

South Carolina Stream Quantification Tool

Version 1.1

Debit Calculator User Manual



US Army Corps
of Engineers®



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Acknowledgements

The South Carolina Stream Quantification Tool (SC SQT) and Debit Calculator is the collaborative result of federal and state agency representatives, collectively referred to as the South Carolina Steering Committee. The SC SQT and supporting materials are adapted from the North Carolina SQT (NC SQT), which was developed by Stream Mechanics and Ecosystem Planning and Restoration (EPR) with funding and technical support by Environmental Defense Fund. The regionalization of the SC SQT and Debit Calculator was funded by the South Carolina Department of Natural Resources (DNR) through a Wetland Program Development Grant provided by the US Environmental Protection Agency (USEPA). DNR contracted Stream Mechanics, and its subcontractor EPR, to facilitate and complete the SC SQT and Debit Calculator as well as subsequent updates that account for physicochemical and biology parameters, metrics, and reference curves.

South Carolina Steering Committee

SC Department of Natural Resources (Lead Agency)

US Army Corps of Engineers, Charleston District

US Environmental Protection Agency

SC Department of Health and Environmental Control

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Version

SC Debit Calculator Version	Date finalized	Description
Version 1.0	December 2021	Original version
Version 1.1	December 2022	Revised parameters, metrics, reference curves, and methods for physicochemical and biology functional categories. Updated Flow Type categories.

Acronyms

BEHI/NBS – Bank erosion hazard index/Near-bank stress

BHR – Bank height ratio

DNR – South Carolina Department of Natural Resources

ECS – Existing condition score

ER – Entrenchment ratio

FF – Functional feet/foot

Δ FF – Change in functional feet

$-\Delta$ FF – Functional loss

$+\Delta$ FF – Functional lift

FFS – Functional foot score

PCS – Proposed condition score

RPW/Non-RPW – Relatively permanent waters/Non-relatively permanent waters

SC – South Carolina

SFPF – Stream Functions Pyramid Framework

SQT – Stream Quantification Tool

USACE – United States Army Corps of Engineers

USEPA – United States Environmental Protection Agency

Glossary of Terms

Armoring – Bank armoring is defined as any rigid, human-made stabilization practice, such as rip-rap, gabion baskets, concrete, boulder toe and other engineered materials that cover the entire bank height and permanently prevent lateral migration processes. Bank stabilization practices that include toe protection to reduce excessive erosion are not considered armoring if the stone or wood does not extend from the streambed to an elevation that is beyond one-third the bank height and the remainder of the bank height is vegetated.

Condition – The relative ability of an aquatic resource to support and maintain a community of organisms having a species composition, diversity, and functional organization comparable to reference aquatic resources in the region (USACE & USEPA, 2008).

Concentrated flow points – Storm drains or erosional features, such as swales, gullies, or other channels, that are created by anthropogenic impacts. Natural ephemeral tributaries and outlets of stormwater control measures (also known as best management practices) are not considered concentrated flow points.

Credit – A unit of measure (e.g., a functional or areal measure or other suitable metric) representing the accrual or attainment of aquatic functions at a compensatory mitigation site. The measure of aquatic functions is based on the resources restored, established, enhanced, or preserved (USACE & USEPA, 2008).

Cumulative impact – Defined by the National Environmental Policy Act, it is the additive impact on the environment that results, regardless of the entity or multiple entities undertaking the impact, incrementally from the past, present, or reasonably foreseeable future (USACE).

Debit – A unit of measure (e.g., a functional or areal measure or other suitable metric) representing the loss of aquatic functions at an impact or project site. The measure of aquatic functions is based on the resources impacted by the authorized activity (USACE & USEPA, 2008).

Field value – A field or desktop measurement or calculation from an existing assessment method that is input into the SQT for a specific metric. Units vary based on the assessment method used.

Function-based parameter – A structural measure which characterizes a condition at a point in time, or a function (i.e., process, expressed as a rate) that describes and supports the functional statement of each functional category (Harman et al., 2012).

Functional category – The levels of the Stream Functions Pyramid: Hydrology, Hydraulics, Geomorphology, Physicochemical, and Biology. Each category is defined by a functional statement (Harman et. al., 2012).

Functional change – Proposed functional foot score (Proposed FFS) minus existing functional foot score (Existing FFS).

Functional foot score (FFS) – The product of a condition score and stream length.

- Existing FFS = Existing Functional Foot Score. Calculated by measuring the existing stream length and multiplying it by the ECS.
- Proposed FFS = Proposed Functional Foot Score. Calculated by measuring the proposed stream length and multiplying it by the PCS.

Functional lift – A positive functional foot score or positive net change in functional feet (+ Δ FF).

Functional loss – A negative functional foot score or negative net change in functional feet (- Δ FF).

Functions – The physical, chemical, and biological processes that occur in ecosystems (USACE & USEPA, 2008).

Impact duration – The length of time an adverse impact is expected to last; categorized as temporary, recurrent, or permanent (USACE).

Index value – Dimensionless value between 0.00 and 1.00 that expresses the relative condition of a metric field value compared with reference condition. Index values convert the different units used in the assessment methods to one scale. These values are derived from reference curves for each metric.

Metric – Specific tools, equations, assessment methods, etc., that are used to quantify a function-based parameter. (Also called measurement method in *A Function-Based Framework for Stream Assessment and Restoration Projects* [Harman et al., 2012]).

Mitigation Rule – The 2008 Federal Compensatory Mitigation Rule administered by the USACE and the USEPA (USACE & USEPA, 2008; 33 CFR Parts 325 and 332; 40 CFR Part 230).

Performance standards – Observable or measurable physical (including hydrological), chemical, and/or biological attributes that are used to determine if a compensatory mitigation project meets its objectives (USACE & USEPA, 2008).

Permitted impacts – Activities that adversely affect waters of the United States and may require compensatory mitigation (USACE & USEPA, 2008).

Priority category – Factor used to determine the value of the aquatic resource in question in relation to the functions or services it is providing based on its position in the landscape relative to water quality and/or habitat connectivity, or based on its functions and services it provides related to rare, threatened, or endangered species (USACE).

Project area – The geographic extent of a project. A project area may include multiple project reaches where there are variations in stream physical characteristics and/or differences in impact activity.

Project reach – A homogeneous stream reach within the project area, i.e., a stream segment with similar valley morphology, stream type (Rosgen, 1996), stability condition, riparian vegetation type, and bed material composition. Multiple project reaches may exist in a project area where there are variations in stream physical characteristics and/or differences in impact activity.

Reference condition – A stream condition that is considered fully functioning for the parameter assessed, where functioning ranges from an unaltered/pristine to minimally disturbed condition. Reference condition is NOT the best available condition that can be achieved at a site. Also known as reference standard in the SQT. Note that this definition differs from USACE & USEPA (2008) definition.

Reference curves – A relationship between observable or measurable metric field values and dimensionless index values. These curves are fitted to threshold values that represent the degree of departure from a reference condition for a given field value. These curves are used to calculate the index value for a given metric at a project reach.

Representative sub-reach – A length of stream within a project reach that is selected for field data collection of function-based parameters and metrics. The representative sub-reach is typically 20 times the bankfull width or two meander wavelengths (Leopold, 1994).

Stream Functions Pyramid Framework (SFPF) – The Stream Functions Pyramid (Pyramid) is comprised of five functional categories based on the premise that lower-level functions (hydrology, hydraulics, geomorphology) support higher-level functions (physicochemical and biology) and that they are all influenced by local geology and climate. The SFPF includes the organization of function-based parameters, metrics (or measurement methods), and reference curves (performance standards) to assess the functional categories of the Pyramid (Harman et al., 2012).

Stream type – This distinction is based on regulatory implementation of the Clean Water Act and the jurisdictional determination of the stream as either a: non-relatively permanent water (Non-RPW), a 1st or 2nd Strahler stream order RPW, or all other streams greater than 2nd stream order tributaries and traditional navigable waters (USACE).

Chapter 1. Introduction

The South Carolina (SC) Debit Calculator is an application of the Stream Quantification Tool (SQT) used to assess functional loss caused by permitted stream impacts. The purpose of this Debit Calculator User Manual is to introduce key concepts and provide instruction on how to use the SC Debit Calculator workbook for impacts under the purview of the US Army Corps of Engineers (USACE) Charleston District.

This manual is used in conjunction with the *South Carolina Stream Quantification Tool Data Collection and Analysis Manual* (Data Collection and Analysis Manual), which provides information on data collection for the SC SQT and Debit Calculator (see SC SQT Manual Directory below). The *SQT Spreadsheet User Manual* provides background on the SQT as well as rules and procedures for using the SQT workbook; the *SQT Spreadsheet User Manual* is not needed to use the Debit Calculator.

Version 1.0 of the SC SQT and Debit Calculator was informed by SQT and Debit Calculator development in states across the United States, including North Carolina (Harman and Jones, 2017), Tennessee (TDEC, 2018), Wyoming (USACE, 2018a), Georgia (USACE, 2018b), Colorado (USACE, 2020), Minnesota (MNSQT SC, 2019), and Michigan (EGLE, 2020). Additionally, data collected in South Carolina¹ and in the southeast region were used to develop reference curves for select metrics. Version 1.1 of the SC SQT and Debit Calculator includes updated parameters, metrics, and reference curves for the physicochemical and biology functional categories using data from South Carolina.

SC SQT Manual Directory

1. **Debit Calculator Manual** – *Describes data collection method options along with rules and procedures for using the Debit Calculator Microsoft Excel workbook* (This document).
 - Appendix A – Practical Debit Calculator Example (provided by USACE Charleston District).
2. **Data Collection and Analysis Manual** – *Describes instructions to collect and analyze data for the SQT and/or Debit Calculator input.*
3. **SQT Spreadsheet User Manual** – *Describes rules and procedures for using the SQT Microsoft Excel workbook.*

1.1 Purpose of the Debit Calculator

The Debit Calculator is an application of the SQT. The Debit Calculator was developed to quantify functional loss associated with permitted impact activities, while the SQT was developed to assess and quantify both functional lift and loss associated with stream mitigation or impact activities. The Debit Calculator can be used to determine debits from reach-scale impacts typically encountered in the Clean Water Act (CWA) §404 program. The Debit

¹ <https://www.dnr.sc.gov/environmental/streamrestoration.html>

Calculator implements the same quantification approach as the SQT to ensure parity between the functional change measured by the SQT and Debit Calculator tools. Specifically, the same function-based parameters and metrics used to assess functional change with the SQT are also used to assess functional loss with the Debit Calculator.

The same function-based parameters and metrics used to assess functional change with the SQT are also used to assess functional loss with the Debit Calculator.

A main goal of the SQT and Debit Calculator is to produce objective, verifiable, and repeatable results by consolidating well-defined, quantitative data collection procedures for stream condition and underlying processes. The SQT and the Debit Calculator were specifically developed to:

1. Quantify the numerical differences between an existing (pre-activity) stream condition and the proposed (post-activity) stream condition. This numerical difference is known as functional lift or loss and can be related to a stream credit determination method as defined by the Mitigation Rule (USACE & USEPA, 2008).
2. Relate restoration and impact activities to changes in stream functions by primarily selecting function-based parameters and metrics that can be altered by reach-scale practices.
3. Create parity or equivalency between functional lift (credits) and loss (debits).

The purposes above translate into different uses for the SQT and Debit Calculator in South Carolina, including:

1. Site Selection – The tools can help with impact avoidance and minimization by determining which site and/or design will yield the least functional loss for a proposed activity.
2. Functional Lift or Loss – The tools can quantify functional change for a proposed or active project.
3. Calculation of Debits for Compensatory Mitigation Requirements for §404 Permits – The Debit Calculator was developed to incorporate the change in function (i.e., the proposed functional foot score minus the existing functional foot score). This can be used to assist in determining the appropriate number of debits which result from a proposed project, and which would need to be offset through purchase or other means of credit generation (i.e., permittee responsible mitigation).
4. Stream Relocations – The SQT can be applied to on-site relocations to help determine if the proposed mitigation activities will offset the proposed impacts. The Debit Calculator and SQT can be used together to determine whether proposed activities will offset proposed impacts when the impact and restoration occur on separate reaches within the project area.

1.1.1. PRIMARY DIFFERENCES BETWEEN THE SQT AND DEBIT CALCULATOR

To measure functional change, the SQT requires measurement of the existing (pre-activity) and proposed conditions (post-activity), as well as monitoring to verify the proposed condition. The

primary challenge with measuring functional loss using the SQT is that the proposed condition is *not monitored*, which prevents verification of the proposed condition. The proposed condition must be estimated through project design documents, modeling, literature reviews, and best professional judgement.

Thus, *the Debit Calculator was created to provide an alternative, rapid method to assess the proposed condition for permitted impacts.*

This rapid, proposed condition method uses impact severity tiers (Section 2.5) to determine the proposed condition.

Additionally, *the Debit Calculator provides alternative options, varying in level of effort, to assess the existing condition for permitted impacts.* The rapid existing condition method(s) applies standard scores to functional parameters in all functional categories.

The Debit Calculator was created to provide:

- An alternative, rapid method to assess the proposed condition for permitted impacts.
- Alternative options to assess the existing condition, varying in level of effort, for permitted impacts.

The primary differences between the SQT and Debit Calculator, with respect to the Debit Calculator, are:

1. Proposed condition is determined using impact severity tiers.
2. All five functional categories must be scored.
3. There are assessment options for determining the existing condition score. This provides rapid alternatives for assessment and ensures that the functional lift calculated by the SQT equals the functional loss calculated by the Debit Calculator.

1.2 SQT and Debit Calculator Key Concepts

The following concepts are critical in understanding the applicability and limitations of the SQT and Debit Calculator:

- The SQT and Debit Calculator provide quantification of functional loss from proposed impacts in terms of debits and quantification of functional lift from proposed restoration activities in terms of credits. They may be used to inform decisions about compensatory mitigation requirements, however the SQT and Debit Calculator do not determine whether a particular activity would require compensatory mitigation under current USACE Regulatory Authority.
- The parameters and metrics in the SQT and Debit Calculator were selected due to their sensitivity in responding to reach-scale changes associated with the types of activities commonly used in stream restoration and permitted impacts. These parameters are *not intended* to comprehensively characterize all structural measures or processes that occur within a stream.
- The SQT and Debit Calculator do not quantitatively score watershed condition. The SQT assesses watershed condition qualitatively and uses the information to inform restoration

potential for a given site or watershed. Impact activities should consider watershed condition as part of avoidance and minimization of impacts.

- The SQT and Debit Calculator assess the reach corridor, including the stream channel, adjacent floodplain, riparian buffer extent, and the lateral drainage area. The SQT and Debit Calculator outputs reflect the condition of the riparian corridor even though the unit of measure is stream feet (linear feet).
- The SQT and Debit Calculator are designed to assess the same parameters and metrics pre-activity and post-activity to provide parity between methods used to quantify change in condition. Unless the same parameters and metrics are used, it is not appropriate to compare scores across sites.
- Reference curves relate point-in-time condition measurements to functional capacity on a scale of 0.00 to 1.00, where 0.00 represents no functional capacity and 1.00 represents pristine or unaltered condition. Reference curves standardize all metrics to an ecologically relevant scale.
- The overall existing and proposed condition scores range from 0.00 to 1.00, where each of the five functional categories contributes a maximum of 20% to the overall score.² Overall condition scores in the SQT and Debit Calculator are additive. In the Debit Calculator, all five categories are assessed; whereas, in the SQT, users have the option to assess parameters in the physicochemical and biology parameters.
- Functional feet are calculated by multiplying the quantity (stream length in linear feet) by the overall condition score. The unit of measure provides scale to the overall condition score, an otherwise unit-less measure. Scale is necessary for debit and credit quantity determinations.
- The primary output of the Debit Calculator is functional loss ($-\Delta FF$). However, the SC Debit Calculator outputs a total debit score as well, which applies adjustments to $-\Delta FF$ based on the following adjustment factors: cumulative impact, impact duration, priority category, and stream type (USACE).

1.3 Downloading and Revising the SQT and Debit Calculator Package

The SC SQT package, including the Debit Calculator workbook and this user manual, can be downloaded from the SC Department of Natural Resources website.³ Feedback may be submitted at any time to DNR.

In addition to this user manual, the following spreadsheets and documents are available:

- SC SQT workbook – Microsoft Excel workbook described in the SC SQT Spreadsheet User Manual.

² The SC Debit Calculator has a scoring override for streams that are assessed as having an overall existing condition score less than 0.30. In this scenario, a minimum existing condition score of 0.30 will be assigned.

³ www.dnr.sc.gov/sqt

- SC SQT Spreadsheet User Manual (South Carolina Steering Committee, 2022a) – Describes the calculations performed by the SC SQT workbook and how to use the workbook for stream restoration projects.
- SC SQT Data Collection and Analysis Manual (South Carolina Steering Committee, 2022b) – Describes how to collect and process data and calculate input for the SC SQT.
- SC Debit Calculator workbook – Microsoft Excel workbook used to calculate debits.

Supporting information can be found at the Stream Mechanics webpage⁴, including other state SQTs, the Debit Tool White Paper, the Stream Functions Pyramid diagram, *A Function-Based Framework for Stream Assessment and Restoration Projects* (Harman et al., 2012), and new function-based parameters with metrics and reference standards (not included in Harman et al. [2012]). In addition, the Workshops tab on the Stream Mechanics site provides a list of courses providing further education on the Stream Functions Pyramid Framework, the SQT, and other courses related to stream assessment and restoration.

The SC SQT and Debit Calculator will be updated and revised periodically as additional data are gathered and reference curves and metrics are refined. Field data supporting refinement of reference curves and evaluation of metrics are appreciated. The SQT and Debit Calculator architectures are flexible and future versions of the tools can accommodate additional parameters and metrics. If a user is interested in proposing additional parameters or metrics for incorporation into the tool, they should provide a written proposal for consideration to DNR. The written proposal should include a justification and rationale (e.g., data sources and/or literature references) and should follow the Streams Functions Pyramid Framework for identifying reference curves, threshold values, and index scores (see Section 1.4 below).

1.4 Background and Concepts

The SC Debit Calculator is a Microsoft Excel workbook used to quantify functional loss and inform debits. The Debit Calculator and SQT apply concepts from the Stream Functions Pyramid Framework (SFPF; Harman et al., 2012). The Debit Calculator and SQT use the same function-based parameters and metrics to assess five functional categories: hydrology, hydraulics, geomorphology, physicochemical, and biology (South Carolina Steering Committee, 2022a).

The Stream Functions Pyramid (Figure 1) is based on the premise that lower-level functions support higher-level functions and that they are all influenced by local geology and climate. Each functional category is defined by a functional statement. For example, the functional statement for level 1, Hydrology is “the transport of water from the watershed to the channel”, which supports all higher-level functions. The Stream Functions Pyramid *alone* depicts a hierarchy of stream functions but does not provide a specific mechanism for addressing functional capacity, establishing reference standards, or communicating functional change. Building off the Stream Functions Pyramid, the SFPF lays out a framework to quantify stream

⁴ <https://stream-mechanics.com/>

functions. The SQT and Debit Calculator utilize this structure and key components are described below:

- **Functional categories** describe levels 1 through 5 of the Stream Functions Pyramid: hydrology, hydraulics, geomorphology, physicochemical, and biology. Each functional category is defined by a functional statement.
- **Function-based parameters** describe and support the functional statements for each functional category. Parameters are “function-based” because they are described by metrics that quantitatively measure stream condition; the metrics themselves are not direct measures of stream function.
- **Metrics** (known as measurement methods in Harman et al. [2012]) are specific tools, equations, assessment methods, etc., that quantify the function-based parameter. There can be more than one metric for a single function-based parameter. Metrics selected for the SQT and Debit Calculator are structural or compositional attributes that indicate condition at a given point-in-time. Thus, metrics are surrogates for stream functions (USACE & USEPA, 2008). Metrics support the functional statement of the functional category in which it resides.
- **Reference curves** (known as performance standards in Harman et al. [2012]) relate point-in-time condition measurements to functional capacity on a scale of 0.00 to 1.00, where 0.00 represents no functional capacity and 1.00 represents pristine or culturally unaltered condition. Reference curves standardize all metrics to an ecologically relevant scale. See Section 3.5.1.4 for more information on reference curves.

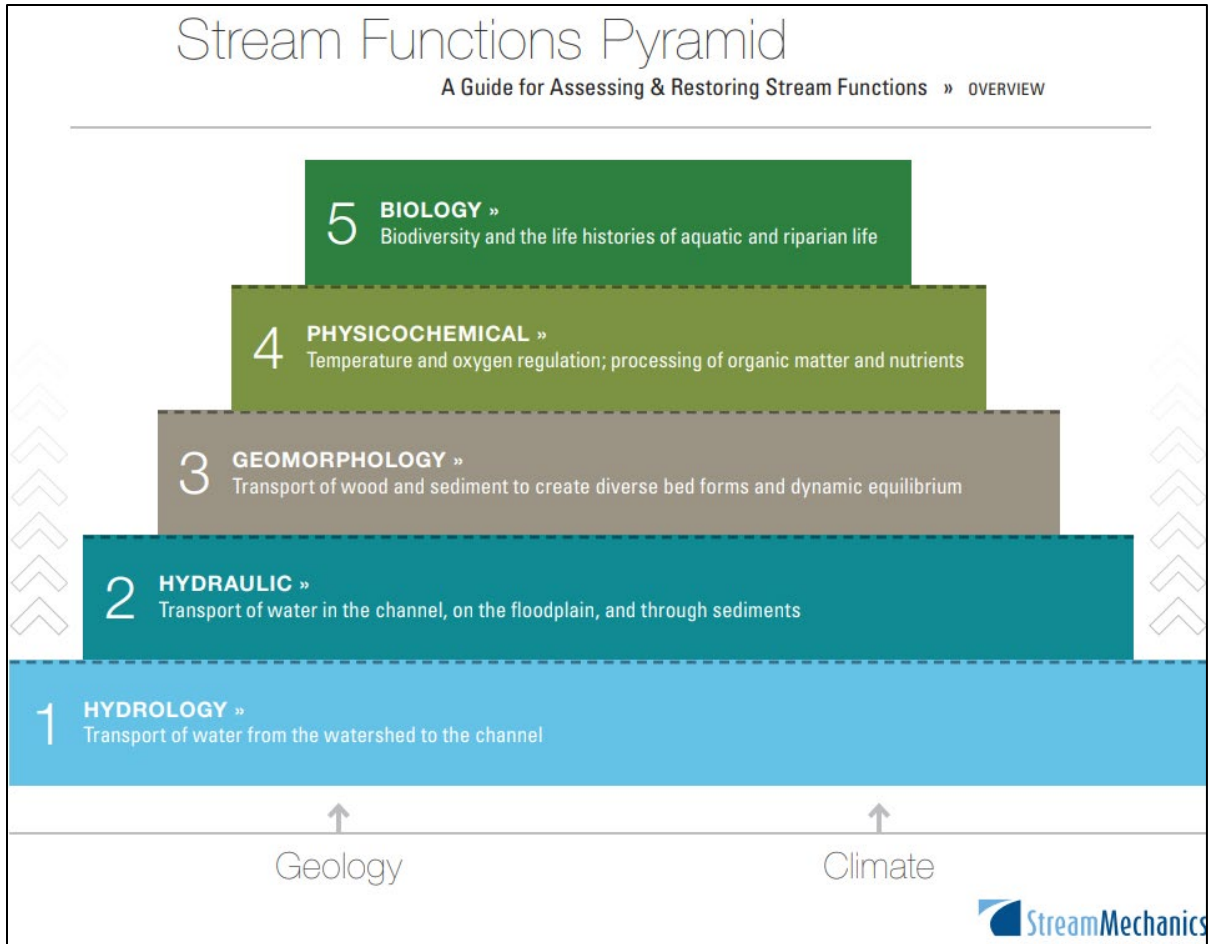


Figure 1. The Stream Functions Pyramid is based on the premise that lower-level functions support higher-level functions and that they are all influenced by local geology and climate.

Chapter 2. Getting Started

This chapter outlines how to implement the Debit Calculator and details concepts unique to the Debit Calculator.

2.1 Debit Calculator Process

The typical process for evaluating functional change imposed by stream impact projects with the Debit Calculator is outlined in Table 1.

Table 1. Typical stream impact evaluation process using the Debit Calculator

Phase and Task(s)	Associated Spreadsheet
Project and Reach Delineation (Section 2.2)	
Delineate the project area(s) and determine project reaches primarily based on impact activities.	Project Summary
Existing Conditions Assessment (Sections 2.3 and 2.4)	
Select the Debit Option to assess the existing condition. Different Debit Options can be selected for different project reaches. Directions are provided for each Debit Option below.	Functional Loss
➔ Debit Option 1	
Select Priority Category. No data collection required.	Project Summary
➔ Debit Options 2a, 2b, and 3	
Coordinate with regulating agencies to select parameters and metrics based on your reach-specific setting and proposed impacts.	Parameter and Metric Selection
Collect data to characterize the existing condition. The number of parameters measured depends on the Debit Option selected. For all Debit Options, existing condition standard scores will be assumed for parameters not measured.	Existing Conditions
Proposed Conditions Assessment (Section 2.5)	
Coordinate with regulating agencies to select the appropriate impact severity tier for each project reach.	Functional Loss

2.2 Reach Delineation

The SQT is a reach corridor assessment methodology. Large impact projects may be subdivided into multiple reaches. Reach delineation is largely influenced by differences in morphology or condition and the degree of impact to function-based parameters associated with an impact activity. Guidance for reach delineation is provided in Section 3.1 of the Data Collection and Analysis Manual (South Carolina Steering Committee, 2022b).

For long reaches, certain parameters can be assessed within a representative sub-reach to avoid quantitative assessment of long stream lengths with similar physical conditions (Section 3.2, Data Collection and Analysis Manual, 2022b). The sub-reach must be 20 times the bankfull width or two meander wavelengths (Leopold, 1994), whichever is longer. Sub-reach delineation is applicable to Debit Options 2a, 2b, and 3, where applicants elect to measure some or all parameters in all five functional categories.

For short reaches, the entire reach length should be assessed. A common example is a short reach (e.g., 25 feet) between two culverts. In this example, the 25 feet of stream corridor between the two culverts is assessed. Some metrics in the SQT require a minimum sample size or reach length. Instruction is provided below for the LWD and bed form diversity parameters:

- Scale the LWDI field value or LWD piece count field value to 328 ft, the length of the LWD assessment reach. This is applicable to Debit Options 2a, 2b, and 3 where the LWD parameter is measured.
- Assess a stream length that is longer than the project reach to capture the necessary data to determine bed form diversity metrics. This is applicable to Debit Options 2b and 3 where the bed form diversity parameter is measured.

2.3 Existing Condition Assessment Options (Debit Options)

The SC Debit Calculator includes four Debit Options to assess the existing condition. The Debit Options and their recommended use are presented in Table 2. Debit Option 1 requires the least effort because it requires no field or desktop assessment; instead, standard scores are assumed for parameters in all five functional categories. As the Debit Option number increases, the assessment requires more field data collection and analysis effort.

Table 2. Description of Debit Options and recommended use.

Debit Options	How to Determine the Existing Condition Score	Recommended Use
1	No assessment – Assume standard scores for parameters in all five functional categories.	Permit applicants who do not want to perform an assessment. Typically used if the existing condition is good.
2a	Partial Assessment – Estimate the existing condition score by assessing a <i>minimum</i> number of parameters (see Section 3.4.1 for list of parameters to measure). Parameters that are not assessed are assigned a standard score.	Permit applicants who want to assess a minimum number of parameters. Typically used if the existing condition is degraded; select Debit Option 2a or 2b based on observed impairments and available resources.
2b	Partial Assessment – Estimate the existing condition score by assessing some, but not all, parameters (see Section 3.4.1 for list of parameters). Parameters that are not assessed will be assigned a standard score.	Permit applicants who want to assess more than the minimum (option 2a), but not all parameters (option 3). Typically used if the existing condition is degraded; select Debit Option 2a or 2b based on observed impairments and available resources.
3	Full Assessment – Perform existing condition assessment of all applicable parameters. Standard scores are not assumed.	Permit applicants who have the staff and expertise to perform assessments in all five functional categories. Typically used for larger projects, or when the existing channel and contributing watershed are degraded and a cost/benefit analysis proves this option is worthwhile.

2.4 Existing Condition Survey Assessment Methods

When users elect to partially or fully measure the existing condition (i.e., Debit Options 2a, 2b, or 3), users have the option to use rapid or detailed survey methods to quantify hydraulic and geomorphology metrics that require survey data.

- For the *rapid method*, parameters are quantitatively measured using tapes and stadia rods instead of standard surveying equipment like laser levels or a total station. Profiles cannot be plotted using this method.
- For the *detailed method*, a longitudinal profile is surveyed consisting of at least four profiles: thalweg, water surface, bankfull, and low bank. Standard survey methods can be used to collect these data using a survey-grade GPS, laser or standard level, total station, or similar equipment (Harrelson et al., 1994; Rosgen, 2014).

See Section 3.3 in the Data Collection and Analysis Manual (South Carolina Steering Committee, 2022b) for more information.

2.4.1 EXISTING CONDITION STANDARD SCORES

Debit Options 1, 2a, and 2b assign standard scores to function-based parameters for the existing condition when the metric is NOT measured/assessed. The standard score is assigned based on priority category. Priority category is a factor that recognizes the importance of aquatic resources that provide valuable functions and services on a watershed scale, that occupy important positions in the landscape, or that are considered important because of their rarity. Adverse impacts to primary priority areas should be avoided and minimized to the maximum extent practicable (USACE).

Priority categories are defined as follows and include any project that is within or immediately adjacent (USACE):

- **Primary Priority** areas include: waters in or adjacent to State Heritage Preserves or Wildlife Management Areas, National Wildlife Refuges, National or State Forests; National Park Service or State Park Lands, Federal Wild and Scenic Rivers; anadromous fish spawning habitat; Outstanding Resource Waters or Outstanding Natural Resource Waters; Essential Fish Habitat; state natural trout streams; waters with Federal/State listed Threatened and Endangered species; or waters that are federally designated critical habitat.
- **Secondary Priority** areas include: CWA §303(d) listed streams; waters with Federal At-Risk Species; waters with State Wildlife Action Plan conservation priority species; State “Trout - Put, Grow, and Take” or “Trout - Put and Take” streams; stream and river reaches within 0.5 river miles upstream or downstream of a Primary Priority reach; or waters in State Scenic River Corridors.
- **Tertiary Priority** areas include: all other streams.

The Debit Calculator assigns standard scores as follows:

- Primary 1.00
- Secondary 0.80
- Tertiary 0.70

2.4.2 MINIMUM EXISTING CONDITION STANDARD SCORES

The SC Debit Calculator will implement a scoring override for streams that are assessed as having an overall existing condition score less than 0.30. In this scenario, a minimum existing condition score of 0.30 will be assigned. This override ensures that all stream impacts, regardless of the starting condition of the stream, will yield functional loss. This accounts for losses to stream functions that are not quantified by the SQT.

2.5 Proposed Condition Assessment and Impact Severity Tiers

The SC Debit Calculator assigns a proposed condition score using impact severity tiers for all Debit Options.

The impact severity tier is a categorical determination of adverse impacts to stream functions, ranging from no loss to total loss. Tier 0 represents no permanent loss of stream functions and

Tier 6 represents complete loss of stream functions. Therefore, under a Tier 0 scenario, the applicant would not need to complete the Debit Calculator process.

Each tier is delineated by the severity and magnitude of impacts to stream functions, represented by function-based parameters. As tier number increases, the number of parameters affected and the severity of impacts increase. The impact severity tiers focus on impacts to parameters caused by the activities, rather than the activities themselves. Because the tiers focus on impacts to functions, specific activities may be appropriately assigned to multiple tiers depending on the magnitude of the impact and the particulars of a proposed project. For example, a small bank stabilization project may be a Tier 1 impact if only riparian vegetation and/or lateral migration parameters are impacted. However, if the bank stabilization was large enough to impact physicochemical and/or biological functions, then the project would be a Tier 4 impact.

Impact severity tier category descriptions, and percent functional loss associated with each tier are presented in Table 3.

Table 3. Impact severity tier category descriptions, example activities, and percent functional loss associated with each tier.

Impact Severity Tier	Impacts to Function-Based Parameters	Functional Loss (%)
Tier 0	No permanent impacts to aquatic functions; impacts do not require compensatory mitigation.	0
Tier 1	Minor impacts, primarily to reach runoff, flow dynamics, riparian vegetation, lateral migration, and some physicochemical and/or biological functions.	10
Tier 2	Minor impacts to reach runoff. Minor to moderate impacts to bed form diversity, flow dynamics, and large woody debris. Typically accompanied by moderate to severe impacts to riparian vegetation and lateral migration. Minor impacts to some physicochemical and/or biological functions.	20
Tier 3	Moderate impacts to reach runoff, bed form diversity, and riparian vegetation. Severe impacts to floodplain connectivity. Moderate to severe impacts to flow dynamics and large woody debris. Minor to moderate impacts to some physicochemical and biology functions.	50
Tier 4	Moderate to severe impacts to most hydraulic and geomorphologic functions. Moderate impacts to physicochemical and biology functions.	70
Tier 5	Severe impacts to all aquatic functions except for hydrology.	80
Tier 6	Total and permanent loss of all aquatic functions.	100

2.5.1 DEVELOPMENT OF IMPACT SEVERITY TIERS AND FUNCTIONAL LOSS VALUES

The functional loss values (%) associated with each impact severity tier were developed by modeling impact activities common in South Carolina streams. The modeling exercise predicts the effect of impact activities on each function-based parameter included in the SQT and Debit Calculator to ultimately determine a range of functional loss for each impact severity tier. By relating the effect of impact activities on function-based parameters, the Debit Calculator shifts the focus from impact activities to stream function, where function-based parameters serve as surrogates for stream functions.

The modeling exercise was an iterative process that followed the steps outlined below:

1. Definitions for impact severity tiers were determined by the Steering Committee. The definitions outline which parameters are typically impacted and the degree to which each parameter is impacted (i.e., no functional loss, minor loss, moderate loss, severe loss, or complete loss).
 - a. Due to the interconnected nature of stream functions and regulatory minimum thresholds for impacts, impacts to physicochemical and biological functions were attributed to every impact severity tier.
 - b. No mitigation is required for a Tier 0 impact.
2. A data matrix was created to model the functional loss (%) associated with each parameter for each impact severity tier. Functional loss values (%), ranging on a scale of 0 to 100%, were applied as follows: 0% represented no functional loss, 25% represented minor loss, 50% represented moderate loss, 75% represented severe loss, and 100% represented complete loss. Generally, as the impact severity tier increases, the functional loss values (%) increase and the number of parameters impacted increases. Minimum and maximum scenarios were modeled for each tier. Using a range acknowledged the uncertainty in matching a given activity to the impact of a specific function. For each tier minimum and maximum scenarios, a total percent functional loss was calculated using the roll-up scoring method in the SQT (Section 3.5.1.4). Generally, the average of the minimum and maximum total percent functional loss for a given tier was the functional loss value (%) associated with that tier; the Steering Committee chose to round the total percent functional loss multipliers to the nearest ten.
 - a. For example, functional loss values (%) of 8% and 14% were determined for the Tier 1 minimum and maximum scenarios, respectively. The average of these values is 11% which was rounded to 10%, the nearest ten. Therefore, the functional loss (%) associated with Tier 1 impacts is 10%.
3. Common impact activities were obtained from the USACE Charleston District Compensatory Mitigation Guidelines and Steering Committee input. Example activities were ranked by scale of impact and assigned to an impact severity tier based on the definition for each tier (Table 3). Functional loss values (%) were assigned by parameter for each example activity using the values described in step 2. For each example activity, a total percent functional loss was calculated using the roll-up scoring method in the SQT (Section 3.5.1.4). Results were compared with the output matrix from step 2 to determine if the total functional loss values (%) for each tier were reasonable.
4. The output from step 3 was used to:

- a. Improve data matrix outputs from step 2, i.e., the total functional loss values (%) for each tier.
- b. Improve impact severity tier definitions.
- c. Determine whether the number of tiers adequately capture the range of functional loss associated with common South Carolina stream impact activities.

Figure 2 depicts the iterative modeling results: the minimum and maximum functional loss values (%) associated with each functional category for each impact severity tier. Final functional loss values (%) are presented in Table 3. Additionally, the Steering Committee determined that six tiers sufficiently expressed the range of functional loss associated with common South Carolina stream impact activities.

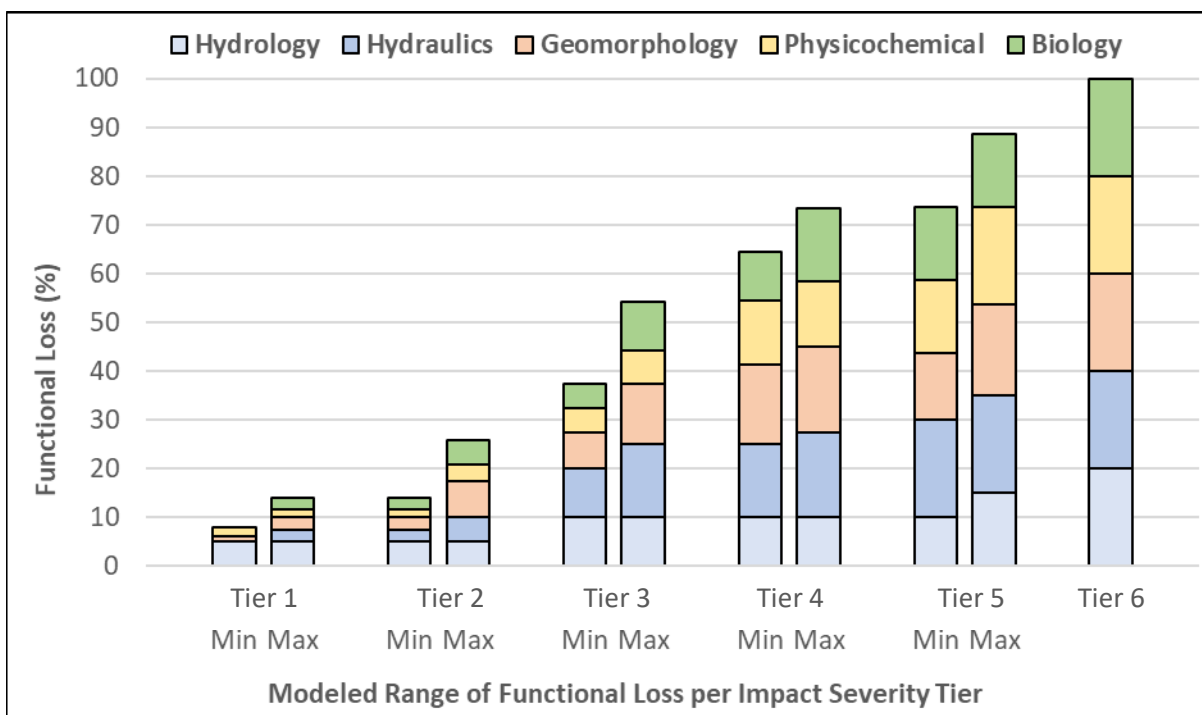


Figure 2. Modeled minimum and maximum functional loss values (%), displayed by functional category, for each impact severity tier.

2.5.2 SCORING IN THE SQT VERSUS DEBIT CALCULATOR

To measure functional change, the SQT and Debit Calculator require measurement of the existing (pre-activity) and proposed conditions (post-activity). When using the Debit Calculator, the existing condition is the condition pre-impact, and the proposed condition is the condition post-impact. The SQT and Debit Calculator outputs existing condition scores (ECSs) and proposed conditions scores (PCSs). In the Debit Calculator, the ECS is a standard score based on priority category (Debit Option 1) or the overall score output from the existing condition assessment (Debit Options 2a, 2b, and 3; Section 2.4.1). The PCS automatically calculates based on the selected impact severity tier (Section 2.5) and the ECS.

The SQT determines functional loss and functional lift in units of functional feet (FF). Functional foot scores (FFSs) are calculated using an ECS and existing stream length or a PCS and a proposed stream length. Functional change (ΔFF) is calculated using the proposed FFS and the existing FFS as follows:

- $Existing\ FFS = Existing\ Condition\ Score * Existing\ Stream\ Length$
- $Proposed\ FFS = Proposed\ Condition\ Score * Proposed\ Stream\ Length$
- $\Delta FF = Proposed\ FFS - Existing\ FFS$

Functional loss is generated when the PCS is lower than the ECS, and the ΔFF yields a negative value ($-\Delta FF$). Functional lift is generated when the PCS is greater than the ECS, and the ΔFF yields a positive value ($+\Delta FF$). Debits are informed by functional loss ($-\Delta FF$) and credits are informed by functional lift ($+\Delta FF$).

In the Debit Calculator, the existing condition score is calculated using the same equations as in the SQT. However, the Debit Calculator provides existing condition assessment *options*, ranging in level of effort (Section 2.3). The PCS is calculated within the Functional Loss spreadsheet by applying a multiplier to the ECS, as follows:

- $PCS = ECS * (100 - Functional\ Loss\ [\%])$

Percent functional loss ranges from 0 to 100% and is determined by the impact severity tier. Impact severity tiers are described in Section 2.5. The PCS is calculated as a function of the ECS. Therefore, the functional loss value (%) associated with an impact severity tier is subtracted from 100%. For example, consider an impact to a reach categorized as a Tier 4 impact, where the existing condition score is 0.80. Tier 4 impacts are associated with 70% functional loss (Table 3). Plugging in 0.80 as the ECS variable and 70% as the functional loss variable in the above equation yields a PCS of 0.24 as follows:

- $PCS = ECS * (100 - Functional\ Loss\ [\%])$
- $0.24 = 0.80 * (100 - 70\ [\% \text{ use decimals}])$

Once the PCS is calculated in the Debit Calculator, the Proposed FFS and Functional Change (ΔFF) are calculated using the equations above.

Chapter 3. South Carolina Debit Calculator Workbook

This chapter outlines content in the SC Debit Calculator workbook step-by-step. The SC Debit Calculator workbook includes four visible spreadsheets and two hidden spreadsheets. All equations are visible and there are no macros. All spreadsheets are locked to prevent editing in certain cells.

The spreadsheets include:

1. Project Summary
2. Functional Loss
3. Parameter and Metric Selection
4. Existing Conditions (applicable to Debit Options 2a, 2b, and 3)
5. Reference Standards (hidden) – This contains the linear equations for all the reference curves included in the SQT.
6. Pull Down Notes (hidden) – This spreadsheet contains all the inputs for drop-down menus throughout the workbook.

This chapter describes each of the visible spreadsheets in detail. Reference curves are described in Section 3.5.1.4 in this manual. See the SQT Spreadsheet User Manual for more information on scoring using reference curves.

3.1 Quick Reference Guide for Debit Option 1 Users

Pertinent sections in this chapter are outlined below for Debit Option 1 users for a quick reference.

Debit Option 1: No assessment – Assume standard scores for all required parameters, and complete the following:

- Project Summary spreadsheet (Section 3.2.)
 - Reach Summary table (Section 3.2.1.2.)
 - Adverse Impact Adjustment Factors table (Section 3.2.1.3.)
- Functional Loss spreadsheet (Section 3.3.1.)
 - Functional Loss Summary table (Section 3.3.1.1.)

3.2 Project Summary Spreadsheet

The purpose of the Project Summary spreadsheet is to provide project information, identify and describe the reaches within a project area, and summarize the functional loss and total debits associated with the project. The Project Summary spreadsheet requires the user to provide general and detailed information regarding the proposed project.

3.2.1 COMPONENTS OF THE PROJECT SUMMARY SPREADSHEET

3.2.1.1 *Project Summary Spreadsheet*

Project Name – Provide the name of the project. For example, this could be a developing subdivision, a road project, or commercial and retail space.

Applicant – Identify the name of the person or entity legally responsible for the project.

Date – Provide the date the Debit Calculator workbook was completed.

Project ID / Permit Number(s) – Provide the unique project ID. Or, if applying for a regulatory permit, provide the permit number.

Project Description – Provide a description of the project including the purpose and any associated previous activity or permits.

Total Functional Loss (-ΔFF) – Sums the results from the Reach Summary table within the Project Summary spreadsheet.

Total Debits – Sums the results from the Adverse Impact Adjustment Factors table within the Project Summary spreadsheet.

3.2.1.2 *Reach Summary Table*

Figure 3 displays the Reach Summary table as shown on the Project Summary spreadsheet. Data inputs are detailed below.

Reach Summary					
Reach ID	Flow Type	Strahler Stream Order	Priority Category	Reach and Impact Description	Functional Loss (-ΔFF)
Reach 1	Perennial	2	Secondary	Rip-rap armoring and culvert installation	

Figure 3. Example Reach Summary table as shown on the Project Summary spreadsheet.

Reach ID – Identify each impact by stream and project reach. For example, STR-1 R-2 would be the second reach of the first stream impacted in the project. If there is only one reach along

the impacted stream, no reach identifier is needed (e.g., STR-1). This information automatically populates the fields in the Functional Loss and Existing Conditions spreadsheets.

Flow Type – Drop-down menu with option to select perennial, seasonal intermittent, intermittent, or ephemeral. Seasonal intermittent streams typically have continuous flow for at least three months while intermittent and ephemeral streams do not.

Strahler Stream Order – Drop-down menu with option to select 1, 2, 3, or 4+. Stream order, as defined by Strahler (1957), is a classification system based on stream/tributary relationships. Headwater streams are first order; the stream becomes second order downstream of the confluence of two first order streams; the stream becomes third order downstream of the confluence of two second order streams; and so on.

Priority Category – Drop-down menu with option to select primary, secondary, or tertiary. Priority categories are described in Section 2.4.1. This information automatically populates fields in the Functional Loss and Existing Conditions spreadsheets.

Reach and Impact Description – Describe the proposed impact to the stream. For example, impacts such as 300 linear feet of 6' x 4' culvert, 600 linear feet of full bank hard armoring, or 250 linear feet of stream fill.

Functional Loss (- Δ FF) – Automatically populates the functional loss, or net change in functional feet per project reach from the Functional Loss spreadsheet.

Aerial Photograph of Project Area – Provide an aerial photograph of the project area. The photo could include labels indicating where work is proposed, the project reaches, and any important features within the project site or catchment.

3.2.1.3 Adverse Impact Adjustment Factors Table

Figure 4 displays the Adverse Impact Adjustment Factors table as shown on the Project Summary spreadsheet. Table items are detailed below.

Adverse Impact Adjustment Factors							
Reach ID	Existing Stream Length (LF)	Stream Type	Stream Type R Factor	Impact Duration	Impact Duration R Factor	Sum of R Factors	Debits (FF)
Reach 1	200	1st and 2nd Order RPWs	0.8			0.9	
						0.1	
						0.1	
						0.1	
						0.1	
						0.1	
						0.1	
						0.1	
						0.1	
						0.1	
Additional Existing Project Length (ft)			Cumulative Impact R Factor	<div style="border: 1px solid black; padding: 5px; background-color: #ffffcc;"> Note: Add additional length from any additional project workbook(s) if more than one workbook is used. </div>			
Total Existing Project Length (ft)	200		0.1				

Figure 4. Example Adverse Impact Adjustment Factors table as shown on the Project Summary spreadsheet.

Reach ID – Automatically populates from input in the Reach Summary table.

Existing Stream Length – Automatically populates from the Functional Loss spreadsheet.

Additional Existing Project Length – Input additional length from any additional project workbook(s) if more than one workbook is used.

Total Existing Project Length – Sums the total existing project length, including each reach’s existing stream length and any additional existing project length in other workbooks. This value is used to determine the Cumulative Impact R Factor, described below.

Stream Type – Automatically populates based on flow type and stream order input in the Reach Summary table (USACE):

- **Non-Relatively Permanent Waters (Non-RPW)** are non-navigable tributaries that are not relatively permanent (i.e., the tributaries typically do not have continuous flow for at least 3 months of the year).
- **1st and 2nd Strahler Stream Order RPWs** are non-navigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically have continuous flow, or at least seasonal flow (e.g., typically three months).
- **All Other Streams** includes streams greater than 2nd order tributaries, and traditional navigable waters.

Stream Type R Factor – Automatically populates the R factor (adjustment factor) based on stream type per the Charleston District Guidelines for Preparing a Compensatory Mitigation Plan:

- **Non-Relatively Permanent Waters:** The Debit Calculator automatically populates a value of 0.1 for Non-RPWs.
- **1st and 2nd Strahler Stream Order RPWs:** The Debit Calculator automatically populates a value of 0.8 for 1st and 2nd Order RPWs.
- **All Other Streams:** The Debit Calculator automatically populates a value of 0.4 for all other streams.

Cumulative Impact – The impact on the environment, which results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency, or person undertakes such other actions, as defined by the National Environmental Policy Act. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time.

Cumulative Impact R Factor – Automatically populates the R Factor (adjustment factor) based on the cumulative impact based on the linear feet of stream impacted (Table 4).

Table 4. Adverse impact adjustment factor values for cumulative impact (linear feet) per the Guidelines for Preparing a Compensatory Mitigation Plan (USACE).

Cumulative Impact in Linear Feet	Cumulative Impact R Factor Value
50 feet or less	0.01
51 – 300	0.10
301 – 500	0.20
501 – 999	0.40
1000 – 6000	1.5
Greater than 6000 feet	3.0

Impact Duration – Drop-down menu with the option to select temporary, recurrent, or permanent. **Impact duration** means the length of time the adverse impacts are expected to last per the Guidelines for Preparing a Compensatory Mitigation Plan (USACE):

- **Temporary** means impacts will occur for a period of one year or less and restoration of the aquatic system will occur following termination of the permitted activity.
- **Recurrent** refers to repeated impacts of short duration (such as on-channel 24-hour storm detention).
- **Permanent** means project impacts will occur for a period of greater than one year.

Impact Duration R Factor – Automatically populates the R Factor (adjustment factor) based on the impact duration. **Impact duration** categories are defined as follows per the Guidelines for Preparing a Compensatory Mitigation Plan (USACE):

- **Temporary:** The Debit Calculator automatically populates a value of 0.05 for temporary impacts.
- **Recurrent:** The Debit Calculator automatically populates a value of 0.10 for recurrent impacts.
- **Permanent:** The Debit Calculator automatically populates a value of 0.30 for permanent impacts.

Sum of R Factors – Automatically sums the R Factors (adjustment factors) associated with stream type, cumulative impact, and impact duration.

Debits – Automatically calculates the debits by multiplying functional loss ($-\Delta FF$) with the Sum of R Factors associated with each respective reach.

3.3 Functional Loss Spreadsheet

The Functional Loss spreadsheet is the main sheet in the SC Debit Calculator workbook where users enter data to describe the existing stream reach and the impact activity. By selecting an impact severity tier, functional loss is quantified. Cells that allow input are shaded and most other cells are locked. Each component of the Functional Loss spreadsheet is discussed below.

Users enter data and make selections on this spreadsheet to quantify functional loss per project reach. Up to 10 reaches can be entered into one Debit Calculator workbook. The spreadsheet automatically sums the total functional loss on the Project Summary spreadsheet. If more than 10 reaches are located in a project area, the user must use an additional Debit Calculator workbook. The additional project lengths from any additional Debit Calculator workbooks must be entered into the Project Summary spreadsheet in the Additional Existing Project Length cell of the Adverse Impact Adjustment Factors table.

3.3.1 COMPONENTS OF THE FUNCTIONAL LOSS SPREADSHEET

3.3.1.1 Functional Loss Summary Table

Figure 5 depicts the Functional Loss Summary table where users enter data including the Debit Option, impact severity tier, and stream length for the existing and proposed conditions. Table items are detailed below.

FUNCTIONAL LOSS SUMMARY									
Reach ID	Priority Category	Debit Option	Existing Stream Length	Proposed Stream Length	Existing Condition Score (ECS)	Impact Severity Tier	Proposed Condition Score (PCS)	Functional Loss (-ΔFF)	Flow Type and Stream Order
Reach 1	Secondary	2a	200	200	0.68	Tier 2	0.54	-28	P2
0	0								
0	0								
0	0								
0	0								
0	0								
0	0								
0	0								
0	0								
0	0								
Functional Loss (-ΔFF)								-28	

Figure 5. Example Functional Loss Summary table from the Functional Loss spreadsheet.

Reach ID – Automatically populates from the Project Summary spreadsheet.

Priority Category – Automatically populates from the Project Summary spreadsheet.

Debit Option – Drop-down menu with option to select one of the four Debit Options for determining the existing site conditions. These options (1, 2a, 2b, and 3) are described in Section 2.3. Please note, Debit Options can vary for each stream reach within the project area. Coordinate with any regulating agencies to select parameters and metrics based on your reach-specific setting and proposed impacts.

Existing Stream Length – Calculate the length of the stream that will be directly impacted by the permitted activity. Stream length should be measured along the centerline of the channel prior to impact, such as measuring the channel length of the stream before a culvert is installed.

Proposed Stream Length – Calculate the length of stream channel after the impact has occurred. For pipes, the proposed length is the length of the pipe at a minimum. If the stream will be straightened by the permitted activity, the proposed length will be less than the existing length. **Proposed stream lengths should not be longer than the impact length; the debit calculator will highlight the cell if the existing stream length is shorter than the proposed stream length.** Streams cannot be lengthened by pipes. Therefore, a 300-foot pipe along 275 feet of stream will only impact 275 linear feet of stream.

Existing Condition Score (ECS) – Represents pre-activity condition on a scale of 0.00 to 1.00. Standard ECS values automatically populate in this column once the Debit Option is selected

(and after the priority category is selected on the Project Summary spreadsheet). For Debit Options 2a, 2b, and 3 where the existing condition is partially or fully assessed, users can input data in the Existing Conditions spreadsheet to update the ECS score in the functional loss summary table.

Impact Severity Tier – Drop-down menu to select an impact severity tier in order to calculate a proposed condition score. The impact severity tier is a categorical determination of the amount of adverse impact to stream functions, ranging from no loss to total loss from a proposed activity (Section 2.5).

Proposed Condition Score (PCS) – Automatically calculates using the selected impact severity tier and the ECS. Represents post-impact condition on a scale of 0.00 to 1.00. Section 2.5 describes how the PCS is calculated.

Functional Loss (- Δ FF) – Automatically calculates the change in functional feet associated with the ECS and PCS. Section 2.5 describes how Δ FF are calculated.

Flow Type and Stream Order – A label describing flow type and stream order (e.g., P2 for a perennial or seasonal, second order stream) automatically populates based on stream order and flow type inputs on the Project Summary spreadsheet. Flow type and stream order (Strahler, 1957) provide context for the Δ FF value generated.

3.3.1.2 Debit Option Summary Table

This table outlines instructions to assess the ECS and PCS for each Debit Option. Debit Options are described in Section 2.3.

3.3.1.3 Existing Condition Standard Scores Table

When Debit Option 1 is selected, this table summarizes the standard scores used for the existing condition based on the priority category (e.g., primary, secondary, or tertiary). The Existing Conditions spreadsheet also uses these values to score any parameters that are not assessed for Debit Options 2a and 2b.

3.3.1.4 Existing Condition Score Summary Table

When Debit Options 2a, 2b, or 3 are used, this table summarizes the overall ECSs from each condition assessment in the Existing Conditions spreadsheet. The values in this table are presented in the order they are entered into the Project Summary spreadsheet. Users should ensure they have entered the data for the correct reach in the Existing Conditions spreadsheet.

3.3.1.5 Impact Severity Tier Summary Table

This table summarizes functional loss (%) and describes impacts to function-based parameters associated with each impact severity tier. Impact severity tiers are described in Section 2.5.

3.4 Parameter and Metric Selection Spreadsheet

This spreadsheet applies to an applicant that elects to assess some or all of the existing condition by choosing Debit Options 2a, 2b, or 3. Recall that if an applicant elects to not measure a parameter, a standard score will be assumed for each parameter that is not measured based on priority category type. Thus, the Debit Calculator will quantify a condition score using all five functional categories regardless of the Debit Option selected.

For each Debit Option, this spreadsheet outlines which parameters and metrics are required or optional. The information in this spreadsheet is duplicated below to provide additional instructions for parameter and metric selection by Debit Option and applicability to the landscape.

3.4.1 DEBIT OPTIONS

Debit Option 2a requires measurement of five parameters, listed below. The tool will assume values for bed form diversity, riparian vegetation, temperature, bacteria, nitrogen, phosphorus, suspended sediment, macroinvertebrates and fish parameters. The exception to the list below is if the parameter is not applicable (see Section 3.4.2).

- Reach Runoff
- Floodplain Connectivity
- Flow Dynamics
- Large Woody Debris
- Lateral Migration

Debit Option 2b requires measurement of seven parameters, listed below. The tool will assume values for physicochemical and biology parameters. The exception to the list below is if the parameter is not applicable (see Section 3.4.2).

- Reach Runoff
- Floodplain Connectivity
- Flow Dynamics
- Large Woody Debris
- Lateral Migration
- Riparian Vegetation
- Bed Form Diversity

Debit Option 3 requires measurement of all parameters within all five functional categories, listed below. The exception to the list below is if the parameter is not applicable (see Section 3.4.2).

- Floodplain Connectivity
- Flow Dynamics
- Large Woody Debris
- Lateral Migration
- Riparian Vegetation
- Bed Form Diversity
- Temperature

- Bacteria
- Nitrogen
- Phosphorus
- Suspended Sediment
- Macroinvertebrates
- Fish

3.4.2 PARAMETER AND METRIC APPLICABILITY

Even if a parameter is required by a Debit Option, it will only be measured if it is also applicable to the project reach. Information on parameter and metric selection based on applicability to the landscape, presented below, is organized by functional category and function-based parameter.

Hydrology

Reach Runoff: This parameter is applicable to all stream systems. Land use coefficient and concentrated flow point metrics are applicable to all stream systems.

Hydraulics

Floodplain Connectivity: This parameter is applicable to all stream systems. Bank height ratio (BHR) is applicable to all stream systems. Entrenchment ratio (ER) is applicable to all single-thread perennial, seasonal intermittent, and intermittent stream systems.

Flow Dynamics: This parameter is applicable to all single-thread stream systems. Width/depth ratio state is applicable to all single-thread perennial, seasonal intermittent, and intermittent stream systems.

Geomorphology

Large Woody Debris (LWD): This parameter is applicable to all stream systems. Users have an option to evaluate either the large woody debris index (LWDI) or LWD piece count metric, but not both.

- *LWDI* characterizes the quantity and quality of large woody debris in the stream channel.
- *LWD piece count* (number per 100 meters) characterizes the quantity of large woody debris in the stream channel.

Lateral Migration: This parameter is applicable to all stream systems except for systems naturally in disequilibrium (e.g., some braided or ephemeral streams, and alluvial fans or other systems with naturally high rates of bank erosion). Additionally, applicability varies based on metric:

- *Dominant bank erosion hazard index/near-bank stress (BEHI/NBS)* and *percent streambank erosion* metrics are evaluated together. Dominant BEHI/NBS and percent streambank erosion metrics are applicable to single-thread channels only.
- *Erosion rate* (feet per year) can be measured in substitute of dominant BEHI/NBS and percent streambank erosion.

- *Percent streambank armoring (%)* is assessed only when armoring techniques are present or proposed in the project reach.

Riparian Vegetation: This parameter is applicable to all stream systems. Buffer width (feet), average diameter at breast height (DBH), and tree density (number/acre) are applicable to all stream systems. Invasive/non-native cover should be reported for all project reaches although this metric is not scored. In addition to those metrics, users should measure the following metrics when applicable:

- *Native shrub density* (number/acre) is measured IF the riparian vegetation community consists of pastureland, cropland, or other land uses without existing trees that renders the canopy cover at <20%.
- *Native herbaceous cover (%)* is measured IF the area adjacent to the project reach is or should be a Piedmont prairie vegetation community.
- *Monoculture Area (%)* is measured IF silviculture operations are present or proposed within the project area.

Bed Form Diversity: This parameter is applicable to all single-thread perennial, seasonal intermittent, and intermittent stream systems. Bed form diversity should not be assessed in multi-thread channels, bedrock streams, or naturally straight sand-bed channels where the bedforms are created by large wood. Pool spacing ratio (feet per feet), pool depth ratio (feet per feet), and percent riffle (%) are applicable to all single-thread, perennial, seasonal intermittent, and intermittent streams.

Physicochemical

Temperature, Bacteria, Nitrogen, Phosphorus, and Suspended Sediment Parameters: These parameters are applicable to wadeable, perennial streams. One or more parameters can be applied at a project reach, and notes regarding the temperature and suspended solids parameters is listed below:

- Temperature is only applicable to coldwater streams and is recommended for streams that are designated Trout (Natural; Put, Grow, and Take; Put and Take) streams under S.C. Code of Regulation 61-69 (DHEC, 2020).
- Where the Suspended Sediment parameter is used, Debit Calculator users must use either the Turbidity or Total Suspended Solids (TSS) metric, not both. This parameter is required for project reaches measuring through the biology functional category.

Biology

Macroinvertebrates Parameter: This parameter is applicable to wadeable, perennial streams with drainage areas 3 square miles (approximately 7 square kilometers) or larger.

Fish Parameter: The Fish parameter is applicable to wadeable, perennial streams with drainage areas between 1.5 square miles and 63 square miles (approximately 4 square kilometers and 165 square kilometers respectively).

3.5 Existing Conditions Spreadsheet

The Existing Conditions spreadsheet is the calculator that quantifies the existing condition prior to a permitted impact for **Debit Options 2a, 2b, and 3**. Recall that standard scores are assumed for all parameters not measured for Debit Options 2a, and 2b. Standard scores are based on priority category as described in Section 2.4.1.

Users enter existing condition data into this spreadsheet for each project reach assessed. Users should ensure they have entered the data for the correct reach in the Existing Conditions spreadsheet. There is space to input data for 10 reaches. If a project has more than 10 reaches, an additional Debit Calculator workbook will need to be used.

3.5.1 COMPONENTS OF THE EXISTING CONDITIONS SPREADSHEET

3.5.1.1 Site Information and Reference Curve Stratification Table

The Site Information and Reference Curve Stratification section is shown in Figure 6. Users input values into the gray cells and select inputs from the drop-down menus in the blue cells. White cells within this table are locked from editing and the input is provided by the user on the Project Summary and Functional Loss spreadsheets. **Instructions for collecting data for this table are provided in the Data Collection and Analysis Manual (South Carolina Steering Committee, 2022b)**, with the exception of latitude and longitude.

Many of the fields in this table are linked to the selection of parameters, metrics, and reference curves, known as *stratification*. Where reference curves for a metric are stratified, the index value calculation cells will use the input provided in this table to select the appropriate reference curves. Note that incorrect information in the Site Information and Reference Curve Stratification table may result in applying reference curves that are not suitable for the project, affecting site scoring.

Site Information and Reference Curve Stratification							
Reach ID:	STR-1 R-1	Ecoregion:	Piedmont	Buffer Valley Slope (%):	21 - 40 %	Upstream Latitude:	
Priority Category:	Secondary	Existing Stream Type:	G	Dominant Buffer Land Use:	Commercial / Golf Course / Agriculture / Silviculture	Upstream Longitude:	
Debit Option:	2b	Reference Stream Type:	C	Canopy Cover (%):	> 20 %	Downstream Latitude:	
Strahler Stream Order:	2	Valley Type:	Unconfined Alluvial	Stream Temperature:	Warmwater	Downstream Longitude:	
Flow Type:	Perennial	Drainage Area (sq.mi.):	4	Fish Bioassessment Class:	2 - Upland Savannah	River Basin:	Broad

Figure 6. Site Information and Reference Curve Stratification input fields.

3.5.1.2 Existing Condition Assessment Table

In the Existing Condition Assessment table, metrics are listed by functional category and then parameter (Figure 7). Under the Field Value column in the Existing Condition Assessment table, users input values into the gray cells and select inputs from the drop-down menus in the blue

cells. Field values are a measurement or calculation input into the Debit Calculator for a specific metric. Units and scale vary by metric (see Table 5). The column to the right of the Field Value column is the Index Value column. Index values are dimensionless values between 0.00 and 1.00 that express the relative condition of a metric field value compared with reference condition (Section 3.5.1.4). Index values are automatically calculated when metric field values are entered (Figure 7).

Following the example presented in Figure 6, the applicant implemented Debit Option 2b for a “secondary” priority category reach. Therefore, the applicable parameters and metrics within the hydrology, hydraulics, and geomorphology categories were assessed (Figure 7). In this Debit Option 2b example, physicochemical and biology metrics were not measured; therefore, standard scores were assumed, which occurs at the parameter level (Figure 7). Prior to data entry, the existing conditions assessment table will depict a standard score of 0.80 for all parameter, category, and ECS scores. Standard ECS scores of 0.80 are assumed for “secondary” priority category reaches (see Section 2.4.1). If the priority category had been “primary” the existing condition assessment table would depict 1.00 for the parameter, category, and ECS scores. Similarly, if the priority category had been “tertiary” the existing condition assessment table would depict 0.70 for the parameter, category, and ECS scores.

EXISTING CONDITION ASSESSMENT					Roll-Up Scoring			
Functional Category	Function-Based Parameter	Metric	Field Value	Index Value	Parameter	Category	Category	ECS
Hydrology	Reach Runoff	Land Use Coefficient	60	0.78	0.74	0.74	Functioning	0.66
		Concentrated Flow Points (#/1000 LF)	2	0.70				
Hydraulics	Floodplain Connectivity	Bank Height Ratio (ft/ft)	2	0.00	0.35	0.49	Functioning At Risk	
		Entrenchment Ratio (ft/ft)	1.4	0.7				
	Flow Dynamics	Width/Depth Ratio State (O/E)	0.7	0.63				
Geomorphology	Large Woody Debris	LWD Index	265	0.52	0.52	0.45	Functioning At Risk	
		LWD Piece Count (#/100m)						
	Lateral Migration	Erosion Rate (ft/yr)			0.33			
		Dominant BEHI/NBS	M/M	0.50				
		Percent Streambank Erosion (%)	23	0.49				
		Percent Streambank Armoring (%)	35	0.00				
	Riparian Vegetation	Buffer Width (ft)	50	0.16	0.59			
		Average DBH (in)	8	0.86				
		Tree Density (#/acre)	100	0.74				
		Native Shrub Density (#/acre)						
		Native Herbaceous Cover (%)						
		Monoculture Area (%)						
Bed Form Diversity	Pool Spacing Ratio (ft/ft)	6	0.23	0.35				
	Pool Depth Ratio (ft/ft)	2	0.30					
	Percent Riffle (%)	80	0.51					
Physicochemical	Temperature	Summer Daily Maximum (°F)			0.80	Functioning		
	Bacteria	E. Coli (MPN/100 ml)						
	Nitrogen	Total Nitrogen (mg/L)						
	Phosphorus	Total Phosphorus (mg/L)						
	Suspended Sediment	Total Suspended Solids (TSS)					0.80	
		Turbidity (NTU)			0.80			
Biology	Macroinvertebrates	EPT Taxa Present			0.80	Functioning		
	Fish	South Carolina Biotic Index					0.80	

Figure 7. Existing condition results for a Debit Option 2b assessment of a “secondary” priority category reach. In this example, physicochemical and biology metrics were not measured; therefore, standard scores of 0.80 (“secondary” priority category) were assumed, which occurs at the parameter level (Parameter column under Roll-Up Scoring). Roll-Up Scoring results in an overall ECS score of 0.66.

3.5.1.3 Common Data Entry Errors and Tips

FALSE Return

When a field value is entered into the Existing Condition Assessment table, the neighboring index value cell checks the data in the Site Information and Reference Curve Stratification section and either returns an index value based on the appropriate reference curve or returns FALSE (Figure 8). A FALSE is returned when:

- Data are missing from the Site Information and Reference Curve Stratification section on the Existing Conditions spreadsheet (Figure 6),
or
- Reference curves do not exist for the selected input. For example, the summer daily maximum temperature metric only has reference standards for coldwater streams. If the project reach classifies as warmwater, then the field value will return FALSE.

Metric	Field Value	Index Value
Pool Spacing Ratio	3.4	FALSE
Pool Depth Ratio	1.8	FALSE
Percent Riffle (%)	40	0.00

Figure 8. Index value errors.

Erroneous Index Value

If the spreadsheet does not return an index value as expected, the user should check the Site Information and Reference Curve Stratification section for that reach for data entry errors. Then, check the stratification information provided in Appendix A of the SC SQT Spreadsheet User Manual (South Carolina Steering Committee, 2022a) to see if there are reference curves applicable to the project location. Incorrect information in the Site Information and Reference Curve Stratification section may result in applying reference curves that are not suitable for the project.

Expected Range of Metric Field Values

Table 5 provides the expected range of values for each metric. **Guidance on collecting and analyzing data to calculate field values for the condition assessments is provided in the Data Collection and Analysis Manual (South Carolina Steering Committee, 2022b).** Additionally, Appendix A in the SQT User Manual includes a list of all function-based parameters, metrics, reference curve thresholds, and applicable references for reference standards. The appropriate number of significant digits for each metric field value should be determined based on the accuracy of the measurements.

Table 5. Expected range of values for metric field values.

Metric	Field Value Range	Metric	Field Value Range
Land Use Coefficient	0 – 100	Native Shrub Density (#/Ac)	≥ 0
Concentrated Flow Points (#/1000 LF)	≥ 0.0	Native Herbaceous Cover (%)	0 – 100
Bank Height Ratio	≥ 1.00	Monoculture Area (%)	0 – 100
Entrenchment Ratio	≥ 1.0	Invasive/Non-native Cover (%) ¹	0 – 100
Width/Depth Ratio State	≥ 0.0	Pool Spacing Ratio	≥ 0.0
LWD Index	≥ 0	Pool Depth Ratio	≥ 1.00
LWD Piece Count (#/100m)	≥ 0	Percent Riffle (%)	0 – 100
Erosion Rate (ft/yr)	≥ 0.00	Summer Daily Maximum (°F)	≥ 0.0
Percent Streambank Erosion (%)	0 – 100	E. coli (MPN/100 ml)	≥ 0
Percent Streambank Armoring (%)	0 – 100	Total Nitrogen (mg/L)	≥ 0.00
Buffer Width (ft)	≥ 0	Total Phosphorus (mg/L)	≥ 0.00
Average DBH (in)	≥ 0.0	TSS or Turbidity (mg/L or NTU)	≥ 0
Tree Density (#/Ac)	≥ 0	EPT Taxa Present	≥ 0
		South Carolina Biotic Index	-1.00 – 1.00

¹ This metric is for tracking purposes only. It is not used for scoring and is only included in the monitoring condition assessments.

3.5.1.4 Scoring the Existing Condition

Metrics in the SQT and Debit Calculator are linked to reference curves that relate measured field values to a function index scale ranging from 0.00 to 1.00. The function index scale rates field values relative to departure from the reference condition in the region. The function index value range is standardized across metrics by determining how field values relate to functional capacity (i.e., functioning, functioning-at-risk, and not functioning conditions; Table 6). The Debit Calculator and SQT use the same reference curves to score metrics. Reference curves can be viewed in the SQT workbook.

Table 6. Functional capacity definitions used to define reference curves, from the SC SQT Spreadsheet User Manual (South Carolina Steering Committee, 2022a).

Functional Capacity	Definition	Index Score Range
Functioning (F)	A functioning value means that the metric is quantifying the functional capacity of one aspect of a function-based parameter in a way that fully supports aquatic ecosystem structure and function . The reference condition concept aligns with the definition for a reference condition for biological integrity (Stoddard et al., 2006). A score of 1.00 represents an unaltered or pristine condition (native or natural condition). The range of values (0.70-1.00) accounts for natural variability in high-quality reference datasets and the potential for these datasets to include minimally and least disturbed sites.	0.70 to 1.00
Functioning-at-risk (FAR)	A functioning-at-risk value means that the metric is quantifying one aspect of a function-based parameter in a way that may support aquatic ecosystem structure and function , but not at a reference condition. In many cases, this indicates the parameter is adjusting in response to changes in the reach or the catchment towards lower or higher function.	0.30 to <0.70
Not functioning (NF)	A not functioning value means that the metric is quantifying or describing one aspect of a function-based parameter in a way that does not support aquatic ecosystem structure and function . An index value less than 0.30 represents an impaired or severely altered condition relative to reference condition; an index value of 0.00 represents a condition that provides no functional capacity for that metric.	0.00 to <0.30

Roll-up Scoring

Scoring occurs automatically as field values are entered into the existing condition assessments. The SQT uses a roll-up scoring process as follows (see Figure 7):

- The reference curve outputs an index value ranging from 0.00 to 1.00 for a given metric based on the user input metric field value.
- Index values are averaged per parameter to calculate parameter scores. For metrics that are not assessed (i.e., a field value is not entered), the metric is removed from the scoring and no index value is provided. It is NOT counted as a zero for the parameter score calculation.

- Parameter scores are averaged per functional category to calculate functional category scores.
- Functional category scores are weighted evenly and summed to calculate an overall condition score.

Scoring Exceptions

There are two scoring exceptions in the SQT and Debit Calculator:

- **Width/Depth Ratio State (O/E):** The width/depth ratio state metric captures problems associated with aggradation (width/depth ratio is larger than reference value) and incision (width/depth ratio is less than reference value). A width/depth ratio that is smaller than the reference width/depth ratio is only a problem if the channel is incised, as indicated by the BHR. Thus, when a field value less than 1 is entered into the Debit Calculator for the width/depth ratio state metric, the index value calculation will check whether the BHR is greater than 1.2. If BHR is greater than 1.2, then the reference curve will be used to calculate the index value. If BHR is less than or equal to 1.2, then the reference curve is not used to compute the index value and instead, a 1.00 index value is assigned.
- **Percent Streambank Armoring:** The percent streambank armoring metric captures problems associated with hardened, streambank armoring techniques. If present or proposed armoring techniques exceed 50% of the project reach, then the lateral migration parameter will score a 0.00 and the other lateral migration metrics (dominant BEHI/NBS and percent streambank erosion) do not need to be assessed. At this magnitude, the armoring is so pervasive that lateral migration processes would likely have no functional value.

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Appendix A.

Practical Example: Provided by U.S. Army Corps of Engineers Charleston District

Project Description – Example

The applicant proposes to impact 1,840 linear feet of stream channel for the construction of a subdivision in the lower piedmont region. Portions of this stream system have been previously disturbed. All reaches have intact forested buffers in an unconfined alluvial valley extending out 50 feet.

PROJECT IMPACTS:

Reach 1

The construction of a parking lot involving permanent fill in 440 linear feet of a 1st order perennial stream:

Stream Type = 1st and 2nd Order RPWs

Priority Category = Tertiary

Duration = Permanent

Fill Cumulative Impact (for entire single and complete project) = 1840 LF

Debit Option = Option 1

Reach 2

Culvert (48" Reinforced Concrete Pipe) of 940 LF of 2nd order perennial stream into a 920 linear feet RCP

Stream Type = 1st and 2nd Order RPWs

Priority Category = Tertiary

Duration = Permanent

Cumulative Impact (for entire single and complete project) = 1840 LF

Debit Option = Option 2a

Reach 3

Stabilization with rip rap of 460 linear feet of the left and right descending bank of a 4th order perennial stream. Based on the drawing, rip rap comprised of 2-4' diameter granite/limestone begins at the top of bank and extends below the Mean High-Water Line approximately 10 ft into the channel bed on either side. Channel width from MHW to MHW is 25 ft.

Stream Type = All Other Streams

Priority Category = Tertiary

Duration = Permanent

Cumulative Impact (for entire single and complete project) = 1840 LF

Debit Option = Option 1

PROJECT IMPACTS ANALYSIS

Step 1: Insert information in the Project Summary spreadsheet of the Debit Tool (Figure A-1).

Step 2: Insert information in the Functional Loss tab of the SQT Debit Tool (Figure A-2).

SC SQT Debit Calculator Tool v1.1							
Project Name		Example 1 Third Party Mitigation					
Applicant		ABC Residential Development				Date	
Project ID / Permit Number(s) (optional)		SAC-202X-0000					
Project Description		The applicant proposes to impact 1840 linear feet of stream channel for the construction of a subdivision in the lower piedmon region. Portions of this stream system have been previously disturbed.					
Total Functional Loss (-ΔFF)		-932					
Total Debits (FF)		-2359					
Reach Summary							
Reach ID	Flow Type	Strahler Stream Order	Priority Category	Reach and Impact Description			Functional Loss (-ΔFF)
Reach 1	Perennial	1	Tertiary	Permanent fill of 440 LF of 1st order stream			-308
Reach 2	Perennial	2	Tertiary	940 LF of 2nd order stream into 920 LF of 48" RCP			-463
Reach 3	Perennial	4+	Tertiary	460 LF of rip rap of 4th order stream			-161
Adverse Impact Adjustment Factors							
Reach ID	Existing Stream Length (LF)	Stream Type	Stream Type R Factor	Impact Duration	Impact Duration R Factor	Sum of R Factors	Debits (FF)
Reach 1	440	1st and 2nd Order RPWs	0.8	Permanent	0.30	2.6	-801
Reach 2	940	1st and 2nd Order RPWs	0.8	Permanent	0.30	2.6	-1204
Reach 3	460	All Other Streams	0.4	Permanent	0.30	2.2	-354
Additional Existing Project Length (ft)			Cumulative Impact R Factor				
Total Existing Project Length (ft)	1840		1.5				

Figure A-1. Project Summary spreadsheet in the SC Debit Calculator (note that some rows present in the Debit Calculator have been hidden in this figure).

Name:	Example 1 Third Party Mitigation	Notes							
Date:	1/0/1900	1. Users input values							
Project ID / Permit Applicant Number(s):	SAC-202X-0000	2. Users select values from a pull-down menu							
		3. Values are automatically calculated							
FUNCTIONAL LOSS SUMMARY									
Reach ID	Priority Category	Debit Option	Existing Stream Length	Proposed Stream Length	Existing Condition Score (ECS)	Impact Severity Tier	Proposed Condition Score (PCS)	Functional Loss (-ΔFF)	Flow Type and Stream Order
Reach 1	Tertiary	1	440	0	0.70	Tier 6	0.00	-308	P1
Reach 2	Tertiary	2a	940	920	0.61	Tier 5	0.12	-463	P2
Reach 3	Tertiary	1	460	460	0.70	Tier 3	0.35	-161	P4+
Functional Loss (-ΔFF)								-932	

Figure A-2. Functional Loss Summary Table from the Functional Loss spreadsheet.

Step 3: Determine Impact Severity Tier

Reach 1

Reach 1 involves the filling of the entire reach of stream. This would include the complete loss of all stream functional categories, including hydrology. Therefore, this impact would fall into a Tier 6 Impact Severity Tier.

Reach 2

Reach 2 involves the installation of a 48" Reinforced Concrete Pipe (RCP). If installed correctly, a 48" RCP would have limited to no effect on hydrology, as water would continue to convey through the pipe. Hydraulics would be significantly affected, as the stream would have no floodplain connectivity. All geomorphology metrics would be significantly affected including large woody debris, lateral migration, riparian vegetation, and bed form diversity. Physicochemical and biology would be negatively affected due to lack of sunlight, nutrient sinks, or habitat. Four of the five functional categories would be significantly affected and therefore this culvert as designed would fall into a Tier 5 Impact Severity Tier.

Reach 3

Reach 3 involves the installation of rip rap along both banks of a fourth order stream. Hydrology would be minimally affected. Hydraulics may be moderately affected, as rip rap typically extends over the top of the bank, thereby decreasing floodplain connectivity. Geomorphology would be moderately affected due to loss of lateral migration, moderate degradation of bed form diversity, and no effect on riparian vegetation and minimal effects on large woody debris. Physicochemical may show minimal effects due to potential loss of nutrient sinks with a change in geomorphology. Biology may show minimal effects due to reduction in habitat availability. Based on the amount of rip rap when compared to the size of the stream, rip rap being confined to one side of the channel, and the effect of rip rap on stream functions, this impact would fall under a Tier 3 Impact Severity Tier.

Step 4: Based on Debit Option, fill out existing condition score on the Existing Condition Score

Reach 1 and Reach 3

The permittee selected Debit Option 1 for these two reaches. Since these reaches are in the tertiary priority category, these reaches will automatically receive an Existing Condition Score of 0.70.

Reach 2

The permittee selected Option 2A for this reach. Option 2A requires the hydrology, hydraulics, and geomorphology through lateral migration to be completed. Riparian vegetation, bed form diversity and the functional categories of physicochemical and biology will automatically score a 0.70. The permittee included the following:

Hydrology

- A. Drainage area and map
- B. Land use coefficient percentages
- C. Concentrated flow point locations

Hydraulics

- A. Cross sectional data for representative riffle to include BHR, ER, W/D Ratio
- B. List of bankfull indicators
- C. Regional curves used to estimate bankfull/bankfull area

Geomorphology

- A. LWDI data sheet
- B. BEHI/NBS

The field values are represented on the existing condition assessment for Reach 2 (Figure A-3).

Site Information and Reference Curve Stratification								
Reach ID:	Reach 2	Ecoregion:	Piedmont	Buffer Valley Slope (%):	< 5 %	Upstream Latitude:		
Priority Category:	Tertiary	Existing Stream Type:	C	Dominant Buffer Land Use:	Single Family Residential	Upstream Longitude:		
Debit Option:	2a	Reference Stream Type:	C	Canopy Cover (%):	> 20 %	Downstream Latitude:		
Strahler Stream Order:	2	Valley Type:	Unconfined Alluvial	Stream Temperature:	Coldwater	Downstream Longitude:		
Flow Type:	Perennial	Drainage Area (sq.mi.):	2	Fish Bioassessment Class:		River Basin:	Savannah	
EXISTING CONDITION ASSESSMENT					Roll-Up Scoring			
Functional Category	Function-Based Parameter	Metric	Field Value	Index Value	Parameter	Category	Category	ECS
Hydrology	Reach Runoff	Land Use Coefficient	70	0.35	0.68	0.68	Functioning At Risk	0.61
		Concentrated Flow Points (#/1000 L)	0	1.00				
Hydraulics	Floodplain Connectivity	Bank Height Ratio (ft/ft)	1.4	0.44	0.51	0.45	Functioning At Risk	
		Entrenchment Ratio (ft/ft)	2	0.58				
	Flow Dynamics	Width/Depth Ratio State (O/E)	1.5	0.38	0.38			
Geomorphology	Large Woody Debris	LWD Index	150	0.30	0.30	0.54	Functioning At Risk	
		LWD Piece Count (#/100m)						
	Lateral Migration	Erosion Rate (ft/yr)						
		Dominant BEHI/NBS	M/H	0.40	0.47			
		Percent Streambank Erosion (%)	20	0.54				
	Percent Streambank Armoring (%)							
Riparian Vegetation	Buffer Width (ft)				0.70			
	Average DBH (in)							
	Tree Density (#/acre)							
	Native Shrub Density (#/acre)							
		Native Herbaceous Cover (%)						
		Monoculture Area (%)						
		Invasive/Non-native Cover (%)						
Bed Form Diversity	Pool Spacing Ratio (ft/ft)				0.70			
	Pool Depth Ratio (ft/ft)							
	Percent Riffle (%)							
Physicochemical	Temperature	Summer Daily Maximum (°F)			0.70	0.70	Functioning	
	Bacteria	E. Coli (MPN/100 ml)			0.70			
	Nitrogen	Total Nitrogen (mg/L)			0.70			
	Phosphorus	Total Phosphorus (mg/L)			0.70			
	Suspended Sediment	Total Suspended Solids (TSS)			0.70			
		Turbidity (NTU)			0.70			
Biology	Macroinvertebrates	EPT Taxa Present			0.70	0.70	Functioning	
	Fish	South Carolina Biotic Index			0.70			

Figure A-3. Example for Reach 2 Debit Option 2a.

Under this assessment, the existing score reduced from a 0.70 default value to a 0.61 value.

SC SQT Debit Calculator Tool v1.1			
Project Name	Example 1 Third Party Mitigation		
Applicant	ABC Residential Development	Date	
Project ID / Permit Number(s) (optional)	SAC-202X-0000		
Project Description	The applicant proposes to impact 1840 linear feet of stream channel for the construction of a subdivision in the lower piedmon region. Portions of this stream system have been previously disturbed.		
Total Functional Loss (-ΔFF)	-932		
Total Debits (FF)	-2359		

Figure A-4. Total Debits are displayed in the Project Summary tab.

With the existing condition field values entered into the Existing Conditions tab, the applicant can calculate their total debits for Reach 2 and for the entire project (Figure A-4).