



Quito Geotechnical Database (Quito/GEO-299 v1.0)

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1 INTRODUCTION

The city of Quito, Ecuador, lies within a volcanic, landslide-prone region which has been subject to frequent seismic activity in recent years, including the notable 2014 earthquake (Aguilar et al., 2014). The Quito Geotechnical Database (Quito/GEO-299 v1.0) provides a catalogue of geotechnical property data and shear wave velocity (V_s) measurements to inform slope stability assessments and seismic site response analysis, as well as being more widely applicable. It is part of a series of geotechnical databases being developed for regions where such data are needed for geotechnical hazard assessment and for identifying disaster resilient development strategies. For example, the SAFER borehole database, SAFER/GEO-591 v1.1, provides seismic geotechnical properties for Kathmandu, Nepal (Gilder et al., 2019). Quito/GEO-299 v1.0 is presented in a similar format to SAFER/GEO-591 v1.1.

The Quito Geotechnical Database has been compiled and digitised from an extensive review of soil geotechnical test results reported in published literature including reports, dissertations, and peer-reviewed research papers. The database describes geotechnical and geophysical soil properties distributed throughout Quito, Ecuador, recorded at 299 different locations, comprising the results of both *in situ* tests and geotechnical laboratory tests.

The database file structure is inspired by the Association of Geotechnical and Geoenvironmental Engineering Specialists (AGS) data format (AGS, 2017). Some tables have been adapted from the AGS format and extended to accommodate Quito’s geotechnical hazard setting and the uniqueness of data (such modifications are highlighted in grey). This report outlines the database structure, methodology and details of the meta-data available in the database.

The database has been uploaded to the “data.bris” Research Data Repository at the University of Bristol (<https://doi.org/10.5523/bris.3m2ficmw3ltjx2m0yl4cwptkqm>), and has been released online for use by the community under the CC-BY 4.0 Licence.

2 DATA SOURCES AND DATABASE BUILDING

2.1 Data sources

The Quito database includes data from open access sources including literature, dissertations, books and reports. All sources are referenced in Appendix I. All the sample locations included in the database have been allocated a unique identifier (ID) reflecting the source type, the organisation/author name(s), the year of data publication and an excavation point code (e.g. H1 or S1, where H indicates a borehole; S indicates a superficial sample, and the given number corresponds to the borehole or trial pit number as it appears in the original source). It should be noted that each unique identifier describes a distinct point location (borehole or trial pit) at which samples were collected for testing (note, where unique location identifiers share geographical coordinates, this is a result of multiple boreholes or trial pits being excavated in close proximity at a given location). Some examples of unique identifiers are provided in Table 1, below.

Table 1. Examples of unique identifiers

Type ⁽¹⁾	Organisation/ author abbreviation	Year	Excavation point code ⁽²⁾	Unique Identifier
T	ARMO	2016	H1	T_ARMO_2016_H1
R	PLAZ	2016	H1	R_PLAZ_2016_H1
B	FALC	2017	S1	B_FALC_2017_S1

⁽¹⁾ Source type (where T = thesis/dissertation; R = Report; B = book)

⁽²⁾ Borehole or superficial excavation (where H = borehole; S = superficial sample)

Within the unique identifier, authorship is indicated by a four-letter abbreviation (the first four letters of the first author or of the publishing organisation).

2.2 Database structure

2.2.1 Overview

The geotechnical database consists of one principal spreadsheet named QUITO/GEO-299 (QUITO-GEO-299_v1.0.xlsx). This spreadsheet contains a series of internal tables or ‘tabs’, which are also provided as separate .csv files (e.g. LOCA.csv). These tabs have been named following the specifications of the AGS data format (AGS, 2017) and are given four-letter group names (e.g. ‘LOCA’, for location details; or ‘GEOL’ for stratigraphic materials from parent rock to weathered strata and deposited soils, for example).

Each tab contains the top four rows of headers, detailed as follows:

- Row 1 - overall column header detailing the information held in that column;

- Row 2 - abbreviated column header, structured as follows: the tab name, followed by a further abbreviated descriptor of the database field, e.g. GEOL_TOP, which describes the ‘depth to top of stratum’ within the GEOL tab;
- Row 3 – units pertaining to each field column;
- Row 4 – data type (where data can be broadly described as either text or numeric). The individual data types are detailed further in Table 2, below:

Table 2. Data format

Data type	Description
ID	Unique identifier used across the database
X	Text-only field
XN	Generic text/number field, which may include notes or codes
ODP, 1DP, 2DP	Numeric field, where the number indicates the number of decimal places

The field LOCA_ID will always hold the unique identifier for the data source information as described in Section 2.1. A screen shot of the ‘LOCA’ table within the QUITO/GEO-299 Excel spreadsheet is provided in Figure 1.

Location ID	Easting (X)	Northing (Y)	Ground level (Z)	Ground Level (DEM)	Final depth	General remarks
LOCA_ID	LOCA_NATE	LOCA_NATN	LOCA_GL	LOCA_DEM	LOCA_FDEP	LOCA_REM
ID	2DP	2DP	2DP	2DP	2DP	XN
T_ARMO_2016_H1	780241.00	9983954.00	2834.00	2806.00	9.00	La Luz - Barrio La Kennedy
T_ARMO_2016_H2	780493.00	9984235.00	2850.00	2817.00	9.00	La Kennedy
T_ARMO_2016_H3	779162.00	9985945.00	2826.00	2808.00	10.00	El Rosario (Cabecera Norte Del Parque Bicentenario)
T_ARMO_2016_H4	777239.00	9977352.00	2884.00	2860.00	9.00	Miraflores (Piscina De La Concentración Deportiva De Pichincha)
T_ARMO_2016_H5	779962.00	9976470.00	2822.00	2795.00	9.00	La Vicentina (Parque Central)
T_ARMO_2016_H6	779543.00	9976232.00	2818.00	2799.00	11.00	La Vicentina (Velódromo De La Concentración Deportiva De Pichincha)
T_ARMO_2016_H7	775319.00	9973020.00	2837.00	2809.00	8.50	Parque De Los Enamorados, Villaflora (Clínica Ecuasanitas)

Figure 1. Showing the first four rows of the ‘LOCA’ table of the Excel spreadsheet (QUITO-GEO-299_v1.0.xlsx).

2.3 Database tables

This section describes each table in the database separately and explains any further details relating to the quality of the meta-data. These tables have been reproduced from guidance provided in the AGS format document (AGS, 2017). In the following sections of this report, modifications to the AGS standard format are indicated by grey cells, as are any new fields which have been developed to produce a structure relevant to the specific data available for Quito. It should be noted that some of the data in this database were derived from original data found in the source documents (i.e. V_{S30} data for T_MACH_2012_H1, which were calculated from the provided V_S data). In the database files, any derived data are indicated in the general comments column.

2.3.1 Location details

The database holds the geospatial information relevant to each site location or dataset. In cases where the location of the site was difficult to determine from the original record, this was estimated from other information: for example, evidence of location may have been derived from the thesis/project name, the city/area name or other details that are shown in the original record, such as sketch maps. Where specific site coordinates were reported in the source, these were included directly into the database. The database geospatial information is held in the projected coordinate system: WGS_1984_UTM_Zone_17S. Elevation information was unavailable for some of the sites included in the database. In these cases, the site level was obtained from a Digital Elevation Model (DEM) with a 30m resolution using Google Earth images. The DEM level has also been provided for all site entries in the database (in some cases this differs from the elevation value available in the original data, as noted in the “General Comments” tab). The LOCA table also contains the database record quality designation LOCA_QUAL, described in Section 2.4. Table 2 describes the fields held within the ‘LOCA’ table in the database spreadsheet.

Table 3. LOCA - Codes for location details using AGS (2017) format and extended to include Quito-specific data fields (grey rows)

Heading	Unit	Description	Example	Data type (1)
LOCA_ID		Location identifier	T_ARMO_2016_H1	ID
LOCA_NATE	m	Easting of location based on WGS_1984_UTM_Zone_17S	780241.00	2DP
LOCA_NATN	m	Northing of location WGS_1984_UTM_Zone_17S	9983954.00	2DP
LOCA_GL	m	Ground elevation or level relative to datum of mean sea level (m MSL)	2834.00	2DP
LOCA_DEM	m	Ground elevation or level from 30m resolution digital elevation model	2806.00	2DP
LOCA_FDEP	m	Final depth	9.00	2DP
LOCA_REM		General remarks	La Luz- Barrio la Kennedy	XN
LOCA_LOGQ	-	Site description quality based on categories described in Table 18 of Section 2.4 (1-3)	1	0DP
LOCA_QUAL	-	Quality designation according to Table 18 of Section 2.4 (1-11)	5	0DP
LOCA_REF	-	Reference identifier pertaining to references in Appendix I	R1	XN
LOCA_COM	-	General comments about data locations	-	XN

(1) Refer to Table 2 for data formats

2.3.2 Descriptions of the ground conditions and stratigraphy – (soils and geology)

Records from general site ground conditions are referenced in terms of metres below ground level. Prior to digitisation, the site location information was assigned a general logging quality designation. This is described in further detail in section 2.4. The soil type within a depth interval has also been described

using a legend code, as does the field LEG_CODE in the AGS format (AGS, 2017). These 3-digit legend codes allow distinction of soil type according to a specified number. A soil described as a silt will always have a legend code starting with 3 e.g. a sandy SILT legend code is 303. All legend codes used are detailed in Appendix III. The information presented in the geology tab of the database is provided in Table 4.

Table 4. GEOL - Codes for field geological descriptions (AGS 2017 format, extended for Quito in grey)

Heading	Unit	Description	Example	Data Type
LOCA_ID	-	Location identifier	T_ARMO_2016_H1	ID
GEOL_TOP	m	Depth to the top of stratum	5.00	2DP
GEOL_BASE	m	Depth to the base of description	5.30	2DP
GEOL_LEG	-	Legend code	207	XN (<i>See Appendix III</i>)
GEOL_ORIG	-	Description of stratum from original data source	Silty clayey sand	X

2.3.3 Standard Penetration Testing (SPT)

The database holds Standard Penetration Testing results or SPT-N values which have been digitised from original resources. The testing was generally undertaken according to ASTM D1586-11 (2011) and involved recording blow count over three 150mm increments. The metadata usually associated with SPT testing such as hammer weight or type, diameter of the drilling rods, rod length were not always available, therefore, if readers wish to assess full compliance with the testing standards they should refer to the original sources. Table 5 describes the database structure for the SPT results.

Table 5. ISPT - Standard Penetration Test results (AGS 2017 format, extended for Quito in grey)

Heading	Unit	Description	Example	Data Type
LOCA_ID	-	Location identifier	T_ARMO_2016_H1	ID
ISPT_DPT	m	Depth of test	1.00	2DP
ISPT_NVAL	-	SPT 'N' Value (uncorrected)	5.0	1DP
ISPT_N60	-	SPT 'N' Value (corrected for an efficiency of 60%) obtained from the source	4.0	1DP
ISPT_N160	-	SPT 'N' Value (corrected to effective overburden pressure of 100 kPa) obtained from the source	4.0	1DP

2.3.4 Shear wave velocity data

The average shear wave velocity is obtained by plotting the corrected travel time with depth; the average velocity of the layer is equal to the slope of the fitted line across the layer depth interval. The calculated average S-wave velocities have been presented at the geophysical intervals defined by plotting the corrected travel-time with depth i.e. the slope of the fitted lines through each interval of data which exhibits a similar linear trend. For data in the database, only the velocities between intervals were available so the original time meta-data is not available. Table 6 describes the structure of the data presented in the VELO tab. It should be noted that soils in Quito are classified according to shear wave velocity following the standards detailed in the International Building Code (IBC, 2003).

Table 6. VELO – Downhole geophysical test calculated velocities (AGS 2017 format, extended for Quito in grey)

Heading	Unit	Description	Example	Data Type
LOCA_ID		Location identifier	R_VALV_2002_H1	ID
VELO_TOP	m	Depth to the top of measurement interval	14.00	2DP
VELO_BASE	m	Depth to the base of measurement interval	16.50	2DP
VELO_VS	m/s	Calculated shear wave velocity	480	0DP

2.3.5 Shear wave velocity in the first 30 m (V_{S30})

V_{S30} (the average shear wave velocity over the first 30 m of soil depth) is a useful parameter for engineering applications as it provides quantification for the effects of local site conditions on earthquake ground motions. It is a synthetic parameter which assumes that the majority of these effects will be attributed to the upper 30 m of soil. Although in region-specific cases this may vary, it is still a widely used parameter, used for both earthquake design and modelling purposes. Some of the sources of shear wave velocity data within the database have also calculated V_{S30} values, however, where not explicitly given, they have been derived as follows:

The data described in Section 2.3.4 were used to derive site-specific values of shear wave velocity at 30 m of soil depth (V_{S30}). This is calculated using equation 1, below, where h_i is thickness (in metres) and v_i is the shear wave velocity of the i^{th} layer, for a total of N layers, existing in the top 30 m, as per Eurocode 8 (CEN 2004, clause 3.1.2).

$$V_{S30} = \frac{30}{\sum_{i=1,N} \frac{h_i}{v_i}} \quad \text{Equation 1}$$

The V_{S30} values of any hole with depths less than 30 metres were estimated using extrapolating methods in equation 2, (Boore, 2004).

$$\log \bar{V}_{s30} = a + b \log \log \bar{V}_s (d) \quad \text{Equation 2}$$

Table 7 describes the structure of the data presented in the VS30 tab. Note, details regarding the data origin (i.e. V_{S30} obtained directly from source or calculated using the method detailed above) are provided in the “General comments” tab.

Table 7. Calculated V_{S30} values (AGS 2017 format, extended for Quito in grey)

Heading	Unit	Description	Example	Data Type
LOCA_ID		Location identifier	R_VALV_2002_H1	ID
VS30_TOP	m	Depth to the top of measurement interval	0.00	2DP
VS30_BASE	m	Depth to the base of measurement interval	16.50	2DP
VS30_VAL	m/s	Calculated shear wave velocity at 30 m depth	409	0DP
VS30_COM		General comments	Value extrapolated to 30 m using source data (Boore, 2004)	XN

2.3.6 Geotechnical Laboratory Testing

This section describes the structure of the geotechnical laboratory test results available. Indicators from original test certificates suggest that ASTM standard practices are followed in Ecuador.

Particle Size Distribution

Data from particle size distribution tests indicate that the ASTM standard practice for soil classification has been used (ASTM D2487 – 17). The structure is provided in Table 8.

Table 8. GRAG - Particle Size Distribution (AGS 2017 format, extended for Quito in grey)

Heading	Unit	Description	Example	Data Type
LOCA_ID		Location identifier	T_AGUI_2017_H1	ID
GRAG_TOP	m	Depth to top of sample	0.00	2DP
GRAG_BASE	m	Depth to bottom of sample	0.00	2DP
GRAG_PASS 4	%	Percentage of material passing sieve number 4	98.90	2DP
GRAG_PASS 10	%	Percentage of material passing sieve number 10	95.90	2DP
GRAG_PASS 40	%	Percentage of material passing sieve number 40	82.30	2DP
GRAG_PASS 200	%	Percentage of material passing sieve number 200	49.90	2DP

Table 8. GRAG - Particle Size Distribution (continued)

Heading	Unit	Description	Example	Data Type
GRAG_GRAV	%	Percentage of material tested in range 75mm to 4.75mm (gravel)	1.1	1DP
GRAG_SAND	%	Percentage of material tested in range 4.75mm to 75um (sand)	49.0	1DP
GRAG_FINE	%	Percentage less than 75um	49.9	1DP
GRAG_UC		Coefficient of uniformity	25.4	1DP
GRAG_CC		Coefficient of curvature	0.8	1DP
GRAG_D10		Effective size of particles corresponding to 10%	0.0	1DP
GRAG_D30		Effective size of particles corresponding to 30%	0.0	1DP
GRAG_D60		Effective size of particles corresponding to 60%	0.1	1DP
GRAG_COM		General comments	-	XN

Moisture content and Atterberg limits

Moisture content, degree of saturation and Atterberg limits are described in Table 9 and Table 10 respectively.

Table 9. LNMC - Moisture Content tests (AGS 2017 format, extended for Quito in grey)

Heading	Unit	Description	Example	Data Type
LOCA_ID		Location identifier	T_MAGA_2012_S1	ID
LNMC_DPT	m	Depth of sample	0.00	2DP
LNMC_MC	%	Water/moisture content	36.70	2DP
LNMC_C	%	Degree of Saturation	86.83	2DP

Table 10. LLPL - Liquid and Plastic Limit tests (AGS 2017 format, extended for Quito in grey)

Heading	Unit	Description	Example	Data Type
LOCA_ID		Location identifier	T_ARMO_2016_H5	ID
LLPL_TOP	m	Depth to top of sample	3.00	2DP
LLPL_BASE	m	Depth to bottom of sample	5.00	2DP
LLPL_LL	%	Liquid limit	28.00	0DP
LLPL_PL	%	Plastic limit	24.00	0DP
LLPL_PI	%	Plasticity Index	4.00	0DP
LLPL_COM		General comments	-	XN

Density tests

The results of all density tests including bulk density and dry and saturated densities are structured as in Table 11.

Table 11. LDEN - Density tests (AGS 2017 format, extended for Quito in grey)

Heading	Unit	Description	Example	Data Type
LOCA_ID		Location identifier	T_PLZA_1987_S1	ID
LDEN_DPT	m	Depth of sample	0.00	2DP
LDEN_INF		Available information about collected sample including the compaction of the sample and sample number	-	XN
LDEN_DEN	g/cm ³	Bulk density	1.30	2DP
LDEN_DDEN	g/cm ³	Dry density	-	2DP
LDEN_WDEN	g/cm ³	Saturated density	-	2DP
LDEN_UNW	kN/m ³	Unit Weight	12.80	2DP
LDEN_DUNW	kN/m ³	Dry Unit Weight	11.01	2DP
LDEN_GS		Specific Gravity	2.58	2DP
LDEN_COM		General Comments	Bulk density value was calculated from the bulk unit weight value from the source	XN

Triaxial Tests

The results of triaxial tests are detailed within the TRIG tab, structured as described in Table 12. These results may describe Unconsolidated Undrained (UU), Consolidated Undrained (CU) or Consolidated Drained (CD) triaxial tests, as specified in the TRIG_TEST column. The authors would like to make a note of caution here – the bulk of triaxial testing reported in Quito is undertaken using the Unconsolidated Undrained triaxial test which describes the total stress condition, and therefore reports the total stress parameters (i.e. total cohesion and total friction angle), as water is unable to drain from the specimen during triaxial compression. The Consolidated Undrained triaxial test reports total stress parameters but may also report effective stress parameters (effective cohesion and effective friction angle) if the triaxial measurement is combined with pore water pressure measurement. The Consolidated Drained triaxial, which is least frequently undertaken due to its long running-time, reports effective stress parameters. Assessing whether reported values describe a total or effective stress condition may not always be straightforward (e.g. a study may state that the Consolidated Undrained test was used, but data regarding pore water pressure may not be included). As such, it is not within the remit of this database compilation to assess the exact details and parameters of the test, and users are recommended to refer to the original, open-source materials in order to fully investigate the stress condition, where applicable.

Considering the above, the following approach has been implemented in reporting the results of triaxial tests:

- Where it is known that a database entry describes the total stress condition (i.e. UU test result), the relevant fields are TRIG_TCOH, TRIG_TPHI (total cohesion and total friction angle).
- Where it is known that a database entry describes the effective stress condition (i.e. CD test result), the relevant fields are TRIG_ECOH, TRIG_EPHI (effective cohesion and effective friction angle).
- Where the stress condition is not known (e.g. CU without explicit information), the relevant fields are TRIG_COH, TRIG_PHI (cohesion and friction angle where the total/effective stress condition is not clearly specified).

Table 12. TRIG - Triaxial tests (AGS 2017 format, extended for Quito in grey)

Heading	Unit	Description	Example	Data Type
LOCA_ID		Location identifier	T_CARO_2018_S1	ID
TRIG_TOP	m	Depth to top of sample	0.00	2DP
TRIG_INF		Available information about collected sample	Undisturbed	XN
TRIG_TEST		Test type	UU	XN
TRIG_TCOH	kPa	Total cohesion	86.30	2DP
TRIG_TPHI	deg	Total angle of friction	18.16	2DP
TRIG_ECOH	kPa	Effective cohesion	-	2DP
TRIG_EPHI	deg	Effective angle of friction	-	2DP
TRIG_COH	kPa	Cohesion, unspecified	-	2DP
TRIG_PHI	deg	Angle of friction , unspecified	-	2DP
TRIG_COM		General comments	-	XN

Direct Shear Tests

The cohesion and angle of friction from Direct Shear tests in the database are described in Table 13.

Table 13. SHBO – Direct shear testing (AGS 2017 format, extended for Quito in grey)

Heading	Unit	Description	Example	Data Type
LOCA_ID		Location identifier	T_ILLE_2019_S1	ID
SHBO_DPT	m	Depth of sample	0.00	2DP
SHBO_INF		Available information about collected sample	DS Loose	XN
SHBO_COH	kPa	Cohesion	-	2DP
SHBO_PHI	deg	Angle of friction	32.30	2DP
SHBO_COM		General Comments	No cohesion value was reported in the source	XN

Void ratio

Void ratio and porosity for some of the sites in Quito are described in Table 14.

Table 14. VOLU – Void ratio and porosity (AGS 2017 format, extended for Quito in grey)

Heading	Unit	Description	Example	Data Type
LOCA_ID		Location identifier	T_PEME_2014_S1	ID
VOLU_INF		Available information about sample including the compaction of the sample and sample number	A	X
VOLU_VORA		Void ratio	0.90	2DP
VOLU_PORO	%	Porosity	47.37	2DP

Unified Soil Classification System

Some of the sites in Quito have the soil classified according to the Unified Soil Classification System (USCS); these classifications were directly reported as in the source document and were not checked using the Casagrande chart. The soil classification with depth is described in Table 15.

Table 15. USCS – Soil classifications

Heading	Unit	Description	Example	Data Type
LOCA_ID		Location identifier	T_ARMO_2016_H1	ID
USCS_TOP		Depth to top of sample	0.00	2DP
USCS_BASE		Depth to bottom of sample	1.00	2DP
USCS_CLAS ⁽¹⁾		Soil classification	ML	X

⁽¹⁾ Soil classification according to USCS (Full list is shown in Appendix III)

2.4 Source data quality designation

All database source information has been assigned a data quality number which is based on the site logging quality and the amount of meta-data which is associated with each site location. Where the logging descriptions were considered reliable (i.e. geotechnical testing) or less reliable (logging is based on un-official testing) these have been put into site description categories 1 and 2 respectively. Category 3 is where no geological information is available. This information is held within the field LOCA_LOGQ in the database. The data are further classified according to whether each location contains accompanying geophysical tests, geotechnical *in situ* tests or geotechnical laboratory testing. The variations held in the database are set out in Table 16. The derived quality category information is held within the LOCA table of the database spreadsheet in field LOCA_QUAL.

Table 16. Quality categories

Site descriptions ⁽¹⁾			Geophysical testing	<i>In situ</i> testing	Geotechnical laboratory testing	Quality Category
1	2	3				
✓			✓	✓	✓	1
✓			✓	✗	✗	2
✓			✗	✓	✓	3
✓			✗	✓	✗	4
✓			✗	✗	✓	5
	✓		✓	✗	✗	6
	✓		✗	✓	✗	7
	✓		✗	✗	✓	8
		✓	✗	✓	✓	9
		✓	✗	✓	✗	10
		✓	✗	✗	✓	11

(1) Site description quality categories: 1. Contains engineering/geotechnical soil and rock descriptions 2. The descriptions of site soils are based on unofficial testing (i.e. testing in university laboratory). 3. No geological information provided.

3 DATABASE STATISTICS

The count of *in situ* geotechnical test and geotechnical laboratory test results, and individual geophysical velocity measurements for each of the logging quality classes (as described in Section 2.4) is provided in Table 17, separated by log description quality; Table 18 presents a summary of the individual datasets available from each source included in the database.

Table 17. Distribution of database information across logging quality categories (1-3)

Log description quality	Count (number of database entries)												
	LOCA_LOGQ	ISPT	GEOL	VELO	VS30	GRAG	LNMC	LLPL	LDEN	TRIG	SHBO	VOLU	USCS
1		349	67	306	82	74	277	100	269	231	92	218	500
2		21	0	0	0	0	0	0	0	0	0	0	21
TOTAL		370	67	306	82	74	277	100	269	231	92	218	521

GEOL = No. of Geology data

ISPT = No. of SPT tests

VELO = No. of individual velocity measurements undertaken at intervals at that location

VS30 = No. of calculated velocities at 30 metres of depth

GRAG = No. of particle size distribution or sedimentation tests

LNMC = No. of natural moisture content tests

LLPL = No. of Atterberg Limits

LDEN = No. of density tests

TRIG = No. of Triaxial tests

SHBO = No. of Direct shear tests

USCS = No. of recorded USCS classification

Table 18. Database geotechnical properties and in situ testing distribution

Source	Code	Year	Log quality category	Overall quality	Counts											
					GEOL	SPT's	Velocity measurements	Velocity measurements at 30 meters	Particle size distribution	Natural Moisture Contents	Liquid Limits	Bulk Density	USCS	Triaxial	Direct Shear	Void Ratio
B	FALC	2017	1	2	0	0	0	25	0	0	0	0	0	0	0	0
R	PLAZ	2016	1	1	0	44	0	0	0	0	0	31	48	8	23	0
	VALV	2002	1	1	0	125	125	16	0	0	0	125	125	0	0	0
T	AGUI	2017	1	5	10	0	0	0	10	10	7	0	10	0	0	10
	ARMA	2015	1	1	0	0	0	0	0	3	0	0	21	3	9	3
	ARMO	2016	1	5	46	45	0	0	56	34	40	0	56	0	0	0
	CAIZ	2015	1	5	0	0	0	0	0	4	4	4	4	4	0	0
	CARO	2018	1	5	0	0	0	0	0	1	1	0	1	1	0	0
	CHIC	2018	1	1	0	0	0	0	0	19	8	19	19	19	0	0
	FLAN	2018	1	5	3	0	0	0	0	3	3	3	3	0	0	0
	GISC	2018	1	1	0	0	74	20	0	0	0	74	0	0	0	0
	ILLE	2019	1	5	0	0	0	0	0	20	4	0	20	0	60	60
	JACO	2019	2	8	0	21	0	0	0	0	0	0	21	0	0	0
	MACH	2012	1	1	0	107	107	21	0	5	2	0	5	0	0	0
	MAGA	2012	1	5	8	0	0	0	8	8	7	8	8	16	0	8
	PEME	2014	1	5	0	0	0	0	0	132	0	0	132	132	0	132
	PLZA	1987	1	5	0	0	0	0	0	5	0	5	0	0	0	5
	QUMU	2015	1	5	0	28	0	0	0	0	33	24	0	0	48	0

4 SUMMARY

This manual describes the development and structure of a new database comprising data from 299 testing sites in various geological deposits throughout the city of Quito. The data originated from a variety of literature and report sources. The database is available for download on the “data.bris” University of Bristol Research Data Repository. The data format is inspired by the AGS format (AGS, 2017). It is hoped that this database will be a useful source of information for researchers and practitioners subject to the disclaimer on page x. Users of the database are encouraged to let the authors know of any errors or omissions they may find. Users are welcome to add the data to their own databases, or to download a version of the database from data.bris and use it as a basis for continuing to collate and manage geotechnical data in Quito.

5 REPORT REFERENCES

- Aguiar, R., Rivas, A., Benito, M., Gaspar, J., Trujillo, S., Arciniegas, S., Villalba, P. and Parra, H., 2014. Aceleraciones Registradas Y Calculadas Del Sismo Del 12 De Agosto De 2014 En Quito. *Revista Ciencia*, 16(2), pp.139-1153. Available from:
<https://core.ac.uk/download/pdf/148678405.pdf> [18/01/2022]
- Association of Geotechnical and Geoenvironmental Specialists (AGS), 2017. *Electronic Transfer of Geotechnical and Geoenvironmental Data*, Edition 4.0.4. Bromley, Kent, UK.
<https://www.ags.org.uk/> [18/01/2022]
- ASTM – D2487:2017. *Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)*. American Society for Testing and Materials.
<https://doi.org/10.1520/d2487>
- ASTM D1586-11. 2011. *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*. American Society for Testing and Materials. <https://doi.org/10.1520/D1586-11>
- Boore, D. M., 2004. Estimating VS(30) (or NEHRP Site Classes) from Shallow Velocity Models (Depths <30 m). *Bulletin of the Seismological Society of America*, 94(2), 591 – 597.
<https://doi.org/10.1785/0120030105>
- CEN. 2004. *Eurocode 8: Design of Structures for Earthquake Resistance – Part 1: General Rules, Seismic Actions and Rules for Buildings*. Brussels, Belgium. European Committee for Standardization (CEN).
- Gilder, C. E. L., Pokhrel, R. M., Vardanega, P. J. (2019). *The SAFER Borehole Database (SAFER/GEO-591_v1.1): User Manual*, December 2019, v1.1. University of Bristol, Bristol, UK.
<https://doi.org/10.5523/bris.3gjcvx51lnpuv269xsa1yrb0rw>

Appendix I: Database Sources

Table 19. Database source information

Source type	Year	Code	Source ID	Site-IDs	Count	General Remarks on location and study
T	2016	ARMO	R1	H1, H2, H3, H4, H5, H6, H7, H8, H9	9	La Luz- Barrio la Kennedy, La Kennedy, El Rosario (Cabecera norte del parque Bicentenario), Miraflores (piscina de la Concentración Deportiva de Pichincha), La Vicentina (Parque Central), La Vicentina (Velódromo de la Concentración Deportiva de Pichincha), Parque de los enamorados, Villaflores (Clínica Ecuasanitas), Parque de la avenida 1 De Mayo (cerca al Mercado Santa María, sector Chimbacalle), Chimbacalle (Estadio de Chimbacalle)
T	2018	CARO	R2	S1	1	-
T	2015	CAIZ	R3	S1, S2, S3, S4	4	Aloag-Tambillo, Vía Pifo, Parque Metropolitano, Vía Nono
T	2019	JACO	R4	H1, H2, H3	3	de Santa Teresita del Valle
T	2017	AGUI	R5	H1, H10, H2, H3, H4, H5, H6, H7, H8, H9	10	Quitumbe
T	2018	FLAN	R6	S1, S2, S3	3	Laderas del Cisne
T	2019	ILLE	R7	S1, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S2, S20, S3, S4, S5, S6, S7, S8, S9	20	Pomasqui
T	2012	MAGA	R8	S1, S2, S3, S4, S5, S6, S7, S8	8	La Forestal, Amagás del Inca
T	2015	ARMA	R9	H1, H10, H2, H3, H4, H5, H6, H7, H8, H9	10	La Lira, Ruta Collas, Guayllabamba, Batan Alto, Av 12 De Octubre
T	2018	CHIC	R10	S1, S10, S11, S12, S13, S14, S15, S2, S3, S4, S5, S6, S7, S8, S9	15	Pueblo Unido, Valles del Sur, Lucha de los pobres, La argelia alta, La argelia, La Forestal, Loma de puengasi, patrimonio familiar, San pedro de monjas
T	2014	PEME	R11	S1, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S2, S20, S21, S22, S23, S24, S25, S26, S27, S28, S29, S3, S30, S31, S32, S33, S34, S35, S36, S37, S38, S39, S4, S40, S41, S42, S43, S44, S5, S6, S7, S8, S9	44	
T	2015	QUMU	R12	H1, H10, H11, H12, H13, H14, H15, H16, H17, H18, H19, H2, H20, H21,	48	Jorge Drom y José Villalengua, Calle Alpallana y Av. Diego de Almagro, Pillagua - Cumbayá, Calle Mariano Aguilera y Av. Diego de Almagro,

Source type	Year	Code	Source ID	Site-IDs	Count	General Remarks on location and study
				H22, H23, H24, H25, H26, H27, H28, H29, H3, H30, H31, H32, H33, H34, H35, H36, H37, H38, H39, H4, H40, H41, H42, H43, H44, H45, H46, H47, H48, H5, H6, H7, H8, H9		Conocoto, Calle El Tiempo y El Telégrafo, Barrio Rojas, Sector La Primavera Cumbayá, Hernán Vásquez y Jorge González en la Urbanización Ñaquito Alto II en el lote #75, Av. Mariscal Sucre Sector El Bosque, Calle Camilo Cienfuegos, Barrio La Bota - Quito, Calle Flavio Alfaro y 26 de Agosto, El Triunfo, Pasaje N 24 H y Gerona, la Floresta -Quito, Calle Tegucigalpa Y Nicaragua -Quito, Calle Legarda y Transversal 8, Santa Anita, Calle San Francisco de la Pita y cuarta Transversal, Calle Fernando Ayarza E 13-68 y Quiteño Libre, Calle Gaspar de Carvajal N30-53, Calle Alonso De Torres y Mariscal Sucre, Pasaje Carlos Tamayo y Av. 6 de Diciembre, Calle Moscú - Quito - Prov. Pichincha, Calle Cóndor, Sector El Bosque - Quito, Calle Guanguiltagua - Quito, La Pinta y Amazonas, Calle de Los Cipreses Y Helechos, Tumbaco, Av. Pichincha y Calle Chile, La Marín, Calle Orton y Av. Paul Rivet, San Patricio, Cumbayá, Av. 6 de Diciembre y Pasaje la Paz, Carcelén Alto, Río Coca y Av. 6 de Diciembre, Calle Mañosca y Av. Occidental, Calle La Razón, Av. Eloy Alfaro y Catalina Aldaz
R	2016	PLAZ	R13	H1, H10, H11, H12, H13, H14, H15, H16, H17, H18, H19, H2, H20, H21, H22, H23, H24, H25, H26, H27, H28, H29, H3, H30, H31, H32, H33, H4, H5, H6, H7, H8, H9	33	La Ofelia, Mariscal Sucre, Colinas del Norte, Roldós, Pilona 1, Pilona 2, Pilona 03, Pilona 4, Pilona 5, Pilona 6, Pilona 7, Pilona 8, Pilona 9, Pilona 10, Pilona 11, Pilona 12, Pilona 13, Pilona 14, Pilona 15, Pilona 16, Pilona 17, Pilona 18, Pilona 19, Pilona 20, Pilona 21, Pilona 22, Pilona 23, Pilona 24, Pilona 25, Pilona 26, Pilona 27, Pilona 28
B	2017	FALC	R14	S1, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S2, S20, S21, S22, S23, S24, S25, S3, S4, S5, S6, S7, S8, S9	25	Solanda, Chimbacalle, La Gasca, Quito Tennis, Andalucía, County, Liceo Fernandez Madrid, Sucre School, Quitumbe, Moran Valverde, El Calzado, El Recreo, La Magdalena, San Francisco, La Alameda, U Central, La Carolina, Ñaquito con ñ jipijapa, El Labrador, Benalcázar School, Mirror School, Metropolitan Park
R	2002	VALV	R15	H1, H10, H11, H12, H13, H14, H15, H16, H17, H18, H2, H3, H4, H5, H6, H7, H8, H9	18	
T	1987	PLZA	R16	S1, S2, S3, S4, S5	5	Bellavista and Guangilagua
T	2018	GISC	R17	H1, H10, H11, H12, H13, H14, H15, H16, H17, H18, H19, H2, H20, H3, H4, H5, H6, H7, H8, H9	20	"Flancos Pichincha Norte, Flancos Pichincha Sur, Conos de Deyección Norte, Conos de Deyección Sur, Cumbayá (Valle del DMQ), Turubamba (Zona al Sur), Cercano al Río Monjas en el Norte, Calderón (Zona sobre la loma BC), Prueba 1, Cercano al Peaje de Guayasamín, Cangahua Sur al
T	2012	MACH	R18	H1, H10, H11, H12, H13, H14, H15, H16, H17, H18, H19, H2, H20, H21, H22, H23, H3, H4, H5, H6, H7, H8, H9	23	SMQ-8, SMQ-9

- R1. Flor Arroyo, A.D., 2016. Determinación De Ángulo De Fricción Y Cohesión Del Suelo Mediante Correlaciones Obtenidas En Los Ensayos De Plasticidad, Módulo De Elasticidad Y NSPT De Suelos De Tres Sectores De La Ciudad De Quito (Bachelor's Thesis, PUCE). Pontificia Universidad Católica del Ecuador, Quito, Ecuador. <http://repositorio.puce.edu.ec/handle/22000/10618> [17.01.2022]
- R2. Betancourt Campuzano, P.R., 2018. Mechanical, Mineralogical, Morphological and Computational Characterization of Ecuadorian soil: A Nationwide First Data Baseline (Bachelor's thesis, Quito). Universidad San Francisco de Quito, Quito, Ecuador. <http://repositorio.usfq.edu.ec/handle/23000/7208> [17.01.2022]
- R3. Pachacama, N., 2015. Caracterización De Cangahuas Mediante Ensayos Triaxiales No Consolidados-No Drenados (Uu) Y Consolidado No Drenado (Cu), Aplicación A La Estabilidad De Taludes. Universidad De Las Fuerzas Armadas ESPE, Cayambe, Ecuador. <http://repositorio.espe.edu.ec/handle/21000/10939> [17.01.2022]
- R4. Camino Jácome, D.M., 2019. Análisis Del Nivel De Riesgo-Exposición A Amenazas Por Movimientos En Masa En El Barrio Comité Pro-Mejoras Santa Teresita De Conocoto, Zona Valle De Los Chillos, Distrito Metropolitano De Quito (Bachelor's Thesis, Quito, 2019.). Escuela Politécnica Nacional, Quito, Ecuador. <http://bibdigital.epn.edu.ec/handle/15000/19982> [17.01.2022]
- R5. Carrera Aguilar, S.V. and Carlosama Morejón, F.J., 2017. Análisis Del Peligro Por Fenómenos De Remoción En Masa En Los Taludes De Un Tramo De La Quebrada Shanshayacu, Zona Quitumbe, Distrito Metropolitano De Quito (Bachelor's Thesis, Quito, 2017.). Escuela Politécnica Nacional, Quito, Ecuador. <http://bibdigital.epn.edu.ec/handle/15000/17237> [17.01.2022]
- R6. Flores, C. and Xavier, B., 2018. Análisis De Estabilidad De Taludes En El Barrio Virgen Del Cisne, Sector Atucucho (Bachelor's Thesis, Quito: UCE). Universidad Central Del Ecuador, Quito, Ecuador. <http://www.dspace.uce.edu.ec/handle/25000/16221> [17.01.2022]
- R7. Tenesaca Illescas, L.F. and Caiza Flores, D.F., 2019. Correlación Entre El Angulo De Fricción Y La Relación De Vacíos En Arenas Utilizando El Ensayo De Corte Directo (Bachelor's Thesis). Universidad Politécnica Salesiana, Cuenca, Ecuador. <http://dspace.ups.edu.ec/handle/123456789/17738> [17.01.2022]
- R8. Gaibor Lombeida, A.M. and Guano Zambrano, M.P., 2012. Resistencia De La Cangahua En Función De Su Composición Mineralógica Y Contenido De Humedad En Dos Sectores De Quito: Sur Y Norte (Bachelor's Thesis). Universidad Politécnica Salesiana, Cuenca, Ecuador. <http://dspace.ups.edu.ec/handle/123456789/3981> [17.01.2022]
- R9. Medina Muñoz, C.A., 2015. Análisis De La Resistencia Al Corte Interfacial (IFSS) De Compuestos Reforzados Con Nanoestructuras. Universidad de Concepción, Quito, Ecuador. <http://repositorio.udec.cl/jspui/handle/11594/1911> [17.01.2022]
- R10. Montatixe Chicaiza, E.C. and Chango Alvarez, D.F., 2018. Análisis De Estabilidad De Taludes En Un Tramo De Las Avenidas Simón Bolívar Y Gonzalo Pérez Bustamante, Distrito Metropolitano De Quito (Bachelor's Thesis, Quito, 2018.). Escuela Politécnica Nacional. Quito, Ecuador. <http://bibdigital.epn.edu.ec/handle/15000/19971> [17.01.2022]
- R11. Monereo Pérez, J., 2014. Determinación Del Módulo De Deformación A Través De Ensayos De Compresión Triaxial En Cangahua (Bachelor's Thesis). Universidad Politécnica Salesiana, Cuenca, Ecuador. <http://dspace.ups.edu.ec/handle/123456789/11363> [17.01.2022]

- R12. Ortiz Quinteros, C.A., 2015. Análisis Comparativo De Las Propiedades Geomecánicas De Varios Suelos Del Ecuador Aplicados A La Estabilidad De Taludes (Bachelor's Thesis, Quito/UIDE/2015). Universidad Internacional Del Ecuador, Quito, Ecuador. <http://repositorio.uide.edu.ec/handle/37000/2190> [17.01.2022]
- R13. EMMOP, E.M., 2016. Estudio Hidrológico Y Meteorológico Para El Proyecto:“Estudios Complementarios Para El Detalle De Ingenierías De Las Línea Roldós-Ofelia”.
- R14. Falconí, R.A., 2017. *Microzonificación Sísmica De Quito*. Centro De Investigaciones Científicas. https://www.researchgate.net/profile/RobertoAguiar/publication/277305703_Microzonificacion_Sismica_de_Quito/links/59a988690f7e9bdd114ac115/Microzonificacion-Sismica-de-Quito.pdf [18.01.2022]
- R15. Valverde, J., Fernández, J., Jiménez, E., Vaca, T. and Alarcón, F., 2002. Microzonificación Sísmica De Los Suelos Del Distrito Metropolitano De La Ciudad De Quito. Escuela Politécnica Nacional Del Ecuador, Quito. https://biblio.flacsoandes.edu.ec/shared/biblio_view.php?bibid=126795&tab=opac [18.01.2022]
- R16. Crespo, E., 1987. Slope Stability Of The Cangahua Formation, A Volcaniclastic Deposit From The Interandean Depression Of Ecuador (Doctoral Dissertation, Thesis Presented To Cornell University, At Ithaca, NY, In Partial Fulfillment Of The Requirements For The Degree Of Master Of Science).
- R17. Giráldez, A. And Schmitz, M., 2018. Generación De Mapas Vs30 Y Microzonas Sísmicas En El Distrito Metropolitano De Quito, Ecuador. Universidad Simón Bolívar.
- R18. Machado, C., Aldana, M. and Cataldi, A., 2012. Caracterización De La Zona Sur De La Línea 1 Del Metro De Quito-Ecuador Utilizando El Método Remi. Universidad Simón Bolívar.

Appendix II: List of resources

Table 20. List of resources provided with the database

Files: Spreadsheets & comma delimited files	Description
QUITO-GEO-299_v1.0.xlsx	Main database Excel sheet which contains the originally sourced data
LOCA.csv, GEOL.csv, ISPT.csv, VELO.csv, VS30.csv, GRAG.csv, LNMC.csv, LLPL.csv, LDEN.csv, TRIG.csv, SHBO.csv, VOLU.csv, USCS.csv.	Breakdown of each database table as a comma delimited file.
Table_17.xlsx	Soft copy of Table 17 provided in the manual
Table_18.xlsx	Soft copy of Table 18 provided in the manual
Table_19.xlsx	Soft copy of Table 19 provided in the manual

Appendix III: Geology codes

Table 21. Abbreviations GEOL_LEG & USCS_CLAS

Code	Description	Code	Description	Code	Description
0	Unknown	231	Silty gravelly cobbly CLAY	412	Silty gravelly SAND
101	TOPSOIL	301	SILT	413	Silty gravelly cobbly SAND
102	MADE GROUND	302	Clay/Silt	414	Silty gravelly cobbly bouldery SAND
201	CLAY	303	Sandy SILT	415	Gravelly cobbly SAND
202	Silty CLAY	304	Gravelly SILT	416	Gravelly cobbly bouldery SAND
203	Sandy CLAY	305	Organic SILT	417	Gravelly bouldery SAND
204	Gravelly CLAY	309	Clayey sandy SILT	418	Cobbly bouldery SAND
205	Cobbly CLAY	310	Sandy gravelly SILT	419	Silty cobbly SAND
206	Bouldery CLAY	312	Clayey sandy gravelly SILT	430	SAND and GRAVEL
207	Silty sandy CLAY	314	Clayey sandy gravelly organic cobbly SILT	431	Organic SAND
208	Silty gravelly CLAY	316	Sandy cobbly SILT	433	Silty organic SAND
209	Silty cobbly CLAY	317	Sandy bouldery SILT	434	Gravelly organic SAND
210	Silty bouldery CLAY	318	Sandy organic SILT	435	Cobbly organic SAND
211	Silty sandy gravelly CLAY	319	Sandy gravelly organic SILT	436	Bouldery organic SAND
212	Silty sandy cobbly CLAY	320	Sandy gravelly cobbly SILT	501	GRAVEL
213	Silty sandy bouldery CLAY	321	Sandy gravelly organic cobbly SILT	502	Clayey GRAVEL
214	Silty sandy gravelly cobbly CLAY	322	Gravelly cobbly SILT	503	Silty GRAVEL
215	Silty sandy gravelly bouldery CLAY	323	Gravelly bouldery SILT	504	Sandy GRAVEL
216	Silty sandy gravelly cobbly bouldery CLAY	324	Gravelly organic SILT	505	Organic GRAVEL
217	Silty sandy organic CLAY	325	Gravelly organic cobbly SILT	506	Cobbly GRAVEL
218	Silty sandy gravelly organic CLAY	326	Cobbly SILT	507	Bouldery GRAVEL
219	Silty organic CLAY	327	Cobbly bouldery SILT	509	Clayey sandy GRAVEL
220	Sandy gravelly CLAY	328	Organic cobbly SILT	510	Clayey cobbly GRAVEL
222	Sandy cobbly CLAY	331	Bouldery SILT	511	Clayey bouldery GRAVEL
223	Sandy bouldery CLAY	332	Sandy gravelly clayey cobbly SILT	512	Clayey organic GRAVEL
224	Sandy gravelly cobbly CLAY	401	SAND	513	Clayey sandy cobbly GRAVEL
225	Sandy gravelly bouldery CLAY	402	Clayey SAND	517	Clayey sandy organic GRAVEL
226	Sandy gravelly cobbly bouldery CLAY	403	Silty SAND	520	Silty sandy GRAVEL
227	Sandy organic CLAY	404	Gravelly SAND	521	Silty cobbly GRAVEL
228	Sandy gravelly organic CLAY	405	Cobbly SAND	522	Silty bouldery GRAVEL
229	Organic CLAY	406	Bouldery SAND		
230	Gravelly cobbly CLAY	410	Clayey gravelly SAND		
		411	Clayey gravelly cobbly SAND		

Code	Description
523	Silty organic GRAVEL
524	Silty organic sandy GRAVEL
525	Sandy cobbly GRAVEL
526	Sandy bouldery GRAVEL
527	Sandy organic GRAVEL
528	Silty sandy cobbly GRAVEL
601	PEAT
602	Clayey PEAT
603	Silty PEAT
604	Sandy PEAT
605	Gravelly PEAT
606	Cobbly PEAT
608	Clayey sandy PEAT
609	Clayey gravelly PEAT
612	Silty sandy PEAT
613	Silty sandy gravelly PEAT
614	Sandy gravelly PEAT
701	COBBLES
702	Clayey COBBLES
703	Silty COBBLES
704	Sandy COBBLES
705	Gravelly COBBLES
706	Organic COBBLES
708	Clayey sandy COBBLES
709	Clayey gravelly COBBLES
713	Silty sandy COBBLES
714	Silty gravelly COBBLES
715	Silty organic COBBLES
716	Silty gravelly sandy COBBLES
717	Silty sandy organic COBBLES
718	Silty sandy gravelly organic COBBLES
719	Sandy gravelly COBBLES
720	Sandy organic COBBLES
721	Gravelly organic COBBLES

Code	Description
725	COBBLES and BOULDERS
730	BOULDERS
731	Gravelly cobbly BOULDERS
801	MUDSTONE
802	SILTSTONE
803	SANDSTONE
804	LIMESTONE
806	COAL (lignite)
812	Fine grained METAMORPHIC
813	Medium grained METAMORPHIC
814	Coarse grained METAMORPHIC

Code	Description
G	Gravel
S	Sand
M	Silt
C	Clay
O	Organic
P	Poorly graded (many particle of about the same size)
W	Well-graded (many different particle sizes)
H	High plasticity
L	Low plasticity

Appendix IV: Database Overview

Table 22. Database overview

Source	Code	Year	BH_ID	Log quality	Easting	Northing	Elevation m (MSL)
				LOCA_LOGQ	LOCA_NATE	LOCA_NATN	LOCA_DEM
T	ARMO	2016	H1	1	780241.00	9983954.00	2806
T	ARMO	2016	H2	1	780493.00	9984235.00	2817
T	ARMO	2016	H3	1	779162.00	9985945.00	2808
T	ARMO	2016	H4	1	777239.00	9977352.00	2860
T	ARMO	2016	H5	1	779962.00	9976470.00	2795
T	ARMO	2016	H6	1	779543.00	9976232.00	2799
T	ARMO	2016	H7	1	775319.00	9973020.00	2809
T	ARMO	2016	H8	1	776480.00	9973007.00	2846
T	ARMO	2016	H9	1	776561.00	9972787.00	2839
T	CARO	2018	S1	1	780446.00	9984238.00	2817
T	CAIZ	2015	S1	1	773128.00	9955367.00	2793
T	CAIZ	2015	S2	1	795145.00	9968339.00	2662
T	CAIZ	2015	S3	1	782606.00	9980516.00	2965
T	CAIZ	2015	S4	1	771994.00	9989280.00	3241
T	JACO	2019	H1	2	778159.00	9970801.00	2879
T	JACO	2019	H2	2	778159.00	9970801.00	2879
T	JACO	2019	H3	2	778159.00	9970801.00	2879
T	AGUI	2017	H1	1	771715.00	9965847.00	2958
T	AGUI	2017	H2	1	771731.00	9965886.00	2954
T	AGUI	2017	H3	1	771824.00	9965966.00	2949
T	AGUI	2017	H4	1	771757.00	9965910.00	2953
T	AGUI	2017	H5	1	771776.00	9965929.00	2952
T	AGUI	2017	H6	1	771869.00	9966000.00	2947
T	AGUI	2017	H7	1	772408.00	9966752.00	2919
T	AGUI	2017	H8	1	772439.00	9966904.00	2914
T	AGUI	2017	H9	1	772244.00	9966634.00	2931
T	AGUI	2017	H10	1	772556.00	9967034.00	2907
T	FLAN	2018	S1	1	776907.00	9985382.00	3050

Table 22. Database overview (continued)

Source	Code	Year	BH_ID	Log quality	Easting	Northing	Elevation m (MSL)
				LOCA_LOGQ	LOCA_NATE	LOCA_NATN	LOCA_DEM
T	FLAN	2018	S2	1	777026.00	9985485.00	3069
T	FLAN	2018	S3	1	777372.00	9985710.00	3042
T	ILLE	2019	S1	1	784604.07	9995157.18	2458
T	FLAN	2018	S2	1	777026.00	9985485.00	3069
T	FLAN	2018	S3	1	777372.00	9985710.00	3042
T	ILLE	2019	S1	1	784604.07	9995157.18	2458
T	ILLE	2019	S2	1	784702.15	9995096.54	2468
T	ILLE	2019	S3	1	784709.00	9995277.00	2456
T	ILLE	2019	S4	1	784873.25	9995466.00	2466
T	ILLE	2019	S5	1	784916.01	9999039.30	2377
T	ILLE	2019	S6	1	784949.86	9999172.65	2373
T	ILLE	2019	S7	1	785104.00	9999238.00	2382
T	ILLE	2019	S8	1	785392.86	9999300.16	2344
T	ILLE	2019	S9	1	785213.00	9997463.00	2420
T	ILLE	2019	S10	1	785218.00	9997535.00	2434
T	ILLE	2019	S11	1	785226.91	9997600.82	2428
T	ILLE	2019	S12	1	785294.17	9997662.07	2419
T	ILLE	2019	S13	1	776764.45	9999308.22	2819
T	ILLE	2019	S14	1	776584.75	9999266.10	2818
T	ILLE	2019	S15	1	776463.83	9999367.15	2817
T	ILLE	2019	S16	1	776410.77	9999458.42	2820
T	ILLE	2019	S17	1	761944.29	9997460.00	1961
T	ILLE	2019	S18	1	761871.48	9997339.00	2003
T	ILLE	2019	S19	1	761725.68	9997259.00	2056
T	ILLE	2019	S20	1	761641.89	9997250.00	2077
T	MAGA	2012	S1	1	777994.00	9972267.00	3074
T	MAGA	2012	S2	1	777562.00	9971237.00	3073
T	MAGA	2012	S3	1	777525.00	9971938.00	3012
T	MAGA	2012	S4	1	777341.00	9972044.00	2972
T	MAGA	2012	S5	1	783056.00	9984961.00	2867

Table 22. Database overview (continued)

Source	Code	Year	BH_ID	Log quality	Easting	Northing	Elevation m (MSL)
				LOCA_LOGQ	LOCA_NATE	LOCA_NATN	LOCA_DEM
T	MAGA	2012	S6	1	782745.00	9984730.00	2898
T	MAGA	2012	S7	1	783169.00	9986129.00	2731
T	MAGA	2012	S8	1	783300.00	9986055.00	2723
T	ARMA	2015	H1	1	784423.00	9977905.00	2485
T	ARMA	2015	H2	1	791311.00	9988307.00	2000
T	ARMA	2015	H3	1	791398.00	9988372.00	2021
T	ARMA	2015	H4	1	791713.00	9992054.00	2122
T	ARMA	2015	H5	1	791861.00	9992183.00	2059
T	ARMA	2015	H6	1	780407.00	9978800.00	2773
T	ARMA	2015	H7	1	780431.00	9978776.00	2778
T	ARMA	2015	H8	1	791861.00	9992183.00	2059
T	ARMA	2015	H9	1	780422.00	9978793.00	2775
T	ARMA	2015	H10	1	780128.91	9977414.29	2817
T	CHIC	2018	S1	1	774814.90	9966719.60	3021
T	CHIC	2018	S2	1	774754.90	9966693.20	3000
T	CHIC	2018	S3	1	775327.30	9967697.20	3069
T	CHIC	2018	S4	1	775469.60	9968031.40	3109
T	CHIC	2018	S5	1	775830.90	9967923.90	3136
T	CHIC	2018	S6	1	776111.60	9968289.40	3146
T	CHIC	2018	S7	1	776146.80	9968345.60	3143
T	CHIC	2018	S8	1	777197.00	9969784.00	3165
T	CHIC	2018	S9	1	777985.50	9971488.20	3080
T	CHIC	2018	S10	1	777831.20	9972036.60	3069
T	CHIC	2018	S11	1	778424.00	9973116.00	3037
T	CHIC	2018	S12	1	778062.00	9973540.00	2936
T	CHIC	2018	S13	1	779335.00	9973883.00	2948
T	CHIC	2018	S14	1	779045.00	9974287.00	2936
T	CHIC	2018	S15	1	779352.00	9974348.00	2923
T	PEME	2014	S1	1	779484.00	9974277.00	2917
T	PEME	2014	S2	1	779484.00	9974277.00	2917

Table 22. Database overview (continued)

Source	Code	Year	BH_ID	Log quality	Easting	Northing	Elevation m (MSL)
				LOCA_LOGQ	LOCA_NATE	LOCA_NATN	LOCA_DEM
T	PEME	2014	S3	1	779137.00	9974102.00	2952
T	PEME	2014	S4	1	779137.00	9974102.00	2952
T	PEME	2014	S5	1	779137.00	9974102.00	2952
T	PEME	2014	S6	1	779137.00	9974102.00	2952
T	PEME	2014	S7	1	779137.00	9974102.00	2952
T	PEME	2014	S8	1	779137.00	9974102.00	2952
T	PEME	2014	S9	1	778558.00	9973161.00	3008
T	PEME	2014	S10	1	778558.00	9973161.00	3008
T	PEME	2014	S11	1	778558.00	9973161.00	3008
T	PEME	2014	S12	1	778558.00	9973161.00	3008
T	PEME	2014	S13	1	778558.00	9973161.00	3008
T	PEME	2014	S14	1	778558.00	9973161.00	3008
T	PEME	2014	S15	1	778558.00	9973161.00	3008
T	PEME	2014	S16	1	778159.00	9972873.00	3034
T	PEME	2014	S17	1	778159.00	9972873.00	3034
T	PEME	2014	S18	1	778159.00	9972873.00	3034
T	PEME	2014	S19	1	777834.00	9971164.00	3097
T	PEME	2014	S20	1	777655.00	9970875.00	3111
T	PEME	2014	S21	1	777488.00	9970706.00	3119
T	PEME	2014	S22	1	776940.00	9969499.00	3150
T	PEME	2014	S23	1	776940.00	9969499.00	3150
T	PEME	2014	S24	1	776940.00	9969499.00	3150
T	PEME	2014	S25	1	776203.00	9968494.00	3150
T	PEME	2014	S26	1	776203.00	9968494.00	3150
T	PEME	2014	S27	1	776203.00	9968494.00	3150
T	PEME	2014	S28	1	776203.00	9968494.00	3150
T	PEME	2014	S29	1	774730.00	9966607.00	2990
T	PEME	2014	S30	1	774730.00	9966607.00	2990
T	PEME	2014	S31	1	774730.00	9966607.00	2990
T	PEME	2014	S32	1	774730.00	9966607.00	2990

Table 22. Database overview (continued)

Source	Code	Year	BH_ID	Log quality	Easting	Northing	Elevation m (MSL)
				LOCA_LOGQ	LOCA_NATE	LOCA_NATN	LOCA_DEM
T	PEME	2014	S33	1	774730.00	9966607.00	2990
T	PEME	2014	S34	1	774730.00	9966607.00	2990
T	PEME	2014	S35	1	774730.00	9966607.00	2990
T	PEME	2014	S36	1	774730.00	9966607.00	2990
T	PEME	2014	S37	1	783056.00	9984961.00	2867
T	PEME	2014	S38	1	782745.00	9984730.00	2898
T	PEME	2014	S39	1	783169.00	9986129.00	2731
T	PEME	2014	S40	1	783300.00	9986055.00	2723
T	PEME	2014	S41	1	778107.00	9972633.00	3046
T	PEME	2014	S42	1	777878.00	9972249.00	3067
T	PEME	2014	S43	1	777810.00	9971966.00	3070
T	PEME	2014	S44	1	777828.00	9971812.00	3070
T	QUMU	2015	H1	1	779853.00	9980872.00	2784
T	QUMU	2015	H2	1	779853.00	9980872.00	2784
T	QUMU	2015	H3	1	780088.00	9978429.00	2776
T	QUMU	2015	H4	1	787049.00	9978157.00	2348
T	QUMU	2015	H5	1	779995.00	9978290.00	2777
T	QUMU	2015	H6	1	779334.00	9967636.00	2597
T	QUMU	2015	H7	1	780271.00	9980900.00	2781
T	QUMU	2015	H8	1	785988.00	9976049.00	2351
T	QUMU	2015	H9	1	785988.00	9976049.00	2350
T	QUMU	2015	H10	1	777941.00	9980921.00	2958
T	QUMU	2015	H11	1	777941.00	9980921.00	2958
T	QUMU	2015	H12	1	785988.00	9976049.00	2351
T	QUMU	2015	H13	1	778532.00	9982058.00	2894
T	QUMU	2015	H14	1	778532.00	9982058.00	2894
T	QUMU	2015	H15	1	782700.00	9987126.00	2722
T	QUMU	2015	H16	1	777041.00	9986312.00	2971
T	QUMU	2015	H17	1	780391.00	9976612.00	2807
T	QUMU	2015	H18	1	777179.00	9976831.00	2909

Table 22. Database overview (continued)

Source	Code	Year	BH_ID	Log quality	Easting	Northing	Elevation m (MSL)
				LOCA_LOGQ	LOCA_NATE	LOCA_NATN	LOCA_DEM
T	QUMU	2015	H19	1	777179.00	9976831.00	2909
T	QUMU	2015	H20	1	784088.00	9977915.00	2509
T	QUMU	2015	H21	1	780759.00	9979369.00	2795
T	QUMU	2015	H22	1	778525.00	9979323.00	2853
T	QUMU	2015	H23	1	778525.00	9979323.00	2853
T	QUMU	2015	H24	1	778631.00	9981720.00	2909
T	QUMU	2015	H25	1	778634.00	9981717.00	2908
T	QUMU	2015	H26	1	780462.00	9979532.00	2778
T	QUMU	2015	H27	1	780462.00	9979532.00	2778
T	QUMU	2015	H28	1	779321.00	9982406.00	2816
T	QUMU	2015	H29	1	781366.00	9980220.00	2860
T	QUMU	2015	H30	1	779345.00	9978026.00	2785
T	QUMU	2015	H31	1	779345.00	9978026.00	2785
T	QUMU	2015	H32	1	781289.00	9985952.00	2911
T	QUMU	2015	H33	1	790979.00	9976678.00	2389
T	QUMU	2015	H34	1	790979.00	9976678.00	2389
T	QUMU	2015	H35	1	777358.00	9975338.00	2792
T	QUMU	2015	H36	1	777358.00	9975338.00	2792
T	QUMU	2015	H37	1	780292.00	9978312.00	2792
T	QUMU	2015	H38	1	780292.00	9978312.00	2792
T	QUMU	2015	H39	1	784110.00	9976357.00	2436
T	QUMU	2015	H40	1	780038.00	9978066.00	2781
T	QUMU	2015	H41	1	780038.00	9978066.00	2781
T	QUMU	2015	H42	1	781057.00	9989609.00	2802
T	QUMU	2015	H43	1	781044.00	9981911.00	2790
T	QUMU	2015	H44	1	778127.00	9980590.00	2906
T	QUMU	2015	H45	1	780645.00	9980623.00	2782
T	QUMU	2015	H46	1	780645.00	9980623.00	2782
T	QUMU	2015	H47	1	780824.00	9979553.00	2800
T	QUMU	2015	H48	1	780824.00	9979553.00	2800

Table 22. Database overview (continued)

Source	Code	Year	BH_ID	Log quality	Easting	Northing	Elevation m (MSL)
				LOCA_LOGQ	LOCA_NATE	LOCA_NATN	LOCA_DEM
R	PLAZ	2016	H1	1	779617.94	9987789.66	2755
R	PLAZ	2016	H2	1	778797.91	9988408.80	2722
R	PLAZ	2016	H3	1	778821.91	9988402.79	2722
R	PLAZ	2016	H4	1	777579.86	9989338.98	2742
R	PLAZ	2016	H5	1	777157.89	9990412.11	2875
R	PLAZ	2016	H6	1	779603.94	9987811.67	2756
R	PLAZ	2016	H7	1	779575.94	9987811.67	2756
R	PLAZ	2016	H8	1	779476.93	9987810.68	2754
R	PLAZ	2016	H9	1	779300.93	9988030.72	2740
R	PLAZ	2016	H10	1	779102.92	9988180.75	2734
R	PLAZ	2016	H11	1	778972.92	9988283.77	2730
R	PLAZ	2016	H12	1	778898.91	9988338.78	2727
R	PLAZ	2016	H13	1	778833.91	9988389.79	2722
R	PLAZ	2016	H14	1	778778.91	9988427.80	2720
R	PLAZ	2016	H15	1	778750.91	9988445.80	2720
R	PLAZ	2016	H16	1	778694.90	9988490.81	2720
R	PLAZ	2016	H17	1	778518.90	9988626.84	2727
R	PLAZ	2016	H18	1	778376.89	9988737.86	2734
R	PLAZ	2016	H19	1	778202.88	9988866.89	2738
R	PLAZ	2016	H20	1	778018.88	9989007.92	2726
R	PLAZ	2016	H21	1	777928.87	9989076.93	2727
R	PLAZ	2016	H22	1	777740.86	9989217.96	2742
R	PLAZ	2016	H23	1	777479.85	9989410.00	2797
R	PLAZ	2016	H24	1	777443.85	9989469.00	2798
R	PLAZ	2016	H25	1	777442.86	9989494.01	2797
R	PLAZ	2016	H26	1	777421.86	9989564.01	2812
R	PLAZ	2016	H27	1	777383.86	9989678.03	2848
R	PLAZ	2016	H28	1	777347.87	9989806.04	2881
R	PLAZ	2016	H29	1	777323.87	9989876.05	2894
R	PLAZ	2016	H30	1	777302.87	9989947.06	2892

Table 22. Database overview (continued)

Source	Code	Year	BH_ID	Log quality	Easting	Northing	Elevation m (MSL)
				LOCA_LOGQ	LOCA_NATE	LOCA_NATN	LOCA_DEM
R	PLAZ	2016	H31	1	777230.88	9990167.08	2866
R	PLAZ	2016	H32	1	777191.89	9990304.10	2870
R	PLAZ	2016	H33	1	777161.89	9990375.11	2878
B	FALC	2017	S1	1	774129.42	9969786.59	2856
B	FALC	2017	S2	1	776641.90	9972714.06	2842
B	FALC	2017	S3	1	777579.44	9978134.20	2858
B	FALC	2017	S4	1	779166.84	9981621.05	2849
B	FALC	2017	S5	1	778269.84	9984390.85	2868
B	FALC	2017	S6	1	778905.06	9989137.70	2692
B	FALC	2017	S7	1	777156.65	9974842.50	2802
B	FALC	2017	S8	1	777166.85	9975231.72	2798
B	FALC	2017	S9	1	772330.50	9968305.50	2908
B	FALC	2017	S10	1	773182.00	9968919.50	2878
B	FALC	2017	S11	1	773073.50	9970170.50	2861
B	FALC	2017	S12	1	774490.00	9972250.50	2827
B	FALC	2017	S13	1	776045.50	9973075.50	2816
B	FALC	2017	S14	1	775898.00	9974343.50	2967
B	FALC	2017	S15	1	777100.50	9975659.50	2813
B	FALC	2017	S16	1	778193.00	9977027.00	2803
B	FALC	2017	S17	1	778331.50	9978873.50	2842
B	FALC	2017	S18	1	780137.00	9979837.50	2782
B	FALC	2017	S19	1	780651.00	9980530.00	2784
B	FALC	2017	S20	1	780245.50	9981217.50	2783
B	FALC	2017	S21	1	780250.00	9981607.00	2783
B	FALC	2017	S22	1	779751.00	9983577.50	2806
B	FALC	2017	S23	1	781434.00	9980537.00	2853
B	FALC	2017	S24	1	777863.00	9976840.00	2810
B	FALC	2017	S25	1	783616.62	9979865.47	2739
R	VALV	2002	H1	1	770709.00	9968873.00	3025
R	VALV	2002	H2	1	773537.00	9973851.00	3040

Table 22. Database overview (continued)

Source	Code	Year	BH_ID	Log quality	Easting	Northing	Elevation m (MSL)
				LOCA_LOGQ	LOCA_NATE	LOCA_NATN	LOCA_DEM
R	VALV	2002	H3	1	776885.00	9975568.00	2820
R	VALV	2002	H4	1	777823.00	9980685.00	2950
R	VALV	2002	H5	1	777517.00	9983574.00	3001
R	VALV	2002	H6	1	776370.00	9986023.00	3053
R	VALV	2002	H7	1	774379.00	9975292.00	3202
R	VALV	2002	H8	1	773691.00	9967772.00	2888
R	VALV	2002	H9	1	771971.00	9969576.00	2886
R	VALV	2002	H10	1	780271.00	9980780.00	2781
R	VALV	2002	H11	1	780116.00	9978690.00	2773
R	VALV	2002	H12	1	779544.00	9984938.00	2814
R	VALV	2002	H13	1	776519.00	9969330.00	3109
R	VALV	2002	H14	1	784324.00	9985737.00	2620
R	VALV	2002	H15	1	780193.00	9976013.00	2726
R	VALV	2002	H16	1	783635.00	9987445.00	2669
R	VALV	2002	H17	1	783712.00	9991017.00	2525
R	VALV	2002	H18	1	771929.00	9963556.00	3075
T	PLZA	1987	S1	1	781666.00	9979618.00	2906
T	PLZA	1987	S2	1	781666.00	9979618.00	2906
T	PLZA	1987	S3	1	781666.00	9979618.00	2906
T	PLZA	1987	S4	1	781666.00	9979618.00	2906
T	PLZA	1987	S5	1	781666.00	9979618.00	2906
T	GISC	2018	H1	1	776823.17	9984183.20	3057
T	GISC	2018	H2	1	771379.04	9970552.21	2980
T	GISC	2018	H3	1	778565.16	9988672.38	2720
T	GISC	2018	H4	1	771793.98	9963864.17	3065
T	GISC	2018	H5	1	785685.98	9975908.67	2378
T	GISC	2018	H6	1	774099.62	9970095.93	2856
T	GISC	2018	H7	1	783568.90	9999510.73	2460
T	GISC	2018	H8	1	787533.49	9992904.08	2748
T	GISC	2018	H9	1	786670.87	9988526.98	2666

Table 22. Database overview (continued)

Source	Code	Year	BH_ID	Log quality	Easting	Northing	Elevation m (MSL)
				LOCA_LOGQ	LOCA_NATE	LOCA_NATN	LOCA_DEM
T	GISC	2018	H10	1	782661.39	9978760.61	2676
T	GISC	2018	H11	1	778016.11	9971491.90	3080
T	GISC	2018	H12	1	775788.41	9965276.23	3131
T	GISC	2018	H13	1	787168.87	9986771.71	2567
T	GISC	2018	H14	1	781857.55	9964572.22	2500
T	GISC	2018	H15	1	793292.86	9986483.45	2367
T	GISC	2018	H16	1	790950.16	9976707.49	2387
T	GISC	2018	H17	1	794085.13	9976113.77	2513
T	GISC	2018	H18	1	783255.15	9967413.48	2461
T	GISC	2018	H19	1	789158.24	9988409.07	2373
T	GISC	2018	H20	1	789001.38	9993354.27	2555
T	MACH	2012	H1	1	772975.00	9969151.00	2871
T	MACH	2012	H2	1	772975.00	9969151.00	2871
T	MACH	2012	H3	1	772975.00	9969151.00	2871
T	MACH	2012	H4	1	772975.00	9969151.00	2871
T	MACH	2012	H5	1	772975.00	9969151.00	2871
T	MACH	2012	H6	1	772975.00	9969151.00	2871
T	MACH	2012	H7	1	772975.00	9969151.00	2871
T	MACH	2012	H8	1	772975.00	9969151.00	2871
T	MACH	2012	H9	1	772975.00	9969151.00	2871
T	MACH	2012	H10	1	772975.00	9969151.00	2871
T	MACH	2012	H11	1	772975.00	9969151.00	2871
T	MACH	2012	H12	1	772975.00	9969151.00	2871
T	MACH	2012	H13	1	772975.00	9969151.00	2871
T	MACH	2012	H14	1	772975.00	9969151.00	2871
T	MACH	2012	H15	1	772975.00	9969151.00	2871
T	MACH	2012	H16	1	772975.00	9969151.00	2871
T	MACH	2012	H17	1	772975.00	9969151.00	2871
T	MACH	2012	H18	1	772975.00	9969151.00	2871
T	MACH	2012	H19	1	772975.00	9969151.00	2871

Table 22. Database overview (continued)

Source	Code	Year	BH_ID	Log quality	Easting	Northing	Elevation m (MSL)
				LOCA_LOGQ	LOCA_NATE	LOCA_NATN	LOCA_DEM
T	MACH	2012	H20	1	772975.00	9969151.00	2871
T	MACH	2012	H21	1	772975.00	9969151.00	2871
T	MACH	2012	H22	1	772975.00	9969151.00	2871
T	MACH	2012	H23	1	772975.00	9969151.00	2871