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PEC Pole Embedment Calculator – User Manual (ASP Version)

28 January 2021 Rev 1.2

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Document Management

Revision History

Revision	Date	Revision Description	Author
0.1	10/07/2019	This is the first informal revision of the document.	Peter De Lore
1.0	23/7/2019	Updates included after document review	Dominic Shields
1.1	05/11/2019	This version approved for distribution	Peter De Lore
1.2	28/1/2021	Line Security Update, Pole Foundation Class category added	Dominic Shields

Stakeholder List

Name	Area Represented	Action (Signoff, Review, Information)	Approved / Complete (as applicable)	Date
Dominic Shields	Mains Engineering	Review / Sign-off	Dominic Shields Digitally signed by Dominic Shields Date: 2021.02.02 10:42:13 +11'00'	28/1/2021
Glenn Ford	Mains Engineering	Review / Sign-off	Glenn Ford Digitally signed by Glenn Ford Date: 2021.02.02 10:35:14 +11'00'	28/1/2021

Pole Embedment Calculator – User Manual

28 January 2021

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1 Foreword

This manual describes the capabilities of PEC (Pole Embedment Calculator) and shows how to use the program.

PEC is a software tool to enable Ausgrid ASP (Accredited Service Providers) Overhead Power Line designers to identify and specify power pole footing requirements including calculating the required minimum pole size, embedment depths for laterally loaded poles, specifying the backfill types and determining excavation size. The software integrates previously acknowledged soil property information obtained from the Newcastle University with an improved algorithm making use of the time-proven P-Y method of lateral pile foundation design. The benefits of the P-Y method include;

- Calculation of bending moments, shear forces, deflections and rotations along the full embedment depth,
- Can be used to limit the rotation of the pole in the foundation, which aligns with the requirements of IEC60826, and allows better alignment with asset inspection rules.
- The use of rotation limitations provides more practical control over the foundation design for pole structures, as opposed to other linear-static approximations designed for piles that support structures with minimal allowable foundation movement (such as Brinch Hansen and Broms methods),
- The calculation uses a finite element analysis which is more accurate than historical finite difference solutions,
- The supporting documentation for the P-Y method is readily available, and is supported by extensive full-scale destructive testing, giving confidence that the design embedment depths are warranted.

This document is intended to define the technical software inputs & outputs, provide the background on the method used as well as being a detailed user manual for the software.

If you have any questions about PEC functionality or power line foundation design within Ausgrid, please contact Mains Design within the Design Management group.

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Block B East
Wallsend, Newcastle

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The distribution and maintenance of PEC as well as technical support are provided by the Engineering Application Development Team within Asset Information.

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2 Disclaimer and Software Limitations

The PEC program is developed specifically for the design of Ausgrid's pole foundations. It has been adapted from the P-Y finite difference method for lateral design of piles.

The program should only be used for designs on the Ausgrid network and should only be used by trained and competent persons, in accordance with the documentation for the software and any additional training/advice.

There is no warranty, express or implied given for the use of this software.

The PEC software is intended to be used in a large range of soil types and for the full range of poles that are available on Ausgrid’s AML (approved material list). However, the PEC will not provide a solution in all cases. Expert advice/design assistance shall be sought for designs involving the following situations;

- Poles where the PEC calculator gives a result that is more than 2m larger than the 10% of the pole length plus 600mm historical rule-of-thumb. PEC will solve only if this rule is satisfied;

- Poles that are to be installed in swampy soils (very low strength, high water table);
- Poles that are to be installed in Very Loose sands that are more than 2m deep; and
- Poles where the PEC calculator cannot find a solution from the available sizes and design loads.

It is also important to note that when dealing with any sort of structural design relating to soil strength, there are a large number of variables, which means that designs are normally conservative to try and overcome the variability. One of the biggest variables with respect to pole foundation design are the generalisations related to the soil type and physical properties. It is important to confirm the assumptions used in design calculation are applicable to the actual conditions during installation (if not before). Refer to Section 9.4 for advice on how to do this.

Despite the popularity of the P-Y method, it also has limitations as described below:

- The soil is idealised as a series of independent nonlinear springs represented by P-Y curves. Therefore, the continuous nature of the soil is not explicitly modeled.
- The results are very sensitive to the P-Y curves used. The selection of adequate P-Y curves is the most crucial problem when using this methodology to analyse laterally loaded poles.
- Selecting appropriate P-Y modulus and P-Y curves is a difficult task. While the selection of values of the initial P-Y modulus is related to the soil modulus, it is also related to the interaction between the pole and the soil. Reese and Van Impe point out that P-Y curves and modulus are influenced by several pole-related factors, such as:
    - Pole type and flexural stiffness.
    - Type of loading (monotonic or cyclic).
    - Pole geometry.
    - Pole cap conditions.
    - Pole installation conditions.

Fortunately, the high stiffness poles mean that the standard P-Y relationships for standard soil type and property relationships give reasonable assessment of P-Y curves.

The benefit of the P-Y method is that it can be updated as and when new information or P-Y curve formulation techniques become available.

Contact your Ausgrid representative if assistance is required

3 System Requirements

The PEC software requires the following for successful operation

- Windows 7 Operating System (or later)
- .NET Framework version 4.6.1 or higher

Note that the installer package provided will include the .NET Framework installer package if required.

4 Referenced Documents

Table 4-1 Referenced Documents

Date	Version	Author	Document Name and Link
			Network Standard NS220

5 Acronyms & Definitions

AI	Asset Information
AML	Approved Material List
ASP	Accredited Service Provider
CPT	Cone Penetration Test
DLL	Dynamic Link Library
EADT	Engineering Application Development Team
GIS	Geographic Information System
ICT	Information Communication & Technology
MGA	Map Grid of Australia
P-Y	Load V's Displacement Analysis
PEC	Pole Embedment Calculator
SPT	Standard Penetration Test
UI	User Interface
VBA	Visual Basic for Applications

6 Theory

This section provides an overview of the proposed solution architecture for the Pole Embedment Calculator project.

The P-Y method models the interaction between the soil and the pole using a "Beam on elastic foundation" model first outlined by Winkler in 1867. This approach models the soil as discrete springs with load vs. deflection curves, or "P-Y" curves. A graphical representation of this is given in 6.1.

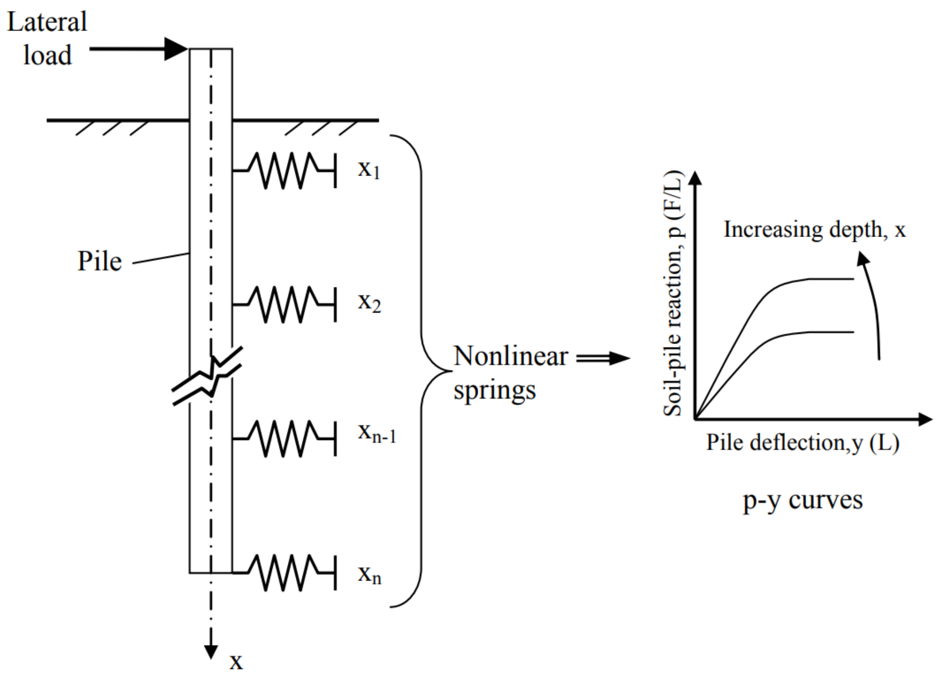


Figure 6-1: Simplistic graphical representation of the P-Y model

The curves vary depending on the type of soil/rock, whether the load is cyclic or static, and whether the layer is below the water table or not. The P-Y curves are defined by published relationships for the various soil materials.

Whilst there is some benefit to increased diameter, one of the biggest benefits to the P-Y method is that it gives a far greater benefit from increasing the depth compared to increasing the diameter of the foundation. This is much closer to reality and overcomes one of the issues with the Brinch Hansen method.

The P-Y method used is based on the COM624P program used by L-Pile and others, developed for the Department of Transportation in the US. This method is detailed in the reference "COM624P—Laterally Loaded Pile Analysis Program for the Microcomputer" (Wang & Reese, 1993). One difference is that the solver for PEC is a finite element analysis approach rather than a finite difference analysis. The finite element analysis has been shown to be more consistent than the finite difference method when compared to the results of field tests. In some cases, the finite element method also appears to be able to find a solution before the finite difference method will converge.

The P-Y method has a lot of research history and continues to be improved for specific soil types. It is also easy to update and add calculations that improve the accuracy for specific soil types, which is another reason why it was the preferred method to build into the PEC.

For more in-depth information about P-Y theory, consult the US DOT documentation (Wang & Reese, 1993).

7 Software Inputs

7.1.1 Inputs

This section will detail the required inputs for the calculator library to determine the required output for a single calculation. Fundamental calculator inputs are detailed in section 7.1.1.1 while derived inputs are detailed in section 7.1.1.3.

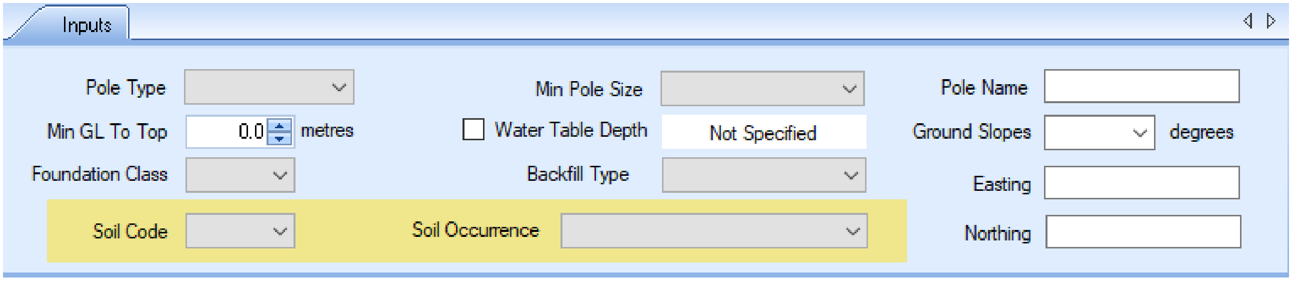


Figure 7-1: Graphical User Interface for User Inputs

7.1.1.1 Fundamental Calculator Inputs

The inputs detailed in this section identify the core inputs required to determine the minimum pole size required and to calculate the required embedment depth for this pole. Note that this section does NOT include the derived inputs required to carry out the calculation (many of which are re-calculated on every iteration of embedment depth).

Table 7-1 Fundamental Calculator Inputs

Name	Units	Sample Value	Comments
Pole Type	N/A	Timber	Available options are as follows - Timber - Timber Stay - Concrete - Concrete Stay - Steel - Titan - Titan Equipment
Min Pole Size (Pole Under Test)	N/A	Timber Pole 11m 24kN	The pole identifies the following fundamental data fields - length - ultimate tip load - tip diameter - butt diameter - thickness (excl. timber) - pre-stressed (concrete)
Name	N/A	MD-12345	Asset Number

Name	Units	Sample Value	Comments
Min GL to top (Min Distance from GL to Pole Top	m	10	This is the minimum pole length above ground that is required for other purposes such as maintaining minimum ground clearances. It equals A+S+C as per Figure 7.2
Water Table Depth	m	5	Enter the depth of the water table below ground. To be included if known
Ground Slope	Degrees	5	The slope of the ground at the pole location. This is to enable consideration of the reduced foundation strength for poles that are placed on a slope. Selection limited to the following - 0 - 5 - 10 - 15 - 20 - 25 - 30
Foundation Class	N/A	1	The foundation class determines which of the rotation & deflection limits are applied in determining an acceptable result (see Table 7.2). Available options are as follows - 1 - 2 3
Backfill Type	N/A	Concrete	This is the selection for the type of backfill that is to be used. Concrete means the bore-hole diameter is used in the strength calculations, cement stabilised means the average of the bore hole diameter and the pole diameter is used, and the others just use the pole diameter. Options are; Concrete, Cement Stabilised, Select Aggregate, Site Spoil. Concrete is not recommended for timber poles for durability reasons. Available options are as follows - Concrete - Cement Stabilised - Select Aggregate - Site Spoil Footing arrangement drawings for Timber Pole 508726 Concrete Pole 512331 Steel Pole 178123 Composite Fibre 248464
Soil Code	N/A	“ah”	See section 7.3 for more information regarding Soil Data
Soil Occurrence	N/A	“Generally”	See section 7.3 for more information regarding Soil Data

Name	Units	Sample Value	Comments
Required Embedment Depth (per iteration) (Not user defined input)	m	2.20	This value is initialised with a suitable minimum value and is incremented in 0.05m increments in the course of the calculation in order to determine the required result.

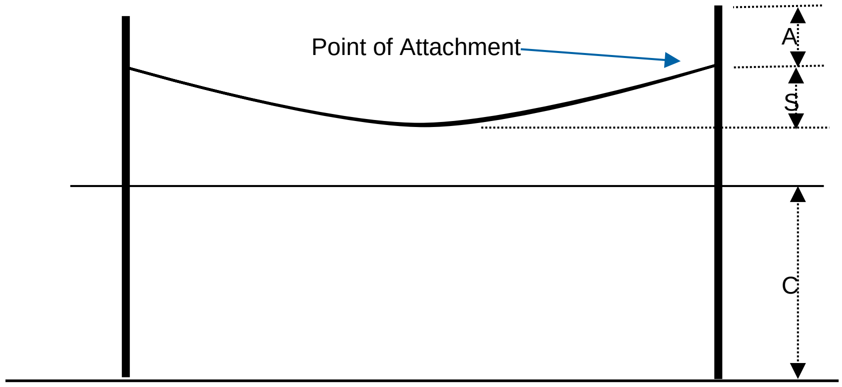


Figure 7-2: Minimum required distance from GL to pole top (graphical representation)

7.1.1.2 Level of Design, Line Security and Foundation Class Inputs

An overhead electrical line, including its foundations shall be designed to withstand the load conditions for the selected security level as defined in table 7.2, based on the lines importance to the system, its location and exposure to climatic conditions, and public safety and design working life. Refer to NS220 Clause 5 for Design requirements.

Table 7-2 Line Security Inputs and Foundation Class Classification for Foundation Design

NS220 Security Level	Line type	Design working life	Maximum design wind return period	Foundation Class
I	• LV pole lines • HV pole lines	50 years	50 years	1 or 3 (see note 1 below)
II	• 33kV pole lines • 66kV pole lines	50 years	100 years	2 or 3 (see note 1 below)
III	• 132kV pole lines	50 years	200 years	3
	• Steel tower transmission / subtransmission	100 years	400 years	3

Note:

1. **A Foundation Class 3 is required for Line Security I – III when any of the following conditions (but not limited to) are encountered:**

a. Sustained loads: such as large deviation angles, terminations, tee-offs, stay poles or where construction loads should be considered for strategic stringing locations;
b. Eccentric Loads: where load acting on the pole is offset from the centroid of the pole eg. Transformers, regulators and reclosers;
c. Higher reliability foundations: where by any pole movement could compromise the clearances of the following – water crossings, railways, RMS roads, Easements/encroachments/buildings and unattached crossings or highly populated/frequented areas or where aesthetic / visually sensitive considerations are required;
d. Difficult re-instatement, where re-instatement of that pole would be hampered by location or access limitations.

***User Note: The designer is responsible for the discretionary application of this requirement*.**

7.1.1.3 Derived Inputs

This section details the input values that are derived from the fundamental inputs. Many of these input values are re-calculated on each new embedment value determined in the course of the calculation.

Table 7-3 Derived Calculator Inputs - General

Name	Units	Comments
Minimum Embedment Depth	m	Derived from respective pole table data (e.g. Timber, Concrete, etc) using the pole length, e.g. 10% * pole length + 0.6. This is derived only once for any given pole.
Axial Force	kN	Derived (initialised) once for each calculation
Bending Moment	kNm	Re-calculated on each iteration of embedment depth.
Shear Force	kN	Re-calculated on assignment of new pole in the calculation.
Strength Reduction Factor	N/A	Derived from Scenario type and pole type (from lookup table). See 7.2.1.
EI Groundline	Nm^2	Derived from fundamental pole inputs. Re-calculated on each iteration of embedment depth.
EI Butt	Nm^2	Derived from fundamental pole inputs as well as Initial Nominal Depth. Re-calculated on each iteration of embedment depth.
EI Groundline (uncracked)	Nm^2	For concrete poles only. Re-calculated on each iteration of embedment depth.
EI Butt (uncracked)	Nm^2	For concrete poles only. Re-calculated on each iteration of pole length.

The derived soil inputs are shown in the following table. Note that there are a significant collection of tables that are related to managing the soil data and these are detailed separately in sections 7.3 and 10.

Table 7-4 Derived Calculator Inputs – Soil

Name	Units	Comments
Layer thickness	m	Derived from respective soil table data
Layer Base Depth	m	Cumulative value derived from layer thickness
Soil Type	N/A	Available options are as follows - Clay - Sand - Sandstone - Shale
Strength	N/A	Sample value is “Stiff to Very Stiff”
Cohesion	kPa	500
Friction Angle	degrees	29.5
Density	kN/m^3	22.5
Submerged Density	kN/m^3	Referenced in place of ‘Density” when layer is identified as below the water table depth
Eps50		0.01
Soil Type (2)	Enum	Possible values are 1, 2 or 3
Initial Stiffness, ki	kN/m^3	5000

Submerged Initial Stiffness, ki	kN/m^3	Referenced in place of 'Initial Stiffness" when layer is identified as below the water table depth

7.1.2 Outputs

This section will detail the identified outputs for the calculator library given the inputs specified in section 7.1.1. Note that these nominated outputs are for a single calculation and are stored in the database for retrieval on request.

Table 7-5 Calculation Outputs

Name	Data Type	Units	Comments
Required Pole	Complex object	N/A	The required pole as determined by the calculation will be displayed similar to the following… 9.5m 10kN
Minimum Depth	Floating point	m	Although stored with a value of 2 decimal places, this will be displayed rounded to 1 decimal place
Min Auger Size (> Pole Butt DIA.+ 200mm)	Floating point	mm	Sample value = 600mm Standard auger sizes are; 450, 500, 600, 750, 900, 1050, 1200, 1350, 1500, 1750 and 2000mm
Bending Moment for Governing Load Case	Floating point	kNm	
Ultimate Deflection Result	Floating point	m	Only specified if the "Check Ultimate" is true in the Inputs.
Ultimate Rotation Result	Floating point	m	Only specified if the "Check Ultimate" is true in the Inputs.
Serviceability Deflection Result	Floating point	m	
Serviceability Rotation Result	Floating point	m	
Sustained Deflection Result	Floating point	m	
Sustained Rotation Result	Floating point	m	
Calculation Date	DateTime	N/A	Date that the calculation was carried out
User Name	String	N/A	Identifies the name of the user who invoked the calculation.

7.2 Mapping Tables

This section details much of the underlying table data required to carry out the calculations.

7.2.1 Strength Reduction Factors

Table 7-6 Strength Reduction Factors for Pole Types and Load Cases

SRF	Ultimate	Serviceability	Sustained
Concrete	0.8	0.5	0.3
Timber	0.5	0.5	0.5
Steel	0.9	0.9	0.9
Titan	0.75	0.3	0.3

7.2.2 Deflection and Rotation Limits

Table 7-7 Deflection and Rotation Limits

	Ultimate		Serviceability		Sustained	
Foundation Class	**Rotation (degrees)**	**Deflection (mm)**	**Rotation (degrees)**	**Deflection (mm)**	**Rotation (degrees)**	**Deflection (mm)**
1	15	400	5	150	2	75
2	10	250	3	100	1	50
3	10	250	2	75	0.5	25

7.2.3 Rocla Pole Data

The following tables represent the Rocla pole data for concrete poles

Table 7-8 Rocla RC Poles

Pole Strength ultimate (kN)	Max Tip Dia (mm)	Uncracked	Cracked
6	150	44000	7500
10	225	44000	7500
16	240	45000	9000
24	315	46000	10000
32	315	47000	11000
40	360	48000	12000
60	405	49000	13000
80	450	51000	16000
100	495	55000	20000

Table 7-9 Rocla RPC Poles

Pole Strength ultimate (kN)	Max Length (m)	Uncracked	Cracked
16	All	49000	12000
20	All	49000	12000
24	All	49500	12500
28	All	50000	13000
32	All	50000	13500
36	All	50000	14500
40	All	50000	14500
44	All	50000	15000
52	All	50000	15000
60	All	50000	15000
80	24	51000	16000
80	30	53000	18000
100	10	53000	18000
140	10	53000	18000
180	10	53000	18000

7.3 Soil Model

The soil model utilised by the calculator was derived from the “Soil Type” and “Soil Table” worksheets of the original PEC spreadsheet. The application uses a combination of “Soil Code” and “Soil Occurrence” to index into this derived soil model, where the results produce a collection of layers that specify the respective soil strengths required as inputs to the core calculator components.

The derived soil model is shown diagrammatically as follows. This diagram was generated by the SQL Server Management Studio referencing the respective soil tables in the PEC database.

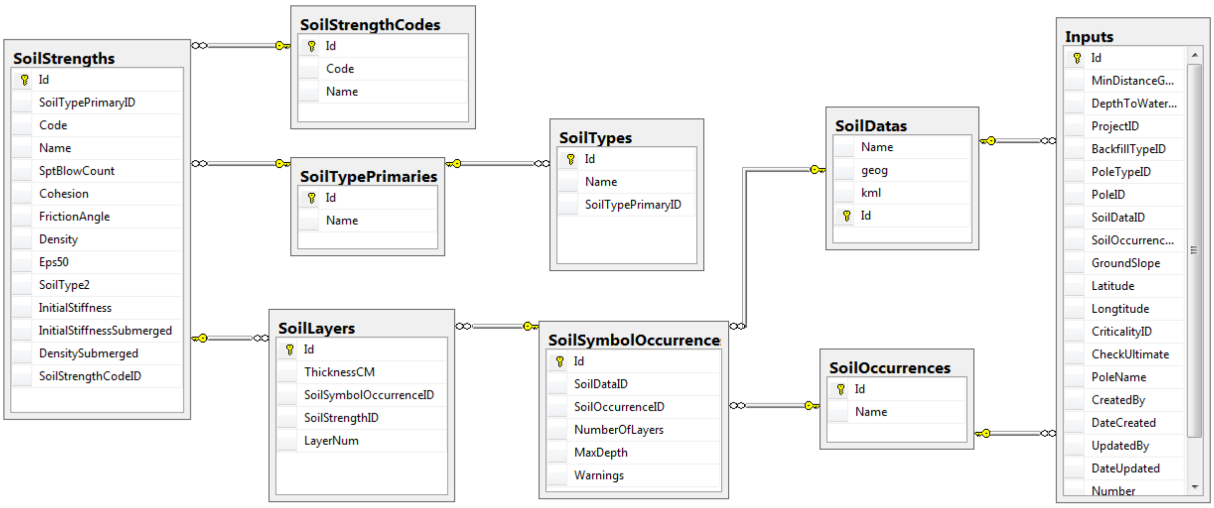


Figure 7-3: Soil Model

7.3.1 Soil Codes (Symbols)

The soil symbols that currently reside in the database are listed as follows

Table 7-10 Soil Symbols

Soil Symbol Name	Soil Symbol Name	Soil Symbol Name
ad	ghc	of
ah	ghc	ol
as	gi	pk
aw	gk	pr
awa	gl	qb
ba	gn	rc
be	gnz	rh
bf	gt	ri
bfa	gu	rt
bg	gw	rv
bgz	gy	sb
bh	ha	sbc
bi	hb	sc
bia	hh	se
bj	hm	sea
bl	hn	sf
bn	hoz	sg
br	hr	sh
brz	hs	sk
bt	hu	sl
btz	hua	sn
bu	hub	so
bw	ig	sp
by	ima	ss
bz	jp	st
ca	ki	su
cb	la	sua
cc	lcz	tb
ce	ld	tbb
cg	lg	tg
ch	lh	tm
cl	lp	ts
cm	lv	tw
cn	lw	ty
co	ma	tya
cp	mb	tyb
ct	mc	va
db	md	wa
dcz	me	waz
do	mf	wb
dv	mg	wc
ec	mi	wd
eca	mj	we
er	ml	wea
etz	mn	wg
fbz	mo	wga
fc	mv	wm
fh	mw	wn
ga	nc	wo
gb	ne	wp
gc	ng	wpz
ge	nhg	wr
gg	nm	ww
gga	npz	wy
gh	nw	ya

7.3.2 Soil Occurrence

The soil occurrence and soil symbol combination determine the soil layers to be considered in the calculation. The available Soil Occurrences are listed in Table 7-11. Note that only selected soil occurrences are valid for any soil code selection. The valid soil code – occurrence combinations available are listed in section 10.1.

Table 7-11 Soil Occurrences

Soil Occurrence Name	Soil Occurrence Name
Adjacent to Hillslopes	North of Swansea
Alluvial Fans & Drainage Lines	Outcrops & Crests
Alluvial Terraces	Oxbows & Levees
Boulder Outcrop	Parent Material on Crests
Colluvial Benches	Ridges & Side Slopes
Commonly	River Flats & Lake Shore
Crests	River Flats & Stream Banks
Crests & Low Slopes	Riverbank / Channel
Crests & Ridges	Sandy rises
Crests & Ridges South	Scattered Outcrops
Crests & Upper Slopes	Scrub or Heathlands
Crests and Sideslopes	Shale geology
Crests North	Side Slopes
Crests on Cong & Sast	Sideslopes
Crests on Resistant Materials	Slopes
Drainage	Slopes & Benches
Drainage & Midslopes	Slopes & Crests
Drainage & Valley Flats	Slopes & Terraces
Drainage and Fans	Sphagnum Bogs & Moors
Drainage Lines	Steep Sideslopes
Flats	Steep Sideslopes (Cong & Sast)
Floodplains & Backplains	Steep Slopes & Crests
Footslopes & Low Hills	Steep Upper Slopes
Footslopes (Variant gga)	Steep Upper Slopes & Crests
Generally	Steeper Slopes
Generally, Centrally	Summit & Benches
Gentle Sideslopes	Swamp Margins
Gentle Slopes	Tamboy a
Gentler Slopes (<20%) eca	Tamboy b
Lower Drainage	The Junction & Adjacent Areas
Lower Slopes	Upper & Lower Slopes
Lower Slopes & Drainage	Upper Slopes
Lower Tracts	Upper Slopes & Crests
Mangroves & Saltmarsh	Upper Tracts
Mid to Lower Slopes	Upstream of Maitland
Midslopes	Variant tbb
Midslopes & Crests	Well Drained
Midslopes and Benches	Where bfa occurs
North of Laguna (Singleton Sheet)	

7.3.3 Soil Layer

The soil layer model is defined as follows

Table 7-12 Soil Layer Model

Field Name	Units	Sample Entry	Comments
Thickness	cm	50	Observed that some non-null entries in this table did NOT specify a thickness value
Type	N/A	SC	Appears to map to another enumeration / string field soil type (clay, sand etc.)
Strength	N/A	V	Appears to map to another enumeration / string field code related to strength of the layer

7.3.4 Soil Strength

The soil strength data included in the solution is shown in the following table

Table 7-13 Soil Strength Data

Soil Type	Code	Strength	Cohesion	Friction Angle	Density	Eps50	Soil Type 2	Initial Stiffness	Initial Stiffness Submerged
Clay	VS	Very Soft	6		16	0.02	1	10000	
Clay	VS - S	Very Soft to Soft	12		17	0.02	1	20000	
Clay	S	Soft	30		18	0.02	1	30000	
Clay	S - F	Soft to Firm	48		18	0.015	1	40000	
Clay	F	Firm	72		19	0.01	2	50000	
Clay	F - ST	Firm to Stiff	96		19	0.0085	2	70000	
Clay	ST	Stiff	144		20	0.007	2	110000	
Clay	ST - VST	Stiff to Very Stiff	192		21	0.005	2	165000	
Clay	VST	Very Stiff	287.5		21.5	0.004	2	220000	
Clay	VST - H	Very Stiff to Hard	383		22	0.003	2	230000	
Clay	H	Hard	500		22.5	0.002	2	240000	
Sand	VL	Very Loose		27	11		3	3000	1500
Sand	VL - L	Very Loose to Loose		28	14		3	5000	3000
Sand	L	Loose		29.5	16		3	7000	5000
Sand	L - M	Loose to Medium Dense		30	18		3	16000	10000
Sand	M	Medium Dense		33	19		3	25000	15000
Sand	M - D	Medium Dense to Dense		36	20		3	42500	25000
Sand	D	Dense		38	21		3	60000	35000
Sand	D - VD	Dense to Very Dense		41	22		3	60000	35000
Sand	VD	Very Dense		43	24		3	60000	35000
Sandstone	I	Class I	68200		25	0.03	2	802300	
Sandstone	II	Class II	49050		24	0.03	2	802300	
Sandstone	III	Class III	29900		23	0.03	2	802300	
Sandstone	IV	Class IV	15000		22	0.18	2	413550	
Sandstone	V	Class V	1005		20	0.18	2	24800	
Shale	I	Class I	59990		25	0.03	2	802300	
Shale	II	Class II	44945		24	0.03	2	802300	
Shale	III	Class III	29900		23	0.18	2	413550	
Shale	IV	Class IV	15000		22	0.18	2	24800	
Shale	V	Class V	1000		20	0.35	2	17300	

8 Calculation Process

This section attempts to provide a high level view of the algorithm used to carry out the calculation for the Pole Embedment Calculator. The core of the calculator code was ported from VBA code in the Excel prototyping spreadsheet to C# in the target solution

The process is shown diagrammatically in the flowcharts presented on the following pages.

The first flowchart (see Figure 8-1) represents a high level view of the calculation process. In this flowchart there are multiple references to a “Perform Calcs” step. The detail of the “Perform Calcs” step is shown in the second flowchart in Figure 8.2.

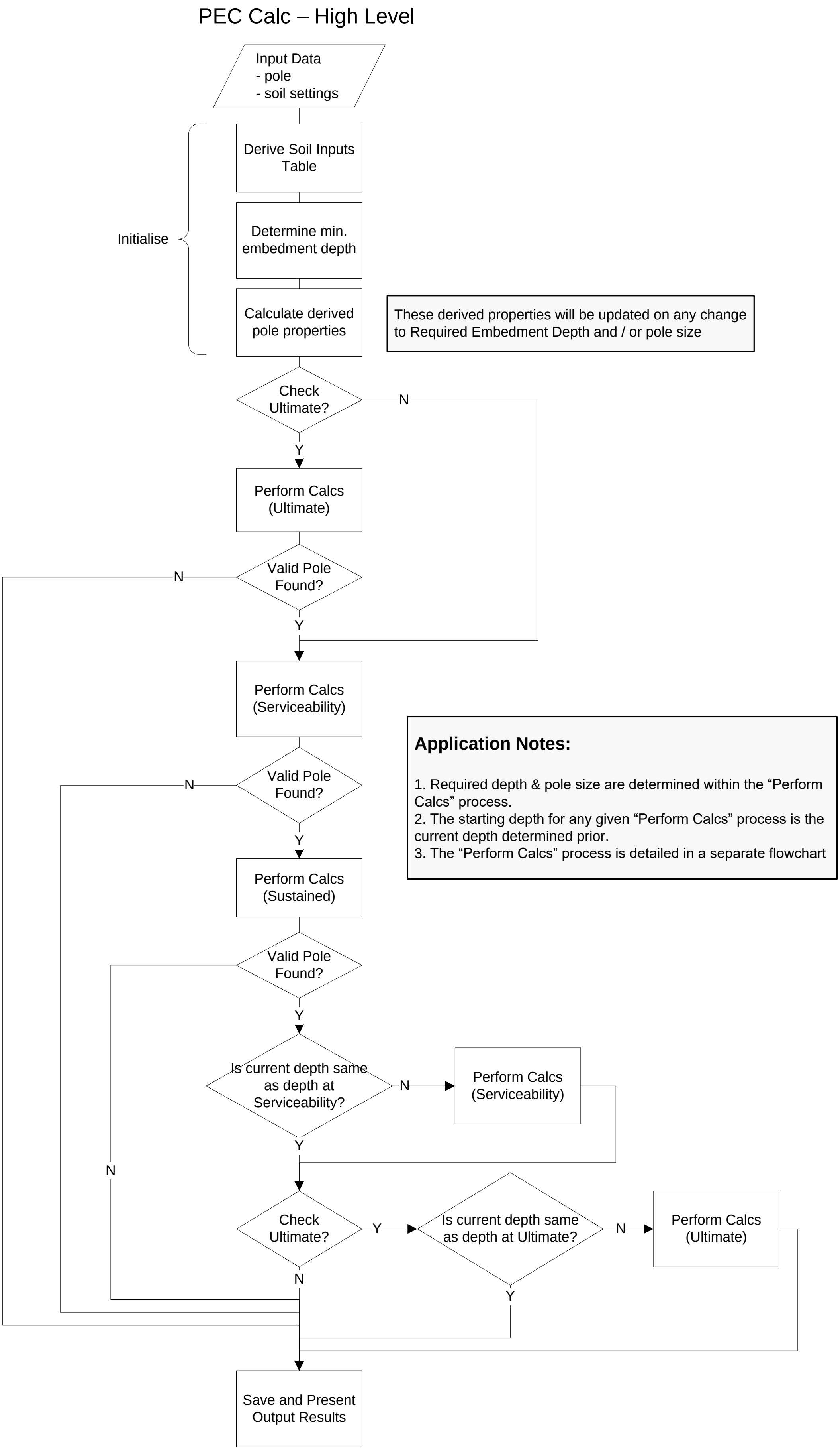


Figure 8-1 Calculation Process - High Level

PEC – Perform Calcs

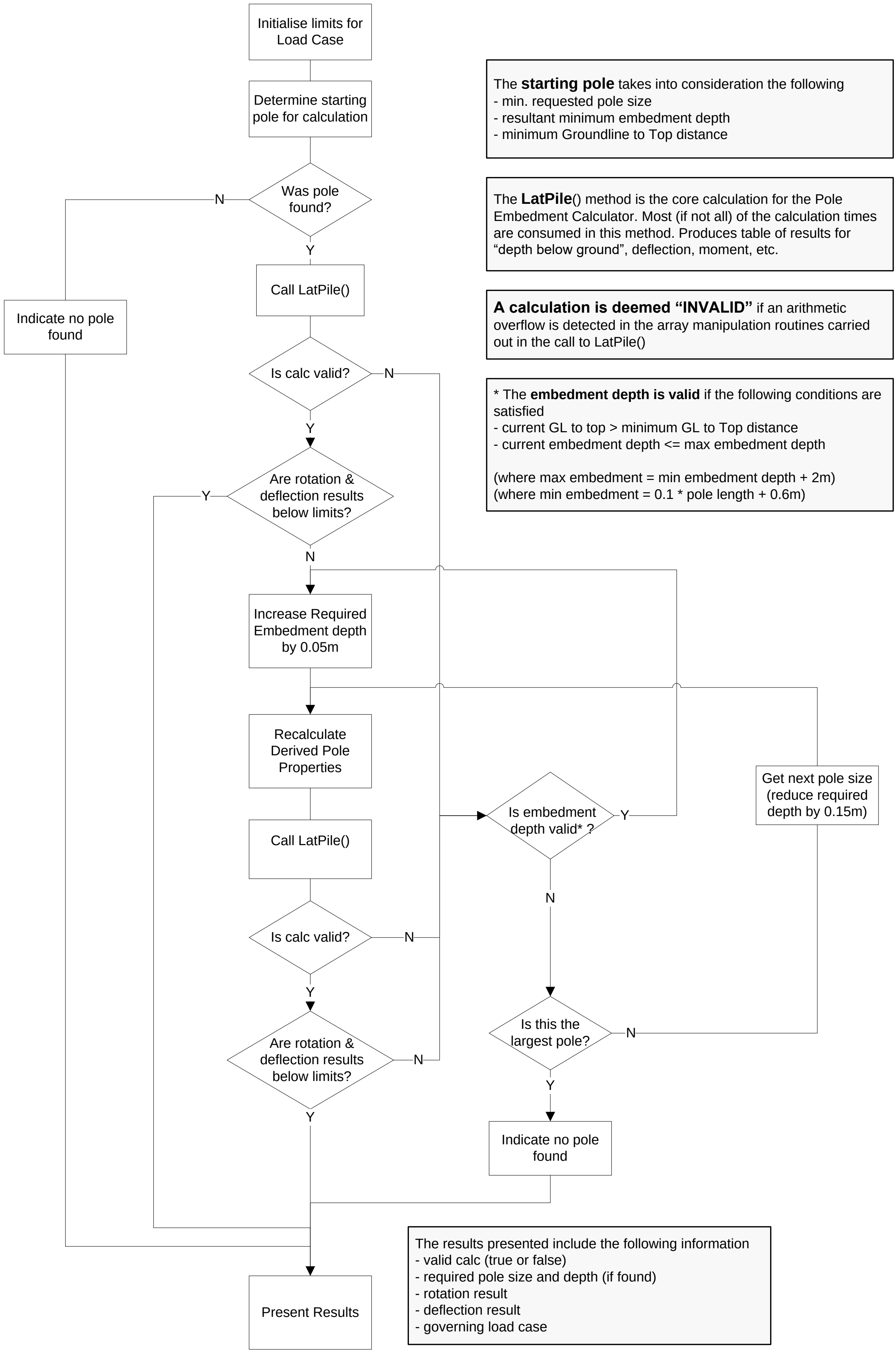


Figure 8-2: Performing Calculations

9 Getting Started

The following section describes the process of acquiring access to and using the PEC software.

The installer for the PEC software can be found on the Ausgrid website at the following URL:

https://www.ausgrid.com.au/ASPs-and-Contractors/Technical-documentation/Network-Standards

Please note that the PEC software requires licensing before it can be used to carry out any calculations. This process is described in the following section.

9.1 Licensing

Please note that Administrator rights will be required to install the software. Once successfully installed, the application will request a license file (as shown in the following screenshot)

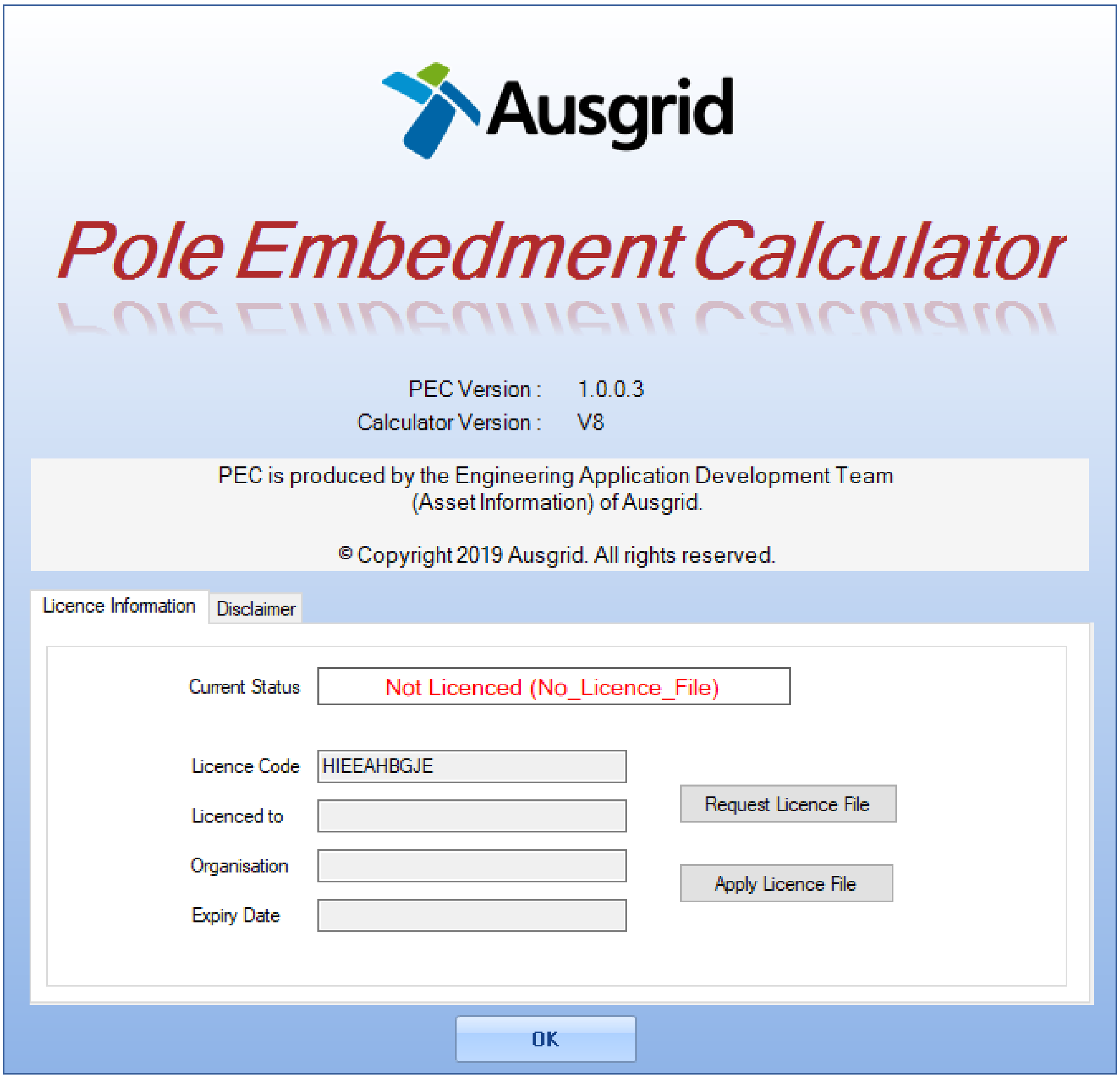


Figure 9-1 PEC Licence Screen

Click on the “Request License File” button to initiate the license request process. This will include sending the provided License Code to a nominated email address for processing. Once a license file is generated by the Mains Design group of Ausgrid, it will be returned by reply email along with the necessary instructions to apply.

9.2 PEC Main Screen

Once the provided license file has been successfully applied, the main screen of the application will be displayed similar to the following screenshot.

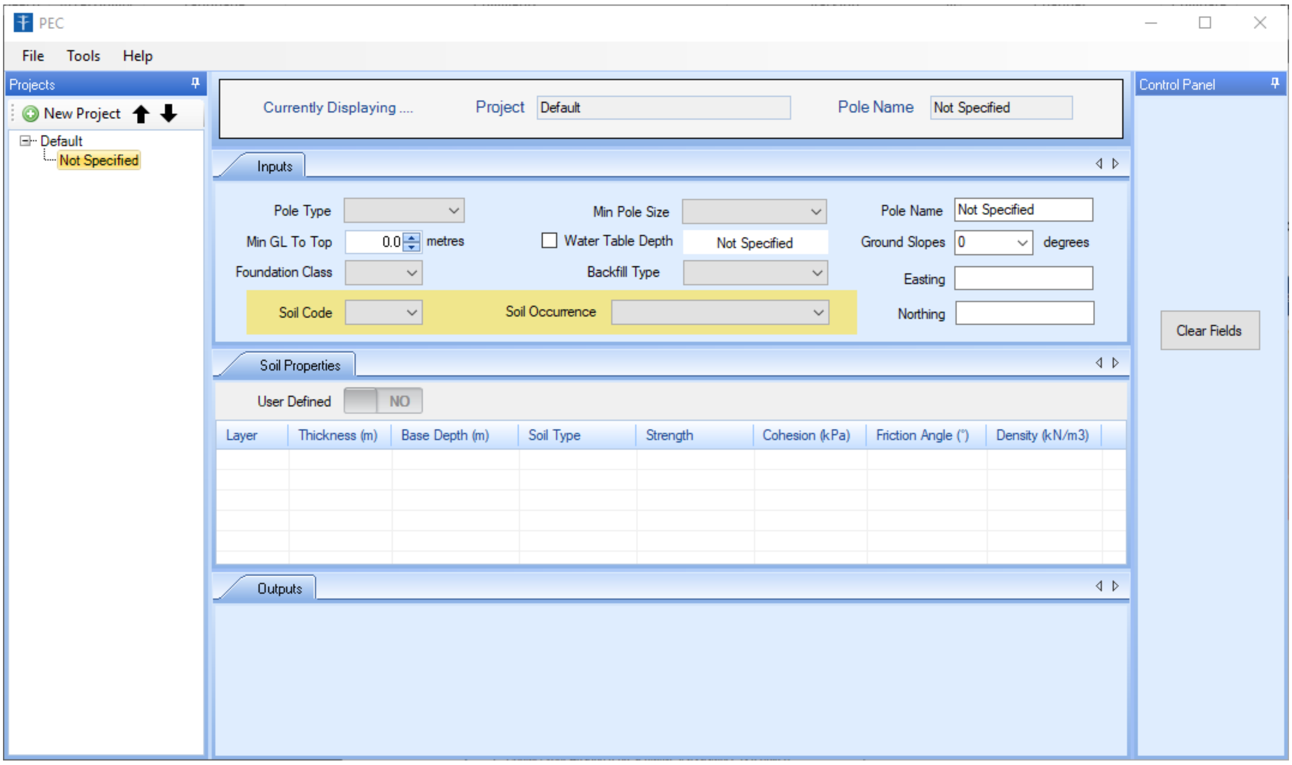


Figure 9-2: PEC Main Page

The major components of the main screen are described in the following sections. They are the Projects List Window, Inputs window, Soil Properties Window and Outputs Window.

9.2.1 Projects List Window

The Projects List window is on the left-hand side of the main screen. This section is where Projects can be created and managed. A given project may then have a collection of poles.

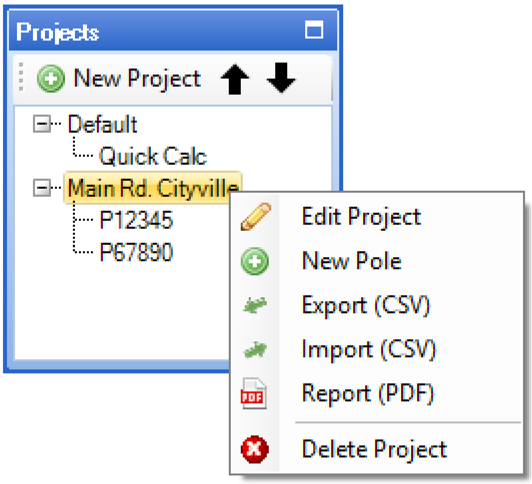


Figure 9-3 Projects List Window

The above screenshot shows the possible actions that can be invoked on a Project (right mouse click to access).

- ***Edit Project***. Allows Project name to be updated.
- ***New Pole***. Adds a new pole to this project and clears all input fields.
- ***Export (CSV)***. Exports the project to a CSV in a format that can be sent to Ausgrid for upload into the Ausgrid WebPEC for certification review
- ***Import (CSV)***. Allows for import of poles from a CSV file in the same format as above. Note: existing pole records in this project will remain unmodified. This will only import new poles that are not included in this project.
- ***Report (PDF)***. This will display preview Report lists all poles in the project, including details of the inputs, soil properties, and calculated results. This report can be then exported to a PDF file and included as part of the certification documentation.
- ***Delete Project***. This will delete this project including all poles in the collection.

9.2.2 Inputs Window

The Inputs window is shown in the following screenshot.

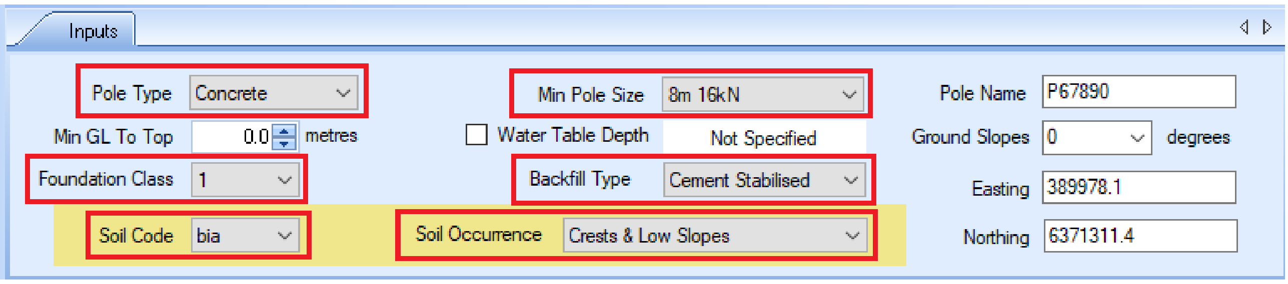


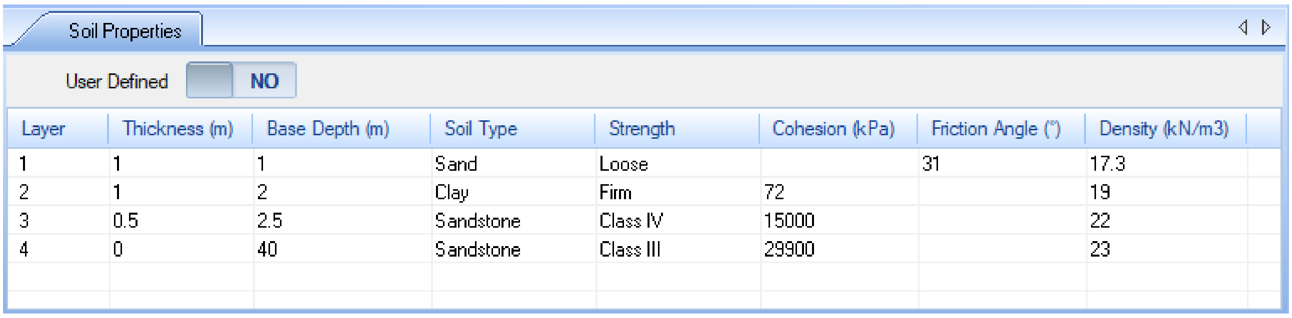
Figure 9-4 Inputs Window

The input fields that are outlined in red are mandatory fields. A calculation will only be allowed if these fields have been entered. Note that this section allows the soil inputs to be identified by Soil Code and Soil Occurrence. Note that soil layers can be assigned manually if required. See the following section for more information.

User Note: The Easting and Northing Coordinates are to be manually entered by the user and are optional only. They will be included as part of the export reporting option.

9.2.3 Soil Properties Window

The Soil Properties window is shown in the following screenshot



Layer	Thickness (m)	Base Depth (m)	Soil Type	Strength	Cohesion (kPa)	Friction Angle (°)	Density (kN/m3)
1	1	1	Sand	Loose		31	17.3
2	1	2	Clay	Firm	72		19
3	0.5	2.5	Sandstone	Class IV	15000		22
4	0	40	Sandstone	Class III	29900		23

Figure 9-5 Soil Properties Window

The data displayed in the Soil Properties window is the discrete soil layer detail. This data typically corresponds to the Soil Code and Soil Occurrence input settings selected in the Inputs window (see section 9.2.2). The User Defined option allows soil layers to be explicitly defined if required. Refer to section 9.5 for detailed information regarding the use of soil properties in determining the required pole embedment depth.

9.2.4 Outputs Window (Results)

The calculated outputs are shown in the following screenshot.

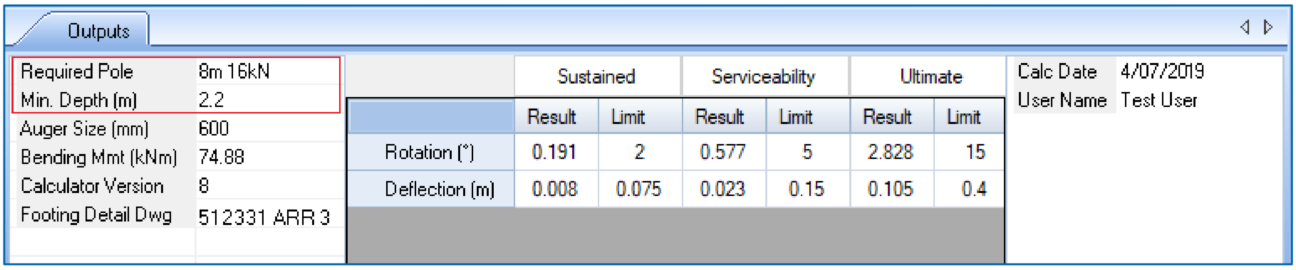


Figure 9-6 Outputs Window (Results)

The calculated outputs will present the Required Pole and the Required Embedment Depth in the top left-hand corner. More information regarding the Outputs window is detailed in section 9.6

9.3 Project Filing

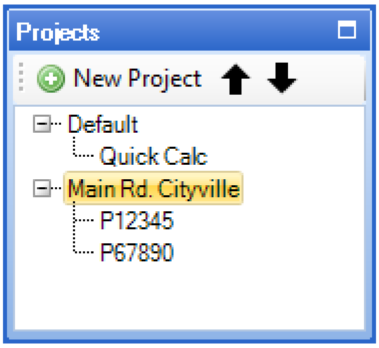


Figure 9-7: Projects List Window

The PEC platform had been developed with the ability for all foundation designs to be stored for every project that the designer has completed. Under each new project created, multiple pole design instances can be created.

Note: The top entry of the Projects listing is the “Default” project. This project cannot be removed or renamed and allows for quick calculations to be carried out when required.

9.3.1.1 Creating a New Project

In order to create a new Project, click on the “New Project” button in the Projects List window. The following will be displayed.

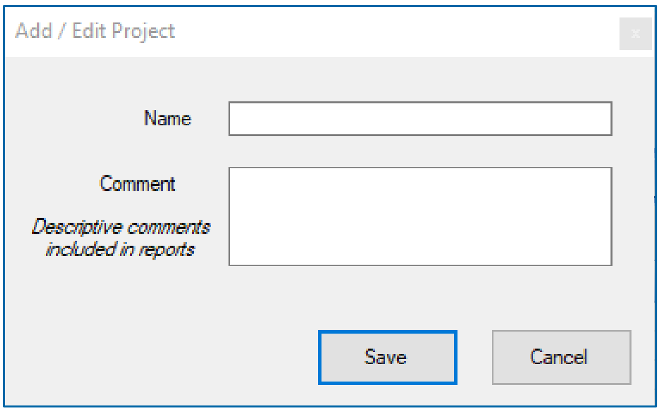


Figure 9-8 New Project Window

- Enter the **Name** field as required.
- Input a **Comment** about what the project is about. Note that the project comment field will be included in any PDF reports generated on this project.

Example

Name: Brandy Hill 11kV Feeder 48164

Comment: Overhead Mains Upgrade

Click **Save** to create the project and return to the PEC main screen.

9.3.1.2 Creating a New Pole

You can either create a new pole instance or alternatively, you can batch import from a pre-populated file. The latter option will be covered at the end of this section.

To create a new pole instance in a given project, right-mouse click on the Project node in the list view (in this example, right mouse click on the node text "Brandy Hill 11kV Feeder 48164") and select the "New Pole" menu entry (as shown in the following screenshot).

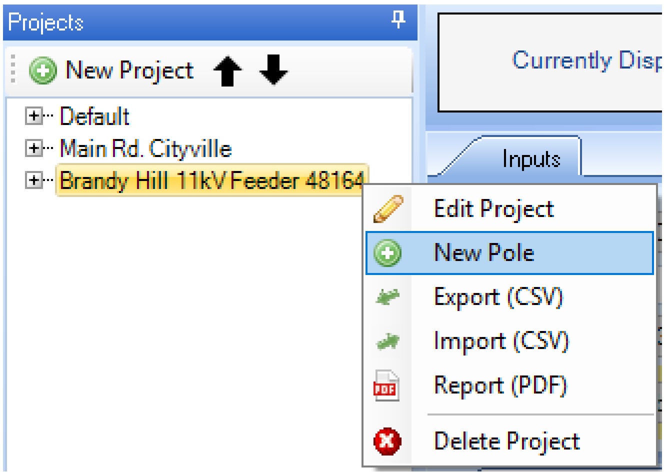


Figure 9-9 Creating a New Pole

***User Notes**: PEC has every available pole size for each pole class, being timber, concrete steel or composite fibre poles that is available on Ausgrid's approved materials list.*

The pole type selection is based on the length and ultimate kN rating for the pole, regardless of material type.

The pole selection is reasonably critical for foundation design because the overall design is significantly influenced by the stiffness of the pole, which can be considerably different for poles of different materials.

Creating a new pole will clear all of the main screen fields as shown in the following screenshot.

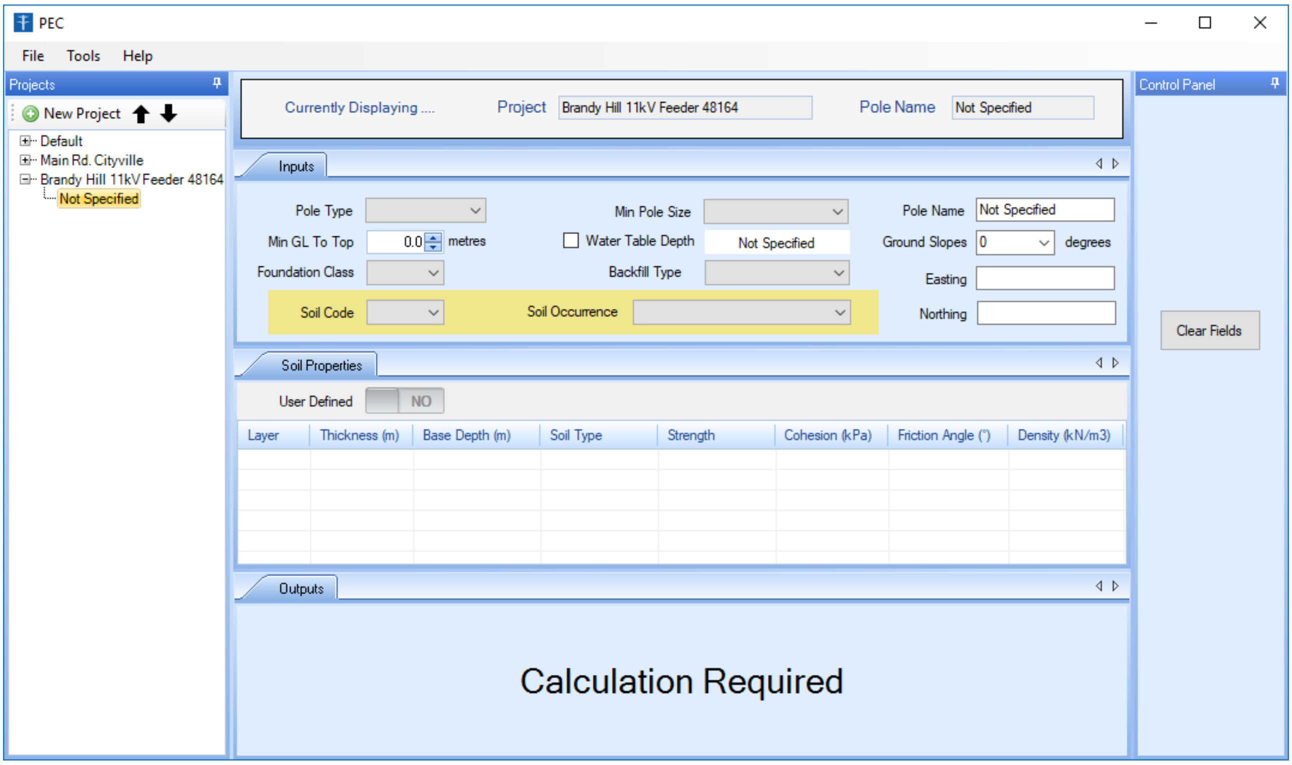


Figure 9-10: PEC Calculator Input User Interface

This window allows the user to perform the calculation based upon the set of input fields selected. The required input fields are **Pole Type**, **Min Pole size**, **Name**, **Min GL to top**, **Water Table Depth Ground Slope**, **Foundation Class**, **Backfill type**, **Soil Code** and **Soil Occurrence**. Once you have selected a suitable input for each of these, the **Calculate** button will become available to compute the set of input variables. A detailed explanation of each input is in section 7.

9.4 Application Settings

The PEC application has user specific settings that are primarily referenced when reports are generated. These can be accessed from the main menu entry Tools → Settings. The following screenshot displays these fields.

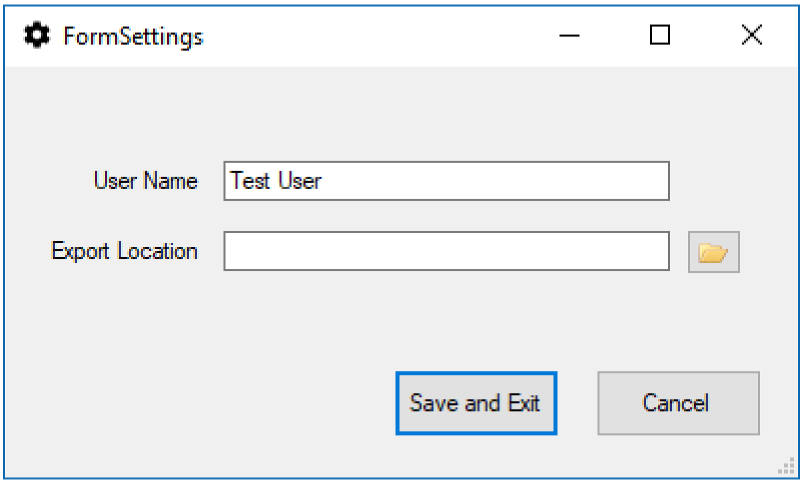


Figure 9-11 User Settings

Note that the ***User Name*** field needs to be entered if this user is to be identified in the PDF reports.

9.5 Soil Properties, Soil Codes and Occurrence

Ideally, the profiles defined would be perfectly applicable over all of the area nominated for the class. In reality, the conditions in one class area evolve gradually into those in the adjacent area: they do not start and stop abruptly at the line drawn on a map. The profiles vary with location within any particular foundation class, with changes in geology, topography etc: this is partly accounted for in the different occurrences.

Even within a particular location, where geology and topography seem consistent, significant variations can occur over a short distance for no apparent reason.

It would be naïve to expect that the foundation class model could be exactly correct in every location. However, the data is likely to be a reasonable estimate of the conditions in a given region, in the majority of cases. The foundation class model will never be an excuse for designers to stop having to think/scrutinise or to have specific input into the design process. While it is reasonable to use the soil codes or geotechnical reports for nearby investigations when designing the foundations, it is important that the engineer and/or construction crew conduct a site investigation to confirm that the design used a reasonably representative soil type. A field guide should be used, which is adapted from the NZ Geotechnical Society Inc. field guide sheets. Refer to Annexure 3. The field installation crew also has a responsibility to check that the conditions predicted by the model are generally achieved, and to draw attention to any gross deviations/anomalies.

Ausgrid have two options for soil input; **Soil Codes** and **User Defined Input**. The soil codes relate to the soil types that have been mapped for the entire Ausgrid network. To utilise this calculator, it is required that you know the soil code for the required location. This can then be entered into the required drop-down list.

User Notes: The 'xx' soil classification is defined as introduced fill, ie. there is no certainty of the soil type in that area.

Further investigation (in the form of geo-technical analysis, pre-boring and analysis, cone penetration testing or standard penetration testing) is required for designs related to this area.

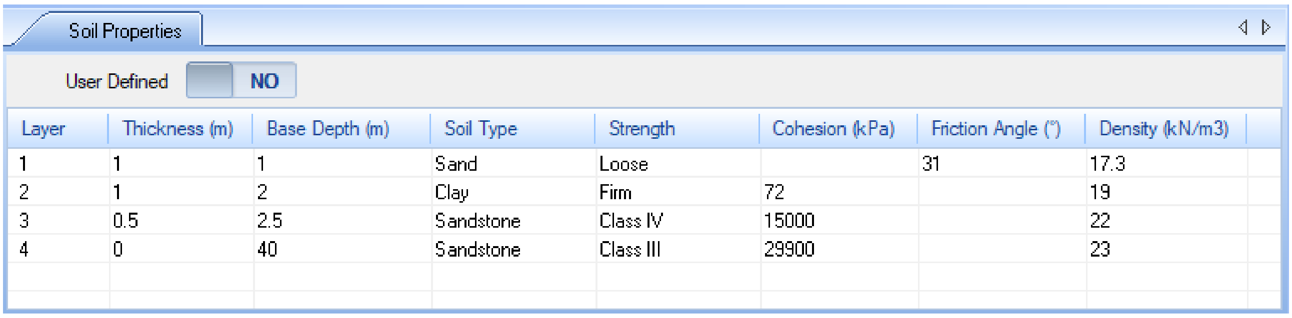
This data can then be input into the manage soil layers feature of the PEC

9.5.1.1 Soil Occurrence

Occurrences are unique soil profile descriptors that apply to particular areas within a particular soil landscape, and in some cases, as many as 8 different occurrences are recognised in the soil landscape definitions. The occurrences are typically defined either by association with particular topographical features/landforms (crests, ridges, upper slopes, steep slopes, drainage lines, channels, levees, back swamps, floodplains or by association with a particular bedrock geology, on sandstone, on shale etc. As the areas for which particular occurrences apply are not identified on the soil code Map, the user will have to specify which soil occurrence is most suitable for that location. Refer to Annexure 2 for guidance regarding selecting the most suitable Soil Occurrence.

9.5.1.2 Displaying Soil Data

Once you have located the site of the asset to be designed and populated the soil code and soil occurrence, the soil properties for that layer will be displayed in the Soil Properties window, see below



Layer	Thickness (m)	Base Depth (m)	Soil Type	Strength	Cohesion (kPa)	Friction Angle (°)	Density (kN/m3)
1	1	1	Sand	Loose		31	17.3
2	1	2	Clay	Firm	72		19
3	0.5	2.5	Sandstone	Class IV	15000		22
4	0	40	Sandstone	Class III	29900		23

Figure 9-12: Soil Properties Display Screen

Water table User Note: *The designer may not always know the depth to the water table. Local experience would suggest that a depth to water table of 1m in the low-lying alluvial areas (i.e. river flats), 2m for undulating hilly areas where the soil depth is >2m, and no water table for rocky hills/mountains where the soil depth is less than 2m before rock is encountered.*

If the water table is selected and the water table value is within the design layers, this will not change the values in table 9.11. However, the PEC algorithm is changing the soil layer properties for that layer and below to their corresponding saturated values.

9.5.1.3 User Defined Soil Layer

If the designer has additional geotechnical information about the site specific location then the **User Defined** soil layer manager can be used. This is located to the left of the soil properties table. Toggle the switch to enable this function and to enter into the soil layer manager. The information to be entered has to be in the form of soil type and strength as categorised in table. If geo-tech data is being procured for the use in PEC, then the geo-tech engineer is required to provide the results in this format.

The following screenshot shows the User Soil Management Window

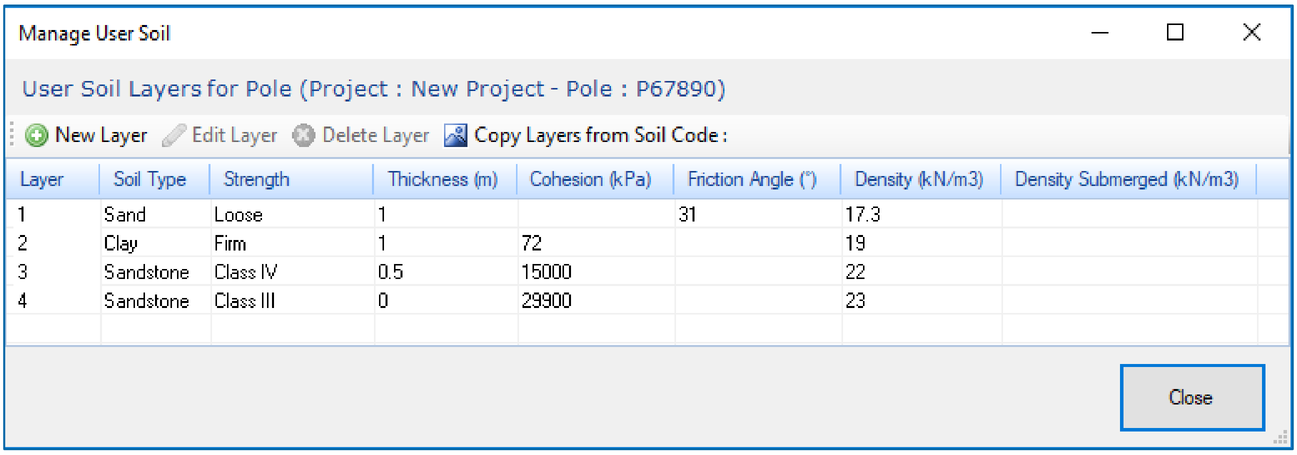


Figure 9-13 User Soil Management Window

To create a new soil layer hit the **New Layer** button

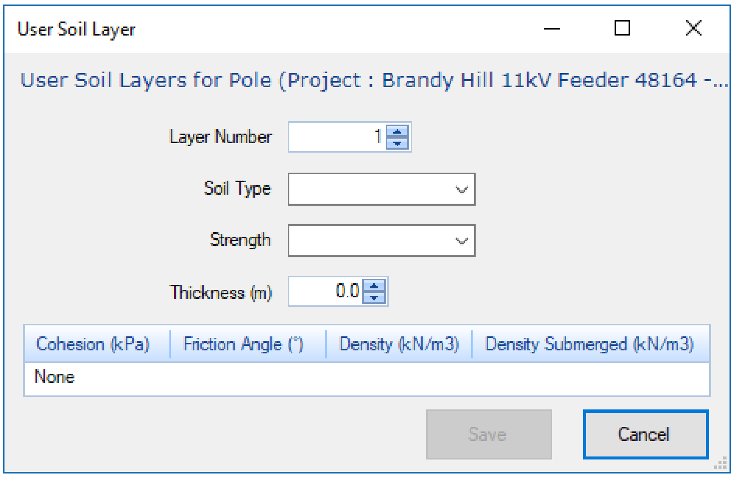


Figure 9-14: Creating User Defined Soil Layer Screen

By creating one layer at a time, select the layer number, soil type and strength with their corresponding thickness. Click **Save**. Create the 2nd layer by hitting **New Layer** again. Repeat this process until you have created the necessary number of layers. Then click **Close**. Your user defined soil layer stratum is now moved into the soil properties window for that pole calculation on the main screen. You can also edit or delete any layer with the **edit** and **delete** buttons above the soil layer listing. A maximum of 20 layers can be utilised.

9.5.1.4 **Copying Layer From Soil Code**

You can also copy the soil layer properties from the defined soil properties pull down. This may be useful if you need to modify the variables within the soil properties. In the Manage User Soils window, click **copy layers from soil code**. If there was already data in the fields, you will get warned that this will override any existing User Soil Configurations for this pole. Click **OK** to continue.

If you edit a soil layer, save the changes rather then returning to the list after the changes have been made.

***Soil User Notes**: The soil properties that are assumed should be included on construction drawings to be checked and confirmed onsite by the construction crew.*

Soil can be considered a non-Newtonian fluid in that it is stronger when a rapid force is applied, and weaker against a sustained load. Therefore, the sustained load rotation and deflection constraints are more stringent than the serviceability and ultimate cases.

The rotation and deflection limits at ground line are pre-set by Ausgrid based on alignment with other business rules and design parameters.

The depth of a pole footing has a far greater effect on strength than the diameter**.** This is because the soil resistance changes based on the cube of the depth and only a power of one for the width. This was a significant issue with the Brinch Hansen method used previously because it awarded larger diameter foundations disproportionally to ones with larger depth

Using the Soil Type and Strength option, you can select the soil type (Clay, Sand, Sandstone or Shale), and then the strength code that aligns best with the soil testing. This will populate the appropriate soil properties as per those in the following Table. The SPT blow count / RQD[1] column is not used in the software but is provided to assist with the determination of the soil strength, as some tests will report on this figure.

Table 9-1: Soil Properties Reference Table

	Strength	Code	SPT Blow Count (Corrected) / RQD for Rock	Cohesion (kPa)	Friction Angle (°)	Density (kN/m³)	ε_{50}	Cyclic Initial Stiffness (kN/m³)	Submerged Cyclic Initial Stiffness (kN/m³)
Clay / Silt	VS	Very Soft	1	6		15.5	0.0353	1600	1600
	VS - S	Very Soft to Soft	2	12		16	0.028	2400	2400
	S	Soft	3	30		17	0.02	4100	4100
	S - F	Soft to Firm	4	48		18	0.016	5700	5700
	F	Firm	6	72		19	0.012	13700	13700
	F - ST	Frim to Stiff	8	96		20	0.01	26300	26300
	ST	Stiff	12	144		20.5	0.008	69400	69400
	ST - VST	Stiff to Very Stiff	16	192		20.8	0.0066	70800	70800
	VST	Very Stiff	24	287.5		21	0.0052	118500	118500
	VST - H	Very Stiff to Hard	32	383		21.5	0.0043	174800	174800
	H	Hard	50	500		22	0.0033	289400	289400
Sand / Gravel	VL	Very Loose	2		27	15.6		400	800
	VL - L	Very Loose to Loose	4		28.5	16.5		2100	2400
	L	Loose	7		31	17.3		6300	5200
	L - M	Loose to Medium Dense	10		32.8	18		11500	8400
	M	Medium Dense	15		34.9	18.7		20400	13400
	M - D	Medium Dense to Dense	30		37.9	19.3		42800	25400
	D	Dense	40		38.9	19.6		56900	32900
	D - VD	Dense to Very Dense	50		40	20.4		74100	41800
	VD	Very Dense	70		42.1	21.5		96400	41800
Sandstone	I	Class I	>75%	68200		25	0.03	802300	
	II	Class II	50-75%	49050		24	0.03	802300	
	III	Class III		29900		23	0.03	802300	
	IV	Class IV		15000		22	0.18	413550	
	V	Class V	<50%	1005		20	0.18	24800	
Shale	I	Class I	>75%	59990		25	0.03	802300	
	II	Class II	50-75%	44945		24	0.03	802300	
	III	Class III		29900		23	0.18	413550	
	IV	Class IV		15000		22	0.18	24800	
	V	Class V	<50%	1000		20	0.35	17300	

[1] RQD = Rock Quality Density and is commonly reported by geotechnical investigators.

The values for sand and clay soils are based on the values in the USS “Steel Sheet Piling Design Manual” (United States Steel - Updated by US Department of Transportation / FHWA, 1984), the USDOT “Handbook on Design of Piles and Drilled Shafts Under Lateral Load” (US Department of Transportation, 1984) and “Laterally Loaded Behavior of Drilled Shafts” by L. C. Reese (Welsh & Reese, 1972).

It should be noted that the values for rock are based on the values from “Rock Engineering” (Franklin & Dusseault, 1989). In the case of the PEC calculator, Conglomerate and Breccia are grouped with Sandstone. In the case of the AllPile software, they are used in combination with a friction angle for a combined cohesive/cohesionless P-Y curve. In this case we have only used the values for a cohesive (clay) soil analysis and hence we use the stiff clay P-Y model to generate the P-Y curves for rock. This is conservative compared to some models, but it does use cohesion values that are higher than some models would use.

There are many published relationships between the different soil strength categories and their associated physical properties. PEC has used those that coincide with the values used in the AllPile software as they align with other published values, whilst covering the largest range of strengths.

9.6 Calculate

After filling in all the required input fields the calculation is ready to be executed.

Hit **Calculate**, the calculation results will be displayed.

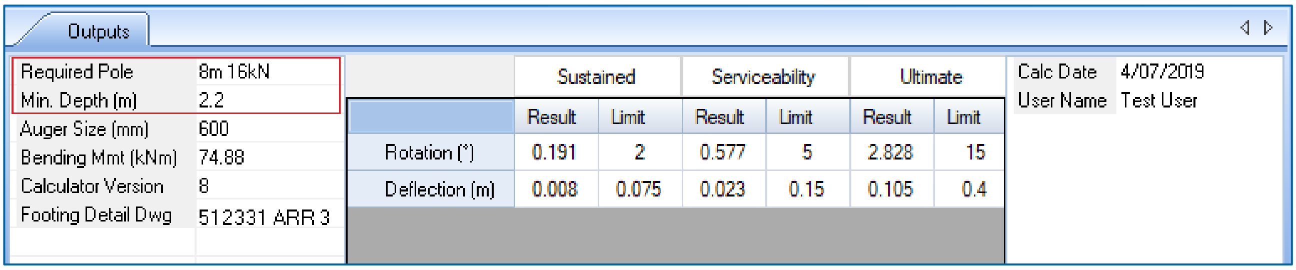
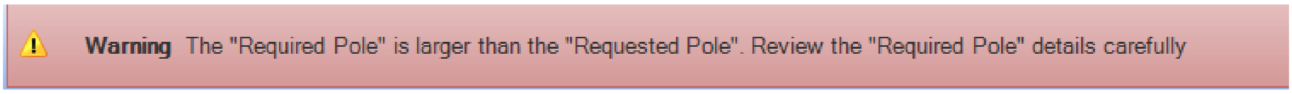


Figure 9-15: Calculation Results Screen

The calculation results window displays the calculated software outputs including required pole size and the minimum required embedment depth.

User Note*: the required pole size may be different to the min pole size requested in the input fields. This will occur when a solution could not be found for the min pole selected. If this happens a red banner will appear at the top of the screen to alert the user that this has occurred. There are a number of reasons why this can occur.*



The Calculated embedment depth must satisfy being less than 10% of the pole length plus 600mm (historical rule-of-thumb) plus 2000mm (0.1 x Pole Length +2.6). If this rule is not satisfied, the algorithm will select the next size pole and then try to solve again. This process will repeat until either a solution is found or until there is no pole that will enable the calculation to solve. The Calculation will not iterate through pole class and pole type ie. The software will not try and solve for a concrete pole if a timber pole solution is required and cannot be found. The software will not use a timber stay pole to solve for a normal timber pole. The software will not iterate using stay poles for normal pole solutions and the software will not solve using composite fibre equipment poles where the required pole is a standard composite fibre poles and vice versa.

User Note*: If the analysis cannot find a suitable pole length and embedment depth, the soil profile is likely too weak for the proposed loading arrangement, or there isn’t a pole option long enough to satisfy the requirements. Try changing to a different pole type, or try a different backfill medium.*

The calculation removes the rotation due to the bending within the pole itself, so the reported rotation is just due to the foundation movement, except for the sustained load case, because this will be representative of what is seen on site during inspections or by the public. Serviceability and ultimate loads are transient and the rotation without the load applied will correspond more to the desired limits. This also prevents the calculations from failing the foundation where the rotation of the pole itself is causing the majority of the rotation

Three load cases are being satisfied during the calculation. The Sustained load case, the Serviceability Load case and the Ultimate Load case, all have a different set of criteria to check against (see Table 7.2.1 & 7.2.2

Other data is also displayed including the bending moment of the pole, the rotation and deflection limits and the actual rotations and deflections for each load case calculated. These values are displayed to help the user understand the outcome in an effort to modify the inputs, if the output results are undesirable / not suitable.

The min. auger size field is populated to satisfy the following rule:

Min auger size > 200m + pole butt diameter.

A larger auger size is not to be used to reduce the min. required embedment depth. To do this a further footing design evaluation is required by a qualified civil engineer.

9.7 Backfill Type

Ideally, site spoil should be the first type selected in attempting to solve the foundation calculation. In some clayey or rocky soils, compaction of the soil can be difficult, in which case one of the other backfill options can be used. In general, if the design is based on using site spoil, any of the other options can be used for construction as they will be conservative. *However,* ***the use of concrete as a timber pole backfill is not allowable unless approved on a case-by-case basis with special construction details to be approved by Transmission & Distribution Mains Engineering and Asset Management departments.***

User Note: *Site spoil should only be used for poles with minimal sustained loads such as intermediate, strain (as long as there is no unbalanced tension at the time of installation) or 4 way poles. The order of preferred backfill types is site spoil, select aggregate, cement stabilised and then concrete.*

The following drawings shall be referenced in design plans for construction:

Timber Pole Footing Arrangement drg: 508726 Arrangement 1/2/3

Concrete Pole Footing Arrangement drg: 512331 Arrangement 1/2/3/4

Steel Pole Footing Arrangement: drg: 178123 Arrangement 1/2/3/4

Composite Fibre (Titan) Footing Arrangement: drg 248464 Arrangement 1/2/3/4

The most current uncontrolled versions of these drawings have been included in the annexure for information. The latest versions must be made available at the time of construction.

Save Record

Once you select **Calculate**, this will automatically save the field inputs for that pole, however if you wanted to leave this page prior to calculating the set of input fields, select **Save Record**. This will ensure the data you have placed in the field will be saved and available next time you enter into that pole. The **Save Record** button will only be available once all of the input fields have been populated.

9.8 Reporting and Exporting

Project data can be obtained from the PEC calculator in two formats

- PDF Report
- CSV Export

9.8.1 PDF Report

The PDF report can be previewed by right-mouse clicking on the respective Project node in the list view (in this example, right mouse click on the node text “Brandy Hill 11kV Feeder 48164”) and select the “Report (PDF)” menu entry (as shown in the following screenshot).

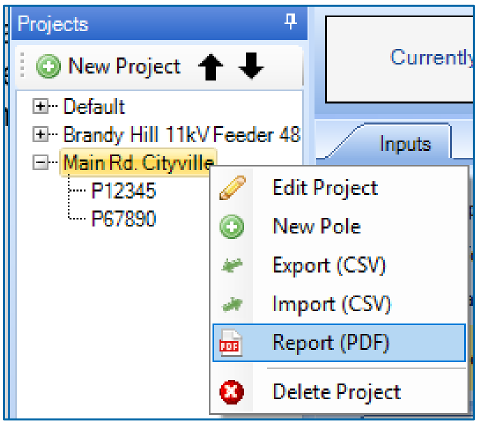


Figure 9-16 Generating a PDF Report

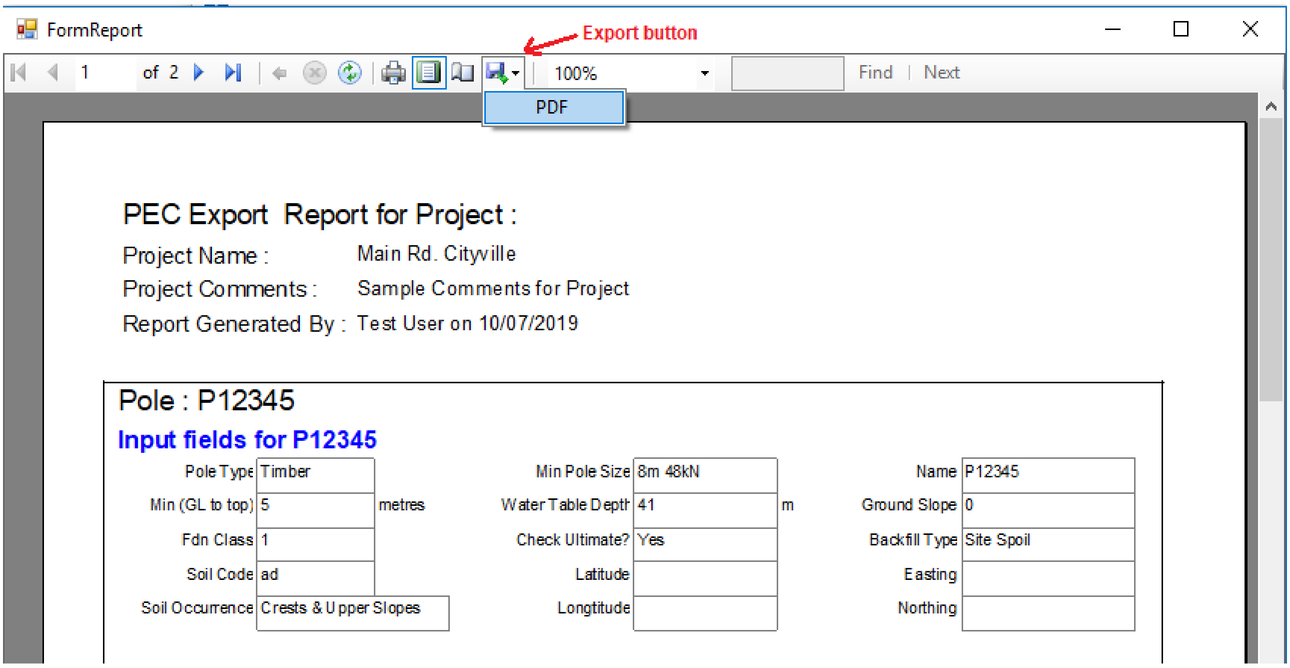


Figure 9-17 PDF Report Viewer

The report will be displayed on the screen in the report viewer. The report can then be exported to a PDF document by clicking on the Export button on the report viewer menu, and then selecting the PDF option (as shown in the above screenshot)

This report also contains a section view of the required foundation including the soil stratum. This report can be useful for planning jobs as it contains a visualisation of the expected soil types to be uncounted and also contains the required backfill volume required.

Use this report in job packs to communicate the expected soil properties to the construction crews. Where deviances from this report are encountered in the field, this information should be reported back to the engineer to determine if it warrants a re-design. Appreciating what is in the field will never be exactly what is on this report, a mechanism of feedback from construction to design is critical in ensuring quality outcomes.

PEC Export Report for Project :

Project Name : Brandy Hill 11kV Feeder 48164

Project Comments : Overhead Mains Upgrade

Report Generated By : Test User on 10/07/2019

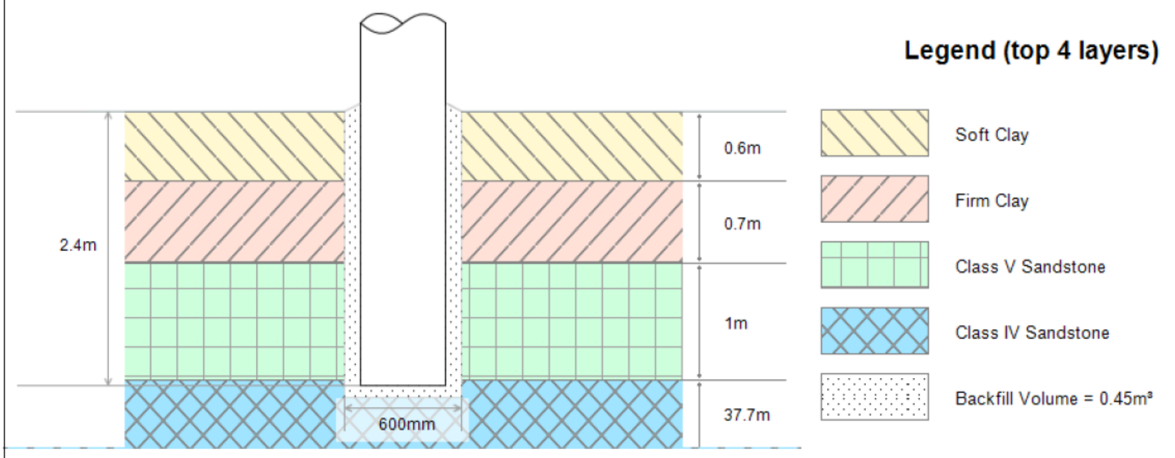
Pole : P1234

Input fields for P1234

Pole Type	Timber		Min Pole Size	8m 48kN		Name	P1234
Min (GL to top)	2	metres	Water Table Depth	41	m	Ground Slope	0
Fdn Class	2		Check Ultimate?	Yes		Backfill Type	Site Spoil
Soil Code	bt		Latitude			Easting	
Soil Occurrence	Generally		Longtitude			Northing	

Soil Properties

Layer	Thickness (m)	Base Depth (m)	Soil Type	Strength	Cohesion (kPa)	Friction Angle	Density (kN/m3)
1	0.6	0.6	Clay	Soft	30		17
2	0.7	1.3	Clay	Firm	72		19
3	1	2.3	Sandstone	Class V	1005		20
4	0	40	Sandstone	Class IV	15000		22



Calculation Results

Required Pole	8m 48kN
Depth (m)	2.35
Min Auger Size (mm)	600
Bending Mmt (kNm)	135.6
Footing Detail Dwg	508726 ARR 1

	Sustained		Serviceability		Ultimate	
	Result	Limit	Result	Limit	Result	Limit
Rotation (°)	0.235	1	0.69	3	1.53	10
Deflection (m)	0.01	0.05	0.027	0.1	0.058	0.25

Calc Date	7/10/2019
User Name	Test User
Calc Version	8

PEC Version : 1.0.0.3 Calculator Version : 8 Page 1 of 1

Figure 9-18: Exported PDF Report, including pole Footing Cross Section

9.8.2 CSV Export

The project data can be exported to a CSV file format by right-mouse clicking on the respective Project node in the list view (in this example, right mouse click on the node text “Brandy Hill 11kV Feeder 48164”) and select the “Export (CSV)” menu entry (as shown in the following screenshot).

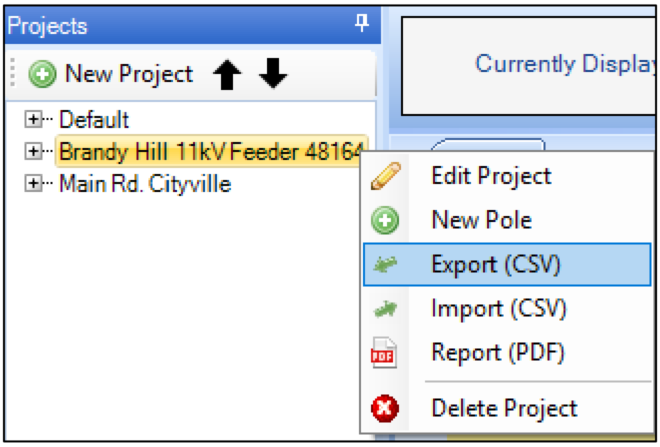


Figure 9-19 Generating a CSV Export

This last may be useful in copying this data to design plans and can be viewed in Excel as shown in the following screenshot.

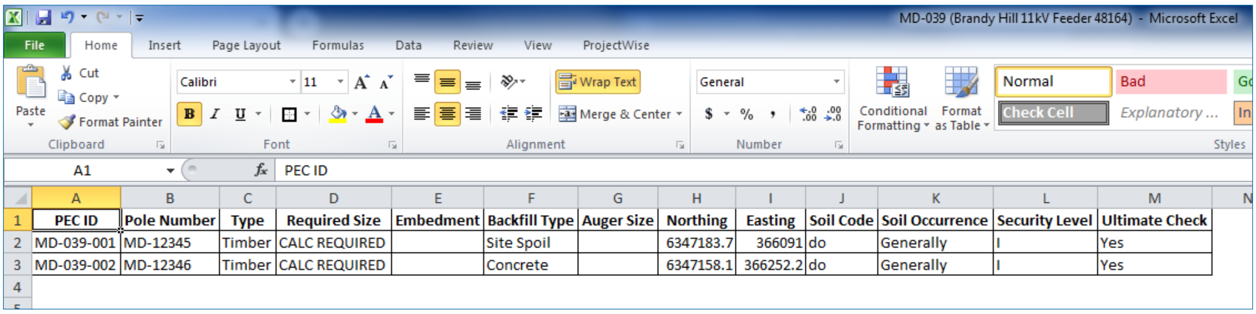


Figure 9-20: Excel Version of Report

9.9 Batch Importing

The PEC has a capability of importing multiple pole instances with one process. This may be useful when exporting the data from the line design software for a project with multiple poles.

Multiple pole data entries can be exported from a CSV file format by right-mouse clicking on the respective Project node in the list view (in this example, right mouse click on the node text “Brandy Hill 11kV Feeder 48164”) and select the “Import (CSV)” menu entry (as shown in the following screenshot).

Note this file format is the same as that detailed for the CSV Export option.

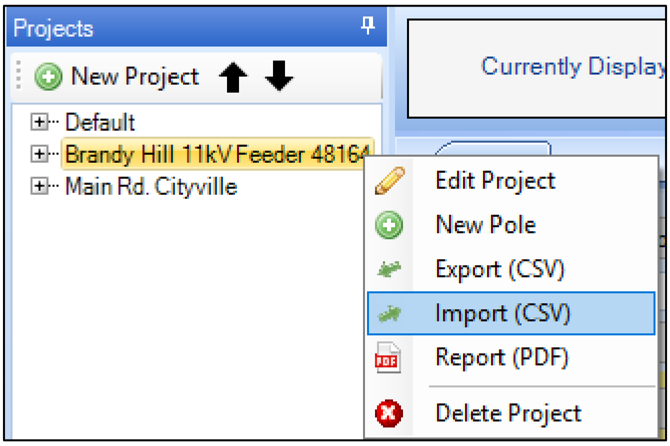


Figure 9-21 Importing Pole Data from CSV

This will then prompt you to choose a file to import. Locate the file and then click **open file**. If the file was successfully imported, the pole data will be displayed under the respective project node

User Notes

10 Annexure 1

10.1 Soil Code – Soil Occurrence Combinations

This sections details all valid soil code – soil occurrence combinations as included in the database at the time of development. Note that this is identified as static data and is considered unlikely to change

Table 10-1: Soil Code and Occurrence Combinations

Soil Code	Soil Occurrence
ad	Crests & Upper Slopes
ad	Drainage
ad	Generally
ah	Generally
as	Generally
aw	Generally
awa	Steep Slopes & Crests
ba	Generally
be	Drainage
be	Lower Slopes
be	Scattered Outcrops
be	Upper Slopes & Crests
bf	Generally
bfa	Where bfa occurs
bg	Mid to Lower Slopes
bg	Upper Slopes
bgz	Generally
bh	Drainage & Valley Flats
bh	Generally
bh	Upper Slopes & Crests
bi	Steep Sideslopes
bi	Upper Slopes
bia	Crests & Low Slopes
bj	Generally
bl	Generally
bn	Generally
br	Drainage
br	Generally
br	Scattered Outcrops
brz	Generally
bt	Generally
bt	Sphagnum Bogs & Moors
btz	Crests
btz	Slopes
bu	Generally
bw	Gentle Slopes
bw	Steep Upper Slopes & Crests
by	Generally
bz	Generally
ca	Generally
cb	Generally

Soil Code	Soil Occurrence
cc	Generally
ce	Generally
cg	Generally
ch	Generally
ch	Scattered Outcrops
cl	Generally
cl	Scattered Outcrops
cm	Generally
cn	Steeper Slopes
co	Generally
cp	Generally
ct	Generally
db	Generally
dcz	Generally
do	Generally
dv	Generally
ec	Generally
eca	Gentler Slopes (<20%) eca
er	Generally
etz	Swamp Margins
fbz	Generally
fc	Mangroves & Saltmarsh
fh	Generally
ga	Crests on Cong & Sast
ga	Drainage
ga	Shale geology
ga	Steep Sideslopes (Cong & Sast)
gb	Generally
gc	Generally
ge	Generally
gg	Generally
gga	Footslopes (Variant gga)
gh	Generally
ghc	Generally
ghc	Outcrops & Crests
gi	Generally
gi	Midslopes
gk	Generally
gl	Drainage
gl	Generally
gl	Scattered Outcrops
gn	Generally
gnz	Generally
gt	Commonly
gu	Generally
gw	Alluvial Terraces
gw	Footslopes & Low Hills
gw	Parent Material on Crests

Soil Code	Soil Occurrence
gy	Generally
ha	Crests & Ridges
ha	Drainage Lines
ha	Slopes & Benches
hb	Drainage
hb	Generally
hh	Colluvial Benches
hh	Steep Upper Slopes
hm	Adjacent to Hillslopes
hm	Generally, Centrally
hm	The Junction & Adjacent Areas
hn	Generally
hoz	Generally
hr	Generally
hs	Generally
hu	Riverbank / Channel
hu	Upstream of Maitland
hua	Floodplains & Backplains
hub	Oxbows & Levees
ig	Generally
ima	Midslopes & Crests
ima	Ridges & Side Slopes
ima	Steep Slopes & Crests
jp	Generally
ki	Crests
ki	Drainage Lines
ki	Sideslopes
la	Generally
lcz	Generally
ld	Generally
lg	Generally
lg	North of Laguna (Singleton Sheet)
lh	Generally
lp	Generally
lv	Generally
lw	Flats
lw	Sandy rises
ma	Crests
ma	Generally
mb	Generally
mc	Generally
md	Commonly
me	Generally
mf	Generally
mg	Generally
mi	Commonly
mi	Drainage
mi	Gentle Sideslopes

Soil Code	Soil Occurrence
mj	Boulder Outcrop
mj	Commonly
ml	Generally
mn	Generally
mo	Generally
mv	Generally
mw	River Flats & Stream Banks
mw	Slopes & Terraces
nc	Generally
ne	Crests and Sideslopes
ne	Drainage Lines
ng	Generally
nhg	Commonly
nhg	Drainage & Midslopes
nm	Generally
npz	Generally
nw	Generally
of	Generally
ol	Generally
ol	Lower Slopes & Drainage
pk	Generally
pr	Generally
qb	Generally
rc	Generally
rh	Generally
ri	Generally
rt	Upper Slopes
rv	Generally
sb	Generally
sbc	Generally
sc	Generally
se	Generally
sea	Generally
sf	Generally
sg	Generally
sh	Drainage Lines
sh	Generally
sk	Generally
sl	Generally
sn	Midslopes and Benches
sn	Upper & Lower Slopes
so	Scrub or Heathlands
so	Slopes
sp	Generally
ss	Generally
st	Generally
su	Scattered Outcrops
su	Steep Sideslopes

Soil Code	Soil Occurrence
sua	Summit & Benches
tb	Generally
tbb	Variant tbb
tg	Generally
tm	Crests on Resistant Materials
tm	Drainage
tm	Generally
ts	Generally
tw	Generally
ty	River Flats & Lake Shore
tya	Tamboy a
tyb	Tamboy b
va	Alluvial Fans & Drainage Lines
va	Slopes & Crests
wa	Drainage
wa	Generally
waz	Well Drained
wb	Generally
wc	Generally
wd	Generally
we	Lower Drainage
we	Side Slopes
wea	Steep Upper Slopes
wg	Commonly
wga	Drainage and Fans
wm	Generally
wn	Crests & Ridges South
wn	Crests North
wn	Generally
wo	Generally
wp	Generally
wpz	Generally
wr	Generally
ww	Generally
wy	Commonly
xx	Introduced Fill
ya	Lower Tracts
ya	Upper Tracts

User Notes: The 'xx' soil classification is defined as introduced fill, ie. there is no certainty of the soil type in that area.

Further investigation (in the form of geo-technical analysis, pre-boring and analysis, cone penetration testing or standard penetration testing) is required for designs related to this area.

This data can then be input into the manage soil layers feature of the PEC

10.2 Pole Data

This section details all of the pole data utilised by the current version of the PEC Calculator (Version 3 at the time of drafting this document).

10.2.1 Timber Poles

Table 10-2: Timber Pole Details

Designation	Length (m)	Ultimate Tip Load (kN)	Tip Diameter (mm)	Butt Diameter (mm)
8m 16kN	8	16	164	241
8m 24kN	8	24	194	271
8m 32kN	8	32	219	296
8m 48kN	8	48	259	336
9.5m 16kN	9.5	16	167	258
9.5m 24kN	9.5	24	200	291
9.5m 32kN	9.5	32	226	317
9.5m 48kN	9.5	48	268	359
11m 24kN	11	24	203	309
11m 32kN	11	32	231	337
11m 48kN	11	48	274	380
12.5m 16kN	12.5	16	171	291
12.5m 24kN	12.5	24	206	326
12.5m 32kN	12.5	32	235	355
12.5m 48kN	12.5	48	280	400
14m 24kN	14	24	208	344
14m 32kN	14	32	237	373
14m 48kN	14	48	284	420
15.5m 24kN	15.5	24	209	359
15.5m 32kN	15.5	32	239	389
15.5m 48kN	15.5	48	288	438
17m 24kN	17	24	209	374
17m 32kN	17	32	241	406
17m 48kN	17	48	290	455
18.5m 24kN	18.5	24	210	389
18.5m 32kN	18.5	32	242	421
18.5m 48kN	18.5	48	293	472
20m 32kN	20	32	242	436
20m 48kN	20	48	294	488
21.5m 32kN	21.5	32	242	451
21.5m 48kN	21.5	48	295	504
23m 48kN	23	48	294	518

10.2.2 Concrete Poles

Table 10-3: Concrete Pole Details

Designation	Length (m)	Ultimate Tip Load (kN)	Tip Diameter (mm)	Butt Diameter (mm)	Thickness (mm)	Type
8m 10kN	8	10	225	345	52	RC
8m 16kN	8	16	240	360	56	RC
8m 24kN	8	24	270	390	62	RC
9.5m 10kN	9.5	10	225	367.5	53	RC
9.5m 16kN	9.5	16	240	382.5	57	RC
9.5m 24kN	9.5	24	270	412.5	63	RC
10m 60kN	10	60	405	555	70	RC
10m 80kN	10	80	450	600	70	RC
10m 100kN	10	100	450	600	75	RC
Stay 10m 100kN	10	100	388	485	80	RPC
Stay 10m 140kN	10	140	440	537	90	RPC
Stay 10m 180kN	10	180	487	584	100	RPC
11m 10kN	11	10	225	390	54	RC
11m 16kN	11	16	240	405	58	RC
11m 24kN	11	24	270	435	64	RC
11m 32kN	11	32	315	480	68	RC
11m 40kN	11	40	330	495	71	RC
12.5m 10kN	12.5	10	225	412.5	55	RC
12.5m 16kN	12.5	16	240	427.5	59	RC
12.5m 24kN	12.5	24	270	457.5	65	RC
12.5m 32kN	12.5	32	315	502.5	69	RC
12.5m 40kN	12.5	40	330	517.5	72	RC
14m 10kN	14	10	225	435	55	RC
14m 16kN	14	16	240	450	59	RC
14m 24kN	14	24	270	480	65	RC
14m 32kN	14	32	315	525	69	RC
14m 40kN	14	40	330	540	72	RC
15.5m 10kN	15.5	10	225	457.5	56	RC
15.5m 16kN	15.5	16	240	472.5	60	RC
15.5m 24kN	15.5	24	270	502.5	66	RC
15.5m 32kN	15.5	32	315	547.5	70	RC
15.5m 40kN	15.5	40	360	592.5	73	RC
17m 16kN	17	16	270	525	64	RPC
17m 24kN	17	24	270	525	66	RPC
17m 32kN	17	32	315	570	69	RPC
17m 40kN	17	40	360	615	69	RPC
17m 60kN	17	60	450	705	74	RPC
17m 80kN	17	80	495	750	74	RPC
18.5m 16kN	18.5	16	270	547.5	64	RPC
18.5m 24kN	18.5	24	270	547.5	66	RPC
18.5m 32kN	18.5	32	315	592.5	69	RPC
18.5m 40kN	18.5	40	360	637.5	69	RPC

Designation	Length (m)	Ultimate Tip Load (kN)	Tip Diameter (mm)	Butt Diameter (mm)	Thickness (mm)	Type
18.5m 60kN	18.5	60	450	727.5	74	RPC
18.5m 80kN	18.5	80	495	772.5	75	RPC
20m 16kN	20	16	270	570	65	RPC
20m 24kN	20	24	270	570	67	RPC
20m 32kN	20	32	315	615	70	RPC
20m 40kN	20	40	360	660	70	RPC
20m 60kN	20	60	450	750	75	RPC
20m 80kN	20	80	495	795	75	RPC
21.4m 16kN	21.4	16	270	591	66	RPC
21.4m 24kN	21.4	24	270	591	68	RPC
21.4m 32kN	21.4	32	315	636	71	RPC
21.4m 40kN	21.4	40	360	681	71	RPC
21.4m 60kN	21.4	60	450	771	76	RPC
21.4m 80kN	21.4	80	495	816	76	RPC
23m 16kN	23	16	270	615	67	RPC
23m 24kN	23	24	270	615	69	RPC
23m 32kN	23	32	315	660	72	RPC
23m 40kN	23	40	360	705	72	RPC
23m 60kN	23	60	450	795	77	RPC
23m 80kN	23	80	495	840	77	RPC
24m 16kN	24	16	270	630	67	RPC
24m 24kN	24	24	270	630	69	RPC
24m 32kN	24	32	315	675	72	RPC
24m 40kN	24	40	360	720	72	RPC
24m 60kN	24	60	450	810	77	RPC
24m 80kN	24	80	495	855	77	RPC
26m 24kN	26	24	270	660	70	RPC
26m 32kN	26	32	270	660	73	RPC
26m 40kN	26	40	360	750	73	RPC
26m 60kN	26	60	450	840	78	RPC
26m 80kN	26	80	495	885	78	RPC
28m 24kN	28	24	270	682.5	71	RPC
28m 32kN	28	32	315	727.5	72	RPC
28m 40kN	28	40	360	772.5	74	RPC
28m 60kN	28	60	450	862.5	79	RPC
28m 80kN	28	80	487.5	900	79	RPC
30m 24kN	30	24	315	772.5	72	RPC
30m 32kN	30	32	315	772.5	75	RPC
30m 40kN	30	40	360	817.5	75	RPC
30m 60kN	30	60	450	907.5	80	RPC
30m 80kN	30	80	495	952.5	80	RPC
32m 24kN	32	24	315	795	73	RPC
32m 32kN	32	32	315	795	76	RPC
32m 40kN	32	40	360	840	76	RPC
32m 60kN	32	60	450	930	81	RPC

Designation	Length (m)	Ultimate Tip Load (kN)	Tip Diameter (mm)	Butt Diameter (mm)	Thickness (mm)	Type
32m 80kN	32	80	495	975	81	RPC
34m 24kN	34	24	315	817.5	75	RPC
34m 32kN	34	32	315	817.5	75	RPC
34m 40kN	34	40	360	862.5	77	RPC
34m 60kN	34	60	450	952.5	82	RPC
34m 80kN	34	80	540	1042.5	82	RPC
36m 24kN	36	24	540	1087.5	75	RPC
36m 32kN	36	32	540	1087.5	76	RPC
36m 40kN	36	40	540	1087.5	78	RPC
36m 60kN	36	60	540	1087.5	83	RPC
36m 80kN	36	80	540	1087.5	83	RPC
38m 24kN	38	24	540	1110	76	RPC
38m 32kN	38	32	540	1110	78	RPC
38m 40kN	38	40	540	1110	80	RPC
38m 60kN	38	60	540	1110	84	RPC
38m 80kN	38	80	540	1110	84	RPC

10.2.3 Steel Poles

Table 10-4: Steel Pole Details

Designation	Length (m)	Ultimate Tip Load (kN)	Tip Diameter (mm)	Butt Diameter (mm)	Thickness (mm)
9.5m 16kN	9.5	16	125	330	4
11m 16kN	11	16	125	362	4
11m 24kN	11	24	155	440	4
12.5m 16kN	12.5	16	125	395	4
12.5m 24kN	12.5	24	155	479	4
14m 16kN	14	16	135	413	4
14m 24kN	14	24	160	517	4
15.5m 16kN	15.5	16	135	444	4
15.5m 24kN	15.5	24	160	556	4
17m 16kN	17	16	135	475	4
17m 24kN	17	24	160	595	4
18.5m 24kN	18.5	24	180	639	4
18.5m 40kN	18.5	40	255	708	5
18.5m 60kN	18.5	60	310	774	6
18.5m 80kN	18.5	80	380	826	7
18.5m 100kN	18.5	100	430	955	7
18.5m 120kN	18.5	120	447	920	7
18.5m 140kN	18.5	140	500	1042	8
20m 24kN	20	24	180	677	4
20m 40kN	20	40	255	746	5
20m 60kN	20	60	310	813	6
20m 80kN	20	80	380	864	7
21.5m 24kN	21.5	24	180	715	4

Designation	Length (m)	Ultimate Tip Load (kN)	Tip Diameter (mm)	Butt Diameter (mm)	Thickness (mm)
21.5m 40kN	21.5	40	255	783	5
21.5m 60kN	21.5	60	310	851	6
21.5m 80kN	21.5	80	380	901	7
22m 24kN	22	24	180	727	4
22m 40kN	22	40	255	796	5
22m 60kN	22	60	310	864	6
22m 80kN	22	80	380	913	7
23m 24kN	23	24	180	743	4
23m 40kN	23	40	255	810	5
23m 60kN	23	60	310	877	6
23m 80kN	23	80	380	923	7
23m 100kN	23	100	430	1071	7
23m 120kN	23	120	445	1021	8
23m 140kN	23	140	500	1160	8
23m 160kN	23	160	520	1250	8
24m 24kN	24	24	180	769	4
24m 40kN	24	40	255	835	5
24m 60kN	24	60	310	902	6
24m 80kN	24	80	380	948	7
24m 100kN	24	100	430	1100	7
24m 120kN	24	120	447	1048	8
24m 160kN	24	160	520	1282	8
24.5m 24kN	24.5	24	180	781	4
24.5m 40kN	24.5	40	255	847	5
24.5m 60kN	24.5	60	310	915	6
24.5m 80kN	24.5	80	380	960	7
26m 24kN	26	24	180	819	5
26m 40kN	26	40	255	885	5
26m 60kN	26	60	310	954	6
26m 80kN	26	80	380	997	7
26m 100kN	26	100	430	1159	7
26m 120kN	26	120	447	1100	8
26m 140kN	26	140	500	1250	8
26m 160kN	26	160	520	1350	8
26m 180kN	26	180	570	1505	8
26m 200kN	26	200	610	1380	10
28m 24kN	28	24	180	870	5
28m 40kN	28	40	255	935	5
28m 60kN	28	60	310	1006	6
28m 80kN	28	80	380	1047	7
30m 24kN	30	24	180	920	5
30m 40kN	30	40	255	985	6
30m 60kN	30	60	310	1057	6
30m 80kN	30	80	380	1097	7
32m 24kN	32	24	180	971	5

Designation	Length (m)	Ultimate Tip Load (kN)	Tip Diameter (mm)	Butt Diameter (mm)	Thickness (mm)
32m 40kN	32	40	255	1036	6
32m 60kN	32	60	310	1109	6
32m 80kN	32	80	380	1147	7
34m 24kN	34	24	180	1010	5
34m 40kN	34	40	255	1074	6
34m 60kN	34	60	310	1147	7
34m 80kN	34	80	380	1181	7

10.2.4 Titan Poles

Table 10-5 Composite Fibre (Titan) Pole Details

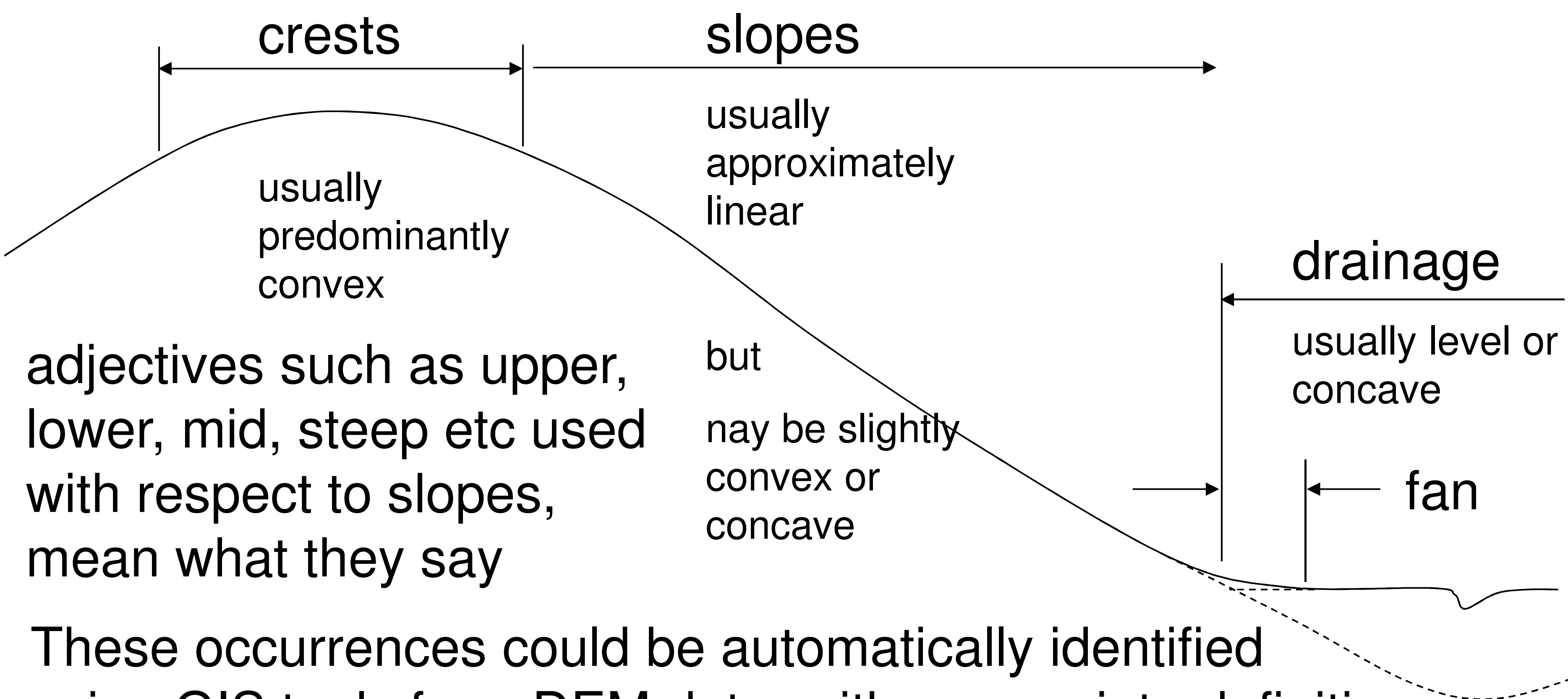
Designation	Length (m)	Ultimate Tip Load (kN)	Tip Diameter (mm)	Butt Diameter (mm)	Thickness (mm)
9.5m 16kN	9.5	16	325	435	53
9.5m 24kN	9.5	24	335	445	63
11m 16kN	11	16	330	460	42
11m 24kN	11	24	340	470	52
12.5m 16kN	12.5	16	320	470	50
12.5m 24kN	12.5	24	335	485	65
14m 16kN	14	16	325	435	60
14m 24kN	14	24	335	435	80
15.5m 16kN	15.5	16	325	455	85
15.5m 24kN	15.5	24	335	455	85
17m 16kN	17	16	325	475	92
17m 24kN	17	24	365	505	90
18.5m 16kN	18.5	16	360	505	70
18.5m 24kN	18.5	24	365	530	100
20m 16kN	20	16	360	540	85
20m 24kN	20	24	365	545	90
21.5m 16kN	21.5	16	360	565	110
21.5m 24kN	21.5	24	365	565	110

11 Annexure 2

11.1 Determining Occurance

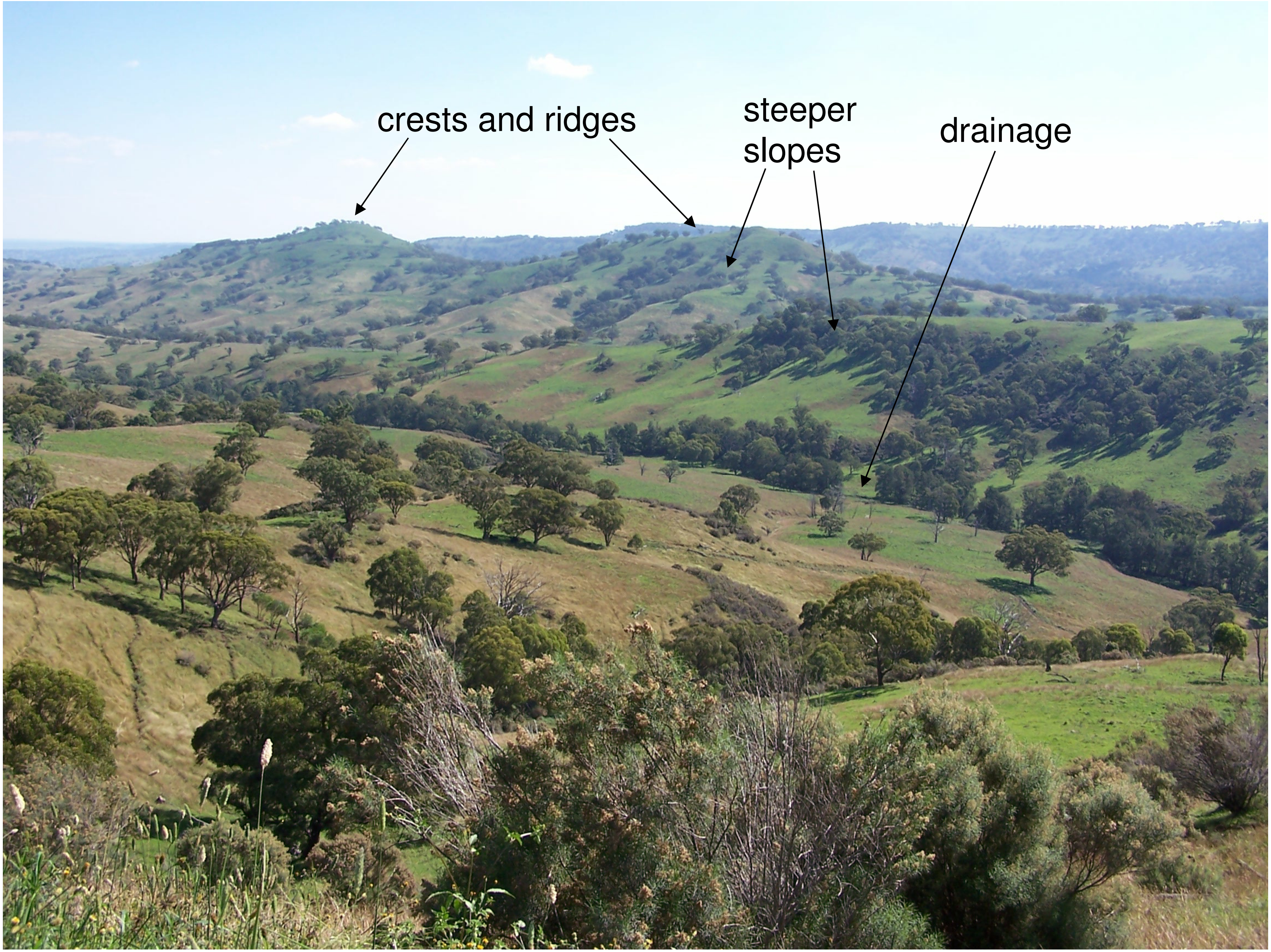
How do we incorporate different occurrences within a particular foundation class?

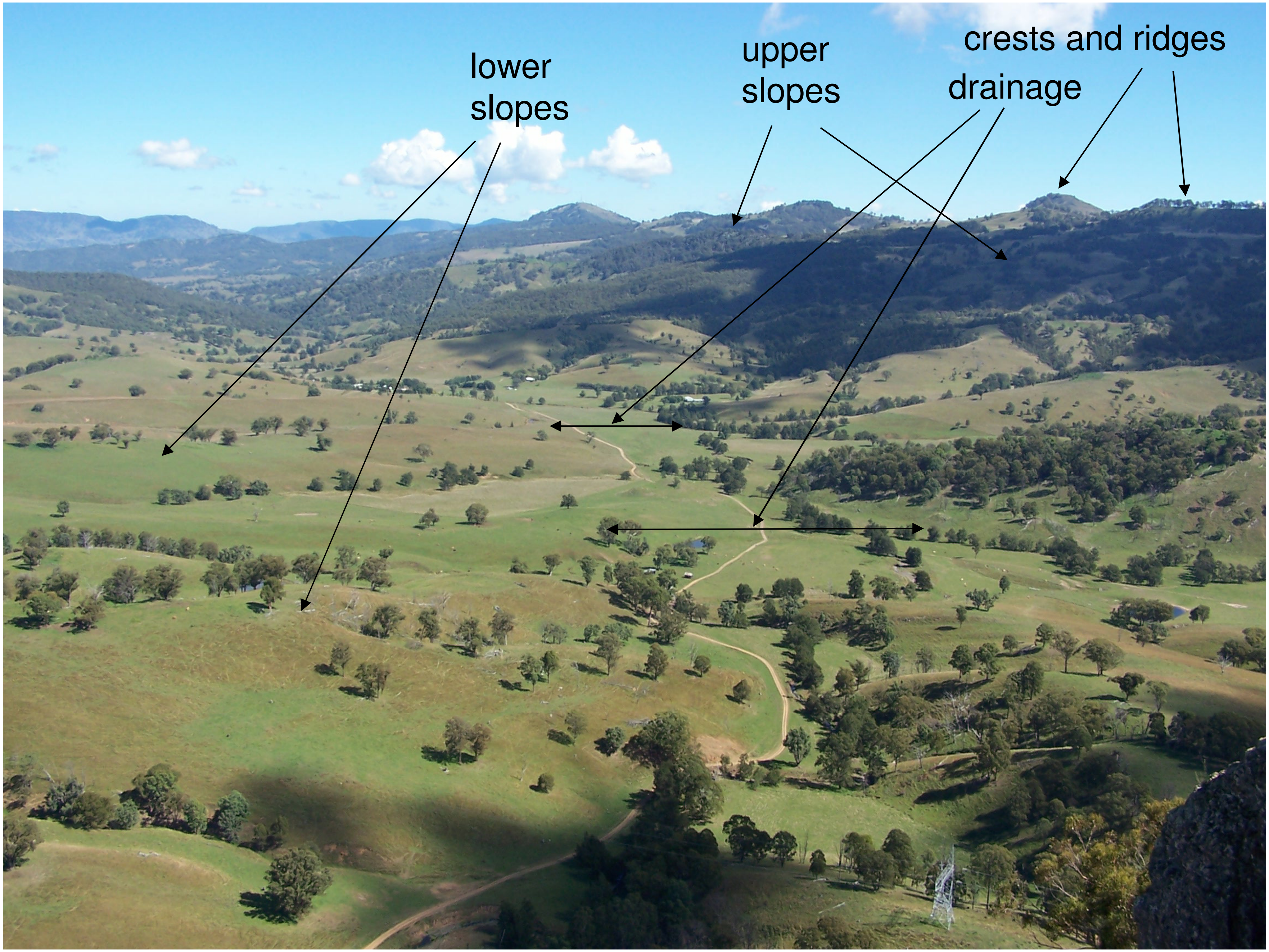
- Slopes, Crests, Drainage, Fans



adjectives such as upper, lower, mid, steep etc used with respect to slopes, mean what they say

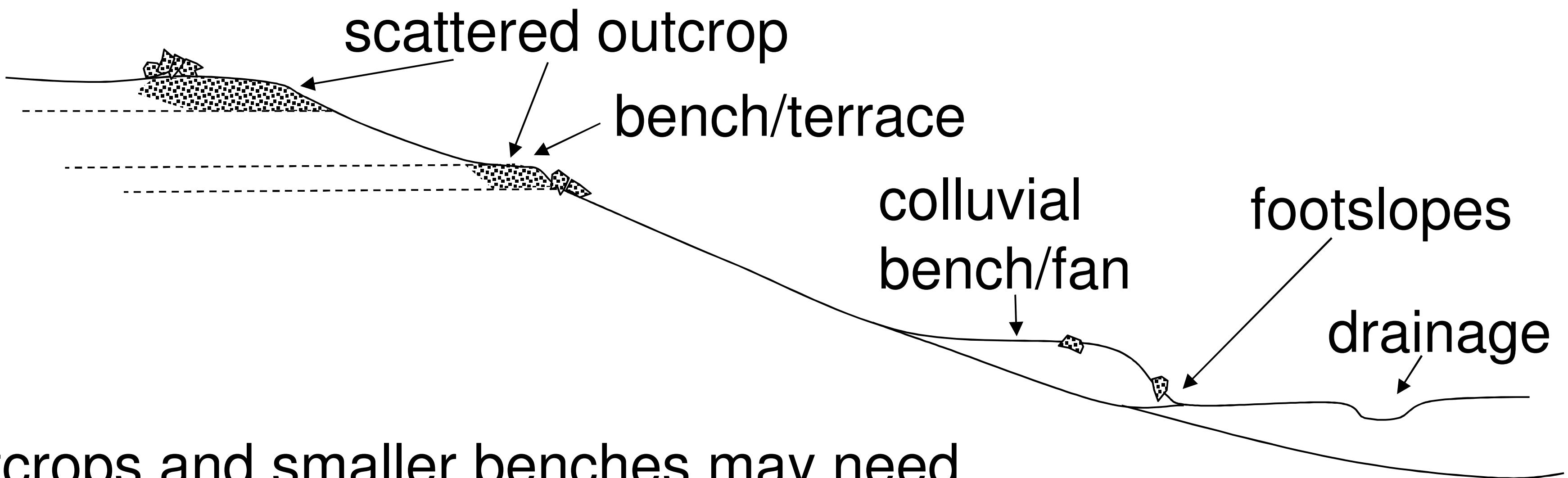
These occurrences could be automatically identified using GIS tools from DEM data, with appropriate definitions


crests and ridges
steeper
slopes
drainage


lower
slopes
upper
slopes
crests and ridges
drainage

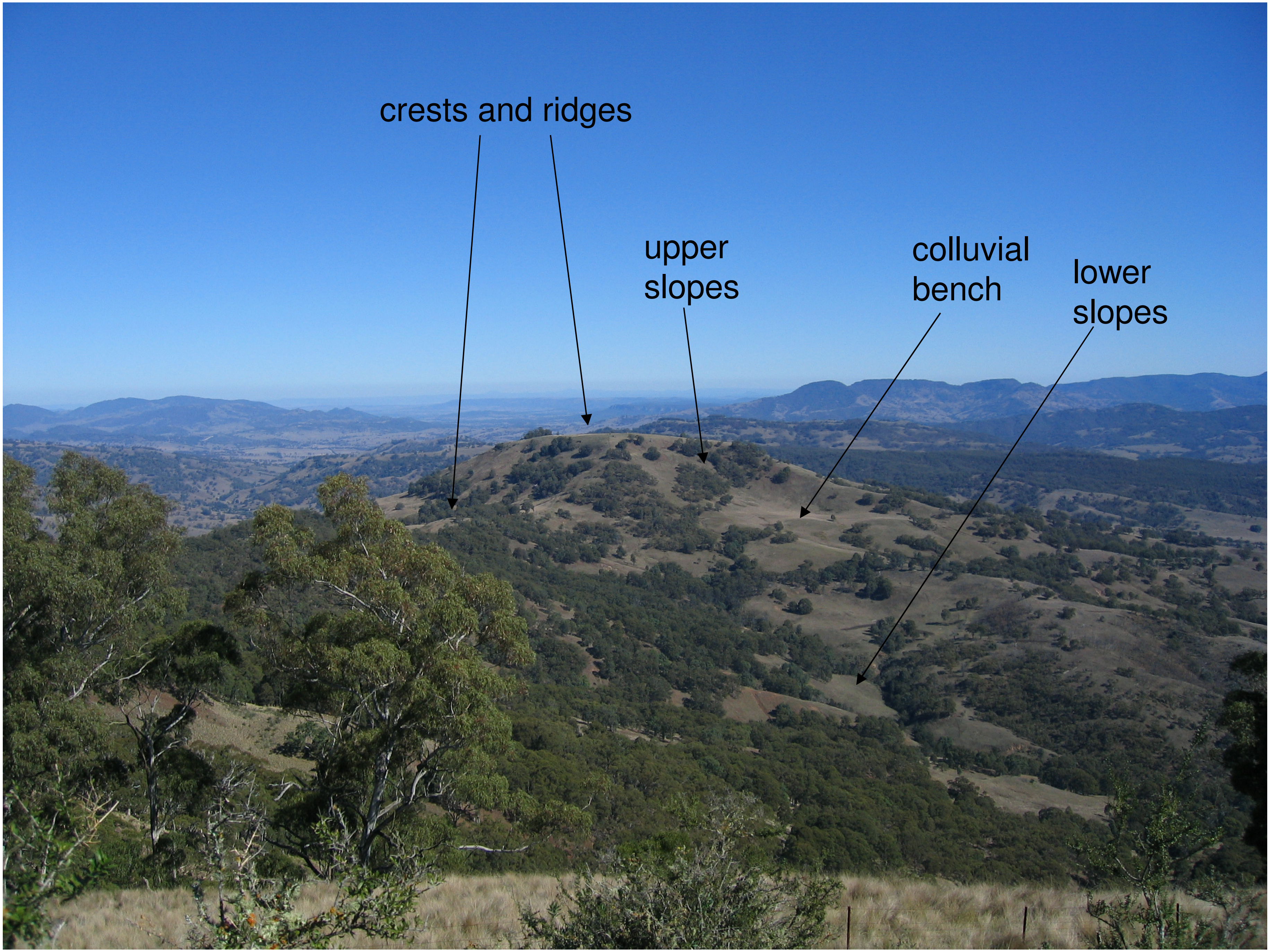
How do we incorporate different occurrences within a particular foundation class?

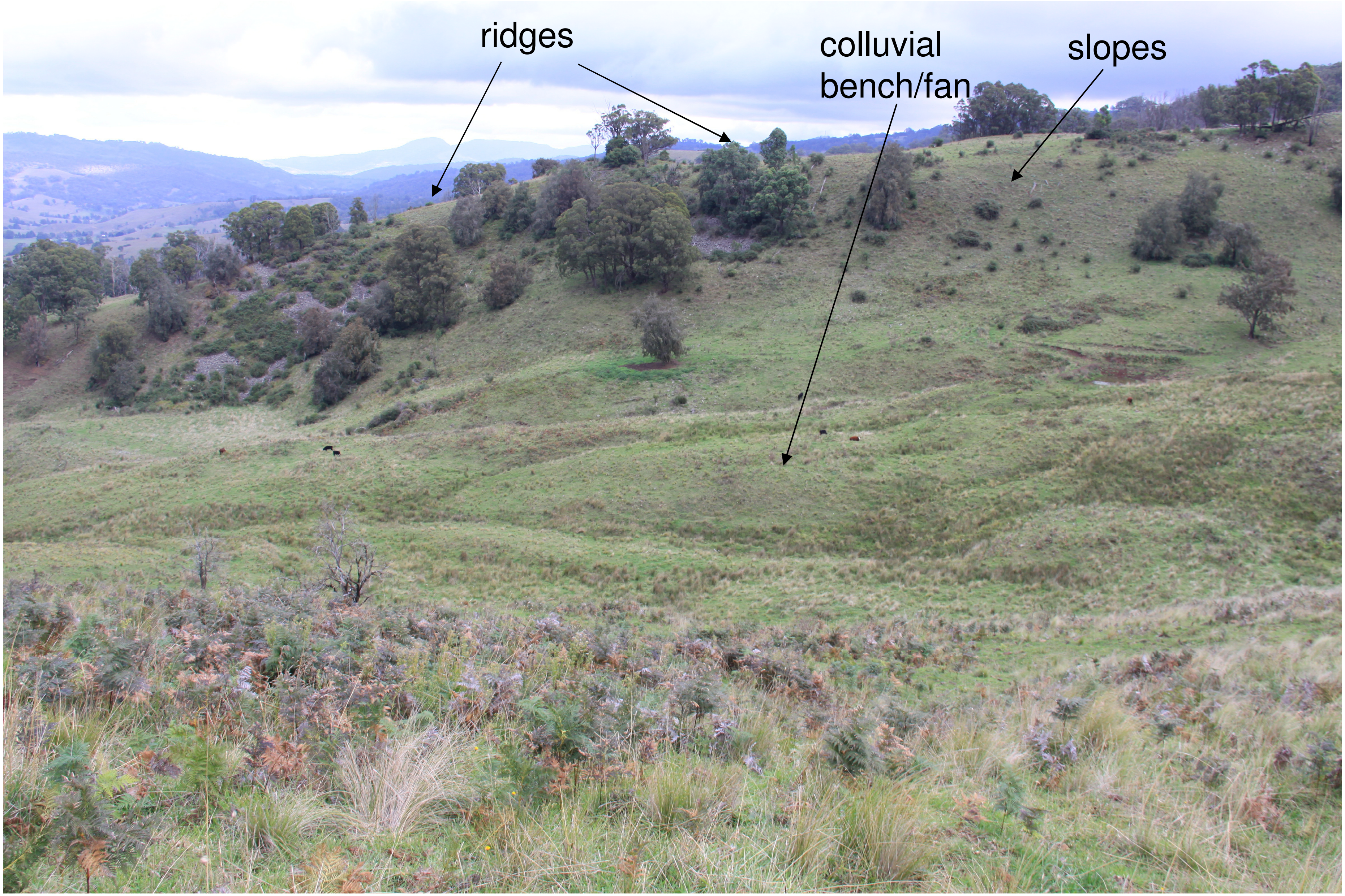
- Scattered Outcrops, Colluvial Benches, Footslopes, Terraces



outcrops and smaller benches may need to be identified from field reconnaisance, as they may not show up in DEMs


scattered outcrop


crests and ridges
upper slopes
colluvial bench
lower slopes


ridges
colluvial
bench/fan
slopes

12 Annexure 3

Confirming Soil Types Discriptions

Table 12-1: Sand (Coarse Soils)

Soil Strength	Diagnostic Features
Very Loose	Loose, easily disturbed soil, like beach sand. Dry and powdery.
Loose	Holds some structure but easily disturbed and excavated.
Medium Dense	Feels firm and hard packed, but can be disturbed by hand with some effort.
Dense	Densely packed grains, takes considerable force to excavate and disturb, may look similar to rock but excavates like a dense soil.
Very Dense	Almost like rock, hard to disturb but crumbles when struck with a blunt object.

Note: for sand, a general rule is the larger the particle size, the higher the friction angle (i.e. stronger the soil)

Table 12-2: Clay (Cohesive Soils)

Soil Strength	Diagnostic Features
Very Soft	Easily Exudes between fingers when squeezed
Soft	Easily Indented by fingers
Firm	Indented by strong finger pressure and can be indented by thumb pressure
Stiff	Cannot be indented by thumb pressure when flat to the surface but can be by the tip of the thumb.
Very Stiff	Can be readily indented by thumbnail
Hard	Difficult to indent by thumbnail

Table 12-3: Rock (Sandstone & Shale)

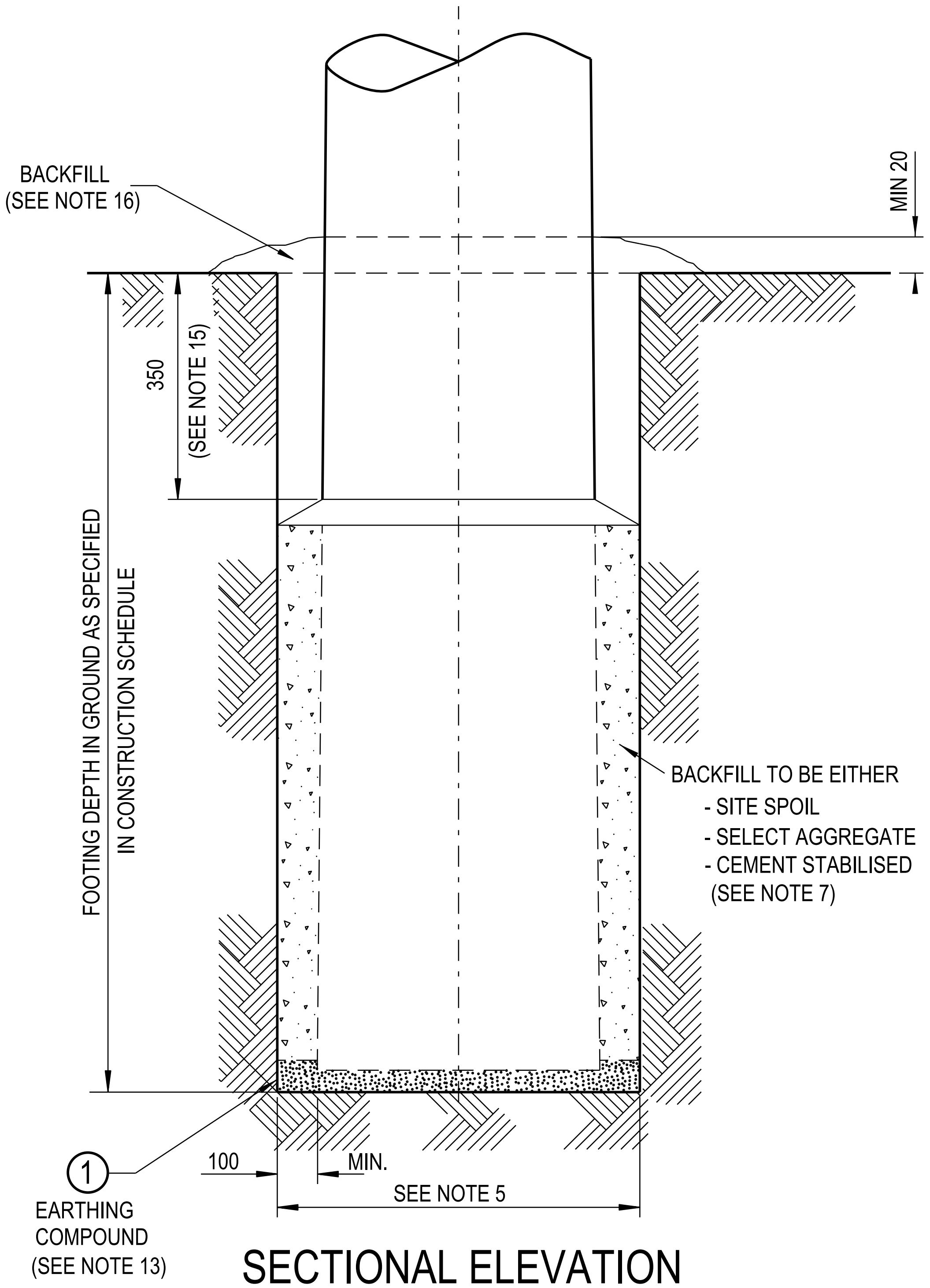
Rock Strength	Diagnostic Features
Class I – Very Strong	Requires many blows of a geological hammer to break it.
Class II - Strong	Requires more than one blow of a geological hammer to fracture it.
Class III – Moderately Strong	Cannot be scraped or peeled with a pocket knife. Can be fractured with a single firm blow of a geological hammer.
Class IV - Weak	Can be peeled by a pocket knife with difficulty. Shallow indentations made by firm blow with the point of a geological hammer.
Class V – Very Weak	Can be peeled by a pocket knife. Crumbles under firm blows with point of geological Hammer. Badly weathered to the point of being similar to a dense soil.

Anything less than “Very Weak” rock should be classified as a soil. Sandstone can be differentiated from other rock relatively easily because it is granular, with grains that are at least visible to the eye. Shale tends to be packed in layers that are relatively easily separated, with grains that are not usually visible to the naked eye. Geological hammers are those that look like.

Figure 12-1: Geological Hammers

13 Annexure 4

13.1 Timber Pole Footing Arrangement



SECTIONAL ELEVATION

ARRANGEMENT 1 - SITE SPOIL BACKFILL
ARRANGEMENT 2 - SELECT AGGREGATE BACKILL
ARRANGEMENT 3 - CEMENT STABILISED BACKFILL

GENERAL NOTES :

1. ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH CURRENT AUSTRALIAN AND NETWORK STANDARDS.
2. AN APPROVED PRESERVATIVE SHALL BE BRUSHED THOROUGHLY INTO THE CREVICES OF THE EXPOSED, UNTREATED TIMBER IMMEDIATELY FOLLOWING THE CUTTING OR TRIMMING OF A POLE.
3. SAPWOOD SHALL BE REMOVED FROM UNTREATED POLES TO A HEIGHT OF 300mm ABOVE GROUND LEVEL.
4. TREATED POLES SHALL NOT BE TRIMMED OR DRILLED DURING DRESSING, BETWEEN THE BUTT AND 1m ABOVE GROUND LINE.
5. AUGER SIZE SHALL BE DETERMINED BY ADDING MINIMUM OF 200mm TO THE POLE BUTT DIAMETER.
6. ANY DEVIATION AWAY FROM THE DEFAULT AUGER SIZE IS ALLOWED, HOWEVER WILL NOT RESULT IN A REDUCTION OF REQUIRED EMBEDMENT DEPTH UNLESS IT IS ACCOMPANIED BY A DESIGN FROM A QUALIFIED CIVIL ENGINEER.
7. THE POLE IS TO BE INSTALLED WITH THE BACKFILL TYPE AND DEPTH NOMINATED IN THE CONSTRUCTION SCHEDULE.
8. A POLE EMBEDMENT CALCULATION REPORT CAN BE USED IN LIEU OF A CONSTRUCTION SCHEDULE.
9. SOIL CONDITIONS ARE TO BE CHECKED ON SITE AND CONFIRMED BY THE CONSTRUCTION CREWS.
10. WHERE THE CONDITIONS FOUND ARE NOT GENERALLY THE CONDITIONS AS SPECIFIED IN THE DESIGN, THE DESIGNER SHALL BE CONSULTED PRIOR TO POLE INSTALLATION.
11. WHERE SOLID ROCK OR BETTER GROUND CONDITIONS THAN EXPECTED ARE ENCOUNTERED, THE DEPTH OF THE FOOTING MAY BE REDUCED, SUBJECT TO A REDESIGN BY THE DESIGNER.
12. FOR AS BUILT CERTIFCATION, A POLE & PILLAR DATA CAPTURE SHEET IS TO BE COMPLETED .
13. ENSURE THAT A 15 kg BAG OF EARTHING COMPOUND HAS BEEN SPREAD EVENLY OVER THE BOTTOM OF THE HOLE BEFORE THE POLE IS ERECTED WHEN A POLE BUTT EARTH IS TO BE INSTALLED.

BACKFILL NOTES :

14. ONLY APPROVED BACKFILL IS TO BE USED.
15. BACK FILLING IS TO BE RAM COMPACTED EVERY 150 mm THICK TO GROUND LINE. THE AREA BETWEEN 350 mm BELOW GROUND LEVEL TO THE ACTUAL GROUND LEVEL SHOULD BE FILLED WITH CLEAN STONE-FREE SANDY LOAM TYPE SOIL TO FACILITATE FUTURE INSPECTIONS AND AVOID CONDITIONS FOR ACCELERATED DECAY WITHIN THE CRITICAL ZONE.
16. SANDY LOAM IS TO BE TAMPED DOWN AND SLOPED AWAY FROM THE POLE SO THAT THE FINISHED LEVEL AT THE POLE IS MIN 20 mm ABOVE THE SURROUNDING GENERAL GROUND LEVEL.
17. COMPACTION LEVEL FOR THE LAYERED BACKFILL IS TO BE 98% OF STANDARD COMPACTION, WITH 1-2% OPTIMUM MOISTURE CONTENT. REFER TO AS 1289 METHOD OF TESTING SOILS FOR ENGINEERING PURPOSES (SOIL COMPACTION AND DENSITY TESTS).
18. FOR REINSTATEMENT OF PAVED AREAS, ANY CONCRETE OR DECORATIVE PAVING MUST TERMINATE A MINIMUM OF 300 mm FROM THE FACE OF A TIMBER POLE, TO FACILITATE POLE INSPECTION AND MAINTENANCE. REFER TO NS128 FOR FURTHER REQUIREMENTS

ARR - 1 : SITE SPOIL BACKFILL NOTES :

1-1. SITE SPOIL SHOULD ONLY BE USED IF SUITABLE TO BACKFILL AND RAM COMPACT. IF IT IS DEEMED UNSUITABLE, SELECT AGGREGATE OR CEMENT STABILISED BACKFILL IS TO BE USED.
1-2. HANDLE & DISPOSE OF ALL CONTAMINATED MATERIAL IN ACCORDANCE WITH RELEVANT WHS. ACTS & REGULATIONS AND EPA REQUIREMENTS.

ARR - 2 : SELECT AGGREGATE BACKFILL:

2-1. ROADBASE TO BE SUPPLIED IN ACCORDANCE WITH RMS SPECIFICATION 3051 - DGS-20 & ASSOCIATED RMS SPECIFICATIONS. A WELL GRADED MAXIMUM SIZE 20 mm AGGREGATE IS TO BE USED.

ARR - 3 : CEMENT STABILISED BACKFILL:

3-1. CEMENT STABILISED BACKFILL SHALL BE A BLEND OF 3% BY VOLUME TYPE GB GENERAL BLEND CEMENT (60% CEMENT, 40% FLY ASH) TO AS3972 THOROUGHLY MIXED WITH SITE SPOIL OR SELECT AGGREGATE BACKFILL. THE AIM IS TO ACHIEVE MINIMUM UNCONFINED COMPRESSION STRENGTH OF 1MPA AT 3 DAYS.

ITEM	DESCRIPTION	STOCK CODE	QTY
1	EARTHING COMPOUND 15kg BAG (SEE NOTE 13)	99861	1

DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE

CAD DRAWING
DO NOT MANUALLY AMEND

AMENDMENTS

AMD	DWN	CHKED	DATE / DESCRIPTION	APP'D by
7	DOMINIC SHIELDS	PHILLIP JONES	25/01/2019 SECTION & NOTES AMENDED. ARRANGEMENTS 1 - 3 ADDED.	GLENN FORD

ASSOCIATED DRAWINGS
POLE & PILLAR DATA CAPTURE SHEET

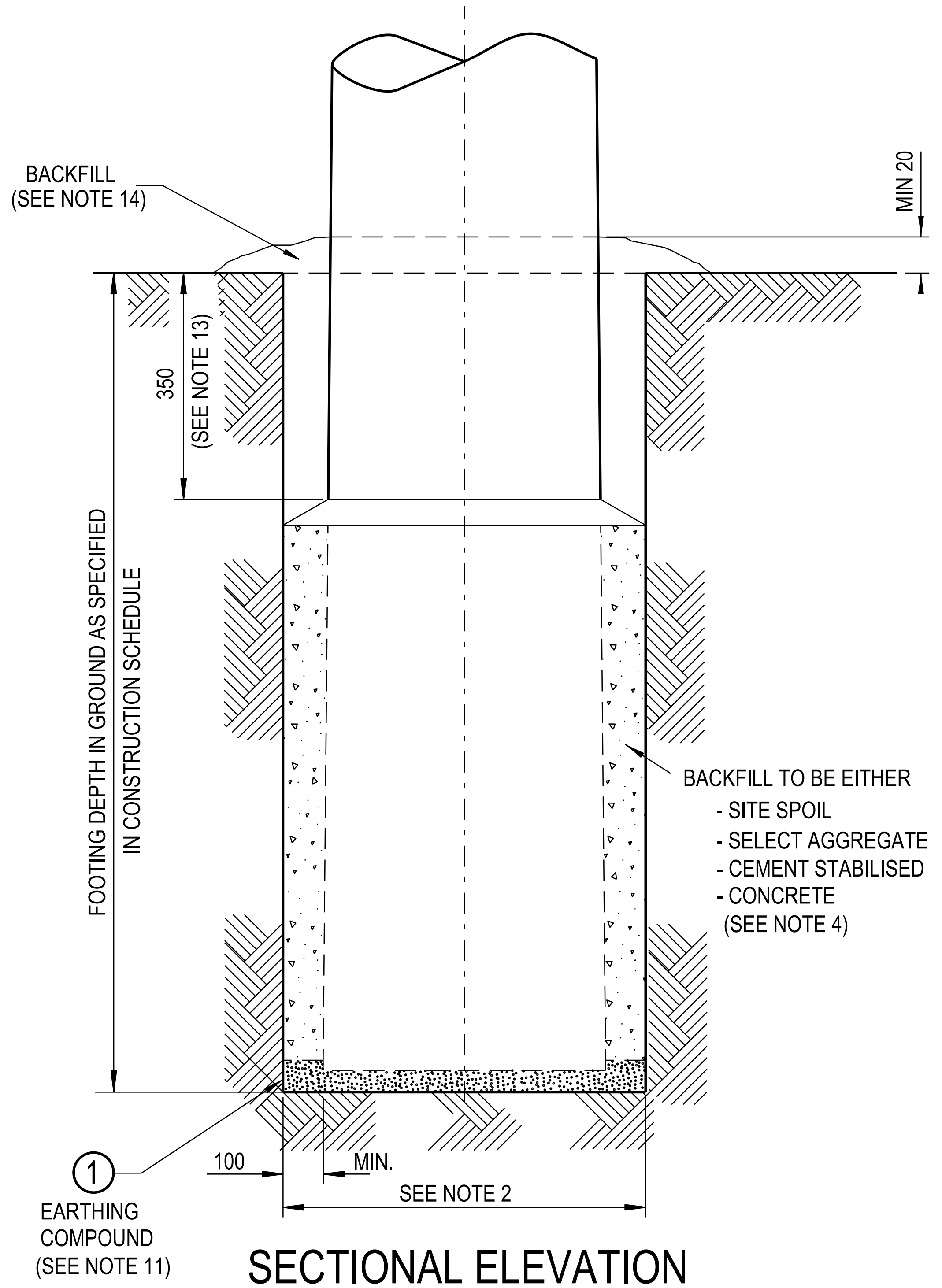
NETWORK STANDARD
Ausgrid
145 NEWCASTLE RD WALLSEND, NSW 2287

SCALE	NTS
DESIGNED	
DRAWN	PS
CHECKED	
APPROVED	G SKINNER
DATE	22/09/97
PROJECT NUMBER	STD
PROJTRAK NUMBER	

STANDARD CONSTRUCTION
TIMBER POLE
FOOTING ARRANGEMENT

SIZE	DRAWING No	SHEET	AMD
A3	508726	01	7

13.2 Concrete Pole Footing Arrangement



SECTIONAL ELEVATION

ARRANGEMENT 1 - SITE SPOIL BACKFILL
ARRANGEMENT 2 - SELECT AGGREGATE BACKILL
ARRANGEMENT 3 - CEMENT STABILISED BACKFILL
ARRANGEMENT 4 - CONCRETE BACKFILL

GENERAL NOTES :

1. ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH CURRENT AUSTRALIAN AND NETWORK STANDARDS.
2. AUGER SIZE SHALL BE DETERMINED BY ADDING MINIMUM OF 200mm TO THE POLE BUTT DIAMETER.
3. ANY DEVIATION AWAY FROM THE DEFAULT AUGER SIZE IS ALLOWED, HOWEVER WILL NOT RESULT IN A REDUCTION OF REQUIRED EMBEDMENT DEPTH UNLESS IT IS ACCOMPANIED BY A DESIGN FROM A QUALIFIED CIVIL ENGINEER.
4. THE POLE IS TO BE INSTALLED WITH THE BACKFILL TYPE AND DEPTH NOMINATED IN THE CONSTRUCTION SCHEDULE.
5. A POLE EMBEDMENT CALCULATION REPORT CAN BE USED IN LIEU OF A CONSTRUCTION SCHEDULE.
6. SOIL CONDITIONS ARE TO BE CHECKED ON SITE AND CONFIRMED BY THE CONSTRUCTION CREWS.
7. WHERE THE CONDITIONS FOUND ARE NOT GENERALLY THE CONDITIONS AS SPECIFIED IN THE DESIGN, THE DESIGNER SHALL BE CONSULTED PRIOR TO POLE INSTALLATION.
8. CARE SHALL BE TAKEN TO ENSURE THE POLE IS NOT EXPOSED TO CHEMICALLY AGGRESSIVE WATER CONDITION. IF THIS OCCURS, REFER MAINS DESIGN FOR USE OF AGGRESSIVE SOIL FOOTING ARRANGEMENT.
9. WHERE SOLID ROCK OR BETTER GROUND CONDITIONS THAN EXPECTED ARE ENCOUNTERED, THE DEPTH OF THE FOOTING MAY BE REDUCED, SUBJECT TO A REDESIGN BY THE DESIGNER.
10. FOR AS BUILT CERTIFCATION, A POLE & PILLAR DATA CAPTURE SHEET IS TO BE COMPLETED .
11. ENSURE THAT A 15 kg BAG OF EARTHING COMPOUND HAS BEEN SPREAD EVENLY OVER THE BOTTOM OF THE HOLE BEFORE THE POLE IS ERECTED.

BACKFILL NOTES :

12. ONLY APPROVED BACKFILL IS TO BE USED.
13. BACK FILLING IS TO BE RAM COMPACTED EVERY 150 mm THICK TO GROUND LINE. THE AREA BETWEEN 350 mm BELOW GROUND LEVEL TO THE ACTUAL GROUND LEVEL SHOULD BE FILLED WITH CLEAN STONE-FREE SANDY LOAM TYPE SOIL TO FACILITATE FUTURE INSPECTIONS.
14. SANDY LOAM IS TO BE TAMPED DOWN AND SLOPED AWAY FROM THE POLE SO THAT THE FINISHED LEVEL AT THE POLE IS MIN 20 mm ABOVE THE SURROUNDING GENERAL GROUND LEVEL.
15. COMPACTION LEVEL FOR THE LAYERED BACKFILL IS TO BE 98% OF STANDARD COMPACTION, WITH 1-2% OPTIMUM MOISTURE CONTENT. REFER TO AS 1289 METHOD OF TESTING SOILS FOR ENGINEERING PURPOSES (SOIL COMPACTION AND DENSITY TESTS).
16. FOR REINSTATEMENT OF PAVED AREAS, ANY CONCRETE OR DECORATIVE PAVING MUST TERMINATE A MINIMUM OF 300 mm FROM THE FACE OF A CONCRETE POLE, TO FACILITATE POLE INSPECTION AND MAINTENANCE. REFER TO NS128 FOR FURTHER REQUIREMENTS.

ARR - 1 : SITE SPOIL BACKFILL NOTES :

1-1. SITE SPOIL SHOULD ONLY BE USED IF SUITABLE TO BACKFILL AND RAM COMPACT. IF IT IS DEEMED UNSUITABLE, SELECT AGGREGATE OR CEMENT STABILISED BACKFILL IS TO BE USED.
1-2. HANDLE & DISPOSE OF ALL CONTAMINATED MATERIAL IN ACCORDANCE WITH RELEVANT WHS. ACTS & REGULATIONS AND EPA REQUIREMENTS.

ARR - 2 : SELECT AGGREGATE BACKFILL:

2-1. ROADBASE TO BE SUPPLIED IN ACCORDANCE WITH RMS SPECIFICATION 3051 - DGS-20 & ASSOCIATED RMS SPECIFICATIONS. A WELL GRADED MAXIMUM SIZE 20 mm AGGREGATE IS TO BE USED.

ARR - 3 : CEMENT STABILISED BACKFILL:

3-1. CEMENT STABILISED BACKFILL SHALL BE A BLEND OF 3% BY VOLUME TYPE GB GENERAL BLEND CEMENT (60% CEMENT, 40% FLY ASH) TO AS3972 THOROUGHLY MIXED WITH THE SPOIL OR IMPORTED MATERIAL. THE AIM IS TO ACHIEVE MINIMUM UNCONFINED COMPRESSION STRENGTH OF 1MPA AT 3 DAYS.

ARR - 4 : CONCRETE BACKFILL NOTES:

4-1. THE CONCRETING MUST CEASE AT 350 mm BELOW GROUND LINE AND MUST NOT COVER EARTHING FERRULE, LOCATED BELOW GROUND LEVEL TO ENSURE ACCESS FOR CONNECTION, INSPECTION AND TESTING OF THE POLE EARTHING SYSTEM.
4-2. WHERE AGGRESSIVE SOIL IS LOCATED, CONCRETING TO GROUND LEVEL IS PREFERRED, HOWEVER SUITABLE TIMBER FORMWORK IS TO BE ATTACHED TO THE POLE SO THAT WHEN THE FOOTING IS POURED, CONCRETE IS KEPT CLEAR OF THE EARTH FERRULE LOCATION TO A DEPTH OF 350 mm BELOW GROUND LEVEL. REFER DRG: 514133
4-3. THE CONCRETE SHALL BE A MINIMUM OF 20MPA GENERAL PURPOSE CONCRETE WITH MAXIMUM 10 mm AGGREGATE AND A SLUMP OF 80-120mm.
4-4. THE CONCRETE SHALL BE MECHANICALLY VIBRATED IN MAXIMUM 400 mm LIFTS. VIBRATION SHOULD CONTINUE TO THE POINT WHERE WATER IS JUST STARTING TO RISE THROUGH THE SURFACE.

ITEM	DESCRIPTION	STOCK CODE	QTY
1	EARTHING COMPOUND 15kg BAG	99861	1

DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE

CAD DRAWING
DO NOT MANUALLY AMEND

AMENDMENTS				
13	DATE: 29/01/2019 SECTION & NOTES AMENDED.	DWN: PATRICIA RIOS	CHKED: PHILLIP JONES	APP'D by: DOMINIC SHIELDS

ASSOCIATED DRAWINGS

POLE AND PILLAR DATA CAPTURE SHEET	
CONCRETE POLE -AGGRESSIVE SOIL FOOTING ARR.	514133

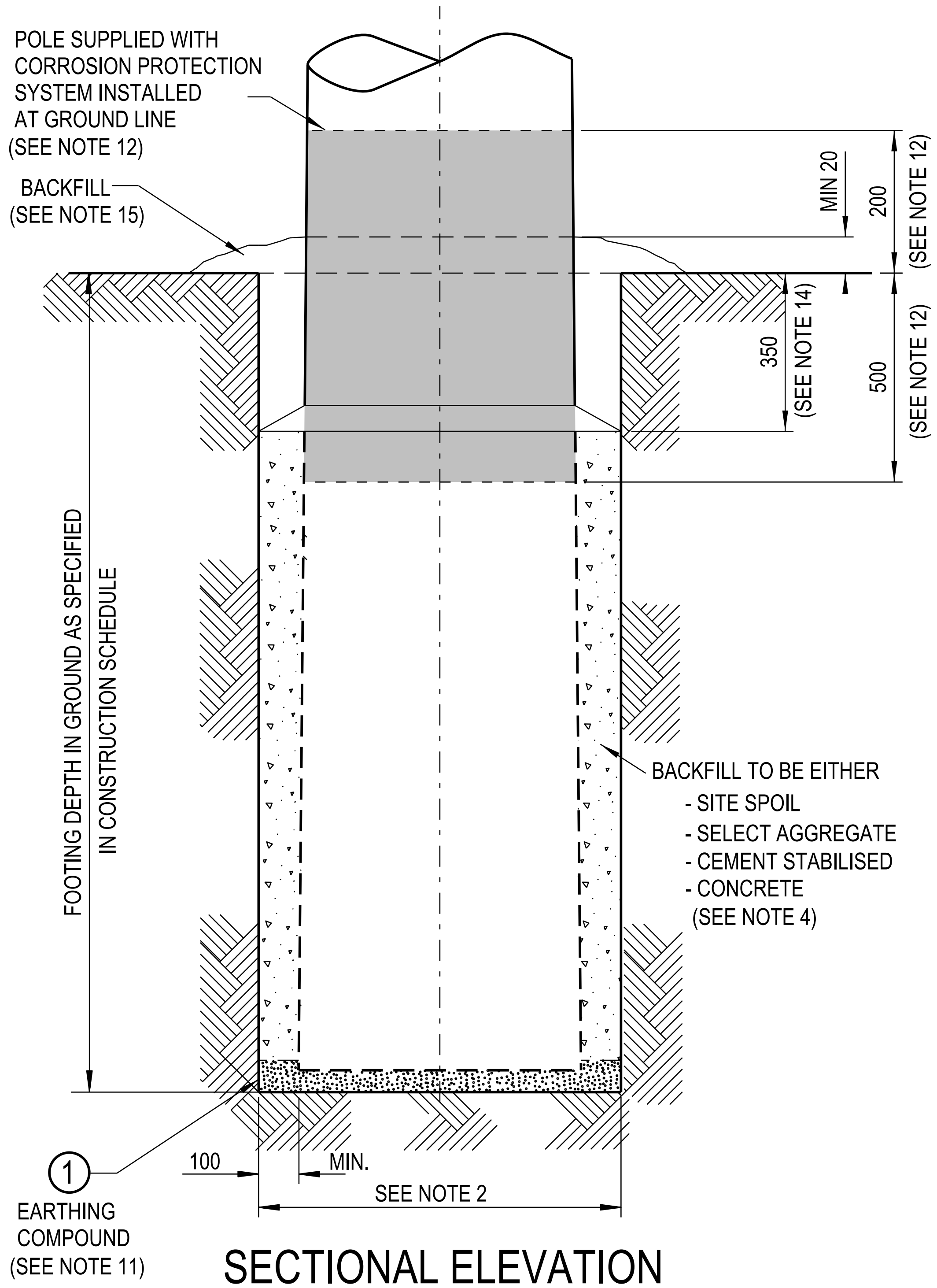
NETWORK STANDARD
Ausgrid
145 NEWCASTLE RD WALLSEND, NSW 2287

SCALE	NTS
DESIGNED	-
DRAWN	PETER SAUNDERS
CHECKED	-
APPROVED	I.NICHOLS
DATE	17/09/93
PROJECT NUMBER	STD
PROJTRAK NUMBER	-

STANDARD CONSTRUCTION
CONCRETE POLE
FOOTING ARRANGEMENT

SIZE	DRAWING No	SHEET	AMD
A3	512331	01	13

13.3 Steel Pole Footing Arrangement



SECTIONAL ELEVATION

ARRANGEMENT 1 - SITE SPOIL BACKFILL
ARRANGEMENT 2 - SELECT AGGREGATE BACKILL
ARRANGEMENT 3 - CEMENT STABILISED BACKFILL
ARRANGEMENT 4 - CONCRETE BACKFILL

GENERAL NOTES :

1. ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH CURRENT AUSTRALIAN AND NETWORK STANDARDS.
2. AUGER SIZE SHALL BE DETERMINED BY ADDING MINIMUM OF 200mm TO THE POLE BUTT DIAMETER.
3. ANY DEVIATION AWAY FROM THE DEFAULT AUGER SIZE IS ALLOWED, HOWEVER WILL NOT RESULT IN A REDUCTION OF REQUIRED EMBEDMENT DEPTH UNLESS IT IS ACCOMPANIED BY A DESIGN FROM A QUALIFIED CIVIL ENGINEER.
4. THE POLE IS TO BE INSTALLED WITH THE BACKFILL TYPE AND DEPTH NOMINATED IN THE CONSTRUCTION SCHEDULE.
5. A POLE EMBEDMENT CALCULATION REPORT CAN BE USED IN LIEU OF A CONSTRUCTION SCHEDULE.
6. SOIL CONDITIONS ARE TO BE CHECKED ON SITE AND CONFIRMED BY THE CONSTRUCTION CREWS.
7. WHERE THE CONDITIONS FOUND ARE NOT GENERALLY THE CONDITIONS AS SPECIFIED IN THE DESIGN, THE DESIGNER SHALL BE CONSULTED PRIOR TO POLE INSTALLATION.
8. CARE SHALL BE TAKEN TO ENSURE THE POLE IS NOT EXPOSED TO CHEMICALLY AGGRESSIVE WATER CONDITION. IF THIS OCCURS, REFER MAINS DESIGN FOR USE OF AGGRESSIVE SOIL FOOTING ARRANGEMENT.
9. WHERE SOLID ROCK OR BETTER GROUND CONDITIONS THAN EXPECTED ARE ENCOUNTERED, THE DEPTH OF THE FOOTING MAY BE REDUCED, SUBJECT TO A REDESIGN BY THE DESIGNER.
10. FOR AS BUILT CERTIFCATION, A POLE & PILLAR DATA CAPTURE SHEET IS TO BE COMPLETED .
11. ENSURE THAT A 15 kg BAG OF EARTHING COMPOUND HAS BEEN SPREAD EVENLY OVER THE BOTTOM OF THE HOLE BEFORE THE POLE IS ERECTED.
12. ALL STEEL POLES ARE TO BE INSTALLED WITH THE CORROSION PROTECTION SYSTEM AT A MINIMUM OF 200mm ABOVE GROUND LEVEL AND 500mm BELOW GROUND LEVEL.

BACKFILL NOTES :

13. ONLY APPROVED BACKFILL IS TO BE USED.
14. BACK FILLING IS TO BE RAM COMPACTED EVERY 150 mm THICK TO GROUND LINE. THE AREA BETWEEN 350 mm BELOW GROUND LEVEL TO THE ACTUAL GROUND LEVEL SHOULD BE FILLED WITH CLEAN STONE-FREE SANDY LOAM TYPE SOIL TO FACILITATE FUTURE INSPECTIONS.
15. SANDY LOAM IS TO BE TAMPED DOWN AND SLOPED AWAY FROM THE POLE SO THAT THE FINISHED LEVEL AT THE POLE IS MIN 20 mm ABOVE THE SURROUNDING GENERAL GROUND LEVEL.
16. COMPACTION LEVEL FOR THE LAYERED BACKFILL IS TO BE 98% OF STANDARD COMPACTION, WITH 1-2% OPTIMUM MOISTURE CONTENT. REFER TO AS 1289 METHOD OF TESTING SOILS FOR ENGINEERING PURPOSES (SOIL COMPACTION AND DENSITY TESTS).
17. FOR REINSTATEMENT OF PAVED AREAS, ANY CONCRETE OR DECORATIVE PAVING MUST TERMINATE A MINIMUM OF 300 mm FROM THE FACE OF A STEEL POLE, TO FACILITATE POLE INSPECTION AND MAINTENANCE. REFER TO NS128 FOR FURTHER REQUIREMENTS.

ARR - 1 : SITE SPOIL BACKFILL NOTES :

1-1. SITE SPOIL SHOULD ONLY BE USED IF SUITABLE TO BACKFILL AND RAM COMPACT. IF IT IS DEEMED UNSUITABLE, SELECT AGGREGATE OR CEMENT STABILISED BACKFILL IS TO BE USED.
1-2. HANDLE & DISPOSE OF ALL CONTAMINATED MATERIAL IN ACCORDANCE WITH RELEVANT WHS. ACTS & REGULATIONS AND EPA REQUIREMENTS.

ARR - 2 : SELECT AGGREGATE BACKFILL:

2-1. ROADBASE TO BE SUPPLIED IN ACCORDANCE WITH RMS SPECIFICATION 3051 - DGS - 20 & ASSOCIATED RMS SPECIFICATIONS. A WELL GRADED MAXIMUM SIZE 20 mm AGGREGATE IS TO BE USED.

ARR - 3 : CEMENT STABILISED BACKFILL:

3-1. CEMENT STABILISED BACKFILL SHALL BE A BLEND OF 3% BY VOLUME TYPE GB GENERAL BLEND CEMENT (60% CEMENT, 40% FLY ASH) TO AS3972 THOROUGHLY MIXED WITH THE SPOIL OR IMPORTED MATERIAL. THE AIM IS TO ACHIEVE MINIMUM UNCONFINED COMPRESSION STRENGTH OF 1MPA AT 3 DAYS.

ARR - 4 : CONCRETE BACKFILL NOTES:

4-1. THE CONCRETING MUST CEASE AT 350 mm BELOW GROUND LINE AND MUST NOT COVER EARTHING FERRULE, LOCATED BELOW GROUND LEVEL TO ENSURE ACCESS FOR CONNECTION, INSPECTION AND TESTING OF THE POLE EARTHING SYSTEM.
4-2. WHERE AGGRESSIVE SOIL IS LOCATED, CONCRETING TO GROUND LEVEL IS PREFERRED, HOWEVER SUITABLE TIMBER FORMWORK IS TO BE ATTACHED TO THE POLE SO THAT WHEN THE FOOTING IS POURED, CONCRETE IS KEPT CLEAR OF THE EARTH FERRULE LOCATION TO A DEPTH OF 350mm BELOW GROUND LEVEL.
4-3. THE CONCRETE SHALL BE A MINIMUM OF 20MPA GENERAL PURPOSE CONCRETE WITH MAXIMUM 10mm AGGREGATE AND A SLUMP OF 80-120mm.
4-4. THE CONCRETE SHALL BE MECHANICALLY VIBRATED IN MAXIMUM 400 mm LIFTS. VIBRATION SHOULD CONTINUE TO THE POINT WHERE WATER IS JUST STARTING TO RISE THROUGH THE SURFACE.

ITEM	DESCRIPTION	STOCK CODE	QTY
1	EARTHING COMPOUND 15kg BAG (SEE NOTE 11)	99861	1

DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE

CAD DRAWING
DO NOT MANUALLY AMEND

AMENDMENTS

AMD	DWN	CHKED	DATE	APP'D by:
2	PATRICIA RIOS	PHILLIP JONES	29/01/2019 SECTION & NOTES AMENDED.	DOMINIC SHIELDS

ASSOCIATED DRAWINGS
POLE & PILLAR DATA CAPTURE SHEET

NETWORK STANDARD
Ausgrid
145 NEWCASTLE RD WALLSEND, NSW 2287

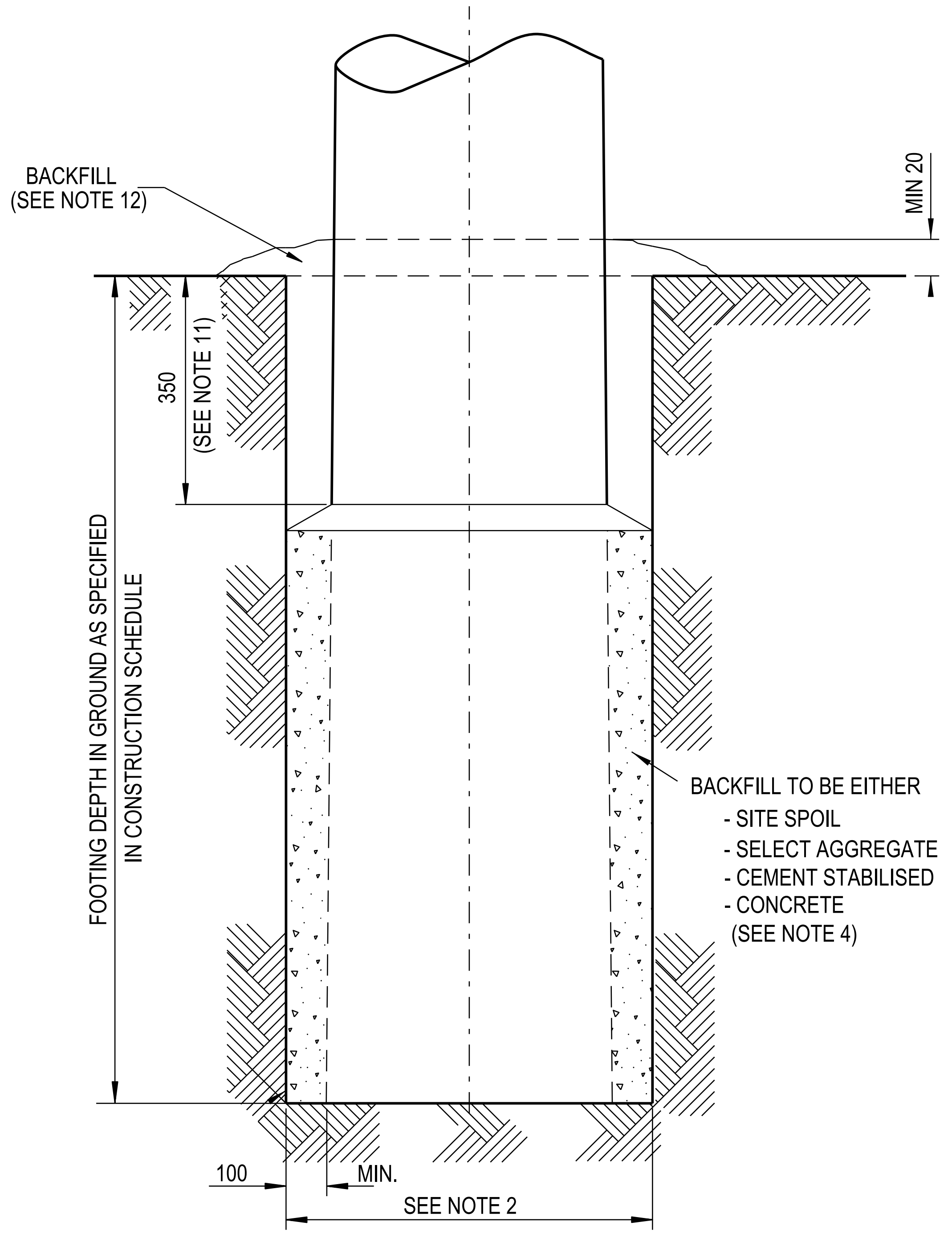
SCALE	NTS
DESIGNED	PHIL JONES
DRAWN	PATRICIA RIOS
CHECKED	PHIL JONES
APPROVED	STEPHEN CONNOR
DATE	10/04/07
PROJECT NUMBER	STD
PROJTRAK NUMBER	-

STANDARD CONSTRUCTION
STEEL POLE
CONCRETE FOOTING ARRANGEMENT

SIZE	DRAWING No	SHEET	AMD
A3	178123	01	2

20110901

13.4 Composite Fibre (Titan) Pole Footing Arrangement



SECTIONAL ELEVATION

ARRANGEMENT 1 - SITE SPOIL BACKFILL
ARRANGEMENT 2 - SELECT AGGREGATE BACKILL
ARRANGEMENT 3 - CEMENT STABILISED BACKFILL
ARRANGEMENT 4 - CONCRETE BACKFILL

GENERAL NOTES :

1. ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH CURRENT AUSTRALIAN AND NETWORK STANDARDS.
2. AUGER SIZE SHALL BE DETERMINED BY ADDING MINIMUM OF 200mm TO THE POLE BUTT DIAMETER.
3. ANY DEVIATION AWAY FROM THE DEFAULT AUGER SIZE IS ALLOWED, HOWEVER WILL NOT RESULT IN A REDUCTION OF REQUIRED EMBEDMENT DEPTH UNLESS IT IS ACCOMPANIED BY A DESIGN FROM A QUALIFIED CIVIL ENGINEER.
4. THE POLE IS TO BE INSTALLED WITH THE BACKFILL TYPE AND DEPTH NOMINATED IN THE CONSTRUCTION SCHEDULE.
5. A POLE EMBEDMENT CALCULATION REPORT CAN BE USED IN LIEU OF A CONSTRUCTION SCHEDULE.
6. SOIL CONDITIONS ARE TO BE CHECKED ON SITE AND CONFIRMED BY THE CONSTRUCTION CREWS.
7. WHERE THE CONDITIONS FOUND ARE NOT GENERALLY THE CONDITIONS AS SPECIFIED IN THE DESIGN, THE DESIGNER SHALL BE CONSULTED PRIOR TO POLE INSTALLATION.
8. WHERE SOLID ROCK OR BETTER GROUND CONDITIONS THAN EXPECTED ARE ENCOUNTERED, THE DEPTH OF THE FOOTING MAY BE REDUCED, SUBJECT TO A REDESIGN BY THE DESIGNER.
9. FOR AS BUILT CERTIFCATION, A POLE & PILLAR DATA CAPTURE SHEET IS TO BE COMPLETED .

BACKFILL NOTES :

10. ONLY APPROVED BACKFILL IS TO BE USED.
11. BACK FILLING IS TO BE RAM COMPACTED EVERY 150 mm THICK TO GROUND LINE. THE AREA BETWEEN 350 mm BELOW GROUND LEVEL TO THE ACTUAL GROUND LEVEL SHOULD BE FILLED WITH CLEAN STONE-FREE SANDY LOAM TYPE SOIL TO FACILITATE FUTURE INSPECTIONS.
12. SANDY LOAM IS TO BE TAMPED DOWN AND SLOPED AWAY FROM THE POLE SO THAT THE FINISHED LEVEL AT THE POLE IS MIN 20 mm ABOVE THE SURROUNDING GENERAL GROUND LEVEL.
13. COMPACTION LEVEL FOR THE LAYERED BACKFILL IS TO BE 98% OF STANDARD COMPACTION, WITH 1-2% OPTIMUM MOISTURE CONTENT. REFER TO AS 1289 METHOD OF TESTING SOILS FOR ENGINEERING PURPOSES (SOIL COMPACTION AND DENSITY TESTS).
14. FOR REINSTATEMENT OF PAVED AREAS, ANY CONCRETE OR DECORATIVE PAVING MUST TERMINATE A MINIMUM OF 300 mm FROM THE FACE OF A COMPOSITE POLE, TO FACILITATE POLE INSPECTION AND MAINTENANCE. REFER TO NS128 FOR FURTHER REQUIREMENTS.

ARR - 1 : SITE SPOIL BACKFILL NOTES :

1-1. SITE SPOIL SHOULD ONLY BE USED IF SUITABLE TO BACKFILL AND RAM COMPACT. IF IT IS DEEMED UNSUITABLE, SELECT AGGREGATE OR CEMENT STABILISED BACKFILL IS TO BE USED.
1-2. HANDLE & DISPOSE OF ALL CONTAMINATED MATERIAL IN ACCORDANCE WITH RELEVANT WHS. ACTS & REGULATIONS AND EPA REQUIREMENTS.

ARR - 2 : SELECT AGGREGATE BACKFILL:

2-1. ROADBASE TO BE SUPPLIED IN ACCORDANCE WITH RMS SPECIFICATION 3051 - DGS-20 & ASSOCIATED RMS SPECIFICATIONS. A WELL GRADED MAXIMUM SIZE 20 mm AGGREGATE IS TO BE USED.

ARR - 3 : CEMENT STABILISED BACKFILL:

3-1. CEMENT STABILISED BACKFILL SHALL BE A BLEND OF 3% BY VOLUME TYPE GB GENERAL BLEND CEMENT (60% CEMENT, 40% FLY ASH) TO AS3972 THOROUGHLY MIXED WITH THE SPOIL OR IMPORTED MATERIAL. THE AIM IS TO ACHIEVE MINIMUM UNCONFINED COMPRESSION STRENGTH OF 1MPA AT 3 DAYS.

ARR - 4 : CONCRETE BACKFILL NOTES:

4-1. THE CONCRETING MUST CEASE AT 350 mm BELOW GROUND LINE AND MUST NOT COVER ANY EARTHING LEADS, LOCATED BELOW GROUND LEVEL TO ENSURE ACCESS FOR CONNECTION, INSPECTION AND TESTING OF THE POLE EARTHING SYSTEM.
4-2. WHERE AGGRESSIVE SOIL IS LOCATED, CONCRETING TO GROUND LEVEL IS PREFERRED, HOWEVER SUITABLE TIMBER FORMWORK IS TO BE ATTACHED TO THE POLE SO THAT WHEN THE FOOTING IS POURED, CONCRETE IS KEPT CLEAR OF THE EARTH LEADS LOCATION TO A DEPTH OF 600 mm BELOW GROUND LEVEL
4-3. THE CONCRETE SHALL BE A MINIMUM OF 20MPA GENERAL PURPOSE CONCRETE WITH MAXIMUM 10mm AGGREGATE AND A SLUMP OF 80-120mm.
4-4. THE CONCRETE SHALL BE MECHANICALLY VIBRATED IN MAXIMUM 400 mm LIFTS. VIBRATION SHOULD CONTINUE TO THE POINT WHERE WATER IS JUST STARTING TO RISE THROUGH THE SURFACE.

DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE

CAD DRAWING
DO NOT MANUALLY AMEND

AMENDMENTS

AMD	DWN	CHKED	DATE	NOTES	APP'D by
1	GLENN FORD	PHILLIP JONES	22/02/2019	NOTES AMENDED	DOMINIC SHIELDS

POLE AND PILLAR DATA CAPTURE SHEET

ASSOCIATED DRAWINGS

NETWORK STANDARD

Ausgrid

145 NEWCASTLE RD WALLSEND, NSW 2287

SCALE	NTS
DESIGNED	DOMINIC SHIELDS
DRAWN	PATRICIA RIOS
CHECKED	PHILLIP JONES
APPROVED	GLENN FORD
DATE	21/02/19
PROJECT NUMBER	STD
PROJTRAK NUMBER	-

STANDARD CONSTRUCTION
COMPOSITE POLE (TITAN)
FOOTING ARRANGEMENT

SIZE	DRAWING No	SHEET	AMD
A3	248464	01	1

20110901