan to adapt to it.

TC-010

B) COMMENTS ON SPECIFIC GSP SECTIONS USING THE COMMENT FORM PROVIDED

Chapter	Page	Section	Line/Table/ Figure #	Comment	
2	79	2.2.1.5	1500-1504	"Streamflow data from all available sources will be further assessed during hydrologic model development to identify important critical conditions. Data quantity and quality impact both selection of data to be used for calibration and interpretation of model performance during associated time periods. More weight is given to locations and time periods with higher quality data." This wording seems to suggest this work was not done as part of model calibration to date, but this appears incorrect, true? If so, it should be reworded in past tense.	TC-011
2	87-91	2.2.2.2	Figure 35-39	Based on the values this is, indeed, a depth to water map, but then it is not an "Elevation Map" as stated. It is a bit confusing as it appears to show cones of depressions in the far eastern and western areas, but as the land is sloping it is not clear how much these values reflect changes in land surface elevation versus water groundwater surface elevation. Why not present WL elevation maps and depth to water maps separately? In the latter case, it would be good to include a more detailed land surface elevation map than that provided in Figure 6 (which is in 2,000 foot increments).	TC-012
2	107	2.2.2.6	2071	This is supposed to read "south to north" not "~~north to south~~", right?	TC-013
2	108	2.2.2.6	2124-2166	We assume these measurements will continue into the future and measurements obtained throughout the year. This is important because winter periods may prove best for understanding the ultimate degree of GS/SW interaction because of the lack of nearby irrigation pumping. In addition, a year-round analysis would provide a fuller picture of this interaction.	TC-014
2	111	2.2.2.6	2128	It is coinciding, so suggest following edit: "~~potentially coinciding~~" to "coincident".	TC-015
2	133-134	2.2.2.7	2433, Figure 58	Why are these maps (Figure 58 and in Appendix 2-G) so different from Figures 35-39? Is it simply a matter of scale? Suggest replacing Figures 35-39 with these figures and including WL Elevation maps separately.	TC-016
2	136-137	2.2.2.7	2506, Figure 59	Why is this survey considered a maximum and not a minimum possible extent? There are a lot of acknowledged generalizations in this section. We would think you'd want a relatively quick field check before dismissing all the "Assumed not a GDE" areas. In addition, as noted, perched zones were not captured in the analysis. Recommend that you include something like "Representative areas currently classed as 'Assumed not a GDE' will be reviewed in the field as part of future work".	TC-017
2	138	2.2.3	Figure 60	This graph (or an additional one) should include change in storage through time.	TC-018

Chapter	Page	Section	Line/Table/ Figure #	Comment	
2	138	2.2.3	Figure 60	It is important that groundwater ET be modeled explicitly in the GSFLOW model to better understand and illustrate the changes in amount and location of potential impacts to GDEs through time in areas of shallow water tables. We assume this was done. In any case, it is easy to do in MODFLOW by adding in an ET surface corresponding to ground surface with general groundwater ET extinction point rules. We assume there is a comparable simple way to do this in GSFLOW. This needs to be reported as part of the water budgets (Figures 60-61). This would be in addition to the analysis mentioned on page 141, which we don't fully understand – given groundwater ET changes as a function of WLs, how could it be calculated ahead of time and then used as input? We realize we may misunderstand this. Clarification in the text would be very useful.	TC-019
2	138	2.2.3	2521-2531	It appears that you deem domestic and public pumping to be inconsequential. We do not necessarily disagree, but an estimate of these values needs to be provided to substantiate this position.	TC-020
2	141	2.2.3.1	2603-2609	It is important that the GSFLOW model be used to calculate groundwater ET because the water table fluctuates through time due to changing stresses. What is the benefit to calculating this outside the model and then using it as input?	TC-021
2	143	2.2.3.1	Table 15 & 16	Delete one of the "~~within the~~" in each, and in Table 16 we think you mean watershed boundary, not ~~Basin~~ boundary	TC-022
2	144	2.2.3.1	Table 18	Looks like Average and Maximum values are reversed for Agricultural Pumping, or one of the values is erroneous.	TC-023
2	145	2.2.3.4	2695	"Winter rains and winter/spring runoff ~~fill~~recharge the aquifer system between October and April (Figure 23)." Replace ~~fill~~ with recharge. If it filled there wouldn't be many of the issues we are dealing with here.	TC-024
2	146	2.2.3.4	2731-2734	"The response of the groundwater discharge to the stream system will be delayed relative to the timing of the changes in pumping or recharge – by a few days if changes occur within a few tens or hundreds of feet of a stream, by weeks to months if they occur at larger distances from the stream." This statement requires proof. Assuming delay calculations were performed for the local aquifer they should be included somewhere in the document.	TC-025
2	151	2.2.4.2	Figure 67	"Baseline" line should be removed from graph and legend because it is confusing and same color as "Wet"	TC-026

Chapter	Page	Section	Line/Table/ Figure #	Comment	
2	151	2.2.4.2	Figure 67	"Figure 67. Projected flow at the Shasta River near Yreka gage, in difference (cfs) from Baseline, for four future projected climate change scenarios" Perhaps we are mis-understanding what these scenarios are, but are extremely skeptical of any claims that the temperature-driven changes in precipitation form due to climate change (i.e., more rain and less snow) are not going to substantially decrease river flows in summer and fall, regardless of what happens to total annual amount of precipitation. The GSP should acknowledge these realities and then describe how the model predicts that this will seasonally change river flow and groundwater. The format of the graph makes it very difficult to see meaningful seasonal patterns. The y-axis scale that ranges from -2,000 to +12,000 cfs makes it impossible to see what is happening during low flows. Can you add a second panel that to graph so that the low-flow period is legible (maybe -100 to +100 cfs?)? Or maybe limit the months to just show April through October?	TC-027
2	151	2.2.5	2816-2818	Delete "~~Groundwater pumping has not caused significant and unreasonable conditions in the Basin during the last 20 years~~". The Basin has recognized problems and is a Medium Priority to the State and its why we are doing this SGMA Plan. You can say it's not in overdraft (continuously declining WLs), but that's it.	TC-028
2	151	2.2.5	2827	Suggest: "…acre-feet per ~~year minus any future~~ reduction in…" to "…acre-feet per year. It may change in the future due to reduction in…"	TC-029
2	152	2.2.5	2849-2857	It appears you are saying that the sustainable yield is less than the current value of pumping. The sustainable yield needs to be defined as part of this SGMA plan and then used as the management target. As it is currently worded in the document, there is apparently no lower limit to reductions in pumping.	TC-030
3	5	3.2	114-116	The first sustainability goal listed is "Groundwater elevations and groundwater storage do not significantly decline below their historically measured range, protect the existing well infrastructure from outages, protect groundwater-dependent ecosystems, and avoid significant additional stream depletion due to groundwater pumping." There is not definition of what "significant" means, so we suggest removing that word. Without a definition, isn't this meaningless? It should probably either be percent (e.g., 1%) or volume?	TC-031
3	5	3.2	123	In "Groundwater will continue to provide river baseflow as interconnected surface water with no ~~significant or unreasonable~~further reduction in volume." strike "~~significant or unreasonable~~" and replace with "further'. Without a definition, significant is too vague.	TC-032

Chapter	Page	Section	Line/Table/ Figure #	Comment	
3	6-33			We generally agree with sites and parameters proposed in Section 3.3 Monitoring Networks, but we are extremely concerned that funding will not be available to actually implement the monitoring. As described in our comments on Chapter 3, Section 3.3, pages 16-17, Table 1, we also recommend continuous flow monitoring of the springs, and adding two additional springs to the flow monitoring sites: Bridge Field Springs and Black Meadow Springs.	TC-033
3	16-17	3.3	Table 1	From our perspective, monitoring the flow of the springs is the most important. The output of these springs is what sustains aquatic ecosystems and agriculture in the Shasta River. In addition, the ability to predict flow in these springs is the primary endpoint upon which we will judge the performance of the Shasta Watershed Groundwater Model. We need to understand how groundwater elevations and groundwater pumping affect the flow in these springs. The monitoring plan proposes monthly monitoring of the springs, however, this is insufficient given the importance of these springs and the potential insights that high-resolution data could provide into the complex dynamics of Shasta Valley groundwater. At what time scales do the flow of these springs fluctuate (seasonal, weekly, daily, hourly, etc.) and what do these fluctuations appear to correspond with (e.g., Dwinnell reservoir levels, nearby groundwater pumps cycling on/off, flood irrigation, snowmelt, storm events, etc.)? How can we understand this without data? The two largest springs, Big Springs and Little Springs, are especially important. Other critically important springs that need continuous flow monitoring include Bridge Field Springs (on Shasta Springs Ranch, owned by Emmerson), Black Meadow Springs (on Shasta Springs Ranch, owned by Emmerson), Kettle Springs (on Shasta Springs Ranch, owned by Emmerson), and Hole in the Ground Spring. We noticed that Bridge Field Springs and Black Meadow Springs were not included in the monitoring plan. We strongly urge that both these springs be added to the monitoring plan.	TC-034
3	6	3.3	155	"A detailed discussion of potential data gaps, and strategies for resolving them, is included as Appendix 3-A~~Z~~"	TC-035
3	25	3.3.3.1	Table 3	Specific conductivity can readily be obtained at the wellhead using a meter. We suggest taking annually when sampling for nitrate.	TC-036
3	28	3.3.4.1	458-472	Suggest using WLs from "permanent" stilling well in stream and WLs from two nearby adjacent piezometers at different depths to track changes in gradients through time.	TC-037

Chapter	Page	Section	Line/Table/ Figure #	Comment	
3	29	3.3.4.1	Figure 6	Should "gradient near Scott River" be changed to "gradient near Shasta River?" If you did mean this to be for the Scott River, then some discussion should be added to justify using conditions in the Scott Valley for analyses in the Shasta valley. Also, not all information is given in explaining the generation of 70 cfs of baseflow for a single water-level gradient. That gradient would have to apply to some length of the river. Is the baseflow number for the entire basin? And would one water-level gradient explain that number (70 cfs)? Normally the quantity would be given as "cfs per unit length of river," or "cfs for reach X," where reach X has some defined length.	TC-038
3	29	3.3.4.1	Figure 6 caption	This caption seems to be for a map figure, not for the schematic cross section shown.	TC-039
3	30	3.3.4.1	490-492	The text states "*The goal is to use this approach for the first 5 years of implementation, collect more data, and at the GSP update provide a stream depletion approach based on more reliable results produced by the further calibrated SWGM*." Two fundamental questions regarding groundwater development in the Shasta Valley are "What effect has past and present groundwater pumping had on surface-water flow in the Shasta River, tributaries, and springs in the Valley?" "What effect will future groundwater pumping have on surface-water resources in the Shasta Valley?" From the stated text, it seems that the Shasta Watershed Groundwater Model (SWGM) will not be used to answer these questions for at least 5 years. If the groundwater part of the model can be used to calculate water budget components as has already been done, why can't it be used to calculate streamflow depletions? Conversely, if the model can't be used to reliably calculate streamflow depletions, why can it be used to calculate water-budget components? Using a groundwater model, streamflow depletion from groundwater pumping is always determined using model-calculated water budget components. At this stage of development of the groundwater model, uncertainty in computed streamflow depletion will most likely be in the timing of the depletion, rather than the relative amounts that various surface-water features are affected. In five years, there will still be uncertainty in the timing of depletion, but perhaps that uncertainty will be lower. Nonetheless, a delay of five years in tackling fundamental questions seems to be ignoring the current value of the model. If key calculations were run and re-run as the model was being improved, then the modelers would learn the sensitivity of model results to changes in parameters.	TC-040
3	30	3.3.4.2	502-511	Suggest incorporating the in-stream stilling well and adjacent vertical gradient piezometers as future improvements	TC-041
3	30	3.3.4.2	Table 5	We are confused why the "Shasta River near Yreka (SRY)" is listed in the Table 5 "Future monitoring locations for monitoring" with the Agency listed "NA"? Isn't that a long-term flow gage that has been operated for decades by the USGS?	TC-042

Chapter	Page	Section	Line/Table/ Figure #	Comment	
3	31	3.3.4.3		"Surface diversions will be entered into the County data management system" Please describe whether or not these data will be publicly accessible. Data collected for demonstrating SGMA compliance should be publicly accessible.	TC-043
3	35	3.4.1.1	607	You appear to use Management Trigger as a formal term, but it is not in Acronym list and is only used here. If used it should be formally defined and listed in Acronyms (would conflict with Minimum Threshold)	TC-068
3	36	3.4.1.2	641-642	Suggest change "the ~~historic low~~" to "the historic smallest depth to groundwater"	TC-044
3	36-37	3.4.1.2-.3	641, Table 6, Fig 8	Why is MT set below historic low? This conflicts with previous statements of trying to reduce GW pumping and maintain or raise WLs (see Section 2.2.5)	TC-045
3	37	3.4.1.3	Table 6	"AT" is not in Acronym list.	TC-046
3	41	3.4.3.1	772-773	It is not at all clear why municipal water users are apparently de minimis. No data have been supplied to support this claim.	TC-047
3	42	3.4.3.2	787-792	"The GSA will not be using a numerical groundwater-surface water model to evaluate ISW at this time. A temporary approach based on baseflow calculation will be used." We strongly suggest using the model in parallel with the planned approach to better understand model behavior recalibration (as you note in 3.4.3.6).	TC-048
3	43	3.4.3.2	Equation, table 7	Some additional explanation would be helpful. First, mention somewhere that change in storage in the reach is assumed to be zero. We suggest changing "SRM is flow out of the USGS maintained SRM gage" to "SRM is flow at USGS maintained Shasta River near Montague (SRM) gage 11517000, located at the downstream end of the reach" A schematic with arrows for various components would help. More importantly, some sort of error analysis should be done to determine uncertainty in groundwater contributions. If an uncertainty can be estimated for each of the components of the water budgets, an analysis can be carried out to determine uncertainty in computed groundwater contributions.	TC-049

Chapter	Page	Section	Line/Table/ Figure #	Comment	
3	42-44	3.4.3.2	784-832	A very important factor that does not appear to us to be mentioned in "Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives" is that there appears to be no accounting for return flows such as tailwater. If much of the irrigation along this reach of the river uses flood irrigation (i.e., in contrast to sprinklers), then isn't there a substantial quantity of tailwater that returns to the river from agricultural fields? If tailwater returns are not accounted for, then "baseflow" could be substantially overestimated in the methods described. While there are some records of tailwater quantities (i.e., from the SVRCD reports), it likely is not possible to estimate these quantities very accurately. But wouldn't it be better to at least make some educated guess about the percent of the diversions that return as tailwater (e.g., perhaps it is in the range of 10-50%) and include that in the calculation, instead of completing ignoring it? You are calling it "Groundwater Contributions" so, it should be your best estimate of groundwater. If you don't apply an adjustment for tailwater, then you should call it something else, like "Groundwater Contributions Plus Tailwater Returns," otherwise it is misleading. We do not have access to the all the reports and data sources cited in the chapter, so perhaps tailwater was indeed already accounted for and we are not aware of it, but from the descriptions provided in the GSP it appears that tailwater was ignored.	TC-050
3	43	3.4.3.2	821	We suggest changing "Riparian diverters are not measured" to "Riparian diverters are not measured, despite requirements to measure and report diversions under California Senate Bill 88"	TC-051
3	45	3.4.3.4	846	The proposed Minimum Threshold (MT) for Interconnected Surface Water (ISW) is 100 cfs of groundwater contributions, based on a water balance of the Shasta River reach between Dwinnell Dam and the USGS flow gage near Montague. The estimated diversions used in the water balance are highly uncertain and unreliable, derived from private watermaster records. The bounds of uncertainty on these diversion estimates are so large as to make them nearly useless as a decision-making tool. Rather than estimating groundwater contributions based on a highly uncertain water balance (i.e., not the dramatic week to week fluctuations in Table 7), we would much rather have the MT ISW be based on the sum of measured discharges from key individual springs (i.e., Big Springs, Little Springs, Bridge Field Springs, Black Meadow Springs, Kettle Springs, and Hole in the Ground Spring). While these individual springs do not represent the entirety of the groundwater contributions (i.e., there may be some diffuse contributions as well as addition smaller springs), data on the spring flows are required for anyway for management and model calibration, and should provide a more reliable relative metric of groundwater contributions than the water balance. There are not yet much data yet on these spring flows, but measurements need to begin as soon as possible.	TC-052

Chapter	Page	Section	Line/Table/ Figure #	Comment	
3	46-47	3.4.3.6	906-913	What other long-term source of water is there for the wells (see Theis, 1940, The Sources of Water Derived from Wells)? It is important to strike "…~~does not allow the development of a reliable estimate of stream depletion due to pumping~~." and replace with something like " …makes current model predictions of location and timing of impacts uncertain."	TC-053
4	14	4.2	304	The "Avoiding Significant Increase of Total Net Groundwater Use from the Basin" PMA does not provide a definition of what "significant" means, so we suggest removing that word. Without a definition, isn't this PMA meaningless? It should probably either be percent (e.g., 1%) or volume? See related comment regarding Chapter 4, page 19, section 4.2, line 505-508.	TC-054
4	14	4.2	326-331	We are unable to understand exactly what the "Avoiding Significant Increase of Total Net Groundwater Use from the Basin" PMA means, especially, this excerpt: "Due to the direct relationship between net groundwater use and ET, implementation of the MA is measured by comparing the most recent five- and ten-year running averages of agricultural and urban ET over both the Basin and watershed, to the maximum value of Basin ET measured in the 2010-2020 period, within the limits of measurement uncertainty." Can it be re-stated more clearly, such as, "The goal of this MA is for X not to exceed Y by Z percent?" Can you provide information on the limits of measurement uncertainty? What is the rationale for using the maximum as the basis for the comparison? Is the purpose of the running averages to smooth out climatic variation (i.e., is ET higher in wet years than dry years)? If there is substantial variation between water year types, then should the goal be different in different water year types? What about the contribution of surface water irrigation to ET? We anticipate that climate change will cause increased reliance on groundwater because surface water flows are going to recede earlier in the irrigation season (due less snowmelt), which could result in ET staying the same but groundwater extraction will increase and flows be lower, all without violating this MA.	TC-055
4	15	4.2	341-343	"To be flexible in adjusting the limit on total net groundwater extraction if and where additional groundwater resources become available due to additional recharge dedicated to later extraction." Groundwater is already over-extracted, and there is not extra water available to use in enhancing recharge. See comments on Chapter 4, Section 4.3, page 30, line 895.	TC-056
4	19	4.2	505-508	"The permitting program would ensure that construction of new extraction wells does not significantly expand current total net groundwater use in the Basin (to the degree that such expansion may cause the occurrence of undesirable results)." How are "undesirable results" defined? Please add a definition or citation here. See related comment regarding Chapter 4, page 14, section 4.2, line 304.	TC-057

Chapter	Page	Section	Line/Table/ Figure #	Comment	
4	19	4.2	513-514	“Here are two illustrative examples of an appropriate use of well replacement…” … “Example 2: Replacement of a 1,000-gpm agricultural well that will be properly decommissioned with a new 2,000-gpm capacity agricultural well is permissible with the explicit condition that the 10-year average total net groundwater extraction within the combined area serviced by the old and the new well does not exceed the average groundwater extraction over the most recent 10-years.” Since groundwater use is mostly unmetered (much less publicly accessible), how would this be tracked or enforced?	TC-058
4	23	4.2	659-667	The proposed monitoring of irrigation efficiency omits a key tool– metering of water use. Without metering, how can we know if the efficiency projects are actually working?	TC-059
4	23	4.2	659-667	The proposed monitoring of irrigation efficiency lists “Assessment of the increase in irrigation efficiency, with particular emphasis on assessing the reduction or changes in consumptive water use (evaporation, evapotranspiration) based on equipment specification, scientific literature, or field experiments.” Doesn’t efficiency usually not affect consumptive water use but instead just change recharge (that’s how it is represented in the SVIHM, right?). What is the physical basis for thinking efficiency would affect consumptive use for crops like pasture and alfalfa that have low-lying continuous canopy cover (i.e., in contrast to orchards or row crops like tomatoes where efficient delivery systems like drip irrigation could reduce evaporation from bare soil)?	TC-060
4	25	4.2	668	“Juniper Removal: The GSA, USGS and other agencies and private stakeholders will remove excess juniper within the watershed to improve groundwater levels.” While it is conceptually possible to increase water yield for some number of years following juniper removal, it is difficult to actually implement at a watershed scale and maintain it over time. Furthermore, juniper removal will not necessarily increase water yield in all climates, so local conditions should be evaluated (Niemeyer et al. 2017). Such projects should be considered within a holistic management framework that re-establishes historical fire regimes and does not focus solely on water yield. Maintenance would be needed because the benefits of one-time removal projects are likely to be short-lived (Fogarty et al. 2021). References: Fogarty, D. T., de Vries, C., Bielski, C., & Twidwell, D. (2021). Rapid Re-encroachment by Juniperus virginiana After a Single Restoration Treatment. Rangeland Ecology & Management, 78, 112–116. https://doi.org/10.1016/j.rama.2021.06.002. Niemeyer, R. J., Link, T. E., Heinse, R., & Seyfried, M. S. (2017). Climate moderates potential shifts in streamflow from changes in pinyon-juniper woodland cover across the western U.S. Hydrological Processes, 31(20), 3489–3503. https://doi.org/10.1002/hyp.11264	TC-061

Chapter	Page	Section	Line/Table/ Figure #	Comment	
4	30	4.3	895	Given that there is already a dam in place that captures winter runoff from the upper Shasta River watershed, we oppose the Managed Aquifer Recharge (MAR) or In-Lieu Recharge (ILR) PMA. Dwinnell Dam already reduces winter and spring flows enough that there are not sufficient high flows to maintain natural geomorphic processes in the Shasta River. There is no "extra" water in the Shasta River that can be used to recharge groundwater. The way to improve groundwater conditions is demand reduction.	TC-062
4	32	4.3	954	We support the Strategic Groundwater Pumping Curtailment PMA.	TC-063
App 2-E	10			We did not receive this appendix with the model documentation until September 13, so did not have time to review it in detail. Many sections of it appear to only be partially complete. We look forward to reviewing this when it is complete.	TC-064
App 2-I	8			How do the total evapotranspiration of applied water (ETaw) and precipitation (ETpr) values calculated in this report compare with previous estimates such as from CDWR Land and Water Use Estimates (https://water.ca.gov/Programs/Water-Use-And-Efficiency/Land-And-Water-Use/Agricultural-Land-And-Water-Use-Estimates), and/or the remote-sensing based Baldocchi et al. (2019)? Full citation: Baldocchi, D., Dralle, D., Jiang, C., & Ryu, Y. (2019). How Much Water Is Evaporated Across California? A Multiyear Assessment Using a Biophysical Model Forced With Satellite Remote Sensing Data. Water Resources Research, 55(4), 2722–2741. https://doi.org/10.1029/2018WR023884	TC-065
App 3-A	10		Table 2	Why are flow gages not listed in the Table 2 Data Gap Prioritization? Shouldn't measuring the flow rates of the largest springs (i.e., Big Springs, Little Springs, etc.) be the highest priority? We do not understand how it will be possible to calibrate groundwater model without having data for these springs.	TC-066
App 3-A	11		Table 2	The groundwater extraction row of Table 2 says "No strategy has been defined yet to fill this data gap. Only voluntary measures are being considered to gathered extraction data." This is disappointing. How can groundwater be effectively managed without data about how much groundwater is being pumped?	TC-067

Quartz Valley Indian Reservation

September 22, 2021

To: Siskiyou County Flood Control and Water Conservation District

From: Quartz Valley Indian Community

RE: Scott River Groundwater Sustainability Plan Comments

Chairman Kobseff,

We thank you this opportunity to provide comments on the Scott Valley Groundwater Sustainability Plan (GSP). The Quartz Valley Indian Community (QVIC) sees this process enacted by the Sustainable Groundwater Management Act (SGMA) as an important and necessary step towards ecological balance in the Scott River system. The demands of drinking water, agriculture and the environment have been competing for decades and drought conditions of recent years are exacerbating this issue.

As you are aware, the QVIC was granted a seat on the Scott Groundwater Advisory Committee (SGAC). Our staff was an active participant throughout the entire process reviewing materials and providing verbal and written comments. We feel that many of these comments were not adequately addressed in the development of the current draft of the GSP. SGMA was enacted to be a collaborative process and we were hopeful that this would be a first step in working with our neighbors to develop a GSP that could meet all the needs of the Scott community. We never expected that the SGMA process would resolve all the water problems in the valley, in part because SGMA only applies to a subset of groundwater users (i.e., those not already covered by the existing water rights adjudications) and does not apply to surface water users. However, we are disappointed that the GSP did not propose more ambitious steps towards addressing the critical lack of instream flows in the river during summer and fall. Instead of providing long-term solutions, the GSP seems primarily aimed at continuing the status quo, with only slight improvements proposed. We can envision a future in which fish have the water they need to survive, and farmers and ranchers have secure access to the water needed for their operations; however, the GSP does not do enough to bring that vision closer to becoming reality. Many of the comments herein have already been stated throughout the development of the GSP, we also had an additional technical review from our consultants during this public comment period. QVIC-001

The technical review has revealed a concerning weakness in the model, particularly in October and November when the groundwater basin is transitioning between draining and filling, those details are included herein. This is most concerning to the Tribe since this is when our salmon are in the Scott system trying to access as much habitat as possible to spawn. We feel that these modeling weaknesses could be refined and alleviated through a more robust monitoring program throughout the valley. On the ground information, through data collection and sharing, will be necessary to build our trust in the accuracy of the model being used to manage the Scott system. QVIC-002

A significant legal analysis of the GSP was provided to QVIC by the Karuk Tribe, and we have included those comments herein. These legal issues have created uncertainty in the development of the GSP and we feel, had they been resolved early on, a better GSP could have been produced.

We hope these comments are useful and can lead to a final draft that is working toward restoration and a water management strategy that is effective at meeting the needs the Scott River basin.

Administration: 530-468-5907 Fax: 530-468-5908

13601 Quartz Valley Road, Fort Jones, CA 96032

We have also attached a Technical Memorandum developed by our consultants on the Shasta GSP. Many of the same legal questions apply to the Shasta GSP as well. Although QVIC staff were focused on the Scott GSP development, the Tribe has ancestral lands in the Shasta basin and development of a solid GSP is just as important there as in the Scott River basin to QVIC membership. QVIC-003

Thank you and please contact my staff lead, Crystal Robinson, Environmental Director crystal.robinson@qvir-nsn.gov, if you have any technical questions or follow up to these comments.

Sincerely,

Harold Bennett, Tribal Chairman
Quartz Valley Indian Reservation

Attachment C – Shasta Valley Groundwater Sustainability Plan Tribal Comment and Comment Response Matrix

Author	CIN	Group	Sub-Category	Description	Chapter	Page	Section	Line/ Table/ Fig #	Comment	Response / Recommended Action	MCR	Response Location in GSP
Karuk Tribe	Karuk-001	C	GE	References Other Comments					The Karuk Tribe supports and incorporates by reference the technical comments prepared by Riverbend Sciences on behalf of the Klamath Tribal Water Quality Consortium dated September 21, 2021 regarding review and comments on Public Draft Shasta Valley Groundwater Sustainability Plan. These comments are attached.	Noted.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-001	B	TR	Lack of Data Transparency					How will transparency and public access to data be incorporated into reporting and data sharing agreements? All data that is paid for with public money should be accessible to the public. All GSP reporting (i.e., annual and five-year review reports) should include electronic appendices with easily accessible data, so others could run their own analyses on the data.	The GSA will follow DWR guidelines for data and model transparency. Per DWR's modeling BMP document, "final model files used for decision making in the GSP should be packaged for release to the Department". We anticipate that model files will be uploadable with the GSP in digital format. Similarly, we anticipate that DWR will collect annual report data in digital format.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-002	B	AL	Well Metering, Lack of Data Transparency					We understand the political sensitivity of well metering, but how can groundwater be managed at a basinwide scale without metering? At least some subset of the wells should be mandated to be metered. Examples could include the largest wells, or new wells drilled after the passage of the SGMA legislation or after adoption of the Shasta Valley GSP. How can existing ordinances, such as the prohibition on the use of groundwater for cannabis production or the requirement for permits being needed for inter-basin transfers of groundwater, be enforced without the well metering? How can the effects of efficiency projects be verified without metering? The lack of metering requirements suggests a lack of transparency, which further suggests a lack of will to actually manage groundwater extraction.	See MCR "5-year Update"		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-003	B	BR	Water Management					Watermastering should be returned to the State of California, with well-organized publicly accessible records of diversions.	Noted.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-004	B	PM	GSP Terminology and Plans/Actions Inssuficiently Defined					The GSP full of things like that sound great like the “Avoiding Significant Increase of Total Net Groundwater Use from the Basin” project and management action (PMA), but when we look closely at the details we see that the wording is loosely defined so that it does not actually guarantee anything. Since all well metering is voluntary, how is it possible to verify this? If the GSP is to actually achieve the stated objectives, it needs more things that can actually be readily verified. Examples that we recommend include: No additional wells for new land use or additional cropping will be permitted in the basin. Only new wells intended to replace old wells and existing crops will be permitted, and these replacement wells will be metered. The intent here is to avoid net increase in groundwater use. Wells intended to replace stream diversions will not be permitted, even if there will be no additional net water usage (i.e., pumped groundwater will be used to replace surface water irrigation of existing crops). The intent here is to allow the SWRCB to ascertain and regulate surface water rights and stream and spring flows. The use of groundwater wells in place of stream or spring diversions simply moves the point of diversion and lessens the ability of the SWRCB to carry out its mission.	See MCR "PMA Selection Criteria" and "5-Year Update"		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-005	B	MN	Monitoring Network – Lack of Available Funding to Implement					We generally agree with sites and parameters proposed in Section 3.3 Monitoring Networks, but we are extremely concerned that funding will not be available to actually implement the monitoring. The GSA has a responsibility to provide the funding needed to collect these data. Without the monitoring, critical data gaps will persist and it will be impossible to understand or properly manage the intricate Shasta Valley groundwater system.	See MCR General Data Gaps		

Author	CIN	Group	Sub-Category	Description	Chapter	Page	Section	Line/ Table/ Fig #	Comment	Response / Recommended Action	MCR	Response Location in GSP
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-006	B	IS	Modeling/Monitoring Insufficient –Interconnected Surface Waters					The monitoring plan proposes monthly monitoring of the springs, however, this is insufficient given the importance of these springs and the potential insights that high-resolution data could provide into the complex dynamics of Shasta Valley groundwater. At what time scales do the flow of these springs fluctuate (seasonal, weekly, daily, hourly, etc.) and what do these fluctuations appear to correspond with (e.g., Dwinnell reservoir levels, nearby groundwater pumps cycling on/off, flood irrigation, snowmelt, storm events, etc.)? How can we understand this without data? The two largest springs, Big Springs and Little Springs, are especially important. Other critically important springs that need continuous flow monitoring include Bridge Field Springs (on Shasta Springs Ranch, owned by Emmerson), Black Meadow Springs (on Shasta Springs Ranch, owned by Emmerson), Kettle Springs (on Shasta Springs Ranch, owned by Emmerson), and Hole in the Ground Spring. We noticed that Bridge Field Springs and Black Meadow Springs, were not included in the monitoring plan. We strongly urge that both these springs be added to the monitoring plan.	See MCR Data Gaps - ISW		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-007	A	IS	Minimum Threshold for IS Insufficient					The GSP proposed a Minimum Threshold (MT) for Interconnected Surface Water (ISW) of 100 cfs groundwater contributions, based on a water balance of the Shasta River reach between Dwinnell Dam and the USGS flow gage near Montague. The estimated diversions used in the water balance are highly uncertain and unreliable, derived from private watermaster records. The bounds of uncertainty on these diversion estimates are so large as to make them nearly useless as a decision-making tool. Rather than estimating groundwater contributions based on a highly uncertain water balance, we would much rather have the MT ISW be based on the sum of measured discharges from key individual springs (i.e., Big Springs, Little Springs, Bridge Field Springs, Black Meadow Springs, Kettle Springs, and Hole in the Ground Spring). While these individual springs do not represent the entirety of the groundwater contributions (i.e., there may be some diffuse contributions as well as additional smaller springs), data on the spring flows are required anyway for management and model calibration, and should provide a more reliable relative metric of groundwater contributions than the water balance. There are not yet much data yet on these spring flows, but measurements need to begin as soon as	See MCR ISW		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-008	B	IS	Interconnected Surface Water – GSP Does Not Account for Depletion of Surface Water Through Groundwater Pumping					We highlight this issue because at times the GSP document seems to not acknowledge this fundamental physical reality. For example, from Chapter 3, page 46: As explained in the previous section, the lack of historical and high-frequency groundwater elevation data in the Basin, spatial gaps in streamflow and spring measurements, and uncertainty in the historical and current data regarding surface water diversions and groundwater does not allow the development of a reliable estimate of stream depletion due to pumping. Acknowledging these uncertainties and existing data gaps, the GSA finds it inappropriate to define the interconnected surface water SMC at this stage using modeled results of stream depletion. Instead, the GSA proposes as adaptive approach that would help improve the SMC setting in the future using newly collected data while addressing SGMA requirements… What other long-term source of water is there for the wells (see Theis, 1940, The Sources of Water Derived from Wells)? It is important to strike "…does not allow the development of a reliable estimate of stream depletion due to pumping." and replace with something like " …makes current model predictions of location and timing of impacts uncertain."	See MCR ISW		

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Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-009	B	HM	Modeling Insufficient – Streamflow Depletion					A primary reason given for this is lack of data. Our comment regarding this issue (Chapter 3, page 30) is: The text states “The goal is to use this approach for the first 5 years of implementation, collect more data, and at the GSP update provide a stream depletion approach based on more reliable results produced by the further calibrated SWGM.” Two fundamental questions regarding groundwater development in the Shasta Valley are “What effect has past and present groundwater pumping had on surface-water flow in the Shasta River, tributaries, and springs in the Valley?” “What effect will future groundwater pumping have on surface-water resources in the Shasta Valley?” From the stated text, it seems that the Shasta Watershed Groundwater Model (SWGM) will not be used to answer these questions for at least 5 years. If the groundwater part of the model can be used to calculate water budget components as has already been done, why can’t it be used to calculate streamflow depletions? Conversely, if the model can’t be used to reliably calculate streamflow depletions, why can it be used to calculate water-budget components? Using a groundwater model, streamflow depletion from groundwater pumping is always determined using model-calculated water budget components. At this stage of development of the groundwater model, uncertainty in computed streamflow depletion will most likely be in the timing of the depletion, rather than the relative amounts that various surface-water features are affected. In five years, there will still be uncertainty in the timing of depletion, but perhaps that uncertainty will be lower. Nonetheless, a delay of five years in tackling fundamental questions seems to be ignoring the current value of the model. If key calculations were run and re-run as the model was being improved, then the modelers would learn the sensitivity of model results to changes in parameters.	See MCR ISW		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-010	B	HM	Modeling Insufficient – Climate Change					The GSP does include model runs for future climate change, these results are not presented in a coherent way that highlights the major challenges that climate change will pose to water management. A warming climate will cause a shift in precipitation form (less snow, more rain) that will in turn shift the seasonal timing of tributary surface flows into the valley. Regardless of what happens to total precipitation or total runoff, this change in precipitation form and runoff timing is a huge issue that water management is going to need to	See MCR Water Budgets	Water Budgets	
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-011	C	HM	Specific Edit to Plan Requested	2	79	2.2.1.5	1500-1504	“Streamflow data from all available sources will be further assessed during hydrologic model development to identify important critical conditions. Data quantity and quality impact both selection of data to be used for calibration and interpretation of model performance during associated time periods. More weight is given to locations and time periods with higher quality data.” This wording seems to suggest this work was not done as part of model calibration to date, but this appears incorrect, true? If so, it should be reworded in past tense.	The text was updated to properly reflect intial data assessment was completed for historical USGS streamflow gages, but as new streamflow data is being collected and as the model period is being extended to recent years more data assessment will be completed.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-012	B	SB	Specific Edit to Plan Requested	2	87-91	2.2.2.2	Figure 35-39	Based on the values this is, indeed, a depth to water map, but then it is not an “Elevation Map” as stated. It is a bit confusing as it appears to show cones of depressions in the far eastern and western areas, but as the land is sloping it is not clear how much these values reflect changes in land surface elevation versus water groundwater surface elevation. Why not present WL elevation maps and depth to water maps separately? In the latter case, it would be good to include a more detailed land surface elevation map than that provided in Figure 6 (which is in 2,000 foot increments).	The groundwater contour maps have been updated in Chapter 2 and additional maps have been added to Appendix 2-C.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-013	C	GE	Specific Edit to Plan Requested	2	17	2.2.2.6	2071	This is supposed to read “south to north” not “~~north to south~~”, right?	The GSP text will be updated.		

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Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-014	B	IS	Modeling/Monitoring Insufficient – Interconnected Surface Waters	2	108	2.2.2.6	2124-2166	We assume these measurements will continue into the future and measurements obtained throughout the year. This is important because winter periods may prove best for understanding the ultimate degree of GS/SW interaction because of the lack of nearby irrigation pumping. In addition, a year-round analysis would provide a fuller picture of this interaction.	See MCR ISW		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-015	C	GE	Specific Edit to Plan Requested	2	111	2.2.2.6	2128	It is coinciding, so suggest following edit: "~~potentially coinciding~~" to "coincident".	The exact end of the irrigation season and cessation of upstream diversions are uncertain thus the use of potentially coincidinng.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-016	C	OR	Specific Edit to Plan Requested	2	133-134	2.2.2.7	2433, Figure 58	Why are these maps (Figure 58 and in Appendix 2-G) so different from Figures 35-39? Is it simply a matter of scale? Suggest replacing Figures 35-39 with these figures and including WL Elevation maps separately.	The GDE analysis (Figure 58 and Appendix 2-G) used groundwater level data in a three-year rolling average while Figures 35-39 represent seasonal highs and lows in a given year.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-017	C	GD	Specific Edit to Plan Requested	2	136-137	2.2.2.7	2506, Figure 59	Why is this survey considered a maximum and not a minimum possible extent? There are a lot of acknowledged generalizations in this section. We would think you'd want a relatively quick field check before dismissing all the "Assumed not a GDE" areas. In addition, as noted, perched zones were not captured in the analysis. Recommend that you include something like "<u>Representative areas currently classed as 'Assumed not a GDE' will be reviewed in the field as part of future work</u>".	Edit Complete		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-018	B	OR	Specific Edit to Plan Requested	2	138	2.2.3	Figure 60	This graph (or an additional one) should include change in storage through time.	The water budget figures will be updated to include change in storage.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-019	B	HM	Modeling/Monitoring – GDEs	2	138	2.2.3	Figure 60	It is important that groundwater ET be modeled explicitly in the GSFLOW model to better understand and illustrate the changes in amount and location of potential impacts to GDEs through time in areas of shallow water tables. We assume this was done. In any case, it is easy to do in MODFLOW by adding in an ET surface corresponding to ground surface with general groundwater ET extinction point rules. We assume there is a comparable simple way to do this in GSFLOW. This needs to be reported as part of the water budgets (Figures 60-61). This would be in addition to the analysis mentioned on page 141, which we don't fully understand – given groundwater ET changes as a function of WLs, how could it be calculated ahead of time and then used as input? We realize we may misunderstand this. Clarification in the text would be very useful.	Groundwater dependent ET will be included in the five year update of the model. It was not included in the current version of the model because historical groundwater levels throughout the Basin and over the entire simulation period are sufficiently deep that significant feedback to the land/soil subsystem are absent or negligible for purposes of estimating groundwater pumping. Water budgets of the annual evapotranspiration due to applied water and preciptitation can be found in Appendix 2-I.	GW_ET	
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-020	B	AL	Pumping Allocations	2	138	2.2.3	2521-2531	It appears that you deem domestic and public pumping to be inconsequential. We do not necessarily disagree, but an estimate of these values needs to be provided to substantiate this position.	Similar to most groundwater basins in California there was no measured groundwater pumping data of agricultural, domestic and publicy suppy uses. In the case of agriculture it has been established that applied water is a sufficient proxy for pumping estimates. [No action needed] See General Data Gaps		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-021	B	HM	Modeling/Monitoring – GSFLOW	2	141	2.2.3.1	2603-2609	It is important that the GSFLOW model be used to calculate groundwater ET because the water table fluctuates through time due to changing stresses. What is the benefit to calculating this outside the model and then using it as input?	There is insufficient data on shallow groundwater dynamics to determine the depth of influence of vegetation on groundwater thus ET was calculated prior to modeling. Recent data collection of shallow groundwater transects will aid in understanding the potential draw of shallow groundwater due to vegetation and allow for inclusion of ET into the model.	GW_ET	

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Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-022	C	GE	Specific Edit to Plan Requested	2	143	2.2.3.1	Table 15 & 16	Delete one of the "~~within the~~" in each, and in Table 16 we think you mean watershed boundary, not ~~Basin~~ boundary	Corrected Basin to Watershed and removed extra text of within the.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-023	B	GE	Specific Edit to Plan Requested	2	144	2.2.3.1	Table 18	Looks like Average and Maximum values are reversed for Agricultural Pumping, or one of the values is erroneous.	The script used to create the table will be checked and the table will be updated to fix this.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-024	C	GE	Specific Edit to Plan Requested	2	145	2.2.3.4	2695	"Winter rains and winter/spring runoff ~~fill~~recharge the aquifer system between October and April (Figure 23)." Replace ~~fill~~ with recharge. If it filled there wouldn't be many of the issues we are dealing with here.	GSP text changed from fill to recharge to clarify the meaning, the original use of fill was meant to indicate fill as an action of putting more water in a bucket and not completely filling a bucket.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-025	B	TR	Lack of Data Transparency	2	146	2.2.3.4	2731-2734	"The response of the groundwater discharge to the stream system will be delayed relative to the timing of the changes in pumping or recharge – by a few days if changes occur within a few tens or hundreds of feet of a stream, by weeks to months if they occur at larger distances from the stream." This statement requires proof. Assuming delay calculations were performed for the local aquifer they should be included somewhere in the document.	The GSP will be updated to include a citation on general stream-aquifer dynamics (Theis 1941) and the text will be updated stating the assumption that the dynamics would be under the same aquifer conditions.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-026	C	OR	Specific Edit to Plan Requested	2	151	2.2.4.2	Figure 67	"Baseline" line should be removed from graph and legend because it is confusing and same color as "Wet"	The figure was updated to remove baseline.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-027	C	OR	Specific Edit to Plan Requested	2	151	2.2.4.2	Figure 67	"Figure 67. Projected flow at the Shasta River near Yreka gage, in difference (cfs) from Baseline, for four future projected climate change scenarios" Perhaps we are mis-understanding what these scenarios are, but are extremely skeptical of any claims that the temperature-driven changes in precipitation form due to climate change (i.e., more rain and less snow) are not going to substantially decrease river flows in summer and fall, regardless of what happens to total annual amount of precipitation. The GSP should acknowledge these realities and then describe how the model predicts that this will seasonally change river flow and groundwater. The format of the graph makes it very difficult to see meaningful seasonal patterns. The y-axis scale that ranges from -2,000 to +12,000 cfs makes it impossible to see what is happening during low flows. Can you add a second panel that to graph so that the low-flow period is legible (maybe -100 to +100 cfs?)? Or maybe limit the months to just show April through October?	The GSP includes Figure 67 to show changes in both wet season and dry season streamflows in future climate scenarios, these scenarios are based on climate change factors provided by DWR, if improved climate change factor data becomes available it will be considered for model updates. The y-axis scale on the figure ranges from -500 to 1,000 cfs not -2,000 to 12,000 cfs. The goal of Figure 67 was to indicate the general trend in streamflow between the baseline and other climate scenarios as increasing or decreasing. More detailed analysis or visualization may be done by those interested when the Shasta Valley Integrated Hydrologic Model results will be made available with the submission of the final GSP.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-028	C	OR	Specific Edit to Plan Requested	2	151	2.2.5	2816-2818	Delete "~~Groundwater pumping has not caused significant and unreasonable conditions in the Basin during the last 20 years~~". The Basin has recognized problems and is a Medium Priority to the State and its why we are doing this SGMA Plan. You can say it's not in overdraft (continuously declining WLs), but that's it.		Sustainable Yield	
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-029	C	OR	Specific Edit to Plan Requested	2	151	2.2.5	2827	Suggest: "…acre-feet per ~~year minus any future~~ reduction in…" to "…acre-feet per year. It may change in the future due to reduction in…"		Sustainable Yield	

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Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-030	B	OR	GSP Terminology and Plans/Actions Insufficiently Defined	2	152	2.2.5	2849-2857	It appears you are saying that the sustainable yield is less than the current value of pumping. The sustainable yield needs to be defined as part of this SGMA plan and then used as the management target. As it is currently worded in the document, there is apparently no lower limit to reductions in pumping.	See MCR Sustainable Yield	Sustainable Yield	
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-031	B	OR	GSP Terminology and Plans/Actions Insufficiently Defined	3	5	3.2	114-116	The first sustainability goal listed is "Groundwater elevations and groundwater storage do not significantly decline below their historically measured range, protect the existing well infrastructure from outages, protect groundwater-dependent ecosystems, and avoid significant additional stream depletion due to groundwater pumping." There is not definition of what "significant" means, so we suggest removing that word. Without a definition, isn't this meaningless? It should probably either be percent (e.g., 1%) or volume?	See MCR "SGMA"	SGMA	
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-032	B	OR	GSP Terminology and Plans/Actions Insufficiently Defined	3	5	3.2	123	In "Groundwater will continue to provide river baseflow as interconnected surface water with no ~~significant or unreasonable~~further reduction in volume." strike "~~significant or unreasonable~~" and replace with "further'. Without a definition, significant is too vague.	See MCR "SGMA"	SGMA	
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-033	B	MN	Monitoring Network – Lack of Available Funding to Implement	3	6-33			We generally agree with sites and parameters proposed in Section 3.3 Monitoring Networks, but we are extremely concerned that funding will not be available to actually implement the monitoring. As described in our comments on Chapter 3, Section 3.3, pages 16-17, Table 1, we also recommend continuous flow monitoring of the springs, and adding two additional springs to the flow monitoring sites: Bridge Field Springs and Black Meadow Springs.	See MCR Data Gaps - ISW		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-034	B	MN	Monitoring Network – Network Insufficient	3	16-17	3.3	Table 1	From our perspective, monitoring the flow of the springs is the most important. The output of these springs is what sustains aquatic ecosystems and agriculture in the Shasta River. In addition, the ability to predict flow in these springs is the primary endpoint upon which we will judge the performance of the Shasta Watershed Groundwater Model. We need to understand how groundwater elevations and groundwater pumping affect the flow in these springs. The monitoring plan proposes monthly monitoring of the springs, however, this is insufficient given the importance of these springs and the potential insights that high-resolution data could provide into the complex dynamics of Shasta Valley groundwater. At what time scales do the flow of these springs fluctuate (seasonal, weekly, daily, hourly, etc.) and what do these fluctuations appear to correspond with (e.g., Dwinnell reservoir levels, nearby groundwater pumps cycling on/off, flood irrigation, snowmelt, storm events, etc.)? How can we understand this without data? The two largest springs, Big Springs and Little Springs, are especially important. Other critically important springs that need continuous flow monitoring include Bridge Field Springs (on Shasta Springs Ranch, owned by Emmerson), Black Meadow Springs (on Shasta Springs Ranch, owned by Emmerson), Kettle Springs (on Shasta Springs Ranch, owned by Emmerson), and Hole in the Ground Spring. We noticed that Bridge Field Springs and Black Meadow Springs were not included in the monitoring plan. We strongly urge that both these springs be added to the monitoring plan.	See MCR Data Gaps - ISW		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-035	C	GE	Specific Edit to Plan Requested	3	6	3.3	155	"A detailed discussion of potential data gaps, and strategies for resolving them, is included as Appendix 3-A~~Z~~"	Edit Complete		

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Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-036	B	AL	Monitoring Network – Monitoring Plan Insufficient	3	25	3.3.3.1	Table 3	Specific conductivity can readily be obtained at the wellhead using a meter. We suggest taking annually when sampling for nitrate.	Comment noted, specific conductivity will be considered for testing during future groundwater sampling.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-037	B	GL	Well Inventory	3	28	3.3.4.1	458-472	Suggest using WLs from “permanent” stilling well in stream and WLs from two nearby adjacent piezometers at different depths to track changes in gradients through time.	See MCR Data Gaps - ISW		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-038	B	OR	Specific Edit to Plan Requested	3	29	3.3.4.1	Figure 6	Should "gradient near Scott River" be changed to "gradient near Shasta River?" If you did mean this to be for the Scott River, then some discussion should be added to justify using conditions in the Scott Valley for analyses in the Shasta valley. Also, not all information is given in explaining the generation of 70 cfs of baseflow for a single water-level gradient. That gradient would have to apply to some length of the river. Is the baseflow number for the entire basin? And would one water-level gradient explain that number (70 cfs)? Normally the quantity would be given as "cfs per unit length of river," or “cfs for reach X,” where reach X has some defined length.	The figure caption has been updated.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-039	C	OR	Specific Edit to Plan Requested	3	29	3.3.4.1	Figure 6 caption	This caption seems to be for a map figure, not for the schematic cross section shown.	Edit Complete		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-040	B	WB	Modeling Insufficient For Water Budget	3	30	3.3.4.1	490-492	The text states “*The goal is to use this approach for the first 5 years of implementation, collect more data, and at the GSP update provide a stream depletion approach based on more reliable results produced by the further calibrated SWGM* .” Two fundamental questions regarding groundwater development in the Shasta Valley are “What effect has past and present groundwater pumping had on surface-water flow in the Shasta River, tributaries, and springs in the Valley?” “What effect will future groundwater pumping have on surface-water resources in the Shasta Valley?” From the stated text, it seems that the Shasta Watershed Groundwater Model (SWGM) will not be used to answer these questions for at least 5 years. If the groundwater part of the model can be used to calculate water budget components as has already been done, why can’t it be used to calculate streamflow depletions? Conversely, if the model can’t be used to reliably calculate streamflow depletions, why can it be used to calculate water-budget components? Using a groundwater model, streamflow depletion from groundwater pumping is always determined using model-calculated water budget components. At this stage of development of the groundwater model, uncertainty in computed streamflow depletion will most likely be in the timing of the depletion, rather than the relative amounts that various surface-water features are affected. In five years, there will still be uncertainty in the timing of depletion, but perhaps that uncertainty will be lower. Nonetheless, a delay of five years in tackling fundamental questions seems to be ignoring the current value of the model. If key calculations were run and re-run as the model was being improved, then the modelers would learn the sensitivity of model results to changes in parameters.	Sensitivity analysis is an important component of understanding the impact of parameters on model results, but for a sensitivity analysis to be useful it requires surface water and groundwater data sets with good spatial and temporal coverage, these are data gaps to be filled in the first five years, to discern how changes in model parameters impact the difference between simulated and observed values. The primary difference here is that the groundwater budgets are cumulative over the entire basin and watershed which allow for averaging out of discrepancies such as uncertainty in which reaches are gaining or losing which is critical in ISW, but provides sufficient understanding of the groundwater budget to understand the respective impact of various sources and sinks. Stream leakage from the aquifer to the stream occurs when groundwater levels are above the ground surface which is considered a loss from the groundwater system, if this loss did not occur to the stream leakage at a certain reach then it would result in an increase in groundwater outflow somewhere else in the domain such as near the drainage of the Shasta River from the watershed, thus there would not be a major change to the overall groundwater budget. In five years there will be sufficient groundwater and surface water level data to understand what groundwater conditions are near the river to calibrate model conditions to match these which will result in spatially accurate ISW, while stream gages will allow for potentially individually calibrating the streambed	ISW_update	

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Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-041	B	WI	Well Inventory	3	30	3.3.4.2	502-511	Suggest incorporating the in-stream stilling well and adjacent vertical gradient piezometers as future improvements	See MCR Data Gaps - ISW		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-042	C	GE	Specific Edit to Plan Requested	3	30	3.3.4.2	Table 5	We are confused why the “Shasta River near Yreka (SRY)” is listed in the Table 5 “Future monitoring locations for monitoring” with the Agency listed “NA”? Isn’t that a long-term flow gage that has been operated for decades by the USGS?	Edit Complete		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-043	B	TR	Request for Clarification	3	35	3.4.1.1	607	“Surface diversions will be entered into the County data management system” Please describe whether or not these data will be publicly accessible. Data collected for demonstrating SGMA compliance should be publicly accessible	The GSA will follow DWR guidelines for data and model transparency.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-044	C	GE	Specific Edit to Plan Requested	3	36	3.4.1.2	641-642	Suggest change “the ~~historic low~~” to “the historic smallest depth to groundwater”	Edit Complete		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-045	A	PM	Request for Clarification	3	36-37	3.4.1.2-.3	641 Table 6 Fig 8	Why is MT set below historic low? This conflicts with previous statements of trying to reduce GW pumping and maintain or raise WLs (see Section 2.2.5)	The MT for groundwater levels is set slightly below the historical low to provide some buffer in the GSP to avoid breaking the MT in the first few years of plan implementation before PMAs are implemented to begin improving water levels and reduce groundwater pumping.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-046	C	OR	Specific Edit to Plan Requested	3	37	3.4.1.3	Table 6	“AT” is not in Acronym list.			
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-047	B	TR	Lack of Data Transparency	3	41	3.4.3.1	772-773	It is not at all clear why municipal water users are apparently de minimis. No data have been supplied to support this claim.	The GSP text is not classifying municipal water users as de minimis users, it was stating that the GSP's PMAs would not change the operations for municipal users.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-048	B	HM	Modeling	3	42	3.4.3.2	787-792	“The GSA will not be using a numerical groundwater-surface water model to evaluate ISW at this time. A temporary approach based on baseflow calculation will be used.” We strongly suggest using the model in parallel with the planned approach to better understand model behavior recalibration (as you note in 3.4.3.6).	See MCR ISW	ISW	
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-049	B	GL	Specific Edit to Plan Requested	3	43	3.4.3.2	Equation table 7	Some additional explanation would be helpful. First, mention somewhere that change in storage in the reach is assumed to be zero. We suggest changing “*SRM* is flow out of the USGS maintained SRM gage” to “*SRM* is flow at USGS maintained Shasta River near Montague (SRM) gage 11517000, located at the downstream end of the reach” A schematic with arrows for various components would help. More importantly, some sort of error analysis should be done to determine uncertainty in groundwater contributions. If an uncertainty can be estimated for each of the components of the water budgets, an analysis can be carried out to determine uncertainty in computed groundwater contributions.	See MCR "ISW"		

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Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-050	B	TR	Lack of Data Transparency	3	42-44	3.4.3.2	784-832	A very important factor that does not appear to us to be mentioned in "Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives" is that there appears to be no accounting for return flows such as tailwater. If much of the irrigation along this reach of the river uses flood irrigation (i.e., in contrast to sprinklers), then isn't there a substantial quantity of tailwater that returns to the river from agricultural fields? If tailwater returns are not accounted for, then "baseflow" could be substantially overestimated in the methods described. While there are some records of tailwater quantities (i.e., from the SVRCD reports), it likely is not possible to estimate these quantities very accurately. But wouldn't it be better to at least make some educated guess about the percent of the diversions that return as tailwater (e.g., perhaps it is in the range of 10-50%) and include that in the calculation, instead of completing ignoring it? You are calling it "Groundwater Contributions" so, it should be your best estimate of groundwater. If you don't apply an adjustment for tailwater, then you should call it something else, like "Groundwater Contributions Plus Tailwater Returns," otherwise it is misleading. We do not have access to the all the reports and data sources cited in the chapter, so perhaps tailwater was indeed already accounted for and we are not aware of it, but from the descriptions provided in the GSP it appears that tailwater was ignored.	See MCR ISW		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-051	C	OR	Specific Edit to Plan Requested	3	43	3.4.3.2	821	We suggest changing "Riparian diverters are not measured" to "Riparian diverters are not measured, despite requirements to measure and report diversions under California Senate Bill 88"	The text remains unchanged because under California Senate Bill 88 requirements to measure and report diversions depends on other circumstances such as total amount diverted, water rights, and permitting.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-052	A	PM	Specific Edit to Plan Requested	3	45	3.4.3.4	846	The proposed Minimum Threshold (MT) for Interconnected Surface Water (ISW) is 100 cfs of groundwater contributions, based on a water balance of the Shasta River reach between Dwinnell Dam and the USGS flow gage near Montague. The estimated diversions used in the water balance are highly uncertain and unreliable, derived from private watermaster records. The bounds of uncertainty on these diversion estimates are so large as to make them nearly useless as a decision[1]making tool. Rather than estimating groundwater contributions based on a highly uncertain water balance (i.e., not the dramatic week to week fluctuations in Table 7), we would much rather have the MT ISW be based on the sum of measured discharges from key individual springs (i.e., Big Springs, Little Springs, Bridge Field Springs, Black Meadow Springs, Kettle Springs, and Hole in the Ground Spring). While these individual springs do not represent the entirety of the groundwater contributions (i.e., there may be some diffuse contributions as well as addition smaller springs), data on the spring flows are required for anyway for management and model calibration, and should provide a more reliable relative metric of groundwater contributions than the water balance. There are not yet much data yet on these spring flows, but measurements need to begin as soon as possible.	See MCR ISW		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-053	C	OR	Specific Edit to Plan Requested	3	46-47	3.4.3.6	906-913	What other long-term source of water is there for the wells (see Theis, 1940, The Sources of Water Derived from Wells)? It is important to strike "…~~does not allow the development of a reliable estimate of stream depletion due to pumping~~." and replace with something like " …makes current model predictions of location and timing of impacts uncertain."	Edit complete		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-054	B	PM	Request for Clarification	4	14	4.2	304	The "Avoiding Significant Increase of Total Net Groundwater Use from the Basin" PMA does not provide a definition of what "significant" means, so we suggest removing that word. Without a definition, isn't this PMA meaningless? It should probably either be percent (e.g., 1%) or volume? See related comment regarding Chapter 4, page 19, section 4.2, line 505-508.	See MCR "SGMA"	SGMA	

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Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-055	B	PM	Request for Clarification	4	14	4.2	326-331	We are unable to understand exactly what the "Avoiding Significant Increase of Total Net Groundwater Use from the Basin" PMA means, especially, this excerpt: "Due to the direct relationship between net groundwater use and ET, implementation of the MA is measured by comparing the most recent five- and ten-year running averages of agricultural and urban ET over both the Basin and watershed, to the maximum value of Basin ET measured in the 2010-2020 period, within the limits of measurement uncertainty." Can it be re-stated more clearly, such as, "The goal of this MA is for X not to exceed Y by Z percent?" Can you provide information on the limits of measurement uncertainty? What is the rationale for using the maximum as the basis for the comparison? Is the purpose of the running averages to smooth out climatic variation (i.e., is ET higher in wet years than dry years)? If there is substantial variation between water year types, then should the goal be different in different water year types? What about the contribution of surface water irrigation to ET? We anticipate that climate change will cause increased reliance on groundwater because surface water flows are going to recede earlier in the irrigation season (due less snowmelt), which could result in ET staying the same but groundwater extraction will increase and flows be lower, all without violating this MA.	The GSA may choose to use Basin ET in lieu of metering wells to ensure that consumptive water use in the Basin will not rise further. When chossing ET as a measure of groundwater consumptive use, future running average ET (more recent five-year period or the most recent 10=year period) cannot exceed the maximum annual observed ET in the 2010-2020 periods.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-056	C	GE	References Other Comments	4	15	4.2	341-343	"To be flexible in adjusting the limit on total net groundwater extraction if and where additional groundwater resources become available due to additional recharge dedicated to later extraction." Groundwater is already over-extracted, and there is not extra water available to use in enhancing recharge. See comments on Chapter 4, Section 4.3, page 30, line 895.	If no water is available for recharge and no MAR or ILR occurs, then total net groundwater extraction would not be expanded.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-057	C	OR	Request for Clarification	4	19	4.2	505-508	"The permitting program would ensure that construction of new extraction wells does not significantly expand current total net groundwater use in the Basin (to the degree that such expansion may cause the occurrence of undesirable results)." How are "undesirable results" defined? Please add a definition or citation here. See related comment regarding Chapter 4, page 14, section 4.2, line 304.	Undesirable results are defined in chapter 3		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-058	B	AL	Request for Clarification	4	19	4.2	513-514	"Here are two illustrative examples of an appropriate use of well replacement…" … "Example 2: Replacement of a 1,000-gpm agricultural well that will be properly decommissioned with a new 2,000-gpm capacity agricultural well is permissible with the explicit condition that the 10-year average total net groundwater extraction within the combined area serviced by the old and the new well does not exceed the average groundwater extraction over the most recent 10-years." Since groundwater use is mostly unmetered (much less publicly accessible), how would this be tracked or enforced?	The extraction could be measured with a flow meter, or by assessing changes in ET from lands that may be serviced by this well.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-059	B	AL	Request for Clarification	4	23	4.2	659-667	The proposed monitoring of irrigation efficiency omits a key tool– metering of water use. Without metering, how can we know if the efficiency projects are actually working?	See MCR "5-year Update"		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-060	B	GE	Request for Clarification	4	23	4.2	659-667	The proposed monitoring of irrigation efficiency lists "Assessment of the increase in irrigation efficiency, with particular emphasis on assessing the reduction or changes in consumptive water use (evaporation, evapotranspiration) based on equipment specification, scientific literature, or field experiments." Doesn't efficiency usually not affect consumptive water use but instead just change recharge (that's how it is represented in the SVIHM, right?). What is the physical basis for thinking efficiency would affect consumptive use for crops like pasture and alfalfa that have low[1]lying continuous canopy cover (i.e., in contrast to orchards or row crops like tomatoes where efficient delivery systems like drip irrigation could reduce evaporation	This comment refers to the Scott Valley groundwater basin numerical model, when these comments are for the Shasta Valley Basin. However, the irrigation efficiency PMA has been updated for clarity to address this comment.		

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Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-061	B	GL	Groundwater Level Improvement Plan Insufficient	4	25	4.2	668	“Juniper Removal: The GSA, USGS and other agencies and private stakeholders will remove excess juniper within the watershed to improve groundwater levels.” While it is conceptually possible to increase water yield for some number of years following juniper removal, it is difficult to actually implement at a watershed scale and maintain it over time. Furthermore, juniper removal will not necessarily increase water yield in all climates, so local conditions should be evaluated (Niemeyer et al. 2017). Such projects should be considered within a holistic management framework that re-establishes historical fire regimes and does not focus solely on water yield. Maintenance would be needed because the benefits of one-time removal projects are likely to be short-lived (Fogarty et al. 2021). References: Fogarty, D. T., de Vries, C., Bielski, C., & Twidwell, D. (2021). Rapid Re-encroachment by Juniperus virginiana After a Single Restoration Treatment. Rangeland Ecology & Management, 78, 112–116. https://doi.org/10.1016/j.rama.2021.06.002. Niemeyer, R. J., Link, T. E., Heinse, R., & Seyfried, M. S. (2017). Climate moderates potential shifts in streamflow from changes in pinyon-juniper woodland cover across the western U.S. Hydrological Processes, 31(20),	Added the recommended text and references.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-062	A	PM	Alternative PMA Suggested	4	30	4.3	895	Given that there is already a dam in place that captures winter runoff from the upper Shasta River watershed, we oppose the Managed Aquifer Recharge (MAR) or In-Lieu Recharge (ILR) PMA. Dwinnell Dam already reduces winter and spring flows enough that there are not sufficient high flows to maintain natural geomorphic processes in the Shasta River. There is no “extra” water in the Shasta River that can be used to recharge groundwater. The way to improve groundwater conditions is demand reduction.	For the MAR and ILR PMA, the GSA will conduct a pilot study and discuss with the SWRCB regarding the diversion of water to evaluate the sustainabiltiy of water diversion. See MCR "PMA Selection Criteria".		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-063	C	GE	Projects and Management Actons	4	32	4.3	954	We support the Strategic Groundwater Pumping Curtailment PMA.	Noted. See MCR "PMA Selection Criteria".		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-064		GE	Modeling	App 2-E	10			We did not receive this appendix with the model documentation until September 13, so did not have time to review it in detail. Many sections of it appear to only be partially complete. We look forward to reviewing this when it is complete.	Model documentation is included in Appendix 2-E.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality Consortium	TC-065	B	OR	Request for Clarification	App 2-I	8			How do the total evapotranspiration of applied water (ETaw) and precipitation (ETpr) values calculated in this report compare with previous estimates such as from CDWR Land and Water Use Estimates (https://water.ca.gov/Programs/Water-Use-And-Efficiency/Land-And-Water[1]Use/Agricultural-Land-And-Water-Use-Estimates), and/or the remote-sensing based Baldocchi et al. (2019)? Full citation: Baldocchi, D., Dralle, D., Jiang, C., & Ryu, Y. (2019). How Much Water Is Evaporated Across California? A Multiyear Assessment Using a Biophysical Model Forced With Satellite Remote Sensing Data. Water Resources Research, 55(4), 2722–2741. https://doi.org/10.1029/2018WR023884	Thank you for this comment. The estimates of total evapotranspiration of applied water and precipitation were developed using best professional practices and sources of information cited in Appendix 2-I (Section 3), but a direct comparison to the other two sources of information cited here has not been completed at this time. This comparison will be taken into consideration for revisions for the final GSP and during GSP implementation, as each may provide a helpful point of reference and potential opportunity for improving estimates of evapotranspiration within the Basin.		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-066	B	OR	Request for Clarification	App 3-A	10		Table 2	Why are flow gages not listed in the Table 2 Data Gap Prioritization? Shouldn’t measuring the flow rates of the largest springs (i.e., Big Springs, Little Springs, etc.) be the highest priority? We do not understand how it will be possible to calibrate groundwater model without having data for these springs.	See MCR Data Gaps - ISW		
Riverbend Sciences on behalf of Tribes of the Klamath Tribal Water Quality	TC-067	B	OR	Request for Clarification	App 3-A	11		Table 2	The groundwater extraction row of Table 2 says “No strategy has been defined yet to fill this data gap. Only voluntary measures are being considered to gathered extraction data.” This is disappointing. How can groundwater be effectively managed without data about how much groundwater is being pumped?	See MCR General Data Gaps	General Data Gaps	

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Quartz Valley Indian Community	QVIC-001	B	PM	PMAs For Instream Flows Insufficient					However, we are disappointed that the GSP did not propose more ambitious steps towards addressing the critical lack of instream flows in the river during summer and fall.	See MCR "ISW"		
Quartz Valley Indian Community	QVIC-002	B	HM	Modeling Insufficient					The technical review has revealed a concerning weakness in the model, particularly in October and November when the groundwater basin is transitioning between draining and filling, those details are included herein. This is most concerning to the Tribe since this is when our salmon are in the Scott system trying to access as much habitat as possible to spawn. We feel that these modeling weaknesses could be refined and alleviated through a more robust monitoring program throughout the valley.	See MCR Data Gaps - ISW	HCM	
Quartz Valley Indian Community	QVIC-003	C	GE	References Other Comments					We have also attached a Technical Memorandum developed by our consultants on the Shasta GSP. Many of the same legal questions apply to the Shasta GSP as well. Although QVIC staff were focused on the Scott GSP development, the Tribe has ancestral lands in the Shasta basin and development of a solid GSP is just as important there as in the Scott River basin to QVJC membership.	Noted.		

SHASTA VALLEY GROUNDWATER SUSTAINABILITY PLAN
PUBLIC COMMENT SUMMARY – MULTIPLE COMMENT RESPONSE

November 2021

Multiple Comment Response Directory Table

ID	Multiple Comment Response
ISW	Clarifying text has been added to Section 3.4.3.2., where the GSP identifies and describes an effective method for quantifying streamflow depletion on calculating Baseflow contribution. The methodology is used in lieu of an integrated hydrologic model, which is currently under development. In the interim, groundwater contributions to baseflow are held at historic levels to avoid new undesirable results. SGMA defines that depletion of ISW (354.16) is based on groundwater conditions occurring throughout the basin and not explicitly groundwater extraction or use. The GSP sets the minimum threshold (MT) based on the calculated baseflow contributions from groundwater which is a function of groundwater conditions in the basin. However, the Basin is expected to operate above the measurable objective (MO) at 145 CFS; the difference between the MO and MT is and should be treated as an operational buffer zone to prevent the Basin from approaching the MT. At this time a preliminary Minimum Threshold of 100 cfs of baseflow has been chosen by looking at the typical baseflow under recent conditions, which is limited by a short historical record that lacks sufficient drought year representation. The MT is set at 100 cfs and not higher (closer to 150 cfs in some years) to account for the lack of baseflow data during drought years that would result in lower baseflow contribution. This will prevent the MT from being passed under current conditions in a drought year. The Minimum Threshold may increase pending further discussion with the Watermaster and analysis of new groundwater and surface water monitoring data under a greater variety of water year types. This analysis can be completed prior to the scheduled 5-year GSP update, if new data from 2019-2021 is obtained. The GSA plans to collaborate with CDFW to develop in-stream flow requirements with the SWRCB to better protect environmental beneficial users. Fundamentally, the GSA currently lacks sufficient groundwater and surface water monitoring data and models to identify depletion of surface water specifically from groundwater pumping and appropriately calibrate the model. At this time there is insufficient groundwater and surface water monitoring data to distinguish what baseflow contribution occurs during periods of influence from groundwater pumping and what baseflow occurs during periods of no influence from groundwater pumping, however, baseflow is still a direct measure of ISW. The numerical groundwater-surface water model cannot be used for this calculation until the identified data gaps are filled. After the data gaps are addressed, the model can be calibrated to properly represent the flow exchange and evaluate groundwater contributions during the entire year. The focus of the 2027 GSP update is to address data gaps related to the Big Springs Complex, and the focus of the following GSP update will be the Little Shasta River and other Shasta River tributaries, dependent on funding. The UC Davis Center for Watershed Sciences (CWS) is in the process of developing an

ID	Multiple Comment Response
	in-stream flow assessment of the Little Shasta River (LSR) and have been sharing information that will support the GSP in eventually creating ISW criteria for the LSR as currently there is insufficient data to quantify streamflow depletions or more specifically streamflow depletions due to groundwater extraction. Due to these data gaps, the GSP also does not have detailed interim milestones for the ISW SMC. These will be developed during first five-year implementation period as additional data become available and the integrated hydrologic model becomes available for developing a more specific ISW SMC, including interim milestones. This may also include determining which reaches that could benefit from reduction in pumping or recharge projects during critical times of the year. The GSA acknowledges the data gaps in the ISW analysis in Section 2.2.2.6, outlines how to address them in Appendix 3-A, and discusses the implementation plan in Chapter 5. Additional text has been added to Section 2.2.2.6 and Appendix 3-A for clarity and an additional management action "Interconnected Surface Water Data Gaps" has been added to Chapter 4. A more detailed implementation for PMAs and data gaps has been added to Chapter 5. The GSA looks forward to working with CDFW and other relevant agencies to fill these data gaps of ISWs in Shasta Valley in the next 5 years for the next GSP update.
GDE	Section 2.2.2.7 lists all the protected species in Shasta Valley. The section provides Table 2.6, which lists all freshwater species with any federal and state level status, from endangered to watch list. This list of observed species within the Butte Valley groundwater basin was collected from the California Department of Fish and Wildlife (CDFW) Biogeographic Information and Observation System (BIOS) Viewer. Describing potential impacts on GDEs requires a better understanding of the location and nature of GDEs in the Basin. The location of species within the Basin requires local confirmation and fine-tuning of general online maps. The GDE monitoring network must be expanded; SV02 is currently the best and only groundwater well to monitor any subset of GDEs. The aim of the GSP is to protect existing GDEs. By setting the water level SMCs such that water level conditions during the baseline period (1991-2014) are preserved, these existing GDEs are sufficiently protected. Representative areas currently classed as 'Assumed not a GDE' will be reviewed in the field as part of future work and reanalyzed as data gaps are filled. The GSA acknowledges the data gaps in the GDE analysis in Section 2.2.2.7 and outlines how to address them in Appendix 3-A and Chapter 5. Additional text has been added to Section 2.2.2.7 and Appendix 3-A for clarity and an additional management action "Groundwater Dependent Ecosystem Data Gaps" has been added to Chapter 4. The GSA looks forward to working with

ID	Multiple Comment Response
	CDFW and other agencies to fill these data gaps of local habitat in Shasta Valley in the next 5 years for the next GSP update.
Water Budgets	A table with the data shown in Figures 60 and 61 in Chapter 2 is now included, presenting the historic groundwater basin and watershed water budgets. Tables 13-18 in Chapter 2 present summary statistics for the water budget, computed with SWGM. The model is currently calibrated for the period from 1990 to 2018 using twice annual water level data from DWR's CASGEM database plus local monthly data provided by The Nature Conservancy for few locations in the Basin. With new continuous water level monitoring now in place since 2019, and with additional data collection efforts to address data gaps identified in the GSP, future model calibration will provide the basis for improving the representation of the groundwater-surface water interface in the model, including canal leakage, lake seepage, and surface water depletion due to groundwater pumping. The future climate models were prepared by DWR and used in accordance with DWR guidance.
HCM	The entire Basin is considered one principal aquifer, with sub aquifers or water bearing formations reflected in the parametrization of the model. Text has been modified to make this clearer. Groundwater elevation maps are included in Section 2.2.2. Aquifer parameters are described in Chapter 2.2 and documentation of the Shasta Watershed Groundwater Model (SWGM) in Appendix 2-E. For purposes of the GSP, a representative groundwater monitoring program was developed across multiple water bearing formations, representative of the varied geology across the basin. The network encompasses both, alluvial formations and volcanic formations. Data do not currently exist to distinguish water level conditions in multiple overlying geologic units. Future nested piezometer well development should help determine vertical gradients between aquifers. The geologic model, based on well logs, defined different hydrogeologic formations. These were assigned appropriate hydraulic parameters based on geologic properties and further adjusted with model calibration. Unlike alluvial basins elsewhere in California, the principle aquifer in Shasta Valley is not the alluvium; rather it is a combination of the alluvium, volcanic debris and lava flows. A definable base is not presented in the HCM because a clear spatial definition of the contact between alluvium, volcanics, and bedrock is not available, especially where volcanic rocks are very thick. It is possible to calculate the approximate storage in the principle aquifer using groundwater elevation, expected (range of) values for formation specific yield, and formation thicknesses, but given the large uncertainty about the thickness

ID	Multiple Comment Response
	of the volcanics, our focus is on changes in groundwater storage rather than total groundwater storage. We note that water bearing formations may have variable yields throughout the basin due to changes in geologic structure, preferential flow paths (e.g. fractures), and groundwater conditions.
Data Gaps - ISW	SMCs for ISWs will be revisited during the next 5-year GSP update. The GSA acknowledges the data gaps in the ISW analysis in Section 2.2.2.6, outlines how to address them in Appendix 3-A, and discusses the implementation plan in Chapter 5. Additional text has been added to Section 2.2.2.6 and Appendix 3-A for clarify and an additional management action "Interconnected Surface Water Data Gaps" has been added to Chapter 4. A more detailed implementation for PMAs and data gaps has been added to Chapter 5. The GSA looks forward to working with CDFW and other relevant agencies to fill these data gaps of ISWs in Shasta Valley in the next 5 years for the next GSP update.
Data Gaps - GDE	See MCR GDE
Opinion	Noted.
Water Quality	The GSA only sets SMCs for two COCs but will continue to monitor other identified COCs for any increasing temporal and spatial trends. As shown in Appendix 2-B, benzene contamination is highly localized and is monitored and managed by the Regional Board through the Leaking Underground Storage Tank (LUST) program. The GSA feels that SMCs are not needed at this time for benzene but will continue to monitor trends. The GSA feels that an SMC is not needed for naturally occurring arsenic, boron, iron, manganese, and pH, but will continue to monitor the constituents for any future issues.
Public Trust	Case law does not support the assertion that the Public Trust Doctrine (PTD) requires a GSA generally, or a special act district acting in such capacity, to take specific actions with respect to public trust resources in the context of developing a GSP. Therefore, the consensus building of the Advisory Committee (AC) is a legitimate means of specifying an approach to considering the PTD, where the AC - consisting of a wide range of stakeholders - considered this MT to be a workable compromise between local economic interests, tribal interests, and environmental needs. The GSA operates under the SGMA and its associated regulations. SGMA clearly outlines a staged process to full compliance with the sustainability criteria by 2042. Furthermore, an extended implementation period for actions to protect public trust resources is not unprecedented: Several decades separate the Mono Lake court decision (National Audubon Society v. Superior Court (Supreme Court of California, 1983, 33 Cal.3d 419) from achieving its management (i.e., sustainability) goal, which has yet to be reached (https://www.monolake.org/learn/stateofthelake/). A short section on the PTD has been added to Chapter 2 - Section 2.1.2.6.

SHASTA VALLEY GROUNDWATER SUSTAINABILITY PLAN
PUBLIC COMMENT SUMMARY – MULTIPLE COMMENT RESPONSE

November 2021

ID	Multiple Comment Response
General Data Gaps	The GSA acknowledges existing data gaps in Chapter 3 and Appendix 3-A, proposes PMAs in Chapter 4, and discusses an implementation plan in Chapter 5. General data gaps include water levels from domestic wells and groundwater extraction. Based on existing and available data, the GSP contains an accurate water budget, clearly defined sustainable management criteria, including minimum thresholds. The GSP will be updated as needed when data gaps are filled but will be dependent on outside sources of funding. The current data gap in groundwater extraction does not limit effective groundwater management as estimating groundwater extraction based on land use is sufficient to quantify basin groundwater budgets that determine groundwater sustainability for the basin. Future voluntary collection of groundwater extraction will serve for modeled groundwater pumping validation and verification of the success of PMAs.
Overdraft	As defined in Bulletin 118, overdraft refers to a long-term trend in groundwater storage, not to short-term fluctuations in water levels that may seasonally lead to some undesirable results.
Sustainable Yield	The GSP is more conservative than a specific sustainable yield. Sustainable yield is a function of future climate and of project implementation. It may be less in the future than it is currently. The sustainable yield selected by the GSP is a formula that accounts for such changes. Prescribing a fixed sustainable yield is technically incorrect and practically insufficient to achieve long-term sustainability. The starting value of the sustainable yield is focused on the historic average of groundwater pumping which will translate into looking at the future averages of annual groundwater pumping rather than specific years. The undesirable results are prevented through the minimum threshold. The minimum threshold will be reached by implementation of PMAs that achieve the required level of reversal in streamflow depletion. To the degree that those PMAs require a future reduction in groundwater pumping, that amount of pump reduction must be subtracted from the sustainable yield, which was computed for the pre-2015 baseline period. By providing a definition of sustainable yield that is not a fixed number, but accounts for future PMAs in a well-prescribed protocol, the sustainable yield is specific and implicitly adjusts to the implementation of PMAs. The GSP's definition of sustainable yield avoids the possibility that a new pumper will claim the amount of pumping that was retired through a PMA elsewhere in the basin. This also provides for managed or in lieu aquifer recharge to not be added to the sustainable yield of the basin if that recharge is explicitly dedicated to the reversal of stream depletion. The approach is consistent with that, e.g., in overdrafted basins, where the sustainable yield, in some basins, is defined as the sustainable yield during the base period plus any future increases in managed aquifer recharge (a PMA).
Groundwater Storage	**Moved to HCM**
PMA Selection Criteria	Chapter 5 outlines how PMAs will be selected for prioritization during GSP implementation. Text has been added to Chapter 4.1 and Chapter 5 implementation schedule. After GSP adoption, the GSA will prioritize certain

ID	Multiple Comment Response
	PMAs for feasibility reviews and preliminary engineering studies. Based on review and study results, PMAs may move forward to implementation.
SGMA	The terms are part of SGMA language. The definitions of unreasonable results are explained in Chapter 3 for the different sustainability indicators.
5-year Update	At this time, the GSA has elected to use a voluntary program for groundwater extraction reporting. For the next five years, the GSA will conduct public outreach to encourage voluntary participation. This may be revisited in the 5-year update. Siskiyou County is currently considering a revised well drilling permit.
Surface Water Temperature	CCR 354.28(c)(4) explicitly refers to "contaminant plumes" and "supply wells", indicating that groundwater quality must be monitored ("Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin."). Furthermore, in interpreting this regulation, DWR's BMP 6 guidelines (https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-6-Sustainable-Management-Criteria-DRAFT_ay_19.pdf) provide no indication that surface water quality monitoring is required where and when baseflow conditions occur. With respect to surface water temperature, it is described as an undesirable result associated with low groundwater levels and storage, and insufficient baseflow.
Emergency Regulations	The SWRCB regulations at 23 CCR 875 et seq. identify "emergency minimum flows" and authorize the Division of Water Rights to curtail diversions where necessary to ensure Shasta River flows are not reduced below the emergency minimum flows. In this regard, the emergency minimum flows serve as a target to guide the Division of Water Rights in determining whether to curtail diversions. These minimum flows do not apply outside this context such that local water use, and planning decisions must attempt to achieve the emergency minimum flows. Further, SWRCB's action only pertains to extremely dry years and/or is anchored in a governor's drought emergency declaration. Some language on this topic has been added to Chapter 2.
References	This topic is already discussed in Chapter 2, based on existing scientific data. Additional statements must be supported by scientific references and documented data. If relevant references are missing from the GSP, please submit to the GSA during the next GSP update.
Well Outtage Appendix	A well outage analysis has been added to the GSP, in Appendix 3-C.

SHASTA VALLEY GROUNDWATER SUSTAINABILITY PLAN
PUBLIC COMMENT SUMMARY – MULTIPLE COMMENT RESPONSE

November 2021

ID	Multiple Comment Response
Data System	The GSA will follow DWR guidelines for data and model transparency. Per DWR's modeling BMP document, "final model files used for decision making in the GSP should be packaged for release to the Department". We anticipate that model files will be unloadable with the GSP in digital format. Similarly, we anticipate that DWR will collect annual report data in digital format.

Table Key:
AC = Advisory Committee
BMP = best management practice
CASGEM = California Statewide Groundwater Elevation Monitoring Program
CDFW = California Department of Fish and Wildlife
COC = Water Quality Constituent of Concern
DWR = Department of Water Resources
GDE = Groundwater Dependent Ecosystem
GSA = Groundwater Sustainability Agency
GSP = Groundwater Sustainability Plan
HCM = Hydrologic Conceptual Model
ISW = Interconnected Surface Water
MT = Minimum Threshold
PMA = Project and Management Action
PTD = Public Trust Doctrine
SGMA= Sustainable Groundwater Management ACt
SMC = Sustainable Management Criteria
SWGM = Shasta Watershed Groundwater Model
SWRCB = State Water Resource Control Board

Appendix 1-E Karuk Memorandum of Understanding

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE SISKIYOU COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
AND
THE KARUK TRIBE

This Memorandum of Understanding is entered into by and between the Karuk Tribe ("Tribe") and the Siskiyou County Flood Control and Water Conservation District ("District"), collectively referred to as "the Parties".

WHEREAS, in September of 2014, the Governor of the State of California signed legislation known as the Sustainable Groundwater Management Act, codified as California Water Code, §§ 10720 *et seq.*, ("SGMA") that requires groundwater resources throughout California to be managed by local Groundwater Sustainability Agencies; and,

WHEREAS, the District has been designated by the California Department of Water Resources as the Groundwater Sustainability Agency ("GSA") for the Butte, Scott and Shasta Valley Groundwater Basins ("Basins"); and,

WHEREAS, the Basins have been designated under SGMA as medium priority basins, requiring the District to prepare and adopt a Groundwater Sustainability Plan ("GSP") for the Basins by January 31, 2022; and,

WHEREAS, the Tribe is a federally recognized Indian tribe; and,

WHEREAS, the District recognizes the established Federal and State laws under which Native American tribal governments are treated as distinct legal and political entities, with their own powers of self-governance and self-determination; and,

WHEREAS, the Tribe has notified the District that the Tribe's aboriginal territory includes the mouth of the Scott River and it has a long standing interest in the health and productivity of both the Scott and Shasta Rivers; and,

WHEREAS, the Tribe has expressed that these rivers are fundamental to the health of the Klamath Basin fisheries, supporting populations of Spring Chinook Salmon, Fall Chinook salmon, ESA-listed Coho salmon, Pacific Lamprey, Summer steelhead, and Winter steelhead, and each of these species are intrinsic parts of the Tribe's culture and identity; and,

WHEREAS, the Scott River is a navigable waterway and 303(d) listed for water temperature impairment and sediment impairment; and, WHEREAS, the North Coast Regional Water Quality Control Board's September 2006 Action Plan for the Scott River Sediment and Temperature Total Maximum Daily Loads stated that excessive sediment loads and elevated temperatures had resulted in degraded water quality conditions that impaired designated beneficial uses of water for the Scott River; and,

WHEREAS, the Shasta River is a navigable waterway and 303(d) listed for water temperature impairment and dissolved oxygen impairment; and,

WHEREAS, the North Coast Regional Water Quality Control Board's June 28, 2006 Action Plan for the Shasta River Temperature and Dissolved Oxygen Total Maximum Daily Loads stated that elevated temperature and low dissolved oxygen had resulted in degraded water quality conditions that impaired designated beneficial uses of water for the Shasta River; and,

WHEREAS, the Tribe continues to develop technical and scientific data through its Department of Natural Resources, which the District agrees to consider, with the understanding that a fair and balanced approach is pivotal to the success of a collaboratively developed GSP for the Basins; and,

WHEREAS, the Parties intend to memorialize a Communications Protocol intended to strengthen meaningful communication and information sharing, with the goal of enhancing the quality of the GSP that will result from the District's implementation of SGMA.

I. AUTHORITY.

a. The Tribe, acting by and through the Karuk Tribal Council pursuant to the Karuk Constitution exercises its inherent sovereign authority to enter into this MOU.

b. The District is a special district, established in 1959 by the Siskiyou County Flood Control and Water Conservation District Act, (Cal Uncod. Water Deer, Act 1240 §§ 1-38), and is the GSA for the Shasta, Scott and Butte Valley groundwater basins. The District's powers include the ability to enter into agreements and memorandums of understanding with other parties.

II. PURPOSE.

The Purpose of this MOU is to formalize good faith Communication Protocols between the Tribe and the District to i) mutually exchange and disseminate information pertinent to the District's development of a GSP pursuant to SGMA, and ii) discuss and ensure full dialog around science and technical information in order to understand and attempt to dispel discrepancies.

III. IMPLEMENTING ACTIONS.

i. The Parties agree to meet in order to share disclosable information pertinent to the development of the GSP at mutually agreed upon dates, locations and times.

ii. Any information the Tribe considers confidential, which the Tribe desires to share with the District, shall be marked as "confidential" in bold red font at the top of the first page of the document, and shall be accompanied by a statement of the legal basis upon which the District may withhold the document from the public pursuant to the California Public Records Act, Government Code section 6250 *et seq*.

iii. The Parties agree that each Party will appoint a single representative to respond to inquiries on issues addressed in or affected by the MOU. The Tribe's representative may address public inquires, but is not required to.

iv. The Parties agree that each Party may request DWR facilitation services to ensure the Parties continue working together.

v. The Parties agree that at any time any Party may request an informal consultation meeting that will include two (2) Siskiyou County elected representatives and two (2) Karuk Tribal Council elected representatives and relevant staff for the purpose of attempting to resolve any issues arising from Technical Meetings or development of the GSP.

vi. The Parties agree that if there is a lack of resolution at the informal consultation meeting any Party may request and be given an official Government to Government consultation meeting that would include a majority of the Karuk Tribal Council and the District Board, and be held in accordance with California's Ralph M. Brown Act.

vii. In the event, after good faith communication, the Tribe considers an issue unresolved, the Tribe may document the issue by way of letter or memorandum and submit it to the District prior to the District's adoption of the GSP during the local comment period. The Tribe's letter or memorandum and the District's response shall be included in full in a Tribal Comments and Response appendix of the GSP.

IV. TERM.

a. This MOU shall become effective upon execution by each of the Parties.

b. The term of this MOU is from the effective date to January 31st, 2022, or, if earlier, to the date of the District's GSP submittal to DWR, unless terminated in accordance with the provisions of Section V.

V. TERMINATION.

Either Party may terminate this agreement upon thirty (30) days written notice to the other Party.

VI. LEGAL EFFECT.

a. This MOU imposes no legally binding obligations upon any Party hereto. Rather it sets out terms for cooperation and data sharing, with the goal of enhancing the quality of the GSP that will result from the District's implementation of SGMA.

b. The parties agree that the MOU is a public document.

VII. NOTIFICATIONS.

Any notification required under the MOU shall be in writing and shall be addressed as follows:

If to District:

Matt Parker
1312 Fairlane Road
Yreka, California 96097
mparker@co.siskiyou.ca.us

If to Tribe:

Joshua Saxon
64236 Second Avenue
PO Box 1016
Happy Camp, California 96039
jsaxon@karuk.us

VIII. AMENDMENT.

This MOU may be amended at any time during the term of this MOU upon the mutual consent of both parties. No addition to, or alteration of, the terms of this MOU shall be valid unless made in writing and signed by the parties hereto.

IX. ENTIRE AGREEMENT.

This MOU contains all of the terms and conditions agreed upon by the parties hereto and no other agreements, oral or otherwise, regarding the subject matter of this MOU shall be deemed to exist.

X. AUTHORITY TO EXECUTE.

Each person executing this MOU represents and warrants that he or she is duly authorized and has legal authority to execute and deliver this MOU.

KARUK TRIBE:

By: ______________________
Russell "Buster" Attebery
Karuk Tribe Chairman

Date: 3-12-2020

SISKIYOU COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT

By: ______________________
Michael Kobseff, Board Chair
Board of Directors

Date: 3/17/2020

ATTEST:
LAURA BYNUM
Clerk, Board of Directors

By: ______________________
Deputy

Appendix 1-F DWR Element Guide

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
§ 354.			**Introduction to Plan Contents**					
			This Article describes the required contents of Plans submitted to the Department for evaluation, including administrative information, a description of the basin setting, sustainable management criteria, description of the monitoring network, and projects and management actions.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
SubArticle 1.			**Administrative Information**					
§ 354.2.			**Introduction to Administrative Information**					
			This Subarticle describes information in the Plan relating to administrative and other general information about the Agency that has adopted the Plan and the area covered by the Plan.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.4.			**General Information**					
			Each Plan shall include the following general information:					
(a)			An executive summary written in plain language that provides an overview of the Plan and description of groundwater conditions in the basin.	28:40				
(b)			A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.	325:333				
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10733.2 and 10733.4, Water Code.					
§ 354.6.			**Agency Information**					
			When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:					
(a)			The name and mailing address of the Agency.	43				
(b)			The organization and management structure of the Agency, identifying persons with management authority for implementation of the Plan.	43				
(c)			The name and contact information, including the phone number, mailing address and electronic mail address, of the plan manager.	43				
(d)			The legal authority of the Agency, with specific reference to citations setting forth the duties, powers, and responsibilities of the Agency, demonstrating that the Agency has the legal authority to implement the Plan.	43				
(e)			An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs.	40, 43:44, 323:324				
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.8, 10727.2, and 10733.2, Water Code.					
§ 354.8.			**Description of Plan Area**					
			Each Plan shall include a description of the geographic areas covered, including the following information:					
(a)			One or more maps of the basin that depict the following, as applicable:					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(1)		The area covered by the Plan, delineating areas managed by the Agency as an exclusive Agency and any areas for which the Agency is not an exclusive Agency, and the name and location of any adjacent basins.	53				
	(2)		Adjudicated areas, other Agencies within the basin, and areas covered by an Alternative.	N/A				The Basin does not have adjudicated areas, other GSAs, or Alternatives.
	(3)		Jurisdictional boundaries of federal or state land (including the identity of the agency with jurisdiction over that land), tribal land, cities, counties, agencies with water management responsibilities, and areas covered by relevant general plans.	55, 69				
	(4)		Existing land use designations and the identification of water use sector and water source type.	57				
	(5)		The density of wells per square mile, by dasymetric or similar mapping techniques, showing the general distribution of agricultural, industrial, and domestic water supply wells in the basin, including de minimis extractors, and the location and extent of communities dependent upon groundwater, utilizing data provided by the Department, as specified in Section 353.2, or the best available information.	59				
(b)			A written description of the Plan area, including a summary of the jurisdictional areas and other features depicted on the map.	51:59				
(c)			Identification of existing water resource monitoring and management programs, and description of any such programs the Agency plans to incorporate in its monitoring network or in development of its Plan. The Agency may coordinate with existing water resource monitoring and management programs to incorporate and adopt that program as part of the Plan.	60:72				
(d)			A description of how existing water resource monitoring or management programs may limit operational flexibility in the basin, and how the Plan has been developed to adapt to those limits.	60:72				
(e)			A description of conjunctive use programs in the basin.	60:72				
(f)			A plain language description of the land use elements or topic categories of applicable general plans that includes the following:					
	(1)		A summary of general plans and other land use plans governing the basin.	73:74				
	(2)		A general description of how implementation of existing land use plans may change water demands within the basin or affect the ability of the Agency to achieve sustainable groundwater management over the planning and implementation horizon, and how the Plan addresses those potential effects	73:74, 77				
	(3)		A general description of how implementation of the Plan may affect the water supply assumptions of relevant land use plans over the planning and implementation horizon.	73:74, 77				
	(4)		A summary of the process for permitting new or replacement wells in the basin, including adopted standards in local well ordinances, zoning codes, and policies contained in adopted land use plans.	75				
	(5)		To the extent known, the Agency may include information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management.	76:77				
(g)			A description of any of the additional Plan elements included in Water Code Section 10727.4 that the Agency determines to be appropriate.	75:77				

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10720.3, 10727.2, 10727.4, 10733, and 10733.2, Water Code.					
§ 354.10.			**Notice and Communication**					
			Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:					
(a)			A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties.	45:49				
(b)			A list of public meetings at which the Plan was discussed or considered by the Agency.	357				
(c)			Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.	360:632				
(d)			A communication section of the Plan that includes the following:					
	(1)		An explanation of the Agency’s decision-making process.	44				
	(2)		Identification of opportunities for public engagement and a discussion of how public input and response will be used.	47				
	(3)		A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin.	46:49				
	(4)		The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.	44				
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.8, 10728.4, and 10733.2, Water Code					
SubArticle 2.			**Basin Setting**					
§ 354.12.			**Introduction to Basin Setting**					
			This Subarticle describes the information about the physical setting and characteristics of the basin and current conditions of the basin that shall be part of each Plan, including the identification of data gaps and levels of uncertainty, which comprise the basin setting that serves as the basis for defining and assessing reasonable sustainable management criteria and projects and management actions. Information provided pursuant to this Subarticle shall be prepared by or under the direction of a professional geologist or professional engineer.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.14.			**Hydrogeologic Conceptual Model**					
(a)			Each Plan shall include a descriptive hydrogeologic conceptual model of the basin based on technical studies and qualified maps that characterizes the physical components and interaction of the surface water and groundwater systems in the basin.	78:186				
(b)			The hydrogeologic conceptual model shall be summarized in a written description that includes the following:					
	(1)		The regional geologic and structural setting of the basin including the immediate surrounding area, as necessary for geologic consistency.	78:79				

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(2)		Lateral basin boundaries, including major geologic features that significantly affect groundwater flow.	78:79				
	(3)		The definable bottom of the basin.	513				
	(4)		Principal aquifers and aquitards, including the following information:					
		(A)	Formation names, if defined.	89:115				
		(B)	Physical properties of aquifers and aquitards, including the vertical and lateral extent, hydraulic conductivity, and storativity, which may be based on existing technical studies or other best available information.	78, 94:102				
		(C)	Structural properties of the basin that restrict groundwater flow within the principal aquifers, including information regarding stratigraphic changes, truncation of units, or other features.	78, 94:102				
		(D)	General water quality of the principal aquifers, which may be based on information derived from existing technical studies or regulatory programs.	136:146				
		(E)	Identification of the primary use or uses of each aquifer, such as domestic, irrigation, or municipal water supply.	51:59				The Basin has only one aquifer.
	(5)		Identification of data gaps and uncertainty within the hydrogeologic conceptual model	1308:1332				
(c)			The hydrogeologic conceptual model shall be represented graphically by at least two scaled cross-sections that display the information required by this section and are sufficient to depict major stratigraphic and structural features in the basin.	107:115				
(d)			Physical characteristics of the basin shall be represented on one or more maps that depict the following:					
	(1)		Topographic information derived from the U.S. Geological Survey or another reliable source.	80				
	(2)		Surficial geology derived from a qualified map including the locations of cross-sections required by this Section.	107				
	(3)		Soil characteristics as described by the appropriate Natural Resources Conservation Service soil survey or other applicable studies.	116:121				
	(4)		Delineation of existing recharge areas that substantially contribute to the replenishment of the basin, potential recharge areas, and discharge areas, including significant active springs, seeps, and wetlands within or adjacent to the basin.	94:102, 122:128, 150:186				
	(5)		Surface water bodies that are significant to the management of the basin.	122:128				
	(6)		The source and point of delivery for imported water supplies.	N/A				Water is not imported into the Basin.
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2, 10733, and 10733.2, Water Code.					
§ 354.16.			**Groundwater Conditions**					
			Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:					
(a)			Groundwater elevation data demonstrating flow directions, lateral and vertical gradients, and regional pumping patterns, including:					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(1)		Groundwater elevation contour maps depicting the groundwater table or potentiometric surface associated with the current seasonal high and seasonal low for each principal aquifer within the basin.	132:135, 764:788				
	(2)		Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.	136, 790:839				
(b)			A graph depicting estimates of the change in groundwater in storage, based on data, demonstrating the annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions, including the annual groundwater use and water year type.	136, 188				
(c)			Seawater intrusion conditions in the basin, including maps and cross-sections of the seawater intrusion front for each principal aquifer.	N/A				The Basin is not near the ocean.
(d)			Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes.	136:146				
(e)			The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.	147:149				
(f)			Identification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems, utilizing data available from the Department, as specified in Section 353.2, or the best available information.	150:167				
(g)			Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information.	168:186				
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10727.4, and 10733.2, Water Code.					
§ 354.18.			**Water Budget**					
(a)			Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form.	187:208				
(b)			The water budget shall quantify the following, either through direct measurements or estimates based on data:					
	(1)		Total surface water entering and leaving a basin by water source type.	187:194				
	(2)		Inflow to the groundwater system by water source type, including subsurface groundwater inflow and infiltration of precipitation, applied water, and surface water systems, such as lakes, streams, rivers, canals, springs and conveyance systems.	187:194				
	(3)		Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.	187:194				
	(4)		The change in the annual volume of groundwater in storage between seasonal high conditions.	187:194				

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(5)		If overdraft conditions occur, as defined in Bulletin 118, the water budget shall include a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions.	187:194				
	(6)		The water year type associated with the annual supply, demand, and change in groundwater stored.	187:194				
	(7)		An estimate of sustainable yield for the basin.	209				
(c)			Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:					
	(1)		Current water budget information shall quantify current inflows and outflows for the basin using the most recent hydrology, water supply, water demand, and land use information.	187:194				
	(2)		Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:					
		(A)	A quantitative evaluation of the availability or reliability of historical surface water supply deliveries as a function of the historical planned versus actual annual surface water deliveries, by surface water source and water year type, and based on the most recent ten years of surface water supply information.	187:194				
		(B)	A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.	187:194				
		(C)	A description of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability of the Agency to operate the basin within sustainable yield. Basin hydrology may be characterized and evaluated using water year type.	187:194				
	(3)		Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:					
		(A)	Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.	194:208				

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
		(B)	Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.	194:208				
		(C)	Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate.	194:208				
(d)			The Agency shall utilize the following information provided, as available, by the Department pursuant to Section 353.2, or other data of comparable quality, to develop the water budget:					
	(1)		Historical water budget information for mean annual temperature, mean annual precipitation, water year type, and land use.	187:208, 1106-1156				
	(2)		Current water budget information for temperature, water year type, evapotranspiration, and land use.	187:208, 1106-1156				
	(3)		Projected water budget information for population, population growth, climate change, and sea level rise.	194:208, 1106-1156				
(e)			Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow. If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater, the Plan shall identify and describe an equally effective method, tool, or analytical model to evaluate projected water budget conditions.	187:208, 1106-1156				
(f)			The Department shall provide the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and the Integrated Water Flow Model (IWFM) for use by Agencies in developing the water budget. Each Agency may choose to use a different groundwater and surface water model, pursuant to Section 352.4.	187:208, 1106-1156				
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10721, 10723.2, 10727.2, 10727.6, 10729, and 10733.2, Water Code.					
§ 354.20.			**Management Areas**					
(a)			Each Agency may define one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin.	210				

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(b)			A basin that includes one or more management areas shall describe the following in the Plan:					
	(1)		The reason for the creation of each management area.	N/A				The Basin does not use management areas.
	(2)		The minimum thresholds and measurable objectives established for each management area, and an explanation of the rationale for selecting those values, if different from the basin at large.	N/A				The Basin does not use management areas.
	(3)		The level of monitoring and analysis appropriate for each management area.	N/A				The Basin does not use management areas.
	(4)		An explanation of how the management area can operate under different minimum thresholds and measurable objectives without causing undesirable results outside the management area, if applicable.	N/A				The Basin does not use management areas.
(c)			If a Plan includes one or more management areas, the Plan shall include descriptions, maps, and other information required by this Subarticle sufficient to describe conditions in those areas.	N/A				The Basin does not use management areas.
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10733.2 and 10733.4, Water Code.					
SubArticle 3.			**Sustainable Management Criteria**					
§ 354.22.			**Introduction to Sustainable Management Criteria**					
			This Subarticle describes criteria by which an Agency defines conditions in its Plan that constitute sustainable groundwater management for the basin, including the process by which the Agency shall characterize undesirable results, and establish minimum thresholds and measurable objectives for each applicable sustainability indicator.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.24.			**Sustainability Goal**					
			Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish the sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.	214				
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10721, 10727, 10727.2, 10733.2, and 10733.8, Water Code.					
§ 354.26.			**Undesirable Results**					
(a)			Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.	243, 248:249, 249, 260:261, 268				
(b)			The description of undesirable results shall include the following:					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(1)		The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.	243, 248:249, 249:250, 261:262, 268				
	(2)		The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.	244, 247, 1341:1366, 248:248, 251:254, 266, 268				
	(3)		Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.	247:249, 250:251, 262, 268				
(c)			The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.	227:242				
(d)			An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.	214				Seawater intrusion is not applicable to the Basin.
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10721, 10723.2, 10727.2, 10733.2, and 10733.8, Water Code.					
§ 354.28.			**Minimum Thresholds**					
(a)			Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.	245, 248:249, 256, 263, 268:269				
(b)			The description of minimum thresholds shall include the following:					
	(1)		The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.	244, 248:248, 251:254, 266, 268:269				
	(2)		The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.	247:249, 256, 267:268, 269				
	(3)		How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.	N/A				The minimum thresholds will not affect adjacent basins.

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(4)		How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.	247:249, 250:251, 262, 268				
	(5)		How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.	244, 249, 259:260				
	(6)		How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.	227:242				
(c)			Minimum thresholds for each sustainability indicator shall be defined as follows:					
	(1)		Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:					
		(A)	The rate of groundwater elevation decline based on historical trends, water year type, and projected water use in the basin.	244				
		(B)	Potential effects on other sustainability indicators.	247:248				
	(2)		Reduction of Groundwater Storage. The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.	248-249				
	(3)		Seawater Intrusion. The minimum threshold for seawater intrusion shall be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results. Minimum thresholds for seawater intrusion shall be supported by the following:					
		(A)	Maps and cross-sections of the chloride concentration isocontour that defines the minimum threshold and measurable objective for each principal aquifer.	N/A				Seawater intrusion is not present in the Basin.
		(B)	A description of how the seawater intrusion minimum threshold considers the effects of current and projected sea levels.	N/A				Seawater intrusion is not present in the Basin.
	(4)		Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.	262:263				
	(5)		Land Subsidence. The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results. Minimum thresholds for land subsidence shall be supported by the following:					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
		(A)	Identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including an explanation of how the Agency has determined and considered those uses and interests, and the Agency's rationale for establishing minimum thresholds in light of those effects.	268:269				
		(B)	Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.	149				
	(6)		Depletions of Interconnected Surface Water. The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. The minimum threshold established for depletions of interconnected surface water shall be supported by the following:					
		(A)	The location, quantity, and timing of depletions of interconnected surface water.	251:254				
		(B)	A description of the groundwater and surface water model used to quantify surface water depletion. If a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model to accomplish the requirements of this Paragraph.	251:254				
(d)			An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.	248:249, 254:256				
(e)			An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.	214				Seawater intrusion is not present in the Basin.
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10733, 10733.2, and 10733.8, Water Code.					
§ 354.30.			**Measurable Objectives**					
(a)			Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.	244:245, 249, 255:256, 264:265, 269				
(b)			Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.	244:245, 249, 255:256, 264:265, 269				
(c)			Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.	244:245, 249, 254:256, 264:265, 269				

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(d)			An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.	248:249, 254:256				
(e)			Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.	244:246, 248:249, 254:256, 264:265, 269				
(f)			Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.	N/A				The Plan does not set measurable objectives nor interim milestones for additional Plan elements.
(g)			An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.	N/A				The measureable objectives in the Plan have reasonable margins of operational flexibility.
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2, 10727.4, and 10733.2, Water Code.					
SubArticle 4.			**Monitoring Networks**					
§ 354.32.			**Introduction to Monitoring Networks**					
			This Subarticle describes the monitoring network that shall be developed for each basin, including monitoring objectives, monitoring protocols, and data reporting requirements. The monitoring network shall promote the collection of data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions that occur through implementation of the Plan.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.34.			**Monitoring Network**					
(a)			Each Agency shall develop a monitoring network capable of collecting sufficient data to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, and yield representative information about groundwater conditions as necessary to evaluate Plan implementation.	215:242				
(b)			Each Plan shall include a description of the monitoring network objectives for the basin, including an explanation of how the network will be developed and implemented to monitor groundwater and related surface conditions, and the interconnection of surface water and groundwater, with sufficient temporal frequency and spatial density to evaluate the affects and effectiveness of Plan implementation. The monitoring network objectives shall be implemented to accomplish the following:					
	(1)		Demonstrate progress toward achieving measurable objectives described in the Plan.	215:242				
	(2)		Monitor impacts to the beneficial uses or users of groundwater.	215:242				

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(3)		Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.	215:242				
	(4)		Quantify annual changes in water budget components.	215:242				
(c)			Each monitoring network shall be designed to accomplish the following for each sustainability indicator:					
	(1)		Chronic Lowering of Groundwater Levels. Demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features by the following methods:					
		(A)	A sufficient density of monitoring wells to collect representative measurements through depth-discrete perforated intervals to characterize the groundwater table or potentiometric surface for each principal aquifer.	218, 224, 227:230				
		(B)	Static groundwater elevation measurements shall be collected at least two times per year, to represent seasonal low and seasonal high groundwater conditions.	218, 227:230				
	(2)		Reduction of Groundwater Storage. Provide an estimate of the change in annual groundwater in storage.	218, 227:230, 230:231				
	(3)		Seawater Intrusion. Monitor seawater intrusion using chloride concentrations, or other measurements convertible to chloride concentrations, so that the current and projected rate and extent of seawater intrusion for each applicable principal aquifer may be calculated.	N/A				The Basin does not have seawater intrusion.
	(4)		Degraded Water Quality. Collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues.	231:235				
	(5)		Land Subsidence. Identify the rate and extent of land subsidence, which may be measured by extensometers, surveying, remote sensing technology, or other appropriate method.	241:242				
	(6)		Depletions of Interconnected Surface Water. Monitor surface water and groundwater, where interconnected surface water conditions exist, to characterize the spatial and temporal exchanges between surface water and groundwater, and to calibrate and apply the tools and methods necessary to calculate depletions of surface water caused by groundwater extractions. The monitoring network shall be able to characterize the following:					
		(A)	Flow conditions including surface water discharge, surface water head, and baseflow contribution.	219:220, 223, 235:240				
		(B)	Identifying the approximate date and location where ephemeral or intermittent flowing streams and rivers cease to flow, if applicable.	219:220, 223, 235:240				
		(C)	Temporal change in conditions due to variations in stream discharge and regional groundwater extraction.	219:220, 223, 235:240				
		(D)	Other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water.	219:220, 223, 235:240				

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(d)			The monitoring network shall be designed to ensure adequate coverage of sustainability indicators. If management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area.	215:217				
(e)			A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.	215:242				
(f)			The Agency shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors:					
	(1)		Amount of current and projected groundwater use.	215:242				
	(2)		Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.	215:242				
	(3)		Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal.	215:242				
	(4)		Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.	215:242				
(g)			Each Plan shall describe the following information about the monitoring network:					
	(1)		Scientific rationale for the monitoring site selection process.	215:242				
	(2)		Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.	215:242				
	(3)		For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.	243:270				
(h)			The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.	215:242				
(i)			The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.	1333:1340				
(j)			An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.	214				The Basin does not have seawater intrusion.
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10727.4, 10728, 10733, 10733.2, and 10733.8, Water Code					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
§ 354.36.			**Representative Monitoring**					
			Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:					
(a)			Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.	215:242				
(b)			(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:					
	(1)		Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.	238, 230:231				
	(2)		Measurable objectives established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.	248:249, 254:256				
(c)			The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.	238, 230:231				
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2 and 10733.2, Water Code					
§ 354.38.			**Assessment and Improvement of Monitoring Network**					
(a)			Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.	215:222, 1308:1332				
(b)			Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.	215:222, 1308:1332				
(c)			If the monitoring network contains data gaps, the Plan shall include a description of the following:					
	(1)		The location and reason for data gaps in the monitoring network.	215:222, 1308:1332				
	(2)		Local issues and circumstances that limit or prevent monitoring.	215:222, 1308:1332				
(d)			Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.	215:222, 1308:1332				
(e)			Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:					
	(1)		Minimum threshold exceedances.	222				

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(2)		Highly variable spatial or temporal conditions.	222				
	(3)		Adverse impacts to beneficial uses and users of groundwater.	222				
	(4)		The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.	222				
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10728.2, 10733, 10733.2, and 10733.8, Water Code					
§ 354.40.			**Reporting Monitoring Data to the Department**					
			Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10728, 10728.2, 10733.2, and 10733.8, Water Code.					
SubArticle 5.			**Projects and Management Actions**					
§ 354.42.			**Introduction to Projects and Management Actions**					
			This Subarticle describes the criteria for projects and management actions to be included in a Plan to meet the sustainability goal for the basin in a manner that can be maintained over the planning and implementation horizon.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.44.			**Projects and Management Actions**					
(a)			Each Plan shall include a description of the projects and management actions the Agency has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin.	270:308				
(b)			Each Plan shall include a description of the projects and management actions that include the following:					
	(1)		A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent. The Plan shall include the following:					
		(A)	A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management actions, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.	270:308, 291				
		(B)	The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.	319				

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(2)		If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.	270:308				
	(3)		A summary of the permitting and regulatory process required for each project and management action.	270:308				
	(4)		The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.	275:281, 1475:1481				
	(5)		An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.	270:308, 318				
	(6)		An explanation of how the project or management action will be accomplished. If the projects or management actions rely on water from outside the jurisdiction of the Agency, an explanation of the source and reliability of that water shall be included.	270:308				
	(7)		A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.	270:308				
	(8)		A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.	270:308				
	(9)		A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.	270:308				
(c)			Projects and management actions shall be supported by best available information and best available science.	270:308				
(d)			An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.	270:308, 318				
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2, 10727.4, and 10733.2, Water Code.					

Hydrostratigraphic Modeling Investigation Methodology

Data collection

While there has not been a great deal of study regarding the large-scale hydrogeology of Shasta Valley and the surround basin, there have been a few key studies, mostly by the United States Geological Survey and the State of California, that have studied the basin's geology and how it directly relates to the groundwater system throughout the Valley. Usage of this information was key to constructing the 3-D geological model of Shasta Valley and the surrounding basin.

-DWR OSWCR database

The California Department of Water Resources' (CDWR) Online System for Well Completion Reports (OSWCR) database (https://data.ca.gov/dataset/well-completion-reports) contains records of all of the legally drilled and completed (as well as abandoned or destroyed) groundwater wells in the basin. The OSWCR database contains details relating to precise (or general) location, date of operations, notes on events encountered during drilling and completion operations, drillers' lithologic logs, completion design (usually including screened zone(s) information and total complete depth), any available aquifer performance tests, geophysical borehole logs, planned well use type, and other information. However, the OSWCR database is known to contain many errors and inconsistencies in potentially any of the fields in the database that require additional review by the user to verify the usage of these records. This specifically applies to the inconsistent, and many times inaccurate, interpretation of lithology encountered during drilling operations. Additionally, as the majority of well completion reports have been spatially registered to the center of the Public Land Survey System section (one square mile or ~2.6 square kilometers), the user of the records usually needs to more precisely locate the well. The OSWCR database is the only known source of information regarding lithology in the basin.

-USGS GW & Geology Features of Shasta Valley

Mack (1960) contributed what is considered to be the most comprehensive hydrogeologic investigation of the Valley as the Valley's hydrogeology was not studied prior to the 1950's and study at a similar scale to Mack (1960) has essentially not taken place since. Mack (1960) investigated the thickness and extent of water-bearing geologic zones, hydrogeologic properties of the aquifer materials, groundwater flow, water chemistry analyses, hydrographs, water well records, aquifer pumping rates, and broad groundwater storage estimate of the Valley. The report contains a number of geologic cross sections through the Valley based on limited drillers' lithologic logs available at the time. All of the available information included in this study are incorporated directly into the geological model.

Blodgett and others (1985) provide a follow-on study to Mack (1960) but mainly investigated the updated information regarding groundwater hydrographs and water quality of more springs at higher elevation on Mount Shasta. The data presented in this report are useful for understanding potential changes over time to water quality signatures that would infer geologic control on the groundwater system and particularly for an updated mapping of the springs, which imply geological contrasts useful for knowledge in constructing the geological model.

-Holliday Thesis on Yellow Butte Fault geology

Holliday (1982) investigated the Paleozoic and Mesozoic geology in the southeast area of the Valley. This study was mainly restricted to the Haystack and Yellow Buttes and the Yellow Butte Fault zone that surrounds the horst features. A number of cross sections were developed for this area and integrated in the construction of the geologic model for the subset area of covered by this study.

-USGS Mt. Shasta Debris Avalanche geologic analysis
Crandell and others (1984) and Crandell (1989) reinterpreted the central volcanic deposits of the Valley as a very large, catastrophic debris avalanche originating of the collapse of Ancestral Mount Shasta, which altered the surface and groundwater hydrology of the Valley. One the most pertinent aspects of the studies is that they define the extent and thickness of the debris avalanche deposit, which impacts the flow of groundwater across the Valley.

-CGS surface geologic map
Wagner and Saucedo (1987) represents the most recent and detailed surface geologic map of the entire basin. The publication also includes two thick, large-scale E-W cross sections across the basin. The cross sections are to the north and south of the basin boundary but nonetheless provide a geologic framework for the deep-seated basement rock underlying the basin.

-DWR Draft Report – data needs assessment
Ward and Eaves (2011) compiled and reinterpreted the vast majority of the data resources found in published reports from the United States Geological Survey and the State of California (particularly mapping publications available from the California Geologic Survey (in cooperation with the United States Geological Survey) as well as in unpublished data from California Department of Water Resources. This includes updated drilling logs and cross sections. The study integrates all of the available information to provides updated estimates to the extents and thicknesses of aquifer zones and to cross sections across the Valley, some coincide with previously published cross sections of Mack (1960). Additionally, Ward and Eaves (2011) provided digitization into GIS shapefile format of the published surface geology polygons of Wagner and Saucedo (1987). This shapefile was directly used in the construction of the geologic model with the surface geology as a hard constraint for the geologic boundaries of the formations and a guide to interpreting drilling logs located within each surface geologic polygon.

-Other USGS reports defining Paleozoic plutonic/metamorphic & Mesozoic sedimentary geology
Irwin (1972, 1994) provide deep study of the Paleozoic geology of the plutonic and metamorphic rocks that make up the Klamath Mountains, which also largely underlie the sedimentary and volcanic rocks of the Valley. These studies are helpful for guiding the estimation of basement rock in the geologic model either explicitly where encountered in the drilling logs or implicitly based on structural geologic trends.

DWR WCR Location Process

California Department of Water resources has about 3,400 Well Completion Reports (WCRs) in its database (CA OSWCR) listed for the Shasta Valley hydrologic basin (eight-digit Hydrologic Unit Code 18010207). These WCRs contain the pertinent hydrogeologic information needed to assist in constructing a geologic model for groundwater investigation purposes. However, many of the WCRs are not precisely located enough standards of constructing an appropriate resolved geologic model.

-Recently drilled and logged WCRs with precise locations
While roughly half of the WCRs are listed as being within 50 feet (15.24 m) of their noted coordinate location, the rest are located to the center of the township and range section (an area of one square mile). The WCRs listed as being within 50 feet (15.24 m) are considered to be precise enough for purposes of constructing this geologic model and were included in the model construction.

-WCR Logs with imprecise locations but have addresses and/or detailed site maps

The other roughly half of the WCRs available for the basin are not precisely located well enough for purposes of constructing the geologic model and needed to be located more precisely for inclusion in the model. However, a subset of the WCRs with imprecise locations do have an included map or physical address detailing the location of the well within the township and range section. WCRs with this mapped or addressed location information were included in the model. We used Google Earth Pro (Alphabet, Inc.) to more precisely locate wells given the address and/or detailed map. We located the well visually in available satellite imagery by either directly locating it, if outside, or indirectly in a likely external shed or enclosure, or at the residence listed at the address if unable to locate the well outside the dwelling. In some cases, Siskiyou County was able to provide septic tank records that map groundwater wells at least 100 feet (30.48 m) away from the septic tank (California state regulation).

-WCR Logs with imprecise locations and no addresses or detailed site maps but list APN record

While some WCRs did not have a precise location, address, or map included, some did have an attached Assessor Parcel Number (APN) recorded in the report. We used the APN as a final locating method for those records not containing the other well location information. We assumed that if an APNs area is relatively small, then its centroid location would not be very far from the actual well's location. In these instances, we utilized the APN's centroid as an approximate location for the well location.

Drilling Log Interpretation Procedure and 3-D Geologic modeling

Once located more precisely, we could utilize the resulting subset of precisely located WCR lithologic logs to construct a representative subsurface geologic model with a focus on hydrogeologic properties and matched to mapped surface geologic units. Initially, we chose to model lithological descriptions as specified simplified bins but realized that the scale of the basin and large distances between some of the wells were too great to adequately model with a discrete, computerized geologic model. Instead, we then chose to model the interpreted geological formation that the lithology of the well most closely represented, based on mapped surface geological units (which contain descriptions of the various lithologies present in various formations) of the area in which the wells were located and the projected depths of those units based on the lithologic logs and published cross sections of the basin.

-Standardization of WCR lithologies to set of classification bins

Driller's lithologic logs recorded in WCRs are consistently reported as the lithologic type observed (e.g. gravel, clayey sand, basalt etc.), however in many cases the drillers are not trained geologists or experienced in the locality-specific geology of the basin area to be able to accurately assess the lithology of recovered drilling samples. In some cases, there is enough detail and context in the logs to discern what basic lithologic type of sediment or rock is being described. We reclassified the observed lithology with depth for each WCR included in the model. We settled on 19 classification bins that fit all of the drilling log descriptions of sediments and rocks encountered. The table below lists the specific classification bins we chose to use to reclassify the driller descriptions. While in the end these classification bins were not modeled directly, they were saved in the database to help guide the interpretation of the lithologic descriptions into the most likely geologic units to which they belong.

alluvium
boulders
clay
cobble

conglomerate
fractured metamorphic rock
fractured mudrock
fractured plutonic rock
fractured sandstone
fractured volcanic rock
gravel
metamorphic rock
mudrock
plutonic rock
sand
sandstone
silt
volcanic rock
volcanic sediment

-Interpretation of lithological classifications to geologic surface formations

The binned lithologic classifications are not classified as a geologic unit or formation (e.g. Hornbrook Formation). While a more accurate, high-resolution hydrogeologic model would keep track of these lithologic classification types, which are needed for fine-scale understanding of how groundwater flows preferentially through the basin, it is too much to discretize for a discrete computerized geologic model at the scale of this basin (approximately 800 square miles or ~2,000 square kilometers). Instead, we chose to follow the approach used in published cross sections of the Valley and converted lithologic types to their likely geologic formation, using the mapped surface geologic units (shown in first table below) as a guiding template for the geologic interpretation.

Table of Geologic units identified present in Shasta Valley River basin WCRs analyzed

Cbg- Bragdon Formation - Basement
Dc- Copley Greenstone - Basement
Dkn- Kennett Formation - Basement
Dsg- Gazelle Formation - Basement
Kh- Hornbrook Formation
Mzd- Plutonic Dioritic rocks - Basement
MzPz ms- metasedimentary rocks - Basement
MzPz mv- metavolcanic rocks - Basement
MzPz mvs- metavolcanoclastic sedimentary rocks - Basement
MzPz s- Stuart Fork Formation - Basement
MzPz- Undifferentiated - Basement
Oam- Antelope Mountain Quartzite - Basement
Op- Trinity peridotite - Basement
Ogb- Gabboric and dioritic rocks - Basement

Pv- Pliocene Volcanic rocks
Pza- Abrams Mica Schist - Basement
Q- Alluvium
Qg- Glacial deposits
Qv- Pleistocene Volcanic rocks
Qvs- Volcanic rocks of Shasta Valley
Smc- Moffett Creek Formation - Basement
SOd- Duzel Formation - Basement
Tv- Western Cascade Volcanics

Table of Finalized hydrostratigraphic units included in hydrogeologic model

Basement - Basement rock group
Kh- Hornbrook Formation
Pv- Pliocene Volcanic rocks
Q- Alluvium
Qg- Glacial deposits
Qv- Pleistocene Volcanic rocks
Qvs- Volcanic rocks of Shasta Valley
Tv- Western Cascade Volcanics

The approach we took to convert the lithologic classification bins to geologic formations using geologic interpretation was as follows: 1.) map the lithologic classification bin in a 3-D geologic modeling software; we used the Leapfrog software package (Seequent Ltd.) 2.) import various georeferenced geologic mapping products (most in GIS shapefile format) in the model space to assist in our interpretation of the geology 3.) interpret the upper-most lithology in the log to that which matches the surface geologic unit it falls within 4.) find lithologic contacts that most certainly represent changes in geologic unit and utilize published geologic mapping products as a guide as to what unit is encountered 5.) continue Step 4 from top down, going from areas where geologic unit contacts are better known (e.g. published in cross sections georeferenced in 3-D space in the model framework) to areas where they are not as well-known.

After initially converting the lithologic classifications to interpreted geologic units for each of the logs, we then used those logs as input in the geologic model to build contact surfaces. Leapfrog uses an in-house, proprietary method for constructing geologic models which they call "Implicit Modeling" using the FastRBF™ algorithm, which is a type of radial basis function (RBF) that Seequent has developed for Leapfrog. The method honors the data it is given (i.e. surface geology polygon and digitized borehole geology data) and additionally honors the geologic type and timing of the deposit to create geologic contact surfaces. These surfaces can then be used to construct 3-D geologic unit volumes. Once we constructed the initial geologic contact surfaces, we were able to refine the logs to better represent the geologic contact surfaces as close as feasibly possible to what we interpret as geologic reality. We were additionally able to incorporate structural geologic controls on the geologic surface constructions in the software based on published literature to guide the surfaces to what we interpret as the most realistic trends of the geologic surfaces. After several iterations of interpretation of log descriptions and creating geologic surfaces, we arrived at the most probable structural interpretation of the geology of the basin given all of the available data. We then used the surfaces to construct the final resulting geologic model.

Visual Accompanying Addendum Material to the 3-D Geologic Interpretation and Modeling Procedure

The attached addendum presentation adds visualizations to this modeling methodology to better illustrate the steps taken to develop the Shasta Valley Geological Model building process and verification. It is attached after the reference section of this technical memorandum. It highlights the process described above visually to help clarify the detailed modeling process.

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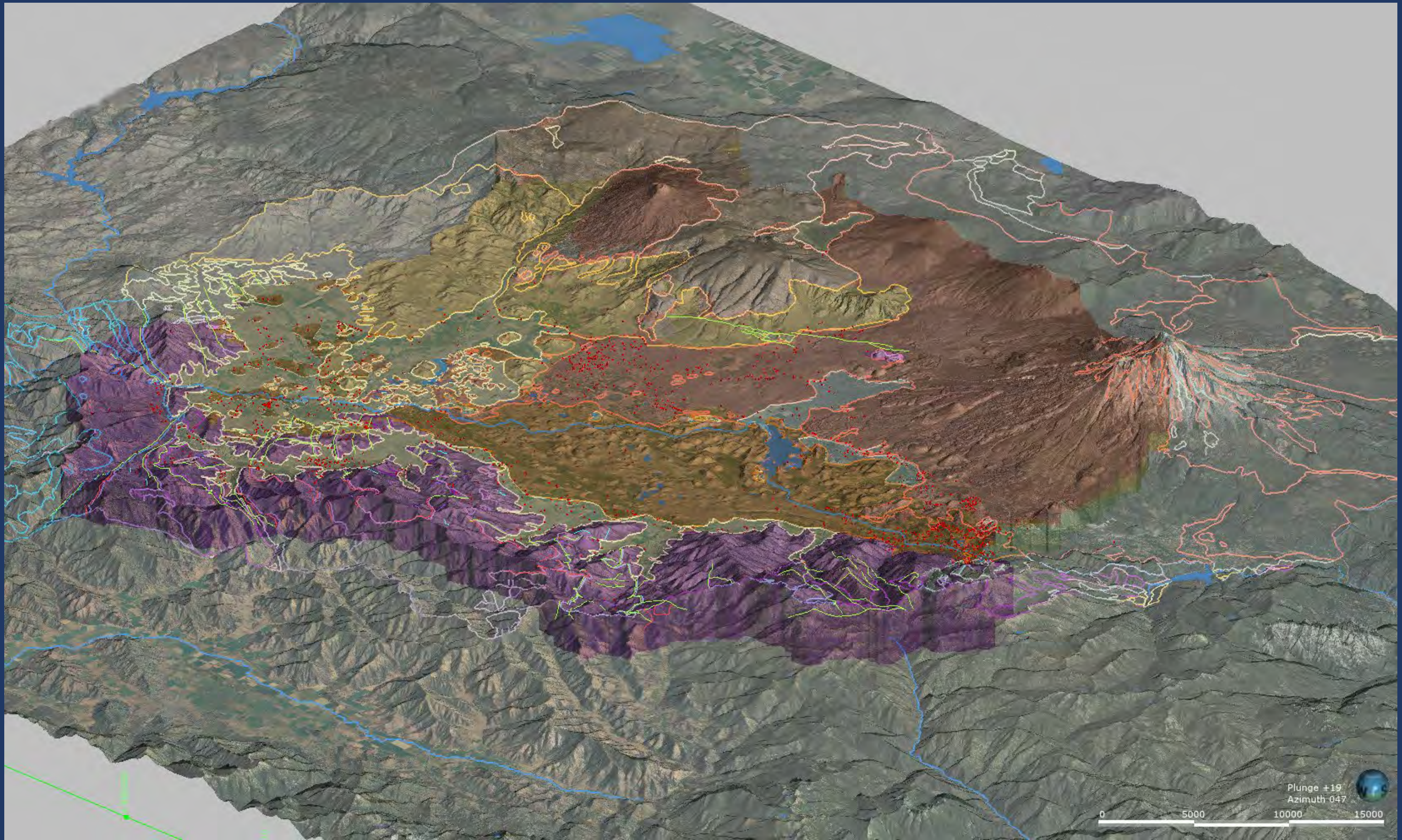
3-D Geological & Geophysical Mapping/Modeling

Joint research (UC Davis) & consulting (LWA) project:

- Shasta Valley Groundwater Basin 3-D geological model



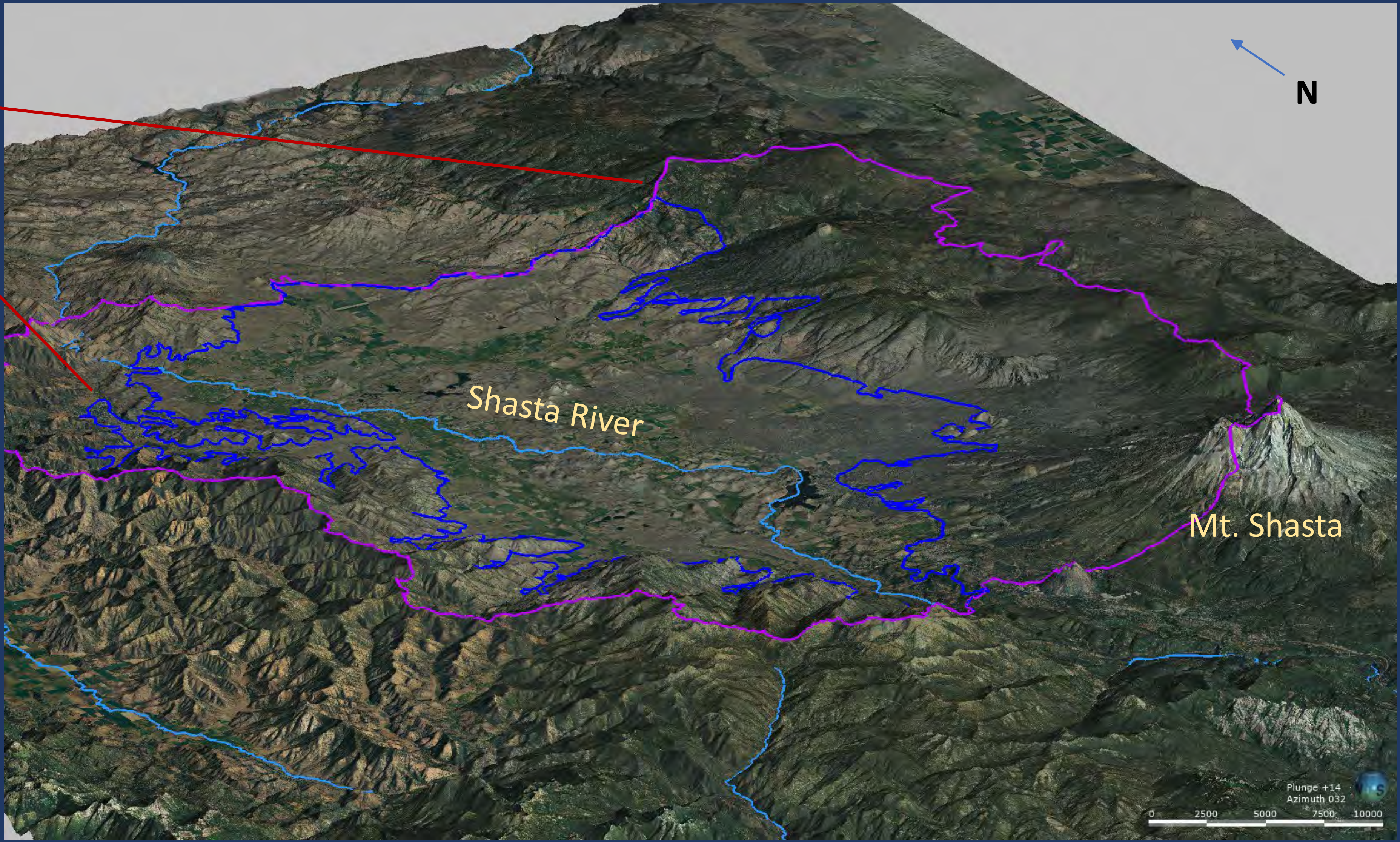
Shasta Valley Groundwater Basin 3-D geological model

Shasta Valley

Shasta Valley Groundwater Basin 3-D geological model

Shasta Valley

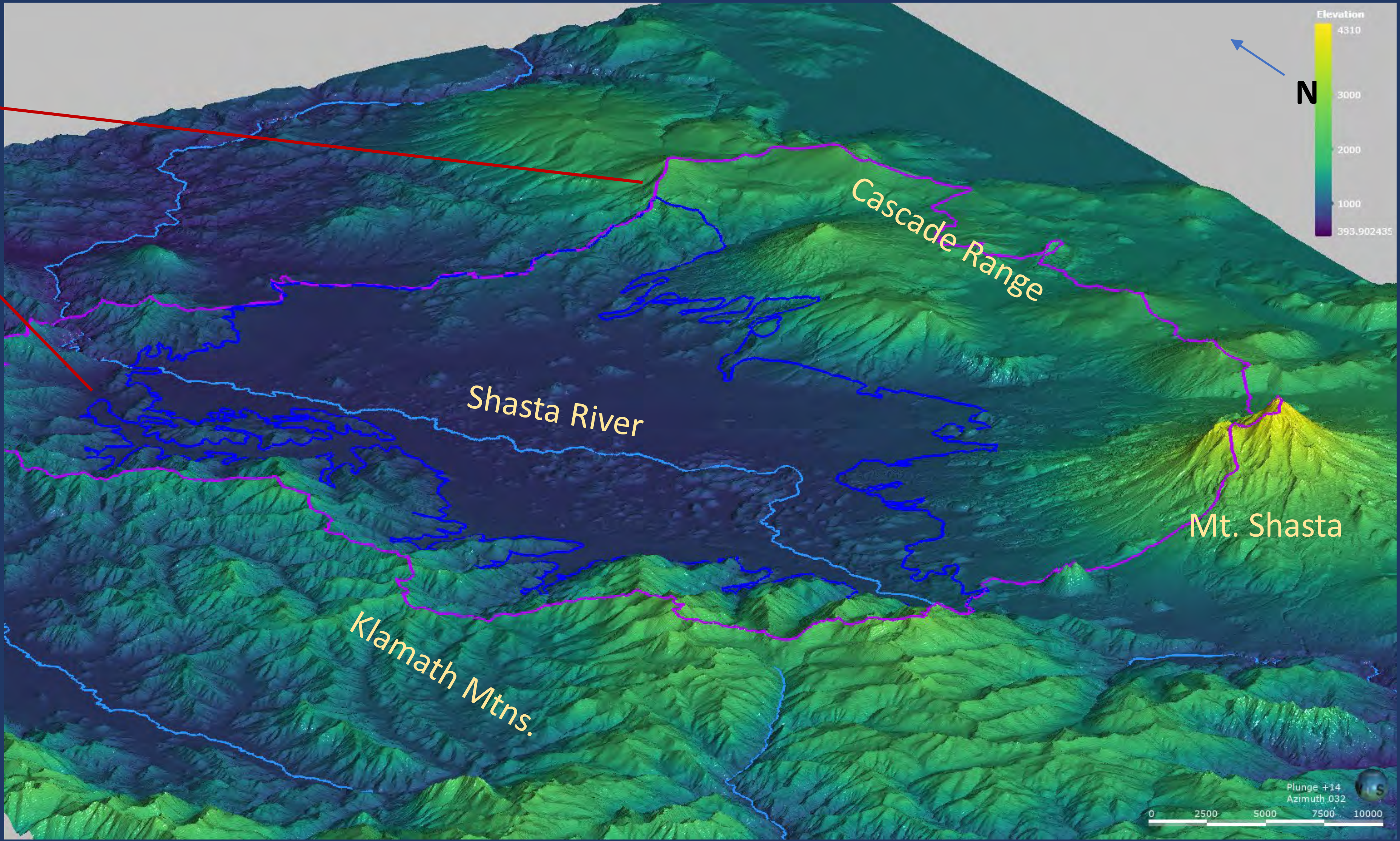
- ~800 mi^2 watershed
- ~350 mi^2 Bulletin 118 groundwater basin



Shasta Valley Groundwater Basin 3-D geological model

Shasta Valley

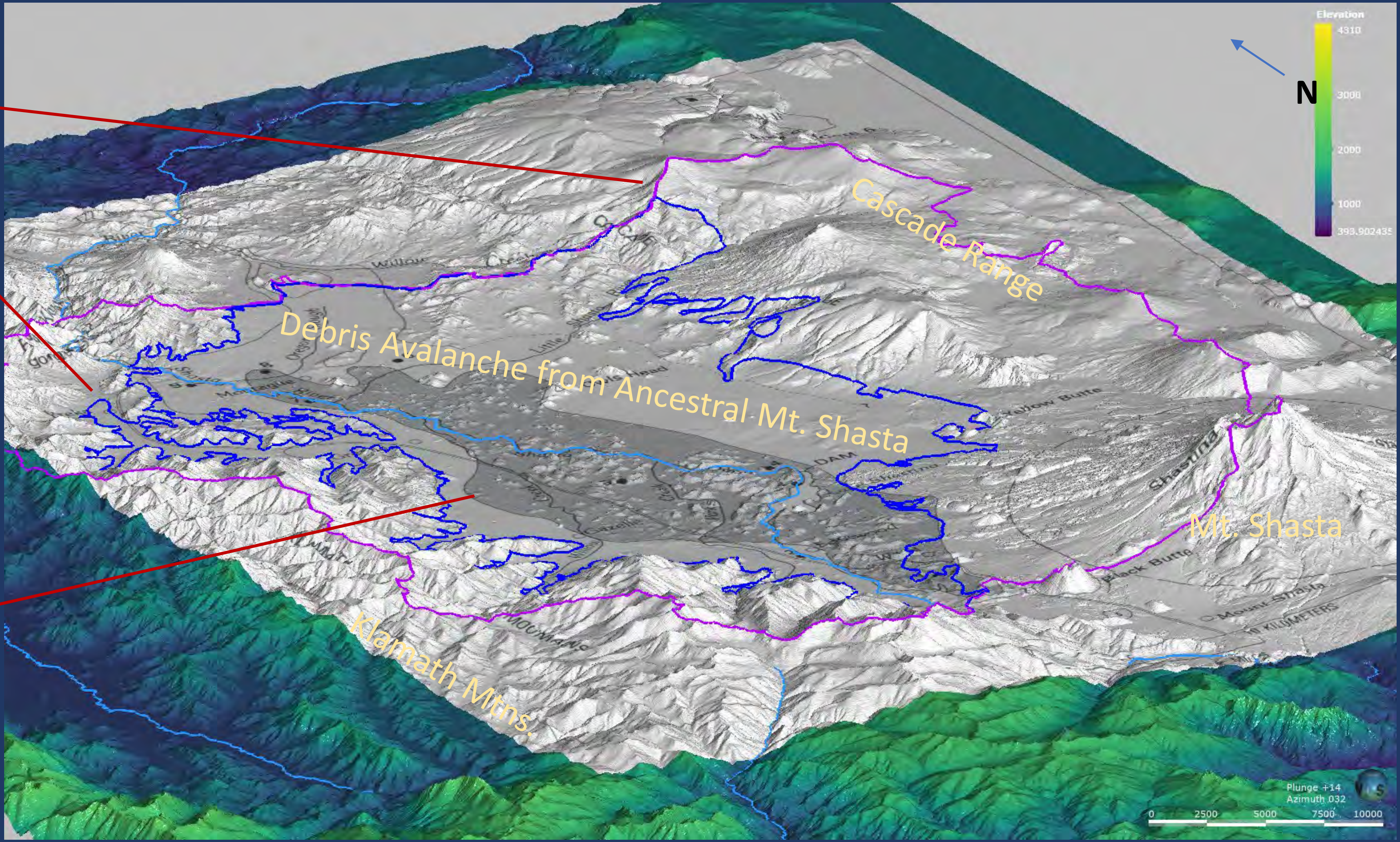
- ~800 mi^2 watershed
- ~350 mi^2 Bulletin 118 groundwater basin
- ~2k-14k ft amsl elevation range
- North-dipping valley floor



Shasta Valley Groundwater Basin 3-D geological model

Shasta Valley

- ~800 mi^2 watershed
- ~350 mi^2 Bulletin 118 groundwater basin
- ~2k-14k ft amsl elevation range
- North-dipping valley floor
- Large Q-aged debris avalanche covers much of the valley



Draped map on topography from Crandell et al. (1989)

Shasta Valley Groundwater Basin 3-D geological model

Shasta Valley

- ~800 mi^2 watershed
- ~350 mi^2 Bulletin 118 groundwater basin
- ~2k-14k ft amsl elevation range
- North-dipping valley floor
- Large Q-aged debris avalanche covers much of the valley
- Complex geology

Draped map on topography from CGS (1987)

Shasta Valley Groundwater Basin 3-D geological model

Data available

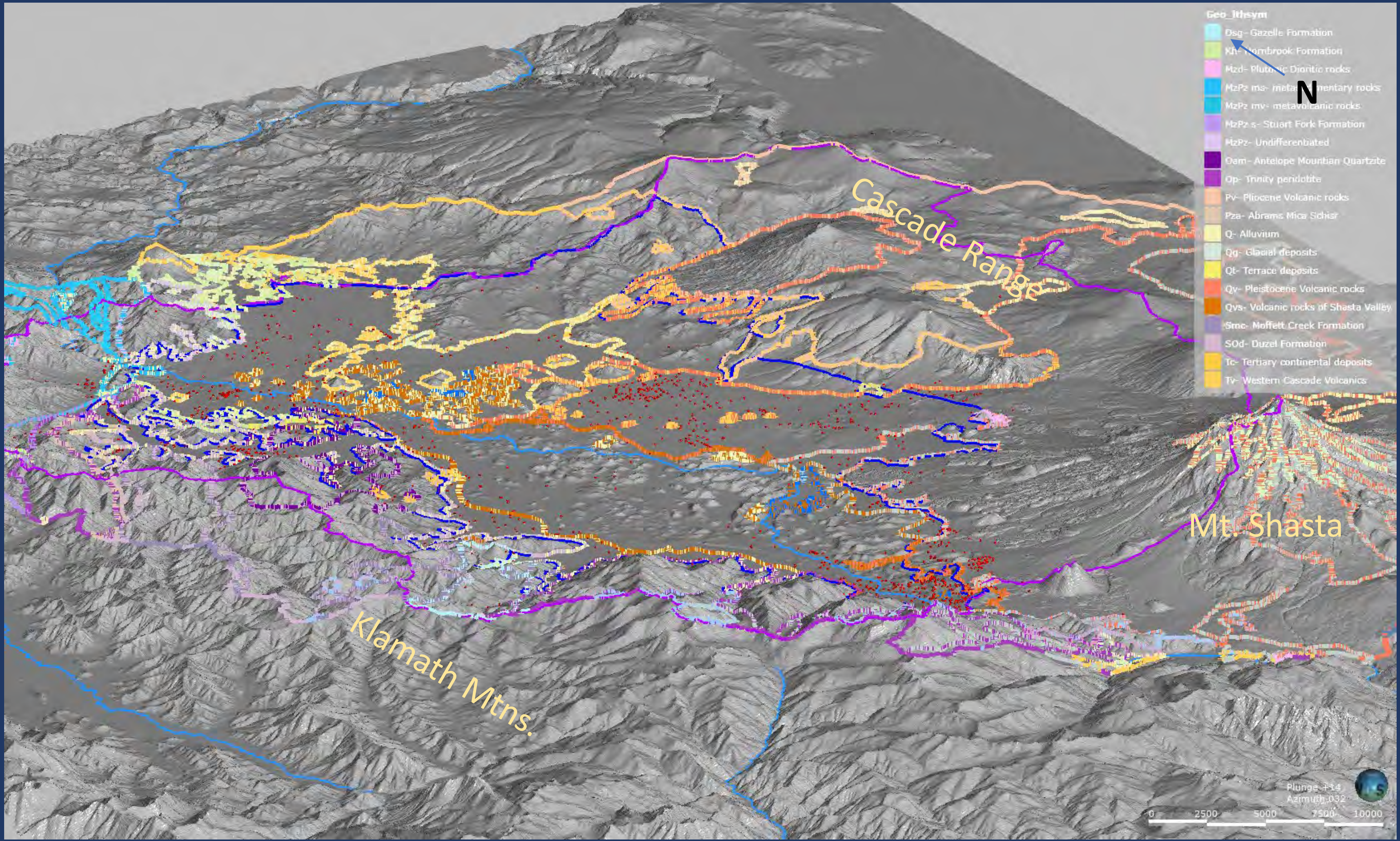
- Digitized surface geologic maps

Draped map on topography from CGS (1987), digitized by DWR-NRO (2011)

Shasta Valley Groundwater Basin 3-D geological model

Data available

- Digitized surface geologic maps
- ~3,400 total WCRs

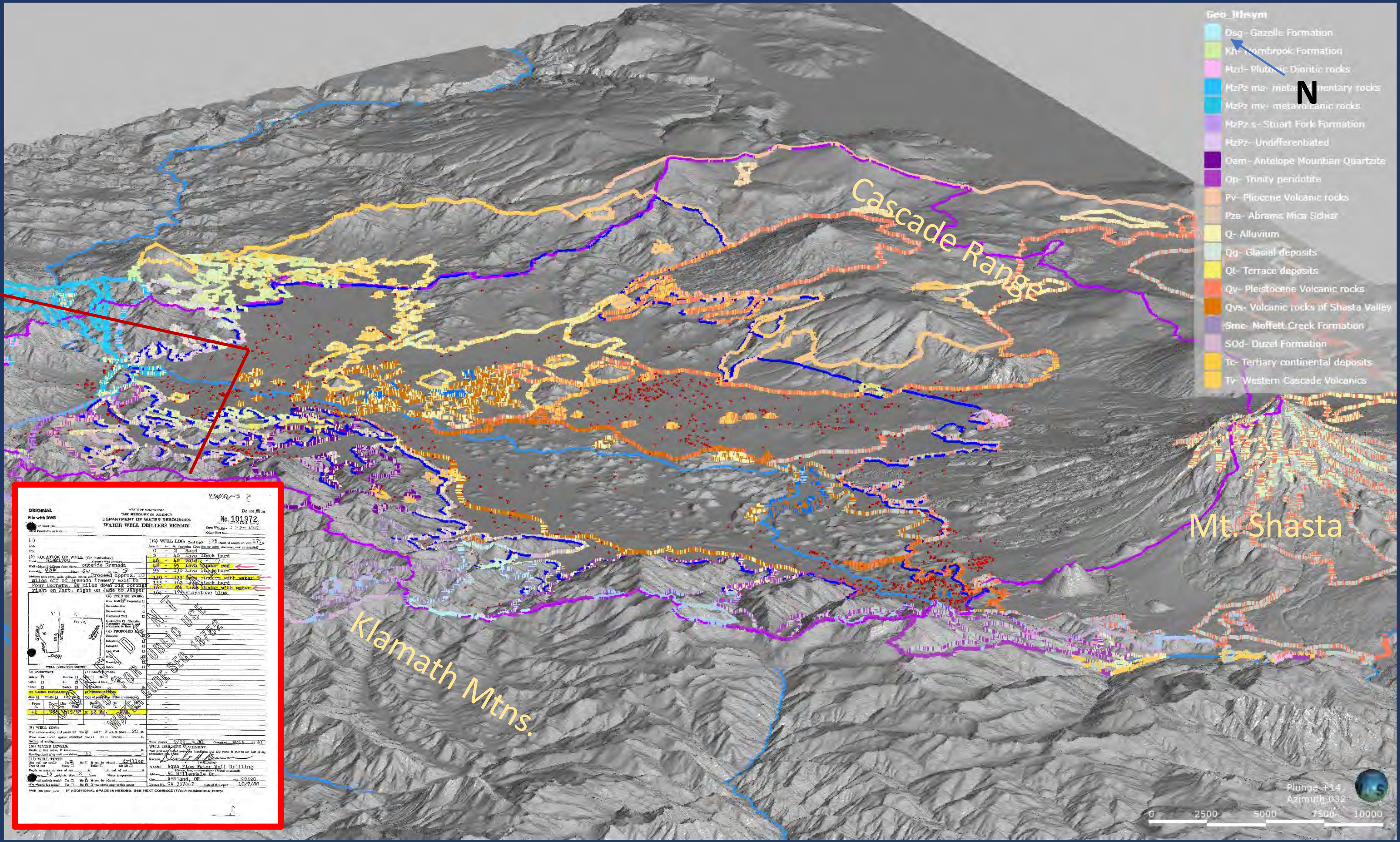


Draped map on topography from CGS (1987), digitized by DWR-NRO (2011)

Shasta Valley Groundwater Basin 3-D geological model

Data available

- Digitized surface geologic maps
- ~3,400 total WCRs
- 1,300+ WCRs precisely <u>located</u> and <u>digitized</u>

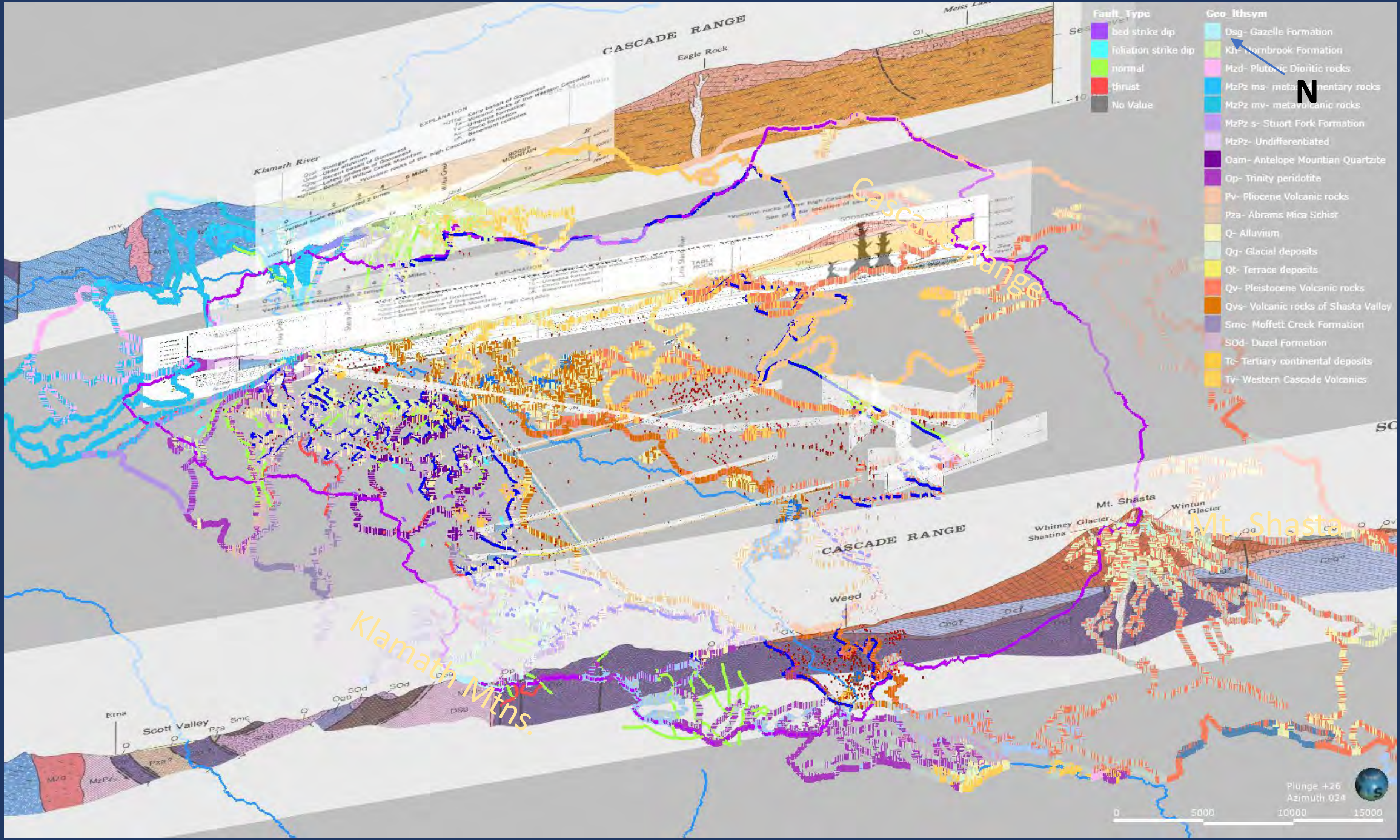


Draped map on topography from CGS (1987), digitized by DWR-NRO (2011)

Shasta Valley Groundwater Basin 3-D geological model

Data available

- Digitized surface geologic maps
- ~3,400 total WCRs
- 1,300+ WCRs precisely <u>located</u> and <u>digitized</u>
- Cross sections available, but based on limited drilling data
- USGS geologic formation descriptions (included with other surface maps)
- Geophysical data (*not shown*)

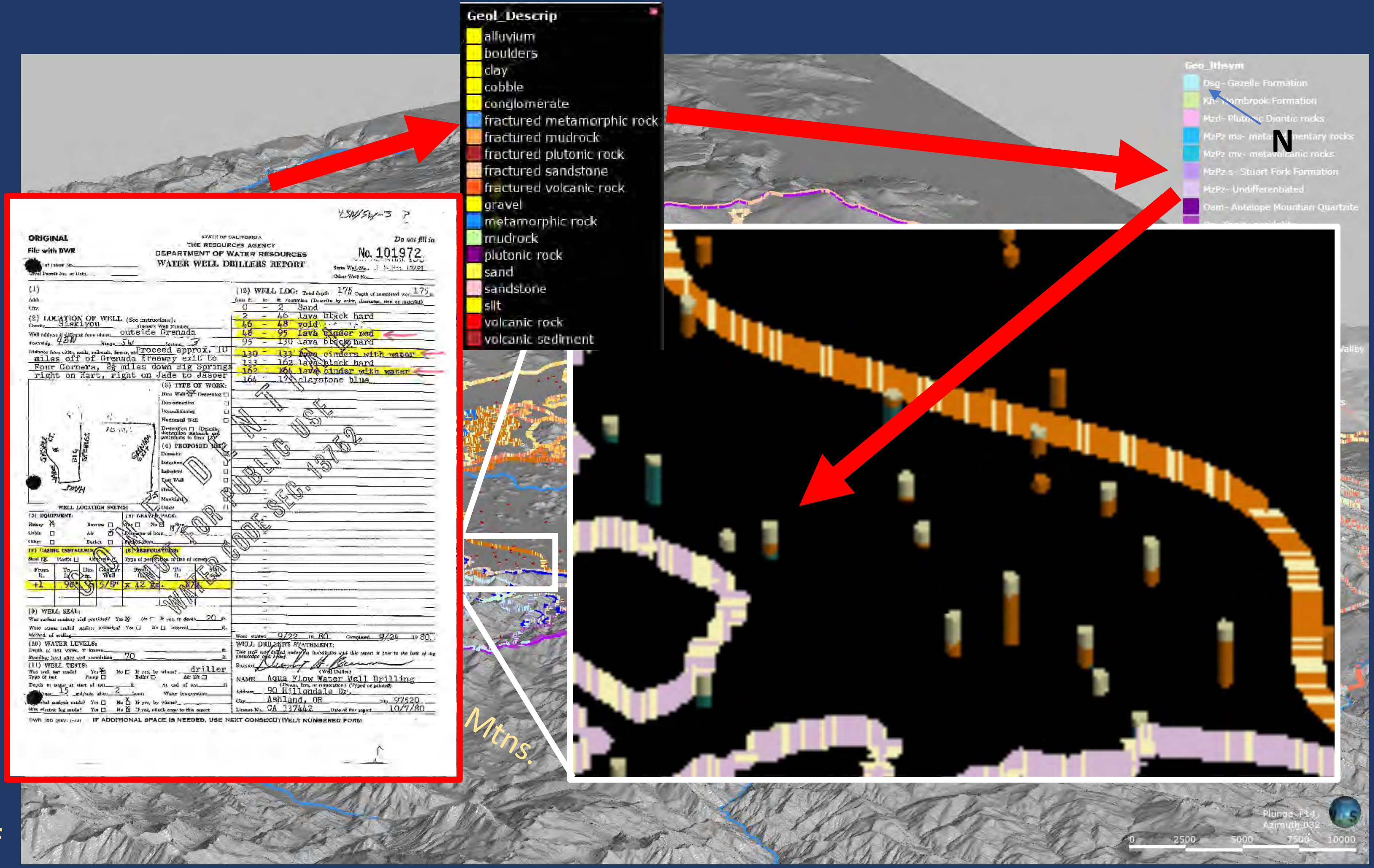


Cross sections from Mack (1960), Holliday (1983), CGS (1987), & DWR-NRO (2011)

Shasta Valley Groundwater Basin 3-D geological model

Methods

- Convert WCR lithology into geologic units using mapped surface geology
- Start at the top lithology and work down depth
- Geologically complex area yields driller terms that vary enough for geologist to ID stratigraphic changes (e.g. alluvium-volc.-meta)
- USGS descriptions of geologic Fms are key

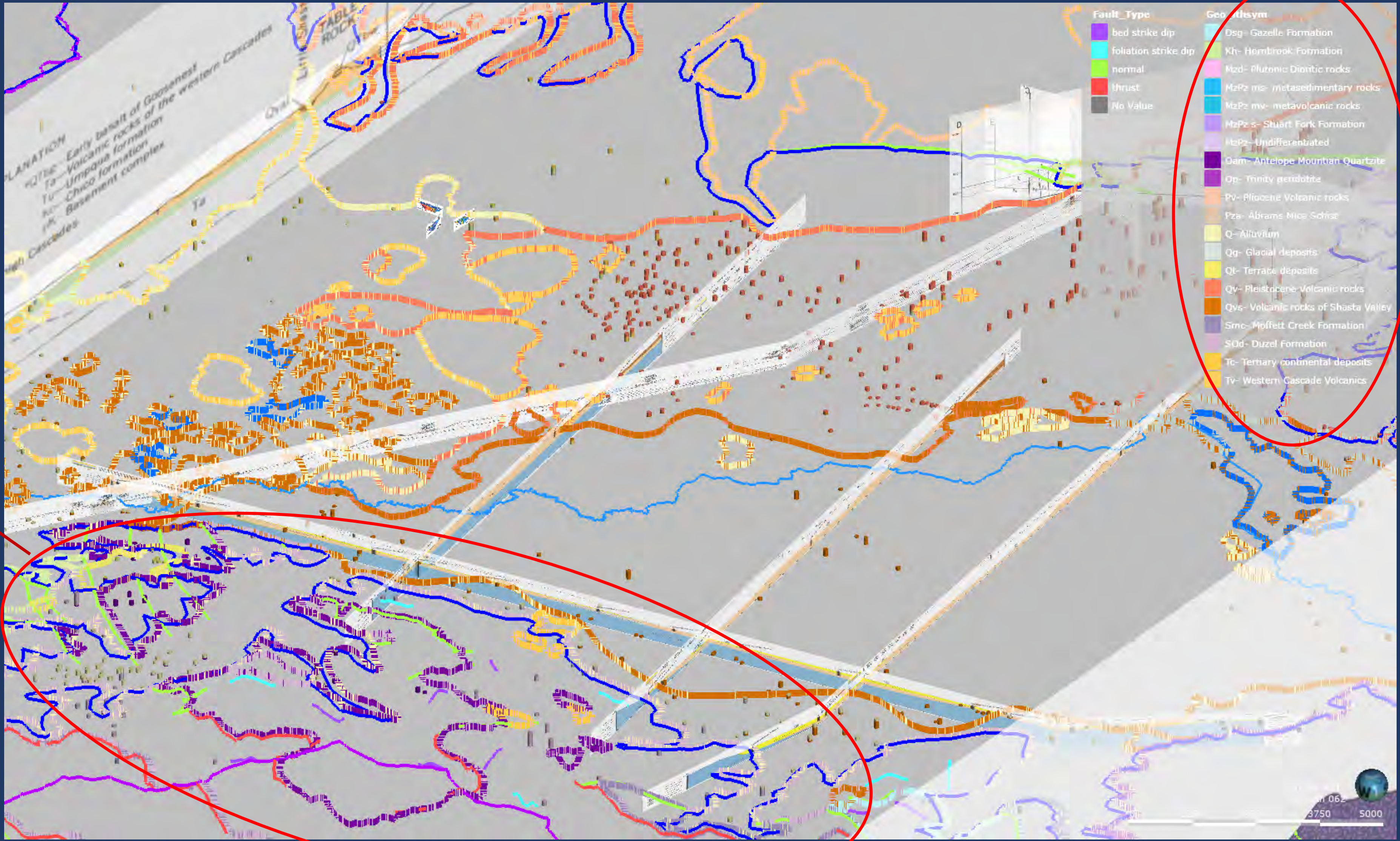


Utilized Leapfrog modeling software for model construction and figures

Shasta Valley Groundwater Basin 3-D geological model

Methods

- Fit-for-purpose geological modeling mentality
- Purpose is ultimately for groundwater modeling grids
- Lump metamorphic basement units into grouped basement unit



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Shasta Valley Groundwater Basin 3-D geological model

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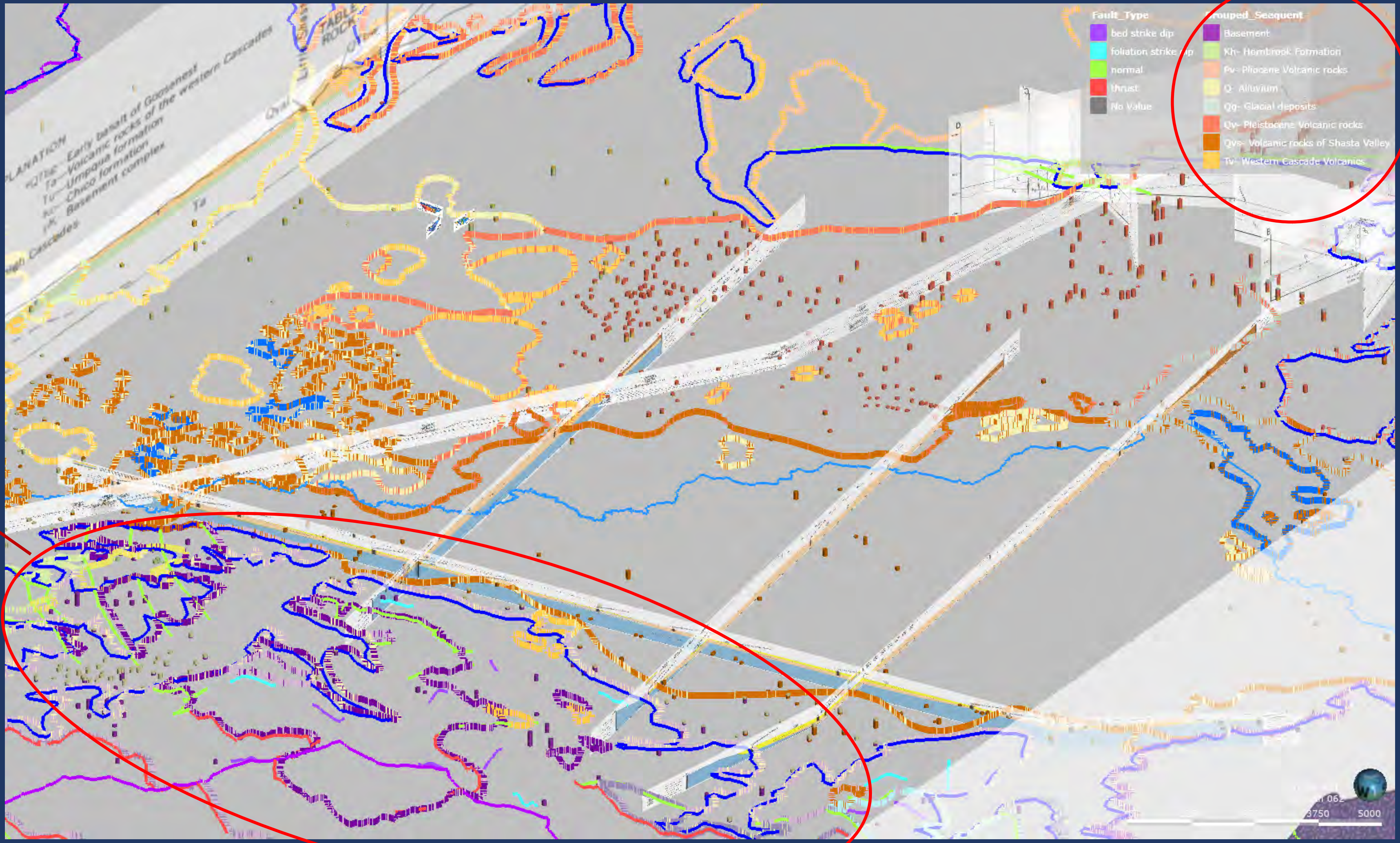

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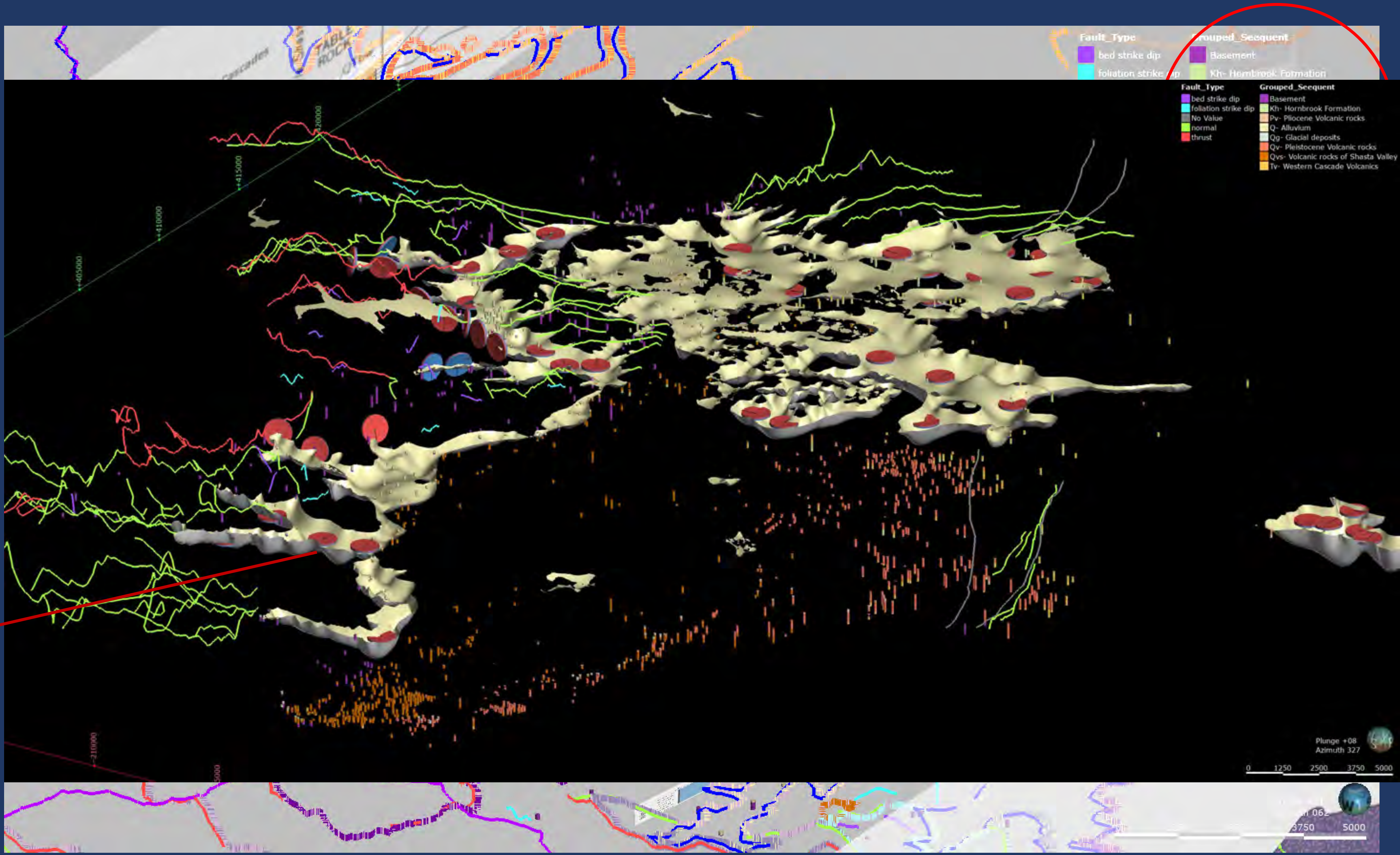
Shasta Valley Groundwater Basin 3-D geological model

Methods

- Fit-for-purpose geological modeling mentality
- Purpose is ultimately for groundwater modeling grids
- Lump metamorphic basement units into grouped basement unit
- Use structural data and cross sections to guide creation of contact surfaces

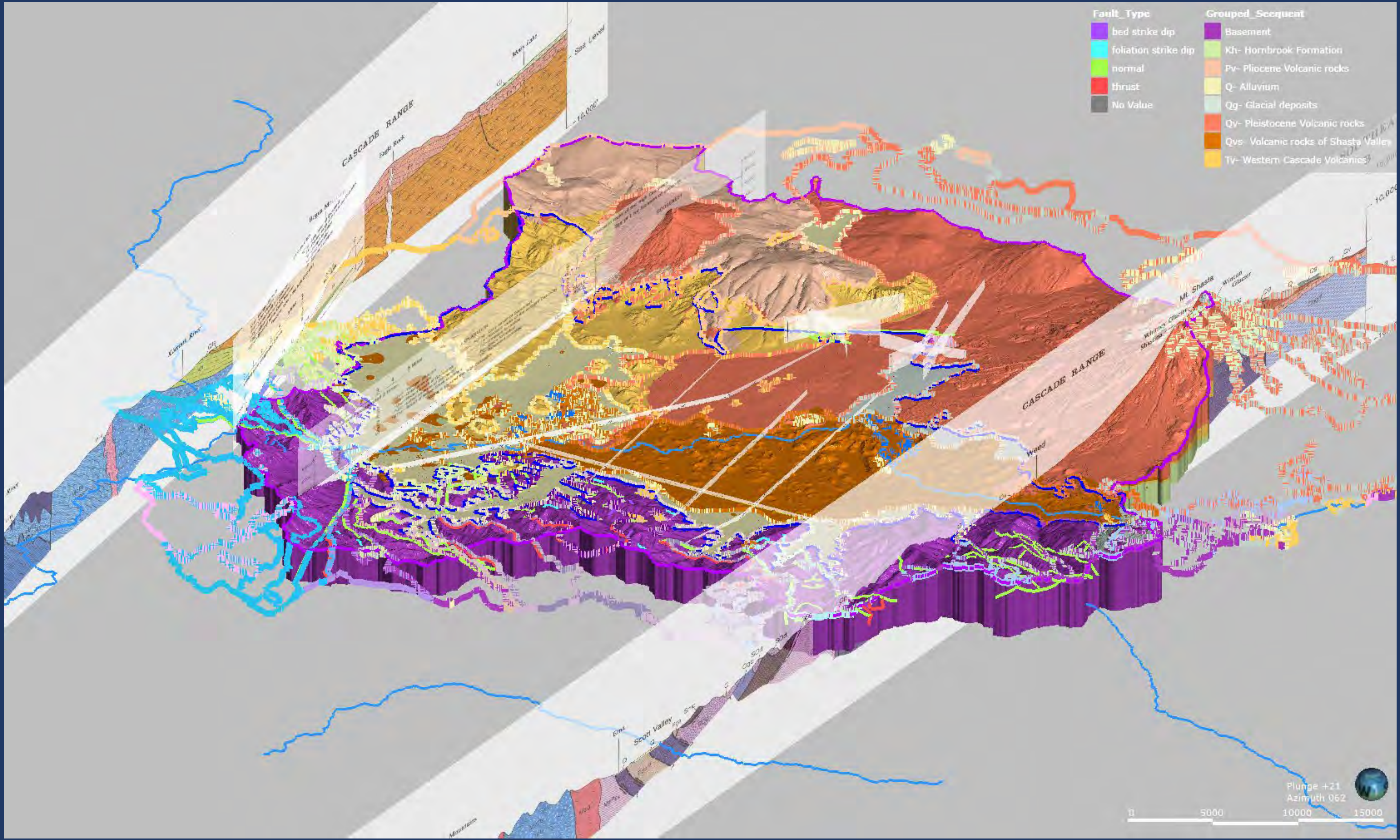


<u>*Utilized Leapfrog modeling software for model construction and figures*</u>

Shasta Valley Groundwater Basin 3-D geological model

Methods

- Fit-for-purpose geological modeling mentality
- Purpose is ultimately for groundwater modeling grids
- Lump metamorphic basement units into grouped basement unit
- Use structural data and cross sections to guide creation of contact surfaces
- Create block model

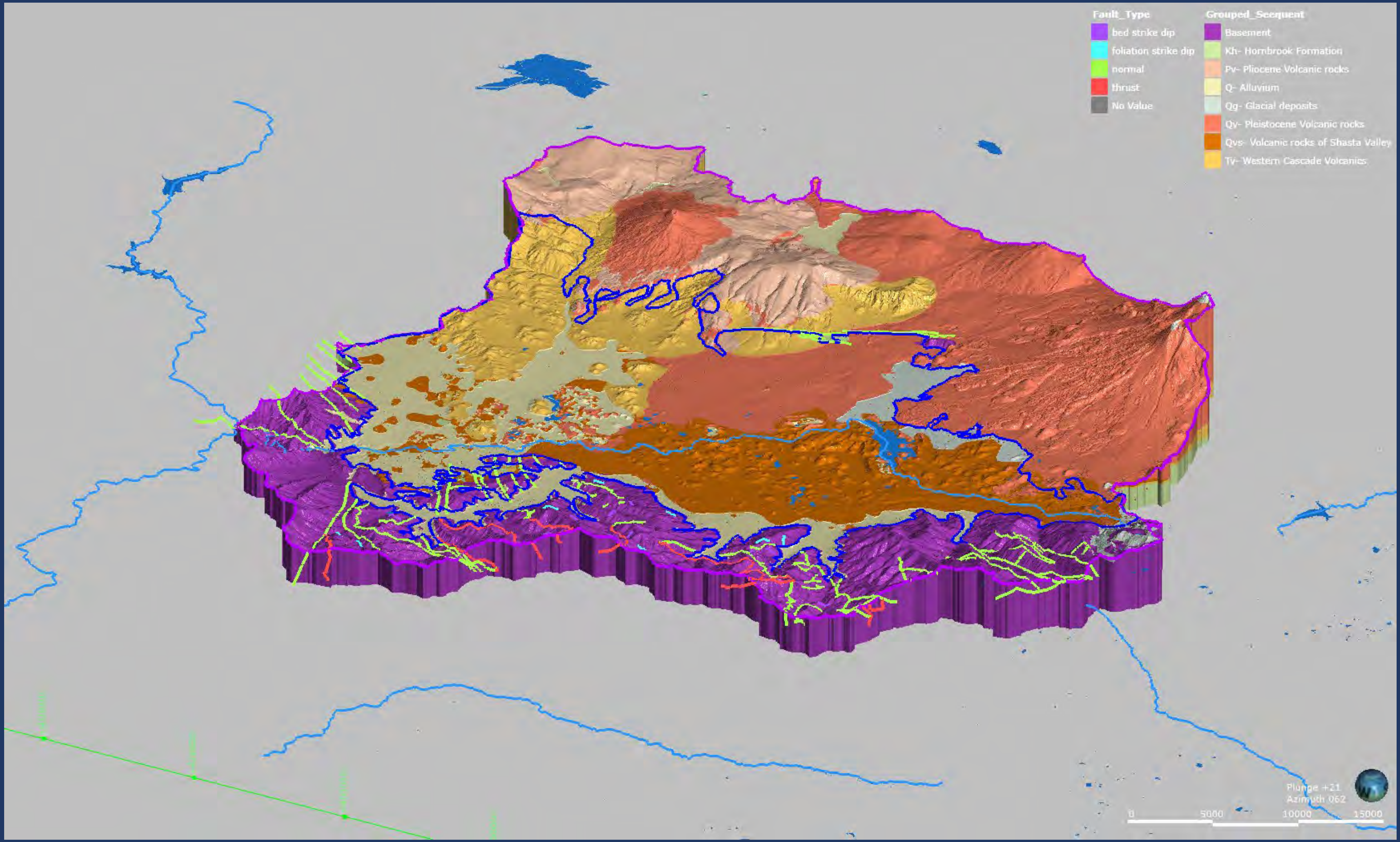


Utilized Leapfrog modeling software for model construction and figures

Shasta Valley Groundwater Basin 3-D geological model

Methods

- Fit-for-purpose geological modeling mentality
- Purpose is ultimately for groundwater modeling grids
- Lump metamorphic basement units into grouped basement unit
- Use structural data and cross sections to guide creation of contact surfaces
- Create block model
- Iterate until fit for use

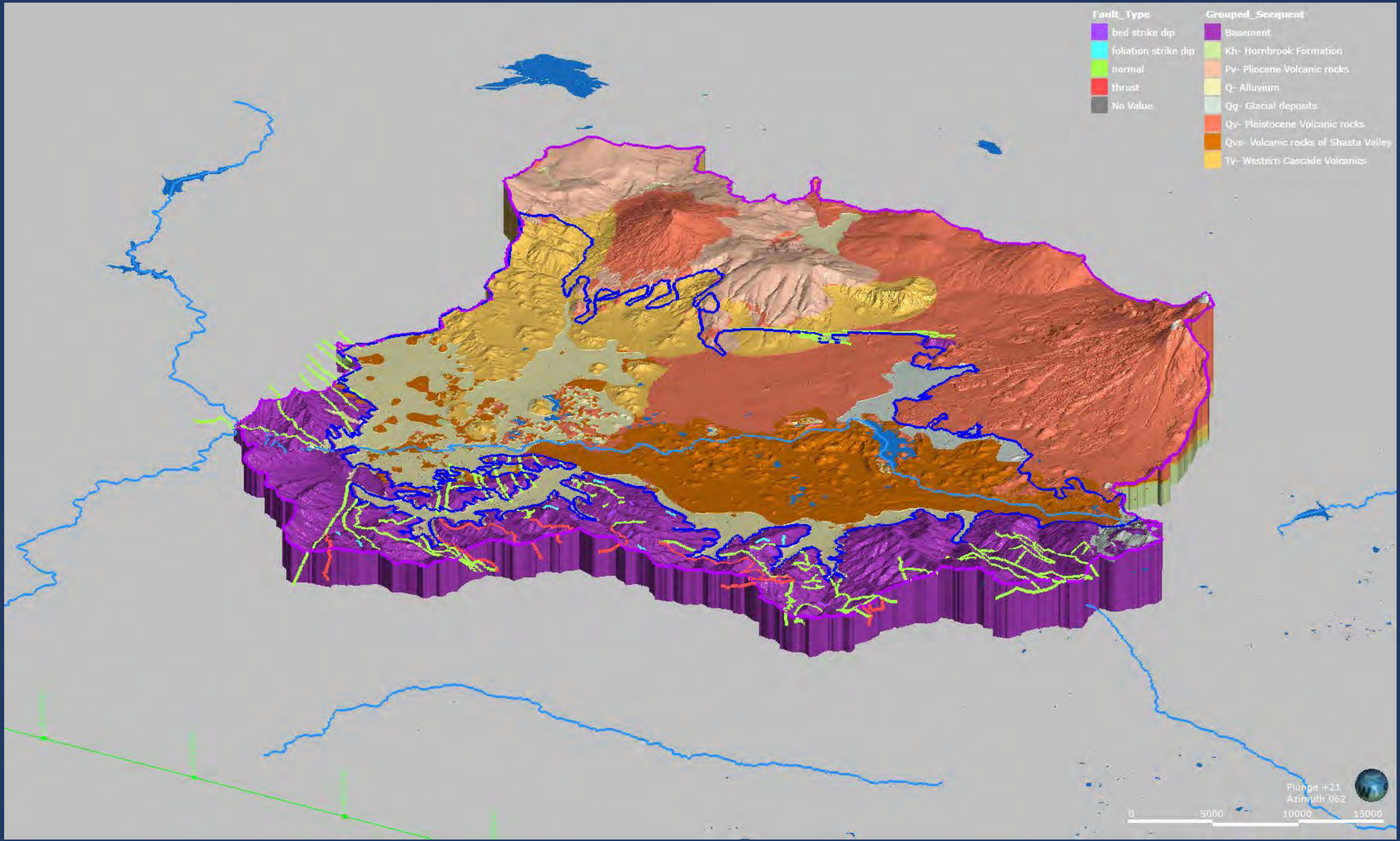


Utilized Leapfrog modeling software for model construction and figures

Shasta Valley Groundwater Basin 3-D geological model

Results

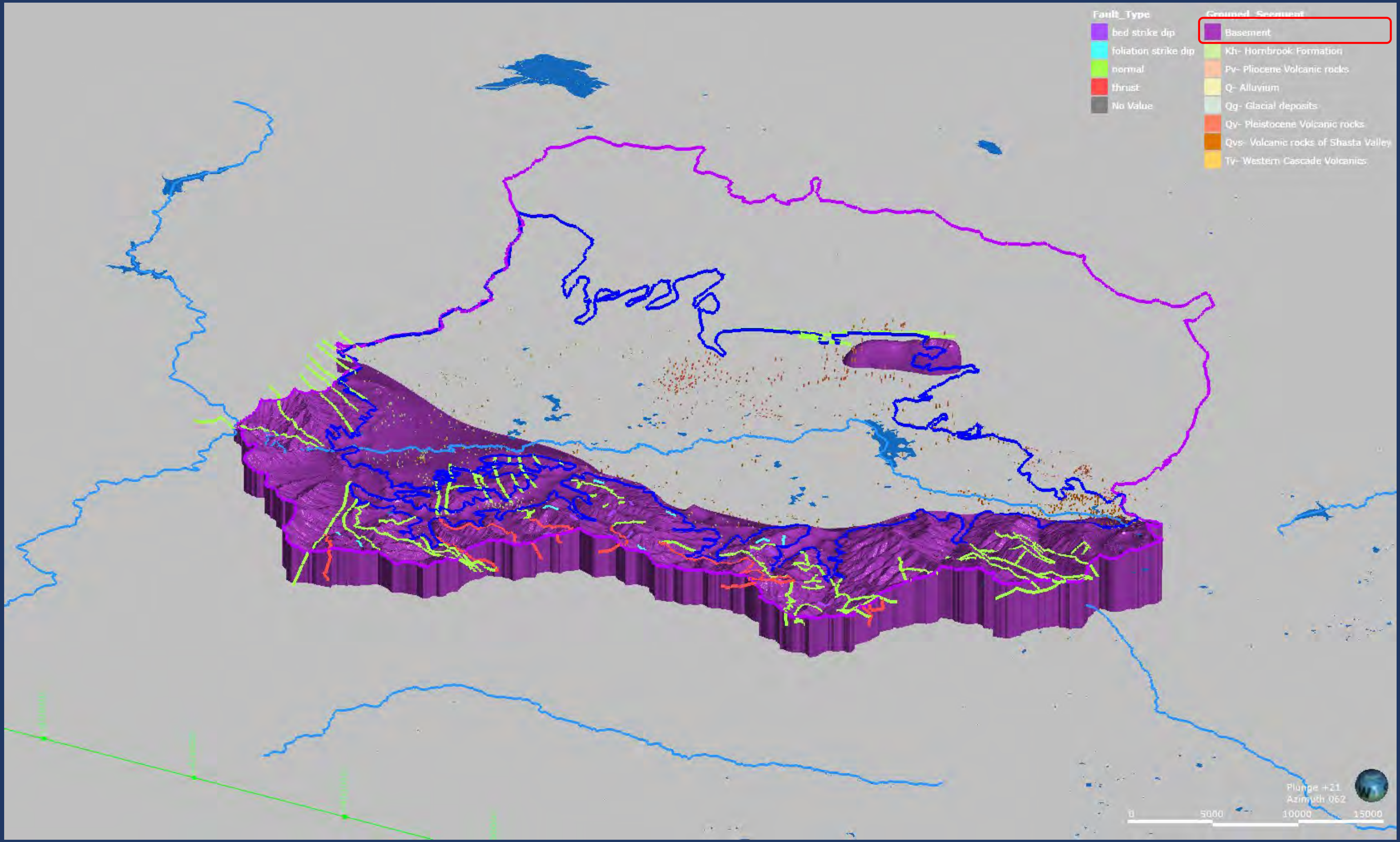
- Fit-for-purpose for groundwater modeling
- Focus is on the valley floor where drilling data inform the model the most and groundwater resources are most relevant
- Limited data in upland recharge areas



Shasta Valley Groundwater Basin 3-D geological model

Results

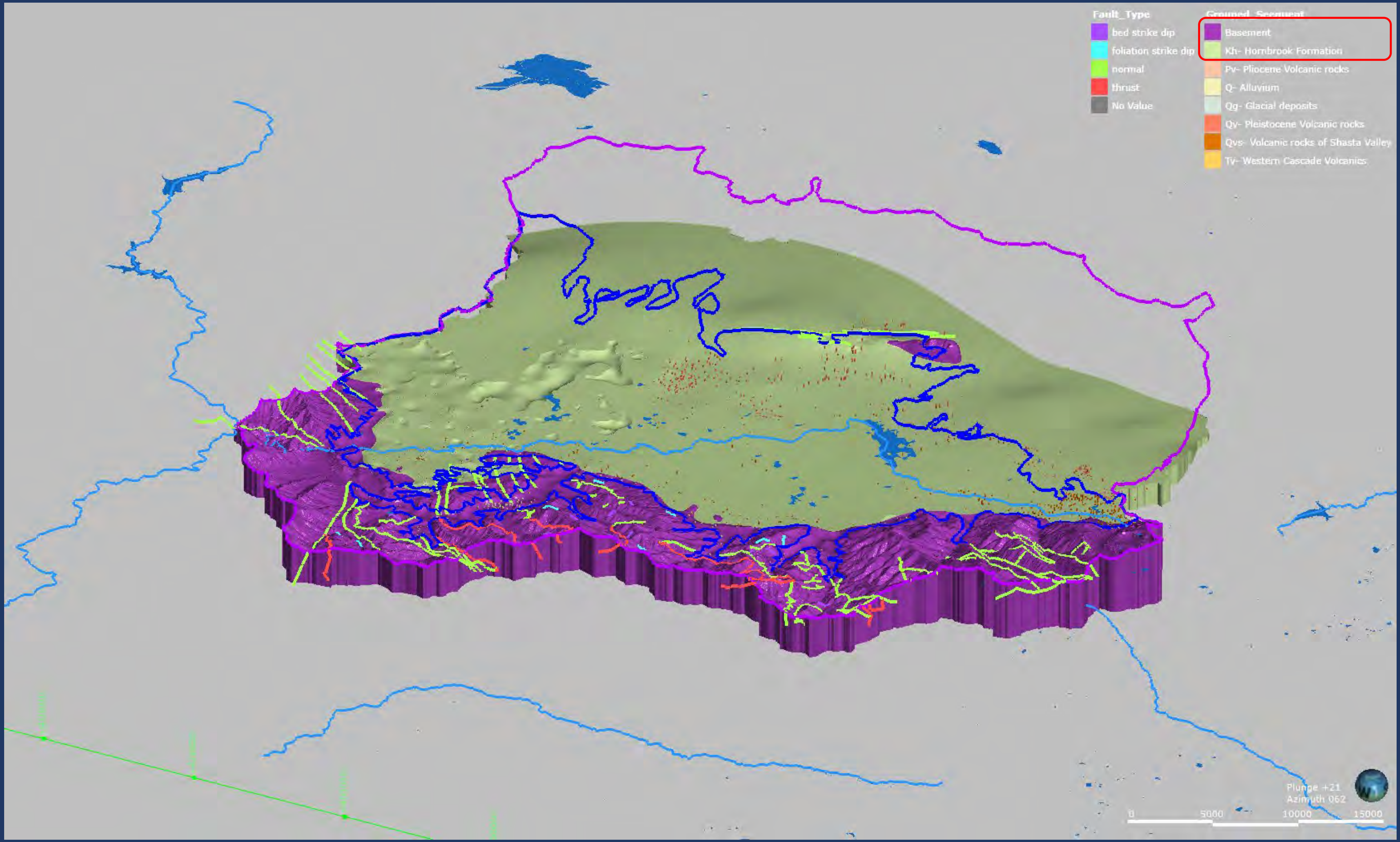
- Fit-for-purpose for groundwater modeling
- Focus on the valley floor where drilling data inform the model the most and groundwater resources are most relevant
- Limited data in upland recharge areas
- Basement- *Paleozoic*



Shasta Valley Groundwater Basin 3-D geological model

Results

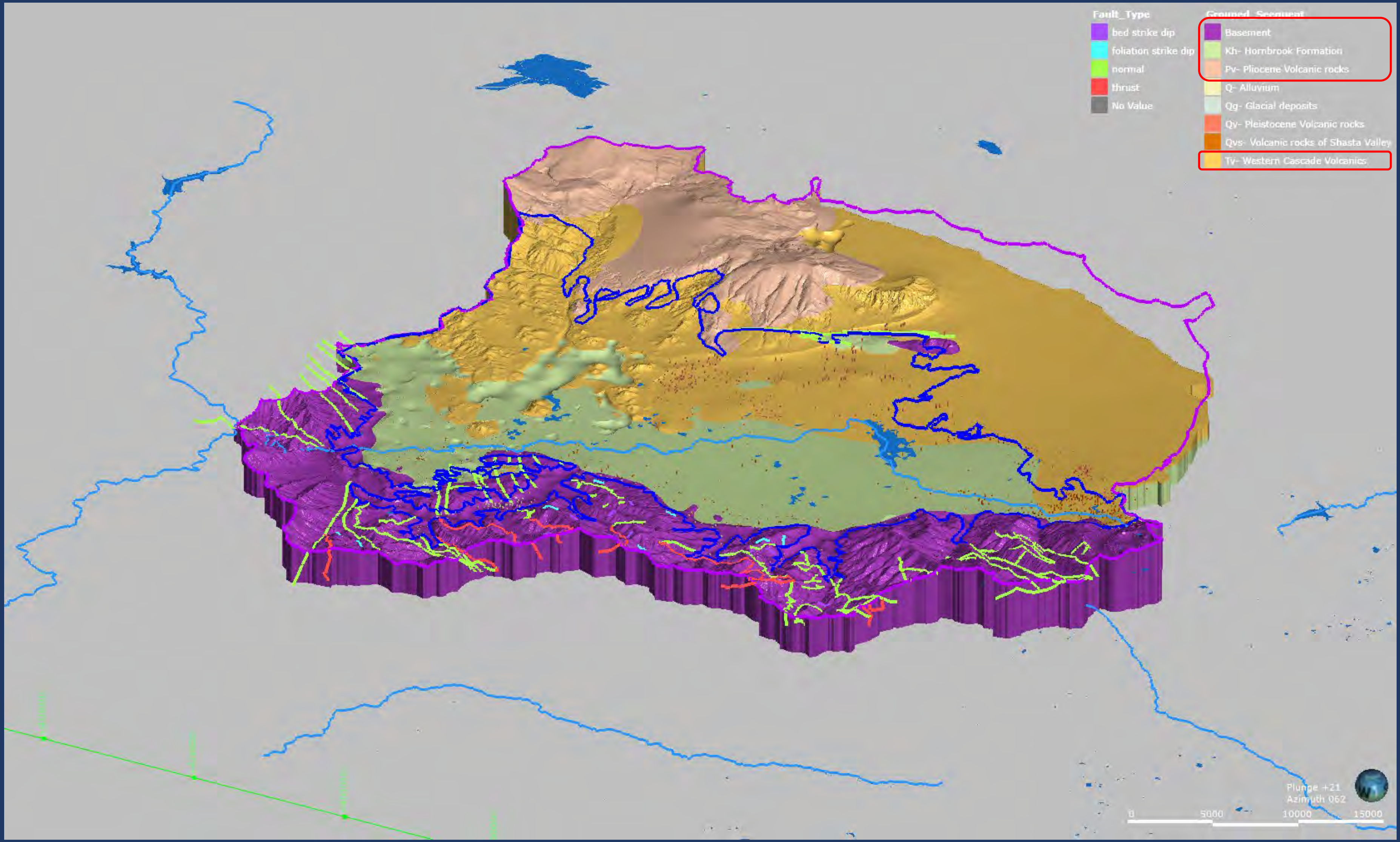
- Fit-for-purpose for groundwater modeling
- Focus on the valley floor where drilling data inform the model the most and groundwater resources are most relevant
- Limited data in upland recharge areas
- Basement- *Paleozoic*
- Mesozoic



Shasta Valley Groundwater Basin 3-D geological model

Results

- Fit-for-purpose for groundwater modeling
- Focus on the valley floor where drilling data inform the model the most and groundwater resources are most relevant
- Limited data in upland recharge areas
- Basement- *Paleozoic*
- Mesozoic
- Cenozoic



Shasta Valley Groundwater Basin 3-D geological model

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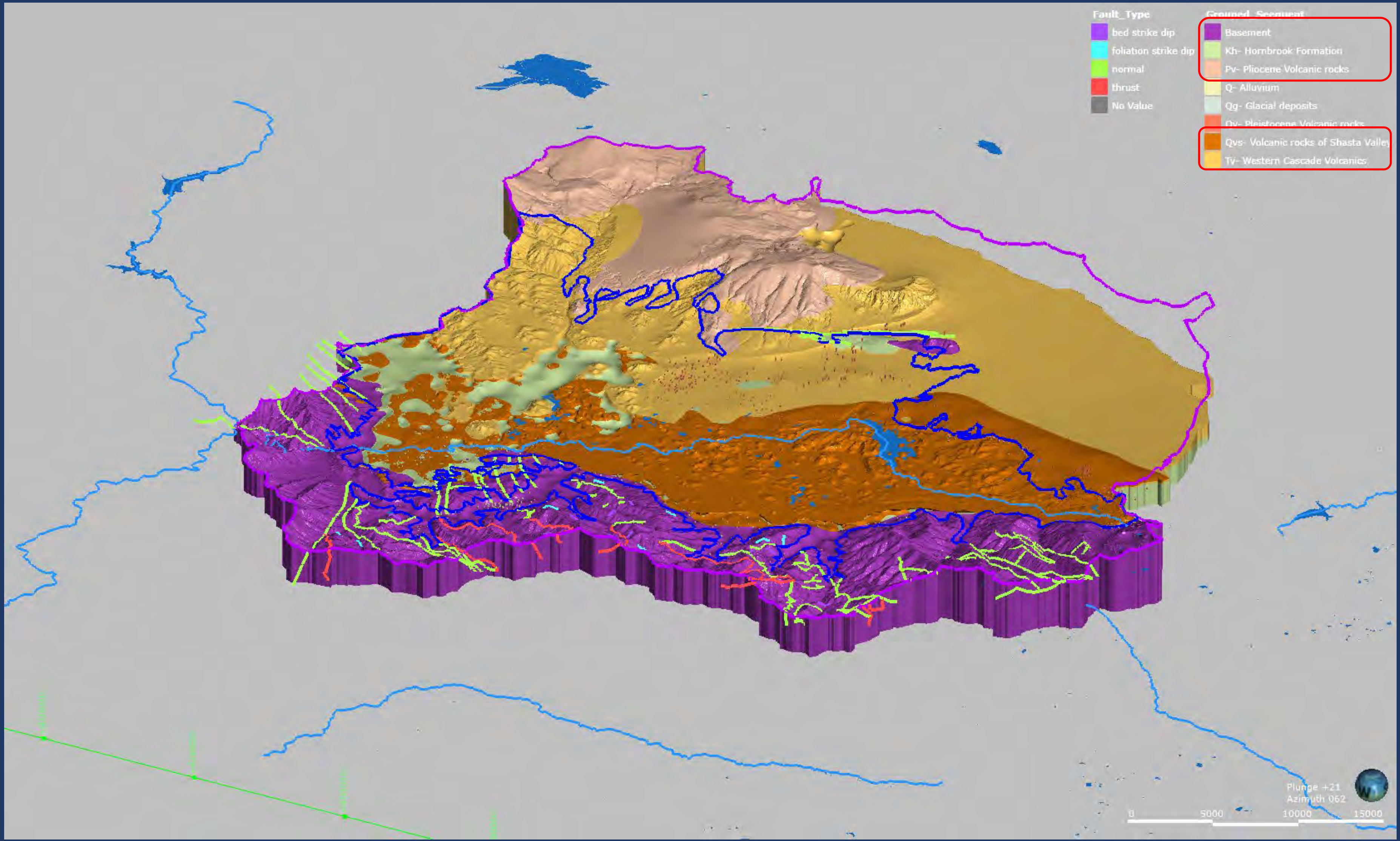

Shasta Valley Groundwater Basin 3-D geological model

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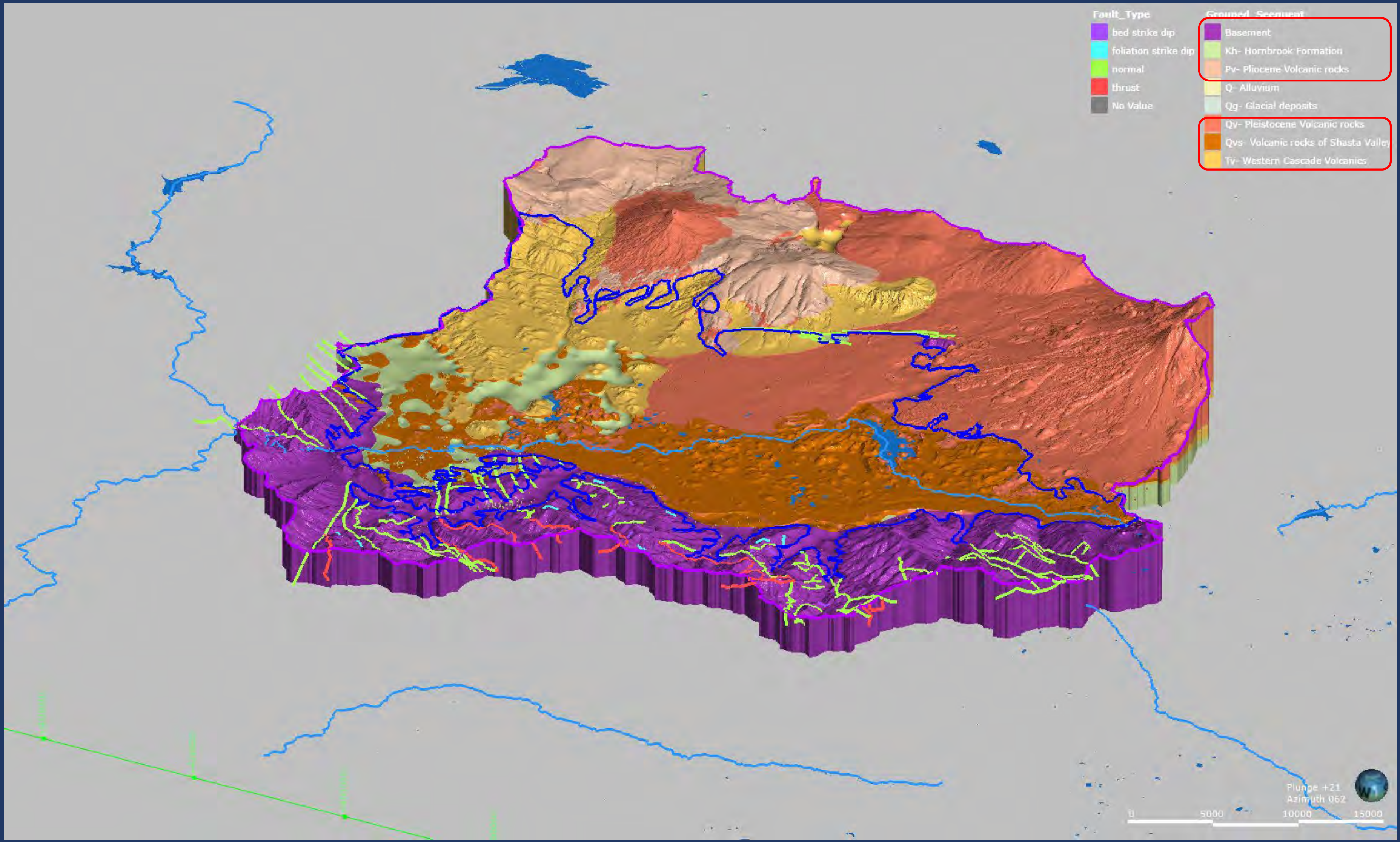

Shasta Valley Groundwater Basin 3-D geological model

Results

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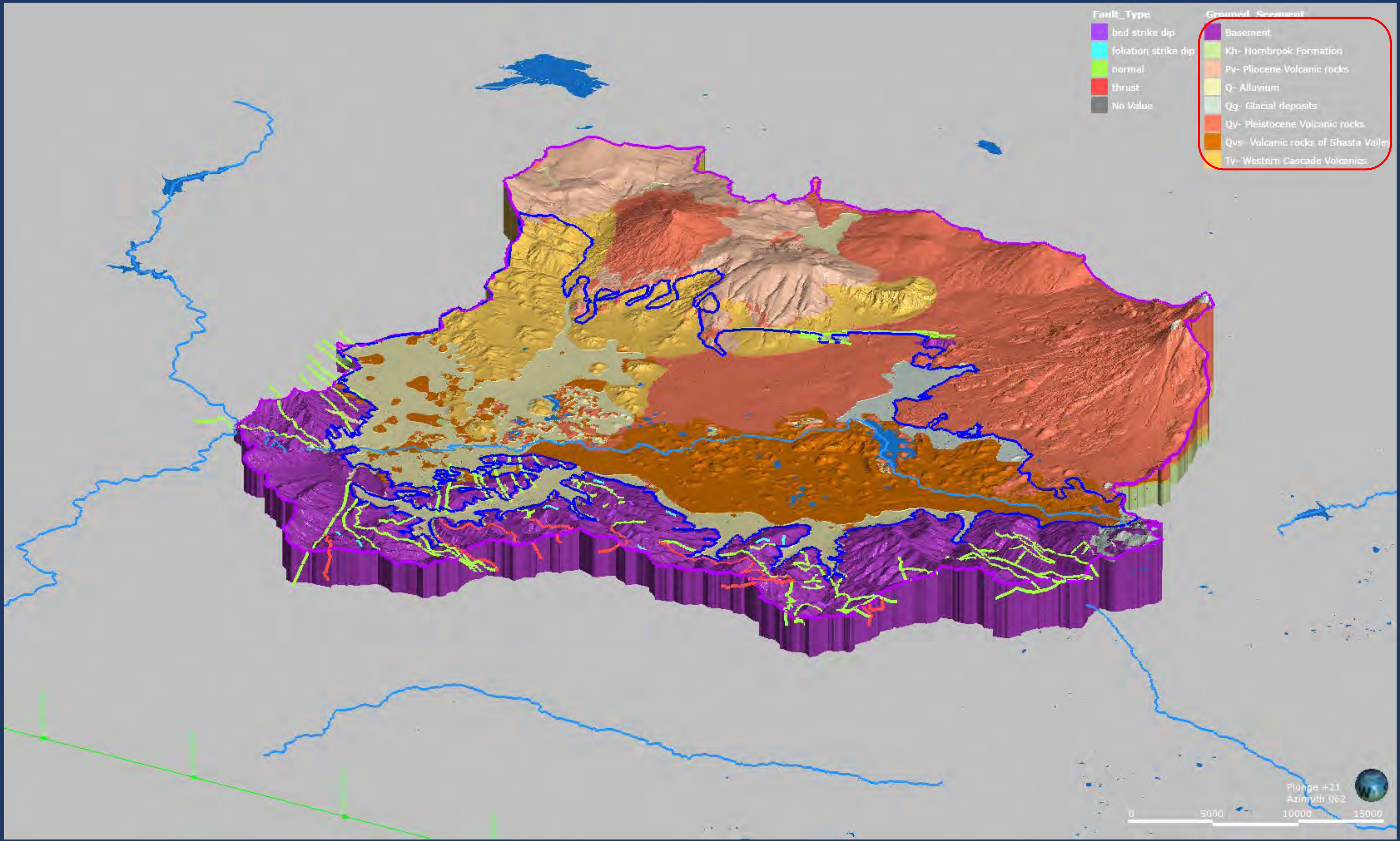
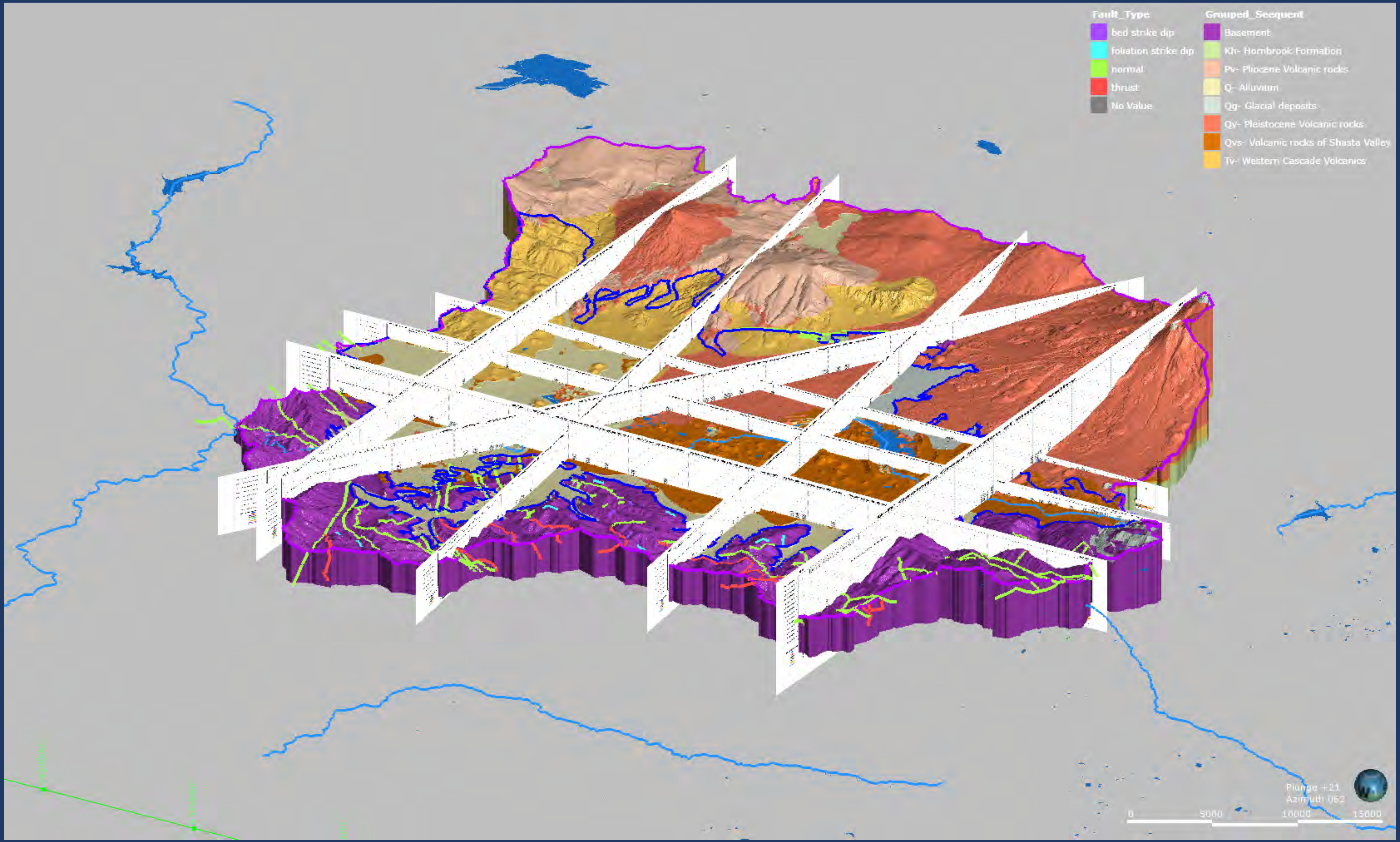


Shasta Valley Groundwater Basin 3-D geological model

Products

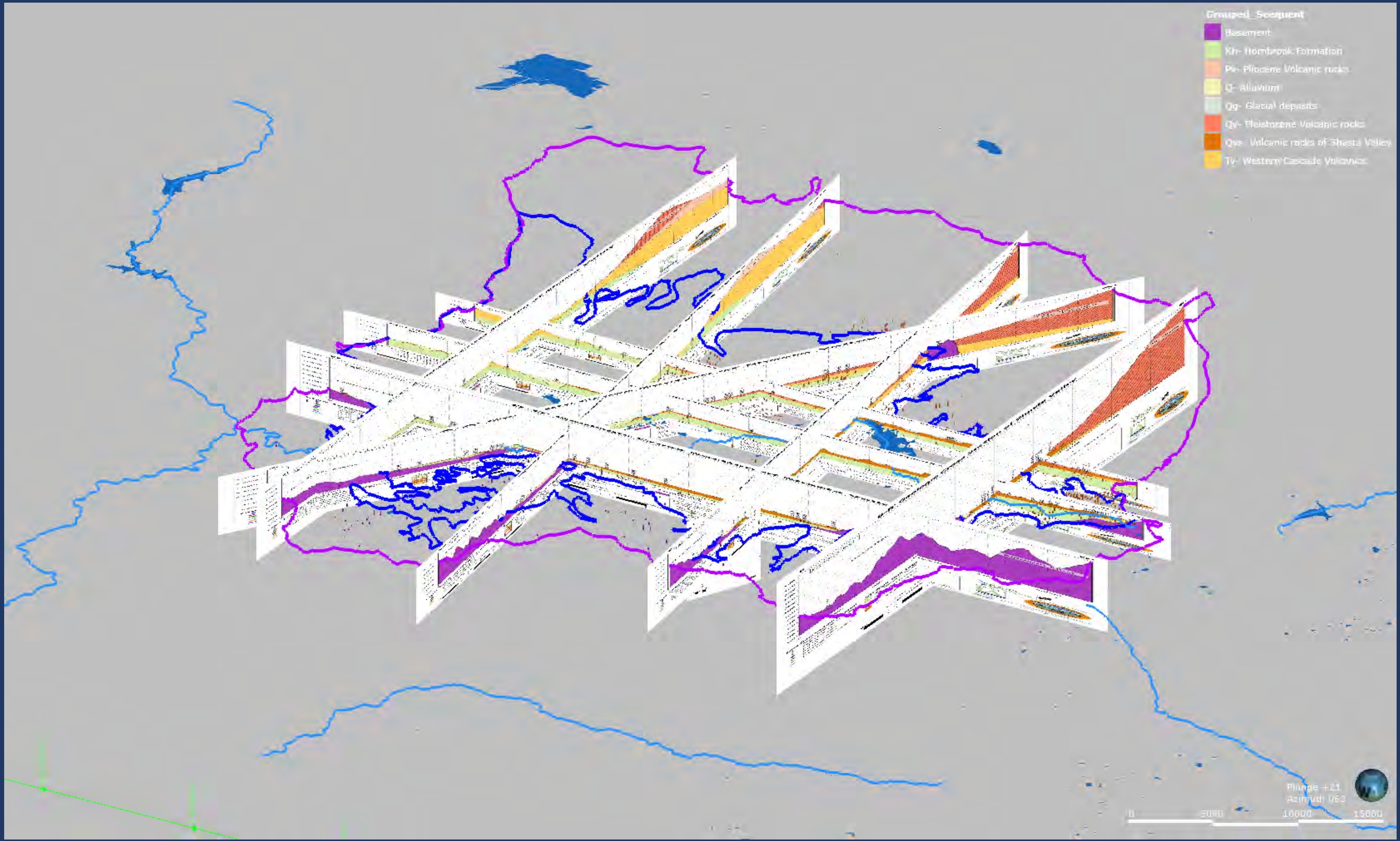
- Cross sections required by SGMA for GSP



Shasta Valley Groundwater Basin 3-D geological model

Products

- Cross sections required by SGMA for GSP



Shasta Valley Groundwater Basin 3-D geological model

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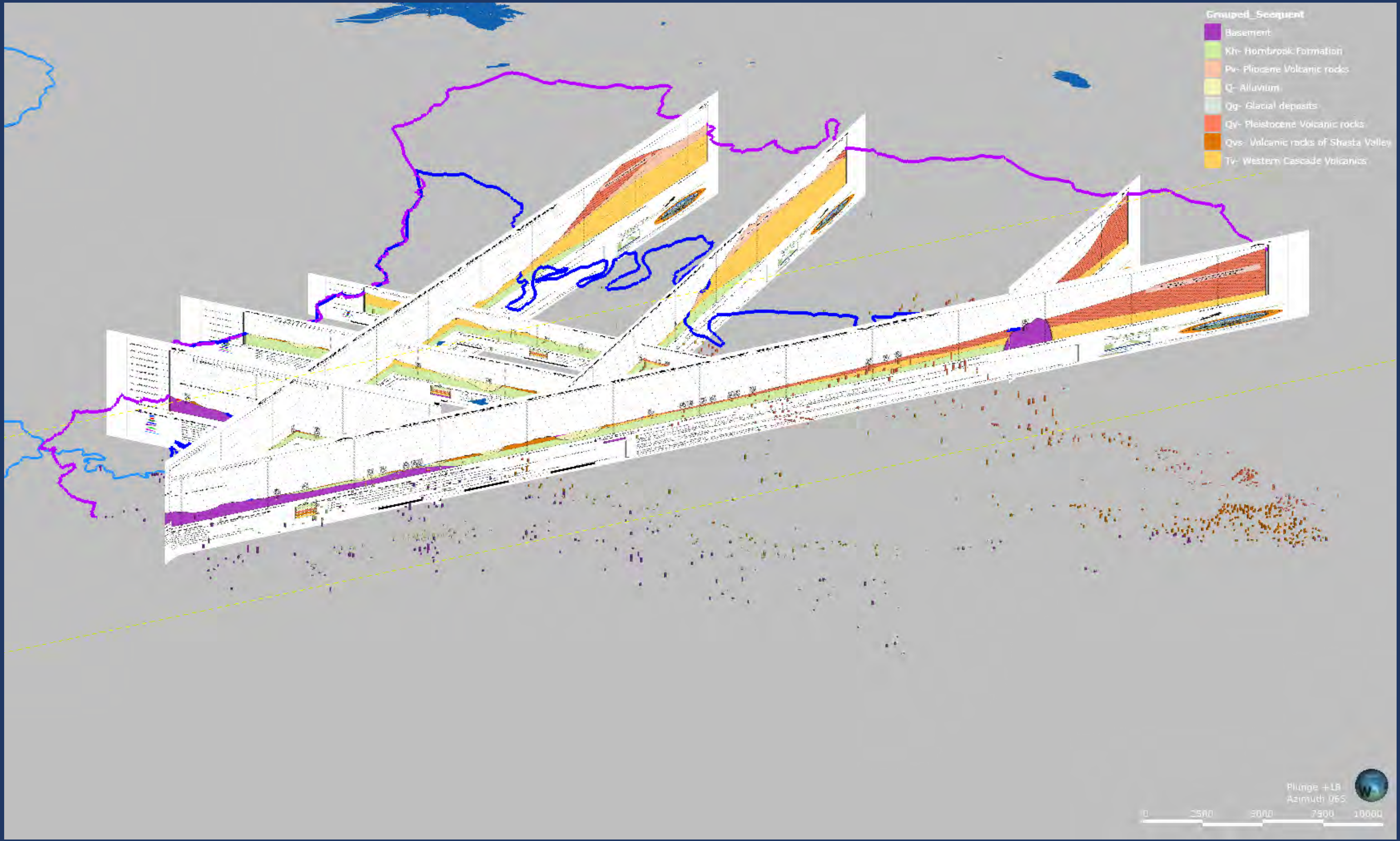
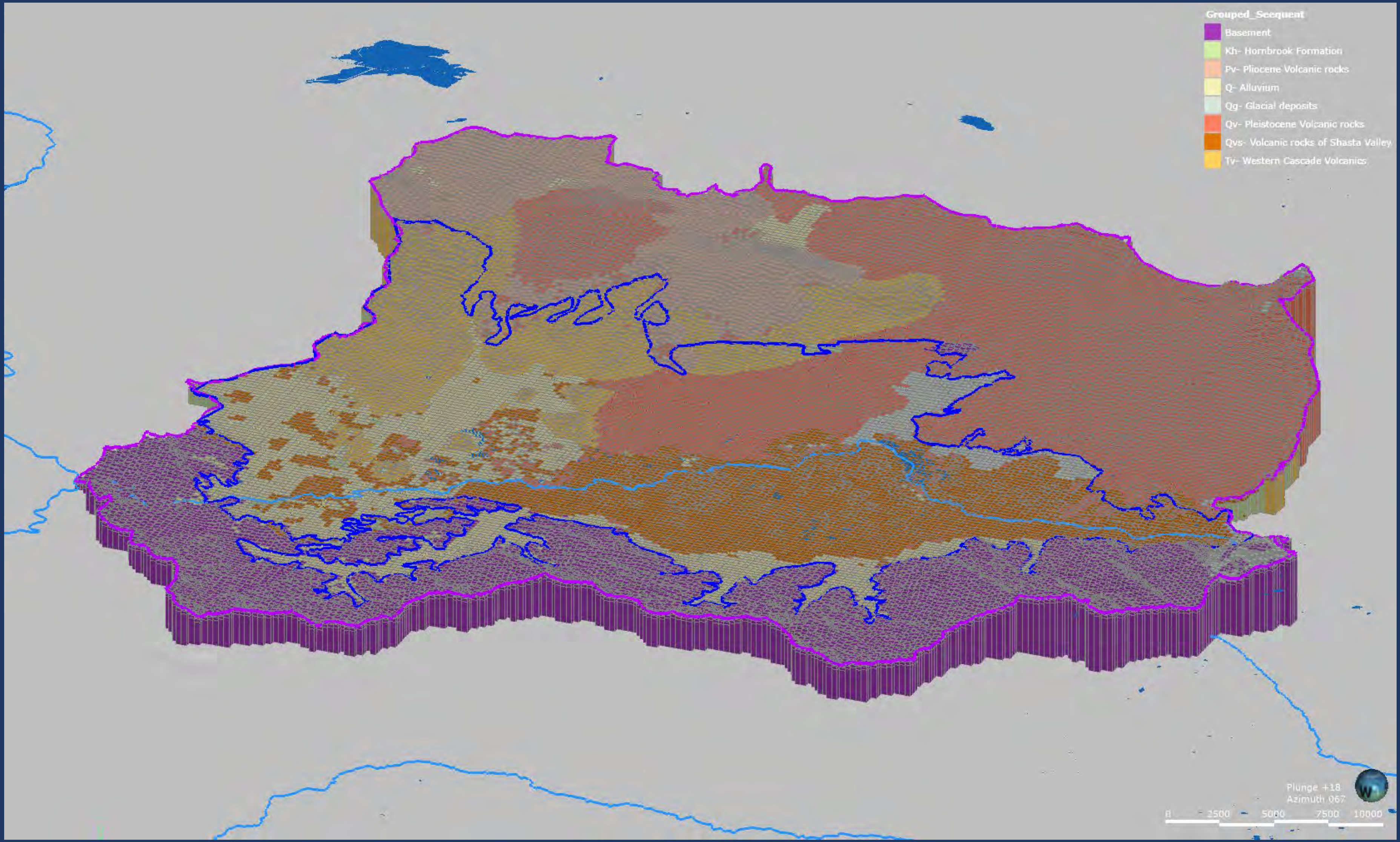


Shasta Valley Groundwater Basin 3-D geological model

Products

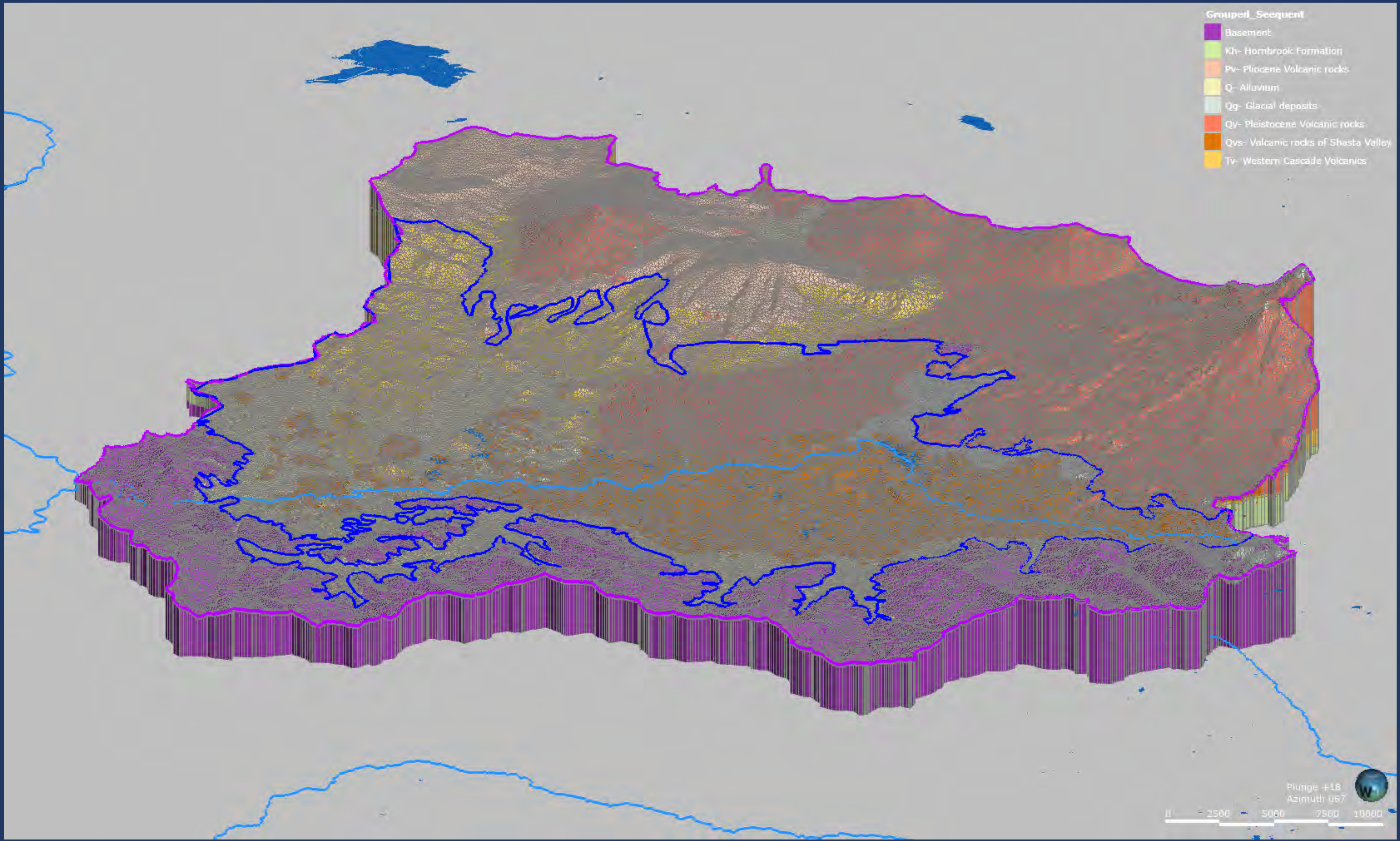
- Cross sections required by SGMA for GSP
- Groundwater modeling grids
  - MODFLOW



Shasta Valley Groundwater Basin 3-D geological model

Products

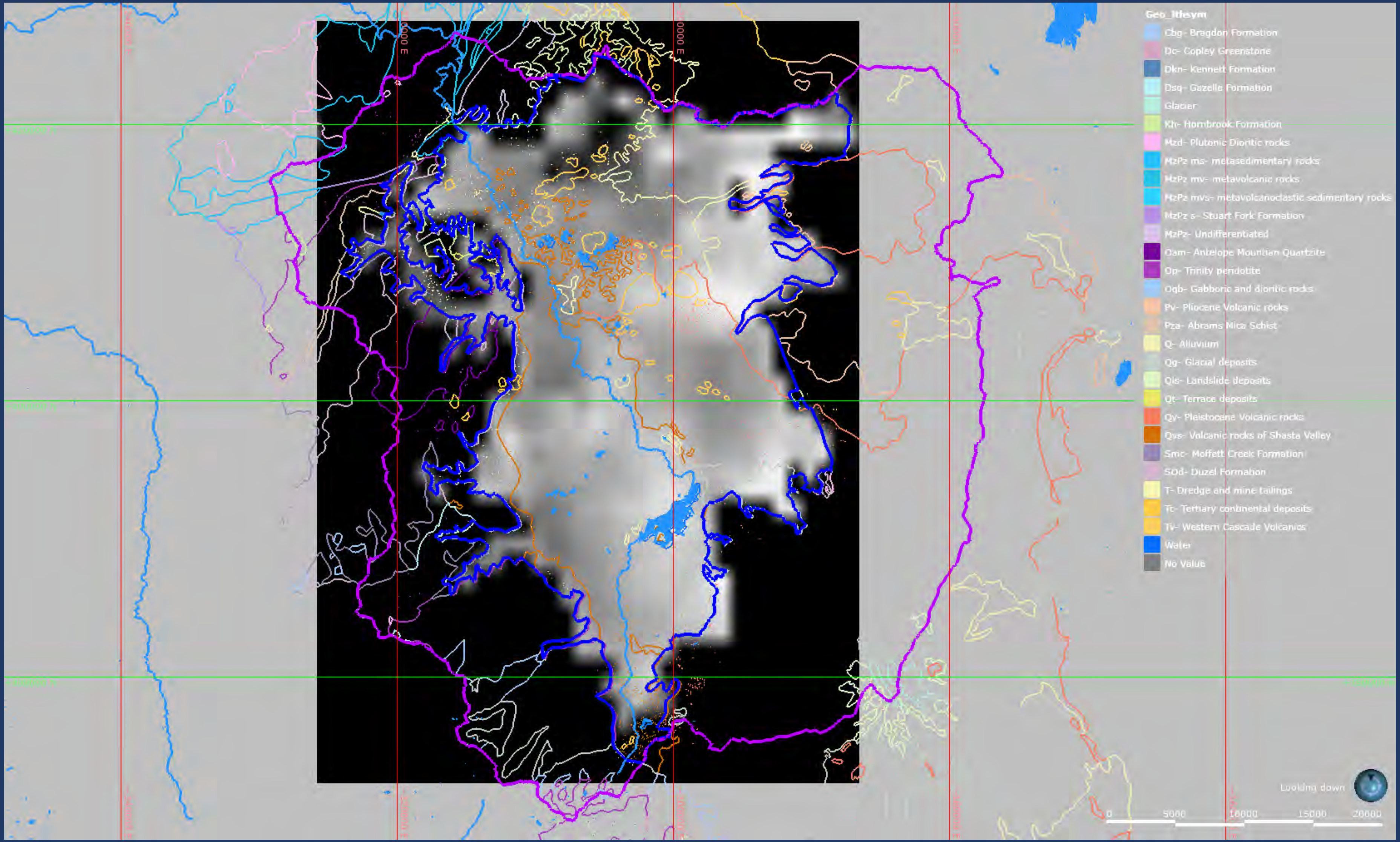
- Cross sections required by SGMA for GSP
- Groundwater modeling grids
  - MODFLOW
  - FEFLOW



Shasta Valley Groundwater Basin 3-D geological model

Products

- Cross sections required by SGMA for GSP
- Groundwater modeling grids
  - MODFLOW
  - FEFLOW
- Comparison with InSAR subsidence data



Shasta Valley Groundwater Basin 3-D geological model

Products

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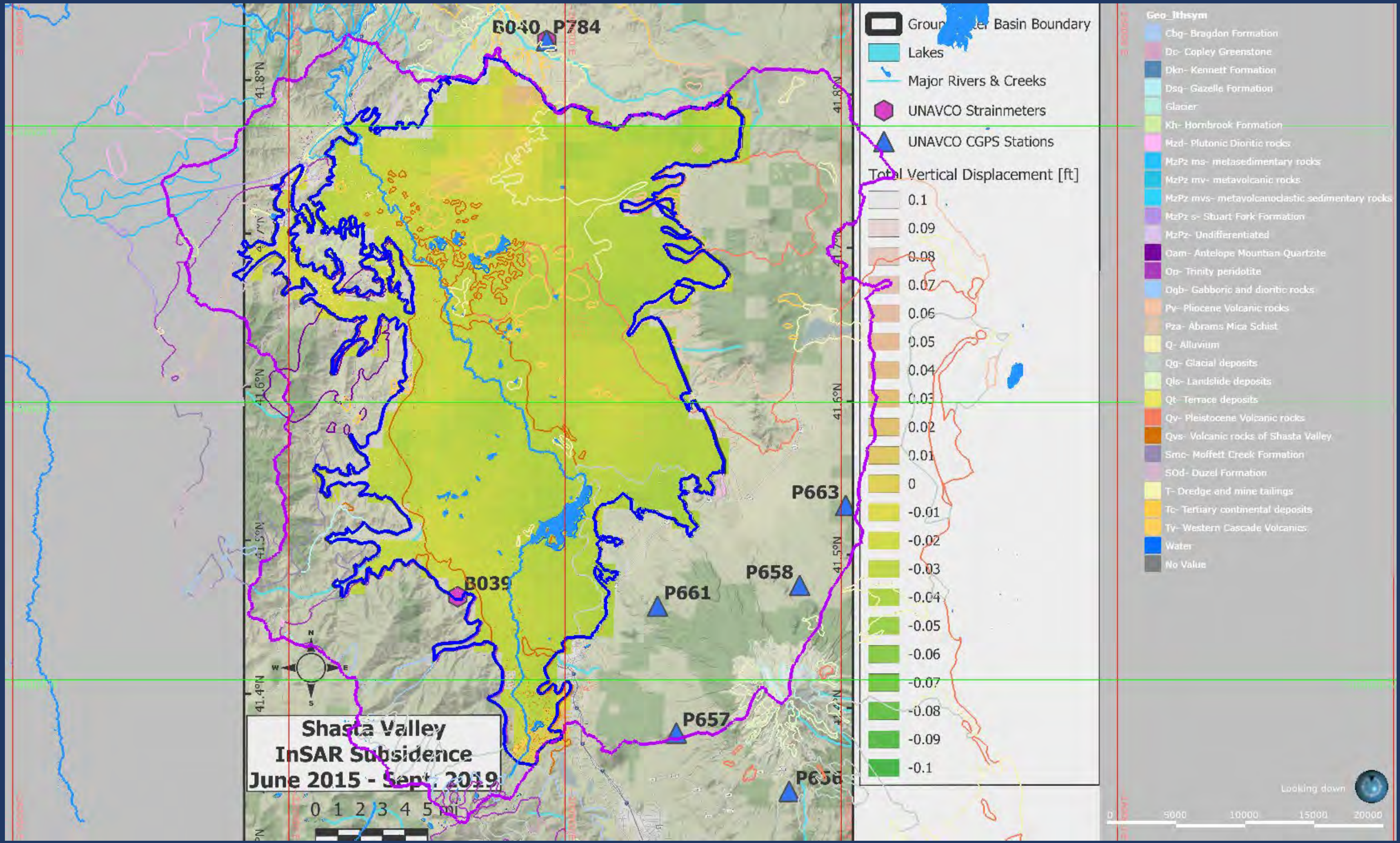
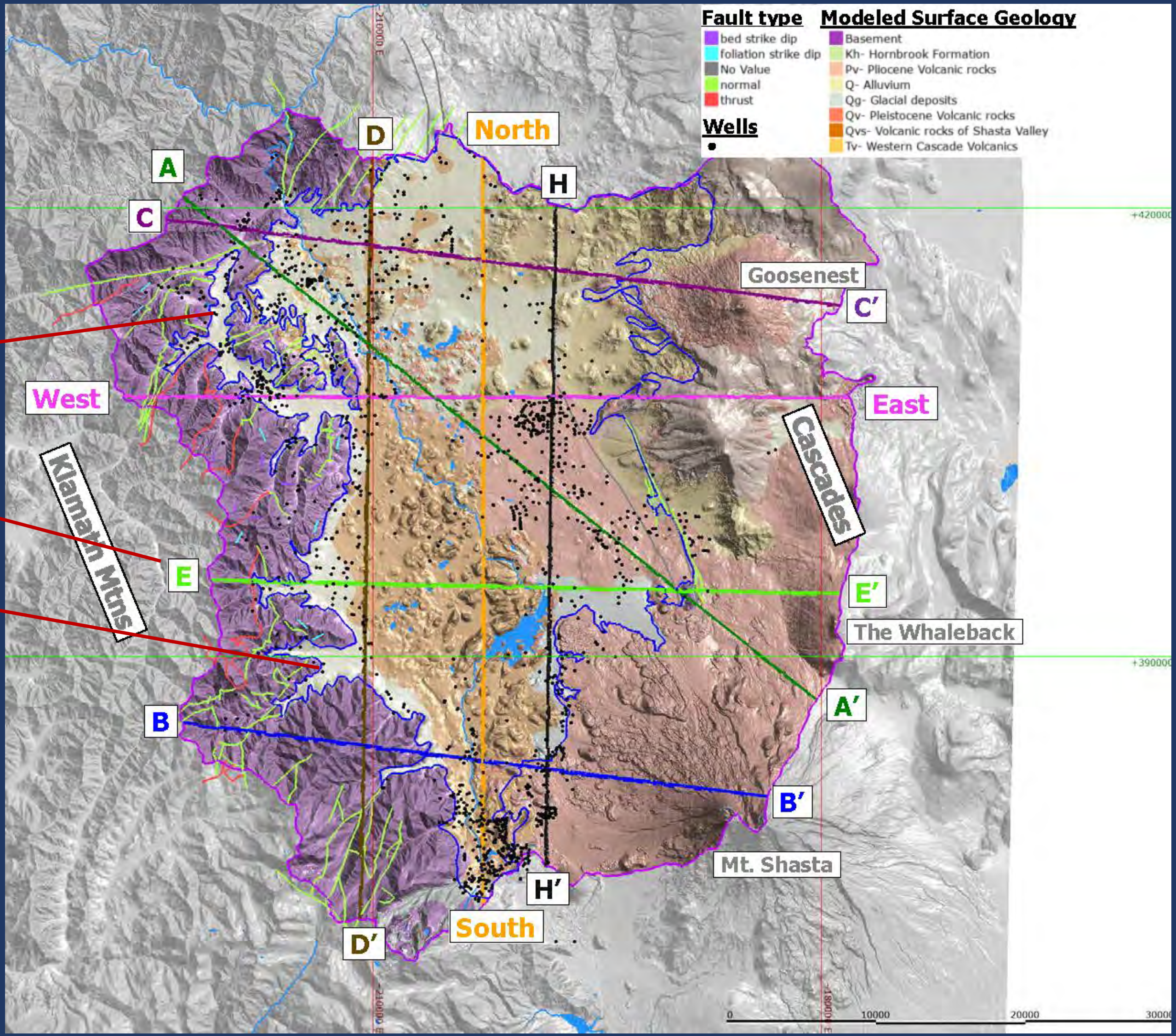


Shasta Valley Groundwater Basin 3-D geological model

Uncertainties

- Uncertainty is generally expected to be greatest in areas furthest from data points, including:
  - WCRs
  - Published x-secs
  - Digitized geologic surface map contacts



Shasta Valley Groundwater Basin 3-D geological model

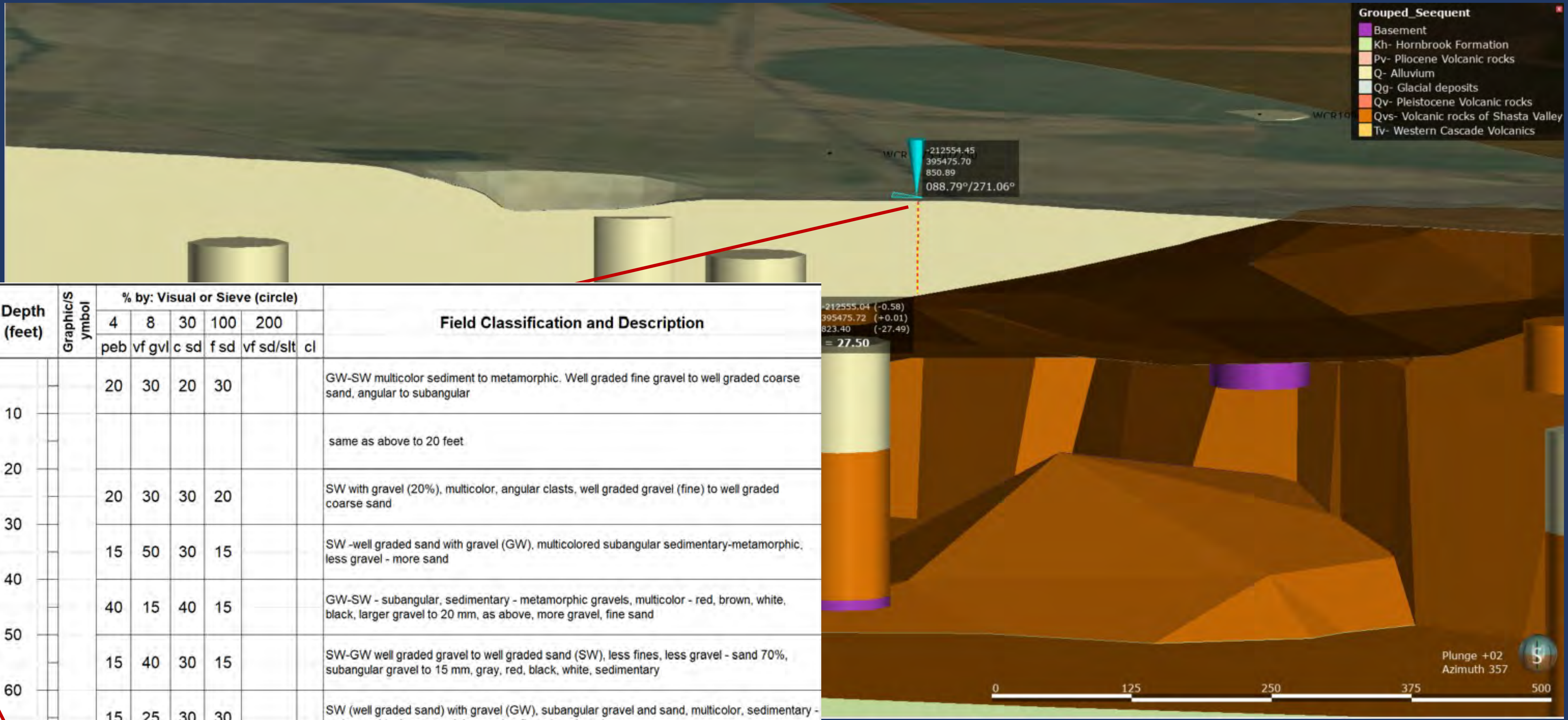
Uncertainties

- DWR TSS monitoring well drilled after model completion
- Qa to Qvs transition modeled at ~90’ bgs at proposed well location

Shasta Valley Groundwater Basin 3-D geological model

Uncertainties

- DWR TSS monitoring well drilled after model completion
- Qa to Qvs transition modeled at ~90’ bgs at proposed well location
- Drilling data showed this to be close at ~100’ bgs

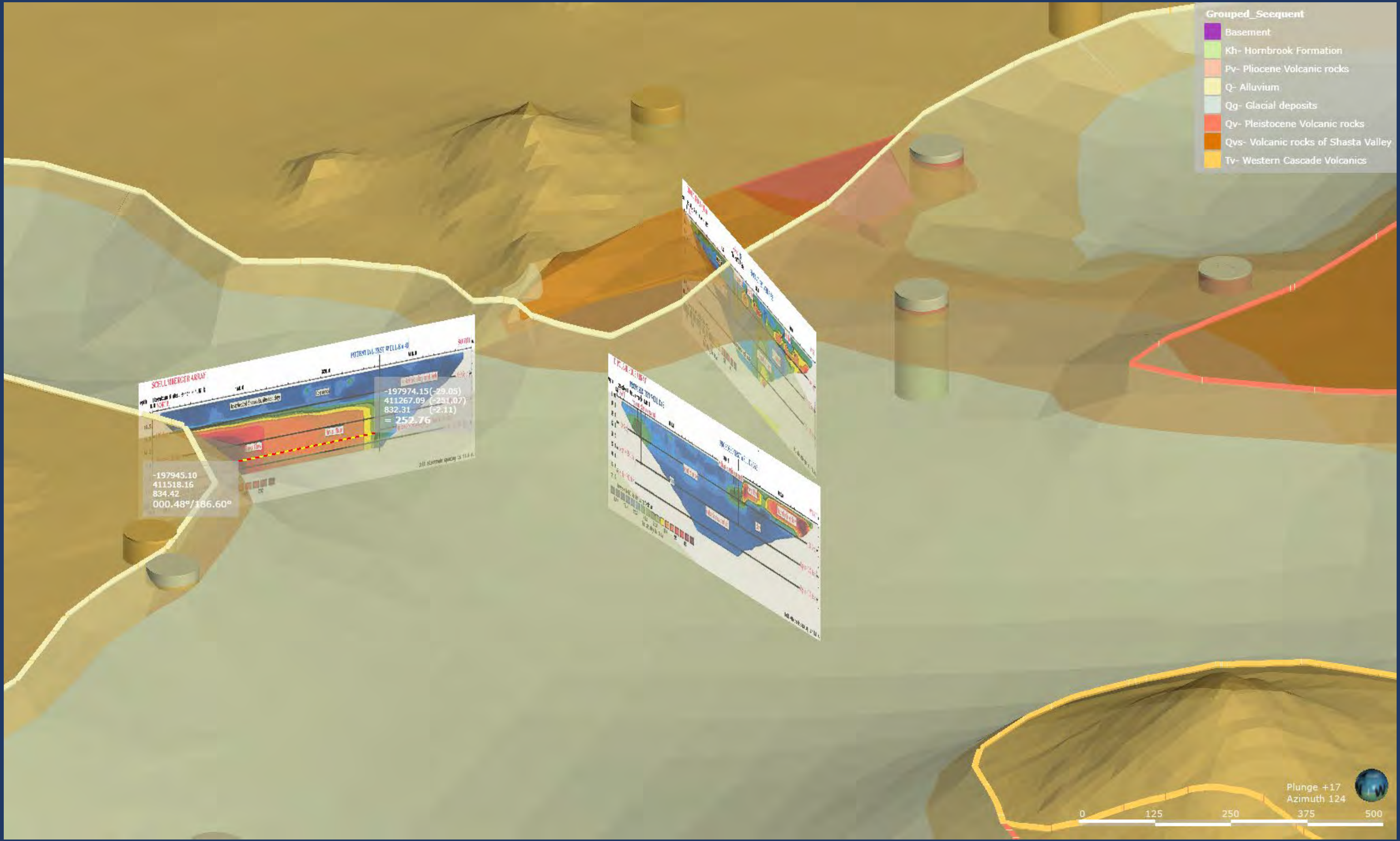


Depth (feet)	Graphic/Symbol	% by: Visual or Sieve (circle) 4 peb	8 vf gvl	30 c sd	100 f sd	200 vf sd/slt	cl	Field Classification and Description
10		20	30	20	30			GW-SW multicolor sediment to metamorphic. Well graded fine gravel to well graded coarse sand, angular to subangular
20								same as above to 20 feet
30		20	30	30	20			SW with gravel (20%), multicolor, angular clasts, well graded gravel (fine) to well graded coarse sand
40		15	50	30	15			SW -well graded sand with gravel (GW), multicolored subangular sedimentary-metamorphic, less gravel - more sand
50		40	15	40	15			GW-SW - subangular, sedimentary - metamorphic gravels, multicolor - red, brown, white, black, larger gravel to 20 mm, as above, more gravel, fine sand
60		15	40	30	15			SW-GW well graded gravel to well graded sand (SW), less fines, less gravel - sand 70%, subangular gravel to 15 mm, gray, red, black, white, sedimentary
70		15	25	30	30			SW (well graded sand) with gravel (GW), subangular gravel and sand, multicolor, sedimentary - metamorphic, less gravel, increasing fines (as above)
80		10	35	35	20			SW (with fines) to SM, little gravel, primarily coarse to medium sand, red, gray, white grains, subangular, well graded sand to silty sand, more fines than gravel, gravel same description as above to 15 mm
90		15	30	40	15			SW, coarse to medium sand, as above, brown, gray, red, white, gravel to 1/2 inch
100		15	35	30	20			SW, well graded sand increasing silt content, subangular gravel, GW, multicolor as above, gravel to 1/2 inch
		5	5	5	85			ML-CL, gravelly, sandy, silty clay, medium plasticity, light gray, can see grains

Shasta Valley Groundwater Basin 3-D geological model

Uncertainties

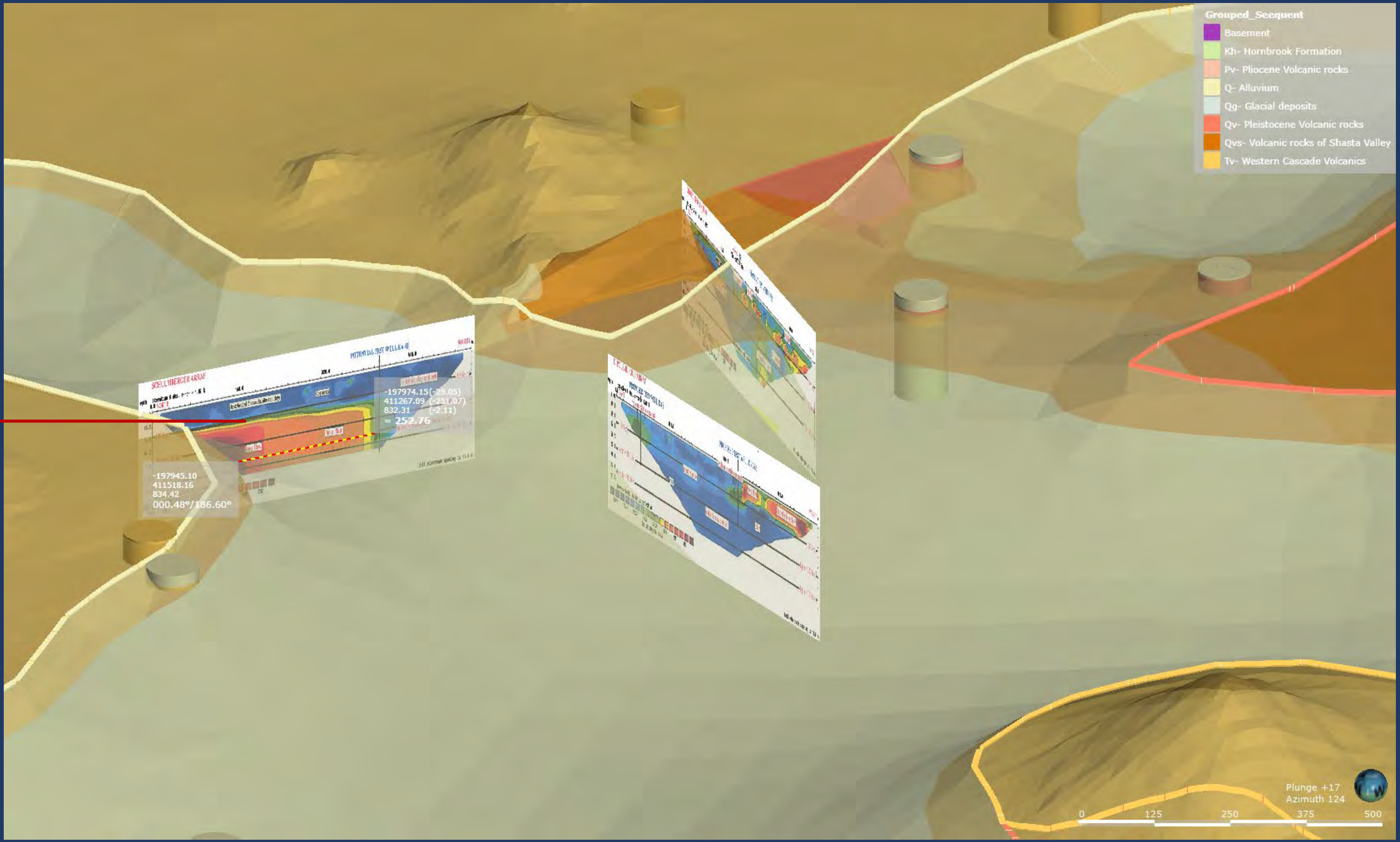
- Old geophysical survey results for farm-property scale provided after modeling completed



Shasta Valley Groundwater Basin 3-D geological model

Uncertainties

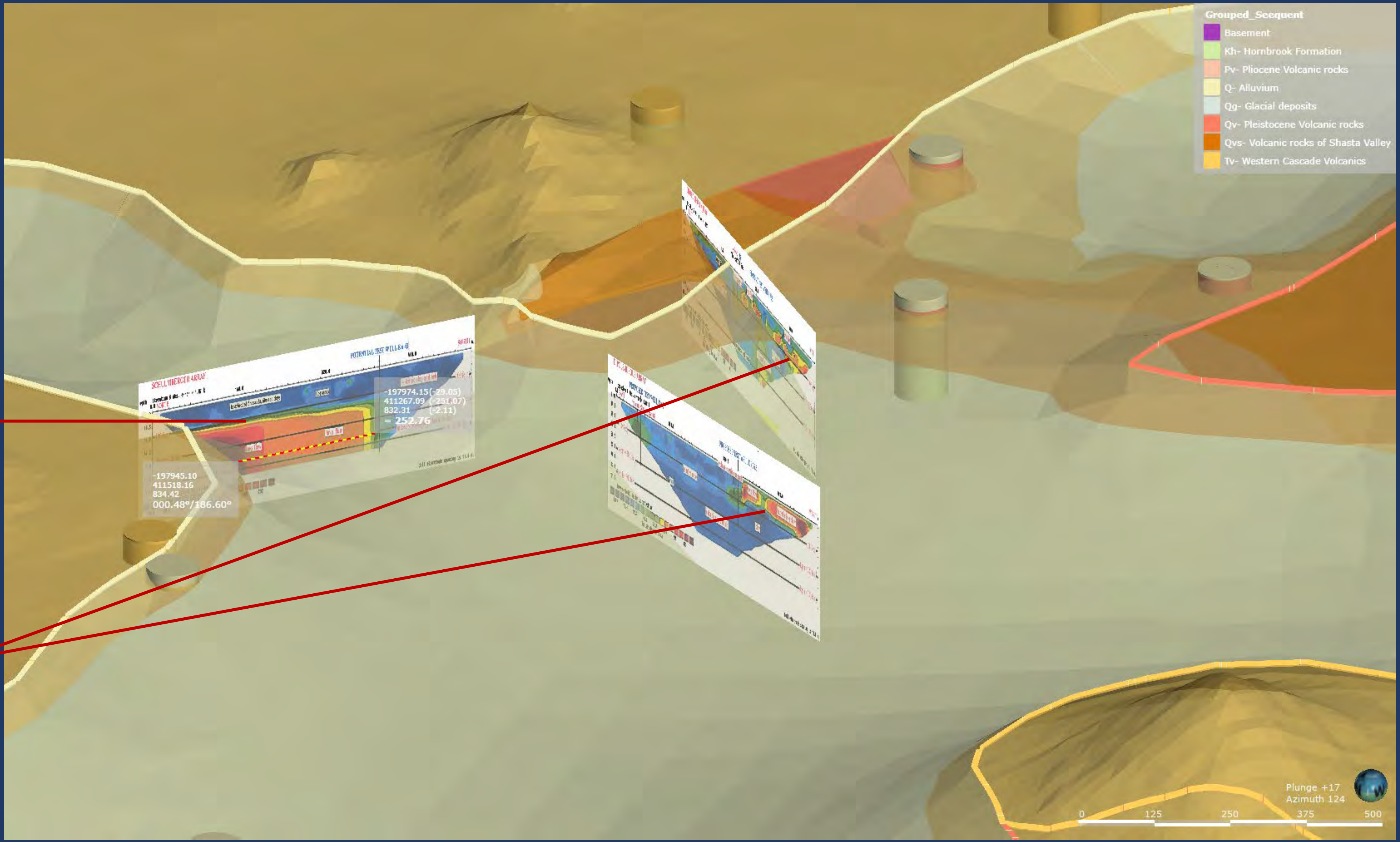
- Old geophysical survey results for farm-property scale provided after modeling completed
- Some larger modeled volcanic structures are close to geophysical feature geometries



Shasta Valley Groundwater Basin 3-D geological model

Uncertainties

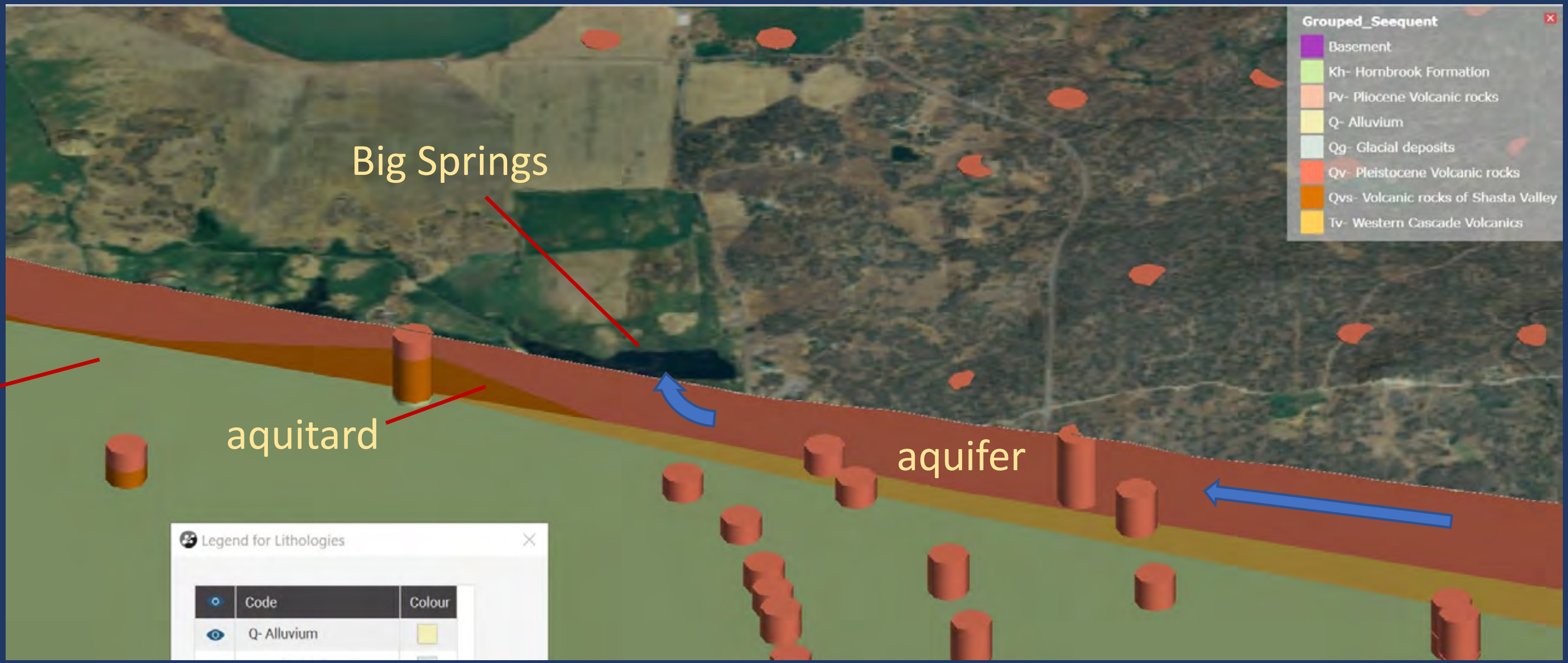
- Old geophysical survey results for farm-property scale provided after modeling completed
- Some larger modeled volcanic structures are close to geophysical feature geometries
- Small-scale volcanic features and contacts are not able to be accurately modeled



Shasta Valley Groundwater Basin 3-D geological model

Limitations/Utility

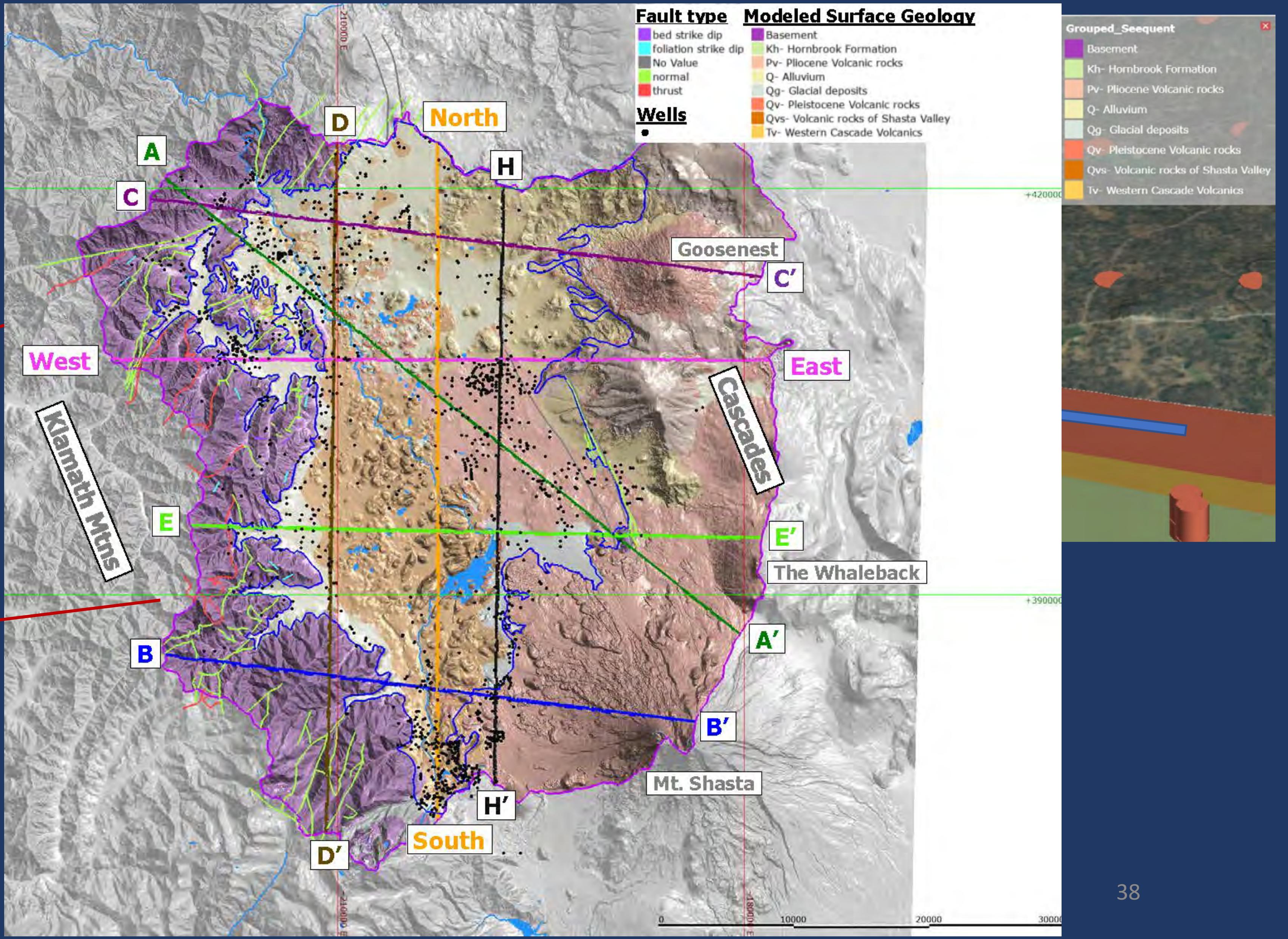
- Geological model is useful for using for groundwater investigations at basin- to field-scale (larger Ag fields)
- May be useful as a starting point for managed recharge operations and integrated surface water/groundwater studies



Shasta Valley Groundwater Basin 3-D geological model

Limitations/Utility

- Geological model is useful for using for groundwater investigations at basin- to field-scale (larger Ag fields)
- May be useful as a starting point for managed recharge operations and integrated surface water/groundwater studies
- 3-D WCR database alone is a major effort for future management & planning purposes



Appendix 2-B. Water Quality Assessment

Contents

Regulatory Background

Federal and State Regulations

The overarching federal law concerning water quality is the Clean Water Act, passed in 1972, and is applicable to surface waters and wetlands. In contrast, the federal Safe Drinking Water Act (SDWA) applies to both surface and groundwater, providing protection to drinking water supplies. Under the SDWA, federal standards were established through the United States Environmental Protection Agency (USEPA), in the form of maximum contaminant levels (MCLs). Secondary maximum contaminant levels (SMCLs) have also been established at the federal level; these address aesthetics of drinking water sources and are not enforceable. The state of California has its own Safe Drinking Water Act that includes MCLs and SMCLs which are, for select constituents, stricter than those set at the federal level. The California MCLs and SMCLs are codified in Title 22 of the California Code of Regulations (CCR). The standards established under the federal and state Safe Drinking Water Acts are enforced through the State Water Resource Control Board's (SWRCB's) Division of Drinking Water (DDW).

The California Porter-Cologne Water Quality Act, contained in California Water Code Division 7, applies to groundwater and surface waters, designating responsibility for water quality and safe drinking water to the SWRCB and the nine Regional Water Quality Control Boards (RWQCB) in California. The Act requires RWQCBs to develop water quality control plans to manage the quality of surface water and groundwater in specific regions; the plans contain defined water quality objectives for each region. These water quality objectives protect the quality of surface waters, groundwaters, and associated beneficial uses. The water quality control plan must be approved by both the SWRCB and the USEPA. The Shasta Valley Basin is in the North Coast Region and is regulated under the North Coast Regional Water Quality Control Board (Regional Water Board), with water quality objectives detailed in the Water Quality Control Plan for the North Coast Region (Basin Plan).[1]

The SWRCB's Policy for Water Quality Control For Recycled Water (Recycled Water Policy),[2] most recently amended in 2018, includes additional requirements to address salt and nutrients. Under this policy, Regional Water Boards are required to assess basins or subbasins within the region where water quality is threatened by salt and nutrients, and where management is required. In basins or subbasins where salt and nutrients are identified as a threat, a salt and nutrient management plan (SNMP) or equivalent management plan is required; this plan can address other constituents in addition to salt and nutrients.

Water Quality Control Plan for the North Coast Region

The Water Quality Control Plan for the North Coast Region (Basin Plan) is a regulatory tool used by the North Coast Regional Water Quality Control Board (Regional Water Board) to protect water quality within the North Coast Region. The Basin Plan is adopted by the NCRWQCB and approved by the State Water Resources Control Board; the water quality standards are approved by the United States Environmental Protection Agency (USEPA). Within the Basin Plan, beneficial uses of water, water quality objectives, including an antidegradation policy and plans for implementing

[1] {North Coast Regional Water Quality Control Board. 2018. "Water Quality Control Plan for the North Coast Region." Available: https://www.waterboards.ca.gov/northcoast/water_issues/programs/basin_plan/}

[2] {SWRCB Resolution No. 2018-0057 and "Amendment to the Policy for Water Quality Control For Recycled Water." Available: https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2018/121118_7_final_amendment_oal.pdf}

protections are included. Table 2-1 of the Basin Plan designates the following beneficial uses of for all groundwater (California North Coast Regional Water Quality Control Board 2018):

- Municipal and Domestic Supply (MUN)
- Agricultural Supply (AGR)
- Industrial Service Supply (IND)
- Native American Culture (CUL)

Potential beneficial uses of groundwater include:

- Industrial Process Supply (PRO)
- Aquaculture (AQUA)

For chemical constituents in waters with MUN beneficial uses, the Basin Plan specifies that no waters are to exceed the MCL in Title 22 of the California Code of Regulations (CCR). The Basin Plan also includes numeric water quality objectives, specifically for groundwaters in the Shasta Valley hydrologic area.

A complete list of constituents, comparison concentrations and sources are listed in Table 2.

Water Quality Assessment

Data Sources

Water quality data was obtained from several databases and supplemented with data provided by local organizations and community members. The majority of the water quality data used in the assessment was sourced from the SWRCB's Groundwater Ambient Monitoring and Assessment Program (GAMA), a database containing datasets from agencies including the Department of Pesticide Regulation (DPR), Department of Water Resources (DWR), the State Water Board, Lawrence Livermore National Laboratory (LLNL) and the United States Geological Survey (USGS). Additional data in the Shasta Valley Wildlife Area was directly provided by the California Department of Fish and Wildlife.

The datasets in GAMA with information in Shasta Valley Groundwater Basin are:

- **The Public Water System Wells** dataset includes wells regulated by the State Water Board's Division of Drinking Water (DDW). This dataset includes information for active and inactive drinking water sources with 15 or more connections or more than 25 people per day.

- **National Water Information System (NWIS)**, a dataset provided by USGS with samples from water supply wells and reported quarterly to the State Water Board's data management system, GeoTracker.

- **Monitoring wells** regulated by the State Water Board includes wells under different regulatory programs, with data available for download through GeoTracker. There are monitoring wells in Shasta Valley Basin for the following programs:

  - Leaking Underground Storage Tank (LUST) Cleanup sites
  - Cleanup Program Sites
  - Land Disposal Sites

- **GAMA's Priority Basin Project**, a State Water Board, USGS and LLNL initiative to assess groundwater quality statewide. Data primarily collected from public water system wells but private domestic, monitoring and irrigation wells are also sampled.
- **DWR's Water Data Library**, a dataset including groundwater quality and depth data with samples from multiple well types including irrigation, stock, domestic and public supply.
- **Department of Pesticide Regulation's Groundwater Protection program**, a compilation of information from DPR and other public agencies from domestic, public supply and irrigation wells.

Selection of Numeric Thresholds

Numeric thresholds are used with well data to evaluate groundwater quality. These numeric standards are selected to satisfy all relevant groundwater quality standards and objectives; the general selection approach used is consistent with recommendations by the State Water Board for determination of assessment thresholds for groundwater [Reference]. More than one water quality objective or standard may apply to a constituent and a prioritization process is used to select the numeric threshold value. Where available, the strictest value, of the federal and state regulated water quality standards, and water quality objectives specified in the Basin Plan, is used.

The following sources were used in establishing the numeric thresholds:

i) Basin Plan numeric water quality objectives

   Specific groundwater quality objectives are defined in the Basin Plan for specific conductance, pH, hardness and boron. These limits are listed in Table 1 below.

ii) State and Federal Maximum Contaminant Levels (MCLs)

   MCL-CA: State of California MCLs

   MCL-US: Federal MCLs

   Per the Basin Plan, groundwaters in the Shasta Valley hydrologic area have a designated beneficial use as domestic or municipal water supply (MUN) beneficial use and must not exceed the maximum contaminant levels (MCLs) and secondary maximum contaminant levels (SMCLs) defined in Title 22 of the California Code of Regulations (CCR). The strictest value of the state and federal MCLs and SMCLs is used.

The complete list of constituents and corresponding sources and values for comparison concentrations used in the water quality analysis can be found in Table 2.

Table 1: Basin Plan Specific Water Quality Objectives
for Groundwaters in the Shasta Valley Hydrologic Area

Constituent	Limit Type	Value
Specific Conductance (mmhos) at 77 degrees F	90% Upper Limit	800
Specific Conductance (mmhos) at 77 degrees F	50% Upper Limit	500
pH	Maximum	8.5
pH	Minimum	7
Boron (mg/L)	90% Upper Limit	1
Boron (mg/L)	50% Upper Limit	0.3
Hardness (mg/L)	50% Upper Limit	180

[a] 90% upper and lower limits represent the 90 percentile values for a calendar year. 90% or more of the values must be less than or equal to an upper limit and greater than or equal to a lower limit

[b] 50% upper and lower limits represent the 50 percentile values of the monthly means for a calendar year. 50% or more of the monthly means must be less than or equal to an upper limit and greater than or equal to a lower limit

Table 2: Comparison concentrations and data sources
for constituents used in the water quality assessment.

Full Name	MCL	Units	Source
1,1 Dichloroethylene (1,1 DCE)	6	ug/L	Title 22 Table 64444-A
1,1,1 Trichloroethane	200	ug/L	Title 22 Table 64444-A
1,1,2,2 Tetrachloroethane (PCA)	1	ug/L	Title 22 Table 64444-A
1,1,2 Trichloro-1,2,2-Trifluoroethane (Freon 113)	1.2	mg/L	Title 22 Table 64444-A
1,1,2 Trichloroethane	5	ug/L	Title 22 Table 64444-A
1,1 Dichloroethane (1,1 DCA)	5	ug/L	Title 22 Table 64444-A
1,2 Dibromoethane (EDB)	0.05	ug/L	Title 22 Table 64444-A
1,2 Dichlorobenzene (1,2-DCB)	600	ug/L	Title 22 Table 64444-A
1,2 Dichloroethane (1,2 DCA)	0.5	ug/L	Title 22 Table 64444-A
1,2 Dichloropropane (1,2 DCP)	5	ug/L	Title 22 Table 64444-A
1,2,3 Trichloropropane (1,2,3 TCP)	0.005	ug/L	Title 22 Table 64444-A
1,2,4 Trichlorobenzene (1,2,4 TCB)	5	ug/L	Title 22 Table 64444-A
1,2,4 Trimethylbenzene	330	ug/L	NL
1,2 Dibromo-3-chloropropane (DBCP)	0.2	ug/L	Title 22 Table 64444-A
1,3 Dichloropropene	0.5	ug/L	Title 22 Table 64444-A
1,3,5 Trimethylbenzene	330	ug/L	NL
1,3 Dichlorobenzene	600	ug/L	US-HAL
1,4 Dichlorobenzene (p-DCB)	5	ug/L	Title 22 Table 64444-A
1,4 Dioxane	1	ug/L	HBSL
2 Chlorotoluene	140	ug/L	US-HAL
2,3,7,8 TCDD	0.00003	ug/L	MCL-US
2,4,5 TP (Silvex)	50	ug/L	Title 22 Table 64444-A
2,4,6 Trinitrotoluene (TNT)	1	ug/L	US-HAL
2,4 Dichlorophenoxyacetic acid (2,4 D)	70	ug/L	Title 22 Table 64444-A
4 Chlorotoluene	140	ug/L	HBSL
4,4’ DDD	0.1	ug/L	CA-CPF
4,4’ DDE	0.1	ug/L	CA-CPF
4,4’ DDT	0.1	ug/L	CA-CPF
Acetone	6300	ug/L	RfD
Alachlor	2	ug/L	Title 22 Table 64444-A
Aldicarb	7	ug/L	HBSL
Aldicarb Sulfone	7	ug/L	HBSL
Aldicarb sulfoxide	7	ug/L	HBSL
Alpha-Benzene Hexachloride (Alpha-BHC)	0.15	ug/L	CA-Prop65
Aluminum	200	ug/L	Title 22 Table 64449-A
Ammonia	30	mg/L	US-HAL
Antimony	6	ug/L	Title 22 Table 64431-A
Arsenic	10	ug/L	Title 22 Table 64431-A
Asbestos	7	MFL	Title 22 Table 64431-A
Atrazine	1	ug/L	Title 22 Table 64444-A
Azinphos Ethyl	10	ug/L	HBSL
Barium	1	mg/L	Title 22 Table 64431-A

Continued on next page

Table 2: Comparison concentrations and data sources for constituents used in the water quality assessment.

Full Name	MCL	Units	Source
Bensulfuron Methyl	1000	ug/L	HBSL
Bentazon	18	ug/L	Title 22 Table 64444-A
Benzene	1	ug/L	Title 22 Table 64444-A
Benzo(a)pyrene	0.2	ug/L	Title 22 Table 64444-A
Beryllium	4	ug/L	Title 22 Table 64431-A
Beta-Benzene Hexachloride (Beta- BHC)	0.25	ug/L	CA-Prop65
Boron	0.3 (50% UL), 1.0 (90% UL)	mg/L	Basin Plan Table 3-1
Bromacil	70	ug/L	US-HAL
Bromate	10	ug/L	MCL-US
Bromodichloromethane (THM)	80	ug/L	MCL
Bromoform (THM)	80	ug/L	MCL
Cadmium	5	ug/L	Title 22 Table 64431-A
Carbaryl (1-naphthyl methylcarbamate)	40	ug/L	HBSL
Carbofuran	18	ug/L	Title 22 Table 64444-A
Carbon Disulfide	160	ug/L	HBSL
Carbon Tetrachloride	0.5	ug/L	Title 22 Table 64444-A
Chlorate	800	ug/L	NAS-HAL
Chlordane	0.1	ug/L	Title 22 Table 64444-A
Chloride	500	mg/L	Title 22 Table 64449-B
Chlorite	1	mg/L	MCL-US
Chlorobenzene	70	ug/L	Title 22 Table 64444-A
Chloroform (THM)	80	ug/L	MCL
Chloropicrin	12	ug/L	NAS-HAL
Chromium	50	ug/L	Title 22 Table 64431-A
Chromium, Hexavalent (Cr6)	20	ug/L	HBSL
cis-1,2 Dichloroethylene	6	ug/L	Title 22 Table 64444-A
Copper	1	mg/L	Title 22 Table 64449-A
Cyanazine	0.3	ug/L	HBSL
Cyanide (CN)	150	ug/L	Title 22 Table 64431-A
Cypermethrin	40	ug/L	HBSL
Dacthal	70	ug/L	HBSL
Dalapon	200	ug/L	Title 22 Table 64444-A
Deethylatrazine	50	ug/L	CA-Prop65
Di(2-ethylhexyl)adipate	0.4	mg/L	Title 22 Table 64444-A
Di(2-ethylhexyl)phthalate (DEHP)	4	ug/L	Title 22 Table 64444-A
Diazinon	1.2	ug/L	HBSL
Dibromochloromethane (THM)	80	ug/L	MCL
Dicamba	210	ug/L	RfD
Dichlorodifluoromethane	1	mg/L	HBSL
Dichloromethane (Methylene Chloride)	5	ug/L	Title 22 Table 64444-A
Dichlorprop	300	ug/L	HBSL
Dichlorvos (DDVP)	0.4	ug/L	HBSL

Continued on next page

Table 2: Comparison concentrations and data sources
for constituents used in the water quality assessment.

Full Name	MCL	Units	Source
Dieldrin	0.002	ug/L	HBSL
Diesel	100	ug/L	US-HAL
Dimethoate	2	ug/L	HBSL
Dinoseb	7	ug/L	Title 22 Table 64444-A
Diquat	20	ug/L	Title 22 Table 64444-A
Diuron	2	ug/L	HBSL
Endosulfan I	42	ug/L	RfD
Endosulfan II	42	ug/L	RfD
Endosulfan Sulfate	42	ug/L	RfD
Endothall	100	ug/L	Title 22 Table 64444-A
Endrin	2	ug/L	Title 22 Table 64444-A
EPTC	200	ug/L	HBSL
Ethylbenzene	300	ug/L	Title 22 Table 64444-A
Ethylene glycol	14	mg/L	US-HAL
Fecal Coliform (bacteria)	0.99	Count	MCL
Fenamiphos	0.7	ug/L	HBSL
Fluoride	2	mg/L	Title 22 Table 64431-A
Foaming Agents (MBAS)	0.5	mg/L	Title 22 Table 64449-A
Fonofos	10	ug/L	HBSL
Formaldehyde	100	ug/L	US-HAL
Gasoline	5	ug/L	US-HAL
Glyphosate (Round-up)	700	ug/L	MCL-US
Gross Alpha radioactivity	15	pCi/L	Title 22 Table 64442
Gross beta	50	pCi/L	MCL-US
Guthion (Azinphos Methyl)	10	ug/L	HBSL
Heptachlor	0.01	ug/L	Title 22 Table 64444-A
Heptachlor Epoxide	0.01	ug/L	Title 22 Table 64444-A
Hexachlorobenzene (HCB)	1	ug/L	MCL-US
Hexachlorobutadiene	0.9	ug/L	HBSL
Hexachlorocyclopentadiene	50	ug/L	Title 22 Table 64444-A
Hexazinone	400	ug/L	HBSL
Iodide	1190	ug/L	NAS-HAL
Iprodione	0.8	ug/L	HBSL
Iron	300	ug/L	Title 22 Table 64449-A
Isopropylbenzene (Cumene)	770	ug/L	HBSL
Kerosene	100	ug/L	US-HAL
Lead	15	ug/L	AL
Lindane (Gamma-BHC)	0.2	ug/L	Title 22 Table 64444-A
Linuron	5	ug/L	HBSL
Malathion	500	ug/L	HBSL
Manganese	50	ug/L	Title 22 Table 64449-A
Mercury	2	ug/L	Title 22 Table 64431-A
Metalaxyl	500	ug/L	HBSL

Continued on next page

Table 2: Comparison concentrations and data sources for constituents used in the water quality assessment.

Full Name	MCL	Units	Source
Methomyl	200	ug/L	HBSL
Methoxychlor	30	ug/L	Title 22 Table 64444-A
Methyl Bromide (Bromomethane)	10	ug/L	US-HAL
Methyl Isobutyl Ketone (MIBK)	120	ug/L	NL
Metolachlor	700	ug/L	HBSL
Metribuzin	90	ug/L	HBSL
Molinate	20	ug/L	Title 22 Table 64444-A
Molybdenum	40	ug/L	US-HAL
MTBE (Methyl-tert-butyl ether)	5	ug/L	Title 22 Table 64449-A
Naled	10	ug/L	HBSL
Naphthalene	17	ug/L	HBSL
Napropamide	800	ug/L	HBSL
n-Butylbenzene	260	ug/L	NL
Nickel	100	ug/L	Title 22 Table 64431-A
Nitrate as N	10	mg/L	Title 22 Table 64431-A
Nitrate+Nitrite	10	mg/L	Title 22 Table 64431-A
Nitrite as N	1	mg/L	Title 22 Table 64431-A
N-Nitrosodiethylamine (NDEA)	0.01	ug/L	CA-CPF
N-Nitrosodimethylamine (NDMA)	0.01	ug/L	CA-CPF
N-Nitrosodi-N-Propylamine (NDPA)	0.01	ug/L	CA-CPF
Norflurazon	10	ug/L	HBSL
n-Propylbenzene (Isocumene)	260	ug/L	NL
Octogen (HMX)	0.35	mg/L	US-HAL
Oxamyl	50	ug/L	Title 22 Table 64444-A
Oxyfluorfen	20	ug/L	HBSL
Parathion	0.02	ug/L	HBSL
PCNB	21	ug/L	RfD
Pentachlorophenol (PCP)	1	ug/L	MCL-US
Perchlorate	6	ug/L	Title 22 Table 64431-A
Perfluorooctanoic acid	5.1	ng/L	US-HAL
Perfluorooctanoic sulfonate	6.5	ng/L	NL
Permethrin	4	ug/L	HBSL
pH	7.0-8.5	-log[H+]	Basin Plan Table 3-1
Phorate	4	ug/L	HBSL
Picloram	0.5	mg/L	Title 22 Table 64444-A
Polychlorinated Biphenyls (PCBs)	0.5	ug/L	MCL-US
Prometon	400	ug/L	HBSL
Prometryn	300	ug/L	HBSL
Propachlor (2-Chloro-N-isopropylacetanilide)	90	ug/L	HBSL
Propanil	6	ug/L	HBSL
Propargite	1	ug/L	HBSL
Radium 226	5	pCi/L	Title 22 Table 64442
Radium 228	5	pCi/L	Title 22 Table 64442

Continued on next page

Table 2: Comparison concentrations and data sources
for constituents used in the water quality assessment.

Full Name	MCL	Units	Source
Radon 222	4000	pCi/L	MCL-US
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	0.3	mg/L	US-HAL
sec-Butylbenzene	260	ug/L	NL
Selenium	50	ug/L	Title 22 Table 64431-A
Silver	100	ug/L	Title 22 Table 64449-A
Simazine	4	ug/L	Title 22 Table 64444-A
Sodium	50	mg/L	AL
Specific Conductivity	500 (50% UL), 800 (90% UL)	umhos	Basin Plan Table 3-1
Strontium	4000	ug/L	US-HAL
Strontium 90	8	pCi/L	Title 22 Table 64443
Styrene	100	ug/L	Title 22 Table 64444-A
Sulfate	500	mg/L	Title 22 Table 64449-B
tebuthiuron	1000	ug/L	HBSL
tert-Butyl alcohol (TBA)	12	ug/L	NL
tert-Butylbenzene	260	ug/L	NL
Tetrachloroethene (PCE)	5	ug/L	Title 22 Table 64444-A
Thallium	2	ug/L	Title 22 Table 64431-A
Thiabendazole	231	ug/L	HHBP
Thiobencarb	1	ug/L	Title 22 Table 64449-A
Toluene	150	ug/L	Title 22 Table 64444-A
Total Coliform Bacteria	0.99	Count	MCL
Total Dissolved Solids	1000	mg/L	Title 22 Table 64449-B
Total Trihalomethanes	80	ug/L	MCL-US
Toxaphene	3	ug/L	Title 22 Table 64444-A
trans-1,2, Dichloroethylene	10	ug/L	Title 22 Table 64444-A
Trichlopyr	400	ug/L	HBSL
Trichloroethene (TCE)	5	ug/L	Title 22 Table 64444-A
Trichlorofluoromethane (Freon 11)	150	ug/L	Title 22 Table 64444-A
Trifluralin	20	ug/L	HBSL
Tritium	20000	pCi/L	Title 22 Table 64443
Uranium	20	pCi/L	Title 22 Table 64442
Vanadium	50	ug/L	RfD
Vinyl Chloride	0.5	ug/L	Title 22 Table 64444-A
Warfarin	2	ug/L	HBSL
Xylene, Isomers m & p	1750	ug/L	Title 22 Table 64444-A
Xylenes (total)	1750	ug/L	Title 22 Table 64444-A
Zinc	5	mg/L	Title 22 Table 64449-A

Rank	Comparison Concentration	Description
1	Basin Plan/Title 22	Basin Plan Groundwater Requirements in Table 3-1 and specific Title 22 tables
2	MCL-CA	California drinking water maximum contaminant level
3	MCL-US	Federal drinking water maximum contaminant level
4	AL-US	Federal Action Level
5	HBSL	Cancer or non-cancer Health Based Screening Level
6	HHBP	Chronic non-cancer Human Health Benchmark for Pesticides
7	US-HAL	Federal Health Advisory Level
8	RfD	Reference Dose as a drinking water level
9	NAS-HAL	National Academy of Science Health Advisory Level
10	CA-CPF	California Cancer Potency Factor
11	CA-Prop. 65	California Proposition 65 Safe Harbor Levels as a drinking water level
12	SMCL	Secondary MCL
13	NL	Notification Level

Calculations

Specific water quality objectives for the Shasta Valley hydrologic area groundwaters, as defined in the Basin Plan, have specific limits and calculation requirements associated with specific conductance, hardness and boron. Per the Basin Plan, the 50% upper limit and 90% upper limit are defined as follows:

- 50% upper limits represent “the 50 percentile values of the monthly means for a calendar year. 50% or more of the monthly means must be less than or equal to an upper limit and greater”

- 90% upper limits represent “the 90 percentile values for a calendar year. 90% or more of the values must be equal to an upper limit and greater than or equal to a lower limit.”

The monthly means of specific conductance and boron measurements were compared to the 50% and 90% upper limits.

Filtering Process

To analyze groundwater quality, several filters were applied for relevance and quality. Though groundwater quality data for the Basin is available from the 1950s, data was limited to only include information collected in the past 30 years. Restricting the timespan from which data was collected increases confidence in data collection methods and quality of the data and focuses on information that is reflective of current groundwater quality conditions.

Groundwater quality for each constituent was analyzed by comparing the well data to the corresponding comparison concentration. Maps showing the location of wells where samples were collected were generated for each constituent. The maximum concentration sampled at each well is displayed on the map as one of the following groups:

a) Not detected
b) Detected but below half of the comparison concentration
c) Detected and above half of the comparison concentration
d) Above the comparison concentration

The number of samples in each category is displayed in the map's legend. Two iterations of map generation were conducted with the following scenarios:

1. Data is limited to those collected in the past 30 years only (1990-2020)
2. Data is limited to wells that have more than one data point in the past 30 years (1990-2020)

For the second scenario, where data is limited to wells that have more than one data point in the past 30 years, timeseries are generated for each constituent and well to identify changes over time in groundwater quality at a location.

The following sections contain the maps produced from these analyses.

Results

Constituents of Concern (COCs)

Constituents of Concern (COCs) were identified based on visual identification of potential groundwater quality issues using the maps generated in this assessment, identification of common constituents of concern, and through discussion with stakeholders. Resulting from this analysis and discussion with stakeholders, the full list of constituents of concern (COCs) were:

1. Arsenic
2. Boron
3. Benzene
4. Iron
5. Manganese
6. Nitrate as N
7. pH
8. Specific Conductivity

A series of maps for each COC, with water quality data from the past 30 years (1990-2020), show the location of tested wells and whether the maximum concentration ever recorded in that well has exceeded the MCL. In Shasta Valley, the water quality source database categorized some wells as either municipal or monitoring. Municipal wells are a public supply well, typically related to a city or town. Monitoring wells are used for monitoring groundwater, such as for site cleanup programs or Irrigated Lands Regulatory Program. Time series graphs included in this section plot the concentration of the COC versus time for applicable wells. For easy visual assessment, each graph only includes seven wells. Multiple graphs were created for each constituent and are arranged from the maximum sampled concentration in each well, to the lowest.

Figure 1 shows all wells that have been tested for Total Arsenic, even if only one monitoring event has occurred. Figure 2 filters the wells for those with two or more monitoring events. In the past 30 years, two wells near Edgewood and one near Grenada had high concentrations. Timeseries of wells in Figure 2 show that wells with high arsenic have not been sampled since 2012 (Figure 3 to Figure 7). The municipal well east of Grenada has elevated but declining arsenic. The remaining wells have low arsenic or non-detect.

The majority of boron water quality data in Shasta Valley is only the dissolved fraction while water quality regulations refer to the total fraction. Total boron can be greater or equal to dissolved boron. Therefore the following boron graphs are conservative. Figure 8 shows a number of high dissolved boron wells, though many of these wells have only one monitoring event and a trend analysis cannot be completed. Figure 9 has seventeen boron wells available for trend analysis. The three wells with high boron have not been sampled since 2011 and two have decreasing concentrations (Figure 10 to Figure 12). The remaining wells have low boron.

High benzene in Shasta Valley is associated with cleanup sites near Yreka and Carrick (Figure 13 and Figure 14). Trend analysis show that benzene concentrations have remained steady or are decreasing over time (Figure 15 to Figure 18).

High iron is detected in the east side of the valley, east of Grenada and Gazelle (Figure 19). Trend analysis is only completed for wells shown in Figure 20. Trend analysis shows low iron for all wells since 1991 (Figure 21 to Figure 24).

High manganese occurs in selected wells through most of Shasta Valley (Figure 25. Trend analysis is completed for wells in Figure 26, similar to iron, the analysis shows low manganese for all wells since 1991 (Figure 27 to Figure 30).

High nitrate only occurs in a few wells in Montague and Grenada (Figure 31 and Figure 32). In wells with elevated nitrate, trend analysis show that nitrate has been generally decreasing or steady through time (Figure 33). Well 45N06W27D002M in Montague has high nitrate but was only sampled twice. Wells with low nitrate have generally maintained steady levels (Figure 34 and Figure 37).

Shasta Valley has limited pH data, with most data outside the limits set by the Basin Plan (Figure 38 and Figure 39). Trend analysis of two wells show pH that is slightly more basic than the Basin Plan limits (Figure 40).

Specific conductivity is elevated in the central portion of Shasta Valley (Figure 41). Trend analysis conducted on wells in Figure 42 shows that wells with high specific conductivity have not been sampled since 2011 (Figure 43 and Figure 46).

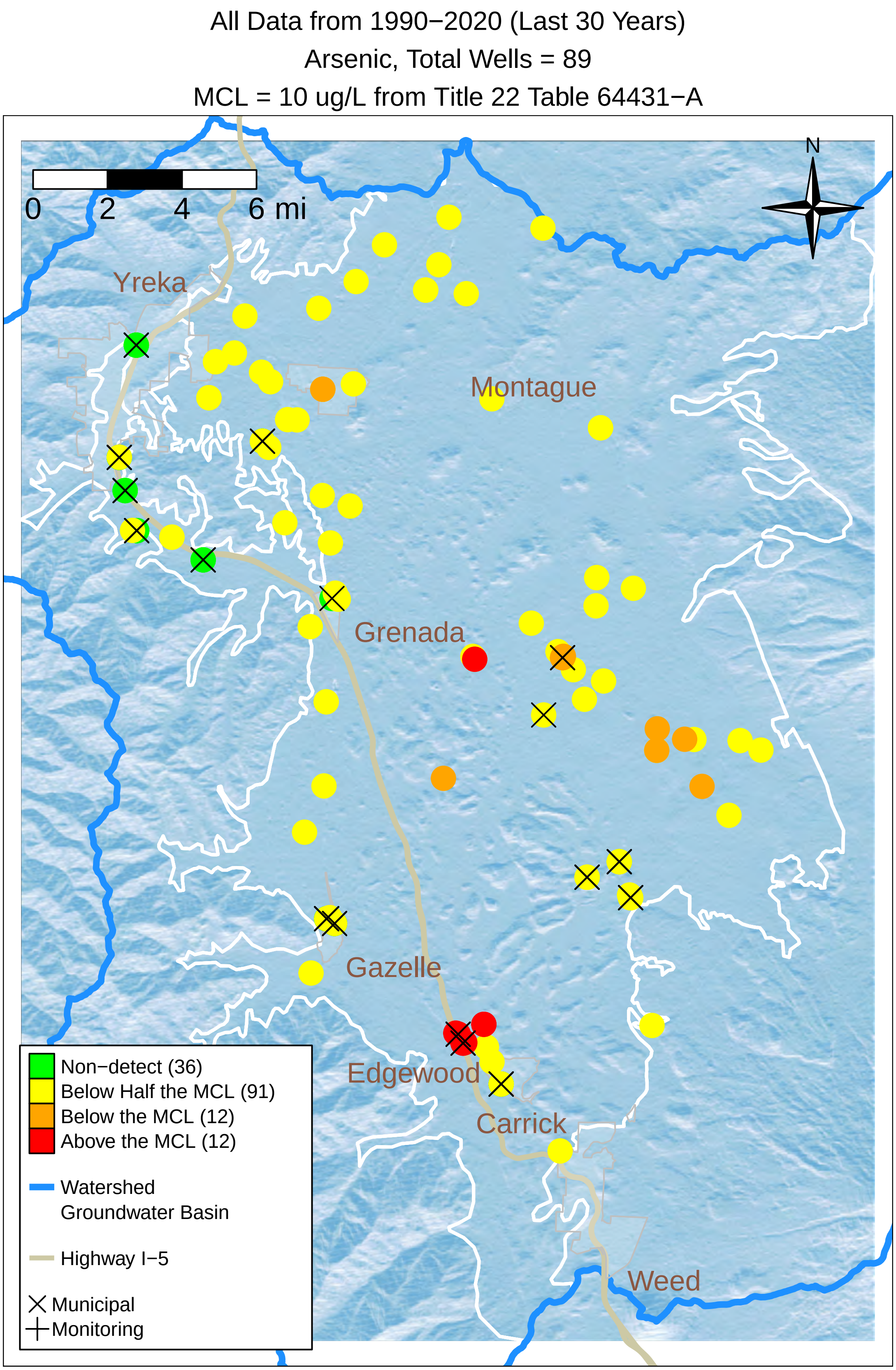


Figure 1: Groundwater Quality Observations of the Constituent Short List

Wells with two or more monitoring events, from 1990−2020 (Last 30 Years)
Arsenic, Total Wells = 29
MCL = 10 ug/L from Title 22 Table 64431−A

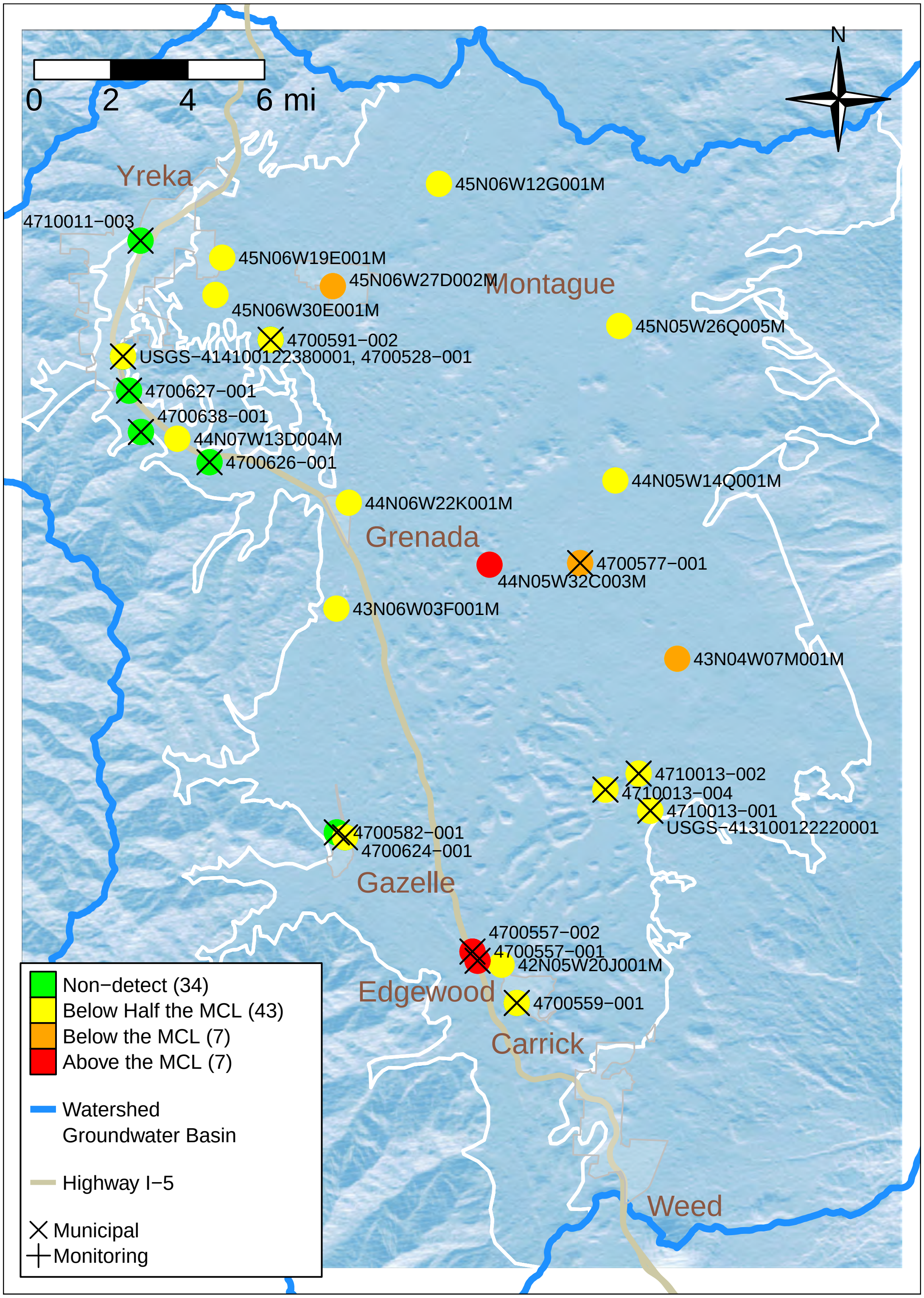


Figure 2: Filtered Groundwater Quality Observations of the Constituent Short List

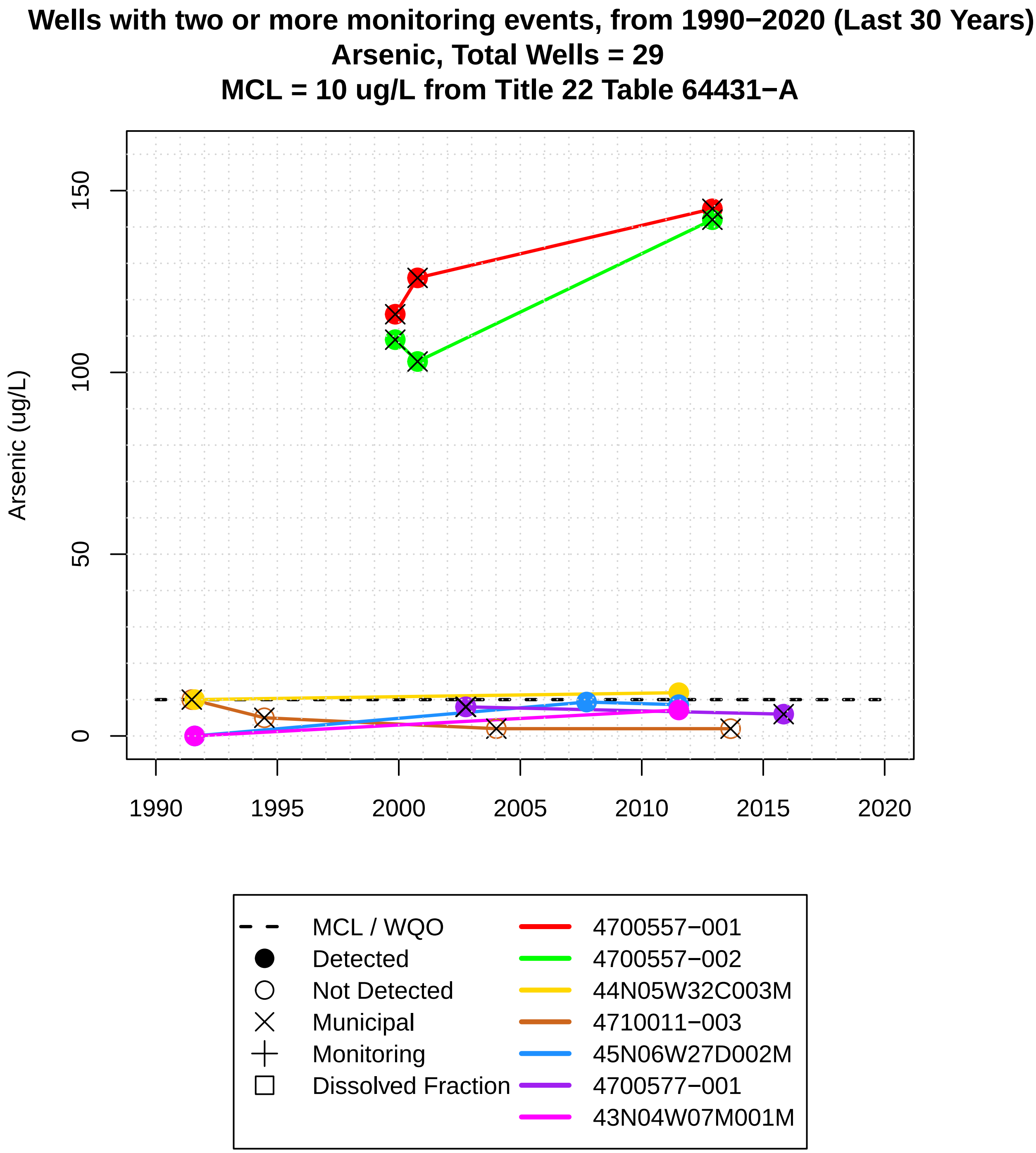


Figure 3: Filtered Groundwater Quality Observations of the Constituent Short List

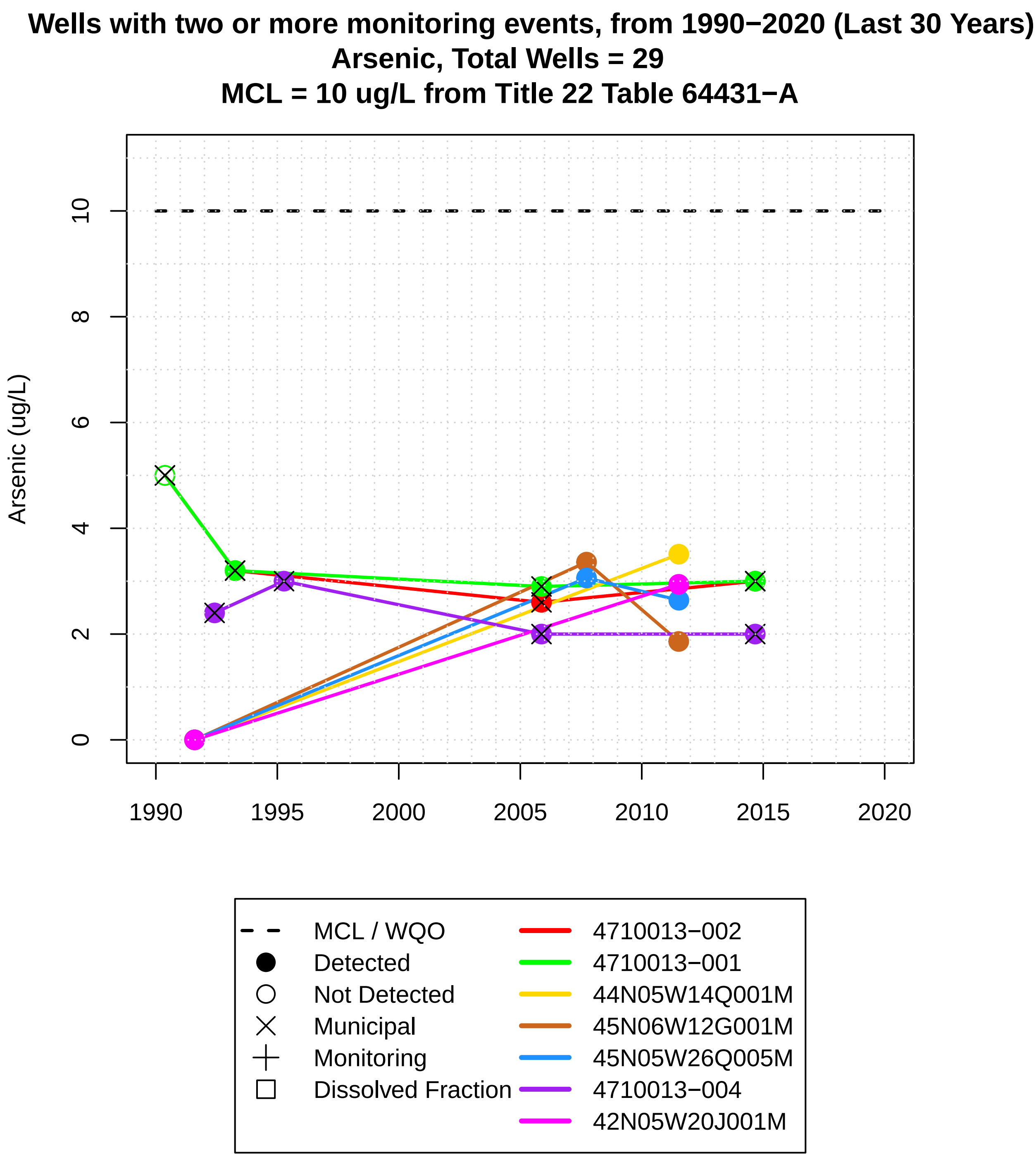


Figure 4: Filtered Groundwater Quality Observations of the Constituent Short List

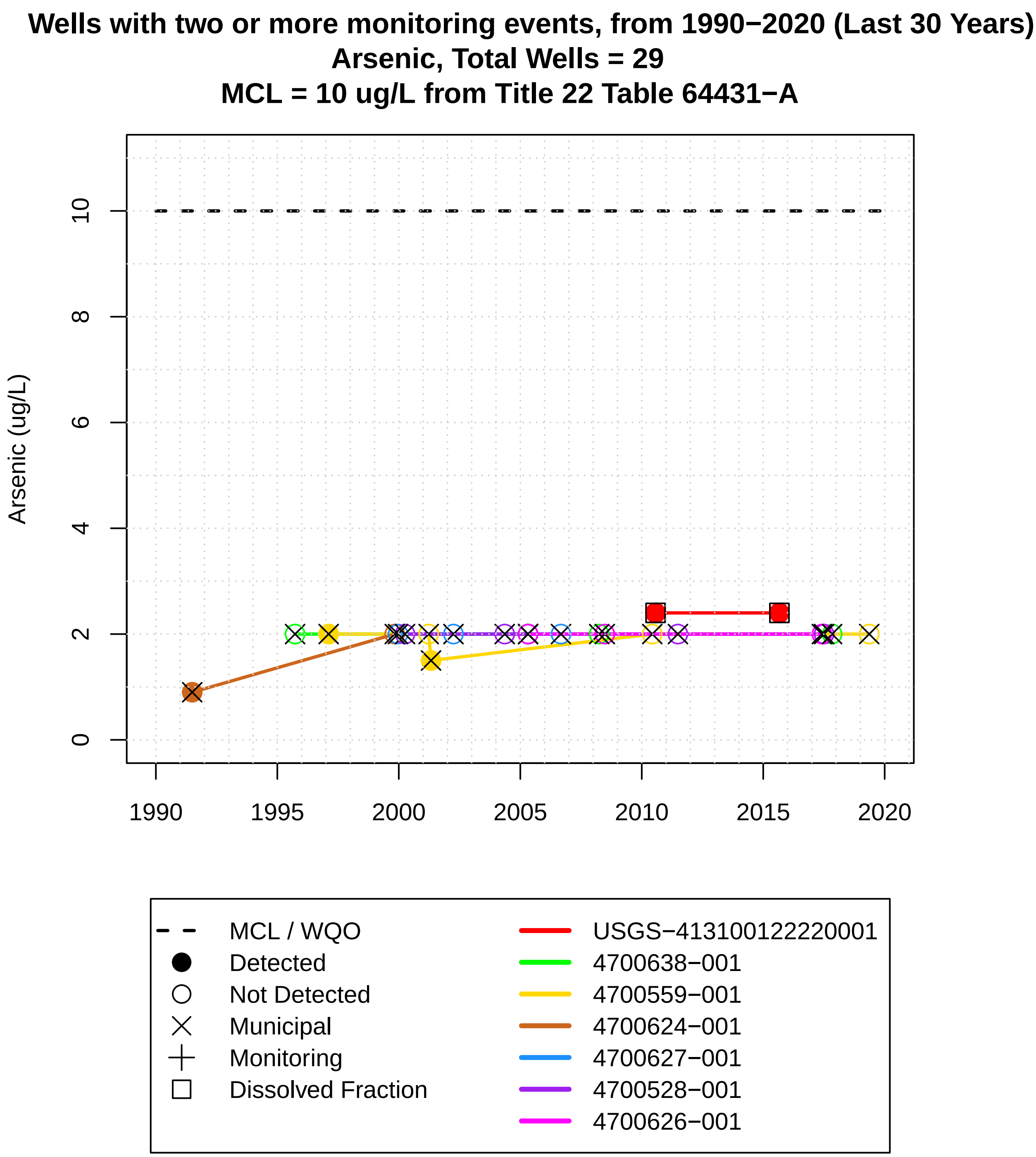


Figure 5: Filtered Groundwater Quality Observations of the Constituent Short List

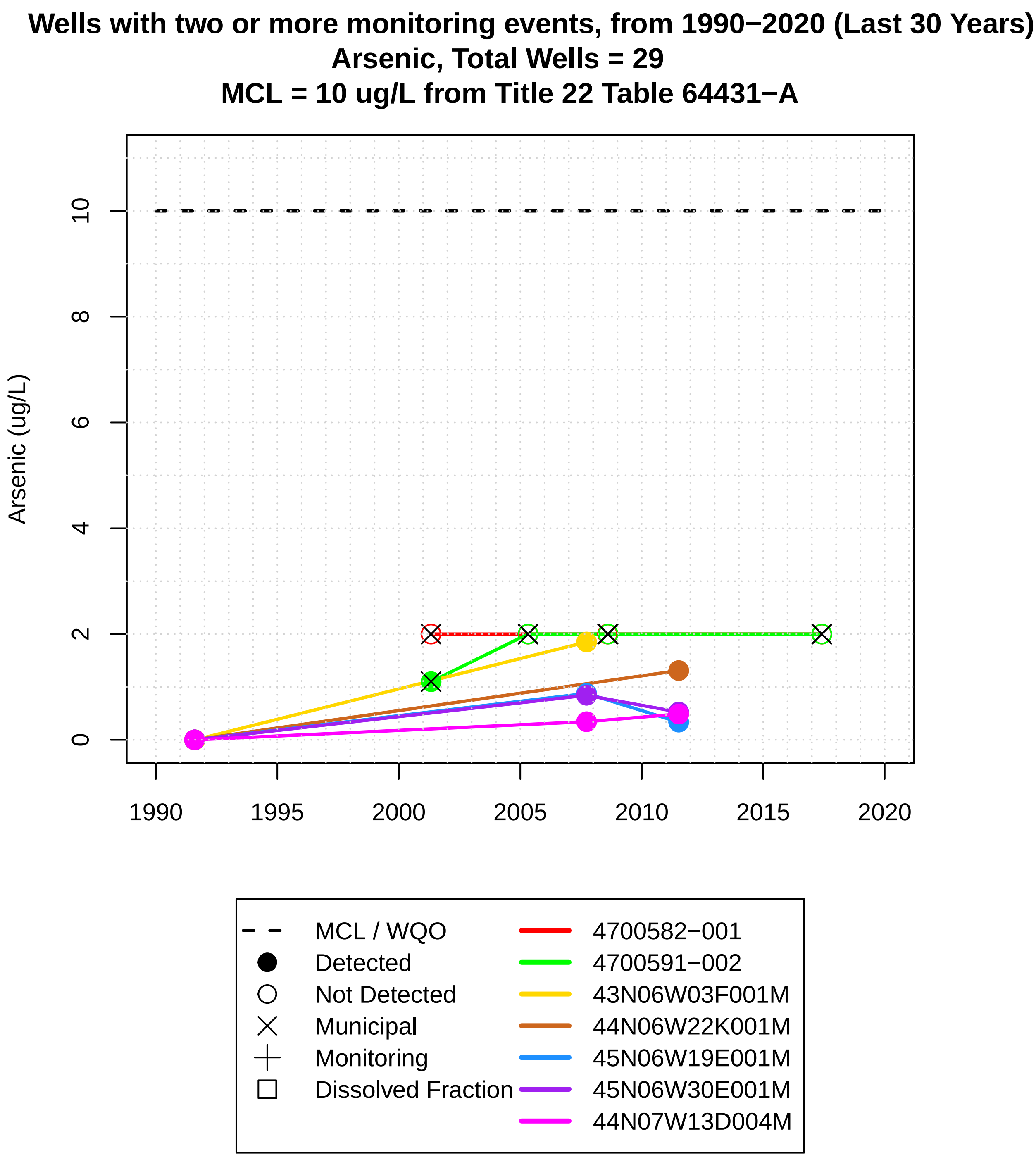


Figure 6: Filtered Groundwater Quality Observations of the Constituent Short List

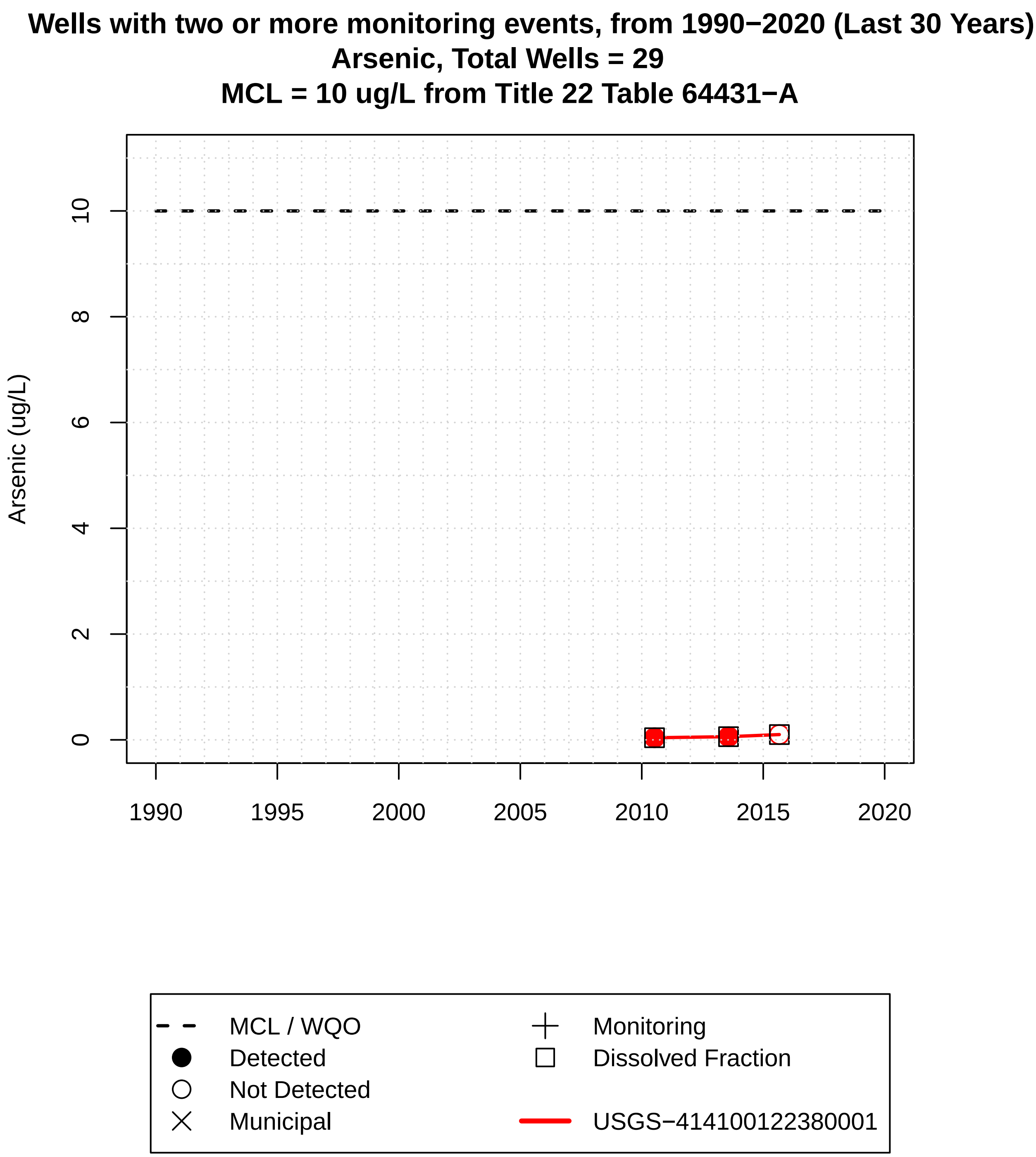


Figure 7: Filtered Groundwater Quality Observations of the Constituent Short List

All Data from 1990−2020 (Last 30 Years)
Boron, Total Wells = 77
WQO = 0.3 (50% UL), 1.0 (90% UL) mg/L from Basin Plan Table 3−1

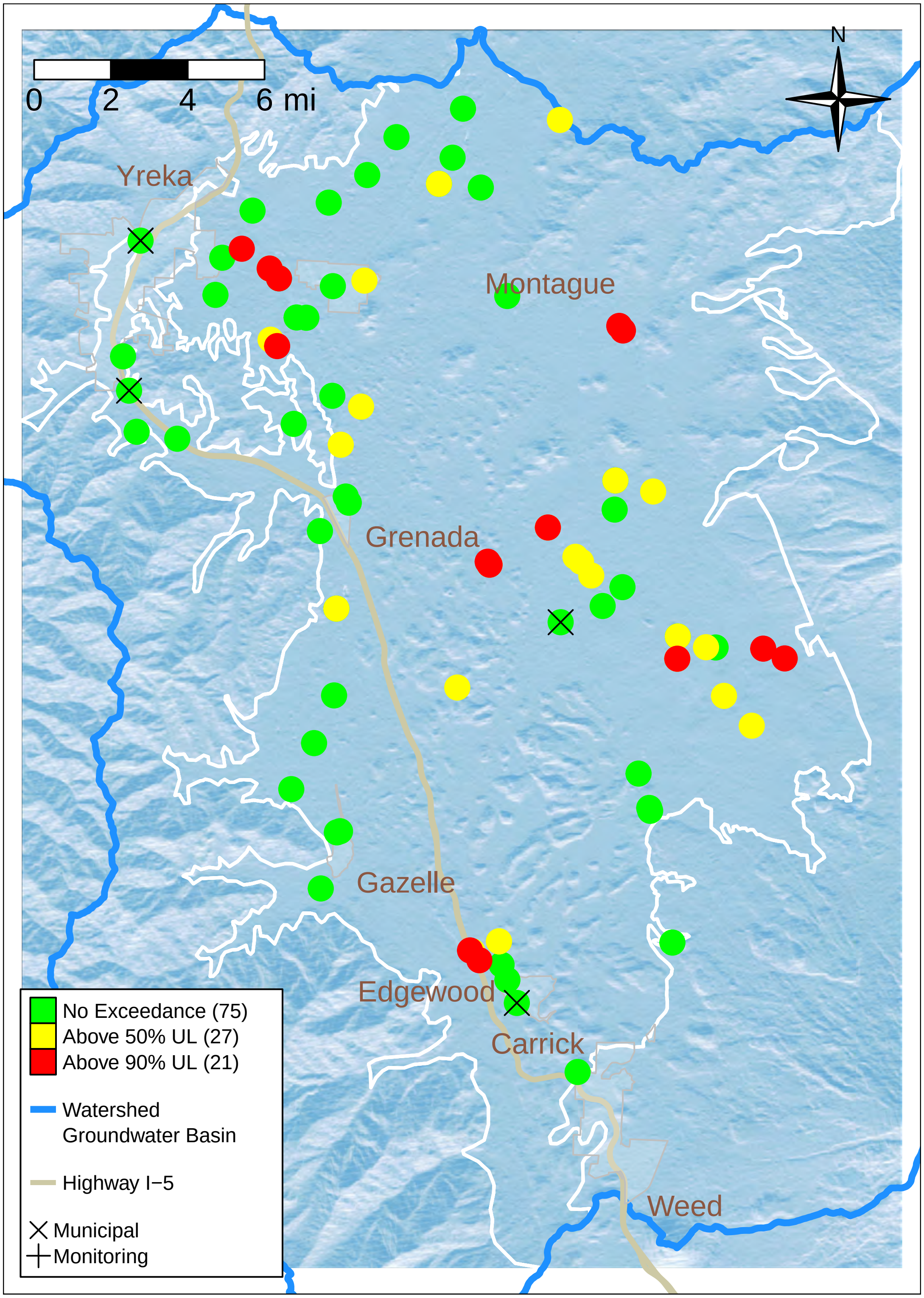


Figure 8: Groundwater Quality Observations of the Constituent Short List

Wells with two or more monitoring events, from 1990−2020 (Last 30 Years)
Boron, Total Wells = 17
WQO = 0.3 (50% UL), 1.0 (90% UL) mg/L from Basin Plan Table 3−1

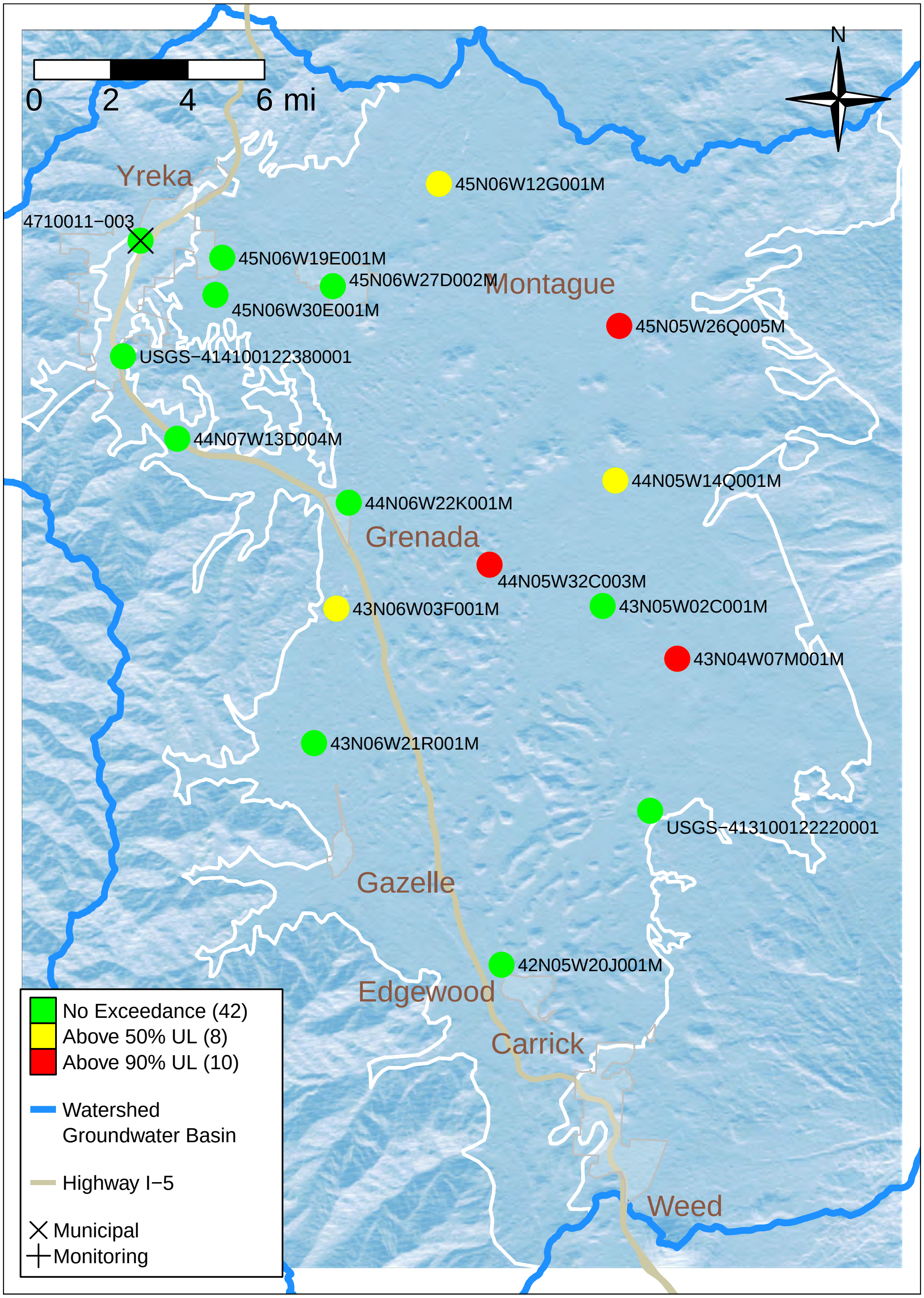


Figure 9: Filtered Groundwater Quality Observations of the Constituent Short List

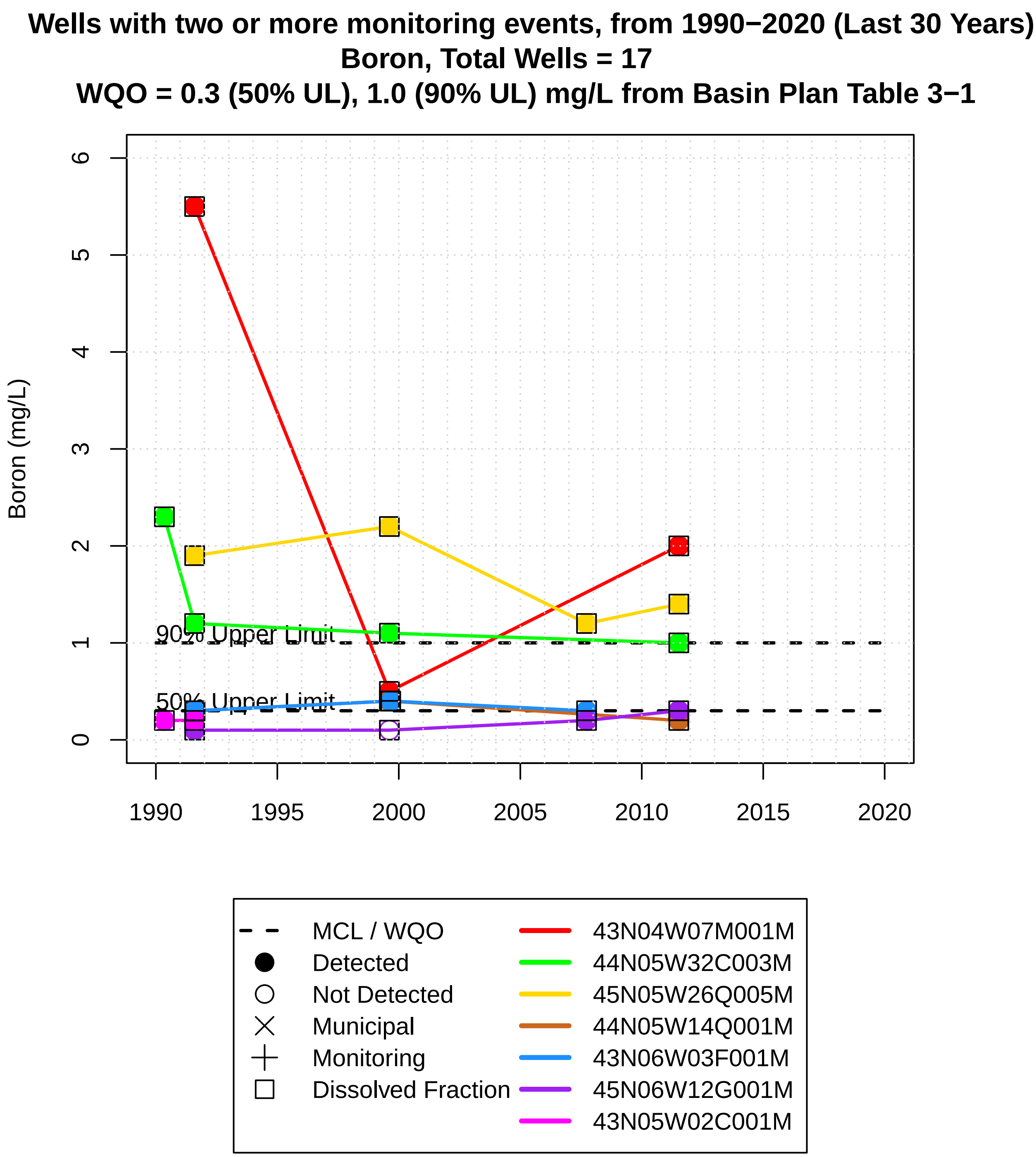


Figure 10: Filtered Groundwater Quality Observations of the Constituent Short List

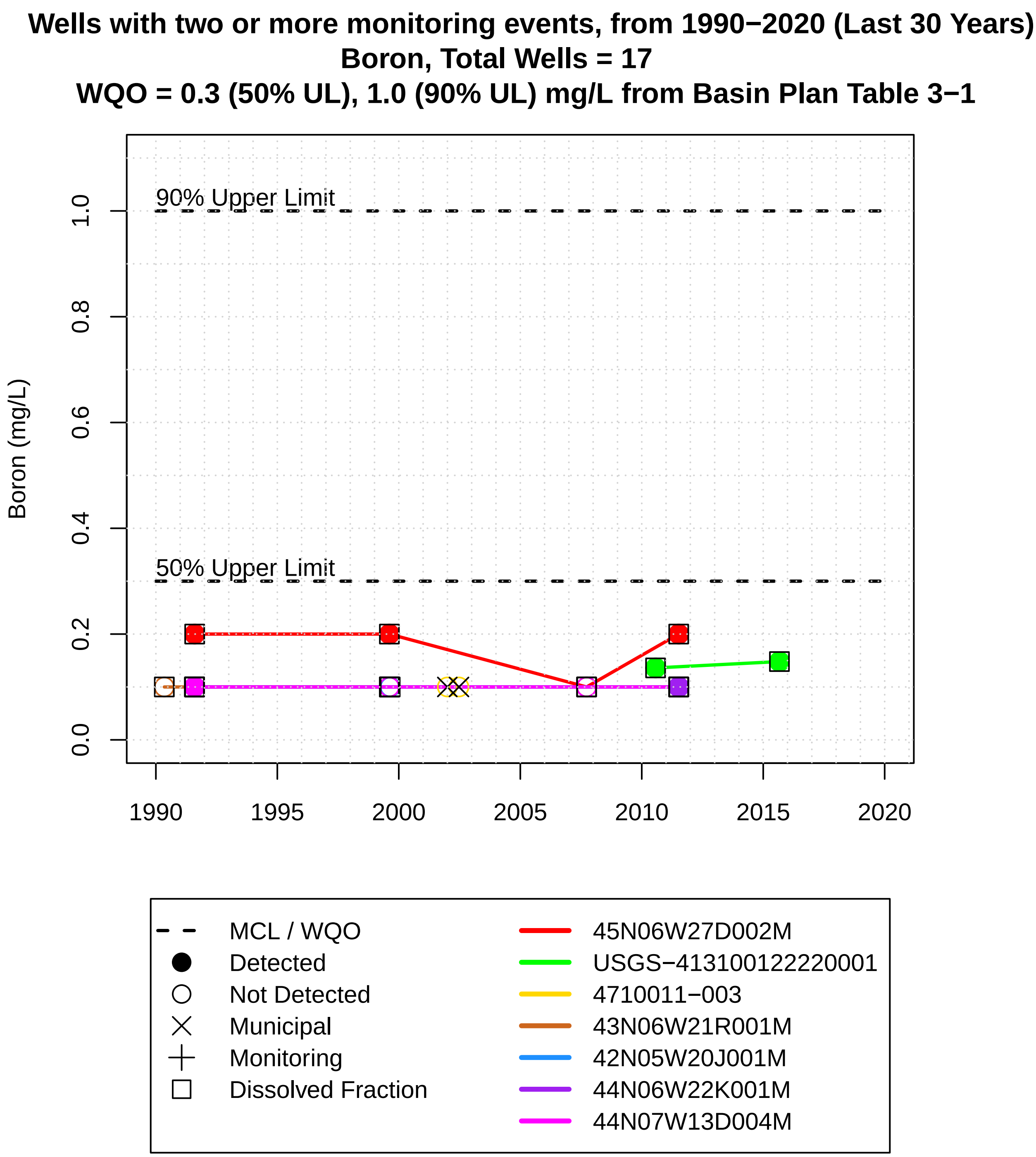


Figure 11: Filtered Groundwater Quality Observations of the Constituent Short List

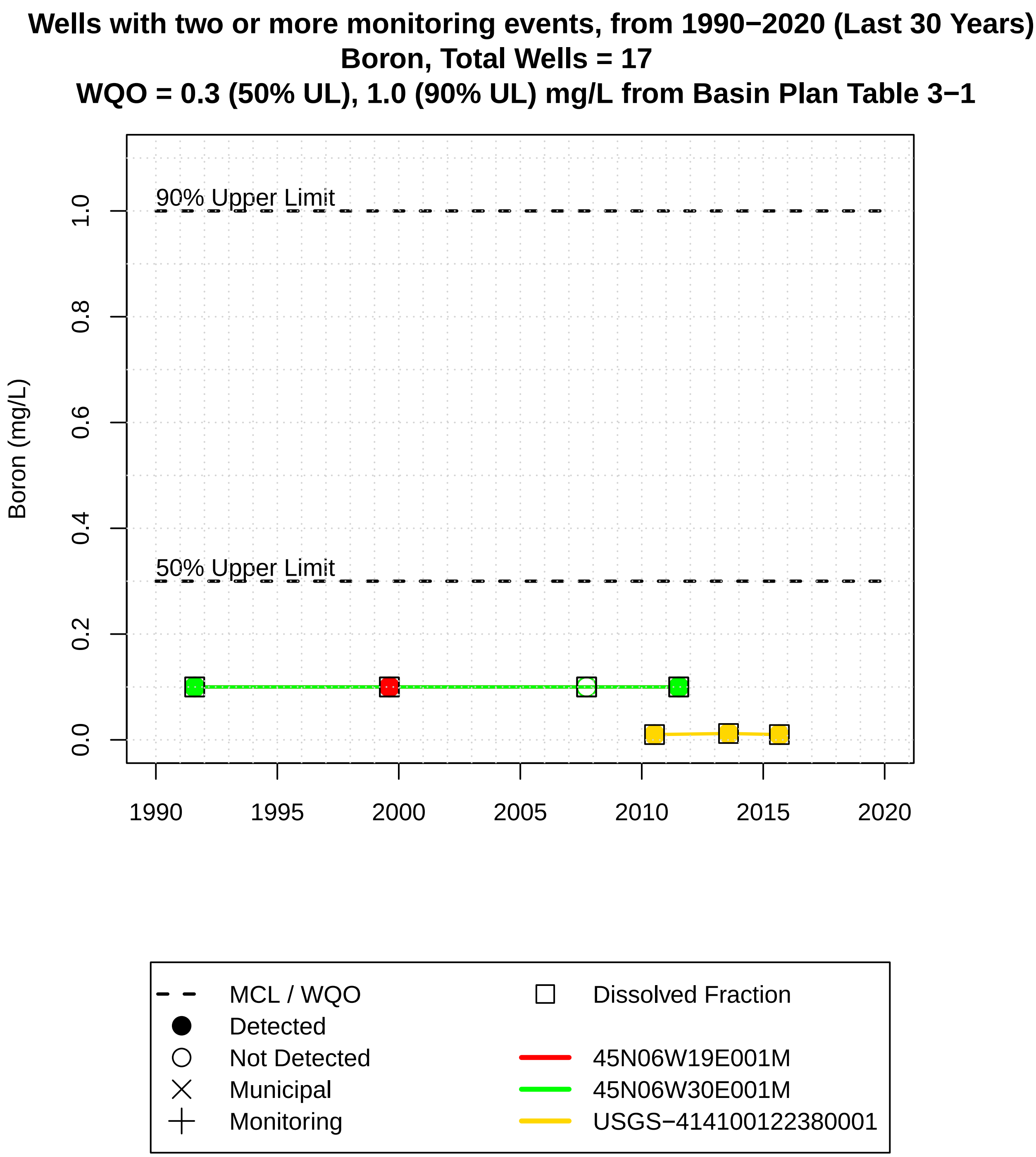


Figure 12: Filtered Groundwater Quality Observations of the Constituent Short List

All Data from 1990−2020 (Last 30 Years)
Benzene, Total Wells = 77
MCL = 1 ug/L from Title 22 Table 64444−A

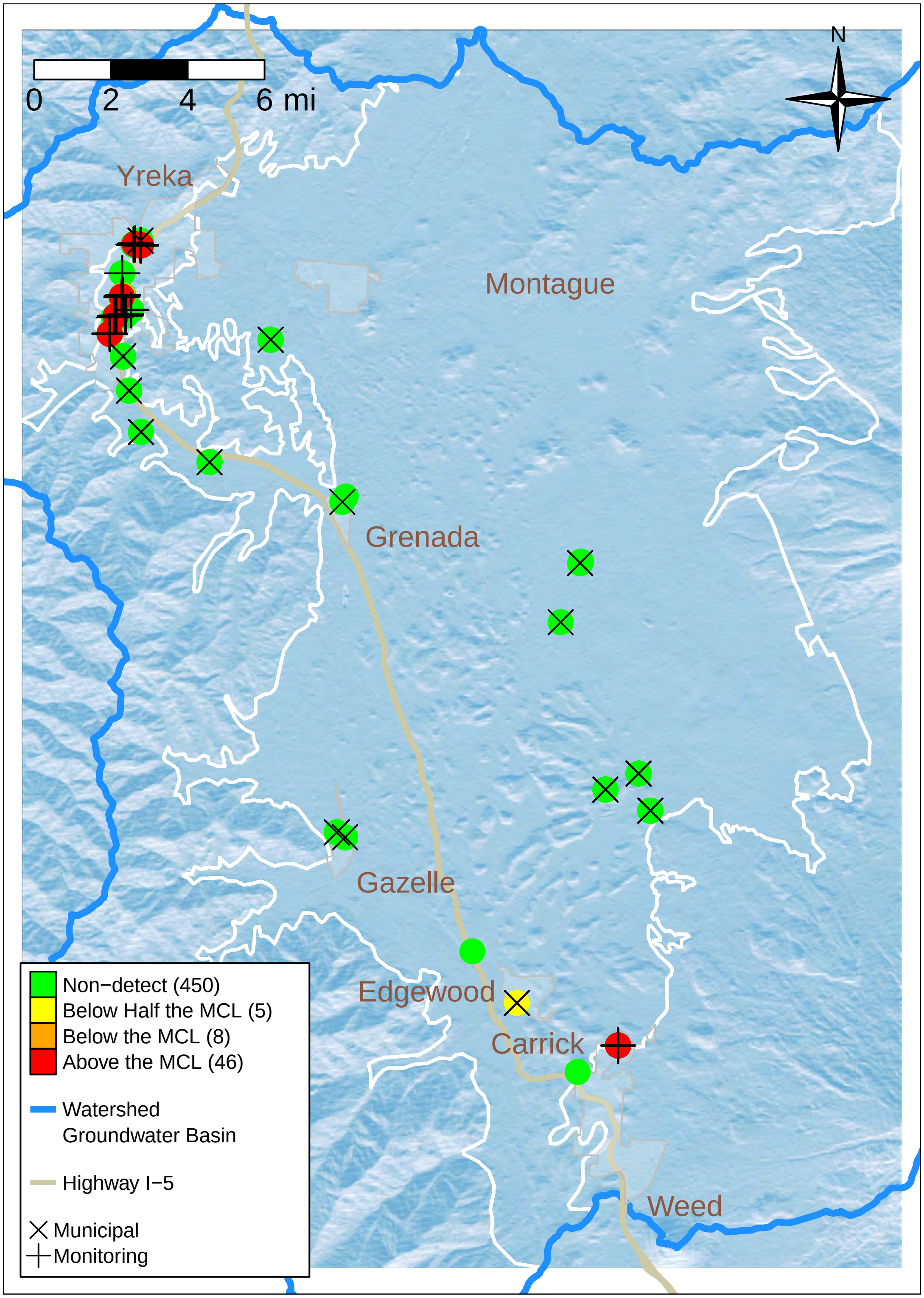


Figure 13: Groundwater Quality Observations of the Constituent Short List

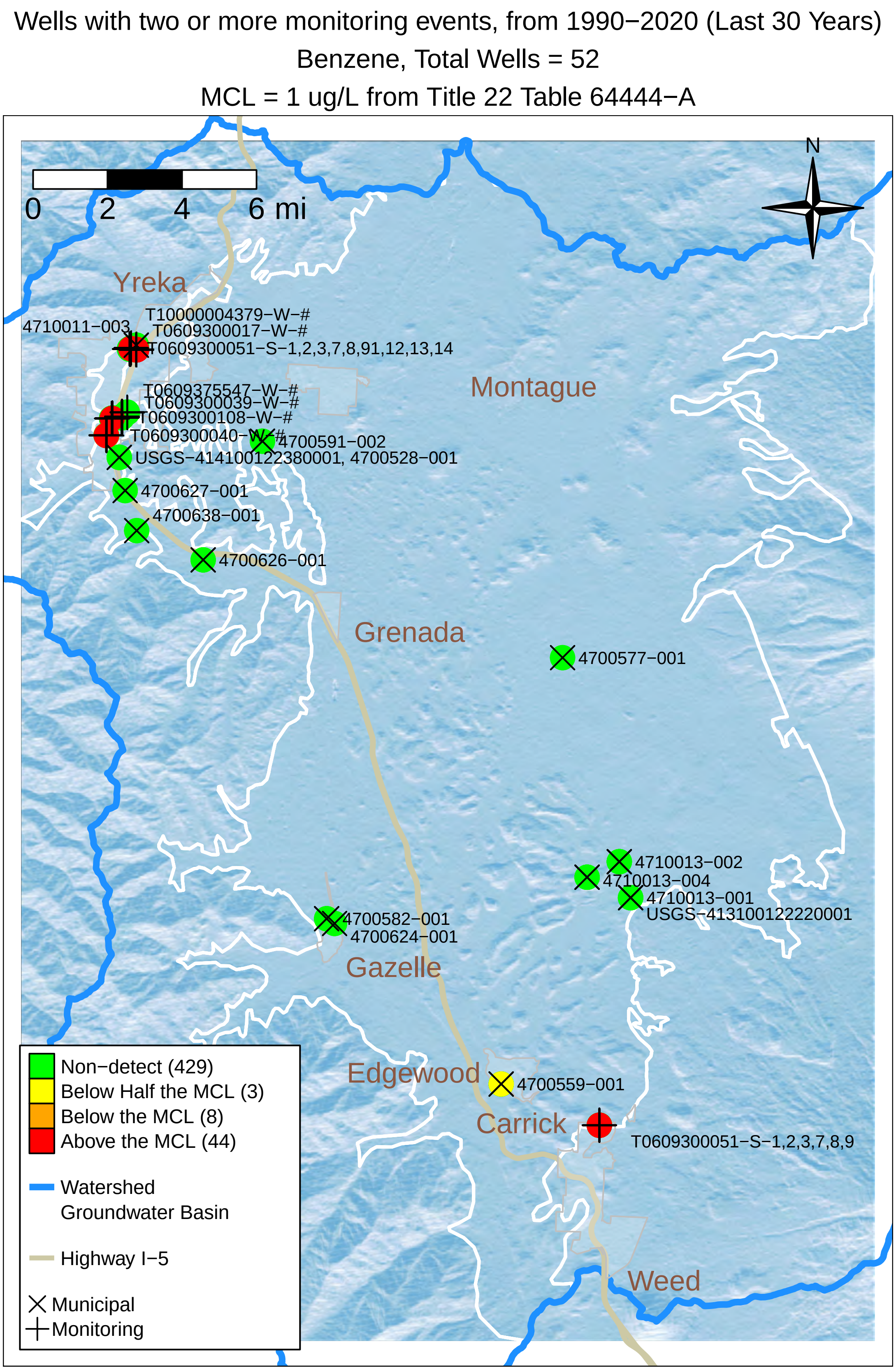


Figure 14: Filtered Groundwater Quality Observations of the Constituent Short List

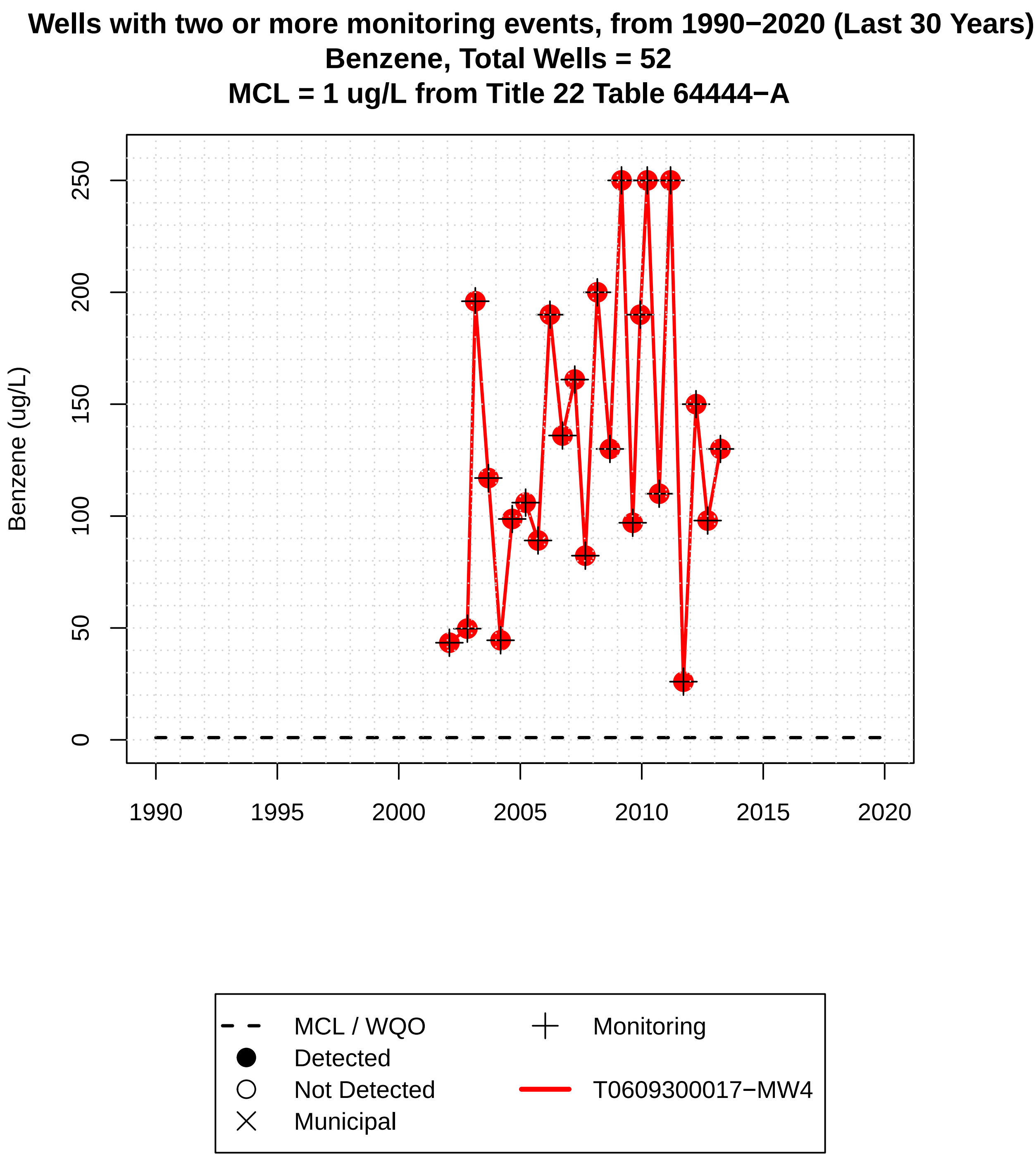


Figure 15: Filtered Groundwater Quality Observations of the Constituent Short List

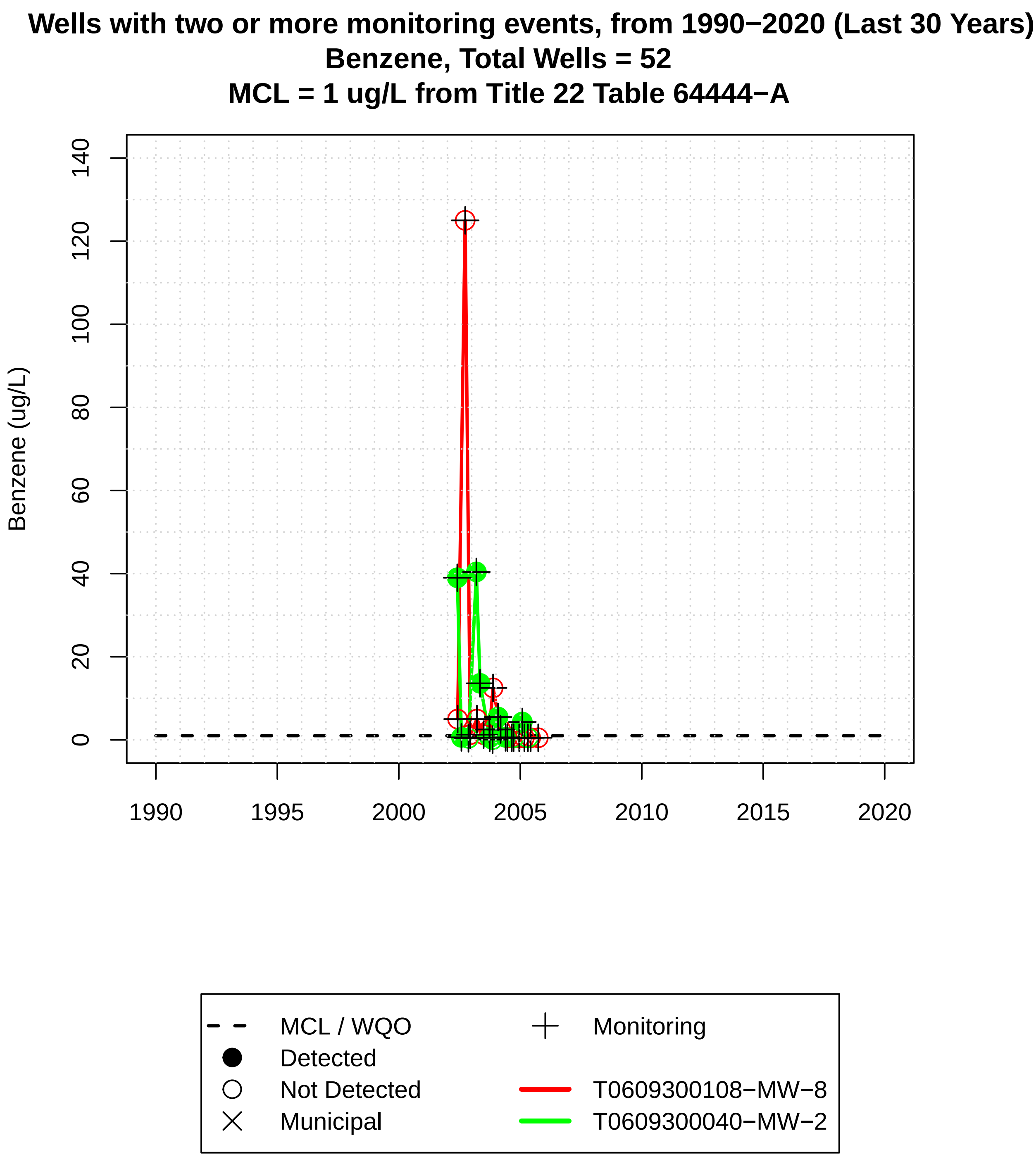


Figure 16: Filtered Groundwater Quality Observations of the Constituent Short List

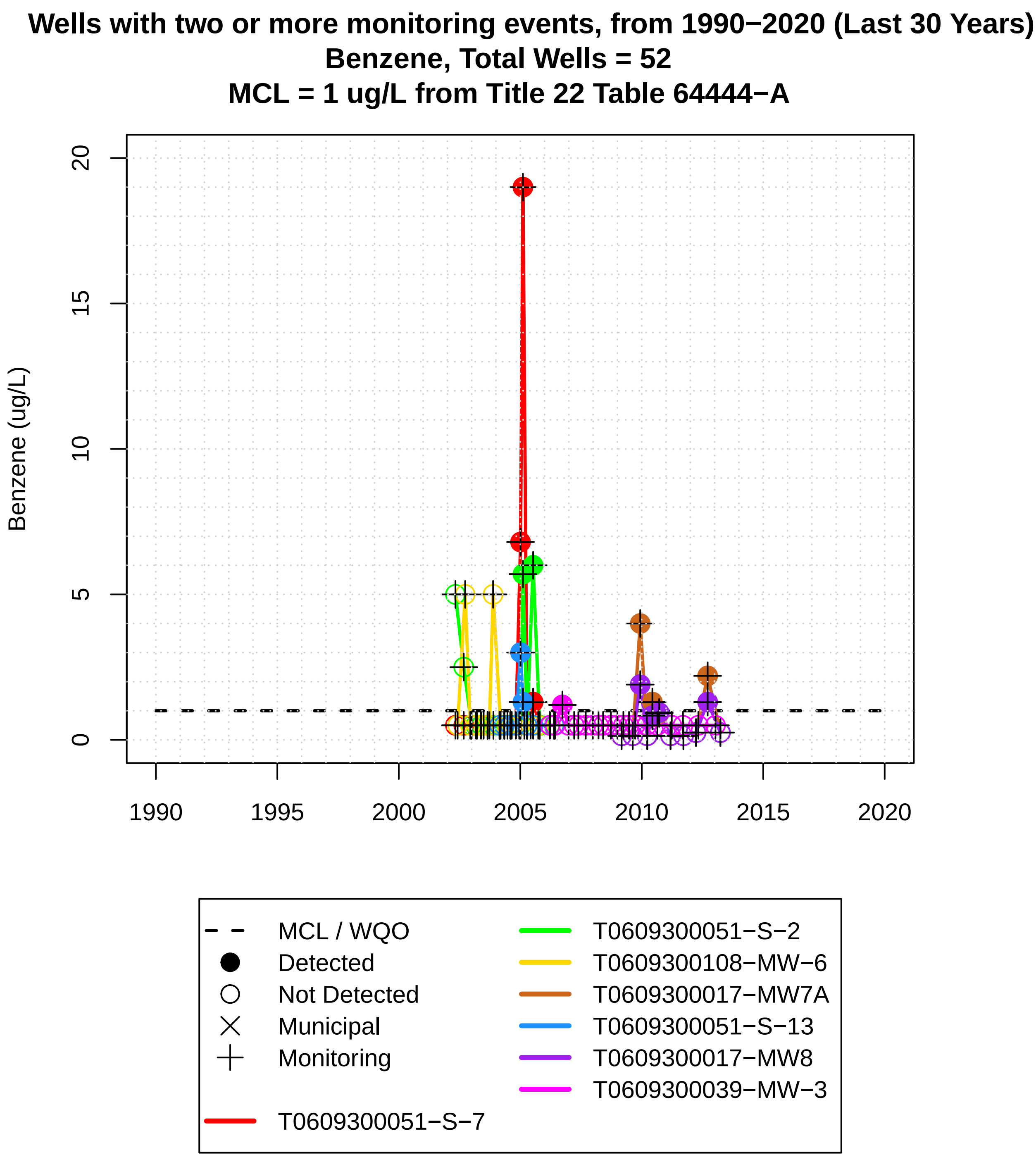


Figure 17: Filtered Groundwater Quality Observations of the Constituent Short List

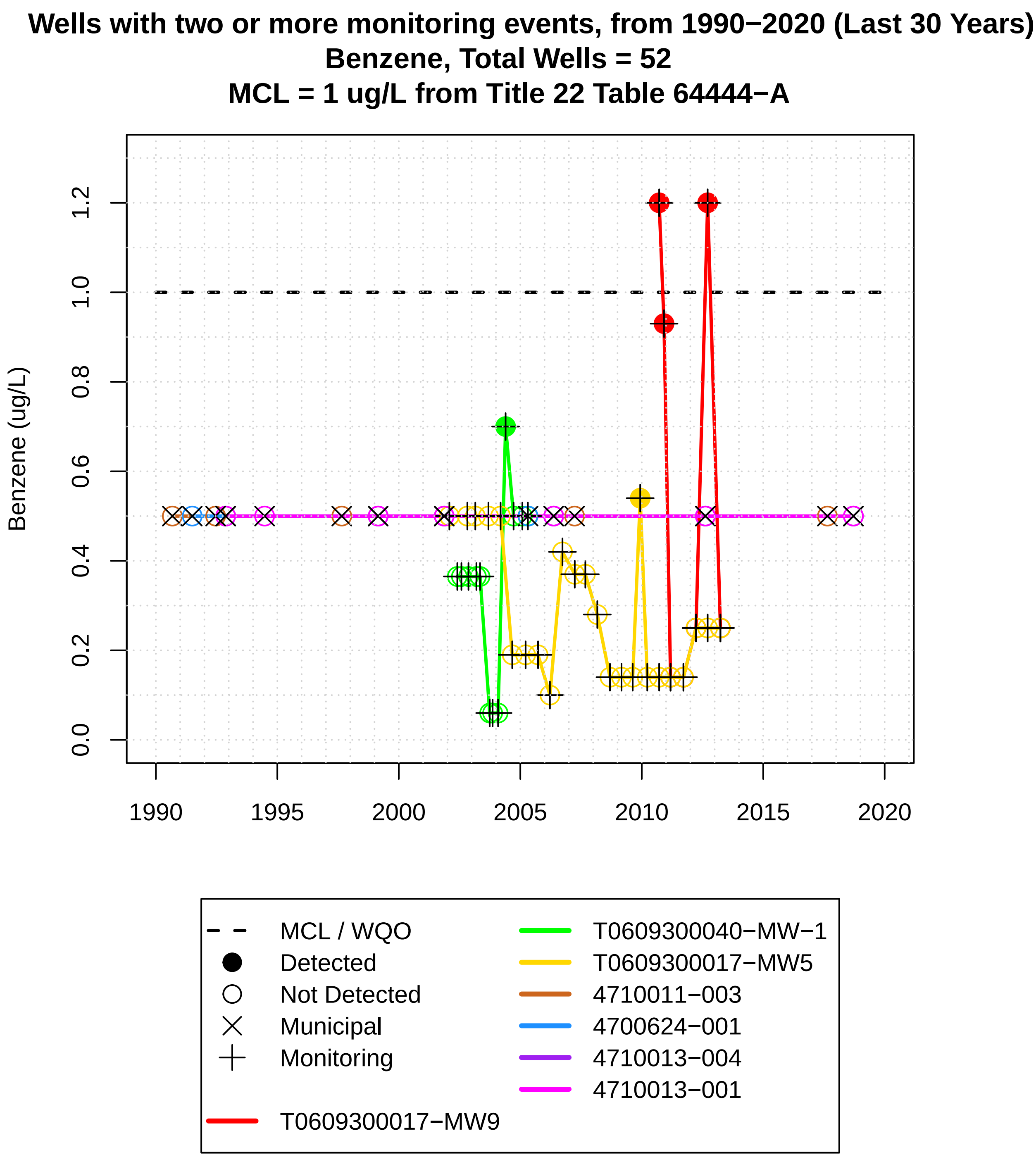


Figure 18: Filtered Groundwater Quality Observations of the Constituent Short List

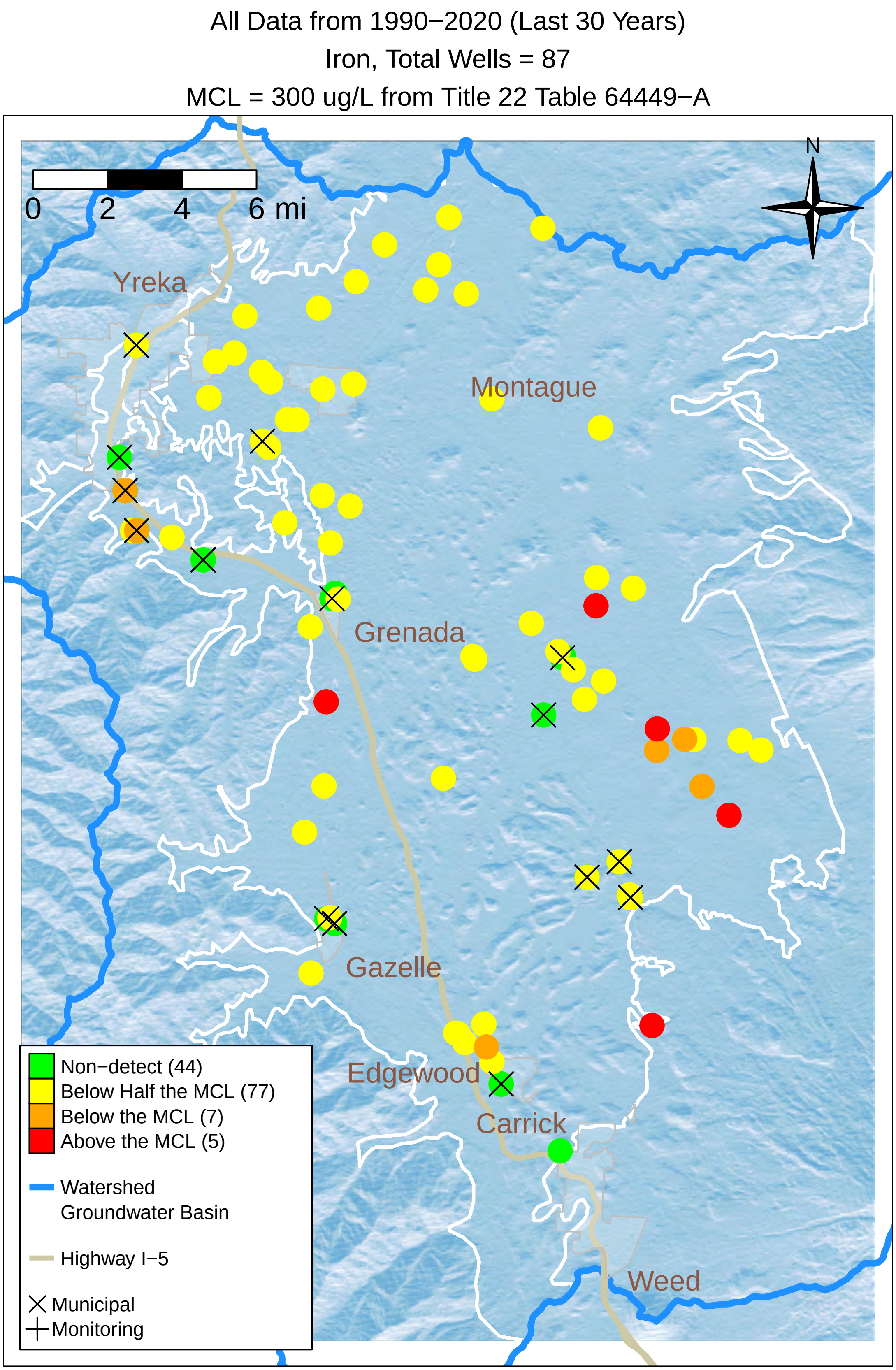


Figure 19: Groundwater Quality Observations of the Constituent Short List

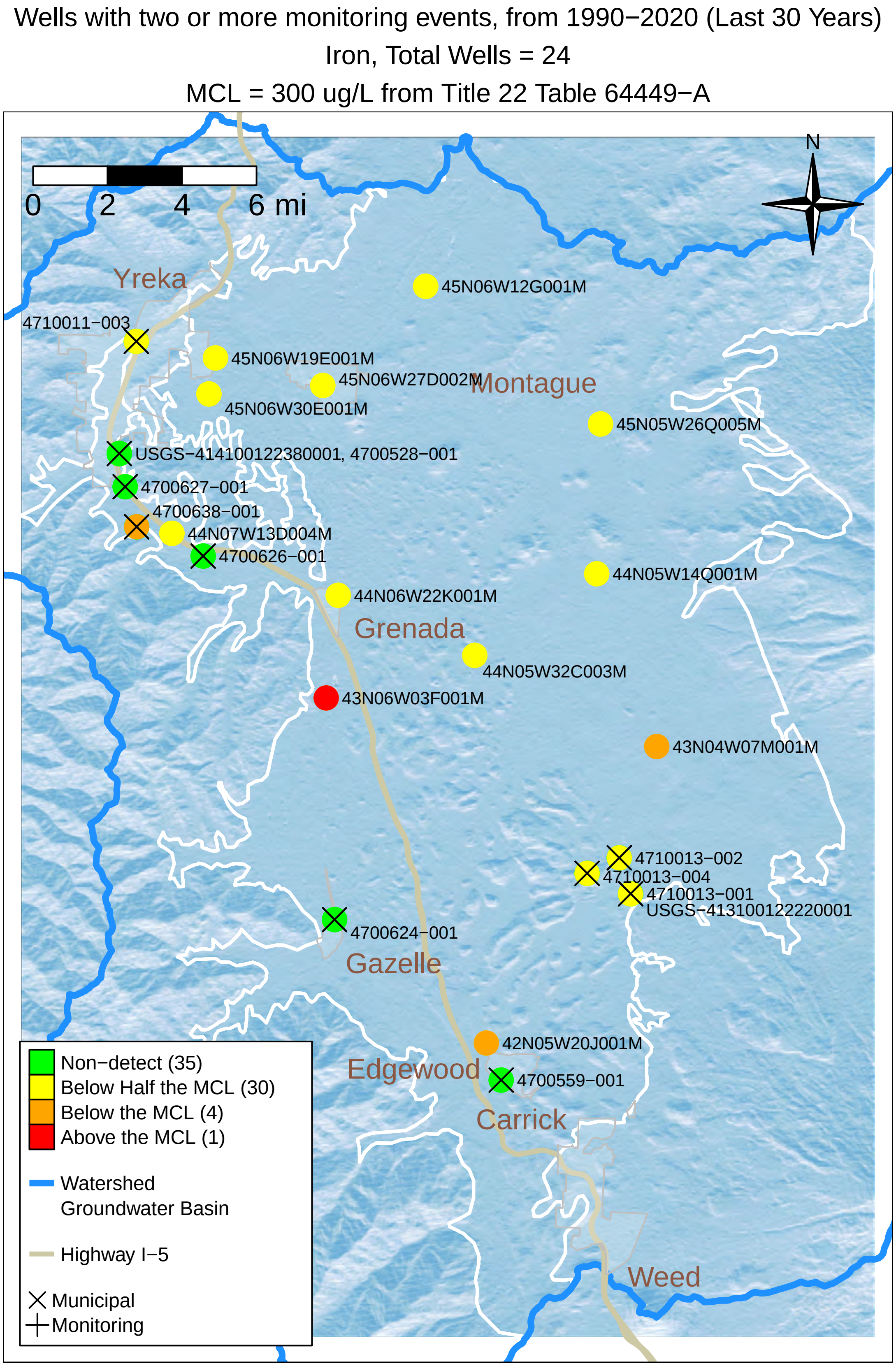


Figure 20: Filtered Groundwater Quality Observations of the Constituent Short List

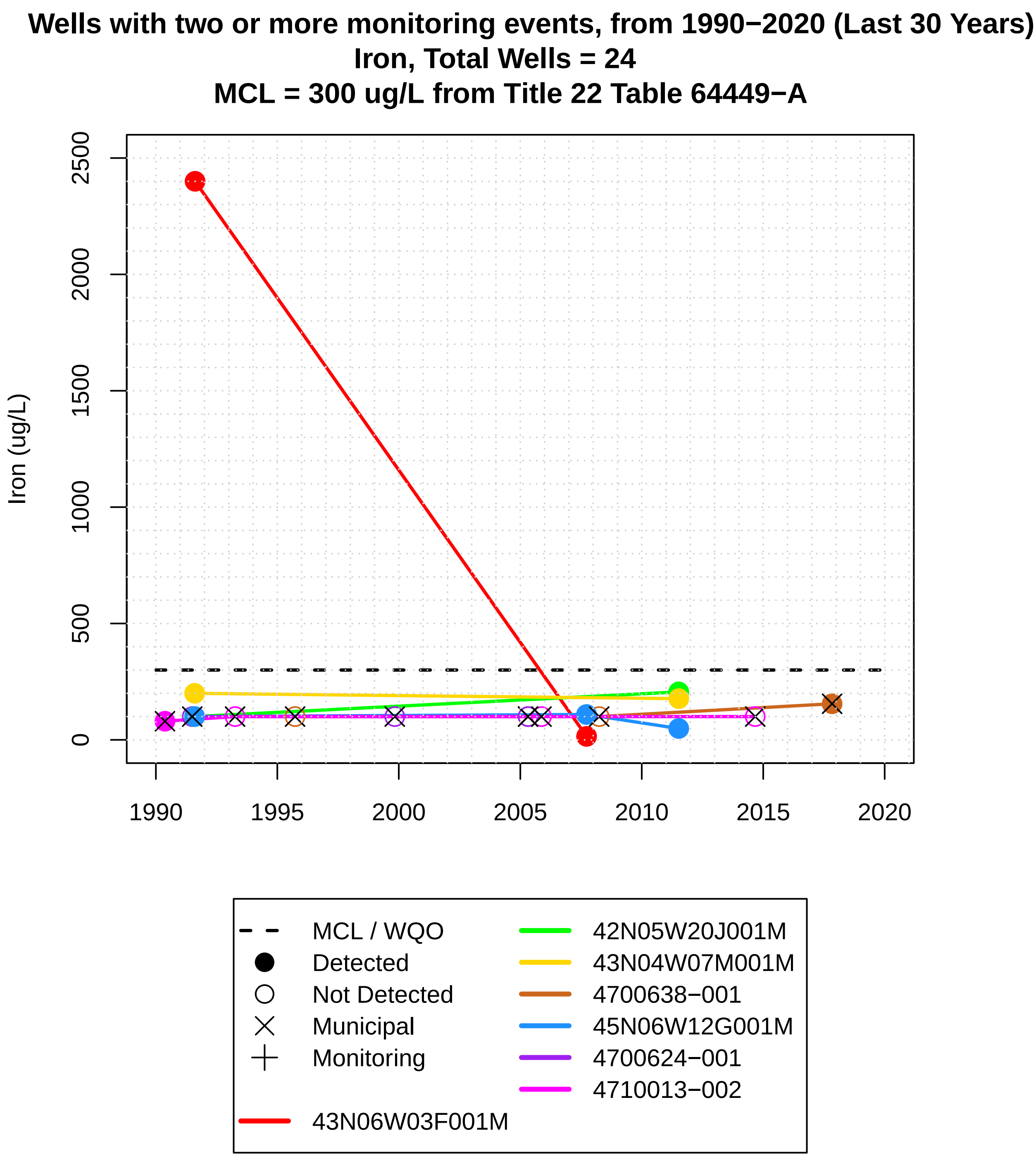


Figure 21: Filtered Groundwater Quality Observations of the Constituent Short List

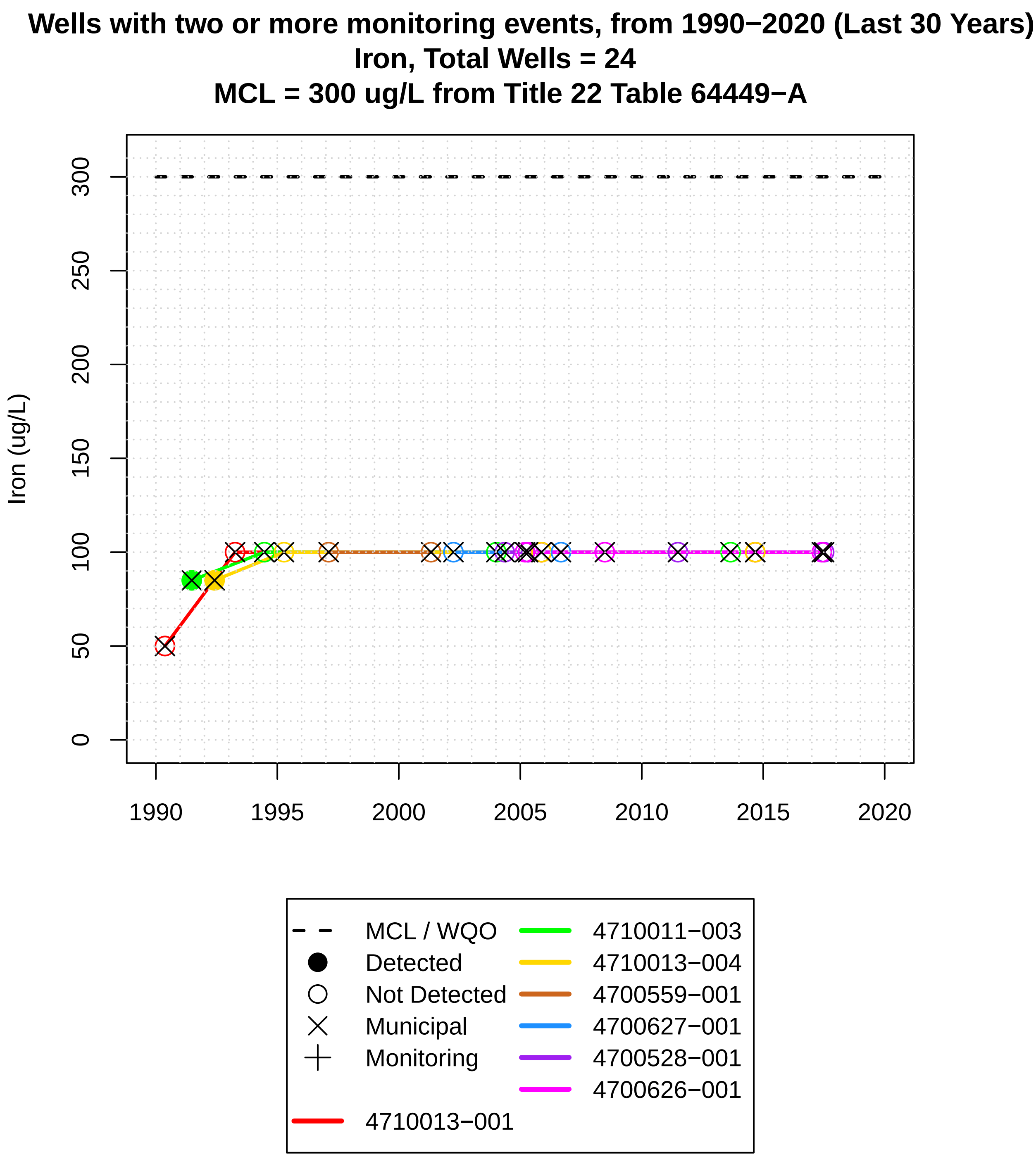


Figure 22: Filtered Groundwater Quality Observations of the Constituent Short List

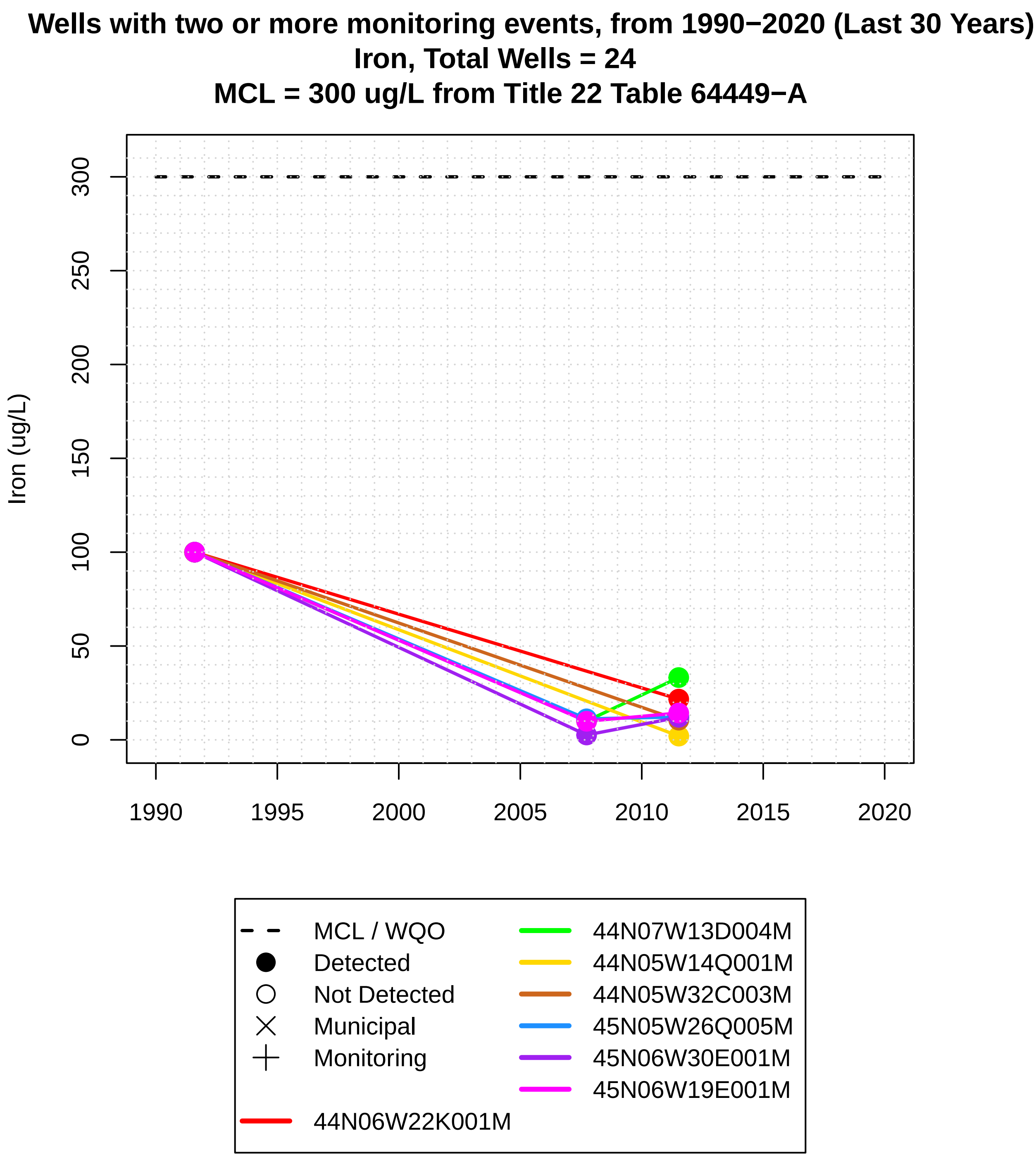


Figure 23: Filtered Groundwater Quality Observations of the Constituent Short List

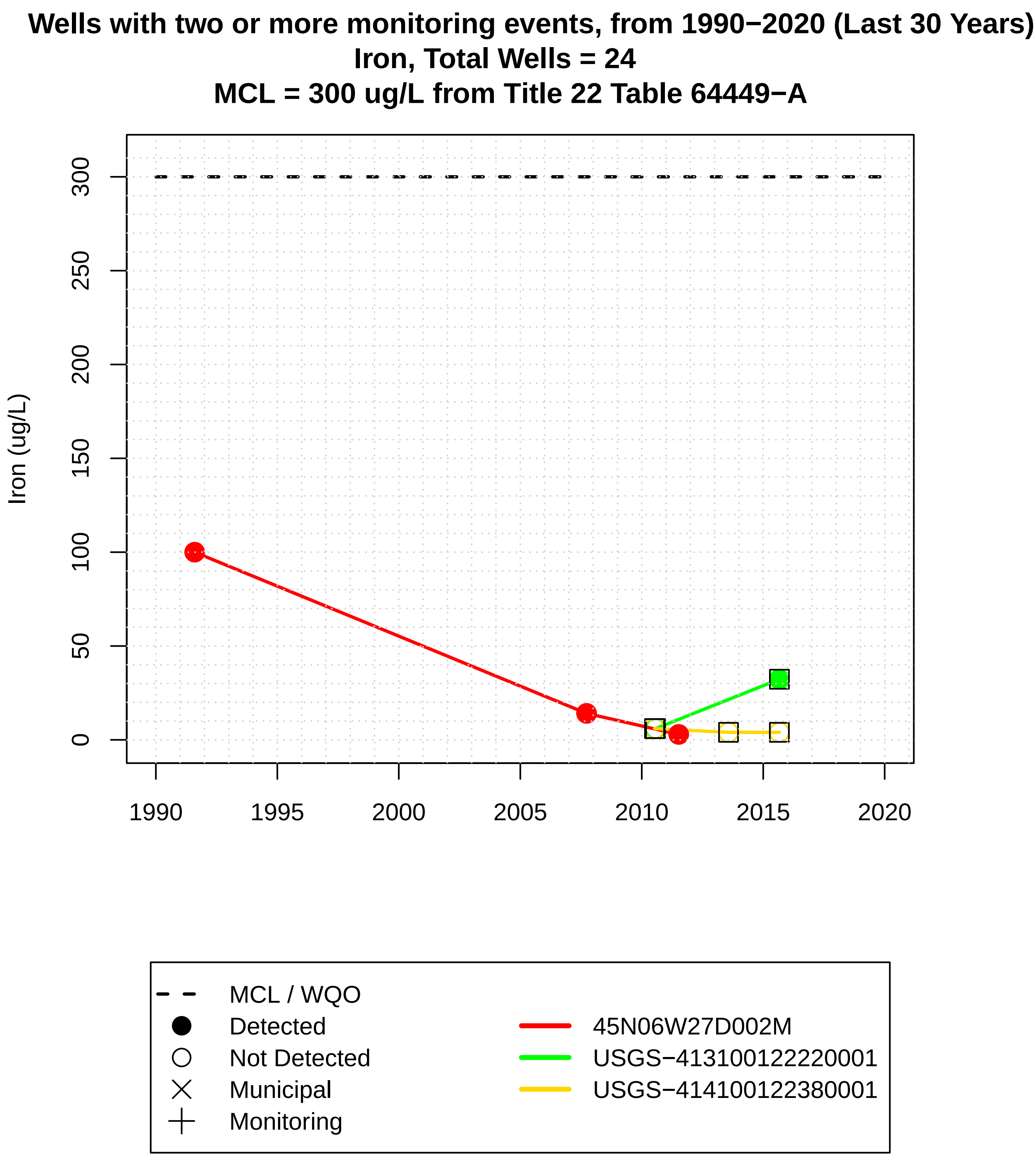


Figure 24: Filtered Groundwater Quality Observations of the Constituent Short List

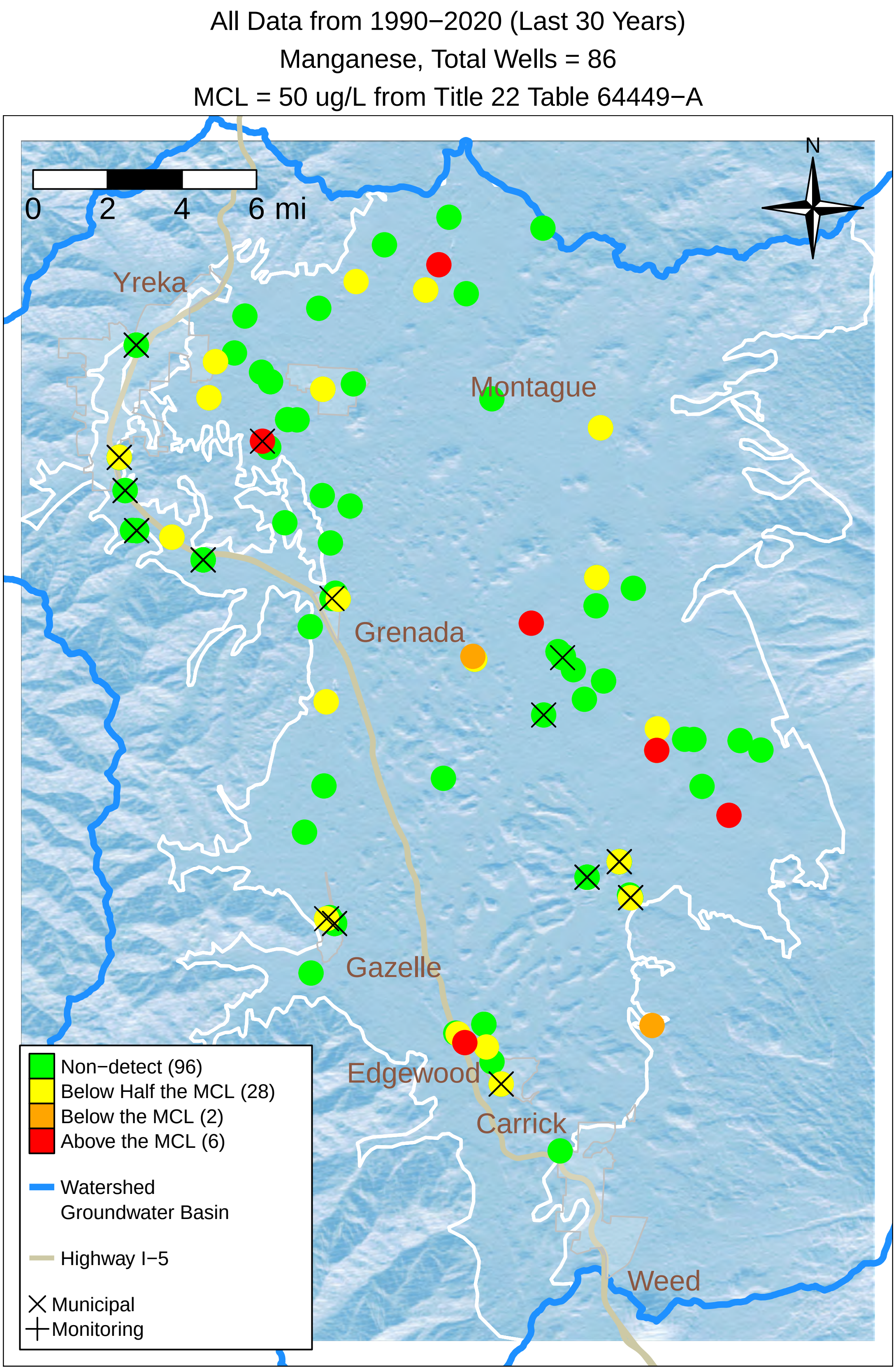


Figure 25: Groundwater Quality Observations of the Constituent Short List

Wells with two or more monitoring events, from 1990−2020 (Last 30 Years)
Manganese, Total Wells = 24
MCL = 50 ug/L from Title 22 Table 64449−A

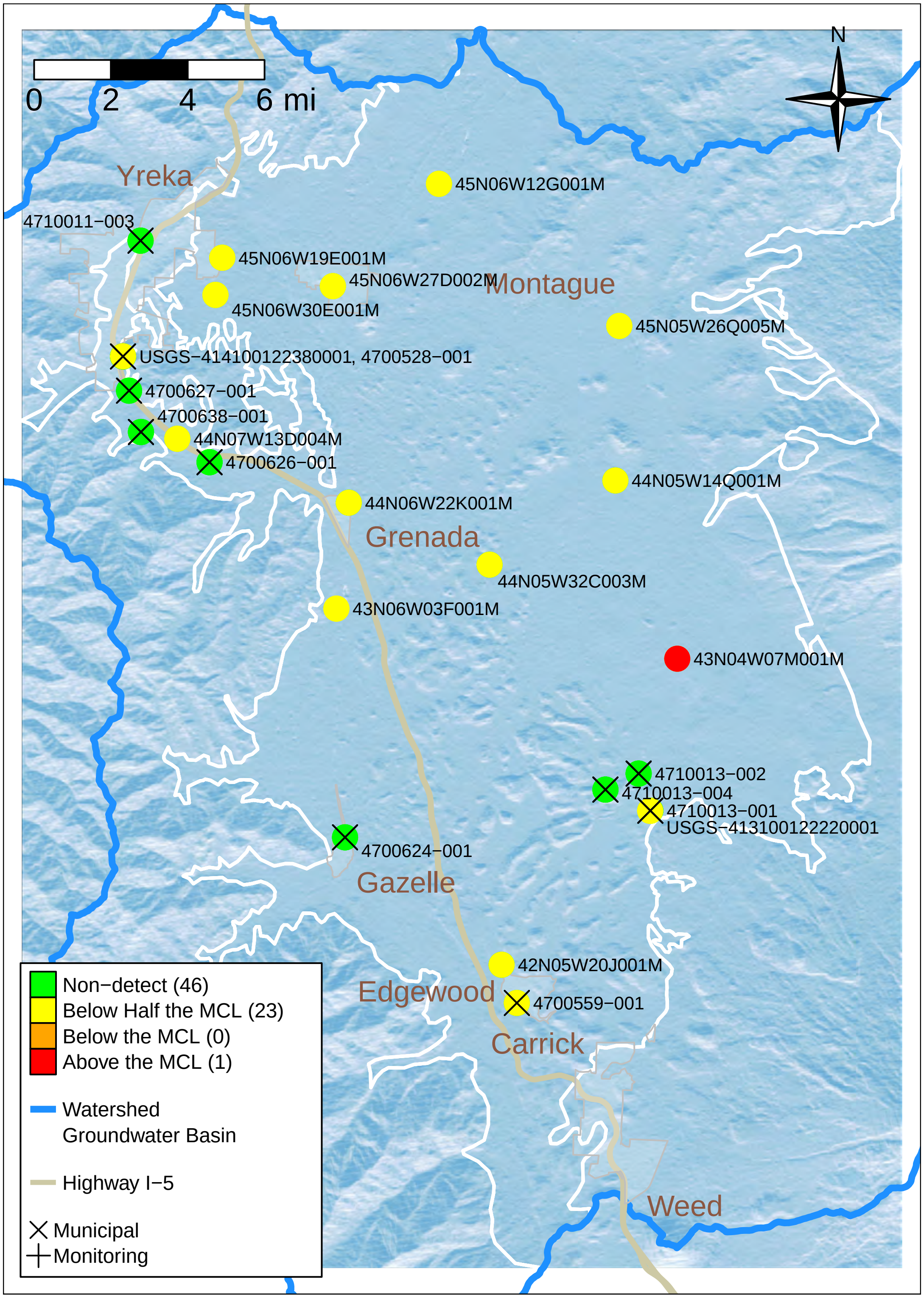


Figure 26: Filtered Groundwater Quality Observations of the Constituent Short List

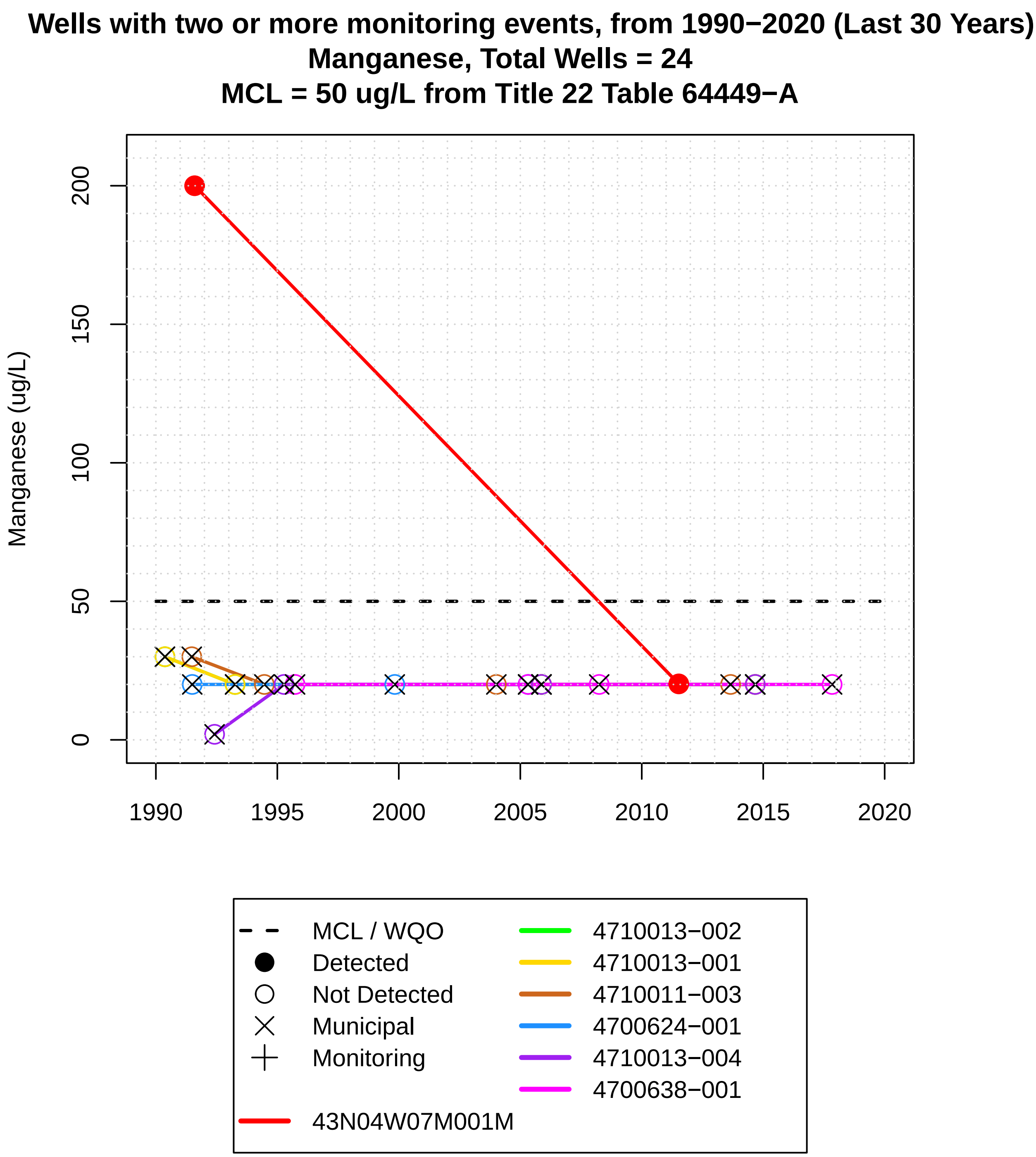


Figure 27: Filtered Groundwater Quality Observations of the Constituent Short List

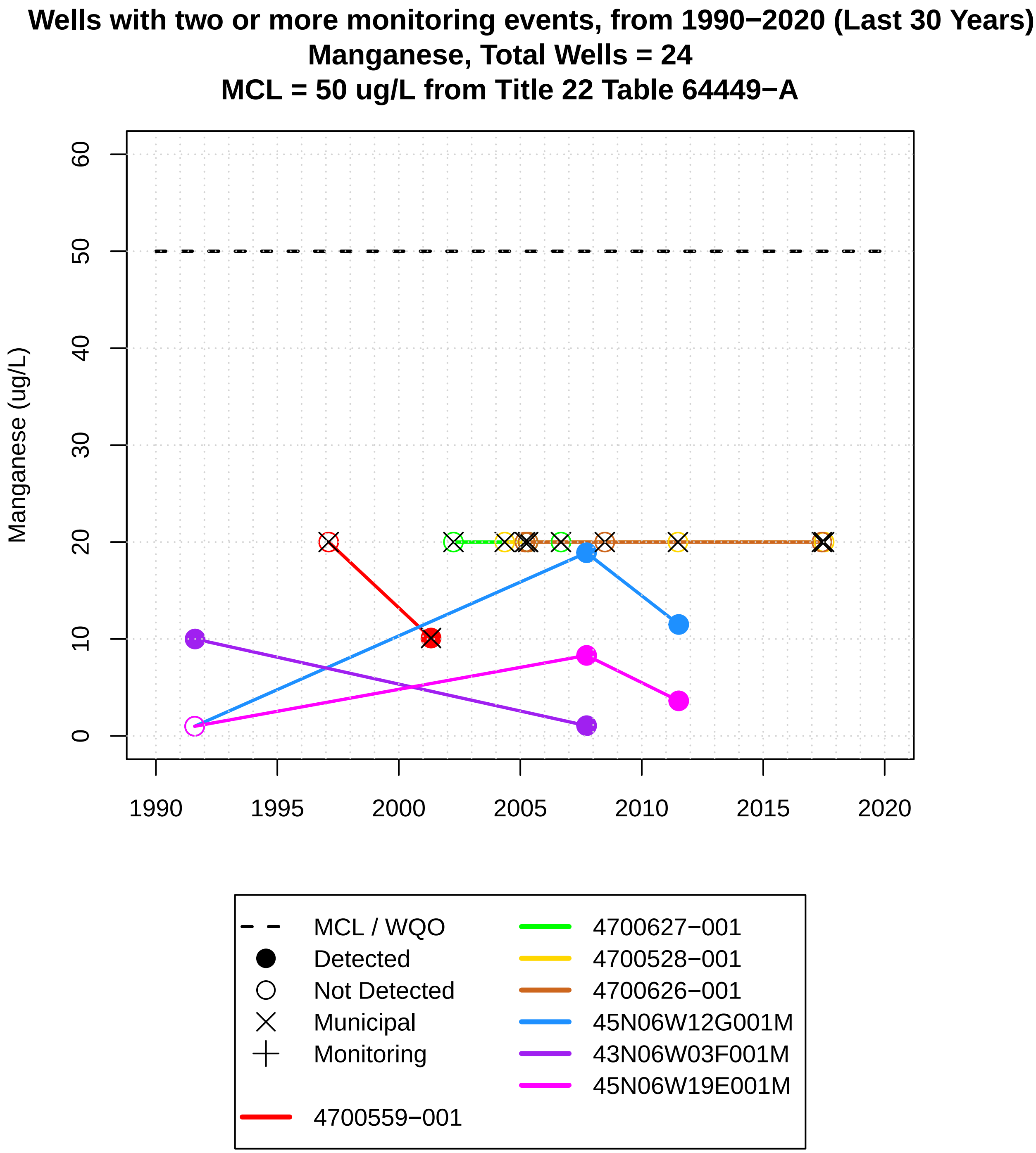


Figure 28: Filtered Groundwater Quality Observations of the Constituent Short List

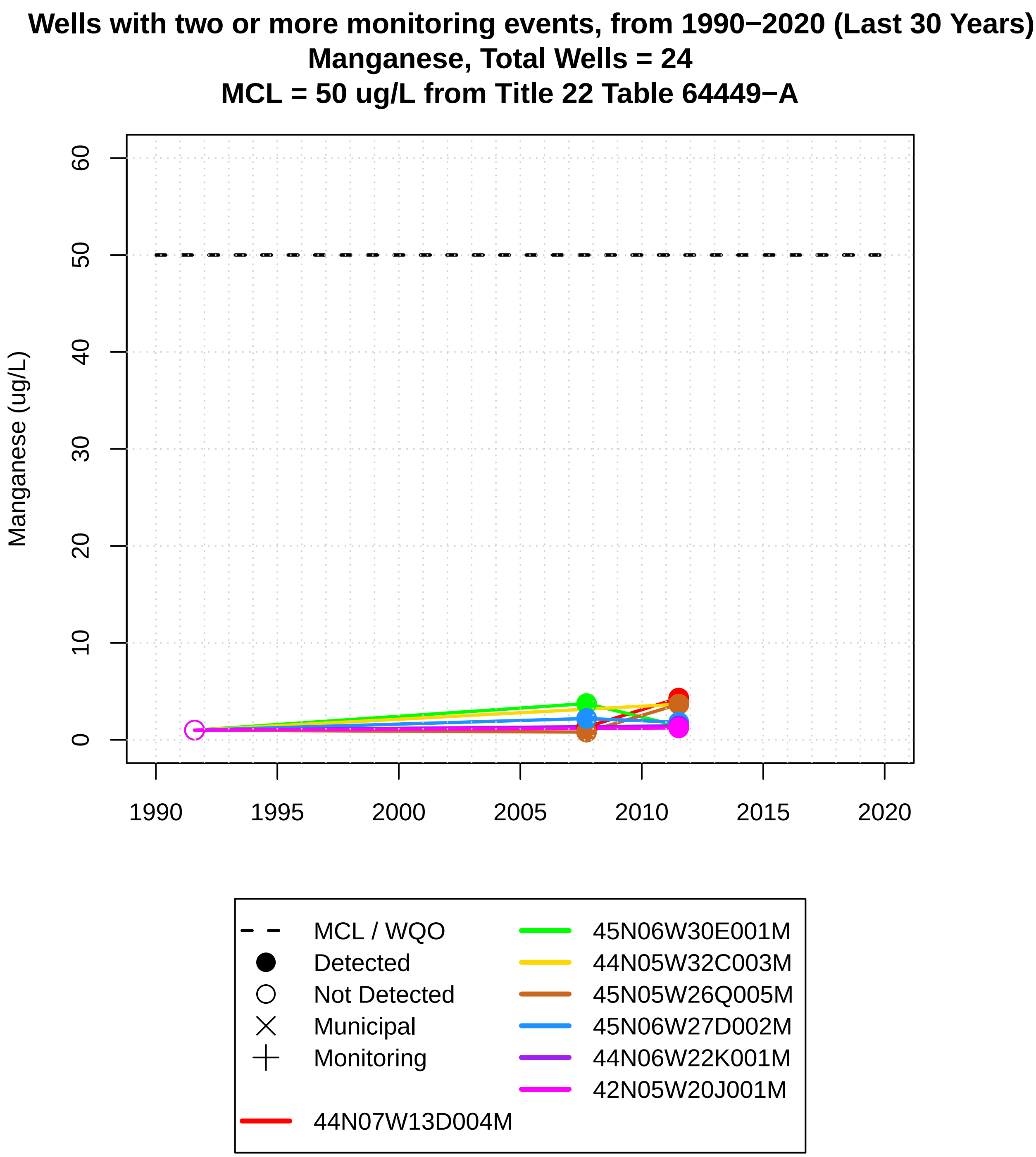


Figure 29: Filtered Groundwater Quality Observations of the Constituent Short List

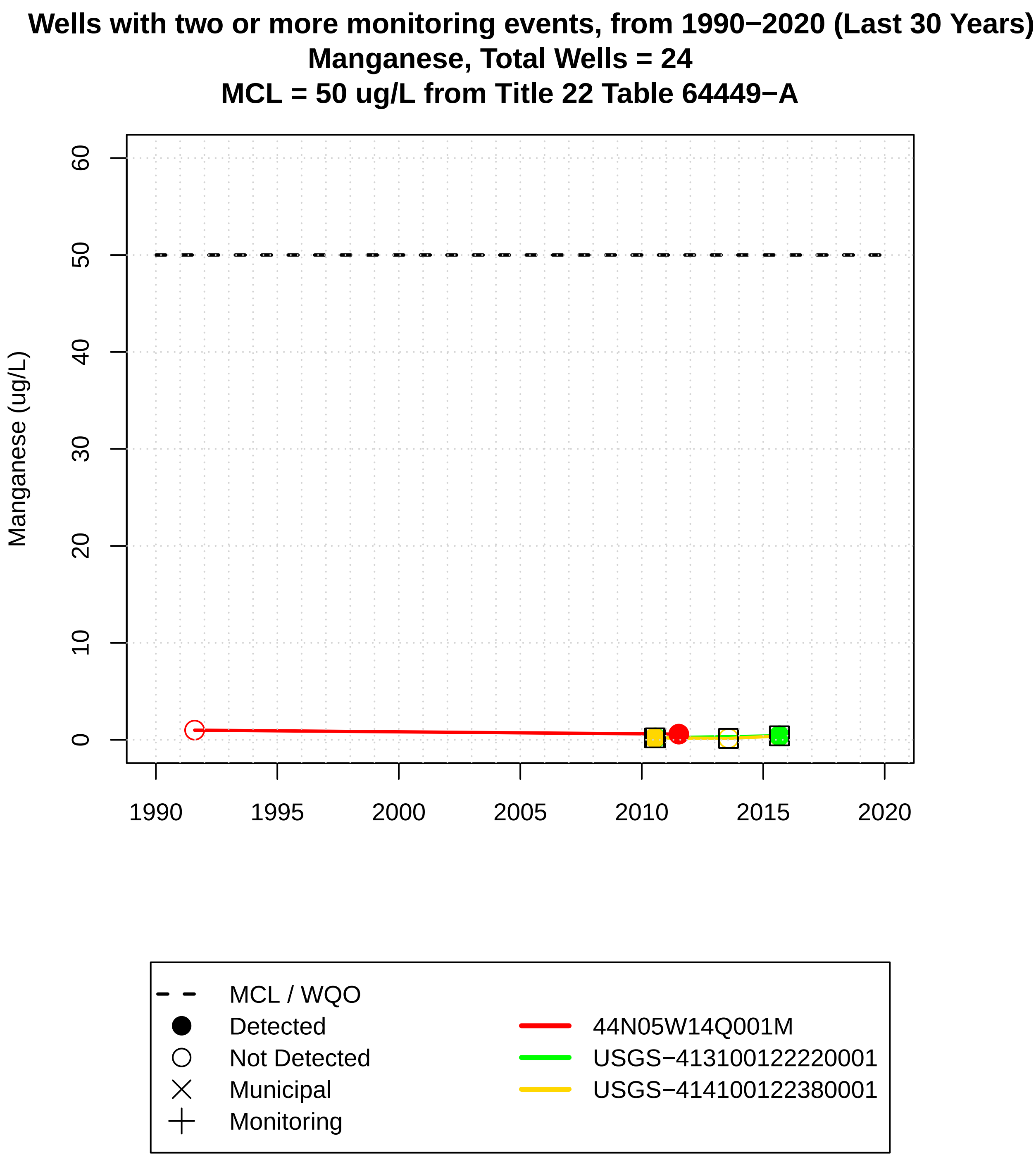


Figure 30: Filtered Groundwater Quality Observations of the Constituent Short List

All Data from 1990−2020 (Last 30 Years)
Nitrate as N, Total Wells = 50
MCL = 10 mg/L from Title 22 Table 64431−A

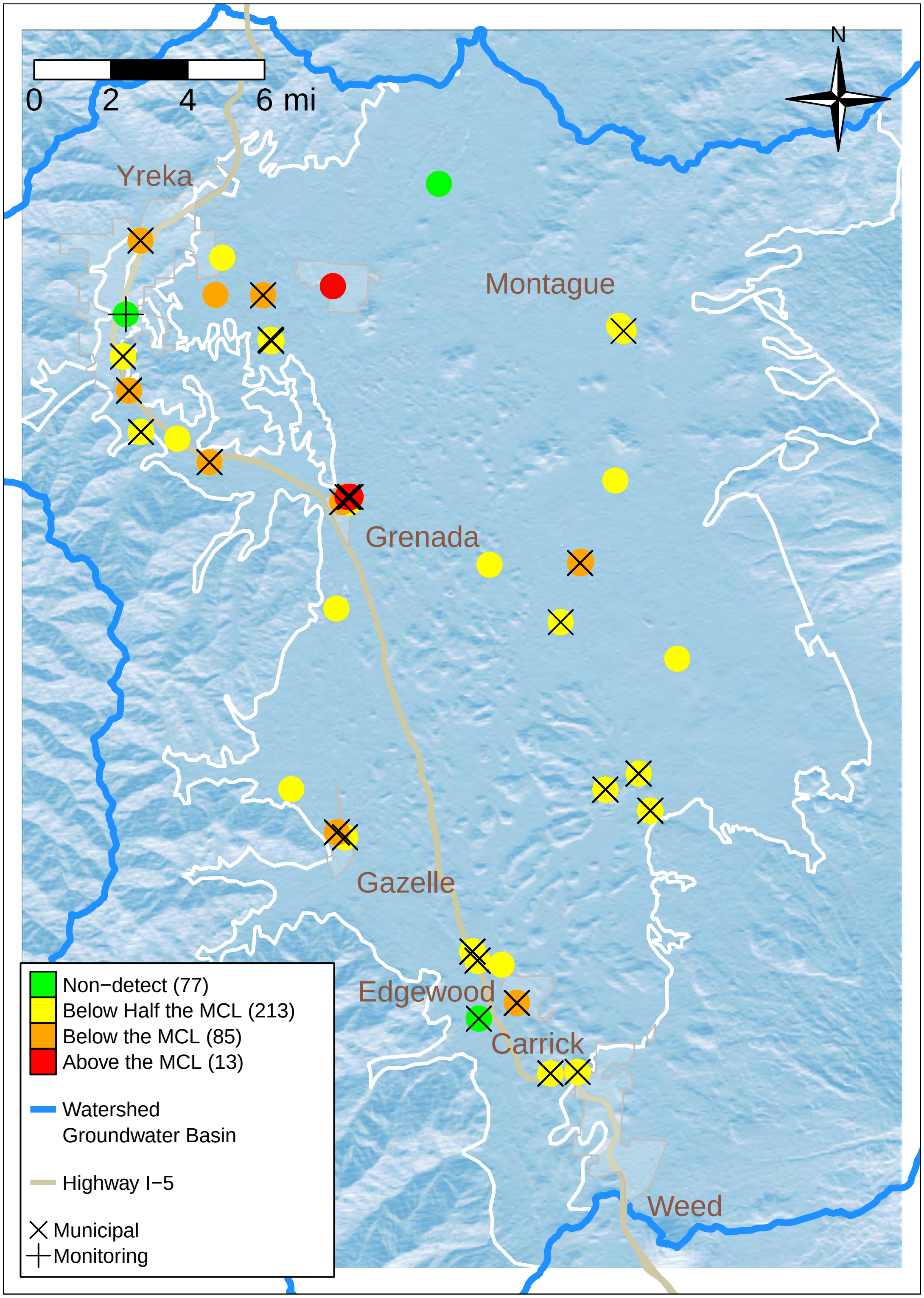


Figure 31: Groundwater Quality Observations of the Constituent Short List

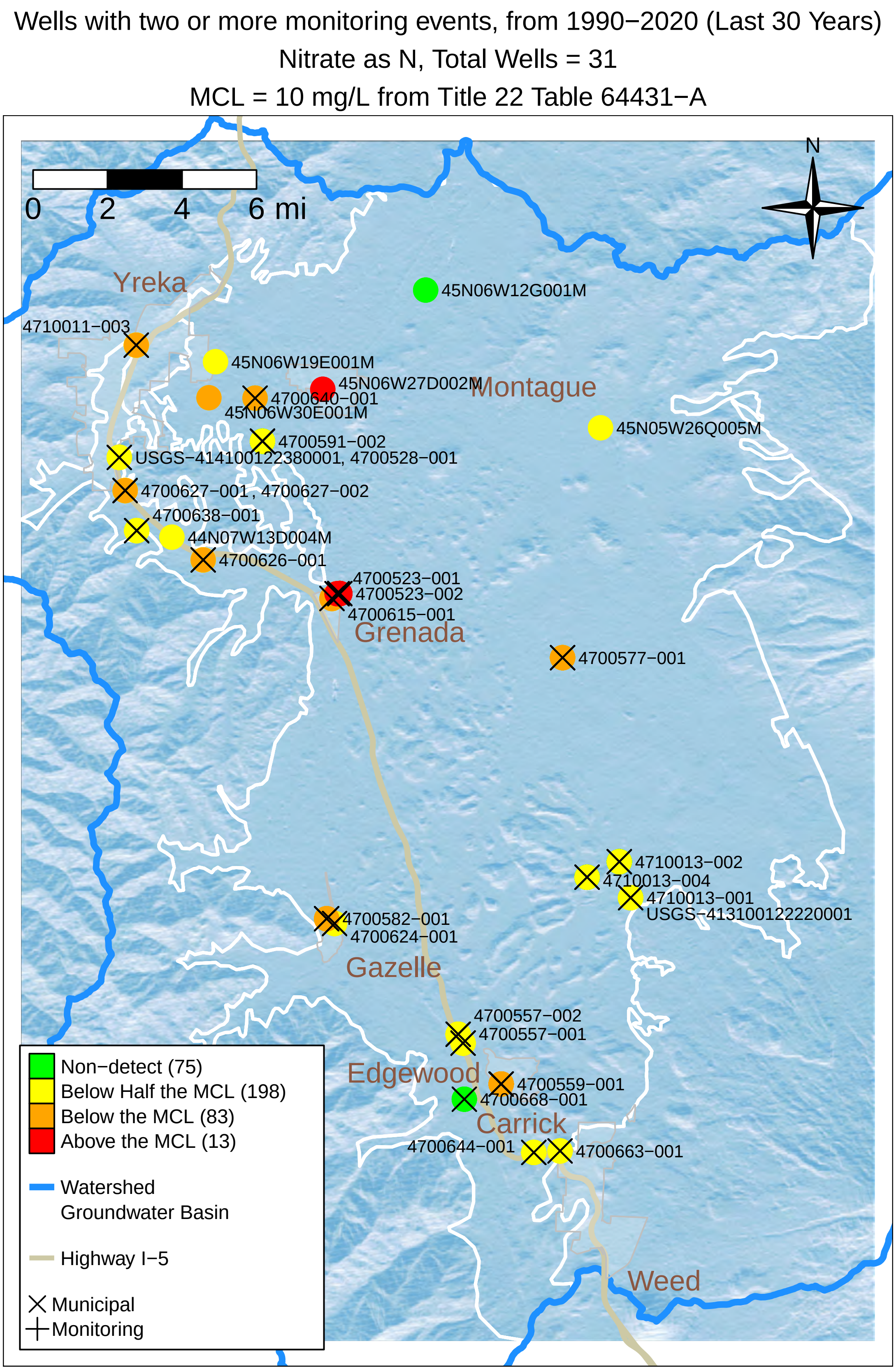


Figure 32: Filtered Groundwater Quality Observations of the Constituent Short List

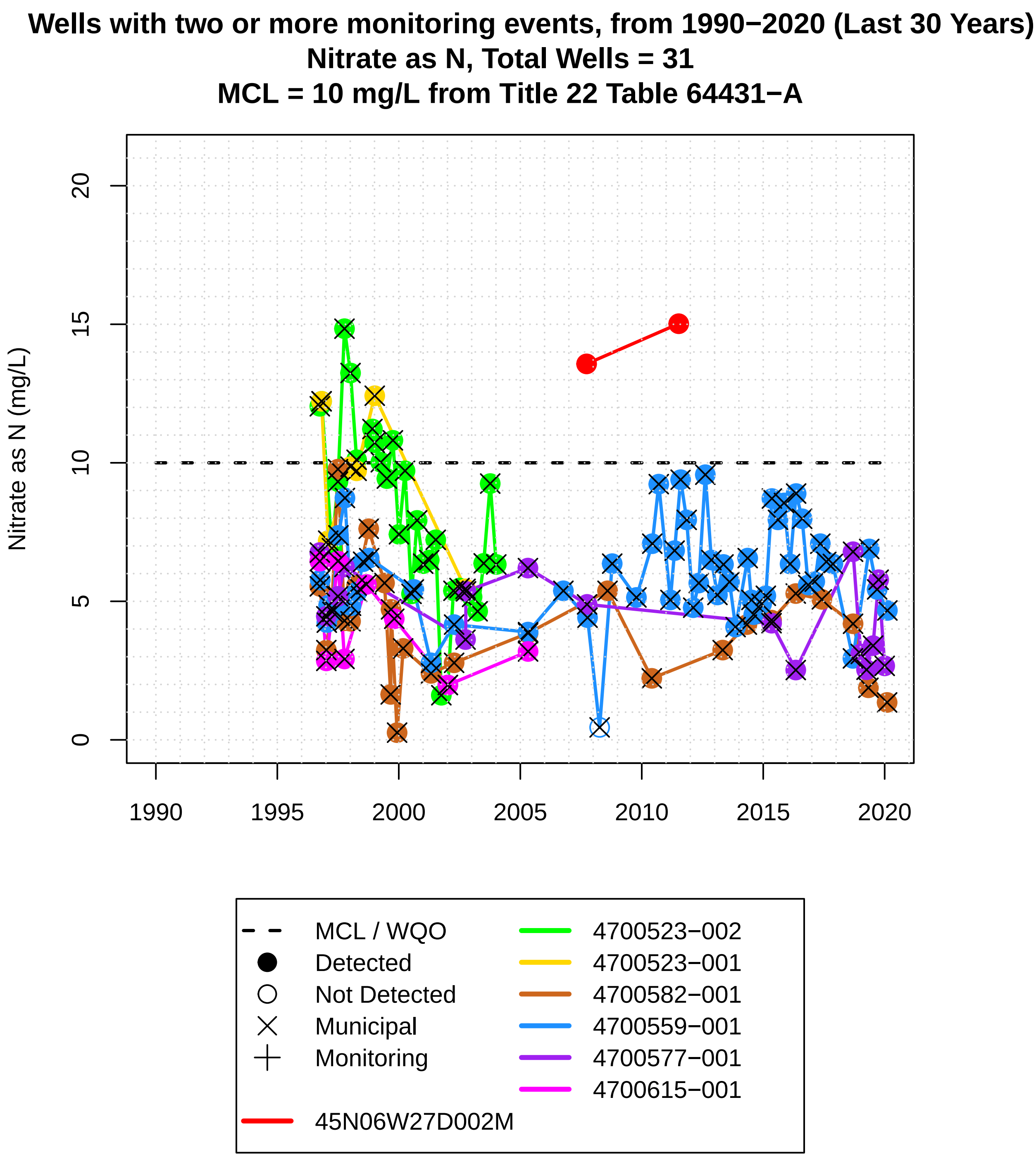


Figure 33: Filtered Groundwater Quality Observations of the Constituent Short List

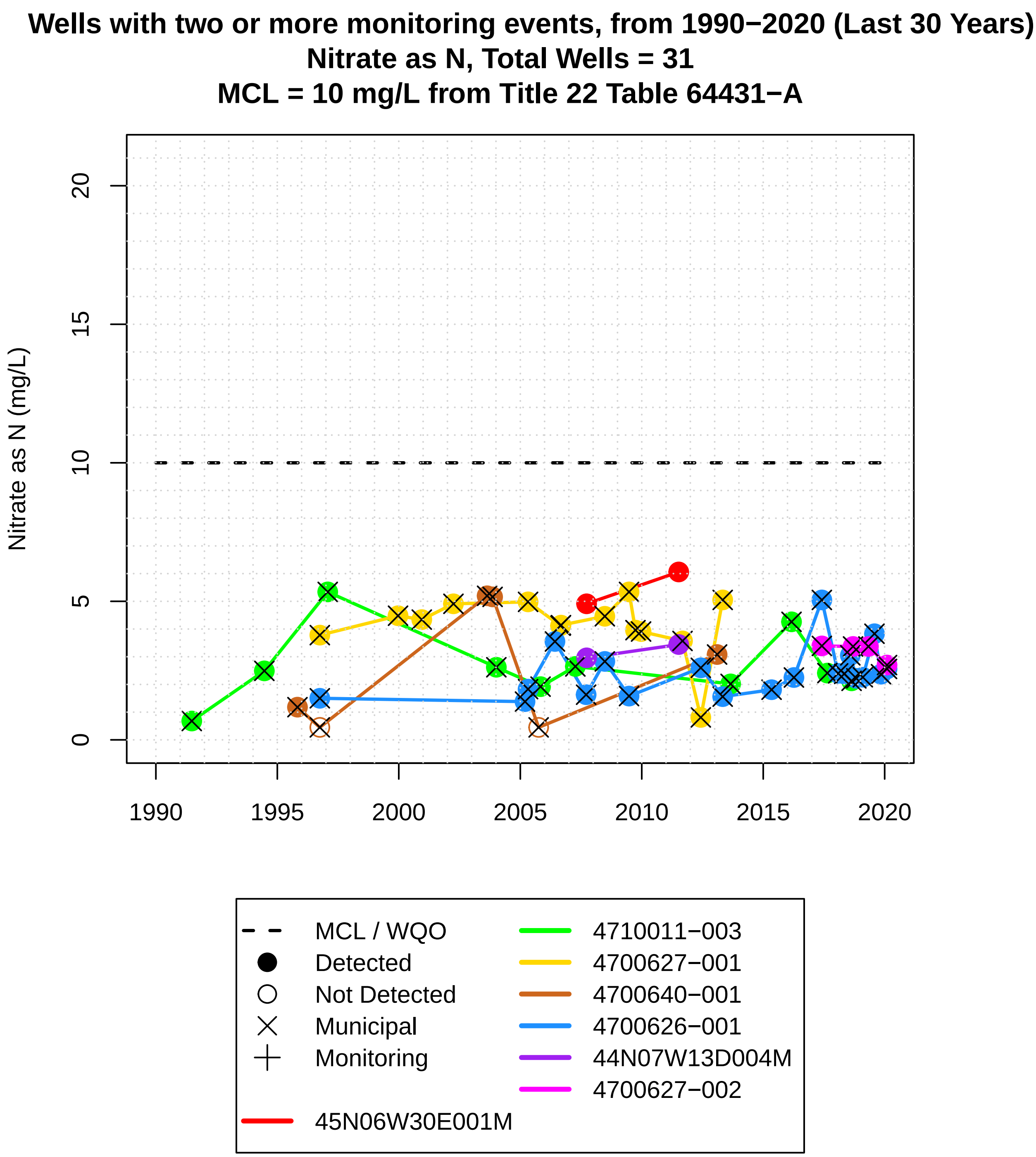


Figure 34: Filtered Groundwater Quality Observations of the Constituent Short List

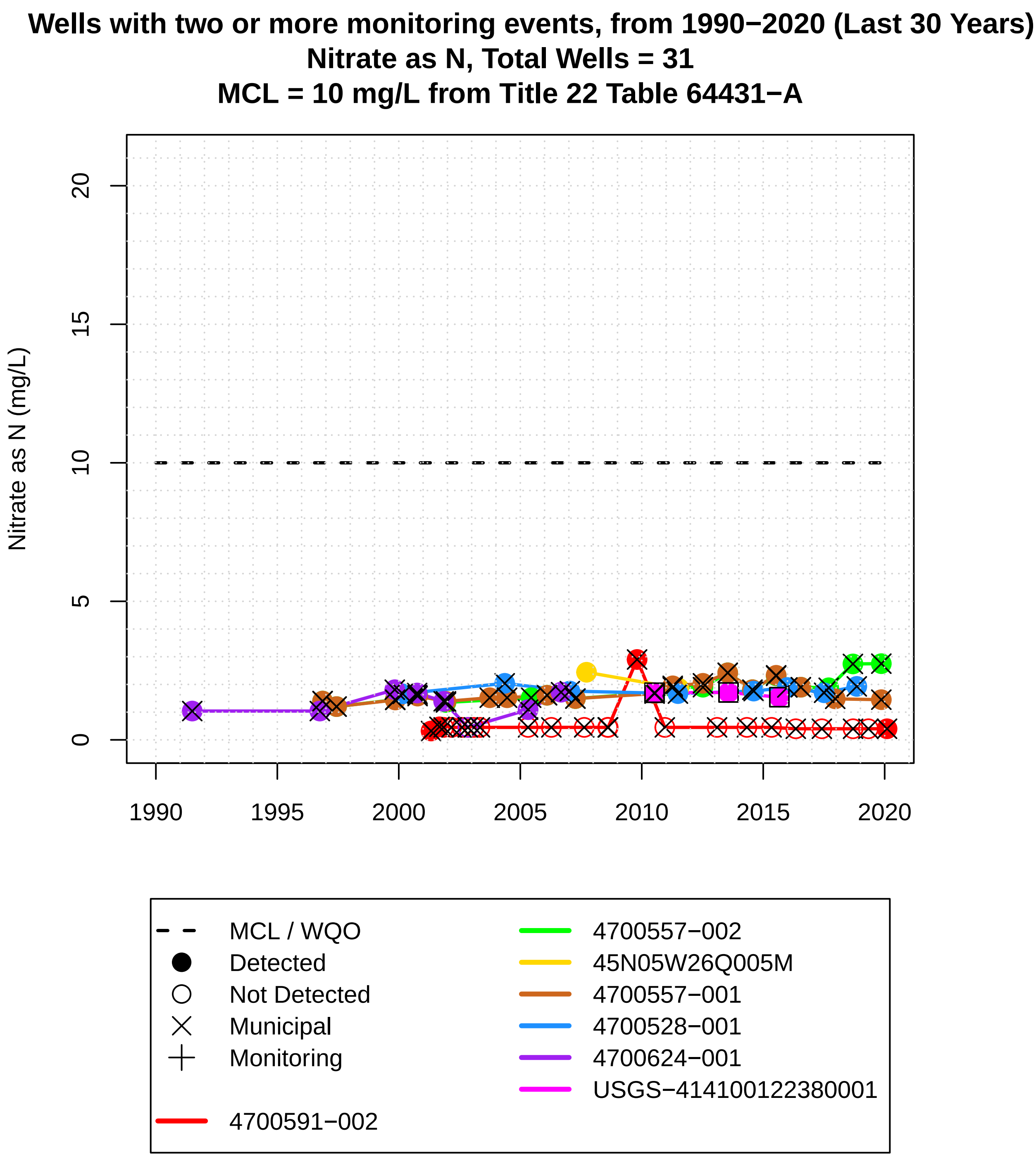


Figure 35: Filtered Groundwater Quality Observations of the Constituent Short List

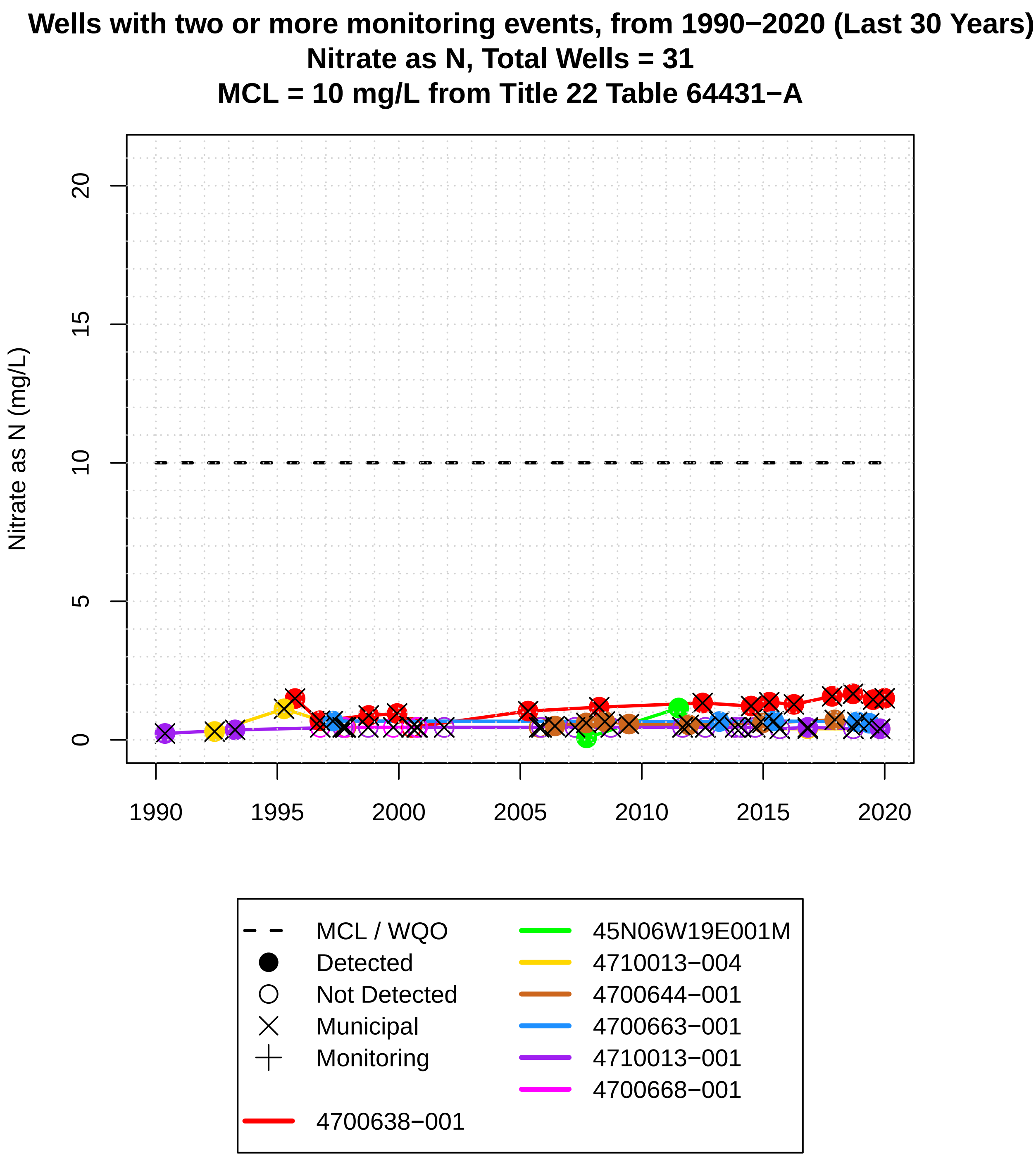


Figure 36: Filtered Groundwater Quality Observations of the Constituent Short List

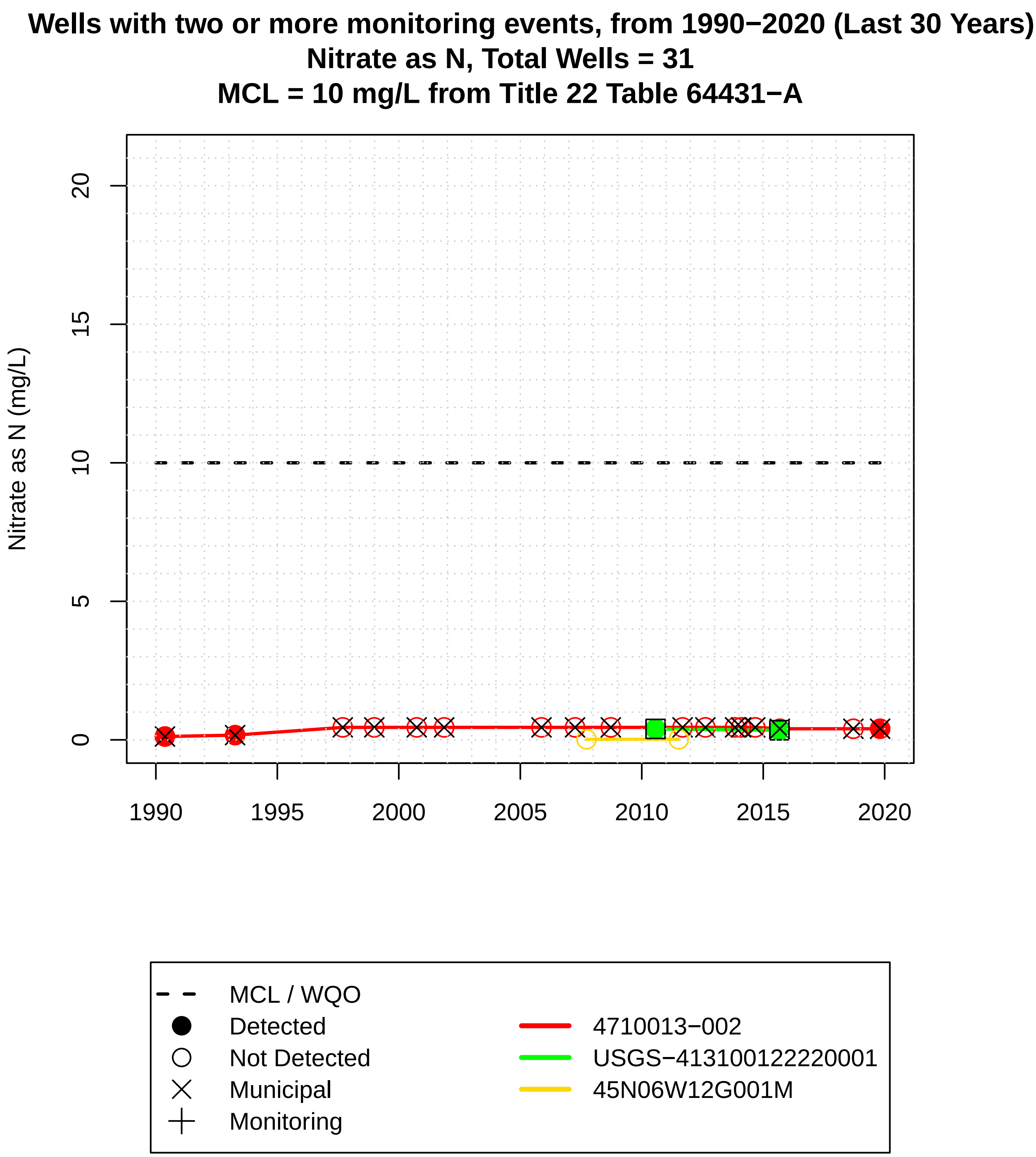


Figure 37: Filtered Groundwater Quality Observations of the Constituent Short List

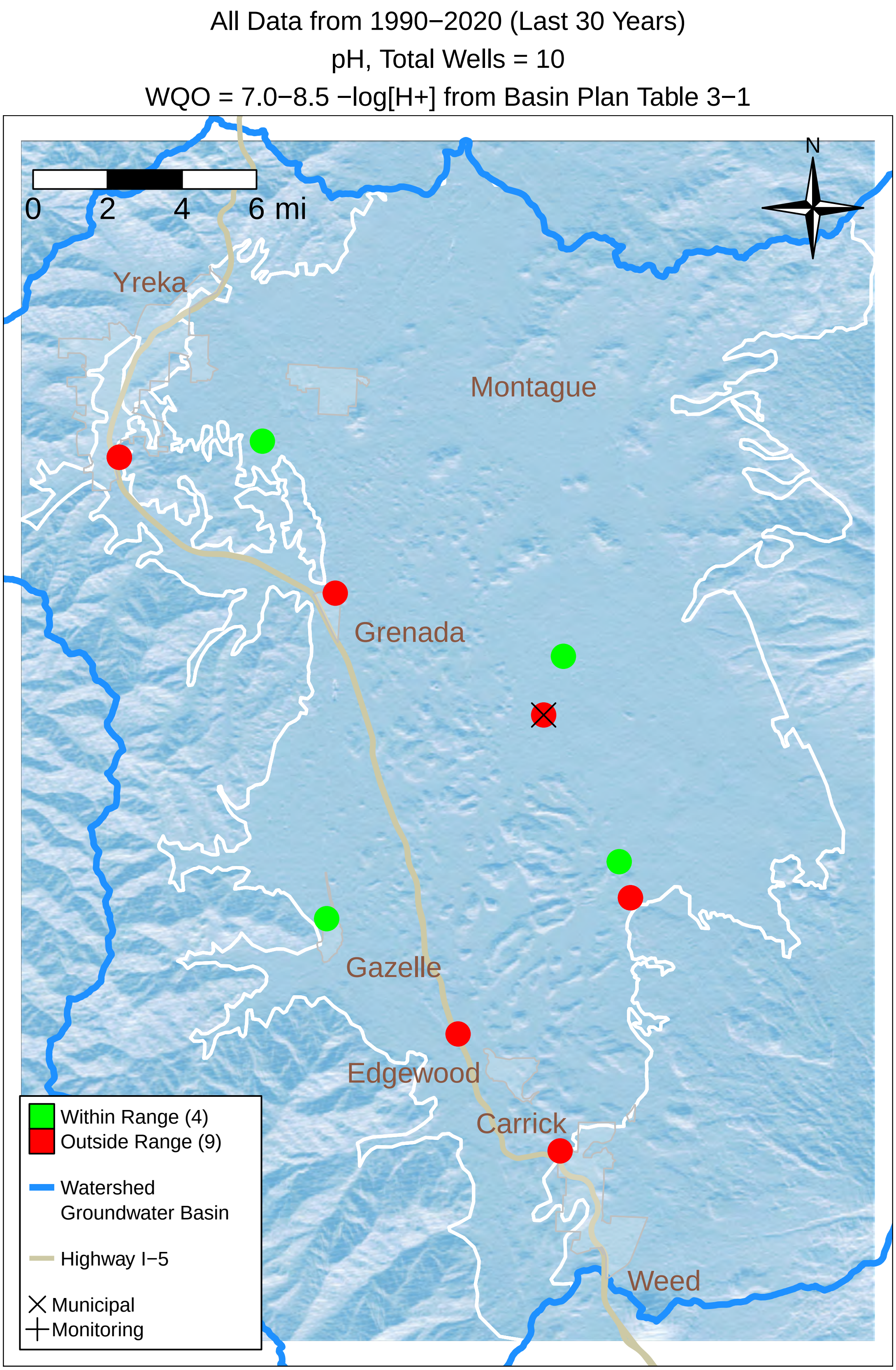


Figure 38: Groundwater Quality Observations of the Constituent Short List

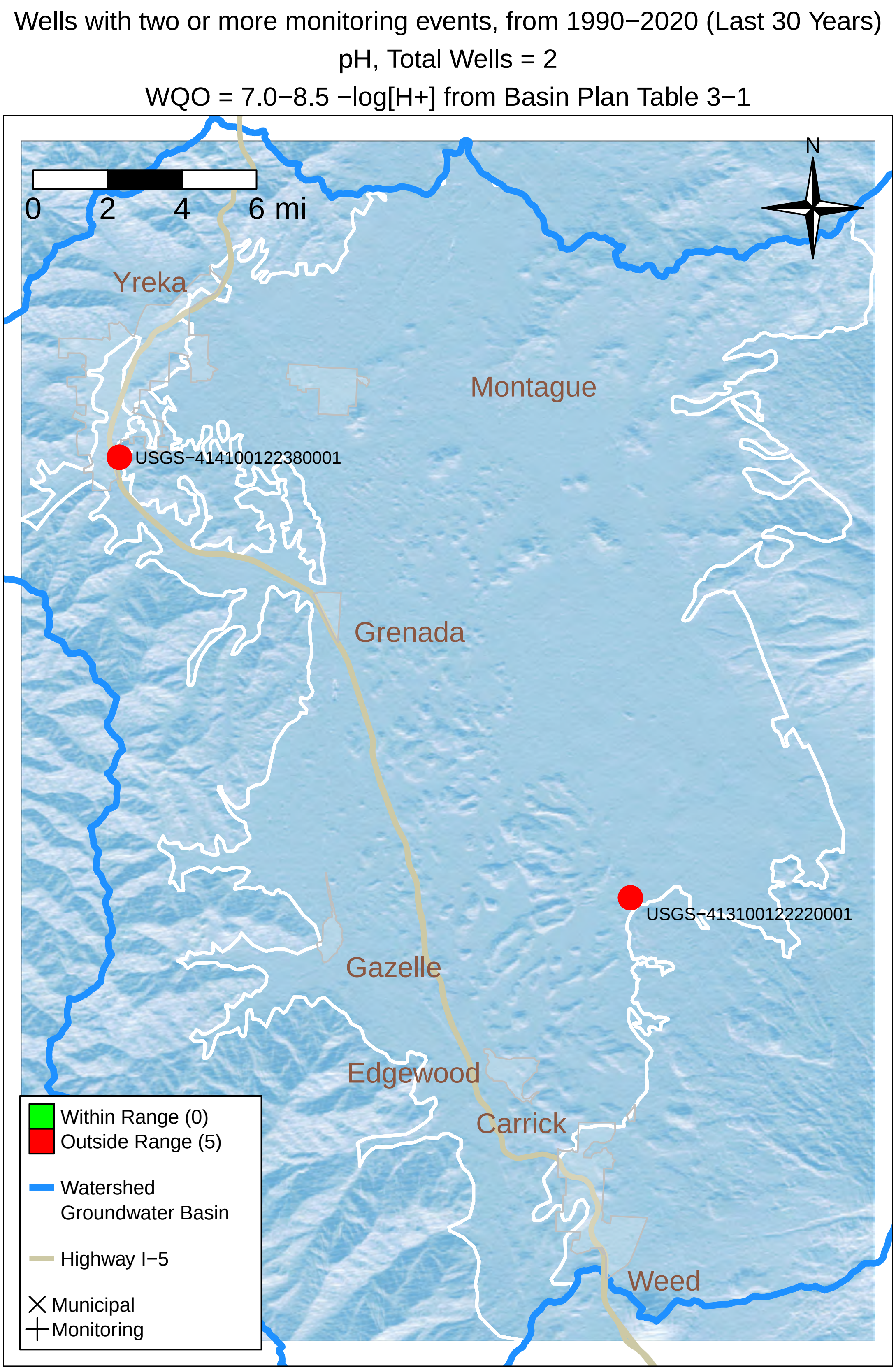


Figure 39: Filtered Groundwater Quality Observations of the Constituent Short List

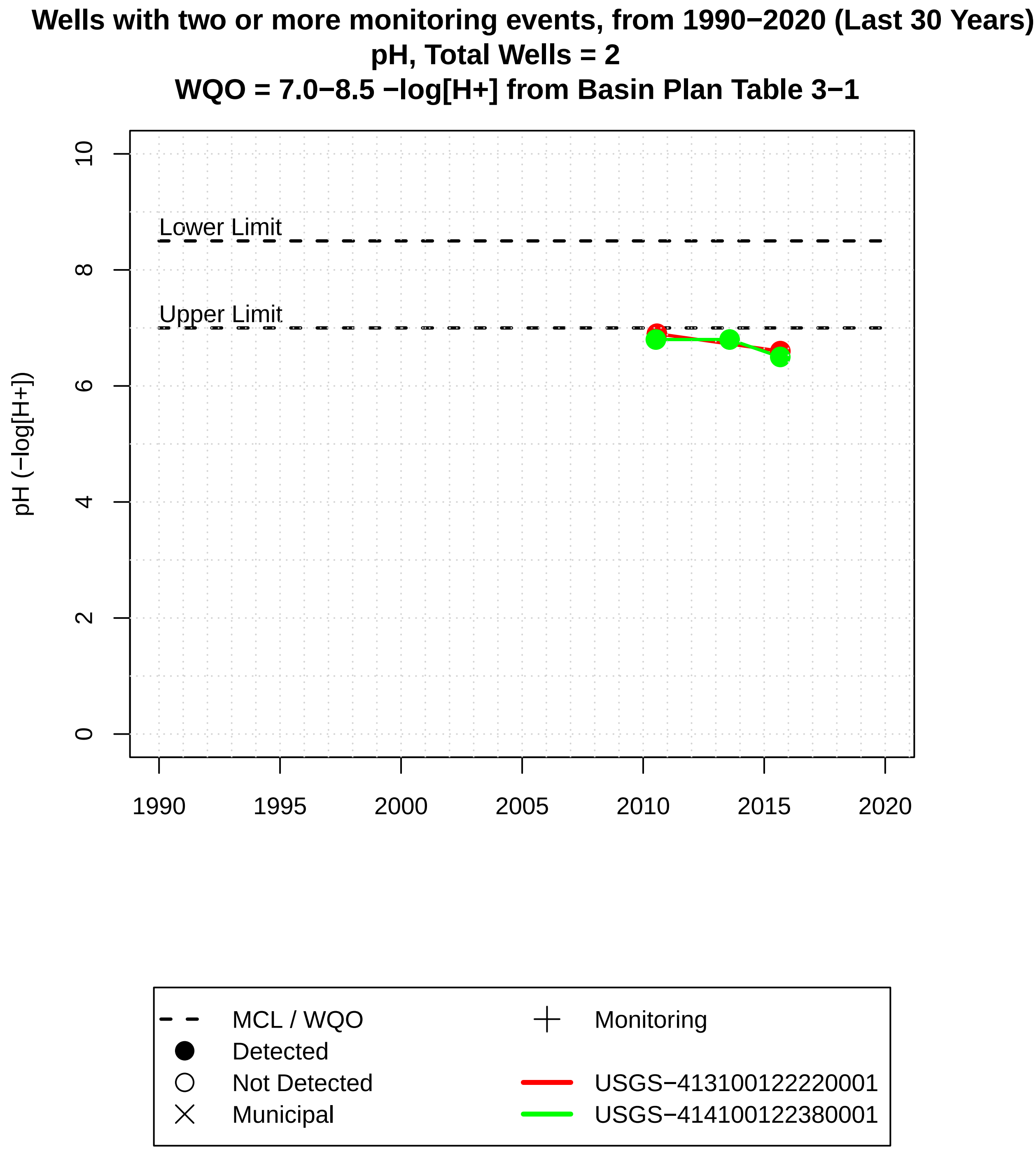


Figure 40: Filtered Groundwater Quality Observations of the Constituent Short List

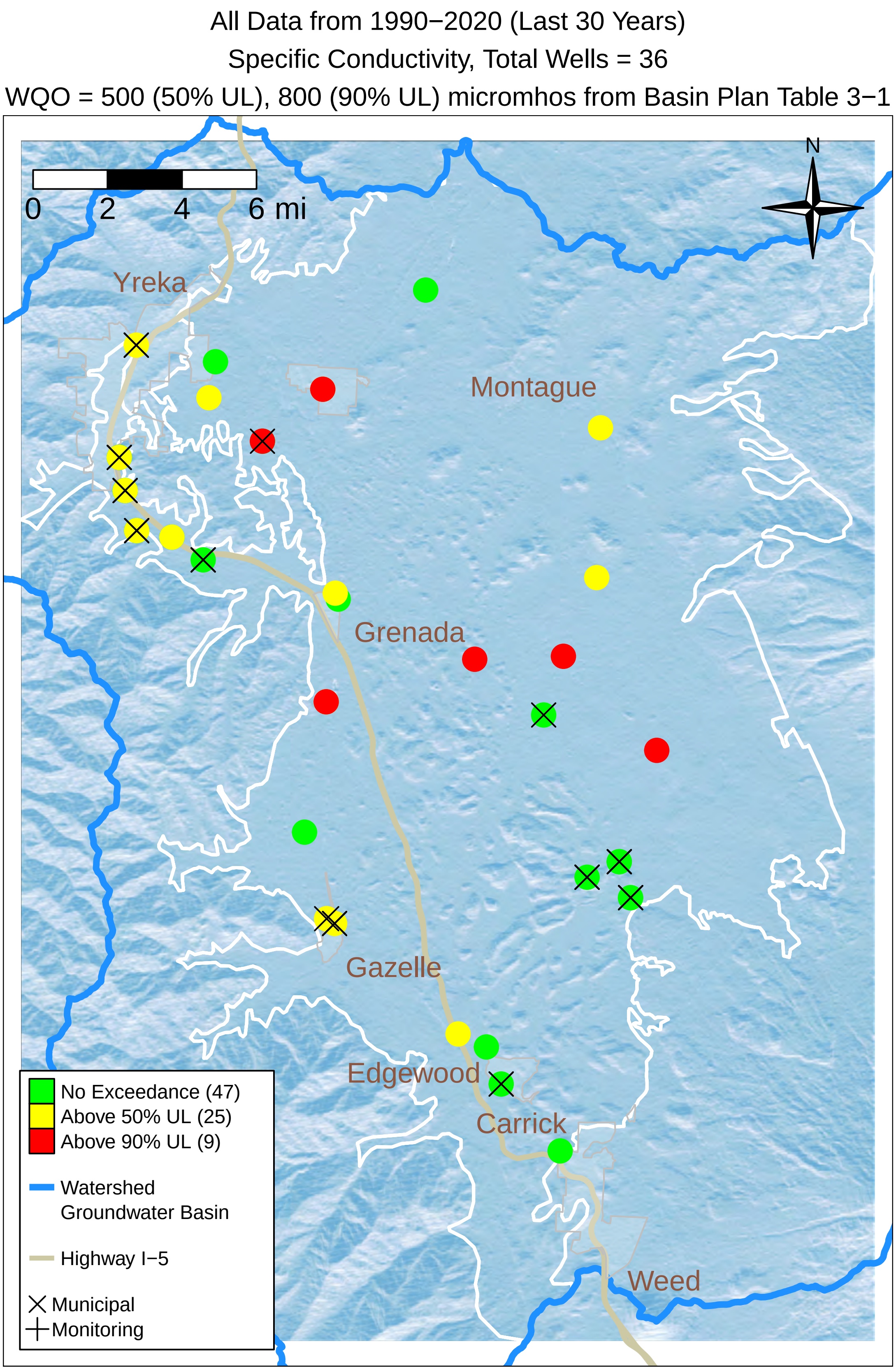


Figure 41: Groundwater Quality Observations of the Constituent Short List

Wells with two or more monitoring events, from 1990−2020 (Last 30 Years)
Specific Conductivity, Total Wells = 24
WQO = 500 (50% UL), 800 (90% UL) micromhos from Basin Plan Table 3−1

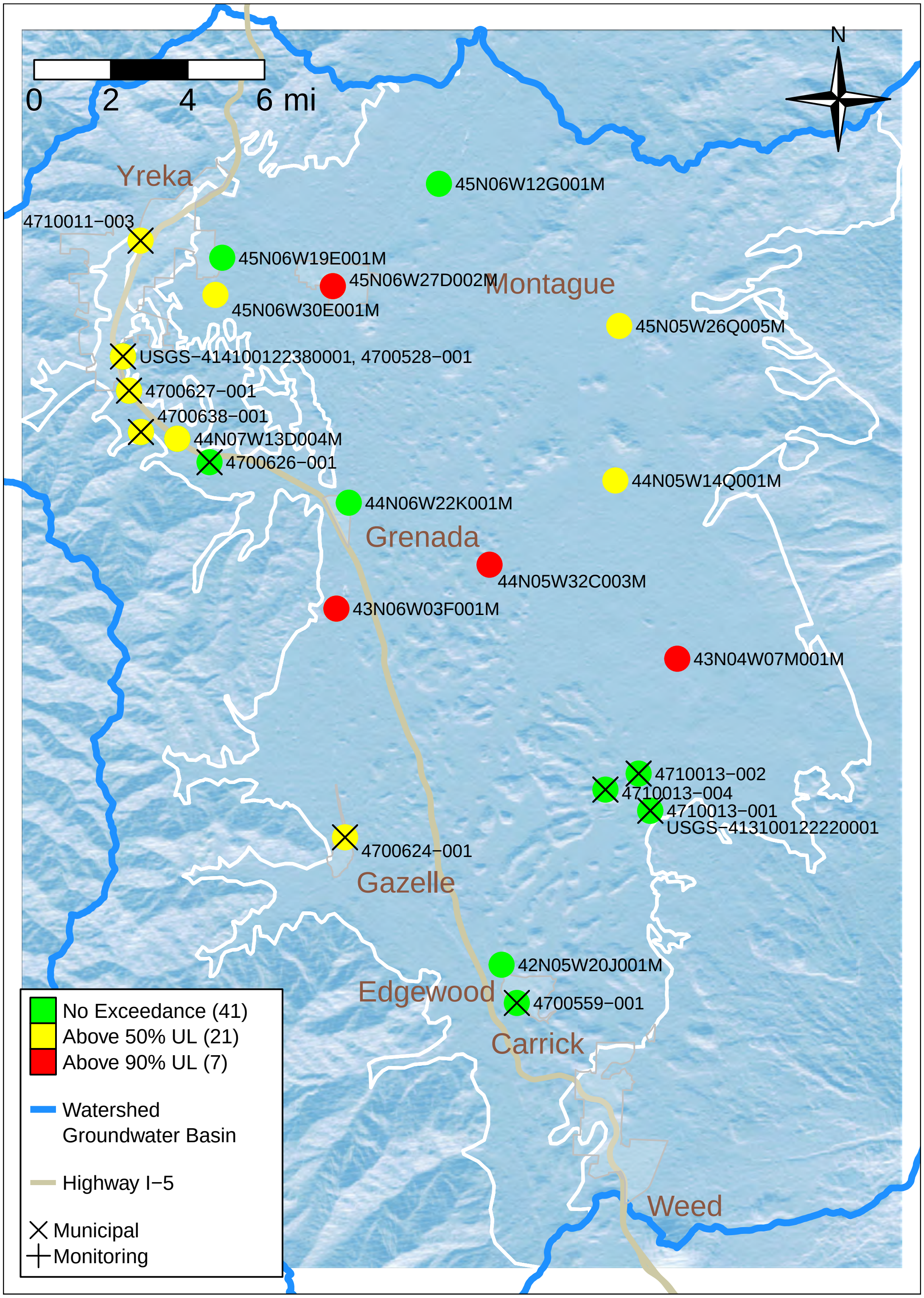


Figure 42: Filtered Groundwater Quality Observations of the Constituent Short List

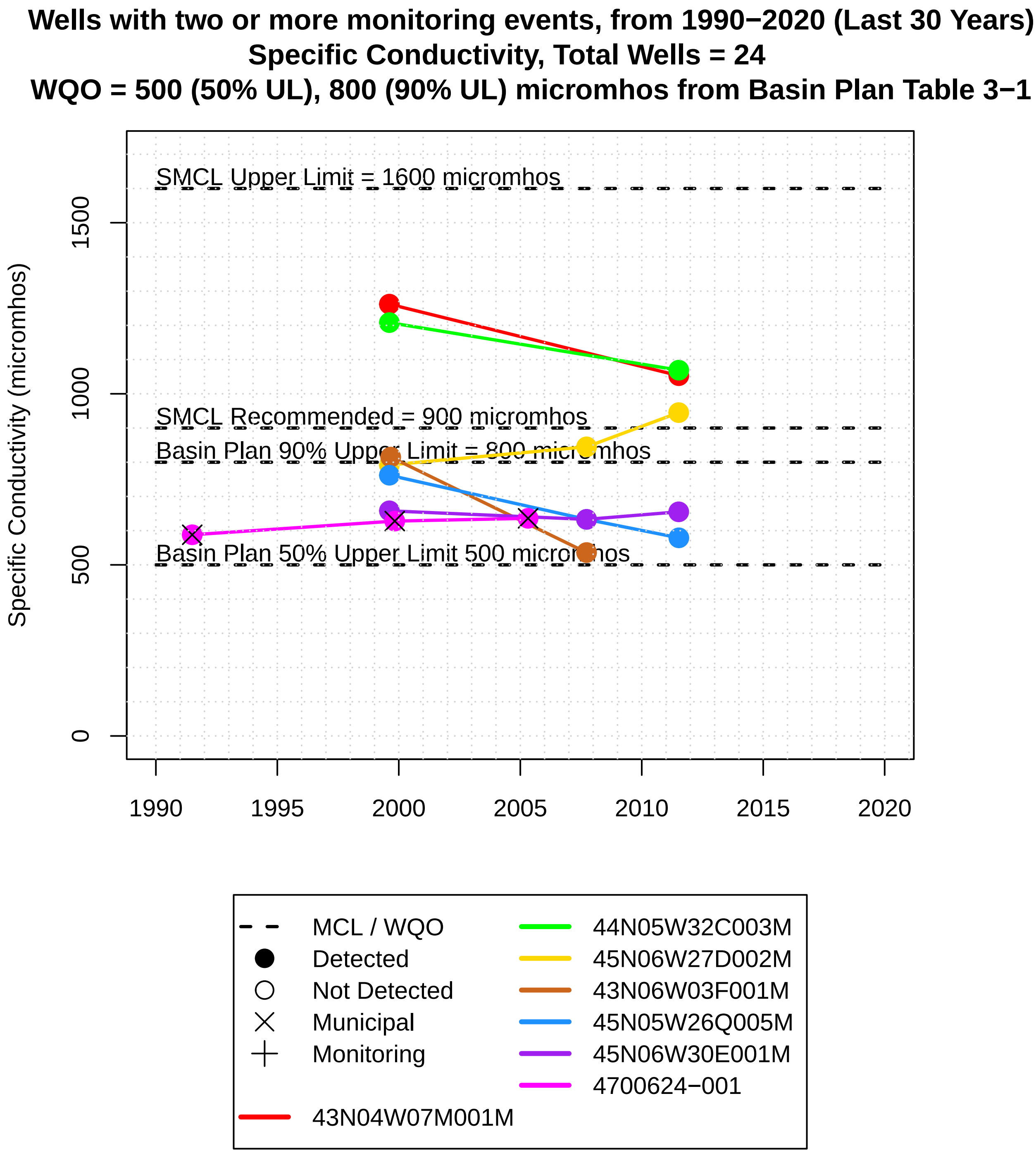


Figure 43: Filtered Groundwater Quality Observations of the Constituent Short List

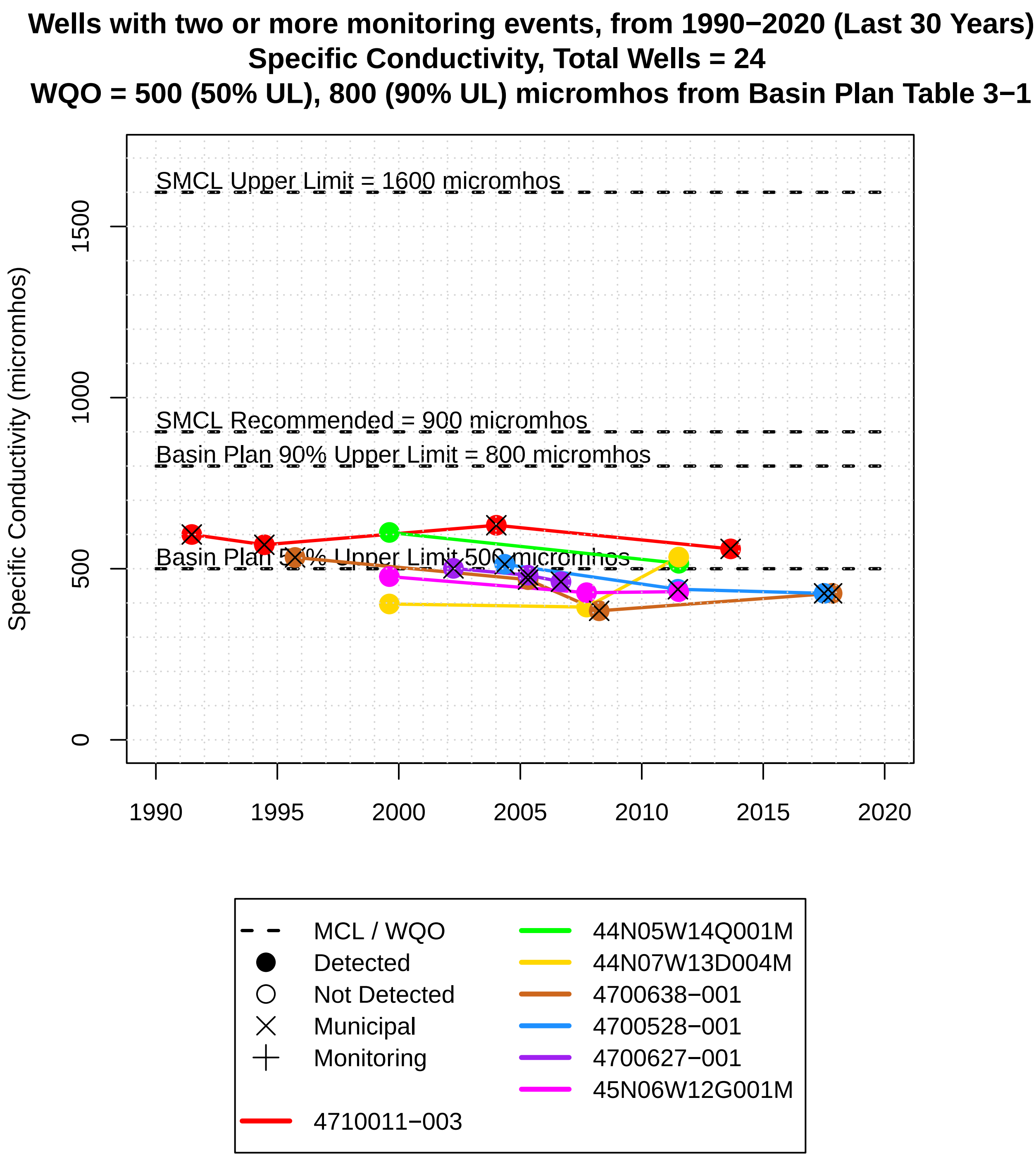


Figure 44: Filtered Groundwater Quality Observations of the Constituent Short List

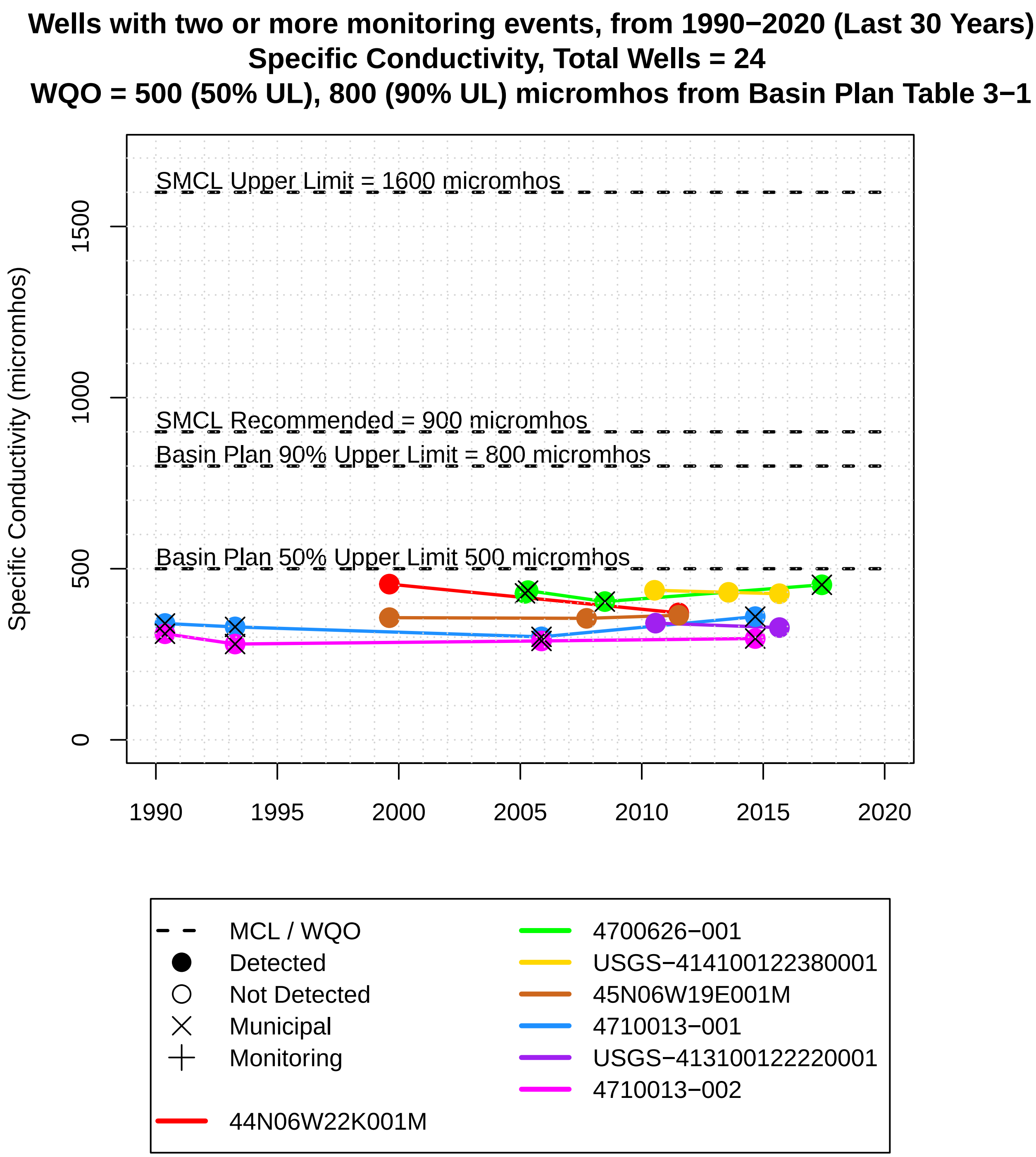


Figure 45: Filtered Groundwater Quality Observations of the Constituent Short List

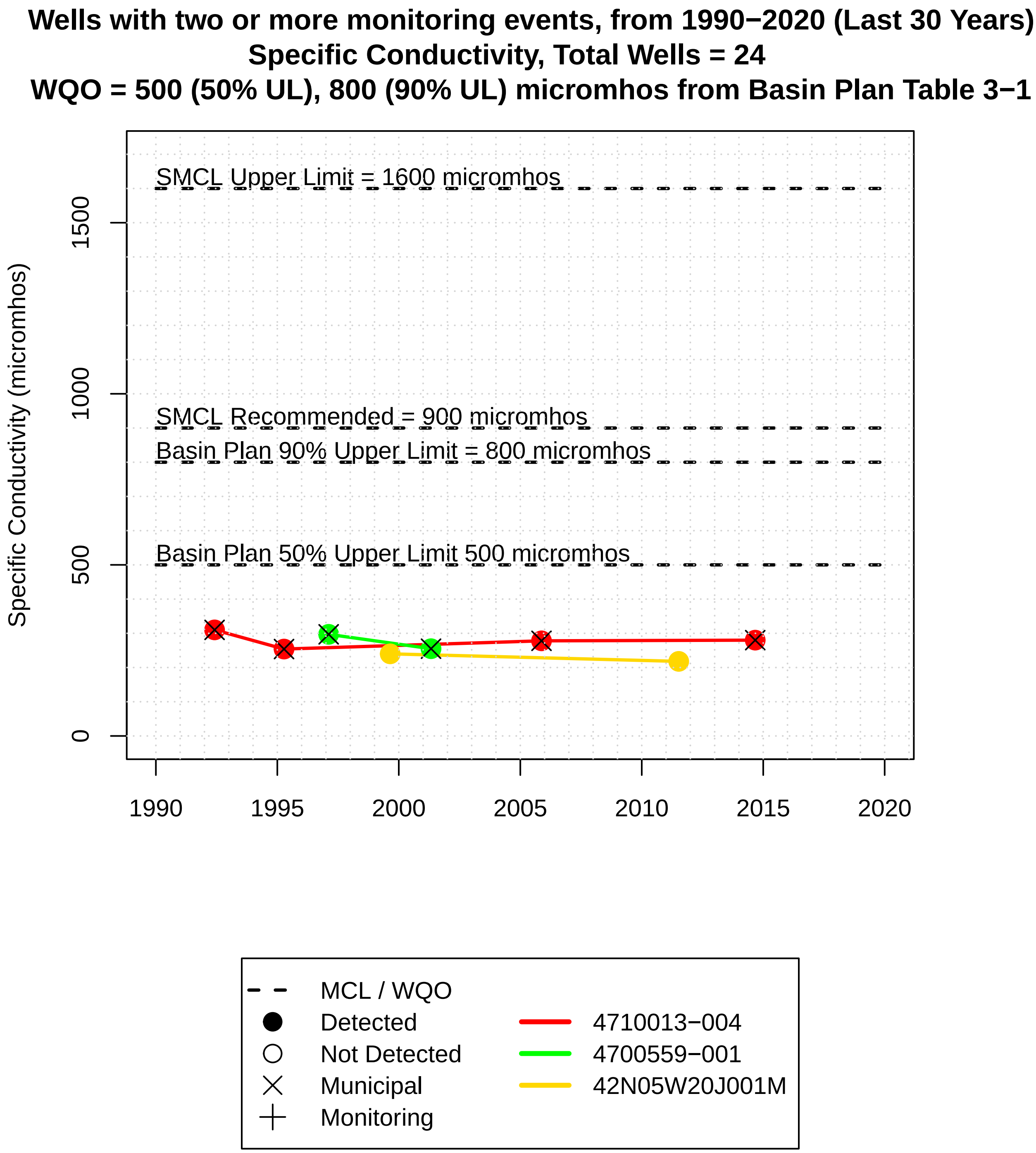


Figure 46: Filtered Groundwater Quality Observations of the Constituent Short List

References

California North Coast Regional Water Quality Control Board. 2018. “North Coast Basin Plan Chapter 2: Beneficial Uses.” June.

Appendix 2-C. Expanded Basin Setting

Contents

Expanded Basin Setting

This Appendix provides further background information for Section 2.2 - Basin Setting, such as additional geologic maps, cross-sections, and groundwater elevation maps.

Groundwater Elevation

Water level changes are shown in Figure 12 for the period between Spring 1978 and Spring 2018. Groundwater Elevations in Spring 2019 are shown in Figure 1. Spring 2018 groundwater elevations are shown in Figure 3. Spring 2017 groundwater elevations are shown in Figure 4. Spring 2016 groundwater elevations are shown in Figure 5. Spring 2008 groundwater elevations are shown in Figure 8. Spring 1991 groundwater elevations are shown in Figure 9. Spring 1986 groundwater elevations are shown in Figure 10.

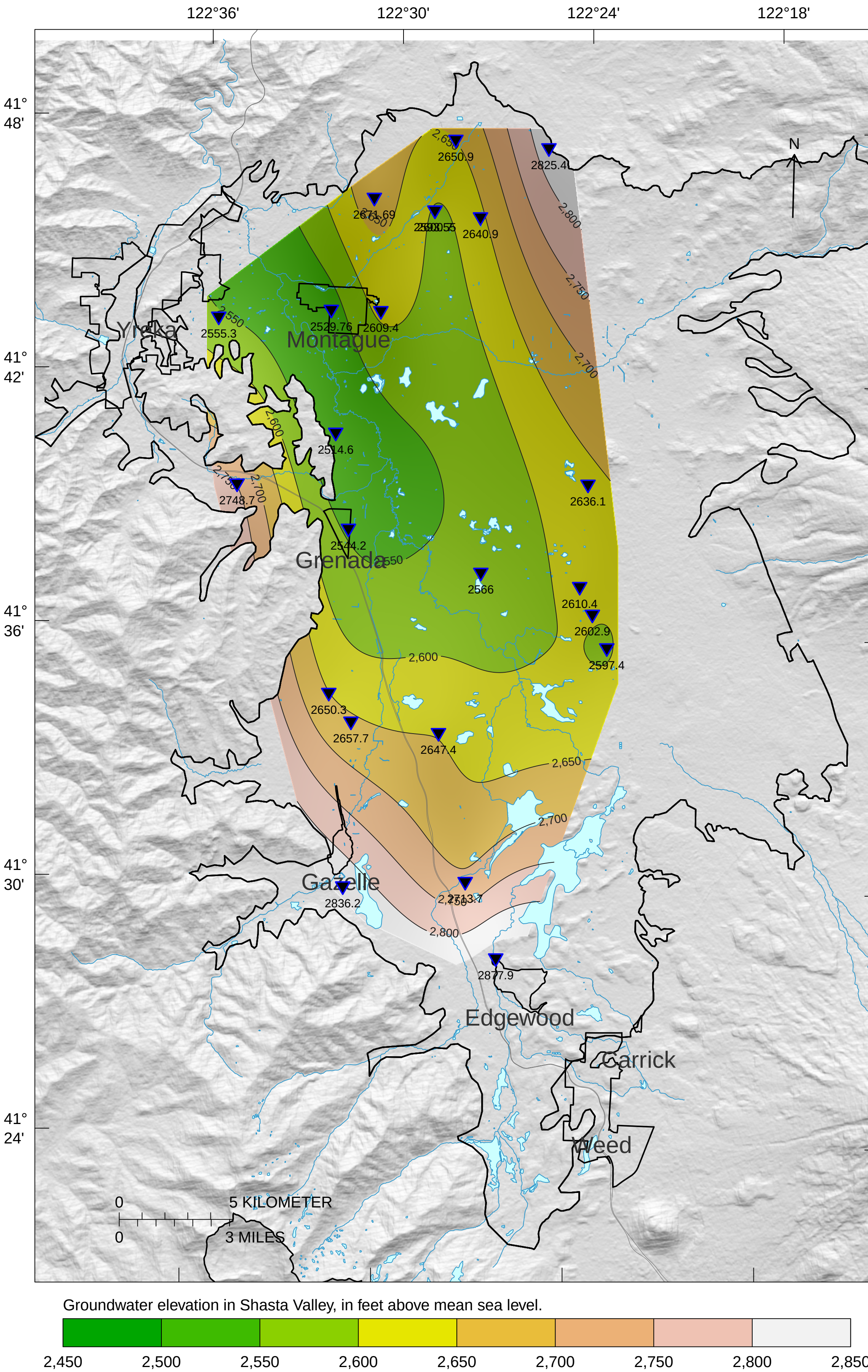


Figure 1: Shasta Valley Groundwater Elevations, Spring 2019

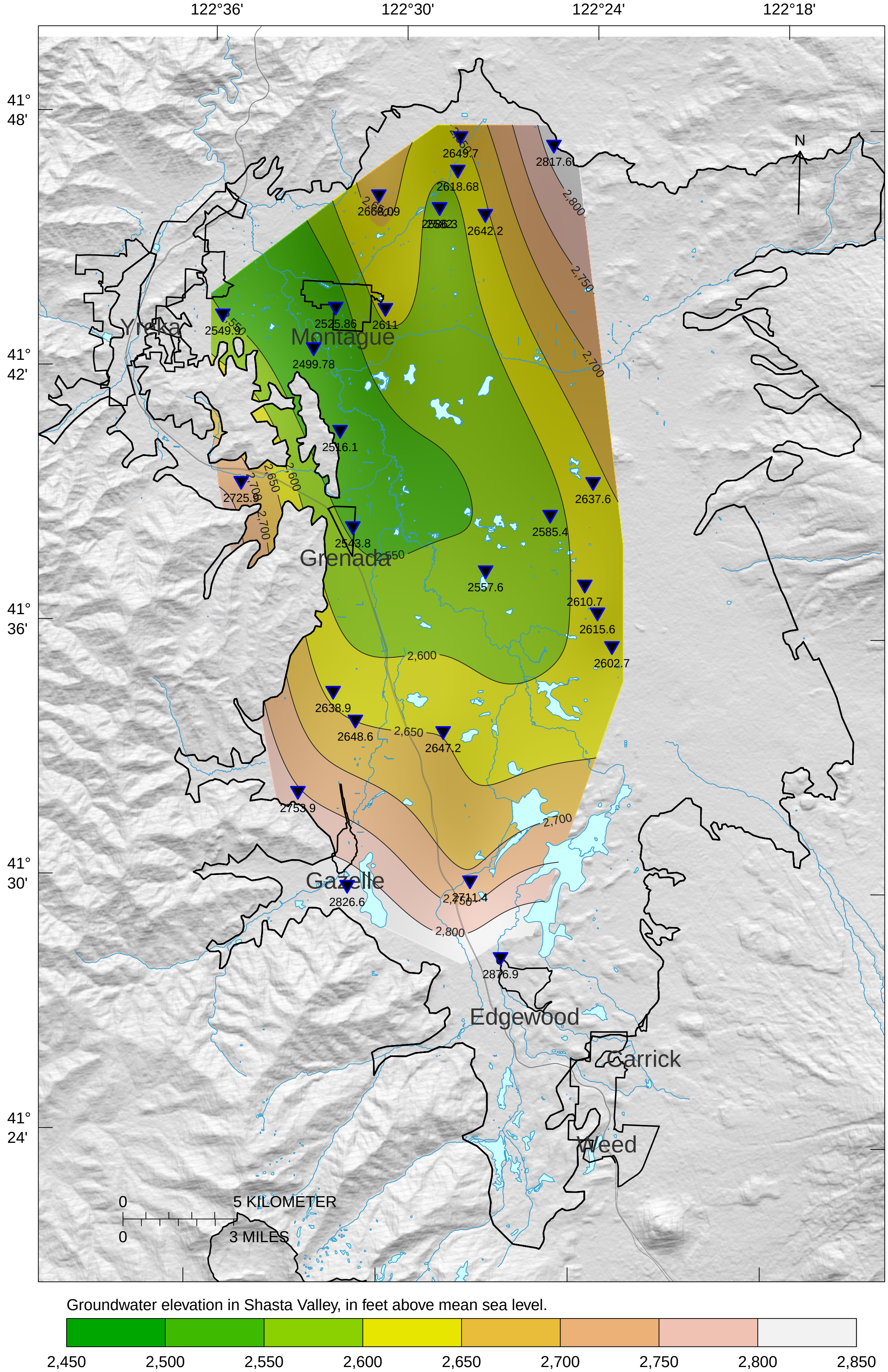


Figure 2: Shasta Valley Groundwater Elevations, Fall 2018

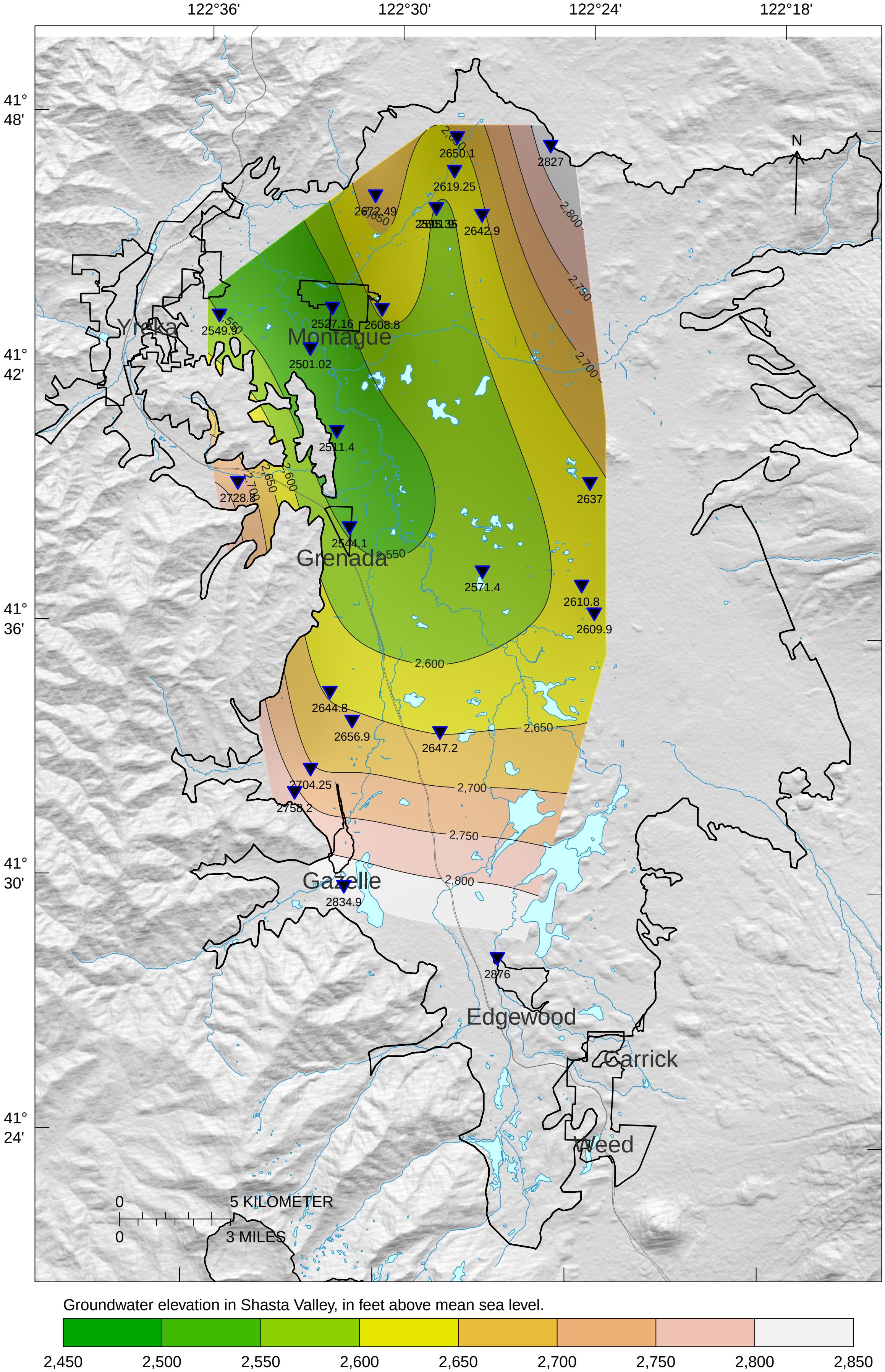


Figure 3: Shasta Valley Groundwater Elevations, Spring 2018

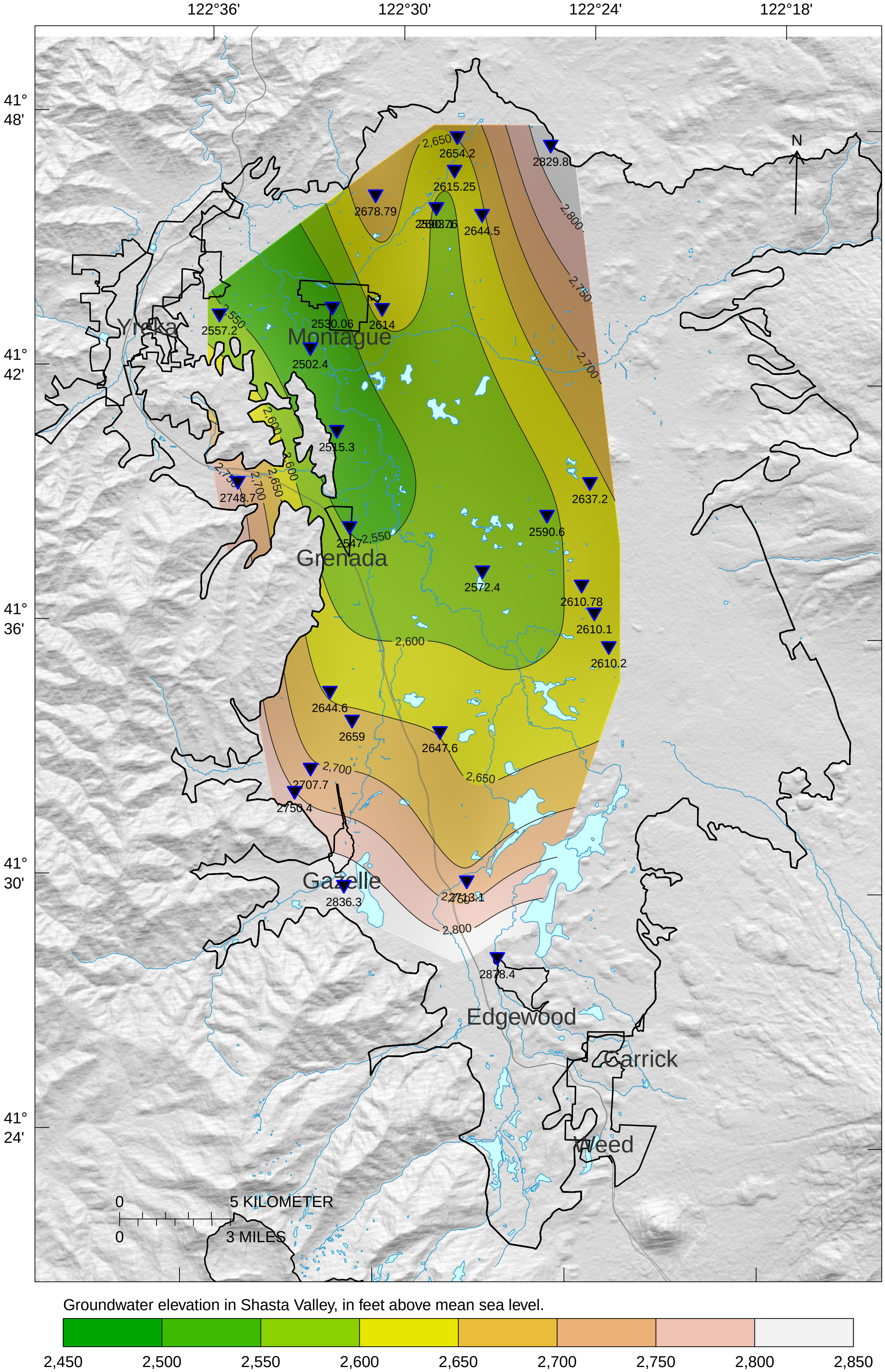


Figure 4: Shasta Valley Groundwater Elevations, Spring 2017

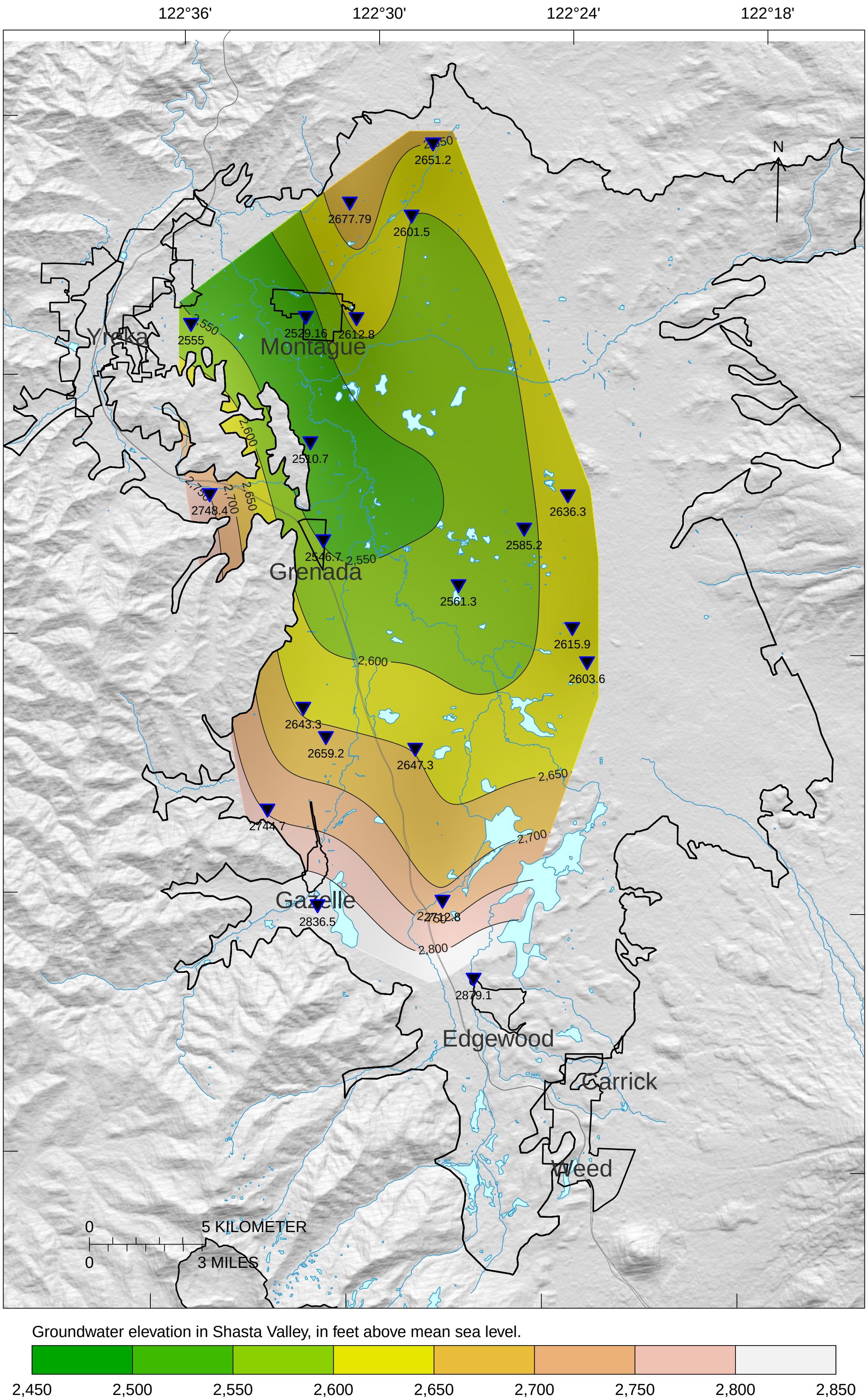


Figure 5: Shasta Valley Groundwater Elevations, Spring 2016

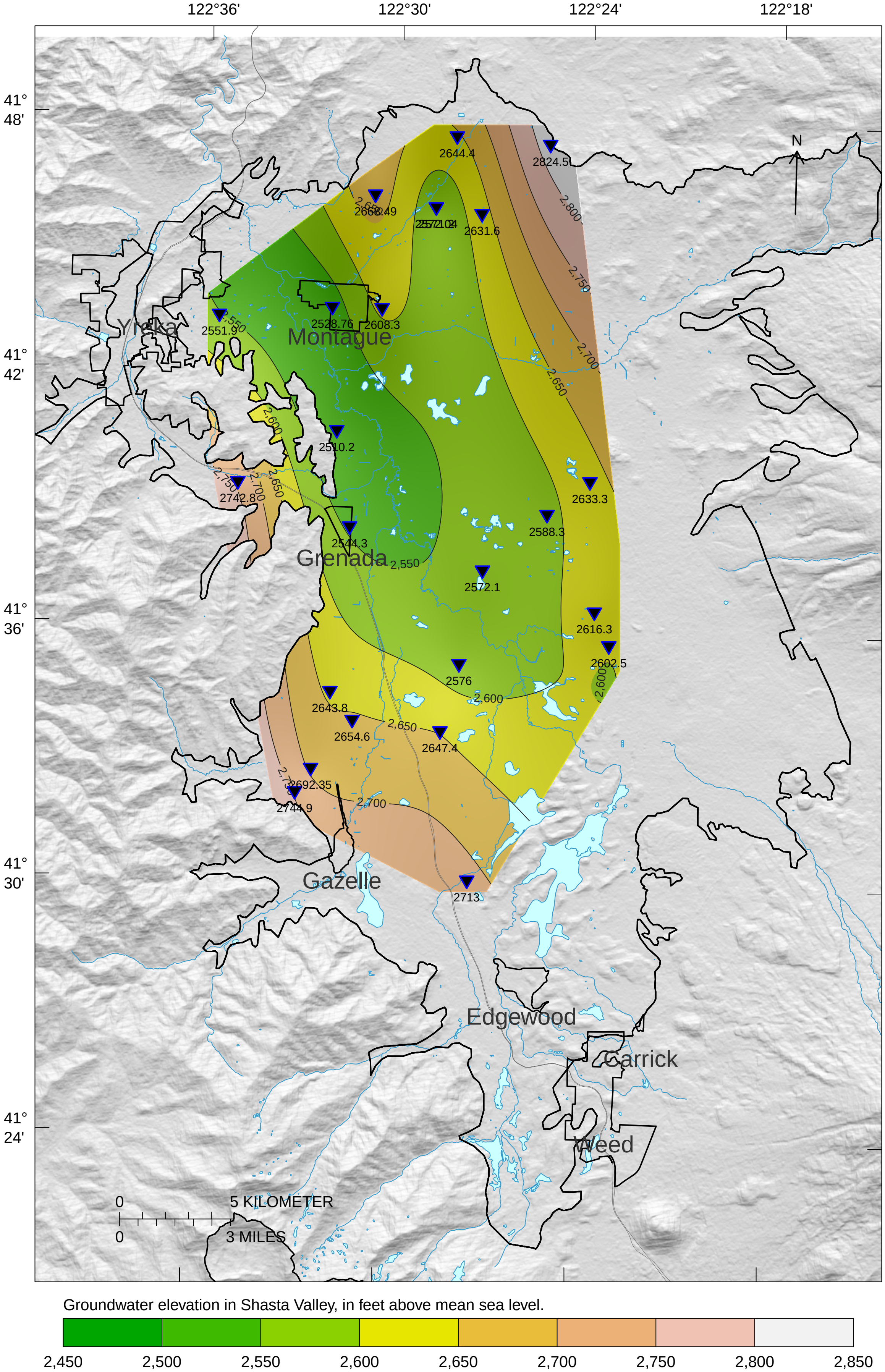


Figure 6: Shasta Valley Groundwater Elevations, Spring 2015

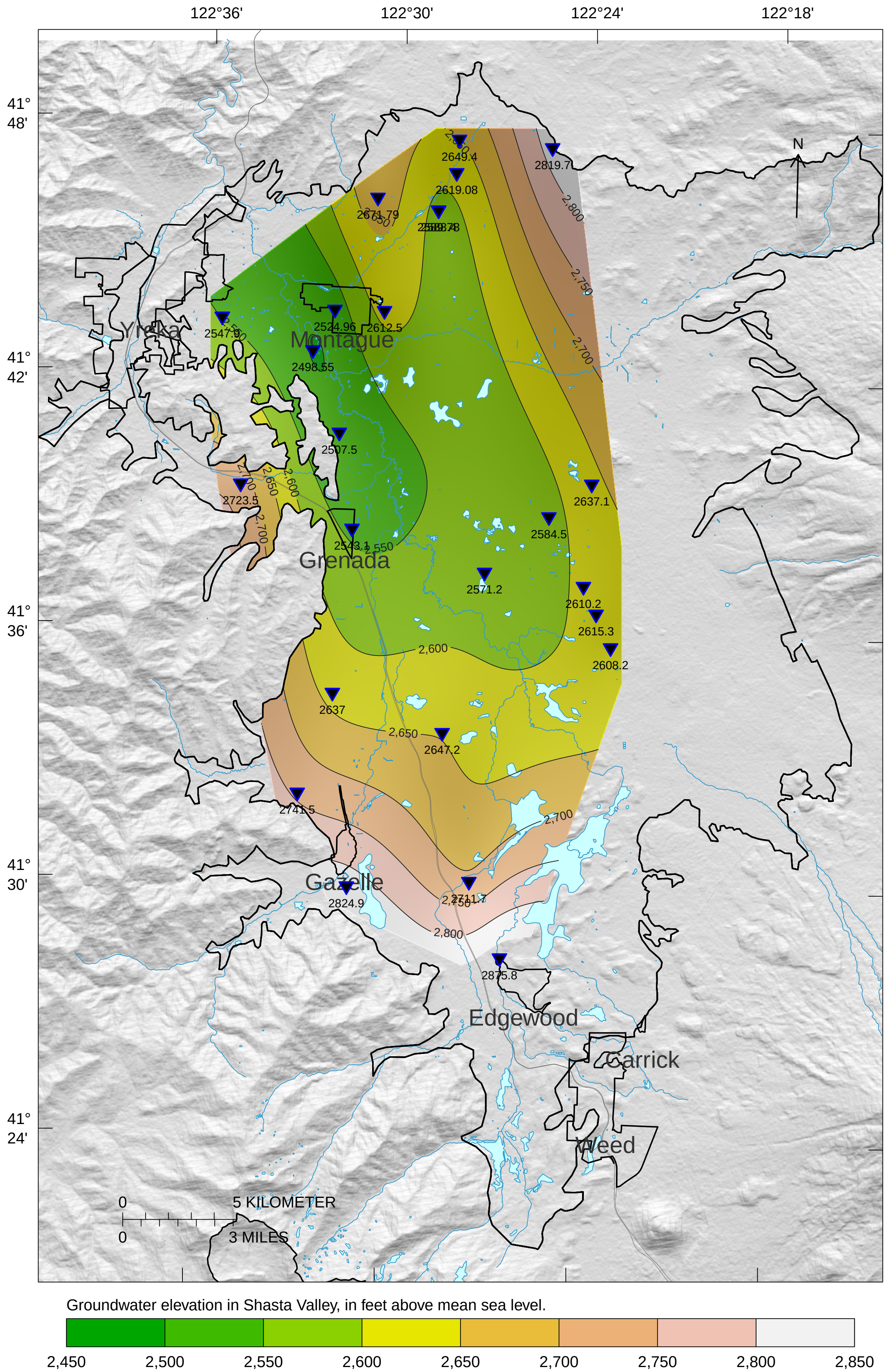


Figure 7: Shasta Valley Groundwater Elevations, Fall 2015

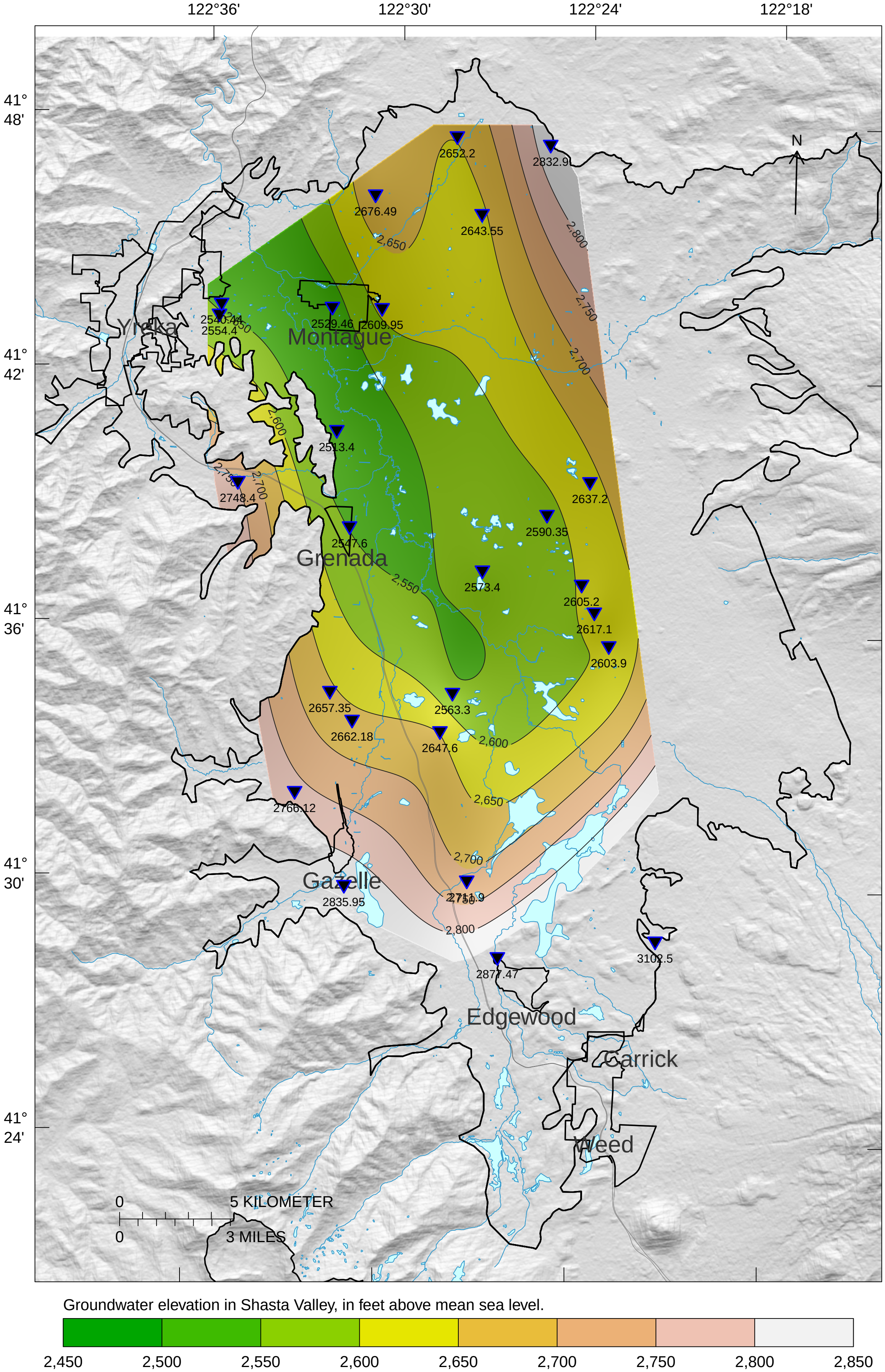


Figure 8: Shasta Valley Groundwater Elevations, Spring 2008

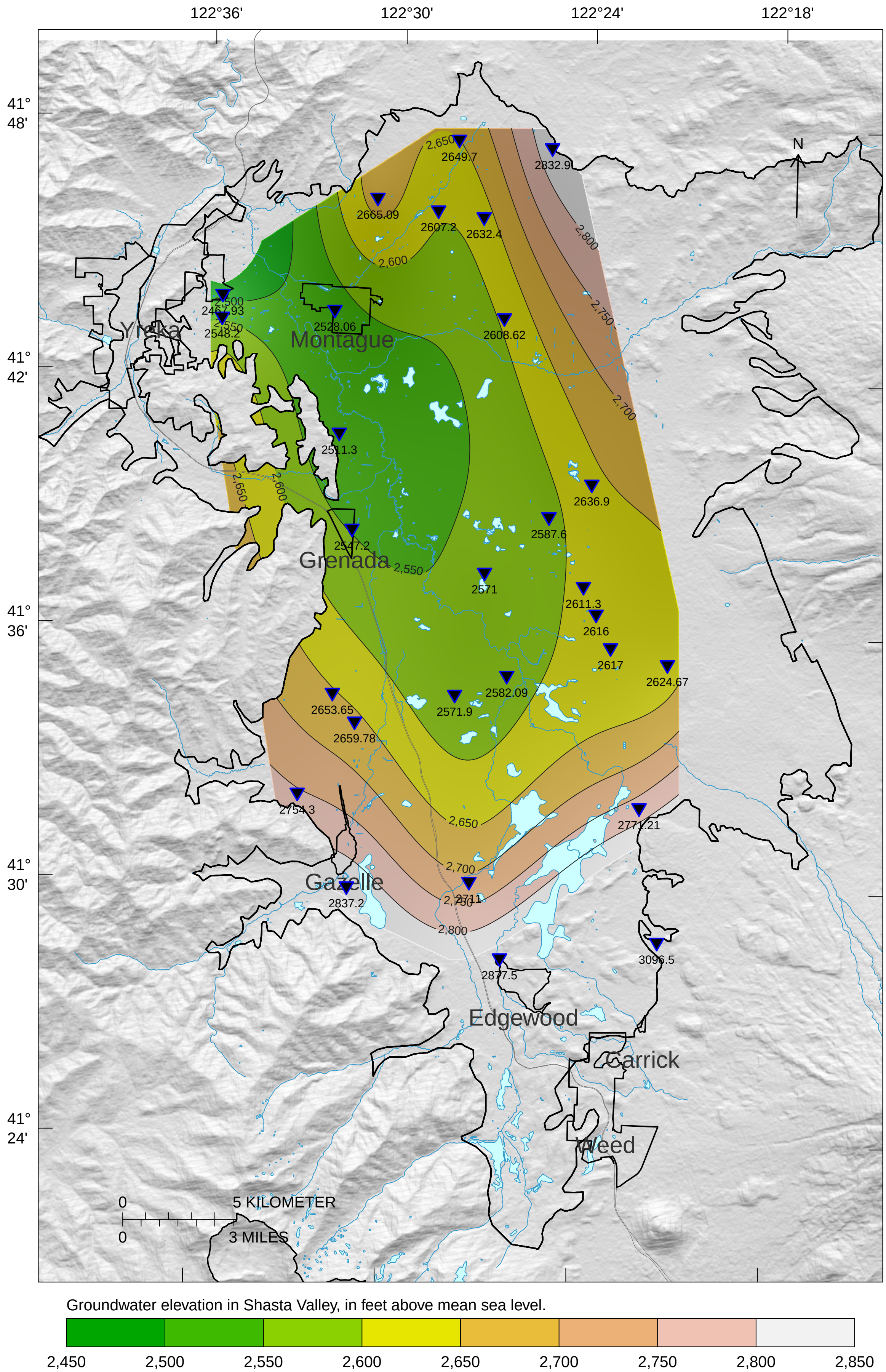


Figure 9: Shasta Valley Groundwater Elevations, Spring 1991

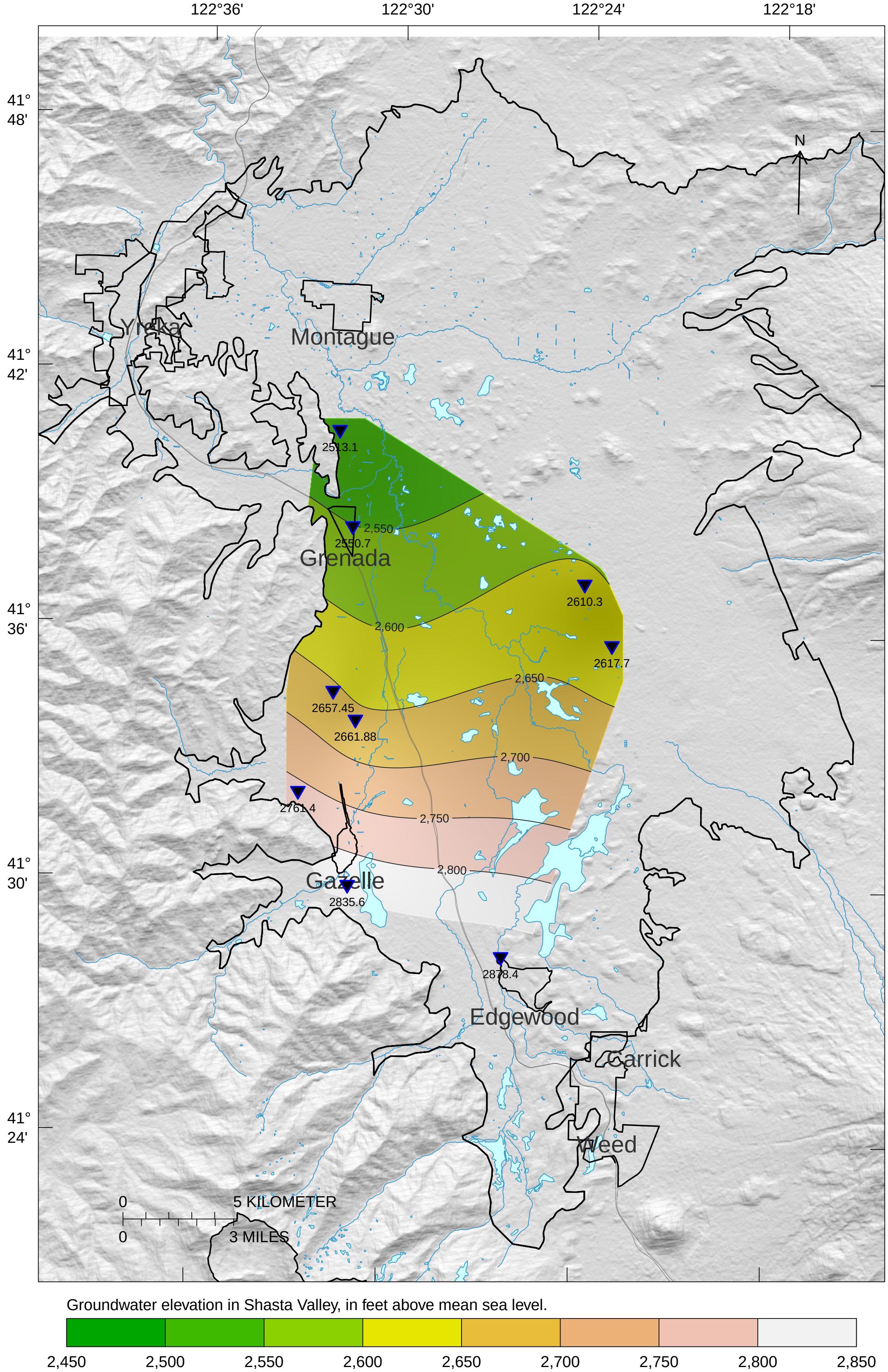


Figure 10: Shasta Valley Groundwater Elevations, Spring 1986

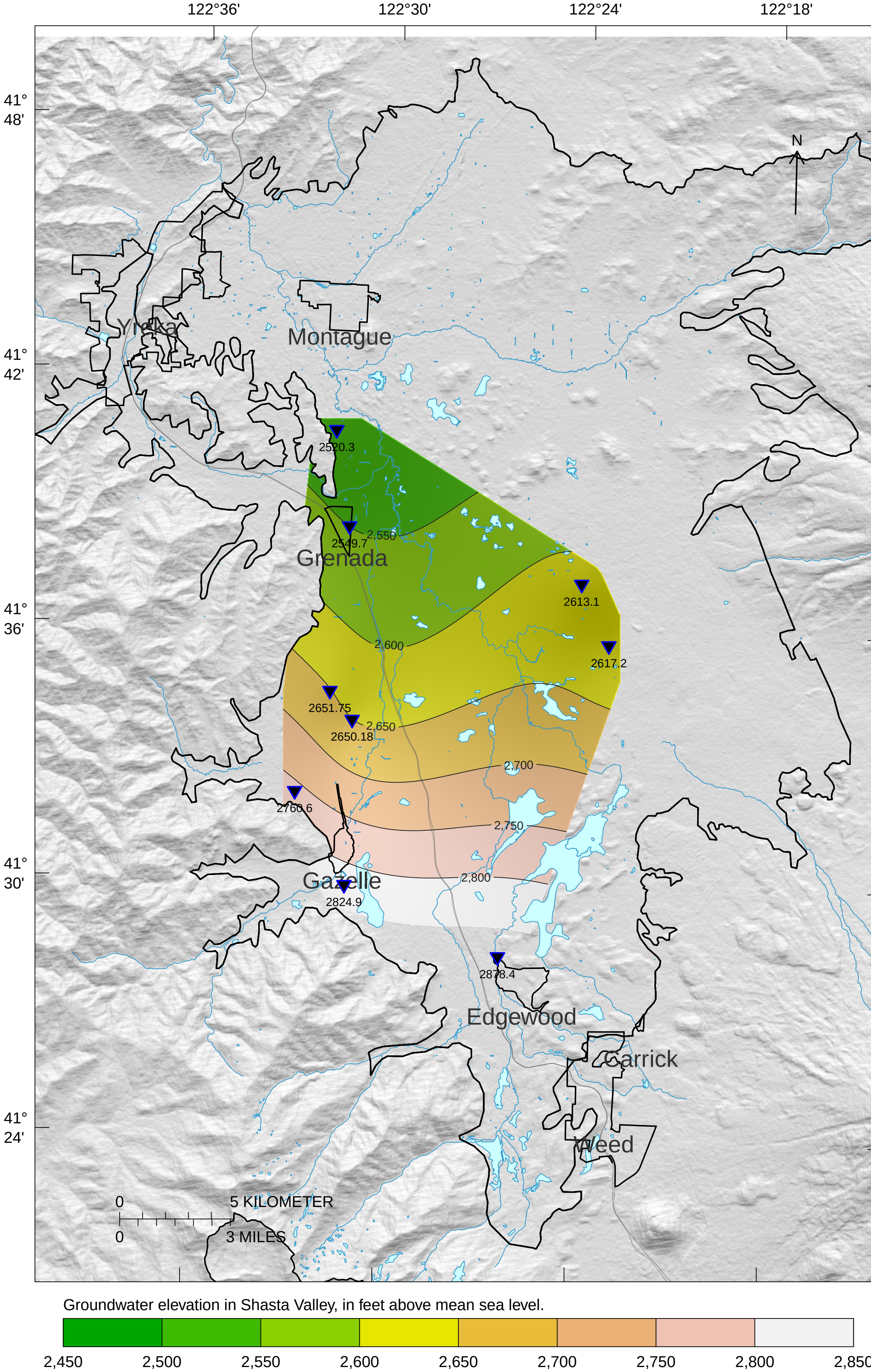


Figure 11: Shasta Valley Groundwater Elevations, Fall 1979

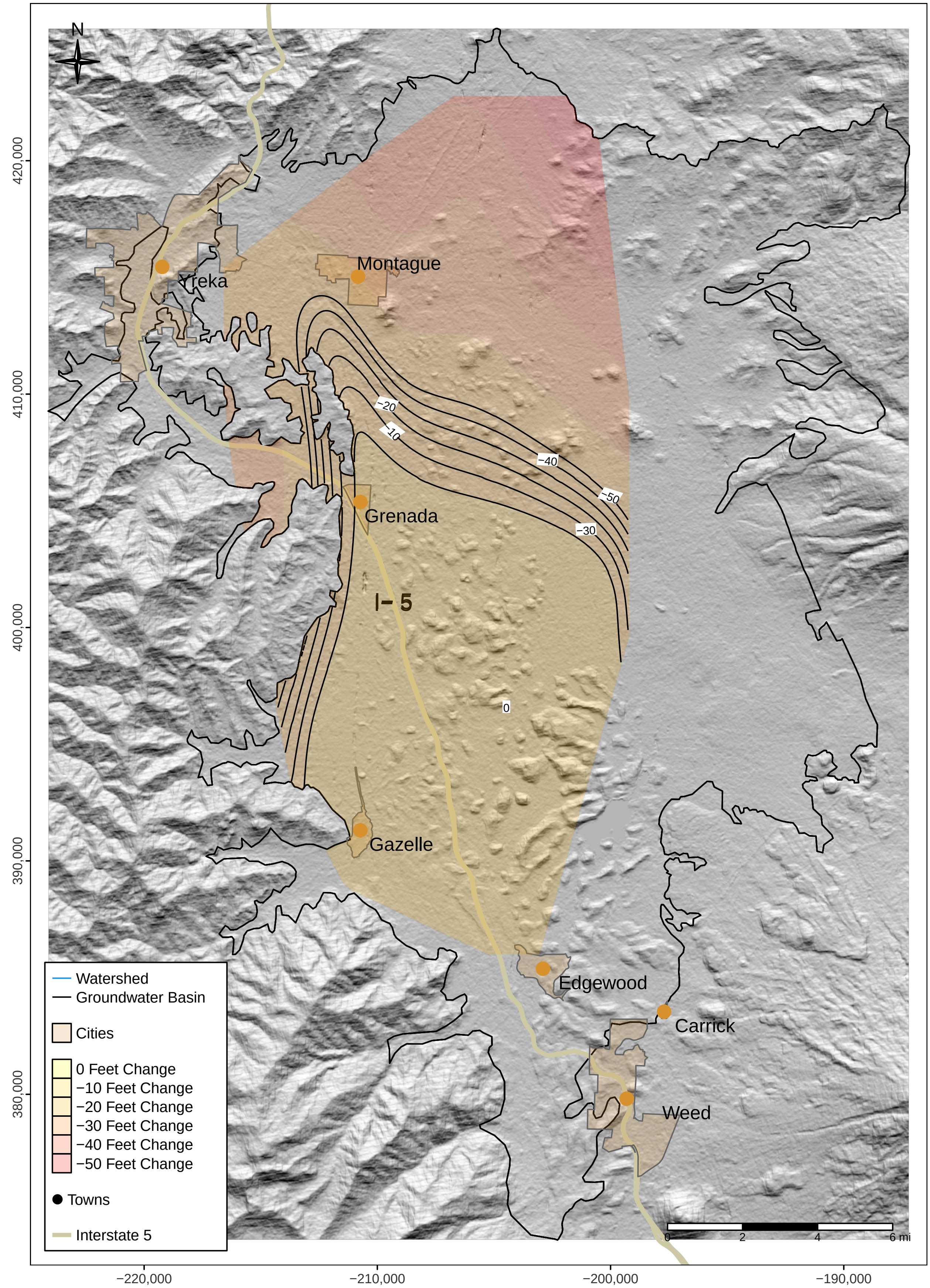


Figure 12: Shasta Valley Groundwater Change from Spring 1986 to Spring 2018

Groundwater Contour Maps - Depth Below Groundwater Surface

Water level changes are shown in Figure 23 for the period between Spring 1978 and Spring 2018. Groundwater contours for depth below ground surface are below.

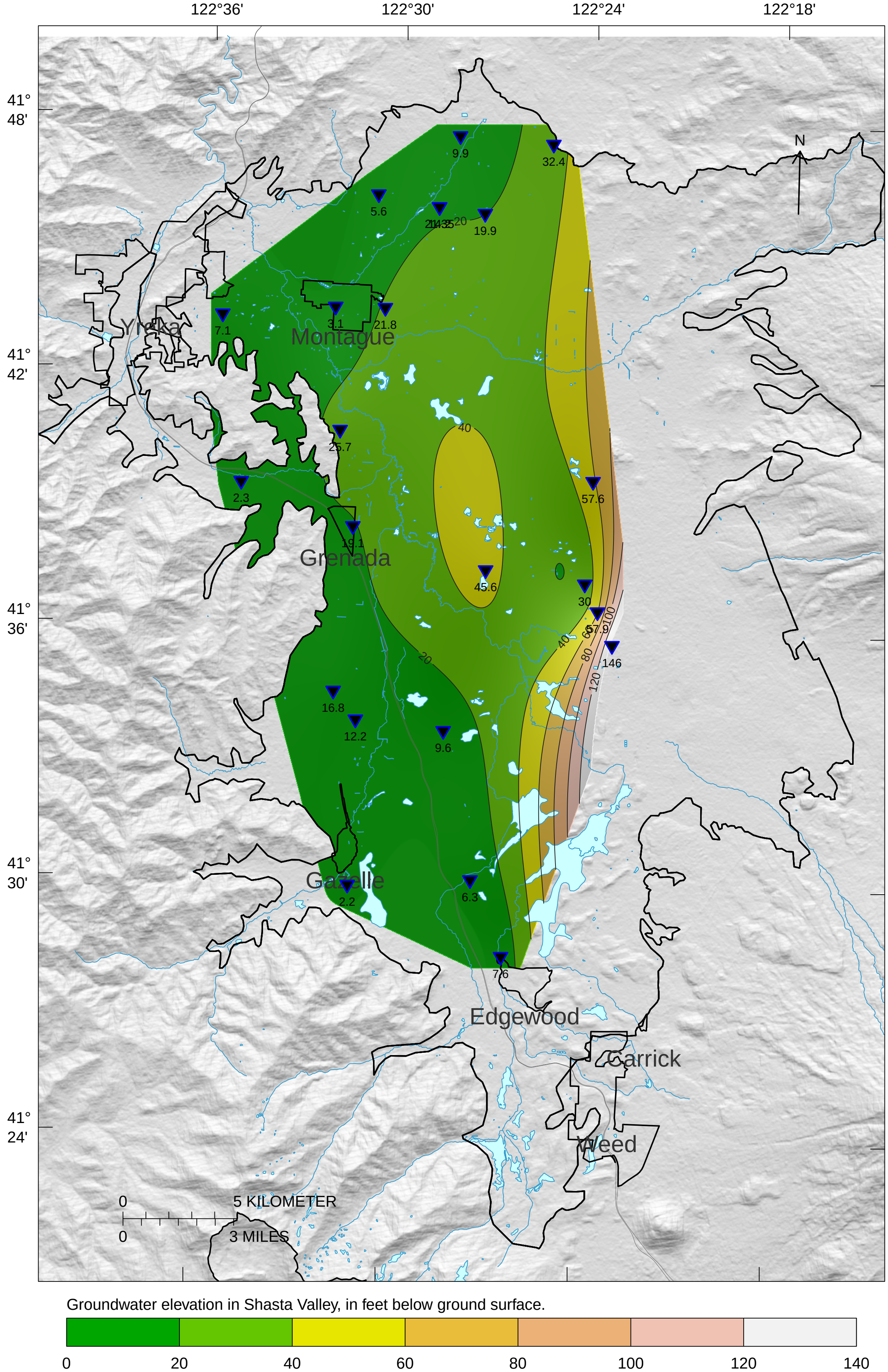


Figure 13: Shasta Valley Groundwater Contours, Spring 2019

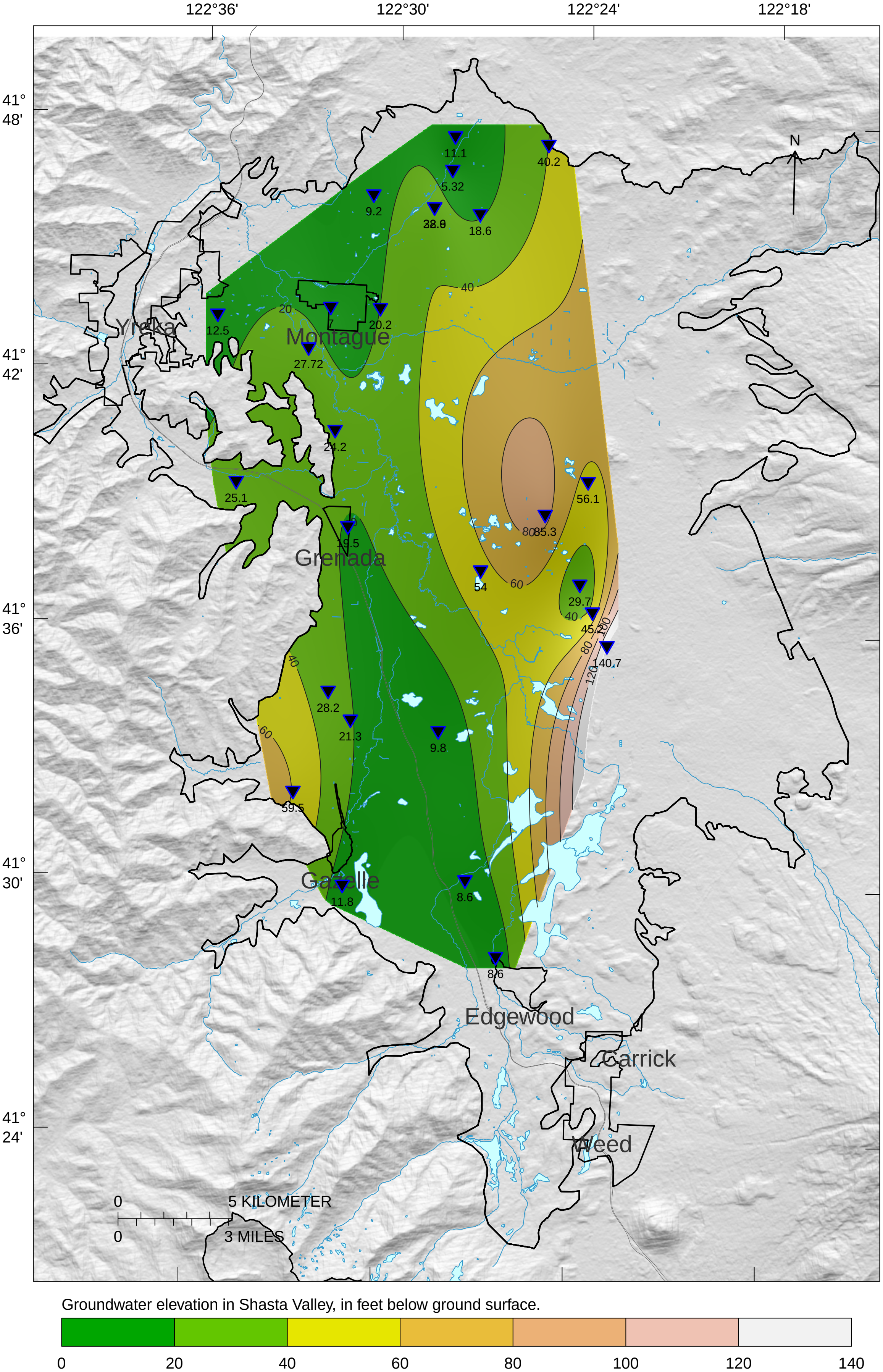


Figure 14: Shasta Valley Groundwater Contours, Fall 2018

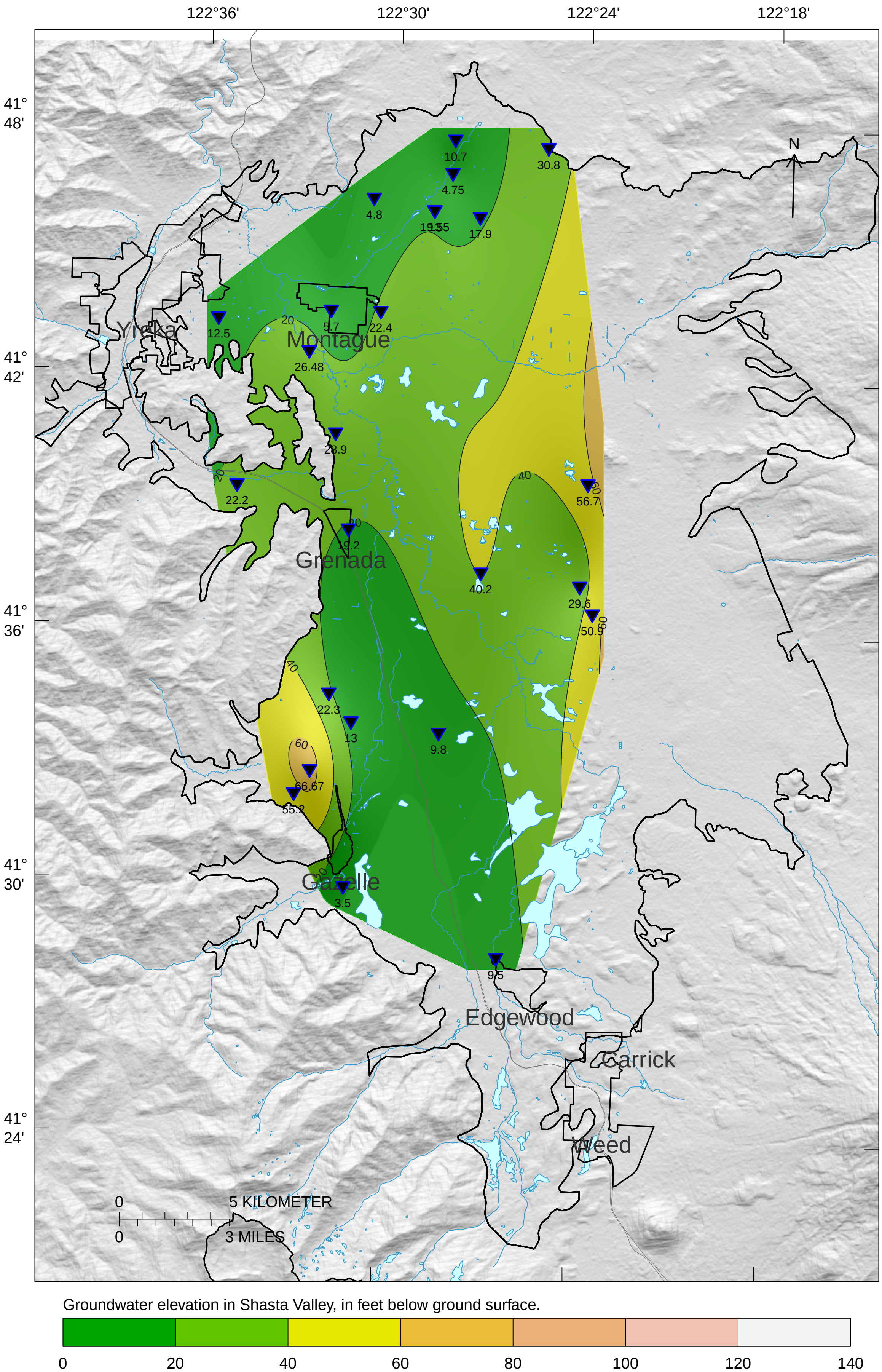


Figure 15: Shasta Valley Groundwater Contours, Spring 2018

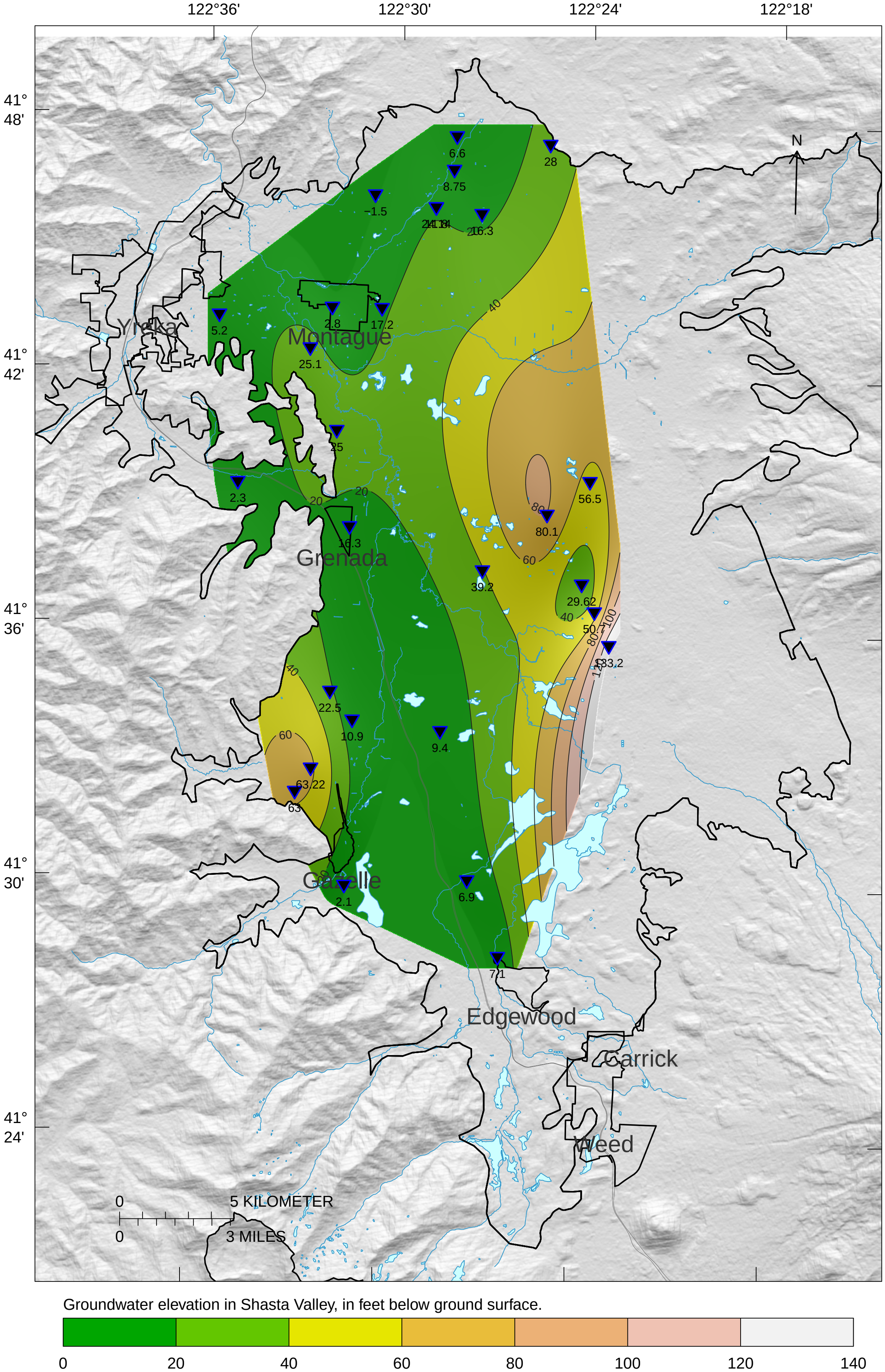


Figure 16: Shasta Valley Groundwater Contours, Spring 2017

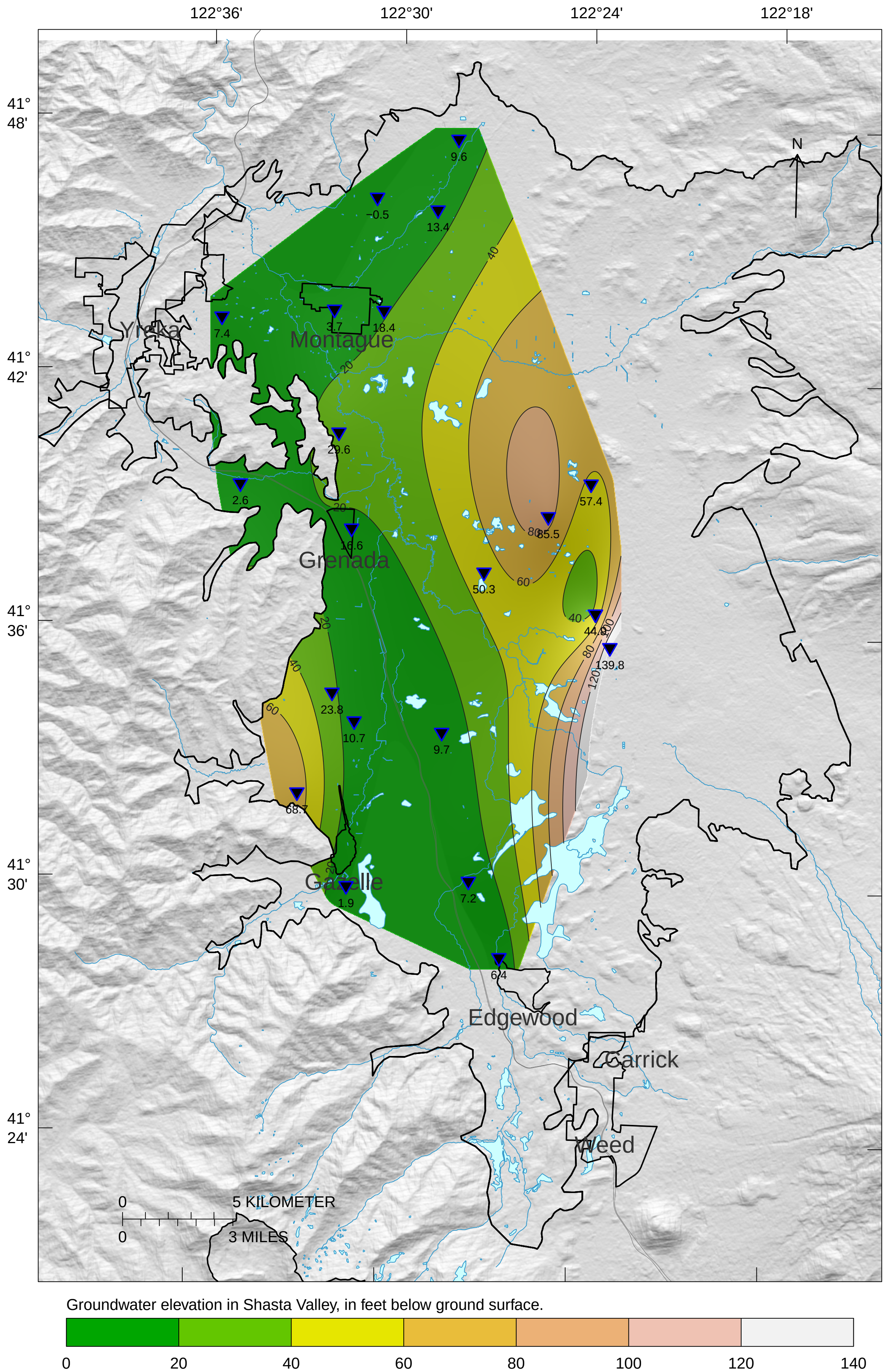
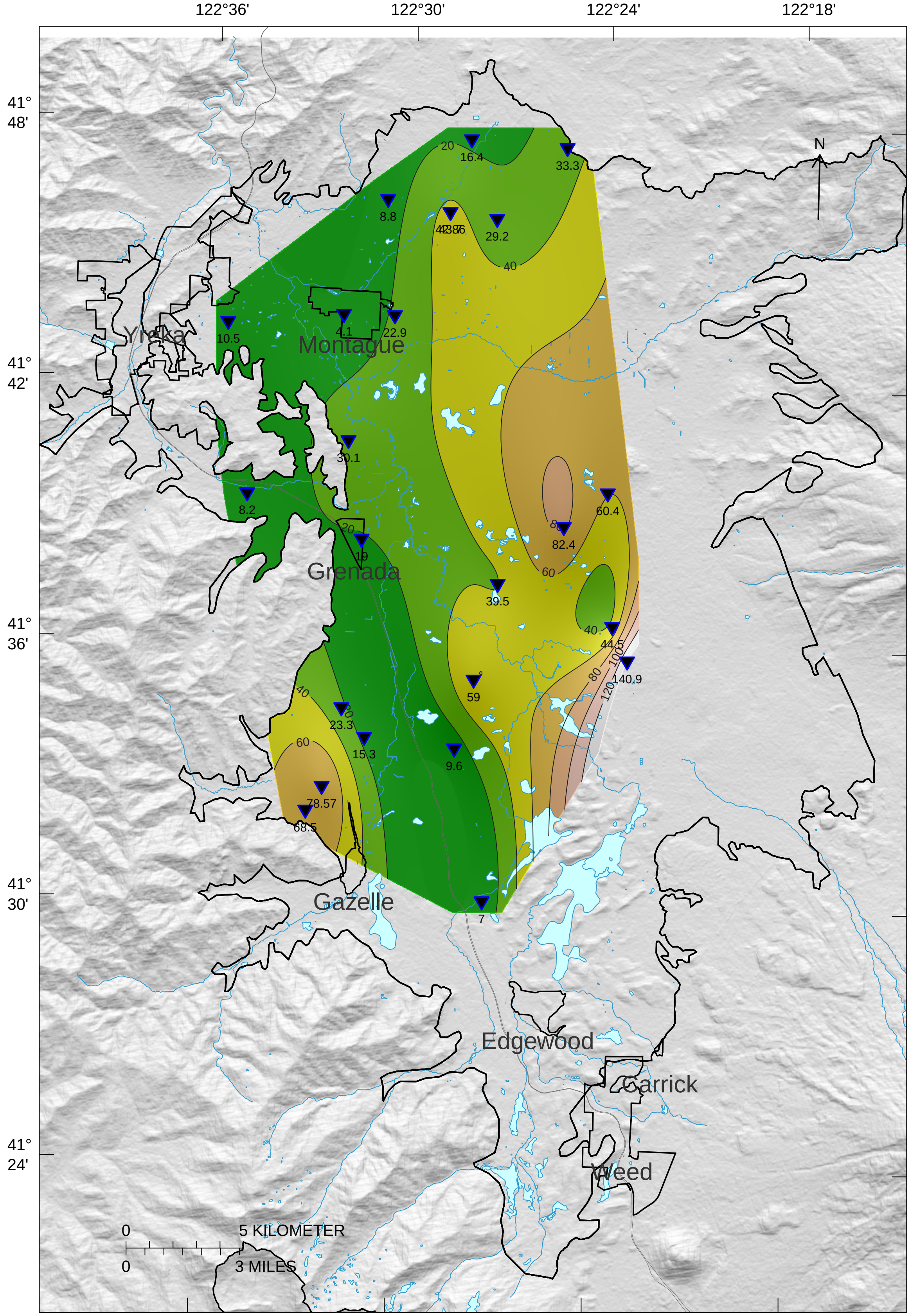


Figure 17: Shasta Valley Groundwater Contours, Spring 2016



Groundwater elevation in Shasta Valley, in feet below ground surface.

0	20	40	60	80	100	120	140

Figure 18: Shasta Valley Groundwater Contour, Spring 2015

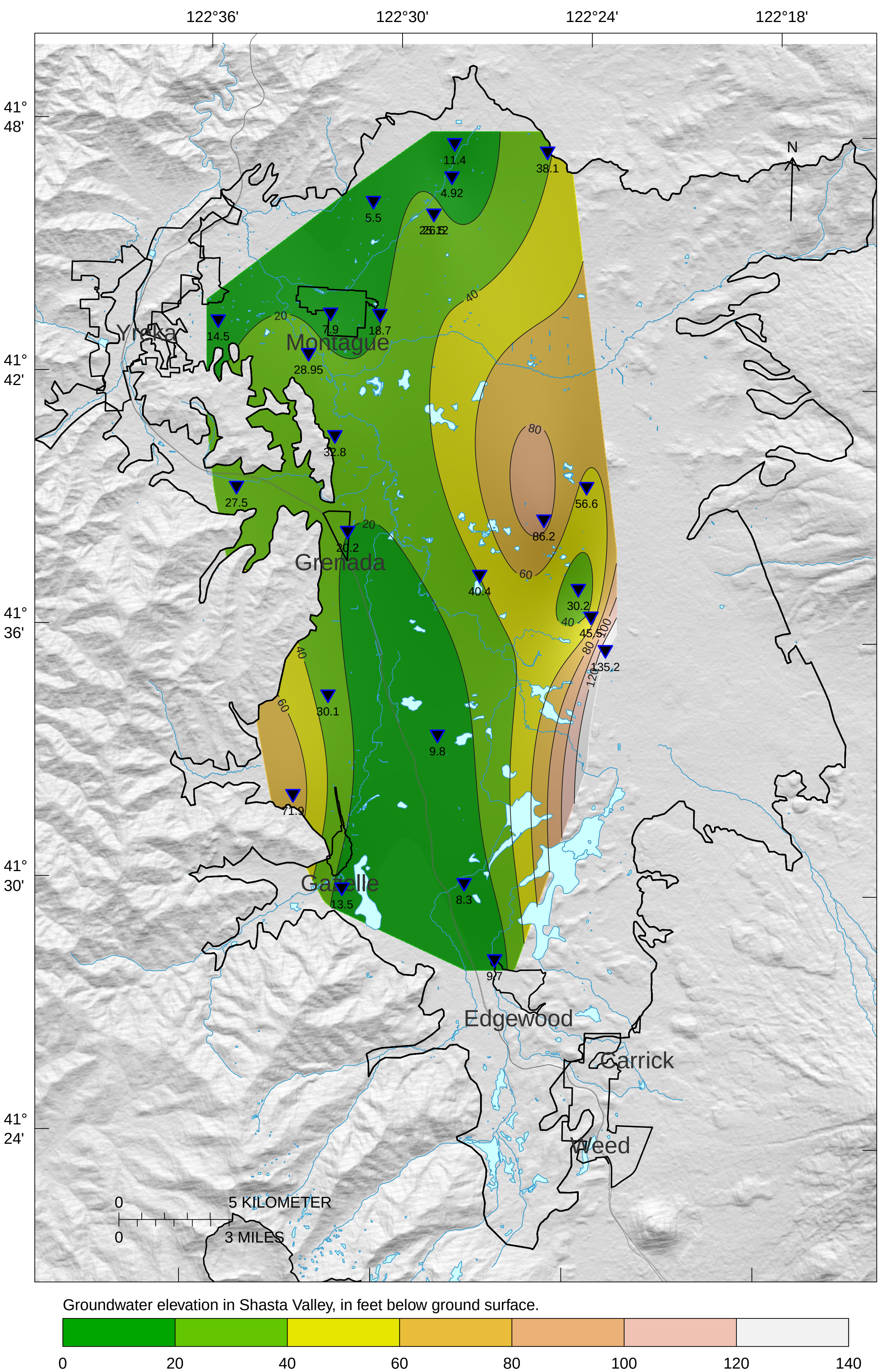


Figure 19: Shasta Valley Groundwater Contour, Fall 2015

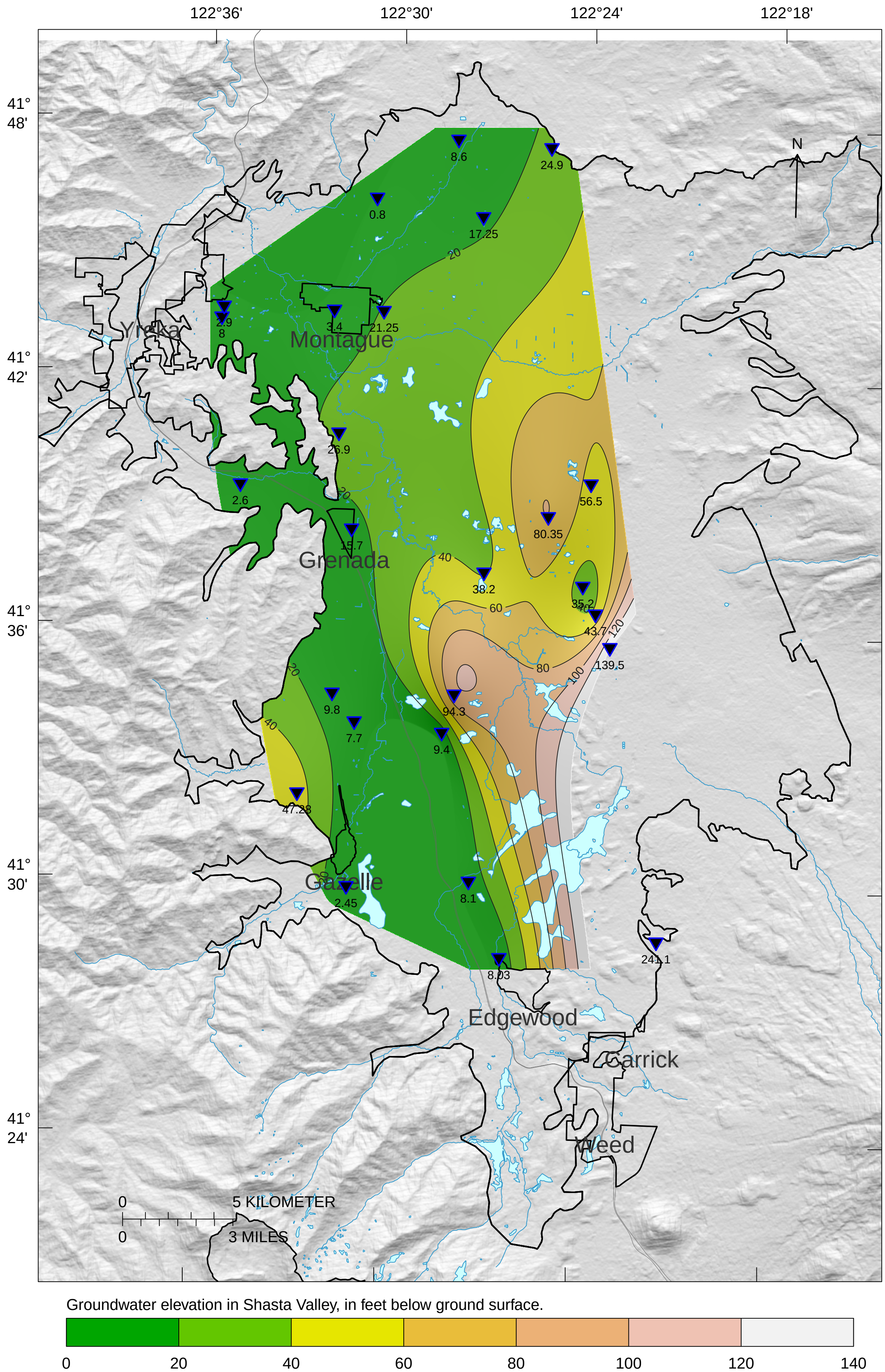


Figure 20: Shasta Valley Groundwater Contours, Spring 2008

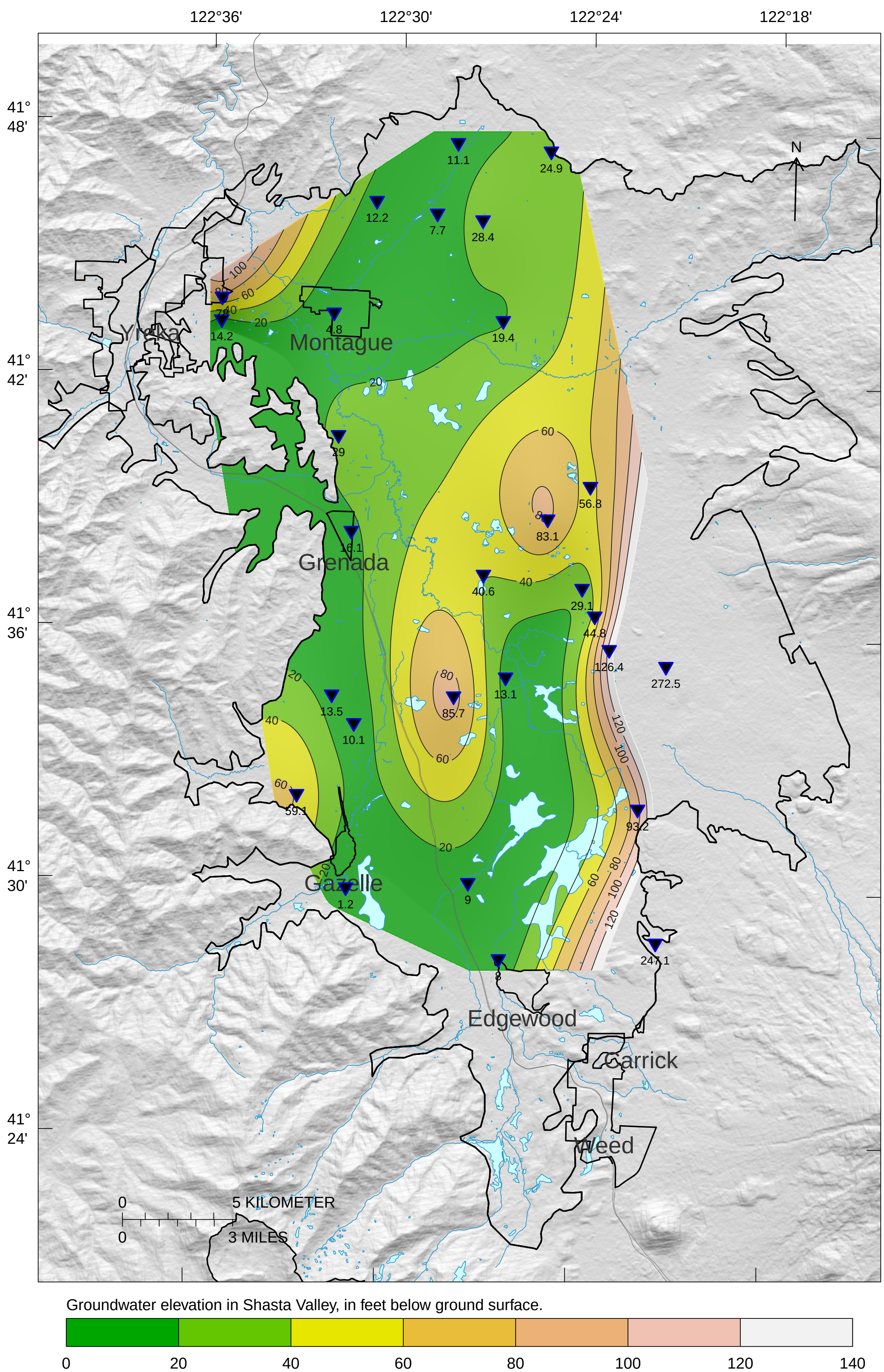


Figure 21: Shasta Valley Groundwater Contours, Spring 1991

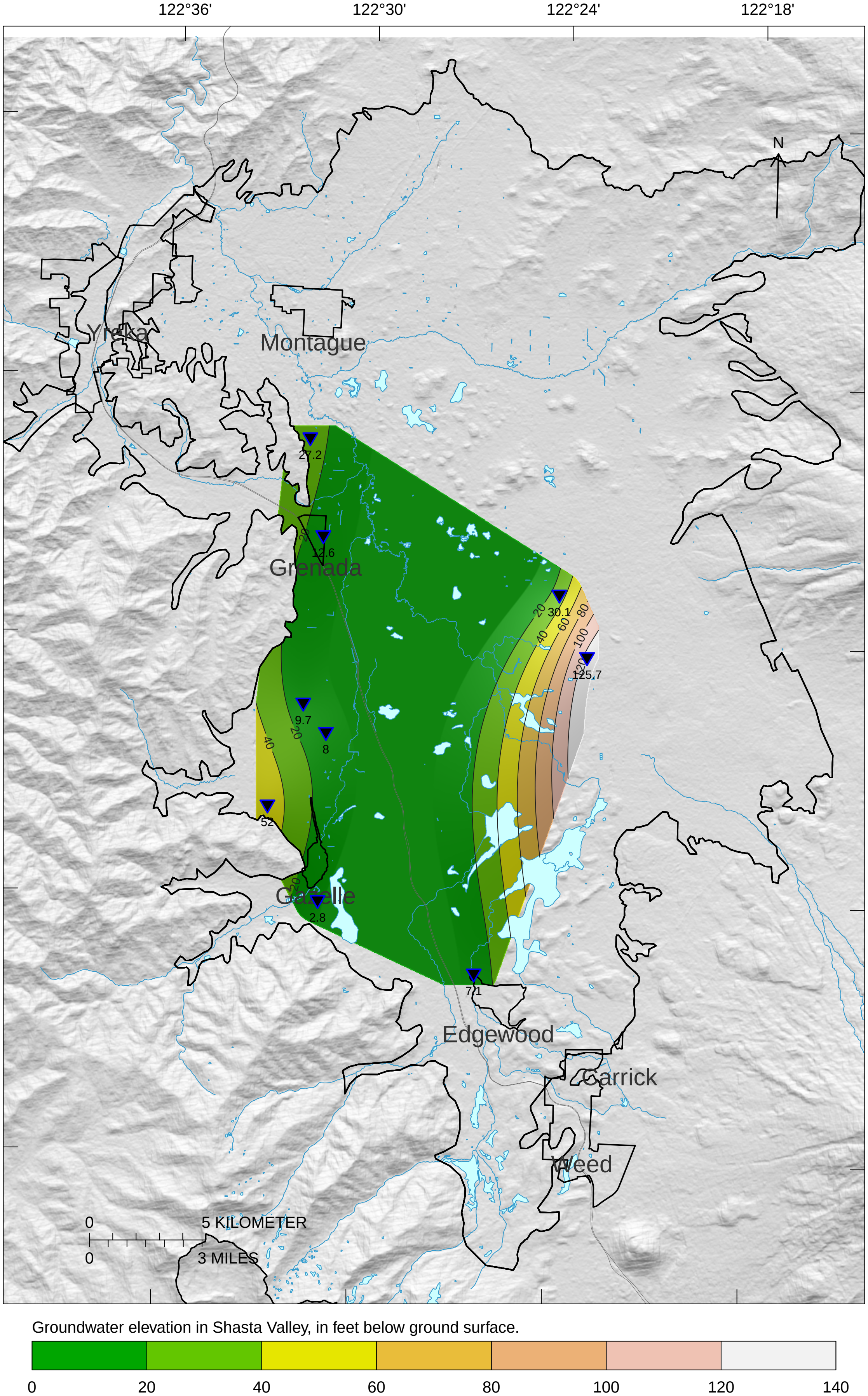


Figure 22: Shasta Valley Groundwater Contours, Spring 1986

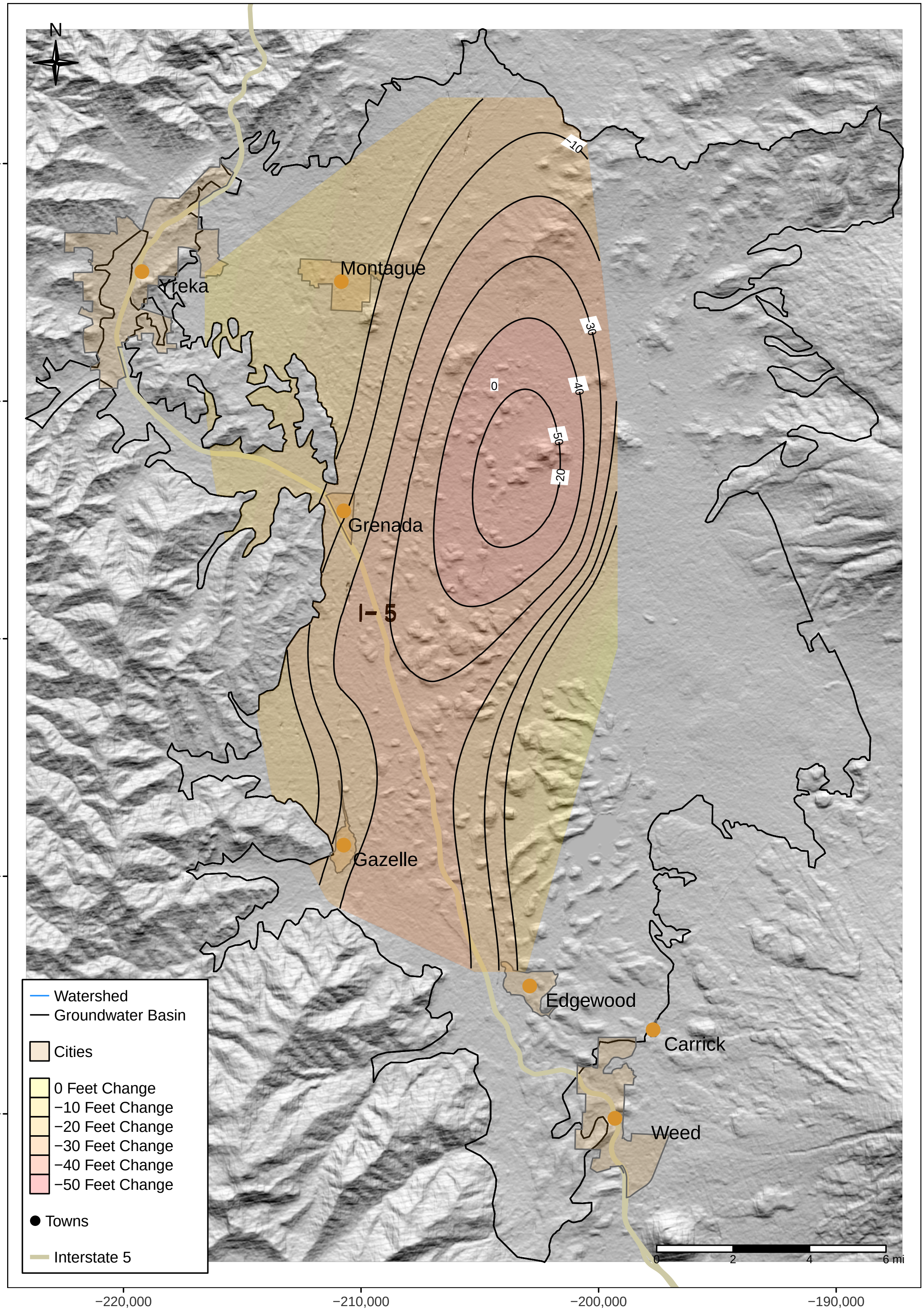
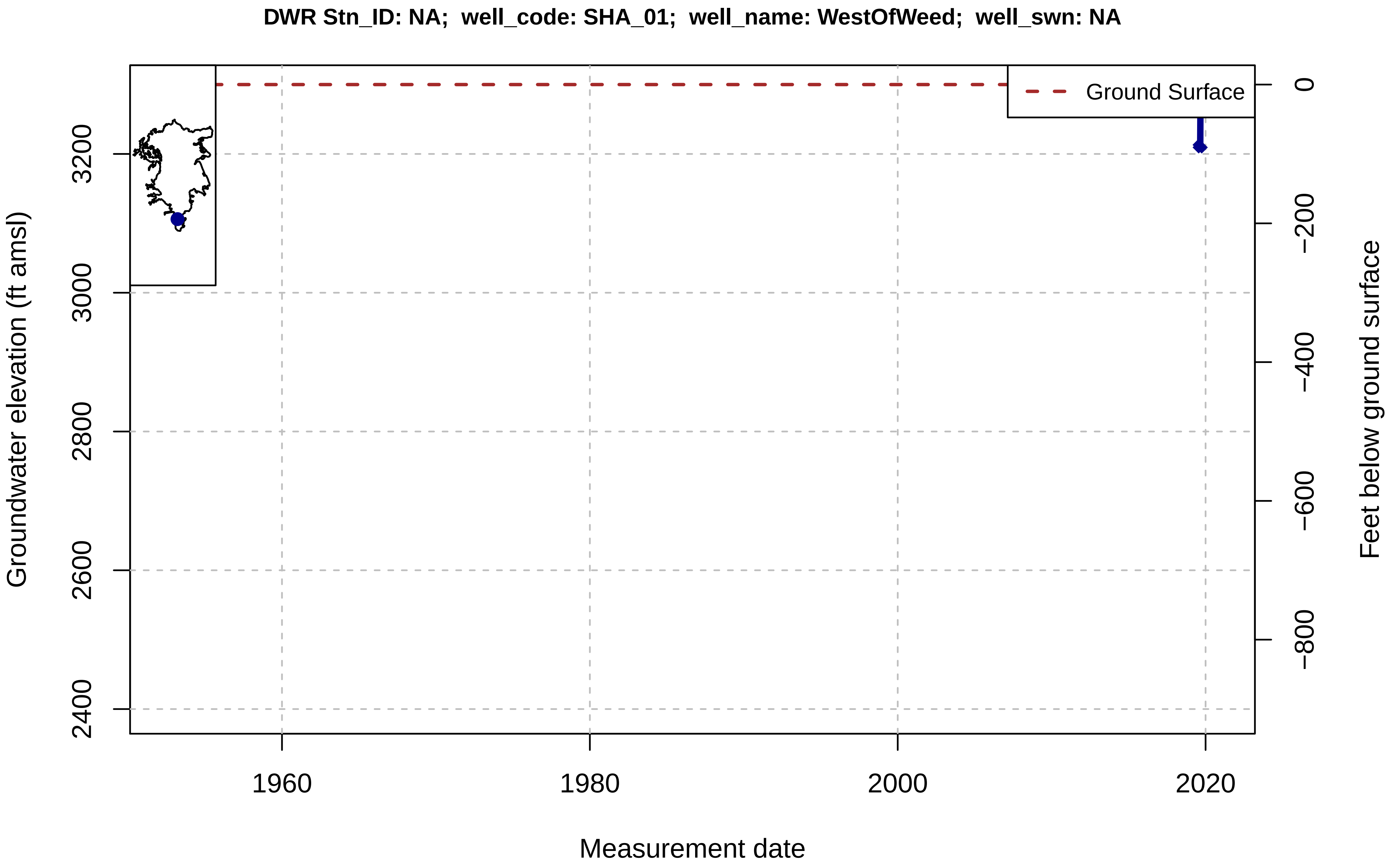


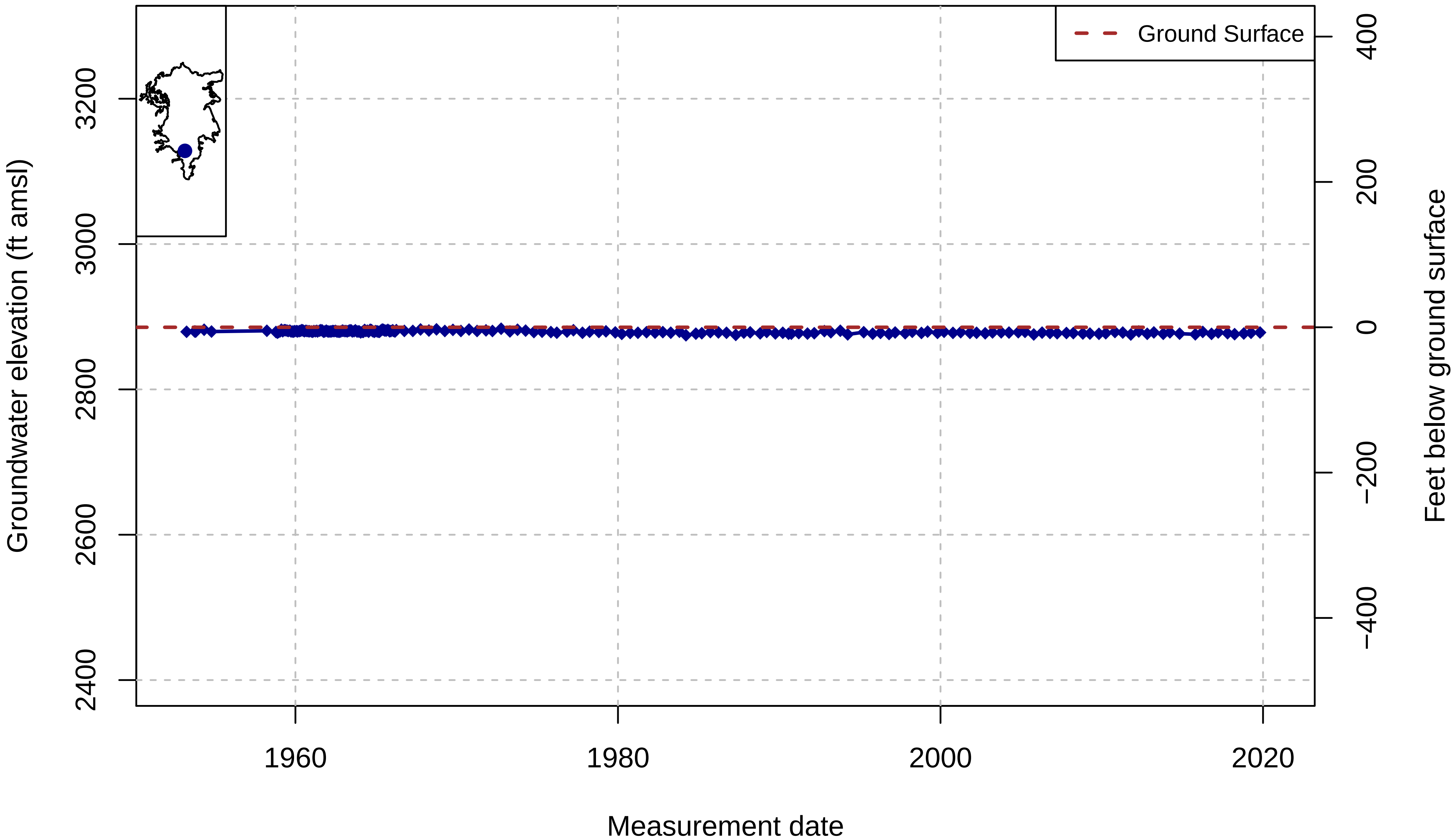
Figure 23: Shasta Valley Groundwater Change from Spring 1986 to Spring 2018

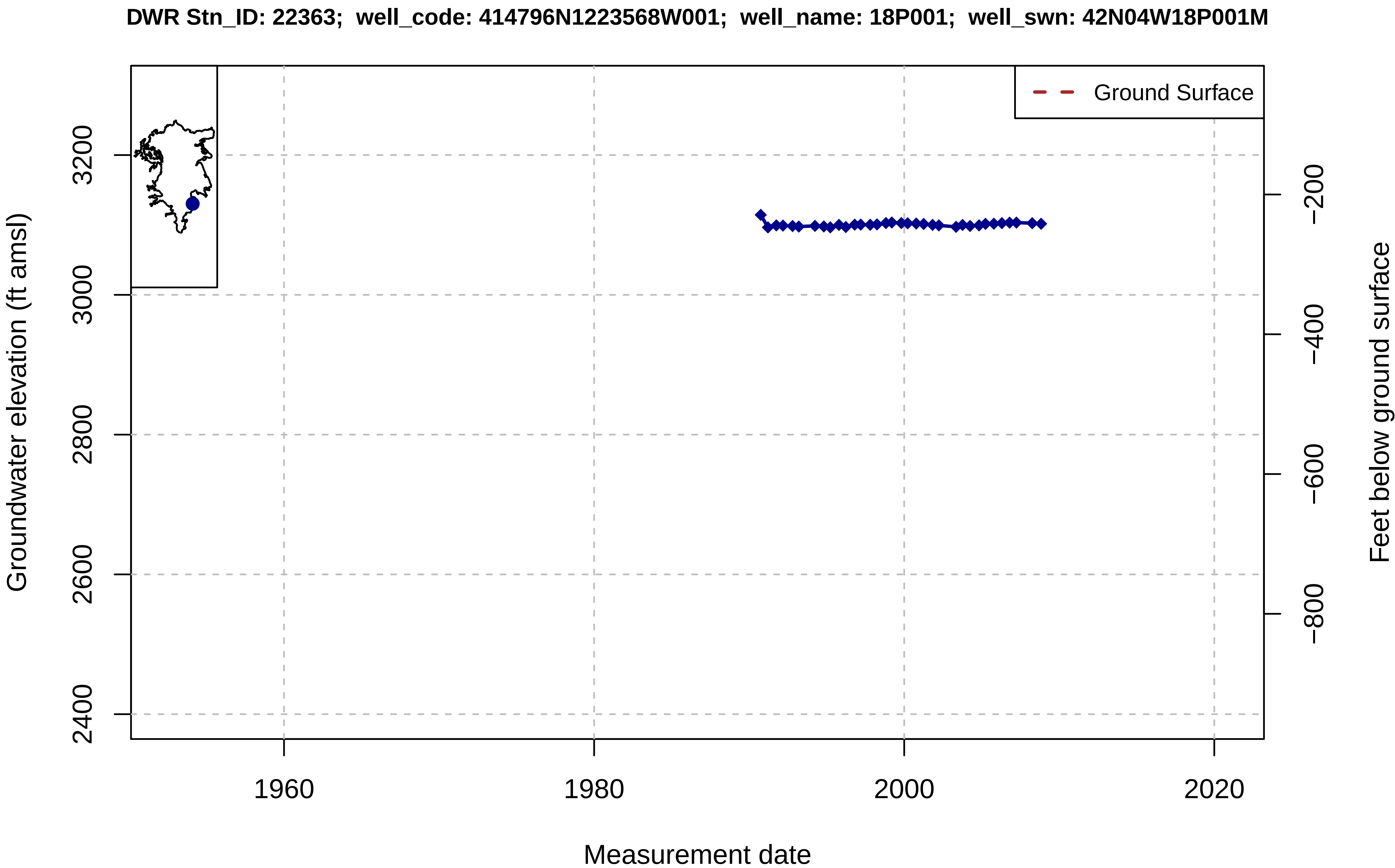
Hydrographs

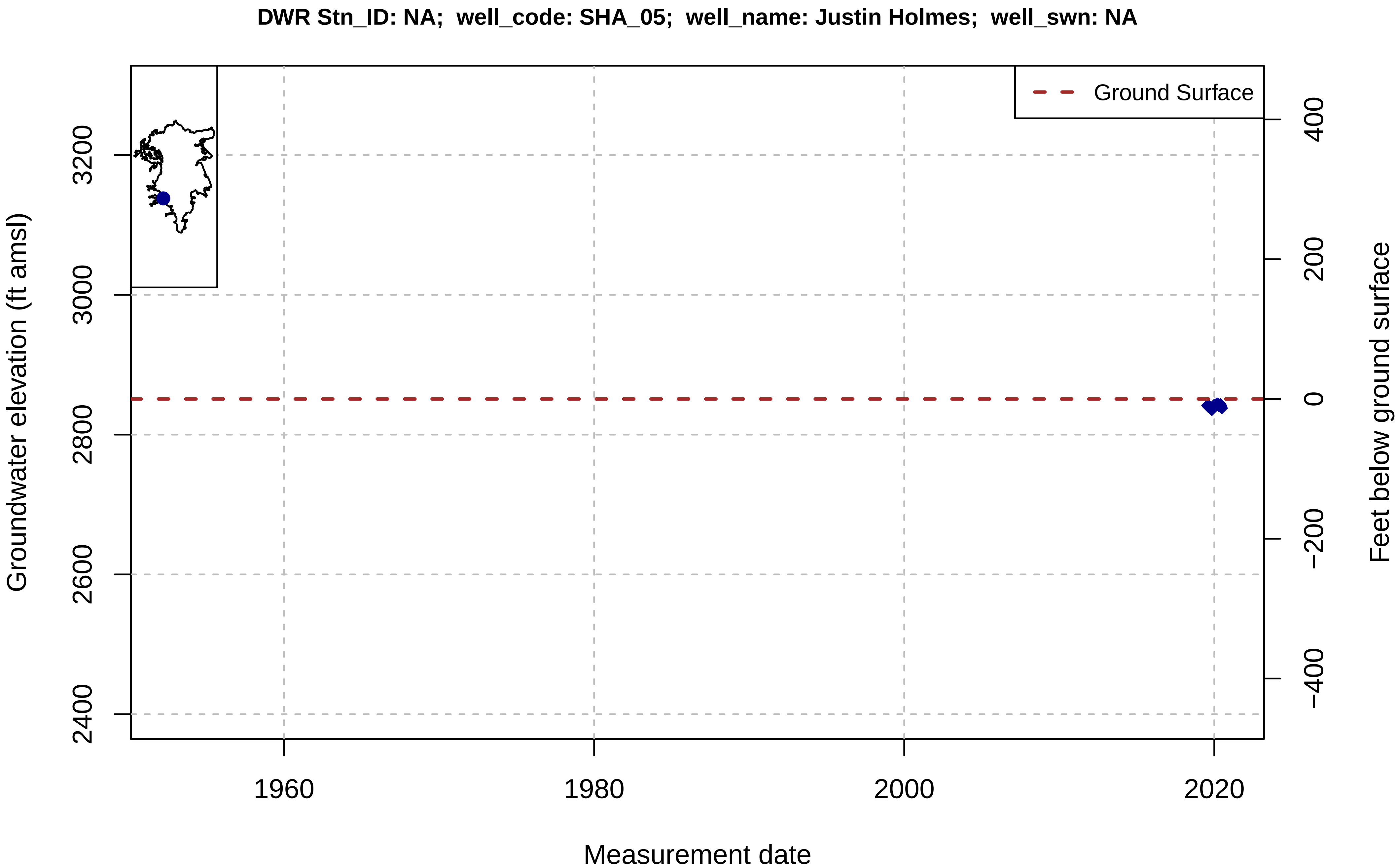


DWR Stn_ID: NA; well_code: SHA_01; well_name: WestOfWeed; well_swn: NA
Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
0
−200
−400
−600
−800
1960
1980
2000
2020
Measurement date

DWR Stn_ID: 22364; well_code: 414719N1224394W001; well_name: 42N05W20J001M; well_swn: 42N05W20J001M

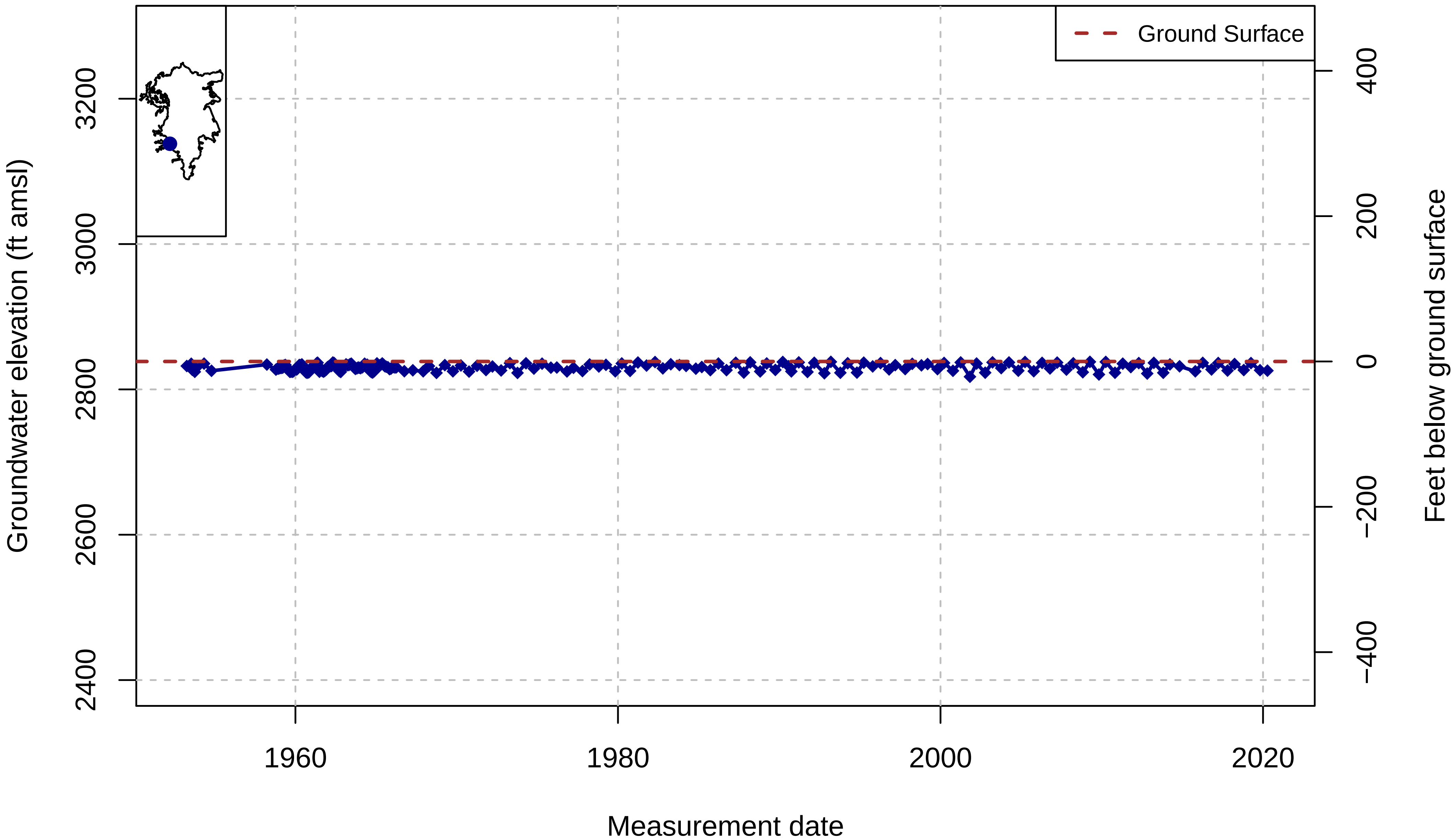


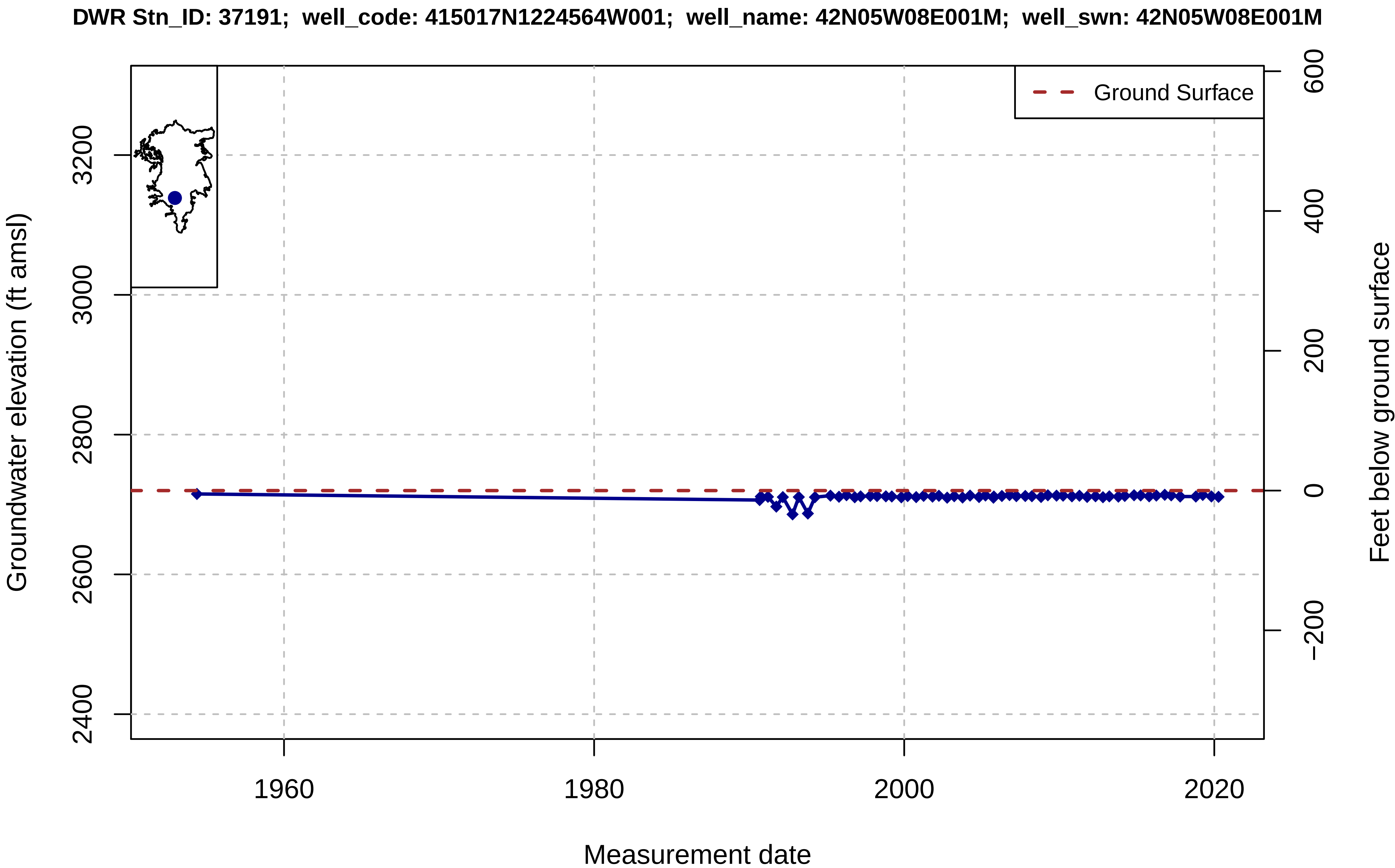

DWR Stn_ID: 22363; well_code: 414796N1223568W001; well_name: 18P001; well_swn: 42N04W18P001M
Ground Surface
Groundwater elevation (ft amsl)
3200
3000
2800
2600
2400
Feet below ground surface
−200
−400
−600
−800
1960
1980
2000
2020
Measurement date



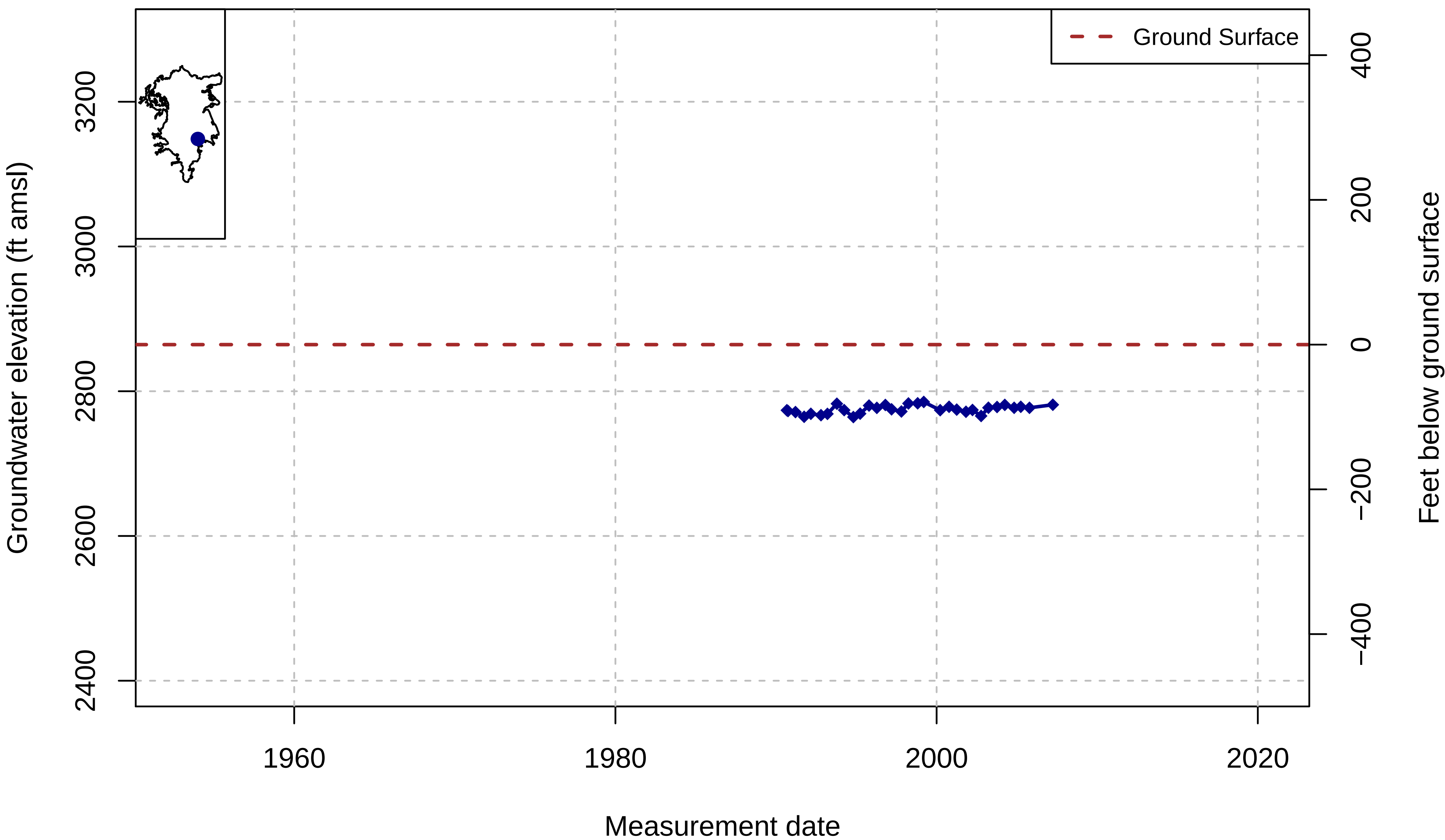
DWR Stn_ID: NA; well_code: SHA_05; well_name: Justin Holmes; well_swn: NA
Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
400
200
0
−200
−400
1960
1980
2000
2020
Measurement date

DWR Stn_ID: 22365; well_code: 414987N1225202W001; well_name: 42N06W10J001M; well_swn: 42N06W10J001M

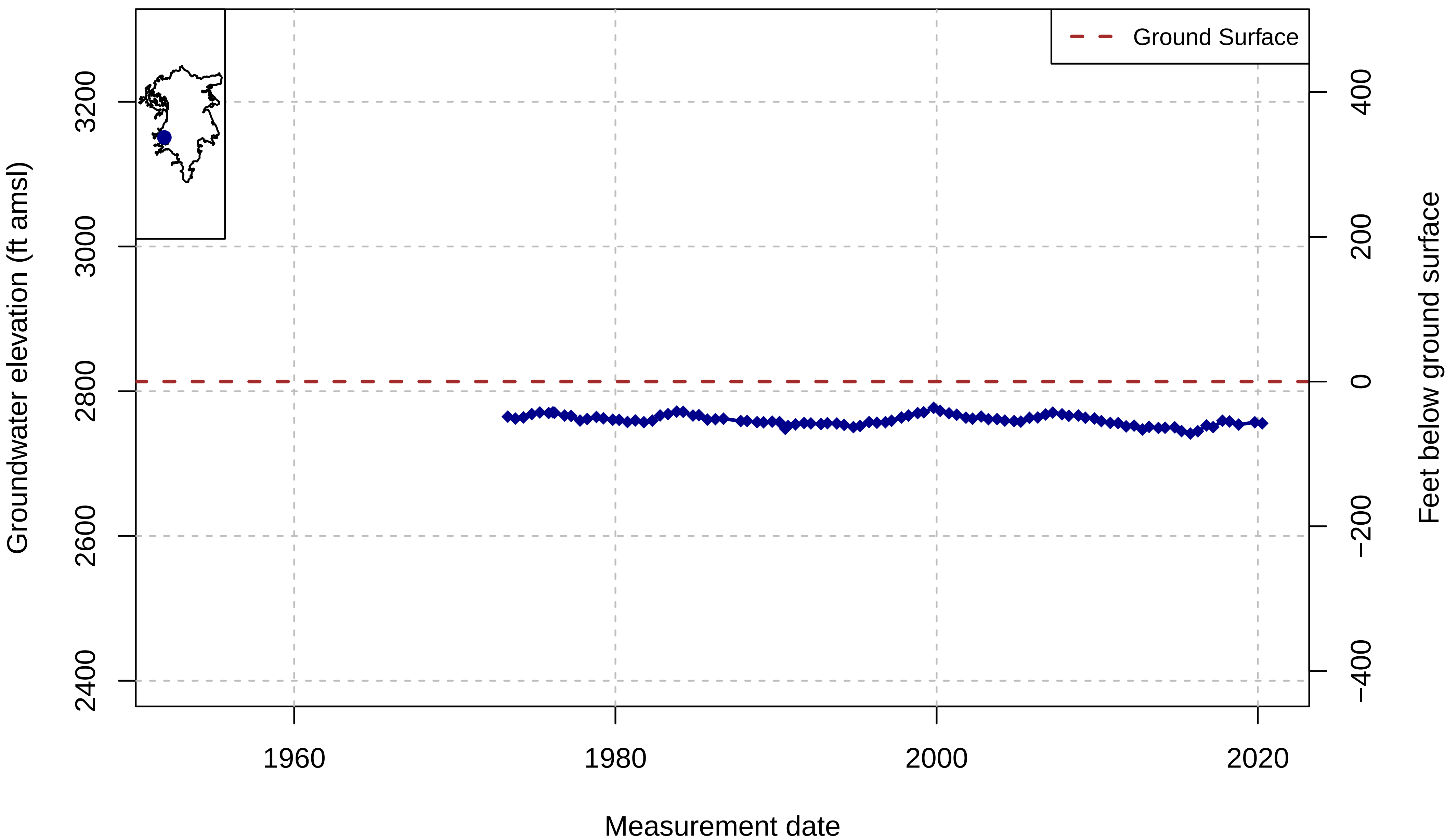



DWR Stn_ID: 37191; well_code: 415017N1224564W001; well_name: 42N05W08E001M; well_swn: 42N05W08E001M
Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
−200
0
200
400
600
1960
1980
2000
2020
Measurement date

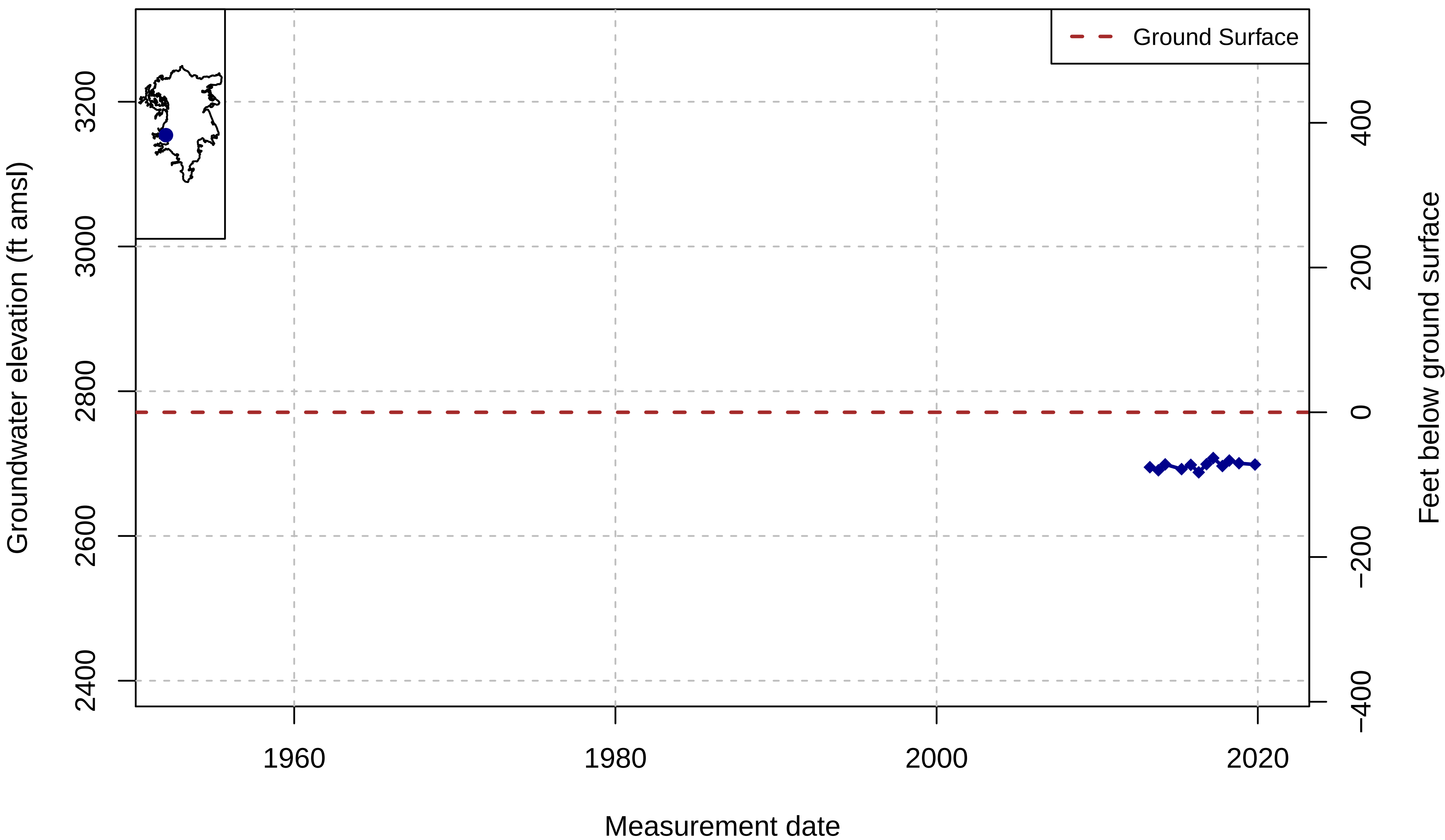
DWR Stn_ID: 37195; well_code: 415324N1223676W001; well_name: 36G001M; well_swn: 43N05W36G001M

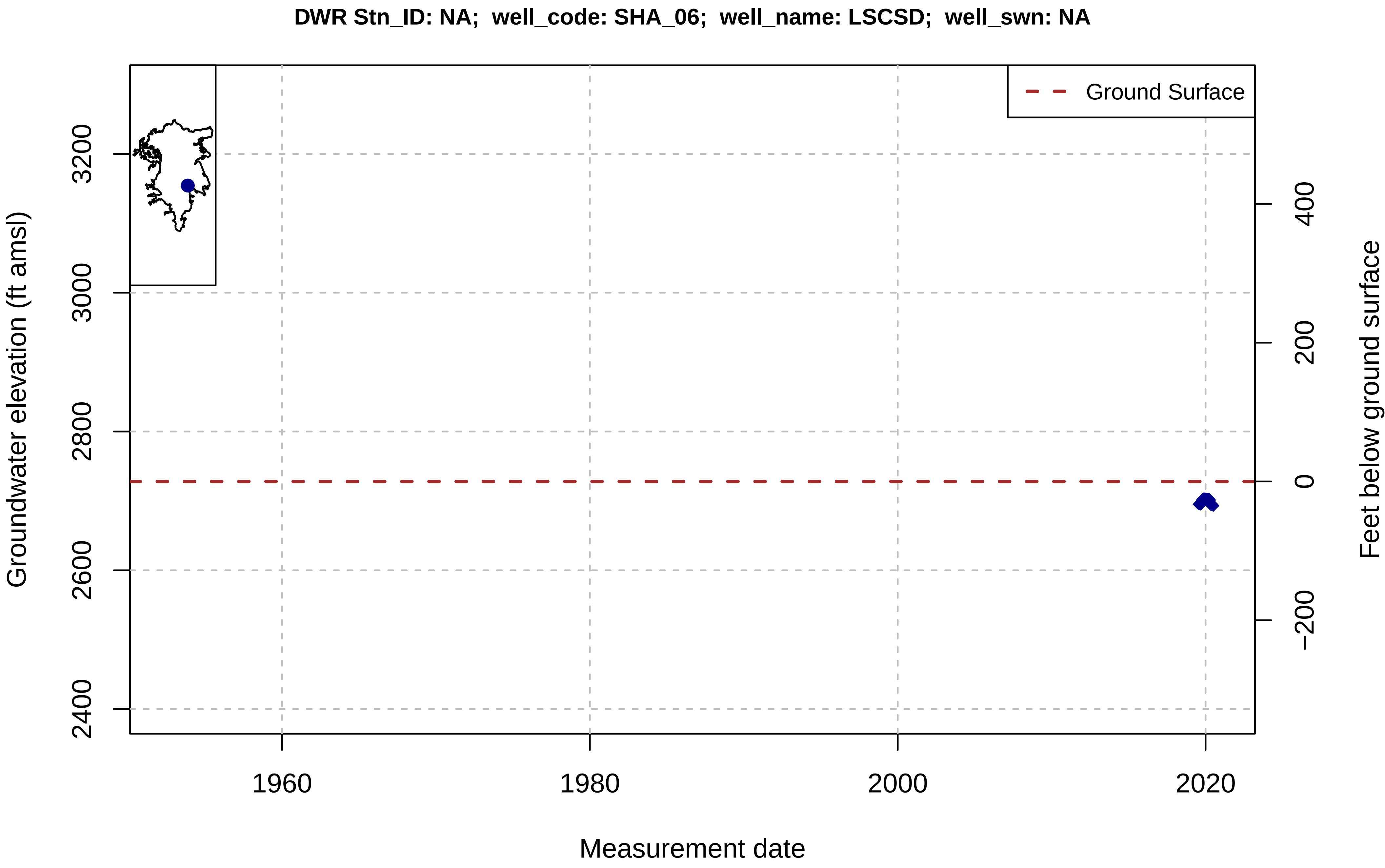


DWR Stn_ID: 22373; well_code: 415351N1225474W001; well_name: 43N06W33C001M; well_swn: 43N06W33C001M

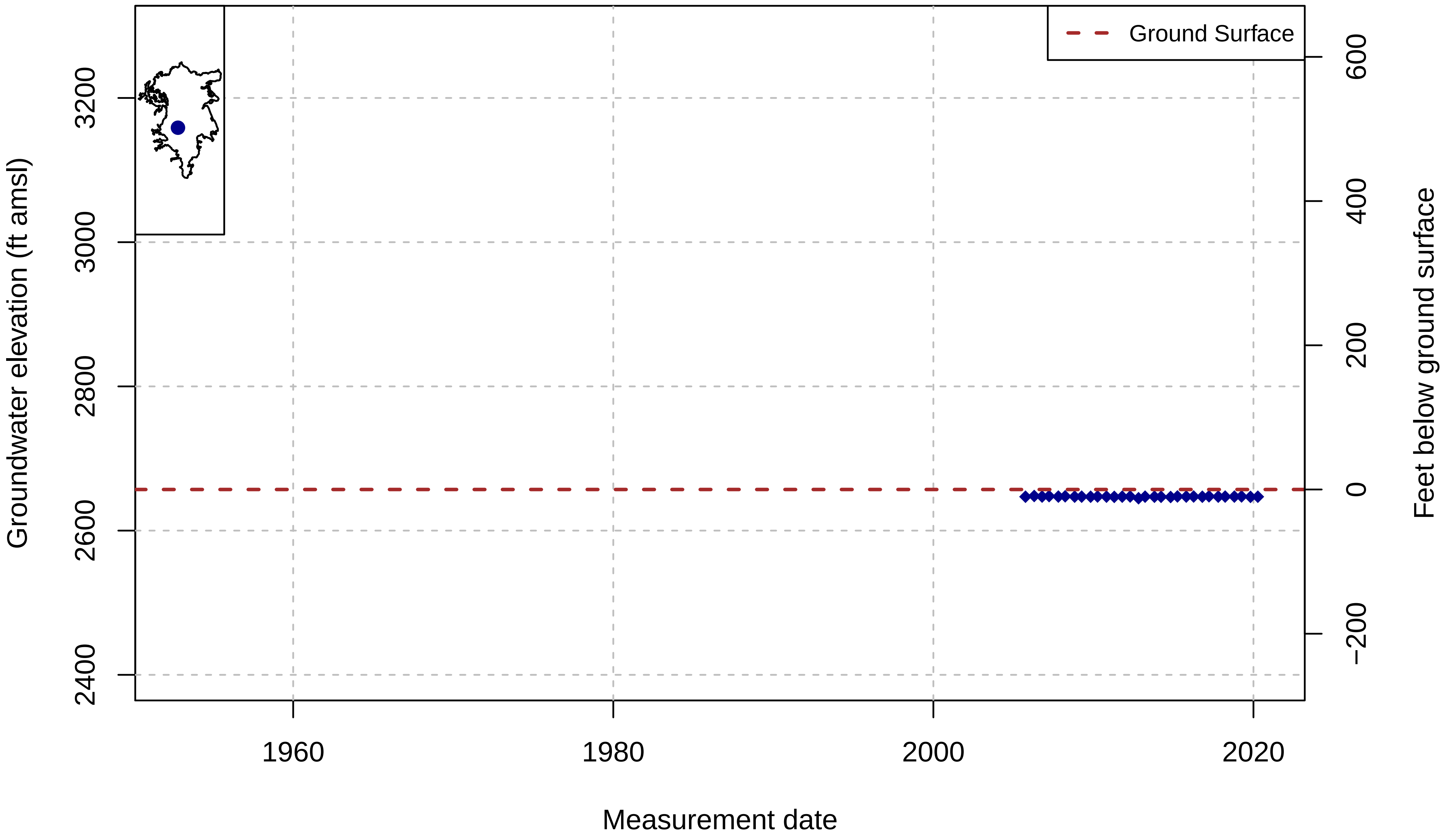


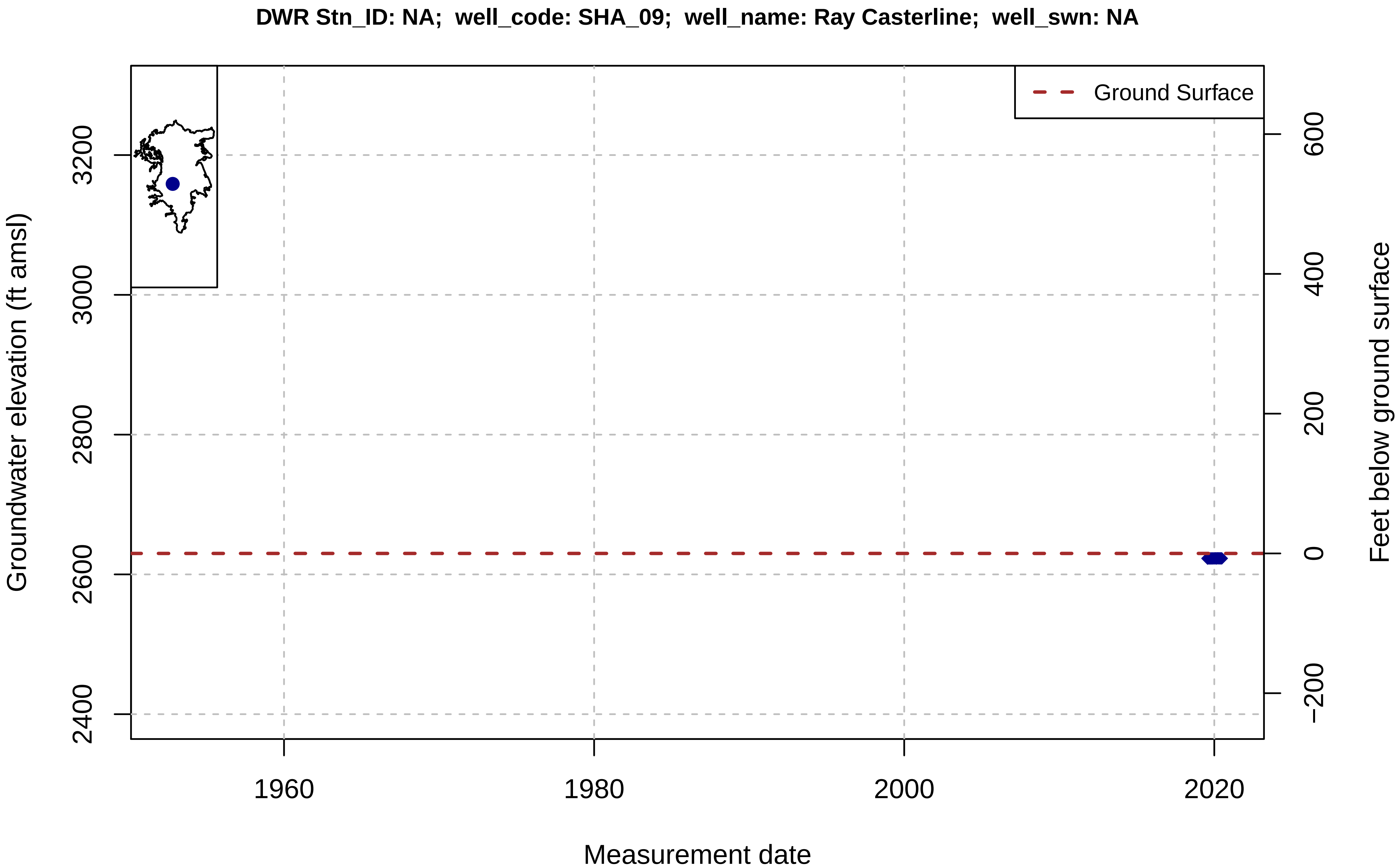
DWR Stn_ID: 49002; well_code: 415444N1225387W001; well_name: SV03; well_swn: NA



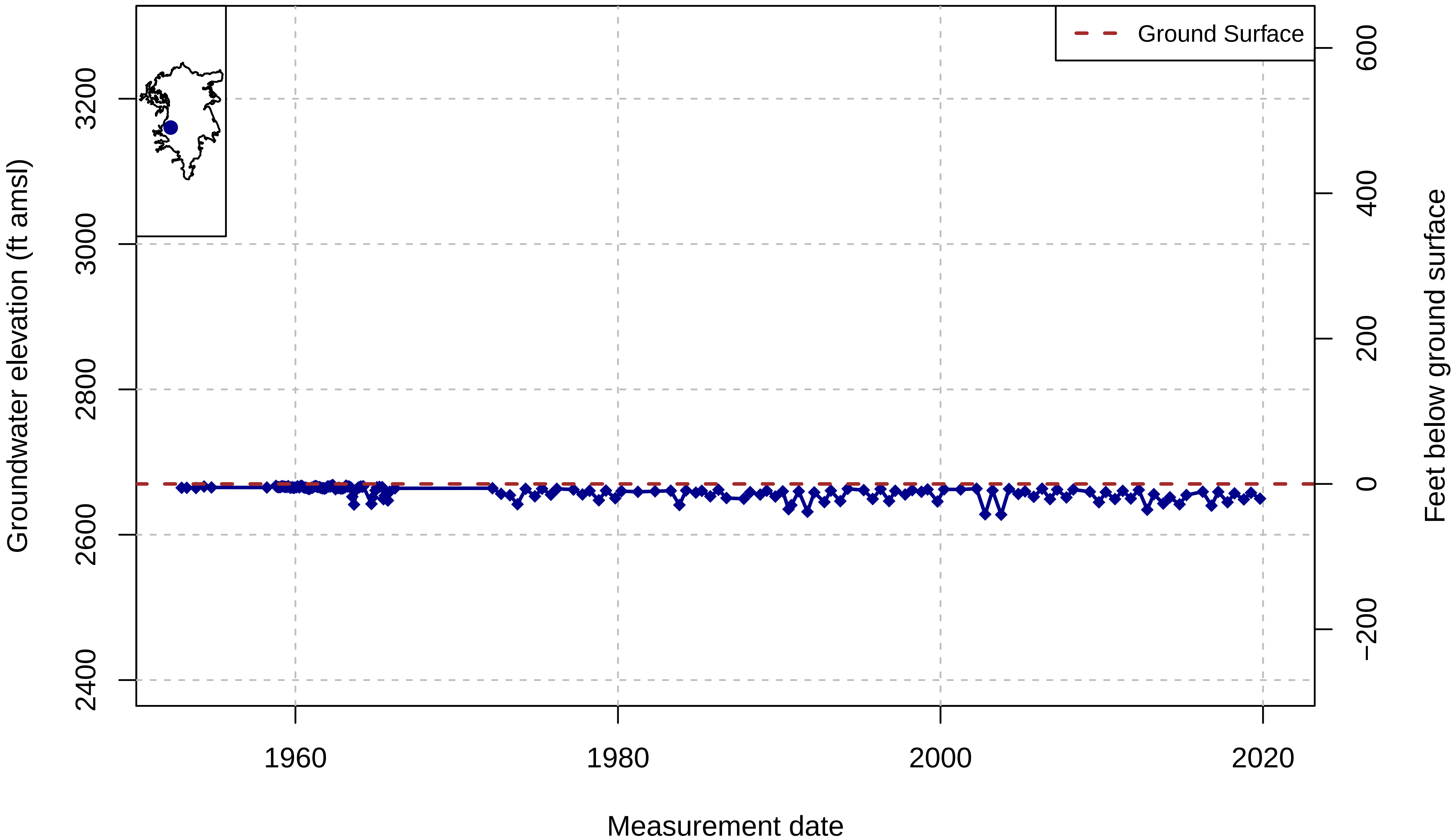

DWR Stn_ID: NA; well_code: SHA_06; well_name: LSCSD; well_swn: NA
Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
-200
0
200
400
1960
1980
2000
2020
Measurement date

DWR Stn_ID: 49294; well_code: 415601N1224718W001; well_name: 43N05W19F002M; well_swn: 43N05W19F002M

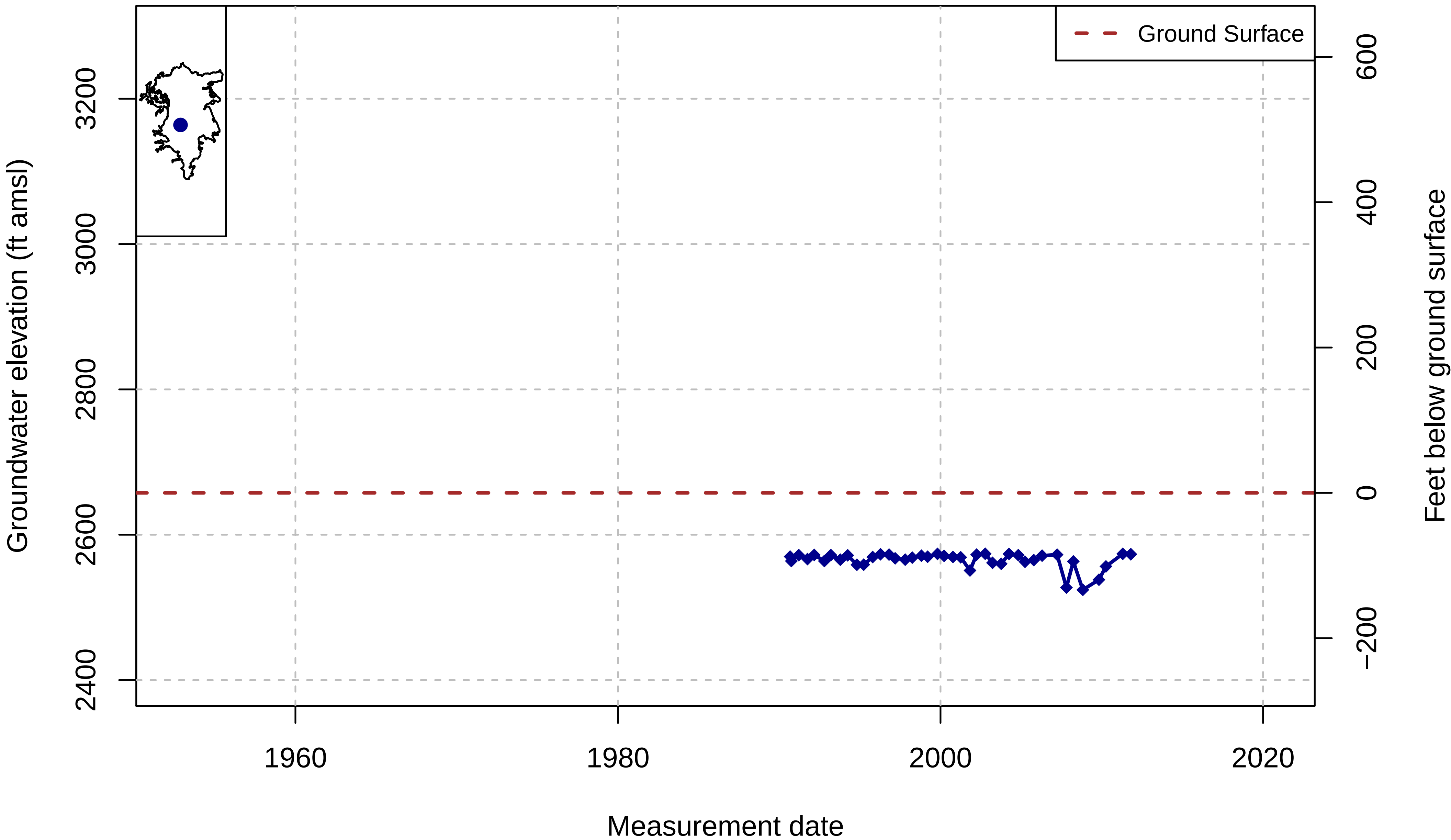


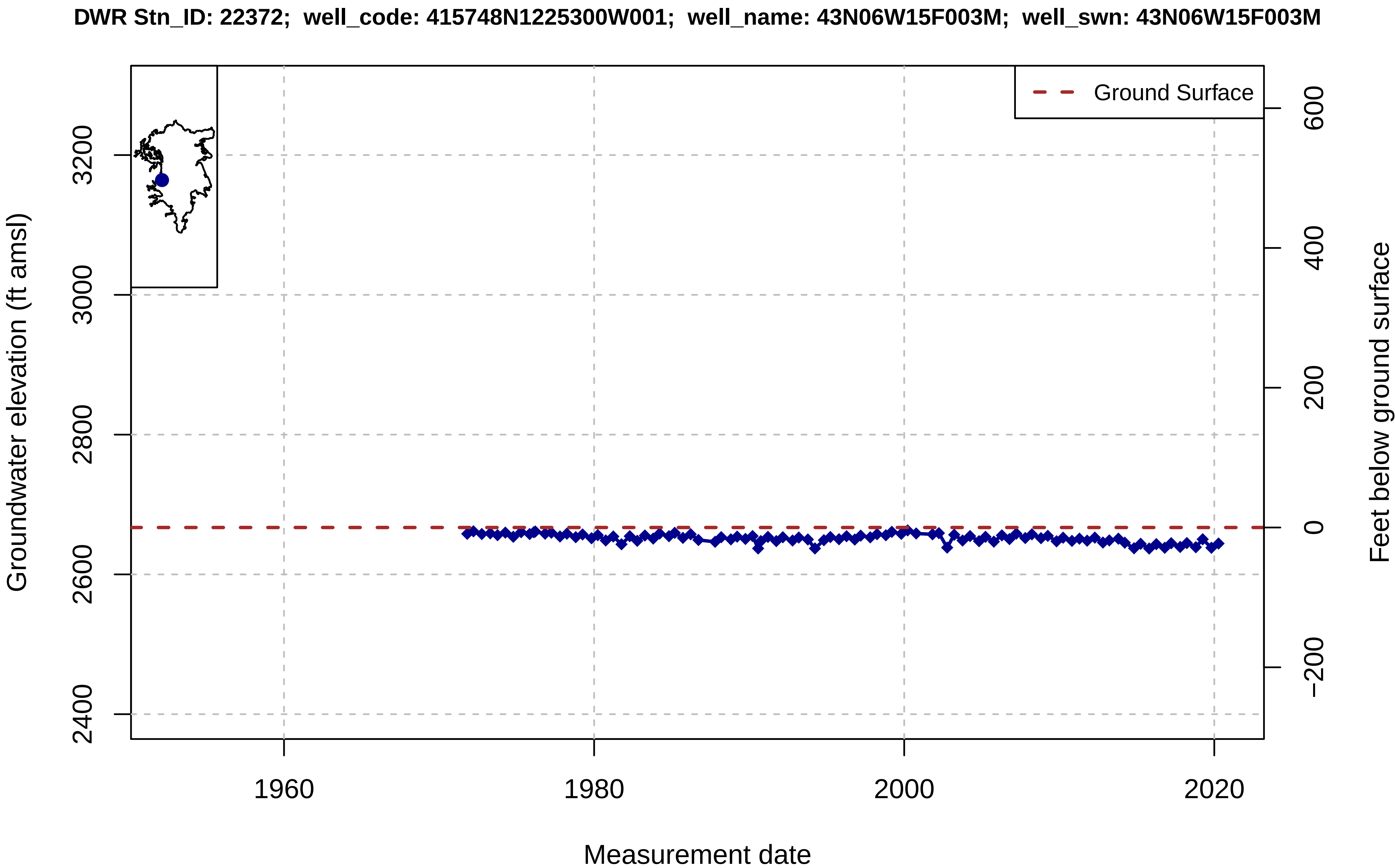

DWR Stn_ID: NA; well_code: SHA_09; well_name: Ray Casterline; well_swn: NA
Ground Surface
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
2400
2600
2800
3000
3200
−200
0
200
400
600
1960
1980
2000
2020

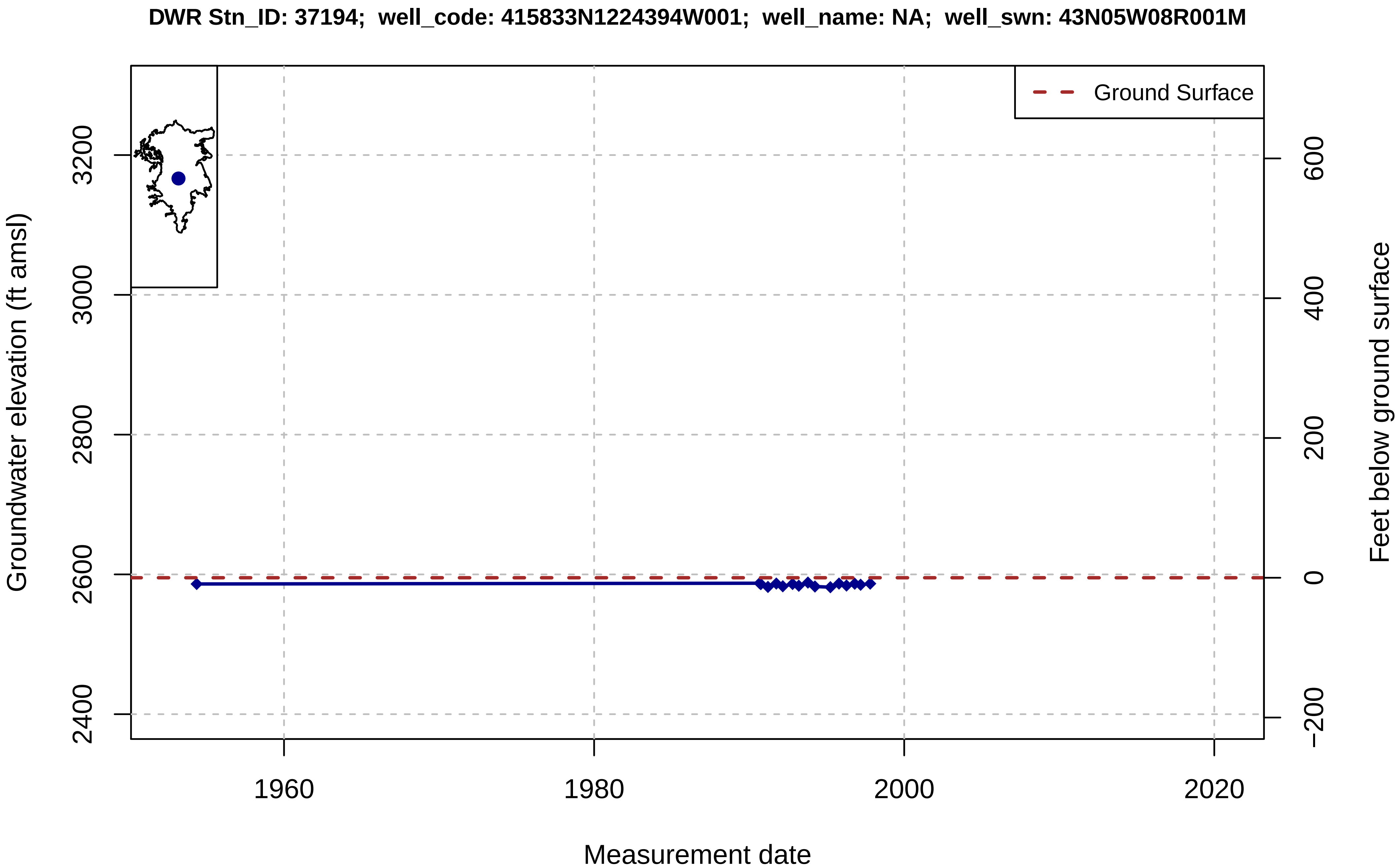
DWR Stn_ID: 37196; well_code: 415637N1225176W001; well_name: 43N06W22A001M; well_swn: 43N06W22A001M



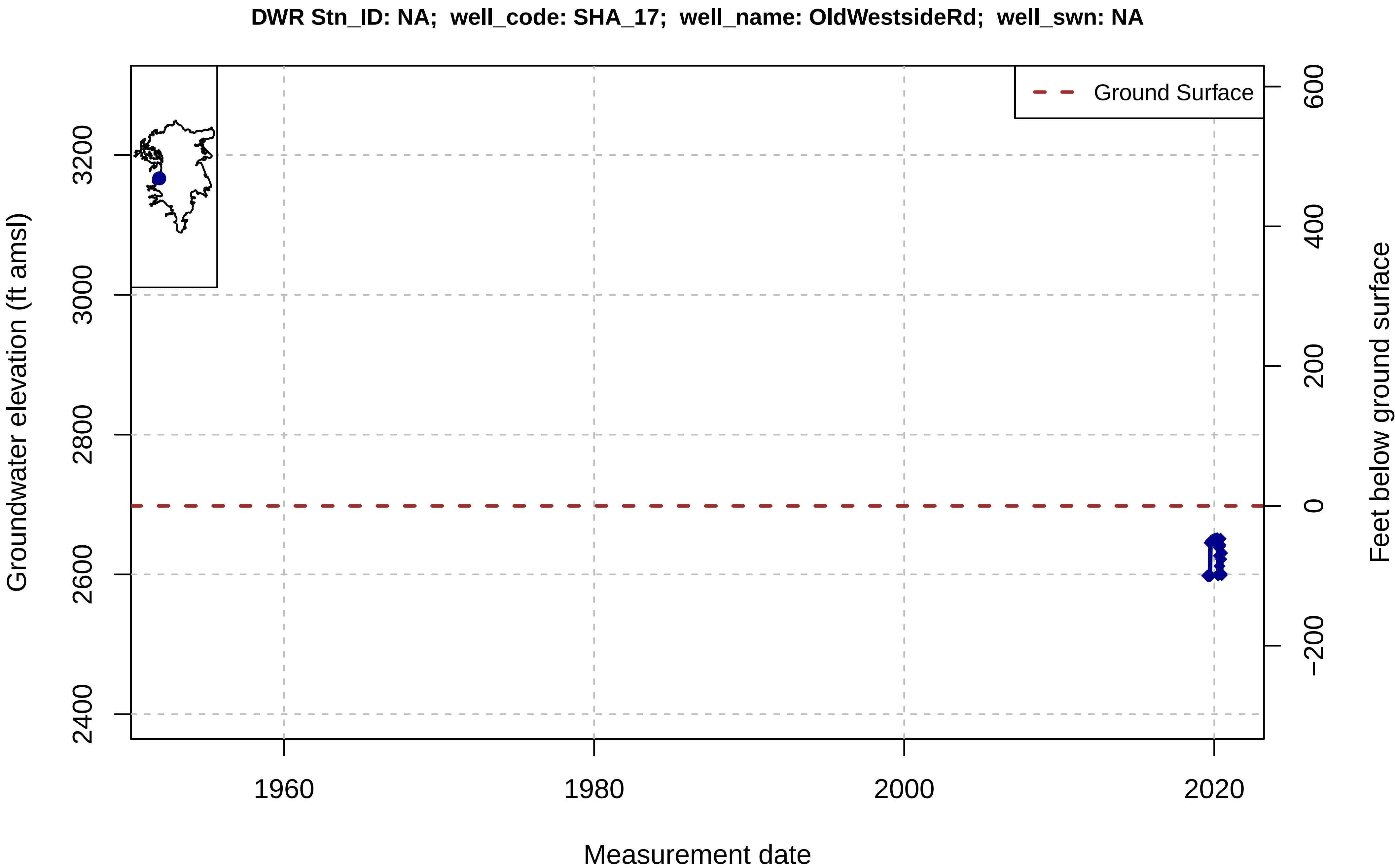
DWR Stn_ID: 22371; well_code: 415753N1224660W001; well_name: 43N05W18G001M; well_swn: 43N05W18G001M



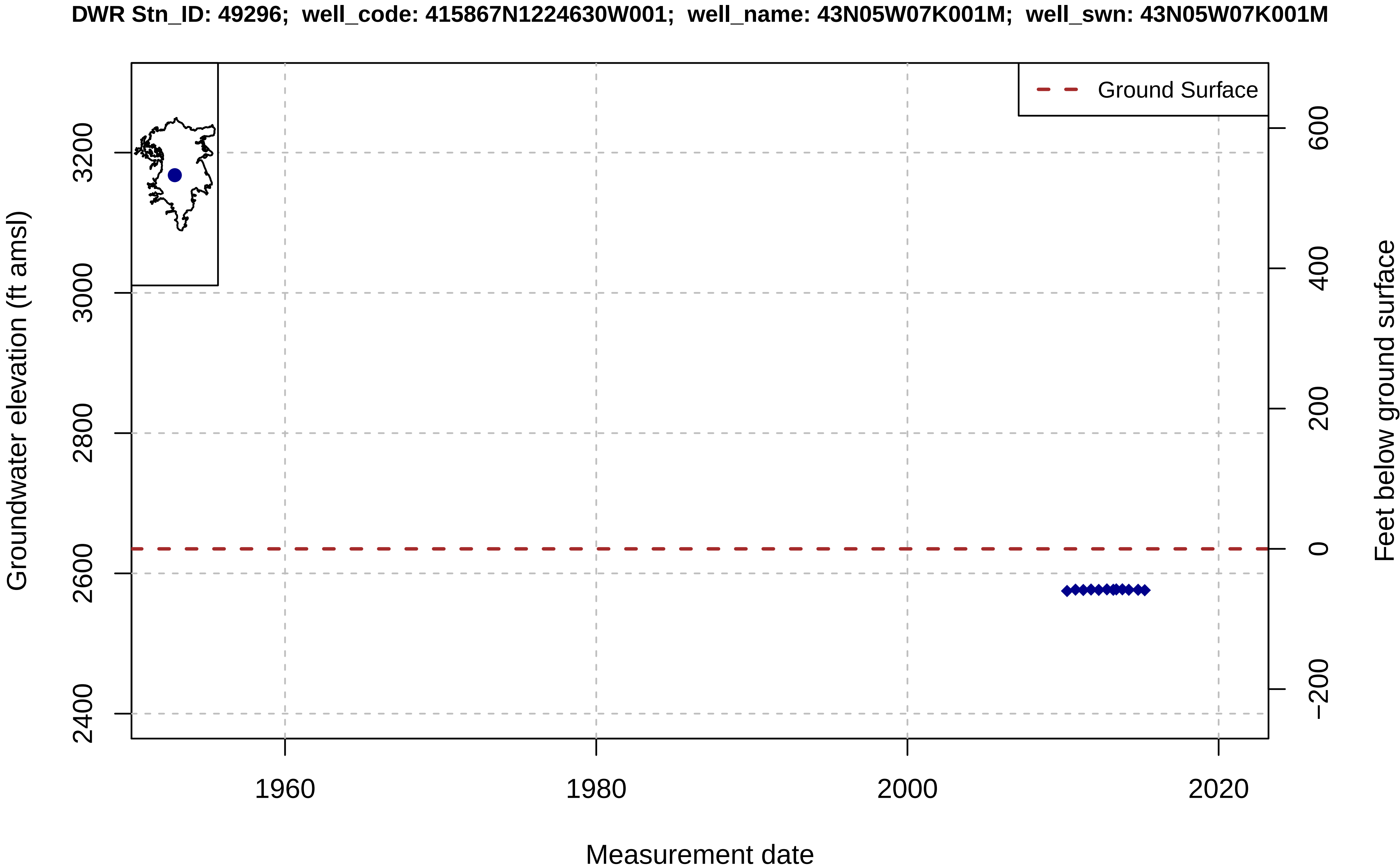

DWR Stn_ID: 22372; well_code: 415748N1225300W001; well_name: 43N06W15F003M; well_swn: 43N06W15F003M
Ground Surface
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
2400
2600
2800
3000
3200
600
400
200
0
−200
1960
1980
2000
2020



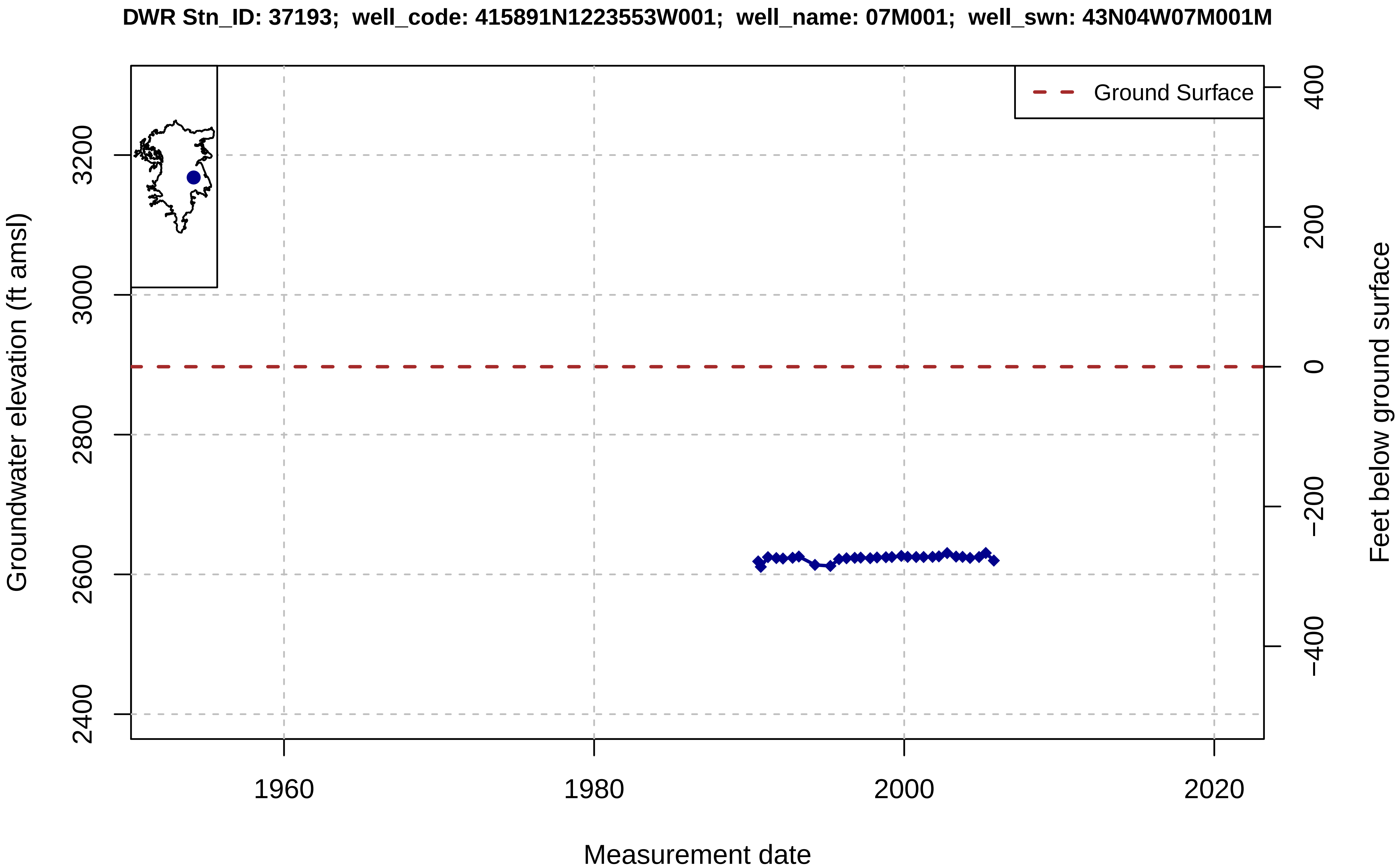
DWR Stn_ID: 37194; well_code: 415833N1224394W001; well_name: NA; well_swn: 43N05W08R001M
Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
−200
0
200
400
600
1960
1980
2000
2020
Measurement date

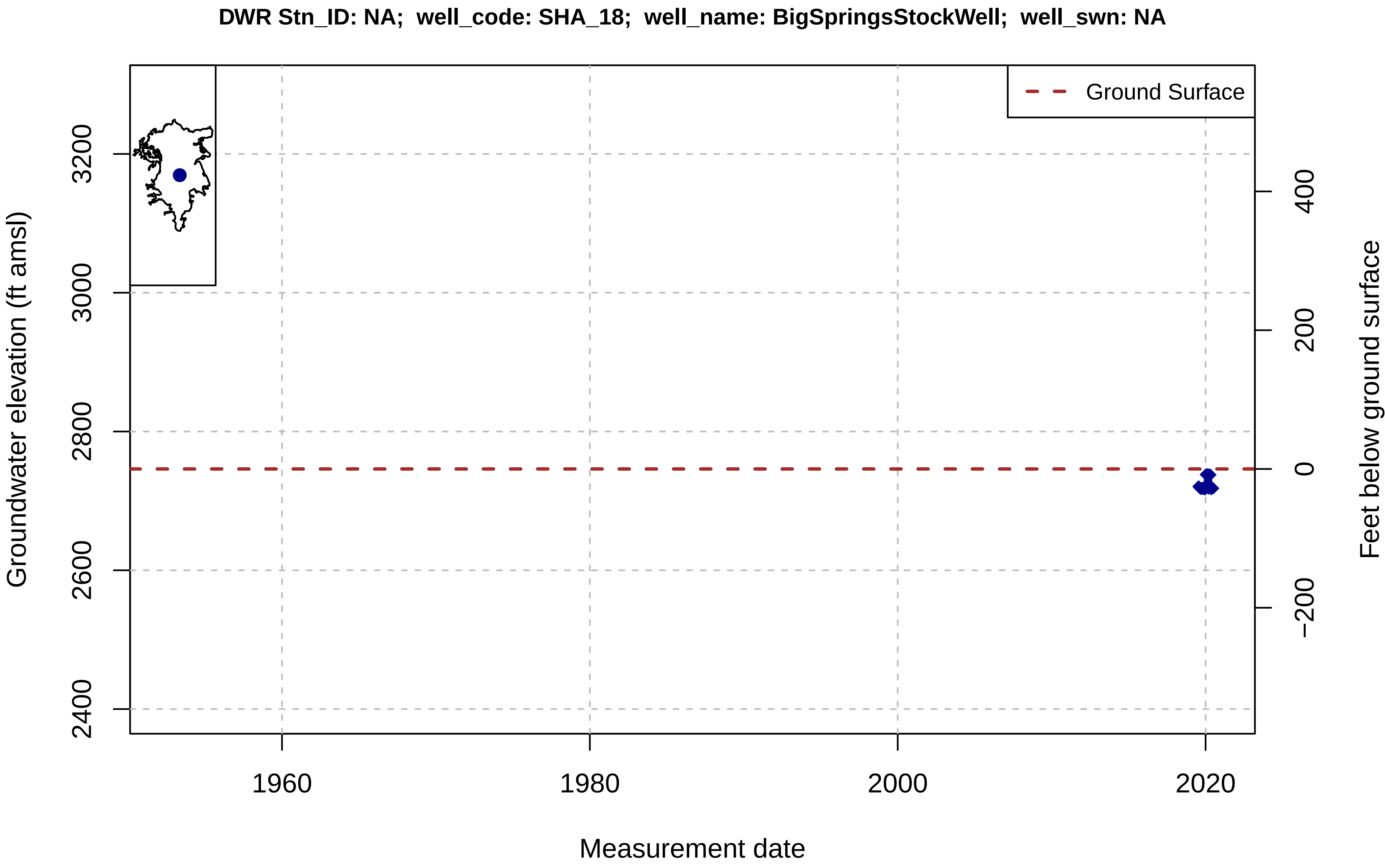


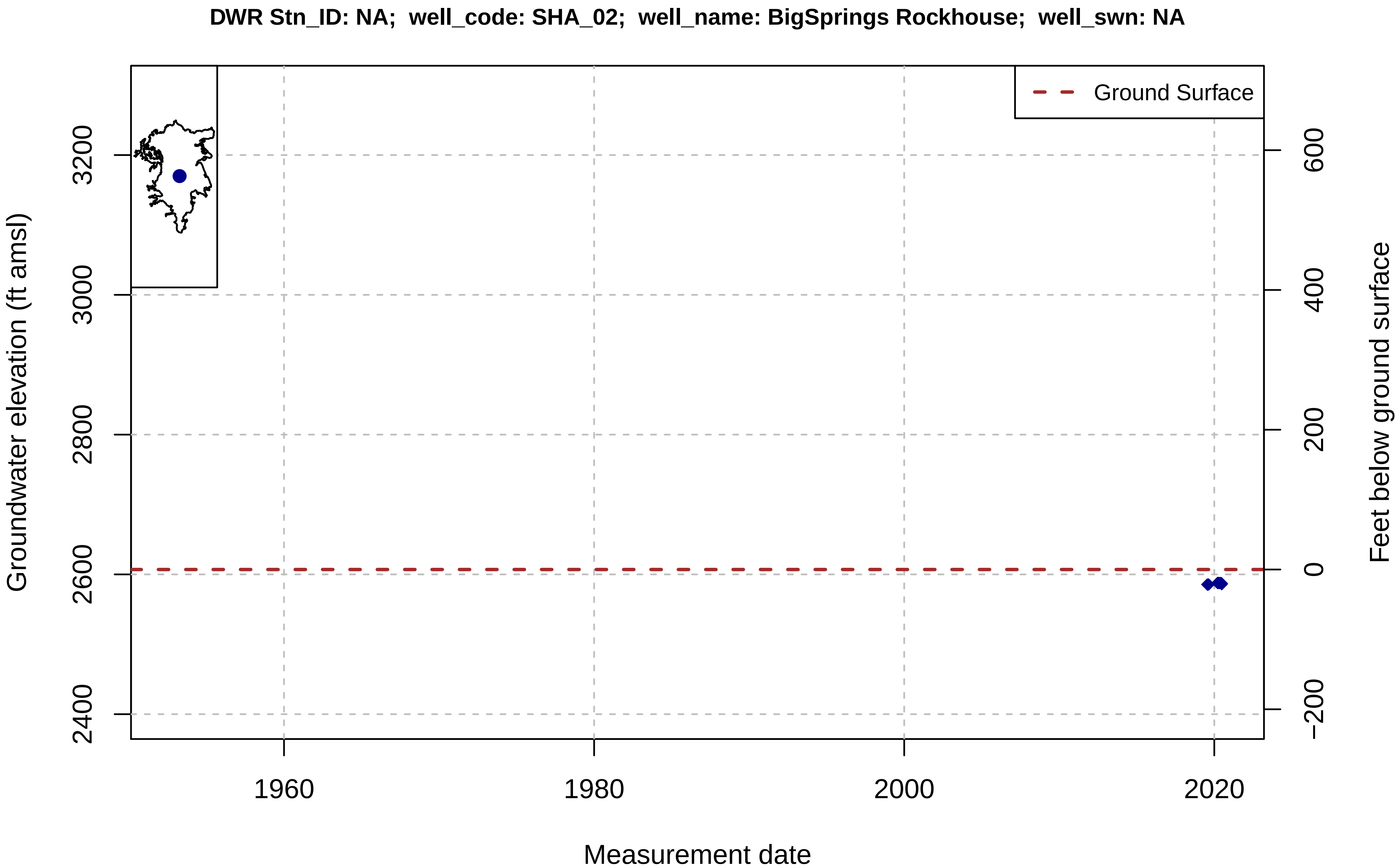
DWR Stn_ID: NA; well_code: SHA_17; well_name: OldWestsideRd; well_swn: NA
Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
−200
0
200
400
600
1960
1980
2000
2020
Measurement date



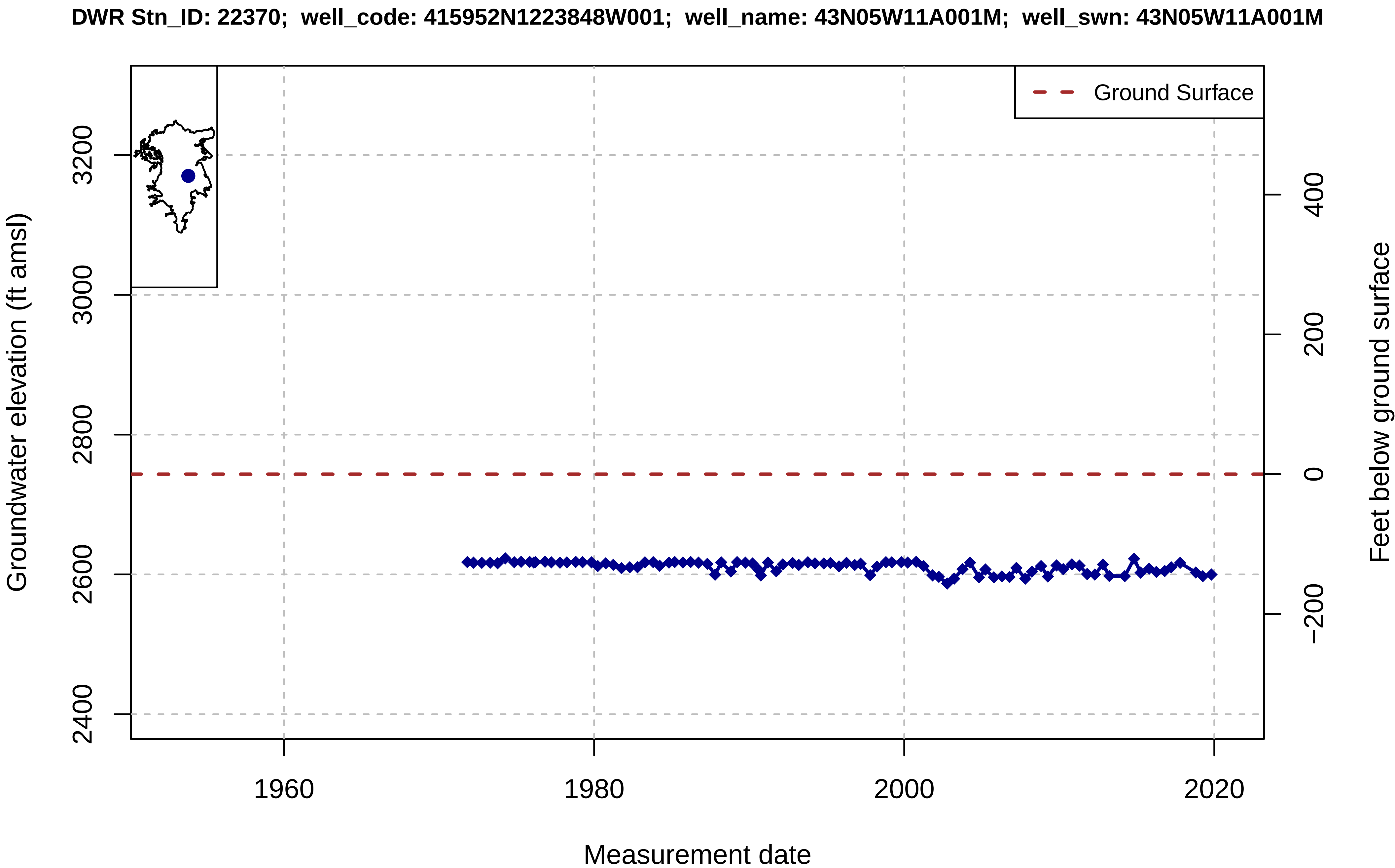
DWR Stn_ID: 49296; well_code: 415867N1224630W001; well_name: 43N05W07K001M; well_swn: 43N05W07K001M
Ground Surface
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
2400
2600
2800
3000
3200
−200
0
200
400
600
1960
1980
2000
2020


DWR Stn_ID: 37193; well_code: 415891N1223553W001; well_name: 07M001; well_swn: 43N04W07M001M
Ground Surface
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
2400
2600
2800
3000
3200
400
200
0
−200
−400
1960
1980
2000
2020

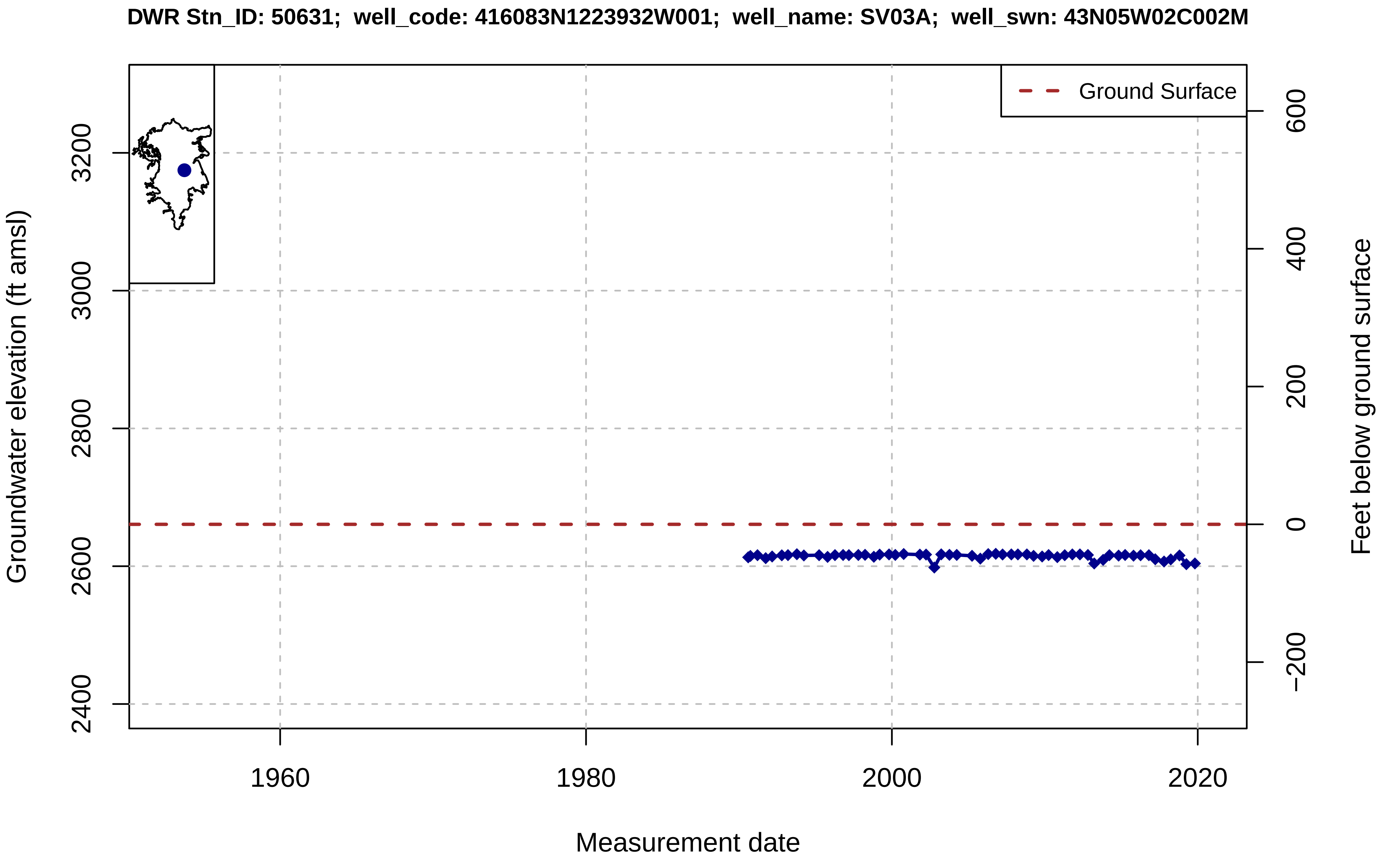

DWR Stn_ID: NA; well_code: SHA_18; well_name: BigSpringsStockWell; well_swn: NA
Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
−200
0
200
400
1960
1980
2000
2020
Measurement date



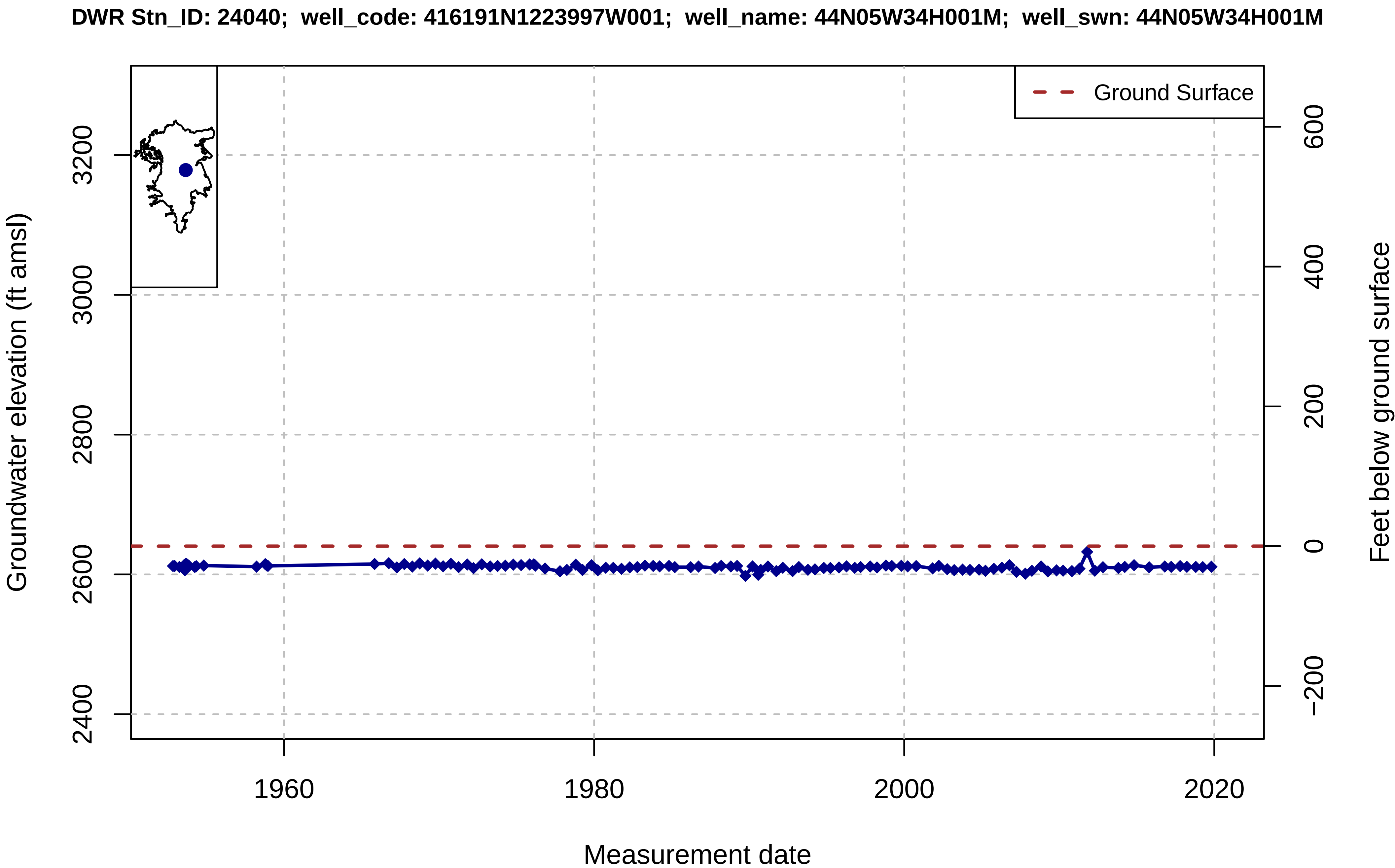
DWR Stn_ID: NA; well_code: SHA_02; well_name: BigSprings Rockhouse; well_swn: NA
Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
−200
0
200
400
600
1960
1980
2000
2020
Measurement date



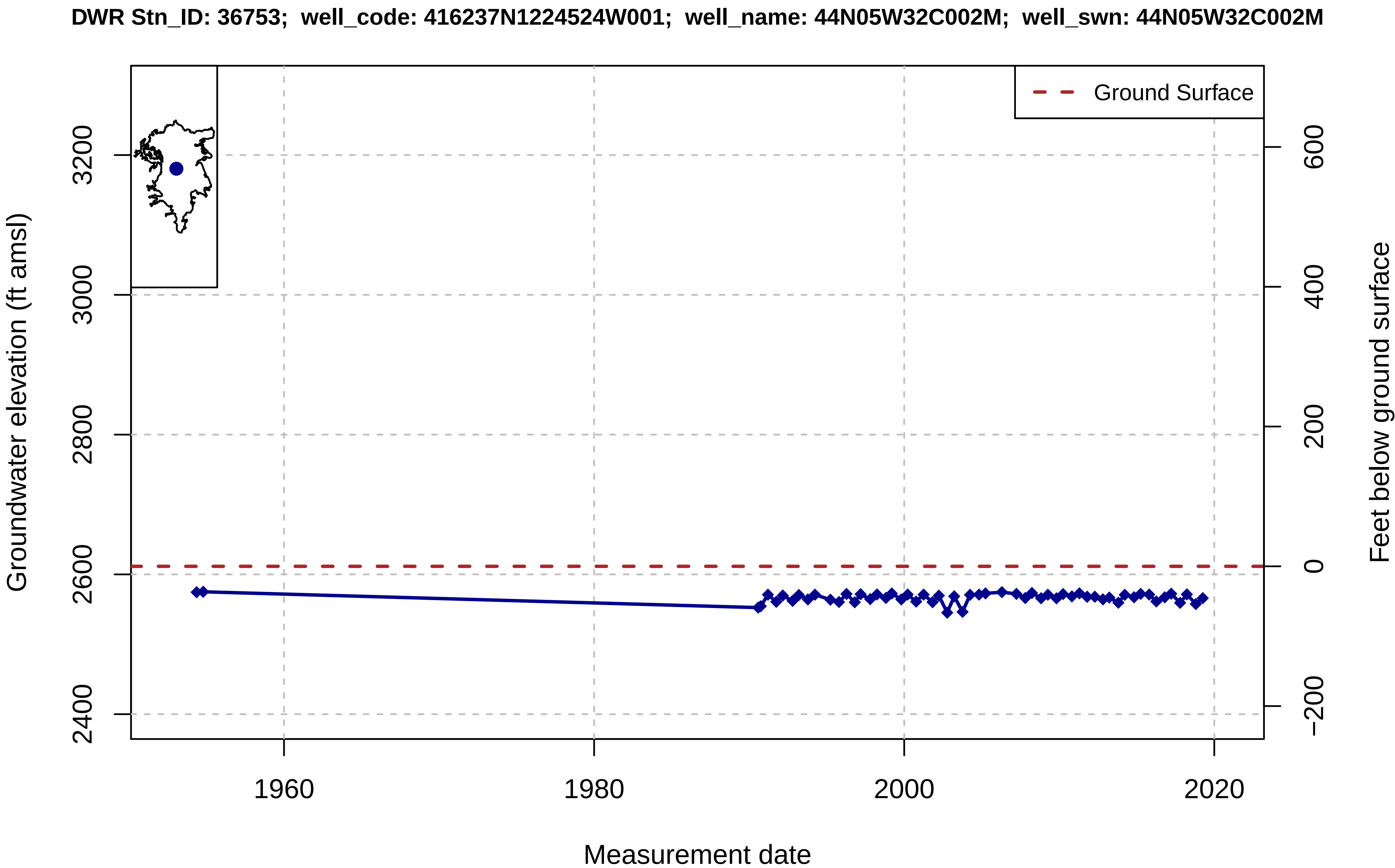
DWR Stn_ID: 22370; well_code: 415952N1223848W001; well_name: 43N05W11A001M; well_swn: 43N05W11A001M
Ground Surface
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
3200
3000
2800
2600
2400
400
200
0
−200
1960
1980
2000
2020



DWR Stn_ID: 50631; well_code: 416083N1223932W001; well_name: SV03A; well_swn: 43N05W02C002M
Ground Surface
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
2400
2600
2800
3000
3200
600
400
200
0
−200
1960
1980
2000
2020



DWR Stn_ID: 24040; well_code: 416191N1223997W001; well_name: 44N05W34H001M; well_swn: 44N05W34H001M
Ground Surface
Groundwater elevation (ft amsl)
3200
3000
2800
2600
2400
Feet below ground surface
600
400
200
0
−200
1960
1980
2000
2020
Measurement date


DWR Stn_ID: 36753; well_code: 416237N1224524W001; well_name: 44N05W32C002M; well_swn: 44N05W32C002M
Ground Surface
Groundwater elevation (ft amsl)
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Feet below ground surface
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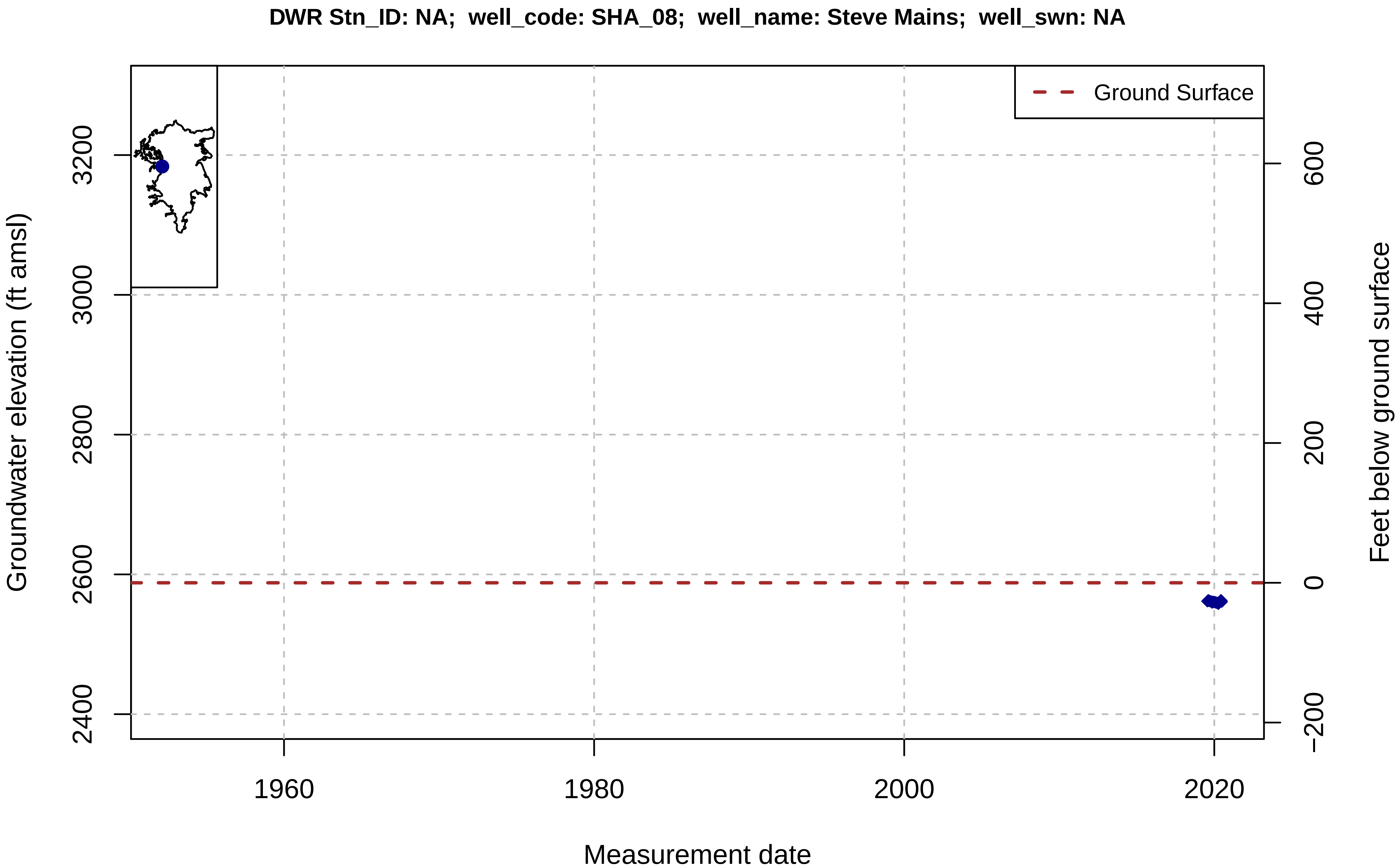
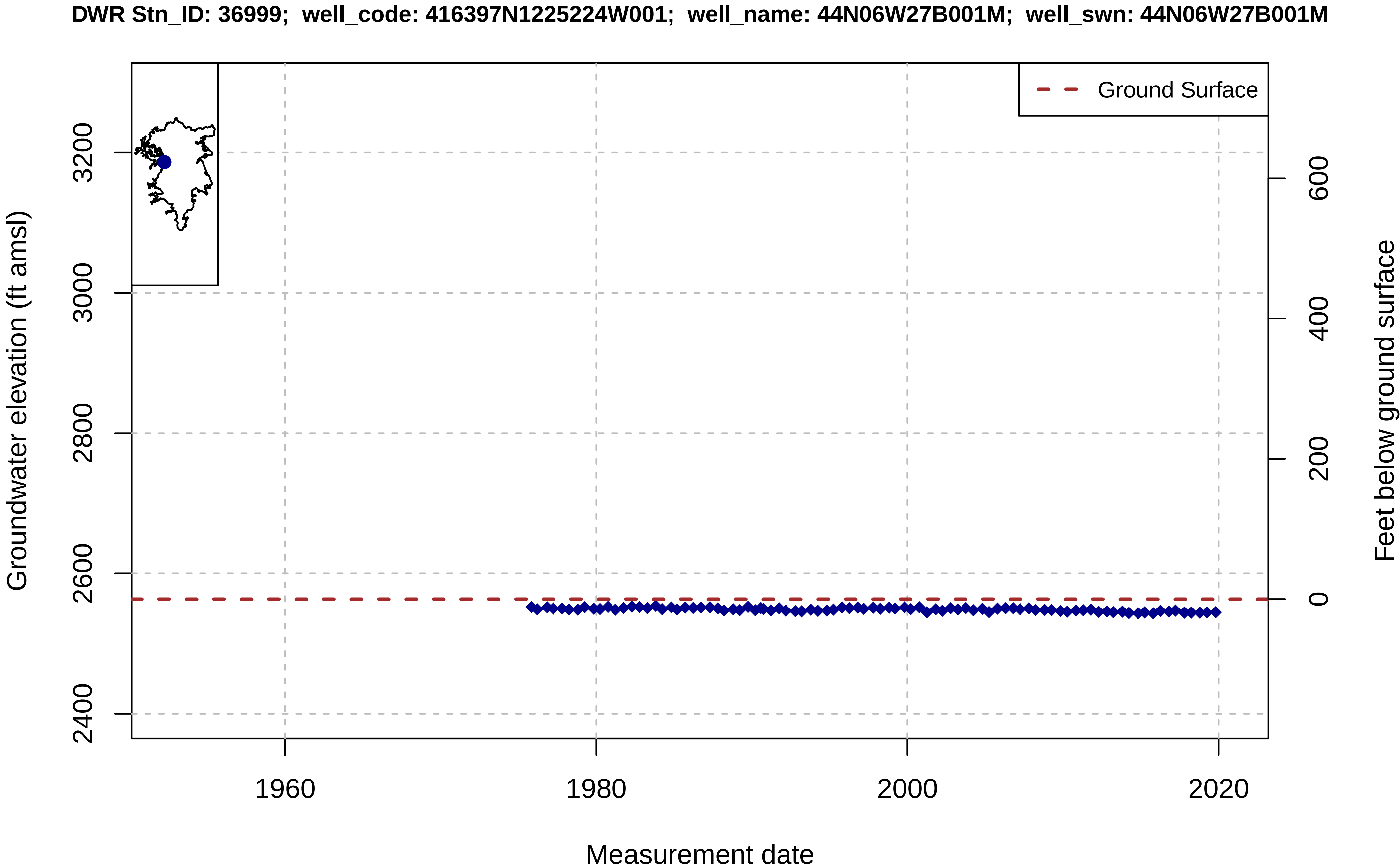
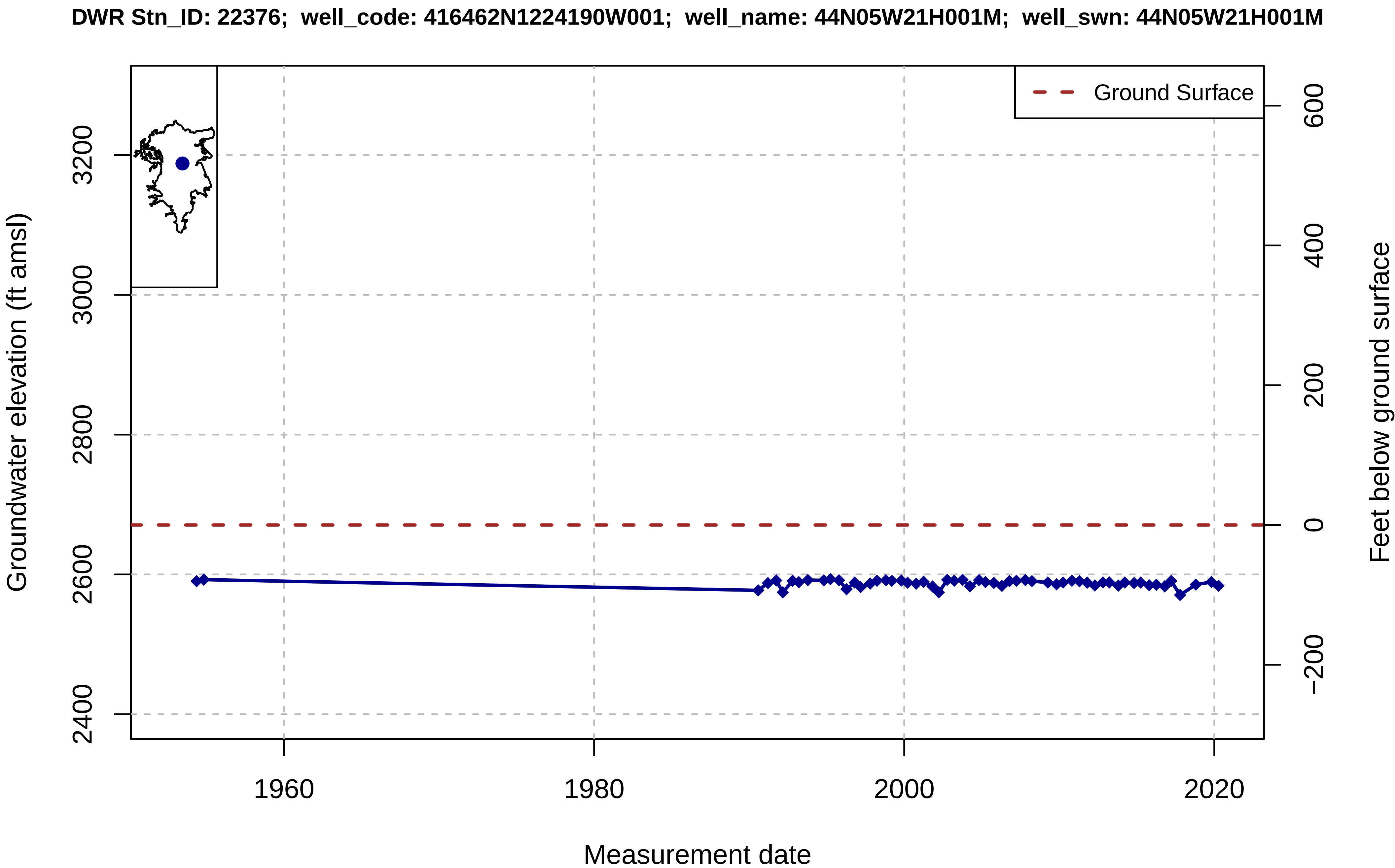
400
600
1960
1980
2000
2020
Measurement date



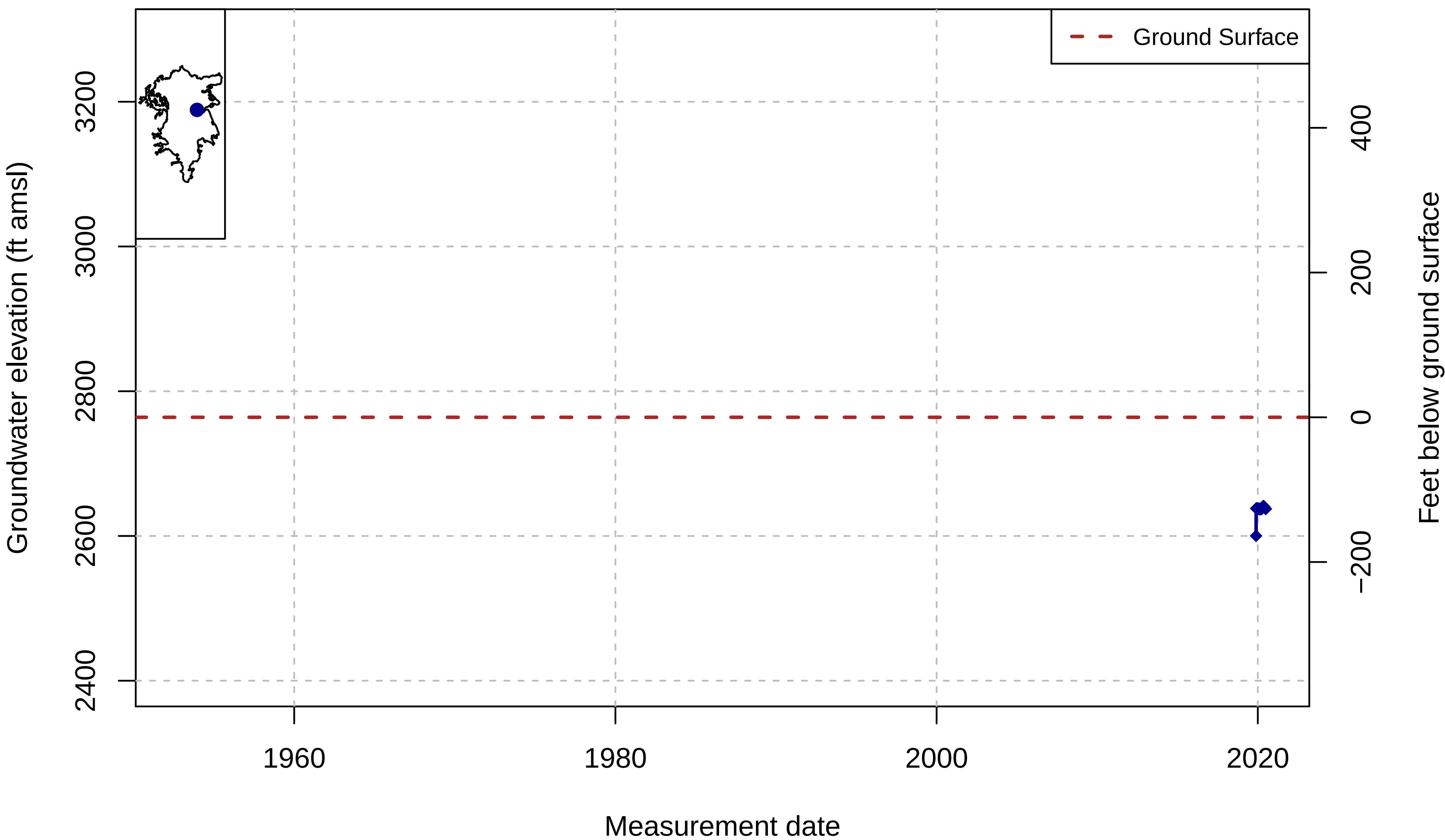
DWR Stn_ID: NA; well_code: SHA_08; well_name: Steve Mains; well_swn: NA
Ground Surface
Groundwater elevation (ft amsl)
3200
3000
2800
2600
2400
Feet below ground surface
600
400
200
0
−200
1960
1980
2000
2020
Measurement date

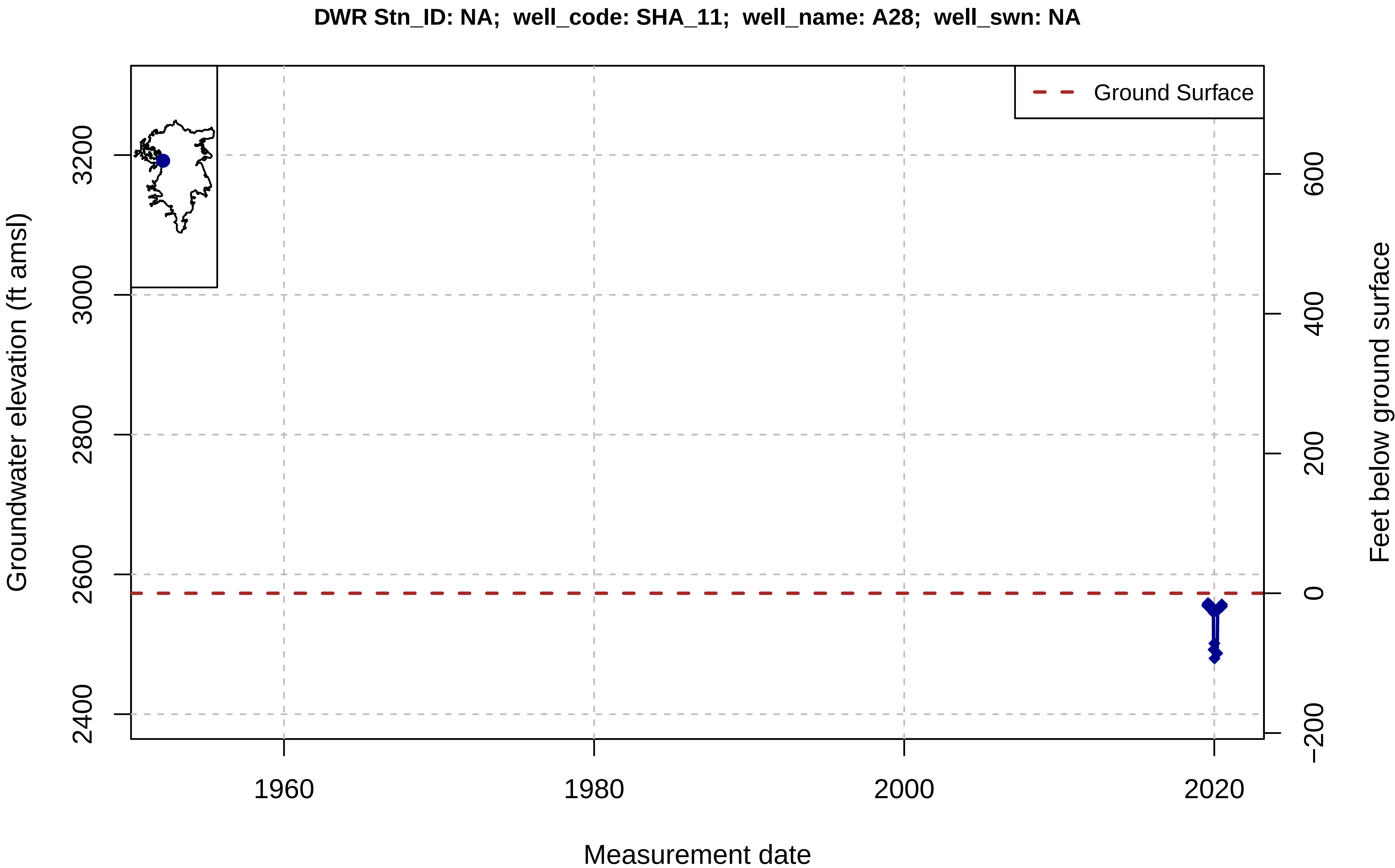


DWR Stn_ID: 36999; well_code: 416397N1225224W001; well_name: 44N06W27B001M; well_swn: 44N06W27B001M
Ground Surface
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
2400
2600
2800
3000
3200
0
200
400
600
1960
1980
2000
2020

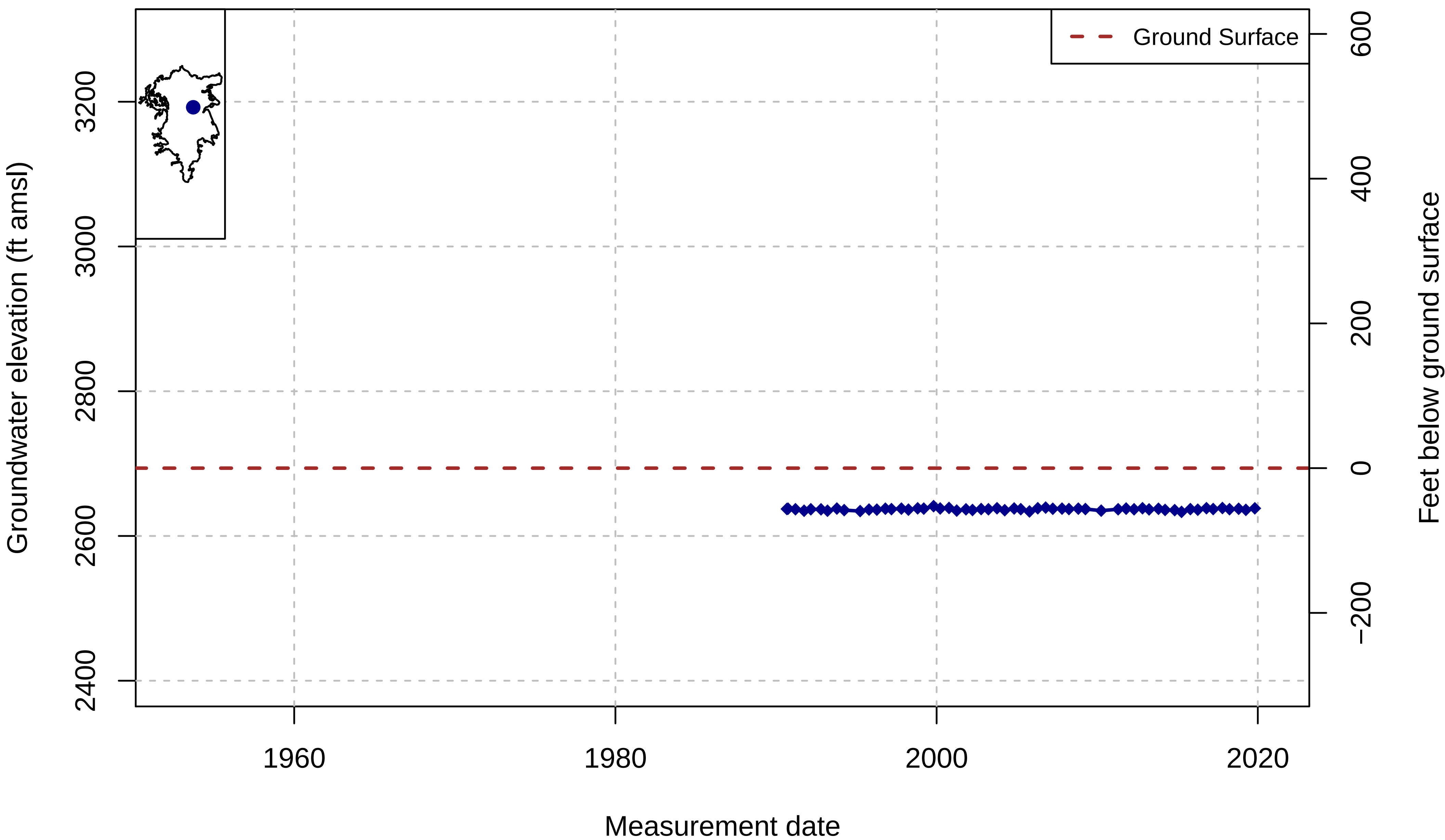

DWR Stn_ID: 22376; well_code: 416462N1224190W001; well_name: 44N05W21H001M; well_swn: 44N05W21H001M
Ground Surface
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
2400
2600
2800
3000
3200
−200
0
200
400
600
1960
1980
2000
2020

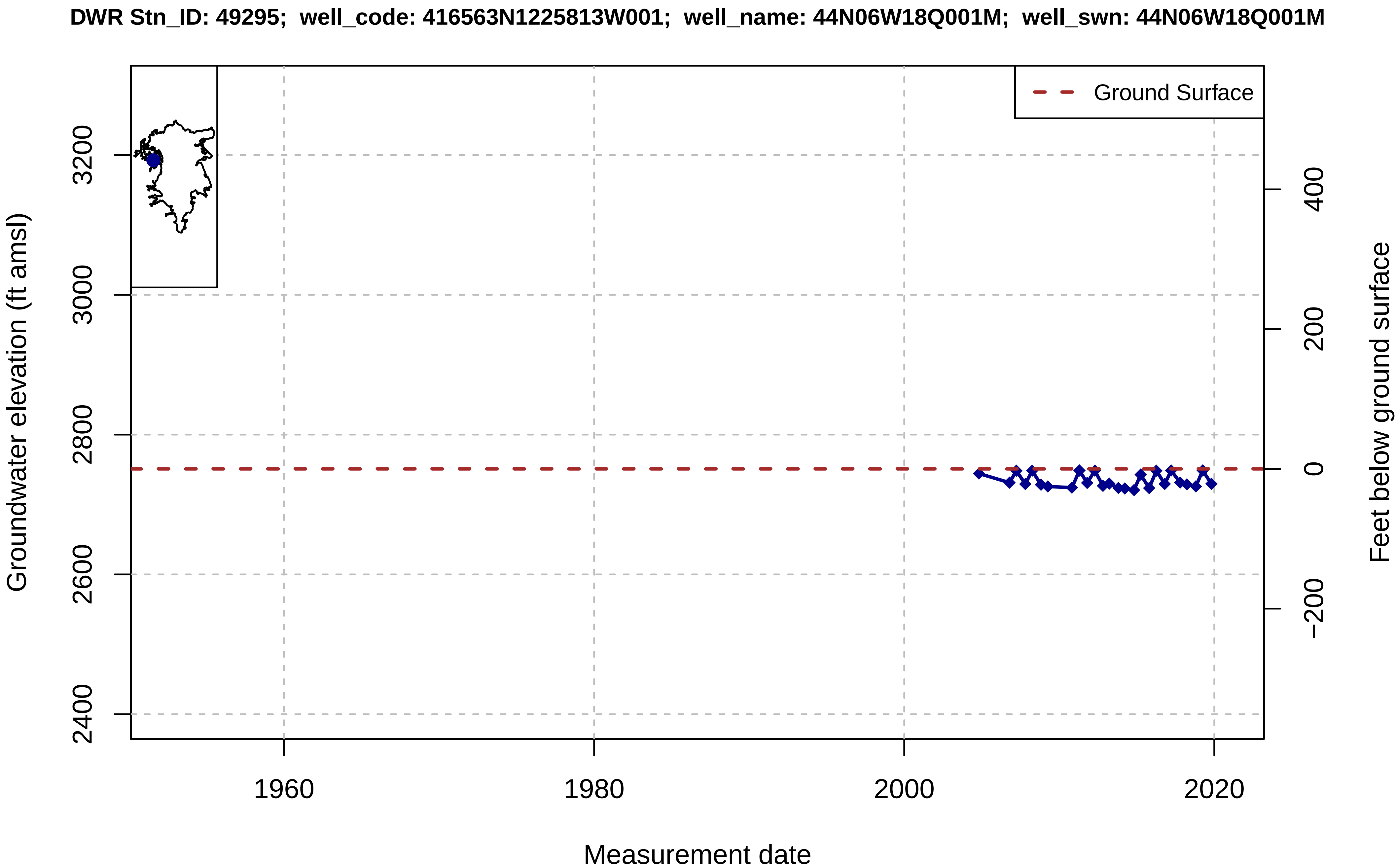
DWR Stn_ID: NA; well_code: SHA_172; well_name: FrontierRd; well_swn: NA

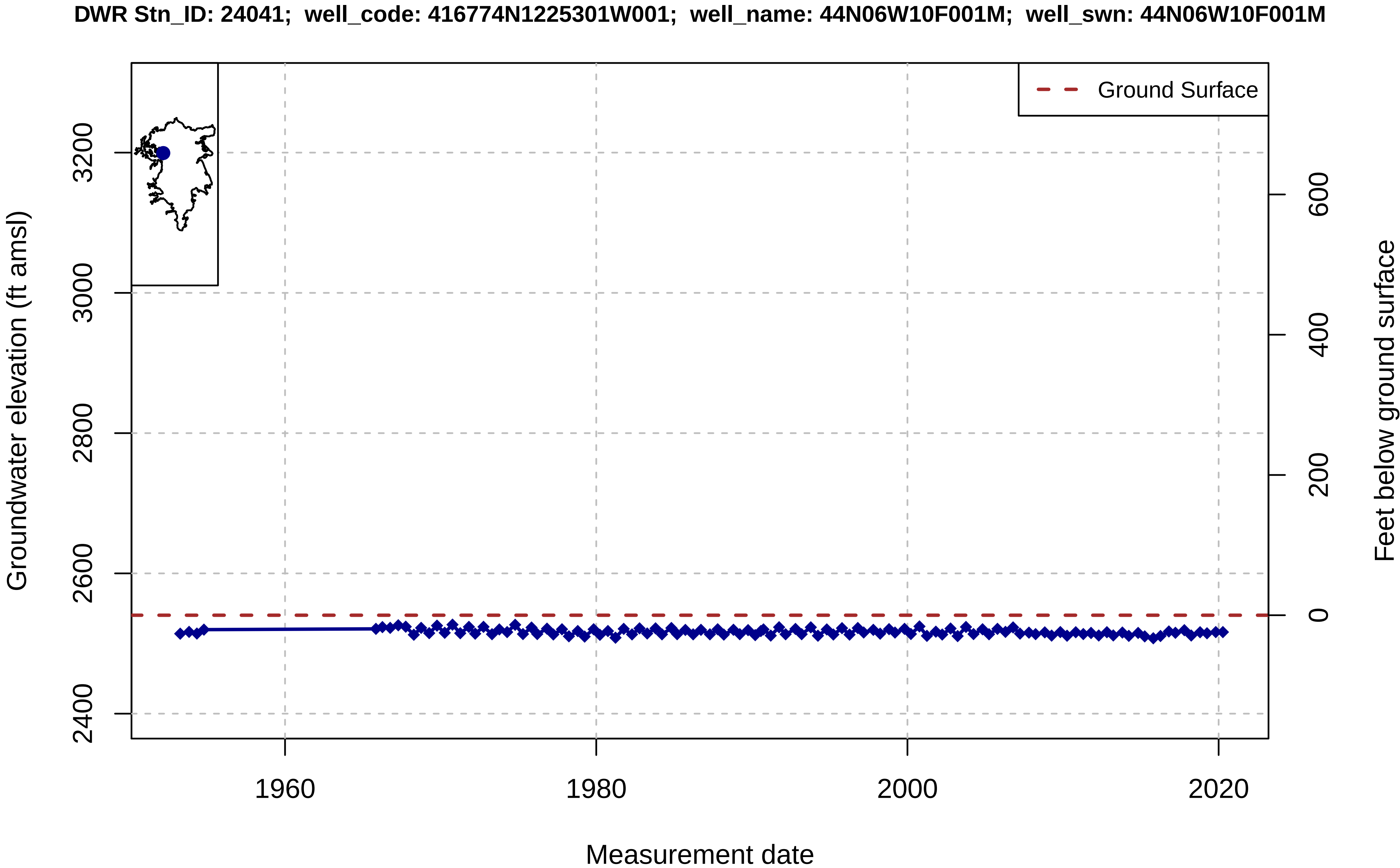


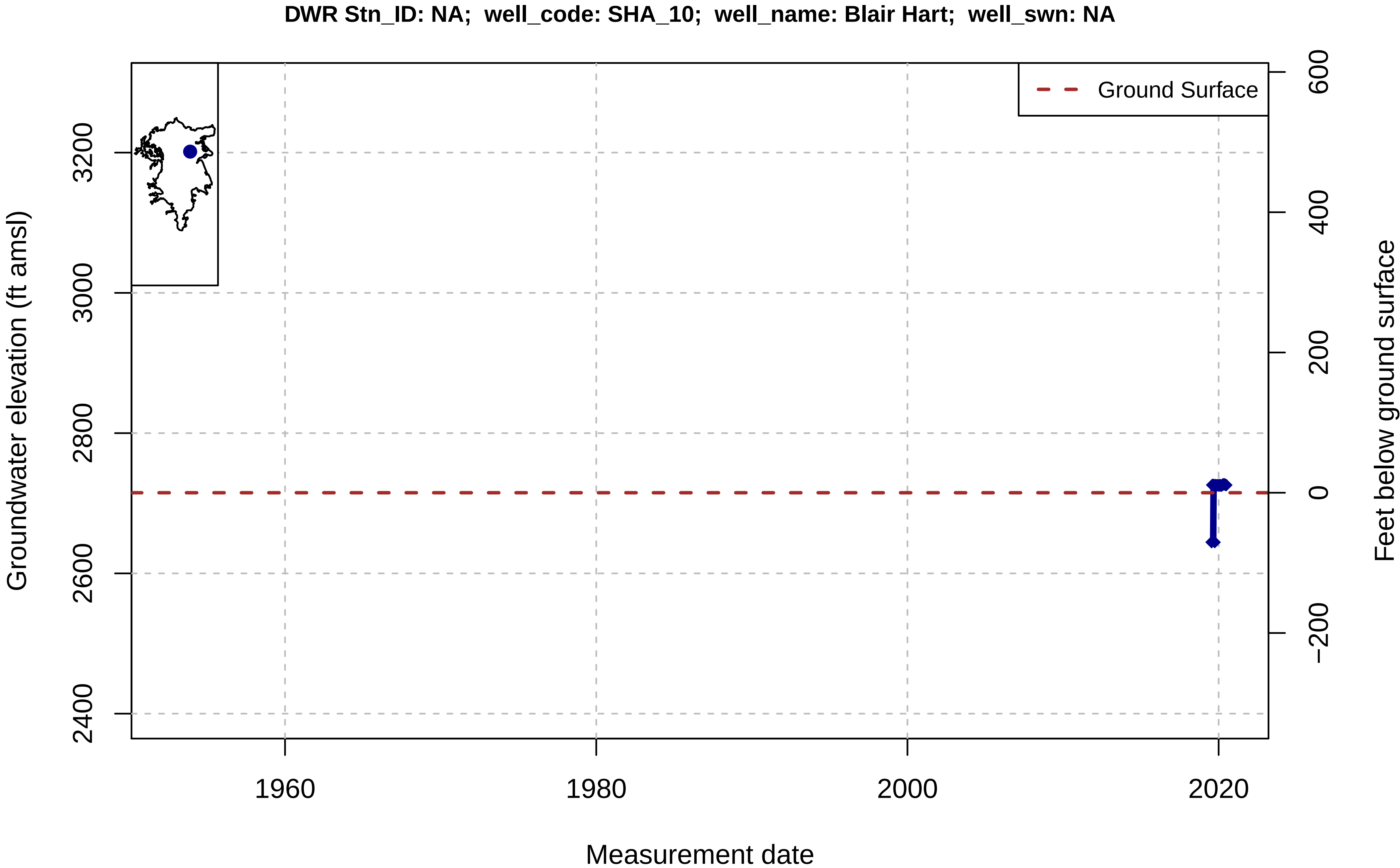

DWR Stn_ID: NA; well_code: SHA_11; well_name: A28; well_swn: NA
Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
−200
0
200
400
600
1960
1980
2000
2020
Measurement date

DWR Stn_ID: 22375; well_code: 416595N1223971W001; well_name: 44N05W14M002M; well_swn: 44N05W14M002M




DWR Stn_ID: 49295; well_code: 416563N1225813W001; well_name: 44N06W18Q001M; well_swn: 44N06W18Q001M
Ground Surface
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
3200
3000
2800
2600
2400
400
200
0
−200
1960
1980
2000
2020


DWR Stn_ID: 24041; well_code: 416774N1225301W001; well_name: 44N06W10F001M; well_swn: 44N06W10F001M
Ground Surface
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
2400
2600
2800
3000
3200
0
200
400
600
1960
1980
2000
2020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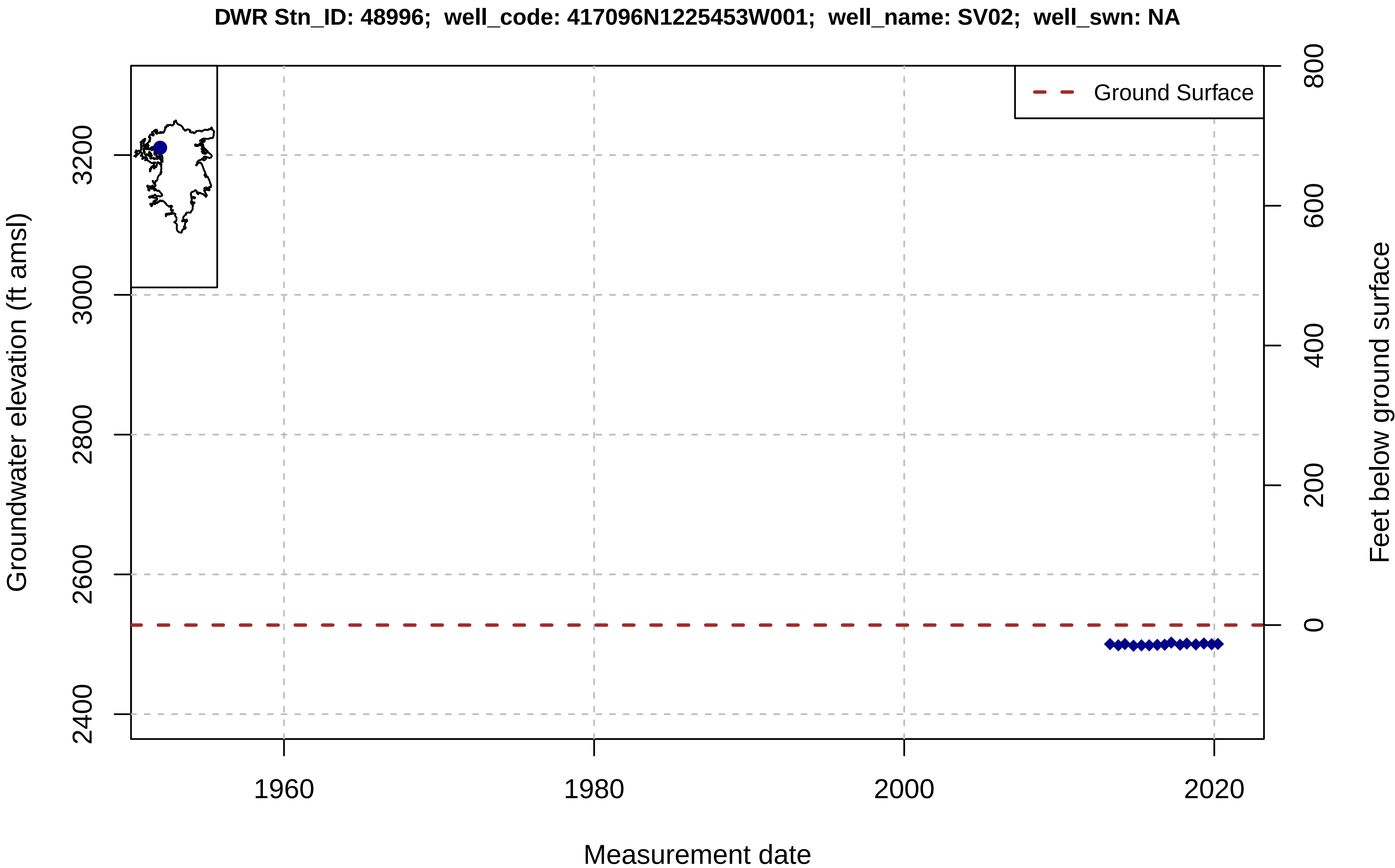
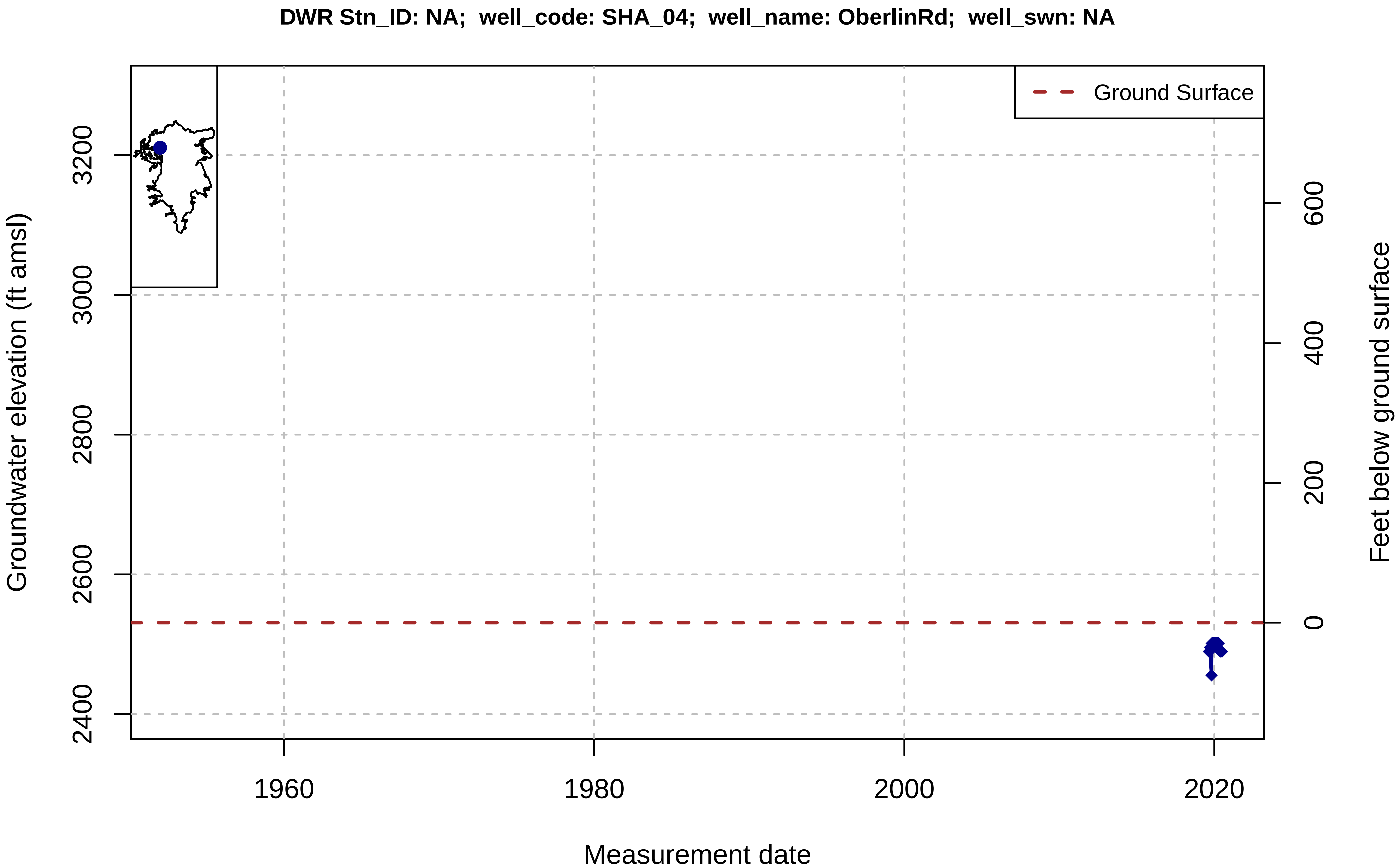
Ground Surface
Groundwater elevation (ft amsl)
3200
3000
2800
2600
2400
Feet below ground surface
600
400
200
0
−200
1960
1980
2000
2020
Measurement date



DWR Stn_ID: 48996; well_code: 417096N1225453W001; well_name: SV02; well_swn: NA
Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
0
200
400
600
800
1960
1980
2000
2020
Measurement date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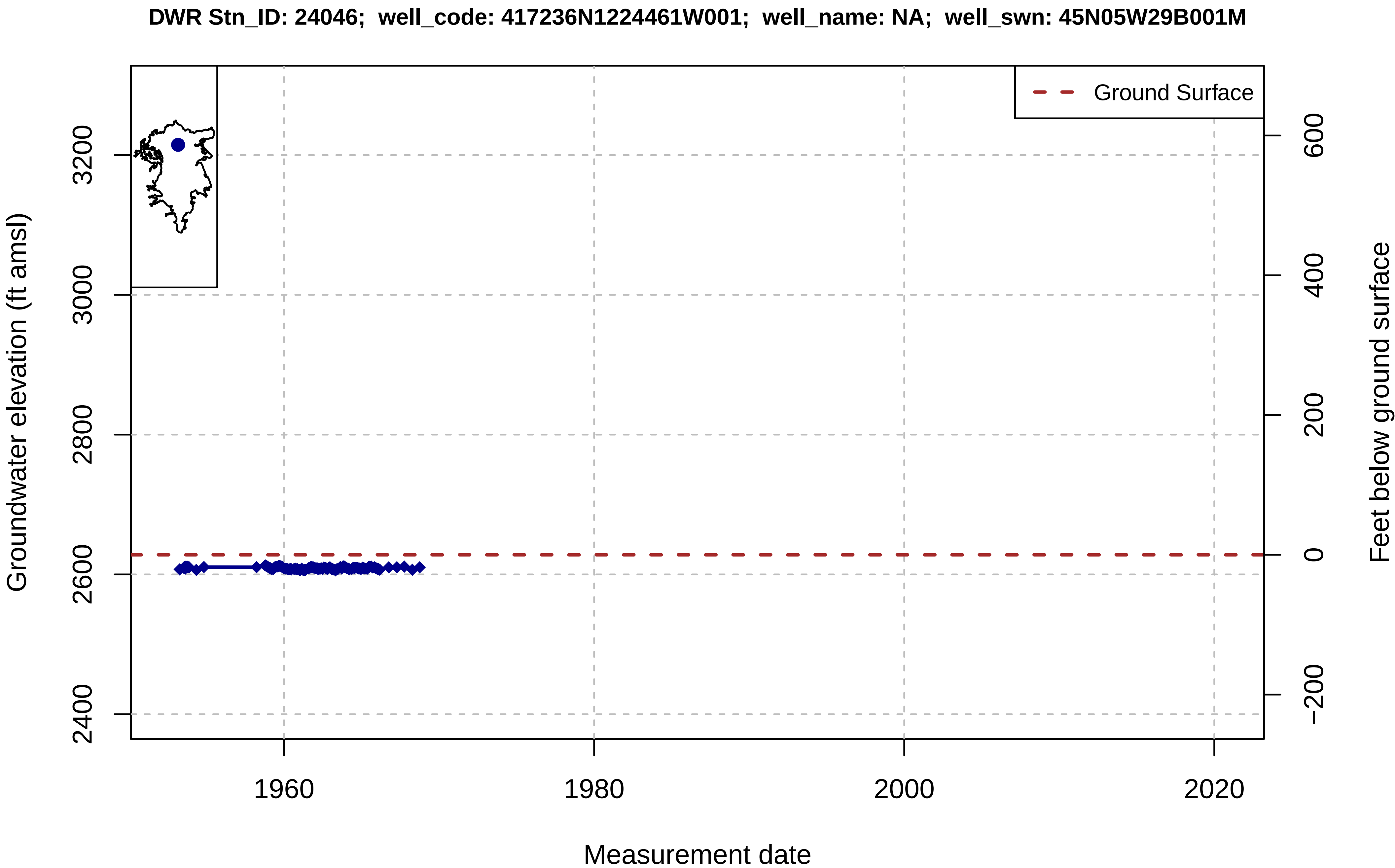
Ground Surface
Groundwater elevation (ft amsl)
3200
3000
2800
2600
2400
Feet below ground surface
600
400
200
0
1960
1980
2000
2020
Measurement date



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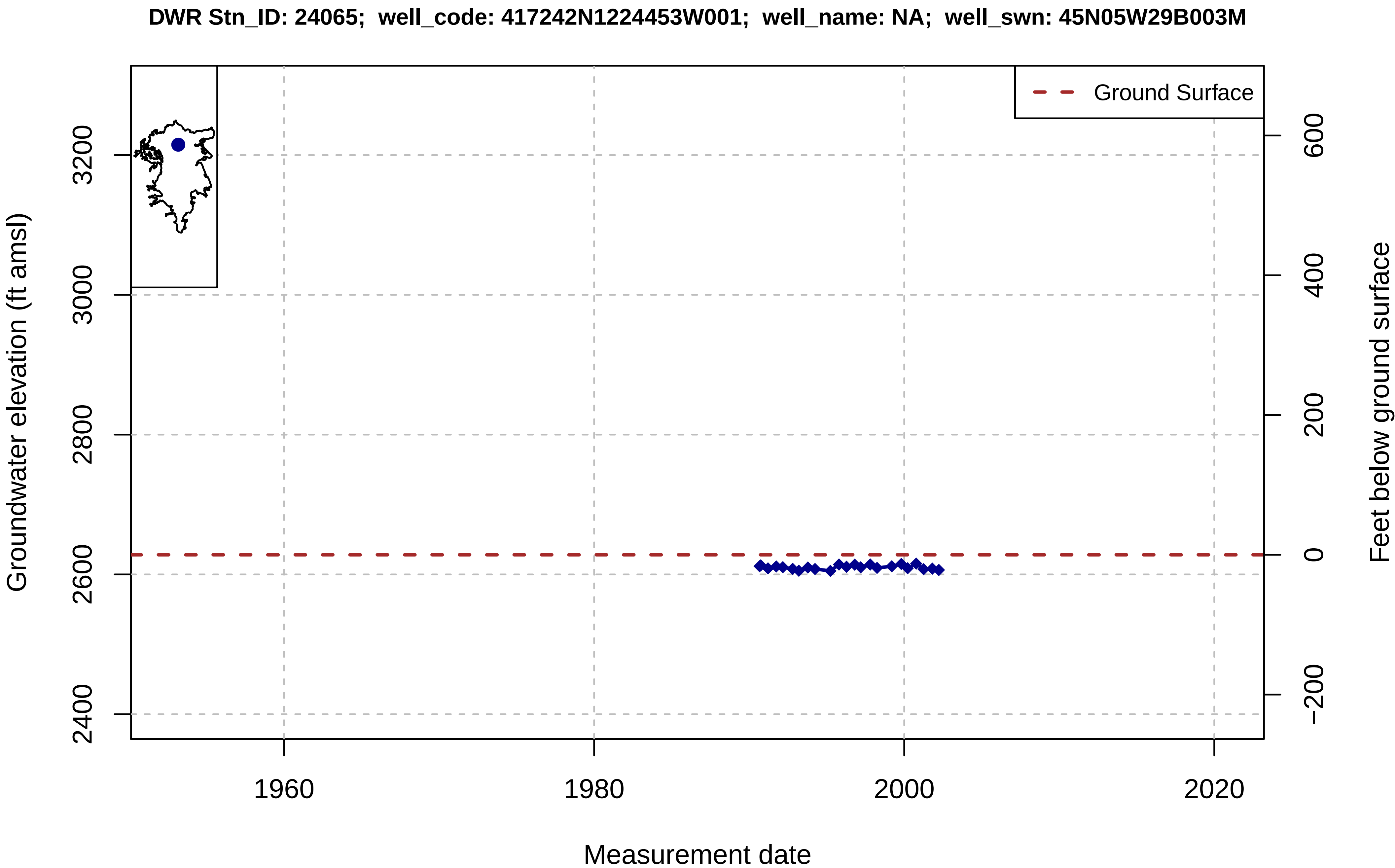
Ground Surface
Groundwater elevation (ft amsl)
3200
3000
2800
2600
2400
Feet below ground surface
600
400
200
0
−200
1960
1980
2000
2020
Measurement date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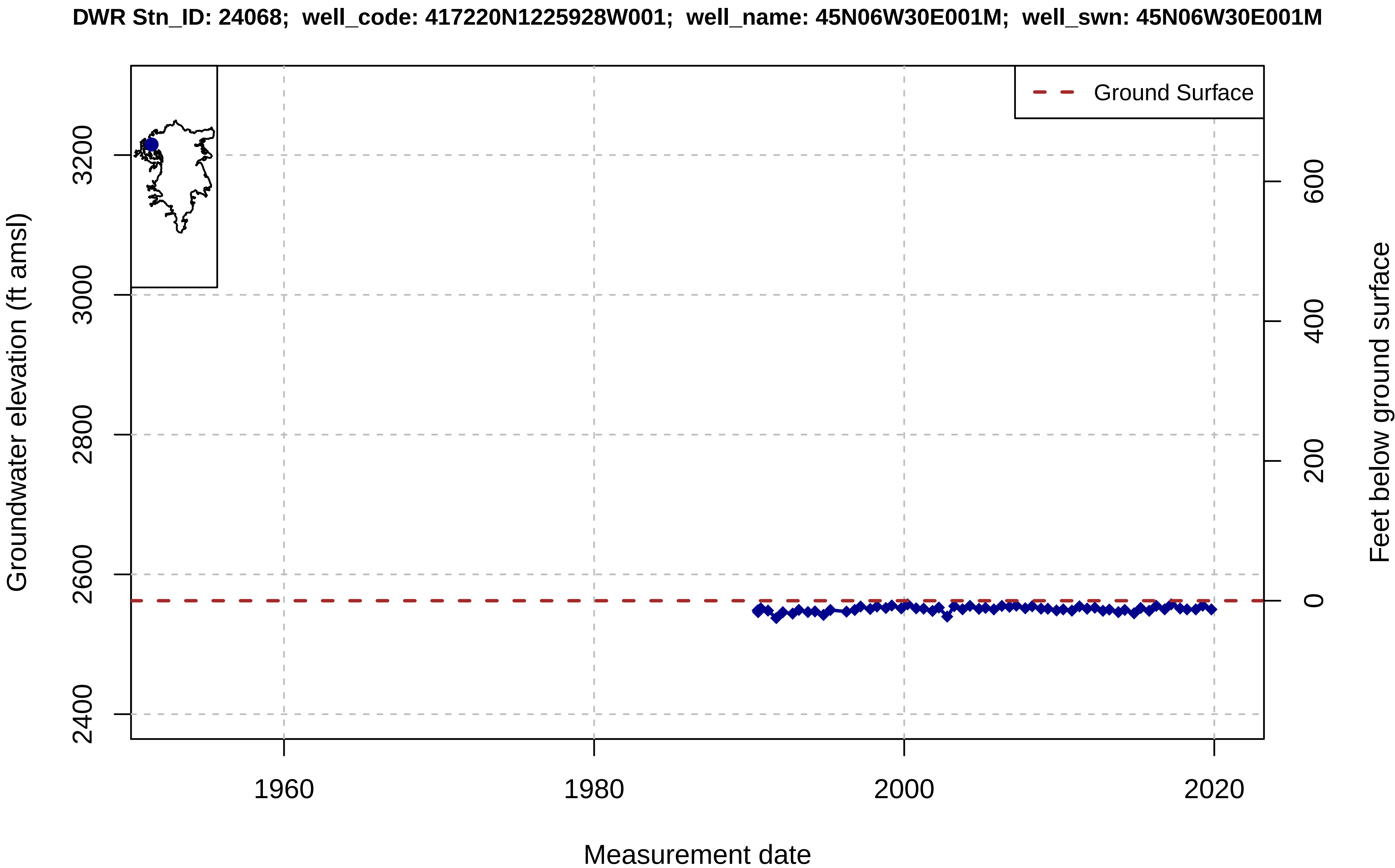
Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
−200
0
200
400
600
1960
1980
2000
2020
Measurement date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Ground Surface
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
2400
2600
2800
3000
3200
0
200
400
600
1960
1980
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2020

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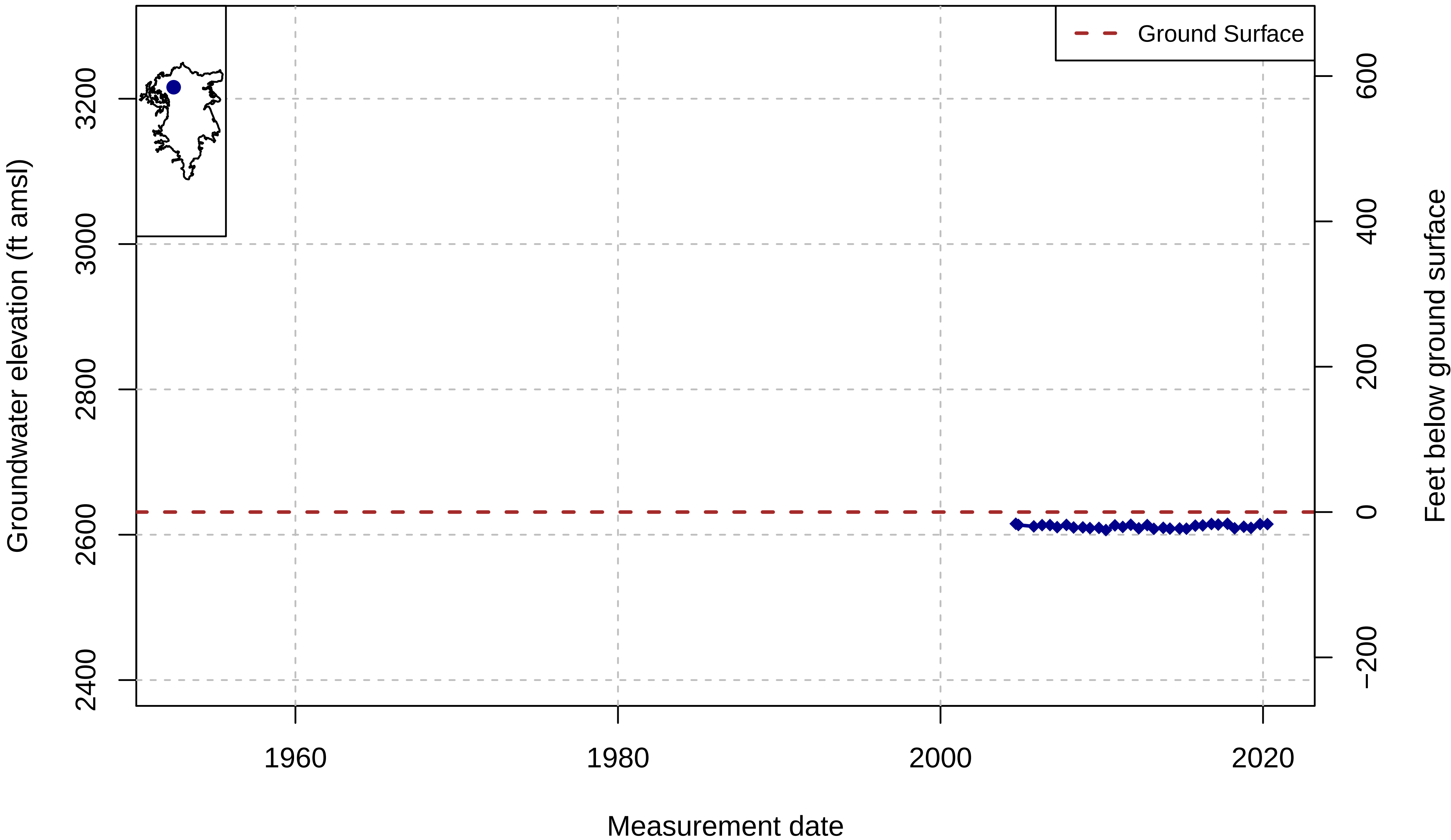

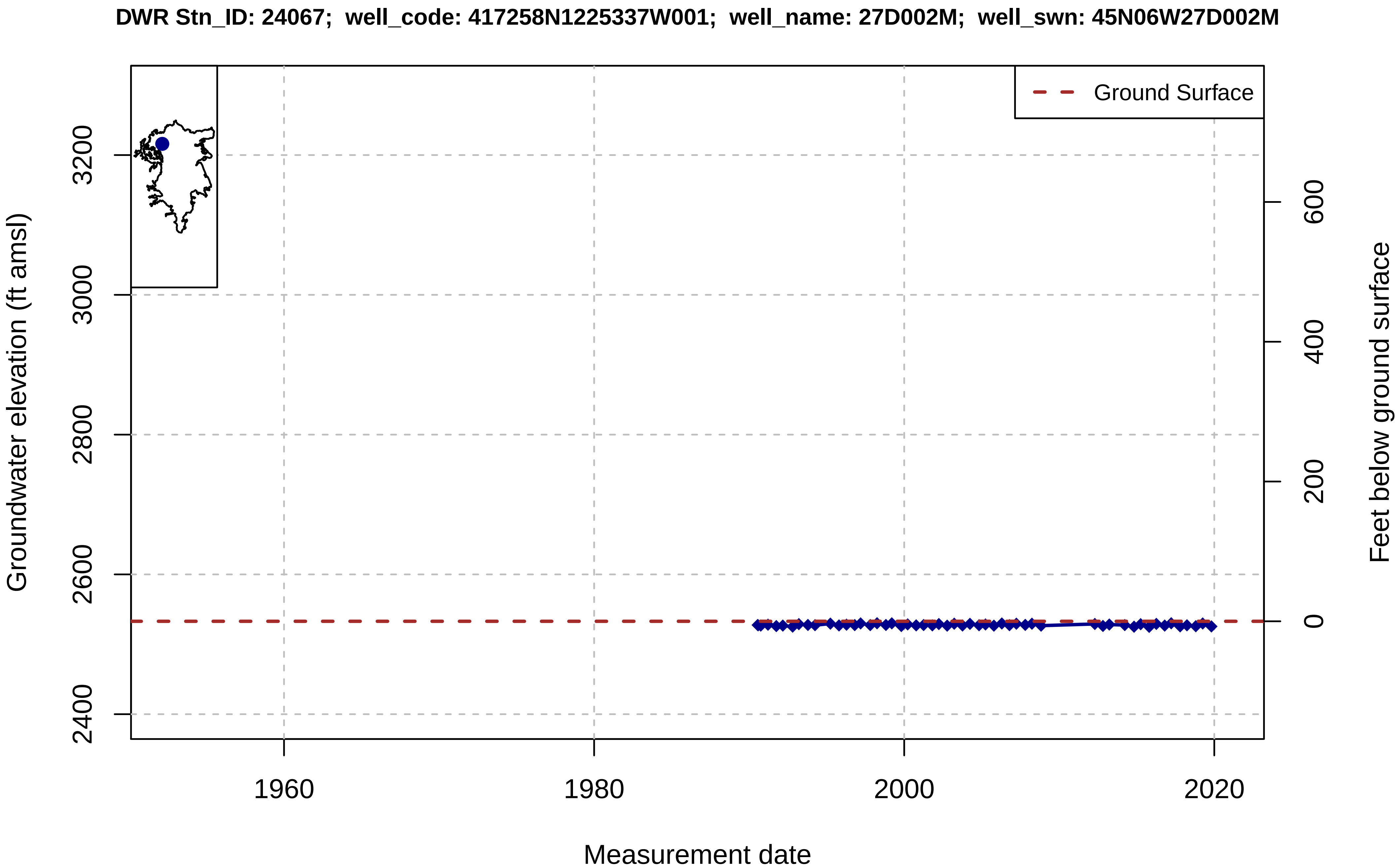

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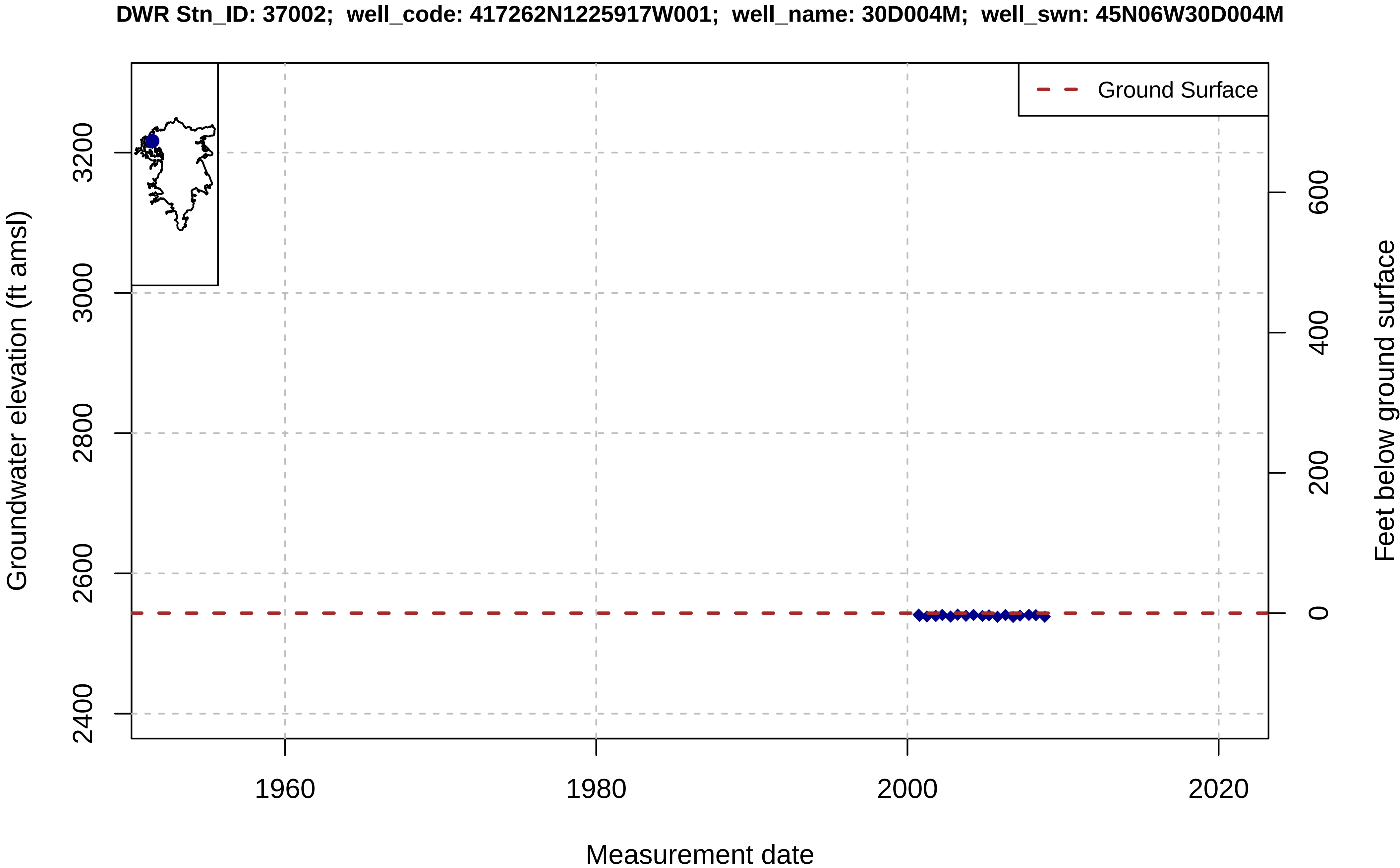
Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
0
200
400
600
1960
1980
2000
2020
Measurement date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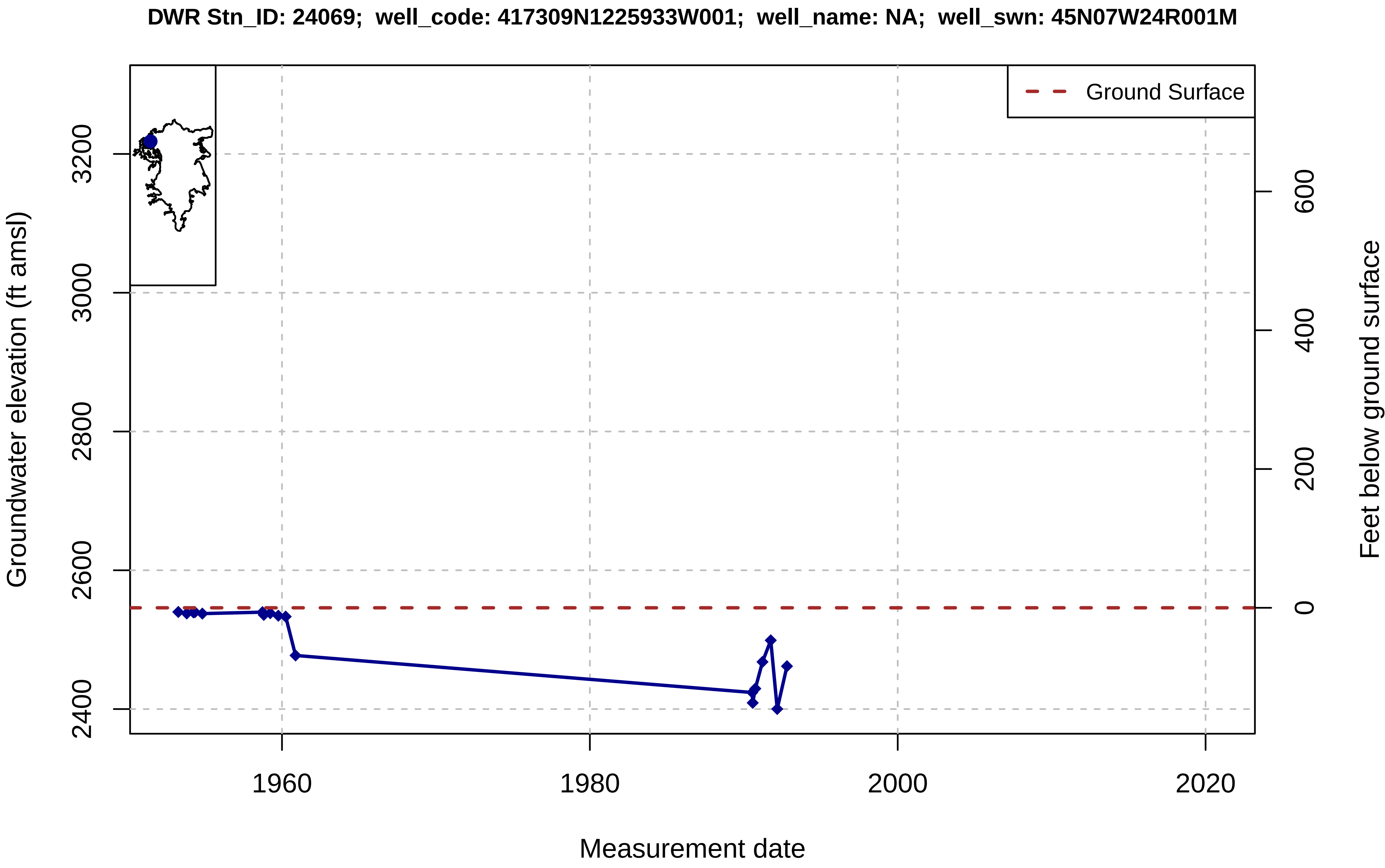
Ground Surface
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
2400
2600
2800
3000
3200
0
200
400
600
1960
1980
2000
2020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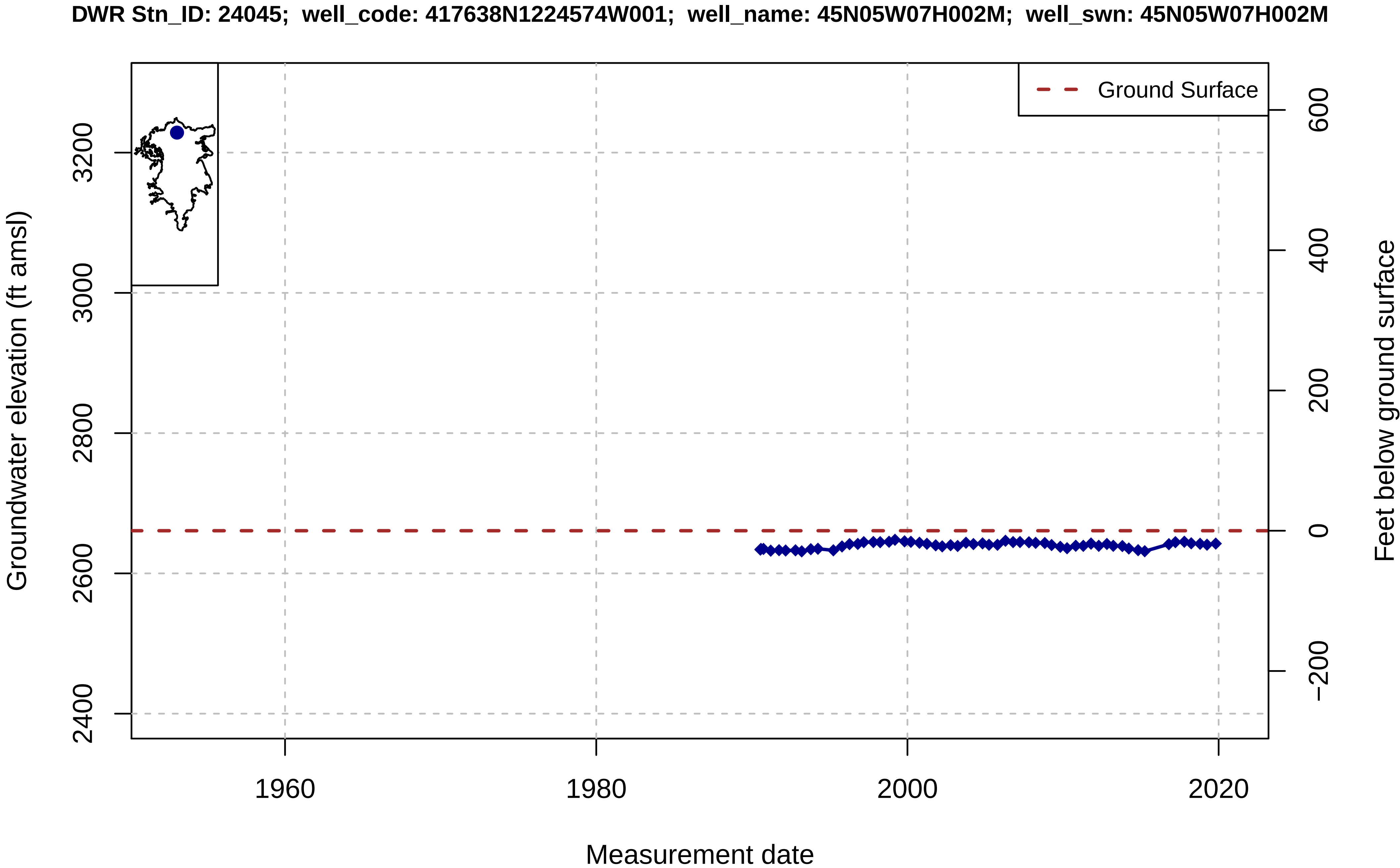
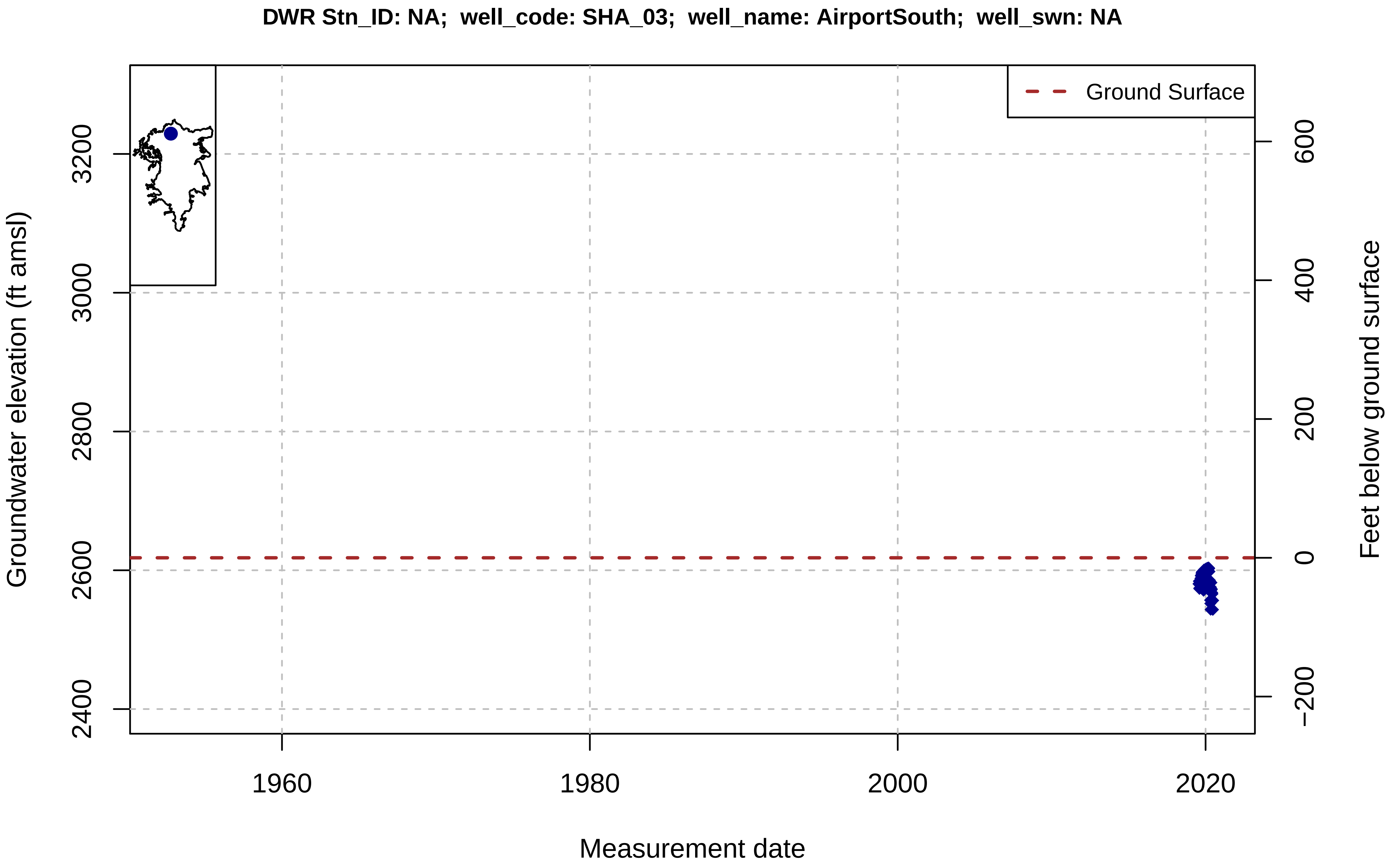
Ground Surface
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
2400
2600
2800
3000
3200
0
200
400
600
1960
1980
2000
2020



DWR Stn_ID: 24045; well_code: 417638N1224574W001; well_name: 45N05W07H002M; well_swn: 45N05W07H002M
Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
−200
0
200
400
600
1960
1980
2000
2020
Measurement date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Ground Surface
Groundwater elevation (ft amsl)
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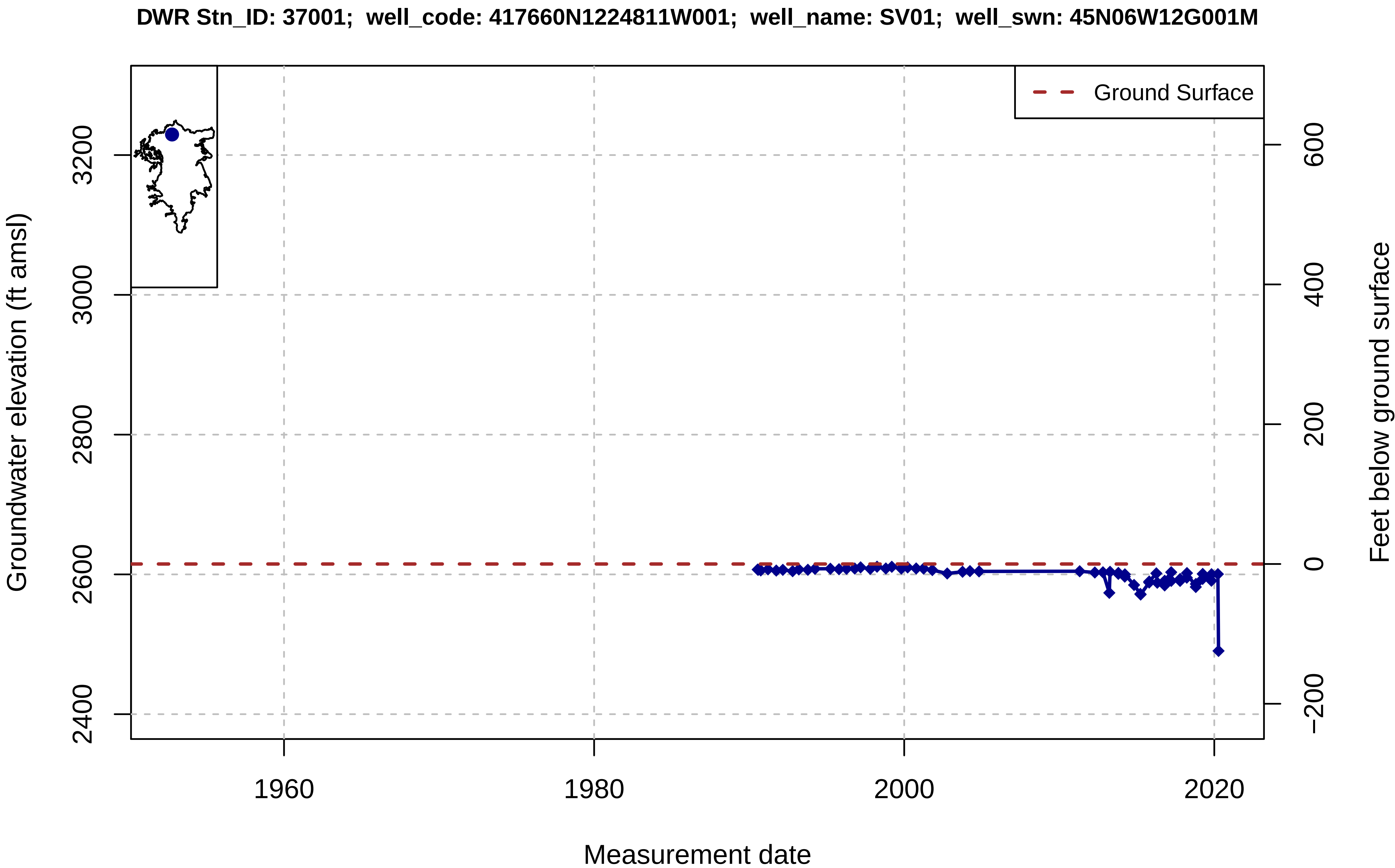
1960
1980
2000
2020
Measurement date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Ground Surface
Groundwater elevation (ft amsl)
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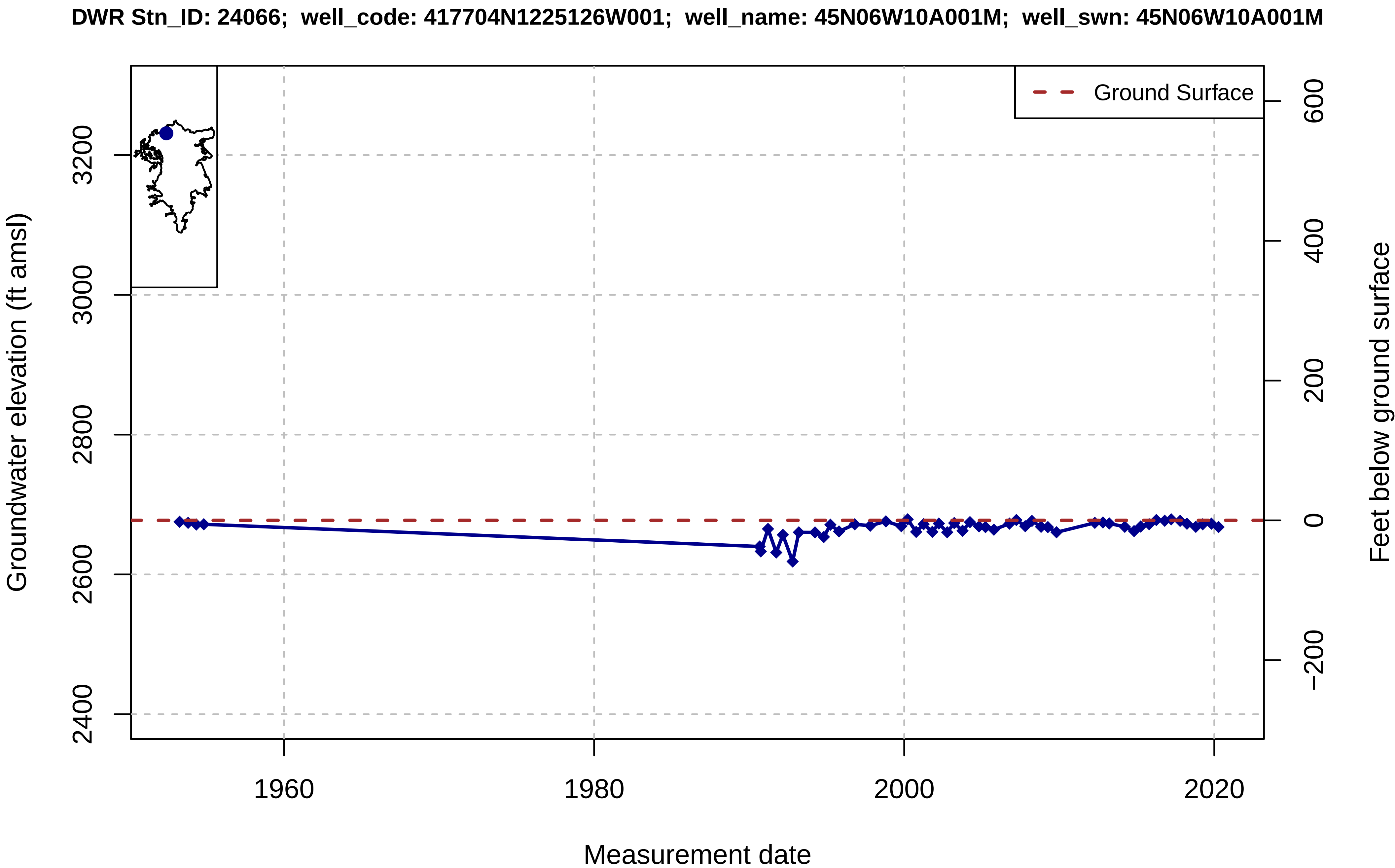
1960
1980
2000
2020
Measurement date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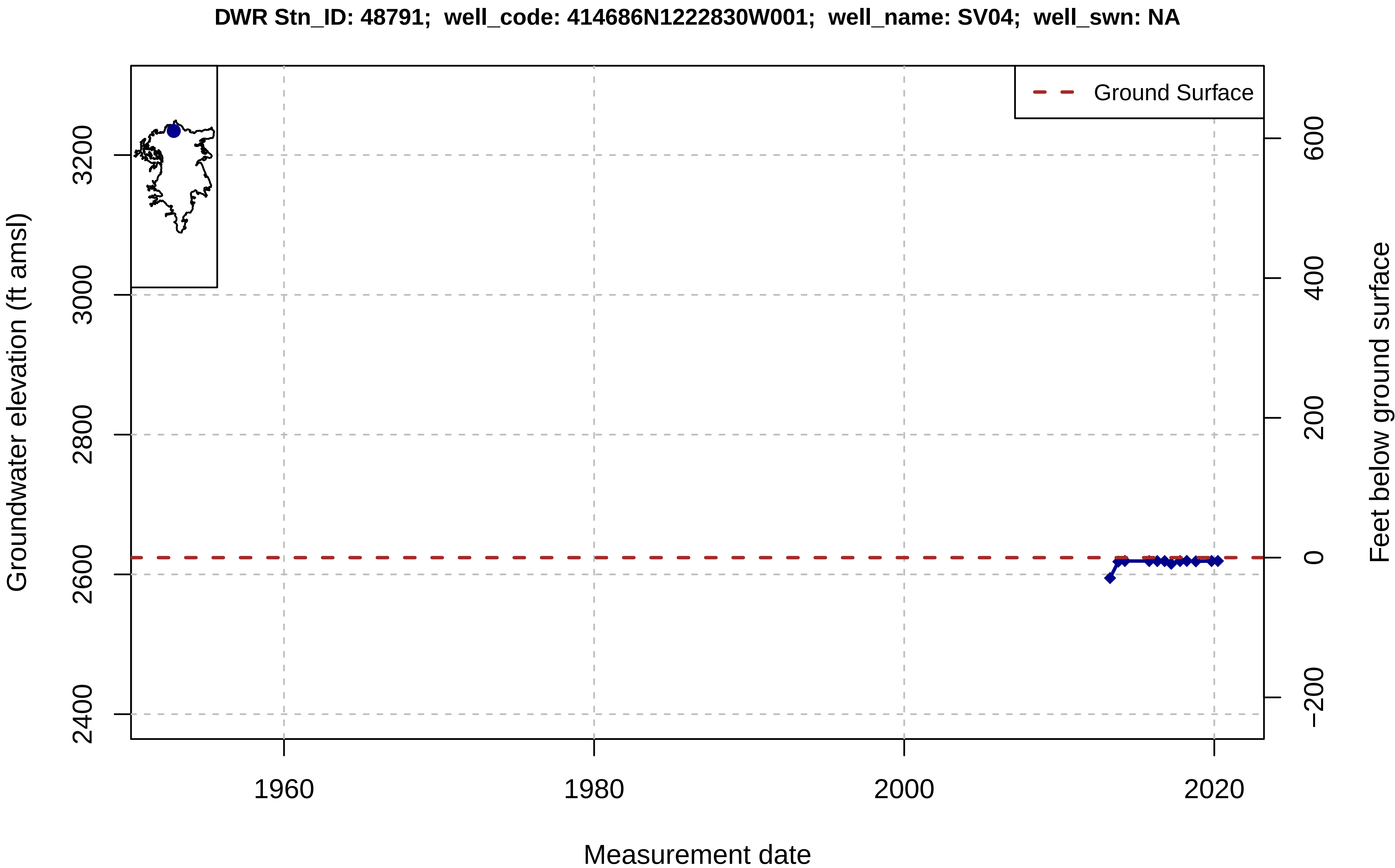
1960
1980
2000
2020
Measurement date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Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
2400
2600
2800
3000
3200
−200
0
200
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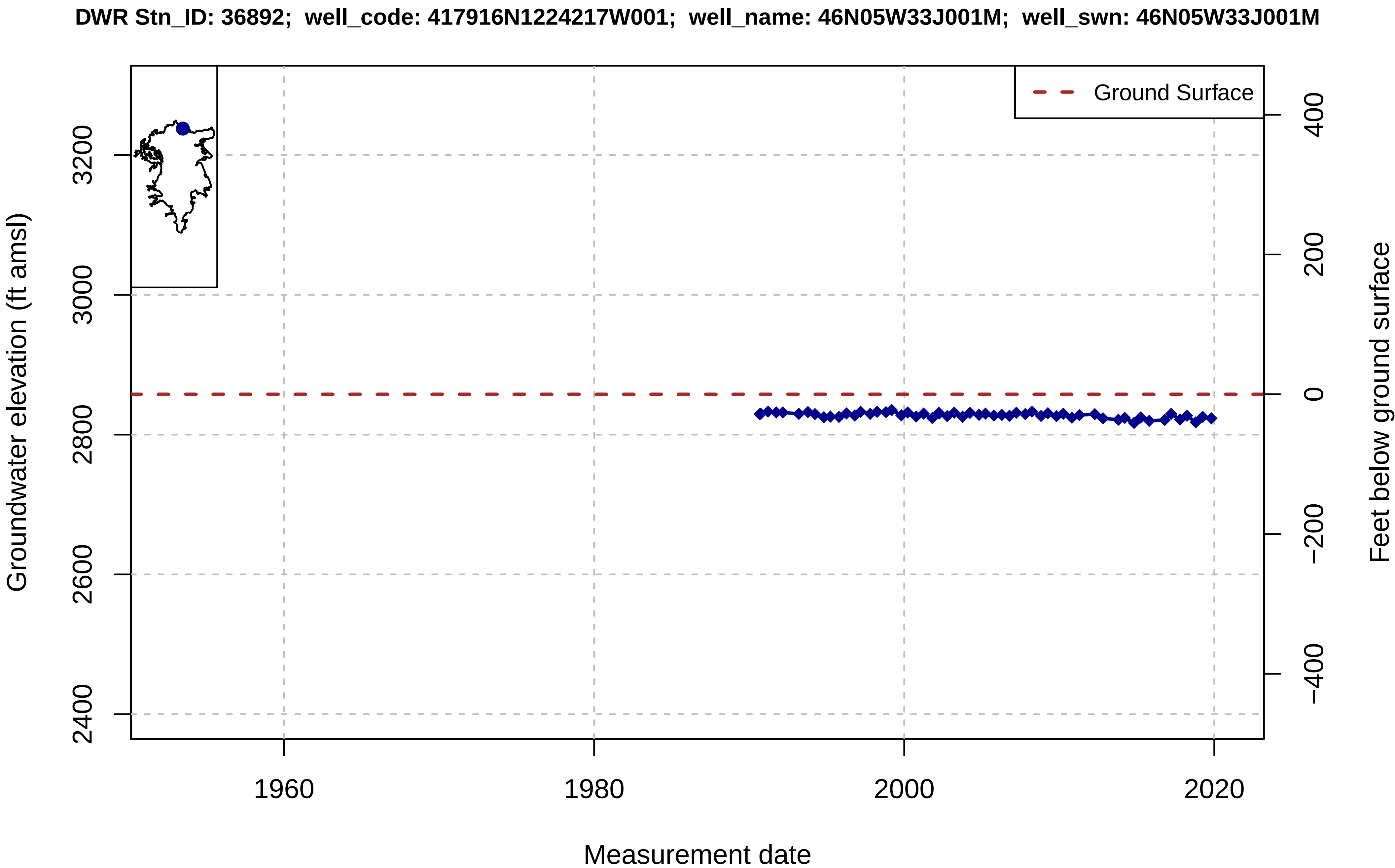
600
1960
1980
2000
2020



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Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
−400
−200
0
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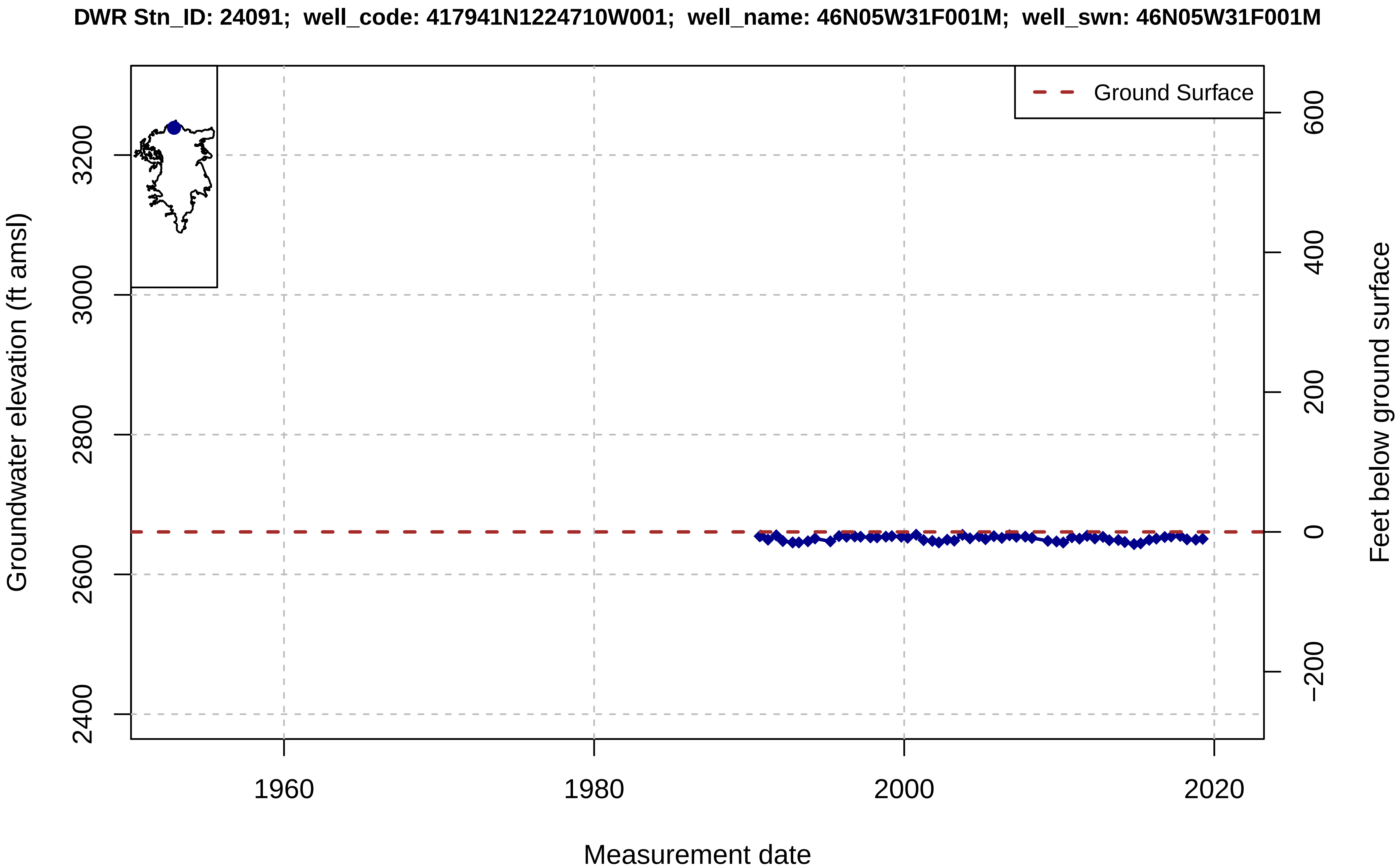
400
1960
1980
2000
2020
Measurement date



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Ground Surface
Groundwater elevation (ft amsl)
2400
2600
2800
3000
3200
Feet below ground surface
−200
0
200
400
600
1960
1980
2000
2020
Measurement date

InSAR Data Accuracy for California Groundwater Basins
CGPS Data Comparative Analysis
January 2015 to September 2019

Final Report

March 23, 2020

Prepared for:
California Department of Water Resources
Contract No. 4600011239
Task Order No. 37

Prepared by:
Towill, Inc.
Project No. 14750-0137

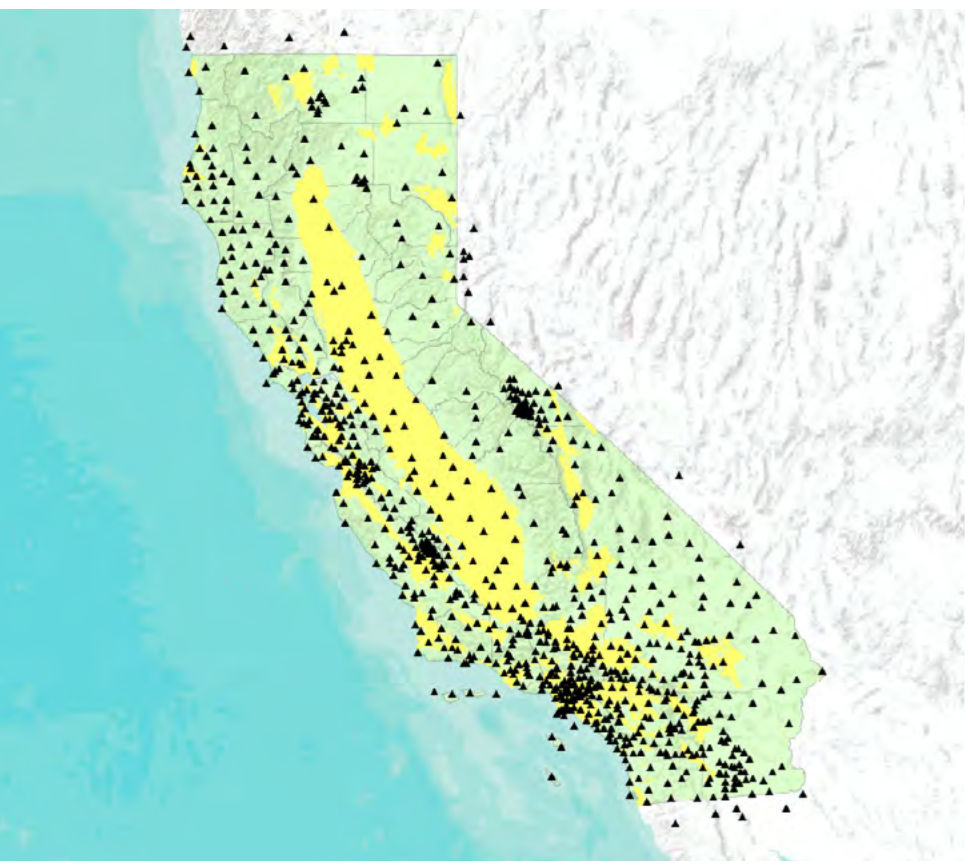

Photo Credit: European Space Agency

Photo Credit: UNAVCO

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CONTENTS

LIST OF FIGURES

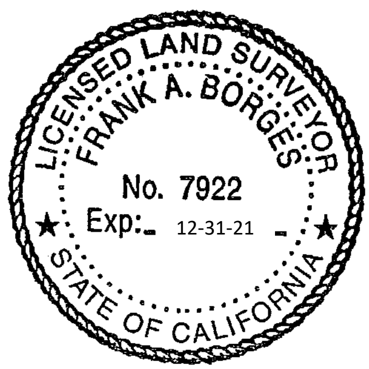
SURVEYOR'S CERTIFICATION STATEMENT

I hereby certify that this report was prepared by me or under my direction, and its contents represent an accurate assessment of the results shown.

Frank Borges, PLS, CA, No. 7922
Associate Principal

Signature: ______________________

Date: 3/23/2020



1. Executive Summary

Towill, Inc. and TRE Altamira, Inc., performed a study analyzing change in ground elevations across California for the period January 1, 2015 through September 19, 2019. The study compares measurements of vertical displacement in ground surface using two sets of time-series data, one set derived from a state-wide network of continuously operating global positioning system (CGPS) base stations, and another set based on interferometric synthetic aperture radar (InSAR) data collected by the European Space Agency's (ESA) Sentinel remote sensing satellites. The objective of this study is to demonstrate through quantitative analysis the accuracy of vertical ground surface deformation models derived from InSAR datasets through comparison to CGPS datasets whose accuracy and reliability are well established.

This work was performed under contract with the California Department of Water Resources (DWR) as part of DWR's technical assistance program supporting the Sustainable Groundwater Management Act (SGMA), by providing important relevant data to local Groundwater Sustainability Agencies working towards Groundwater Sustainability Plan development and implementation.

This study utilizes data from a network of CGPS stations installed across California by government agencies and scientific academic entities. The specific time-series datasets used in this study were acquired from two separate university-governed consortiums, UNAVCO and SOPAC, which are devoted to researching, analyzing, and archiving high-precision geodetic data. Motion in latitude, longitude, and ellipsoidal height of 878 CGPS stations fixed to the ground were analyzed for each day of the study period. Three hundred ninety-one (391) of these CGPS stations were selected for incorporation into this study based on data completeness in relation to the study period and geographic proximity to the groundwater basins which comprise the study area.

InSAR derived time-series data used in this study were collected by ESA's Sentinel 1A and 1B satellites. The Sentinel-1 mission is comprised of two polar-orbiting satellites which use C-band synthetic aperture radar (SAR) imaging collecting data that supports interferometric methods of detecting and measuring deformation of the earth's surface. The Sentinel datasets were selected for this study based upon: 1) their comprehensive geographic coverage of California; 2) the two satellites have opposite polar orbits, providing both ascending and descending Line of Site (LOS), which allows change in vertical displacement to be isolated from horizontal motion; and 3) Sentinel-1 mission data is made available to users without direct cost.

The objective of this study is to validate the accuracy of the InSAR data through quantitative analysis by comparing to CGPS data where the two time-series datasets align in time and space. TRE Altamira (www.tre-altamira.com) was responsible for acquiring and processing the InSAR data and Towill (www.towill.com) was responsible for acquiring and processing the CGPS data and performing the comparative analysis of the two datasets. Technical details describing how CGPS data were incorporated into the study were presented originally in the report titled CGPS Data Acquisition and Analysis, prepared by Towill, Inc. and dated February 2019, and expanded further in this report. Technical details describing how the InSAR data were processed and incorporated into the study are contained in the report titled InSAR Land Surveying and Mapping Services in Support of the DWR SGMA Program, prepared by TRE Altamira, Inc. and dated March 2020. These reports are attached as Appendices C and D, respectively. The methods and results of the comparative analysis are presented in the present report.

Towill aligned calendar dates for the InSAR and CGPS time-series data using a seven-day interval, plus the first day of each month, for the study period January 1, 2015 through September 19, 2019. The two datasets were also aligned geographically by selecting for analysis only those CGPS stations that are located within 100 meters of an InSAR measurement point. Using these techniques, 181 stations were analyzed as validation points using two quantitative measures: 1) the absolute difference in vertical displacement between the two datasets was calculated and used to develop a root mean square error (RMSE) value for each station separately and as a consolidated state-wide dataset; and 2) the correlation coefficient was calculated between the two datasets. The comparative analysis demonstrates very small absolute differences in the measurement of vertical displacement between the two datasets. RMSE values for individual stations range from 20.97mm to 1.45mm. The consolidated state-wide RMSE value is 7.91mm. Also, the data demonstrates a high degree of positive correlation between the two time-series datasets. Thirty-five stations (19% of total) have a correlation of 0.9 or higher and the consolidated state-wide mean correlation value is 0.70.

The quantitative analysis performed by comparing the CGPS and InSAR time-series data provides strong evidence that the InSAR data accurately models change in ground elevation. InSAR has several important advantages over CGPS for modeling change in ground elevations. First, the individual InSAR measurement points (MP) are far denser than CGPS measurements. For example, this study utilized 391 CGPS measurement stations compared to more than 185 million InSAR Measurement Points (MP) within the same study area. Secondly, there are several California groundwater basins which do not contain any CGPS stations and other areas where they are very sparse. InSAR datasets are effective in filling these gaps.

Accuracy Statement

The National Standard for Spatial Data Accuracy (NSSDA), developed by the Federal Geographic Data Committee (Document Number FGDC-STD-007.3-1998), offers a well-defined statistic and testing methodology for positional accuracy of geospatial data derived from various surveying methods, including satellite remote sensing. The NSSDA is based on comparison of data from the tested dataset to values from an independent source of higher accuracy. For this study, variation in vertical displacement of California's ground surface over time, as measured from interferometric synthetic aperture radar (InSAR) satellites, was statistically compared to available ground-based continuous global positioning systems (CGPS) data.

Tested: 16 mm vertical accuracy at 95% confidence level.

As tested by the processes described, this analysis provides statistical evidence that InSAR data accurately measured vertical displacement in California's ground surface to within 16 mm (value conservatively rounded up from 15.50 mm) for the period January 1, 2015 through September 19, 2019. This statement of accuracy is based on the assumptions that the number, distribution, and characteristics of CGPS check point locations provide a representative sample of the entire study area and of the entire InSAR dataset, and that the CGPS data constitutes an independent source of higher accuracy. This statement of accuracy applies to the state-wide dataset and may vary for regional or localized area subsets.

2. Background

2.1 Summary of Scope of Work and Purpose

California Department of Water Resources in June 2018 issued Towill, Inc. Task Order No. 26 under Contract No. 4600011239 as part of DWR's technical assistance role under the Sustainable Groundwater Management Act (SGMA). Under Task Order No. 26, changes over time in ground surface elevations were measured using satellite-based interferometric synthetic aperture radar (InSAR) and compared to time-series data recorded by ground-based, continuously operating Global Positioning System (CGPS) stations located throughout many of the groundwater basins in the state. Task Order 26 was completed, and a Final Report covering the study period January 1, 2015 to June 1, 2018 was published on May 28, 2019.

A second contract, Task Order No. 37, was issued to Towill, Inc. to extend the study period through September 2019. Several new groundwater basins were added to the study area under Task Order No. 37 and as a result, both the InSAR and CGPS datatsets were reprocessed for the complete study period January 1, 2015 through September 19, 2019. This report describes the methods and results of the InSAR-CGPS Data Comparative Analysis – January 2015 to September 2019.

2.2 Points of Contact

Questions regarding this report should be addressed to:

Contractor's Project Manager	Contractor's Contract Manager
Frank Borges, PLS	Brian Young
2300 Clayton Road, Suite 1200	2300 Clayton Road, Suite 1200
Concord, California 94520-2176	Concord, California 94520-2176
Phone: (925) 682-6976 ext. 1036	Phone: (925) 682-6976 ext. 1041
Frank.Borges@towill.com	Brian.Young@ towill.com

3. Continuous Global Positioning Systems (CGPS) Time-Series Data

Towill analyzed time-series data for 878 CGPS stations distributed throughout California. These data were acquired from online archives maintained by the University NAVSTAR Consortium (UNAVCO) and the Scripps Orbit and Permanent Array Center (SOPAC). General details and an overview of CGPS time-series data processing are documented in Towill's report ***CGPS Data Acquisition and Analysis*** dated February 2019 (see Appendix C).

Several important updates to CGPS data processing were implemented for the January 1, 2015 to September 19, 2019 study period as listed below:

- UNAVCO time-series dataset "cwu.igs.csv" was downloaded on October 22, 2019 and used for the January 2015 through September 2019 study period.
- SOPAC time-series dataset "WNAM_Clean_TrendNeuTimeSeries_sopac_20200207.tar" was downloaded on February 7, 2020 and used for the January 2015 through September 2019 study period.

- CGPS time-series null values up to 15 consecutive days were replaced with calculated values estimated through linear interpolation.

- Three SOPAC stations (CHOW, TEHA, MULN), located in an area of high subsidence, are included in the January 2015 to September 2019 study with modification. Each of these stations has a similar unexplained data spike where the height of each of these station drops approximately 100mm in a two-day period starting April 19, 2016. Time-series data for these three stations were included for the period following the unexplained data spike.

Towill's subconsultant, TRE Altamira, who performed the collection and analysis of the InSAR data for this project, selected 232 CGPS points for calibrating the InSAR datasets. The InSAR data calibration process performs a plane removal function which removes possible errors based on satellite orbital inaccuracies. The calibration process also helps "fix" the elevation of the InSAR image frame reference points (RP) necessary for seismically active areas such as California. Technical details on the InSAR data calibration process are described in TRE Altamira's report ***InSAR Land Surveying and Mapping Services in Support of DWR's SGMA Program*** dated March 2020 (see Appendix D).

Towill's objective for validation points was to identify CGPS stations which meet the following criteria:

1. Located within a groundwater basin included in the SGMA study area
2. Located within 100 meters of an InSAR synthetic Measurement Point (sMP)
3. Not used by TRE Altamira for the InSAR data calibration process

Geographic Information System (ArcGIS) software was used to identify 160 CGPS points meeting the above criteria; however, all of these are located south of Sacramento. The density of CGPS stations north of Sacramento is sparse and a decision was made to use those available for the InSAR data calibration process. Further evaluation of TRE's report clarified that the calibration methodology involves stabilizing local InSAR reference points to the absolute CGPS time-series reference system; this methodology does not constrain the InSAR dataset to match the individual CGPS time-series data. Based upon this more complete understanding of the calibration method, a decision was made to include in the InSAR-CGPS validation process stations in northern California which were also used for calibration. This compromise provides 10 additional validation points.

Figure 1 shows the distribution of the CGPS stations used as validation points for comparative analysis of the InSAR data. Figure 2 shows the distribution of CGPS stations used by TRE Altamira as InSAR calibration points.

4. InSAR Time-Series Source Data

Details regarding the InSAR time-series data used by Towill for this study are described in TRE Altamira's report ***InSAR Land Surveying and Mapping Services in Support of DWR's SGMA Program*** (Appendix D). The state-wide InSAR dataset used by Towill for performing the comparative analysis used synthetic Measurement Points (sMP) developed by TRE. Synthetic Measurement Points (sMP) were calculated by averaging all InSAR Measurement Point (MP) values within a 100-meter grid. The larger MP dataset contains more than 185 million individual measurement which were consolidated into 4.6 million sMPs based on a 100-meter grid.

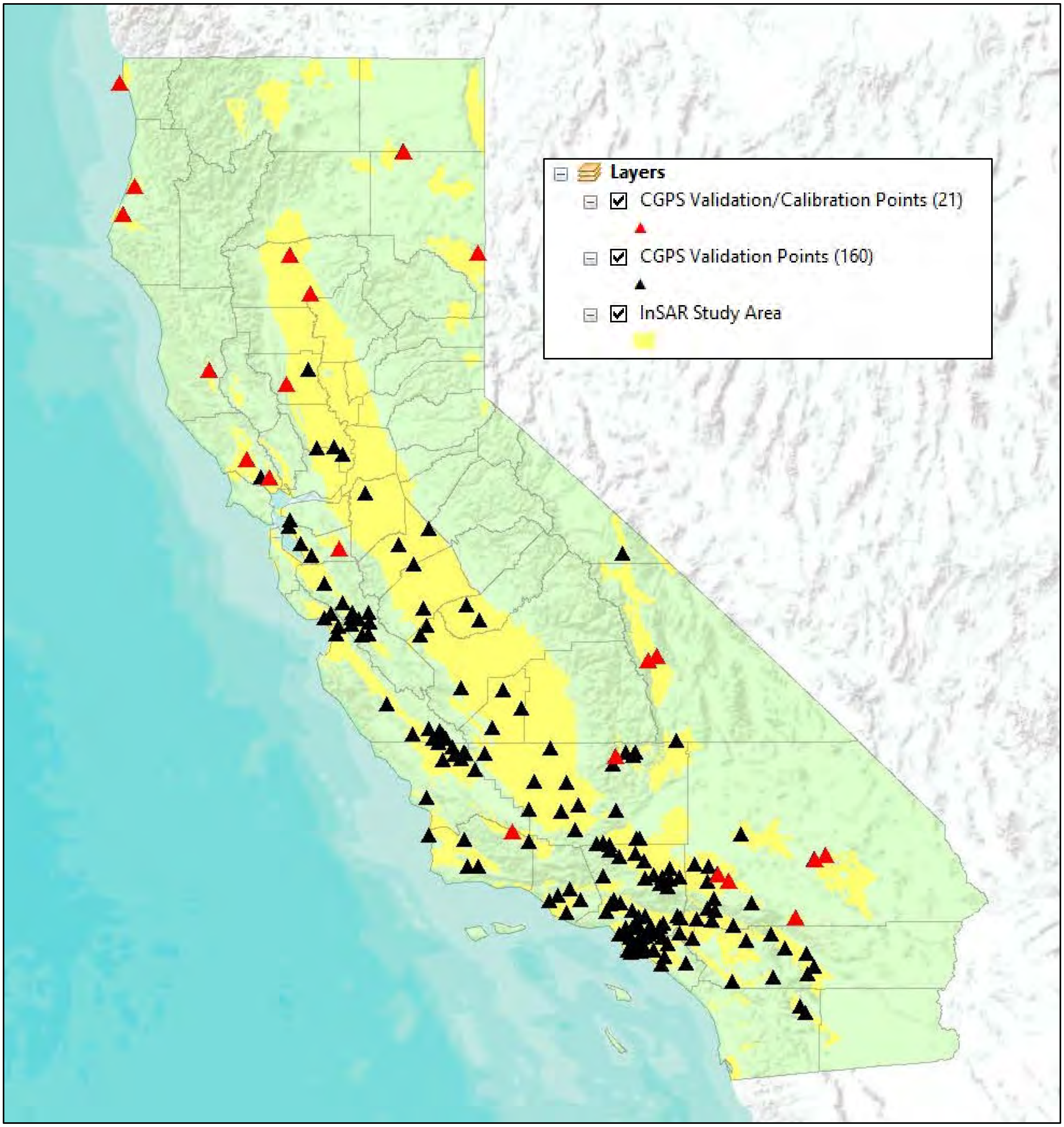


Figure 1 – Distribution of CGPS Stations used for Comparative Analysis

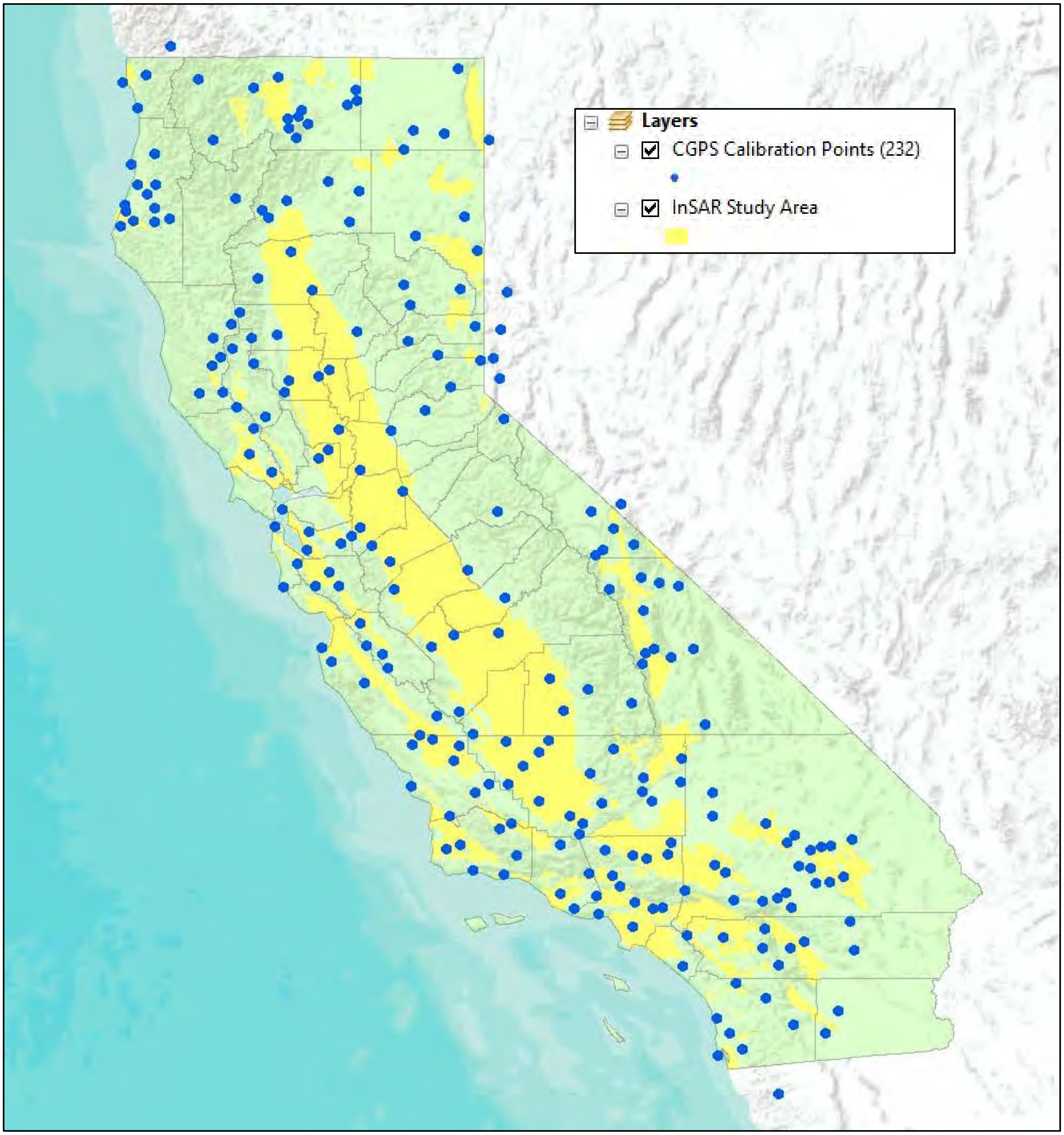


Figure 2 – CGPS Stations Selected for the InSAR Data Calibration Process

5. Comparative Data Analysis

The methods and procedures used to perform the InSAR-CGPS comparative data analysis are described below:

1. InSAR data were downloaded from TRE's web-portal "TREmaps"; ten shapefiles named *"CALIFORNIA_DWR_1_VERT"* through *"CALIFORNIA_DWR_10_VERT"* representing the Variable Start Date dataset (01 January 2015 through September 19, 2019) were used in this study.

2. ArcGIS was used to select which CGPS station were located inside the SGMA InSAR study area and are within 100 meters of an InSAR sMP.

3. CGPS time-series data (daily) were reduced in frequency to align with the specific dates of the Variable Period InSAR dataset. Start dates for InSAR sMP range from 01 January 2015 through 19 September 2019. Data values for all InSAR sMP start no later than 13 June 2015.

4. Python and its Pandas library for data analysis and manipulation were used to create a dataframe for each CGPS-InSAR data station in the comparative analysis. The absolute difference in vertical motion between the CGPS station and InSAR sMP were compared and used to develop a Root Mean Square Error (RMSE) for each station and the consolidated state-wide dataset and the correlation coefficient was calculated comparing the two time-series datasets. Formulas for each are presented below:

$$NSSDA\ RMSE = RMSE_z = sqrt\left[\sum (Z_{data\ i} - Z_{check\ i})^{2} / n\right]$$

$$Correlation\ Coefficient\ (X,Y) = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2\ \sum(y-\bar{y})^2}}$$

5. The statistical results of the InSAR-CGPS comparative data analysis are presented in tabular form in Appendix A and graphic form in Appendix B. An example of the charts found in Appendix B is shown in Figure 3.

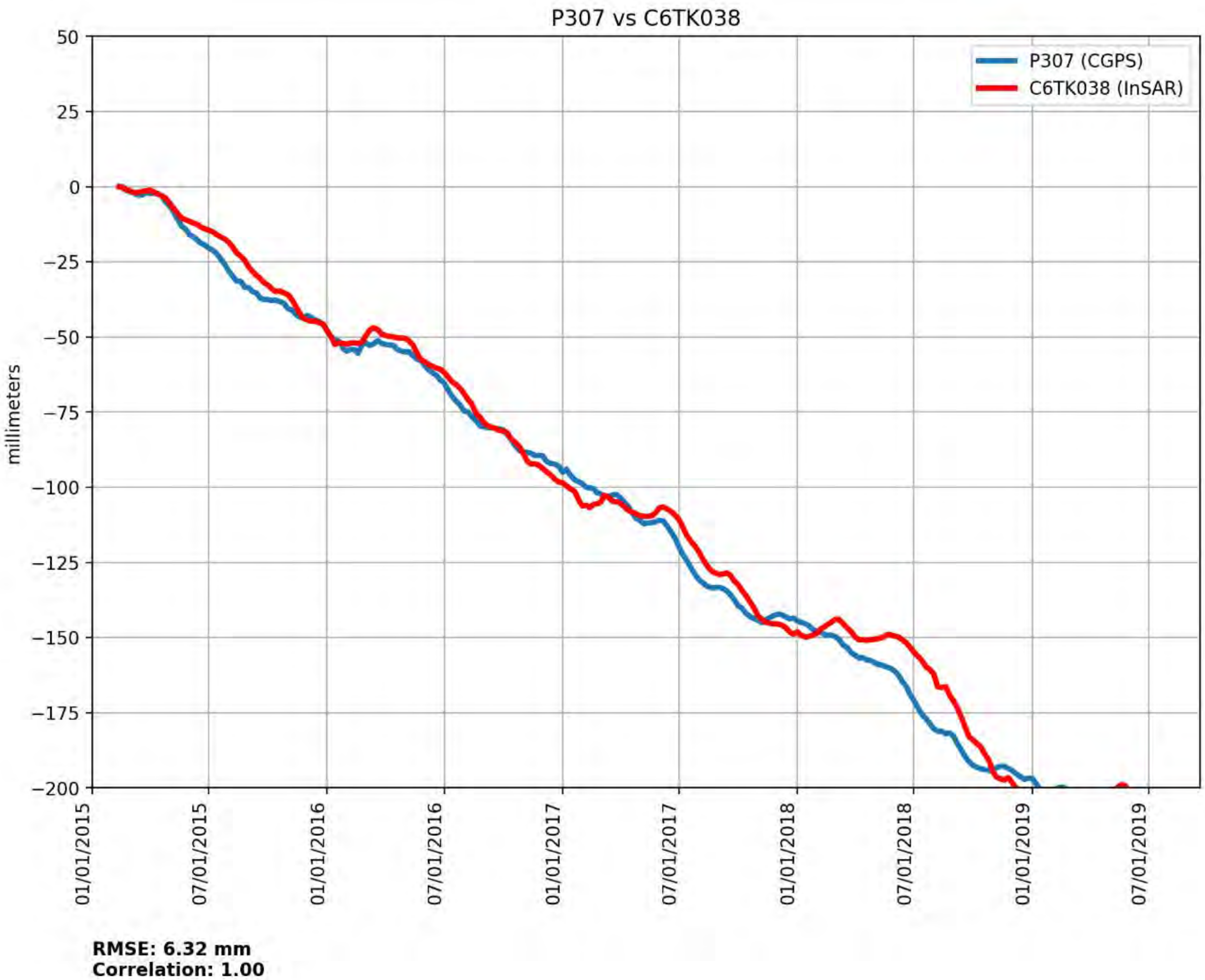


Figure 3 – Example of Graphic Data Presentation from Appendix B

6. Conclusions

The comparative analysis demonstrates very small absolute differences in the measurement of vertical displacement between the two datasets. RMSE values for individual stations range from 20.97mm to 1.45mm. The consolidated state-wide RMSE value is 7.91mm. Also, the data demonstrates a high degree of positive correlation between the two time-series datasets. Thirty-five stations (19% of total) have a correlation of 0.9 or higher and the consolidated state-wide mean correlation value is 0.70.

The quantitative analysis performed by comparing the CGPS and InSAR time-series data provides strong evidence that the InSAR data accurately models change in ground elevation to an accuracy tested to be 16mm at 95% confidence.

7. Opportunities for InSAR-CGPS Study Enhancements

Listed below are several considerations which were identified in the course of conducting this study. Each item is outside the scope of the present study, but-should be considered as opportunities for enhancing future studies of a similar type:

- Distribution of CGPS stations is not uniform across the SMGA study boundary and some basins have no CGPS stations in proximity. DWR should consider sponsoring new CGPS stations in areas of high interest.

- The InSAR dataset is based on highly coherent Measurement Points (MP) and these values are used to interpolate vertical displacement through areas of less coherence. Additional analysis should be performed to identify areas of greatest interpolation and weighting data reliability.

- CGPS stations are not equally reliable and have individual error budgets. Additional effort may be devoted to modeling differences among CGPS stations and weighting their influence accordingly.

APPENDIX A

StatID	System	CGPS-InSAR	Distance (M)	Correlation	RMSE (MM)
ALPP	UNAVCO	ALPP vs B3SH1D2	44.53	0.856	3.75
ALTH	SOPAC	ALTH vs C5RG8YG	53.82	0.574	7.71
ARM1	UNAVCO	ARM1 vs BAPXNOO	20.78	0.991	8.33
ARM2	UNAVCO	ARM2 vs BAPXNOO	30.74	0.992	7.93
AVRY	UNAVCO	AVRY vs AX9AUGL	52.20	0.684	4.40
AZRY	UNAVCO	AZRY vs AG6VIIS	24.72	0.788	4.96
BBRY	UNAVCO	BBRY vs ATI5GBN	31.08	0.858	2.03
BFLD	SOPAC	BFLD vs BEMFYCX	33.73	0.872	8.80
BFSH	SOPAC	BFSH vs BHVQCWK	52.62	0.297	16.02
BGIS	UNAVCO	BGIS vs AO1ODTQ	19.99	0.751	4.62
BKMS	UNAVCO	BKMS vs ANY3S8O	57.58	-0.036	6.74
BKR1	SOPAC	BKR1 vs B9GOPKO	45.81	0.990	5.18
BLSA	SOPAC	BLSA vs AKYCBSI	61.23	0.570	13.26
BRAN	UNAVCO	BRAN vs AS1RA53	48.11	0.794	3.77
BSRY	UNAVCO	BSRY vs B5IZL0Z	49.07	0.888	6.19
BUEG	UNAVCO	BUEG vs AZWK56H	60.47	0.296	16.63
CCCS	SOPAC	CCCS vs AM4M3UQ	43.14	0.407	6.79
CHOW	SOPAC	CHOW vs C9C1VXP	41.63	0.998	6.62
CIT1	UNAVCO	CIT1 vs AR5LVKR	45.39	0.786	2.91
CLAR	UNAVCO	CLAR vs AQNQVPO	49.81	0.865	3.46
CMOD	SOPAC	CMOD vs CJKL6UT	50.84	0.415	12.57
CRCN	SOPAC	CRCN vs BRI8M90	49.05	0.999	7.18
CRFP	UNAVCO	CRFP vs APDB2XX	38.77	0.108	13.11
CRHS	UNAVCO	CRHS vs ALEF0YI	39.05	-0.367	20.97
CSCI	UNAVCO	CSCI vs ARQG14M	58.09	0.758	4.60
CSDH	UNAVCO	CSDH vs AM3F8DK	70.92	0.832	4.16
CSN1	UNAVCO	CSN1 vs ATB07Y5	15.12	0.823	8.97
CTDM	UNAVCO	CTDM vs AY4USJ3	99.19	-0.094	9.59
CTMS	UNAVCO	CTMS vs AQX9UAW	49.90	0.837	2.43
CUHS	UNAVCO	CUHS vs B5Z28JQ	33.39	0.974	18.56
CVHS	UNAVCO	CVHS vs AQ5AFTU	50.16	0.854	6.15
DVPB	UNAVCO	DVPB vs AW8ZE2U	52.87	0.481	11.56
DYH2	UNAVCO	DYH2 vs ANIMIHN	55.73	0.551	7.46
EBMD	SOPAC	EBMD vs CMRHTQG	13.34	0.920	2.96
ELSC	UNAVCO	ELSC vs AP6RAJ7	32.87	0.932	4.66
ELTN	UNAVCO	ELTN vs B1KOYHF	60.21	0.252	7.65
EWPP	UNAVCO	EWPP vs AQK6A7I	53.09	0.700	3.06
FOXG	UNAVCO	FOXG vs B24XP6F	30.66	0.958	2.30
FVPK	SOPAC	FVPK vs AIFUFWK	26.19	0.355	7.25
GHRP	UNAVCO	GHRP vs ASE9EFY	25.56	0.521	4.29
HBCO	UNAVCO	HBCO vs AKO7YBZ	32.22	0.785	2.75
HOGS	UNAVCO	HOGS vs BMYIE9S	33.86	0.751	6.89
HOLP	UNAVCO	HOLP vs AN93KS7	63.70	0.772	6.03
IDQG	UNAVCO	IDQG vs AKDI6U4	56.90	0.457	6.39
ISLK	UNAVCO	ISLK vs BJ7D1BD	63.20	0.786	11.59
JLN5	SOPAC	JLN5 vs BN2OF9K	14.46	0.525	5.77

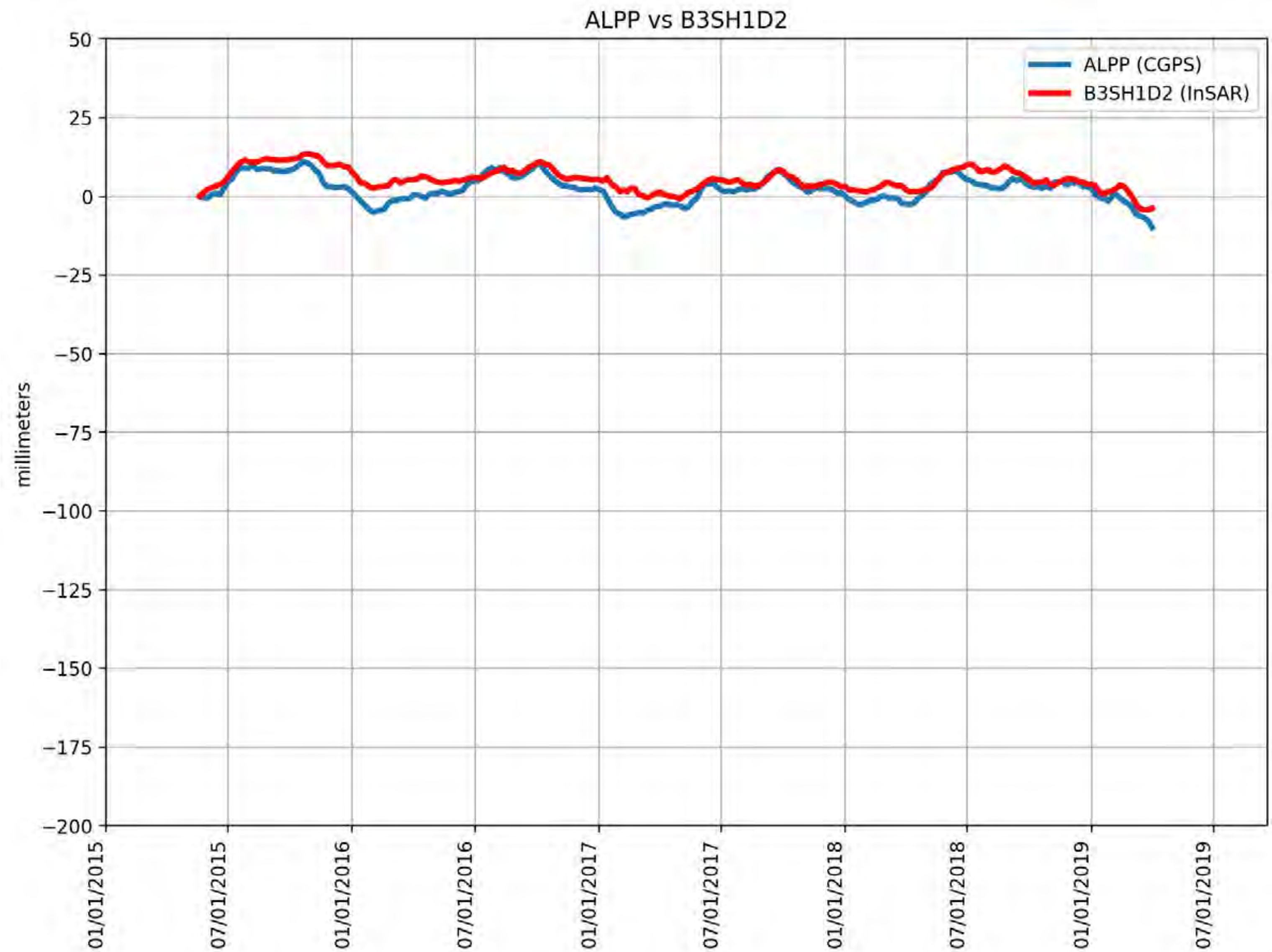
StatID	System	CGPS-InSAR	Distance (M)	Correlation	RMSE (MM)
JNHG	UNAVCO	JNHG vs AWW7ALU	50.53	0.738	3.82
KBRC	UNAVCO	KBRC vs AVYV00H	65.18	0.748	6.14
LAPC	UNAVCO	LAPC vs ARZDJIO	45.34	0.553	10.49
LBC1	UNAVCO	LBC1 vs ALKDD3M	50.65	0.434	13.02
LBC2	UNAVCO	LBC2 vs AKTKUUQ	31.98	0.904	2.45
LBCH	UNAVCO	LBCH vs AKQLOT4	54.79	0.922	2.81
LEMA	SOPAC	LEMA vs BURJ09Z	52.69	0.997	8.16
LINJ	UNAVCO	LINJ vs B0TB0UO	20.59	0.505	5.50
LL01	UNAVCO	LL01 vs AXKM2HP	58.15	0.767	2.85
LLAS	UNAVCO	LLAS vs AZEP6MY	51.97	0.373	10.20
LORS	UNAVCO	LORS vs AR385ES	50.83	0.681	2.67
LOWS	UNAVCO	LOWS vs BM8WR6I	63.46	0.489	6.17
LPHS	UNAVCO	LPHS vs AP4YZW1	20.14	0.609	4.34
LRRG	UNAVCO	LRRG vs AYC006P	47.05	0.718	2.52
LUTZ	SOPAC	LUTZ vs CD20DX5	24.94	0.846	6.18
MASW	UNAVCO	MASW vs BMBVXB3	76.99	0.362	15.87
MILK	UNAVCO	MILK vs AR5LVKS	58.61	0.824	6.45
MPWD	UNAVCO	MPWD vs AU2ZL50	59.87	0.825	8.82
MTA1	UNAVCO	MTA1 vs APO0V1U	47.17	0.771	3.96
MULN	SOPAC	MULN vs BZSIRYU	12.10	0.990	10.54
NOCO	UNAVCO	NOCO vs AN6PURR	89.37	0.849	2.09
NOPK	UNAVCO	NOPK vs AOA0G60	20.10	0.769	3.35
OVLS	UNAVCO	OVLS vs AUNTR4S	44.90	0.781	4.81
OXYC	UNAVCO	OXYC vs AR08Z2S	37.91	0.658	8.42
P058	UNAVCO	P058 vs E70YGIK	40.61	0.913	2.88
P093	UNAVCO	P093 vs C0JBBM8	38.17	0.956	1.45
P151	UNAVCO	P151 vs DW86H7N	51.61	0.949	2.17
P161	UNAVCO	P161 vs E2N6L42	37.90	0.818	6.35
P190	UNAVCO	P190 vs DCZ5UXO	77.07	0.850	4.89
P197	UNAVCO	P197 vs CY1JFZ1	46.09	0.829	2.59
P198	UNAVCO	P198 vs CUX0IQX	98.31	0.826	5.85
P199	UNAVCO	P199 vs CV0L4G7	84.53	0.976	2.23
P208	UNAVCO	P208 vs DAJN5ME	54.04	0.883	9.05
P210	UNAVCO	P210 vs C4EMOMO	95.22	0.878	3.08
P211	UNAVCO	P211 vs C5JPLE5	93.74	0.751	8.53
P212	UNAVCO	P212 vs C732WJF	49.22	0.829	3.66
P214	UNAVCO	P214 vs C7T9Z7A	58.29	0.644	6.71
P217	UNAVCO	P217 vs C9P5E9I	72.46	0.588	7.53
P228	UNAVCO	P228 vs CIUE3RR	50.41	0.292	14.28
P233	UNAVCO	P233 vs C43WVYA	44.55	0.610	9.30
P236	UNAVCO	P236 vs C60DQFF	31.07	0.724	4.50
P239	UNAVCO	P239 vs C732WR5	48.89	0.069	15.28
P240	UNAVCO	P240 vs C7WUL07	94.94	0.196	7.68
P242	UNAVCO	P242 vs C6XQ0D6	96.43	0.923	6.15
P243	UNAVCO	P243 vs C69WO99	33.42	0.788	5.68
P244	UNAVCO	P244 vs C7ZTR5O	74.63	0.552	7.92

StatID	System	CGPS-InSAR	Distance (M)	Correlation	RMSE (MM)
P251	UNAVCO	P251 vs C4BNIV5	57.30	0.585	11.17
P265	UNAVCO	P265 vs CZWTFVU	77.35	0.450	5.82
P273	UNAVCO	P273 vs CSACME6	41.98	0.799	5.65
P291	UNAVCO	P291 vs BNZF9NY	17.40	0.649	12.06
P300	UNAVCO	P300 vs BV0GI0I	72.75	0.785	9.91
P301	UNAVCO	P301 vs C482XNB	20.63	0.913	4.86
P303	UNAVCO	P303 vs C8SEKMW	56.67	0.997	5.53
P306	UNAVCO	P306 vs CMDSVXQ	95.69	0.709	5.64
P307	UNAVCO	P307 vs C6TK038	60.43	0.997	6.32
P344	UNAVCO	P344 vs DPM11WQ	56.43	0.432	14.41
P345	UNAVCO	P345 vs DVWV784	58.58	0.919	3.89
P347	UNAVCO	P347 vs ECNZBXE	26.46	0.944	8.96
P467	UNAVCO	P467 vs BZW3EYJ	33.30	0.922	2.06
P470	UNAVCO	P470 vs AX54T2A	39.30	0.800	5.12
P477	UNAVCO	P477 vs AFIGQE1	37.19	0.947	2.71
P486	UNAVCO	P486 vs AB1PPLF	14.00	0.884	3.72
P491	UNAVCO	P491 vs AGU3FDZ	51.28	0.688	2.39
P513	UNAVCO	P513 vs B5BUBAH	51.79	0.216	13.50
P530	UNAVCO	P530 vs BIICSJJ	16.10	0.772	2.96
P531	UNAVCO	P531 vs BLL3F0T	55.89	0.624	5.85
P532	UNAVCO	P532 vs BIOB4QJ	19.64	0.646	9.32
P533	UNAVCO	P533 vs BKRX6HR	44.46	0.733	4.86
P538	UNAVCO	P538 vs BGU80OZ	54.35	0.154	10.81
P541	UNAVCO	P541 vs BJMUA06	71.37	0.908	7.24
P547	UNAVCO	P547 vs BO75X13	53.45	0.774	8.13
P552	UNAVCO	P552 vs BJNFPFZ	45.14	0.325	9.51
P556	UNAVCO	P556 vs B2TCGRU	30.41	0.843	2.20
P560	UNAVCO	P560 vs B3RA69A	59.04	0.778	2.70
P563	UNAVCO	P563 vs BEQ0JQD	39.05	0.912	6.54
P565	UNAVCO	P565 vs BKOY18O	20.36	0.986	7.80
P570	UNAVCO	P570 vs BJAC7HI	49.05	0.813	6.34
P577	UNAVCO	P577 vs AU8XY90	19.87	0.707	5.98
P578	UNAVCO	P578 vs BJS76AC	39.78	0.772	7.84
P581	UNAVCO	P581 vs AY0ORWA	16.44	0.856	1.91
P582	UNAVCO	P582 vs B0AULI1	18.63	0.616	3.79
P584	UNAVCO	P584 vs AMO9FFS	23.78	0.589	10.35
P586	UNAVCO	P586 vs AYHCX52	56.18	0.682	2.61
P603	UNAVCO	P603 vs B1TMI6T	25.84	0.881	4.88
P612	UNAVCO	P612 vs AS2Y607	58.33	0.433	6.94
P651	UNAVCO	P651 vs CI4SJ06	34.34	0.916	2.19
P782	UNAVCO	P782 vs BJS76AW	30.10	0.792	8.52
P799	UNAVCO	P799 vs ANBHB3X	24.30	0.707	9.14
P800	UNAVCO	P800 vs AP1EDZR	25.21	0.251	11.69
P808	UNAVCO	P808 vs B407O9Z	42.45	0.200	10.65
P809	UNAVCO	P809 vs BKOY18O	21.49	0.983	7.67
PBPP	UNAVCO	PBPP vs AXZHWJZ	33.29	0.876	5.40

StatID	System	CGPS-InSAR	Distance (M)	Correlation	RMSE (MM)
PKRD	UNAVCO	PKRD vs APYQNY6	48.31	0.686	5.93
PSAP	UNAVCO	PSAP vs ALBFW58	65.87	0.578	5.81
PTSG	UNAVCO	PTSG vs ENOHYKD	50.75	0.888	3.46
QCY2	UNAVCO	QCY2 vs BSD74MZ	30.86	0.672	4.09
RAGG	UNAVCO	RAGG vs B17014A	59.98	0.858	2.01
RNCH	UNAVCO	RNCH vs BNKJFMG	33.77	0.499	14.32
RSTP	UNAVCO	RSTP vs B4QER6P	33.28	0.859	2.15
RTHS	UNAVCO	RTHS vs AQA1X1H	56.01	0.816	2.85
SACY	SOPAC	SACY vs AJXFGDJ	12.44	0.846	8.06
SCIA	UNAVCO	SCIA vs AZSZLGN	53.84	0.923	1.85
SHN5	SOPAC	SHN5 vs BJF3MWL	50.36	-0.061	19.68
SHP5	SOPAC	SHP5 vs BBYL4UV	52.52	0.459	7.19
SLHG	UNAVCO	SLHG vs A9T279R	15.99	0.654	4.44
SNHS	SOPAC	SNHS vs ANBHBD6	37.73	0.685	6.90
SRB1	SOPAC	SRB1 vs CNUSFO7	22.68	0.953	2.61
SYNG	UNAVCO	SYNG vs AZSZJMY	71.85	0.946	6.23
TAFT	SOPAC	TAFT vs B9WRENH	44.92	0.688	13.54
TEHA	SOPAC	TEHA vs B9NTX9P	65.61	0.259	5.60
TMAP	UNAVCO	TMAP vs AI1K2LE	66.53	0.152	16.93
TORP	UNAVCO	TORP vs AKXQVZB	63.87	0.811	2.84
TOWG	UNAVCO	TOWG vs BLVT9SQ	45.33	0.962	8.04
TPOG	UNAVCO	TPOG vs B4SSHKX	39.68	0.876	2.28
TRLK	SOPAC	TRLK vs CGD33M4	29.24	0.344	7.88
TWMS	UNAVCO	TWMS vs AO4NK59	61.57	0.638	4.42
UCD1	SOPAC	UCD1 vs D00ZH9A	53.82	0.461	9.19
USC2	UNAVCO	USC2 vs AP07ITY	35.82	0.758	3.98
VCST	UNAVCO	VCST vs B4AXGKU	47.08	0.958	4.27
VINZ	SOPAC	VINZ vs B6C5SCV	39.20	0.530	7.14
VNCO	UNAVCO	VNCO vs ATPW1L3	40.91	0.965	14.85
VNCX	UNAVCO	VNCX vs AU17ALC	50.95	0.717	8.30
VNPS	UNAVCO	VNPS vs AXVBV6O	46.69	0.656	2.88
WCHS	UNAVCO	WCHS vs APS6WIH	46.61	0.876	6.16
WHC1	UNAVCO	WHC1 vs AOA0GDR	46.47	0.738	7.37
WHFG	UNAVCO	WHFG vs BJSSN6C	48.14	0.841	5.57
WHYT	SOPAC	WHYT vs AINL2YT	67.95	0.507	4.29
WIN2	UNAVCO	WIN2 vs CJSBSXY	56.65	0.712	8.42
WINT	UNAVCO	WINT vs CJSBSXY	60.25	0.569	8.51
WMAP	UNAVCO	WMAP vs ATF699A	75.57	0.814	6.16
WNRA	UNAVCO	WNRA vs APFOSPJ	50.05	0.688	19.81
WORG	UNAVCO	WORG vs BJTE2UT	44.45	0.571	11.54
WRHS	UNAVCO	WRHS vs ANVQ1LE	47.39	0.790	2.85
WWMT	UNAVCO	WWMT vs ANTXRZJ	65.17	0.387	10.61
ZOA1	SOPAC	ZOA1 vs CHROX84	40.50	0.886	3.85
Consolidated State-Wide Mean Values			**47.05**	**0.694**	**7.91**

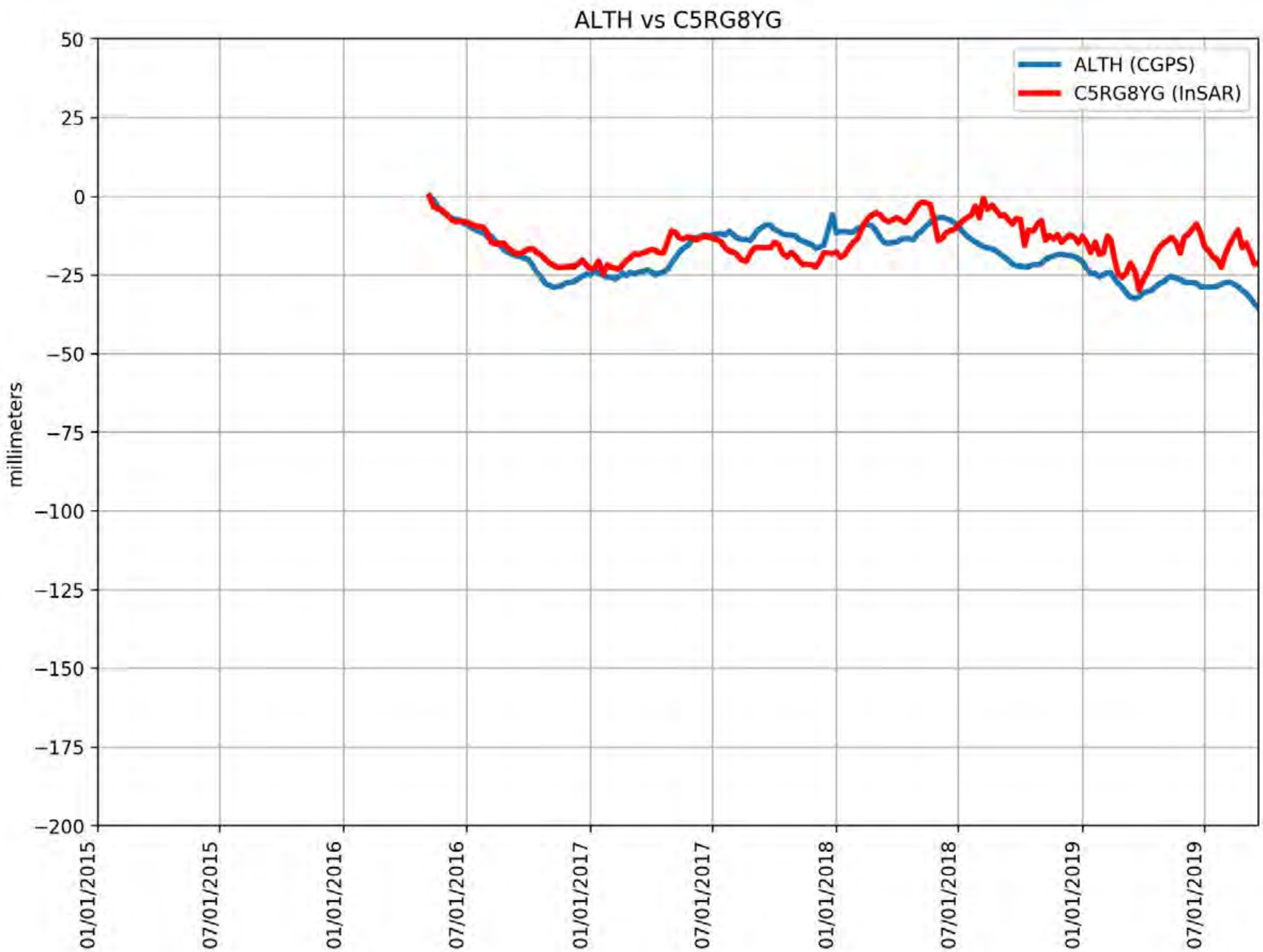
APPENDIX B

Appendix B



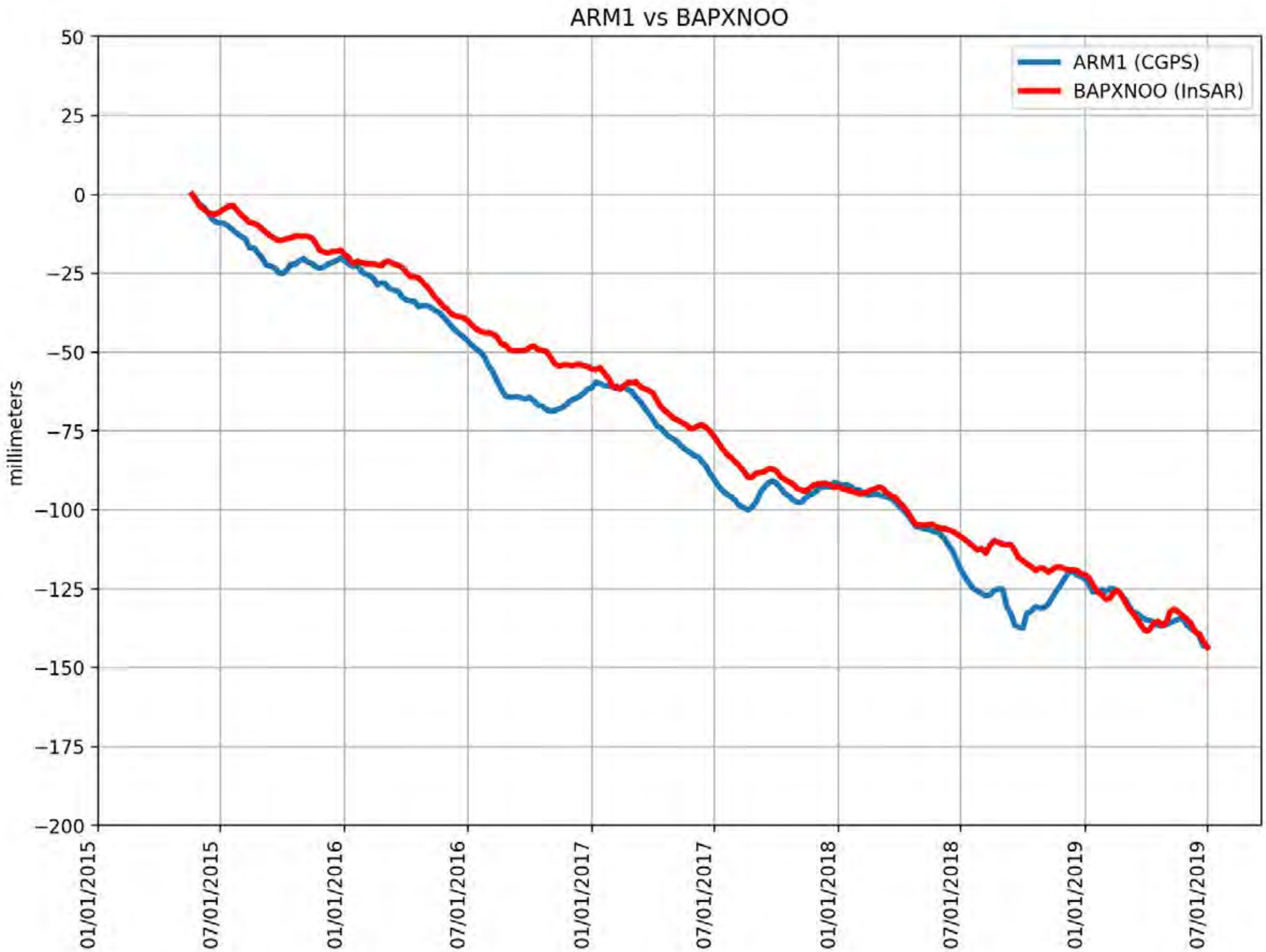
RMSE: 3.75 mm
Correlation: 0.86

Appendix B



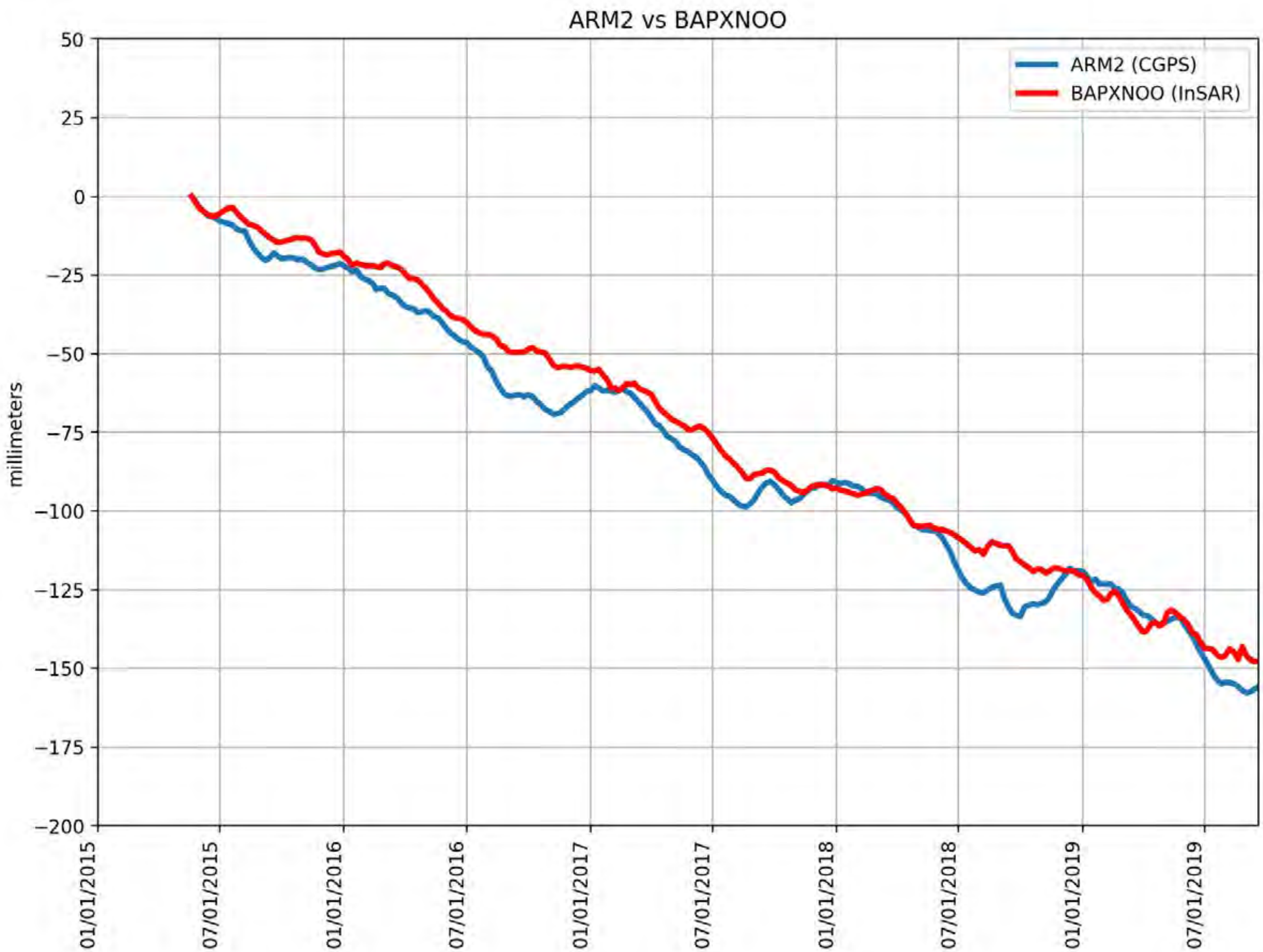
RMSE: 7.71 mm
Correlation: 0.57

Appendix B



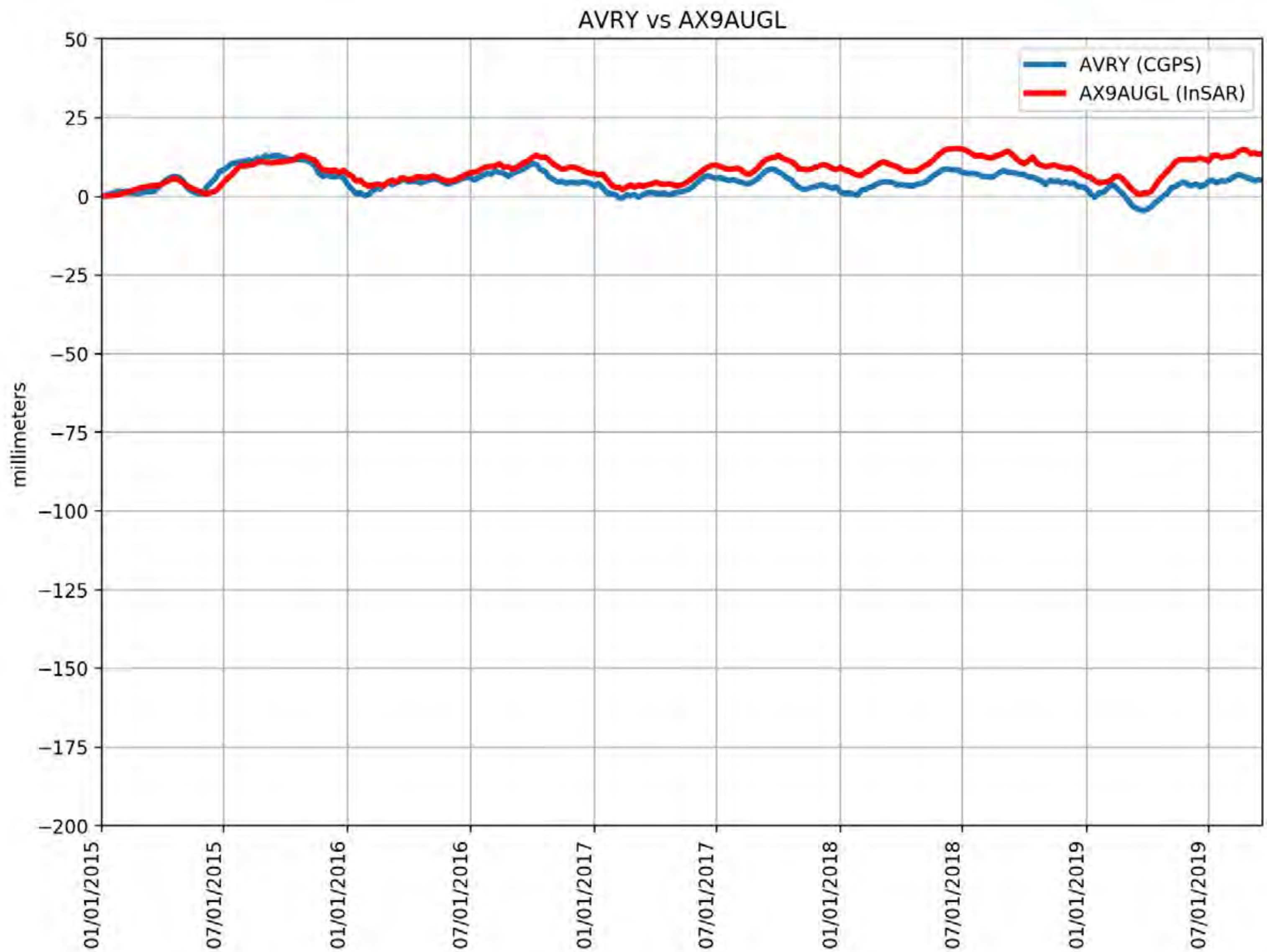
RMSE: 8.33 mm
Correlation: 0.99

Appendix B



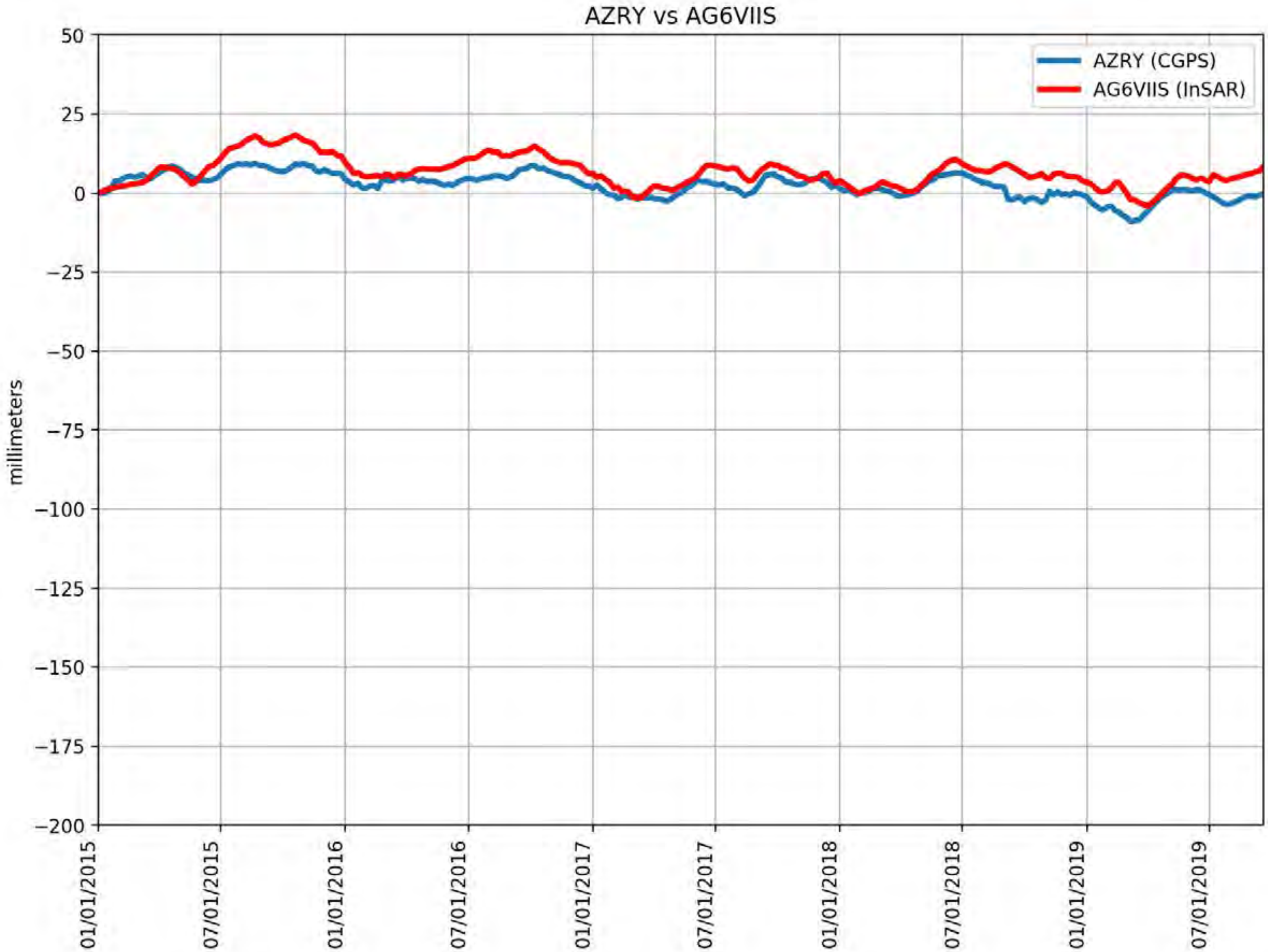
RMSE: 7.93 mm
Correlation: 0.99

Appendix B



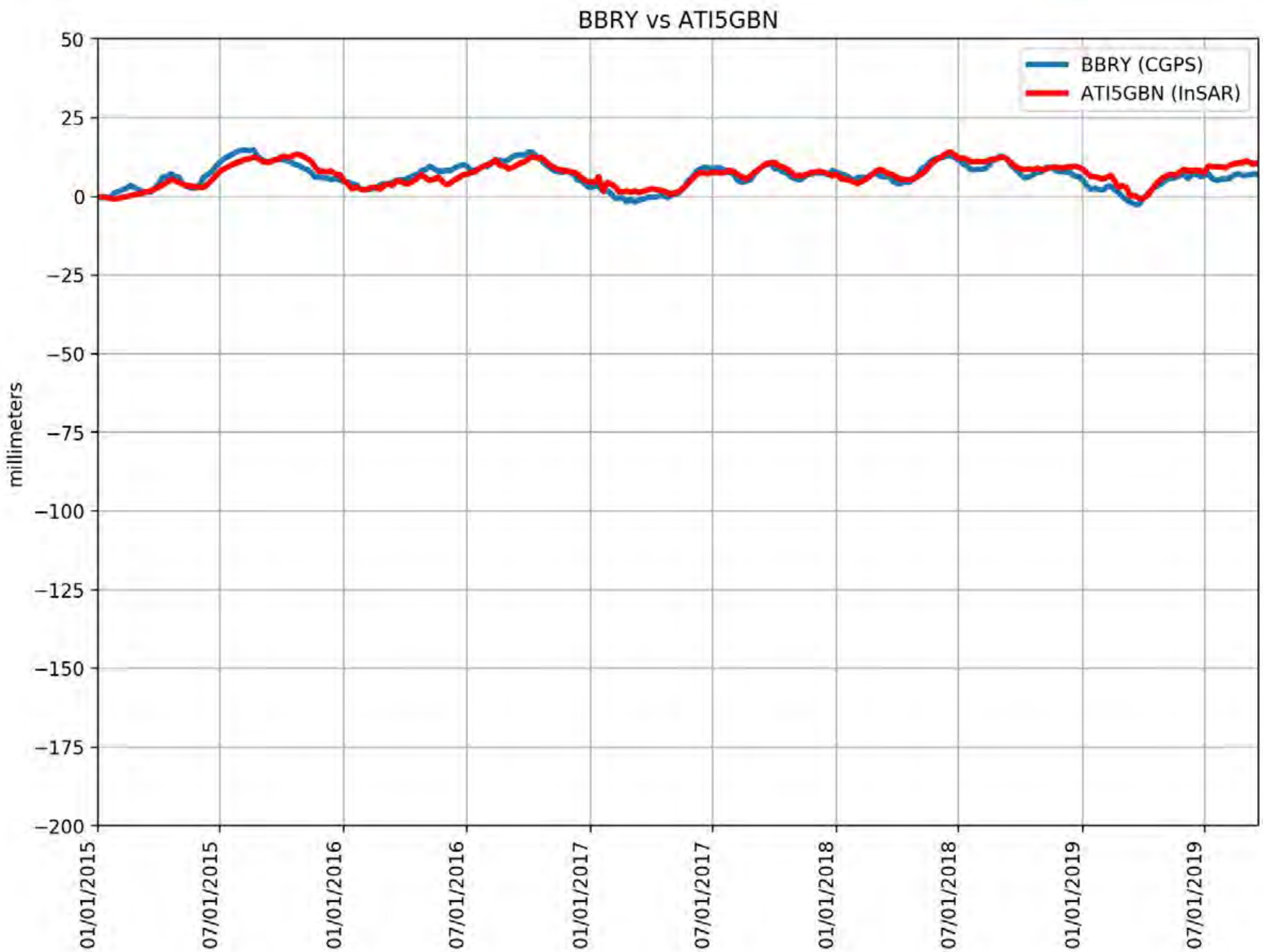
RMSE: 4.40 mm
Correlation: 0.68

Appendix B



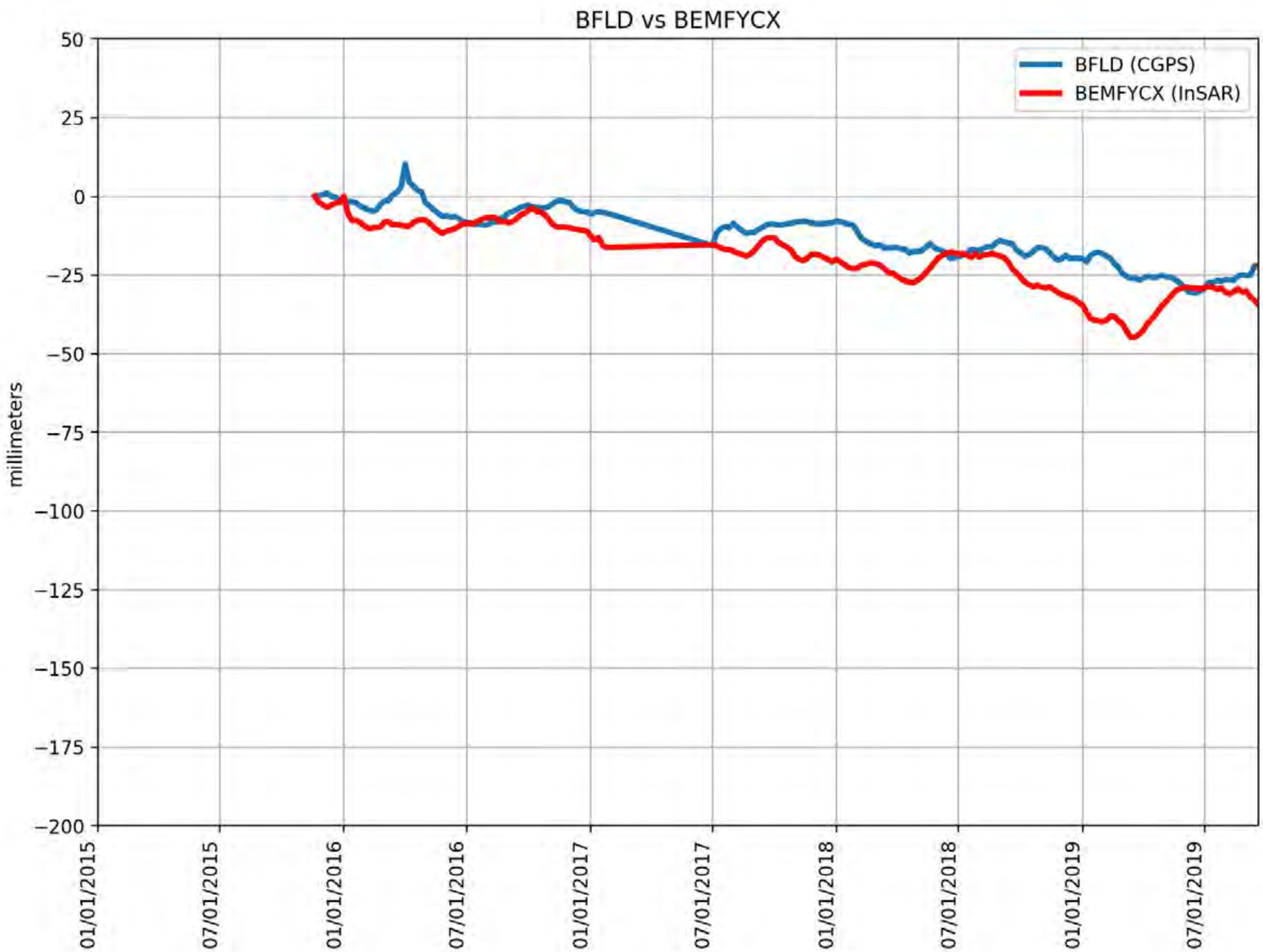
RMSE: 4.96 mm
Correlation: 0.79

Appendix B



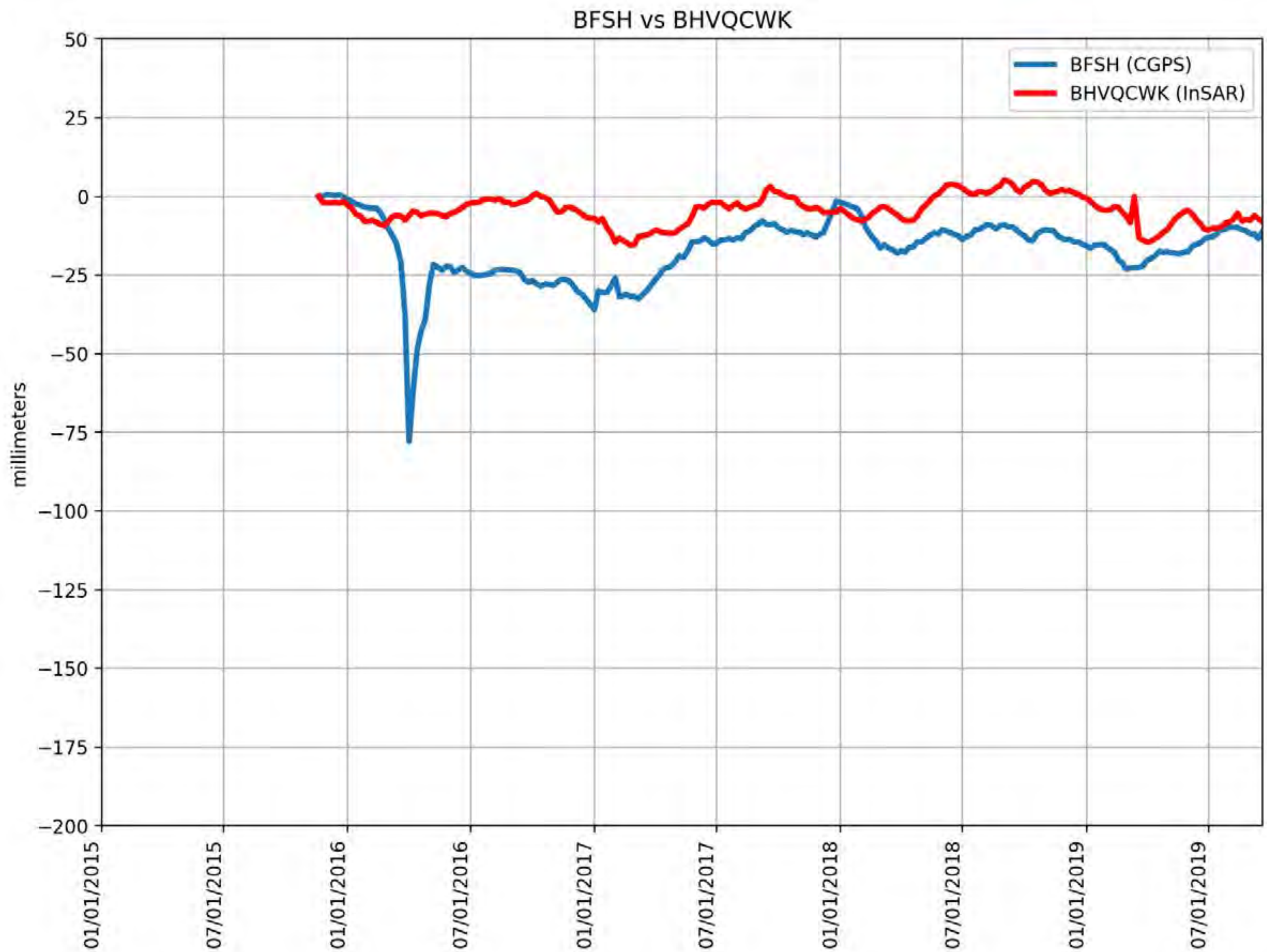
RMSE: 2.03 mm
Correlation: 0.86

Appendix B



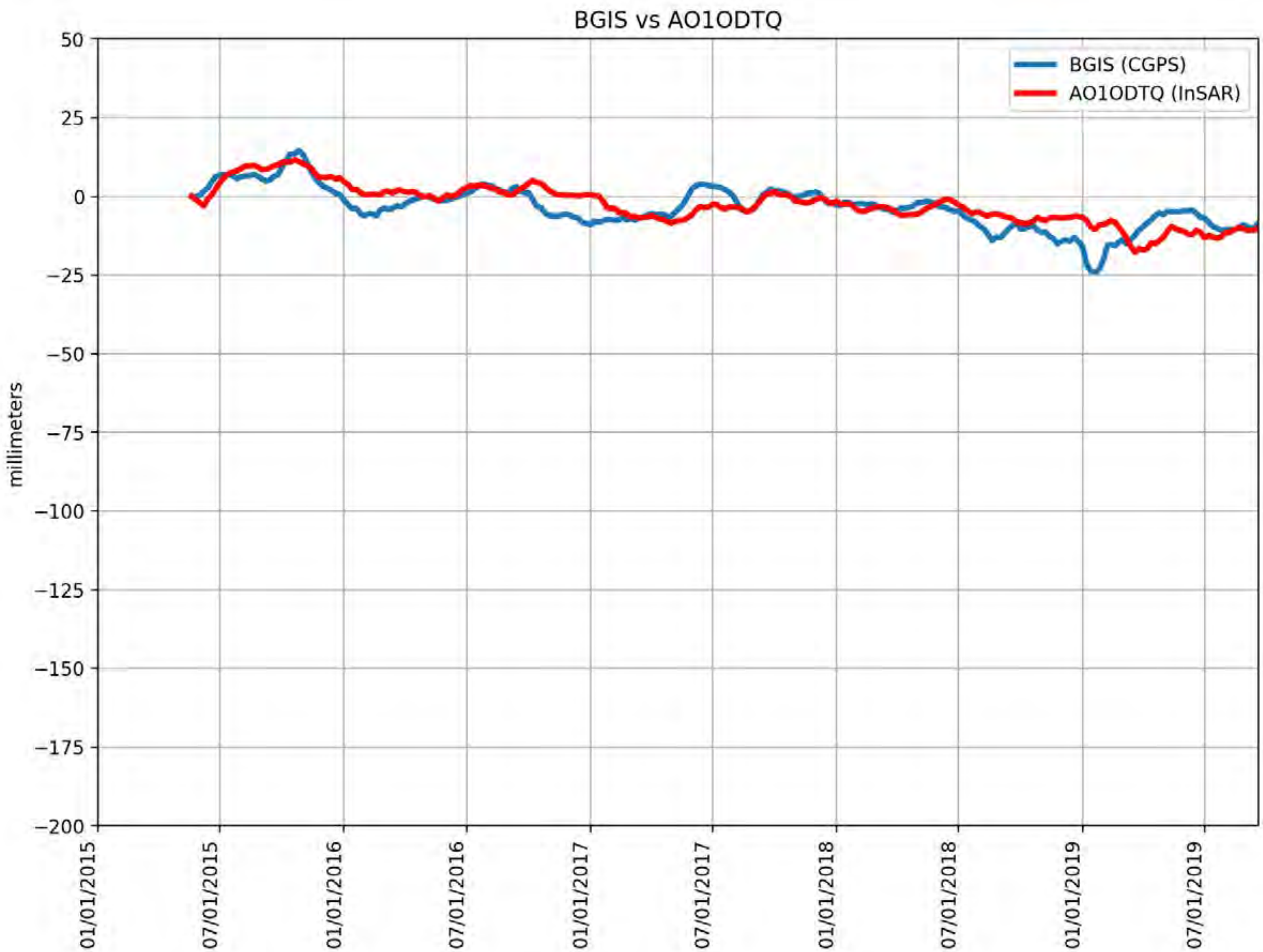
RMSE: 8.80 mm
Correlation: 0.87

Appendix B



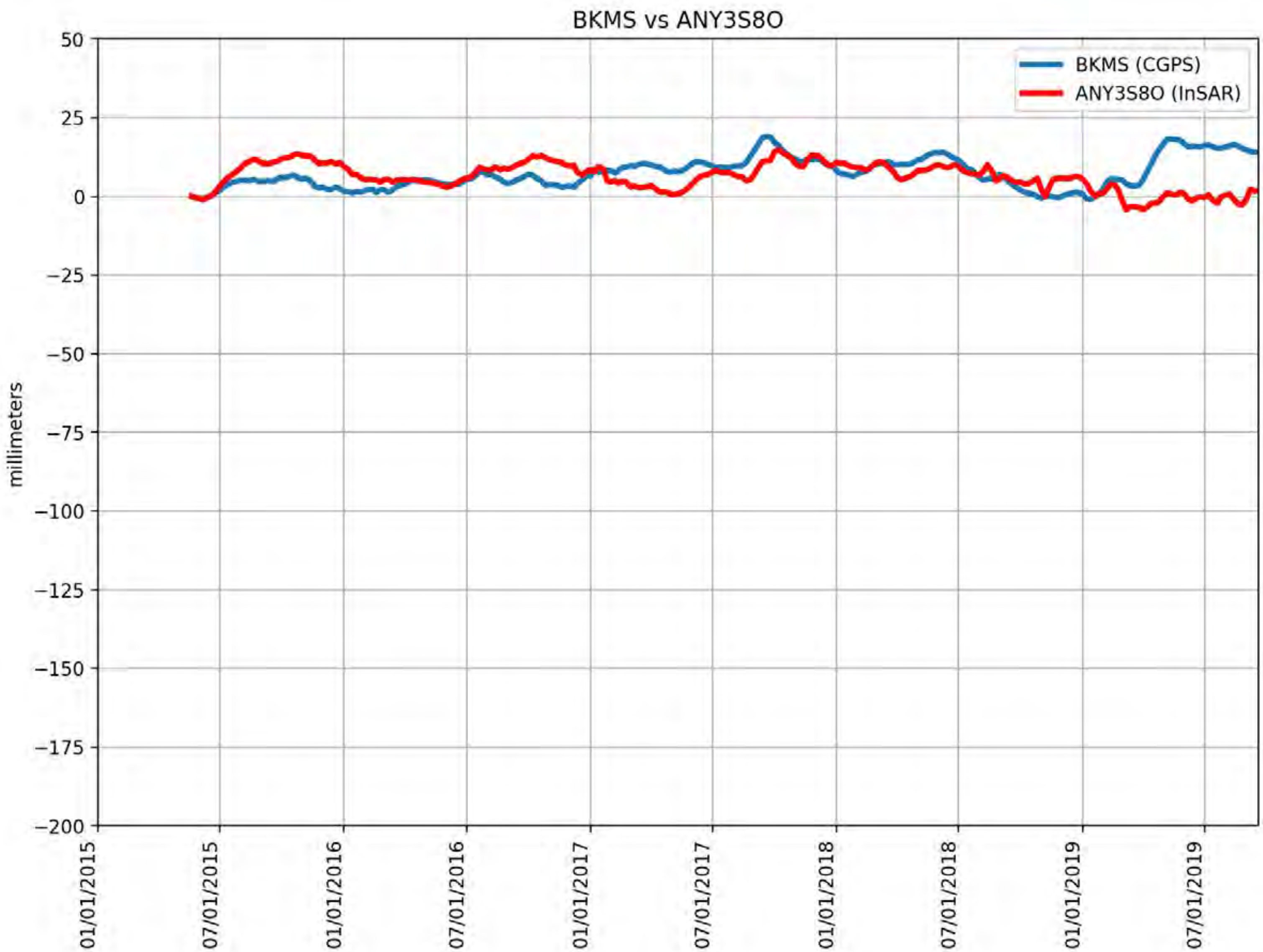
RMSE: 16.02 mm
Correlation: 0.30

Appendix B



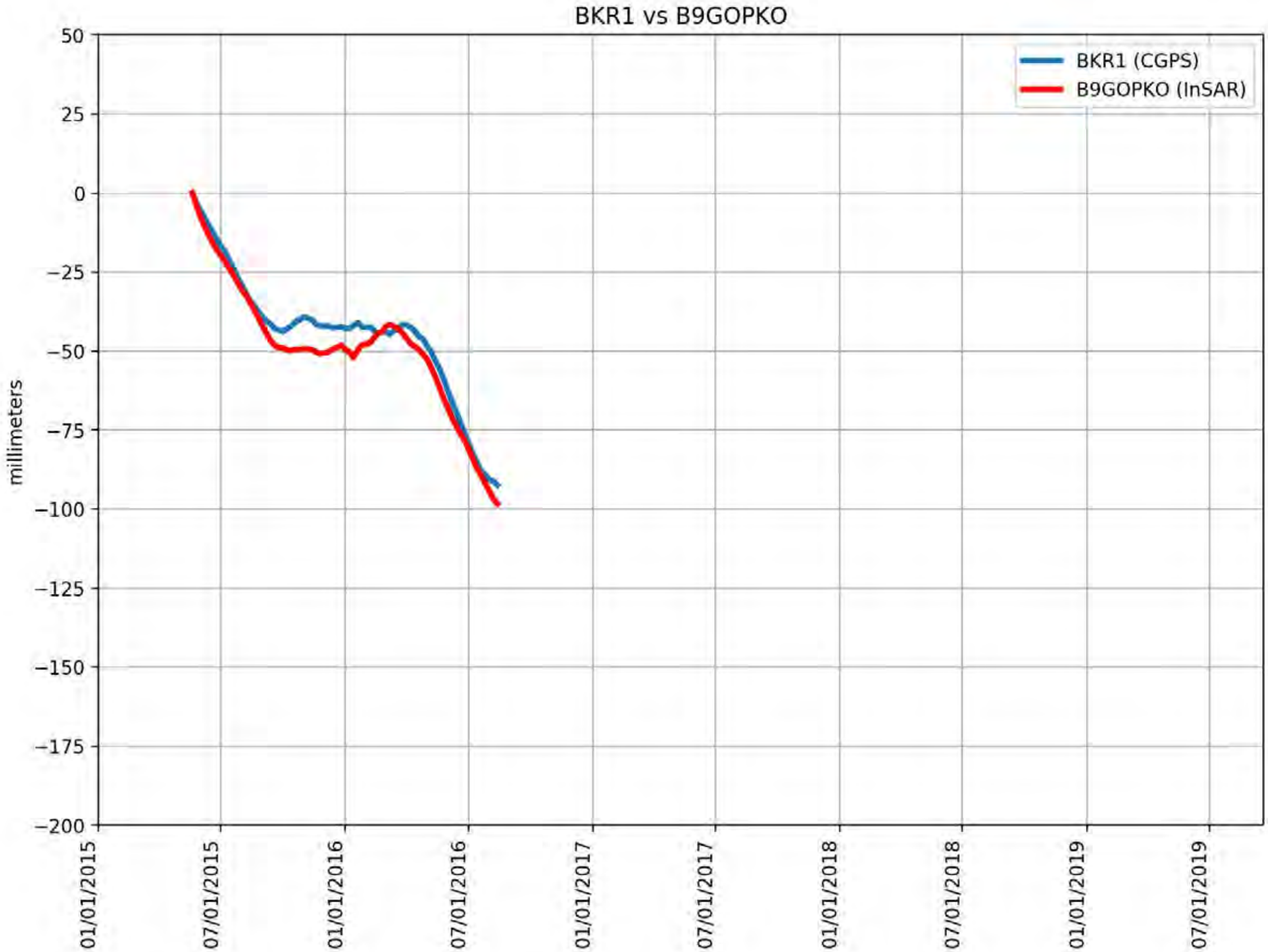
RMSE: 4.62 mm
Correlation: 0.75

Appendix B



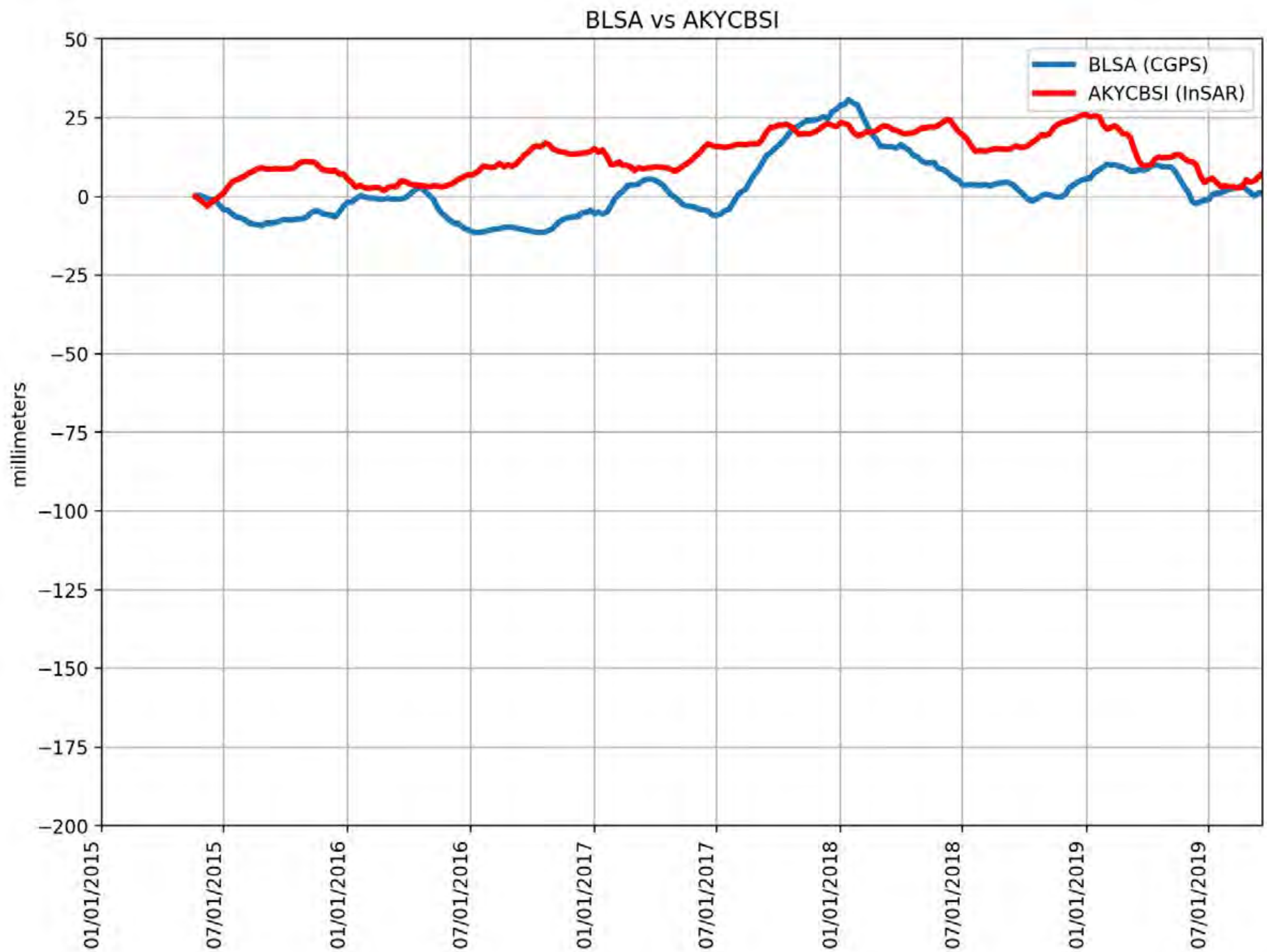
RMSE: 6.74 mm
Correlation: -0.04

Appendix B



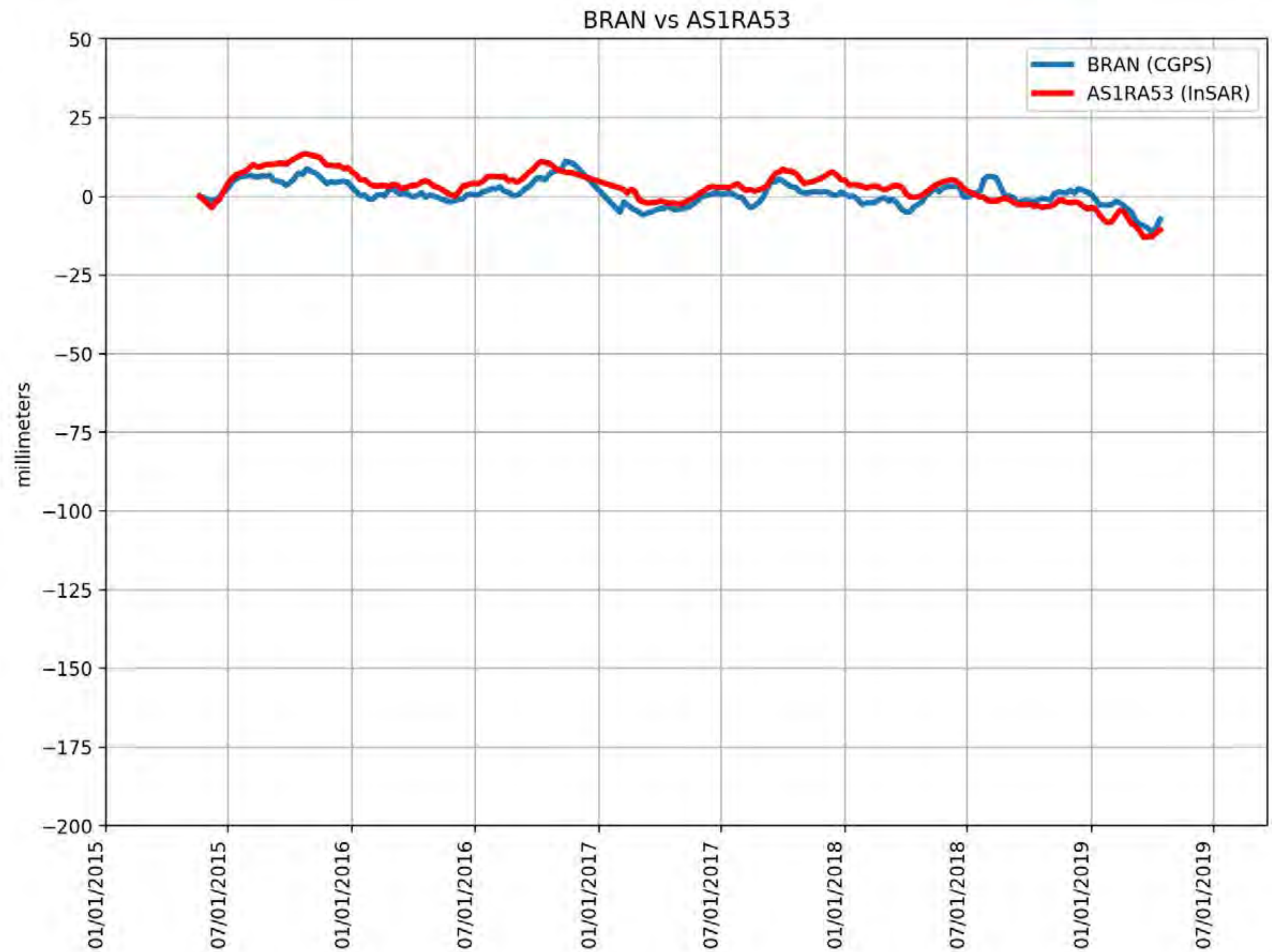
RMSE: 5.18 mm
Correlation: 0.99

Appendix B



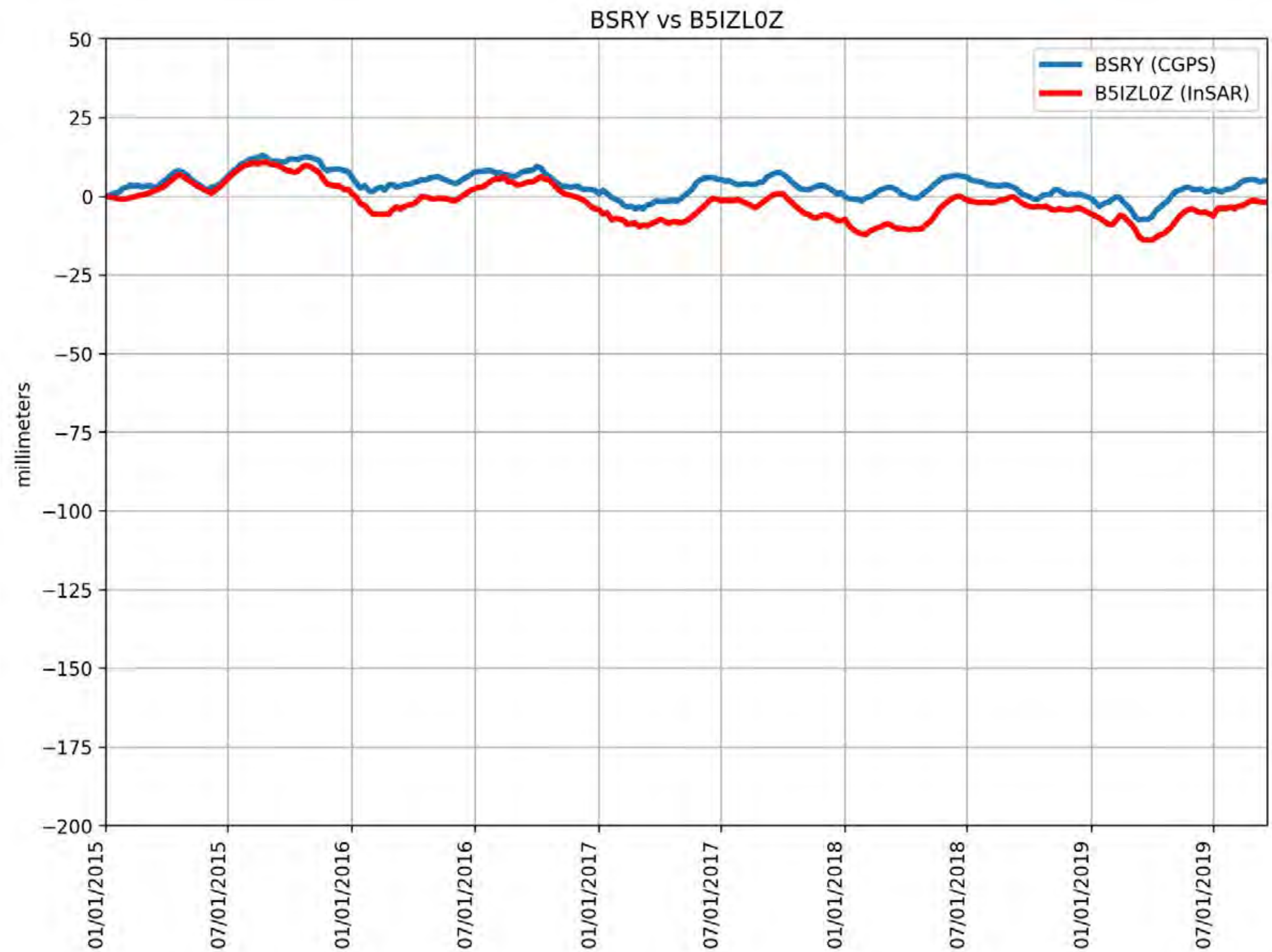
RMSE: 13.26 mm
Correlation: 0.57

Appendix B



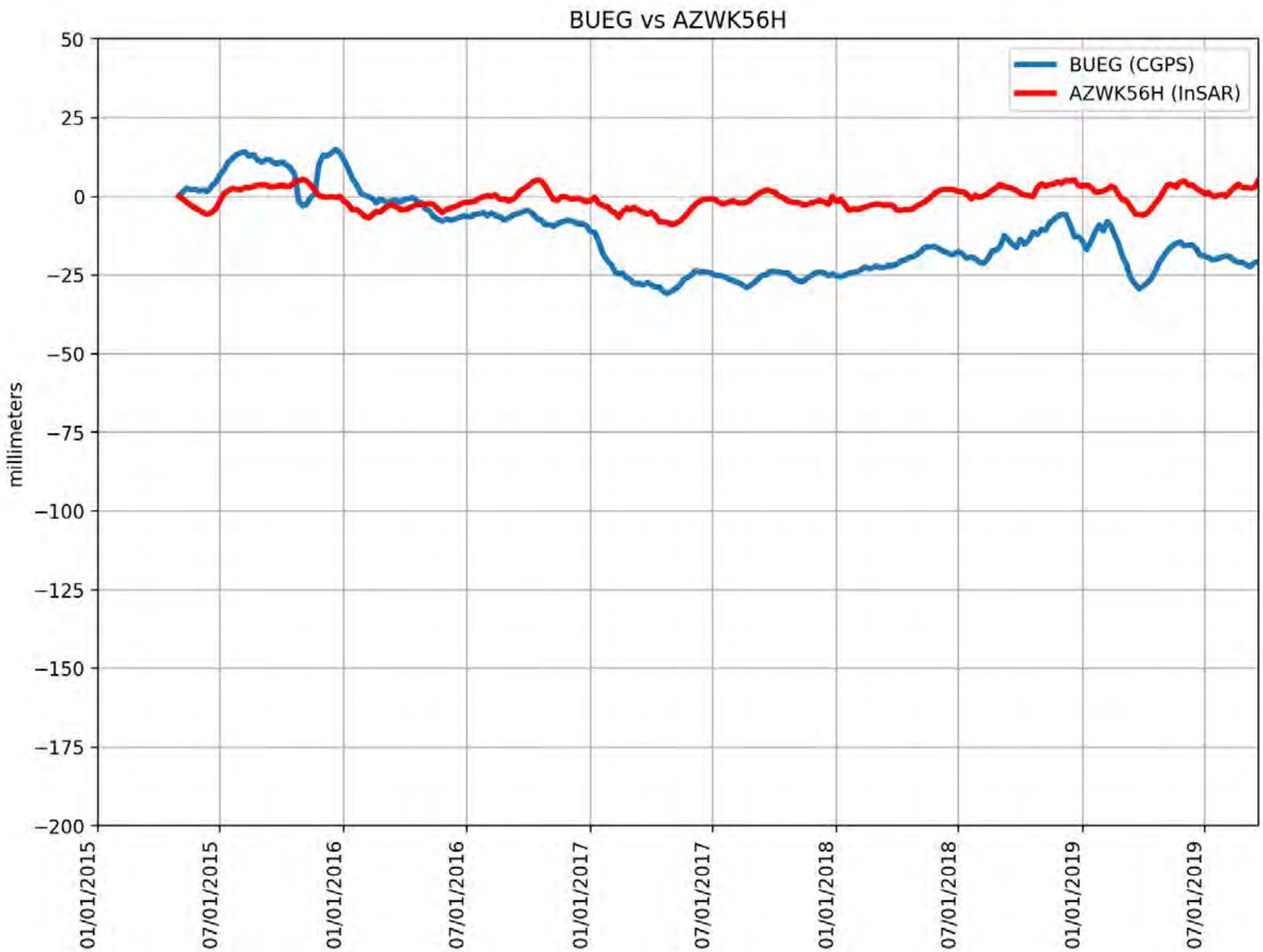
RMSE: 3.77 mm
Correlation: 0.79

Appendix B



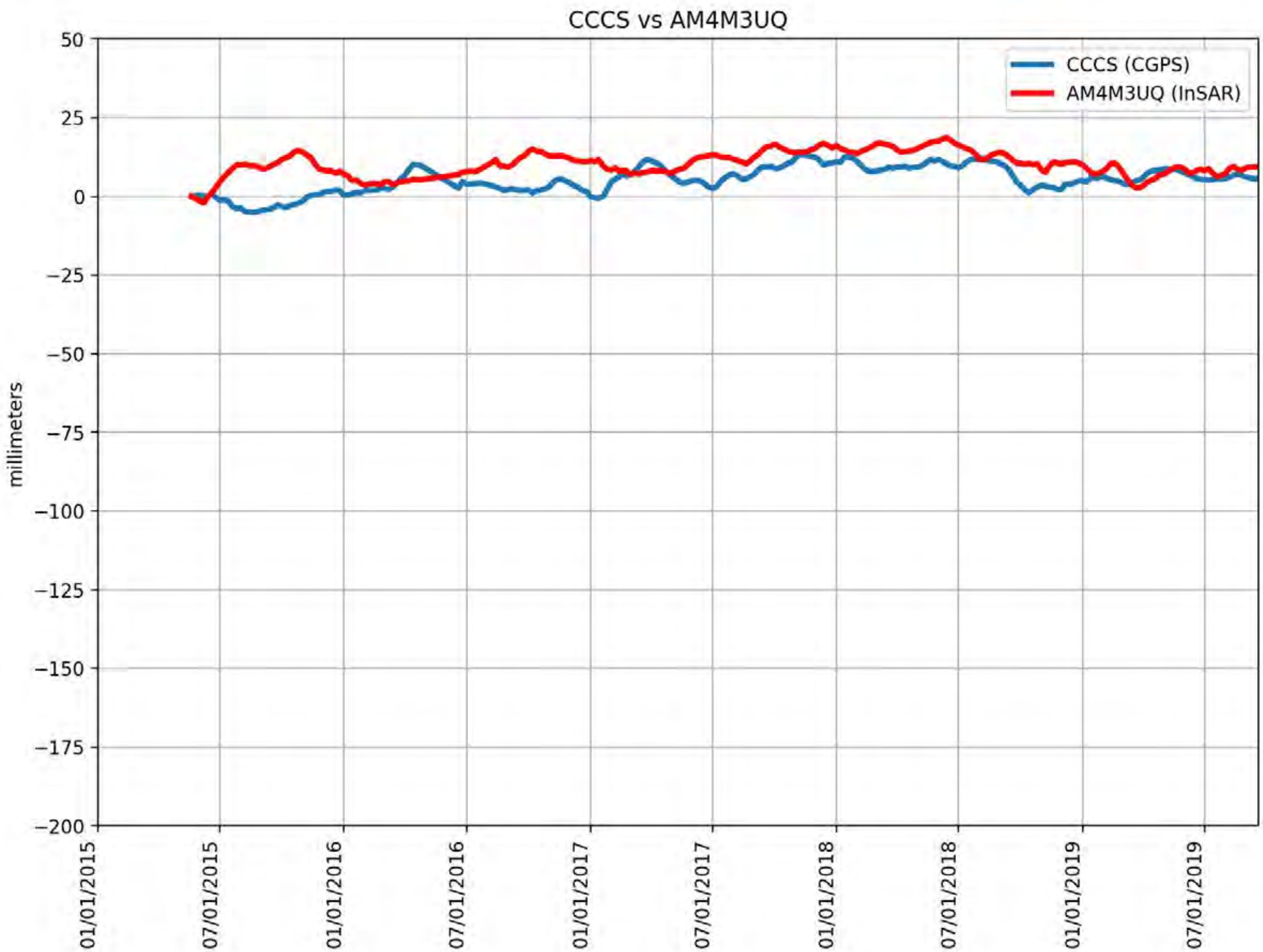
RMSE: 6.19 mm
Correlation: 0.89

Appendix B



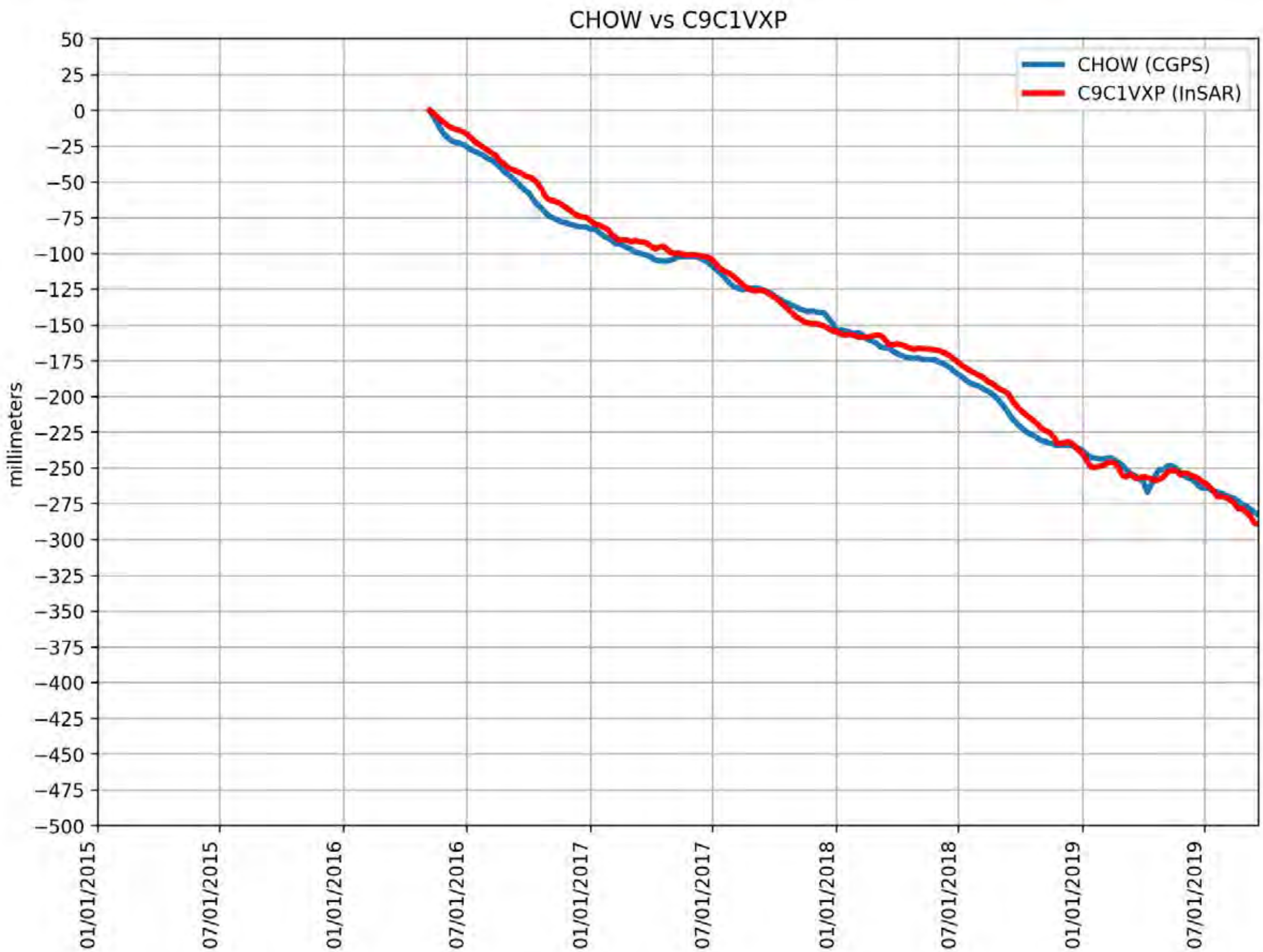
RMSE: 16.63 mm
Correlation: 0.30

Appendix B



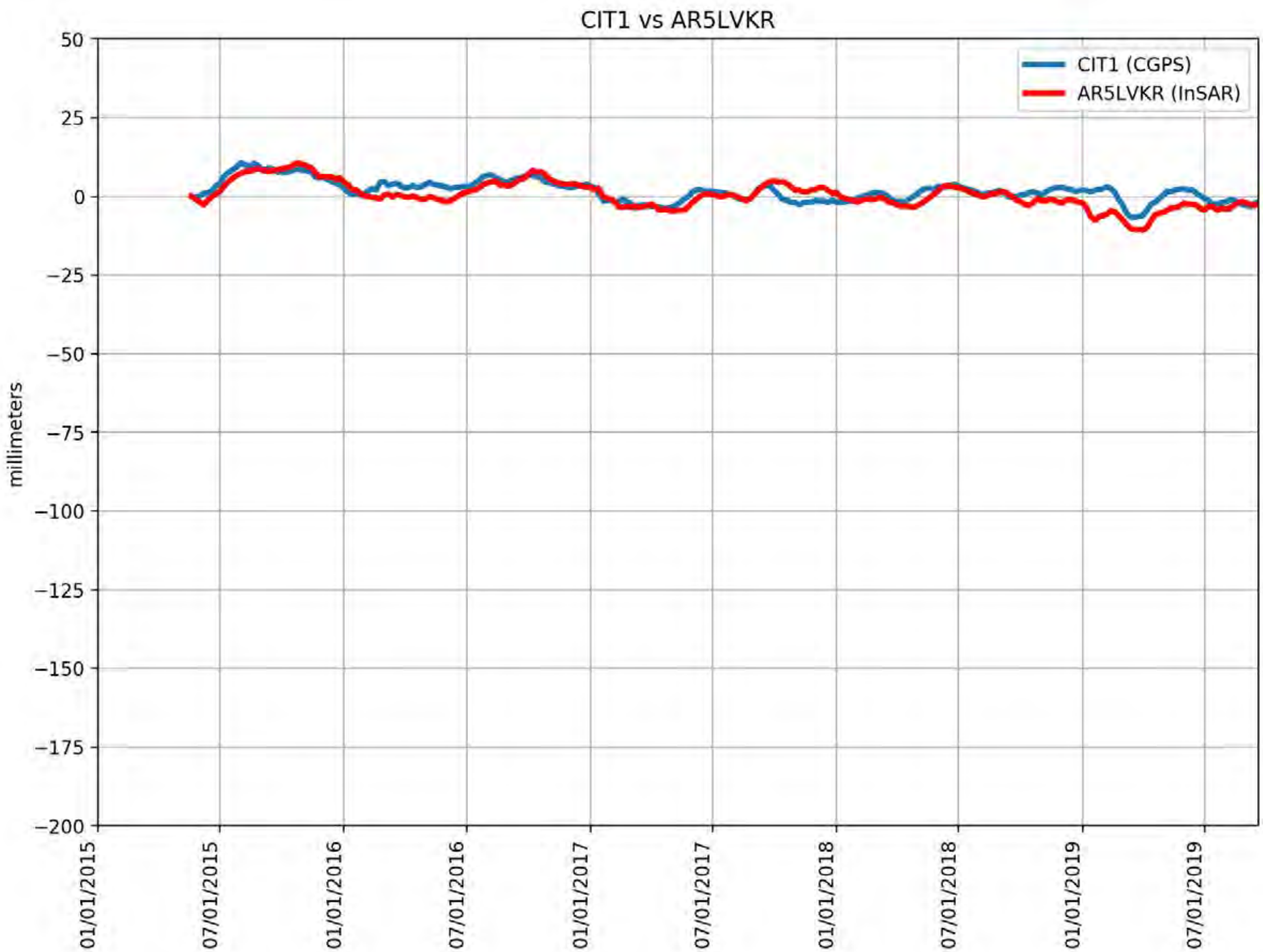
RMSE: 6.79 mm
Correlation: 0.41

Appendix B



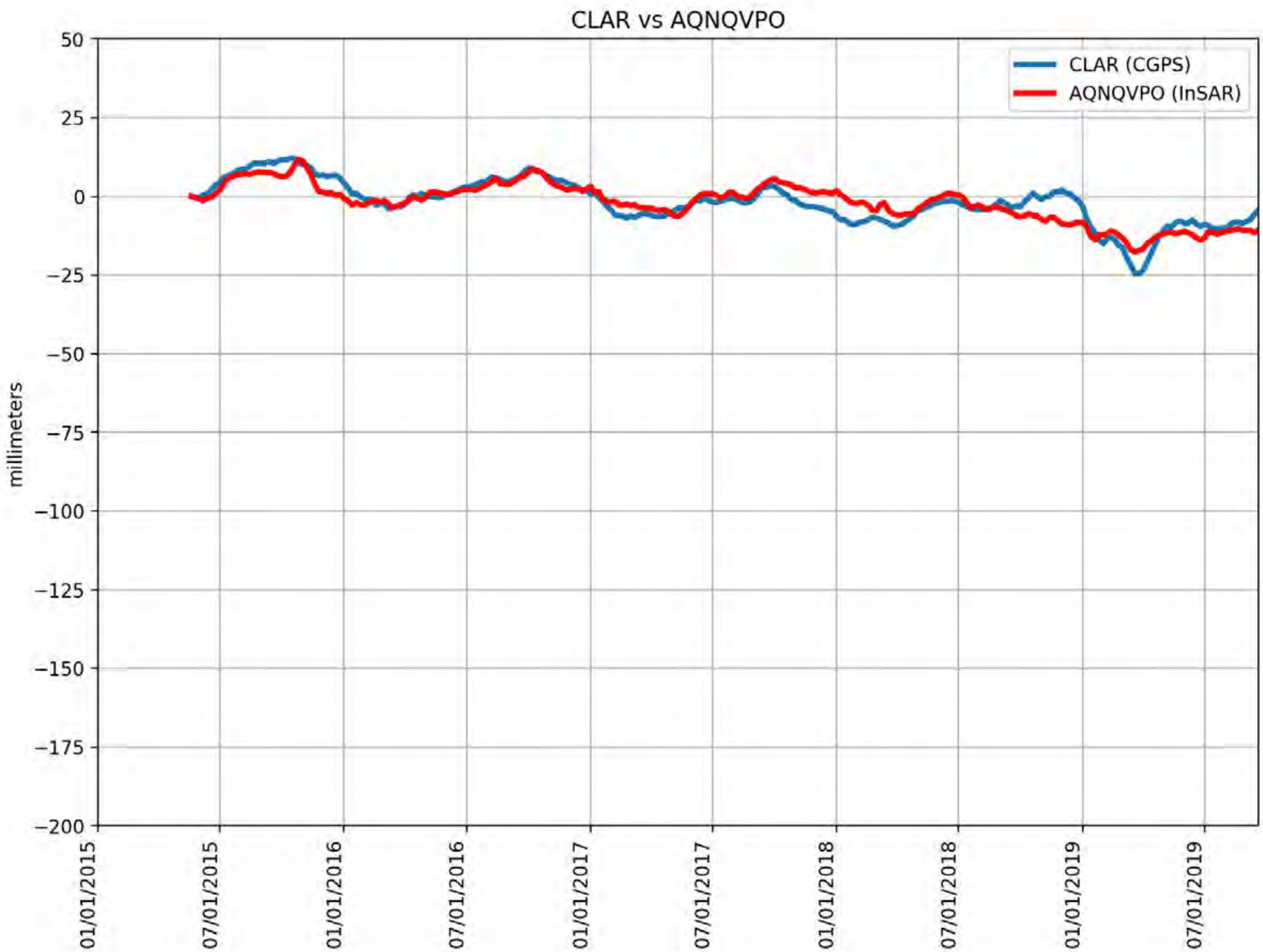
RMSE: 6.62 mm
Correlation: 1.00

Appendix B



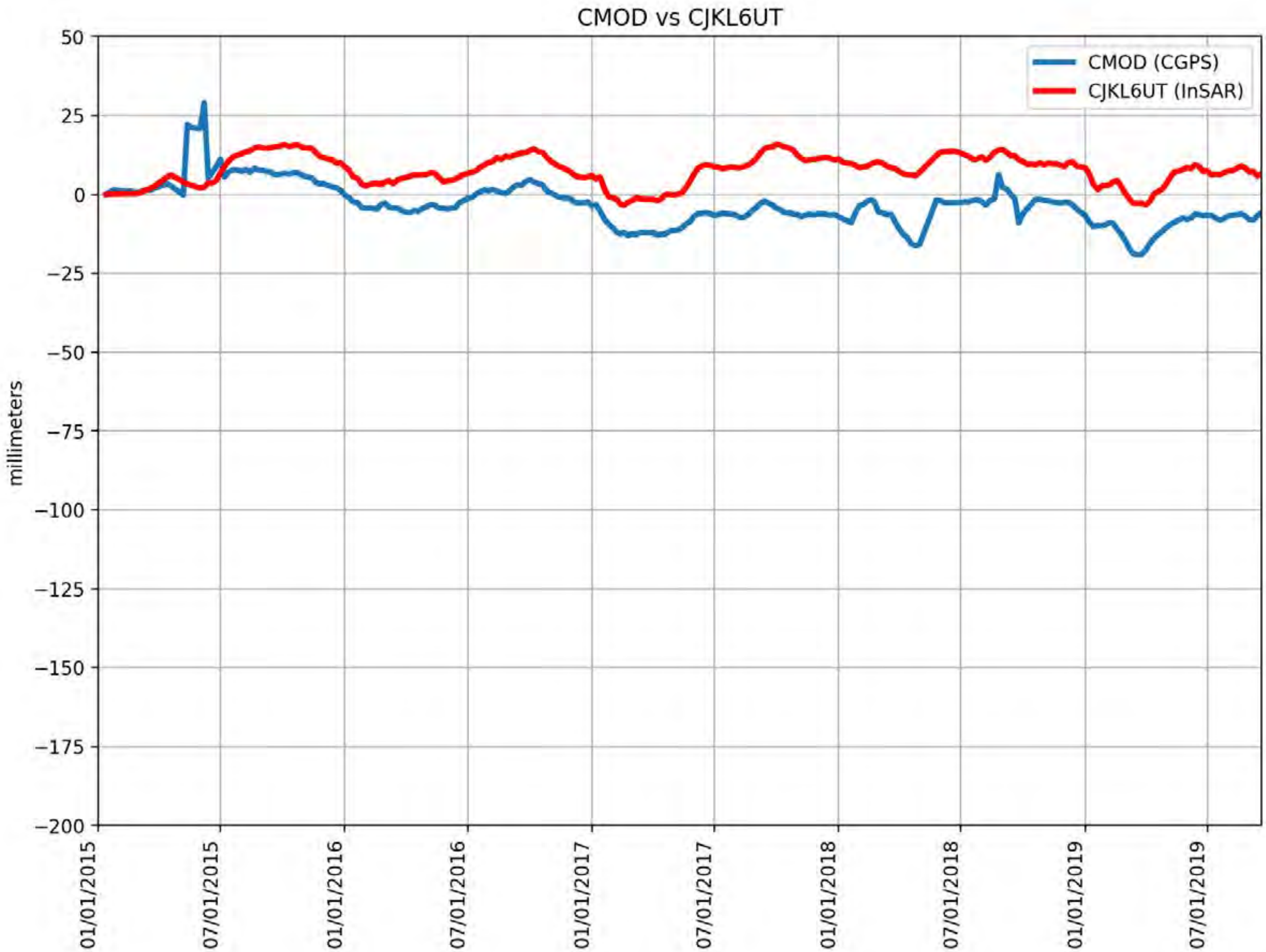
RMSE: 2.91 mm
Correlation: 0.79

Appendix B



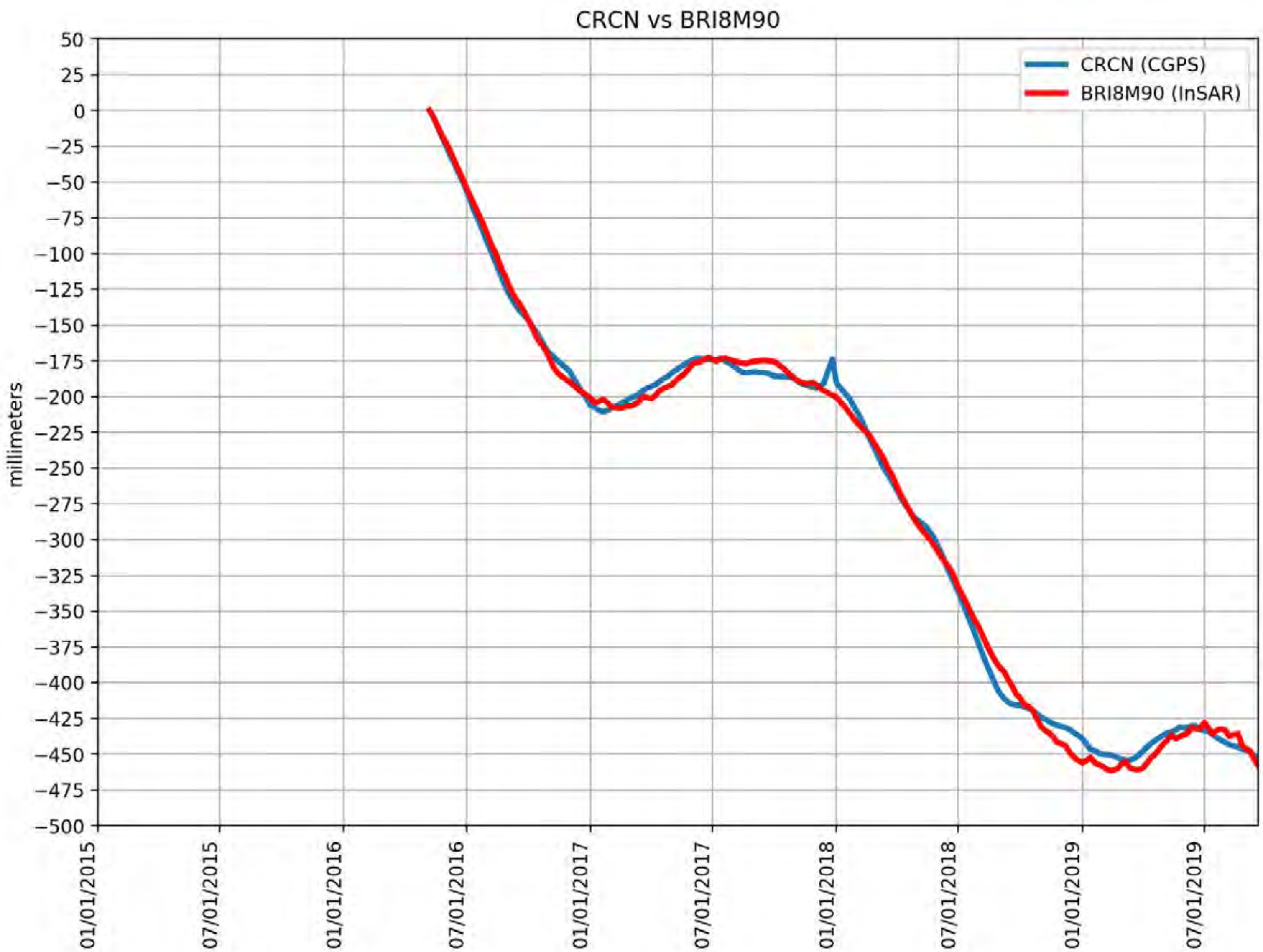
RMSE: 3.46 mm
Correlation: 0.87

Appendix B



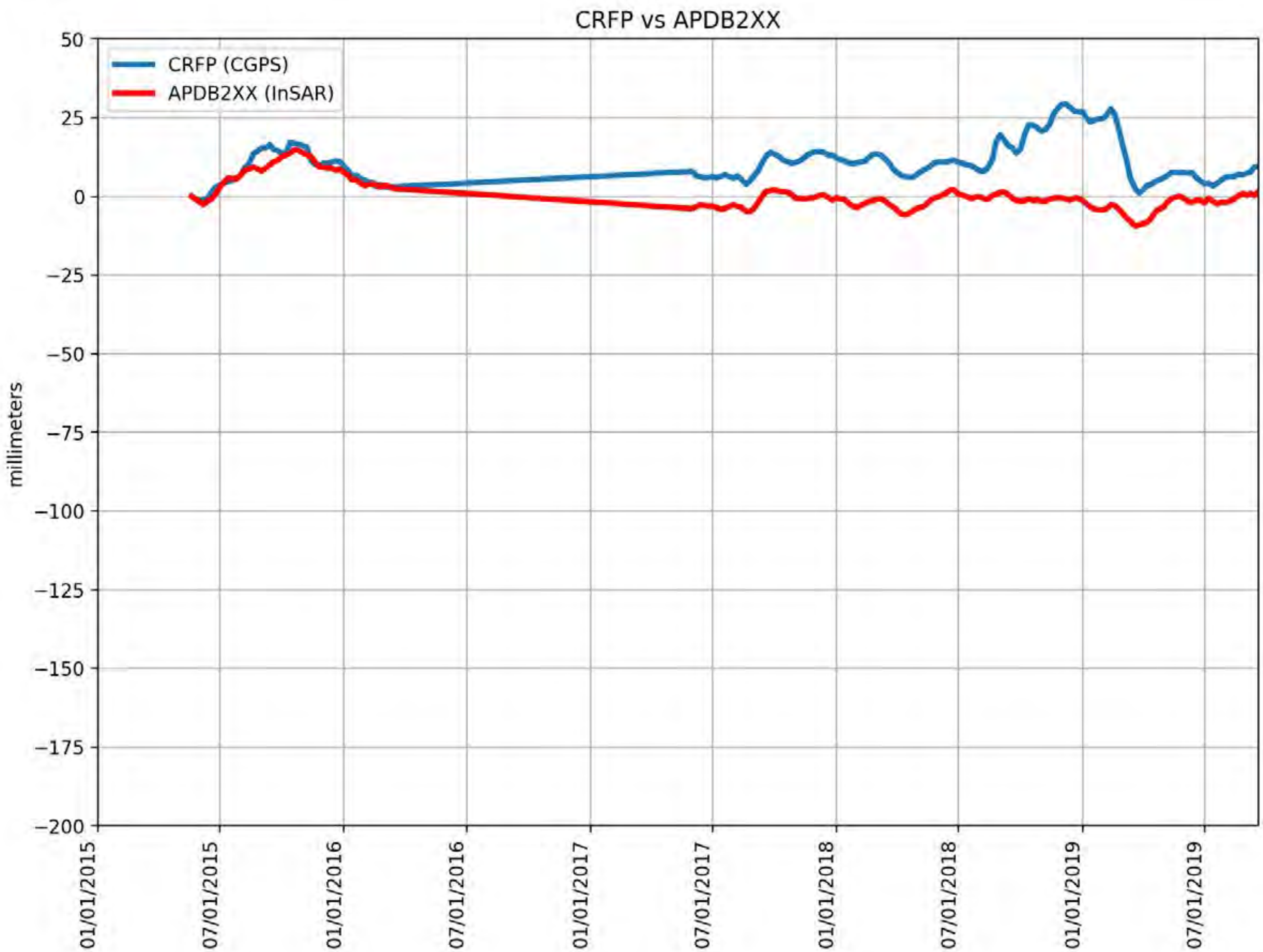
RMSE: 12.57 mm
Correlation: 0.42

Appendix B



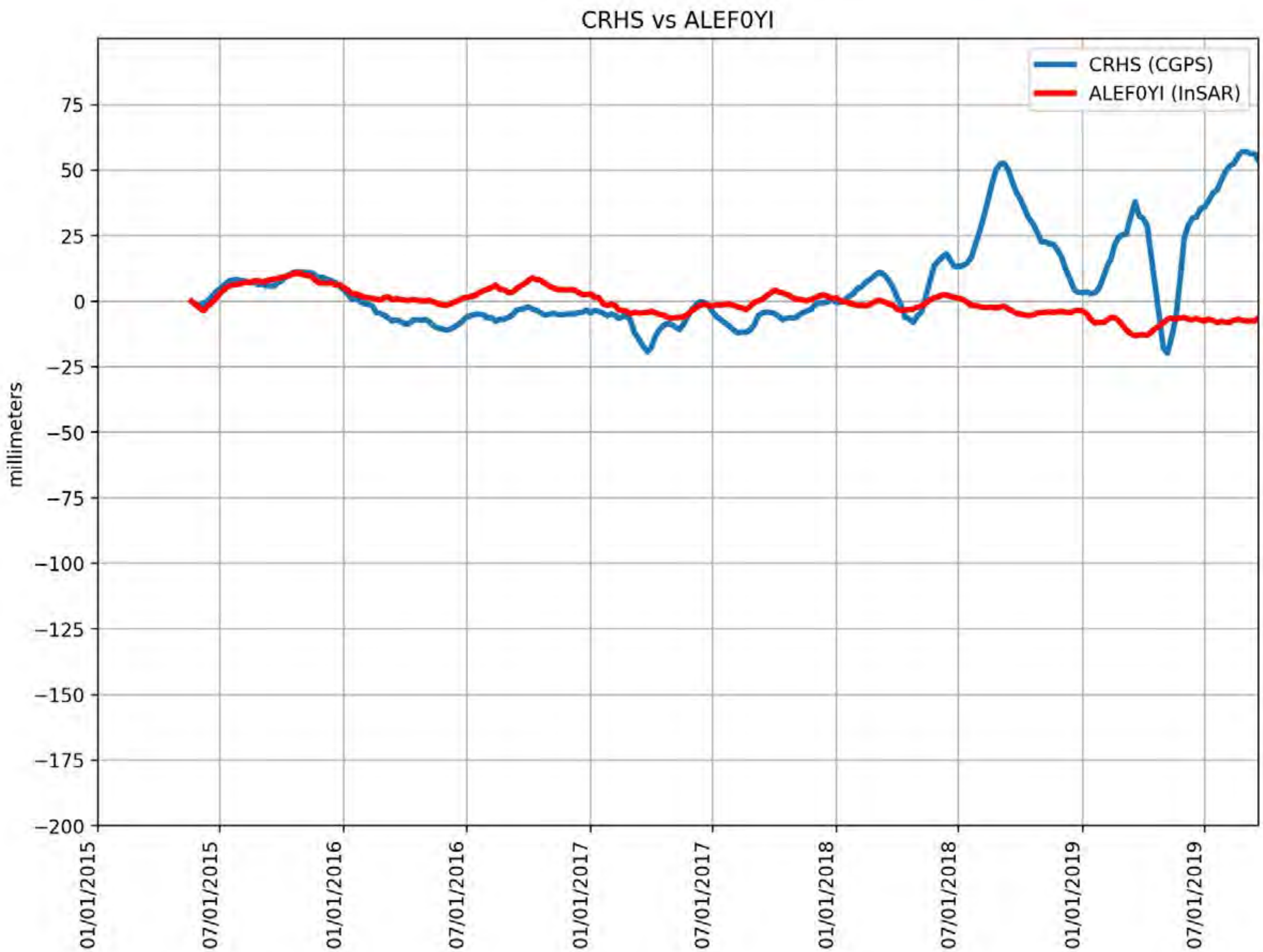
RMSE: 7.18 mm
Correlation: 1.00

Appendix B



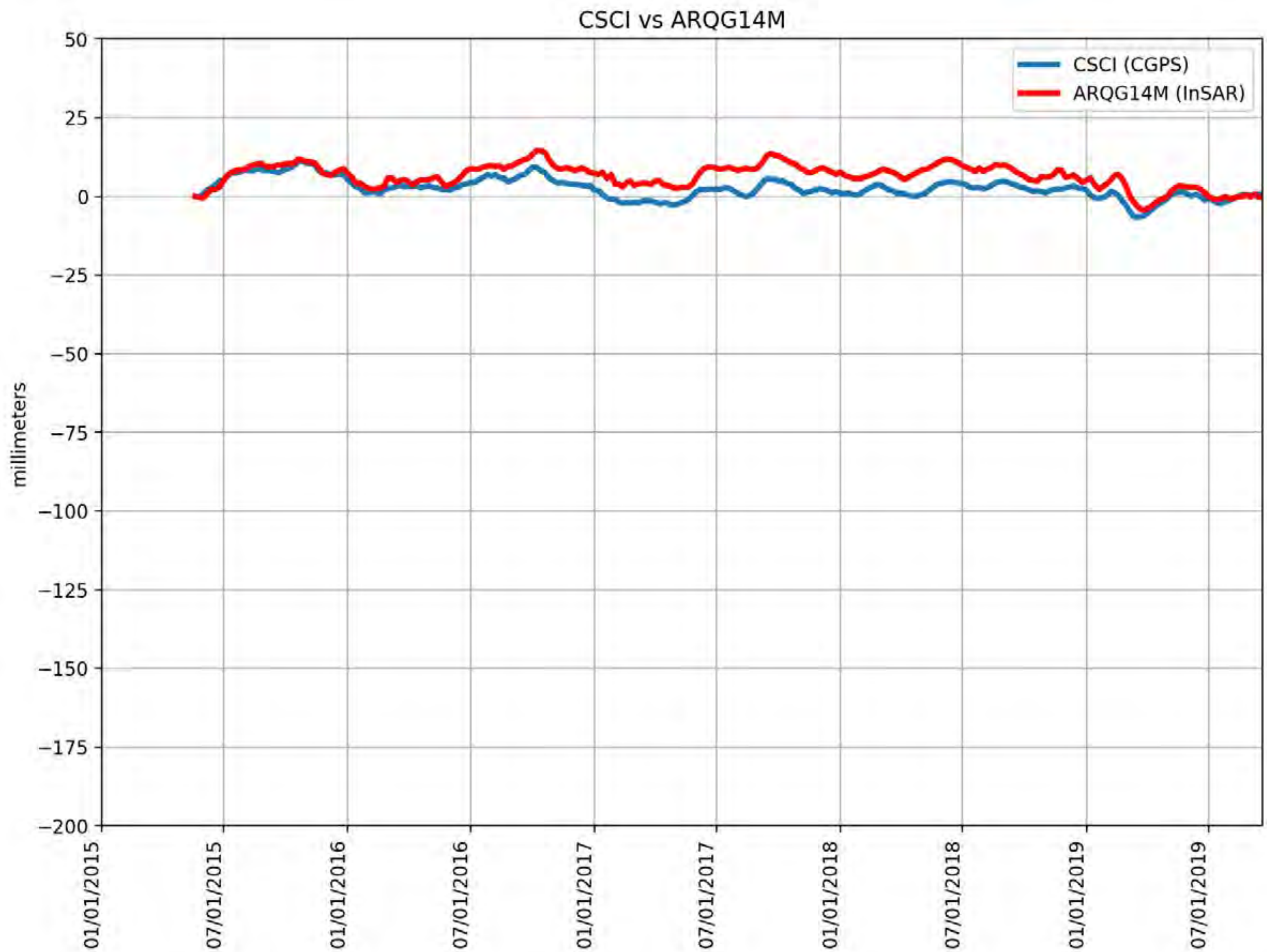
RMSE: 13.11 mm
Correlation: 0.11

Appendix B



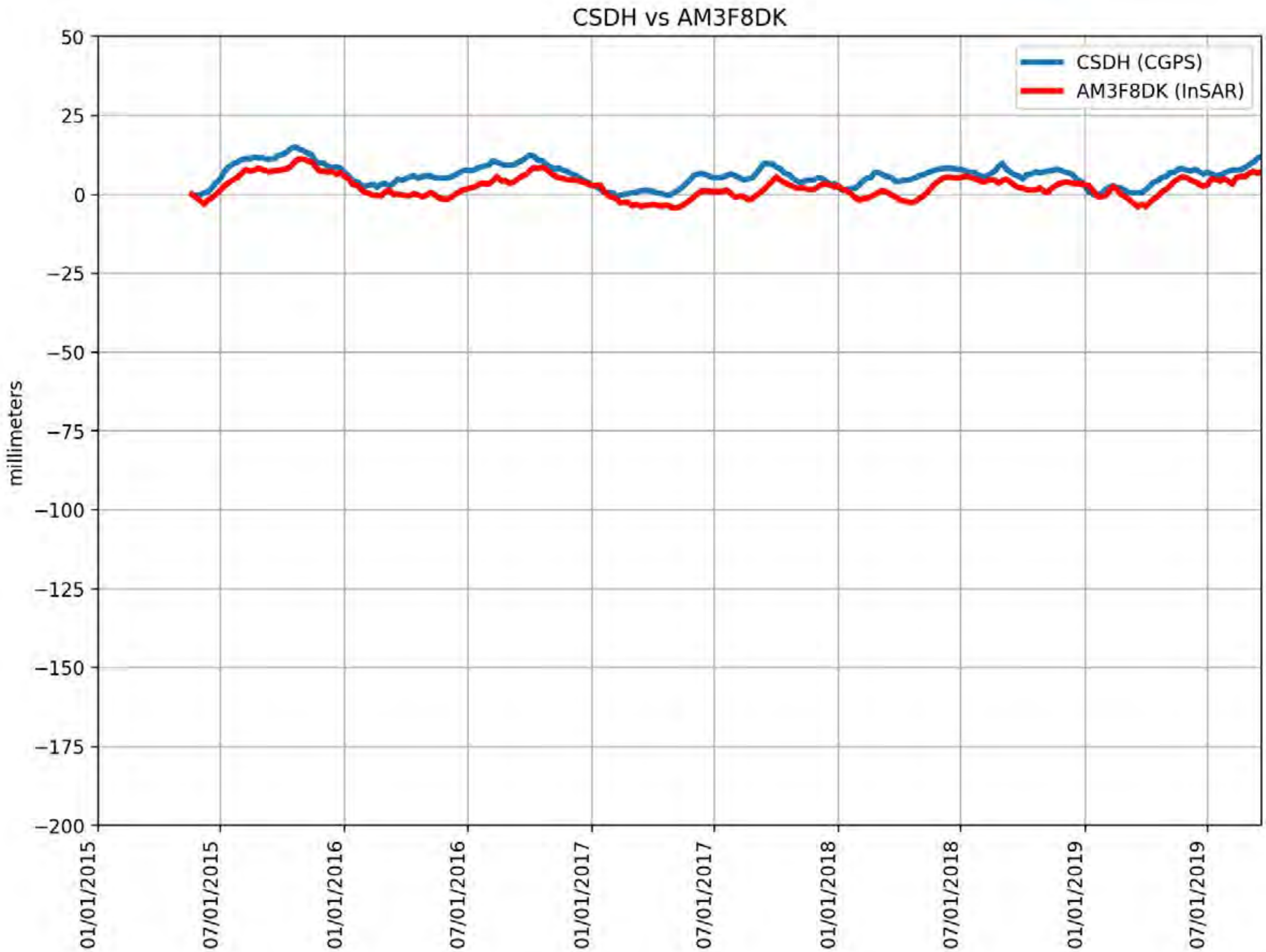
RMSE: 20.97 mm
Correlation: -0.37

Appendix B



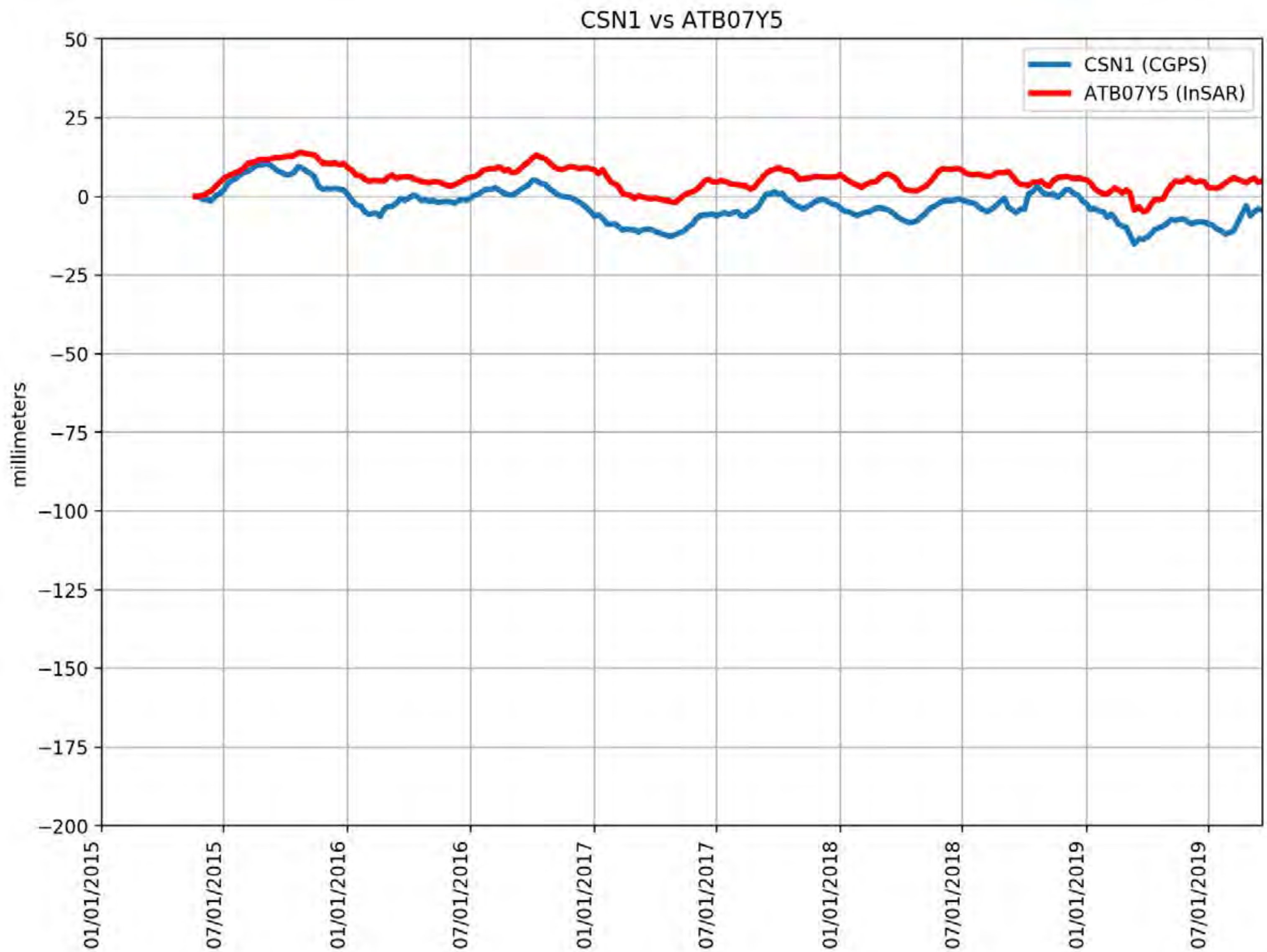
RMSE: 4.60 mm
Correlation: 0.76

Appendix B



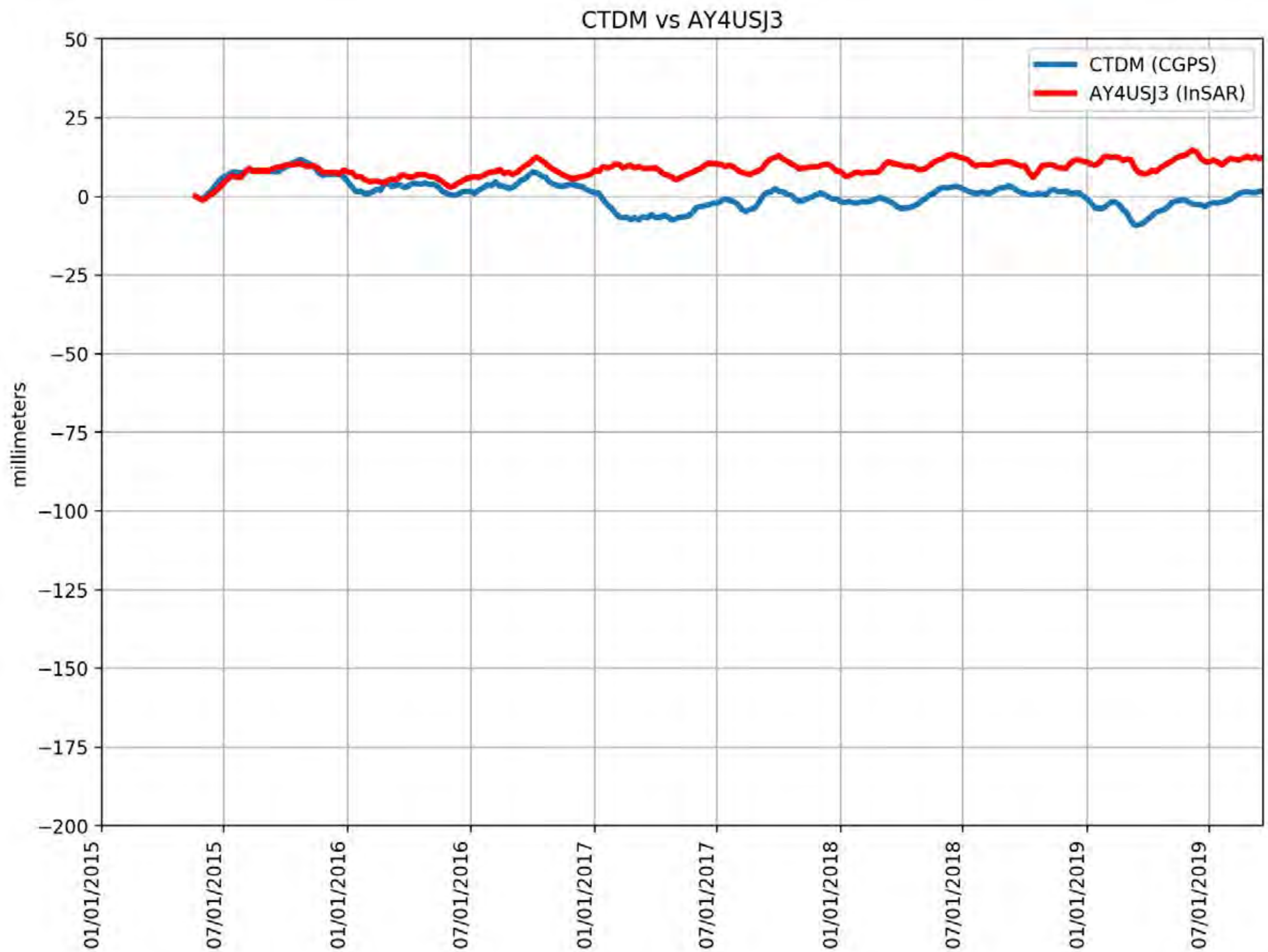
RMSE: 4.16 mm
Correlation: 0.83

Appendix B



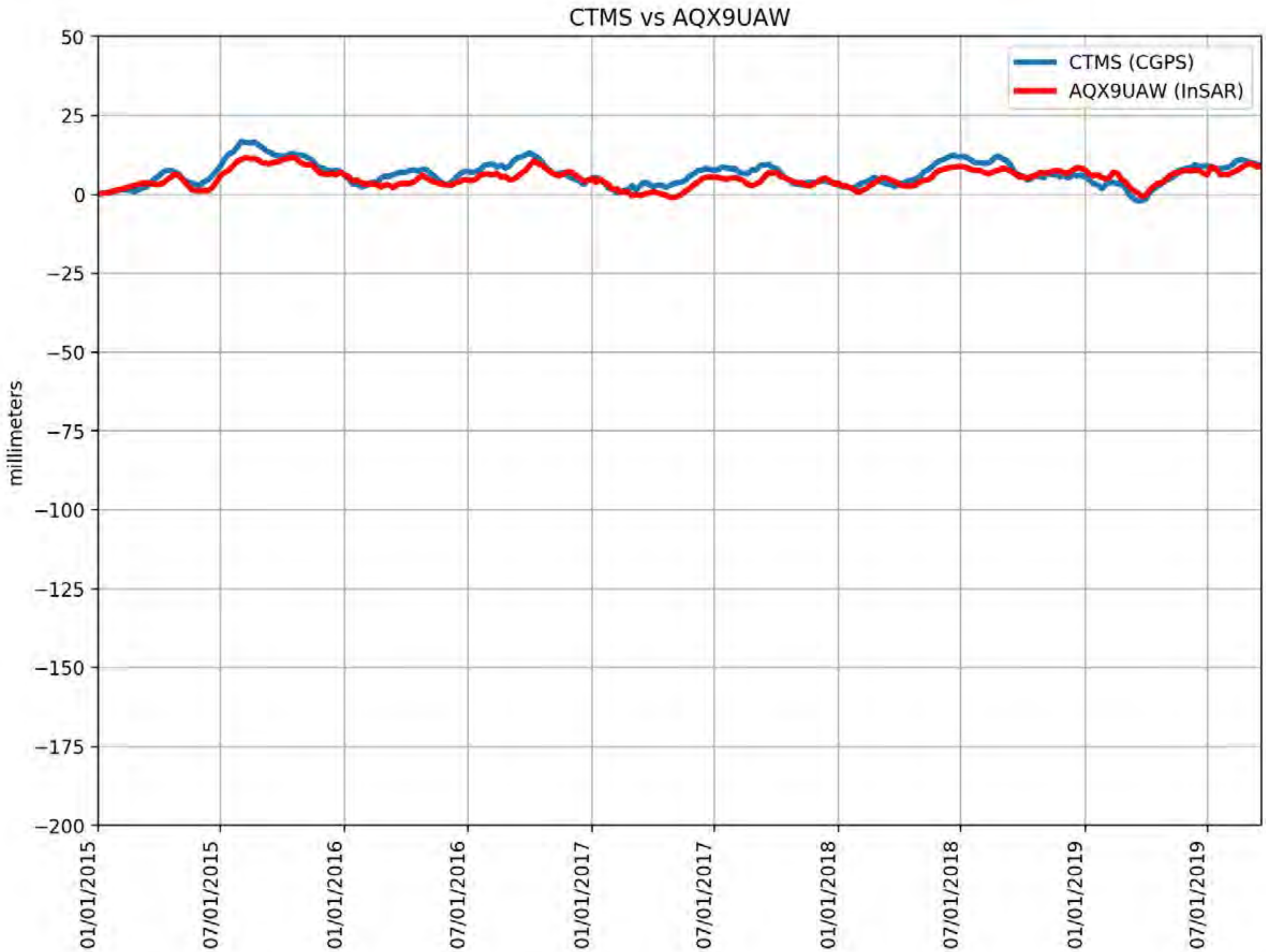
RMSE: 8.97 mm
Correlation: 0.82

Appendix B



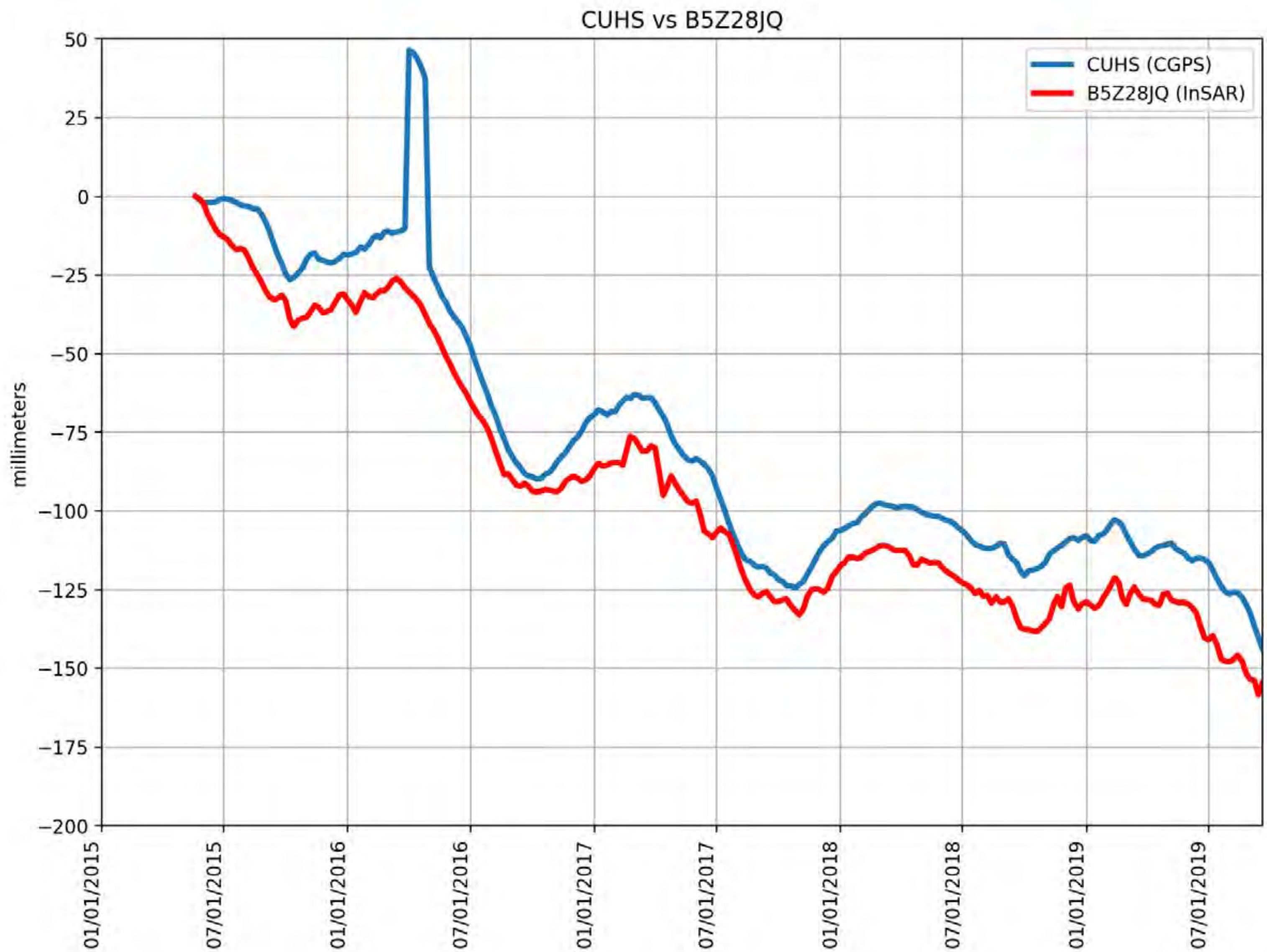
RMSE: 9.59 mm
Correlation: -0.09

Appendix B



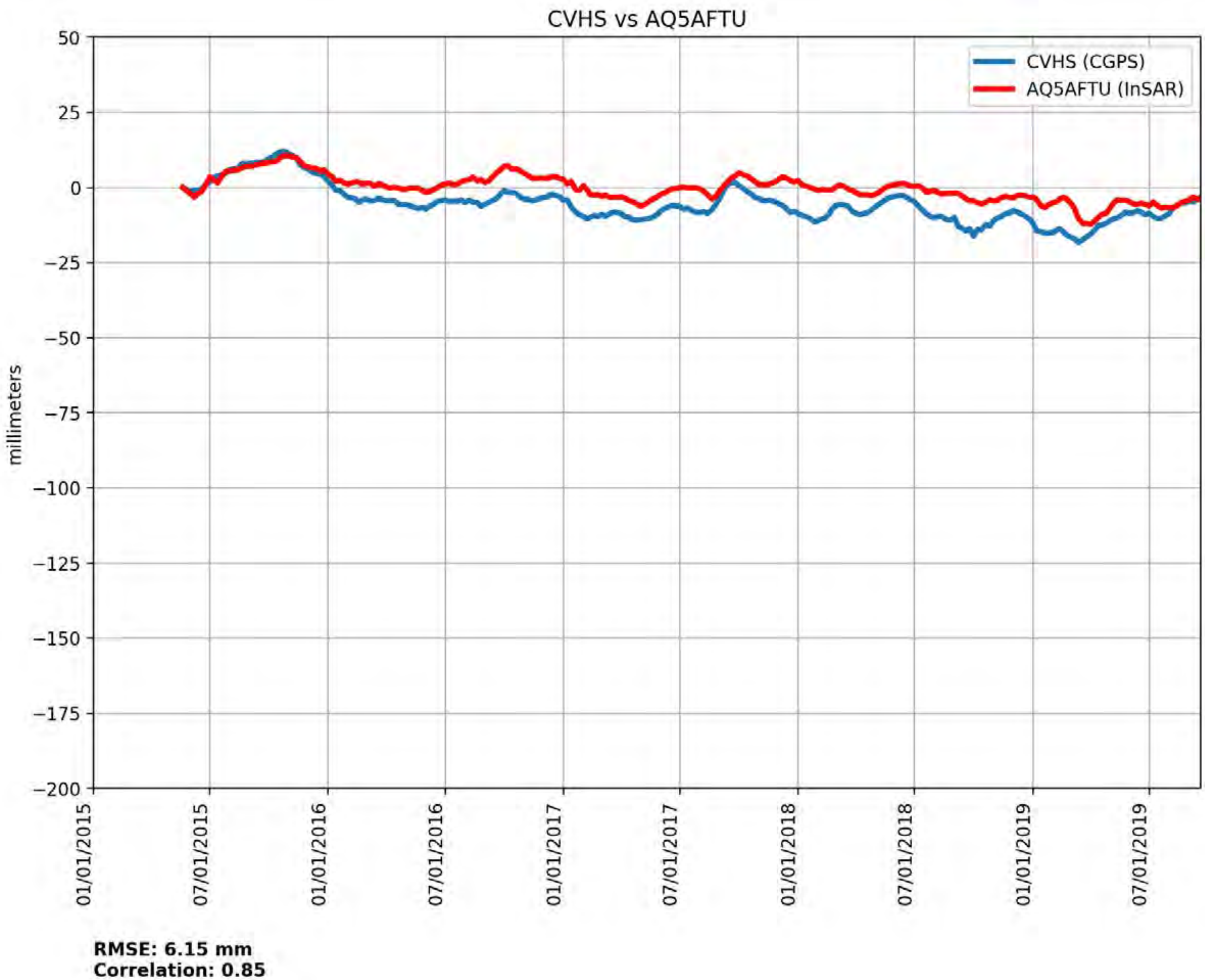
RMSE: 2.43 mm
Correlation: 0.84

Appendix B

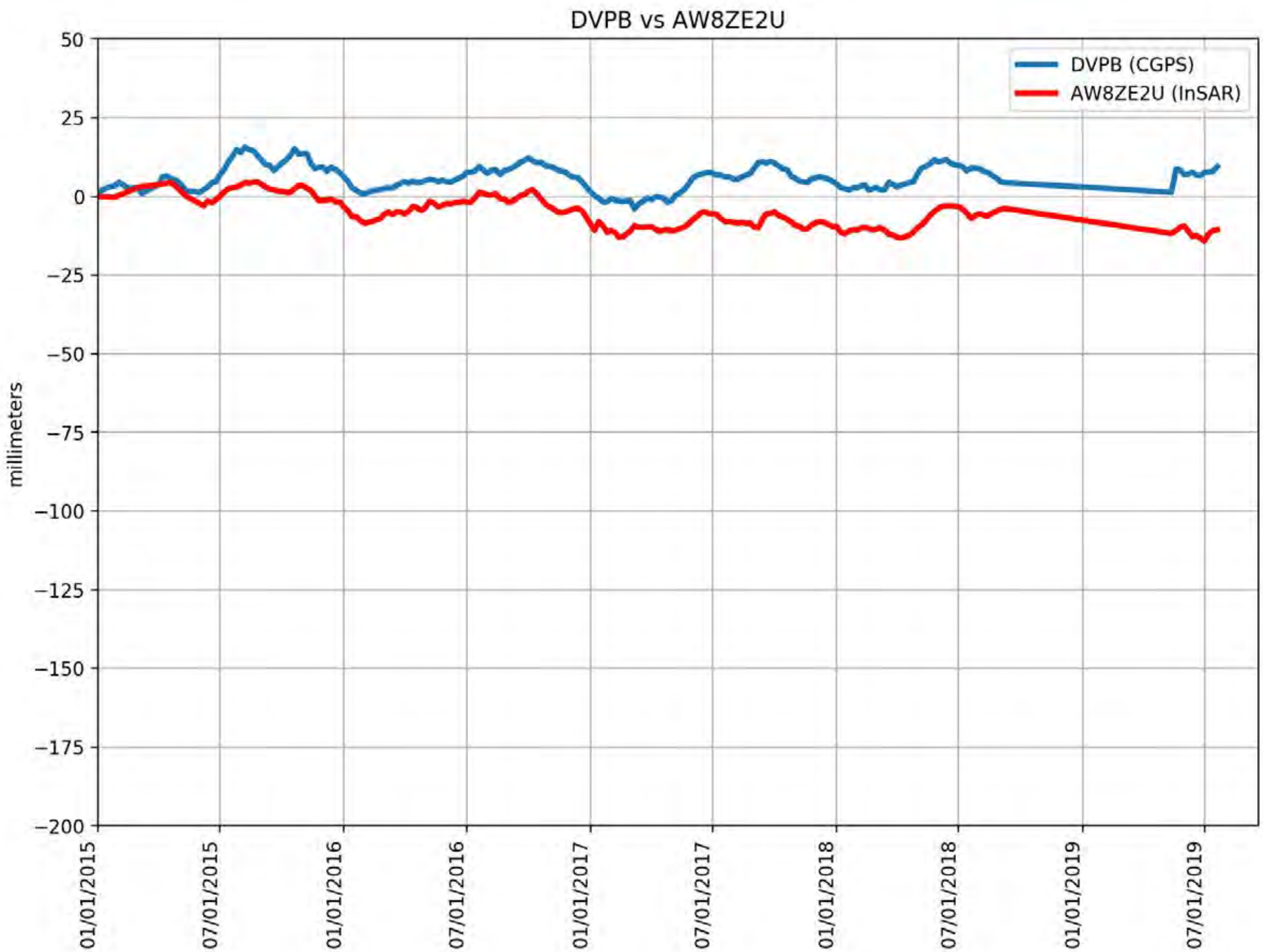


RMSE: 18.56 mm
Correlation: 0.97

Appendix B

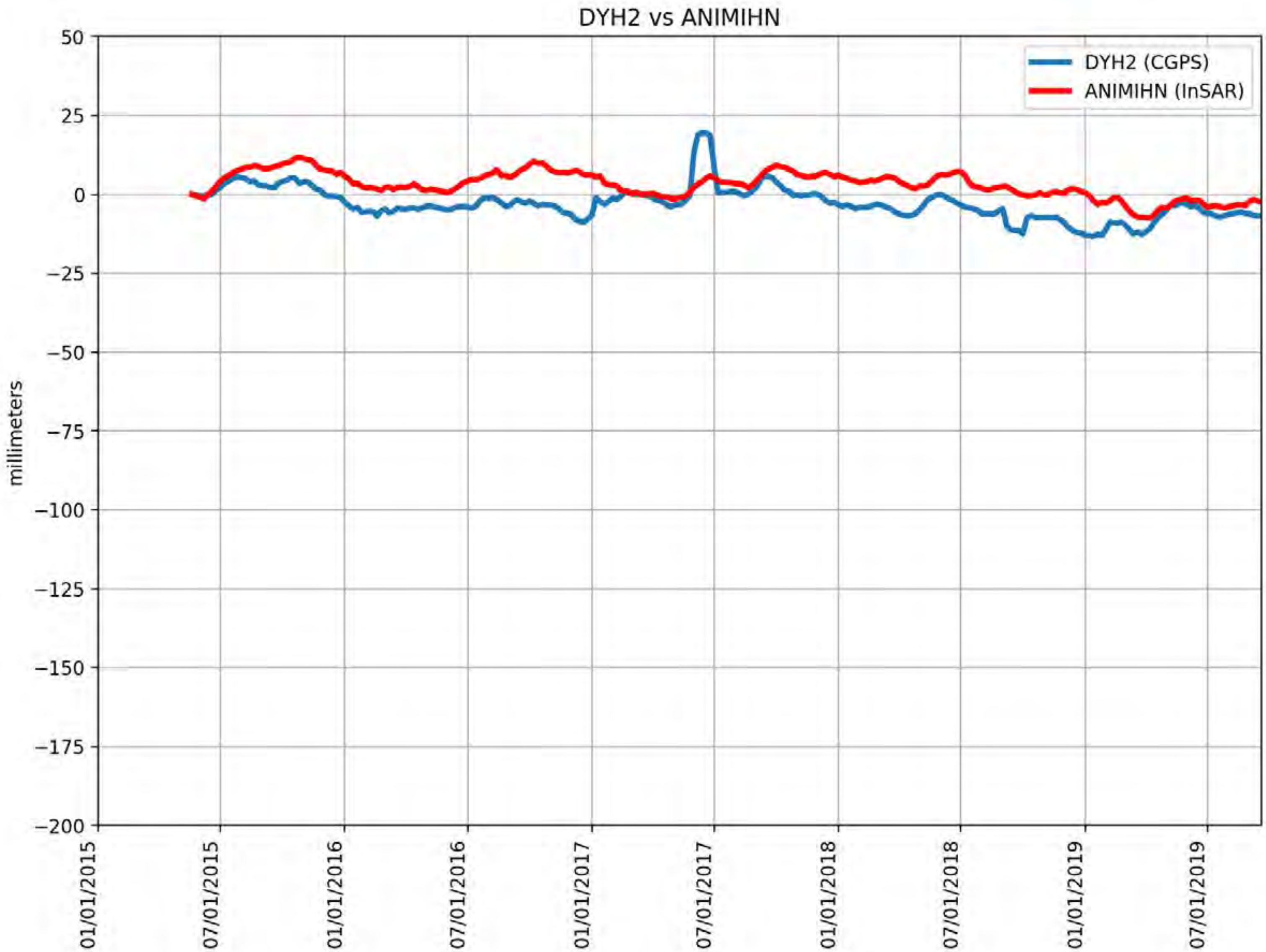

CVHS vs AQ5AFTU
CVHS (CGPS)
AQ5AFTU (InSAR)
millimeters
50
25
0
−25
−50
−75
−100
−125
−150
−175
−200
01/01/2015
07/01/2015
01/01/2016
07/01/2016
01/01/2017
07/01/2017
01/01/2018
07/01/2018
01/01/2019
07/01/2019
RMSE: 6.15 mm
Correlation: 0.85

Appendix B



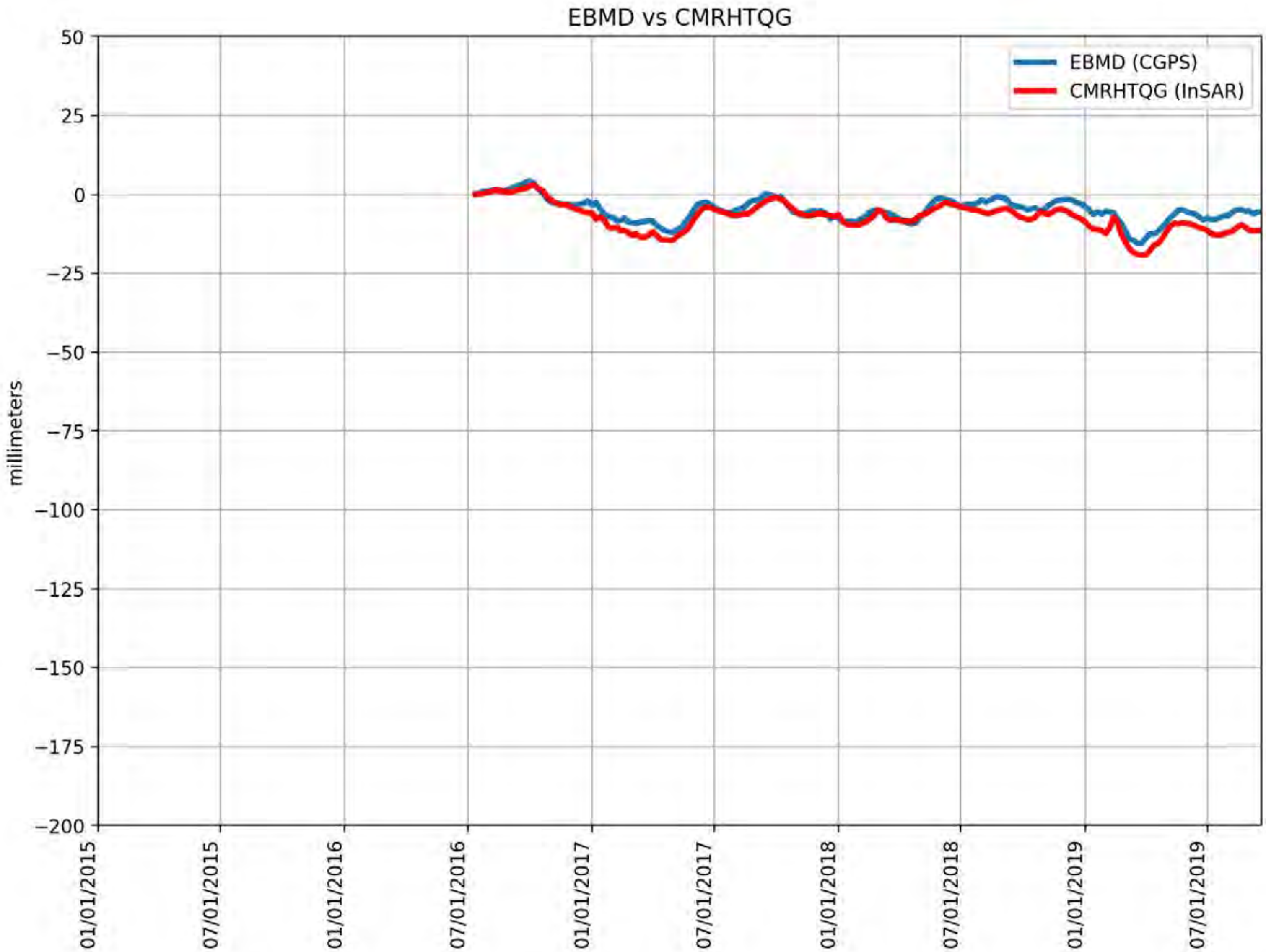
RMSE: 11.56 mm
Correlation: 0.48

Appendix B



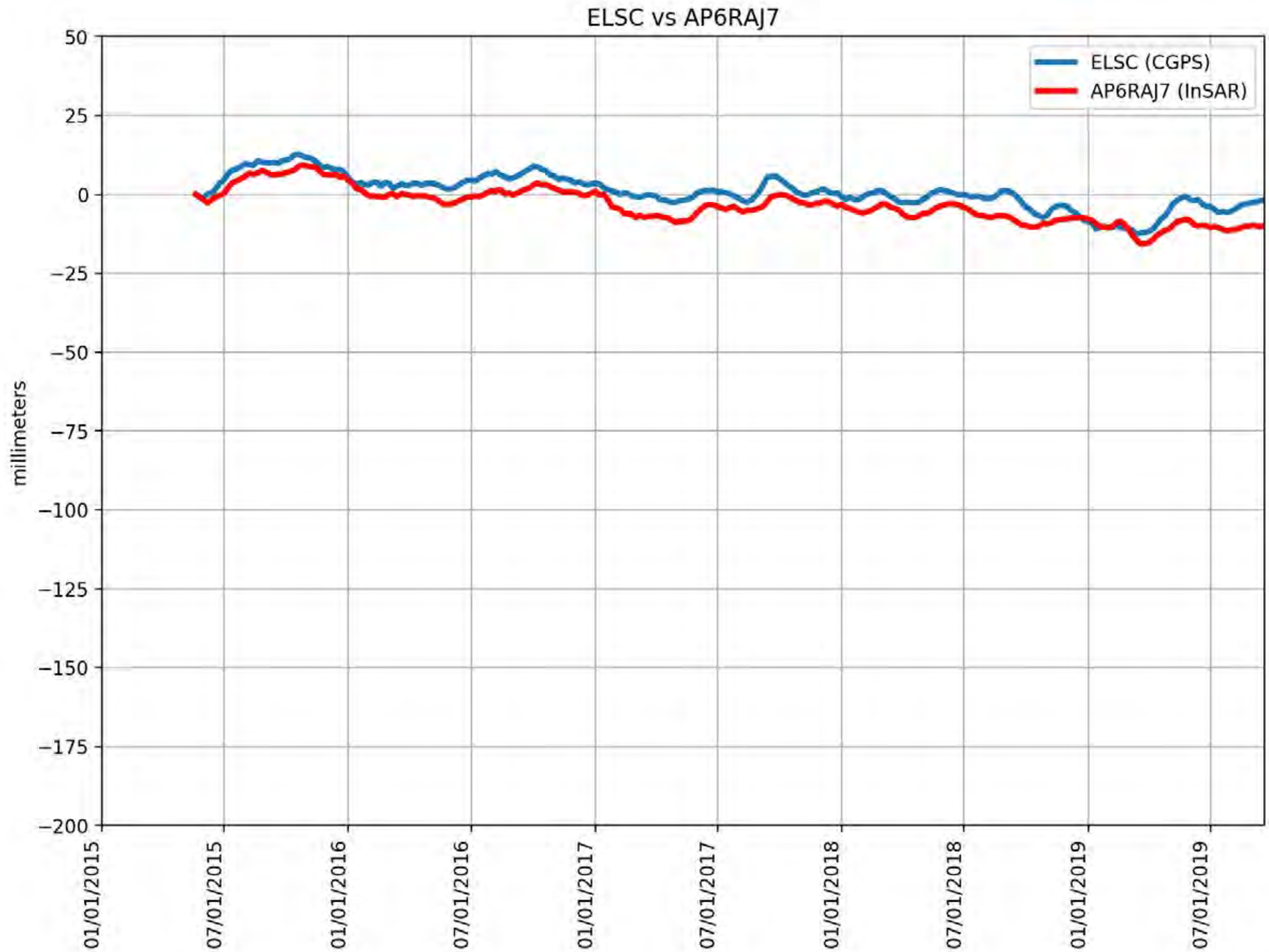
RMSE: 7.46 mm
Correlation: 0.55

Appendix B



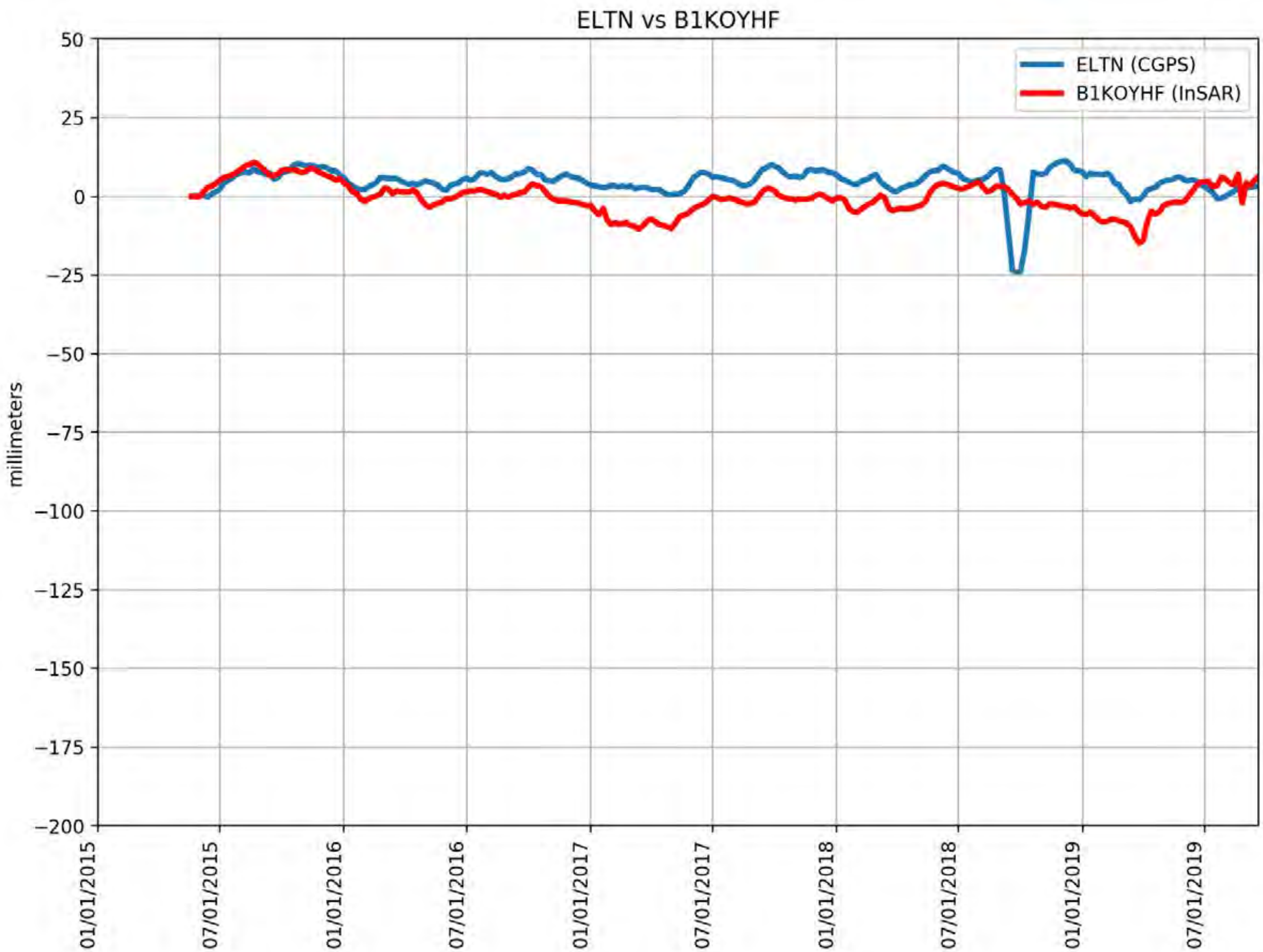
RMSE: 2.96 mm
Correlation: 0.92

Appendix B



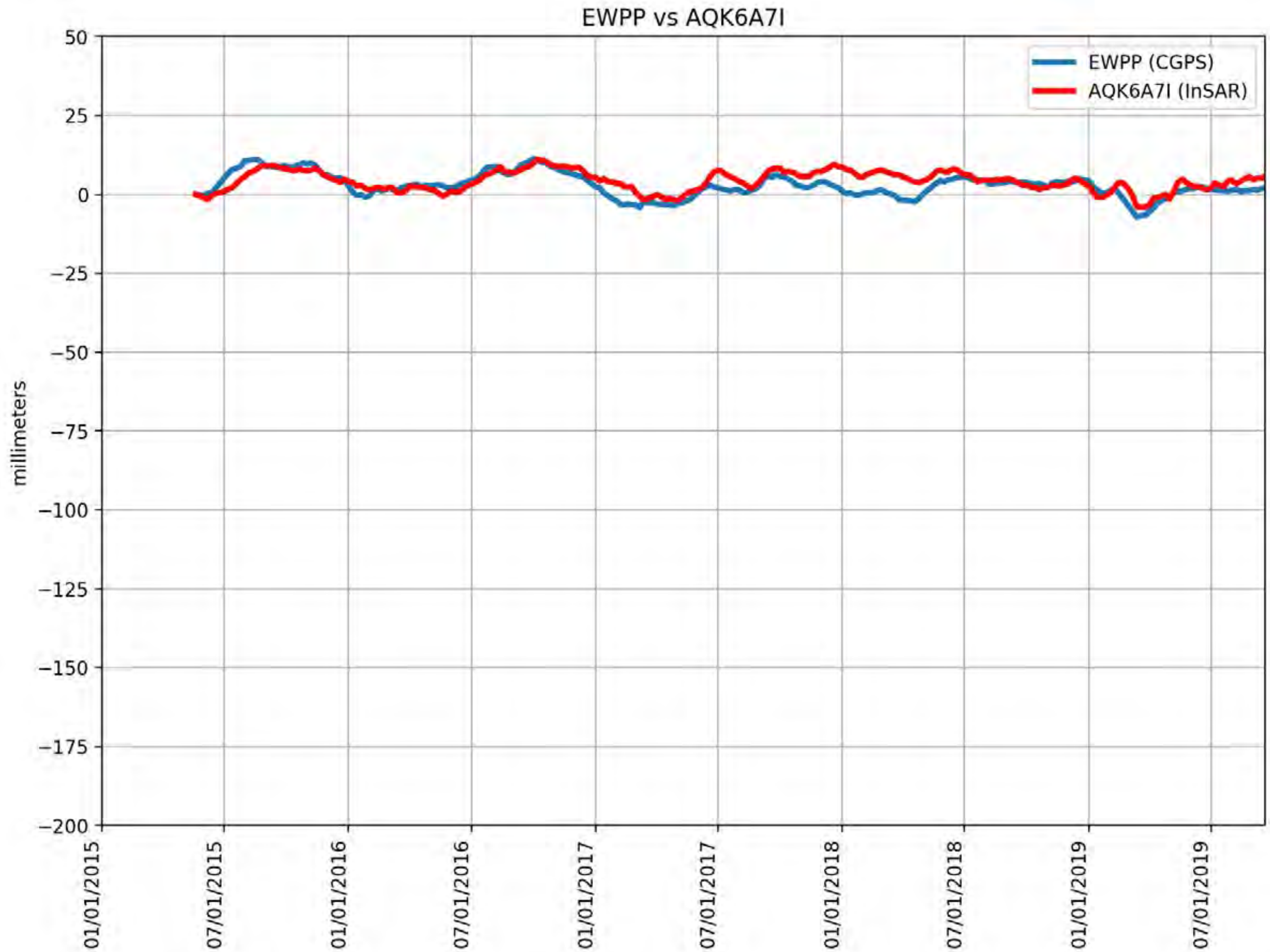
RMSE: 4.66 mm
Correlation: 0.93

Appendix B



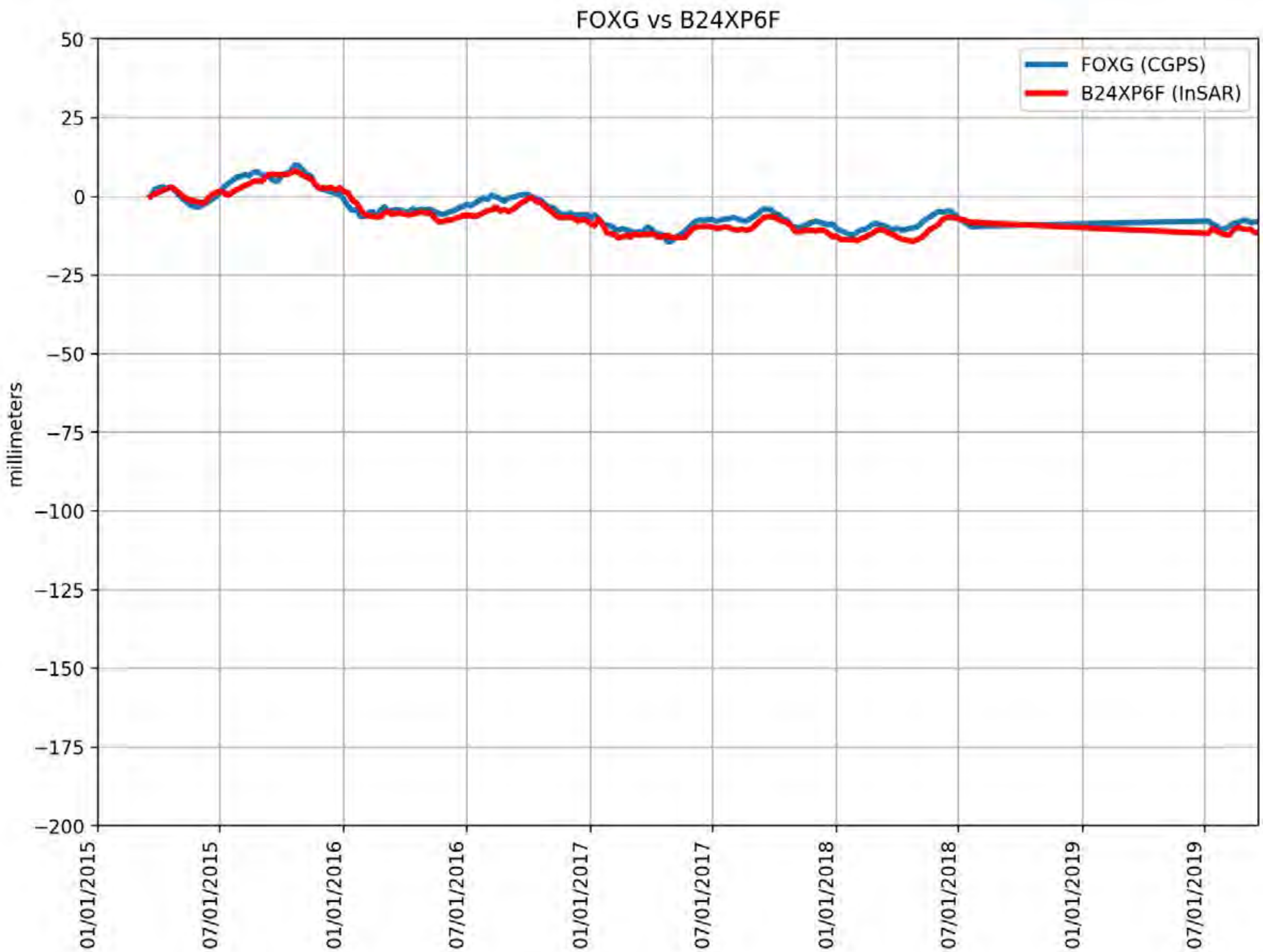
RMSE: 7.65 mm
Correlation: 0.25

Appendix B



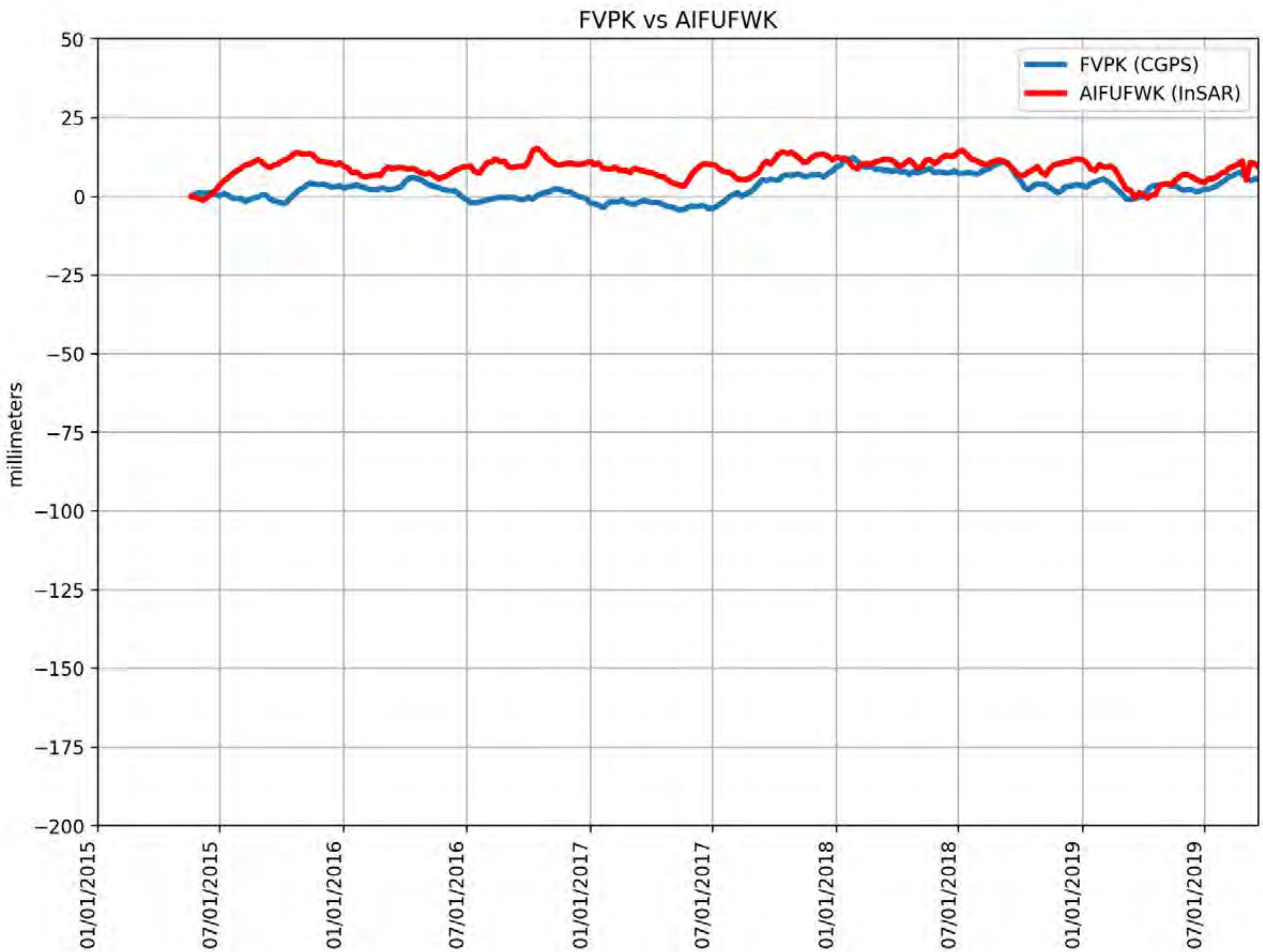
RMSE: 3.06 mm
Correlation: 0.70

Appendix B



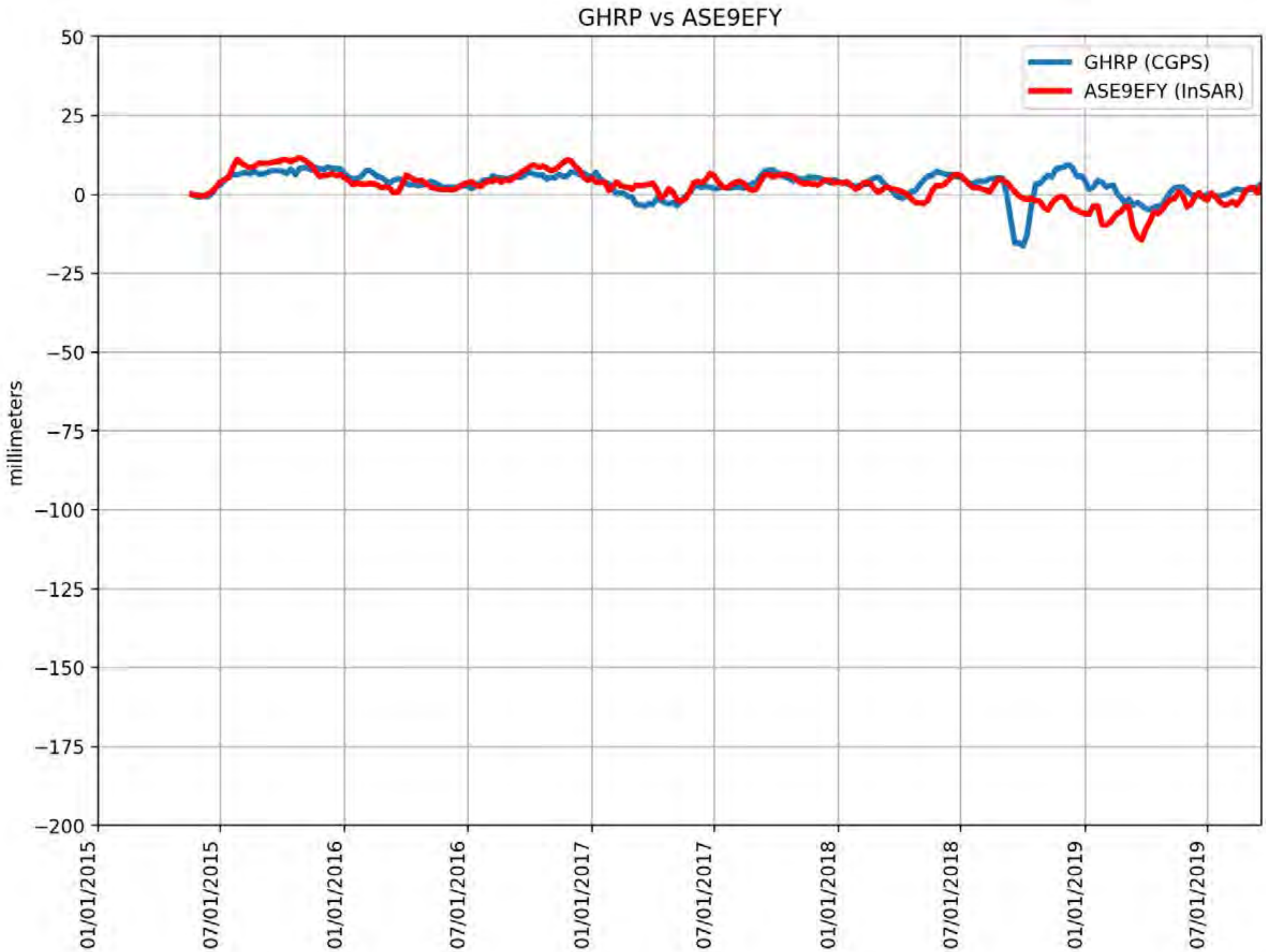
RMSE: 2.30 mm
Correlation: 0.96

Appendix B



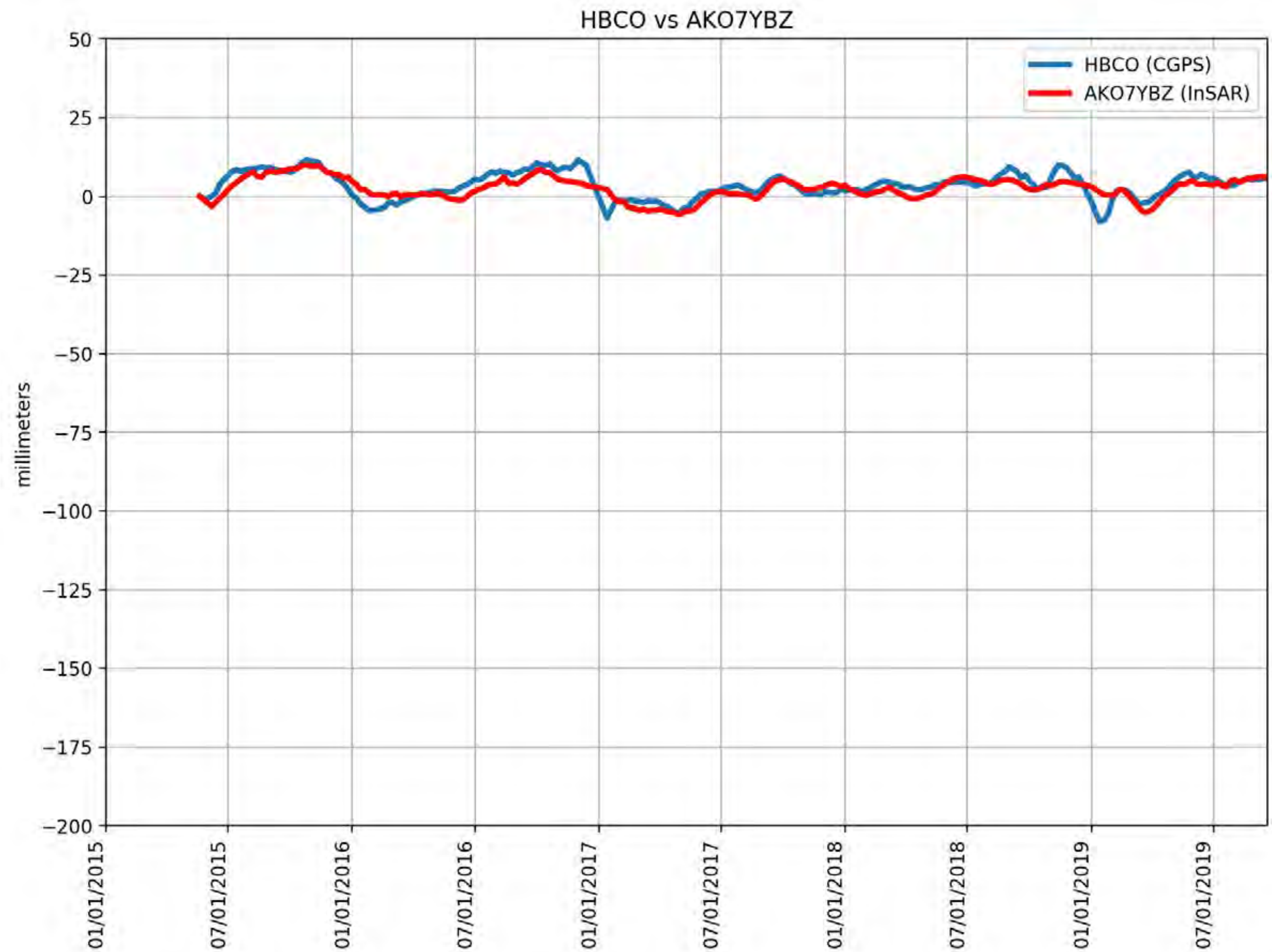
RMSE: 7.25 mm
Correlation: 0.36

Appendix B



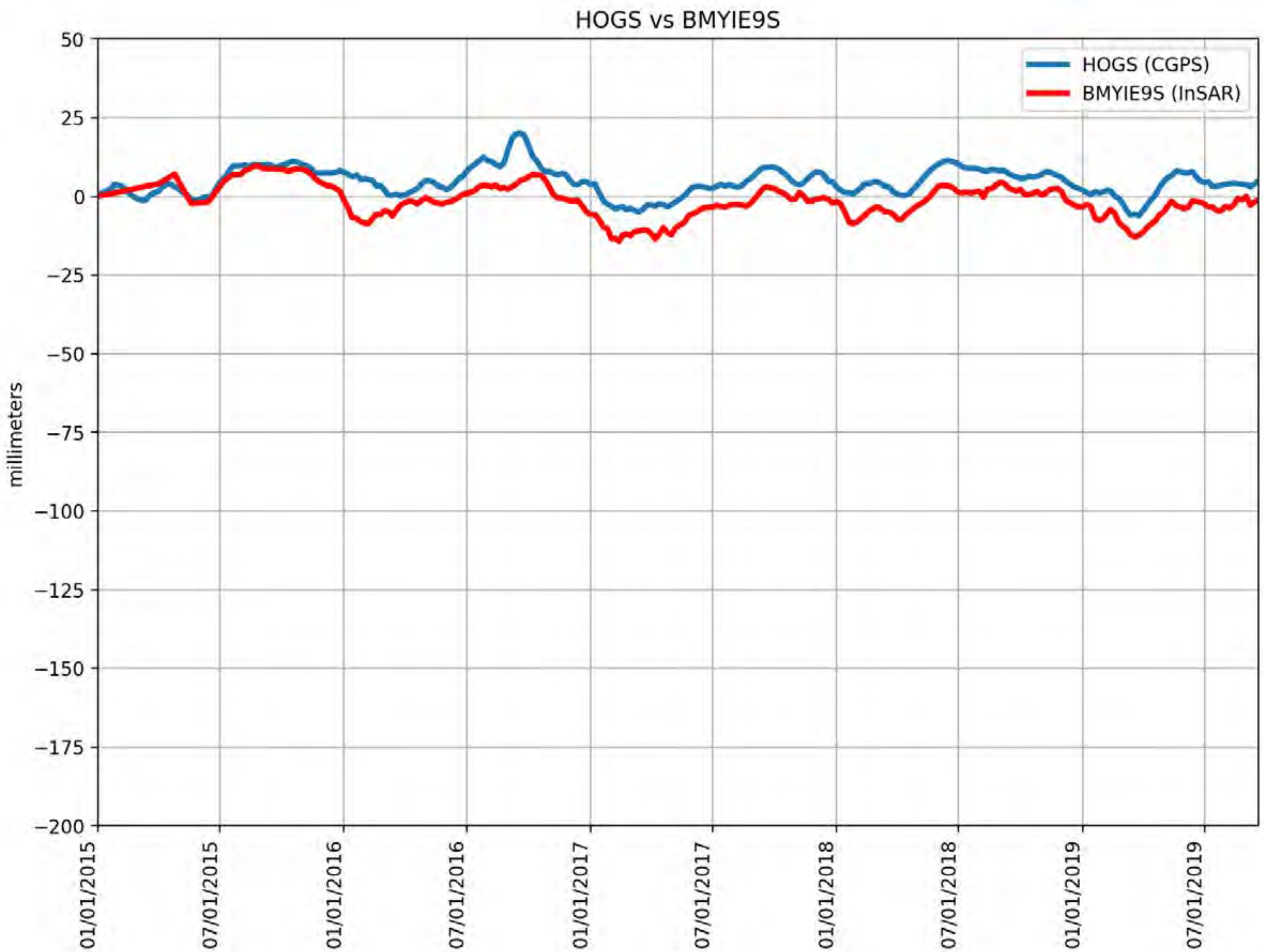
RMSE: 4.29 mm
Correlation: 0.52

Appendix B



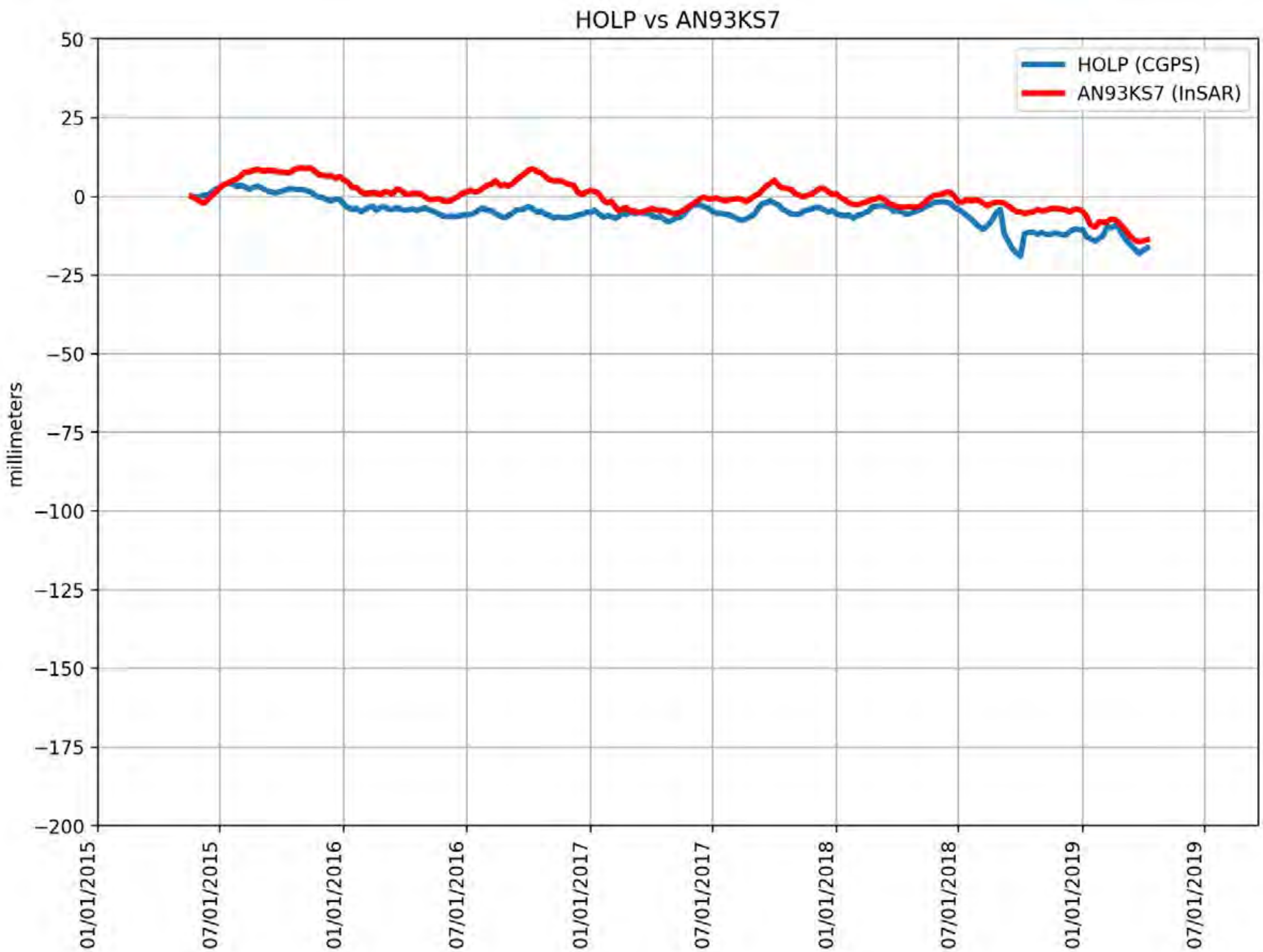
RMSE: 2.75 mm
Correlation: 0.78

Appendix B



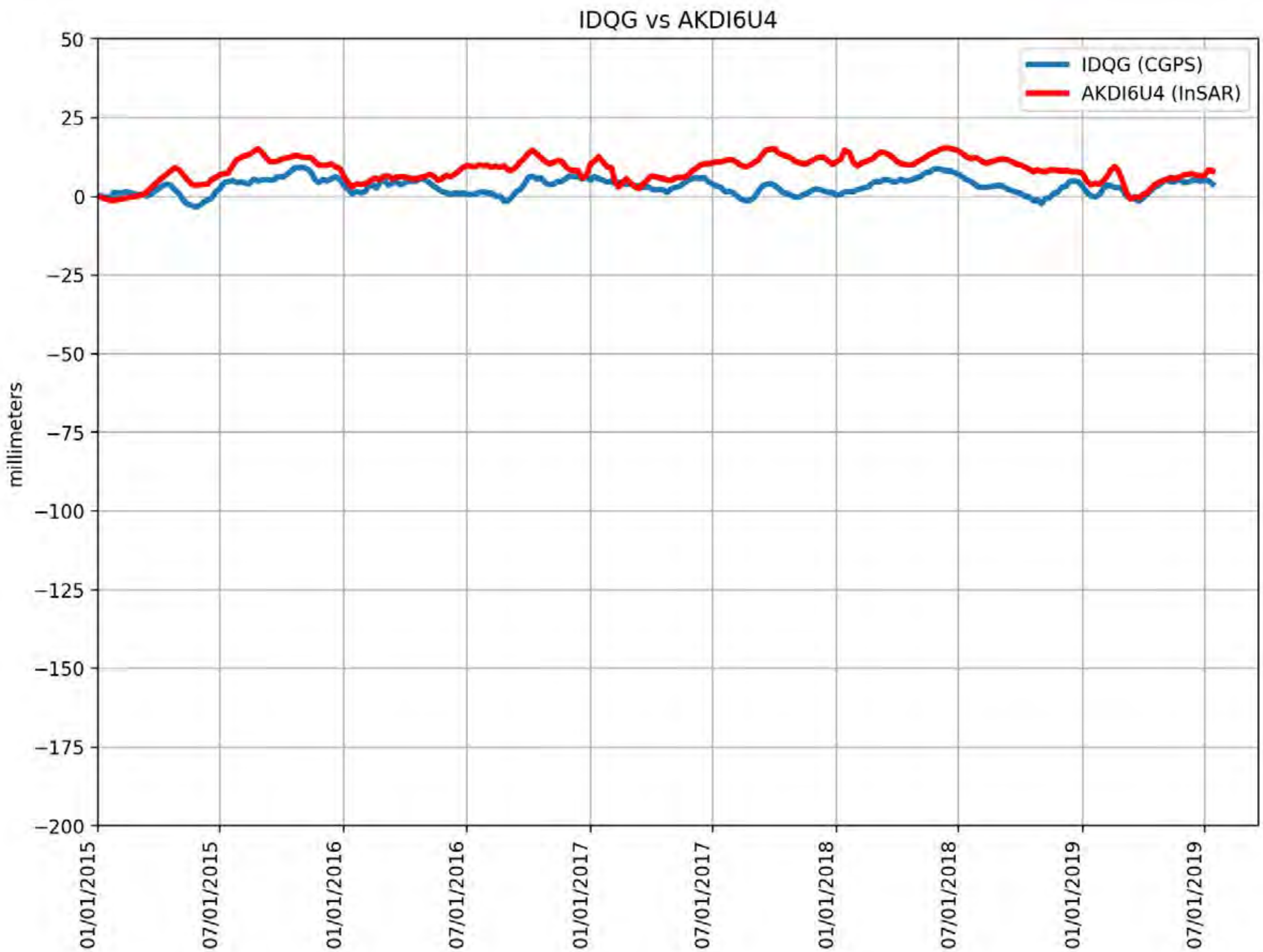
RMSE: 6.89 mm
Correlation: 0.75

Appendix B



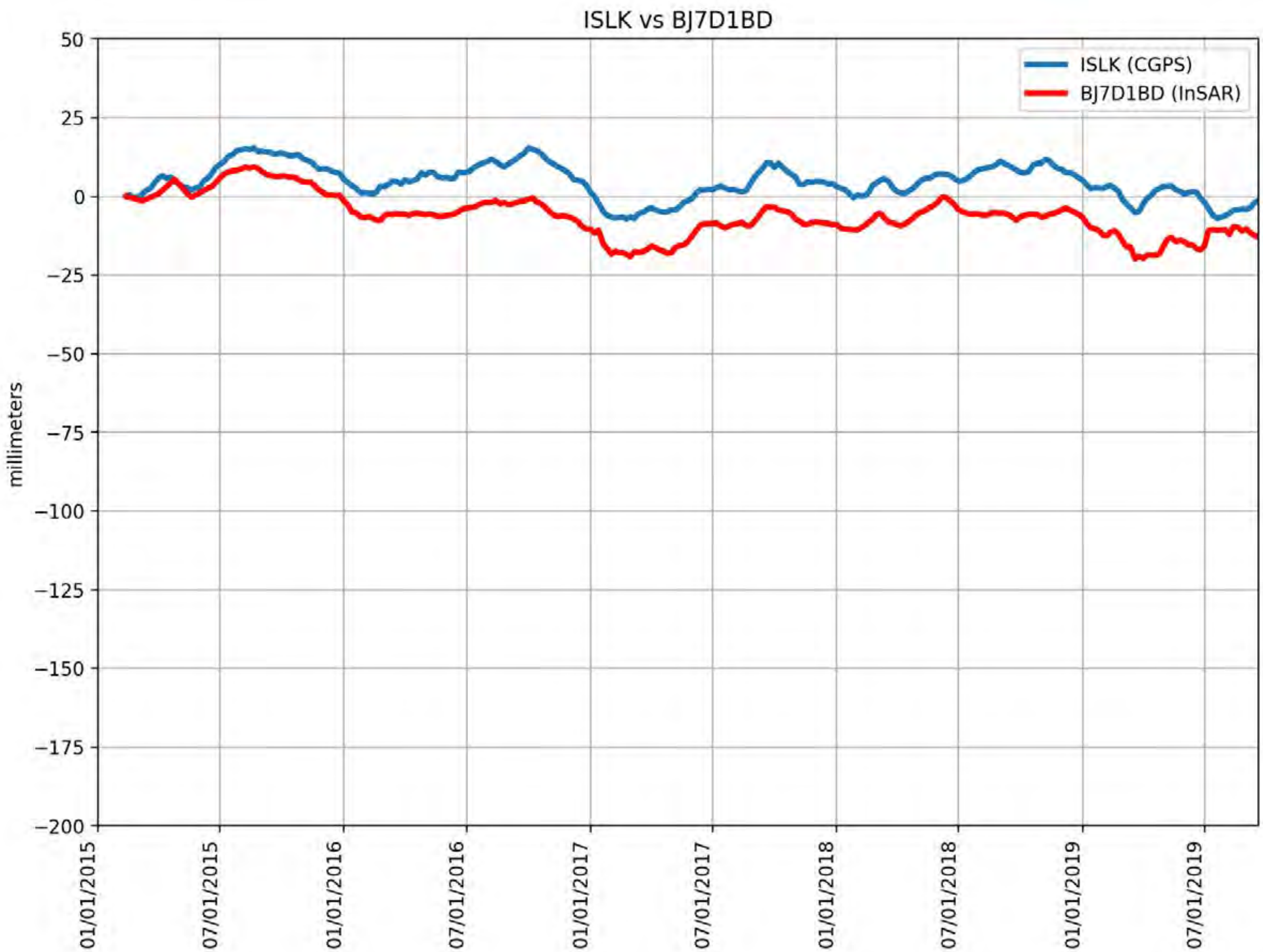
RMSE: 6.03 mm
Correlation: 0.77

Appendix B



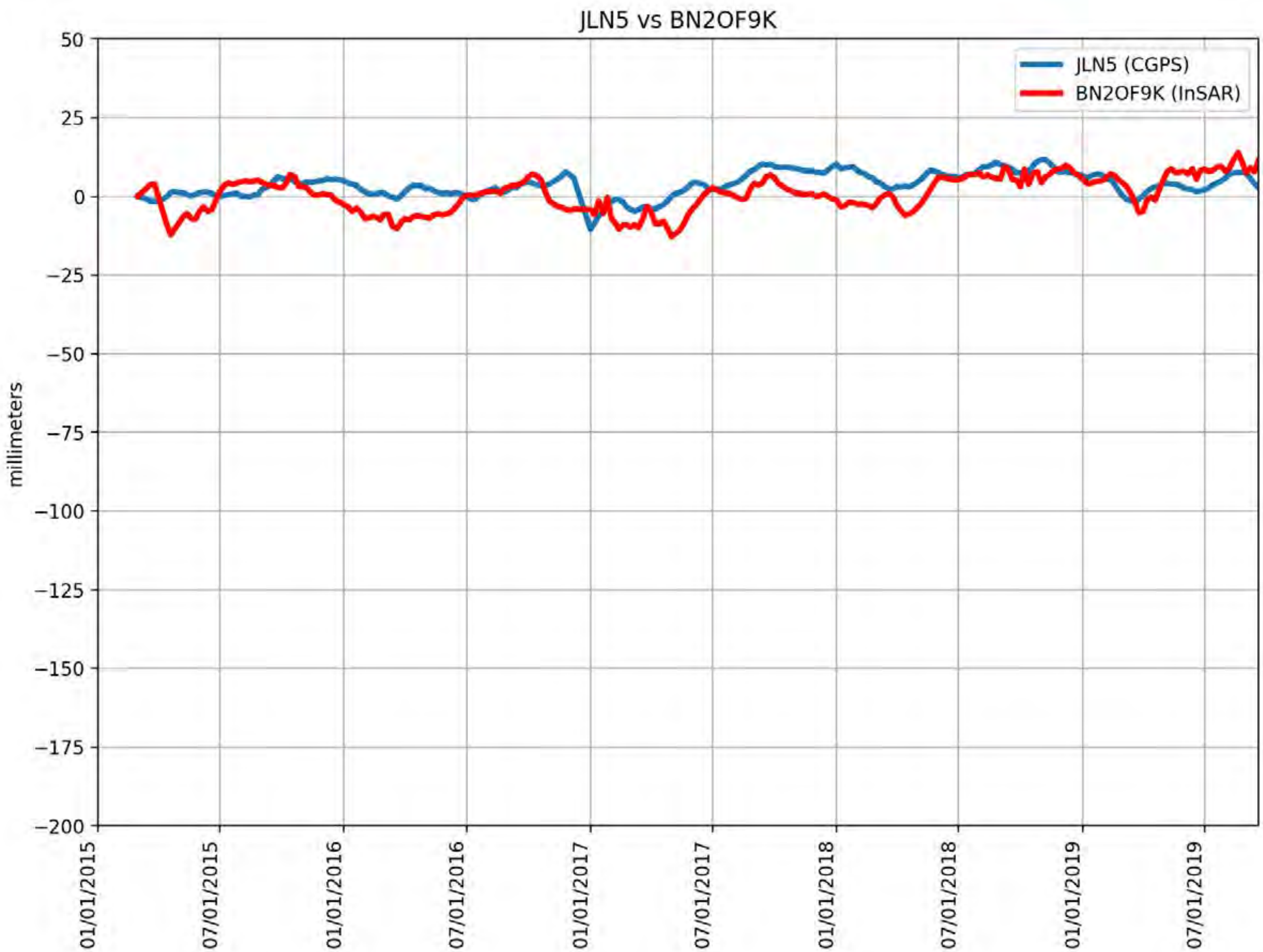
RMSE: 6.39 mm
Correlation: 0.46

Appendix B



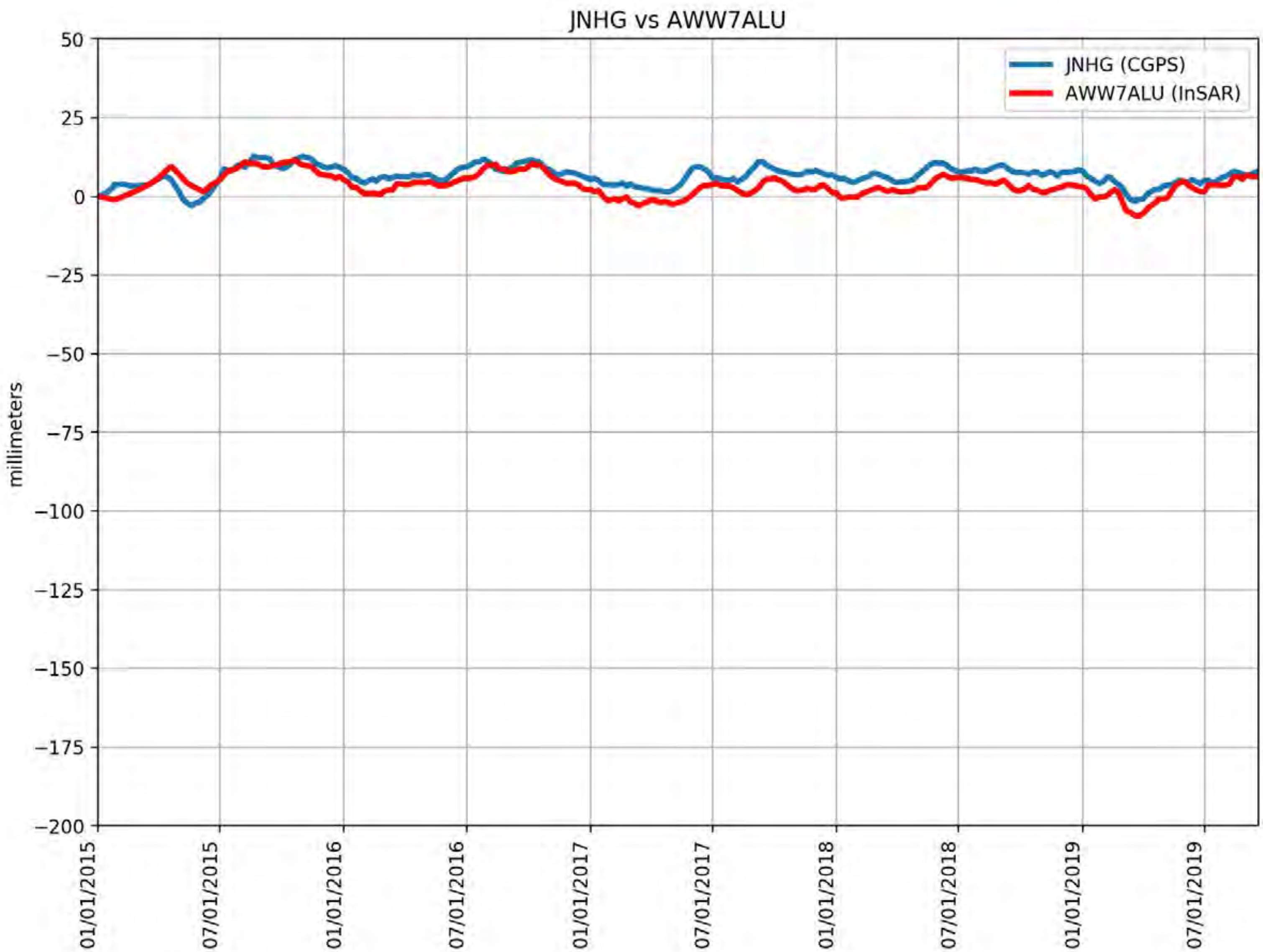
RMSE: 11.59 mm
Correlation: 0.79

Appendix B



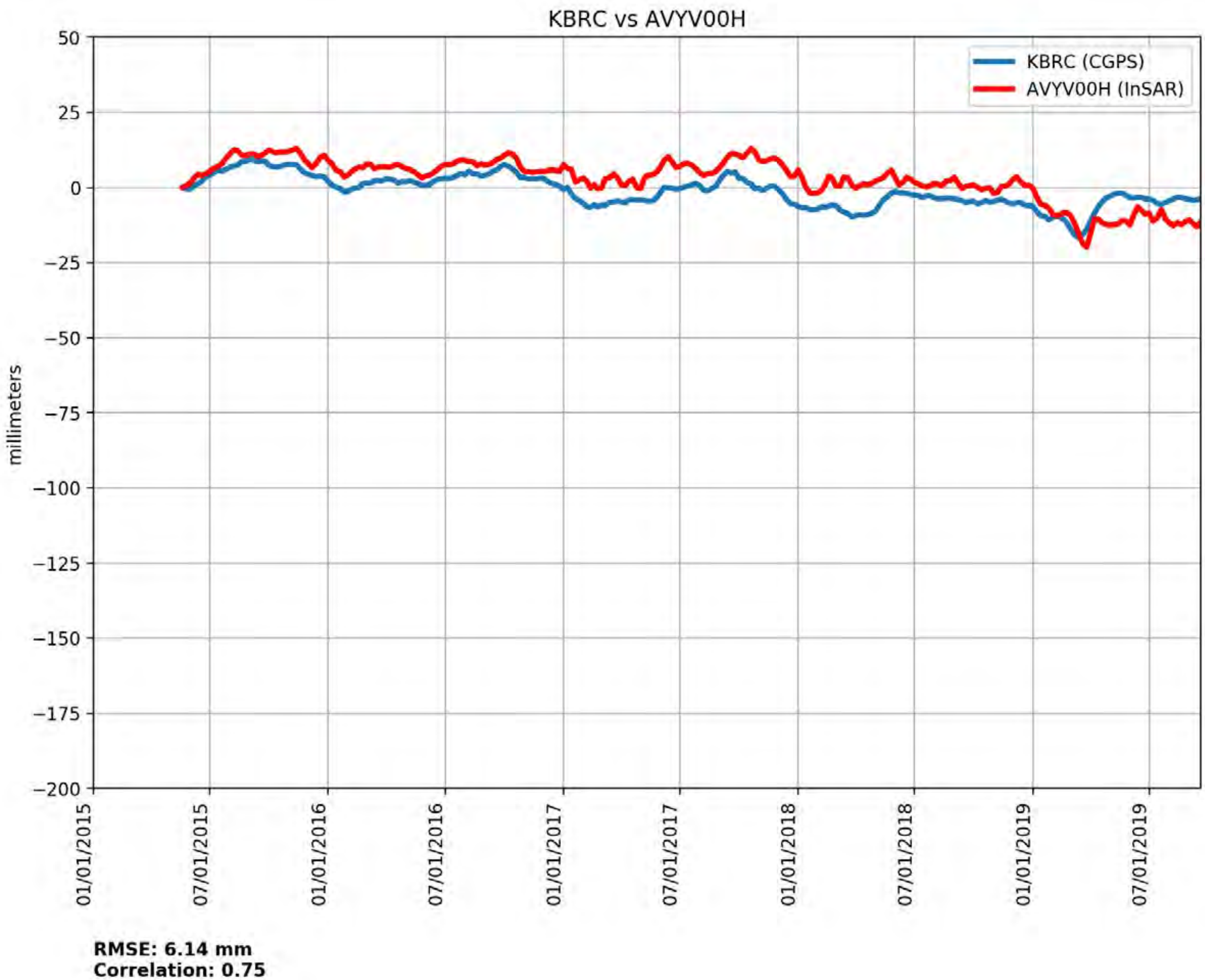
RMSE: 5.77 mm
Correlation: 0.52

Appendix B

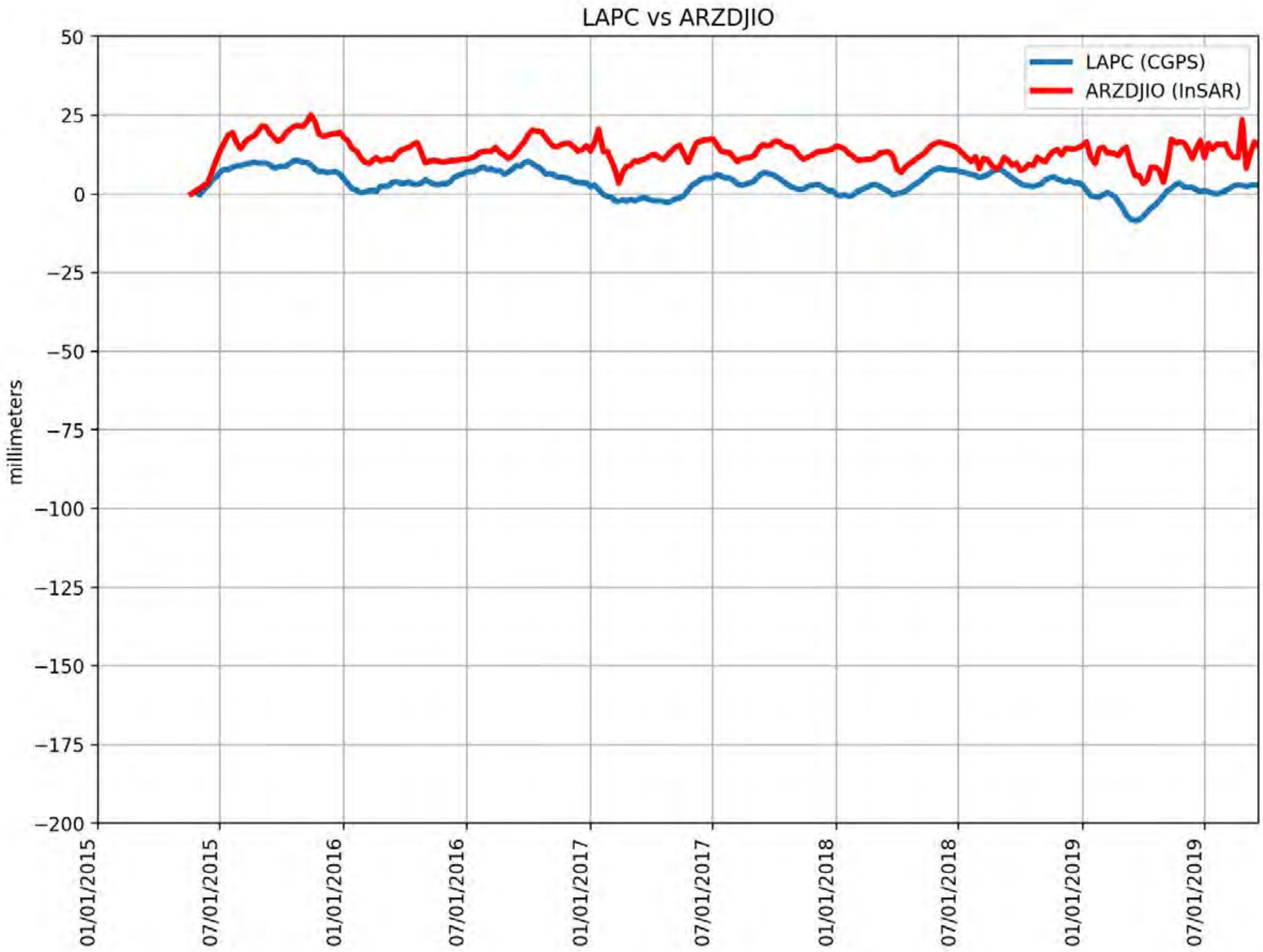


RMSE: 3.82 mm
Correlation: 0.74

Appendix B

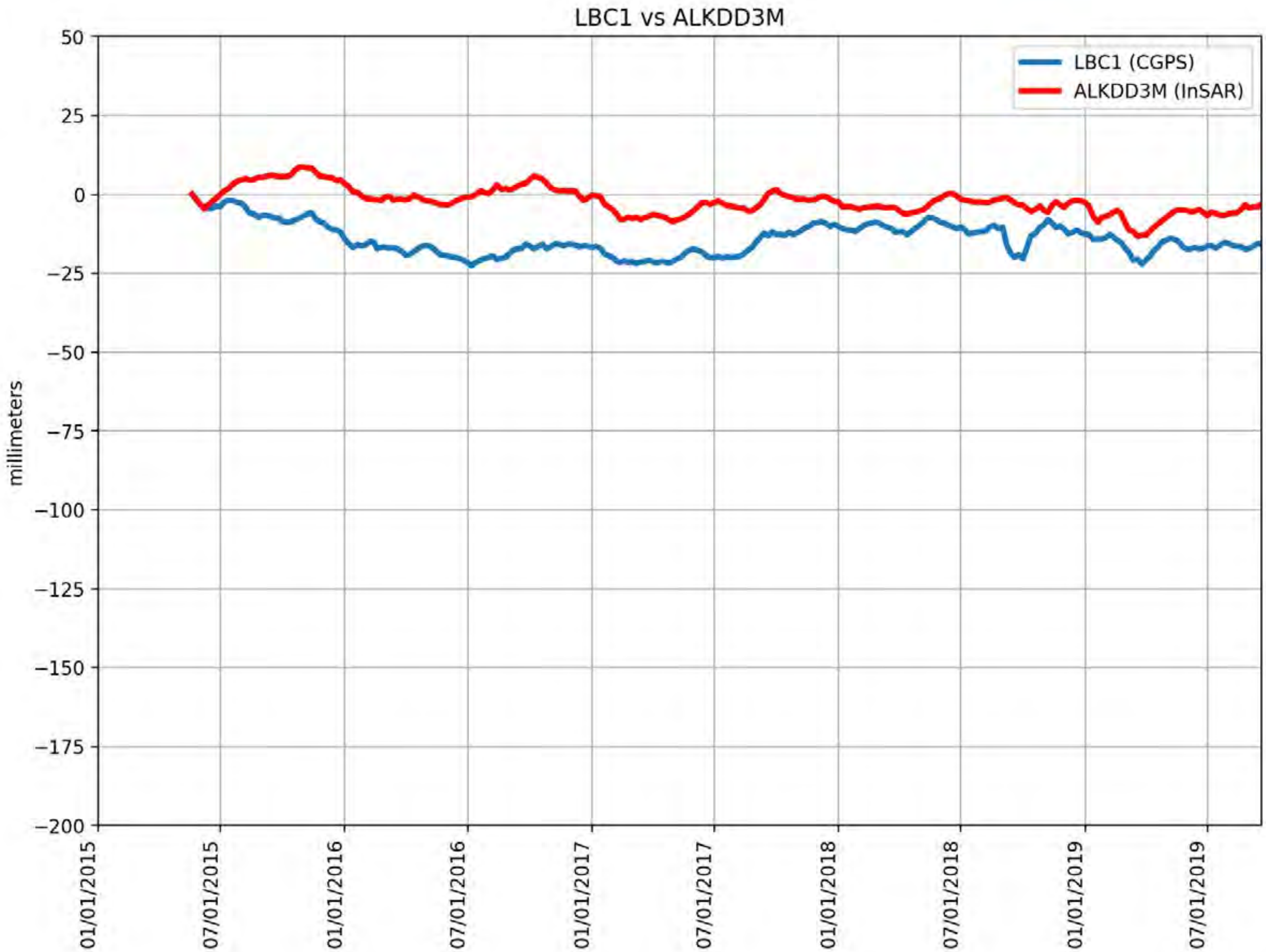

KBRC vs AVYV00H
KBRC (CGPS)
AVYV00H (InSAR)
millimeters
50
25
0
−25
−50
−75
−100
−125
−150
−175
−200
01/01/2015
07/01/2015
01/01/2016
07/01/2016
01/01/2017
07/01/2017
01/01/2018
07/01/2018
01/01/2019
07/01/2019
RMSE: 6.14 mm
Correlation: 0.75

Appendix B



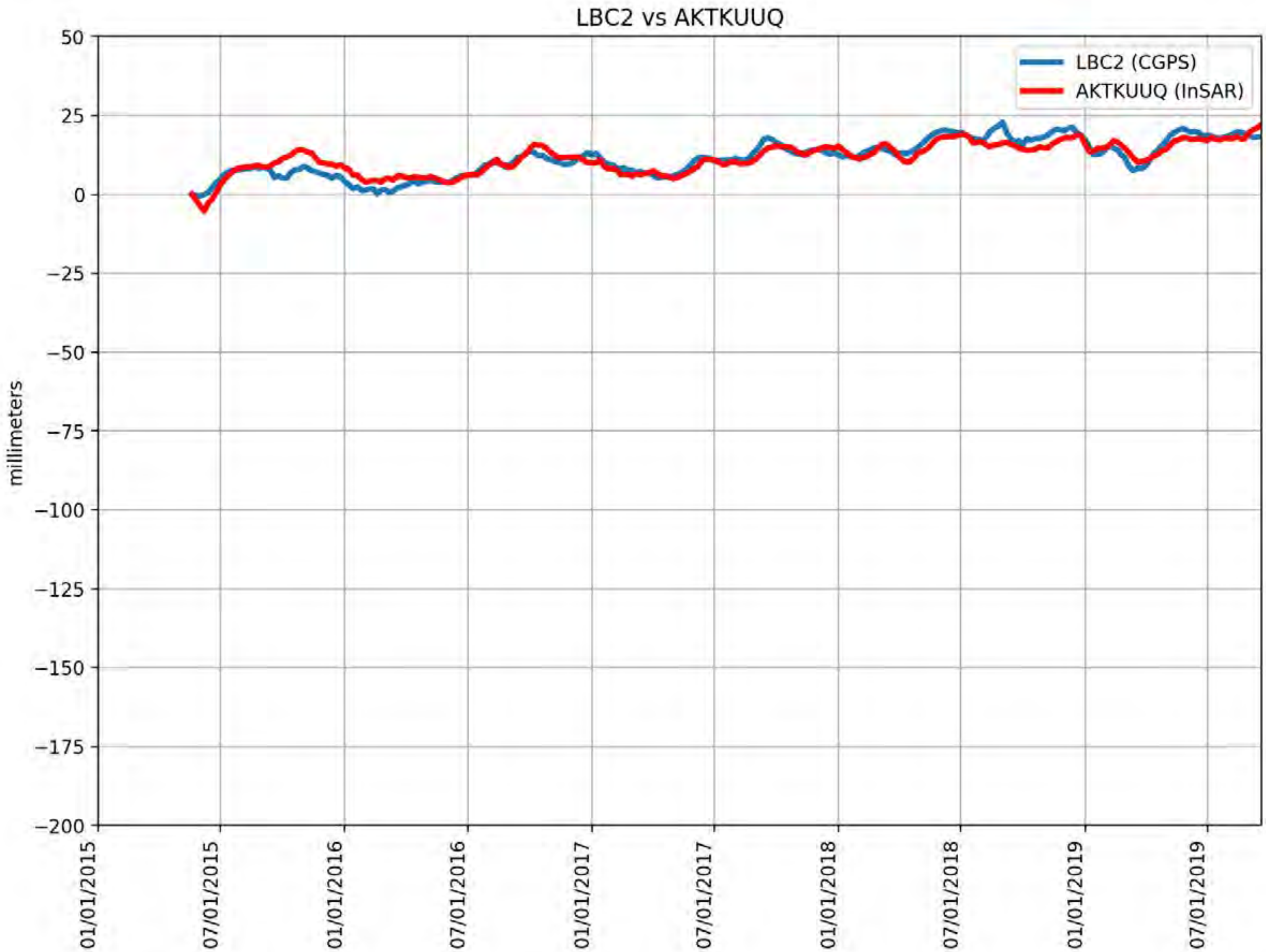
RMSE: 10.49 mm
Correlation: 0.55

Appendix B



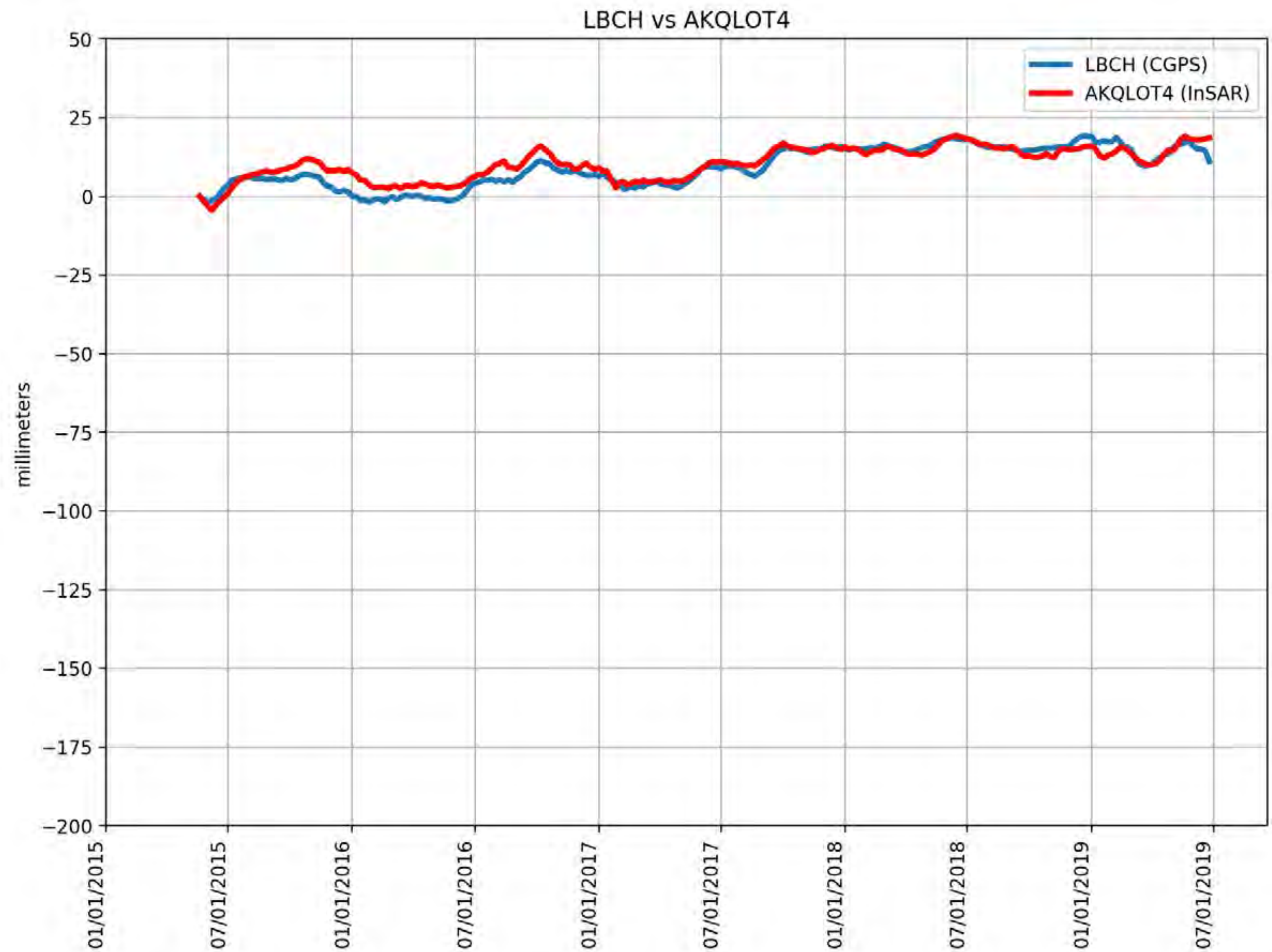
RMSE: 13.02 mm
Correlation: 0.43

Appendix B



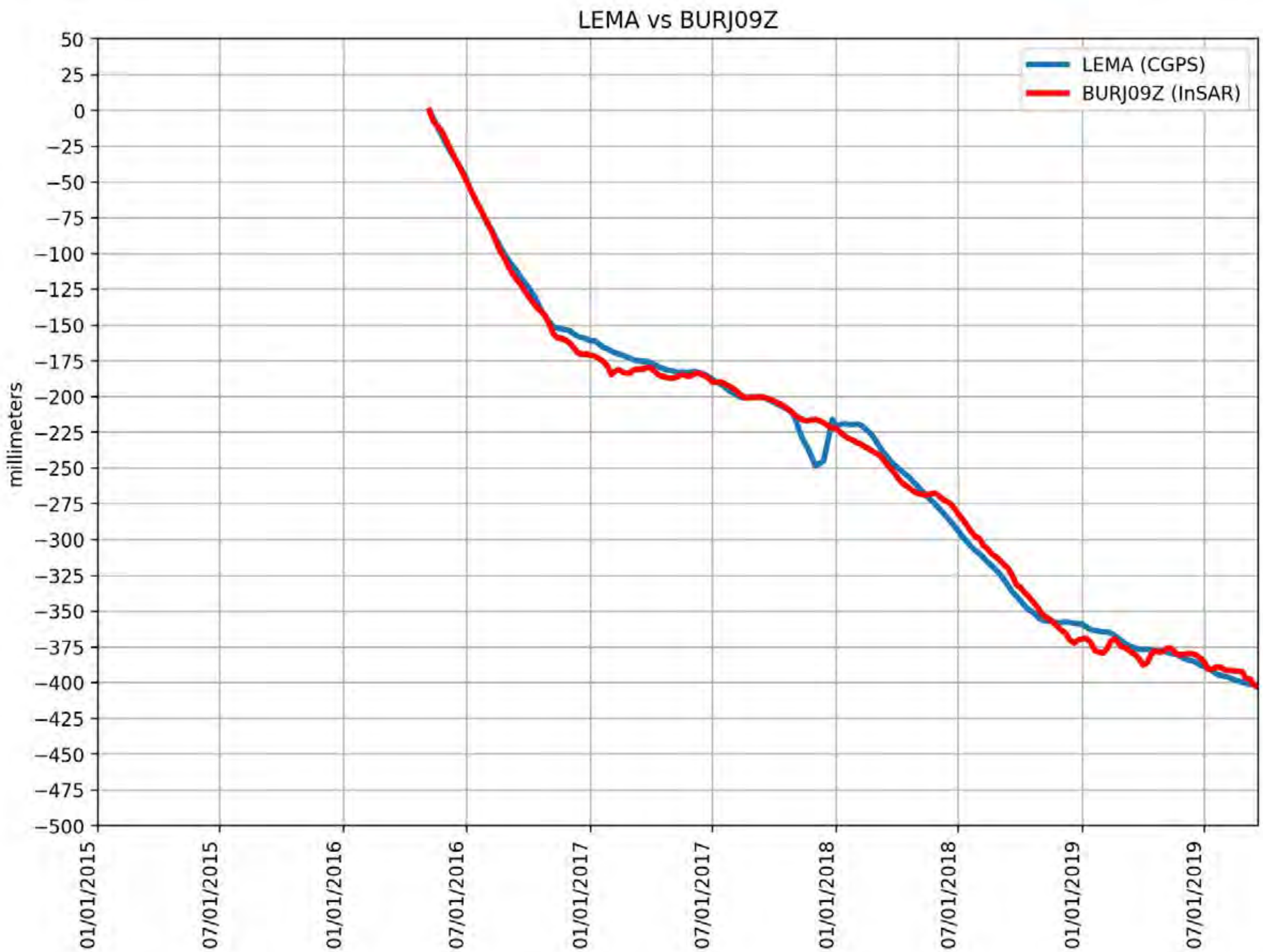
RMSE: 2.45 mm
Correlation: 0.90

Appendix B



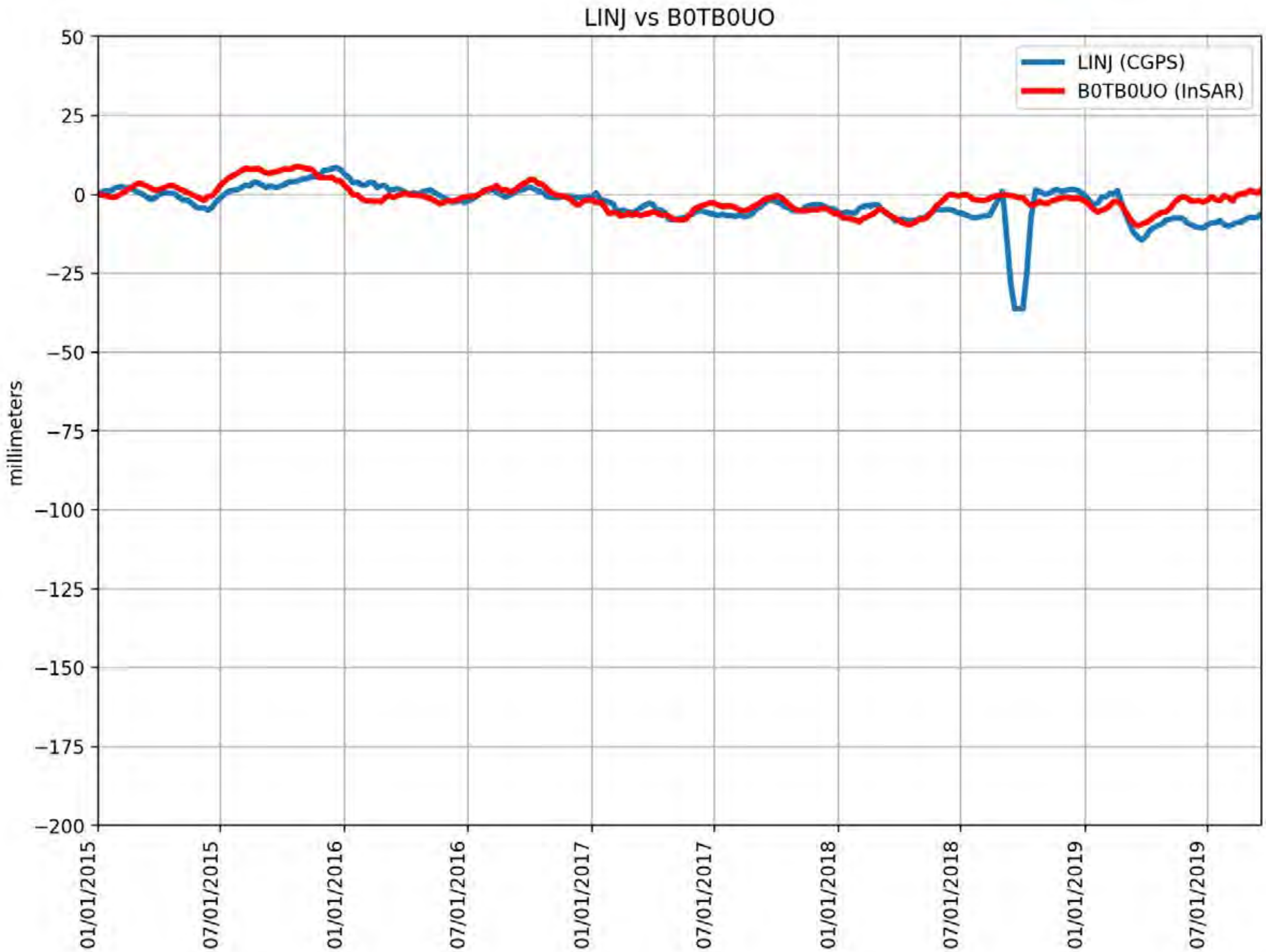
RMSE: 2.81 mm
Correlation: 0.92

Appendix B



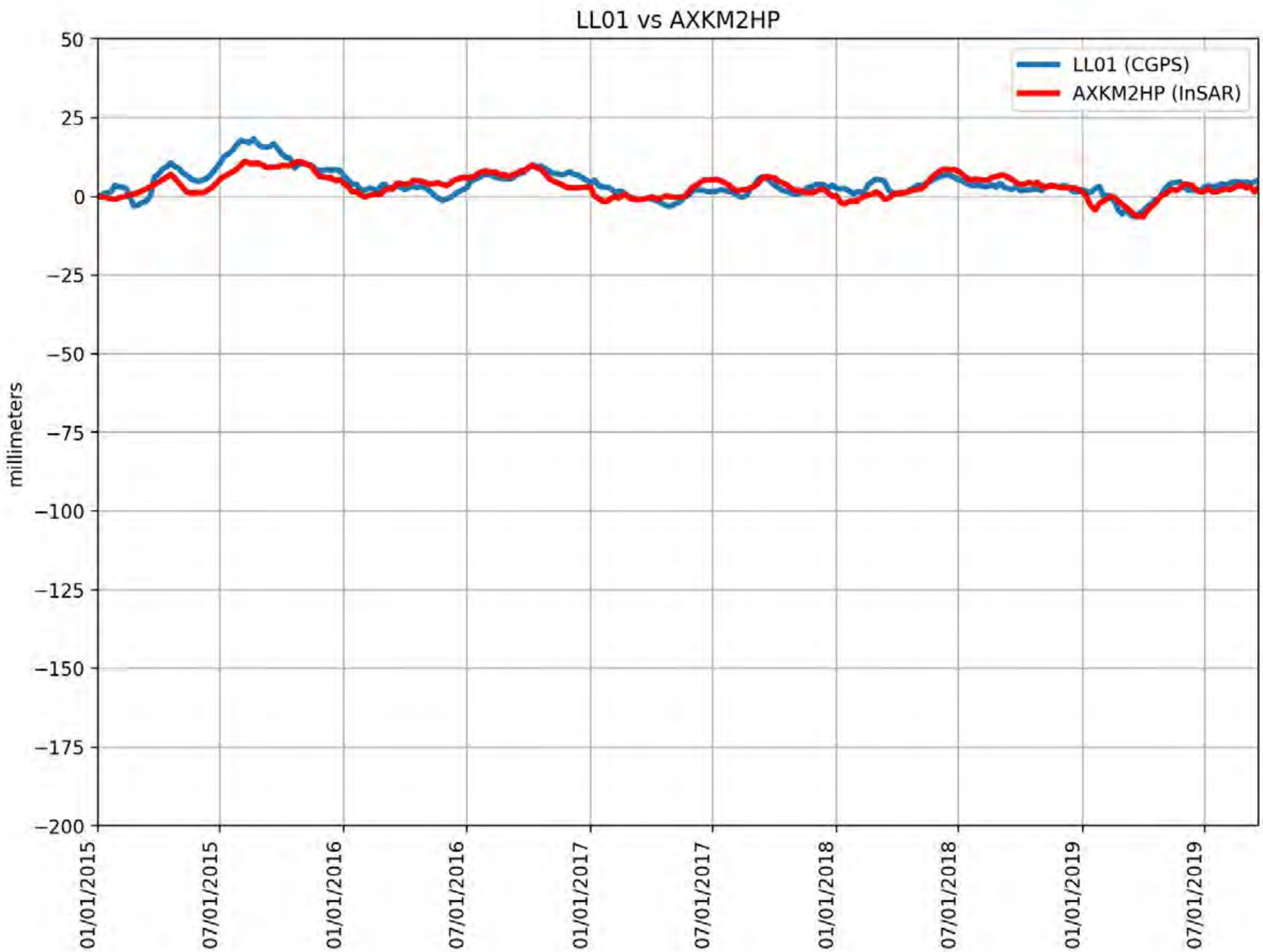
RMSE: 8.16 mm
Correlation: 1.00

Appendix B



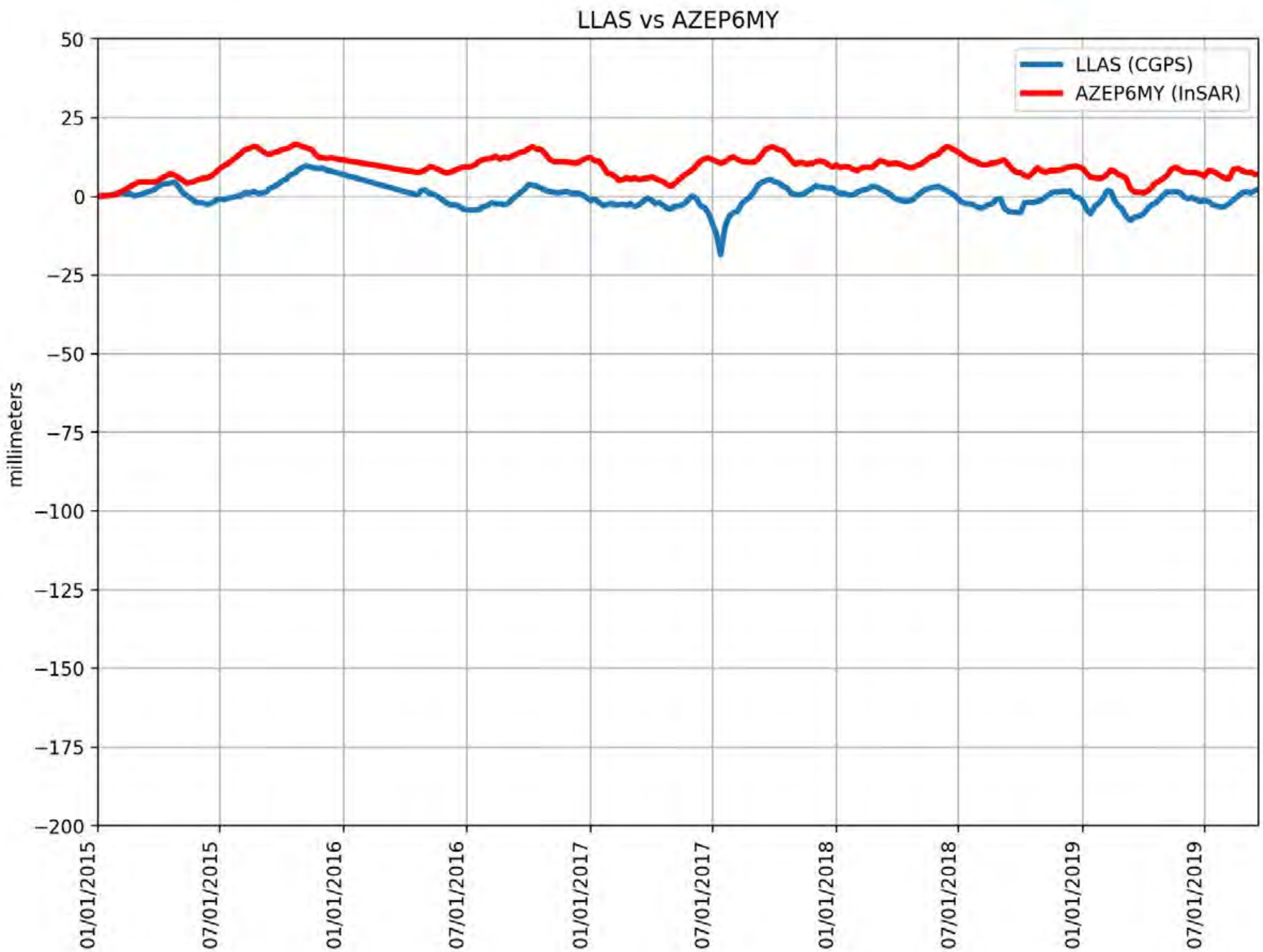
RMSE: 5.50 mm
Correlation: 0.51

Appendix B



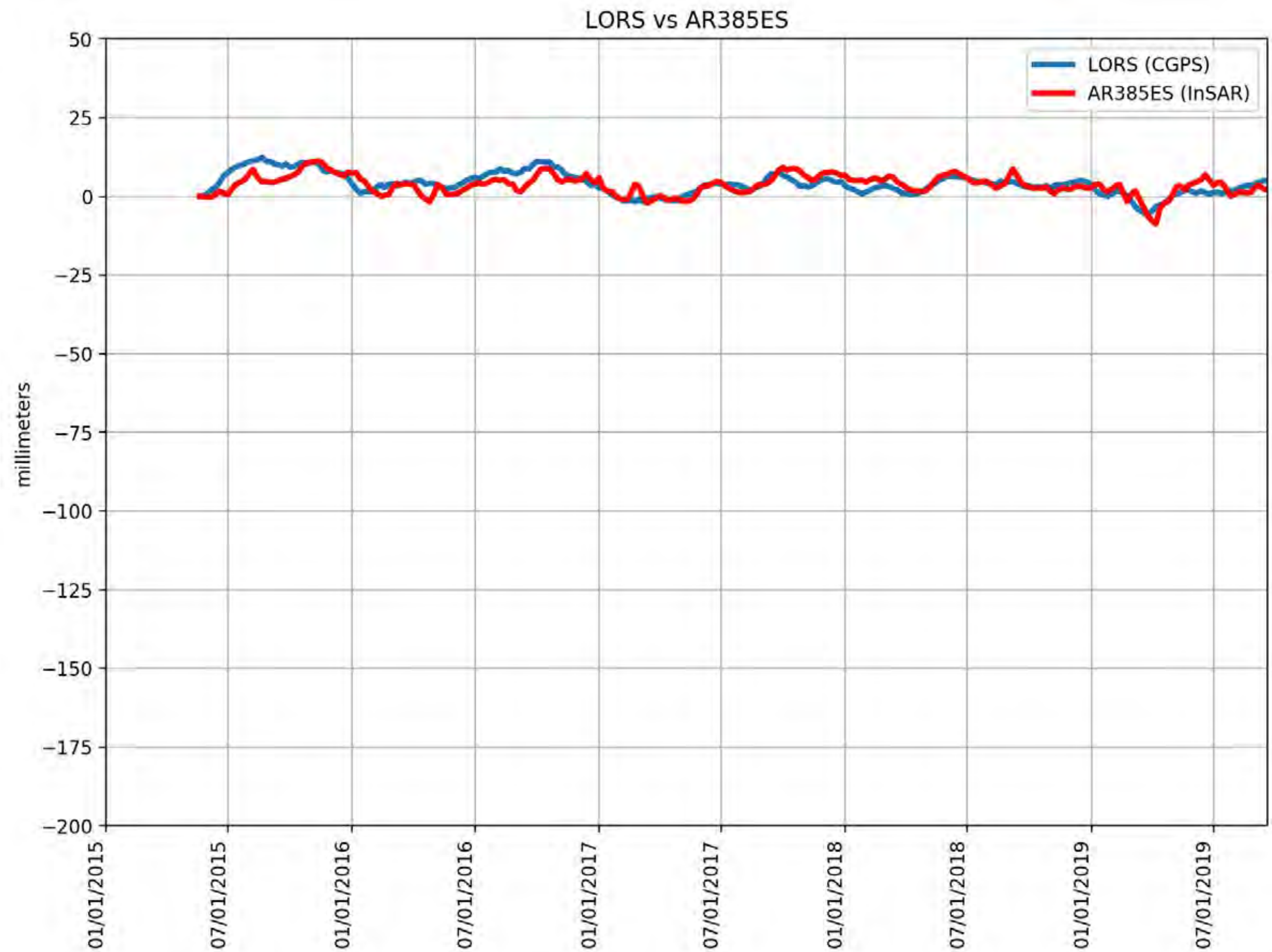
RMSE: 2.85 mm
Correlation: 0.77

Appendix B



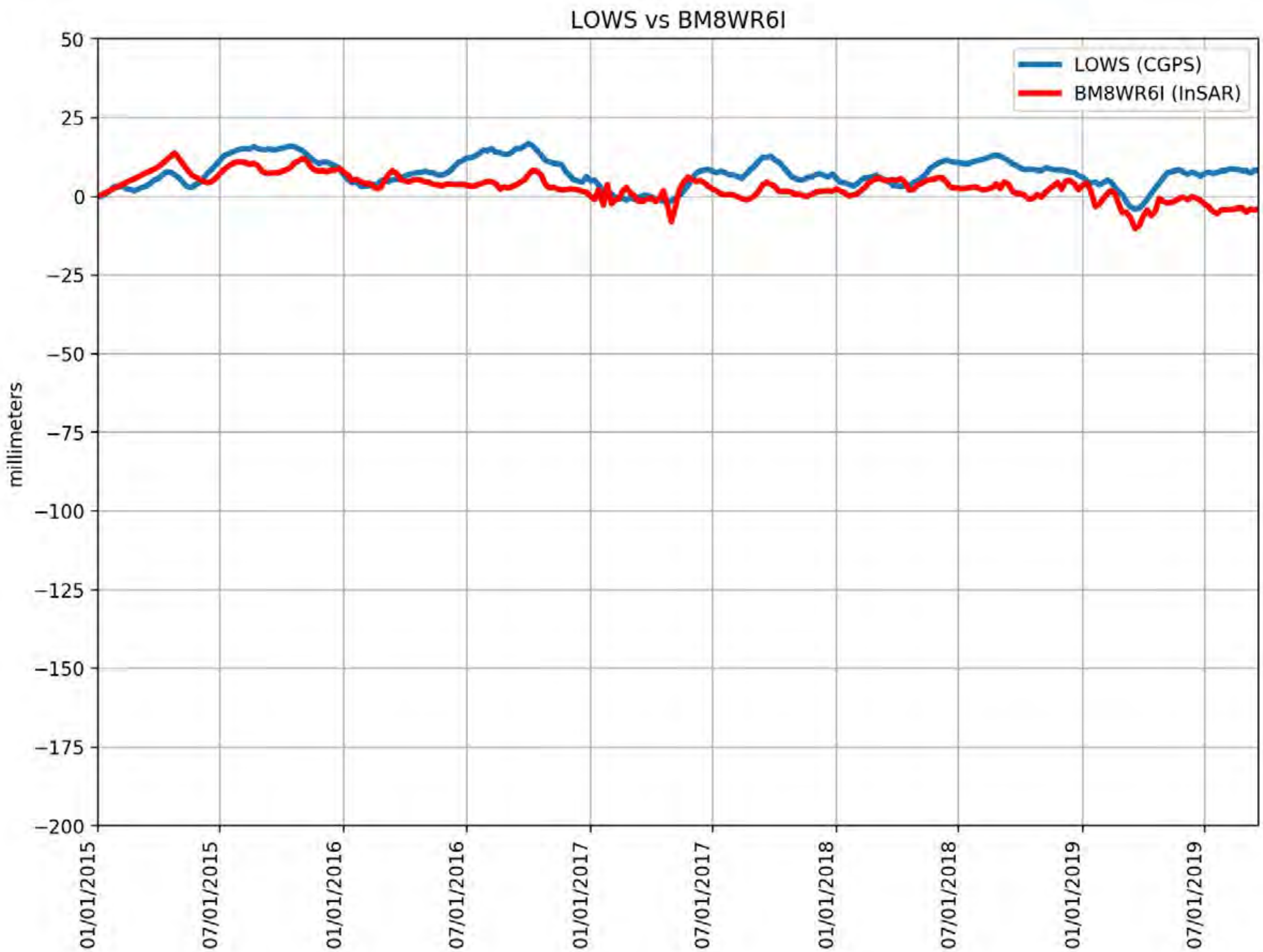
RMSE: 10.20 mm
Correlation: 0.37

Appendix B



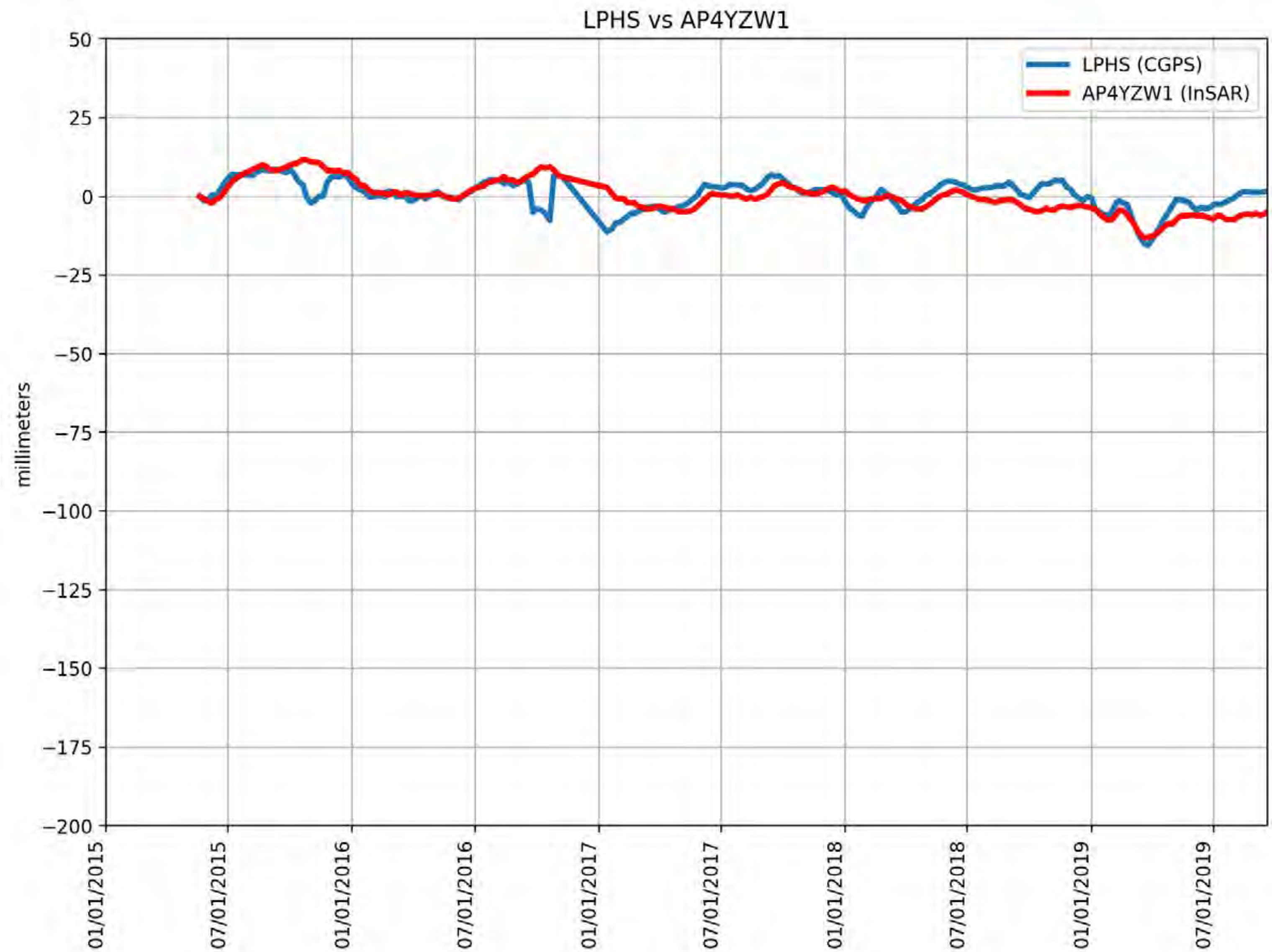
RMSE: 2.67 mm
Correlation: 0.68

Appendix B



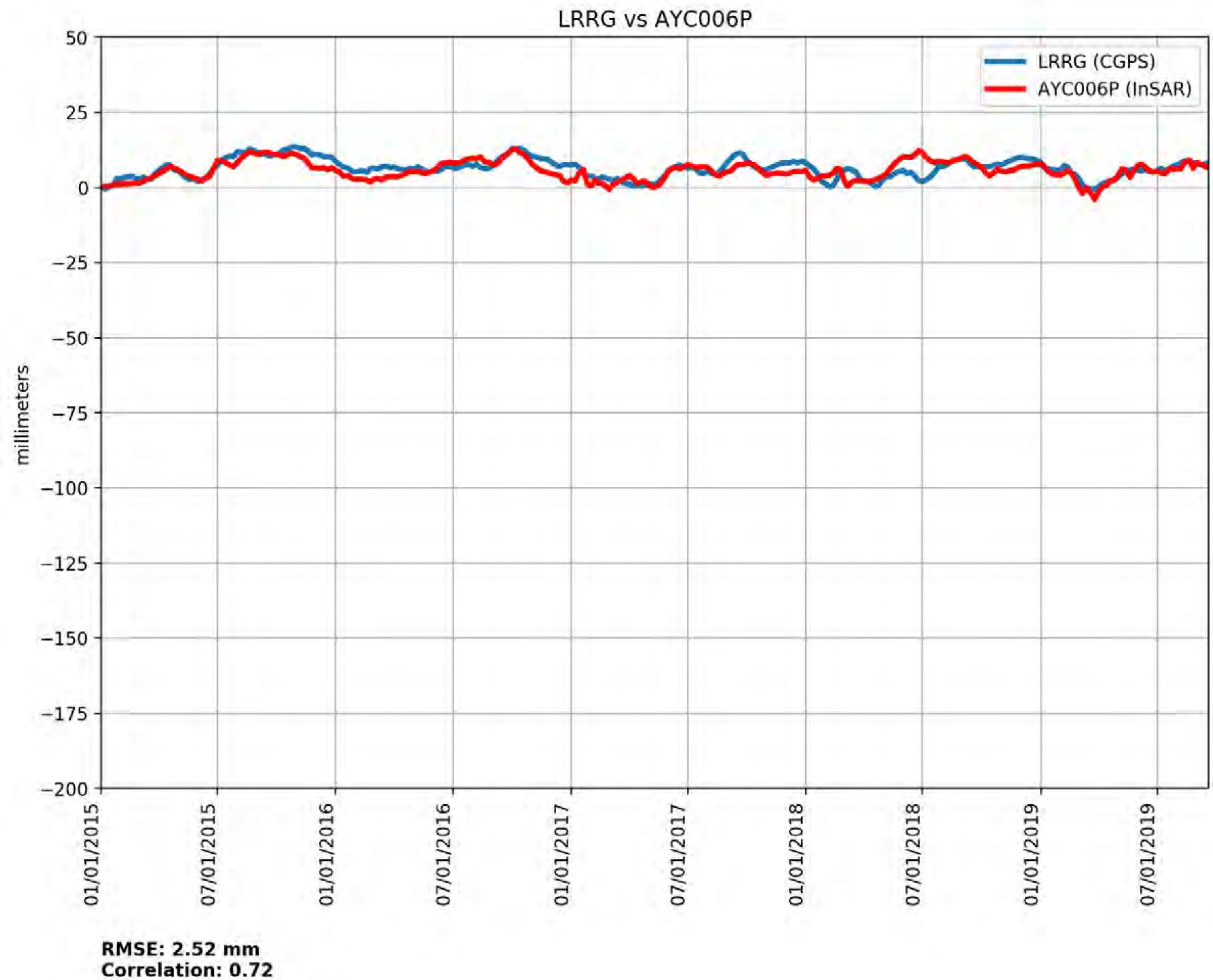
RMSE: 6.17 mm
Correlation: 0.49

Appendix B

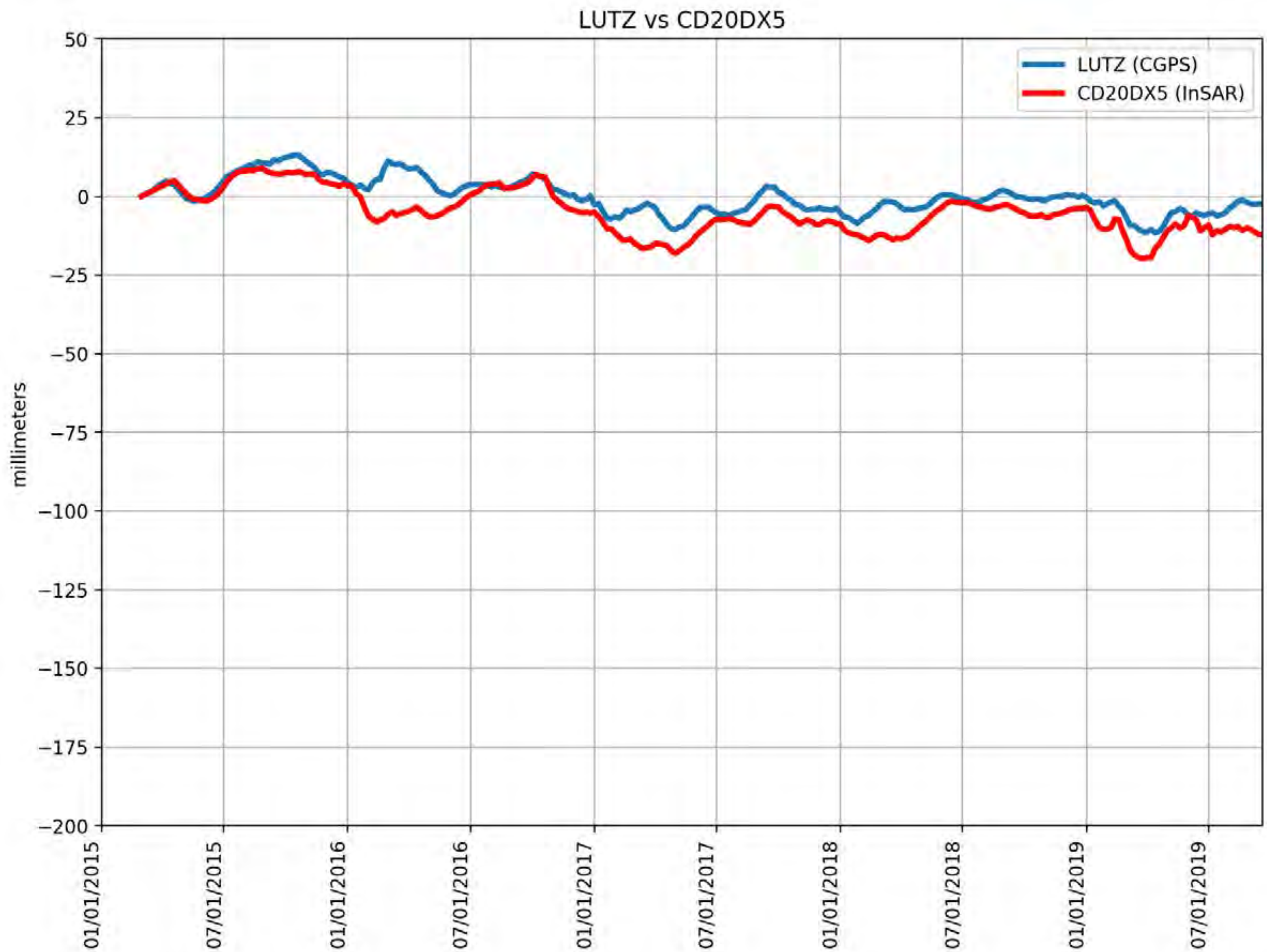


RMSE: 4.34 mm
Correlation: 0.61

Appendix B

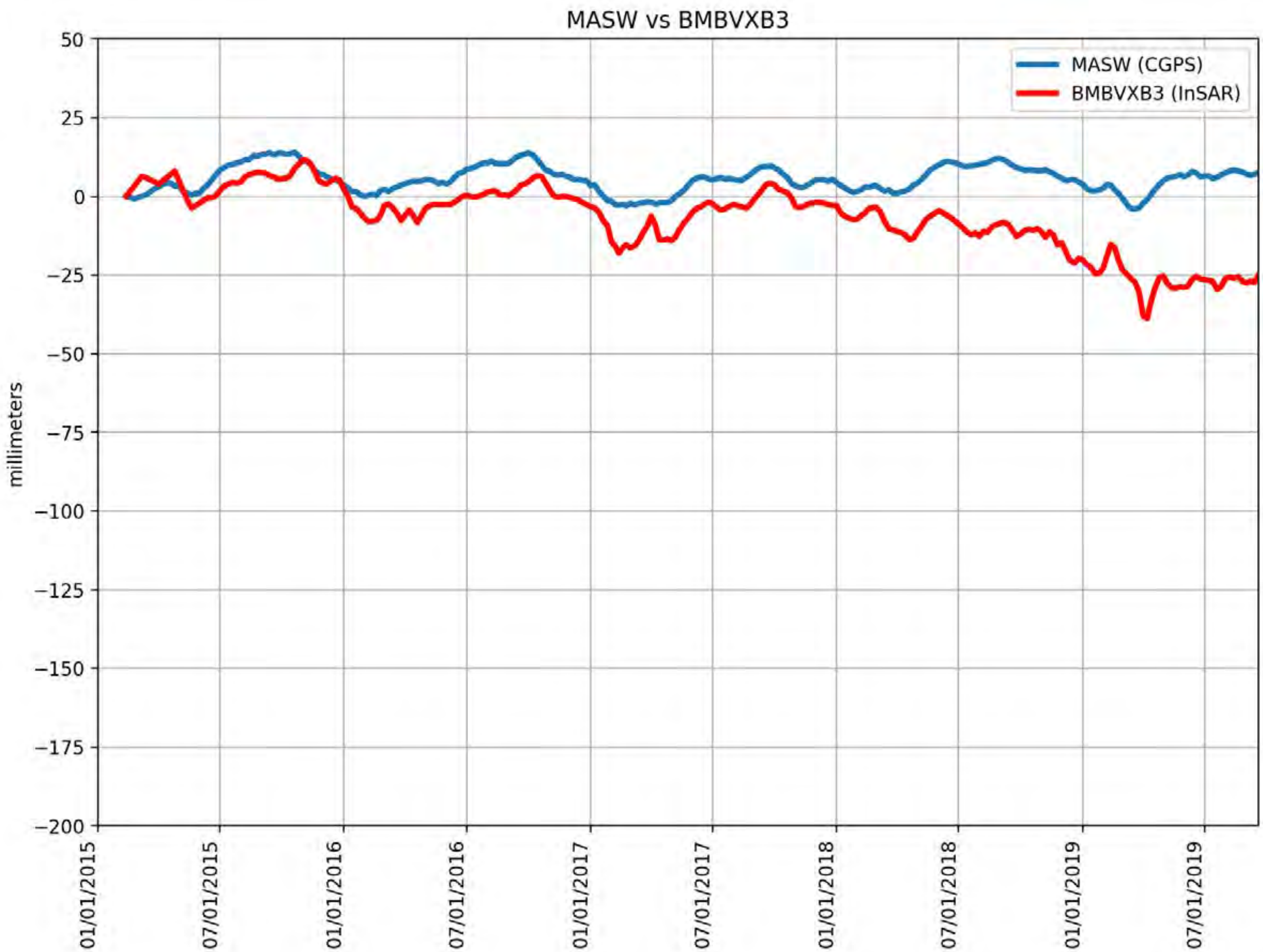

LRRG vs AYC006P
LRRG (CGPS)
AYC006P (InSAR)
millimeters
50
25
0
−25
−50
−75
−100
−125
−150
−175
−200
01/01/2015
07/01/2015
01/01/2016
07/01/2016
01/01/2017
07/01/2017
01/01/2018
07/01/2018
01/01/2019
07/01/2019
RMSE: 2.52 mm
Correlation: 0.72

Appendix B



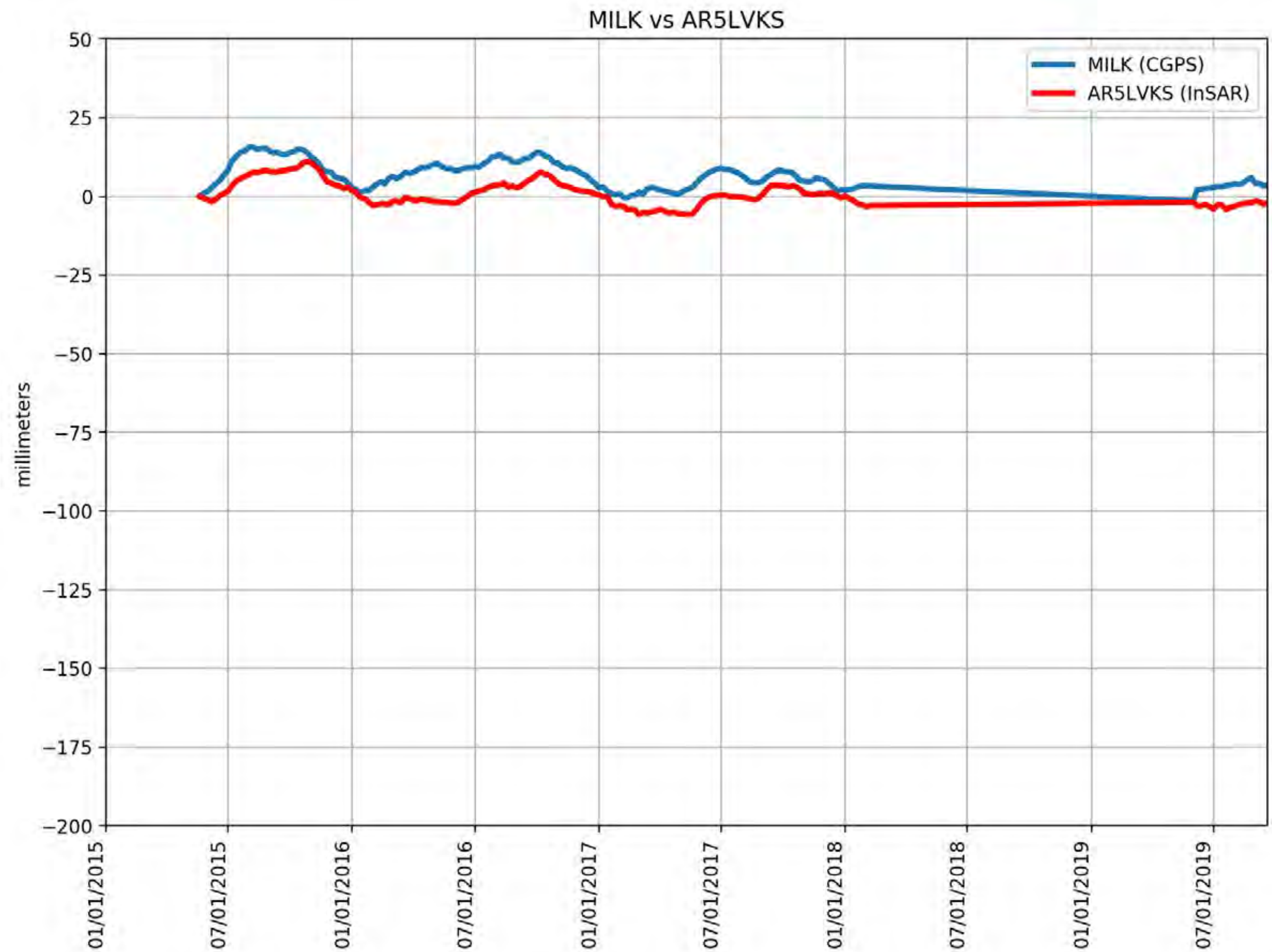
RMSE: 6.18 mm
Correlation: 0.85

Appendix B



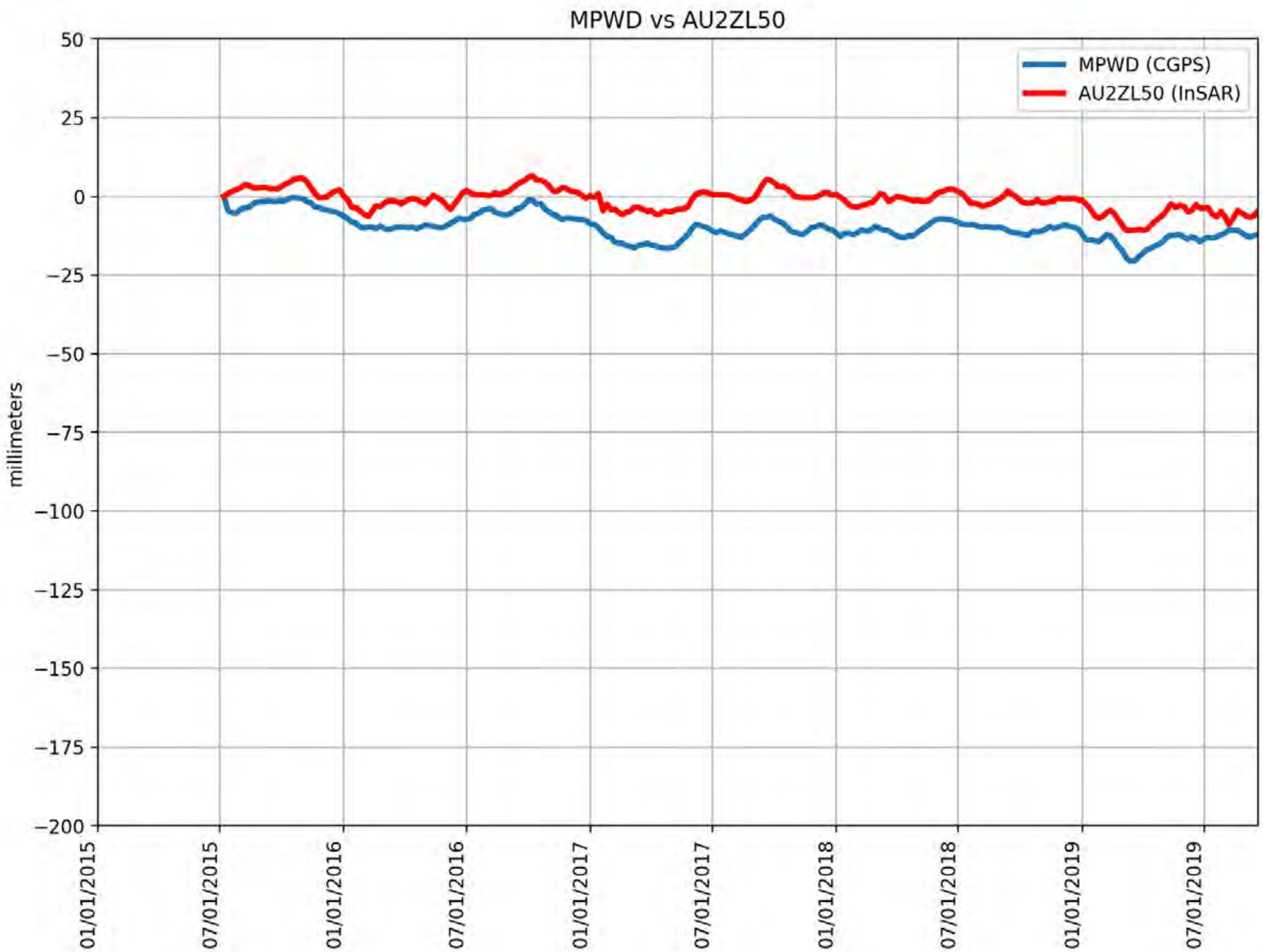
RMSE: 15.87 mm
Correlation: 0.36

Appendix B



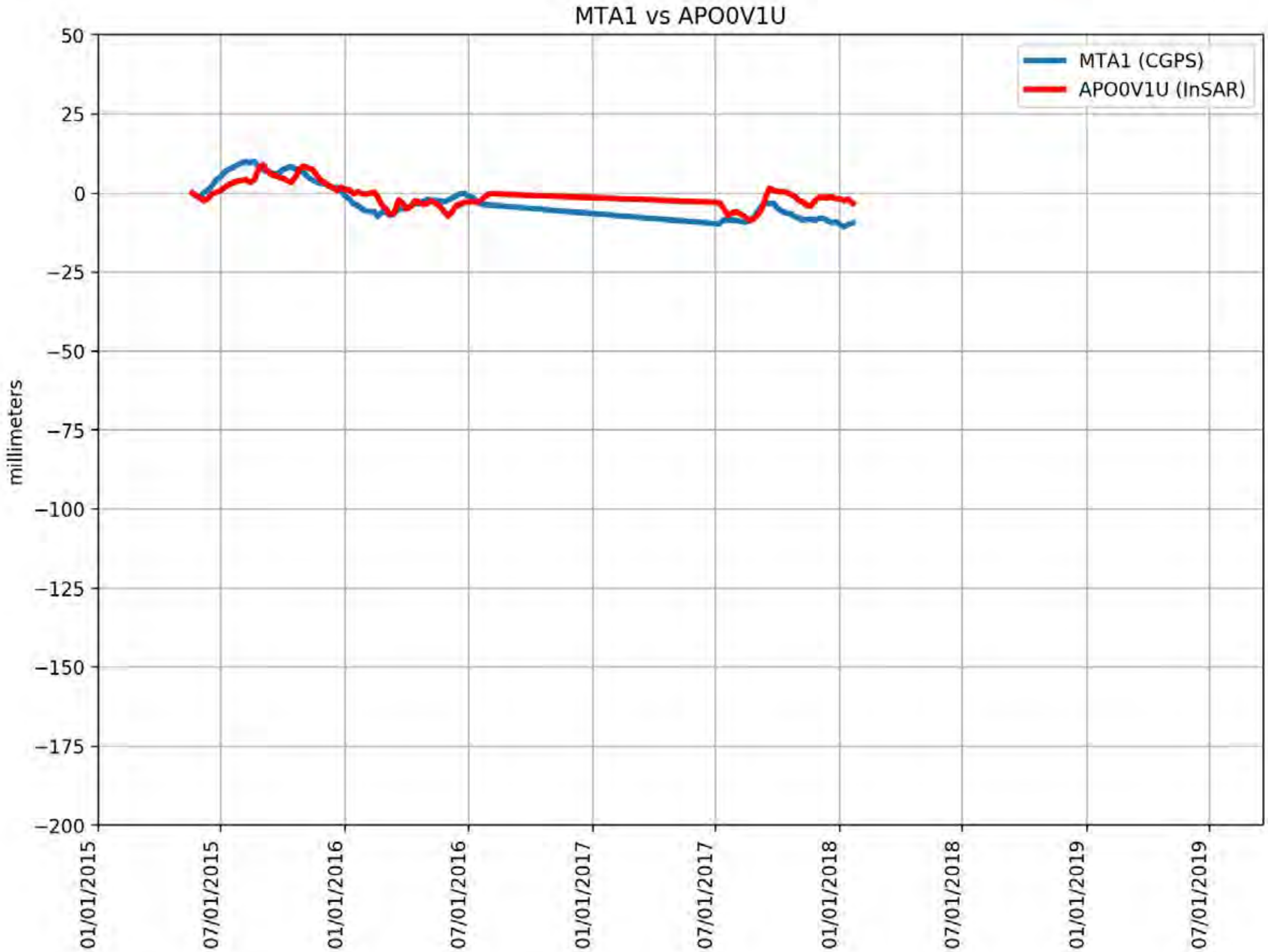
RMSE: 6.45 mm
Correlation: 0.82

Appendix B



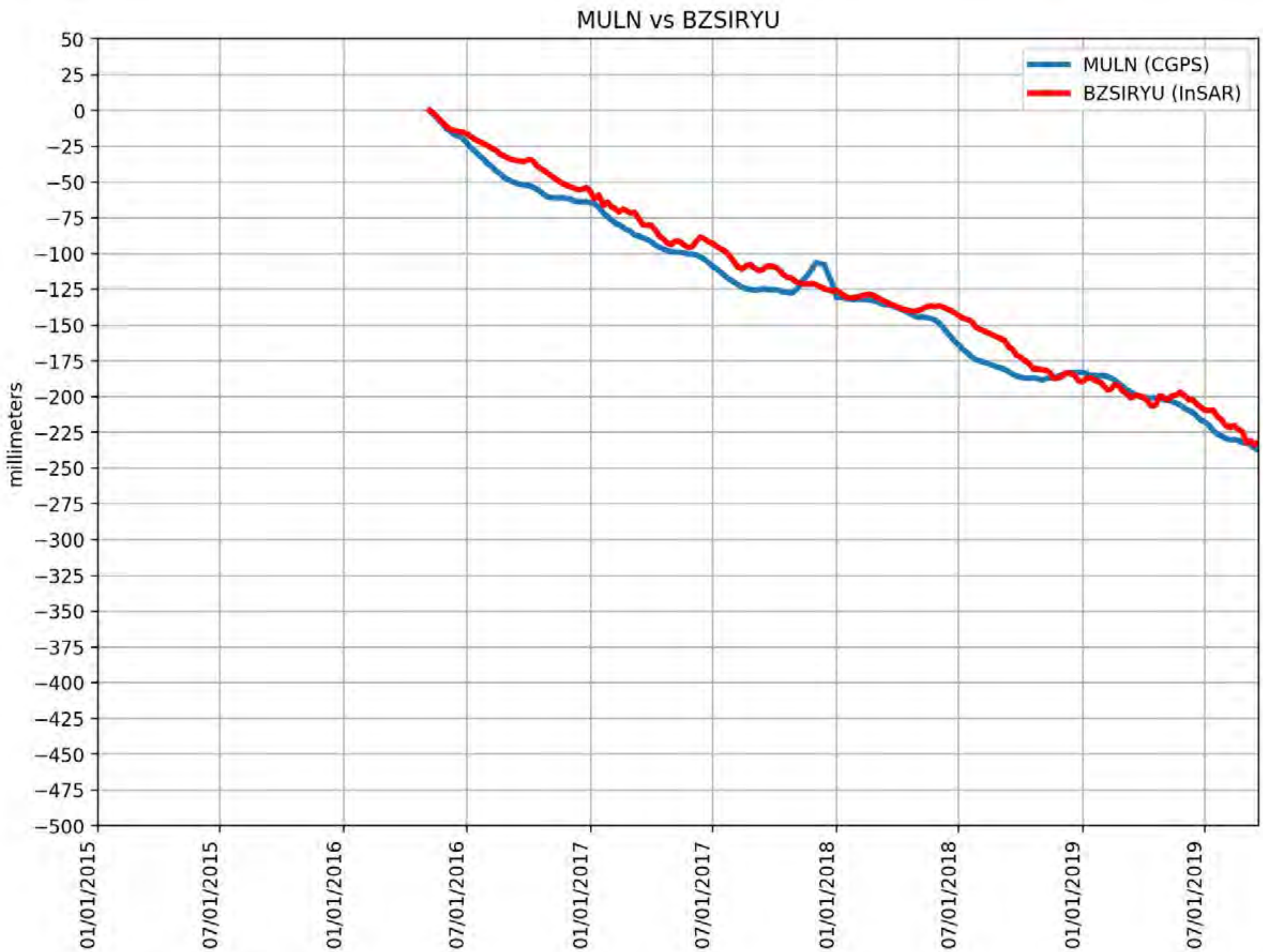
RMSE: 8.80 mm
Correlation: 0.82

Appendix B



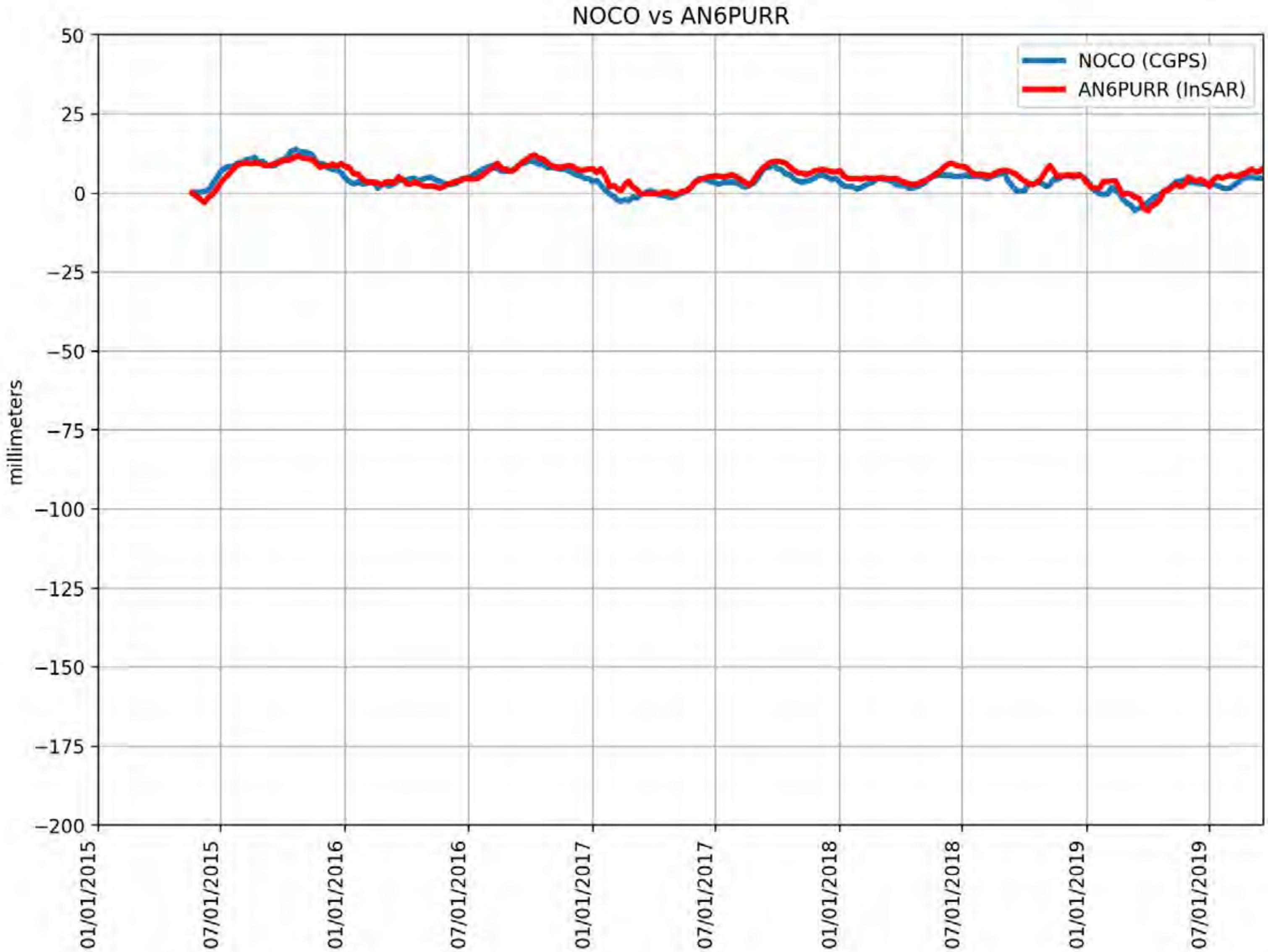
RMSE: 3.96 mm
Correlation: 0.77

Appendix B



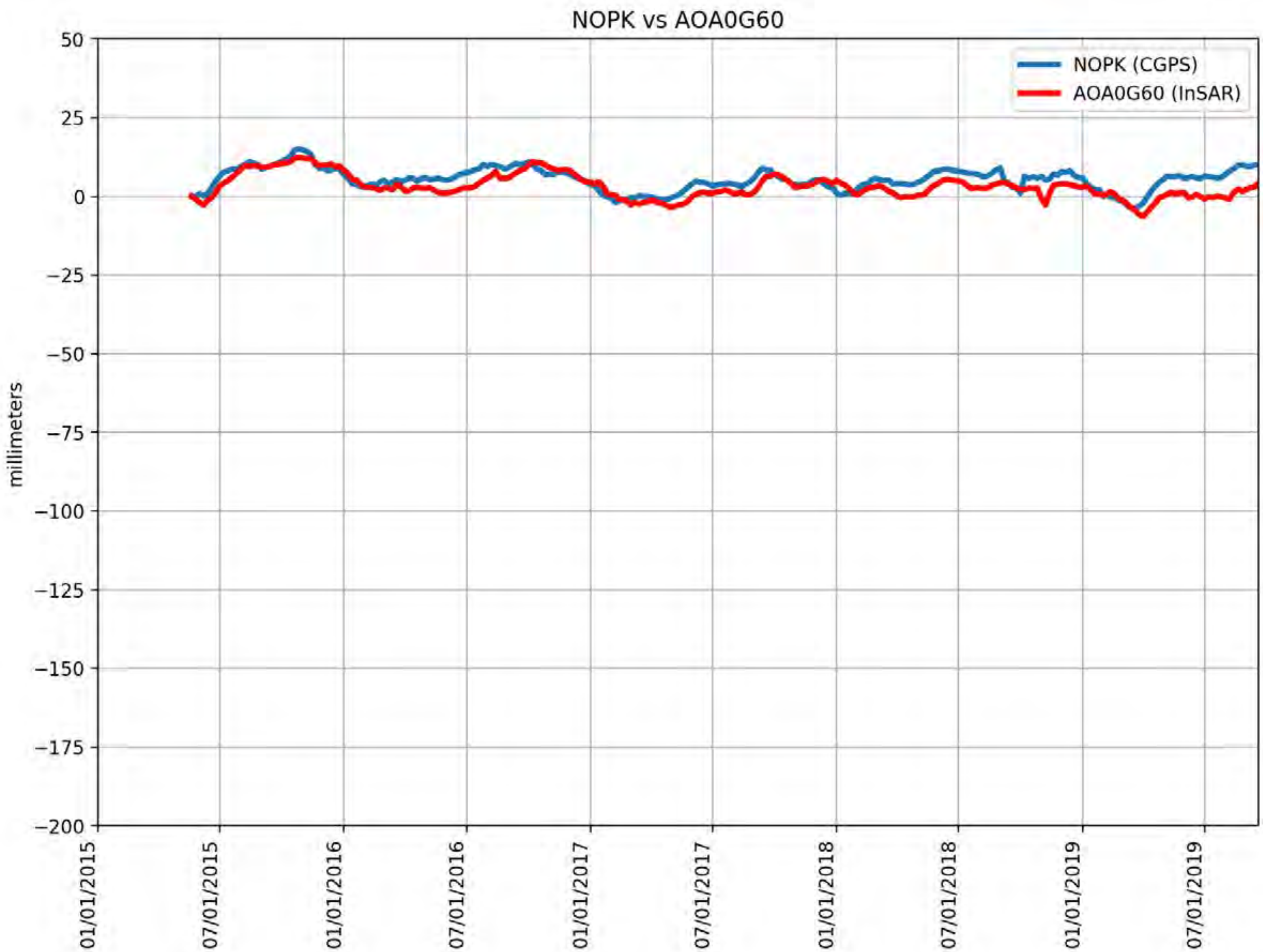
RMSE: 10.54 mm
Correlation: 0.99

Appendix B



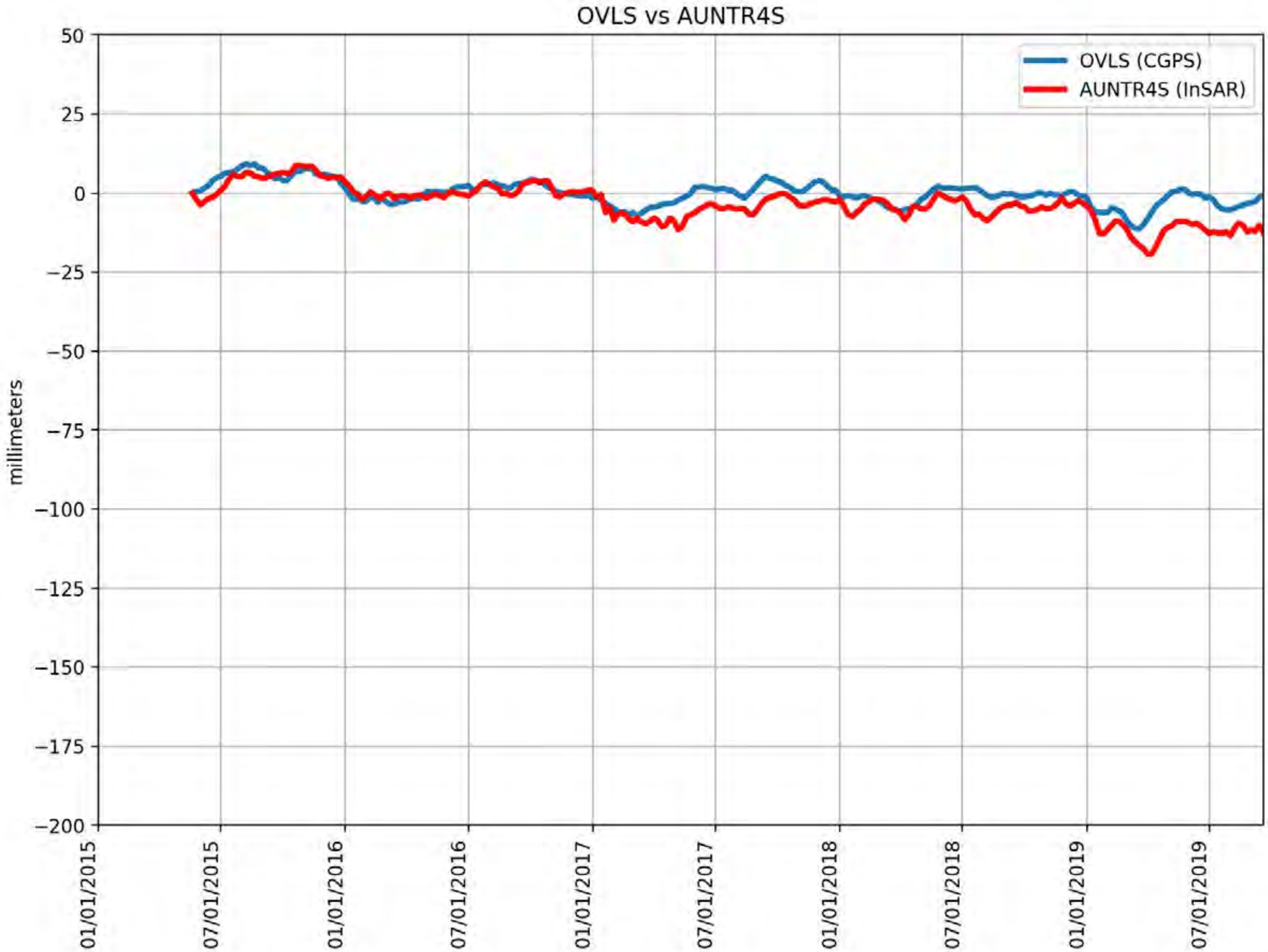
RMSE: 2.09 mm
Correlation: 0.85

Appendix B



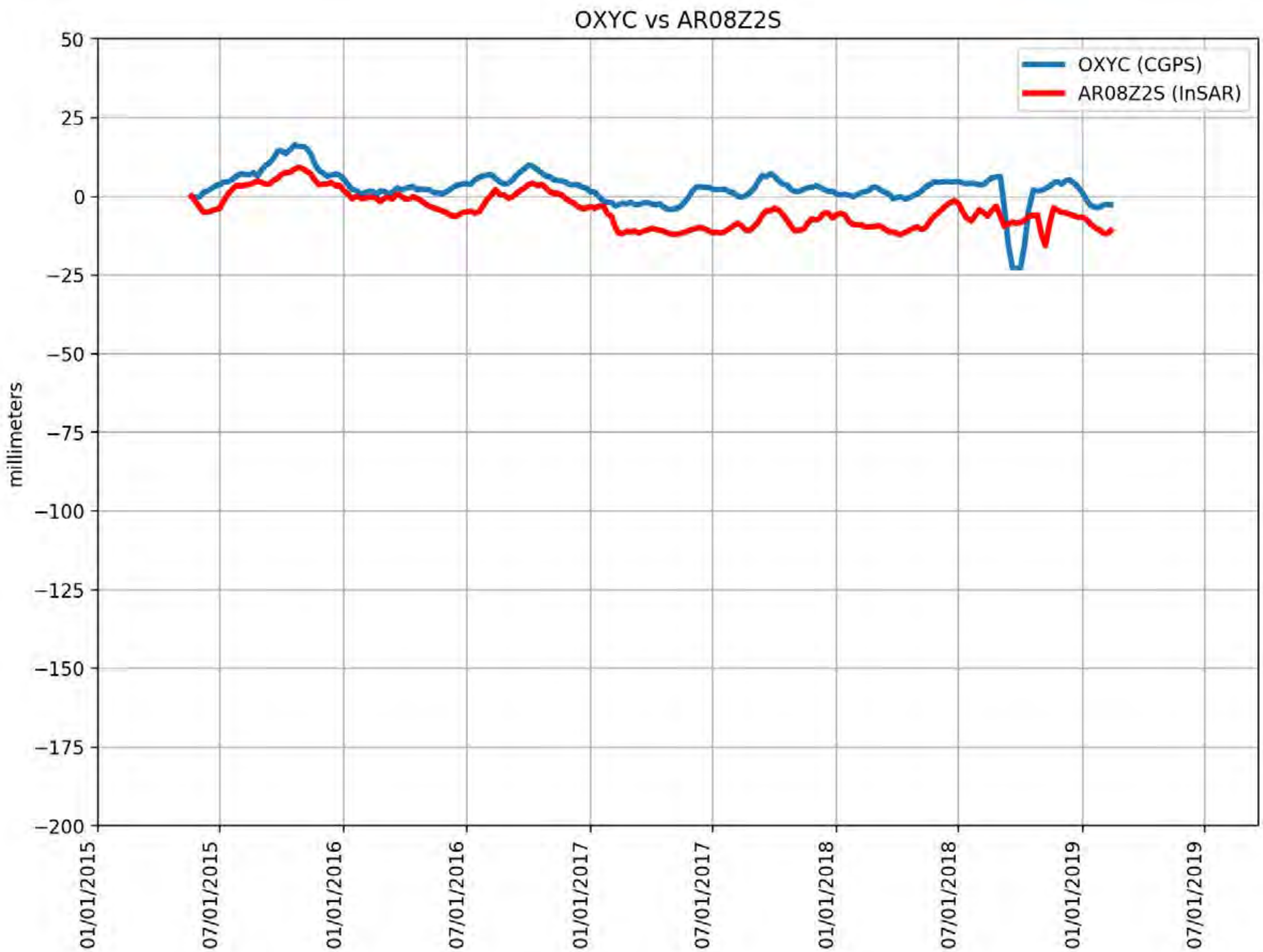
RMSE: 3.35 mm
Correlation: 0.77

Appendix B



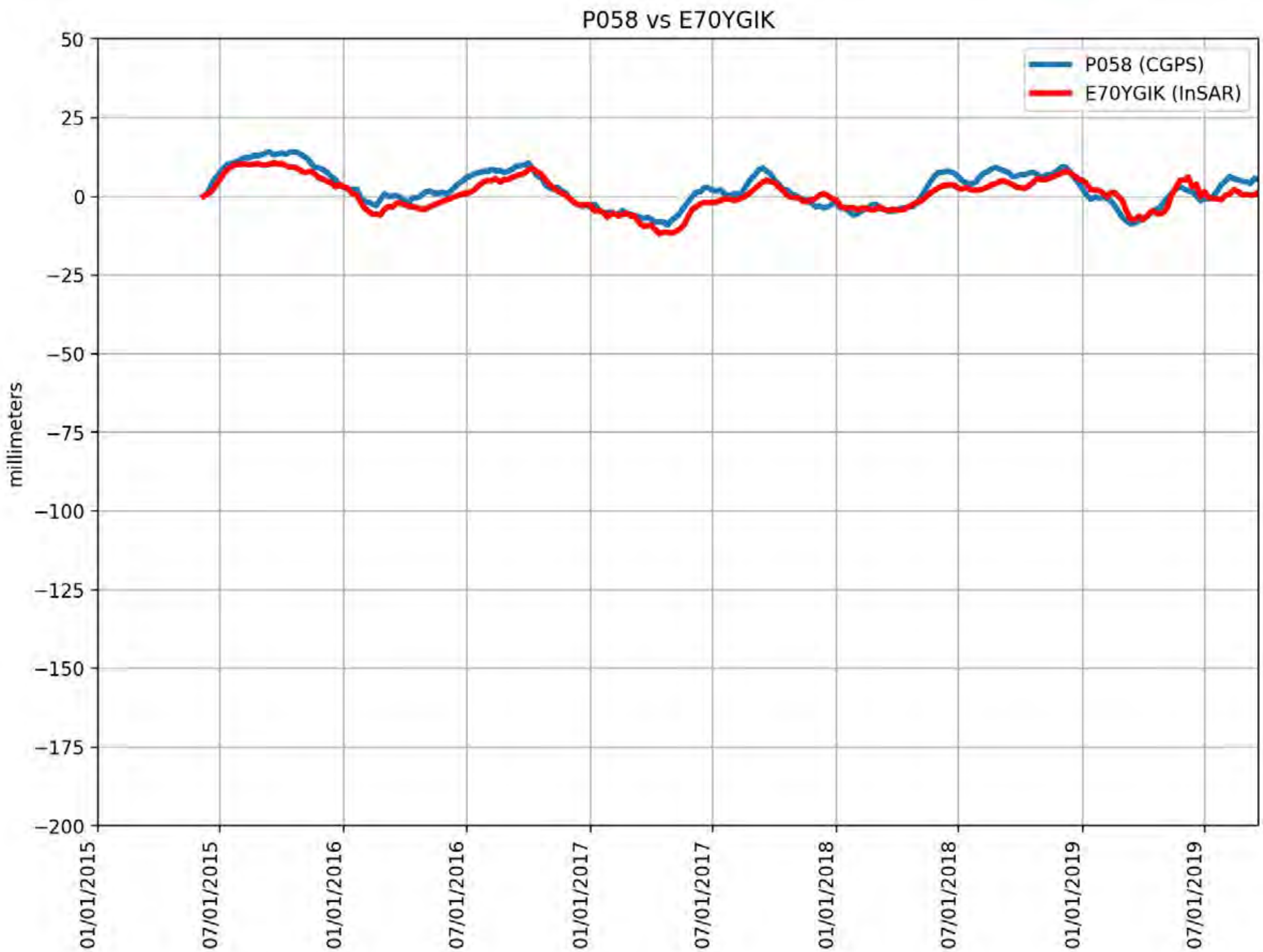
RMSE: 4.81 mm
Correlation: 0.78

Appendix B



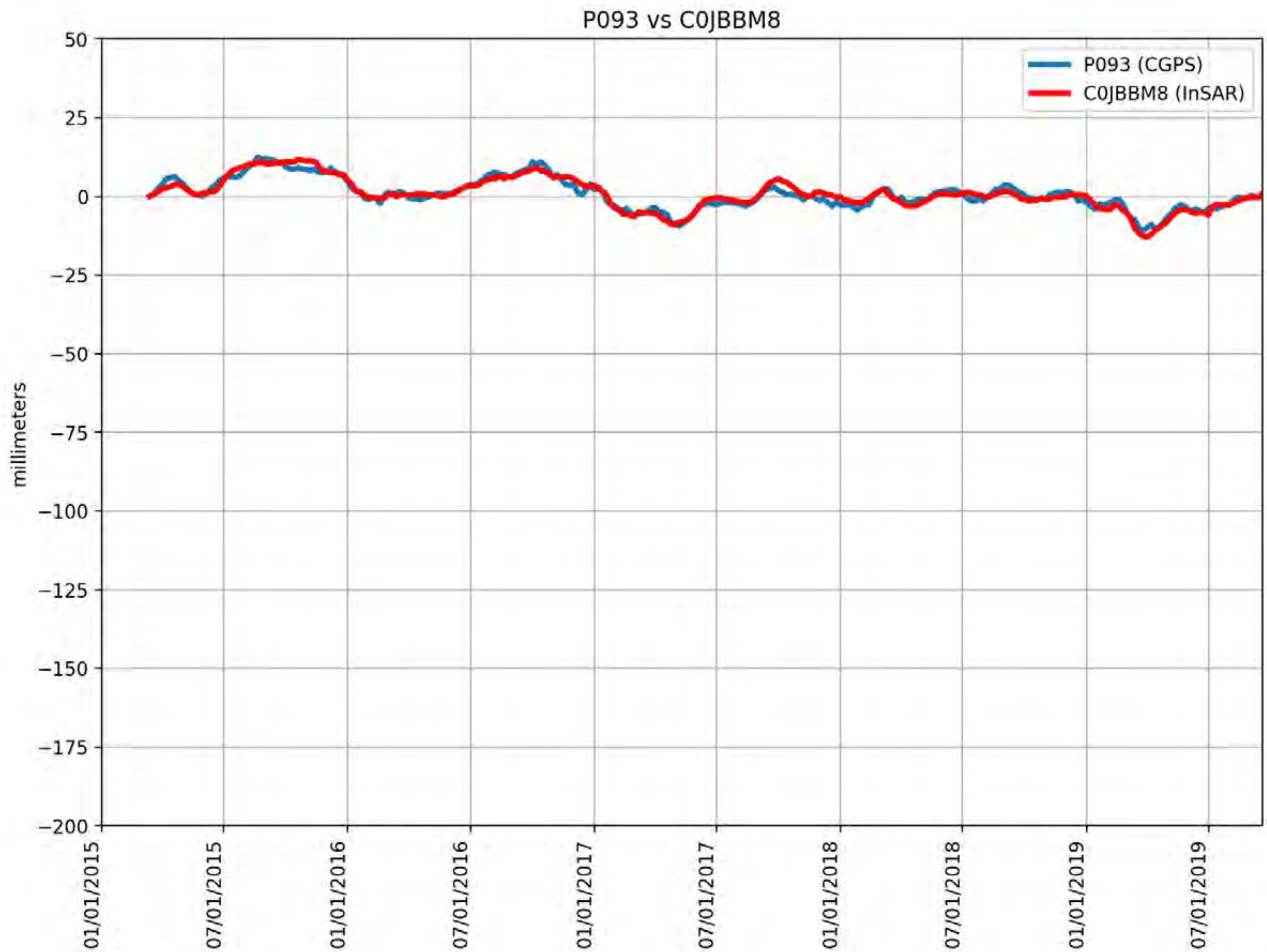
RMSE: 8.42 mm
Correlation: 0.66

Appendix B



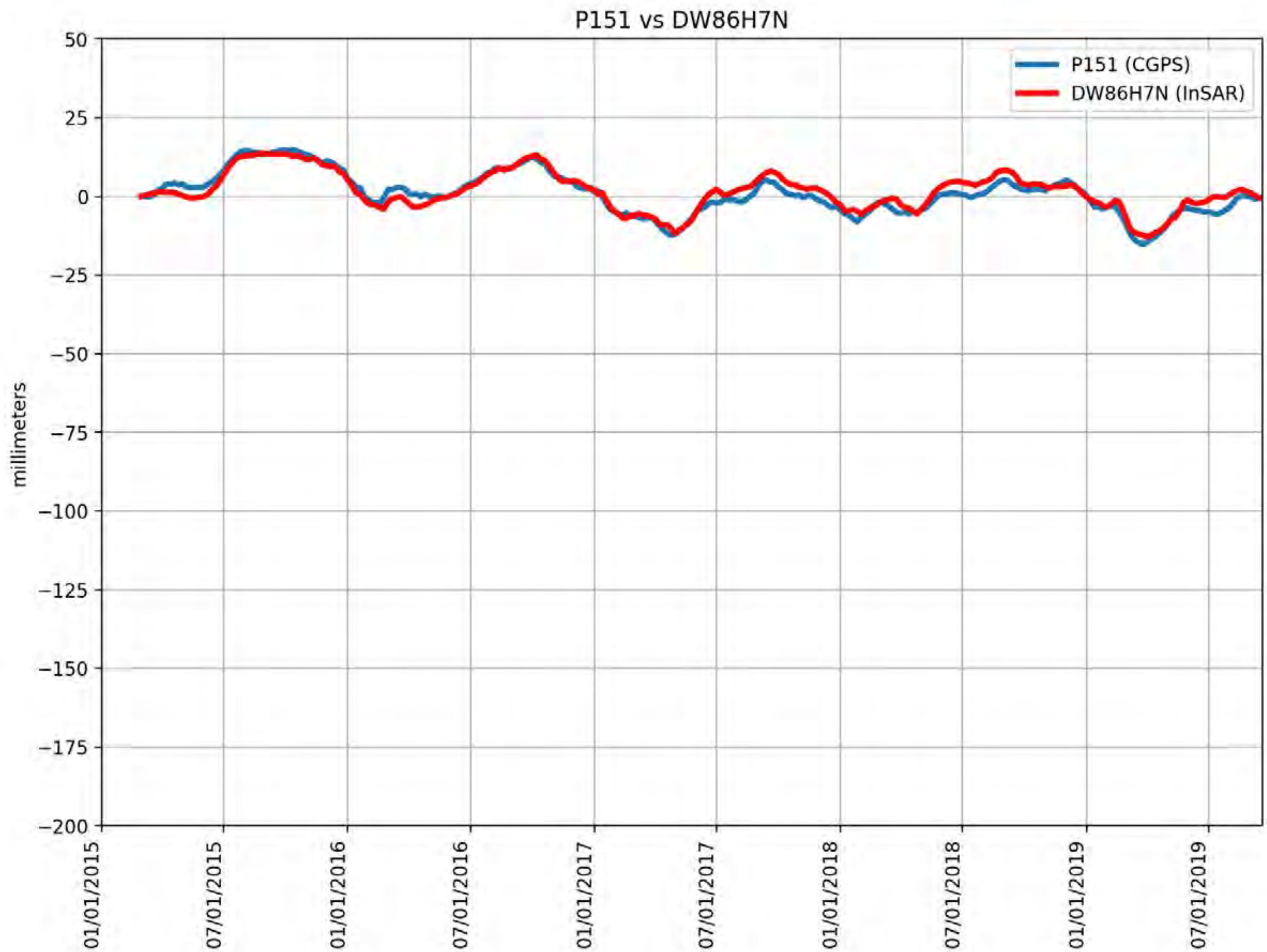
RMSE: 2.88 mm
Correlation: 0.91

Appendix B



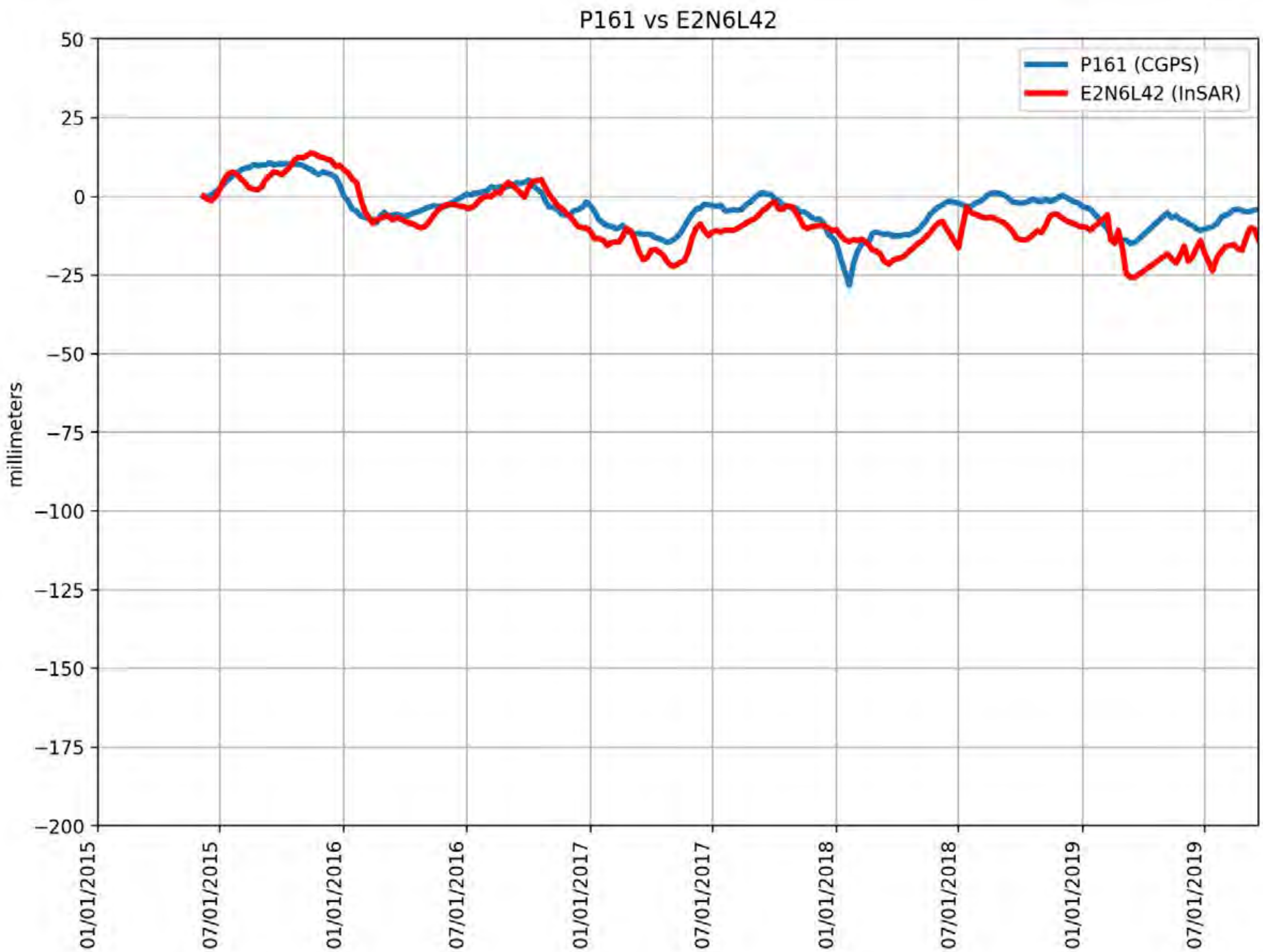
RMSE: 1.45 mm
Correlation: 0.96

Appendix B



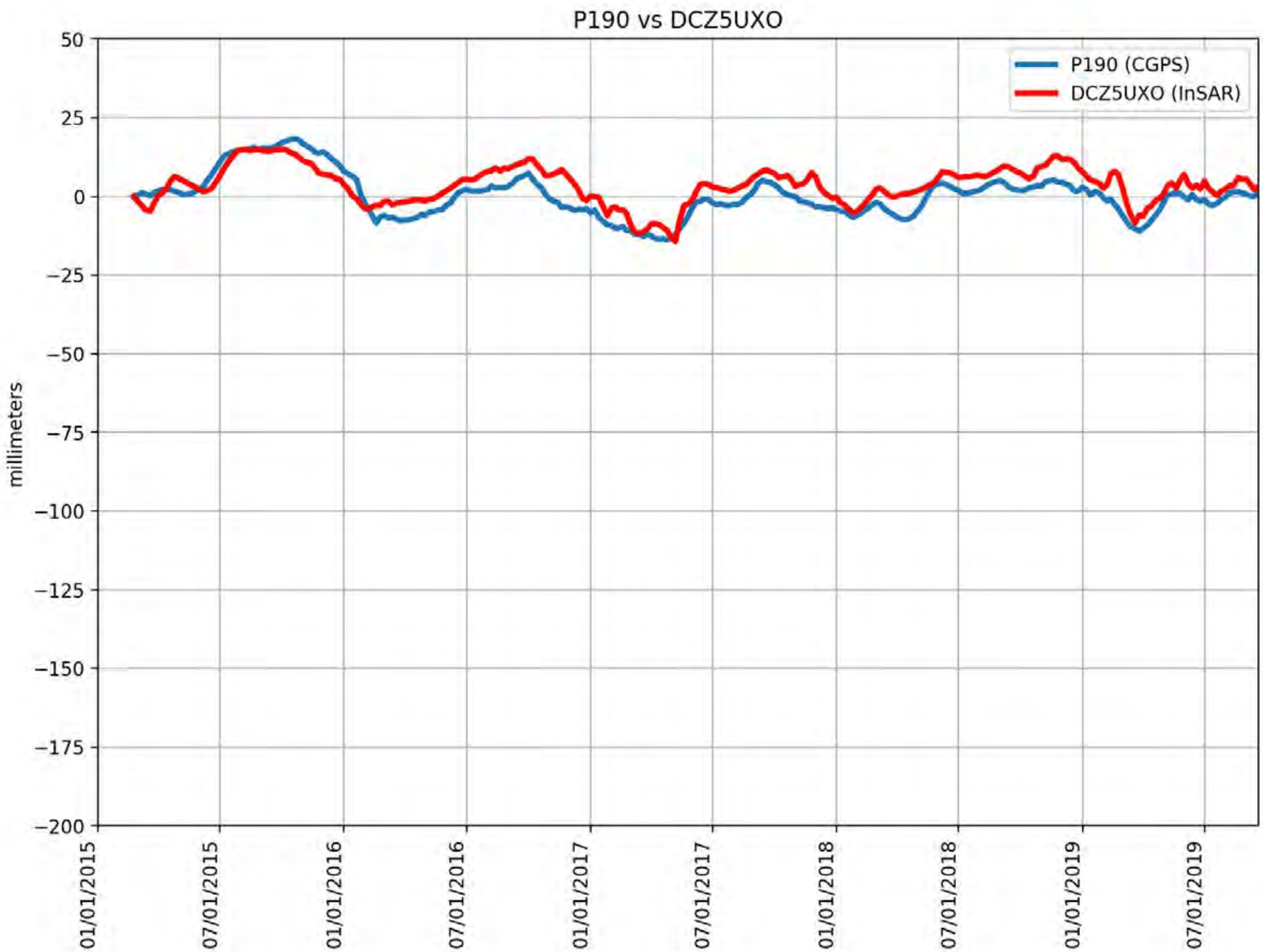
RMSE: 2.17 mm
Correlation: 0.95

Appendix B



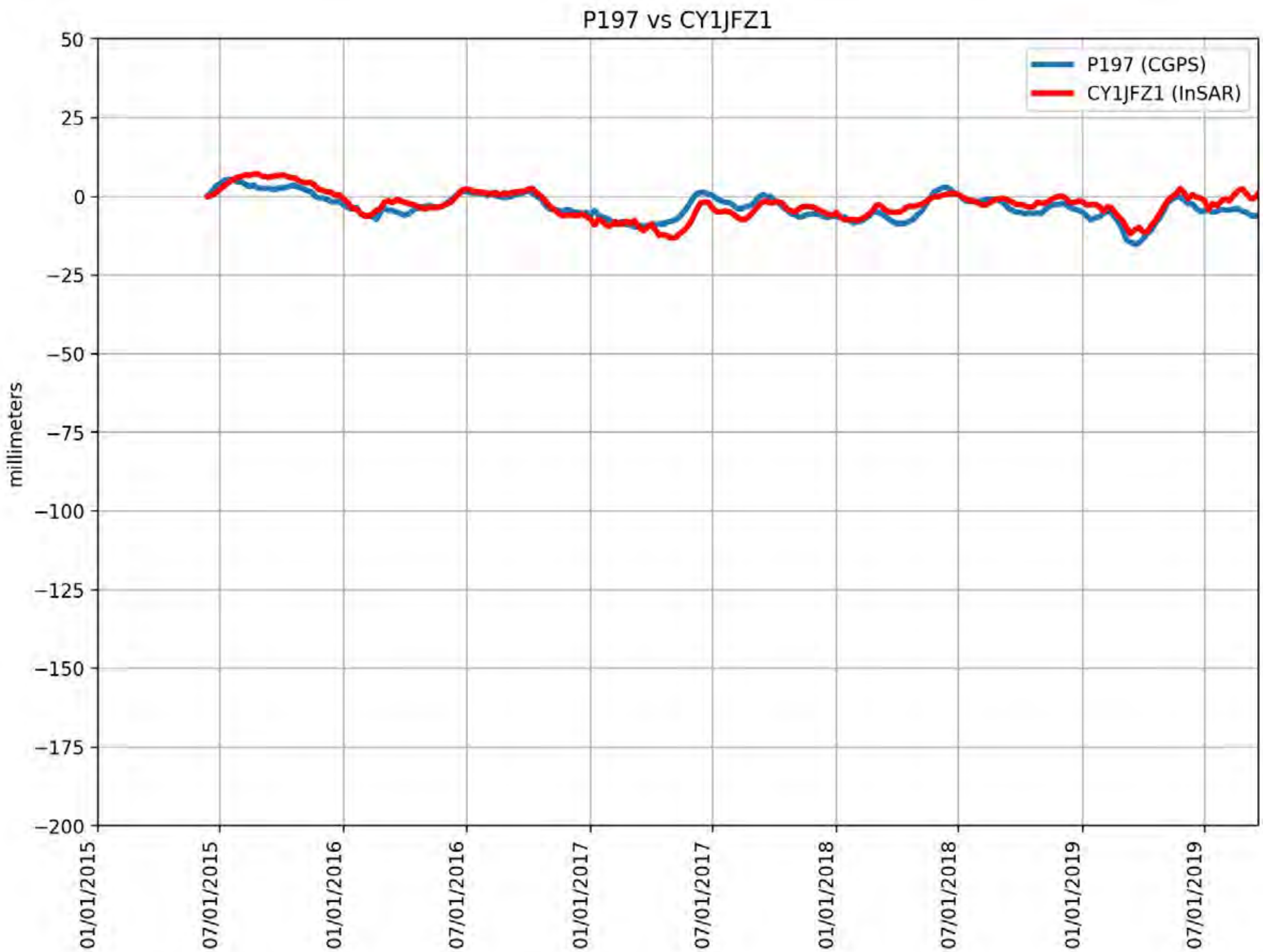
RMSE: 6.35 mm
Correlation: 0.82

Appendix B



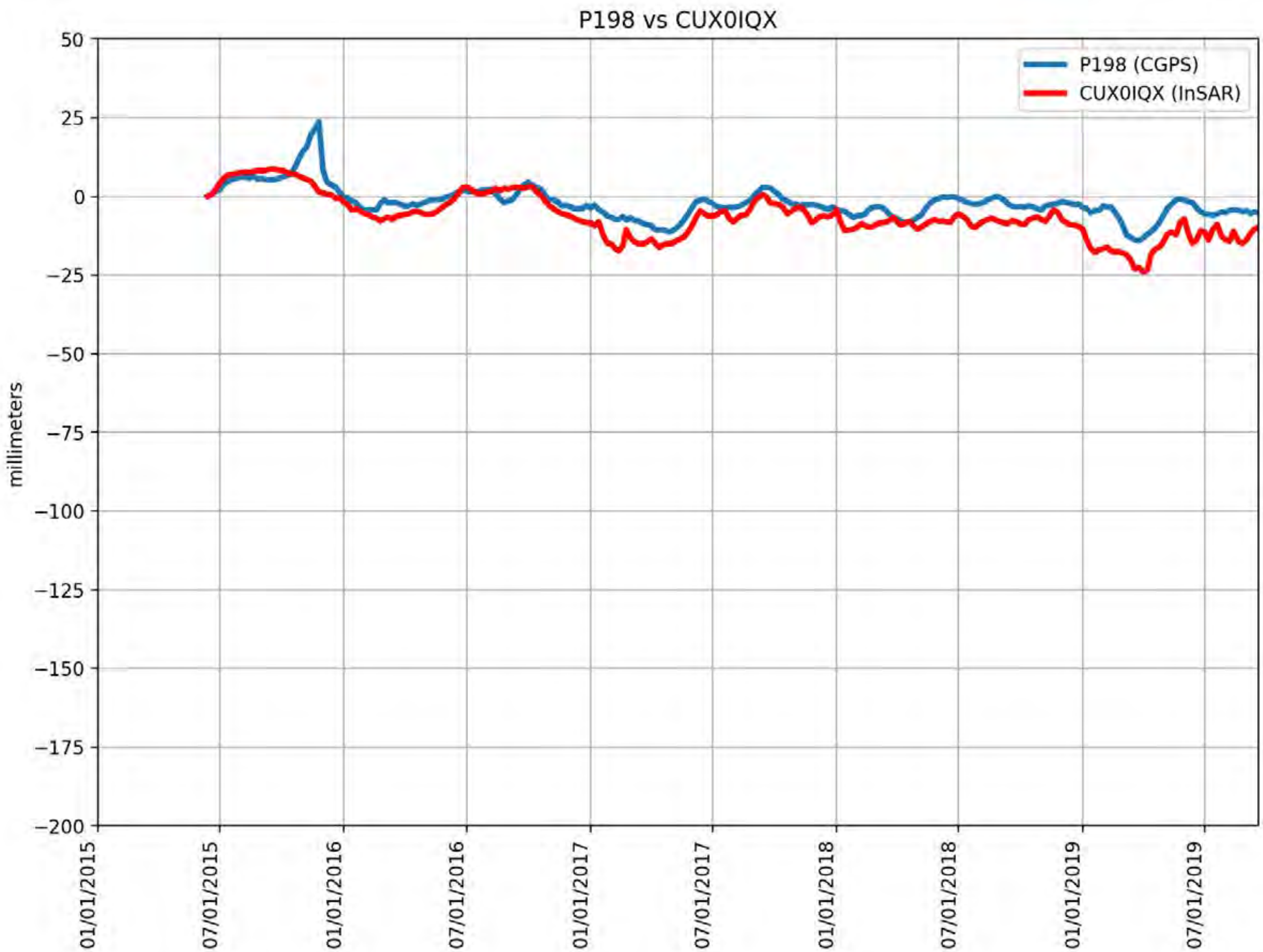
RMSE: 4.89 mm
Correlation: 0.85

Appendix B



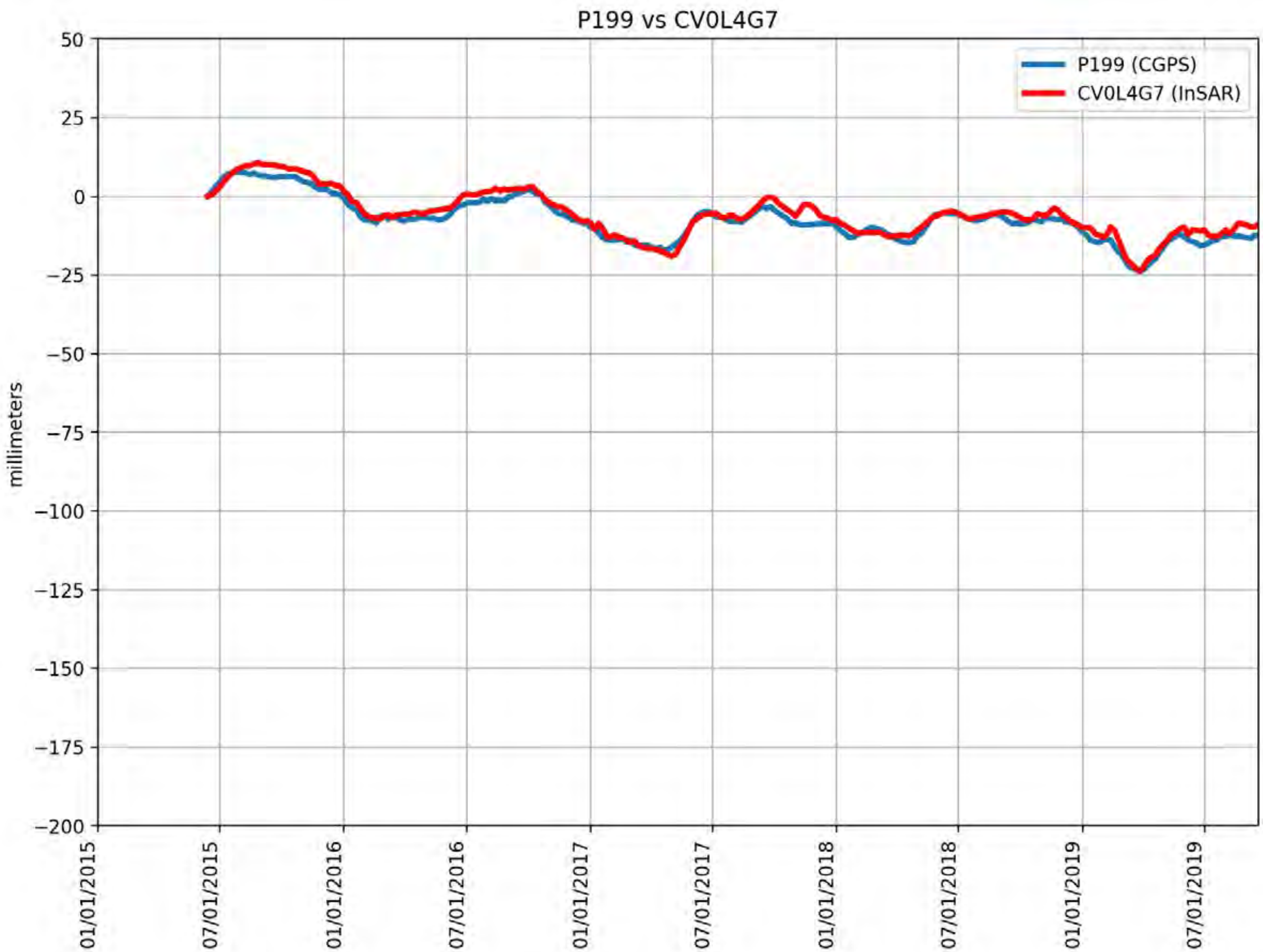
RMSE: 2.59 mm
Correlation: 0.83

Appendix B



RMSE: 5.85 mm
Correlation: 0.83

Appendix B



RMSE: 2.23 mm
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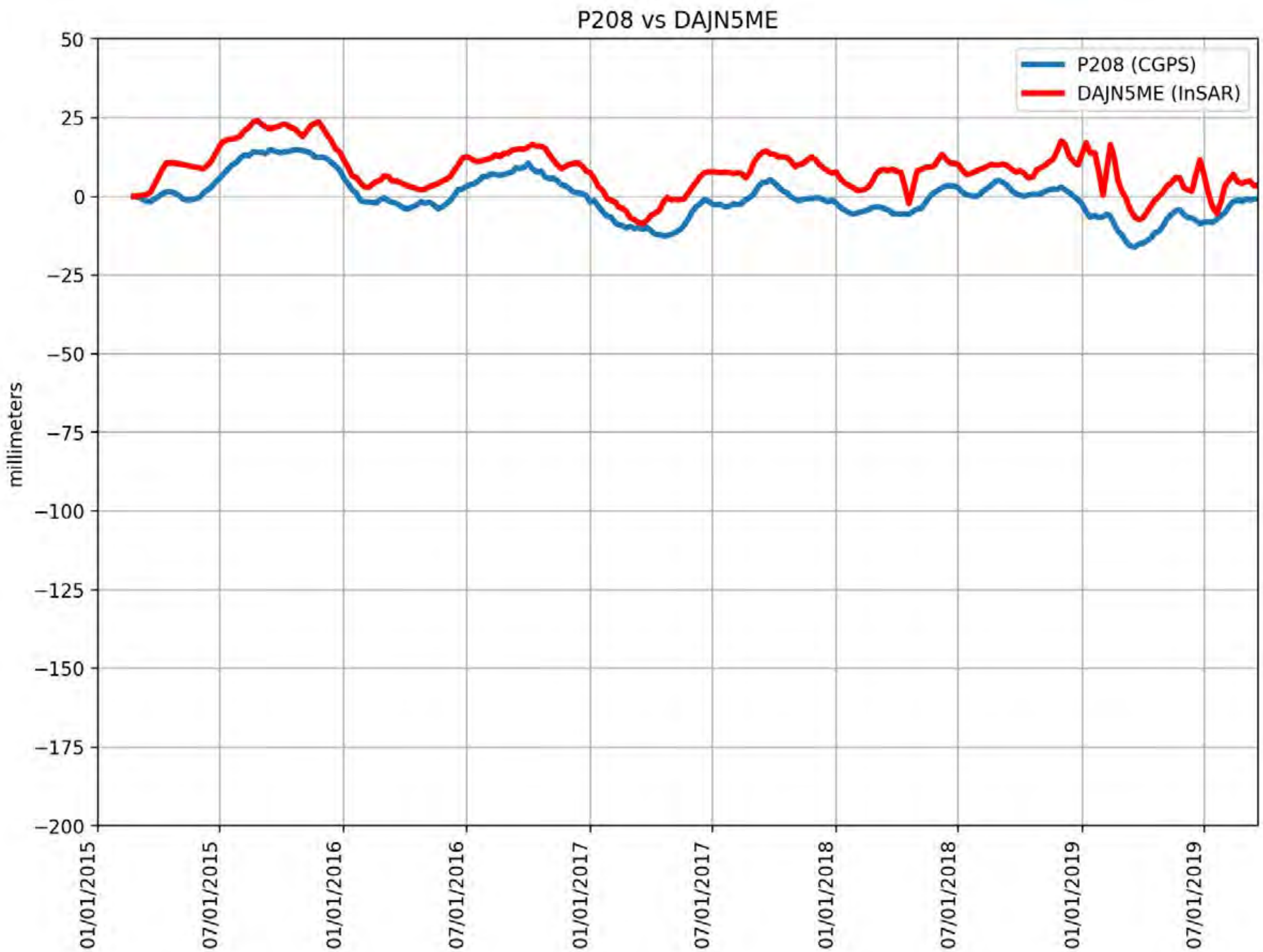
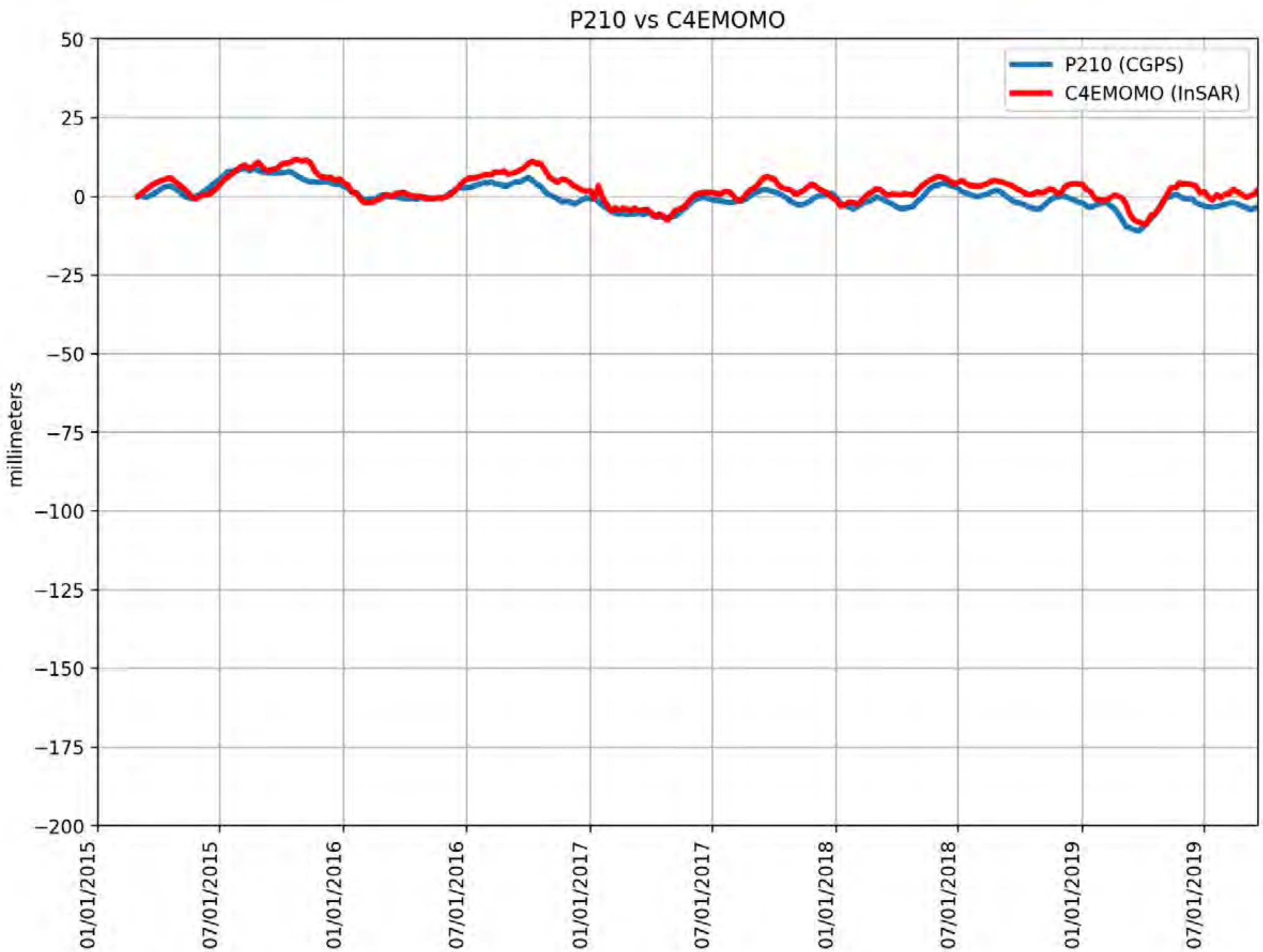
Appendix B



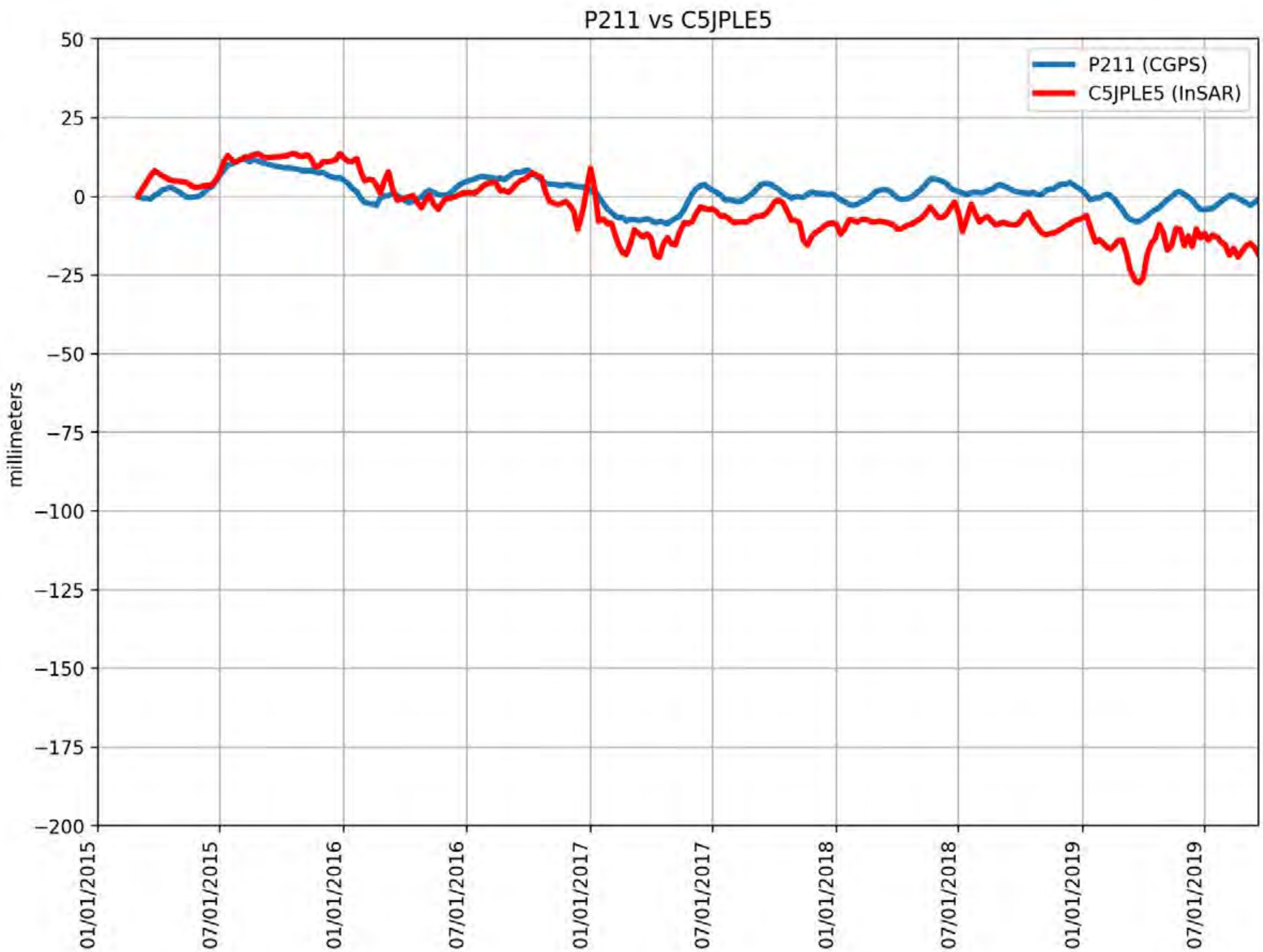
RMSE: 9.05 mm
Correlation: 0.88

Appendix B



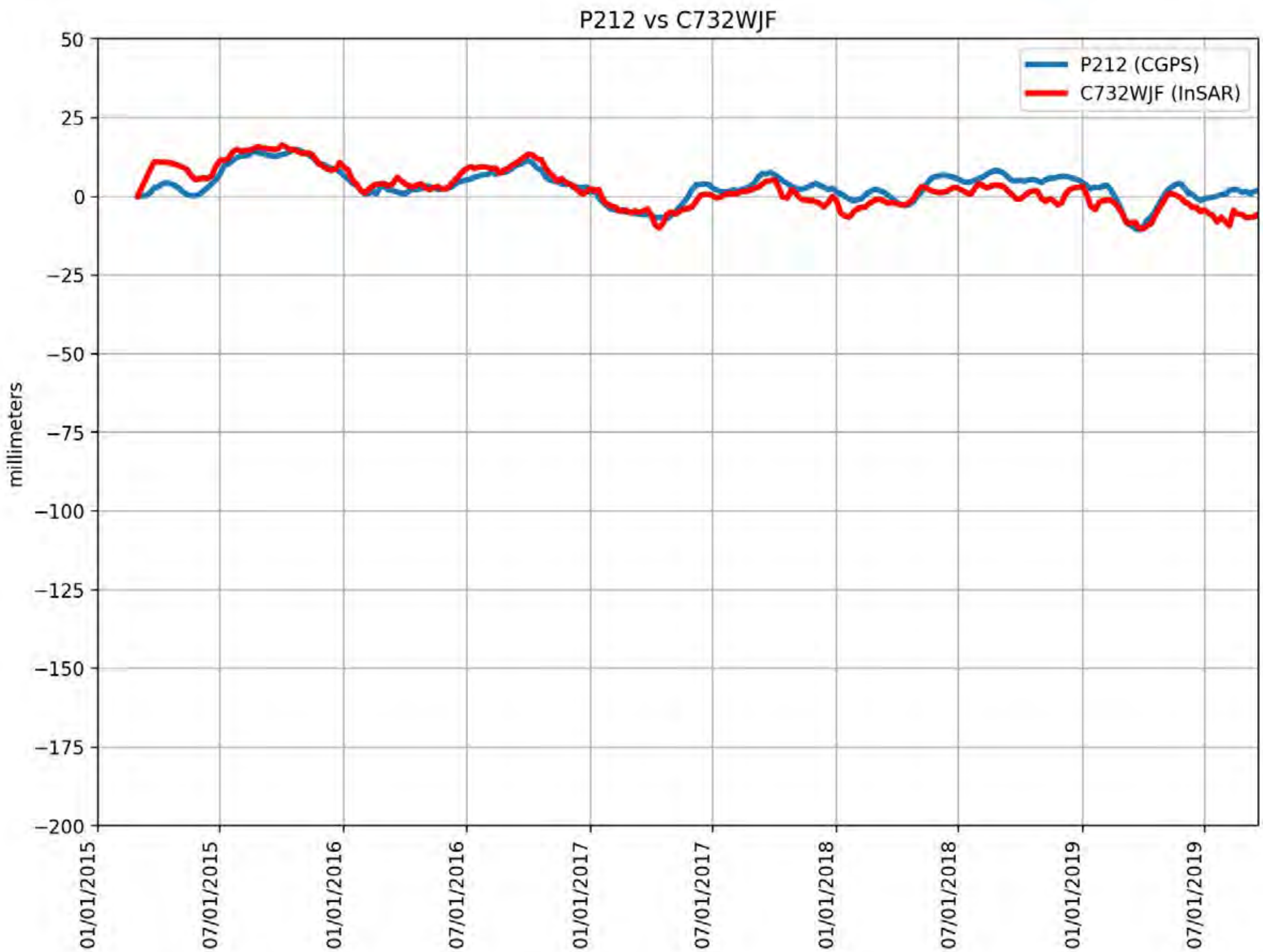
RMSE: 3.08 mm
Correlation: 0.88

Appendix B



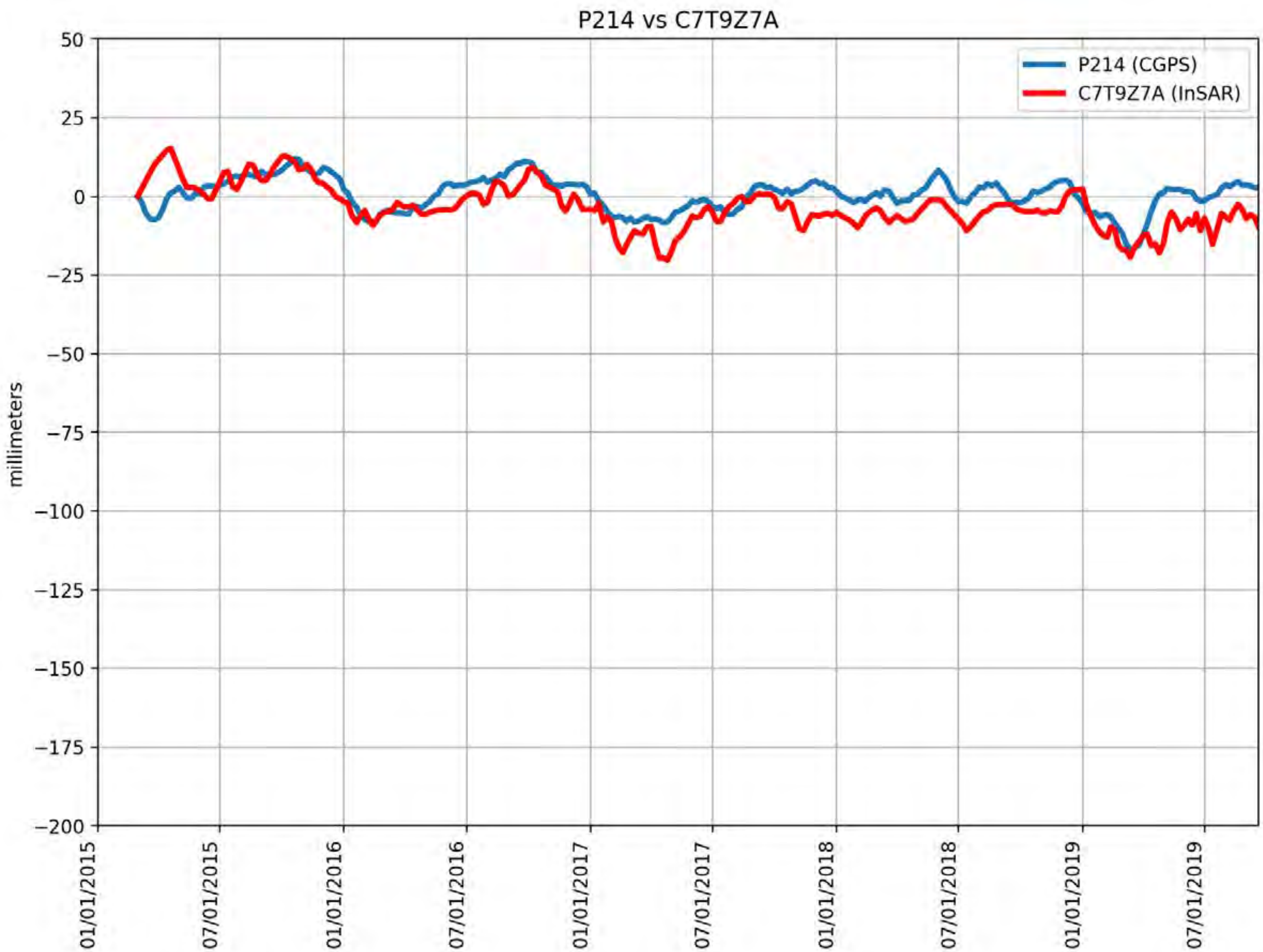
RMSE: 8.53 mm
Correlation: 0.75

Appendix B



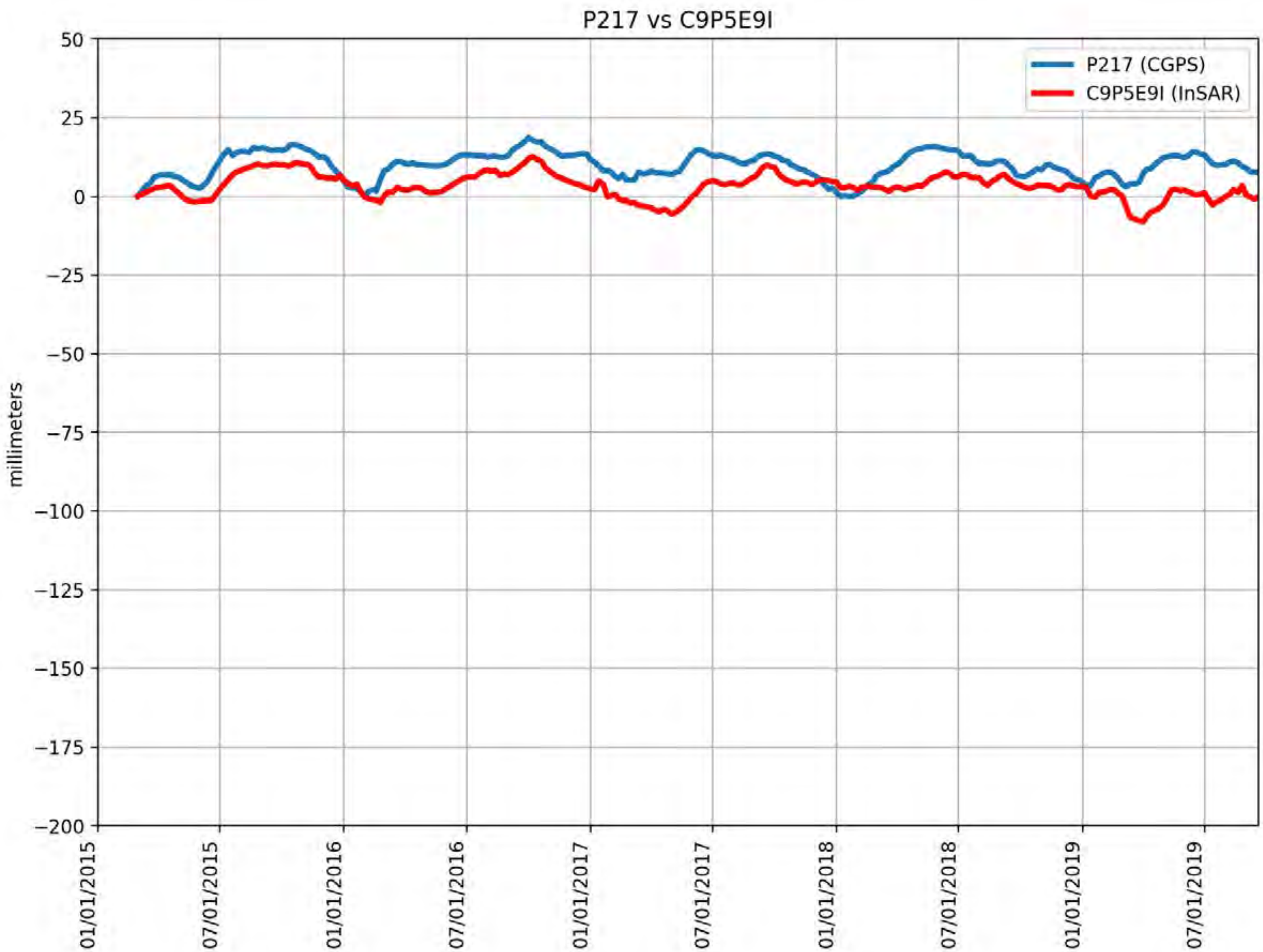
RMSE: 3.66 mm
Correlation: 0.83

Appendix B



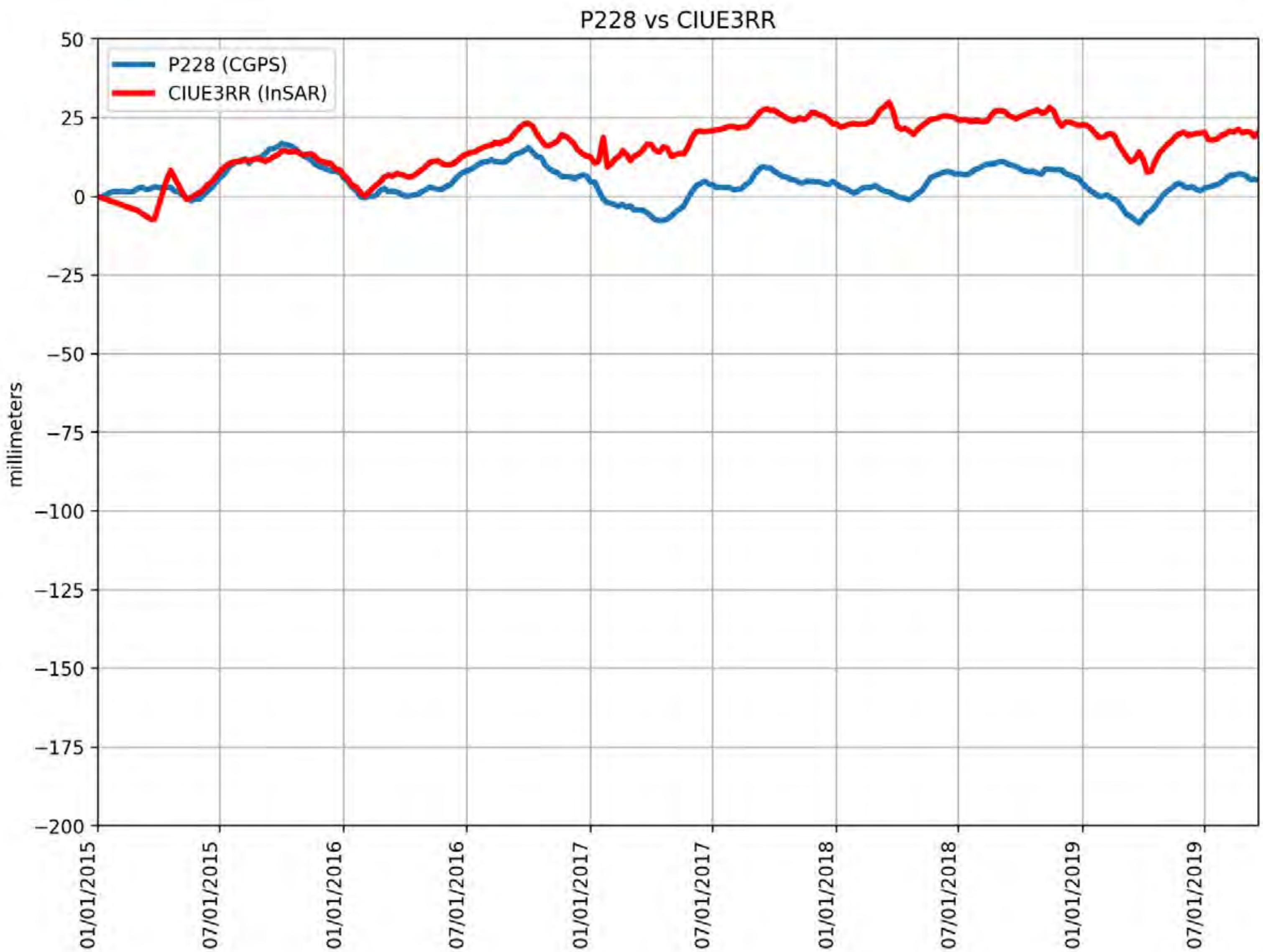
RMSE: 6.71 mm
Correlation: 0.64

Appendix B



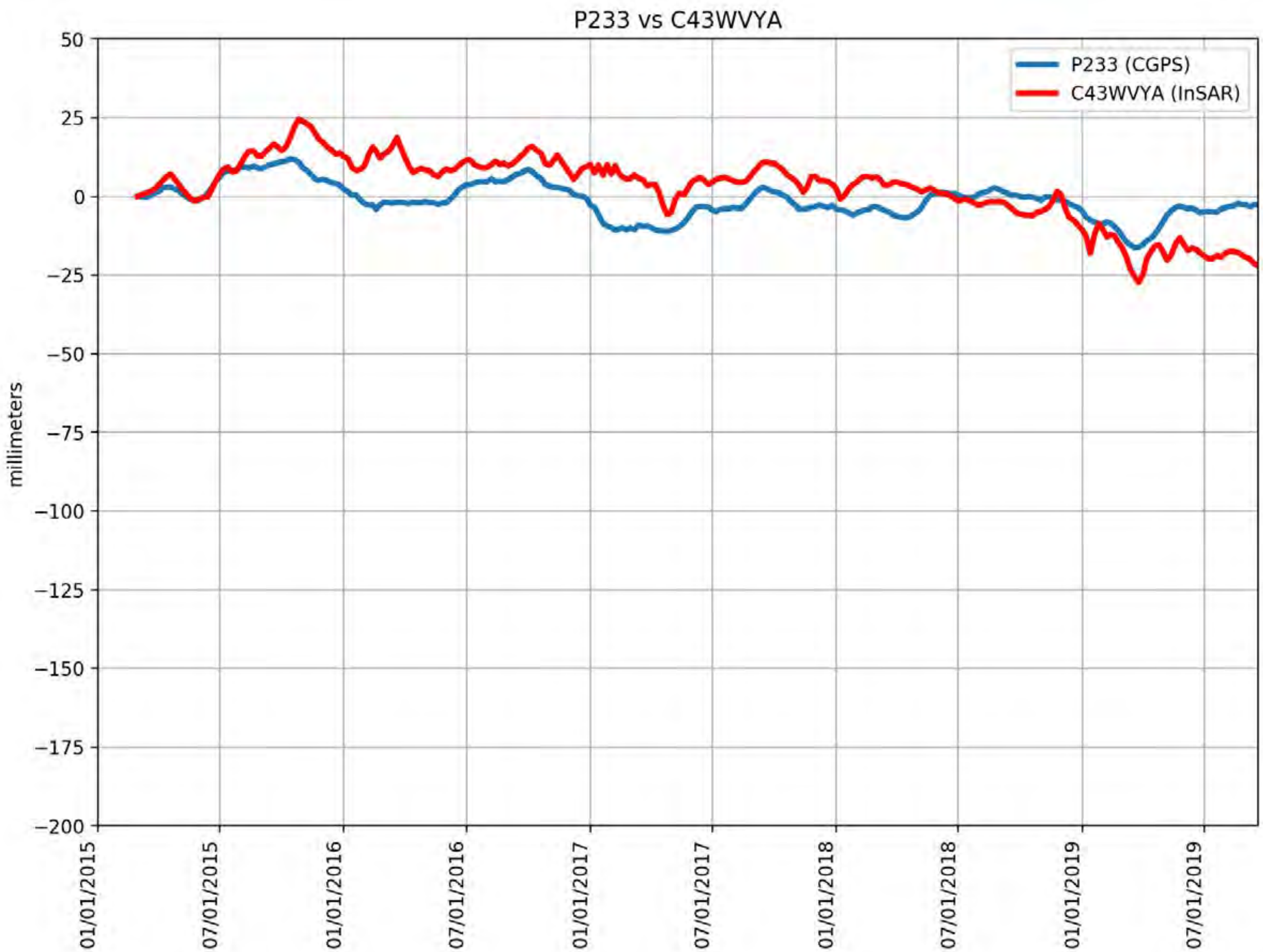
RMSE: 7.53 mm
Correlation: 0.59

Appendix B



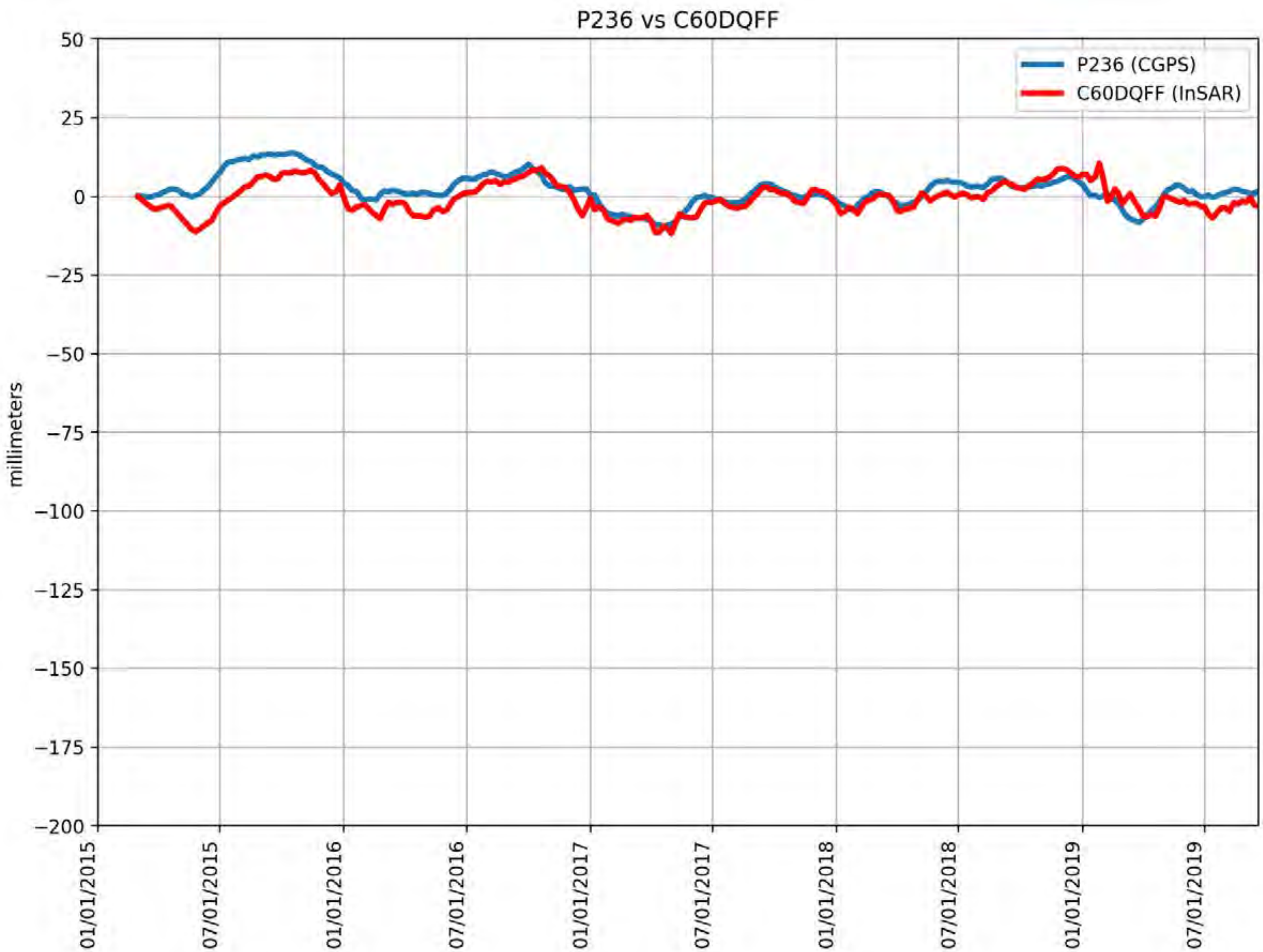
RMSE: 14.28 mm
Correlation: 0.29

Appendix B



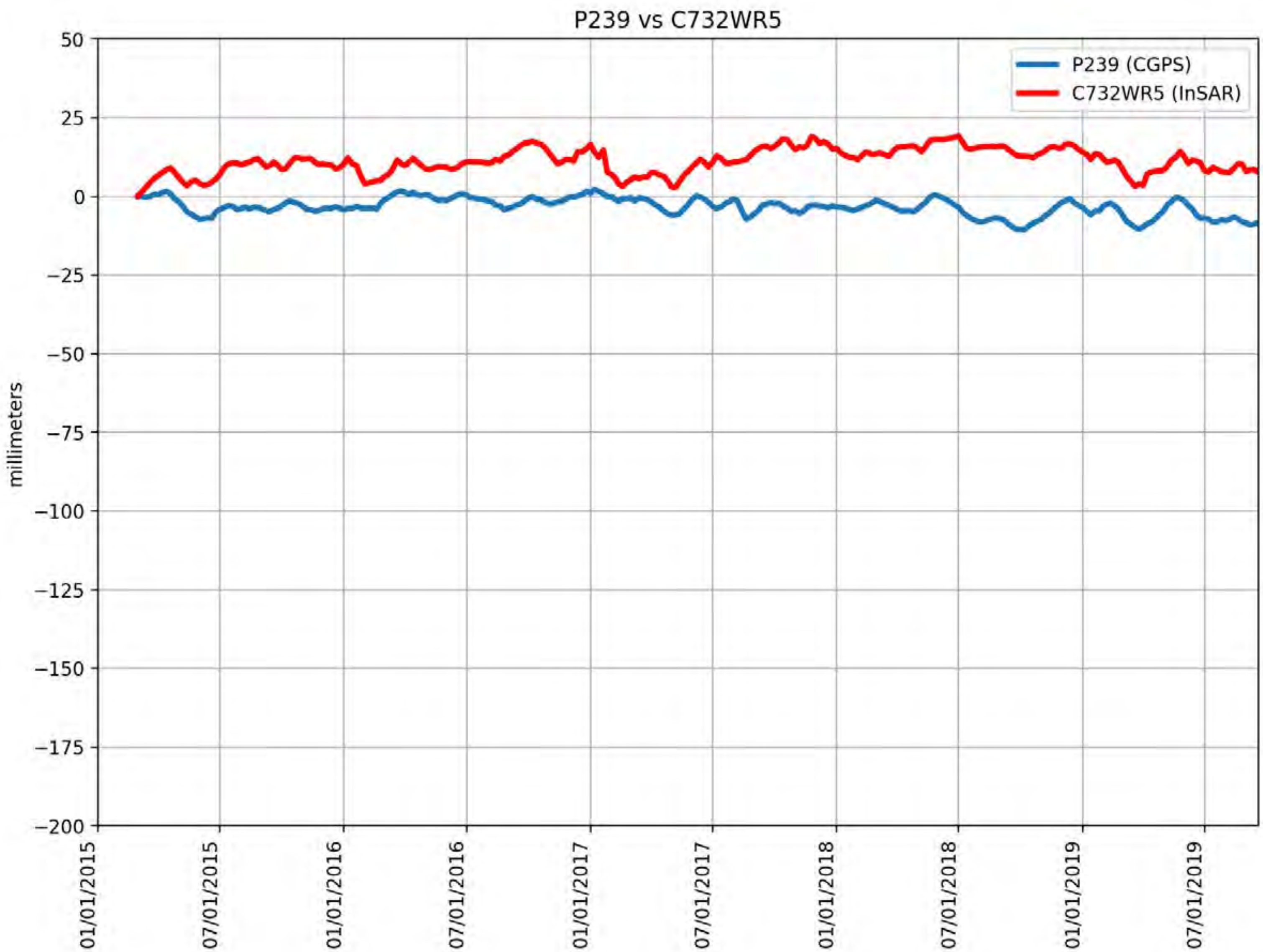
RMSE: 9.30 mm
Correlation: 0.61

Appendix B



RMSE: 4.50 mm
Correlation: 0.72

Appendix B



RMSE: 15.28 mm
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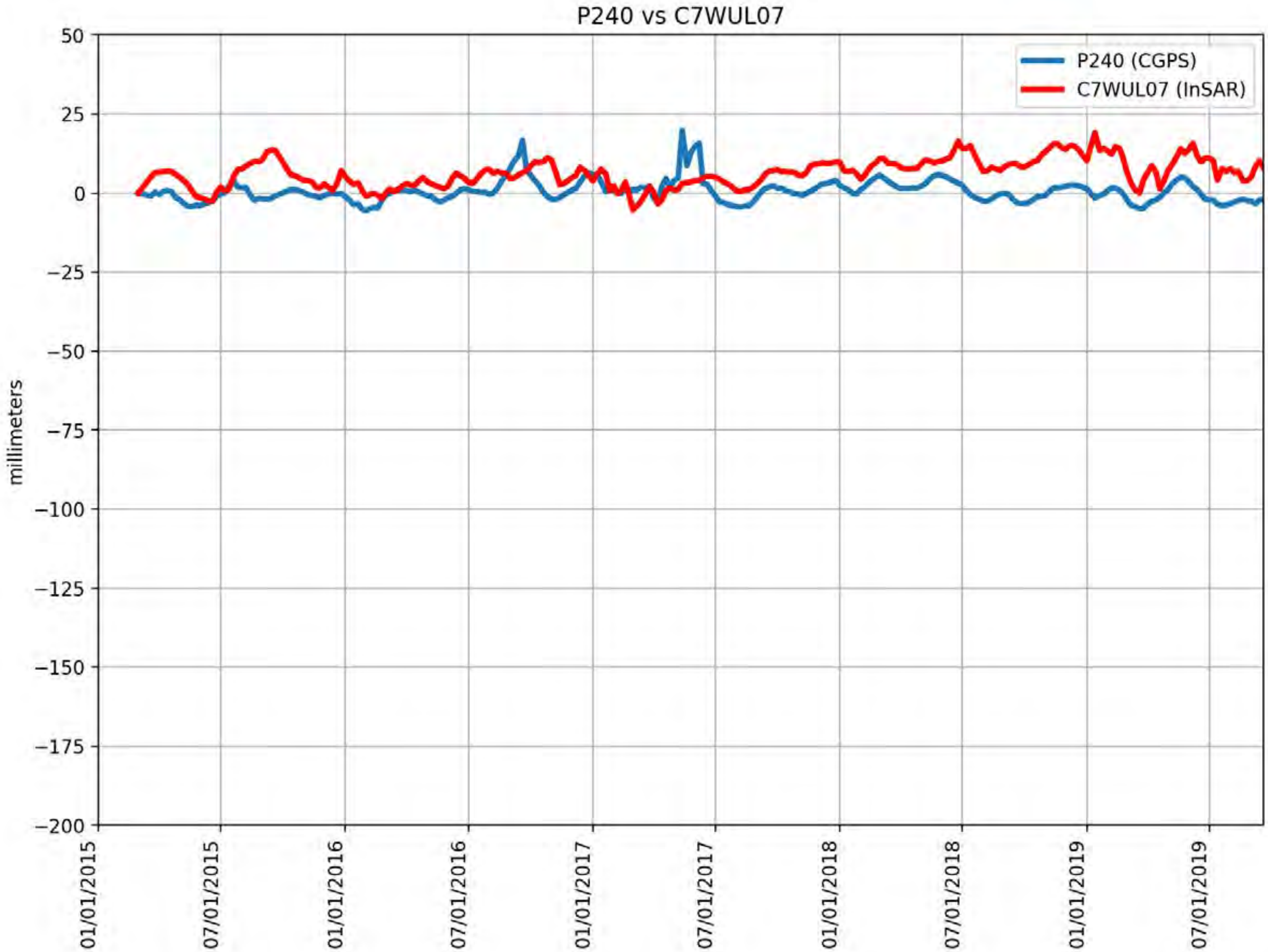
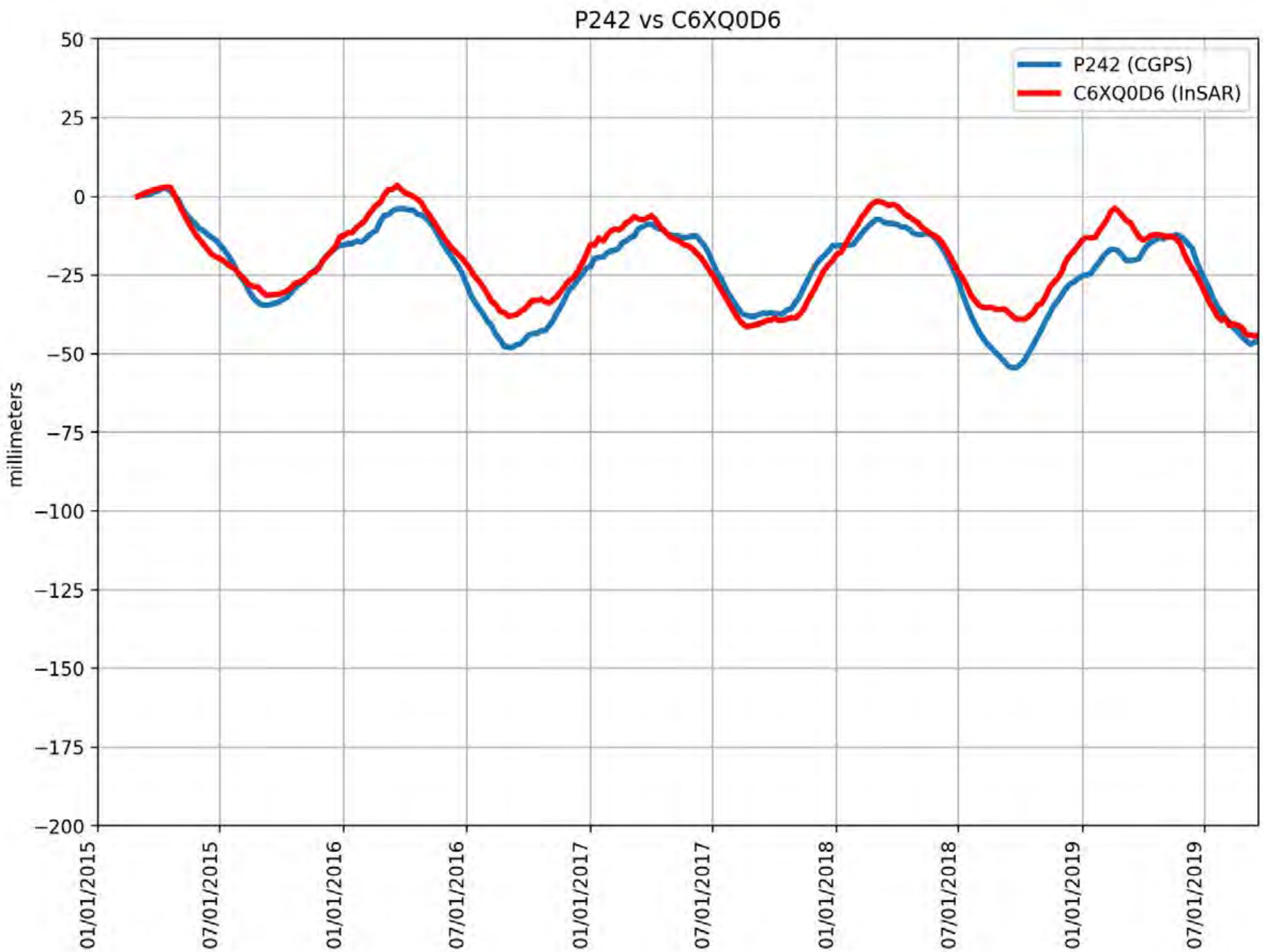
Appendix B



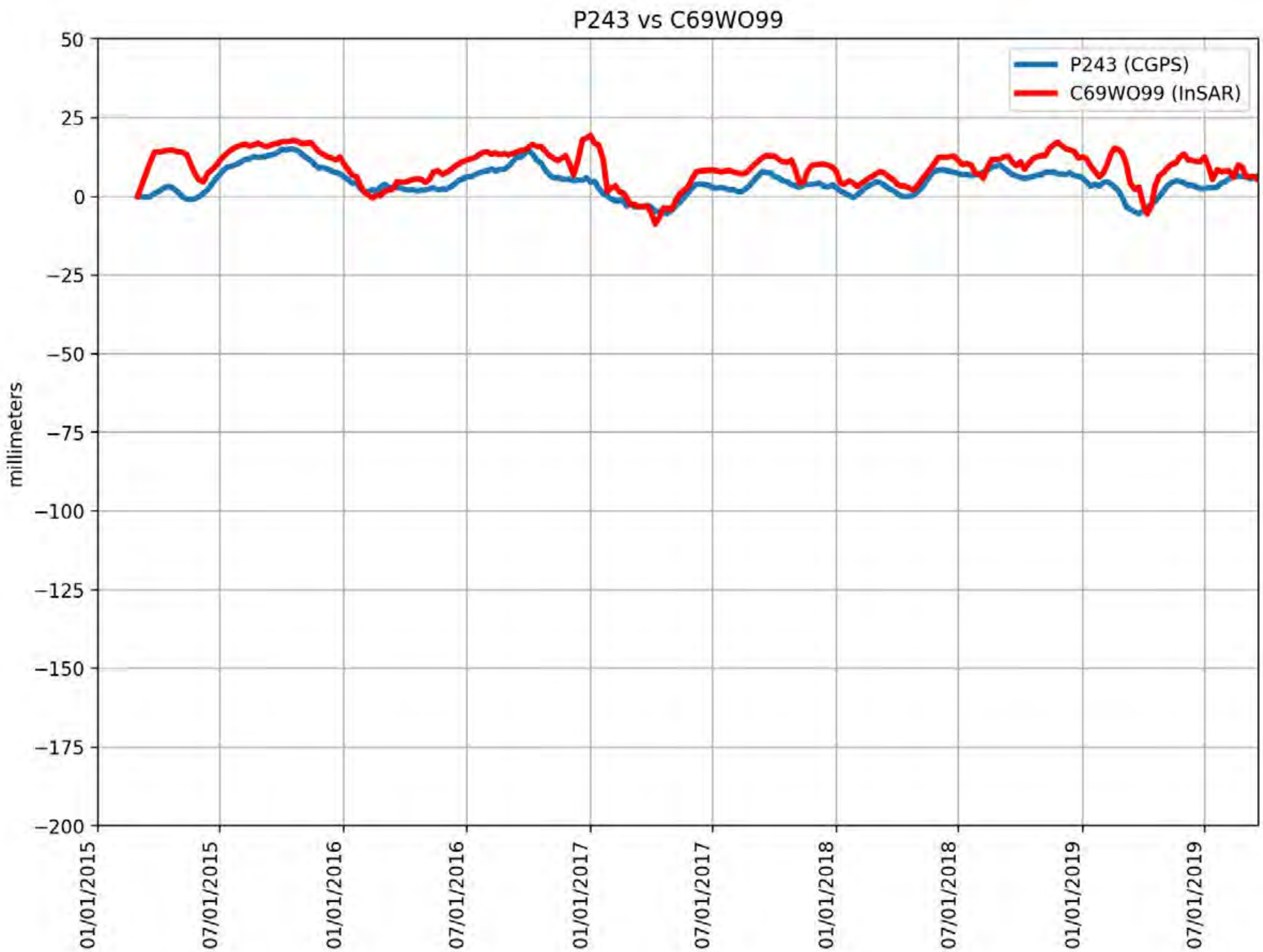
RMSE: 7.68 mm
Correlation: 0.20

Appendix B



RMSE: 6.15 mm
Correlation: 0.92

Appendix B



RMSE: 5.68 mm
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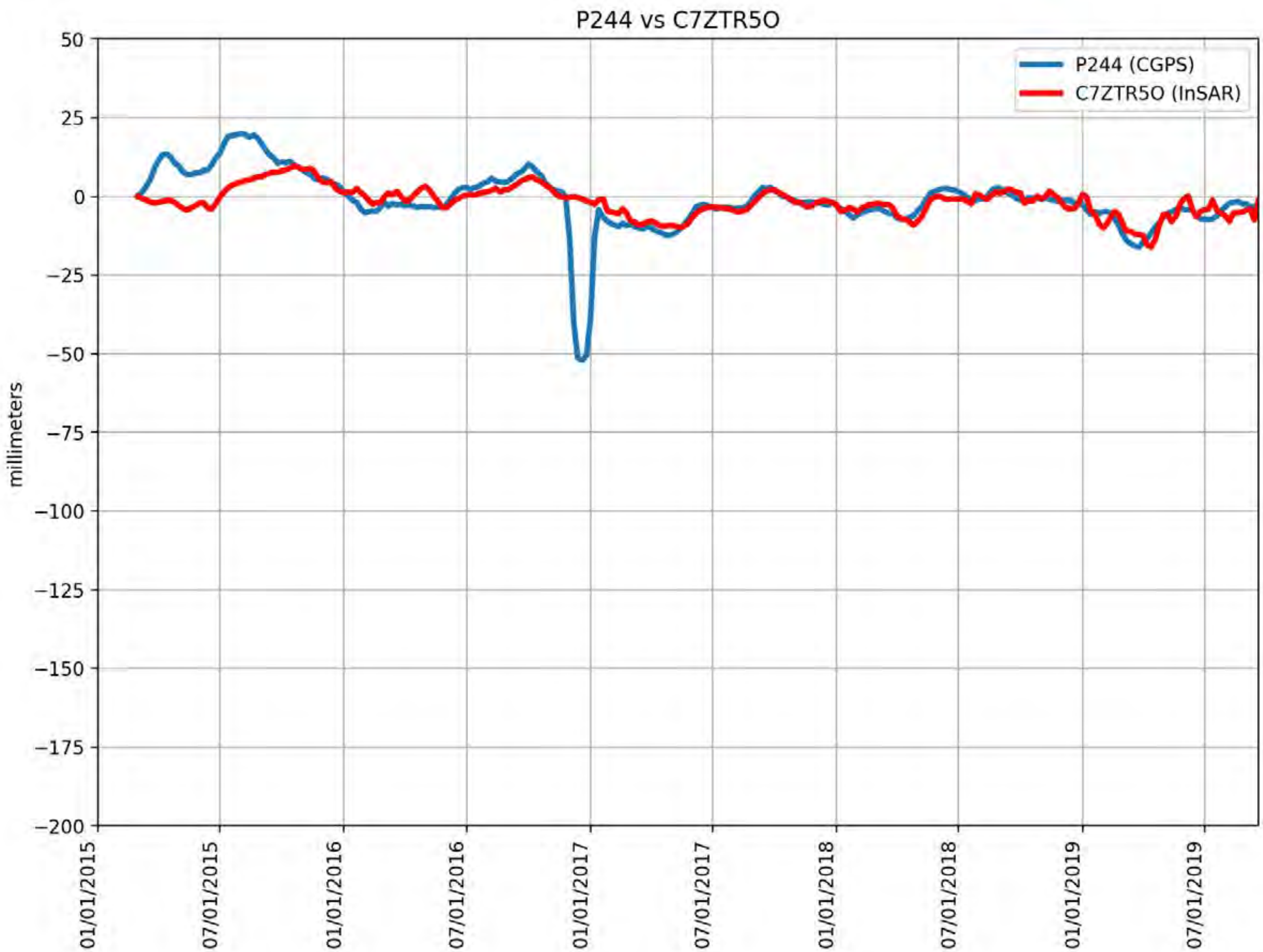

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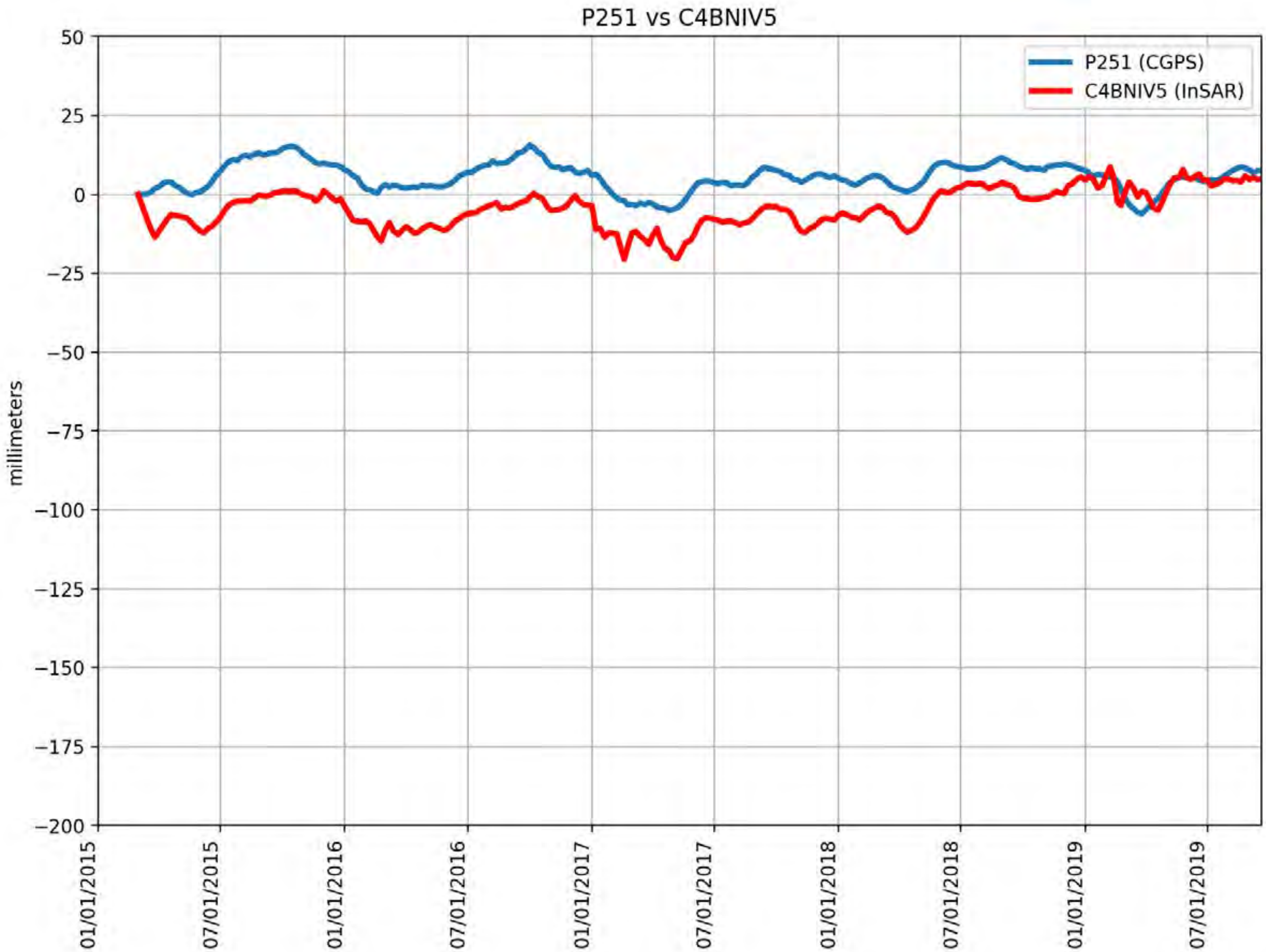
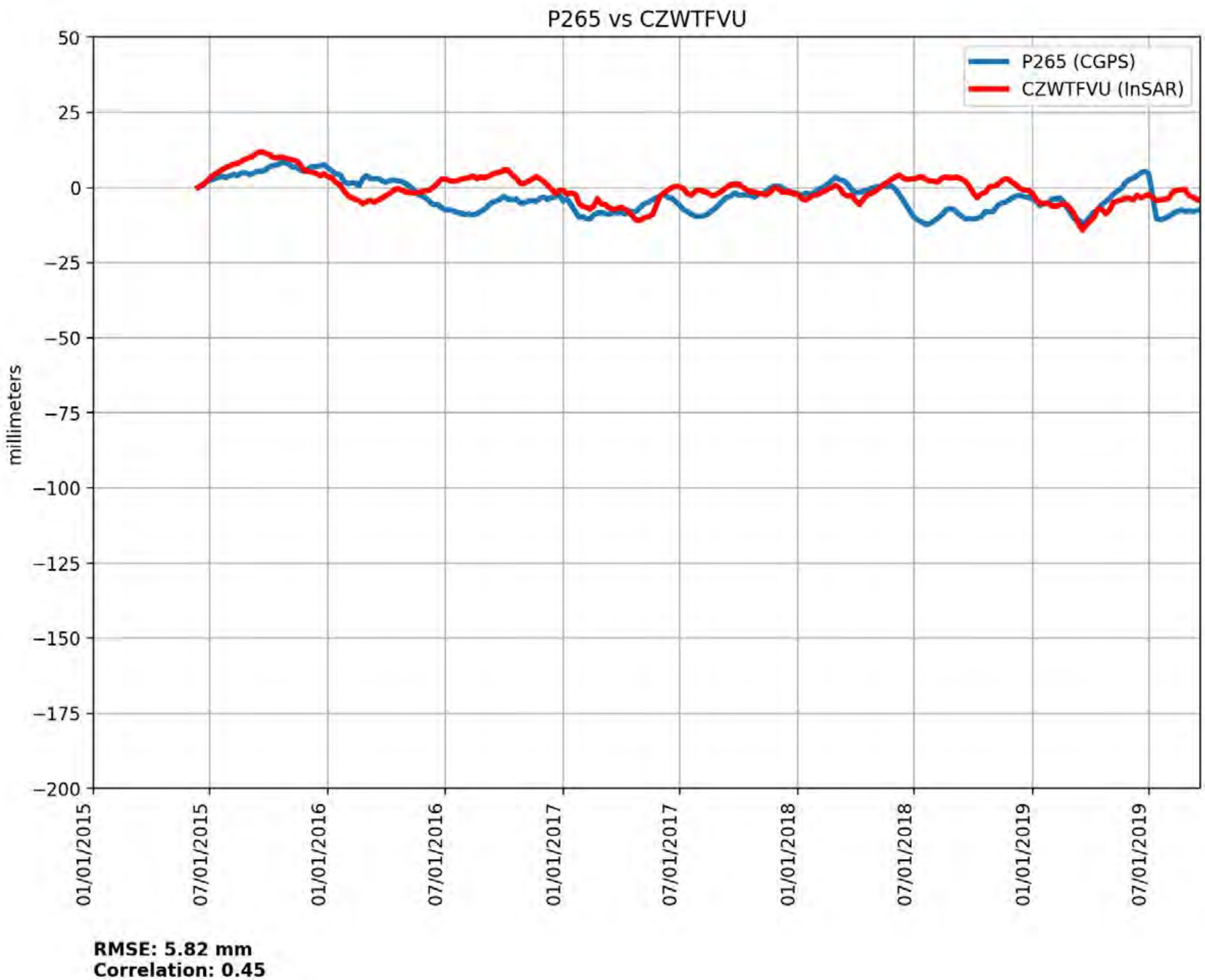
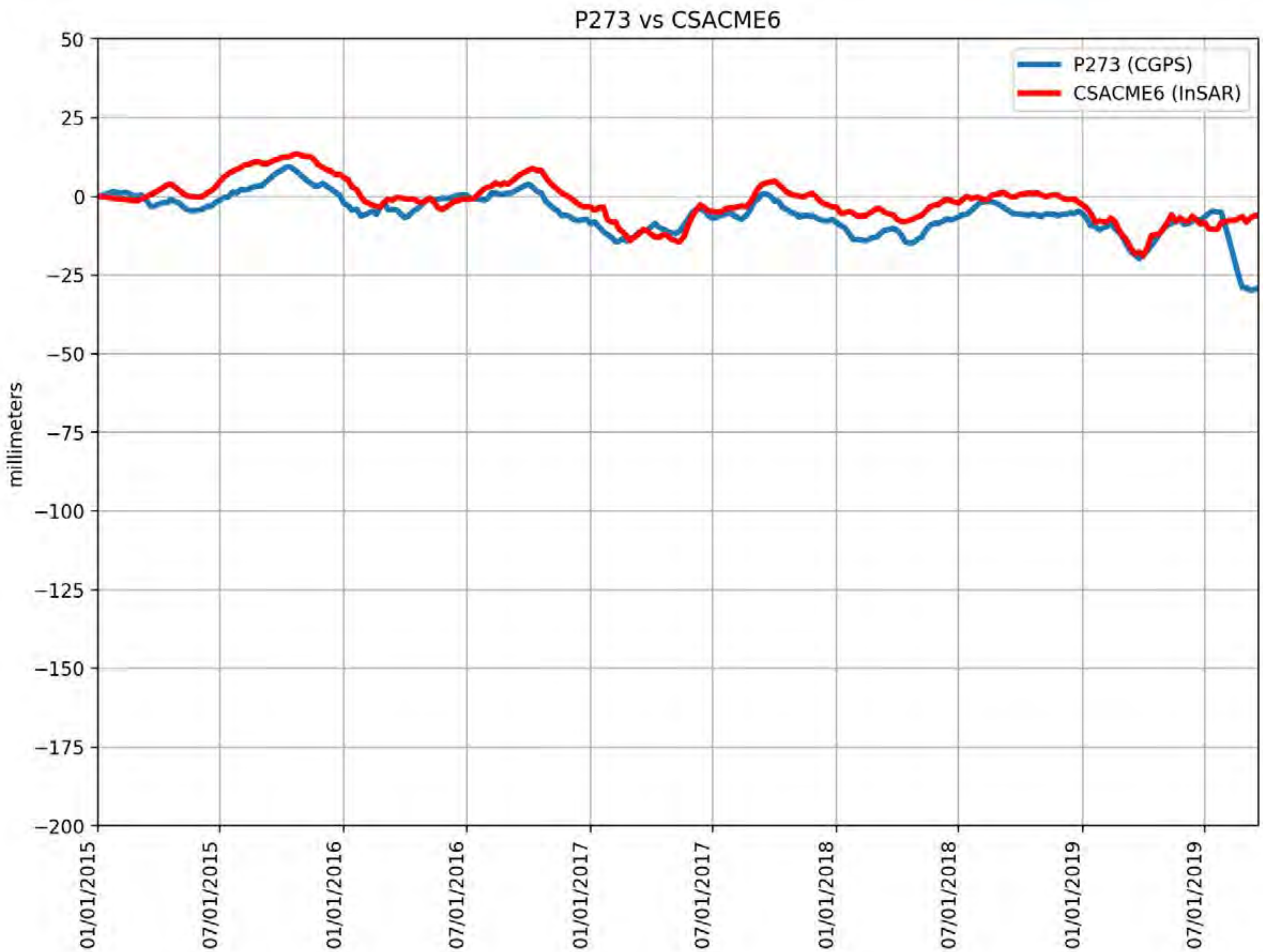


RMSE: 11.17 mm
Correlation: 0.58

Appendix B

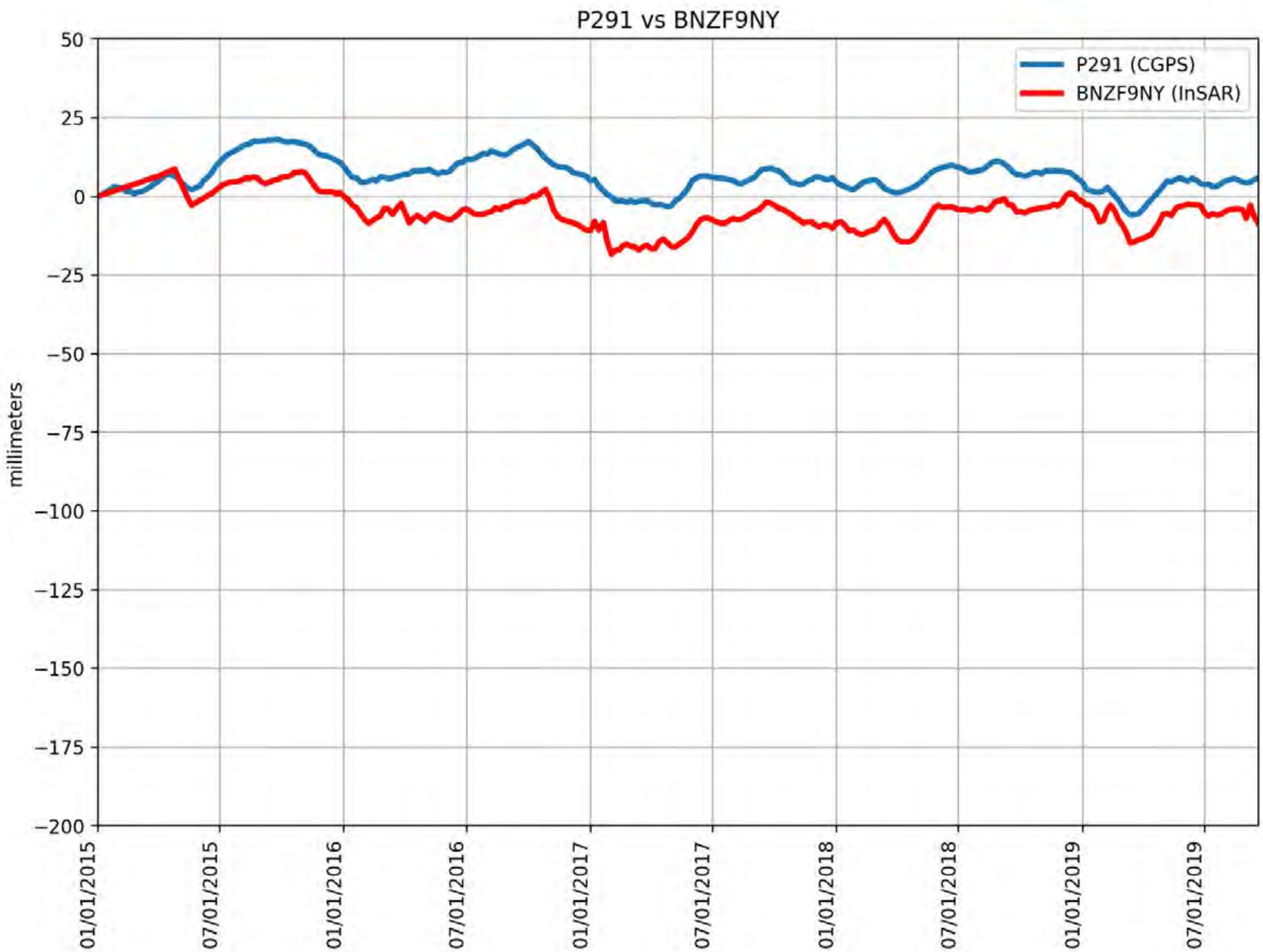

P265 vs CZWTFVU
P265 (CGPS)
CZWTFVU (InSAR)
millimeters
50
25
0
−25
−50
−75
−100
−125
−150
−175
−200
01/01/2015
07/01/2015
01/01/2016
07/01/2016
01/01/2017
07/01/2017
01/01/2018
07/01/2018
01/01/2019
07/01/2019
RMSE: 5.82 mm
Correlation: 0.45

Appendix B



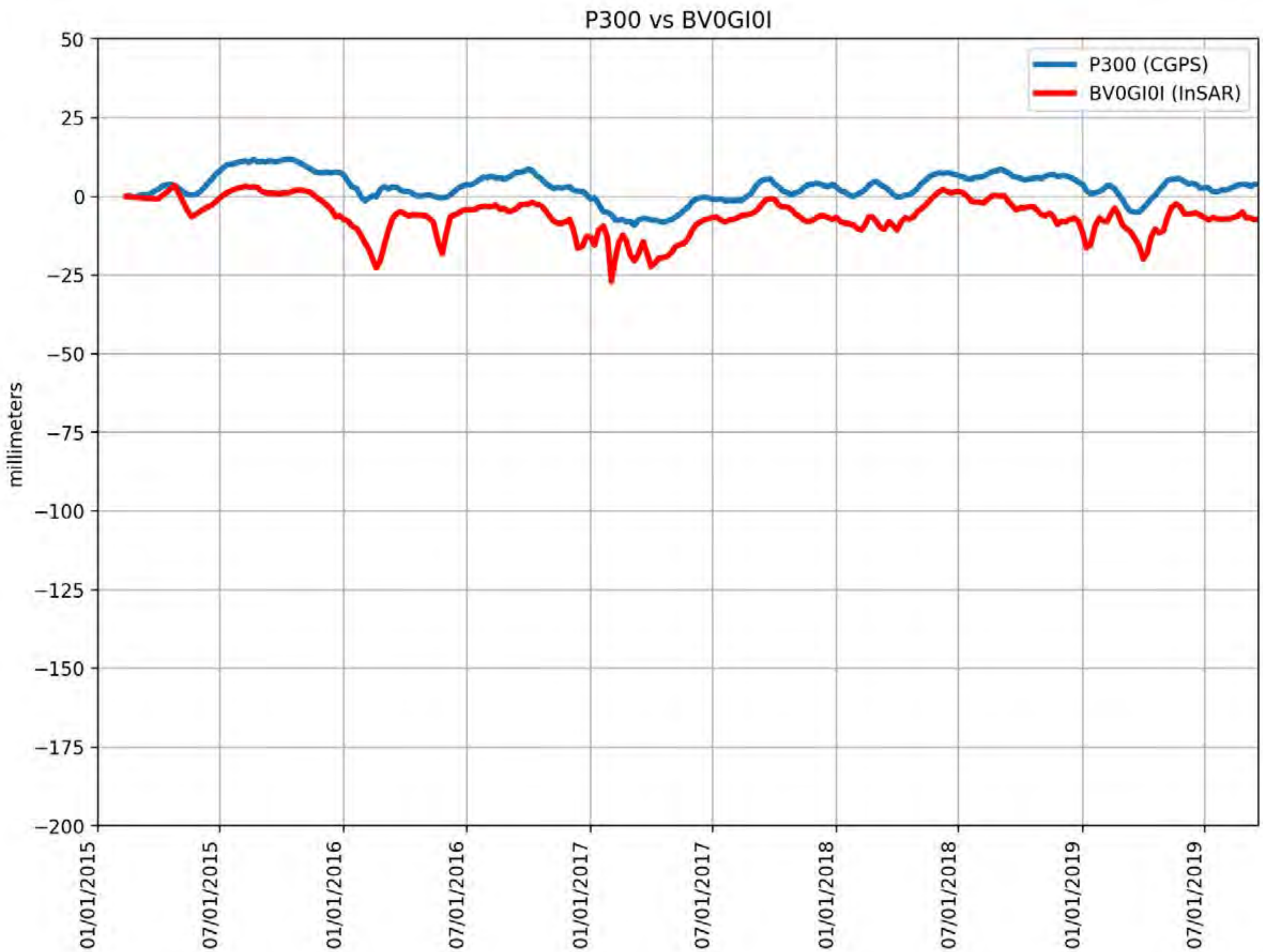
RMSE: 5.65 mm
Correlation: 0.80

Appendix B



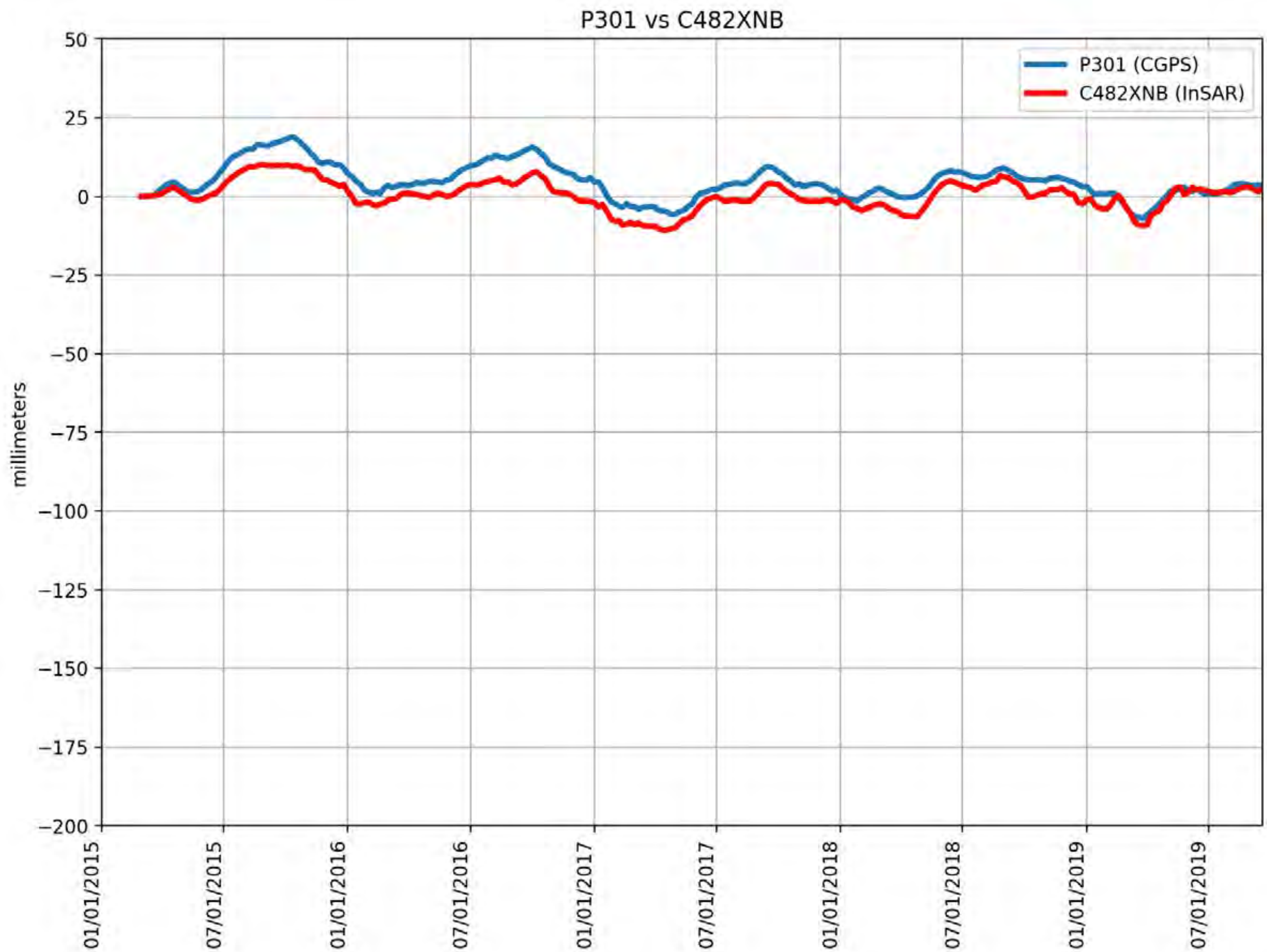
RMSE: 12.06 mm
Correlation: 0.65

Appendix B



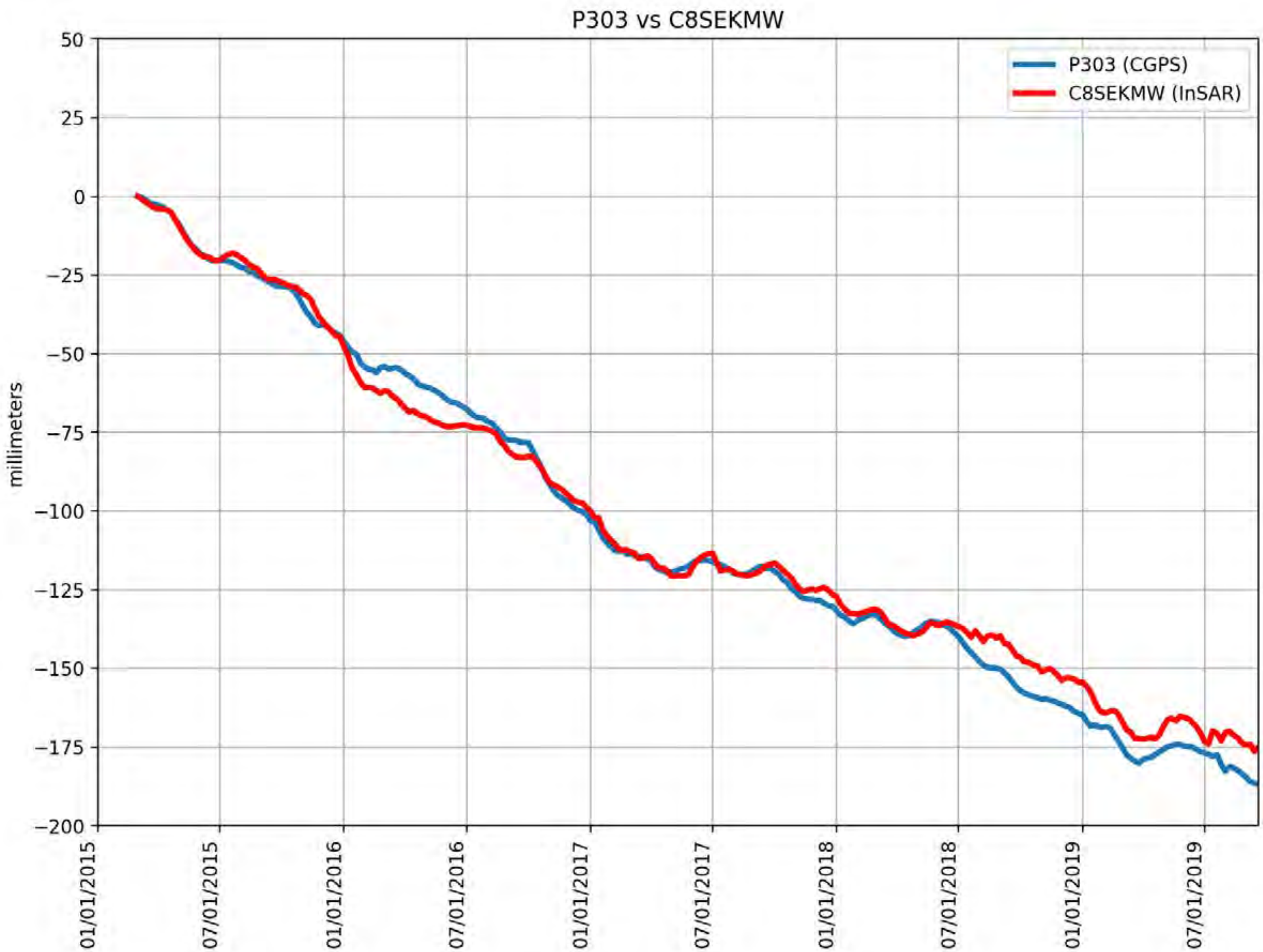
RMSE: 9.91 mm
Correlation: 0.78

Appendix B



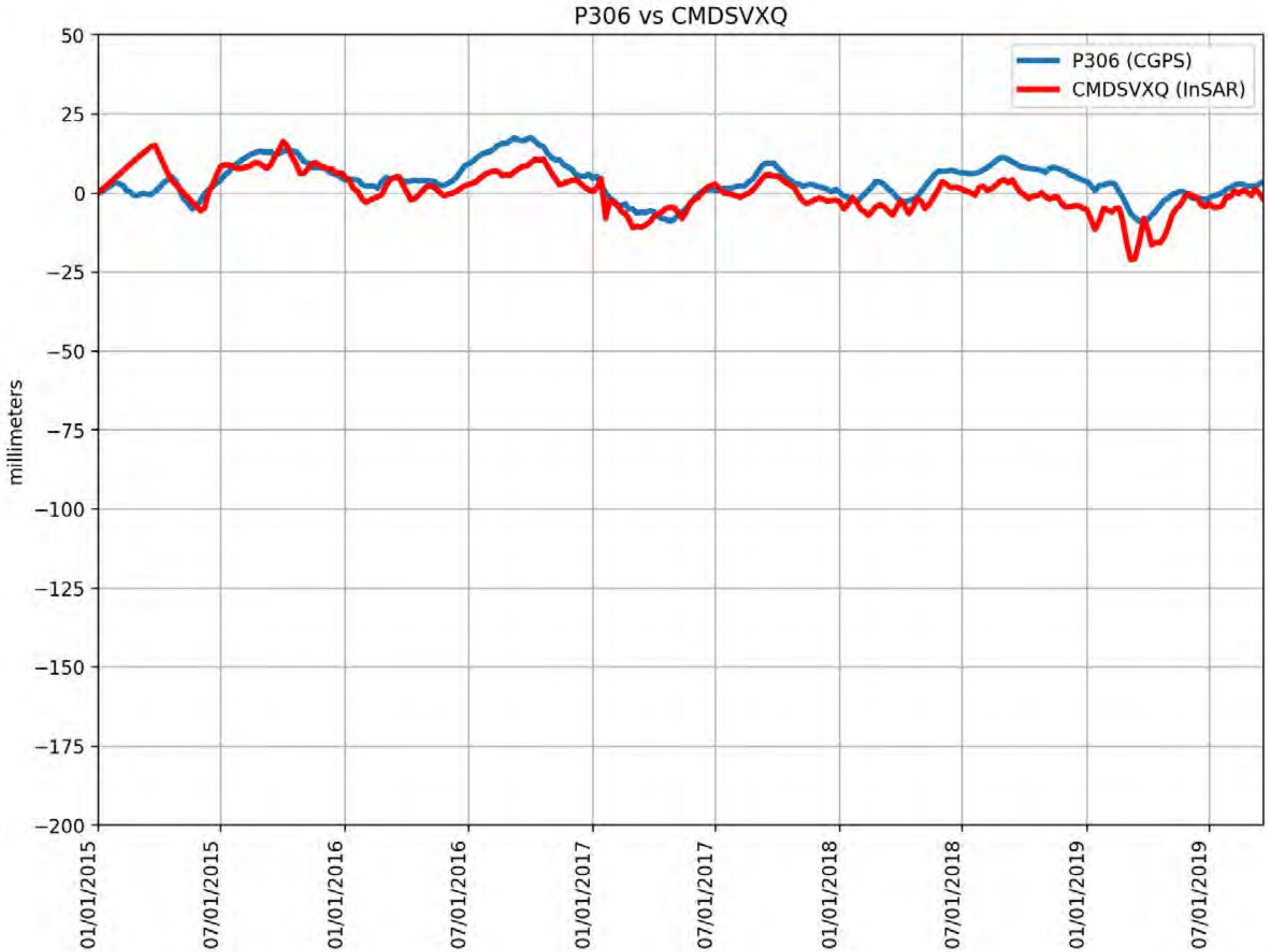
RMSE: 4.86 mm
Correlation: 0.91

Appendix B



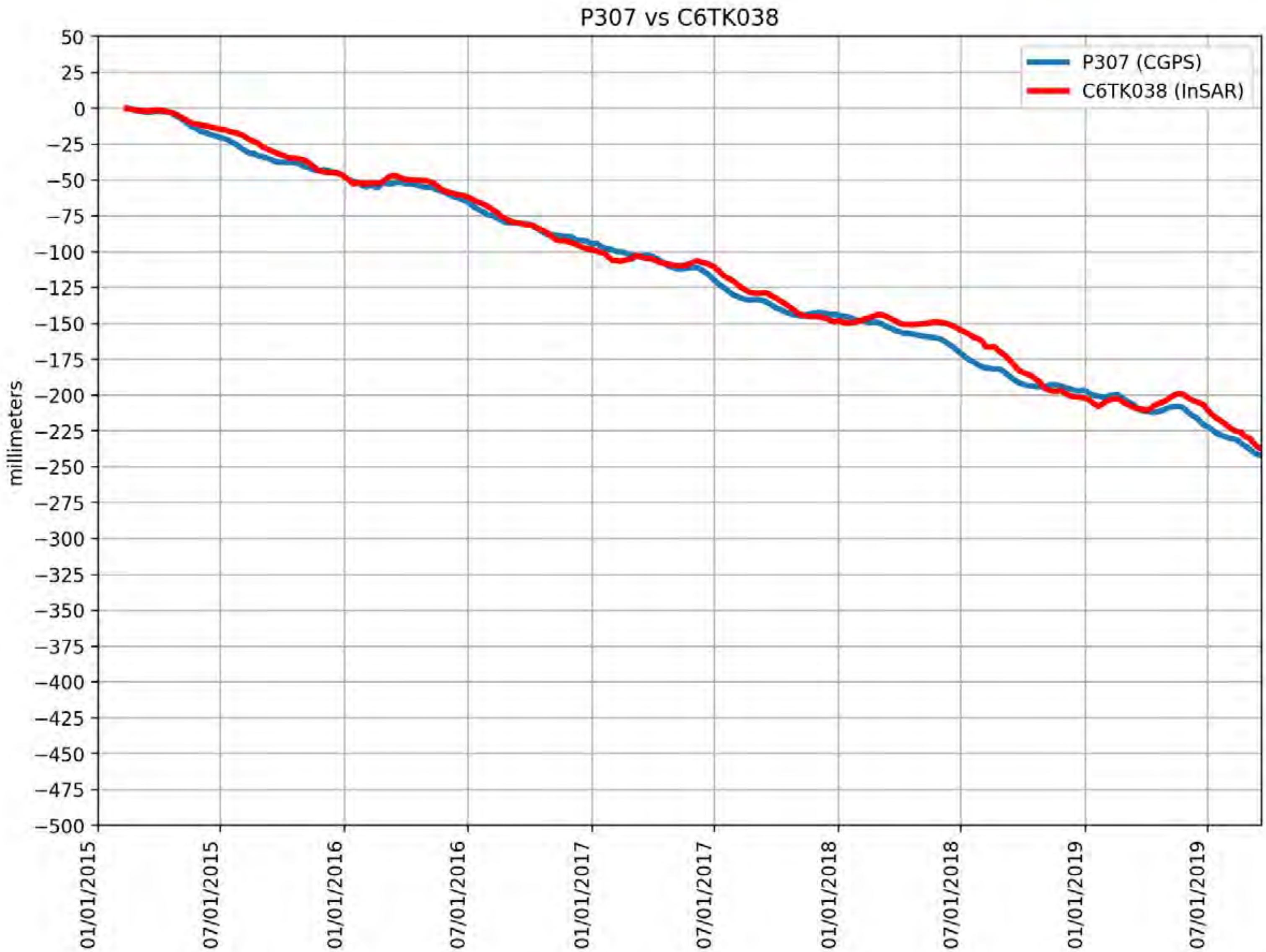
RMSE: 5.53 mm
Correlation: 1.00

Appendix B



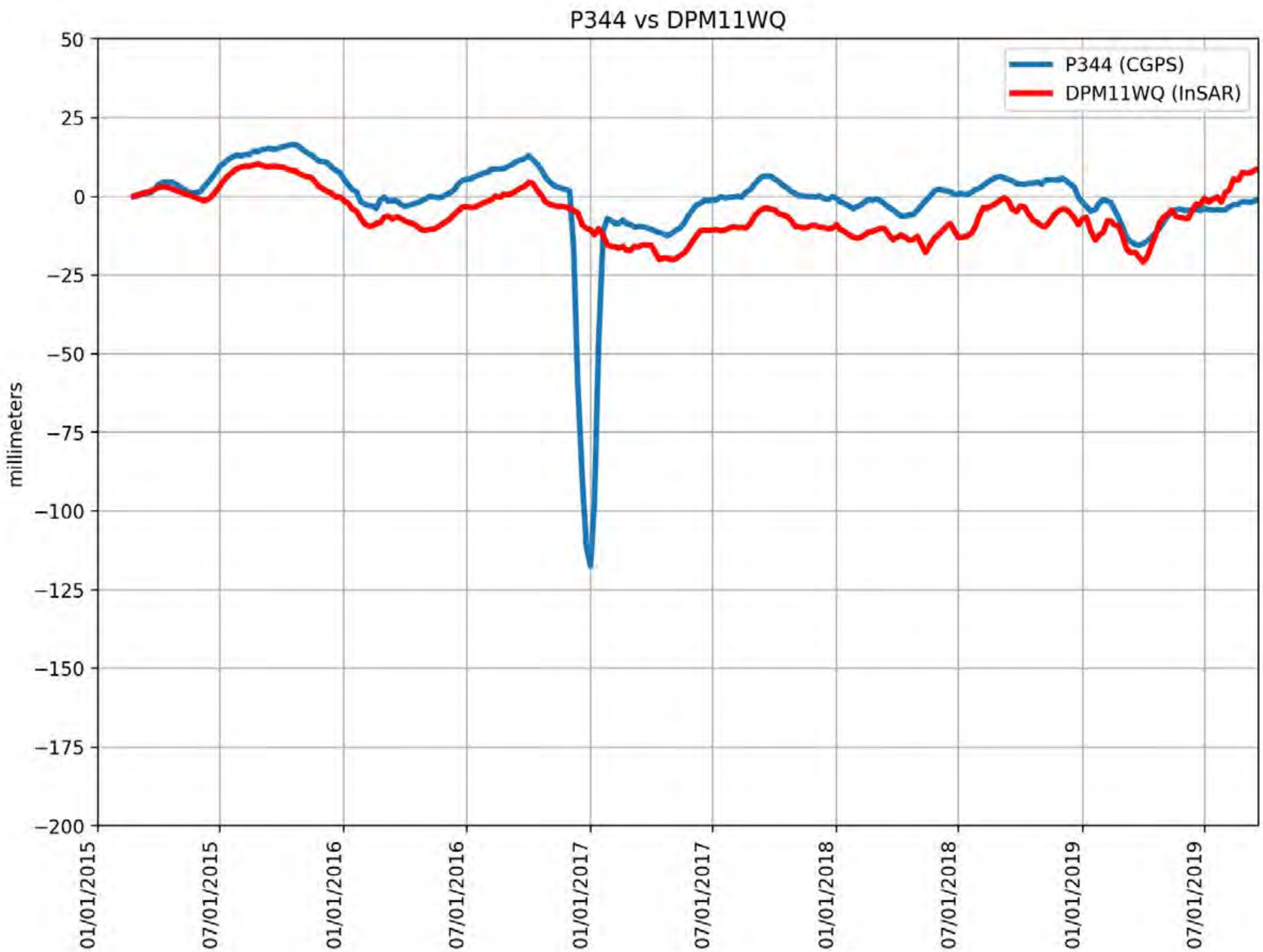
RMSE: 5.64 mm
Correlation: 0.71

Appendix B



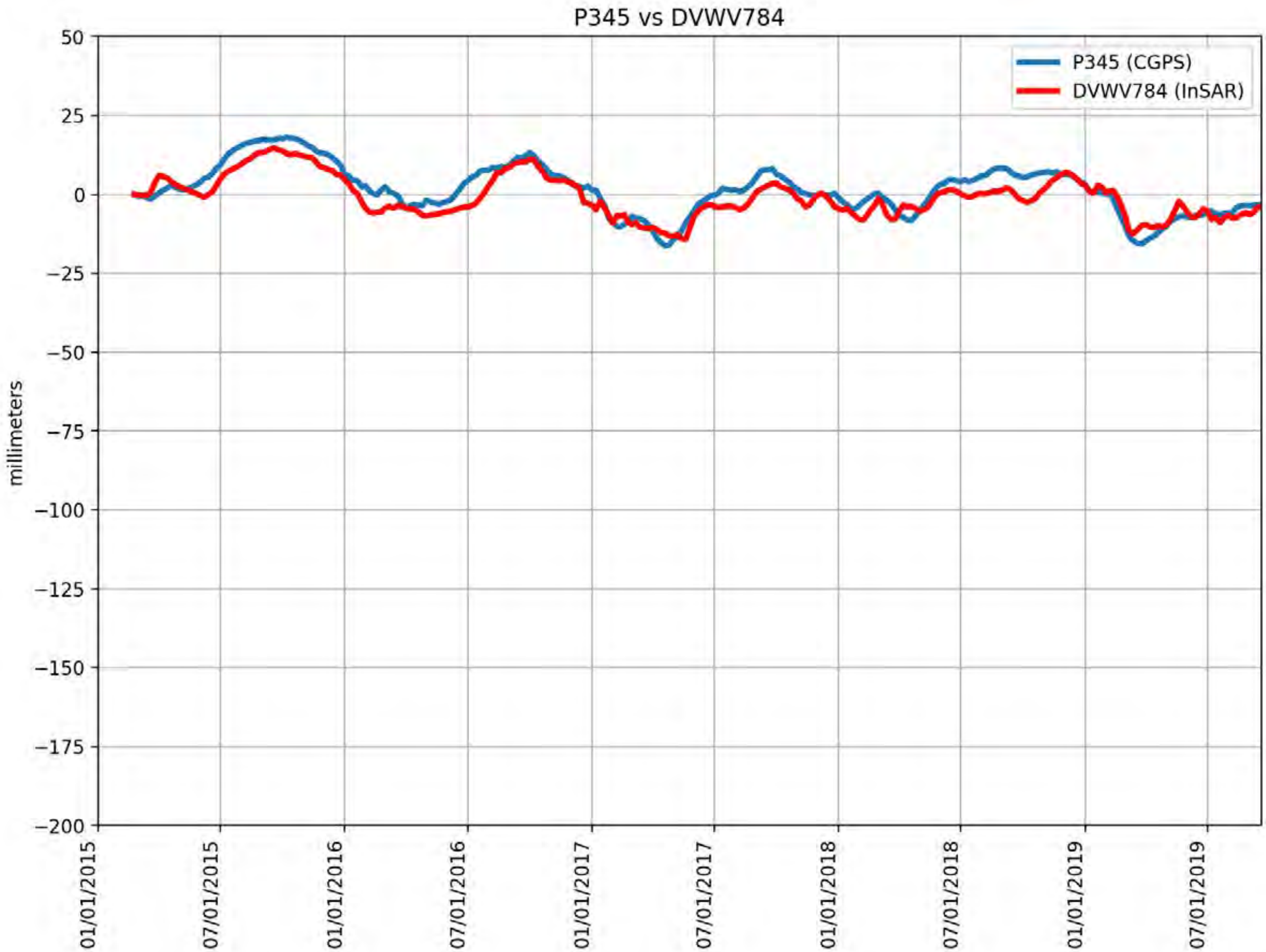
RMSE: 6.32 mm
Correlation: 1.00

Appendix B



RMSE: 14.41 mm
Correlation: 0.43

Appendix B



RMSE: 3.89 mm
Correlation: 0.92

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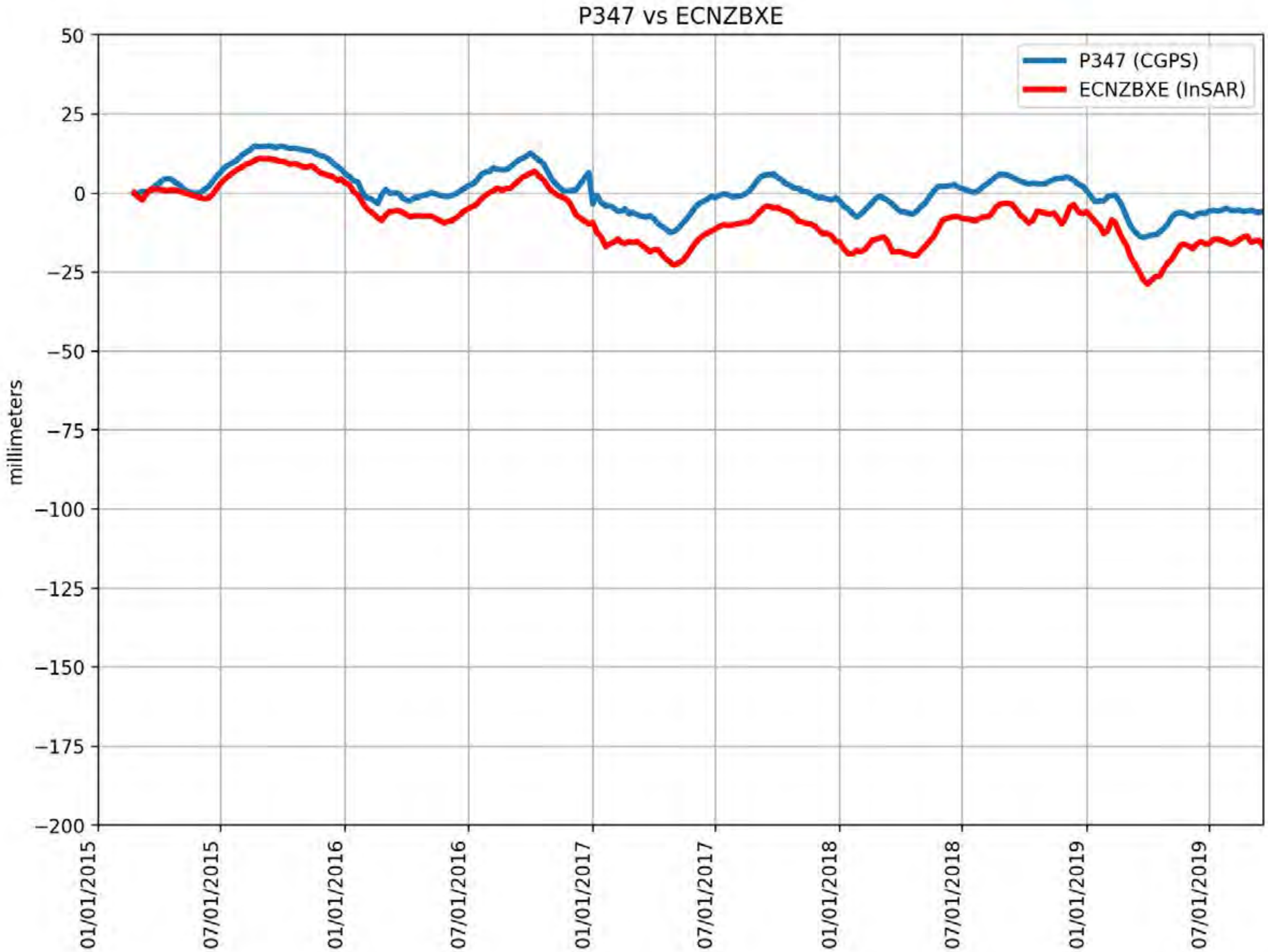
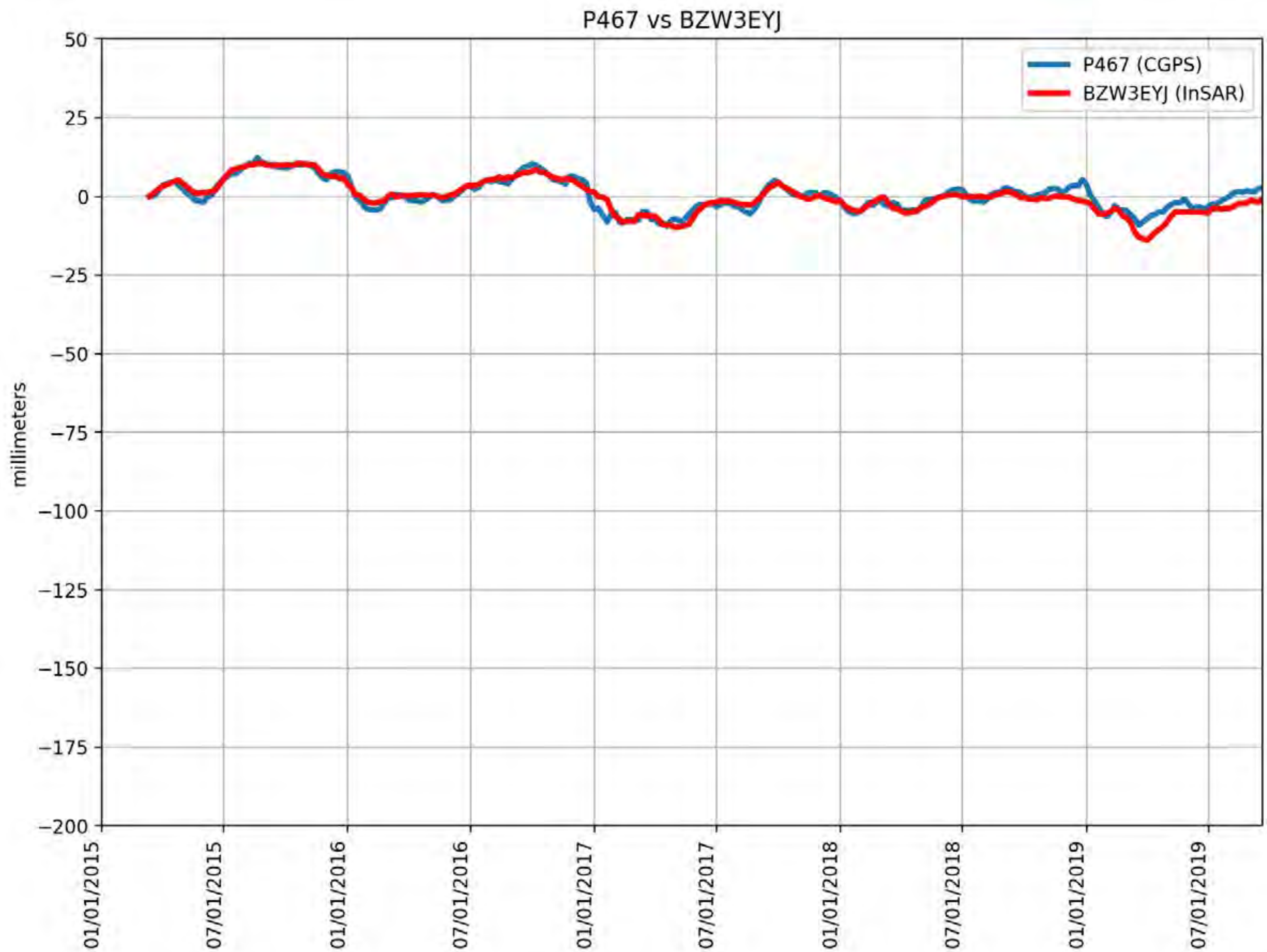


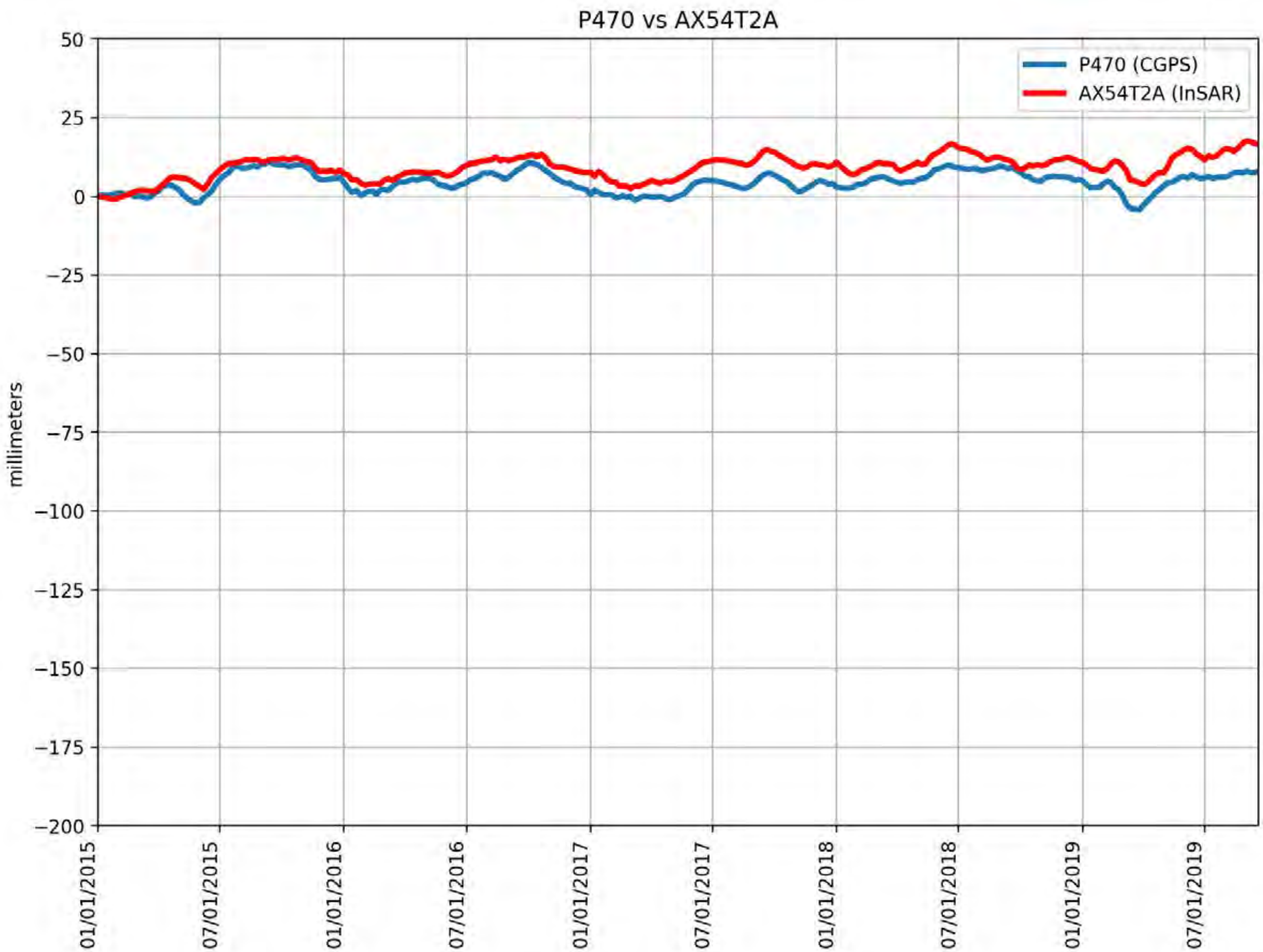
RMSE: 8.96 mm
Correlation: 0.94

Appendix B



RMSE: 2.06 mm
Correlation: 0.92

Appendix B



RMSE: 5.12 mm
Correlation: 0.80

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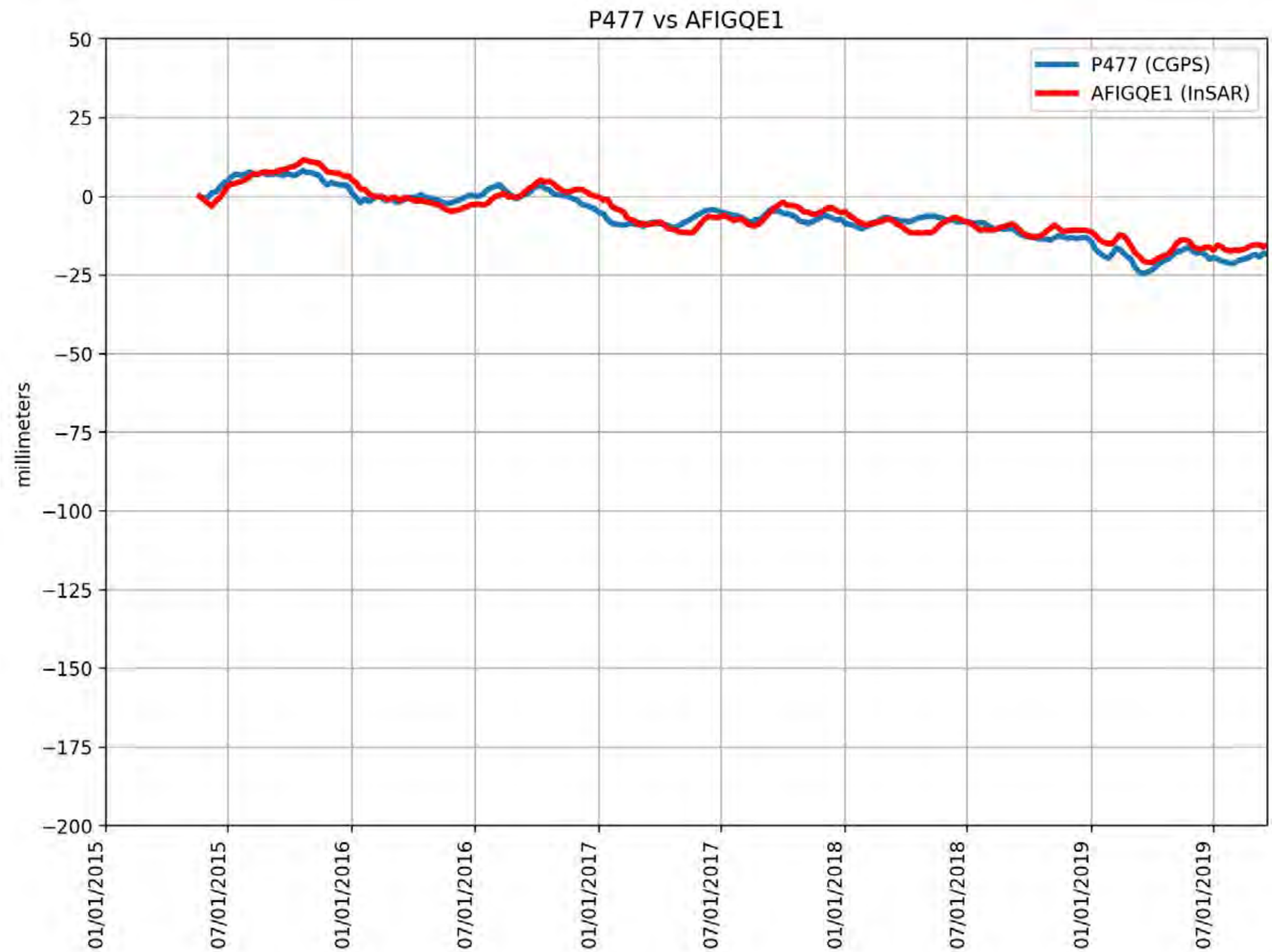
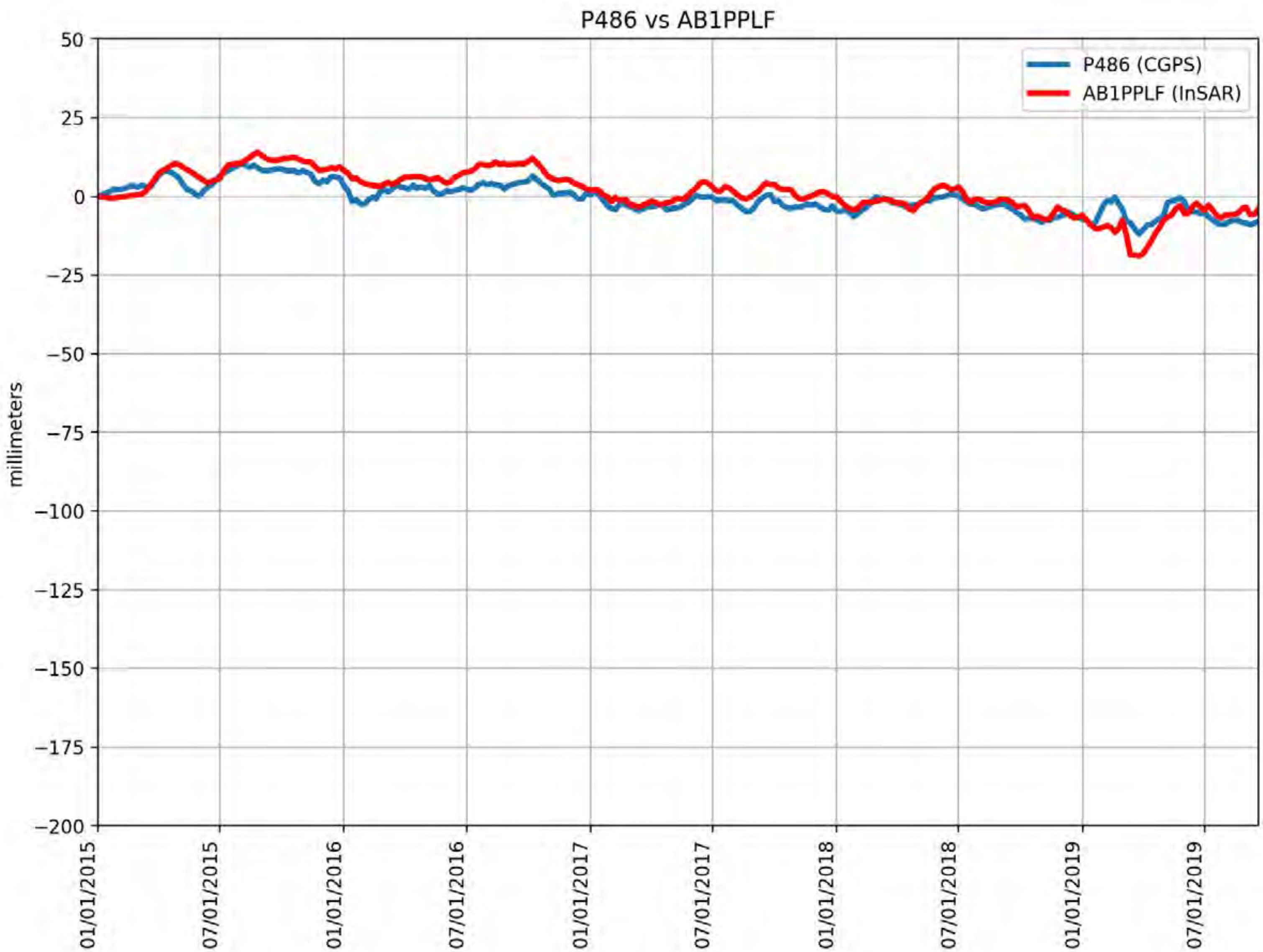


RMSE: 2.71 mm
Correlation: 0.95

Appendix B



RMSE: 3.72 mm
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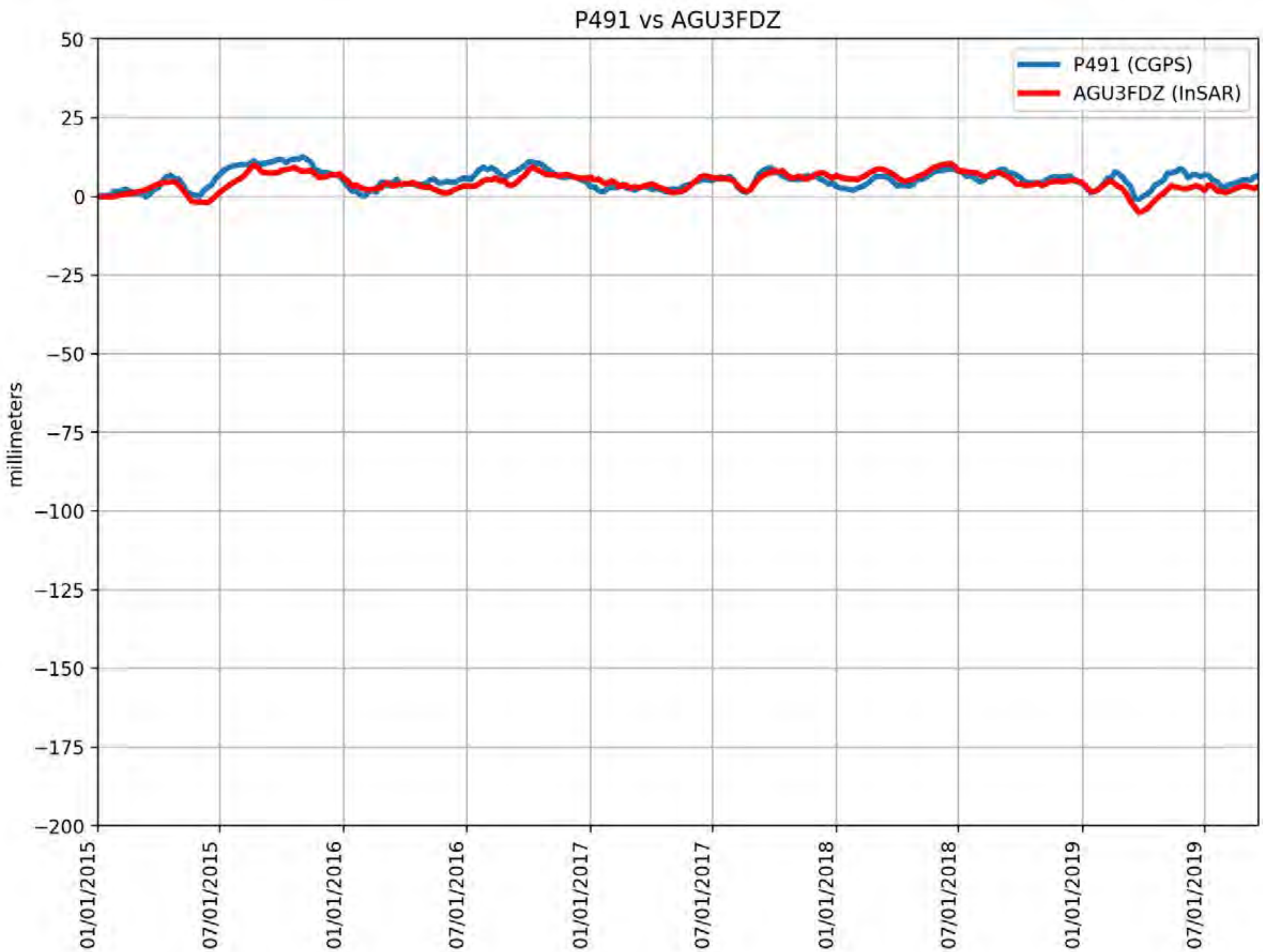
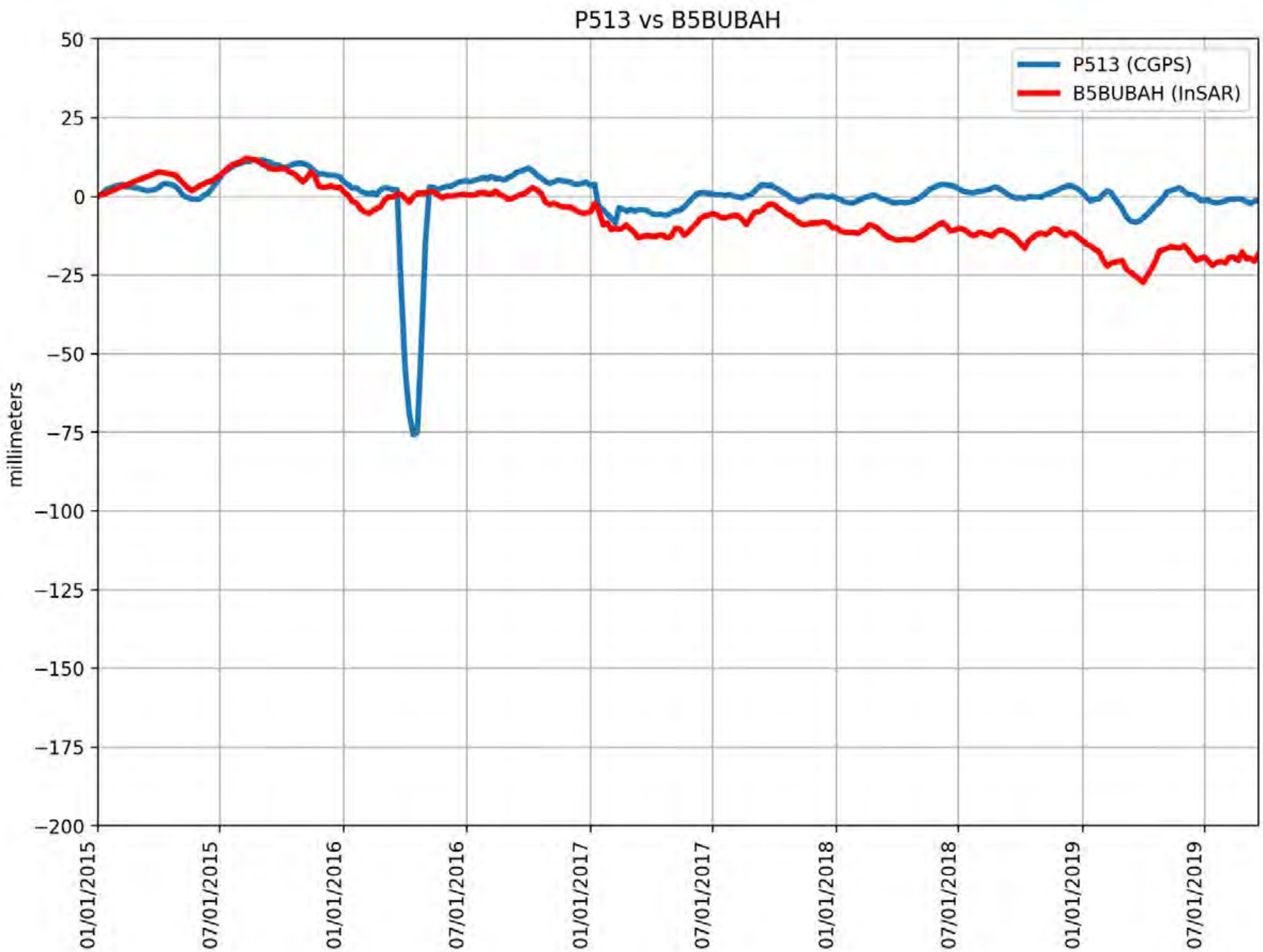
Appendix B



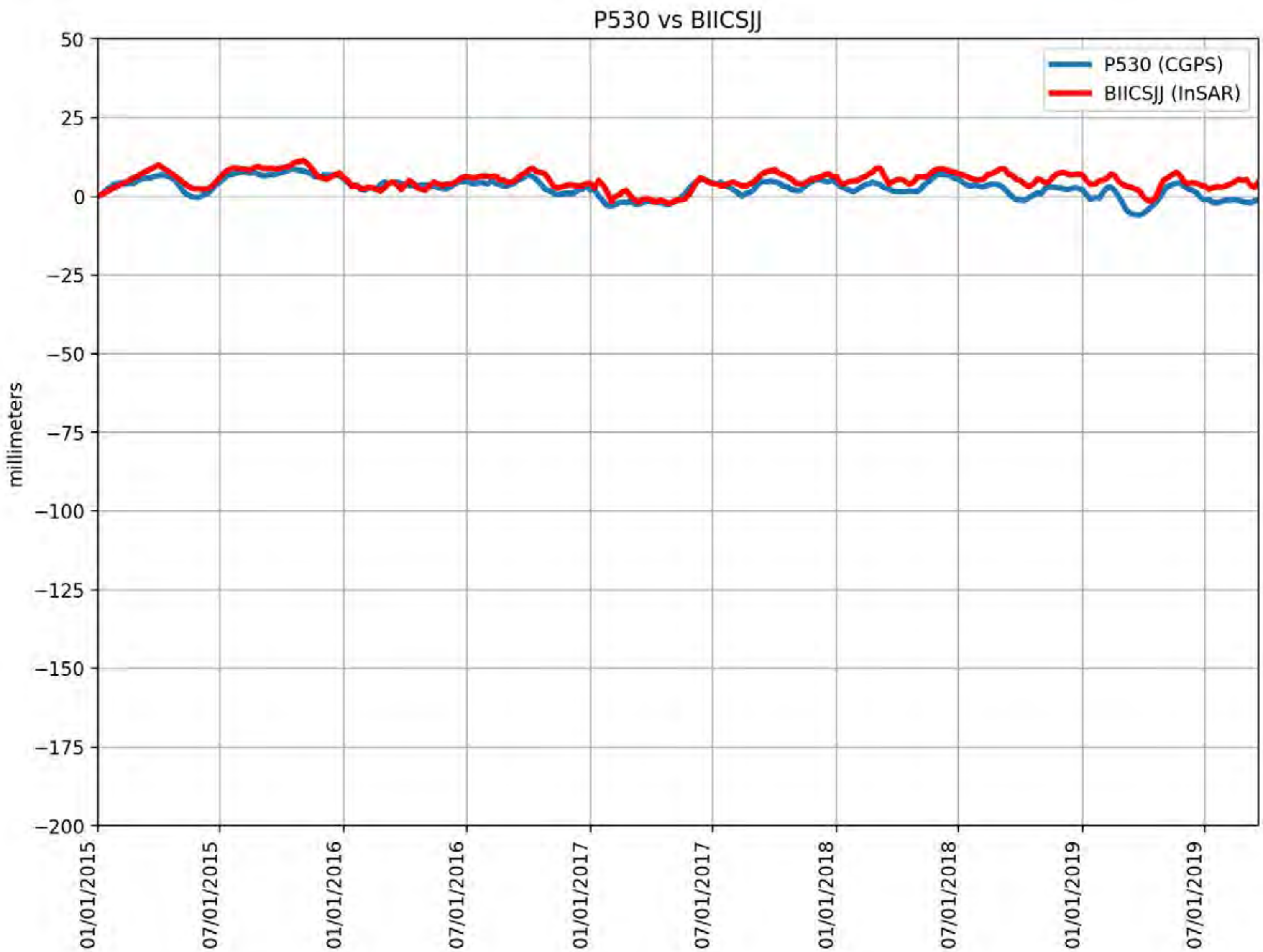
RMSE: 2.39 mm
Correlation: 0.69

Appendix B



RMSE: 13.50 mm
Correlation: 0.22

Appendix B



RMSE: 2.96 mm
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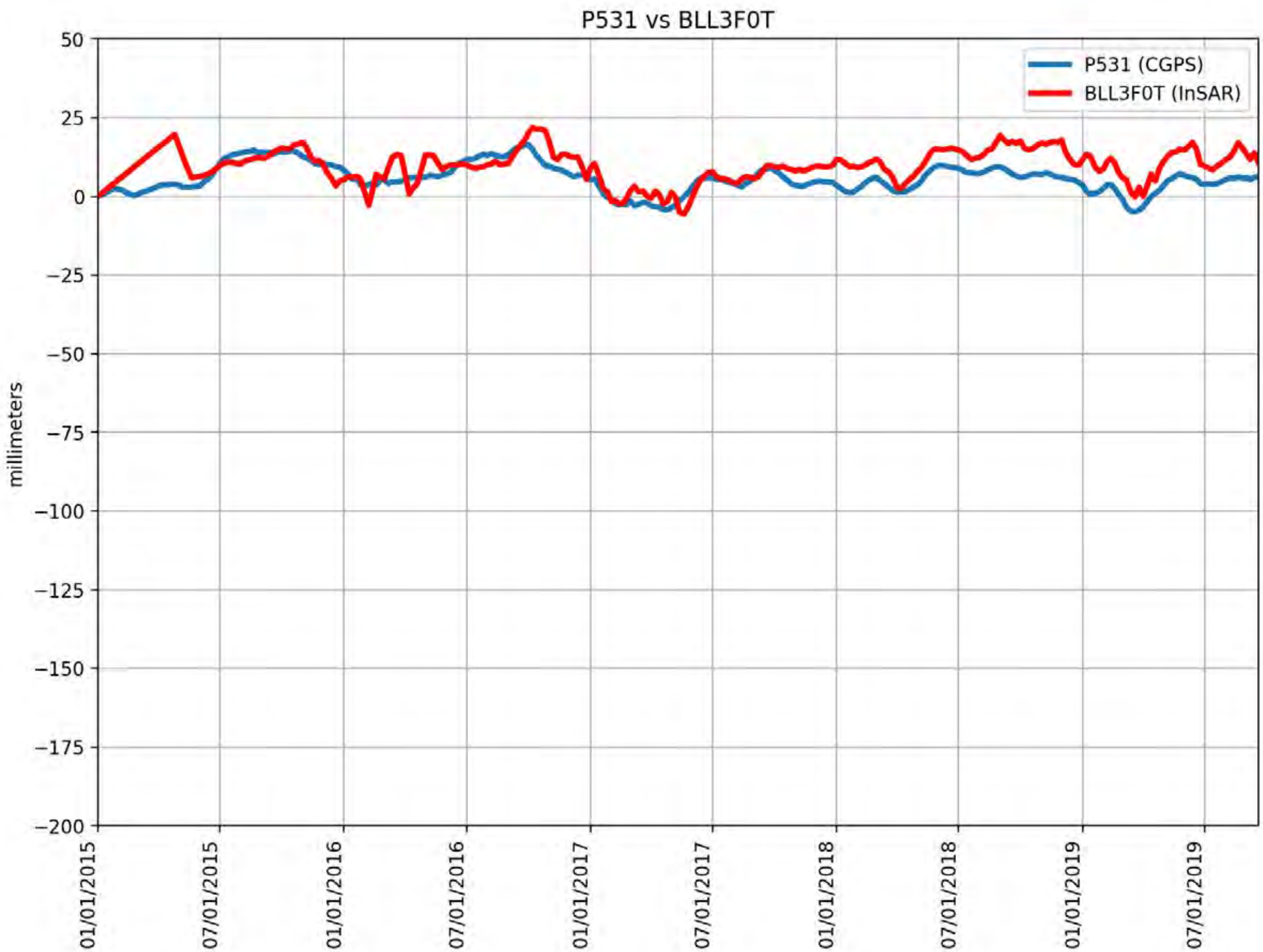

RMSE: 5.85 mm
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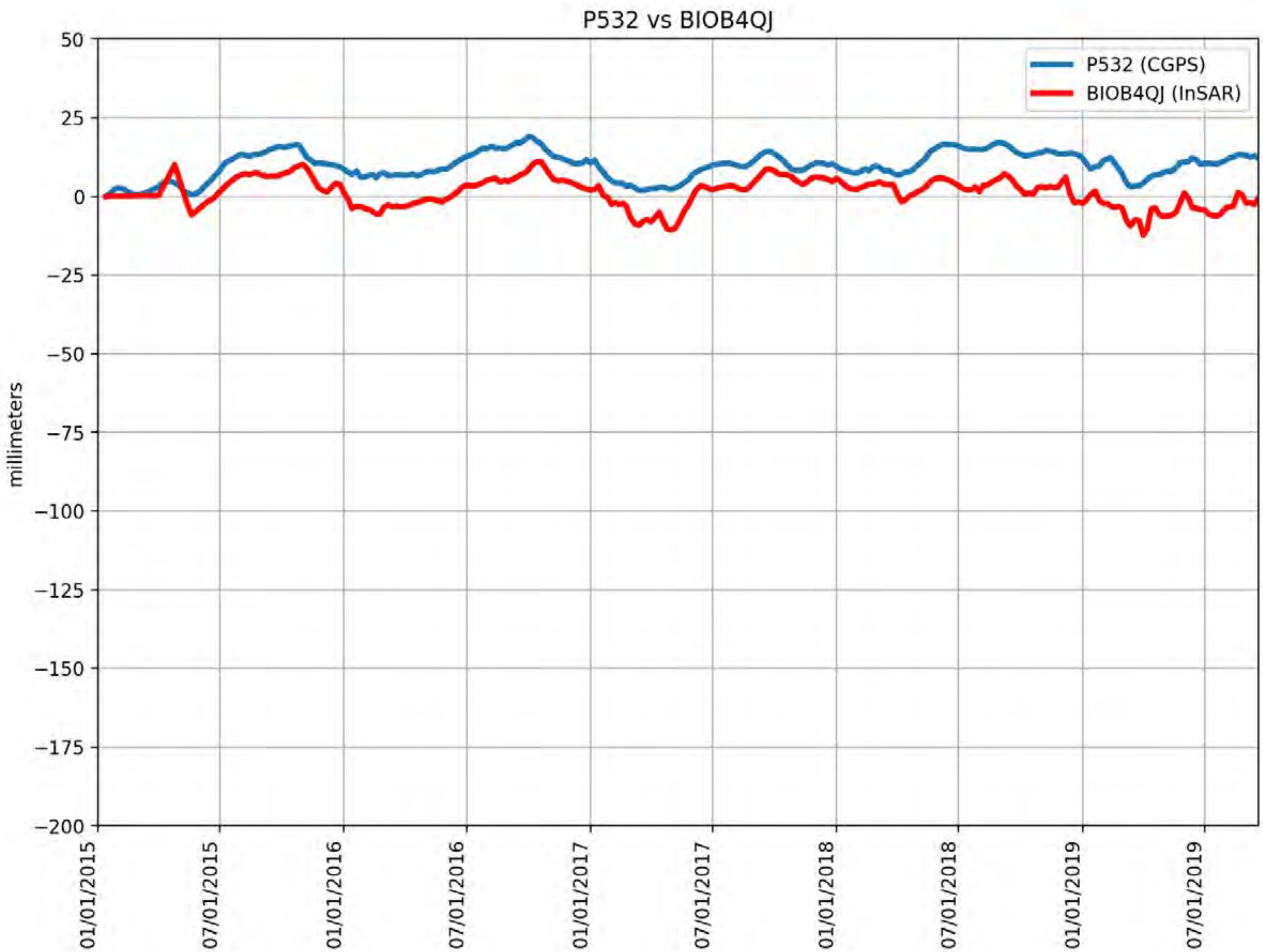
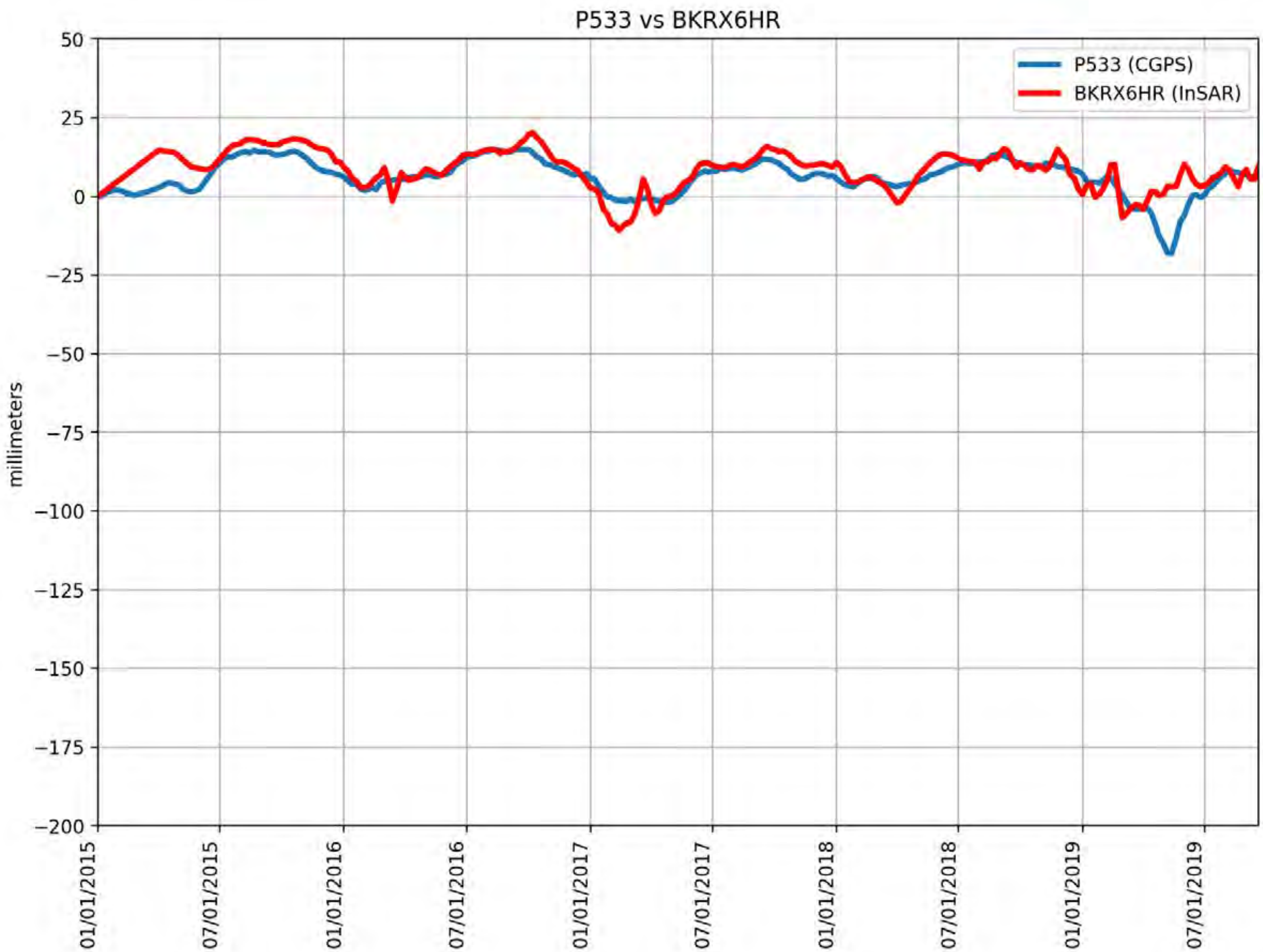


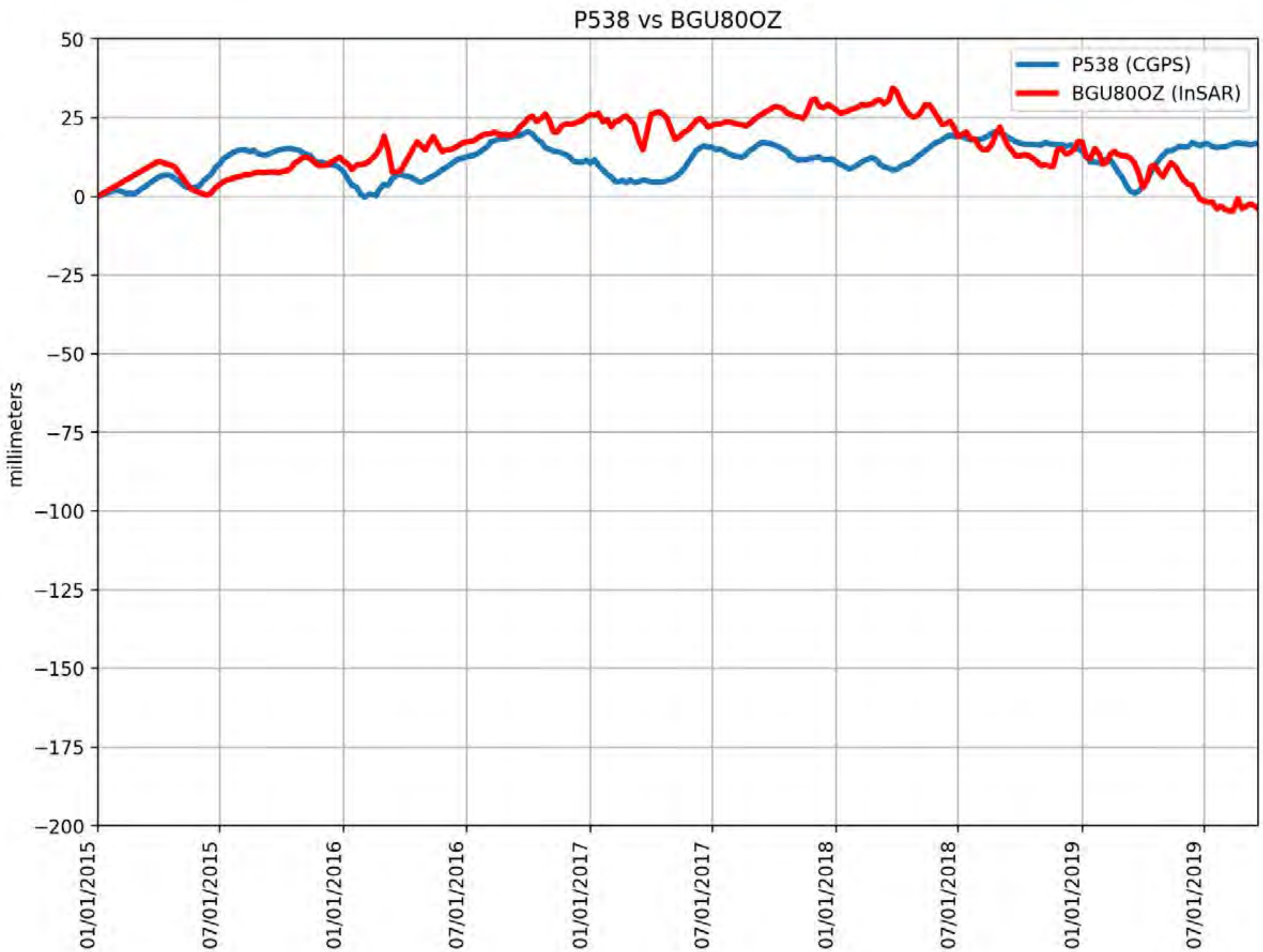
RMSE: 9.32 mm
Correlation: 0.65

Appendix B



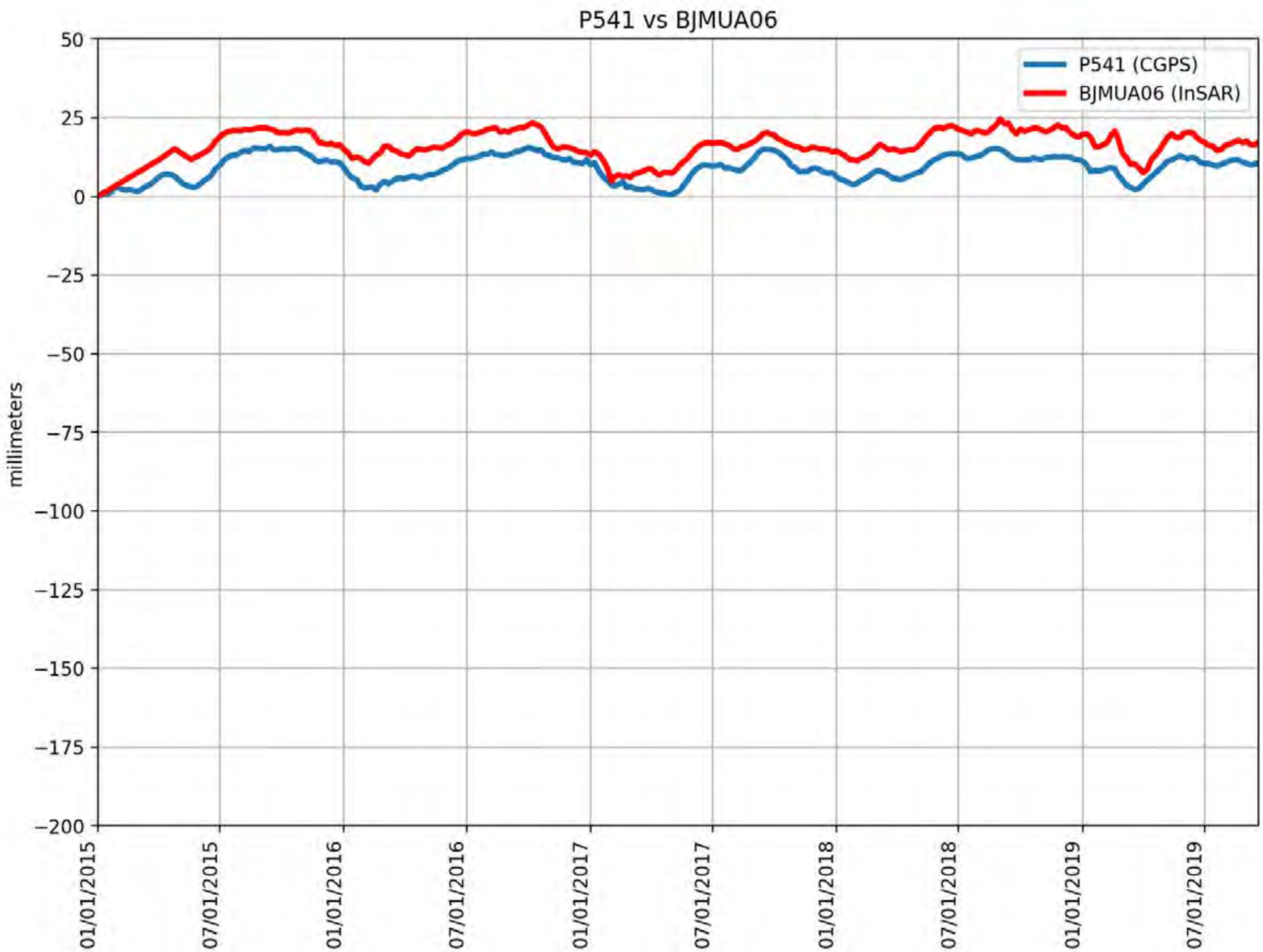
RMSE: 4.86 mm
Correlation: 0.73

Appendix B



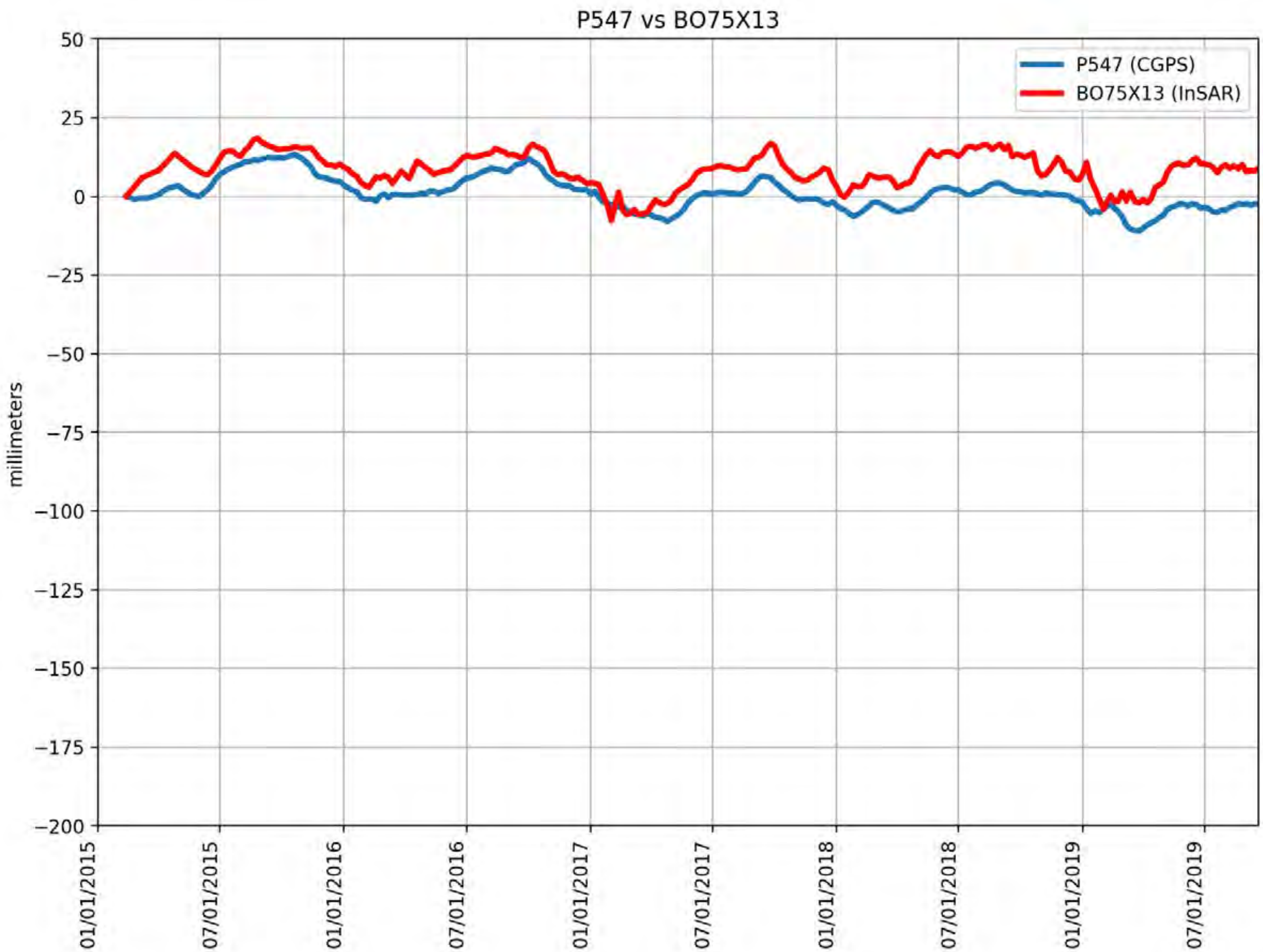
RMSE: 10.81 mm
Correlation: 0.15

Appendix B



RMSE: 7.24 mm
Correlation: 0.91

Appendix B



RMSE: 8.13 mm
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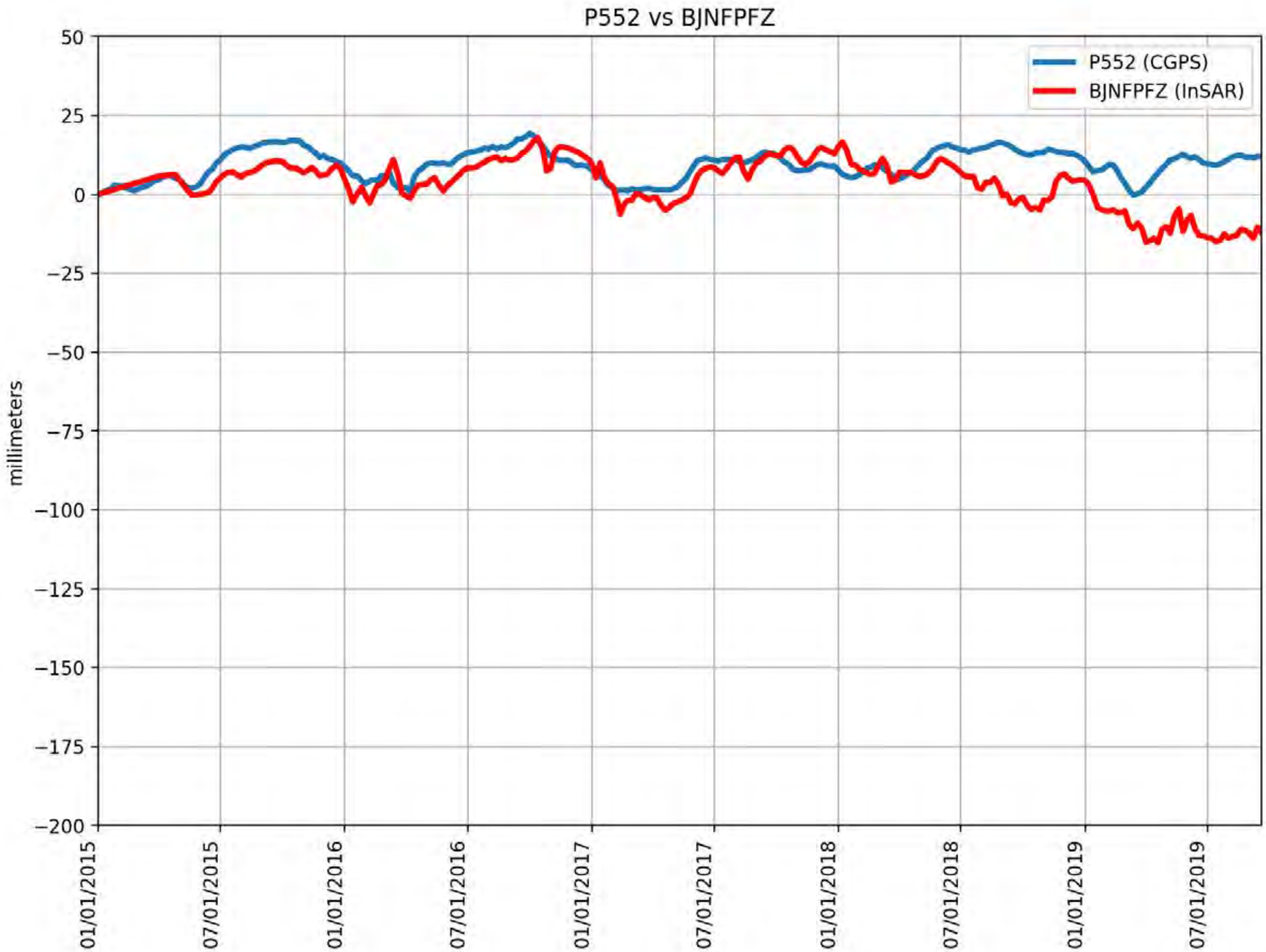
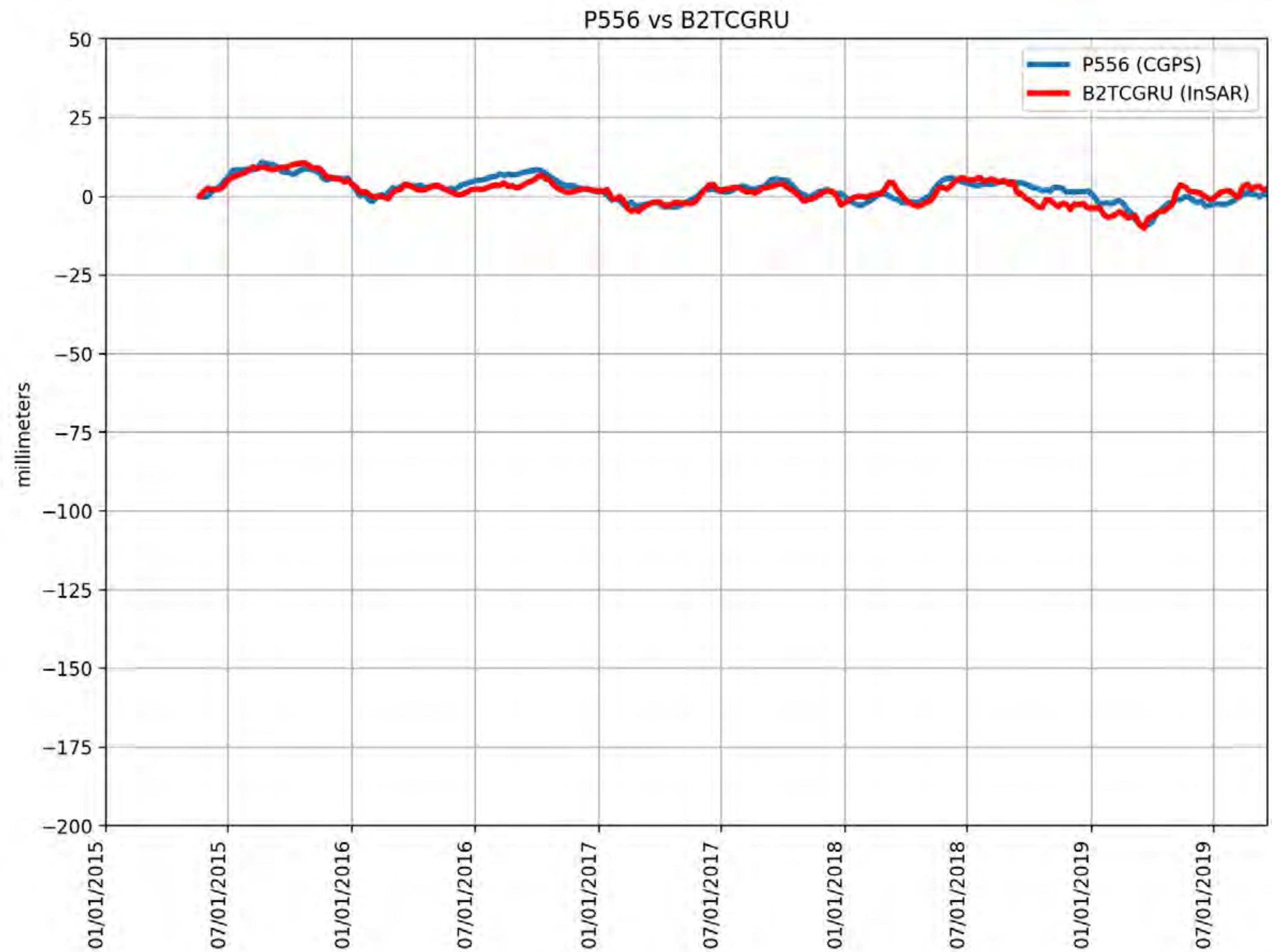
Appendix B



RMSE: 9.51 mm
Correlation: 0.32

Appendix B



RMSE: 2.20 mm
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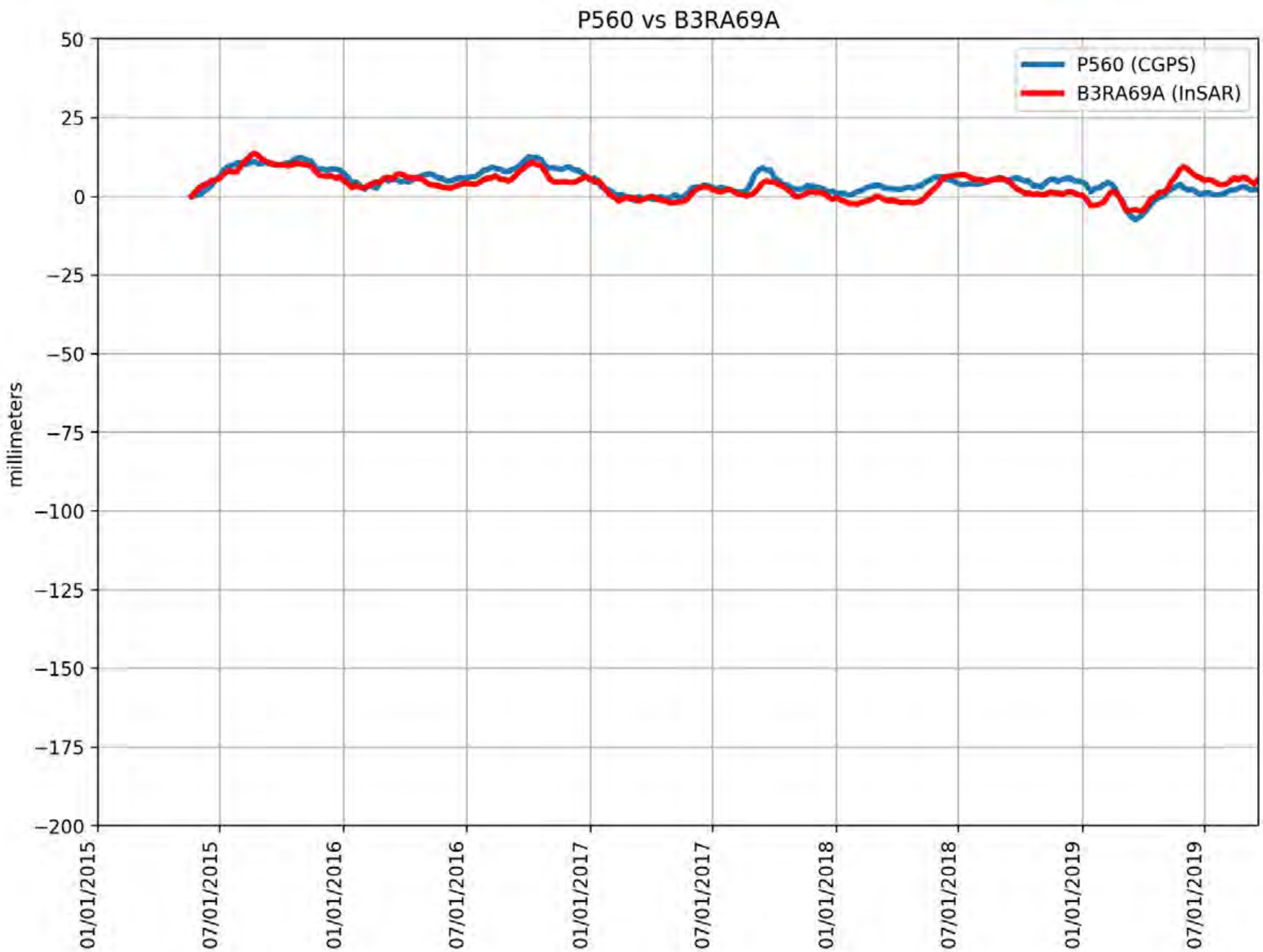
Appendix B



RMSE: 2.70 mm
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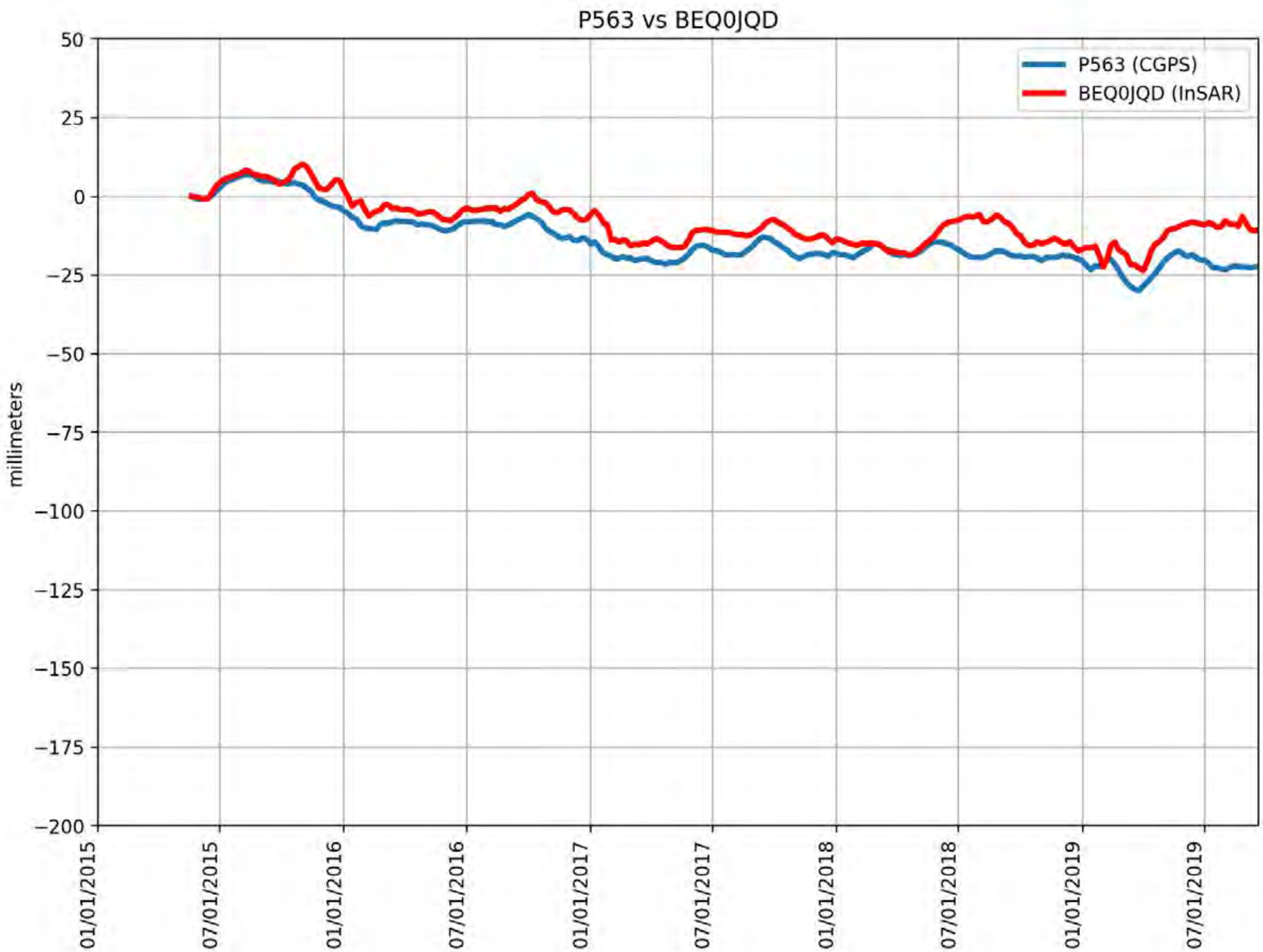

RMSE: 6.54 mm
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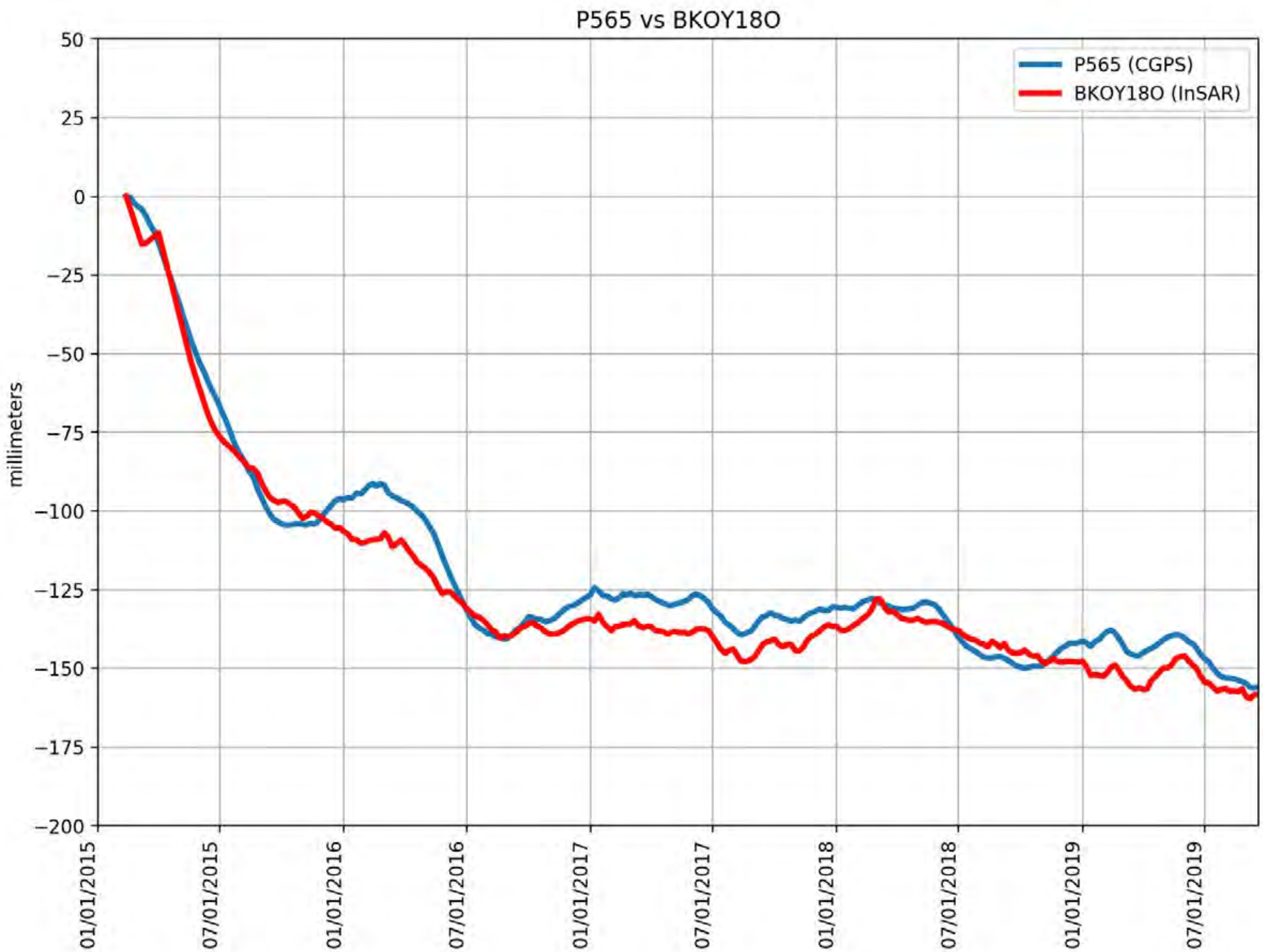

RMSE: 7.80 mm
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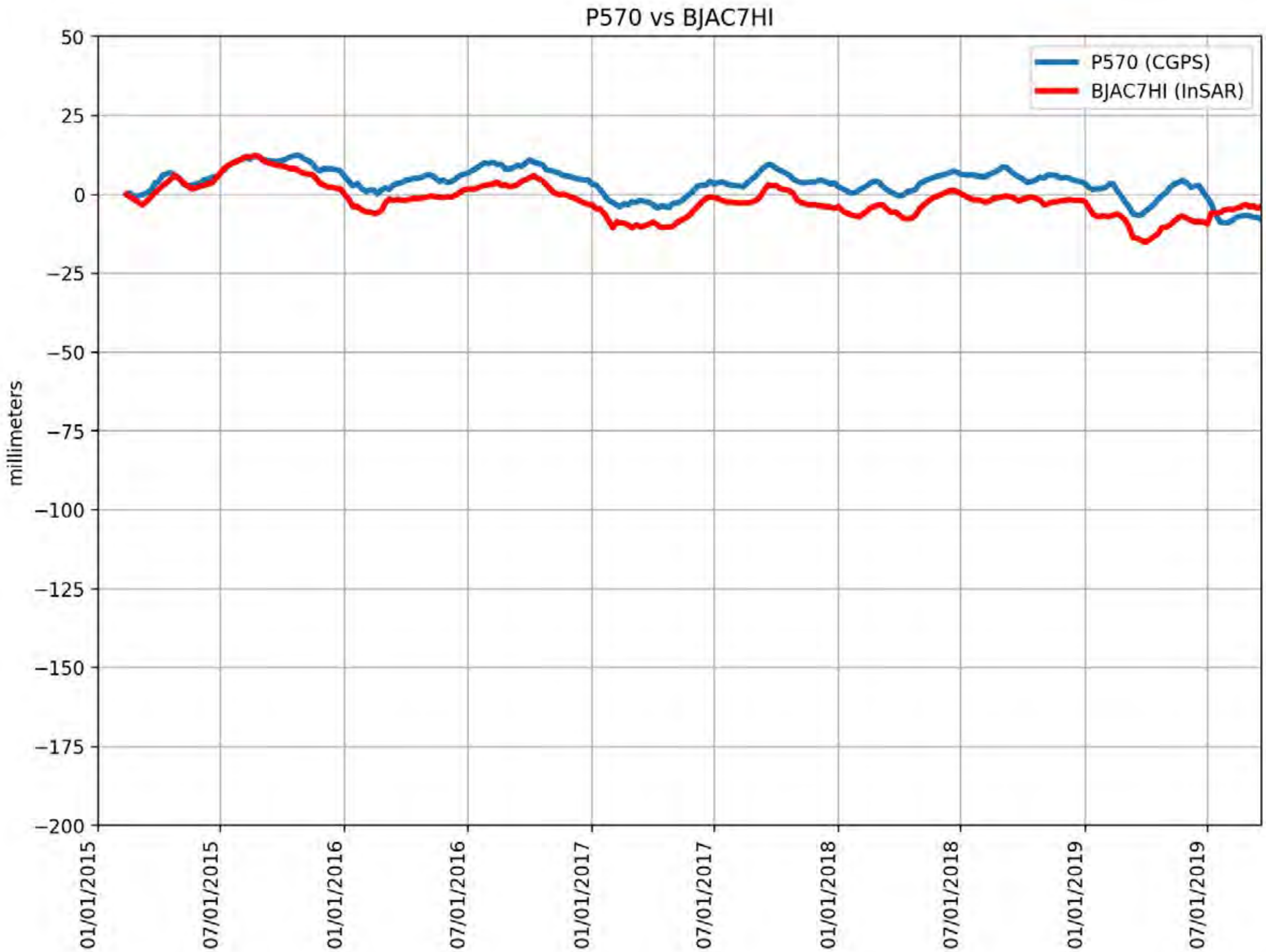
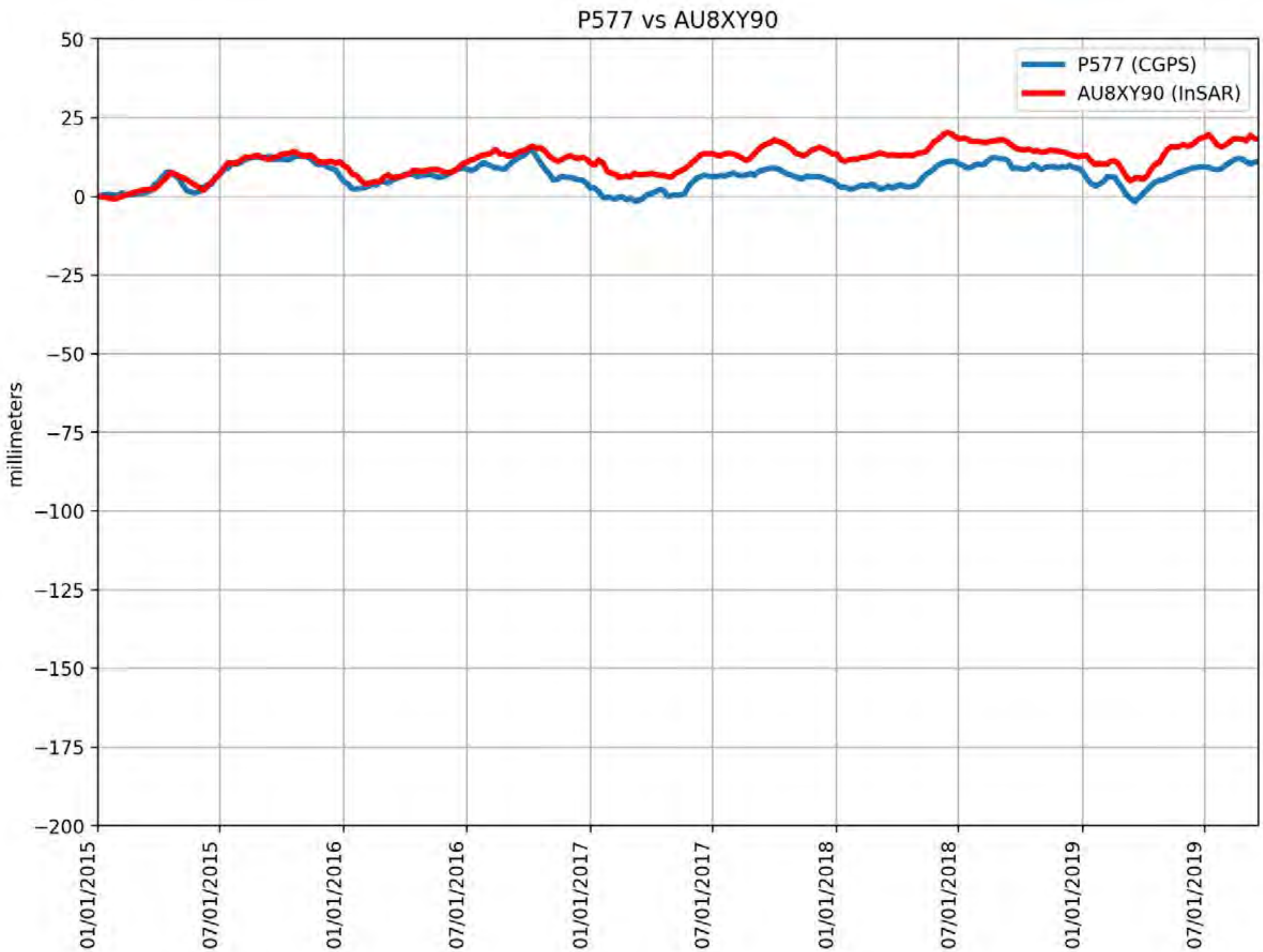


RMSE: 6.34 mm
Correlation: 0.81

Appendix B



RMSE: 5.98 mm
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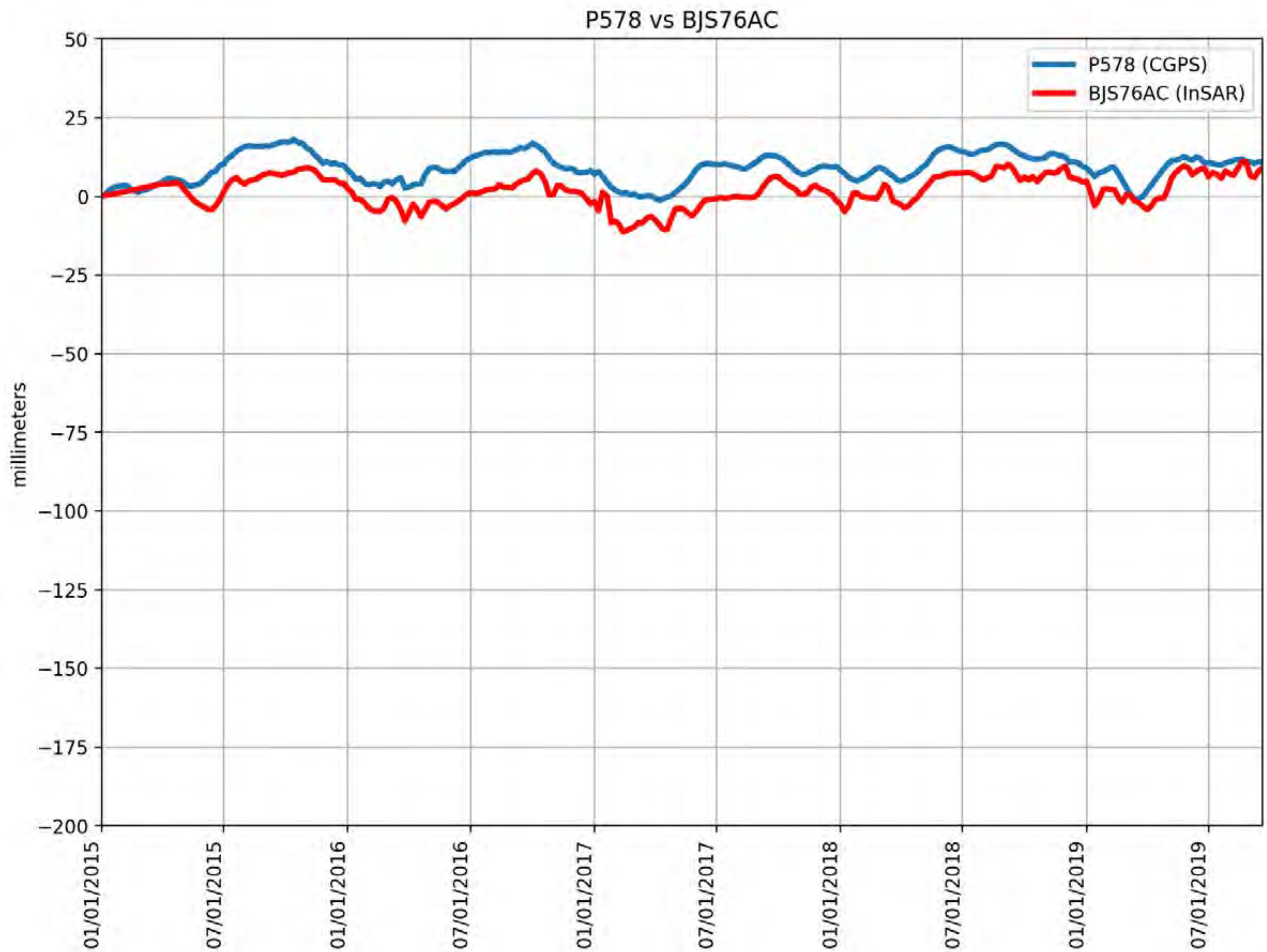
Appendix B



RMSE: 7.84 mm
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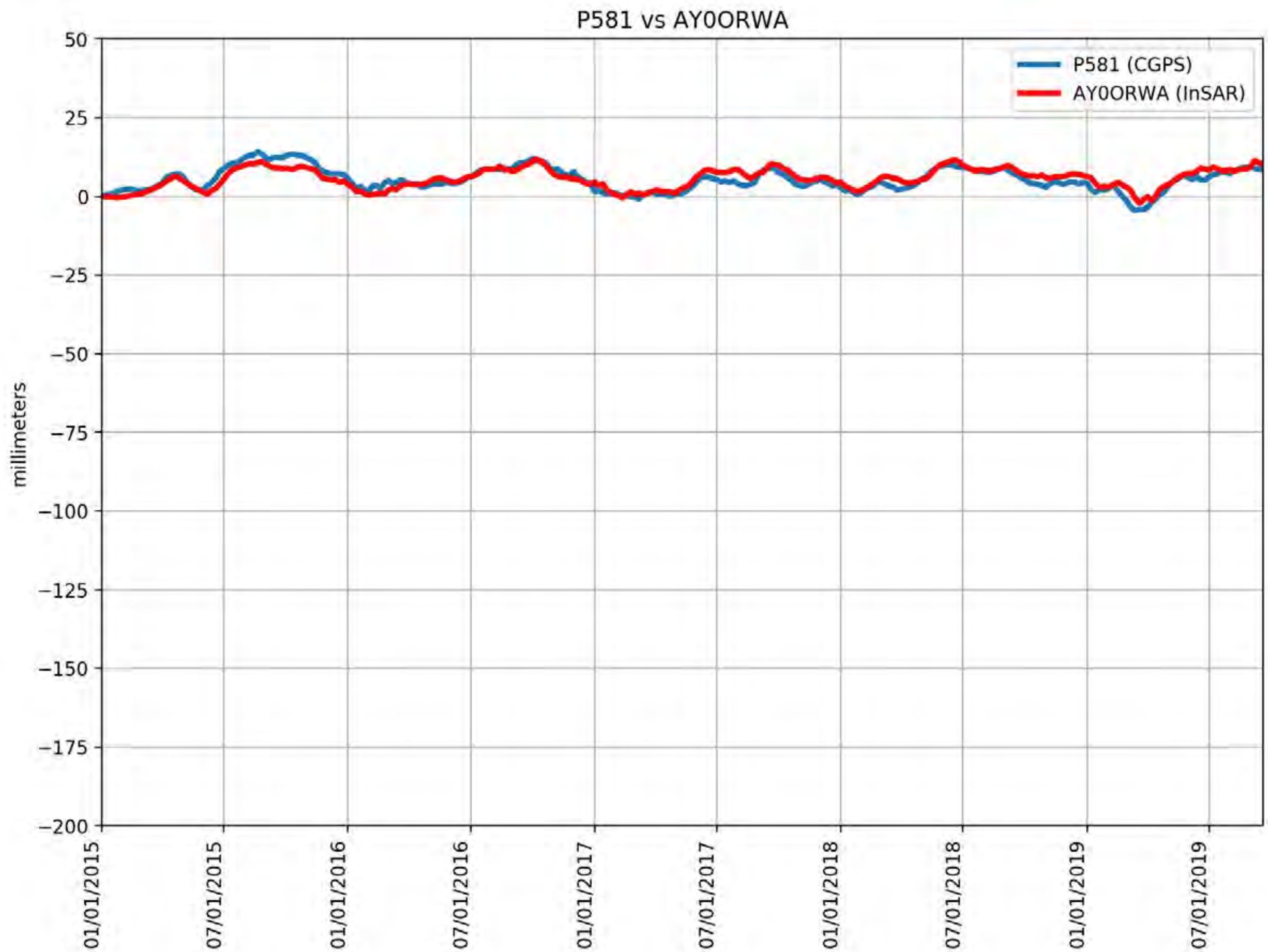

RMSE: 1.91 mm
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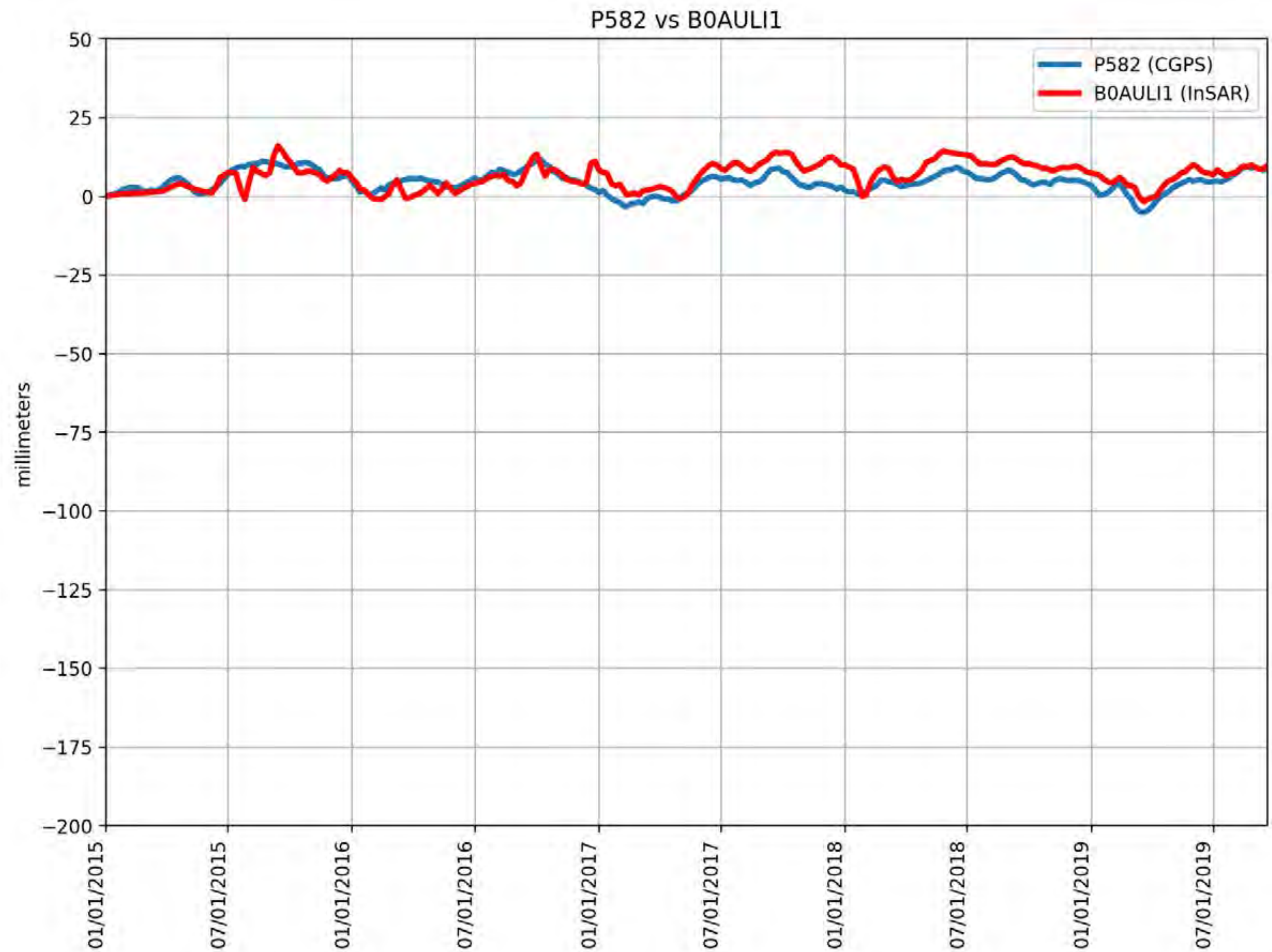
Appendix B



RMSE: 3.79 mm
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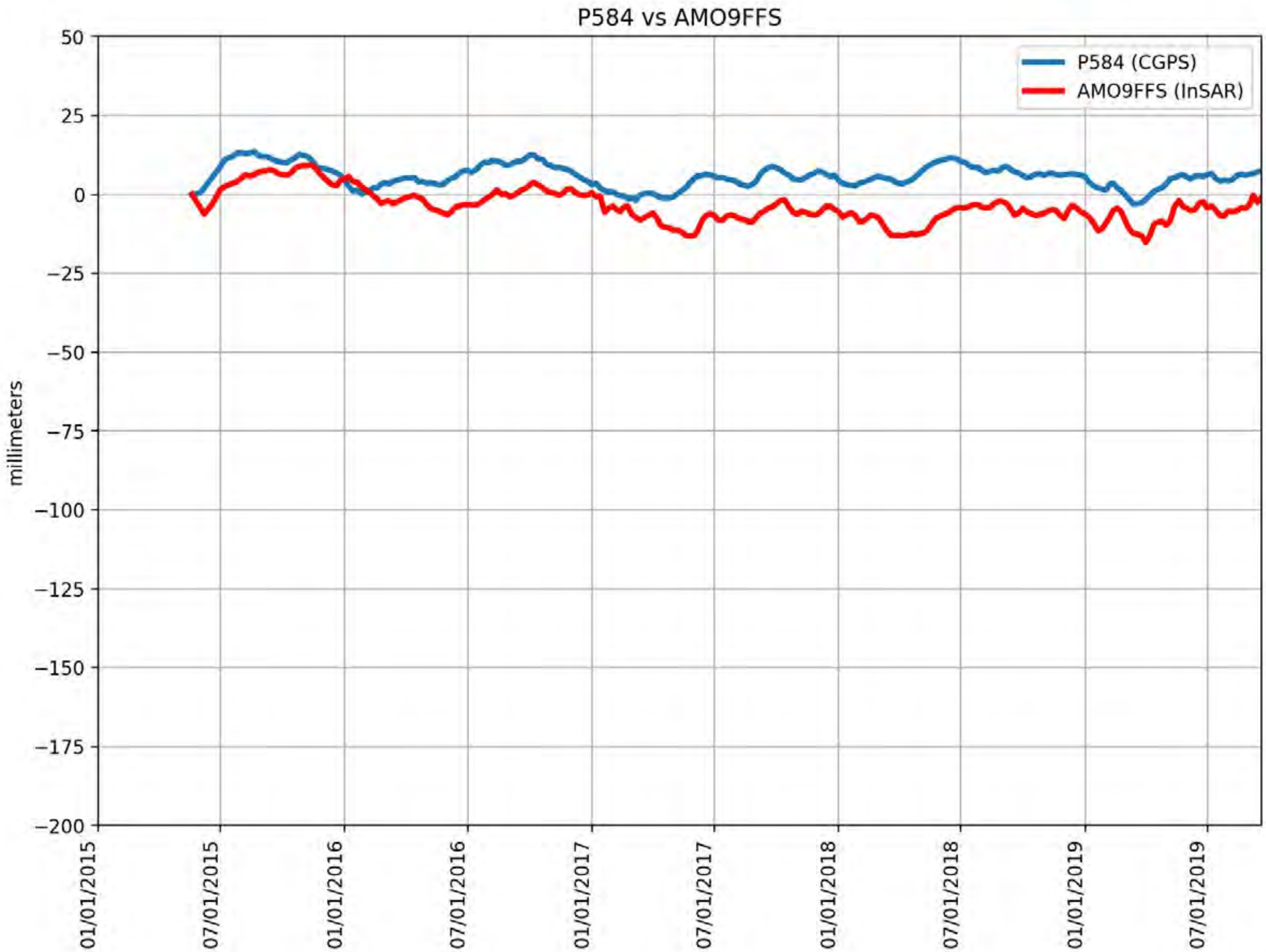

RMSE: 10.35 mm
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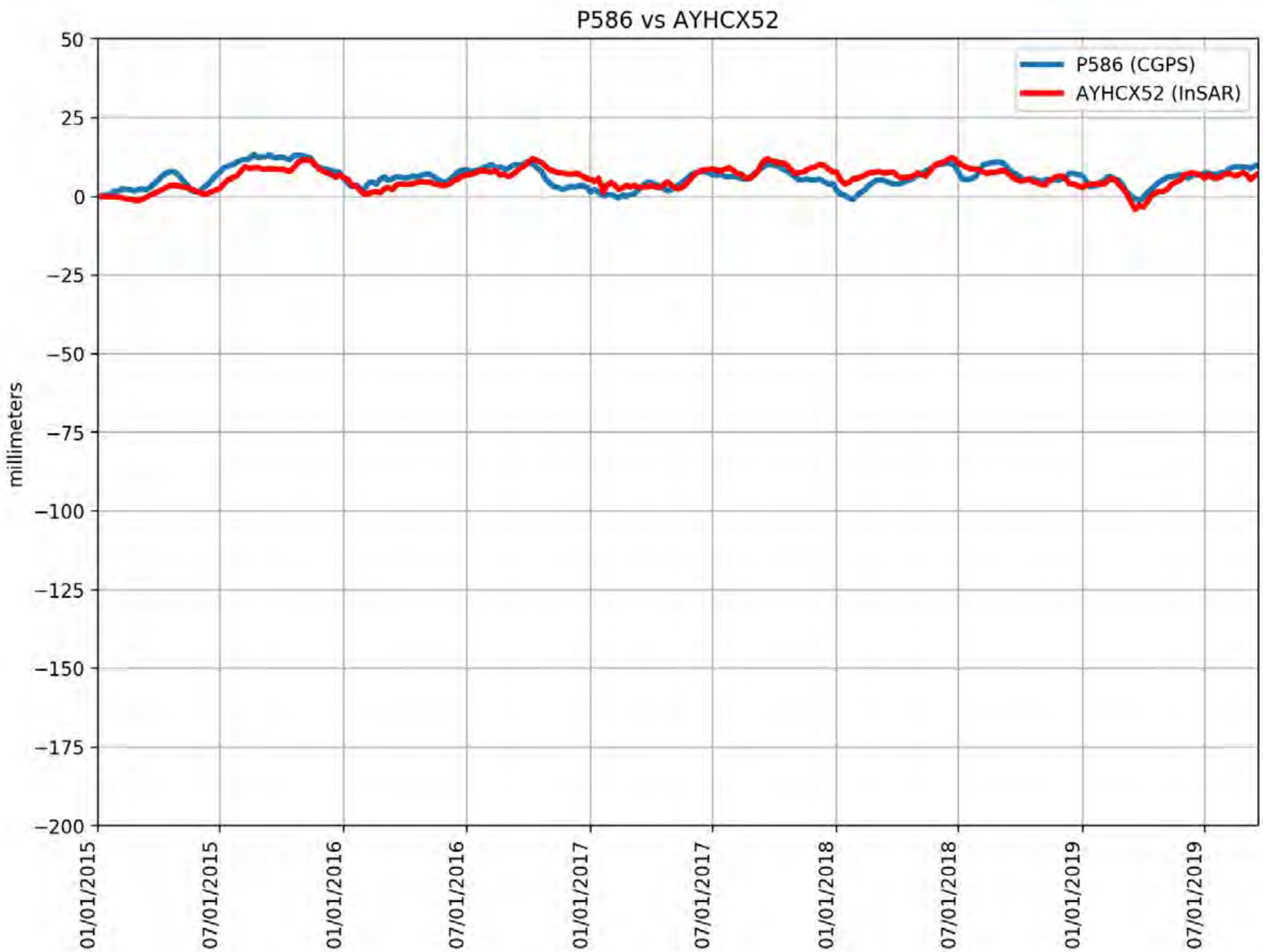

RMSE: 2.61 mm
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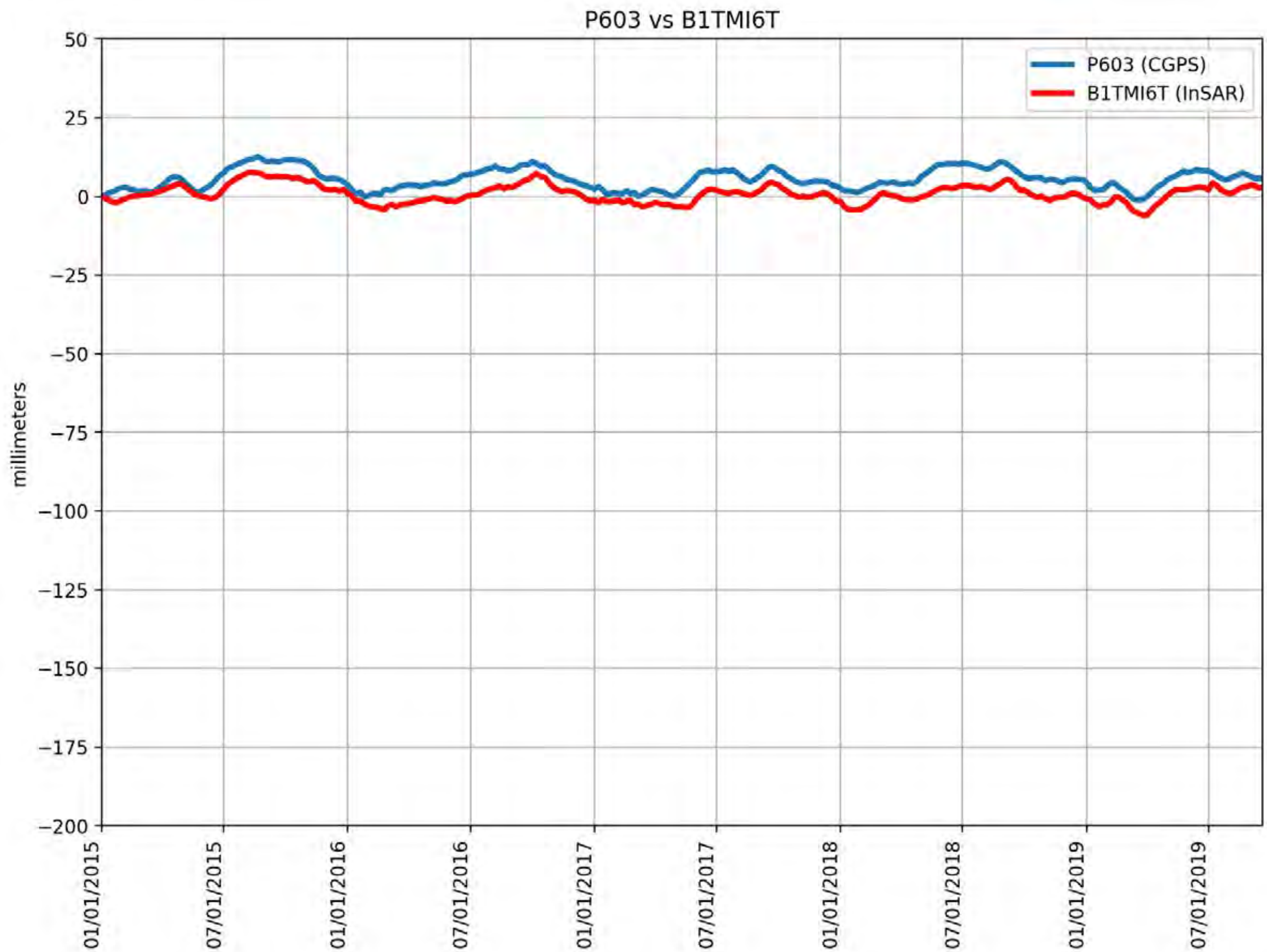
Appendix B



RMSE: 4.88 mm
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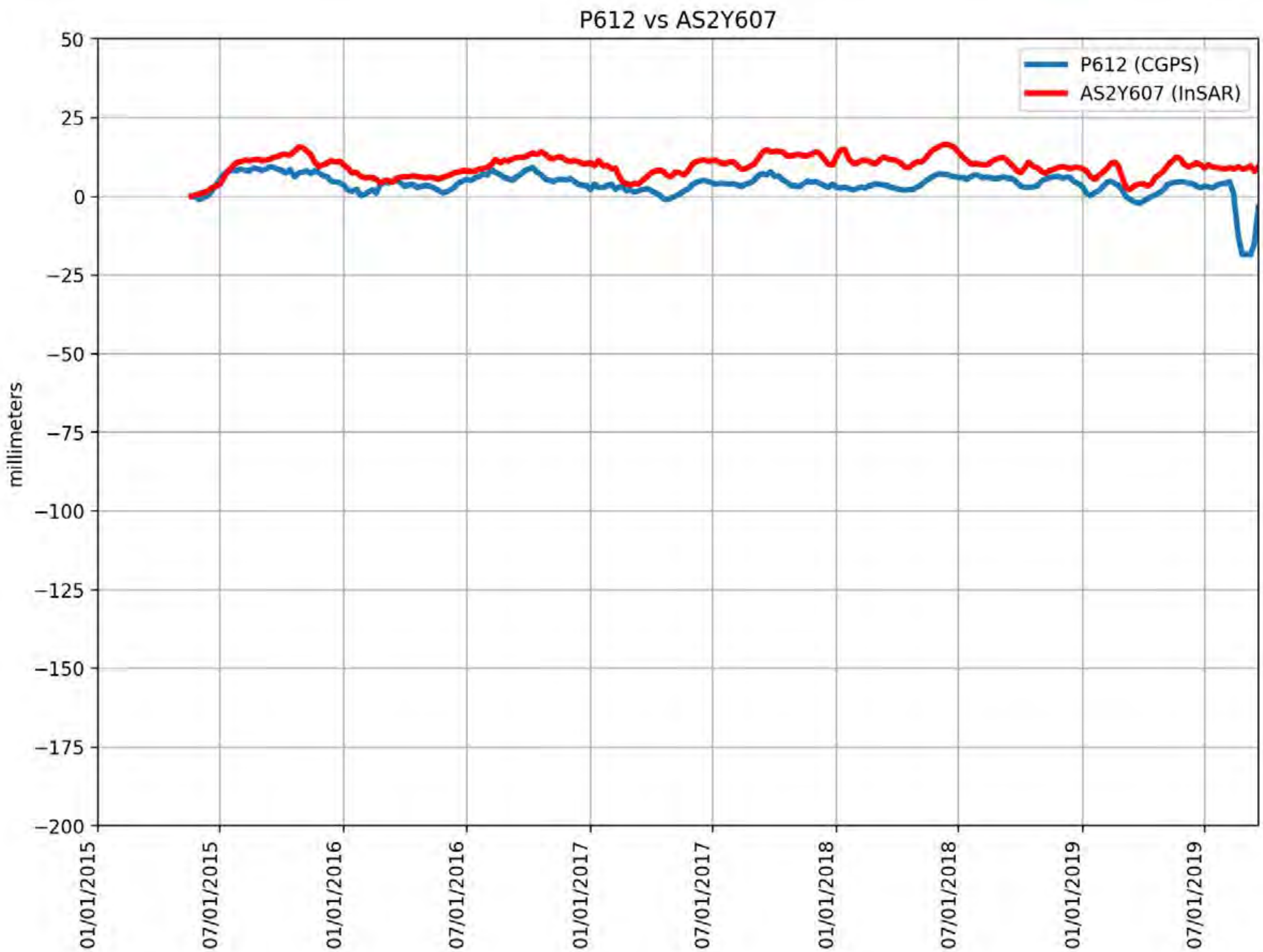

RMSE: 6.94 mm
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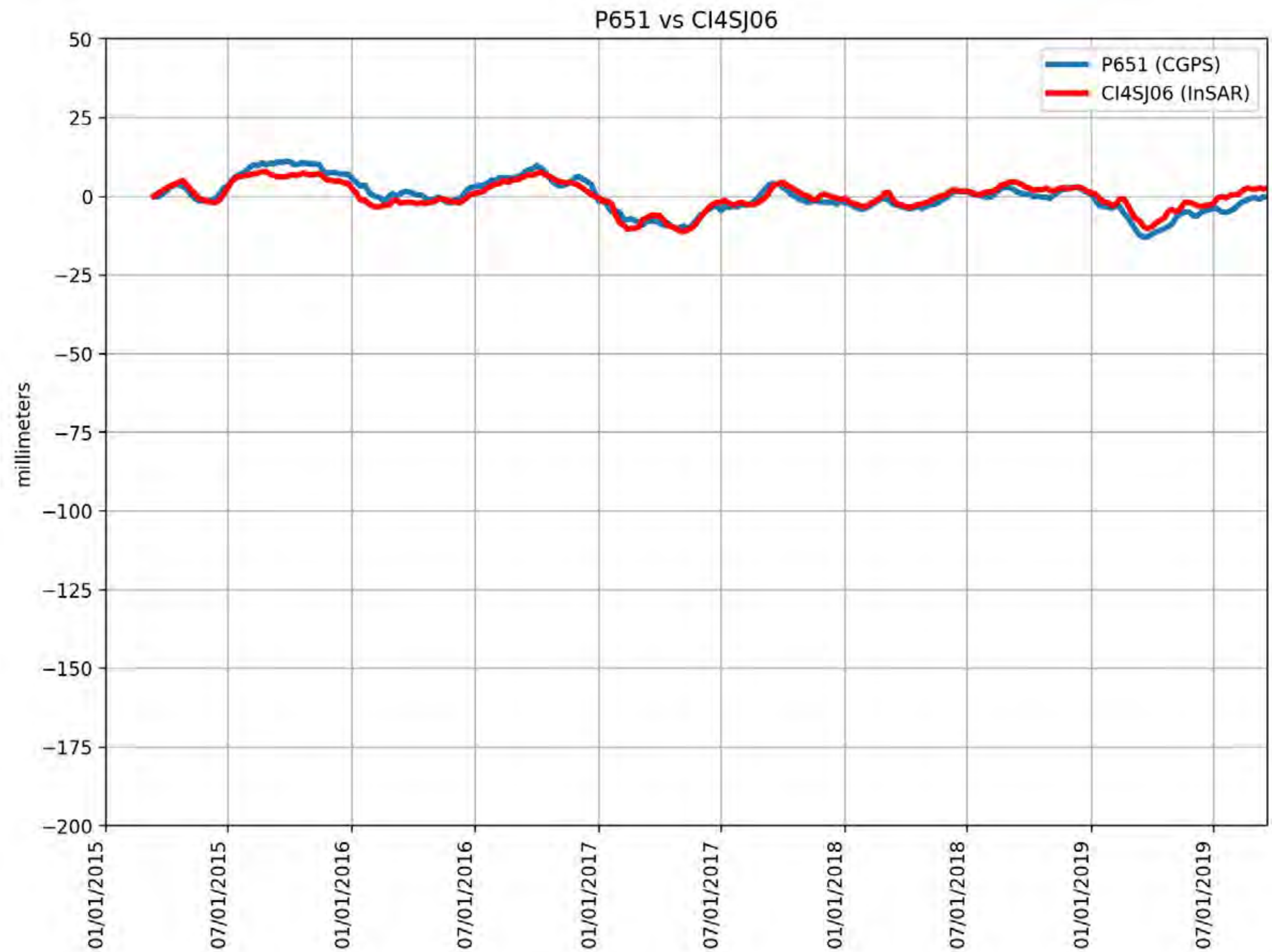
Appendix B



RMSE: 2.19 mm
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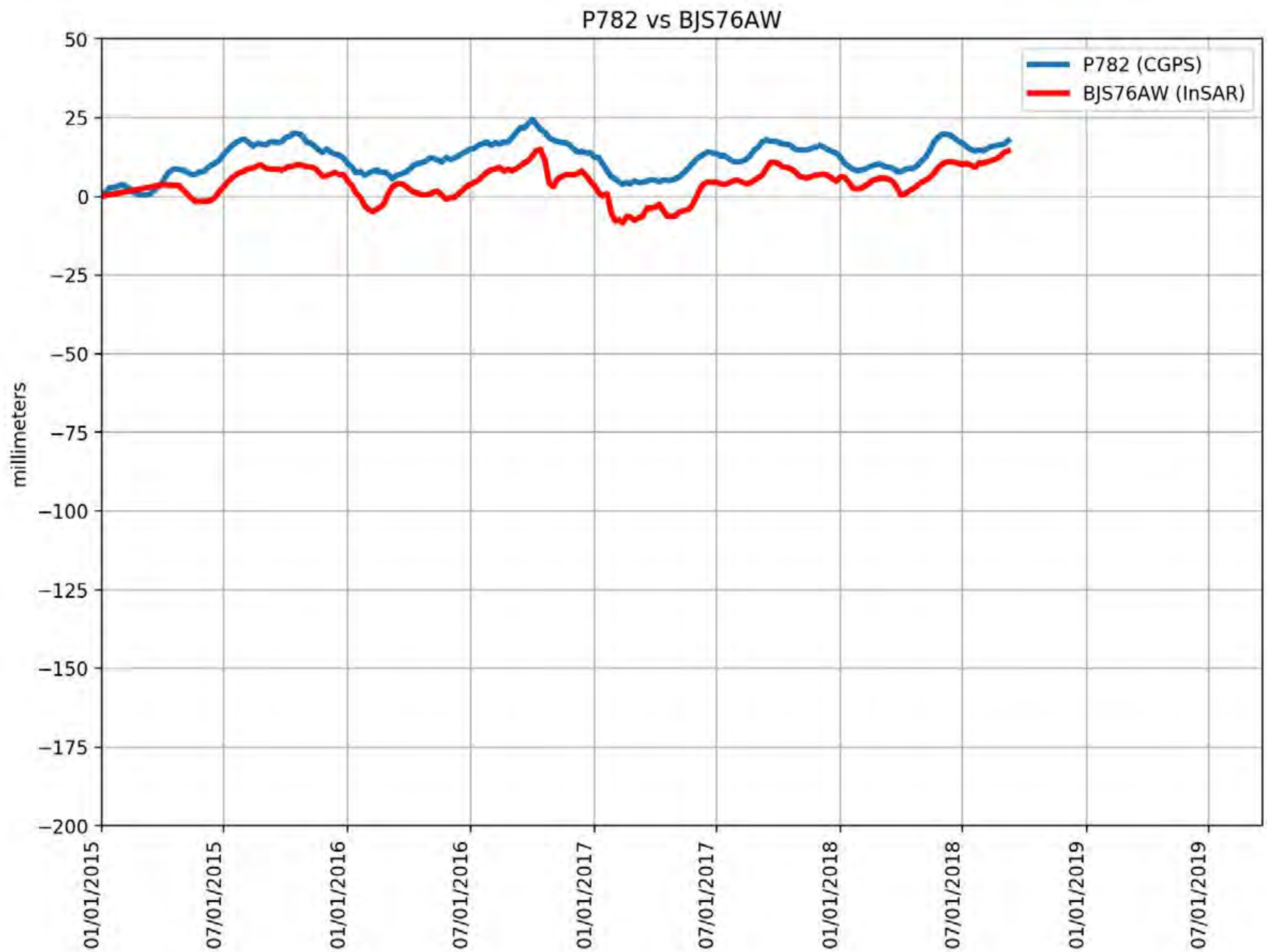
Appendix B



RMSE: 8.52 mm
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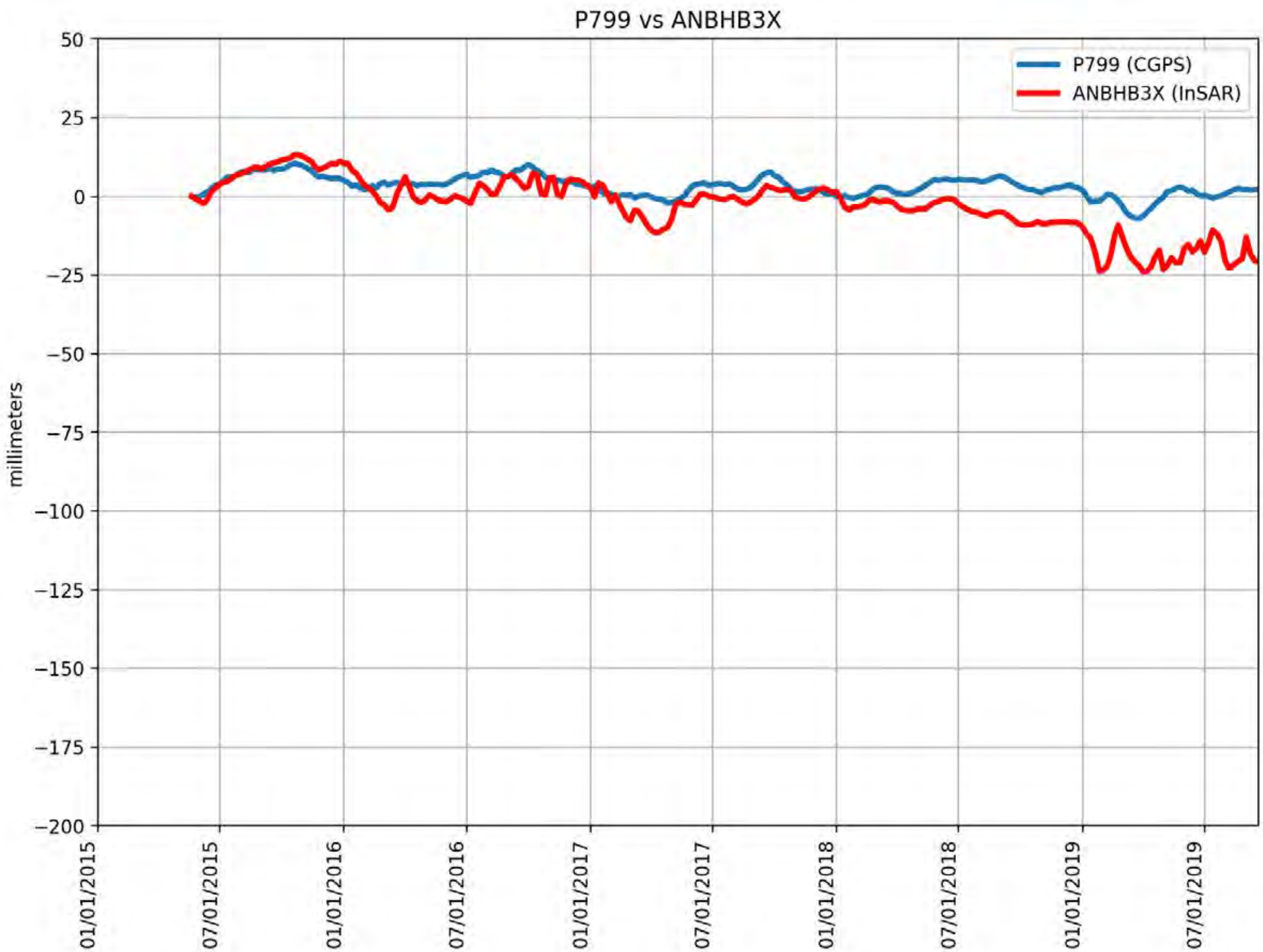
Appendix B



RMSE: 9.14 mm
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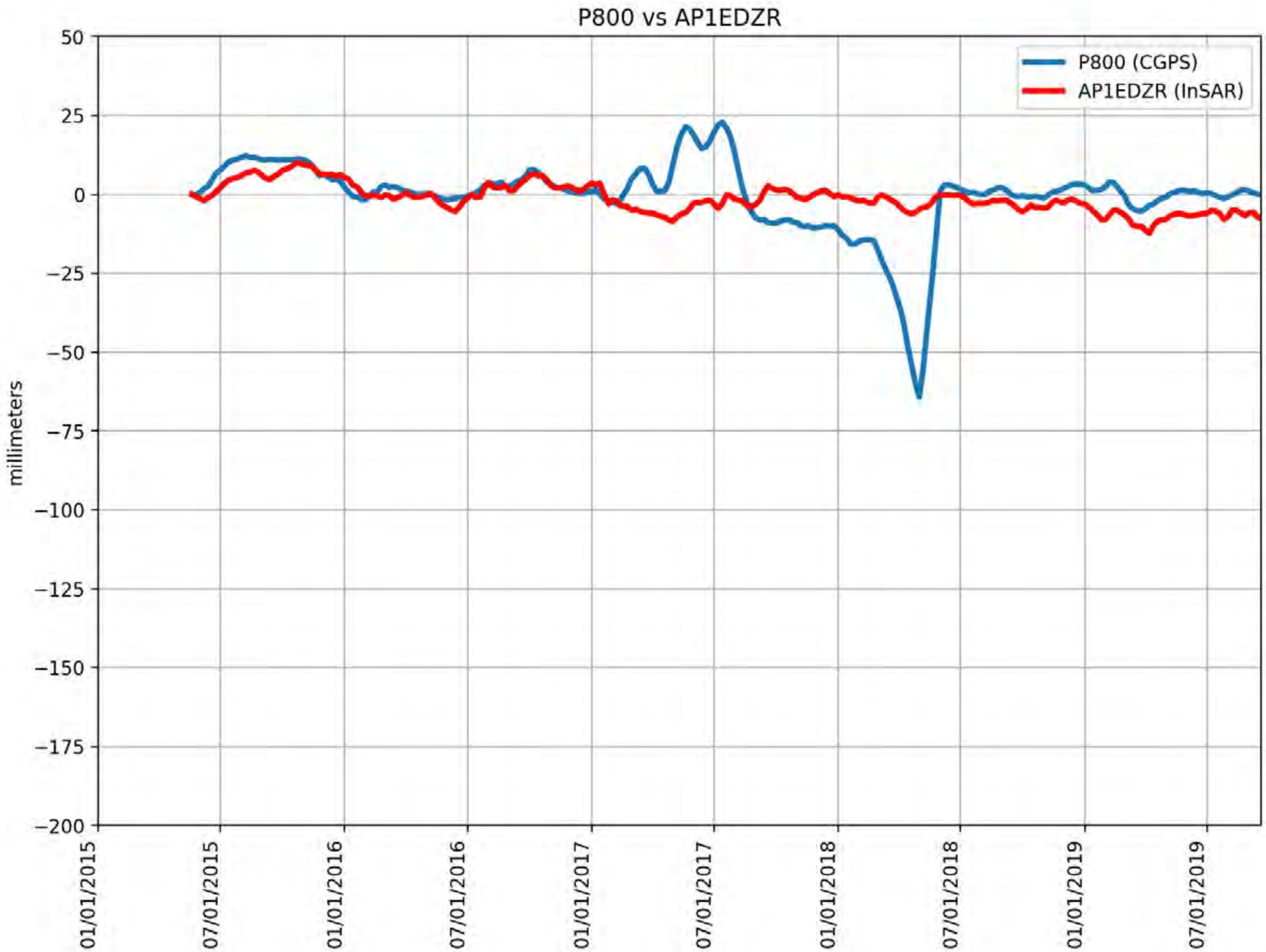
Appendix B



RMSE: 11.69 mm
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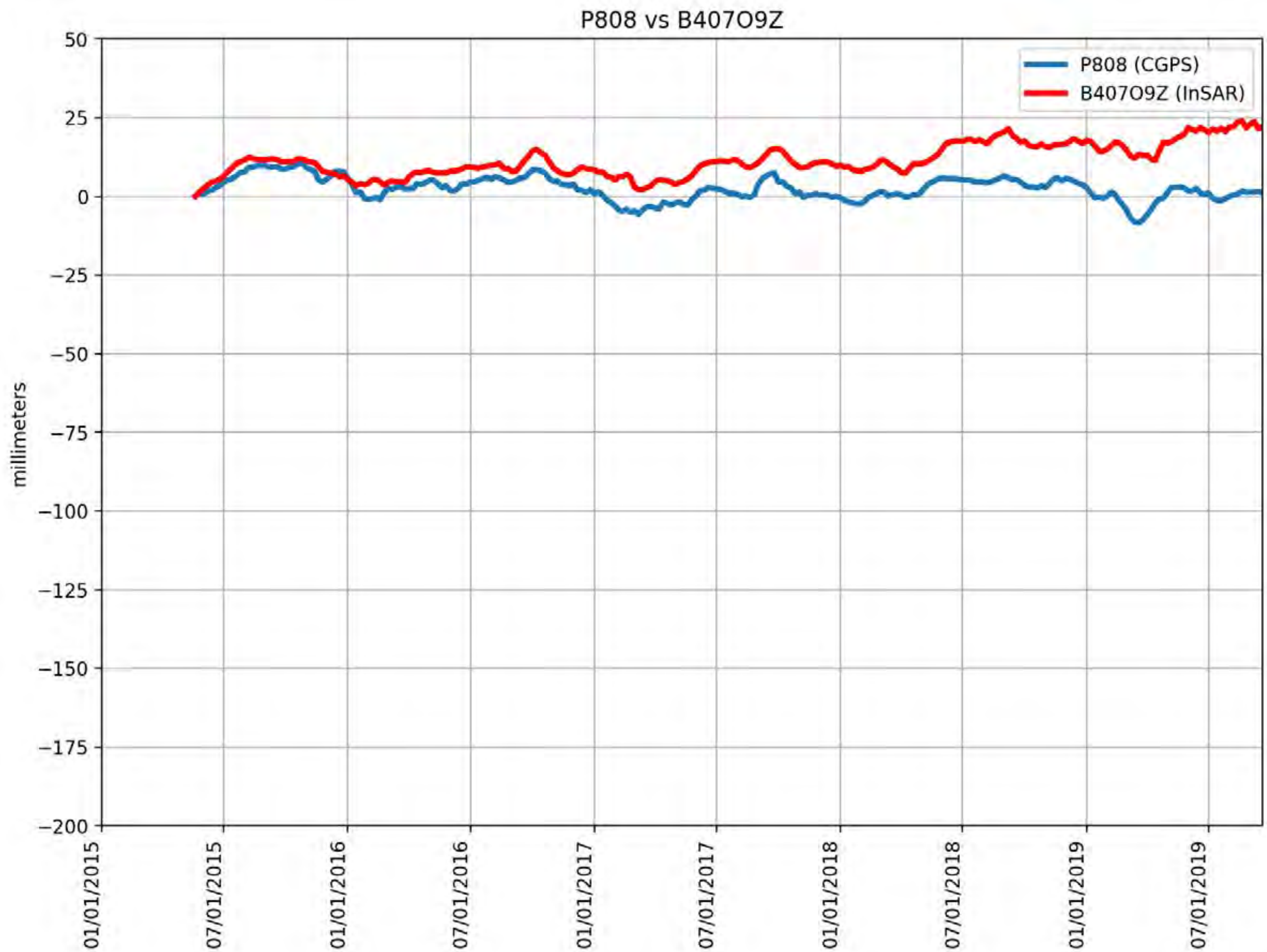
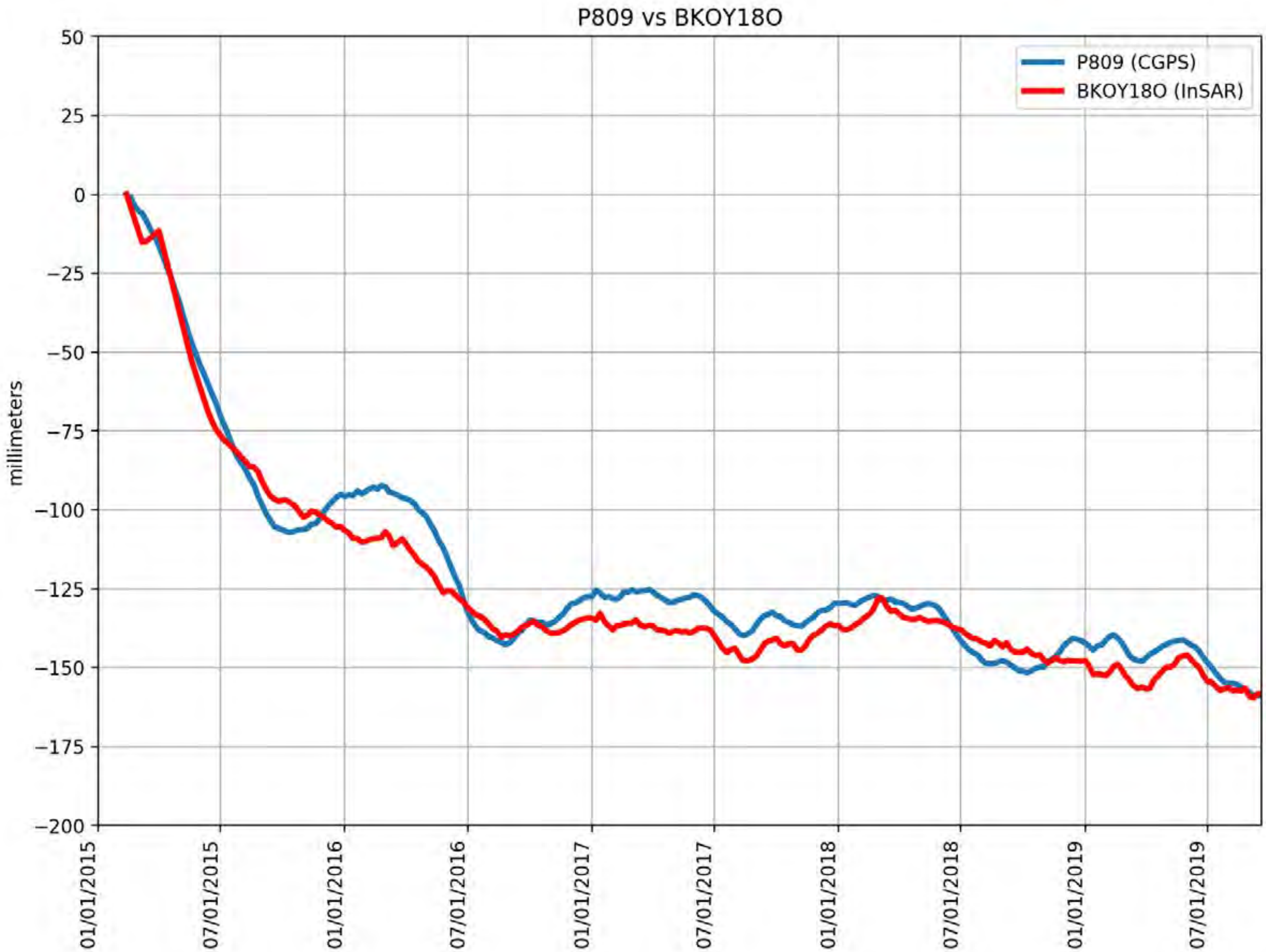
Appendix B



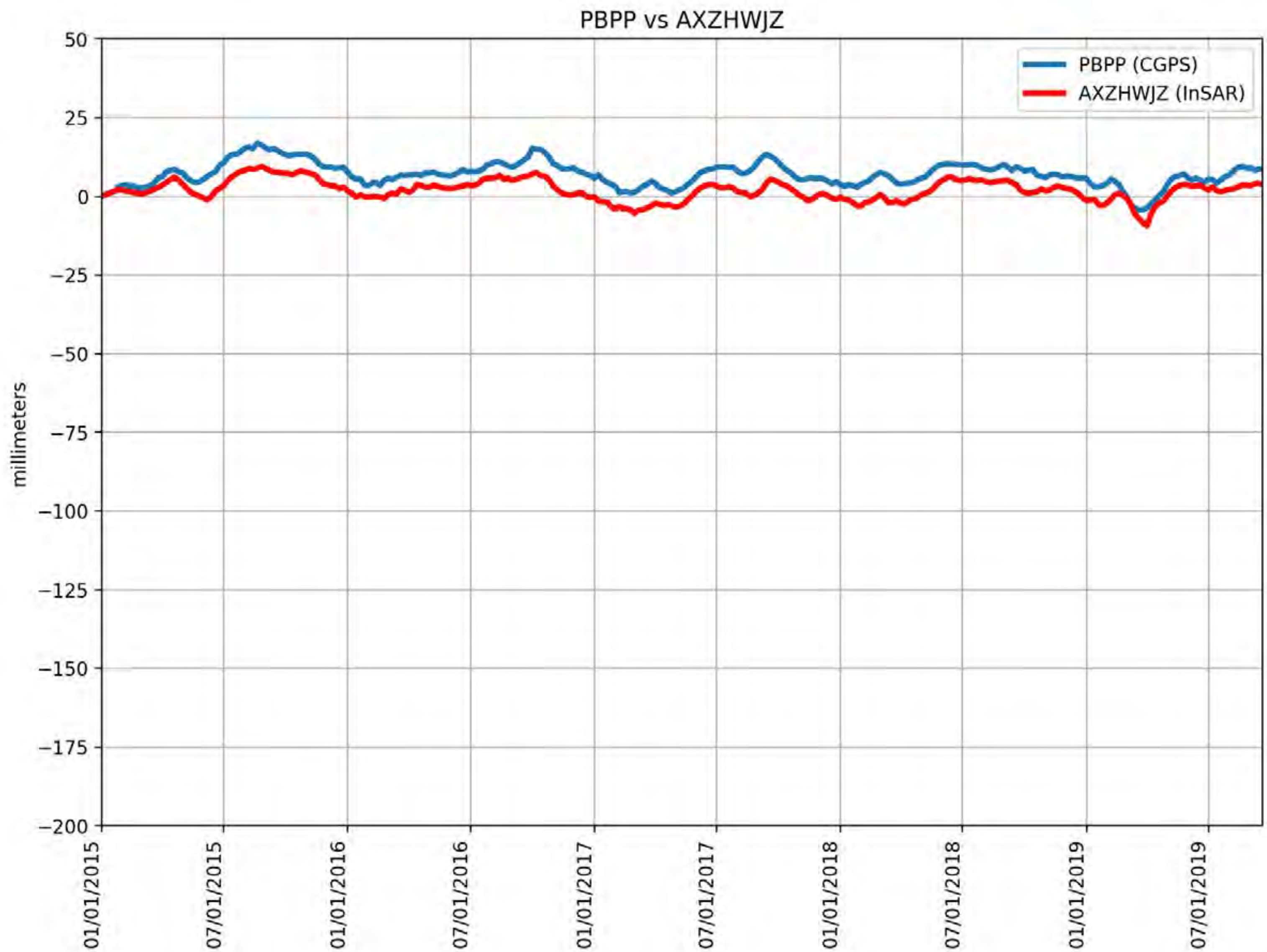
RMSE: 10.65 mm
Correlation: 0.20

Appendix B



RMSE: 7.67 mm
Correlation: 0.98

Appendix B



RMSE: 5.40 mm
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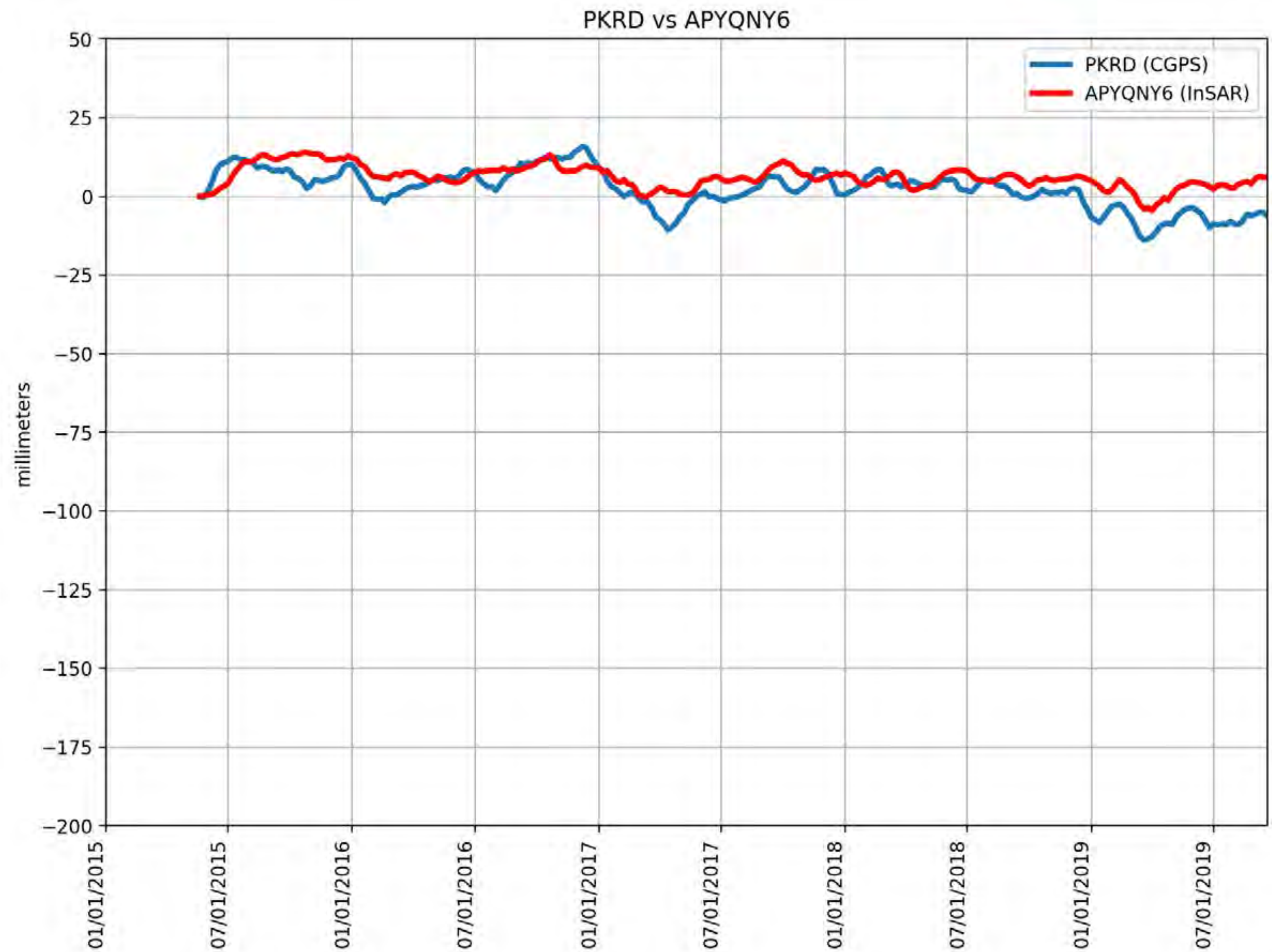
Appendix B



RMSE: 5.93 mm
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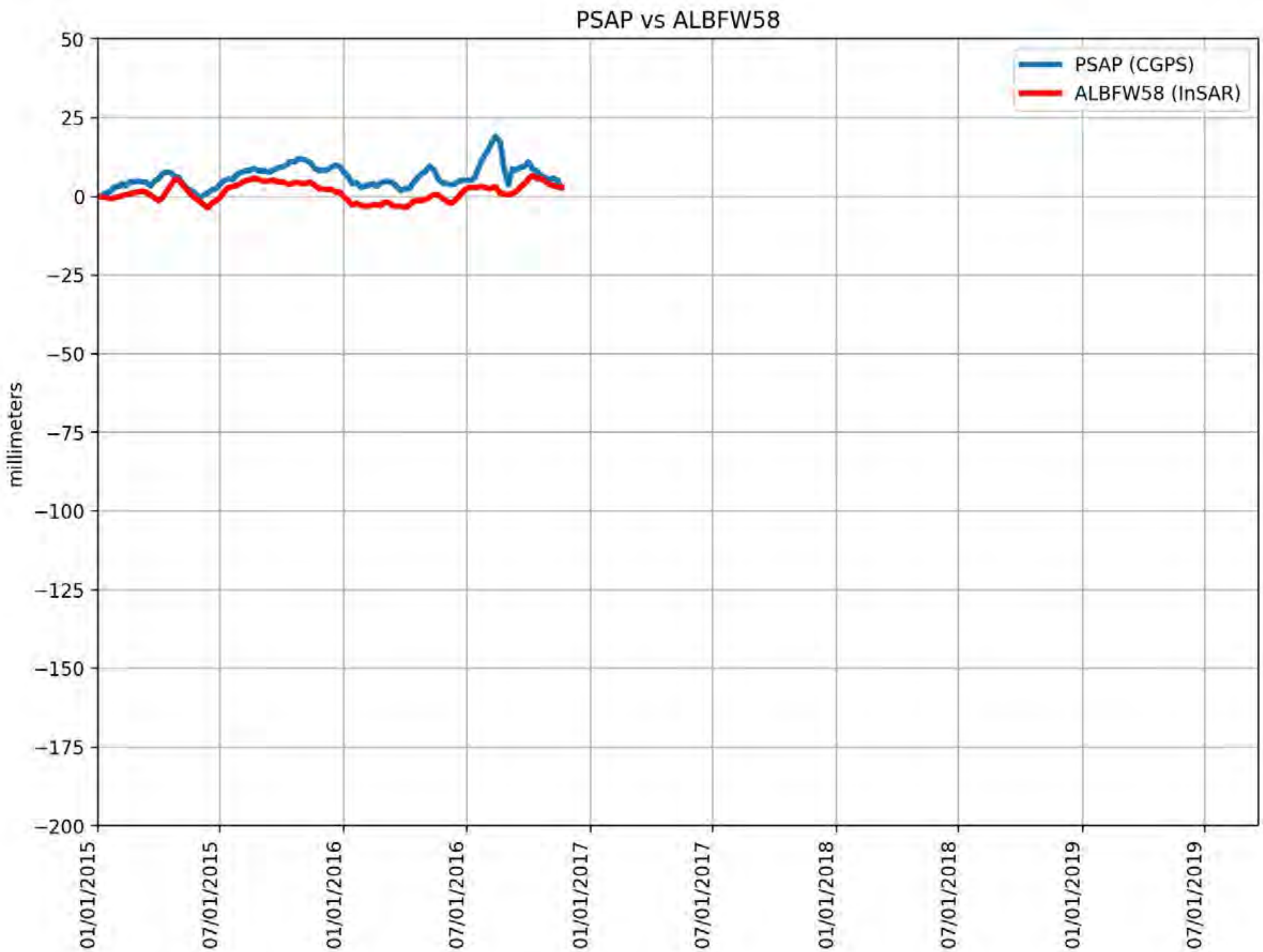
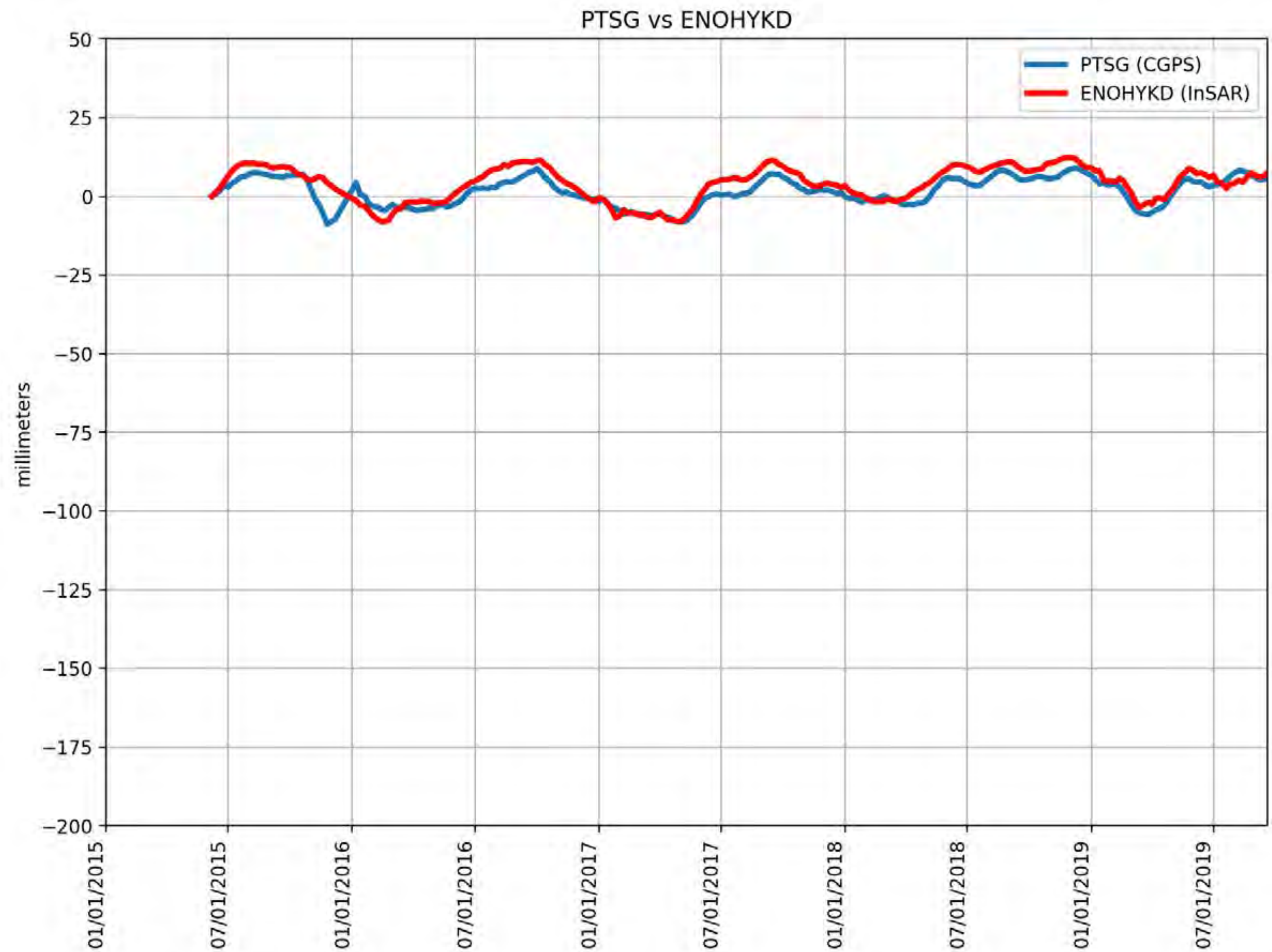
Appendix B



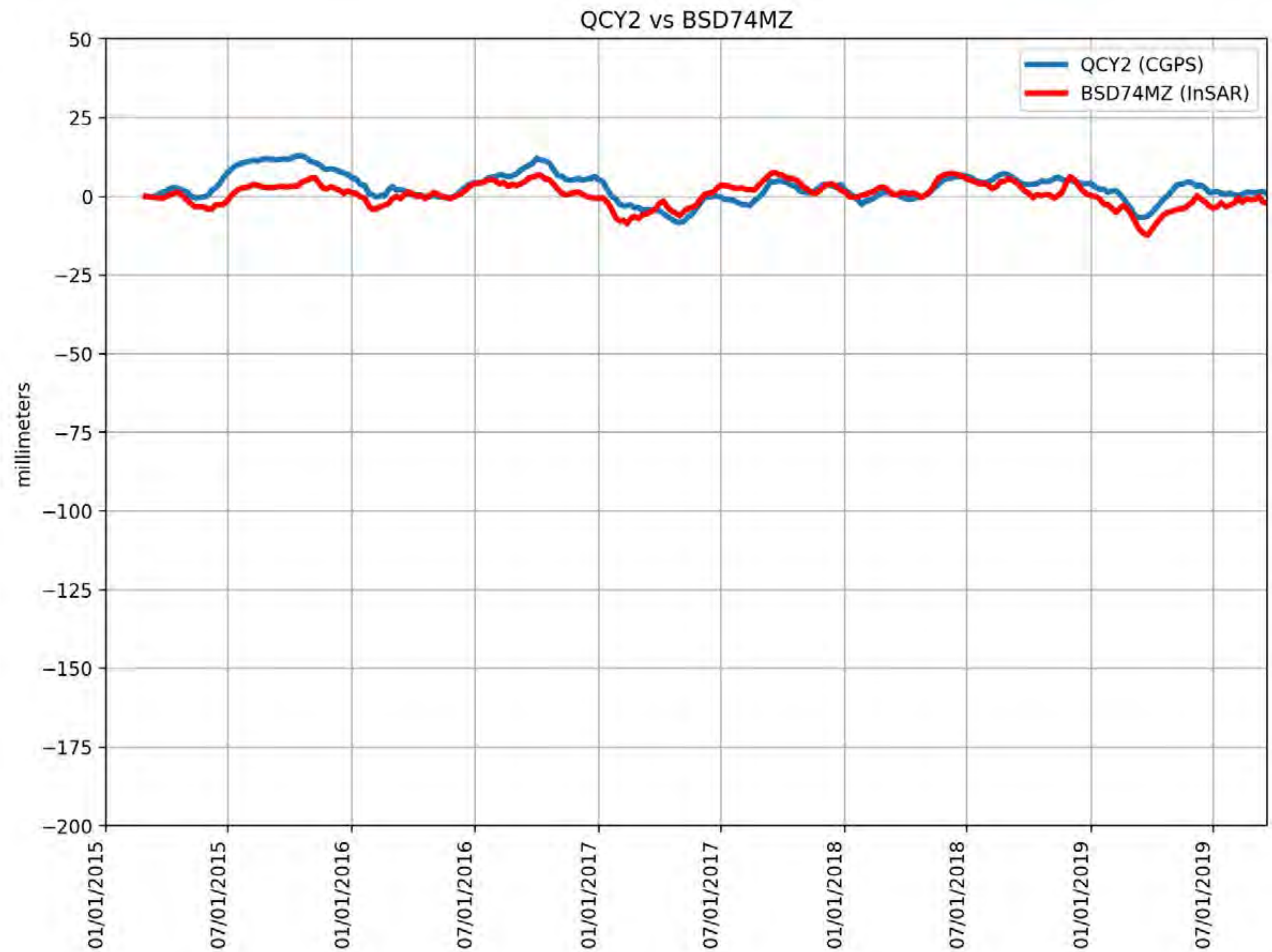
RMSE: 5.81 mm
Correlation: 0.58

Appendix B



RMSE: 3.46 mm
Correlation: 0.89

Appendix B



RMSE: 4.09 mm
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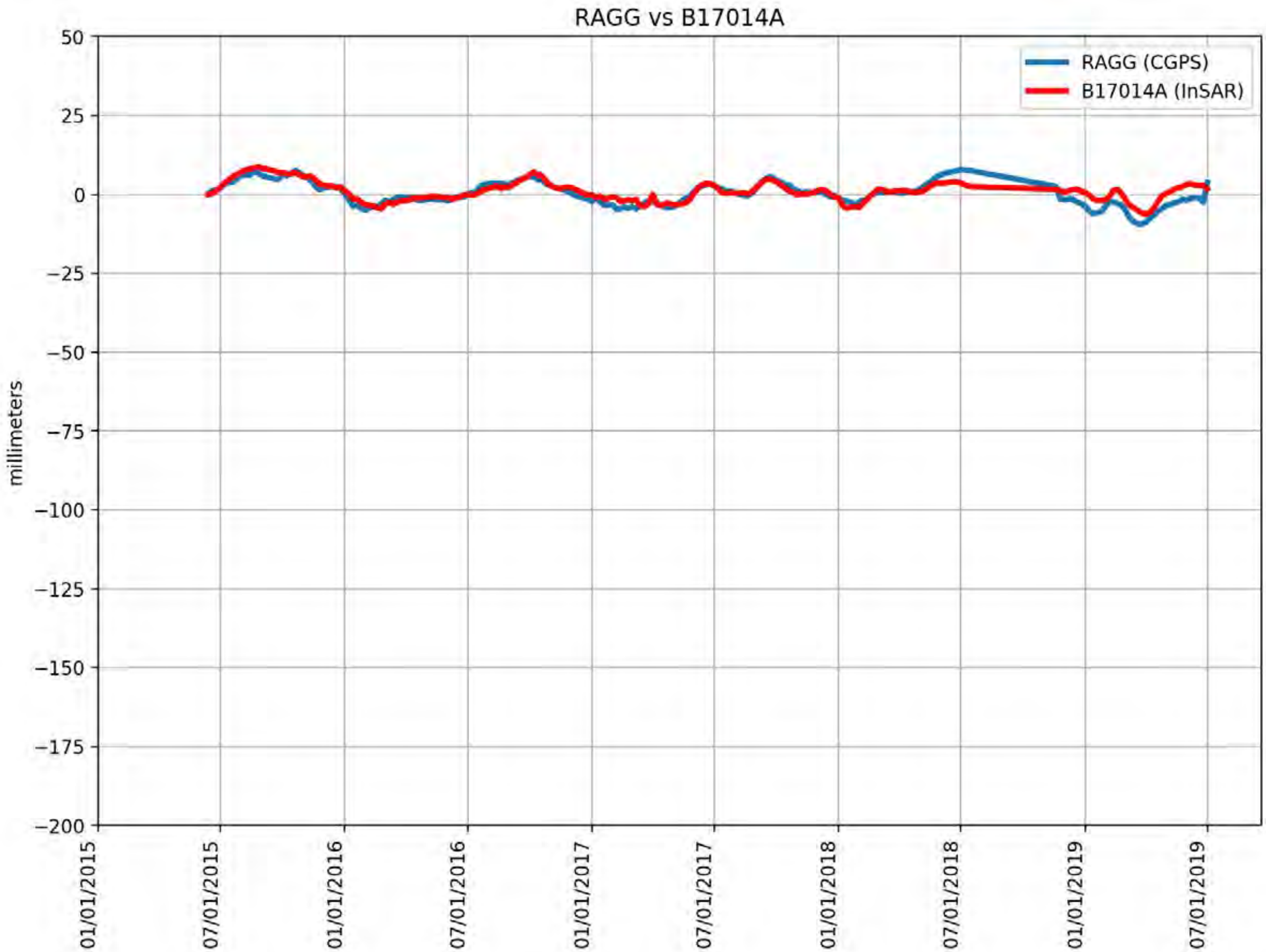
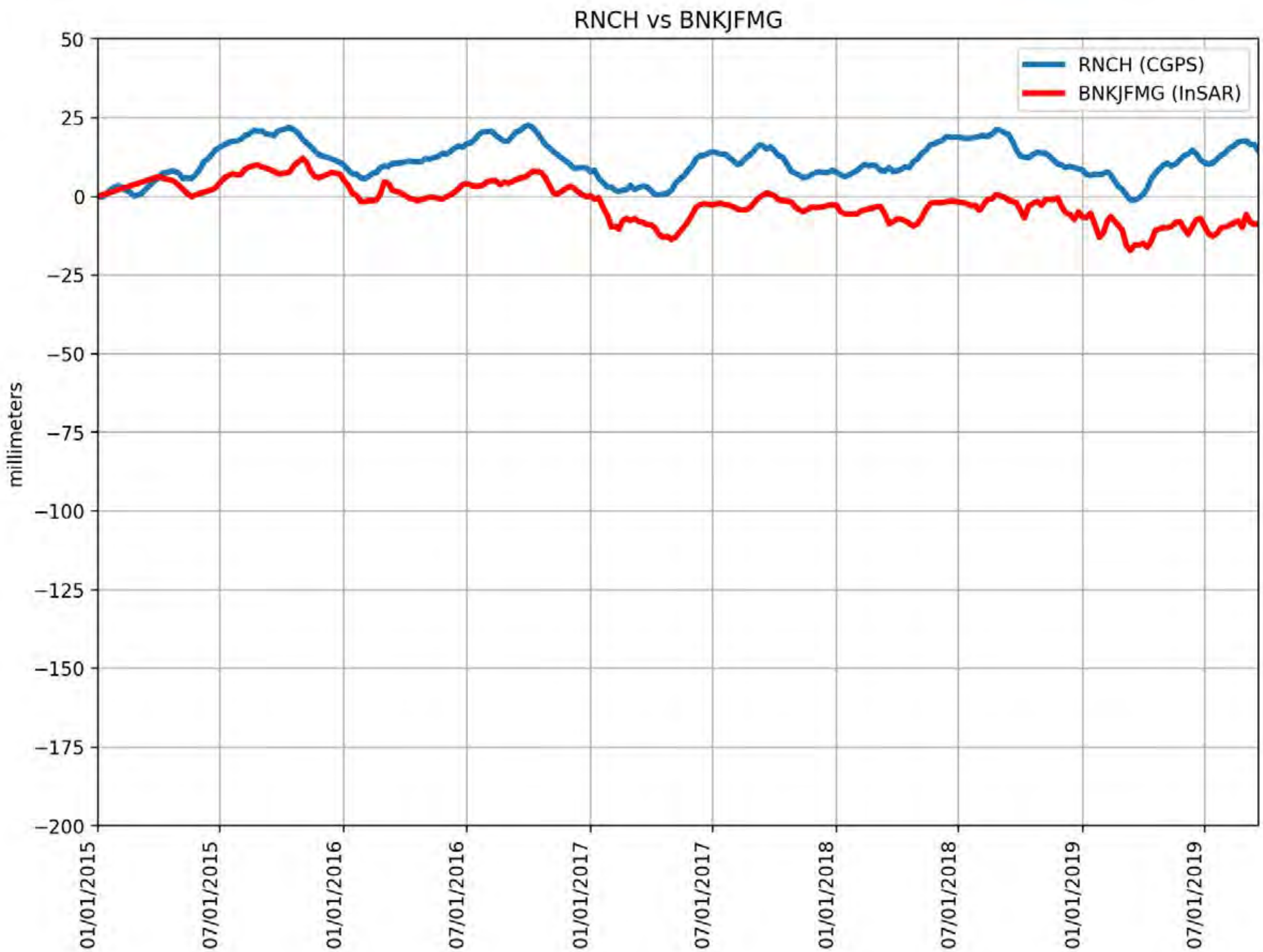
Appendix B



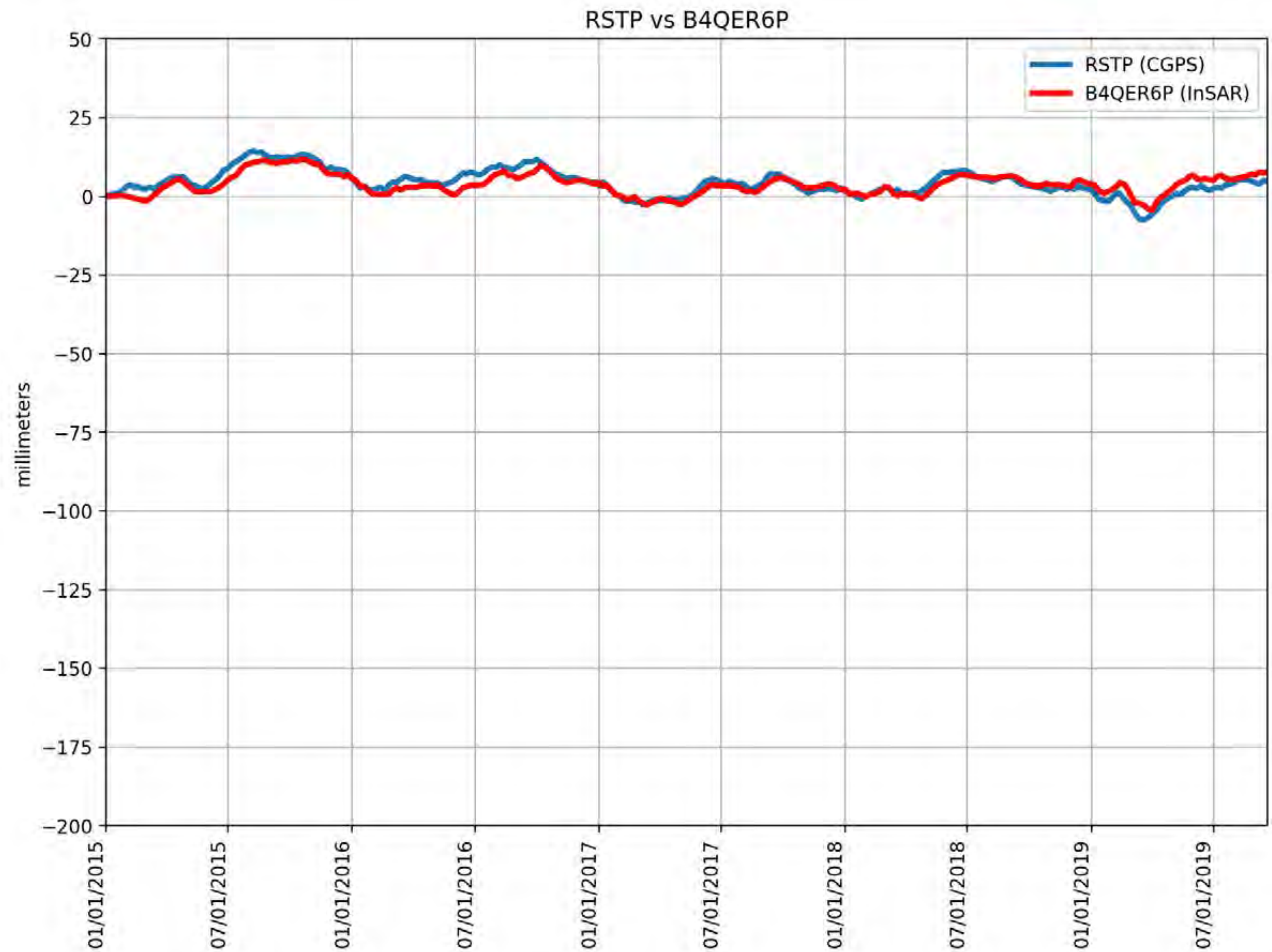
RMSE: 2.01 mm
Correlation: 0.86

Appendix B



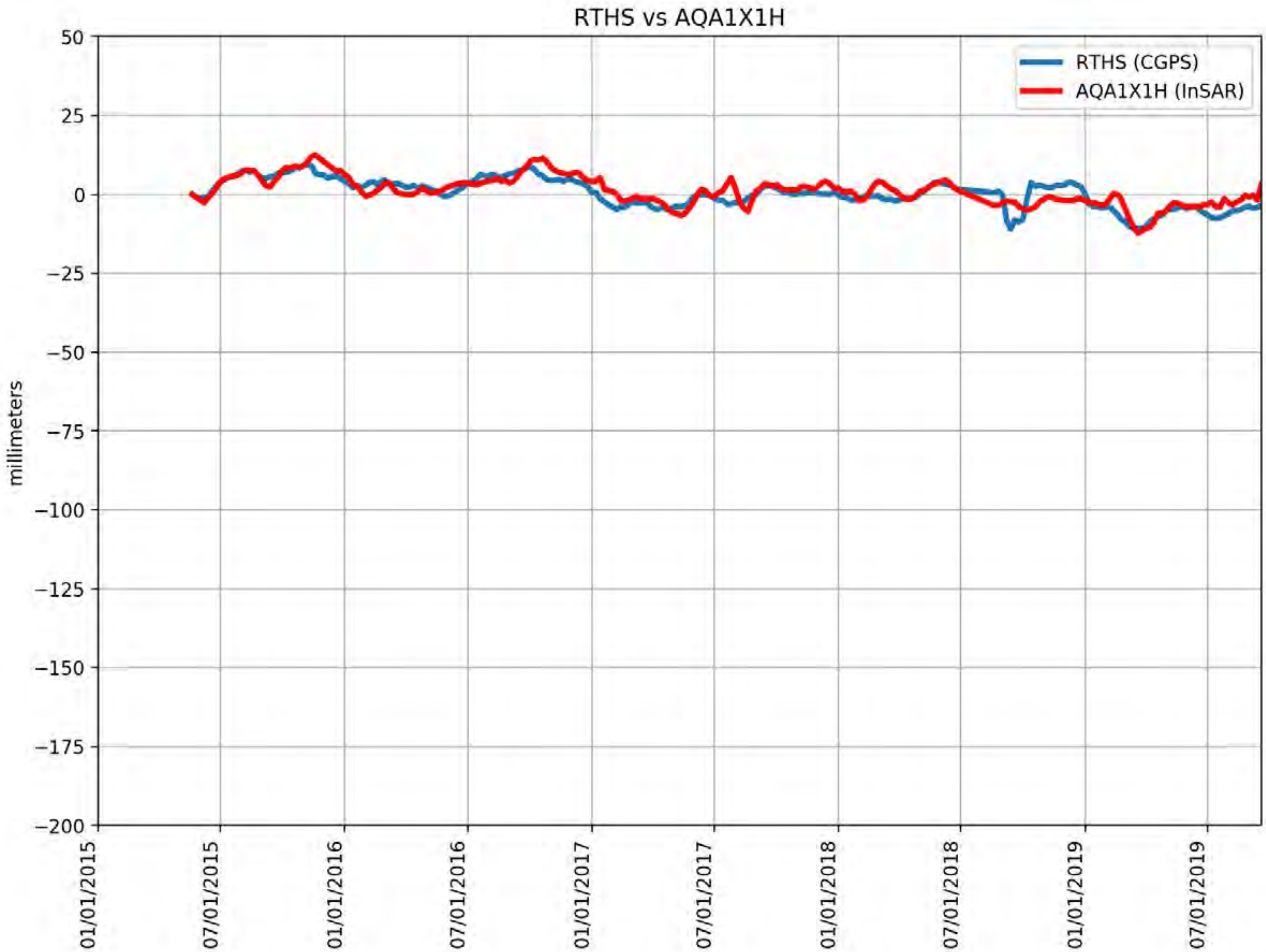
RMSE: 14.32 mm
Correlation: 0.50

Appendix B



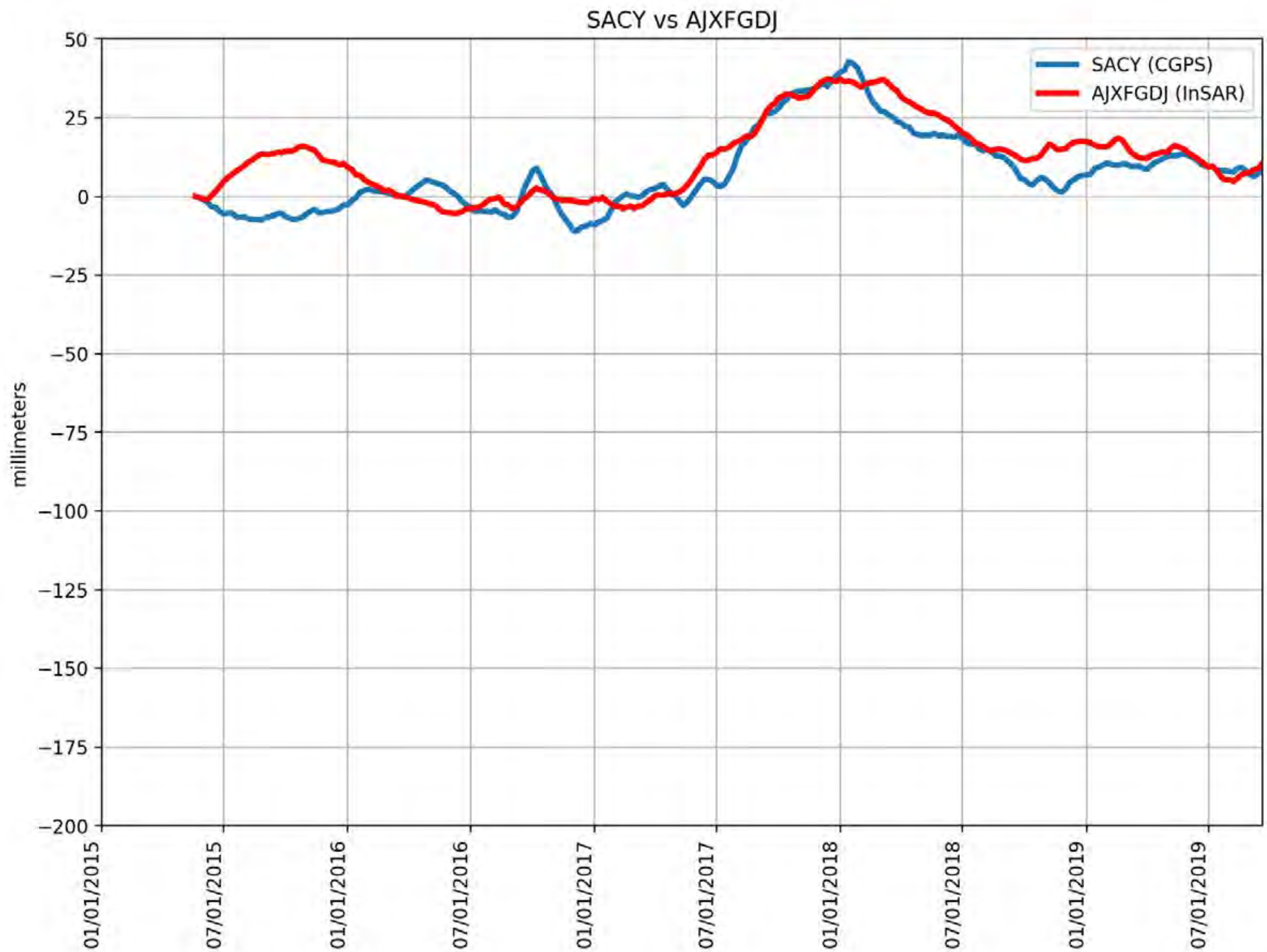
RMSE: 2.15 mm
Correlation: 0.86

Appendix B



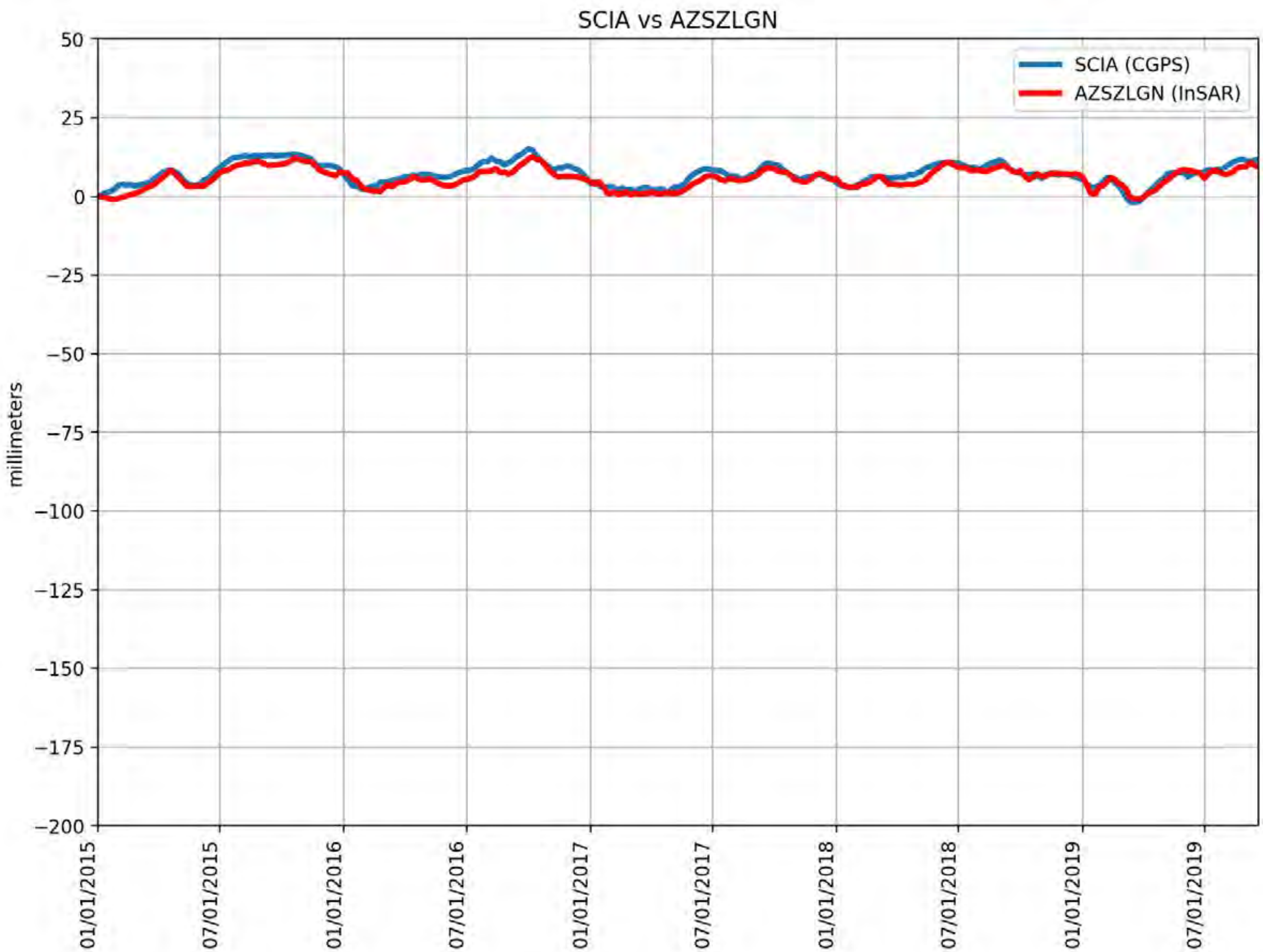
RMSE: 2.85 mm
Correlation: 0.82

Appendix B



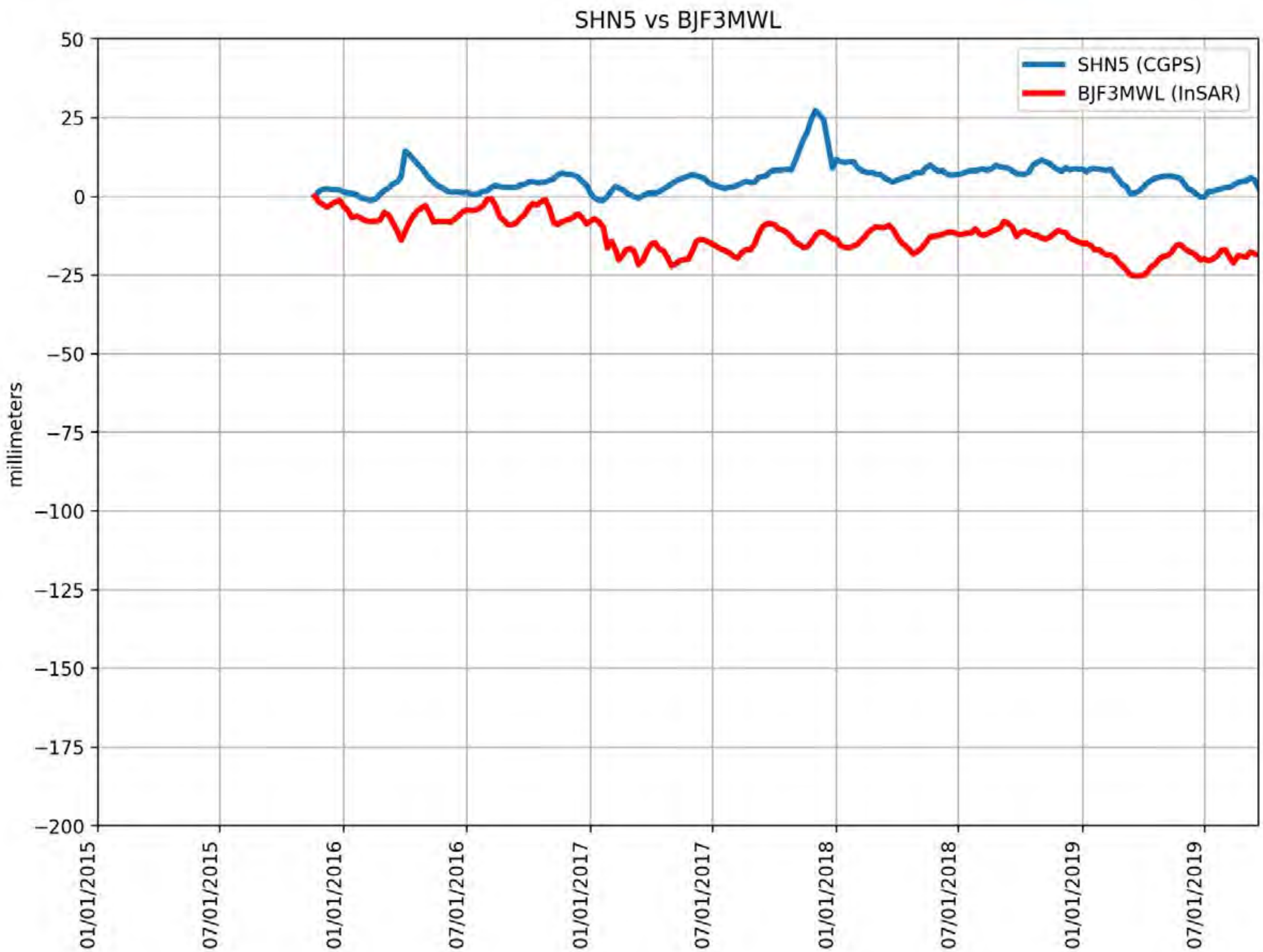
RMSE: 8.06 mm
Correlation: 0.85

Appendix B



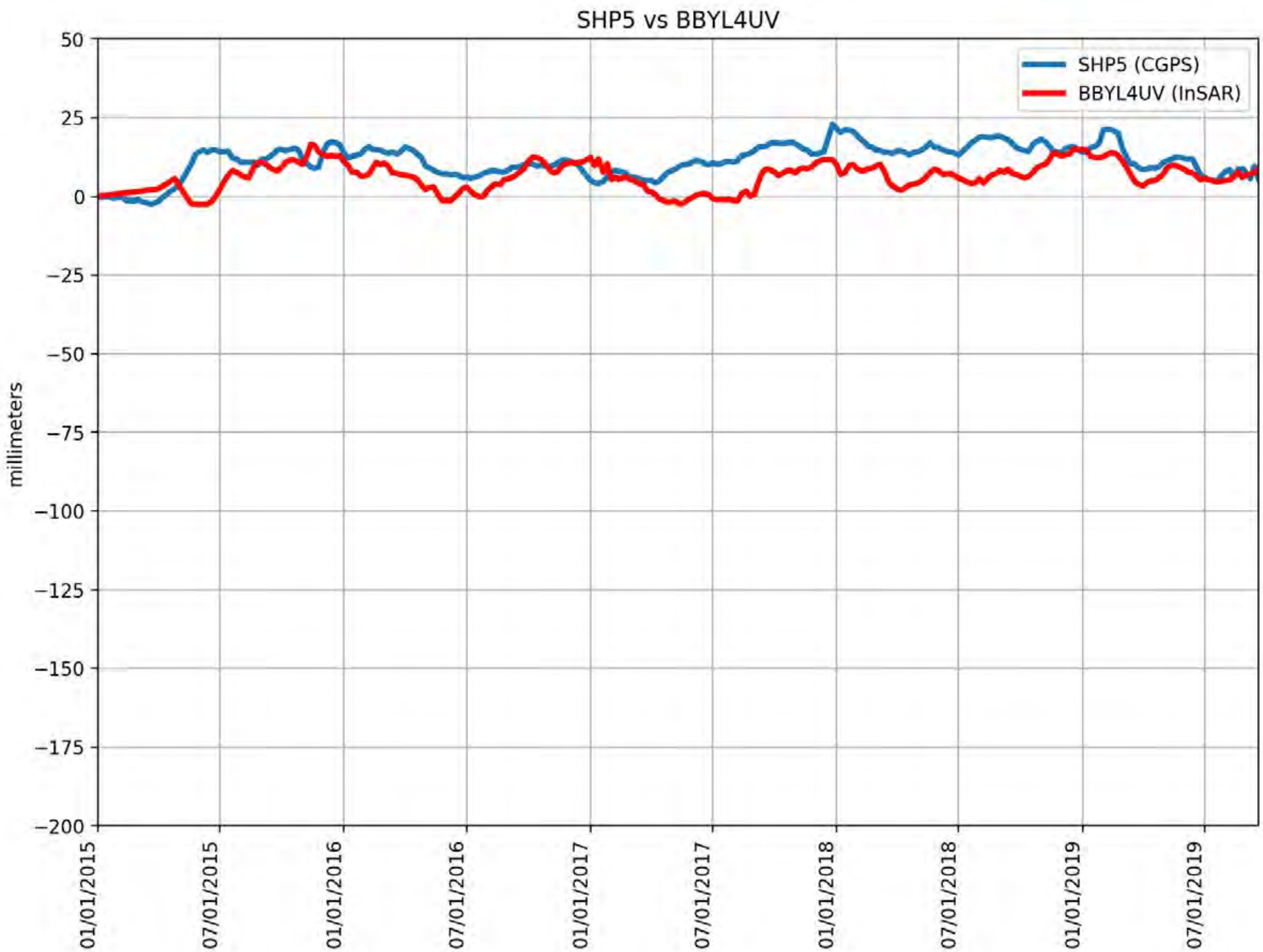
RMSE: 1.85 mm
Correlation: 0.92

Appendix B



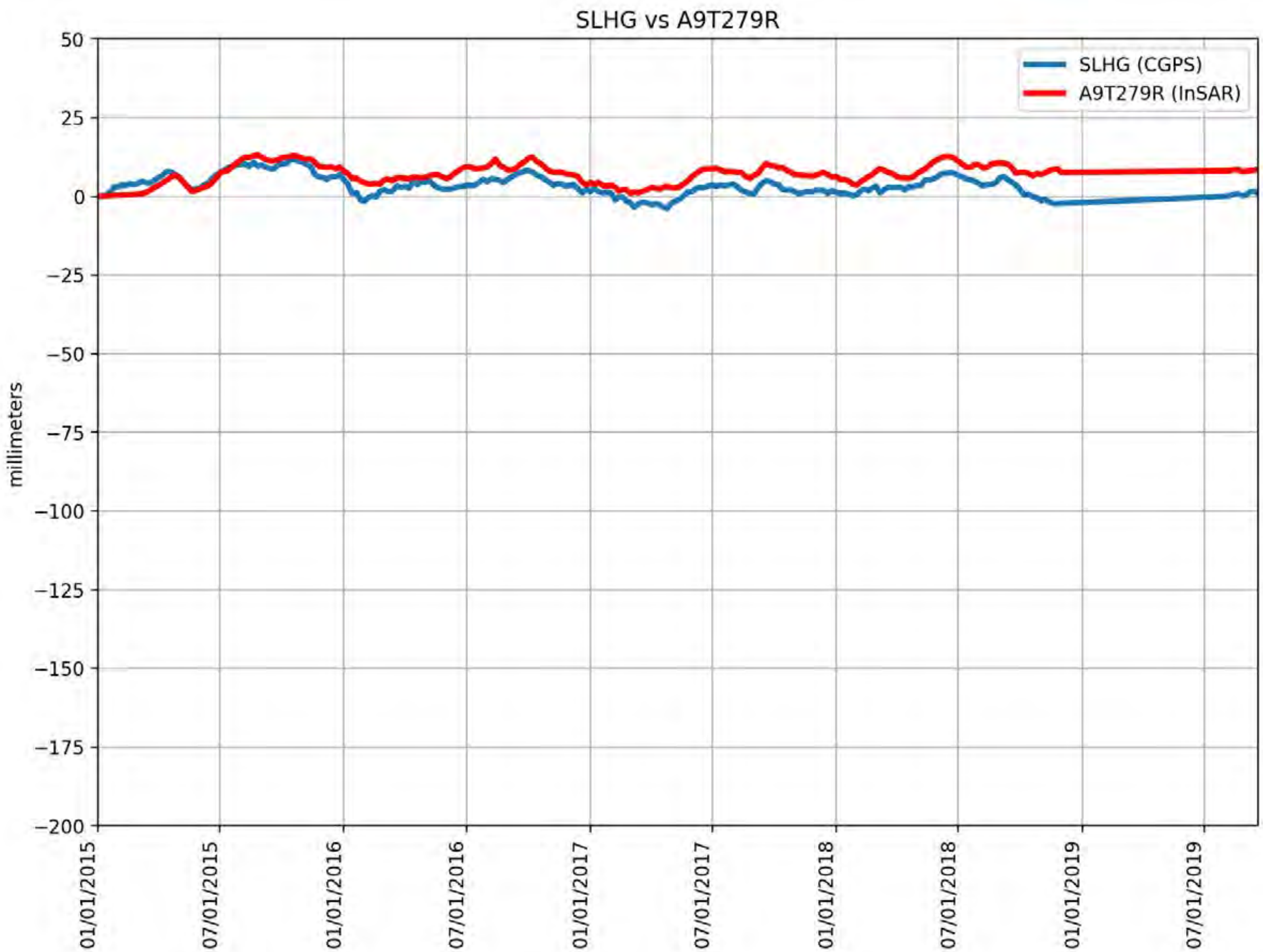
RMSE: 19.68 mm
Correlation: -0.06

Appendix B



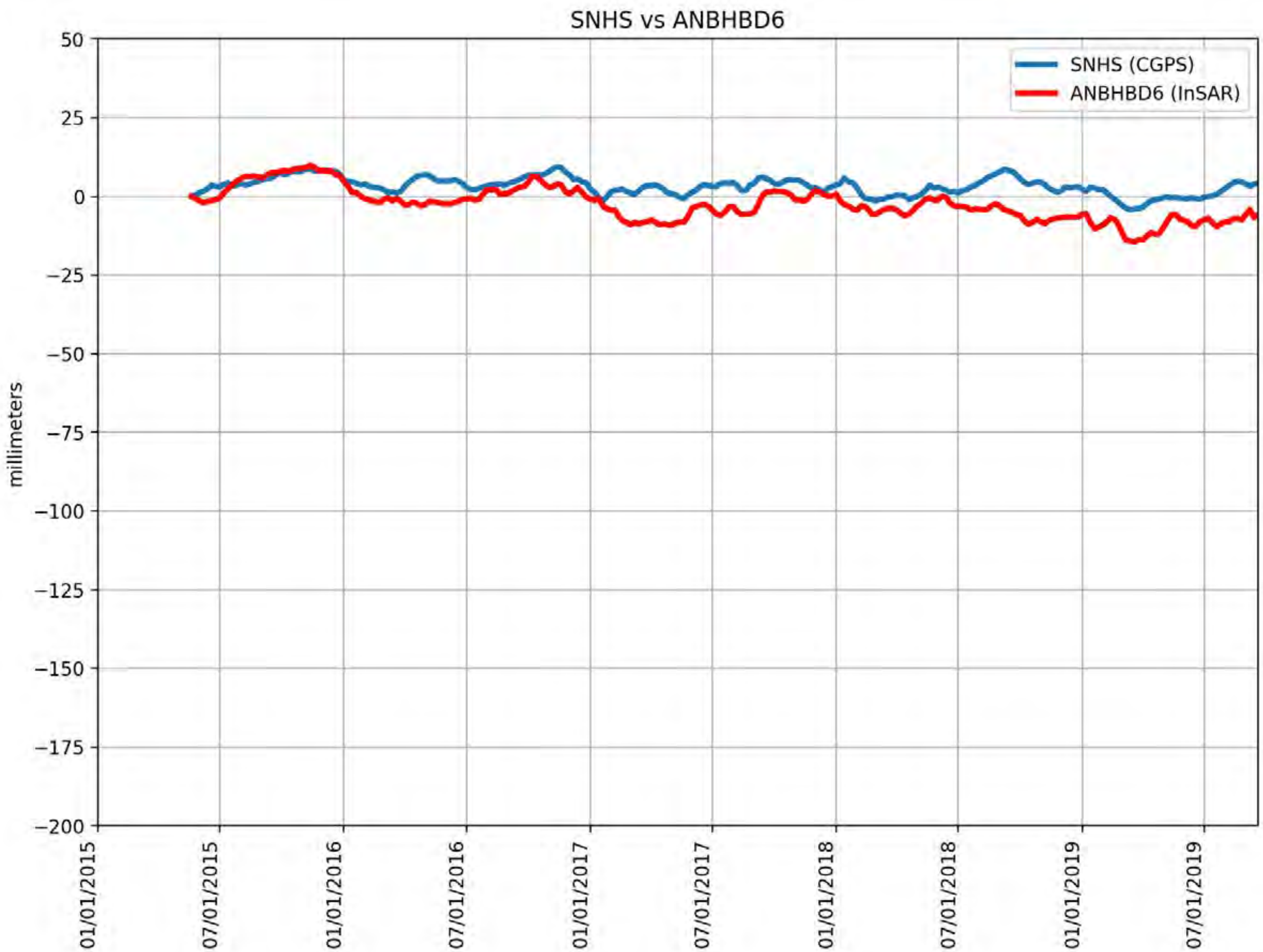
RMSE: 7.19 mm
Correlation: 0.46

Appendix B



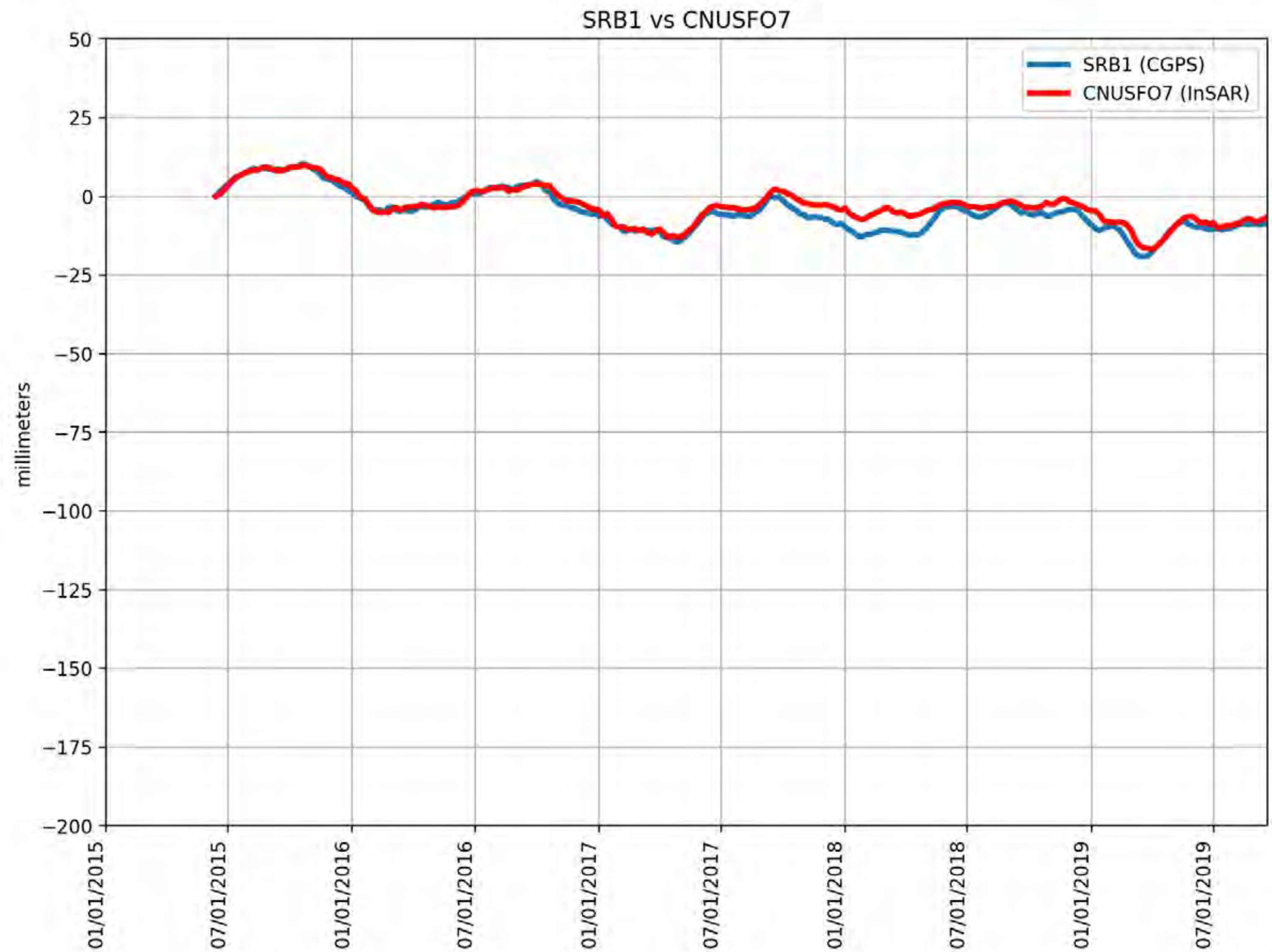
RMSE: 4.44 mm
Correlation: 0.65

Appendix B



RMSE: 6.90 mm
Correlation: 0.69

Appendix B



RMSE: 2.61 mm
Correlation: 0.95