# Appendix G: Time Series Comparisons for Streamflow Gages and Water Quality Monitoring Stations in the Falls Lake Watershed Compared to WARMF Simulated Values for the Calibration (2015 and 2016) and Validation (2017 and 2018) Periods

This appendix provides additional graphical comparisons for the Upper Neuse River Basin Association (UNRBA) Falls Lake Watershed Analysis Risk Management Framework (WARMF) watershed model relative to what is provided in the main report.

Section 6 of the main report describes the model calibration and performance criteria, calibration challenges, third-party review (described more fully in Appendix H), and the model approval by the UNRBA. For reference, a description of the challenges associated with model calibration are repeated in this section.

Watershed models aim to simulate many processes that impact hydrology and pollutant loading. Accurate characterization of the watershed, meteorology, and nutrient inputs impact how well the model performs. Accuracy of the stream flow data and water quality observations also impact performance. Limitations associated with the input data sets are described in Section 3 and Section 4 of the main report.

The UNRBA Modeling Quality Assurance Project Plan (QAPP) describes the visual evaluations and statistical criteria used to gage the watershed model performance. While the goal is to achieve the best fit across as many parameters and locations as possible, there are constraints not only on model inputs but also on time and model development resources. Literature values and best professional judgement inform the range of potential variation in the model coefficients. The modeling team worked closely with subject matter experts and third-party reviewers throughout the calibration process. The range of adjustments that were evaluated reflects the expected variation based on other modeling efforts. Additionally, as the watershed model provides crucial input to the WARMF Lake and EFDC models of Falls Lake, timely completion was essential to meet the schedule of the reexamination.

The following challenges were discussed during UNRBA Modeling and Regulatory Support Workgroup (MRSW) and Path Forward Committee (PFC) meetings as the model was developed in addition to those associated with watershed characterization and input data sets:

- **Model limitations for river reaches** – The WARMF watershed model has been developed to simulate the transport of flow and material primarily through river. When the simulated flow in a river reach goes to zero, the model does not output a simulated concentration. Because river reaches are generally flowing, growth of algae in the simulation is difficult to achieve. To overcome these limitations and allow some growth of algae to occur prior to discharge to Falls Lake, some storage in the downstream reaches was assumed. These storage areas affect other water quality parameters as well, and the calibration aimed to fit as many parameters as possible. The WARMF model assumes that river reaches are fully mixed across the water column, and this assumption impacts the water temperature and dissolved oxygen concentrations simulated by the model. These parameters are important drivers of many reaction rates.
- **Hydrologic response** – some of the streams in the Falls Lake watershed have a “flashy” hydrologic response where the stream flows rise and fall relatively quickly in response to storm events. To simulate these patterns, the vertical hydraulic conductivities in these modeling catchments (e.g., Ellerbe Creek) were decreased relative to other catchments in the Triassic Basin. Triassic Basin soils already have lower vertical hydraulic conductivities compared to Carolina Slate Belt and Raleigh Belt soils. Decreasing the vertical hydraulic conductivities has the effect of lowering the baseflow contribution to the streams and limiting the amount of interaction with the subsurface soil layers in these catchments. Adjustments of vertical hydraulic conductivities were applied to catchments draining to a USGS stream flow gage, or to the catchments between two gages if applicable. Vertical hydraulic conductivities for ungaged tributaries were set based on those applied to nearby, gaged catchments.

- **Low observed concentrations** - When observed concentrations are very low on average, it can be difficult to meet the performance criteria which are based on percentages for the WARMF model as described in the QAPP. Low concentrations of some parameters may not greatly affect loading to the lake especially if they occur during low flows. For parameters that are linked in terms of reaction rates or other factors, the modeler may prioritize improving the model fit for the parameter that is a more substantial part of the load. For example, if the average ammonia concentration is 0.1 mg-N /L, a 50 percent bias could represent an average concentration of 0.05 mg-N /L or 0.15 mg-N /L. A difference in concentration of 0.05 mg-N/L does not significantly affect overall nitrogen loading to Falls Lake (0.05 mg-N/L in 100 L of water is 5 mg N). Alternatively, if the average nitrate concentration is 1 mg-N/L, a 50 percent bias could be 0.5 mg-N /L or 1.5 mg-N /L. These higher concentrations have a greater potential to impact loading to the lake (0.5 mg-N/L in 100 L of water = 50 mg-N).
- **Model input limitations** - The model can only be as good as its inputs. While this watershed model represents more data and information than is usually available, some localized events may not be captured by the input data. For example, nitrate observations in Knap of Reeds Creek at the lake loading station (KRC-4.5) indicate relatively high concentrations for a period in late 2015 and early 2016 (Figure 6-2 of the main report). These could be due to variations at the WWTP that were not captured by the composite sampling conducted during that period, sanitary sewer overflow(s) that were not identified, or some other illicit discharge. The model does not perform well at this location during this period because the input files do not accurately reflect nutrient inputs to the stream. This negatively impacts the performance criteria at Knap of Reeds Creek for the calibration period, but the statistics improve during the validation period when the higher concentrations are no longer present. The only way to improve model performance would be to adjust the model input files until the simulated concentrations match those observed, which would not be considered good modeling practice.
- **Upstream impoundments** - The presence of upstream impoundments in the watershed also complicates the calibration. Frequent water quality measurements in these waterbodies are not available, so it is difficult to evaluate how well the model is simulating their processes. It is also difficult to pinpoint the best adjustments to model coefficients because these impoundments are less studied than Falls Lake. At the suggestion of the MRSW, the modeling team reviewed quarterly USGS measurements where available. This data guided revisions to simulated processes in Little River Reservoir and nitrogen simulations downstream at LTR-1.9 improved as a result. Further adjustment in the simulation of these impoundments could take a significant amount of effort given lack of information and would not represent a significant change in results. Without extensive data, there is no reasonable basis to develop more detailed lake behavior in these impoundments. For these reasons, model calibration efforts for stations downstream of these impoundments was deemed sufficient by the MRSW and PFC.
- **Inconsistencies with simulated time steps and point-in-time water quality observations** - Time presents another challenge to the model calibration. Water quality observations are collected at specific points in time and represent instantaneous conditions, not an average condition. The WARMF model time step is 6-hours, so each model output represents a 6-hour average, not a specific moment in time. Water quality concentrations can change quickly, especially in response to storm events. Therefore, comparing the 6-hour average simulated values to point-in-time observations is not an accurate comparison when conditions are changing quickly, particularly in response to storm events.

Monitoring locations in the watershed are shown in Figure G-1.

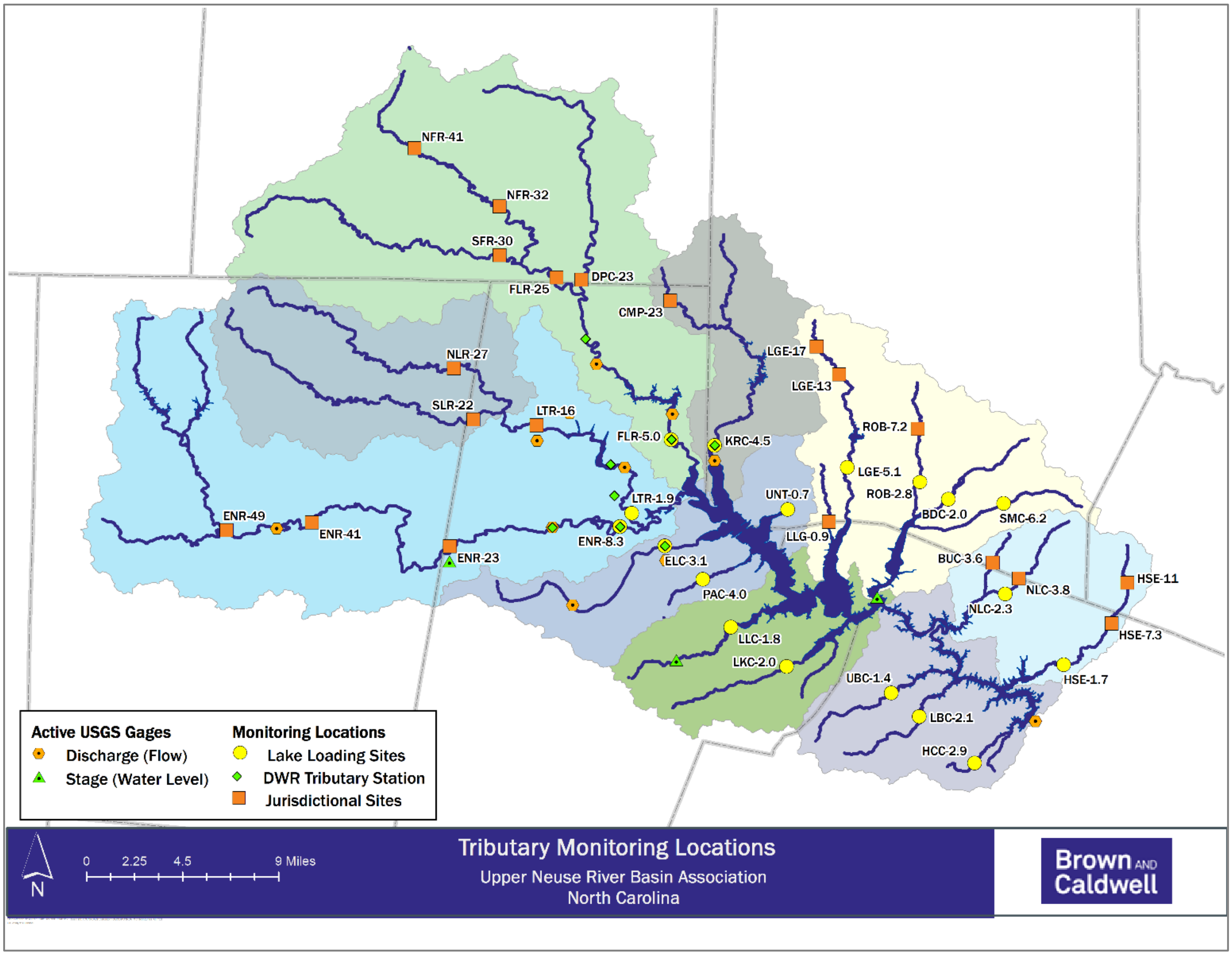


**Figure G-1. Locations of sources of water quality data within the Falls Lake watershed**

# Ellerbe Creek

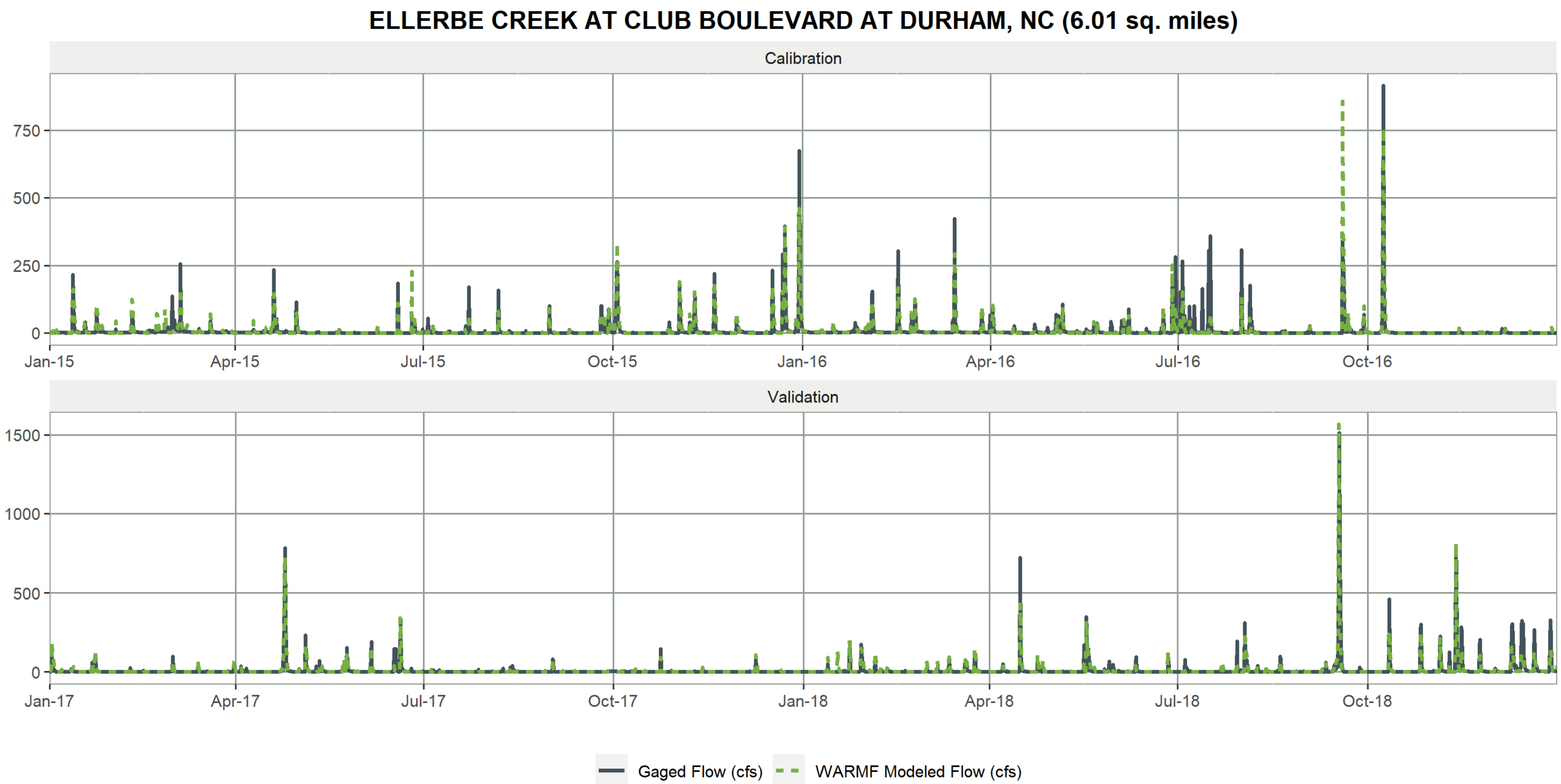


**Figure G-2. Comparison of Observed and Simulated Stream Flows at Ellerbe Creek at Club Boulevard at Durham, NC (6.01 square miles)**

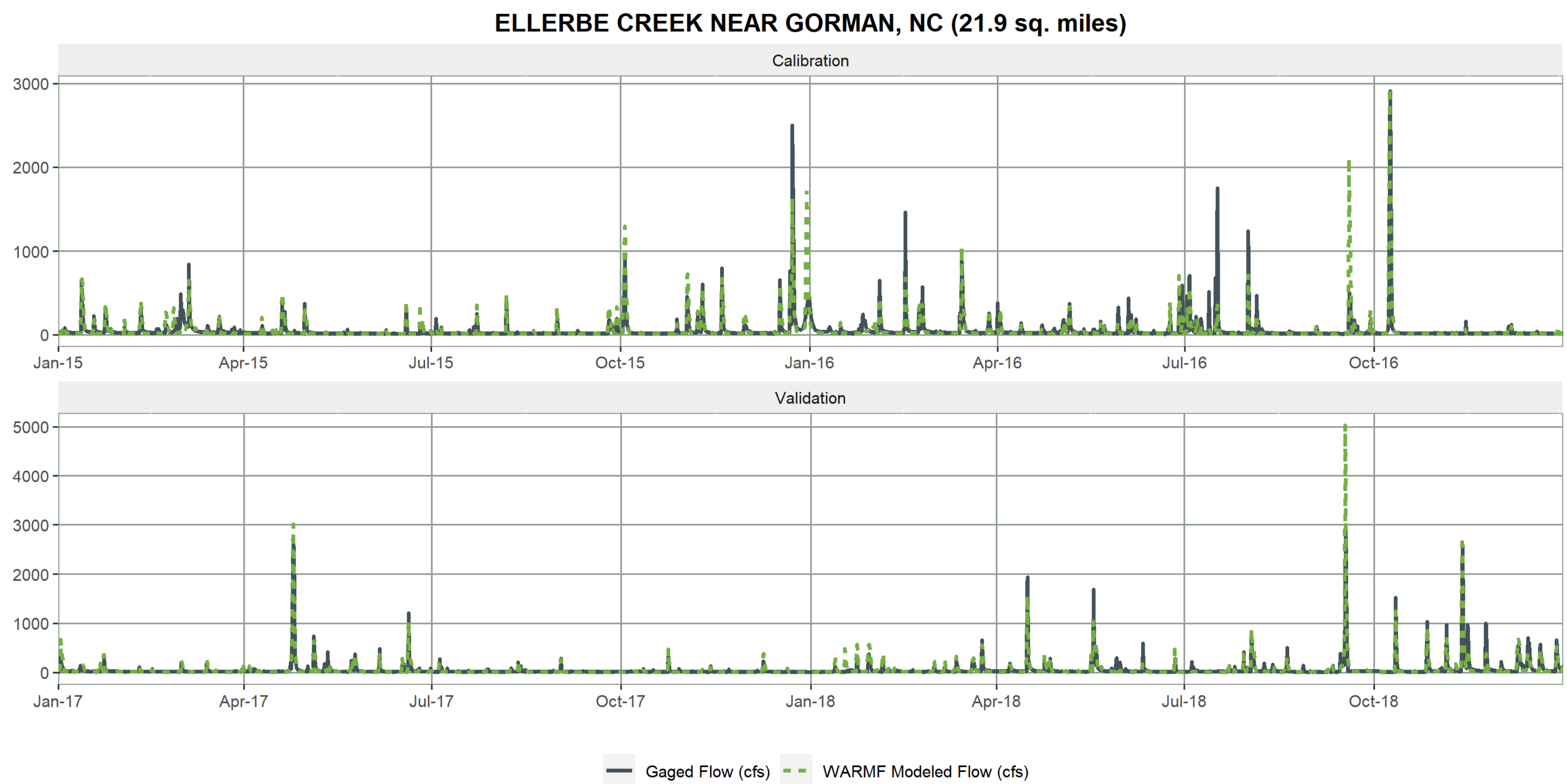


**Figure G-3. Comparison of Observed and Simulated Stream Flows at Ellerbe Creek near Gorman, NC (21.9 square miles)**

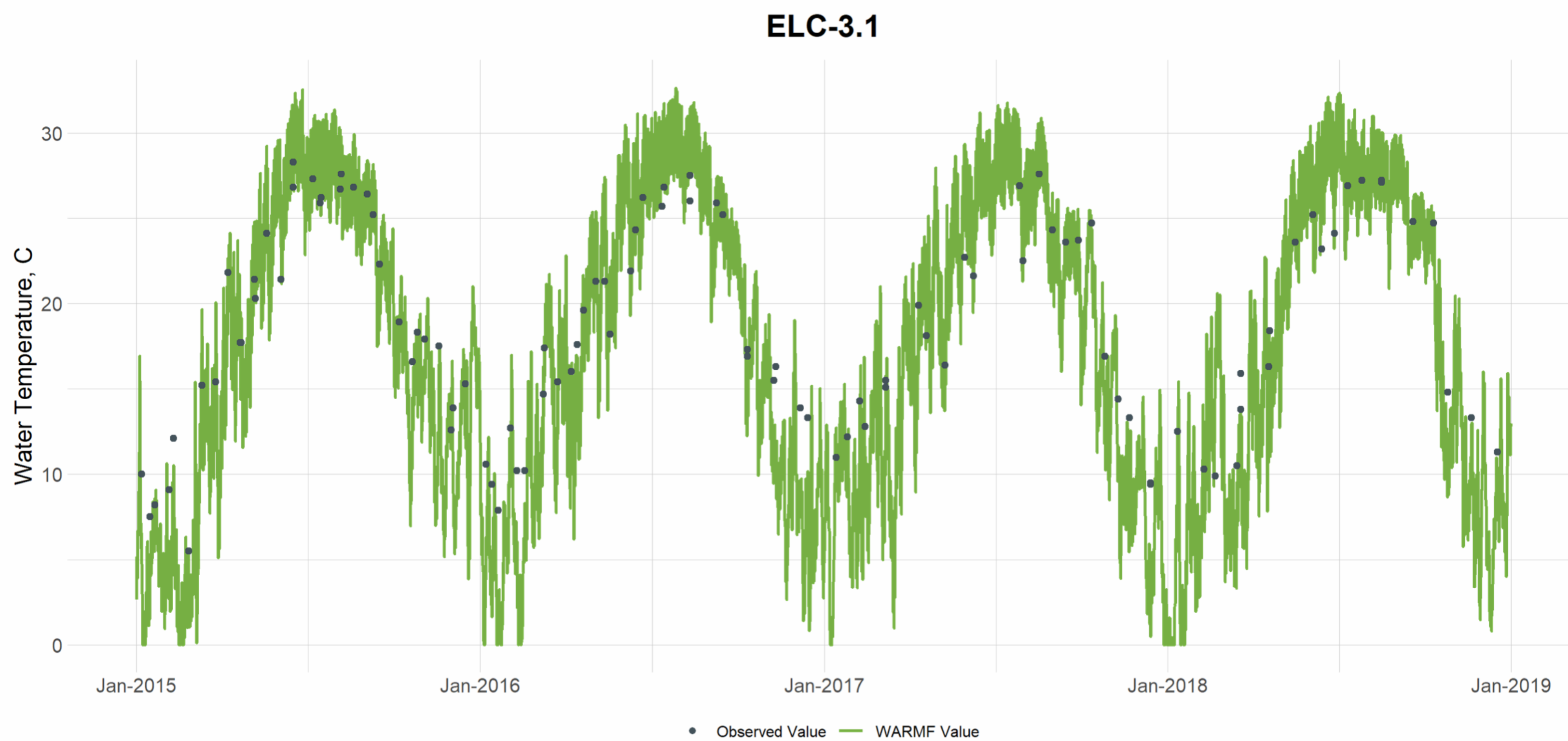


**Figure G-4. Comparison of Observed and Simulated Stream Temperatures at Ellerbe Creek at Station ELC-3.1**

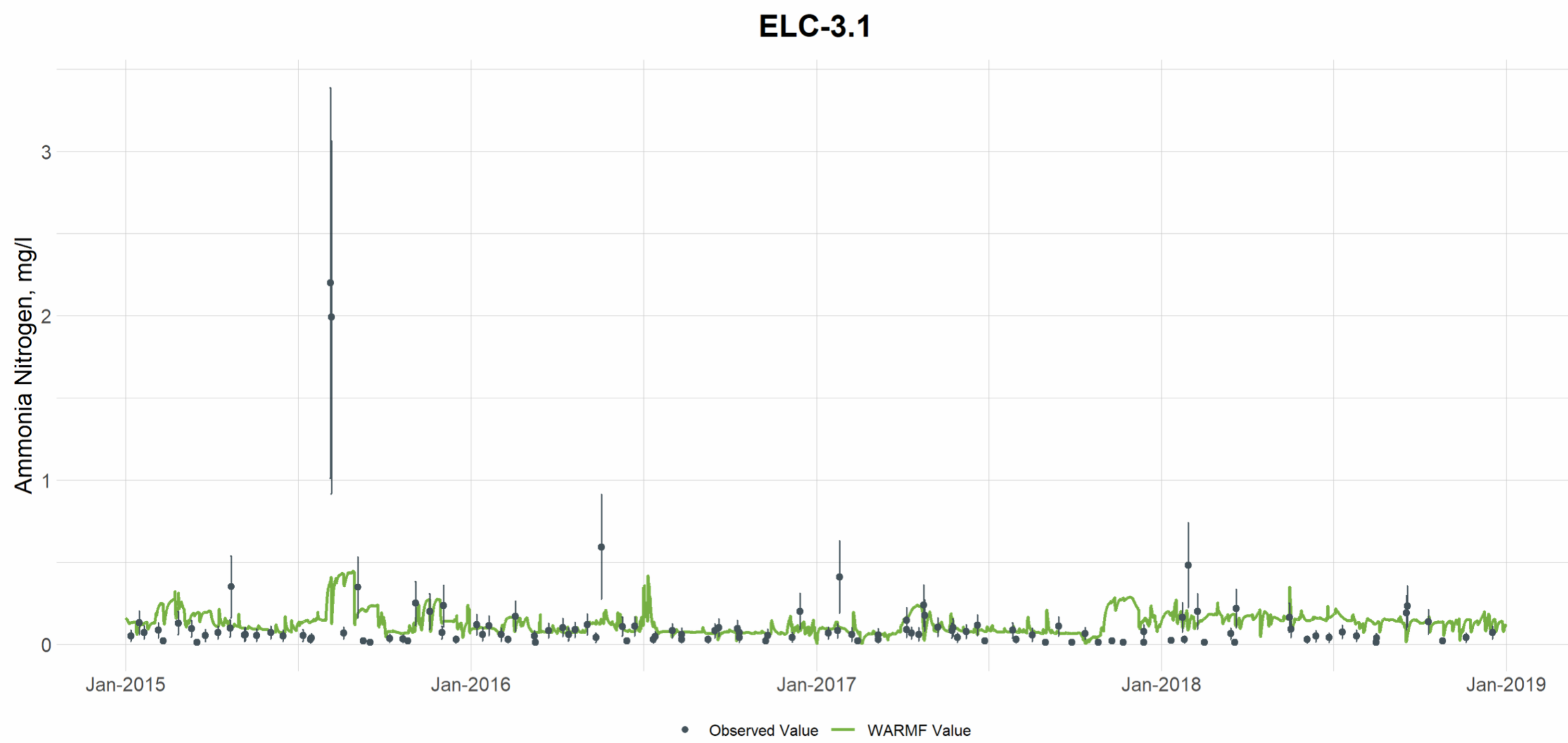


**Figure G-5. Comparison of Observed and Simulated Ammonia Concentrations at Ellerbe Creek at Station ELC-3.1 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

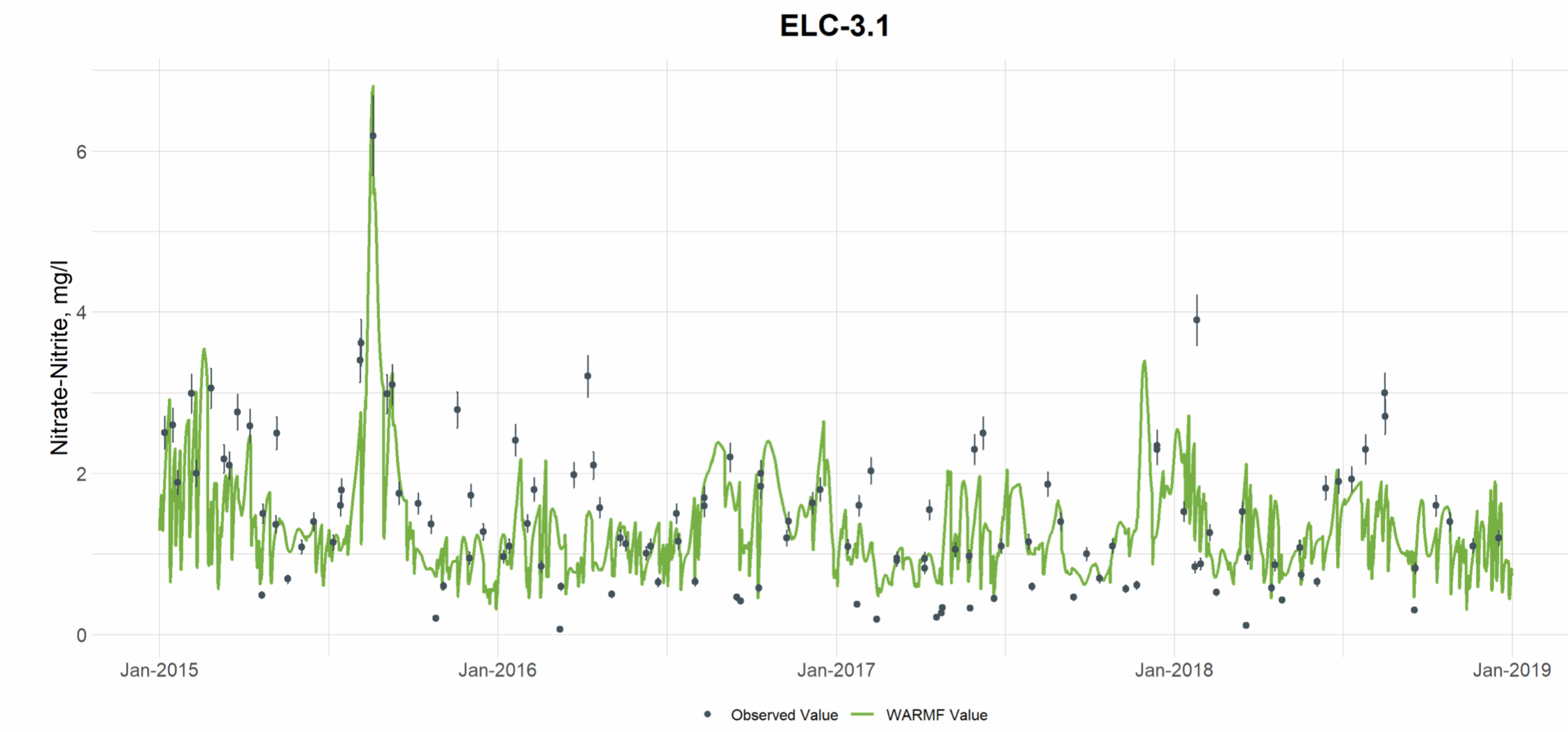


**Figure G-6. Comparison of Observed and Simulated Nitrate-Nitrite Concentrations at Ellerbe Creek at Station ELC-3.1 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

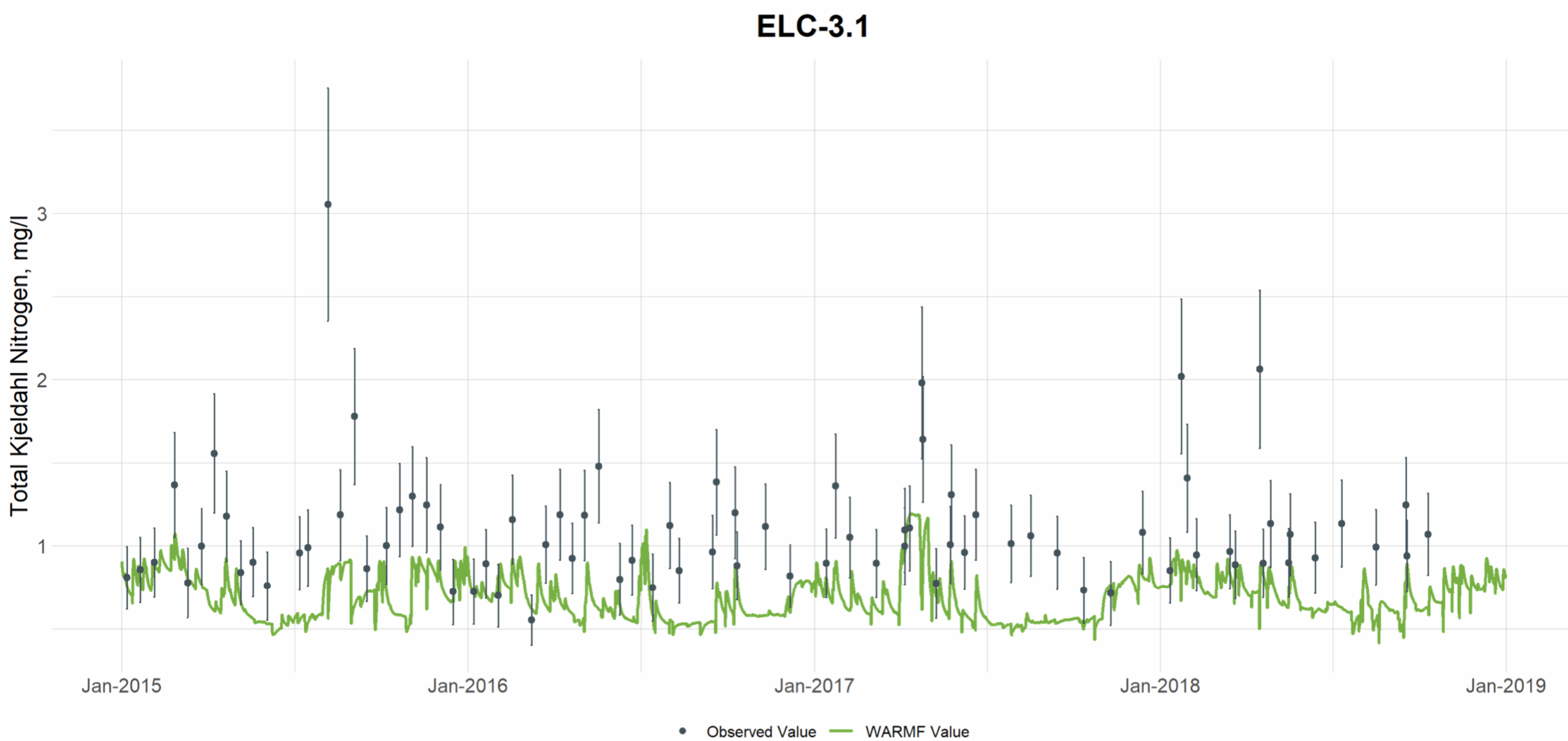


**Figure G-7. Comparison of Observed and Simulated Total Kjeldahl Nitrogen Concentrations at Ellerbe Creek at Station ELC-3.1** (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)

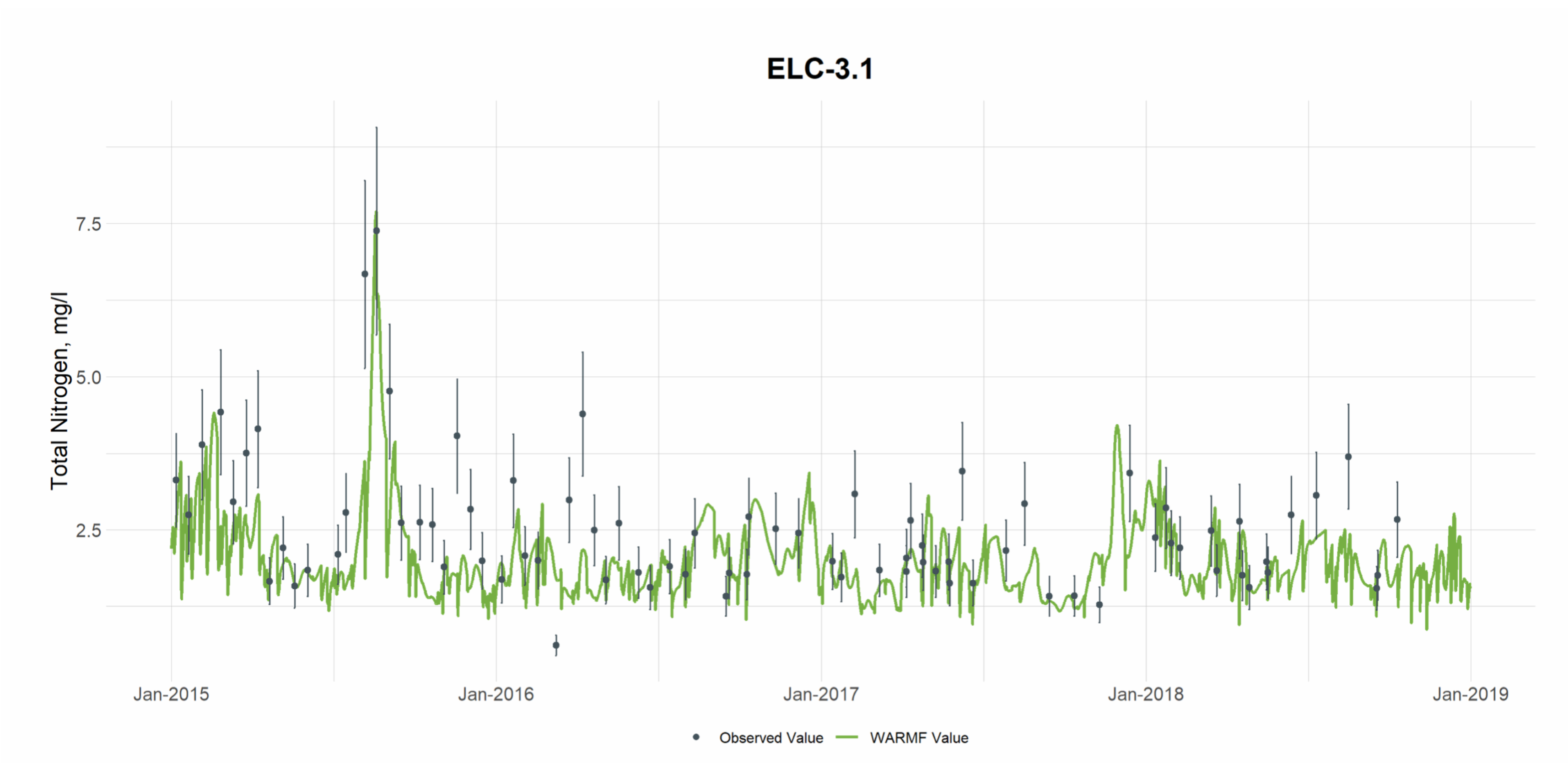


**Figure G-8. Comparison of Observed and Simulated Total Nitrogen Concentrations at Ellerbe Creek at Station ELC-3.1 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

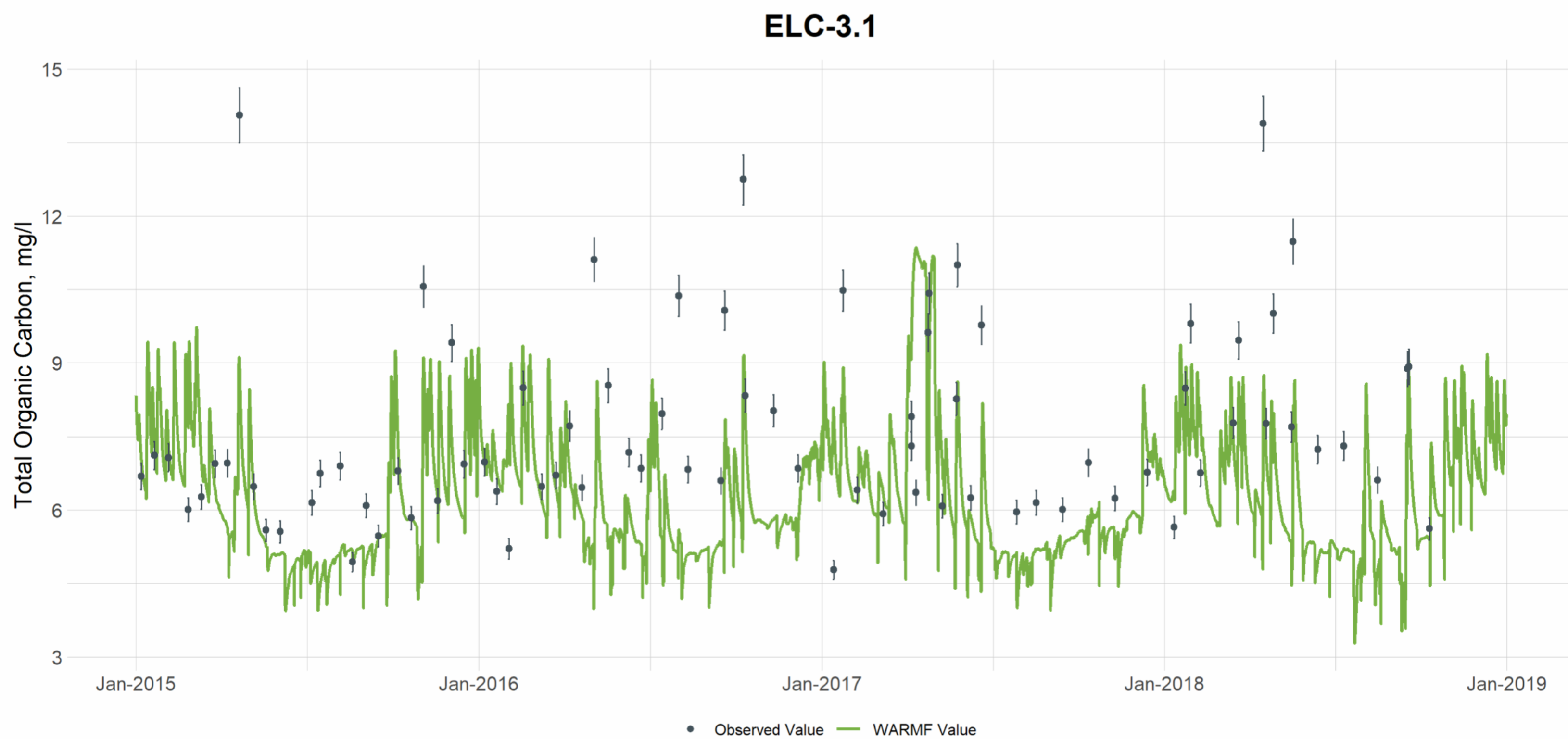


**Figure G-9. Comparison of Observed and Simulated Total Organic Carbon Concentrations at Ellerbe Creek at Station ELC-3.1 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

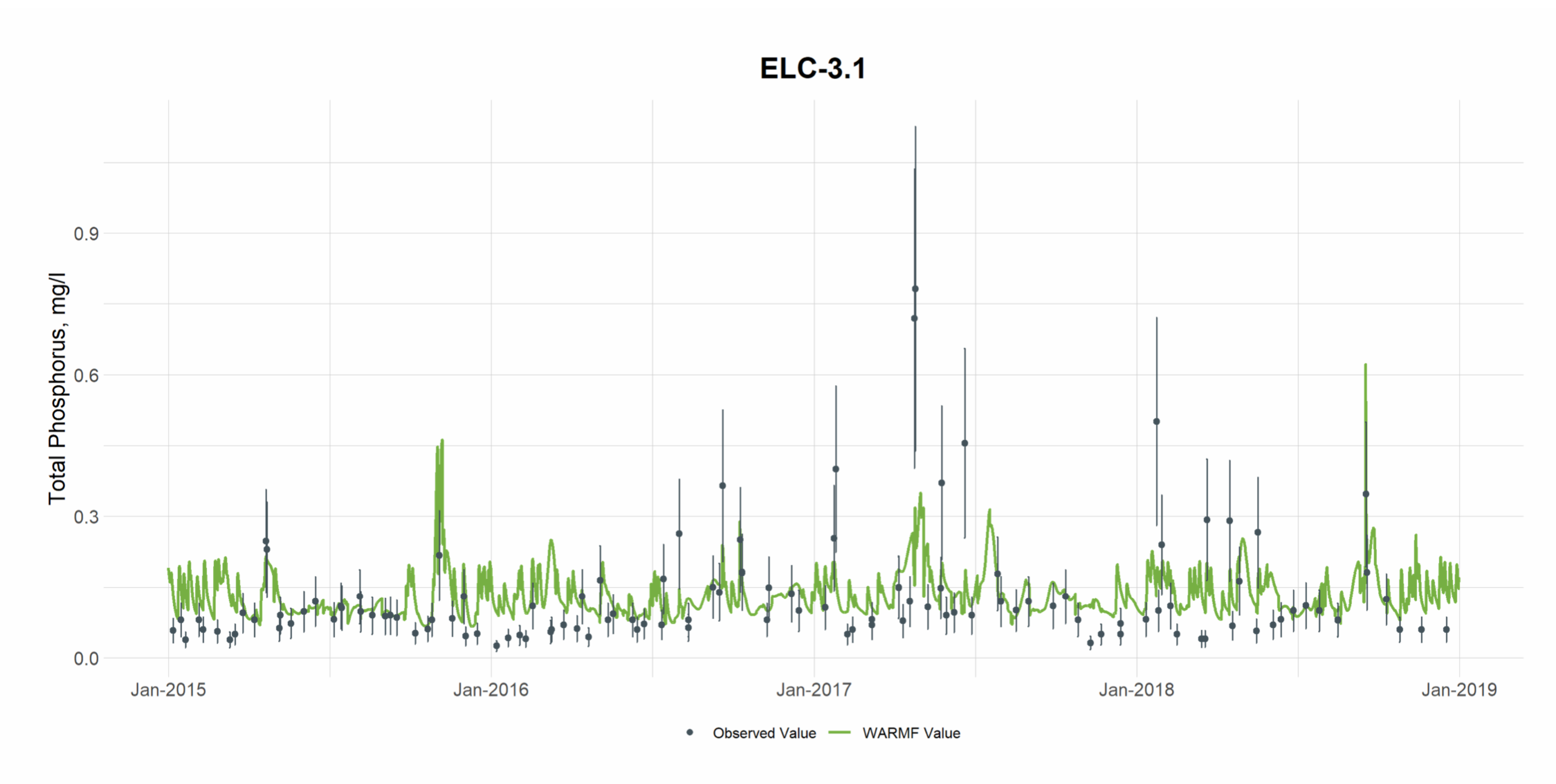


**Figure G-10. Comparison of Observed and Simulated Total Phosphorus Concentrations at Ellerbe Creek at Station ELC-3.1 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

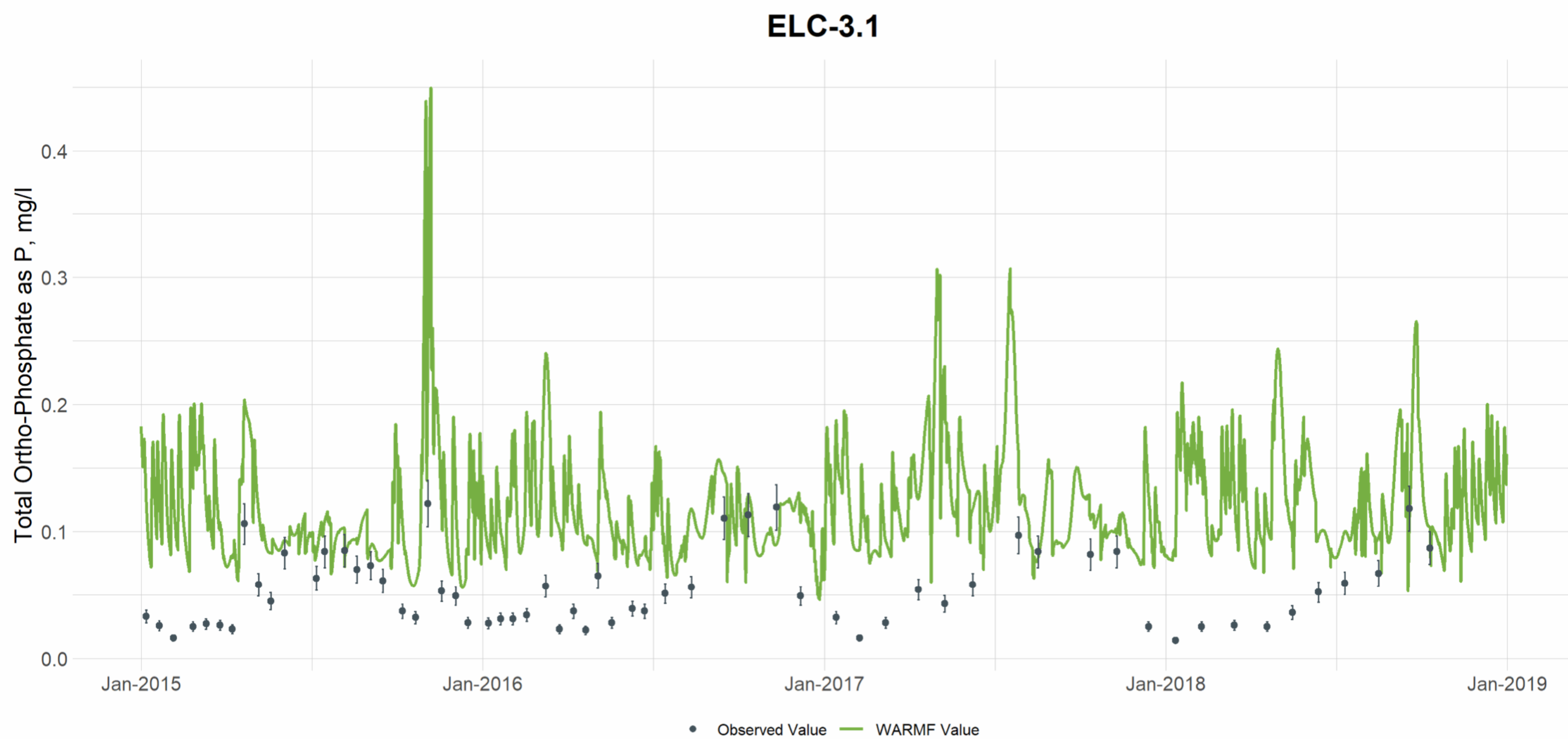


**Figure G-11. Comparison of Observed and Simulated Total Ortho-Phosphate Concentrations at Ellerbe Creek at Station ELC-3.1 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

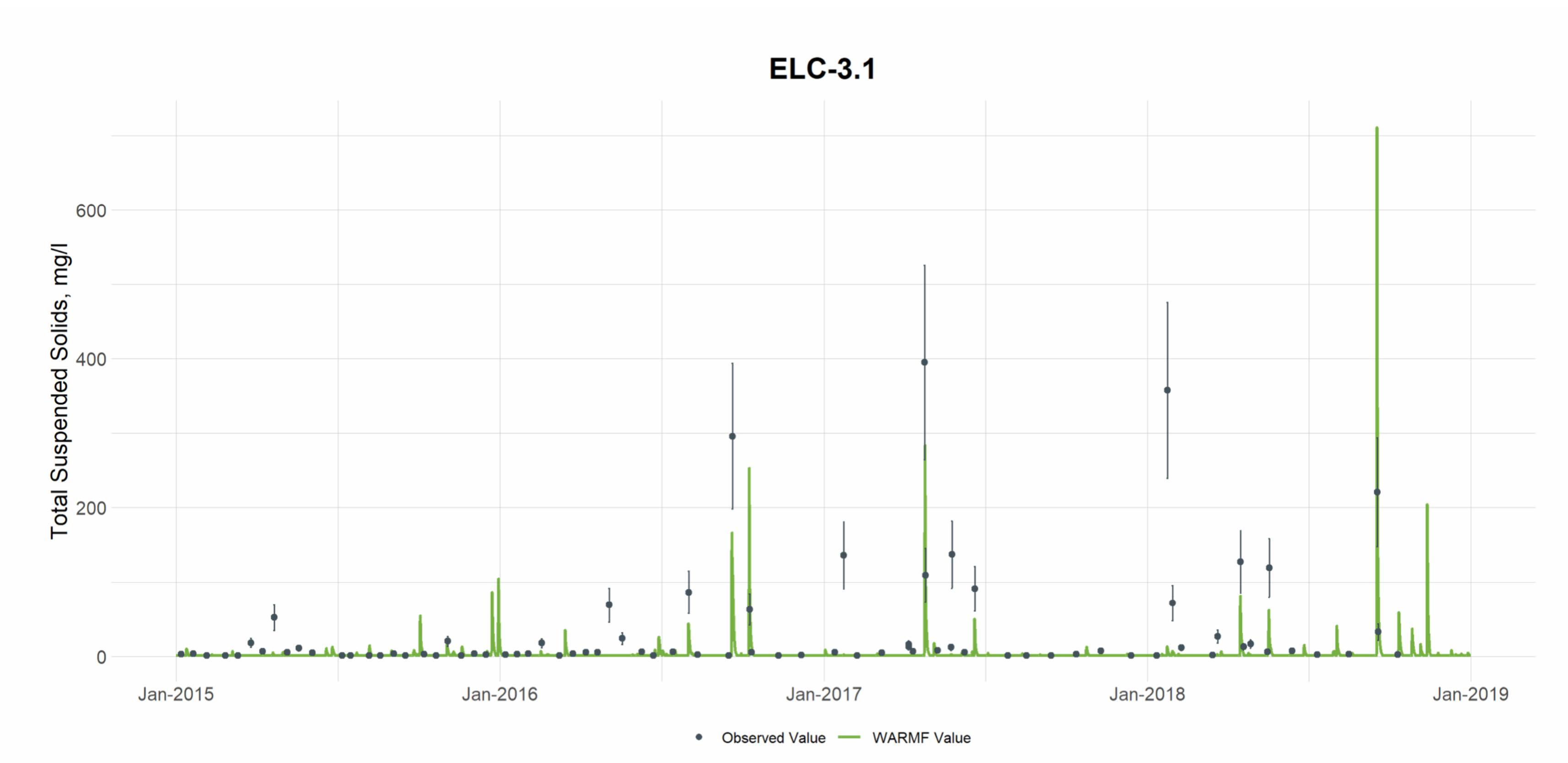


**Figure G-12. Comparison of Observed and Simulated Total Suspended Solids (silt+clay) Concentrations at Ellerbe Creek at Station ELC-3.1 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

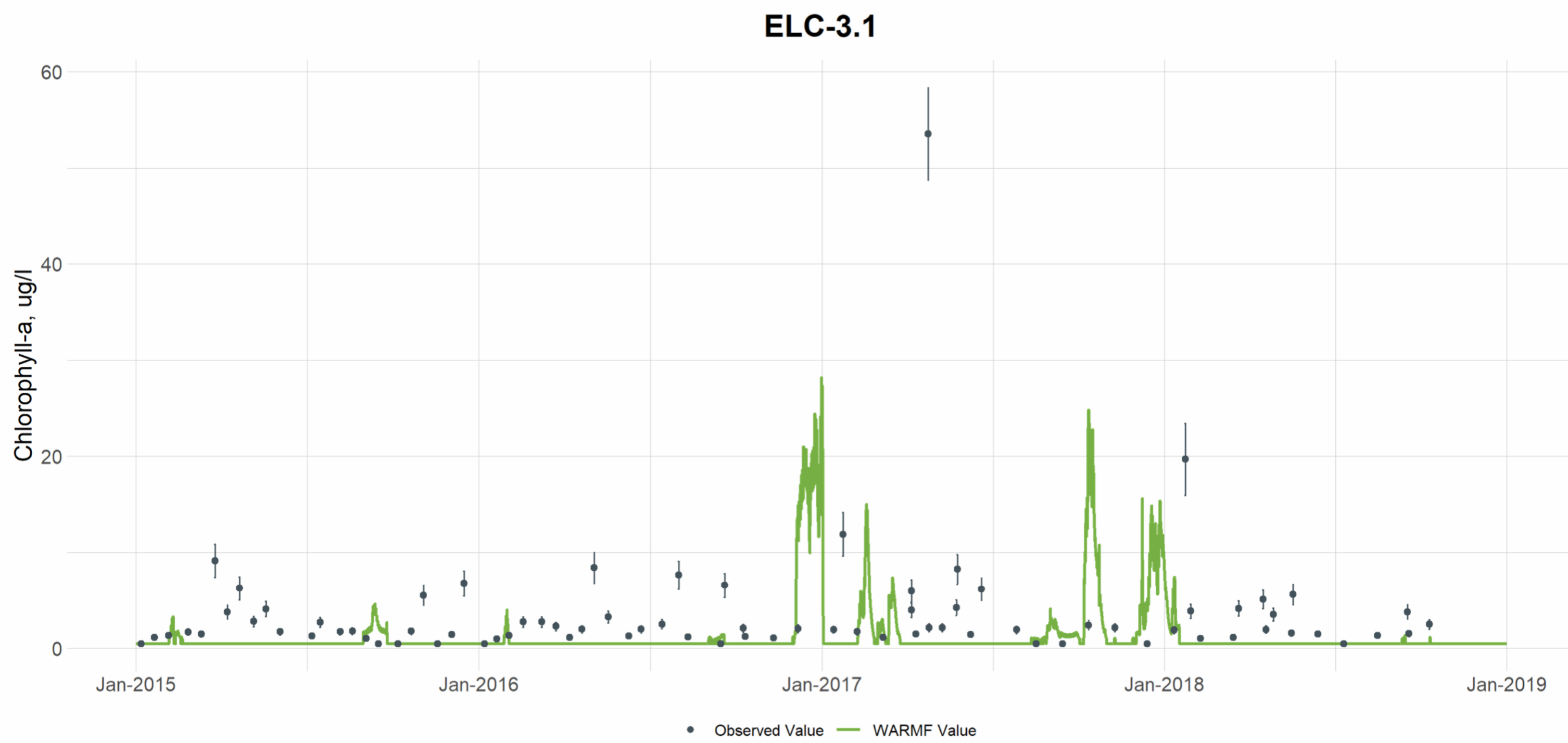


**Figure G-13. Comparison of Observed and Simulated Chlorophyll-a Concentrations at Ellerbe Creek at Station ELC-3.1 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

# Eno River

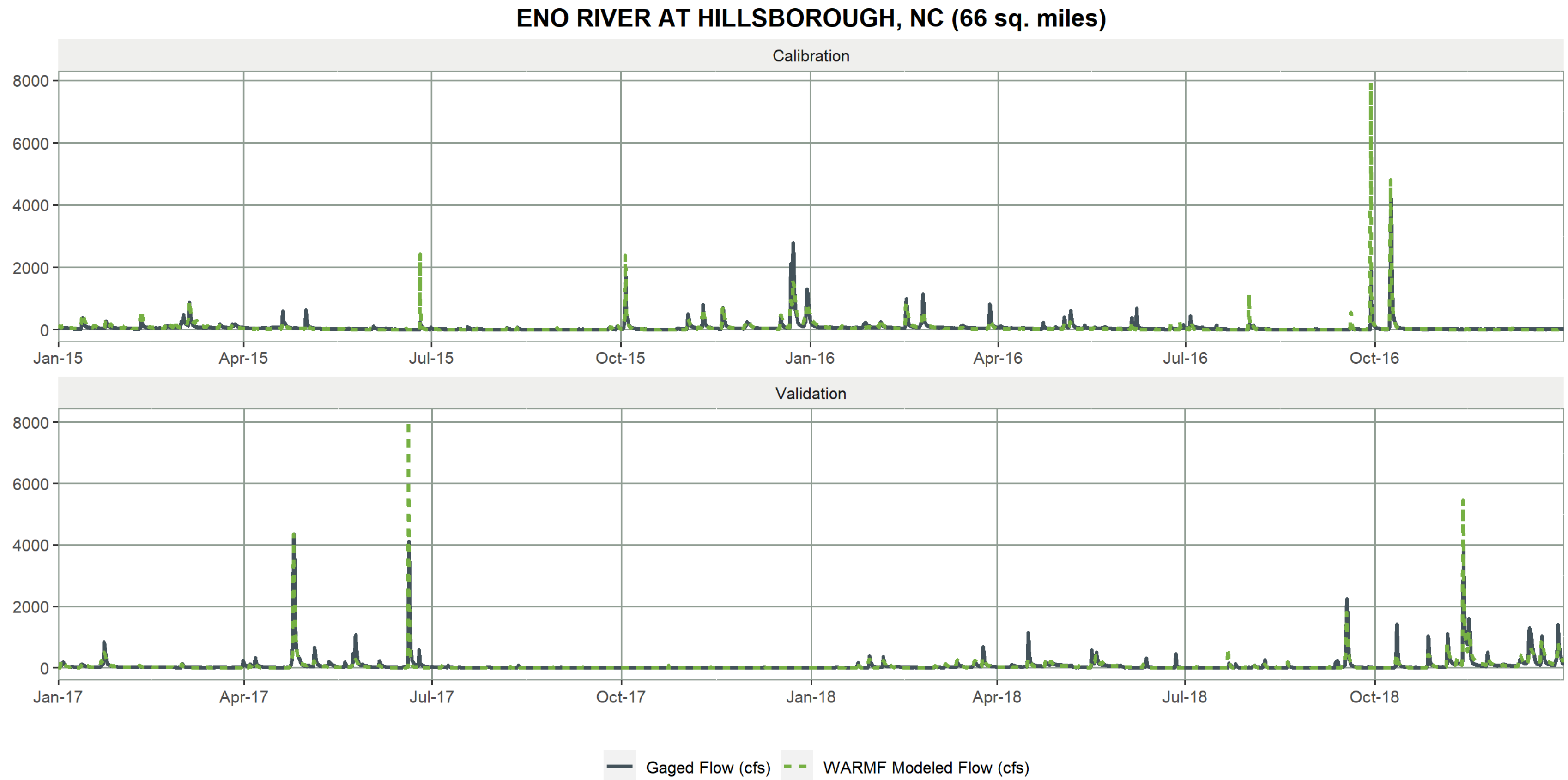


**Figure G-14. Comparison of Observed and Simulated Stream Flows at Eno River at Hillsborough, NC (66 square miles)**

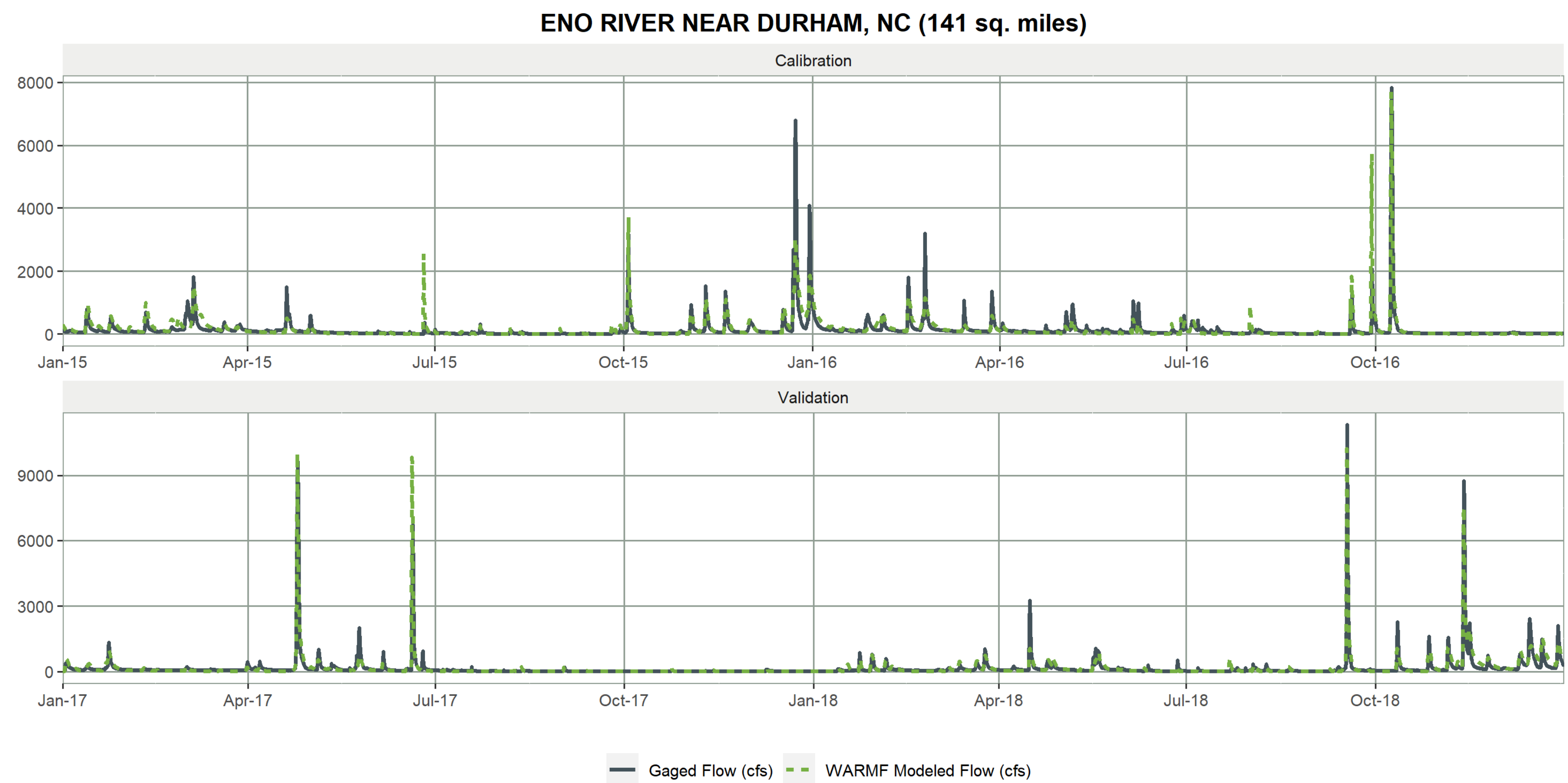


**Figure G-15. Comparison of Observed and Simulated Stream Flows at Eno River near Durham, NC (141 square miles)**

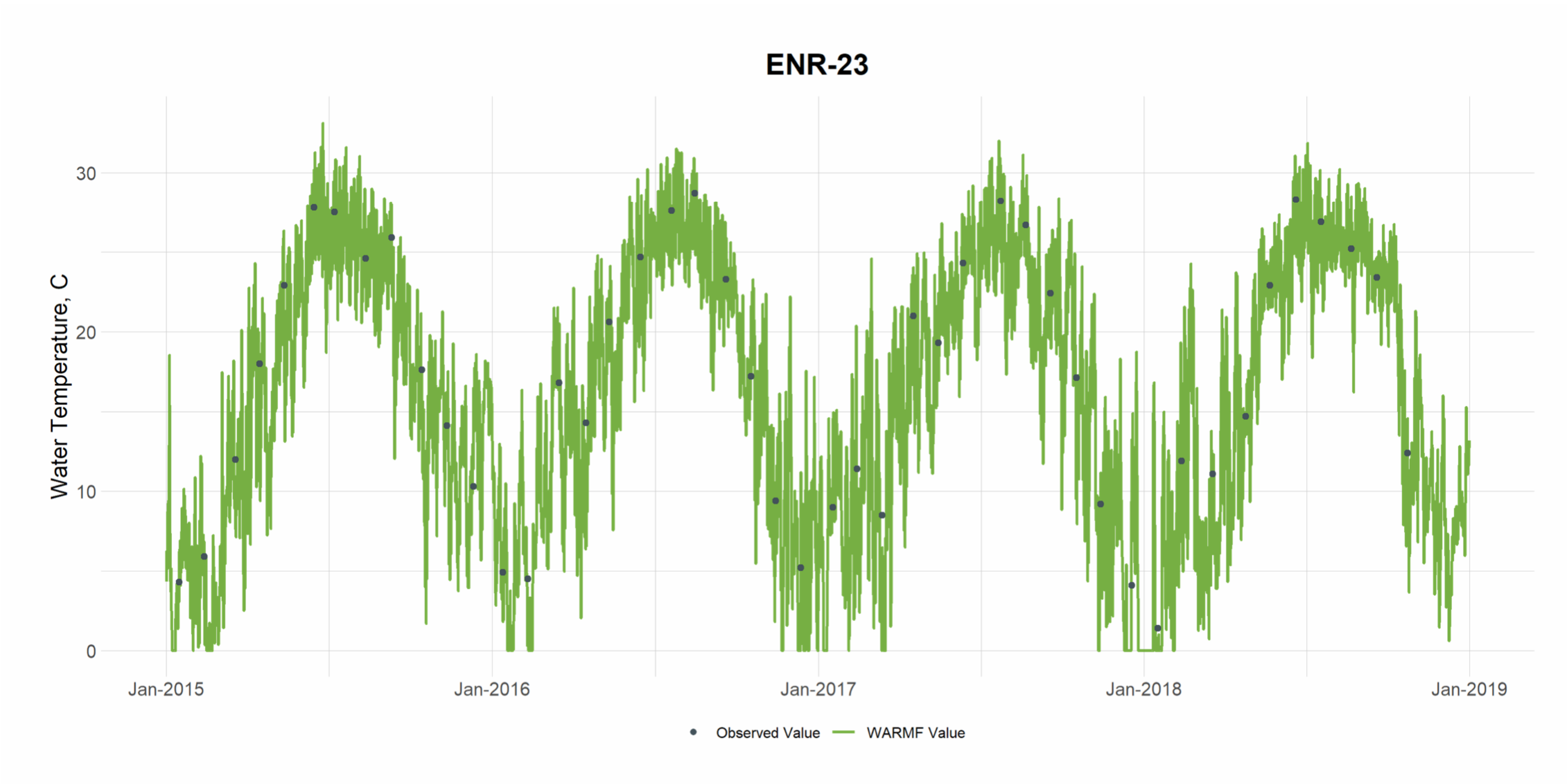


**Figure G-16. Comparison of Observed and Simulated Stream Temperatures at Eno River at Station ENR-23**

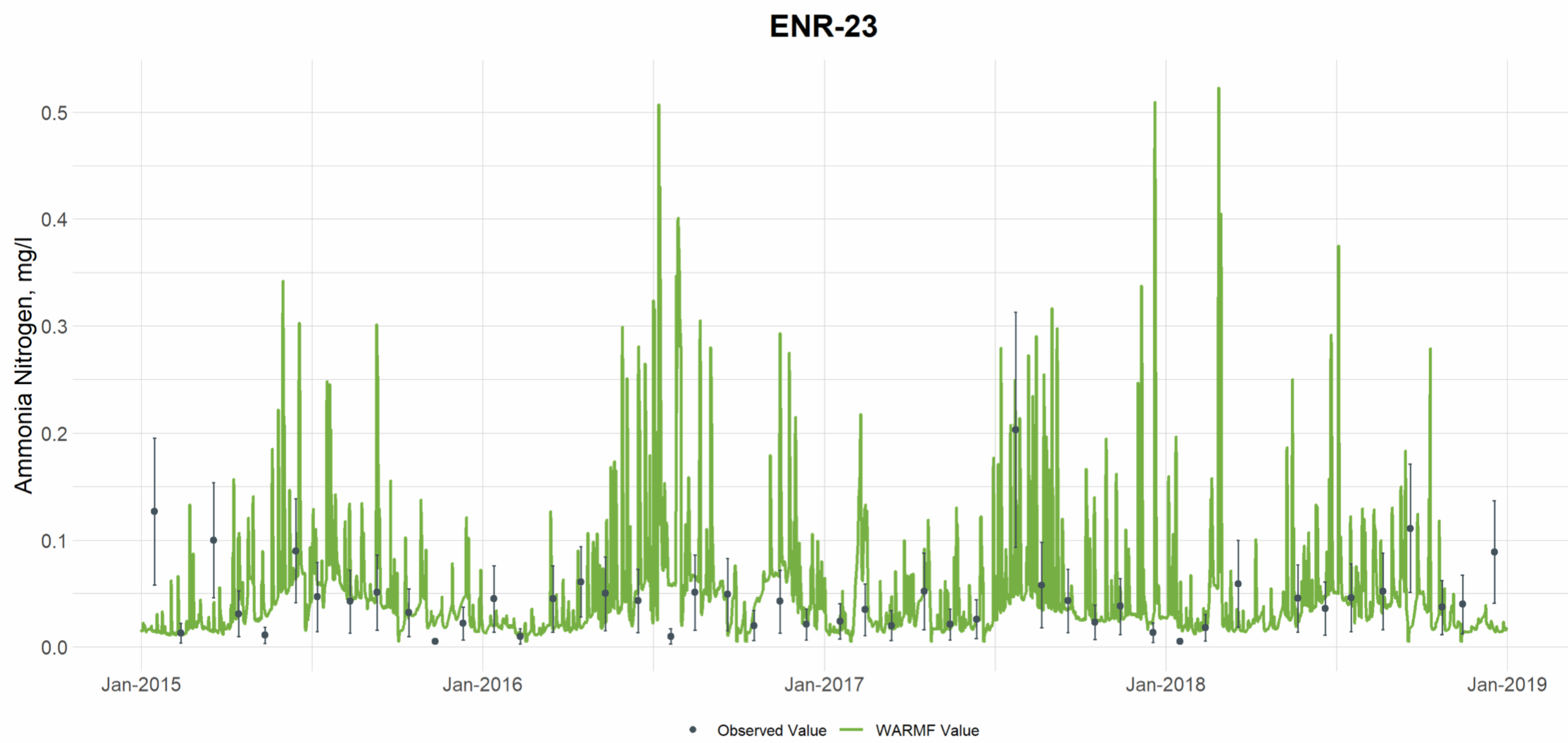


**Figure G-17. Comparison of Observed and Simulated Ammonia Concentrations at Eno River at Station ENR-23 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

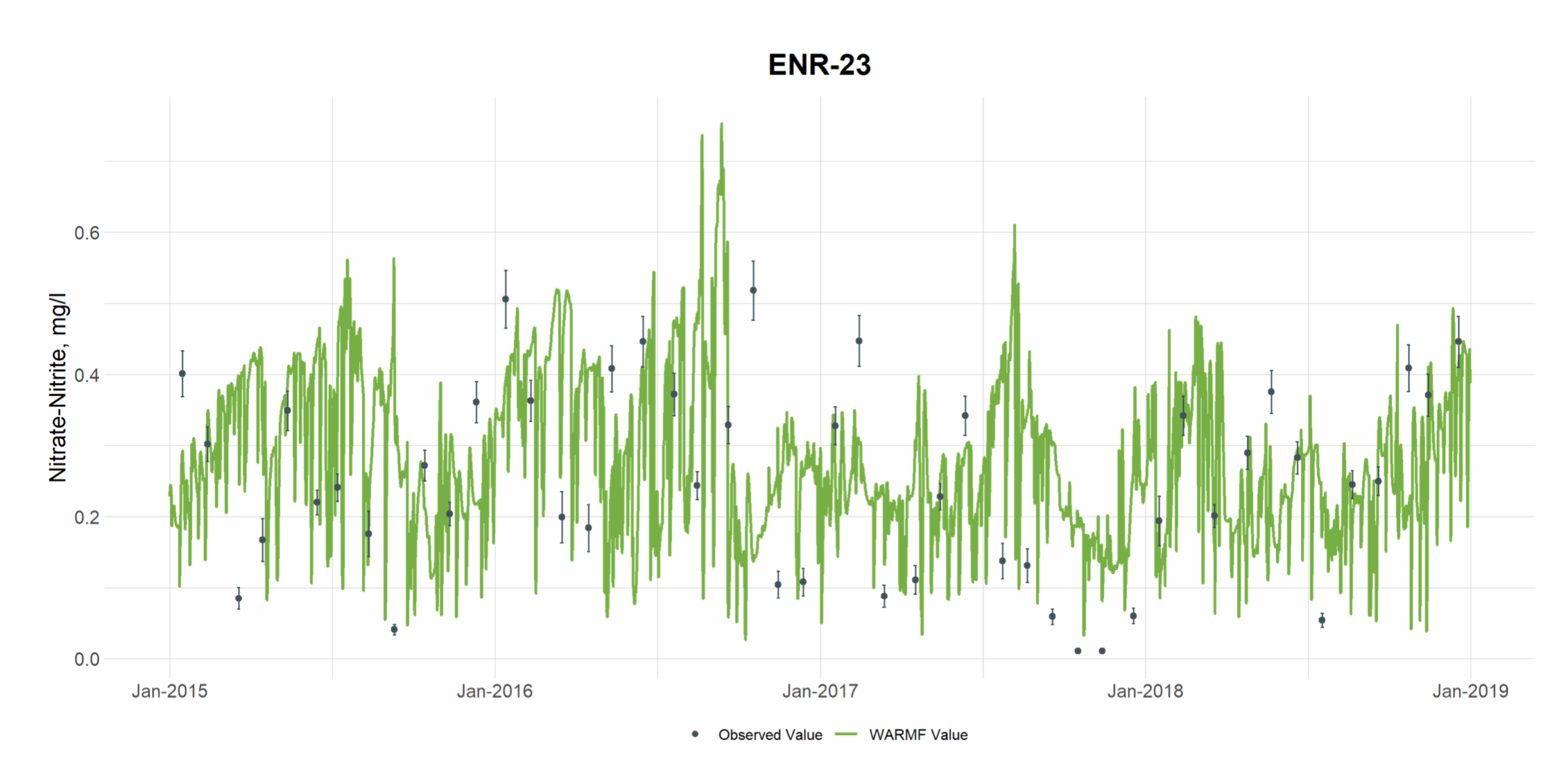


**Figure G-18. Comparison of Observed and Simulated Nitrate-Nitrite Concentrations at Eno River at Station ENR-23 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

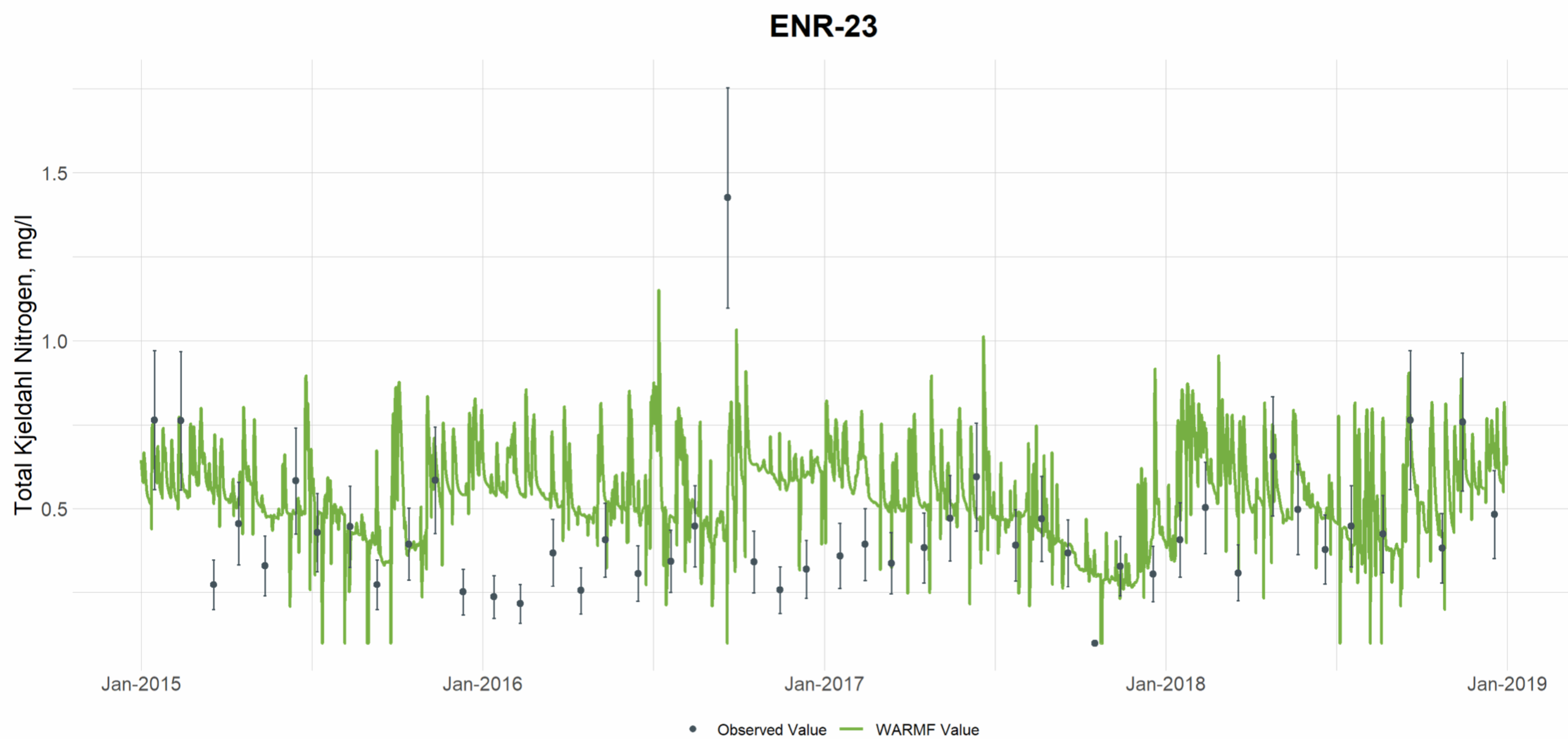


**Figure G-19. Comparison of Observed and Simulated Total Kjeldahl Nitrogen Concentrations at Eno River at Station ENR-23 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

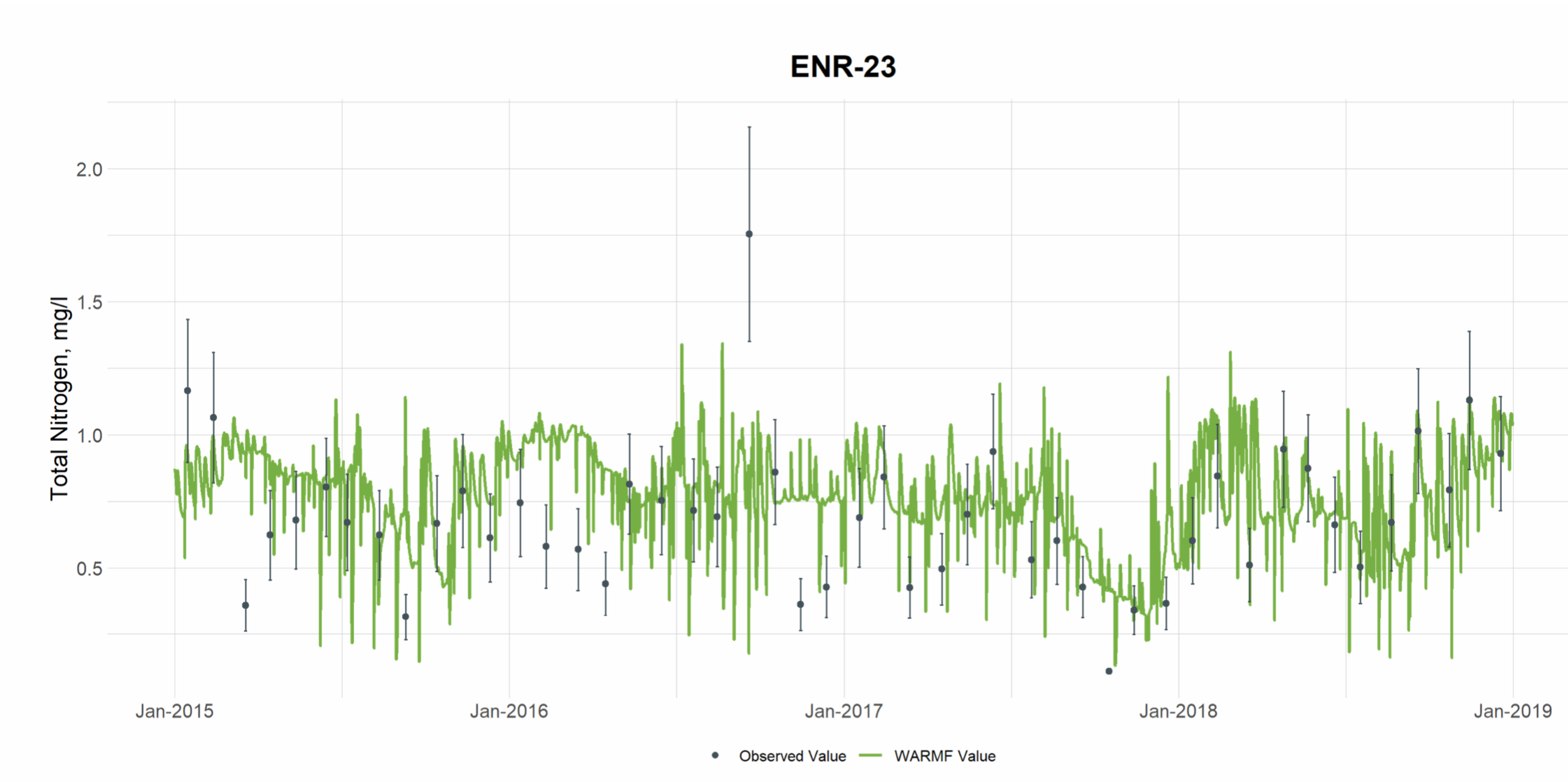


**Figure G-20. Comparison of Observed and Simulated Total Nitrogen Concentrations at Eno River at Station ENR-23 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

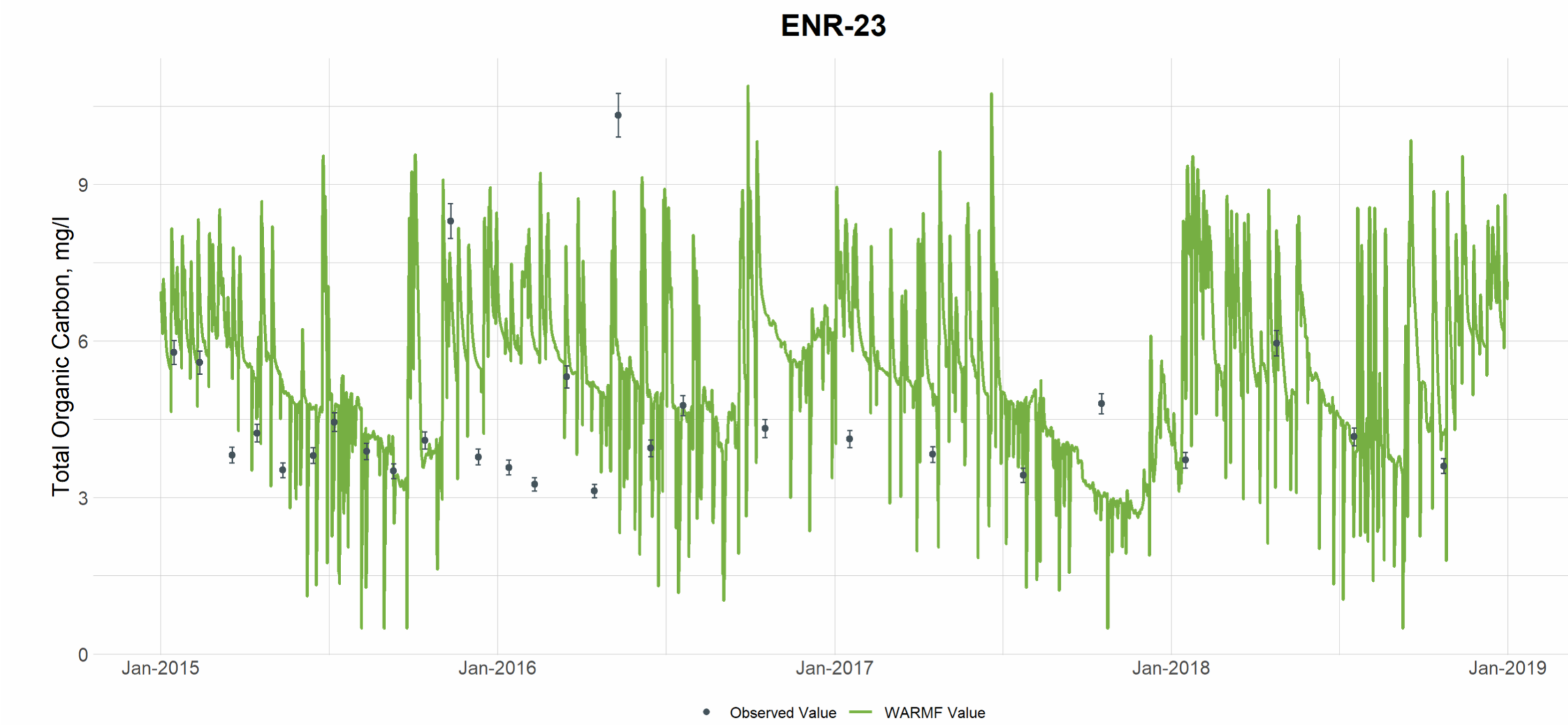


**Figure G-21. Comparison of Observed and Simulated Total Organic Carbon Concentrations at Eno River at Station ENR-23 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

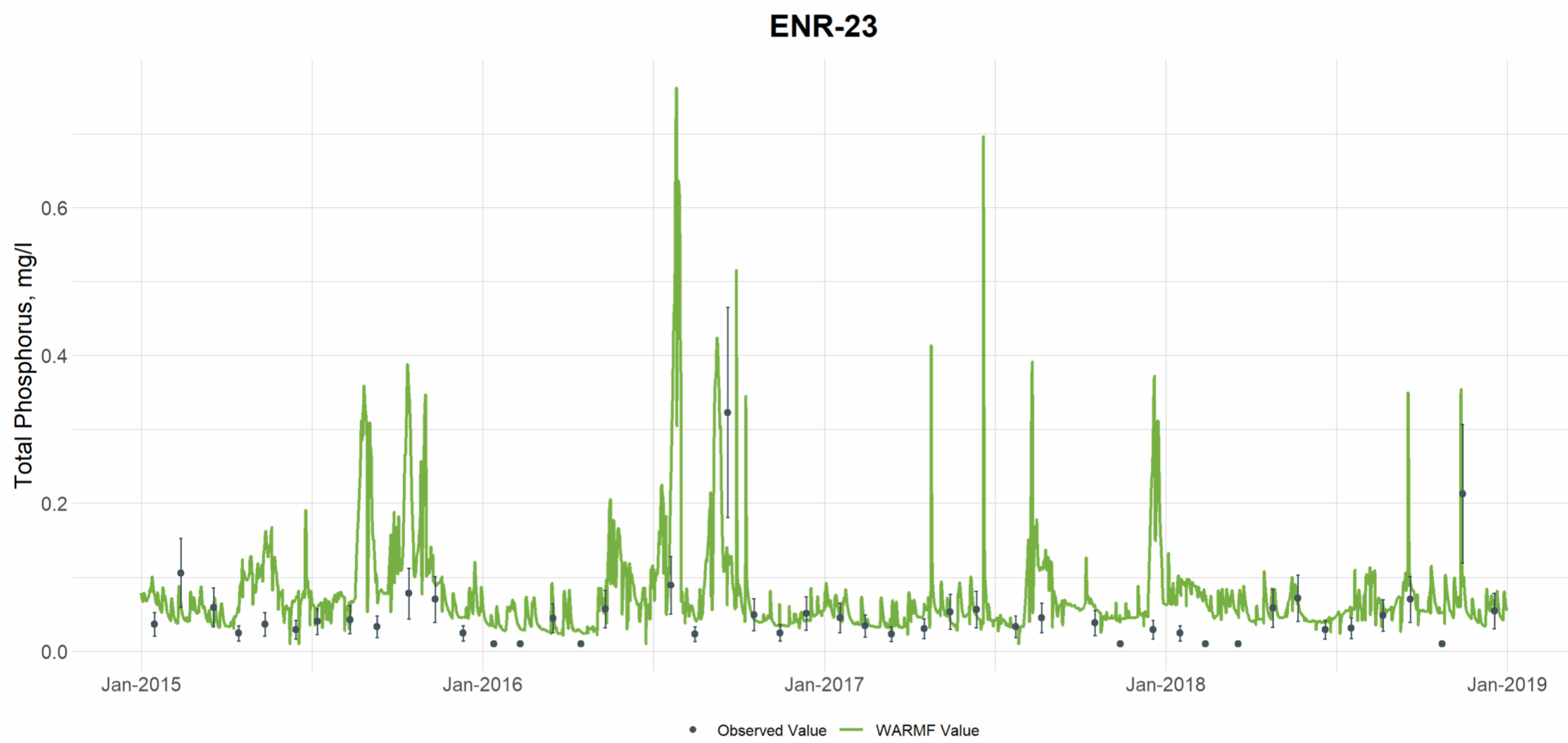


**Figure G-22. Comparison of Observed and Simulated Total Phosphorus Concentrations at Eno River at Station ENR-23 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

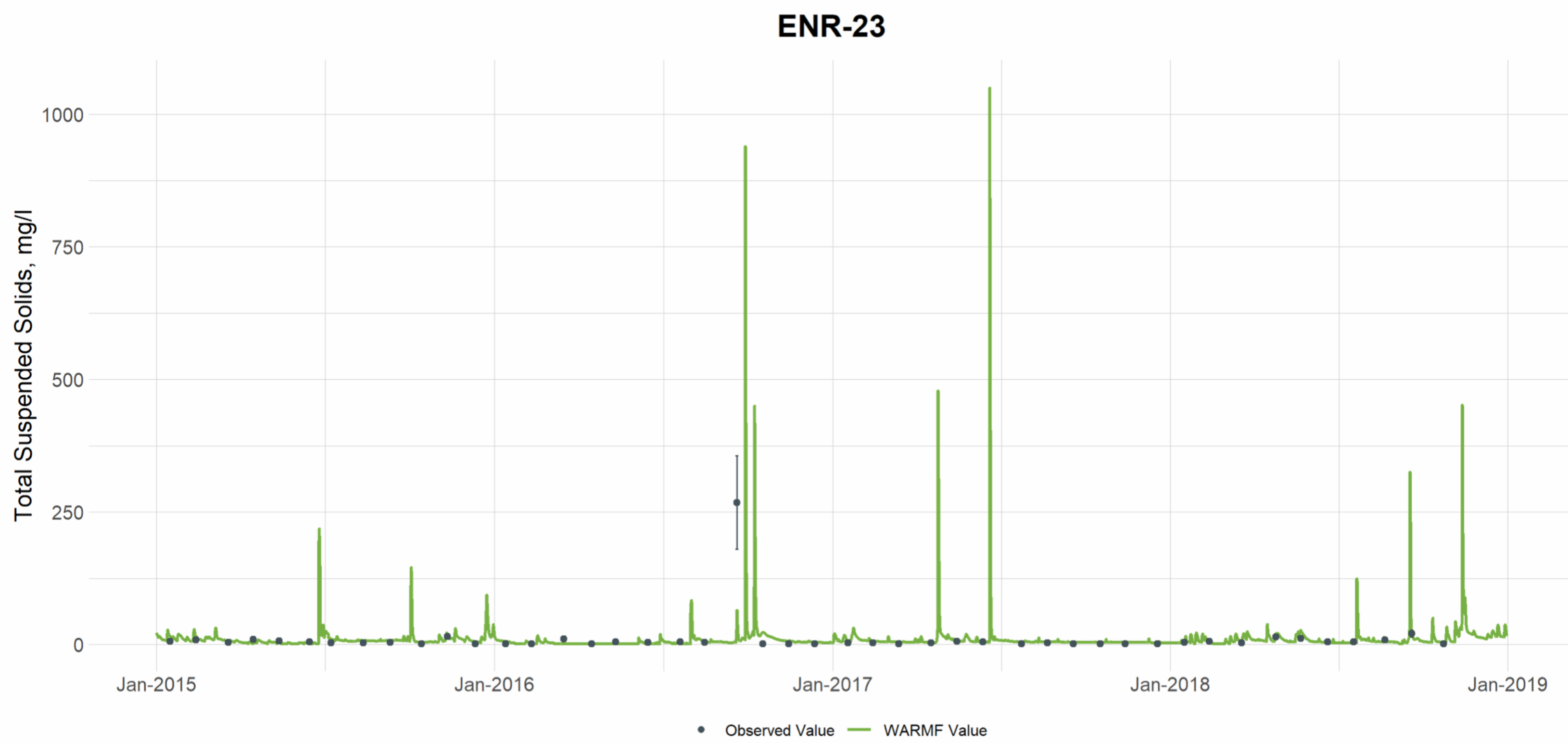


**Figure G-23. Comparison of Observed and Simulated Total Suspended Solids (silt+clay) Concentrations at Eno River at Station ENR-23 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

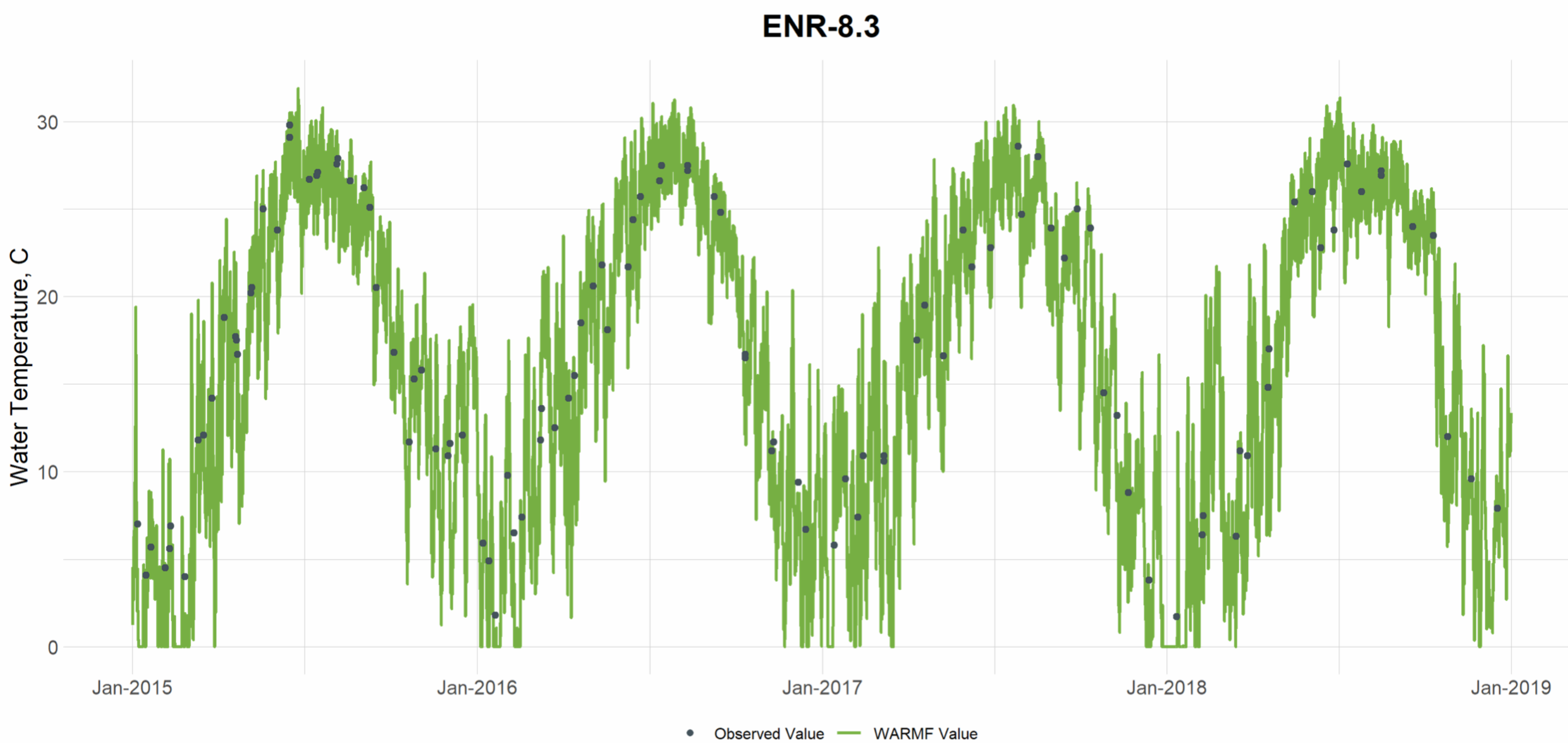


**Figure G-24. Comparison of Observed and Simulated Stream Temperatures at Eno River at Station ENR-8.3**

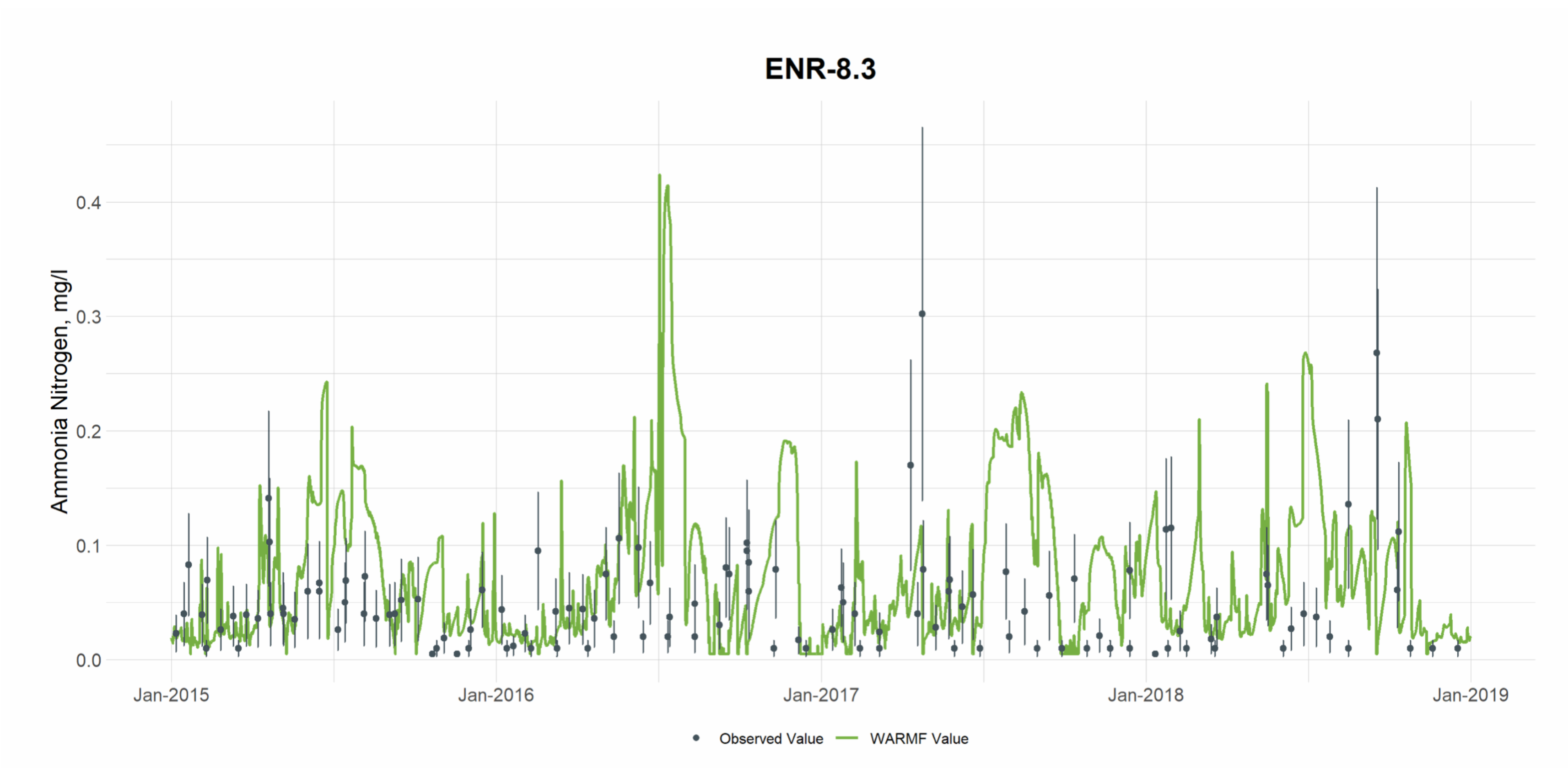


**Figure G-25. Comparison of Observed and Simulated Ammonia Concentrations at Eno River at Station ENR-8.3 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

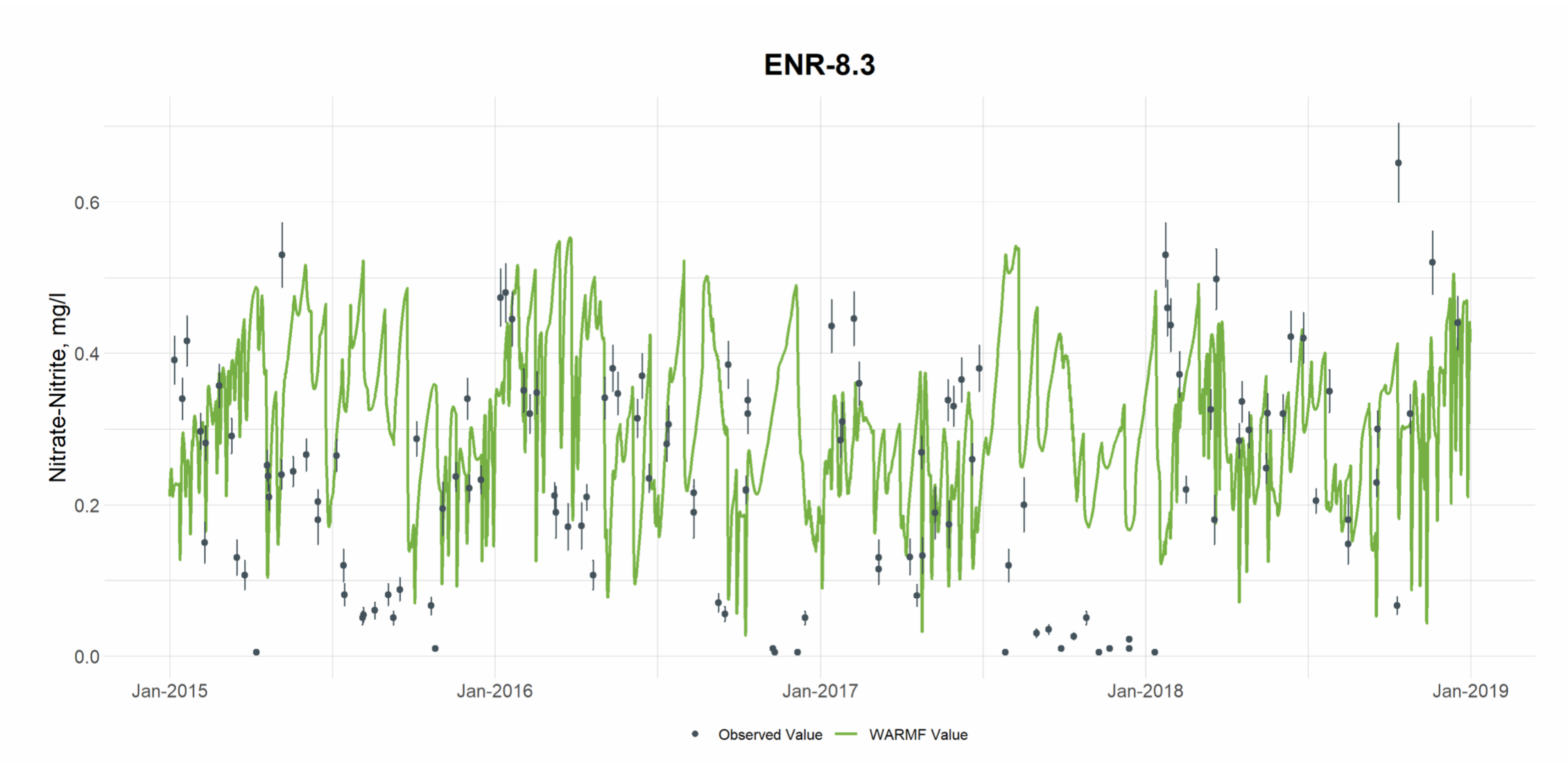


**Figure G-26. Comparison of Observed and Simulated Nitrate-Nitrite Concentrations at Eno River at Station ENR-8.3 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

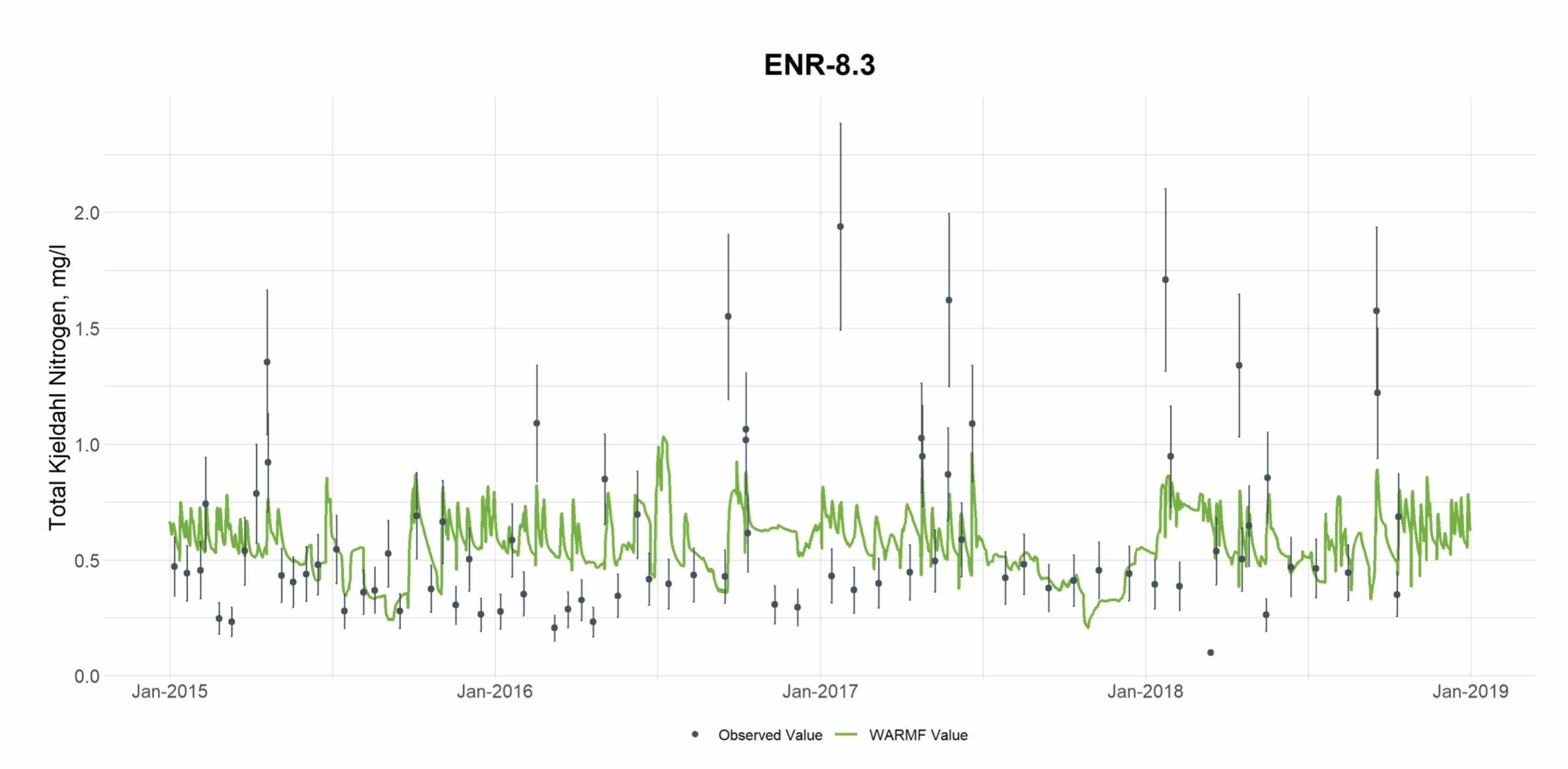


**Figure G-27. Comparison of Observed and Simulated Total Kjeldahl Nitrogen Concentrations at Eno River at Station ENR-8.3 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

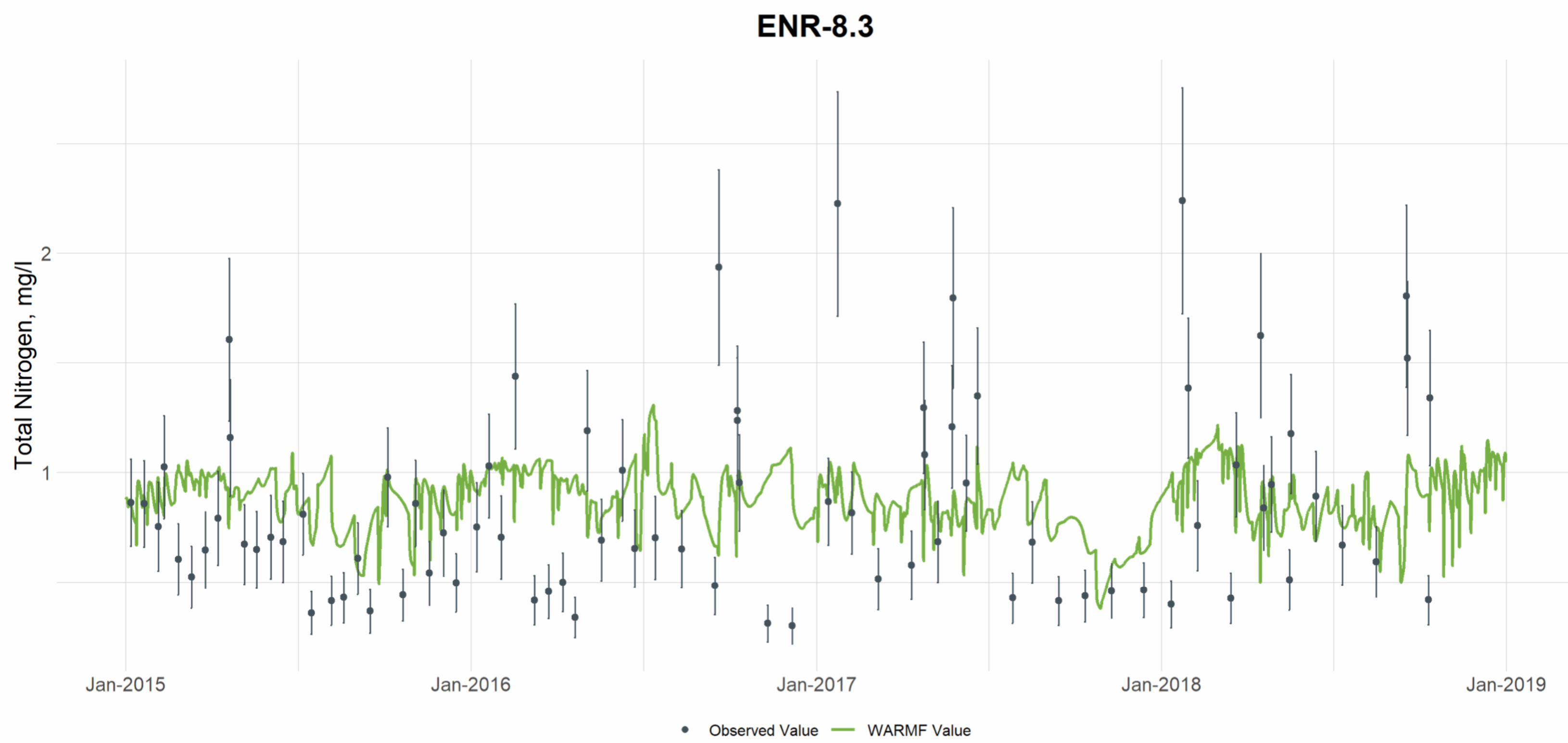


**Figure G-28. Comparison of Observed and Simulated Total Nitrogen Concentrations at Eno River at Station ENR-8.3 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

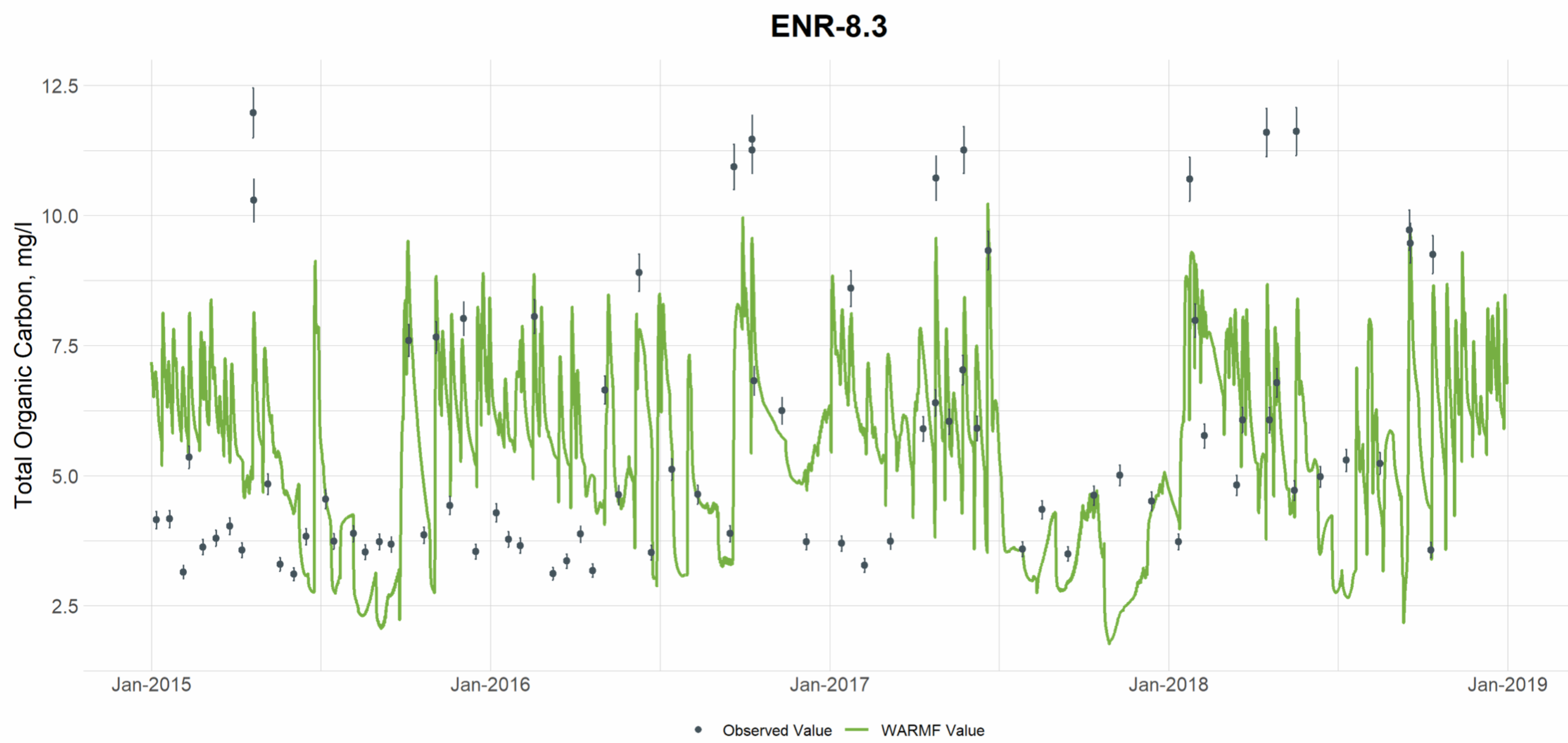


**Figure G-29. Comparison of Observed and Simulated Total Organic Carbon Concentrations at Eno River at Station ENR-8.3 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

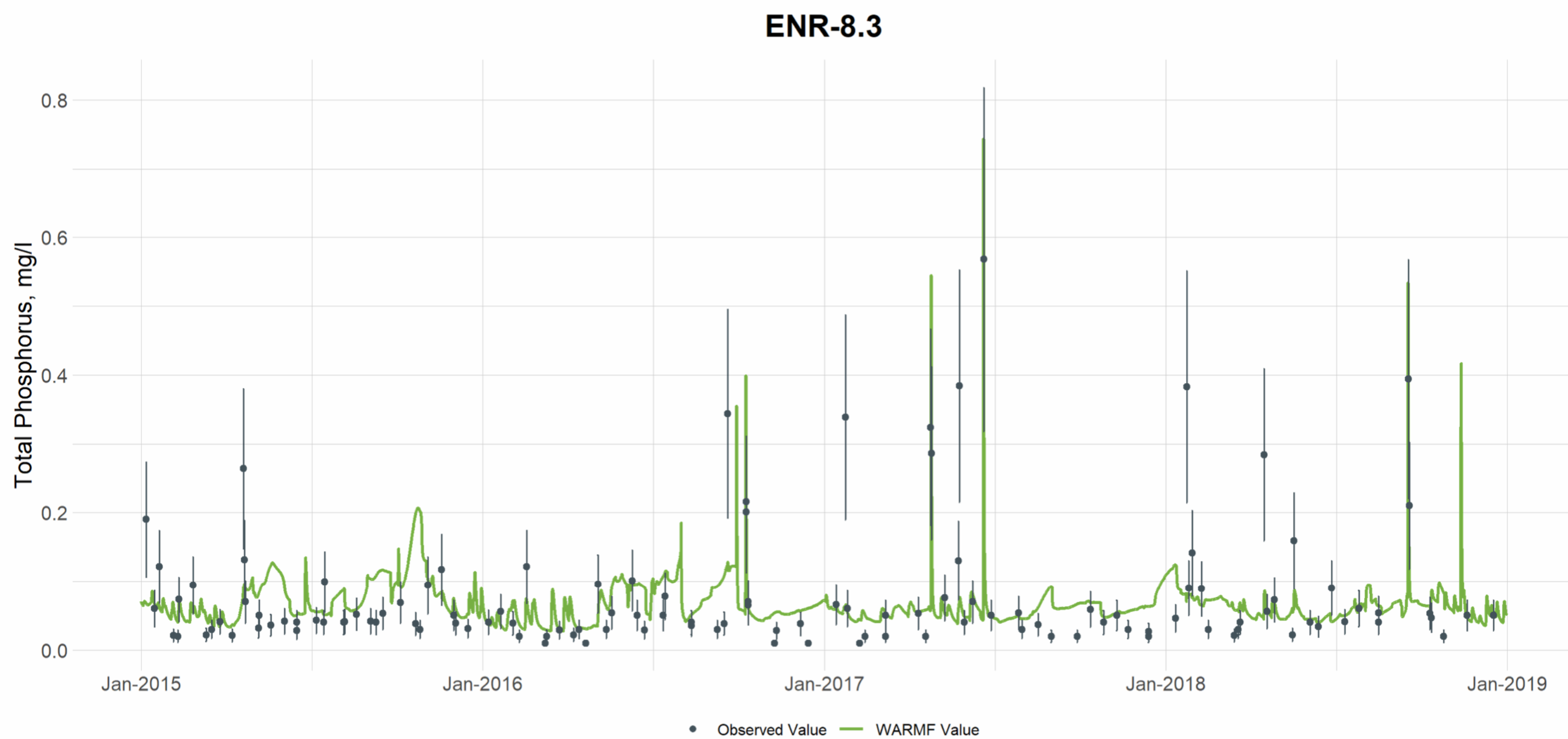


**Figure G-30. Comparison of Observed and Simulated Total Phosphorus Concentrations at Eno River at Station ENR-8.3 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter**

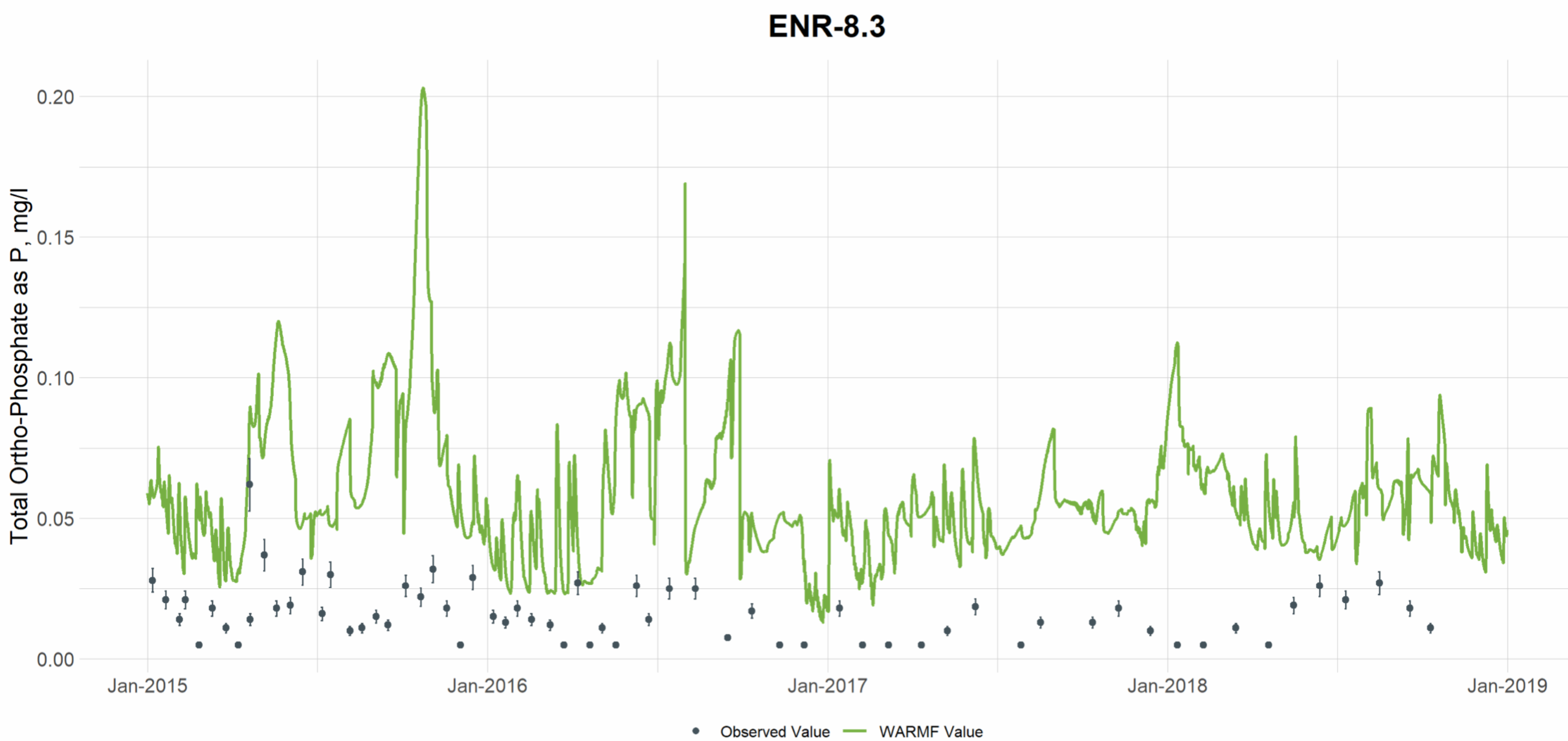


**Figure G-31. Comparison of Observed and Simulated Total Ortho-Phosphate Concentrations at Eno River at Station ENR-8.3 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

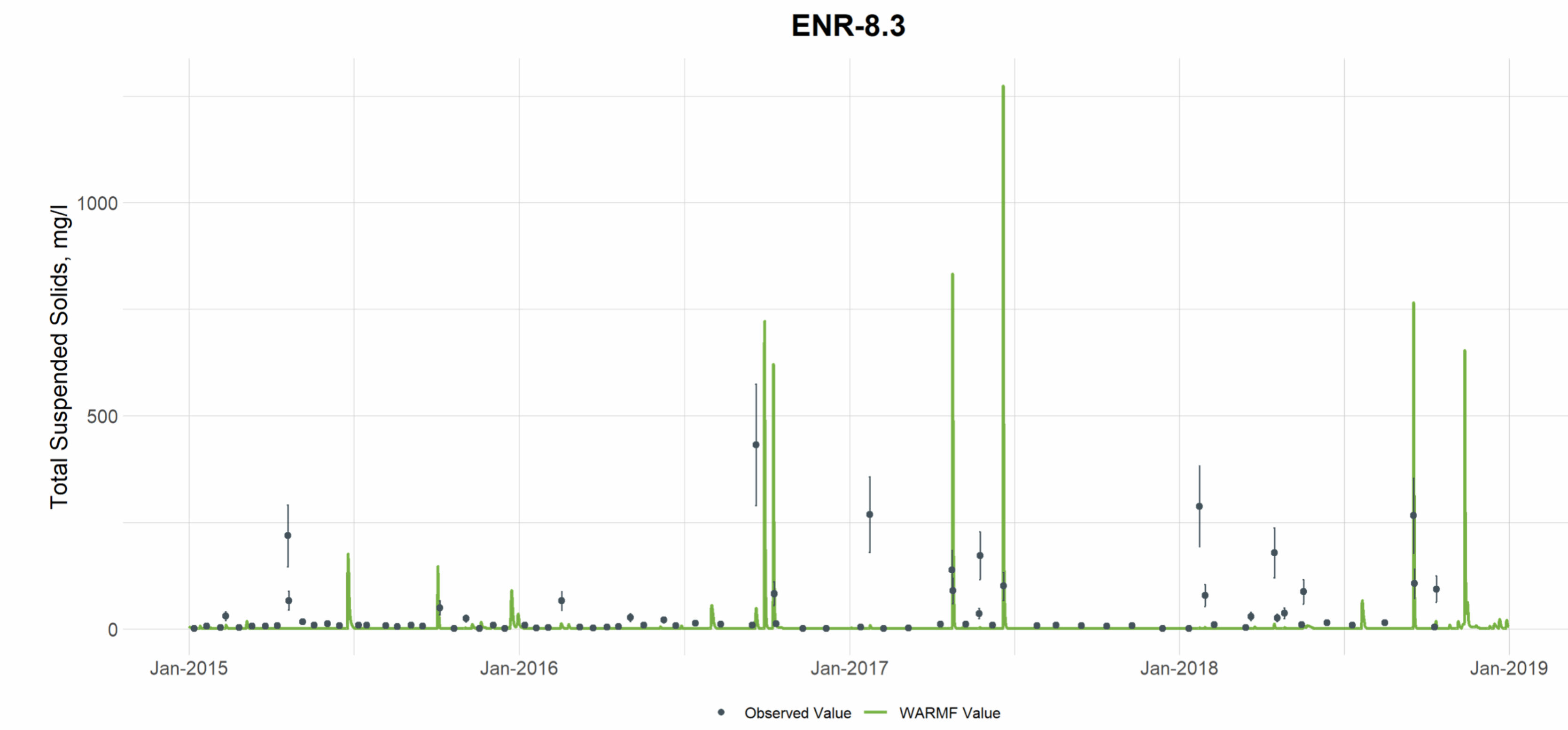


**Figure G-32. Comparison of Observed and Simulated Total Suspended Solids (silt+clay) Concentrations at Eno River at Station ENR-8.3 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

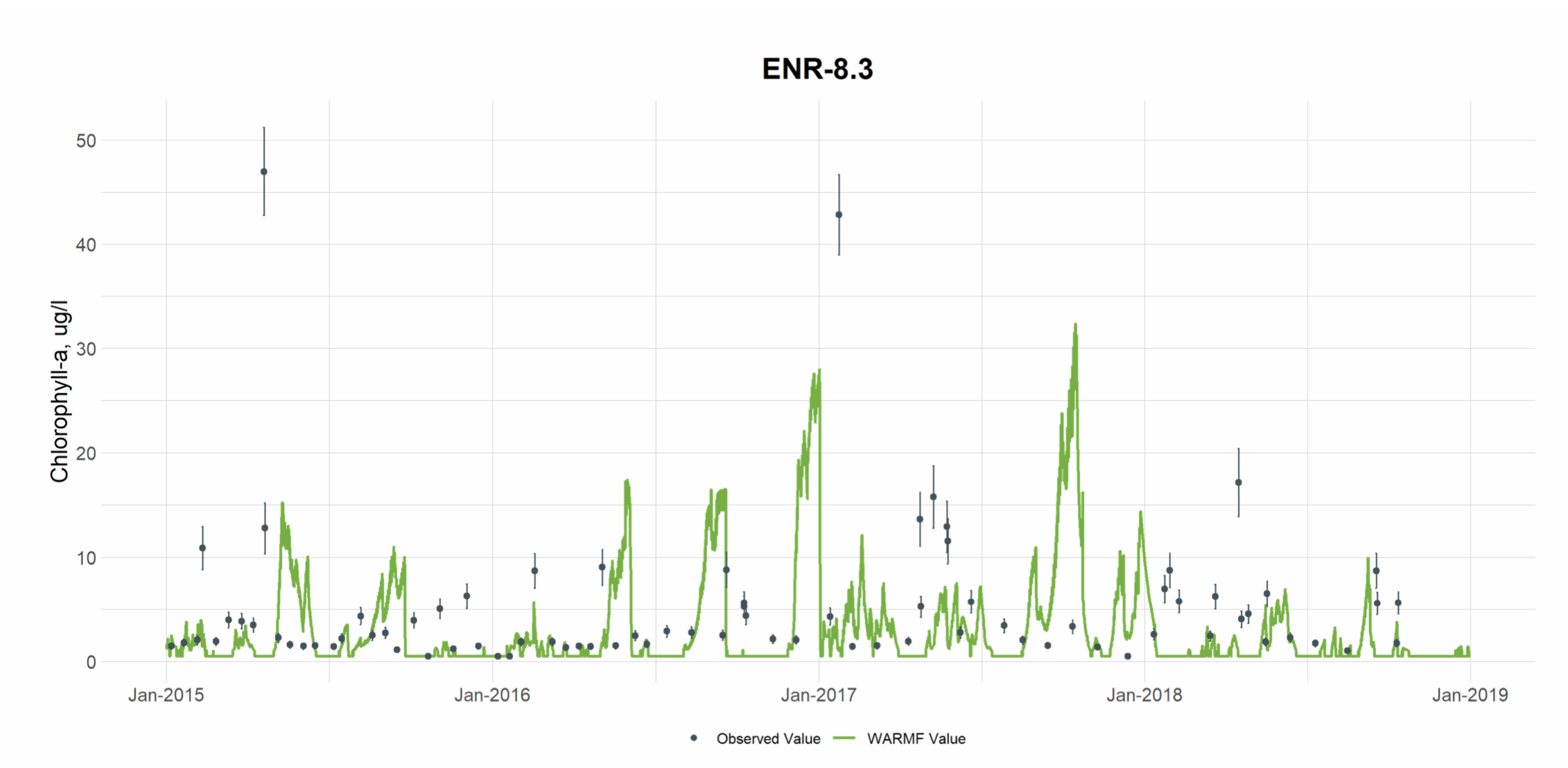


**Figure G-33. Comparison of Observed and Simulated Chlorophyll-a Concentrations at Eno River at Station ENR-8.3 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

## Flat River

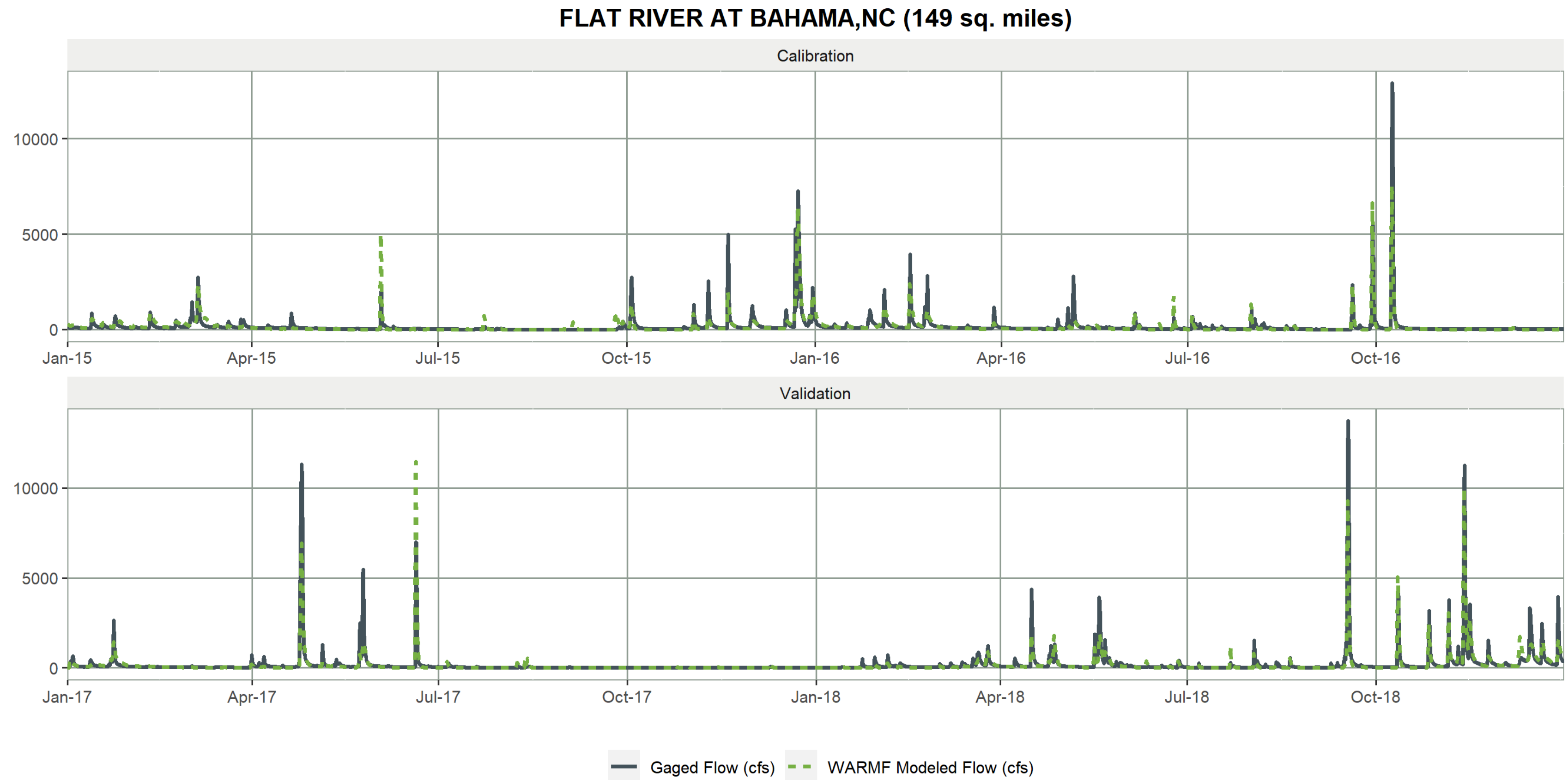


**Figure G-34. Comparison of Observed and Simulated Stream Flows at Flat River at Bahama, NC (149 square miles)**

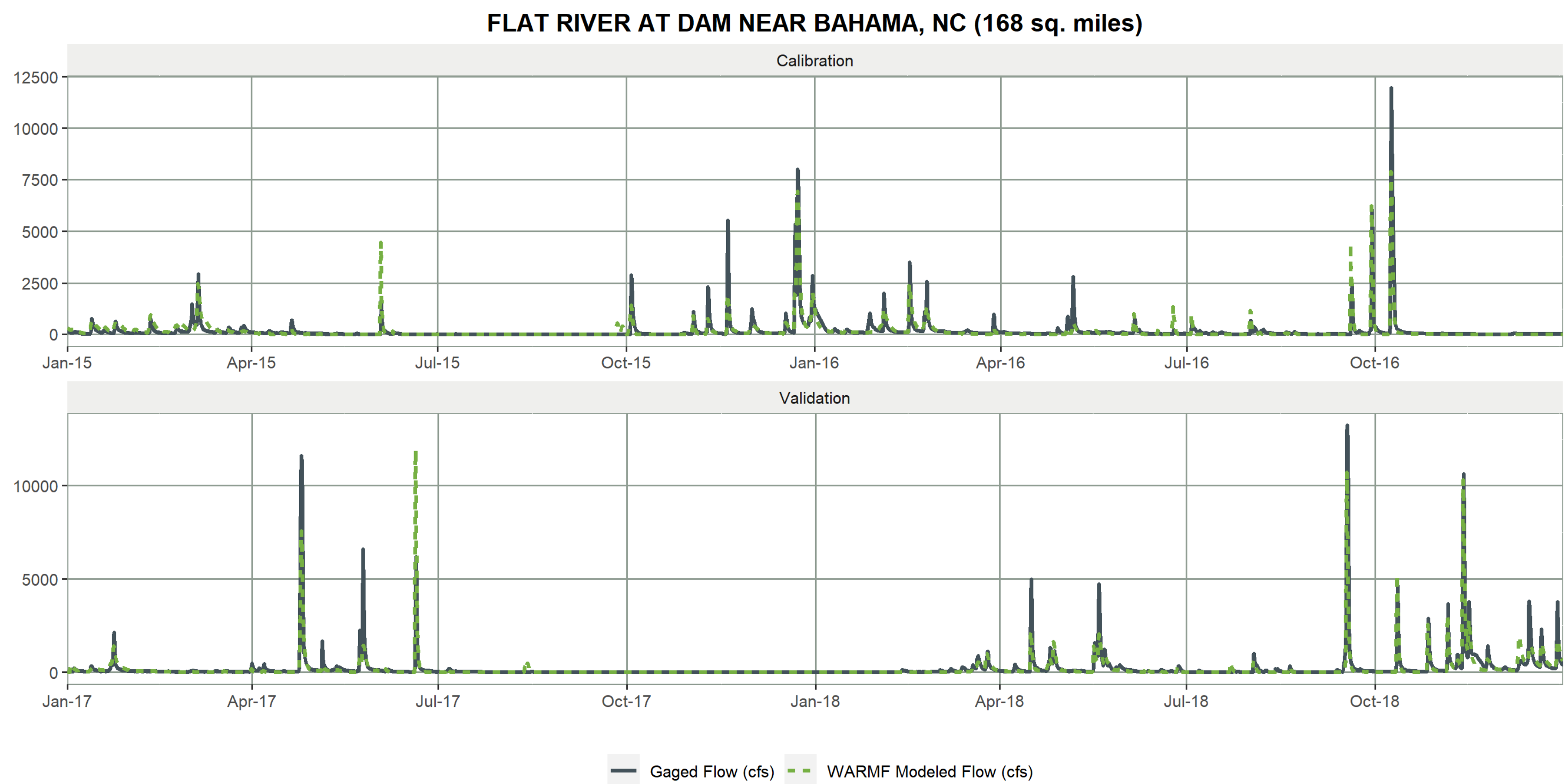


**Figure G-35. Comparison of Observed and Simulated Stream Flows at Flat River at Dam near Bahama, NC (168 square miles)**

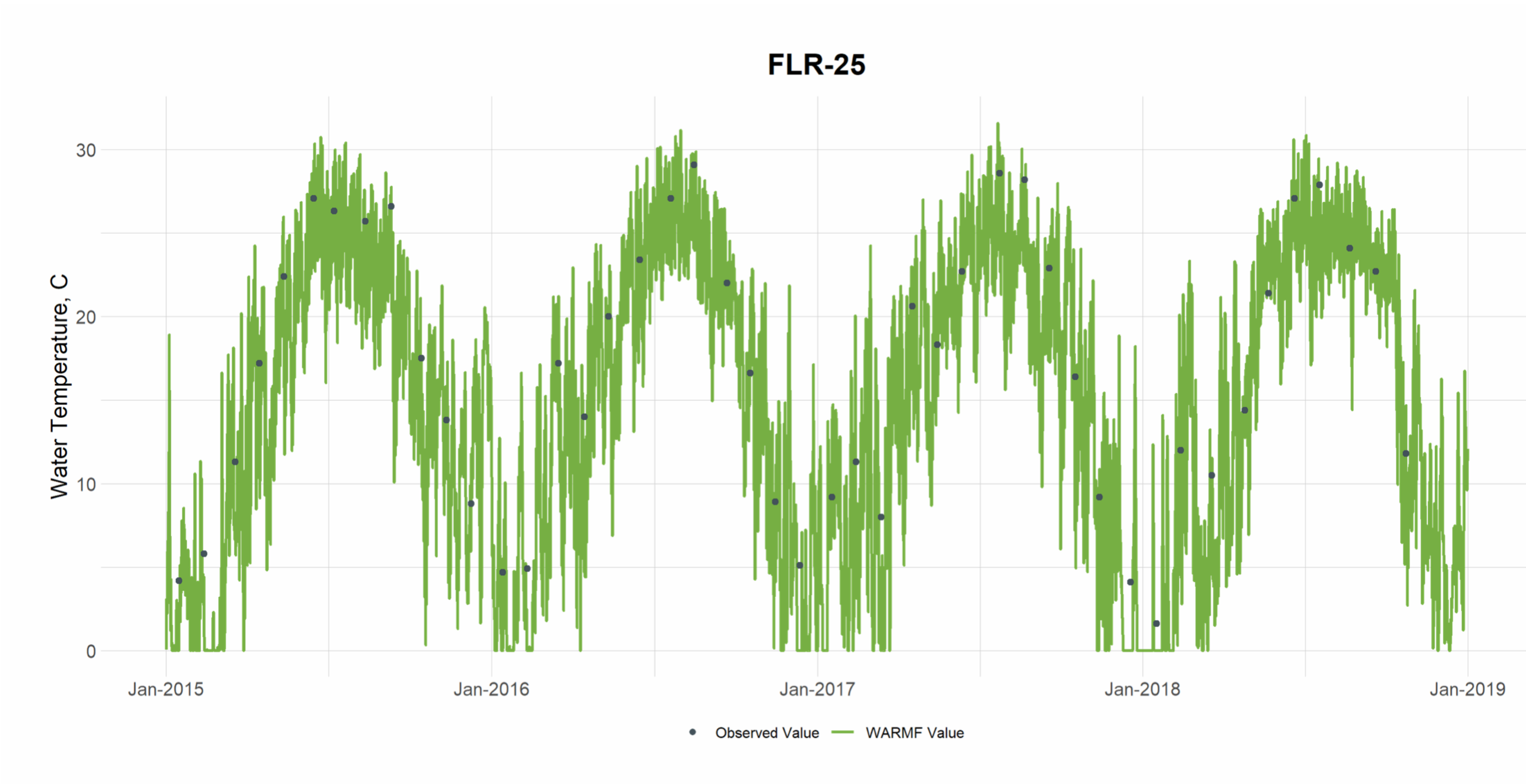


**Figure G-36. Comparison of Observed and Simulated Stream Temperatures at Flat River at Station FLR-25**

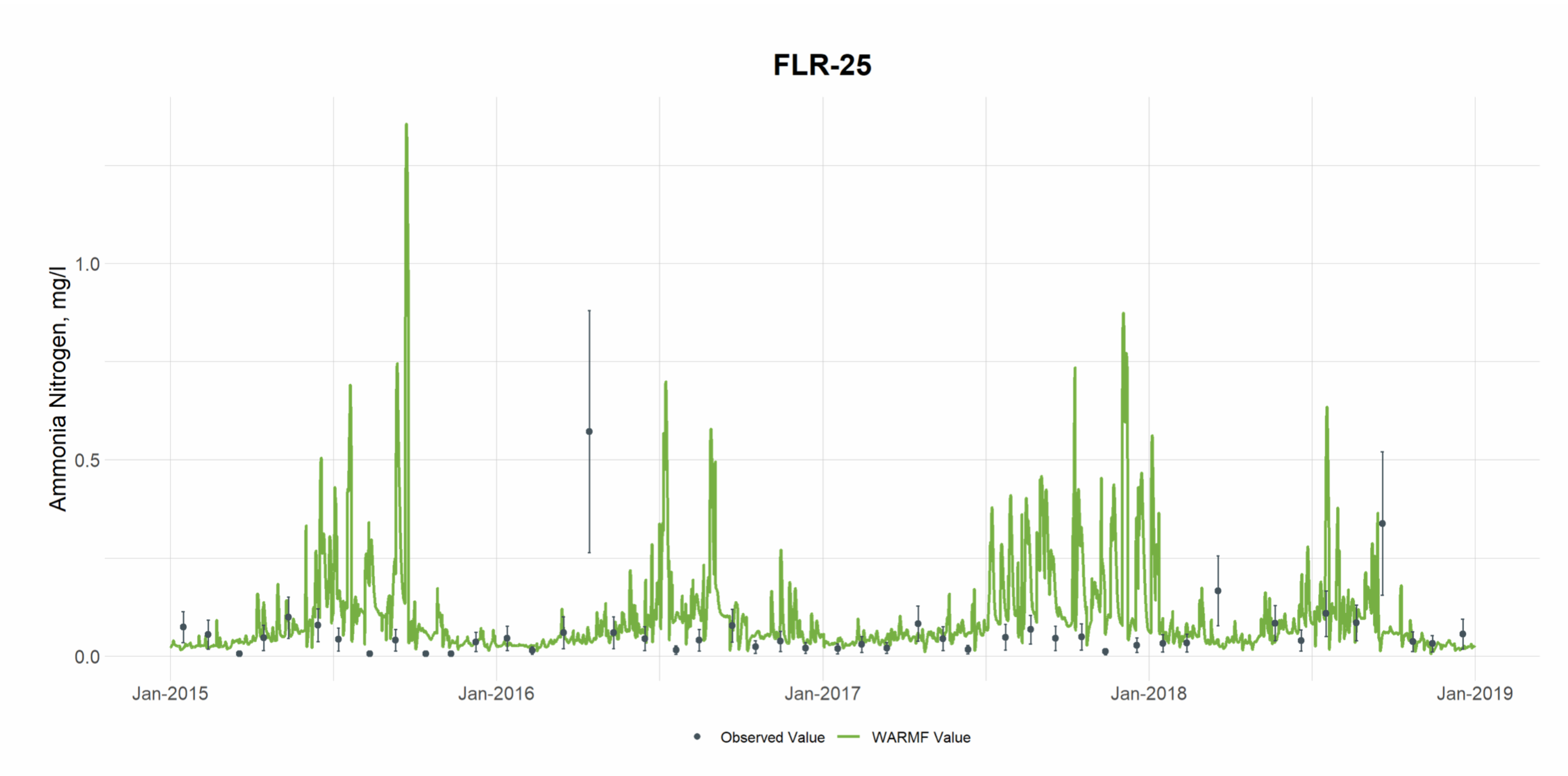


**Figure G-37. Comparison of Observed and Simulated Ammonia Concentrations at Flat River at Station FLR-25** (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)

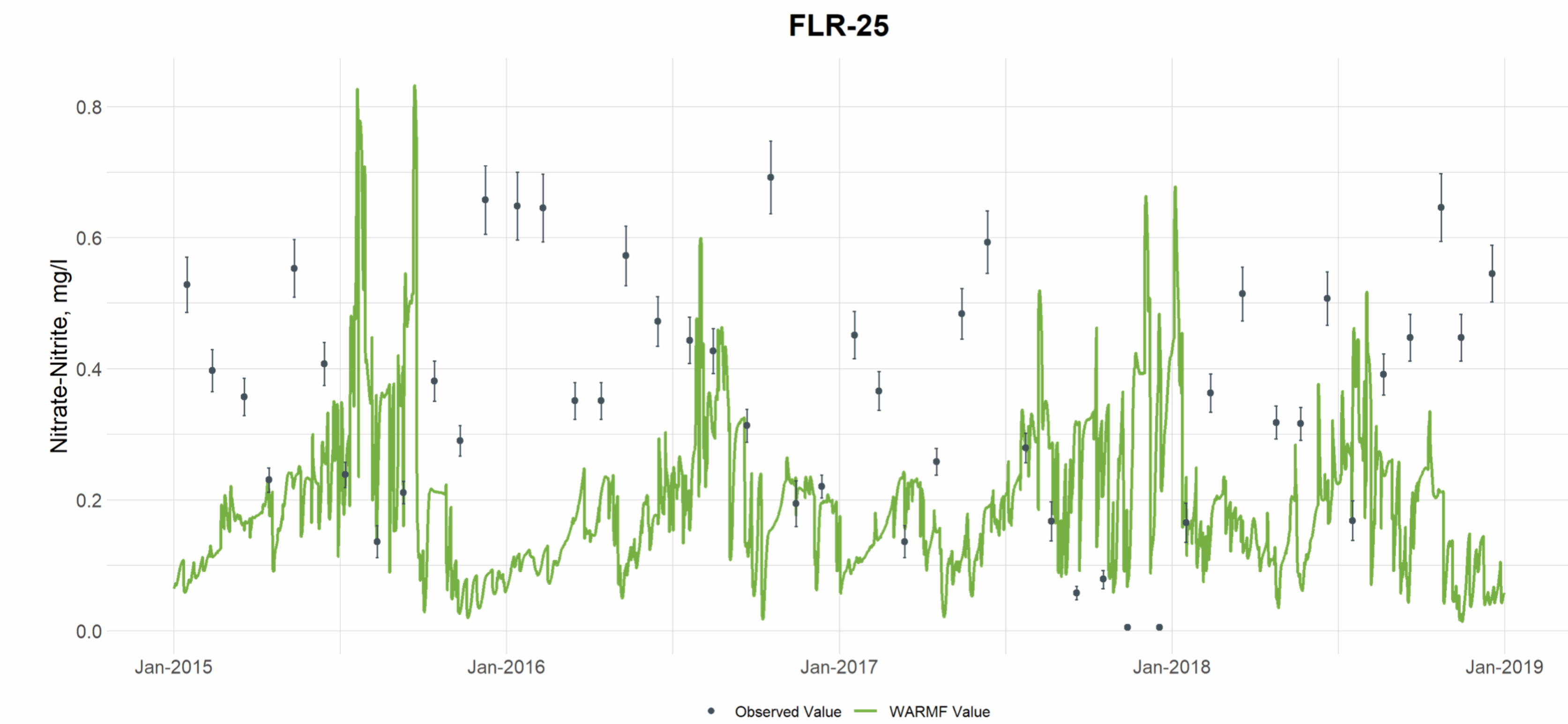


**Figure G-38. Comparison of Observed and Simulated Nitrate-Nitrite Concentrations at Flat River at Station FLR-25** (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)

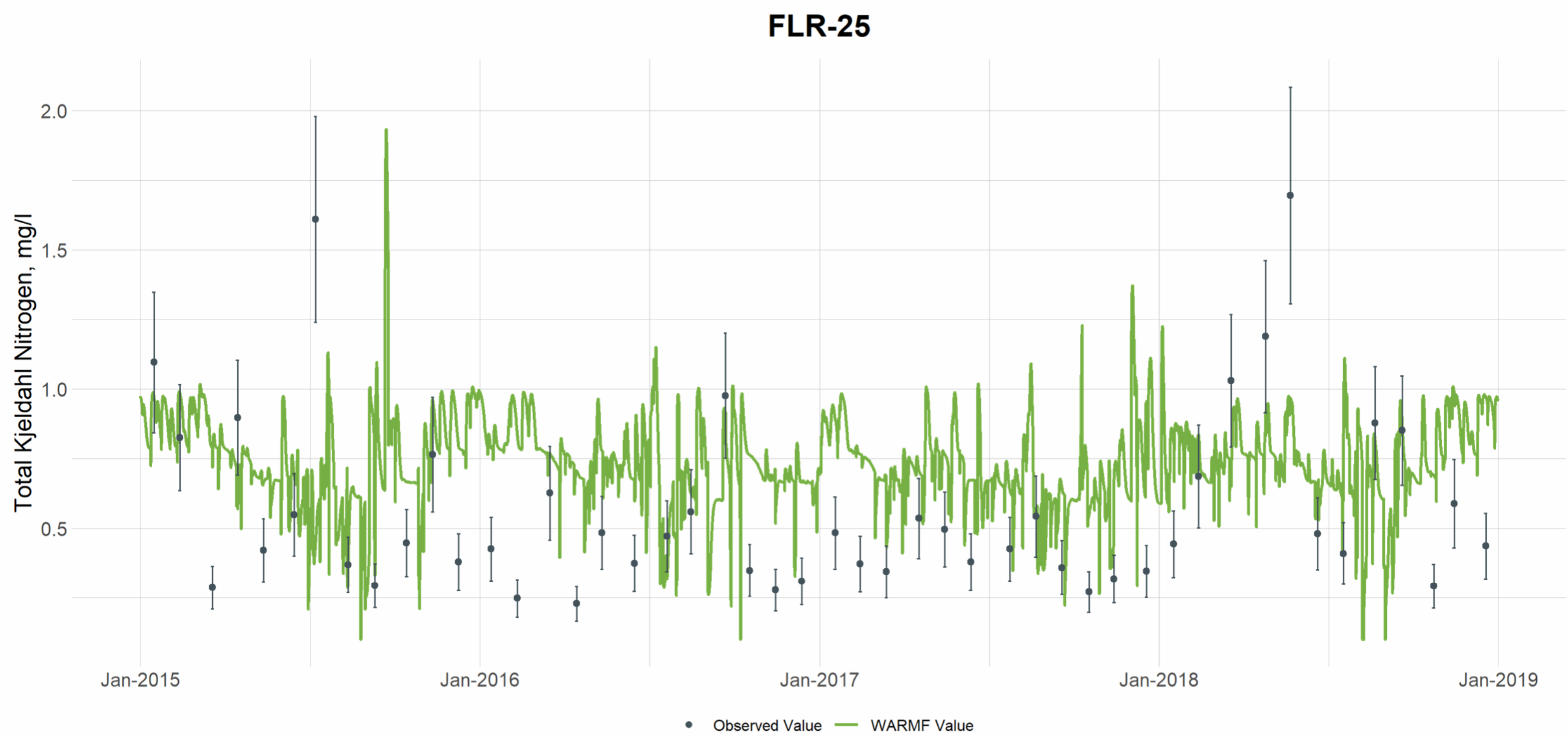


**Figure G-39. Comparison of Observed and Simulated Total Kjeldahl Nitrogen Concentrations at Flat River at Station FLR-25** (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)

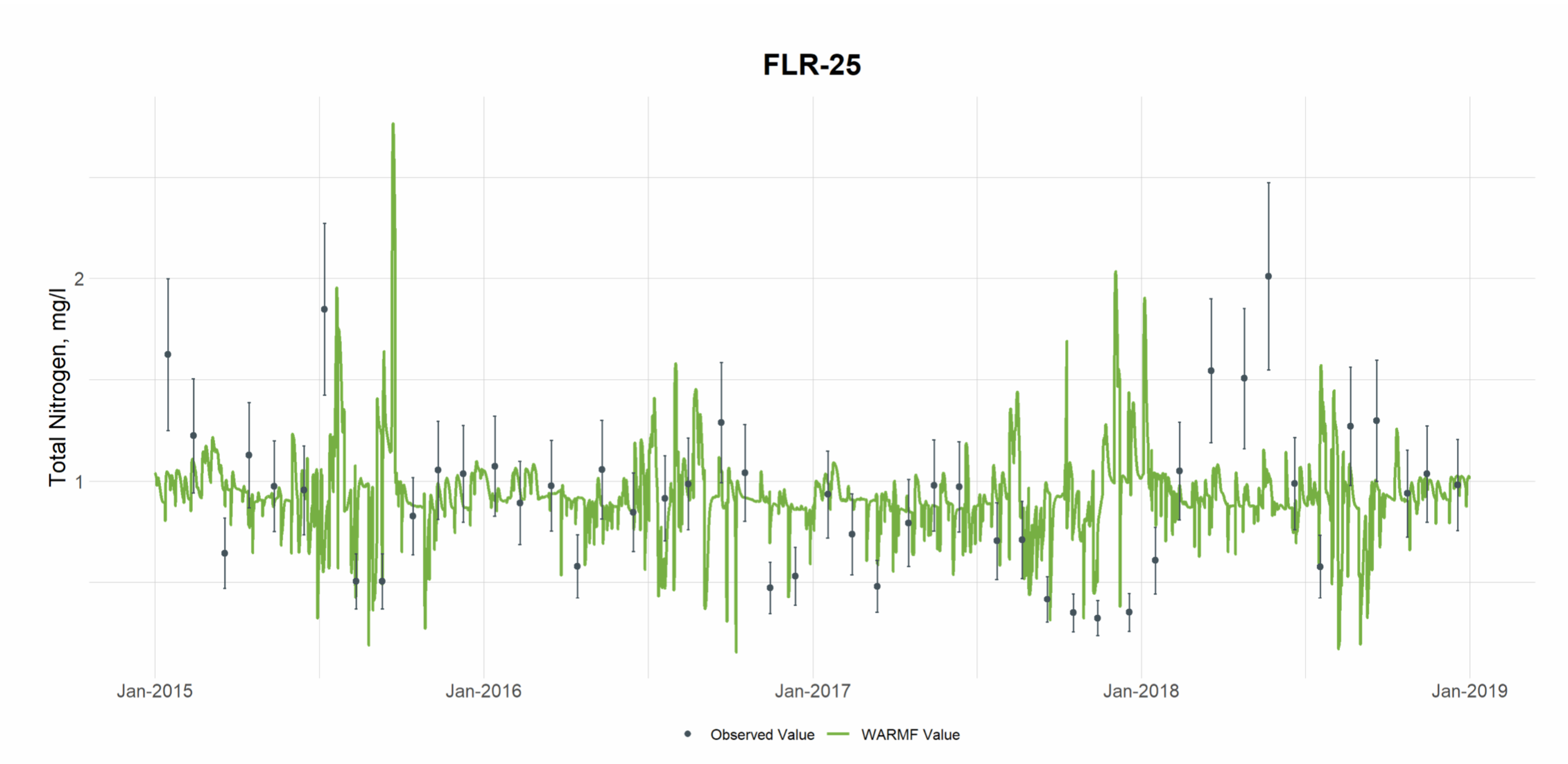


**Figure G-40. Comparison of Observed and Simulated Total Nitrogen Concentrations at Flat River at Station FLR-25 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

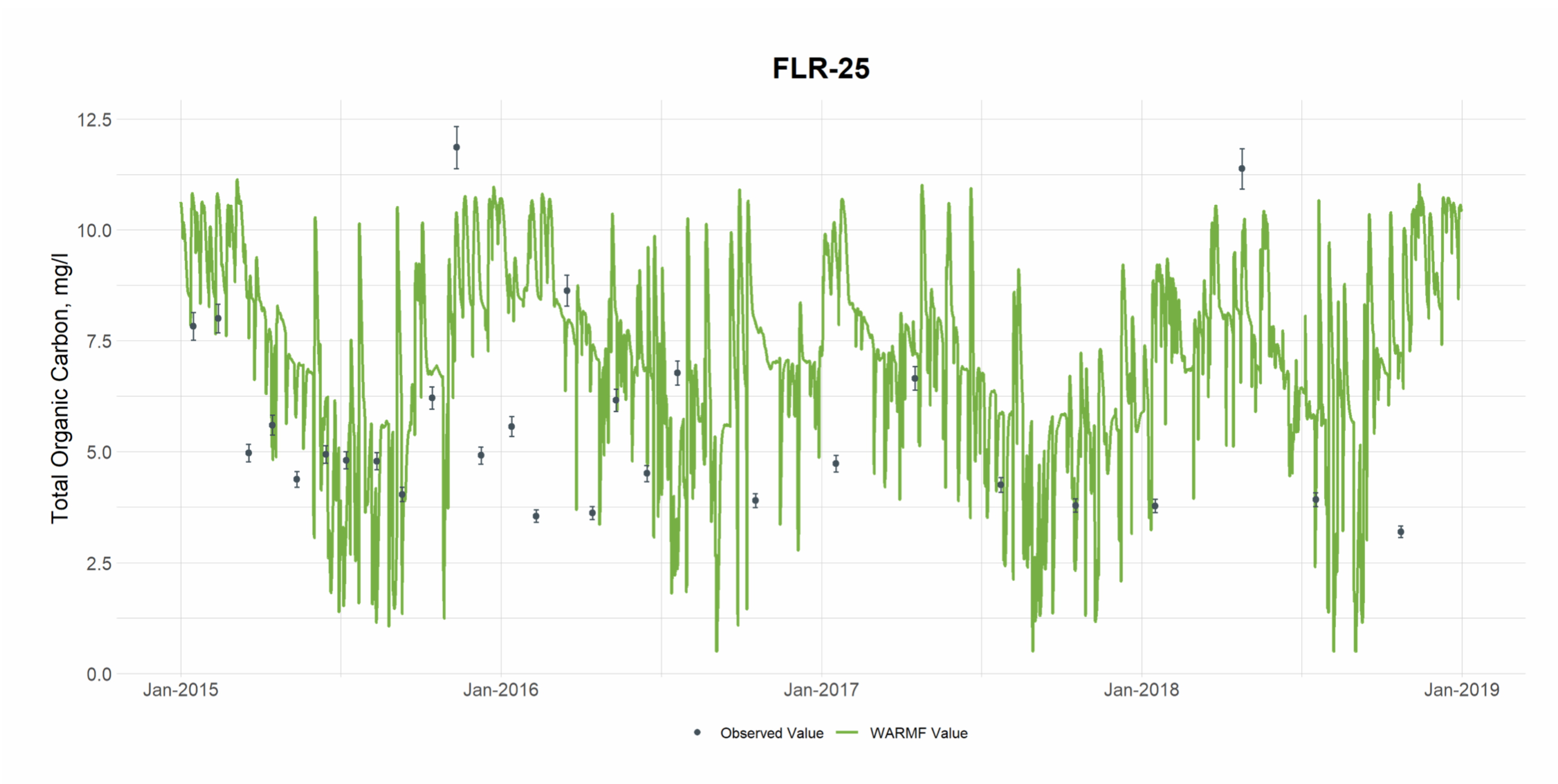


**Figure G-41. Comparison of Observed and Simulated Total Organic Carbon Concentrations at Flat River at Station FLR-25** (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)

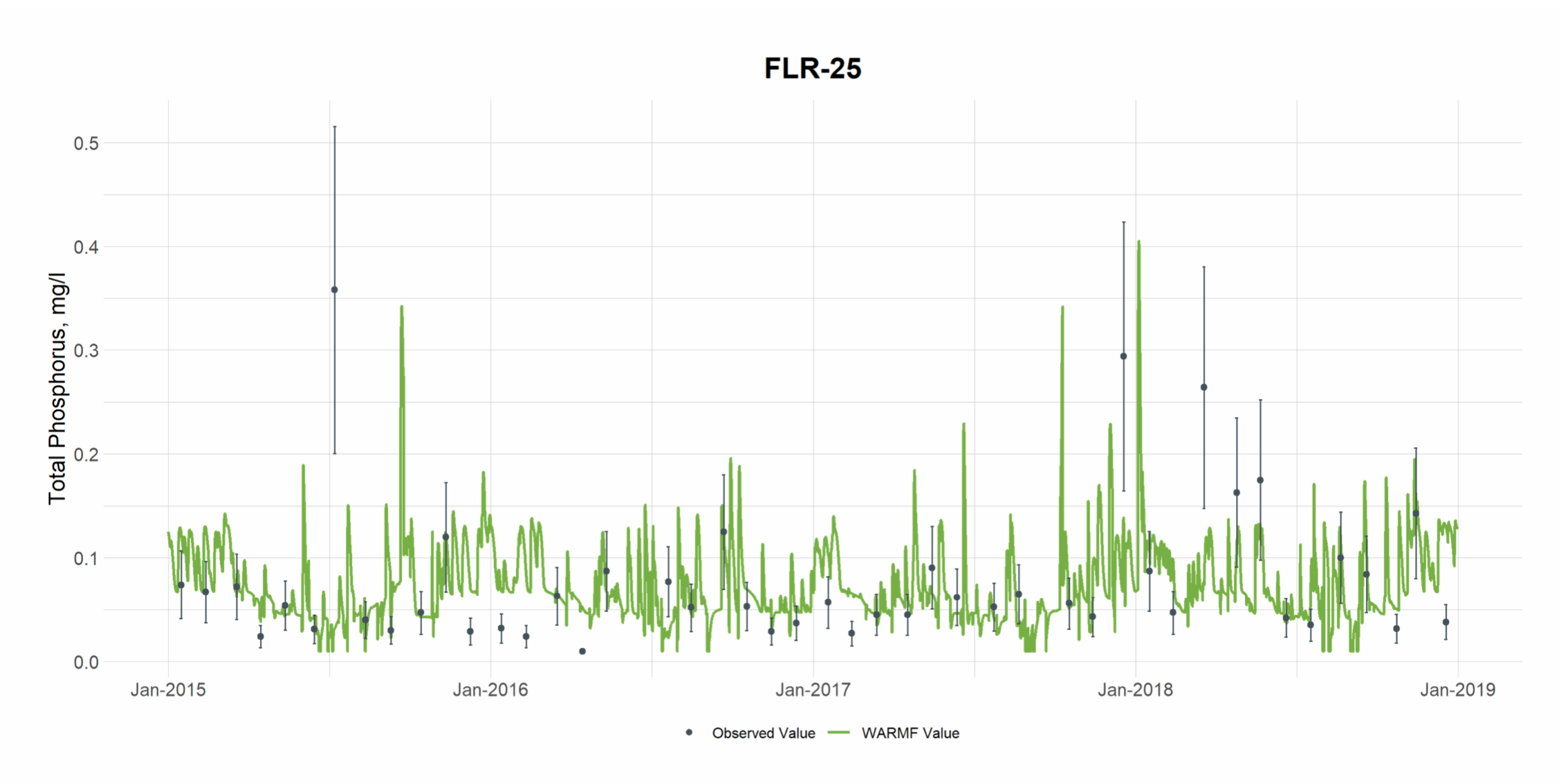


**Figure G-42. Comparison of Observed and Simulated Total Phosphorus Concentrations at Flat River at Station FLR-25** (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)

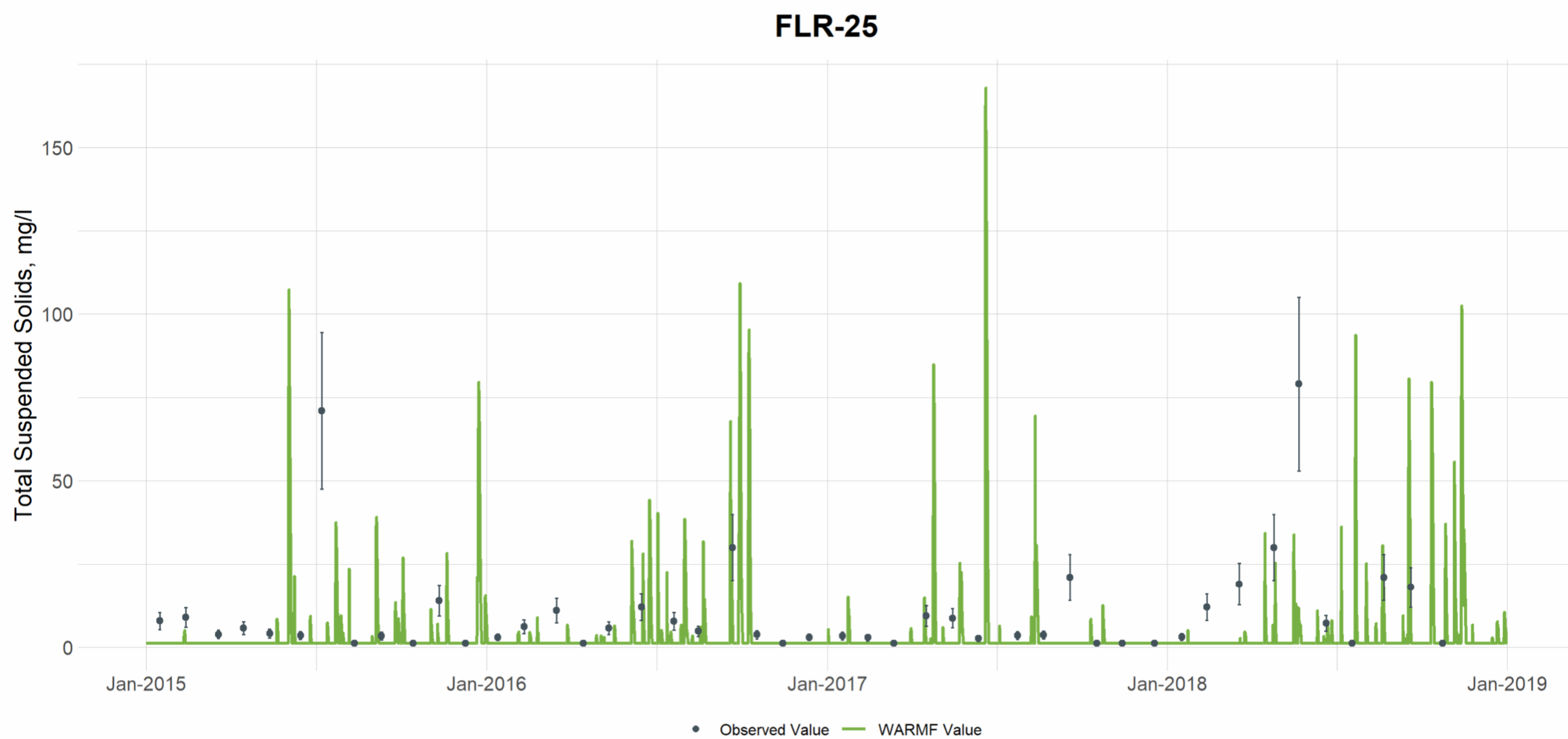


**Figure G-43. Comparison of Observed and Simulated Total Suspended Solids (silt+clay) Concentrations at Flat River at Station FLR-25 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

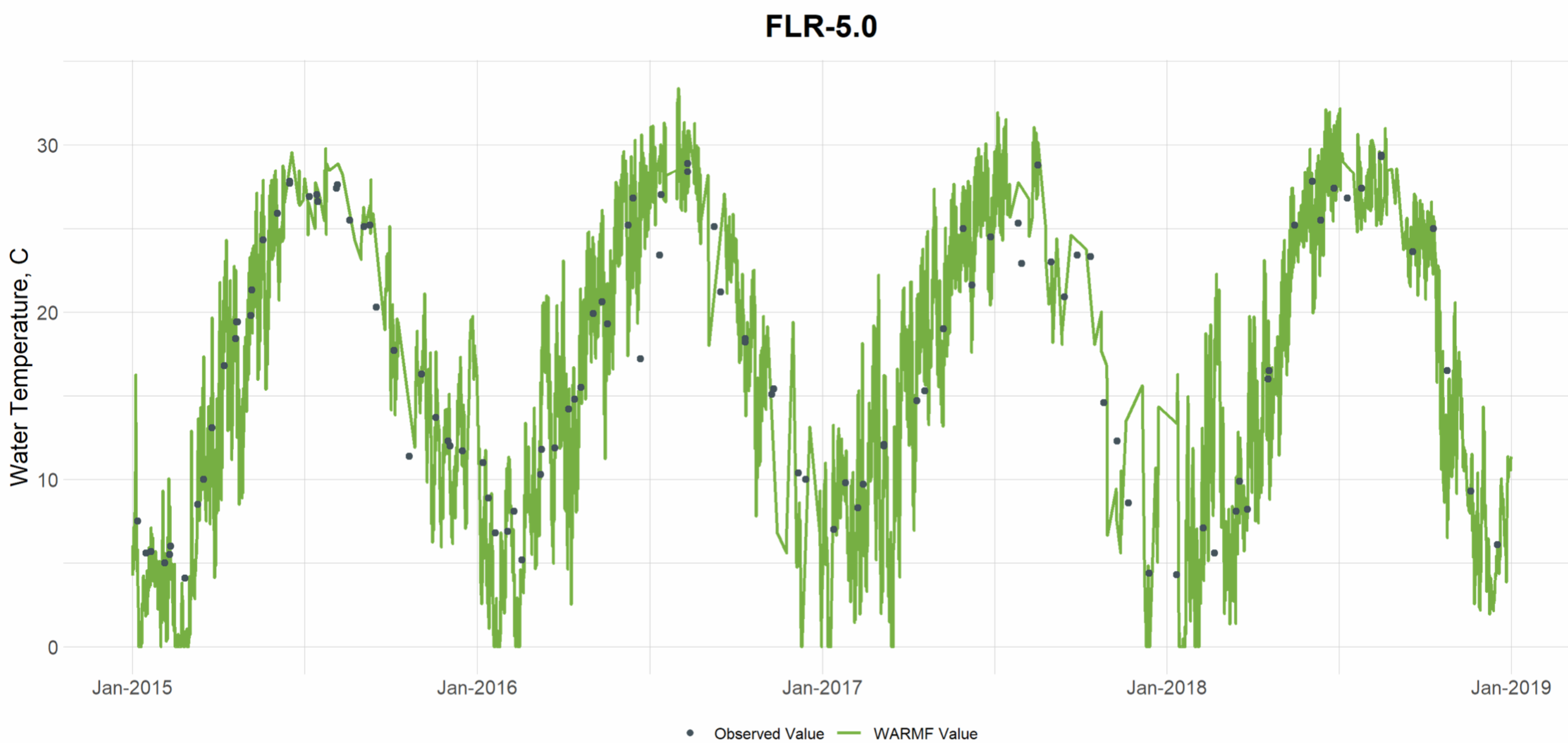


**Figure G-44. Comparison of Observed and Simulated Stream Temperatures at Flat River at Station FLR-5 (downstream of Lake Michie)**

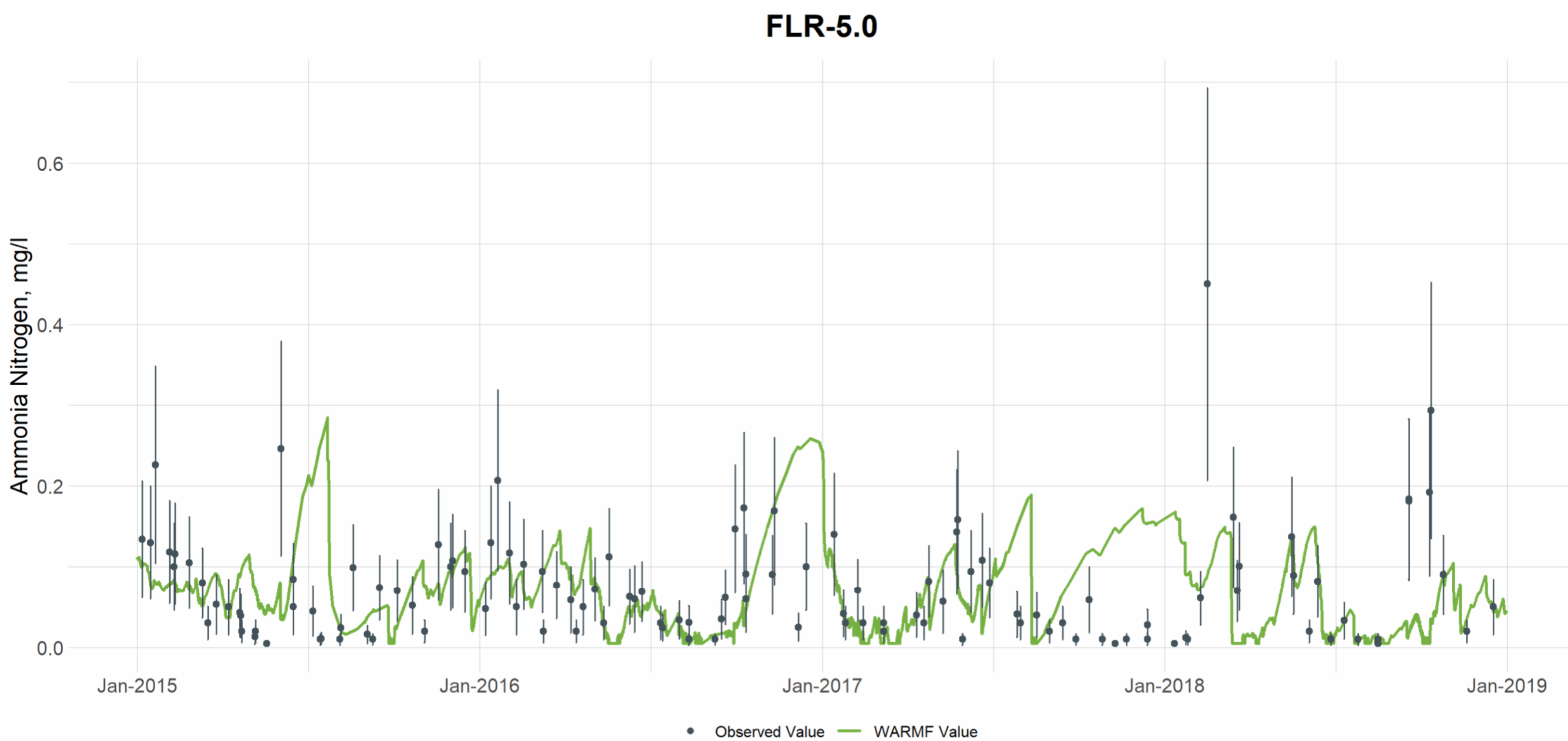


**Figure G-45. Comparison of Observed and Simulated Ammonia Concentrations at Flat River at Station FLR-5 (downstream of Lake Michie) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

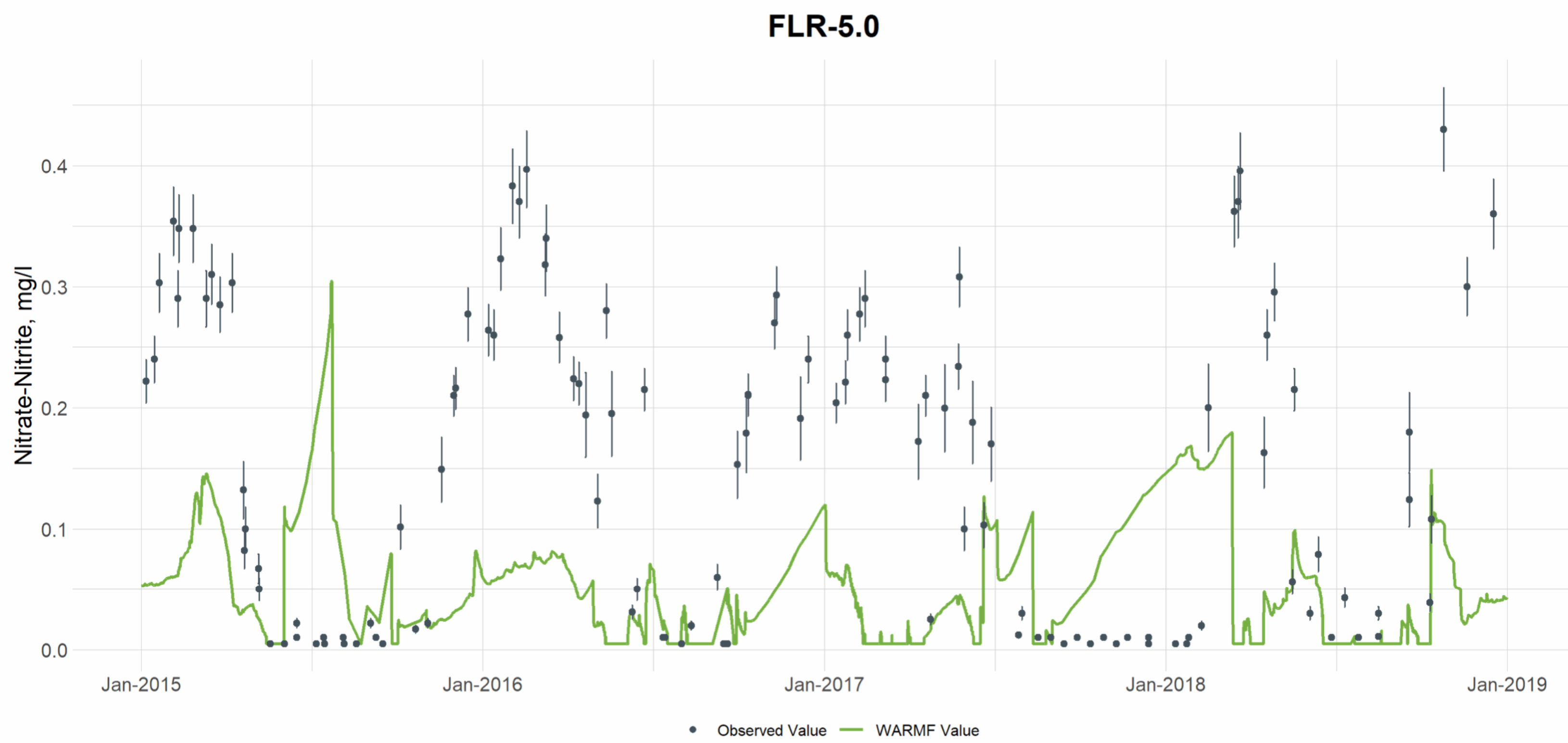


**Figure G-46. Comparison of Observed and Simulated Nitrate-Nitrite Concentrations at Flat River at Station FLR-5 (downstream of Lake Michie) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

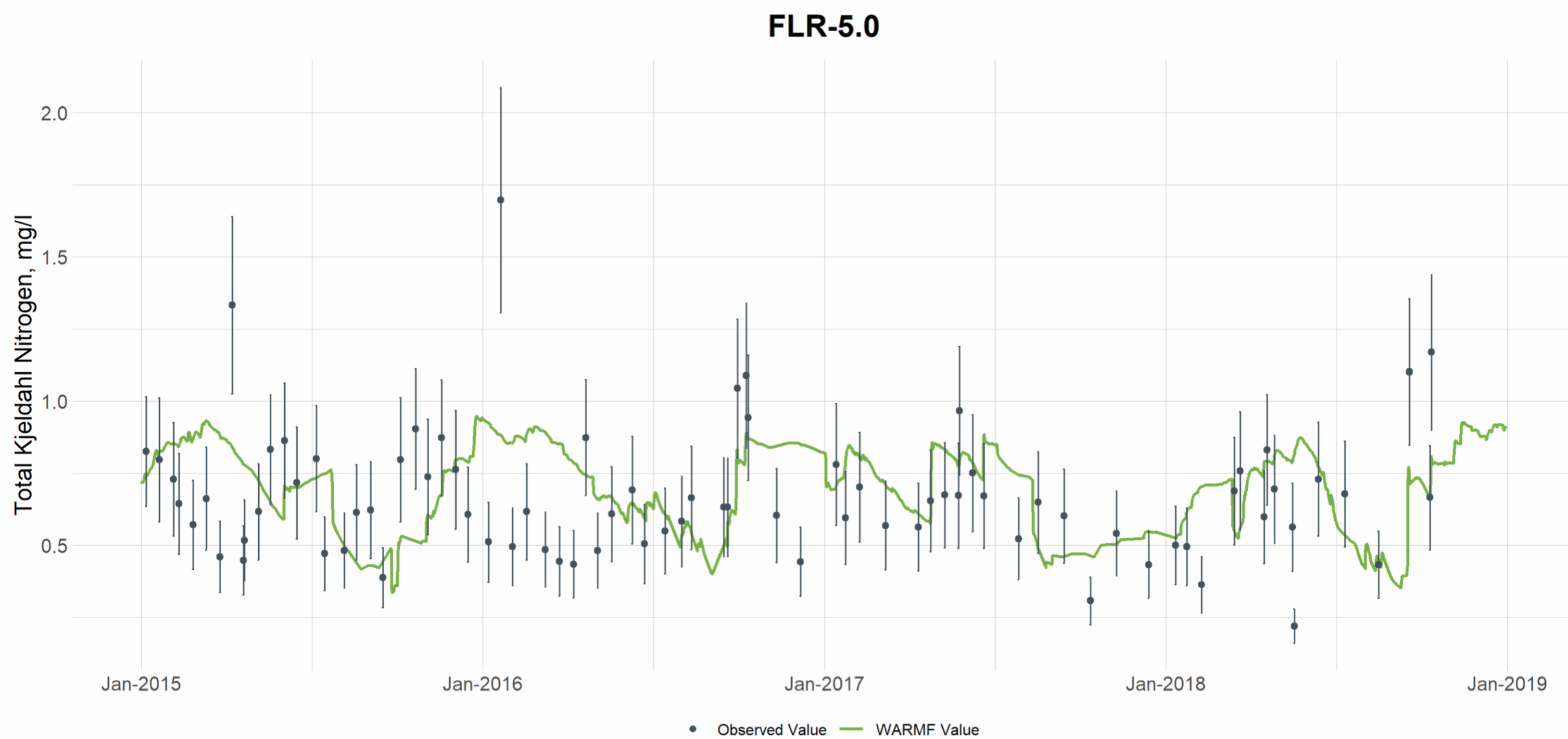


**Figure G-47. Comparison of Observed and Simulated Total Kjeldahl Nitrogen Concentrations at Flat River at Station FLR-5 (downstream of Lake Michie) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

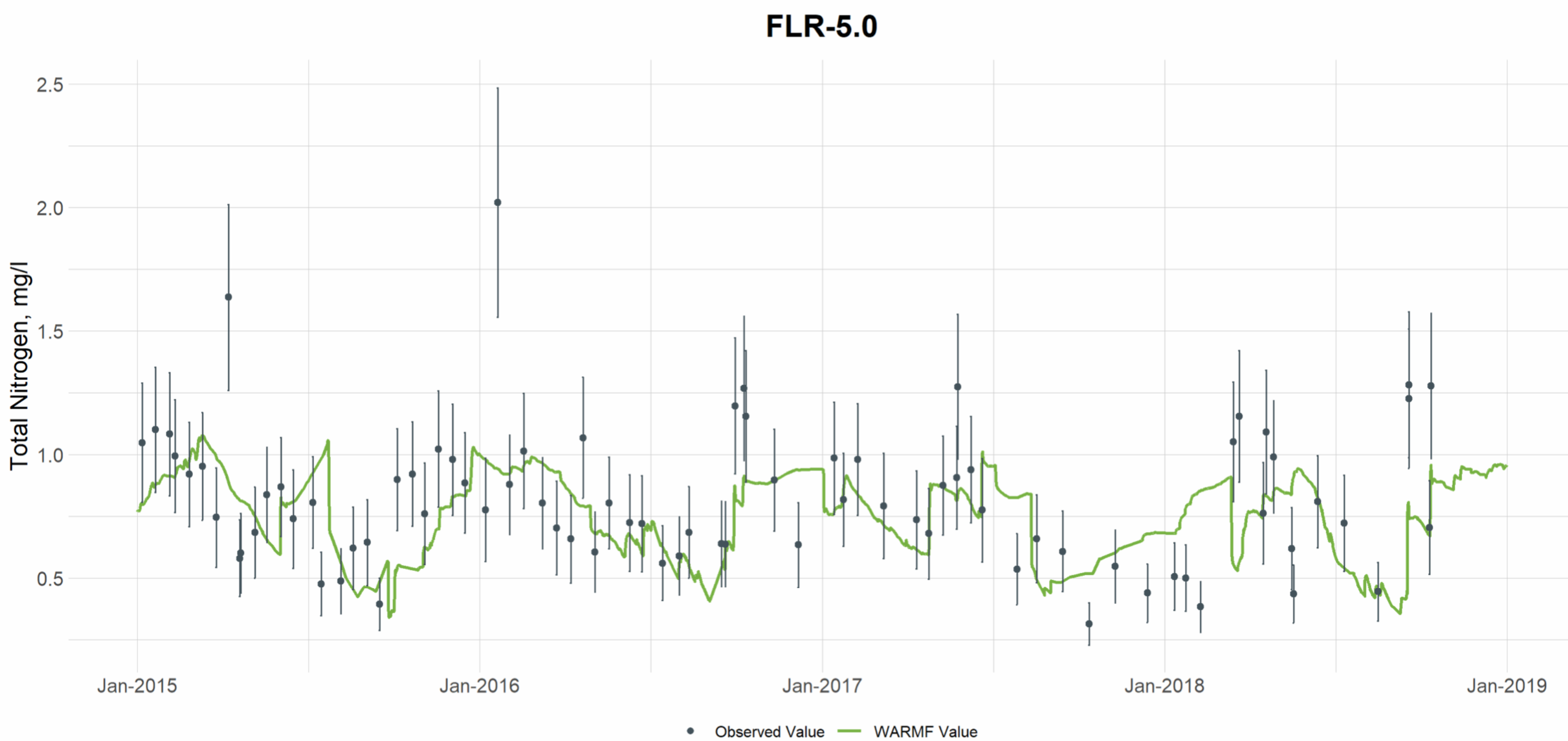


**Figure G-48. Comparison of Observed and Simulated Total Nitrogen Concentrations at Flat River at Station FLR-5 (downstream of Lake Michie) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

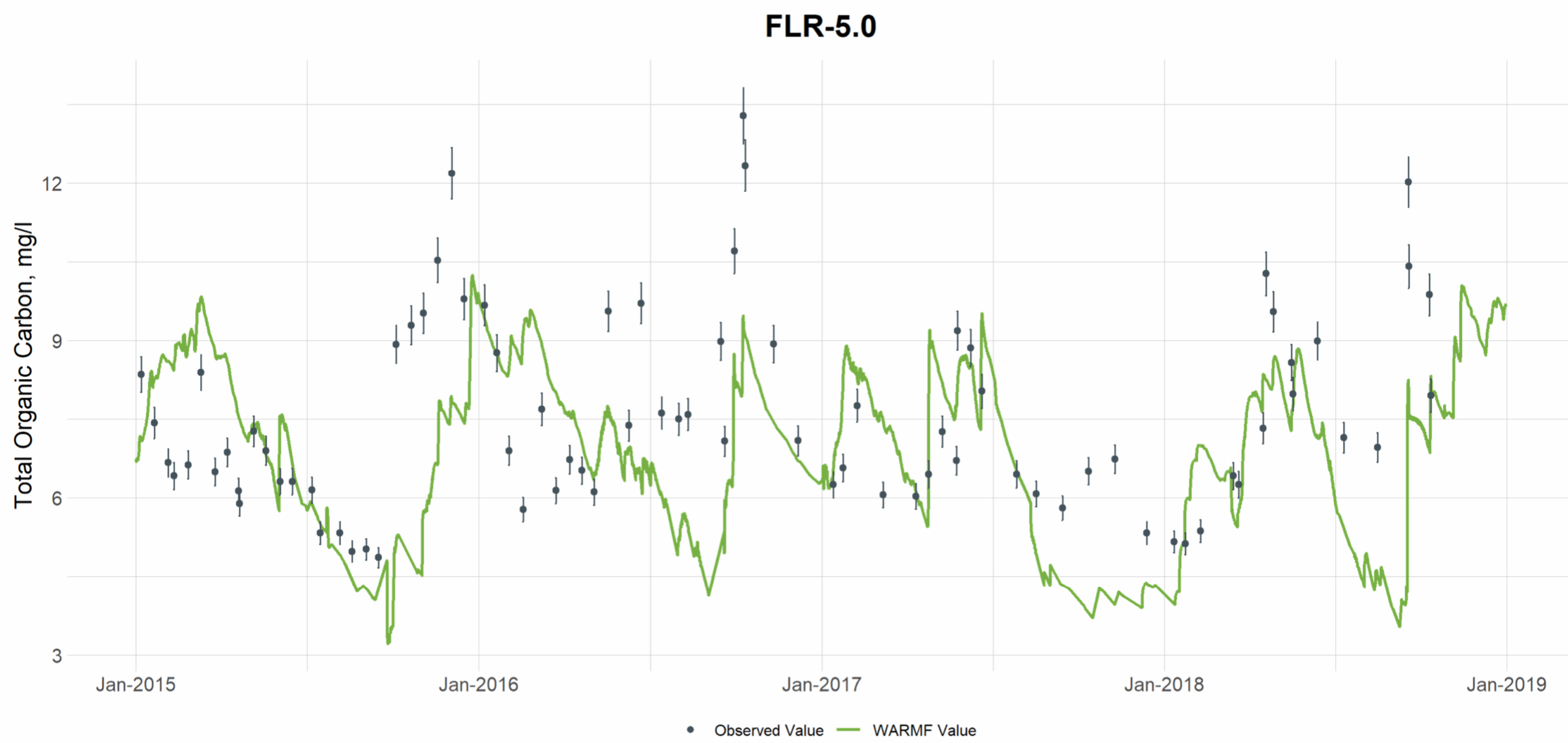


**Figure G-49. Comparison of Observed and Simulated Total Organic Carbon Concentrations at Flat River at Station FLR-5 (downstream of Lake Michie) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

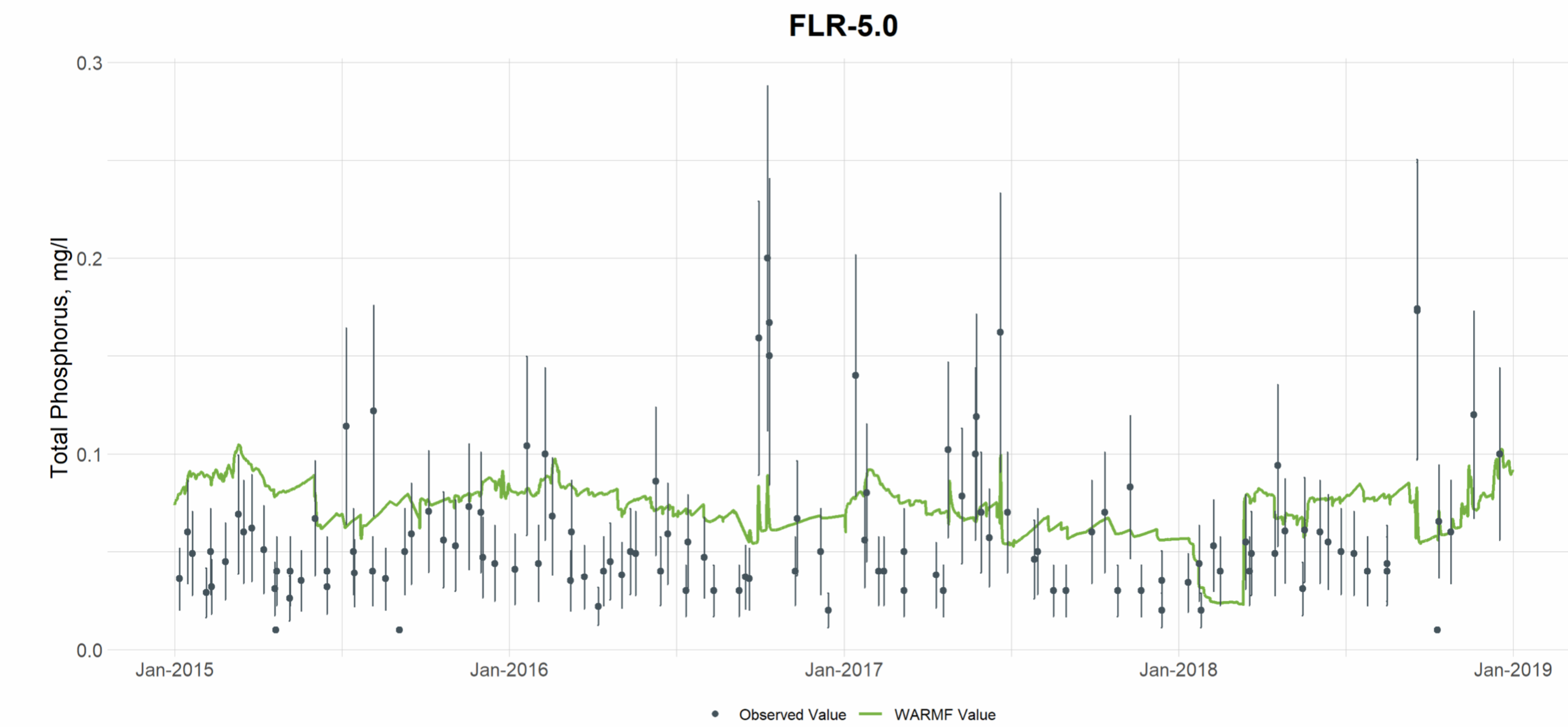


**Figure G-50. Comparison of Observed and Simulated Total Phosphorus Concentrations at Flat River at Station FLR-5 (downstream of Lake Michie) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

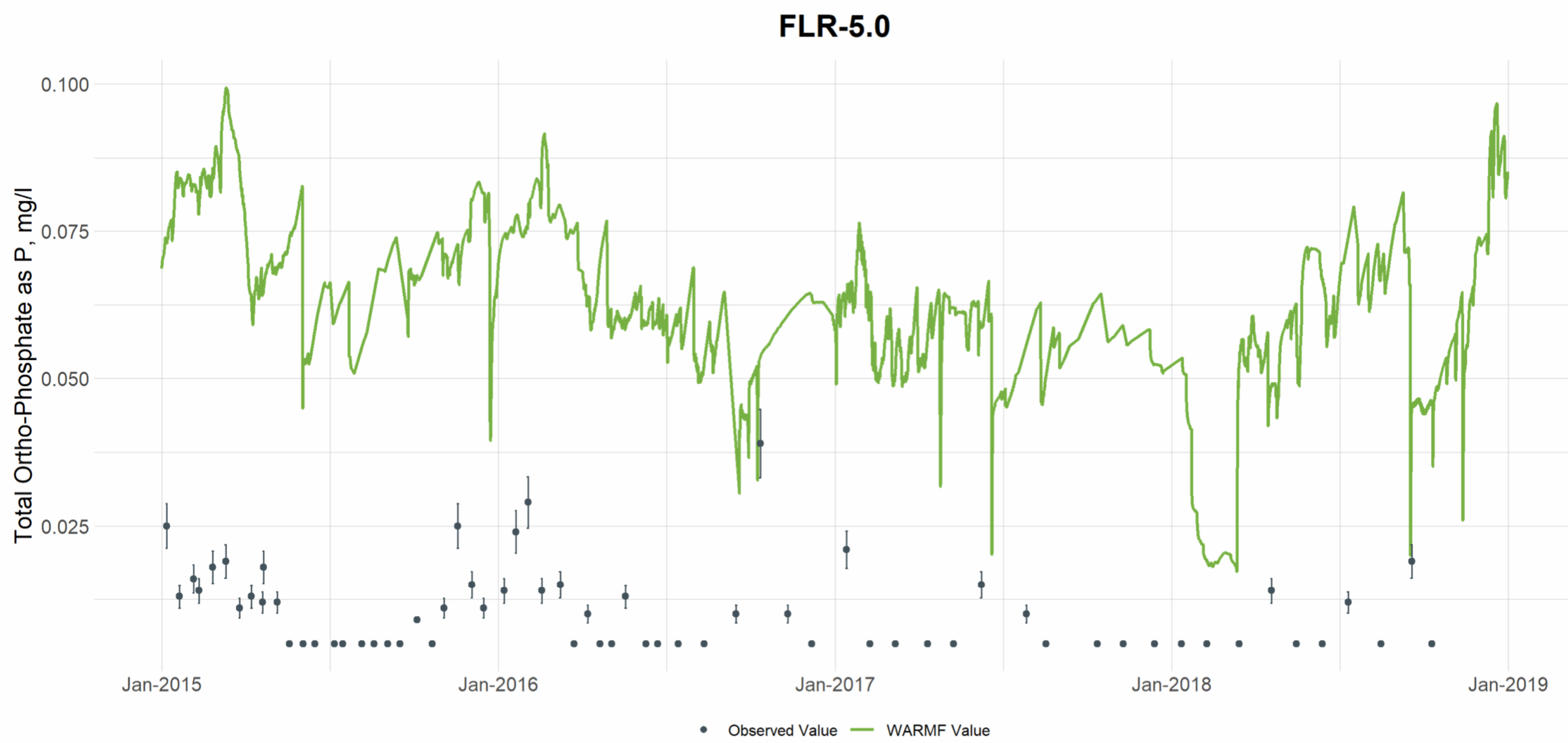


**Figure G-51. Comparison of Observed and Simulated Total Ortho-Phosphate Concentrations at Flat River at Station FLR-5 (downstream of Lake Michie) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

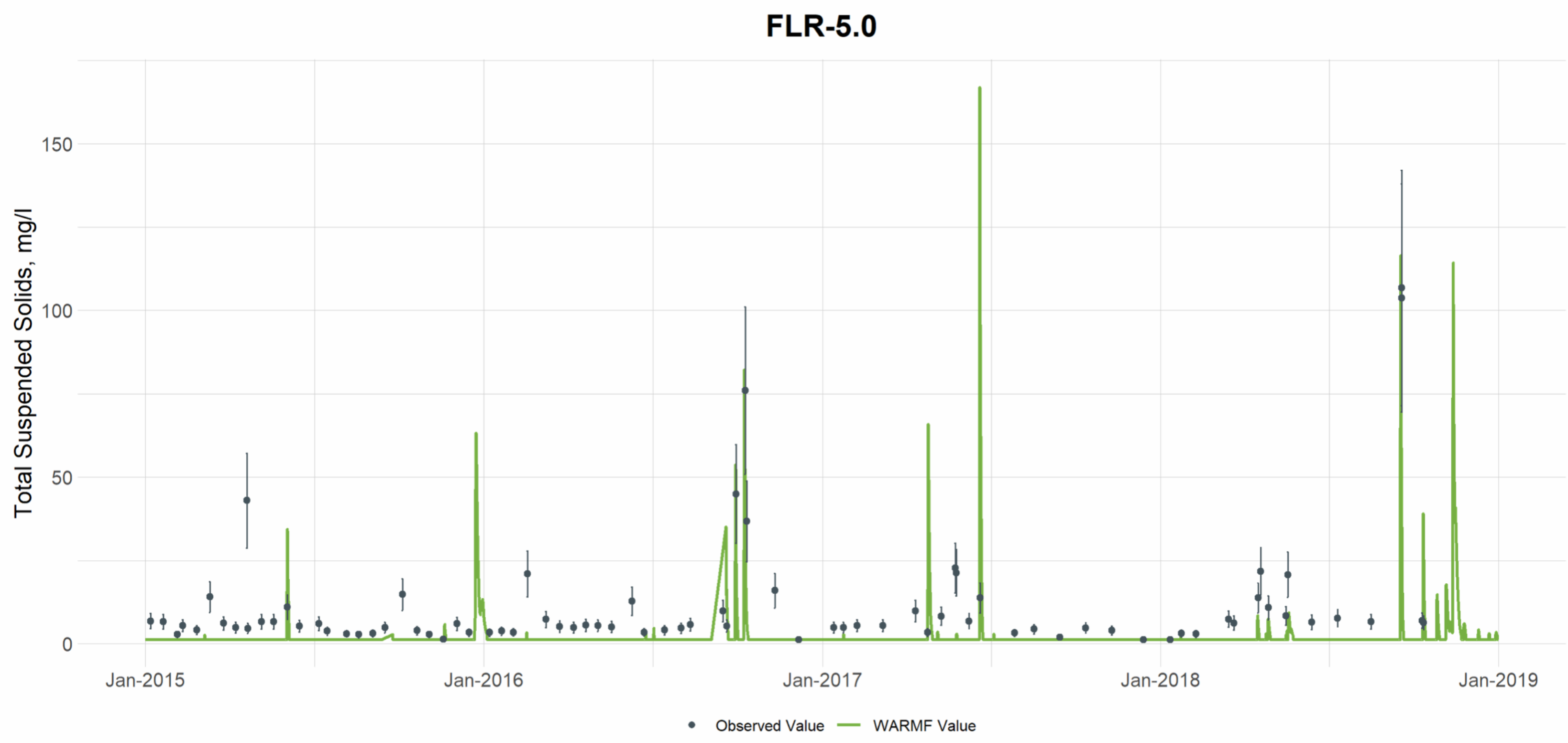


**Figure G-52. Comparison of Observed and Simulated Total Suspended Solids (silt+clay) Concentrations at Flat River at Station FLR-5 (downstream of Lake Michie) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

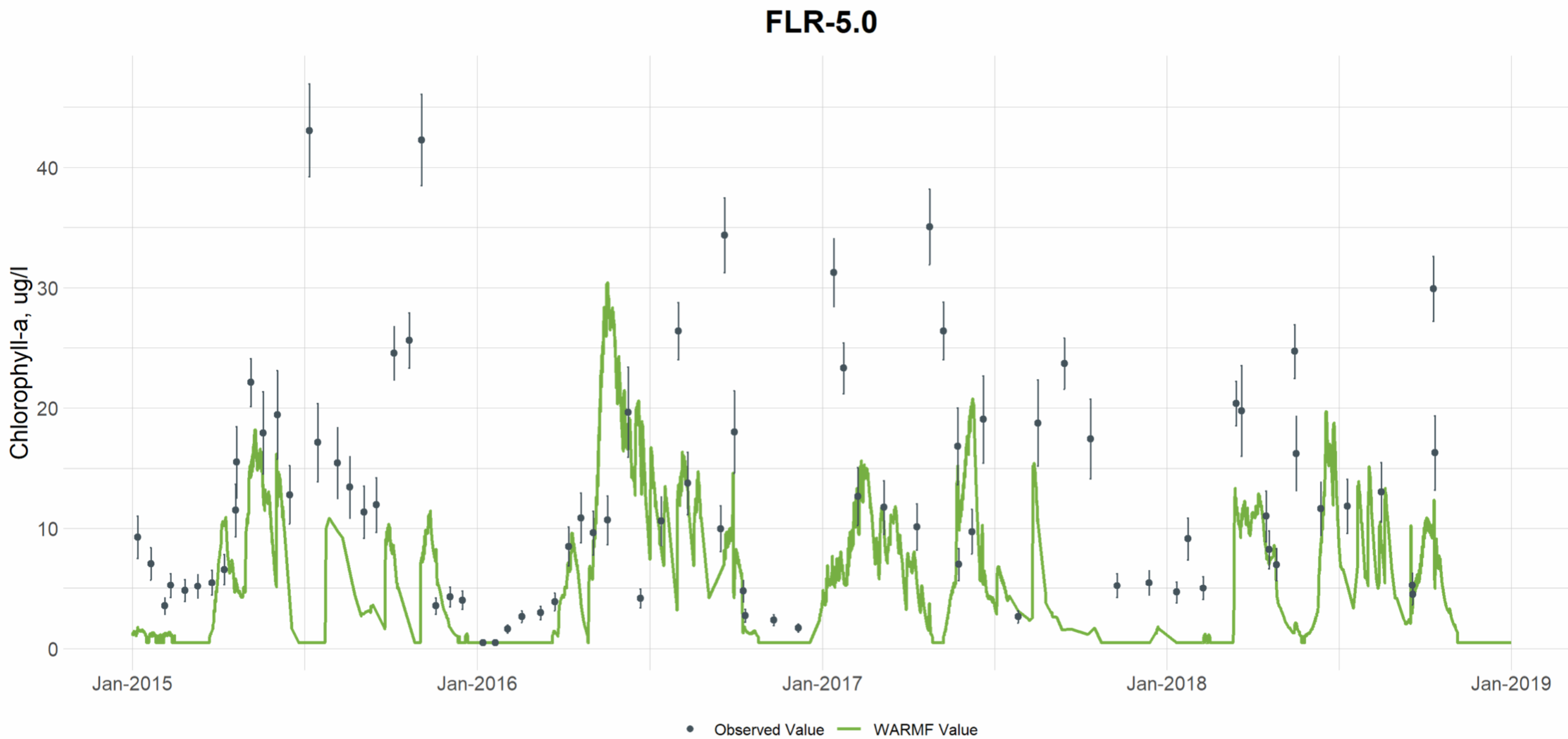


**Figure G-53. Comparison of Observed and Simulated Chlorophyll-a Concentrations at Flat River at Station FLR-5 (downstream of Lake Michie) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

## Knap of Reeds Creek

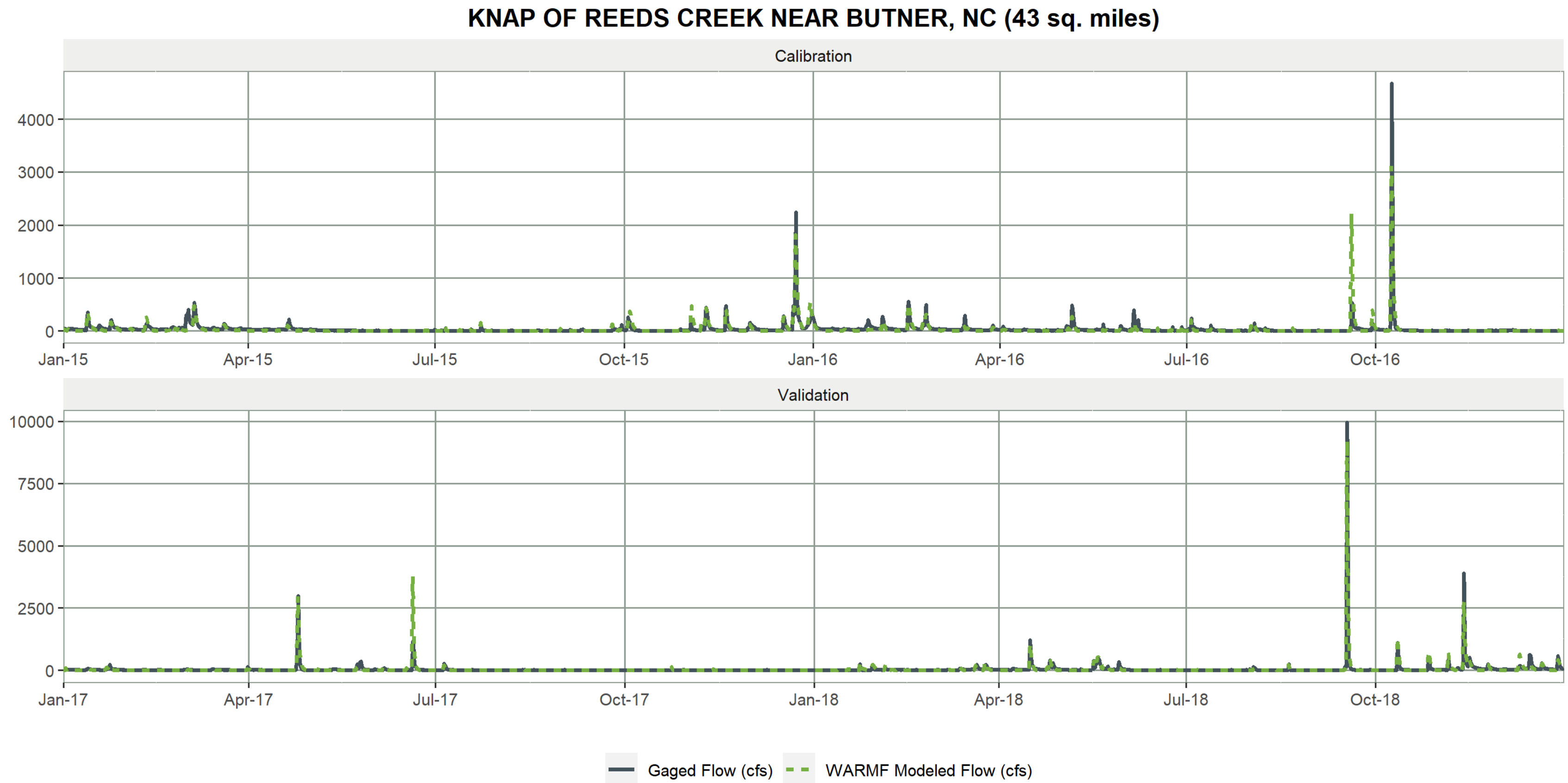


**Figure G-54. Comparison of Observed and Simulated Stream Flows at Knap of Reeds Creek near Butner, NC (43 square miles)**

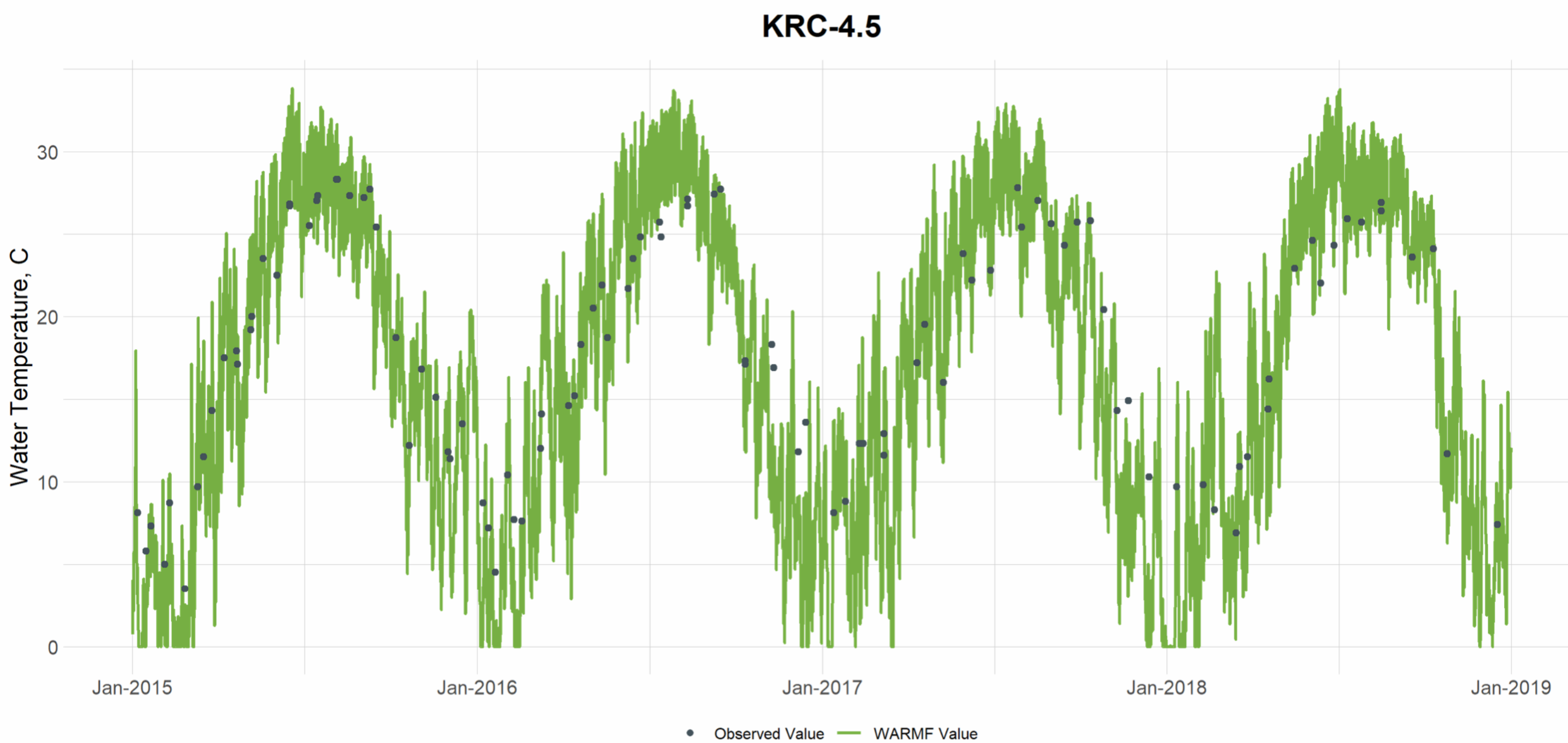


**Figure G-55. Comparison of Observed and Simulated Stream Temperatures at Knap of Reeds Creek at Station KRC-4.5**

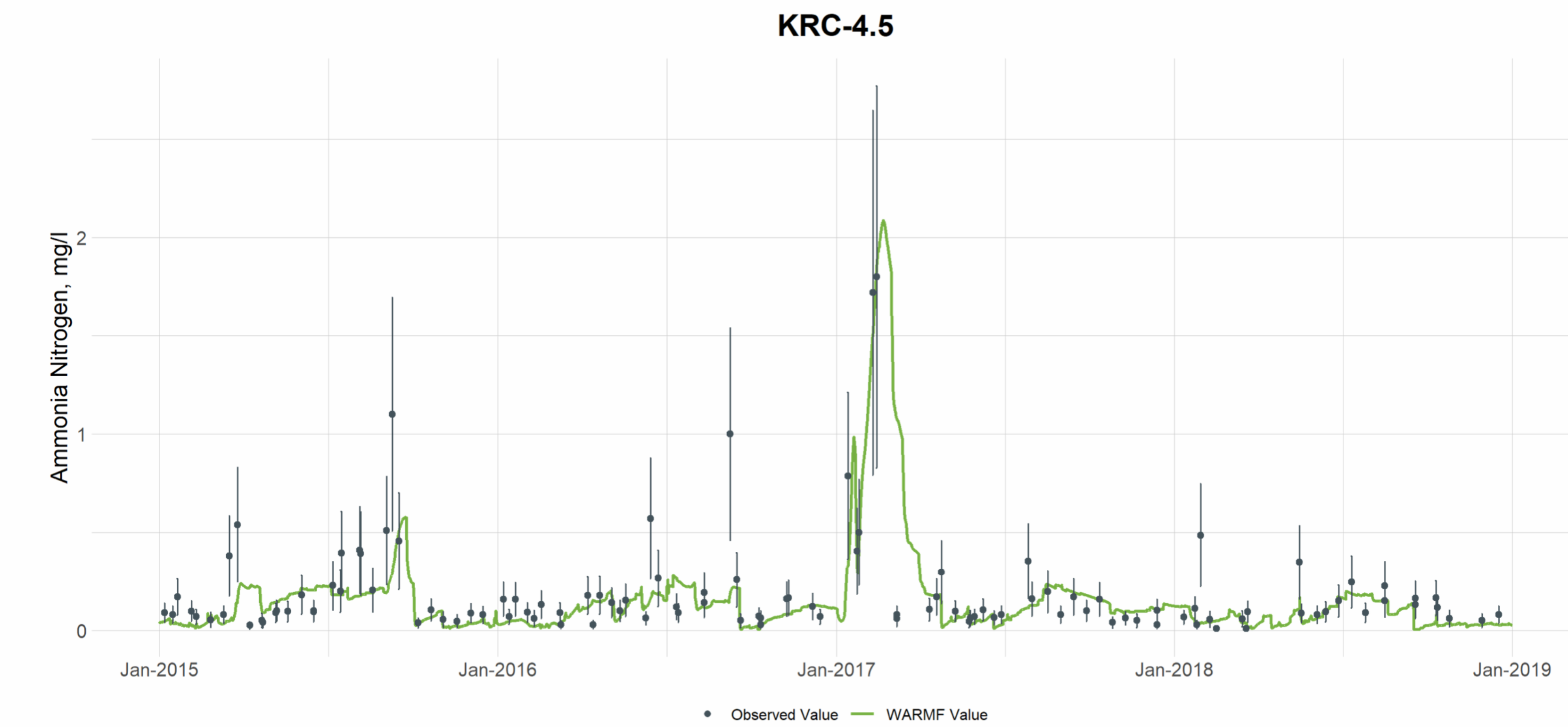


**Figure G-56. Comparison of Observed and Simulated Ammonia Concentrations at Knap of Reeds Creek at Station KRC-4.5** (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)

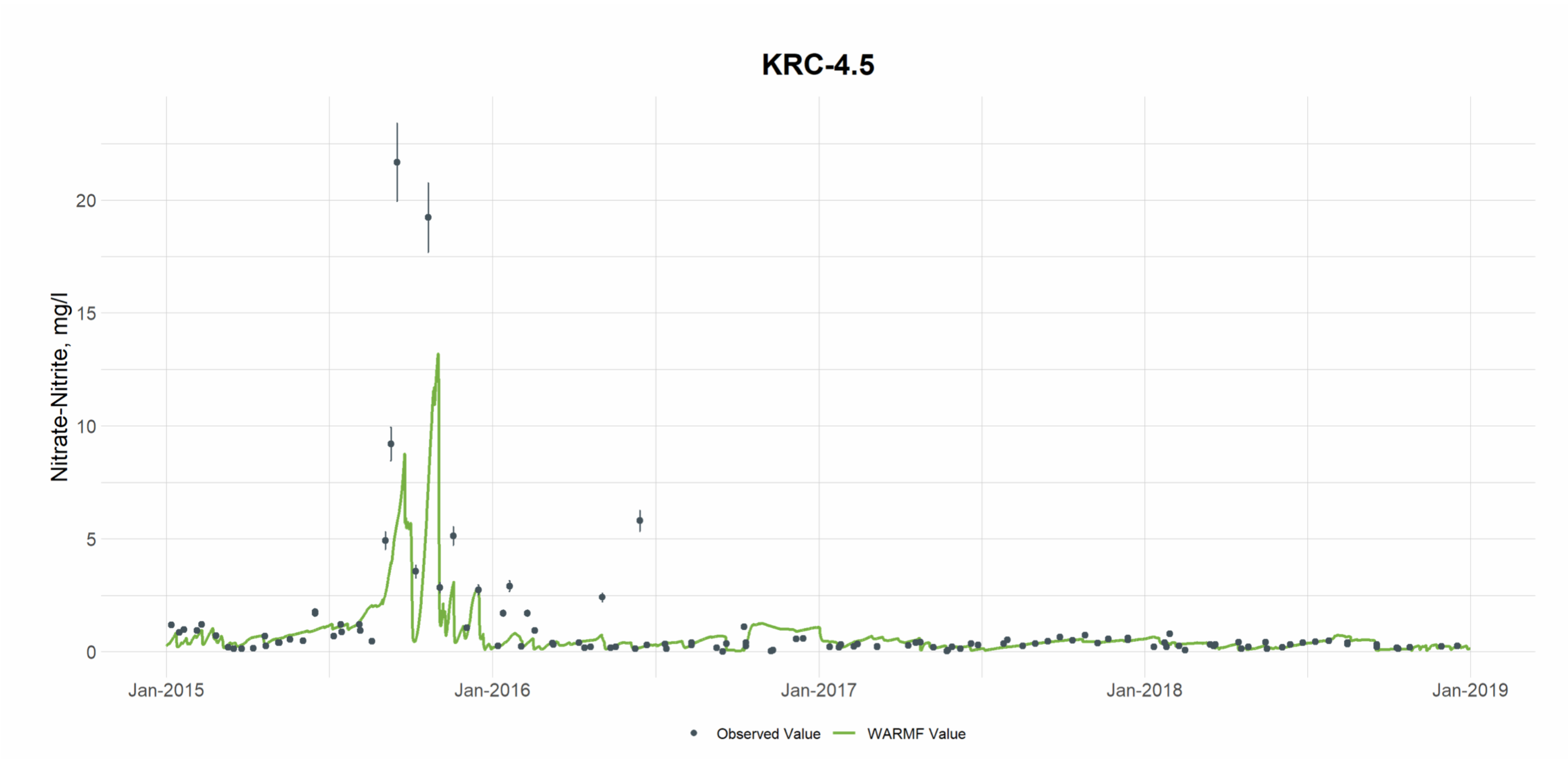


**Figure G-57. Comparison of Observed and Simulated Nitrate-Nitrite Concentrations at Knap of Reeds Creek at Station KRC-4.5 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

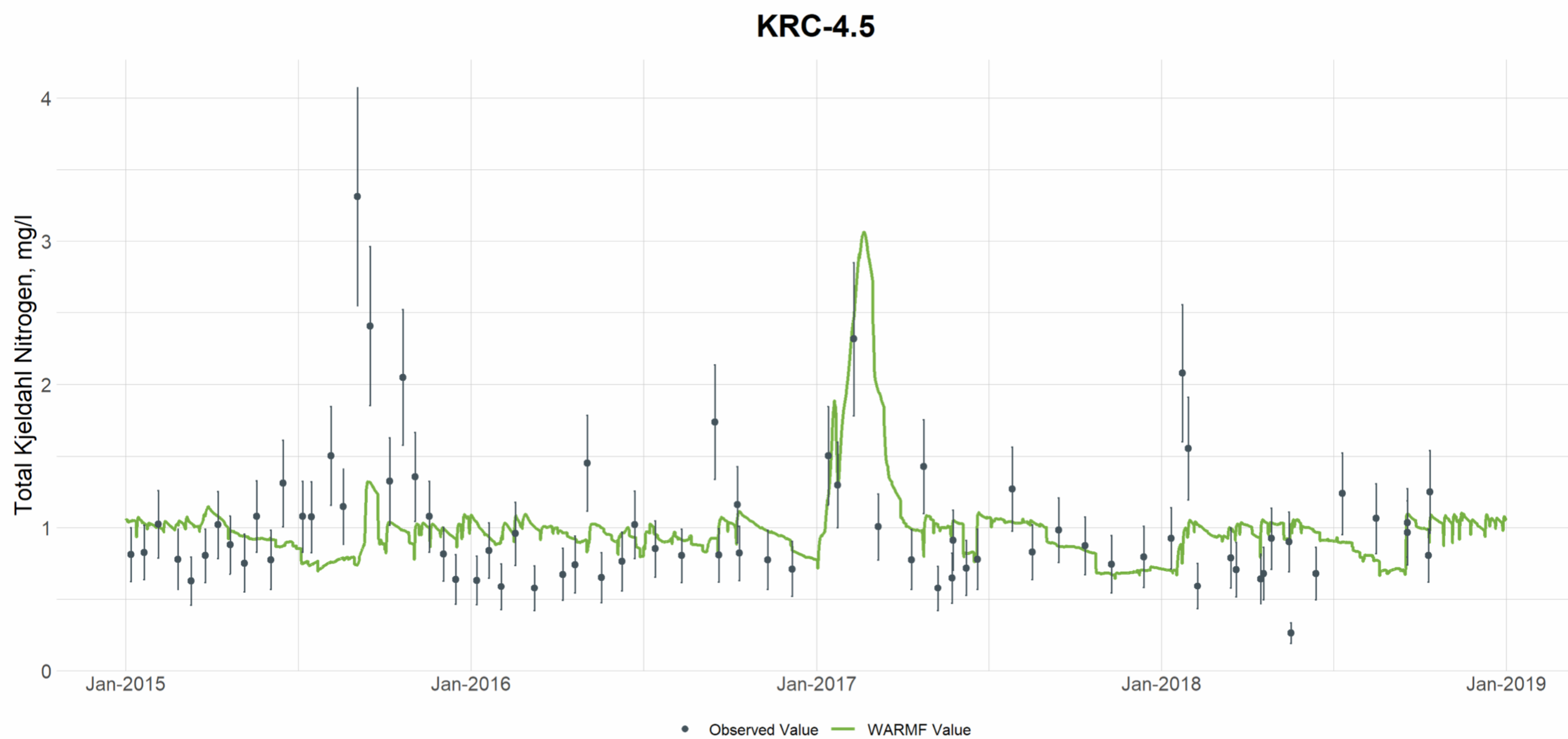


**Figure G-58. Comparison of Observed and Simulated Total Kjeldahl Nitrogen Concentrations at Knap of Reeds Creek at Station KRC-4.5 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

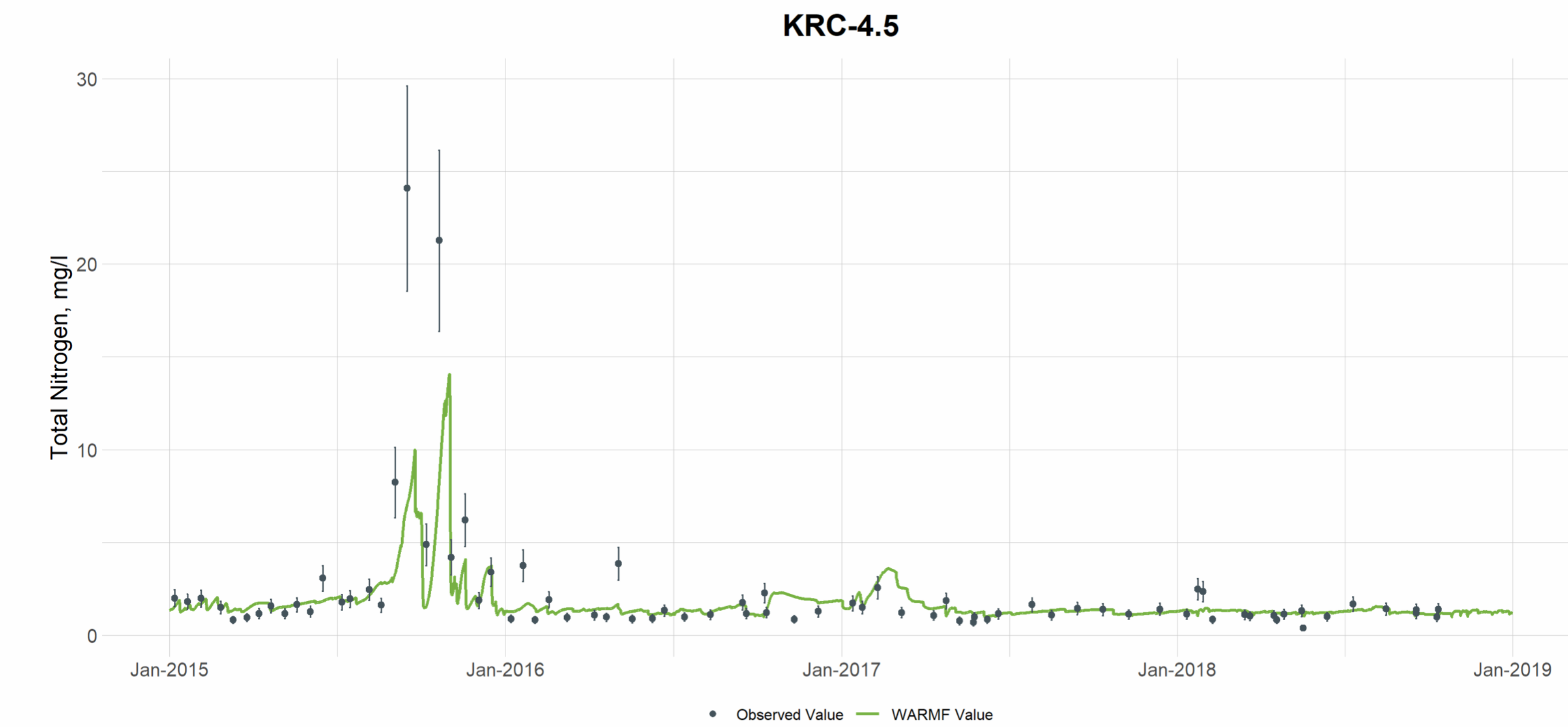


**Figure G-59. Comparison of Observed and Simulated Total Nitrogen Concentrations at Knap of Reeds Creek at Station KRC-4.5 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

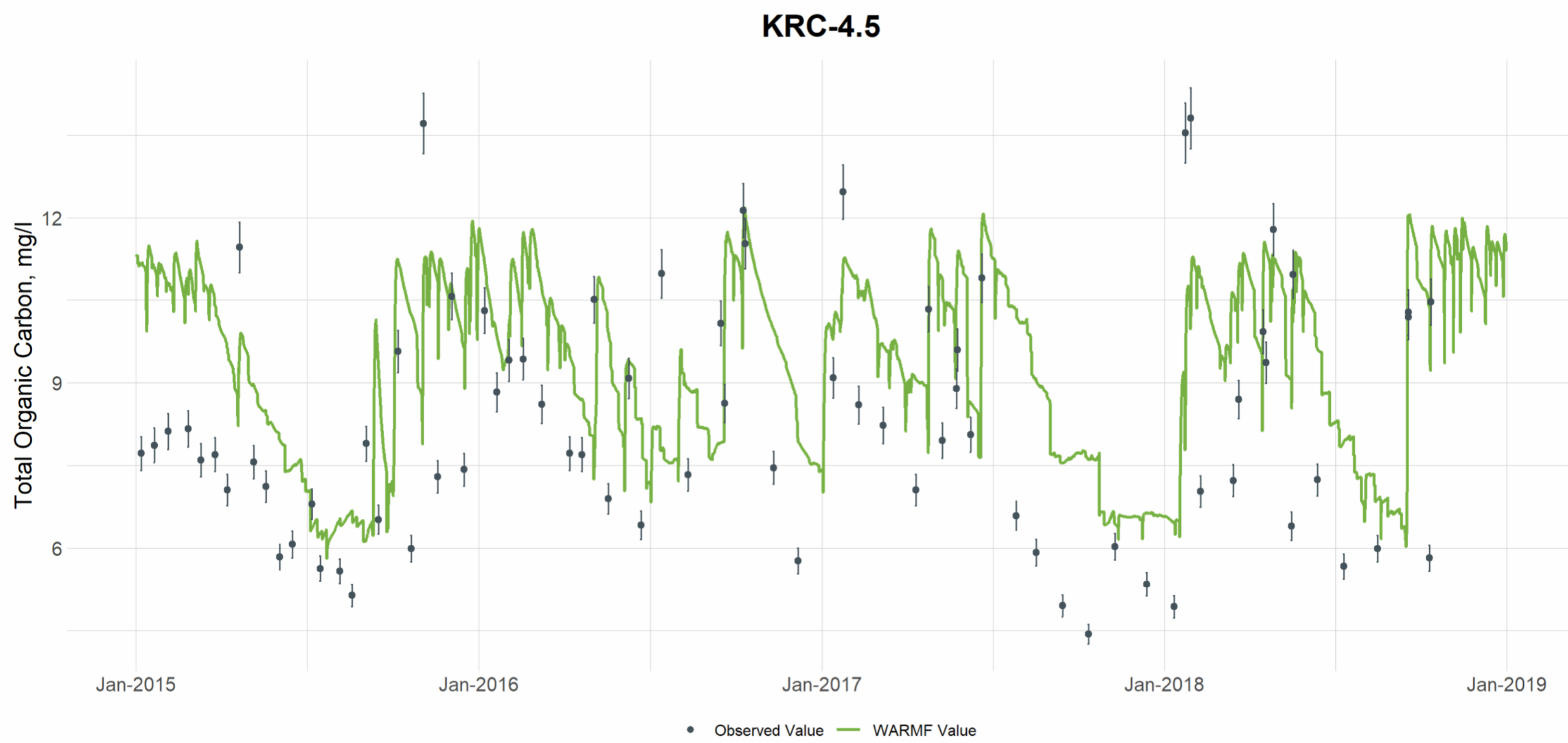


**Figure G-60. Comparison of Observed and Simulated Total Organic Carbon Concentrations at Knap of Reeds Creek at Station KRC-4.5 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

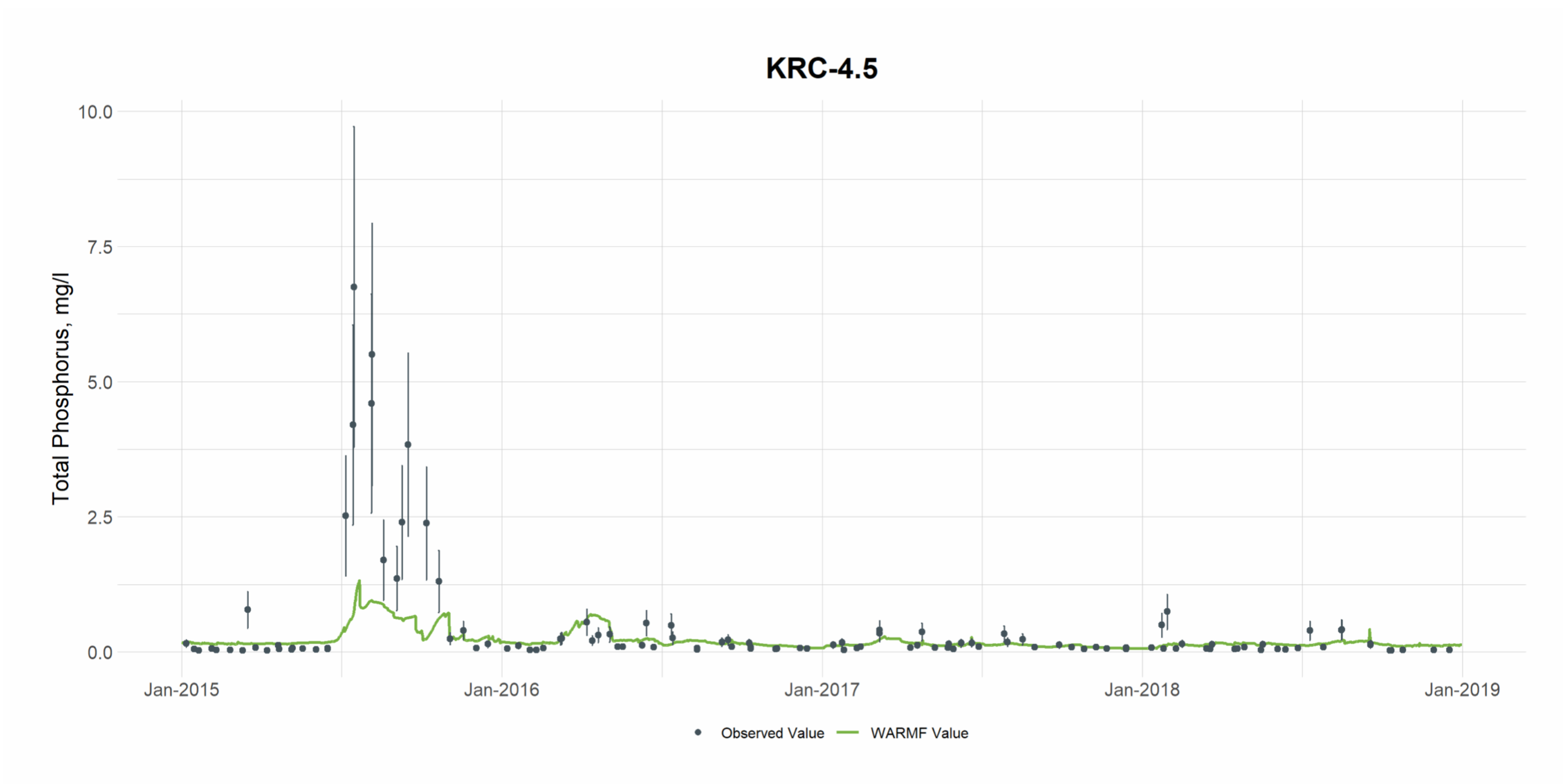


**Figure G-61. Comparison of Observed and Simulated Total Phosphorus Concentrations at Knap of Reeds Creek at Station KRC-4.5 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

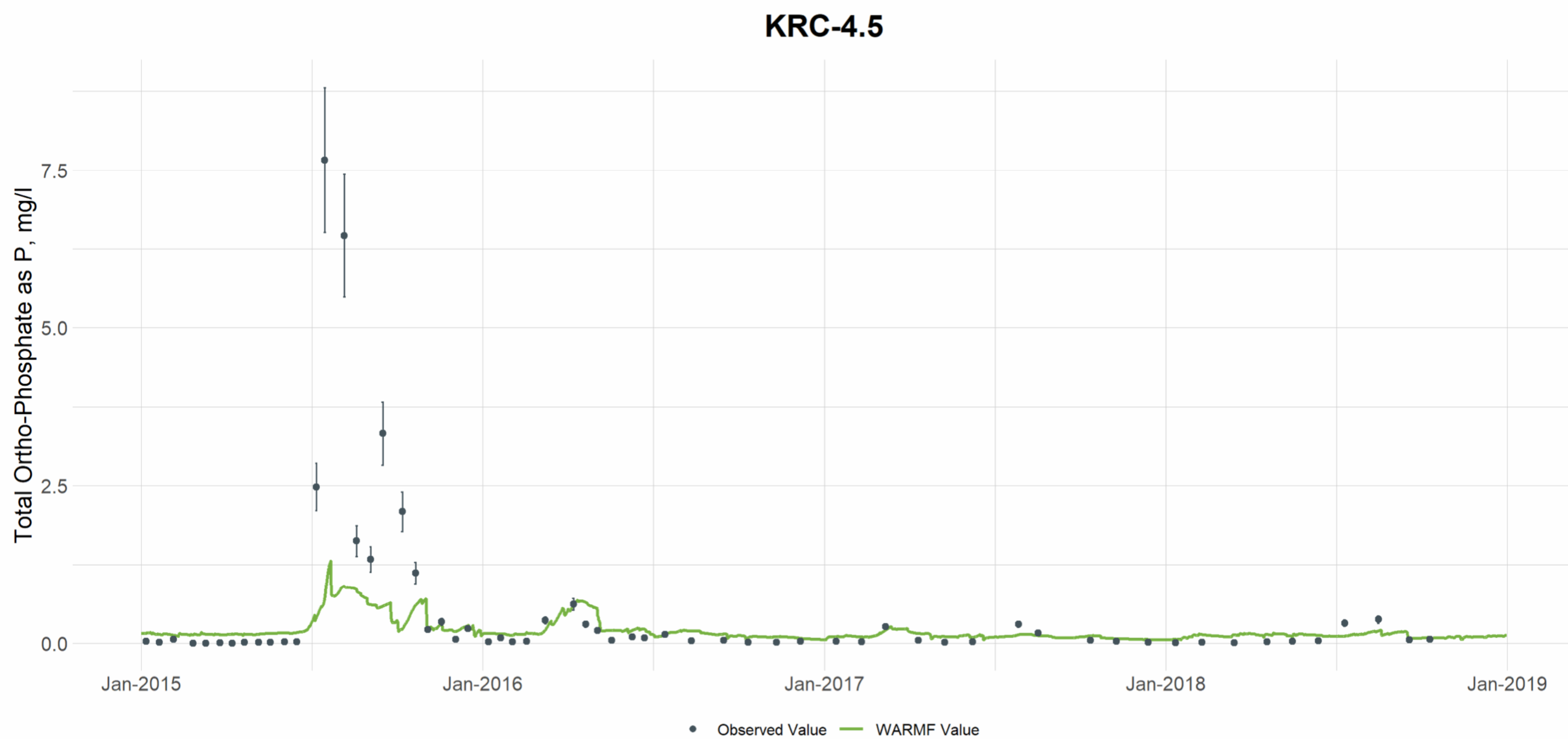


**Figure G-62. Comparison of Observed and Simulated Total Ortho-Phosphate Concentrations at Knap of Reeds Creek at Station KRC-4.5 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

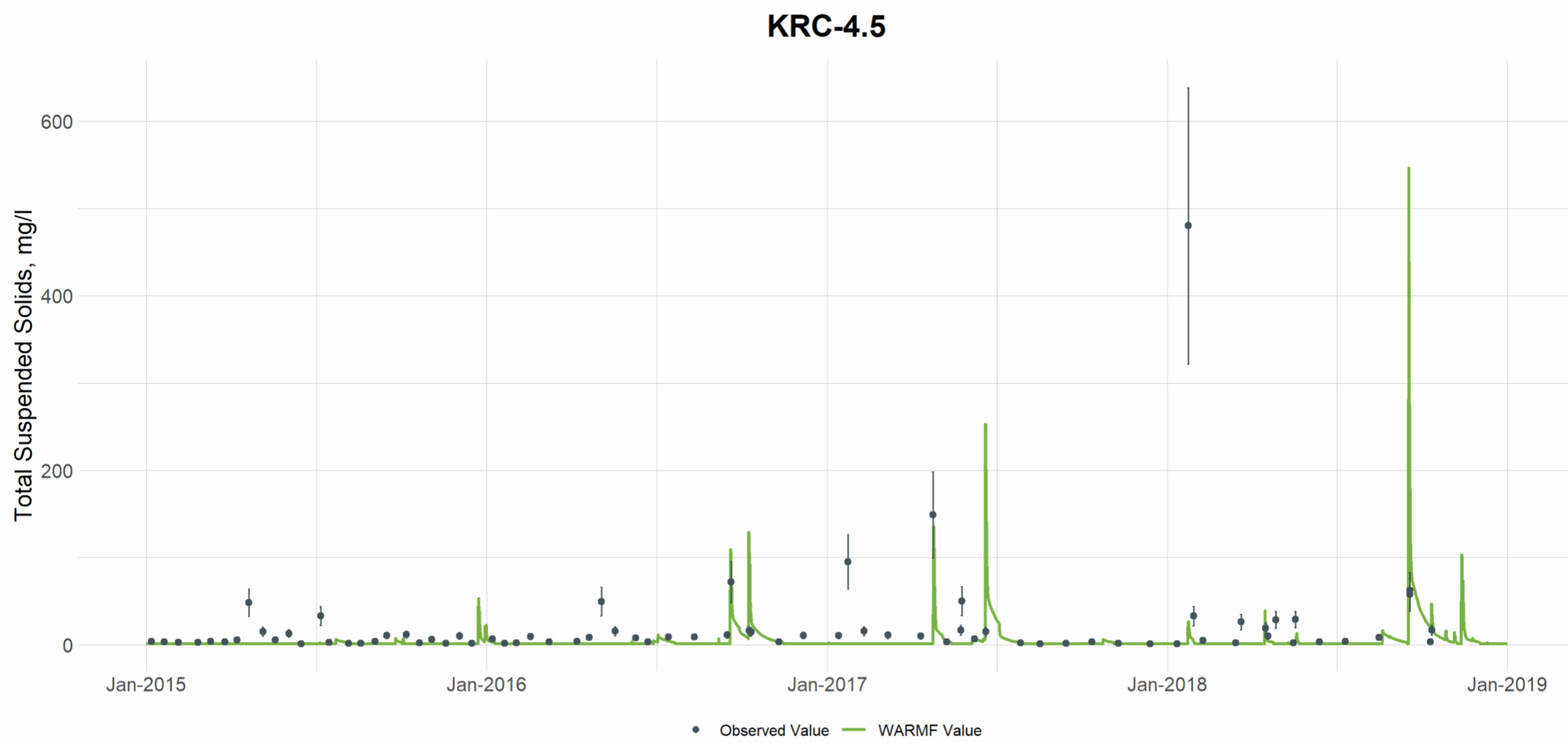


**Figure G-63. Comparison of Observed and Simulated Total Suspended Solids (silt+clay) Concentrations at Knap of Reeds Creek at Station KRC-4.5 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

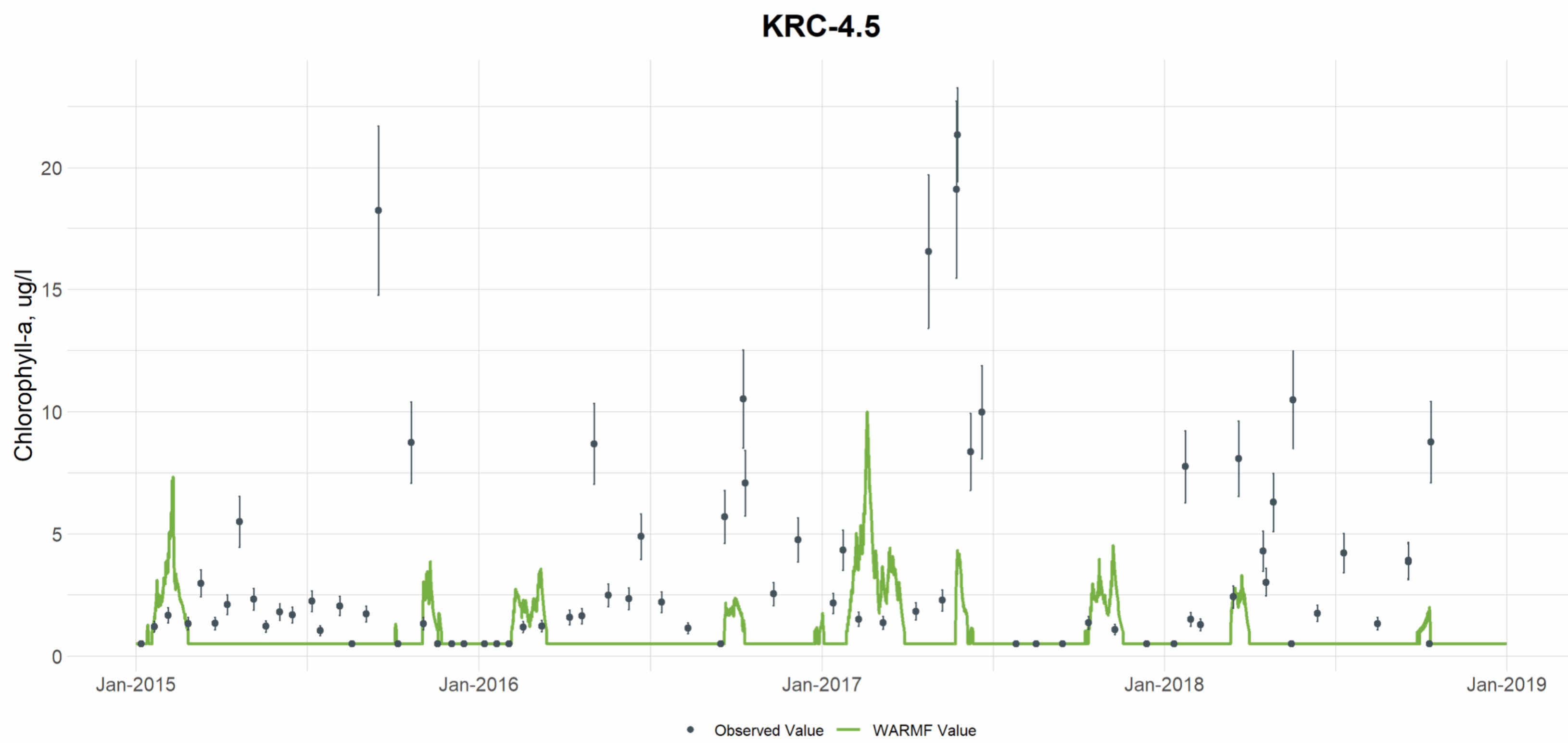


**Figure G-64. Comparison of Observed and Simulated Chlorophyll-a Concentrations at Knap of Reeds Creek at Station KRC-4.5 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

## Little River

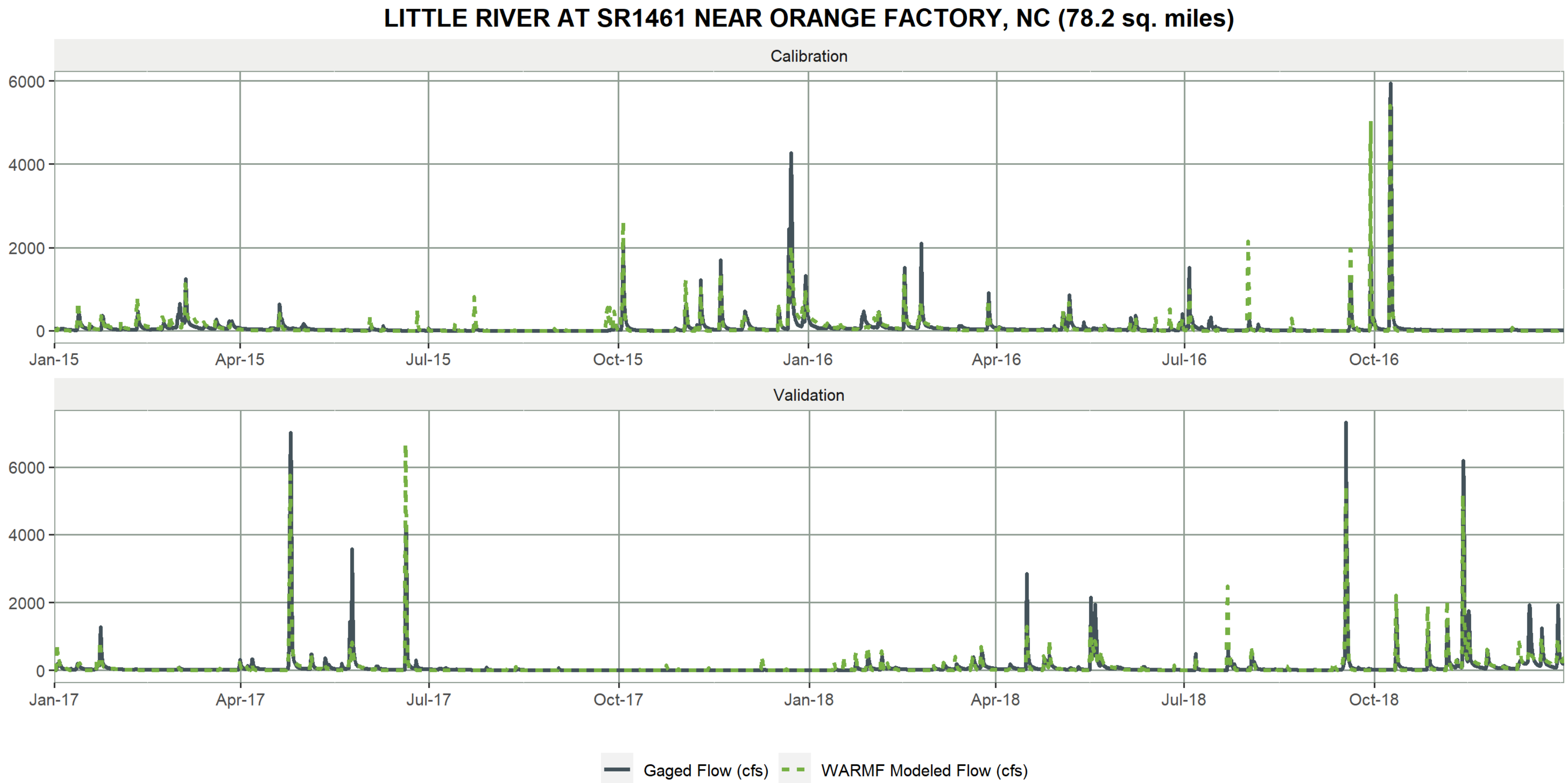


**Figure G-65. Comparison of Observed and Simulated Stream Flows at Little River at SR1461 near Orange Factory, NC (78.2 square miles)**

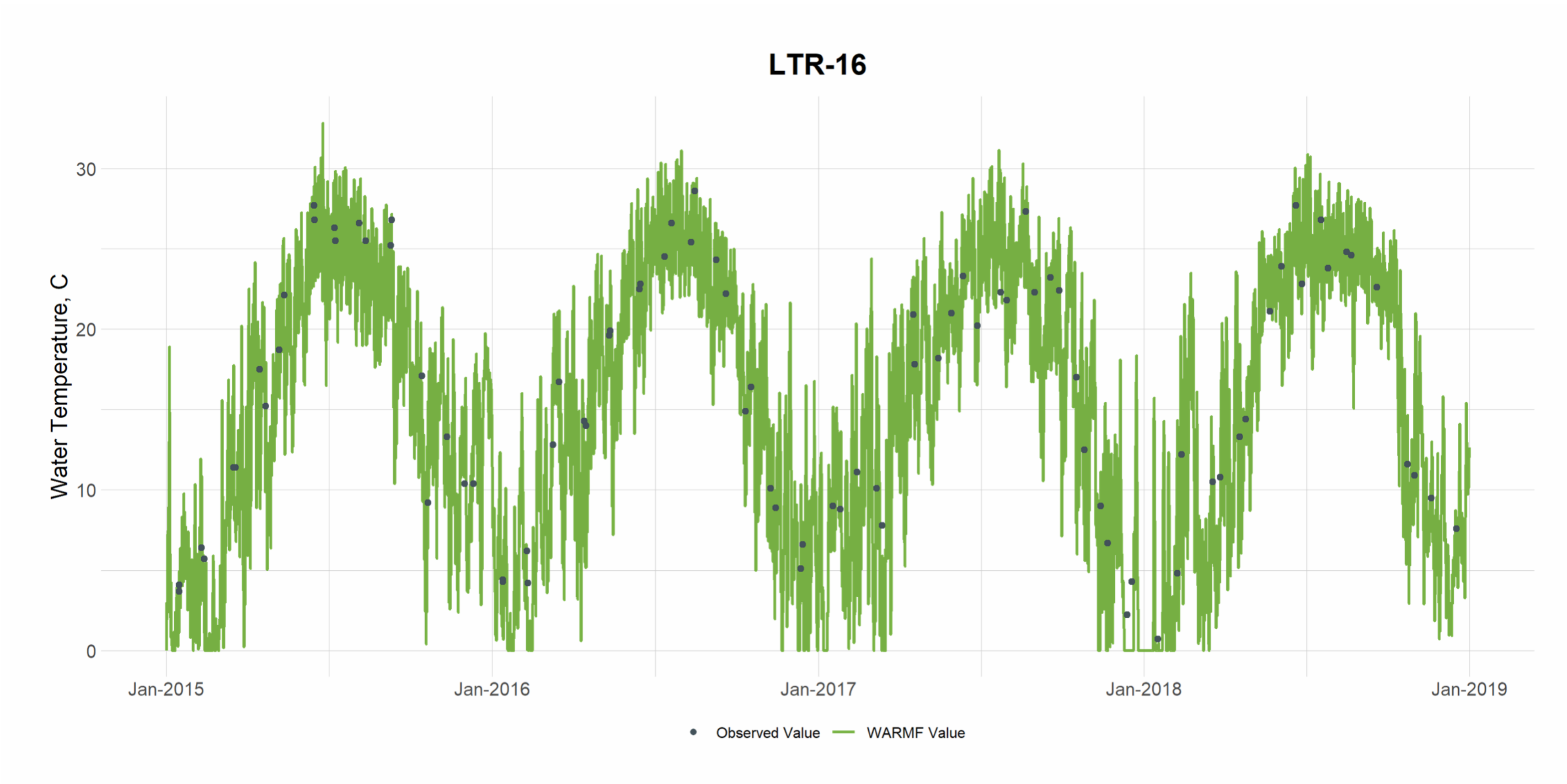


**Figure G-66. Comparison of Observed and Simulated Stream Temperatures at Little River at Station LTR-16**

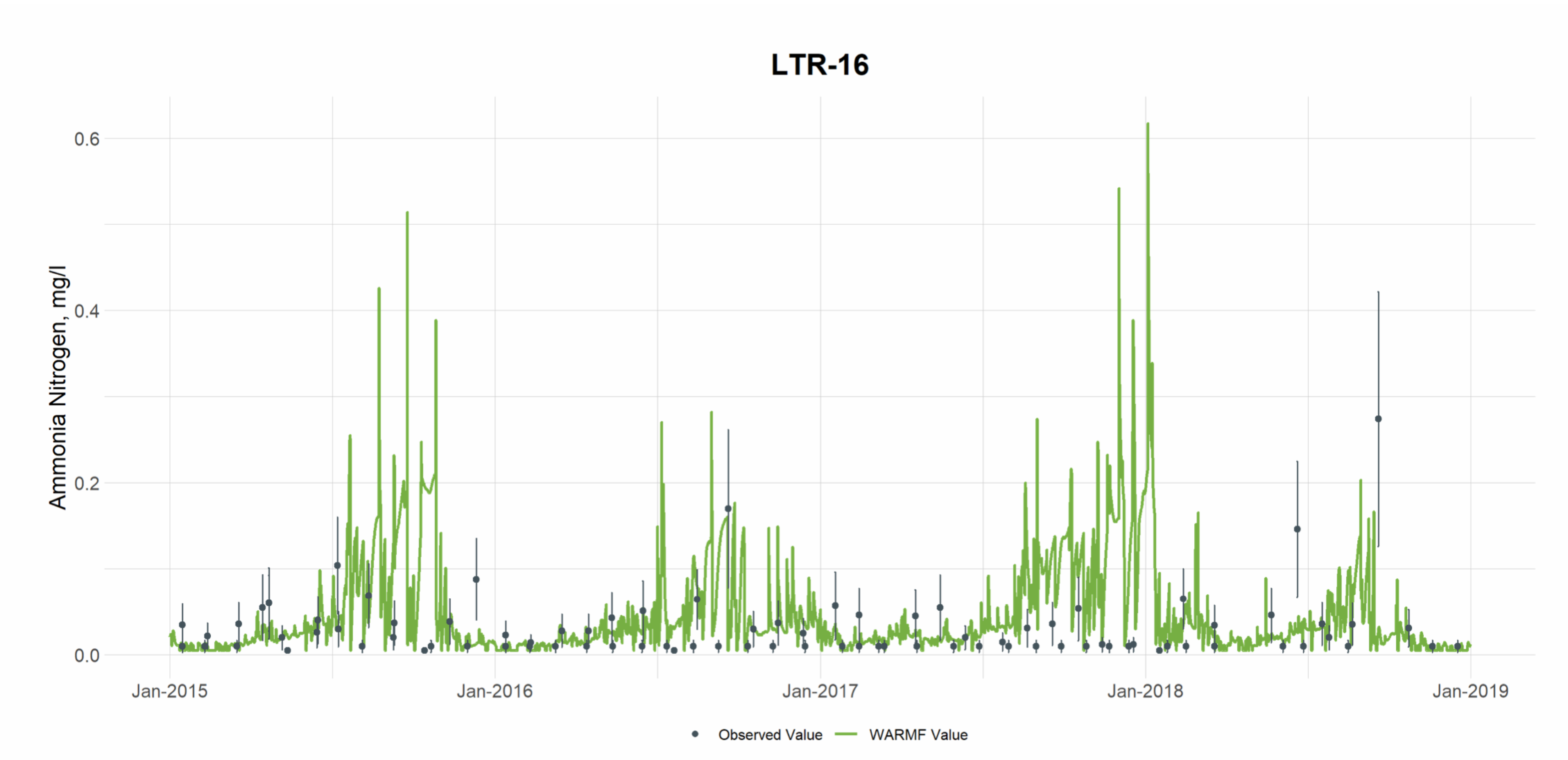


**Figure G-67. Comparison of Observed and Simulated Ammonia Concentrations at Little River at Station LTR-16 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

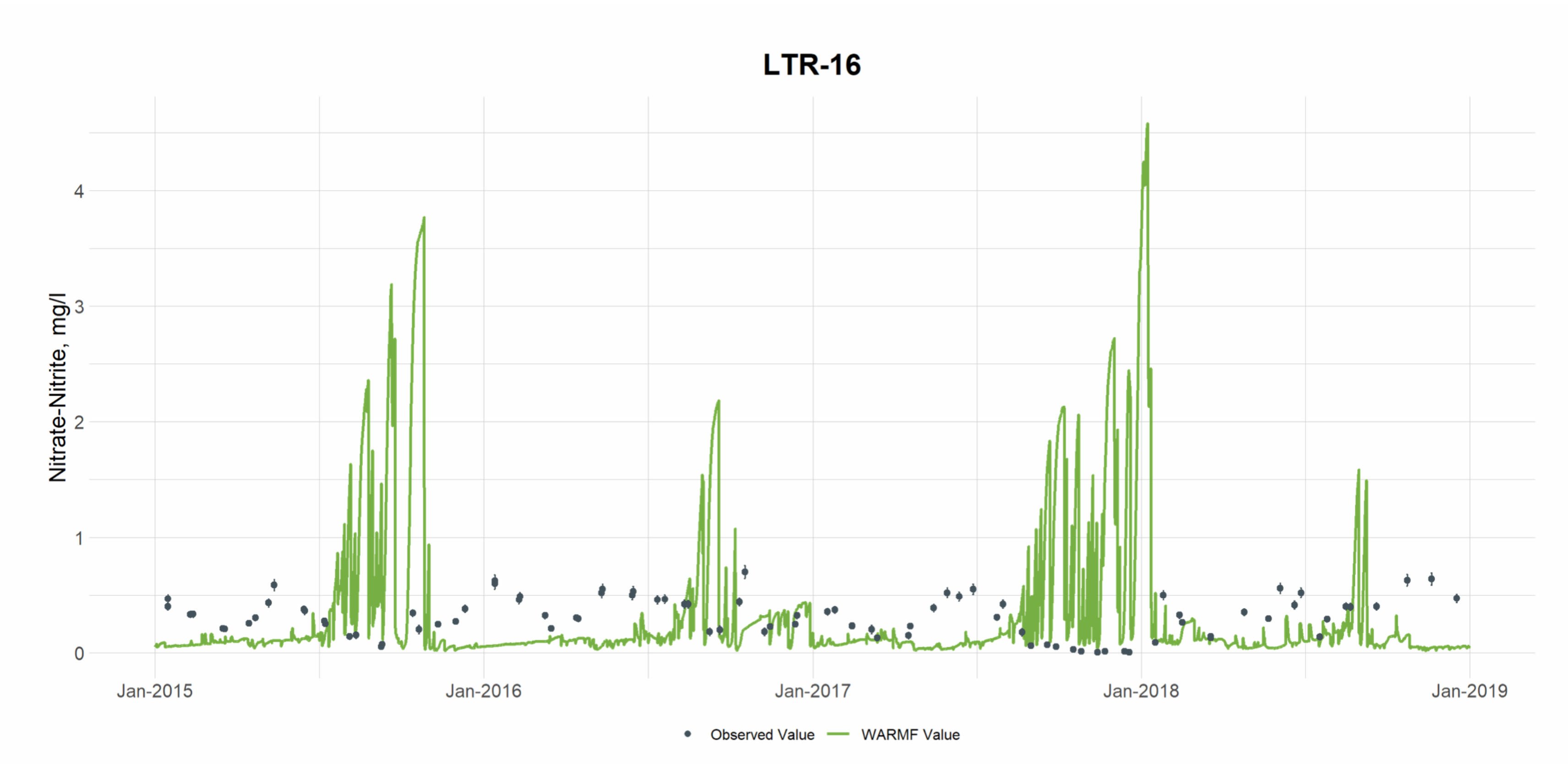


**Figure G-68. Comparison of Observed and Simulated Nitrate-Nitrite Concentrations at Little River at Station LTR-16 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

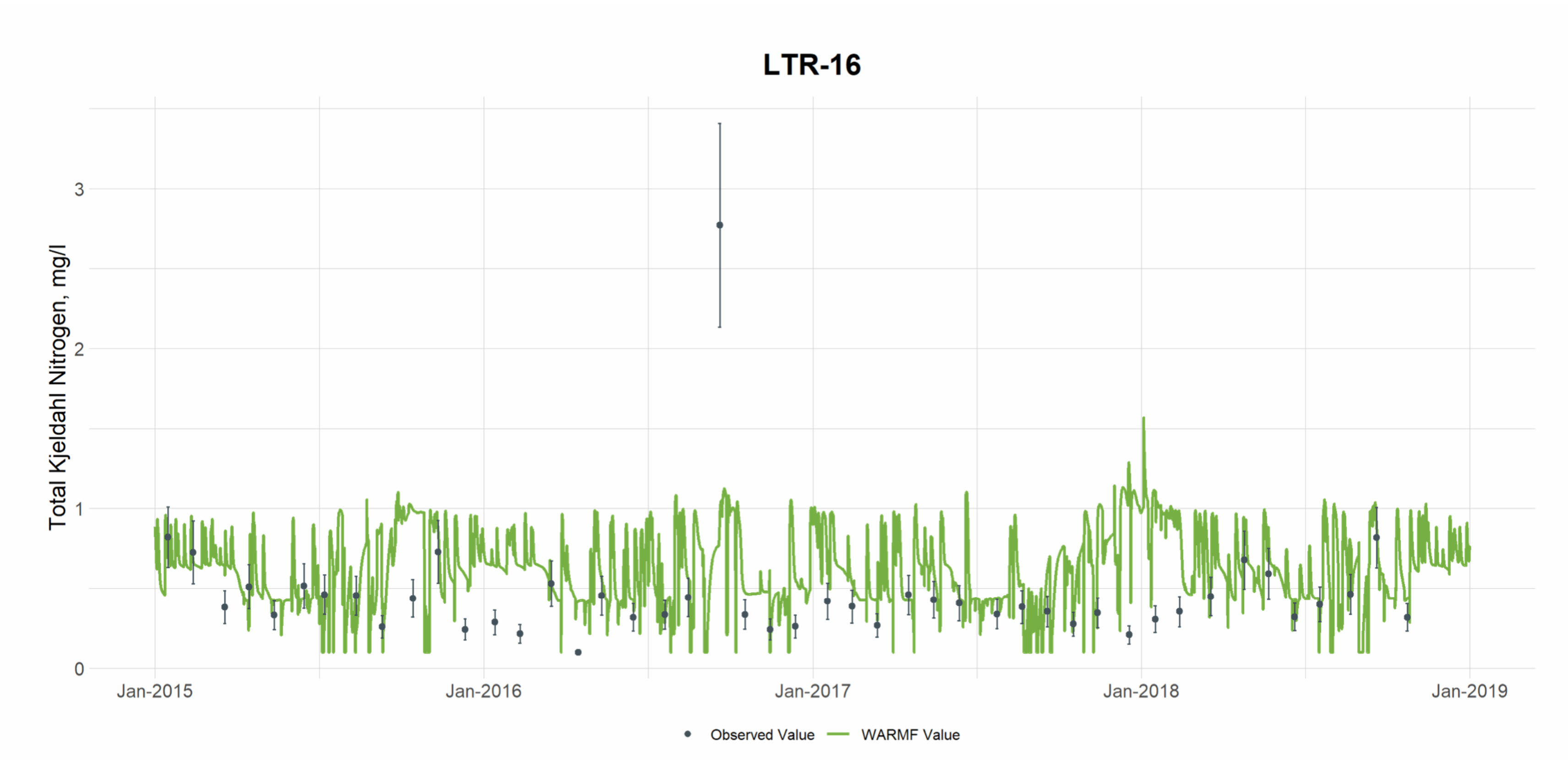


**Figure G-69. Comparison of Observed and Simulated Total Kjeldahl Nitrogen Concentrations at Little River at Station LTR-16 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

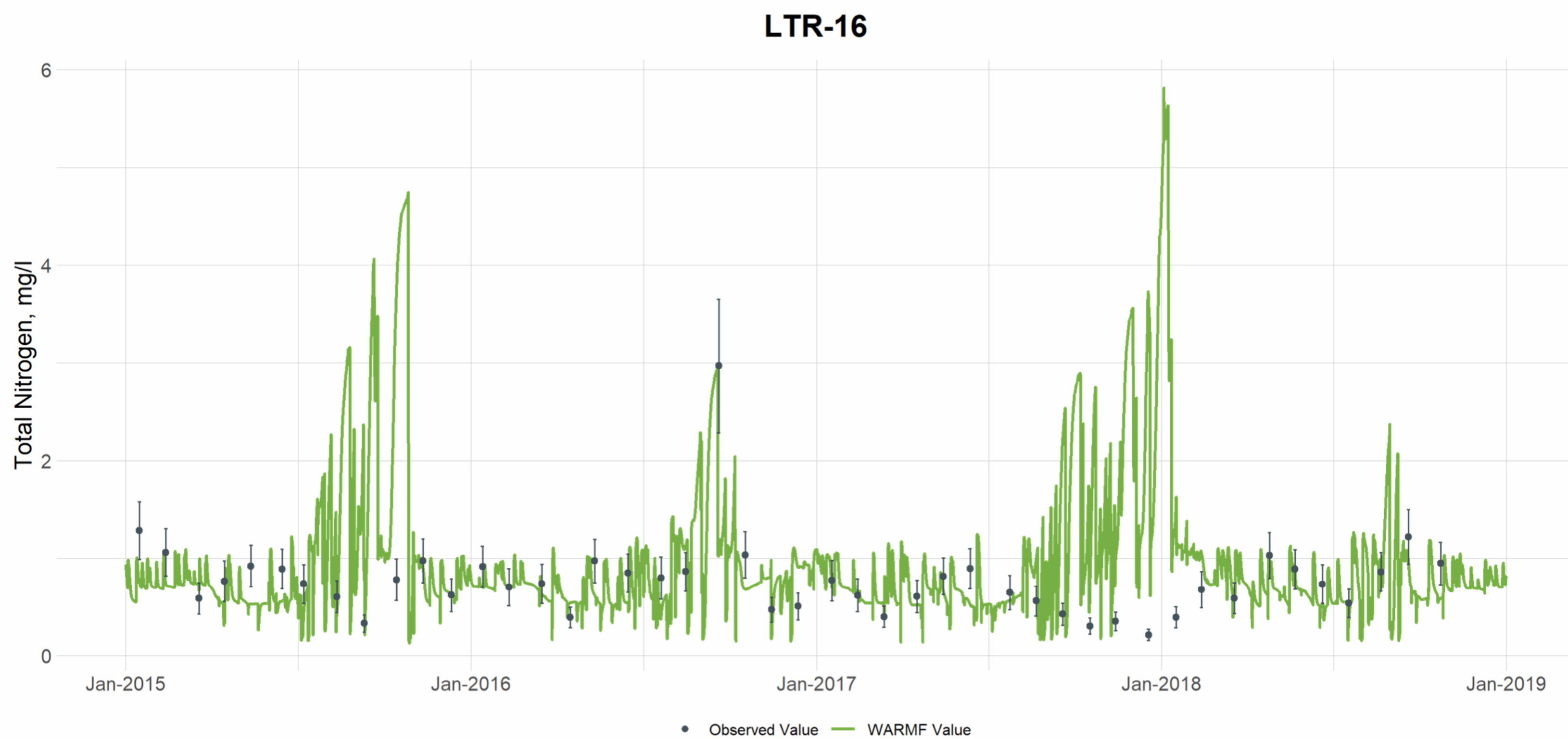


**Figure G-70. Comparison of Observed and Simulated Total Nitrogen Concentrations at Little River at Station LTR-16 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

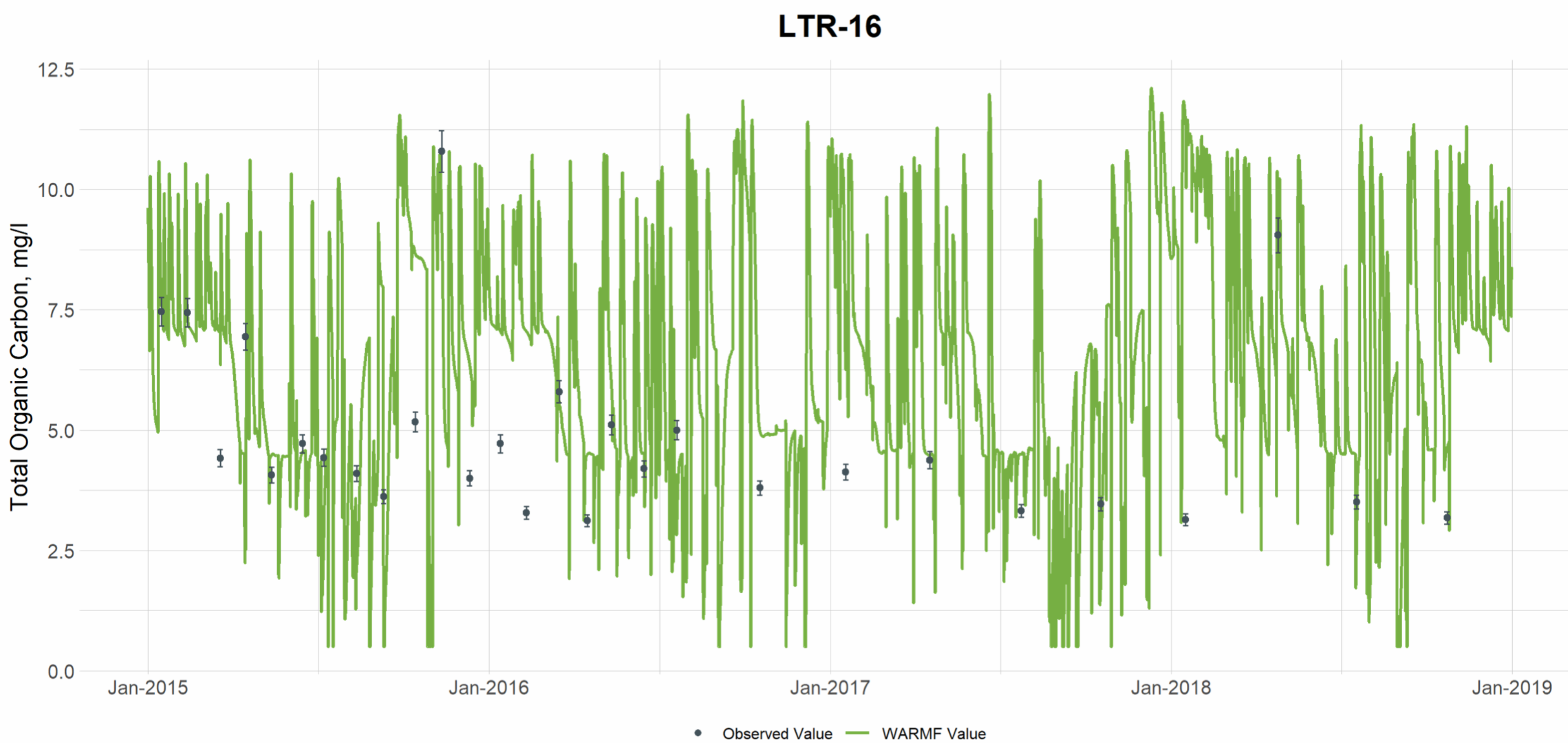


**Figure G-71. Comparison of Observed and Simulated Total Organic Carbon Concentrations at Little River at Station LTR-16** (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)

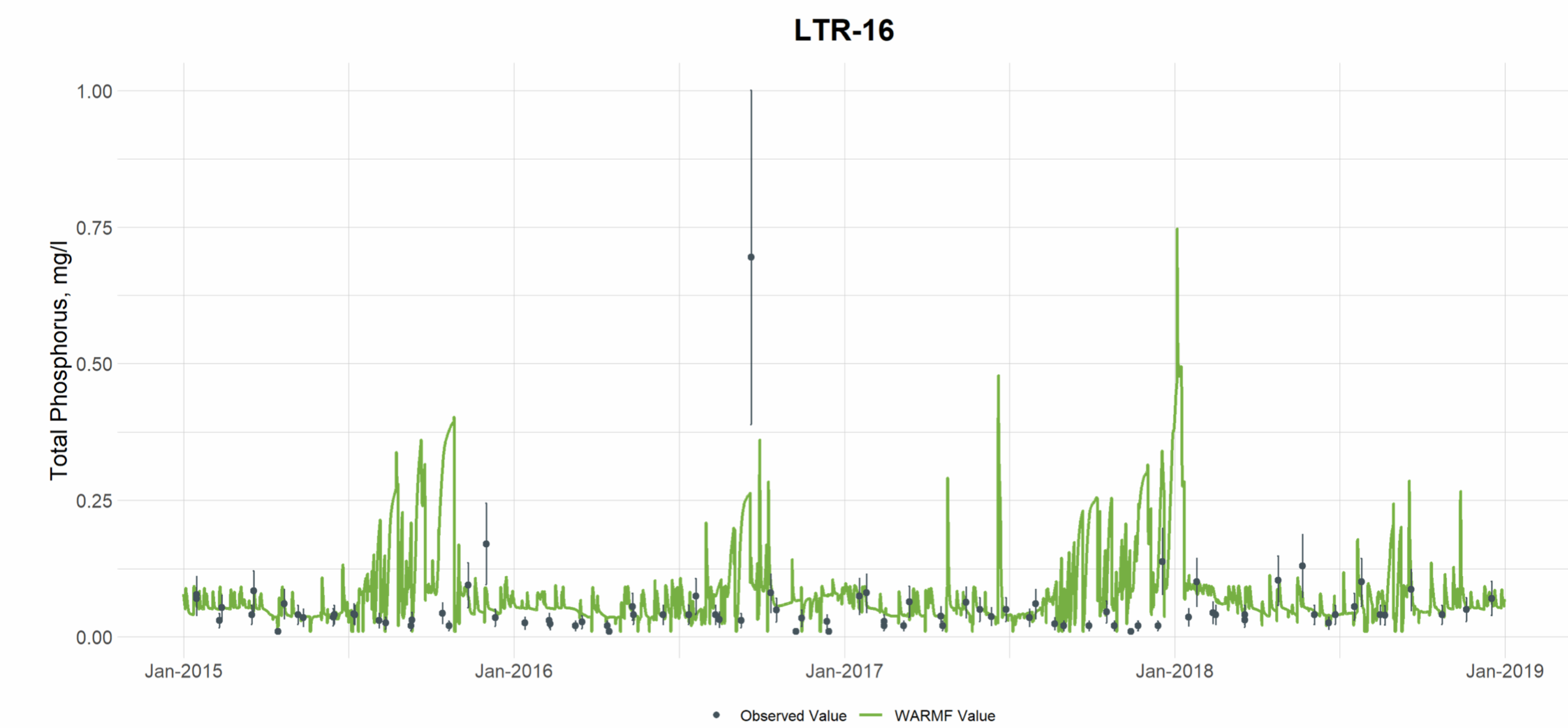


**Figure G-72. Comparison of Observed and Simulated Total Phosphorus Concentrations at Little River at Station LTR-16 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

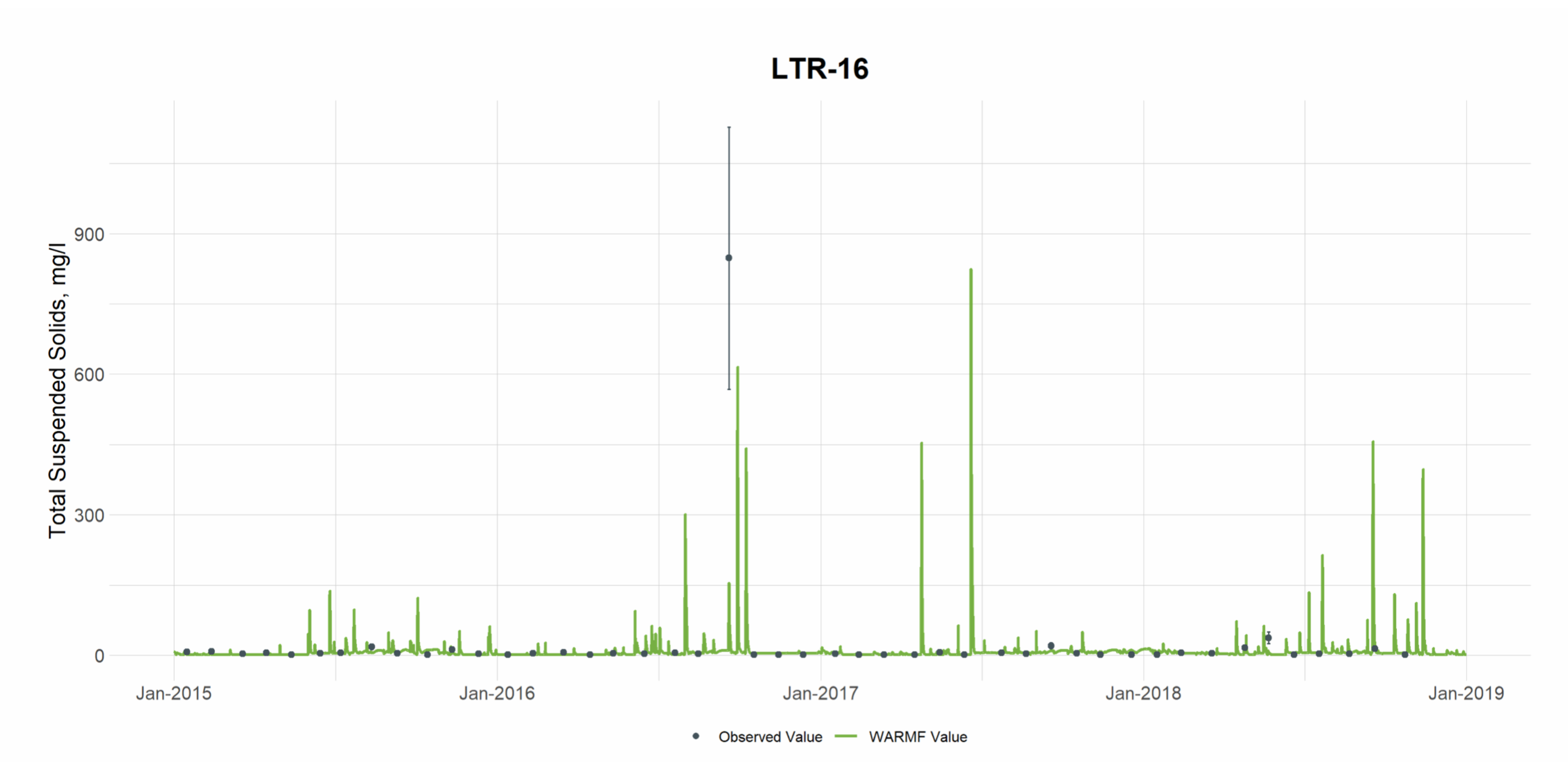


**Figure G-73. Comparison of Observed and Simulated Total Suspended Solids (silt+clay) Concentrations at Little River at Station LTR-16 (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

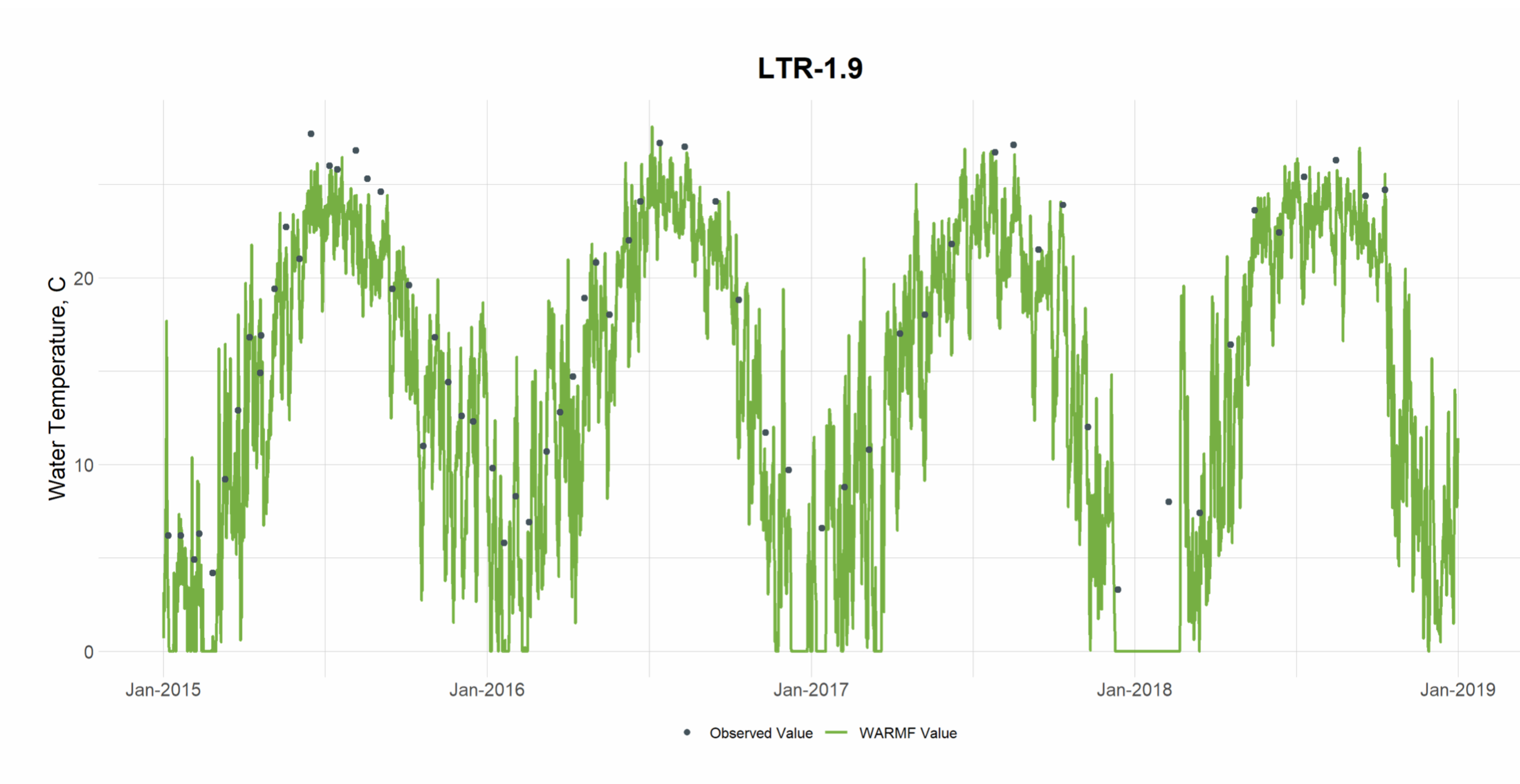


**Figure G-74. Comparison of Observed and Simulated Stream Temperatures at Little River at Station LTR-1.9 (downstream of Little River Reservoir)**

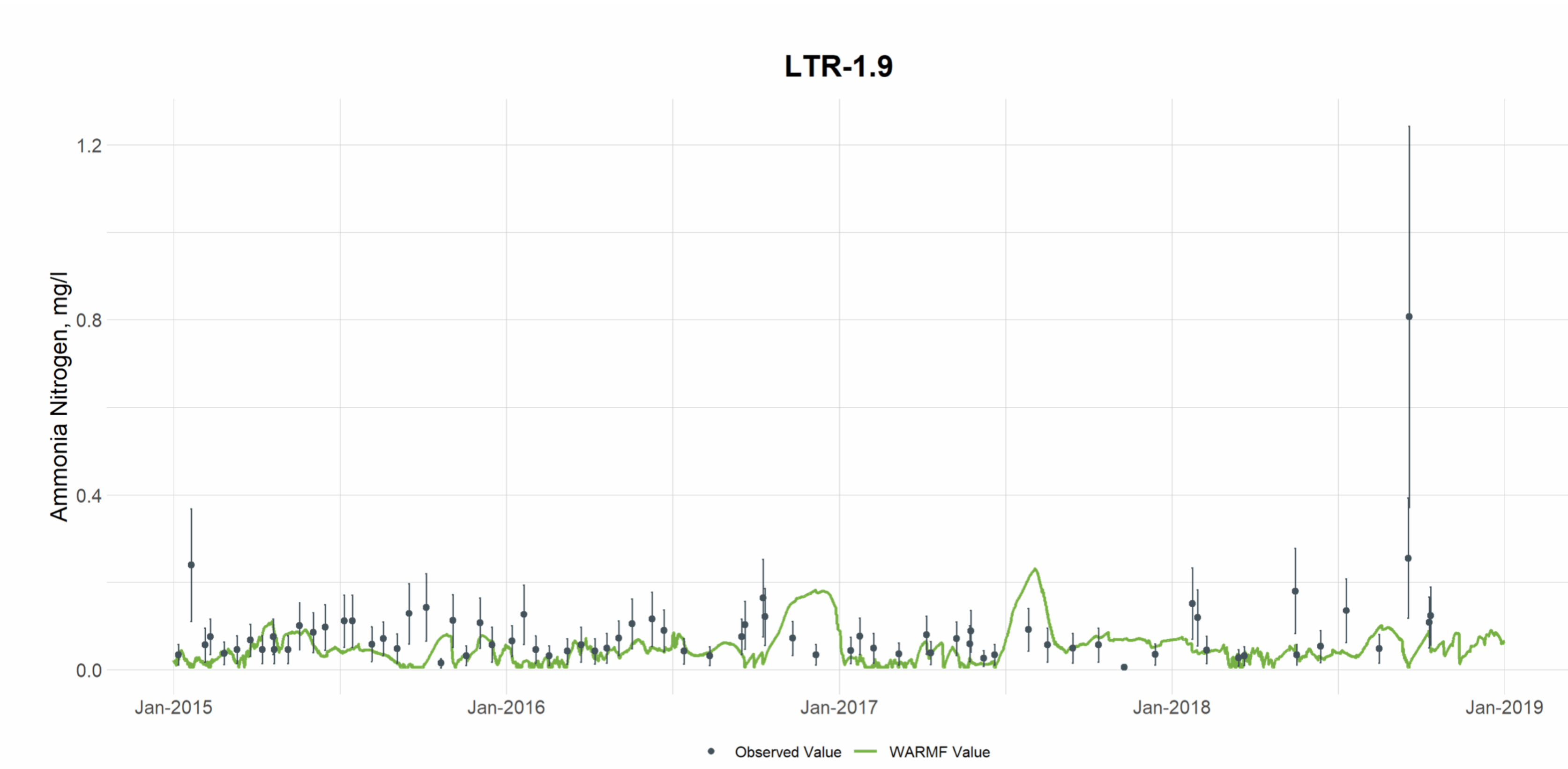


**Figure G-75. Comparison of Observed and Simulated Ammonia Concentrations at Little River at Station LTR-1.9 (downstream of Little River Reservoir) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

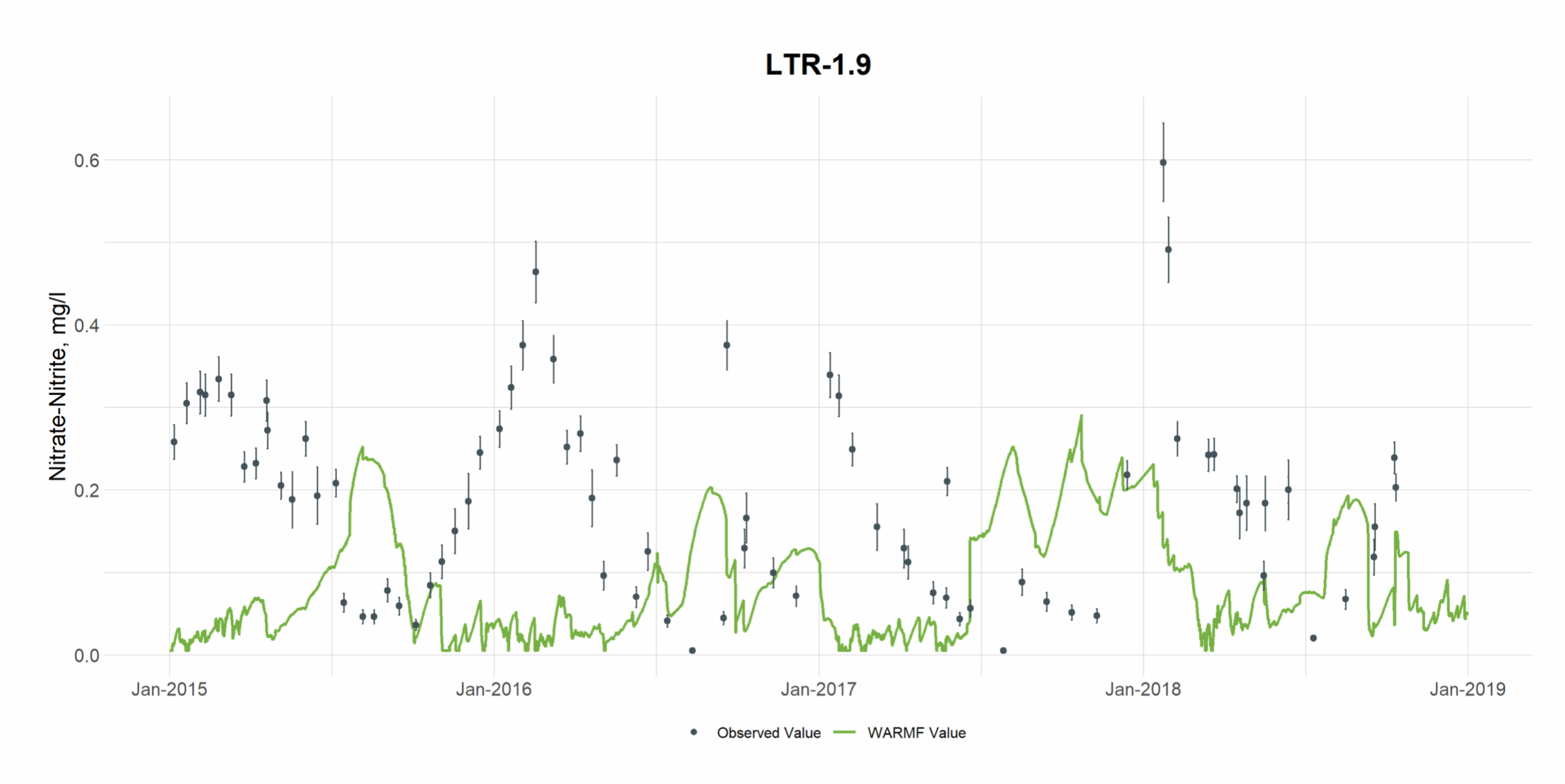


**Figure G-76. Comparison of Observed and Simulated Nitrate-Nitrite Concentrations at Little River at Station LTR-1.9 (downstream of Little River Reservoir) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

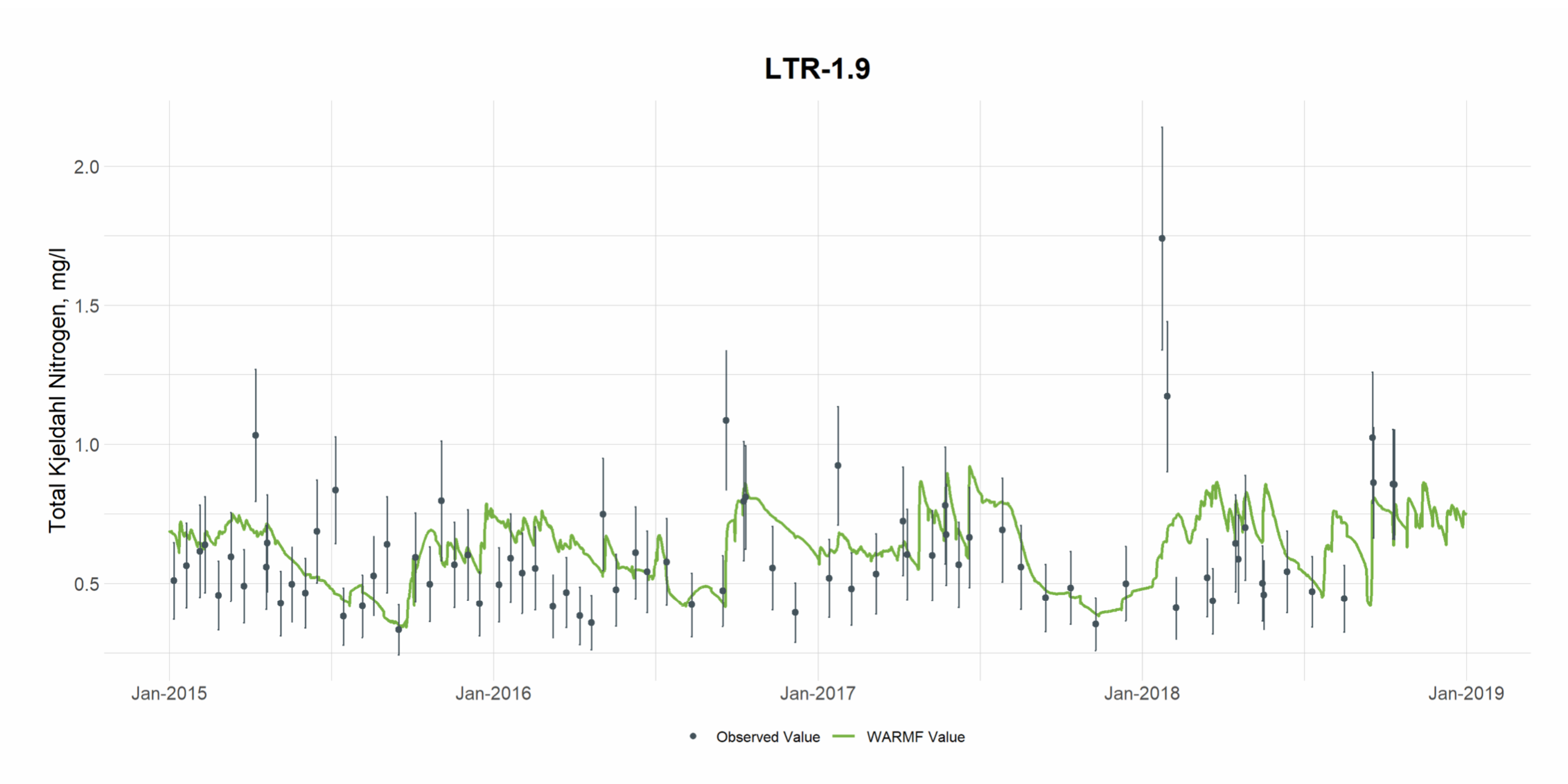


**Figure G-77. Comparison of Observed and Simulated Total Kjeldahl Nitrogen Concentrations at Little River at Station LTR-1.9 (downstream of Little River Reservoir) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

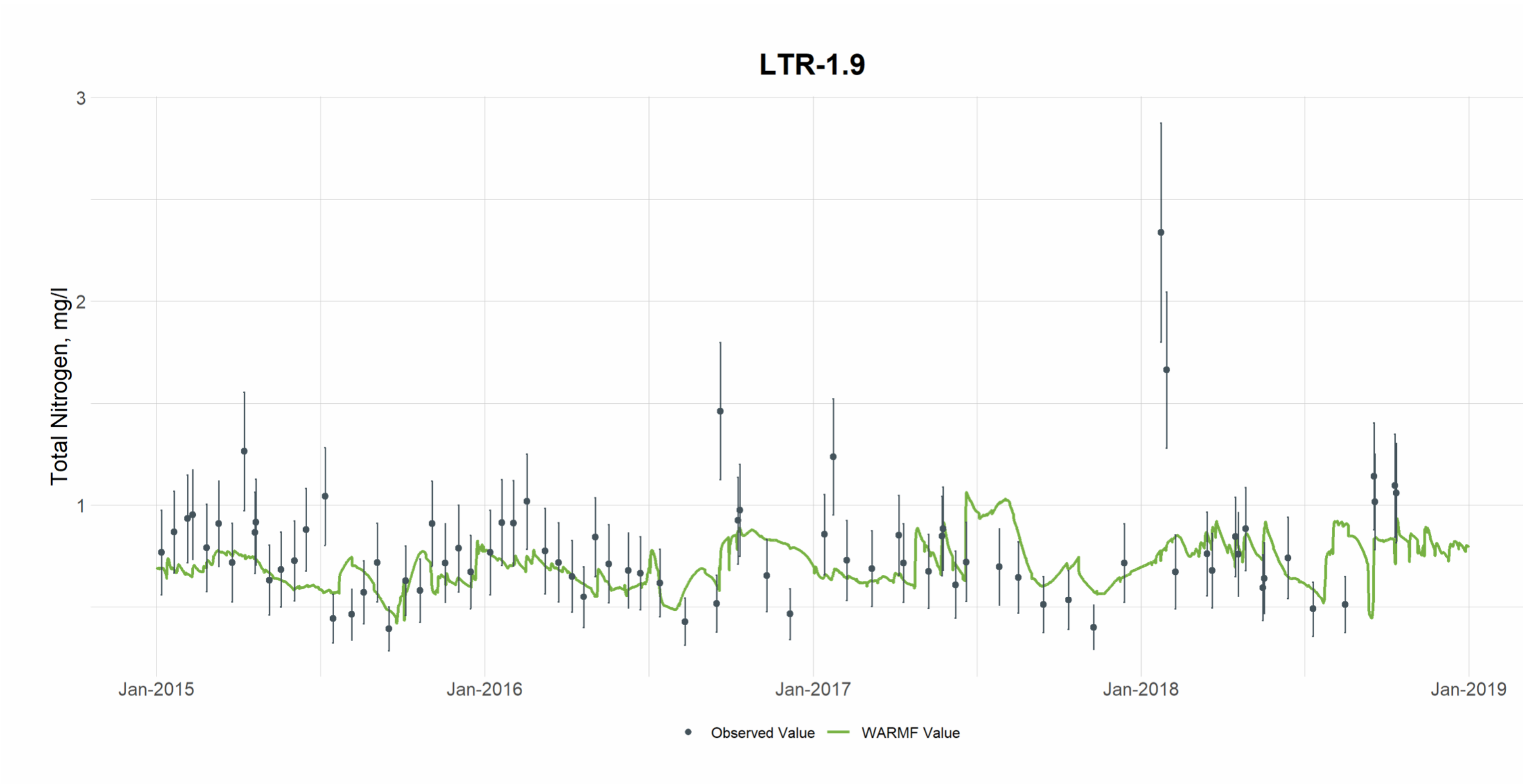


**Figure G-78. Comparison of Observed and Simulated Total Nitrogen Concentrations at Little River at Station LTR-1.9 (downstream of Little River Reservoir) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

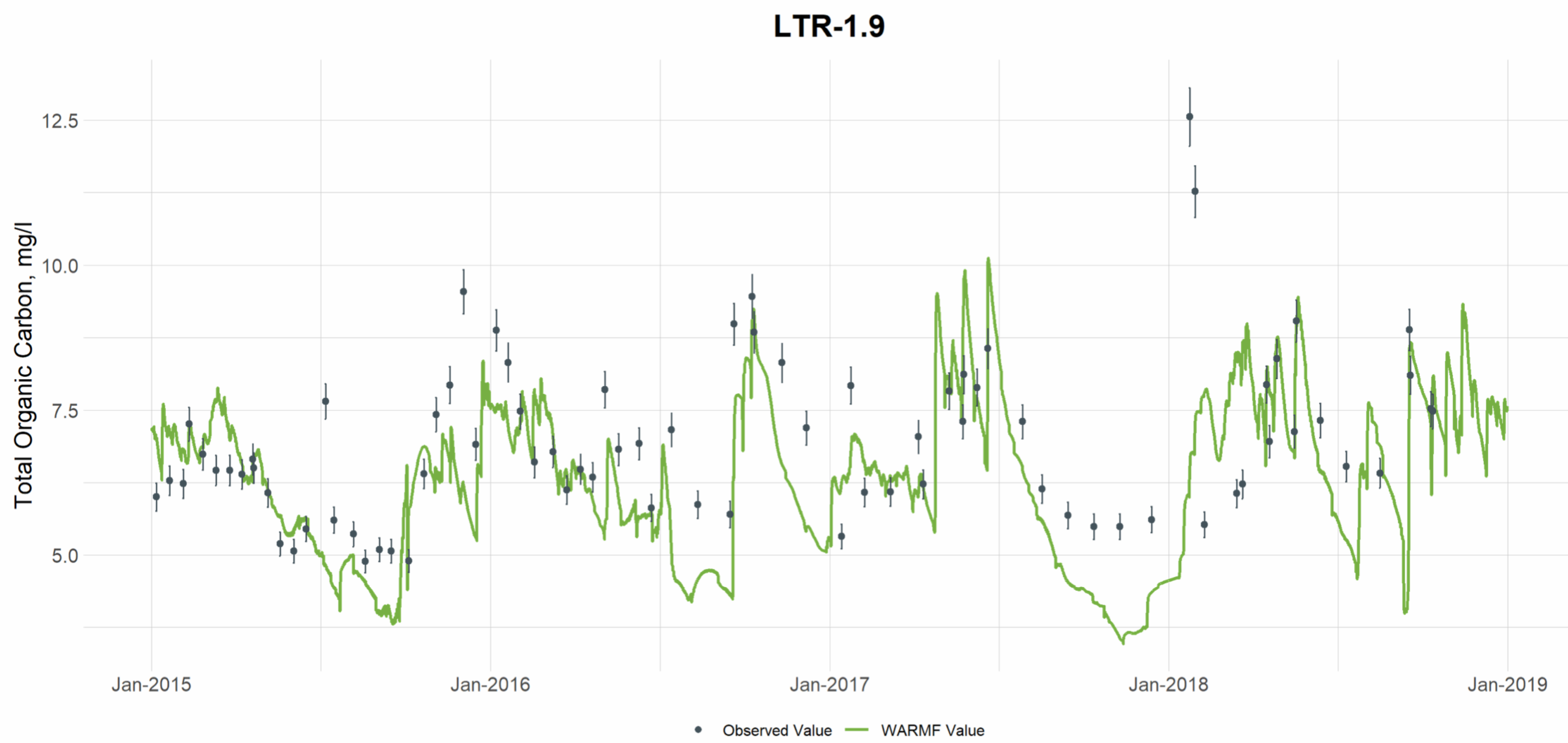


**Figure G-79. Comparison of Observed and Simulated Total Organic Carbon Concentrations at Little River at Station LTR-1.9 (downstream of Little River Reservoir) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

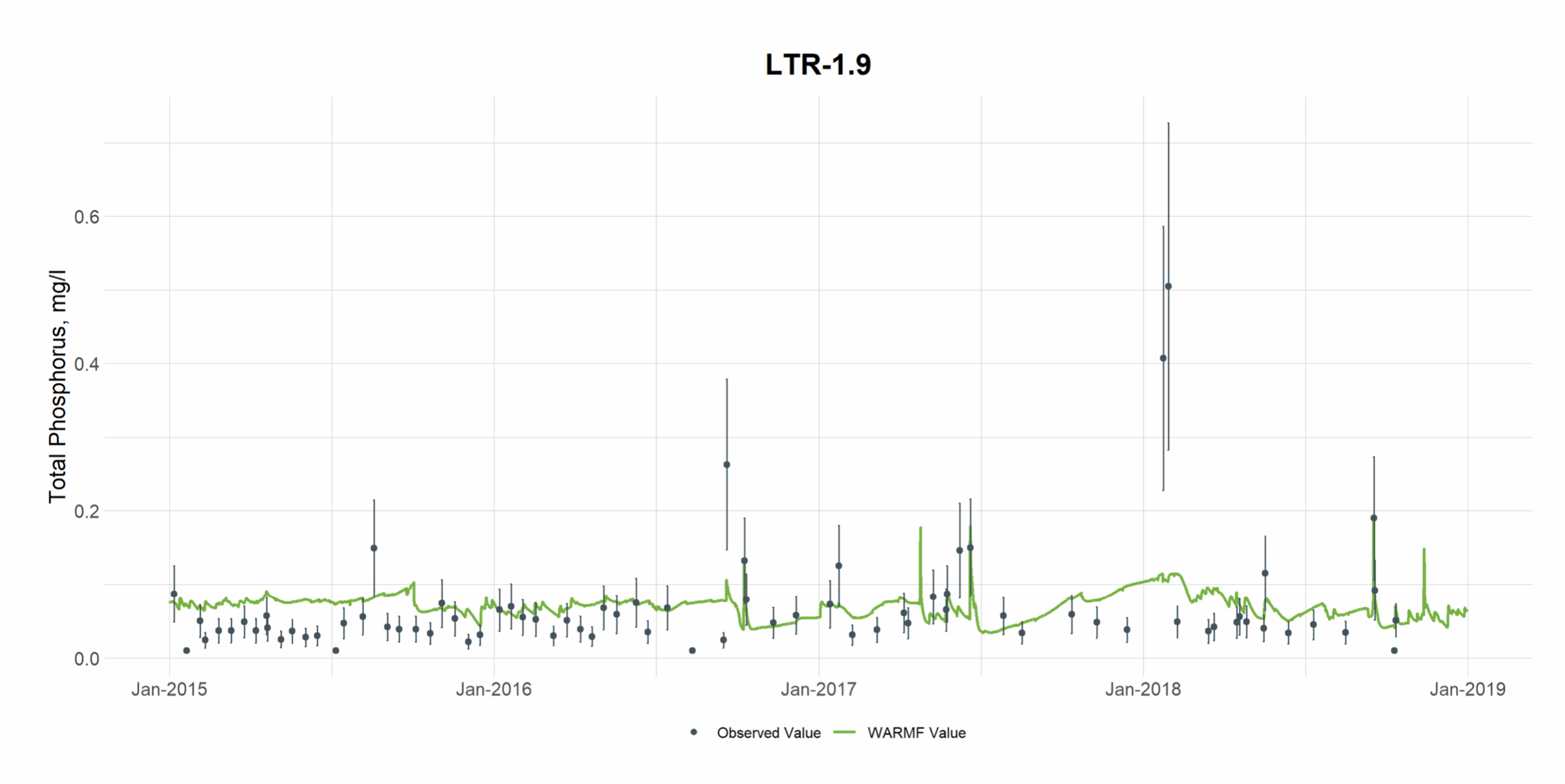


**Figure G-80. Comparison of Observed and Simulated Total Phosphorus Concentrations at Little River at Station LTR-1.9 (downstream of Little River Reservoir) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

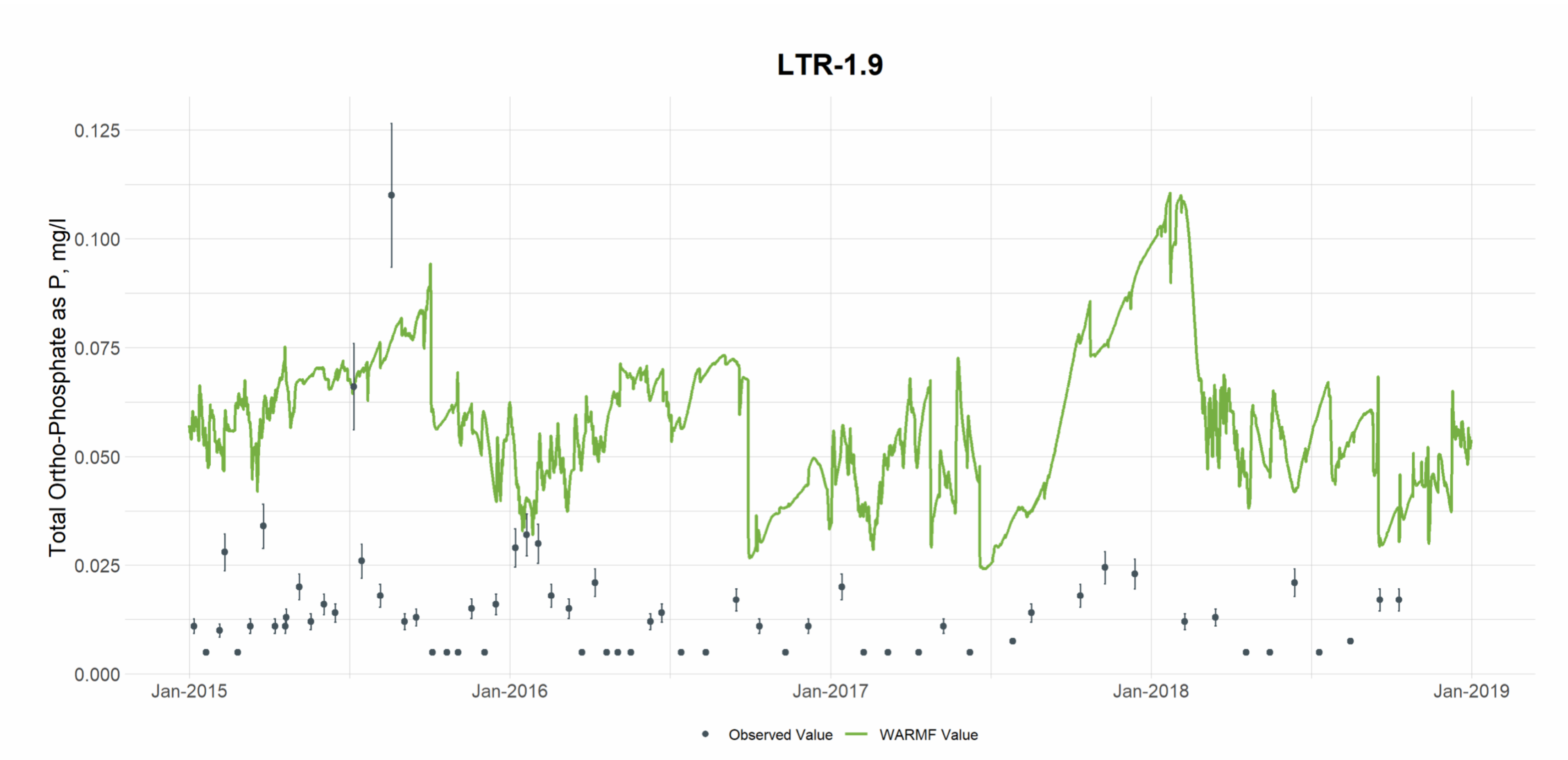


**Figure G-81. Comparison of Observed and Simulated Total Ortho-Phosphate Concentrations at Little River at Station LTR-1.9 (downstream of Little River Reservoir) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

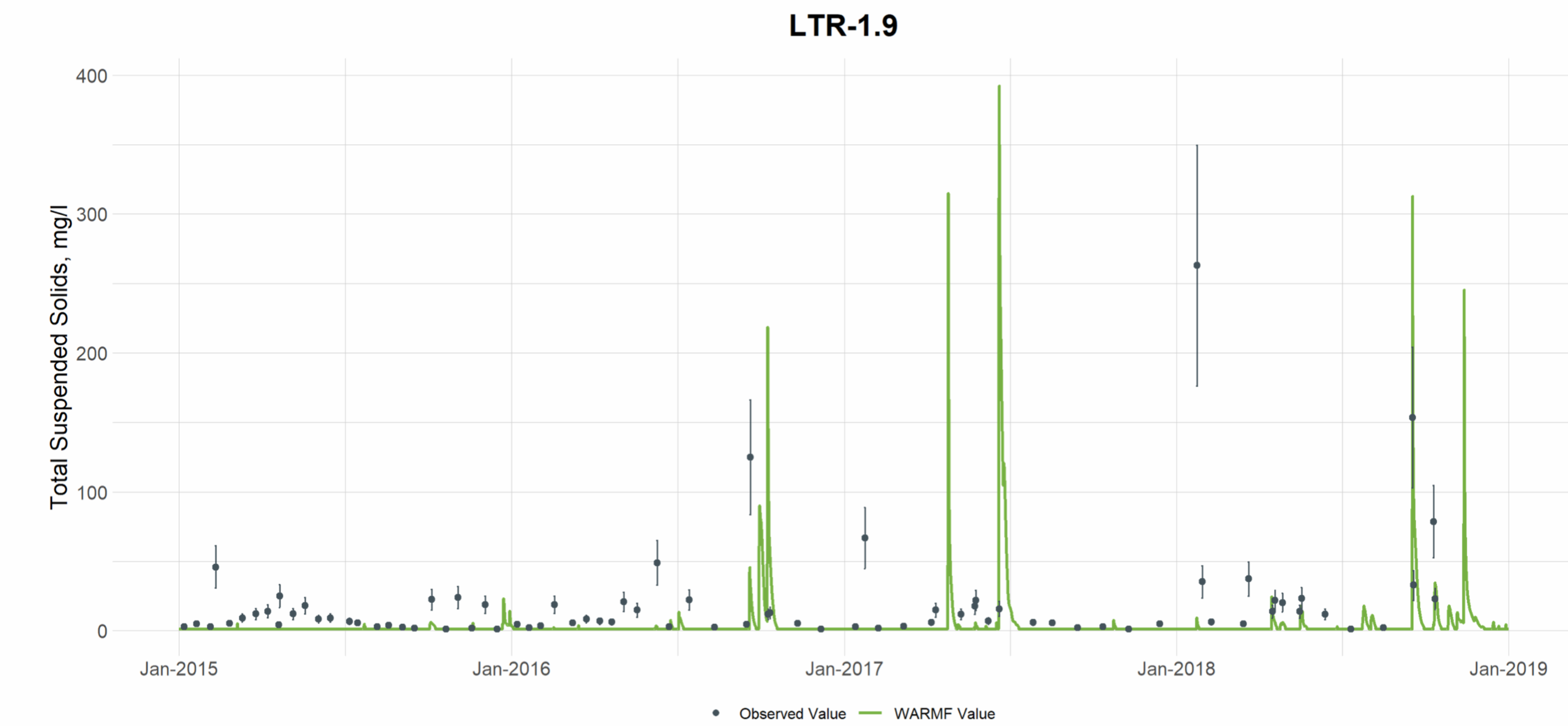


**Figure G-82. Comparison of Observed and Simulated Total Suspended Solids (silt+clay) Concentrations at Little River at Station LTR-1.9 (downstream of Little River Reservoir) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**

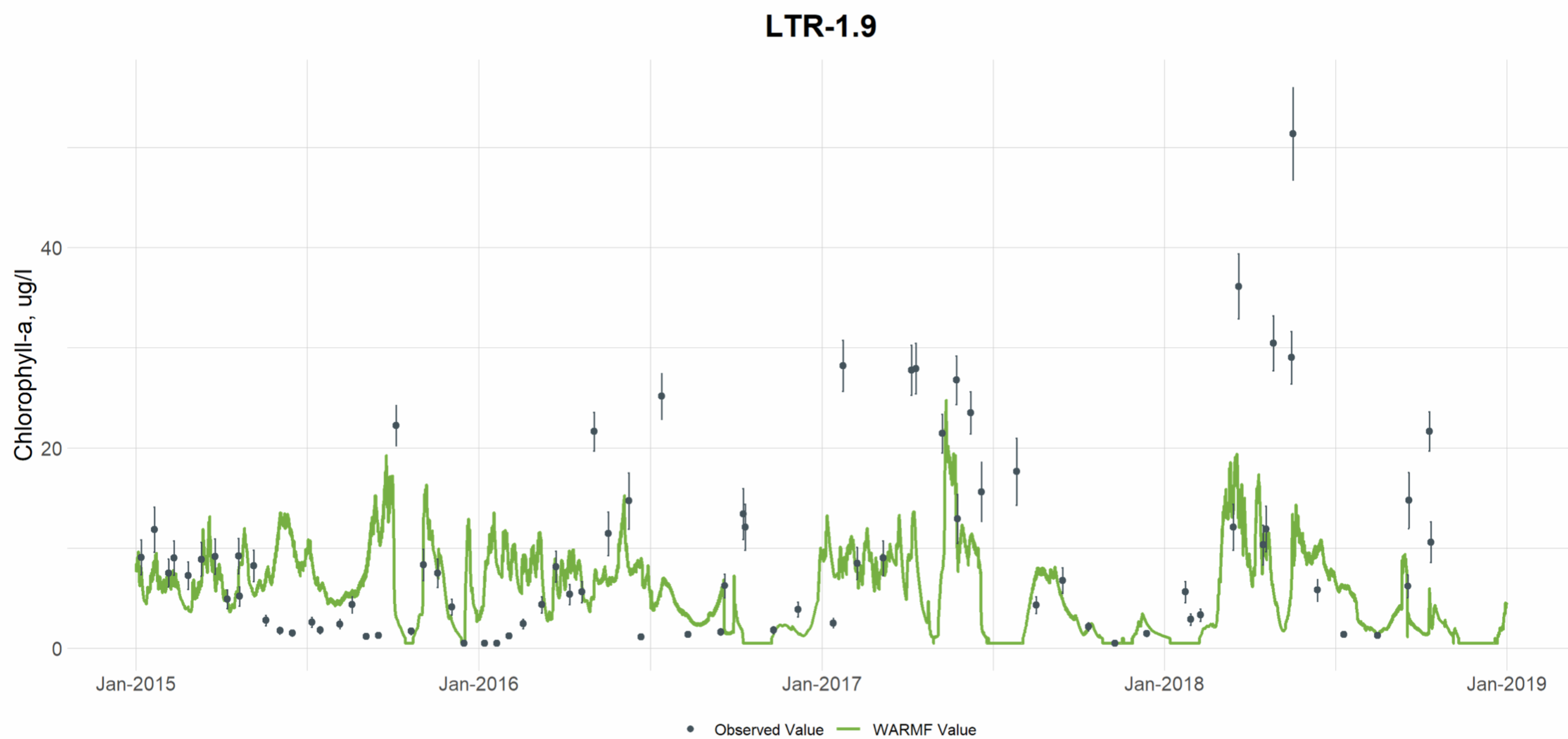


**Figure G-83. Comparison of Observed and Simulated Chlorophyll-a Concentrations at Little River at Station LTR-1.9 (downstream of Little River Reservoir) (vertical bars are used to illustrate the uncertainty with laboratory analyses and are based on the 95th percentile confidence interval calculated from the UNRBA data set for each parameter)**