Chapter 21: Developing Interpretation Criteria

Chapter 19 provided the basic concepts underlying NASIS interpretations: interpretive statements, fuzzy logic (or approximate reasoning), and converting fuzzy logic results to rating classes. Chapter 20 introduced the running of interpretation reports and selecting existing interpretive criteria to run against the selected set data. Chapter 21 demonstrates how to create new criteria. It introduces the NASIS Interpretation Generator and the editors used for building interpretations. With these tools, new interpretations can be created based on documented criteria and current NASIS data. Once the interpretation is created, calculations are automatically performed by NASIS providing the capability of applying new interpretive criteria to soil data. All interpretation data is stored in the local database and available in the Interpretations. Prior to developing interpretive criteria, there must be an understanding of articulating interpretive statements, fuzzy logic, and converting fuzzy numbers into rating classes.

The NASIS interpretation module is designed for interdisciplinary experts who thoroughly understand the process of developing interpretive criteria. Users must understand the relationships of soil properties to the system or application being evaluated. Expert opinion is required throughout the process of creating interpretive criteria with NASIS. Use of this chapter requires that the user have basic NASIS training on the subjects of navigation, database structure, and object ownership.

Overview of Interpretation Criteria

In NASIS, interpretive results are generated by applying interpretive criteria to soil data. Interpretive criteria are divided into four parts: *Interpretations, Sub Rules, Evaluations*, and *Properties.* These parts are located in the Interpretations Explorer panel.

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Three Component Concept of an Interpretation

In NASIS, interpretive results are generated by applying interpretive criteria to soil data. Interpretive criteria are divided into three basic parts: *properties*, *evaluations*, and *rules* (includes interpretation and sub rules).



A property is a specification used to extract soil property data from the database. This can be anything from a simple query statement to a complex calculation based on several queries.

An evaluation is some test that will be applied to the data returned from a property to determine the truth of some proposition. Evaluations can be either fuzzy (returning any value between 0 and 1) or crisp (returning only 0 or 1).

Rules are used to combine the results of evaluations and/or other rules to create new propositions. A sub rule provides the results from at least one evaluation or other sub rule. An interpretation is the top level rule that combines the results of all sub rules associated with the specific interpretation.

At the top level, a report can invoke one or more rules and format the resulting values for output.

Properties

A *property* is the specified soil data retrieved from the soil database. The term *property* can also refer to the SQL-like statement that retrieves the soil data. Properties are stored in the Interpretations Explorer under the Property folder and organized by NASIS Site. A property used by an Evaluation must create variables named Low, High or RV. Case does not matter. This allows the evaluation process to search the property's symbol table for the correct entries. It is important to note that the user must also set a choice list field in the property record to tell what the expected return values will be: high-low, high-low-rv, or just rv. The evaluation will expect to find the corresponding variable names.

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🗹 👍 View Ready to Use Only	IP AGR-DEPTH TO BEDROO	K	retrieved; in this case,			
View Primary Rules Only	General Property Text		the depth to bedrock			
🔄 🔮 View Checked Out Only	Seq:					
🕂 🔤 Rules	Property Name:	AGR-DEPTH TO BEDROCK				
🕂 🧰 Evaluations 📃	Description:	Finds the top depth of the first restrictive layer of type "bedrock (lithi	c)" or "bedrock (paralithic)".			
Properties		Returns values for low, high, and rv: each has a single value.	, ,			
NSSC Pangaea NSSC Pangaea NSSC Pangaea NSSC Pangaea		Recurs values for low, high, and ty, each has a single value.				
200 SIEVE PASSING ABOVE REST			✓			
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AASHTO Calculation	Units:	cm	documented in the			
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AASHTO GROUP INDEX NUMBER	Maximum:	9999	the General tab.			
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AGR-AVAILABLE WATER CAPACITY	Ready to use?					
- 🥁 AGR-BULK DENSITY MAXIMUM IN	Property NASIS Site:	NSSC Pangaea				
AGR-CLAY ACTIVITY IN DEPTH 0	NASIS Group:	Interp/Agronomy				
GR-DEPTH TO BEDROCK	Object Last Updated:	9/1/2006 4:32:30 AM				
AGR-DEPTH TO BEDROCK SOFT	Object Last Updated By:	Finnell, Paul R.				
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The property record also contains fields to specify the data type and default value for the property results. The data type is either character or numeric, and must correspond to the type of data produced by the property script. The default value is optional. It is used to replace null values in the property results. If a null value is not replaced by a default, the evaluation will interpret the null as an unknown, resulting in a 0 to 1 evaluation range.

Each property must have a "base table". When an evaluation requests data from a property it specifies which row of the base table the data should be produced for, by passing the values of the primary key for that row. It is not possible to mix properties with different base tables in a set of interpretations. The report specifies a base table, and all properties used by the rules and evaluations for that report must use the same base table. A property is written in the text editor as shown in the Figure on the next page.

IP AGE	In Section Constraints of the section of the secti	 Second second sec	The actual SQL-like statement that retrieves the property from the database is created and
1 2 3 4	<pre>base table component. # Get low, high and RV depths to a restriction of type be # Select first occurrence in case there is more than one.</pre>		stored in this text field editor referred to as the Property Editor
5 6 7 8 9	<pre>exec sql select resdept_l low, resdept_h high, resdept_r from component, corestrictions where join component to corestrictions and reskind in ("bedrock, lithic", "bedrock, paralithic", "be sort by rv</pre>		x, densic");
11		retr the	e SQL statement that ieves the property from database is created accessed from here

Testing Properties

Properties can be run against a single component to test the property. This is done by selecting a single component in the Component table, returning to the Property and choosing to "Run Property Against Local Database" from the Interpretation Menu or the Editor Toolbar (as shown below).



The report provides the results of the property against the specific component. This report is used for testing the validity of the property.

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high	NUMERIC	50		
rv	NUMERIC	30		
coiid_key1	CHARACTER	"159041"		
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Where Used "Properties"

Properties are developed to be used by more than one evaluation. The "Where Used" icon or menu option is used to identify evaluations using a specific property. This allows the user to identify the impact of any changes made to the property. Highlight the property in the Interpretation Explorer, or with the Property open in the Editor Panel, choose "Where Used" icon or menu option.



The resulting report identifies the Evaluations using the selected property:

Evaluations using Property DEP	TH TO BED
Evaluation Name	Evaluation Site
Depth to bedrock (hard or soft) 25-50cm - MO2	MLRA02_Office
Depth to bedrock (hard or soft) 25-50cm - MO2	MLRA08_Office
4brigbrLHH	MLRA12_Office
AAA -Biffy BR	MLRA13_Office
ak dm Shallow to Bedrock (100 to 150 cm (40 to 60"))	MLRA17_Office
ak dm Shallow to Bedrock less than 7 feet	MLRA17_Office
AVVM-Depth to Bedrock (20-60") 51-152cm	MLRA05_Office
Bedrock	MLRA16_Office
brigbrLHH	MLRA12_Office
Cecil Shallow to Bedrock 12 - 40in (30 to 100cm)	MLRA13_Office
CLS - Bedrock less than 138cm	MLRA05_Office
cp Not Shallow to Bedrock (100 to 150 cm (40 to 60"))	MLRA17_Office
cp Not Shallow to Bedrock (50 to 100cm (20 to 40"))	MLRA17_Office
Depth to Bedrock	MLRA16_Office
Depth to bedrock (100 to 180cm (40 to 72")) - MO2	MLRA02_Office
Depth to bedrock (hard or soft) 50-100cm - MO2	MLRA02_Office
Depth to bedrock (hard or soft) 50-150cm - MO2	MLRA02_Office
Depth to bedrock 25-50cm - HAWAII	MLRA02_Office
Depth to bedrock 36 to 72 inch	NSSC Data
Depth to Rock	MLRA16_Office
FL64E-Depth to Bedrock (<137cm (<54"))	MLRA15_Office
ELEAE Denth to Bedrock (137-180cm (54-70"))	MLRA15 Office

Evaluations

An *evaluation* is an assessment of a particular soil property for its relative impact as a limiting feature. It is the relationship between the property and its impact on the interpretive application. The evaluation is basically a transformation of the data returned from the property into the domain of real numbers from 0 to 1, where 0 means the test is completely false, 1 means the test is completely true, and numbers in between represent the degree of truth. The evaluation can return up to 4 values, representing the lowest and highest evaluations for the full range of the property's values, and the lowest and highest evaluations for the property's representative values.

Evaluations are stored in the Evaluation folder in the Interpretations Explorer and organized by NASIS Site as shown this figure.

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Evaluations are named for the limiting feature. The Evaluation is documented in the Description field under the General tab:

📕 🛛 ENG - Septic Tank Absorp	tion F Ir Filter Field 60 - 150cm (24-60 Ie Filter Field 60 to 150cm (24 t	×				
General Evaluation Text						
Seq:						
Evaluation Name:	Filter Field 60 to 150cm (24 to 60")					
Description:	7/99 Modification: This evaluation checks the filtering capacity of the soil. The maximum high, low, and representative values for sat_hydraulic_conductivity are selected for each horizon between 24 to 72 inches and above any restrictive layer. The fuzzy space is defined as the condition: Where the soil horizon property sat_hydraulic_conductivity > 42 micrometers/second (6.0 inches/hr), the evaluaton is					
	absolutely true and the restrictive feature is poor effluent filter field. AND Where the soil horizon property sat_hydraulic_conductivity <= 42 micrometers/second (6.0 inches/hour), the evaluation is absolutely false and the restrictive feature is not poor effluent filter field. If no data is entered, then an artificial default value(s) is used.					
	In 1990 the evaluation depth was extended from a base of 40 inches to a base of 60 inches. \sim					
Ready to use?						
Evaluation NASIS Site:	NSSC Pangaea					
NASIS Group:	Interp/Engineering					
Object Last Updated:	10/3/2006 7:05:02 AM					
Object Last Updated By:	Finnell, Paul R.					
Rec ID:	224					

The first step in creating an evaluation is to select a property to be evaluated. The user interface does this with a choice list having a database option, in the same way the user selects other objects like queries or reports. The selected combination of database (NASIS site) and property name uniquely identifies a property record.

iorresponding Prop Property:	-	MUM ABOVE RESTRICTIVE LAYER 24 to 60		Open			
valuation	Select Property						
valuation Type	NASIS Site Name 🛧	Property Name 🔶	Ready to use?	alution Results?			
	NSSC Pangaea	KSAT HIGHEST MINIMUM ABOVE RESTRICTIVE LAYER 24 to 60					
	NSSC Pangaea	KSAT HIGHEST MINIMUM, 0-150CM OR FIRST RESTRICTION					
•	NSSC Pangaea	KSAT HIGHEST MINIMUM, 30-200cm OR FIRST RESTRICTION	~				
	NSSC Pangaea	KSAT MAX HIGH IN DEPTH 0-20CM	~				
	NSSC Pangaea	KSAT MAX HIGH IN DEPTH 0-50CM	~				
lembership Graph	NSSC Pangaea	KSAT MAX HIGH SURFACE HORIZON TO 20CM					
<u> 역</u> 1.00 -	NSSC Pangaea	KSAT MAX HIGH SURFACE HORIZON TO 50CM					
0.80 Alue	NSSC Pangaea	KSAT MAX HIGH, 0-150CM OR FIRST RESTRICTION	~				
	NSSC Pangaea	KSAT MAX HIGH, 0-50CM	~				
5	NSSC Pangaea	KSAT MAX HIGH, 20-150CM, OR FIRST RESTRICTION	~				
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E 0.20	NSSC Pangaea	KSAT MAX HIGH, TOP DEPTH > 0CM	~				
Σ 0.00	NSSC Pangaea	KSAT MAX LOW IN DEPTH 0-20CM	~				
0.00	NSSC Pangaea	KSAT MAX RV IN DEPTH 0-20CM	~	24.00			
	NSSC Pangaea	KSAT MAX RV SURFACE HORIZON TO 50CM	~				
	NSSC Pangaea	KSAT MAX RV, TOP DEPTH > 0CM	~				
	NSSC Pangaea KSAT MAX TOP ABOVE RESTRICTIVE LAYER >60						
	NISC Pancaea KSAT MAXIMUM of Annarent Water Table						

The definition of a property specifies the type of data the property returns, which can be either character or numeric. All types of evaluations can be used with numeric data, but **only a crisp**

evaluation can be used with character data. The property definition also specifies whether the property returns a single (representative) value, a range (low high), or both (all three values). The property may also have a default value, which the evaluation process any time the property returns a null value, and a minimum and maximum value for the property's domain.

Property Name:	KSAT HIGHEST MINIMUM ABOVE RESTRICTIVE LAYER 24 to 60	
Description:	Finds the lowest value for permeability (K-Sat) in horizons tha and above a restrictive feature. Returns values for low, high, and rv: each has a single value.	
		and
Data Type:	Numeric	
Modality:	High, Low, Representative Value	
Units:	UM/S	uses
Minimum:		
Maximum:		
Default Value:		

Using the principles of fuzzy logic (fully explained in Chapter 19), a graph is created to identify the impact in the Evaluation Editor, as shown on the next page. The graph is used to evaluate the soil property and its relative truthfulness of being a limiting feature. For example, if a soil has a Ksat Class of absolutely too rapid (assuming greater than or equal to 42 micrometers per second), the fuzzy value would be 1. If the Ksat is absolutely not too rapid (assuming less than 14 micrometers per second), the fuzzy value would be 0. Fuzzy logic evaluates the property when it falls in the range between absolutely too rapid (1) and absolutely not too rapid (0). For example, if the soil Ksat is moderately slow, it could be plotted as 0.5, meaning that the soil has a 0.5 truthfulness of water movement being absolutely not too rapid (28.00 micrometers per second).



Evaluations specify the ranges used to assess the relative truthfulness of a statement about a soil property. For example, the evaluation criteria set the limits for determining whether the statements "soil Ksat is too rapid" and "soil Ksat is not too rapid" are absolutely not true, absolutely true, or somewhere in between.

Fuzzy logic allows for the relative statements about soil properties. For example, in the traditional view, the logical statement A AND B means that both A and B must be absolutely true for the statement to be true. But with fuzzy logic, each of A and B represent some degree of truthfulness (membership in a class), from absolutely *not* true to absolutely true. The statement A AND B evaluates the minimum truthfulness for either of A and B. For example, if a soil must be deep and dry in March to be suitable for early tillage, and the soil is deep but moist, the statement that the soil is deep is true but the statement that the soil is dry is only partly true. Therefore, the soil is partly suited to early tillage.

This statement about soil behavior can be understood in terms of relative truthfulness. If the soil is very nearly dry, then its degree of truthfulness is very nearly 1 (perhaps 0.9), and it is very nearly suited (0.9) to early tillage. The degree of truthfulness is numerical and can be used in mathematical operations or converted into classes such as slightly limited, somewhat limited, and very limited. Regardless of how you use it, fuzzy logic allows you to make more intuitive, more precise, and more useful interpretations. This concept helps you deal with relative statements about soil properties. If you have not already done so, refer to Chapter 19 for a full discussion of fuzzy logic.

Evaluation Types

There are several evaluation types or curves that can be used to assess a soil property for its relative impact. Both crisp and fuzzy systems curve options are available.

Crisp Curve

The crisp curve is used to represent classed data sets that have well defined definite boundaries. For instance, soils can be evaluated to find those with a depth to bedrock less than or equal to 20 cm as being absolutely "too shallow" (1).



Crisp set evaluations are the only ones that can be used for character data. While it is possible to use the operators <, <=, > or >= they do not make as much sense for character property type.

Sigmoid Curve

The sigmoid curve is used to represent an increasing nonlinear fuzzy data set. The fuzzy set moves from no membership at the left hand side to full membership on the right hand side. The membership function is pivoted around the 50% membership point. This is called the inflection point. This S shaped curve is used to depict natural processes by time.

In this instance the soil is evaluated between the depths of 25 and 100 cm. The depth less than 25 returns a fuzzy value of 1 (absolutely limiting) and the depth greater than 100 returns a fuzzy value of 0 (absolutely not limiting). Values between 25 and 100 are assigned membership values based on the intersection of the sigmoid curve and the soil depth. (Note that the graph is set "Invert Evaluation Results".)



The Sigmoid curve must be used with caution due to the curvature at the beginning and end points. Note that the values between 25.00 and 33.00 have a minor differentiation of the Membership Value. This should be seriously considered when developing an evaluation using a sigmoid curve and the soil properties should be assigned as accurately as possible to identify the absolutes.



Linear Curve

The linear fuzzy surface is considered to be the simplest representation of a fuzzy data set. The membership value (y) is proportional to the domain value (x). The depth to bedrock less than 25 returns a fuzzy value of 1 (absolutely limiting) and the depth greater than 100 returns a fuzzy value of 0 (absolutely not limiting). Values between 25 and 100 are assigned membership values based on the intersection of the line and the soil depth. (Note that the graph is set "Invert Evaluation Results.)



Comparison of the Sigmoid and Linear Curves

Notice the difference in the relationship of the Membership Value and Depth to Bedrock between the Sigmoid and the Linear curves. At a depth of 45 cm, the Sigmoid Curve assigns a Membership Value of 0.875 whereas the Linear Curve assigns a Membership Value of 0.725. Inverse results will appear at the 85 cm depth where the Sigmoid Curve assigns a Membership Value of 0.15 and the Linear Curve assigns a Membership Value of 0.25. Issues such as this should be considered during the planning of the interpretation.

Arbitrary Curve

The arbitrary curve is used when the distribution of the membership values is not directly adaptable to standard curve architectures. Assign the soil properties to the X axis and identify the Membership Value to be assigned for each intersection on the Y axis.



Arbitrary Linear

Similar to the Arbitrary Curve, the arbitrary linear curve is used when the distribution of the membership values needs to be defined more accurately than standard curve architectures are capable of doing. The membership values in related fuzzy data sets may fall to zero or plateau for some part of the set.



PI Curve

The PI fuzzy set is represented by a curve composed of two sigmoid curves back to back. It has a central point at which it has full membership and going either left or right of this point causes a nonlinear decline in membership value. The PI curve is used to represent a fuzzy data set that approximates a normal distribution (bell shape) around a central membership value. This inverted PI Curve would assign soil depths at 0 and at 200 a membership value of 1 (absolutely limiting) and those between it would evaluate based on the intersection of the curve and the soil depth.



Beta Curve

The beta fuzzy set is represented by a bell type curve. It has a central point at which it has full membership and going either left or right of this point causes a nonlinear decline in membership value.

The shape of the Beta curve is hyperbolic, so it does not approach zero as quickly as a gaussian curve. The beta fuzzy set would be used to represent numbers clustered around a central point but with a different distribution that the PI or Gaussian sets.

To enter a beta fuzzy set you must provide a center value and an inflection point offset. The value at point is 1 and the value at points is 0.5. Further out from the center the value becomes smaller but never reaches exactly zero.



Gaussian Curve

The Gaussian fuzzy set is represented by a bell curve. It has a central point at which it has full membership and going either left or right of this point causes a nonlinear decline in membership value. The curve for a Gaussian fuzzy set looks similar to a PI set but is not as rounded at the top. The Gaussian curve is similar to the beta curve except for the fact that the slope of the bell curve is very steep and possesses relatively short tails. The membership value of the fuzzy data set goes to zero very quickly. This normal Gaussian curve would assign an absolute limiting value of 1 to the depth of 50 cm. All other depths would be assigned membership values based on the intersection of the curve. Mathematically speaking, the sides of a Gaussian curve are an exponential curve, while the Sigmoid curve is a quadratic or parabolic curve.



The most common use of the Gaussian fuzzy set is to represent numbers in a statistically normal distribution. If you are describing values clustered around a central point, you may be in a situation where a Gaussian curve would work well. Gaussian sets are not as popular as PI curves for representing fuzzy numbers because it is not as easy to predict the shape of the curve for a given width factor.

To enter a Gaussian fuzzy set you must provide a center value and a width factor. Note that the width factor operates in an inverse manner-as the width factor gets larger the curve gets narrower. The value at point is 1 and as you go out from the center the value becomes very small but never reaches exactly zero.

Triangle

The Triangular fuzzy set is represented by a triangle. It has a central point at which it has full membership and going either left or right of this point causes a linear decline in membership value. The triangular curve spreads the membership values evenly across the domain (x axis) and the contour is defined through linear interpolation.



To enter a triangular fuzzy set you must provide a low value and a high value. The center point of the triangle is assumed to be half way between the low and high values, and has a membership value of 1. The inverted triangle above assigns a membership value of 1 (limiting) to those soils with bedrock depths less than 25 cm and any greater than 150 cm. The depth of 88 cm is assigned a membership value of 0 (not limiting).

Trapezoidal

The Trapezoidal fuzzy set is similar to a triangle fuzzy set, but instead of having a single point at full membership, there are a range of points at full membership. Moving either left or right of this range causes a linear decline in membership value. The trapezoidal curve is a triangular curve truncated by a plateau. The width of the plateau is proportional to the number of

membership values that are true. To enter a trapezoidal fuzzy set you must provide a low value and a high value and the minimum and maximum values for the top plateau.



Is Null

The Is Null evaluation is used to assign a value to those properties that are used in the interpretation but are not populated in the database. Simply, a null field can be assigned any single value inclusively between 0 and 1.



Testing Evaluations

Evaluations can be run against a single component to test the results of the evaluation. This is done by selecting a single component in the Component table, returning to the Evaluation and choosing to "Run Evaluation Against Local Database" from the Interpretation Menu or the Editor Toolbar (as shown below).



The resulting report is used to test the Evaluation results:

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McAfee SiteAdvisor									
Evaluations									^
Evaluation Nam	e	Low Low Value	Low RV Value		High High Value	Null Data	Default Data	Inconsistent Data	
Shallow to Bedr to 180cm (40 to		1	1	1	1	false	false	false	
Property: DEPT	H TO BEDR	ROCK							
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high 1	NUMERIC	50							
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Using Multiple Values

When multiple input values are provided from a property, the evaluation returns a range of membership values. The following cases can occur.

If a property provides ranged data with a low and high value, the two values are evaluated separately. The lower membership value is called the "low-low" result and the higher value is called the "high-high". Note that the lower input value does not necessarily produce the low-low result. Depending on the evaluation function the smaller input value could produce a higher membership value, which would then become the high-high result. A property can also return data from more than one database row at once, so there could be several low and high inputs. Still, the lowest result is the low-low and the highest is the high-high.

If a property provides representative values, they are evaluated separately from the low and high values. The lowest result of this group is the "low-rv" value, and the highest is the "high-rv" value. If only one representative value is provided, the low-ry and high-ry results are equal.

Evaluations							
Evaluation Name	Low Low Value	Low RV Value	High RV Value	High High Value	Null Data	Default Data	Inconsistent Data
Shallow to Bedrock (100 to 180cm (40 to 72"))	1	1	1	1	false	false	false

If a null value is provided from a property, and there is no default value defined, the result is considered to be "unknown", meaning that its membership value could be anything from 0 to 1 (unless the NULL evaluation type is used). If a null occurs in the low or high input columns, the low-low becomes 0 and the high-high becomes 1. If the null occurs in the representative value column, the low-ry becomes 0 and the high-ry becomes 1. In addition, if any nulls are provided from a property a "Null Data" flag is set in the evaluation result, which can be used during rule processing to handle cases where the absence of data is significant.

Where Used "Evaluations"

Evaluations are developed to be used by more than one Rule. The "Where Used" icon or menu option is used to identify rules using a specific evaluation. This allows the user to identify the rules that will be impacted due to any changes made to the evaluation. Highlight the evaluation in the Interpretation Explorer, or with the Evaluation open in the Editor Panel, choose "Where Used" icon or menu option.

Interpretations «	i 🖪 🖬 🖪 😵 🥡	- • • • • • • • • • • • • • • • • • • •
🔽 🍐 View Ready to Use Only	T Component	🕼 Shallow to Bedrock 100 - 180cm 🛛 🔤 Shallow to Bedrock (100 to 180 🦻 DEPTH TO
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Siew Checked Out Only	Corresponding Prope	erty
SAR Maximum in depth 25-150cm SAR of the Thickest Layer to 100cm SAR of the Thickest Layer to 100cm SAR WTD_AVG 0 to 30 cm SAR, WTD_AVG 0 to 100cm	Property: Evaluation Evaluation Type:	DEPTH TO BEDROCK
		Low Value
Seepage (4 to 14 um/sec) 30 to	Data	100
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Seepage (botton layer) disposal		
Shallow to Bedrock (<50cm (<20"))	Membership Graph	
Shallow to Bedrock (100 to 150 c		
Shallow to Bedrock (100 to 180c 🔲	<u><u> </u></u>	
	Open	Ctrl+Shift+O
Shallow to Bedrock (75 to 100cm	Check Out	Ctrl+Shift+K
Shallow to Bedrock < 200cm	Mark for Deletion	Ctrl+Shift+M
	Remove Deletion Mark	Ctrl+Shift+M
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	View Where Used	Ctrl+Shift+W
T Tables	View Information Fin	nd out where this Evaluation is referenced.

The report provides the Property name used in the Evaluation and the Rule(s) using the specific evaluation.

Evaluation Shallow to Bedrock (100 to 180cm (40 to 72"))							
Property used by Evaluation							
Property Name	Property 9	Site					
DEPTH TO BEDROCK	NSSC Pan <u>c</u>	aea					
Rules using this	Rules using this Evaluation						
Rule Name		Rule Site					
Shallow to Bedrock 10	00 - 180cm	NSSC Pangaea					

NASIS interpretations

An *Interpretation* or primary rule is a root rule in NASIS. The interpretation uses *Evaluations* and *Sub Rules* to derive interpretive values. The interpretation is a logical statement about land use, limiting features, and the relationship among limiting features. The land use is identified in the Rule Name, as depicted in the image below. The interpretation's limiting features and the relationship among them (relative weights and interactions) are depicted graphically with a special Rule Editor (see page 22). NASIS interpretations are stored in the Interpretation Explorer panel, organized by the NASIS Site and identified by the letter "P" in the graphical "thumbs up" icon.



Limiting features, the relationships among the Sub Rules and evaluations, and their link to the interpretation are depicted in a special Rule Editor accessed when the interpretation is opened in the Editor Panel. Interpretations are loaded into the Editor Panel by using the "open" on the Interpretations Explorer menu, using the right click menu, double-clicking the specific interpretation, or using the hot keys "Ctrl+Shift+O".



Rule Editor Symbols

The Rule Editor lets you illustrate the interpretation or sub rule graphically with symbols called rule components. Refer to the figure below for a description of each rule component.



Rule Components and Symbols.

Start State

Every rule begins with a start state. The start symbol is shown as an upside down triangle in the rule editor. There can be just one component attached to the start state.

Operators

Operators are shown as circles in the rule editor. Operators require at least one other component to be attached as operands. Many operators require a specific number of operands and are highlighted as "incomplete" until the correct number of operands is attached.

Hedges

Hedges are shown as squares in the rule editor. All hedges pass on the weight of their children, except for the weight hedge which sets it to some value other than 0.

Evaluations

An evaluation is shown as an oval in the rule editor. A rule can refer to an evaluation of a database property. In fact this is how rules are connected to the database.

Rules

A rule is shown as a rectangle on the rule editor. A rule can use the result of another rule as part of its definition. This is a rule reference. Rules cannot be recursive. If A is a rule then A cannot be referenced either directly or indirectly by rule A.



Rule Editor Depicting Sub Rules

The existing interpretation must be "Checked out" before edits can be made. After being checked out, a menu option lets you edit to add operator, hedge, sub rule and/or evaluation.



If the Interpretation is checked out, the Sub Rules can be opened by double clicking on the particular sub rule or using the right click menu and Open:

T Component Ir ENG - Se	ptic Tank Absorption F	·]
General Rule Rating Classes	Text	
Zoom: 75% 🗸		
	(NSSC Pang Open	aea) Filter Field 60 - 150cm (24-60'')
	Select	aea) Percolation 60 - 180cm (24-72'')
	Edit Delete Move Up	: Pangaea) Slope 8 to > 15%
	Move Up Move Down	

Sub Rules

A *Sub Rule* is a logical statement about one limiting feature. A Sub Rule says nothing about the land use; therefore, the same Sub Rule can be used in building different interpretations. Sub Rules are aggregated into an interpretation and are considered the basis, or building blocks, of an interpretation. Like interpretations, Sub Rules are stored in the Rule table, as shown in the image below. The limiting feature is stored as the Rule Name. A naming guideline helps you distinguish Sub Rules from interpretations.



Interpretations Explorer Panel Displaying Sub Rules

Sub Rules have at least one evaluation linked to them. The linked evaluation(s) are depicted graphically in the Rule Editor shown in the image below.



Rule Editor Showing Link to Evaluation

In order to report out interpretive results, an evaluation must be linked to a Sub Rule. The Sub Rule gives you the flexibility of reusing evaluations for different interpretations.

Testing Sub Rules

The results of a Sub Rule can be tested against a single component using the "Run Against Local Database" option found on the Interpretations Explorer menu or the right click menu.



The resulting report is used to verify the results of the Sub Rule, Evaluation(s) and Property(s).

Address 🖉 C:\Documer	its and Setti	ngs\All User:	s\Application Data	\USDA\NRCS\ITS\Nasis6	i.x\Te	mp\NasisInterpR	esults.html						💙 🄁 Go
	Interpretation: Filter Field 60 - 150cm (24-60")												
Interpretatio	n: Filte	rrieiu	00 - 1300	11(24-00)									
Sub-rule Name	Depth	Low Lo	ow Rating	Low RV Ratin	g	High RV I	Rating	High Ratir	High Ig	Null Data	Defaul Data	t Inconsist Data	tent
Filter Field 60 - 150cm (24-60'')	0	No filt capaci limitat		No filtering capacity limitation (0)		No filteri capacity limitatior	0	Filter capa	ing city (1)	false	false	false	
Evaluations													
Evaluation Na	ime		Low Low Value	Low RV Value		igh RV alue	High H Value	ligh	Null Data	Def Dat		Inconsister Data	nt
Filter Field 60 to 60")) to 150)cm (24	0	0	0		1		false	fals	e	false	
Property: KS/	AT HIG	HEST	MINIMUM	ABOVE REST	RIC		/ER 24	to 60					
Variable Nam	e Value	е Туре	Value										
hzdept_r	NUME		41, 69, 12	22									
hzdepb_r	NUME	ERIC	69, 122, 2	203									
ksat_l	NUME	ERIC	14.109999	966, 14.10999	966	, 42.3300	0183						
ksat_r	NUME	ERIC	28, 45, 92	2									
ksat_h	NUME	ERIC	42.33000	183, 141.1100	006	6, 141.110	0006						
depth	NUME	ERIC	250										
min_depth	NUME	ERIC	203										
in_range	NUME	ERIC	1, 1, 1										
low	NUME	ERIC	14.109999	966									
high	NUME	ERIC	42.330001	183									
rv	NUME	ERIC	28										
coiid_key1	CHAF	ACTER	"158660"										

Operators

The operator defines the interactions between the limiting features (sub rules). Refer to Chapter 19 Introducing Interpretations page 19.5 for an explanation of the Operators "OR" and "AND".



Regardless of the Operator used, the reported value is never a negative number nor is it ever greater than 1.

The "**AND**" operator will review the Membership Value numbers assigned to each sub rule and select the **Minimum** value to report for the interpretation.

The "**OR**" operator will review the Membership Value numbers assigned to each sub rule and select the **Maximum** value to report for the interpretation.

The "**SUM**" operator will review the Membership Value numbers assigned to each sub rule and **add all value** to report for the interpretation.

The "**AVERAGE**" operator will review the Membership Value numbers assigned to each sub rule, sum the values and divide by the number of values to report for the interpretation.

The "**PRODUCT**" operator will review the Membership Value numbers assigned to each sub rule and **multiply** the values to report for the interpretation.

The "+", "-" and "*" operators are used to add, subtract or multiply the Membership Values between sub rules to report for the interpretation.

The mathematical definition of the "PRODUCT" operator.

Chapter 21: DEVELOPING INTERPRETATION CRITERIA (Version 6.0, January 2010)

Hedges

A hedge is a mathematical transformation (such as a square, square root, reciprocal, or cube), in the form of an adjective statement, that changes the meaning of an evaluation. For example, if the statement is the "soil is steep", then the hedge "very" can be applied which performs the mathematical function "square." The hedge is assigned using the right click menu. In this scenario, using an existing interpretation, the sub rule is highlighted and the right click menu is used to add a hedge to "Add Left". Creating a new interpretation, the "Add" option is used to add the hedge.



Once the hedge is added, it c Right click menu and "Select.			The Rule Editor us the symbolize the hed graphically.		
Ir * Ir ENG - Septic Tank	Abs	orption F *			
General Rule Rating Classes	<u>I</u> e	xt			
Zoom: 75%					
START OR		VERY -	(NSSC Pangaea) Shallow t	to Bedrock 100 - 1	180cm
		Open			
		Add 🕨			
The hedge options are included		Add Left 🔹 🕨	SC Pangaea) Permafrost		
in the Rule Editor.		Select 🕨 🕨	NOT		
		Edit	EXTREMELY		
		Delete	VERY	Jhat Limited	
		Move Up	SOMEWHAT	Mar Lininey	
		Move Down	SLIGHTLY		
			POSITIVELY		
	-	(NSSC	GENERALLY		
			ADD		
			SUBTRACT		
			MULTIPLY		
		(NSSC Pangaea)	DIVIDE	30cm	
			POWER		
			ALPHA		
	_	(NSSC Pangaea) Wet, (20 - 180cm)	
			NOT NULL AND NULL OR		
		(NSSC Panga	NULL NOT RATED		

A hedge:

- is placed after the operator,
- is placed before the sub rule in an interpretation,
- is placed before an evaluation in a sub rule, and
- can be edited after it's placed in the rule.

Although all of these hedges have a default value, they can be edited and their parameter changed to reflect the user's needs. *Regardless of the hedge used, fuzzy numbers cannot be negative and cannot exceed a value of one.* Thus, if the "SUM" operator is used and the sum of the fuzzy numbers exceeds a value of one, then 1.0 will be reported. This condition is known as "saturation." Consider the needs of the interpretation when using hedges.

"Null" hedges

The ability to take full advantage of the capabilities of the NASIS interpretation generator requires the database to be completed populated with accurate scientific data for the soil properties that are included in the interpretive criteria.

Dealing with the fact that there are soil properties that are not populated in a component requires an understanding of the following definitions.

Null value: A condition in which no data is returned, regardless of whether the value is absent because a row does not exist, a specific column is not populated in a row that does exist, or the conditions exclude the return of a value that does exist in the database.

Determinate null: A null value in the database for which *a legitimate conclusion can be determined* regarding its membership in the interpretive set. It implies meta-knowledge about the guidelines and conventions used to populate the database, especially with regard to recording non-existent features of a component in the database. An example would be depth to bedrock. If depth to bedrock is not populated in the database: then depth to bedrock can be assumed to be greater then the depth of observation and therefore, the soil would not be a member of the group of soils that has depth to bedrock as a restrictive feature.

Indeterminate null: A null value in the database for which *no legitimate conclusion can be determined* regarding its membership in the interpretive set. An example would be the percent clay of any soil layer. If percent clay is not populated in the database: then no logical assumption can be made because percent clay could be anything within its domain of values (0 to 100).

For any specific interpretation, if physical, chemical, or morphological characteristics required by the interpretive criteria are populated, the requirement is to generate an interpretive result for that component. This means that miscellaneous areas such as dune land, river wash, rock outcrop, and even water can be interpreted if the specific interpretive criteria require only the limited characteristics that might be populated for these components.

For any specific interpretation, if any required characteristic is not populated there are two outcomes:

- 1. If no legitimate conclusion can be determined regarding its membership in the interpretive set (indeterminate null), then return a "not rated" result for that component.
- 2. If a legitimate conclusion can be determined regarding its membership in the interpretive set (determinate null), then return a result based on the legitimate conclusion.

The ultimate goal is to have a completely populated database so that these types of decisions do not have to be made. The interpretation relies on a populated database to report its result. It is required for any specific interpretation that if the physical, chemical, or morphological characteristics required by the interpretive criteria are populated, then an interpretive result must be generated for that component. Null data fields require the user to make conscious decisions on its resulting impact of the interpretation.

In order for the above requirements to be fulfilled, one of the following "null" hedges (e.g. NOT NULL AND, NULL OR, or NULL NOT RATED) should be used in all sub rules.

The "**NOT NULL AND**" hedge assigns a Membership Value of 0 (not limiting) to null data elements encountered by the linked evaluation. In this "Shallow to Bedrock" sub rule, if the Component Restriction depth is not populated, then the membership value of this sub rule is assigned as 0 a non limiting value.

Ir Shallow to Bedrock 100 - 180cm Ir Wet, Ground Water Near the Sur
General Rule Rating Classes Text
Zoom: 100% 🗸
START NOT NULL AND (NSSC Pangaea) Shallow to Bedrock (100 to 180cm (40 to 72"))

The "**NULL OR**" hedge assigns a fuzzy value of 1 (limiting value) to null data elements encountered by the linked evaluation. In this sub rule looking at the Ksat, if Ksat is not populated then the sub rule is assigned a membership value of 1, a limiting value.

Ir ENG - Septic Tank Absorption F Ir Filter Field 60 - 150cm (24-60*) General Rule Rating Classes Text						
Zoom: 100% V						
START M	NULL OR	(NSSC Pangaea) Filter Field 60 to 150cm (24 to 60'')				

The "**NULL NOT RATED**" hedge will considers the soil characteristic so important that if the field is NULL, then the interpretation can not run to completion and provide a result. In this sub rule for slope percentage, if the slope is not populated, this hedge will assign "Not rated" to the sub rule and the interpretation will end.



Mathematical Hedges

The "NOT" hedge performs a reciprocal mathematical transformation of the linked evaluation.

Hedge: NOT (NOT A => 1 - A)

The "EXTREMELY" hedge cubes the evaluation linked to it.

Hedge: EXTREMELY (EXTREMELY A => A^3)

The "VERY" hedge squares the evaluation linked to it.

Hedge: VERY (VERY A => A^2)

The "SOMEWHAT" hedge raises the linked evaluation to the 0.5 power.

Hedge: SOMEWHAT (SOMEWHAT A => A^0,5)

The "SLIGHTLY" hedge raises the linked evaluation to the 0.3 power.

Hedge: SLIGHTLY (SLIGHTLY A => A^0.3)

The "**POSITIVELY**" hedge squares the linked evaluation, multiplies it by two, and subtracts the resulting quotient from one when the evaluation variable is less than 0.5. When the evaluation variable is greater than or equal to 0.5 the "POSITIVELY" hedge squares it and multiplies it by two.

Hedge: POSITIVELY (POSITIVELY A => if A<0.5, 1-2*A^2 else 2*A^2)

The "**GENERALLY**" hedge raises the linked evaluation to the 0.5 power, multiplies it by 0.8, and subtracts the resulting quotient from one when the evaluation variable is less than 0.5. When the evaluation variable is greater than or equal to 0.5 the "GENERALLY" hedge raises it to the 0.5 power and multiplies it by 0.8.

Hedge: GENERALLY (GENERALLY A => if A<0.5, 1-0.8*A^0.5 else 0.8*A^0.5)

The "ADD" hedge adds a user specified number to the fuzzy result of the evaluation.

Hedge: ADD (A ADD 0.500000 => A + 0.500000)

The "**SUBTRACT**" hedge subtracts a user specified number from the fuzzy result of the evaluation.

Hedge: SUBTRACT (A SUBTRACT 0.500000 => A - 0.500000)

The "MULTIPLY" hedge multiplies the linked evaluation by a user specified number.

Hedge: MULTIPLY (A MULTIPLY 2.000000 => A * 2.000000)

The "DIVIDE" hedge divides the linked evaluation by a user specified number.

Hedge: DIVIDE (A DIVIDE 2.000000 => A / 2.000000)

The "POWER" hedge raises the linked evaluation to the power of four.

Hedge: POWER (A POWER 4.000000 => A^4.000000)

The "**ALPHA**" hedge sets the linked evaluation to zero if it is less than a threshold fuzzy number specified by the user.

Hedge: ALPHA (A ALPHA 0.100000 => if (A < 0.100000) A = 0)

The "LIMIT" hedge sets the result of the evaluation to the number if it is greater than the limiting number.

Hedge: LIMIT (A LIMIT 0.900000 => if (A > 0.900000) A = 0.900000)

The "**WEIGHT**" hedge gives the linked evaluation a multiplier of two in order to increase its importance in the rule.

Hedge: WEIGHT (A WEIGHT 2.000000 => A WEIGHT 2.000000)

The ADD, SUBTRACT, MULTIPLY, DIVIDE, POWER, WEIGHT, ALPHA, LIMIT and WEIGHT are user defined hedges. A parameter box appears when these are selected and the user then assigns the hedge value.

Enter a value for the hedge:	
2	
OK Reset	Cancel

Rating Classes

Rating classes translate the numerical Membership Value into an adjective class name. Rating classes are assigned to sub rules to identify property limitations. Rating classes are assigned to interpretation rules to identify the interpretation rating class.

Sub Rule rating class

A *Sub Rule* is a logical statement about one limiting feature. Since this sub rule deals with one limiting feature, then the rating class will identify that limiting feature. The Membership Value passed to the sub rule from the evaluation is translated from a numeric to a character class. In this instance, the sub rule receives the membership value from the "Slopes <8 to >15%" evaluation. That number is passed through the rating class and its number is assigned a class.



Ι <u>Γ</u> Ε	Ir ENG - Septic Tank Absorption F Ir Slope 8 to > 15%							
General	General Rule Rating Classes Text							
	Rating Class Name	Rating Class Upper Boundary	¥	Rec ID				
•	Too steep		1.00	36				
	Slope		0.60	38				
	No slope limitation 0.00 39							

In this example, the membership value between 0.00 and 0.60 is converted to the class "No slope limitation"; values greater than 0.60 and less than 1.00 are converted to the class "Slope"; and the value of 1.00 is converted to "Too steep". These terms are those used to define the restrictive features in an interpretation report.

Each sub rule contains a rating class that translates its membership value to a rating class name for reporting for the interpretation report.

Naming Convention: Rating class names for all rules are to be "Sentence case". Only the first letter in the first word of the name is capitalized. Rating names for sub rules are to be brief, but descriptive, providing detail to the property limiting feature.

There is a "NULL NOT RATED" hedge in the "Slope 8 to >15%" sub rule. As explained earlier, this hedge will rate the interpretation as "Not Rated" if the slope is not populated. This class assignment is identified as the "Not Rated Phrase:" on the General tab for each sub rule. This assignment is made only if the specific sub rule contains a "NULL NOT RATED" hedge.

🛛 📕 🛛 ENG - Septic Tank Absorp	Ir ENG - Septic Tank Absorption F Ir Slope 8 to > 15%					
General <u>R</u> ule Rating Classe	s <u>I</u> ext					
Seq:						
Rule Name:	Slope 8 to > 15%					
Description:	Slope: Steep slopes impede trafficability of heavy machinery and r					
	Property used: SLOPE (Modality - low, high, representat					
	Restriction limits: Limiting > 15% Somewhat limiting >= 8 and <= 15% Not limiting < 8%					
Primary Interpretation?						
Rule Design:	limitation					
Not Rated Phrase:	Not rated; Slope					
Ready to use?						
Rule NASIS Site:	NSSC Pangaea 📃					
NASIS Group:	Interp/Engineering					
Object Last Updated:	1/6/2010 9:58:19 AM					
Object Last Updated By:	Finnell, Paul R.					
Rec ID:	10192					

Interpretation rating class

An *Interpretation* or primary rule is the root rule in NASIS. The interpretation uses *Evaluations* and *Sub Rules* to collectively derive interpretive values. The interpretation is a logical statement about land use, limiting features, and the relationship among limiting features. The Interpretation is a collection of sub rules. Each sub rules contains its rating class for identifying the specific property limitation.

Ir ENG - Septic Tank Absorption F			The Interpretation collects the information to identify the rating class for
Zoom: 75%			the interpretation. The OR operator will
START OR	(NSSC Pangaea) Permafrost	0	accept the maximum membership value from all the sub rules.
— (NS	ISC Pangaea) Flooding Very Rare/Rare Freq. Somew	hat l <mark>ad</mark> ited	That value is then assigned a rating
-	(NSSC Pangaea) Ponded > 4 hours	0	class name based on the classes assigned in the Rating Classes for the Interpretation.
-	(NSSC Pangaea) Shallow to Bedrock 100 - 180cr	n 1	
	(NISSC Panasas) Shallow to Conserted Pan 100 - 18	0em 0	The adjective printed for the

Interpretation Rating Class of "1" will be "Very Limited".

Ir ENG - Septic Tank Absorption F Ir Slope 8 to > 15% Ir Flooding Very Rare/Rare Freq							
General Rule Rating Classes Text							
	Rating Class Name	Rating Class Upper Boundary 🛛 👻	Rec ID				
⊧Е	Very limited	1.00	90				
E	Somewhat limited	0.99	91				
E	Not limited	0.00	92				

The resulting rating classes appear in the interpretation report as an interpretation rating class and property limiting features.

Sewage Disposal Inte	rpretations			
Reno County, Kansas				Interpretation Rating Class
Map symbol and soil name	Pct. of map unit	ENG - Septic Tank Absorption/Fie	lds	Property limiting
		Rating class and limiting features	s Value I	feature from sub
2266:				
Tobin	100	Very limited		
		Flooding	1.00	
		Slow water movement	0.50	
3405:				
Longford, moderately eroded	90	Very limited		
		Slow water movement	1.00	
2024				

Naming Convention:

Rating class names

All rule rating class names are to be "Sentence case". Only the first letter in the first word of the name is capitalized.

Interpretation Rating Class Names were historically "Slight", "Moderate" and "Severe", but later changed in NASIS to "Not limited", "Somewhat limited" and "Very limited". Deviations from the norm should be seriously considered before being assigned. All rating names should be as brief as possible.

Rule Names:

Interpretation Names (Sub rules): interpretations are prefixed with discipline abbreviations:

Ag Waste Management (AWM) Agronomy (AGR) Forestry (FOR) Grazing Land (GRL) Recreation (REC) Standard Engineering (ENG) Urban (URB) Waste Management Systems (WMS) Water Quality (WAQ) Wildlife (WLF)

Special National Interpretations:

Military (MIL) Department of Homeland Security (DHS) Under no circumstances are these National Interpretations to be copied or modified to create local interpretations by states.

Local Interpretations:

Local interpretations created by states are to be named in order to identify the state. The local interpretation name will be suffixed with a space, followed by an open parentheses, the two letter state code in upper caser, followed by a closed parentheses; for example "ENG – Septic Tank Absorption Field (GA)".

Sub Rule names: a brief name is used to identify the limiting feature.

Documentation:

The Interpretation will contain documentation in the Description field under the General tab detailing each sub rule, its evaluations and the properties used in each evaluation. The interpretation documentation will be complete for all sub rules, evaluations and properties used within the Primary Rule.

The sub rule will contain documentation with the details of its specific evaluation(s) and its specific properties. This documentation is written into the Description field under the General tab.

Testing Interpretations

The results of an Interpretation can be tested against a single component using the "Run Against Local Database" option found on the Interpretations Explorer menu or the right click menu.



The resulting report is a detailed report providing the results of all sub rules, all evaluations and all properties associated with the interpretation.

C:\Documents and Settings	s VAII Us	ers\Application Data\L	JSDAWRCS\ITS\Nasis6.	x\Temp\NasisInterpRe	s - Microsoft Internet I	Explorer	r	
File Edit View Favorites To								
Address C:\Documents and Sett	ings\All U	sers\Application Data\USDA\	NRCS\ITS\Nasis6.x\Temp\N	asisInterpResults.html				🚩 🄁 Go
McAfee SiteAdvisor								
Interpretation: ENG	i - Sej	ptic Tank Absor	ption Fields					<u>^</u>
Sub-rule Name	Depth	Low Low Rating	Low RV Rating	High RV Rating	High High Rating	Null Data	Default Data	Inconsistent Data
ENG - Septic Tank Absorption Fields	0	Very limited (1)	Very limited (1)	Very limited (1)	Very limited (1)	false	true	false
Shallow to Bedrock 100 - 180cm	1	Depth to bedrock (1)	Depth to bedrock (1)	Depth to bedrock (1)	Depth to bedrock (1)	false	false	false
Slope 8 to > 15%	1	No slope limitation (0)	Too steep (0.63)	Too steep (0.63)	Too steep (1)	false	false	false
Seepage Bottom Layer, Not Aridic	1	No seepage (0)	No seepage (0)	No seepage (0)	Seepage, bottom layer (1)	false	false	false
Not Aridic	2	Not aridic environment (1)	Not aridic environment (1)	Not aridic environment (1)	Not aridic environment (1)	false	false	false
Permafrost	1	No permafrost depth limitation (0)	false	false	false			
Flooding Very Rare/Rare Freq. Somewhat Limited	1	No flooding limitation (0)	No flooding limitation (0)	No flooding limitation (0)	No flooding limitation (0)	false	false	false
Ponded > 4 hours	1	No ponding limitation (0)	No ponding limitation (0)	No ponding limitation (0)	No ponding limitation (0)	false	false	false
Shallow to Cemented Pan 100 - 180cm	1	No cemented pan depth limitation (0)	false	false	false			
Wet, Ground Water Near the Surface (120 - 180cm)	1	No wetness depth limitation (0)	false	false	false			
Filter Field 60 - 150cm (24-60'')	1	No filtering capacity limitation (0)	false	false	false			
Percolation 60 - 180cm (24-72'')	1	Ksat not restrictive (0)	Ksat not restrictive (0)	Ksat not restrictive (0)	Ksat not restrictive (0)	false	false	false
Total Subsidence > 60cm (24")	1	No subsidence limitation (0)	No subsidence limitation (0)	No subsidence limitation (0)	No subsidence limitation (0)	false	false	false
Large Stones - Fract. >3in, 24.9 to >50%, Wght. Av. 0-40	1	No large stone limitation (0)	false	false	false			
		No unstable fill	No unstable fill	No unstable fill	No unstable fill			
E Done							3	My Computer

Where Used "Rules"

Rules are developed to be used by more than one Rule. The "Where Used" icon or menu option is used to identify rules using a specific evaluation. This allows the user to identify the impact to other evaluations and rules when changes are made to the specific rule. Highlight the rule in the Interpretation Explorer, or with the Rule open in the Editor Panel, choose "Where Used" icon or menu option.

Mew Property mponent Is st k for Deletion Cr/H4 more Deletion Mark. Cr/H4 e As	C Pangeor Shallow to Bedrock (100 to 180cm (40 to
New Property k ou Cri-K for Deletion Corl-K in Granges k in Cri-S v Ac r Cri-C Cri-K cri-S cri-C Cri-K cri-S cri-C Cri-K cri-S cri-C Cri-K cri-K cri-K cri-S cri-K cri-S cri-K cri-S cri-K cri-S cri-K cri-S cri-K cri-S cri-K cri-S cri-K cri-S cri-K cri-S cri-K cri-S cri-K c	ihallow to Bedrock 100 - 180cm
klout Ctrl+K Arrow Deletion Ctrl+M over Deletion Mark Ctrl+M over Deletion Mark Ctrl+M add Changes Ctrl+S klin Ctrl+G over Ctrl+G Ctrl+G over Deletion Mark for Deletion Ctrl+G Selected Rows for Deletion Ctrl+Strl+U Apparto Local Database Ctrl+W	
ve Deletion Mark Child C	C Pangeed Shallow to Bedrock (100 to 180cm (40 to 7
Ac	C Pangeon Shallow to Bedrock (100 to 180cm (40 to 7
P.A and Changes dic The Certification (Certification Certification (Certification Ce	C Pangaga Shallow to Bedrock (100 to 180cm (40 to 7
k In Ctrl+3 Check Out Status Ctrl+4 Check Out Status Ctrl+4	C Pangeod Shallow to Bedrock (100 to 180cm (40 to 7
Check Out, Status Crif+G	
y Ctrl+C Ctrl+X Ctrl+V a Ctrl+V b Ctrl+V c Ctrl+V Replace Ctrl+V c Ctrl+V c Ctrl+V c Ctrl+V c Ctrl+V c Ctrl+V c Ctrl+Del cSelected Rows for Deletion Alk+Shift+D Aparet Local Database Ctrl+L Where Used Ctrl+W	
Crif+X CriF+V CriF+V Crif+V Crif+R Ever Row Crif+Ins Call Crif+Cell Selected Rows for Deletion Ark+Shift+D ve Deletion Mark for Deletions Ark+Shift+D ugganet Local Darbase Crif+L Where Used Crif+W	
Corl+ X Corl+ V Corl+ V Corl+ V Corl+ R Replace Corl+ R Rev Row Corl+ Row Corl+ Row Corl+ Row Corl+ Row Corl+ Row Corl+ Row Corl+ Row Corl+ Row Corl+ V Corl+ R Corl+ V Corl+ R Corl+ V Corl+ R Corl+ V Corl+ R Corl+ Corl+	
Critery Replace Context Context Cell Selected Rows for Delators Alk+SMR+D Alk+SMR+D Alk+SMR+U Against Local (trabase ChiteL	
Replace Corl+R dew Row Corl+Ins Cal Corl+Col Selected Rows for Deletion Corl+Col Alk+Shift+D we Deletion Mark for Deleticad Rows Alk+Shift+D Where Used Corl+L Where Used Corl+L	
Replace Ctrl+R etern Row Ctrl+Ins Cal Crl+Cel Cal Crl+Cel Selected Rows for Deletin Crl+Cel Alk+Shift+D worketh Mark for Selected Rows Alk+Shift+U against Local Crl+Bases Ctrl+L Where Used Ctrl+W	
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Against Local Durabase Ctrl+L Where Used Ctrl+W	
Where Used Ctrl+W	
Find out where the Rule in the Editor is referenced.	
s Using This Rule	
Name F	Rule Site
	MLRA11_Office
	MLRA17_Office
	NSSC Data
	MLRA10_Office
	MLRA14_Office
Septic Tank (PI)	MLRA02_Office
Septic Tank Absorption Fields	NSSC Pangaea
Septic Tank Absorption Fields (DE)	MLRA13_Office
	 MLRA13_Office
Septic Tank Absorption Fields (OH) N	MLRA11_Office
	MLRA16_Office
	MLRA02_Office
	MERA02_OTHER
Septic Tanks (PI) test N	MLRA15_Office
Septic Tanks (PI) test MO15: SEPTIC TANK ABSORPTION FIELDS M	
Septic Tanks (PI) test M MO15: SEPTIC TANK ABSORPTION FIELDS M NG - Septic Tank Absorption Fields M	MLRA15_Office MLRA10_Office
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Septic Tank (PI) N Septic Tank Absorption Fields	MLRA02_Office NSSC Pangaea

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Summary

The figure below illustrates that sub rules focus on one limiting feature and must link to at least one evaluation. Sub Rules say nothing about the land use. Therefore, they can be used in different interpretations. Sub Rules are aggregated into an interpretation and are considered the basis, or building blocks, of an interpretation. An evaluation is the relationship between a soil property's value and its relative truthfulness of being a limiting feature.



Relationships Among Interpretive Criteria