APPENDIX I
STORM SEWER EVALUATION

Return to Table of Contents

Appendix I
Storm Sewer Evaluation

PFAS CERCLA Remedial Investigation Site Characterization Summary Report
Former Loring Air Force Base, Limestone, ME

Background

The former Loring Air Force Base (Loring) encompasses approximately 8,704 acres in the lower Aroostook River Basin in the northeastern tip of Maine. Loring was operated by the United States Air Force from 1950 to 1994. During base operations, aqueous firefighting foam (AFFF) containing per- and polyfluoroalkyl substances (PFAS) was used for fire suppression activities. PFAS was released intentionally into the environment during emergency response, training exercises, calibration of fire suppression systems, and unintentionally during fire suppression system malfunctions. The installation was operated by the United States Air Force until it was deactivated in September of 1994. Most of the former base buildings and infrastructure are currently owned and managed by the Loring Development Authority (LDA).

Infrastructure was constructed at Loring to support base activities, including a storm sewer system to collect stormwater runoff and a network of underdrains designed to drain shallow groundwater from underneath the airfield taxiways and runways to the storm sewer system. This storm sewer system is used to transmit stormwater from Loring to surface water discharge locations that feed Greenlaw Brook and Butterfield Brook, Figure I-1. Historically, AFFF released onto paved surfaces would have been washed into the storm drain system for discharge into receiving surface water bodies.

A review of historical topographic maps from the United States Geological Survey (USGS) indicated that many parts of Loring were constructed across areas of wetlands, Figure I-2. These areas previously identified as wetlands include portions of the Runway, the flightline, portions of the Nose Dock Area, the Fuel Tank Farm, and areas to the north of the Structural Fire Station. These areas were drained either using an underdrain system or by surface drainage channels, which are extensive in these areas, allowing for the draining of surface water and shallow groundwater from these former wetlands. Portions of the areas drained by the stormwater and underdrain system have become impacted by the historic usage of AFFF, resulting in the contamination of groundwater across Loring. The presence of water discharging from storm water outfalls during dry periods is an indication that groundwater is infiltrating into the system. This infiltration can occur through damaged storm sewer infrastructure that is installed below the water table or through the underdrain system.

Storm Sewer Remedial **Investigation Work Activities**

Storm sewer outfalls and at manholes throughout the storm sewer network were sampled for PFAS as part of Remedial Investigation (RI) activities detailed in **Section 4.4.1** and analytical data is provided in Table 4-8.

Flow meters were installed at seven storm sewer outfalls, Figure I-3, and monitored discharge from the stormwater system at 15-minute intervals from May through November 2024. The flow meters used were the Greyline MantaRay, which measure stream velocity and cross-sectional area using a submerged sensor. These parameters are used to calculate discharge. To calculate discharge effectively the sensors need to be submerged and free of obstructions. If the sensor is obstructed or not submerged, it will report no flow.

Outfalls C1, C2, and C3 drain the largest networks of the stormwater collection system, including the majority of the nose docks, the majority of the flightline, and the majority of the runway. These outfalls discharge to the Flightline Drainage Ditch (FLDD). ST12001 and ST11001 drain two smaller stormwater collection systems that drain the west side of the nose docks. Both outfalls discharge to infiltration basins, the overflow of which discharge to the West Branch of Greenlaw Brook. ST16002 drains a stormwater collection system at the south end of the runway and one of the ready areas. The outfall discharges to a tributary of the East Branch of Greenlaw Brook. ST20001 drains a stormwater collection system at the north end of the runway and discharges to a tributary of Butterfield Brook.

The data were compiled from the six outfalls that reported flow and compared to reported daily precipitation from the Limestone Weather Station. These data are presented in Figure I-4 through Figure I-9. One of the outfalls that was monitored, ST11001, reported a discharge of 0.0 gallons per minute (GPM) throughout the entire monitoring period. This is attributed to the fact that the outfall discharges to standing water and exhibits very little flow reported during field reconnaissance. Additionally, the presence of obstructions including organic matter in standing water were identified at the outfall.

PFAS Analytical Analysis and Comparison to Source Areas

Storm sewer locations were sampled as part of RI activities detailed in **Section 4.4.1** and analytical data is provided in Table 4-8. Radar plots displaying the relative proportion of the predominant PFAS compounds in the storm sewer samples were constructed for each outfall with axes for perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorohexane sulfonic acid (PFHxS), perfluorobutane sulfonic acid (PFBS), and 6:2 fluorotelomer sulfonate (6:2 FTS). These compounds are displayed on the radar plots as they represent the majority of the total PFAS identified in the samples, Figure I-10. The PFAS signature from the storm sewer samples were compared to three groundwater samples from monitoring wells, OW07001, BW05009, and BW06006. These wells are representative of groundwater impacts attributed to PFAS source areas identified during the remedial investigation from the Crash Fire Station, the Structural Fire Station, and the Burn House.

Concentrations of PFOS at the three outfalls that feed the FLDD, C1, C2 and C3, ranged from 17 nanograms per liter (ng/L) at C1 to as high as 665 ng/L at C3. Outfall C3 exhibited the highest concentrations of PFAS chemicals of the three outfalls. ST12001 exhibited the highest concentrations of PFOS of any of the outfalls sampled with a maximum concentration of 4,560 ng/L. Samples collected from ST12001 were collected from standing water at in a stormwater infiltration basin at the outfall. This sample is representative of a combination of stormwater discharge with stagnant water that has been in contact with PFAS-impacted sediment in the infiltration basin. PFOS concentrations at ST12006 ranged from 37 to 87 ng/L and PFOS concentrations at ST20001 ranged from 140 to 339 ng/L. Samples collected from ST12006 and ST 12001 were collected from standing water at the base of the stormwater outfall, resulting in a mixing of stormwater discharge with stagnant water that has been in contact with PFAS impacted sediment at the discharge location.

The relative proportions of PFAS in storm sewer outfalls and groundwater illustrate the predominant PFAS compounds identified were PFOS and PFHxS, with more minor components of PFOA and 6:2 FTS. This signature is consistent with the relative proportions of PFAS in AFFF and the impacts identified at PFAS source areas across Loring.

Storm Sewer **Response to Precipitation**

Storm sewer discharge and precipitation were plotted on hydrographs to show each location's response to rainfall events.

- Flow rates at Outfall C1 ranged from between 11 to approximately 20,000 GPM during rainfall events.
- Flow rates at Outfall C2 ranged from 3 to approximately 20,000 GPM during rainfall events.
- Flow rates at Outfall C3 ranged from 11 to approximately 20,000 GPM during rainfall events.
- Flow rates at ST12001 ranged from 10 GPM to 4,000 GPM during rainfall events. Flow rate monitoring at ST12001 was sporadic between rainfall due to the influence of debris and buildup on the sensor.
- Flow rates at ST20001 ranged from 10 GPM to approximately 4,000 GPM during rain events. Flow rate readings at ST20001 were interrupted starting in mid-July and ceased by September. Field reconnaissance reported that there was beaver activity in the area and the cord to the sensor had been chewed through.
- Flow rates at ST16002 ranged from approximately 15 GPM to 6,000 GPM during rainfall events.

Outfall C1, Outfall C2, and Outfall C3 all had consistent and measurable baseflow of water during the monitoring period between rainfall events as reported from the flow meters and confirmed through field reconnaissance. The consistent baseflow indicates that the storm sewer system is receiving water not just through stormwater collection during precipitation events but also through groundwater infiltration during periods without precipitation. The other monitored outfalls exhibited much lower discharge between and after rain events. Field reconnaissance indicated that these other outfalls discharge to standing water in either infiltration basins or poorly drained areas. At outfall ST20001, beaver activity was confirmed during field activities, where the beavers were filling the outfall with mud and woody debris.

Potential Areas of Infiltration

Areas where the infiltration of shallow groundwater may be occurring were evaluated. Elevation of the storm sewer inverts reported from historic record drawings were compared to modeled groundwater elevations across Loring. The groundwater flow model was created in MODFLOW to support the PFAS RI, with details provided in **Section 4.11** and Appendix O. The model is calibrated to the average water level elevations from semi-annual synoptic water level gauging events completed between 2022 and 2024. This modeled surface represents an average of the recorded seasonal high and seasonal low water table. The distance of the storm sewer invert below the water table was calculated at each manhole where the invert elevation is reported in historical record drawings. This was completed by subtracting the elevation of the reported storm sewer inverted elevations from the modeled water table elevation. The elevations of the inverts and modeled water table elevations are included in Figure I-1.

Areas where the storm sewer is submerged below the water table are highlighted on the figure in the "Storm Sewer Invert Distance Below Water Table" layer. This layer was created using inverse distance weighted interpolation techniques, completed in ArcGIS. These areas are interpreted as having the greatest likelihood of groundwater infiltration into the storm sewer piping. It is interpreted that infiltration outside of these areas is primarily attributed to inflow of precipitation or contributions of groundwater from the underdrains. Isolated perched aquifers may result in groundwater infiltration in portions of the storm sewer system which may exist in areas not highlighted by that layer. Seasonal variation can result in the rising of the water table, which could submerge additional storm water lines, or lowering of the water table, which could result in areas shown as submerged on the figure being above the water table.

Outfalls C1, C2, and C3 have portions of their drainage network submerged below the average water table. The other storm sewer systems monitored by flow meters do not have inverts installed below the average water table. Additional potential sources of infiltration of groundwater could be coming through the underdrain system. C1, C2, and to a lesser extent, C3, have much more extensive underdrain networks than the other outfalls that were monitored. The underdrain networks for these storm sewer collection systems include coverage across areas which historically were identified as wetlands, Figure I-2. These former wetlands are likely to host shallow groundwater, which would then be captured by the underdrain system and discharged to the outfalls.

Outfalls C1, C2, and C3 were found to have been designed to be more conducive to groundwater infiltration and subsequently exhibit the most consistent and highest baseflow discharge of the storm sewer system across the base. These three storm sewers also drain portions of Loring which exhibit elevated concentrations of PFAS associated with source areas identified within their network. Discharge at the other outfalls that were monitored are primarily attributed to stormwater runoff, with identified concentrations of PFAS at the outfalls attributed to the mixing of stormwater discharge with stagnant water in poorly drained areas or infiltration basins which were subject to historical releases of AFFF during site operations.

Modeling of Storm Sewer Discharge Values Through RI **Investigation Perio**d

Portions of the measurements for the outfall readings for C1, C2, and C3 are incomplete and can report wide variation in successive readings. These conditions result in uncertainty regarding estimates of flow throughout the monitoring period.

Reducing the noise and filling in the gaps of the data to allow for the calculation of estimates of flow through the RI period was completed by plotting the discharge readings against coincident readings reported on 15-minute intervals from the downstream United States Geological Survey (USGS) stream gauge on the Little Madawaska River, number 01017290. Using the equations detailed on Figures I-11 through I-13, corrected discharge values for C1, C2, and C3 were calculated. The calculated values are shown compared to the raw data on Figures I-4 through I-6, and in comparison, to the readings reported at the Little Madawaska River, on Figure I-14. Discharge readings of 0.000 GPM were not included in the evaluation. For C1 and C2 a simple relationship where the line of best fit was matched between the reported readings at the outfall and the stream gauge readings. For C3, it was identified that readings below approximately 100 GPM were not reported, which is inconsistent with field reconnaissance and the expected behavior of the outfall based on the reported readings from the other outfalls. C3 drains a portion of the base with relatively higher concentrations of legacy contaminants, including VOCs. This legacy contamination results in highly reducing conditions, leading to more significant iron floc buildup at the outfall, which likely obscured the flow meter readings during lower flow conditions. The relationship identified used an iterative approach to respect those missing baseflow values and match the higher flows reported. As shown on Figures I-4 through I-6, and I-11 through I-13, the calculated discharge does vary from the reported readings, with portions of the calculated values being lower or higher than the reported readings, for each of the outfalls. The calculated readings are estimates that facilitate further evaluation of the dataset.

Mass Flux of PFAS Evaluation at C1, C2, and C3

The calculated discharge readings allow for further evaluation of the reported discharge, facilitating mass flux estimates over the investigation period. Using the relationships identified between the outfall discharge measurements and the reported readings on the Little Madawaska River, discharge measurements can be calculated through the extent of the RI. These calculated discharge measurements were then compared to PFAS analytical data from sampling events going back to 2022, Figure I-13. Plots comparing the reported PFAS concentration to the calculated discharge are presented in Figure I-15 through I-17. As shown, the concentration of PFAS decreases with increased flow rate. This relationship is strongest in C1 and C2 and weakest in C3. This is likely due to the increased uncertainty due to the lack of reported readings below 100 GPM at C3, ultimately tied to water quality within that storm sewer system. C3 also exhibits the highest concentrations of PFAS throughout the storm sewer network as it drains the area around the Crash Fire Station, which is one of the primary source areas. Due to its location near a PFAS source area which overlaps with legacy impacts, there is greater uncertainty regarding the estimates of the calculated values as compared to C1 and C2.

By developing this relationship between PFAS concentration and discharge, predicted PFAS concentrations can be developed throughout the investigation for each calculated discharge value. The mass flux at each of the measurements can be calculated by completing the appropriate unit conversions, then multiplying the estimated discharge rate by the estimated concentration. The total PFAS mass removed from the system was then calculated by multiplying the mass flux for each reading by the total time of discharge.

Figures I-18 through I-20 illustrate the calculated discharge, the calculated PFAS concentration, and the cumulative mass of PFAS discharged from each of the stormwater outfalls. The plots illustrate that as discharge increases, PFAS concentration decreases, however mass transport of PFAS is increased during higher discharge periods for C1, C2, and C3.

A second analysis to estimate mass flux from the storm sewer system was completed as reported in Table I-1. For this analysis, average PFOA and PFOS concentrations from outfall sampling were compared to the average measured outfall measurements from the flow meters at C1, C2, and C3 between June and October of 2024. The average concentration reported for stormwater samples was multiplied by the average discharge, to determine the average mass flux, in nanograms and grams per minute. This value was then multiplied by the total amount of time that had passed between when the flow meters were deployed on June 6th through October 31st, 2024, for each outfall. This mass was summed and compared to the results of the estimated mass discharge from the more detailed mass flux evaluation as described above for the same time period. The total mass discharged over this period ranged between an estimated value of 35 grams of PFOA and PFOS from the detailed evaluation to 34 grams discharged over the same period, using the average values.

Comparison of Mass Flux of PFAS Impacts from Stormwater Outfalls to Groundwater Discharge

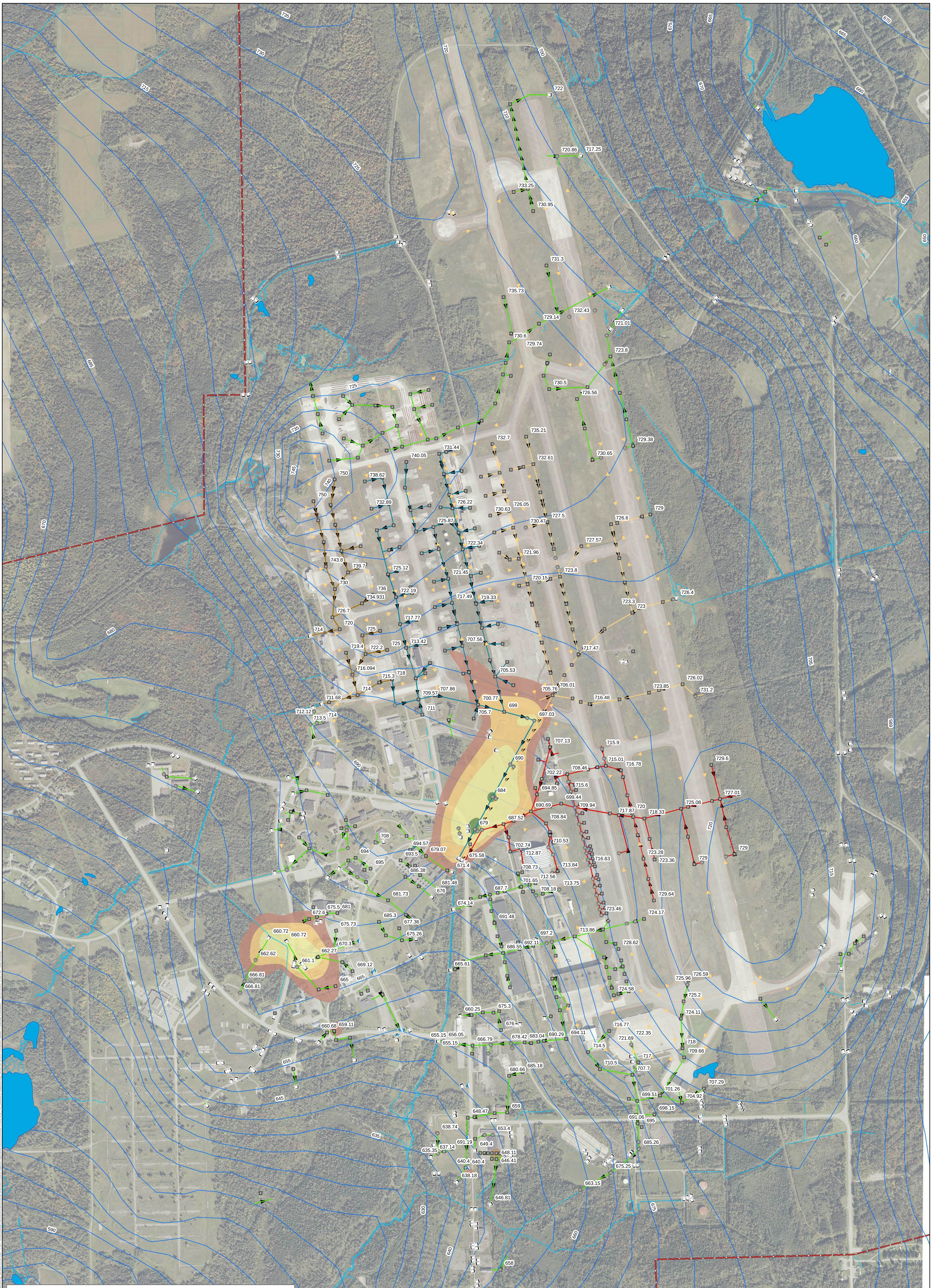
An evaluation of the relative contribution of PFOA and PFOS from the C1, C2, and C3 outfalls to the local surface water bodies was completed, as reported in Table I-2. For this evaluation, average discharge readings collected from stream gauges along Greenlaw Brook and the East Branch of Greenlaw Brook were calculated, as reported in Appendix E. Stream gauge locations are shown on Figure 4-21. This average flow rate was multiplied by the average concentration of surface water samples collected in the vicinity of those stream gauges during field events from 2022 through 2024. Average mass flux estimates of PFOA and PFOS at those stream gauges were then compared to the average mass flux from the outfall measurements at C1, C2, and C3. It was identified that roughly 60-70% of the mass flux of PFOS and PFOA along the FLDD and downstream along the upper portions of the East Branch of Greenlaw Brook is attributed to stormwater discharge from C1, C2, and C3 during the summer months. This suggests that groundwater discharge is largely responsible for the other 30-40% of mass loading of PFOA and PFOS along this portion of the brook. This relative proportion decreases to roughly 40% further downstream along the East Branch of Greenlaw Brook and is reduced to roughly 25% of the mass flux along Greenlaw Brook past the confluence of the East and West Branches of the Brook.

Conclusions

Groundwater infiltration is responsible for a portion of the flow through the storm sewer collection system that discharges to the FLDD at the C1, C2, and C3 outfalls. Other outfalls that were monitored have a much lower potential for groundwater infiltration and subsequent discharge. PFAS impacts identified at stormwater outfalls ST12001, ST11001, ST16002, and ST20001 are attributed to the retention of historic AFFF releases which were flushed through the storm sewer system. These residual impacts are present in the sediment at these outfalls. The outfalls discharge to poorly drained areas with standing water. The standing water at these outfalls mixes with the stormwater discharge, resulting in the concentrations identified in samples collected at the outfalls.

A portion of the PFAS concentrations identified in the surface water are attributed to transport from PFAS source areas identified during the Remedial Investigation at Loring. Mass flux estimates were used to generate estimates of mass removal of PFAS attributed to the storm sewer. Estimates of the relative contribution of PFAS mass attributed to the storm sewer compared to the discharge of impacted groundwater to Greenlaw Brook was completed. These estimates indicate that a total of roughly 100 grams of PFOA and PFOS have been discharged from storm sewer outfalls C1, C2, and C3 between June 2022 and November 2024. This mass discharged from the storm sewer system to the FLDD is estimated to be roughly 60% of the total mass identified in the FLDD and contributes roughly 25% of the mass of PFOA and PFOS downstream of the LDA wastewater treatment plant along Greenlaw Brook.

FIGURES



NOTES:

- Storm Sewer invert elevations at manholes and collection network were obtained from historical site utility record drawings.
- Modeled groundwater contours represent the water table generated from a modflow groundwater flow model generated by WSP for the Loring PFAS Remedial Investigation (RI) Summary Report, in progress.
- The modeled water table is calibrated to the average water level elevation from semi-annual synoptic water level gauging events between 2022 and 2024, and represents an average of the recorded seasonal high and seasonal low water levels.
- The distance of the storm sewer invert below the water table was calculated at each manhole where the invert elevation is reported in historical record drawings. This was completed by subtracting the elevation of the reported storm sewer invert elevations from the modeled water table elevations.
- This distance is highlighted on this figure in the "Storm Sewer Invert Distance Below Water Table" layer, which was developed using inverse distance weighted interpolation techniques on the calculated distance. Only portions of this interpolated layer that show where the infrastructure is below the water table, are displayed on this layer.

Elevations reported compared to the North American Vertical Datum 1988

SYMBOL KEY

Former Installation Boundary
Stream
Surface Water Body
Modeled Water Table
640 Water Level Elevation

Storm Sewer Features:
Catch Basin
Culvert
Inlet
Manhole
638.18 Invert elevation at manhole

Storm Sewer Lines:
Nose Dock Area-FLDD-C1
Northern Runway-FLDD-C2
Southern Runway-FLDD-C3
Nose Dock 40/44
Other Storm Sewer Drainage
Underdrain Network
Arrows indicate flow direction

Storm Sewer Invert Distance Below Water Table
>10 feet
5-10 feet
2.5-5 feet
0-2.5 feet
Above Water Table

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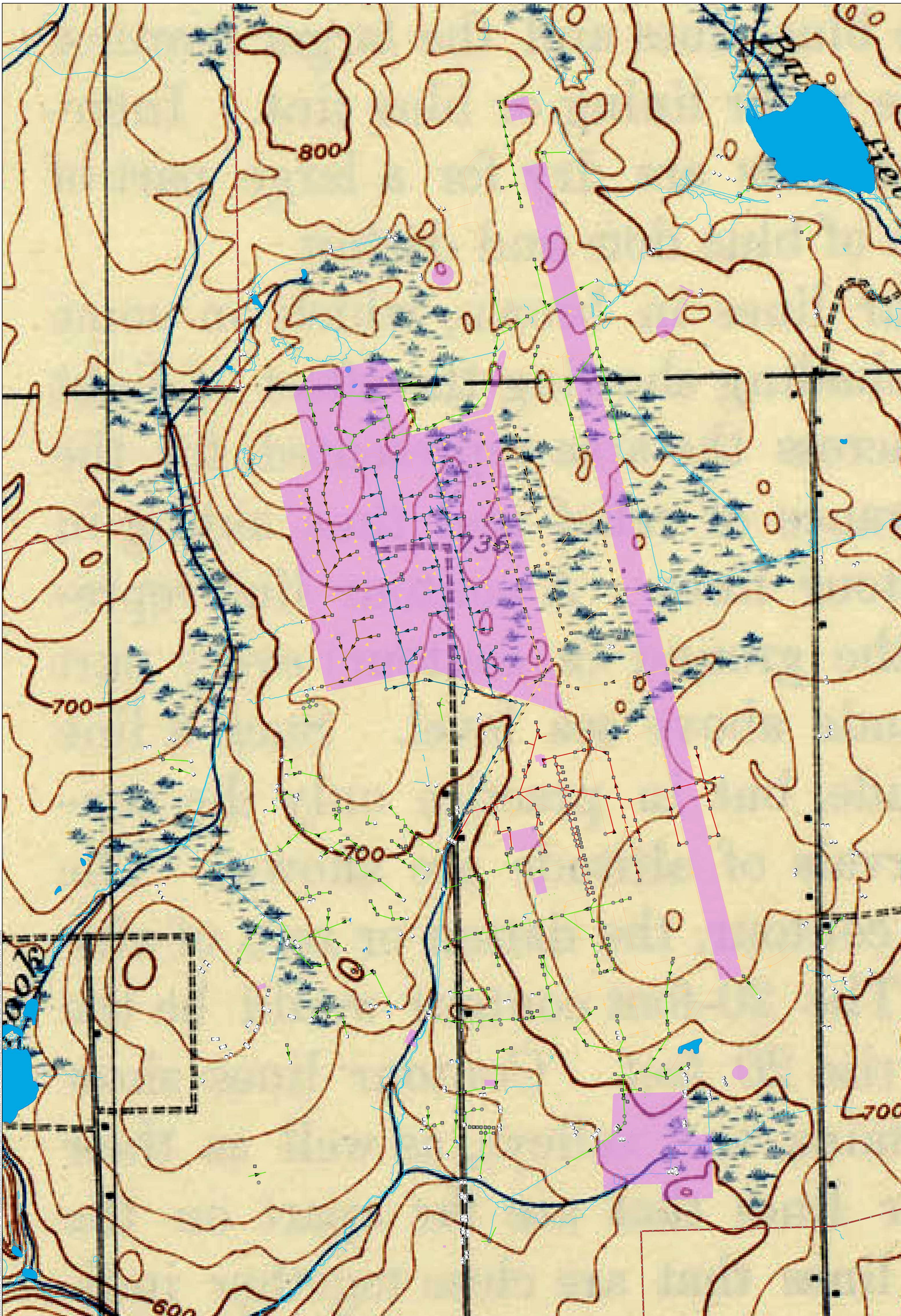
Figure I-1
Storm Sewer Potential Infiltration

PFAS CERCLA Remedial Investigation Site Characterization Summary Report
Former Loring Air Force Base, Limestone, ME

0 75 150 300 450 600 750 Meters
0 300 600 1,200 1,800 2,400 Feet

SOURCES:
Aerial Imagery obtained from NAIP, USDA-FSA. Published September, 2021.

Drawn: RJO	Drawn Date: 10/1/2025	PROJ: 775361701
Checked: LP	Check Date: 10/2/2025	



NOTES:
- Storm Sewer collection network were obtained from historical site utility record drawings.
- 1930 Historic United States Geologic Survey Topographic Map downloaded from the National Geologic Map Database and was georeferenced to current site features.

SYMBOL KEY

Potential Aqueous Film Forming Foam Release Area
Former Installation Boundary
Stream
Surface Water Body

Storm Sewer Features:
Catch Basin
Culvert
Inlet
Manhole

Storm Sewer Lines:
Nose Dock Area-FLDD-C1
Northern Runway-FLDD-C2
Southern Runway-FLDD-C3
Nose Dock 40/44
Other Storm Sewer Drainage
Underdrain Network
Arrows indicate flow direction

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0 75 150 300 Meters
0 300 600 1,200 Feet

Figure I-3
Historical Topographic Contours and Storm Sewer Collection System
PFAS CERCLA Remedial Investigation Site Characterization Summary Report
Former Loring Air Force Base, Limestone, ME

NOTES:
Aerial Imagery obtained from NAIP, USDA-FSA. Published September, 2021.

Drawn By: RJO	Drawn Date: 10/1/2025	PROJ: 775361701
Check By: LP	Check Date: 10/6/2025	

NOTE:
- Storm sewer infrastructure shown is based on available historical documentation.
- Storm Sewer outfall discharge measurements collected using mantaray flow meters.
- Precipitation measurements were downloaded from the National Oceanic and Atmospheric Administration Climate Data Online tool for the Limestone Maine weather station.

SYMBOL KEY

- Surface Water Body
- Former Installation Boundary
- Stream
- Potential Aqueous Film Forming Foam Release Area

Storm Sewer:
- Nose Dock Area-FLDD-C1
- Northern Runway-FLDD-C2
- Southern Runway-FLDD-C3
- Nose Dock 40/44
- Other Storm Sewer Drainage
- Underdrain Network

- Catch Basin
- Manhole
- Culvert
- Inlet

Note:
- FLDD = Flightline Drainage Ditch
- Arrows indicate flow direction

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0 75 150 300 Meters
0 300 600 1,200 Feet

Figure I-3
Storm Sewer Outfall Discharge Measurements
PFAS CERCLA Remedial Investigation Site Characterization Summary Report
Former Loring Air Force Base, Limestone, ME

NOTES:
Aerial Imagery obtained from NAIP, USDA-FSA. Published September, 2021.

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Drawn: LP	Checked Date: 10/1/2025	

Figure I-4

Storm Sewer Discharge Readings and Calculated Discharge- C-1

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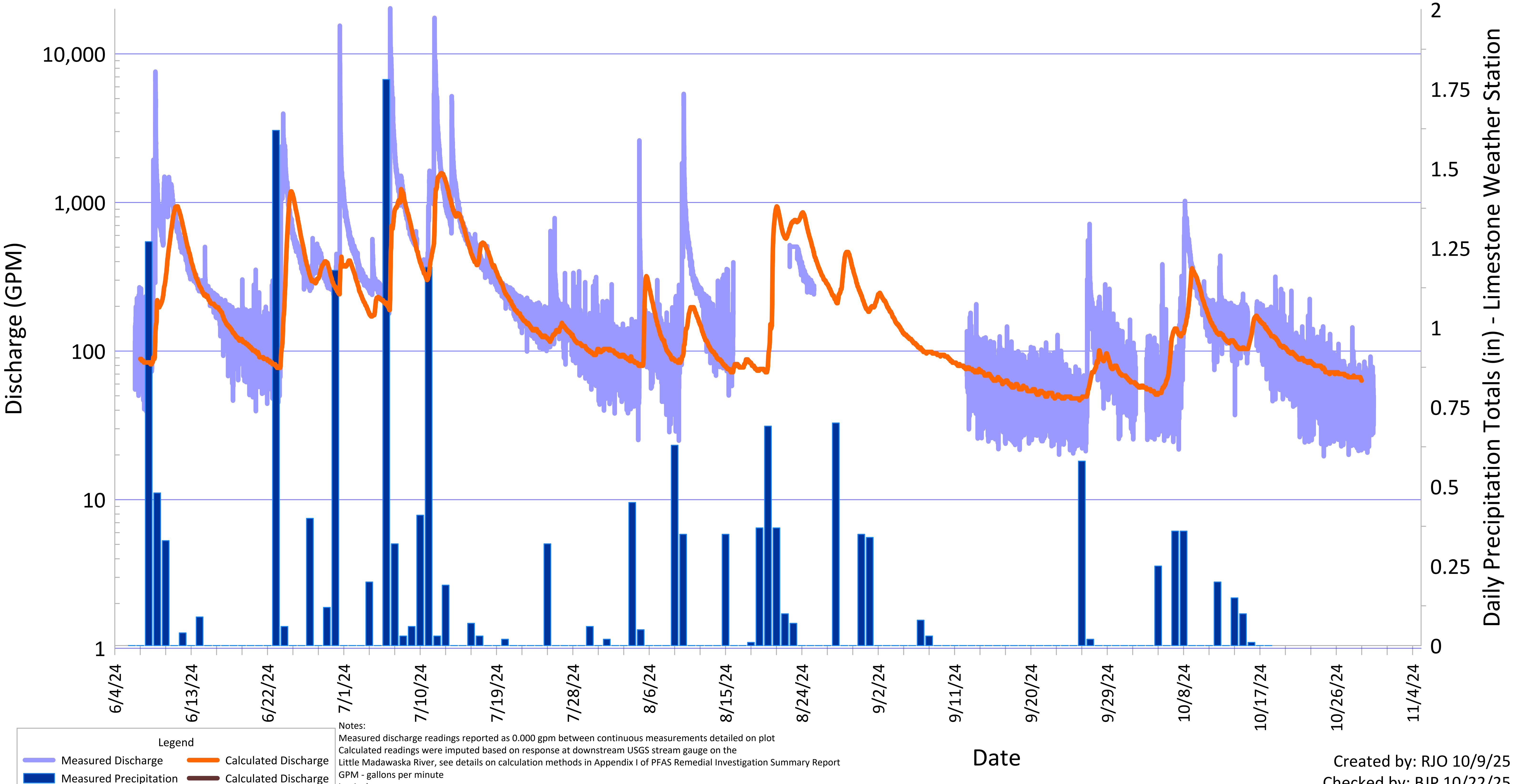
Limestone, ME



Notes:
Measured discharge readings reported as 0.000 gpm between continuous measurements detailed on plot
Calculated readings were imputed based on response at downstream USGS stream gauge on the Little Madawaska River, see details on calculation methods in Appendix I of PFAS Remedial Investigation Summary Report
GPM - gallons per minute
in - inches

Created by: RJO 10/9/25
Checked by: BJP 10/22/25

Figure I-5

Storm Sewer Discharge Readings and Calculated Discharge- C-2

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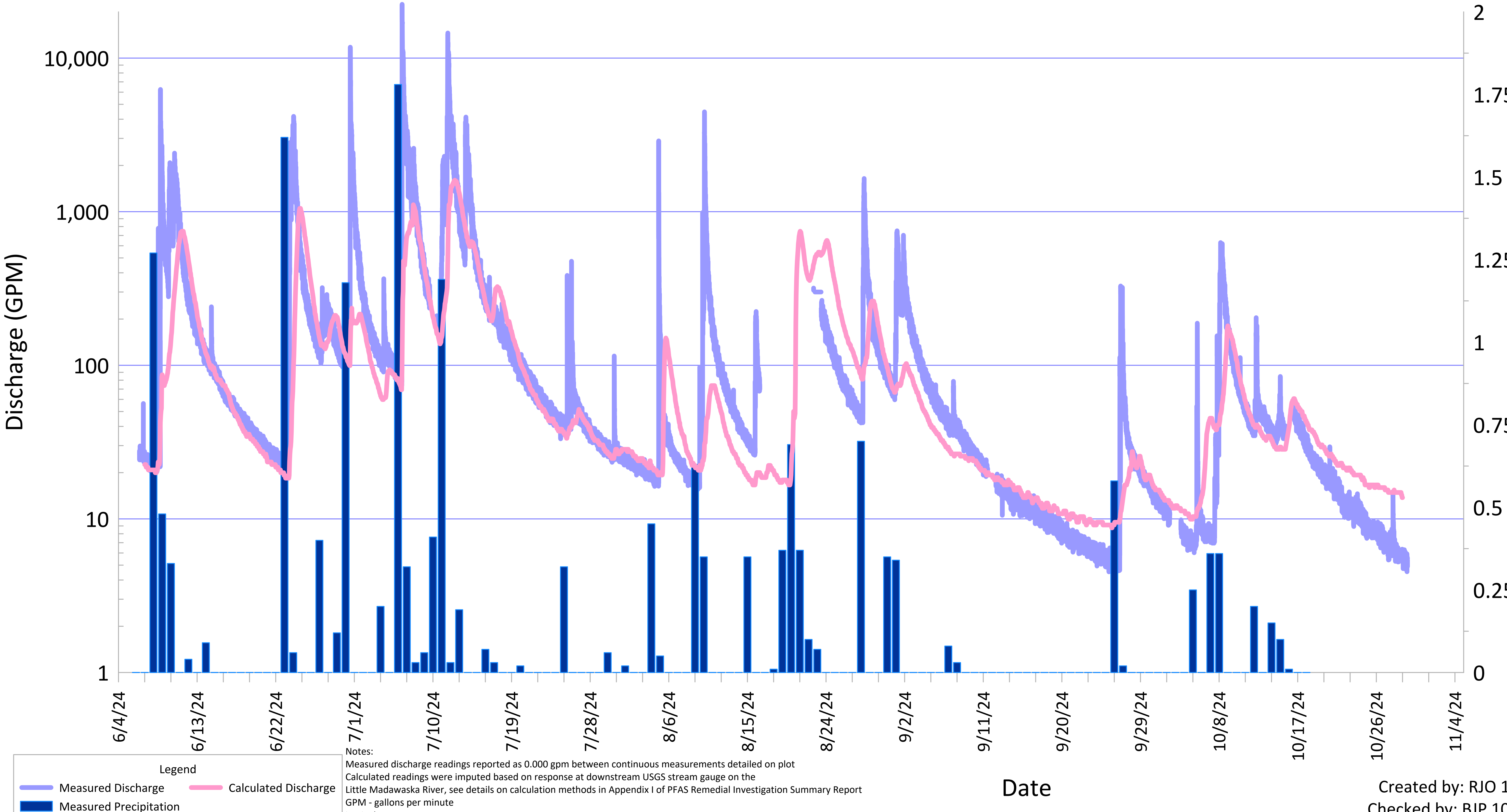

Notes:
Measured discharge readings reported as 0.000 gpm between continuous measurements detailed on plot
Calculated readings were imputed based on response at downstream USGS stream gauge on the Little Madawaska River, see details on calculation methods in Appendix I of PFAS Remedial Investigation Summary Report
GPM - gallons per minute
in - inches

Created by: RJO 10/9/25
Checked by: BJP 10/21/25

Figure I-6

Storm Sewer Discharge Readings and Calculated Discharge- C-3

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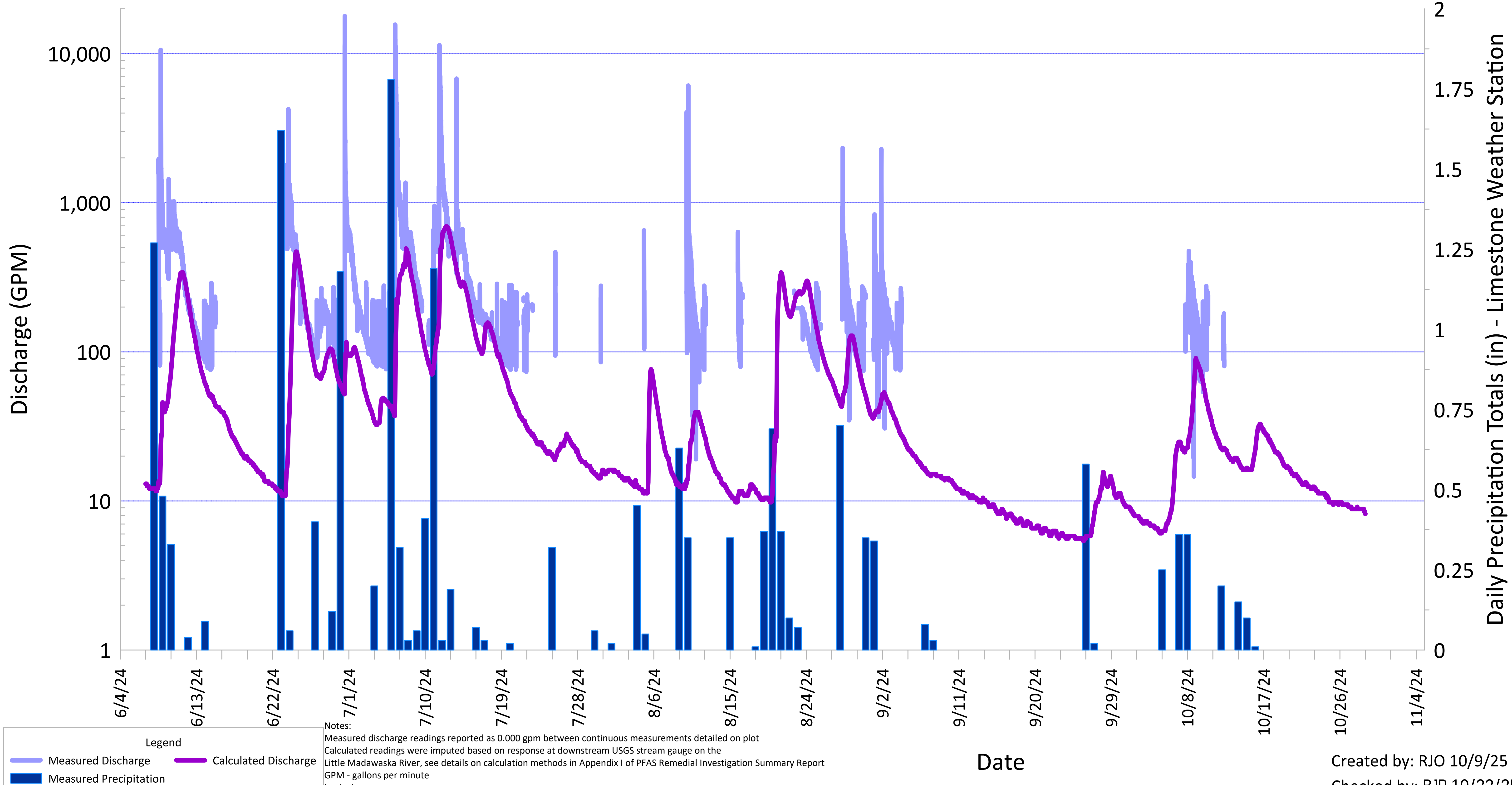
Limestone, ME



Notes:
Measured discharge readings reported as 0.000 gpm between continuous measurements detailed on plot
Calculated readings were imputed based on response at downstream USGS stream gauge on the
Little Madawaska River, see details on calculation methods in Appendix I of PFAS Remedial Investigation Summary Report
GPM - gallons per minute
in - inches

Created by: RJO 10/9/25
Checked by: BJP 10/22/25

Figure I-7

Storm Drain Discharge Readings - ST12001

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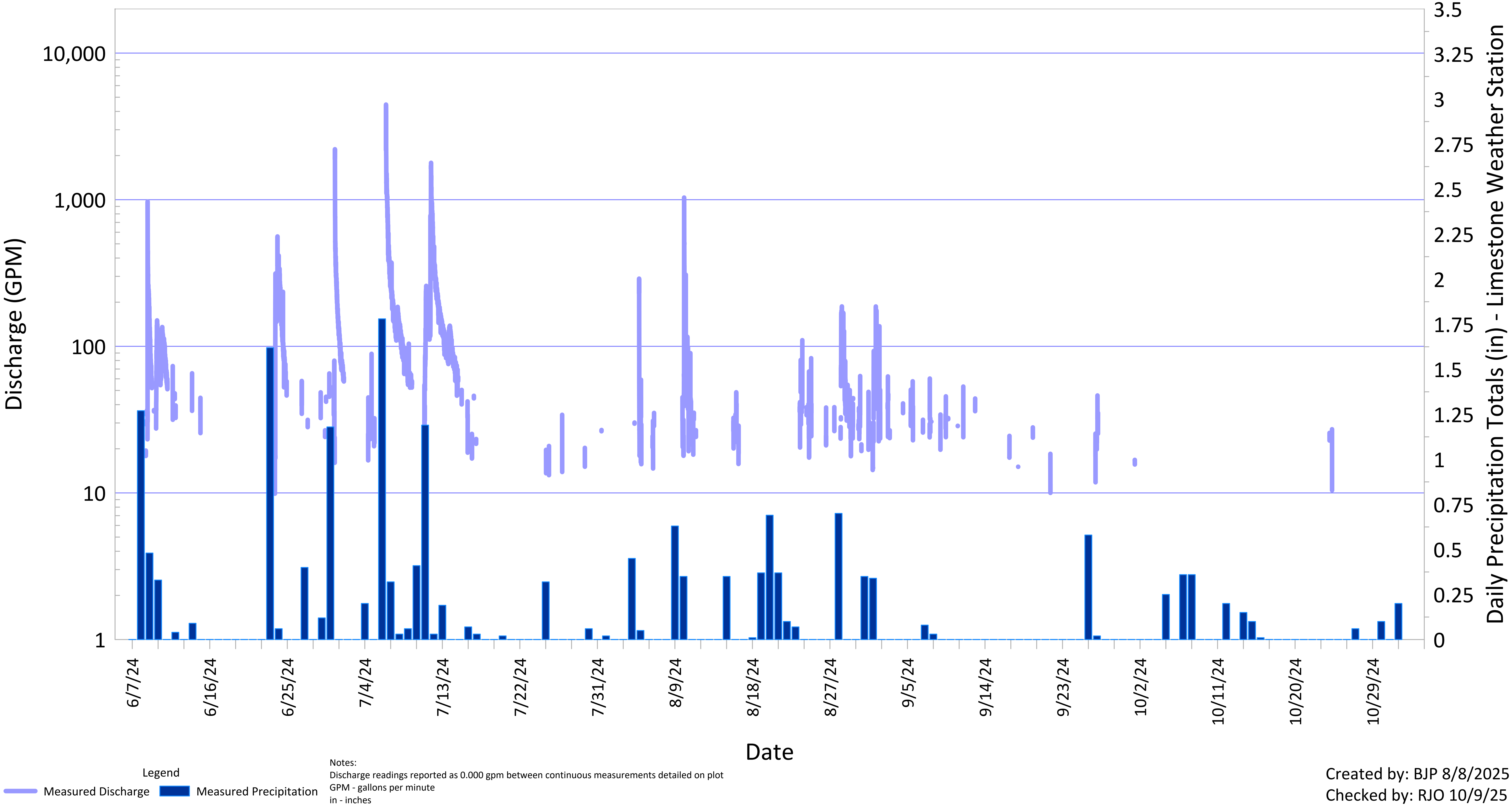
Limestone, ME



Notes:
Discharge readings reported as 0.000 gpm between continuous measurements detailed on plot
GPM - gallons per minute
in - inches

Created by: BJP 8/8/2025
Checked by: RJO 10/9/25

Figure I-8

Storm Sewer Discharge Readings - ST16002

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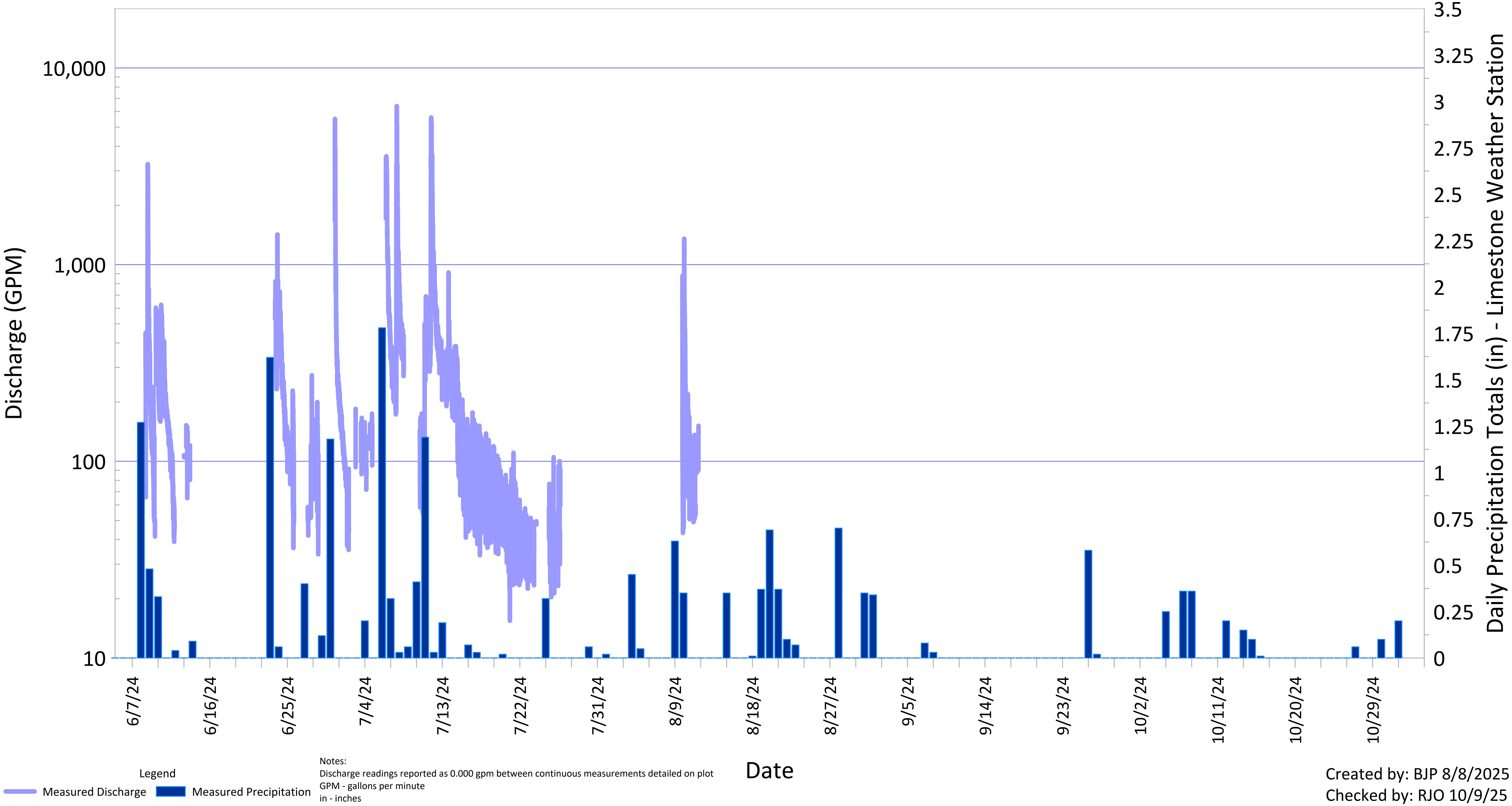

Notes:
Discharge readings reported as 0.000 gpm between continuous measurements detailed on plot
GPM - gallons per minute
in - inches

Created by: BJP 8/8/2025
Checked by: RJO 10/9/25

Figure I-9

Storm Sewer Discharge Readings - ST20001

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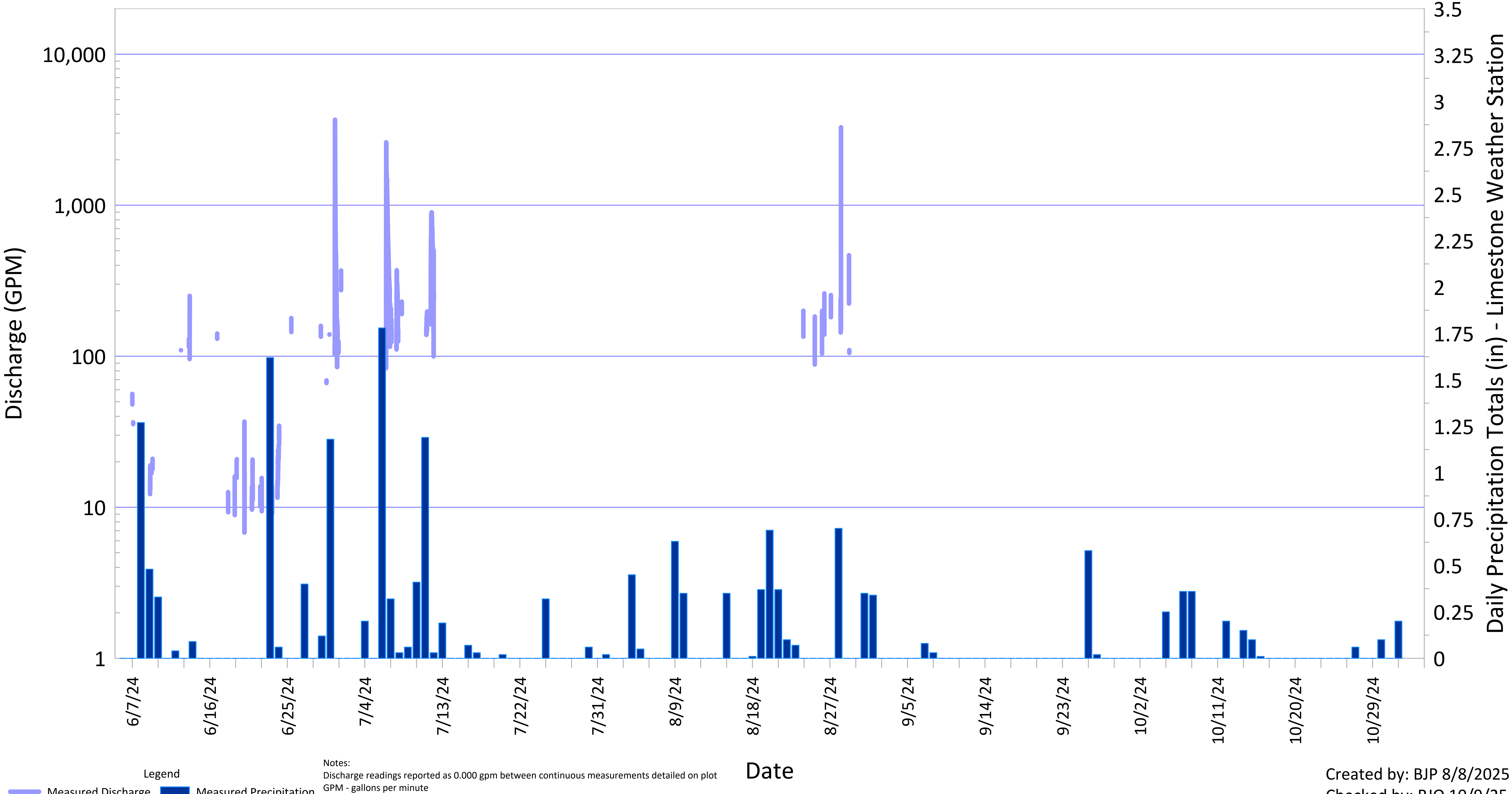
Former Loring Air Force Base
Limestone, ME



Notes:
Discharge readings reported as 0.000 gpm between continuous measurements detailed on plot
GPM - gallons per minute
in - inches

Created by: BJP 8/8/2025
Checked by: RJO 10/9/25

SYMBOL KEY

Storm Sewer:
- Nose Dock Area-FLDD-C1
- Northern Runway-FLDD-C2
- Southern Runway-FLDD-C3
- Nose Dock 40/44
- Other Storm Sewer Drainage
- Underdrain Network
- Catch Basin
- Manhole
- Culvert
- Inlet
- Storm Sewer Sample Location
- Stream
- Surface Water Body
- Potential Aqueous Film Forming Foam Release Area
- Former Installation Boundary

Note: Arrows indicate flow direction

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Figure I-10
Storm Sewer PFAS Radar Plots

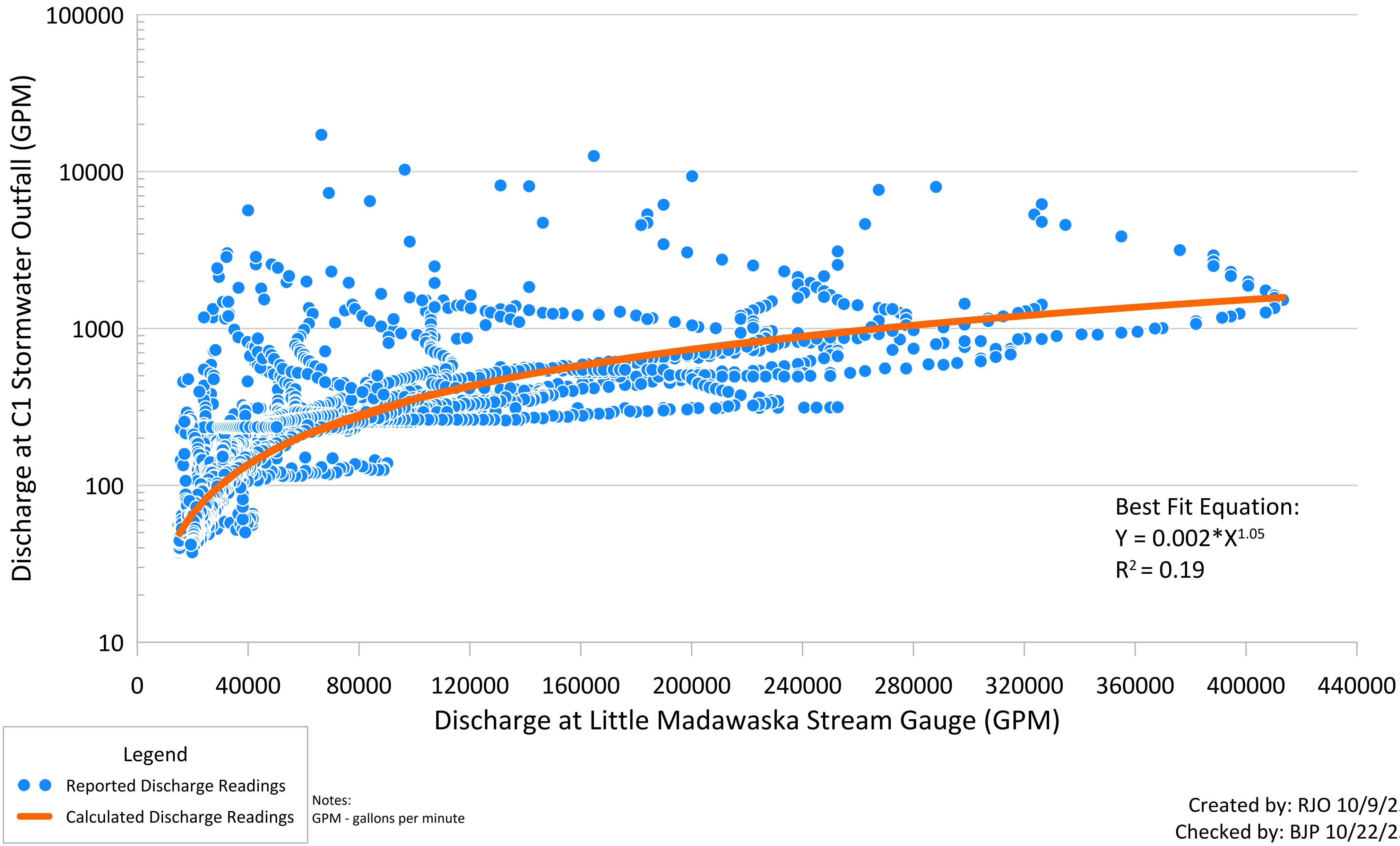
PFAS CECRLA Remedial Investigation Site Characterization Summary Report
Former Loring Air Force Base, Limestone, ME

SOURCES:
- Aerial Imagery obtained from NAIP, USDA-FSA. Published September, 2021.
- Storm sewer infrastructure shown is based on available historical documentation and may reflect inaccuracies.

Drawn: RJO	Checked: LP	PROJ: 775361701
Drawn Date: 8/14/2025	Checked Date: 9/26/2025	

Figure I-11
Discharge Readings at Little Madawaska US Geological Survey Stream Gauge (01017290) Compared to Reported Discharge at C1 Outfall

PFAS CERCLA Remedial Investigation Site Characterization Summary Report
Former Loring Air Force Base
Limestone, ME



Notes:
GPM - gallons per minute

Created by: RJO 10/9/25
Checked by: BJP 10/22/25

Figure I-12

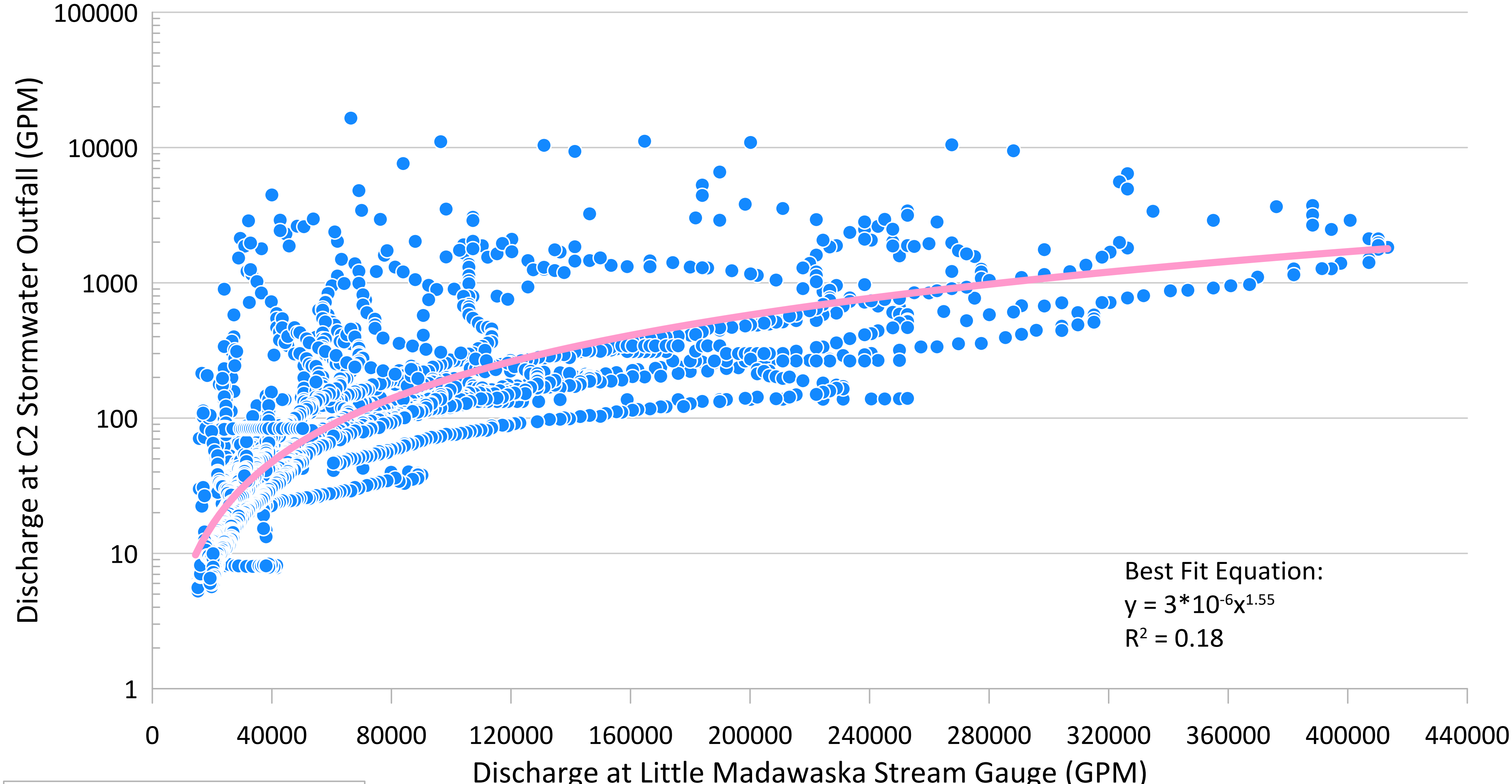
Discharge Readings at Little Madawaska US Geological Survey Stream Gauge (01017290)

Compared to Reported Discharge at C2 Outfall

PFAS CERCLA Remedial Investigation Site Characterization Summary Report

Former Loring Air Force Base

Limestone, ME



Legend

Reported Discharge Readings

Calculated Discharge Readings

Notes:

GPM - gallons per minute

Created by: RJO 10/9/25

Checked by: BJP 10/21/25

Figure I-13
Discharge Readings at Little Madawaska US Geological Survey Stream Gauge (01017290) Compared to Reported Discharge at C3 Outfall

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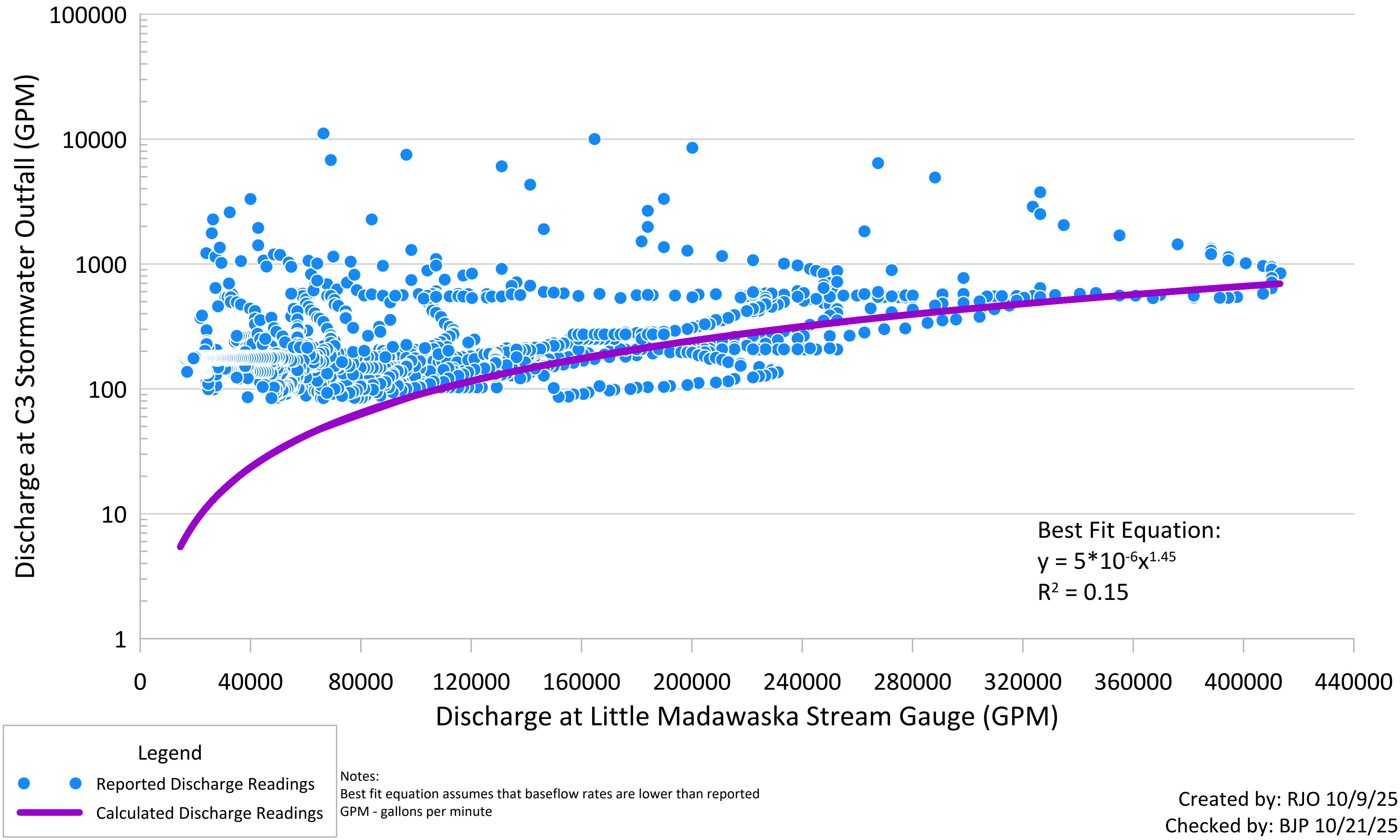
Former Loring Air Force Base
Limestone, ME



Notes:
Best fit equation assumes that baseflow rates are lower than reported
GPM - gallons per minute

Created by: RJO 10/9/25
Checked by: BJP 10/21/25

Figure I-14
Discharge Readings at Little Madawaska US Geological Survey Stream Gauge (01017290) and Calculated Discharge at Storm Sewer Outfalls C1, C2, and C3

PFAS CERCLA Remedial Investigation Site Characterization Summary Report

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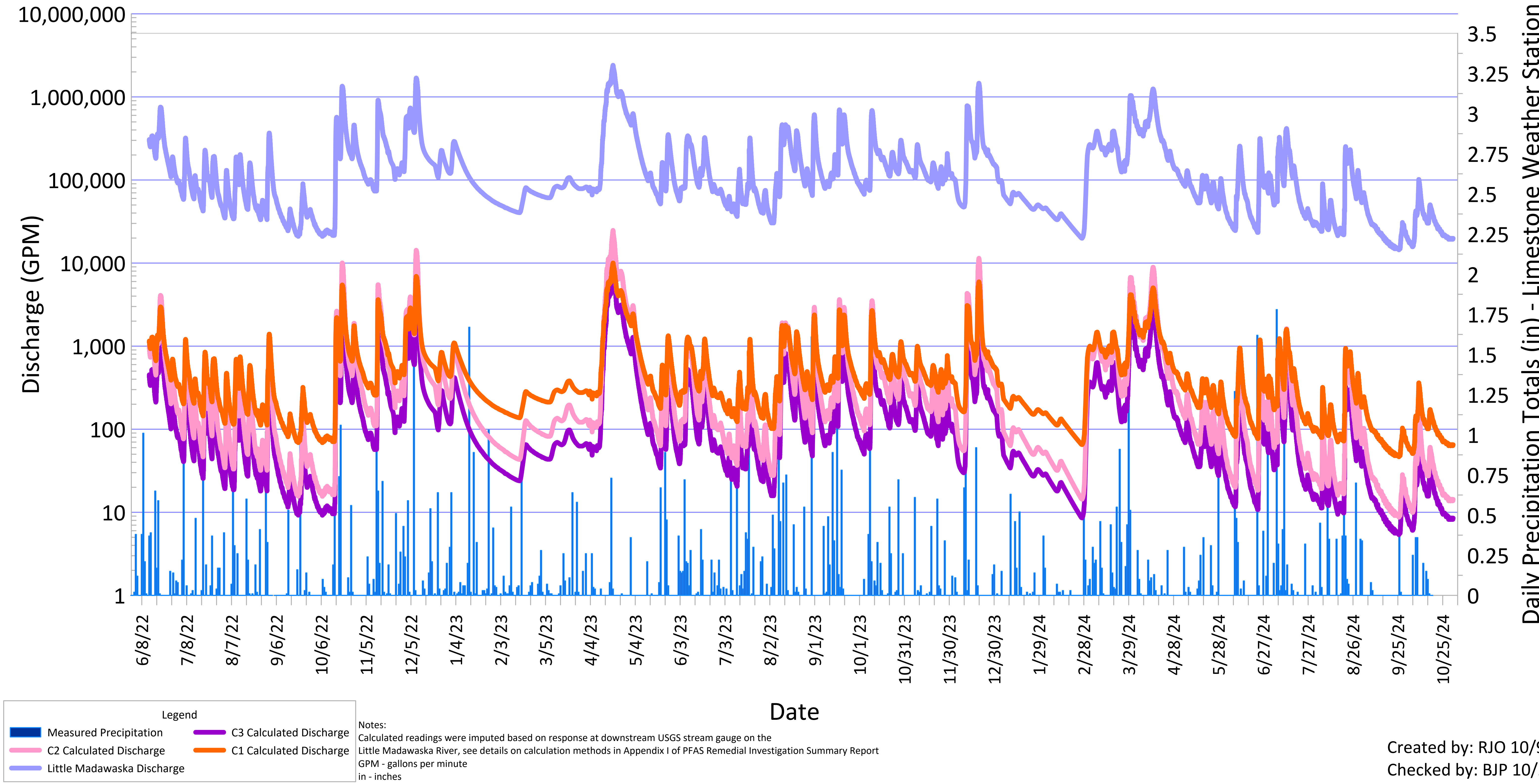

Notes:
Calculated readings were imputed based on response at downstream USGS stream gauge on the Little Madawaska River, see details on calculation methods in Appendix I of PFAS Remedial Investigation Summary Report
GPM - gallons per minute
in - inches

Created by: RJO 10/9/25
Checked by: BJP 10/22/25

Figure I-15

Calculated Discharge Compared to PFOS and PFOA Concentrations - C1

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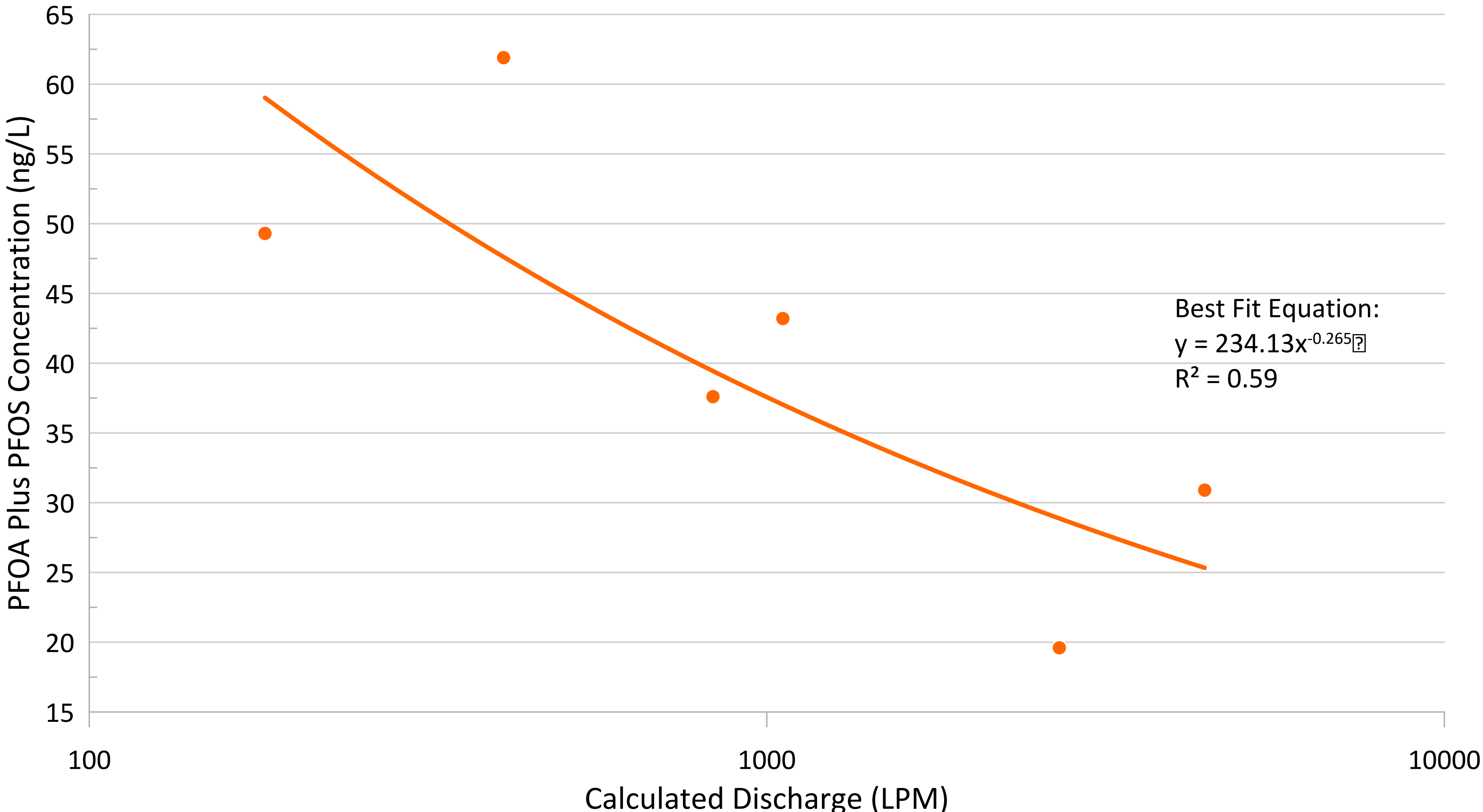

Legend

- C1 PFAS Concentrations vs Discharge
- Power Fit - C1 PFAS Concentrations vs Discharge

Notes:
LPM - Liters per minute
ng/L - nanograms per liter

Created by: RJO 10/10/25
Checked by: BJP 10/21/25

Figure I-16
Calculated Discharge Compared to PFOS and PFOA Concentrations - C2
PFAS CERCLA Remedial Investigation Site Characterization Summary Report
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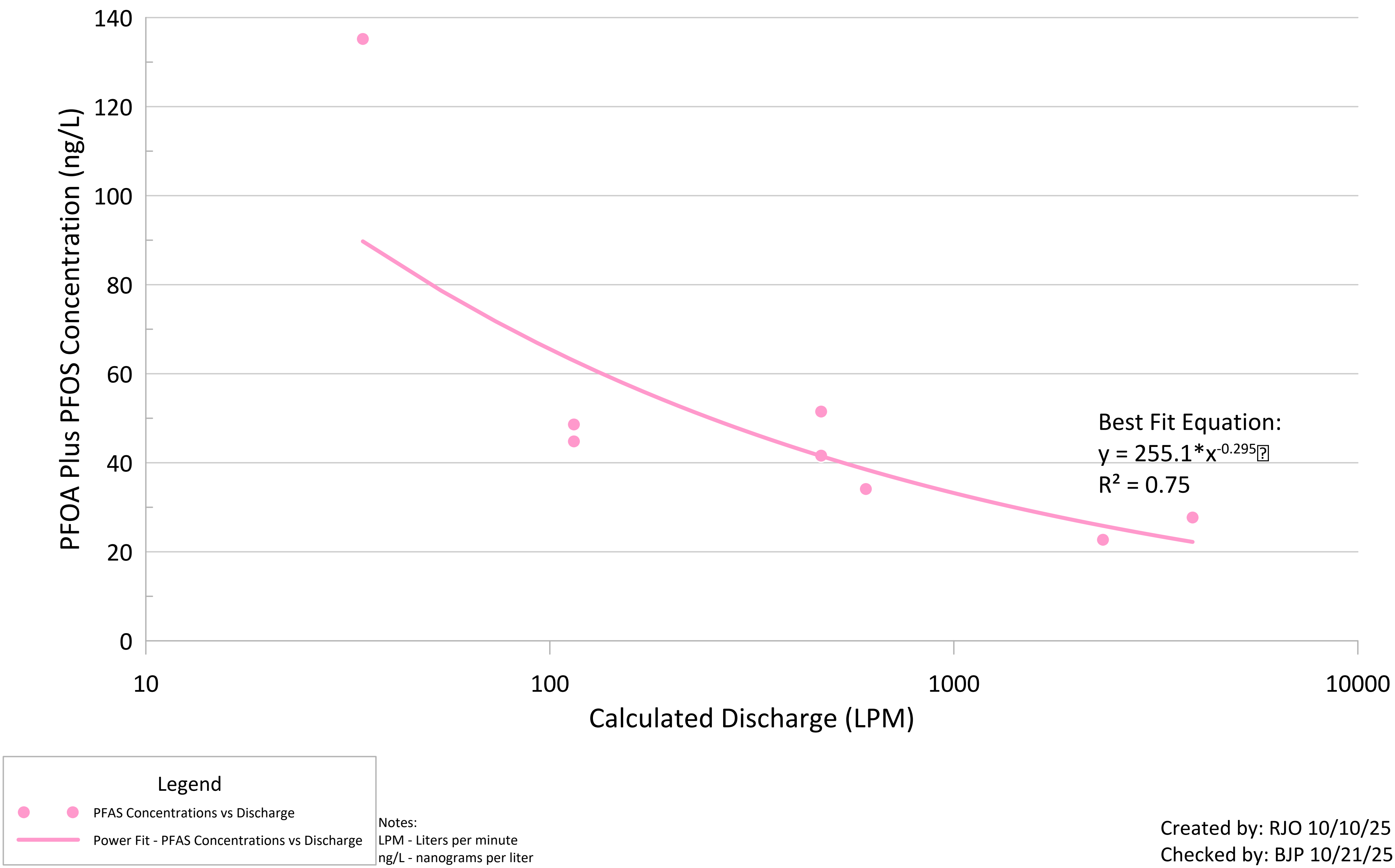
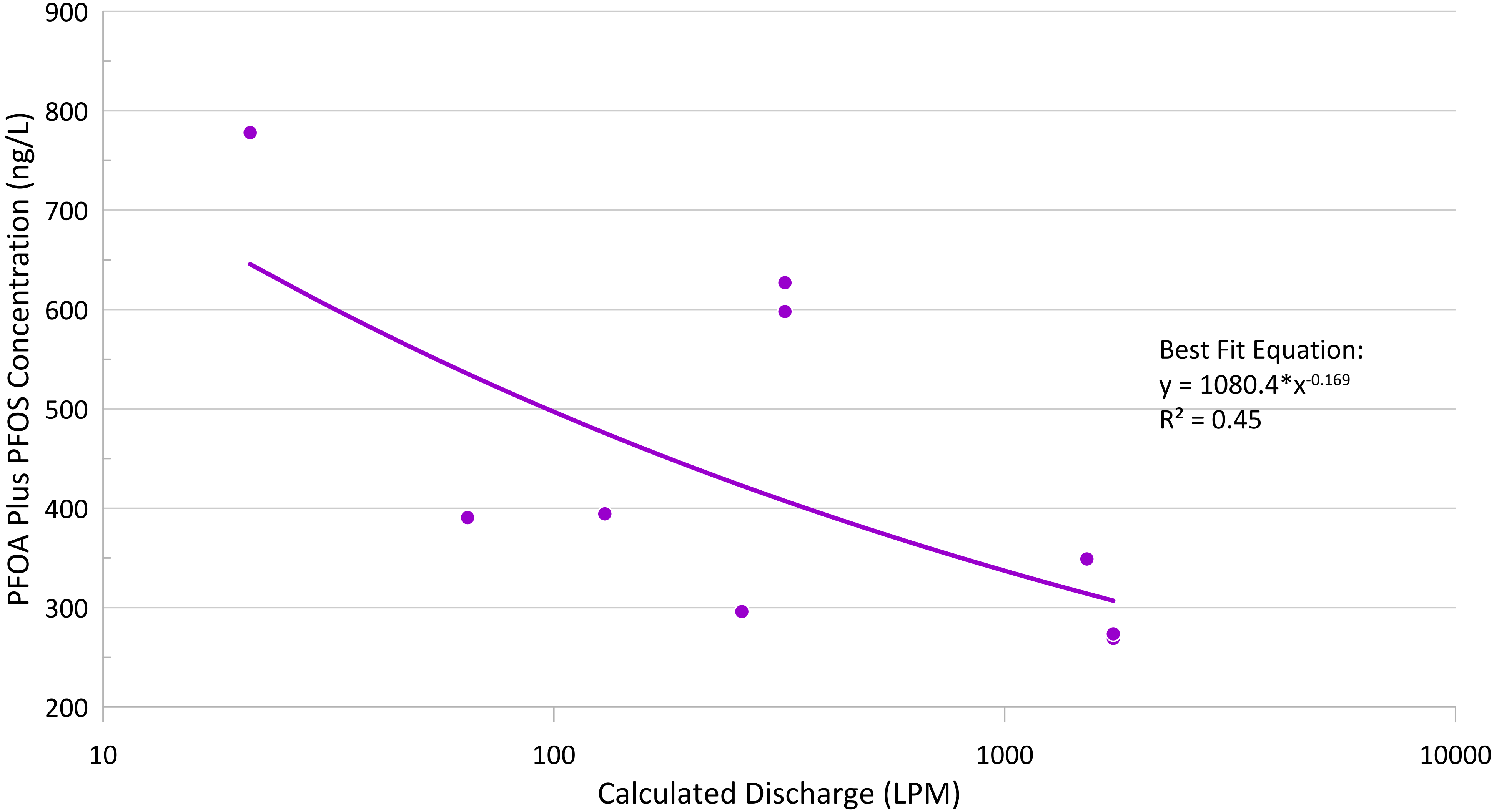
Limestone, ME



Notes:
LPM - Liters per minute
ng/L - nanograms per liter

Created by: RJO 10/10/25
Checked by: BJP 10/21/25

Figure I-17
Calculated Discharge Compared to PFOS and PFOA Concentrations - C3
PFAS CERCLA Remedial Investigation Site Characterization Summary Report
Former Loring Air Force Base
Limestone, ME



Legend
- PFAS Concentrations vs Discharge
- Power Fit - PFAS Concentrations vs Discharge

Notes:
LPM - Liters per minute
ng/L - nanograms per liter

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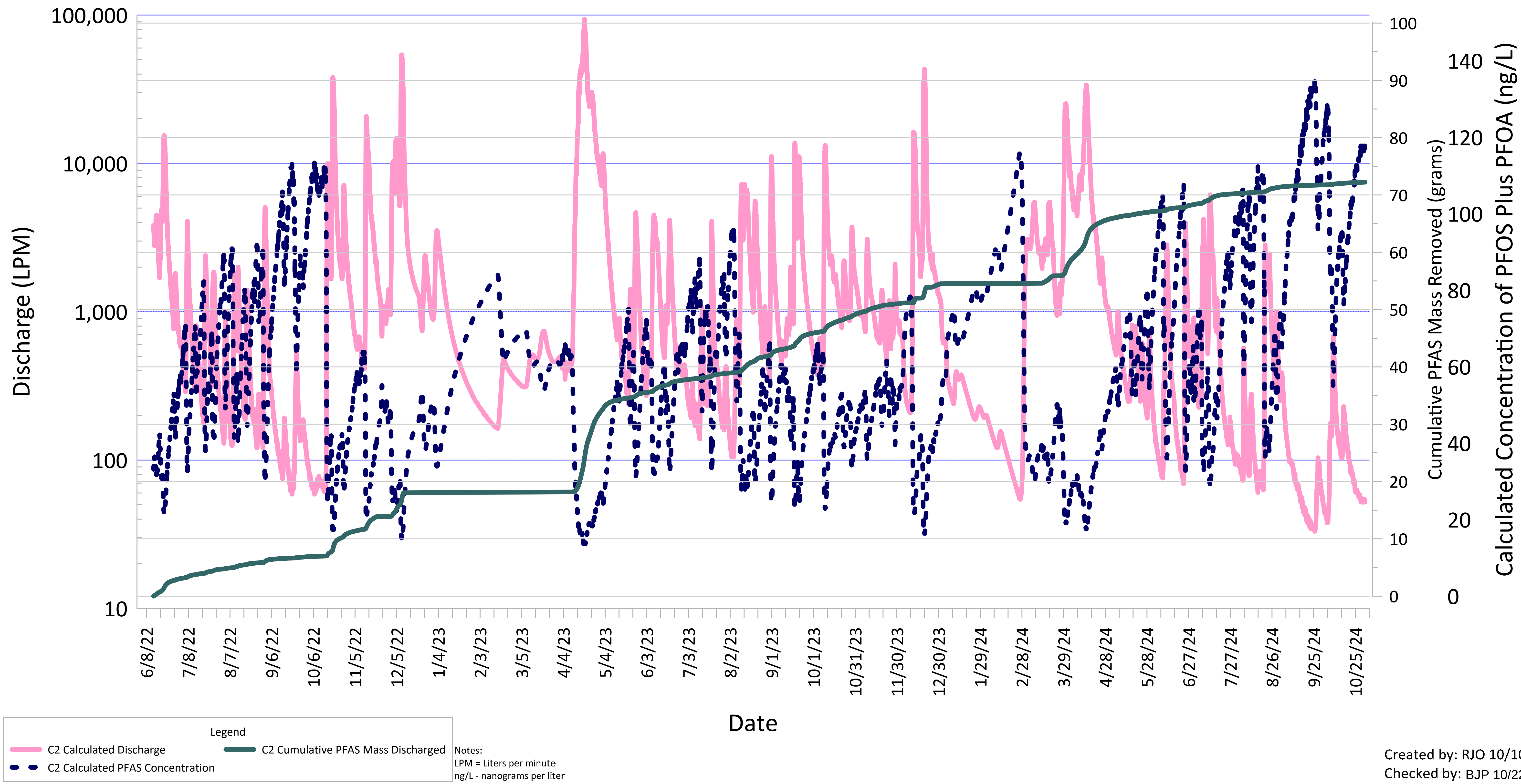
Checked by: BJP 10/21/25

Figure I-18
Modeled Discharge and PFAS Concentrations with the Calculated Cumulative PFAS Mass Discharged from Storm Sewer Outfall C2

PFAS CERCLA Remedial Investigation Site Characterization Summary Report
Former Loring Air Force Base
Limestone, ME



Notes:
LPM = Liters per minute
ng/L - nanograms per liter

Created by: RJO 10/10/25
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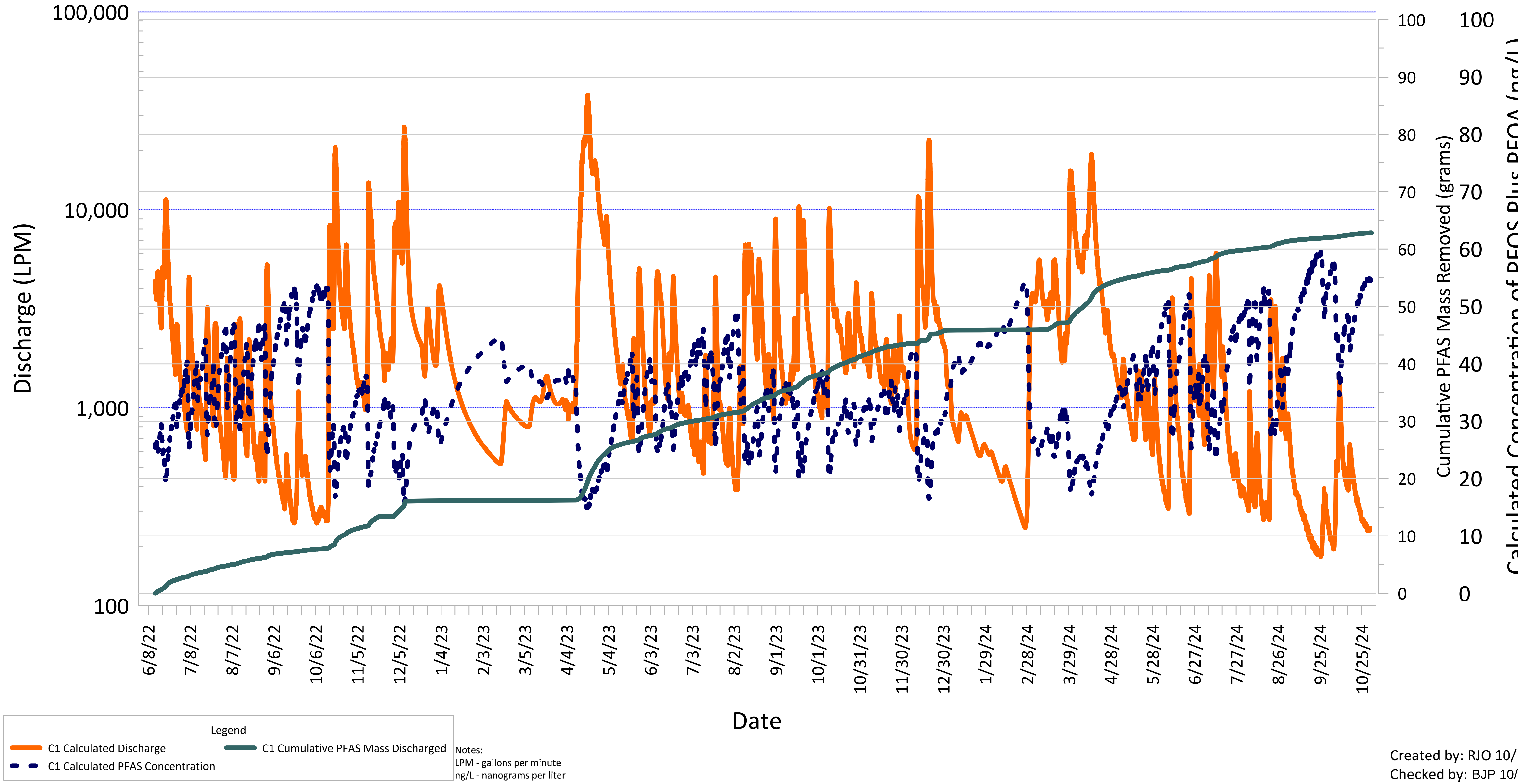
Figure I-19
Modeled Discharge and PFAS Concentrations with the Calculated Cumulative PFAS Mass Discharged from Storm Sewer Outfall C1

PFAS CERCLA Remedial Investigation Site Characterization Summary Report
Former Loring Air Force Base
Limestone, ME



Notes:
LPM - gallons per minute
ng/L - nanograms per liter

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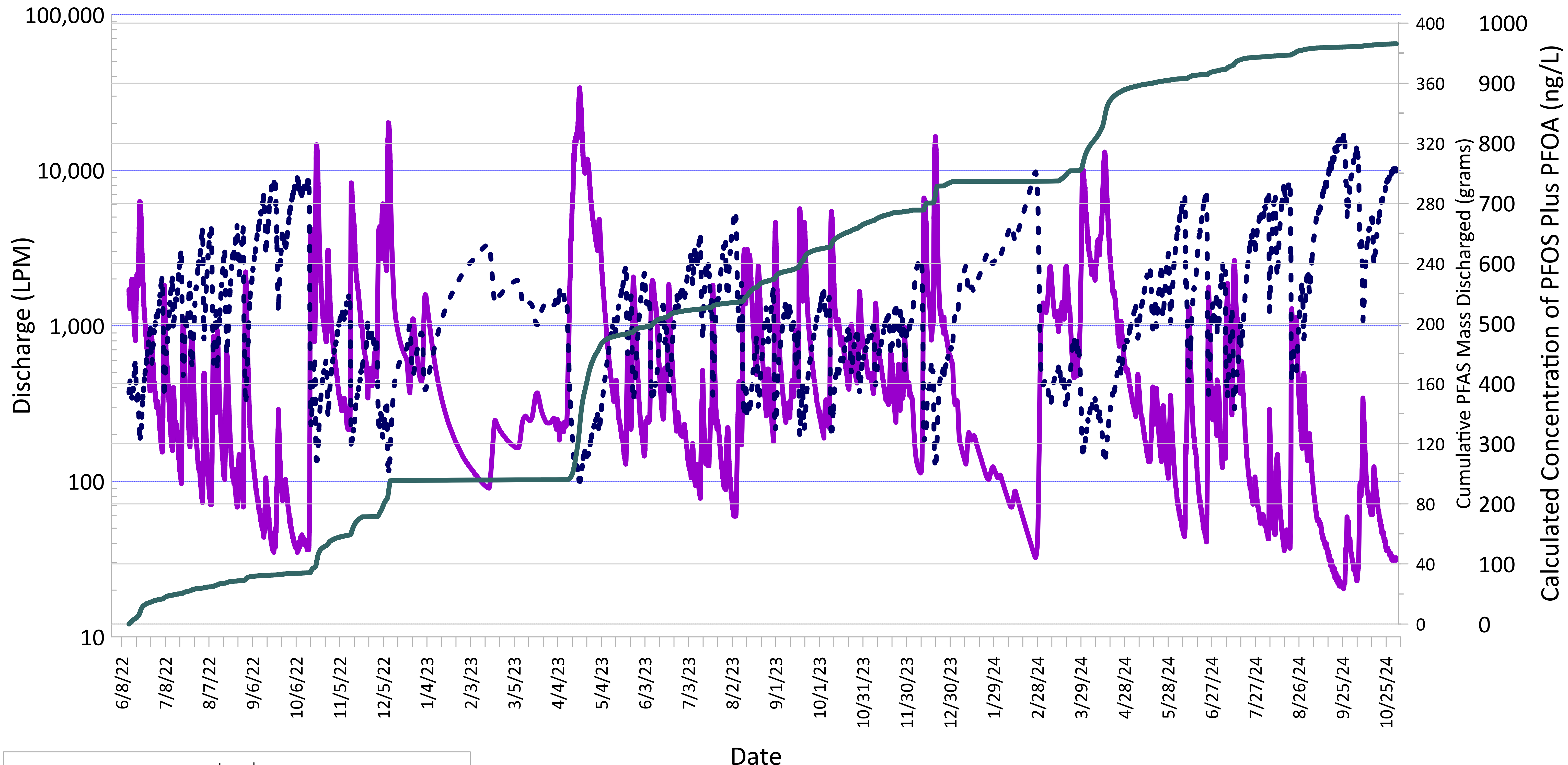
Figure I-20
Modeled Discharge and PFAS Concentrations with the Calculated Cumulative PFAS Mass Discharged from Storm Sewer Outfall C3

PFAS CERCLA Remedial Investigation Site Characterization Summary Report
Former Loring Air Force Base
Limestone, ME



Notes:
LPM - liters per minute
ng/L - nanograms per liter

Created by: RJO 10/10/25
Checked by: BJP 10/22/25

TABLES

Table I-1
Estimated Mass Flux of PFOA and PFOS from Stormwater Sewer System at C1, C2, and C3 Outfalls
PFAS CERCLA Remedial Investigation Site Characterization Summary Report
Former Loring Air Force Base
Limestone, ME

Average Stormwater Outfall Monitoring						Stormwater Outfall Calculated Results
Outfall	Average Concentration of PFOA +PFOS from Samples Collected Between 2022 and 2024 (ng/L)	Average Outfall Discharge Flow Rates June 6th to October 31, 2024 (L/min)	Cumulative Mass Flux of PFOA + PFOS (ng/min)	Cumulative Mass Flux of PFOA + PFOS (g/min)	Estimated PFOA plus PFOS Discharge from Evaluation of Average Concentrations and Flow Rates 06/2022 - 10/2024 (grams)	Estimated PFOA plus PFOS Discharge from Calculated Mass Flux Evaluation 06/2022 - 10/2024 (grams)
C1	40.4	858	34,663	3.47E-05	7	7
C2	50.78	464	23,562	2.36E-05	5	5
C3	441.77	226	99,840	9.98E-05	21	23
TOTAL		**1,548**	**158,065**	**1.58E-04**	**34**	**35**

Notes:
ng/L = nanograms per liter
L/min = Liters per minute
ng/min = nanograms per minute
g/min = grams per minute
Average flow rates calculated from modeled discharge readings based on reported readings between June 6th and October 31, 2024 from outfall discharge meters
Average PFOA and PFOS concentrations reflect analytical data from outfall samples collected between June 2022 and October 2024
Estimates for total discharge completed between June 6, 2022 and October 31, 2024

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Table I-2

Proportion of Mass Flux of PFOA and PFOS Along Greenlaw Brook Attributed to C1, C2, and C3 Discharge to the FLDD

PFAS CERCLA Remedial Investigation Site Characterization Summary Report

Former Loring Air Force Base

Limestone, ME

Stream Gauge	Surface Water Samples in Vicinity of Stream Gauge	Concentration PFOA + PFOS (ng/L)	Average Flow Rate (L/min)	Mass flux of PFOA plus PFOS (ng/min)	Mass flux of PFOA plus PFOS (g/min)	Proportion of Average PFOA plus PFOS Mass Flux from Storm Sewers (%)
LSG-06	E-A-SW01V	113.5	1,953	229,640	2.30E-04	69
LSG-06	E-A-SW02V	150.1	1,953	229,640	2.30E-04	69
LSG-06	E-A-SW03V	143.8	1,953	229,640	2.30E-04	69
LSG-06	SW/SD08002	76	1,953	229,640	2.30E-04	69
LSG-06	SW/SD08002	83.9	1,953	229,640	2.30E-04	69
LSG-06	SW/SD09002	138.2	1,953	229,640	2.30E-04	69
LSG-06	Average Concentration	117.6	1,953	229,640	2.30E-04	69
LSG-04	E-A-SW01W	135	2,338	271,831	2.72E-04	58
LSG-04	E-A-SW01W	124	2,338	271,831	2.72E-04	58
LSG-04	EBGB_001	89.8	2,338	271,831	2.72E-04	58
LSG-04	Average Concentration	116	2,338	271,831	2.72E-04	58
LSG-02	E-A-SW01Y	61.5	5,213	391,844	3.92E-04	41
LSG-02	LT-10-01	67.2	5,213	391,844	3.92E-04	41
LSG-02	LT-10-01	96.8	5,213	391,844	3.92E-04	41
LSG-02	Average	75.17	5,213	391,844	3.92E-04	41
LSG-01	LT-10-06A	48.03	10,939	624,699	6.25E-04	25
LSG-01	LT-10-06A	67.9	10,939	624,699	6.25E-04	25
LSG-01	E-A-SW02Z	58.9	10,939	624,699	6.25E-04	25
LSG-01	E-A-SW01Z	53.6	10,939	624,699	6.25E-04	25
LSG-01	Average	57.11	10,939	624,699	6.25E-04	25

Notes:

ng/L = nanograms per liter

L/min = Liters per minute

ng/min = nanograms per minute

g/min = grams per minute

Average Flow Rate at stream gauges reflect measured discharge between 2022 and 2024 during remedial investigation activities, reported in Appendix E

Proportion of PFOA and PFOS mass flux at stream gauge is compared to mass flux estimates reported on table I-1

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Checked By: BJP 10/21/2025