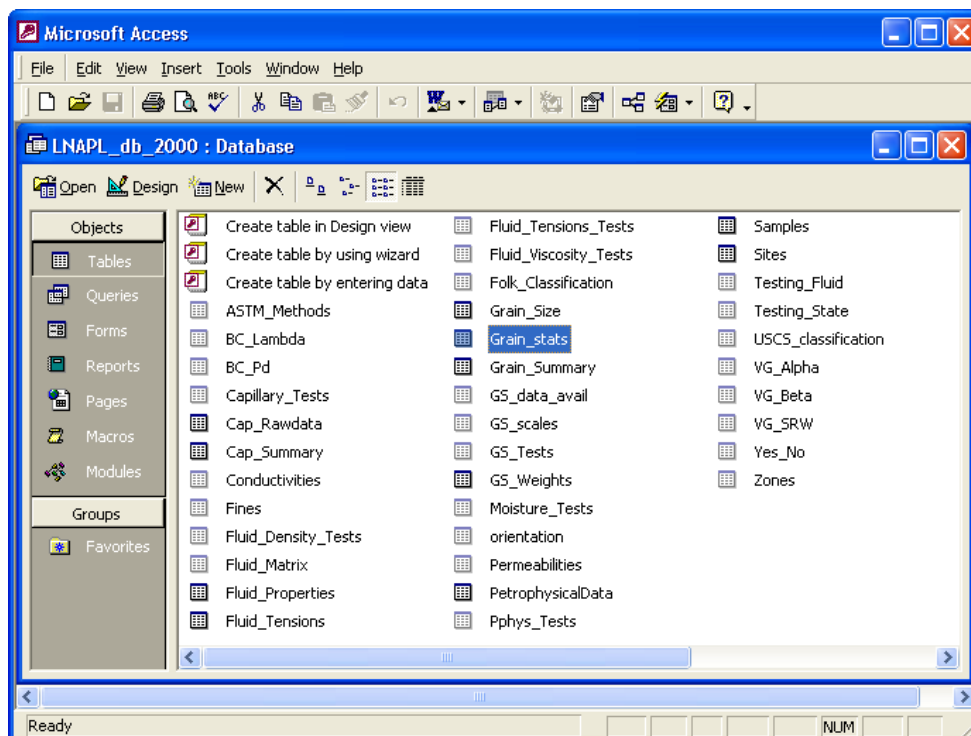


Light Non-Aqueous Phase Liquid (LNAPL) Parameters Database

Version 2.0 Users Guide

Regulatory Analysis & Scientific Affairs Department

Publication Number 4731
December 2003



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PREPARED UNDER CONTRACT BY:
G.D. Beckett
Steven Joy
Aqui-Ver, Inc.
La Jolla, California

FORWARD

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API STAFF CONTACT

Harley Hopkins, Regulatory Analysis and Scientific Affairs Department (RASA)

MEMBERS OF THE API SOIL AND GROUNDWATER TECHNICAL TASK FORCE

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PREFACE

The Light Non-aqueous Phase Liquid (LNAPL) Parameters Database is a collection of information about samples that have had their capillary parameters determined, as well as other physical parameters measured. Capillary properties are critical in multiphase calculations, and those results have very high sensitivity to these properties. The primary purpose of this database is to provide information to users who are trying to characterize the movement and distribution of LNAPL within a site that has a limited set of direct observations of the capillary properties of the site. Other databases of related parameters have typically been derived from measurements in the agricultural or the petroleum extraction industries; neither being necessarily representative of near-surface environmental conditions. This database give the user the opportunity to understand the range of capillary characteristics observed at sites that are geologically similar, but where there are more direct and laboratory observations available.

This document is broken up into 4 primary sections: Data Retrieval, Data Entry, Database Design, and Database Maintenance. Most users have interest in the first topic.

- The Data Retrieval section describes the types of data that are contained in the database and how a user can quickly retrieve subsets of the database that match various user input filters or selection criteria. This section includes several user scenarios with user inputs and database outputs conveyed through a series of sample screens and text.
- The Data Entry section describes how a user can add new data to the database using two primary data entry methods: 1) manual data entry through data entry forms, and 2) data import from electronic sources. Both methods are described and examples are provided. API recommends that only individuals and organizations with a high level of technical and database expertise attempt to add data to the database.
- Appendices A-C are written for database developers. A detailed description of the database design is provided in the first appendix. This section describes the structure of the database and the relationships between its tables, queries, forms, reports, and macros. The database maintenance section describes areas within the database that will require periodic maintenance and how to perform that maintenance, data validation, removing data from the database, etc.

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1 Getting information out of the database: Data Retrieval

The most basic use of this database of LNAPL parameters involves retrieving a subset of data records that match a particular set of selection criteria. In database jargon, this process is called “querying the database”. Users specify what subset of information they would like to retrieve, and the set of criteria by which matching records should be determined. However, before one can get started retrieving data, one must know a little bit about the types of data stored in the database.

1.1 Database contents

The LNAPL Parameters Database is a collection of information about samples that have had their capillary parameters determined, as well as other physical parameters measured. Capillary properties are critical in multiphase calculations, and those results have very high sensitivity to these properties. Capillary properties are sparsely documented in technical literature, and the documentation that exists is generally for other fields of study. Thus, they are not as applicable to environmental release conditions. There are significant property differences between the environmental samples in the subject database and those found in the historic literature. The purpose of this manual is not to discuss these differences, but rather document the construction and content of the API LNAPL parameters database.

The data (samples) contained in this database come from a number of different sources and sites (refineries, fuel storage facilities, military bases, etc.); information now in the public domain. The data that have been included in this database were not collected for the purpose of populating a database of useful parameters. The samples were collected to answer site-specific questions and to aid in the mitigation and remediation of site-specific problems. Given this diverse sample background, it is not surprising that the range of tests performed on each sample and the testing procedures used during the tests differ in many cases. Nevertheless, this is currently the most complete set of laboratory measurements of samples whose properties have been analyzed for the purpose of understanding LNAPL remediation in near-surface aquifers.

The database contains the following types of information:

- Sample capillary parameters and the raw data from which they were derived. This information is available for nearly all samples in the database.
- Petrophysical data including density (bulk/grain), porosity, permeability, conductivity, water and hydrocarbon saturations, etc.
- Grain size data. Grain size data are collected and presented in several ways.
 - Raw grain size distribution data (weight fraction vs. grain size)
 - Grain size at various percentages of the cumulative sample weight (i.e. the grain size at the 10th, 50th, and 90th percentiles).
 - Grain size distribution statistics (mean, median, standard deviation)
 - Fraction of the sample in various grain size classifications (% sand, % silt, etc.)

Typically, if the full raw grain size distribution is available, then all of the summary parameters are also available. For some samples, only summary data is available, while others have no data available.

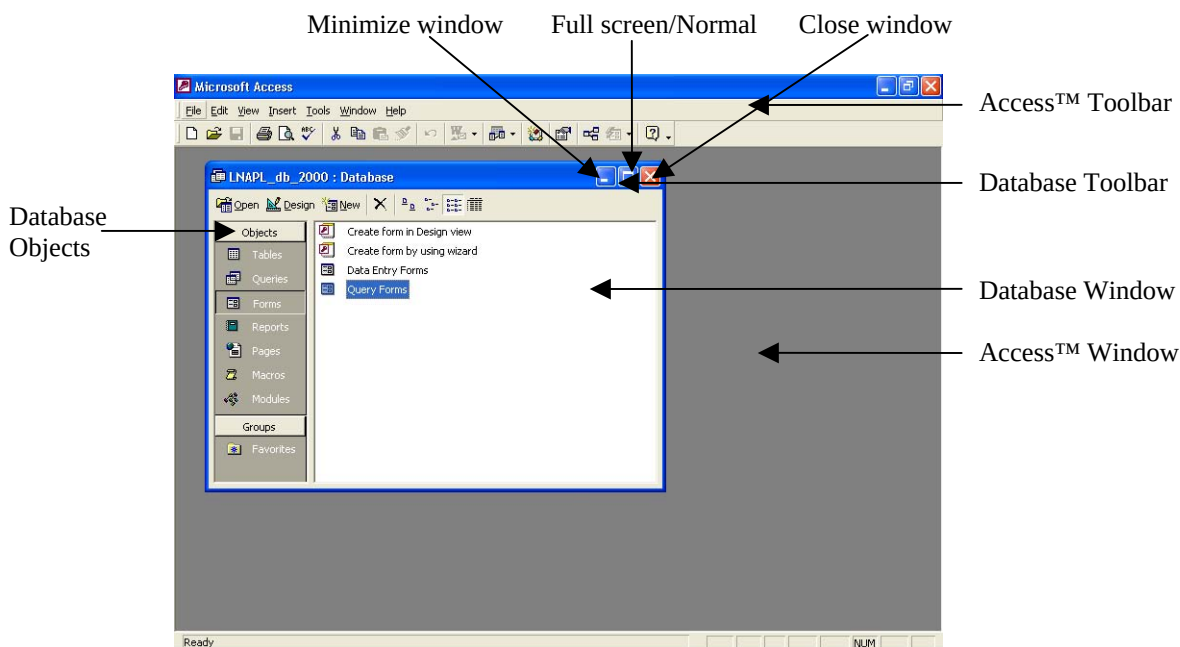
- Fluid properties (viscosity, density, interfacial tensions). Typically, fluid properties samples are not taken from the same samples where rock properties are measured. Fluid properties samples are provided as a form of site characterization, rather than for direct comparison with other samples within the site.

In many cases, the process of measuring one set of sample properties (grain size) makes the sample useless for measuring other properties (e.g., porosity). In general, the collection of measurements attributed to a single sample is obtained from slices of a single core not separated by more than 6 vertical inches from the slice where the sample capillarity was determined.

1.2 Getting Started

The first step is to open the database in Microsoft Access™. Locate the database file *LNAPL_db_2000.mdb* and then double click the left mouse button on the file. After opening the database, your screen should look like the screen in Figure 1.

Figure 1: Basic Access screen with annotations



The database should open with the *Forms* object open and the *Query Forms* option highlighted. However, the database will open in the state that it was in when it was last closed. If the last user did not leave the database in normal state, then some set-up might be necessary prior to getting started. On the left hand side of the screen, under the heading *Objects* (see figure 1), select *Forms* (single or double left-mouse click). The screen should now look like the screen in figure 1. Double click the left mouse button to on *Query Forms* to bring up the various query forms.

Helpful Hint: The query forms are displayed in the most user-friendly manner when the database window is maximized (full screen).

Figure 2: Query Forms

The screenshot shows the Microsoft Access interface. The title bar reads "Microsoft Access - [Query Forms : Form]". The menu bar includes File, Records, Edit, View, Format, Insert, Tools, Window, and Help. The toolbar contains various icons for database operations. The database name "Tahoma" is displayed. The "1) Basic Queries" pane on the left lists the following queries: "Query by Soil Type", "Query by Range of Fines", "Query by Permeability Range", "Query by Conductivity Range", "Query by Capillary Parameters", "Query by Site", "Query Raw Capillary Data with Curve Fits", and "Query Raw Grain Size Data". Two black arrows point to the "Query by Range of Fines" and "Query Raw Capillary Data with Curve Fits" entries. The status bar at the bottom shows "Record: 1 of 1" and "Form View".

Figure 2 shows the *Query Forms* screen. At the top of the form are 5 buttons that provide access to the basic parameter queries. At the bottom of the screen are 2 buttons that provide access to raw data for individual samples.

For now, we will concentrate on the basic parameter queries and results; raw data queries/results will be discussed later. All of the basic parameter query screens look similar to each other, and provide output in the same formats. The only difference between the 5 queries is how the data are selected for display. We will use *Query by Permeability Range* for our examples, and discussion of the various types of query results and displays. Select any query options by clicking (left mouse) on the desired button.

Figure 3: Query by Permeability Range screen (maximized) with annotations

Drop down menu buttons

Query restriction data input windows

Query-type Groupings

Individual query selection buttons

When the *Query by Permeability Range* option is selected the screen should look like the example in Figure 3. At the top of the screen is the user input area. At the bottom of the screen is a collection of data return and display options. The user must first specify a minimum and maximum permeability. You can either type values into each of the entry forms or you can select from the options provided in the menu (click on down arrow next to the data entry area). The options provided in the menu characterize the statistical distribution of the parameter that is controlling the query. These include the parameter minimum, maximum, average, median (50th percentile), first quartile (25th percentile), and third quartile (75th percentile). Even if you decide to enter a specific value, you should probably check the menu items to get a feel for the database content. Make sure that the maximum value selected/entered is greater than the minimum value selected/entered!

After the controlling parameter(s) is (are) set, the next user should select the data that should be returned and the format of the display from the options provided in the bottom two-thirds of the screen. The following pages show the types of screens that are returned for each of the available options.

Figure 4: Database Summary: All parameters, 1 page per sample

Query results organized into sections by topic

Vertical scroll bar slider

First page Previous page Current page # Next page Last page

Database summary of samples within specified permeability range		
Sample ID 197	Permeability (mD) 9.810E+02	
Soil Description of Sample		
Folk Sample Description	Folk Ternary Diagram Symbol	USCS_symbol
slightly gravelly muddy sand	(g) mS	SP-SM
Folk Sorting Description	Uniformity Coefficient	
poorly sorted	4.81	
Capillary Parameters Summary		
VanGenuchten Alpha (cm)	1.97E-02	Brooks-Corey Bubbling Pres (cm water) 2.78E+01
VanGenuchten Beta	1.54	Brooks-Corey lambda 0.45
Fit R squared	1.00	Brooks-Corey Fit R squared 1.00
Residual Saturation	22.1%	
Petrophysical Parameter Summary		
Permeability (mD)	9.810E+02	depth (feet) 102.0
Conductivity (cm/s)	6.660E-04	Sampling Zone Smear Zone
Sample Orientation (V or H)	V	Bulk Density (g/cc) 1.83
Effective Porosity (% Vb)	0.315	Grain Density (g/cc) 2.67
Air Filled Porosity (% Vb)		Testing Fluid Inert Oil
Water Saturation (% Pw)	0.555	Testing State Native
Hydrocarbon Saturation (% Ph)	0	Confining Pressure (psi) 25
Moisture Content (% Wt)	9.5	
Grain Sizes as Percentage of Total Sample		
Total Sand	Total Fines	Gravel Coarse Sand Medium Sand Fine Sand Silt Clay

The retrieval/display option at the top/center of the options list is the *Database Summary: All parameters, 1 page per sample* option. As the title indicates, this option will display in *Report* format the complete set of database parameters available for all samples that fall within the user specified parameter range. The results for each sample are provided on separate pages in the report. To “flip” the pages in the report, select one of the page turning options as outlined in Figure 4 (first page, back one page, ahead one page, last page). As noted in the Database Contents section (1.1), not all samples have all possible forms of data included in the database. A blank field in the report indicates that this data type is unavailable for this sample. For example, in Figure 4, the Air Filled Porosity (%Vb) field is blank while the other values within the *Petrophysical Parameter Summary* are all present. This indicates

that the petrophysical properties of sample 197 were measured but this particular parameter was not. In many cases, whole sections of the report (*Soil Description, Capillary Parameters, Petrophysical Summary, Grain Sizes, Grain Weight Percentages, Grain Size Statistics*) may be blank for a given sample if those tests were not performed on the sample. At the bottom of the report (not shown), both the page number and the total number of pages are provided. The number of pages is the same as the number of samples in the database that match the query input.

Helpful Hint: To return to the Query by Permeability Range screen, close the report screen (click the close screen box in the upper right-hand corner).

The remaining query options provide access to a subset of the entire database holdings that match the basic parameter query. There are three subsections: *Capillary Parameters* (this section is not present in the *Query by Capillary Parameters* basic parameter query area), (petrophysical) *Rock Properties*, and *Grain Size Parameters*. Each subsection has three options. To minimize the redundancy, only the individual options from the *Capillary Parameters* section will be shown here. The screens from the other options mimic the capillary parameter output in format but not content. The content of the other items was shown in the *All Parameters* example above.

Figure 5: Report: Samples and Stats

Individual samples display area

Query statistics display area

Sample Id	Permeability	Van Genuchten Alpha <cm-1>	Van Genuchten Beta (N)	Van Genuchten Fit R-squared	Residual Water	Brooks-Corey Bubbling Pressure (Pd) <cm>	Brooks-Corey Lambda	Brooks-Corey Fit R-squared
177	3710	2.86E-02	2.85E+00	0.953	4.4%	2.90E+01	1.72	0.988
118	3712	8.70E-03	2.72E+00	0.997	24.9%	4.85E+01	1.02	0.987
189	3720	1.90E-02	1.53E+00	0.578	1.0%	1.05E+01	0.33	0.993
Statistical summary of query results		Records: 3						
Parameter	Average	Minimum	Maximum	Std Deviation				
VG - alpha (cm-1)	1.88E-02	8.70E-03	2.86E-02	9.85E-03				
VG - Beta (N)	2.37E+00	1.53E+00	2.85E+00	7.27E-01				
VG - Res. Water	10.1%	1.0%	24.9%	12.9%				
BC Pd (cm)	2.93E+01	1.05E+01	4.85E+01	1.90E+01				
BC lambda	1.02	0.33	0.33	0.69				

Figure 5 shows the result of a Capillary Parameters Report: Samples and Stats query for a permeability range of 3700-3750 mD. The capillary fit (van Genuchten and Brooks-Corey) parameters for each matching sample are displayed in report format. A statistical summary (average [mean], minimum, maximum, standard deviation, and number of matching samples) of the matching records is provided at the end of the report. If the number of matching samples is large, the report will span many pages. Selecting the *Report: Stats only* option produces just the stats portion of the report from the previous query. No information about the individual samples is returned.

Figure 6: Tabular Listing of Matching Samples

sample id	VG alpha (cm-1)	VG beta	VG Srw	VG fit Rsq	BC Pd (cm)	BC lambda	BC fit Rsq	permeability (mD)
149	2.77E-02	1.68	44.0%	0.983	2.71E+01	0.63	0.990	1.081E+03
120	1.27E-02	2.41	23.9%	0.987	4.80E+01	1.16	0.996	1.263E+03
156	1.13E-02	2.14	31.0%	0.999	6.55E+01	0.96	0.993	1.432E+03
2	4.50E-03	2.64	13.0%	0.998	1.62E+02	1.43	0.993	1.472E+03
155	2.40E-02	1.62	34.0%	0.997	2.76E+01	0.55	0.985	1.609E+03
195	1.30E-02	2.57	12.2%	0.996	4.64E+01	0.96	0.995	1.621E+03
103	1.23E-02	2.53	25.4%	0.999	2.45E+01	1.69	0.967	1.625E+03
12	1.06E-02	2.06	30.0%	0.998	6.85E+01	0.93	0.987	1.645E+03
15	6.29E-03	1.55	68.0%	0.993	5.65E+01	0.34	0.938	1.678E+03
123	7.55E-03	1.95	33.3%	0.999	6.55E+01	0.67	0.961	1.737E+03
7	9.20E-03	2.45	11.0%	0.999	7.09E+01	1.11	0.987	1.765E+03
114	1.64E-02	1.69	33.8%	0.994	2.71E+01	0.42	0.992	1.913E+03
232	1.66E-03	2.20	6.0%	0.993	1.64E+02	0.24	0.954	2.060E+03
196	3.17E-02	1.53	23.5%	0.989	3.69E+01	0.57	0.998	2.072E+03
102	6.00E-03	1.57	23.8%	0.999	2.30E+01	0.35	0.997	2.106E+03
121	1.72E-02	1.96	30.9%	0.997	4.47E+01	0.90	0.984	2.249E+03
115	1.69E-02	2.06	26.0%	0.990	3.19E+01	0.36	0.962	2.270E+03
127	1.30E-02	2.25	13.0%	0.998	5.31E+01	0.72	0.928	2.285E+03
4	6.50E-02	1.42	40.0%	0.998	1.52E+01	0.41	0.947	2.295E+03
180	5.54E-02	2.66	4.9%	0.994	1.49E+01	2.21	0.981	2.360E+03

The final query display option is to display the query results as a simple spreadsheet table. Column headings are displayed at the top of each column. Values are formatted for display according to the representation (decimal, scientific, percentage) and precision rules that are defined within the database.

1.3 Retrieve samples for a given soil type

The database can be queried to return all samples for a user-specified soil type by selecting the *Query by Soil Type* option from the main query screen (see Figure 2).

Figure 7: Soil Type Selection Menu

USCS Symbol list →

USCS Classification Criteria →

Select Soil Type

- ML: silt (fines > 50%, silt > clay, sand < 20%)
- SM: sandy silt (fines > 50%, silt > clay, sand > 20%)
- SP: silty sand (fines > 12%, coarse > 50%, sand > gravel, silt > clay)
- SP-SM: poorly graded sand (fines < 5%, coarse > 50%, sand > gravel)
- SW: silty sand, poorly graded (5% < fines < 12%, coarse > 50%, sand > gravel)
- SW-SM: well graded sand (fines < 5%, coarse > 50%, sand > gravel)
- SW-SM: silty sand, well graded (5% < fines < 12%, coarse > 50%, sand > gravel)

View capillary parameters for this soil type

Report: Samples and Stats Report: Stats only Tabular Listing of Matching Samples

View rock properties for this soil type

Report: Samples and Stats Report: Stats only Tabular Listing of Matching Samples

View grain size summary data for this soil type

Report: Samples and Stats Report: Stats only Tabular Listing of Matching Samples

The user is provided with a drag-down menu of Unified Soil Classification System ([USCS symbols](#)), and their definitions in terms of the fraction of fines (silt + clay), sands, and gravels, within a sample. Once the user selects a soil type, all of the queries described in [section 1.2](#) are available to the user.

The drag-down menu does not include all possible USCS symbols. There are two reasons for this: 1) The database does include samples of all soil types, and only the soil types present within the database are shown, and 2) the laboratory that performed the grain size analysis on the bulk of samples in the database does not separate clay fractions by organic content. All clays are assumed to be inorganic within the database.

1.4 Retrieve samples within a range of fine (silt + clay) percentages

The database can be queried to return only samples that fall within a user specified range of fine particles. Fines are defined to include the sum of the silt and clay fractions. Many samples, particularly those whose grain size distributions were determined by screening, do not distinguish between fine silt and clay. Setting a low limit on the fine fraction boundary is equivalent to requiring primarily sand size (or greater) particles. Figure 8 shows the data input window for this type of query.

Figure 8: Query by Range of Fines Menu and Options

1.5 Retrieve samples within a permeability range

The retrieval of samples matching a user specified range of permeability was used as the primary example of database usage and will not be repeated here. Please see section 1.2 ([Getting Started](#)) and Figure 3 for additional information.

1.6 Retrieve samples within a conductivity range

Retrieving samples by specifying a range of matching sample conductivities is exactly analogous to retrieving data by specifying a permeability range. The only real differences are the units of conductivity and the valid ranges for the minimum and maximum values.

The units of conductivity are cm/s and the valid range is 0-100 cm/s (generous upper limit). Please refer to sections 1.2 ([Getting Started](#)) and [Figure 3](#) for additional information.

1.7 Retrieve samples with capillary parameters that match search criteria

Retrieving samples where the capillary parameters (van Genuchten and Brooks-Corey) match user specified limits is slightly different from the types of queries that have previously been discussed.

Figure 9: Querying by Capillary Parameters

Parameter Name	Minimum	Maximum
VanGenuchten Alpha (cm ⁻¹) Range = (0-1)	0	1
VanGenuchten Pore Uniformity (Beta) Range = (1-100)	1	100
Residual Water Saturation (Srw) Range=(0-1)	0	1
Brooks-Corey Bubbling Pressure (Pd- cm H2O) Range = (0-50000)	0	50000
Brooks-Corey Pore Uniformity (lambda) Range = (0-10)	0	10

Database Summary:
All Parameters, 1 page per sample

View rock properties for this conductivity range

Report: Samples and Stats Report: Stats only Tabular Listing of Matching Samples

View grain size summary data for this conductivity range

Report: Samples and Stats Report: Stats only Tabular Listing of Matching Samples

Record: 1 of 1

The most important distinction is in the number parameters that are available to restrict the output. It is very easy for a user to over specify restriction criteria such that no samples are returned. Parameter minima, maxima, and other menu items are not dynamically generated to match the subset of parameters available given previously specified selection criteria. These

values reflect the database as a whole. Users are cautioned to add restriction criteria one at a time. For example, if you want to restrict returned values to a range of VG Alpha values and VG Beta, it would be prudent to run the query first with only the VG Alpha restriction and examine the results to see if any samples match your desired VG Beta restriction criteria. If so, add the second restriction and run the query again.

Note that the *Capillary Parameters* section of the query form ([see Figure 3](#)) is missing.

1.8 Retrieve samples from a particular site

There are times when a user would like to examine all of the samples from a given site (location), to understand the amount of variability in the sites. In addition, some database parameters, such as the various fluid properties, are really site characteristics not associated with individual samples. The *Query by Site* function provides this capability. In this query, the user is asked to select a site from a list of available sites (Figure 10). Not all sites have associated fluid properties data so the user is presented with two options: a list of all available sites and a list of sites where fluid data is available. Note that this query form looks slightly different than the normal basic query forms in that there is an extra category set at the bottom where fluid properties data can be queried. Also note that there is no “query statistics only” function available for the fluids query. Fluid properties are typically measured over a range of temperatures and it does not make sense to “average” these values.

Figure 10: Query by site form

User can select a site from a pick-list of available sites

Fluid properties data can be retrieved for a given site – assuming such data are available

1.9 Raw data retrieval

Raw capillary and grain size data differ from other sorts of data in the database in that many values are associated with a single sample. Permeabilities, capillary parameters, mean grain sizes, etc. are all single valued for a given sample. To extract raw distribution data from the database, a specific sample must be identified. Unfortunately, there are no simple ways to provide the user with much information about a sample in the sample selection menu. Users are encouraged to perform other queries prior to querying the database for raw data. If you find a sample of particular interest, and you would like to know more about the raw data, write down (or remember) the sample ID number and then begin your raw data query.

1.9.1 Raw capillary data for a given sample

Raw capillary data for a given sample can be displayed in three ways: 1) Report format with a plot of the van Genuchten parameter fit, 2) Report format with the Brooks-Corey parameter fit, 3) Table view.

Figure 11: Raw capillary data report with van Genuchten parameter fit

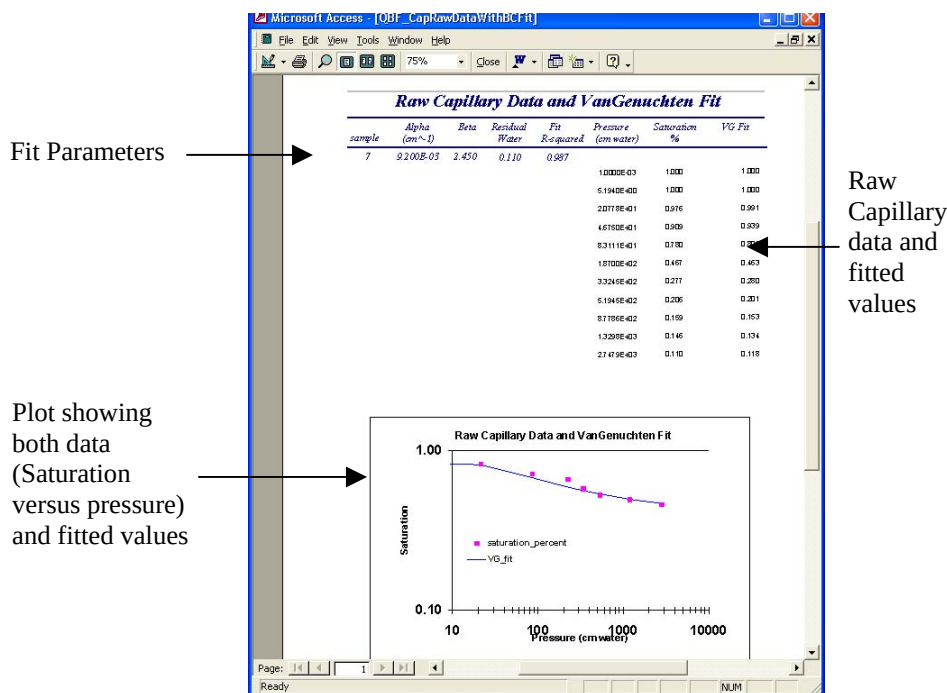
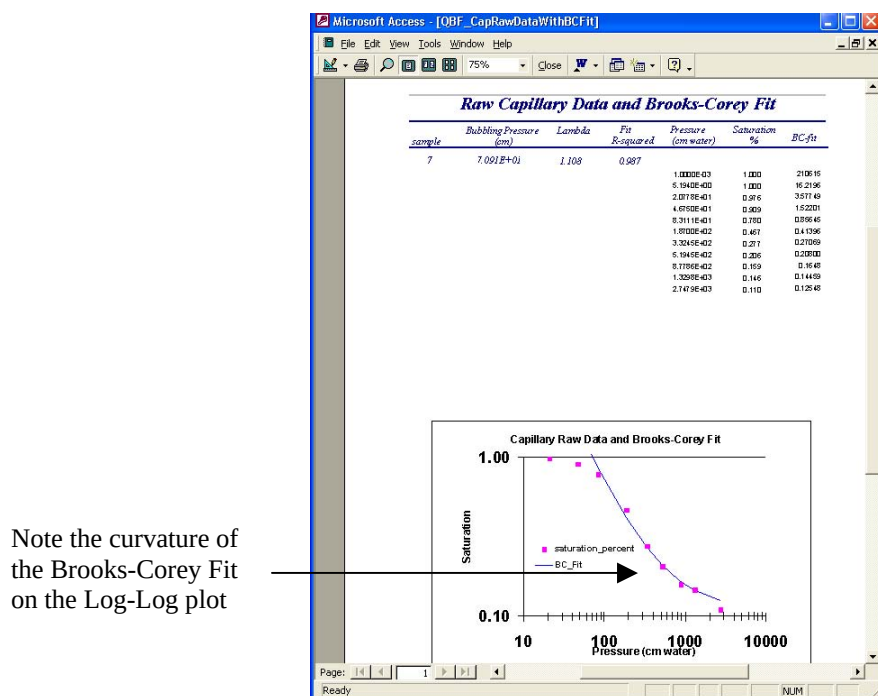


Figure 12: Raw capillary data with Brooks-Corey fit

Some of the raw capillary data with Brooks-Corey analysis and fit plots may look a bit unusual to users familiar with this form of analysis. The Brooks-Corey technique fits a linear function of the logarithm of pressure to the logarithm of effective saturation. Clearly the curve shown in Figure 12 for sample 7 above is not linear and the plot is provided on a log-log scale. The curvature is the result of plotting total saturation (S) versus pressure on a log-log scale. Effective saturation (S_e) is related to total saturation (S) by the expression:

$$S_e = \frac{S - S_{rw}}{1 - S_{rw}}$$

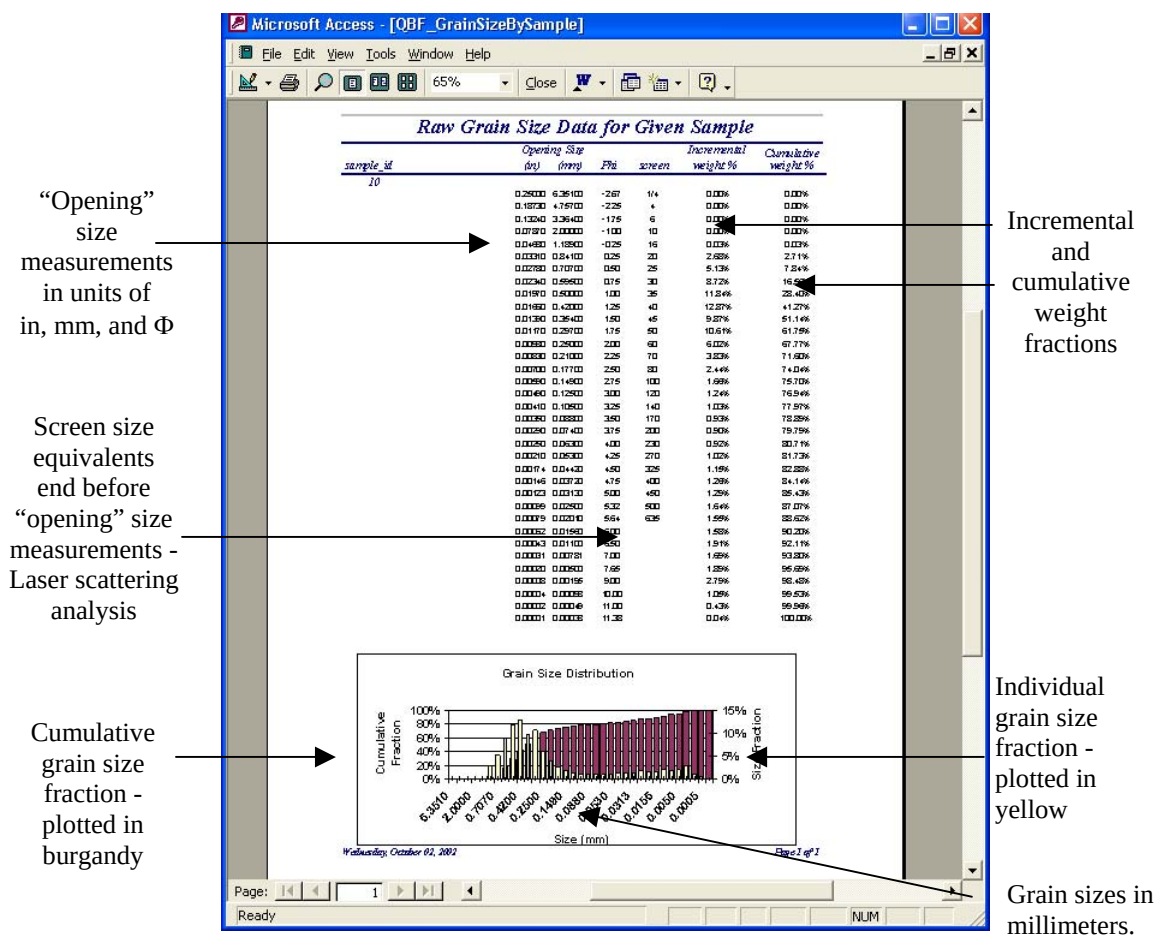
where S_{rw} is the residual saturation.

The raw capillary data table view looks like the result in [Figure 6](#) but with different columns. Both the raw capillary data and the two fit results (VG, B-C) are shown.

1.9.2 Raw grain size data for a given sample

Raw grain size data can be retrieved either as a table of values or formatted as a report with a plot showing the grain size distribution. The table format looks like the result shown in [Figure 6](#) but with different columns. The report format for the raw grain size data is similar to the format for the raw capillary data in that the report tabulates the distribution and includes a plot of the data ([Figure 13](#)). Raw grain size distributions are measured in one of two ways, screening or by laser scattering. A user can quickly determine which method was used for a given sample by viewing the raw data. If the distribution extends to sizes below the minimum screen size, laser scattering analysis must have been performed. Conversely, if grain sizes extend only to the limits available to screening analysis, then this must be the analysis technique.

Figure 13: Raw grain size data with grain size distribution plot



2 Data Entry

This version of the database has input data for 235 samples from 24 different sites. While this is a good start, many more data sets can and should be entered into the database. This chapter describes the various methods for adding new data to the database. Data that could be entered into the database exist in two common formats, electronic files and paper documents. [Section 2.2](#) describes the tools developed to aid in the transcription of data stored in hardcopy documents. [Section 2.3](#) describes the tools provided for the reformatting of electronic data sets into forms that are easily imported into the database. However, before we describe how to add data to the database we should comment on what data should be added to the database.

2.1 Selecting data for entry into the database

The primary purpose of this database is to provide information to users who are trying to characterize the flow of LNAPL within a site that has a limited set of direct observations of the capillary properties of the site. The basic idea is to try and understand the range of capillary characteristics observed at sites that are geologically similar, but where there are more direct and laboratory observations available. Given this objective, the availability capillary data and analysis should be the principal requirement for the inclusion of a data set (sample) in the database. However, capillary analysis alone is insufficient. Without any other sample characterization (grain size analysis, petrophysical analysis, fluid analysis), the capillary data is not useful in terms of understanding other sites.

There are no features of this database that restrict which data can be entered into the database. It is up to the database user to decide what additional data gets entered. However, if the initial objectives of the database are to be maintained, then only samples that have contain capillary analysis and at least one other form of analysis should be considered for inclusion in the database.

2.2 Manual data entry using data entry forms

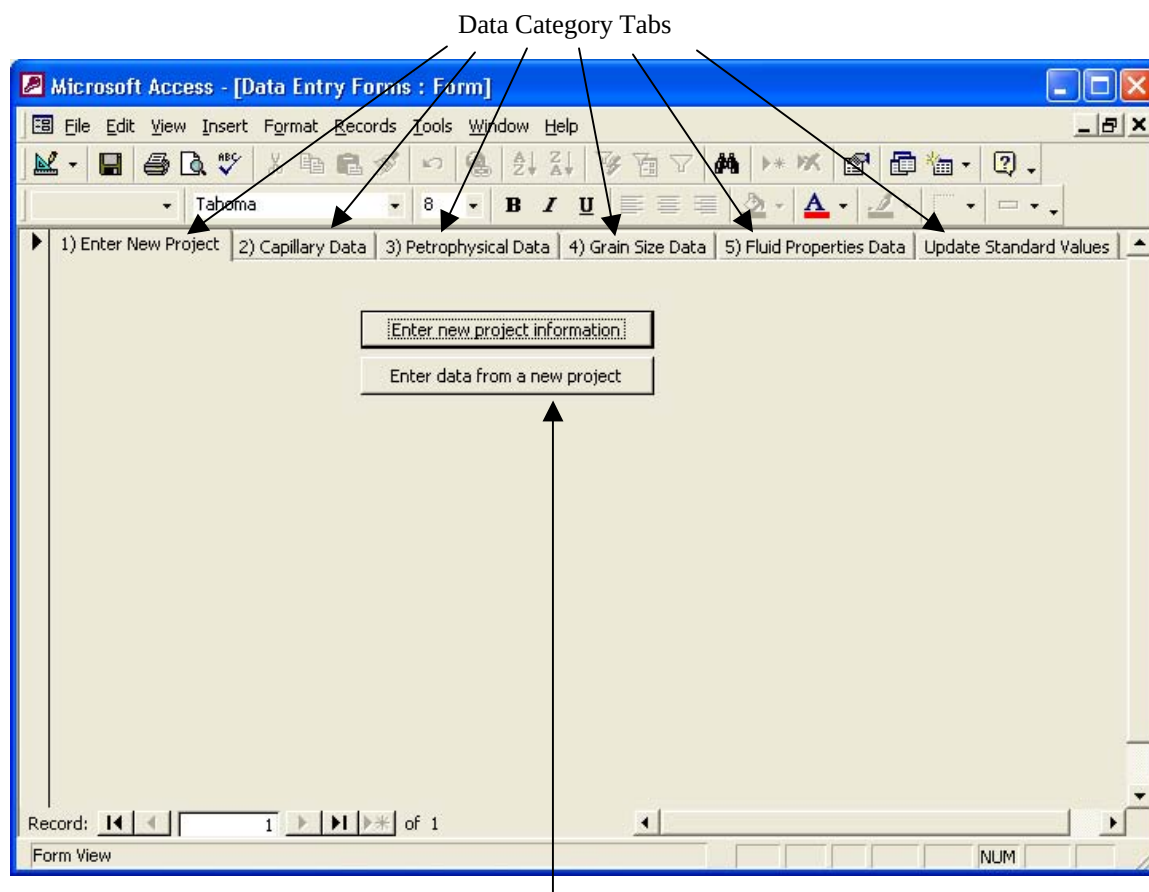
The person entering data needs to have the data well organized prior to getting started. In particular, the user must have determined which samples are going to be represented as a single sample within the database. As described earlier in this document, labs often cannot make multiple measurement types (capillary analysis, petrophysical analysis, grain size analysis) on a single physical sample. The data entered into the database thus far associates data into a single sample record values that were acquired within 6 vertical inches (same well) of the sample analyzed for capillary properties. In other words, the grain size data for a sample collected in well MW17 at 20.5 ft below grade could be associated with a capillary sample collected anywhere between 20 and 21 ft below grade from MW17. Samples from sites where the strata are very finely layered might require more restrictive sample correlation criteria.

In addition to knowing which samples are going to be associated within the database using a single sample identifier, all of the sample analysis methods (ATSM methods) need to be known for each sample and data type (capillary, grain size, fluid viscosity, etc.). This information is included in the database in the **Samples** table.

Data entry will be far more efficient and less prone to mistakes if the data are well organized and documented prior to beginning the data entry process.

To start the data entry process, open the database and select the *Data Entry Forms* from the *Forms* object by double clicking the left mouse button on this item (see Figure 1). This will bring up the basic data entry form (Figure 14). Across the top of the form are a number of tabs. Each tab provides access to a set of data entry forms for similar types of data. Typically the data entry process begins by entering information about the site and its samples. This information must be entered before any further information about the samples can be added to the database.

Figure 14: Basic data entry form



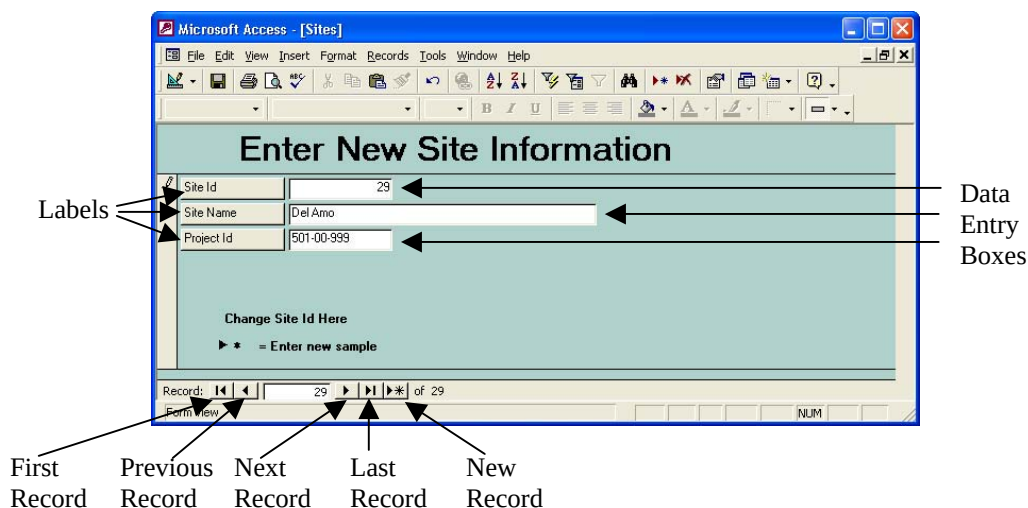
Data Entry forms within the selected data category (Enter New Project)

2.2.1 Site Entry Form (*Enter New Project Information*)

A site is a small geographic area where one or more samples have been collected. Commonly, sites are places like refineries, military bases, or service stations. Only the most basic information about a site is stored in the database. This includes a site number, name, and project number (see figure 15). The site number is required value; the other values can be left blank, if desired. Some sites are identified within an organization by a project number. Project numbers can provide a mechanism for identifying a site within the database in a

manner that is only identifiable to members of the organization that provided the data. New site data is entered in the blank fields beside the field identifiers. A user can advance to the end of the list of sites by clicking on the “last value in list” icon at the bottom of the screen (►►). Figure 15 shows the current last record in the **Sites** table. This lets the user know the highest site number that currently exists in the database. The new **Site_id** should be 30 or one more than the last value currently in the database. The user needs to remember the site number when entering new samples into the database (next section). To advance the form to a “new record”, either select (left mouse click) the new record (►*) icon or the next record (►) icon.

Figure 15: Site data entry form



2.2.2 Samples Entry Form (*Enter Data From a New Project*)

The samples data entry form is the most complex of the data entry forms. Basic information about the analysis techniques performed on the sample must be added to the database for completeness. To simplify data entry, most input parameters have standard value pick-lists available ([Figure 16](#)). All of the samples for a given site must be entered into the **Samples** tables (using this form) prior to entering further information about the sample into the database.

As with the **Sites** table, the first step in the data entry process is to determine the **sample_id** of the last sample entered into the database. Click on the “last record” icon and read the **sample_id** number. The **sample_id** values should increase by one for each new sample. As shown in Figure 16, the last **sample_id** is 235. The **sample_id** entered for the next new sample should be 236 and the **site_id** should be 30 (from the previous section). Each sample that a user enters into the database already has some name by which it is referred to by the organization and/or testing facility that analyzed the sample. To preserve this name it must be entered into the database and associated with the **sample_id**.