

Standard Operating Procedure (SOP) #7

Selecting Water Quality Sampling Stations

Version 4.0 (November 12, 2024)

Change History

New Version #	Revision Date	Author	Changes Made	Reasons for Change	Previous Version #
1.01	5/31/2016	Scott Kichman	Updated software versions and configuration.	Software no longer in production.	1.0
2.0	12/17/2018	Mark Wasser	Major update to reflect current software and best practices.	Software updates, other updated policies and procedures, standardization across PACN.	1.01
3.0	8/1/2019	Mark Wasser	Removal of outdated materials, update of randomization process in GIS.	Currency with actual PACN procedures, clarity & consistency, ease of use.	2.0
3.01	12/2/2020	Mark Wasser	Updated software and associated procedures, updated directories, no repeating temp Anchialine Pools within a year.	Reflect migration to ArcGIS Pro, Spatial_Info directory changes, and Anchialine Pool changes.	3.0
3.02	3/1/2021	Mark Wasser, Kim Weisenborn	Updated point generation workflow. Added more detail about exported products. Renumbered SOP from #6 to #5; updated SOP references throughout this SOP.	Reflect more efficient methodology and full suite of products produced. Some SOPs were removed or renumbered within the protocol.	3.01
3.03	3/9/2022	Kim Weisenborn, Mark Wasser	Updated content to refer to new PACN I&M SharePoint. Added captions to figures.	PACN data is no longer stored on a networked server (I:\ drive) and is now stored on the PACN I&M SharePoint site. Added captions to figures for clarity.	3.02
3.04	12/19/2022	Mark Wasser	Minor changes and updates to naming conventions and other details.	Standardize and provide better clarity for file structure and product names	3.03
4.0	11/12/2024	Kim Weisenborn, Mark Wasser	Renumbered SOP from #5 to #7. Updated SOP references. Updates to Marine Water Quality sampling point generation.	Some SOP reference #s have changed. Marine Water Quality Protocol update. Change from Quarterly to Bi-Annual sampling. De-coupling of Benthic/Marine Fish and Marine WQ temporary sites.	3.04

New Version #	Revision Date	Author	Changes Made	Reasons for Change	Previous Version #

Only changes in this specific SOP will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, changes made, and reason for the change along with the new version number.

Purpose

This SOP describes how to select water quality sampling stations. Sample stations will be selected within three different sampling frames: accessible reaches of perennial streams, marine waters with potential park impacts, and brackish water resources (anchialine pools, fishponds, and a saline lake).

A master equipment list for the entire Water Quality Vital Signs Monitoring Protocol can be found in Appendix SOP 2.a of [SOP #2 General Tasks Prior to Conducting Field Work](#). The master equipment list should be updated simultaneously if this or any SOP requiring an equipment list is revised. A list of equipment required to complete the tasks specified in this SOP has been provided in [Appendix SOP 7.a](#). in this SOP.

Selecting Water Quality Sampling Locations

The following steps will be done prior to conducting any field work.

Note: Fixed sampling points were originally generated using ArcMap® 9.3 and Hawth's Tools. No new fixed sites need to be generated, so those procedures are no longer outlined in this SOP.

The Marine component of the Water Quality protocol was revised in 2023, and new 'near-shore' fixed sampling points were added at that time. These fixed sites were established by crews in the field based on specific criteria. Field crews recorded the sampling point location in the field, this location was then added to the master spatial databases by the PACN GIS Specialist.

The three different sampling frames require different methods for temporary sampling station point generation or selection. All three methods are outlined below.

- [Perennial Streams](#) – Generate random points along streams (polylines).
- [Marine Areas](#) – Generate random points within sampling frames (polygon).
- [Anchialine Pools](#) – Select random points from preset list of all available anchialine pools.

Generating and Selecting Random Points for Temporary Sampling Stations

The GIS Specialist or other trained staff will generate and select random points for sampling using ArcGIS® desktop software (as of publication, the version in use is ArcGIS Pro 3.3.1). Please refer to [Appendix SOP 7.b](#) for a complete sampling schedule and list of points needed for each park and sampling frame.

Generating Random Points for Temporary Sampling Locations in Perennial Streams

1. Open ArcGIS Pro and load the park specific map project and necessary layers including park boundaries, coastlines, roads, trails, and sampling streams. The previous year's Pro Project will be located in the [Water Quality Monitoring project workspace](#) in the PACN I&M SharePoint site¹ within the directory indicated below. Save a new copy of the Pro Project to a similar directory for the current year.

Previous year's directory: "[Spatial_info](#)" folder > Year folder > "[YYYYY]²_WQ_point_generation" folder in SharePoint (Figure SOP 7.1).

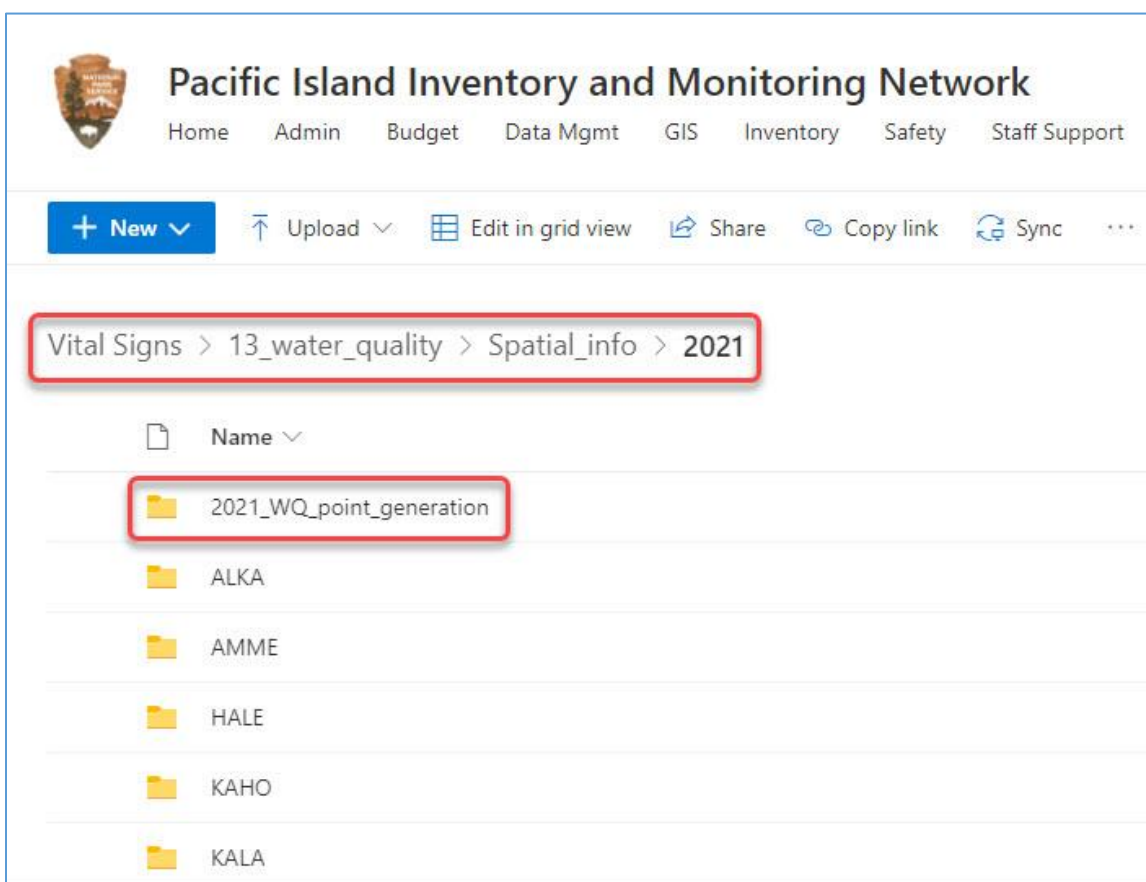


Figure SOP 7.1. Example of previous year's Water Quality Monitoring point generation in SharePoint.

¹ PACN I&M SharePoint site, <https://doimspp.sharepoint.com/sites/nps-PWR-PACNIM> (last accessed 12 November 2024).

² [YYYYY] = 4-digit year, referenced throughout this SOP.

2. Create a temporary file geodatabase (.gdb) within the current year's WQ_point_generation folder (same directory as above except for current year, see Figure SOP 7.1 for an example). This geodatabase file can house all the temporary files created during random point generation.
3. Generate random points along sampling streams.
 - a. Open the Create Random Points Tool (Tools button is located within the Analysis Tab, Geoprocessing Group on the Pro ribbon) and set the following criteria (Figure SOP 7.2):

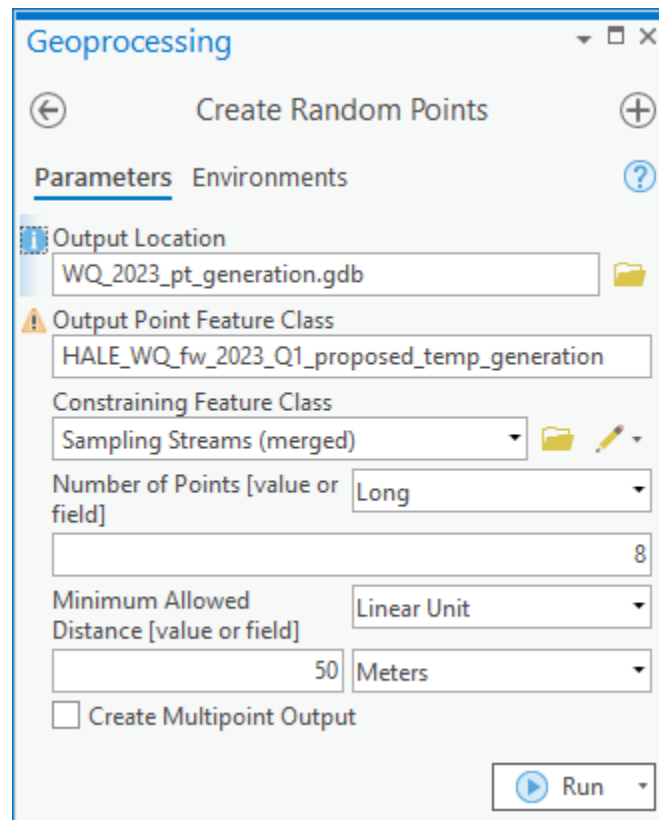


Figure SOP 7.2. Create Random Points Tool and setting criteria.

- i. Set *Output Location* and *Output Point Feature Class* to the temp geodatabase created in Step 2, (.gdb) and name the output feature class as desired.
Suggested name =
[PARK]_WQ_fw_[YYYY]_[Quarter]_proposed_temp_generation
- ii. Select the *Constraining Feature Class*. This will be the sampling stream segments of the sampling frame in question. These feature classes are located within “sampling_streams_freshwater” Feature Dataset of the master PACN Water Quality GIS database (PACN_WQ_MASTER.gdb), located in the

“[Data](#)” folder in the PACN Monitoring Archive³ for Water Quality Monitoring in SharePoint.

Important Note: *the sampling stream segments must all be merged into a single attribute or the tool will not run properly. If segments are separate attributes, the number of desired points for the entire stream sampling frame will be generated for each segment regardless of size, and not overall for the sampling frame. In addition to producing too many points, this will skew point generation to the smaller segments.*

- iii. Enter the desired number of points to be generated in the “Long” field under *Number of Points* [value or field]. Refer to [Appendix SOP 7.b.](#) to determine the number of points needed.
 - iv. Set the “Linear Unit” field under *Minimum Allowed Distance* [value or field] to 50 meters.
 - v. **Do not** check the box for *Create Multipoint Output*—if checked, then uncheck.
 - vi. Run the tool. The output generated is the random points.
4. Verify successful point generation. Random points should not be within 50 m of one another (this is set in the *Minimum Allowed Distance* input of the tool) but may be within any distance of a fixed points.
 5. Repeat steps 2-3, and then complete steps 6-9 for all ‘sampling frames’ (i.e., Quarters).
 6. Add the following data fields for each of the recently generated feature classes—you can copy and paste fields within the Field editor in ArcGIS Pro. (Figure SOP 7.3).
 - *Samp_Frame* (Text, 5 characters)
 - *Random* (Float)
 - *Rnd* (Short Integer)

³ PACN Monitoring Archive, https://doimspp.sharepoint.com/sites/nps-PWR-PACNIM/monitoring_archive (accessed 19 December 2022).

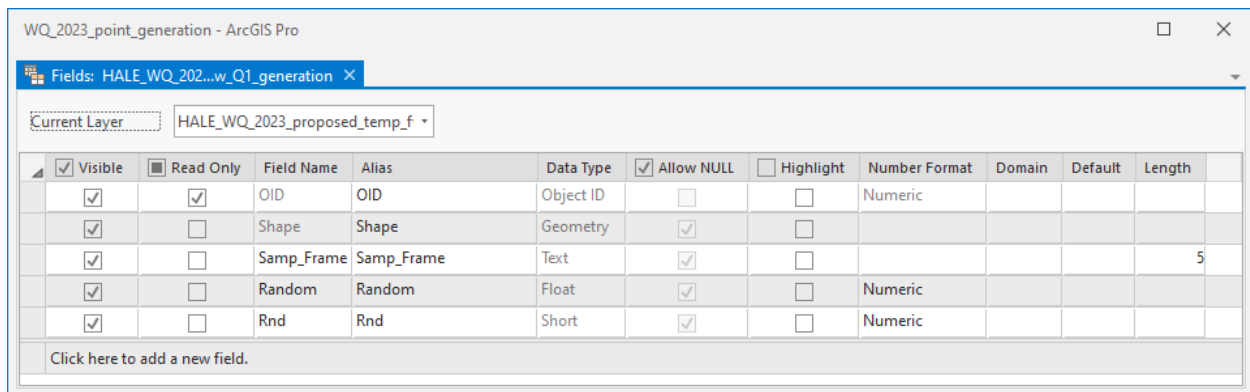


Figure SOP 7.3. Adding data fields for each of the recently generated featured classes.

7. Populate the *Sampling Frame* field with the appropriate Quarter (i.e., Q1, Q2, etc.).
8. Use the Field Calculator Tool to generate a set of random numbers for cells in the *Random* field by setting the following criteria (Figure SOP 7.4, below):

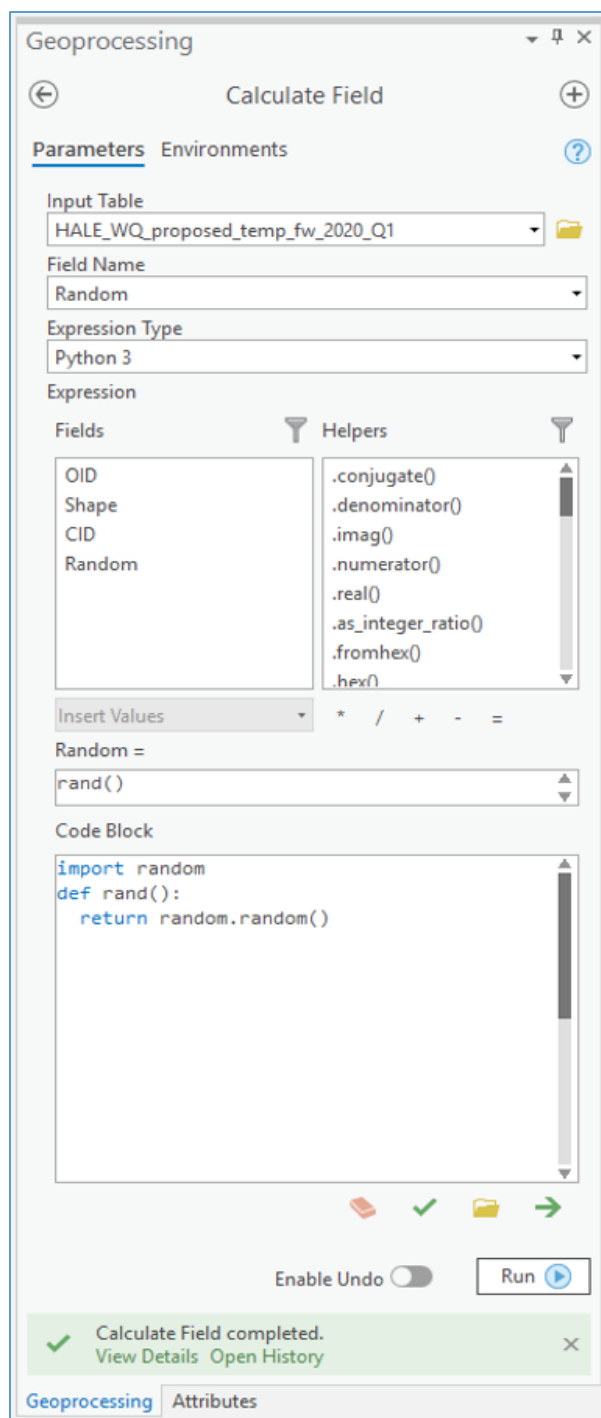


Figure SOP 7.4. Field Calculator Tool and setting criteria.

- Within the Field Calculator Tool, make sure the *Expression Type* is set to “Python 3.”
- Type the following code into the *Code Block* field:

```
import random
```

```
def rand():
    return random.random()
```

c. Then type the following code into the *Random* = field:
 rand()

d. Run the tool.

9. Verify a new set of random numbers has been generated in the Random attribute field.

10. Sort (ascending) the attribute table by the *Random* field (Figure SOP 7.5), and then populate the *Rnd* field with ascending numbers in the order generated by sorting the Random field (Figure SOP 7.6).

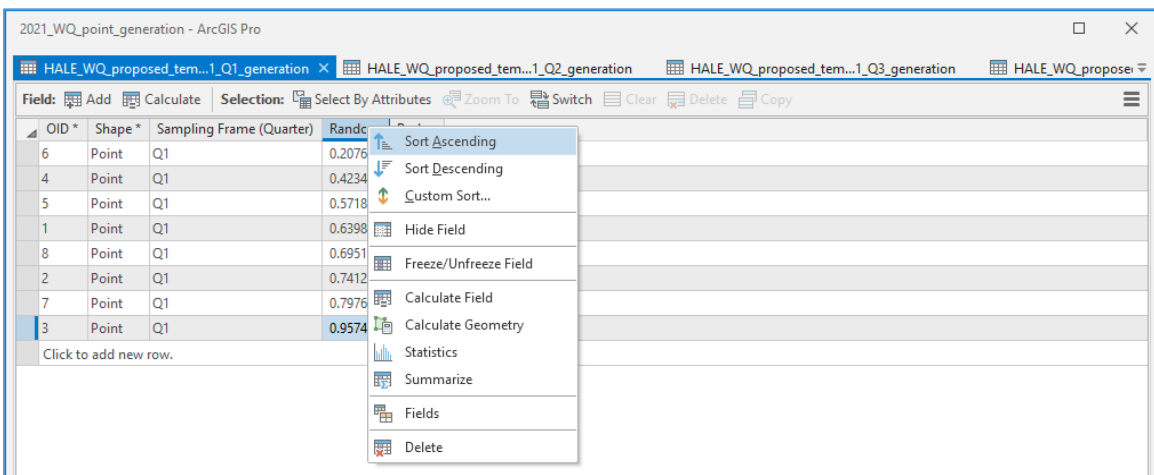


Figure SOP 7.5. Sorting the *Random* field in the attribute table by ascending order.

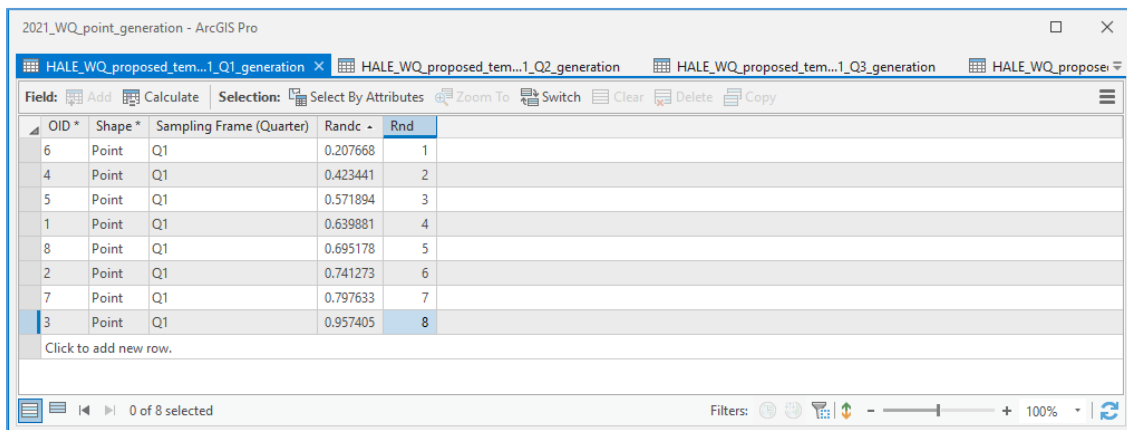


Figure SOP 7.6. Populating the *Rnd* field with ascending numbers.

11. Run the Merge Tool (ArcToolbox > Data Management Tools > General > Merge) and merge all the random point feature classes that have just been created. Suggested name = [PARK]_fw_[YYYY]_WQ_proposed_temp_merge. Open the new merged feature class.

12. Define/create schema on the merged feature class, and populate fields as described (Figure SOP 7.7)—recommend that a schema template is created and then fields are copy/pasted in.

Specify schema as follows:

- Unit_Code (Text, 5 characters long); fill in as appropriate
- Samp_Year (Short integer); fill in as appropriate (YYYY format)
- Station_ID (Text, 15 long); populate in next step
- Loc_Type (Text, 25 long); all cells populated with value “Freshwater”
- Loc_Name (Text, 25 long); populate as appropriate
- Samp_Frame (Text, 5 long); populate with quarter sampling is for (i.e., “Q1”)
- Latitude (Double)
- Longitude (Double)
- Rnd (Short integer); populate with plot number only, no zero in front
- GCS (Text, 50); All cells populated with value “World Geodetic System 1984”
- Geo_Datum (Text, 15); All cells populated with value “D_WGS_1984”

Current Layer		HALE_WQ_proposed_temp_fw_202 ▾									
▲	☒ Visible	☒ Read Only	Field Name	Alias	Data Type	☒ Allow NULL	☐ Highlight	Number Format	Domain	Default	Length
	☒	☒	OBJECTID	OID	Object ID	☐	☐	Numeric			
	☒	☐	Shape	Shape	Geometry	☒	☐				
	☒	☐	Random	Random	Float	☒	☐	Numeric			
	☒	☐	Latitude	Latitude	Double	☒	☐	Numeric			
	☒	☐	Longitude	Longitude	Double	☒	☐	Numeric			
	☒	☐	Unit_Code	Unit_Code	Text	☒	☐				5
	☒	☐	Samp_Year	Samp_Year	Short	☒	☐	Numeric			
	☒	☐	Station_ID	Station_ID	Text	☒	☐				15
	☒	☐	Loc_Type	Loc_Type	Text	☒	☐			Freshwater	25
	☒	☐	Loc_Name	Loc_Name	Text	☒	☐				25
	☒	☐	Samp_Frame	Samp_Frame	Text	☒	☐				5
	☒	☐	Rnd	Rnd	Short	☒	☐	Numeric			
	☒	☐	GCS	GCS	Text	☒	☐			World Geodetic System 1984	50
	☒	☐	Geo_Datum	Geo_Datum	Text	☒	☐			D_WGS_1984	15
Click here to add a new field.											

Figure SOP 7.7. Setting criteria for the merged feature class in the current layer.

13. Select the *Station_ID* field in the attribute table. Populate that field with the temporary point names. The naming convention for temporary stream points is as follows:
“T[PARK][2-digit plot number]_fw”

Plot numbers start at 01 and ascend in sequence. To do this, use the Field Calculator Tool with Arcade as the Expression Type and input the following expression (WAPA is used as the Park Identifier in the code example below—change as needed when naming for other parks): "TWAPA0" + \$feature.Rnd + "_fw".

Double check that station ID's have been properly named *T[PARK]xx_fw* (xx = 01-08 or up

to the number of plots required). For example, the third plot on the list for Guam stream sampling in a given quarter would be named “TWAPA03_fw”.

Note: If more than 9 points have been generated, the Arcade example given will add an extra ‘0’ into the Station_ID for plots 10 and up. To generate proper Station IDs for plots 10 and higher, remove the ‘0’ after the park identifier in the Arcade example given.

14. Run the Sort Tool (ArcToolbox > Data Management Tools > General > Sort) on the merged feature class (Figure SOP 7.8).
 - a. Sort by *Sampling Frame* (ascending), and then by *Rnd* (ascending).
 - b. Suggested name = *[PARK]_WQ_fw_[YYYY]_proposed_tempmerge_sort*
 - c. Open the new feature class and verify proper sorting (Figure SOP 7.9).

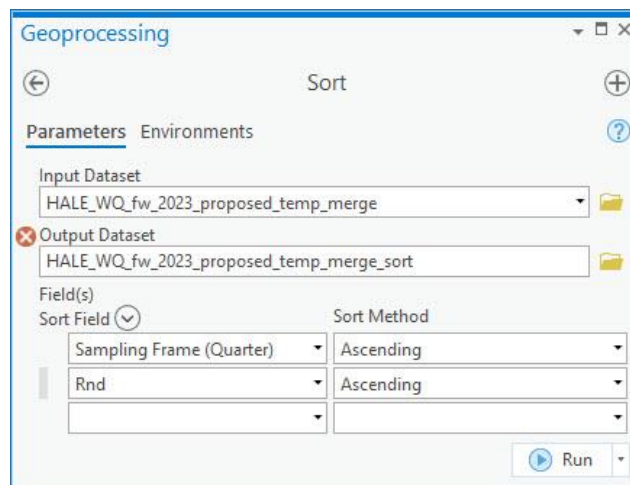


Figure SOP 7.8. Running the Sort Tool with set criteria.

2021_WQ_point_generation - ArcGIS Pro

HALE_WQ_proposed_tem...21_Q_merge_sort

Field: Add Calculate Selection: Select By Attributes Zoom To Switch Clear Delete Copy

OBJECTID	Shape	Sampling Frame (Quarter)	Rnd	Unit_Code	Samp_Year	Station_ID	Location Type	Location Name	Latitude	Longitude	GCS	Datum
1	Point	Q1	1	HALE	2020	THALE01_fw	Freshwater	Palikea_Upper	20.669354	-156.056193	World Geodetic Syste...	D_WGS_1984
2	Point	Q1	2	HALE	2020	THALE02_fw	Freshwater	Palikea_Lower	20.665047	-156.048052	World Geodetic Syste...	D_WGS_1984
3	Point	Q1	3	HALE	2020	THALE03_fw	Freshwater	Palikea_Lower	20.669286	-156.052785	World Geodetic Syste...	D_WGS_1984
4	Point	Q1	4	HALE	2020	THALE04_fw	Freshwater	Alelele	20.648213	-156.084438	World Geodetic Syste...	D_WGS_1984
5	Point	Q1	5	HALE	2020	THALE05_fw	Freshwater	Pipiwai	20.673124	-156.056157	World Geodetic Syste...	D_WGS_1984
6	Point	Q1	6	HALE	2020	THALE06_fw	Freshwater	Alelele	20.649648	-156.085816	World Geodetic Syste...	D_WGS_1984
7	Point	Q1	7	HALE	2020	THALE07_fw	Freshwater	Pipiwai	20.670023	-156.05347	World Geodetic Syste...	D_WGS_1984
8	Point	Q1	8	HALE	2020	THALE08_fw	Freshwater	Alelele	20.653527	-156.086539	World Geodetic Syste...	D_WGS_1984
9	Point	Q2	1	HALE	2020	THALE01_fw	Freshwater	Pipiwai	20.677075	-156.056696	World Geodetic Syste...	D_WGS_1984
10	Point	Q2	2	HALE	2020	THALE02_fw	Freshwater	Palikea_Upper	20.669465	-156.057063	World Geodetic Syste...	D_WGS_1984
11	Point	Q2	3	HALE	2020	THALE03_fw	Freshwater	Alelele	20.650196	-156.085617	World Geodetic Syste...	D_WGS_1984
12	Point	Q2	4	HALE	2020	THALE04_fw	Freshwater	Pipiwai	20.678215	-156.056647	World Geodetic Syste...	D_WGS_1984
13	Point	Q2	5	HALE	2020	THALE05_fw	Freshwater	Palikea_Lower	20.665568	-156.050373	World Geodetic Syste...	D_WGS_1984
14	Point	Q2	6	HALE	2020	THALE06_fw	Freshwater	Palikea_Lower	20.663057	-156.042012	World Geodetic Syste...	D_WGS_1984
15	Point	Q2	7	HALE	2020	THALE07_fw	Freshwater	Alelele	20.648333	-156.084633	World Geodetic Syste...	D_WGS_1984
16	Point	Q2	8	HALE	2020	THALE08_fw	Freshwater	Pipiwai	20.67477	-156.05635	World Geodetic Syste...	D_WGS_1984
17	Point	Q3	1	HALE	2020	THALE01_fw	Freshwater	Pipiwai	20.674489	-156.056315	World Geodetic Syste...	D_WGS_1984
18	Point	Q3	2	HALE	2020	THALE02_fw	Freshwater	Palikea_Lower	20.668051	-156.051898	World Geodetic Syste...	D_WGS_1984
19	Point	Q3	3	HALE	2020	THALE03_fw	Freshwater	Pipiwai	20.674018	-156.05635	World Geodetic Syste...	D_WGS_1984
20	Point	Q3	4	HALE	2020	THALE04_fw	Freshwater	Palikea_Lower	20.66373	-156.042976	World Geodetic Syste...	D_WGS_1984
21	Point	Q3	5	HALE	2020	THALE05_fw	Freshwater	Pipiwai	20.677467	-156.056817	World Geodetic Syste...	D_WGS_1984
22	Point	Q3	6	HALE	2020	THALE06_fw	Freshwater	Pipiwai	20.671668	-156.055083	World Geodetic Syste...	D_WGS_1984
23	Point	Q3	7	HALE	2020	THALE07_fw	Freshwater	Palikea_Lower	20.662953	-156.041839	World Geodetic Syste...	D_WGS_1984
24	Point	Q3	8	HALE	2020	THALE08_fw	Freshwater	Palikea_Lower	20.663866	-156.044661	World Geodetic Syste...	D_WGS_1984
25	Point	Q3	9	HALE	2020	THALE09_fw	Freshwater	Palikea_Lower	20.663855	-156.043799	World Geodetic Syste...	D_WGS_1984
26	Point	Q3	10	HALE	2020	THALE10_fw	Freshwater	Pipiwai	20.67082	-156.054252	World Geodetic Syste...	D_WGS_1984
27	Point	Q3	11	HALE	2020	THALE11_fw	Freshwater	Pipiwai	20.676143	-156.056636	World Geodetic Syste...	D_WGS_1984
28	Point	Q3	12	HALE	2020	THALE12_fw	Freshwater	Palikea_Lower	20.663446	-156.042483	World Geodetic Syste...	D_WGS_1984
29	Point	Q4	1	HALE	2020	THALE01_fw	Freshwater	Alelele	20.652366	-156.08592	World Geodetic Syste...	D_WGS_1984
30	Point	Q4	2	HALE	2020	THALE02_fw	Freshwater	Palikea_Lower	20.664072	-156.045901	World Geodetic Syste...	D_WGS_1984
31	Point	Q4	3	HALE	2020	THALE03_fw	Freshwater	Palikea_Upper	20.669423	-156.056937	World Geodetic Syste...	D_WGS_1984
32	Point	Q4	4	HALE	2020	THALE04_fw	Freshwater	Palikea_Upper	20.670029	-156.053725	World Geodetic Syste...	D_WGS_1984
33	Point	Q4	5	HALE	2020	THALE05_fw	Freshwater	Palikea_Upper	20.669885	-156.054361	World Geodetic Syste...	D_WGS_1984
34	Point	Q4	6	HALE	2020	THALE06_fw	Freshwater	Alelele	20.64869	-156.085384	World Geodetic Syste...	D_WGS_1984
35	Point	Q4	7	HALE	2020	THALE07_fw	Freshwater	Pipiwai	20.672923	-156.056021	World Geodetic Syste...	D_WGS_1984
36	Point	Q4	8	HALE	2020	THALE08_fw	Freshwater	Alelele	20.649127	-156.085685	World Geodetic Syste...	D_WGS_1984

Click to add new row.

0 of 36 selected

Filters: 100%

Figure SOP 7.9. Verifying settings in the new feature class.

15. Once all points have been generated, attributes populated, and sorted properly, export each quarter as a shapefile (field staff can then upload to Garmin devices using DNRGPS). Files should be exported and named as follows (Figure SOP 7.10):

- File Location:
“Spatial_info” folder > Year folder > Park folder > “GIS_Data” folder > “Shapefiles_for_upload” folder in SharePoint
- Shapefile Name:
[PARK]_WQ_fw_[YYYY]_[Quarter]_proposed_temp
(e.g., WAPA_WQ_fw_2023_Q1_proposed_temp.shp)

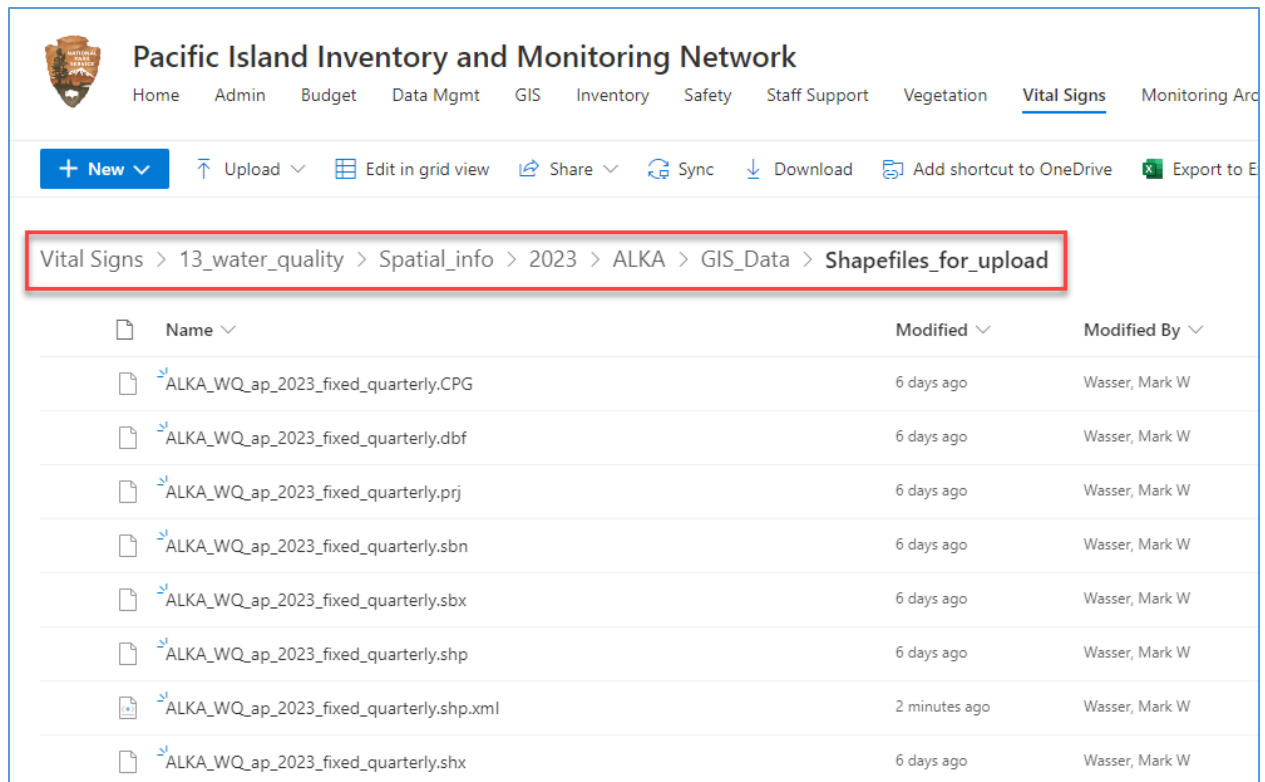


Figure SOP 7.10. Example of exported shapefile location for a particular year and park in SharePoint.

16. Create (or import from previous year) a map layout within the Pro Project and generate PDF maps for each sampling quarter. Files should be exported and named as follows (Figure SOP 7.11):

- Export maps to the following directory:
“[Spatial_info](#)” folder > Year folder > Park folder > “Map_Products” folder in SharePoint
- Suggested naming convention:
[PARK]_WQ_fw_[YYYY]_[sampling_quarter]_[page_size]_[page_orientation].pdf
(e.g., KALA_WQ_fw_2023_Q1_letter_port.pdf)

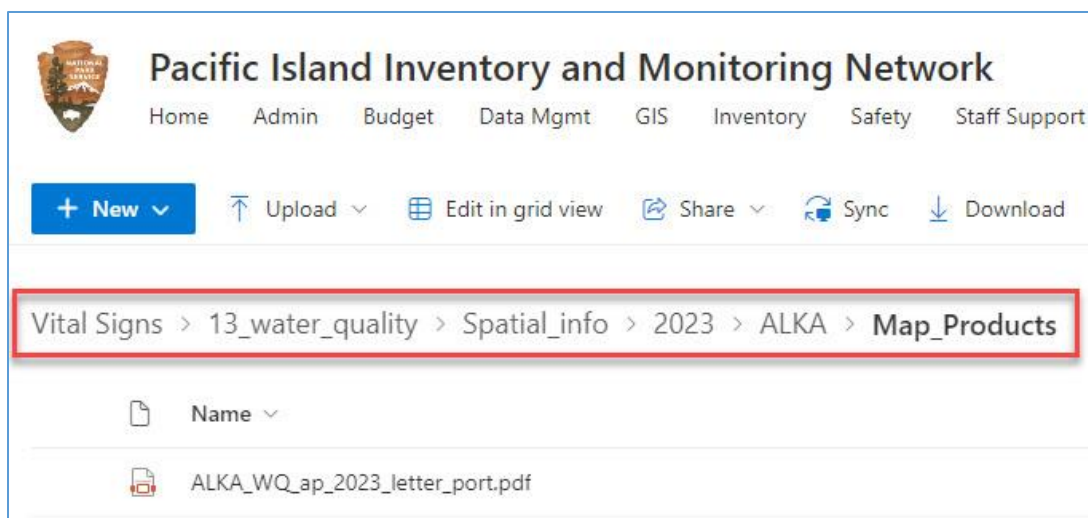


Figure SOP 7.11. Example of exported maps PDF file location for a particular year and park in SharePoint.

17. Save copies of both Pro map (.mapx) and layout templates (.pagx) in the following directory:
 “[Spatial_info](#)” folder > Year folder > Park folder > “GIS_Data” folder > “Projects” folder in
 SharePoint (Figure SOP 7.12).

- Suggested naming conventions are (Figure SOP 7.12):
 [PARK]_WQ_fw_[YYYY].mapx (Map Templates)
 (e.g., KALA_WQ_fw_2020.mapx)

[PARK]_WQ_fw_[YYYY]_[Sampling_Quarter]_[page_size]_[page_orientation].pag
 x (Layout Templates) (e.g., KALA_WQ_fw_2023_Q1_letter_port.pagx)

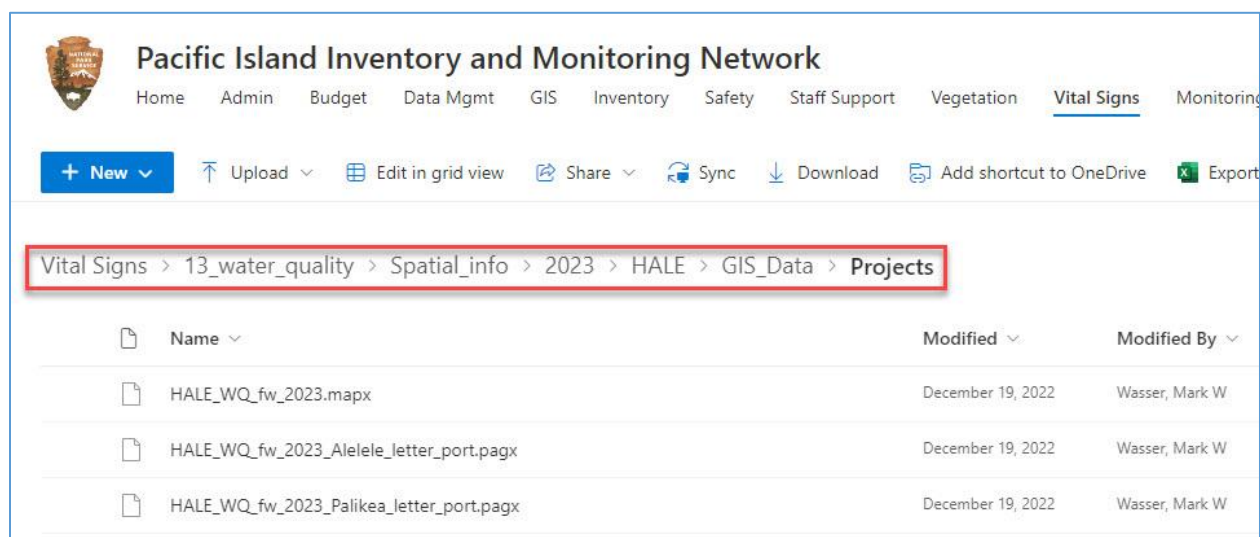


Figure SOP 7.12. Example of Pro map (.mapx) and layout templates (.pagx) file location for a particular year and park in SharePoint.

Generating Random Point for Temporary Sampling Locations in Marine Areas

Following the protocol update in 2023, temporary sampling stations for Marine Water Quality (WQ) and Benthic/Marine Fish are no longer co-located. Some WQ data are still collected at the Benthic/Marine Fish temporary stations (they are “YSI only sites” for WQ), so both kinds of temporary sampling stations continue to be included in this SOP.

There are now two types of temporary sampling locations generated for Marine Areas.

- a. Benthic & Marine Fish / Water Quality “YSI Only” Sites – sampled yearly
- b. Water Quality Near Shore Sites – sampled bi-annually

Steps are the same as point generation for perennial streams, with the following changes for all marine areas: Replace ‘fw’ > ‘mr’ and ‘Freshwater’ > ‘Marine’ anywhere those text sequences are used or referenced in script, code, or naming conventions

For Benthic & Marine Fish / Water Quality “YSI Only” Sites (Yearly):

1. Steps 1 and 2 from the Perennial Stream section are unchanged. Use the same ArcGIS Pro project and file geodatabase created there.
2. Follow step 3 instructions from the Perennial Stream section with the following changes:
 - a. Change from Step 3.i in the previous section – replace “WQ” with “BENT” in the output class feature name (i.e. KAH0_BENT mr_2025_Q4_temp_site_generation.shp).
 - b. Change from step 3.ii, in the previous section – The *Constraining Feature Class* will be the polygon feature class for the marine sampling frame in question. These feature classes are located within “sampling_frames_marine” Feature Dataset of the master PACN Water Quality GIS database (PACN_WQ_MASTER.gdb), located in the “[Data](#)” folder in the PACN Monitoring Archive for Water Quality Monitoring in SharePoint.
 - c. Change from step 3.iii in the previous section – the number of points to be generated for each park will be set to 20 (or set to 22-24 in case any are rejected, and then discard any unused ones in excess of 20). Refer to [Appendix SOP 7.b.](#) for more details.

Important Note: *Like the stream segments, the marine sampling frame polygons must all be merged into a single attribute, or the tool will not run properly. The exception to this is at WAPA – the marine temp sites need to be split evenly between Asan and Agat Marine Units, so the Create Random Points geoprocessing tool should be run with those two polygons not merged into a single attribute.*

The Marine (Benthic) Sampling Frames were delineated with the following criteria:

- Within park boundaries plus adjacent coastal areas that may impact (or be impacted by) the park. Adjacent coastal areas extend to the edges of the watershed(s) in which the park lies.
 - Within 10 to 20 m depth contours.
 - On hard substrate (basalt or limestone, or coral reef) that has been predetermined from the benthic habitat map.
3. Follow steps 4-14 from the Perennial Stream section, making the ‘fw’ to ‘mr’ and ‘freshwater’ to ‘marine’ changes noted at the beginning of this section.
 - a. For step 5, the geoprocessing tool should be run four times – once for each unit with these temporary marine sites which are sampled yearly. Upon completion there should be four different output feature classes.
 - b. Step 7 – the *Sampling Frame* field should be populated with the appropriate quarters as follows: KAHO = Q4; KALA = Q3; NPSA = Q2; WAPA = Q2.
 4. Follow step 15 from the Perennial Stream section, but replace “WQ” with “BENT” in the exported shapefile names, and remove ‘fw’ from the name.
 - a. File Location:
 “[Spatial info](#)” folder > Year folder > Park folder > “GIS_Data” folder > “Shapefiles_for_upload” folder in SharePoint
 - b. Shapefile Name:
 [PARK]_BENT_[YYYY]_[Quarter]_proposed_temp
 (e.g., KAHO_BENT_2024_Q4_proposed_temp.shp)
 5. Follow steps 16-17 from the Perennial Stream section, replacing “WQ_fw” with “BENT” in naming conventions for pdf map products, and map and layout templates for these sites. For quarters with both Benthic & Marine Fish / Water Quality “YSI Only” Sites and Water Quality Near Shore Sites, separate PDF maps will be generated for each site type for those respective quarters, but single Pro Map and Layout Templates can be used for both.

For Water Quality Near Shore Sites (Bi-Annual):

1. Steps 1 and 2 from the Perennial Stream section are unchanged. Use the same ArcGIS Pro project and file geodatabase created there
2. Follow step 3 instructions from the Perennial Stream section with the following changes:
 - a. Change from Step 3.i in the Perennial Steam section – the output feature class will be named “WQ_mr_[YYYY]_open_water_temp_site_generation_cycle_[x]” (this is done twice so it will either be cycle 1 or cycle 2).

- b. Change from step 3.ii, in the Perennial Stream section – The *Constraining Feature Class* will be the “WQ_sampling_temp_generation_areas_marine_2023_ply” feature class located within “sampling_frames_marine” Feature Dataset of the master PACN Water Quality GIS database (PACN_WQ_MASTER.gdb), located in the “[Data](#)” folder in the PACN Monitoring Archive for Water Quality Monitoring in SharePoint.

Important Note: *The polygons for near shore temporary sampling site generation do not need to be merged into a single attribute when running the Create Random Points geoprocessing tool. Since the same number of temp sites (two) are generated for each polygon in the feature class per park per sampling period (see [Appendix SOP 7.b.](#)), the tool can be run for all parks at the same time.*

3. Follow steps 4-14 from the Perennial Stream section, making the ‘fw’ to ‘mr’ and ‘freshwater’ to ‘marine’ changes noted at the beginning of this section. Also make the following adjustments:
 - a. Change from step 5 in the Perennial Stream section. The tool can be run for all parks simultaneously since the same number of temp sites (two) are generated for each polygon in the feature class per park per sampling period (see [Appendix SOP 7.b.](#)) Each park is now sampled bi-annually, so the tool will be run twice (capturing all parks at once for each sampling cycle) for the near shore marine temporary sites. The output for this section will be two feature classes (named per Step 2.a this section).
 - b. Step 7 – the *Sampling Frame* field should be populated with the appropriate quarters as follows (also see [Appendix SOP 7.b.](#))
 - i. Cycle 1: Q2 for all parks (KAHO, KALA, NPSA, WAPA)
 - ii. Cycle 2: KAHO = Q4, KALA = Q3, NPSA = Q4, WAPA = Q4
 - c. Omit Step 11.
 - d. Step 13 – continue to use ascending plot numbers. If a sampling frame (Quarter) also has Benthic & Marine Fish / Water Quality “YSI Only” Sites (i.e. NPSA Q2, etc), the Water Quality Near Shore Sites numbering for that quarter will start at 21 instead of 01 as those sites are already labeled 01-20.
 - e. Omit Step 14.
4. Follow step 15 from the Perennial Stream section, replacing ‘fw’ with ‘mr’ as described.
 - a. File Location:
“[Spatial info](#)” folder > Year folder > Park folder > “GIS_Data” folder > “Shapefiles_for_upload” folder in SharePoint

b. Shapefile Name:

[PARK]_WQ_mr_[YYYY]_[Quarter]_proposed_temp
(e.g., KALA_WQ_mr_2024_Q2_proposed_temp.shp)

5. Follow steps 16-17 from the Perennial Stream section, replacing “fw” with “mr” and “freshwater” with “marine” in naming conventions for pdf map products, and map and layout templates for these sites. For quarters with both Benthic & Marine Fish / Water Quality “YSI Only” Sites and Water Quality Near Shore Sites, separate PDF maps will be generated for each site type for those respective quarters, but single Pro Map and Layout Templates can be used for both.

Selecting Random Points for Temporary Sampling Locations in Anchialine Pools

1. Open ArcGIS Pro and load the layer that contains the rotational site list for Anchialine Pools. The source data is the feature class named *WQ_rotating_ap_sample_sites_pts* and is found within the master PACN Water Quality GIS database (PACN_WQ_MASTER.gdb), located in the “[Data](#)” folder in the PACN Monitoring Archive for Water Quality Monitoring in SharePoint.
2. Open the attribute table and select the field named *Random*. Right-click on the *Random* field header and open the Field Calculator Tool (ok to do outside an edit session).
3. Use the Field Calculator Tool to generate a new set of random number for the *Random* attribute field. This will overwrite the existing set of random numbers and be done every time random points are selected. See step 8 of the [Perennial Stream](#) instructions and follow the same procedures to do this.
4. Once random number have been generated, sort the attribute table by the *Random* field (ascending order) (Figure SOP 7.13).

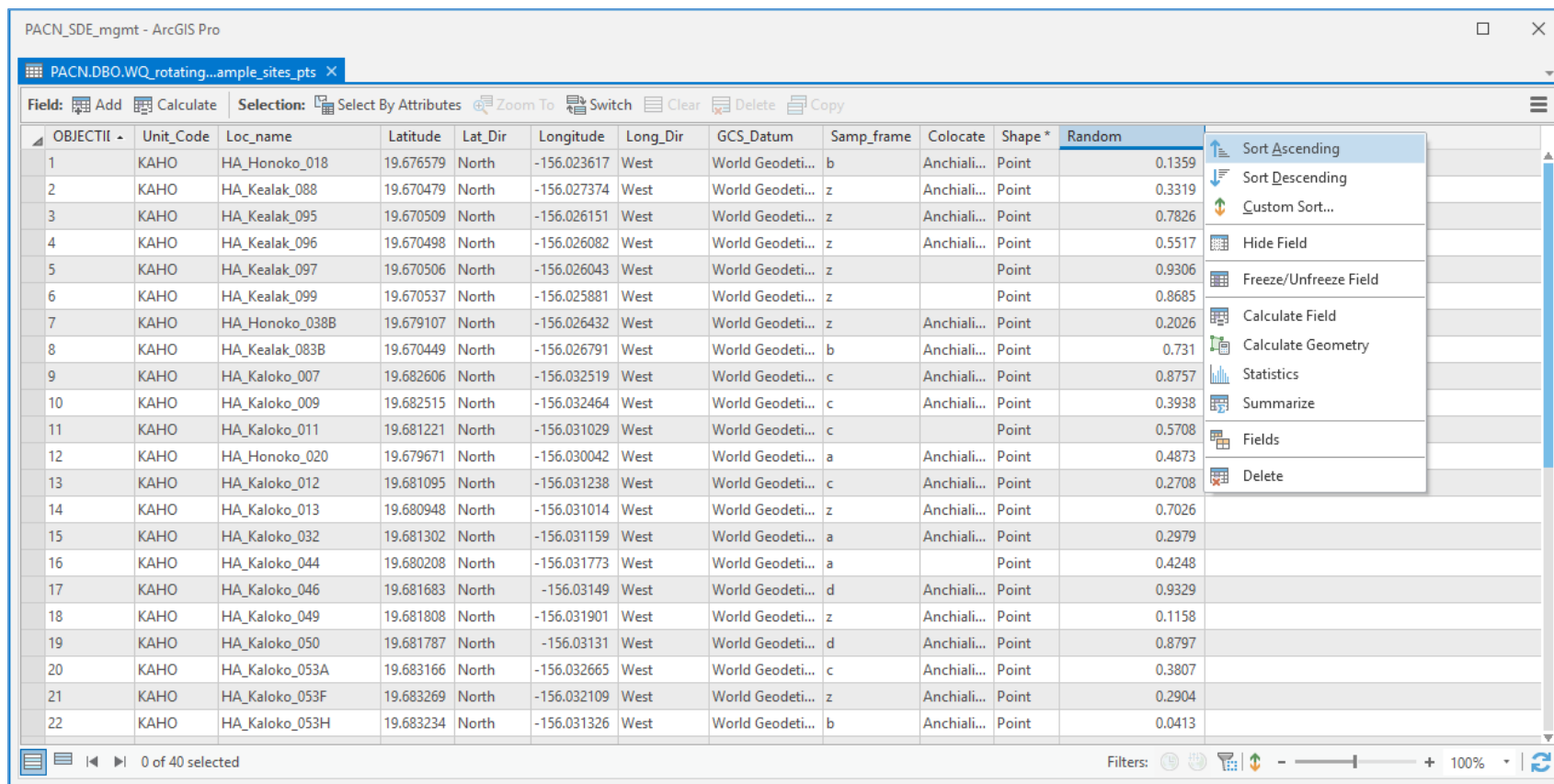


Figure SOP 7.13. Sorting the *Random* field by ascending order in the attribute table.

5. Random points will only be generated once annually for Anchialine Pools since pools from the list should not be sampled more than once in a single year. The first 8 pools on the random number sort will be used for Q1 temporary, the next eight for Q2 temporary, etc.
6. Select the first 8 records in the attribute table. Then go back to the Contents Pane, right-click on the AnchPool Rotational Site list layer and select “**Data**” > “**Export**” (Figure SOP 7.14).
 - a. Export the 8 selected records to the following directory (Figure SOP 7.10):
“[Spatial_info](#)” folder > Year folder > Park folder > “GIS_Data” folder > “Shapefiles_for_upload” folder in SharePoint
 - b. Name the exported shapefile as follows (Figure SOP 7.10):
KAHO_WQ_ap_[YYYY]_[Sampling_Quarter]_proposed_temp
(e.g., KAHOWQ_ap_2019_Q1_proposed_temp.shp)

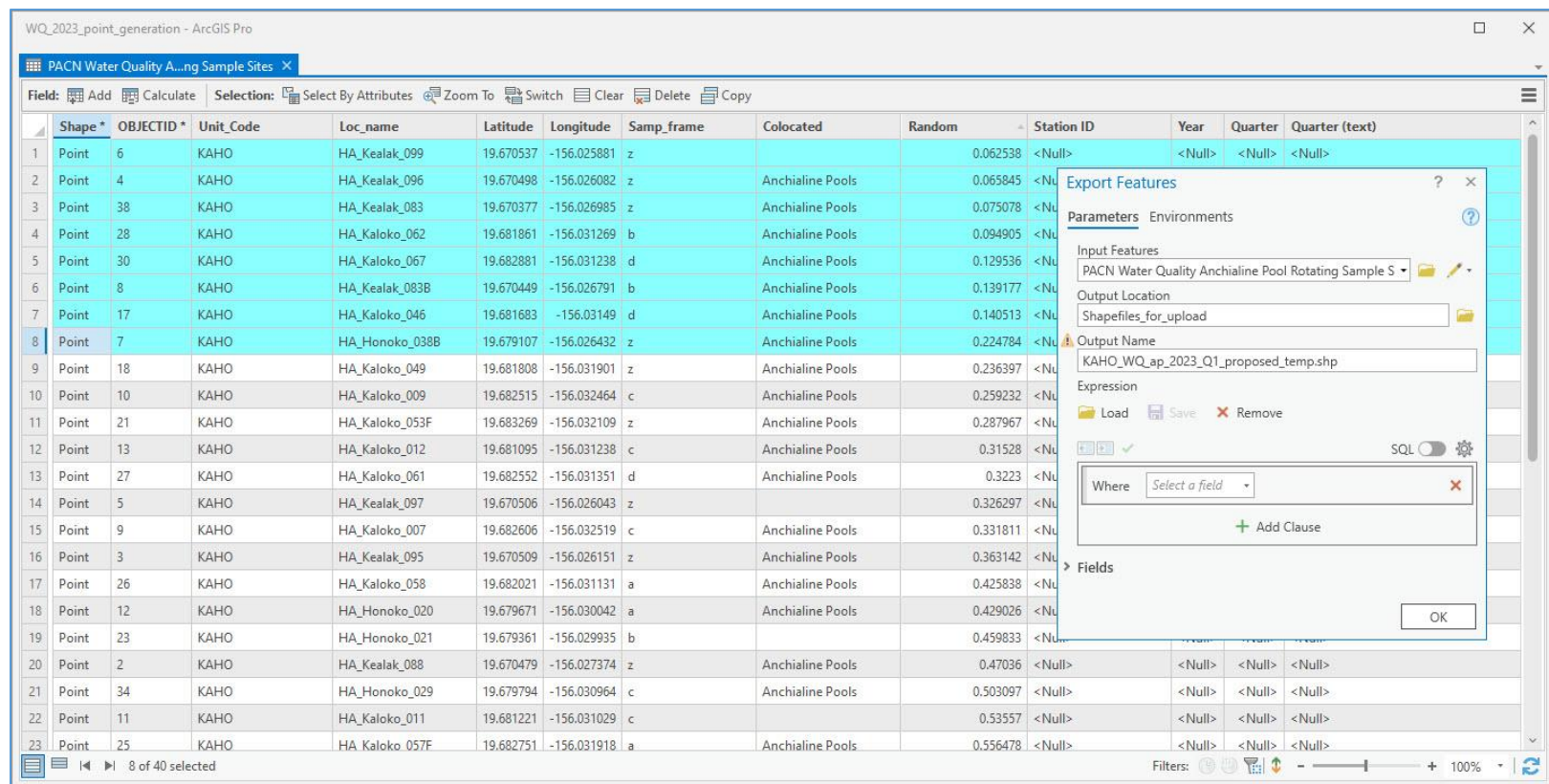


Figure SOP 7.14. Selecting the first 8 records in the attribute table and exporting as a shapefile to be uploaded to the SharePoint.

7. Bring the exported shapefile into the existing project and open the attribute table. Populate the Station_ID field. Use the Field Calculator Tool to populate that field with the following expression (use Arcade as the Expression Type) (Figure SOP 7.15):

"TKAHO0" & ([FID] +1) & "_ap"

Double check that station ID's have been properly named *TKAHOxx_ap* (xx = 01-08r).

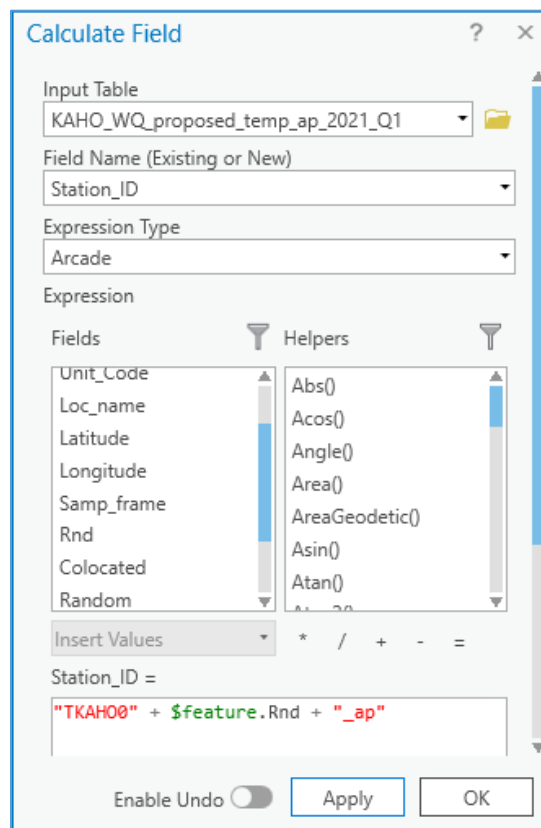


Figure SOP 7.15. Using the Field Calculator Tool to populate the *Station_ID* field.

8. Populate the *Year* and *Quarter* fields in your shapefile as appropriate (these fields are held blank in the AnchPool Rotational Site list layer, so they are ready to be populated in the exported shapefile).
9. Repeat steps 6 and 7 for Q2-Q4, using each sequential set of 8 records from the list. Name exported shapefiles accordingly. Station_ID naming conventions will repeat for each quarter (always TKAHO01_ap thru TKAHO08_ap) (Figure SOP 7.16).

WQ_2023_point_generation - ArcGIS Pro

KAHO Anchialine Temp Sites 2023 Q1

Field: Add Calculate Selection: Select By Attributes Zoom To Switch Clear Delete Copy

	Shape	FID	Unit_Code	Station_ID	Loc_name	Latitude	Longitude	Colocated	Year	Quarter	Quarter_tx
1	Point	0	KAHO	TKAHO01_ap	HA_Kaloko_046	19.681683	-156.03149	Anchialine Pools	2023	1	Q1
2	Point	1	KAHO	TKAHO02_ap	HA_Kaloko_062	19.681861	-156.031269	Anchialine Pools	2023	1	Q1
3	Point	2	KAHO	TKAHO03_ap	HA_Kaloko_053H	19.683234	-156.031326	Anchialine Pools	2023	1	Q1
4	Point	3	KAHO	TKAHO04_ap	HA_Kealak_099	19.670537	-156.025881		2023	1	Q1
5	Point	4	KAHO	TKAHO05_ap	HA_Kaloko_129	19.688746	-156.034236	Anchialine Pools	2023	1	Q1
6	Point	5	KAHO	TKAHO06_ap	HA_Kaloko_009	19.682515	-156.032464	Anchialine Pools	2023	1	Q1
7	Point	6	KAHO	TKAHO07_ap	HA_Honoko_038B	19.679107	-156.026432	Anchialine Pools	2023	1	Q1
8	Point	7	KAHO	TKAHO08_ap	HA_Kaloko_011	19.681221	-156.031029		2023	1	Q1

Click to add new row.

0 of 8 selected

Filters: 100%

Figure SOP 7.16. Example of an exported shapefile.

Appendix SOP 7.a. Equipment Necessary to Install Fixed or Random Water Quality Sampling Locations

Equipment (#/quantity)	Preparation & Maintenance
GARMIN® Global Positioning System (G.P.S.) unit (1)	Ensure that this equipment is available and set-up appropriately (according to SOP #4 Using Garmin GPS Units).
AA batteries (6)	Ensure this equipment is available. If rechargeable, ensure fully charged.
Waterproof case with desiccant and strap (1)	Ensure that this equipment is available. Replace desiccant pack biannually or if saturated.
Charts and grid layouts	Ensure that this equipment is available. Store in field binder.
Random number pair list	Create document and store in the field binder.
Compass (1)	Ensure that this equipment is available. Store in field binder.
Map of fixed and random sampling sites (2 copies)	Update prior to each trip with GIS specialist. Print in color to waterproof paper. Label sites. Store in field binder.
Fixed sampling site descriptions (with photo and compass heading)	Print to waterproof paper and store in field binder. Update If necessary prior to subsequent field sampling.
Park brochure and general map	Store in field binder.
ArcGIS Pro 2.x, DNRGPS	Check for software updates regularly

Appendix SOP 7.b. Sampling Schedule and List of Points Needed for Each Park and Sampling Frame

Freshwater Sites

Park	Stream Mon	FW Quarterly Sites	Qtrly Temp Sites Needed	FW Yearly Sites	Yearly Temp Sites Needed	Notes
AMME	n/a	Fixed only	0	n/s	0	No temp fw sites needed
HALE	Q3	Q1, Q2, Q4	8	Q3	12	
KALA	Q3	Q1, Q2, Q4	8	Q3	12	
NPSA	Q3	Q1, Q2, Q4	0	Q3	0	No temp fw sites needed
WAPA	Q1	Q2, Q3, Q4	8	Q1	12	

Marine Sites

Park	Benthic Mon	MR WQ Bi-Annual Sites	Bi-Annual MR WQ Temp Sites Needed	Benthic Yearly Sites	Yearly Benthic Temp Sites Needed	Notes
KAHO	Q4	Q2, Q4	6	Q4	20	Three Marine WQ temp site areas. Two sites each area / sampling quarter.
KALA	Q3	Q2, Q3	6	Q3	20	Three Marine WQ temp site areas. Two sites each area / sampling quarter.
NPSA	Q2	Q2, Q4	4	Q2	20	Two Marine WQ temp site areas. Two sites each area / sampling quarter.
WAPA	Q2	Q2, Q4	4	Q2	20	Two Marine WQ temp site areas. Two sites each area / sampling quarter.

***Following the protocol update in 2023, temporary sampling stations for Marine Water Quality (WQ) and Benthic/Marine Fish are no longer co-located. Some WQ data are still collected at the Benthic/Marine Fish temporary stations (they are “YSI only sites” for WQ), so those stations continue to be included in this SOP.*

Anchialine Pool Sites

Park	AP Quarterly Sites	Qtrly Temp Sites Needed	AP Yearly Sites	Notes
ALKA	Fixed only (6)	0	0	FALKA03_ap, FALKA05_ap, FALKA06_ap, FALKA07_ap, FALKA08_ap, FALKA09_ap
KAHO	Q1, Q2, Q3, Q4	8	n/a	
PUHE	Fixed only (3)	0	0	FPUHE01_bb, FPUHE02_bb, FPUHE03_bb
PUHO	Fixed only (5)	5	0	FPUHO02_ap thru FPUHO05_ap, and FPUHO08_ap