Massachusetts Department of Environmental Protection (MassDEP)

Division of Watershed Management (DWM)

Watershed Planning Program (WPP)

8 New Bond Street

Worcester, MA

**2022-2023 Chloride Project SAP**

CN 575.0

1. **Overview**

**1.1 Background:**

Sodium chloride (NaCl) is applied to roadways in winter as a deicer. Mattson and Godfrey (1994) found that road salt is the major source of salt loading to Massachusetts streams. Chloride (Cl-) levels have also been correlated with impervious surfaces and urbanization (Wallace and Biastoch, 2016). Chloride is a recognized contaminant with potential to impair waterbodies and impact biological communities (Delaune, Nesich, Goos, and Relyea, 2021). It has also been shown to contribute to year-round elevated Cl- levels (Todd and Kaltenecker, 2012).

**1.2 Purpose:**

This plan involves collection of continuous conductivity data and discrete surface water samples to estimate chloride levels using DEP’s conductivity-chloride regression at the selected stream locations in the watershed. This collection will take place starting in October 2022 through November 2023. Estimated chloride data will help assess how seasonal road salt (NaCl) applications may affect surface water quality. This study will collect continuous conductivity data for 1) application of the MA correlation between specific conductivity and chloride; and (2) analysis of data for comparison to EPA ambient criteria for acute and chronic toxicity.

**1.3 Sampling & Analysis:**

Continuous conductivity data will be collected using HOBO U24 freshwater data loggers. Attended, discrete quality control (QC) readings will be taken at each visit using an Orion Portable Conductivity Meter. On five of the survey rounds, water samples will be collected for chloride (only) and analyzed by the Wall Experiment Station (WES) laboratory.

**1.4 Data Analysis:**

Conductivity data will be analyzed using WPP’s chloride regression tool, which was previously verified, to estimate ambient chloride levels. Chloride concentrations from the discrete water samples shall be used to strengthen the chloride regression formula.

**1.5 Locations:**

This study will occur at locations in the Chicopee and Charles Watersheds. The waterbodies and sampling locations in each watershed are identified in Table 2 and the figures in Appendix A.

The study will focus on waterbodies based on their proximity to major roadways, routes, intersections, and/or estimated high salt deposit areas, as well as proximity to drinking water wells. See Appendix B for individual land use characteristics.

1. **Project Definition and Background**

**2.1 Project Goals and Objectives**

The data collected in this study will help the Massachusetts Department of Environmental Protection (MassDEP) - Division of Watershed Management (DWM), Watershed Planning Program, (WPP) identify potential impacts of road salt on freshwater bodies. From this study, WPP can better understand how road salt, urbanization, and/or other factors affect chloride concentrations of adjacent waterbodies, aquatic biotic health, and drinking water supplies. The results of this study have the potential to influence MassDEP water quality alert levels for chloride and provide baseline data for potential future development of Total Maximum Daily Loads (TMDLs). The sampling objectives for this study are:

1. Estimate chloride levels in-stream by collecting continuous conductivity data at multiple stations using HOBO U24 conductivity loggers during the period of October 2022 through November 2023. The data will then be used by applying the MA correlation between specific conductivity and chloride.
2. Analyze resulting data to determine if estimated concentrations exceed MA state surface water quality standards (EPA ambient criteria for chloride).
3. Collect water samples for chloride measurement. Measured amounts of chloride

in water samples will be compared to simultaneously specific conductance

measures to continue to evaluate and improve the MA correlation between

specific conductance and chloride.

1. **Project Personnel and Responsibilities**

**3.1 Project Personnel**

Specific descriptions of WPP staff roles and responsibilities for this monitoring project are detailed in Table 1. The WPP fulltime Chloride Project staff will be augmented by the seasonal employees from May through September to ensure that enough personnel are available to carry out field surveys throughout the height of the 2023 monitoring season.

| **Table 1.** Project Roles and Responsibilities related to monitoring and data use | |
| --- | --- |
| **Project Personnel** | **Responsibility** |
| Project Oversight  -Matthew Reardon  -Richard Chase  -Arthur Johnson | Provide project guidance, review and approval of SAP. |
| Project Coordinators  --Shervon De Leon (Charles Watershed – Group 1)  -Mason Saleeba (Chicopee Watershed – Group 2)  -Peter Mitchell (Chicopee Watershed – Group 3) | Responsible for site reconnaissance, obtaining landowner access permission, defining logistics for efficient monitoring and generation of useable data at assigned sites using the procedures contained in WPP SOPs. |
| Water quality survey crews  -Peter Mitchell (lead)  -Mason Saleeba (lead)  -Shervon De Leon (lead)  -WPP staff and seasonal employees | Responsible for the collection of samples and data at assigned sites using the sample collection techniques and probe use procedures contained in WPP SOPs. |

For each field monitoring survey event, the staff member serving as the survey crew leader (at a minimum) will have met the following qualifications:

• Familiarity with this SAP and all applicable SOPs for that survey

• Completion of a multiprobe sampling/grab sampling/QC training segment

• Prior field experience with survey equipment and with similar monitoring surveys

• Be physically able to access the sites, carry equipment and samples, and perform the sampling.

Survey crew leaders will be accompanied by one or more additional crew members for each survey. All field survey crew personnel and WES/WPP lab personnel will be trained in the proper application of standard operating procedures (SOPs).

Dr. Oscar Pancorbo, Director of MassDEP’s Wall Experiment Station (WES), and/or his designees, will coordinate with the WPP regarding sample delivery, analyses, and reporting. WES has been selected to perform chloride analysis.

1. **Surface Water Quality Monitoring**

**4.1 Standard Operating Procedures**

This SAP will be implemented consistent with DWM’s EPA-approved programmatic Quality Assurance Program Plan (QAPP) for surface water monitoring in 2020/2024 (CN 520.1), and the project-specific QAPP for Chloride Monitoring & Assessment (CN 540.0).

Onset HOBO U24 Conductivity (and Temperature) Loggers will be deployed at the selected water quality monitoring stations in the Massachusetts northeastern watersheds from November 2021 to October 2022. These deployments will be performed to collect continuous conductivity and temperature readings at fixed, 30-minute, recording intervals. The HOBO units will be used in accordance with the Watershed Planning Program’s *Standard Operating Procedure for Continuous Conductivity Monitoring* (CN 349.0) and the manufacturer’s instructions. The loggers’ sensor faces will be cleaned before each intermittent data collection shuttle-technology download. After retrieval of deployed multiprobes, post-deployment calibration and QC checks on the data will be performed. At deployment and prior to retrieval of multiprobes, as well as at various times during the deployment, QC readings will be taken using a separate meter as specified in WPP’s unattended probe SOPs.

A Thermo Scientific Orion Star A322 Conductivity Portable Meter (Thermo Scientific) will be used for QC purposes approximately every 3rd month between October 2022 and November 2023 at each of the stations. This quality control will be conducted primarily to collect data on temperature and specific conductivity. HOBO conductivity data will be transformed to specific conductance and then reviewed to compare to Thermo Scientific specific conductance data.

Water samples will be collected at each sampling location on the five separate surveys for each watershed group in 250ml HDPE bottles, using standard WPP sampling protocols as defined in the program QAPP. Samples will be preserved and delivered to the WES lab for analysis using method SM 4500-Cl E, within 14 days of receipt.

**4.2 Non-Direct Measurements**

To better interpret data from the study, the following information will also be collected:

* Road salt use recorded by Massachusetts Department of Transportation and area towns to

estimate chloride loading

* Land use area (forest cover, impervious cover, urban cover, and road mile per watershed area) within each station’s watershed. (Table 3)
* Location of drinking water wells/intakes
* Weather statistics

**4.3 Data Analyses**

Conductivity data will be corrected to specific conductivity and used to estimate ambient chloride levels using the DWP’s chloride assessment tool, previously verified for this study and in accordance with Standard Operating Procedure CN 349.0. Once available, final data will be summarized in a Technical Memorandum (project-specific or bundled into a larger report).

**4.4 Design Rationale and Sampling Locations**

Specific sampling locations are shown below (Table 2) and in Appendix A. In general, sites were selected to be representative of typical urban and suburban conditions including percentage impervious cover, impact from roadways and parking lots. In certain cases, a site may have been selected based on indications of historically high levels of chloride or due to site proximity to a suspected high salt loading area or salt storage area, or a drinking water well or withdrawal point. On occasion, recent or concurrent WPP monitoring projects may yield non-continuous conductivity measures resulting in sites of interest to the Chloride Project. These sites may then be included into the Chloride Project for further investigation. Concurrent and contemporary WPP projects may also include biological and chemical measures that may enhance the Chloride Project. Year round safe and easy access to sites were taken into consideration during site selection. Of the sites proposed, none lie in any AUs that are currently impaired for aquatic life use due to chloride. One site is typically chosen per AU, but if the WPP Assessment requests data for multiple sites in an AU, then that request will be fulfilled.

**Table 2.** Site details for the 2022-2023 Chloride Project

| **Basin** | **Group** | **Order** | **Town/City** | **Waterbody** | **Site ID** | **Coordinates** | **AUID** | **Unique ID** | **Site selection rationale** | **Site Description** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Charles | 1 | 1 | Milford | Huckleberry Brook | HUCKL | 42.16299  -71.52308 | NO AUID | W3116 | U/S\* PWS\*; D/S\* urban area & I-495 | [approximately 425 feet south/downstream from Shadowbrook Lane, Milford] |
| Charles | 1 | 2 | Milford | Godfrey Brook | GOD | 42.13099  -71.51550 | MA72-51 | W1585 | U/S PWS, D/S Rte 16, Rte 140 & Milford | [Vernon Street, Milford] |
| Charles | 1 | 3 | Milford | Charles River | CHAS6 | 42.12557  -71.50915 | MA72-33 | W1712 | D/S PWS; D/S Milford town center & Rte 16 | [Howard Street, Milford] |
| Charles | 1 | 4 | Medway | Charles River | CHAS5 | 42.13997  -71.38964 | MA72-04 | W0414 | U/S PWS; D/S urban area | [Walker Street, Medway (near USGS flow gaging station #01103280) (upstream of Charles River Pollution Control District (MA0102598) discharge )] |
| Charles | 1 | 5 | Holliston | Jar Brook | JAR | 42.21957  -71.43499 | NO AUID | W3115 | D/S urban area & PWS | [Travis Road, Holliston] |
| Charles | 1 | 6 | Dover | Charles River | CHAS4 | 42.26927  -71.29981 | MA72-06 | W3163 | U/S PWS; D/S Rte 16, Rte 27 & South Natick | [downstream at Dover Road/Charles River Street, Dover/Needham] |
| Charles | 1 | 7 | Cambridge | Charles River | CHAS1 | 42.35534  -71.09679 | MA72-38 | W3164 | D/S urban and commercial area | [northern bank of river at MIT Pierce Boathouse, approximately 1200 feet upstream of Massachusetts Avenue, Cambridge] |
| Charles | 1 | 8 | Watertown | Charles River | CHAS2 | 42.36468  -71.20869 | MA72-07 | W3165 | D/S urban and commercial area | [northern bank of river approximately 1350 feet west/upstream of Bridge Street, Watertown] |
| Charles | 1 | 9 | Auburndale | Charles River | CHAS3 | 42.34122  -71.25781 | MA72-07 | W3166 | D/S I95/I90 Interchange, Rte 30 & PWS | [Walker Street, Medway (near USGS flow gaging station #01103280) (upstream of Charles River Pollution Control  District (MA0102598) discharge)] |
| Charles | 1 | 10 | Weston | Seaverns Brook | SEAV | 42.34148  -71.26679 | MA72-44 | W1590 | U/S PWS. D/S I-90 & Rte 30 | [approximately 1100 feet downstream from Park Road, Weston] |
| Chicopee | 2 | 1 | Chicopee | Chicopee River | CHIC1 | 42.15022  -72.60445 | MA36-25 | W3167 | D/S I-291 & urban area | [approximately 830 feet east/upstream of the Route 116 bridge, north of Lower Grape Street, Chicopee] |
| Chicopee | 2 | 2 | Chicopee | Cooley Brook | COOLEY | 42.16244  -72.56040 | MA36-38 | W1028 | D/S I-90 | [Fuller Road, approximately 1100 feet northwest of Haynes Circle, Chicopee (on southerly flowing channelized diversion of Cooley Brook)] |
| Chicopee | 2 | 3 | Indian Orchard | Chicopee River | CHIC2 | 42.16036  -72.51022 | MA36-24 | W1031 | D/S I-90 & urban area | [River Street/West Street bridge, Springfield/Ludlow] |
| Chicopee | 2 | 4 | Wilbraham | Calkins Brook | CALK | 42.15094  -72.38982 | MA36-26 | W3168 | D/S PWS; D/S I-90 & Rte 20; U/S PWS | [approximately 80 feet west/downstream from Silver Street (and tributary to northern bank), Wilbraham] |
| Chicopee | 2 | 5 | Palmer | Chicopee River | CHIC3 | 42.17719  -72.37546 | MA36-22 | W1033 | D/S urban area & PWS | [near the intersection of New Hampshire Avenue and Springfield Street, Palmer] |
| Chicopee | 2 | 6 | Palmer | Quaboag River | QUAB1 | 42.17284  -72.34611 | MA36-17 | W1015 | D/S Palmer town center, crosses Rte 20 and I-90 twice; D/S PWS | [Palmer Street bridge, Palmer] |
| Chicopee | 2 | 7 | Palmer | Quabaog River | QUAB2 | 42.18222  -72.26417 | MA36-16 | W0491 | D/S Warren Town center. Crosses Rte 67 at least twice and runs alongside it for at least 5 miles | [east of Route 67, (near USGS flow gaging station #01176000), Palmer/Brimfield] |
| Chicopee | 2 | 8 | Brimfield | Penny Brook | PENNY | 42.16864  -72.261155 | NO AUID | W3169 | No observable chloride sources | [south of John Haley Road, approximately 200 feet southeast/upstream of Washington Road, Brimfield] |
| Chicopee | 2 | 9 | Brimfield | Blodget Mill Brook | BLODG | 42.17025  -72.26086 | NO AUID | W3177 | D/S I-90 | [Washington Road, Brimfield] |
| Chicopee | 3 | 1 | Ware | Ware River | WARE3 | 42.28481  -72.21608 | MA36-05 | W1009 | D/S Hardwick town center, Rte 32 and Rte 122; U/S PWS | [Upper Church Street, Ware] |
| Chicopee | 3 | 2 | Ware | Ware River | WARE2 | 42.23872  -72.28547 | MA36-07 | W1014 | D/S Ware Town center, & Rte 32 | [Route 32 at Gibbs Crossing, Ware] |
| Chicopee | 3 | 3 | Belchertown | Swift River | SWIFT2 | 42.253858  -72.33579 | MA36-09 | W3170 | Crosses Rte 9, D/S McLaughlin Hatchery. Flows along River Rd | [east of East Street, Belchertown approximately 4500 feet north/upstream of Cold Spring Street, Belchertown/Old Belchertown Road, Ware] |
| Chicopee | 3 | 4 | Palmer | Ware River | WARE1 | 42.19192  -72.34926 | MA36-07 | W1014 | D/S Ware town center, PWS & Rte 32. U/S PWS | [Route 181, Palmer] |
| Chicopee | 3 | 5 | Belchertown | Swift River | SWIFT1 | 42.21074  -72.34658 | MA36-10 | W1013 | D/S Rte 9 and flows along River Rd, Bondsville Rd and Main St for 12 miles | [Route 181, Belchertown/Palmer] |
| Chicopee | 3 | 6 | Belchertown | Jabish Brook | JAB | 42.21131  -72.364811 | MA36-73 | W3171 | At PWS well field; D/S Rte 181 | [field access-bridge approximately 650 feet north/upstream of South Street, Belchertown] |
| Chicopee | 3 | 7 | Shutesbury | Briggs Brook | BRIGGS | 42.42085  -72.39923 | MA36-61 | W3172 | D/S Rte 202; U/S PWS (Quabbin reservoir) | [approximately 180 feet east/downstream from Daniel Shays Highway, Shutesbury] |
| Chicopee | 3 | 8 | New Salem | West Branch Swift River | WSWIFT | 42.457868  -72.38246 | MA36-31 | W3173 | D/S Rte 202; U/S PWS (Quabbin reservoir) | [Daniel Shays Highway, New Salem] |
| Chicopee | 3 | 9 | New Salem | Swift River | MSWIFT | 42.53413  -72.30268 | MA36-33 | W3174 | D/S PWS & Rte 202; U/S PWS (Quabbin reservoir) | [Orange Millington Road, New Salem] |
| Chicopee | 3 | 10 | Petersham | East Branch Swift River | ESWIFT | 42.43848  -72.20729 | MA36-35 | W2025 | D/S Rte 32A; U/S PWS (Quabbin reservoir) | [Route 32A (Hardwick Road), Petersham] |
| Chicopee | 3 | 11 | Petersham | Unnamed Tributary to Quabbin Reservoir | QUABT | 42.42147  -72.20582 | NOAUID | W3175 | D/S Rte 32A; U/S PWS (Quabbin reservoir) | [unnamed tributary to Pottapaug Pond, Hardwick Road, Petersham] |
| Chicopee | 3 | 12 | Barre | Ware River | WARE4 | 42.39111  -72.06556 | MA36-03 | W3176 | D/S Warren & West Warren towns centers | [south of Route 122, west/downstream at Gaging Station Pool Dam (NAT ID: MA02565), Barre ] |

*D/S = Downstream, U/S = Upstream, PWS = Public Water Supply*

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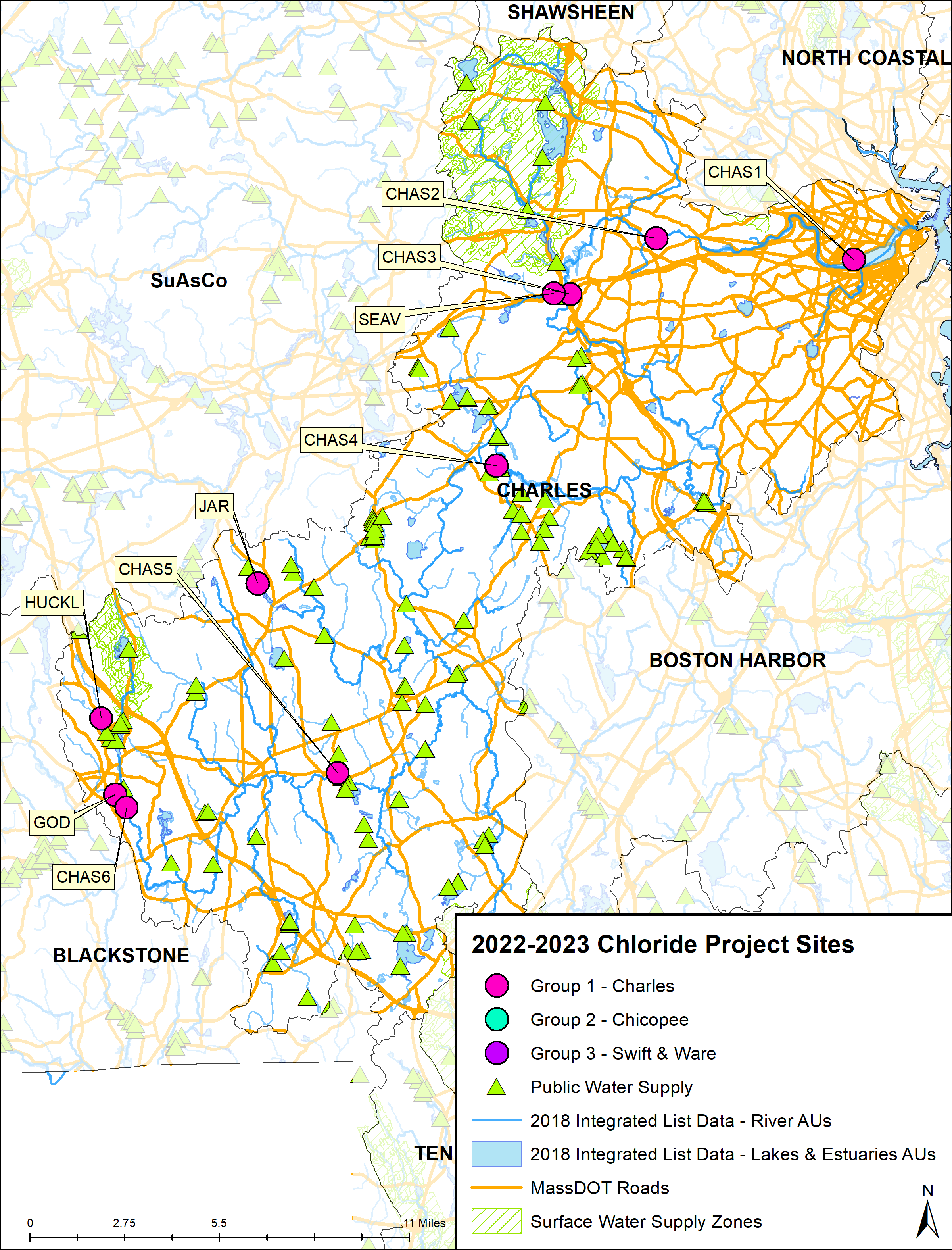
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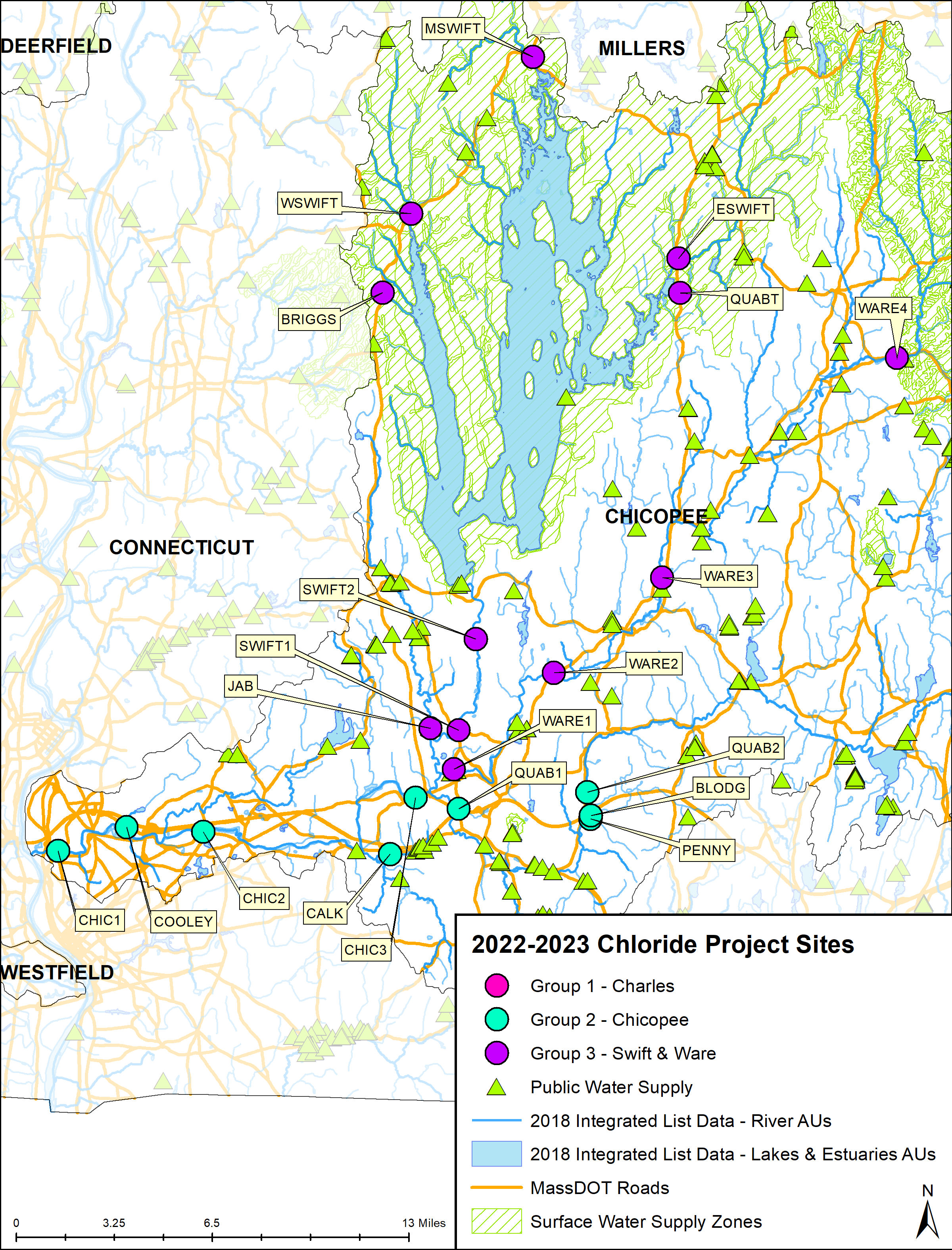
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**Appendix A**



**Figure 1 -** Chloride 2022-2023 sites in the Charles River Watershed



**Figure 2 -** Map showing Chloride 2022-2023 sites in the Chicopee River Waters

**Appendix B**

Site Watershed Characteristics

| **Basin Group Order** | **Site ID** | **Watershed Area (mi2)** | **Percent Forest Cover** | **Percent**  **Impervious Cover** | **Percent Urban Land** | **Road miles in watershed** | **Road Miles per watershed mi2** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Charles Group 1 Site 1 | HUCKL | 3.30 | 42.54 | 17.34 | 52.14 | 30.25 | 9.17 |
| Charles Group 1 Site 2 | GOD | 1.89 | 18.04 | 44.11 | 87.53 | 31.32 | 16.61 |
| Charles Group 1 Site 3 | CHAS6 | 11.39 | 42.21 | 24.05 | 53.39 | 118.15 | 10.37 |
| Charles Group 1 Site 4 | CHAS5 | 65.23 | 51.82 | 17.53 | 44.29 | 508.01 | 7.79 |
| Charles Group 1 Site 5 | JAR | 1.61 | 42.58 | 18.99 | 56.34 | 14.95 | 9.27 |
| Charles Group 1 Site 6 | CHAS4 | 173.86 | 50.77 | 13.83 | 39.95 | 1280.18 | 7.36 |
| Charles Group 1 Site 7 | CHAS1 | 282.95 | 42.01 | 19.33 | 48.45 | 2817.71 | 9.96 |
| Charles Group 1 Site 8 | CHAS2 | 265.83 | 44.25 | 17.29 | 45.73 | 2413.83 | 9.08 |
| Charles Group 1 Site 9 | CHAS3 | 220.38 | 46.67 | 15.73 | 43.64 | 1857.17 | 8.43 |
| Charles Group 1 Site 10 | SEAV | 2.21 | 55.96 | 9.16 | 35.03 | 16.52 | 7.47 |
| Chicopee Group 2 Site 1 | CHIC1 | 718.52 | 65.28 | 2.63 | 10.47 | 2433.39 | 3.39 |
| Chicopee Group 2 Site 2 | COOLEY | 0.14 | 47.60 | 19.78 | 43.91 | 0.75 | 5.27 |
| Chicopee Group 2 Site 3 | CHIC2 | 690.19 | 66.95 | 1.73 | 8.55 | 2151.25 | 3.12 |
| Chicopee Group 2 Site 4 | CALK | 2.71 | 73.95 | 2.44 | 12.58 | 9.85 | 3.64 |
| Chicopee Group 2 Site 5 | CHIC3 | 646.42 | 67.44 | 1.43 | 7.81 | 1928.47 | 2.98 |
| Chicopee Group 2 Site 6 | QUAB1 | 210.96 | 62.99 | 2.23 | 10.71 | 786.81 | 3.73 |
| Chicopee Group 2 Site 7 | QUAB2 | 149.36 | 59.89 | 2.03 | 10.18 | 548.35 | 3.67 |
| Chicopee Group 2 Site 8 | PENNY | 1.52 | 84.97 | 0.27 | 4.63 | 3.84 | 2.53 |
| Chicopee Group 2 Site 9 | BLODG | 7.74 | 71.54 | 1.41 | 10.30 | 27.68 | 3.58 |
| Chicopee Group 3 Site 1 | WARE3 | 160.39 | 71.87 | 1.18 | 6.88 | 486.93 | 3.04 |
| Chicopee Group 3 Site 2 | WARE2 | 198.11 | 71.22 | 1.43 | 7.51 | 615.84 | 3.11 |
| Chicopee Group 3 Site 3 | SWIFT2 | 190.42 | 69.59 | 0.29 | 3.85 | 342.28 | 1.80 |
| Chicopee Group 3 Site 4 | WARE1 | 215.44 | 70.80 | 1.47 | 7.81 | 681.01 | 3.16 |
| Chicopee Group 3 Site 5 | SWIFT1 | 194.89 | 69.62 | 0.32 | 3.95 | 358.70 | 1.84 |
| Chicopee Group 3 Site 6 | JAB | 16.79 | 68.58 | 1.60 | 10.91 | 62.06 | 3.70 |
| Chicopee Group 3 Site 7 | BRIGGS | 0.41 | 98.89 | 0.02 | 0.93 | 0.07 | 0.18 |
| Chicopee Group 3 Site 8 | WSWIFT | 12.51 | 91.23 | 0.25 | 4.73 | 21.19 | 1.69 |
| Chicopee Group 3 Site 9 | MSWIFT | 9.00 | 78.21 | 1.08 | 7.80 | 25.62 | 2.85 |
| Chicopee Group 3 Site 10 | ESWIFT | 30.01 | 81.79 | 0.48 | 5.05 | 74.90 | 2.50 |
| Chicopee Group 3 Site 11 | QUABT | 2.31 | 76.28 | 0.35 | 4.63 | 6.19 | 2.67 |
| Chicopee Group 3 Site 12 | WARE4 | 96.46 | 77.77 | 1.05 | 6.33 | 286.47 | 2.97 |