

## Query Sample Purpose

The purpose of this sample is to discuss the attributes related to fuzzy logic soil interpretations, and how those attributes are related to one another, and to illustrate the typical kinds of queries that one might want to make in regards to fuzzy logic soil interpretations. For additional background on fuzzy logic soil interpretations, please see the section titled "Fuzzy Logic Soil Interpretations" in the Soil Data Mart Query Guide at:

<http://sdmdataaccess.nrcs.usda.gov/QueryHelp.aspx>

## Important Concepts

It is important to remember that which fuzzy logic soil interpretations are included with the other soil data for a survey area is determined only when a new version of the tabular data for the corresponding survey area is created. In other words, which fuzzy logic soil interpretations are available in the Soil Data Mart database varies over time. There are two important ramifications of this fact:

1. The exact same set of fuzzy logic soil interpretations will be available for every map unit component in a given survey area. While this is true, for a given fuzzy logic soil interpretation, not every map unit component in a given survey area may have been able to be rated, due to insufficient data. When this occurs, data for that fuzzy logic soil interpretation for that map unit component will still exist, but the corresponding rating class name will be "Not rated", or some other phrase corresponding to "not rated".
2. For an area of interest that spans more than one survey area, there is no guarantee that the same set of fuzzy logic soil interpretations will be available for all map unit components in that area of interest.

The Soil Survey Division does have guidelines stating that all national military fuzzy logic soil interpretations and all national Department of Homeland Security fuzzy logic soil interpretations should be included with the data for any survey area, but this is not currently strictly enforced.

Another thing to be aware of is that there are national fuzzy logic soil interpretations and state specific fuzzy logic soil interpretations, and for any particular fuzzy logic soil interpretation, both a national and one or more state specific versions may exist. A national fuzzy logic soil interpretation may have no state specific counterparts. Conversely, a state may have developed a state specific fuzzy logic soil interpretation that has no national counterpart.

A national fuzzy logic soil interpretation is designed to not take any state specific criteria into account when coming up with a rating for a particular use. National fuzzy logic soil interpretations provide a way to compare apples to apples for any two geographic regions, no matter how widely separated.

A soil data steward in a state may decide to create a state specific fuzzy logic soil interpretation for a couple of reasons.

1. There may be certain potential land uses in that state that aren't applicable nationwide.

2. For a given land use, state or local statutes may require explicit rating criteria that aren't applicable nationwide.
3. For some other reason, a soil data steward in a state may decide that the criteria used in the national version of a particular fuzzy logic soil interpretation isn't entirely appropriate in deriving a rating for that particular land use in their state.

Some states include both the national and state specific version of a given fuzzy logic soil interpretation and some states include the state specific version of a given fuzzy logic soil interpretation in lieu of the national version.

How can you distinguish a national fuzzy logic soil interpretation from a state specific fuzzy logic soil interpretation? A state specific fuzzy logic soil interpretation has the corresponding state postal code, in parenthesis, appended to soil interpretation name, e.g. "ENG - Septic Tank Absorption Fields (TX)".

A state specific fuzzy logic soil interpretation is considered to be a state specific counterpart to a national fuzzy logic soil interpretation when base soil interpretation names, i.e. the soil interpretation names minus any appended state reference, match verbatim.

How can you determine if there is a state specific counterpart to a national fuzzy logic soil interpretation, and vice versa? You could submit a query that returns the distinct set of fuzzy logic soil interpretation names in the Soil Data Mart database that begin with a particular substring, and the results of such a query will confirm whether or not both a national and state specific version exists. But keep in mind that which fuzzy logic soil interpretations are available in the Soil Data Mart database varies over time. Just because there isn't a counterpart at any given point in time doesn't mean that there never will be.

## Sample Query Syntax

There are a number of potential queries one might want to make in regards to fuzzy logic soil interpretations. All of the sample queries below pertain to an area of interest that is defined by a set of map unit keys. In general, you should avoid returning data for one or more fuzzy logic soil interpretations for the entire database, and if and when there is a legitimate reason for doing so, you should probably return data for only one fuzzy logic soil interpretation at a time. For a single fuzzy logic soil interpretation that is available for every survey area in the Soil Data Mart database, the volume of data for that soil interpretation would be very large, due to the fact that the query returns not only multiple attributes for a given fuzzy logic soil interpretation, but multiple records too.

Always keep in mind that for an area of interest that spans more than one survey area, any given fuzzy logic soil interpretation that is available for that area of interest may not be available for all map unit components in that area of interest. The reason for this is explained in the section titled "Important Concepts".

***Sample 1 - Return a list of all fuzzy logical soil interpretations that are available for an area of interest.***

The following query returns a list of all fuzzy logic soil interpretation that are available for any of the map unit components for the SSURGO map units in a small area of interest that spans Curry County Oregon and Del Norte County California. Keep in mind that for any particular fuzzy logic soil interpretation returned by this query, that fuzzy logic soil interpretation may not be available for all map unit components of all map units in that area of interest.

```
--Sample query begins...
--Note that a pair of dashes denotes the beginning of a comment.
SELECT DISTINCT
mrulename -- fuzzy logic soil interpretation name

FROM mapunit mu
  INNER JOIN component c ON c.mukey = mu.mukey
  AND mu.mukey IN
('65021', '65025', '65027', '65118', '470302', '470303', '470304', '470305')
  INNER JOIN cointerp ci ON ci.cokey = c.cokey

ORDER BY mrulename
--Sample query ends.
```

***Sample 2 - Determine if a specific fuzzy logic soil interpretation is available for an area of interest.***

The following query determines if the fuzzy logic soil interpretation named "ENG - Construction Materials; Roadfill" is available for any of the map unit components of the SSURGO map units in a small area of interest that spans Curry County Oregon and Del Norte County California. Keep in mind that just because a fuzzy logic soil interpretation is available for some map unit components of some map units in an area of interest doesn't mean that it is available for all map unit components of all map units in an area of interest.

```
--Sample query begins...
--Note that a pair of dashes denotes the beginning of a comment.
SELECT count(*) AS countofrecordsincointerp

FROM mapunit mu
  INNER JOIN component c ON c.mukey = mu.mukey
  AND mu.mukey IN
('65021', '65025', '65027', '65118', '470302', '470303', '470304', '470305')
  INNER JOIN cointerp ci ON ci.cokey = c.cokey

WHERE mrulename = 'ENG - Construction Materials; Roadfill'
--Sample query ends.
```

For the sample query above, if the value of "countofrecordsincointerp" is anything other than zero, the fuzzy logic soil interpretation in question is available for at least some map unit components in the corresponding area of interest.

### ***Sample 3 - Determine which versions of a specific fuzzy logic soil interpretation are available for an area of interest.***

The following query determines which versions of the fuzzy logic soil interpretation "ENG - Construction Materials; Gravel Source" are available for any of the map unit components of the SSURGO map units in a small area of interest that spans Curry County Oregon and Del Norte County California.

```
--Sample query begins...
--Note that a pair of dashes denotes the beginning of a comment.
SELECT DISTINCT
mrulename -- fuzzy logic soil interpretation name

FROM mapunit mu
  INNER JOIN component c ON c.mukey = mu.mukey
  AND mu.mukey IN
('65021','65025','65027','65118','470302','470303','470304','470305')
  INNER JOIN cointerp ci ON ci.cokey = c.cokey

WHERE mrulename LIKE 'ENG - Construction Materials; Gravel Source%'

ORDER BY mrulename
--Sample query ends.
```

In the sample query above, 'ENG - Construction Materials; Gravel Source' corresponds to a fuzzy logic soil interpretation name without any appended state reference, i.e. "ENG - Construction Materials; Gravel Source" rather than "ENG - Construction Materials; Gravel Source (CA)". The percent sign in the literal 'ENG - Construction Materials; Gravel Source%' is a wildcard character that corresponds to "any sequence of characters of any length". By using the LIKE operator with a string terminated by "%", the query will return every fuzzy logic soil interpretation whose name begins with "ENG - Construction Materials; Gravel Source".

By "which versions" we mean, for a given base fuzzy logic soil interpretation name, for the area of interest in question, does a national version of that soil interpretation exist, and which state specific versions of that soil interpretation exist, if any. For a discussion of national soil interpretations versus state specific soil interpretations, please see the section titled "Important Concepts".

### ***Sample 4 - Return data for all fuzzy logic soil interpretations that are available for an area of interest.***

The following query returns data for all fuzzy logic soil interpretation that are available for any of the map unit components for the SSURGO map units in a small area of interest that spans Curry County Oregon and Del Norte County California. Keep in mind that for any particular fuzzy logic soil interpretation returned by this query, that fuzzy logic soil interpretation may not be available for all map unit components of all map units in that area of interest.

```
--Sample query begins...
--Note that a pair of dashes denotes the beginning of a comment.
SELECT
saversion, saverest, -- attributes from table "sacatalog"
l.areasymbol, l.areaname, l.lkey, -- attributes from table "legend"
musym, muname, museq, mu.mukey, -- attributes from table "mapunit"
compct_r, compname, localphase, slope_r, c.cokey, -- attributes from
table "component"
mrulename, ruledesign, ruledepth, ci.seqnum, interphr, interphrc --
attributes from table "cointerp"

FROM sacatalog sac
  INNER JOIN legend l ON l.areasymbol = sac.areasymbol
  INNER JOIN mapunit mu ON mu.lkey = l.lkey
  AND mu.mukey IN
('65021', '65025', '65027', '65118', '470302', '470303', '470304', '470305')
  LEFT OUTER JOIN component c ON c.mukey = mu.mukey
  LEFT OUTER JOIN cointerp ci ON ci.cokey = c.cokey

--WHERE...

--ORDER BY l.areaname, museq, compct_r DESC, compname, c.cokey,
mrulename, ci.seqnum -- standard soil interpretation report ordering
--Sample query ends.
```

### ***Sample 5 - Return data for selected fuzzy logic soil interpretations that are available for an area of interest.***

The following query returns data for selected fuzzy logic soil interpretation that are available for any of the map unit components for the SSURGO map units in a small area of interest that spans Curry County Oregon and Del Norte County California. Keep in mind that for any particular fuzzy logic soil interpretation returned by this query, that fuzzy logic soil interpretation may not be available for all map unit components of all map units in that area of interest.

```
--Sample query begins...
```

```
--Note that a pair of dashes denotes the beginning of a comment.
SELECT
saversion, saverest, -- attributes from table "sacatalog"
l.areasymbol, l.areaname, l.lkey, -- attributes from table "legend"
musym, muname, museq, mu.mukey, -- attributes from table "mapunit"
compct_r, compname, localphase, slope_r, c.cokey, -- attributes from
table "component"
mrulename, ruledesign, ruledepth, ci.seqnum, interphr, interphrc --
attributes from table "cointerp"

FROM sacatalog sac
  INNER JOIN legend l ON l.areasymbol = sac.areasymbol AND l.areatypename
= 'Non-MLRA Soil Survey Area'
  INNER JOIN mapunit mu ON mu.lkey = l.lkey
  AND mu.mukey IN
('65021', '65025', '65027', '65118', '470302', '470303', '470304', '470305')
  LEFT OUTER JOIN component c ON c.mukey = mu.mukey
  LEFT OUTER JOIN cointerp ci ON ci.cokey = c.cokey

WHERE mrulename IN (
'AWM - Manure and Food Processing Waste',
'ENG - Sanitary Landfill (Area) (CA)'
)
OR mrulename LIKE 'ENG - Construction Materials; Topsoil%'
OR mrulename LIKE 'ENG - Construction Materials; Sand Source%'

--ORDER BY l.areaname, museq, compct_r DESC, compname, c.cokey,
mrulename, ci.seqnum -- standard soil interpretation report ordering
--Sample query ends.
```

For the fuzzy logic soil interpretation names in the In clause of the Where clause above, this query will return results only when it finds a match on those soil interpretation names, verbatim. For the fuzzy logic soil interpretation names following the LIKE operator in the Where clause above, this query will return results for any national or state specific version of those fuzzy logic soil interpretations.

## Working with the Attributes and Records that Characterize a Fuzzy Logic Soil Interpretation Result

As discussed in the Soil Data Mart Query Guide, a fuzzy logic soil interpretation result doesn't correspond to a single attribute; it corresponds to multiple attributes in multiple records in the table named "cointerp". When displaying a fuzzy logic soil interpretation result, only a subset of those attributes is typically displayed.

## ***Fuzzy Logic Soil Interpretation Related Attributes***

Here are the attributes in table "cointerp" of primary interest to most end-users:

### **cokey**

This is the primary key of the corresponding map unit component. At the current time, fuzzy logic soil interpretations are only available for map unit components. Nothing actually excludes the possibility of eventually providing fuzzy logic soil interpretations for map units or soil horizons or layers.

### **mrulename**

This is the name of the corresponding fuzzy logic soil interpretation. In the information system where fuzzy logic soil interpretations are generated, a fuzzy logic soil interpretation is referred to as a "rule". The term "mrulename" corresponds to "main rule name", which is another term for a top level fuzzy logic soil interpretation, as opposed to a sub-interpretation.

### **ruledesign**

This is an integer value that indicates if the corresponding fuzzy logic soil interpretation is a limitation interpretation (ruledesign = 1), a suitability interpretation (ruledesign = 2) or a "class" interpretation (ruledesign = 3). We haven't discussed class fuzzy logic soil interpretations up to this point. A class interpretation does not determine if a soil is unsuitable or suitable for a particular use; a class interpretation assigns a soil to a specific class, where one class isn't considered to be any better or worse than any other class. Conservation Tree Shrub Group is an example of a class fuzzy logic soil interpretation. For a class fuzzy logic soil interpretation, only the overall final rating class name is typically displayed. In other words, for a class fuzzy logic soil interpretation, no results are typically displayed for any sub-interpretation.

### **ruledepth**

This is an integer value that distinguishes between top level interpretations (cointerp.ruledepth = 0) and sub-interpretations (cointerp.ruledepth = 1). For a given fuzzy logic soil interpretation result, there will be only one record where cointerp.ruledepth = 0. For a given fuzzy logic soil interpretation result where corresponding soil was found to be fully suitable for the corresponding use, there will be no records where cointerp.ruledepth = 1. For a given fuzzy logic soil interpretation where the corresponding soil was found to be anything less than fully suitable for the corresponding use, there will be anywhere from one to five records where cointerp.ruledepth = 1. Only the five most "significant" sub-interpretation results are ever returned.

## **seqnum**

This number logically sequences the results of a fuzzy logic soil interpretation based on an ascending sort on `cointerp.cokey`, `cointerp.mrulename`, `cointerp.ruledepth`, and a sort on `cointerp.interphr` that takes into account if the corresponding fuzzy logic soil interpretation is a limitation interpretation or a suitability interpretation. This sort results in the main interpretation result occurring before the sub-interpretation results, if any, and orders the sub-interpretation results by "significance".

For a limitation interpretation, the sub-interpretation results, if any, are sorted in descending order on `cointerp.interphr`. The closer to one, the more unsuited that soil is for the corresponding use. For a suitability interpretation, the sub-interpretation results, if any, are sorted in ascending order on `cointerp.interphr`. The closer to zero, the more unsuited that soil is for the corresponding use. Therefore "significance" always corresponds to the degree to which a soil is unsuitable for a particular use.

## **interpll, interpllc**

"`cointerp.interpll`" records the fuzzy logic rating value, and "`cointerp.interpllc`" records the corresponding rating class name. A fuzzy logic rating value is a floating point value in the range zero to one. A rating class name may contain up to 254 characters, although the vast majority of rating class names are relatively short. For a limitation interpretation, this pair of values corresponds to the most optimistic result. For a suitability interpretation, this pair of values corresponds to the most pessimistic result.

## **interplr, interplrc**

"`cointerp.interplr`" records the fuzzy logic rating value, and "`cointerp.interplrc`" records the corresponding rating class name. A fuzzy logic rating value is a floating point value in the range zero to one. A rating class name may contain up to 254 characters, although the vast majority of rating class names are relatively short. For a limitation interpretation, this pair of values corresponds to the moderately optimistic result. For a suitability interpretation, this pair of values corresponds to the moderately pessimistic result.

## **interphr, interphrc**

"`cointerp.interphr`" records the fuzzy logic rating value, and "`cointerp.interphrc`" records the corresponding rating class name. A fuzzy logic rating value is a floating point value in the range zero to one. A rating class name may contain up to 254 characters, although the vast majority of rating class names are relatively short. For a limitation interpretation, this pair of values corresponds to the moderately pessimistic result. For a suitability interpretation, this pair of values corresponds to the moderately optimistic result.



## **interphh, interphrc**

"cointerp.interpll" records the fuzzy logic rating value, and "cointerp.interpllc" records the corresponding rating class name. A fuzzy logic rating value is a floating point value in the range zero to one. A rating class name may contain up to 254 characters, although the vast majority of rating class names are relatively short. For a limitation interpretation, this pair of values corresponds to the most pessimistic result. For a suitability interpretation, this pair of values corresponds to the most optimistic result.

## ***Which of these attributes are displayed in a traditional soil interpretation report?***

In any traditional soil interpretation report available from the Soil Data Mart website, the Web Soil Survey website or an MS Access SSURGO Template Database, only the following fuzzy logic soil interpretation related attributes are displayed.

For the top level fuzzy logic soil interpretation result, cointerp.interphrc is displayed. I don't know why we display the rating class name but not the rating value for the overall or top level result.

For each sub-interpretation result, both cointerp.interphrc (rating class name) and cointerp.interphr (rating value) are displayed, in order of "significance".

Below is a sample from a traditional soil interpretation report:

### Dwellings and Small Commercial Buildings

Hall County, Nebraska

Map symbol and soil name	Pct. of map unit	Dwellings without basements		Dwellings with basements		Small commercial buildings	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
1689:							
O'Neill	35	Not limited		Not limited		Not limited	
Pivot, loamy surface	15	Not limited		Not limited		Not limited	
1678:							
Bolent, occasionally flooded	85	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
		Depth to saturated zone	0.07	Depth to saturated zone	1.00	Depth to saturated zone	0.07
1680:							
Bolent, occasionally flooded	85	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
		Depth to saturated zone	0.07	Depth to saturated zone	1.00	Depth to saturated zone	0.07
1688:							
Bolent, occasionally flooded	90	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
		Depth to saturated zone	0.07	Depth to saturated zone	1.00	Depth to saturated zone	0.07
1704:							
Bolent, occasionally flooded	85	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
		Depth to saturated zone	0.07	Depth to saturated zone	1.00	Depth to saturated zone	0.07
Calamus, rarely flooded	30	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
				Depth to saturated zone	0.35		
1796:							
Brocksburg	85	Not limited		Not limited		Not limited	
1930:							
Butler	94	Very limited		Very limited		Very limited	
		Depth to saturated zone	1.00	Depth to saturated zone	1.00	Depth to saturated zone	1.00
		Shrink-swell	1.00	Shrink-swell	0.50	Shrink-swell	1.00

In a traditional soil interpretation report, these values are displayed *for both limitation and suitability fuzzy logic soil interpretations*, which is counter to what I actually recommended in the Soil Data Mart Query Guide.

This means that in a traditional soil interpretation report, for a limitation interpretation we are displaying the moderately pessimistic result, but for a suitability interpretation we are displaying the moderately optimistic result. I had recommended displaying the moderately pessimistic result in both cases, but this would require displaying `cointerp.interphr` and `cointerp.interphrc` for a limitation interpretation, and displaying `cointerp.interplr` and `cointerp.interplrc` for a suitability interpretation.

The advantage of always displaying `cointerp.interphr` and `cointerp.interphrc` is that by leveraging the existing sort already reflected in `cointerp.seqnum`, you don't have to worry about having one set of logic for limitation interpretations and another set of logic for suitability interpretations. In other words, to take advantage of the existing sort already reflected in `cointerp.seqnum`, the records in table "cointerp" should be explicitly sorted on `cointerp.cokey` ascending, `cointerp.mrulename` ascending, `cointerp.ruledepth` descending and `cointerp.seqnum` ascending. This works because the sequence in `cointerp.seqnum` already takes into account the difference between how sub-interpretation results should be sorted differently between limitation and suitability interpretations.

If you want to display the moderately pessimistic result for both limitation and suitability interpretations, not only are you going to have to display one set of attributes in one case and a different set of attribute in the other case, for suitability interpretations you won't be able to leverage the sort already reflected in `cointerp.seqnum`. For any suitability interpretation, you would need to explicitly sort records in table "cointerp" on `cointerp.cokey` ascending, `cointerp.mrulename` ascending, `cointerp.ruledepth` descending and `cointerp.interplr` descending.