

Standard Operating Procedure 2.2.15

Please cite this as:

Summary

Revision Log

[illegible]

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Overview

This SOP outlines step-by-step instructions for creating data summary reports for the data collected as part of the Southeast Coast Network (SECN) wadeable stream habitat monitoring protocol (McDonald et al. 2018a).

It is assumed that all data have gone through the required QA/QC procedures prior to being used to generate any reports. The author should make sure that the data are ready for public distribution (pending park approval, see Protected Information section in the wadeable stream protocol narrative [McDonald et al. 2018a]) and have been officially certified by the protocol lead before creating a data report. If processing errors are identified during the course of the report generation, the protocol lead or the lead stream technician should be notified. If a processing or data error is encountered, the data will need to be corrected and re-certified prior to publication and release of the data.

To construct the reports, the following software is required:

- ArcMap*
- Microsoft Excel*
- Microsoft Word*
- R-Statistical Software*
- Adobe InDesign* (used by the SECN editing team)

*Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Make sure the only fonts used when constructing figures are Frutiger and NPS Rawlinson. See the SECN information technology (IT) point-of-contact (POC) if you need these fonts installed on your computer.

Export all figures as 600 dpi CMYK jpgs. Make sure that all figures are exported at the size that is specified in this SOP and are not greater than 6.5 inches wide and no more than 8 inches tall.

Report Authorship

Guidelines for report authorship are outlined in SOP 2.1.03 *Southeast Coast Network Authorship Guidelines—Version 2.0* (SECN 2016). In general, authorship is determined in a manner consistent with Director's Order #79, which instructs adherence to appropriate professional standards and responsible publication of scholarly and scientific documents.

Baseline Report

A baseline report will be produced for each site (reach) after the first survey. Baseline reports provide a short synopsis of the methods that were used to collect the data and provide the results of the survey in the form of the figures and tables described in Tables 1 and 2 and more thoroughly described in the following sections.

List of Figures and Tables

Table 1. List of figures to include in the baseline report.

Number	Short Title / Description	Source	Instructions
Figure 1	Park Overview Map	Map and/or data to produce map can be found on SECN GISdrive	Instructions in this document
Figure 2	Scales of Measurement	Stored on SECNShare drive in wadeable reporting figures folder	Insert figure from SECNShare drive
Figure 3	Reach layout	"	"
Figure 4	Detailed transect measurements	"	"
Figure 5	Basin-scale map of stream reach	Map and/or data to produce map can be found on SECN GIS drive	Instructions in this document
Figure 6	Reach-scale stream map	SECNShare drive	Methods used to create this map/figure are found in SECN SOP 2.2.14 (McDonald et al. 2018b)
Figure 7	Detailed Transect 1	SECNShare drive	"
Figure 8	Detailed Transect 2	SECNShare drive	"
Figure 9	Detailed Transect 3	SECNShare drive	"
Figure 10	Longitudinal Profile	SECNShare drive	"

Table 2. List of tables to include in the baseline report.

Number	Short Title / Description	Source	Instructions
Table 1	Bank Stability Index Table	SECNShare drive in wadeable reporting figures folder	Insert table from SECNShare drive
Table 2	Watershed Characteristics	SECNShare drive, Certified data folder, Basin Characteristics workbook	Methods used to create table are found in SECN SOP 2.2.14 (McDonald et al. 2018b)
Table 3	Land Use/Land Cover	"	"
Table 4	Geomorphic Channel Units	SECNShare drive, Certified data folder, Form 1 workbook	"
Table 5	Pebble Count statistics	"	"
Table 6	Large Woody Debris counts	"	"
Table 7	Canopy Cover estimates	"	"
Table 8	Thalweg Characteristics	SECNShare drive, Certified data folder, Form 2 workbook	"
Table 9	Reach-Scale Width Measurements	"	"
Table 10	Reach-Scale Bank Characteristics	"	"
Table 11	Detailed Transect 1	SECNShare drive, Certified data folder, Detailed Transect workbook	"
Table 12	Detailed Transect 2	"	"
Table 13	Detailed Transect 3	"	"
Table 14	Average Detailed Transect	"	"

Baseline Report Figures

Figure 1. Park overview map

Overview maps for each of the riverine parks with wadeable streams (Horseshoe Bend NMP, Kennesaw Mountain NBP, Chattahoochee NRA, Ocmulgee NM, and Congaree NP) and the ArcMap document required to construct the maps can be found on the SECN GIS drive at the following location:

SECN GIS:\GIS\projects\StreamHabitat\Wadeable*PARK*\Report_Figures

Prior to publication, review the most recent map to determine if any changes need to be made or if any of the layers need to be updated. The data that is needed to make the maps, their locations, and their display characteristics are described below.

Figure 1 Main Map Instructions

1. Park boundary (add it twice)
 - a. SECN GIS:\GIS\secn_gis*PARK*\data\basedata\boundary\park
 - b. Make the top layer hollow (with black outline, 1.00 width) and make the bottom layer with a “White” fill, no outline, and 66% transparent. Also, rename the bottom layer “Park Boundary” and add it to the legend
2. Stream Habitat Reach(s)
 - a. SECN
GIS:\GIS\projects\StreamHabitat\Wadeable*PARK*\Data*PARK*_wadeable_sites.shp
 - b. Use the Circle 2 symbol, size 7, and color “Electric Gold” (third Orange from top)
 - c. Rename the point Stream Habitat Reach(s) and add to the legend
 - d. Be sure to add an in map label for each of the reaches (e.g., KEMO 001 and KEMO 002)
3. Hillshade
 - a. SECN
GIS:\GIS\projects\StreamHabitat\Wadeable*PARK*\Data\Basin*PARK*_10m_hill
 - b. Place this layer below the layers that have already been added
4. National Land Cover Dataset (add it twice)
 - a. SECN GIS:\GIS\state_regional_gis\data\basedata\landcover
 - b. Make one of the layers 50% transparent and place it on top of the hillshade layer

- c. Place the other layer at the bottom of the layer stack and add to the legend
 - d. In the legend properties > Items, change the layer name font size to 7, the heading to font size 6, and make sure only visible classes are shown
5. 20 hectare (2.5 acre) flow accumulation stream network
 - a. SECN
GIS:\GIS\projects\StreamHabitat\Wadeable\PARK\Data\Basin\PARK_20ha_streams.shp
 - b. Make this layer have a width of 0.5, “Cretan Blue”, 50% transparent, place it above the administrative boundary, rename it “Rivers/Streams”, and add it to the legend
6. Roads
 - a. SECN GIS:\GIS\secn_gis\PARK\data\basedata\trans
 - b. Make this layer have a width of 0.5, “60% grey”, and place it on top of the NHDhd dataset, rename it “Roads” (if needed), and add it to the legend
7. Map legend outline
 - a. SECN GIS:\GIS\projects\StreamHabitat\Wadeable\PARK\Report_Figures
 - b. This shapefile is drawn behind the legend, scale, and north arrow to provide a transparent background for these map elements. If the map is changed at all these polygons may need to be edited so that they are in the correct position.
8. Map background
 - a. The layer is a single polygon drawn beyond the extent of the map and should be colored “Light Sienna” and made 75% transparent.
 - b. This layer is for aesthetic purposes only and is at the discretion of the map maker to include or not

Figure 1 Inset Map Instructions

1. States
 - a. SECN GIS:\GIS\state_regional_gis\data\basedata\boundary\political_bound\state
 - b. Make “40% grey” and keep the default width of 0.4
2. Stream Habitat Reach(s)
 - a. SECN
GIS:\GIS\projects\StreamHabitat\Wadeable\PARK\Data\Park_wadeable_sites.shp

- b. Use the Circle 2 symbol, size 7, and color “Electric Gold” (third Orange from top)

Figure 1 Additional information

1. Use ESRI north arrow 2
2. Include a scale bar on both the main and inset maps.
 - a. For the main map scale bar, add two bars and make one in kilometers and one in miles (make sure they have the same amount of divisions and ticks)
3. Make the map 6.5 inches (16.5 centimeters [cm]) wide and 8 inches (20.3 cm) tall.

Figure 1 Caption

Modify the following text to use as a caption for Figure 1 in the report: Figure 1. Map showing [FULL NAME OF PARK] and its wadeable stream monitoring sites. The land use/land cover (NLCD 2011; Homer et al. 2015) and perennial streams (derived from a 10-meter [32.8-feet] digital elevation model; data available from the U.S. Geological Survey) near the park are shown to provide a context for the data presented in this report.

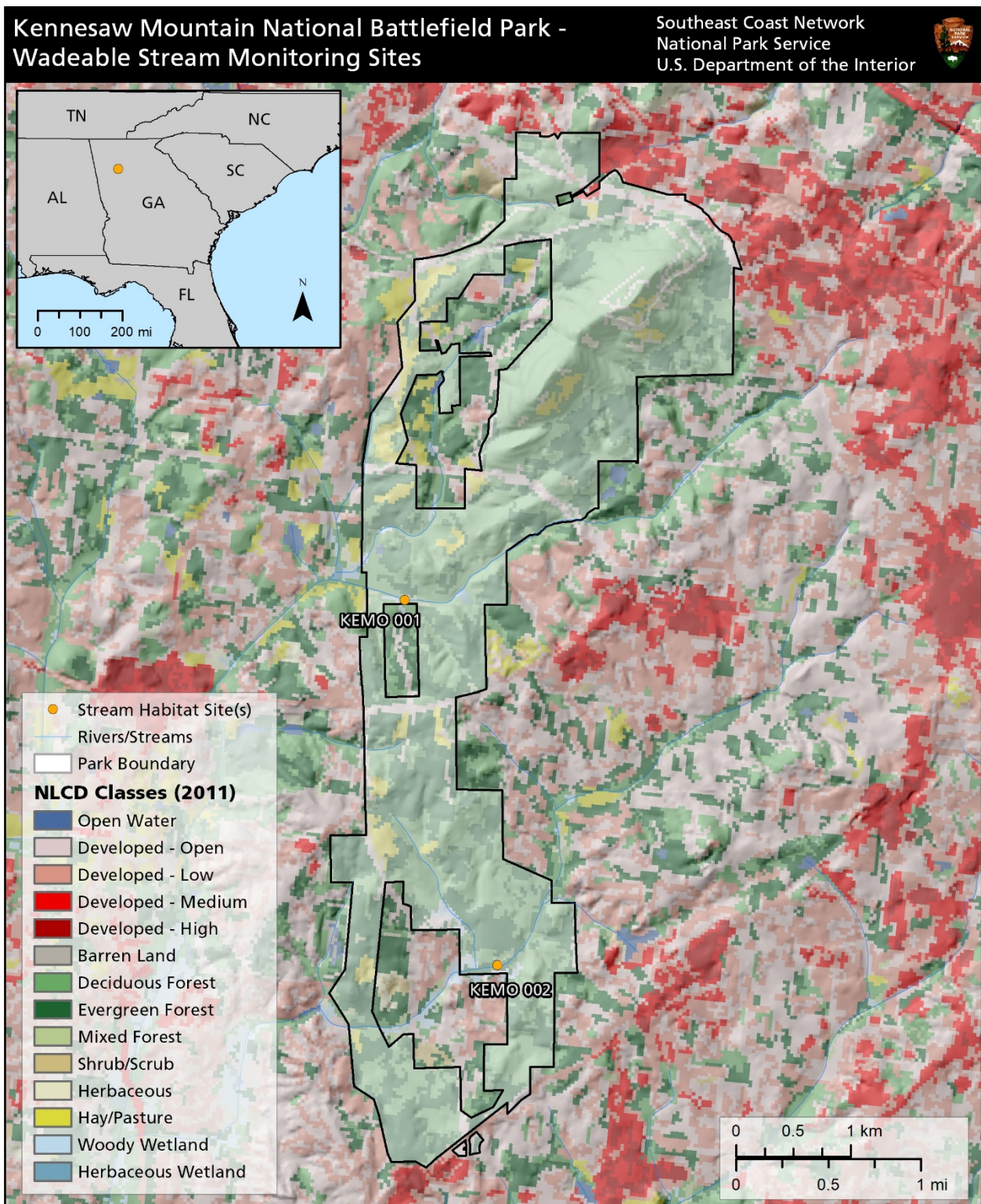


Figure 1. Example of Figure 1 in the baseline report for a site at Kennesaw Mountain National Battlefield.

Figure 2. Scales of Analysis

SECNShare: \Monitoring\StreamHabitat\Wadeable\Reports\Figures

The file is named:

Figure2_ScalesOfAnalysis.pptx

Once the figure has been located, submit this file along with the other figures/files to the editing team.

Figure 2 caption

Use the following text as the figure caption: Figure 2. Spatial hierarchy of stream systems and scales of data collection (modified from Fitzpatrick et al. 1998).

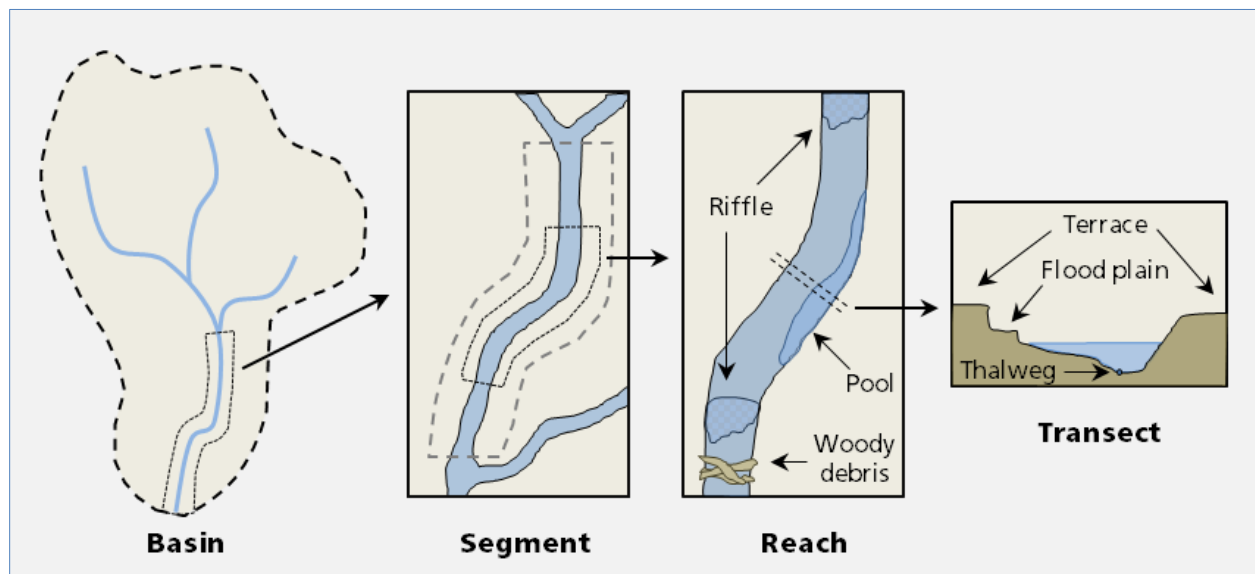


Figure 2. An example of Figure 2 in a baseline report.

Figure 3. Example Reach layout

This figure depicts a hypothetical stream layout. The figure can be found at the following location:

SECN Share: \Monitoring\StreamHabitat\Wadeable\Reports\Figures

The file is named:

Figure3_StreamReachLayout.pptx

Once the figure has been located, submit this file to the editing team.

Figure 3 caption

Use the following text as the figure caption: Figure 3. Example layout of stream reach with benchmarks, tie-in points, and transects.

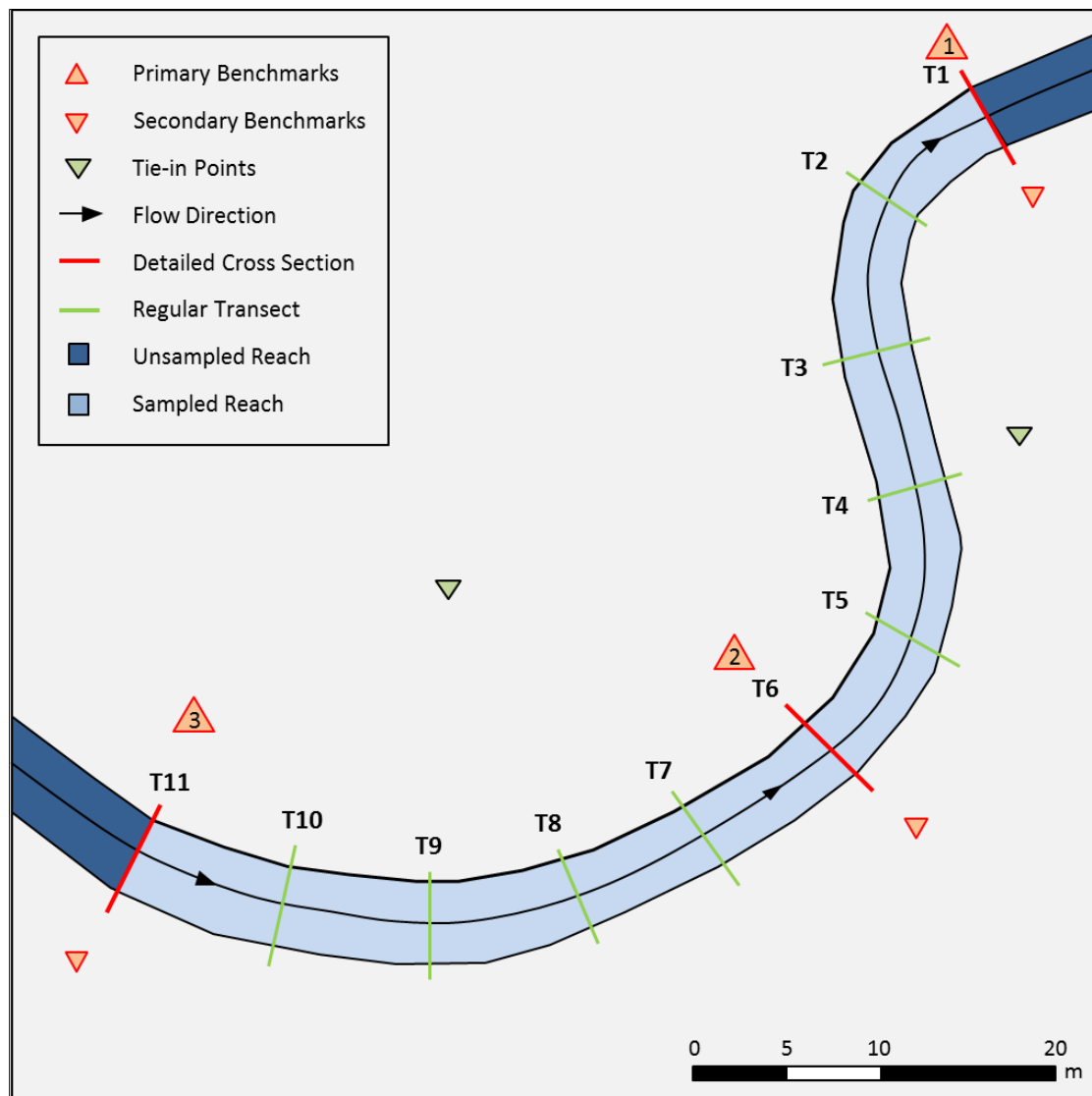


Figure 3. An example of Figure 3 in a baseline report.

Figure 4. Detailed Transect Cross-Sectional Measurements

This figure depicts a hypothetical detail transect survey and the different metrics that can be calculated from the survey. The figure can be found at the following location:

SECN Share:\Monitoring\StreamHabitat\Wadeable\Reports\Figures

The file is named:

Figure4_DetailedTransectDiagram.pptx

Once the figure has been located, submit this file to the editing team.

Figure 4 caption

Use the following text as the figure caption: Figure 4. Hypothetical detailed transect cross-sectional survey showing the diagnostic geomorphic surfaces that should be surveyed and the descriptive characteristics that will be derived from the data.

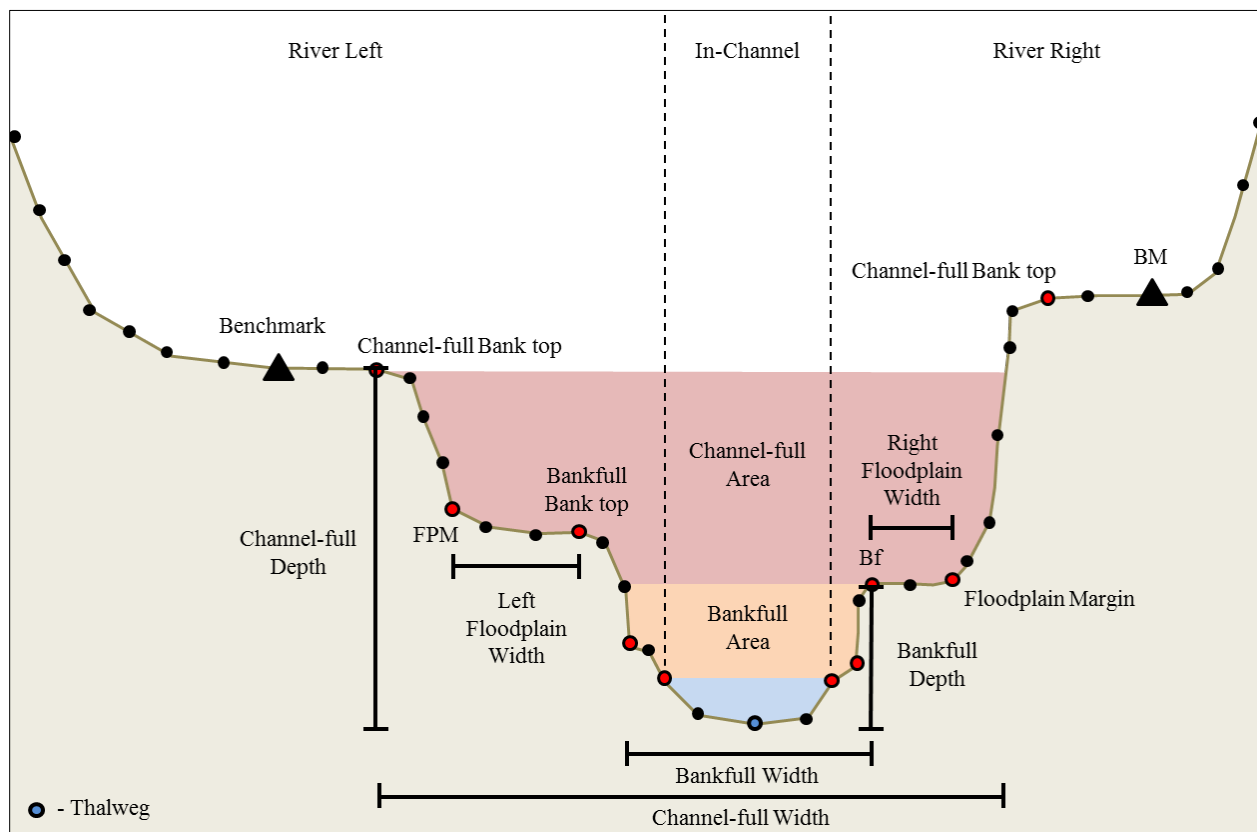


Figure 4. An example of figure 4 in a baseline report.

Figure 5. Reach-specific Basin Map(s)

Basin-scale maps for each stream survey site and the ArcMap documents required to construct the maps can be found on the SECN GIS drive at the following location:

SECN GIS: \GIS\projects\StreamHabitat\Wadeable\PARK\Report_Figures

Prior to publication, review the available maps to determine if any changes need to be made or if any of the layers need to be updated. Only include the basins that are described in the report. The data that is needed to make the maps, their locations, and their display characteristics are described below.

Figure 5 Main Map Instructions

1. Park boundary (insert twice)
 - a. SECN GIS: \GIS\secn_gis\PARK\data\basedata\boundary\park
 - b. Make the top layer hollow (with black outline, 1.00 width) and make the bottom layer with a “White” fill, no outline, and 66% transparent. Also rename the bottom layer “Park Boundary” and add it to the legend
2. Stream Habitat Reach(s)
 - a. SECN
GIS:\GIS\projects\StreamHabitat\Wadeable\PARK\Data\PARK_wadeable_sites.shp
 - b. Use the Circle 2 symbol, size 7, and color “Electric Gold” (3rd Orange from top)
 - c. Rename the point Stream Habitat Reach(s) and add to the legend
 - d. Be sure to add an in map label for each of the reaches (e.g., HOBE 001)
3. Stream Habitat Watershed
 - a. SECN
GIS:\GIS\projects\StreamHabitat\Wadeable\PARK\Data\PARK_wadeable_WS.shp
 - b. Make the polygon hollow and use an “Electron Gold” outline with a width of 1.00.
 - c. Rename the polygon Stream Habitat Watershed and add to the legend
4. Hillshade
 - a. SECN
GIS:\GIS\projects\StreamHabitat\Wadeable\PARK\Data\Basin\PARK_10m_hill
 - b. Place this layer below the layers that have already been added
5. National Land Cover Dataset (x2)
 - a. SECN GIS:\GIS\state_regional_gis\data\basedata\landcover
 - b. Make one of the layers 50% transparent and place it on top of the hillshade layer
 - c. Place the other layer at the bottom of the layer stack and add to the legend
 - d. In the legend properties > Items, change the layer name font size to 7, the heading to font size 6, and make sure only visible classes are shown
6. 20-hectare (2.5-acre) flow accumulation stream network

- a. SECN
GIS:\GIS\projects\StreamHabitat\Wadeable\PARK\Data\Basin\PARK_20ha_streams.shp
 - b. Make this layer have a width of 0.5, “Cretan Blue”, 50% transparent, place it above the administrative boundary, rename it “Rivers/Streams”, and add it to the legend
7. Roads
 - a. SECN GIS:\GIS\secn_gis\PARK\data\basedata\trans
 - b. Make this layer have a width of 0.5, “60% grey”, and place it on top of the NHDhd dataset, rename it “Roads” (if needed), and add it to the legend
8. Map legend outline
 - a. SECN GIS:\GIS\projects\StreamHabitat\Wadeable\PARK\Report_Figures
 - b. This shapefile is drawn behind the legend, scale, and north arrow to provide a transparent background for these map elements. If the map is changed at all these polygons may need to be edited so that they are in the correct position.
9. Map background
 - a. The layer is a single polygon drawn beyond the extent of the map and should be colored “Light Sienna” and made 75% transparent.
 - b. This layer is for aesthetic purposes only and is at the discretion of the map maker to include or not

Figure 5 Inset Map Instructions

1. States
 - a. SECN Gis:\GIS\state_regional_gis\data\basedata\boundary\political_bound\state
 - b. Make “40% grey” and keep the default width of 0.4
2. Stream Habitat Reach(s)
 - a. SECN
GIS:\GIS\projects\StreamHabitat\Wadeable\PARK\Data\PARK_wadeable_sites.shp
 - b. Use the Circle 2 symbol, size 7, and color “Electric Gold” (third Orange from top)

Figure 5 Additional Information

1. Use ESRI north arrow 2
2. Include a scale bar on both the main and inset maps.
 - a. For the main map scale bar, add two bars and make one in kilometers and one in miles (make sure they have the same amount of divisions and ticks)
3. Make the map 6.5 inches (16.51 cm) wide and 5.25 inches (13.34 cm) tall.

Figure 5 caption

Modify the following text and include it as the caption to the figure: Figure 5. Map showing the watershed draining to [PARK ###] at [FULL NAME OF PARK]. The land use/land cover (NLCD 2011, Homer et al. 2015) and perennial streams (derived from a 10 m digital elevation model; data available from the U.S. Geological Survey) in the vicinity of the park are also shown.

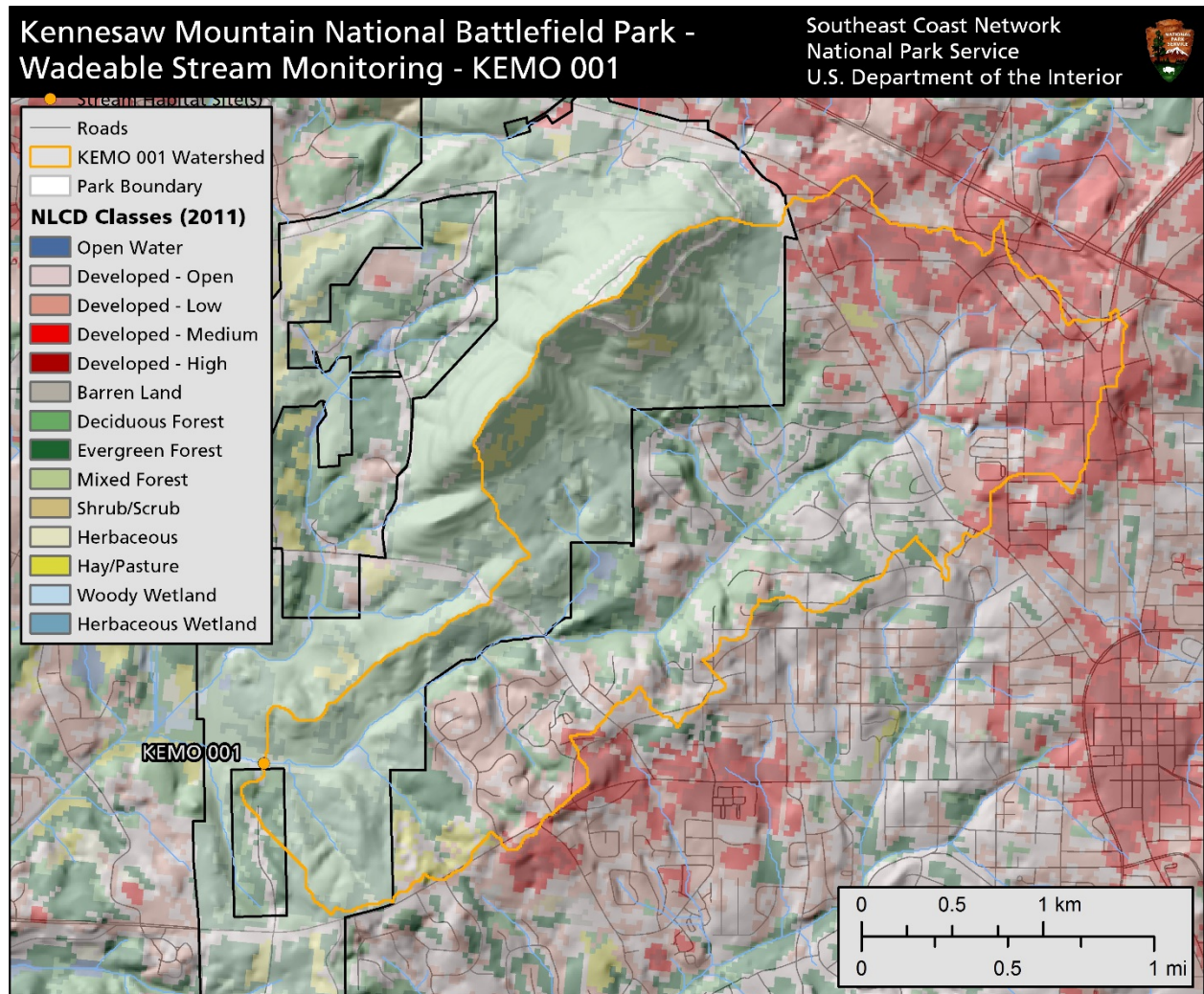


Figure 5. An example of Figure 5 in a baseline report for KEMO 001.

Figure 6. Reach-Scale Stream Map

Reach-scale maps for each of the stream survey reaches can be found on the SECN Share drive at the following location:

SECN Share: \Monitoring\StreamHabitat\Wadeable\Reports*PARK*\Figures

The stream map document will either be in powerpoint (pptx) or Adobe Illustrator (ai) format and named:

PARK###_StreamMap.pptx(or .ai)

The procedure for making this map can be found in SOP 2.2.14 *Wadeable Stream Data Processing and Analysis—Version 1.0* (McDonald et al. 2018b). Once the map has been created, export the map and submit along with the other files and figures to the editing team.

Figure 6 caption

Modify the following text and include as the caption for the figure: Figure 6. Reach-scale map of [PARK ###]. Important geomorphic surfaces and in-channel features are labeled to provide a context for the standard and detailed transect information provided in this report. The canopy cover circles are varying shades of grey which indicate the amount of canopy cover at each transect (high and low coverages are labeled).

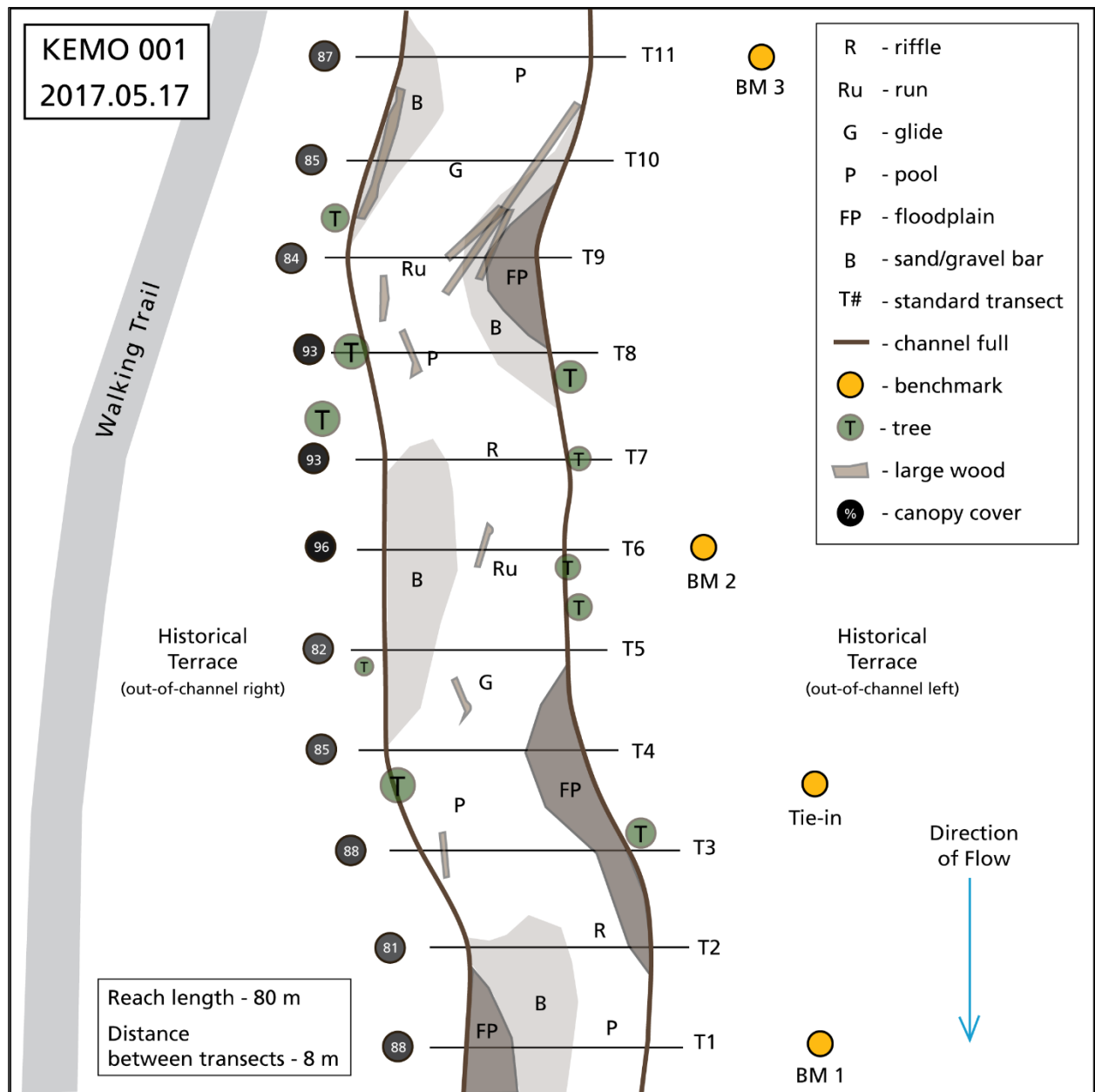


Figure 6. An example of Figure 6 in a baseline report for KEMO 001.

Figure 7, 8, or 9. Detailed Transect 1–3

These figures show the cross-sections surveyed at each of the three detailed transects at each wadeable stream reach. Detailed instructions on how to construct these figures is found in SOP 2.2.14 (McDonald et al. 2018b). These figures are produced in R and are exported to:

- SECN Share:\Monitoring\StreamHabitat\Wadeable\Data\PAK\C_Certified\PAK###

The file is named:

- PAK###_YYYYMMDD_T#_plot.png

Once these figures are created and someone from the stream survey team has made sure that they are correct, these figures can be inserted into the report document.

Figure 7 caption

Modify the following text and include as the figure caption: Figure 7. Detailed transect 1 at [PAK ###]. The surveyed locations of the left and right benchmarks, channel-full bank-tops, and interpreted bankfull bank height are shown on the figure. Additionally, the channel-full (light blue) and bankfull (dark blue) cross-sectional areas are also included (channel-full cross-sectional area equals light blue plus dark blue).

Figure 8 caption

Modify the following text and include as the figure caption: Figure 8. Detailed transect 2 at [PAK ###]. The surveyed locations of the left and right benchmarks, channel-full bank-tops, and bankfull bank height are shown on the figure. Channel-full (light blue) and bankfull (dark blue) cross-sectional areas are also included (channel-full cross-sectional area equals light blue plus dark blue).

Figure 9 caption

Modify the following text and include as the figure caption: Figure 9. Detailed transect 3 at [PAK ###]. The surveyed locations of the left and right benchmarks, channel-full bank-tops, and interpreted bankfull bank height are shown on the figure. Channel-full (light blue) and bankfull (dark blue) cross-sectional areas are also included (channel-full cross-sectional area equals light blue plus dark blue).

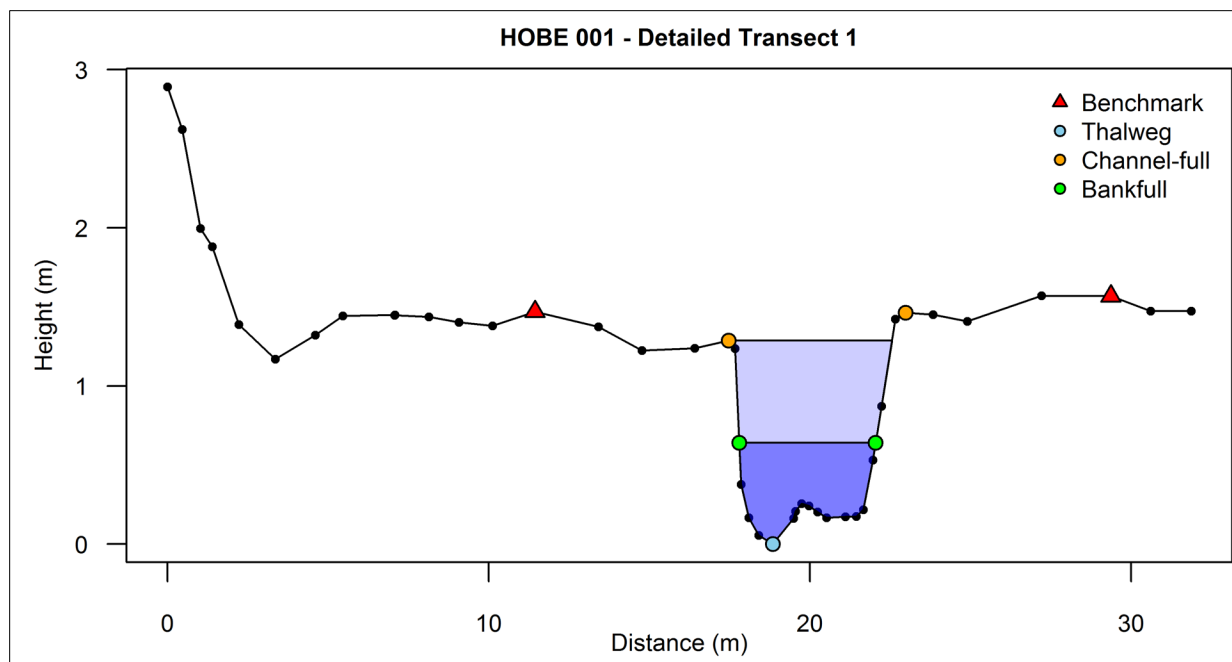


Figure 7. An example of Figure 7 in a baseline report.

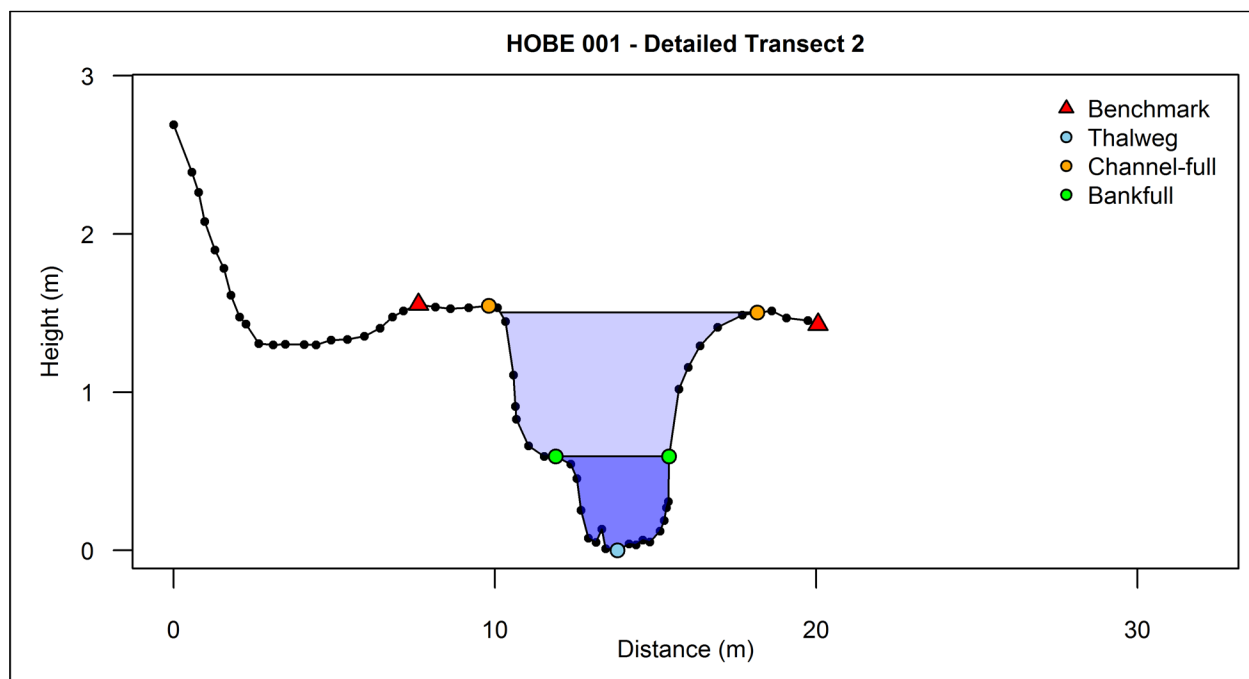


Figure 8. An example of Figure 8 in a baseline report.

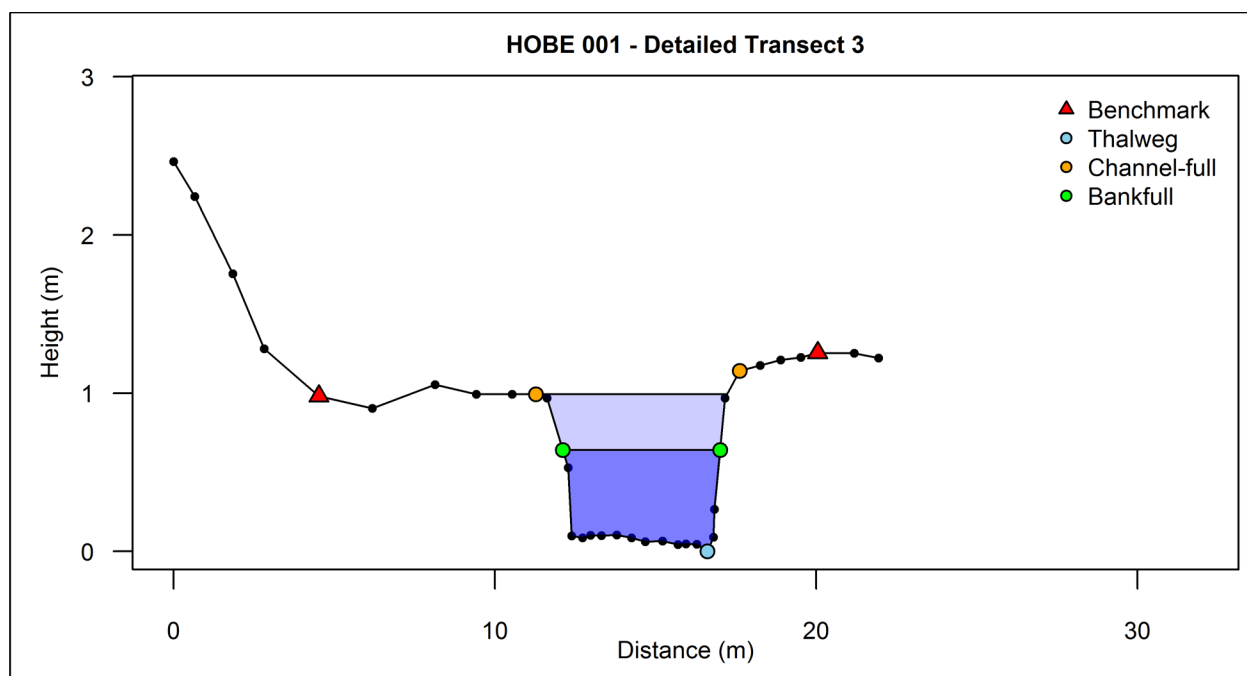


Figure 9. An example of Figure 9 in a baseline report.

Figure 10. Comparison of Detailed Transects

This figure compares the three detailed transects surveyed at each wadeable stream reach. Detailed instructions on how to construct these figures is found in SOP 2.2.14 (McDonald et al. 2018b). These figures are produced in R and are exported to:

- SECN Share:\Monitoring\StreamHabitat\Wadeable\Data\PARK\C_Certified\PARK###

The file is named:

- PARK###_YYYYMMDD_Tall_plot.png

Once the figure is created and someone from the stream survey team has made sure that it is correct, the figure can be inserted into the report document.

Figure 10 caption

Modify the following text and include as the figure caption: Figure 10. Comparison of all three detailed transects at [PARK ###]. The location of the left channel full point for each transect was used to visually normalize the transects.

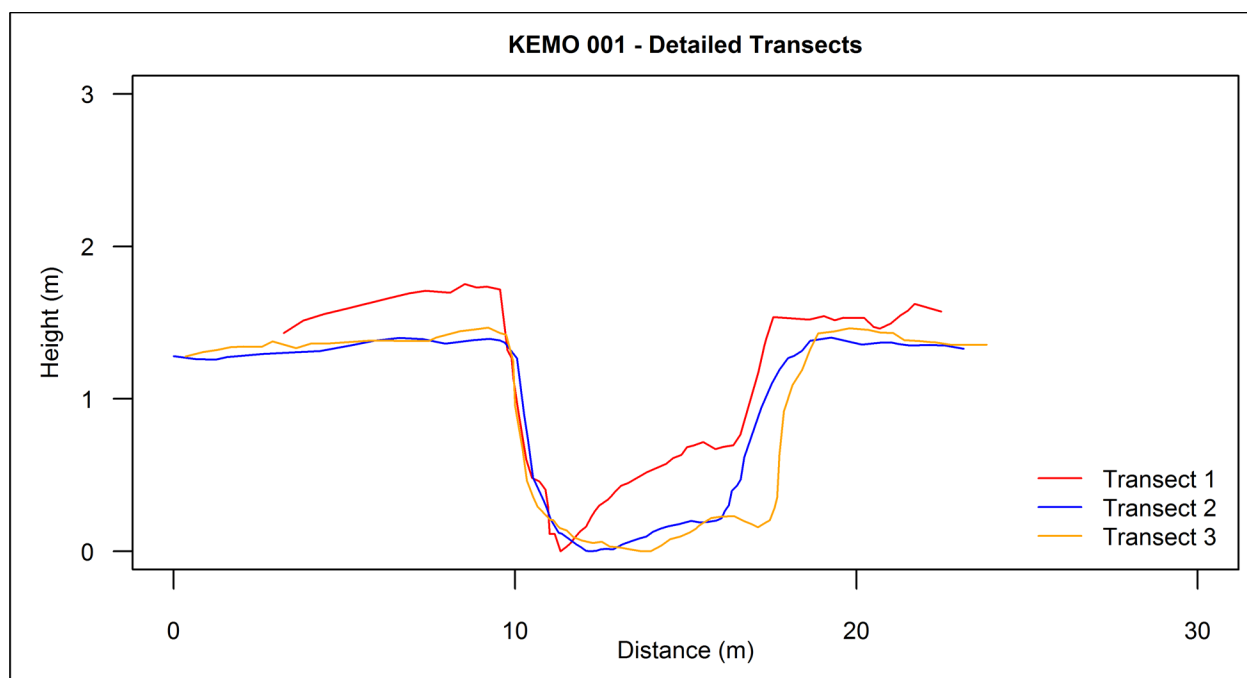


Figure 10. An example of Figure 10 in a baseline report.

Figure 11. Longitudinal Profile

This figure depicts the water surface points that were collected to determine the slope of each surveyed reach. Detailed instructions on how to construct these figures is found in SOP 2.2.14 (McDonald et al. 2018b). These figures are produced in R and are exported to:

- SECN Share:\Monitoring\StreamHabitat\Wadeable\Data*PARK*\C_Certified*PARK*###

The file is named:

- *PARK*###_YYYYMMDD_LongitudinalProfile.png

Once this figure has been created and someone from the stream survey team has made sure that it is correct, the longitudinal profile can be inserted into the report document.

Figure 11 caption

Modify the following text and include as the figure caption: Figure 11. Longitudinal profile for [*PARK* ###]. The red line on the map corresponds to the interpreted slope of the reach. The r^2 value included in the figure describes the strength of the trend line.

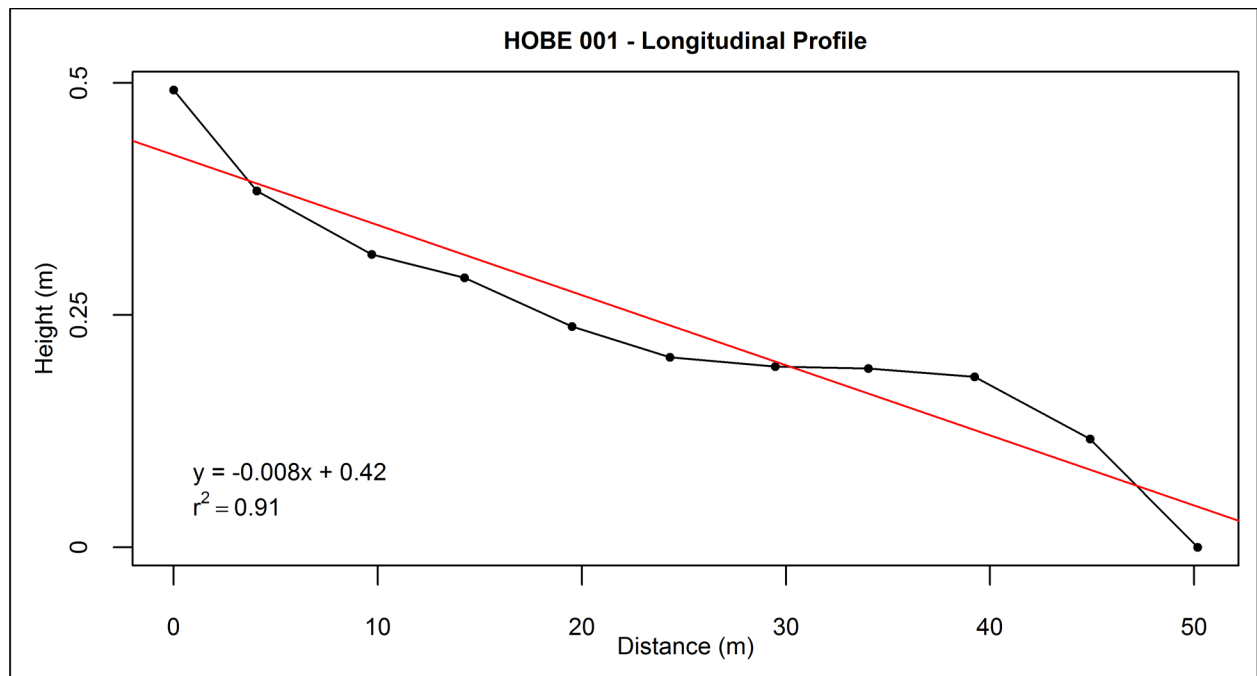


Figure 11. An example of Figure 11 in a baseline report.

Baseline Report Tables

Table 1. Bank Stability Index Table

This table provides an explanation of how the bank stability index scores are derived. The table can be found at the following location:

SECN Share:\Monitoring\StreamHabitat\Wadeable\Reports\Figures

The file is named:

Table1_BankStabilityIndex.xlsx

Once the table has been located, paste it into the report document.

Table 1 caption

Use the following text as the table caption: Table 1. Bank Stability Index (BSi) from Fitzpatrick et al. (1998). A BSi score is determined by adding up the bank angle, vegetative cover, bank height, and bank sediment scores for each bank (separate score for left and right banks at each transect)¹.

Table 3. An example of Table 1 in a baseline report.

Bank Stability Factor	Classification	Score
Angle	0°–30°	1
	31°–60°	2
	> 60°	3
Percentage Vegetative Cover	> 80%	1
	50–80%	2
	20–49%	3
	< 20%	4
Bank Height	0–1 feet	1
	1.1–2 feet	2
	2.1–3 feet	3
	3.1–4 feet	4
	> 4 feet	5
Bank Sediment type	Bedrock, artificial	1
	Boulder, cobble	3
	Clay	4
	Silt	5
	Sand	8
	Gravel/sand	10

¹ Ratings and total score: 4–7 stable, 8–10 at-risk, 11–15 unstable, and 16–22 very unstable.

Table 2. Watershed Characteristics for the Surveyed Reach

This table provides a description of the geomorphic and hydrologic characteristics of the watershed that drains to each surveyed reach. This table is created using data calculated with ArcMap (or a similar GIS program). The data is then imported into a data processing template.

See SOP 1.2.15 *Wadeable Stream Basin- and Segment-Scale Data Summary—Version 1.0* (McDonald et al. 2018c) for detailed instructions on how to derive the data.

Also see SOP 2.2.14 (McDonald et al. 2018b) for detailed instructions on how to populate the basin characteristics table with the GIS results.

This data table will be found at:

- SECN Share:\Monitoring\StreamHabitat\Wadeable\Data\PAK\C_Certified\PAK###

The data table is named:

- PAK###_YYYYMMDD_BasinCharacteristics_Cert_INI.xlsx
 - (INI will be the initials of the person that certified the data)

Table 2 caption

Modify the following text and use for the table caption: Table 2. Watershed characteristics for [PAK ###] calculated using the National Elevation Dataset (NED) 10 meter (32.8 feet [ft]) digital elevation model.

Table 4. An example of Table 2 in a baseline report.

Basin Characteristic	KEMO 001
Drainage Area (km ²)	8.30
Total Stream Length (km)	12.68
Drainage Density	1.53
Strahler Order	3
Bifurcation Ratio	2
Entire Stream Gradient	0.0109
Stream Gradient	0.0049
Slope - Average	0.03
Slope - Std. Dev.	6.69
Basin Length (km)	6.35
Basin Shape	0.21
Basin Relief (m)	5754
Basin Relief Ratio	0.041
Elevation - Std. Dev. (m)	261

Table 3. Land Use/Land Cover

This table provides a description of the land use/land cover characteristics of the watershed that drains to each surveyed reach. This table includes data calculated using ArcMap (or a similar GIS program). The data is then imported into a data processing template.

See SOP 1.2.15 (McDonald et al. 2018c) for detailed instructions on how to derive the data.

Also see SOP 2.2.14 (McDonald et al. 2018b) for detailed instructions on how to populate the basin characteristics table with the GIS results.

This data table will be found at:

- SECN Share:\Monitoring\StreamHabitat\Wadeable\Data*PARK*\C_Certified*PARK*###

The table is named:

- *PARK*###_YYYYMMDD_BasinCharacteristics_Cert_INI.xlsx
 - (INI will be the initials of the person that certified the data)

Table 3 caption

Modify the following text and use for the table caption: Table 3. Land use/land cover characteristics for 2001, 2006, and 2011 for [*PARK* ###]. The data included in this table are from the National Land Cover Dataset.

Table 5. An example of Table 3 in a baseline report.

NLCD Class	2001 percent of watershed	2006 percent of watershed	2011 percent of watershed
Open Water	0	0	0
Developed; Open	3	3	3
Developed; Low*	1	1	1
Developed; Medium*	0	0	0
Developed; High*	0	0	0
Barren	0	0	0
Deciduous	61	60	53
Evergreen	16	16	16
Mixed Forest	1	1	0
Shrub	1	3	11
Grassland	11	11	11
Pasture	5	5	5
Cultivated	0	0	0
Woody Wetland	0	0	0
Herbaceous Wetland	0	0	0

* refers to the intensity or type of development

Table 4. Geomorphic Channel Units

This table provides a description of the geomorphic channel units that are present within each study reach. The data in this table have been input into the data entry, processing and reporting template (Form1_DataEntryProcessingAndReporting.xlsx) and can be found at:

- SECN Share:\Monitoring\StreamHabitat\Wadeable\Data\PAK\C_Certified\PAK###

The file is named:

- PAK###_YYYYMMDD_Form1_Cert_INI.xlsx
 - (INI will be the initials of the person that certified the data)

Once the data have been checked by the protocol lead or another member of the survey crew, this table can be copied and pasted into the report document.

Table 4 caption

Modify the following text and use for the table caption: Table 4. Geomorphic channel units (GCU) observed in the area between transects at [PAK ###]. The data describe the percent coverage of each type of GCU.

Table 6. An example of Table 4 in a baseline report.

Transect	(%) Riffle	(%) Run	(%) Glide	(%) Pool
1–2	90	10	0	0
2–3	65	10	0	25
3–4	5	15	0	80
4–5	0	30	0	70
5–6	0	10	30	60
6–7	55	0	0	45
7–8	75	10	0	15
8–9	60	40	0	0
9–10	70	0	0	30
10–11	85	0	0	15
Frequency	8	7	1	8
Max (%)	90	40	30	80
Average (%)	51	13	3	34
SD (%)	35	13	9	29

Table 5. Pebble count statistics

This table provides summary statistics of the pebble count conducted at each reach. This table contains data input into the data entry, processing and reporting template (Form1_DataEntryProcessingAndReporting.xlsx) and can be found at:

- SECN Share:\Monitoring\StreamHabitat\Wadeable\Data\C_Certified\PAK###

The table will be named:

- PAK###_YYYYMMDD_Form1_Cert_INI.xlsx
 - (INI will be the initials of the person that certified the data)

Once the data have been checked by the protocol lead or another member of the survey crew, this table can be copied and pasted into the report document.

Table 5 caption

Modify the following text and use for the table caption: Table 5. Particle size distribution of bed sediment (in mm) from the pebble count survey conducted at [PAK ###]. The subscripts indicate the percent of the sample that is smaller than the reported diameter.

Table 7. An example of Table 5 in a baseline report.

Statistic (n = 100)	Diameter (mm)
Min	1
D ₅	3.00
D ₁₆	7.00
D ₅₀	16.00
D ₈₄	27.00
D ₉₅	37.90
Max	50

Table 6. Large Woody Debris characteristics

This table describes the amount, size, and type of large woody debris (LWD) observed at each reach. This table contains data input into the data entry, processing and reporting template (Form1_DataEntryProcessingAndReporting.xlsx) and can be found at:

- SECN Share:\Monitoring\StreamHabitat\Wadeable\Data\PAK\C_Certified\PAK###

The file is named:

- PAK###_YYYYMMDD_Form1_Cert_INI.xlsx
 - (INI will be the initials of the person that certified the data)

Once the data have been checked by the protocol lead or another member of the survey crew, this table can be copied and pasted into the report document.

Table 6 caption

Modify the following text and use it as the table caption: Table 6. Characteristics of the large woody debris observed at [PAK ###].

Table 8. An example of Table 6 in a baseline report. Modify the following text and use it as the table caption: Summary of the large woody debris observed at HOBE 001.

LWD ID	Length (m)	Diameter (m)	Volume (m ³)	Midpoint Location (Transect)	Function	Position
1	1.87	0.16	0.04	3	None	Free
2	1.60	0.13	0.01	5	Jam	Buried, Jam
3	2.49	0.11	0.02	6	None	Buried
4	1.56	0.12	0.01	6	Bank Protection	Buried
5	1.15	0.14	0.02	8	Sediment trap, Habitat creation	Buried
6	2.04	0.11	0.02	9	None	Free
7	1.07	0.10	0.01	9	Jam, Organic and Sediment trap, Habitat creation	Buried
8	10.00	0.11	0.10	10	Bank protection, Organic trap	Ramp
9	6.34	0.12	0.07	10	None	Free
10	5.15	0.10	0.04	10	Organic trap	Free
11	1.70	0.14	0.01	11	Sediment trap	Buried

Table 7. Large Woody Debris summary statistics

This table provides a summary of the amount, size, and volume of large woody debris (LWD) observed at each reach. This table contains data input into the data entry, processing and reporting template (Form1_DataEntryProcessingAndReporting.xlsx) and can be found at:

- SECN Share:\Monitoring\StreamHabitat\Wadeable\Data\PARK\C_Certified\PARK###

The file is named:

- PARK###_YYYYMMDD_Form1_Cert_INI.xlsx
 - (INI will be the initials of the person that certified the data)

Once the data have been checked by the protocol lead or another member of the survey crew, this table can be copied and pasted into the report document.

Table 7 caption

Modify the following text and use it as the table caption: Table 7. Summary statistics for the large woody debris observed at [PARK ###].

Table 9. An example of Table 7 in a baseline report.

Statistic (n = 11)	Length (m)	Diameter (m)	Volume (m ³)
Min	1.07	0.10	0.01
Max	10.00	0.16	0.10
Average	2.91	0.12	0.03
SD	3.02	0.02	0.03
Sum	-	-	0.34
Per Channel Area (m ³ /m ²)	-	-	0.0005

Table 8. Canopy cover estimates

This table provides a summary of the variability in canopy cover observed at each reach. This table contains data input into the data entry, processing and reporting template (Form1_DataEntryProcessingAndReporting.xlsx) and can be found at:

- SECN Share:\Monitoring\StreamHabitat\Wadeable\Data\PARK\C_Certified\PARK###

and is named:

- PARK###_YYYYMMDD_Form1_Cert_INI.xlsx
 - (INI will be the initials of the person that certified the data)

Once the data have been checked by the protocol lead or another member of the survey crew, this table can be copied and pasted into the report document.

Table 8 caption

Modify the following text and use it as the table caption: Table 8. Variability of canopy cover observed at [PARK ###].

Table 10. An example of Table 8 in a baseline report.

Transect or Statistic	Canopy Cover (%)
1	76
2	71
3	76
4	82
5	65
6	71
7	88
8	76
9	65
10	59
11	71
Min (%)	59
Max (%)	88
Mean (%)	73
SD (%)	8
CV	0.12

Table 9. Thalweg characteristics

This table provides a reach-scale summary of thalweg conditions at each reach. This table contains data input into the data entry, processing and reporting template

(Form2_DataEntryProcessingAndReporting.xlsx) and can be found at:

- SECNshare:\Monitoring\StreamHabitat\Wadeable\Data\PARK\C_Certified\PARK###

The file is named:

- PARK###_YYYYMMDD_Form2_Cert_INI.xlsx
 - (INI will be the initials of the person that certified the data)

Once the data have been checked by the protocol lead or another member of the survey crew, this table can be copied and pasted into the report document.

Table 9 caption

Modify the following text and use it for the table caption: Table 9. Reach-scale average thalweg conditions at [PARK ###]. Depth measurements are in meters and the position is the percent distance from the left bank.¹

Table 11. An example of Table 9 in a baseline report.

Thalweg	n	Min	Max	Mean	SD	CV
Depth (m)	11	0.09	0.44	0.22	0.12	0.52
Position ¹ (%)	11	10	90	41	28	0.68

¹ position is percent distance from left bank.

Table 10. Reach-scale width measurements

This table provides the average reach-scale width characteristics of each reach. This table contains data input into the data entry, processing and reporting template (Form2_DataEntryProcessingAndReporting.xlsx) and can be found at:

- SECNshare:\Monitoring\StreamHabitat\Wadeable\Data\PAK\C_Certified\PAK###

The file is named:

- PAK###_YYYYMMDD_Form2_Cert_INI.xlsx
 - (INI will be the initials of the person that certified the data)

Once the data have been checked by the protocol lead or another member of the survey crew, this table can be copied and pasted into the report document.

Table 10 caption

Modify the following text and use it for the table caption: Table 10. Reach-scale averaged width characteristics of [PARK ###].

Table 12. An example of Table 10 in a baseline report.

Widths	n	Min (m)	Max (m)	Mean (m)	SD (m)	CV (%)
Wetted	11	1.72	3.70	2.69	0.59	22
Active Channel	11	2.60	5.50	4.00	1.00	25
Bankfull	6	3.60	5.70	4.75	0.83	17
Channel-Full	5	4.00	7.50	5.37	1.34	25

Table 11. Bank Characteristics

This table provides the average reach-scale bank characteristics of each reach. This table contains data that was input into the data entry, processing and reporting template (Form2_DataEntryProcessingAndReporting.xlsx) and can be found at:

- SECNshare:\Monitoring\StreamHabitat\Wadeable\Data\PARK\C_Certified\PARK###

The file is named:

- PARK###_YYYYMMDD_Form2_Cert_INI.xlsx
 - (INI will be the initials of the person that certified the data)

Once the data have been checked by the protocol lead or another member of the survey crew, this table can be copied and pasted into the report document.

Table 11 caption

Modify the following text and use it for the table caption: Table 11. Average reach-scale bank characteristics at [PARK ###].

Table 13. An example of Table 11 in a baseline report.

Bank Characteristics	n (Left)	n (Right)	Min (Left)	Min (Right)	Max (Left)	Max (Right)	Mean (Left)	Mean (Right)	SD (Left)	SD (Right)	CV (Left)	CV (Right)
Bank Height ¹ (m)	11	11	0.56	0.41	1.57	1.39	1.04	1.09	0.31	0.31	0.30	0.29
Floodplain Height ^{1,2} (m)	3	3	0.56	0.41	0.76	0.83	0.64	0.63	0.10	0.21	0.16	0.33
Channel-full Height ^{1,2} (m)	8	8	0.97	1.15	1.57	1.39	1.19	1.26	0.20	0.09	0.17	0.07
Water Depth at Base ³ (m)	11	11	-0.15	-0.20	0.33	0.02	0.01	-0.04	0.15	0.06	-	-
Bank Undercut ² (m)	5	2	0.18	0.09	0.44	0.36	0.32	0.23	0.10	0.19	0.31	0.85
Bank Angle (°)	11	11	35	10	140	65	82	49	38	22	0.46	0.45
Vegetation Cover (%)	11	11	5	0	95	80	58	36	30	28	0.53	0.78
Bank Stability ⁴	11	11	At-Risk	At-Risk	Unstable	Unstable	Unstable	Unstable	1.63	1.33	0.16	0.12

¹ above thalweg

² statistics are based on the transects where feature is present (# in parentheses)

³ a negative number indicates base of bank is above the water surface

⁴ See Table 1 for explanation of scores

Table 12, 13, and 14. Detailed Transect Cross-Sectional Characteristics

These tables provide an understanding of the width, depth, and other cross-sectional characteristics of the three detailed transects. This table contains data input into a data entry and reporting template (CrossSection_data_table_template.xlsx) and can be found at:

- SECN Share:\Monitoring\StreamHabitat\Wadeable\Data\PARK\C_Certified\PARK###

The file is named:

- PARK###_YYYYMMDD_XS_tables.xlsx
 - (INI will be the initials of the person that certified the data)

Once the data have been checked by the protocol lead or another member of the survey crew, these tables can be copied and pasted into the report document.

Table 12 caption

Modify and use the following text for the table caption: Table 12. Cross-sectional characteristics for detailed transect 1 at [PARK ###].

Table 13 caption

Modify and use the following text for the table caption: Table 13. Cross-sectional characteristics for detailed transect 2 at [PARK ###].

Table 14 caption

Modify and use the following text for the table caption. Table 14. Cross-sectional characteristics for detailed transect 3 at [PARK ###].

Table 14. An example of Table 12 in a baseline report.

Type	Area (m ²)	Perimeter (m)	Hydraulic Radius (m)	Width (m)	Depth (m)	Width/Depth
Bankfull	1.94	4.80	0.40	4.25	0.64	6.63
Channel-full	4.90	6.44	0.76	5.08	1.29	3.95
Ratio	0.40	0.75	0.53	0.84	0.50	1.68

Table 15. An example of Table 13 in a baseline report.

Type	Area (m ²)	Perimeter (m)	Hydraulic Radius (m)	Width (m)	Depth (m)	Width/Depth
Bankfull	1.48	4.14	0.36	3.53	0.59	5.94
Channel-full	6.40	9.32	0.69	8.00	1.50	5.32
Ratio	0.23	0.44	0.52	0.44	0.40	1.12

Table 16. An example of Table 14 in a baseline report.

Type	Area (m ²)	Perimeter (m)	Hydraulic Radius (m)	Width (m)	Depth (m)	Width/Depth
Bankfull	2.60	5.68	0.46	4.90	0.64	7.65
Channel-full	4.45	7.05	0.63	5.95	0.99	6.00
Ratio	0.58	0.81	0.72	0.82	0.64	1.28

Table 15. Average Cross-Sectional Characteristics of the Detailed Transects

This table provides an understanding of the average width, depth, and other cross-sectional characteristics of the three detailed transects. This table contains data input into a data entry and reporting template (CrossSection_data_table_template.xlsx) and can be found at:

- SECN Share:\Monitoring\StreamHabitat\Wadeable\Data\PARK\C_Certified\PARK###

The file is named:

- *PARK###_YYYYMMDD_XS_tables.xlsx*
 - (INI will be the initials of the person that certified the data)

Once the data have been checked by the protocol lead or another member of the survey crew, these tables can be copied and pasted into the report document.

Table 15 caption

Use the following text for the table caption: Table 15. Average cross-sectional characteristics for the reach, based on the results of the surveys of the three detailed transects.

Table 17. An example of Table 15 in a baseline report.

Type	Area (m ²)	Perimeter (m)	Hydraulic Radius (m)	Width (m)	Depth (m)	Width/Depth
Bankfull	2.00	4.87	0.41	4.22	0.62	6.74
Channel-full	5.25	7.60	0.69	6.35	1.26	5.09
Ratio	2.86	1.61	1.73	1.56	2.03	0.76

Synthesis Data Summary Report

Step-by-step instructions for creating the stream habitat synthesis reports will be included in this SOP when all network reaches have been surveyed and/or when multi-year data become available. Tables and figures may be similar to those found in annual reports and will summarize data across multiple samplings events (years) and/or reaches.

Literature Cited

- McDonald, J. M., M. B. Gregory, J. W. Riley, and E. N. Starkey. 2018a. Monitoring wadeable stream habitat conditions in Southeast Coast Network parks: Protocol narrative. Natural Resource Report NPS/SECN/NRR—2018/1715. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2254874> (last accessed September 2018).
- McDonald, J. M., E. N. Starkey, and M. B. Gregory. 2018b. Wadeable stream data processing and analysis—Version 1.0. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP—2.2.14. National Park Service, Athens, Georgia. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2254015> (last accessed July 2018).
- McDonald, J. M., M. B. Gregory, and J. Riley. 2018c. Wadeable stream basin- and segment-scale data summary—Version 1.0. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP—1.2.15. National Park Service, Athens, Georgia. <https://irma.nps.gov/DataStore/Reference/Profile/2254012> (last accessed July 2018).
- Southeast Coast Network (SECN). 2016. Southeast Coast Network authorship guidelines—Version 2.0. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP—2.1.03. Southeast Coast Network, Athens, Georgia. <https://irma.nps.gov/DataStore/Reference/Profile/2237829> (last accessed July 2018).
- U. S. Geological Survey (USGS). 2013. National Hydrography Geodatabase. The National Map viewer available on the World Wide Web (<http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd>; last accessed March 2017).

Appendix A. Annotated Baseline Report Template

Baseline reports will be produced for each stream reach where sampling occurred. Authors of baseline data reports should not omit any of the information or sections below. The only exception is that only the ‘Survey Location’ description for the appropriate park should be used (e.g., HOBE 001 is being reported on so only Horseshoe Bend National Military Park’s blurb should be used). If necessary, additional information can be added but all attempts to keep a consistent reporting structure should be made. All of the tables and figures referenced below are referring to the baseline report numbering scheme and not this SOP’s table and figure numbers.

Report Template

[START of ANNUAL REPORT]

Summary and Key Findings

The Southeast Coast Network (SECN) stream habitat monitoring protocol provides data to give park resource managers insight into the status and trends of stream and riparian habitat conditions. The wadeable stream assessments are currently implemented at the five SECN inland parks with wadeable streams. These parks are Horseshoe Bend National Military Park (HOBE), Kennesaw Mountain National Battlefield (KEMO), Ocmulgee National Monument (OCMU), Chattahoochee River National Recreation Area (CHAT), and Congaree National Park (CONG). Streams chosen for assessment were specifically targeted for management interest (e.g., trail erosion issues and upstream urban development). For the purposes of this report, wadeable streams are narrowly defined as small- to medium-sized, perennially-flowing waterbodies with easily identifiable channel banks that can be accessed and traversed without the use of a watercraft.

On MONTH DAY, YEAR, data were collected to characterize the in-stream and riparian habitat on a reach (PARK ###) at FULL NAME OF PARK. These data, along with in-office analysis of remotely sensed geographic information system (GIS) data, are presented in this report to describe the watershed-, reach-, and transect-scale characteristics of the study reach which allows this stream to be placed within a regional context.

Basin Characteristics

- Describe interesting watershed characteristics (e.g., drainage area, slope, and relief)
- Describe land use/land cover characteristics

Reach Characteristics

- Provide a qualitative description of the reach (i.e., entrenchment and floodplain development).
- Describe in-channel habitat and sediment
- Depth and width averages
- Bank heights and angles
- Summary of detailed cross-sections
- Longitudinal profile

Introduction

The Southeast Coast Network (SECN) stream habitat monitoring protocol provides data to give park resource managers insight into the status and trends of stream and riparian habitat conditions. Wadeable stream assessments are currently implemented at the five SECN inland parks with wadeable streams. The stream assessments are conducted at specifically targeted reaches to either address a management concern or to provide a context for a paired stream.

For the purposes of this report, wadeable streams are narrowly defined as small- to medium-sized, perennially-flowing waterbodies with easily identifiable channel banks that can be accessed and traversed without the use of a watercraft. The wadeable streams referred to herein do not include some non-perennial channel-like features typically found on large river flood plains or ephemeral drainages typical of a gullied topography.

The objectives of this protocol are to:

- Determine the status of upstream watershed characteristics such as basin area, basin slope, and drainage density, and changes to land cover that may affect stream habitat,
- Determine the status of and trends in the geomorphic dimensions (cross-sectional morphology) of selected wadeable stream reaches including channel widths, bank characteristics (e.g., heights, angles, and vegetative cover), and reach slope and sinuosity, and
- Determine the status of and trends in physical measures of benthic and riparian habitat features present in selected wadeable stream reaches such as the size, type, and distribution of bed sediment and large woody debris, the distribution of geomorphic channel units, and the amount of canopy cover.

This report provides a summary of the wadeable stream survey completed at PARK (spelled out [No Acronyms]) during the SEASON of YEAR. This report is intended to provide park resource managers and partners with information on the characteristics of the stream reach surveyed and

provide an understanding of the basin-scale processes that may be influencing the evolution of the surveyed reach.

Survey Location: (Only Include Information on One Park)

Chattahoochee River National Recreation Area

The Chattahoochee River NRA is made up of 6,800 acres (2,752 hectares [ha]) of mixed pine/hardwood forests and wetlands that buffer 48 miles (77.2 kilometers [km]) of the Chattahoochee River (Figure 2). The park consists of 16 non-contiguous management units along this stretch of the river as it flows through north Atlanta, Georgia, the Southeast's largest metropolitan area (U.S. Census Bureau 2010). Chattahoochee River NRA offers green space and water-based recreational opportunities for the Atlanta metropolitan area and was designated as America's first official National Water Trail in 2012. This section of the Chattahoochee River is highly regulated by flows from Buford Dam, which was completed in 1957, and is heavily utilized for power generation, water supplies and waste-water assimilation for the greater metropolitan Atlanta area.

The Upper Chattahoochee River's position in a relatively stable fault zone has resulted in a long and narrow watershed (Burkholder et al. 2010) that is dominated by many small tributaries feeding the mainstream along most of the Chattahoochee River NRA-authorized area. Flow alteration associated with the impoundment and release of water for power generation has a pronounced effect on the flow patterns of the main stem. The majority of the streams flowing through Chattahoochee management units are small, lower-order (first to third order) tributaries that are heavily impacted by the direct and indirect effects of urbanization. Changes in the watersheds outside and upstream of the park have led to higher peak flows and lower base flow in the tributaries (Gregory et al. 2012 and Starkey 2015). Stormwater discharges from the urban areas that feed into these tributaries also impact the quality of the water supplied by these small streams by increasing the temperature, turbidity, and bacterial and heavy metal loads. Stream habitat and water quality are also influenced by highways and roads, power line rights-of way, and sewer lines that commonly cross both the wadeable and non-wadeable streams in the park. Within the park, stream bank conditions are impacted by bicycle and foot trails. Additionally, altered stormflow regimes potentially threaten park infrastructure (e.g., parking lots, bridges) due to increased channel instability.

[INSERT FIGURE 1]

Congaree National Park

Congaree National Park is located at the confluence of the Congaree and Wateree Rivers and covers more than 10,521 hectares (26,000 ac) of biologically and geomorphically diverse flood plain forest, of which 4,452 hectares (11,000 ac) are old-growth bottomland forest (Figure 1). The park has the largest concentration and highest diversity of fluvial features in the network, and includes both wadeable and non-wadeable perennial streams. The park also contains a complex group of natural channel features such as meander channels, crevasse channels, meander-scroll swales, and chute channels that typically form on large alluvial flood plains (Meitzen 2011). These channel features are not typically found in upland areas and do not function as traditional hierarchal stream systems. Many channel features at Congaree NP are closely tied to flood events and flow volume of the adjacent larger river (Meitzen 2011). During most of the year these features may be completely dry

and at other times have even been shown to exhibit reverse flows depending on the stage of the Congaree and Wateree Rivers. Up to 90 percent of the park may be annually flooded by major high-flow events in the Congaree River (Knowles et al. 1996). These flows are driven primarily by the Broad River and releases from the Monticello and Parr Reservoirs, as well as flows from the Saluda River and releases from Lake Murray at the Dreher Shoals (Saluda) Dam. Natural flows in the Congaree River have been altered since the late 1920s by the construction of Lake Murray, and by Lake Monticello and the Parr Reservoir since 1978.

[INSERT FIGURE 1]

Horseshoe Bend National Military Park

Horseshoe Bend National Military Park (HOBE) is made up of 825 hectares (2,040 ac) of mixed hardwood forest and is located in eastern Alabama. Most of HOBE is upland forest with a portion of the area (along the southern bank of the Tallapoosa River) being recovering farmland.

Approximately 10 percent of the area (mostly in depression on the floodplain) is classified as wetlands. There are also open areas and fields that commemorate historic battlefronts. Surface-water resources at HOBE include the flow-regulated Tallapoosa River, its relatively narrow flood plain, as well as small intermittent streams along the northern boundary of the Tallapoosa and a small, unnamed perennial stream on the south side of the Tallapoosa River (Figure 1). Recent reconnaissance surveys indicated that under the drought conditions that existed during fall 2012, most of the park's ephemeral streams ceased to flow (M. B. Gregory, SECN Program Manager, personal observation).

[INSERT FIGURE 1]

Kennesaw Mountain National Battlefield Park

Kennesaw Mountain National Battlefield Park consists of approximately 3,000 acres (1,214 ha) of mixed hardwood pine forest and open fields. The park is located within the Atlanta metropolitan area in the Allatoona Mountain range (Figure 5). Kennesaw Mountain itself is located in the northern portion of the park and receives approximately 2.6 million visitors per year. Water resources include some small bog wetlands and mountain seeps (less than ten percent of the area) and two perennial streams. These relatively small third-order streams, Noses Creek and John Ward Creek, originate outside the park boundaries and drain mostly urban and suburban areas prior to flowing through the park. Due to the intense urban and suburban development outside the park, the hydrology of these streams has been substantially altered and they exhibit typical flashy flows consistent with urban streams (Gregory and Calhoun 2007, Gregory et al. 2012, and Starkey 2015). The heavy visitor loads and popularity of horseback riding on trails throughout this urban park have created areas where stream bank erosion is a potential management concern (Stan Bond, former KEMO Park Superintendent, verbal communication).

[INSERT FIGURE 1]

Ocmulgee National Monument

Ocmulgee National Monument is located on the Ocmulgee River just below the fall line (which separates the Piedmont and Coastal Plain physiographic provinces) in Macon, Georgia. The

monument preserves burial and temple mounds, constructed by American Indians, on the Oconee River flood plain and provides recreational opportunities with its green spaces and hiking trails. The 284-hectare (702-ac) monument is surrounded by mostly urban and suburban development. Development in eastern Macon has altered sediment delivery and streamflow inside the monument's boundaries. Portions of the monument's North Plateau are rapidly eroding and this material is being deposited on the Middle and South Plateaus (KellerLynn 2013). Walnut Creek, the park's largest perennial stream, originates outside of the monument's boundaries and has several areas of severe bank erosion and sedimentation (Figure 1). Other smaller, intermittent streams at Ocmulgee NM have been similarly impacted. Roughly 121 hectares (300 ac) of the park are classified as emergent wetlands, and stream reconnaissance conducted in 2012 noted extensive beaver activity within the monument along Walnut Creek, which has significantly altered flowing stream habitats in this stream corridor (M.B. Gregory, SECN Program Manager, personal observation). Although the monument owns approximately one mile (1.6 kilometers [km]) of river frontage along the Ocmulgee River, the construction of Interstate-16 through the monument's flood plain severed its direct connection with the river.

[INSERT FIGURE 1]

Methods

This protocol monitors and documents channel morphology and riparian characteristics to provide an understanding of the condition of in- and near-channel habitat. Parameters selected for habitat assessment and geomorphic classification are based on methods used by other organizations (USGS, Fitzpatrick et al. 1998; EPA 2013; and USFS, Harrelson et al. 1994) and published studies (Newson and Newson 2000) that have found the physical structuring of habitat to exert a strong influence on the biological communities and overall ecological integrity of lotic ecosystems. The advantages of monitoring stream habitat are that it not only indicates physical suitability for aquatic species but it can also identify stressors that could degrade other park resources and negatively affect visitor experiences.

The data collected as part of the protocol for wadeable stream monitoring can be divided into three parts (Figure 2):

1. Basin-scale characteristics;
2. Reach-scale (standard transect) measurements; and
3. Detailed cross-sectional measurements.

Though briefly described below, detailed standard operating procedures and methods for the collection and processing of the stream survey data can be found in McDonald et al. (2018a).

[INSERT FIGURE 2]

Basin Characteristics

Basin characteristics are important for interpreting stream and river channel conditions and include a combination of geomorphic descriptors and land use and land cover characteristics. Understanding the physical characteristics of a drainage basin as well as the land use, water withdrawals, and engineering activities upstream of park boundaries may be critical to understanding changes to streams within the park boundaries.

Basin-scale measures are determined in an office setting after permanent reaches have been determined. These measurements and analyses are conducted within a geographic information system (GIS) using digital elevation models (DEMs) from the National Elevation Dataset (NED) and land cover data from the National Land Cover Database (NLCD). Specific detailed instructions for the data analysis can be found in SOP 1.2.15 (McDonald et al. 2018b).

Reach-Scale Measurements

The reach-scale characteristics of each stream reach are determined by collecting data at and between 11 equidistant transects (Figure 3). Data collected at each of these transects include: vegetative bank cover, presence of eroding banks, bed and bank material, wetted and bankfull width, water depth, and bank height/angle. These data provide an understanding of the geomorphic or physical characteristics of the stream reach and are used to derive a bank stability score for the reach (Table 1). Note: While

many banks in the southeastern United States may be scored as ‘at-risk’ or ‘unstable,’ these are relatively ‘natural’ conditions and are related to land use history and the stream beginning to reestablish a functional floodplain within a highly entrenched channel system.

[INSERT TABLE 1]

Between each of the transects, canopy cover, the amount and type of in-stream habitat (e.g., high-energy riffles vs. low-energy pools), the presence/absence of large woody debris and in-channel features (e.g., sand/cobble bars), and bed material composition are described. These reach-scale measures provide an understanding of the in-stream and riparian habitats that are available.

[INSERT FIGURE 3]

Detailed Transect Cross-Sections

Three of the 11 standard transects (usually T1, T6, and T11) were surveyed using a survey grade (sub-millimeter accuracy) total station. These surveys allow lateral variability along each transect to be identified and in- and out-of-channel changes to be monitored through time (Figure 4). Repeated surveying of channel cross-sections allows changes in streambed elevation and bank profiles to be quantitatively assessed in relation to a known point (benchmark). These data will be used to calculate various geomorphic metrics (e.g., entrenchment ratio) and will be used along with the bank stability index to assess the condition and stability of the reach.

[INSERT FIGURE 4]

Results

Stream survey data were collected at one reach (REACH) at PARK by the Southeast Coast Network on MONTH DAY, YEAR.

Basin Characteristics

- Describe watershed characteristics (i.e., drainage area, slope, and relief) (Table 2)
- Describe land use/land cover and any changes that have occurred (Table 3)

Reach Characteristics

- Describe reach and reference Figure 5.
- Describe geomorphic channel units (Table 4) and bed sediment (Table 5).
- Describe large woody debris occurrence (Tables 6 and 7) and canopy cover (Table 8).
- Describe thalweg characteristics (Table 9) and channel width (Table 10).
- Describe bank characteristics (Table 11).
- Report bank stability scores (Table 11) and add “(See Methods for explanation on how to interpret BSi scores)” at end of sentence.
- Qualitatively group detailed transects (e.g., detailed transect 1 and 2 are similar...) and describe reach averaged cross-sectional characteristics (Tables 12–15 and Figures 7–10).
- Describe the longitudinal profile of the stream (Figure 11).

Literature Cited

Each park will have a slightly different literature cited section.

- Fitzpatrick, F. A., I. R. Waite, P. J. D'Arconte, M. R. Meador, M. A. Maupin, and M. E. Gurtz. 1998. Revised methods for characterizing stream habitat in the National Water Quality Assessment Program: U.S. Geological Survey Water Resources Investigations Report 98-4052. Available at: <http://water.usgs.gov/nawqa/protocols/WRI98-4052/index.html> (last accessed December 2016).
- Harrelson, C. C., C. L. Rawlins, and J. P. Potyondy. 1994. U. S. Forest Service's (USFS) stream channel reference site: an illustrated guide to field techniques. U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.
- Homer, C. G., J. A. Dewitz, L. Yang, S. Jin, P. Danielson, G. Xian, J. Coulston, N. D. Herold, J. D. Wickham, and K. Megown. 2015. Completion of the 2011 national land cover database for the conterminous United States—representing a decade of land cover change information. *Photogrammetric Engineering and Remote Sensing*. 81:345–354.
- McDonald, J. M., M. B. Gregory, J. W. Riley, and E. N. Starkey. 2018a. Monitoring Wadeable stream habitat conditions in Southeast Coast Network parks: Protocol narrative. Natural Resource Report NPS/SECN/NRR—2018/1715. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2254874> (last accessed September 2018).
- McDonald, J. M., M. B. Gregory, and J. Riley. 2018b. Wadeable stream basin- and segment-scale data summary—Version 1.0. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP—1.2.15. National Park Service, Athens, Georgia. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2254012> (last accessed July 2018).
- Newson, M. D., and C. L. Newson. 2000. Geomorphology, ecology and river channel habitat: Mesoscale approaches to basin-scale challenges. *Progress in Physical Geography* 24(2):1195–217.
- U.S. EPA. 2013. National Rivers and Streams Assessment 2013-2014: Field operations manual – Wadeable. EPA841-B-12-009b. U.S. Environmental Protection Agency, Office of Water, Washington, D. C.

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