CHAPTER

3

APPENDICES

Appendix 3.1 Geological Logs

Geological logs were obtained from the Geological Survey of Western Australia, (GSWA) Hydrogeology Branch (now incorporated into Water and Rivers Commission). The GSWA compiled drillers logs for much of the drilling on the Swan Coastal Plain in the 1960's and 1970's. In many cases GSWA geologists attended drilling sites and logged the cuttings themselves. These logs are all believed to have been logged by GSWA personnel and represent the only deep sub surface information on the hydrogeology of the unconfined aquifer below Perry Lakes. Data here has been transcribed from the original logs and stratigraphic columns. The 'Irrigation' number refers to the current bore designations within Perry Lakes Reserve (refer Figure 3.3).

Appendix 3.2 Grain Size Analysis and Determination of Hydraulic Conductivity

Text summarises the theory and general approaches taken by various workers to provide estimates of hydraulic conductivity using grain size methods. Notes on the preparation and sieving of samples are included.

Table 1 Hydraulic Conductivity Calculations

Data calculated on a sample (metre by metre) basis. Averages are calculated for the wetted section of the aquifer only.

Table 2 Grain Size Distribution

This is the data derived from cumulative frequency curves, reported as percent per weight and as Phi units. Table includes sedimentary statistics (sorting, skewness and kurtosis). Refer Appendix text for details. Data from Table 2 is also reported graphically as histograms. Included are the sedimentary statistics, hydraulic conductivity data and the geological logs for all samples compiled at the time of drilling. The histograms include the raw percent by weight data for each size class. The data in Appendix 3.2 taken as a whole, represents a very detailed sedimentary analysis of the Upper Sand unit at Perry Lakes.

Appendix 3.3 a&b Lake Lining Isopach Survey Station Locations.

Maps show every station where the lake was probed or augered to determine the thickness of the lake lining clays. As indicated by the station distributions, most of the detailed surveying was done around the perimeter of each lake. Each lake is rimmed by a trough, now filled with recent (post 1960) sediment. This trough which varies in depth and width is an artefact of the bank reforming which appears to have been done with a mechanical digger.

Appendix 3.4 Geology and Hydrogeology of the Tamala Limestone

This is a general summary of the literature pertaining to the Tamala Limestone in the Perth Metropolitan area. At Perry Lakes the only information on the limestone unit are the irrigation bore geological logs (Appendix 3.1). Both cable tool and rotary percussion drilling breaks the limestone up. The sample returned to the surface and logged by the geologist bears little resemblance to the consolidated parent rock. Drill logs almost certainly under report the amount of limestone present because weakly cemented limestone is completely disaggregated by the drilling process and returns to the surface as sand.

Appendix 3.5 Hydraulic Conductivity of East Lake Lining Sediments

These permeameter experiments were attempts to directly measure the hydraulic conductivity of lake lining sands and clays. Unlike most permeameter experiments the samples were inserted into the permeameter as in situ undisturbed sedimentary columns. The resulting estimates of hydraulic conductivity are therefore considered much more representative than would have been the case if samples were disturbed and repacked. The real eye opener in this experiment was the relationship between water viscosity (as a function of temperature) and hydraulic conductivity. It is obvious that in clay sediments with their inherent low permeability, the rate at which water moves through them is highly influenced by water temperature.

Appendix 3.6 Determination of Specific Yield of Lake Sediments

Specific yield was required for field experiments to estimate evapotranspiration from water table fluctuations. Sands were found to drain almost completely within 10 hours. Complete draining of the clay lining however is an extremely slow process. The experiment was allowed to run 58 days at which time total water drained was only 2.4% of total sediment volume.

Appendix 3.7 a&b Lake Basin Topography Survey Station Locations

Maps show all stations optically levelled to compute basin topography and volume. Just as with the lake lining surveys, detailed work tended to be concentrated around the basin margin. West Lake was surveyed in 1995 when the lake was dry apart from a small residual pool around the staff gauge. In East Lake work was completed in January 1998. The Town of Cambridge agreed to limit lake maintenance top up during the survey period so that water was maintained only in the South Basin. The remainder of the lake was dry and could be traversed on foot. In the South Basin lake bottom was taken to be the water - false bottom contact.

Appendix 3.8 a&b Depth - Area - Volume Data

Data is tabulated at the following levels of resolution for both lakes:

Lake dry to 3.6m (stage m AHD):	1mm
Stage 3.6 to 4.0m	5mm
Stage 4.0 to 5.0m	10mm

Appendix 3.1: Geological Logs

Irrigation 1

0	6.1	sand
	27.4	limestone
	39.6	c.g. sand
	42.7	clayey sand and shale

Irrigation 2 (GSWA 0396)

0	9.1	f.g. yellow and white sand
	11.3	coarse white sand
	12.8	fine white sand
	15.2	m.g.-c.g. white sand
	25.0	limestone & c.g. white sand
	26.2	c.g. white sand
	28.7	f.g. yellow sand
	29.9	c.g. white sand & limestone
	39.3	c.g. white sand

Irrigation 6 (GSWA 1712)

0	8.5	yellow sand
	12.0	limestone
	13.0	open hole, little water
	14.0	limestone & f.g. sand
	15.0	thick f.g. to very c.g. green to grey sand with layers of clay and c.g. clean sand
	17.5	grey f.g. to c.g. sand w/limestone rubble
	18.0	brown m.g. to c.g. dirty sand and limestone
	21.0	limestone, open hole from 19, no water
	23.0	limestone & c.g. light brown to white sand, some f.g. sand
	26.0	white limestone, & mucky white sand with minor f.g. sand & loose lst
	30.0	solid limestone, open hole
	31.0	limestone rubble and water

Irrigation 7 (GSWA 1711)

0	11.6	yellow sand
	14.0	m.g. sand, bluish, little clay
	14.3	decomposed limestone
	15.8	limestone with f.g. white sand
	19.2	limestone, decomposed, minor yellow clay
	20.4	m.g.-c.g. sand
	21.0	limestone, hard
	22.3	c.g. white sand
	22.9	limestone, hard
	25.0	m.g. sand
	26.5	limestone with c.g. sand
	27.1	hard, quartz cemented w/ c.g. sand
	28.7	limestone, decomposed
	29.9	c.g. sand and quartz
	36.0	f.g. sand

Irrigation 7 (GSWA 1713)

0	10.5	f.g. yellow sand
	15.0	grey m.g. sand
	21.0	hard limestone, brown
	21.5	limestone & f.g. white sand
	22.5	hard limestone, brown
	25.7	limestone & c.g. white sand
	26.3	m.g. gravel
	27.0	f.g. gravel and c.g. sand
	31.0	limestone & c.g. sand
	36.7	m.g. to f.g. sand
	37.0	brown clay

Abandonned (GSWA 1691)

0	13.7	soil and white sand
	14.6	m.g. brown sand
	15.8	m.g. light brown sand
	17.1	c.g. sand, minor limestone
	18.3	m.g.-c.g. sand
	20.4	c.g. sand (good water source)
	23.8	m.g.-f.g. sand
	27.4	limestone with shells and c.g. sand
	30.5	grey clay

Irrigation 8 (GSWA 0151)

0	2.1	sand
	9.5	f.g. sand with clay
	13.1	c.g. white sand with stones
	19.2	limestone with f.g. sand
	30.2	limestone
	36.3	c.g. clean sand

Appendix 3.2
Grain Size Analysis and Hydraulic Conductivity of Upper Sand Unit

Grain size analysis serves three purposes as outlined by Kresic (1997):

- determine the range of grain size present *i.e.* its degree of uniformity
- determine the effective grain size
- estimate the hydraulic conductivity

Numerous empirical formulas have been devised to estimate hydraulic conductivity from grain size. These fall in to two principal types. The majority are non dimensionally homogeneous. They employ either:

- the grain size which principally determines the rate of groundwater flow in the porous medium, the *effective grain size*, usually taken to be d_{10}
- the range of grain sizes present, defined by the slope of the cumulative frequency curve, and usually defined by the uniformity coefficient U where:

$$U = \frac{d_{60}}{d_{10}}$$

Equations relating the grain size of porous media to hydraulic conductivity take the general form defined by Bear (1972):

$$K = f_1(s) f_2(n) d^2$$

Where $f_1(s)$ is a dimensionless parameter which expresses the effect of the shape of the grains, $f_2(n)$ is the porosity factor and *d* is the effective or mean diameter of the grains. This forms the basis of the *Kozeny-Carmen equation* (Bear 1972) and the *Fair-Hatch equation*, as reported by Freeze & Cherry (1979). Combining the product of $f_1(s)$ and $f_2(n)$ as a single dimensionless coefficient leads directly to the simple relation developed by Hazen (1893) cited Freeze & Cherry (1979) where K is defined by the power-law relation:

$$K = Cd_{10}^2$$

with d_{10} defined as the grain size diameter at which 10% of the sediment by weight is finer and 90% coarser. For *K* in cm/s and *d* in mm, *C* is approximately equal to unity.

Refinements of Hazen's method include Harleman *et al* (1963), Beyer (1964) cited Ptak & Teutsch (1994), and Uma *et al* (1989). The basis of all these equations is experimental observation which suggests that a direct power law relationship exists between *K* and a representative size of the sediment. Formulas for the first three are as follows for *K* in cm/s:

Harleman *et al* (1963)	$K = 0.641d_{10}^2$	for water at 20° C, *d* in mm
Beyer (1964) cited Ptak & Teutsch (1994)	$K = c(u)d_{10}^2$	where *c(u)* is an empirical constant defined as d_{60}/d_{10}
Uma *et al* (1989)	$K = Cd_{10}^2$	where *C* varies from 2 (cemented) to 6 (unconsolidated) sediments

At Perry Lakes, the method of Beyer (1964) produced unreasonably large values of *K*. Using the method of Uma *et al* (1989), *C* was taken as 6.

Dimensionally correct methods attempt to take into account the overall grain size distribution. A sediment with a wide range of grain sizes will have lower porosity and hydraulic conductivity. These methods may provide useful results for more heterogeneous, poorly sorted sediments.

Masch & Denny (1966) investigated measures of average grain size, dispersion around the median diameter (in other words the standard deviation or degree of sorting in the sediment), skewness, kurtosis and modality of sample distributions. Their method uses d_{50} grain size and the inclusive standard deviation s_I calculated using phi values after the method of Folk & Ward (1957) where:

$$\sigma_I = \frac{d_{16} - d_{84}}{4} + \frac{d_5 - d_{95}}{6.6}$$

They argue that the inclusive standard deviation, as a measure of dispersion or spread, reflects the range of grain size variability within the sample.

The Breyer equation (Kresic 1997) is:

$$K = \frac{g}{v} C_b d_e^2$$

where

$$C_b = 6 \times 10^{-4} \log \frac{500}{U}$$

The method was developed for poorly sorted material where $1 < U < 20$ and where $1 < d_{10} < 0.6$mm. This includes the majority of the material from piezometers N1-N4.

Reyes (1966) carried out experiments on the applicability of the basic $K = cd^n$ equation to particle size and distribution within sands and gravels. For homogeneous sands he found $K = 9034 d_{50}^{1.93}$ with units of US gallons day^{-1} ft^{-2}.

Shepherd (1989) expanding on Reyes (1966), used regression of 19 sets of published data comprising both grain size and laboratory permeability measurements on unconsolidated sediments ranging from uniform glass spheres to poorly sorted natural sediments and cemented sandstone. Shepherd found that in the basic formula $K = cd^n$ values of *c* and the exponent both generally decrease with decreased textural maturity and increased induration. Shepherd produced 6 variants of the basic equation that relate hydraulic conductivity to the mean grain diameters of different sediment types, using the d_{50} percentile for grain size (again with units of US gallons day^{-1} ft^{-2}.):

Glass spheres	$K = 300{,}000 d_{50}^{2}$
Dune sands	$K = 40{,}000 d_{50}^{1.85}$
Beach sands	$K = 12{,}000 d_{50}^{1.75}$
Channel sands	$K = 3{,}500 d_{50}^{1.65}$
Consolidated sediments	$K = 800 d_{50}^{1.50}$

Values of hydraulic conductivity presented in Chapter 3 (Table 3.2) were calculated using the equation for channel sands only. This provides values which most closely approximate those derived from pump test data and other grain size methods. The beach and dune sand equations produced unrealistically high values of *K*.

Alyamani & Sen (1993) propose an alternate procedure. Rather than using a representative grain size distribution parameter such as diameter or standard deviation, they relate hydraulic conductivity to the initial slope and intercept of the grain size distribution curves. The method involves computing a cumulative frequency plot with grain size plotted arithmetically. The straight line portion of the curve is extrapolated to the x axis. The steeper the slope, the greater the overall amount of fine material in the sample and the smaller the x intercept value, designated I_0. The final equation, for *K* in m/day, based on empirical studies is:

$$K = 1300\left[I_0 + 0.025\left(d_{50} - d_{10}\right)\right]^2$$

At Perry Lakes this method was found to be problematic where distributions are bi modal. There are two straight sections of the curve and, depending on which one is used, the resulting K values are either very large or very small.

Where estimates of porosity from long time specific yield tests were available, hydraulic conductivity was also estimated using the *Fair Hatch equation.* This method utilises porosity (which provides an integrated measure of the packing arrangement) to calculate hydraulic conductivity and also characteristics of the fluid. The hydraulic conductivity of a porous medium consisting of uniform spheres of diameter *d* is given by:

$$K = \left[\frac{\rho g}{\mu}\right] C d^2$$

where ρ is the fluid density and μ is the viscosity. This basic equation evolves to:

$$K = \left[\frac{\rho g}{\mu}\right]\left[\frac{n^3}{(1-n)^2}\right]\left[\frac{1}{m\left(\frac{\theta}{100}\sum\frac{P}{d_m}\right)^2}\right]$$

where m is a packing factor, found experimentally to be about 5, θ is a grain shape factor which varies from 6.0 for spherical grains to 7.7 for angular grains, *P* is the percentage of material retained between adjacent sieves and d_m is the geometric mean of the rated aperture sizes of adjacent sieves. The results fell within the range of other methods tested and have not been reported. An extensive analysis of the *Fair-Hatch equation* is provided in Fraser (1935).

It is important to remember that all of these methods are empirical, based on experimental data from a variety of natural and artificial material. They can provide, at best, only an *approximation* of hydraulic conductivity.

Notes on Sample Preparation

Samples were dried for a minimum 24 hours at 105˚C. Dried samples were disaggregated by mortar and pestle and then sieved using techniques modified from Allman & Lawrence (1972). Each sieve plus bottom receiving pan was weighed empty along with pre-sieved sample weight. Samples were shaken mechanically for 10 minutes. Sieves were then reweighed and sample size fraction weights calculated by difference.

Sieve Aperture Data

Aperture	2.000	1.000	0.500	0.355	0.250	0.180	0.125	0.090	0.063	<.063
phi ș	-1.0	0.0	1.0	1.5	2.0	2.5	3.0	3.5	4.0	<4.0
	granule	v. coarse	course	medium	medium	fine	fine	v. fine	v. fine	silts &
	pebbles	sand	sand	sand	sand	sand	sand	sand	sand	clays

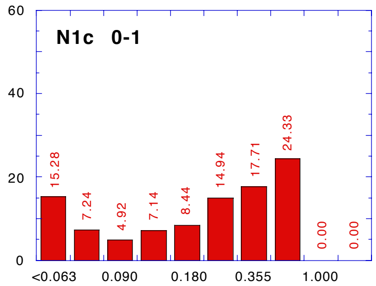
Material retained on a screen was assumed to have a size value equal to the screen aperture diameter. No attempt was made to correct for true weight mid points. Merely assigning a midpoint phi value of the class interval is not valid because for each class interval, the true weight midpoint diameter is different. Folk (1966) p79 provides a more detailed discussion of this problem.

The size distributions within the <.063mm material was not investigated for any of the samples. As a result the sedimentary size distributions are 'open ended' in that they contain a large (up to 5%) proportion of unanalysed fine material. The cumulative frequency curves and inclusive standard deviation, skewness and kurtosis determinations require the entire distribution. Folk (1966) discusses this problem and advocates that where fines are not analysed, that an arbitrary assumption of their mean size be used. In these computations the under size material was arbitrarily assigned a phi value of 5 (.031mm, medium silt).

Cumulative frequency plots were generated using KALEIDAGRAPH and grain diameters at 05, 10, 16, 25, 50, 60, 75, 84 & 95 percent weight calculated. Percentile grain diameters were entered in EXCEL. Diameters were recalculated as phi units ($-\log_2$) and inclusive standard deviation, skewness and kurtosis calculated (Table 2) using the method of Folk & Ward (1957). These are included with the grain size histograms.

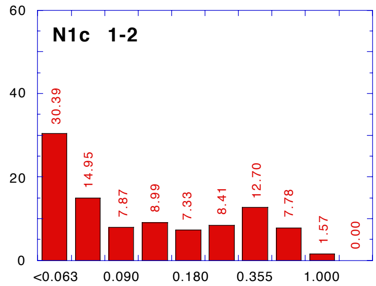
Refer last page for notes and key

Piezometer N1c



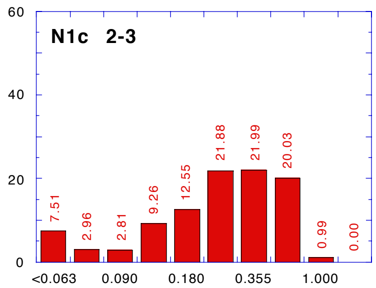
Sorting	1.89	K_1	0.1	K_2	0.08
Skewness	0.56	K_3	3.4	K_4	0.07
Kurtosis	1.19	K_5	10.6	K_6	0.04
				K_7	0.09

Sand, m-c.g.,brown, with organics, silt and minor clay possibly as thin bands, distinctly bi-modal suggesting distinct sand-silt layers



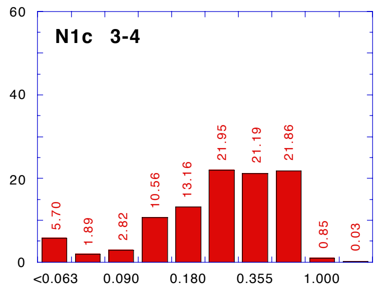
Sorting	2.55	K_1	0.01	K_2	0.01
Skewness	0.35	K_3	2.7	K_4	0.01
Kurtosis	1.09	K_5	2.3	K_6	0.01
				K_7	0.01

Silt and clay bands, brown, organic with poorly sorted very fine to medium sand interbeds
Winter max water table approximately 1.5m



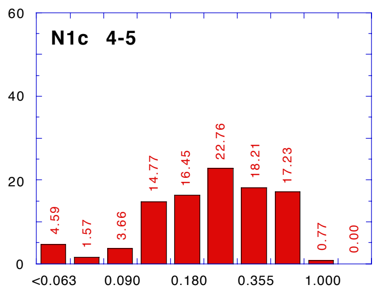
Sorting	1.33	K_1	2.9	K_2	1.9
Skewness	0.41	K_3	5.6	K_4	1.7
Kurtosis	1.73	K_5	12.1	K_6	3.0
				K_7	3.1

Sand, fine-coarse grained, light brown-beige
Summer min water table approximately 2.2m



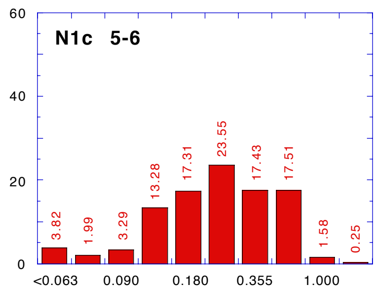
Sorting	1.24	K_1	6.1	K_2	3.9
Skewness	0.37	K_3	6.1	K_4	3.7
Kurtosis	1.59	K_5	12.4	K_6	3.9
				K_7	6.9

Sand, fine-coarse grained, light brown-beige



Sorting	1.01	K_1	7.2	K_2	4.6
Skewness	0.22	K_3	6.1	K_4	4.3
Kurtosis	1.13	K_5	10.5	K_6	3.6
				K_7	8.4

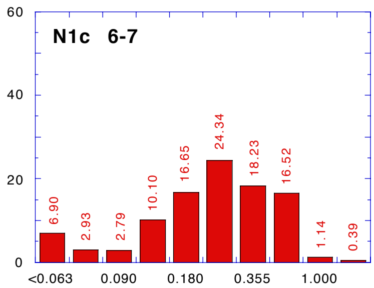
Sand, fine-medium grained, light brown-beige



Sorting	0.96	K_1	7.2	K_2	4.6
Skewness	0.18	K_3	6.3	K_4	4.3
Kurtosis	1.06	K_5	10.7	K_6	5.3
				K_7	8.4

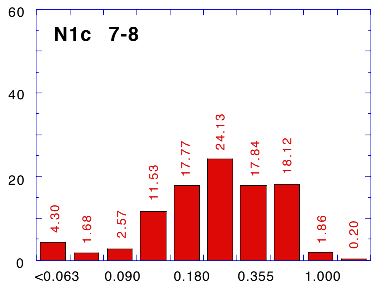
Sand, fine-medium grained, light brown-beige

Piezometer N1c



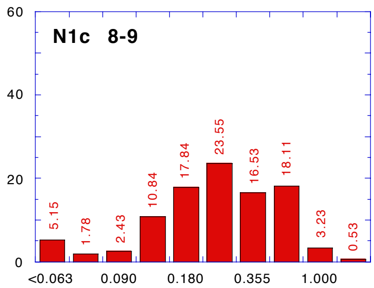
Sorting	1.31	K_1	3.5	K_2	2.3
Skewness	0.35	K_3	5.4	K_4	2.1
Kurtosis	1.84	K_5	10.7	K_6	4.2
				K_7	3.9

Sand, fine-medium grained, light brown-beige



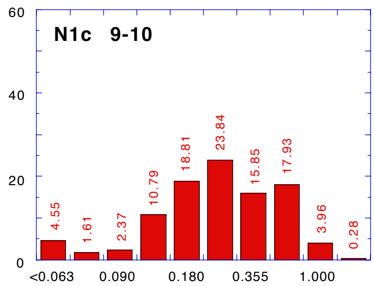
Sorting	0.99	K_1	7.5	K_2	4.8
Skewness	0.19	K_3	6.3	K_4	4.5
Kurtosis	1.17	K_5	11.0	K_6	5.7
				K_7	8.8

Sand, fine-medium grained, brown



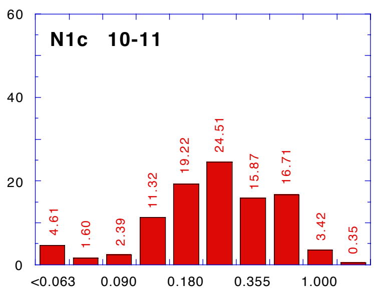
Sorting	1.09	K_1	7.2	K_2	4.6
Skewness	0.23	K_3	6.1	K_4	4.3
Kurtosis	1.31	K_5	11.1	K_6	5.5
				K_7	8.4

Sand, fine-medium grained, light brown-beige
minor coarse fraction



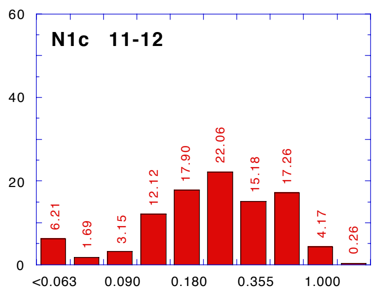
Sorting	1.02	K_1	7.5	K_2	4.8
Skewness	0.17	K_3	6.3	K_4	4.5
Kurtosis	1.20	K_5	11.0	K_6	6.4
				K_7	8.8

Sand, fine-medium grained, light brown-beige
minor coarse fraction, possibly as distinct beds



Sorting	1.02	K_1	7.5	K_2	4.8
Skewness	0.17	K_3	6.2	K_4	4.5
Kurtosis	1.24	K_5	10.7	K_6	6.4
				K_7	8.8

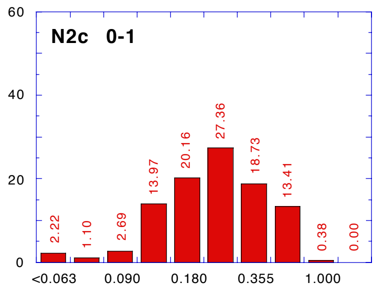
Sand, fine-medium grained, light brown-beige
minor coarse fraction, possibly as distinct beds



Sorting	1.34	K_1	5.4	K_2	3.5
Skewness	0.30	K_3	5.1	K_4	3.2
Kurtosis	1.70	K_5	10.7	K_6	4.0
				K_7	6.2

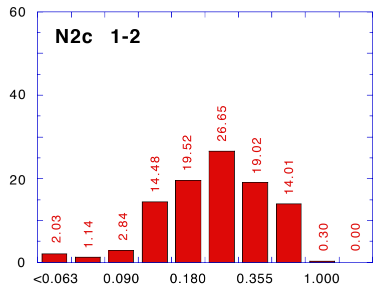
Sand, fine-medium grained, light brown-beige
minor coarse fraction, possibly as distinct beds

Piezometer N2c



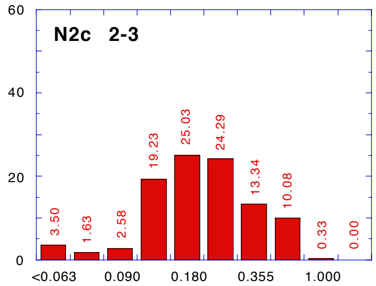
Sorting	0.78	K_1	8.3	K_2	5.3
Skewness	0.08	K_3	6.9	K_4	5.0
Kurtosis	0.96	K_5	10.2	K_6	7.4
				K_7	10.0

Sand, fine-medium grained, light grey



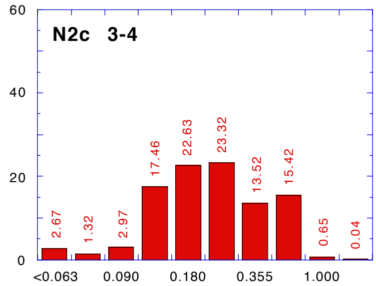
Sorting	0.78	K_1	8.3	K_2	5.3
Skewness	0.07	K_3	6.9	K_4	5.0
Kurtosis	0.93	K_5	10.2	K_6	7.0
				K_7	10.0

Sand, fine-medium grained, light grey
Winter water table max approximately 2.0m



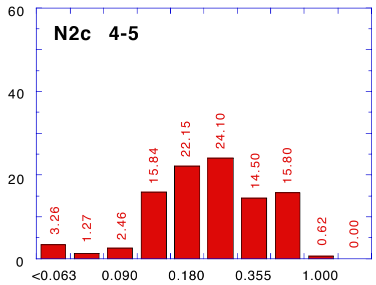
Sorting	0.82	K_1	7.5	K_2	4.8
Skewness	0.02	K_3	5.9	K_4	4.5
Kurtosis	1.13	K_5	7.9	K_6	6.7
				K_7	9.1

Sand, fine-medium grained, light grey
Summer min water table approximately 2.8m



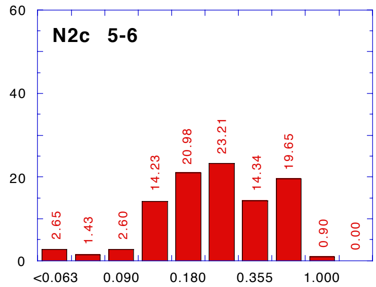
Sorting	0.84	K_1	7.8	K_2	5.0
Skewness	-0.01	K_3	6.3	K_4	4.7
Kurtosis	0.97	K_5	9.0	K_6	7.6
				K_7	9.4

Sand, fine-coarse grained, weakly bi-modal
suggesting distinct fine-coarse beds, light grey



Sorting	0.85	K_1	8.0	K_2	5.1
Skewness	0.03	K_3	6.3	K_4	4.8
Kurtosis	0.98	K_5	9.4	K_6	7.2
				K_7	9.6

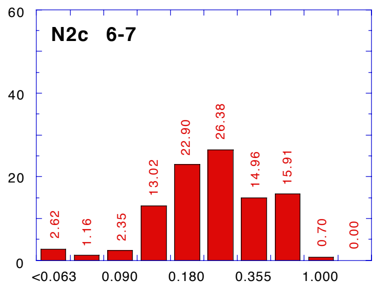
Sand, fine-coarse grained, weakly bi-modal
suggesting distinct fine-coarse beds, light grey



Sorting	0.86	K_1	8.1	K_2	5.2
Skewness	0.04	K_3	6.6	K_4	4.9
Kurtosis	0.89	K_5	10.2	K_6	7.2
				K_7	9.7

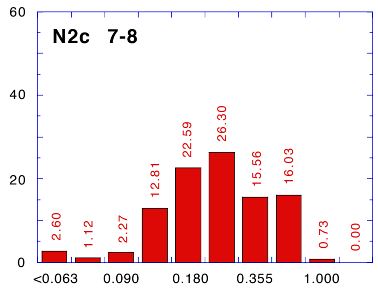
Sand, fine-coarse grained, bi-modal
suggesting distinct fine-coarse beds, beige

Piezometer N2c



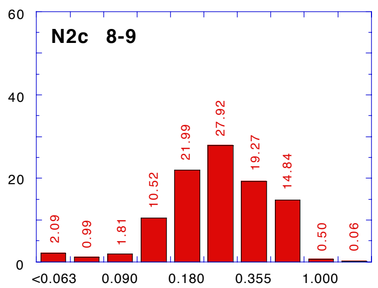
Sorting	0.80	K_1	8.3	K_2	5.3
Skewness	0.01	K_3	6.7	K_4	5.0
Kurtosis	0.99	K_5	9.9	K_6	7.8
				K_7	10.0

Sand, fine-coarse grained, weakly bi-modal suggesting distinct fine-coarse beds, beige



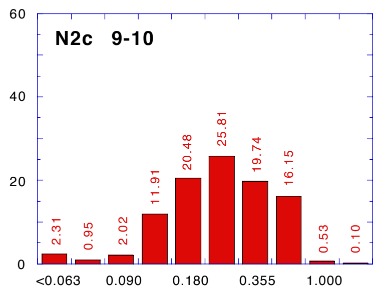
Sorting	0.79	K_1	8.6	K_2	5.5
Skewness	0.02	K_3	6.7	K_4	5.2
Kurtosis	0.97	K_5	10.0	K_6	8.4
				K_7	10.5

Sand, fine-coarse grained, weakly bi-modal suggesting distinct fine-coarse beds, beige



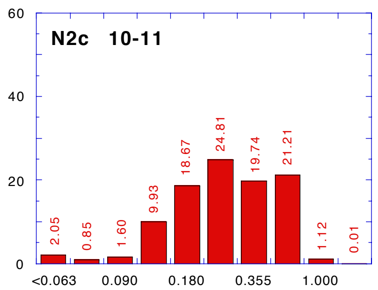
Sorting	0.72	K_1	9.5	K_2	6.1
Skewness	0.01	K_3	7.3	K_4	5.7
Kurtosis	0.94	K_5	10.7	K_6	10.0
				K_7	11.6

Sand, fine-medium grained, light beige to brown



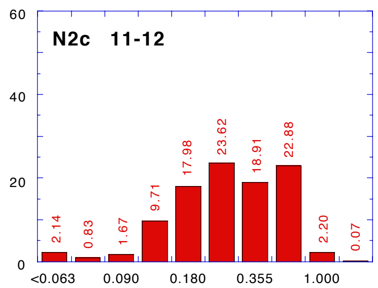
Sorting	0.76	K_1	9.0	K_2	5.8
Skewness	0.04	K_3	7.2	K_4	5.4
Kurtosis	0.91	K_5	10.9	K_6	7.9
				K_7	10.8

Sand, fine-medium grained, light beige to brown



Sorting	0.77	K_1	10.1	K_2	6.5
Skewness	0.05	K_3	7.8	K_4	6.1
Kurtosis	0.84	K_5	12.1	K_6	9.2
				K_7	12.1

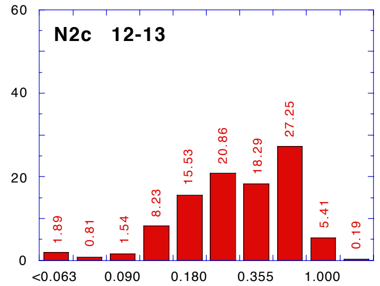
Sand, fine-coarse grained, weakly bi-modal suggesting distinct fine-coarse beds, beige



Sorting	0.78	K_1	10.1	K_2	6.5
Skewness	0.05	K_3	8.0	K_4	6.1
Kurtosis	0.82	K_5	12.5	K_6	9.4
				K_7	12.0

Sand, fine-coarse grained, bi-modal suggesting distinct fine-coarse beds, beige

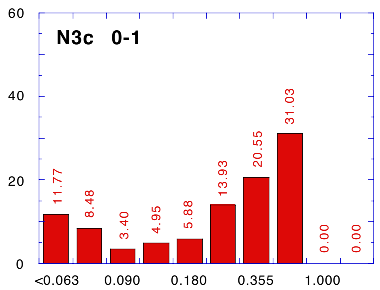
Piezometer N2c



Sorting	0.80	K_1	11.0	K_2	7.1
Skewness	0.13	K_3	8.6	K_4	6.6
Kurtosis	0.82	K_5	14.7	K_6	9.5
				K_7	12.9

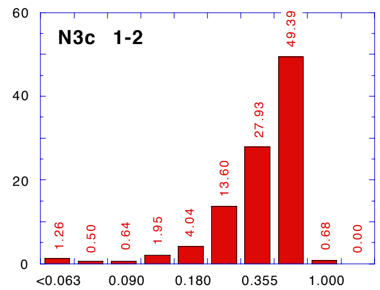
Sand, medium-coarse grained, bi-modal, beige

Piezometer N3c



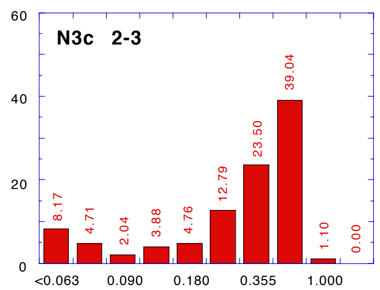
Sorting	1.66	K_1	0.5	K_2	0.3
Skewness	0.62	K_3	4.7	K_4	0.3
Kurtosis	1.16	K_5	15.0	K_6	0.2
				K_7	0.4

Sand, bimodal with silt and medium-coarse grained beds, black-brown, organic, possible dredging spoil and sand fill



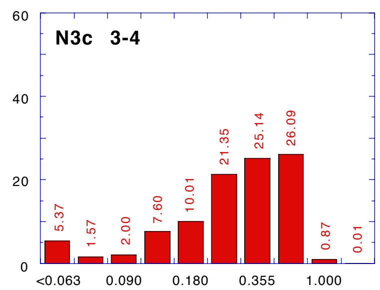
Sorting	0.55	K_1	30.2	K_2	19.4
Skewness	0.45	K_3	18.4	K_4	18.1
Kurtosis	1.09	K_5	26.0	K_6	39.5
				K_7	37.3

Sand, medium-coarse grained, brown with organic material, original surface sands(?)
Water table winter max approximately 1.6m



Sorting	1.39	K_1	1.4	K_2	0.9
Skewness	0.64	K_3	6.3	K_4	0.8
Kurtosis	2.02	K_5	20.1	K_6	12.4
				K_7	1.3

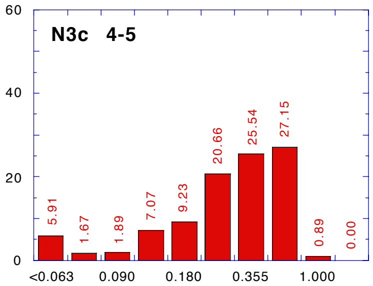
Sand, medium-coarse grained, carbonaceous black, 20-30cm black clay/silt unit 2.0-2.3m
Water table summer min approximately 2.4m



Sorting	1.11	K_1	7.5	K_2	4.8
Skewness	0.41	K_3	7.1	K_4	4.5
Kurtosis	1.63	K_5	15.0	K_6	12.0
				K_7	8.5

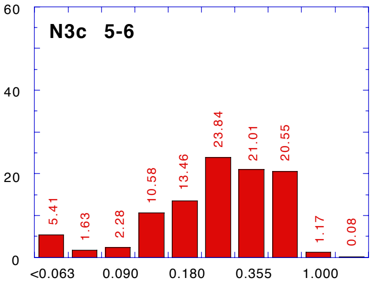
Sand, medium-coarse grained, carbonaceous, black-brown, silty

Piezometer N3c



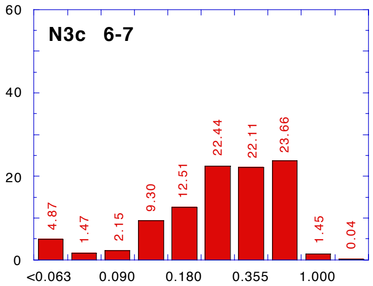
Sorting	1.24	K_1	7.3	K_2	4.7
Skewness	0.47	K_3	6.8	K_4	4.4
Kurtosis	2.01	K_5	15.6	K_6	12.0
				K_7	8.2

Sand, medium-coarse grained, dark brown, silty



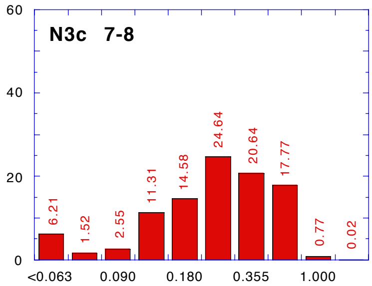
Sorting	1.14	K_1	7.2	K_2	4.6
Skewness	0.33	K_3	6.3	K_4	4.3
Kurtosis	1.48	K_5	12.2	K_6	5.2
				K_7	8.3

Sand, fine-coarse grained, brown, silty



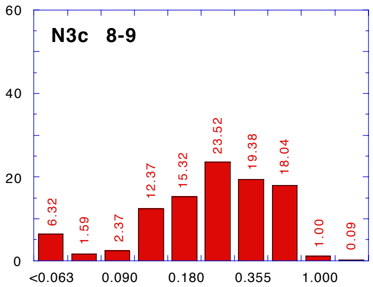
Sorting	1.03	K_1	7.8	K_2	5.0
Skewness	0.32	K_3	7.1	K_4	4.7
Kurtosis	1.31	K_5	13.5	K_6	5.6
				K_7	9.0

Sand, fine-coarse grained, brown, silty



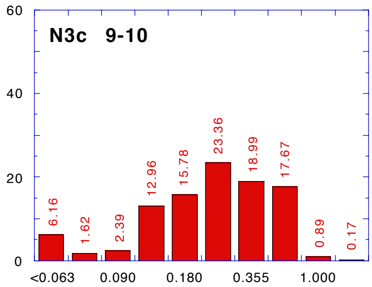
Sorting	1.29	K_1	6.2	K_2	4.0
Skewness	0.37	K_3	5.7	K_4	3.8
Kurtosis	1.85	K_5	11.4	K_6	4.7
				K_7	7.2

Sand, fine-coarse grained, brown, silty



Sorting	1.30	K_1	6.1	K_2	3.9
Skewness	0.36	K_3	5.5	K_4	3.7
Kurtosis	1.79	K_5	11.1	K_6	4.6
				K_7	7.0

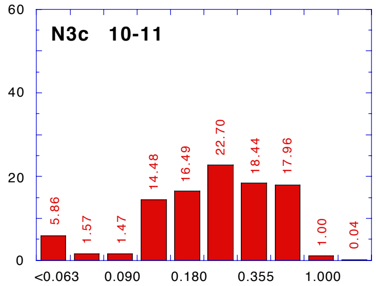
Sand, fine-coarse grained, brown, silty



Sorting	1.30	K_1	6.4	K_2	4.1
Skewness	0.34	K_3	5.5	K_4	3.8
Kurtosis	1.79	K_5	10.9	K_6	4.7
				K_7	7.4

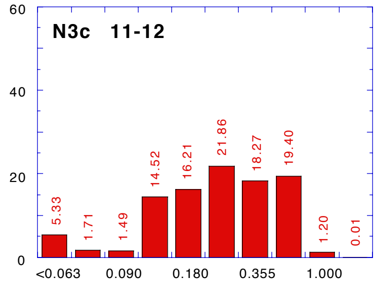
Sand, fine-coarse grained, brown, silty

Piezometer N3c



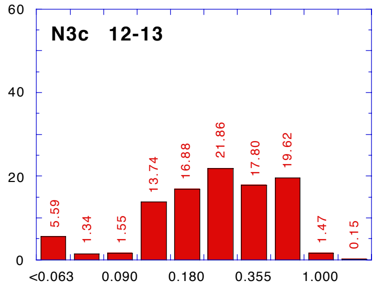
Sorting	1.21	K_1	7.3	K_2	4.7
Skewness	0.30	K_3	5.8	K_4	4.4
Kurtosis	1.57	K_5	10.7	K_6	4.1
				K_7	8.6

Sand, fine-coarse grained, brown, silty



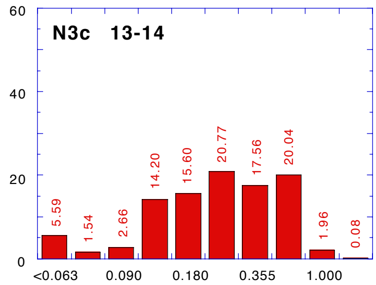
Sorting	1.12	K_1	7.3	K_2	4.7
Skewness	0.26	K_3	5.9	K_4	4.4
Kurtosis	1.36	K_5	10.9	K_6	4.2
				K_7	8.6

Sand, fine-coarse grained, brown, silty



Sorting	1.23	K_1	7.5	K_2	4.8
Skewness	0.30	K_3	5.7	K_4	4.5
Kurtosis	1.57	K_5	11.1	K_6	3.9
				K_7	8.8

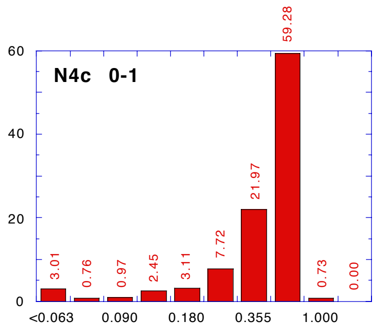
Sand, fine-coarse grained, brown, silty



Sorting	1.24	K_1	7.0	K_2	4.5
Skewness	0.29	K_3	5.7	K_4	4.2
Kurtosis	1.46	K_5	10.9	K_6	4.1
				K_7	8.2

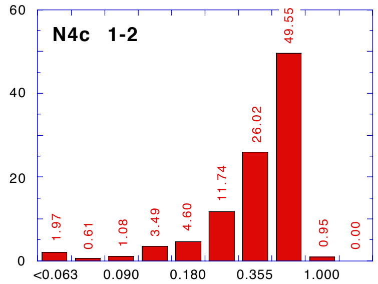
Sand, fine-coarse grained, brown, silty

Piezometer N4c



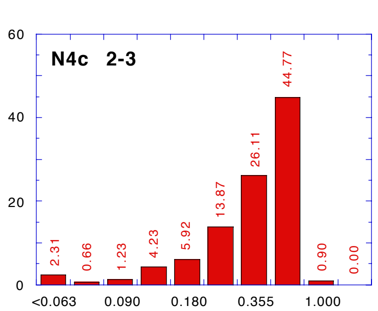
Sorting	0.61	K_1	25.9	K_2	16.6
Skewness	0.57	K_3	18.2	K_4	15.5
Kurtosis	1.55	K_5	28.3	K_6	38.5
				K_7	31.1

Sand, coarse grained, black



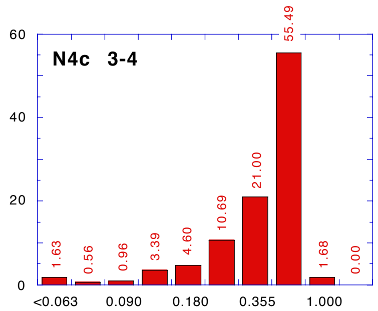
Sorting	0.63	K_1	21.0	K_2	13.5
Skewness	0.51	K_3	16.9	K_4	12.6
Kurtosis	1.27	K_5	26.0	K_6	35.0
				K_7	25.1

Sand, coarse grained, light grey-beige
Water table winter max approximately 1.5m



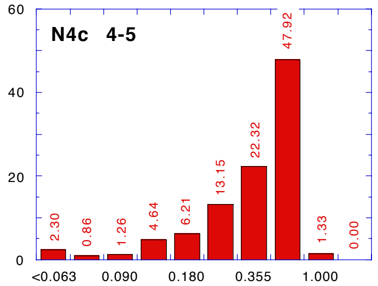
Sorting	0.67	K_1	16.5	K_2	10.6
Skewness	0.45	K_3	14.7	K_4	9.9
Kurtosis	1.12	K_5	23.5	K_6	26.2
				K_7	19.3

Sand, coarse grained, light grey-brown
Summer water table mini approximately 2.2m



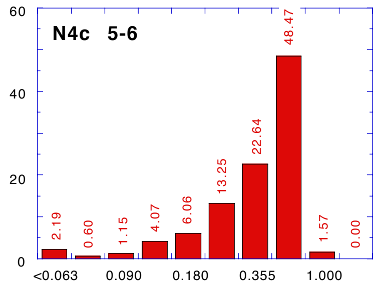
Sorting	0.62	K_1	23.5	K_2	15.1
Skewness	0.55	K_3	17.9	K_4	14.1
Kurtosis	1.25	K_5	27.7	K_6	21.7
				K_7	28.2

Sand, coarse grained, light grey-brown



Sorting	0.69	K_1	15.1	K_2	9.7
Skewness	0.55	K_3	15.1	K_4	9.0
Kurtosis	1.12	K_5	25.7	K_6	17.1
				K_7	17.4

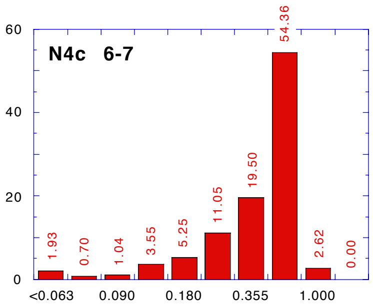
Sand, coarse grained, light grey-brown



Sorting	0.67	K_1	17.2	K_2	11.0
Skewness	0.53	K_3	15.7	K_4	10.3
Kurtosis	1.14	K_5	25.9	K_6	18.2
				K_7	20.1

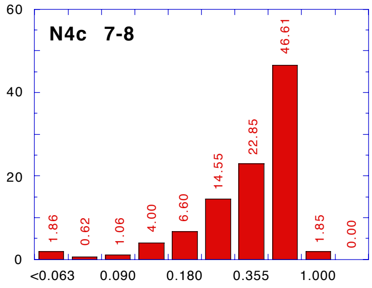
Sand, coarse grained, light grey

Piezometer N4c



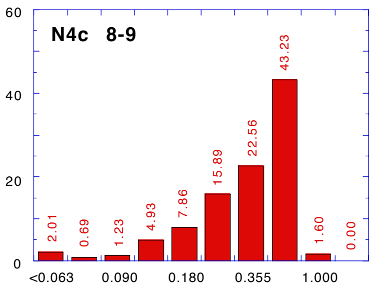
Sorting	0.64	K_1	19.4	K_2	12.5
Skewness	0.58	K_3	17.3	K_4	11.7
Kurtosis	1.23	K_5	27.9	K_6	18.0
				K_7	22.9

Sand, coarse grained, light grey



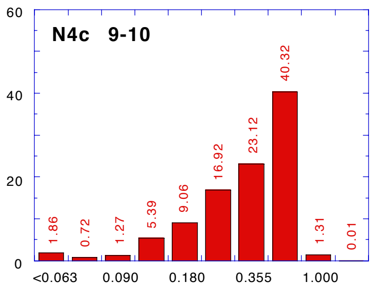
Sorting	0.66	K_1	17.7	K_2	11.3
Skewness	0.48	K_3	15.5	K_4	10.6
Kurtosis	1.06	K_5	24.8	K_6	19.1
				K_7	20.8

Sand, coarse grained, light grey



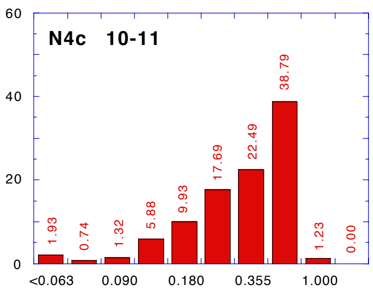
Sorting	0.69	K_1	14.6	K_2	9.4
Skewness	0.44	K_3	13.7	K_4	8.8
Kurtosis	1.00	K_5	22.6	K_6	15.4
				K_7	16.9

Sand, coarse grained, light grey



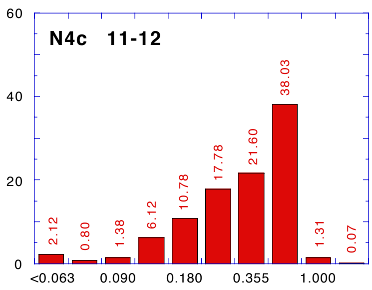
Sorting	0.71	K_1	14.4	K_2	9.2
Skewness	0.39	K_3	12.6	K_4	8.6
Kurtosis	0.97	K_5	21.0	K_6	13.4
				K_7	16.7

Sand, coarse grained, light grey



Sorting	0.73	K_1	13.3	K_2	8.5
Skewness	0.35	K_3	11.6	K_4	8.0
Kurtosis	0.92	K_5	19.7	K_6	11.8
				K_7	15.4

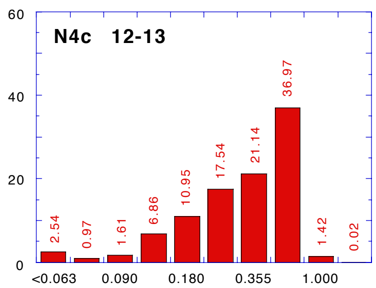
Sand, coarse grained, light grey



Sorting	0.75	K_1	12.9	K_2	8.2
Skewness	0.35	K_3	11.0	K_4	7.7
Kurtosis	0.90	K_5	19.4	K_6	9.3
				K_7	14.9

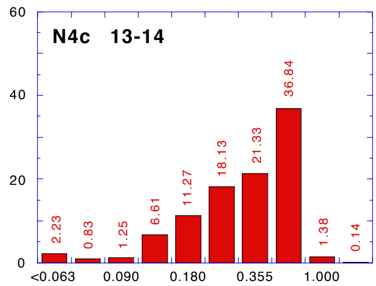
Sand, coarse grained, light grey

Piezometer N4c



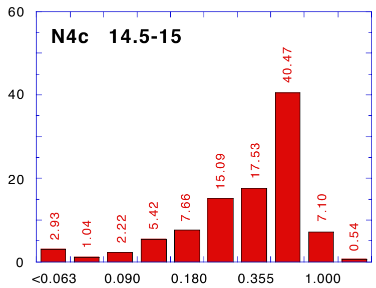
Sorting	0.78	K_1	11.0	K_2	7.1
Skewness	0.35	K_3	10.8	K_4	6.6
Kurtosis	0.91	K_5	18.7	K_6	7.2
				K_7	12.6

Sand, coarse grained, light grey



Sorting	0.75	K_1	12.2	K_2	7.8
Skewness	0.33	K_3	10.8	K_4	7.3
Kurtosis	0.90	K_5	18.7	K_6	8.2
				K_7	14.1

Sand, coarse grained, light grey



Sorting	0.87	K_1	11.0	K_2	7.1
Skewness	0.44	K_3	11.8	K_4	6.6
Kurtosis	1.18	K_5	24.4	K_6	8.7
				K_7	12.4

14.0-14.5 (no sample), possible dark green (glauconoitic(?) sand
14.5-15.0 Sand, coarse to very coarse grained, stained orange-brown

Key:

Sieve fractions represent oversize weight percent
Sieve stack apertures (mm): 0.063, 0.090, 0.125, 0.180, 0.250, 0.355, 0.500, 1.000 & 2.000
K_1-K_6: Hydraulic conductivity (m day^{-1}), calculated as follows: K_1 Hazen (1893),
K_2 Harleman et al (1963), K_3 Masch & Denny (1966) K_4 Uma (1989), K_5 Shepherd (1989),
K_6 Alyamani & Sen (1993), K7 Breyer cited Kresic (1997)

Depth (m)	Hazen	Harleman	Masch & Denny	Uma	Shepherd[1]	Alyamani & Sen	Breyer
Nest N1c							
0-1	0.12	0.08	3.43	0.07	10.61	0.04	0.09
1-2	0.01	0.01	2.73	0.01	2.30	0.01	0.01
2-3	2.91	1.86	5.59	1.74	12.09	3.01	3.07
3-4	6.10	3.91	6.12	3.66	12.36	3.87	6.92
4-5	7.15	4.59	6.12	4.29	10.45	3.63	8.44
5-6	7.15	4.59	6.32	4.29	10.70	5.31	8.42
6-7	3.54	2.27	5.38	2.12	10.70	4.16	3.89
7-8	7.47	4.79	6.32	4.48	10.95	5.65	8.80
8-9	7.15	4.59	6.12	4.29	11.13	5.50	8.39
9-10	7.47	4.79	6.32	4.48	10.95	6.36	8.80
10-11	7.47	4.79	6.20	4.48	10.70	6.35	8.84
11-12	5.39	3.46	5.10	3.24	10.70	3.96	6.18
Av from 2m	6.18	3.96	5.96	3.71	11.07	4.78	7.18
Nest N2c							
0-1	8.30	5.32	6.93	4.98	10.19	7.43	9.99
1-2	8.30	5.32	6.85	4.98	10.19	7.04	9.97
2-3	7.47	4.79	5.91	4.48	7.89	6.74	9.12
3-4	7.80	5.00	6.32	4.68	8.98	7.57	9.42
4-5	7.96	5.10	6.32	4.78	9.37	7.20	9.62
5-6	8.13	5.21	6.61	4.88	10.19	7.24	9.74
6-7	8.30	5.32	6.73	4.98	9.86	7.81	10.01
7-8	8.64	5.54	6.73	5.18	10.03	8.42	10.45
8-9	9.53	6.11	7.34	5.72	10.70	9.97	11.56
9-10	8.99	5.76	7.18	5.39	10.87	7.85	10.82
10-11	10.08	6.46	7.75	6.05	12.09	9.15	12.06
11-12	10.08	6.46	7.95	6.05	12.45	9.39	11.98
12-13	11.03	7.07	8.56	6.62	14.68	9.50	12.89
Av from 2m	8.91	5.71	7.04	5.35	10.65	8.26	10.70
Nest N3c							
0-1	0.50	0.32	4.69	0.30	14.97	0.15	0.41
1-2	30.21	19.37	18.35	18.13	25.97	39.46	37.26
2-3	1.38	0.89	6.32	0.83	20.12	12.39	1.25
3-4	7.47	4.79	7.14	4.48	14.97	11.99	8.48
4-5	7.31	4.69	6.81	4.39	15.66	12.04	8.24
5-6	7.15	4.59	6.32	4.29	12.18	5.22	8.28
6-7	7.80	5.00	7.14	4.68	13.55	5.60	8.97
7-8	6.24	4.00	5.71	3.75	11.39	4.72	7.21
8-9	6.10	3.91	5.51	3.66	11.13	4.56	7.04
9-10	6.39	4.10	5.51	3.83	10.87	4.70	7.41
10-11	7.31	4.69	5.79	4.39	10.70	4.06	8.62
11-12	7.31	4.69	5.91	4.39	10.87	4.22	8.58
12-13	7.47	4.79	5.71	4.48	11.13	3.93	8.78
13-14	7.00	4.49	5.71	4.20	10.87	4.08	8.17
Av from 2m	6.58	4.22	6.13	3.95	12.79	6.46	7.59
Nest N4c							
0-1	25.86	16.58	18.15	15.52	28.29	38.48	31.14
1-2	21.03	13.48	16.92	12.62	25.97	34.96	25.08
2-3	16.45	10.55	14.68	9.87	23.49	26.19	19.27
3-4	23.52	15.08	17.94	14.11	27.67	21.68	28.15
4-5	15.05	9.65	15.09	9.03	25.73	17.06	17.39
5-6	17.18	11.01	15.70	10.31	25.85	18.21	20.10
6-7	19.44	12.46	17.33	11.66	27.92	17.96	22.85
7-8	17.67	11.33	15.50	10.60	24.77	19.06	20.76
8-9	14.60	9.36	13.66	8.76	22.57	15.42	16.93
9-10	14.38	9.22	12.64	8.63	21.00	13.42	16.72
10-11	13.28	8.52	11.62	7.97	19.69	11.84	15.37
11-12	12.86	8.24	11.01	7.72	19.36	9.26	14.85
12-13	11.03	7.07	10.81	6.62	18.72	7.21	12.59
13-14	12.24	7.84	10.81	7.34	18.72	8.18	14.10
14.5-15	11.03	7.07	11.83	6.62	24.42	8.69	12.36
Av from 2m	15.29	9.80	13.74	9.17	23.07	14.94	17.80

[1]Shepherd using formula for channel sands

Nested Piezometer Grain Size Distributions Calculated from Cumulative Frequency Curves

Depth (m)	Interval	Grain Size Diameter (mm)									Grain Size Diameter (Phi units)											
	(m)	d-05	d-10	d-16	d-25	d-50	d-60	d-75	d-84	d-95	ø5	ø10	ø16	ø25	ø50	ø60	ø75	ø84	ø95	Sorting	Skew	Kurtosis
Nest N1c																				(Std Dev)		
0-1	1.0	0.005	0.012	0.033	0.074	0.207	0.258	0.352	0.400	0.465	7.644	6.381	4.921	3.756	2.272	1.955	1.506	1.322	1.105	1.891	0.56	1.19
1-2	1.0	0.001	0.004	0.010	0.023	0.082	0.119	0.224	0.294	0.434	9.966	7.966	6.644	5.442	3.608	3.071	2.158	1.766	1.204	2.547	0.35	1.09
2-3	1.0	0.010	0.058	0.098	0.134	0.224	0.261	0.333	0.385	0.464	6.644	4.108	3.351	2.900	2.158	1.938	1.586	1.377	1.108	1.332	0.41	1.73
3-4	1.0	0.014	0.084	0.106	0.139	0.227	0.265	0.343	0.395	0.467	6.158	3.573	3.238	2.847	2.139	1.916	1.544	1.340	1.099	1.241	0.37	1.59
4-5	1.0	0.038	0.091	0.103	0.125	0.205	0.235	0.309	0.370	0.458	4.718	3.458	3.279	3.000	2.286	2.089	1.694	1.434	1.127	1.005	0.22	1.13
5-6	1.0	0.047	0.091	0.106	0.131	0.208	0.238	0.317	0.380	0.467	4.411	3.458	3.238	2.932	2.265	2.071	1.657	1.396	1.099	0.962	0.18	1.06
6-7	1.0	0.010	0.064	0.100	0.131	0.208	0.236	0.309	0.370	0.467	6.644	3.966	3.322	2.932	2.265	2.083	1.694	1.434	1.099	1.312	0.35	1.84
7-8	1.0	0.041	0.093	0.110	0.137	0.211	0.242	0.321	0.385	0.470	4.608	3.427	3.184	2.868	2.245	2.047	1.639	1.377	1.089	0.985	0.19	1.17
8-9	1.0	0.028	0.091	0.109	0.137	0.213	0.242	0.334	0.395	0.485	5.158	3.458	3.198	2.868	2.231	2.047	1.582	1.340	1.044	1.088	0.23	1.31
9-10	1.0	0.038	0.093	0.112	0.139	0.211	0.242	0.334	0.400	0.492	4.718	3.427	3.158	2.847	2.245	2.047	1.582	1.322	1.023	1.019	0.17	1.20
10-11	1.0	0.037	0.093	0.110	0.137	0.208	0.236	0.321	0.390	0.485	4.756	3.427	3.184	2.868	2.265	2.083	1.639	1.358	1.044	1.019	0.17	1.24
11-12	1.0	0.010	0.079	0.102	0.129	0.208	0.236	0.329	0.397	0.491	6.644	3.662	3.293	2.955	2.265	2.083	1.604	1.333	1.026	1.341	0.30	1.70
Nest N2c																						
0-1	1.0	0.078	0.098	0.113	0.136	0.202	0.227	0.286	0.338	0.444	3.680	3.351	3.146	2.878	2.308	2.139	1.806	1.565	1.171	0.775	0.08	0.96
1-2	1.0	0.079	0.098	0.112	0.136	0.202	0.230	0.290	0.343	0.443	3.662	3.351	3.158	2.878	2.308	2.120	1.786	1.544	1.175	0.781	0.07	0.93
2-3	1.0	0.060	0.093	0.104	0.121	0.173	0.200	0.245	0.305	0.423	4.059	3.427	3.265	3.047	2.531	2.322	2.029	1.713	1.241	0.815	0.02	1.13
3-4	1.0	0.071	0.095	0.107	0.126	0.187	0.216	0.275	0.356	0.449	3.816	3.396	3.224	2.989	2.419	2.211	1.862	1.490	1.155	0.837	-0.01	0.97
4-5	1.0	0.068	0.096	0.107	0.129	0.192	0.218	0.286	0.356	0.452	3.878	3.381	3.224	2.955	2.381	2.198	1.806	1.490	1.146	0.848	0.03	0.98
5-6	1.0	0.072	0.097	0.110	0.134	0.202	0.230	0.315	0.385	0.465	3.796	3.366	3.184	2.900	2.308	2.120	1.667	1.377	1.105	0.860	0.04	0.89
6-7	1.0	0.076	0.098	0.115	0.138	0.198	0.224	0.290	0.361	0.455	3.718	3.351	3.120	2.857	2.336	2.158	1.786	1.470	1.136	0.804	0.01	0.99
7-8	1.0	0.078	0.100	0.115	0.138	0.200	0.226	0.291	0.361	0.455	3.680	3.322	3.120	2.857	2.322	2.146	1.781	1.470	1.136	0.798	0.02	0.97
8-9	1.0	0.090	0.105	0.126	0.147	0.208	0.233	0.297	0.352	0.449	3.474	3.252	2.989	2.766	2.265	2.102	1.751	1.506	1.155	0.722	0.01	0.94
9-10	1.0	0.086	0.102	0.120	0.143	0.210	0.237	0.303	0.361	0.455	3.540	3.293	3.059	2.806	2.252	2.077	1.723	1.470	1.136	0.761	0.04	0.91
10-11	1.0	0.091	0.108	0.127	0.152	0.224	0.258	0.338	0.395	0.467	3.458	3.211	2.977	2.718	2.158	1.955	1.565	1.340	1.099	0.767	0.05	0.84
11-12	1.0	0.091	0.108	0.129	0.155	0.228	0.268	0.356	0.410	0.479	3.458	3.211	2.955	2.690	2.133	1.900	1.490	1.286	1.062	0.780	0.05	0.82
12-13	1.0	0.092	0.113	0.134	0.167	0.252	0.307	0.390	0.437	0.505	3.442	3.146	2.900	2.582	1.989	1.704	1.358	1.194	0.986	0.799	0.13	0.82

Notes:

Grain size distribution calculated from Cumulative Oversize Distribution Curves

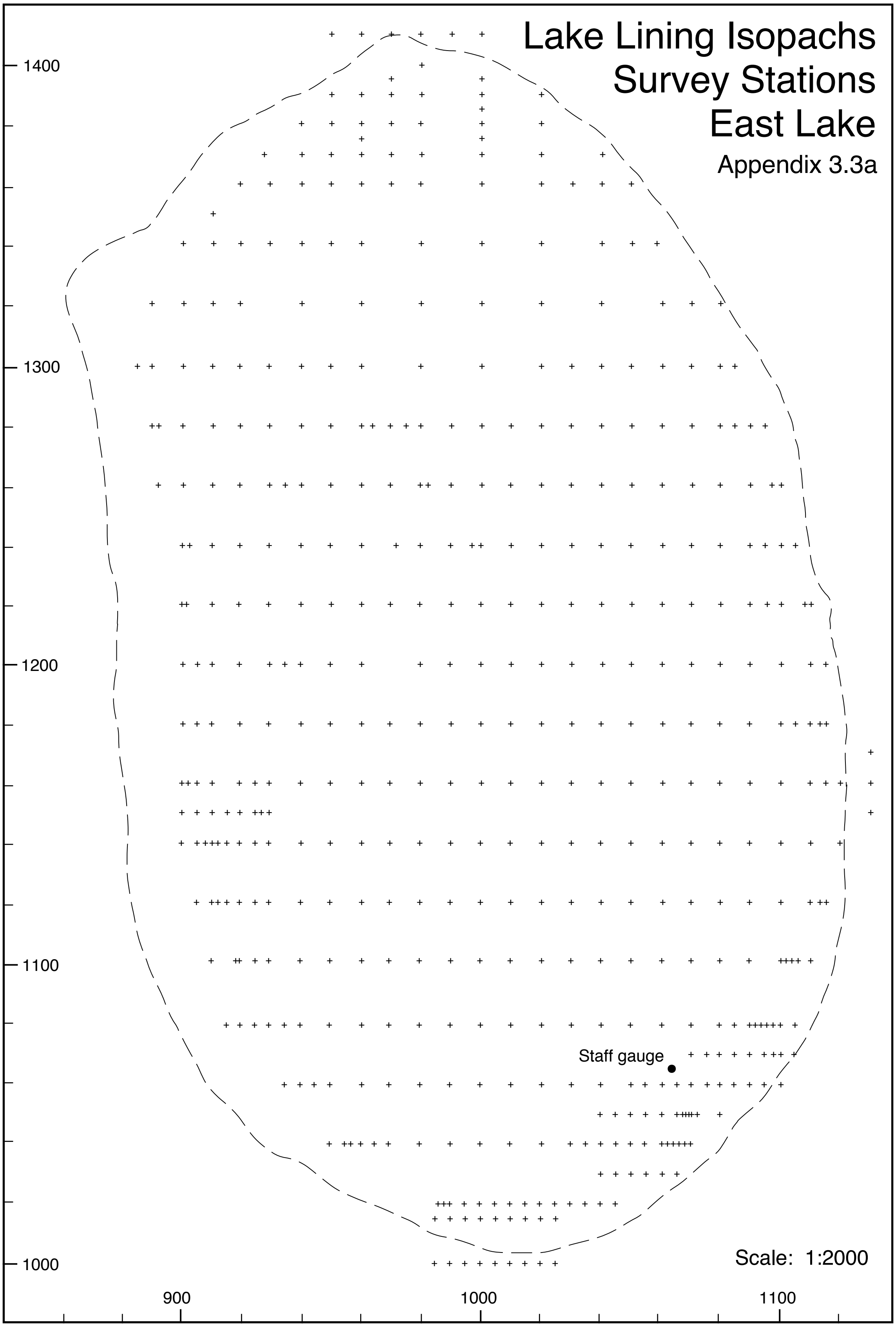
Sieve Stack Apertures: 2.00, 1.00, 0.500, 0.355, 0.250, 0.180, 0.125, 0.090, 0.063mm (-1.0, 0.0, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0 Phi units)

Grain Size d-05, d-10 etc is grain diameter such that 5%, 10% by weight of the sediment consists of smaller grains, as calculated from distribution curves

Phi units (ø): - log to base 2 of the grain diameter

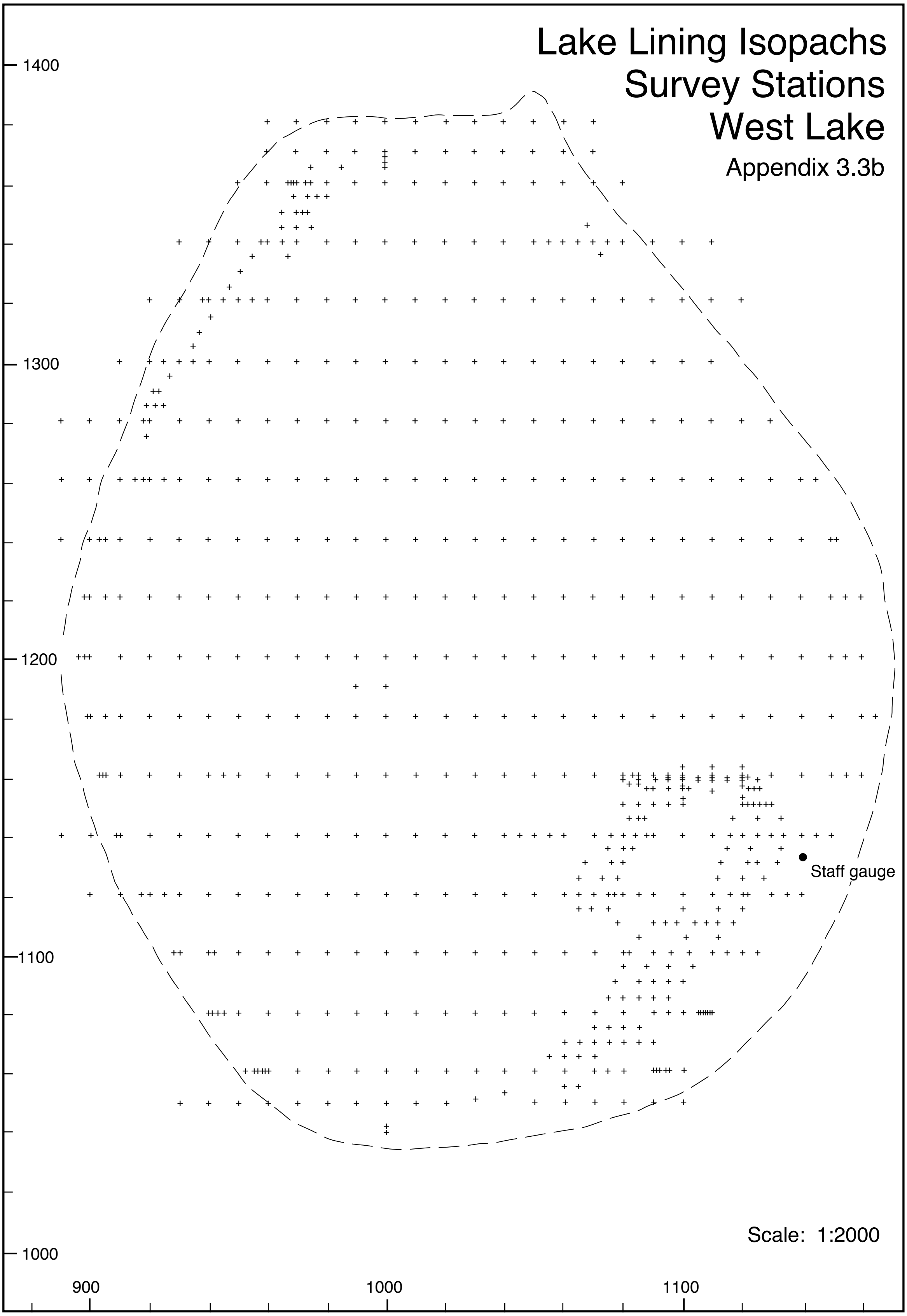
Sorting (standard deviation), Skewness, Kurtosis, all after Folk & Ward (1957)

Depth (m)	Interval	Grain Size Diameter (mm)									Grain Size Diameter (Phi units)											
	(m)	d-05	d-10	d-16	d-25	d-50	d-60	d-75	d-84	d-95	ø5	ø10	ø16	ø25	ø50	ø60	ø75	ø84	ø95	Sorting	Skewness	Kurtosis
Nest N3c																						
0-1	1.0	0.010	0.024	0.043	0.097	0.255	0.303	0.380	0.416	0.473	6.644	5.381	4.540	3.366	1.971	1.723	1.396	1.265	1.080	1.662	0.62	1.16
1-2	1.0	0.132	0.187	0.216	0.258	0.356	0.380	0.421	0.449	0.485	2.921	2.419	2.211	1.955	1.490	1.396	1.248	1.155	1.044	0.548	0.45	1.09
2-3	1.0	0.010	0.040	0.098	0.185	0.305	0.356	0.405	0.438	0.479	6.644	4.644	3.351	2.434	1.713	1.490	1.304	1.191	1.062	1.386	0.64	2.02
3-4	1.0	0.022	0.093	0.121	0.169	0.255	0.294	0.365	0.410	0.473	5.506	3.427	3.047	2.565	1.971	1.766	1.454	1.286	1.080	1.111	0.41	1.63
4-5	1.0	0.012	0.092	0.121	0.173	0.262	0.300	0.366	0.410	0.473	6.381	3.442	3.047	2.531	1.932	1.737	1.450	1.286	1.080	1.243	0.47	2.01
5-6	1.0	0.021	0.091	0.110	0.143	0.225	0.260	0.337	0.390	0.467	5.573	3.458	3.184	2.806	2.152	1.943	1.569	1.358	1.099	1.135	0.33	1.48
6-7	1.0	0.033	0.095	0.117	0.155	0.240	0.279	0.356	0.405	0.473	4.921	3.396	3.095	2.690	2.059	1.842	1.490	1.304	1.080	1.030	0.32	1.31
7-8	1.0	0.010	0.085	0.106	0.136	0.216	0.245	0.317	0.370	0.457	6.644	3.556	3.238	2.878	2.211	2.029	1.657	1.434	1.130	1.286	0.37	1.85
8-9	1.0	0.010	0.084	0.104	0.132	0.213	0.242	0.317	0.375	0.461	6.644	3.573	3.265	2.921	2.231	2.047	1.657	1.415	1.117	1.300	0.36	1.79
9-10	1.0	0.010	0.086	0.104	0.131	0.210	0.242	0.315	0.375	0.462	6.644	3.540	3.265	2.932	2.252	2.047	1.667	1.415	1.114	1.300	0.34	1.79
10-11	1.0	0.015	0.092	0.105	0.129	0.208	0.239	0.315	0.375	0.461	6.059	3.442	3.252	2.955	2.265	2.065	1.667	1.415	1.117	1.208	0.30	1.57
11-12	1.0	0.023	0.092	0.106	0.131	0.210	0.244	0.325	0.385	0.467	5.442	3.442	3.238	2.932	2.252	2.035	1.621	1.377	1.099	1.123	0.26	1.36
12-13	1.0	0.014	0.093	0.108	0.132	0.213	0.245	0.330	0.390	0.469	6.158	3.427	3.211	2.921	2.231	2.029	1.599	1.358	1.092	1.231	0.30	1.57
13-14	1.0	0.015	0.090	0.103	0.127	0.210	0.246	0.334	0.395	0.473	6.059	3.474	3.279	2.977	2.252	2.023	1.582	1.340	1.080	1.239	0.29	1.46
Nest N4c																						
0-1	1.0	0.093	0.173	0.227	0.279	0.375	0.400	0.432	0.455	0.485	3.427	2.531	2.139	1.842	1.415	1.322	1.211	1.136	1.044	0.612	0.57	1.55
1-2	1.0	0.102	0.156	0.202	0.255	0.356	0.380	0.421	0.449	0.485	3.293	2.680	2.308	1.971	1.490	1.396	1.248	1.155	1.044	0.629	0.51	1.27
2-3	1.0	0.096	0.138	0.187	0.230	0.335	0.370	0.416	0.443	0.485	3.381	2.857	2.419	2.120	1.578	1.434	1.265	1.175	1.044	0.665	0.45	1.12
3-4	1.0	0.107	0.165	0.208	0.262	0.370	0.395	0.432	0.455	0.490	3.224	2.599	2.265	1.932	1.434	1.340	1.211	1.136	1.029	0.615	0.55	1.25
4-5	1.0	0.093	0.132	0.182	0.230	0.354	0.380	0.421	0.449	0.485	3.427	2.921	2.458	2.120	1.498	1.396	1.248	1.155	1.044	0.687	0.55	1.12
5-6	1.0	0.097	0.141	0.190	0.236	0.355	0.380	0.422	0.451	0.488	3.366	2.826	2.396	2.083	1.494	1.396	1.245	1.149	1.035	0.665	0.53	1.14
6-7	1.0	0.101	0.150	0.200	0.255	0.372	0.395	0.432	0.456	0.491	3.308	2.737	2.322	1.971	1.427	1.340	1.211	1.133	1.026	0.643	0.58	1.23
7-8	1.0	0.101	0.143	0.187	0.230	0.346	0.377	0.422	0.449	0.488	3.308	2.806	2.419	2.120	1.531	1.407	1.245	1.155	1.035	0.660	0.48	1.06
8-9	1.0	0.096	0.130	0.173	0.213	0.327	0.367	0.412	0.443	0.483	3.381	2.943	2.531	2.231	1.613	1.446	1.279	1.175	1.050	0.692	0.44	1.00
9-10	1.0	0.096	0.129	0.164	0.205	0.313	0.359	0.406	0.440	0.484	3.381	2.955	2.608	2.286	1.676	1.478	1.300	1.184	1.047	0.710	0.39	0.97
10-11	1.0	0.095	0.124	0.156	0.197	0.301	0.354	0.405	0.438	0.480	3.396	3.012	2.680	2.344	1.732	1.498	1.304	1.191	1.059	0.726	0.35	0.92
11-12	1.0	0.093	0.122	0.150	0.192	0.298	0.352	0.405	0.438	0.479	3.427	3.035	2.737	2.381	1.747	1.506	1.304	1.191	1.062	0.745	0.35	0.90
12-13	1.0	0.088	0.113	0.142	0.187	0.292	0.347	0.400	0.438	0.479	3.506	3.146	2.816	2.419	1.776	1.527	1.322	1.191	1.062	0.777	0.35	0.91
13-14	1.0	0.093	0.119	0.147	0.190	0.292	0.347	0.402	0.438	0.480	3.427	3.071	2.766	2.396	1.776	1.527	1.315	1.191	1.059	0.753	0.33	0.90
14.5-15	0.5	0.074	0.113	0.154	0.202	0.343	0.380	0.429	0.461	0.652	3.756	3.146	2.699	2.308	1.544	1.396	1.221	1.117	0.617	0.871	0.44	1.18



East Lake lacustrine sediment isopach contours were generated from 497 soundings. These were made with a stiff 6mm diameter brass rod with a blunt end which penetrated the clays easily but not the basal sands. The rod was 3.5m long. In shallow areas results were checked with a 1.5m hand auger. Survey was completed in summer when the lake was dry apart from the South Basin. This was surveyed from a boat with the water depth subtracted.

Dashed line is 5m surface contour (approximate limit of lake basin)



West Lake lacustrine sediment isopach contours were generated from 646 soundings. These were made with a stiff 6mm diameter brass rod with a blunt end which penetrated the clays easily but not the basal sands. The rod was 3.5m long. In shallow areas results were checked with a 1.5m hand auger. Survey was completed in summer when the lake was dry apart from the residual pond around the staff gauge.

Dashed line is 5m surface contour (approximate limit of lake basin)

Appendix 3:4

Geology and Hydrogeology of the Tamala Limestone

Transmissivity within the Tamala Limestone is extremely variable. Both published and anecdotal data (mostly from local drillers) suggest highly variable aquifer characteristics. Some extremely high transmissivities have been reported. For example, pump tests at the Alcoa Refinery in Kwinana indicate transmissivities of up to 20,000m^2 d^{-1} (Layton Groundwater Consultants 1979). These high transmissivities are believed to reflect zones of karst development and cavernous flow conditions.

Drillers in the City Beach-Ocean Reef area frequently comment that the upper 20m of the aquifer contains thin hard silcrete bands, but is also the most porous zone and often the only zone producing reasonable yields. Below this level it is often difficult to obtain useable flows (M. Davies, W. Brandt pers com). At Jackadder Lake, drill contractors report poor yields in the near surface residual Tamala sands of only 300-400m^3 d^{-1}. In the underlying limestone there is frequently little improvement in yield (K. Wintergreen, pers com). Davidson (1995) notes that the eastern margin of the Tamala Limestone is characterised by finer grained sand and correspondingly lower hydraulic conductivity. The reasons for the extreme variability in flow velocities and aquifer characteristics reflect the geological history of this unit which is summarised below.

Tamala Limestone Geology

The Tamala Limestone is essentially an aeolian deposit, comprising dunes of calcarenite (Playford 1983) along with variable amounts of quartz sand and wind blown shell fragments. Included within it are marine carbonates and grainstones. These include near shore and beach deposits characterised by coarse grained quartz sand and abundant shell fragments, exhibiting varying degrees of carbonate cementation (Klenowski 1975). The Tamala was deposited over a period of at least 100 000 years (Teichert 1967, Playford 1983) and represents numerous periods of dune building under coastal aeolian conditions. Interruptions in the dune building process are marked by prominent soil horizons (Playford 1983) Yellow siliclastic sands overlying the Tamala Limestone have been generally interpreted to represent in situ decalcified limestone (Prider 1948, Lowry 1977) however recent research suggests an aeolian continental provenance representing extensive desert phases co-incident with periods of middle Pleistocene glaciation in higher latitudes (Glassford & Killigrew 1976, Semeniuk & Glassford 1987, Glassford & Semeniuk 1990).

From a hydrological point of view our interest in the Tamala Limestone as an aquifer host is primarily concerned with effective porosity. Drilling through the Tamala confirms numerous alternating hard and soft bands. The soft bands comprise quartz skeletal sands, unconsolidated to weakly cemented at the grain contacts with extensive intergranular porosity. This material is probably typical of Pleistocene aeolian sands world wide which tend to be well sorted (Scholle *et al* 1983). Well sorted sediments approach porosities of 40% obtained experimentally with spheres (Graton & Fraser 1935) and with clastic sediments (Fraser 1935). We would therefore expect that 'typical' limestone will exhibit both high porosity and transmissivity.

Hard bands take a number of forms:

- calcrete, massive to laminar with mm scale banding
- grainstones, in part vuggy comprising quartz and carbonate sand in a carbonate matrix
- vuggy massive limestone, vugs coated with mm scale rims of carbonate

In the Tamala Limestone, zones of reduced porosity and zones of significantly enhanced porosity result from at least three distinct processes:

- carbonate may be dissolved and re-precipitated as dense indurated crusts, a process commonly termed case hardening (Ford & Williams 1989)
- calcrete formation within the vadose zone
- development of distinctive karst topography

Case Hardening

Case hardening is a surface phenomena which imparts a 1-2m thick duricrust which follows the general surface of the ground (Klenowski 1975). Such duricrusts may have porosities as low as 5% (Ford & Williams 1989) while encasing virtually unaltered and still highly porous quartz and carbonate sands. In the Perth area this material contains up to 80% $CaCO_3$ and has been used for making cement and building lime (Playford *et al* 1976). Dune building is a dynamic process. Soil horizons marking interruptions in the dune building process are widespread (Playford 1983). It is likely that many of the hard bands encountered when drilling the Tamala are fossil duricrusts. Within the aquifer their irregular sheet like form and low porosity inhibit vertical groundwater movement. If located at or above the water table, recharge is impeded.

Vadose Zone Processes

The original Tamala calcarenite deposits are generally interpreted to have been decalcified in situ through leaching (Prider 1948, McArthur & Bettenay 1960, Lowry 1977). In this process carbonate is remobilised downwards forming carbonate cemented grainstones at depth and leaving residual quartz sands which may be subsequently reworked. Sub aerial diagenetic processes in calcarenites are highly influenced by climate with greater interstitial porosity resulting from early cementation under arid rather than humid conditions (Ward 1973). Semeniuk & Meagher (1981) describe a variety of calcrete forms which develop in the vadose zone in response to climatic (evaporative) and vegetative (evapotranspirative) processes. Both the water table and proximity to the land surface and vegetation control what sort of calcrete forms. Just as with duricrusts, numerous zones of calcrete may be preserved within the Tamala representing changes in water table level and surface morphology during numerous dune building events.

In the Tamala Park area dense, extremely hard limestone of low porosity is widespread as an undulating sheet up to 3m thick (Cody 1992). Cable tool drillers report extreme difficulties penetrating this material (E. Foley pers com).

Karsting

Karst features include vertical solution pipes, cavities and caves. Solution pipes occur on the scale of centimetres to metres. Where these reach the water table, cave systems may develop. During subsequent erosional cycles the solution pipes frequently become filled and re-cemented, forming pinnacles. Sub aerial weathering, solution and impregnation produces karren structures (Semeniuk & Glassford 1987) which are also referred to as 'pinnacles' by drillers on the Swan Coastal Plain. A buried pinnacle landscape occurs on the south side of Perry Lakes. This was revealed by engineering drilling to investigate the construction of open drains in the 1950's (E. J. Smith pers com).

Cave development in the Tamala Limestone occurred and continues to occur in a geologically youthful material where cementation has done little more than impart weak coherence to what is essentially a carbonate sand. This cementation is the result of dissolution and precipitation of carbonate within the vadose zone. Bastian (1967) describes cave development in the Tamala as a reversal of normal trends. Usually cave formation is initiated along joint planes within competent limestone. In the Tamala however cave development is contemporaneous with the earliest stages of cementation and results in the curious situation where cave development and consolidation of the enveloping rock are occurring simultaneously. Jennings (1968) proposed the concept of *syngenetic karst* development where the same agents are responsible for *simultaneous* lithification and karstification. It is likely that cave development under these conditions can be extremely rapid. In these poorly consolidated sediments, linear cave systems develop readily at the water table and migrate up and down in response to water table variations. Numerous caves and cave systems have been documented within the Perth metropolitan area with the base level of cave development generally lying at or close to the present water table (Playford *et al* 1976). Drillers frequently report cavernous ground well below the water table suggesting fossil karst features from earlier erosional cycles and water table levels. At Tamala Park, approximately 1.5m of dense calcrete coincides with the present water table overlying 6m of cavernous limestone (Cody 1992).

Hydrogeological Summary

Where the superficial aquifer is hosted by Tamala Limestone aquifer characteristics may take one of three general forms:

1: limestone comprising unconsolidated to weakly cemented carbonate and quartz sand will display aquifer characteristics similar to other sand units within the superficial formations but with generally greater hydraulic conductivity.

2: where initial porosity has been destroyed or reduced through duricrusting or vadose zone processes, the limestone may act as an aquitard, inhibiting vertical groundwater movement. Where such limestone comprises a significant portion of the aquifer section overall transmissivity of the aquifer will decrease.

3: limestone containing karst features may exhibit cavernous flow conditions and extremely high transmissivities.

Notes

Murray Davies, Wally Brandt, Kevin Wintergreen and Eddie Foley are all water well drillers operating primarily in the Perth metropolitan area

E. J. Smith was an engineer with the City of Perth

Appendix 3.5

Vertical Hydraulic Conductivity of East Lake Lining Sediments

Sample Collection

Samples were collected in nominal 100mm (107.2mm I.D.) Class 6 PVC storm water pipe. Pipe sections 110cm long were sharpened (bevel out) and driven into sediment using a wooden block and mallet. The clay section was driven until slight deformation was noted indicating commencement of compression in the sample. Driving even sharpened PVC into sand is difficult, 460mm was the maximum depth which could be achieved without shattering the top of the column. A hole was excavated beside each column down to the column base, allowing each column to be removed and fitted with Class 6 PVC pressure caps lined with 53 micron Nytal woven nylon screen and secured with PVC glue. The centre of each cap was threaded and fitted with a quarter inch BSP nipple. No upper caps were used. Instead permeameters were run at extremely small head pressure. Outlet drains consisting of threaded 3mm PVC tube were fitted immediately above the sediment surface. The resulting columns are considered to contain essentially undisturbed vertical sections of lake lining sediment. Details in Figure 1.

Sand Permeameter Methodology

The sand section was saturated slowly (over several hours) from below using de-aired water. It is essential that water is allowed to rise slowly, displacing all interstitial air. The column was run (also using de-aired water) as a falling head permeameter using the formula:

$$K = \frac{A_t L}{A_c t} ln \frac{h_0}{h}$$

where A_t is the reservoir cross sectional area, L is the length of sediment within the permeameter, A_c is the cross sectional area of the permeameter, t is time, and h_0, h the initial and final height of water in the reservoir (above the permeameter outlet). Results are shown in Table 1.

Table 1 Sand permeameter detailed results

Run	Hours	h_0 (cm)	h (cm)	K (m d^{-1})	Run	Hours	h_0 (cm)	h (cm)	K (m d^{-1})
1	2	28.0	24.0	7.16	5a	1	27.5	25.0	8.85
4	1	22.0	19.5	11.20	5b	1	25.0	22.0	11.87
5	3	27.5	19.8	10.17	5c	1	22.0	19.8	9.78
6	10	19.8	7.2	9.39					
			Mean	9.48				Mean	10.17

Clay Permeameter Methodology

The clay section was saturated slowly from below using de-aired water. Approximately 30cm at the base of the section was already saturated being below the standing water table when collected. Approximately 20 days were required for flow to be established using a fixed head of 36cm above the permeameter outlet. The column was run (using de-aired water) as a fixed head permeameter using the formula:

$$K = \frac{VL}{Ath}$$

where V is the volume of water discharging in time t, L is length of sediment section, A is the cross sectional area of the permeameter and h is the reservoir head.

Tests were run in an unheated building during June and July. Minimum run was 12 hours, with readings at 0700 and 1900 hr. The permeameter was run continuously for 27 days with 43 individual reading periods of typically 12 hours. Flows over night were up to 50% of day time flows due to differences in the absolute viscosity of water. Night time and day time data were averaged and corrected to 20˚C using the mean of the daily maximum-minimum air temperatures using the formula:

$$K_{20} = \frac{K_t u_t}{u_{20}}$$

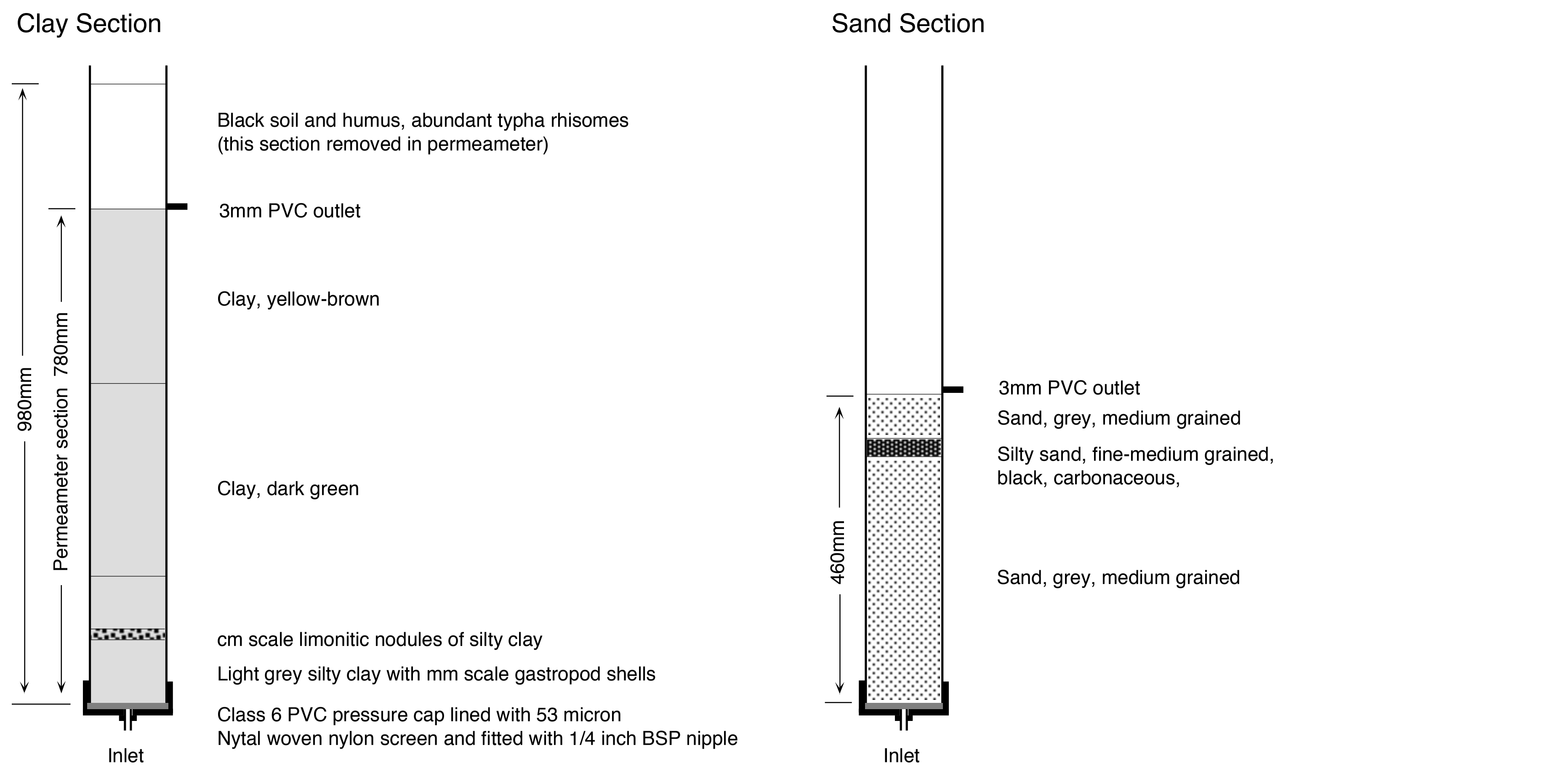
where K_{20} is the hydraulic conductivity at 20˚C, K_t is the hydraulic conductivity at mean temperature *t*, and u_t, u_{20} are the absolute viscosity of water at mean temperature *t* and 20˚C. Data is summarised in Table 2.

Table 2 East Lake clay lining permeameter test

Day	Time	Hr	Day	Air Min	Temp Max	°C Mean	Viscosity u_t (g cm^{-1} sec^{-1})	Water (cc)	raw K (cm d^{-1})	corr K (cm d^{-1})
June 23	0700	12	0.5	7.1		10.0	0.0001307	17.7	0.850	1.108
	1900	12	0.5					17.3	0.831	
24	0700	12	0.5	2.7	19.1	10.9	0.0001274	18.5	0.888	1.093
	1900	12	0.5					22.0	1.056	
25	0700	12	0.5	3.8	18.8	11.3	0.0001259	13.0	0.624	1.056
	1900	12	0.5					24.5	1.176	
26	0700	12	0.5	8.9	16.2	12.6	0.0001218	17.5	0.840	1.226
	1900	12	0.5					22.5	1.080	
27	0700	12	0.5	6.5	16.9	11.7	0.0001245	13.5	0.648	1.074
29	0700	48	2.0	3.3	16.8	10.1	0.0001303	74.5	0.894	1.163
	1900	12	0.5					20.0	0.960	
30	0700	12	0.5	7.6	14.2	10.9	0.0001274	13.0	0.624	1.007
	1900	12	0.5					25.0	1.200	
July 01	0700	12	0.5	8.8	14.3	11.6	0.0001249	17.0	0.816	1.257
	1900	12	0.5					19.0	0.912	
02	0700	12	0.5	9.8	13.7	11.8	0.0001242	19.5	0.936	1.146
	1900	12	0.5					22.0	1.056	
03	0700	12	0.5	8.3	16.5	12.4	0.0001222	16.0	0.768	1.112
	1900	12	0.5					22.5	1.080	
04	0700	12	0.5	13.2	19.2	16.2	0.0001103	19.5	0.936	1.110
	1900	12	0.5					16.5	0.792	
05	0700	12	0.5	4.6	16.9	10.8	0.0001277	13.5	0.648	0.918
	1900	12	0.5					20.0	0.960	
06	0700	12	0.5	8.9	16.1	12.5	0.0001218	16.5	0.792	1.065
07	0700	24	1.0	0.3	14.1	7.2	0.0001420	31.0	0.744	1.055
	1900	12	0.5					20.0	0.960	
08	0700	12	0.5	4.4	14.1	9.3	0.0001334	16.5	0.792	1.167
	1900	12	0.5					21.5	1.032	
09	0700	12	0.5	4.6	17.1	10.9	0.0001274	13.0	0.624	1.053
	1900	12	0.5					22.5	1.080	
10	0700	12	0.5	4.0	17.7	10.9	0.0001274	17.0	0.816	1.206
13	0700	72	3.0	8.6	17.2	12.9	0.0001205	111.0	0.888	
	1900	12	0.5					19.5	0.936	
14	0700	12	0.5	5.9	16.5	11.2	0.0001263	14.5	0.696	1.029
	1900	12	0.5					19.0	0.912	
15	0700	12	0.5	1.4	18.0	9.7	0.0001319	11.5	0.552	0.964
	1900	12	0.5					20.5	0.984	
16	0700	12	0.5	1.9	17.0	9.5	0.0001327	13.5	0.648	1.081
	1900	12	0.5					19.5	0.936	
17	0700	12	0.5	4.4	18.9	11.7	0.0001245	14.0	0.672	0.999
	1900	12	0.5					21.0	1.008	
18	0700	12	0.5	9.5	18.3	13.9	0.0001172	17.0	0.816	1.067
19	0700	24	1.0	10.2	18.0	14.1	0.0001166	33.0	0.792	0.922
									Mean	1.082

Appendix 3.5
Figure 1

Permeameter Details



Appendix 3.6

Determination of Specific Yield on Lake Sediments

Specific yield was determined on the saturated sand and clay columns after the completion of permeameter tests. Columns were suspended vertically and allowed to drain using the methods of Johnson, Prill & Morris (1963) and Prill, Johnson & Morris (1965). Particular attention was paid to obtaining specific yield for the initial 24 hours which was required for calculating estimates of evapotranspiration using water table fluctuations. Results are summarised in Figures 1 and 2.

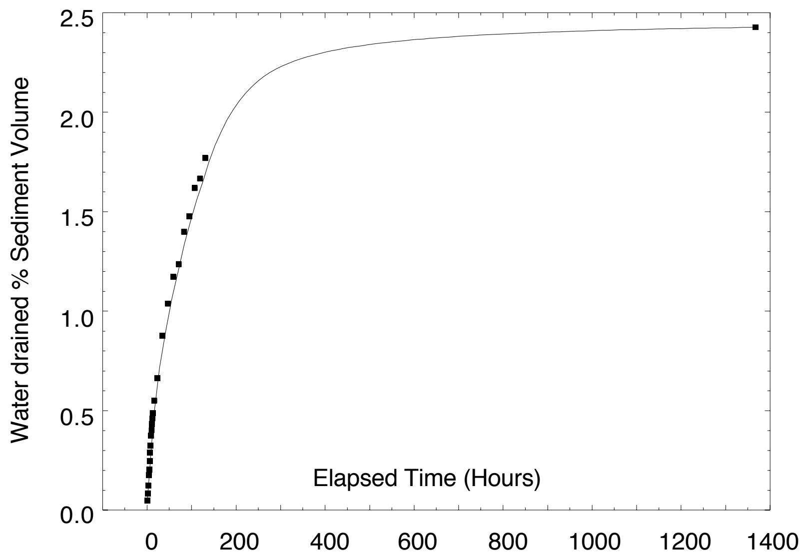


Figure 1: Specific yield lake bed clays, East Lake. Yield at t = 24 hr: 0.692%, Sy 0.0069

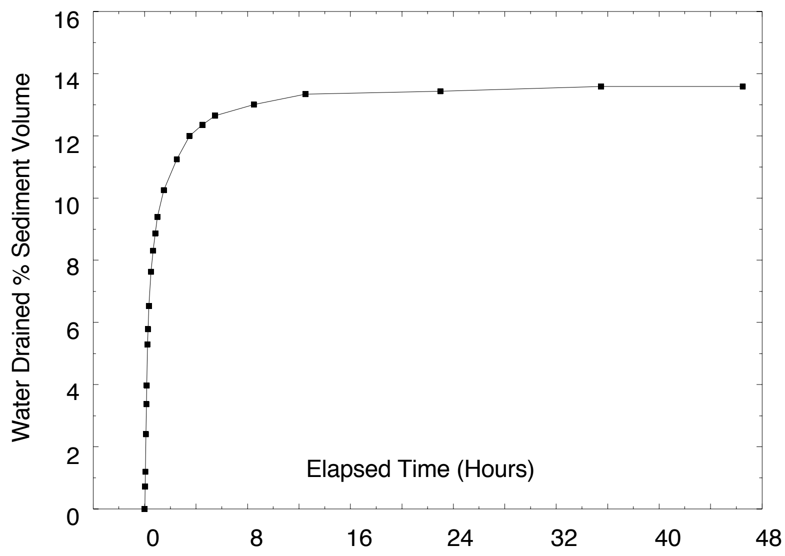
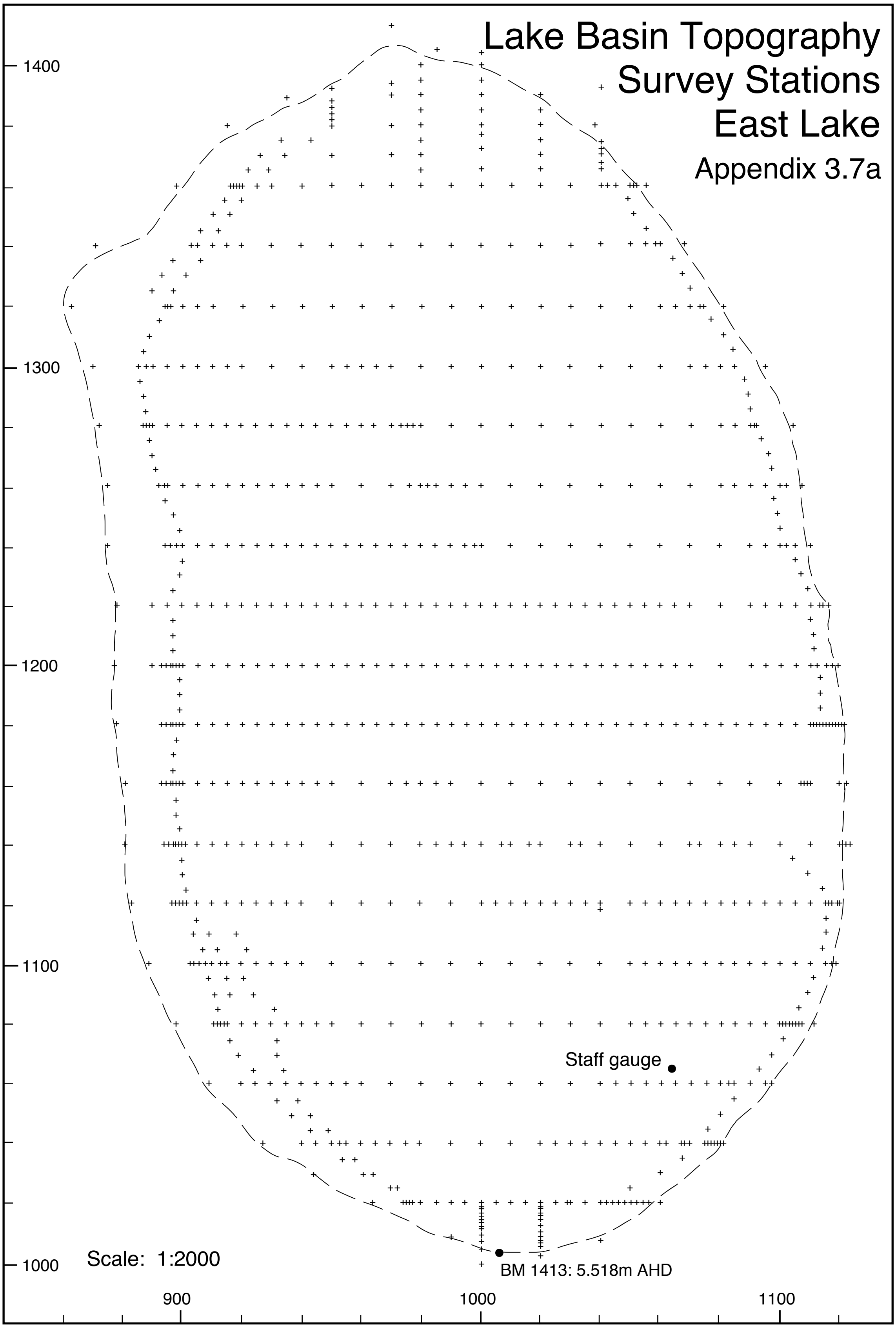
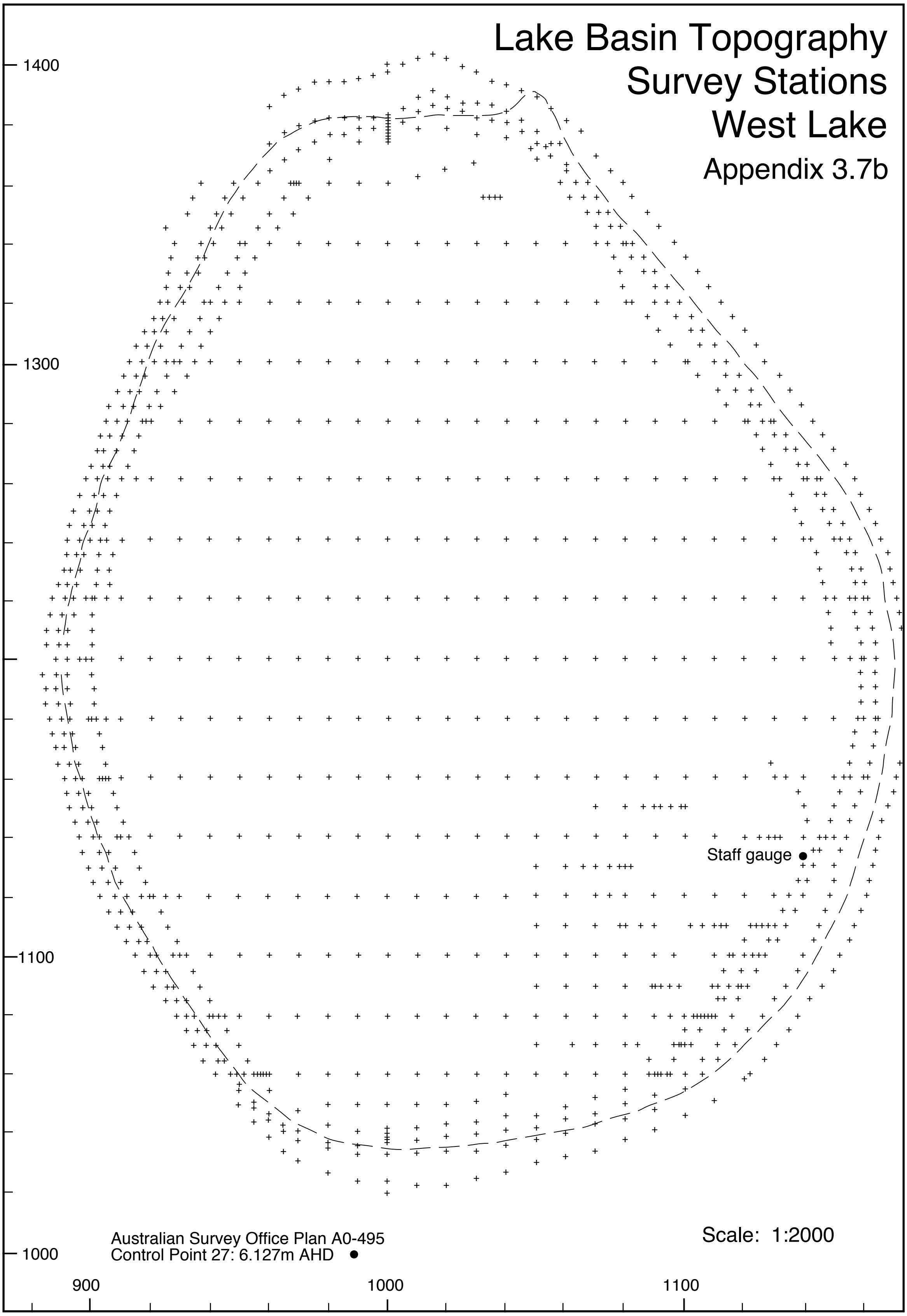


Figure 2: Specific yield, lake bed sands, East Lake. Yield at t = 24 hr: 13.44%, Sy 0.134



East Lake basin topography was generated from 1080 survey points. A surveyed local grid was established over the entire basin, lines 20m apart and 10m stations on each line marked with wooden survey pegs. This was done in January 1998 when the lake was dry apart from the South Basin. Temporary pegs were also established in the South Basin. All levels are metres (AHD), tied to bench mark 1413. Height at each station is accurate to +/- 1mm.

Outer basin margin defined by 5m contour (dashed)



West Lake basin topography generated from 1086 survey points. A surveyed local grid was established over the entire basin, lines 20m apart and 10m stations on each line marked with wooden survey pegs. This was done in February 1995 when the lake was dry apart from a small pond around the staff gauge. All levels are metres (AHD), tied to bench mark AO-495, control point 27. Height at each station is accurate to +/- 1mm. Some surveyed points lie outside the boundaries of the map.

Outer basin margin defined by 5m contour (dashed line).

Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2
2.690	0.03	14.2	2.730	16.5	1068.4	2.770	86.6	2454.2	2.810	220.7	4388.8	2.850	449.9	7110.1	2.890	804.7	10539
2.691	0.05	18.0	2.731	17.6	1105.6	2.771	89.1	2491.6	2.811	225.1	4448.3	2.851	457.0	7186.0	2.891	815.3	10607
2.692	0.07	21.9	2.732	18.7	1141.9	2.772	91.6	2529.3	2.812	229.6	4508.9	2.852	464.3	7259.5	2.892	825.9	10676
2.693	0.09	28.0	2.733	19.8	1176.2	2.773	94.1	2567.4	2.813	234.1	4570.0	2.853	471.6	7331.5	2.893	836.7	10743
2.694	0.12	35.8	2.734	21.1	1209.2	2.774	96.7	2605.7	2.814	238.7	4632.6	2.854	478.9	7402.8	2.894	847.4	10810
2.695	0.16	43.7	2.735	22.3	1242.3	2.775	99.3	2644.4	2.815	243.4	4697.5	2.855	486.4	7474.4	2.895	858.3	10877
2.696	0.21	52.3	2.736	23.6	1275.5	2.776	102.0	2683.3	2.816	248.1	4763.2	2.856	493.9	7546.9	2.896	869.2	10945
2.697	0.27	61.8	2.737	24.9	1308.4	2.777	104.7	2722.8	2.817	252.9	4830.6	2.857	501.5	7620.0	2.897	880.2	11013
2.698	0.34	72.5	2.738	26.2	1341.4	2.778	107.4	2762.7	2.818	257.8	4898.3	2.858	509.1	7694.0	2.898	891.2	11086
2.699	0.41	84.5	2.739	27.5	1374.4	2.779	110.2	2803.1	2.819	262.7	4965.6	2.859	516.9	7770.3	2.899	902.3	11158
2.700	0.51	98.1	2.740	28.9	1407.3	2.780	113.0	2843.8	2.820	267.7	5034.1	2.860	524.7	7847.6	2.900	913.5	11228
2.701	0.61	113.6	2.741	30.4	1439.9	2.781	115.9	2885.0	2.821	272.8	5102.2	2.861	532.6	7926.0	2.901	924.7	11296
2.702	0.73	130.6	2.742	31.8	1472.3	2.782	118.8	2927.0	2.822	277.9	5170.1	2.862	540.5	8006.7	2.902	936.1	11363
2.703	0.87	149.9	2.743	33.3	1504.5	2.783	121.8	2969.6	2.823	283.1	5238.2	2.863	548.6	8092.9	2.903	947.5	11429
2.704	1.03	170.9	2.744	34.8	1536.8	2.784	124.8	3012.8	2.824	288.4	5306.7	2.864	556.8	8279.7	2.904	959.0	11495
2.705	1.21	194.3	2.745	36.4	1569.7	2.785	127.8	3056.8	2.825	293.8	5374.7	2.865	565.1	8414.1	2.905	970.5	11561
2.706	1.42	220.0	2.746	38.0	1603.7	2.786	130.9	3102.8	2.826	299.2	5443.1	2.866	573.6	8534.0	2.906	982.1	11627
2.707	1.66	248.7	2.747	39.6	1637.9	2.787	134.0	3150.3	2.827	304.6	5513.6	2.867	582.2	8651.2	2.907	993.8	11692
2.708	1.92	280.9	2.748	41.2	1672.5	2.788	137.2	3201.2	2.828	310.2	5585.4	2.868	590.9	8773.2	2.908	1006	11755
2.709	2.22	315.0	2.749	42.9	1707.4	2.789	140.4	3263.0	2.829	315.8	5656.2	2.869	599.7	8884.3	2.909	1017	11817
2.710	2.55	347.6	2.750	44.6	1745.5	2.790	143.7	3322.6	2.830	321.5	5728.1	2.870	608.6	8986.0	2.910	1029	11878
2.711	2.91	379.5	2.751	46.4	1781.3	2.791	147.0	3378.5	2.831	327.3	5805.8	2.871	617.7	9081.5	2.911	1041	11938
2.712	3.31	411.1	2.752	48.2	1816.5	2.792	150.5	3431.7	2.832	333.1	5877.2	2.872	626.8	9172.7	2.912	1053	11997
2.713	3.74	442.8	2.753	50.0	1851.6	2.793	153.9	3484.5	2.833	339.0	5948.9	2.873	636.0	9261.0	2.913	1065	12056
2.714	4.19	475.6	2.754	51.9	1886.5	2.794	157.4	3536.9	2.834	345.0	6024.0	2.874	645.3	9346.8	2.914	1077	12114
2.715	4.69	509.5	2.755	53.8	1921.2	2.795	161.0	3588.3	2.835	351.1	6095.9	2.875	654.7	9430.2	2.915	1089	12173
2.716	5.21	544.2	2.756	55.8	1955.9	2.796	164.6	3640.1	2.836	357.2	6161.7	2.876	664.2	9512.0	2.916	1102	12232
2.717	5.78	584.1	2.757	57.7	1990.6	2.797	168.3	3692.2	2.837	363.4	6226.2	2.877	673.7	9591.9	2.917	1114	12290
2.718	6.38	625.9	2.758	59.7	2025.3	2.798	172.0	3744.0	2.838	369.7	6290.0	2.878	683.4	9670.3	2.918	1126	12348
2.719	7.03	664.1	2.759	61.8	2060.2	2.799	175.8	3795.7	2.839	376.0	6353.7	2.879	693.1	9747.6	2.919	1138	12406
2.720	7.71	700.6	2.760	63.9	2095.2	2.800	179.6	3847.5	2.840	382.4	6418.0	2.880	702.9	9823.9	2.920	1151	12467
2.721	8.43	735.8	2.761	66.0	2130.4	2.801	183.4	3899.5	2.841	388.8	6483.3	2.881	712.7	9898.9	2.921	1163	12528
2.722	9.18	770.6	2.762	68.1	2165.6	2.802	187.4	3952.0	2.842	395.3	6549.2	2.882	722.7	9973.0	2.922	1176	12589
2.723	9.97	805.5	2.763	70.3	2200.9	2.803	191.3	4004.7	2.843	401.9	6615.8	2.883	732.7	10046	2.923	1189	12651
2.724	10.8	840.7	2.764	72.5	2236.2	2.804	195.4	4057.8	2.844	408.6	6683.3	2.884	742.8	10118	2.924	1201	12714
2.725	11.7	876.3	2.765	74.8	2271.8	2.805	199.5	4111.5	2.845	415.3	6750.9	2.885	752.9	10189	2.925	1214	12778
2.726	12.6	912.8	2.766	77.1	2307.6	2.806	203.6	4165.8	2.846	422.1	6818.9	2.886	763.1	10259	2.926	1227	12843
2.727	13.5	950.1	2.767	79.4	2344.0	2.807	207.8	4220.7	2.847	428.9	6887.4	2.887	773.4	10329	2.927	1240	12908
2.728	14.5	990.0	2.768	81.8	2380.5	2.808	212.0	4276.0	2.848	435.8	6959.1	2.888	783.8	10398	2.928	1253	12972
2.729	15.5	1030.5	2.769	84.2	2417.3	2.809	216.3	4331.8	2.849	442.8	7032.8	2.889	794.2	10470	2.929	1266	13037

Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2
2.930	1279	13103	2.970	1861	16385	3.010	2615	21969	3.050	3609	27428	3.090	4796	31692	3.130	6132	35025
2.931	1292	13167	2.971	1878	16491	3.011	2637	22156	3.051	3637	27555	3.091	4828	31786	3.131	6167	35108
2.932	1305	13230	2.972	1894	16596	3.012	2659	22332	3.052	3665	27679	3.092	4859	31878	3.132	6202	35186
2.933	1318	13293	2.973	1911	16704	3.013	2681	22495	3.053	3692	27801	3.093	4891	31968	3.133	6237	35264
2.934	1332	13356	2.974	1928	16805	3.014	2704	22660	3.054	3720	27923	3.094	4923	32057	3.134	6272	35344
2.935	1345	13419	2.975	1945	16910	3.015	2727	22822	3.055	3748	28042	3.095	4955	32145	3.135	6308	35425
2.936	1358	13483	2.976	1962	17015	3.016	2750	22983	3.056	3776	28159	3.096	4988	32233	3.136	6343	35507
2.937	1372	13547	2.977	1979	17119	3.017	2773	23140	3.057	3804	28274	3.097	5020	32320	3.137	6379	35586
2.938	1386	13613	2.978	1996	17222	3.018	2796	23292	3.058	3833	28389	3.098	5052	32406	3.138	6414	35665
2.939	1399	13681	2.979	2013	17327	3.019	2819	23441	3.059	3861	28507	3.099	5085	32492	3.139	6450	35742
2.940	1413	13747	2.980	2031	17434	3.020	2843	23587	3.060	3890	28623	3.100	5117	32578	3.140	6486	35818
2.941	1427	13813	2.981	2048	17546	3.021	2866	23729	3.061	3918	28740	3.101	5150	32663	3.141	6522	35893
2.942	1441	13880	2.982	2066	17661	3.022	2890	23869	3.062	3947	28856	3.102	5183	32749	3.142	6558	35969
2.943	1454	13947	2.983	2083	17777	3.023	2914	24010	3.063	3976	28970	3.103	5215	32834	3.143	6594	36045
2.944	1468	14015	2.984	2101	17897	3.024	2938	24150	3.064	4005	29083	3.104	5248	32918	3.144	6630	36121
2.945	1482	14083	2.985	2119	18023	3.025	2962	24290	3.065	4034	29194	3.105	5281	33001	3.145	6666	36197
2.946	1497	14154	2.986	2137	18151	3.026	2987	24430	3.066	4064	29304	3.106	5314	33084	3.146	6702	36275
2.947	1511	14230	2.987	2155	18277	3.027	3011	24565	3.067	4093	29411	3.107	5347	33165	3.147	6738	36349
2.948	1525	14306	2.988	2174	18405	3.028	3036	24697	3.068	4122	29517	3.108	5381	33246	3.148	6775	36420
2.949	1539	14383	2.989	2192	18532	3.029	3061	24827	3.069	4152	29623	3.109	5414	33327	3.149	6811	36491
2.950	1554	14461	2.990	2211	18657	3.030	3086	24959	3.070	4182	29727	3.110	5447	33408	3.150	6848	36561
2.951	1568	14540	2.991	2230	18786	3.031	3111	25091	3.071	4211	29829	3.111	5481	33489	3.151	6884	36630
2.952	1583	14621	2.992	2248	18919	3.032	3136	25221	3.072	4241	29929	3.112	5514	33571	3.152	6921	36699
2.953	1598	14709	2.993	2267	19052	3.033	3161	25349	3.073	4271	30028	3.113	5548	33653	3.153	6958	36768
2.954	1612	14801	2.994	2287	19195	3.034	3186	25474	3.074	4301	30125	3.114	5582	33734	3.154	6995	36837
2.955	1627	14894	2.995	2306	19339	3.035	3212	25596	3.075	4332	30223	3.115	5615	33815	3.155	7032	36905
2.956	1642	14986	2.996	2325	19487	3.036	3238	25715	3.076	4362	30320	3.116	5649	33896	3.156	7068	36973
2.957	1657	15080	2.997	2345	19634	3.037	3263	25834	3.077	4392	30417	3.117	5683	33977	3.157	7105	37041
2.958	1672	15178	2.998	2364	19785	3.038	3289	25951	3.078	4423	30515	3.118	5717	34057	3.158	7143	37109
2.959	1687	15272	2.999	2384	19944	3.039	3315	26069	3.079	4453	30612	3.119	5751	34137	3.159	7180	37177
2.960	1703	15365	3.000	2404	20110	3.040	3341	26186	3.080	4484	30711	3.120	5785	34218	3.160	7217	37244
2.961	1718	15459	3.001	2425	20280	3.041	3368	26304	3.081	4515	30810	3.121	5820	34299	3.161	7254	37313
2.962	1734	15557	3.002	2445	20459	3.042	3394	26423	3.082	4545	30909	3.122	5854	34381	3.162	7292	37381
2.963	1749	15656	3.003	2465	20647	3.043	3421	26544	3.083	4576	31008	3.123	5888	34463	3.163	7329	37448
2.964	1765	15758	3.004	2486	20832	3.044	3447	26665	3.084	4607	31107	3.124	5923	34543	3.164	7366	37516
2.965	1781	15863	3.005	2507	21018	3.045	3474	26794	3.085	4639	31205	3.125	5958	34623	3.165	7404	37583
2.966	1797	15966	3.006	2528	21204	3.046	3501	26918	3.086	4670	31302	3.126	5992	34703	3.166	7442	37650
2.967	1813	16070	3.007	2550	21396	3.047	3528	27046	3.087	4701	31399	3.127	6027	34783	3.167	7479	37718
2.968	1829	16172	3.008	2571	21593	3.048	3555	27174	3.088	4733	31498	3.128	6062	34863	3.168	7517	37787
2.969	1845	16279	3.009	2593	21783	3.049	3582	27302	3.089	4764	31597	3.129	6097	34943	3.169	7555	37855

Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2
3.170	7593	37923	3.210	9163	40608	3.250	10850	43688	3.290	12650	46315	3.330	14558	49075	3.370	16569	51415
3.171	7631	37991	3.211	9204	40683	3.251	10894	43755	3.291	12696	46387	3.331	14607	49138	3.371	16620	51473
3.172	7669	38059	3.212	9244	40759	3.252	10938	43822	3.292	12742	46458	3.332	14656	49201	3.372	16672	51532
3.173	7707	38128	3.213	9285	40835	3.253	10981	43889	3.293	12789	46526	3.333	14706	49264	3.373	16723	51591
3.174	7745	38198	3.214	9326	40912	3.254	11025	43955	3.294	12835	46594	3.334	14755	49326	3.374	16775	51649
3.175	7783	38266	3.215	9367	40988	3.255	11069	44021	3.295	12882	46662	3.335	14804	49387	3.375	16827	51709
3.176	7821	38334	3.216	9408	41066	3.256	11113	44085	3.296	12929	46730	3.336	14854	49447	3.376	16878	51770
3.177	7860	38400	3.217	9449	41144	3.257	11158	44150	3.297	12975	46798	3.337	14903	49508	3.377	16930	51826
3.178	7898	38466	3.218	9490	41225	3.258	11202	44214	3.298	13022	46866	3.338	14953	49568	3.378	16982	51883
3.179	7937	38531	3.219	9532	41311	3.259	11246	44278	3.299	13069	46934	3.339	15002	49628	3.379	17034	51939
3.180	7975	38596	3.220	9573	41400	3.260	11290	44341	3.300	13116	47004	3.340	15052	49688	3.380	17086	51996
3.181	8014	38661	3.221	9614	41484	3.261	11335	44404	3.301	13163	47075	3.341	15102	49747	3.381	17138	52053
3.182	8053	38726	3.222	9656	41564	3.262	11379	44468	3.302	13210	47144	3.342	15152	49807	3.382	17190	52109
3.183	8091	38791	3.223	9697	41644	3.263	11424	44532	3.303	13257	47214	3.343	15201	49866	3.383	17242	52166
3.184	8130	38856	3.224	9739	41724	3.264	11468	44596	3.304	13305	47284	3.344	15251	49926	3.384	17294	52224
3.185	8169	38921	3.225	9781	41803	3.265	11513	44659	3.305	13352	47355	3.345	15301	49985	3.385	17347	52282
3.186	8208	38986	3.226	9823	41882	3.266	11557	44723	3.306	13399	47427	3.346	15351	50045	3.386	17399	52340
3.187	8247	39051	3.227	9865	41961	3.267	11602	44786	3.307	13447	47500	3.347	15401	50104	3.387	17451	52400
3.188	8286	39117	3.228	9907	42039	3.268	11647	44850	3.308	13494	47575	3.348	15451	50163	3.388	17504	52463
3.189	8325	39183	3.229	9949	42117	3.269	11692	44913	3.309	13542	47651	3.349	15502	50221	3.389	17556	52529
3.190	8365	39251	3.230	9991	42194	3.270	11737	44977	3.310	13590	47725	3.350	15552	50280	3.390	17609	52598
3.191	8404	39319	3.231	10033	42271	3.271	11782	45041	3.311	13638	47799	3.351	15602	50338	3.391	17661	52672
3.192	8443	39385	3.232	10075	42348	3.272	11827	45106	3.312	13685	47873	3.352	15653	50395	3.392	17714	52753
3.193	8483	39451	3.233	10118	42424	3.273	11872	45172	3.313	13733	47946	3.353	15703	50453	3.393	17767	52839
3.194	8522	39517	3.234	10160	42500	3.274	11917	45237	3.314	13781	48019	3.354	15753	50510	3.394	17820	52931
3.195	8562	39583	3.235	10203	42577	3.275	11963	45302	3.315	13829	48091	3.355	15804	50567	3.395	17873	53023
3.196	8601	39649	3.236	10245	42655	3.276	12008	45367	3.316	13877	48161	3.356	15855	50623	3.396	17926	53116
3.197	8641	39716	3.237	10288	42732	3.277	12053	45432	3.317	13926	48231	3.357	15905	50679	3.397	17979	53204
3.198	8681	39783	3.238	10331	42809	3.278	12099	45498	3.318	13974	48300	3.358	15956	50736	3.398	18032	53287
3.199	8721	39850	3.239	10374	42886	3.279	12144	45563	3.319	14022	48369	3.359	16007	50792	3.399	18086	53366
3.200	8760	39917	3.240	10417	42963	3.280	12190	45629	3.320	14071	48436	3.360	16058	50848	3.400	18139	53441
3.201	8800	39984	3.241	10460	43043	3.281	12236	45695	3.321	14119	48503	3.361	16108	50904	3.401	18192	53515
3.202	8840	40052	3.242	10503	43119	3.282	12281	45762	3.322	14168	48568	3.362	16159	50961	3.402	18246	53580
3.203	8880	40119	3.243	10546	43192	3.283	12327	45829	3.323	14216	48632	3.363	16210	51017	3.403	18300	53644
3.204	8921	40187	3.244	10589	43265	3.284	12373	45897	3.324	14265	48696	3.364	16261	51073	3.404	18353	53707
3.205	8961	40254	3.245	10632	43337	3.285	12419	45966	3.325	14314	48760	3.365	16312	51129	3.405	18407	53771
3.206	9001	40323	3.246	10676	43409	3.286	12465	46035	3.326	14362	48823	3.366	16364	51185	3.406	18461	53831
3.207	9041	40394	3.247	10719	43479	3.287	12511	46104	3.327	14411	48886	3.367	16415	51241	3.407	18515	53889
3.208	9082	40465	3.248	10763	43550	3.288	12557	46173	3.328	14460	48949	3.368	16466	51298	3.408	18569	53945
3.209	9122	40536	3.249	10806	43619	3.289	12603	46243	3.329	14509	49013	3.369	16517	51356	3.409	18623	54000

Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2
3.410	18677	54055	3.450	20877	55906	3.490	23149	57724	3.530	25499	59643	3.570	27923	61779	3.650	33159	67575
3.411	18731	54109	3.451	20933	55948	3.491	23207	57771	3.531	25558	59684	3.571	27985	61873	3.655	33497	67670
3.412	18785	54163	3.452	20989	55991	3.492	23265	57819	3.532	25618	59725	3.572	28047	61984	3.660	33835	67753
3.413	18839	54214	3.453	21045	56034	3.493	23323	57868	3.533	25678	59766	3.573	28109	62082	3.665	34174	67828
3.414	18893	54264	3.454	21101	56077	3.494	23381	57918	3.534	25738	59808	3.574	28171	62176	3.670	34514	67888
3.415	18948	54314	3.455	21157	56120	3.495	23438	57969	3.535	25798	59850	3.575	28233	62269	3.675	34853	67947
3.416	19002	54363	3.456	21213	56163	3.496	23496	58020	3.536	25857	59892	3.576	28295	62361	3.680	35193	68006
3.417	19056	54412	3.457	21270	56206	3.497	23555	58071	3.537	25917	59935	3.577	28358	62451	3.685	35533	68065
3.418	19111	54461	3.458	21326	56249	3.498	23613	58122	3.538	25977	59978	3.578	28420	62545	3.690	35874	68123
3.419	19165	54510	3.459	21382	56293	3.499	23671	58174	3.539	26037	60022	3.579	28483	62642	3.695	36215	68181
3.420	19220	54558	3.460	21438	56337	3.500	23729	58226	3.540	26097	60065	3.580	28546	62743	3.700	36556	68238
3.421	19274	54605	3.461	21495	56382	3.501	23787	58279	3.541	26157	60110	3.581	28608	62847	3.705	36897	68295
3.422	19329	54652	3.462	21551	56428	3.502	23846	58334	3.542	26218	60156	3.582	28671	62955	3.710	37239	68352
3.423	19384	54699	3.463	21608	56474	3.503	23904	58389	3.543	26278	60205	3.583	28734	63076	3.715	37580	68408
3.424	19438	54746	3.464	21664	56522	3.504	23962	58447	3.544	26338	60255	3.584	28797	63207	3.720	37923	68464
3.425	19493	54793	3.465	21721	56571	3.505	24021	58511	3.545	26398	60310	3.585	28861	63344	3.725	38265	68519
3.426	19547	54840	3.466	21777	56617	3.506	24079	58581	3.546	26459	60363	3.586	28924	63466	3.730	38608	68574
3.427	19603	54887	3.467	21834	56663	3.507	24138	58648	3.547	26519	60416	3.587	28988	63587	3.735	38951	68629
3.428	19658	54935	3.468	21891	56709	3.508	24197	58713	3.548	26579	60471	3.588	29051	63711	3.740	39294	68683
3.429	19713	54984	3.469	21947	56754	3.509	24255	58761	3.549	26640	60526	3.589	29115	63838	3.745	39638	68738
3.430	19768	55036	3.470	22004	56800	3.510	24314	58809	3.550	26700	60580	3.590	29179	63959	3.750	39981	68792
3.431	19823	55085	3.471	22060	56845	3.511	24373	58857	3.551	26761	60631	3.591	29243	64092	3.755	40326	68845
3.432	19878	55133	3.472	22118	56890	3.512	24432	58901	3.552	26822	60684	3.592	29307	64215	3.760	40670	68899
3.433	19933	55178	3.473	22175	56935	3.513	24491	58945	3.553	26882	60736	3.593	29371	64338	3.765	41015	68952
3.434	19988	55221	3.474	22232	56980	3.514	24550	58987	3.554	26943	60789	3.594	29436	64465	3.770	41359	69005
3.435	20043	55265	3.475	22289	57025	3.515	24609	59030	3.555	27004	60842	3.595	29500	64596	3.775	41705	69058
3.436	20099	55308	3.476	22346	57070	3.516	24668	59072	3.556	27065	60895	3.596	29565	64713	3.780	42050	69110
3.437	20154	55351	3.477	22403	57115	3.517	24727	59115	3.557	27126	60947	3.597	29630	64822	3.785	42396	69163
3.438	20209	55395	3.478	22460	57161	3.518	24786	59155	3.558	27187	60999	3.598	29695	64925	3.790	42742	69215
3.439	20265	55438	3.479	22517	57207	3.519	24845	59195	3.559	27248	61051	3.599	29760	65024	3.795	43088	69267
3.440	20320	55481	3.480	22574	57254	3.520	24904	59236	3.560	27309	61103	3.600	29825	65122	3.800	43434	69318
3.441	20376	55523	3.481	22632	57301	3.521	24964	59277	3.561	27370	61155	3.605	30152	65593	3.805	43781	69370
3.442	20431	55566	3.482	22689	57347	3.522	25023	59318	3.562	27431	61209	3.610	30481	65994	3.810	44128	69421
3.443	20487	55608	3.483	22746	57393	3.523	25082	59359	3.563	27492	61269	3.615	30811	66300	3.815	44475	69473
3.444	20543	55651	3.484	22804	57439	3.524	25142	59400	3.564	27554	61331	3.620	31144	66598	3.820	44823	69524
3.445	20598	55694	3.485	22861	57486	3.525	25201	59441	3.565	27615	61397	3.625	31477	66881	3.825	45171	69576
3.446	20654	55736	3.486	22919	57533	3.526	25261	59481	3.566	27677	61466	3.630	31812	67056	3.830	45519	69627
3.447	20710	55778	3.487	22976	57581	3.527	25320	59522	3.567	27738	61539	3.635	32148	67202	3.835	45867	69679
3.448	20766	55821	3.488	23034	57628	3.528	25380	59563	3.568	27800	61615	3.640	32484	67340	3.840	46215	69731
3.449	20821	55863	3.489	23092	57676	3.529	25439	59603	3.569	27861	61693	3.645	32821	67468	3.845	46564	69782

Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2
3.850	46913	69835	4.100	64691	72391	4.500	94498	76642	4.900	126165	82174
3.855	47262	69887	4.110	65415	72497	4.510	95265	76757	4.910	126988	82348
3.860	47612	69939	4.120	66140	72605	4.520	96033	76871	4.920	127812	82523
3.865	47962	69991	4.130	66867	72711	4.530	96802	76986	4.930	128639	82706
3.870	48312	70042	4.140	67595	72826	4.540	97573	77101	4.940	129467	82898
3.875	48662	70093	4.150	68324	72944	4.550	98345	77216	4.950	130297	83098
3.880	49013	70144	4.160	69054	73061	4.560	99117	77332	4.960	131129	83299
3.885	49364	70195	4.170	69785	73173	4.570	99891	77447	4.970	131962	83497
3.890	49715	70246	4.180	70517	73281	4.580	100666	77564	4.980	132798	83699
3.895	50066	70298	4.190	71250	73386	4.590	101442	77681	4.990	133637	83909
3.900	50418	70351	4.200	71985	73488	4.600	102220	77800	5.000	134477	84120
3.905	50770	70403	4.210	72720	73589	4.610	102998	77919			
3.910	51122	70454	4.220	73457	73691	4.620	103778	78040			
3.915	51474	70505	4.230	74194	73794	4.630	104559	78163			
3.920	51827	70556	4.240	74932	73896	4.640	105341	78287			
3.925	52180	70607	4.250	75672	74000	4.650	106125	78411			
3.930	52533	70657	4.260	76412	74103	4.660	106910	78535			
3.935	52886	70707	4.270	77154	74206	4.670	107696	78661			
3.940	53240	70757	4.280	77897	74310	4.680	108483	78789			
3.945	53594	70807	4.290	78640	74418	4.690	109271	78916			
3.950	53948	70857	4.300	79385	74523	4.700	110061	79044			
3.955	54302	70907	4.310	80131	74626	4.710	110852	79175			
3.960	54657	70957	4.320	80877	74728	4.720	111645	79308			
3.965	55012	71007	4.330	81625	74830	4.730	112438	79443			
3.970	55367	71057	4.340	82374	74933	4.740	113233	79580			
3.975	55723	71107	4.350	83124	75036	4.750	114030	79725			
3.980	56078	71157	4.360	83875	75139	4.760	114828	79868			
3.985	56434	71207	4.370	84627	75243	4.770	115627	80018			
3.990	56790	71257	4.380	85380	75347	4.780	116428	80170			
3.995	57147	71307	4.390	86134	75452	4.790	117231	80322			
4.000	57503	71357	4.400	86889	75557	4.800	118035	80478			
4.010	58217	71458	4.410	87645	75663	4.810	118840	80635			
4.020	58932	71560	4.420	88402	75770	4.820	119647	80795			
4.030	59648	71662	4.430	89160	75877	4.830	120456	80956			
4.040	60366	71765	4.440	89919	75984	4.840	121267	81121			
4.050	61084	71869	4.450	90680	76092	4.850	122079	81297			
4.060	61803	71974	4.460	91441	76200	4.860	122893	81474			
4.070	62523	72078	4.470	92204	76309	4.870	123708	81647			
4.080	63245	72183	4.480	92967	76418	4.880	124526	81821			
4.090	63967	72287	4.490	93732	76530	4.890	125345	81995			

Depth-Area-Volume Data, West Lake

Stage AHD	Vol m³	Area m²	Stage AHD	Vol m³	Area m²	Stage AHD	Vol m³	Area m²	Stage AHD	Vol m³	Area m²	Stage AHD	Vol m³	Area m²	Stage AHD	Vol m³	Area m²
			2.250	0.275	14.6	2.290	1.140	28.7	2.330	2.581	43.5	2.370	4.647	60.2	2.410	7.453	80.5
			2.251	0.290	15.0	2.291	1.169	29.0	2.331	2.625	43.9	2.371	4.707	60.6	2.411	7.533	81.0
			2.252	0.305	15.3	2.292	1.198	29.4	2.332	2.669	44.3	2.372	4.768	61.1	2.412	7.615	81.5
2.213	0.000	0.00	2.253	0.320	15.7	2.293	1.227	29.8	2.333	2.713	44.7	2.373	4.829	61.6	2.413	7.696	82.0
2.214	0.000	0.34	2.254	0.336	16.0	2.294	1.257	30.1	2.334	2.758	45.1	2.374	4.891	62.0	2.414	7.779	82.6
2.215	0.001	0.68	2.255	0.352	16.4	2.295	1.288	30.5	2.335	2.803	45.5	2.375	4.953	62.5	2.415	7.862	83.1
2.216	0.002	1.04	2.256	0.369	16.8	2.296	1.318	30.8	2.336	2.849	45.9	2.376	5.016	63.0	2.416	7.945	83.6
2.217	0.003	1.41	2.257	0.386	17.1	2.297	1.349	31.2	2.337	2.895	46.3	2.377	5.079	63.5	2.417	8.029	84.1
2.218	0.004	1.78	2.258	0.403	17.5	2.298	1.381	31.6	2.338	2.942	46.7	2.378	5.143	64.0	2.418	8.113	84.7
2.219	0.006	2.17	2.259	0.421	17.8	2.299	1.413	31.9	2.339	2.988	47.1	2.379	5.207	64.5	2.419	8.198	85.2
2.220	0.009	2.57	2.260	0.439	18.2	2.300	1.445	32.3	2.340	3.036	47.5	2.380	5.272	65.0	2.420	8.284	85.7
2.221	0.011	2.97	2.261	0.457	18.6	2.301	1.477	32.7	2.341	3.083	47.9	2.381	5.338	65.5	2.421	8.370	86.3
2.222	0.015	3.39	2.262	0.476	18.9	2.302	1.510	33.0	2.342	3.131	48.3	2.382	5.403	66.0	2.422	8.456	86.8
2.223	0.018	3.81	2.263	0.495	19.2	2.303	1.543	33.4	2.343	3.180	48.7	2.383	5.470	66.5	2.423	8.543	87.3
2.224	0.022	4.25	2.264	0.515	19.6	2.304	1.577	33.8	2.344	3.229	49.1	2.384	5.536	67.0	2.424	8.631	87.9
2.225	0.027	4.70	2.265	0.534	19.9	2.305	1.611	34.1	2.345	3.278	49.5	2.385	5.604	67.5	2.425	8.719	88.4
2.226	0.032	5.15	2.266	0.554	20.2	2.306	1.645	34.5	2.346	3.328	49.9	2.386	5.671	68.0	2.426	8.808	88.9
2.227	0.037	5.61	2.267	0.575	20.6	2.307	1.680	34.9	2.347	3.378	50.3	2.387	5.740	68.5	2.427	8.897	89.4
2.228	0.043	6.07	2.268	0.595	20.9	2.308	1.715	35.3	2.348	3.428	50.7	2.388	5.808	69.1	2.428	8.986	90.0
2.229	0.049	6.52	2.269	0.617	21.3	2.309	1.750	35.6	2.349	3.479	51.1	2.389	5.878	69.6	2.429	9.077	90.5
2.230	0.056	6.97	2.270	0.638	21.6	2.310	1.786	36.0	2.350	3.530	51.5	2.390	5.948	70.1	2.430	9.167	91.0
2.231	0.063	7.41	2.271	0.660	21.9	2.311	1.822	36.4	2.351	3.582	52.0	2.391	6.018	70.6	2.431	9.259	91.6
2.232	0.071	7.84	2.272	0.682	22.3	2.312	1.859	36.7	2.352	3.634	52.4	2.392	6.089	71.1	2.432	9.351	92.3
2.233	0.079	8.27	2.273	0.704	22.6	2.313	1.896	37.1	2.353	3.687	52.8	2.393	6.160	71.6	2.433	9.443	93.3
2.234	0.087	8.68	2.274	0.727	23.0	2.314	1.933	37.5	2.354	3.740	53.2	2.394	6.232	72.1	2.434	9.537	94.5
2.235	0.096	9.10	2.275	0.750	23.3	2.315	1.971	37.8	2.355	3.793	53.7	2.395	6.304	72.7	2.435	9.632	95.5
2.236	0.105	9.50	2.276	0.774	23.7	2.316	2.009	38.2	2.356	3.847	54.1	2.396	6.377	73.2	2.436	9.728	96.6
2.237	0.115	9.90	2.277	0.798	24.0	2.317	2.047	38.6	2.357	3.902	54.5	2.397	6.451	73.7	2.437	9.825	97.5
2.238	0.125	10.3	2.278	0.822	24.4	2.318	2.086	39.0	2.358	3.956	54.9	2.398	6.525	74.2	2.438	9.923	98.4
2.239	0.135	10.7	2.279	0.846	24.7	2.319	2.125	39.3	2.359	4.011	55.4	2.399	6.599	74.7	2.439	10.022	99.3
2.240	0.146	11.1	2.280	0.871	25.1	2.320	2.165	39.7	2.360	4.067	55.8	2.400	6.674	75.2	2.440	10.122	100.1
2.241	0.157	11.4	2.281	0.896	25.4	2.321	2.205	40.1	2.361	4.123	56.2	2.401	6.750	75.8	2.441	10.222	100.9
2.242	0.169	11.8	2.282	0.922	25.8	2.322	2.245	40.5	2.362	4.179	56.7	2.402	6.826	76.3	2.442	10.324	101.7
2.243	0.181	12.2	2.283	0.948	26.1	2.323	2.285	40.9	2.363	4.236	57.1	2.403	6.902	76.8	2.443	10.426	102.5
2.244	0.193	12.5	2.284	0.974	26.5	2.324	2.327	41.2	2.364	4.294	57.5	2.404	6.979	77.3	2.444	10.529	103.3
2.245	0.206	12.9	2.285	1.001	26.9	2.325	2.368	41.6	2.365	4.351	58.0	2.405	7.057	77.8	2.445	10.632	104.1
2.246	0.219	13.2	2.286	1.028	27.2	2.326	2.410	42.0	2.366	4.410	58.4	2.406	7.135	78.4	2.446	10.737	104.9
2.247	0.233	13.6	2.287	1.055	27.6	2.327	2.452	42.4	2.367	4.468	58.8	2.407	7.214	78.9	2.447	10.842	105.8
2.248	0.246	13.9	2.288	1.083	27.9	2.328	2.495	42.8	2.368	4.527	59.3	2.408	7.293	79.4	2.448	10.948	106.6
2.249	0.261	14.3	2.289	1.111	28.3	2.329	2.537	43.1	2.369	4.587	59.7	2.409	7.373	79.9	2.449	11.06	107.4

Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2
2.450	11.16	108.3	2.490	16.26	158.6	2.530	24.92	291.3	2.570	39.97	465.1	2.610	62.16	651.2	2.650	93.14	901.0
2.451	11.27	109.1	2.491	16.42	162.0	2.531	25.21	295.6	2.571	40.44	469.4	2.611	62.81	656.7	2.651	94.04	906.6
2.452	11.38	109.9	2.492	16.58	165.5	2.532	25.51	300.1	2.572	40.91	473.7	2.612	63.47	662.2	2.652	94.95	912.1
2.453	11.49	110.8	2.493	16.75	168.9	2.533	25.82	304.7	2.573	41.38	477.9	2.613	64.13	667.8	2.653	95.86	917.6
2.454	11.60	111.6	2.494	16.92	171.9	2.534	26.12	309.2	2.574	41.86	482.1	2.614	64.81	673.4	2.654	96.78	923.1
2.455	11.72	112.5	2.495	17.09	174.2	2.535	26.43	313.4	2.575	42.35	486.3	2.615	65.48	679.2	2.655	97.71	928.6
2.456	11.83	113.4	2.496	17.27	176.5	2.536	26.75	317.6	2.576	42.84	490.5	2.616	66.16	685.1	2.656	98.64	934.0
2.457	11.94	114.2	2.497	17.45	178.8	2.537	27.07	321.5	2.577	43.33	494.8	2.617	66.85	691.5	2.657	99.58	939.4
2.458	12.06	115.1	2.498	17.63	181.0	2.538	27.39	325.4	2.578	43.83	499.1	2.618	67.55	697.7	2.658	100.5	944.7
2.459	12.17	116.0	2.499	17.81	183.3	2.539	27.72	329.3	2.579	44.33	503.4	2.619	68.25	704.0	2.659	101.5	950.1
2.460	12.29	116.9	2.500	17.99	185.6	2.540	28.05	333.2	2.580	44.83	507.7	2.620	68.95	710.2	2.660	102.4	955.4
2.461	12.41	117.8	2.501	18.18	187.9	2.541	28.39	337.2	2.581	45.34	512.1	2.621	69.67	716.3	2.661	103.4	960.7
2.462	12.52	118.7	2.502	18.37	190.3	2.542	28.72	341.1	2.582	45.86	516.6	2.622	70.39	722.4	2.662	104.3	966.1
2.463	12.64	119.6	2.503	18.56	192.6	2.543	29.07	345.1	2.583	46.38	521.0	2.623	71.11	728.4	2.663	105.3	971.4
2.464	12.76	120.5	2.504	18.75	194.9	2.544	29.41	349.1	2.584	46.90	525.6	2.624	71.84	734.4	2.664	106.3	976.7
2.465	12.88	121.4	2.505	18.94	197.3	2.545	29.77	353.2	2.585	47.43	530.1	2.625	72.58	740.4	2.665	107.3	982.1
2.466	13.01	122.3	2.506	19.15	199.6	2.546	30.12	357.3	2.586	47.96	534.8	2.626	73.32	746.4	2.666	108.2	987.7
2.467	13.13	123.2	2.507	19.35	202.0	2.547	30.48	361.4	2.587	48.50	539.4	2.627	74.07	752.5	2.667	109.2	993.7
2.468	13.25	124.1	2.508	19.55	204.4	2.548	30.84	365.6	2.588	49.04	544.1	2.628	74.83	758.6	2.668	110.2	1000.1
2.469	13.38	125.0	2.509	19.76	206.8	2.549	31.21	369.8	2.589	49.59	548.9	2.629	75.59	765.0	2.669	111.2	1006.8
2.470	13.50	125.9	2.510	19.97	209.2	2.550	31.58	374.0	2.590	50.14	553.7	2.630	76.36	771.7	2.670	112.2	1013.9
2.471	13.63	126.8	2.511	20.18	211.7	2.551	31.96	378.2	2.591	50.69	558.5	2.631	77.14	778.3	2.671	113.3	1021.0
2.472	13.76	127.7	2.512	20.39	214.5	2.552	32.34	382.6	2.592	51.25	563.1	2.632	77.92	784.9	2.672	114.3	1028.4
2.473	13.88	128.7	2.513	20.61	217.6	2.553	32.72	387.0	2.593	51.82	567.7	2.633	78.70	791.6	2.673	115.3	1035.8
2.474	14.01	129.6	2.514	20.82	221.2	2.554	33.11	391.4	2.594	52.39	572.3	2.634	79.50	798.5	2.674	116.4	1043.3
2.475	14.14	130.6	2.515	21.05	225.1	2.555	33.51	395.9	2.595	52.96	576.8	2.635	80.30	805.4	2.675	117.4	1050.9
2.476	14.28	131.6	2.516	21.27	229.1	2.556	33.91	400.5	2.596	53.54	581.4	2.636	81.11	812.2	2.676	118.5	1058.7
2.477	14.41	132.7	2.517	21.51	233.3	2.557	34.31	405.1	2.597	54.13	586.0	2.637	81.92	819.2	2.677	119.5	1066.1
2.478	14.54	133.8	2.518	21.74	237.8	2.558	34.72	409.8	2.598	54.71	590.7	2.638	82.74	826.1	2.678	120.6	1073.2
2.479	14.67	134.9	2.519	21.98	242.3	2.559	35.13	414.5	2.599	55.31	595.4	2.639	83.58	833.4	2.679	121.7	1080.3
2.480	14.81	136.1	2.520	22.23	246.8	2.560	35.55	419.2	2.600	55.91	600.1	2.640	84.42	840.8	2.680	122.8	1087.5
2.481	14.95	137.2	2.521	22.48	251.3	2.561	35.97	423.8	2.601	56.51	604.9	2.641	85.26	848.0	2.681	123.8	1094.9
2.482	15.08	138.5	2.522	22.73	255.8	2.562	36.39	428.5	2.602	57.12	609.7	2.642	86.11	854.3	2.682	124.9	1102.8
2.483	15.22	139.7	2.523	22.99	260.4	2.563	36.82	433.2	2.603	57.73	614.6	2.643	86.97	860.4	2.683	126.1	1110.9
2.484	15.36	141.1	2.524	23.25	265.1	2.564	37.26	438.0	2.604	58.34	619.7	2.644	87.83	866.4	2.684	127.2	1119.5
2.485	15.51	143.0	2.525	23.52	269.9	2.565	37.70	442.7	2.605	58.97	624.8	2.645	88.70	872.4	2.685	128.3	1129.1
2.486	15.65	145.5	2.526	23.79	274.4	2.566	38.14	447.3	2.606	59.59	629.9	2.646	89.58	878.2	2.686	129.4	1141.3
2.487	15.80	148.6	2.527	24.07	278.7	2.567	38.59	451.9	2.607	60.23	635.2	2.647	90.46	883.9	2.687	130.6	1153.7
2.488	15.95	152.0	2.528	24.35	283.0	2.568	39.05	456.4	2.608	60.86	640.4	2.648	91.34	889.6	2.688	131.7	1166.4
2.489	16.10	155.3	2.529	24.63	287.2	2.569	39.51	460.8	2.609	61.51	645.8	2.649	92.24	895.3	2.689	132.9	1179.0

Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2
2.690	134.1	1190.3	2.730	189.0	1552.2	2.770	261.4	2207.6	2.810	386.3	4311.3	2.850	624.2	7690.5	2.890	1020	12390
2.691	135.3	1201.2	2.731	190.6	1562.3	2.771	263.6	2238.3	2.811	390.7	4383.2	2.851	631.9	7785.4	2.891	1033	12513
2.692	136.5	1211.6	2.732	192.1	1572.6	2.772	265.9	2270.4	2.812	395.1	4455.1	2.852	639.7	7880.9	2.892	1045	12636
2.693	137.7	1221.7	2.733	193.7	1582.9	2.773	268.2	2304.5	2.813	399.6	4527.6	2.853	647.7	7977.6	2.893	1058	12760
2.694	138.9	1231.4	2.734	195.3	1593.4	2.774	270.5	2339.5	2.814	404.1	4601.0	2.854	655.7	8078.7	2.894	1071	12884
2.695	140.2	1240.8	2.735	196.9	1603.9	2.775	272.9	2376.0	2.815	408.8	4675.9	2.855	663.8	8177.0	2.895	1084	13008
2.696	141.4	1250.1	2.736	198.5	1614.6	2.776	275.3	2416.5	2.816	413.5	4752.6	2.856	672.0	8273.9	2.896	1097	13133
2.697	142.7	1259.3	2.737	200.1	1625.2	2.777	277.7	2458.9	2.817	418.3	4832.4	2.857	680.4	8371.3	2.897	1110	13258
2.698	143.9	1268.4	2.738	201.8	1635.7	2.778	280.2	2501.3	2.818	423.1	4916.4	2.858	688.8	8469.8	2.898	1123	13386
2.699	145.2	1277.4	2.739	203.4	1646.1	2.779	282.7	2545.0	2.819	428.1	5001.9	2.859	697.3	8570.4	2.899	1137	13517
2.700	146.5	1286.4	2.740	205.1	1656.3	2.780	285.3	2591.9	2.820	433.1	5089.1	2.860	705.9	8672.4	2.900	1150	13653
2.701	147.8	1295.4	2.741	206.7	1666.5	2.781	287.9	2638.5	2.821	438.3	5178.1	2.861	714.6	8775.8	2.901	1164	13796
2.702	149.1	1304.3	2.742	208.4	1676.6	2.782	290.6	2685.3	2.822	443.5	5265.9	2.862	723.5	8880.4	2.902	1178	13931
2.703	150.4	1313.2	2.743	210.1	1686.8	2.783	293.3	2730.9	2.823	448.8	5354.8	2.863	732.4	8986.2	2.903	1192	14060
2.704	151.7	1322.1	2.744	211.8	1698.1	2.784	296.0	2775.3	2.824	454.2	5439.3	2.864	741.4	9093.3	2.904	1206	14185
2.705	153.0	1330.9	2.745	213.5	1710.0	2.785	298.8	2817.7	2.825	459.7	5521.8	2.865	750.6	9202.9	2.905	1220	14309
2.706	154.4	1339.6	2.746	215.2	1722.4	2.786	301.6	2860.9	2.826	465.3	5603.6	2.866	759.8	9315.1	2.906	1235	14432
2.707	155.7	1348.2	2.747	216.9	1735.0	2.787	304.5	2905.2	2.827	470.9	5684.8	2.867	769.2	9434.9	2.907	1249	14555
2.708	157.1	1356.7	2.748	218.7	1747.6	2.788	307.5	2950.8	2.828	476.6	5766.8	2.868	778.7	9554.1	2.908	1264	14674
2.709	158.4	1365.2	2.749	220.4	1760.0	2.789	310.4	3000.0	2.829	482.4	5850.4	2.869	788.3	9673.2	2.909	1278	14790
2.710	159.8	1373.6	2.750	222.2	1772.1	2.790	313.5	3051.2	2.830	488.3	5935.6	2.870	798.1	9795.5	2.910	1293	14906
2.711	161.2	1382.1	2.751	224.0	1784.3	2.791	316.5	3103.5	2.831	494.3	6021.5	2.871	807.9	9930.2	2.911	1308	15021
2.712	162.6	1390.6	2.752	225.7	1797.6	2.792	319.7	3156.1	2.832	500.4	6106.8	2.872	817.9	10069	2.912	1323	15136
2.713	164.0	1399.1	2.753	227.6	1812.6	2.793	322.9	3209.4	2.833	506.5	6190.7	2.873	828.1	10204	2.913	1339	15250
2.714	165.4	1407.7	2.754	229.4	1829.8	2.794	326.1	3264.1	2.834	512.8	6273.8	2.874	838.3	10335	2.914	1354	15365
2.715	166.8	1416.4	2.755	231.2	1847.8	2.795	329.4	3321.2	2.835	519.1	6356.9	2.875	848.7	10465	2.915	1369	15483
2.716	168.2	1425.1	2.756	233.1	1866.9	2.796	332.7	3379.7	2.836	525.5	6440.8	2.876	859.3	10592	2.916	1385	15604
2.717	169.6	1433.9	2.757	234.9	1886.8	2.797	336.1	3440.4	2.837	531.9	6525.3	2.877	869.9	10718	2.917	1400	15726
2.718	171.1	1442.8	2.758	236.8	1907.4	2.798	339.6	3507.6	2.838	538.5	6610.3	2.878	880.7	10844	2.918	1416	15849
2.719	172.5	1451.7	2.759	238.8	1928.8	2.799	343.2	3568.6	2.839	545.2	6695.1	2.879	891.6	10970	2.919	1432	15969
2.720	174.0	1460.5	2.760	240.7	1951.1	2.800	346.8	3628.8	2.840	551.9	6779.9	2.880	902.6	11096	2.920	1448	16088
2.721	175.4	1469.3	2.761	242.7	1973.8	2.801	350.4	3689.3	2.841	558.7	6865.1	2.881	913.8	11225	2.921	1464	16208
2.722	176.9	1478.1	2.762	244.6	1996.9	2.802	354.1	3750.2	2.842	565.6	6950.9	2.882	925.1	11356	2.922	1481	16326
2.723	178.4	1486.9	2.763	246.7	2020.4	2.803	357.9	3813.6	2.843	572.6	7038.1	2.883	936.5	11492	2.923	1497	16445
2.724	179.9	1495.8	2.764	248.7	2044.4	2.804	361.8	3879.7	2.844	579.7	7126.6	2.884	948.1	11632	2.924	1514	16569
2.725	181.4	1504.7	2.765	250.7	2069.2	2.805	365.7	3946.6	2.845	586.9	7216.2	2.885	959.8	11762	2.925	1530	16695
2.726	182.9	1513.8	2.766	252.8	2094.8	2.806	369.7	4015.5	2.846	594.1	7310.5	2.886	971.6	11889	2.926	1547	16818
2.727	184.4	1523.0	2.767	254.9	2121.4	2.807	373.7	4087.5	2.847	601.5	7406.2	2.887	983.5	12015	2.927	1564	16937
2.728	185.9	1532.5	2.768	257.1	2149.2	2.808	377.8	4163.5	2.848	609.0	7501.2	2.888	995.6	12143	2.928	1581	17054
2.729	187.5	1542.2	2.769	259.2	2178.0	2.809	382.0	4238.9	2.849	616.5	7595.9	2.889	1008	12268	2.929	1598	17173

Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2
2.930	1615	17292	2.970	2414	22635	3.010	3409	26955	3.050	4560	30521	3.090	5849	34025	3.130	7280	37509
2.931	1632	17410	2.971	2437	22761	3.011	3436	27051	3.051	4590	30606	3.091	5883	34117	3.131	7317	37598
2.932	1650	17529	2.972	2460	22887	3.012	3463	27147	3.052	4621	30691	3.092	5917	34208	3.132	7355	37688
2.933	1668	17650	2.973	2483	23011	3.013	3490	27242	3.053	4651	30776	3.093	5951	34297	3.133	7393	37778
2.934	1685	17772	2.974	2506	23130	3.014	3517	27337	3.054	4682	30860	3.094	5985	34386	3.134	7431	37869
2.935	1703	17895	2.975	2529	23247	3.015	3545	27430	3.055	4713	30944	3.095	6020	34475	3.135	7468	37962
2.936	1721	18025	2.976	2552	23362	3.016	3572	27522	3.056	4744	31027	3.096	6054	34564	3.136	7506	38056
2.937	1739	18165	2.977	2576	23476	3.017	3600	27614	3.057	4775	31110	3.097	6089	34652	3.137	7545	38150
2.938	1757	18298	2.978	2599	23590	3.018	3627	27706	3.058	4806	31192	3.098	6124	34741	3.138	7583	38247
2.939	1776	18429	2.979	2623	23704	3.019	3655	27798	3.059	4838	31275	3.099	6158	34828	3.139	7621	38345
2.940	1794	18561	2.980	2647	23815	3.020	3683	27890	3.060	4869	31358	3.100	6193	34916	3.140	7659	38445
2.941	1813	18697	2.981	2670	23925	3.021	3711	27983	3.061	4900	31441	3.101	6228	35003	3.141	7698	38544
2.942	1832	18845	2.982	2694	24034	3.022	3739	28076	3.062	4932	31523	3.102	6263	35091	3.142	7737	38642
2.943	1851	18984	2.983	2718	24142	3.023	3767	28166	3.063	4963	31606	3.103	6299	35179	3.143	7775	38738
2.944	1870	19132	2.984	2743	24249	3.024	3795	28255	3.064	4995	31689	3.104	6334	35267	3.144	7814	38835
2.945	1889	19275	2.985	2767	24356	3.025	3824	28344	3.065	5027	31772	3.105	6369	35354	3.145	7853	38932
2.946	1908	19418	2.986	2791	24463	3.026	3852	28432	3.066	5059	31856	3.106	6404	35443	3.146	7892	39030
2.947	1928	19568	2.987	2816	24570	3.027	3880	28519	3.067	5091	31941	3.107	6440	35532	3.147	7931	39130
2.948	1947	19720	2.988	2841	24676	3.028	3909	28606	3.068	5122	32026	3.108	6476	35620	3.148	7970	39231
2.949	1967	19867	2.989	2865	24781	3.029	3938	28693	3.069	5155	32111	3.109	6511	35706	3.149	8009	39334
2.950	1987	20011	2.990	2890	24886	3.030	3966	28780	3.070	5187	32197	3.110	6547	35792	3.150	8049	39438
2.951	2007	20153	2.991	2915	24991	3.031	3995	28867	3.071	5219	32282	3.111	6583	35877	3.151	8088	39544
2.952	2027	20294	2.992	2940	25095	3.032	4024	28953	3.072	5251	32369	3.112	6619	35961	3.152	8128	39652
2.953	2048	20432	2.993	2965	25200	3.033	4053	29040	3.073	5284	32456	3.113	6655	36046	3.153	8168	39767
2.954	2068	20566	2.994	2990	25304	3.034	4082	29127	3.074	5316	32546	3.114	6691	36131	3.154	8207	39880
2.955	2089	20700	2.995	3016	25409	3.035	4111	29214	3.075	5349	32636	3.115	6727	36215	3.155	8247	39992
2.956	2110	20839	2.996	3041	25513	3.036	4141	29301	3.076	5381	32729	3.116	6763	36300	3.156	8287	40096
2.957	2130	20983	2.997	3067	25618	3.037	4170	29388	3.077	5414	32820	3.117	6800	36385	3.157	8328	40193
2.958	2152	21124	2.998	3093	25726	3.038	4199	29477	3.078	5447	32910	3.118	6836	36470	3.158	8368	40292
2.959	2173	21260	2.999	3118	25833	3.039	4229	29569	3.079	5480	33000	3.119	6872	36555	3.159	8408	40393
2.960	2194	21388	3.000	3144	25939	3.040	4259	29662	3.080	5513	33091	3.120	6909	36640	3.160	8449	40497
2.961	2215	21513	3.001	3170	26045	3.041	4288	29752	3.081	5546	33181	3.121	6946	36726	3.161	8489	40594
2.962	2237	21637	3.002	3196	26150	3.042	4318	29840	3.082	5579	33272	3.122	6983	36811	3.162	8530	40687
2.963	2259	21760	3.003	3222	26253	3.043	4348	29927	3.083	5613	33362	3.123	7019	36897	3.163	8570	40777
2.964	2281	21886	3.004	3249	26357	3.044	4378	30013	3.084	5646	33454	3.124	7056	36983	3.164	8611	40865
2.965	2303	22010	3.005	3275	26459	3.045	4408	30099	3.085	5680	33546	3.125	7093	37069	3.165	8652	40953
2.966	2325	22136	3.006	3302	26561	3.046	4438	30183	3.086	5713	33641	3.126	7130	37156	3.166	8693	41039
2.967	2347	22261	3.007	3328	26661	3.047	4468	30268	3.087	5747	33738	3.127	7168	37243	3.167	8734	41123
2.968	2369	22387	3.008	3355	26760	3.048	4499	30352	3.088	5781	33838	3.128	7205	37331	3.168	8775	41208
2.969	2392	22511	3.009	3382	26858	3.049	4529	30436	3.089	5815	33932	3.129	7242	37419	3.169	8817	41290

Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2
3.170	8858	41372	3.210	10574	44396	3.250	12412	47562	3.290	14368	50032	3.330	16411	52151	3.370	18542	54408
3.171	8899	41454	3.211	10619	44472	3.251	12459	47661	3.291	14418	50083	3.331	16464	52207	3.371	18597	54472
3.172	8941	41535	3.212	10663	44548	3.252	12507	47744	3.292	14468	50134	3.332	16516	52262	3.372	18651	54538
3.173	8983	41615	3.213	10708	44624	3.253	12555	47824	3.293	14519	50185	3.333	16568	52319	3.373	18706	54604
3.174	9024	41695	3.214	10752	44701	3.254	12603	47900	3.294	14569	50235	3.334	16620	52375	3.374	18760	54666
3.175	9066	41775	3.215	10797	44778	3.255	12650	47974	3.295	14619	50286	3.335	16673	52432	3.375	18815	54728
3.176	9108	41854	3.216	10842	44856	3.256	12698	48048	3.296	14669	50337	3.336	16725	52489	3.376	18870	54790
3.177	9150	41935	3.217	10887	44933	3.257	12747	48120	3.297	14720	50389	3.337	16778	52547	3.377	18925	54854
3.178	9192	42017	3.218	10932	45010	3.258	12795	48192	3.298	14770	50442	3.338	16830	52605	3.378	18980	54919
3.179	9234	42098	3.219	10977	45086	3.259	12843	48263	3.299	14821	50495	3.339	16883	52665	3.379	19034	54983
3.180	9276	42177	3.220	11022	45162	3.260	12891	48332	3.300	14871	50547	3.340	16936	52726	3.380	19089	55045
3.181	9318	42256	3.221	11067	45238	3.261	12940	48400	3.301	14922	50600	3.341	16989	52790	3.381	19145	55106
3.182	9360	42334	3.222	11113	45315	3.262	12988	48469	3.302	14972	50653	3.342	17041	52877	3.382	19200	55166
3.183	9403	42413	3.223	11158	45393	3.263	13037	48539	3.303	15023	50707	3.343	17094	52907	3.383	19255	55226
3.184	9445	42492	3.224	11203	45471	3.264	13085	48606	3.304	15074	50760	3.344	17147	52961	3.384	19310	55286
3.185	9488	42570	3.225	11249	45547	3.265	13134	48671	3.305	15125	50814	3.345	17200	53014	3.385	19365	55347
3.186	9530	42646	3.226	11294	45622	3.266	13182	48735	3.306	15175	50867	3.346	17253	53067	3.386	19421	55408
3.187	9573	42721	3.227	11340	45697	3.267	13231	48797	3.307	15226	50921	3.347	17306	53119	3.387	19476	55469
3.188	9616	42795	3.228	11386	45772	3.268	13280	48859	3.308	15277	50973	3.348	17359	53171	3.388	19532	55531
3.189	9659	42868	3.229	11432	45848	3.269	13329	48920	3.309	15328	51025	3.349	17413	53223	3.389	19587	55594
3.190	9701	42941	3.230	11478	45923	3.270	13378	48982	3.310	15379	51077	3.350	17466	53274	3.390	19643	55656
3.191	9744	43013	3.231	11524	45999	3.271	13427	49046	3.311	15430	51129	3.351	17519	53325	3.391	19699	55718
3.192	9787	43085	3.232	11570	46075	3.272	13476	49104	3.312	15482	51181	3.352	17573	53376	3.392	19754	55778
3.193	9831	43158	3.233	11616	46150	3.273	13525	49160	3.313	15533	51233	3.353	17626	53427	3.393	19810	55839
3.194	9874	43230	3.234	11662	46226	3.274	13574	49216	3.314	15584	51285	3.354	17679	53478	3.394	19866	55902
3.195	9917	43303	3.235	11708	46301	3.275	13624	49270	3.315	15635	51336	3.355	17733	53529	3.395	19922	55966
3.196	9960	43375	3.236	11754	46376	3.276	13673	49322	3.316	15687	51388	3.356	17786	53580	3.396	19978	56031
3.197	10004	43447	3.237	11801	46451	3.277	13722	49373	3.317	15738	51440	3.357	17840	53631	3.397	20034	56093
3.198	10047	43519	3.238	11847	46527	3.278	13772	49423	3.318	15790	51492	3.358	17894	53682	3.398	20090	56155
3.199	10091	43591	3.239	11894	46603	3.279	13821	49474	3.319	15841	51545	3.359	17947	53735	3.399	20146	56217
3.200	10134	43662	3.240	11941	46680	3.280	13871	49525	3.320	15893	51598	3.360	18001	53793	3.400	20203	56280
3.201	10178	43734	3.241	11987	46758	3.281	13920	49575	3.321	15944	51651	3.361	18055	53853	3.401	20259	56344
3.202	10221	43807	3.242	12034	46839	3.282	13970	49626	3.322	15996	51705	3.362	18109	53913	3.402	20315	56407
3.203	10265	43879	3.243	12081	46921	3.283	14019	49677	3.323	16048	51760	3.363	18163	53975	3.403	20372	56468
3.204	10309	43952	3.244	12128	47006	3.284	14069	49728	3.324	16100	51816	3.364	18217	54037	3.404	20428	56531
3.205	10353	44026	3.245	12175	47091	3.285	14119	49778	3.325	16151	51873	3.365	18271	54100	3.405	20485	56592
3.206	10397	44099	3.246	12222	47177	3.286	14169	49829	3.326	16203	51930	3.366	18325	54161	3.406	20541	56652
3.207	10441	44173	3.247	12269	47265	3.287	14218	49880	3.327	16255	51985	3.367	18379	54222	3.407	20598	56712
3.208	10486	44247	3.248	12317	47357	3.288	14268	49931	3.328	16307	52041	3.368	18433	54284	3.408	20655	56763
3.209	10530	44321	3.249	12364	47459	3.289	14318	49982	3.329	16359	52096	3.369	18488	54345	3.409	20712	56812

Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2
3.410	20768	56859	3.450	23074	58313	3.490	25434	59613	3.530	27835	60356	3.570	30261	60921	3.650	35174	61860
3.411	20825	56906	3.451	23133	58343	3.491	25494	59639	3.531	27896	60371	3.571	30322	60934	3.655	35483	61912
3.412	20882	56952	3.452	23191	58374	3.492	25554	59667	3.532	27956	60386	3.572	30383	60946	3.660	35793	61964
3.413	20939	56998	3.453	23250	58407	3.493	25613	59696	3.533	28016	60401	3.573	30444	60959	3.665	36103	62015
3.414	20996	57043	3.454	23308	58440	3.494	25673	59723	3.534	28077	60415	3.574	30505	60972	3.670	36413	62065
3.415	21053	57087	3.455	23366	58474	3.495	25733	59750	3.535	28137	60430	3.575	30566	60984	3.675	36723	62115
3.416	21110	57132	3.456	23425	58507	3.496	25792	59772	3.536	28198	60445	3.576	30627	60997	3.680	37034	62164
3.417	21168	57176	3.457	23483	58541	3.497	25852	59794	3.537	28258	60460	3.577	30688	61010	3.685	37345	62212
3.418	21225	57220	3.458	23542	58576	3.498	25912	59815	3.538	28319	60474	3.578	30749	61022	3.690	37656	62261
3.419	21282	57263	3.459	23601	58610	3.499	25972	59836	3.539	28379	60489	3.579	30810	61035	3.695	37968	62309
3.420	21339	57305	3.460	23659	58645	3.500	26032	59857	3.540	28440	60503	3.580	30871	61048	3.700	38279	62357
3.421	21397	57347	3.461	23718	58679	3.501	26092	59877	3.541	28500	60518	3.581	30932	61060	3.705	38591	62404
3.422	21454	57389	3.462	23777	58714	3.502	26152	59895	3.542	28561	60532	3.582	30993	61073	3.710	38903	62451
3.423	21511	57430	3.463	23835	58748	3.503	26211	59914	3.543	28621	60547	3.583	31054	61086	3.715	39216	62497
3.424	21569	57470	3.464	23894	58781	3.504	26271	59932	3.544	28682	60561	3.584	31115	61098	3.720	39528	62543
3.425	21626	57508	3.465	23953	58815	3.505	26331	59950	3.545	28742	60576	3.585	31176	61111	3.725	39841	62589
3.426	21684	57545	3.466	24012	58851	3.506	26391	59968	3.546	28803	60590	3.586	31237	61123	3.730	40154	62634
3.427	21741	57581	3.467	24071	58887	3.507	26451	59986	3.547	28863	60605	3.587	31299	61136	3.735	40468	62678
3.428	21799	57616	3.468	24130	58925	3.508	26511	60003	3.548	28924	60619	3.588	31360	61148	3.740	40781	62723
3.429	21857	57652	3.469	24188	58968	3.509	26571	60021	3.549	28985	60634	3.589	31421	61161	3.745	41095	62767
3.430	21914	57686	3.470	24247	59011	3.510	26631	60038	3.550	29045	60649	3.590	31482	61173	3.750	41409	62811
3.431	21972	57721	3.471	24306	59051	3.511	26691	60055	3.551	29106	60663	3.591	31543	61185	3.755	41723	62855
3.432	22030	57754	3.472	24366	59090	3.512	26751	60072	3.552	29167	60678	3.592	31604	61197	3.760	42037	62899
3.433	22088	57787	3.473	24425	59129	3.513	26811	60089	3.553	29227	60692	3.593	31666	61210	3.765	42352	62943
3.434	22145	57819	3.474	24484	59169	3.514	26872	60105	3.554	29288	60707	3.594	31727	61222	3.770	42667	62986
3.435	22203	57851	3.475	24543	59207	3.515	26932	60122	3.555	29349	60721	3.595	31788	61234	3.775	42982	63029
3.436	22261	57882	3.476	24602	59240	3.516	26992	60139	3.556	29409	60736	3.596	31849	61246	3.780	43297	63072
3.437	22319	57914	3.477	24661	59271	3.517	27052	60155	3.557	29470	60750	3.597	31911	61258	3.785	43612	63115
3.438	22377	57945	3.478	24721	59301	3.518	27112	60171	3.558	29531	60764	3.598	31972	61270	3.790	43928	63158
3.439	22435	57975	3.479	24780	59330	3.519	27172	60187	3.559	29592	60778	3.599	32033	61282	3.795	44244	63201
3.440	22493	58006	3.480	24839	59359	3.520	27232	60202	3.560	29653	60792	3.600	32094	61294	3.800	44560	63243
3.441	22551	58037	3.481	24899	59387	3.521	27293	60218	3.561	29713	60805	3.605	32401	61354	3.805	44877	63285
3.442	22609	58067	3.482	24958	59414	3.522	27353	60234	3.562	29774	60818	3.610	32708	61414	3.810	45193	63327
3.443	22667	58098	3.483	25018	59441	3.523	27413	60249	3.563	29835	60831	3.615	33015	61475	3.815	45510	63369
3.444	22725	58129	3.484	25077	59466	3.524	27473	60264	3.564	29896	60844	3.620	33323	61534	3.820	45827	63410
3.445	22783	58160	3.485	25137	59491	3.525	27534	60280	3.565	29957	60857	3.625	33631	61591	3.825	46144	63452
3.446	22841	58191	3.486	25196	59516	3.526	27594	60295	3.566	30018	60870	3.630	33939	61646	3.830	46461	63493
3.447	22900	58222	3.487	25256	59540	3.527	27654	60310	3.567	30078	60883	3.635	34247	61700	3.835	46779	63534
3.448	22958	58252	3.488	25315	59564	3.528	27715	60326	3.568	30139	60896	3.640	34556	61754	3.840	47097	63575
3.449	23016	58283	3.489	25375	59588	3.529	27775	60341	3.569	30200	60908	3.645	34865	61807	3.845	47415	63616

Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2	Stage AHD	Vol m^3	Area m^2
3.850	47733	63657	4.100	63896	65618	4.500	90753	68690	4.900	118890	72112
3.855	48051	63698	4.110	64552	65694	4.510	91440	68768	4.910	119612	72213
3.860	48370	63739	4.120	65209	65770	4.520	92128	68847	4.920	120334	72316
3.865	48689	63779	4.130	65868	65845	4.530	92817	68927	4.930	121058	72422
3.870	49008	63820	4.140	66526	65921	4.540	93507	69005	4.940	121783	72527
3.875	49327	63860	4.150	67186	65996	4.550	94197	69084	4.950	122508	72633
3.880	49646	63901	4.160	67846	66072	4.560	94888	69163	4.960	123235	72739
3.885	49966	63941	4.170	68507	66147	4.570	95580	69242	4.970	123963	72845
3.890	50286	63981	4.180	69169	66223	4.580	96273	69321	4.980	124692	72952
3.895	50606	64022	4.190	69832	66298	4.590	96967	69401	4.990	125422	73059
3.900	50926	64062	4.200	70495	66374	4.600	97661	69482	5.000	126153	73165
3.905	51246	64102	4.210	71159	66450	4.610	98356	69563			
3.910	51567	64142	4.220	71824	66526	4.620	99053	69644			
3.915	51888	64182	4.230	72490	66602	4.630	99749	69727			
3.920	52209	64222	4.240	73156	66678	4.640	100448	69809			
3.925	52530	64262	4.250	73823	66755	4.650	101146	69893			
3.930	52851	64302	4.260	74491	66831	4.660	101845	69977			
3.935	53173	64341	4.270	75160	66907	4.670	102546	70062			
3.940	53495	64381	4.280	75830	66984	4.680	103247	70149			
3.945	53817	64421	4.290	76500	67060	4.690	103949	70236			
3.950	54139	64460	4.300	77171	67136	4.700	104651	70326			
3.955	54461	64500	4.310	77843	67213	4.710	105355	70420			
3.960	54784	64539	4.320	78515	67289	4.720	106060	70505			
3.965	55107	64579	4.330	79188	67366	4.730	106765	70587			
3.970	55430	64618	4.340	79862	67443	4.740	107471	70670			
3.975	55753	64657	4.350	80537	67520	4.750	108179	70752			
3.980	56076	64697	4.360	81213	67597	4.760	108887	70836			
3.985	56400	64736	4.370	81889	67675	4.770	109595	70920			
3.990	56724	64775	4.380	82566	67753	4.780	110305	71004			
3.995	57048	64814	4.390	83244	67830	4.790	111015	71089			
4.000	57372	64853	4.400	83923	67908	4.800	111727	71176			
4.010	58021	64930	4.410	84602	67985	4.810	112439	71264			
4.020	58670	65008	4.420	85283	68063	4.820	113152	71353			
4.030	59321	65085	4.430	85964	68142	4.830	113866	71442			
4.040	59972	65162	4.440	86645	68220	4.840	114581	71533			
4.050	60624	65238	4.450	87328	68298	4.850	115297	71625			
4.060	61277	65315	4.460	88011	68376	4.860	116013	71719			
4.070	61930	65391	4.470	88696	68454	4.870	116731	71814			
4.080	62585	65467	4.480	89381	68533	4.880	117450	71912			
4.090	63240	65543	4.490	90066	68611	4.890	118169	72011			