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Date: April 2, 2007

Title: **Update to TPA input parameters for hydrostratigraphic unit thicknesses in the UZFT module**

Objectives: Perform work related to assist in selecting hydrostratigraphic unit thicknesses and other supporting work for the TPA input parameter

Project: This work was performed to support IM 06002.01.232.720.

Data: Data used in this work includes the GFM3.1 (CRWMS M&O, 2000) and the MM3.0 (CRWMS M&O, 2002).

Codes: Maps and related Geographic Information System data were generated and plotted by the software ArcInfo Workstation Version 8.0.2 (Environmental Systems Research Institute, 2000) and ArcGIS® Desktop 9.0 (Environmental Systems Research Institute, 2004) which are commercially available software that are maintained in accordance with CNWRA Technical Operating Procedure TOP-018. Information from the three-dimensional geologic and mineralogic models was obtained using EarthVision Version 7.5 (Dynamic Graphics, 2002), also under control at the CNWRA.

In order to obtain information from the pre-existing EarthVision models, staff must have training and/or experience with EarthVision modeling, Geographic Information System (GIS) software, and development and application of shellscripts. Staff should have experience in converting files from standard GIS formats to EarthVision formats, and vice-versa.

Attachment: CD-ROM

References:

CRWMS M&O. "Geologic Framework Model (GFM3.1)." MDL-NBS-GS-000002 Rev. 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. 2000.

CRWMS M&O. "Mineralogic Model (MM3.0) Analysis and Model Report." MDL–NBS–GS– 000003. Rev. 01 ICN 02. Las Vegas, Nevada: CRWMS M&O. 2002.

Entry 1:

Zeolitic distribution data between drift locations and the water table was obtained from the Mineralogic Model (MM) 3.0 to assist in the development of TPA input parameters describing the thickness of hydrostratigraphic units. For units all units except CH and CHnv, data was obtained at 5 points (4 polygon nodes plus a center point) per TPA subarea, and from those points average values were obtained, to use as representative constant unit thicknesses in the TPA input parameters. For Calico Hills vitric units, points were obtained at 200 feet grid node locations of the MM3.0.

Previous estimates of unsaturated zone (UZ) hydrogeologic unit thicknesses are based on earlier versions of TPA subarea coordinates. Corresponding to the new delineation of repository subareas with TPA 5.1, representative unit thicknesses within each subarea are updated.

Topopah Spring, Calico Hills, Prow Pass, Upper Crater Flat, Bullfrog, and Unsatured Fault Zone representative thicknesses

Representative constant thicknesses for the Topopah Spring, Calico Hills, Prow Pass, Upper Crater Flat, Bullfrog, and Unsatured Fault Zone were estimated using the thicknesses from the GFM3.1 model at 5 points per subarea—four polygon nodes plus a center point, and averaging those values. Results are shown in Tables 1 and 2. Visual inspection of the thicknesses of these units in EarthVision indicated that the five-point approach is sufficient to estimate the thicknesses of these units.

Table 1. Subarea center points for thickness and zeolitic distribution calculations. Data are in UTM, NAD27.

Subarea	Easting	Northing
1	558269	769545
2	559078	770294
3	562306	773457
4	560920	770309
5	563232	771121
6	558346	766614
7	559354	766811
8	560970	767420
9	560548	764605
10	560477	762164

Table 2. Unit thicknesses for each subarea.

Unit	Layer Name and Properties	Subarea Thickness [m]									
		1	2	3	4	5	6	7	8	9	10
TSw	Topopah Spring (welded)	52.9	72.4	71.3	111.3	174.3	67.7	111.3	170.2	140.3	120.3
CHn	Calico Hills* (welded)	108.0	125.8	177.1	149.3	144.6	88.9	100.6	119.2	104.1	99.0
PPw	Prow Pass (welded)	43.1	37.1	11.8	12.1	0	47.7	45.8	25.6	46.2	56.4
UCF	Upper Crater Flat (nonwelded)	44.8	19.6	5.0	10.0	0	52.3	30.9	5.3	33.4	52.0
BFw	Bullfrog (welded)	4.6	0	0	0	0	25.0	5.8	0	10.8	27.1
UFZ	Unsaturated Fault Zone	0	0	0	0	0	0	0	0	0	0

Calico Hills Vitric Thickness

Unlike other thicknesses, the five point method was questionable for the thickness of the Calico Hills nonwelded vitric subunits because there is a high degree of lateral variability in zeolitic concentrations within each of the Calico Hills subunits. Because of this high lateral variability, we used an approach that provide more data than five points per subarea, as described in this section.

An EarthVision polygon file was created by copying the new TPA subarea coordinates from the TPA source code. These polygon data had a UTM, NAD27 projection and were reprojected to State Plane, NAD27 coordinates using ArcInfo 8.0.2, in order to use the polygon data with the EarthVision Geologic Framework Model and Mineralogic Model developed by the DOE, which requires the same coordinate system and projection.

Mineralogic data files were processed from the MM 3.0 data files into new files that contained only easting, northing, and weight percent zeolite values on each sample line. The output files include:

Tac1.dat
Tac2.dat
Tac3.dat
Tac4.dat
Tacbt.dat
Tcpuv.dat
Tptpv1bt1.dat
Tptpv2.dat

The shellscript 02_getinputpts.sh was written to clip the grid coordinates from one of those files (Tac1.dat) to the coordinates within the TPA subarea polygons, developing a list of easting and northing coordinates for which Calico Hills vitric thickness would be obtained. The shellscript also removed comment lines from the file. A well path file (wellpath_all.dat) was created from this list of easting and northing coordinates. These "virtual wells" were written to pass through the entire model elevation range (6000 to 0 feet). Information on the stratigraphy and fault elevations along those well paths was obtained by running the user-modified shell script 03_path.sh, which in turn ran an EarthVision well structure query. The output file from this script, tops.dat, was processed to isolate the top and bottom elevation of each subunit within the Calico Hills unit using the shell script 05_gettopsbottoms.sh. The output file (topsbottoms.dat) was imported into Excel (finalcals.xls), where further cacluations were performed. Specifically, the thickness of each unit, bounded by the drift elevations and water table elevations, was calculated. Possibile layer arrangements and corresponding thickness calculations are shown in Table 3.

Table 3. Calculation used to truncate each Calico Hills subunit by the drift and water table elevations.

top location	**bottom location**	**calculation**
above drift	above drift	h=0
above drift	above water table, below drift	h=d-b
above water table, below drift	above water table, below drift	h=t-b
above drift	below water table	h=d-w
above water table, below drift	below water table	h=t-w
below water table	below water table	h=0

t=elevation of top of layer
b=elevation of bottom of layer
d=elevation of drift
w=elevation of water table
h=thickness of layer between drift and water table

Weight percent zeolite at each grid node, for each Calico Hills subunit, was imported into the same Excel file. Whereever a subunit contained a weight percent zeolite concentration of 15% or more, the entire thickness of that subunit was considered zeolitic. Whereever a unit contained a weight percent zeolite concentration of less than 15%, the entire thickness of the subunit was considered vitric. The thicknesses of vitric material was summed over all subunits to obtain an overall virtic thickness for the Calico Hills unit at each grid node. Zeolite thickness, then, was calculated as the Calico Hills unit thickness minus the Calico Hills virtric thickness.

Results of zeolite thicknesses are shown in Figure 1. In addition to the zeolite thickness data, borehole source data locations (CRWMS M&O, 2002) and TPA subarea polygons are shown for reference. This figure was created with ArcMap, and the file is map.mxd.

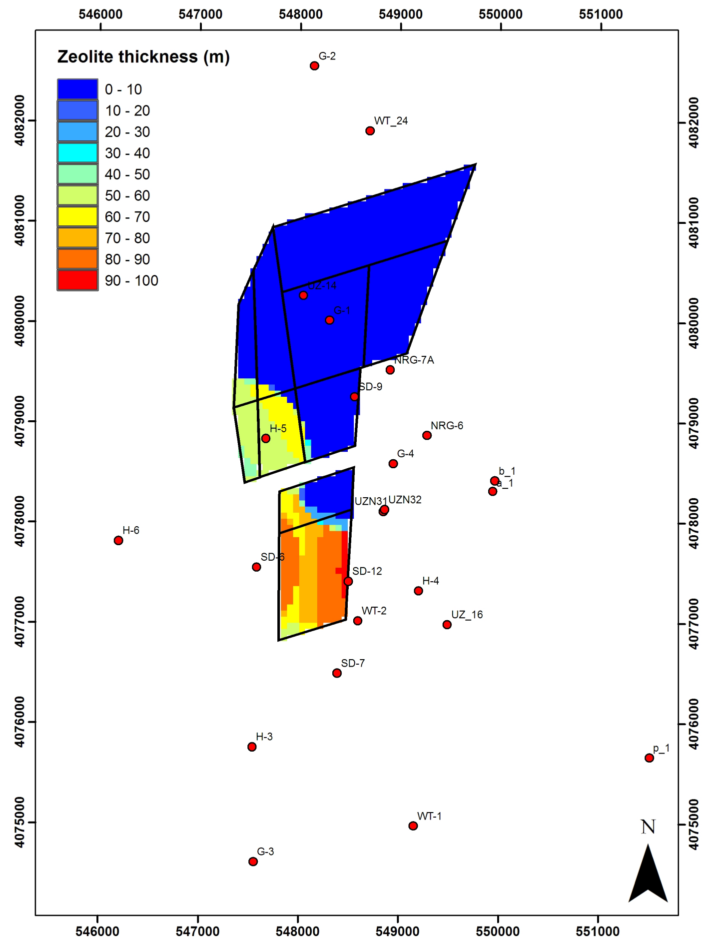
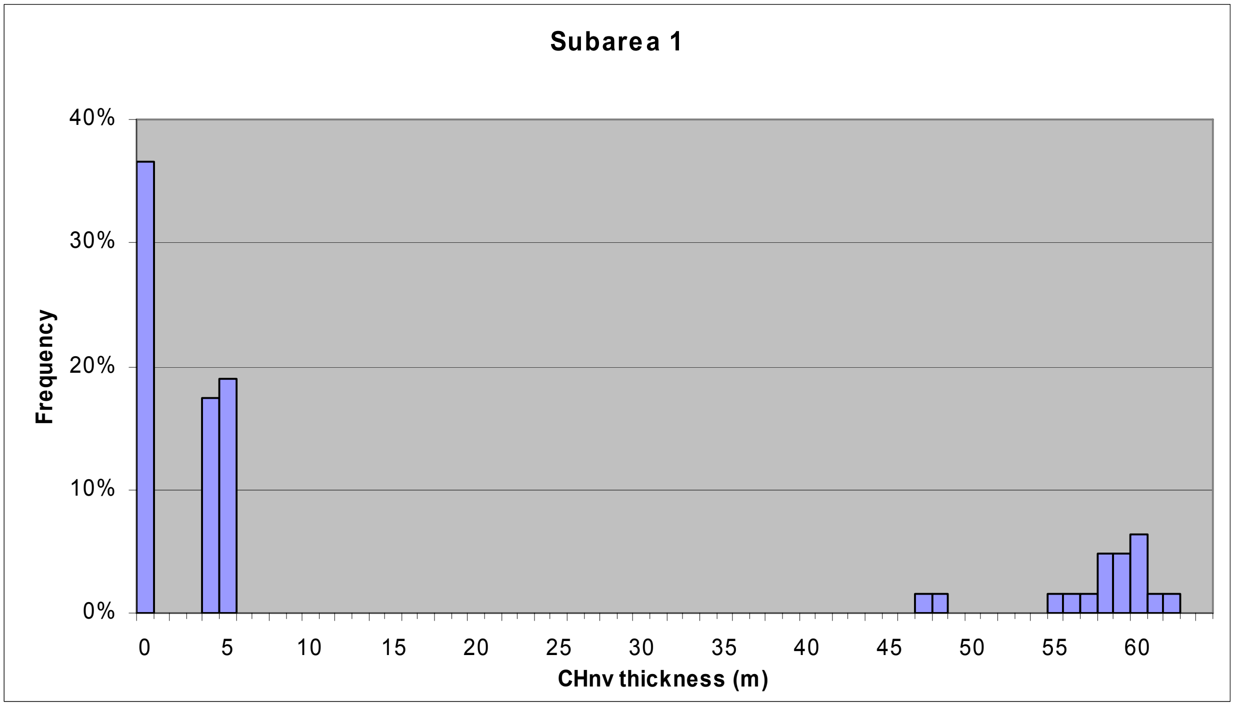
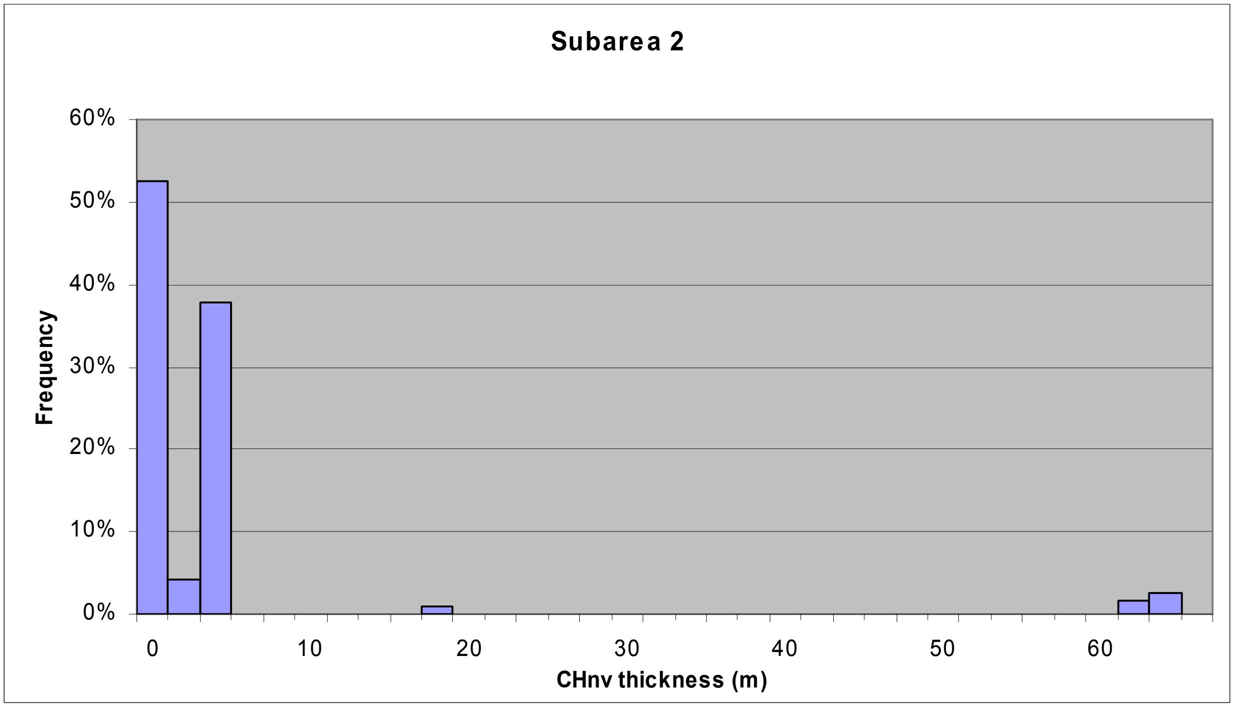
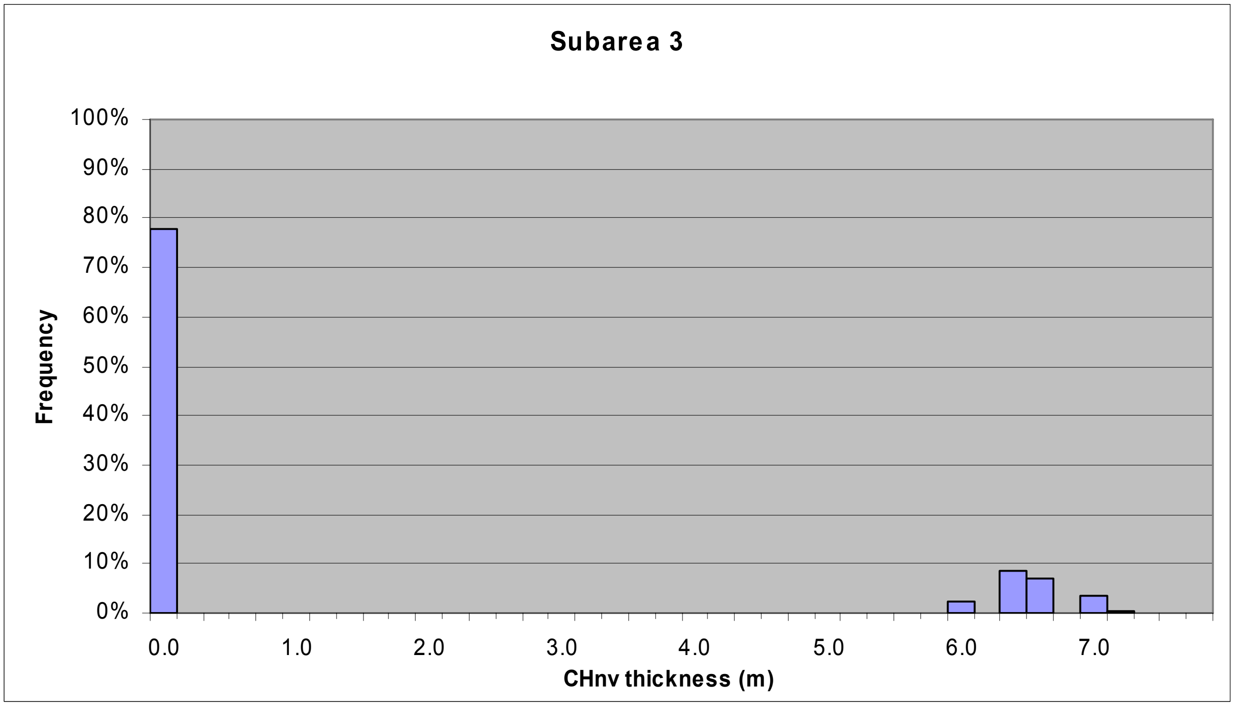


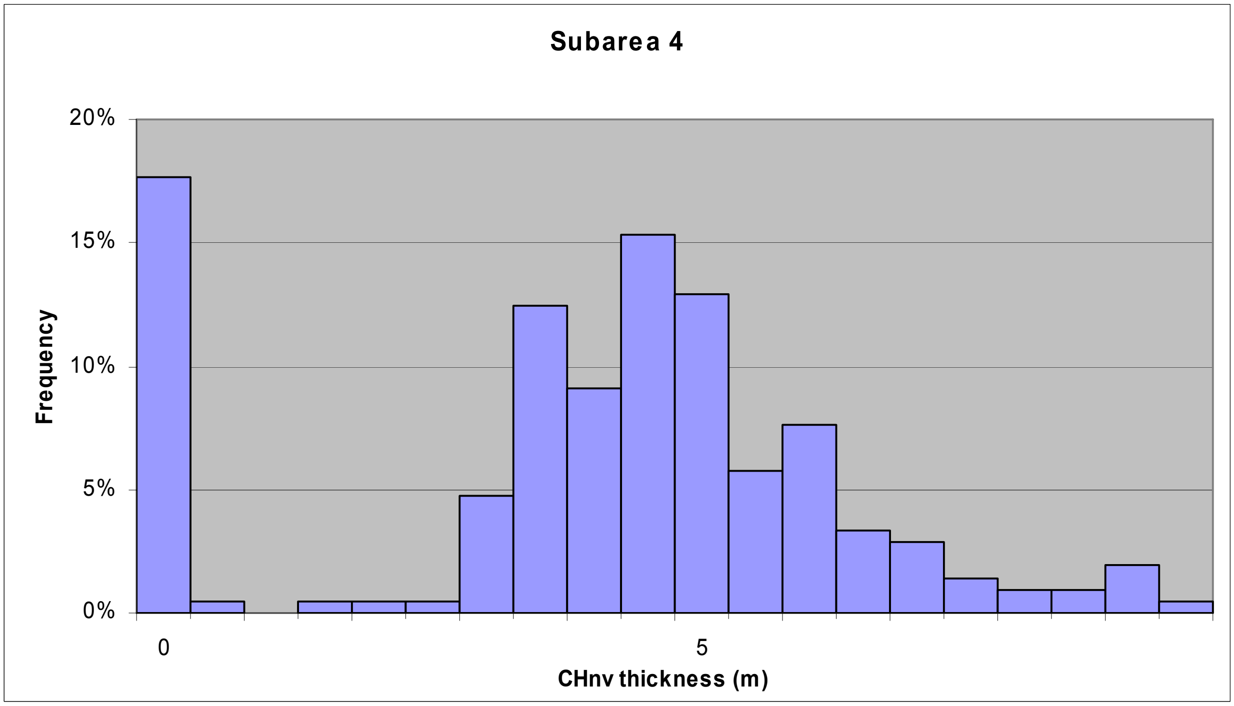
Figure 1. Map of zeolite thicknesses in TPA subareas based on MM3.0. Projection is UTM, NAD 27. Units are meters.

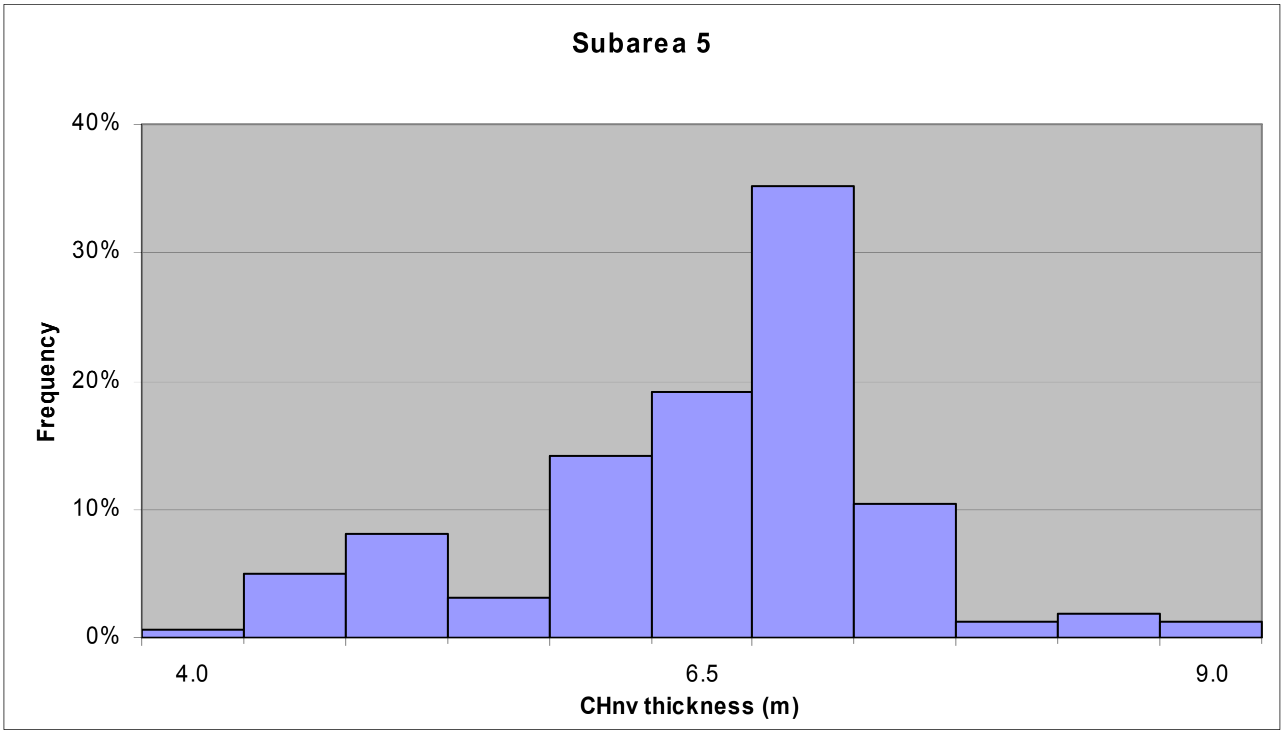
Next, histograms of zeolite thickness were developed for each subarea using Excel. The histograms are contained in the Excel file CHnv_thicknesses.xls, and are shown in Figure 2.

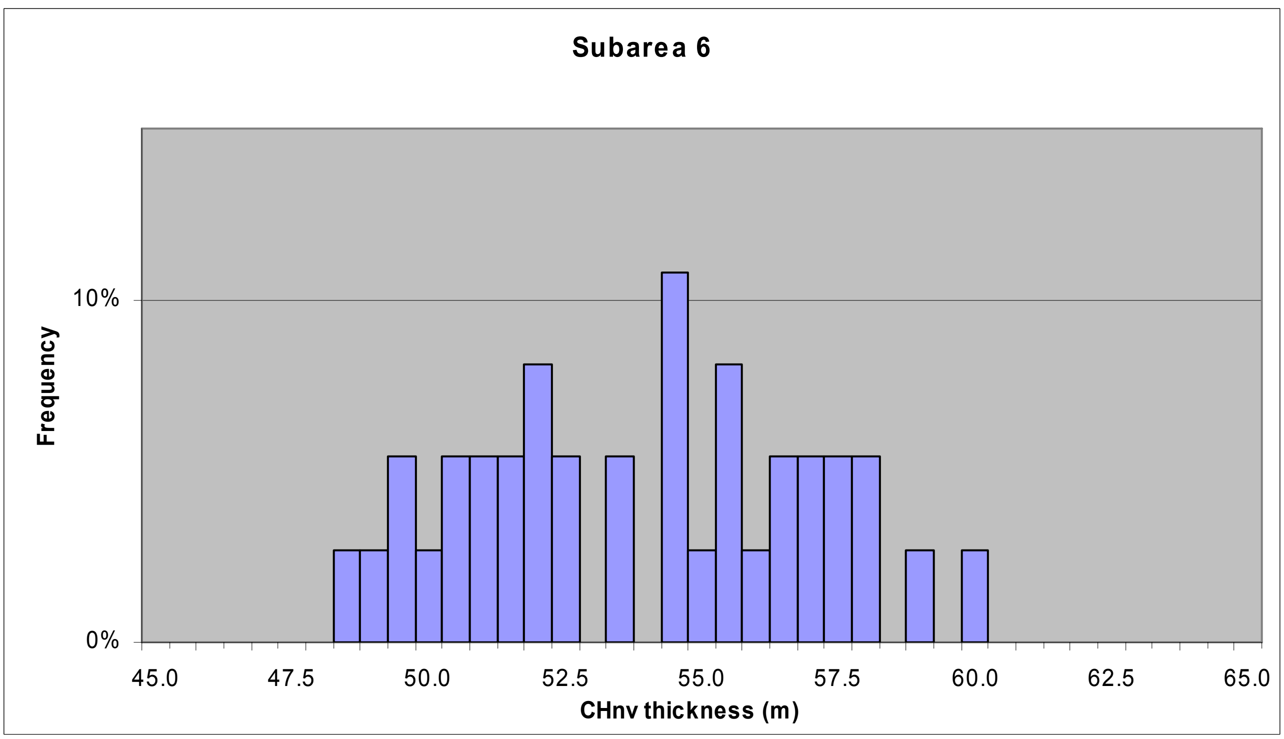

Subarea 1
40%
30%
20%
10%
0%
Frequency
0
5
10
15
20
25
30
35
40
45
50
55
60
CHnv thickness (m)

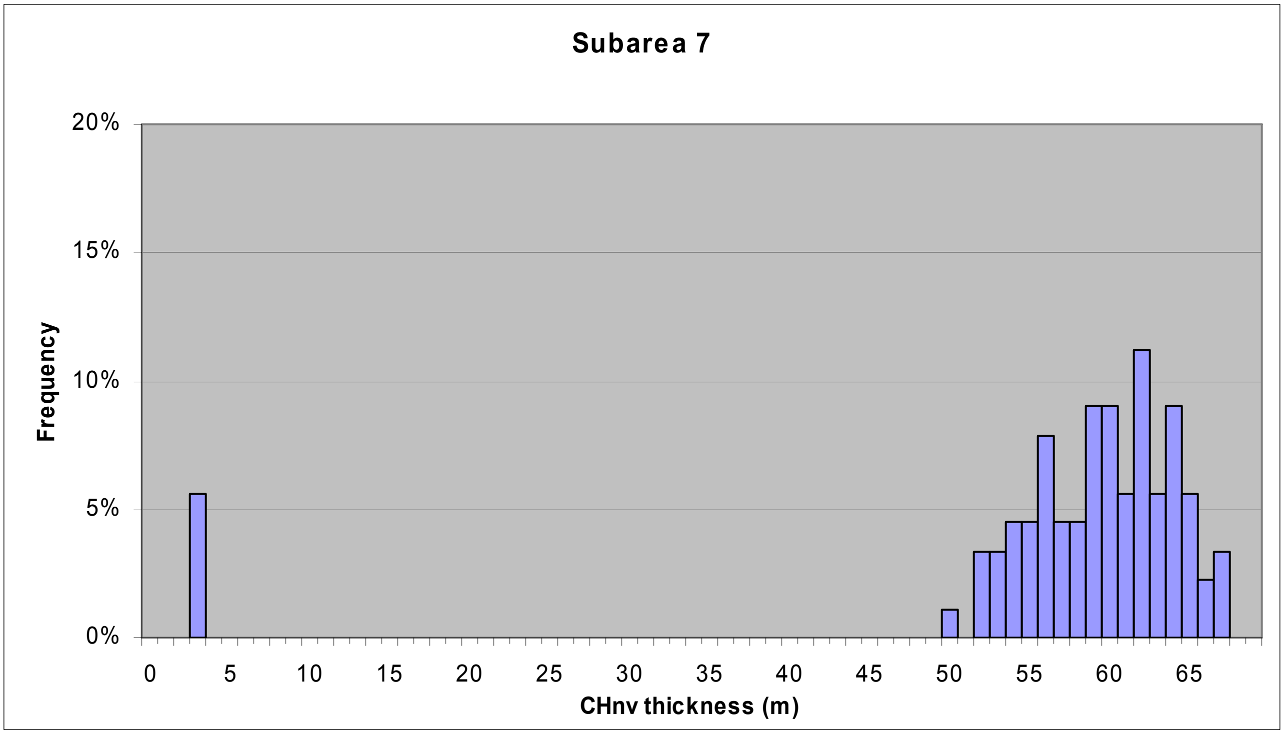

Subarea 2
60%
50%
40%
30%
20%
10%
0%
Frequency
0
10
20
30
40
50
60
CHnv thickness (m)

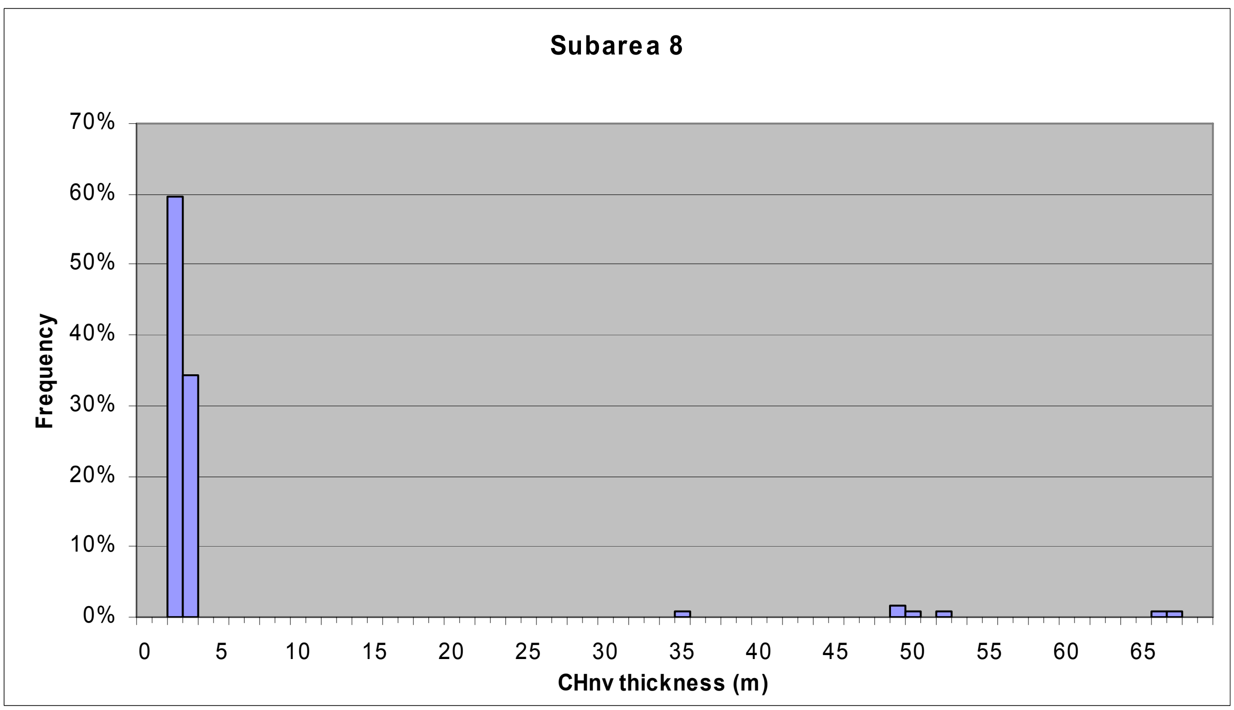

Subarea 3
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Frequency
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
CHnv thickness (m)

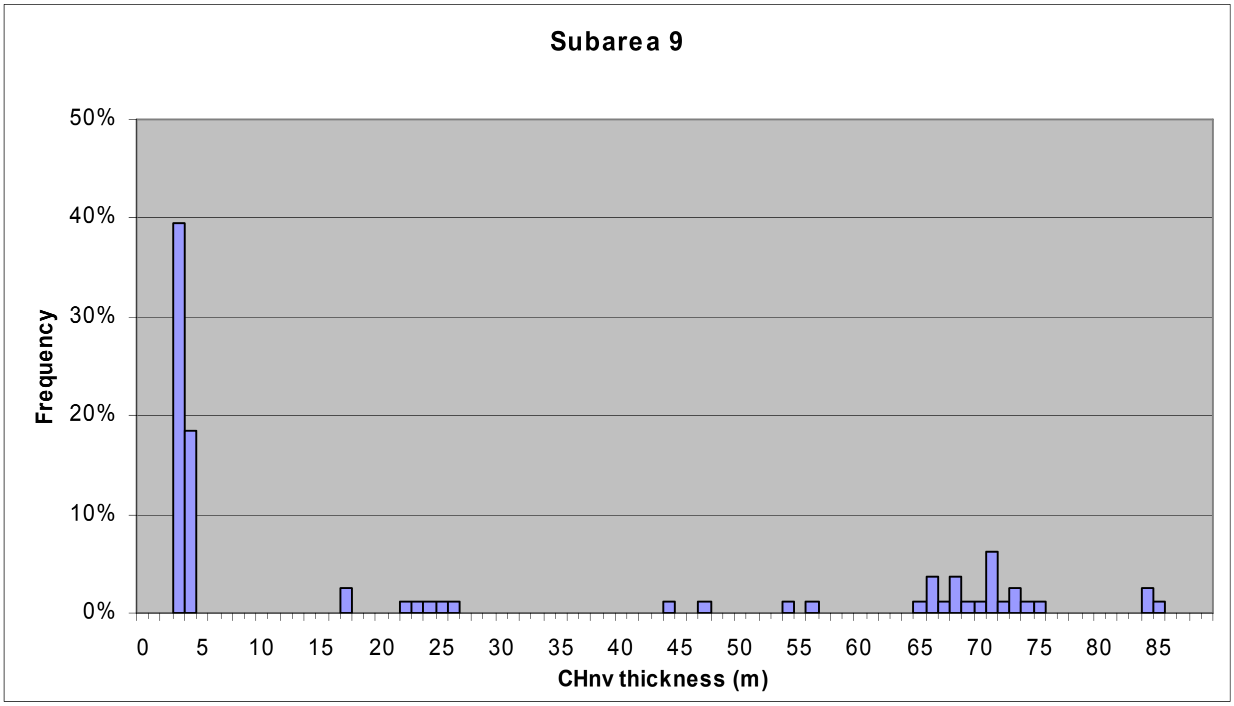

Subarea 4
20%
15%
10%
5%
0%
Frequency
0
5
CHnv thickness (m)


Subarea 5
40%
30%
20%
10%
0%
Frequency
4.0
6.5
9.0
CHnv thickness (m)


Subarea 6
10%
0%
Frequency
45.0
47.5
50.0
52.5
55.0
57.5
60.0
62.5
65.0
CHnv thickness (m)


Subarea 7
20%
15%
10%
5%
0%
Frequency
0 5 10 15 20 25 30 35 40 45 50 55 60 65
CHnv thickness (m)


Subarea 8
70%
60%
50%
40%
30%
20%
10%
0%
Frequency
0 5 10 15 20 25 30 35 40 45 50 55 60 65
CHnv thickness (m)



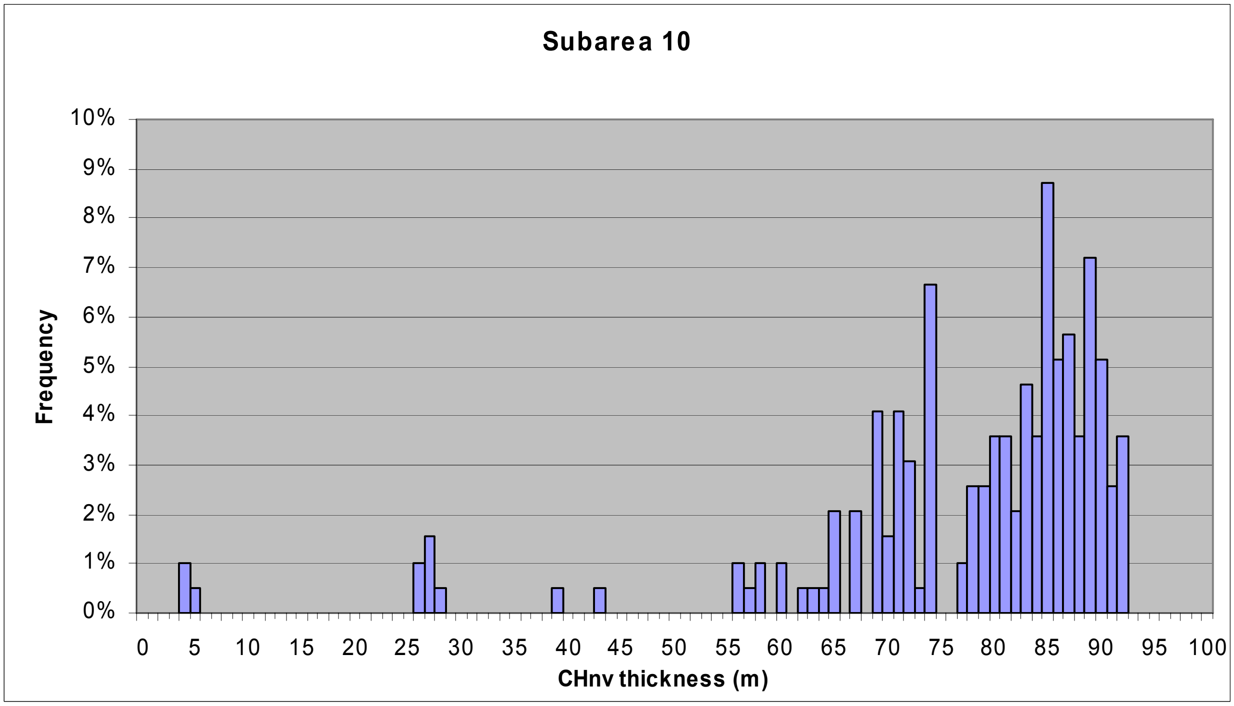


Figure 2: Histograms of CHnv thickness (meters) for each subarea.

Probability distrubitions were estimated from these histograms, and are shown in the Table 4.

Table 4. Probability distribution functions based on histograms of CHnv thickness (m)		
Distribution Type	**Parameter Name**	**Parameters**
usersupplieddiscrete	CHnvThickness_1Subarea[m]	2 0, 0.5 4, 0.5
usersupplieddiscrete	CHnvThickness_2Subarea[m]	2 0, 0.5 5, 0.5
usersupplieddiscrete	CHnvThickness_3Subarea[m]	2 0, 0.8 7, 0.2
usersupplieddiscrete	CHnvThickness_4Subarea[m]	4 0, 0.2 3.5, 0.3 5.5, 0.4 8.3, 0.1
triangular	CHnvThickness_5Subarea[m]	4, 7, 10
uniform	CHnvThickness_6Subarea[m]	49, 60
triangular	CHnvThickness_7Subarea[m]	51, 61, 68
usersupplieddiscrete	CHnvThickness_8Subarea[m]	2 2.5, 0.6 3.5, 0.4
usersupplieddiscrete	CHnvThickness_9Subarea[m]	4 4, 0.6 20, 0.1 50, 0.1 70, 0.2
triangular	CHnvThickness_10Subarea[m]	51, 85, 93

References

CRWMS M&O. "Geologic Framework Model (GFM3.1)." MDL-NBS-GS-000002 Rev. 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. 2000.

CRWMS M&O. "Mineralogic Model (MM3.0) Analysis and Model Report." MDL–NBS–GS– 000003. Rev. 01 ICN 02. Las Vegas, Nevada: CRWMS M&O. 2002.