



MassDEP

**Massachusetts Department of Environmental Protection
Bureau of Water Resources
Division of Watershed Management
Watershed Planning Program**

STANDARD OPERATING PROCEDURE

Monitoring Station Definition

CN 000.61

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**Prepared and
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List of Revisions



Revision Date	Revision	Pages #s	CN/ (Old CN if applicable)	Initials
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**Acronyms:**

Geographic Information System (GIS)
Assessment Unit (AU)
Geographic Coordinate System (CS)
Projected Coordinate System (PCS)
Combined Sewer Overflow (CSO)
United States Geological Survey (USGS)
National Hydrography Dataset (NHD)
National Pollutant Discharge Elimination System (NPDES)

Scope and Application:

For the placement and registration of water quality sampling locations sampled by and / or managed by the Watershed Planning Program (WPP).

Summary of Method:

Defining monitoring stations by comparing intended locations to existing locations and surrounding features to determine if a) a station already exists in that location and b) if not, if a new station at that location would be representative of that target waterbody.

Personnel Qualification/Responsibilities:

Individuals performing stationing work should have experience with GIS software such as ArcGIS Pro

Equipment, Supplies, and Reagents:

GIS Software (ArcGIS Pro,).

Detailed Procedures:**Pre-registration submission and validation**

Monitoring Coordinators or other project staff will provide the GIS Analyst with their intended suite of stations prior to the monitoring season. The information will, at a minimum, include:

- Unique ID
- New (Y or N)
- Waterbody Name
- Description
- Project (Year)
- Station ID (STAID)
- Latitude
- Longitude
- Monitoring Coordinator / associated staff

Plotting and visualization

Plot the intended station locations using GIS software. These intended stations are then compared to the suite of existing stations of the same category, i.e. Water Quality Stations will be compared to Water Quality Stations, Fish Toxics Stations will be compared to Fish Toxics Stations, and so forth. WPP currently has four types of stations:

- Water Quality stations
- Fish Population stations
- Benthic Macroinvertebrate stations
- Fish Toxics stations

The coordinates for all stations are stored in the MasterStationsWorking geodatabase. An archival copy of this geodatabase should be made prior to making any changes.

Geographic Coordinate Systems (GCS) and Projected Coordinate Systems (PCS)



Station coordinates should be added to the map using the WGS84 GCS. Other map features, including but not limited to AUs, basins, municipalities, etc. should be in the NAD 1983 StatePlane Massachusetts FIPS 2001 (Meters) PCS.

Co-location of intended stations with existing stations

New intended stations are designated for each year's monitoring season. For analytical simplicity and to leverage the robustness of longitudinal data, the overall goal should be to register as few new stations as possible. In other words, the more intended stations that are co-located with existing stations, the better.

If an intended station is within approx. 100 feet of an existing station of the same category, that intended station is now a candidate for co-location with that existing station. This 100-foot value can be "stretched" to allow for co-location of existing and intended stations slightly further apart if there is no difference in representativeness between these two locations. As the main goals of station, and subsequently sample, co-location are consistency, representativeness, and longitudinal dataset building, these priorities can take precedence over the specific 100-foot guideline when applied with discretion.

Before officially co-locating, it is important to determine the rationale for the placement of the intended station at the specific location provided. Some scenarios would justify co-location, while others would not.

Small variations in intended station location vs. existing station location can often be attributed to differences in the geography resources utilized to identify intended station locations. Stationing work within ArcGIS Pro primarily references USGS topographic maps (USGS topos), MassDEP 1:25k Hydrography (1:25k), and the National Hydrography Dataset (NHD). Staff may be utilizing other resources, such as orthoimagery or Google Earth derived satellite imagery. These small-scale (less than 100 feet) differences do not exclude intended stations from co-location.

Example 1:

The Monitoring Coordinator intended the station to be co-located with a U.S. Geological Survey (USGS) stream gage. The stream gage is 90 feet away from an existing station. As the intended station is within 100 feet of the existing station and the presence of a USGS stream gage does not impact the representativeness of samples collected historically vs. prospective samples, this intended location can be co-located with an existing station.

Example 2:

Two existing stations are within 100 feet of an intended station. One existing station is associated with the stream conditions overall, while the other is associated with a stormwater drain outfall. The Monitoring Coordinator indicated that the intended station is supposed to be representative of the overall stream. If appropriate based on these guidelines, this intended station should be co-located with the existing station representative of the overall stream reach and should not be co-located with the existing station more representative of the stormwater drain outfall. (As a note, ideally, the existing stream station and the existing stormwater drain outfall station should not be within 100 feet of one another).



Evaluation and creation of new stations

If an intended station cannot be co-located with an existing station, it can potentially be registered as a new station. Similar to co-location evaluation, it is important to consider the intent behind selecting a specific location. This intent should be evaluated against nearby features.

If an intended station has been proposed to evaluate waters representative of a stream overall, various features might interfere with the representativeness.

Considerations include, but are not necessarily limited to:

Discharges and mixing zones

Examples of discharges include National Pollutant Discharge Elimination System (NPDES) sites, effluent pipes (cataloged in the ToxTD database), stormwater outfalls, combined sewer overflows (CSOs), and pipes of any kind. These represent point sources of potential pollution and are associated with a mixing zone. Stations that are intended to be representative of overall stream conditions and not of discharge locations should either be a) upstream enough to be conservatively upstream of the mixing zone or b) downstream enough that mixing has occurred thoroughly.

The presence of a discharge triggers the creation of at least two separate AUs, one upstream of and one downstream of the discharge. Stations should not be associated with any potential mixing zone between these two AUs and instead should be representative of conditions in either the upstream or downstream AU.

Water Intakes

Water intakes should be noted because, although they should have little to no effect on water quality, they can affect stream flow. If this is an important metric for this station, this potential influence should be considered.

Wetlands

The presence of wetlands so that the station location can be evaluated against the overall character of the waterway.

Tidal areas

While tidal flow may contribute to flow direction reversal during certain times of the day, for the purposes of stationing, upstream and downstream are terms used within the context of freshwater stream flow, not marine tidal influence. Upstream therefore refers to the portion of the waterway in the relative direction of the headwaters, and downstream the inverse.

Bridges

Overall, only one station should be registered per bridge location. However, if stations associated with a bridge are greater than 100 feet apart, more than one station should be registered. This could be the case if a bridge is greater than 100 feet wide and there are stations on both the upstream and downstream sides of the bridge. Extra care should be taken in the field to make sure there are no discharges tucked away under bridges and similar structures.

Dams and impoundments

The presence of a dam constitutes the creation of a new AU. Therefore, stations should be representative of either the upstream / impounded section of the waterway or the downstream section of the waterway.

Culverted streams

For concrete box culverts, large metal pipes, and other similar structures, register one station. If a culvert exceeds 50 feet measured from one end to the other, define two stations even if there are no pipes discharging inside the culvert to account for "pipe effects." The availability of local drainage system mapping is important to locate pipes connected to the culvert.



Pond and lakes

Deep hole stations should be identified using bathymetric maps and verified in the field. Shoreline, inlet, and outlet stations should be labelled with enough detail for their differences to be readily apparent. Inlet and outlet stations should be selected with an additional level of care so that these stations are representative of stream conditions and are not subject to pond effects, such as backwater.

Large rivers

If sampling can/will occur at either bank of a stream but these locations are less than 100 feet apart, then a single station should be registered, and its description should not include specific reference to either bank side. If a river is greater than 100 feet wide and samples will be taken from opposite banks, multiple stations should be registered.

Grab vs. composite sampling

If samples are being taken along a transect, grab samples taken less than 100 feet from each other and are representative of the same waterway area, these samples should be associated with the same station. Composite samples along a transect (i.e. river width transect) should be associated with one station regardless of river width.

Developments and anthropogenic influence

Anthropogenic structures like large parking lots with impervious surfaces, new residential developments, shopping centers, etc. should be considered when deciding whether to officially register a station. If these features are consistent with the surrounding landscape, their presence may not be a concern. If they are new and represent development not consistent with the surrounding landscape, it may be worth considering sampling both proximate to the new development and upstream.

Proximity to waterbody

The intended location should also be on, or very close to, the GIS depiction of the target waterbody (ideally the assessment unit (AU)). At a minimum, the station should be within 100 feet of the line or polygon associated with the target waterbody / AU. As mentioned above, some small variations may be observed due to different basemap / geography resources being utilized for station site selection.

Deviations in waterbody features

In general, any substantial change in waterway homogeneity should at least incur scrutiny if the intended location of a station is nearby. This includes any of the above-referenced features, as well as things like dramatic grade breaks, plunge pools, high-traffic roads that are potential chloride sources, or other pollution sources.

The presence of these features should, at minimum, trigger additional consideration for intended station placement. If the presence of these features is deemed a substantial influence on the waterway, their location may also trigger the creation of a new AU, separating the pre-feature, upstream AU from the post-feature, downstream AU at the site of the pollution source.

The presence of any of the features mentioned above might not immediately disqualify a station from being formally registered, but at least indicate that the location should be scrutinized. If none of these features are nearby and/or would not reasonably influence the representativeness of samples collected at the intended station, the station can be formally registered.



Unique ID, Station ID, and Assessment Unit (AU) association

Unique ID

The next available Unique ID will be assigned to it, and that location will be permanently tied to that identifier.

Station ID

In addition, a Station ID is assigned to each station per season and is affiliated with a specific Project Code and Year. This Station ID functions as a “nickname” for staff to utilize in the field and does not need to match, but can match, historical Station IDs.

Example (Hypothetical):

W6502 has been sampled in 2009, 2013, 2016, 2022, and is going to be sampled in 2024. The Station ID was changed a few times over the years due to Monitoring Coordinator preference. The projects have also changed.

Unique ID	Station ID	Project	Year
W6502	CWC	REG-01	2009
W6502	CWC	REG-02	2013
W6502	CWC	REG-03	2016
W6502	COLD	REG-04	2022
W6502	COLD	REG-05	2024

In this way, Unique IDs are consistent *across all sampling years*, while Station IDs are, at a minimum, consistent *within a sampling year* and can otherwise vary. This means that a Unique ID can be associated with several Station IDs, but Station IDs at a particular location are only associated with one, permanent, Unique ID.

Associations with Assessment Units

All stations should be directly associated with an AU. Any stations that are not directly associated with an AU should have AUs created for them as soon as possible. Each AU can have multiple stations associated with it, but each station should only be directly associated with one AU. Please see CN 618.0 for documentation of the AU creation process.

Changing locations during / after the monitoring season

Stations can sometimes have to be adjusted slightly after the monitoring season has been completed due to logistical constraints. This process should be approached with the same level of consideration as the original stationing process described in this SOP.

Selection of basemap / geographic resources

As of April 2025, the current preference for line and polygon hydrography resources when performing stationing work is the MassDEP 1:25k Hydrography dataset which also features wetland coverage. Eventually, WPP may utilize an improved dataset, such as the anticipated 3DHP (3D Hydrography Program) from USGS, or other. The USGS topographic maps are also a good resource for looking at the delineation between intermittent and perennial stream sections.

Decimal places of coordinates

ArcGIS Pro plots points with 7 decimal points of precision (for example: 71.9813299°W, 42.2276664°N). GPS coordinates should be recorded and stored with 7 decimal points of precision as of the 2026 monitoring season.

Station descriptions

Station descriptions should be relatively consistent in formatting and content. Within the Stations database, brackets surround the body of the description to make it apparent when descriptions get truncated during processing. Some examples of station descriptions are:

- [approximately 550 feet downstream/east of Reservoir Road, Lunenburg]



- [approximately 0.2 miles upstream of mouth at confluence with Shawsheen River, north of Oak Road, Tewksbury]
- [unnamed tributary to Round Meadow Pond, Town Farm Road, Westminster]
- [north of St. Johns Cemetery, approximately 2900 feet east/downstream from South Meadow Road, Lancaster] [beach, southeastern edge of pond, off western end of Mecum Way, Becket]
- [South Main Street (Route 140), Mansfield]

The state a station is located in is only included in the description if that station is not within Massachusetts. For example: [... Tiverton, RI].

Post-season Benthic Macroinvertebrate and Fish Population station registration

Unlike Water Quality and Fish Toxics stations, Benthic Macroinvertebrate (Benthic) and Fish Population (Fish Pop) stations are registered after the completion of the monitoring season. These stations are tied to an “anchor” Water Quality station with a W#, but Benthic and Fish Pop stations need their own separate B# and P# unique identifiers, respectively. These separate unique identifiers should be associated with a nearby, but different, set of latitude / longitude coordinates than the “anchor” W#.

For Benthic and Fish Pop stations, their distinct coordinate set should be associated with the start of the reach associated with these biological samples. These coordinates are identified by reviewing the field sheets and their associated sketches and designated by the GIS Analyst.

Data & Records Management: Geographic information is primarily stored in the MasterStationsWorking geodatabase (.gdb). Metadata is stored in the STaID Access database (.mdb) managed by Kari Winfield. Geographic information is exported from the MasterStationsWorking geodatabase and batch uploaded into the STaID Access database.

Data Software: ArcGIS Pro, R, Python