

Decision Support System (DSS) Tutorial

May 3, 2005

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How to Use this Decision Support System (DSS) Tutorial

This tutorial is designed to assist the first time use of the Decision Support System Tool as outlined in the report for NDWRCDP Project Number: WU-HT-03-35, “Variability and Reliability of Test Center and Field Data: Definition of Proven Technology from a Regulatory Viewpoint” as prepared by the New England Interstate Water Pollution Control Commission, April 2005.

The text of this tutorial was adapted from Chapter 3 of the above-mentioned report. Chapter 3, “Using the Weight of Scientific Evidence in Regulatory Decision-Making,” describes the theory and process for regulatory officials to make better informed decisions based on the quality and quantity of the data submitted. The excerpted sections below instruct the user on how to use the DSS Spreadsheets and link the user directly to the appropriate section of the Spreadsheets for data entry. By clicking in the red box, the user is able to jump to the appropriate spreadsheet for that discussion. To return, the user must click again in the red boxed text to return to the spreadsheet table. Although the spreadsheets included in this document are not able to accept data entry, a sample DSS is also provided and included in these CD Resource Tools for Regulators. The sample DSS has data entered for multiple sample studies. This provides the user with a sample to follow to understand how the series of spreadsheets work as a whole.

There is also a DSS PowerPoint Tutorial Show included on the CD Resource Tools for Regulators. The show provides an instructional overview of each step and decision in the process as the user goes through the DSS process.

Decision Support System (DSS) Introduction

It is important to understand that when using the DSS, decisions are made by the regulatory agency, not for them. The DSS is a decision *support* system, not a decision-*making* system. There is no magic here; the regulatory agencies themselves (working with a panel of experts that includes, at least, some on-site wastewater scientists) determine the value of data characteristics. But the DSS process aids in that determination. When the DSS is used as designed to be used, then it can help to assure that there are no unsaid assumptions about the amount of weight assigned to different data quality/quantity attributes. When actual study results are assessed, the DSS helps regulators determine quantitative scores for the data by breaking the scoring of the data down into the eight data attributes. Throughout this entire process the DSS uses a quantitative approach giving quantitative rankings based upon the type of study, as well as quantitative weights for data attributes and numerical data scores for the actual research data.

The DSS assists users in evaluating appropriate rankings for differing types of studies (i.e., datasets). It does not provide the data rankings, but helps regulators and scientists develop their own quantitative rankings for different datasets based upon their understanding of the research process and perceptions (biases) regarding which attributes of the data are most valuable for regulatory decision-making.

An expert panel approach is used wherein a series of questionnaires in the form of Excel spreadsheets are given to the interested parties (onsite technology regulators and onsite wastewater scientists in this case). The DSS approach provides a self-assessment weighting tool to facilitate determining the value of different types of data quality and quantity attributes.

As a DSS is used in real life, a group such as this NEIWPC Project Team can serve as the core of the expert panel that will develop rankings for different dataset attributes. However, it is recommended that other regulators from SORA (State Onsite Regulators Alliance) and/or regulators and scientists from NOWRA (National Onsite Wastewater Recycling Association) also be involved to the extent possible. Ultimately, we see that the use of this DSS could ideally be institutionalized within a national group such as SORA, NOWRA, NEIWPC, NEHA, NSF or NES. We feel this is the best approach since the entire DSS process is fairly complex and may require more effort than some state regulatory agencies can handle. It would also be advantageous to get a national perspective on the decision-making rather than have separate expert panel evaluations in each state.

But having said that a more national approach would provide an ideal situation from many perspectives, we also feel that an individual state or local regulatory jurisdiction could quite easily utilize the DSS system on their own after being trained in its use and with the input, guidance and assistance of a local university scientist. The larger the expert panel used, the more dependable the results may become. But that will not always be the case. There is no outright requirement for having 8 or 10 expert researchers or onsite wastewater regulators before the DSS system can be used. Many local regulatory agencies may not have the staff resources or staff time to easily conduct the scientific assessment required using the DSS system. However, just using the DSS system itself to

the greatest extent possible locally should help, even for a state where the regulatory agency staff resources are stretched thin. One good local scientist could work with the regulatory staff to guide a state-level (or local) technical review committee through the process and utilize the DSS spreadsheets to make the calculations needed for a technology assessment.

The complexity that is present within the DSS system is a result of the inherent complexity of science itself. This is critical to realize. The process of using more scientific approaches to regulatory decision-making injects added complexity into rule-making and technology approvals. But the DSS system should bring more objectivity, dependability and defensibility for the outcomes. Therefore, we encourage local and state regulatory jurisdictions to look upon the DSS as a method to enhance what they are asked to do by society and to use it so as to inject a more scientifically rigorous approach into their regulatory decision-making process. The end result should be better decisions for the clients they serve and clearer guidance to manufacturers and others about expectations regarding submittals for product approval requests.

At the same time that the DSS system is being used locally, we also recognize that a national group, such as NOWRA, could potentially begin the process of maintaining a permanent database of study results and DSS assessments. That type of database could lead to a long-term cumulative DSS system that could be maintained nationally but “tapped into” quite easily by local regulators. If that approach is utilized nationally, then as additional studies are completed or datasets regarding a particular technology become available anywhere in the nation, then these datasets could be submitted to a national organization and quantitatively assessed using the DSS. The scores determined from those assessments could then be added to the on-going running total score for that decision endpoint to help make better science-based decisions regarding potential upgrades to approvals (e.g., from “piloting” status to “innovative use” status to “accepted” status). The expert panel approach used in the DSS process here was adapted from the Mass DEP (1995) method. The expert panel is used to assess, rank and assign numerical weightings for each of the eight data properties, as was suggested earlier by Hoover and Beardsley (2001). These numerical weightings vary depending upon the type of “decision endpoint” that is being evaluated.

Use of an expert panel assumes that each regulator and scientist on the panel independently assigns study ranks, data attribute weights and data scores without undue influence from others. Obviously, after the first round of assessments, discussion will ensue within the expert panel and result in adjustments to the numerical values used. But the process will expose assumptions regarding the values of studies and data attributes. The numerical values from these assessments are then summed and averaged to determine the value of different data types and quantitative scores for that particular decision endpoint. The goal is to eventually have a decision-making group that is as geographically large as possible so as to facilitate consistent decision-making across jurisdiction boundaries. For that reason, we suggest that a national or regional group such as SORA, NOWRA, NEIWPCC, NSF, NEHA or NSFC lead the effort.

The rankings assigned to the ten study types (e.g., datasets that could possibly be submitted for decision-making) and the numerical weights specifying the value for each

of the eight data attributes are assigned in advance. This allows a determination regarding approximately how much of what quality data is needed for a decision prior to the actual assessment of the research data itself from individual studies. The regulatory agency is able then to specify in advance some standards or expectations regarding the data quality and quantity needed for an anticipated decision. Then, the DSS method helps regulators determine whether the actual data submitted supports the proposed decision.

This approach can help the regulatory agency in a number of ways. It helps regulators clarify and quantitatively describe their decision-making process. It allows them to predetermine the value for different datasets (study types) and data quality/quantity attributes. Using these values they can provide guidance regarding how much of what type of data needs to be submitted before a decision. This can and should be done before the actual data is assessed for a specific decision endpoint. Seven steps were identified earlier for the DSS process. Each will be described and illustrated in detail following an introduction to the organization and content of the DSS spreadsheets.

Organization of the DSS Spreadsheets

The DSS itself consists of a series of 15 spreadsheets organized into three categories as indicated in Table 3.3. The DSS is presented in a Microsoft Excel format and is provided on the CD Resource Tools. The DSS is accompanied by this text, sample spreadsheets, and a Microsoft PowerPoint overview on the use of the DSS. The first series of spreadsheets (1-3) are used by individual expert panel members for recording their study ranks, data attribute weights, and data scores. The second series of spreadsheets (4-11) take the data weighting values from individual panel members and use them to calculate weights for the entire panel for each of the eight data quality/quantity attributes. The final series of spreadsheets (12-15) include the summary sheets and calculations of scores for measurement endpoints and the ultimate decision endpoint. These include #12, which is a summary of the expert panel rankings for each study type; #13, which is a summary of the calculated weights assigned by the panel; #14, which is a summary of the data scores assigned by the expert panel; and #15, which provides the details for the calculations of the measurement endpoint scores for each study and then adds these scores to determine the final decision endpoint score for decision-making.

Table 3.3. Summary of spreadsheets included in the DSS.

Sheet	Spreadsheet Page	Description: (Sheets 1-3 are filled out by each expert panel member. These are the only sheets filled out by the panel members,. Multiple copies will be needed for each panel member)
1	Input Study rankings	Ranking levels for 10 study types by each expert panel member
2	Input Attribute Weights	Data attribute weights assigned to 8 data quality and quantity attributes for each study type by each expert panel member
3	Input Data Scores	Data scores assigned for each of 8 data characteristics based upon a specific dataset reviewed by each expert panel member
4	Performance Weight Summary	Summary of performance data attribute weights assigned by all of the expert panel members
5	Flow Data Weight Summary	Summary of flow data attribute weights assigned by all of the expert panel members
6	Replication Weight Summary	Summary of relative weighting assigned for replication in a study assigned by all of the expert panel members
7	Experimental Control Weight Summary	Summary of relative weighting assigned for the importance of experimental control in a study assigned by all of the expert panel members
8	Environmental Conditions Weight Summary	Summary of relative weighting assigned for testing a broad range of environmental conditions in a study assigned by all of the expert panel members
9	O&M Weight Summary	Summary of relative weighting assigned for the importance of having the same O&M conditions during the research as in the real life use of a system as assigned by all of the expert panel members
10	Third Party Weight Summary	Summary of relative weighting assigned for the importance of third party data collection and analysis in a study assigned by all of the expert panel members

Table 3.3 (con't). Summary of spreadsheets included in the DSS.

Sheet	Spreadsheet Page	Description
11	Peer Review Weight Summary	Summary of relative weighting assigned for the importance of peer review in a study assigned by all of the expert panel members
12	Ranking Compilation	Ranking compilation of study types (type of dataset) by expert panel (e.g., taken from sheet 1 for each panel member)
13	Data Weight Compilation	Summary of calculated relative data weighting assigned by the expert panel for all study types (e.g., summary weights taken from sheets 4-11)
14	Data Score Compilation	Summary of data scores assigned by the expert panel for a particular study for all studies submitted or measurement endpoints assessed (e.g., taken from sheet 3 for each panel member)
15	DSS Calculation	Calculation of expert panel summary scores for all studies submitted or measurement endpoints (“ranks”, “weights” and “scores” taken from sheets 12, 13 and 14, respectively and final calculations made to determine total score for the decision endpoint)

Now let’s turn to the details of the seven steps that must be followed when using the DSS.

Step 1: Setting a numerical score for decision-making

Since this is a quantitative process, the ultimate decision depends upon setting a final score needed to support a determination that the scientific weight of evidence has been achieved. In many regulatory jurisdictions the approval process is basically a yes/no decision. That is, once the technology is first approved, hundreds and thousands of the systems can then be installed without any other assessment.

But in a substantial number of jurisdictions, the approval process uses a graded approach wherein approvals are issued in increasingly substantive levels of acceptance, or stages of approval. As a result, it is necessary to identify different types of regulatory decisions. Of course, each regulatory jurisdiction has its own process and stages of approval. These are simplified and summarized here into three basic types of approvals or regulatory decisions as follows:

1. Approved for controlled limited piloting (piloting), which would allow restricted installation of “less than ten to tens” of test systems depending upon the basic category of technology type.
2. Approved for more extended use (extended use), which would allow “hundreds to thousands” of innovative systems depending upon the technology type, but that also includes numerous caveats in the approvals regarding use of the technology beyond that required for typically approved systems.
3. Approved as an accepted technology (accepted), which allows general usual and customary use of the technology throughout the regulatory jurisdiction without special approval caveats (other than those needed to assure continued operation and maintenance).

Each of these “approval levels” goes beyond the basic “experimental approval” that allows testing of technologies at one or two sites. As one goes down the approval list above, each stage of approval requires increasingly higher levels of confidence regarding technology function and performance. The level of data needed to support each of these stages of regulatory approval should be determined in advance. We suggest the appropriate scores needed for each of these approval levels are as follows:

- Piloting/Testing Confirmation Use – 6 points
- Extended Innovative Product Use – 12 points
- General Accepted Use – 24 points

The scores required for the different levels of approval are based upon the expected point levels from various studies. The method to determine point levels is explained later and included in the DSS spreadsheets. However, all of the approval levels above assume that a perfect study that shows excellent system performance is worth a maximum of 8 points.

The transition from piloting to extended use is substantial (a doubling of needed final points), but the level of science that properly allows accepted use of a technology is double that again. Hence, for a technology to be accepted, the approach used here requires three “perfect” studies of the correct type, each confirming that the technology works properly. Alternatively, approximately six substantial studies that are of less than perfect design could suffice, but each must have positive results and address the most pertinent attributes of data quality/quantity.

Step 2: Defining a decision endpoint

As indicated earlier, an important part of this process is to determine very carefully the questions that must be answered about a technology so that a decision can be made. We call this the “decision endpoint.” Each decision endpoint must be thought out and described carefully as it will influence the rest of the DSS process when evaluating a technology. We noted this earlier and stated that the decision endpoint for this DSS demonstration was to “determine how pretreatment systems perform in the field in the long run”. Table 3.4 includes a few examples of other hypothetical types of “decision endpoints” (the technologies are hypothetical). These examples are broader than the specific question regarding pretreatment technology unit performance being considered

here, but are necessary to illustrate one of the key milestone steps in using the DSS. It is important to appreciate how much the decision endpoint could change the assessment of even one specific dataset. Hence, carefully determining the decision endpoint is a key milestone in the process.

As one can surmise, the decision endpoint selected will influence the relative weights assigned to the eight data attributes and the applicability (or numerical ranking) of different types of datasets or research studies. Let us be specific regarding how one would develop a precisely defined decision endpoint. Taking a look back at the preliminary decision endpoint for this DSS demonstration, which was to “determine how pretreatment systems perform in the field in the long run,” it becomes clear that more specifics are needed in order to make decisions. We assume that there is currently some data available regarding this technology and that one wishes to assess whether that data is adequate for dependable decision-making or to determine and define how much additional data (and of what quality) must be collected for such a decision.

Table 3.4. Hypothetical decision endpoints used to illustrate how the decision to be made will influence the value of different data quality attributes.

- The “Biohiggins” pretreatment technology will provide BOD5 and TSS effluent levels 90% of the time < 30 mg/l when used at a single-family home.
- The “Coureventor” trench media will allow a 30 percent reduction in drainfield trench length when used with septic tank effluent at a single-family home.
- The “Bowerseptic” unit will reduce nitrogen loading to the drainfield to < 10 mg/l nitrogen when supplied with any septic tank effluent from a home or commercial facility.
- The “Grovemaster” pretreatment unit will allow reduction in drainfield length by 50 percent when used on all soils.
- The “Hepnamiter” septic tank additive reduces soil clogging and allows use of previously unusable clayey soils for septic systems.

For this DSS demonstration, we plan to determine the conditions of interest as a reduction of BOD5 and TSS to less than 30 mg/l by the pretreatment unit. But we must also consider whether there is a need to specify the temporal performance over time (periodicity) and any other conditions. For example, will these reductions need to be achieved for 85 percent of the time for a system that is used year-round in a northern U.S. climate with quarterly maintenance visits?

Therefore, the decision endpoint must be specific, and we need to determine the conditions, such as a treatment level that is specified to be met (e.g., 45 mg/L, 30 mg/L, 10 mg/L) or a performance that is to be met (e.g., allowing a 50 percent reduction in drainfield trench bottom area without negatively affecting failure rate). By clarifying these types of specific conditions as a part of the decision endpoint, we make it easier to evaluate datasets submitted regarding this decision. We can include as many of these

specifics as needed in the decision endpoint to help assess the technology performance based upon existing studies or to plan new research studies.

For our purposes we revised the decision endpoint and have specified that we wish to “determine if pretreatment units (three types) will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long term.” This is the new revised decision endpoint of this demonstration for assessment using the DSS.

Step 3: Quantitatively ranking each of ten different types of studies (e.g. datasets)

Once a decision endpoint is described, “measurement endpoints” for datasets will be constructed that are useful for assessing that particular decision endpoint. Measurement endpoints are individual research studies or datasets. They are used to assess whether that decision endpoint has been reached. The available data for making a decision typically would include different types of datasets. As discussed earlier, each measurement endpoint, or research study, has its own unique value for assessing the decision endpoint. Essentially a measurement endpoint is a study or dataset submitted for quantitative scoring and consideration. This is a different approach than used in the Mass DEP (1995) document. Since, for our purposes, measurement endpoints are studies, it is appropriate to assess the weight for different types of studies (that is, different types of datasets). This can, and should, be done prior to evaluation of the actual data included in a dataset from a particular study. By doing so, this provides clear guidance to the manufacturer (or other organization that is requesting an approval) on the relative weight that will be given by the expert panel to different types of studies.

One measurement endpoint might be that BOD5 and TSS concentrations below 30 mg/l in a *test center dataset* such as an NSF or ETV study indicate that the system will function at that level for the long term. Another measurement endpoint might be that BOD5 and TSS concentrations below 30 mg/l in a *field study conducted by a third party* indicate that the system will function at that level for the long term. Another measurement endpoint might be that BOD5 and TSS concentrations below 30 mg/l in *manufacturer-developed datasets* indicate that the system will function at that level for the long term. As one can surmise, there would likely be different weights assigned to each of these datasets (e.g., those in Table 3.1). However, there is a critical point to consider: The rank or numerical value assigned to a study is always conditional upon the decision endpoint. For instance, looking back at Table 3.4, it is obvious that a dataset that is highly valued for one decision endpoint might have much less value for a different decision endpoint.

The decision endpoint for this DSS demonstration is specifically to “determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long term.” Each of the study types in Table 3.1 can be numerically ranked relative to its applicability for this decision using the expert panel approach. It is recommended that this expert panel have at least five to ten members, and a national or regional organization such as NOWRA, SORA, or others could certainly be helpful in assembling these experts, particularly with panels of ten or more. For illustration purposes only five expert panel members are shown in Table 3.5. The makeup of the expert panel should

primarily include scientists and regulators, but should also include some manufacturer and industry representatives. It should not be dominated by any one group. Each member of the expert panel independently (without undue influence by other panel members) ranks each of the ten study types from 0.1 to 1.0 for that particular decision endpoint. A rank or numerical score of 1.0 is given to the most appropriate study type for that decision endpoint and a rank of 0.1 is given to the least relative study type with intervening numerical ranks given to the others. These individual ranking scores are entered by each panel member into a copy of Spreadsheet #1 in the DSS.

Table 3.5. Ranking of study types for the decision endpoint “determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long term.”

Study type from Table 3.1	Expert Panel member #1	Expert Panel member #2	Expert Panel member #3	Expert Panel member #4	Expert Panel member #5	Average or median ranking as appropriate
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						

The rankings from each of the panel members are averaged and the average numerical ranking is used to determine the value for that type of study or dataset. By using an expert panel of approximately ten members, any unusual rankings will not have undue influence on the final average results. Alternatively, it may be appropriate in some instances to use geometric means rather than averages if the panel assessments are not normally distributed.

Step 4: Assigning numerical weights for each of eight data quality/quantity attributes

Once the rank for each type of study or dataset is determined, the process of weighting different characteristics of these datasets is conducted, again using the expert panel approach. These weights are assigned prior to evaluating the actual data submitted, and reflect the intrinsic value of different data quality attributes, not the actual data that is collected for a study.

Each person on the expert panel evaluates and assigns numerical weights from one (1.0) to eight (8.0) for each of the eight data attribute properties. These weights are recorded by each panel member on a separate copy of Spreadsheet #2. One (1.0) is the minimum weight that can be assigned for a data attribute that has little value for that particular study type and decision endpoint. Eight (8.0) is the maximum weight that can be assigned for the most valuable attributes. At least one of the data attributes (the most valued one) must be assigned a value of 8.0. Then, weights between 1.0 and 8.0 are assigned as appropriate for each of the other seven data attributes summarized in Table 3.6 and described earlier in more detail in Table 3.2. This process is conducted separately for each of the ten different study types (i.e., those types of studies or datasets indicated in Table 3.1). Table 3.6 illustrates a ranking score sheet for one of the expert panel members. As in Step 3, the geometric mean or median can be used if necessary.

Table 3.6. Weighting sheet for individual panel members to use for weighting eight data quality/quantity attributes. This is done for each of the ten study types for the decision endpoint to “determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long term.”

<i>Study type</i>	Data quality and quantity attributes from Table 3.2 (see Table 3.2 for details)							
	Performance data	Flow data	Replication	Experimental control	Range of environmental conditions	O&M applied during study	3 rd party assessment	Peer review process
A								
B								
C								
D								
E								
F								
G								
H								
I								
J								

Once an expert panel member determines his or her assessment of the numerical weights for the eight data attributes for one type of study or dataset, the weights are recalculated on a relative scale of 0.0 to 8.0. The weights are compared to each other within a study type and adjusted on a scale of 0 to 8 so the total cumulative potential score for all eight data attributes equals 8. This is handled automatically by formulas in Spreadsheets #4 thru #11.

Steps 1 through 4 should be completed prior to actual evaluation of the submitted data. That is, these four steps should be completed before evaluating any actual research study or dataset. Hence, the data attribute weights for each type of study are determined by quantitatively assigning a score for each of the eight data quality attributes previously described in Table 3.2. The relative value (rankings) for different types of research studies (e.g. datasets) is also determined in advance of the actual data analysis. The combination of the study type rankings and data attribute weights can provide numerical guidance regarding the quality and quantity of differing datasets needed for a decision before any data is submitted to the regulatory agency.

In other words, since the process allows one to numerically compare the value for different data attributes and study types, the amount and quality of data needed from different types of research studies can be estimated in advance (prior to conducting the studies and collecting the datasets). Basic numerical data scores (Step 5 below) can be estimated in advance, and this process can help distinguish between the value of data quantity and quality attributes. This prior ranking and weighting can then be used to guide the manufacturer regarding how much data of what quality must be submitted to the regulatory agency before consideration of an approval is appropriate. The manufacturer that will be requesting a regulatory decision can also use this as a guide in deciding what types of studies and data attributes are of most value and worthy of the company's investment of scientific and research resources. Finally, this process allows the regulatory agency to determine how high the bar is for consideration of an approval and possibly to deflect the political pressures that are always present to issue an approval on the basis of limited research.

It is worth noting that Steps 1 through 4 of the DSS process may well identify where there is a lack of consistency or agreement among expert panel members regarding the ranking values assigned for different datasets or weights assigned for data quality attributes. Conducting these steps prior to data collection can help the expert panel clarify its decision-making process and examine its process to determine if biases exist.

Step 5: Determining the value or data score for the research study data

The next step in the DSS process is to examine the research studies (datasets) that have been submitted and to evaluate the characteristics of the data collected during those studies. The relative ranking and value of different study types have already been determined for that decision endpoint. Similarly, the weights for each data quality/quantity attribute have been assigned prior to this point in the process.

What is left to do is to evaluate the data collected and determine the data scores for each of the eight data attributes. These "data scores" are different than the "numerical data weights" previously determined. The data score assigned in Step 5 for each of the data attributes assesses whether the data supports the decision endpoint. The data from each individual study is assessed independently of other datasets, since each study is a measurement endpoint. Even studies that are of the same type (e.g., one of the ten study types in Table 3.1) are separately evaluated.

The expert panel evaluates the data from each study separately. First, each panel member reviews the data submitted for that study and independently assigns a data score from 0.0

to 1.0 for each of the eight data attributes. This is done on a separate copy of Spreadsheet #3 by each panel member for each research study. The scores assigned in Step 5 are the panel's assessment of how well the specific data submitted supports or does not support the decision endpoint.

If the data are of high quality and strongly support the decision endpoint, then a score of 1.0 is assigned for that data attribute. For example, use of excellent sampling methods and a good QAPP during the research study might result in a score of 1.0 for experimental control. Performance data indicating that the technology is performing correctly (e.g., BOD < 30 mg/L) might result in a performance data score of 1.0. If the flow rates tested in the research match well with the flow rates that will be used in the field in real life, then a flow data score of 1.0 would be assigned.

However, if the data submitted are of low quality (for a particular data attribute) or if the data do not support the decision endpoint, then that data attribute receives a score of 0.0. Examples include measured performance data showing an unacceptably high BOD level compared to the decision endpoint level, samples being poorly collected using the wrong technique, flow data for the test systems not matching well with the expected use, and loading rates tested not matching the proposed loading rates in the decision endpoint.

Each of the following eight data attributes in the study are considered and scored separately from the first attribute (performance data) to the last attribute (level of peer-review used in the study).

1. Performance data (e.g., BOD and TSS removal measurements for this demonstration) collected during the study are compared to the decision endpoint.
2. Flow rates used in the study tests are compared to flow rates that will be used in real-life systems.
3. The degree of replication used in the study is evaluated.
4. The extent of experimental control used during the study is assessed.
5. The range of environmental conditions tested during the study are compared to the range of environmental conditions—rainfall, temperatures, soil conditions—that usually occur in the regulatory jurisdiction where the technology is proposed for use.
6. The O&M used during tests of the technology in the study are compared to level of O&M proposed for real-life use of the technology.
7. The independence of the agency or individual collecting the samples, evaluating the data, and preparing the project report is assessed to determine the extent of third party value.
8. The degree of peer-review used during design, implementation and development of the project report is assessed and scored.

Each of these data attributes are scored by the expert panel members in their independent assessments of the data submitted. These are recorded on separate copies of Spreadsheet

#3, and the average data scores for each of the data attribute categories are determined. This is done automatically by formulas in Spreadsheet #14.

Step 6: Summing the results of the calculations

The next step of the DSS process is to quantitatively calculate the results of the expert panel evaluations. During each stage of the process the averages for each individual expert panel score have been determined. These are included in Spreadsheets #12 through #14. The numerical scores (average scores) are then used in Spreadsheet #15 for calculating the overall decision endpoint score. This score gives guidance to the regulatory community regarding a scientifically based decision concerning a proposed regulatory approval. The equation used is:

$$Y = \text{Sum from all studies of (ranking } A \times (\text{sum of (data attribute relative weight } B \times \text{data score } C \text{ for each attribute))}),$$

Where:

- A = the numerical rank value for a measurement endpoint (that is, a particular study type),
- B = the calculated relative weights for the 8 data quality/quantity attributes, and
- C = the data scores assigned for the 8 data attributes.

Note that:

- A, the study type numerical rankings, can range from 0.1 to 1.0.
- B, the data weights, can range from 1.0 to 8.0.
- C, the data scores, can range from 0.0 to 1.0.
- All of these are relative to the decision endpoint being considered.

The maximum score obtainable using this system for any one study is a score of 8.0; the minimum score is 0.0. The score for each study is calculated separately. Then, for all studies (measurement endpoints) that are pertinent to the decision endpoint being considered, the totals are summed. For example, if three studies were conducted and evaluated using the DSS process and the scores were 4 points, 6 points and 1 point, then the total score for the decision endpoint would be $4+6+1 = 11$ points.

Step 7: Comparing the calculated scores to a predetermined standard

The final total score for all studies is then compared to the previously determined decision criteria, or standard value, needed to recommend approval of a regulatory decision.

The decision levels suggested earlier are reiterated again here as follows:

- Piloting/Testing Confirmation Use – 6 points
- Extended Innovative Product Use – 12 points
- General Accepted Use – 24 points

Using the guidance above, the hypothetical scores just given (11 total points) would support a regulatory decision for use of a technology at a piloting stage. This would allow data collection and assessment, but not broad use of the technology.

Ranking of study types (type of dataset) by an expert panel member

Endpoint decision: "Determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term".

The applicability of each study type (type of dataset) is ranked by each individual expert panel member for the decision endpoint	Expert panel member # (insert here)	Name (insert here)	
Study Type	Ranking assigned	Study Type	Ranking assigned
A. Field datasets that are published in refereed journal articles	enter data here	F. Demonstration project datasets such as NODP-like, NDWDP-like, EPA/319h projects	enter data here
B. Laboratory and bench-top datasets that are published in refereed journal articles	enter data here	G. State and county regulatory datasets composed of compliance data samples.	enter data here
C. Datasets in independent published university and governmental research reports, not peer reviewed	enter data here	H. Vendor developed research reports and/or journal articles that are peer-reviewed.	enter data here
D. Exploratory datasets developed by independent university or government researchers.	enter data here	I. Vendor developed research reports, not peer reviewed	enter data here
E. Test center datasets developed using specified protocols such as NSF-like or ETV-like	enter data here	J. Vendor developed datasets (data only) without a summary report	enter data here

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPCC.

Weights assigned to data quality and quantity attributes for each study type by an expert panel member

Decision Endpoint: "determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term".

Expert Panel Member # (insert here) Name (insert here)

Study types (measurement endpoints). A separate evaluation is made for each of the 10 separate study types.	----- Weights assigned for data quality/quantity attributes (columns) for each of the 10 study types (rows) -----								Total
Data attribute to be evaluated	Performance data	Flow data	Replication	Experimental control	Environmental conditions	O&M conducted	Third-party character	Peer-review character	
Weights are assigned from 0.0 to 8.0 for each of the 8 data attributes by comparing the importance of each attribute when analyzing data form that type of study.	How important is performance data collected for this type of study considering the decision endpoint?	How critical is it that the flow rates tested are the same as those that will be used in the field for this decision endpoint?	How important is replication in this type of study considering the decision endpoint being answered?	What weight should be assigned to the importance of experimental control for this type of study and decision endpoint?	How much weight should be assigned to testing a wide range of environmental conditions (soils, climate, etc) considering the decision?	What weight should be assigned to matching the O&M used during testing to that used under field conditions?	Is third party independence important for this type of dataset and decision endpoint? If so, how important?	How much weight should be given to the degree of internal and external peer-review of the study?	
Study Type A - Field datasets published in refereed journal articles	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	0.0
Calculated relative weight for Type A study	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Study Type B - Laboratory and bench-top datasets in refereed journal	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	0.0
Calculated relative weight for Type B study	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Study Type C - Datasets published by university and gov't research reports	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	0.0
Calculated relative weight for Type C study	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Study Type D - Exploratory datasets by university or gov't researchers	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	0.0
Calculated relative weight for Type D study	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Study Type E - Test center datasets w/ controlled protocols (eg NSF-like)	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	0.0
Calculated relative weight for Type E study	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Study Type F - Demonstration project datasets (eg NODP-like, 319h, etc)	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	0.0
Calculated relative weight for Type F study	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Study Type G - State and county regulatory datasets of compliance samples	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	0.0
Calculated relative weight for Type G study	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Study Type H - Vendor research and journal articles that are peer-reviewed	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	0.0
Calculated relative weight for Type H study	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Study Type I - Vendor research reports that are not peer-reviewed	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	0.0
Calculated relative weight for Type I study	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Study Type J - Vendor, manufacturer and inventor datasets not interpreted	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	0.0
Calculated relative weight for Type J study	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPCC.

Scores assigned based upon a specific dataset for data quality and quantity attributes for that particular study by an expert panel member

Decision Endpoint: “determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term”.

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPC.

Expert Panel Member # and name: _____

Name or identity of this particular research study or dataset: **Study No.** _____

Source for this research study or dataset: _____

Name of individual/organization submitting this study or dataset: _____

Study Type = A, B, C, D, E, F, G, H, I, or J: _____

Scores for each data attribute	----- Scores assigned for data from this study -----							
Data attribute to be evaluated	Performance data	Flow data	Replication	Experimental control	Environmental conditions	O&M conducted	Third-party character	Peer-review character
Evaluation of results from this specific study	Did the performance data results from this particular study indicate the system met the desired decision endpoint? Was there adequate data for this type of study?	Did the flow rates tested for in this particular study match those needed to answer the decision endpoint question?	Did this particular study have good replication of sampling, lab analysis, etc considering the type of data?	Was the amount of experimental control used during this particular study adequate for controlling outside extraneous influences on the results?	Were the range of environmental conditions such as weather conditions, soil types, etc. examined during this study appropriate for answering the decision endpoint question being asked?	Was the O&M provided during this research study similar to that expected during system use in real life for the decision endpoint question being considered?	How independent was the research organization that conducted this study from the organizations that could potentially benefit from its results (eg manufacturing company, regulatory agency, etc)?	How much internal and external peer review was used during the planning, design and assessment of the results from this particular study?
Score assigned for each data attribute (between 0.0 and 1.0) are marked to the right	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here	enter data here

4-Performance weight summary

Summary of performance data attribute weights assigned by all of the expert panel members

Decision Endpoint: "Determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term".

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPCC.

Weights assigned for the importance of performance data by the expert panel members for 10 study types

Study types (Measurement endpoints)	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Average weight for entire panel
Study Type A - Field datasets published in refereed journal articles	enter data										#DIV/0!
Study Type B - Laboratory and bench-top datasets in refereed journal articles											#DIV/0!
Study Type C - Datasets published by university and gov't research reports											#DIV/0!
Study Type D - Exploratory datasets by university or gov't researchers											#DIV/0!
Study Type E - Test center datasets using controlled protocols (eg NSF-like)											#DIV/0!
Study Type F - Demonstration project datasets (eg NODP-like, 319h)											#DIV/0!
Study Type G - State and county regulatory datasets of compliance samples											#DIV/0!
Study Type H - Vendor research reports or journal articles with peer-review											#DIV/0!
Study Type I - Vendor research reports that are not peer-reviewed											#DIV/0!
Study Type J - Vendor, manufacturer and inventor datasets not interpreted											#DIV/0!

Summary of flow data attribute weights assigned by all of the expert panel members

Decision Endpoint: "Determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term".

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPCC.

Weights assigned for the importance of flow data being comparable between the study and the field conditions by the expert panel members for 10 study types

Study types (Measurement endpoints)	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Average weight for entire panel
Study Type A - Field datasets published in refereed journal articles	enter data										#DIV/0!
Study Type B - Laboratory and bench-top datasets in refereed journal articles											#DIV/0!
Study Type C - Datasets published by university and gov't research reports											#DIV/0!
Study Type D - Exploratory datasets by university or gov't researchers											#DIV/0!
Study Type E - Test center datasets using controlled protocols (eg NSF-like)											#DIV/0!
Study Type F - Demonstration project datasets (eg NODP-like, 319h)											#DIV/0!
Study Type G - State and county regulatory datasets of compliance samples											#DIV/0!
Study Type H - Vendor research reports or journal articles with peer-review											#DIV/0!
Study Type I - Vendor research reports that are not peer-reviewed											#DIV/0!
Study Type J - Vendor, manufacturer and inventor datasets not interpreted											#DIV/0!

Summary of relative weighting assigned for replication in a study assigned by all of the expert panel members

Decision Endpoint: "Determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term".

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPCC.

Weights assigned for the importance of replication by the expert panel members for 10 study types

Study types (Measurement endpoints)	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Average weight for entire panel
Study Type A - Field datasets published in refereed journal articles	enter data										#DIV/0!
Study Type B - Laboratory and bench-top datasets in refereed journal articles											#DIV/0!
Study Type C - Datasets published by university and gov't research reports											#DIV/0!
Study Type D - Exploratory datasets by university or gov't researchers											#DIV/0!
Study Type E - Test center datasets using controlled protocols (eg NSF-like)											#DIV/0!
Study Type F - Demonstration project datasets (eg NODP-like, 319h)											#DIV/0!
Study Type G - State and county regulatory datasets of compliance samples											#DIV/0!
Study Type H - Vendor research reports or journal articles with peer-review											#DIV/0!
Study Type I - Vendor research reports that are not peer-reviewed											#DIV/0!
Study Type J - Vendor, manufacturer and inventor datasets not interpreted											#DIV/0!

Summary of relative weighting assigned for the importance of experimental control in a study assigned by all of the expert panel members

Decision Endpoint: "Determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term".

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPC.

Weights assigned for the importance of experimental control by the expert panel members for 10 study types

Study types (Measurement endpoints)	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Average weight for entire panel
Study Type A - Field datasets published in refereed journal articles	enter data										#DIV/0!
Study Type B - Laboratory and bench-top datasets in refereed journal articles											#DIV/0!
Study Type C - Datasets published by university and gov't research reports											#DIV/0!
Study Type D - Exploratory datasets by university or gov't researchers											#DIV/0!
Study Type E - Test center datasets using controlled protocols (eg NSF-like)											#DIV/0!
Study Type F - Demonstration project datasets (eg NODP-like, 319h)											#DIV/0!
Study Type G - State and county regulatory datasets of compliance samples											#DIV/0!
Study Type H - Vendor research reports or journal articles with peer-review											#DIV/0!
Study Type I - Vendor research reports that are not peer-reviewed											#DIV/0!
Study Type J - Vendor, manufacturer and inventor datasets not interpreted											#DIV/0!

Summary of relative weighting assigned for testing a broad range of environmental conditions in a study assigned by all of the expert panel members

Decision Endpoint: "Determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term".

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPC.

Weights assigned for the importance of comparable range of environmental conditions between study and anticipated field use by expert panel members for 10 study types

Study types (Measurement endpoints)	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Average weight for entire panel
Study Type A - Field datasets published in refereed journal articles	enter data										#DIV/0!
Study Type B - Laboratory and bench-top datasets in refereed journal articles											#DIV/0!
Study Type C - Datasets published by university and gov't research reports											#DIV/0!
Study Type D - Exploratory datasets by university or gov't researchers											#DIV/0!
Study Type E - Test center datasets using controlled protocols (eg NSF-like)											#DIV/0!
Study Type F - Demonstration project datasets (eg NODP-like, 319h)											#DIV/0!
Study Type G - State and county regulatory datasets of compliance samples											#DIV/0!
Study Type H - Vendor research reports or journal articles with peer-review											#DIV/0!
Study Type I - Vendor research reports that are not peer-reviewed											#DIV/0!
Study Type J - Vendor, manufacturer and inventor datasets not interpreted											#DIV/0!

Summary of relative weighting assigned for the importance of having the same O&M conditions during the research as in the real life use of a system as assigned by all of the expert panel members

Decision Endpoint: "Determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term".

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPC.

Weights assigned for the importance of comparable O&M between study and anticipated field use by expert panel members for 10 study types

Study types (Measurement endpoints)	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Average weight for entire panel
Study Type A - Field datasets published in refereed journal articles	enter data										#DIV/0!
Study Type B - Laboratory and bench-top datasets in refereed journal articles											#DIV/0!
Study Type C - Datasets published by university and gov't research reports											#DIV/0!
Study Type D - Exploratory datasets by university or gov't researchers											#DIV/0!
Study Type E - Test center datasets using controlled protocols (eg NSF-like)											#DIV/0!
Study Type F - Demonstration project datasets (eg NODP-like, 319h)											#DIV/0!
Study Type G - State and county regulatory datasets of compliance samples											#DIV/0!
Study Type H - Vendor research reports or journal articles with peer-review											#DIV/0!
Study Type I - Vendor research reports that are not peer-reviewed											#DIV/0!
Study Type J - Vendor, manufacturer and inventor datasets not interpreted											#DIV/0!

Summary of relative weighting assigned for the importance of third party data collection and analysis in a study assigned by all of the expert panel members

Decision Endpoint: "Determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term".

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPC.

Weights assigned for the importance of independent third party data collection by expert panel members for 10 study types

Study types (Measurement endpoints)	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Average weight for entire panel
Study Type A - Field datasets published in refereed journal articles	enter data										#DIV/0!
Study Type B - Laboratory and bench-top datasets in refereed journal articles											#DIV/0!
Study Type C - Datasets published by university and gov't research reports											#DIV/0!
Study Type D - Exploratory datasets by university or gov't researchers											#DIV/0!
Study Type E - Test center datasets using controlled protocols (eg NSF-like)											#DIV/0!
Study Type F - Demonstration project datasets (eg NODP-like, 319h)											#DIV/0!
Study Type G - State and county regulatory datasets of compliance samples											#DIV/0!
Study Type H - Vendor research reports or journal articles with peer-review											#DIV/0!
Study Type I - Vendor research reports that are not peer-reviewed											#DIV/0!
Study Type J - Vendor, manufacturer and inventor datasets not interpreted											#DIV/0!

Summary of relative weighting assigned for the importance of peer review in a study assigned by all of the expert panel members

Decision Endpoint: "Determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term".

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPC.

Weights assigned for the importance of peer review by expert panel members for 10 study types

Study types (Measurement endpoints)	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Average weight for entire panel
Study Type A - Field datasets published in refereed journal articles	enter data										#DIV/0!
Study Type B - Laboratory and bench-top datasets in refereed journal articles											#DIV/0!
Study Type C - Datasets published by university and gov't research reports											#DIV/0!
Study Type D - Exploratory datasets by university or gov't researchers											#DIV/0!
Study Type E - Test center datasets using controlled protocols (eg NSF-like)											#DIV/0!
Study Type F - Demonstration project datasets (eg NODP-like, 319h)											#DIV/0!
Study Type G - State and county regulatory datasets of compliance samples											#DIV/0!
Study Type H - Vendor research reports or journal articles with peer-review											#DIV/0!
Study Type I - Vendor research reports that are not peer-reviewed											#DIV/0!
Study Type J - Vendor, manufacturer and inventor datasets not interpreted											#DIV/0!

12-Ranking compilation

Ranking compilation of study types (type of dataset) by expert panel

Summary of ranking of study types (datasets) by the expert panel for the decision endpoint “Determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term”.

Study type from Spreadsheet #1. Each study type is assigned a ranking from 0.1 to 1.0	Expert Panel Member #										Average
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	
A. Field datasets that are published in refereed journal articles											#DIV/0!
B. Laboratory and bench-top datasets that are published in refereed journal articles											#DIV/0!
C. Datasets in independent published university and governmental research reports, not peer reviewed											#DIV/0!
D. Exploratory datasets developed by independent university or government researchers.											#DIV/0!
E. Test center datasets developed using specified protocols such as NSF-like											#DIV/0!
F. Demonstration project datasets such as NODP-like, EPA/319h projects											#DIV/0!
G. State and county regulatory datasets composed of compliance data samples.											#DIV/0!
H. Vendor developed research reports and/or journal articles that are peer-reviewed.											#DIV/0!
I Vendor developed research reports, not peer reviewed											#DIV/0!
J. Vendor developed datasets (data only) without a summary report											#DIV/0!

Summary of calculated relative data weighting assigned by the expert panel for all study types

Decision Endpoint: "Determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term".

	----- Summary of relative weights assigned for data attributes for all study types -----								Total
Study type	Performance data	Flow data	Replication	Experimental control	Environmental conditions	O&M conducted	Third-party character	Peer-review character	
Study Type A	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Study Type B	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Study Type C	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Study Type D	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Study Type E	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Study Type F	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Study Type G	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Study Type H	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Study Type I	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Study Type J	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPC.

Summary of data scores assigned by the expert panel for a particular study (eg measurement endpoint)

Decision Endpoint: "determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term".

Study # (measurement endpoint #): _____

Name of this particular research study or dataset (measurement endpoint): _____

Source for this research study or dataset: _____

Name of individual/organization submitting this study or dataset: _____

Study Type = A, B, C, D, E, F, G, H, I, or J: _____

Evaluation of results from this specific study	----- Scores assigned for data from this study -----							
	Performance data	Flow data	Replication	Experimental control	Environmental conditions	O&M conducted	Third-party character	Peer-review character
Expert panel member #1	enter data							
Expert panel member #2								
Expert panel member #3								
Expert panel member #4								
Expert panel member #5								
Expert panel member #6								
Expert panel member #7								
Expert panel member #8								
Expert panel member #9								
Expert panel member #10								
Expert panel summary	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPCC.

Calculation of expert panel summary scores for all measurement endpoints (eg example uses 6 studies)

Decision Endpoint: "Determine if pretreatment units will meet BOD5 and TSS concentrations of 30 mg/l in field systems in the long-term".

Study # (measurement endpoint #): 1
Name of this particular research study or dataset (measurement endpoint): _____
Source for this research study or dataset: _____
Name of individual/organization submitting this study or dataset: _____
Study Type = A, B, C, D, E, F, G, H, I, or J: _____

Study # (measurement endpoint #): 2
Name of this particular research study or dataset (measurement endpoint): _____
Source for this research study or dataset: _____
Name of individual/organization submitting this study or dataset: _____
Study Type = A, B, C, D, E, F, G, H, I, or J: _____

Study # (measurement endpoint #): 3
Name of this particular research study or dataset (measurement endpoint): _____
Source for this research study or dataset: _____
Name of individual/organization submitting this study or dataset: _____
Study Type = A, B, C, D, E, F, G, H, I, or J: _____

Study # (measurement endpoint #): 4
Name of this particular research study or dataset (measurement endpoint): _____
Source for this research study or dataset: _____
Name of individual/organization submitting this study or dataset: _____
Study Type = A, B, C, D, E, F, G, H, I, or J: _____

Study # (measurement endpoint #): 5
Name of this particular research study or dataset (measurement endpoint): _____
Source for this research study or dataset: _____
Name of individual/organization submitting this study or dataset: _____
Study Type = A, B, C, D, E, F, G, H, I, or J: _____

Study # (measurement endpoint #): 6
Name of this particular research study or dataset (measurement endpoint): _____
Source for this research study or dataset: _____
Name of individual/organization submitting this study or dataset: _____
Study Type = A, B, C, D, E, F, G, H, I, or J: _____

Expert panel summary evaluation of study type rankings (0.1 to 1.0), calculated relative data attribute weightings (0.0 to 8.0) and data assessment scores (0.0 to 1.0) for all studies and datasets relating to the decision endpoint.

15-DSS calculation

Study (Measurement endpoint) #	Study type ranking	Performance data		Flow data		Replication		Experimental control		Environ. conditions		O&M conducted		Third-party character		Peer-review character	
		Weight	Data score	Weight	Data score	Weight	Data score	Weight	Data score	Weight	Data score	Weight	Data score	Weight	Data score	Weight	Data score
Range ¹	0.1-1.0	0.0-8.0	0.0-1.0	0.0-8.0	0.0-1.0	0.0-8.0	0.0-1.0	0.0-8.0	0.0-1.0	0.0-8.0	0.0-1.0	0.0-8.0	0.0-1.0	0.0-8.0	0.0-1.0	0.0-8.0	0.0-1.0
Formula ²	A	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C
1																	
2																	
3																	
4																	
5																	
6																	

1 - range of possible scores for that parameter

2- letter from formula in text used for calculations of total score

Calculated measurement endpoint scores for all studies and datasets										
Measurement Endpoint Formula = Rank A x (Sum of (calculated weight B x data score C))										
Study #	Study type ranking	Performance data	Flow data	Replication	Experimental control	Environmental conditions	O&M conducted	Third-party character	Peer-review character	Calculated score for measurement endpoint
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Decision Endpoint Formula = Sum for all measurement endpoints (eg studies or datasets) of Rank A x (Sum of (calculated weight B x data score C))	
Decision endpoint summary value based upon results from measurement endpoints	0.0

Developed by the On-Site Wastewater Corporation and Michael T. Hoover for NEIWPCC.