Frequently Asked Questions about the Stream Quantification Tool

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Why does the Hydraulics functional category come before the Geomorphology category?

This question is directed more towards the Stream Functions Pyramid Framework (SFPF) than the SQT. However, since the SQT is organized from the SFPF the question is relevant here. The question is often asked from the perspective of a practitioner changing hydraulics by changing the geometry of a channel. With this perspective, geomorphology should be listed below hydraulics. For example, one way to reduce the average bankfull velocity (hydraulics) is to increase the sinuosity of the channel (geomorphology), which will reduce the average slope and thereby the average velocity. To increase sinuosity, construction equipment is typically used to re-build the channel.

The SFPF shows that hydraulics is before geomorphology because the framework is built on the premise that natural processes are supporting and effecting functional change. The use of heavy equipment is not a natural process. If we remove heavy equipment from the process, then sinuosity would be increased by the quantity of water produced by the watershed (hydrology) flowing in the channel and on the floodplain (hydraulics) to move sediment and adjust the channel (geomorphology).

Are performance standards also design standards?

Performance standards are used in the SQT to determine the functional capacity of a given measurement method and then rolled up to the parameter level. The terms performance standards and functional capacity come from the Federal Mitigation Rule. In the SQT, a performance standard is scaled from 0.00 to 1.00 with a 0.00 representing no function and a 1.00 representing 100% function as compared to a reference condition. A reference condition is an unaltered, natural condition. Therefore, the performance standard quantifies the quality of each metric relative to an undisturbed or minimally disturbed condition.

This is related to but not exactly equal to a design standard. The performance standards inform the design process by quantifying functional capacity. This could be considered a design target for each parameter but it is highly unlikely that a project could achieve a score of 1.00 for every measurement method. To do this, the practitioner would essentially have to restore the stream to a pristine condition.

Some measurement methods included in the SQT are typically used in the design process. These include: bank height ratio, entrenchment ratio, pool spacing ratio, pool depth ratio, percent riffle and sinuosity. However, site conditions can limit the ability of a reach to achieve a score of 1.00 for any given measurement method and a practitioner may have defensible reasons to deviate from the performance standards built into the SQT. This topic is addressed further in other questions in this document (i.e. questions pertaining to best attainable conditions and data gaps).

In addition, the stratification process creates design options for meeting performance standards. For example bed form diversity is stratified by stream type, and a meandering stream has different performance standards than a step-pool channel. Based on site constraints, goals, and more, the practitioner can choose one approach over the other and thereby the appropriate performance standard curve. The SQT does not dictate the design approach, the practitioner makes these decisions.

There are many things to consider within the design process regarding the approaches and techniques that will work best for a given site. The practitioner must use appropriate assessment and design methods to develop the design, and much of this is completed outside of the SQT. For example, sediment transport is a major design element, but it is not explicitly in the SQT. Rather, the effects of sediment transport are assessed. If the design is degradational (vertical instability), it will show up in the floodplain connectivity and possibly the bedform diversity and lateral stability parameters. If the project is aggradational, it will show up in bedform diversity and lateral stability.

Why are performance standards established using an undisturbed reference condition rather than a best attainable condition?

This question is often asked by mitigation providers who recognize that it's typically not possible to return a degraded stream reach back into a pristine or undisturbed condition. The perception is that they won't get credit if they can't achieve a near-perfect score. First, it is important to remember that the SQT is primarily a "delta tool". This means that the focus is on quantifying the difference between an existing condition and a restored condition (or an impacted condition on the debit side). A minimum quality should be achieved before the delta can be used to justify the project, but once the minimum quality is met, the score is the delta.

The focus on the delta should alleviate concerns about reaching a reference condition. A provider will not be punished for not returning a stream to a reference condition. Instead, practitioners that return a heavily degraded stream to a highly functional stream will create the most lift (delta) and receive the most credit. Conversely, practitioners who take a "good" stream and make it "great," will create a smaller amount of lift and generate less credit. It's all about the lift, after a minimum stability threshold has been met.

Comparing all stream reaches to an undisturbed condition supports the logic of the SFPF. The SFPF logic is that lower-level functions (hydrology, hydraulics, and geomorphology) must be functioning in order to achieve functioning levels in physicochemical and biology. If these lower-level functions were scored against best attainable rather than undisturbed reference condition, the logic would break. A best attainable hydrology score may still not support aquatic biology needs. So, to keep the logic intact, it's critical to compare against natural/undisturbed reference condition.

Finally, by measuring every stream reach against its reference condition, the condition scores can be compared across sites. For example, a 0.65 (if measured through level 5) always means that the reach is functioning at 65% of a natural/unaltered system within the same environmental setting. If a 1.00 was set to be best attainable, the results would have little condition/quality meaning. A 0.65 would simply mean 65% of the best that the practitioner could do (best attainable). A 0.65 or even a 1.00 in this case may still not support a healthy aquatic ecosystem. In fact, it could be highly degraded.

How are performance standard curves created?

All performance standards are listed in the List of Metrics Microsoft Excel Workbook, which is provided on the Stream Mechanics web page. This workbook shows how each measurement method is stratified and the relationship between field values and index values. A field value is the SQT input for a given measurement method before it has been converted into an index value. For example, the pool spacing ratio of 4.0 is a measurement method field value. This field value is converted into an index value from 0.00 to 1.00. A pool spacing ratio field value of 4.0 yields an index value of 1.00 for C and E stream types and a 0.70 for B and Bc stream types.

Performance standards are typically created from field data and/or existing literature. The performance standard example above for pool spacing came from a NC reference reach database, a thesis, project monitoring results, and best professional judgement. Where available, the List of Metrics workbook provides references to the source of the performance standards, but it does not explain how the team translated the field values (from the references) into index values. In broad terms, this was typically done collaboratively with a team of subject-matter experts.

Channel evolution is a function-based parameter in the SFPF, why is it not in the SQT?

Channel evolution is a function-based parameter listed in the SFPF. Two measurement methods are provided: the Simon Channel Evolution Model and the Rosgen Stream Type Succession Scenarios. Performance standards are provided for each measurement method.

An early version of the SQT did include channel evolution, first within the tool and then as an “add on” after a final score had been calculated. During the beta-testing phase, it was quickly determined that channel evolution should be removed from the tool because it predicts a future condition whereas the SQT is meant to score the condition at the time of the assessment. For mitigation and other purposes, adjusting a score based on what might happen in the future does not align well with the purpose of using the SQT to inform debits or credits.

This does not mean that channel evolution isn’t important or that it should not be used as part of a stream restoration project. Channel evolution assessments are a great compliment to the SQT, especially during the site-selection process and the design phase. During site selection, the SQT can provide the existing condition score to determine its level of impairment. Channel evolution can then be used to explain how the condition may change over time. For example, the stream is trending towards a worse condition and restoration solutions are imperative. It can also be used to develop the restoration approach. In the example above, heavy equipment may be needed to alter the channel evolution. Conversely, channel evolution may show that the stream is trending towards stability and better function; perhaps only land use management changes are needed for further recovery. In both cases, channel evolution is used outside the SQT to make better-informed decisions about how to proceed with a project.

Why doesn’t the SQT use more sophisticated methods for the roll-up scoring?

The SQT uses simple averaging to roll up scores to the functional category level. Measurement-method scores are averaged to create parameter scores, which are then averaged to create a functional category score. For the overall reach condition score, the functional category scores are weighted and then summed. The NC SQT weights each category equally at 0.20; each of the five categories represents 20% of the total score. The category-level weighting supports the restoration potential concept, e.g., a project with a level 3 restoration potential is not required to monitor higher levels, but the score caps out at 0.60.

The SQT includes more parameters and measurement methods than will typically be assessed for any given project. When a measurement method is not assessed, it is simply removed from scoring, it does not count as a zero. The averaging and removal of measurement methods creates a simple and flexible architecture. States and regions using the tool can easily change the structure to meet their needs. There is no coding or programming required.

There are other ways to combine scores. Multivariate statistics, such as principal component analysis, could be used; however, a robust data set would be required for individual sites through biology (level 5). Once the weighting/scoring was established, the tool would lose its flexibility, i.e., it would be difficult to add and subtract metrics.

For now, it seems best to keep the architecture and scoring simple to allow for easy implementation. And, since it's primarily a delta tool, the method used to roll up the condition scores is less important than the difference between the overall existing and proposed condition.

What are "The Big Four" parameters and why are they important?

The Big Four parameters are floodplain connectivity, bedform diversity, riparian vegetation, and lateral stability. They are called the Big Four because they are arguably the four most important parameters to restore in any project across the country. (Note, stratification methods make this work, e.g., floodplain connectivity is stratified by stream type. See the SFPF for more information. They are also parameters that can be directly manipulated by a restoration practitioner; they have a lot of control over the outcome as compared to biological metrics like macroinvertebrates or fish.

It is recommended to use the Big Four to establish the minimum condition score before functional lift can be counted. For example, floodplain connectivity, bedform diversity, and lateral stability should be functioning by the end of the monitoring period. Since it takes longer for newly established riparian vegetation to reach a functioning level, its score should be in the functioning-at-risk category.

The Big Four should be included in all stream assessments, but other metrics should be required that fit the region. For example, large woody debris should be included in forested regions and flow alteration should be included in regions where water withdrawal limits functional capacity. The parameter selection process determines the final list of metrics for a given reach beyond the Big Four and is provided in the user documents.

Can function-based parameters, measurement methods, and performance standards be added to the SQT?

Yes, new parameters, measurement methods, and/or performance standards can be added to the SQT; however, the process various by state. Contact Stream Mechanics for more information at contact@stream-mechanics.com.

Are there data gaps within the SQT?

Yes, some regions have better data sets than others. The SQT is currently a perennial, single-thread-stream centric tool. The most robust data sets for hydraulic and geomorphology parameters came from the Piedmont and Mountains regions. There are fewer data sets for the Coastal Plain region, and ephemeral and intermittent flow regimes. Projects completed in this region or flow regimes may need to assess reference condition streams and propose new performance standards.