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Statistical analysis to produce master hydrographs for aquifers in England and Wales

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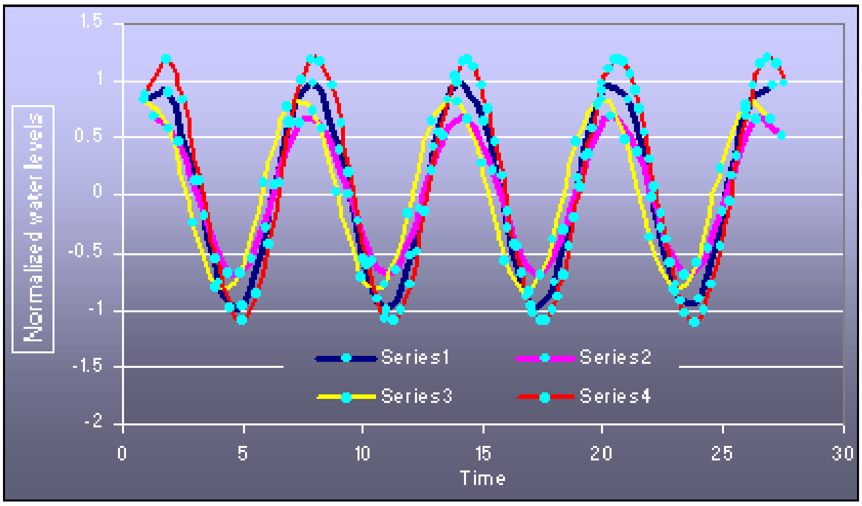

BRITISH GEOLOGICAL SURVEY

GROUNDWATER MANAGEMENT PROGRAMME

OPEN REPORT OR/07/009

Statistical analysis to produce master hydrographs for aquifers in England and Wales

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Examples of normalised water level hydrographs

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1 Introduction

Groundwater level data are a primary resource for all hydrogeological work, from site-specific enquiries to regional numerical modelling studies. However, groundwater level data held at the British Geological Survey is varied in detail. Information is not evenly distributed to cover major aquifers, but is often concentrated in limited areas, that have been mapped in detail or where boreholes have been drilled. The current water level database “Wellmaster”, includes rest water level data for more than 40 000 boreholes across the UK. The data ranges from high frequency measurements over long time periods (ca. 5% of the total data) to one-off measurements. While these raw data are useful for point determination of water level for site-specific investigations, it is not an adequate basis for any spatial coverage. There is, though, a need to provide improved spatial coverage of water level data, allowing some estimate of the likely groundwater level across wide areas. In order to provide such coverage, interpolation of water level data, including one-off point level measurements, is needed.

To include point water level measurements in interpolations, the data need to be categorised as to whether the given reading is likely to represent very low, low, average, high or very high levels for the respective aquifer. This is done by establishing long term hydrographs deemed typical for the aquifer on the basis of boreholes with long time series data, here called master hydrographs. Comparison of point data with the master hydrograph will allow the point data to be tagged within the database as belonging to one of the five categories ranging from “very low” to “very high”. This will allow the selection of, for example, “average” water levels before interpolation is carried out to obtain spatial coverage of level data for a wider area.

This report outlines a basic methodology to process long term hydrographs in order to obtain master hydrographs for the various aquifers in England and Wales. Master hydrographs are established for aquifers with sufficient long-term water level records and findings are detailed in the respective aquifer sections. If, within one aquifer, different response patterns are observed, master hydrographs were developed if a majority of boreholes could be associated with a particular water level response. If this was not the case, it was deemed not feasible to establish a master hydrograph. It was beyond the scope of this present study, to investigate aquifers showing diverse water level responses in more detail to establish the likely causes for particular water level responses over time.

2 Methodology to create master hydrographs

The water level data used to create master hydrographs were derived from the 170 sites across England and Wales for which detailed long-term time series are available. The datasets have been used as received from “Wellmaster”. The data have been analysed using the S-PLUS statistical software and Excel.

The methodology employed involves the following steps:

1. Identifying all available detailed time series for the aquifer under investigation.
2. Plotting available data as time series, referenced to Ordnance Datum, including a linear regression curve using ordinary least squares (OLS) to provide a visual indication of trend.
3. Normalising water level data, so that the mean becomes zero and the standard deviation becomes one. Normalised data are plotted as a time series, including a moving average smoothing line through the data to provide a visual indication of seasonality and long-term trend.
4. The frequency of the water level measurements is analysed, sorting the data into date order and then calculating the interval between successive measurements in days. The sample frequency in days is plotted against time. Median and mean sample frequencies are determined.
5. To check for seasonality, data are autocorrelated using the autocorrelation function (acf). The acf gives the correlation between measurements at different separations in time, with one separation, i.e ‘lag’, representing the time between water level measurements, e.g. weekly. At zero lag, the acf plot has always a value of one, as data are perfectly correlated with themself. With increasing lags, values diminish, indicating the data are less correlated. With highly correlated data, a high correlation would be expected every 12 months or so. If the data are sampled irregularly, the seasonal effect may not be apparent in the acf.
6. Boreholes are grouped on the basis of the analysis described under points 1) to 5) identifying time series showing the same seasonal response and/or trend (Figure 2.1).
7. The normalized water level measurements for the grouped bores are then aggregated to obtain a single time series, which forms the basis for the master hydrograph (Figure 2.2).
8. The time series established under 7) is plotted together with moving averages smoothing lines. To establish the master hydrograph, normalized water levels over an approximately monthly separation in time are averaged. The number of data points that need to be used in order to obtain a monthly time step is calculated on the basis of the median sample frequency of the amalgamated dataset; thus if there are approximately 15 data points per months, then the moving average is calculated using a sample frequency of 15. A second moving average smoothing line is drawn, based on normalized water levels over an approximately yearly separation in time to visualize long-term trends (Figure 2.2).
9. The master hydrograph, i.e. the monthly averages smoothing line, is plotted as a cumulative frequency plot to establish five categories ranging from “Very high” to “Very low” water levels. Water levels in the 0 to 20% category are classed as “very low”, in the 20% to 40% category as “low”, in the 40 to 60% category as “average”, in

the 60 to 80% category as “high” and in the 80% to 100% category as “very high” (Figure 2.3).

10. Arithmetic water level means are calculated for every month based on the available master hydrograph time series, i.e. the monthly averages smoothing line, to establish a monthly look-up table for the “Wellmaster” database. The months are tagged according to the five water level categories established in step 9).

Limitations of the methodology described above and conditions of use of data:

It is likely that assessing water level responses over time at a particular borehole might not be representative for level responses in the entire aquifer. Water levels in one location might be influenced by local conditions such as pumping. Hence, boreholes in the same aquifer, which show broadly the same response over time are grouped. Grouping, however, of boreholes into similar time series in terms of seasonality and/or trend is somewhat subjective. Within this study, grouping is based on trend and seasonality analysis as described under points 1) to 5), but other groupings might be feasible and could alter the shape of the master hydrograph to some degree.

Grouping might be improved if known hydrogeological criteria, such as thickness of the unsaturated zone, proximity to surface water courses, etc are taken into account. This however, is beyond the scope of this present study, and groupings were based purely on statistical analysis. Master hydrographs were only established, if more than two boreholes showed similar time series and could be grouped together. Remaining boreholes were discarded, even though they might be representative for specific hydrogeological conditions within the aquifer. For this to be established, additional data besides the here available long-term hydrographs would have to be sought.

Besides seasonal trend analysis, datasets are additionally tested for linear trends using ordinary least squares (OLS) linear regression, a parametric method, which assumes data to be normally distributed, following the Gaussian distribution. It was beyond the scope of this study to introduce other methods of data analysis for trend detection, e.g non-parametric procedures.

The master hydrograph is based on a moving average smoothing line. Ideally, such data smoothing should be carried out on observations taken at regular intervals. Many of the time series records include irregularly spaced data, as the sample frequency plots reveal. As a consequence, the number of data points used to calculate the average, chosen on the basis of the median sample frequency, spans not necessarily over monthly periods, but in some cases over longer or shorter than monthly time periods.

Classical time series analysis, i.e. autocorrelation, assumes regularly spaced measurement, which is not always strictly true in the datasets used, as sampling frequencies often changed over time.

Ideally, master hydrographs should be cross checked with long term time series datasets from the same aquifer, which were not part of the initial study, in order to check for the graphs representativeness. This however, is beyond the scope of this present study.

Before single point data is tagged using the respective master hydrographs developed in this study, allowance should ideally be made for identifying records where water levels are influenced by local or regional pumping or other known local hydrogeological effects.

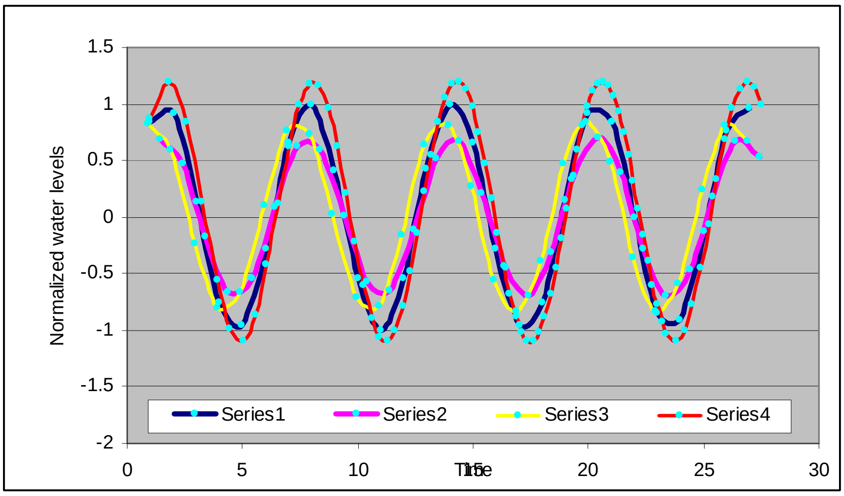


Figure 2.1 Normalized water levels of similar time series

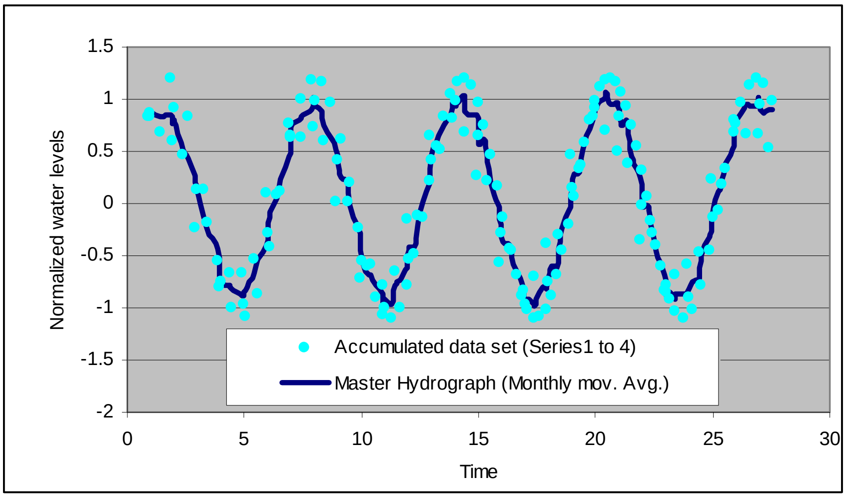


Figure 2.2 Similar time series are accumulated into one group. A monthly averaging smoothing line is calculated on the basis of the aggregated data, i.e the master hydrograph.

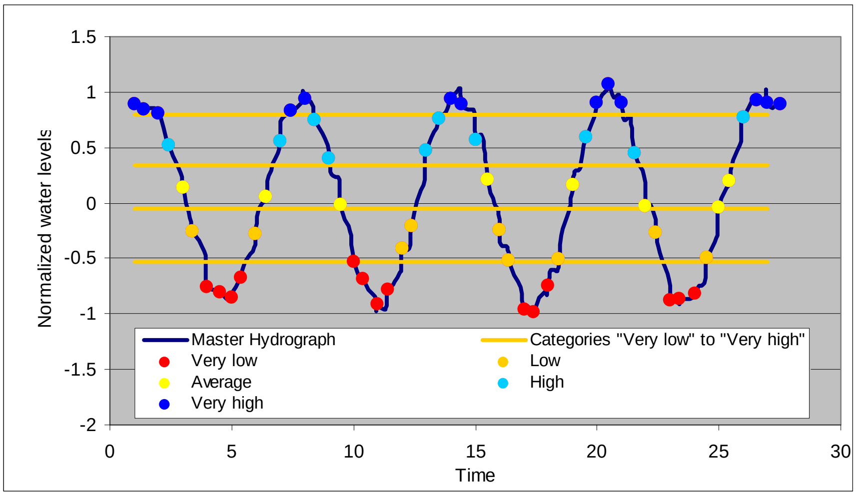


Figure 2.3 Averaged monthly values are divided into five categories, ranging from “Very low” to “Very high”. Categories are determined on the basis of the 0.2, 0.4, 0.6 and 0.8 percentiles.

3 Aquifers investigated

Figure 3.1 shows the investigated aquifers in England and Wales together with the borehole locations, for which detailed water level time series data are available for the respective aquifers.

Figure 3.1 Investigated aquifers in England and Wales and location of boreholes with detailed water level time series.

Table 3.1 list the aquifers investigated during this study, their available number of time series records and the number of hydrographs produced per aquifer. Further details are provided in the sections dedicated to the respective aquifers.

Table 3.1 List of aquifers investigated

Aquifer	No. of time series records available	No. of records discarded due to sparse/erroneous measurements	No. of records discarded due to their unique time series, not mirrored in other boreholes	No. of master hydrographs developed
Magnesian Limestone	14	-	6	2
Millstone Grit	8	-	2	1
Hasting Beds	10	3	-	1
Lower Greensand	9	1	4	1
Middle Jurassic	8	1	2	1
Upper Jurassic	6	-	-	1
Chalk – Berkshire and East Anglia	52	1	-	1
Chalk – South Downs	9	1	1	1
Chalk – Hampshire and Wiltshire	17	-	1	1
Chalk – Lincolnshire and Yorkshire	14	-	2	1
Chalk – North Downs	16	n.a.	n.a.	0
Chalk – London Basin	7	n.a.	n.a.	0
Permo Triassic Sandstone	62	n.a.	n.a	0

The following aquifers were not investigated, due to the limited number of long-term hydrographs available:

Table 3.2 List of aquifers not investigated due to limited data availability

Aquifer	No of time series records available
Lincolnshire Limestone	4
Coal Measures	3
Fell Sandstone	2
Upper Greensand	1
Superficial deposits	3
Carb. Limestone	5
Carboniferous	1

4 Magnesian Limestone

A total of 14 long term water level records are available for the Magnesian Limestone aquifer. Basic statistics on the dataset are provided in Table 4.1. The raw data, together with a linear regression curve is provided in Appendix 1, as are the normalized datasets together with moving average smoothing lines, the sampling frequency plots, the autocorrelation function plots and the developed monthly master hydrograph look-up table.

Table 4.1 Summary statistics on water level time series data from the Magnesian Limestone (water levels in m AOD)

	Min water level [m]	Max water level [m]	Mean water level [m]	Median water level [m]	Standard Dev.	No. Observation	Median sample frequency [d]	From	to	Depth of borehole [m]
NZ 33/20	67.42	88.86	80.09	79.20	3.52	2821	1	8-Jan-74	31-Dec-01	73.20
NZ 32/19	27.48	45.26	37.74	37.58	4.48	2083	6	21-Feb-68	21-Feb-01	112.70
SE 43/14	33.41	34.61	34.01	34.06	0.24	356	30	1-Jan-71	19-Dec-01	27.00
NZ 36/22	1.40	2.63	2.01	2.05	0.24	658	7	24-Jul-78	14-Apr-96	61.00
NZ 32/57	59.25	65.41	61.44	60.98	1.46	979	7	23-Oct-69	11-May-94	79.50
NZ 32/1b	19.01	41.67	29.10	28.52	7.40	598	7	8-Apr-67	13-Apr-85	106.70
SK 58/43	81.45	94.71	85.05	84.32	2.71	707	7	8-Jan-73	8-Apr-02	21.30
SK 46/71	167.41	170.49	168.63	168.57	0.54	674	8	23-Jan-73	13-Jun-02	9.90
SE 28/28	64.89	72.09	67.58	67.31	1.53	267	30	13-Jan-72	10-May-94	19.20
SE 35/4	35.48	37.52	36.54	36.52	0.41	368	30	10-Feb-70	17-Dec-01	53.30
SE 51/2	9.58	14.74	12.48	12.53	0.88	338	30	4-Mar-71	12-Feb-01	38.10
SE 43/9	31.10	37.75	34.26	34.35	1.52	423	30	30-Jan-68	28-May-02	55.40
NZ 22/22	64.77	77.90	74.99	75.95	2.87	2480	1	1-Nov-67	31-Dec-01	62.50
NZ 21/29	78.07	90.10	84.38	84.39	2.75	1637	7	23-Oct-69	24-Jun-04	32.00

Of the 14 time series records available, 4 datasets (NZ36/22, NZ32/57, NZ32/1b and NZ22/22) showed water level responses different to any other borehole records in the same aquifer. These water levels may be influenced by pumping and have been discarded. The remaining 10 time series can be grouped into three distinct water level response groups, based on bore depth.

Group 1 comprises shallow bores (the deepest borehole is 32 metres deep) and include bores SE43/14, SK58/43, SK46/71, SE28/28 and NZ21/29 (Figure 4.1). The time series records show no long term trend, but strong seasonality. The autocorrelation function (acf) plots show evidence of seasonality with a periodicity of about 12 lag units for boreholes with a median monthly sampling frequency and about 50 lag units for boreholes with a median weekly sampling frequency, i.e. a periodicity of about one year (Appendix 1). The five time series were aggregated to produce one master hydrograph for the shallow Magnesian Limestone aquifer from January 1974 to June 2002 (Figure 4.4).

Group 2 is based on three boreholes, i.e. SE51/2, SE43/9 and SE35/4, all showing similar level response patterns over time (Figure 4.5). The group 2 time series show long term trends in water levels. From the late 1960's levels fall sharply until around 1976, when recovery started at the end of the 1976 drought. A second distinct decline is recorded from about 1980 to 1993, when the decline was again arrested by recovery at the end of the 1988 to 1992 drought. On top of this trend, seasonality in water levels is observed but is subdued in comparison with records from Group 1. Time series of these boreholes, all of medium depth (between 38m and 55.4 metres), were amalgamated to produce a master hydrograph for medium depth boreholes in the Magnesian Limestone for the period from May 1971 to February 2001.

The two remaining boreholes (NZ33/20 and NZ32/19) have similar water level time series, which are distinct from Group 1 and Group 2. Both boreholes are with 73.2 m and 112.7 m relatively deep. They are located in close proximity, close to the northern margin of the aquifer. Further work is required to establish, if the response seen is typical for the deep Magnesian Limestone aquifer, or if these records display local hydrogeological effects such as pumping.

Time series plots of Group 1 and Group 2 are shown in Figure 4.1 and Figure 4.5. Both figures display:

(a) the normalized data of the water level records, which form the basis for the respective master hydrographs;

(b) the aggregated normalized water level data, together with the master hydrograph. The master hydrograph is produced by averaging water levels over approximately monthly separations in time. The number of data points to be averaged in order to obtain a monthly time step is thereby calculated on the basis of the median sample frequency of the amalgamated dataset. A second moving average smoothing line is drawn, based on an approximately yearly separation in time to visualize long term trends;

(c) the master hydrograph, i.e. the monthly moving average smoothing line, and the respective threshold lines for the five categories into which water levels are being subdivided. These are calculated on the basis of the cumulative frequency plot of the master hydrograph. Water levels in the 0 to 20% category represent “very low” levels, data in the 20% to 40% category represent “low” levels, data in the 40 to 60% category represent “average” levels, data in the 60 to 80% category represent “high” levels and data in the 80% to 100% category represent “very high” levels.

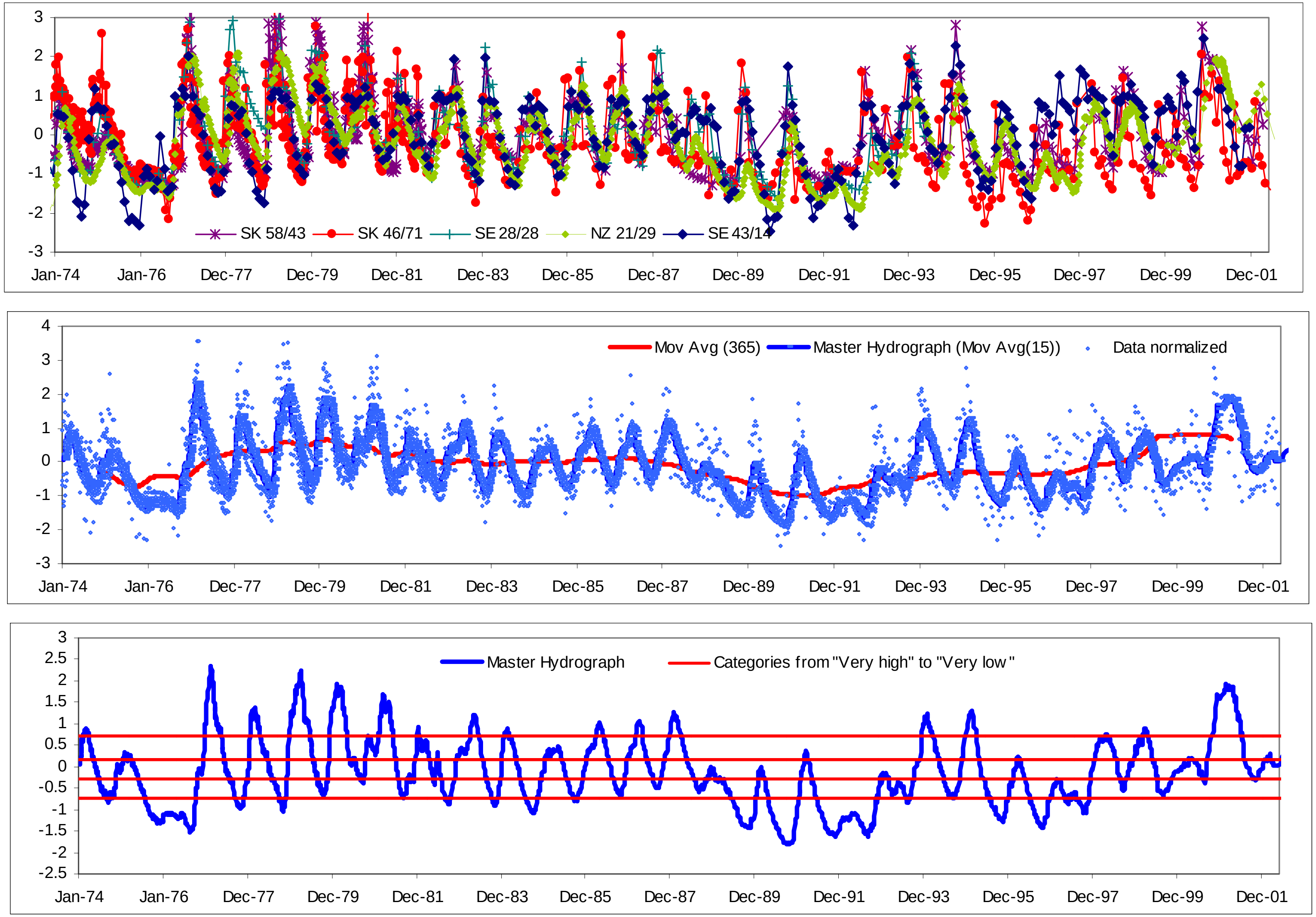


Figure 4.1 a) normalized data of the water level records used to establish the master hydrograph for the shallow Magnesian Limestone aquifer (Group 1); b) aggregated normalized water level data together with the master hydrograph and moving averages smoothing line to show long term trends (Group 1); c) master hydrograph and respective water level categories (Group 1)

Table 4.2 Summary statistics of the data used to produce the master hydrograph for the shallow Magnesian Limestone aquifer (Group 1)

Summary statistics - Master Hydrograph

Aquifer: Magnesium Limestone

Condition: Master Hydrograph to be applied to boreholes of 0 to 35 metres depth

Boreholes	Master Hydrograph =	Moving average (15)
grouped together:	No of observations	3454
SK 58/43;	From	Jan-74
NZ 21/29;	To	Jun-02
SE 28/28;	Median sample frequency	2 days
SK 46/71;	Sample gaps >month	no
SE 43/14	Trend	no
	Seasonality	yes

Categories:	Percentile	Value From	To
Very high	80-100	0.721286	2.331714
High	60-80	0.177076	0.720286
Average	40-60	-0.291576	0.176076
Low	20-40	-0.733158	-0.292576
Very low	0-20	-1.820587	-0.734158

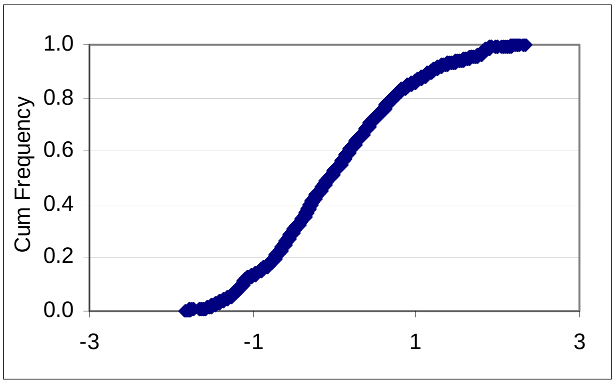


Figure 4.2 Categories used to tag monthly data of the master hydrograph (Group 1)

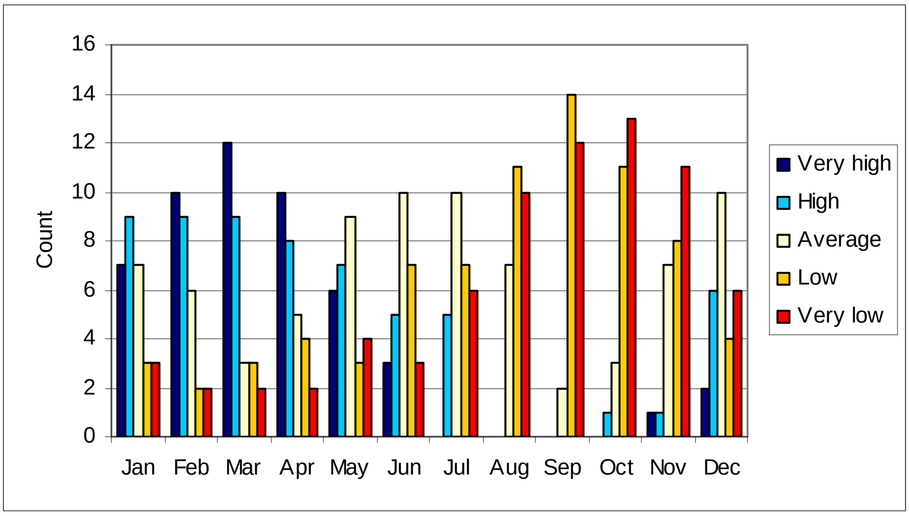


Figure 4.3 Frequency of water level categories per month based on established monthly look-up table (Group 1)

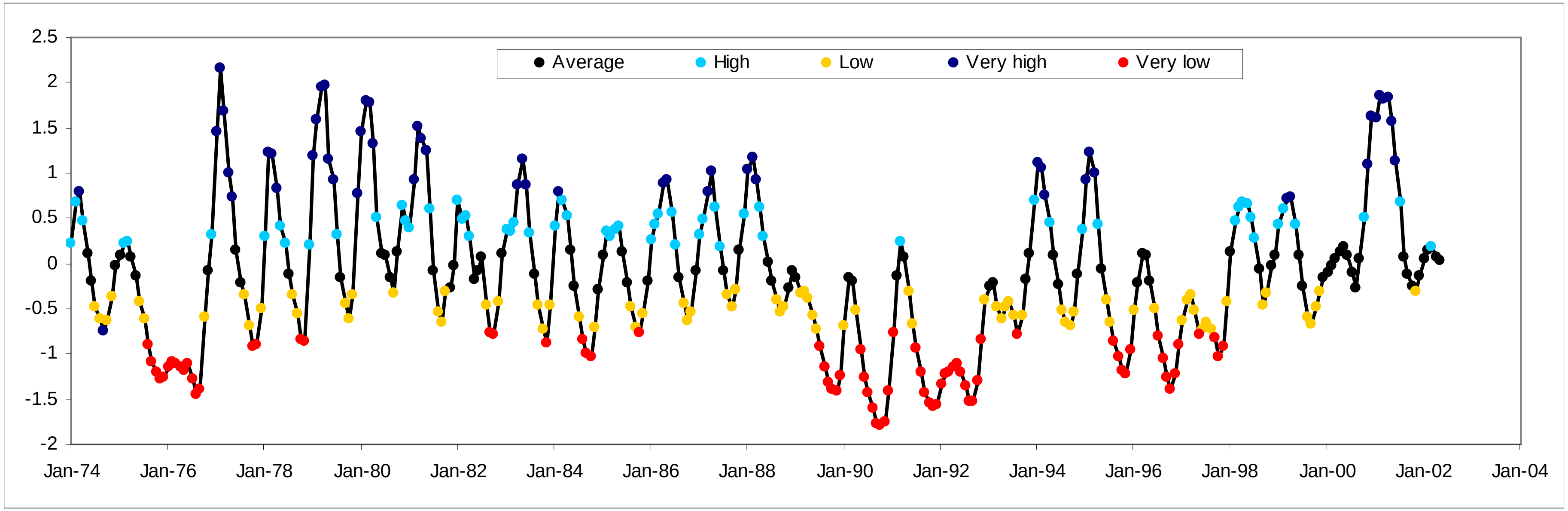


Figure 4.4 Master hydrograph for the shallow Magnesian Limestone aquifer (Group 1)

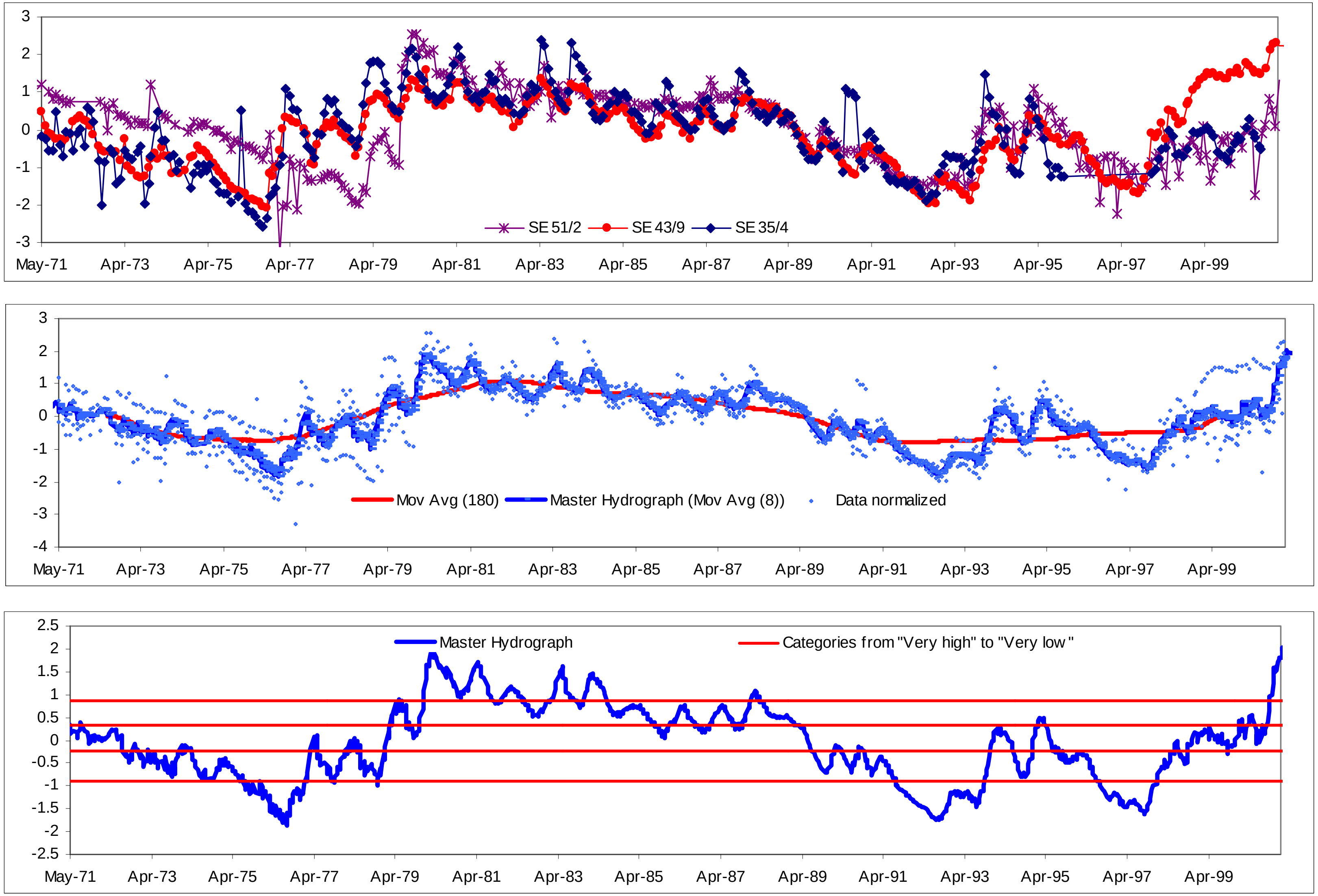


Figure 4.5 a) normalized data of the water level records used to establish the master hydrograph for boreholes of medium depth in the Magnesian Limestone aquifer (Group 2); b) aggregated normalized water level data together with the master hydrograph, and moving averages smoothing line to show long term trends (Group 2); c) master hydrograph and respective water level categories (Group 2)

Table 4.3 Summary statistics of the data used to produce the master hydrograph (Group 2)

Summary statistics - Master Hydrograph

Aquifer: Magnesium Limestone
Condition: Borehole depth 30 to 60m
Comment: Seasonality and distinct trend

Boreholes	Master Hydrograph =	Moving average (8)
grouped together:	No of observations	1129
SE 35/4	From	May-71
SE 51/2	To	February-01
SE 43/9	Median sample frequency	4 days
	Sample gaps >month	yes
	Trend	yes
	Seasonality	yes

Categories:	Percentile	Value From	To
Very high	80-100	0.856	2.558
High	60-80	0.331	0.855
Average	40-60	-0.238	0.330
Low	20-40	-0.912	-0.239
Very low	0-20	3.284	-0.913

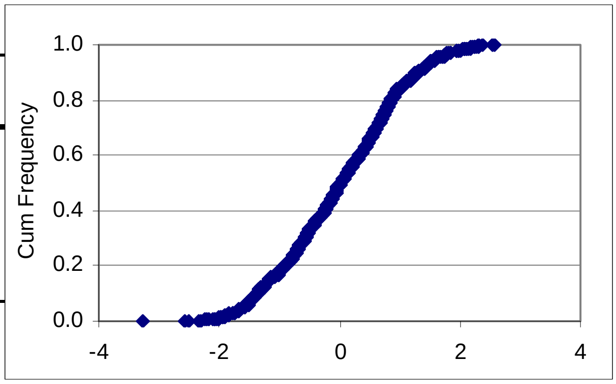


Figure 4.6 Categories used to tag monthly data of the master hydrograph (Group 2)

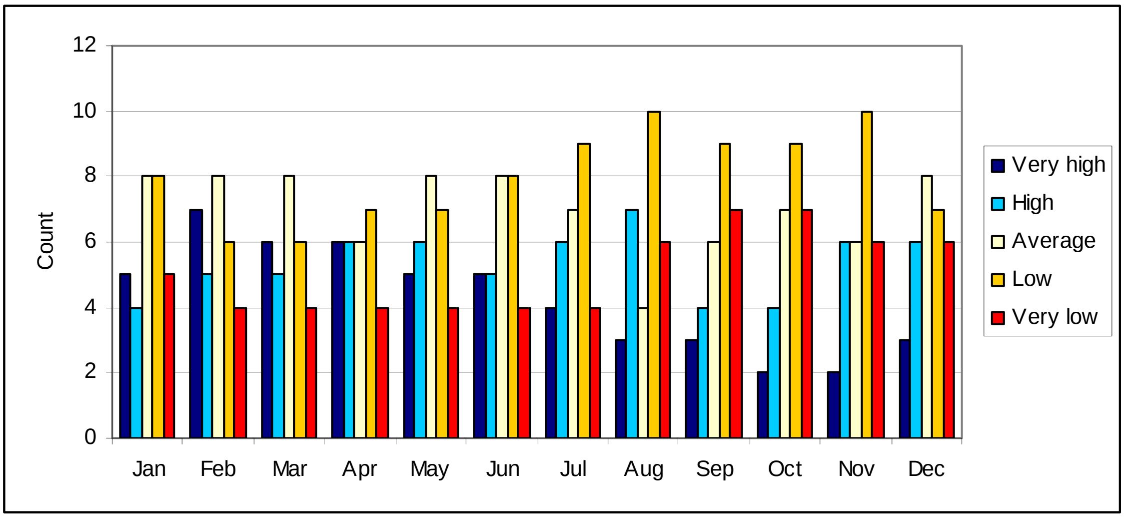


Figure 4.7 Frequency of water level categories per monthly period based on the established monthly look-up table (Group 2)

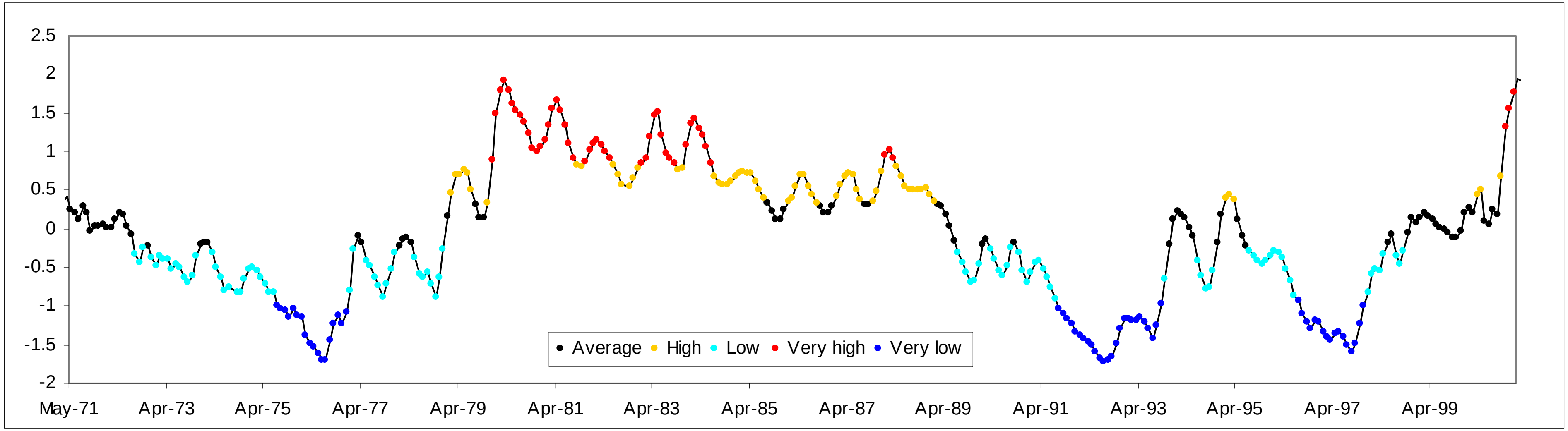


Figure 4.8 Master hydrograph for boreholes of medium depths in the Magnesian Limestone

5 Hasting Beds

A total of 10 long term water level records were available for the Hasting Beds aquifer. Basic statistics on the dataset is provided in Table 5.1. The raw data, together with a linear regression curve are provided in Appendix 2, as are the normalised datasets together with moving averages smoothing lines, the sampling frequency plots, the autocorrelation function plots and the master hydrograph look-up table.

Table 5.1 Summary statistics for time series from the Hasting Beds (water levels in m AOD)

	Min water level [m]	Max water level [m]	Mean water level [m]	Median water level [m]	Standard Dev.	No. Observation	Median sample frequency [d]	From	to	Depth of borehole [m
TQ43/16	167.94	181.31	170.87	169.85	2.59	98	32	14-Mar-73	16-May-83	39.6
TQ61/47	30.83	33.75	32.32	32.11	1.02	48	48	29-Oct-65	24-Oct-73	22
TQ42/10	130.26	139.67	135.11	133.81	3.52	25	34	07-Sep-66	05-Dec-77	14.4
TQ71/123	23.53	30.46	26.63	26.57	1.46	239	31	24-Jan-74	13-May-02	17.9
TQ62/89	84.76	90.43	89.40	90.38	1.84	25	36	19-Mar-73	12-Dec-77	7.1
TQ22/1	86.55	89.77	88.36	88.58	0.74	331	28	04-Sep-64	24-Dec-01	5.5
TQ32/19	67.22	74.37	71.92	72.44	1.80	177	35	14-Jun-68	19-Jul-89	13.5
TQ42/80A	169.67	183.44	176.51	176.18	2.70	181	32	13-Mar-79	15-Apr-02	38.5
TQ62/99	133.48	145.14	137.83	137.44	1.46	198	31	07-Sep-78	09-May-02	19
TQ61/44	109.19	119.68	117.03	117.36	1.38	307	31	31-Jan-64	19-Dec-01	11.2

Of the 10 time series records available, 3 datasets were discarded due to their limited observation periods. These are TQ62/89, TQ42/10 and TQ61/47, all records with less than 50 water level records. The remaining data stets were aggregated into one group to establish one master hydrograph for the Hastings aquifer. These records show an approximately monthly sampling frequency, however data gaps of several months are present. No significant long-term trend is observed, but the data exhibits strong seasonality (Appendix 2). The autocorrelation function (acf) plots show evidence of seasonality with a periodicity of about 12 lag units or about one year. The master hydrograph was established for the period May 1970 to December 2001.

Figure 5.1 shows:

(a) the normalised water level data of the 7 records used to establish the Master Hydrograph, for the period 1970 to 2001;

(b) the aggregated normalised water level data from 1970 to 2001 together with the master hydrograph. The master hydrograph is produced by averaging water levels over approximately monthly separations in time. The number of data points to be averaged in order to obtain a monthly time step is thereby calculated on the basis of the median sample frequency. A second moving average smoothing line is drawn, based on an approximately yearly separation in time to visualise long term trends.

(c) the master hydrograph, i.e. the monthly moving average smoothing line, and the respective threshold lines for the five categories in which water levels are being subdivided. These are calculated on the basis of the cumulative frequency plot of the master hydrograph. Water levels in the 0 to 20% category represent “very low” levels, data in the 20% to 40% category represent “low” levels, data in the 40 to 60% category represent “average” levels, data in the 60 to 80% category represent “high” levels and data in the 80% to 100% category represent “very high” levels.

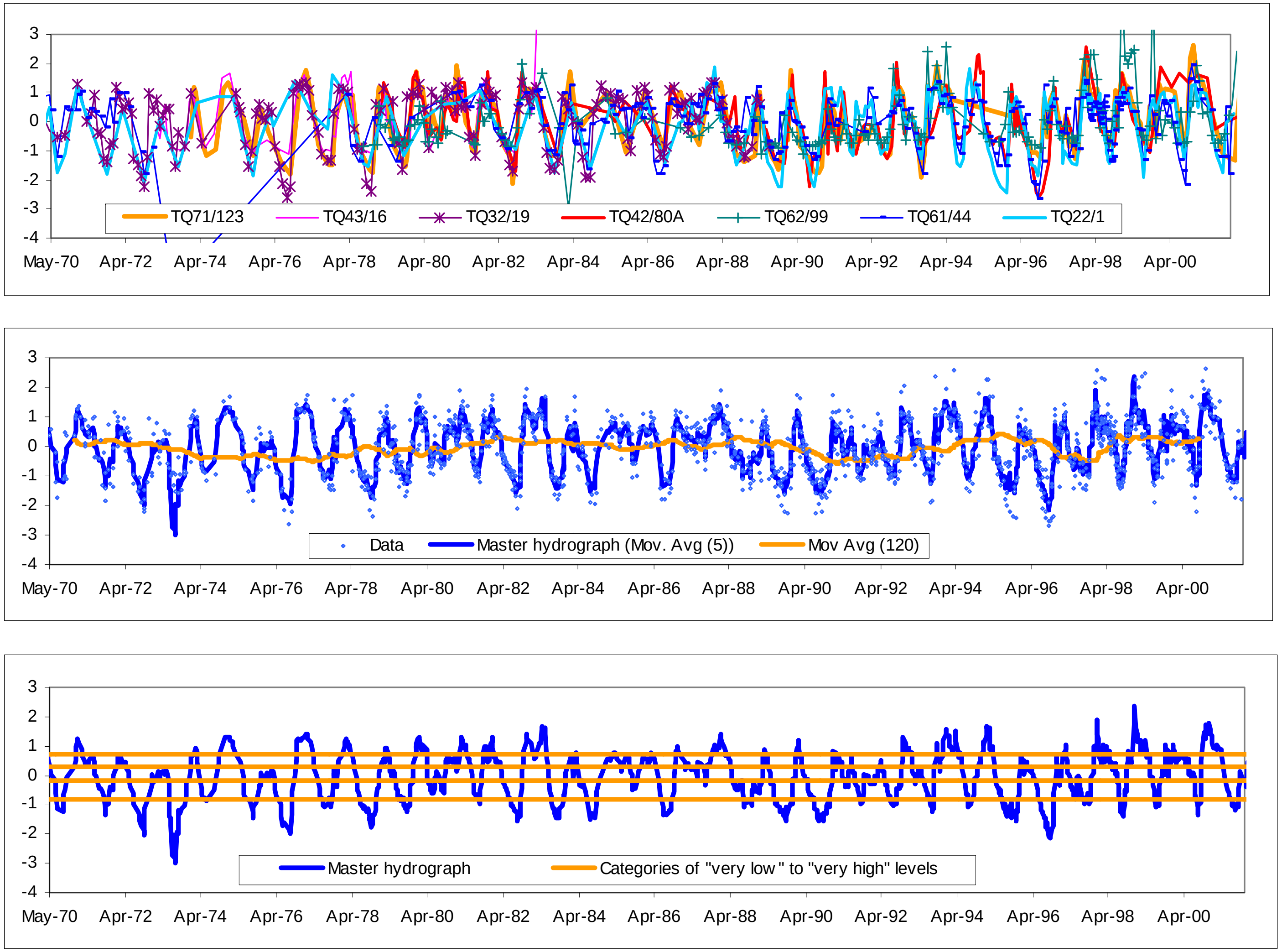


Figure 5.1 a) normalised water level data of the 7 records used to establish the master hydrograph for the Hasting Beds aquifer; b) aggregated normalised water level data together with the master hydrograph, and a moving averages smoothing line to show long term trends; c) master hydrograph and respective water level categories

Table 5.2 Summary statistics of the data used to produce the master hydrograph for the Hastings Bed aquifer

Summary statistics - Master Hydrograph			
Aquifer:	Hasting Beds		
Condition:	Master Hydrograph to be applied to all boreholes		
Boreholes		Master Hydrograph =	Mov. Average (5)
grouped together:		No of observations	1502
TQ43/16	TQ62/99	From	May-70
TQ71/123		To	December-01
TQ22/1		Median sample frequency	6 days
TQ32/19		Sample gaps > month	Yes
TQ42/80A		Trend	no
TQ61/44		Seasonality	yes

Categories:	**Percentile**	**Value From**	**To**
Very high	80-100	0.699	2.365
High	60-80	0.300	0.698
Average	40-60	-0.189	0.299
Low	20-40	-0.821	-0.190
Very low	0-20	-3.008	-0.822

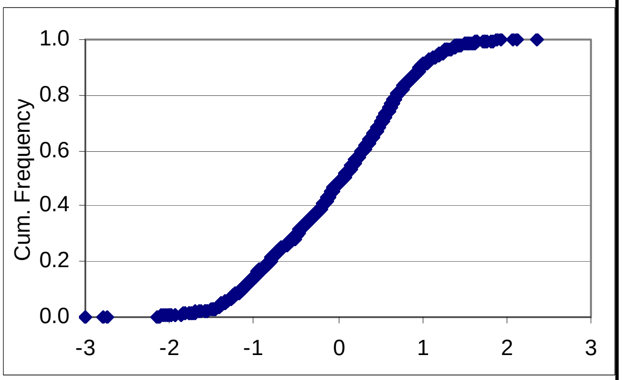


Figure 5.2 Categories used to tag monthly data of the master hydrograph

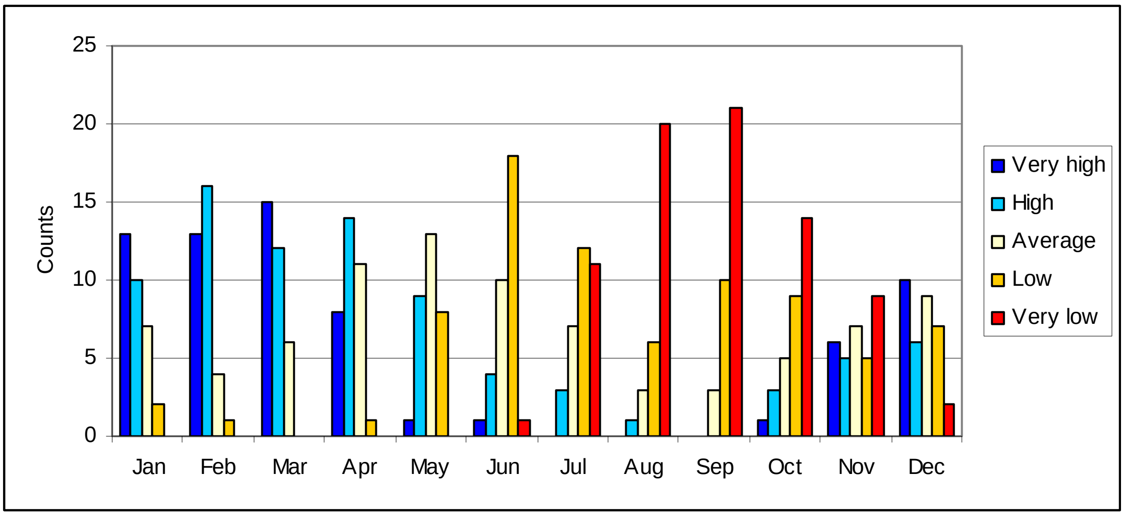


Figure 5.3 Frequency of water level categories per monthly period based on the established monthly look-up table

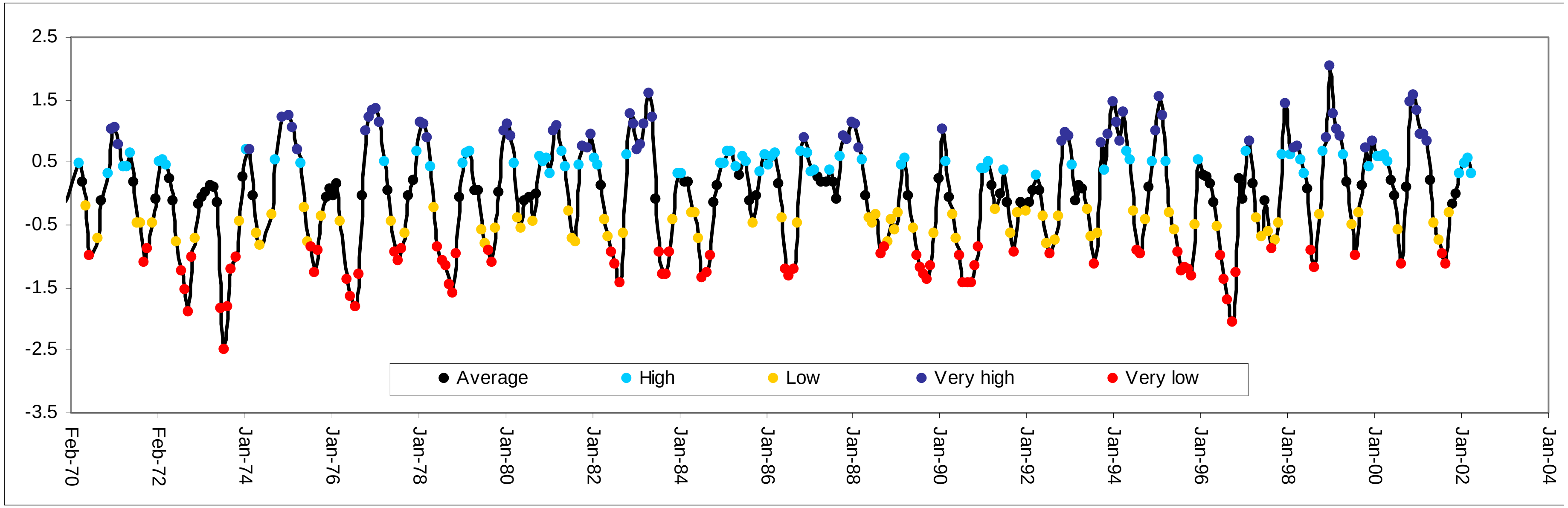


Figure 5.4 Master hydrograph for the Hasting Beds aquifer

6 Middle Jurassic

A total of 8 long term water level records are available for the Middle Jurassic aquifers. Basic statistics on the datasets is provided in Table 6.1. The raw data, together with a linear regression curve is provided in Appendix 3, as are the normalised datasets together with moving averages smoothing lines, the sampling frequency plots, the autocorrelation function plots and the master hydrograph look-up table.

Table 6.1 Summary statistics of long term hydrographs from the Middle Jurassic aquifers (water levels in m AOD)

	Min water level [m]	Max water level [m]	Mean water level [m]	Median water level [m]	Standard Dev.	No. Observation	Median sample frequency [d]	From	to	Depth of borehole [m]
ST89/32A	85.68	118.11	99.62	97.84	6.64	2254	7	15-May-32	22-Jun-88	41.8
ST51/57	54.99	59.68	57.43	57.24	1.27	1306	1	22-Sep-71	01-Jan-02	7.2
ST77/8	104.48	128.58	117.47	118.28	4.91	225	21	02-Oct-73	26-Jun-86	58.0
SP33/41	139.70	144.16	142.04	142.15	1.11	413	7	09-Aug-64	29-Sep-74	54.4
SP20/114	89.50	91.81	90.65	90.56	0.70	28	33	23-Mar-79	19-Nov-81	65.2
SP00/62	97.38	103.45	101.23	101.15	1.10	1778	7	05-Dec-58	02-Nov-04	61.0
SP20/113	80.73	91.41	87.68	87.67	2.70	560	1	20-Jan-83	31-Dec-01	65.8
ST88/62A	60.30	96.19	80.85	82.37	8.71	323	28	03-Oct-77	20-Dec-01	112.1

The median sample frequency of the available eight long term hydrographs is monthly, weekly and daily, respectively. One time series was discarded due to the limited amount of data (SP20/114). Five of the remaining time series data show similar water level responses over time (SP00/62, ST88/62A, ST89/32A, ST51/57, ST77/8) (Figure 6.1). Water levels show strong seasonality, but exhibit no long-term trend. These boreholes, which span depths from 7.2 metres to 112m, were aggregated into one group to produce one master hydrograph for the Middle Jurassic aquifers. The master hydrograph was established from September 1958 to May 2001. The two remaining time series records (SP33/41 and SP20/113) show also strong seasonality, however step changes in water levels over time, which are not observed in any of the other time series records, suggest these boreholes to be influenced by local hydrological factors, such as pumping. The data has not been included in any data manipulation.

Figure 6.1 shows:

(a) the normalised water level data of the five water level records used to establish the master hydrograph;

(b) the aggregated normalised water level data from 1958 to 2001 together with the master hydrograph. The master hydrograph is produced by averaging water levels over approximately monthly separations in time. The number of data points to be averaged in order to obtain a monthly time step is thereby calculated on the basis of the median sample frequency. A second moving average smoothing line is drawn, based on an approximately yearly separation in time to visualise long term trends.

(c) the master hydrograph, i.e. the monthly moving average smoothing line, and the respective threshold lines for the five categories in which water levels are being subdivided. These are calculated on the basis of the cumulative frequency plot of the master hydrograph. Water levels in the 0 to 20% category represent “very low” levels, data in the 20% to 40% category represent “low” levels, data in the 40 to 60% category represent “average” levels, data in the 60 to 80% category represent “high” levels and data in the 80% to 100% category represent “very high” levels.

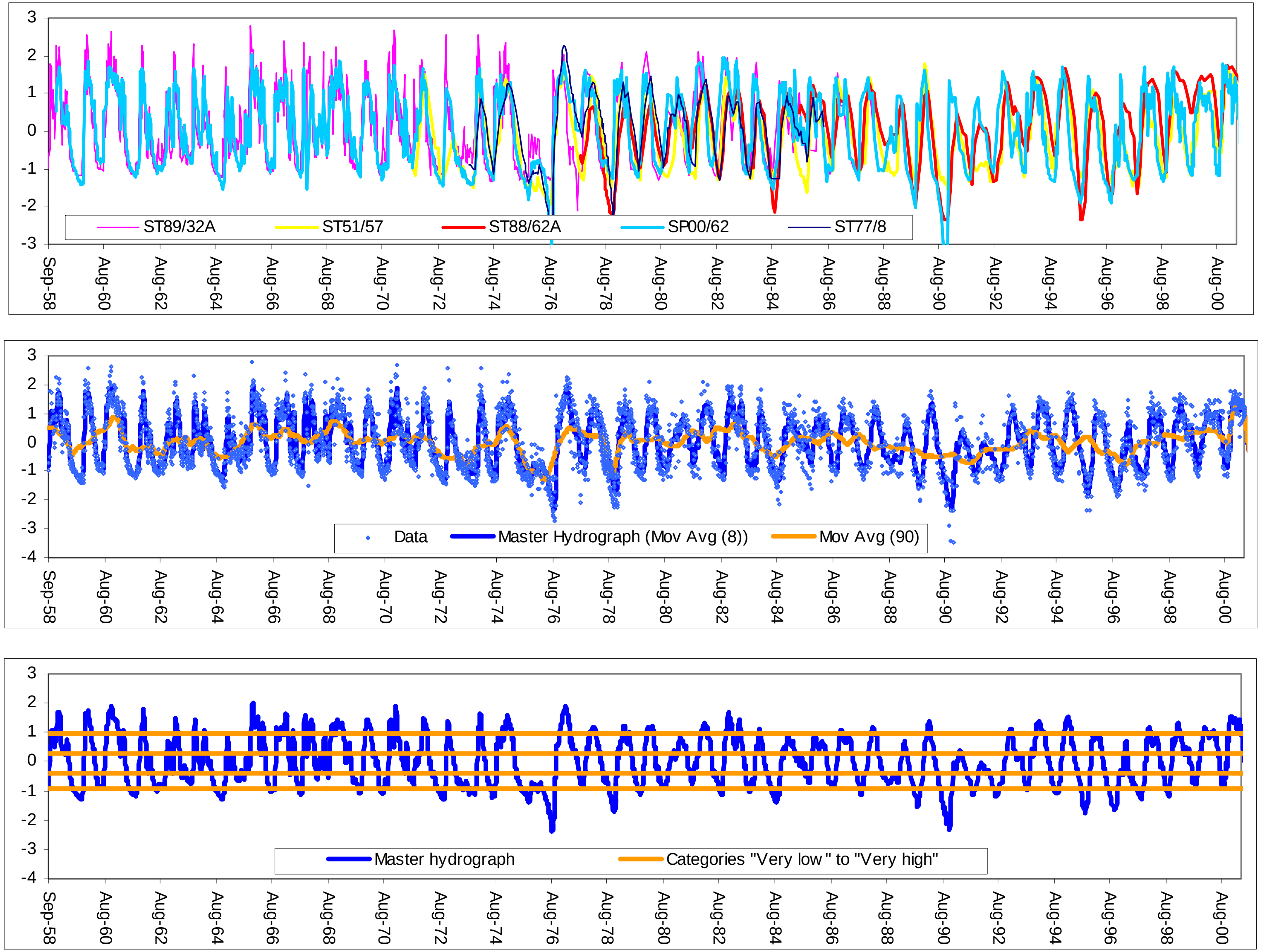


Figure 6.1 a) normalised water level data of the five records used to establish the master hydrograph for the Middle Jurassic aquifer; b) aggregated normalised water level data together with the master hydrograph, and moving averages smoothing line to show long term trends; c) master hydrograph and respective water level categories

Table 6.2 Summary statistics of the data used to produce the master hydrograph for the Middle Jurassic aquifers

Summary statistics - Master Hydrograph			
Aquifer:	Middle Jurassic		
Condition:	Master Hydrograph to be applied to all boreholes		
Boreholes		Master Hydrograph =	Mov. Average (8)
grouped together:		No of observations	4722
SP00/62		From	September-58
ST77/8		To	May-01
ST51/57		Median sample frequer	4 days
ST89/32A		Sample gaps > month	No
ST88/62A		Trend	no
		Seasonality	yes

Categories:	**Percentile**	**Value From**	**To**
Very high	80-100	0.959	2.002
High	60-80	0.284	0.958
Average	40-60	-0.403	0.283
Low	20-40	-0.896	-0.404
Very low	0-20	-2.369	-0.897

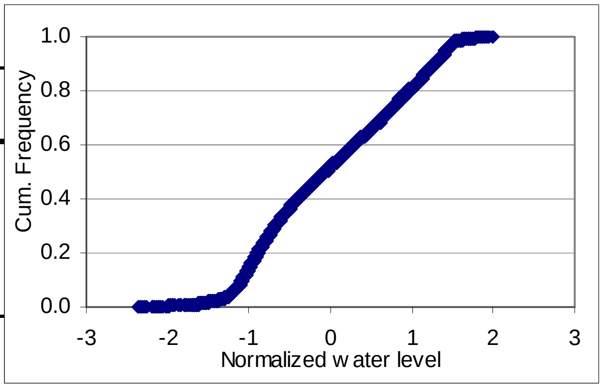


Figure 6.2 Categories used to tag monthly data of the master hydrograph

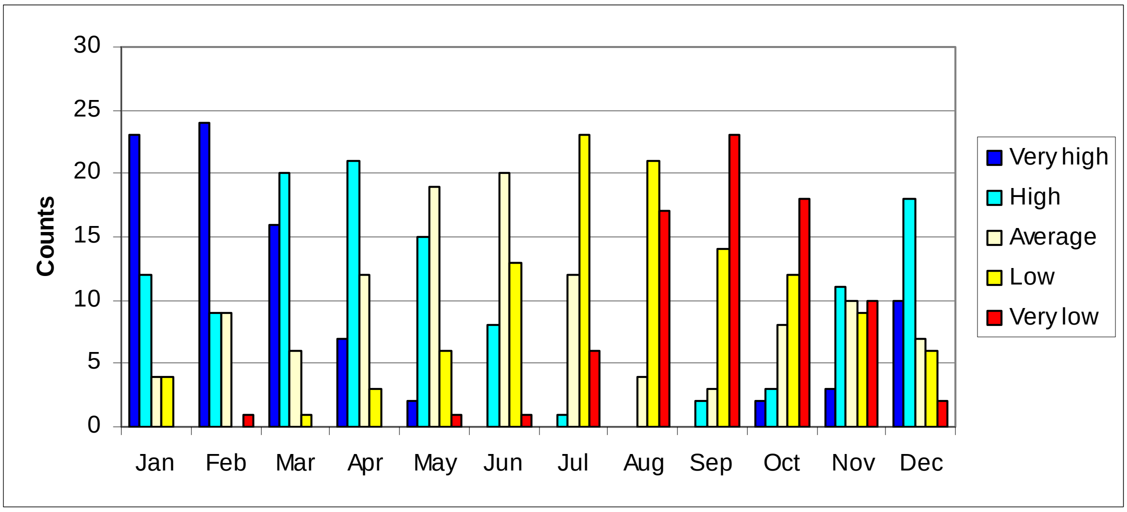


Figure 6.3 Frequency of water level categories per monthly period based on the developed monthly look-up table

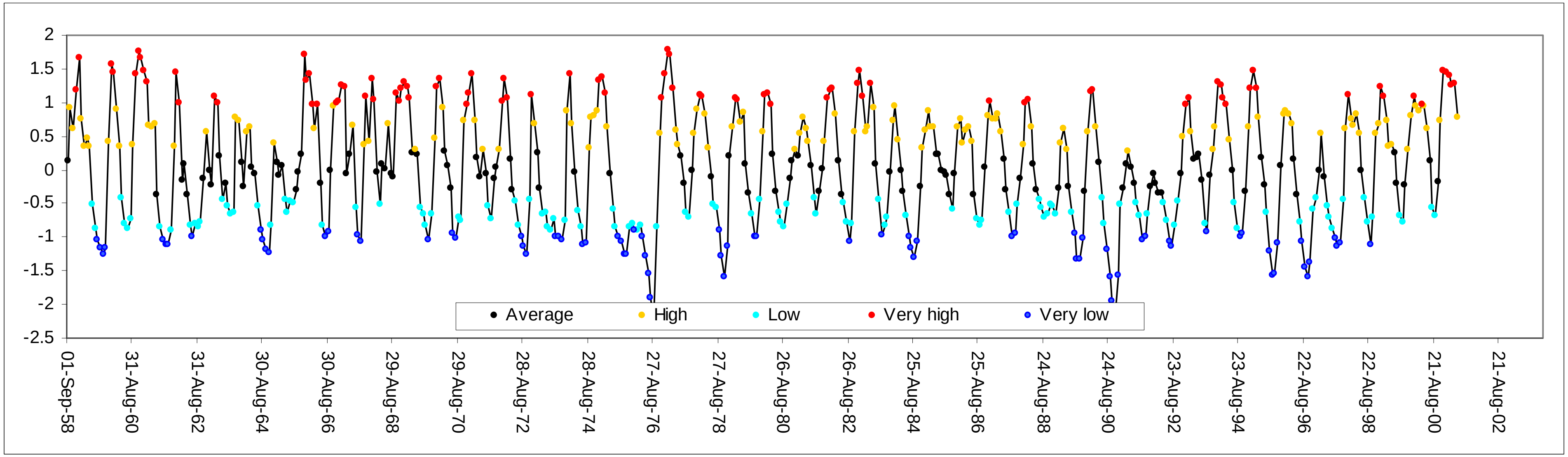


Figure 6.4 Master hydrograph for shallow the Middle Jurassic aquifers

7 Upper Jurassic

A total of 6 long term water level records are available for the Upper Jurassic aquifers. Basic statistics on the datasets is provided in Table 7.1. The raw data, together with a linear regression curve is provided in Appendix 4, as are the normalised datasets together with moving averages smoothing lines, the sampling frequency plots, the autocorrelation function plots and the master hydrograph look-up table.

Table 7.1 Summary statistics of long term hydrographs from the Upper Jurassic aquifers (water levels in m AOD)

	Min water level [m]	Max water level [m]	Mean water level [m]	Median water level [m]	Standard Dev.	No. Observation	Median sample frequency [d]	From	to	Depth of borehole [m]
SE98/23	31.91	35.86	33.04	32.85	0.85	201	28	27-Mar-80	19-Dec-01	35.00
SU49/75B	58.34	59.50	58.84	58.83	0.28	936	6	12-Jan-88	31-Dec-01	9.50
SE68/22E	37.70	41.34	38.65	38.41	0.77	296	28	20-Jan-75	17-Dec-01	24.30
SU49/40B	59.03	59.85	59.36	59.35	0.17	132	28	13-Sep-78	11-May-93	30.50
SE77/76	15.46	22.75	17.48	17.19	1.39	357	28	14-Apr-75	17-Dec-01	70.00
SE98/19	27.19	36.68	31.71	31.60	1.21	342	28	28-Apr-71	1-Apr-93	45.70

The median sample frequency of the available 6 long term hydrographs is monthly and weekly, respectively. Similar water level responses over time are observed for all 6 time series (Figure 7.1). Water levels show seasonality, but exhibit no long-term trend. The strong seasonal periodicity in water levels is displayed in the acf plots (Appendix 4). All boreholes, which span depths from 9.5 metres to 70 m, were aggregated into one group to produce one master hydrograph for the Upper Jurassic aquifers. The master hydrograph was established from March 1975 to December 2001.

Figure 7.1 shows:

(a) the normalised water level data of the five water level records used to establish the master hydrograph;

(b) the aggregated normalised water level data from 1975 to 2001 together with the master hydrograph. The master hydrograph is produced by averaging water levels over approximately monthly separations in time. The number of data points to be averaged in order to obtain a monthly time step is thereby calculated on the basis of the median sample frequency. A second moving average smoothing line is drawn, based on an approximately yearly separation in time to visualise long term trends.

(c) the master hydrograph, i.e. the monthly moving average smoothing line, and the respective threshold lines for the five categories in which water levels are being subdivided. These are calculated on the basis of the cumulative frequency plot of the master hydrograph. Water levels in the 0 to 20% category represent “very low” levels, data in the 20% to 40% category represent “low” levels, data in the 40 to 60% category represent “average” levels, data in the 60 to 80% category represent “high” levels and data in the 80% to 100% category represent “very high” levels.

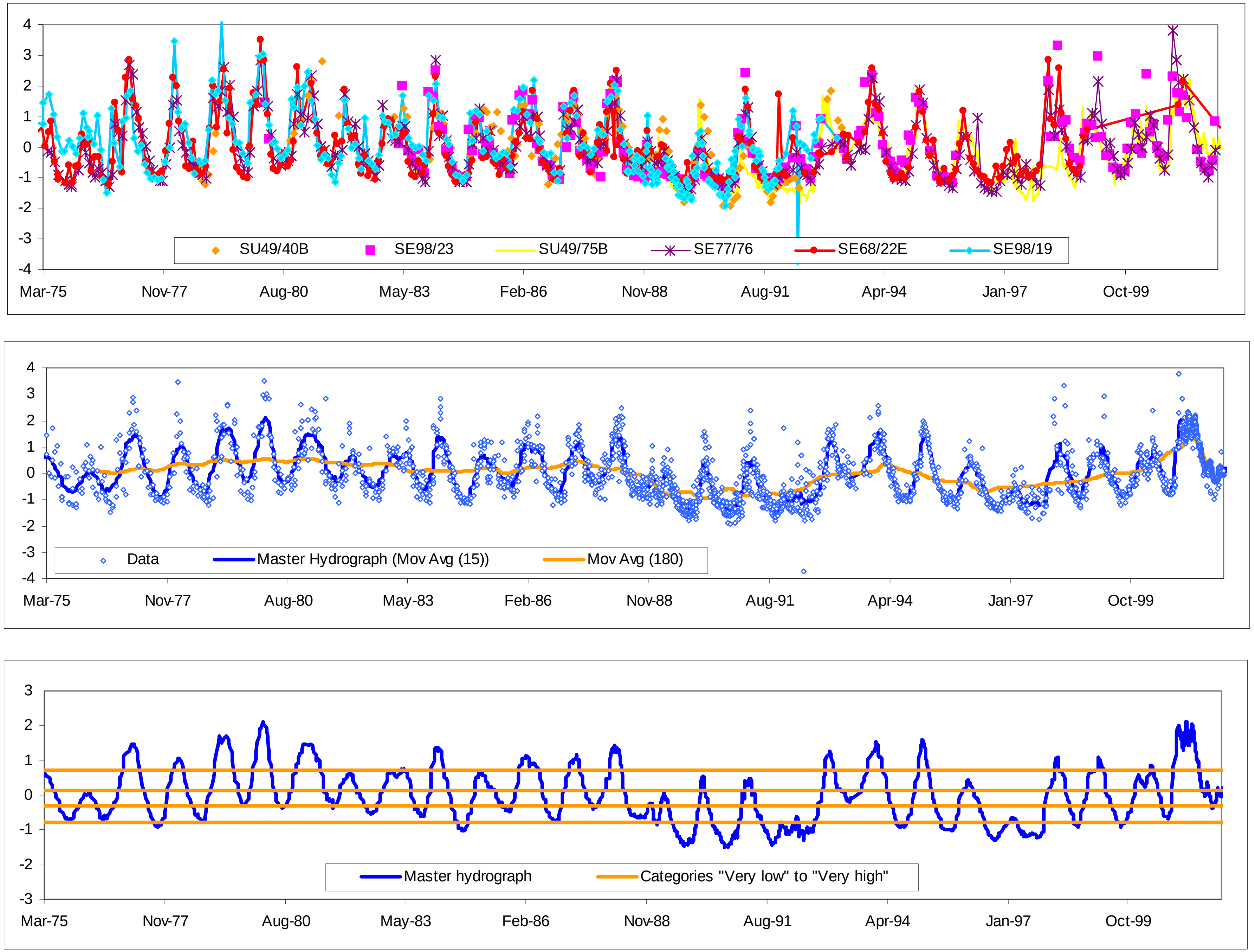


Figure 7.1 a) normalised water level data of the five records used to establish the master hydrograph for the Upper Jurassic aquifer; b) aggregated normalised water level data together with the master hydrograph, and moving averages smoothing line to show long term trends; c) master hydrograph and respective water level categories

Table 7.2 Summary statistics of the data used to produce the master hydrograph for the Upper Jurassic aquifers

Summary statistics - Master Hydrograph		
Aquifer:	Upper Jurassic	
Condition:	Master Hydrograph to be applied to all boreholes	
Boreholes	Master Hydrograph =	Mov. Avg. (15)
grouped together:	No of observations	2245
SE98/23	From	Mar/75
SU49/75B	To	Dec/01
SE68/22E	Median sample frequency	2 days
SU49/40B	Sample gaps > month	yes
SE77/76	Trend	no
SE98/19	Seasonality	yes

Water level categories:	**Percentile**	**normalized value From**	**To**
Very high	80-100	0.72	2.12
High	60-80	0.12	0.72
Average	40-60	-0.30	0.12
Low	20-40	-0.80	-0.30
Very low	0-20	-1.52	-0.80

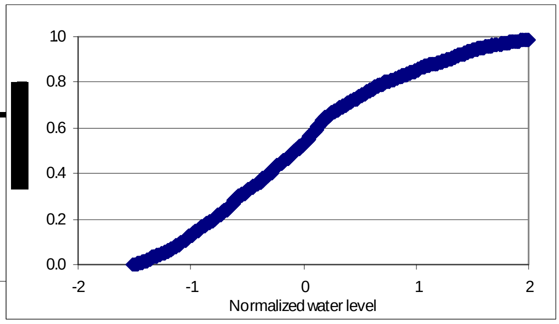


Figure 7.2 Categories used to tag monthly data of the master hydrograph

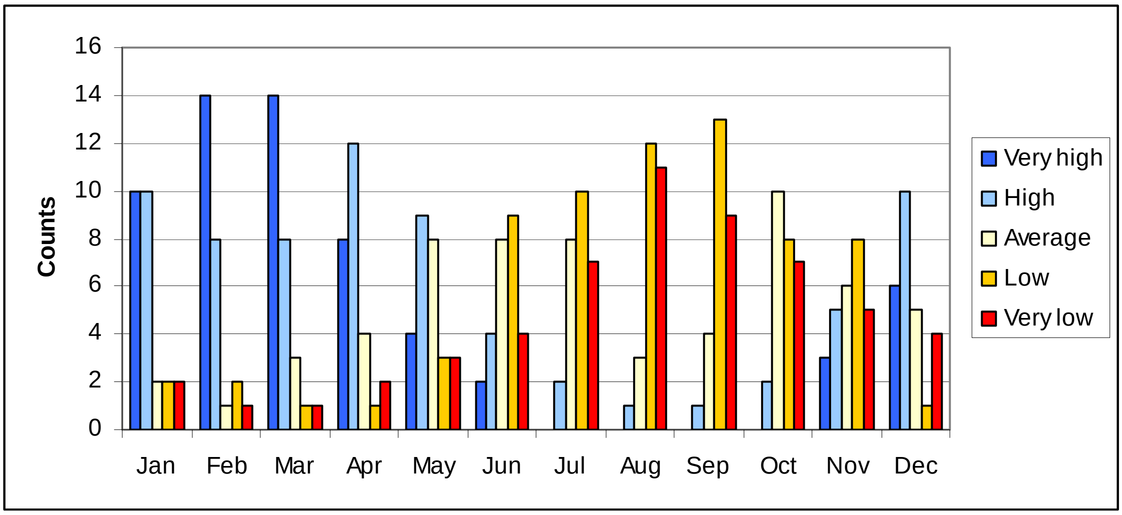


Figure 7.3 Frequency of water level categories per monthly period based on the developed monthly look-up table

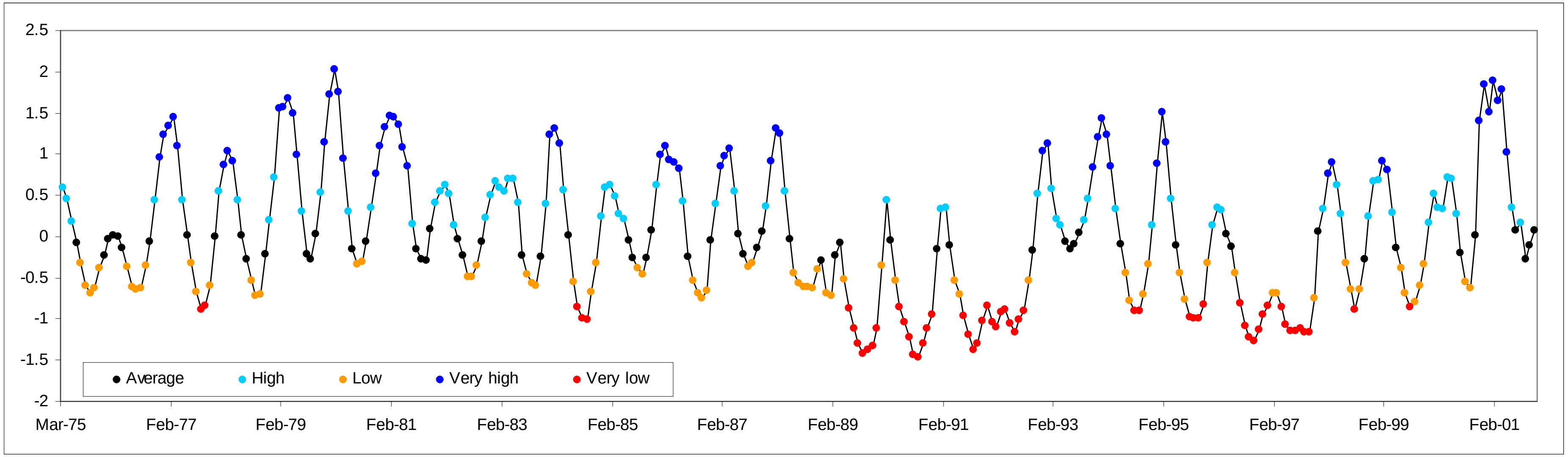


Figure 7.4 Master hydrograph for shallow the Upper Jurassic aquifers

8 Chalk –Hampshire and Wiltshire

A total of 17 long term water level records are available for the Chalk aquifer in Hampshire and Wiltshire. Basic statistics on the datasets is provided in Table 8.1. The raw data, together with a linear regression curve is provided in Appendix 5, as are the normalised datasets together with moving averages smoothing lines, the sampling frequency plots, the autocorrelation function plots and the master hydrograph look-up table.

Table 8.1 Summary statistics of long term hydrographs from the Chalk aquifer in Hampshire and Wiltshire (water levels in m AOD)

	Min water level [m]	Max water level [m]	Mean water level [m]	Median water level [m]	Standard Dev.	No. Observation	Median sample frequency [d]	From	to	Depth of boreholes [m]
SU61/28B	42.83	78.83	53.24	50.46	7.14	443	28	04-Feb-53	26-Mar-84	62.80
SU35/14	93.27	130.40	105.72	104.66	7.16	447	29.5	15-Mar-59	23-Oct-01	43.60
SU73/8	92.25	120.70	102.30	101.61	6.37	1434	7	01-May-66	25-Dec-01	28.30
SU04/2	78.25	99.59	87.80	87.36	6.25	461	11	21-Jan-66	10-Feb-89	21.72
SU01/5B	67.62	109.40	83.34	82.58	9.79	2049	7	12-Jan-42	31-Oct-04	45.10
SU61/46	33.39	76.54	43.31	42.28	6.33	638	28	25-Nov-52	14-Jun-99	111.20
SU51/10	39.87	45.20	42.61	42.48	1.08	340	28	23-Mar-65	11-Nov-93	121.90
SY68/34	63.10	71.52	67.78	67.86	2.26	1084	7	23-Feb-74	31-Oct-04	11.70
SU17/57	128.78	144.11	134.48	133.78	3.45	3612	7	26-Mar-33	02-Nov-04	17.60
SU32/3	32.67	66.63	40.63	39.10	5.59	1896	7	19-Feb-64	19-Dec-01	59.10
SU64/28	90.25	103.65	95.84	95.73	1.76	640	27	15-Oct-58	17-Dec-01	76.00
SU61/32	63.59	92.44	74.08	73.42	6.22	567	28	05-Nov-58	19-Dec-01	41.20
SU34/8A	72.33	90.40	81.03	81.19	2.93	1380	7	19-Mar-63	01-Dec-95	35.10
SU53/94	65.19	67.79	65.85	65.83	0.32	401	28	13-Apr-76	17-Dec-01	85.00
SU14/5C	84.59	91.61	87.29	87.07	1.60	121	28	10-Jan-67	09-Aug-78	183.80
SU34/8D	73.65	92.00	82.33	82.12	4.32	311	7	04-Jan-96	31-Dec-01	
SU51/1	43.88	48.90	45.03	44.69	1.13	163	32	23-Mar-65	18-Jul-01	49.40

The median sample frequency of the 17 long term hydrographs ranges from weekly to monthly. However, some of the sampling was quite irregular. Of the 17 hydrographs available, one was discarded (SU51/1). This showed a response that was anomalous compared with the other hydrographs, particularly during 1992 and 1998 (Appendix 5).

Similar water level responses over time are observed for the remaining 16 time series (Figure 8.1). Water levels show seasonality, and an underlying trend of relatively lower levels around the years 1973 and 1976, and from 1989 to 1992 and around 1997. Extreme high events are seen in the winters of 1993/94 and 2000/2001. Most show little or no long term trend, with the exception of borehole SU34/8D which exhibits a strong upward trend in water level. The acf plots for most boreholes reveal a strong seasonality with a periodicity of about 12 lags for boreholes with monthly median sample frequency and about 50 lags for boreholes with median weekly sample frequency, i.e. about one year. Sixteen boreholes, which span depths from 11.7 metres to 183.8 metres (no depth was available for SU34/8D), were aggregated into one group to produce one master hydrograph for the Chalk aquifer across Hampshire and Wiltshire. The master hydrograph was established from March 1953 to October 2004 and appears similar to the master hydrograph established for the Chalk in the South Downs (section 9).

Figure 8.1 shows:

(a) the normalised water level data of the 16 water level records used to establish the master hydrograph;

(b) the aggregated normalised water level data from 1953 to 2004 together with the master hydrograph. The master hydrograph is produced by averaging water levels over approximately monthly separations in time. The number of data points to be averaged in order to obtain a monthly time step is thereby calculated on the basis of the median sample frequency. A second moving average smoothing line is drawn, based on an approximately yearly separation in time to visualise long term trends.

(c) the master hydrograph, i.e. the monthly moving average smoothing line, and the respective threshold lines for the five categories in which water levels are being subdivided. These are calculated on the basis of the cumulative frequency plot of the master hydrograph. Water levels in the 0 to 20% category represent "very low" levels, data in the 20% to 40% category represent "low" levels, data in the 40 to 60% category represent "average" levels, data in the 60 to 80% category represent "high" levels and data in the 80% to 100% category represent "very high" levels.

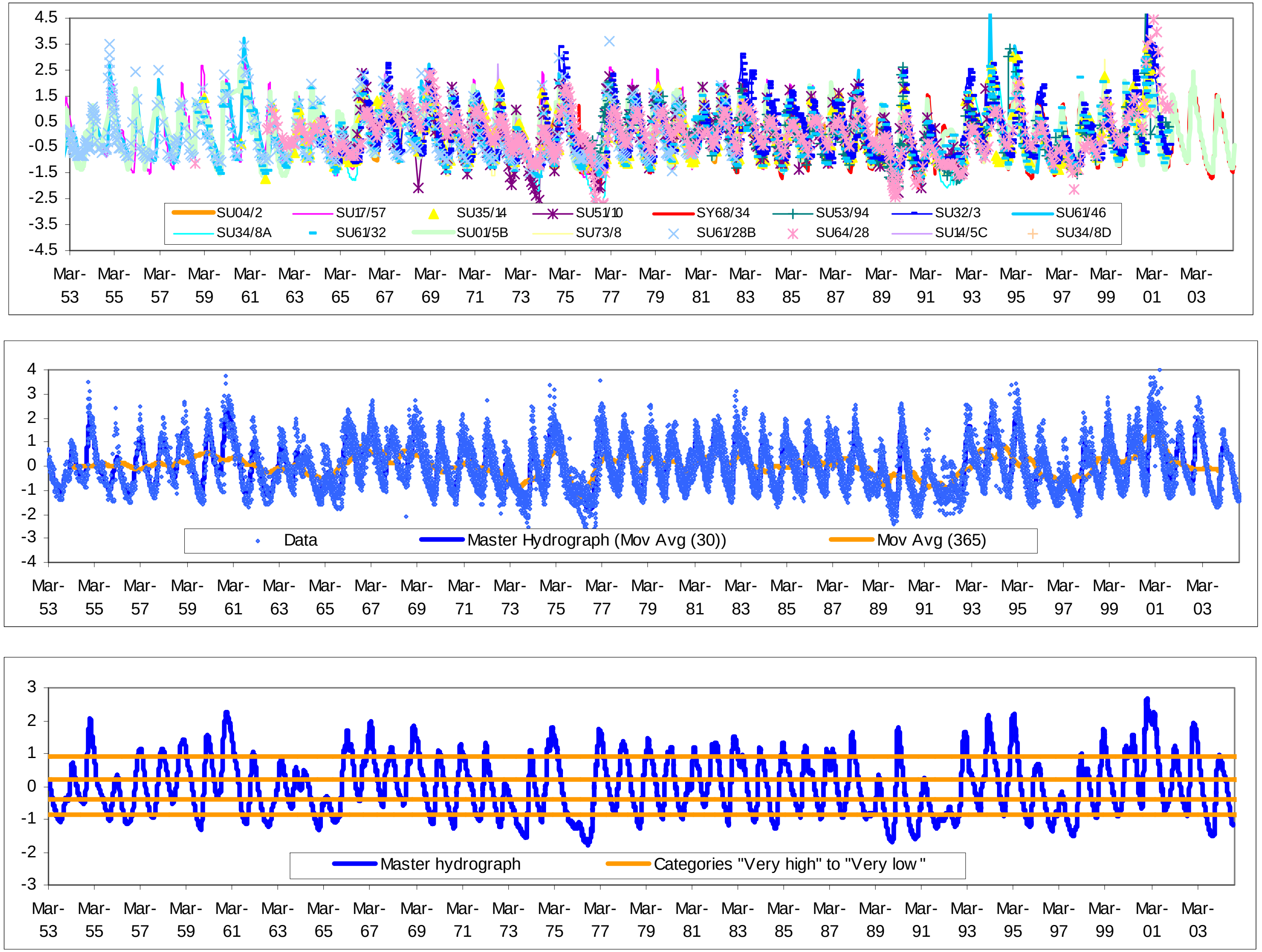


Figure 8.1 a) normalised water level data of the 16 records used to establish the master hydrograph for the Chalk aquifer in Hampshire and Wiltshire; b) aggregated normalised water level data together with the master hydrograph, and moving averages smoothing line to show long term trends; c) master hydrograph and respective water level categories

Table 8.2 Summary statistics of the data used to produce the master hydrograph for the Chalk aquifer in Hampshire and Wiltshire

Summary statistics - Master Hydrograph				
Aquifer:	Chalk - Hamshire and Wiltshire			
Condition:	Master Hydrograph to be applied to all boreholes			
Boreholes			Master Hydrograph	Mov Avg (30)
grouped together:			No of observations	14516
SU35/14	SY68/34	SU53/94	From	Mar-53
SU73/8	SU17/57	SU14/5C	To	Oct-04
SU04/2	SU32/3	SU34/8D	Median sample frequency	1 days
SU01/5B	SU64/28	SU61/28B	Sample gaps > month	no
SU61/46	SU61/32		Trend	no
SU51/10	SU34/8A		Seasonality	Yes

Water level categories:	Percentile	normalized value From	To
Very high	80-100	0.900	2.669
High	60-80	0.228	0.899
Average	40-60	-0.372	0.227
Low	20-40	-0.857	-0.373
Very low	0-20	-1.788	-0.858

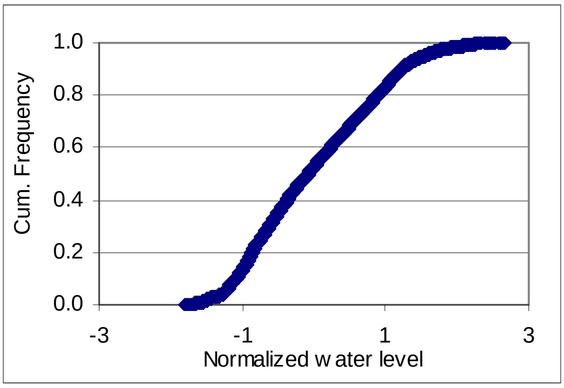


Figure 8.2 Categories used to tag monthly data of the master hydrograph

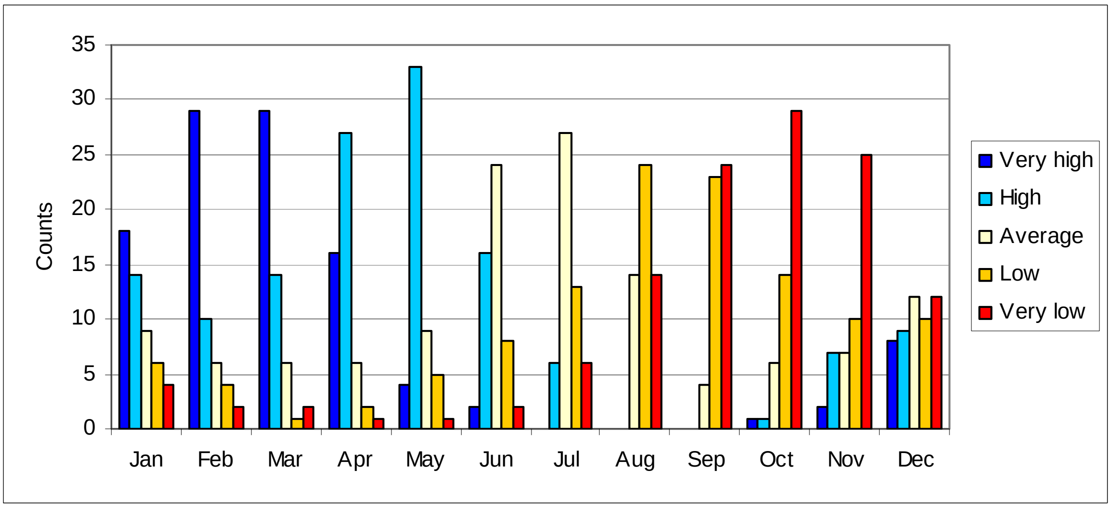


Figure 8.3 Frequency of water level categories per monthly period based on the developed monthly look-up table

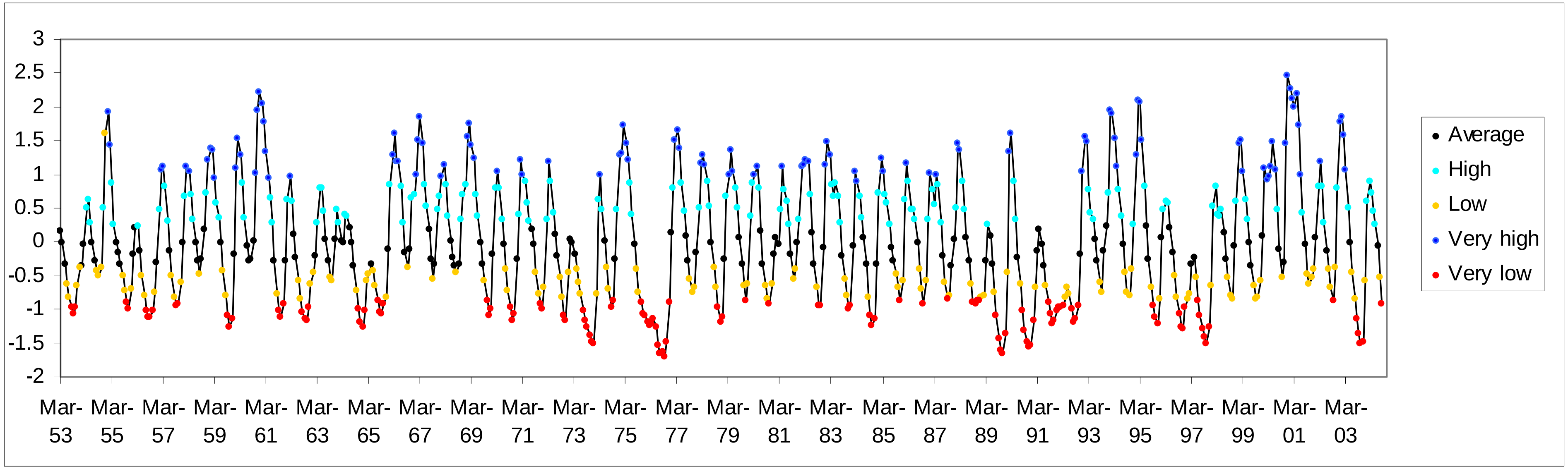


Figure 8.4 Master hydrograph for the Chalk aquifer in Hampshire and Wiltshire

9 Chalk – South Downs

A total of 9 long term water level records are available for the Chalk aquifer in the South Downs (taken to be the extent of the Chalk in East and West Sussex). Basic statistics on the datasets is provided in Table 9.1. The raw data, together with a linear regression curve is provided in Appendix 6, as are the normalised datasets together with moving averages smoothing lines, the sampling frequency plots, the autocorrelation function plots and the master hydrograph look-up table.

Table 9.1 Summary statistics of long term hydrographs from the Chalk aquifer in the South Downs(water levels in m AOD)

	Min water level [m]	Max water level [m]	Mean water level [m]	Median water level [m]	Standard Dev.	No. Observation	Median sample frequency [d]	From	to	Depth of boreholes [m]
TQ41/79	10.34	12.60	11.46	11.52	0.53	45	36.5	06-Oct-69	27-Sep-77	15.20
TQ31/50	58.59	100.80	73.72	71.45	7.45	231	31	09-Nov-79	27-Jun-02	149.96
TQ21/11A	68.68	83.34	72.49	71.73	2.12	576	28	23-Apr-58	27-Jun-02	39.10
TQ50/7	29.87	43.52	34.72	34.49	2.68	387	29	15-Oct-65	19-Dec-01	35.84
SU81/1	34.44	76.51	49.41	46.63	9.70	773	31	31-Jan-00	05-Nov-60	62.48
TV59/7C	1.01	5.03	1.82	1.67	0.52	2947	7	15-Apr-40	28-Nov-97	24.99
SU71/23	27.64	73.37	39.86	37.81	8.50	2510	7	31-Jan-00	31-Oct-04	53.85
TQ40/45B	0.10	5.28	1.14	0.97	0.64	329	31	30-Jan-70	21-Dec-01	66.75
TQ01/133	92.75	117.38	100.95	101.20	4.43	285	30	07-Jan-77	05-Jul-02	143.30

Of the original 9 boreholes, two were removed from analysis. TQ41/79 was not included due to the fact that it was located on Upper Greensand Formation to the north of the Chalk scarp slope. TQ21/11a was not included due to its water level response which was anomalous when compared to the other hydrographs: in particular, the hydrograph frequently seemed to reach a “base level”, when other hydrographs showed recessions for months afterwards. The non-normalised hydrograph shows that there is little response, with normal annual fluctuations being within a few metres, and the hydrograph usually responding then returning to its base level within 3 or 4 months.

The median sample frequency of the remaining 7 long term hydrographs was monthly, with the exception of TV59/7C which was weekly. Similar water level responses over time are observed for the remaining 7 time series (Figure 9.1). The acf plots for most boreholes reveal some seasonality with a periodicity of about 12 lags for boreholes with monthly median sample frequency and about 50 lags for boreholes with median weekly sample frequency, i.e. about one year. The acf’s for some boreholes (TQ21/11A, TQ31/50, SU71/23, and TQ 40/45B) suggest there is a year-on-year dependence in addition to the seasonal effect. The seven boreholes, which span depths from 24.99 metres to 149.96 metres, were aggregated into one group to produce one master hydrograph for the Chalk aquifer across the South Downs. The master hydrograph was established from January 1959 to October 2004 and appears reasonably similar to the master hydrograph established for the Chalk in the Hampshire and Wiltshire (see section 8). It is interesting to note that, although there are years when there is little or no recovery in water levels, the minimum winter level does not vary as much as in other areas; seasonality is more obvious than any long-term trend. As a result, the “Low” and “Very Low” water level limits are close (see Figure 9.1). This means that the drought years that are obvious in other master hydrographs are only notable by the lack of recovery, rather than a decline in minimum water level. These years include the winters of 1972/73, 1975/76, 1991/92, 1995/96 and 1996/97. In contrast, the high recharge winters are very apparent, including 1987/88, 1993/94, 1994/95 and 2000/01.

Figure 9.1 shows:

(a) the normalised water level data of the 7 water level records used to establish the master hydrograph;

(b) the aggregated normalised water level data from 1959 to 2004 together with the master hydrograph. The master hydrograph is produced by averaging water levels over approximately monthly separations in time. The number of data points to be averaged in order to obtain a monthly time step is thereby calculated on the basis of the median sample frequency. A second moving average smoothing line is drawn, based on an approximately yearly separation in time to visualise long term trends.

(c) the master hydrograph, i.e. the monthly moving average smoothing line, and the respective threshold lines for the five categories in which water levels are being subdivided. These are calculated on the basis of the cumulative frequency plot of the master hydrograph. Water levels in the 0 to 20% category represent “very low” levels, data in the 20% to 40% category represent “low” levels, data in the 40 to 60% category represent “average” levels, data in the 60 to 80% category represent “high” levels and data in the 80% to 100% category represent “very high” levels.

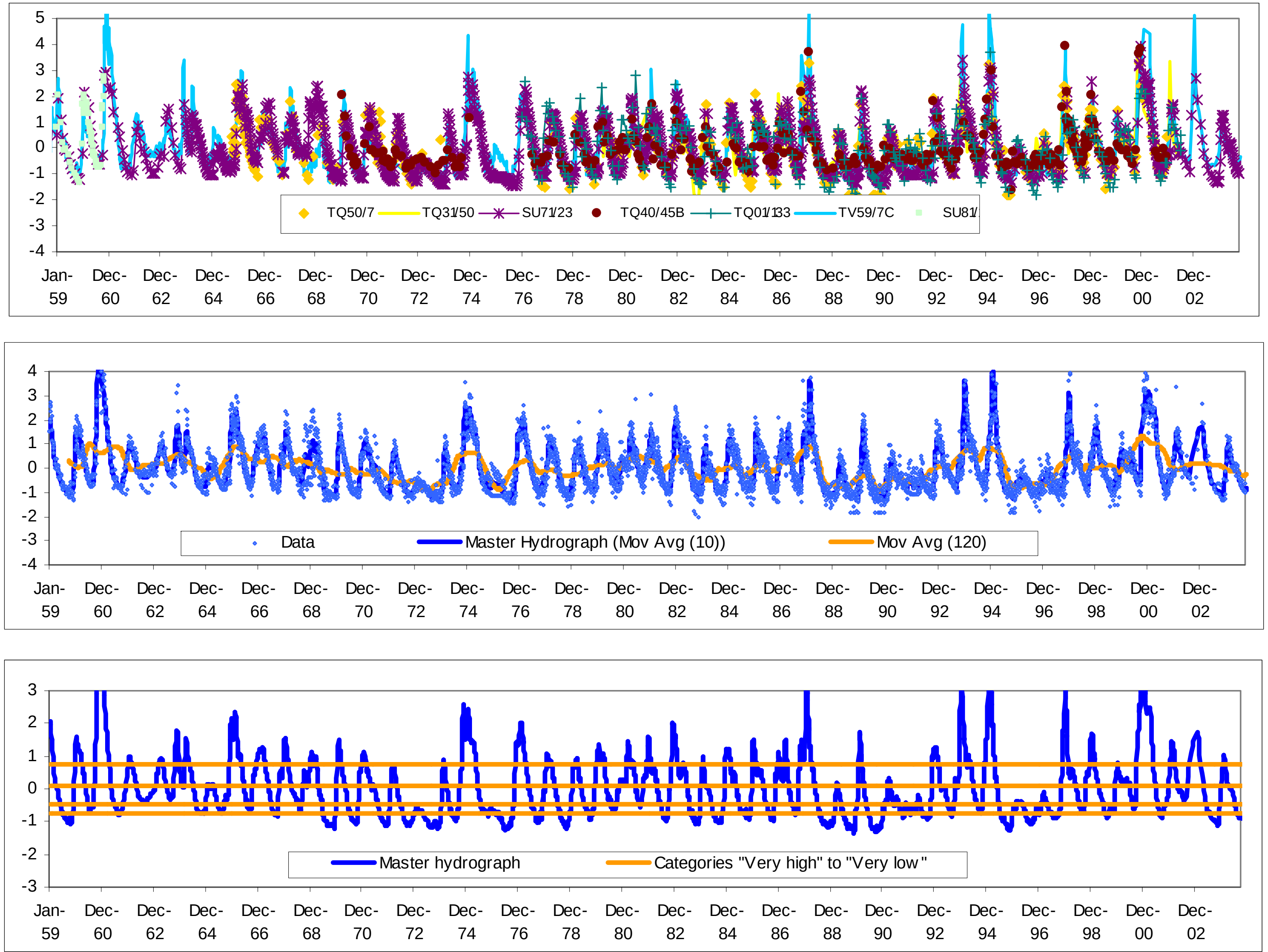


Figure 9.1 a) normalised water level data of the 7 records used to establish the master hydrograph for the Chalk aquifer in the South Downs; b) aggregated normalised water level data together with the master hydrograph, and moving averages smoothing line to show long term trends; c) master hydrograph and respective water level categories

Table 9.2 Summary statistics of the data used to produce the master hydrograph for the Chalk aquifer in the South Downs

Summary statistics - Master Hydrograph			
Aquifer:	Chalk - South Downs		
Condition:	Master Hydrograph to be applied to all boreholes		
Boreholes		Master Hydrograph	Mov Avg (10)
grouped together:		No of observations	5070
TQ31/50	TQ40/45B	From	Jan-59
TQ01/133		To	Oct-04
TQ50/7		Median sample frequency	3 days
SU81/1		Sample gaps > month	no
TV59/7C		Trend	no
SU71/23		Seasonality	Yes

Water level		**normalized value**	
categories:	**Percentile**	**From**	**To**
Very high	80-100	0.770	4.315
High	60-80	0.092	0.769
Average	40-60	-0.462	0.091
Low	20-40	-0.773	-0.463
Very low	0-20	-1.342	-0.774

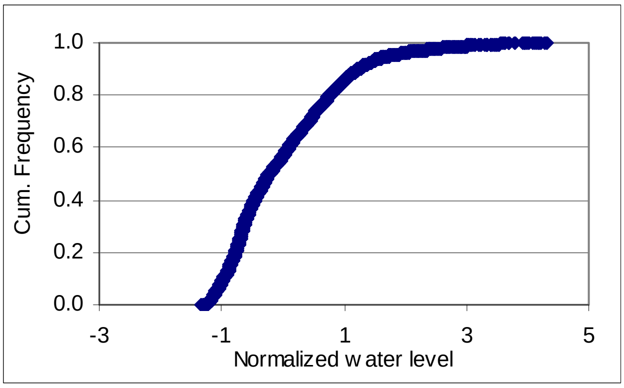


Figure 9.2 Categories used to tag monthly data of the master hydrograph

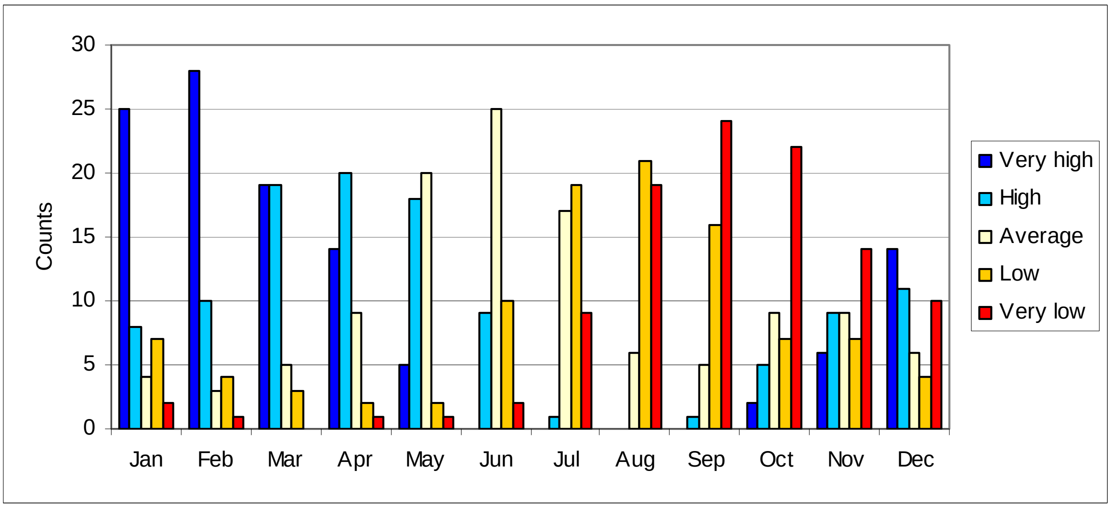


Figure 9.3 Frequency of water level categories per monthly period based on the developed monthly look-up table

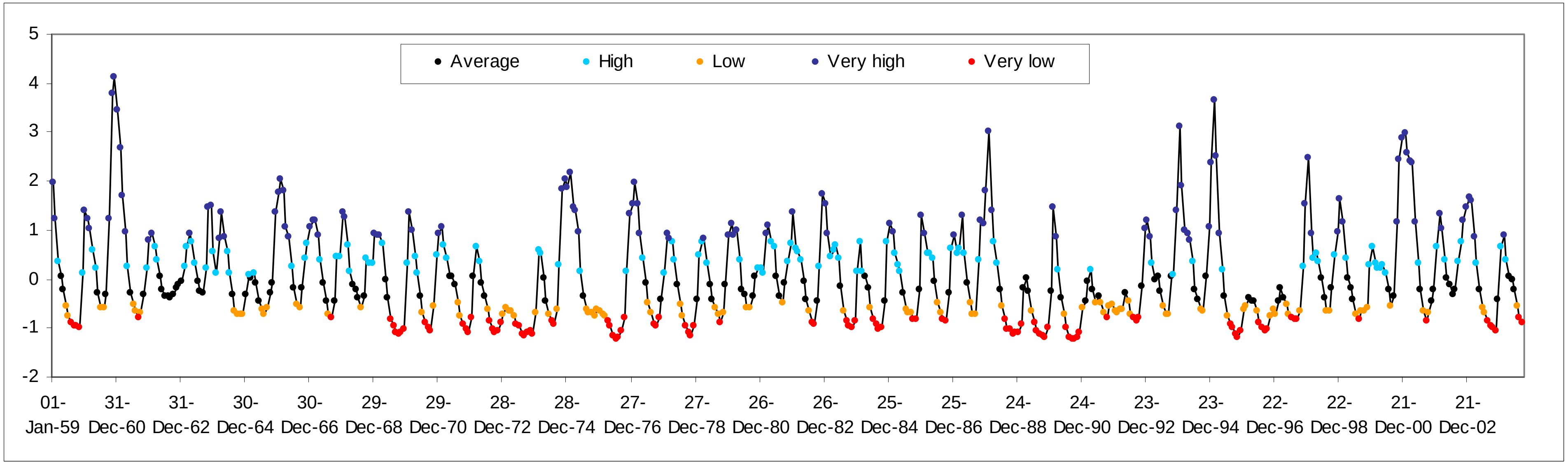


Figure 9.4 Master hydrograph for the Chalk aquifer in the South Downs

10 Chalk – Lincolnshire and Yorkshire

A total of 14 long term water level records are available for the Chalk aquifer in Lincolnshire and Yorkshire. Basic statistics on the datasets is provided in Table 10.1. The raw data, together with a linear regression curve is provided in Appendix 7, as are the normalised datasets together with moving averages smoothing lines, the sampling frequency plots, the autocorrelation function plots and the master hydrograph look-up table.

Table 10.1 Summary statistics of long term hydrographs from the Chalk aquifer in Lincolnshire and Yorkshire (water levels in m AOD)

	Min water level [m]	Max water level [m]	Mean water level [m]	Median water level [m]	Standard Dev.	No. Observation	Median sample frequency [d]	From	to	Depth of boreholes [m]
SE93/4	42.41	57.66	48.40	48.41	1.56	334	26	15-Jan-71	30-Dec-91	43.00
TA07/28	23.53	39.69	31.08	31.57	4.00	452	22	4-Mar-76	11-Nov-01	85.60
TA06/16	16.15	27.90	19.88	19.28	2.25	911	10	16-Aug-64	27-Dec-01	81.10
SE94/5	9.64	23.82	16.89	16.74	3.13	5540	7	1-Jan-00	11-Oct-04	28.50
TA10/40	4.53	25.15	13.38	13.32	3.89	1798	7	4-Jun-26	9-Jun-94	56.40
SE97/31	54.43	80.72	62.56	61.05	5.59	481	27	10-Oct-71	12-Dec-01	76.20
TA11/158	3.45	19.70	10.76	11.14	4.04	374	16	14-Feb-80	17-Jan-00	67.00
TF29/49	4.47	23.17	12.70	12.89	4.45	1051	7	28-Oct-77	17-Dec-01	84.00
SE95/6	16.66	37.37	21.83	20.71	3.51	755	14	10-Oct-71	11-Oct-04	45.72
TA10/63	5.65	22.12	13.78	14.31	4.46	975	7	18-Oct-78	7-Oct-04	101.47
TA10/36	11.16	33.56	19.27	17.96	5.19	1087	8	1-Jan-26	29-Dec-95	52.90
TA21/41A	0.73	2.15	1.22	1.12	0.33	347	29	20-Apr-71	18-Dec-01	49.00
TA10/6	8.67	33.89	16.10	15.20	4.52	1796	7	2-Jan-29	14-Dec-00	74.70
TF29/20	1.63	7.94	4.77	4.78	1.49	246	29	30-Jul-75	3-Nov-95	19.00

The median sample frequency of the 14 long term hydrographs ranges from weekly to monthly. Gaps of several years are present in several time series (Appendix 7). Of the 14 hydrographs available, two were discarded (SE93/4 and TA 10/36). SE93/4 shows a consistent seasonal pattern in water levels from 1979 onwards, however, before 1979 water levels change rapidly and appear to be influenced by local hydrogeological conditions, possibly pumping. The same accounts for TA10/36, which also displays unique changes in water levels not repeated in any other borehole.

Similar water level responses over time are observed for the remaining 12 time series (Figure 10.1). Water levels show seasonality, and an underlying trend of relatively lower levels around the years 1973 and 1976, and from 1989 to 1992 and around 1997. This is observed for deep as well as shallow boreholes. The acf plots reveal for several boreholes strong seasonality with a periodicity of about 12 lags for boreholes with monthly median sample frequency and about 50 lags for boreholes with median weekly sample frequency, i.e. about one year. The twelve boreholes, which span depths from 19.0 metres to 101.5 metres, were aggregated into one group to produce one master hydrograph for the Chalk aquifer in Lincolnshire and Yorkshire. The master hydrograph was established from February 1965 to July 2004 and appears similar to the master hydrograph established for the Chalk in the Berkshire Downs and East Anglia (see section 11).

Figure 10.1 shows:

(a) the normalised water level data of the nine water level records used to establish the master hydrograph;

(b) the aggregated normalised water level data from 1965 to 2004 together with the master hydrograph. The master hydrograph is produced by averaging water levels over approximately monthly separations in time. The number of data points to be averaged in order to obtain a monthly time step is thereby calculated on the basis of the median sample frequency. A second moving average smoothing line is drawn, based on an approximately yearly separation in time to visualise long term trends.

(c) the master hydrograph, i.e. the monthly moving average smoothing line, and the respective threshold lines for the five categories in which water levels are being subdivided. These are calculated on the basis of the cumulative frequency plot of the master hydrograph. Water levels in the 0 to 20% category represent “very low” levels, data in the 20% to 40% category represent “low” levels, data in the 40 to 60% category represent “average” levels, data in the 60 to 80% category represent “high” levels and data in the 80% to 100% category represent “very high” levels.

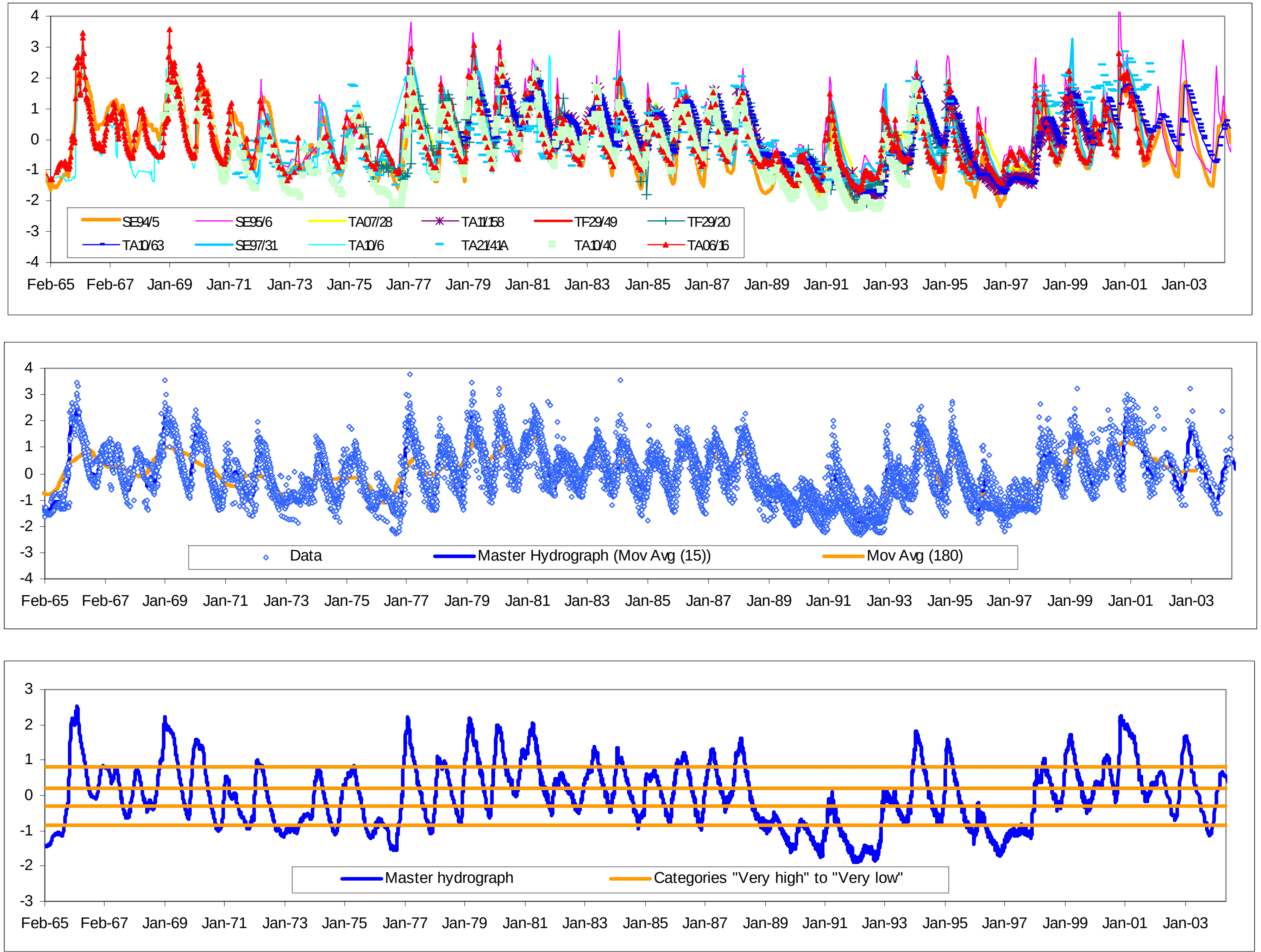


Figure 10.1 a) normalised water level data of the 12 records used to establish the master hydrograph for the Chalk aquifer in Lincolnshire and Yorkshire; b) aggregated normalised water level data together with the master hydrograph, and moving averages smoothing line to show long term trends; c) master hydrograph and respective water level categories

Table 10.2 Summary statistics of the data used to produce the master hydrograph for the Chalk aquifer in Lincolnshire and Yorkshire

Summary statistics - Master Hydrograph

Aquifer: Chalk - Lincolnshire and Yorkshire
Condition: Master Hydrograph to be applied to all boreholes

Boreholes grouped together:		Master Hydrograph	Mov Avg (15)
		No of observations	14725
TA07/28	TF29/49	From	Feb-65
TA06/16	SE95/6	To	Jul-04
SE94/5	TA10/63	Median sample frequency	2 days
TA10/40	TA21/41A	Sample gaps > month	no
SE97/31	TA10/6	Trend	yes
TA11/158	TF29/20	Seasonality	Yes

Water level categories:	Percentile	normalized value From	To
Very high	80-100	0.810	2.649
High	60-80	0.199	0.809
Average	40-60	-0.315	0.198
Low	20-40	-0.828	-0.316
Very low	0-20	-1.897	-0.829

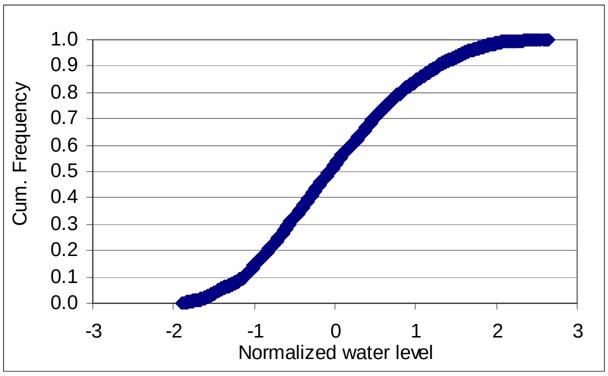


Figure 10.2 Categories used to tag monthly data of the master hydrograph

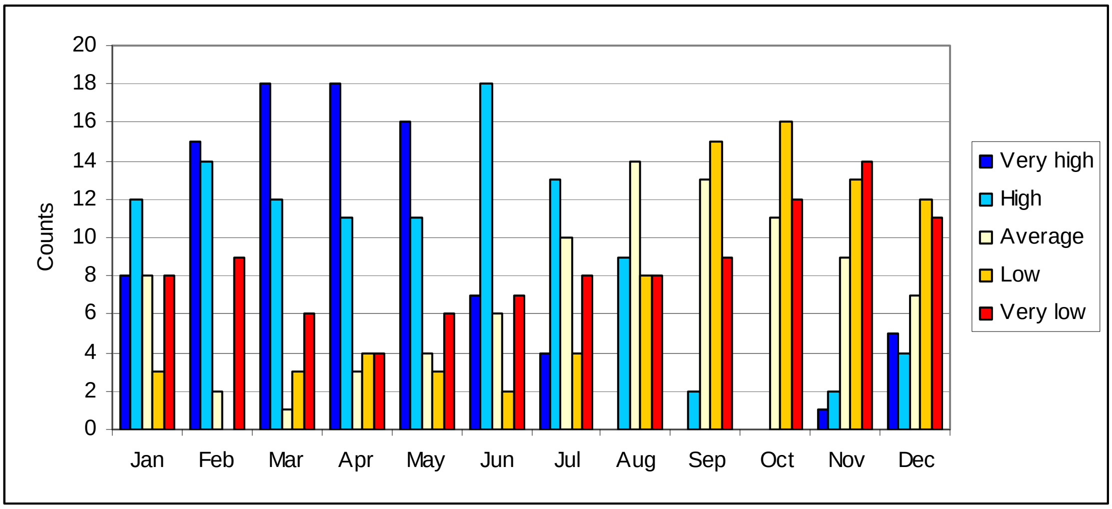


Figure 10.3 Frequency of water level categories per monthly period based on the developed monthly look-up table

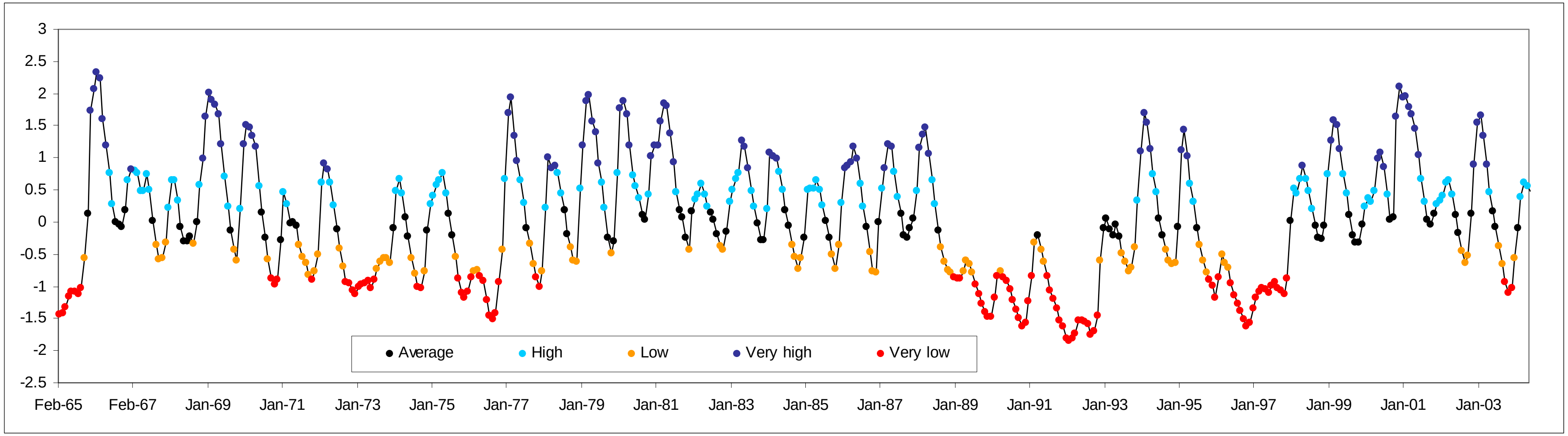


Figure 10.4 Master hydrograph for the Chalk aquifer in Lincolnshire and Yorkshire

11 Chalk – Berkshire Downs and East Anglia

A total of 52 long term water level records are available for the Chalk aquifer stretching from the Berkshire Downs to East Anglia. Due to time constraints, it was not possible to include all records in the statistical evaluation, but 10 records were selected randomly from the entire set. The geographic distribution of these, and location of the remaining boreholes, is shown in Figure 11.1. The area is widely covered with superficial deposits, and 7 out of the 10 boreholes sampled are located on superficial drift. As discussed below, this appears to have little influence on the hydrograph characteristics. Basic statistics on the selected dataset is provided in Table 11.1. The raw data, together with a linear regression curve is provided in Appendix 8, as are the normalised datasets together with moving averages smoothing lines, the sampling frequency plots, the autocorrelation function plots and the master hydrograph look-up table.

Table 11.1 Summary statistics of long term hydrographs from the Chalk aquifer in Berkshire and East Anglia Downs (water levels in m AOD)

	Min water level [m]	Max water level [m]	Mean water level [m]	Median water level [m]	Standard Dev.	No. Observation	Median sample frequency [d]	From	to	Depth of borehole [m]
TL66/2	20.62	35.22	25.48	25.16	3.24	740	7	15-Mar-64	8-Sep-88	64.6
TL84/6	25.21	29.17	26.34	26.17	0.75	1955	7	7-May-63	5-Dec-01	30.1
TF80/33	30.64	43.29	34.94	34.82	1.57	343	31	1-Feb-71	18-Apr-02	40.0
TM26/95	26.51	27.42	26.90	26.89	0.18	293	30	21-May-74	7-Nov-01	45.7
TL33/4	70.69	99.05	79.57	79.16	5.68	1648	30	1-Jan-00	2-Nov-04	83.2
TL11/9	83.87	92.41	87.44	87.29	1.95	1048	7	18-Aug-64	14-Aug-00	80.8
TG12/7	40.08	42.62	41.43	41.50	0.53	310	30	31-May-74	5-Apr-01	61.0
TL42/8	33.10	74.14	56.26	68.42	17.41	936	7	2-Jul-64	31-Dec-01	37.2
SU68/49	54.27	77.38	68.78	69.45	5.15	1492	7	24-Oct-76	31-Dec-01	63.5
SU17/57	128.59	144.38	134.48	133.68	3.45	3612	7	26-Mar-33	2-Nov-04	17.6

The median sample frequency of the randomly selected 10 long term hydrographs is monthly or weekly. Similar water level responses over time are observed for all 10 time series (Figure 11.2), however the water level record from borehole TL42/8 appears to contain faulty data and the series was discarded (Appendix 8). Water levels show seasonality, and an underlying trend of relatively lower levels around the years 1973, 1991 and 1997. This is observed for deep as well as shallow boreholes. The shallowest borehole (SU17/57) reveals the strongest seasonality, with the autocorrelation function plots (ACF) showing a periodicity of about 50 to 60 lags, which equates, based on the median sample frequency, to one year (Appendix 8). The nine boreholes, which span depths from 17.6 metres to 83.2 metres, were aggregated into one group to produce one master hydrograph for the Chalk aquifer of the Berkshire Downs and East Anglia. The master hydrograph was established from November 1963 to April 2002.

Figure 11.2 shows:

(a) the normalised water level data of the nine water level records used to establish the master hydrograph;

(b) the aggregated normalised water level data from 1963 to 2002 together with the master hydrograph. The master hydrograph is produced by averaging water levels over approximately monthly separations in time. The number of data points to be averaged in order to obtain a monthly time step is thereby calculated on the basis of the median sample frequency. A second moving average smoothing line is drawn, based on an approximately yearly separation in time to visualise long term trends.

(c) the master hydrograph, i.e. the monthly moving average smoothing line, and the respective threshold lines for the five categories in which water levels are being subdivided. These are calculated on the basis of the cumulative frequency plot of the master hydrograph. Water levels in the 0 to 20% category represent "very low" levels, data in the 20% to 40% category represent "low" levels, data in the 40 to 60% category represent "average" levels, data in the 60 to 80% category represent "high" levels and data in the 80% to 100% category represent "very high" levels.

As due to time constrains within this study, only ten randomly selected hydrographs could be investigated, it is deemed advisable to examine the remaining long-term hydrographs in any future study.

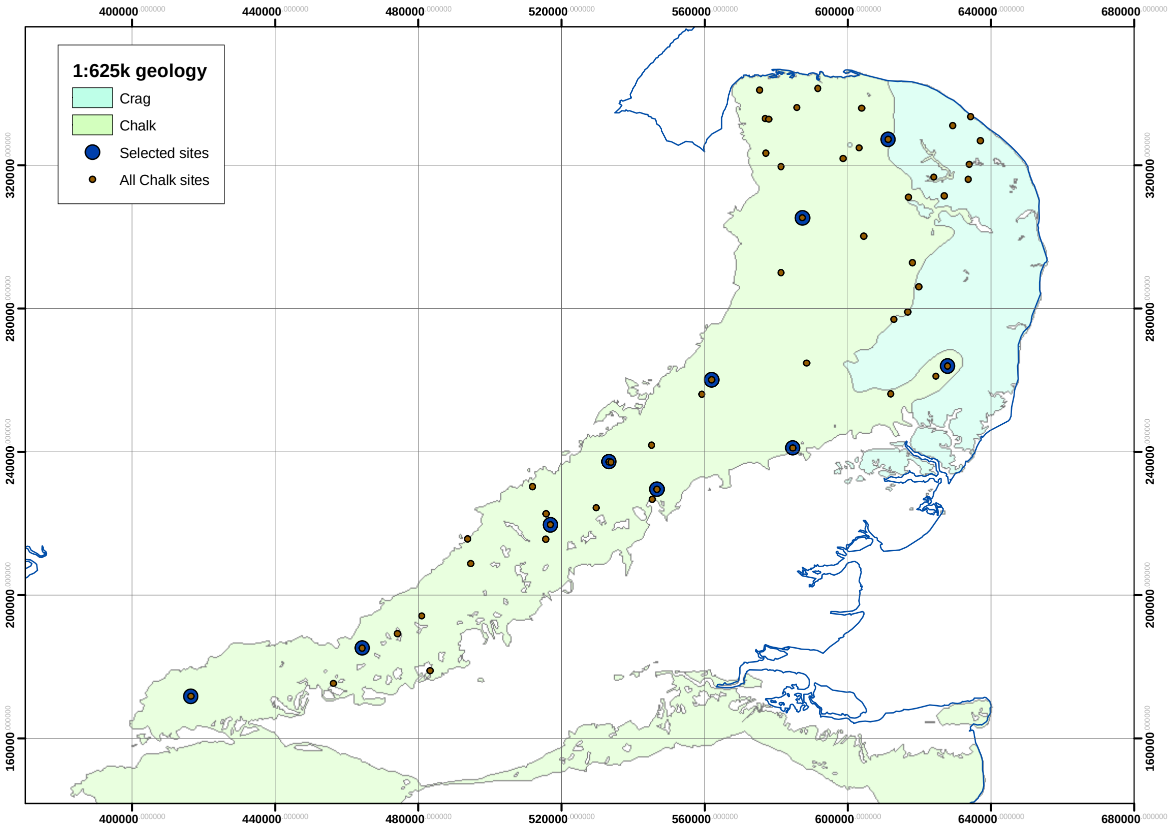


Figure 11.1 Location of randomly selected sites for the Chalk of the Berkshire Downs and East Anglia

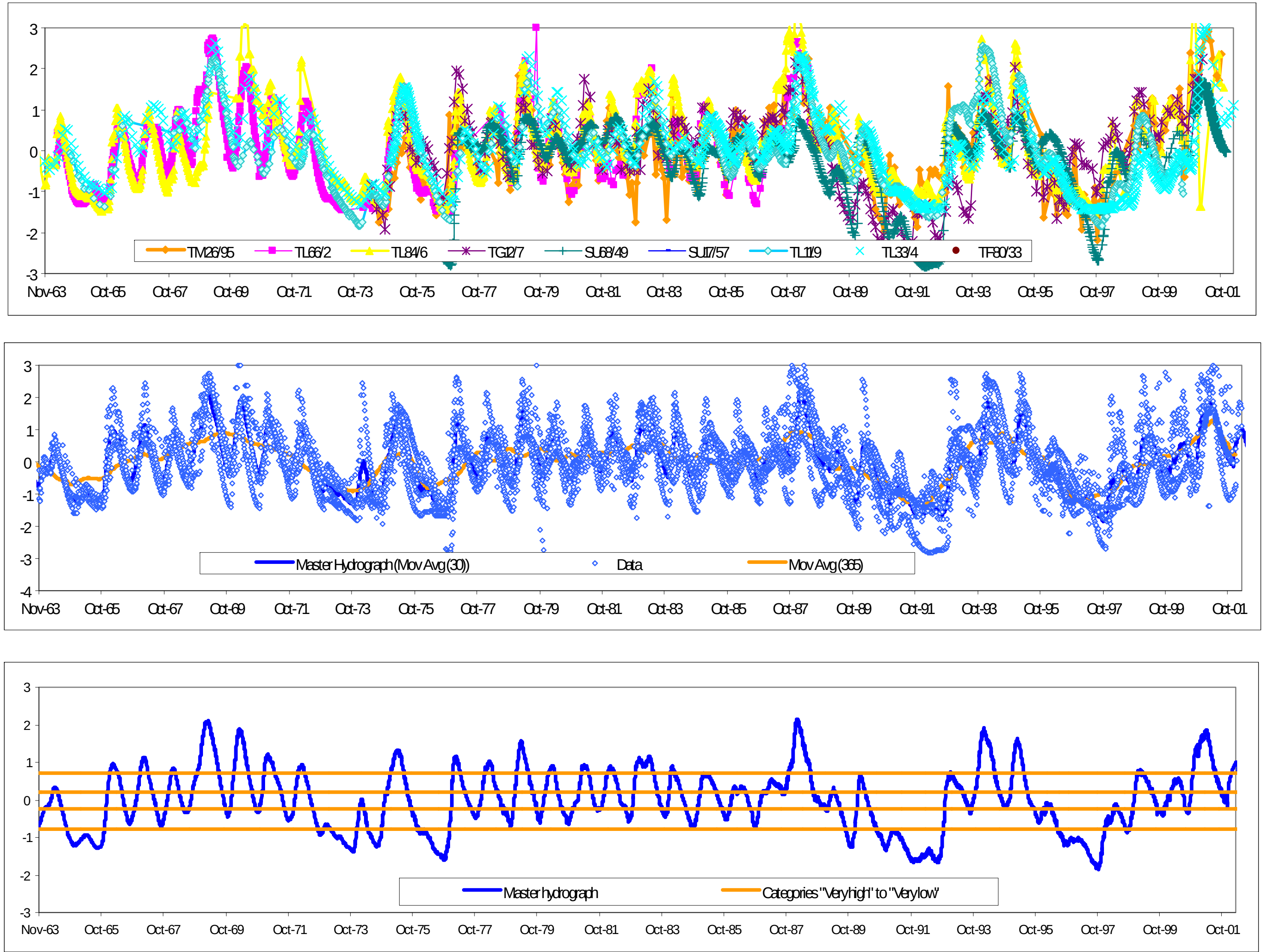


Figure 11.2 a) normalised water level data of the nine records used to establish the master hydrograph for the Chalk aquifer in the Berkshire Downs and East Anglia; b) aggregated normalised water level data together with the master hydrograph, and moving averages smoothing line to show long term trends; c) master hydrograph and respective water level categories

Table 11.2 Summary statistics of the data used to produce the master hydrograph for the Chalk aquifer of the Berkshire Downs and East Anglia

Summary statistics - Master Hydrograph

Aquifer: Chalk · Berkshire and East Anglia
Condition: Master Hydrograph to be applied to all boreholes

Boreholes		Master Hydrograph	Mov Avg (30)
grouped together:		No of observations	11439
TL66/2	TG12/7	From	Nov-63
TL84/6	SU68/49	To	Apr-02
TF80/33	SU17/57	Median sample frequency	1 day
TM26/95		Sample gaps >month	no
TL33/4		Trend	yes
TL11/9		Seasonality	yes

Water level categories:	Percentile	normalized value From	normalized value To
Very high	80-100	0.719	2.765
High	60-80	0.194	0.718
Average	40-60	-0.243	0.193
Low	20-40	-0.771	-0.244
Very low	0-20	-1.851	-0.772

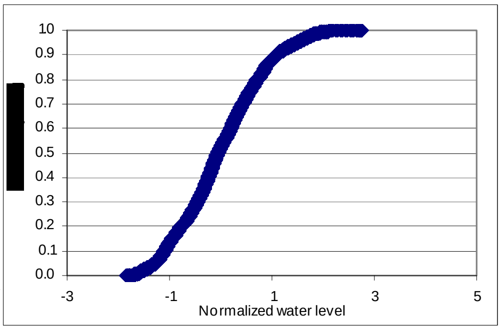


Figure 11.3 Categories used to tag monthly data of the master hydrograph

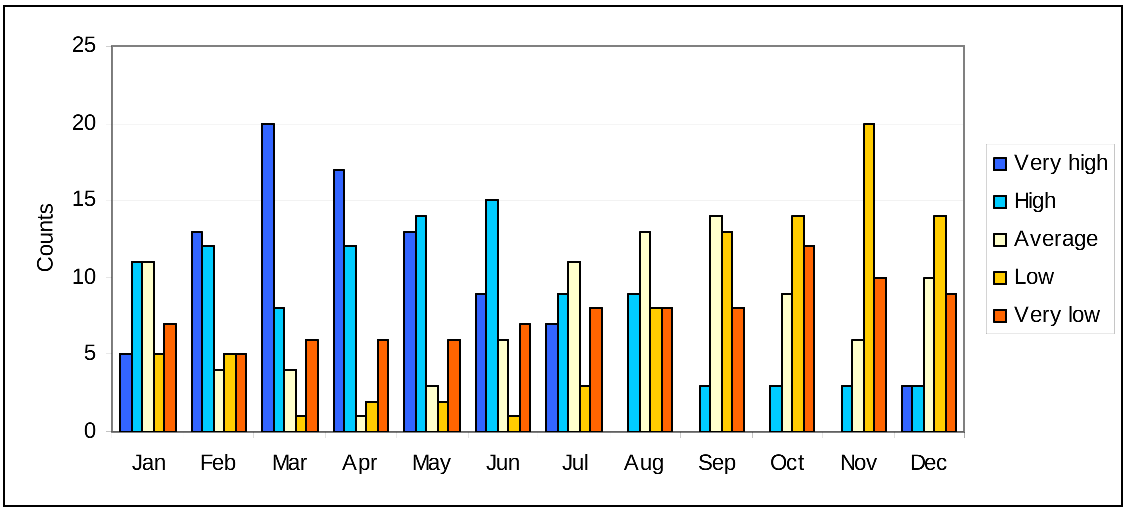


Figure 11.4 Frequency of water level categories per monthly period based on the developed monthly look-up table

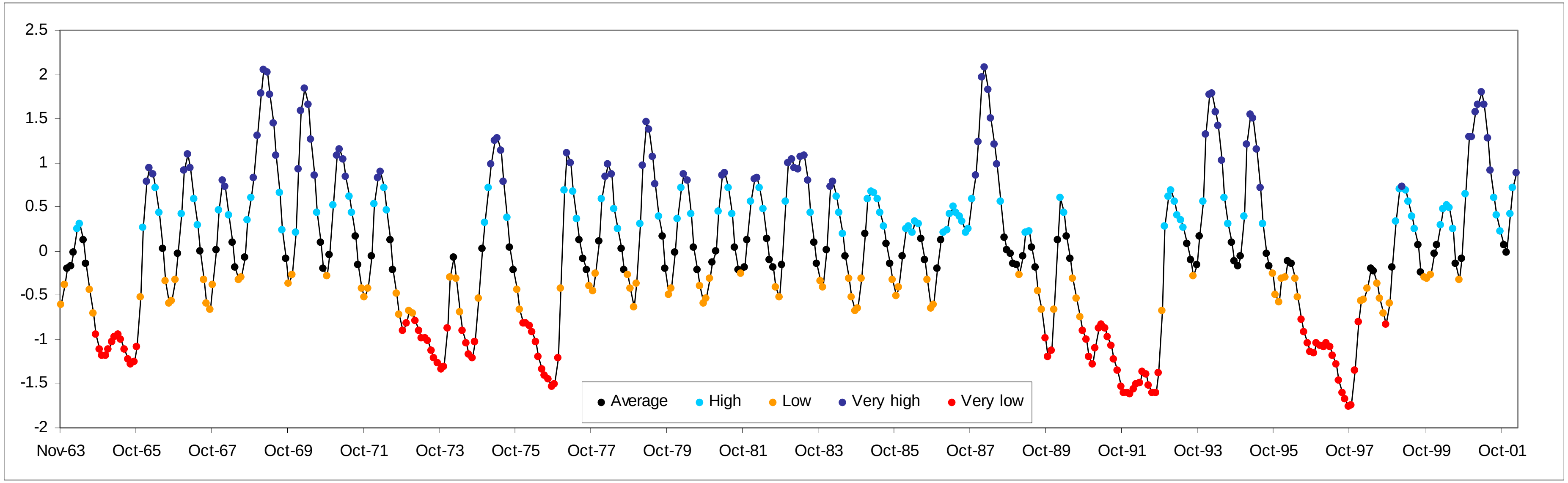


Figure 11.5 Master hydrograph for the Chalk aquifer of the Berkshire Downs and East Anglia

12 Chalk – North Downs

A total of 16 long-term water level records are available for the Chalk aquifer in the North Downs. Basic statistics on the datasets is provided in Table 12.1.

Table 12.1 Summary statistics of long term hydrographs from the Chalk of the North Downs (water levels in m AOD)

	Min water level [m	Max water level [m	Mean water level [m	Median water level [m	Standard Dev.	No. Observation	From	to	Depth of borehole [m]
TQ35/5	60.81	87.50	78.65	79.49	6.97	1295.00	16-May-1876	19-Dec-02	27.00
TQ56/19	79.95	102.95	85.02	84.76	2.31	779.00	20-Apr-61	23-May-02	90.50
TR34/81	17.24	23.68	20.07	19.60	1.28	185.00	6-May-71	14-Oct-88	62.25
TR15/58	38.87	54.16	47.16	47.29	4.35	181.00	6-Aug-70	22-Apr-87	19.90
TR05/6	4.12	10.13	6.24	6.06	1.50	107.00	30-Jun-70	18-Jan-82	34.00
TR14/42	89.32	111.78	95.69	93.91	5.57	157.00	8-Jan-71	28-Oct-86	82.30
TR24/13	24.22	33.44	28.83	29.13	2.18	158.00	2-Mar-64	6-Sep-77	38.30
TR36/62	2.05	8.01	3.57	3.34	1.01	537.00	4-Nov-69	14-Feb-02	43.10
TQ86/55	24.83	40.88	32.04	31.60	3.84	183.00	23-Feb-65	8-Jul-85	51.80
TQ66/48	23.56	26.86	24.98	24.95	0.64	247.00	27-Aug-68	6-Aug-89	68.90
TR05/11	10.03	19.71	13.54	13.80	1.92	195.00	27-Jan-64	21-Jun-88	40.23
TR14/50	83.02	99.51	93.71	93.84	2.51	265.00	2-Oct-70	29-Apr-02	15.60
TR35/49	8.67	13.45	10.32	10.19	1.13	167.00	5-Jan-71	13-Jan-94	10.96
TR14/9	56.77	87.16	68.48	67.74	7.40	859.00	7-Jan-71	31-Oct-04	31.33
TR24/36	30.48	53.42	35.56	33.12	4.67	261.00	5-Feb-71	22-Mar-02	109.72
TQ86/44	22.33	45.57	27.79	27.55	4.59	337.00	20-Jul-82	13-May-02	56.00

The North Downs Chalk long term hydrographs all show some degree of seasonality. However, in contrast to all other Chalk regions examined during this study (except for the London Basin) their water level responses are generally quite diverse. Of the 16 available hydrographs, six show a reasonably similar water level response over time (Figure 12.1). On the other hand, the majority, i.e. ten hydrographs exhibit unique water level responses not mirrored in other boreholes (Figure 12.2). Some appear to be influenced by pumping (e.g. TR14/50 and TR34/81), while others indicate that water levels do not decline below a set elevation (e.g. TR24/36), possibly due to a highly permeable horizon at that level. The boreholes that show a similar response (with the exception of TR36/62) are located in the base of valleys, though others that are also in valley axes do not as easily fit into this pattern.

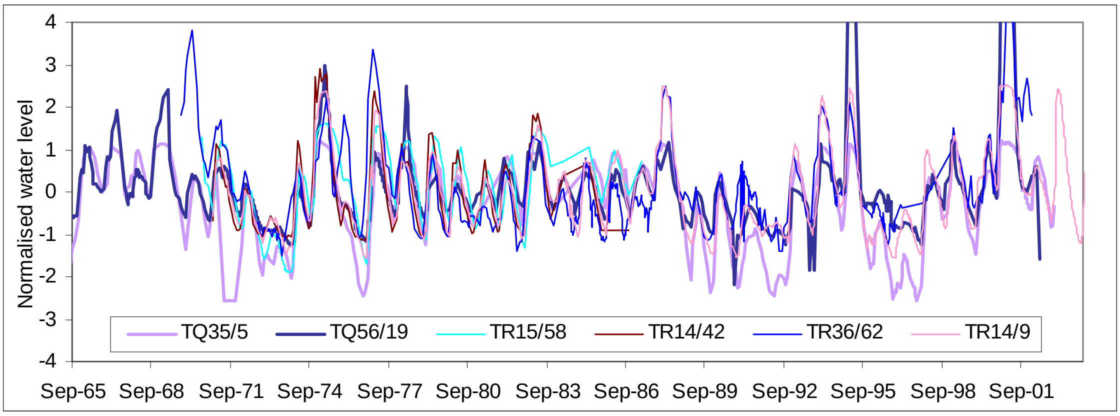


Figure 12.1 Hydrographs from the North Downs Chalk aquifer, which show similar water level responses over time

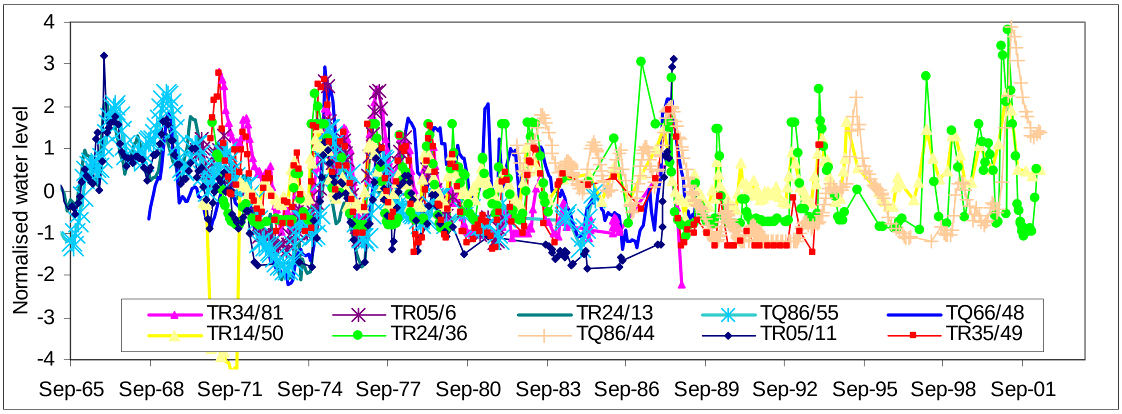


Figure 12.2 The majority of long term hydrographs from the North Downs Chalk aquifer show unique water level responses.

Previous studies (Bloomfield et al, 2001, Low et al, 2004) suggest that water level responses in the Chalk of the North Downs are frequently anomalous. Bloomfield et al. (2001) described eight broad geographical areas, each with its own characteristic features. Many sites on the main interfluve in the area were characterised by relatively little annual range in groundwater levels apart from during extreme recharge events; a similar response was observed by Low et al. in the interfluve boreholes between the Rivers Medway and Great Stour. For example, Church Wood varies by around 1 metre during most years, but in response to exceptional recharge at the end of 1987, increased by around 13 m. Other sites, for example, near the River Medway had poorly defined annual hydrographs with little consistency with any of the other hydrographs investigated. Overall, previous studies suggest there are unusual hydrograph responses in this area. Low et al. suggest the low amplitude variations on the interfluve could be due to large scale lateral flow of recharge in the unsaturated zone.

Overall, it is considered necessary to further investigate the possible reasons for this wide range of water level responses over time in the North Downs Chalk aquifer, before a master hydrograph can be developed with any confidence. This however, is not within the scope of this present study. Previous studies have been carried out, and more detailed data are available for parts of the area; this work would be continued to try to identify the controls on hydrograph response, and so develop a series of master hydrographs.

13 Confined Chalk – London Basin

A total of 7 long-term water level records are available for the confined Chalk aquifer in the London Basin. Basic statistics on the datasets is provided in Table 13.1.

Table 13.1 Summary statistics of long term hydrographs from the confined Chalk aquifer in the London Basin (water levels in m AOD)

	Min water level [m]	Max water level [m]	Mean water level [m]	Median water level [m]	Standard Dev.	No. Observation	Median sample frequency [d]	From	to	Depth of borehole [m]
TQ58/2	-19.83	31.61	9.29	31.24	23.60	688	1	9-May-67	31-Dec-01	182.90
SU76/46	28.71	41.80	35.67	35.35	2.10	1395	7	5-Jan-75	31-Dec-01	131.00
TL92/1	-6.31	14.83	1.19	1.53	2.51	1624	7	23-Jul-61	6-Dec-01	121.90
TQ28/119	-87.59	-34.21	-56.63	-60.95	16.55	3254	7	1-Jan-00	6-Jun-02	116.70
TL72/54	8.96	48.48	17.87	15.24	5.97	14	1	29-Oct-68	6-Dec-01	103.60
TQ99/11B	-34.76	-14.96	-23.79	-23.00	4.92	1020	7	12-Feb-75	26-Nov-01	199.00
TQ38/9B	-29.45	38.94	-25.36	-25.92	3.33	1192	7	13-Jan-53	31-Dec-01	122.20

Every single long-term hydrograph available for the confined Chalk of the London Basin reveals a unique water level response not mirrored in any other borehole (Figure 13.1). All appear to be influenced by pumping, with levels changing rapidly in an apparently random fashion or water levels increasing steadily in accordance to the reduced pumping volumes in the London Basin during the last decades. It was therefore not regarded feasible to establish a master hydrograph for this part of the Chalk aquifer.

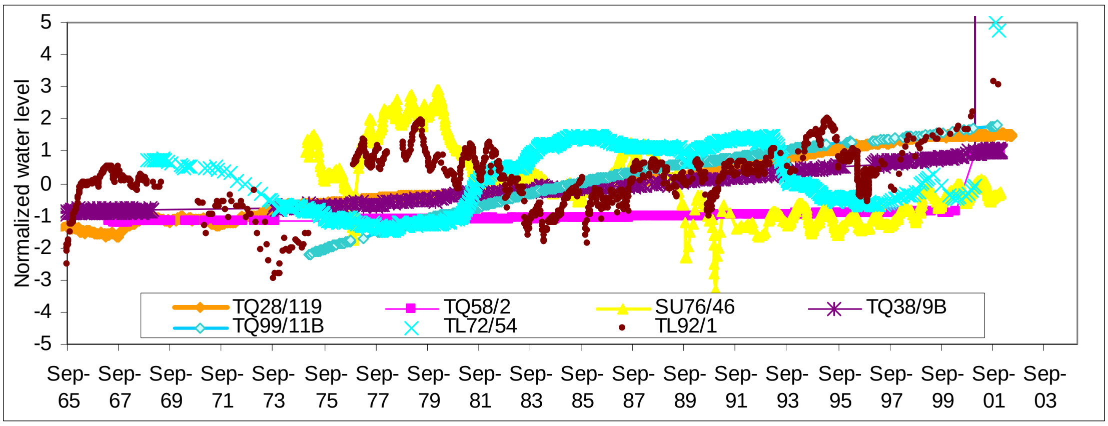


Figure 13.1 Normalised long term hydrographs from the Chalk aquifer in the London Basin.

14 Lower Greensand

A total of 9 long term water level records were available for the Lower Greensand aquifer. Basic statistics on the datasets is provided in Table 14.1. The raw data, together with a linear regression curve is provided in Appendix 9, as are the normalised datasets together with moving averages smoothing lines, sampling frequency plots, the autocorrelation function plots and the master hydrograph look-up table.

Table 14.1 Summary statistics of time series from the Lower Greensand aquifer

	Min water level [m]	Max water level [m]	Mean water level [m]	Standard Dev.	No. Observation	Median sample frequency [d]	From	to	Depth of borehole [m]
TQ75/86	39.76	41.30	40.47	0.35	107	29	08-Jan-73	15-Dec-81	2.8
TR13/21	71.98	80.59	74.34	1.62	223	31	21-Mar-72	16-Jun-95	11.1
TR23/32B	38.62	42.01	40.09	0.54	237	33	24-Mar-72	29-Apr-02	16.7
SU84/8A	54.00	58.29	56.41	1.01	1758	7	02-May-71	31-Dec-01	90.2
TL45/19	6.78	12.43	8.69	0.88	441	7	17-May-73	19-Aug-92	44.5
SU72/47	52.45	54.96	53.43	0.46	161	31	03-Aug-70	04-Jun-85	6.1
TQ41/82	10.05	13.65	11.06	0.53	312	30	15-Apr-75	24-Dec-01	8.3
TL45/14	8.15	13.15	9.43	0.93	113	35	30-Aug-77	08-Jul-93	62.0
SU82/63	106.68	108.29	107.68	0.25	141	35	25-Jan-84	28-May-02	16.8

Of the 9 time series available, 1 dataset was discarded due to its limited observation period (TQ75/86). The median sample frequency for the remaining data stets is monthly and weekly respectively, however data gaps of several month are present in some series. The eight remaining boreholes show distinct differences in their long term water level records:

Borehole SU84/8A shows water level patterns not repeated in any other available time series (Figure 14.1). The borehole is with 90 metres by far the deepest hole of the set, which might explain its very different response. The borehole was not included in any further data manipulation. Borehole TR23/32B was also excluded, due to its unique water level response, not repeated in other datasets (Figure 14.1). Further work is required to establish if those time series could be representative for specific hydrogeological conditions in the aquifer.

Boreholes TL45/19 and TL45/14 show similar time series (Figure 14.2). Both boreholes are of medium depth, i.e. 44.5m and 62 metres respectively, and are in close proximity. Both boreholes show seasonality, and show a sharp rise in water levels from December 1990 onwards, which is not repeated in any of the other available level time series records. Further work is required to establish, if the water level record of these two boreholes is a local effect, e.g. pumping, or representative for a certain hydrogeological setting.

The remaining four borehole records (TR13/21, TQ41/82, SU72/47, SU82/63) show similar water level time series (Figure 14.3). All boreholes are shallow, with the deepest being 16.7 metres. These datasets show no significant long-term trend, but strong seasonality (Appendix 9), especially TR13/21 and SU72/47, which show seasonality in the autocorrelation function with a periodicity of about 11 lag units or about one year. These time series were aggregated into one group to produce a master hydrograph for shallow boreholes in the Lower Greensand. The master hydrograph was established for the period June 1975 to June 2001 (Figure 14.3).

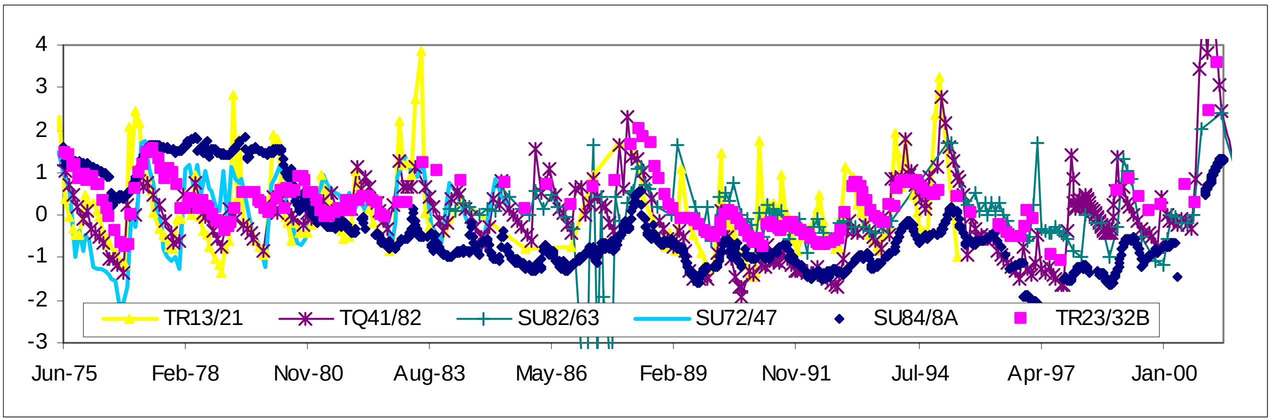


Figure 14.1 TR23/32B and SU84/8A show water level responses, not repeated in other boreholes

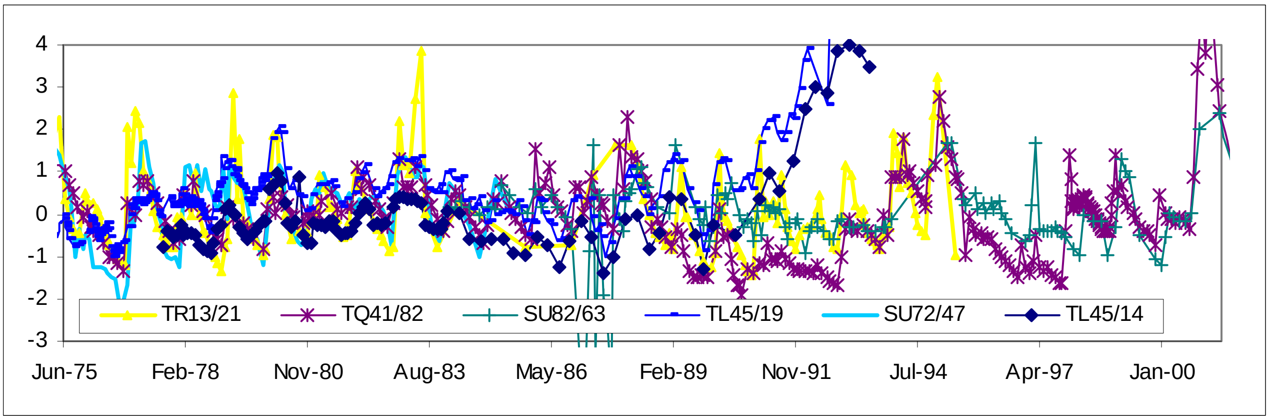


Figure 14.2 TL45/19 and TL45/14 show similar water level responses, which are distinct from other records.

Figure 14.3 shows:

(a) the normalised water level data of the four level records used to establish the master hydrograph;

(b) the aggregated normalised water level data from 1975 to 2001 together with the master hydrograph. The master hydrograph is produced by averaging water levels over approximately monthly separations in time. The number of data points to be averaged in order to obtain a monthly time step is thereby calculated on the basis of the median sample frequency. A second moving average smoothing line is drawn, based on an approximately yearly separation in time to visualise long term trends.

(c) the master hydrograph, i.e. the monthly moving average smoothing line, and the respective threshold lines for the five categories in which water levels are being subdivided. These are calculated on the basis of the cumulative frequency plot of the master hydrograph. Water levels in the 0 to 20% category represent “very low” levels, data in the 20% to 40% category represent “low” levels, data in the 40 to 60% category represent “average” levels, data in the 60 to 80% category represent “high” levels and data in the 80% to 100% category represent “very high” levels.

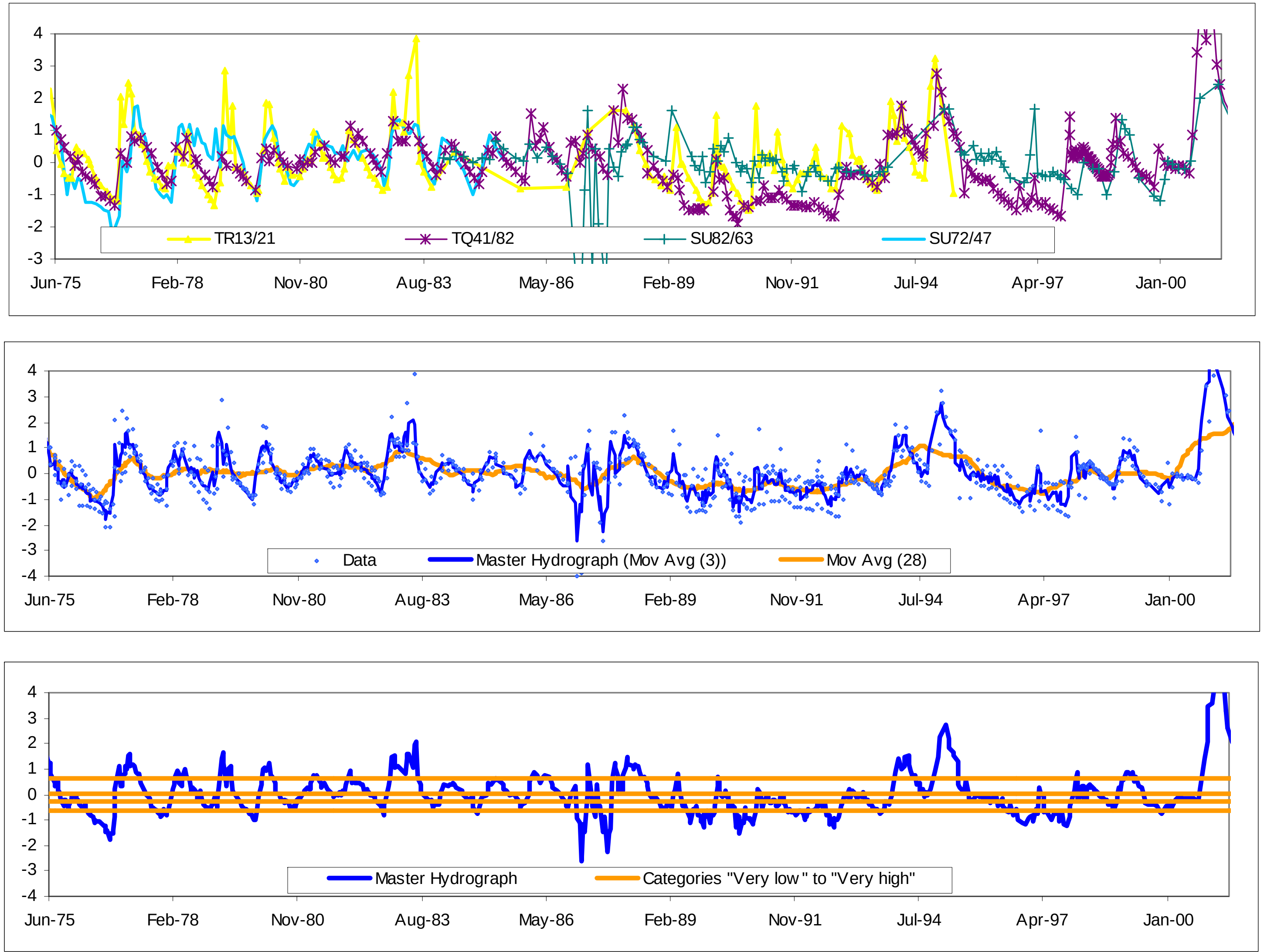


Figure 14.3 a) normalised water level data of the four records used to establish the master hydrograph for the shallow Lower Greensand aquifer; b) aggregated normalised water level data together with the master hydrograph, and a moving averages smoothing line to show long term trends; c) master hydrograph and respective water level categories

Table 14.2 Summary statistics of the data used to produce the master hydrograph for the shallow Lower Greensand aquifer

Summary statistics - Master Hydrograph

Aquifer: Lower Greensand

Condition: Master Hydrograph to be applied to boreholes <35 metres de

Boreholes	Master Hydrograph =	Mov. Average (3)
grouped together:	No of observations	837
TR13/21	From	June-75
TQ41/82	To	June-01
SU72/47	Median sample frequency	12.5 days
SU82/63	Sample gaps > month	Yes
	Trend	no
	Seasonality	yes

Water level		**normalized value**	
categories:	**Percentile**	**From**	**To**
Very high	80-100	0.621	4.495
High	60-80	0.044	0.620
Average	40-60	-0.296	0.043
Low	20-40	-0.648	-0.297
Very low	0-20	-2.625	-0.649

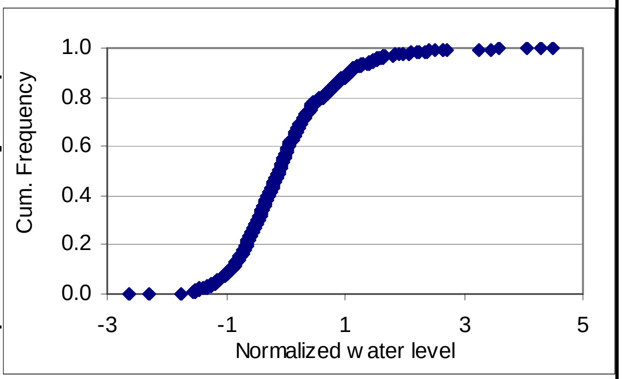


Figure 14.4 Categories used to tag monthly data of the master hydrograph

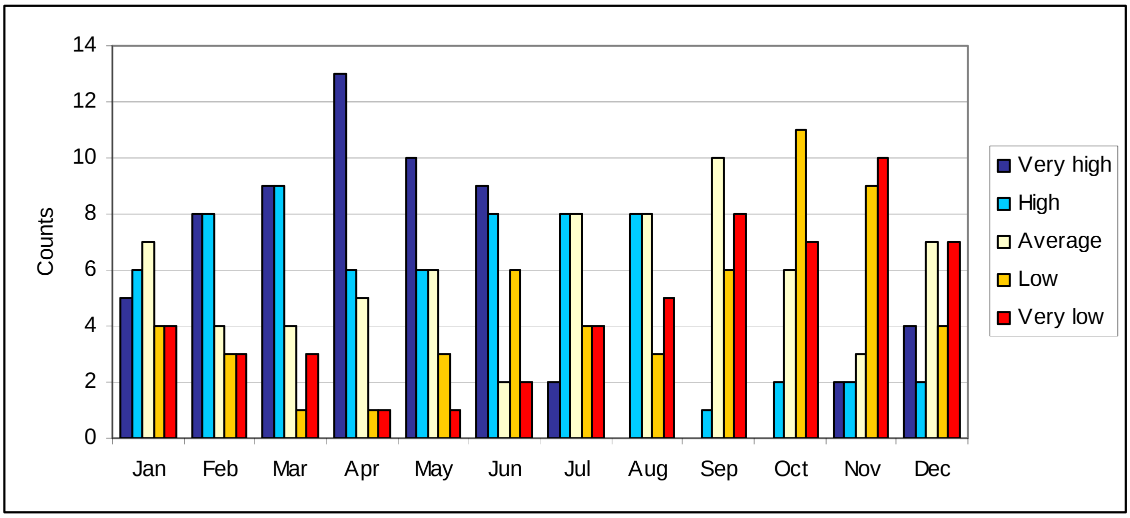


Figure 14.5 Frequency of water level categories per monthly period based on the established monthly look-up table

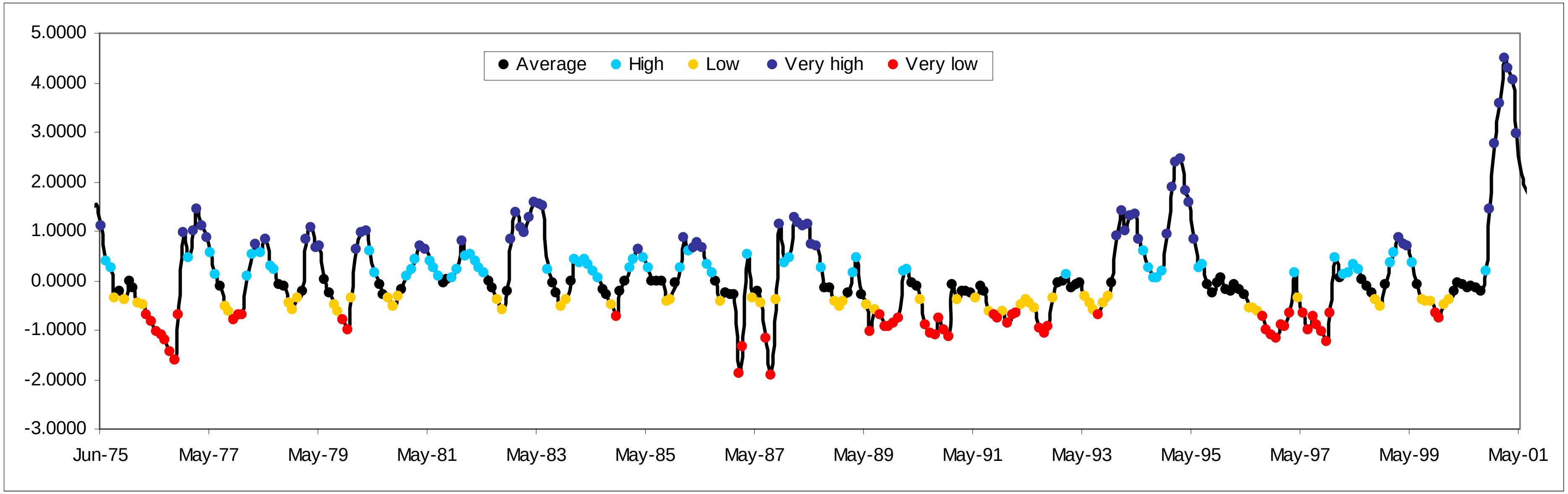


Figure 14.6 Master hydrograph for shallow boreholes in the shallow Lower Greensand aquifer

15 Millstone Grit

A total of 8 long term water level records is available for the Lower Greensand aquifer. Basic statistics on the datasets is provided in Table 15.1. The raw data, together with a linear regression curve is provided in Appendix 10, as are the normalised datasets together with moving averages smoothing lines, the sampling frequency plots, the autocorrelation function plots and the master hydrograph look-up table.

Table 15.1 Summary statistics of long term hydrographs from the Millstone Grit

Summary Statistics

	Min water level [m]	Max water level [m]	Mean water level [m]	Median water level [m]	Standard Dev.	No. Observation	Median sample frequency [d]	From	to	Depth of borehole [m]
SD83/111	130.00	133.52	132.67	132.71	0.47	85	34	11-Feb-74	07-Jun-89	44.8
SD55/5	147.32	148.31	147.74	147.76	0.18	118	32	21-Jul-72	07-Jun-89	30.0
SE04/7	249.34	256.76	254.76	254.94	0.92	291	30	25-Mar-71	20-Dec-00	76.2
SE02/46	193.08	201.97	195.92	195.88	1.37	251	28	05-Apr-77	19-Dec-01	62.0
SE27/8	147.58	157.66	153.07	153.59	1.41	337	30	24-Mar-71	23-Oct-00	45.7
SD92/8	197.20	214.86	205.83	206.18	2.84	167	29	25-Mar-71	16-Nov-87	76.2
SD75/6	208.73	220.30	215.71	215.54	1.94	48	34	11-Apr-73	12-Sep-89	61.0
SE24/2B	114.62	144.17	130.90	130.60	5.56	312	30	25-Mar-71	20-Dec-00	169.2

The median sample frequency of the available long-term hydrographs is monthly, however data gaps of several months are present in several series. Three datasets show data gaps of several years (SD75/6, SD55/5, SD83/111) and half of all records terminate before the year 1990.

The dataset is not consistent between the different boreholes. Two boreholes, SE24/2B and SE27/8, exhibit a distinct rise in water levels between 1973 and 1980, not observed in any other borehole (Figure 15.1). Further work is required to establish, if both boreholes are representative for water level responses under specific hydrogeological conditions, or if these boreholes are possibly affected by local pumping.

The other six of the eight water level time series available show seasonality, but no discernable trend (Figure 15.2). These time series records, which include deep as well as shallow boreholes, were aggregated into one group to produce one master hydrograph for the Millstone Grit. It has to be noted however, that even these six water level responses correspond only marginally well. As such, the master hydrograph is regarded as a good first pass, but in any future study, the Millstone Grit aquifer should be re-visited and the divers water level responses investigated in more detail. Due to the limit data available, the master hydrograph could only be established for the period March 1974 to June 1989.

Figure 15.2 shows:

(a) the normalised water level data of the six records used to establish the master hydrograph;

(b) the aggregated normalised water level data from 1974 to 1989 together with the master hydrograph. The master hydrograph is produced by averaging water levels over approximately monthly separations in time. The number of data points to be averaged in order to obtain a monthly time step is thereby calculated on the basis of the median sample frequency. A second moving average smoothing line is drawn, based on an approximately yearly separation in time to visualise long term trends.

(c) the master hydrograph, i.e. the monthly moving average smoothing line, and the respective threshold lines for the five categories in which water levels are being subdivided. These are calculated on the basis of the cumulative frequency plot of the master hydrograph. Water levels in the 0 to 20% category represent "very low" levels, data in the 20% to 40% category represent "low" levels, data in the 40 to 60% category represent "average" levels, data in the 60 to 80% category represent "high" levels and data in the 80% to 100% category represent "very high" levels.

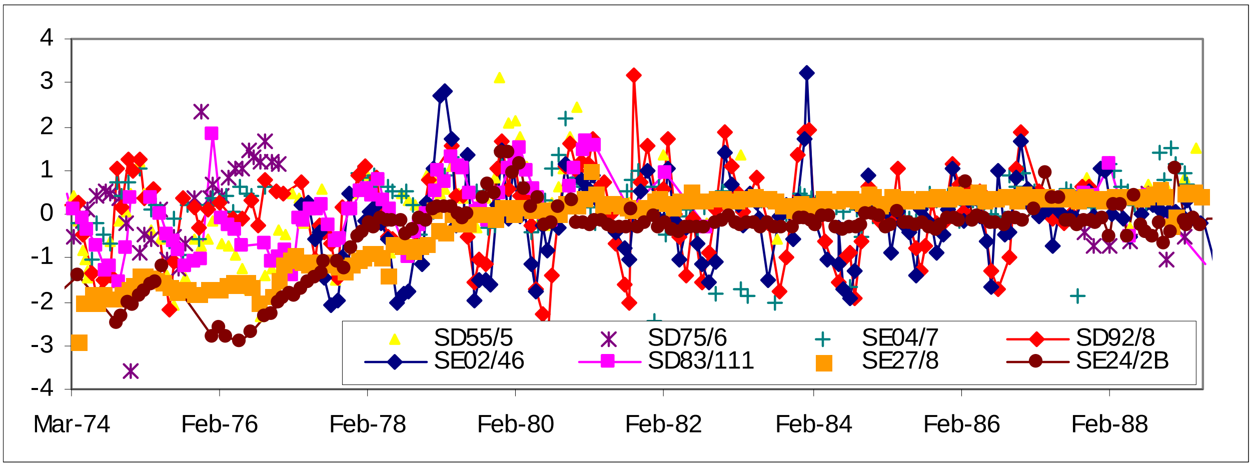


Figure 15.1 SE27/8 and SE24/2B show water level responses distinct from other boreholes

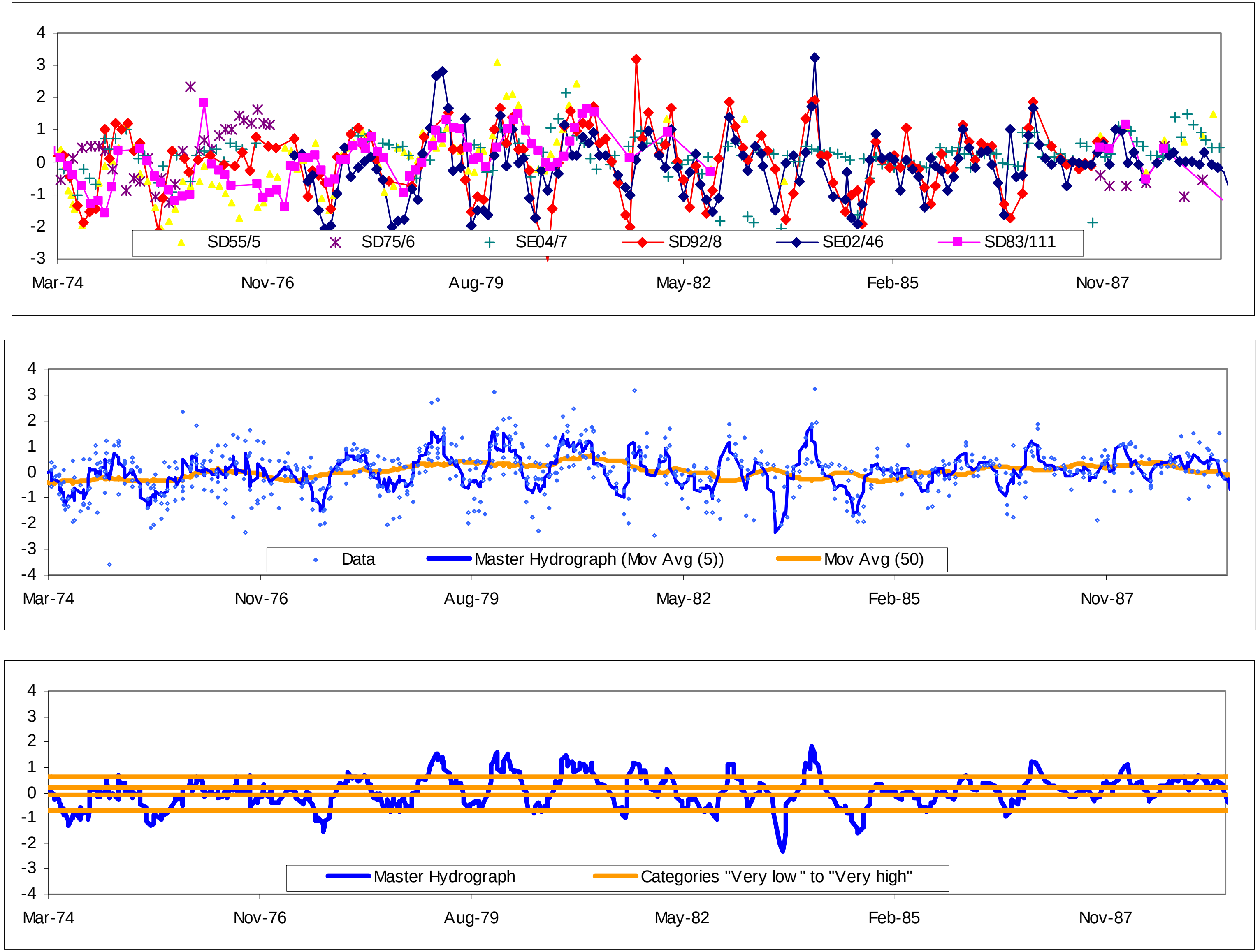


Figure 15.2 a) normalised water level data of the 6 records used to establish the master hydrograph for the Millstone Grit aquifer; b) aggregated normalised water level data together with the master hydrograph, and moving averages smoothing line to show long term trends; c) master hydrograph and respective water level categories

Table 15.2 Summary statistics of the data used to produce the master hydrograph for the Millstone Grit

Summary statistics - Master Hydrograph
Aquifer: Millstone Grit
Condition: Master Hydrograph to be applied to all boreholes

Boreholes	Master Hydrograph =	Mov. Average (3)
grouped together:	No of observations	960
SE02/46	From	March-74
SD83/111	To	June-89
SE04/7	Median sample frequen	7 days
SD75/6	Sample gaps > month	no
SD92/8	Trend	no
SD55/5	Seasonality	yes

Categories	Percentile	Value From	To
Very high	80-100	0.634	0.239
High	60-80	0.239	0.633
Average	40-60	-0.082	0.238
Low	20-40	-0.664	-0.083
Very low	0-20	0.239	-0.665

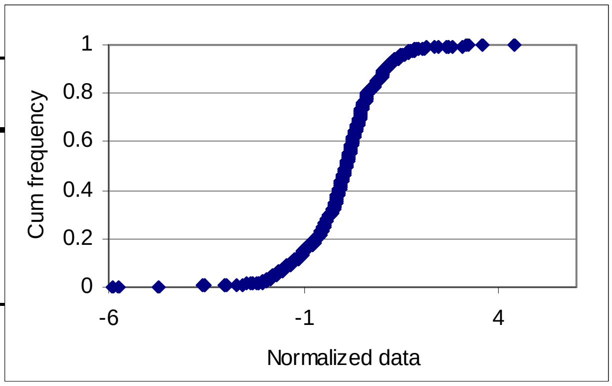


Figure 15.3 Categories used to tag monthly data of the master hydrograph

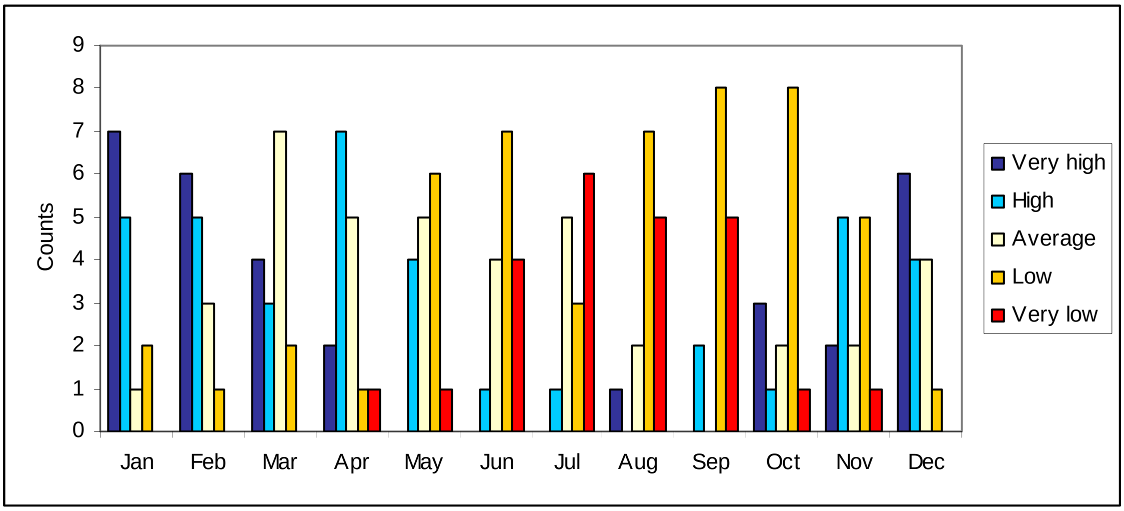


Figure 15.4 Frequency of water level categories per monthly period based on the developed monthly look-up table

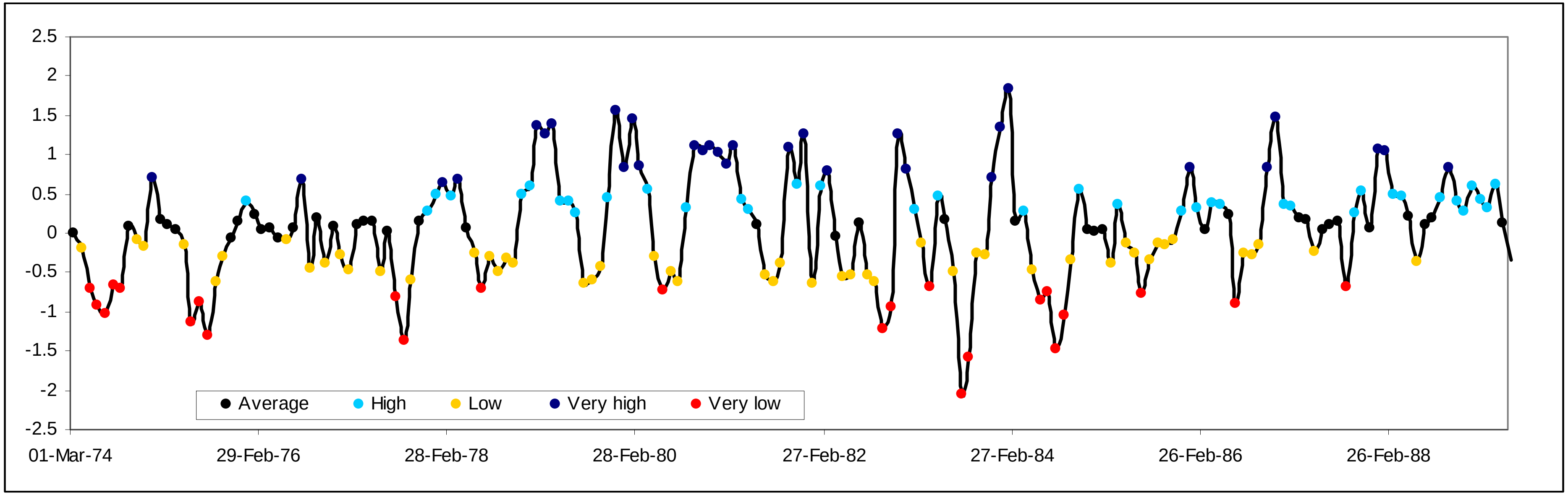


Figure 15.5 Master hydrograph for the Millstone Grit aquifer

16 Permo-Triassic Sandstone

A total of 62 long-term time series are available for the Permo-Triassic Sandstone aquifer. These show stark contrasts in water level responses, with a consistent response pattern not distinguishable. It should be noted that the hydrographs are from a very wide geographical range of settings, stretching from the Otter Sandstone and Exmouth Sandstone in the southwest, to the Sherwood Sandstone Group aquifers of the Midlands, eastern England, and northwest England. There is no Appendix including all 62 long-term time series, rather are examples of some of the response patterns observed given below.

Ten out of 62 hydrographs show seasonality with an underlying trend of relatively low water levels around 1974, 1991 and 1996 (Figure 16.1). These responses are observed in the southern Permo-Triassic aquifer in boreholes ranging in depth from 3.9 metres to 121.9 metres.

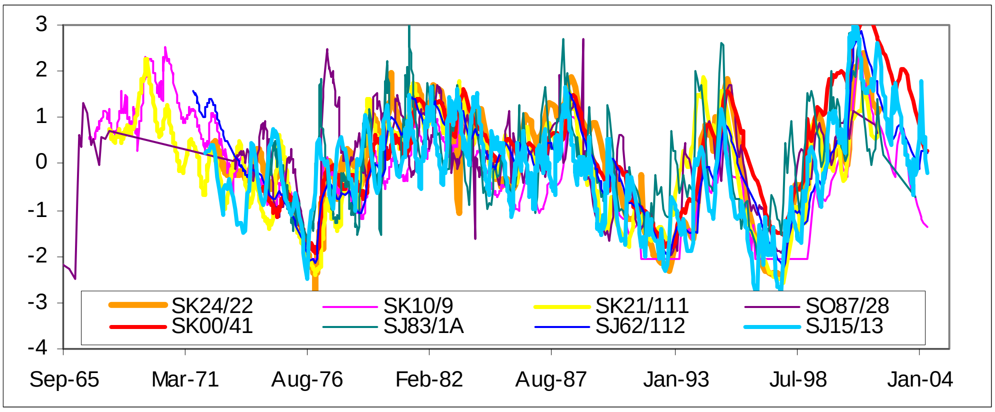


Figure 16.1 Seasonality and underlying trend observed in some of the long term hydrographs available for the Permo-Triassic sandstone (water levels are normalised).

A very similar trend is observed in a further three boreholes, however, the water level response does not exhibit seasonality to any degree (Figure 16.2). The boreholes range in depth between 36 metres and 47 metres and are situated along the eastern margin of the aquifer.

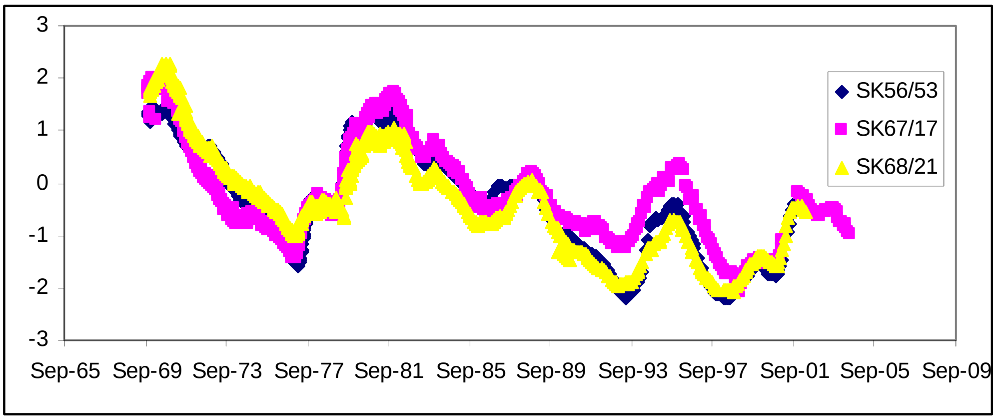


Figure 16.2 Normalised water levels of three long-term hydrographs exhibiting no seasonality but an underlying trend.

Another two boreholes show strong seasonality without any underlying trend (Figure 16.3). Both boreholes are shallow (max. 12 metres).

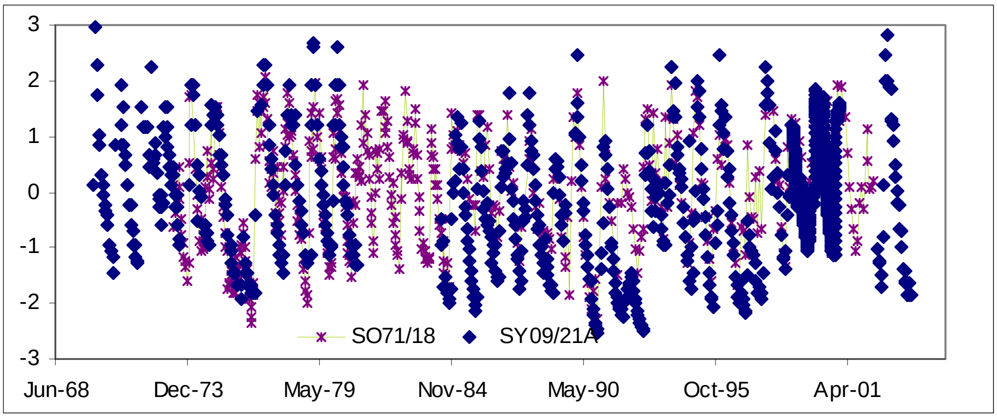


Figure 16.3 Normalised water levels of boreholes exhibiting strong seasonality without any underlying trend.

A large number of long-term hydrographs are unique in their response pattern. Some exhibit gradual increases or decreases in water levels suggesting levels to be influenced by pumping. Others show rapid, but apparently random changes in water levels also likely to induced by pumping (Figure 16.4).

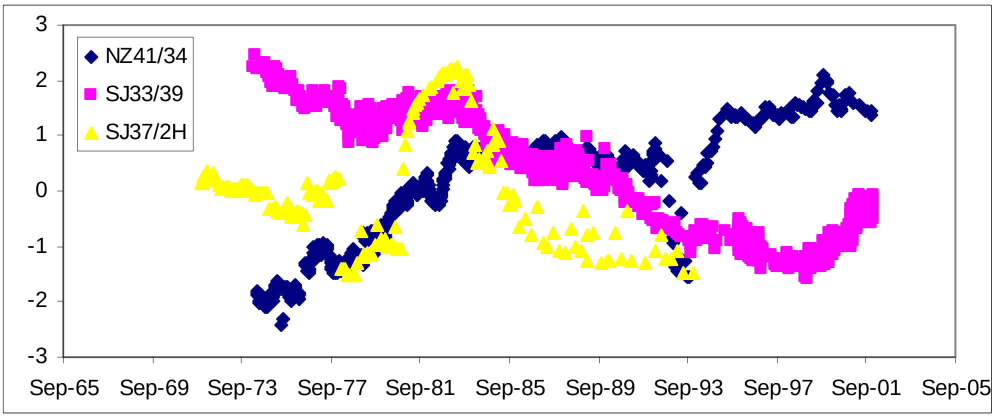


Figure 16.4 Normalised water level data of boreholes assumed to be influenced by pumping

In other boreholes, which also exhibit unique time series, it is unclear, if the response is due to pumping, or if the time series represents a natural, possibly very local hydrogeolgical effect.

In conclusion, the 62 long-term hydrographs of the Permo-Triassic sandstone are a collection of very different water level responses. Based on the available data, no consistent response patterns can be established for which master hydrographs could be developed. However, it is likely, that a detailed survey, which takes other factors, such as depth of the unsaturated zone, regional geographic location, topography etc. into account, could establish groups of boreholes, to which specific hydrogeological conditions apply and for which a typical response pattern could be established. However, due to time constraints this is beyond the scope of this present study.

17 Conclusions and Recommendations

The British Geological Survey has outlined the need to provide improved spatial coverage of water level data, allowing some estimate of the likely groundwater level across aquifers in England and Wales. In order to provide such coverage interpolation of water level data is needed. However, water levels are dynamic, responding to seasonal and longer-term effects. Therefore, in order to include one off measurements when interpolating surfaces, they need to be categorised whether the reading is likely to represent “Low”, “Average” or “High” levels. This report has described a method to do this, by establishing long-term hydrographs deemed typical for the respective aquifer, here called master hydrographs.

It is considered that master hydrographs are a suitable means to categorise one off point level measurements, if the available long-term water level time series for the aquifer are in good agreement. It is then likely, that the assessed water level responses at various locations are representative for level responses in the entire aquifer, i.e. one master hydrograph can be established, representative for the entire aquifer.

This study outlines a methodology to establish master hydrographs based on statistical analysis of long-term water level time series. Master hydrographs were established for ten aquifers in England and Wales, namely:

- Magnesian Limestone: different response patterns are observed that appear to be correlated with depth of the borehole. One single master hydrograph for the entire aquifer is hence not suitable, but two master hydrographs, one for the shallow and one the deeper aquifer, were developed. From Figures ?? and ??, it can be seen that the shallow boreholes have a much more “flashy” or rapid response than the deeper ones, suggesting the response is strongly correlated with yearly recharge. The deeper boreholes still show seasonal response to recharge, but this is relatively insignificant compared to the long-term (5 to 10 year) response, which is indicative of accumulated recharge over several years. Thus the drought of 1976 is shown not just as an absence of recharge during the winter of 1975/76, but as a consequence of low recharge and declining water levels from 1970 onwards. Similarly, high water levels caused by the extreme recharge event of 2000/2001 are shown to be the culmination of high recharge from 1998 onwards. This long-term signal can still be observed in the shallow boreholes, but it is masked by the seasonal response.
- Millstone Grit: the master hydrograph covers a relatively short period of time (around 15 years), however, from this limited time-period, the hydrograph appears to show little long-term trend, with seasonal fluctuations being predominant. Drought events are marked by a much reduced minimum to maximum amplitude, but there is still recovery, even during years such as 1976.
- Hasting Beds: the master hydrograph shows a very strong seasonal response, with very little longer-term trend. Drought events and high recharge events are not clearly shown in the hydrograph response.
- Lower Greensand: again there is a strong seasonal response with generally little longer-term trend (2 to 3 year) observed in the hydrograph, apart from the response to high recharge years and extreme drought. Thus in 1976, there was little recovery followed by continuing recession. However, the drought between 1988 and 1992 is only shown by a reduced magnitude of the recovery each year. The high recharge years of 1994 and 95, and also the exceptional events during the winter of 2000/01, are clearly shown, although they are almost entirely a response to each individual

event; there is little year-on-year accumulation as seen in some other aquifers. The low levels during 1987 are caused by one borehole, and these may be anomalous. It should be noted that the hydrograph was constructed from only four boreholes, and may not be representative of the Lower Greensand as a whole.

- Middle Jurassic: the hydrograph shows strong seasonality and little long term trend. The drought of 1976, however, is very marked, with minimal recovery of water levels. In addition, while there was still recovery every year during the 1988 to 1992 drought, this was much reduced compared with normal. High recharge years, including 2000/01 are barely noticeable on the hydrograph.
- Upper Jurassic: again there is strong seasonality, but with slightly more long-term trend than observed for the Middle Jurassic. Thus 1988 to 1992 are shown as years with generally lower groundwater levels, with 1991/92 particularly showing little recovery and water levels being defined as “very low” for the whole year. Similarly, high water levels can be seen, caused by the extreme recharge event of 2000/2001, but the year-on-year increase from 1998 leading up to this event is not as marked as for other aquifers.
- Chalk aquifer in
  - Berkshire and East Anglia (Group 1)
  - Lincolnshire and Yorkshire (Group 1)
  - Hampshire and Wiltshire (Group 2)
  - South Downs (Group 2)
- All four chalk master hydrographs show a strong seasonal response. However, there are distinct differences between the Group 1 and Group 2 areas above. The Group 1 areas, show a strong seasonal response, but this is overwritten by a longer-term signal. Thus the low recharge years from 1998 to 1992 are shown by a year-on-year decline in groundwater levels, a pattern which is repeated to a slightly less significant extent between 1995 and 1997. Similarly, for Berkshire/East Anglia, and to a lesser degree Lincolnshire/Yorkshire, the high water levels during 2000/01 can be seen to be partly due to cumulative increases in water levels from the end of 1997 onwards. Group 2 boreholes show a much stronger seasonal response compared to the long term signal. As a result, although the low recharge years are marked by limited recovery of water levels, there is little longer-term trend.
- Thus, the Group 2 hydrographs suggests a more responsive (flashy) aquifer compared with the Group 1 hydrographs, in which the response in any one year appears to be the cumulative effect of several years’ recharge. The reasons for the differences between the Chalk areas are not immediately obvious; however, they are not likely to be due to meteorological differences between the areas. In the South Downs, the Chalk is divided into blocks separated by rivers at sea level, and therefore the catchments are limited in size. In addition, transmissivity is high. It is possible that this combination of factors means that response to recharge events is rapid, with little long-term trend. The sea to the south, and the rivers between catchments may act as constant head boundaries, and control the minimum level to which water levels can decline.
- The reasons for the different responses are worth investigating, as they might reflect catchment characteristics, and could aid in understanding resource issues during drought, or groundwater flooding issues during extreme recharge events. However, further discussion is outside the remit of this project.

Long-term hydrographs collected for the other aquifers, show diverse water level responses, and it was not possible to derive master hydrographs. In the cases of the Lower Greensand, Millstone Grit, the Middle Jurassic, the confined Chalk in the London Basin, the Chalk in the North Downs region and the Permo-Triassic Sandstone different response patterns are evident, which cannot be correlated simply to the depth of the borehole. Other hydrogeological conditions such as distance to surface water courses, depth of the unsaturated zone, the influence of local pumping, or a combination of many factors may result in these diverse time series, however, it was beyond the scope of this study, to investigate the problem cases in further detail. While the established hydrographs are regarded as a good "first pass", aquifers with diverse water level responses should be re-examined in any future study to establish if responses are a result of local pumping or if they could be representative for specific hydrogeological conditions in the aquifer, in which case additional master hydrographs could be developed.

It is also advisable in any future study, to test the established master hydrographs against any water level time series, which were not included in the initial statistical study. This would allow testing of whether the established master hydrographs are representative of the aquifer.

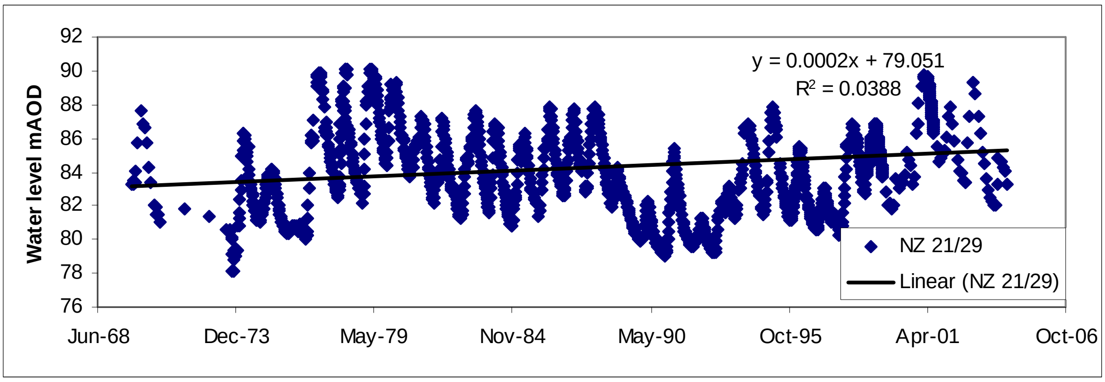
18 References

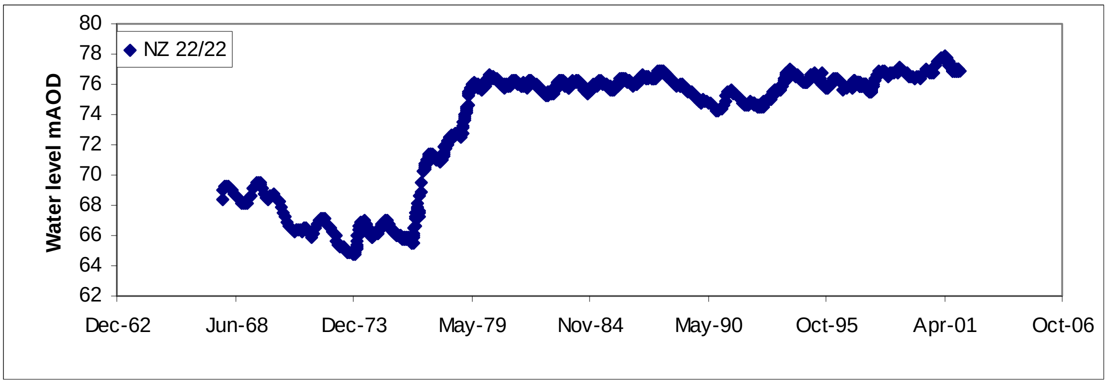
Bloomfield et al 2001

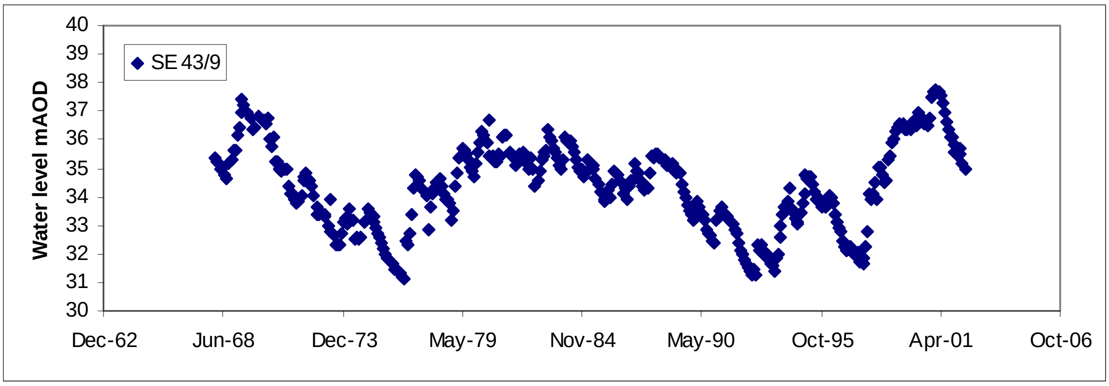
Low et al 2001

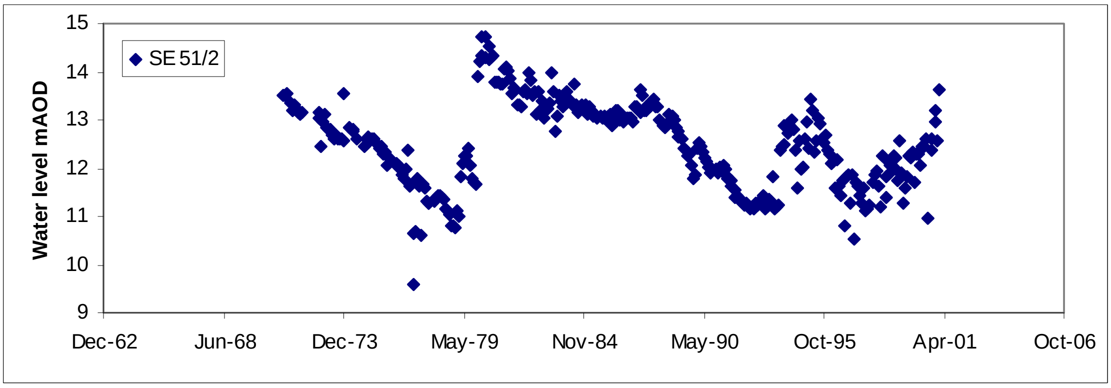
Appendix 1 Magnesian Limestone

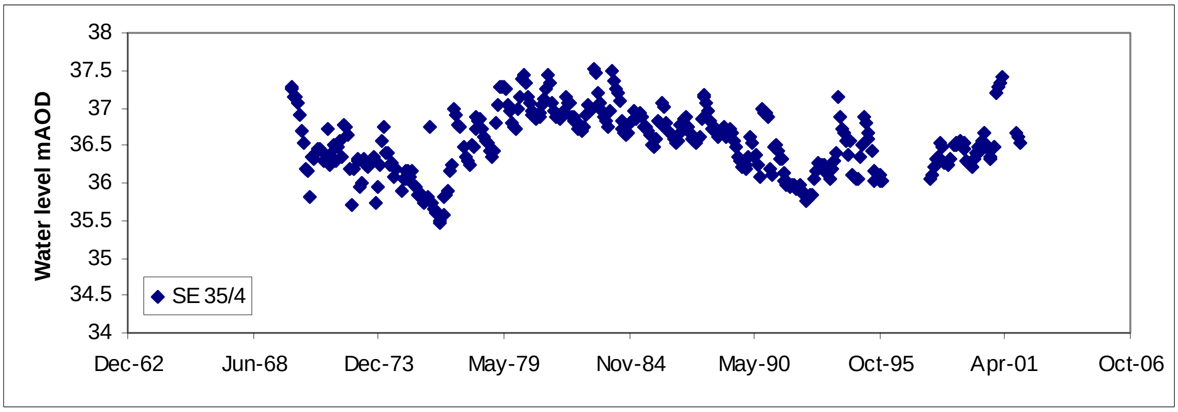
WATER LEVELS ABOVE ORDNANCE DATUM WITH LINEAR REGRESSION CURVE

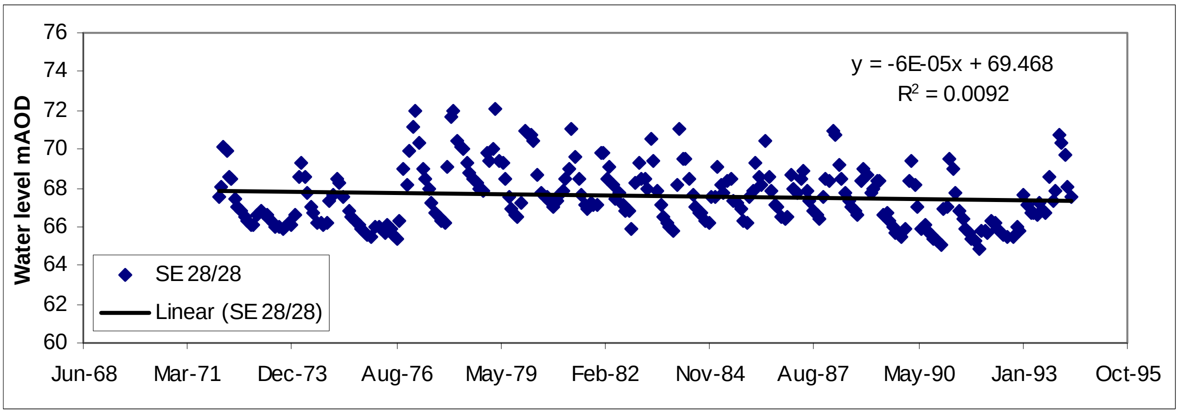


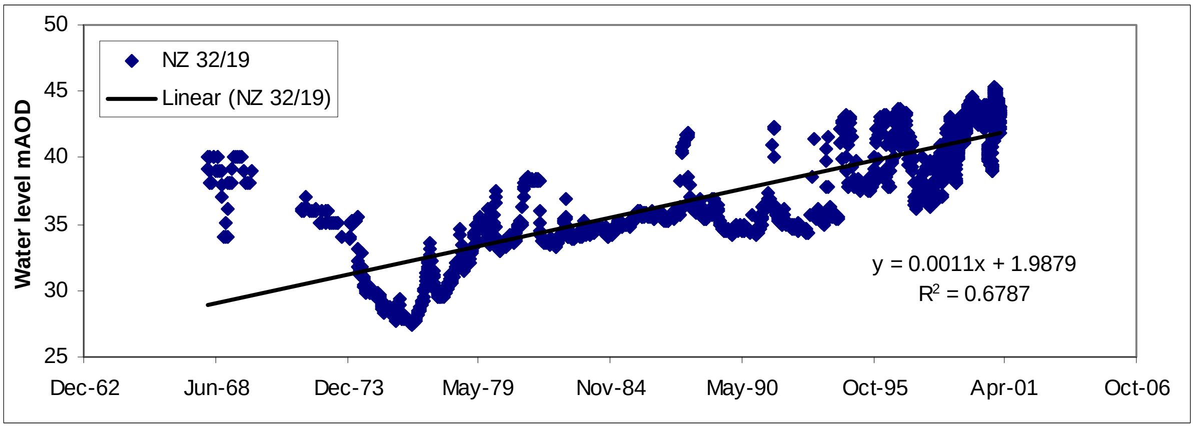


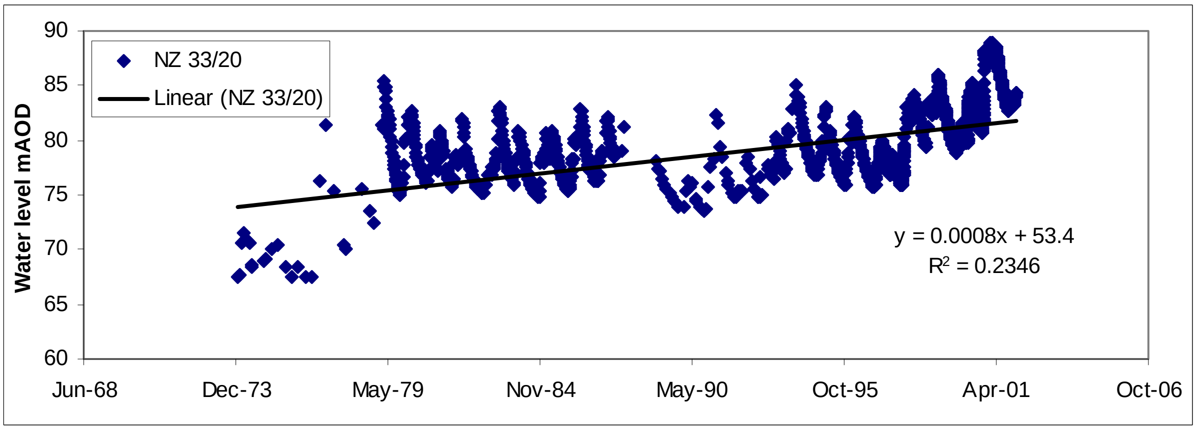


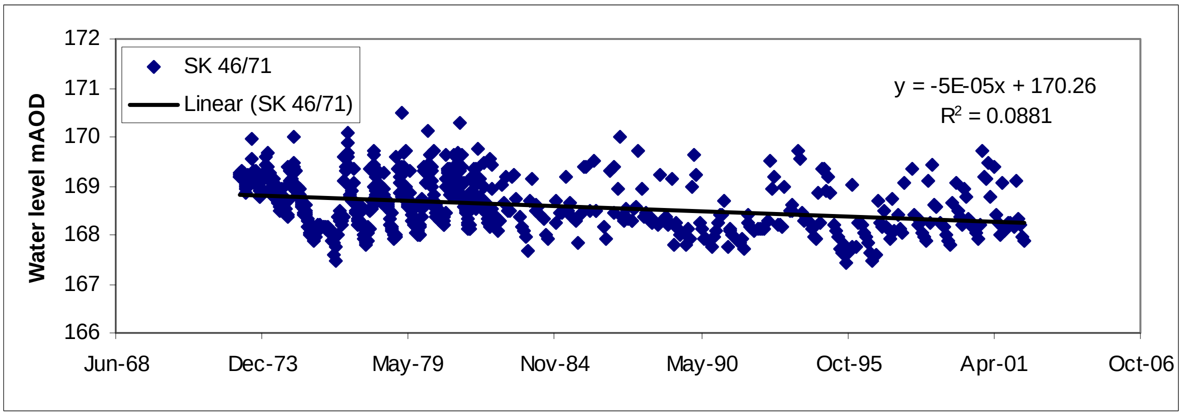


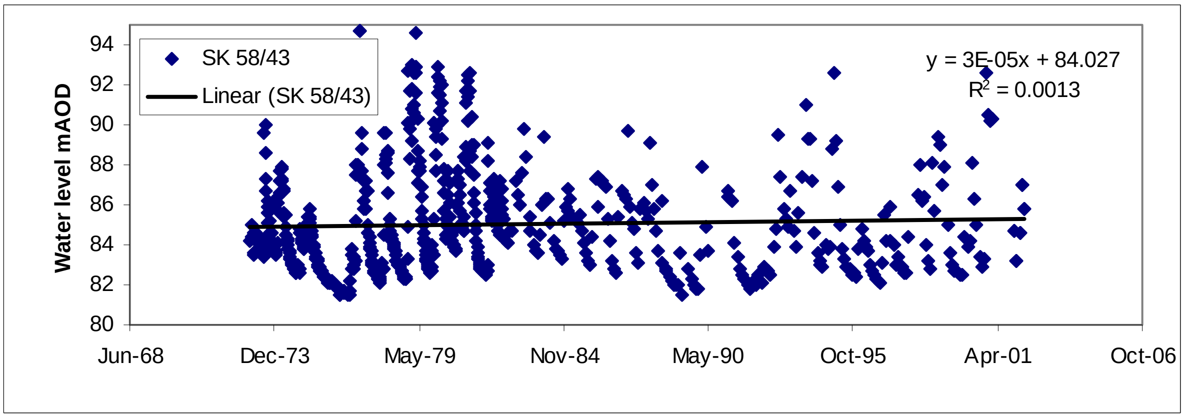

Water level mAOD
SE 35/4
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

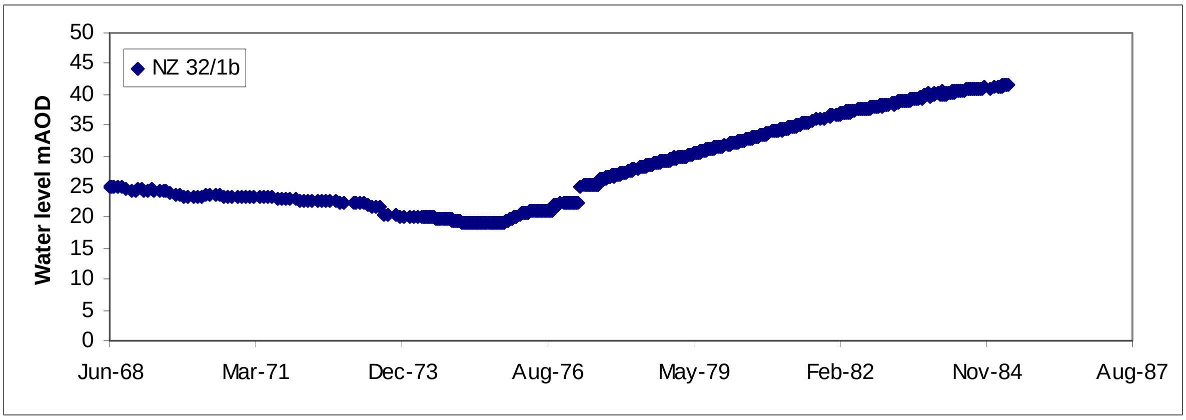

Water level mAOD
y = -6E-05x + 69.468
R^2 = 0.0092
SE 28/28
Linear (SE 28/28)
Jun-68
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95

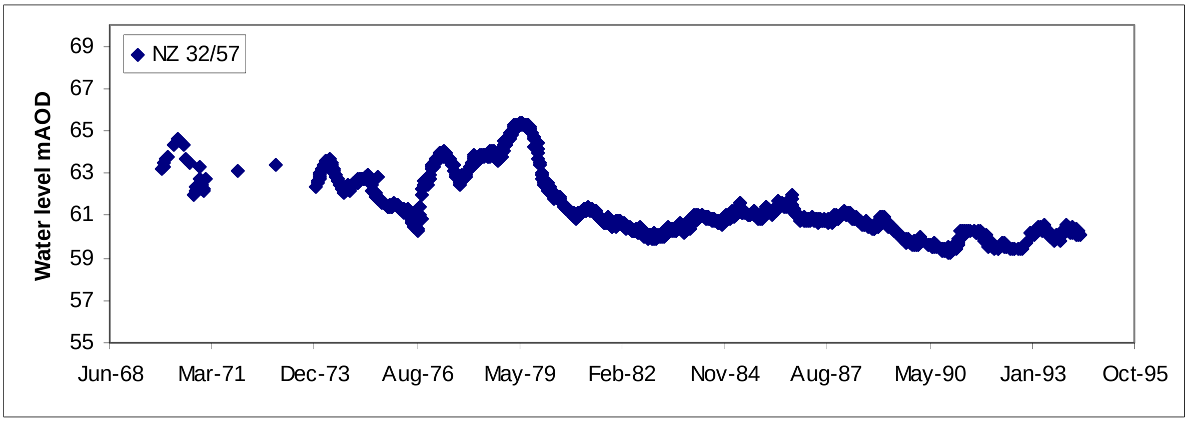

Water level mAOD
NZ 32/19
Linear (NZ 32/19)
y = 0.0011x + 1.9879
R^2 = 0.6787
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

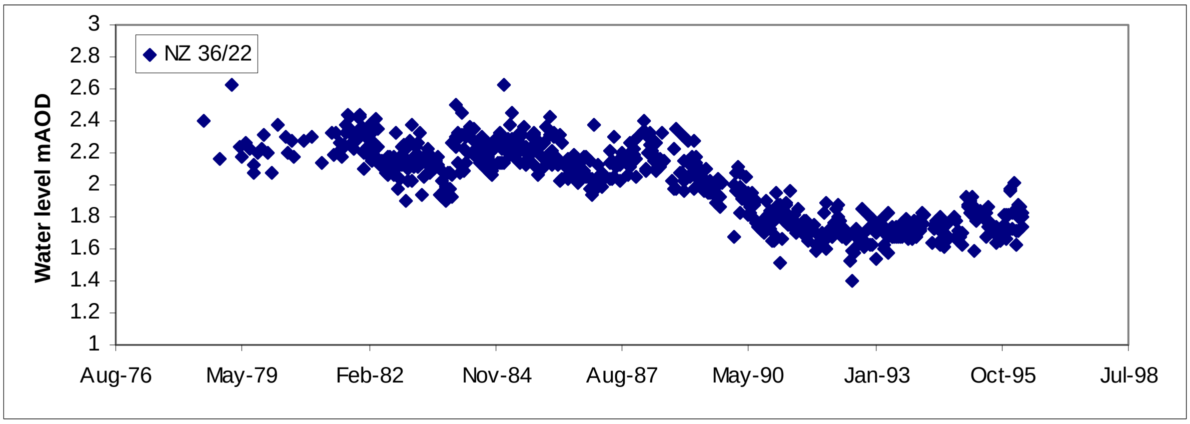

Water level mAOD
NZ 33/20
Linear (NZ 33/20)
y = 0.0008x + 53.4
R^2 = 0.2346
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

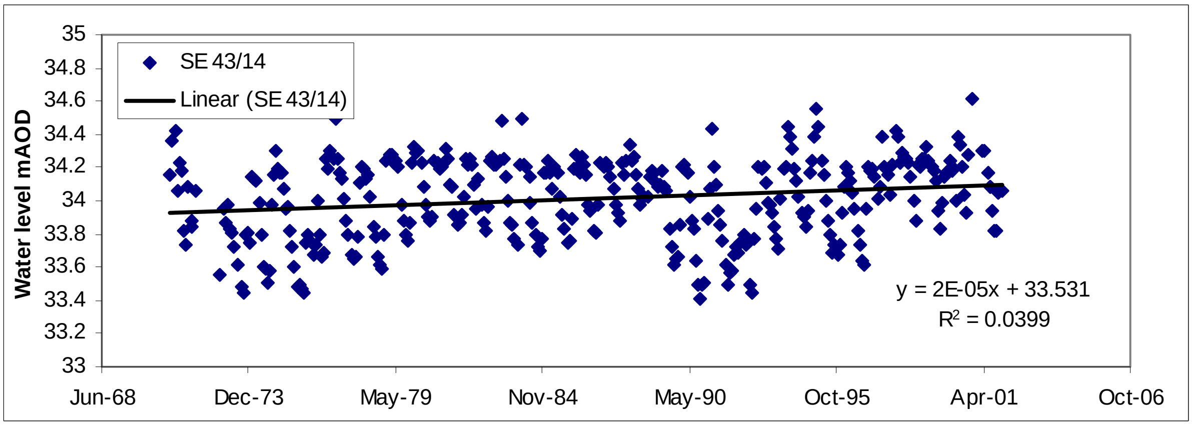

Water level mAOD
172
171
170
169
168
167
166
SK 46/71
Linear (SK 46/71)
y = -5E-05x + 170.26
R^2 = 0.0881
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06


Water level mAOD
94
92
90
88
86
84
82
80
SK 58/43
Linear (SK 58/43)
y = 3E-05x + 84.027
R^2 = 0.0013
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

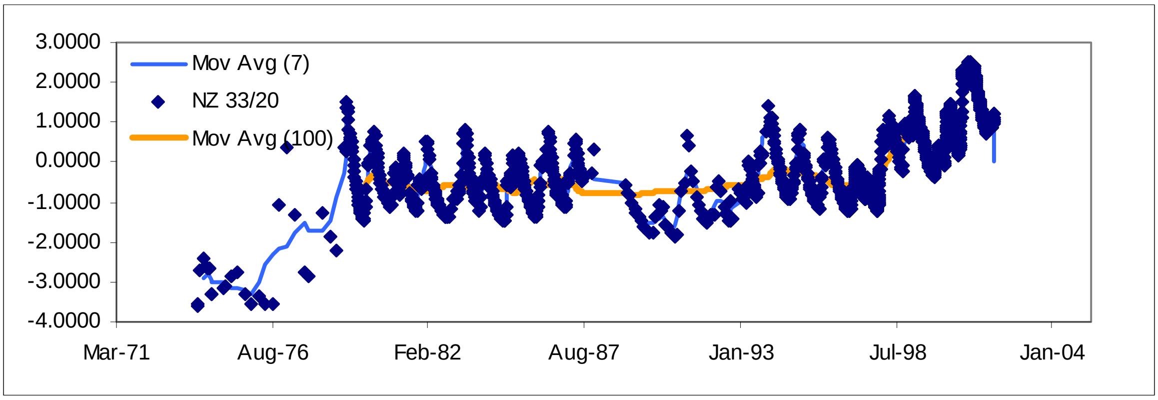

Water level mAOD
50
45
40
35
30
25
20
15
10
5
0
NZ 32/1b
Jun-68
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87

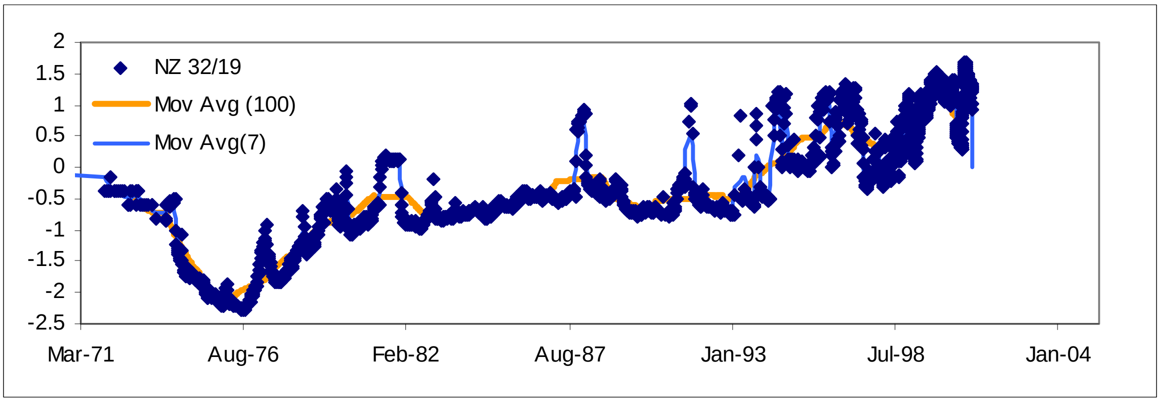

Water level mAOD
69
67
65
63
61
59
57
55
NZ 32/57
Jun-68
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95

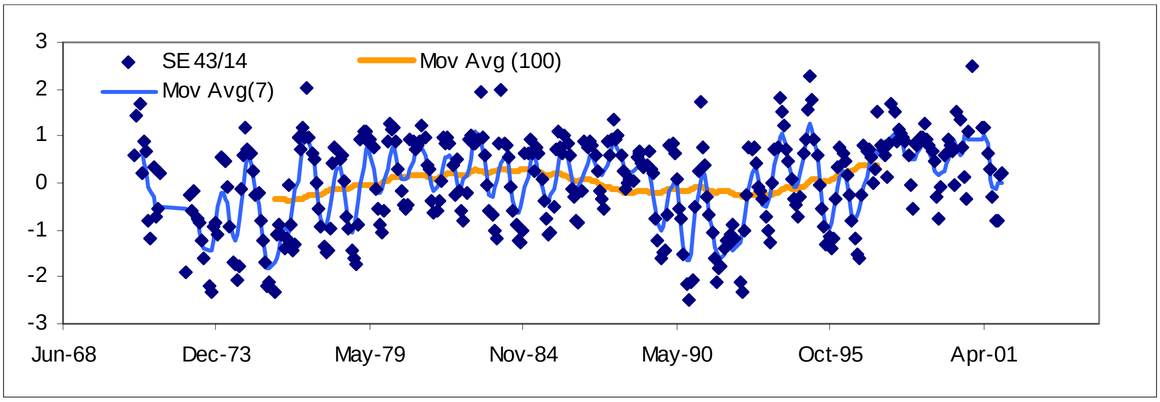

NZ 36/22
Water level mAOD
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95
Jul-98

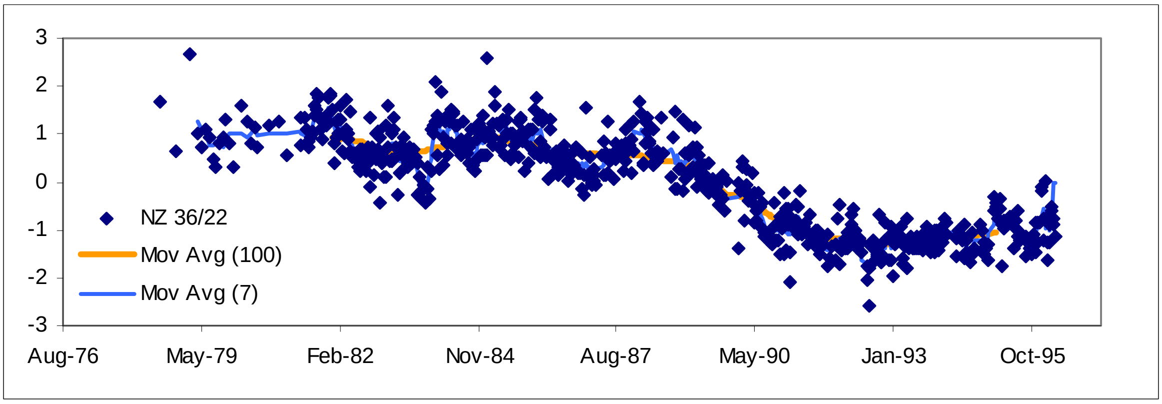

SE 43/14
Linear (SE 43/14)
Water level mAOD
35
34.8
34.6
34.4
34.2
34
33.8
33.6
33.4
33.2
33
y = 2E-05x + 33.531
R2 = 0.0399
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

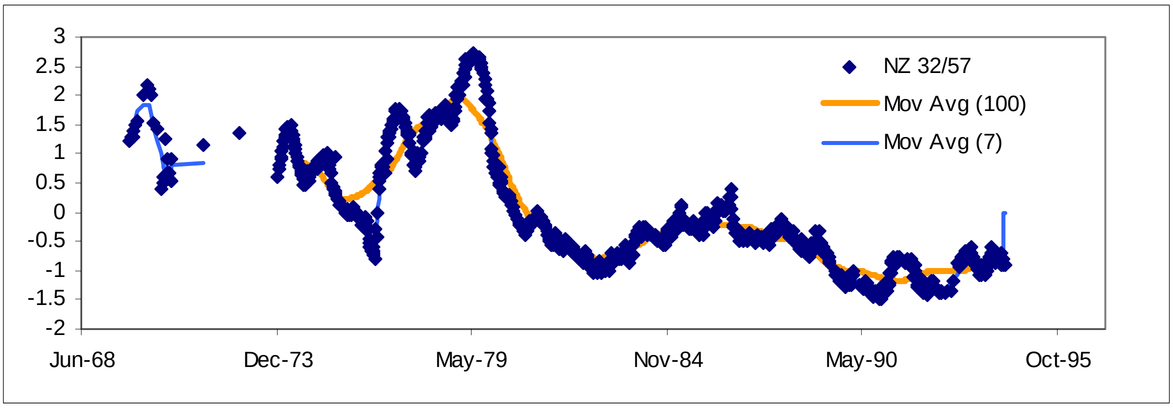
NORMALISED WATER LEVEL DATA WITH MOVING AVERAGES SMOOTHING LINES

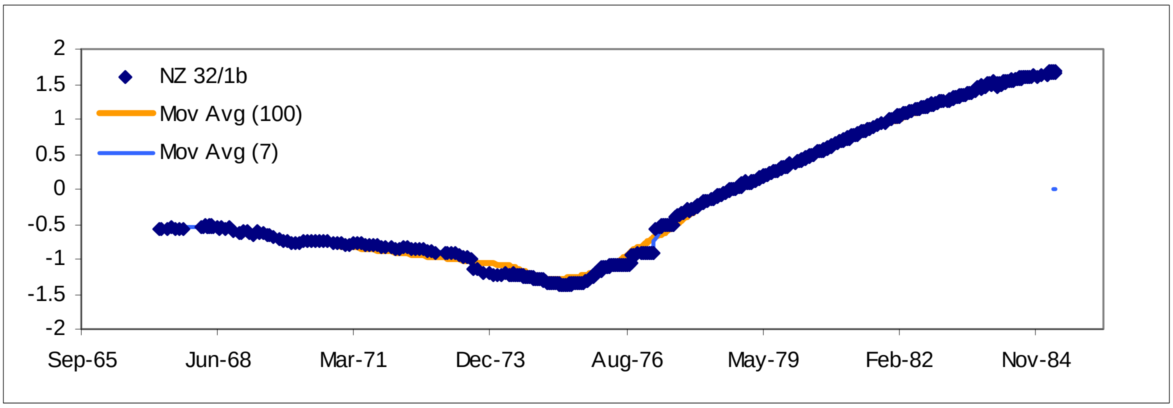


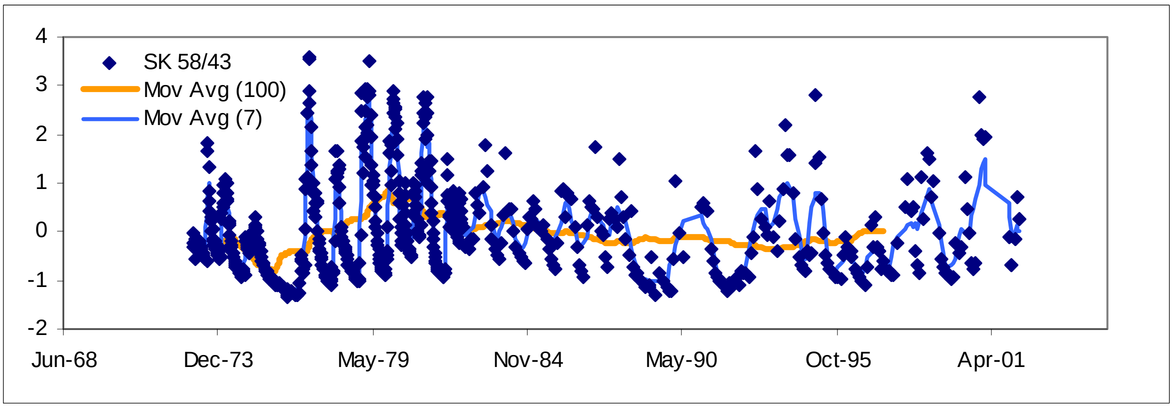


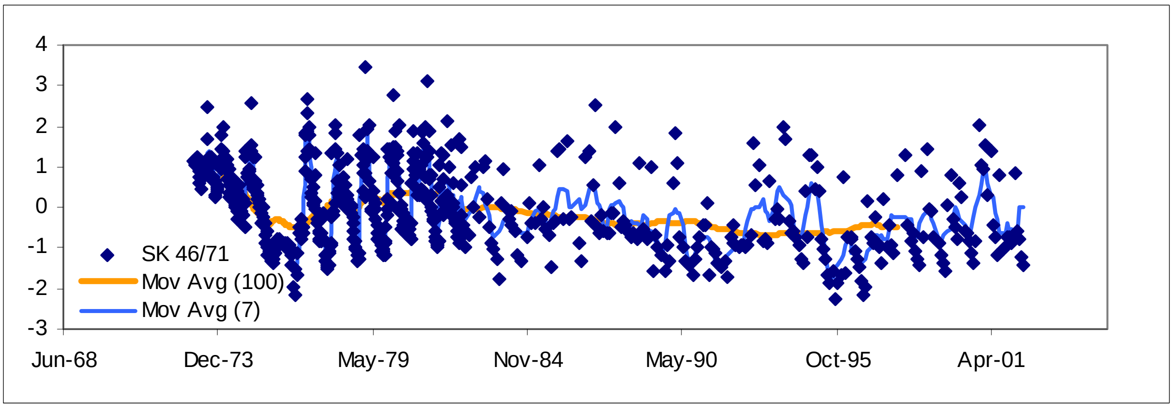


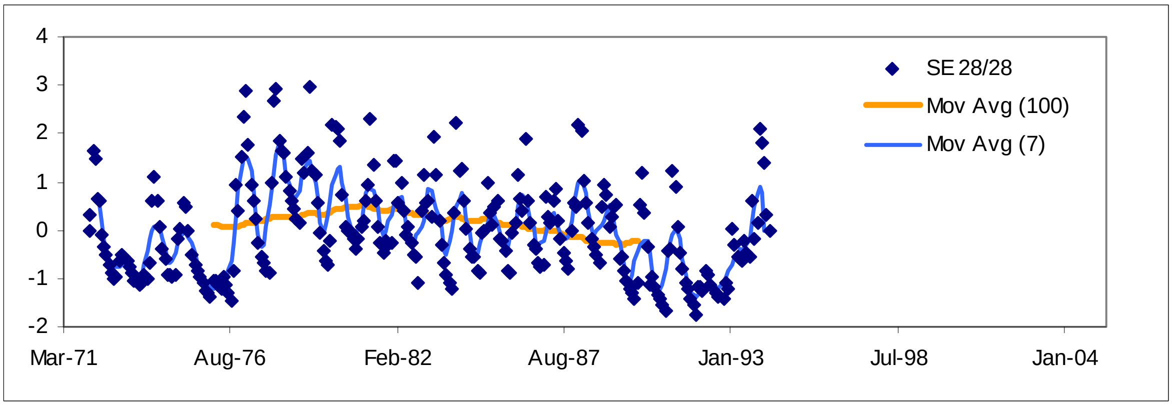


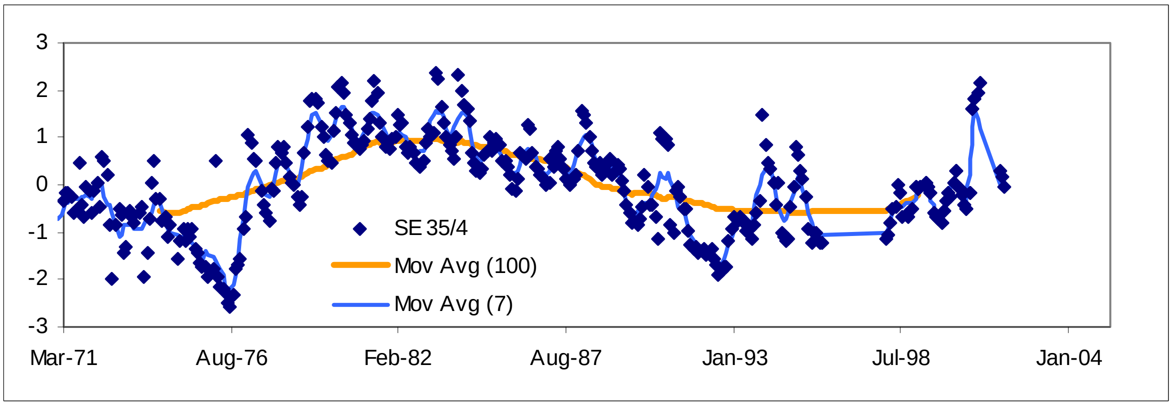

3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
NZ 32/57
Mov Avg (100)
Mov Avg (7)
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95

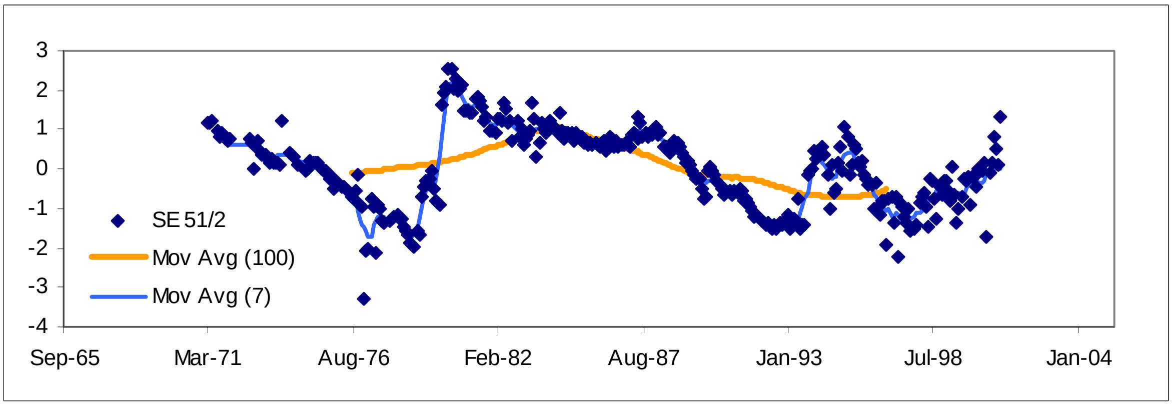

2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
NZ 32/1b
Mov Avg (100)
Mov Avg (7)
Sep-65
Jun-68
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84

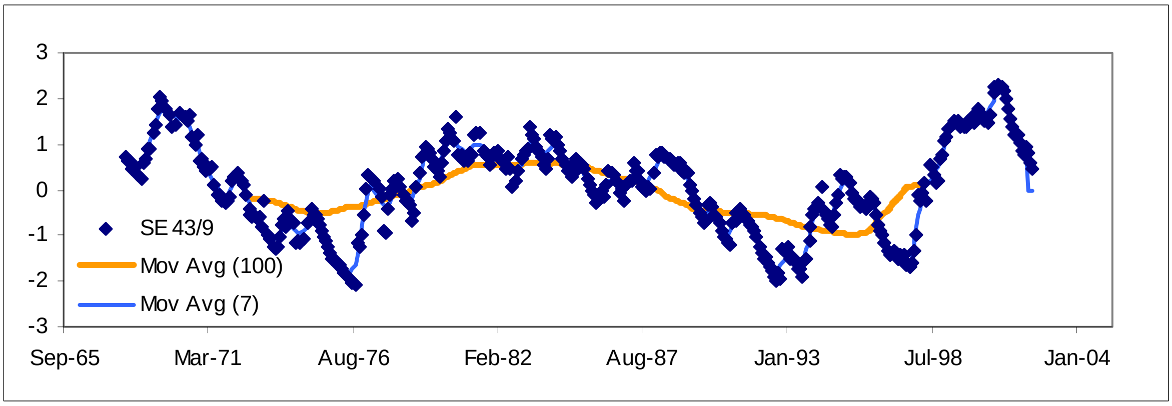

4
3
2
1
0
-1
-2
SK 58/43
Mov Avg (100)
Mov Avg (7)
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

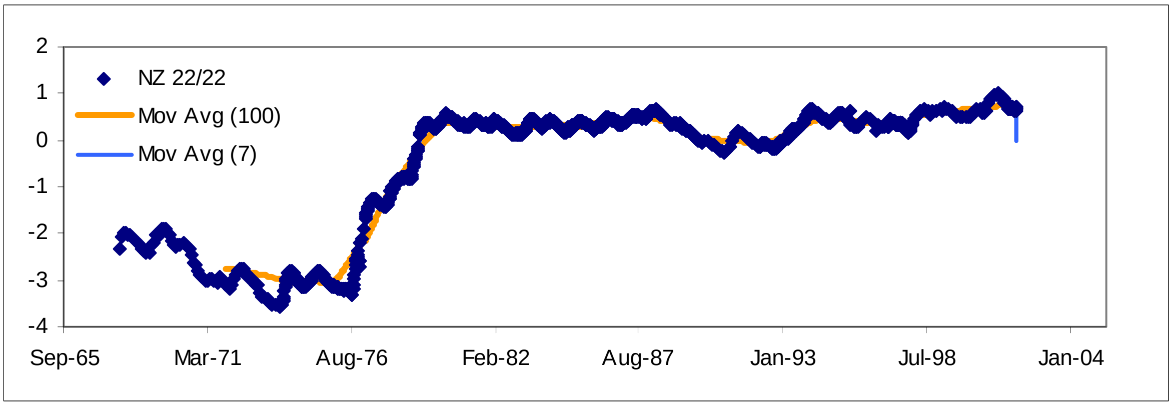

4
3
2
1
0
-1
-2
-3
SK 46/71
Mov Avg (100)
Mov Avg (7)
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

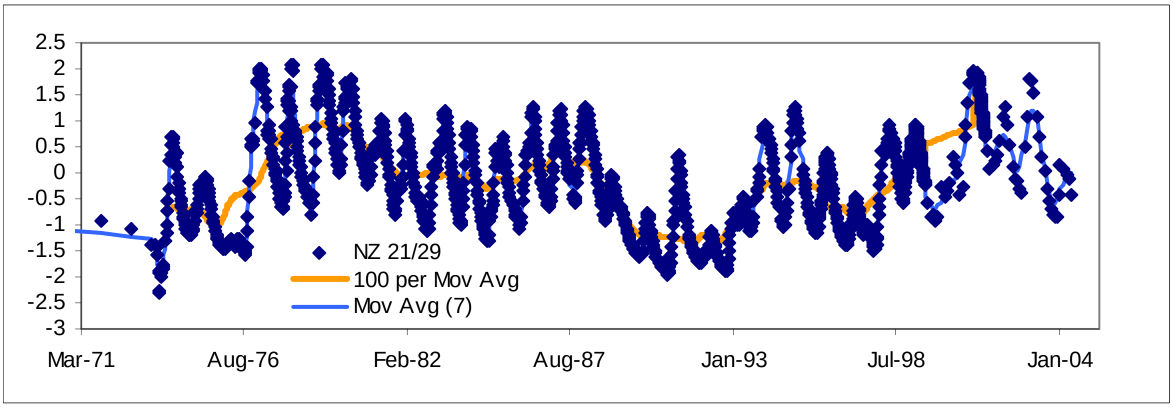

SE 28/28
Mov Avg (100)
Mov Avg (7)
4
3
2
1
0
-1
-2
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04


SE 35/4
Mov Avg (100)
Mov Avg (7)
3
2
1
0
-1
-2
-3
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

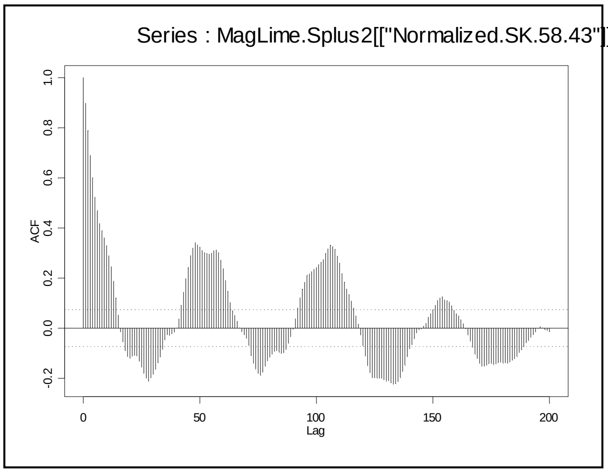

SE 51/2
Mov Avg (100)
Mov Avg (7)
3
2
1
0
-1
-2
-3
-4
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

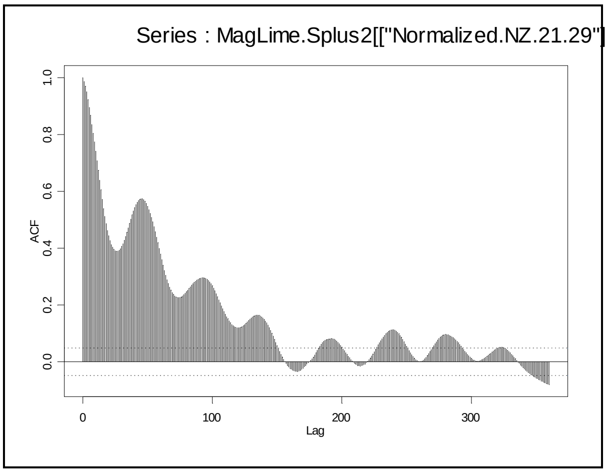

SE 43/9
Mov Avg (100)
Mov Avg (7)
3
2
1
0
-1
-2
-3
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

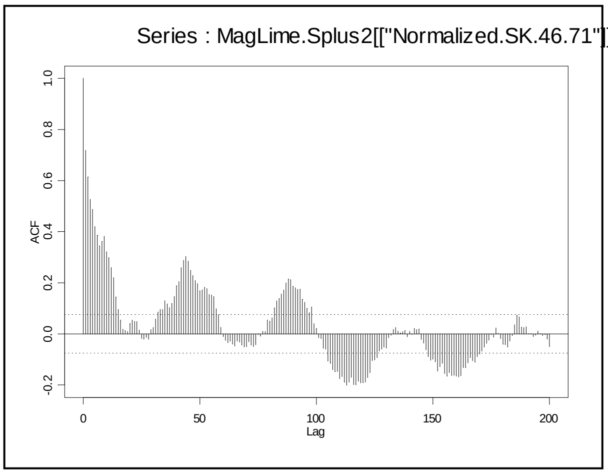

2
1
0
-1
-2
-3
-4
NZ 22/22
Mov Avg (100)
Mov Avg (7)
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

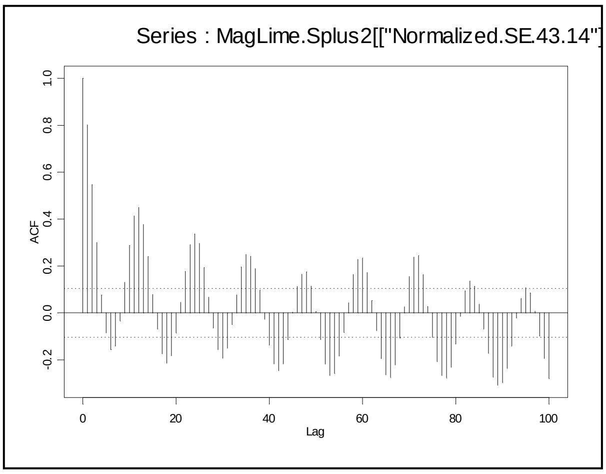

2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
NZ 21/29
100 per Mov Avg
Mov Avg (7)
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

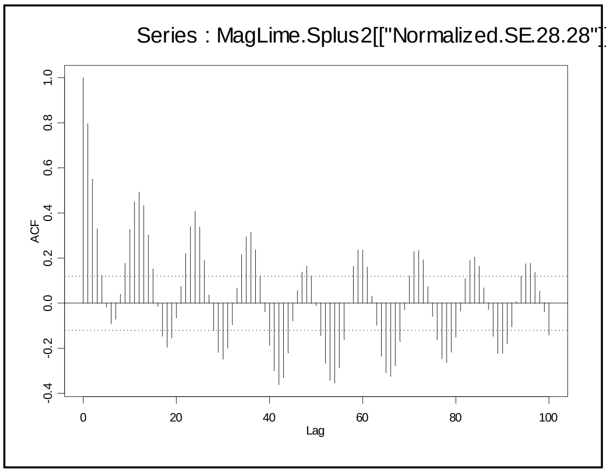
AUTOCORRELATION FUNTION PLOTS

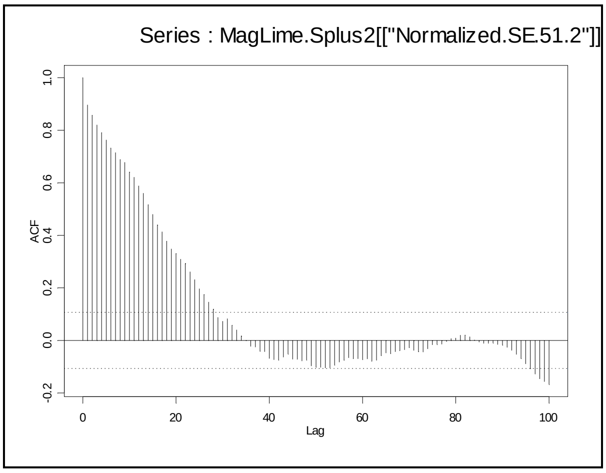


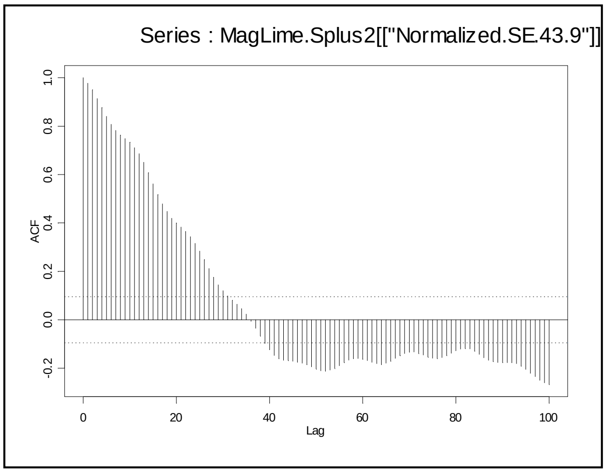
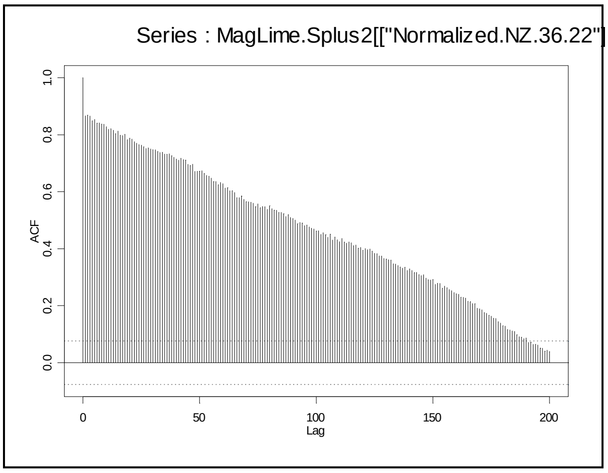
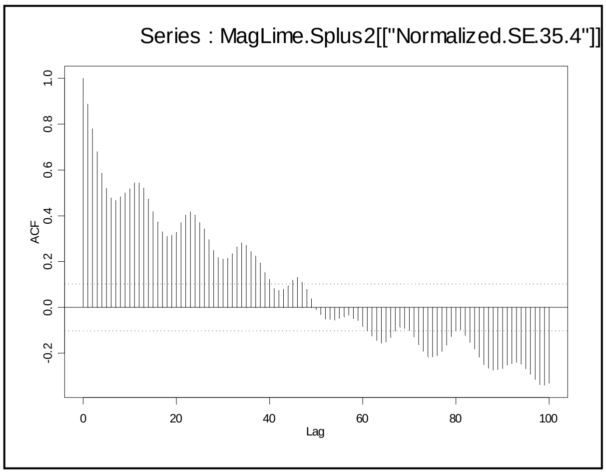
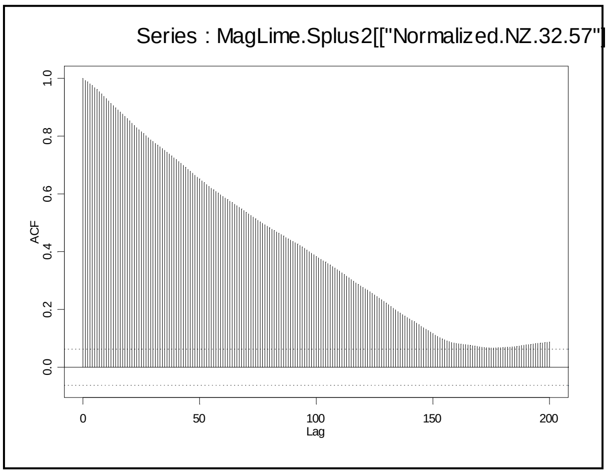
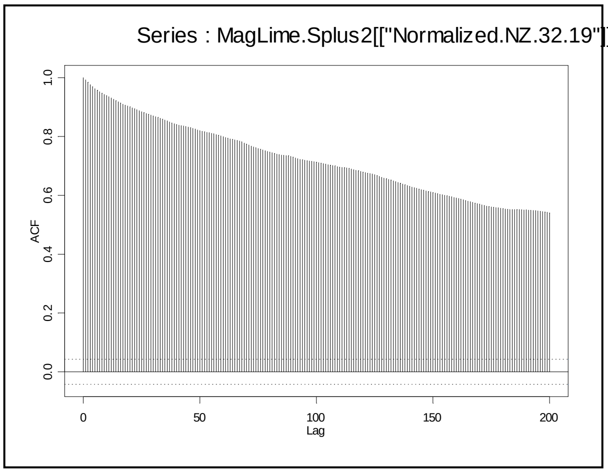
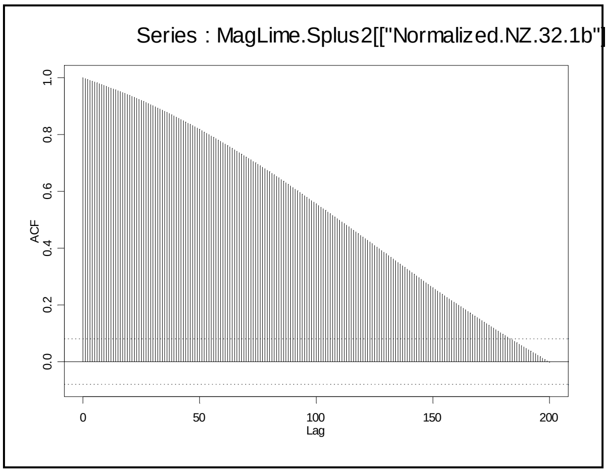


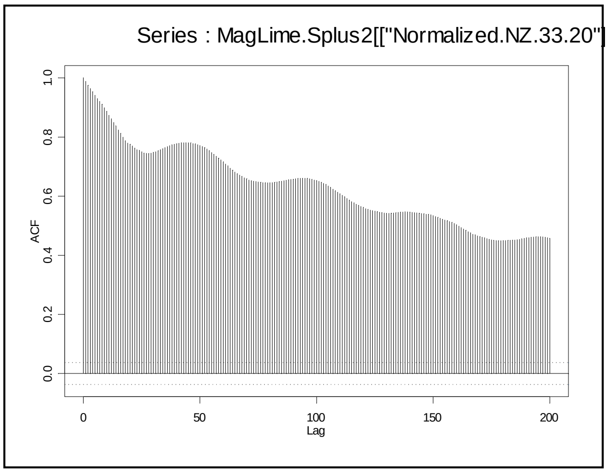




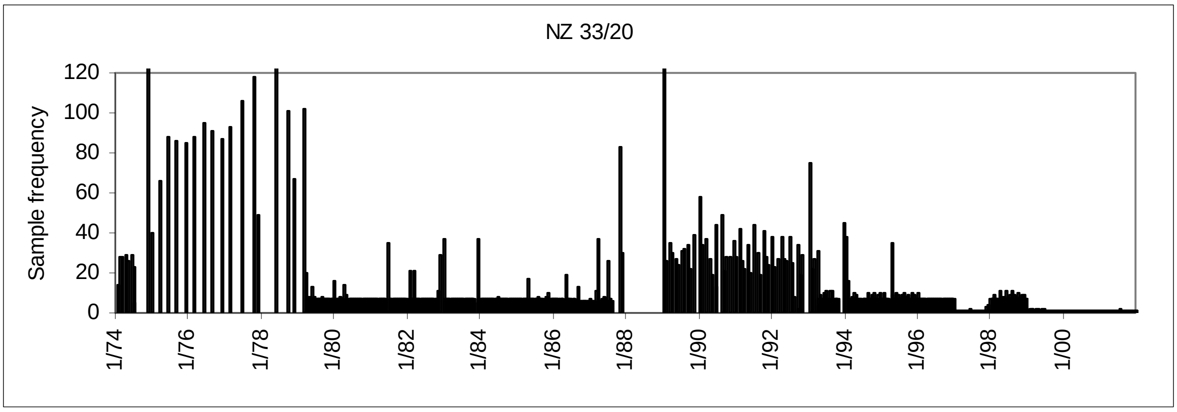


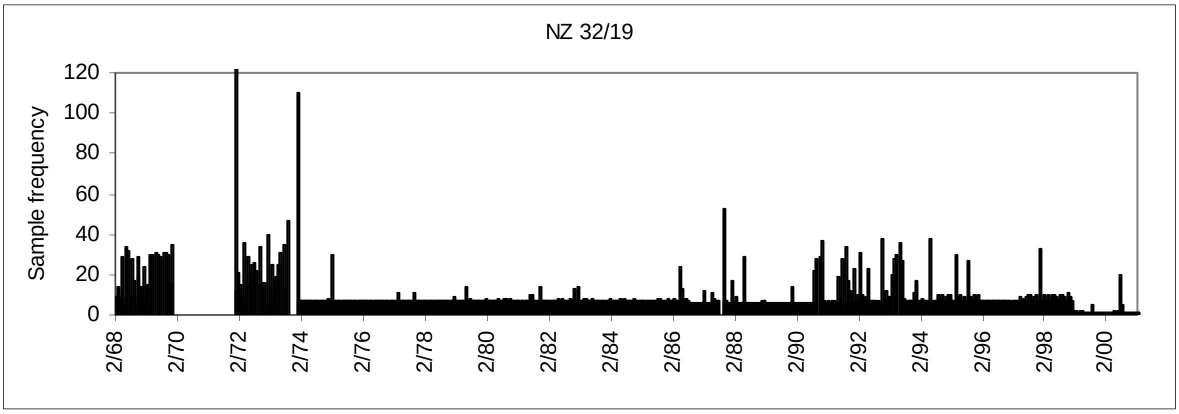


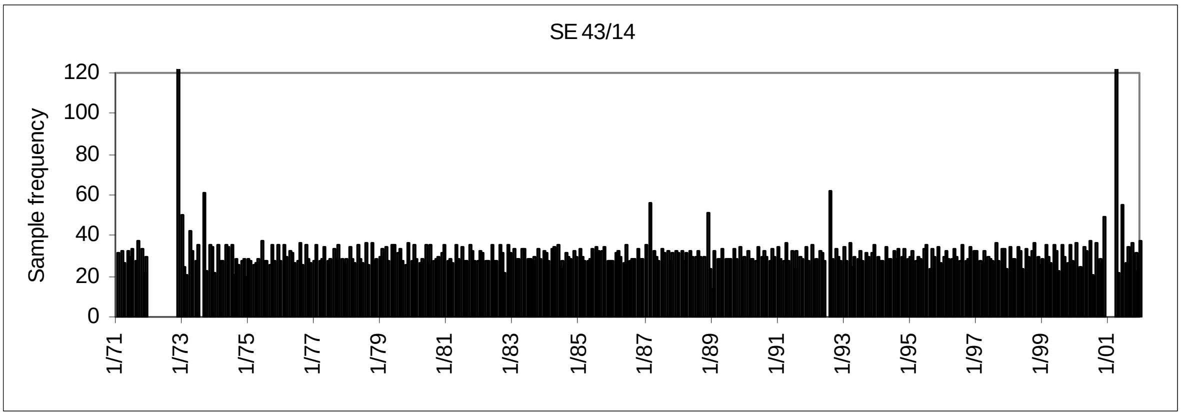

Series : MagLime.Splus2[["Normalized.SE.43.9"]]
ACF
Lag

Series : MagLime.Splus2[["Normalized.NZ.36.22"]
ACF
Lag

Series : MagLime.Splus2[["Normalized.SE.35.4"]]
ACF
Lag

Series : MagLime.Splus2[["Normalized.NZ.32.57"]
ACF
Lag

Series : MagLime.Splus2[["Normalized.NZ.32.19"]]
ACF
Lag

Series : MagLime.Splus2[["Normalized.NZ.32.1b"]
ACF
Lag

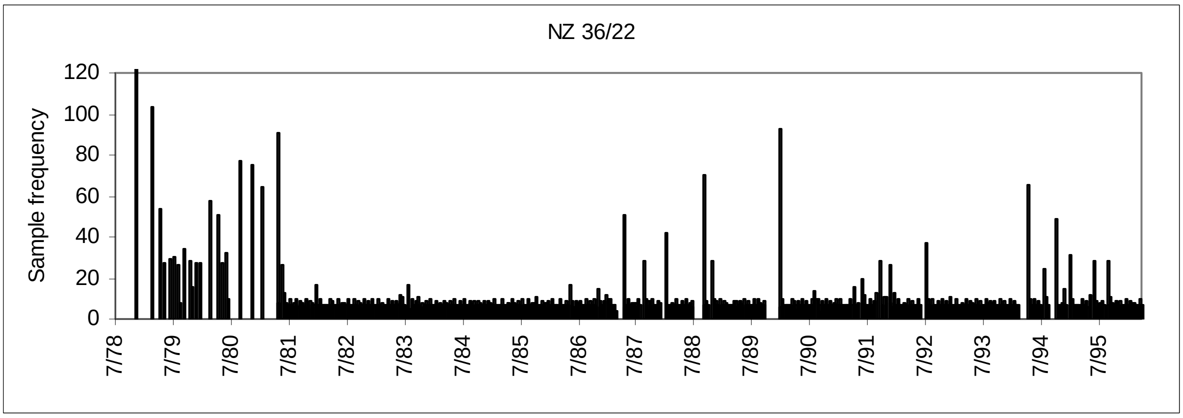

Series : MagLime.Splus2[["Normalized.NZ.33.20"]]
ACF
0.0
0.2
0.4
0.6
0.8
1.0
0
50
100
150
200
Lag

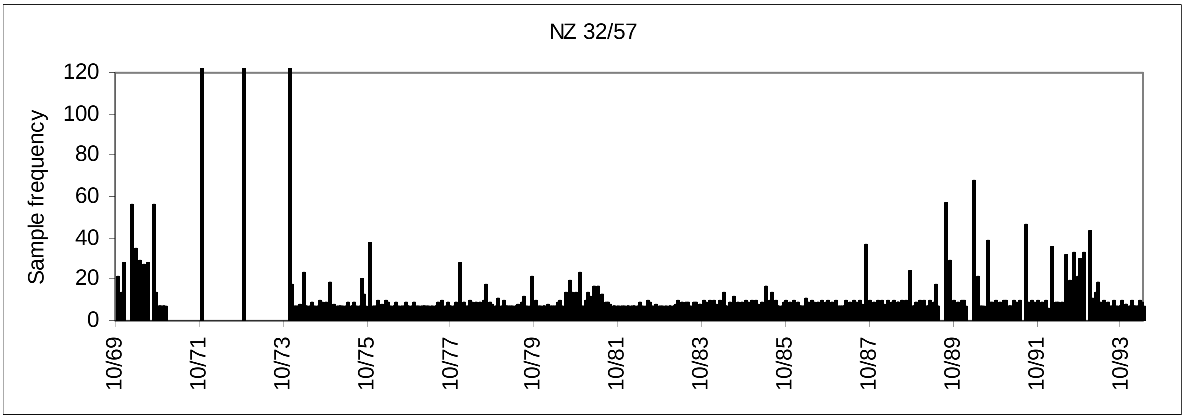
SAMPLE FREQUENCY PLOTS

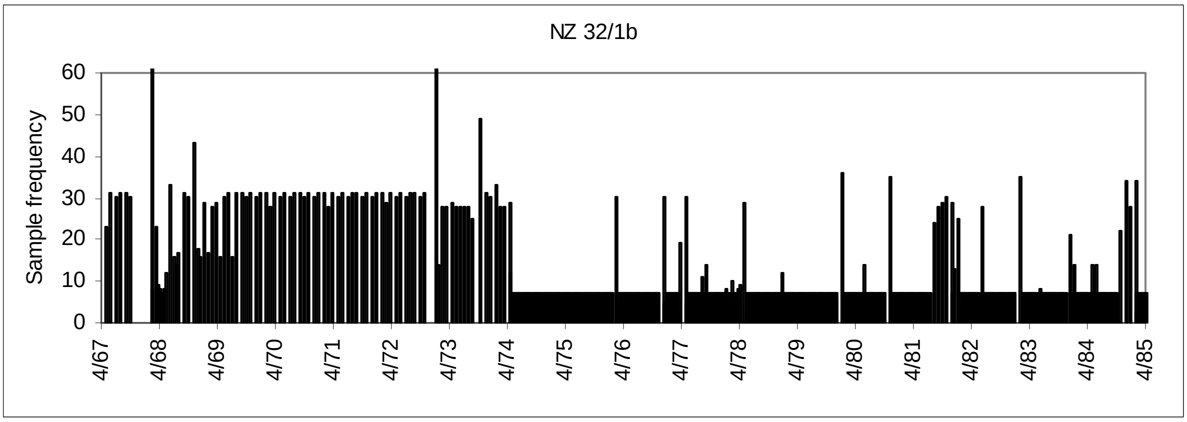


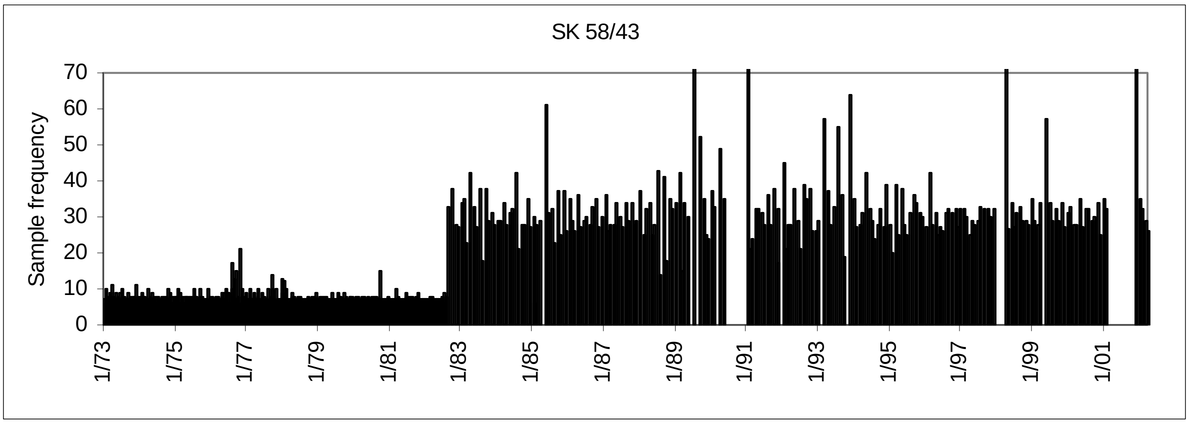


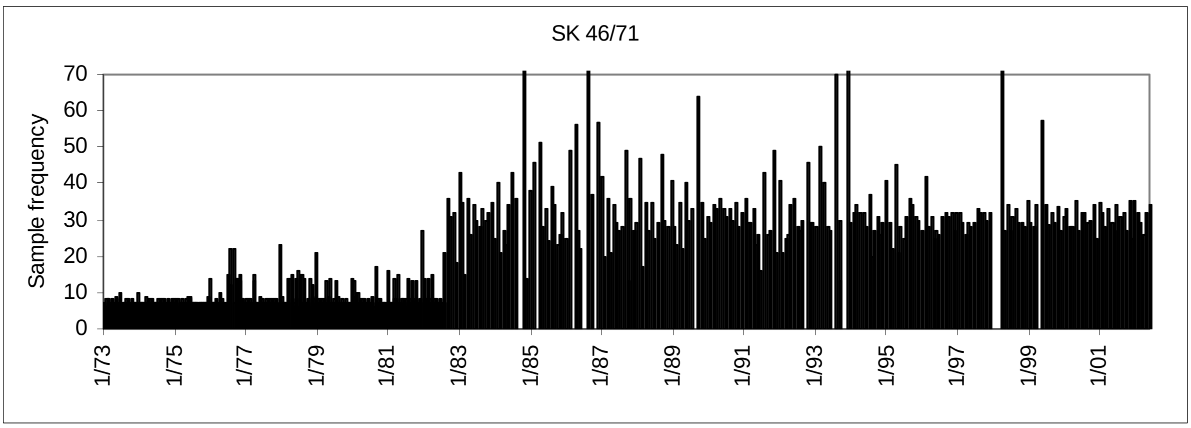


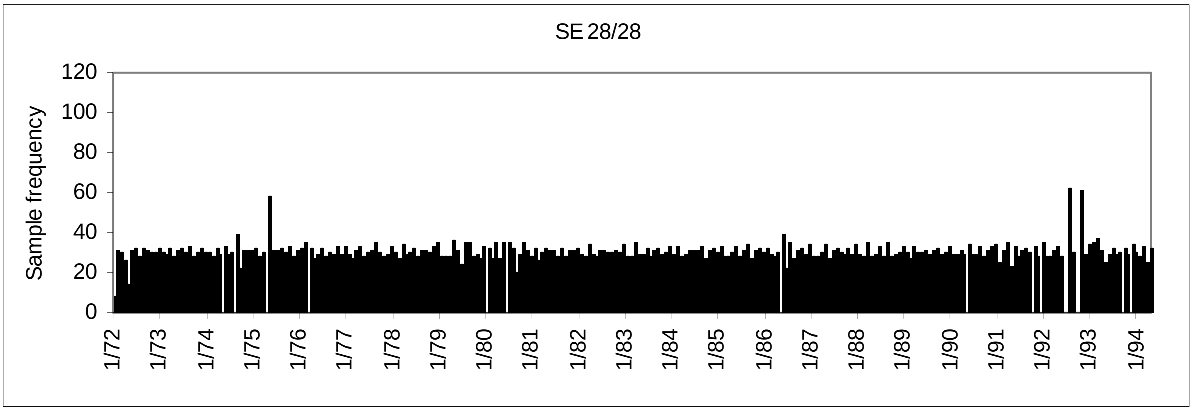


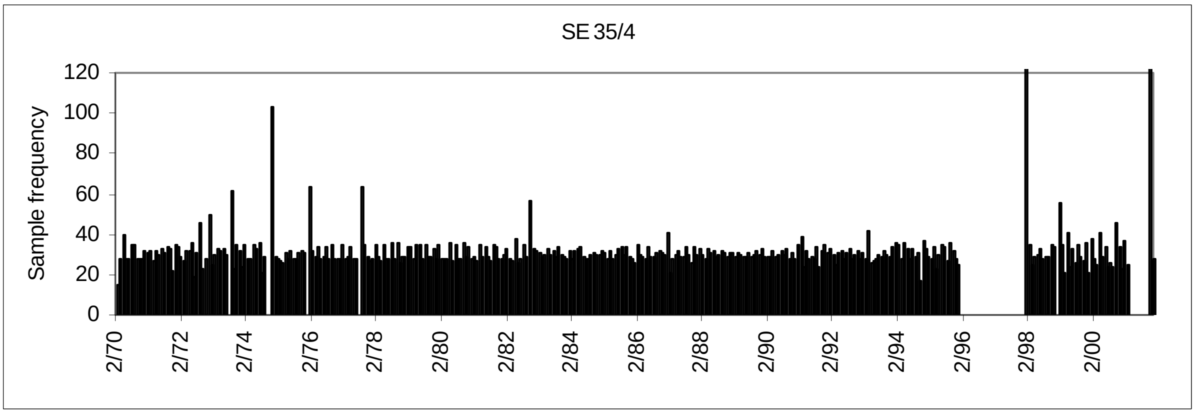

NZ 32/57
Sample frequency
0
20
40
60
80
100
120
10/69
10/71
10/73
10/75
10/77
10/79
10/81
10/83
10/85
10/87
10/89
10/91
10/93

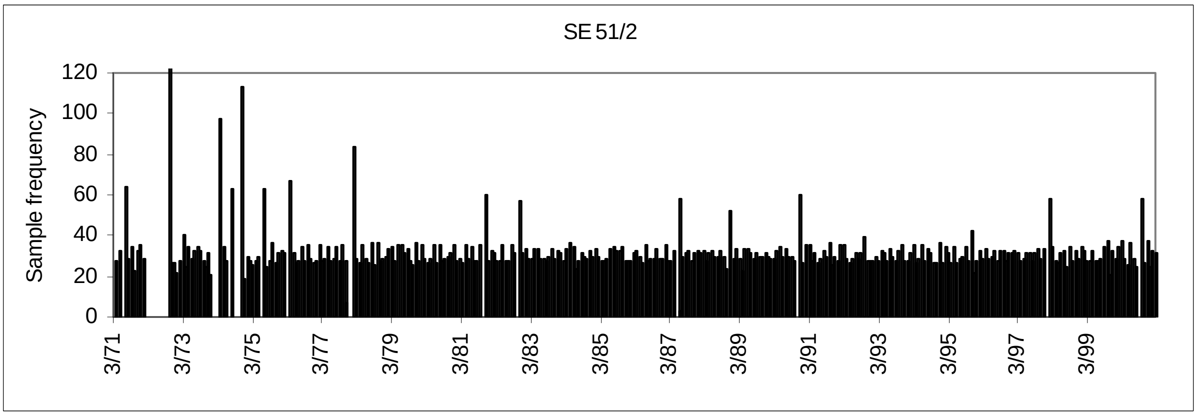

NZ 32/1b
Sample frequency
0
10
20
30
40
50
60
4/67
4/68
4/69
4/70
4/71
4/72
4/73
4/74
4/75
4/76
4/77
4/78
4/79
4/80
4/81
4/82
4/83
4/84
4/85

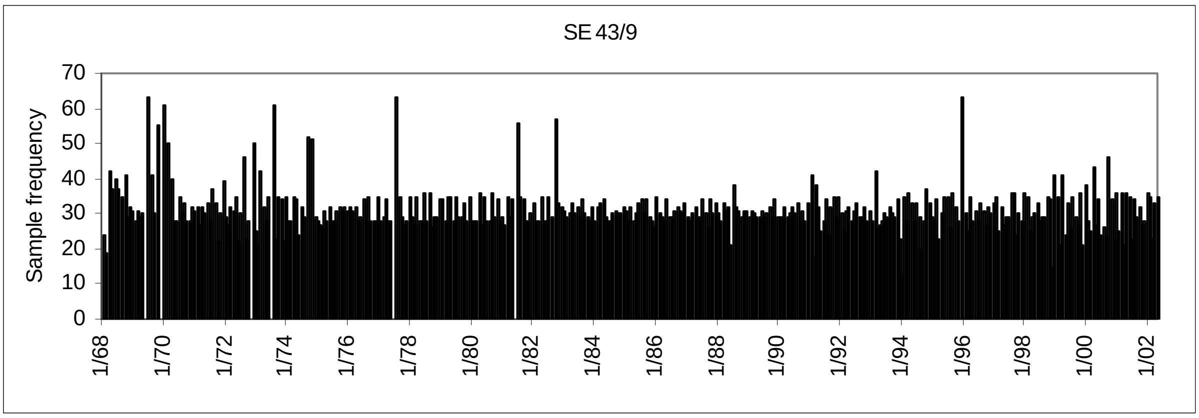

SK 58/43
Sample frequency
0
10
20
30
40
50
60
70
1/73
1/75
1/77
1/79
1/81
1/83
1/85
1/87
1/89
1/91
1/93
1/95
1/97
1/99
1/01

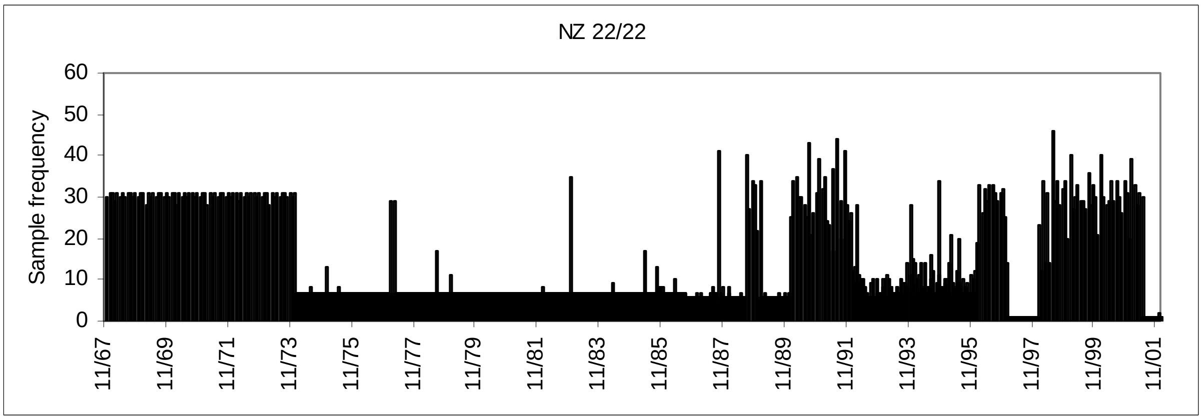

SK 46/71
Sample frequency
0
10
20
30
40
50
60
70
1/73
1/75
1/77
1/79
1/81
1/83
1/85
1/87
1/89
1/91
1/93
1/95
1/97
1/99
1/01

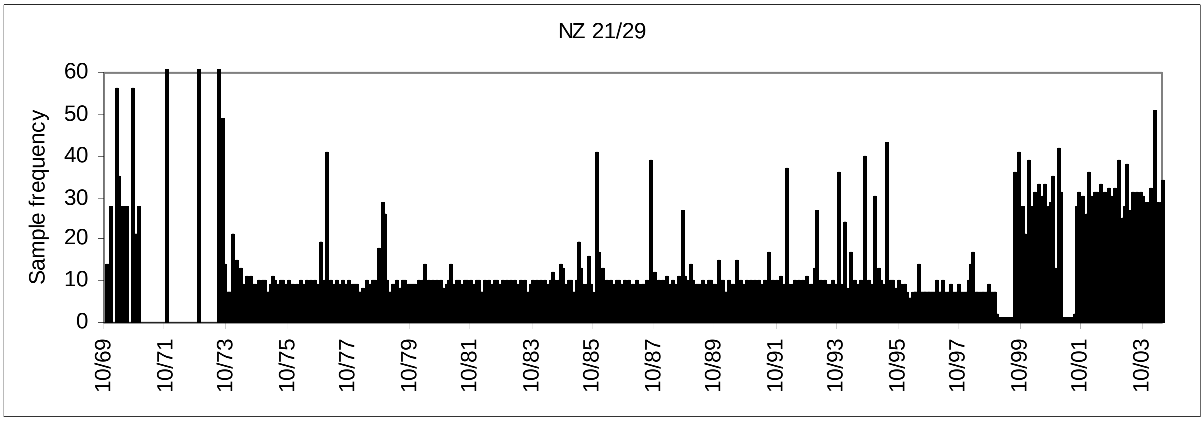

SE 28/28
Sample frequency
0
20
40
60
80
100
120
1/72
1/73
1/74
1/75
1/76
1/77
1/78
1/79
1/80
1/81
1/82
1/83
1/84
1/85
1/86
1/87
1/88
1/89
1/90
1/91
1/92
1/93
1/94


SE 35/4
Sample frequency
0
20
40
60
80
100
120
2/70
2/72
2/74
2/76
2/78
2/80
2/82
2/84
2/86
2/88
2/90
2/92
2/94
2/96
2/98
2/00


SE 51/2
Sample frequency
0
20
40
60
80
100
120
3/71
3/73
3/75
3/77
3/79
3/81
3/83
3/85
3/87
3/89
3/91
3/93
3/95
3/97
3/99


SE 43/9
Sample frequency
0
10
20
30
40
50
60
70
1/68
1/70
1/72
1/74
1/76
1/78
1/80
1/82
1/84
1/86
1/88
1/90
1/92
1/94
1/96
1/98
1/00
1/02


NZ 22/22
Sample frequency
0
10
20
30
40
50
60
11/67
11/69
11/71
11/73
11/75
11/77
11/79
11/81
11/83
11/85
11/87
11/89
11/91
11/93
11/95
11/97
11/99
11/01


NZ 21/29
Sample frequency
0
10
20
30
40
50
60
10/69
10/71
10/73
10/75
10/77
10/79
10/81
10/83
10/85
10/87
10/89
10/91
10/93
10/95
10/97
10/99
10/01
10/03

WELLMASTER LOOK-UP TABLE – GROUP1

Jan	1974 **High**	Feb	1978 **Very high**	Mar	1982 **High**
Feb	1974 **High**	Mar	1978 **Very high**	Apr	1982 **High**
Mar	1974 **Very high**	Apr	1978 **Very high**	May	1982 **Average**
Apr	1974 **High**	May	1978 **High**	Jun	1982 **Average**
May	1974 **Average**	Jun	1978 **High**	Jul	1982 **Average**
Jun	1974 **Average**	Jul	1978 **Average**	Aug	1982 **Low**
Jul	1974 **Low**	Aug	1978 **Low**	Sep	1982 **Very low**
Aug	1974 **Low**	Sep	1978 **Low**	Oct	1982 **Very low**
Sep	1974 **Very low**	Oct	1978 **Very low**	Nov	1982 **Low**
Oct	1974 **Low**	Nov	1978 **Very low**	Dec	1982 **Average**
Nov	1974 **Low**	Dec	1978 **High**	Jan	1983 **High**
Dec	1974 **Average**	Jan	1979 **Very high**	Feb	1983 **High**
Jan	1975 **Average**	Feb	1979 **Very high**	Mar	1983 **High**
Feb	1975 **High**	Mar	1979 **Very high**	Apr	1983 **Very high**
Mar	1975 **High**	Apr	1979 **Very high**	May	1983 **Very high**
Apr	1975 **Average**	May	1979 **Very high**	Jun	1983 **Very high**
May	1975 **Average**	Jun	1979 **Very high**	Jul	1983 **High**
Jun	1975 **Low**	Jul	1979 **High**	Aug	1983 **Average**
Jul	1975 **Low**	Aug	1979 **Average**	Sep	1983 **Low**
Aug	1975 **Very low**	Sep	1979 **Low**	Oct	1983 **Low**
Sep	1975 **Very low**	Oct	1979 **Low**	Nov	1983 **Very low**
Oct	1975 **Very low**	Nov	1979 **Low**	Dec	1983 **Low**
Nov	1975 **Very low**	Dec	1979 **Very high**	Jan	1984 **High**
Dec	1975 **Very low**	Jan	1980 **Very high**	Feb	1984 **Very high**
Jan	1976 **Very low**	Feb	1980 **Very high**	Mar	1984 **High**
Feb	1976 **Very low**	Mar	1980 **Very high**	Apr	1984 **High**
Mar	1976 **Very low**	Apr	1980 **Very high**	May	1984 **Average**
Apr	1976 **Very low**	May	1980 **High**	Jun	1984 **Average**
May	1976 **Very low**	Jun	1980 **Average**	Jul	1984 **Low**
Jun	1976 **Very low**	Jul	1980 **Average**	Aug	1984 **Very low**
Jul	1976 **Very low**	Aug	1980 **Average**	Sep	1984 **Very low**
Aug	1976 **Very low**	Sep	1980 **Low**	Oct	1984 **Very low**
Sep	1976 **Very low**	Oct	1980 **Average**	Nov	1984 **Low**
Oct	1976 **Low**	Nov	1980 **High**	Dec	1984 **Average**
Nov	1976 **Average**	Dec	1980 **High**	Jan	1985 **Average**
Dec	1976 **High**	Jan	1981 **High**	Feb	1985 **High**
Jan	1977 **Very high**	Feb	1981 **Very high**	Mar	1985 **High**
Feb	1977 **Very high**	Mar	1981 **Very high**	Apr	1985 **High**
Mar	1977 **Very high**	Apr	1981 **Very high**	May	1985 **High**
Apr	1977 **Very high**	May	1981 **Very high**	Jun	1985 **Average**
May	1977 **Very high**	Jun	1981 **High**	Jul	1985 **Average**
Jun	1977 **Average**	Jul	1981 **Average**	Aug	1985 **Low**
Jul	1977 **Average**	Aug	1981 **Low**	Sep	1985 **Low**
Aug	1977 **Low**	Sep	1981 **Low**	Oct	1985 **Very low**
Sep	1977 **Low**	Oct	1981 **Low**	Nov	1985 **Low**
Oct	1977 **Very low**	Nov	1981 **Average**	Dec	1985 **Average**
Nov	1977 **Very low**	Dec	1981 **Average**	Jan	1986 **High**
Dec	1977 **Low**	Jan	1982 **High**	Feb	1986 **High**
Jan	1978 **High**	Feb	1982 **High**	Mar	1986 **High**

Apr	1986	**Very high**
May	1986	**Very high**
Jun	1986	**High**
Jul	1986	**High**
Aug	1986	**Average**
Sep	1986	**Low**
Oct	1986	**Low**
Nov	1986	**Low**
Dec	1986	**Average**
Jan	1987	**High**
Feb	1987	**High**
Mar	1987	**Very high**
Apr	1987	**Very high**
May	1987	**High**
Jun	1987	**High**
Jul	1987	**Average**
Aug	1987	**Low**
Sep	1987	**Low**
Oct	1987	**Low**
Nov	1987	**Average**
Dec	1987	**High**
Jan	1988	**Very high**
Feb	1988	**Very high**
Mar	1988	**Very high**
Apr	1988	**High**
May	1988	**High**
Jun	1988	**Average**
Jul	1988	**Average**
Aug	1988	**Low**
Sep	1988	**Low**
Oct	1988	**Low**
Nov	1988	**Average**
Dec	1988	**Average**
Jan	1989	**Average**
Feb	1989	**Low**
Mar	1989	**Low**
Apr	1989	**Low**
May	1989	**Low**
Jun	1989	**Low**
Jul	1989	**Very low**
Aug	1989	**Very low**
Sep	1989	**Very low**
Oct	1989	**Very low**
Nov	1989	**Very low**
Dec	1989	**Very low**
Jan	1990	**Low**
Feb	1990	**Average**
Mar	1990	**Average**
Apr	1990	**Low**
May	1990	**Very low**
Jun	1990	**Very low**
Jul	1990	**Very low**
Aug	1990	**Very low**
Sep	1990	**Very low**
Oct	1990	**Very low**
Nov	1990	**Very low**
Dec	1990	**Very low**
Jan	1991	**Very low**
Feb	1991	**Average**
Mar	1991	**High**
Apr	1991	**Average**
May	1991	**Low**
Jun	1991	**Low**
Jul	1991	**Very low**
Aug	1991	**Very low**
Sep	1991	**Very low**
Oct	1991	**Very low**
Nov	1991	**Very low**
Dec	1991	**Very low**
Jan	1992	**Very low**
Feb	1992	**Very low**
Mar	1992	**Very low**
Apr	1992	**Very low**
May	1992	**Very low**
Jun	1992	**Very low**
Jul	1992	**Very low**
Aug	1992	**Very low**
Sep	1992	**Very low**
Oct	1992	**Very low**
Nov	1992	**Very low**
Dec	1992	**Low**
Jan	1993	**Average**
Feb	1993	**Average**
Mar	1993	**Low**
Apr	1993	**Low**
May	1993	**Low**
Jun	1993	**Low**
Jul	1993	**Low**
Aug	1993	**Very low**
Sep	1993	**Low**
Oct	1993	**Average**
Nov	1993	**Average**
Dec	1993	**High**
Jan	1994	**Very high**
Feb	1994	**Very high**
Mar	1994	**Very high**
Apr	1994	**High**
May	1994	**Average**
Jun	1994	**Average**
Jul	1994	**Low**
Aug	1994	**Low**
Sep	1994	**Low**
Oct	1994	**Low**
Nov	1994	**Average**
Dec	1994	**High**
Jan	1995	**Very high**
Feb	1995	**Very high**
Mar	1995	**Very high**
Apr	1995	**High**
May	1995	**Average**
Jun	1995	**Low**
Jul	1995	**Low**
Aug	1995	**Very low**
Sep	1995	**Very low**
Oct	1995	**Very low**
Nov	1995	**Very low**
Dec	1995	**Very low**
Jan	1996	**Low**
Feb	1996	**Average**
Mar	1996	**Average**
Apr	1996	**Average**
May	1996	**Average**
Jun	1996	**Low**
Jul	1996	**Very low**
Aug	1996	**Very low**
Sep	1996	**Very low**
Oct	1996	**Very low**
Nov	1996	**Very low**
Dec	1996	**Very low**
Jan	1997	**Low**
Feb	1997	**Low**
Mar	1997	**Low**
Apr	1997	**Low**
May	1997	**Very low**
Jun	1997	**Low**
Jul	1997	**Low**
Aug	1997	**Low**
Sep	1997	**Very low**
Oct	1997	**Very low**
Nov	1997	**Very low**
Dec	1997	**Low**
Jan	1998	**Average**
Feb	1998	**High**
Mar	1998	**High**
Apr	1998	**High**
May	1998	**High**
Jun	1998	**High**

Jul	1998	**High**
Aug	1998	**Average**
Sep	1998	**Low**
Oct	1998	**Low**
Nov	1998	**Average**
Dec	1998	**Average**
Jan	1999	**High**
Feb	1999	**High**
Mar	1999	**Very high**
Apr	1999	**Very high**
May	1999	**High**
Jun	1999	**Average**
Jul	1999	**Average**
Aug	1999	**Low**
Sep	1999	**Low**
Oct	1999	**Low**
Nov	1999	**Low**
Dec	1999	**Average**
Jan	2000	**Average**
Feb	2000	**Average**
Mar	2000	**Average**
Apr	2000	**Average**
May	2000	**Average**
Jun	2000	**Average**
Jul	2000	**Average**
Aug	2000	**Average**
Sep	2000	**Average**
Oct	2000	**High**
Nov	2000	**Very high**
Dec	2000	**Very high**
Jan	2001	**Very high**
Feb	2001	**Very high**
Mar	2001	**Very high**
Apr	2001	**Very high**
May	2001	**Very high**
Jun	2001	**Very high**
Jul	2001	**High**
Aug	2001	**Average**
Sep	2001	**Average**
Oct	2001	**Average**
Nov	2001	**Low**
Dec	2001	**Average**
Jan	2002	**Average**
Feb	2002	**Average**
Mar	2002	**High**
Apr	2002	**Average**
May	2002	**Average**

WELLMASTER LOOK-UP TABLE – GROUP2

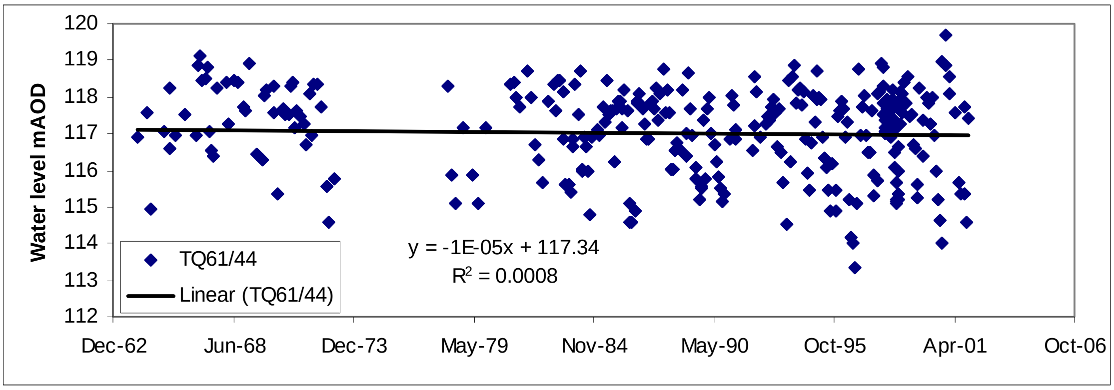
May	1971	**Average**	Oct	1975	**Very low**	Mar	1980	**Very high**
Jun	1971	**Average**	Nov	1975	**Very low**	Apr	1980	**Very high**
Jul	1971	**Average**	Dec	1975	**Very low**	May	1980	**Very high**
Aug	1971	**Average**	Jan	1976	**Very low**	Jun	1980	**Very high**
Sep	1971	**Average**	Feb	1976	**Very low**	Jul	1980	**Very high**
Oct	1971	**Average**	Mar	1976	**Very low**	Aug	1980	**Very high**
Nov	1971	**Average**	Apr	1976	**Very low**	Sep	1980	**Very high**
Dec	1971	**Average**	May	1976	**Very low**	Oct	1980	**Very high**
Jan	1972	**Average**	Jun	1976	**Very low**	Nov	1980	**Very high**
Feb	1972	**Average**	Jul	1976	**Very low**	Dec	1980	**Very high**
Mar	1972	**Average**	Aug	1976	**Very low**	Jan	1981	**Very high**
Apr	1972	**Average**	Sep	1976	**Very low**	Feb	1981	**Very high**
May	1972	**Average**	Oct	1976	**Very low**	Mar	1981	**Very high**
Jun	1972	**Average**	Nov	1976	**Very low**	Apr	1981	**Very high**
Jul	1972	**Average**	Dec	1976	**Very low**	May	1981	**Very high**
Aug	1972	**Average**	Jan	1977	**Very low**	Jun	1981	**Very high**
Sep	1972	**Low**	Feb	1977	**Low**	Jul	1981	**Very high**
Oct	1972	**Low**	Mar	1977	**Low**	Aug	1981	**Very high**
Nov	1972	**Low**	Apr	1977	**Average**	Sep	1981	**Very high**
Dec	1972	**Average**	May	1977	**Average**	Oct	1981	**High**
Jan	1973	**Low**	Jun	1977	**Low**	Nov	1981	**High**
Feb	1973	**Low**	Jul	1977	**Low**	Dec	1981	**Very high**
Mar	1973	**Low**	Aug	1977	**Low**	Jan	1982	**Very high**
Apr	1973	**Low**	Sep	1977	**Low**	Feb	1982	**Very high**
May	1973	**Low**	Oct	1977	**Low**	Mar	1982	**Very high**
Jun	1973	**Low**	Nov	1977	**Low**	Apr	1982	**Very high**
Jul	1973	**Low**	Dec	1977	**Low**	May	1982	**Very high**
Aug	1973	**Low**	Jan	1978	**Low**	Jun	1982	**Very high**
Sep	1973	**Low**	Feb	1978	**Average**	Jul	1982	**High**
Oct	1973	**Low**	Mar	1978	**Average**	Aug	1982	**High**
Nov	1973	**Low**	Apr	1978	**Average**	Sep	1982	**High**
Dec	1973	**Low**	May	1978	**Average**	Oct	1982	**High**
Jan	1974	**Average**	Jun	1978	**Low**	Nov	1982	**High**
Feb	1974	**Average**	Jul	1978	**Low**	Dec	1982	**High**
Mar	1974	**Average**	Aug	1978	**Low**	Jan	1983	**High**
Apr	1974	**Low**	Sep	1978	**Low**	Feb	1983	**Very high**
May	1974	**Low**	Oct	1978	**Low**	Mar	1983	**Very high**
Jun	1974	**Low**	Nov	1978	**Low**	Apr	1983	**Very high**
Jul	1974	**Low**	Dec	1978	**Low**	May	1983	**Very high**
Aug	1974	**Low**	Jan	1979	**Low**	Jun	1983	**Very high**
Sep	1974	**Low**	Feb	1979	**Average**	Jul	1983	**Very high**
Oct	1974	**Low**	Mar	1979	**High**	Aug	1983	**Very high**
Nov	1974	**Low**	Apr	1979	**High**	Sep	1983	**Very high**
Dec	1974	**Low**	May	1979	**High**	Oct	1983	**Very high**
Jan	1975	**Low**	Jun	1979	**High**	Nov	1983	**High**
Feb	1975	**Low**	Jul	1979	**High**	Dec	1983	**High**
Mar	1975	**Low**	Aug	1979	**High**	Jan	1984	**Very high**
Apr	1975	**Low**	Sep	1979	**Average**	Feb	1984	**Very high**
May	1975	**Low**	Oct	1979	**Average**	Mar	1984	**Very high**
Jun	1975	**Low**	Nov	1979	**Average**	Apr	1984	**Very high**
Jul	1975	**Low**	Dec	1979	**High**	May	1984	**Very high**
Aug	1975	**Very low**	Jan	1980	**Very high**	Jun	1984	**Very high**
Sep	1975	**Very low**	Feb	1980	**Very high**	Jul	1984	**Very high**

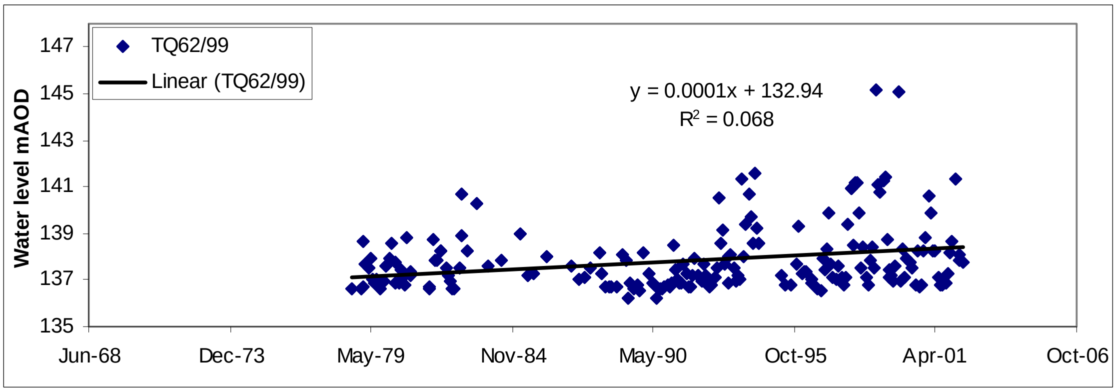
Aug	1984	**High**	Jan	1989	**High**	Jun	1993	**Very low**
Sep	1984	**High**	Feb	1989	**High**	Jul	1993	**Very low**
Oct	1984	**High**	Mar	1989	**Average**	Aug	1993	**Very low**
Nov	1984	**High**	Apr	1989	**Average**	Sep	1993	**Very low**
Dec	1984	**High**	May	1989	**Average**	Oct	1993	**Very low**
Jan	1985	**High**	Jun	1989	**Average**	Nov	1993	**Low**
Feb	1985	**High**	Jul	1989	**Average**	Dec	1993	**Average**
Mar	1985	**High**	Aug	1989	**Low**	Jan	1994	**Average**
Apr	1985	**High**	Sep	1989	**Low**	Feb	1994	**Average**
May	1985	**High**	Oct	1989	**Low**	Mar	1994	**Average**
Jun	1985	**High**	Nov	1989	**Low**	Apr	1994	**Average**
Jul	1985	**High**	Dec	1989	**Low**	May	1994	**Average**
Aug	1985	**High**	Jan	1990	**Low**	Jun	1994	**Average**
Sep	1985	**Average**	Feb	1990	**Average**	Jul	1994	**Low**
Oct	1985	**Average**	Mar	1990	**Average**	Aug	1994	**Low**
Nov	1985	**Average**	Apr	1990	**Low**	Sep	1994	**Low**
Dec	1985	**Average**	May	1990	**Low**	Oct	1994	**Low**
Jan	1986	**Average**	Jun	1990	**Low**	Nov	1994	**Low**
Feb	1986	**High**	Jul	1990	**Low**	Dec	1994	**Average**
Mar	1986	**High**	Aug	1990	**Low**	Jan	1995	**Average**
Apr	1986	**High**	Sep	1990	**Low**	Feb	1995	**High**
May	1986	**High**	Oct	1990	**Average**	Mar	1995	**High**
Jun	1986	**High**	Nov	1990	**Low**	Apr	1995	**High**
Jul	1986	**High**	Dec	1990	**Low**	May	1995	**Average**
Aug	1986	**High**	Jan	1991	**Low**	Jun	1995	**Average**
Sep	1986	**High**	Feb	1991	**Low**	Jul	1995	**Average**
Oct	1986	**Average**	Mar	1991	**Low**	Aug	1995	**Low**
Nov	1986	**Average**	Apr	1991	**Low**	Sep	1995	**Low**
Dec	1986	**Average**	May	1991	**Low**	Oct	1995	**Low**
Jan	1987	**Average**	Jun	1991	**Low**	Nov	1995	**Low**
Feb	1987	**High**	Jul	1991	**Low**	Dec	1995	**Low**
Mar	1987	**High**	Aug	1991	**Low**	Jan	1996	**Low**
Apr	1987	**High**	Sep	1991	**Very low**	Feb	1996	**Low**
May	1987	**High**	Oct	1991	**Very low**	Mar	1996	**Low**
Jun	1987	**High**	Nov	1991	**Very low**	Apr	1996	**Low**
Jul	1987	**High**	Dec	1991	**Very low**	May	1996	**Low**
Aug	1987	**High**	Jan	1992	**Very low**	Jun	1996	**Low**
Sep	1987	**Average**	Feb	1992	**Very low**	Jul	1996	**Low**
Oct	1987	**Average**	Mar	1992	**Very low**	Aug	1996	**Very low**
Nov	1987	**High**	Apr	1992	**Very low**	Sep	1996	**Very low**
Dec	1987	**High**	May	1992	**Very low**	Oct	1996	**Very low**
Jan	1988	**High**	Jun	1992	**Very low**	Nov	1996	**Very low**
Feb	1988	**Very high**	Jul	1992	**Very low**	Dec	1996	**Very low**
Mar	1988	**Very high**	Aug	1992	**Very low**	Jan	1997	**Very low**
Apr	1988	**Very high**	Sep	1992	**Very low**	Feb	1997	**Very low**
May	1988	**High**	Oct	1992	**Very low**	Mar	1997	**Very low**
Jun	1988	**High**	Nov	1992	**Very low**	Apr	1997	**Very low**
Jul	1988	**High**	Dec	1992	**Very low**	May	1997	**Very low**
Aug	1988	**High**	Jan	1993	**Very low**	Jun	1997	**Very low**
Sep	1988	**High**	Feb	1993	**Very low**	Jul	1997	**Very low**
Oct	1988	**High**	Mar	1993	**Very low**	Aug	1997	**Very low**
Nov	1988	**High**	Apr	1993	**Very low**	Sep	1997	**Very low**
Dec	1988	**High**	May	1993	**Very low**	Oct	1997	**Very low**

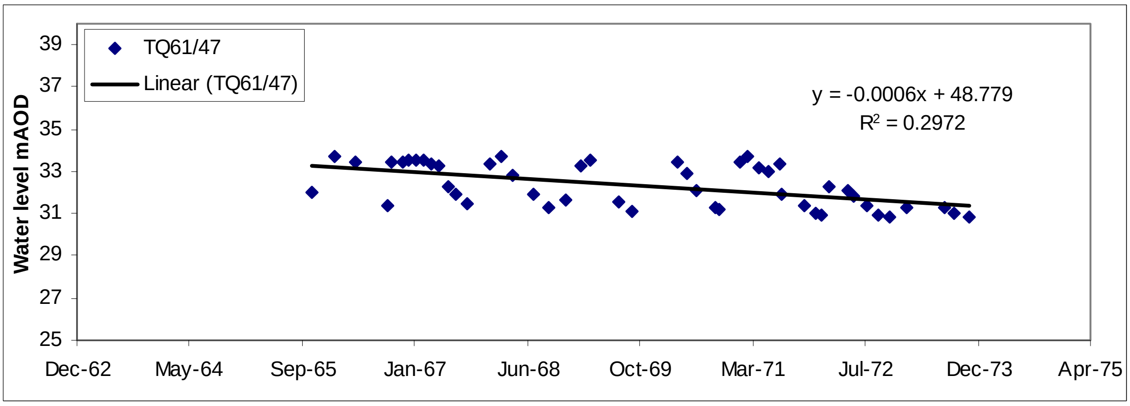
Nov	1997	**Very low**
Dec	1997	**Very low**
Jan	1998	**Low**
Feb	1998	**Low**
Mar	1998	**Low**
Apr	1998	**Low**
May	1998	**Low**
Jun	1998	**Average**
Jul	1998	**Average**
Aug	1998	**Low**
Sep	1998	**Low**
Oct	1998	**Low**
Nov	1998	**Average**
Dec	1998	**Average**
Jan	1999	**Average**
Feb	1999	**Average**
Mar	1999	**Average**
Apr	1999	**Average**
May	1999	**Average**
Jun	1999	**Average**
Jul	1999	**Average**
Aug	1999	**Average**
Sep	1999	**Average**
Oct	1999	**Average**
Nov	1999	**Average**
Dec	1999	**Average**
Jan	2000	**Average**
Feb	2000	**Average**
Mar	2000	**Average**
Apr	2000	**High**
May	2000	**High**
Jun	2000	**Average**
Jul	2000	**Average**
Aug	2000	**Average**
Sep	2000	**Average**
Oct	2000	**High**
Nov	2000	**Very high**
Dec	2000	**Very high**
Jan	2001	**Very high**
Feb	2001	**Very high**

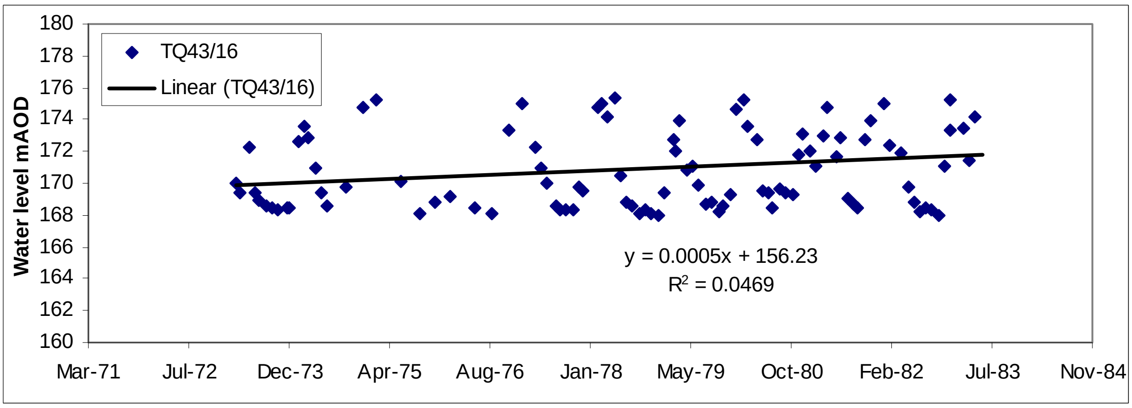
Appendix 2 Hasting Beds

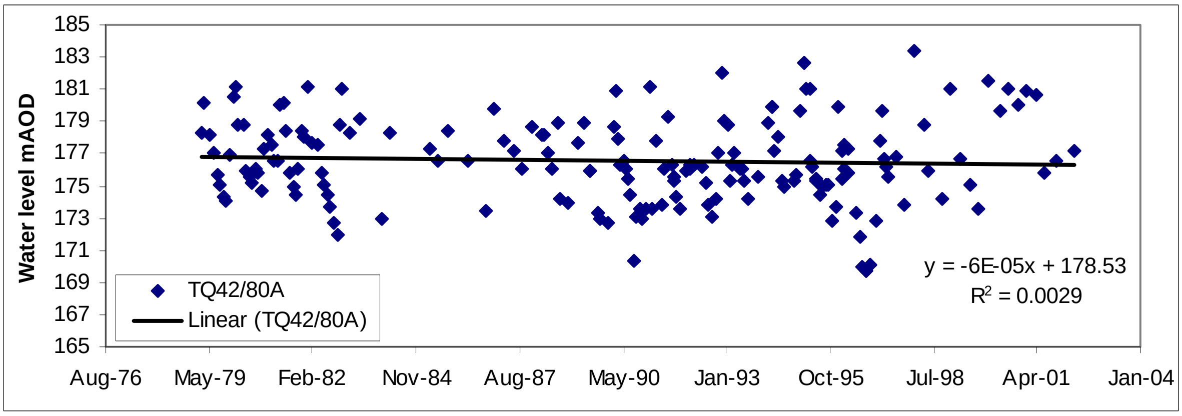
WATER LEVELS ABOVE ORDNANCE DATUM WITH LINEAR REGRESSION CURVE

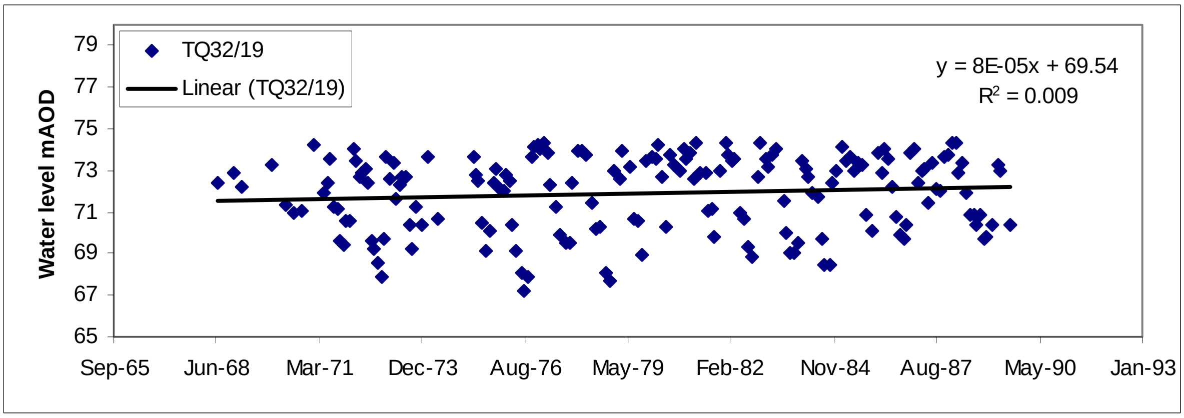


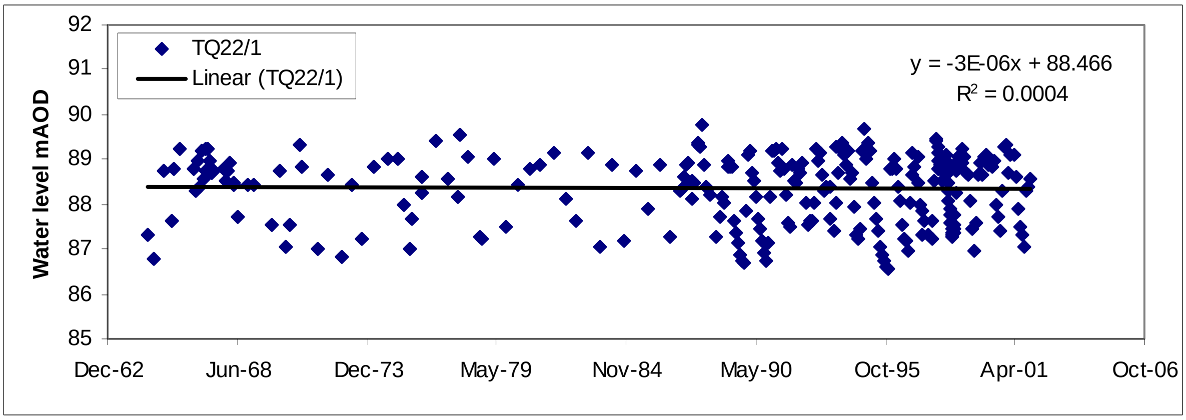


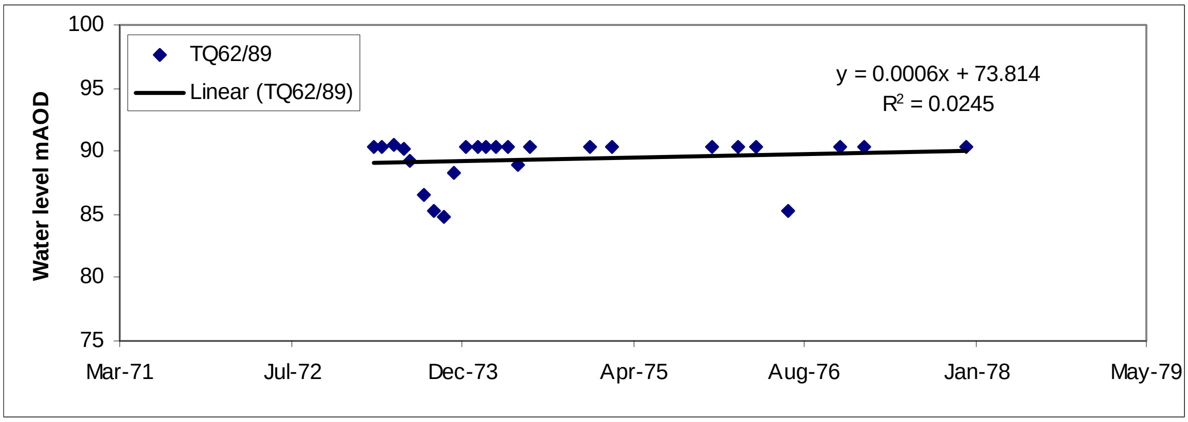


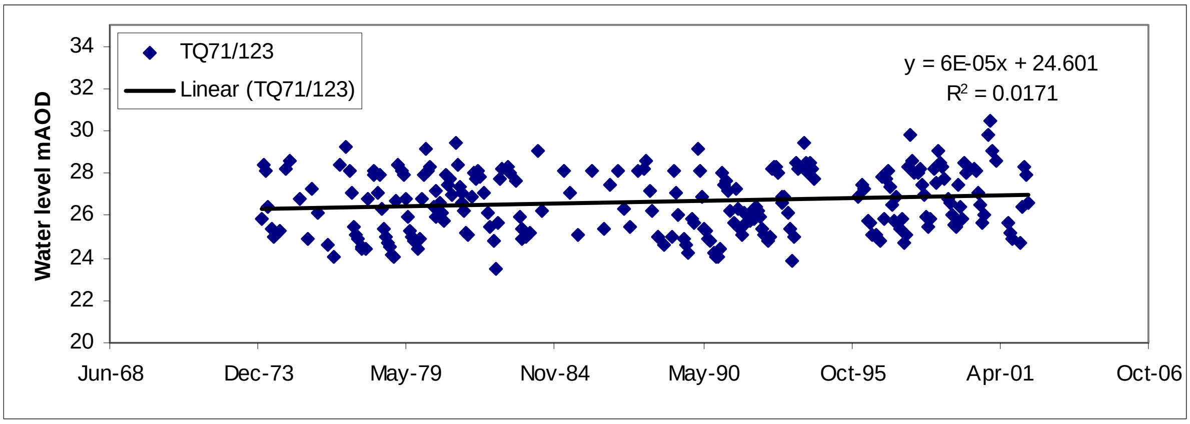


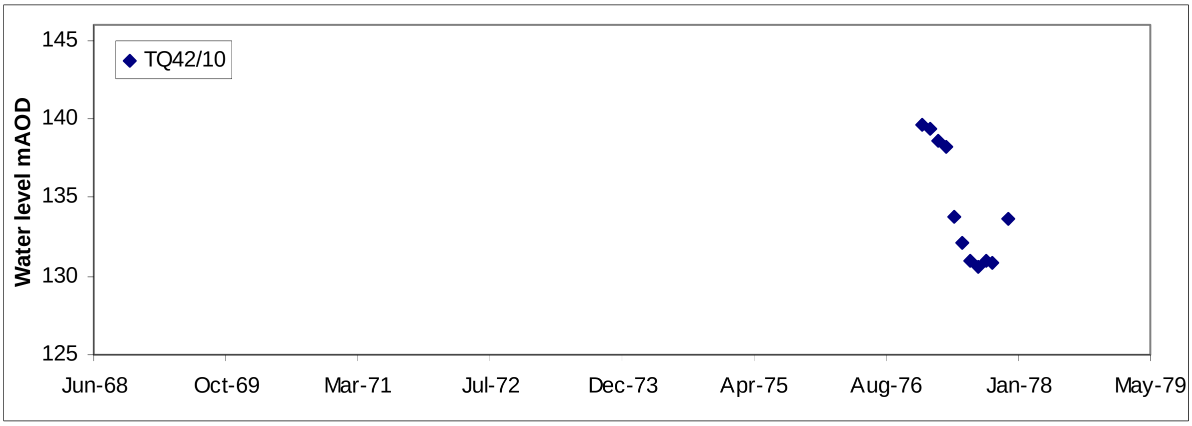

Water level mAOD
185
183
181
179
177
175
173
171
169
167
165
TQ42/80A
Linear (TQ42/80A)
y = -6E-05x + 178.53
R^2 = 0.0029
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95
Jul-98
Apr-01
Jan-04


Water level mAOD
79
77
75
73
71
69
67
65
TQ32/19
Linear (TQ32/19)
y = 8E-05x + 69.54
R^2 = 0.009
Sep-65
Jun-68
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93

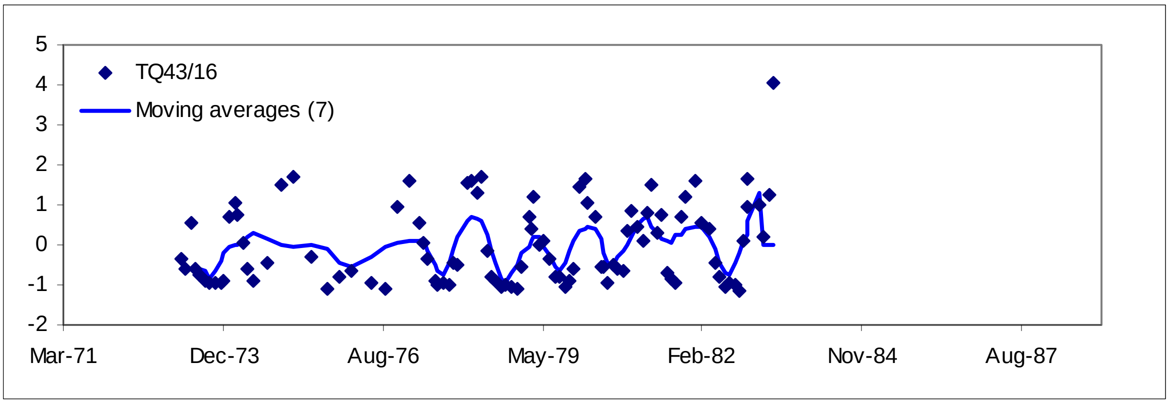

Water level mAOD
92
91
90
89
88
87
86
85
TQ22/1
Linear (TQ22/1)
y = -3E-06x + 88.466
R^2 = 0.0004
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

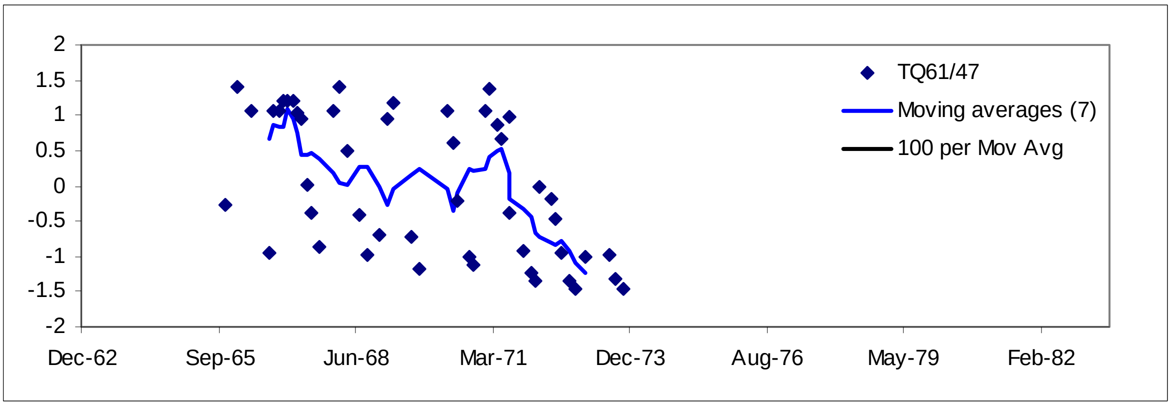

Water level mAOD
100
95
90
85
80
75
TQ62/89
Linear (TQ62/89)
y = 0.0006x + 73.814
R^2 = 0.0245
Mar-71
Jul-72
Dec-73
Apr-75
Aug-76
Jan-78
May-79

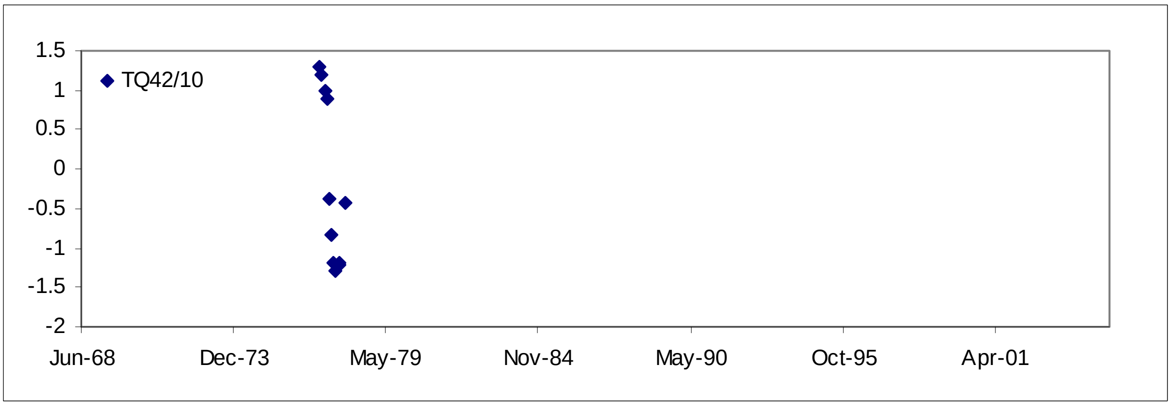

TQ71/123
Linear (TQ71/123)
y = 6E-05x + 24.601
R2 = 0.0171
Water level mAOD
34
32
30
28
26
24
22
20
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

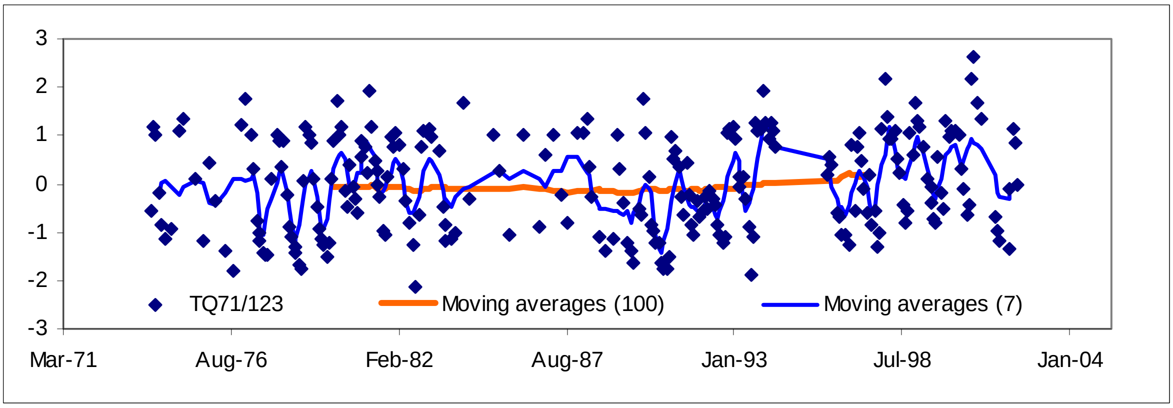

TQ42/10
Water level mAOD
145
140
135
130
125
Jun-68
Oct-69
Mar-71
Jul-72
Dec-73
Apr-75
Aug-76
Jan-78
May-79

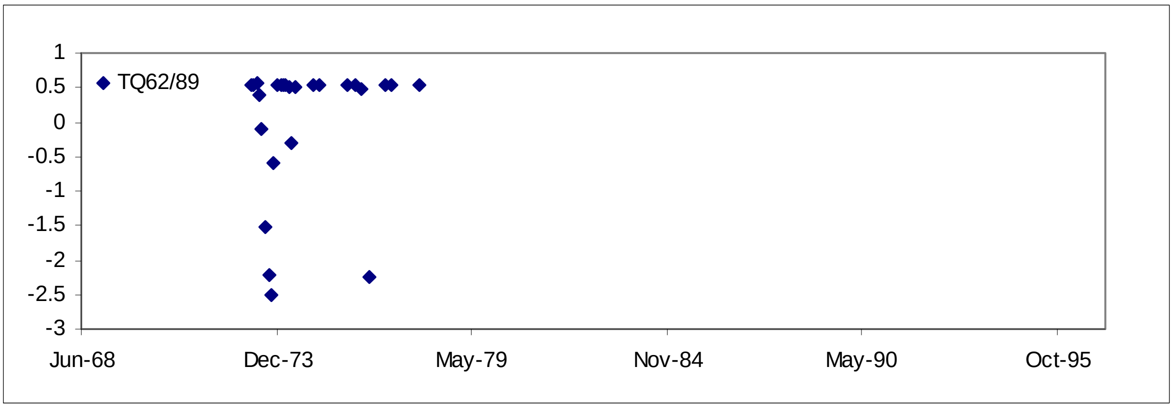
NORMALISED WATER LEVEL DATA WITH MOVING AVERAGES SMOOTHING LINES

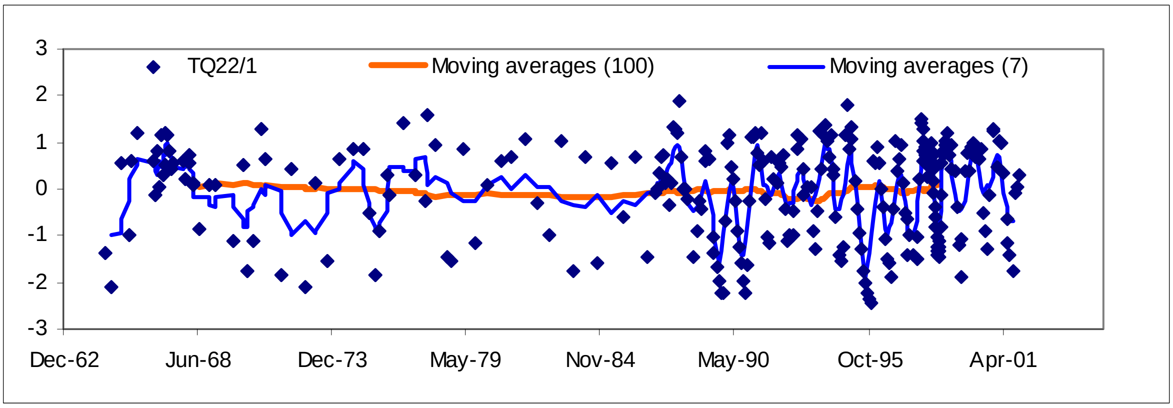


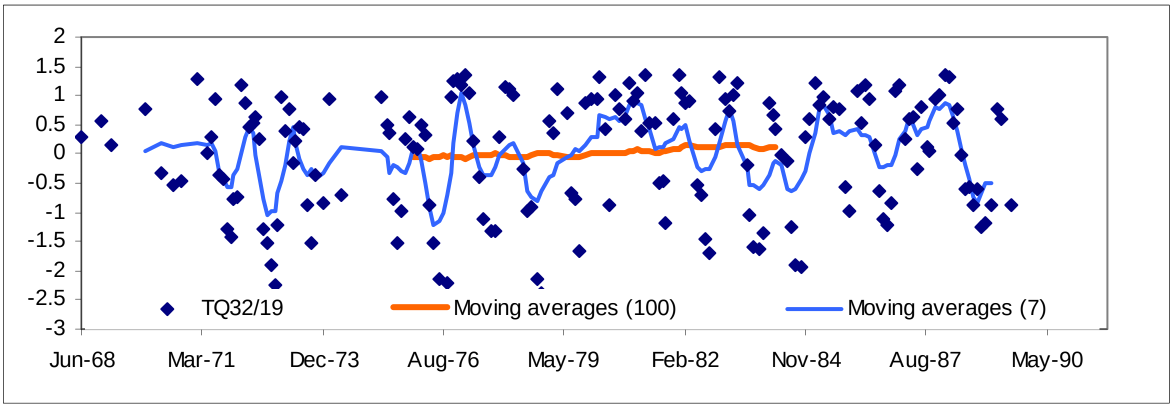


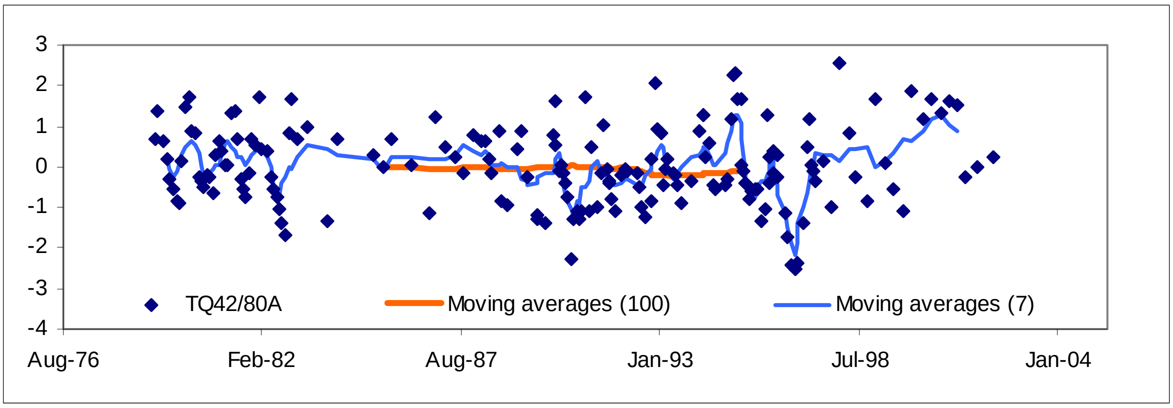


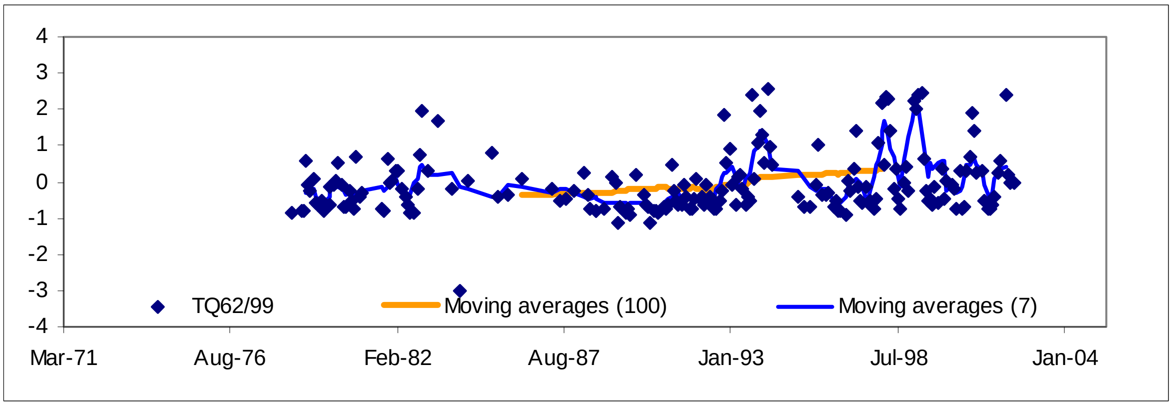


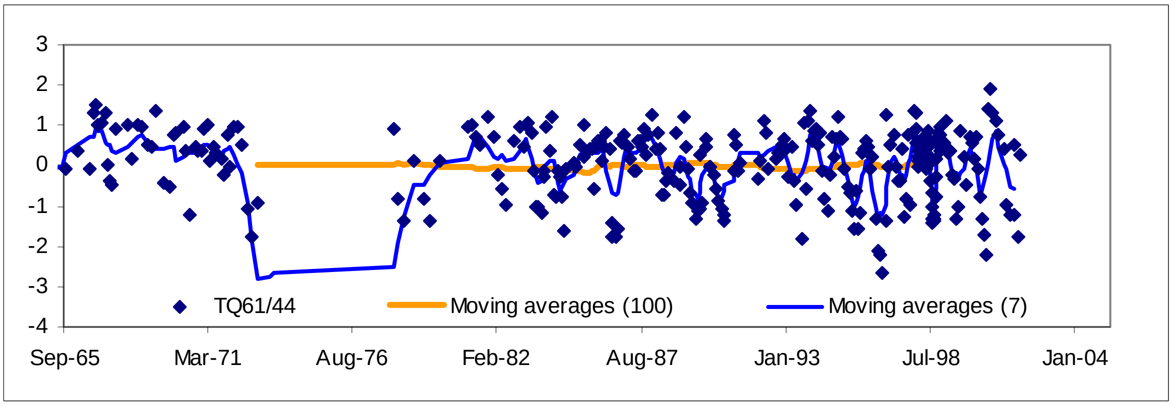

1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
TQ62/89
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95


3
2
1
0
-1
-2
-3
TQ22/1
Moving averages (100)
Moving averages (7)
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

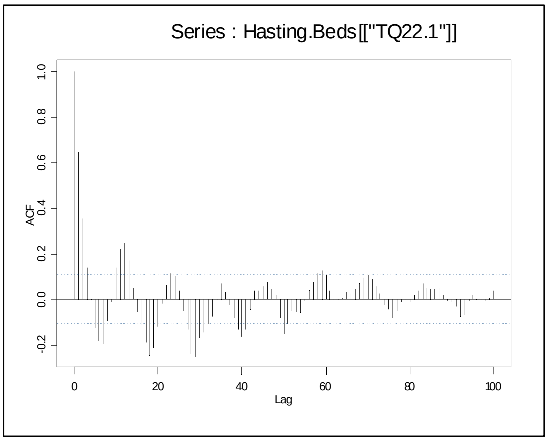

2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
TQ32/19
Moving averages (100)
Moving averages (7)
Jun-68
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90

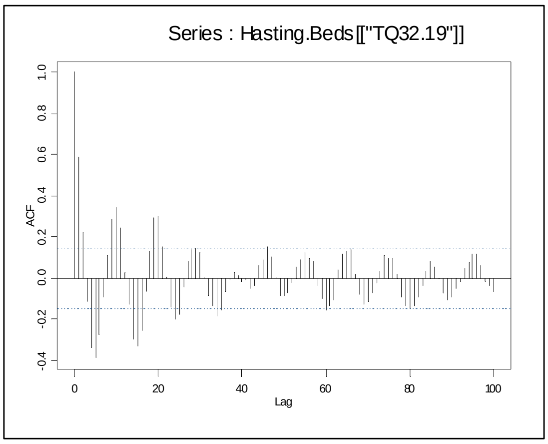

3
2
1
0
-1
-2
-3
-4
TQ42/80A
Moving averages (100)
Moving averages (7)
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

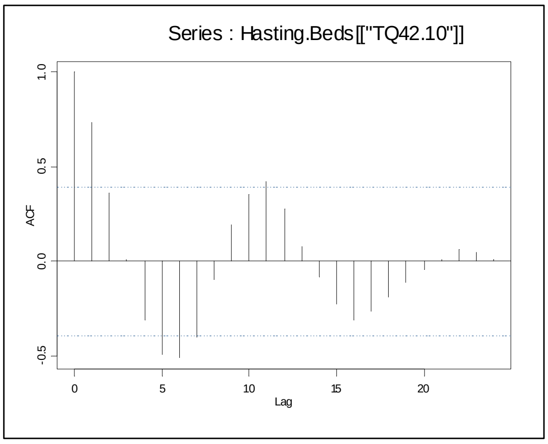

4
3
2
1
0
-1
-2
-3
-4
TQ62/99
Moving averages (100)
Moving averages (7)
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

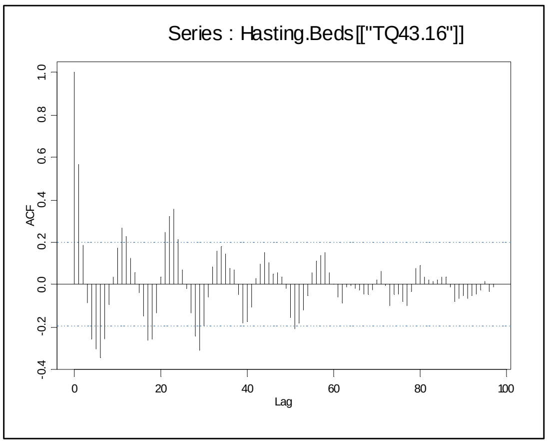

3
2
1
0
-1
-2
-3
-4
TQ61/44
Moving averages (100)
Moving averages (7)
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

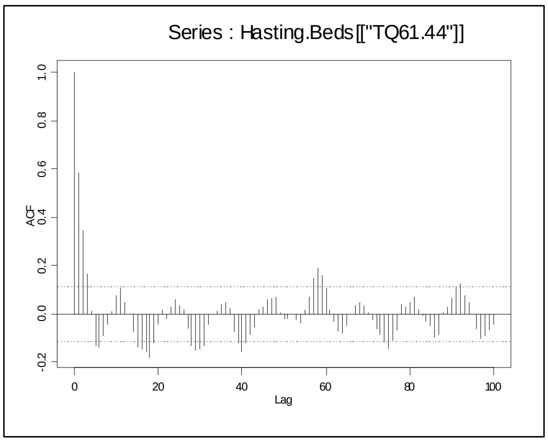
AUTOCORRELATION FUNTION PLOTS

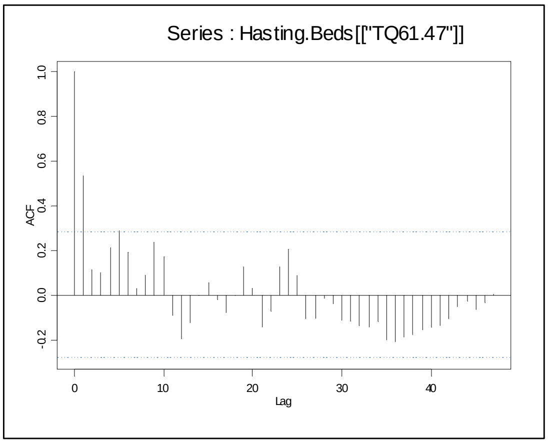








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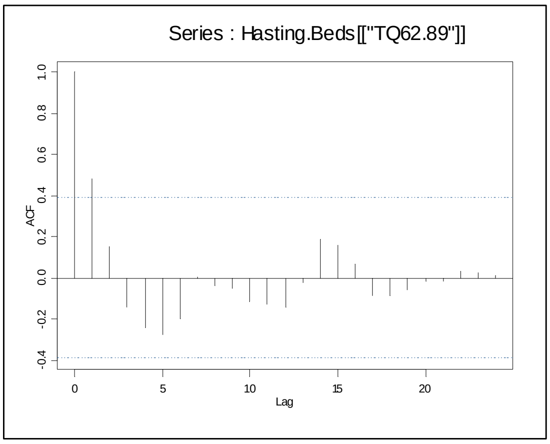
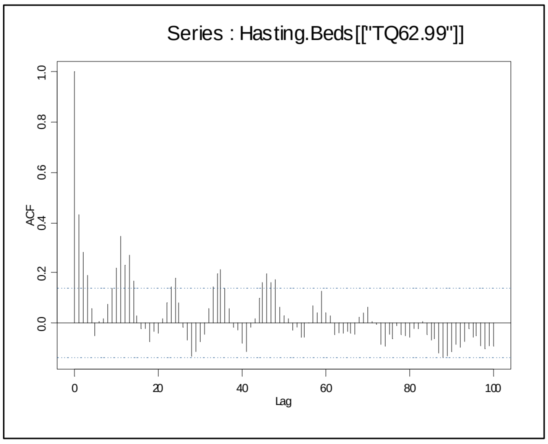
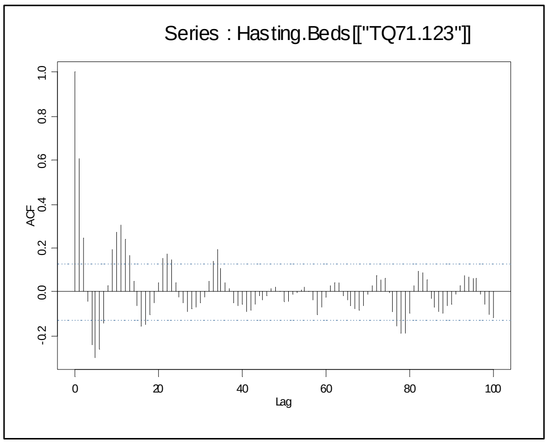
ACF
Lag


Series : Hasting.Beds[["TQ62.89"]]
ACF
Lag


Series : Hasting.Beds[["TQ62.99"]]
ACF
Lag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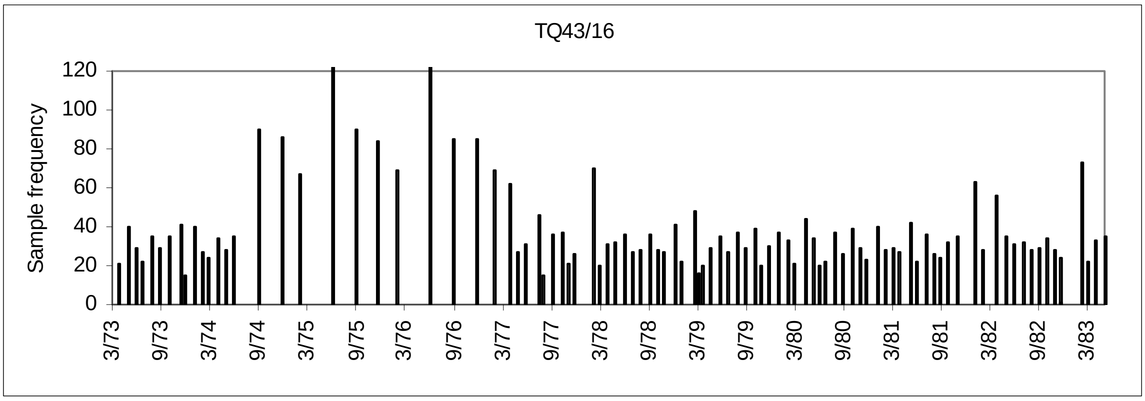
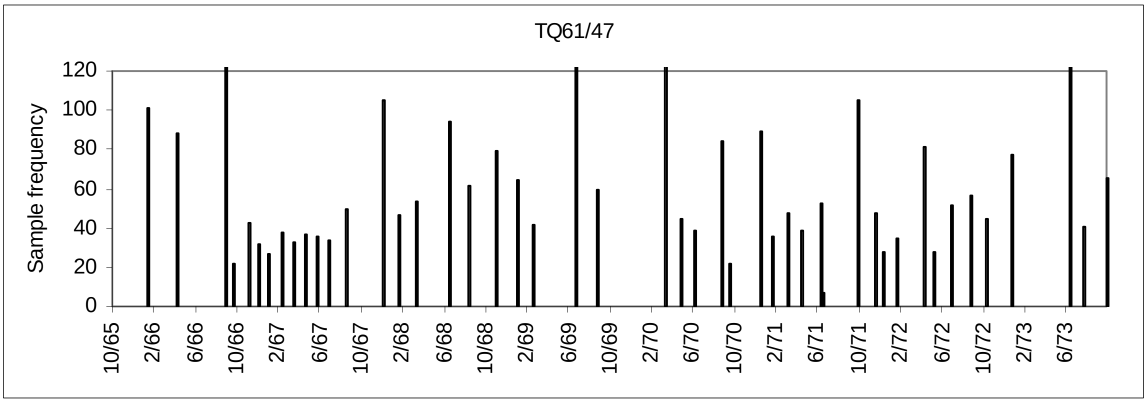
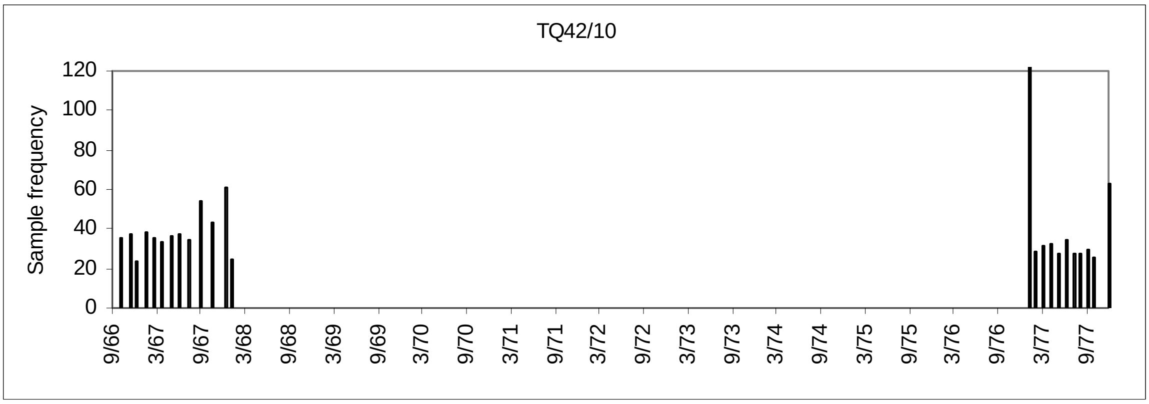
ACF
Lag

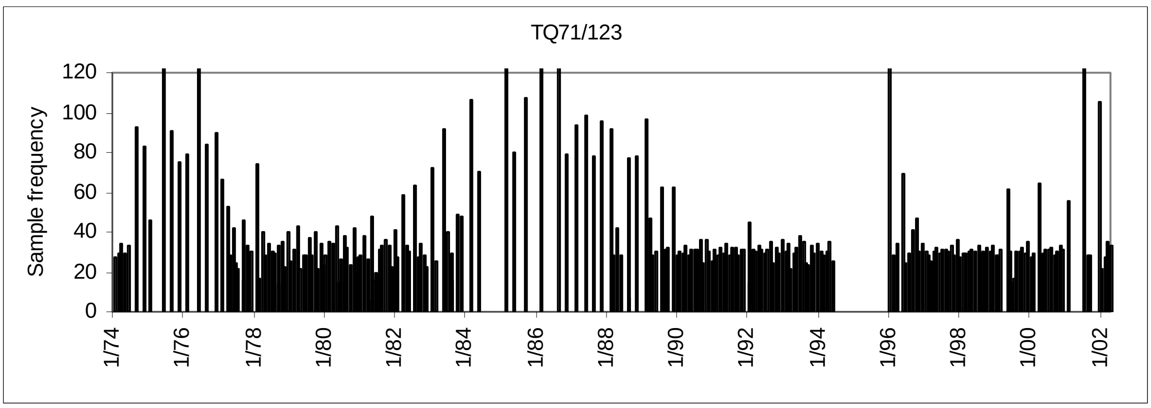
SAMPLE FREQUENCY PLOTS

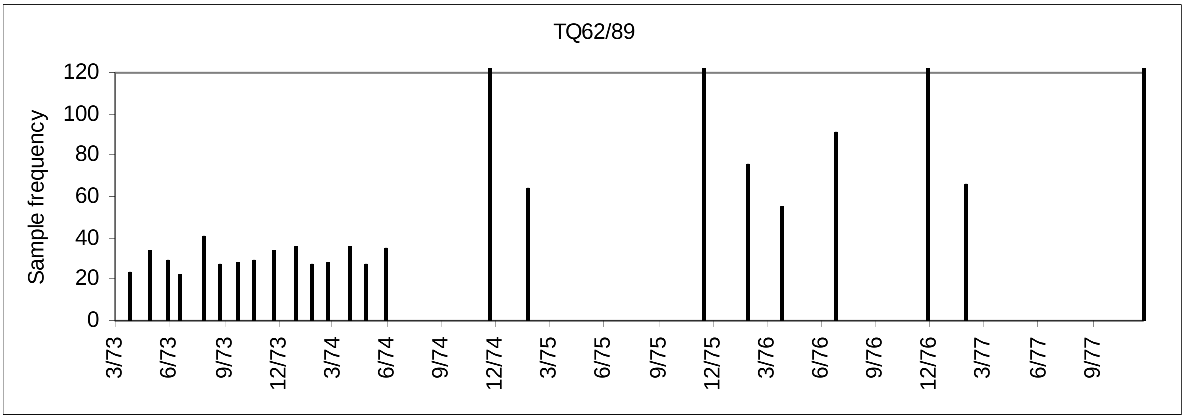
(x axis: time; y axis: sample gaps in days)

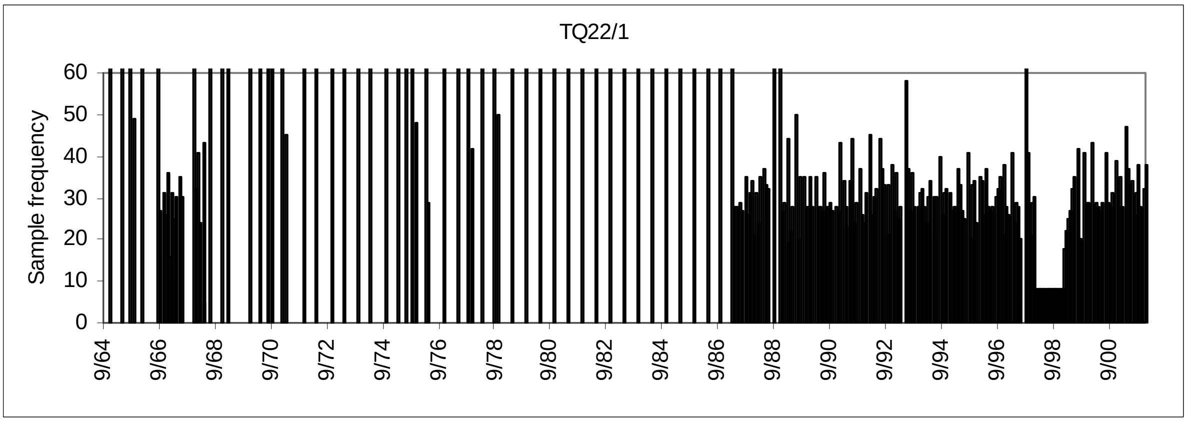


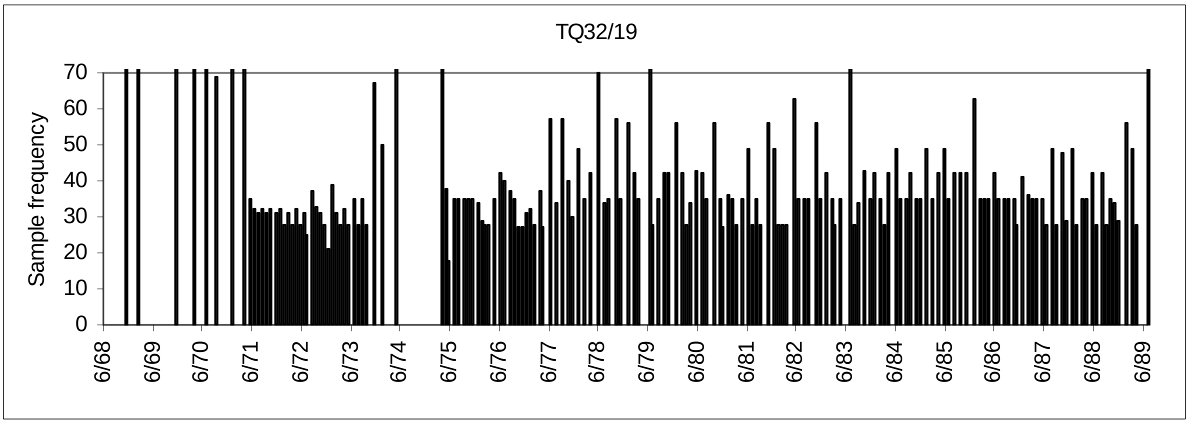







TQ62/89
Sample frequency
120
100
80
60
40
20
0
3/73
6/73
9/73
12/73
3/74
6/74
9/74
12/74
3/75
6/75
9/75
12/75
3/76
6/76
9/76
12/76
3/77
6/77
9/77


TQ22/1
Sample frequency
60
50
40
30
20
10
0
9/64
9/66
9/68
9/70
9/72
9/74
9/76
9/78
9/80
9/82
9/84
9/86
9/88
9/90
9/92
9/94
9/96
9/98
9/00


TQ32/19
Sample frequency
70
60
50
40
30
20
10
0
6/68
6/69
6/70
6/71
6/72
6/73
6/74
6/75
6/76
6/77
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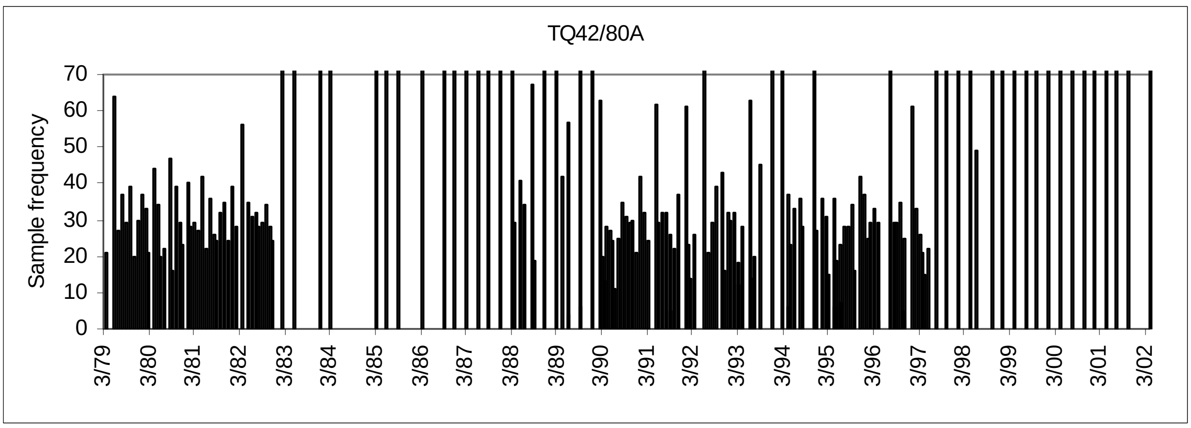
6/86
6/87
6/88
6/89


TQ42/80A
Sample frequency
70
60
50
40
30
20
10
0
3/79
3/80
3/81
3/82
3/83
3/84
3/85
3/86
3/87
3/88
3/89
3/90
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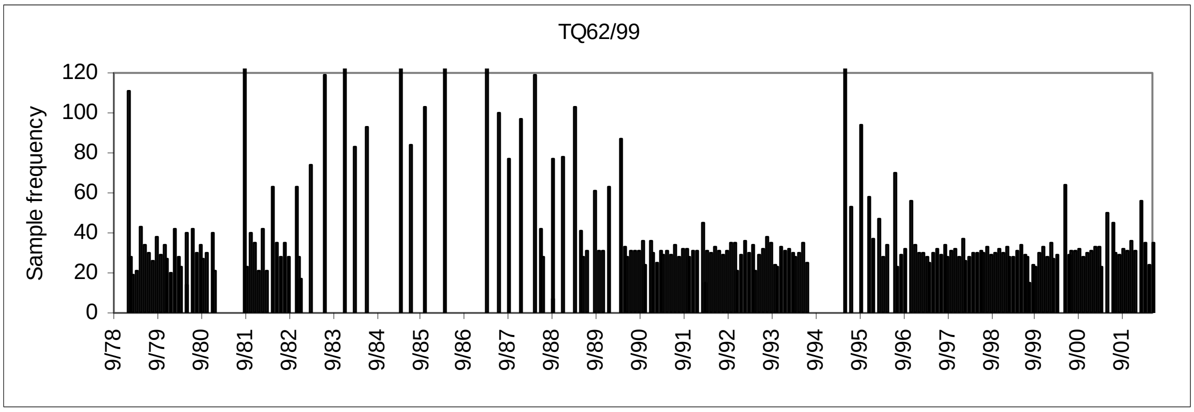
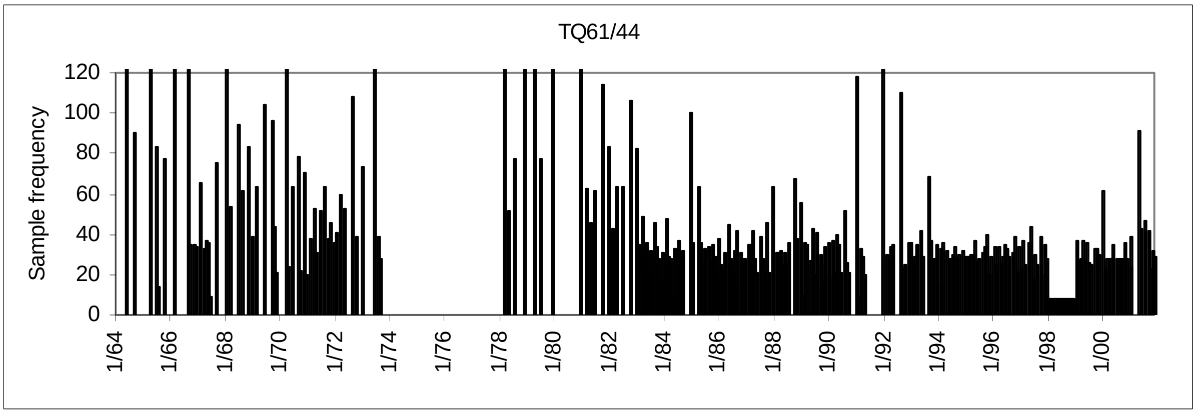
3/99
3/00
3/01
3/02


TQ62/99
Sample frequency
0
20
40
60
80
100
120
9/78
9/79
9/80
9/81
9/82
9/83
9/84
9/85
9/86
9/87
9/88
9/89
9/90
9/91
9/92
9/93
9/94
9/95
9/96
9/97
9/98
9/99
9/00
9/01


TQ61/44
Sample frequency
0
20
40
60
80
100
120
1/64
1/66
1/68
1/70
1/72
1/74
1/76
1/78
1/80
1/82
1/84
1/86
1/88
1/90
1/92
1/94
1/96
1/98
1/00

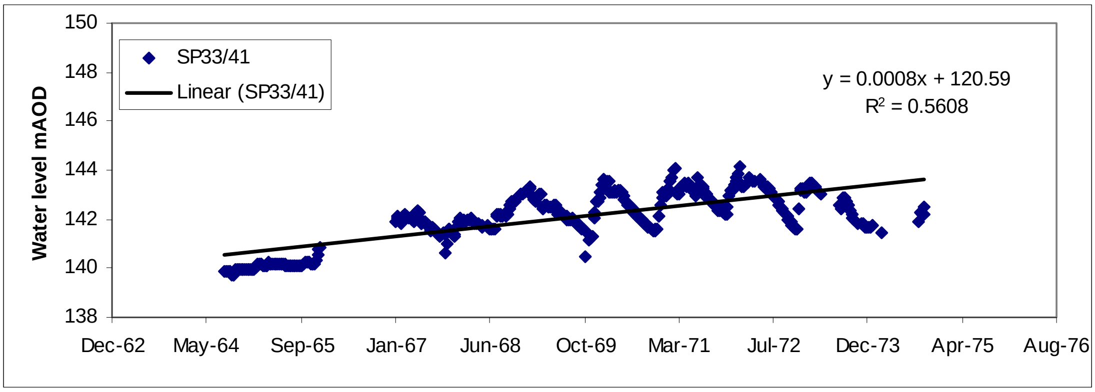
WELLMASTER LOOK-UP TABLE

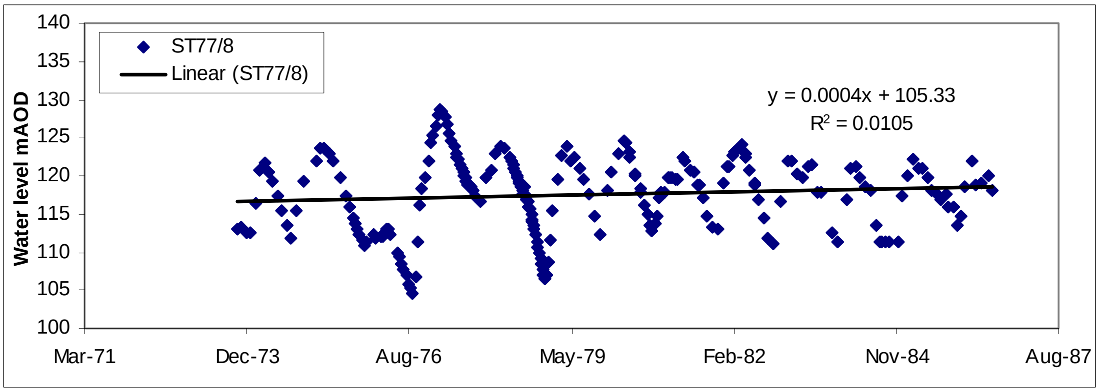
May 15, 1970	**Average**
June 15, 1970	**Low**
July 15, 1970	**Very low**
August 15, 1970	**Very low**
September 15, 1970	**Low**
October 15, 1970	**Average**
November 14, 1970	**Average**
December 15, 1970	**High**
January 15, 1971	**Very high**
February 15, 1971	**Very high**
March 15, 1971	**Very high**
April 15, 1971	**High**
May 15, 1971	**High**
June 15, 1971	**High**
July 15, 1971	**Average**
August 15, 1971	**Low**
September 15, 1971	**Low**
October 15, 1971	**Very low**
November 15, 1971	**Very low**
December 15, 1971	**Low**
January 15, 1972	**Average**
February 15, 1972	**High**
March 15, 1972	**High**
April 15, 1972	**High**
May 15, 1972	**Average**
June 15, 1972	**Average**
July 15, 1972	**Low**
August 15, 1972	**Very low**
September 15, 1972	**Very low**
October 15, 1972	**Very low**
November 15, 1972	**Very low**
December 15, 1972	**Low**
January 15, 1973	**Average**
February 15, 1973	**Average**
March 15, 1973	**Average**
April 15, 1973	**Average**
May 15, 1973	**Average**
June 15, 1973	**Average**
July 15, 1973	**Very low**
August 15, 1973	**Very low**
September 15, 1973	**Very low**
October 15, 1973	**Very low**
November 15, 1973	**Very low**
December 15, 1973	**Low**
January 15, 1974	**Average**
February 15, 1974	**High**
March 15, 1974	**Very high**
April 15, 1974	**Average**
May 15, 1974	**Low**
June 15, 1974	**Low**
July 15, 1974	**Low**
August 15, 1974	**Low**
September 15, 1974	**Low**
October 15, 1974	**High**
November 14, 1974	**Very high**
December 15, 1974	**Very high**
January 15, 1975	**Very high**
February 15, 1975	**Very high**
March 15, 1975	**Very high**
April 15, 1975	**Very high**
May 15, 1975	**High**
June 15, 1975	**Low**
July 15, 1975	**Low**
August 15, 1975	**Very low**
September 15, 1975	**Very low**
October 15, 1975	**Very low**
November 15, 1975	**Low**
December 15, 1975	**Average**
January 15, 1976	**Average**
February 15, 1976	**Average**
March 15, 1976	**Average**
April 15, 1976	**Low**
May 15, 1976	**Very low**
June 15, 1976	**Very low**
July 15, 1976	**Very low**
August 15, 1976	**Very low**
September 15, 1976	**Very low**
October 15, 1976	**Average**
November 15, 1976	**Very high**
December 15, 1976	**Very high**
January 15, 1977	**Very high**
February 15, 1977	**Very high**
March 15, 1977	**Very high**
April 15, 1977	**High**
May 15, 1977	**Average**
June 15, 1977	**Low**
July 15, 1977	**Very low**
August 15, 1977	**Very low**
September 15, 1977	**Very low**
October 15, 1977	**Low**
November 15, 1977	**Average**
December 15, 1977	**Average**
January 15, 1978	**High**
February 15, 1978	**Very high**
March 15, 1978	**Very high**
April 15, 1978	**Very high**
May 15, 1978	**High**
June 15, 1978	**Low**
July 15, 1978	**Very low**
August 15, 1978	**Very low**
September 15, 1978	**Very low**
October 15, 1978	**Very low**
November 15, 1978	**Very low**
December 15, 1978	**Very low**
January 15, 1979	**Average**
February 15, 1979	**High**
March 15, 1979	**High**
April 15, 1979	**High**
May 15, 1979	**Average**
June 15, 1979	**Average**
July 15, 1979	**Low**
August 15, 1979	**Low**
September 15, 1979	**Very low**
October 15, 1979	**Very low**
November 15, 1979	**Low**
December 15, 1979	**Average**
January 15, 1980	**Very high**
February 15, 1980	**Very high**
March 15, 1980	**Very high**
April 15, 1980	**High**
May 15, 1980	**Low**
June 15, 1980	**Low**
July 15, 1980	**Average**
August 15, 1980	**Average**
September 15, 1980	**Low**
October 15, 1980	**Average**
November 15, 1980	**High**
December 15, 1980	**High**
January 15, 1981	**High**
February 15, 1981	**High**
March 15, 1981	**Very high**
April 15, 1981	**Very high**
May 15, 1981	**High**
June 15, 1981	**High**
July 15, 1981	**Low**
August 15, 1981	**Low**
September 15, 1981	**Low**
October 15, 1981	**High**
November 15, 1981	**Very high**
December 15, 1981	**Very high**
January 15, 1982	**Very high**
February 15, 1982	**High**
March 15, 1982	**High**
April 15, 1982	**Average**
May 15, 1982	**Low**
June 15, 1982	**Low**
July 15, 1982	**Very low**
August 15, 1982	**Very low**
September 15, 1982	**Very low**
October 15, 1982	**Low**
November 15, 1982	**High**
December 15, 1982	**Very high**
January 15, 1983	**Very high**
February 15, 1983	**Very high**
March 15, 1983	**Very high**
April 15, 1983	**Very high**
May 15, 1983	**Very high**
June 15, 1983	**Very high**
July 15, 1983	**Average**
August 15, 1983	**Very low**
September 15, 1983	**Very low**
October 15, 1983	**Very low**
November 15, 1983	**Very low**
December 15, 1983	**Low**
January 15, 1984	**High**
February 15, 1984	**High**
March 15, 1984	**Average**
April 15, 1984	**Average**
May 15, 1984	**Low**
June 15, 1984	**Low**
July 15, 1984	**Low**
August 15, 1984	**Very low**
September 15, 1984	**Very low**
October 15, 1984	**Very low**
November 15, 1984	**Average**
December 15, 1984	**Average**
January 15, 1985	**High**
February 15, 1985	**High**
March 15, 1985	**High**
April 15, 1985	**High**
May 15, 1985	**High**
June 15, 1985	**Average**
July 15, 1985	**High**
August 15, 1985	**High**
September 15, 1985	**Average**
October 15, 1985	**Low**
November 15, 1985	**Average**
December 15, 1985	**High**
January 15, 1986	**High**
February 15, 1986	**High**
March 15, 1986	**High**
April 15, 1986	**High**
May 15, 1986	**Average**
June 15, 1986	**Low**
July 15, 1986	**Very low**
August 15, 1986	**Very low**
September 15, 1986	**Very low**
October 15, 1986	**Low**
November 15, 1986	**High**
December 15, 1986	**Very high**
January 15, 1987	**High**
February 15, 1987	**High**
March 15, 1987	**High**
April 15, 1987	**Average**
May 15, 1987	**Average**
June 15, 1987	**Average**
July 15, 1987	**High**
August 15, 1987	**Average**
September 15, 1987	**Average**
October 15, 1987	**High**
November 15, 1987	**Very high**
December 15, 1987	**Very high**

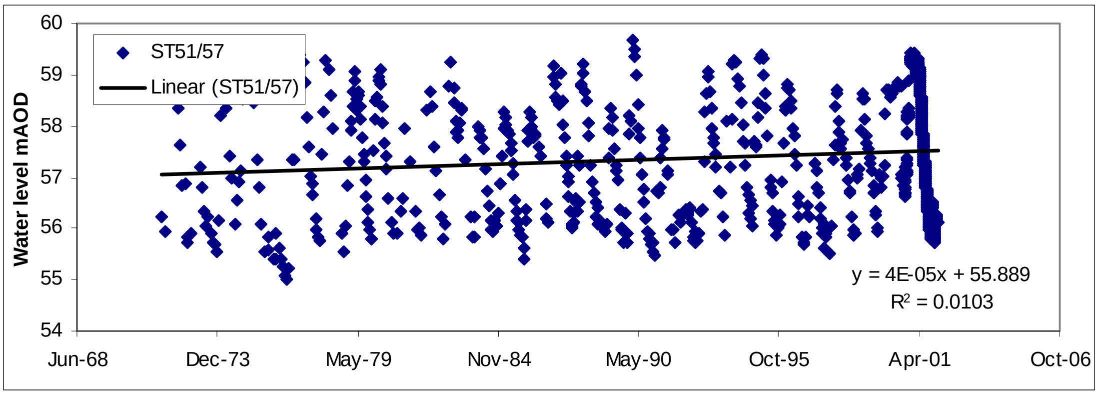
January 15, 1988	**Very high**
February 15, 1988	**Very high**
March 15, 1988	**Very high**
April 15, 1988	**High**
May 15, 1988	**Average**
June 15, 1988	**Low**
July 15, 1988	**Low**
August 15, 1988	**Low**
September 15, 1988	**Very low**
October 15, 1988	**Very low**
November 15, 1988	**Low**
December 15, 1988	**Low**
January 15, 1989	**Low**
February 15, 1989	**Low**
March 15, 1989	**High**
April 15, 1989	**High**
May 15, 1989	**Average**
June 15, 1989	**Low**
July 15, 1989	**Very low**
August 15, 1989	**Very low**
September 15, 1989	**Very low**
October 15, 1989	**Very low**
November 15, 1989	**Very low**
December 15, 1989	**Low**
January 15, 1990	**Average**
February 15, 1990	**Very high**
March 15, 1990	**High**
April 15, 1990	**Average**
May 15, 1990	**Low**
June 15, 1990	**Low**
July 15, 1990	**Very low**
August 15, 1990	**Very low**
September 15, 1990	**Very low**
October 15, 1990	**Very low**
November 15, 1990	**Very low**
December 15, 1990	**Very low**
January 15, 1991	**High**
February 15, 1991	**High**
March 15, 1991	**High**
April 15, 1991	**Average**
May 15, 1991	**Low**
June 15, 1991	**Average**
July 15, 1991	**High**
August 15, 1991	**Average**
September 15, 1991	**Low**
October 15, 1991	**Very low**
November 15, 1991	**Low**
December 15, 1991	**Average**
January 15, 1992	**Low**
February 15, 1992	**Average**
March 15, 1992	**Average**
April 15, 1992	**High**
May 15, 1992	**Average**
June 15, 1992	**Low**
July 15, 1992	**Low**
August 15, 1992	**Very low**
September 15, 1992	**Low**
October 15, 1992	**Low**
November 15, 1992	**Very high**
December 15, 1992	**Very high**
January 15, 1993	**Very high**
February 15, 1993	**High**
March 15, 1993	**Average**
April 15, 1993	**Average**
May 15, 1993	**Average**
June 15, 1993	**Low**
July 15, 1993	**Low**
August 15, 1993	**Very low**
September 15, 1993	**Low**
October 15, 1993	**Very high**
November 15, 1993	**High**
December 15, 1993	**Very high**
January 15, 1994	**Very high**
February 15, 1994	**Very high**
March 15, 1994	**Very high**
April 15, 1994	**Very high**
May 15, 1994	**High**
June 15, 1994	**High**
July 15, 1994	**Low**
August 15, 1994	**Very low**
September 15, 1994	**Very low**
October 15, 1994	**Low**
November 15, 1994	**Average**
December 15, 1994	**High**
January 15, 1995	**Very high**
February 15, 1995	**Very high**
March 15, 1995	**Very high**
April 15, 1995	**High**
May 15, 1995	**Low**
June 15, 1995	**Low**
July 15, 1995	**Very low**
August 15, 1995	**Very low**
September 15, 1995	**Very low**
October 15, 1995	**Very low**
November 15, 1995	**Very low**
December 15, 1995	**Low**
January 15, 1996	**High**
February 15, 1996	**Average**
March 15, 1996	**Average**
April 15, 1996	**Average**
May 15, 1996	**Average**
June 15, 1996	**Low**
July 15, 1996	**Very low**
August 15, 1996	**Very low**
September 15, 1996	**Very low**
October 15, 1996	**Very low**
November 15, 1996	**Very low**
December 15, 1996	**Average**
January 15, 1997	**Average**
February 15, 1997	**High**
March 15, 1997	**Very high**
April 15, 1997	**Average**
May 15, 1997	**Low**
June 15, 1997	**Low**
July 15, 1997	**Average**
August 15, 1997	**Low**
September 15, 1997	**Very low**
October 15, 1997	**Low**
November 15, 1997	**Low**
December 15, 1997	**High**
January 15, 1998	**Very high**
February 15, 1998	**High**
March 15, 1998	**Very high**
April 15, 1998	**Very high**
May 15, 1998	**High**
June 15, 1998	**High**
July 15, 1998	**Average**
August 15, 1998	**Very low**
September 15, 1998	**Very low**
October 15, 1998	**Low**
November 15, 1998	**High**
December 15, 1998	**Very high**
January 15, 1999	**Very high**
February 15, 1999	**Very high**
March 15, 1999	**Very high**
April 15, 1999	**Very high**
May 15, 1999	**High**
June 15, 1999	**Average**
July 15, 1999	**Low**
August 15, 1999	**Very low**
September 15, 1999	**Low**
October 15, 1999	**Average**
November 15, 1999	**Very high**
December 15, 1999	**High**
January 15, 2000	**Very high**
February 15, 2000	**High**
March 15, 2000	**High**
April 15, 2000	**High**
May 15, 2000	**High**
June 15, 2000	**Average**
July 15, 2000	**Average**
August 15, 2000	**Low**
September 15, 2000	**Very low**
October 15, 2000	**Average**
November 15, 2000	**Very high**
December 15, 2000	**Very high**
January 15, 2001	**Very high**
February 15, 2001	**Very high**
March 15, 2001	**Very high**
April 15, 2001	**Very high**
May 15, 2001	**Average**
June 15, 2001	**Low**
July 15, 2001	**Low**
August 15, 2001	**Very low**
September 15, 2001	**Very low**
October 15, 2001	**Low**
November 15, 2001	**Average**
December 15, 2001	**Average**

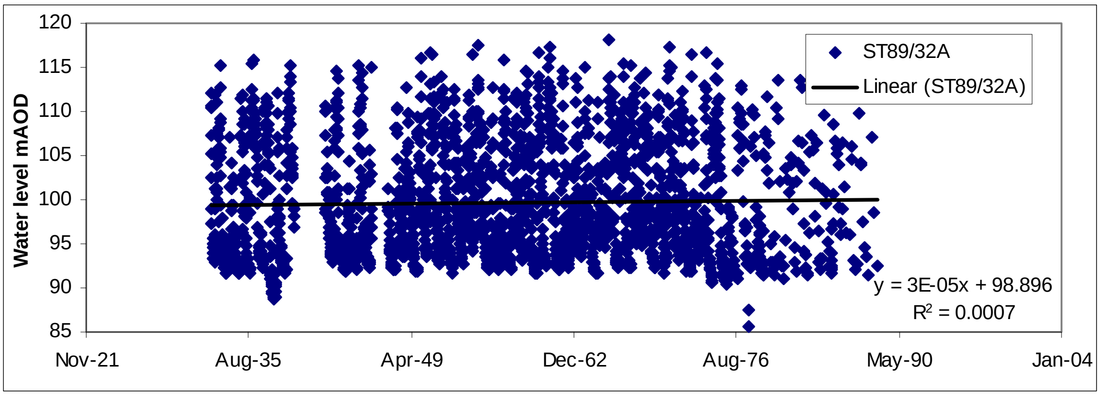
Appendix 3 Middle Jurassic

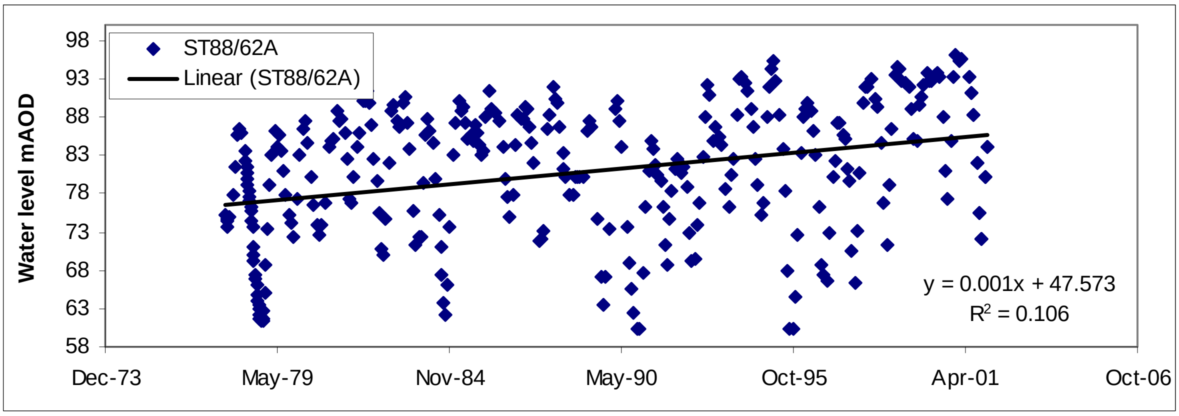
WATER LEVELS ABOVE ORDNANCE DATUM WITH LINEAR REGRESSION CURVE

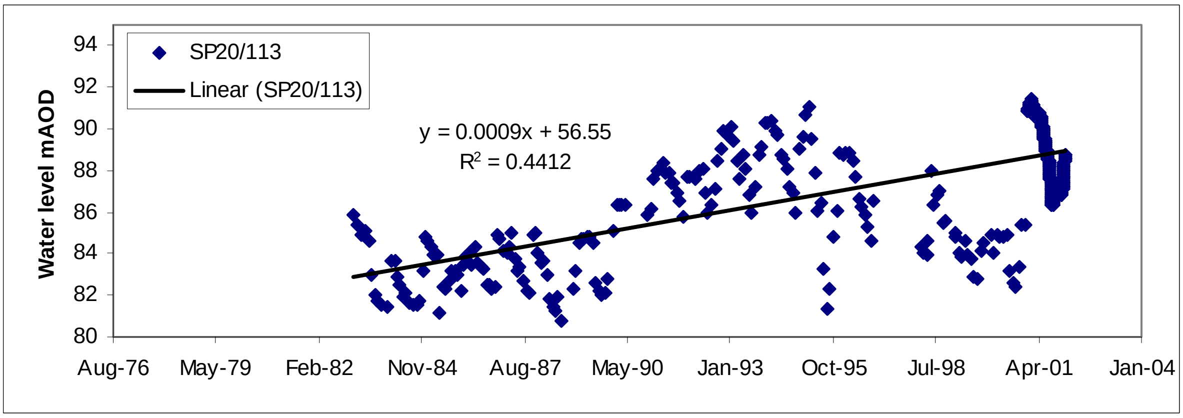


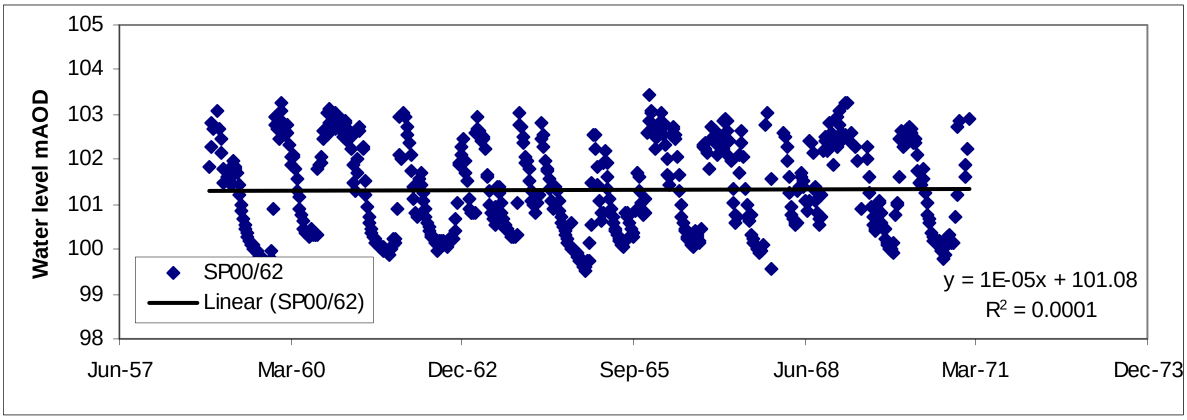


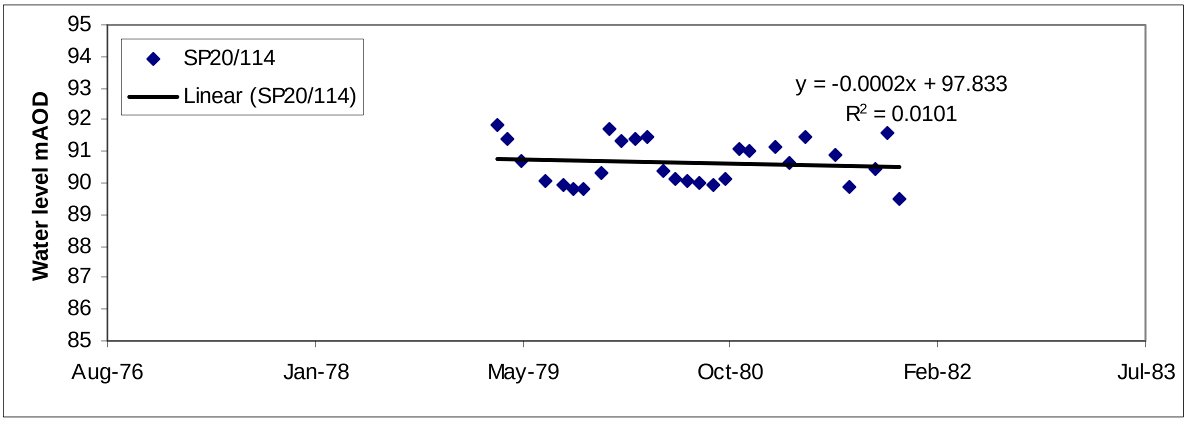




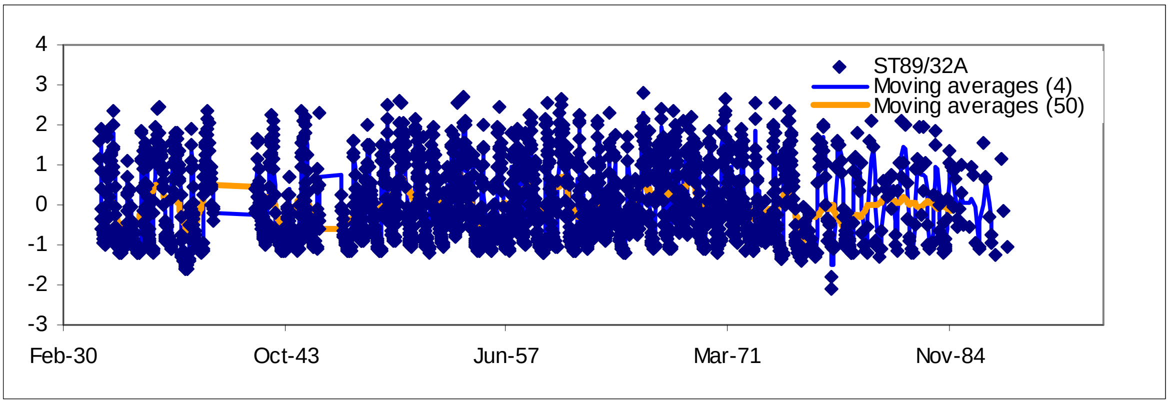

Water level mAOD
98
93
88
83
78
73
68
63
58
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06
ST88/62A
Linear (ST88/62A)
y = 0.001x + 47.573
R² = 0.106

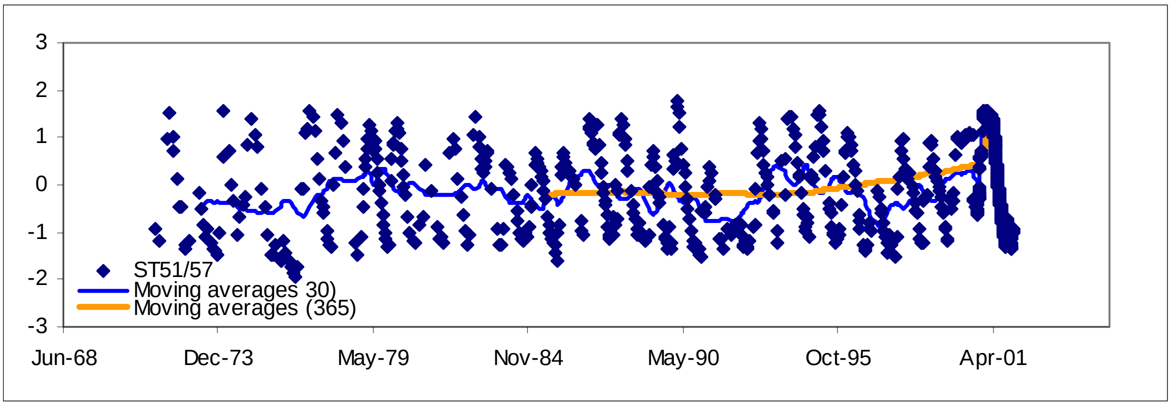

Water level mAOD
94
92
90
88
86
84
82
80
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95
Jul-98
Apr-01
Jan-04
SP20/113
Linear (SP20/113)
y = 0.0009x + 56.55
R² = 0.4412

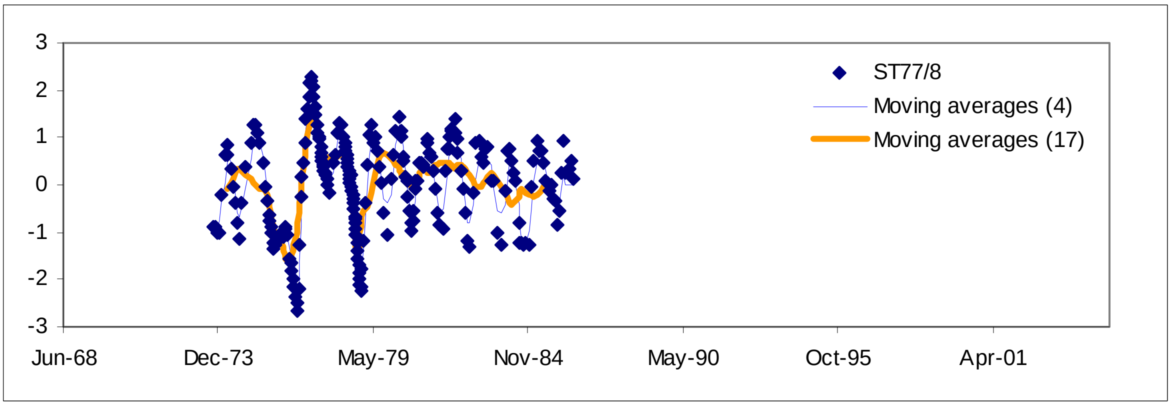

Water level mAOD
105
104
103
102
101
100
99
98
Jun-57
Mar-60
Dec-62
Sep-65
Jun-68
Mar-71
Dec-73
SP00/62
Linear (SP00/62)
y = 1E-05x + 101.08
R² = 0.0001

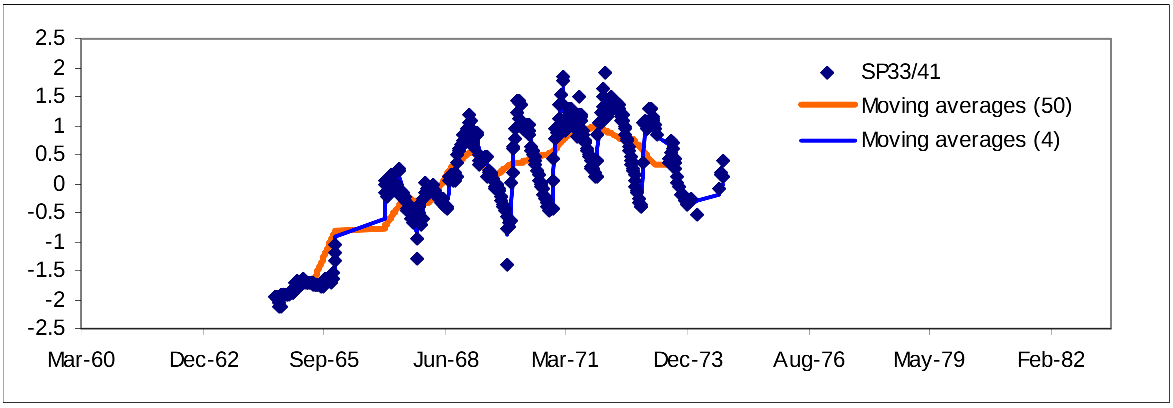

Water level mAOD
95
94
93
92
91
90
89
88
87
86
85
Aug-76
Jan-78
May-79
Oct-80
Feb-82
Jul-83
SP20/114
Linear (SP20/114)
y = -0.0002x + 97.833
R² = 0.0101

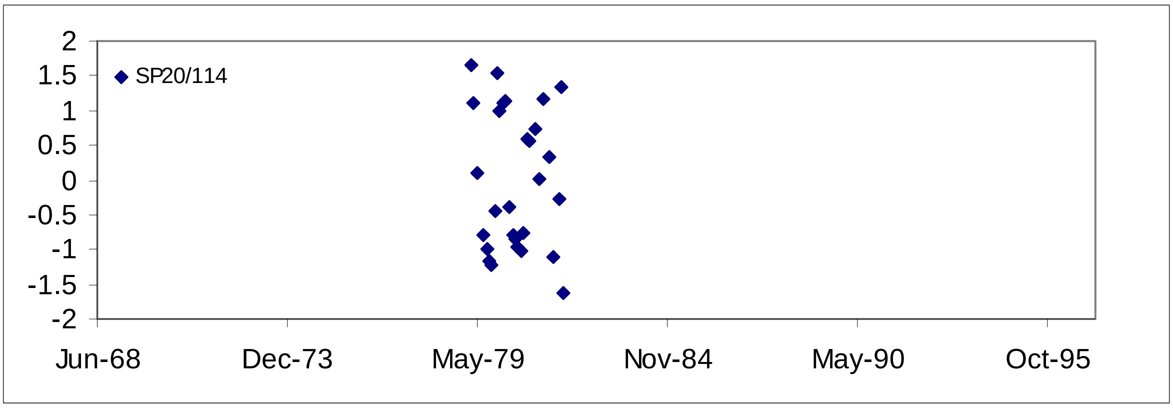
NORMALISED WATER LEVEL DATA WITH MOVING AVERAGES SMOOTHING LINES



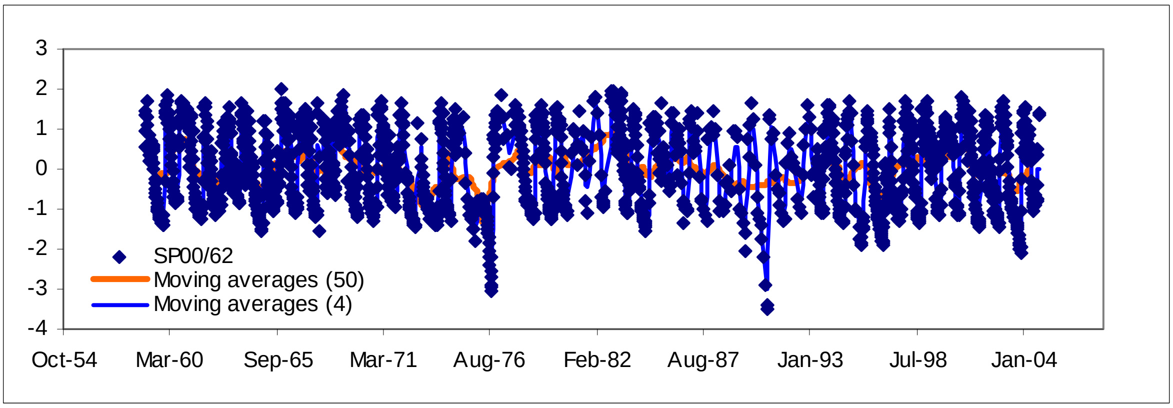




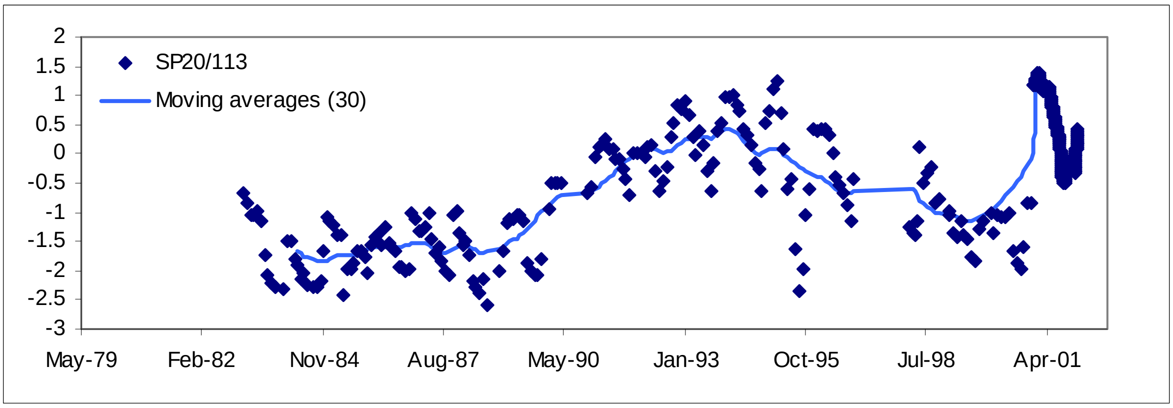




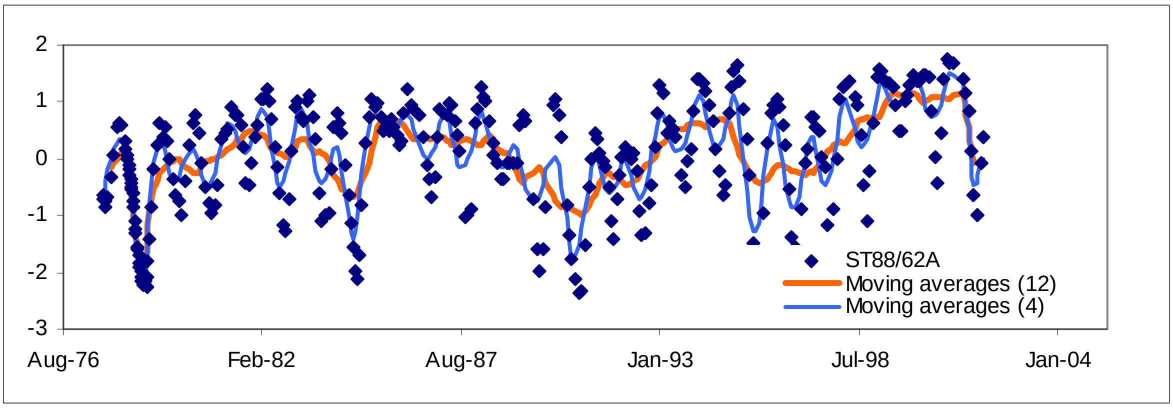
SP20/114
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95



3
2
1
0
-1
-2
-3
-4
SP00/62
Moving averages (50)
Moving averages (4)
Oct-54
Mar-60
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

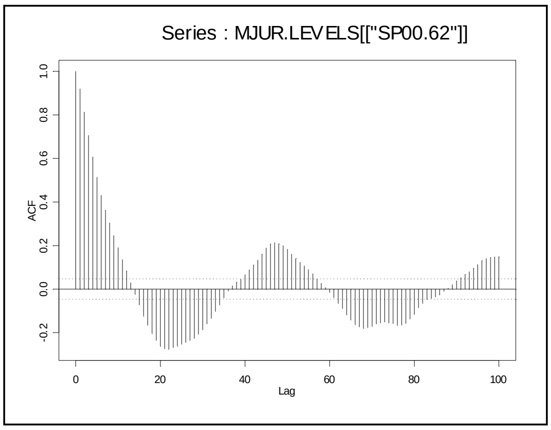


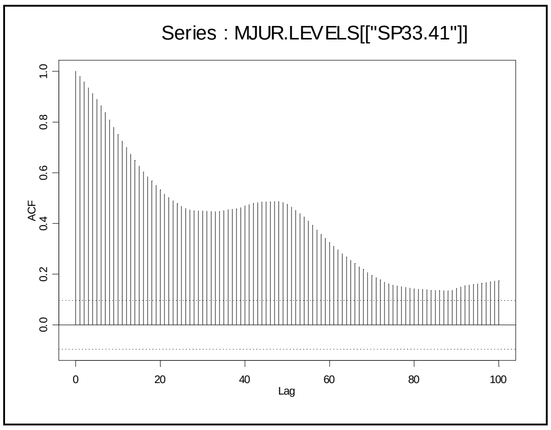
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
SP20/113
Moving averages (30)
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95
Jul-98
Apr-01

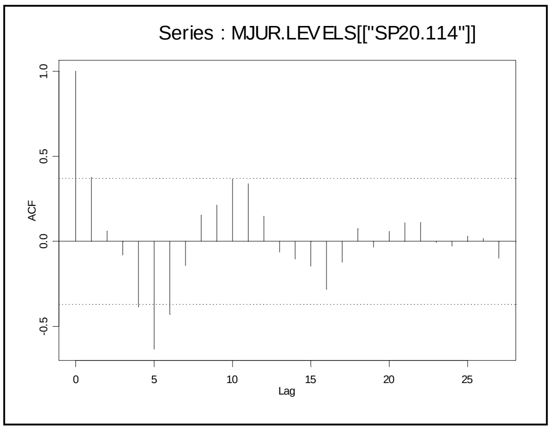


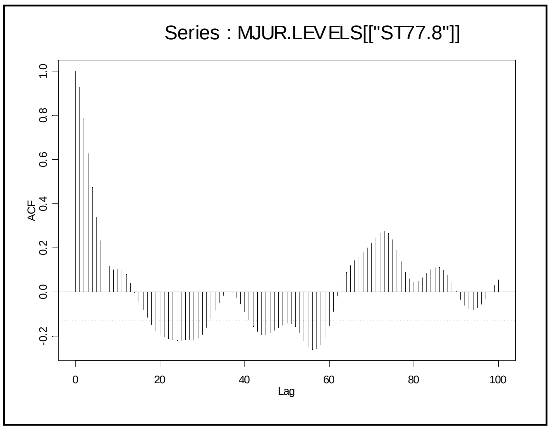
2
1
0
-1
-2
-3
ST88/62A
Moving averages (12)
Moving averages (4)
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

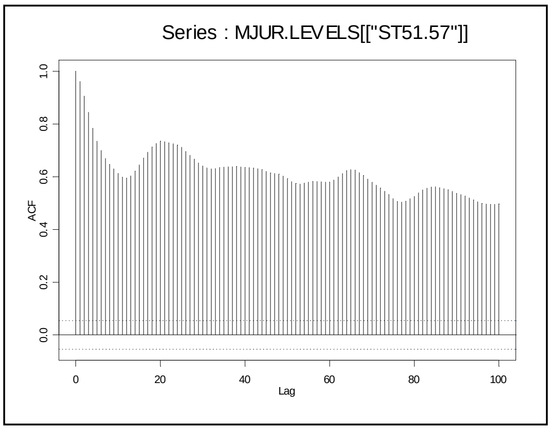
AUTOCORRELATION FUNTION PLOTS

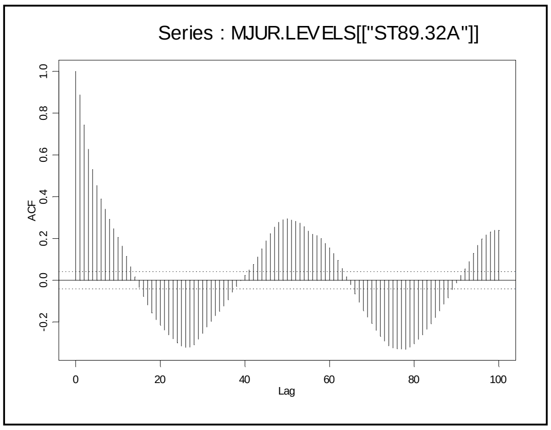


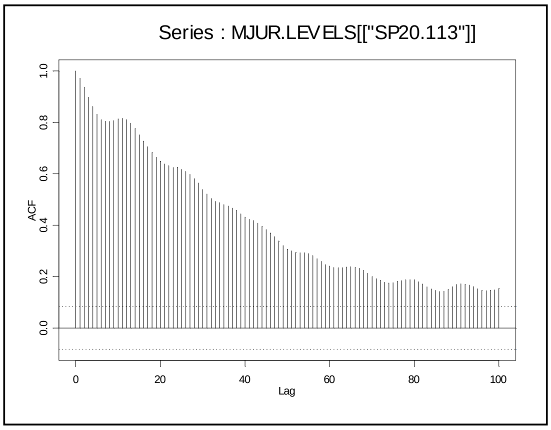


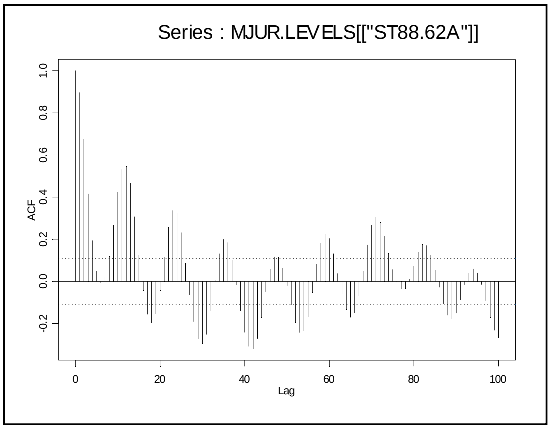




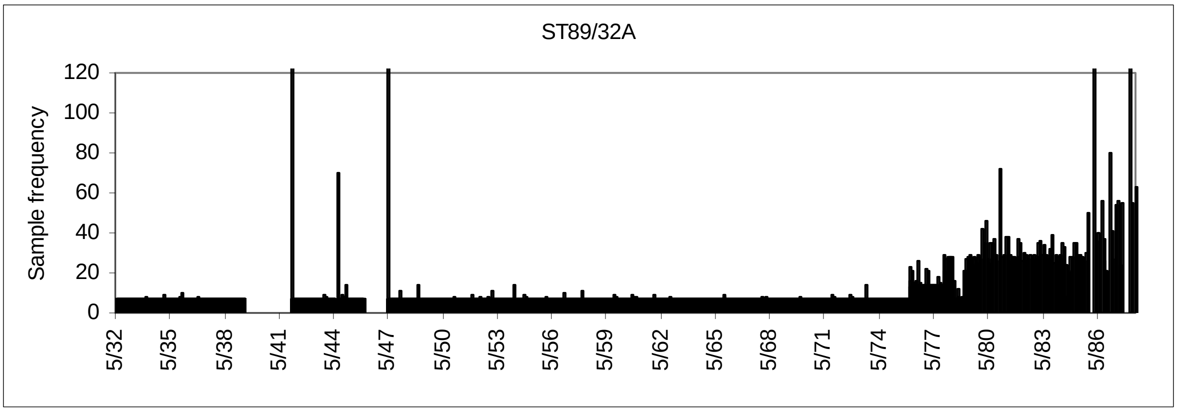


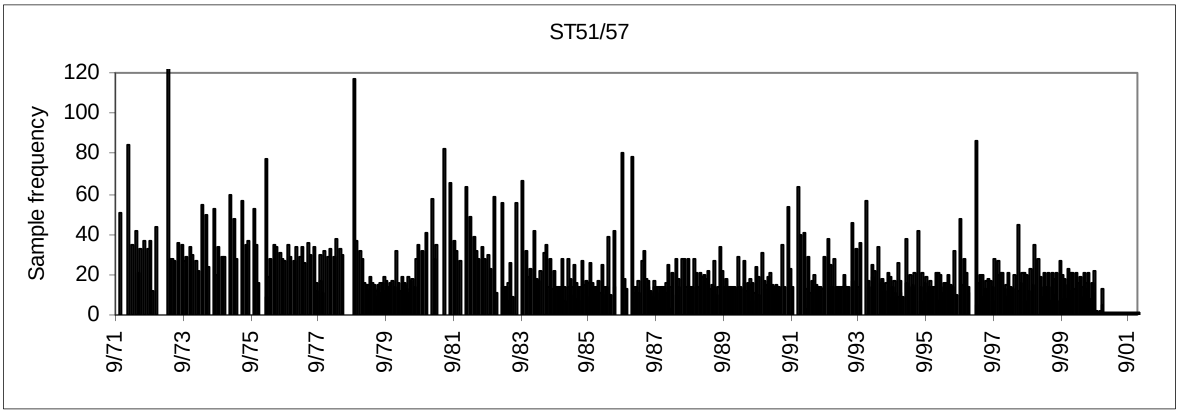


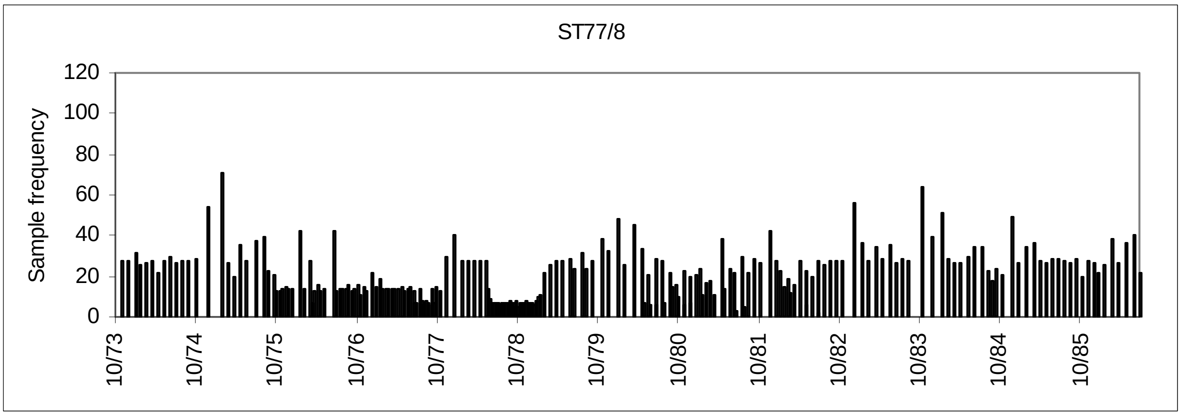


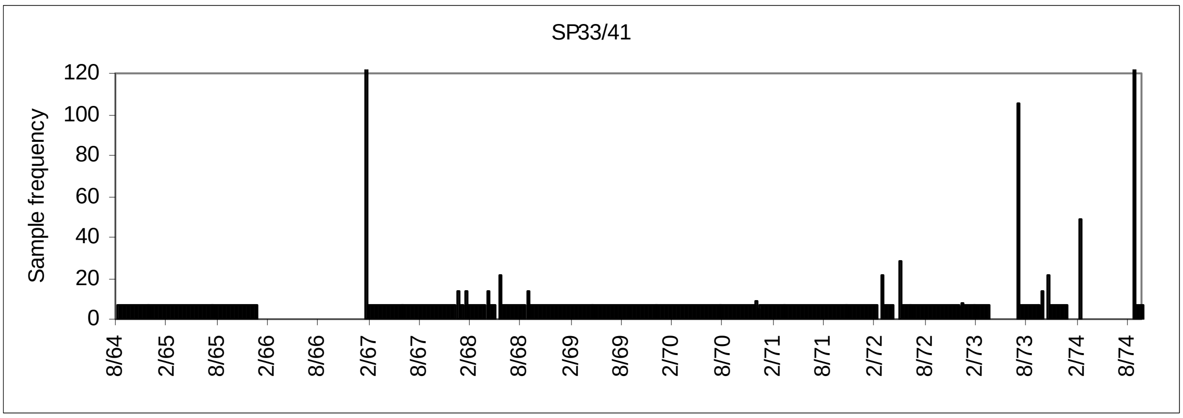


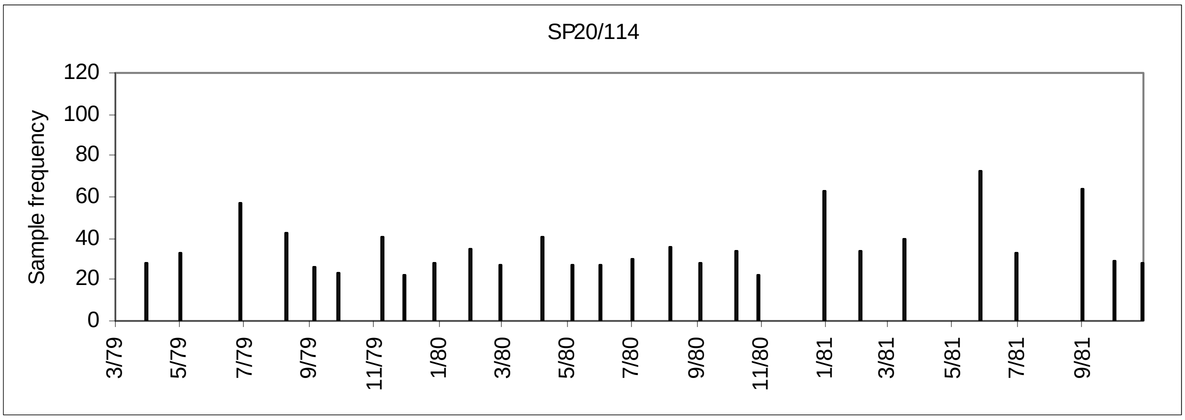
SAMPLE FREQUENCY PLOTS

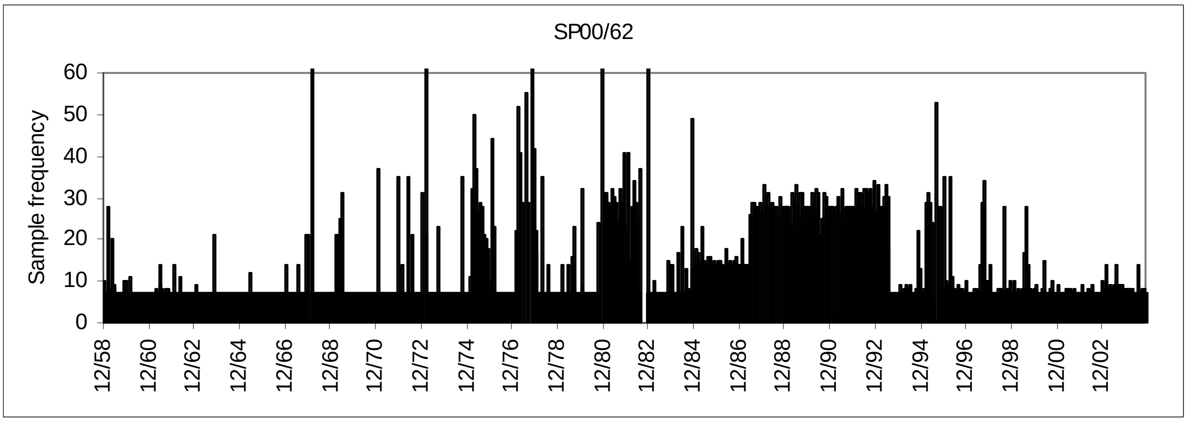


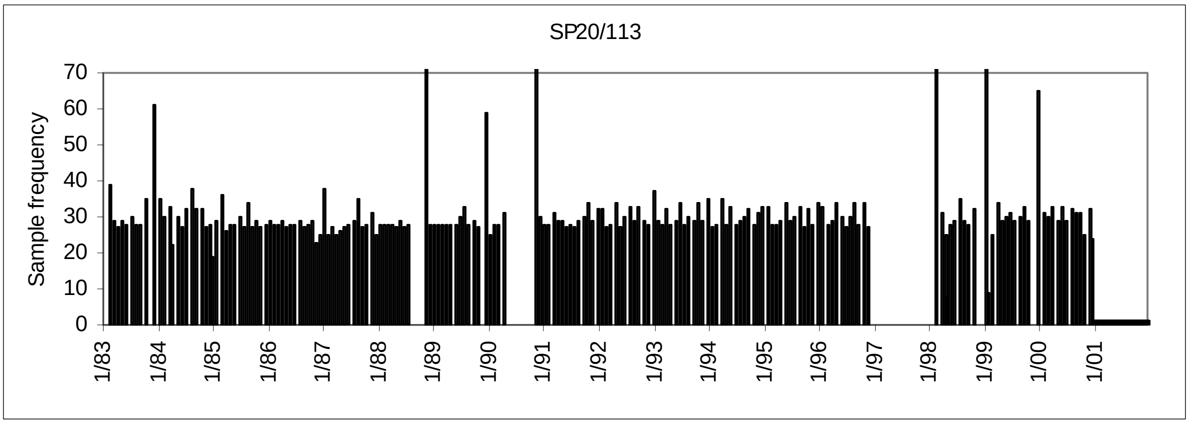


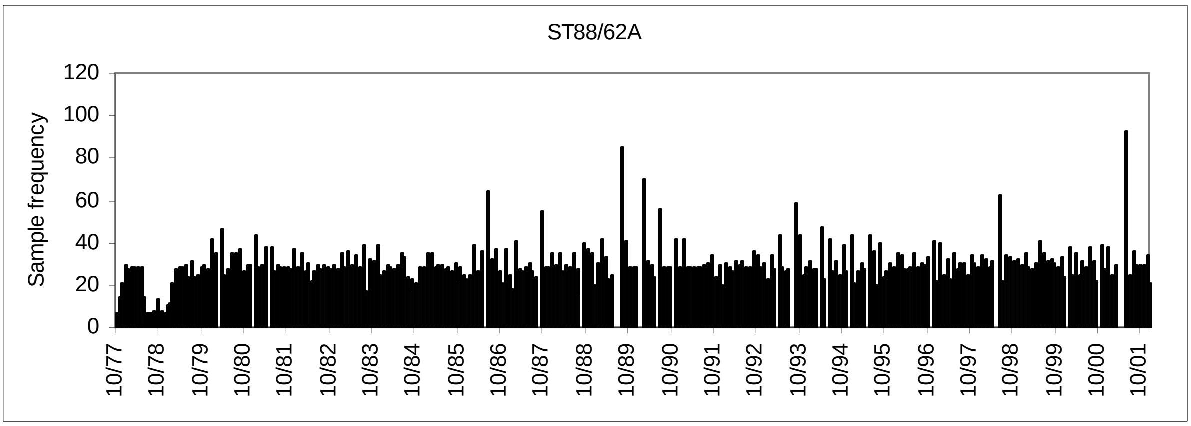





SP20/114
Sample frequency
0
20
40
60
80
100
120
3/79
5/79
7/79
9/79
11/79
1/80
3/80
5/80
7/80
9/80
11/80
1/81
3/81
5/81
7/81
9/81


SP00/62
Sample frequency
0
10
20
30
40
50
60
12/58
12/60
12/62
12/64
12/66
12/68
12/70
12/72
12/74
12/76
12/78
12/80
12/82
12/84
12/86
12/88
12/90
12/92
12/94
12/96
12/98
12/00
12/02


SP20/113
Sample frequency
0
10
20
30
40
50
60
70
1/83
1/84
1/85
1/86
1/87
1/88
1/89
1/90
1/91
1/92
1/93
1/94
1/95
1/96
1/97
1/98
1/99
1/00
1/01


ST88/62A
Sample frequency
0
20
40
60
80
100
120
10/77
10/78
10/79
10/80
10/81
10/82
10/83
10/84
10/85
10/86
10/87
10/88
10/89
10/90
10/91
10/92
10/93
10/94
10/95
10/96
10/97
10/98
10/99
10/00
10/01

WELLMASTER LOOK-UP TABLE

Sept	1958 **Average**	Feb	1963 **Average**	Jul	1967 **Low**
Oct	1958 **High**	Mar	1963 **Very high**	Aug	1967 **Very low**
Nov	1958 **High**	Apr	1963 **Very high**	Sep	1967 **Very low**
Dec	1958 **Very high**	May	1963 **Average**	Oct	1967 **High**
Jan	1959 **Very high**	Jun	1963 **Low**	Nov	1967 **Very high**
Feb	1959 **High**	Jul	1963 **Average**	Dec	1967 **High**
Mar	1959 **High**	Aug	1963 **Low**	Jan	1968 **Very high**
Apr	1959 **High**	Sep	1963 **Low**	Feb	1968 **Very high**
May	1959 **High**	Oct	1963 **Low**	Mar	1968 **Average**
Jun	1959 **Low**	Nov	1963 **High**	Apr	1968 **Low**
Jul	1959 **Low**	Dec	1963 **High**	May	1968 **Average**
Aug	1959 **Very low**	Jan	1964 **Average**	Jun	1968 **Average**
Sep	1959 **Very low**	Feb	1964 **Average**	Jul	1968 **High**
Oct	1959 **Very low**	Mar	1964 **High**	Aug	1968 **Average**
Nov	1959 **Very low**	Apr	1964 **High**	Sep	1968 **Average**
Dec	1959 **High**	May	1964 **Average**	Oct	1968 **Very high**
Jan	1960 **Very high**	Jun	1964 **Average**	Nov	1968 **Very high**
Feb	1960 **Very high**	Jul	1964 **Low**	Dec	1968 **Very high**
Mar	1960 **High**	Aug	1964 **Very low**	Jan	1969 **Very high**
Apr	1960 **High**	Sep	1964 **Very low**	Feb	1969 **Very high**
May	1960 **Low**	Oct	1964 **Very low**	Mar	1969 **Very high**
Jun	1960 **Low**	Nov	1964 **Very low**	Apr	1969 **Average**
Jul	1960 **Low**	Dec	1964 **Low**	May	1969 **High**
Aug	1960 **Low**	Jan	1965 **High**	Jun	1969 **Average**
Sep	1960 **High**	Feb	1965 **Average**	Jul	1969 **Low**
Oct	1960 **Very high**	Mar	1965 **Average**	Aug	1969 **Low**
Nov	1960 **Very high**	Apr	1965 **Average**	Sep	1969 **Low**
Dec	1960 **Very high**	May	1965 **Low**	Oct	1969 **Very low**
Jan	1961 **Very high**	Jun	1965 **Low**	Nov	1969 **Low**
Feb	1961 **Very high**	Jul	1965 **Low**	Dec	1969 **High**
Mar	1961 **High**	Aug	1965 **Low**	Jan	1970 **Very high**
Apr	1961 **High**	Sep	1965 **Average**	Feb	1970 **Very high**
May	1961 **High**	Oct	1965 **Average**	Mar	1970 **High**
Jun	1961 **Average**	Nov	1965 **Average**	Apr	1970 **Average**
Jul	1961 **Low**	Dec	1965 **Very high**	May	1970 **Average**
Aug	1961 **Very low**	Jan	1966 **Very high**	Jun	1970 **Average**
Sep	1961 **Very low**	Feb	1966 **Very high**	Jul	1970 **Very low**
Oct	1961 **Very low**	Mar	1966 **Very high**	Aug	1970 **Very low**
Nov	1961 **Low**	Apr	1966 **High**	Sep	1970 **Low**
Dec	1961 **High**	May	1966 **Very high**	Oct	1970 **Low**
Jan	1962 **Very high**	Jun	1966 **Average**	Nov	1970 **High**
Feb	1962 **Very high**	Jul	1966 **Low**	Dec	1970 **Very high**
Mar	1962 **Average**	Aug	1966 **Very low**	Jan	1971 **Very high**
Apr	1962 **Average**	Sep	1966 **Very low**	Feb	1971 **Very high**
May	1962 **Average**	Oct	1966 **Average**	Mar	1971 **High**
Jun	1962 **Low**	Nov	1966 **High**	Apr	1971 **Average**
Jul	1962 **Very low**	Dec	1966 **Very high**	May	1971 **Average**
Aug	1962 **Low**	Jan	1967 **Very high**	Jun	1971 **High**
Sep	1962 **Low**	Feb	1967 **Very high**	Jul	1971 **Average**
Oct	1962 **Low**	Mar	1967 **Very high**	Aug	1971 **Low**
Nov	1962 **Average**	Apr	1967 **Average**	Sep	1971 **Low**
Dec	1962 **High**	May	1967 **Average**	Oct	1971 **Average**
Jan	1963 **Average**	Jun	1967 **High**	Nov	1971 **Average**

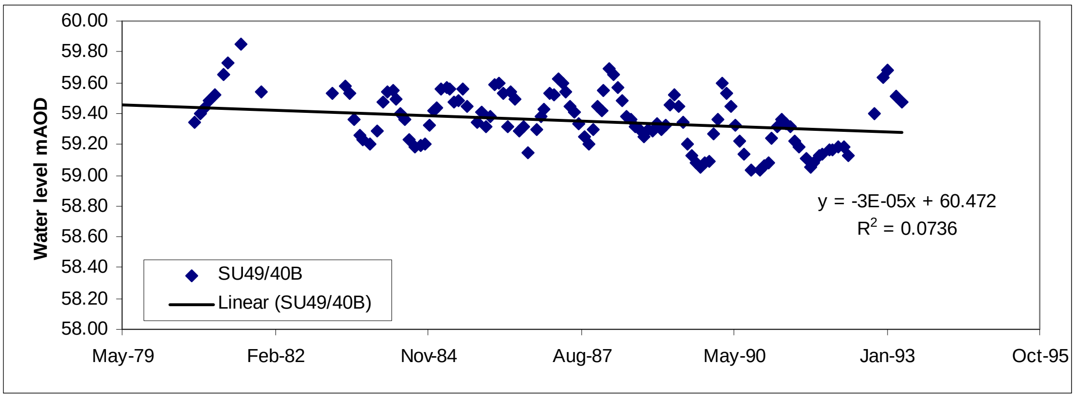
Dec	1971	**High**
Jan	1972	**Very high**
Feb	1972	**Very high**
Mar	1972	**Very high**
Apr	1972	**Average**
May	1972	**Average**
Jun	1972	**Low**
Jul	1972	**Low**
Aug	1972	**Very low**
Sep	1972	**Very low**
Oct	1972	**Very low**
Nov	1972	**Low**
Dec	1972	**Very high**
Jan	1973	**High**
Feb	1973	**Average**
Mar	1973	**Average**
Apr	1973	**Low**
May	1973	**Low**
Jun	1973	**Low**
Jul	1973	**Low**
Aug	1973	**Low**
Sep	1973	**Very low**
Oct	1973	**Very low**
Nov	1973	**Very low**
Dec	1973	**Low**
Jan	1974	**High**
Feb	1974	**Very high**
Mar	1974	**High**
Apr	1974	**Average**
May	1974	**Low**
Jun	1974	**Low**
Jul	1974	**Very low**
Aug	1974	**Very low**
Sep	1974	**High**
Oct	1974	**High**
Nov	1974	**High**
Dec	1974	**High**
Jan	1975	**Very high**
Feb	1975	**Very high**
Mar	1975	**Very high**
Apr	1975	**High**
May	1975	**Average**
Jun	1975	**Low**
Jul	1975	**Low**
Aug	1975	**Very low**
Sep	1975	**Very low**
Oct	1975	**Very low**
Nov	1975	**Very low**
Dec	1975	**Low**
Jan	1976	**Low**
Feb	1976	**Very low**
Mar	1976	**Low**
Apr	1976	**Low**
May	1976	**Very low**
Jun	1976	**Very low**
Jul	1976	**Very low**
Aug	1976	**Very low**
Sep	1976	**Very low**
Oct	1976	**Low**
Nov	1976	**High**
Dec	1976	**Very high**
Jan	1977	**Very high**
Feb	1977	**Very high**
Mar	1977	**Very high**
Apr	1977	**Very high**
May	1977	**High**
Jun	1977	**High**
Jul	1977	**Average**
Aug	1977	**Average**
Sep	1977	**Low**
Oct	1977	**Low**
Nov	1977	**Average**
Dec	1977	**High**
Jan	1978	**High**
Feb	1978	**Very high**
Mar	1978	**Very high**
Apr	1978	**High**
May	1978	**High**
Jun	1978	**Average**
Jul	1978	**Low**
Aug	1978	**Low**
Sep	1978	**Very low**
Oct	1978	**Very low**
Nov	1978	**Very low**
Dec	1978	**Very low**
Jan	1979	**Average**
Feb	1979	**High**
Mar	1979	**Very high**
Apr	1979	**Very high**
May	1979	**High**
Jun	1979	**High**
Jul	1979	**Average**
Aug	1979	**Average**
Sep	1979	**Low**
Oct	1979	**Very low**
Nov	1979	**Very low**
Dec	1979	**Low**
Jan	1980	**High**
Feb	1980	**Very high**
Mar	1980	**Very high**
Apr	1980	**Very high**
May	1980	**Average**
Jun	1980	**Average**
Jul	1980	**Low**
Aug	1980	**Low**
Sep	1980	**Low**
Oct	1980	**Low**
Nov	1980	**Average**
Dec	1980	**Average**
Jan	1981	**High**
Feb	1981	**Average**
Mar	1981	**High**
Apr	1981	**High**
May	1981	**High**
Jun	1981	**High**
Jul	1981	**Average**
Aug	1981	**Low**
Sep	1981	**Low**
Oct	1981	**Average**
Nov	1981	**Average**
Dec	1981	**High**
Jan	1982	**Very high**
Feb	1982	**Very high**
Mar	1982	**Very high**
Apr	1982	**High**
May	1982	**Average**
Jun	1982	**Average**
Jul	1982	**Low**
Aug	1982	**Low**
Sep	1982	**Very low**
Oct	1982	**Low**
Nov	1982	**High**
Dec	1982	**Very high**
Jan	1983	**Very high**
Feb	1983	**Very high**
Mar	1983	**High**
Apr	1983	**High**
May	1983	**Very high**
Jun	1983	**High**
Jul	1983	**Average**
Aug	1983	**Low**
Sep	1983	**Very low**
Oct	1983	**Low**
Nov	1983	**Low**
Dec	1983	**Average**
Jan	1984	**High**
Feb	1984	**High**
Mar	1984	**High**
Apr	1984	**Average**
May	1984	**Average**
Jun	1984	**Low**
Jul	1984	**Very low**
Aug	1984	**Very low**
Sep	1984	**Very low**
Oct	1984	**Very low**
Nov	1984	**Average**
Dec	1984	**High**
Jan	1985	**High**
Feb	1985	**High**

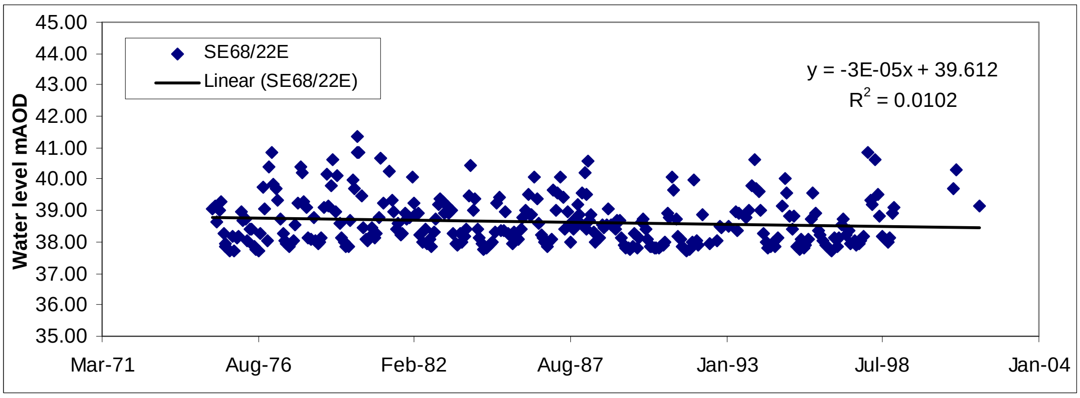
Mar	1985	**High**
Apr	1985	**High**
May	1985	**Average**
Jun	1985	**Average**
Jul	1985	**Average**
Aug	1985	**Average**
Sep	1985	**Average**
Oct	1985	**Average**
Nov	1985	**Low**
Dec	1985	**Average**
Jan	1986	**High**
Feb	1986	**High**
Mar	1986	**High**
Apr	1986	**High**
May	1986	**High**
Jun	1986	**High**
Jul	1986	**Average**
Aug	1986	**Low**
Sep	1986	**Low**
Oct	1986	**Low**
Nov	1986	**Average**
Dec	1986	**High**
Jan	1987	**Very high**
Feb	1987	**High**
Mar	1987	**High**
Apr	1987	**High**
May	1987	**High**
Jun	1987	**Average**
Jul	1987	**Average**
Aug	1987	**Low**
Sep	1987	**Very low**
Oct	1987	**Very low**
Nov	1987	**Low**
Dec	1987	**Average**
Jan	1988	**High**
Feb	1988	**Very high**
Mar	1988	**Very high**
Apr	1988	**High**
May	1988	**Average**
Jun	1988	**Average**
Jul	1988	**Low**
Aug	1988	**Low**
Sep	1988	**Low**
Oct	1988	**Low**
Nov	1988	**Low**
Dec	1988	**Low**
Jan	1989	**Low**
Feb	1989	**Average**
Mar	1989	**High**
Apr	1989	**High**
May	1989	**High**
Jun	1989	**Average**
Jul	1989	**Low**
Aug	1989	**Very low**
Sep	1989	**Very low**
Oct	1989	**Very low**
Nov	1989	**Very low**
Dec	1989	**Average**
Jan	1990	**High**
Feb	1990	**Very high**
Mar	1990	**Very high**
Apr	1990	**High**
May	1990	**Average**
Jun	1990	**Low**
Jul	1990	**Low**
Aug	1990	**Very low**
Sep	1990	**Very low**
Oct	1990	**Very low**
Nov	1990	**Very low**
Dec	1990	**Very low**
Jan	1991	**Low**
Feb	1991	**Average**
Mar	1991	**Average**
Apr	1991	**High**
May	1991	**Average**
Jun	1991	**Average**
Jul	1991	**Low**
Aug	1991	**Low**
Sep	1991	**Very low**
Oct	1991	**Very low**
Nov	1991	**Low**
Dec	1991	**Average**
Jan	1992	**Average**
Feb	1992	**Average**
Mar	1992	**Average**
Apr	1992	**Average**
May	1992	**Low**
Jun	1992	**Low**
Jul	1992	**Very low**
Aug	1992	**Very low**
Sep	1992	**Low**
Oct	1992	**Low**
Nov	1992	**Average**
Dec	1992	**High**
Jan	1993	**Very high**
Feb	1993	**Very high**
Mar	1993	**High**
Apr	1993	**Average**
May	1993	**Average**
Jun	1993	**Average**
Jul	1993	**Average**
Aug	1993	**Low**
Sep	1993	**Very low**
Oct	1993	**Average**
Nov	1993	**High**
Dec	1993	**High**
Jan	1994	**Very high**
Feb	1994	**Very high**
Mar	1994	**Very high**
Apr	1994	**Very high**
May	1994	**High**
Jun	1994	**Average**
Jul	1994	**Low**
Aug	1994	**Low**
Sep	1994	**Very low**
Oct	1994	**Very low**
Nov	1994	**Average**
Dec	1994	**High**
Jan	1995	**Very high**
Feb	1995	**Very high**
Mar	1995	**Very high**
Apr	1995	**High**
May	1995	**Average**
Jun	1995	**Average**
Jul	1995	**Low**
Aug	1995	**Very low**
Sep	1995	**Very low**
Oct	1995	**Very low**
Nov	1995	**Very low**
Dec	1995	**Average**
Jan	1996	**High**
Feb	1996	**High**
Mar	1996	**High**
Apr	1996	**High**
May	1996	**Average**
Jun	1996	**Average**
Jul	1996	**Low**
Aug	1996	**Very low**
Sep	1996	**Very low**
Oct	1996	**Very low**
Nov	1996	**Very low**
Dec	1996	**Low**
Jan	1997	**Low**
Feb	1997	**Average**
Mar	1997	**High**
Apr	1997	**Average**
May	1997	**Low**
Jun	1997	**Low**
Jul	1997	**Low**
Aug	1997	**Very low**
Sep	1997	**Very low**
Oct	1997	**Very low**
Nov	1997	**Low**
Dec	1997	**High**
Jan	1998	**Very high**
Feb	1998	**High**
Mar	1998	**High**
Apr	1998	**High**
May	1998	**High**

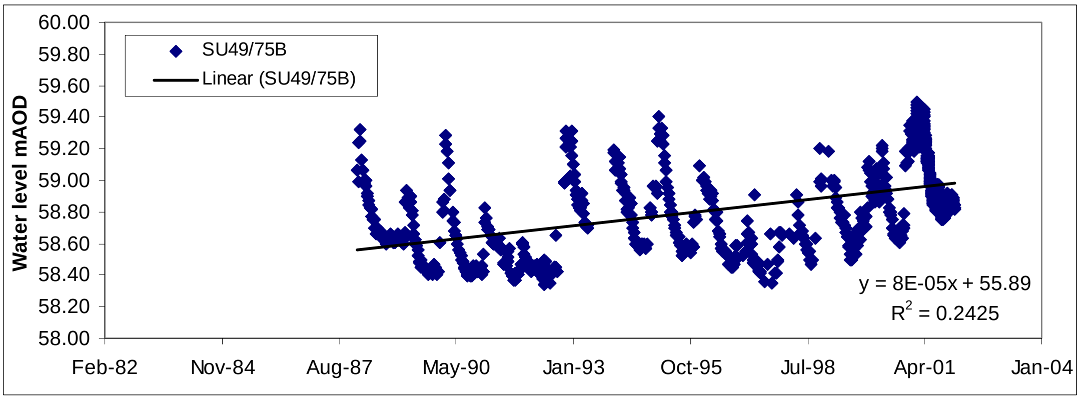
Jun	1998	**Average**
Jul	1998	**Low**
Aug	1998	**Low**
Sep	1998	**Very low**
Oct	1998	**Low**
Nov	1998	**High**
Dec	1998	**High**
Jan	1999	**Very high**
Feb	1999	**Very high**
Mar	1999	**High**
Apr	1999	**High**
May	1999	**High**
Jun	1999	**Average**
Jul	1999	**Average**
Aug	1999	**Low**
Sep	1999	**Low**
Oct	1999	**Average**
Nov	1999	**High**
Dec	1999	**High**
Jan	2000	**Very high**
Feb	2000	**High**
Mar	2000	**High**
Apr	2000	**Very high**
May	2000	**High**
Jun	2000	**High**
Jul	2000	**Average**
Aug	2000	**Low**
Sep	2000	**Low**
Oct	2000	**Average**
Nov	2000	**High**
Dec	2000	**Very high**
Jan	2001	**Very high**
Feb	2001	**Very high**
Mar	2001	**Very high**
Apr	2001	**Very high**
May	2001	**High**

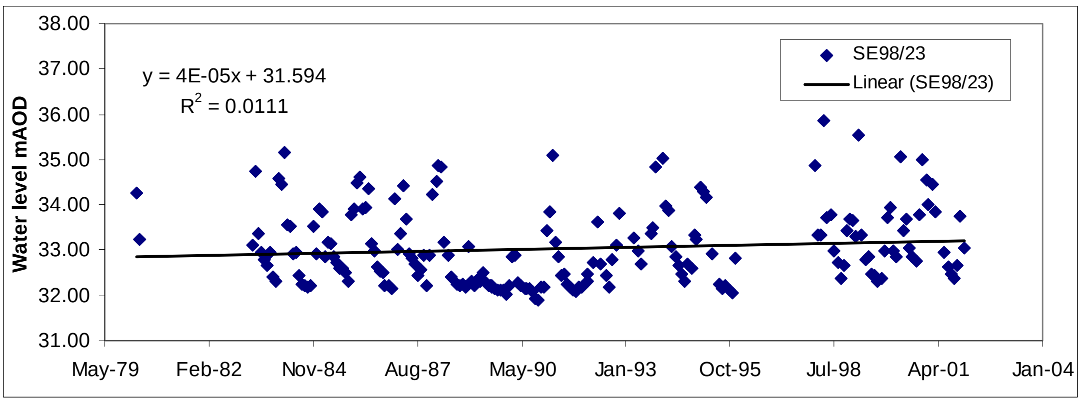
Appendix 4 Upper Jurassic

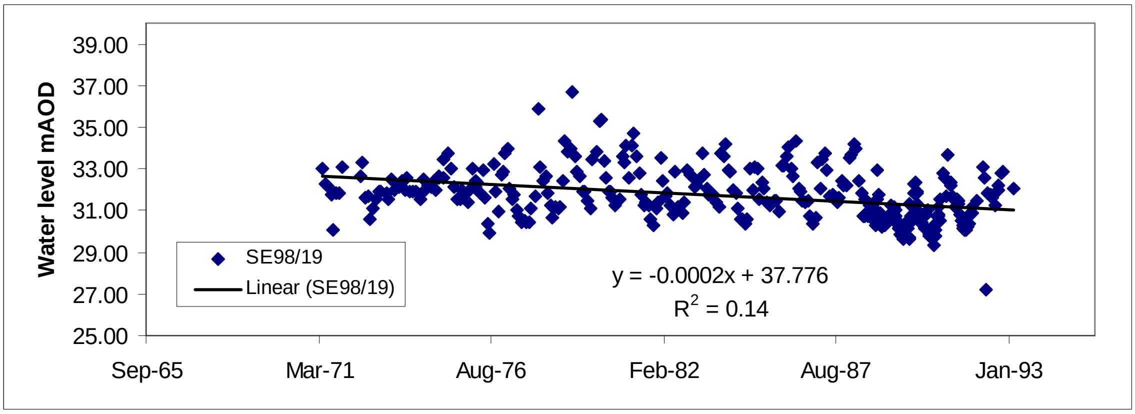
WATER LEVELS ABOVE ORDNANCE DATUM WITH LINEAR REGRESSION CURVE

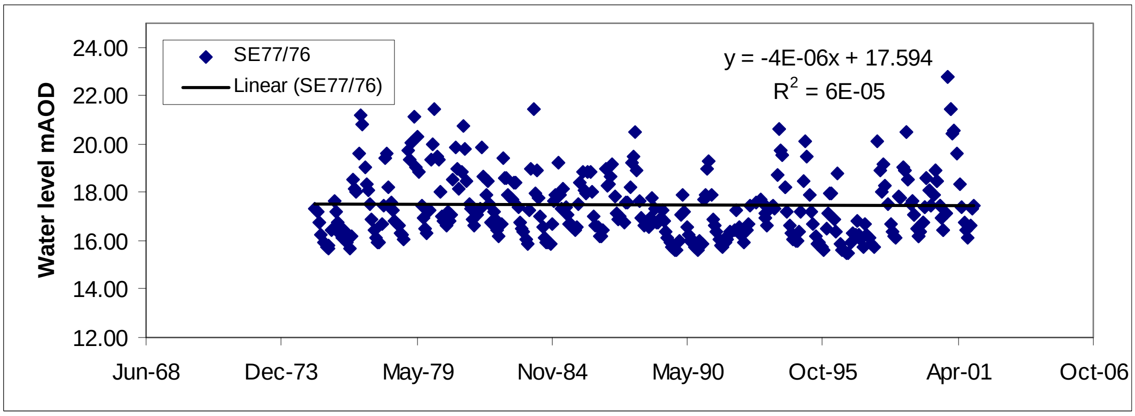




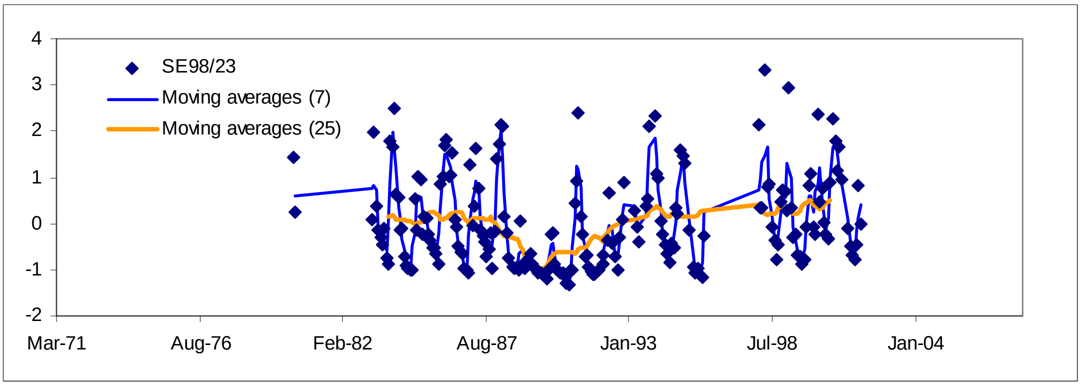


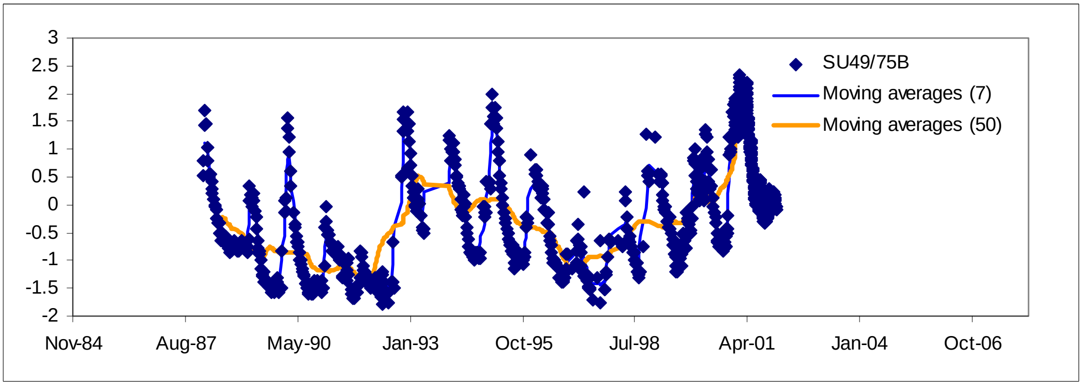


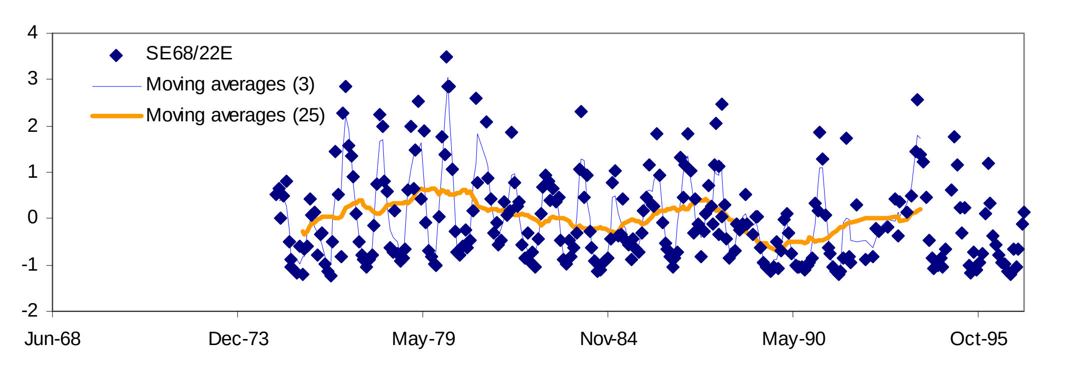

39.00
37.00
35.00
33.00
31.00
29.00
27.00
25.00
Water level mAOD
SE98/19
Linear (SE98/19)
y = -0.0002x + 37.776
R2 = 0.14
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93

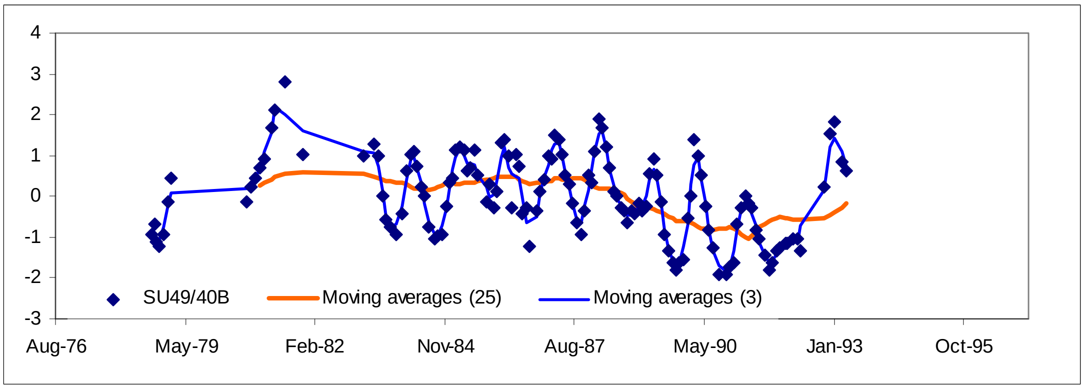

24.00
22.00
20.00
18.00
16.00
14.00
12.00
Water level mAOD
SE77/76
Linear (SE77/76)
y = -4E-06x + 17.594
R2 = 6E-05
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

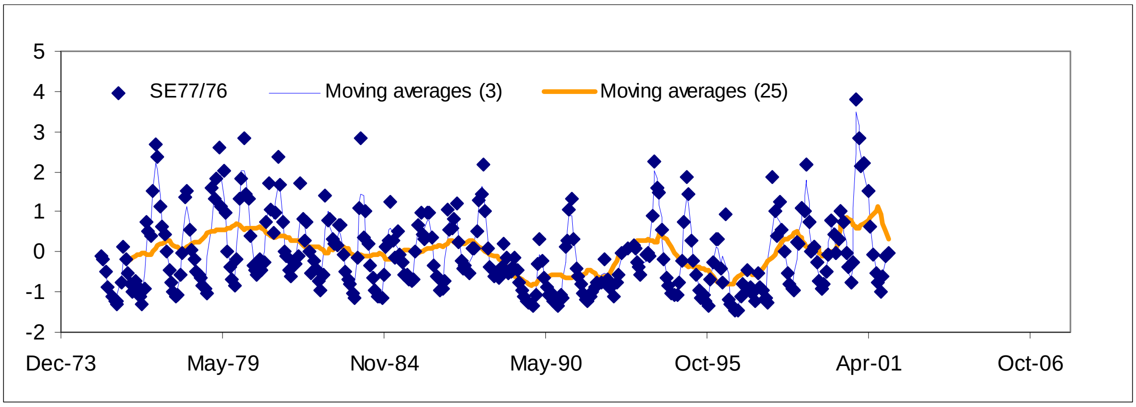
NORMALISED WATER LEVEL DATA WITH MOVING AVERAGES SMOOTHING LINES

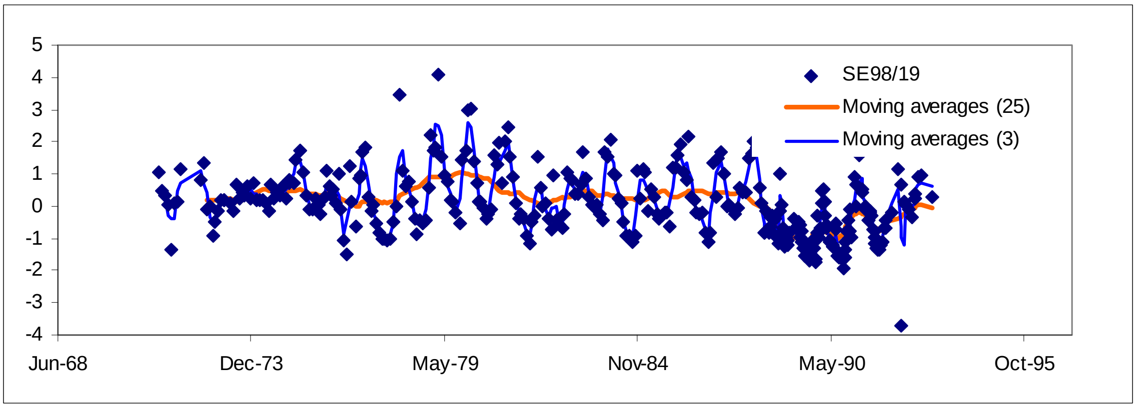




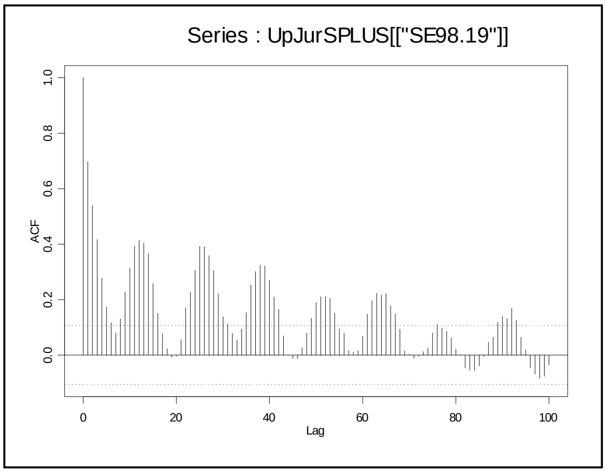


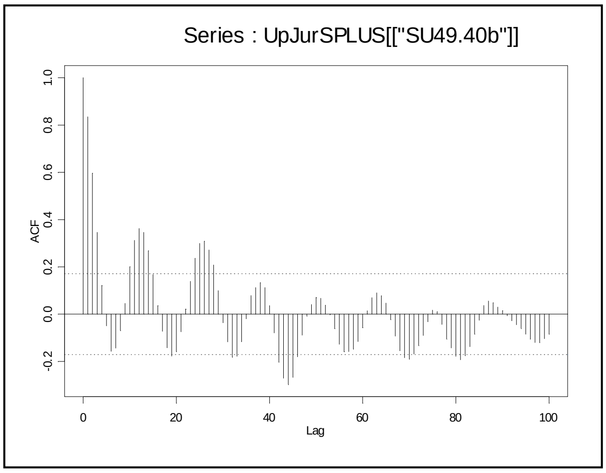


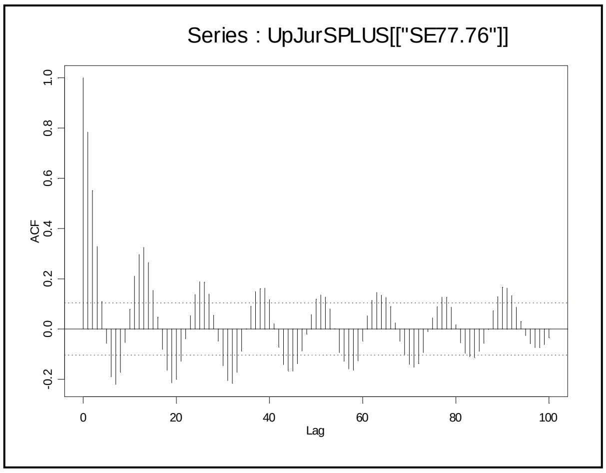

5
4
3
2
1
0
-1
-2
SE77/76
Moving averages (3)
Moving averages (25)
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

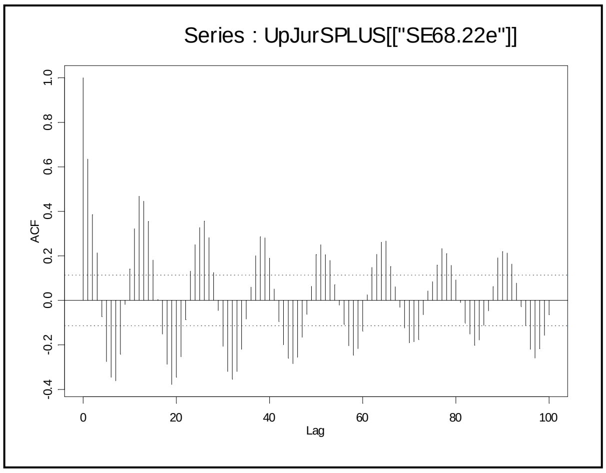

5
4
3
2
1
0
-1
-2
-3
-4
SE98/19
Moving averages (25)
Moving averages (3)
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95

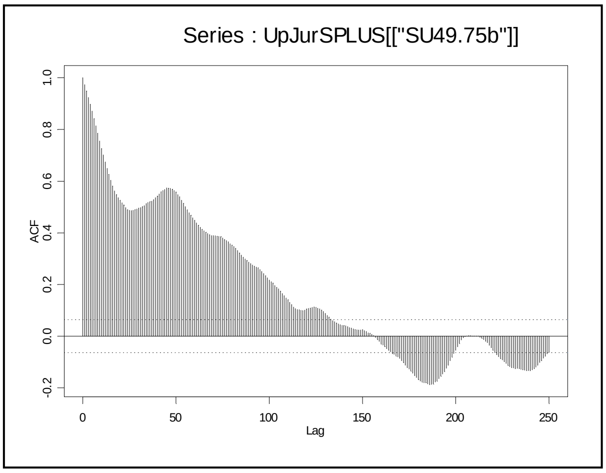
AUTOCORRELATION FUNTION PLOTS

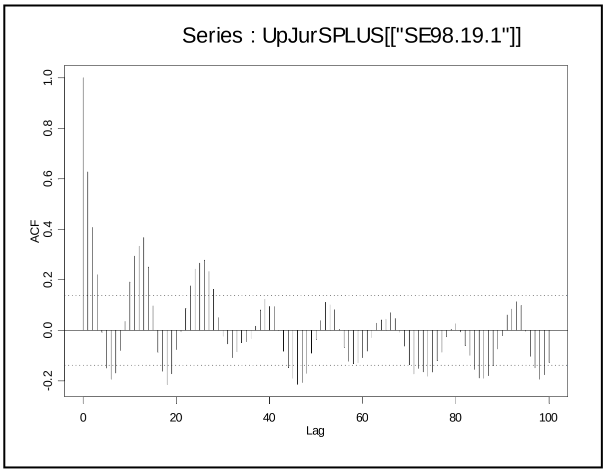




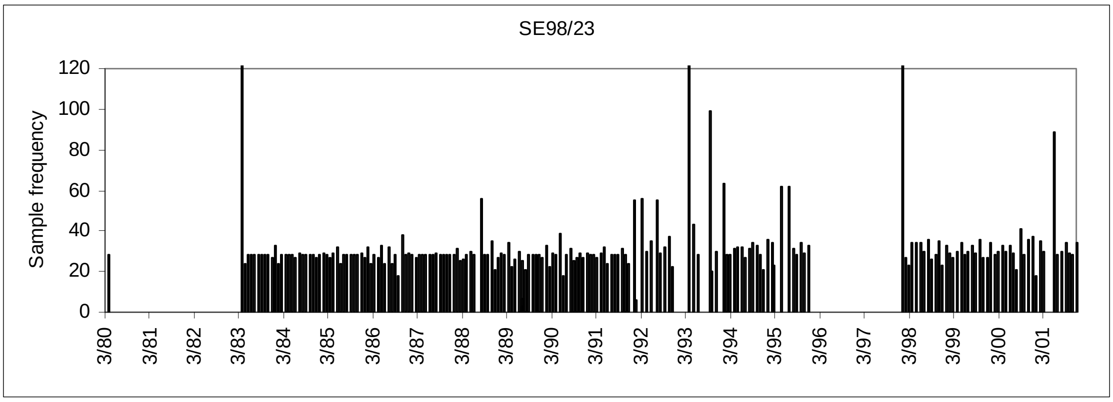


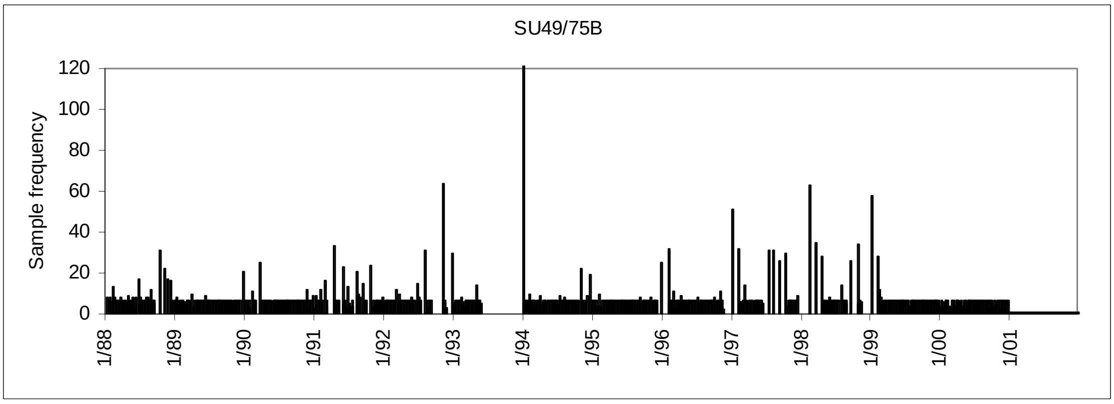


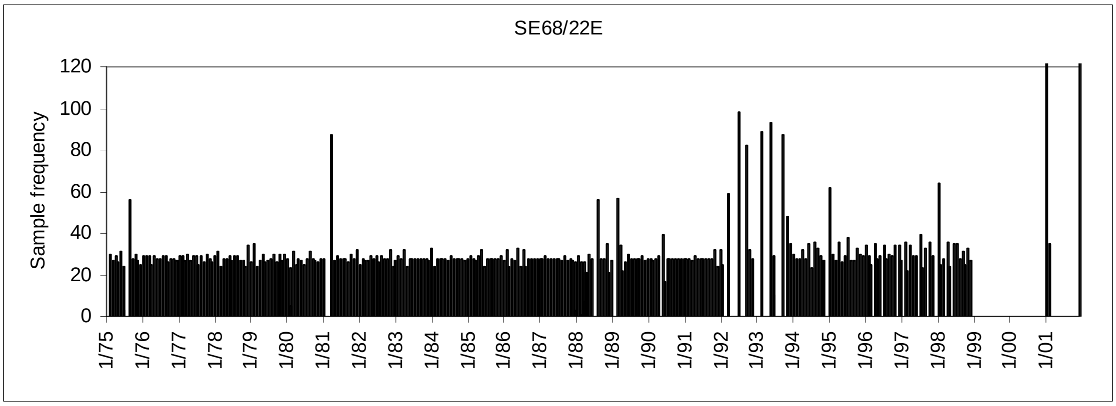


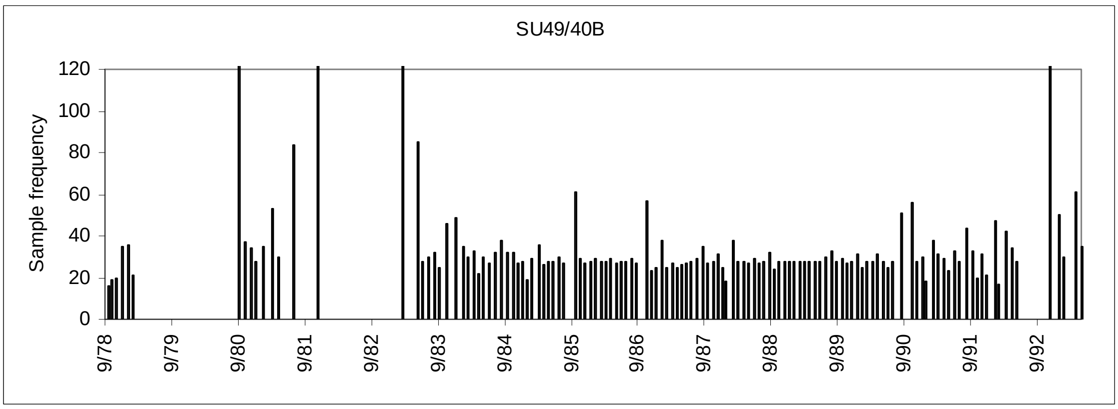


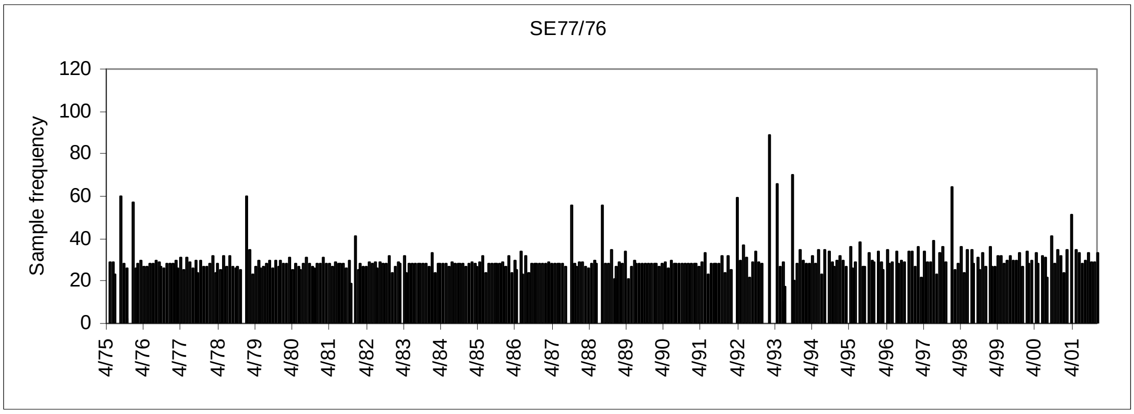
SAMPLE FREQUENCY PLOTS

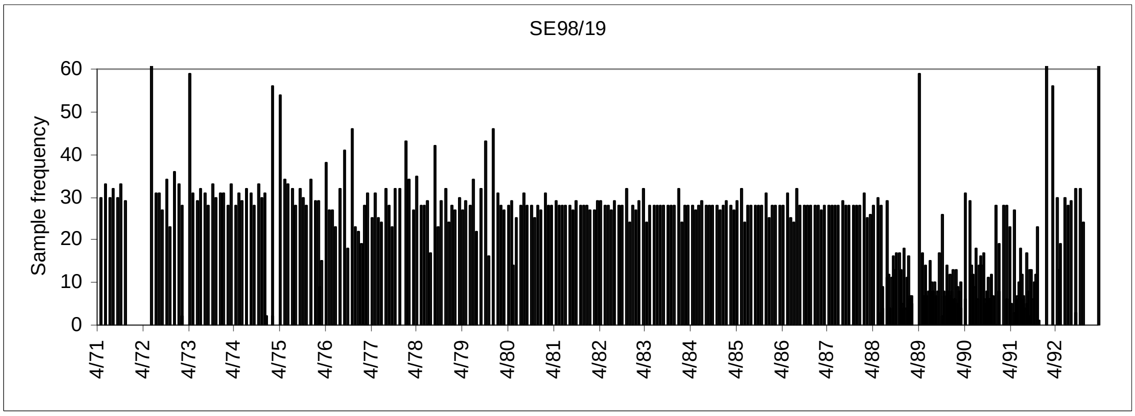









SE77/76
Sample frequency
120
100
80
60
40
20
0
4/75
4/76
4/77
4/78
4/79
4/80
4/81
4/82
4/83
4/84
4/85
4/86
4/87
4/88
4/89
4/90
4/91
4/92
4/93
4/94
4/95
4/96
4/97
4/98
4/99
4/00
4/01


SE98/19
Sample frequency
60
50
40
30
20
10
0
4/71
4/72
4/73
4/74
4/75
4/76
4/77
4/78
4/79
4/80
4/81
4/82
4/83
4/84
4/85
4/86
4/87
4/88
4/89
4/90
4/91
4/92

WELLMASTER LOOK-UP TABLE

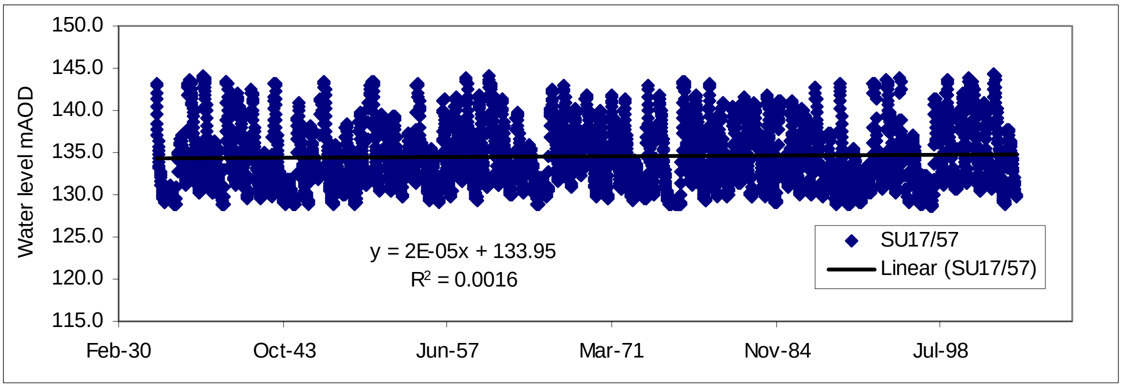
Mar	1975 **High**	Jul	1979 **High**	Nov	1983 **Average**
Apr	1975 **High**	Aug	1979 **Average**	Dec	1983 **High**
May	1975 **High**	Sep	1979 **Average**	Jan	1984 **Very high**
Jun	1975 **Average**	Oct	1979 **Average**	Feb	1984 **Very high**
Jul	1975 **Low**	Nov	1979 **High**	Mar	1984 **Very high**
Aug	1975 **Low**	Dec	1979 **Very high**	Apr	1984 **High**
Sep	1975 **Low**	Jan	1980 **Very high**	May	1984 **Average**
Oct	1975 **Low**	Feb	1980 **Very high**	Jun	1984 **Low**
Nov	1975 **Low**	Mar	1980 **Very high**	Jul	1984 **Very low**
Dec	1975 **Average**	Apr	1980 **Very high**	Aug	1984 **Very low**
Jan	1976 **Average**	May	1980 **High**	Sep	1984 **Very low**
Feb	1976 **Average**	Jun	1980 **Average**	Oct	1984 **Low**
Mar	1976 **Average**	Jul	1980 **Low**	Nov	1984 **Low**
Apr	1976 **Average**	Aug	1980 **Low**	Dec	1984 **High**
May	1976 **Low**	Sep	1980 **Average**	Jan	1985 **High**
Jun	1976 **Low**	Oct	1980 **High**	Feb	1985 **High**
Jul	1976 **Low**	Nov	1980 **Very high**	Mar	1985 **High**
Aug	1976 **Low**	Dec	1980 **Very high**	Apr	1985 **High**
Sep	1976 **Low**	Jan	1981 **Very high**	May	1985 **High**
Oct	1976 **Average**	Feb	1981 **Very high**	Jun	1985 **Average**
Nov	1976 **High**	Mar	1981 **Very high**	Jul	1985 **Average**
Dec	1976 **Very high**	Apr	1981 **Very high**	Aug	1985 **Low**
Jan	1977 **Very high**	May	1981 **Very high**	Sep	1985 **Low**
Feb	1977 **Very high**	Jun	1981 **Very high**	Oct	1985 **Average**
Mar	1977 **Very high**	Jul	1981 **High**	Nov	1985 **Average**
Apr	1977 **Very high**	Aug	1981 **Average**	Dec	1985 **High**
May	1977 **High**	Sep	1981 **Average**	Jan	1986 **Very high**
Jun	1977 **Average**	Oct	1981 **Average**	Feb	1986 **Very high**
Jul	1977 **Low**	Nov	1981 **Average**	Mar	1986 **Very high**
Aug	1977 **Low**	Dec	1981 **High**	Apr	1986 **Very high**
Sep	1977 **Very low**	Jan	1982 **High**	May	1986 **Very high**
Oct	1977 **Very low**	Feb	1982 **High**	Jun	1986 **High**
Nov	1977 **Low**	Mar	1982 **High**	Jul	1986 **Average**
Dec	1977 **Average**	Apr	1982 **High**	Aug	1986 **Low**
Jan	1978 **High**	May	1982 **Average**	Sep	1986 **Low**
Feb	1978 **Very high**	Jun	1982 **Average**	Oct	1986 **Low**
Mar	1978 **Very high**	Jul	1982 **Low**	Nov	1986 **Low**
Apr	1978 **Very high**	Aug	1982 **Low**	Dec	1986 **Average**
May	1978 **High**	Sep	1982 **Low**	Jan	1987 **High**
Jun	1978 **Average**	Oct	1982 **Average**	Feb	1987 **Very high**
Jul	1978 **Average**	Nov	1982 **High**	Mar	1987 **Very high**
Aug	1978 **Low**	Dec	1982 **High**	Apr	1987 **Very high**
Sep	1978 **Low**	Jan	1983 **High**	May	1987 **High**
Oct	1978 **Low**	Feb	1983 **High**	Jun	1987 **Average**
Nov	1978 **Average**	Mar	1983 **High**	Jul	1987 **Average**
Dec	1978 **High**	Apr	1983 **High**	Aug	1987 **Low**
Jan	1979 **High**	May	1983 **High**	Sep	1987 **Low**
Feb	1979 **Very high**	Jun	1983 **High**	Oct	1987 **Average**
Mar	1979 **Very high**	Jul	1983 **Average**	Nov	1987 **Average**
Apr	1979 **Very high**	Aug	1983 **Low**	Dec	1987 **High**
May	1979 **Very high**	Sep	1983 **Low**	Jan	1988 **Very high**
Jun	1979 **Very high**	Oct	1983 **Low**	Feb	1988 **Very high**

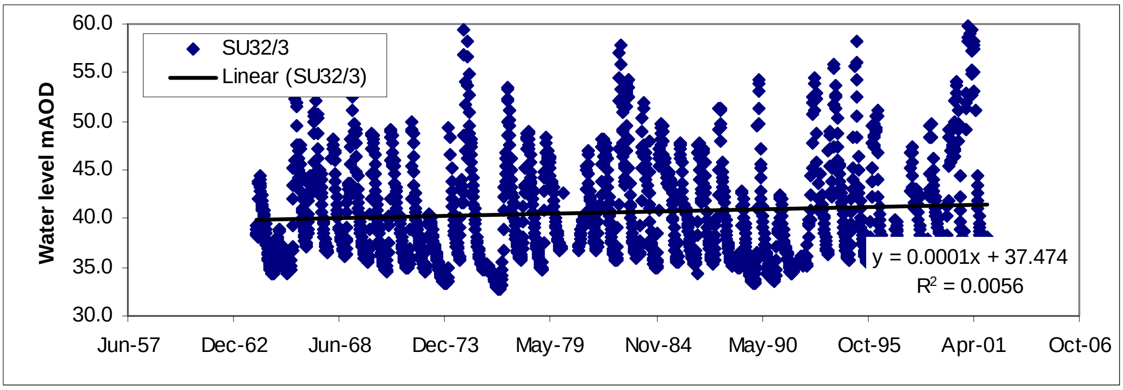
Mar	1988 **Very high**	Jul	1992 **Very low**	Nov	1996 **Very low**
Apr	1988 **High**	Aug	1992 **Very low**	Dec	1996 **Very low**
May	1988 **Average**	Sep	1992 **Low**	Jan	1997 **Very low**
Jun	1988 **Low**	Oct	1992 **Average**	Feb	1997 **Low**
Jul	1988 **Low**	Nov	1992 **High**	Mar	1997 **Low**
Aug	1988 **Low**	Dec	1992 **Very high**	Apr	1997 **Very low**
Sep	1988 **Low**	Jan	1993 **Very high**	May	1997 **Very low**
Oct	1988 **Low**	Feb	1993 **High**	Jun	1997 **Very low**
Nov	1988 **Low**	Mar	1993 **High**	Jul	1997 **Very low**
Dec	1988 **Average**	Apr	1993 **High**	Aug	1997 **Very low**
Jan	1989 **Low**	May	1993 **Average**	Sep	1997 **Very low**
Feb	1989 **Low**	Jun	1993 **Average**	Oct	1997 **Very low**
Mar	1989 **Average**	Jul	1993 **Average**	Nov	1997 **Low**
Apr	1989 **Average**	Aug	1993 **Average**	Dec	1997 **Average**
May	1989 **Low**	Sep	1993 **High**	Jan	1998 **High**
Jun	1989 **Very low**	Oct	1993 **High**	Feb	1998 **Very high**
Jul	1989 **Very low**	Nov	1993 **Very high**	Mar	1998 **Very high**
Aug	1989 **Very low**	Dec	1993 **Very high**	Apr	1998 **High**
Sep	1989 **Very low**	Jan	1994 **Very high**	May	1998 **High**
Oct	1989 **Very low**	Feb	1994 **Very high**	Jun	1998 **Low**
Nov	1989 **Very low**	Mar	1994 **Very high**	Jul	1998 **Low**
Dec	1989 **Very low**	Apr	1994 **High**	Aug	1998 **Very low**
Jan	1990 **Low**	May	1994 **Average**	Sep	1998 **Low**
Feb	1990 **High**	Jun	1994 **Low**	Oct	1998 **Average**
Mar	1990 **Average**	Jul	1994 **Low**	Nov	1998 **High**
Apr	1990 **Low**	Aug	1994 **Very low**	Dec	1998 **High**
May	1990 **Very low**	Sep	1994 **Very low**	Jan	1999 **High**
Jun	1990 **Very low**	Oct	1994 **Low**	Feb	1999 **Very high**
Jul	1990 **Very low**	Nov	1994 **Low**	Mar	1999 **Very high**
Aug	1990 **Very low**	Dec	1994 **High**	Apr	1999 **High**
Sep	1990 **Very low**	Jan	1995 **Very high**	May	1999 **Average**
Oct	1990 **Very low**	Feb	1995 **Very high**	Jun	1999 **Low**
Nov	1990 **Very low**	Mar	1995 **Very high**	Jul	1999 **Low**
Dec	1990 **Very low**	Apr	1995 **High**	Aug	1999 **Very low**
Jan	1991 **Average**	May	1995 **Average**	Sep	1999 **Low**
Feb	1991 **High**	Jun	1995 **Low**	Oct	1999 **Low**
Mar	1991 **High**	Jul	1995 **Low**	Nov	1999 **Low**
Apr	1991 **Average**	Aug	1995 **Very low**	Dec	1999 **High**
May	1991 **Low**	Sep	1995 **Very low**	Jan	2000 **High**
Jun	1991 **Low**	Oct	1995 **Very low**	Feb	2000 **High**
Jul	1991 **Very low**	Nov	1995 **Very low**	Mar	2000 **High**
Aug	1991 **Very low**	Dec	1995 **Low**	Apr	2000 **High**
Sep	1991 **Very low**	Jan	1996 **High**	May	2000 **High**
Oct	1991 **Very low**	Feb	1996 **High**	Jun	2000 **High**
Nov	1991 **Very low**	Mar	1996 **High**	Jul	2000 **Average**
Dec	1991 **Very low**	Apr	1996 **Average**	Aug	2000 **Low**
Jan	1992 **Very low**	May	1996 **Average**	Sep	2000 **Low**
Feb	1992 **Very low**	Jun	1996 **Low**	Oct	2000 **Average**
Mar	1992 **Very low**	Jul	1996 **Very low**	Nov	2000 **Very high**
Apr	1992 **Very low**	Aug	1996 **Very low**	Dec	2000 **Very high**
May	1992 **Very low**	Sep	1996 **Very low**	Jan	2001 **Very high**
Jun	1992 **Very low**	Oct	1996 **Very low**	Feb	2001 **Very high**

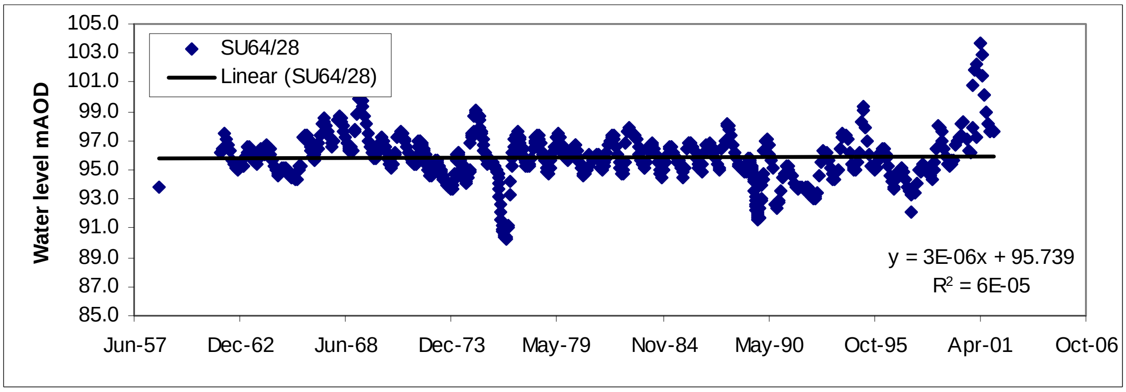
Mar	2001	**Very high**
Apr	2001	**Very high**
May	2001	**Very high**
Jun	2001	**High**
Jul	2001	**Average**
Aug	2001	**High**
Sep	2001	**Average**
Oct	2001	**Average**
Nov	2001	**Average**

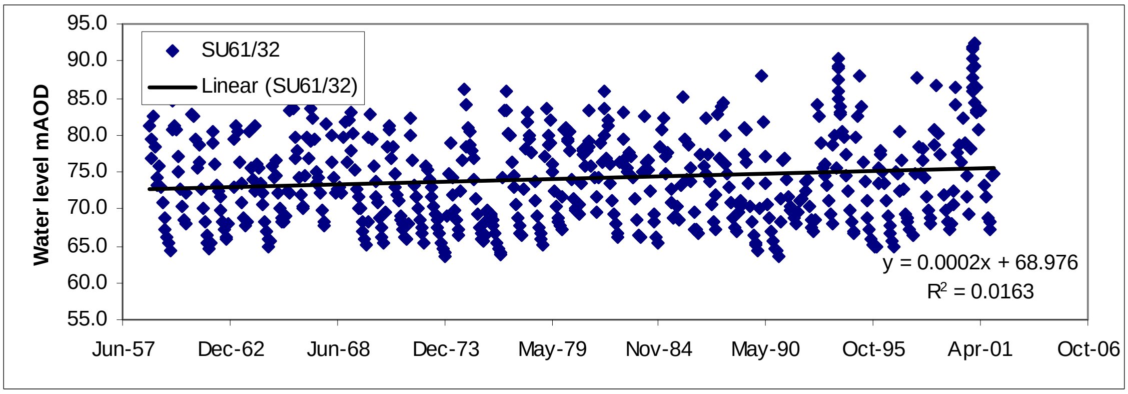
Appendix 5 Chalk – Hampshire and Wiltshire

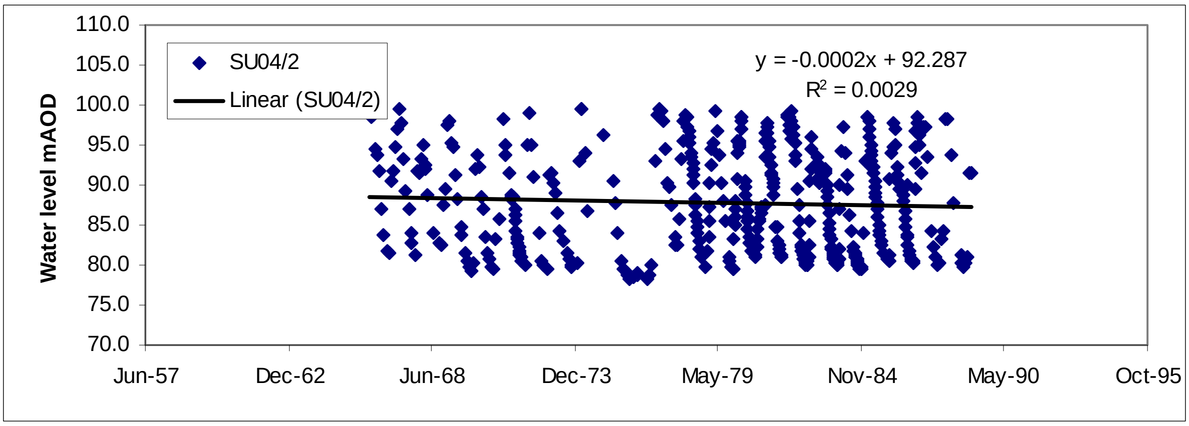
WATER LEVELS ABOVE ORDNANCE DATUM WITH LINEAR REGRESSION CURVE

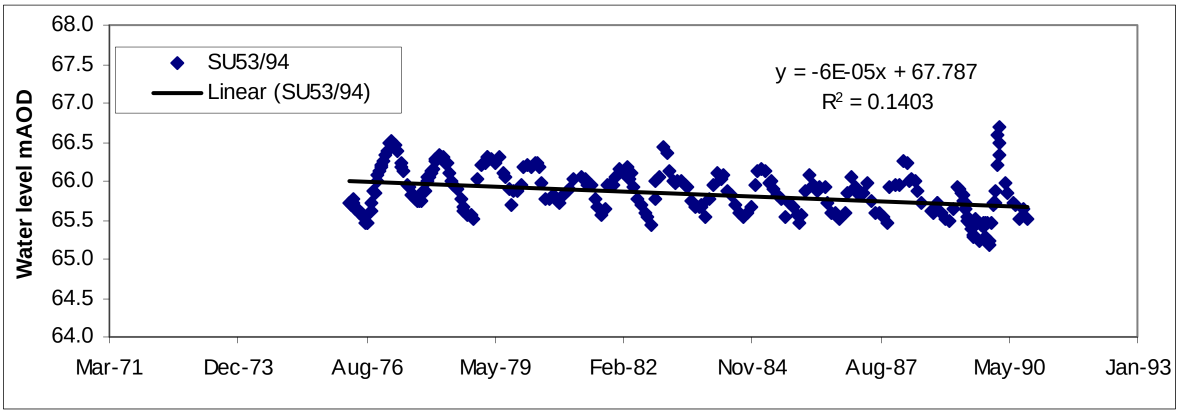


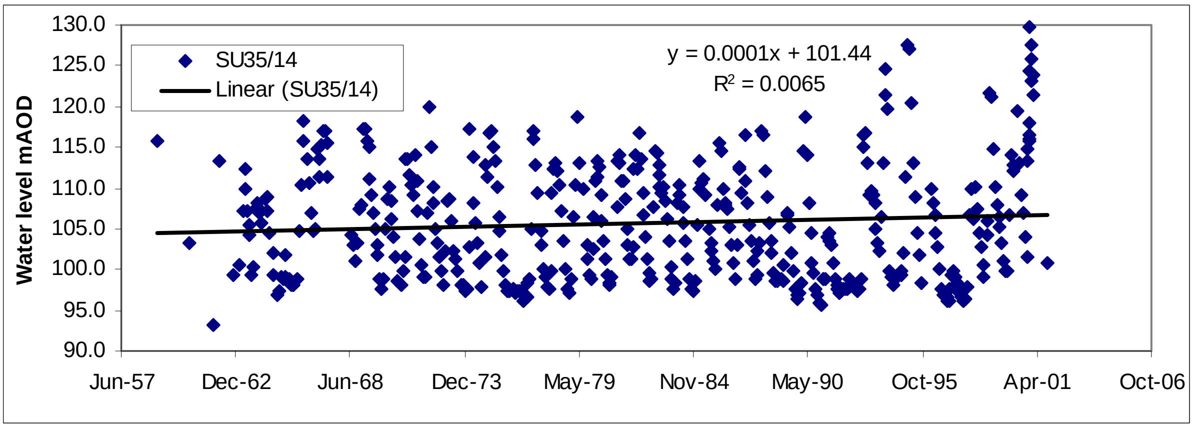


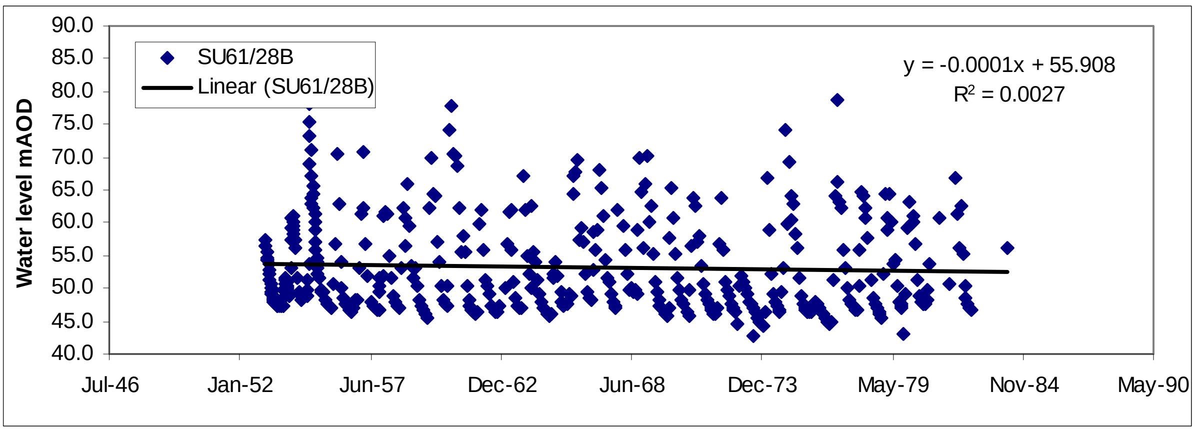


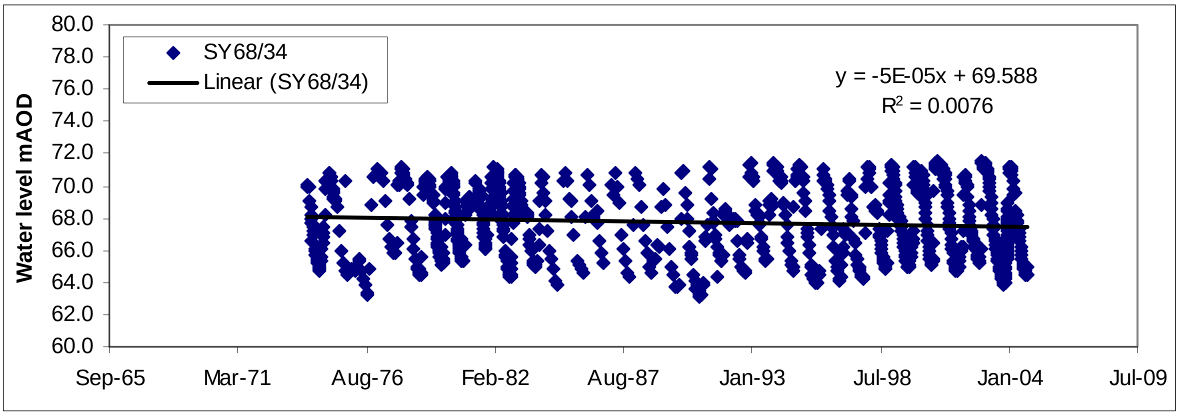


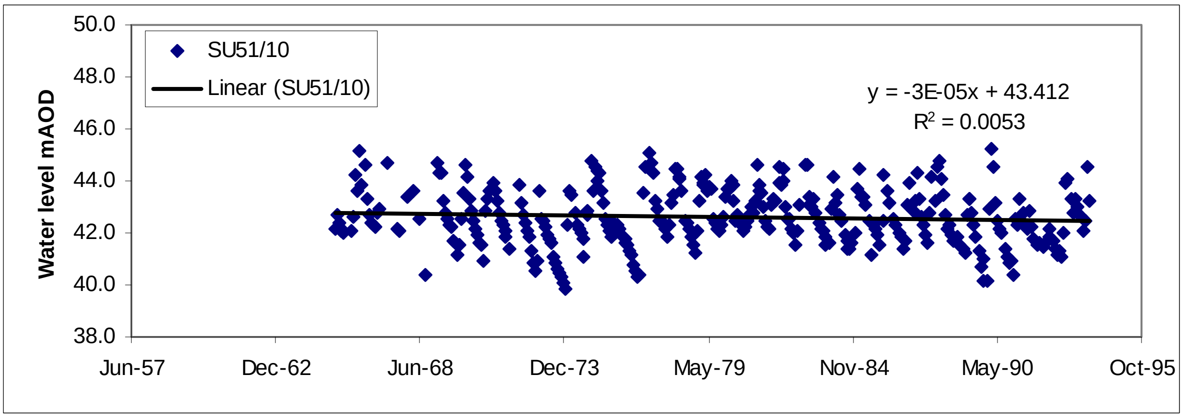

Water level mAOD
110.0
105.0
100.0
95.0
90.0
85.0
80.0
75.0
70.0
Jun-57
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
SU04/2
Linear (SU04/2)
y = -0.0002x + 92.287
R² = 0.0029

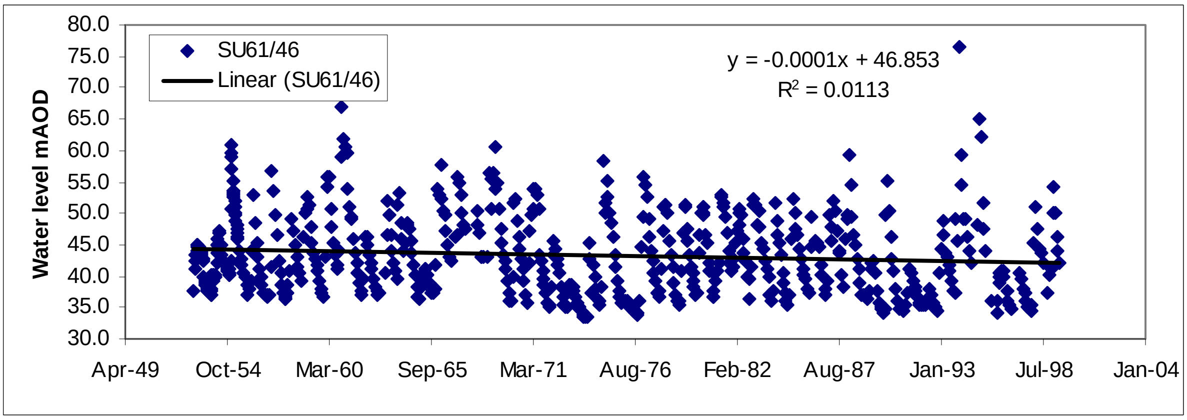

Water level mAOD
68.0
67.5
67.0
66.5
66.0
65.5
65.0
64.5
64.0
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
SU53/94
Linear (SU53/94)
y = -6E-05x + 67.787
R² = 0.1403

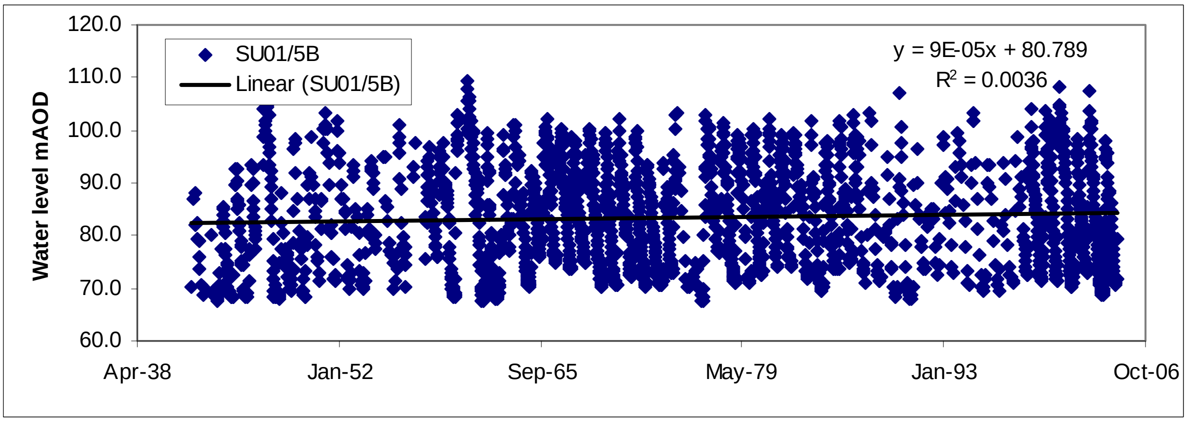

Water level mAOD
130.0
125.0
120.0
115.0
110.0
105.0
100.0
95.0
90.0
Jun-57
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06
SU35/14
Linear (SU35/14)
y = 0.0001x + 101.44
R² = 0.0065

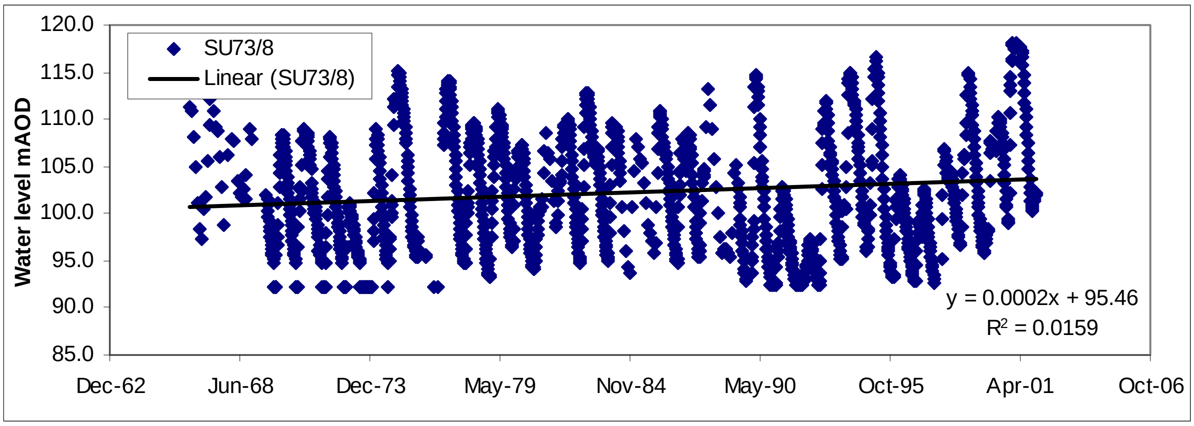

Water level mAOD
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
Jul-46
Jan-52
Jun-57
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
SU61/28B
Linear (SU61/28B)
y = -0.0001x + 55.908
R² = 0.0027

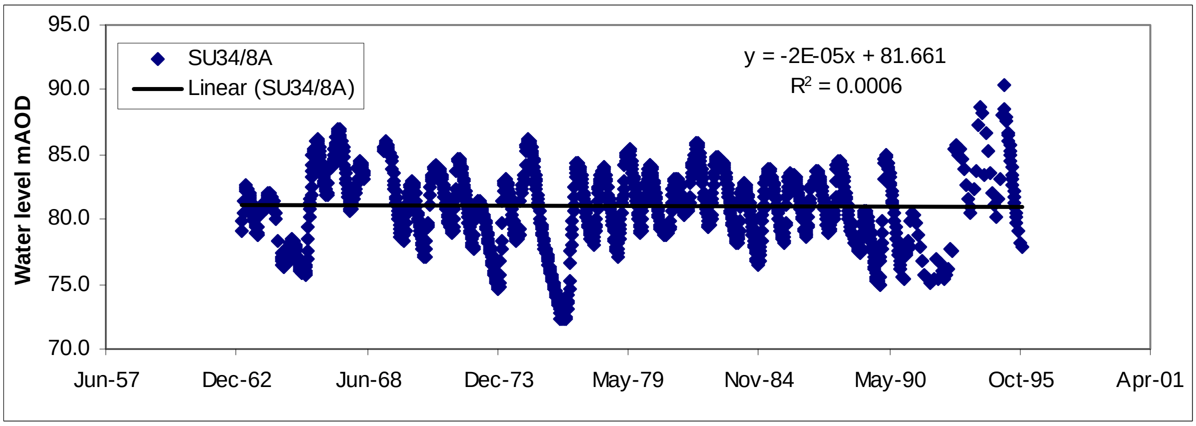

SY68/34
Linear (SY68/34)
y = -5E-05x + 69.588
R² = 0.0076
Water level mAOD
80.0
78.0
76.0
74.0
72.0
70.0
68.0
66.0
64.0
62.0
60.0
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04
Jul-09

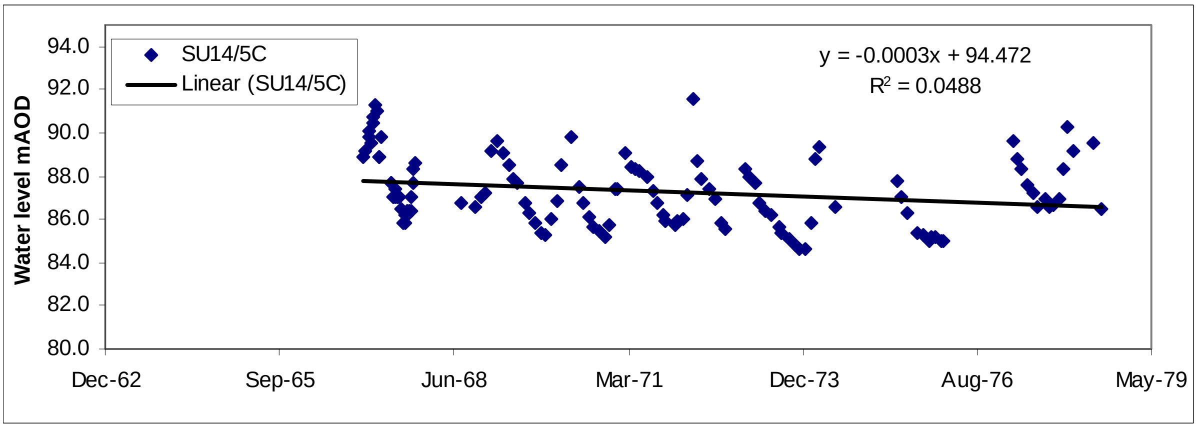

SU51/10
Linear (SU51/10)
y = -3E-05x + 43.412
R² = 0.0053
Water level mAOD
50.0
48.0
46.0
44.0
42.0
40.0
38.0
Jun-57
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95

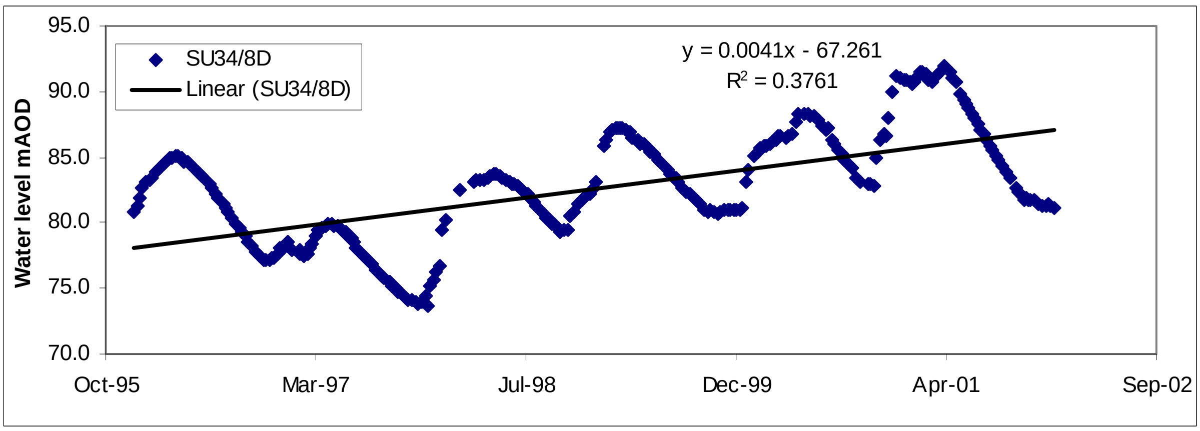

SU61/46
Linear (SU61/46)
y = -0.0001x + 46.853
R² = 0.0113
Water level mAOD
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
Apr-49
Oct-54
Mar-60
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04


SU01/5B
Linear (SU01/5B)
y = 9E-05x + 80.789
R² = 0.0036
Water level mAOD
120.0
110.0
100.0
90.0
80.0
70.0
60.0
Apr-38
Jan-52
Sep-65
May-79
Jan-93
Oct-06

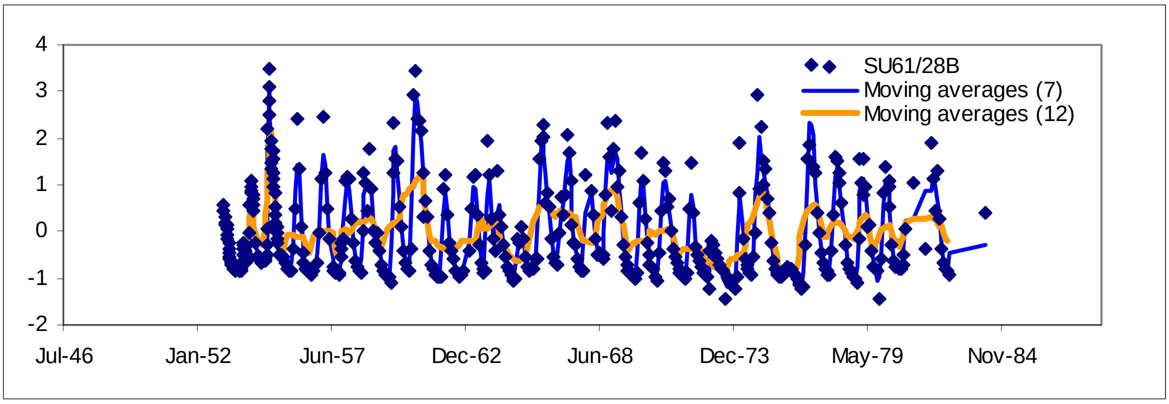

120.0
115.0
110.0
105.0
100.0
95.0
90.0
85.0
Water level mAOD
SU73/8
Linear (SU73/8)
y = 0.0002x + 95.46
R² = 0.0159
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

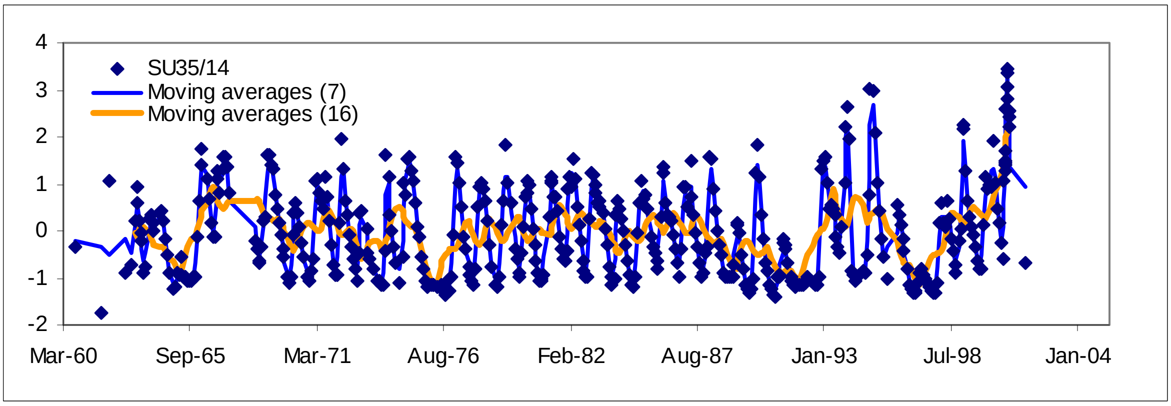

95.0
90.0
85.0
80.0
75.0
70.0
Water level mAOD
SU34/8A
Linear (SU34/8A)
y = -2E-05x + 81.661
R² = 0.0006
Jun-57
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

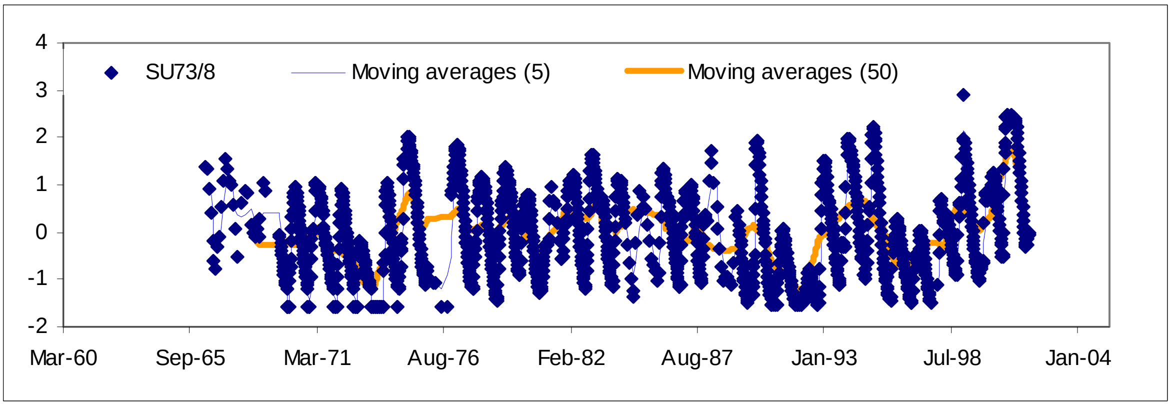

94.0
92.0
90.0
88.0
86.0
84.0
82.0
80.0
Water level mAOD
SU14/5C
Linear (SU14/5C)
y = -0.0003x + 94.472
R² = 0.0488
Dec-62
Sep-65
Jun-68
Mar-71
Dec-73
Aug-76
May-79

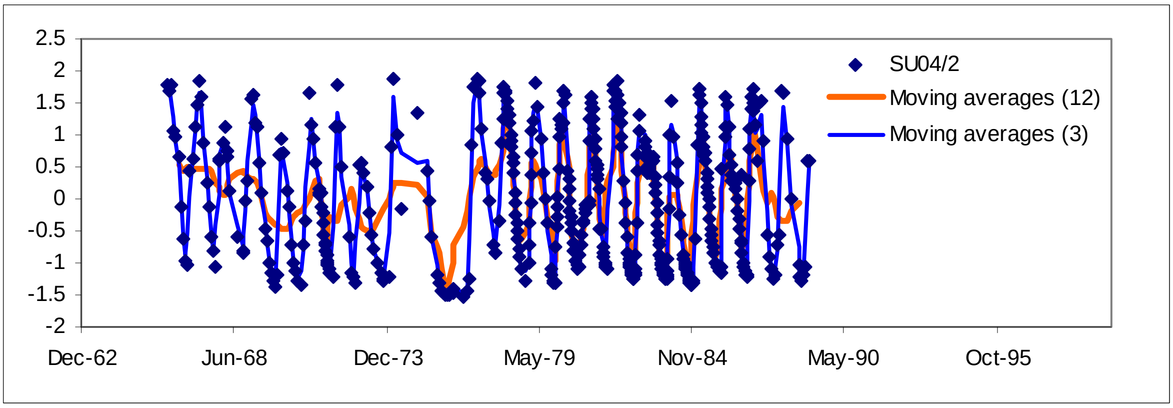

95.0
90.0
85.0
80.0
75.0
70.0
Water level mAOD
SU34/8D
Linear (SU34/8D)
y = 0.0041x - 67.261
R² = 0.3761
Oct-95
Mar-97
Jul-98
Dec-99
Apr-01
Sep-02

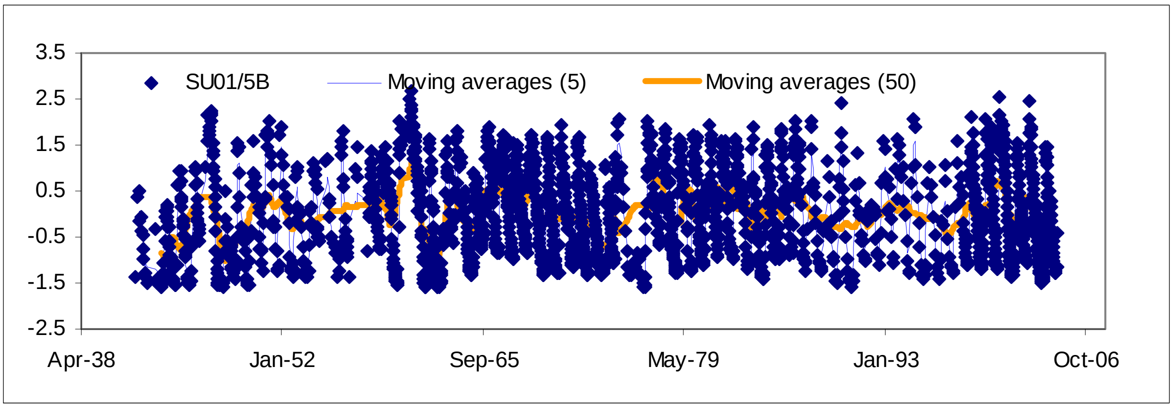
NORMALISED WATER LEVEL DATA WITH MOVING AVERAGES SMOOTHING LINES

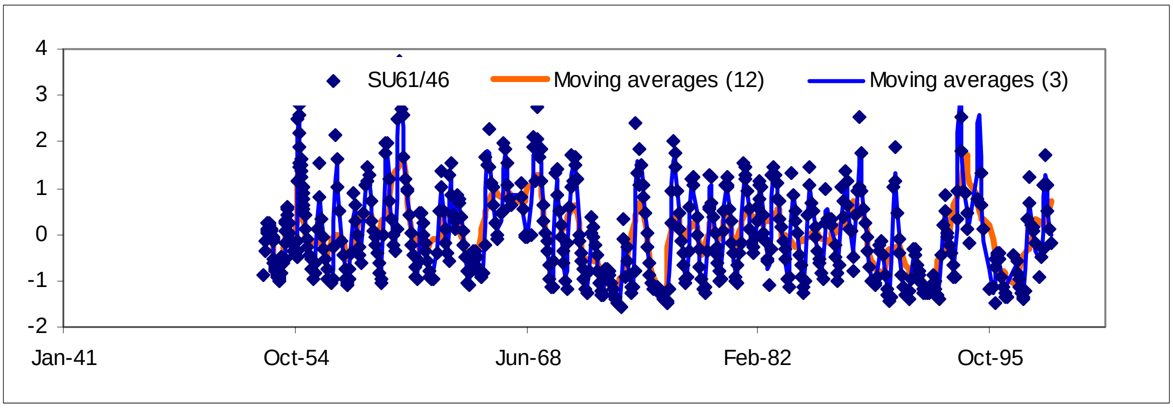


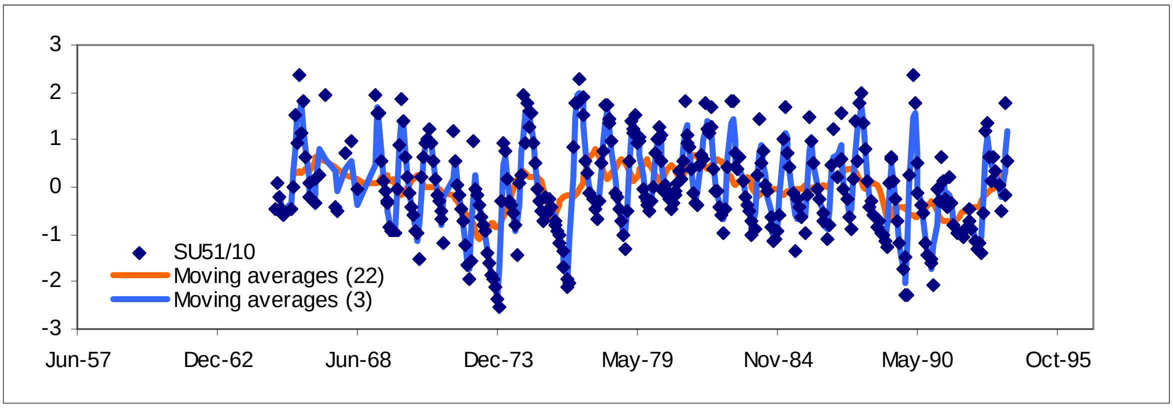


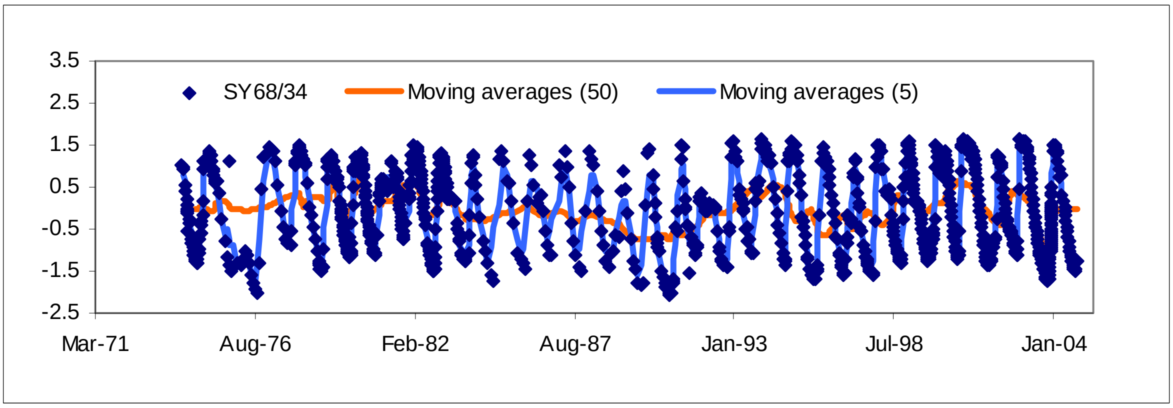


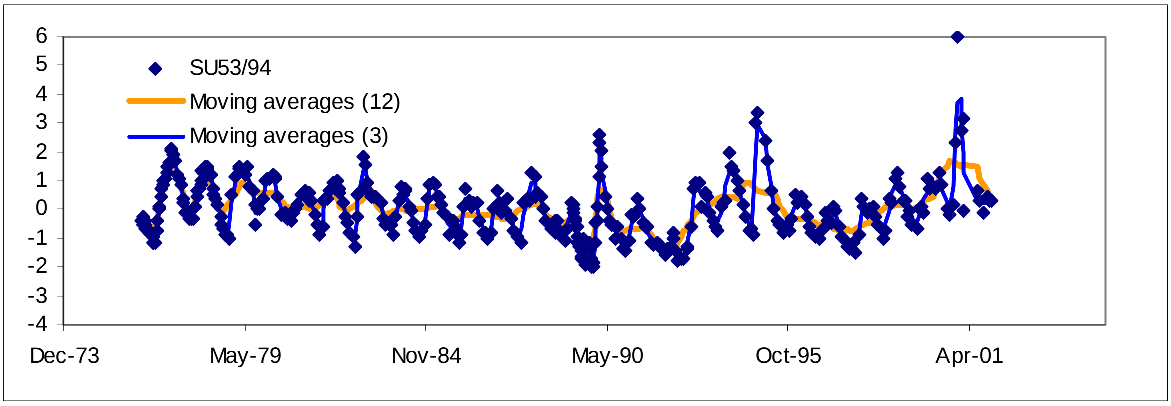


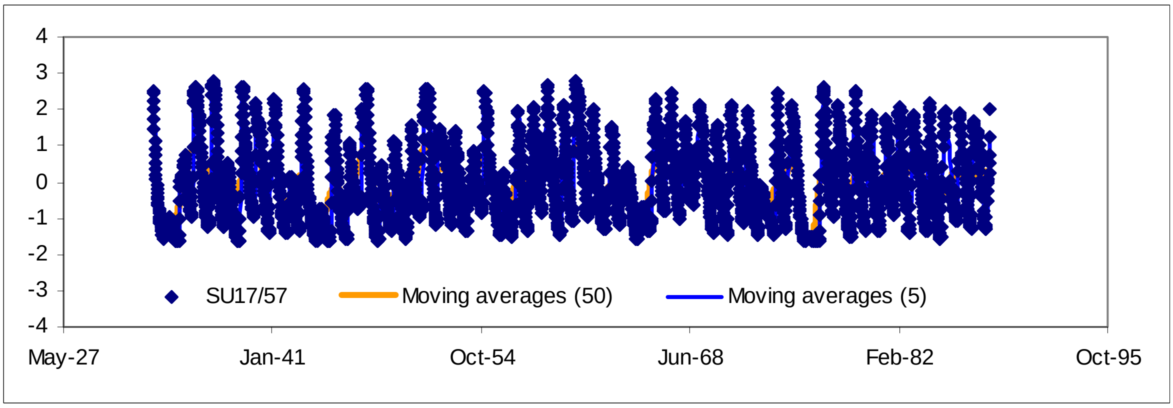

SU01/5B
Moving averages (5)
Moving averages (50)
3.5
2.5
1.5
0.5
-0.5
-1.5
-2.5
Apr-38
Jan-52
Sep-65
May-79
Jan-93
Oct-06

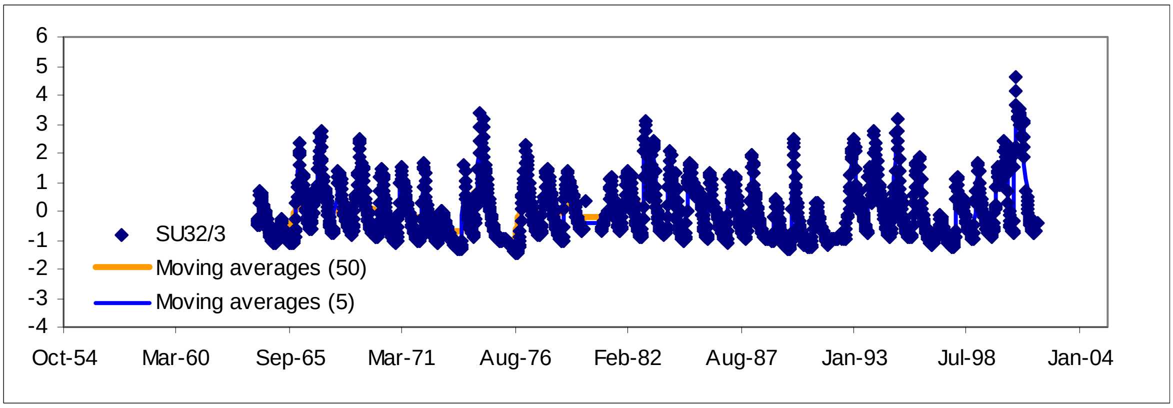

SU61/46
Moving averages (12)
Moving averages (3)
4
3
2
1
0
-1
-2
Jan-41
Oct-54
Jun-68
Feb-82
Oct-95

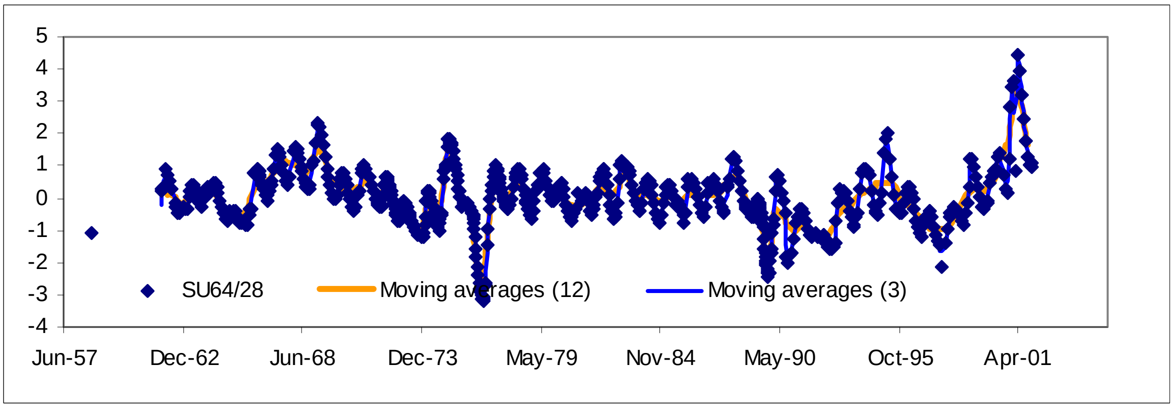

SU51/10
Moving averages (22)
Moving averages (3)
3
2
1
0
-1
-2
-3
Jun-57
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95

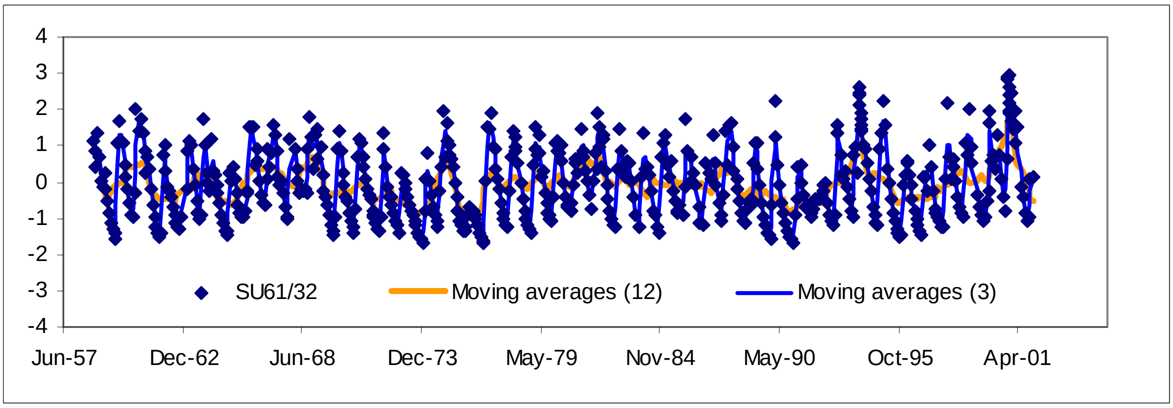

SY68/34
Moving averages (50)
Moving averages (5)
3.5
2.5
1.5
0.5
-0.5
-1.5
-2.5
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

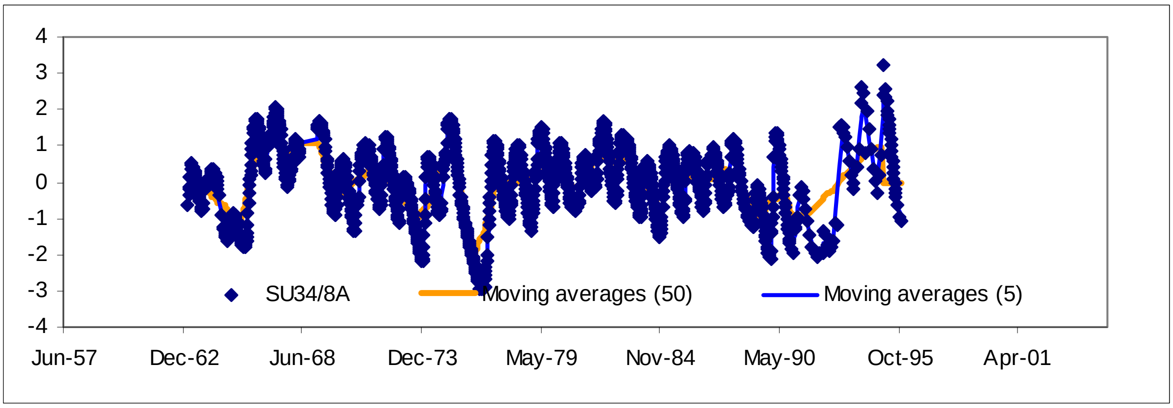

SU53/94
Moving averages (12)
Moving averages (3)
6
5
4
3
2
1
0
-1
-2
-3
-4
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

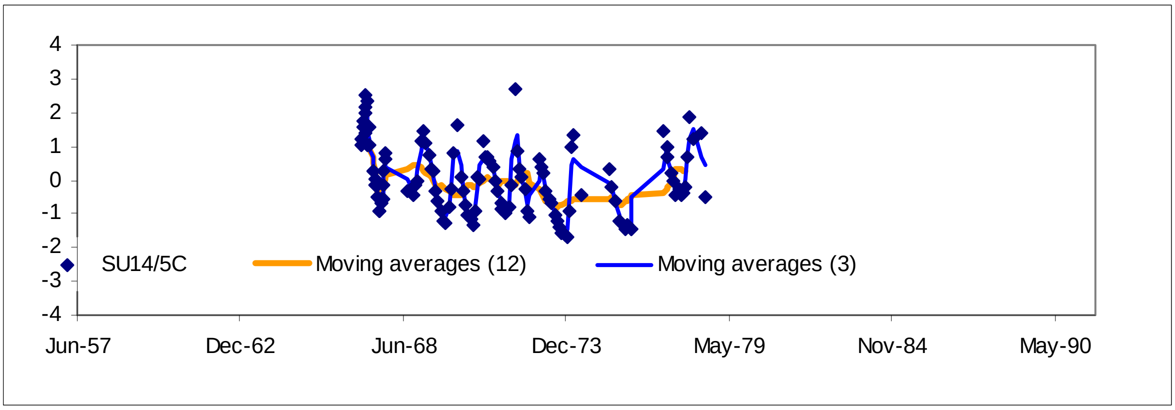

4
3
2
1
0
-1
-2
-3
-4
SU17/57
Moving averages (50)
Moving averages (5)
May-27
Jan-41
Oct-54
Jun-68
Feb-82
Oct-95

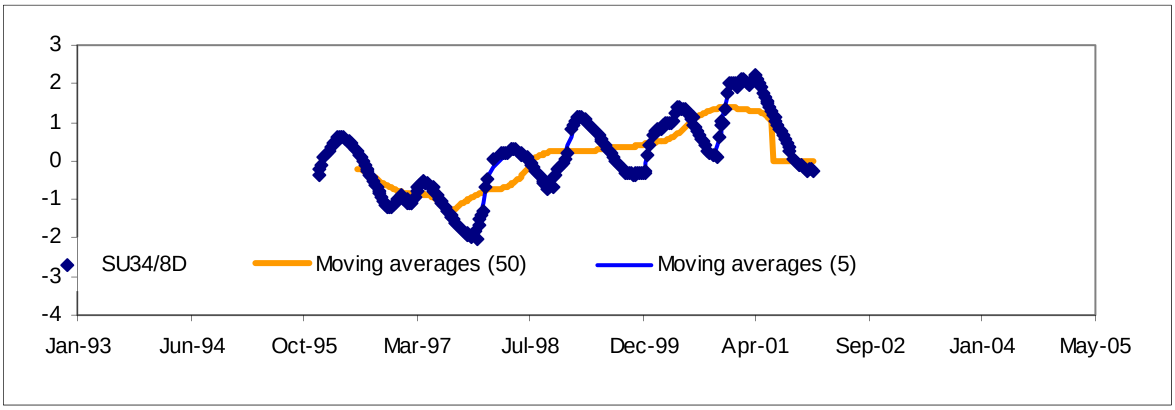

6
5
4
3
2
1
0
-1
-2
-3
-4
SU32/3
Moving averages (50)
Moving averages (5)
Oct-54
Mar-60
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04


5
4
3
2
1
0
-1
-2
-3
-4
SU64/28
Moving averages (12)
Moving averages (3)
Jun-57
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

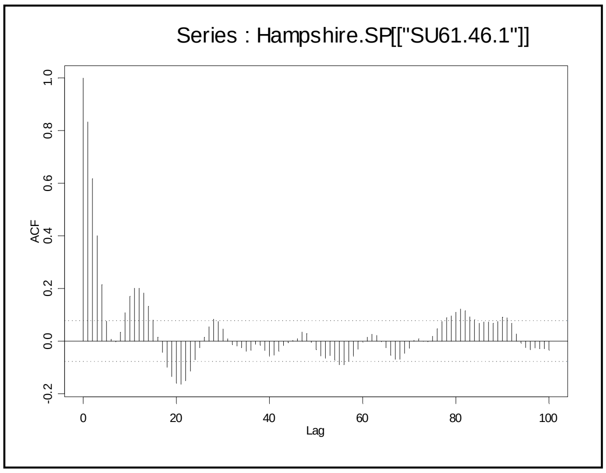

4
3
2
1
0
-1
-2
-3
-4
SU61/32
Moving averages (12)
Moving averages (3)
Jun-57
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

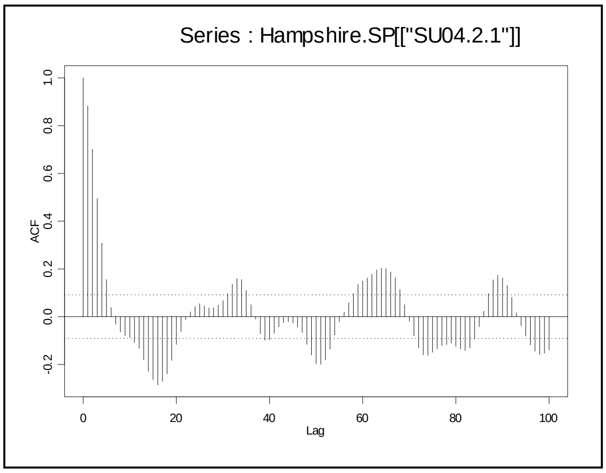

4
3
2
1
0
-1
-2
-3
-4
SU34/8A
Moving averages (50)
Moving averages (5)
Jun-57
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

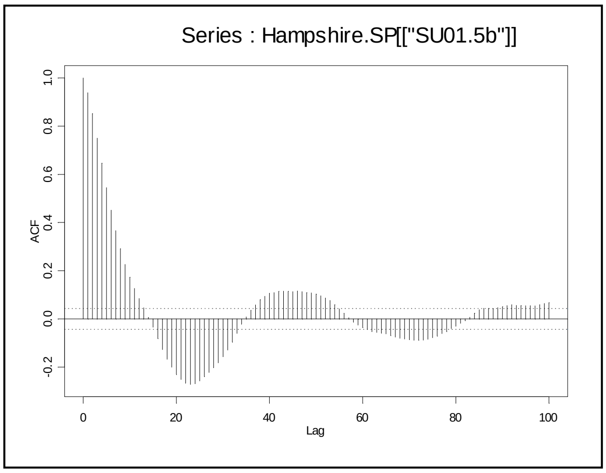

4
3
2
1
0
-1
-2
-3
-4
SU14/5C
Moving averages (12)
Moving averages (3)
Jun-57
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90

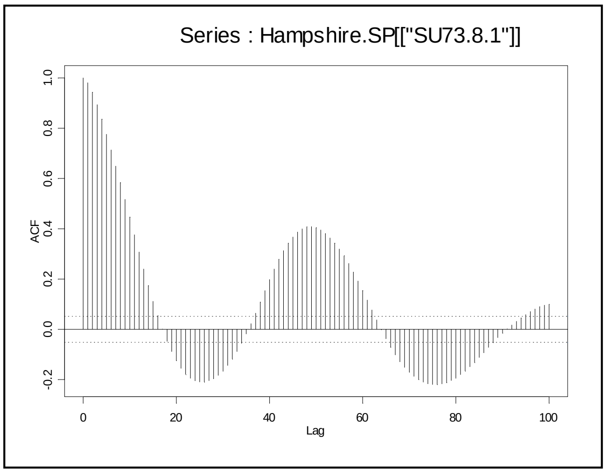

3
2
1
0
-1
-2
-3
-4
SU34/8D
Moving averages (50)
Moving averages (5)
Jan-93
Jun-94
Oct-95
Mar-97
Jul-98
Dec-99
Apr-01
Sep-02
Jan-04
May-05

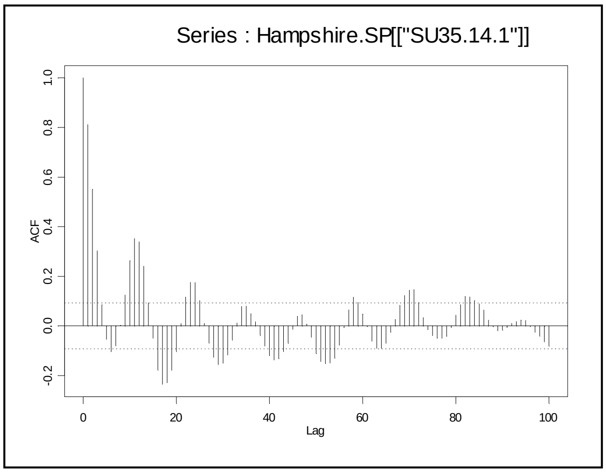
AUTOCORRELATION FUNTION PLOTS

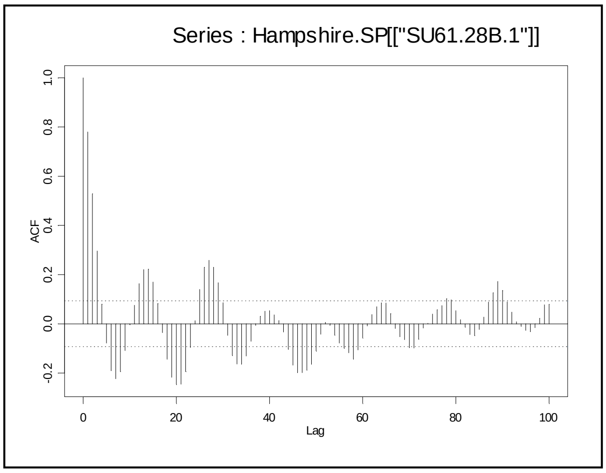


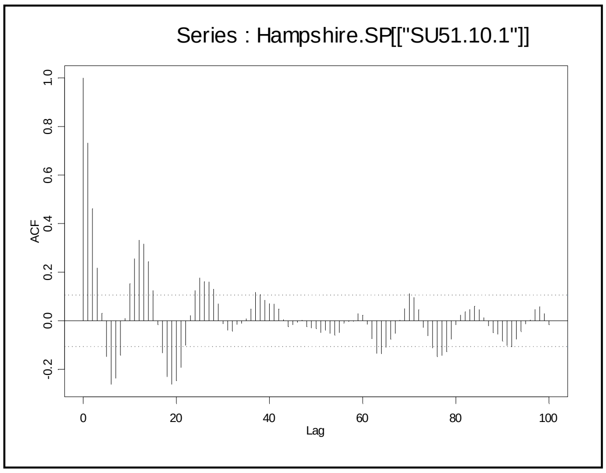


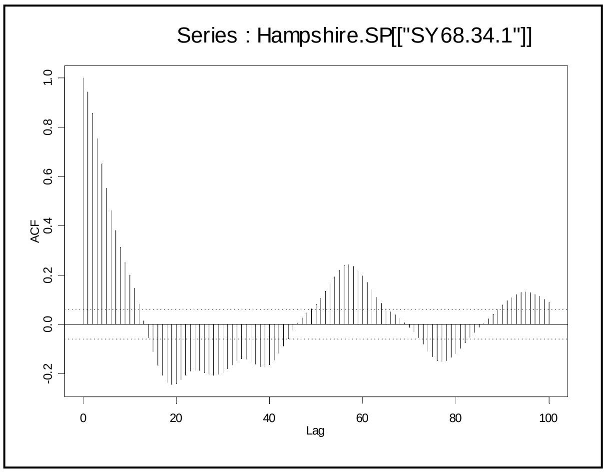


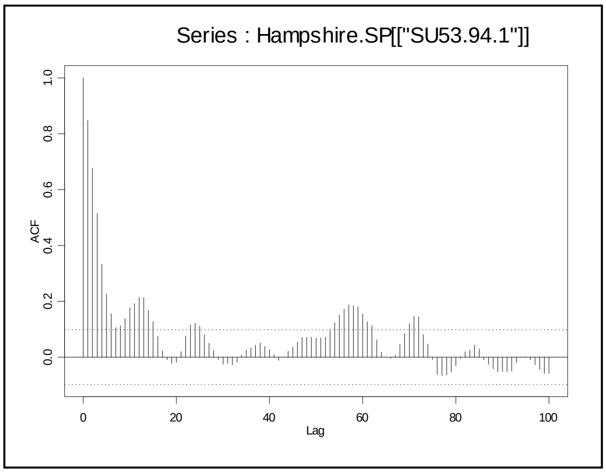







Series : Hampshire.SP[["SU51.10.1"]]
ACF
Lag


Series : Hampshire.SP[["SY68.34.1"]]
ACF
Lag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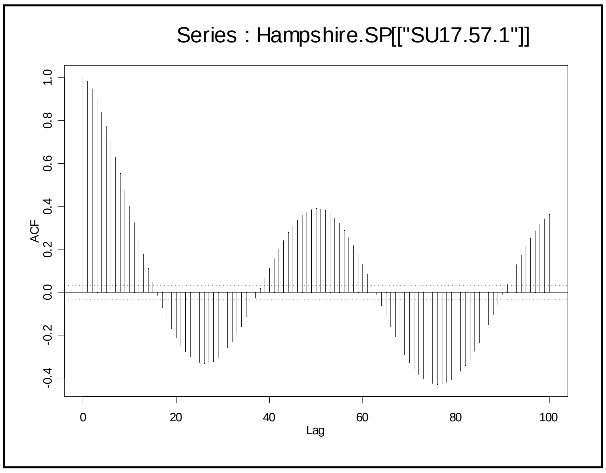
ACF
Lag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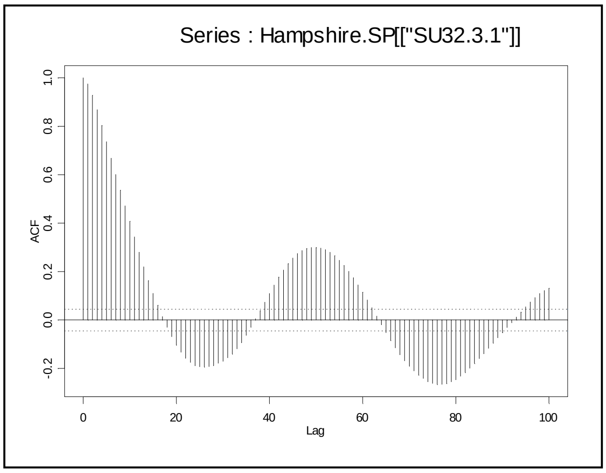
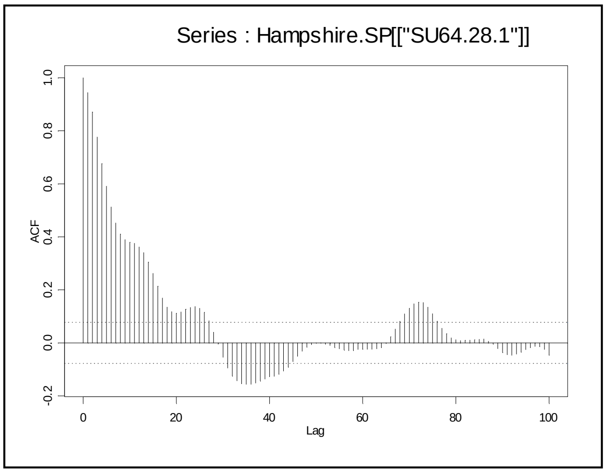
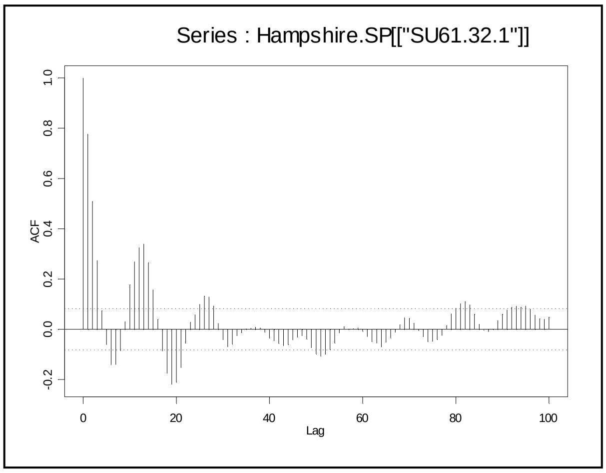
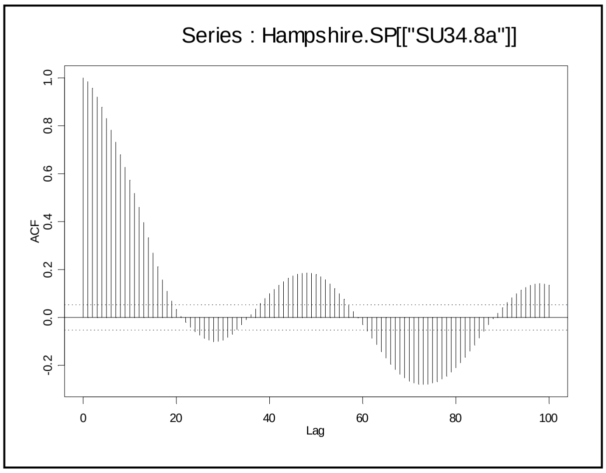
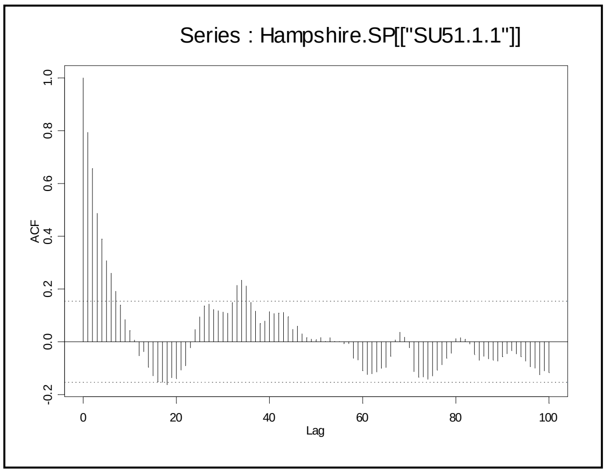
ACF
Lag


Series : Hampshire.SP[["SU32.3.1"]]
ACF
Lag


Series : Hampshire.SP[["SU64.28.1"]]
ACF
Lag


Series : Hampshire.SP[["SU61.32.1"]]
ACF
Lag


Series : Hampshire.SP[["SU34.8a"]]
ACF
Lag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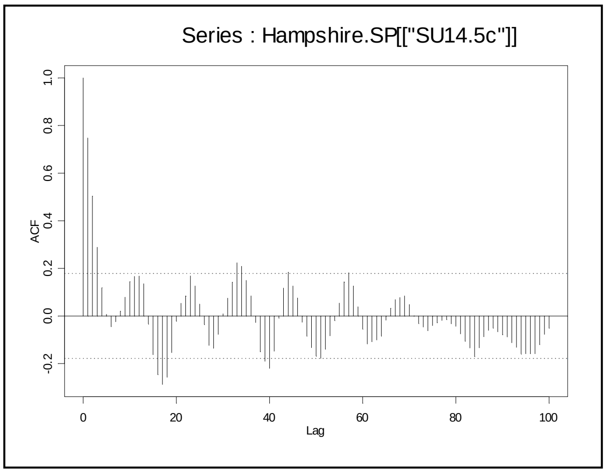
ACF
Lag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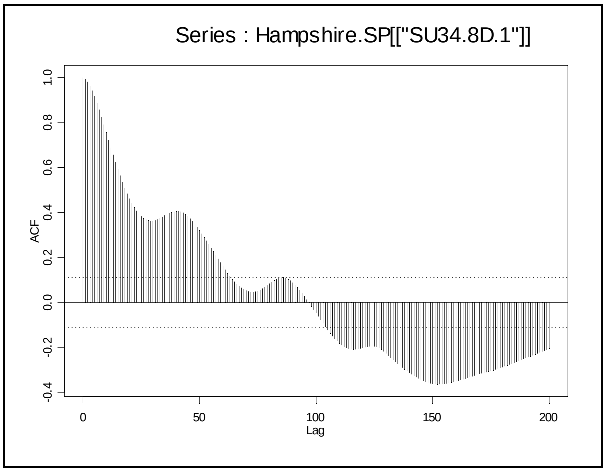
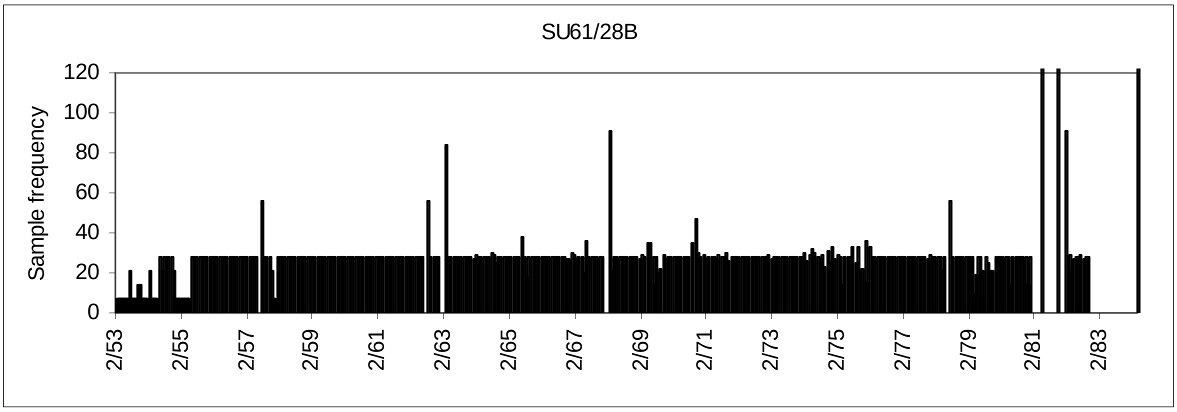
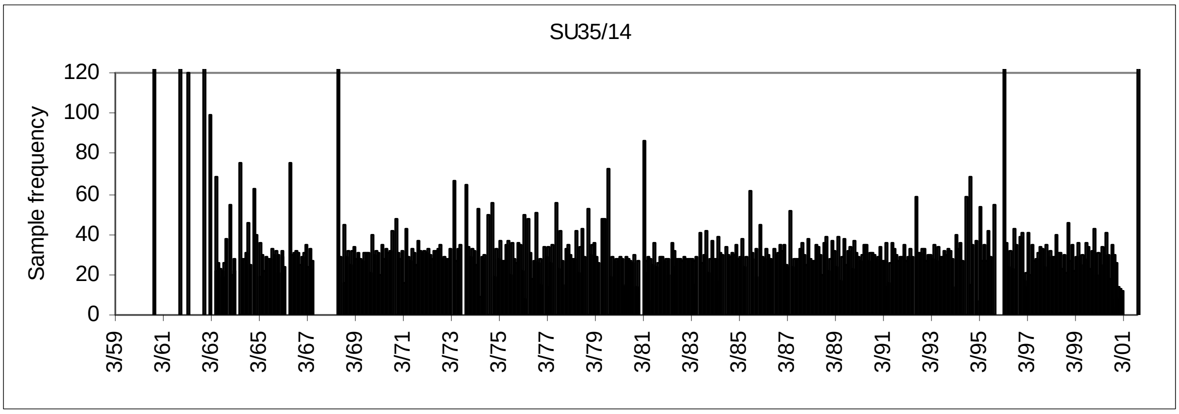
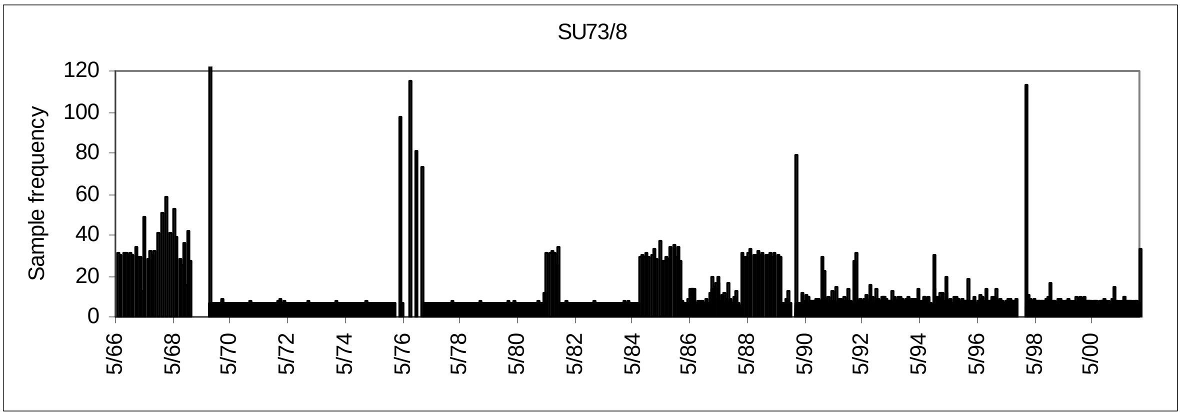
ACF
Lag

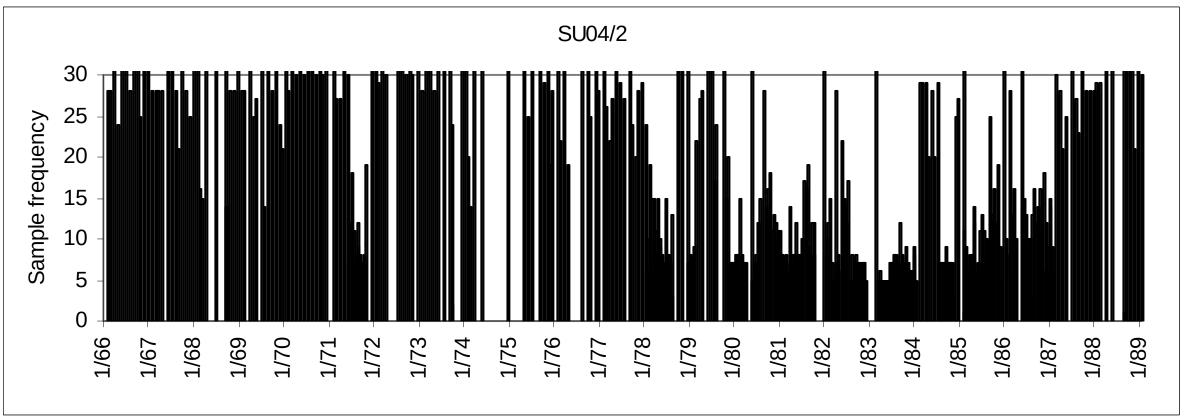

Series : Hampshire.SP[["SU34.8D.1"]]
ACF
Lag

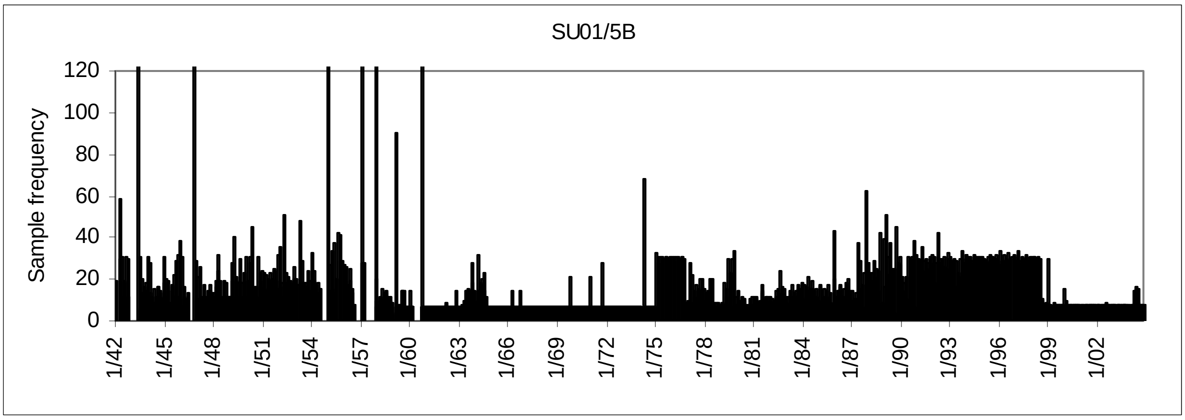
SAMPLE FREQUENCY PLOTS

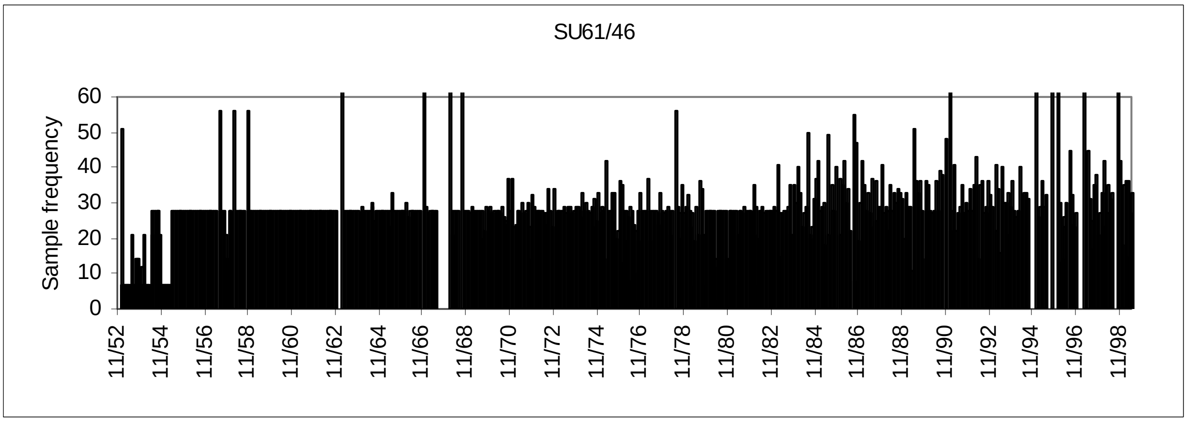


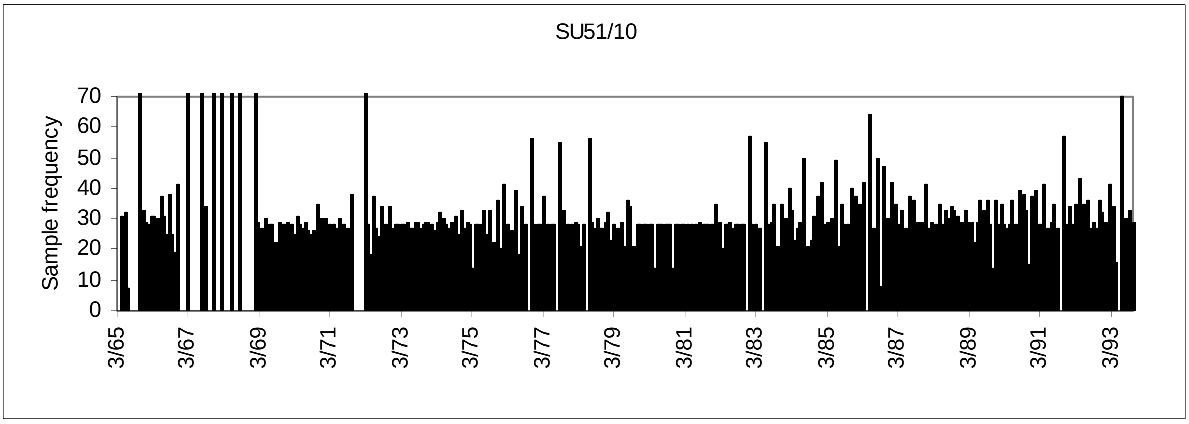


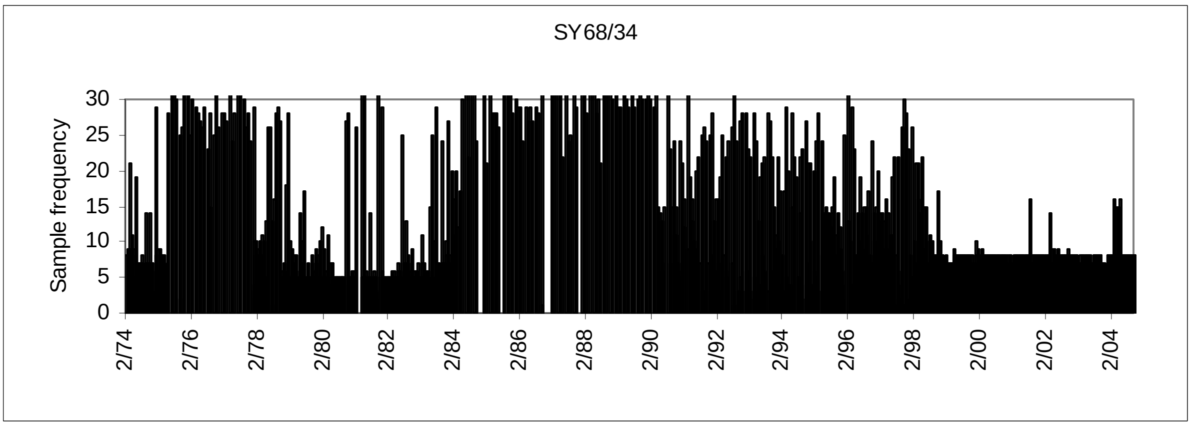


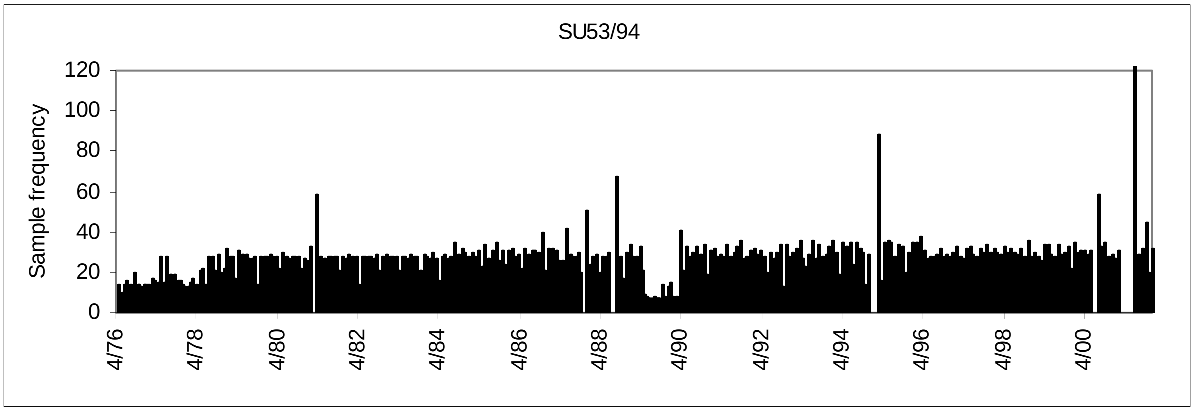


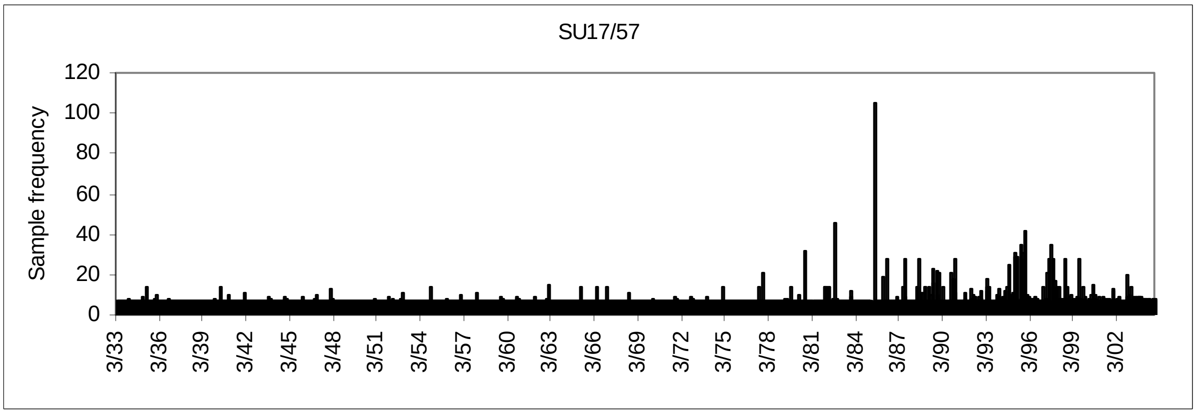

SU01/5B
Sample frequency
120
100
80
60
40
20
0
1/42
1/45
1/48
1/51
1/54
1/57
1/60
1/63
1/66
1/69
1/72
1/75
1/78
1/81
1/84
1/87
1/90
1/93
1/96
1/99
1/02

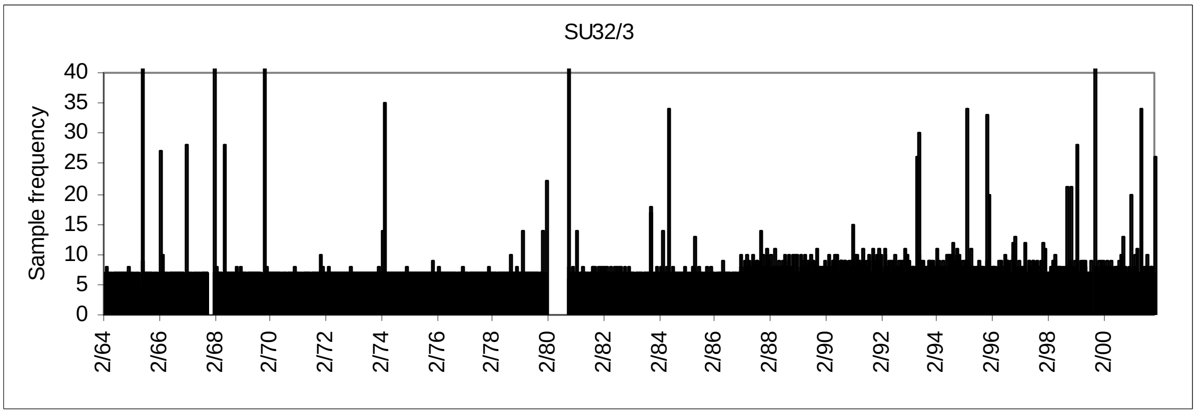

SU61/46
Sample frequency
60
50
40
30
20
10
0
11/52
11/54
11/56
11/58
11/60
11/62
11/64
11/66
11/68
11/70
11/72
11/74
11/76
11/78
11/80
11/82
11/84
11/86
11/88
11/90
11/92
11/94
11/96
11/98

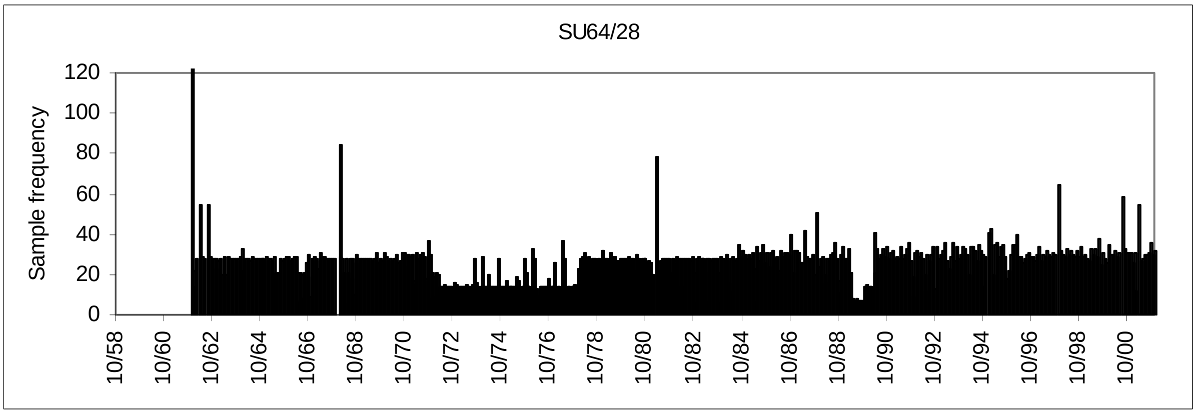

SU51/10
Sample frequency
70
60
50
40
30
20
10
0
3/65
3/67
3/69
3/71
3/73
3/75
3/77
3/79
3/81
3/83
3/85
3/87
3/89
3/91
3/93

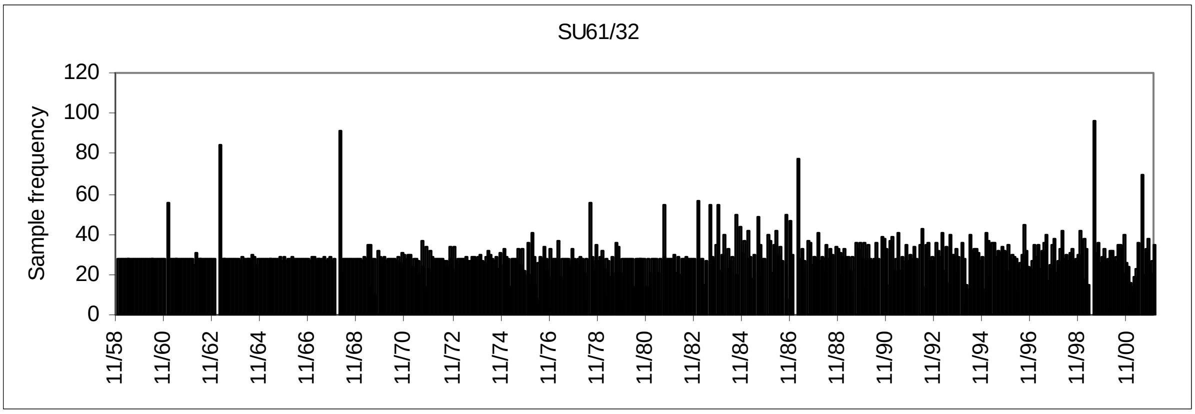

SY68/34
Sample frequency
30
25
20
15
10
5
0
2/74
2/76
2/78
2/80
2/82
2/84
2/86
2/88
2/90
2/92
2/94
2/96
2/98
2/00
2/02
2/04

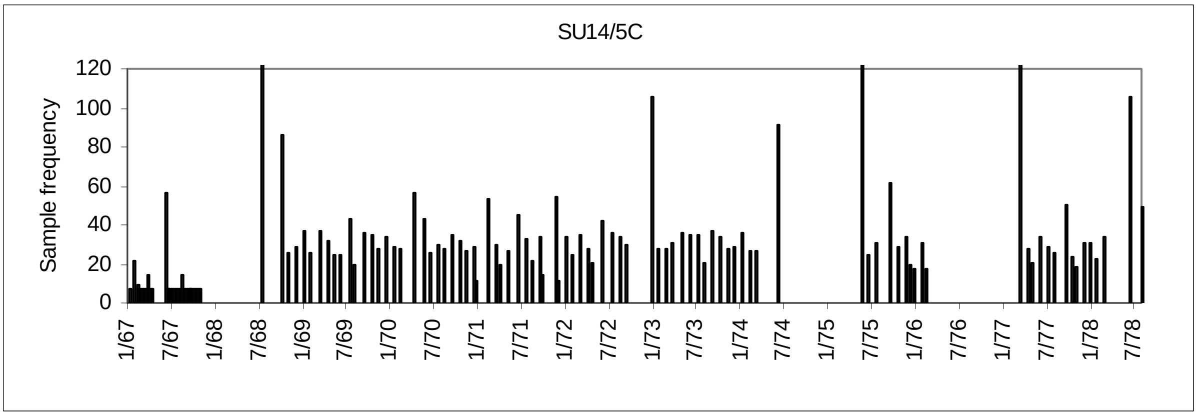

SU53/94
Sample frequency

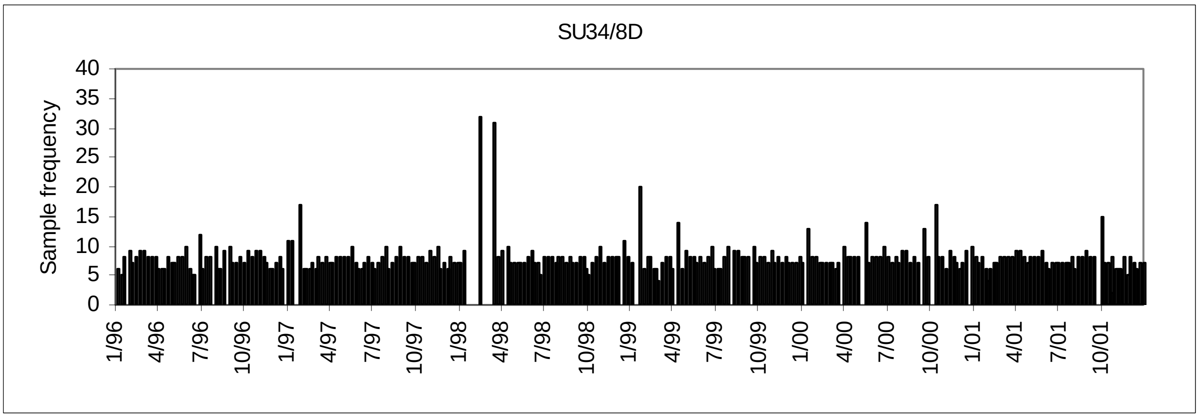

SU17/57
Sample frequency

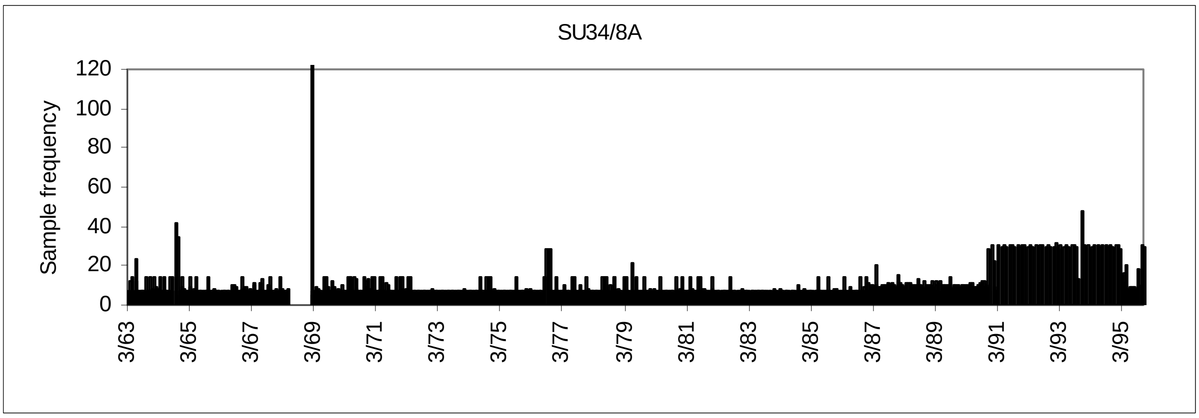

SU32/3
Sample frequency


SU64/28
Sample frequency


SU61/32
Sample frequency
0
20
40
60
80
100
120
11/58
11/60
11/62
11/64
11/66
11/68
11/70
11/72
11/74
11/76
11/78
11/80
11/82
11/84
11/86
11/88
11/90
11/92
11/94
11/96
11/98
11/00


SU14/5C
Sample frequency
0
20
40
60
80
100
120
1/67
7/67
1/68
7/68
1/69
7/69
1/70
7/70
1/71
7/71
1/72
7/72
1/73
7/73
1/74
7/74
1/75
7/75
1/76
7/76
1/77
7/77
1/78
7/78


SU34/8D
Sample frequency
0
5
10
15
20
25
30
35
40
1/96
4/96
7/96
10/96
1/97
4/97
7/97
10/97
1/98
4/98
7/98
10/98
1/99
4/99
7/99
10/99
1/00
4/00
7/00
10/00
1/01
4/01
7/01
10/01


SU34/8A
Sample frequency
0
20
40
60
80
100
120
3/63
3/65
3/67
3/69
3/71
3/73
3/75
3/77
3/79
3/81
3/83
3/85
3/87
3/89
3/91
3/93
3/95

WELLMASTER LOOK-UP TABLE

Mar	1953	Average	Nov	1957	Low	Jul	1962	Low
Apr	1953	Average	Dec	1957	Average	Aug	1962	Very low
May	1953	Average	Jan	1958	High	Sep	1962	Very low
Jun	1953	Low	Feb	1958	Very high	Oct	1962	Very low
Jul	1953	Low	Mar	1958	Very high	Nov	1962	Very low
Aug	1953	Very low	Apr	1958	High	Dec	1962	Low
Sep	1953	Very low	May	1958	High	Jan	1963	Low
Oct	1953	Very low	Jun	1958	Average	Feb	1963	Average
Nov	1953	Low	Jul	1958	Average	Mar	1963	High
Dec	1953	Low	Aug	1958	Low	Apr	1963	High
Jan	1954	Average	Sep	1958	Average	May	1963	High
Feb	1954	Average	Oct	1958	Average	Jun	1963	High
Mar	1954	High	Nov	1958	High	Jul	1963	Average
Apr	1954	High	Dec	1958	Very high	Aug	1963	Average
May	1954	High	Jan	1959	Very high	Sep	1963	Low
Jun	1954	Average	Feb	1959	Very high	Oct	1963	Low
Jul	1954	Average	Mar	1959	Very high	Nov	1963	Average
Aug	1954	Low	Apr	1959	High	Dec	1963	High
Sep	1954	Low	May	1959	High	Jan	1964	High
Oct	1954	Low	Jun	1959	Average	Feb	1964	Average
Nov	1954	High	Jul	1959	Low	Mar	1964	Average
Dec	1954	Very high	Aug	1959	Low	Apr	1964	High
Jan	1955	Very high	Sep	1959	Very low	May	1964	High
Feb	1955	Very high	Oct	1959	Very low	Jun	1964	Average
Mar	1955	High	Nov	1959	Very low	Jul	1964	Average
Apr	1955	High	Dec	1959	Average	Aug	1964	Average
May	1955	Average	Jan	1960	Very high	Sep	1964	Low
Jun	1955	Average	Feb	1960	Very high	Oct	1964	Very low
Jul	1955	Average	Mar	1960	Very high	Nov	1964	Very low
Aug	1955	Low	Apr	1960	High	Dec	1964	Very low
Sep	1955	Low	May	1960	High	Jan	1965	Very low
Oct	1955	Very low	Jun	1960	Average	Feb	1965	Low
Nov	1955	Very low	Jul	1960	Average	Mar	1965	Low
Dec	1955	Low	Aug	1960	Average	Apr	1965	Average
Jan	1956	Average	Sep	1960	Average	May	1965	Low
Feb	1956	Average	Oct	1960	Very high	Jun	1965	Low
Mar	1956	High	Nov	1960	Very high	Jul	1965	Very low
Apr	1956	Average	Dec	1960	Very high	Aug	1965	Very low
May	1956	Low	Jan	1961	Very high	Sep	1965	Very low
Jun	1956	Low	Feb	1961	Very high	Oct	1965	Very low
Jul	1956	Very low	Mar	1961	Very high	Nov	1965	Low
Aug	1956	Very low	Apr	1961	Very high	Dec	1965	Average
Sep	1956	Very low	May	1961	High	Jan	1966	High
Oct	1956	Very low	Jun	1961	High	Feb	1966	Very high
Nov	1956	Low	Jul	1961	Average	Mar	1966	Very high
Dec	1956	Average	Aug	1961	Low	Apr	1966	Very high
Jan	1957	High	Sep	1961	Very low	May	1966	Very high
Feb	1957	Very high	Oct	1961	Very low	Jun	1966	High
Mar	1957	Very high	Nov	1961	Very low	Jul	1966	High
Apr	1957	High	Dec	1961	Average	Aug	1966	Average
May	1957	High	Jan	1962	High	Sep	1966	Low
Jun	1957	Average	Feb	1962	Very high	Oct	1966	Average
Jul	1957	Low	Mar	1962	High	Nov	1966	High
Aug	1957	Low	Apr	1962	Average	Dec	1966	High
Sep	1957	Very low	May	1962	Average	Jan	1967	Very high
Oct	1957	Very low	Jun	1962	Low	Feb	1967	Very high

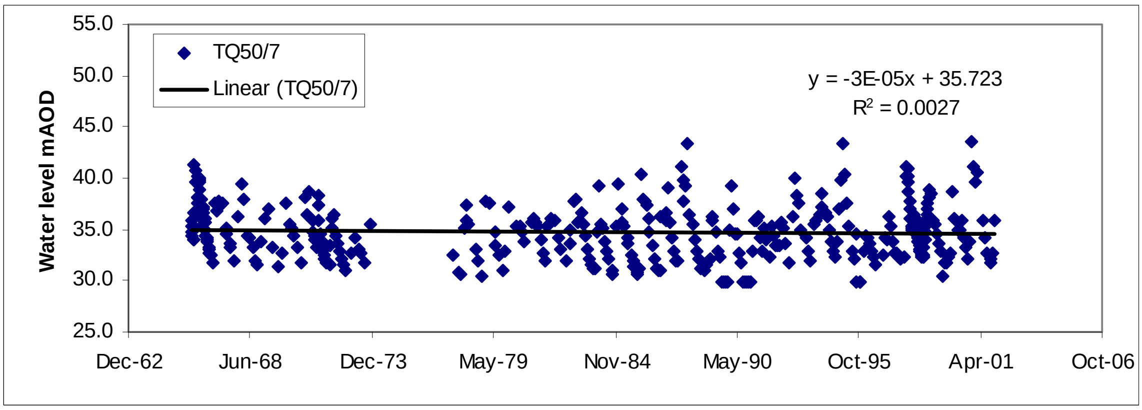
Mar	1967	Very high	Nov	1971	Very low	Jul	1976	Very low
Apr	1967	Very high	Dec	1971	Very low	Aug	1976	Very low
May	1967	High	Jan	1972	Low	Sep	1976	Very low
Jun	1967	High	Feb	1972	High	Oct	1976	Very low
Jul	1967	Average	Mar	1972	Very high	Nov	1976	Very low
Aug	1967	Average	Apr	1972	High	Dec	1976	Average
Sep	1967	Low	May	1972	High	Jan	1977	High
Oct	1967	Average	Jun	1972	Average	Feb	1977	Very high
Nov	1967	High	Jul	1972	Average	Mar	1977	Very high
Dec	1967	High	Aug	1972	Low	Apr	1977	Very high
Jan	1968	Very high	Sep	1972	Low	May	1977	High
Feb	1968	Very high	Oct	1972	Very low	Jun	1977	High
Mar	1968	High	Nov	1972	Very low	Jul	1977	Average
Apr	1968	High	Dec	1972	Low	Aug	1977	Average
May	1968	Average	Jan	1973	Average	Sep	1977	Low
Jun	1968	Average	Feb	1973	Average	Oct	1977	Low
Jul	1968	Average	Mar	1973	Average	Nov	1977	Low
Aug	1968	Low	Apr	1973	Low	Dec	1977	Average
Sep	1968	Average	May	1973	Low	Jan	1978	High
Oct	1968	High	Jun	1973	Low	Feb	1978	Very high
Nov	1968	High	Jul	1973	Very low	Mar	1978	Very high
Dec	1968	High	Aug	1973	Very low	Apr	1978	Very high
Jan	1969	Very high	Sep	1973	Very low	May	1978	High
Feb	1969	Very high	Oct	1973	Very low	Jun	1978	High
Mar	1969	Very high	Nov	1973	Very low	Jul	1978	Average
Apr	1969	Very high	Dec	1973	Very low	Aug	1978	Low
May	1969	High	Jan	1974	Low	Sep	1978	Low
Jun	1969	High	Feb	1974	High	Oct	1978	Very low
Jul	1969	Average	Mar	1974	Very high	Nov	1978	Very low
Aug	1969	Average	Apr	1974	High	Dec	1978	Very low
Sep	1969	Low	May	1974	Average	Jan	1979	Average
Oct	1969	Very low	Jun	1974	Low	Feb	1979	High
Nov	1969	Very low	Jul	1974	Low	Mar	1979	Very high
Dec	1969	Very low	Aug	1974	Very low	Apr	1979	Very high
Jan	1970	Average	Sep	1974	Very low	May	1979	Very high
Feb	1970	High	Oct	1974	Average	Jun	1979	High
Mar	1970	Very high	Nov	1974	High	Jul	1979	High
Apr	1970	High	Dec	1974	Very high	Aug	1979	Average
May	1970	High	Jan	1975	Very high	Sep	1979	Average
Jun	1970	Average	Feb	1975	Very high	Oct	1979	Low
Jul	1970	Low	Mar	1975	Very high	Nov	1979	Very low
Aug	1970	Low	Apr	1975	Very high	Dec	1979	Low
Sep	1970	Very low	May	1975	High	Jan	1980	High
Oct	1970	Very low	Jun	1975	High	Feb	1980	High
Nov	1970	Very low	Jul	1975	Average	Mar	1980	Very high
Dec	1970	Average	Aug	1975	Low	Apr	1980	Very high
Jan	1971	High	Sep	1975	Low	May	1980	High
Feb	1971	Very high	Oct	1975	Very low	Jun	1980	Average
Mar	1971	Very high	Nov	1975	Very low	Jul	1980	Average
Apr	1971	High	Dec	1975	Very low	Aug	1980	Low
May	1971	High	Jan	1976	Very low	Sep	1980	Low
Jun	1971	High	Feb	1976	Very low	Oct	1980	Very low
Jul	1971	Average	Mar	1976	Very low	Nov	1980	Low
Aug	1971	Average	Apr	1976	Very low	Dec	1980	Average
Sep	1971	Low	May	1976	Very low	Jan	1981	Average
Oct	1971	Low	Jun	1976	Very low	Feb	1981	Average

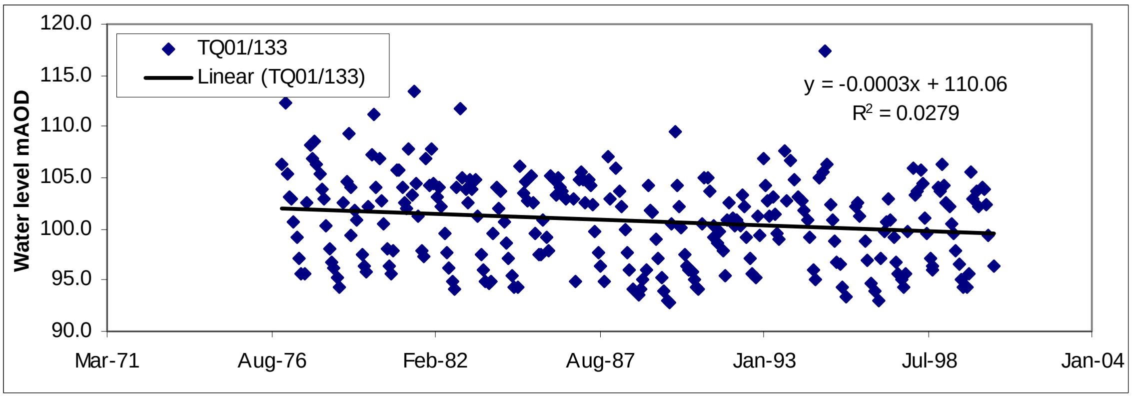
Mar	1981	High	Nov	1985	Very low	Jul	1990	Low
Apr	1981	Very high	Dec	1985	Low	Aug	1990	Very low
May	1981	High	Jan	1986	High	Sep	1990	Very low
Jun	1981	High	Feb	1986	Very high	Oct	1990	Very low
Jul	1981	High	Mar	1986	High	Nov	1990	Very low
Aug	1981	Average	Apr	1986	High	Dec	1990	Very low
Sep	1981	Low	May	1986	High	Jan	1991	Very low
Oct	1981	Low	Jun	1986	High	Feb	1991	Low
Nov	1981	Average	Jul	1986	Average	Mar	1991	Average
Dec	1981	High	Aug	1986	Low	Apr	1991	Average
Jan	1982	Very high	Sep	1986	Low	May	1991	Average
Feb	1982	Very high	Oct	1986	Very low	Jun	1991	Average
Mar	1982	Very high	Nov	1986	Low	Jul	1991	Low
Apr	1982	Very high	Dec	1986	High	Aug	1991	Very low
May	1982	High	Jan	1987	Very high	Sep	1991	Very low
Jun	1982	Average	Feb	1987	High	Oct	1991	Very low
Jul	1982	Average	Mar	1987	High	Nov	1991	Very low
Aug	1982	Low	Apr	1987	Very high	Dec	1991	Very low
Sep	1982	Very low	May	1987	High	Jan	1992	Very low
Oct	1982	Very low	Jun	1987	High	Feb	1992	Very low
Nov	1982	Average	Jul	1987	Average	Mar	1992	Very low
Dec	1982	Very high	Aug	1987	Low	Apr	1992	Low
Jan	1983	Very high	Sep	1987	Very low	May	1992	Low
Feb	1983	Very high	Oct	1987	Low	Jun	1992	Low
Mar	1983	High	Nov	1987	Average	Jul	1992	Very low
Apr	1983	High	Dec	1987	Average	Aug	1992	Very low
May	1983	High	Jan	1988	High	Sep	1992	Very low
Jun	1983	High	Feb	1988	Very high	Oct	1992	Very low
Jul	1983	High	Mar	1988	Very high	Nov	1992	Average
Aug	1983	Average	Apr	1988	High	Dec	1992	Very high
Sep	1983	Low	May	1988	High	Jan	1993	Very high
Oct	1983	Low	Jun	1988	Average	Feb	1993	Very high
Nov	1983	Very low	Jul	1988	Average	Mar	1993	High
Dec	1983	Very low	Aug	1988	Low	Apr	1993	High
Jan	1984	Average	Sep	1988	Very low	May	1993	High
Feb	1984	Very high	Oct	1988	Very low	Jun	1993	Average
Mar	1984	Very high	Nov	1988	Very low	Jul	1993	Average
Apr	1984	High	Dec	1988	Very low	Aug	1993	Low
May	1984	High	Jan	1989	Low	Sep	1993	Low
Jun	1984	Average	Feb	1989	Low	Oct	1993	Average
Jul	1984	Average	Mar	1989	Average	Nov	1993	Average
Aug	1984	Low	Apr	1989	High	Dec	1993	High
Sep	1984	Very low	May	1989	Average	Jan	1994	Very high
Oct	1984	Very low	Jun	1989	Average	Feb	1994	Very high
Nov	1984	Very low	Jul	1989	Low	Mar	1994	Very high
Dec	1984	Average	Aug	1989	Very low	Apr	1994	Very high
Jan	1985	High	Sep	1989	Very low	May	1994	High
Feb	1985	Very high	Oct	1989	Very low	Jun	1994	High
Mar	1985	Very high	Nov	1989	Very low	Jul	1994	Average
Apr	1985	High	Dec	1989	Very low	Aug	1994	Low
May	1985	High	Jan	1990	Low	Sep	1994	Low
Jun	1985	High	Feb	1990	Very high	Oct	1994	Low
Jul	1985	Average	Mar	1990	Very high	Nov	1994	Low
Aug	1985	Average	Apr	1990	High	Dec	1994	High
Sep	1985	Low	May	1990	High	Jan	1995	Very high
Oct	1985	Low	Jun	1990	Average	Feb	1995	Very high

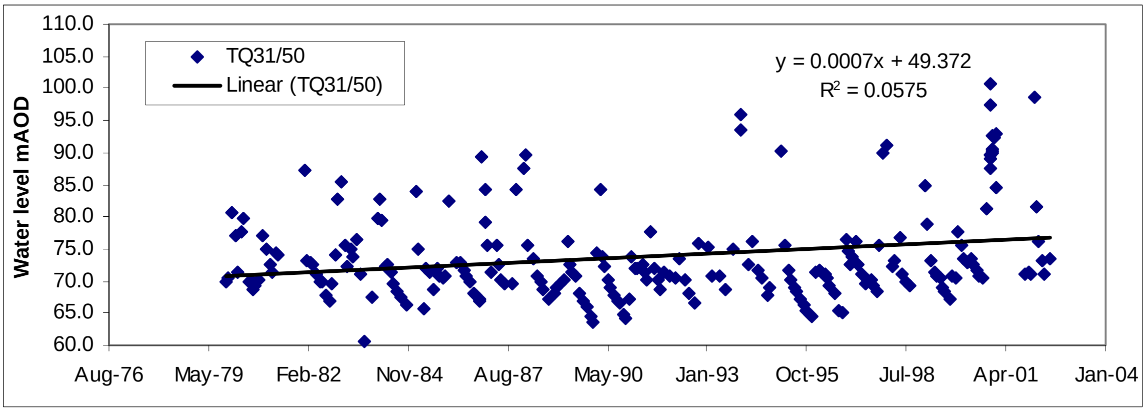
Mar	1995	Very high	Nov	1999	Low
Apr	1995	Very high	Dec	1999	Average
May	1995	High	Jan	2000	Very high
Jun	1995	Average	Feb	2000	Very high
Jul	1995	Average	Mar	2000	Very high
Aug	1995	Low	Apr	2000	Very high
Sep	1995	Very low	May	2000	Very high
Oct	1995	Very low	Jun	2000	Very high
Nov	1995	Very low	Jul	2000	High
Dec	1995	Low	Aug	2000	Average
Jan	1996	Average	Sep	2000	Low
Feb	1996	High	Oct	2000	Average
Mar	1996	High	Nov	2000	Very high
Apr	1996	High	Dec	2000	Very high
May	1996	Average	Jan	2001	Very high
Jun	1996	Average	Feb	2001	Very high
Jul	1996	Low	Mar	2001	Very high
Aug	1996	Low	Apr	2001	Very high
Sep	1996	Very low	May	2001	Very high
Oct	1996	Very low	Jun	2001	Very high
Nov	1996	Very low	Jul	2001	High
Dec	1996	Very low	Aug	2001	Average
Jan	1997	Low	Sep	2001	Low
Feb	1997	Low	Oct	2001	Low
Mar	1997	Average	Nov	2001	Low
Apr	1997	Average	Dec	2001	Low
May	1997	Low	Jan	2002	Average
Jun	1997	Very low	Feb	2002	High
Jul	1997	Very low	Mar	2002	Very high
Aug	1997	Very low	Apr	2002	High
Sep	1997	Very low	May	2002	High
Oct	1997	Very low	Jun	2002	Average
Nov	1997	Very low	Jul	2002	Low
Dec	1997	Low	Aug	2002	Low
Jan	1998	High	Sep	2002	Very low
Feb	1998	High	Oct	2002	Low
Mar	1998	High	Nov	2002	High
Apr	1998	High	Dec	2002	Very high
May	1998	High	Jan	2003	Very high
Jun	1998	Average	Feb	2003	Very high
Jul	1998	Average	Mar	2003	Very high
Aug	1998	Low	Apr	2003	High
Sep	1998	Low	May	2003	Average
Oct	1998	Low	Jun	2003	Low
Nov	1998	Average	Jul	2003	Low
Dec	1998	High	Aug	2003	Very low
Jan	1999	Very high	Sep	2003	Very low
Feb	1999	Very high	Oct	2003	Very low
Mar	1999	Very high	Nov	2003	Very low
Apr	1999	High	Dec	2003	Low
May	1999	High	Jan	2004	High
Jun	1999	Average	Feb	2004	High
Jul	1999	Average	Mar	2004	High
Aug	1999	Low	Apr	2004	High
Sep	1999	Low	May	2004	High
Oct	1999	Low	Jun	2004	Average
			Jul	2004	Low
			Aug	2004	Very low

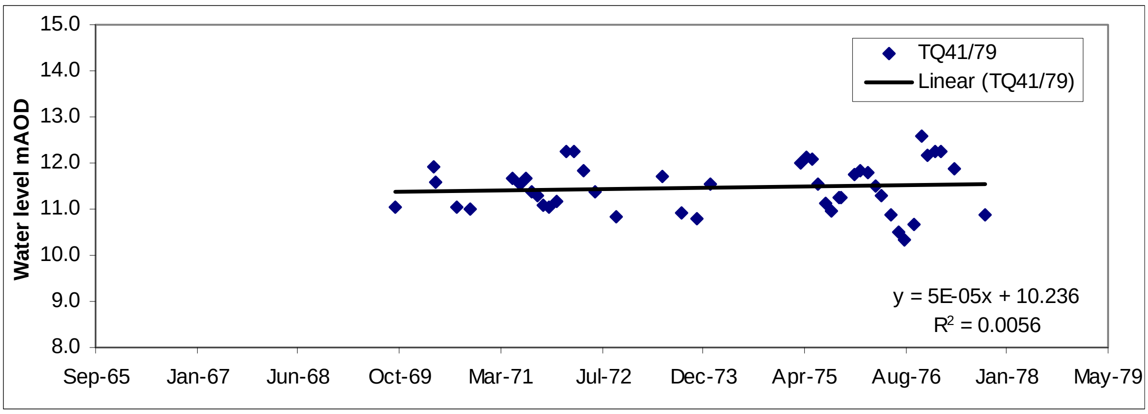
Appendix 6 Chalk – South Downs

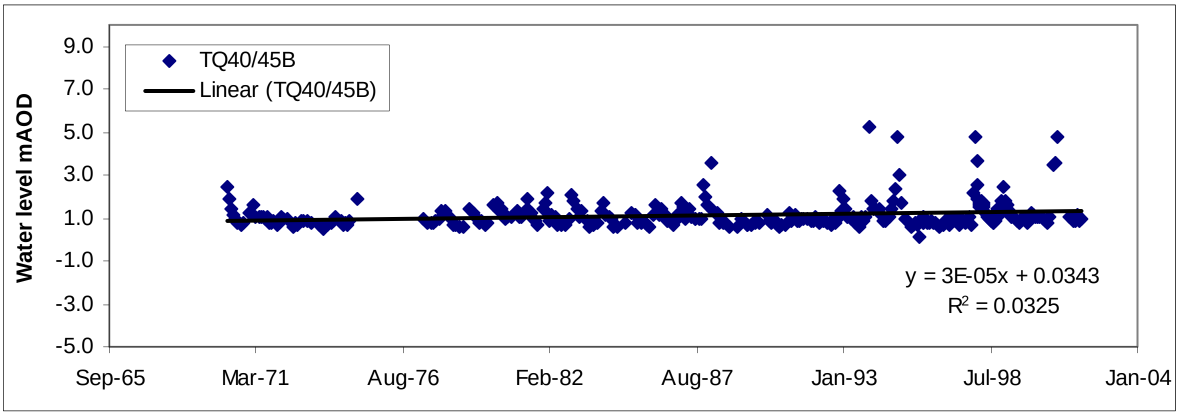
WATER LEVELS ABOVE ORDNANCE DATUM WITH LINEAR REGRESSION CURVE

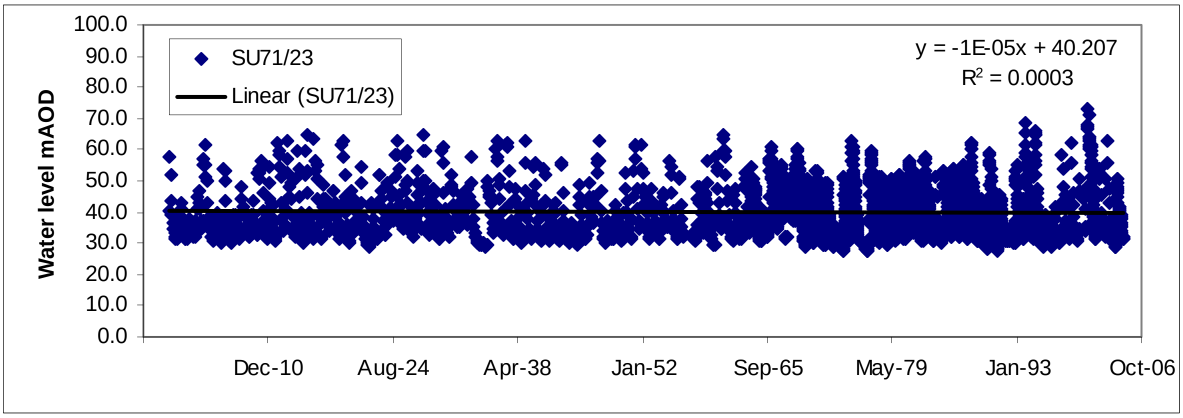


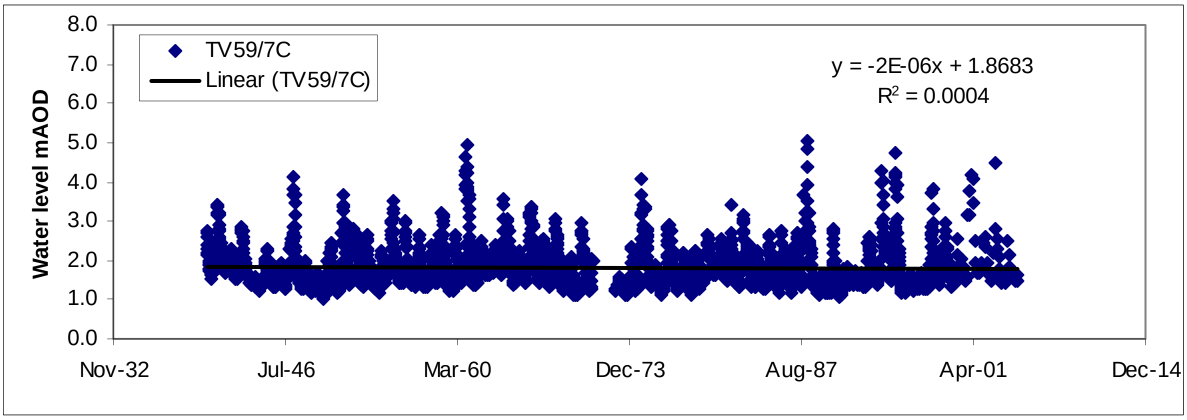


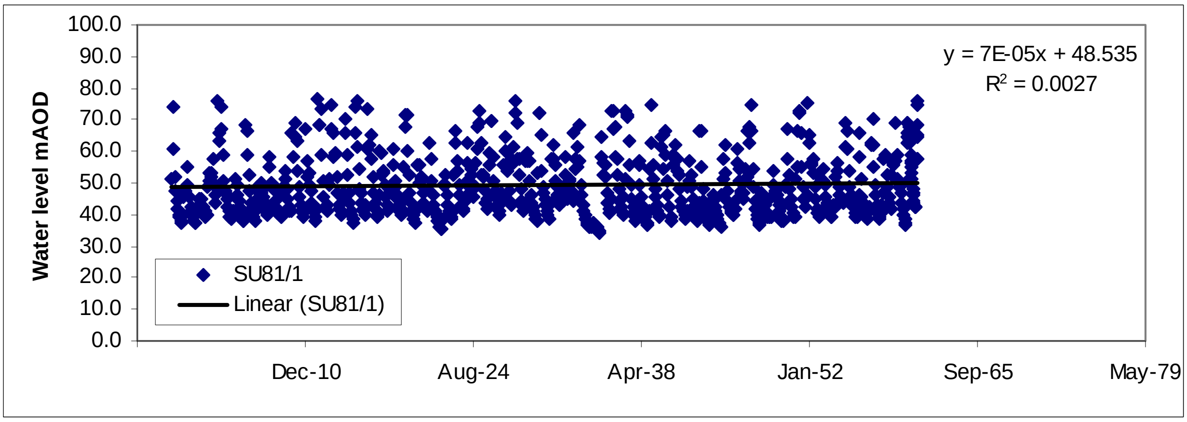


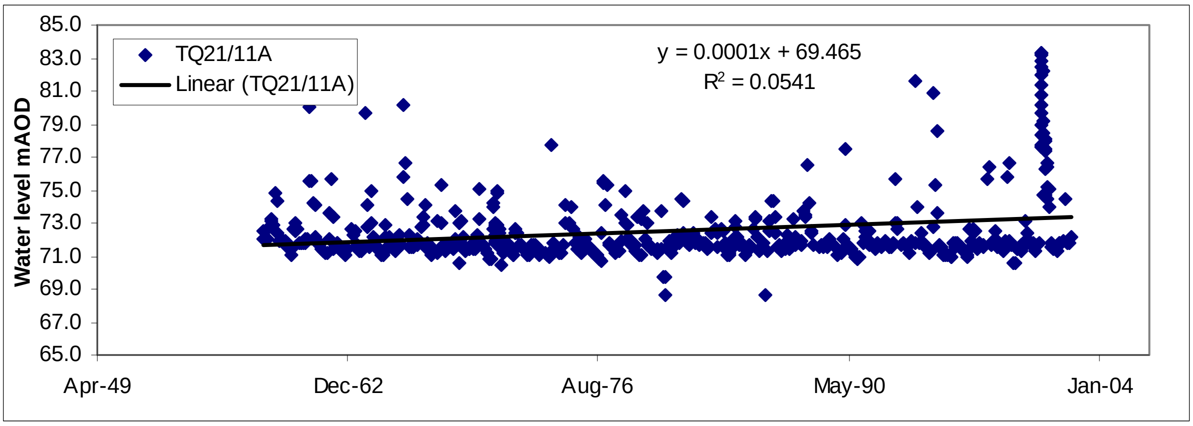



TQ40/45B
Linear (TQ40/45B)
y = 3E-05x + 0.0343
R2 = 0.0325
Water level mAOD
9.0
7.0
5.0
3.0
1.0
-1.0
-3.0
-5.0
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04


SU71/23
Linear (SU71/23)
y = -1E-05x + 40.207
R2 = 0.0003
Water level mAOD
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Dec-10
Aug-24
Apr-38
Jan-52
Sep-65
May-79
Jan-93
Oct-06

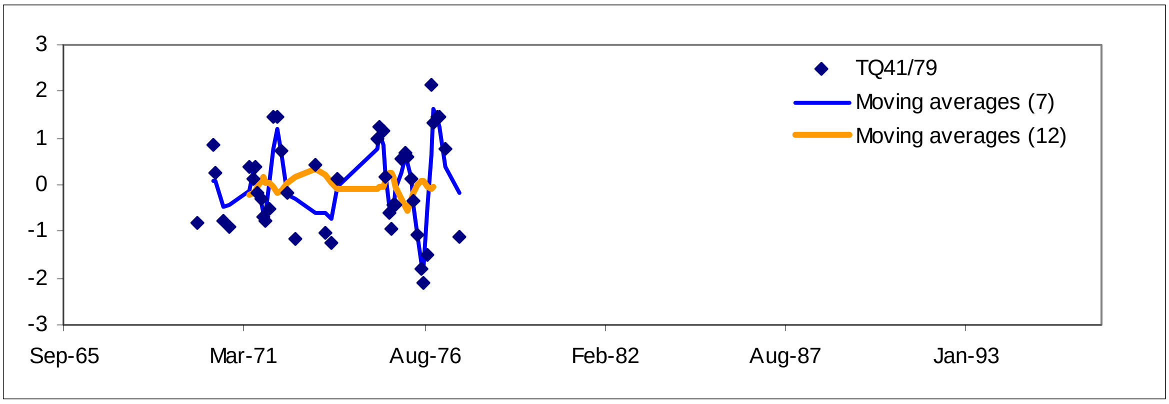

TV59/7C
Linear (TV59/7C)
y = -2E-06x + 1.8683
R2 = 0.0004
Water level mAOD
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Nov-32
Jul-46
Mar-60
Dec-73
Aug-87
Apr-01
Dec-14

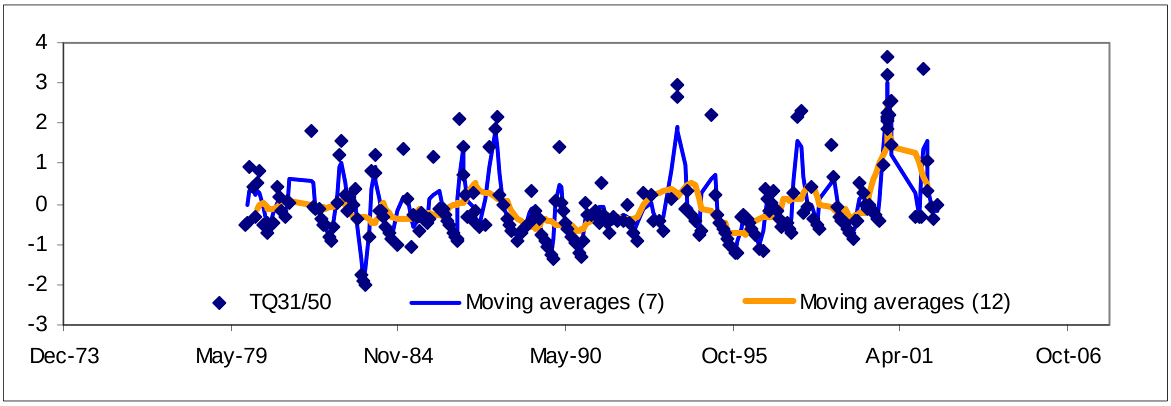

y = 7E-05x + 48.535
R2 = 0.0027
SU81/1
Linear (SU81/1)
Water level mAOD
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Dec-10
Aug-24
Apr-38
Jan-52
Sep-65
May-79

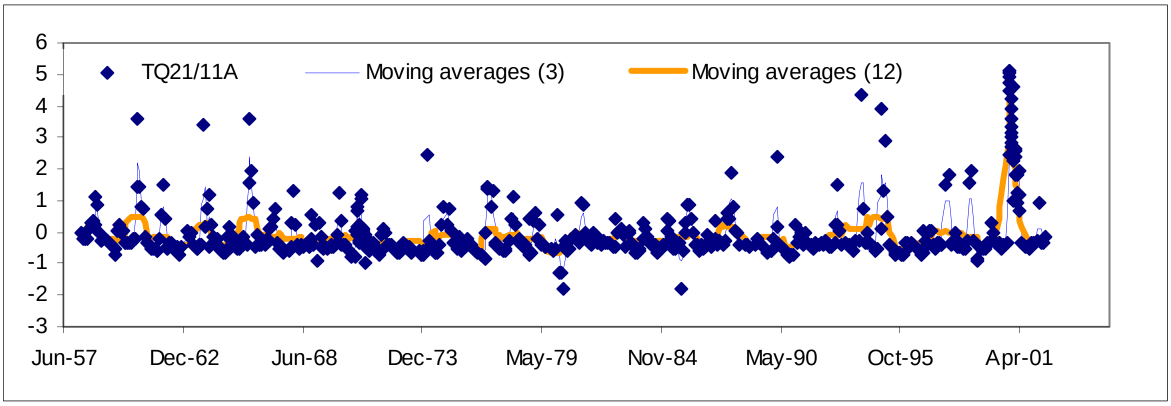


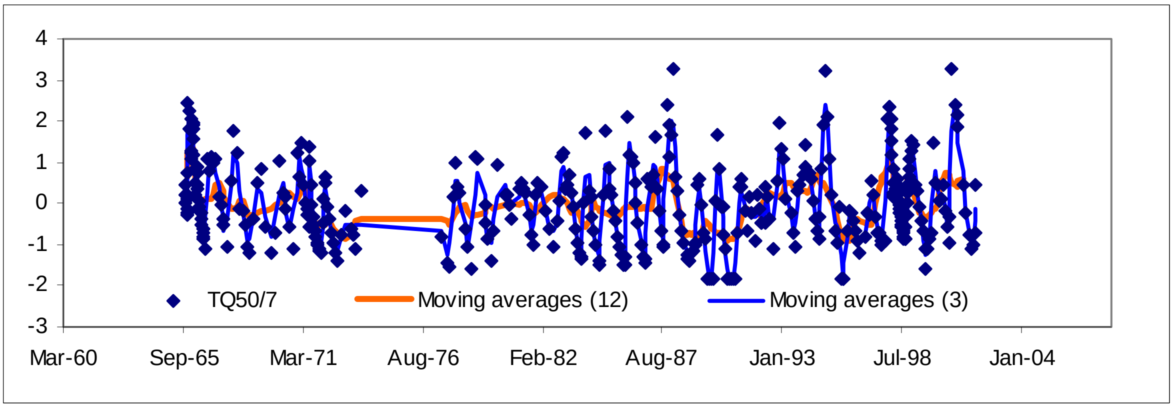
Water level mAOD
85.0
83.0
81.0
79.0
77.0
75.0
73.0
71.0
69.0
67.0
65.0
Apr-49
Dec-62
Aug-76
May-90
Jan-04
TQ21/11A
Linear (TQ21/11A)
y = 0.0001x + 69.465
R2 = 0.0541

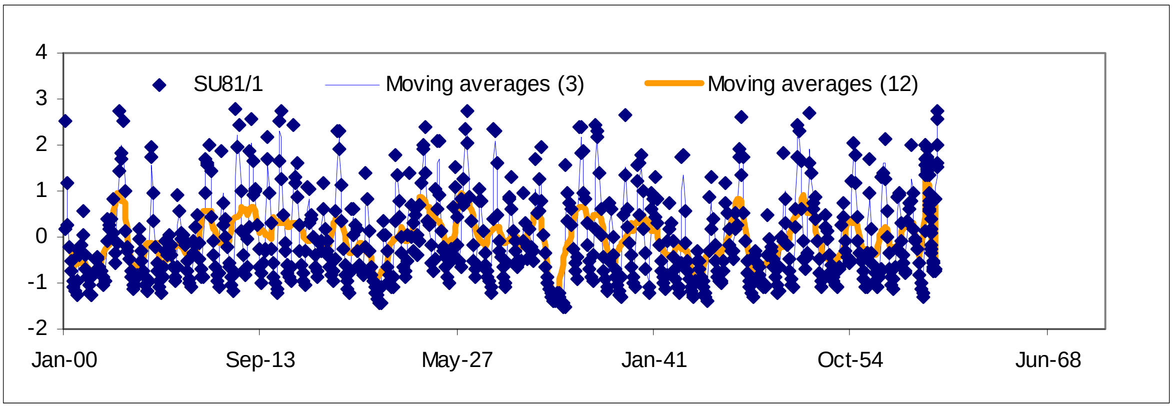
NORMALISED WATER LEVEL DATA WITH MOVING AVERAGES SMOOTHING LINES

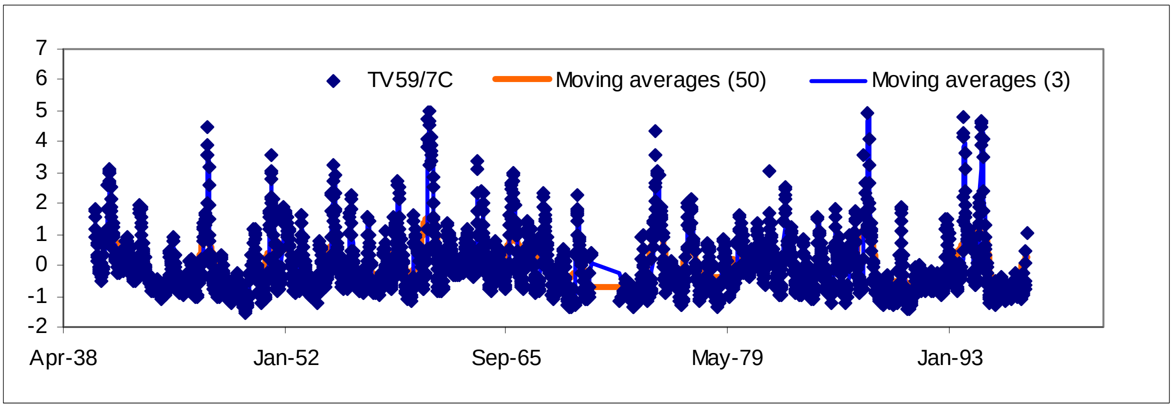


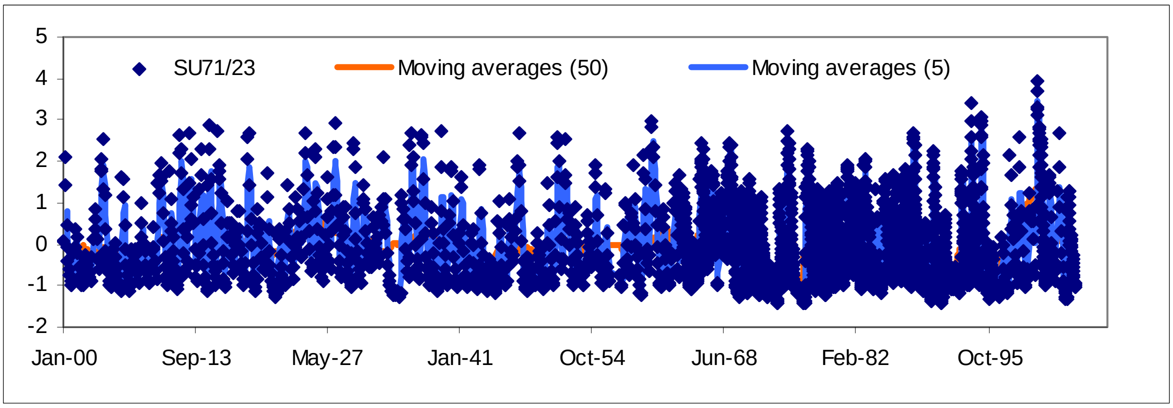


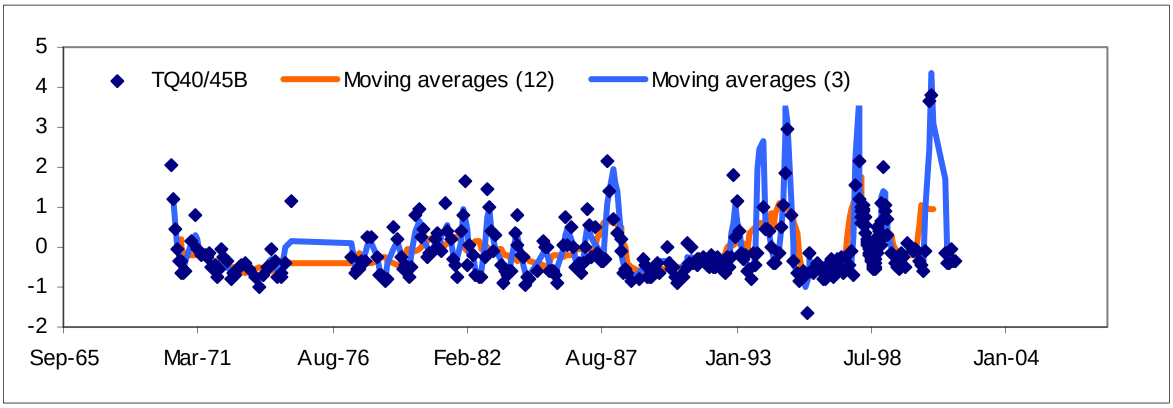


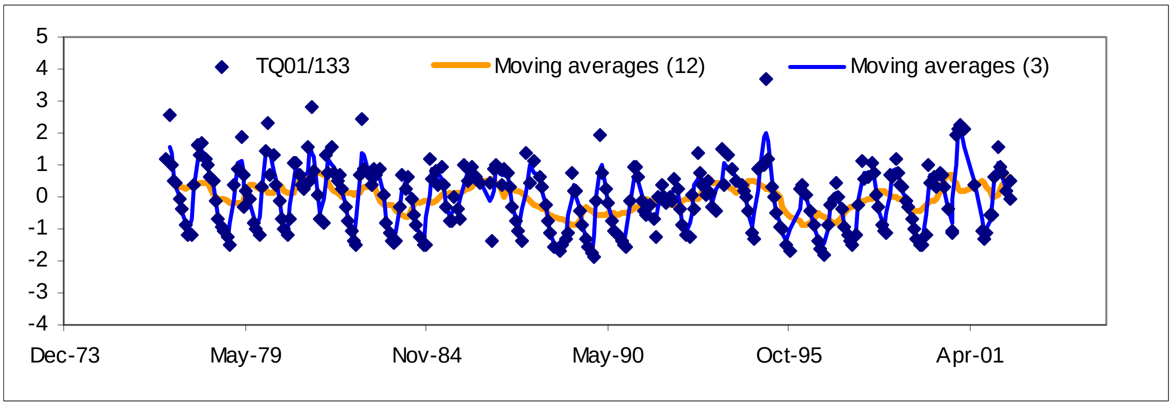



4
3
2
1
0
-1
-2
SU81/1
Moving averages (3)
Moving averages (12)
Jan-00
Sep-13
May-27
Jan-41
Oct-54
Jun-68


7
6
5
4
3
2
1
0
-1
-2
TV59/7C
Moving averages (50)
Moving averages (3)
Apr-38
Jan-52
Sep-65
May-79
Jan-93

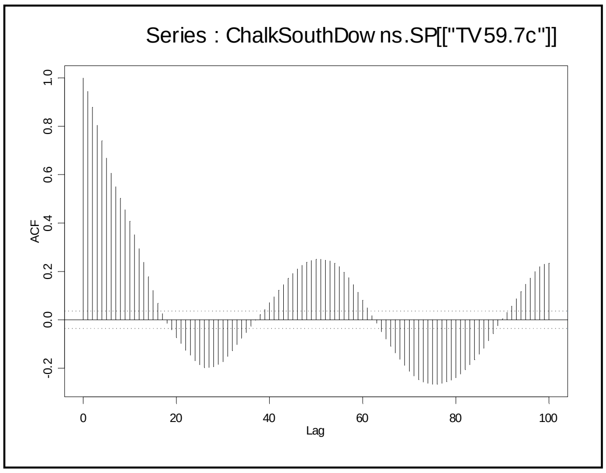

5
4
3
2
1
0
-1
-2
SU71/23
Moving averages (50)
Moving averages (5)
Jan-00
Sep-13
May-27
Jan-41
Oct-54
Jun-68
Feb-82
Oct-95

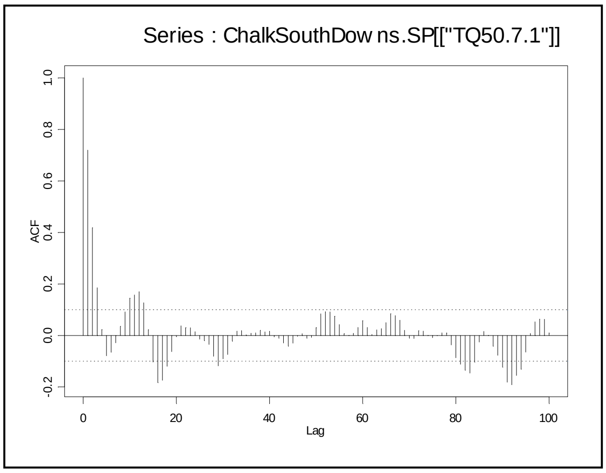

5
4
3
2
1
0
-1
-2
TQ40/45B
Moving averages (12)
Moving averages (3)
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

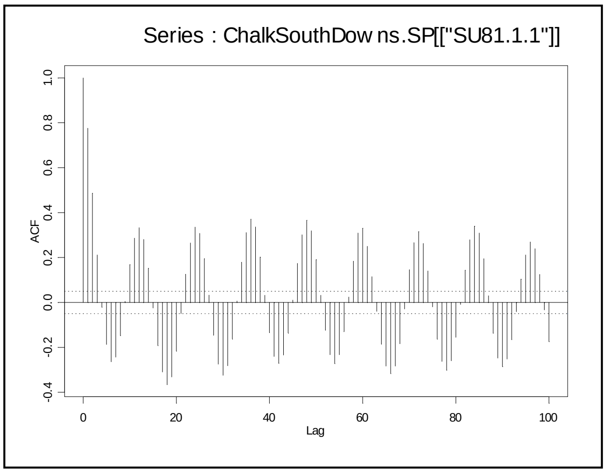


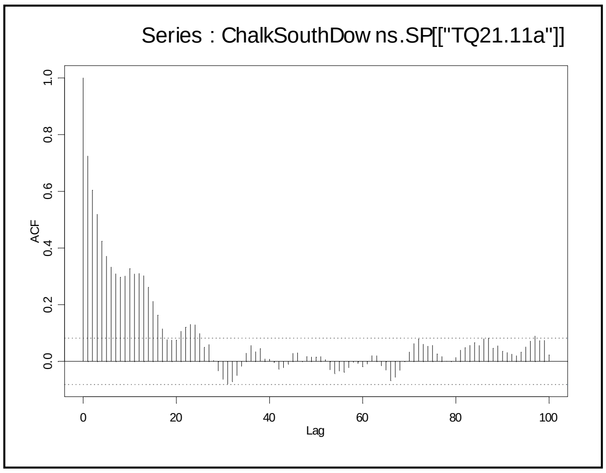
5
4
3
2
1
0
-1
-2
-3
-4
TQ01/133
Moving averages (12)
Moving averages (3)
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

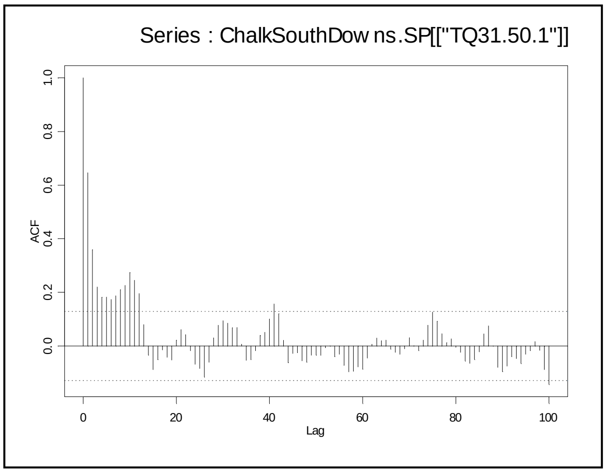
AUTOCORRELATION FUNTION PLOTS

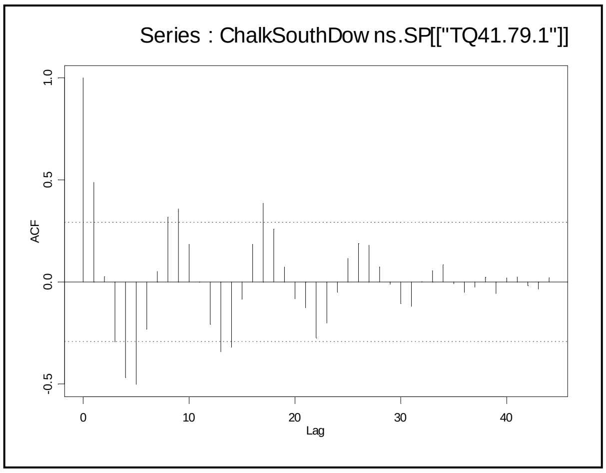


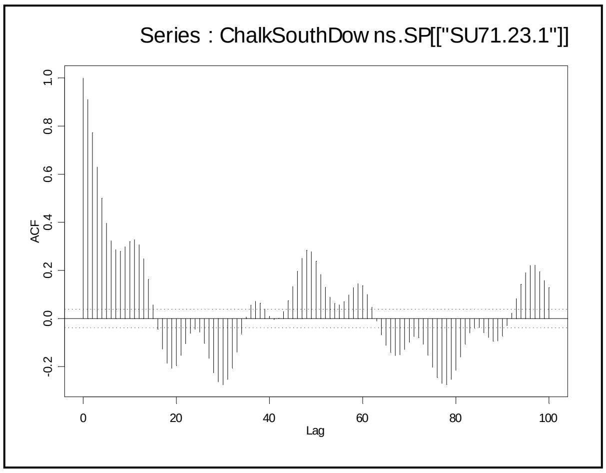








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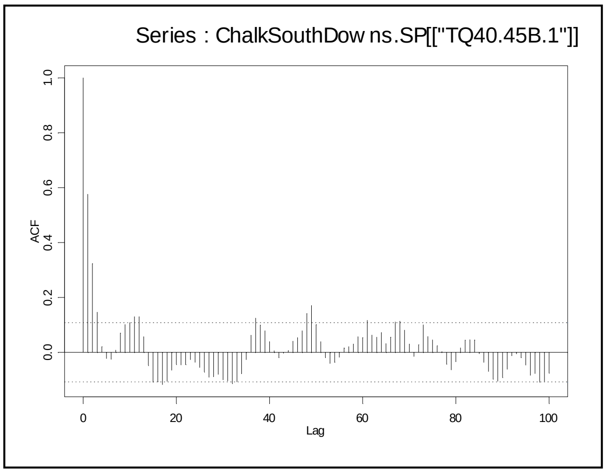
ACF
Lag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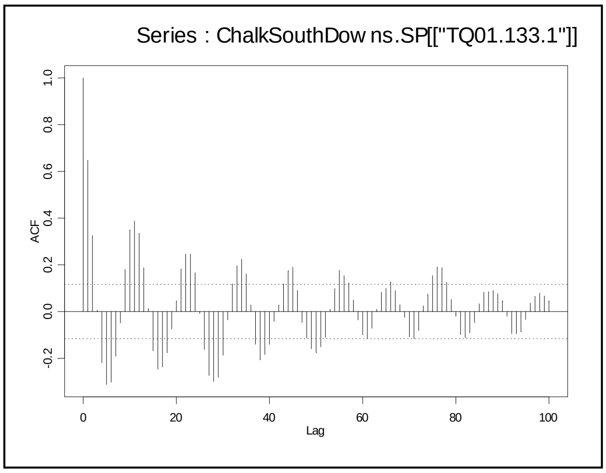
Lag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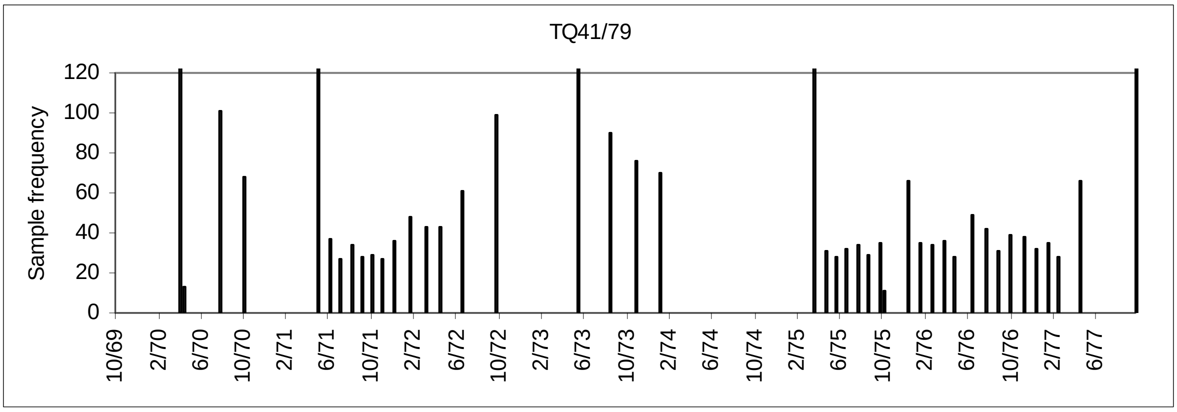
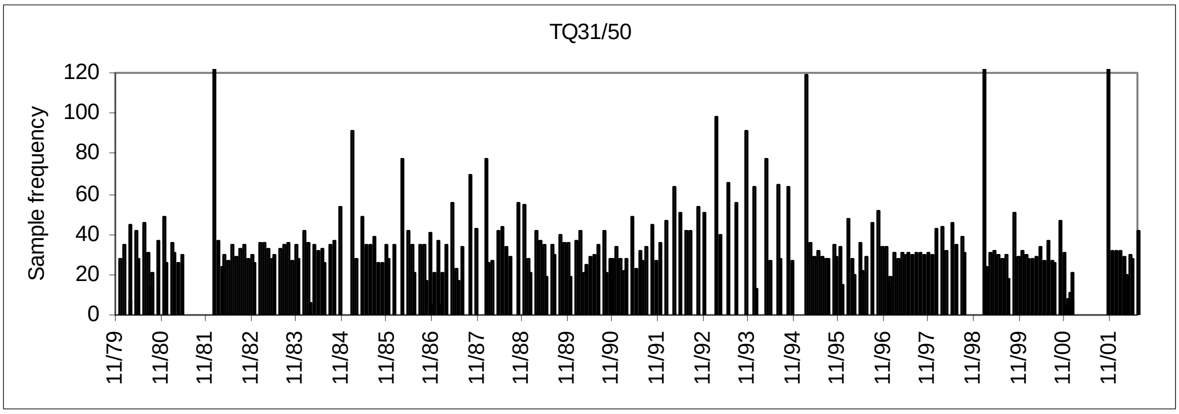
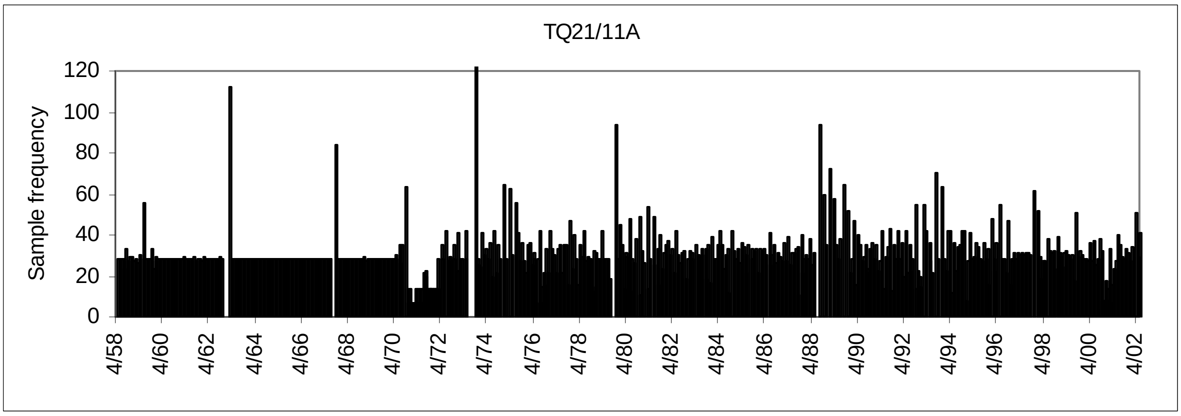
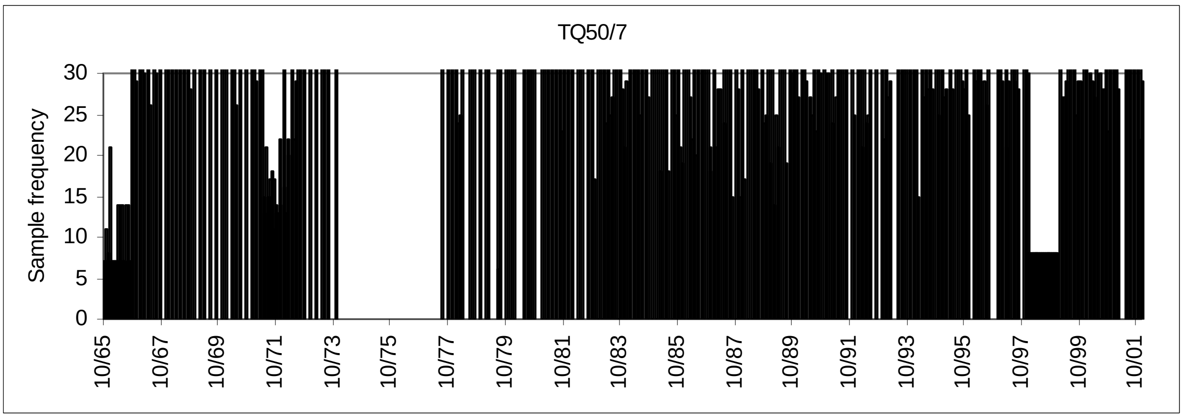
ACF
Lag

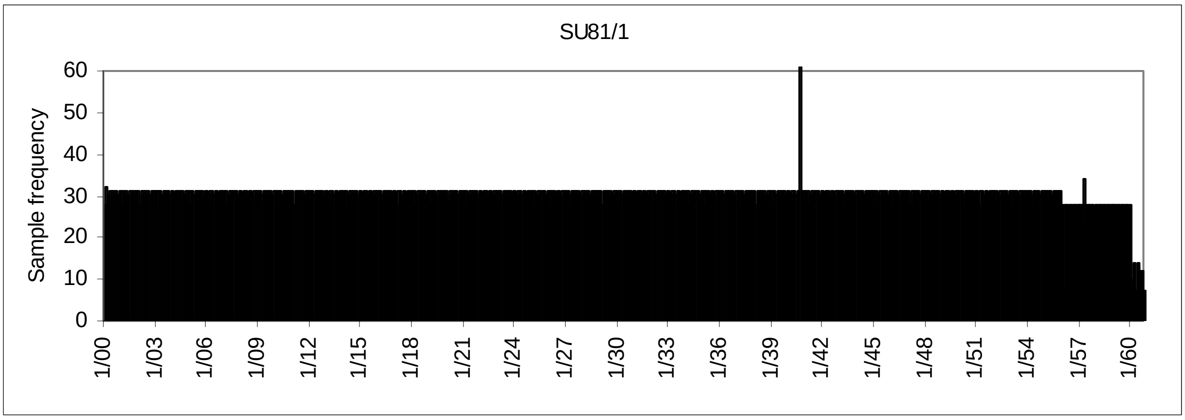
SAMPLE FREQUENCY PLOTS










SU81/1
Sample frequency
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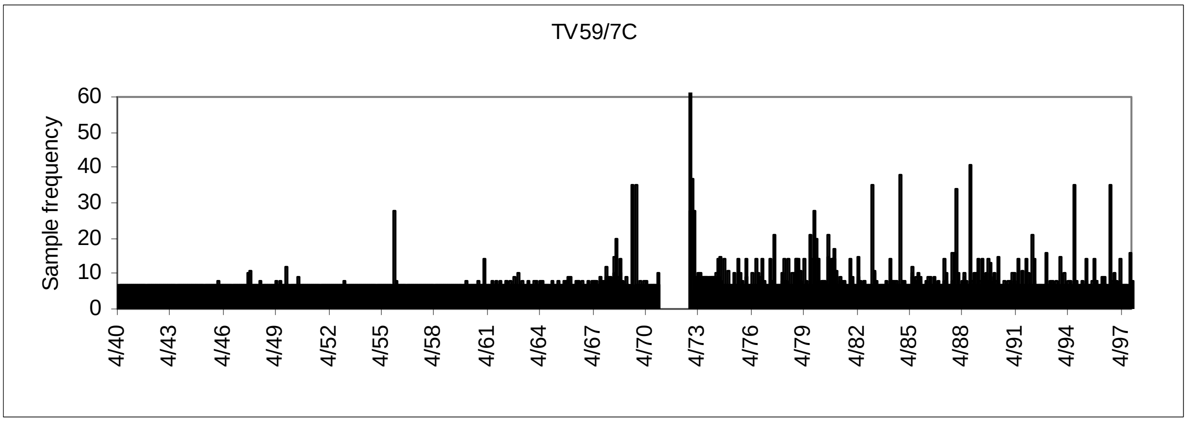
10
20
30
40
50
60
1/00
1/03
1/06
1/09
1/12
1/15
1/18
1/21
1/24
1/27
1/30
1/33
1/36
1/39
1/42
1/45
1/48
1/51
1/54
1/57
1/60


TV59/7C
Sample frequency
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20
30
40
50
60
4/40
4/43
4/46
4/49
4/52
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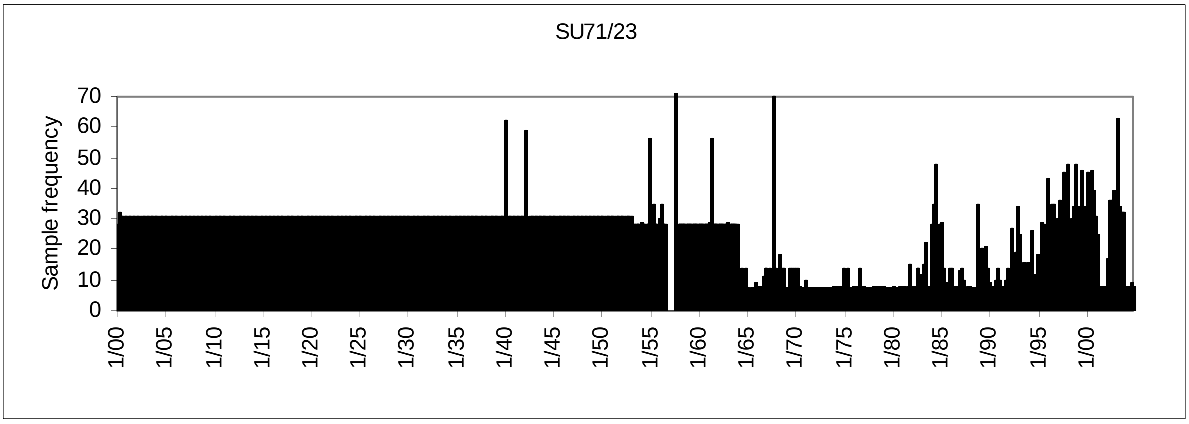
4/58
4/61
4/64
4/67
4/70
4/73
4/76
4/79
4/82
4/85
4/88
4/91
4/94
4/97


SU71/23
Sample frequency
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10
20
30
40
50
60
70
1/00
1/05
1/10
1/15
1/20
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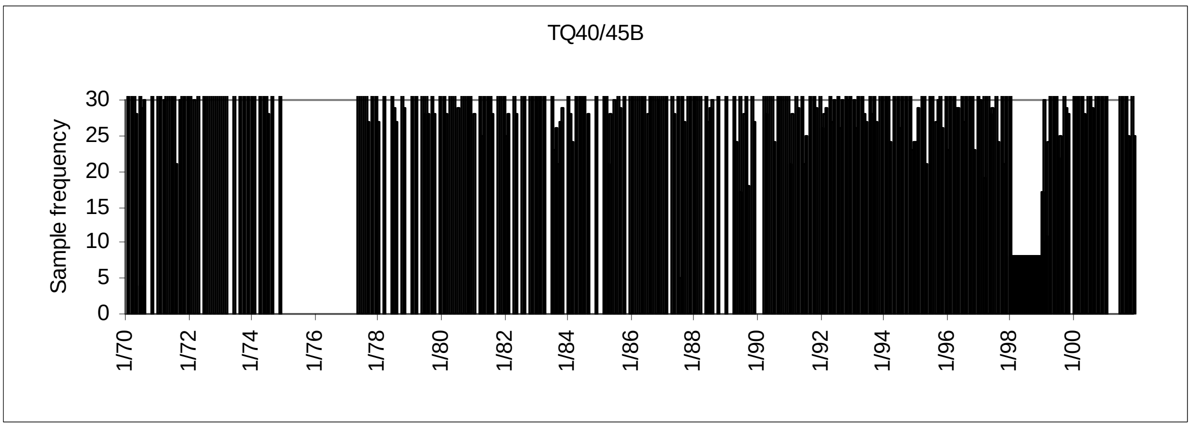
1/30
1/35
1/40
1/45
1/50
1/55
1/60
1/65
1/70
1/75
1/80
1/85
1/90
1/95
1/00


TQ40/45B
Sample frequency
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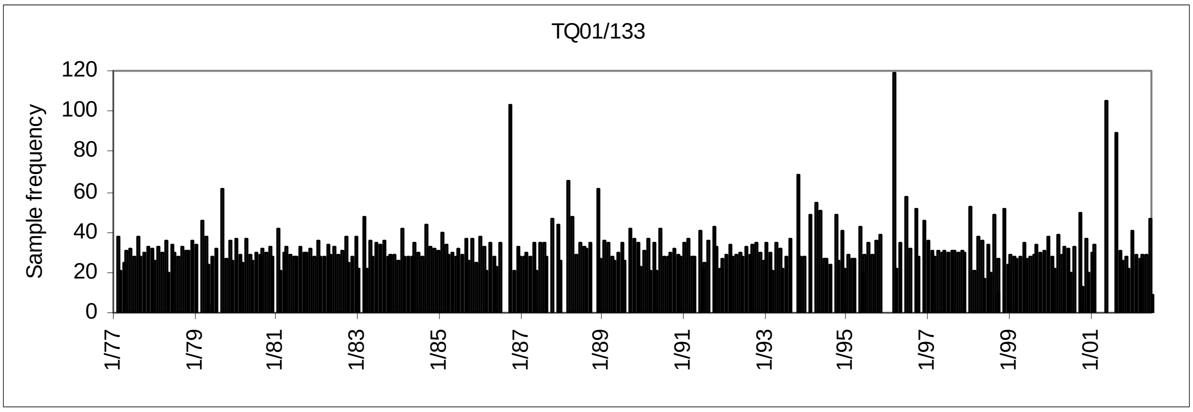
10
15
20
25
30
1/70
1/72
1/74
1/76
1/78
1/80
1/82
1/84
1/86
1/88
1/90
1/92
1/94
1/96
1/98
1/00


TQ01/133
Sample frequency
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60
40
20
0
1/77
1/79
1/81
1/83
1/85
1/87
1/89
1/91
1/93
1/95
1/97
1/99
1/01

WELLMASTER LOOK-UP TABLE

Jan	1959	**Very high**
Feb	1959	**Very high**
Mar	1959	**High**
Apr	1959	**Average**
May	1959	**Average**
Jun	1959	**Low**
Jul	1959	**Low**
Aug	1959	**Very low**
Sep	1959	**Very low**
Oct	1959	**Very low**
Nov	1959	**Very low**
Dec	1959	**High**
Jan	1960	**Very high**
Feb	1960	**Very high**
Mar	1960	**Very high**
Apr	1960	**High**
May	1960	**High**
Jun	1960	**Average**
Jul	1960	**Low**
Aug	1960	**Low**
Sep	1960	**Average**
Oct	1960	**Very high**
Nov	1960	**Very high**
Dec	1960	**Very high**
Jan	1961	**Very high**
Feb	1961	**Very high**
Mar	1961	**Very high**
Apr	1961	**Very high**
May	1961	**High**
Jun	1961	**Average**
Jul	1961	**Low**
Aug	1961	**Low**
Sep	1961	**Very low**
Oct	1961	**Low**
Nov	1961	**Average**
Dec	1961	**High**
Jan	1962	**Very high**
Feb	1962	**Very high**
Mar	1962	**High**
Apr	1962	**High**
May	1962	**Average**
Jun	1962	**Average**
Jul	1962	**Average**
Aug	1962	**Average**
Sep	1962	**Average**
Oct	1962	**Average**
Nov	1962	**Average**
Dec	1962	**Average**
Jan	1963	**Average**
Feb	1963	**High**
Mar	1963	**High**
Apr	1963	**Very high**
May	1963	**High**
Jun	1963	**High**
Jul	1963	**Average**
Aug	1963	**Average**
Sep	1963	**Average**
Oct	1963	**High**
Nov	1963	**Very high**
Dec	1963	**Very high**
Jan	1964	**High**
Feb	1964	**High**
Mar	1964	**Very high**
Apr	1964	**Very high**
May	1964	**Very high**
Jun	1964	**High**
Jul	1964	**High**
Aug	1964	**Average**
Sep	1964	**Low**
Oct	1964	**Low**
Nov	1964	**Low**
Dec	1964	**Low**
Jan	1965	**Average**
Feb	1965	**High**
Mar	1965	**Average**
Apr	1965	**High**
May	1965	**Average**
Jun	1965	**Average**
Jul	1965	**Low**
Aug	1965	**Low**
Sep	1965	**Low**
Oct	1965	**Average**
Nov	1965	**Average**
Dec	1965	**Very high**
Jan	1966	**Very high**
Feb	1966	**Very high**
Mar	1966	**Very high**
Apr	1966	**Very high**
May	1966	**Very high**
Jun	1966	**High**
Jul	1966	**Average**
Aug	1966	**Low**
Sep	1966	**Low**
Oct	1966	**Average**
Nov	1966	**High**
Dec	1966	**High**
Jan	1967	**Very high**
Feb	1967	**Very high**
Mar	1967	**Very high**
Apr	1967	**Very high**
May	1967	**High**
Jun	1967	**Average**
Jul	1967	**Average**
Aug	1967	**Low**
Sep	1967	**Very low**
Oct	1967	**Average**
Nov	1967	**High**
Dec	1967	**High**
Jan	1968	**Very high**
Feb	1968	**Very high**
Mar	1968	**High**
Apr	1968	**High**
May	1968	**Average**
Jun	1968	**Average**
Jul	1968	**Average**
Aug	1968	**Low**
Sep	1968	**Average**
Oct	1968	**High**
Nov	1968	**High**
Dec	1968	**High**
Jan	1969	**Very high**
Feb	1969	**Very high**
Mar	1969	**Very high**
Apr	1969	**High**
May	1969	**Average**
Jun	1969	**Average**
Jul	1969	**Very low**
Aug	1969	**Very low**
Sep	1969	**Very low**
Oct	1969	**Very low**
Nov	1969	**Very low**
Dec	1969	**Very low**
Jan	1970	**High**
Feb	1970	**Very high**
Mar	1970	**Very high**
Apr	1970	**High**
May	1970	**High**
Jun	1970	**Average**
Jul	1970	**Low**
Aug	1970	**Very low**
Sep	1970	**Very low**
Oct	1970	**Very low**
Nov	1970	**Low**
Dec	1970	**High**
Jan	1971	**Very high**
Feb	1971	**Very high**
Mar	1971	**High**
Apr	1971	**High**
May	1971	**Average**
Jun	1971	**Average**
Jul	1971	**Average**
Aug	1971	**Low**
Sep	1971	**Low**
Oct	1971	**Very low**
Nov	1971	**Very low**
Dec	1971	**Very low**
Jan	1972	**Very low**
Feb	1972	**Average**
Mar	1972	**High**
Apr	1972	**High**
May	1972	**Average**
Jun	1972	**Average**
Jul	1972	**Low**
Aug	1972	**Very low**
Sep	1972	**Very low**
Oct	1972	**Very low**
Nov	1972	**Very low**
Dec	1972	**Very low**

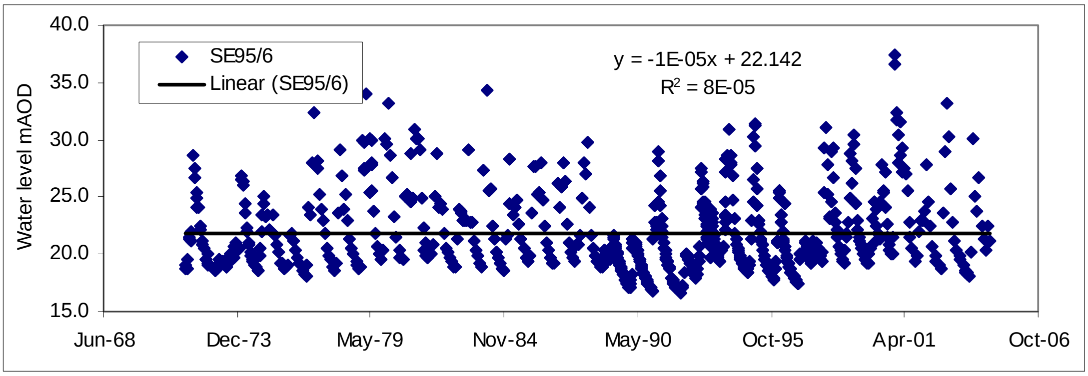
Jan	1973	**Low**	Sep	1977	**Very low**	May	1982	**Average**
Feb	1973	**Low**	Oct	1977	**Very low**	Jun	1982	**Average**
Mar	1973	**Low**	Nov	1977	**Very low**	Jul	1982	**Low**
Apr	1973	**Low**	Dec	1977	**Average**	Aug	1982	**Very low**
May	1973	**Low**	Jan	1978	**High**	Sep	1982	**Very low**
Jun	1973	**Very low**	Feb	1978	**Very high**	Oct	1982	**Average**
Jul	1973	**Very low**	Mar	1978	**Very high**	Nov	1982	**High**
Aug	1973	**Very low**	Apr	1978	**High**	Dec	1982	**Very high**
Sep	1973	**Very low**	May	1978	**High**	Jan	1983	**Very high**
Oct	1973	**Very low**	Jun	1978	**Average**	Feb	1983	**Very high**
Nov	1973	**Very low**	Jul	1978	**Low**	Mar	1983	**High**
Dec	1973	**Very low**	Aug	1978	**Low**	Apr	1983	**High**
Jan	1974	**Low**	Sep	1978	**Very low**	May	1983	**High**
Feb	1974	**High**	Oct	1978	**Very low**	Jun	1983	**High**
Mar	1974	**High**	Nov	1978	**Very low**	Jul	1983	**Average**
Apr	1974	**Average**	Dec	1978	**Very low**	Aug	1983	**Low**
May	1974	**Average**	Jan	1979	**Average**	Sep	1983	**Very low**
Jun	1974	**Low**	Feb	1979	**High**	Oct	1983	**Very low**
Jul	1974	**Very low**	Mar	1979	**High**	Nov	1983	**Very low**
Aug	1974	**Very low**	Apr	1979	**Very high**	Dec	1983	**Very low**
Sep	1974	**Low**	May	1979	**High**	Jan	1984	**High**
Oct	1974	**High**	Jun	1979	**Average**	Feb	1984	**High**
Nov	1974	**Very high**	Jul	1979	**Average**	Mar	1984	**High**
Dec	1974	**Very high**	Aug	1979	**Low**	Apr	1984	**Average**
Jan	1975	**Very high**	Sep	1979	**Low**	May	1984	**Average**
Feb	1975	**Very high**	Oct	1979	**Very low**	Jun	1984	**Low**
Mar	1975	**Very high**	Nov	1979	**Low**	Jul	1984	**Very low**
Apr	1975	**Very high**	Dec	1979	**Average**	Aug	1984	**Very low**
May	1975	**Very high**	Jan	1980	**Very high**	Sep	1984	**Very low**
Jun	1975	**High**	Feb	1980	**Very high**	Oct	1984	**Very low**
Jul	1975	**Average**	Mar	1980	**Very high**	Nov	1984	**Average**
Aug	1975	**Low**	Apr	1980	**Very high**	Dec	1984	**High**
Sep	1975	**Low**	May	1980	**High**	Jan	1985	**Very high**
Oct	1975	**Low**	Jun	1980	**Average**	Feb	1985	**Very high**
Nov	1975	**Low**	Jul	1980	**Average**	Mar	1985	**High**
Dec	1975	**Low**	Aug	1980	**Low**	Apr	1985	**High**
Jan	1976	**Low**	Sep	1980	**Low**	May	1985	**High**
Feb	1976	**Low**	Oct	1980	**Average**	Jun	1985	**Average**
Mar	1976	**Low**	Nov	1980	**Average**	Jul	1985	**Low**
Apr	1976	**Very low**	Dec	1980	**High**	Aug	1985	**Low**
May	1976	**Very low**	Jan	1981	**High**	Sep	1985	**Low**
Jun	1976	**Very low**	Feb	1981	**High**	Oct	1985	**Very low**
Jul	1976	**Very low**	Mar	1981	**Very high**	Nov	1985	**Very low**
Aug	1976	**Very low**	Apr	1981	**Very high**	Dec	1985	**Average**
Sep	1976	**Very low**	May	1981	**High**	Jan	1986	**Very high**
Oct	1976	**Very low**	Jun	1981	**High**	Feb	1986	**Very high**
Nov	1976	**High**	Jul	1981	**Average**	Mar	1986	**High**
Dec	1976	**Very high**	Aug	1981	**Average**	Apr	1986	**High**
Jan	1977	**Very high**	Sep	1981	**Low**	May	1986	**High**
Feb	1977	**Very high**	Oct	1981	**Average**	Jun	1986	**Average**
Mar	1977	**Very high**	Nov	1981	**High**	Jul	1986	**Low**
Apr	1977	**Very high**	Dec	1981	**High**	Aug	1986	**Low**
May	1977	**High**	Jan	1982	**Very high**	Sep	1986	**Very low**
Jun	1977	**Average**	Feb	1982	**High**	Oct	1986	**Very low**
Jul	1977	**Low**	Mar	1982	**High**	Nov	1986	**Average**
Aug	1977	**Low**	Apr	1982	**High**	Dec	1986	**High**

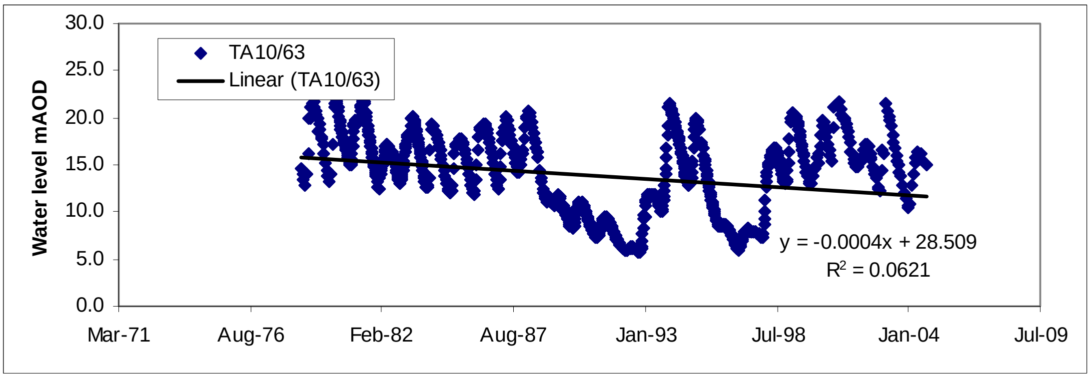
Jan	1987	**Very high**
Feb	1987	**High**
Mar	1987	**High**
Apr	1987	**Very high**
May	1987	**High**
Jun	1987	**Average**
Jul	1987	**Low**
Aug	1987	**Low**
Sep	1987	**Low**
Oct	1987	**High**
Nov	1987	**Very high**
Dec	1987	**Very high**
Jan	1988	**Very high**
Feb	1988	**Very high**
Mar	1988	**Very high**
Apr	1988	**Very high**
May	1988	**High**
Jun	1988	**Average**
Jul	1988	**Low**
Aug	1988	**Very low**
Sep	1988	**Very low**
Oct	1988	**Very low**
Nov	1988	**Very low**
Dec	1988	**Very low**
Jan	1989	**Very low**
Feb	1989	**Very low**
Mar	1989	**Average**
Apr	1989	**Average**
May	1989	**Average**
Jun	1989	**Low**
Jul	1989	**Very low**
Aug	1989	**Very low**
Sep	1989	**Very low**
Oct	1989	**Very low**
Nov	1989	**Very low**
Dec	1989	**Very low**
Jan	1990	**Average**
Feb	1990	**Very high**
Mar	1990	**Very high**
Apr	1990	**High**
May	1990	**Average**
Jun	1990	**Low**
Jul	1990	**Very low**
Aug	1990	**Very low**
Sep	1990	**Very low**
Oct	1990	**Very low**
Nov	1990	**Very low**
Dec	1990	**Very low**
Jan	1991	**Low**
Feb	1991	**Average**
Mar	1991	**Average**
Apr	1991	**High**
May	1991	**Average**
Jun	1991	**Low**
Jul	1991	**Average**
Aug	1991	**Low**
Sep	1991	**Low**
Oct	1991	**Very low**
Nov	1991	**Low**
Dec	1991	**Low**
Jan	1992	**Low**
Feb	1992	**Low**
Mar	1992	**Low**
Apr	1992	**Low**
May	1992	**Average**
Jun	1992	**Low**
Jul	1992	**Low**
Aug	1992	**Very low**
Sep	1992	**Very low**
Oct	1992	**Very low**
Nov	1992	**Average**
Dec	1992	**Very high**
Jan	1993	**Very high**
Feb	1993	**Very high**
Mar	1993	**High**
Apr	1993	**Average**
May	1993	**Average**
Jun	1993	**Average**
Jul	1993	**Low**
Aug	1993	**Low**
Sep	1993	**Low**
Oct	1993	**Average**
Nov	1993	**High**
Dec	1993	**Very high**
Jan	1994	**Very high**
Feb	1994	**Very high**
Mar	1994	**Very high**
Apr	1994	**Very high**
May	1994	**Very high**
Jun	1994	**High**
Jul	1994	**Average**
Aug	1994	**Average**
Sep	1994	**Low**
Oct	1994	**Low**
Nov	1994	**Average**
Dec	1994	**Very high**
Jan	1995	**Very high**
Feb	1995	**Very high**
Mar	1995	**Very high**
Apr	1995	**Very high**
May	1995	**High**
Jun	1995	**Average**
Jul	1995	**Low**
Aug	1995	**Very low**
Sep	1995	**Very low**
Oct	1995	**Very low**
Nov	1995	**Very low**
Dec	1995	**Very low**
Jan	1996	**Low**
Feb	1996	**Low**
Mar	1996	**Average**
Apr	1996	**Average**
May	1996	**Average**
Jun	1996	**Low**
Jul	1996	**Very low**
Aug	1996	**Very low**
Sep	1996	**Very low**
Oct	1996	**Very low**
Nov	1996	**Low**
Dec	1996	**Low**
Jan	1997	**Low**
Feb	1997	**Average**
Mar	1997	**Average**
Apr	1997	**Average**
May	1997	**Low**
Jun	1997	**Low**
Jul	1997	**Very low**
Aug	1997	**Very low**
Sep	1997	**Very low**
Oct	1997	**Low**
Nov	1997	**High**
Dec	1997	**Very high**
Jan	1998	**Very high**
Feb	1998	**Very high**
Mar	1998	**High**
Apr	1998	**High**
May	1998	**High**
Jun	1998	**Average**
Jul	1998	**Average**
Aug	1998	**Low**
Sep	1998	**Low**
Oct	1998	**Average**
Nov	1998	**High**
Dec	1998	**Very high**
Jan	1999	**Very high**
Feb	1999	**Very high**
Mar	1999	**High**
Apr	1999	**Average**
May	1999	**Average**
Jun	1999	**Average**
Jul	1999	**Low**
Aug	1999	**Very low**
Sep	1999	**Low**
Oct	1999	**Low**
Nov	1999	**Low**
Dec	1999	**High**
Jan	2000	**High**
Feb	2000	**High**
Mar	2000	**High**
Apr	2000	**High**
May	2000	**High**
Jun	2000	**High**
Jul	2000	**Average**
Aug	2000	**Low**
Sep	2000	**Average**
Oct	2000	**Very high**
Nov	2000	**Very high**
Dec	2000	**Very high**

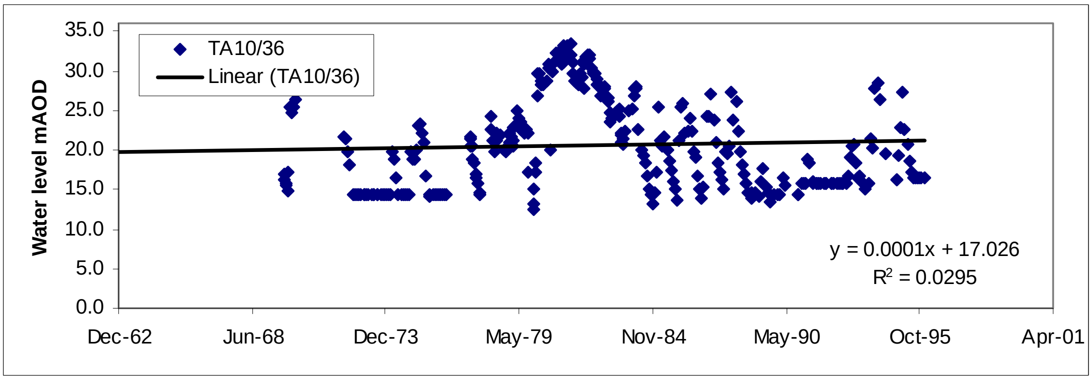
Jan	2001	**Very high**
Feb	2001	**Very high**
Mar	2001	**Very high**
Apr	2001	**Very high**
May	2001	**Very high**
Jun	2001	**High**
Jul	2001	**Average**
Aug	2001	**Low**
Sep	2001	**Very low**
Oct	2001	**Low**
Nov	2001	**Average**
Dec	2001	**Average**
Jan	2002	**High**
Feb	2002	**Very high**
Mar	2002	**Very high**
Apr	2002	**High**
May	2002	**Average**
Jun	2002	**Average**
Jul	2002	**Average**
Aug	2002	**Average**
Sep	2002	**High**
Oct	2002	**High**
Nov	2002	**Very high**
Dec	2002	**Very high**
Jan	2003	**Very high**
Feb	2003	**Very high**
Mar	2003	**Very high**
Apr	2003	**High**
May	2003	**Average**
Jun	2003	**Low**
Jul	2003	**Low**
Aug	2003	**Very low**
Sep	2003	**Very low**
Oct	2003	**Very low**
Nov	2003	**Very low**
Dec	2003	**Average**
Jan	2004	**High**
Feb	2004	**Very high**
Mar	2004	**High**
Apr	2004	**Average**
May	2004	**Average**
Jun	2004	**Average**
Jul	2004	**Low**
Aug	2004	**Very low**
Sep	2004	**Very low**

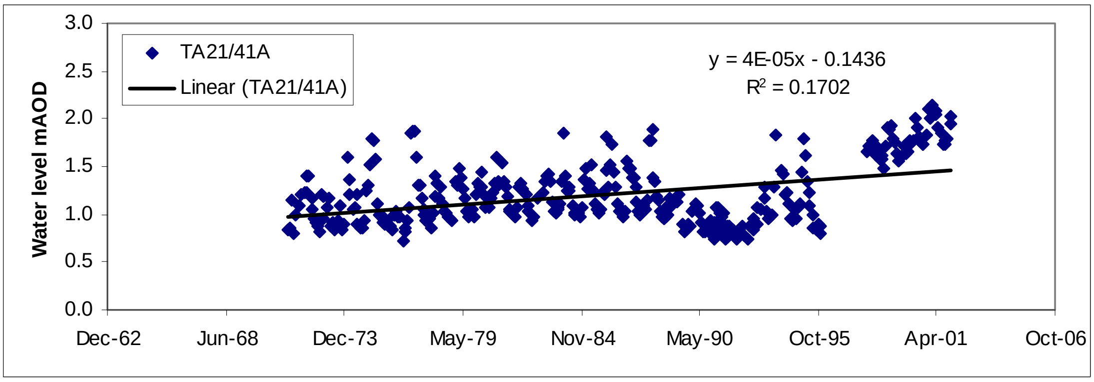
Appendix 7 Chalk – Lincolnshire and Yorkshire

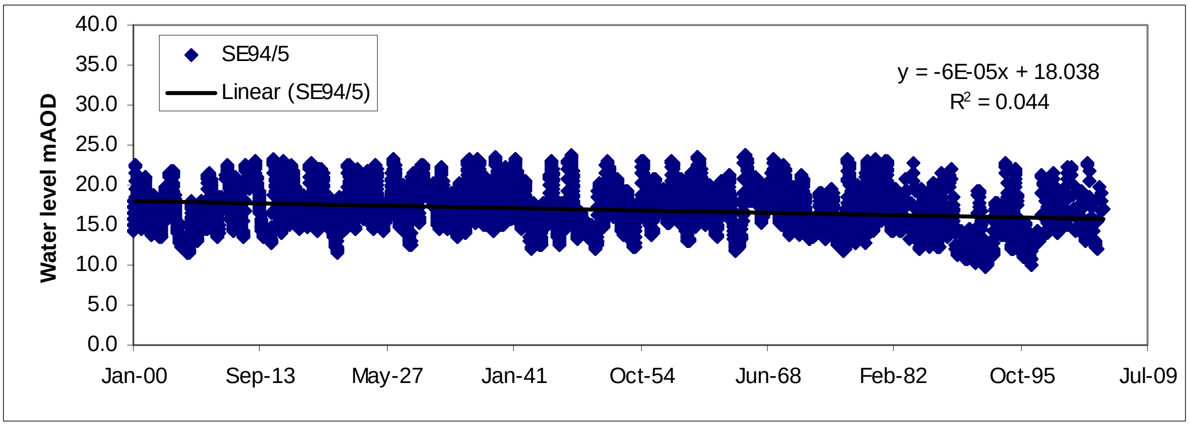
WATER LEVELS ABOVE ORDNANCE DATUM WITH LINEAR REGRESSION CURVE



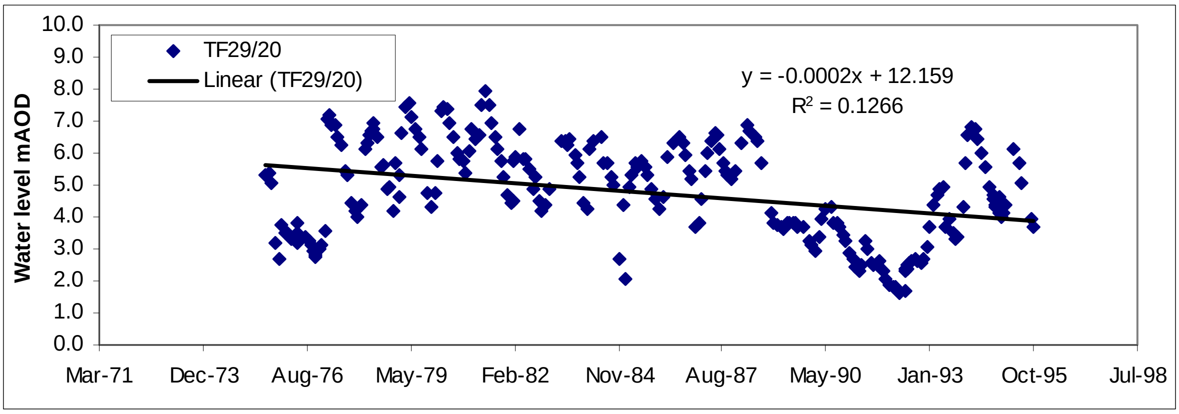




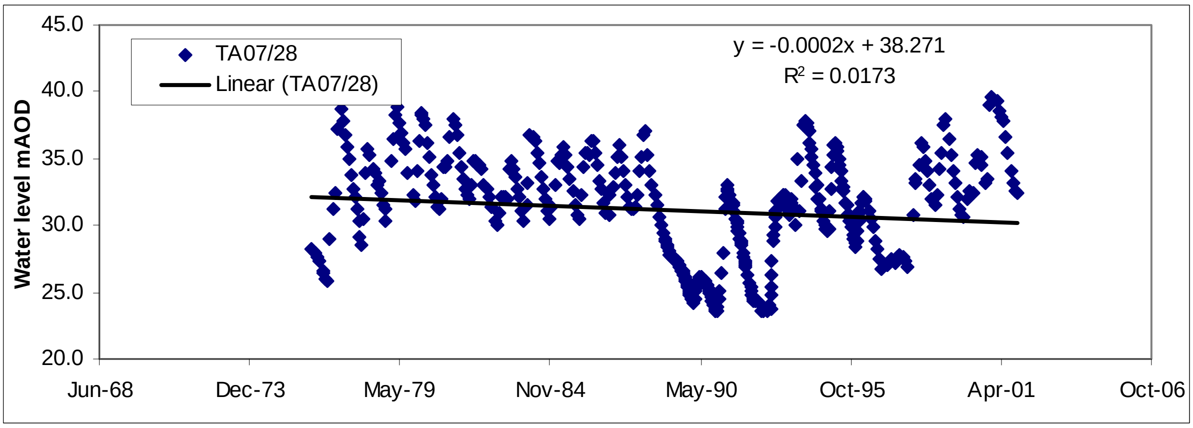




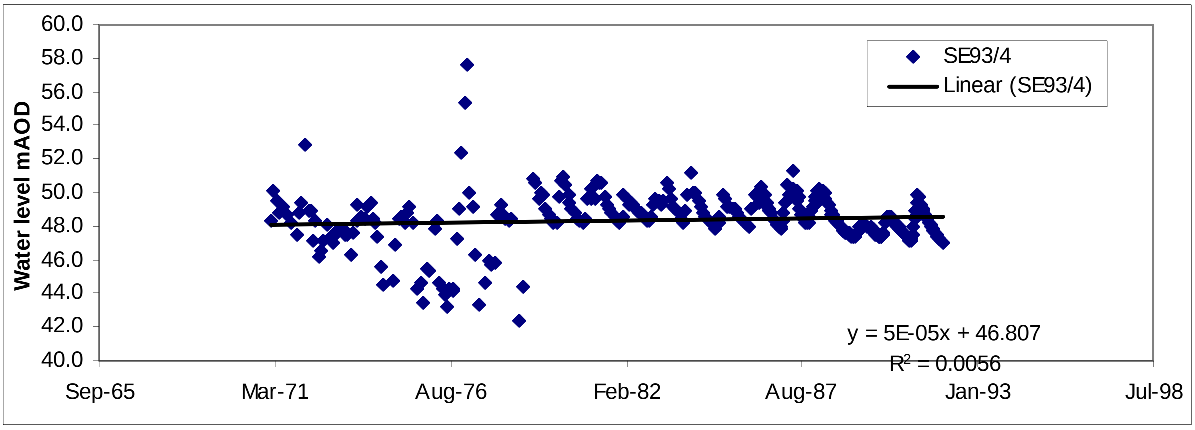
SE94/5
Linear (SE94/5)
y = -6E-05x + 18.038
R^2 = 0.044
Water level mAOD
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Jan-00
Sep-13
May-27
Jan-41
Oct-54
Jun-68
Feb-82
Oct-95
Jul-09



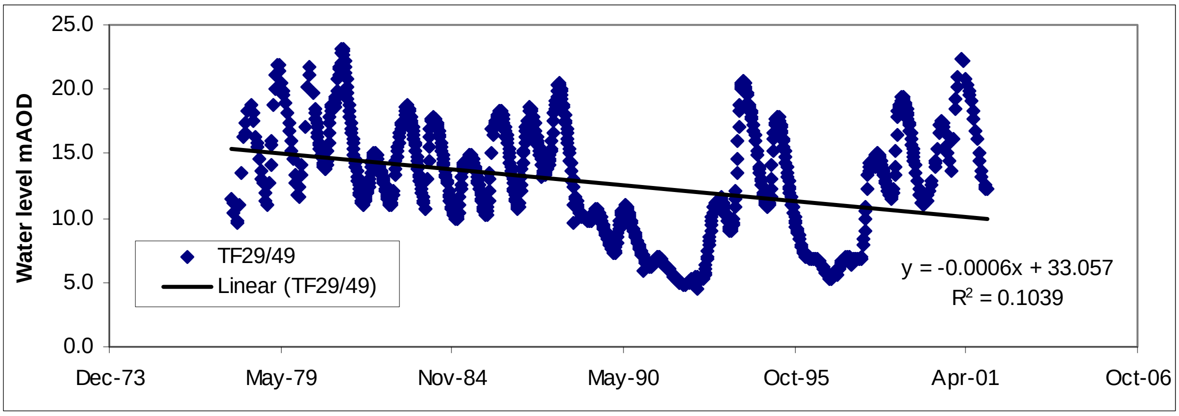
TF29/20
Linear (TF29/20)
y = -0.0002x + 12.159
R^2 = 0.1266
Water level mAOD
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95
Jul-98

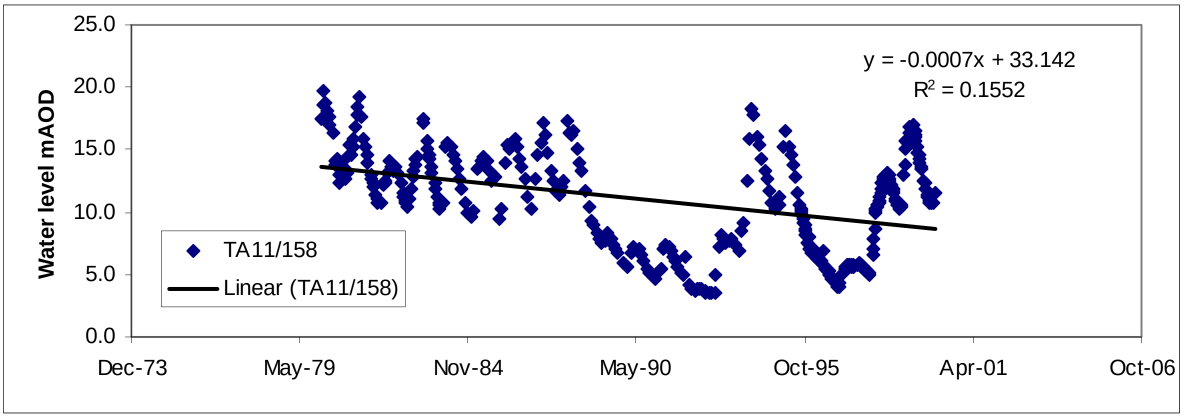


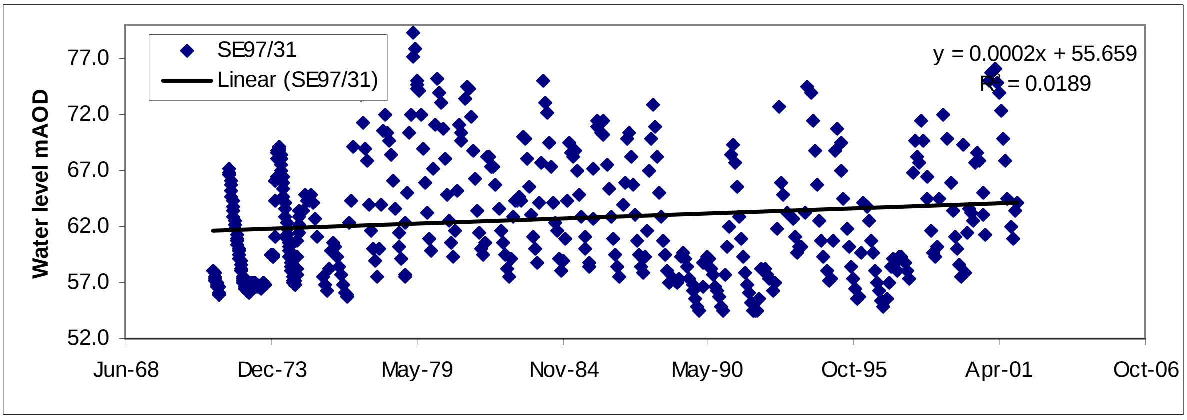
TA07/28
Linear (TA07/28)
y = -0.0002x + 38.271
R^2 = 0.0173
Water level mAOD
45.0
40.0
35.0
30.0
25.0
20.0
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

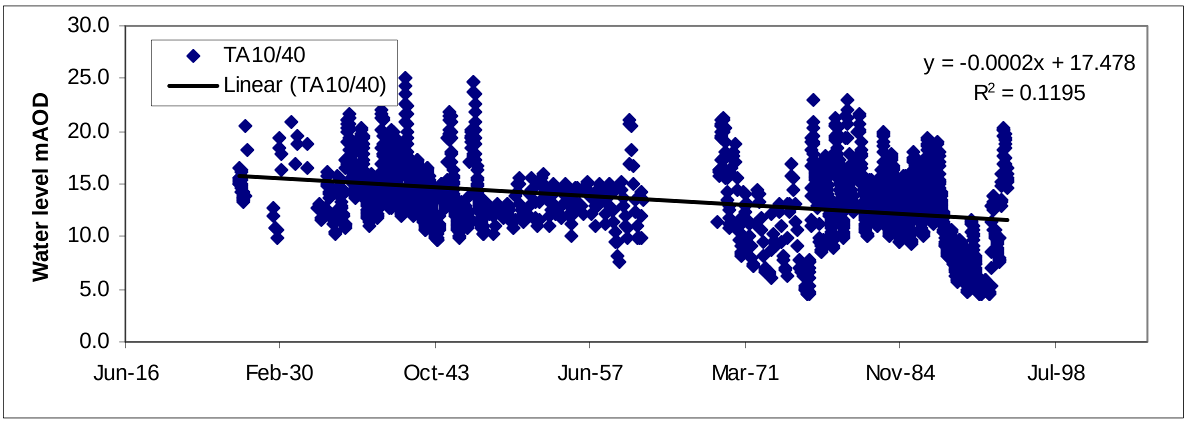


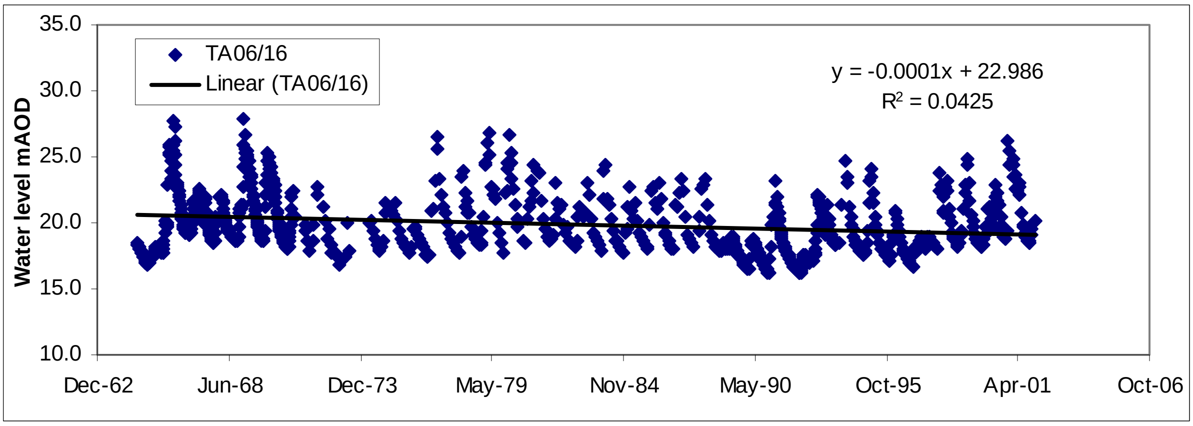
SE93/4
Linear (SE93/4)
y = 5E-05x + 46.807
R^2 = 0.0056
Water level mAOD
60.0
58.0
56.0
54.0
52.0
50.0
48.0
46.0
44.0
42.0
40.0
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98


Water level mAOD
25.0
20.0
15.0
10.0
5.0
0.0
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06
TF29/49
Linear (TF29/49)
y = -0.0006x + 33.057
R² = 0.1039

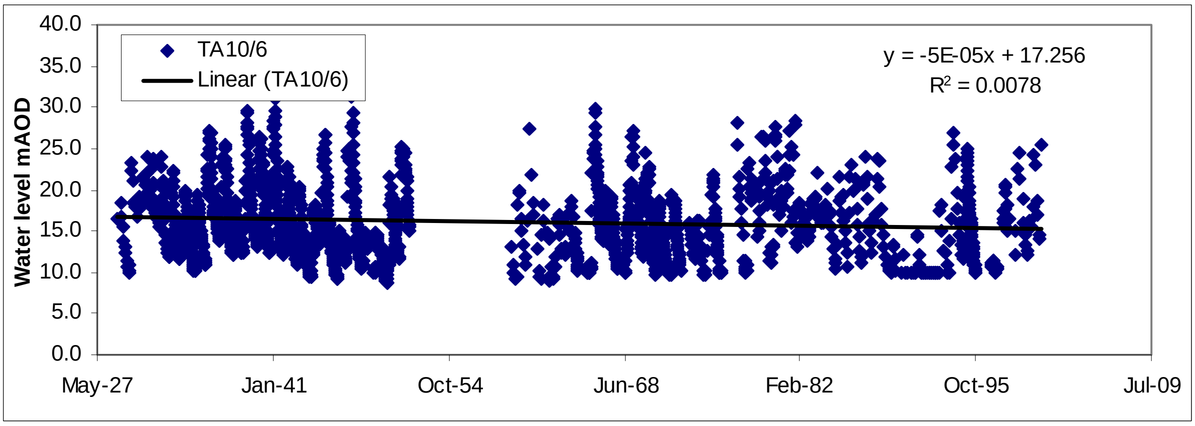

Water level mAOD
25.0
20.0
15.0
10.0
5.0
0.0
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06
TA11/158
Linear (TA11/158)
y = -0.0007x + 33.142
R² = 0.1552


Water level mAOD
77.0
72.0
67.0
62.0
57.0
52.0
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06
SE97/31
Linear (SE97/31)
y = 0.0002x + 55.659
R² = 0.0189


Water level mAOD
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Jun-16
Feb-30
Oct-43
Jun-57
Mar-71
Nov-84
Jul-98
TA10/40
Linear (TA10/40)
y = -0.0002x + 17.478
R² = 0.1195

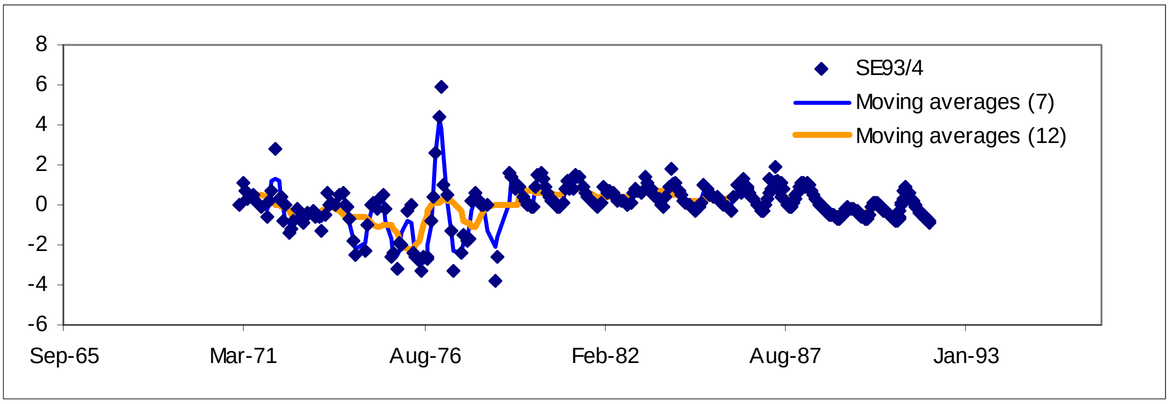


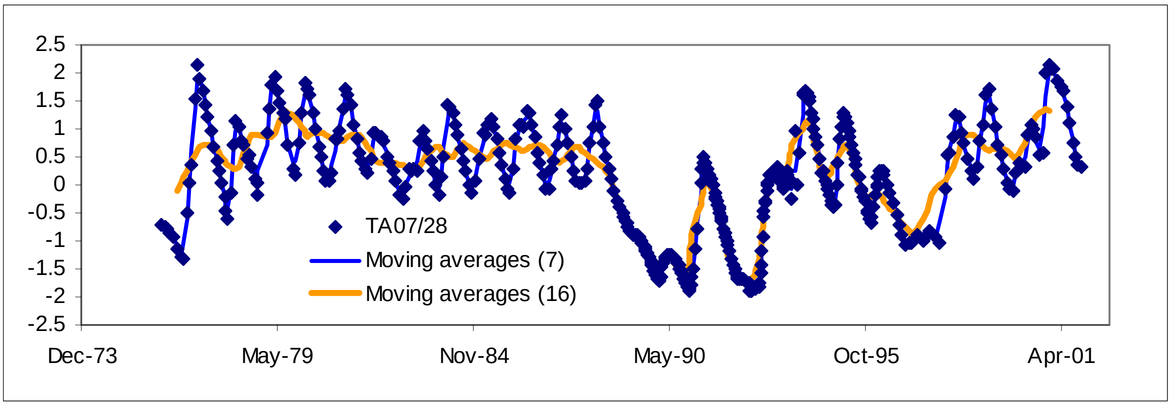
TA06/16
Linear (TA06/16)
y = -0.0001x + 22.986
R² = 0.0425
Water level mAOD
35.0
30.0
25.0
20.0
15.0
10.0
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

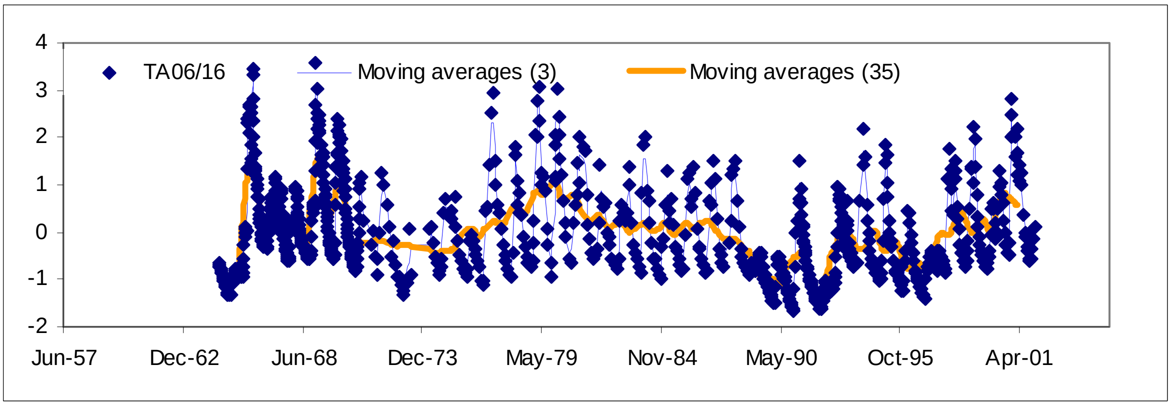


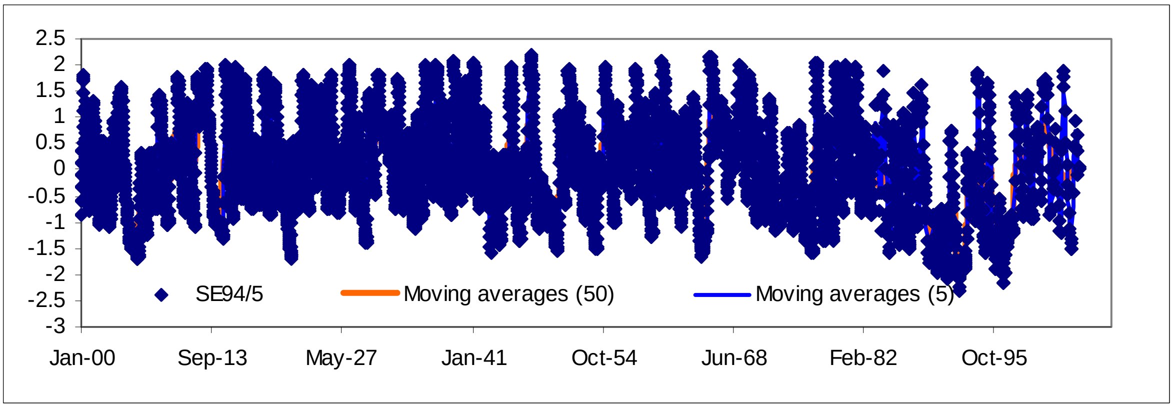
TA10/6
Linear (TA10/6)
y = -5E-05x + 17.256
R² = 0.0078
Water level mAOD
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
May-27
Jan-41
Oct-54
Jun-68
Feb-82
Oct-95
Jul-09

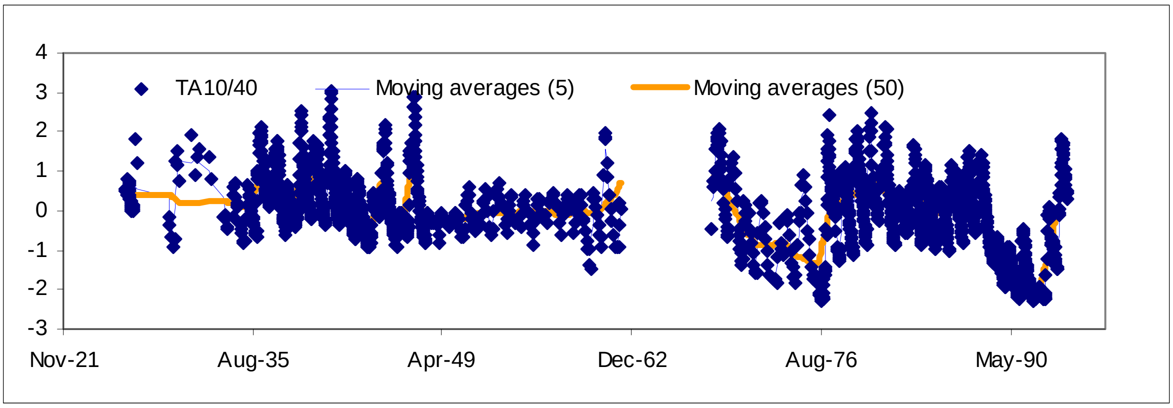
NORMALISED WATER LEVEL DATA WITH MOVING AVERAGES SMOOTHING LINES

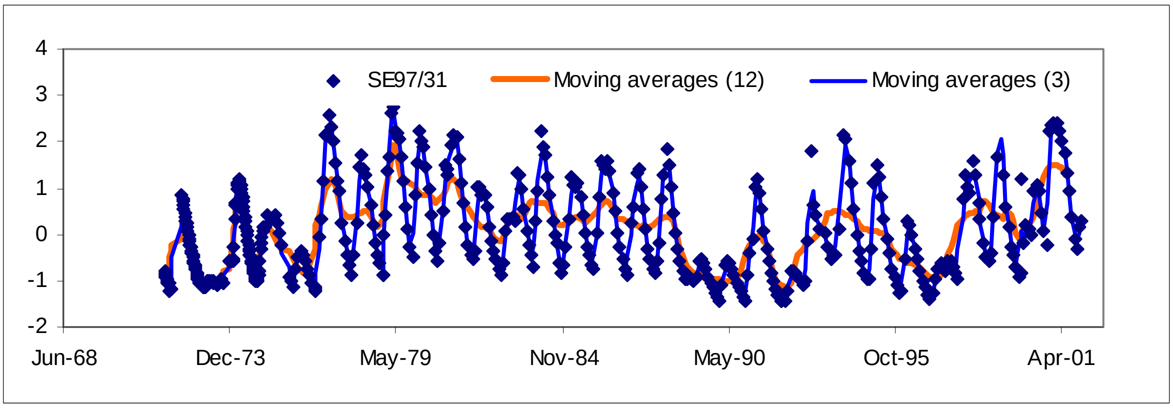


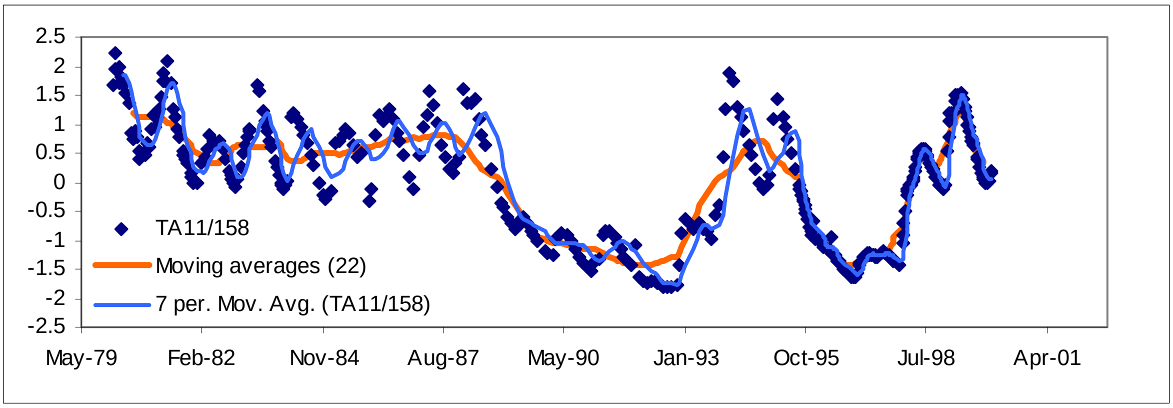


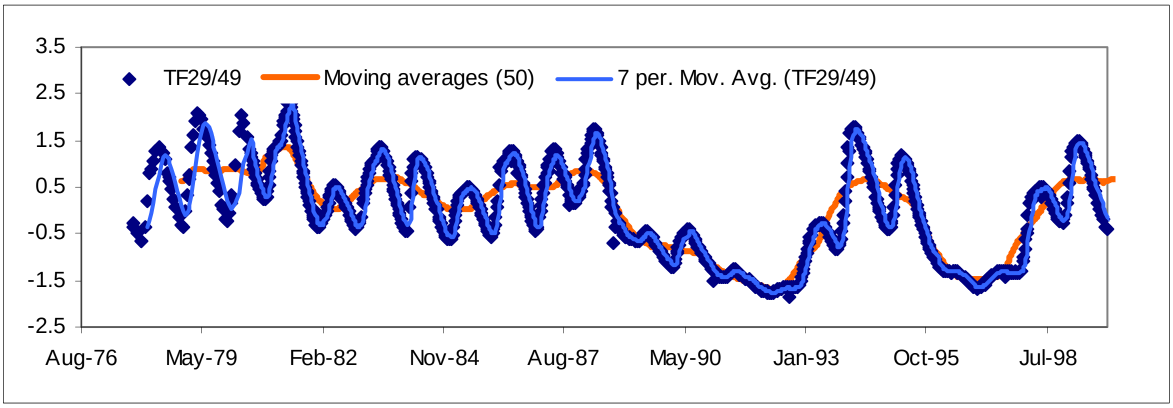


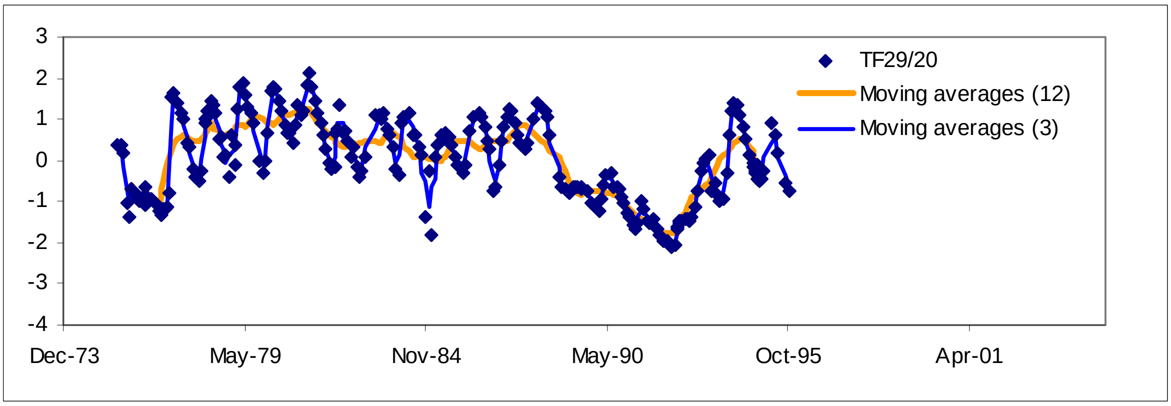


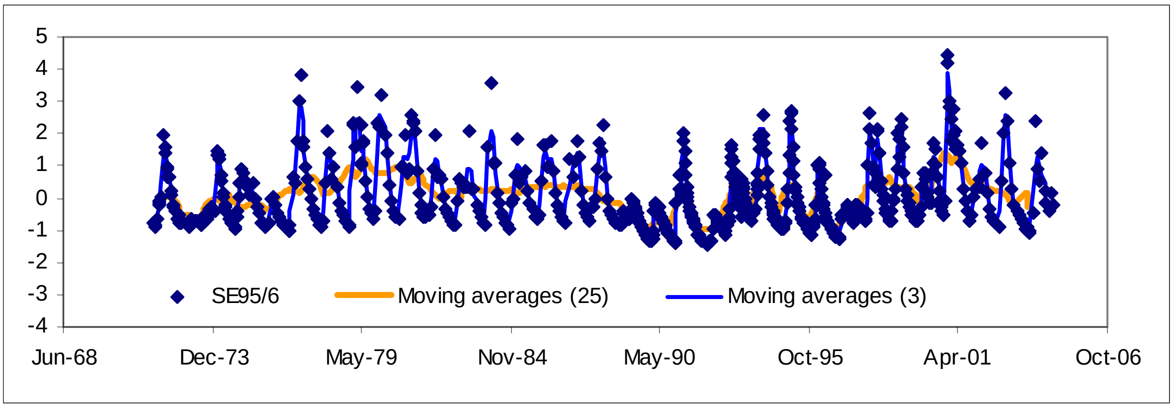

TA10/40
Moving averages (5)
Moving averages (50)
4
3
2
1
0
-1
-2
-3
Nov-21
Aug-35
Apr-49
Dec-62
Aug-76
May-90

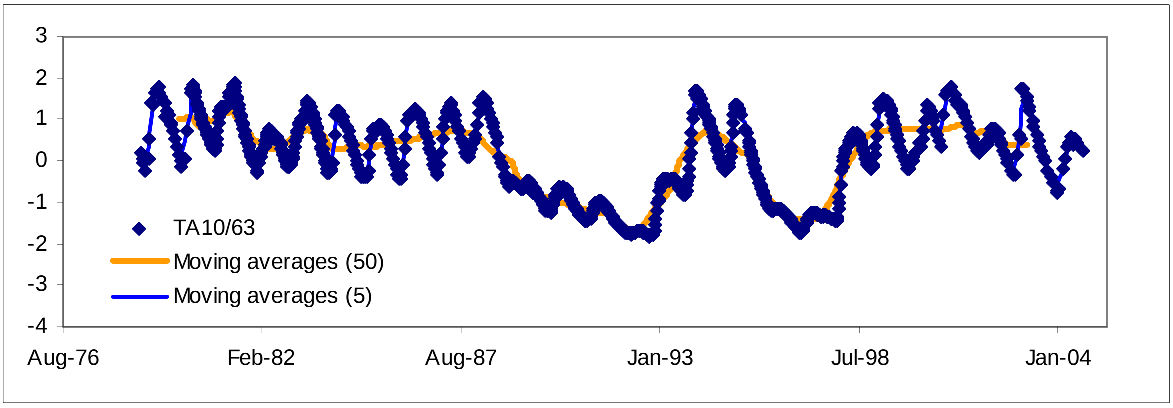

SE97/31
Moving averages (12)
Moving averages (3)
4
3
2
1
0
-1
-2
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

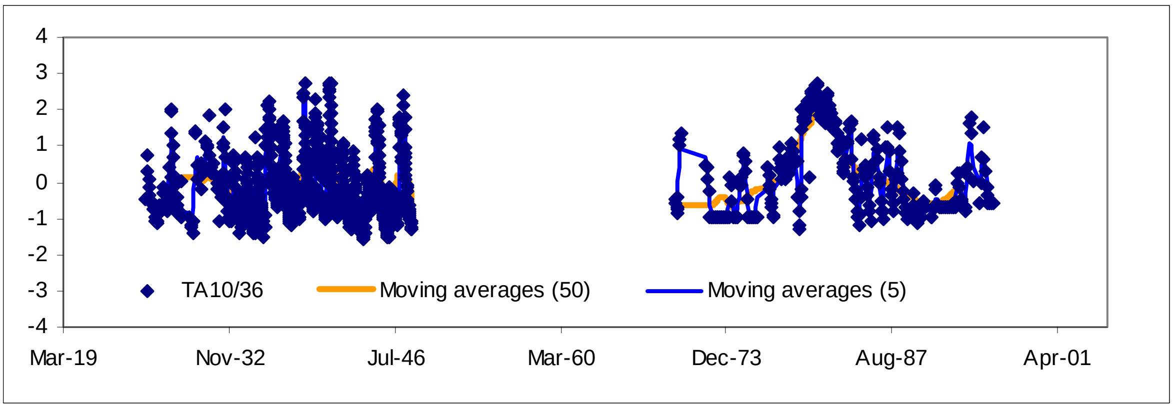

TA11/158
Moving averages (22)
7 per. Mov. Avg. (TA11/158)
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95
Jul-98
Apr-01

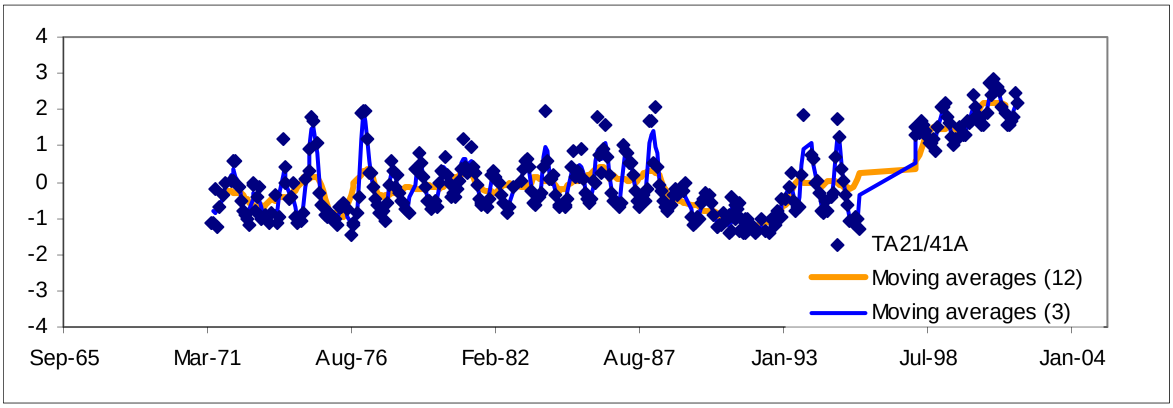

TF29/49
Moving averages (50)
7 per. Mov. Avg. (TF29/49)
3.5
2.5
1.5
0.5
-0.5
-1.5
-2.5
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95
Jul-98

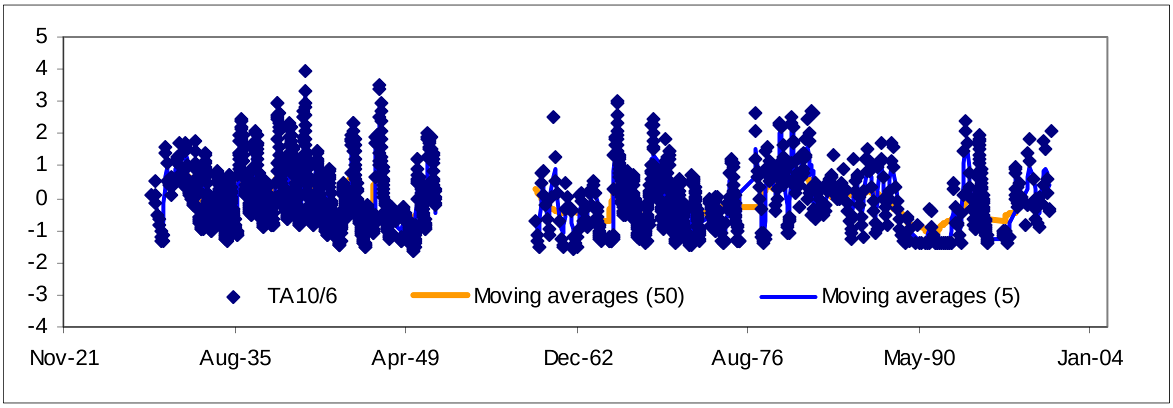

3
2
1
0
-1
-2
-3
-4
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
TF29/20
Moving averages (12)
Moving averages (3)


5
4
3
2
1
0
-1
-2
-3
-4
SE95/6
Moving averages (25)
Moving averages (3)
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

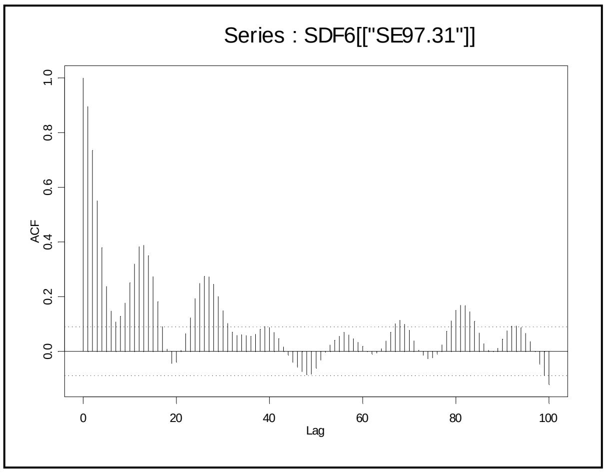

3
2
1
0
-1
-2
-3
-4
TA10/63
Moving averages (50)
Moving averages (5)
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

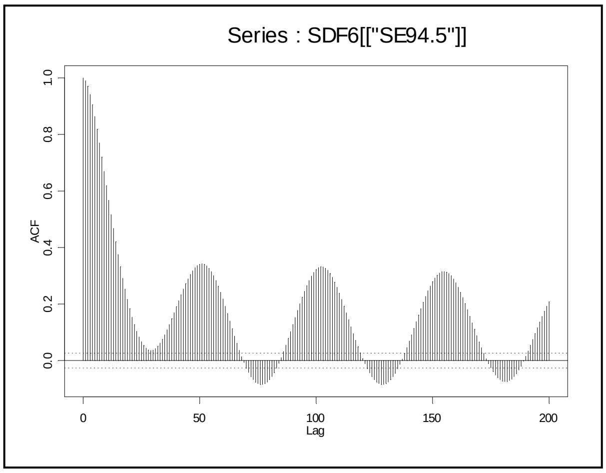

4
3
2
1
0
-1
-2
-3
-4
TA10/36
Moving averages (50)
Moving averages (5)
Mar-19
Nov-32
Jul-46
Mar-60
Dec-73
Aug-87
Apr-01

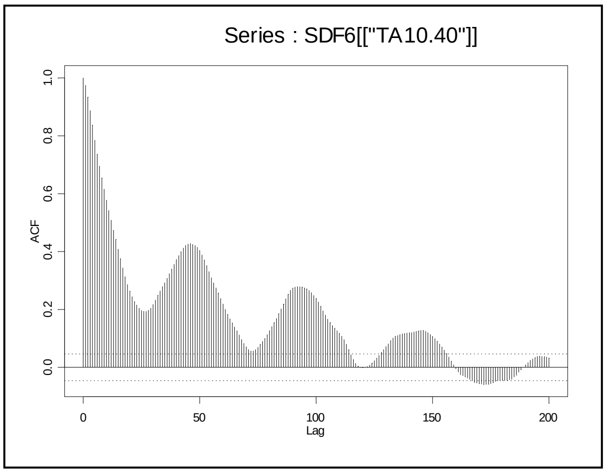

4
3
2
1
0
-1
-2
-3
-4
TA21/41A
Moving averages (12)
Moving averages (3)
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

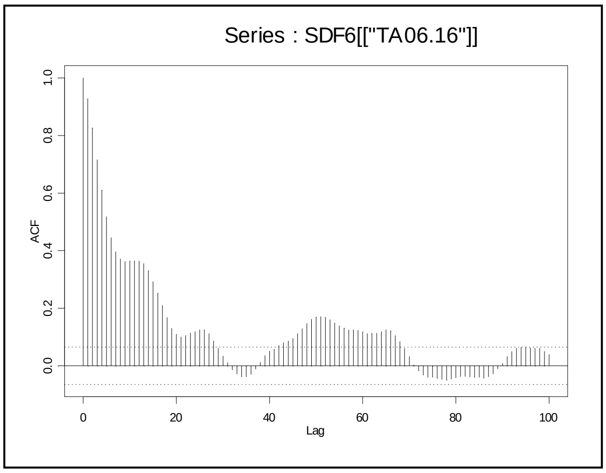

5
4
3
2
1
0
-1
-2
-3
-4
TA10/6
Moving averages (50)
Moving averages (5)
Nov-21
Aug-35
Apr-49
Dec-62
Aug-76
May-90
Jan-04

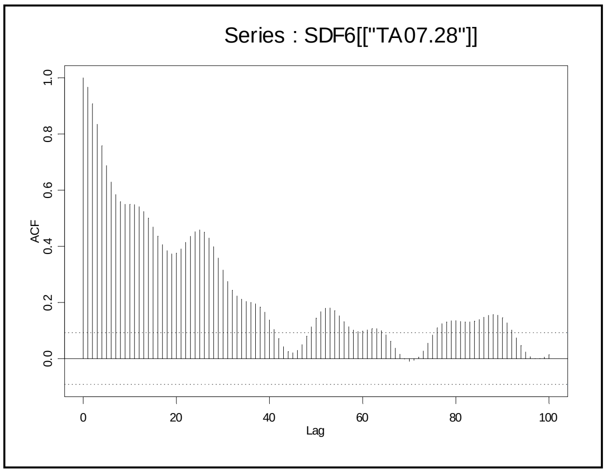
AUTOCORRELATION FUNTION PLOTS

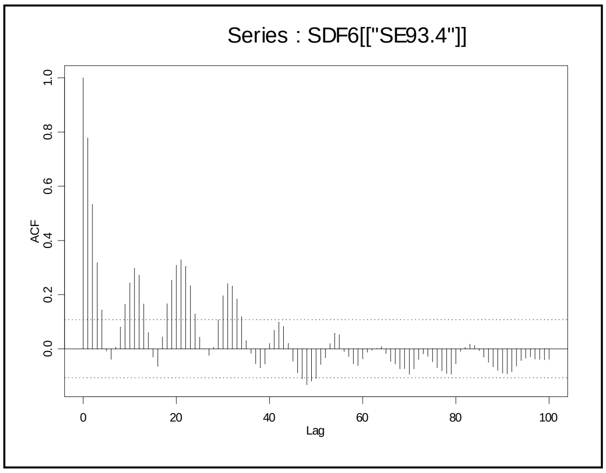


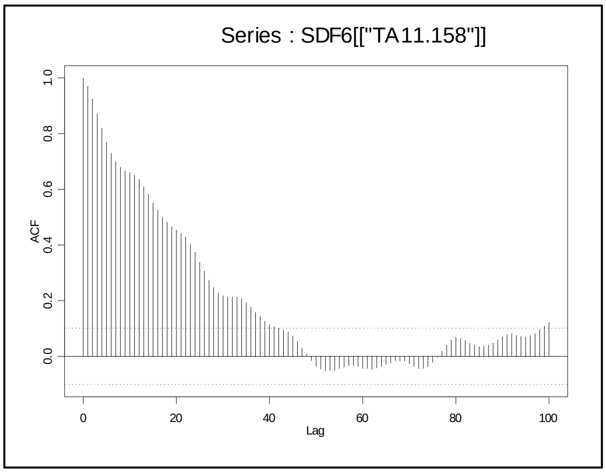


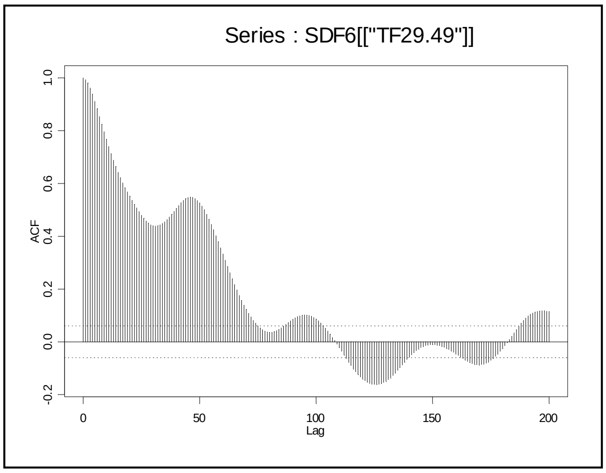









Series : SDF6[["TA11.158"]]
ACF
Lag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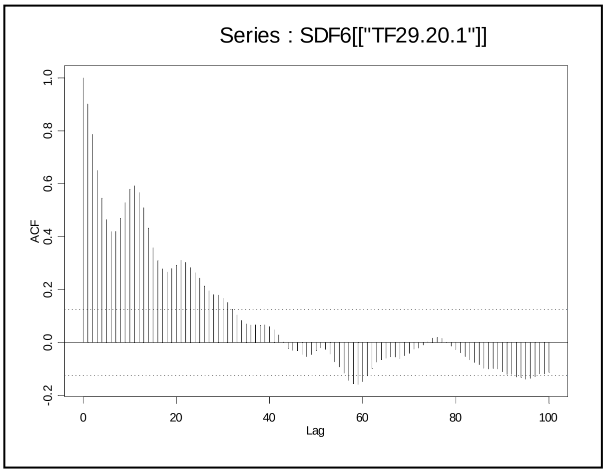
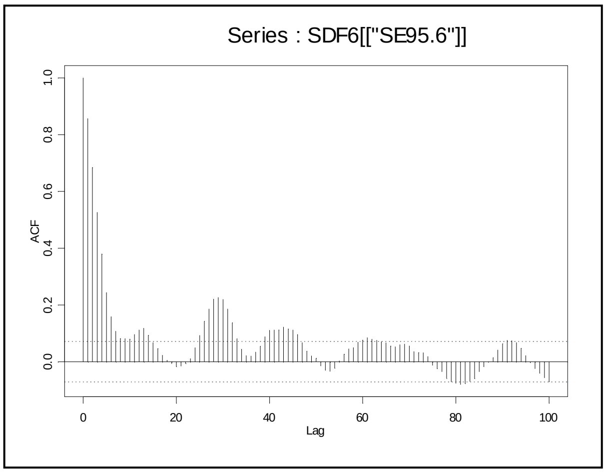
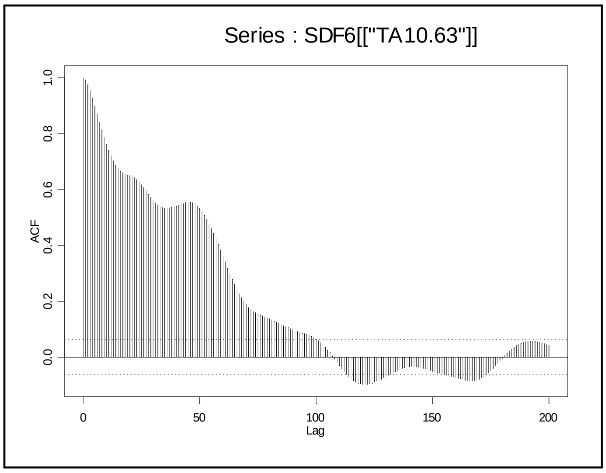
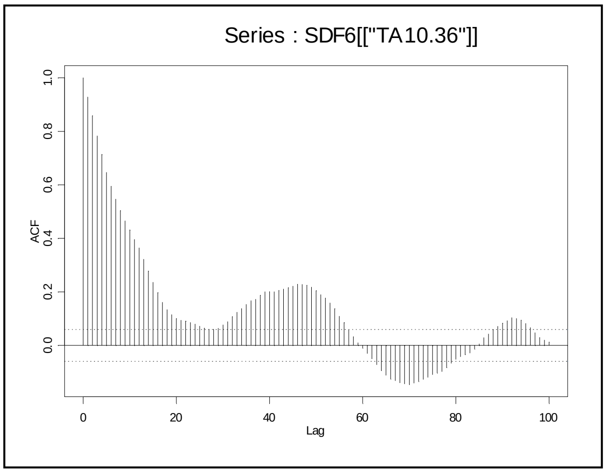
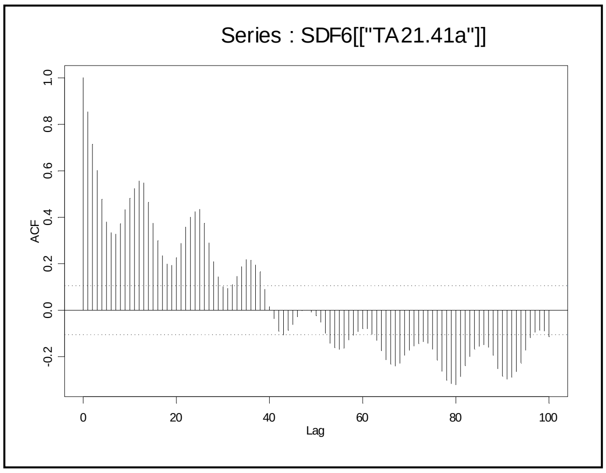
ACF
Lag

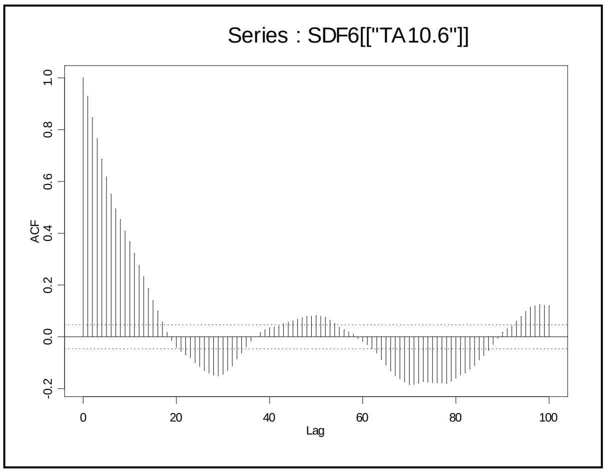

Series : SDF6[["TF29.20.1"]]
ACF
Lag


Series : SDF6[["SE95.6"]]
ACF
Lag

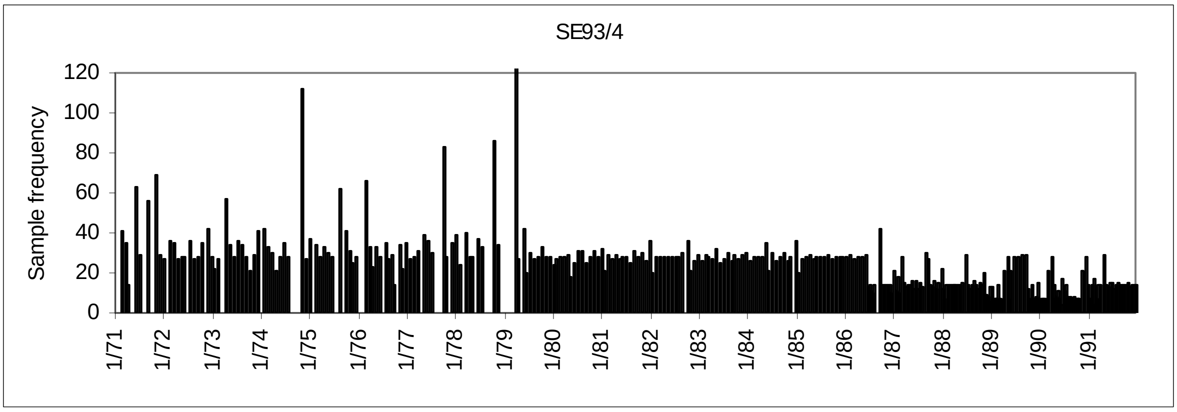

Series : SDF6[["TA10.63"]]
ACF
Lag

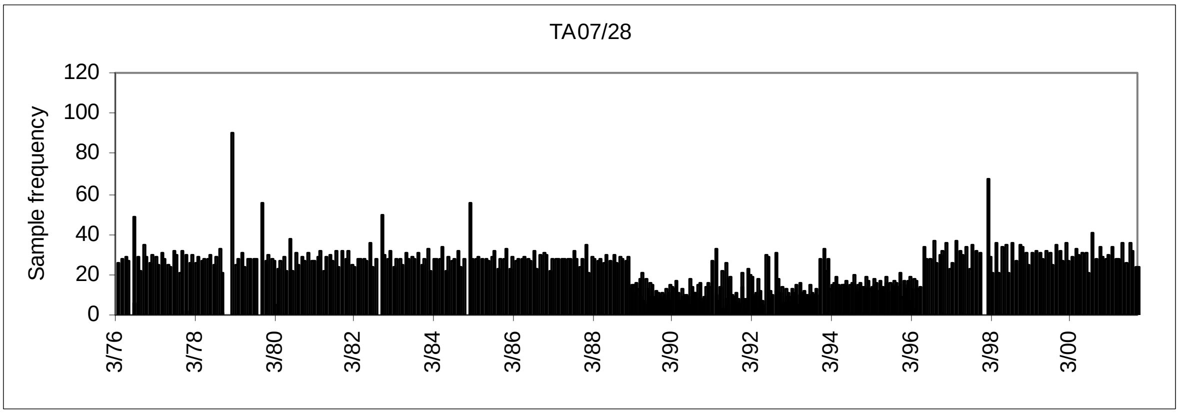

Series : SDF6[["TA10.36"]]
ACF
Lag

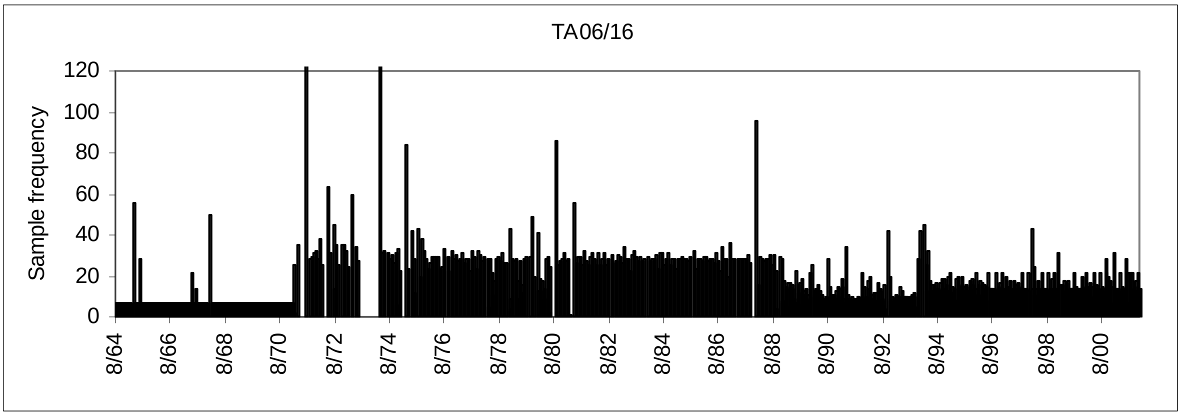

Series : SDF6[["TA21.41a"]]
ACF
Lag

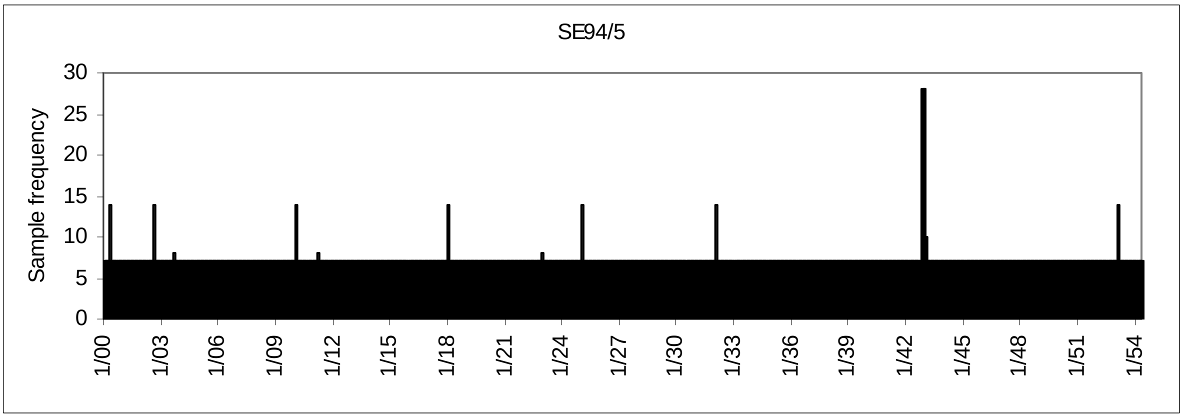

Series : SDF6[["TA10.6"]]
ACF
Lag

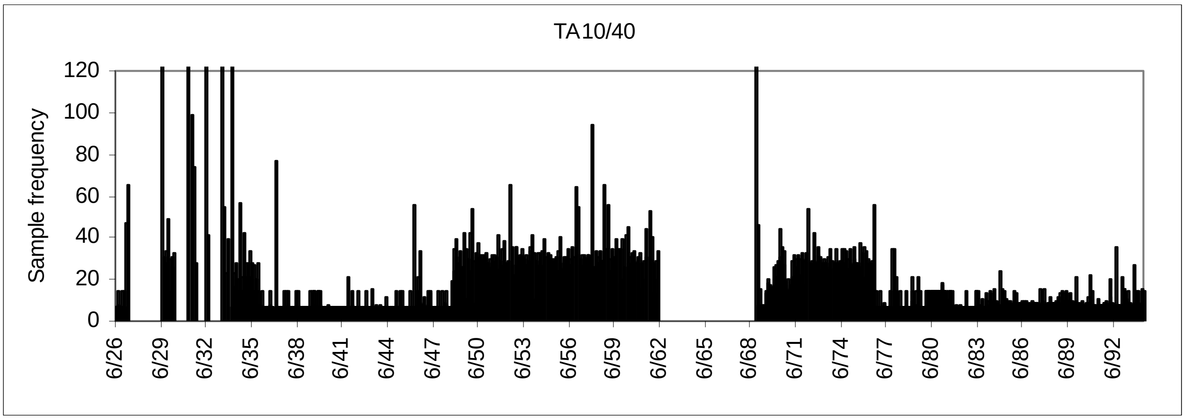
SAMPLE FREQUENCY PLOTS

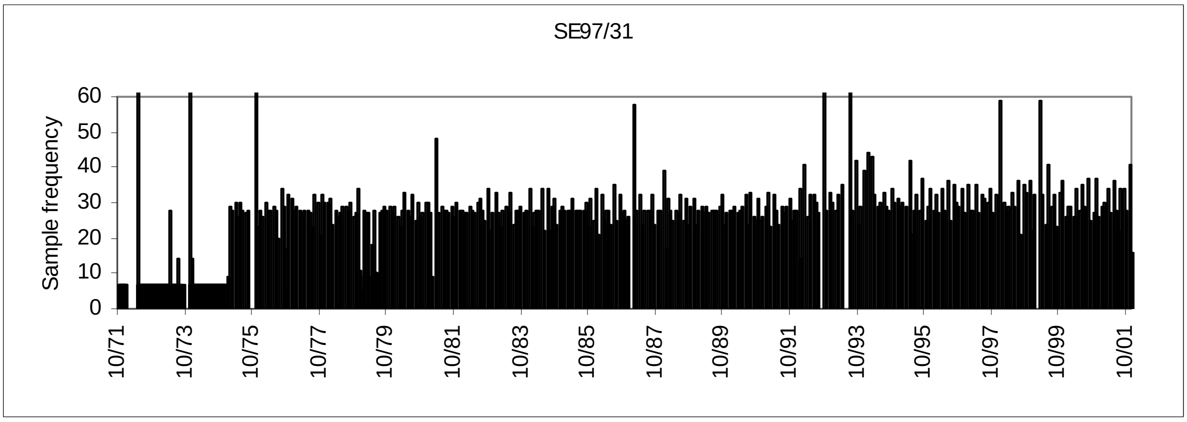


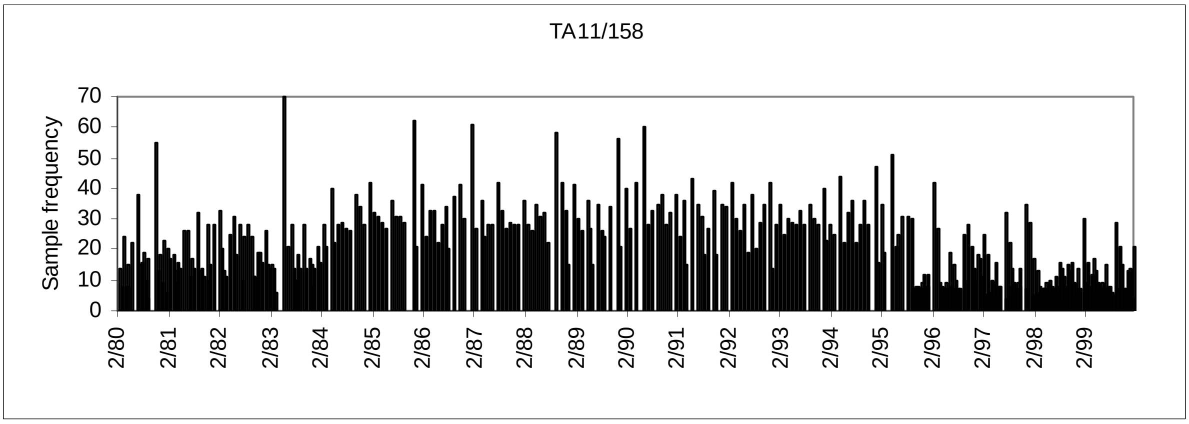


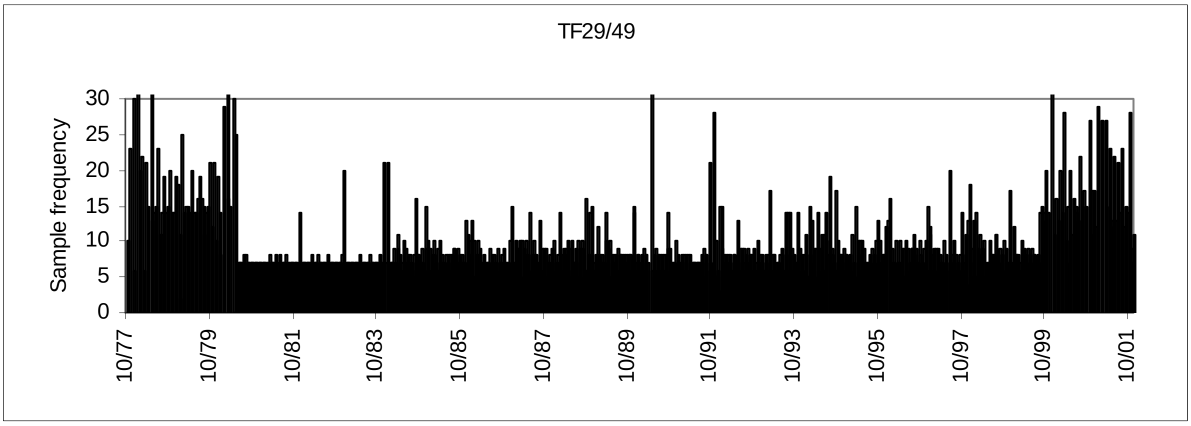


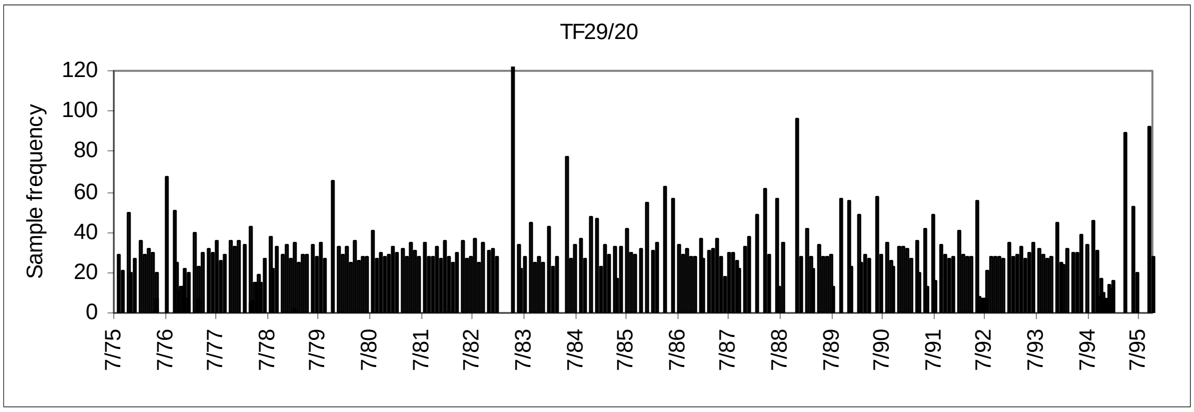


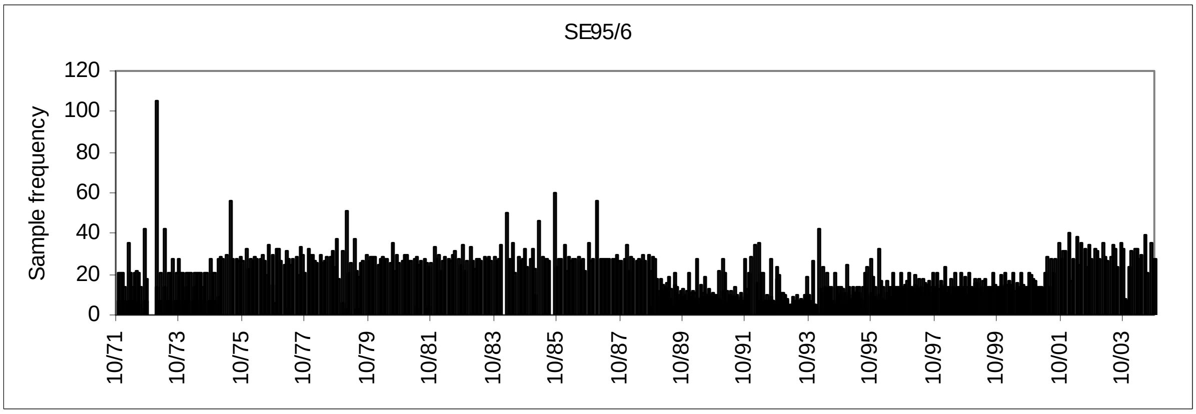

TA10/40
Sample frequency
120
100
80
60
40
20
0
6/26
6/29
6/32
6/35
6/38
6/41
6/44
6/47
6/50
6/53
6/56
6/59
6/62
6/65
6/68
6/71
6/74
6/77
6/80
6/83
6/86
6/89
6/92

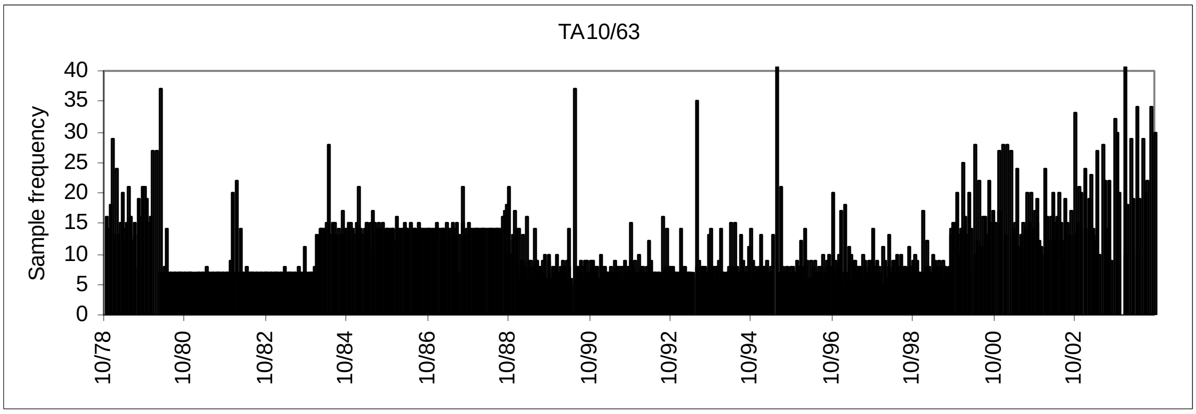

SE97/31
Sample frequency
60
50
40
30
20
10
0
10/71
10/73
10/75
10/77
10/79
10/81
10/83
10/85
10/87
10/89
10/91
10/93
10/95
10/97
10/99
10/01

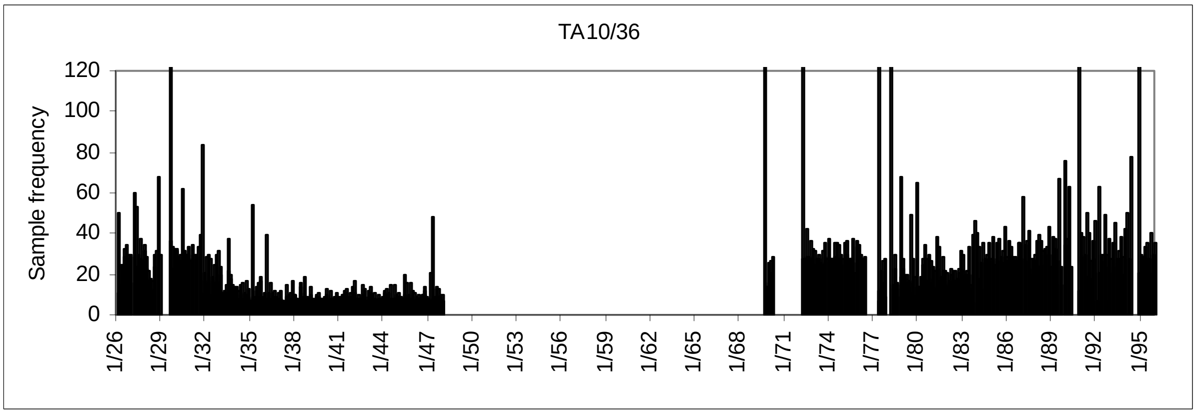

TA11/158
Sample frequency
70
60
50
40
30
20
10
0
2/80
2/81
2/82
2/83
2/84
2/85
2/86
2/87
2/88
2/89
2/90
2/91
2/92
2/93
2/94
2/95
2/96
2/97
2/98
2/99

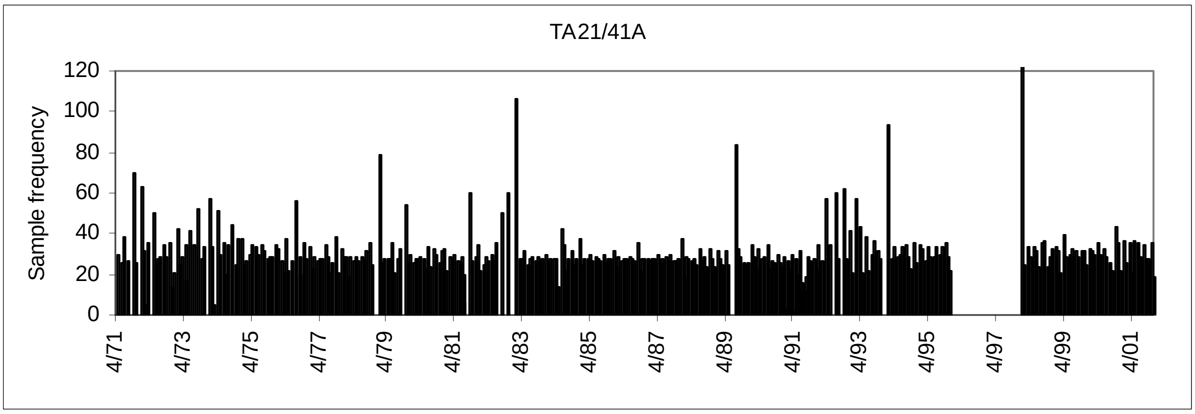

TF29/49
Sample frequency
30
25
20
15
10
5
0
10/77
10/79
10/81
10/83
10/85
10/87
10/89
10/91
10/93
10/95
10/97
10/99
10/01

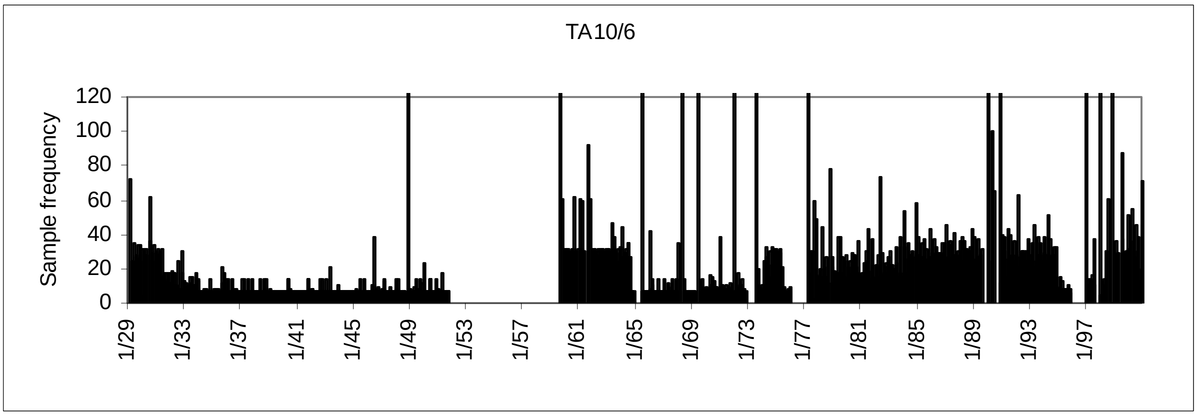

TF29/20
Sample frequency
0
20
40
60
80
100
120
7/75
7/76
7/77
7/78
7/79
7/80
7/81
7/82
7/83
7/84
7/85
7/86
7/87
7/88
7/89
7/90
7/91
7/92
7/93
7/94
7/95


SE95/6
Sample frequency
0
20
40
60
80
100
120
10/71
10/73
10/75
10/77
10/79
10/81
10/83
10/85
10/87
10/89
10/91
10/93
10/95
10/97
10/99
10/01
10/03


TA10/63
Sample frequency
0
5
10
15
20
25
30
35
40
10/78
10/80
10/82
10/84
10/86
10/88
10/90
10/92
10/94
10/96
10/98
10/00
10/02


TA10/36
Sample frequency
0
20
40
60
80
100
120
1/26
1/29
1/32
1/35
1/38
1/41
1/44
1/47
1/50
1/53
1/56
1/59
1/62
1/65
1/68
1/71
1/74
1/77
1/80
1/83
1/86
1/89
1/92
1/95


TA21/41A
120
100
80
60
40
20
0
Sample frequency
4/71
4/73
4/75
4/77
4/79
4/81
4/83
4/85
4/87
4/89
4/91
4/93
4/95
4/97
4/99
4/01


TA10/6
120
100
80
60
40
20
0
Sample frequency
1/29
1/33
1/37
1/41
1/45
1/49
1/53
1/57
1/61
1/65
1/69
1/73
1/77
1/81
1/85
1/89
1/93
1/97

WELLMASTER LOOK-UP TABLE

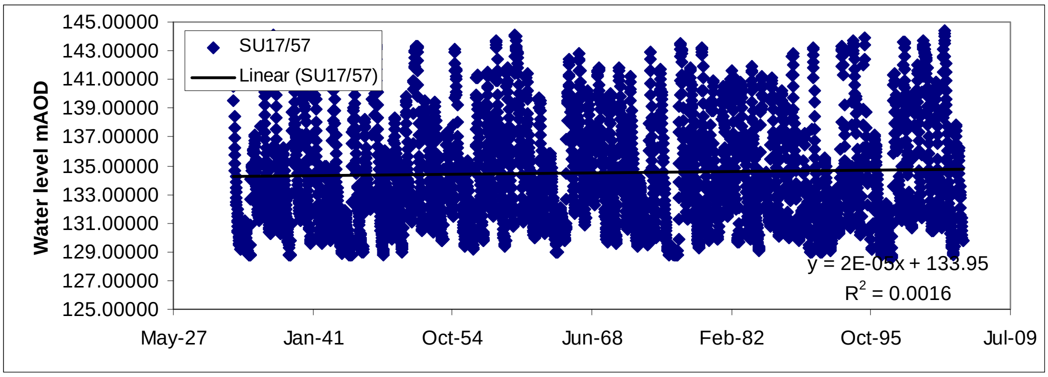
Feb	1965	**Very low**
Mar	1965	**Very low**
Apr	1965	**Very low**
May	1965	**Very low**
Jun	1965	**Very low**
Jul	1965	**Very low**
Aug	1965	**Very low**
Sep	1965	**Very low**
Oct	1965	**Low**
Nov	1965	**Average**
Dec	1965	**Very high**
Jan	1966	**Very high**
Feb	1966	**Very high**
Mar	1966	**Very high**
Apr	1966	**Very high**
May	1966	**Very high**
Jun	1966	**High**
Jul	1966	**High**
Aug	1966	**Average**
Sep	1966	**Average**
Oct	1966	**Average**
Nov	1966	**Average**
Dec	1966	**High**
Jan	1967	**Very high**
Feb	1967	**High**
Mar	1967	**High**
Apr	1967	**High**
May	1967	**High**
Jun	1967	**High**
Jul	1967	**High**
Aug	1967	**Average**
Sep	1967	**Low**
Oct	1967	**Low**
Nov	1967	**Low**
Dec	1967	**Low**
Jan	1968	**High**
Feb	1968	**High**
Mar	1968	**High**
Apr	1968	**High**
May	1968	**Average**
Jun	1968	**Average**
Jul	1968	**Average**
Aug	1968	**Average**
Sep	1968	**Low**
Oct	1968	**Average**
Nov	1968	**High**
Dec	1968	**Very high**
Jan	1969	**Very high**
Feb	1969	**Very high**
Mar	1969	**Very high**
Apr	1969	**Very high**
May	1969	**Very high**
Jun	1969	**Very high**
Jul	1969	**High**
Aug	1969	**High**
Sep	1969	**Average**
Oct	1969	**Low**
Nov	1969	**Low**
Dec	1969	**High**
Jan	1970	**Very high**
Feb	1970	**Very high**
Mar	1970	**Very high**
Apr	1970	**Very high**
May	1970	**Very high**
Jun	1970	**High**
Jul	1970	**Average**
Aug	1970	**Average**
Sep	1970	**Low**
Oct	1970	**Very low**
Nov	1970	**Very low**
Dec	1970	**Very low**
Jan	1971	**Average**
Feb	1971	**High**
Mar	1971	**High**
Apr	1971	**Average**
May	1971	**Average**
Jun	1971	**Average**
Jul	1971	**Low**
Aug	1971	**Low**
Sep	1971	**Low**
Oct	1971	**Low**
Nov	1971	**Very low**
Dec	1971	**Low**
Jan	1972	**Low**
Feb	1972	**High**
Mar	1972	**Very high**
Apr	1972	**Very high**
May	1972	**High**
Jun	1972	**High**
Jul	1972	**Average**
Aug	1972	**Low**
Sep	1972	**Low**
Oct	1972	**Very low**
Nov	1972	**Very low**
Dec	1972	**Very low**
Jan	1973	**Very low**
Feb	1973	**Very low**
Mar	1973	**Very low**
Apr	1973	**Very low**
May	1973	**Very low**
Jun	1973	**Very low**
Jul	1973	**Very low**
Aug	1973	**Low**
Sep	1973	**Low**
Oct	1973	**Low**
Nov	1973	**Low**
Dec	1973	**Low**
Jan	1974	**Average**
Feb	1974	**High**
Mar	1974	**High**
Apr	1974	**High**
May	1974	**Average**
Jun	1974	**Average**
Jul	1974	**Low**
Aug	1974	**Low**
Sep	1974	**Very low**
Oct	1974	**Very low**
Nov	1974	**Low**
Dec	1974	**Average**
Jan	1975	**High**
Feb	1975	**High**
Mar	1975	**High**
Apr	1975	**High**
May	1975	**High**
Jun	1975	**High**
Jul	1975	**Average**
Aug	1975	**Average**
Sep	1975	**Low**
Oct	1975	**Very low**
Nov	1975	**Very low**
Dec	1975	**Very low**
Jan	1976	**Very low**
Feb	1976	**Very low**
Mar	1976	**Low**
Apr	1976	**Low**
May	1976	**Very low**
Jun	1976	**Very low**
Jul	1976	**Very low**
Aug	1976	**Very low**
Sep	1976	**Very low**
Oct	1976	**Very low**
Nov	1976	**Very low**
Dec	1976	**Low**
Jan	1977	**High**
Feb	1977	**Very high**
Mar	1977	**Very high**
Apr	1977	**Very high**
May	1977	**Very high**
Jun	1977	**High**
Jul	1977	**High**
Aug	1977	**Average**
Sep	1977	**Low**
Oct	1977	**Low**
Nov	1977	**Very low**
Dec	1977	**Very low**
Jan	1978	**Low**
Feb	1978	**High**
Mar	1978	**Very high**
Apr	1978	**Very high**
May	1978	**Very high**
Jun	1978	**High**
Jul	1978	**High**
Aug	1978	**Average**
Sep	1978	**Average**
Oct	1978	**Low**
Nov	1978	**Low**
Dec	1978	**Low**
Jan	1979	**High**

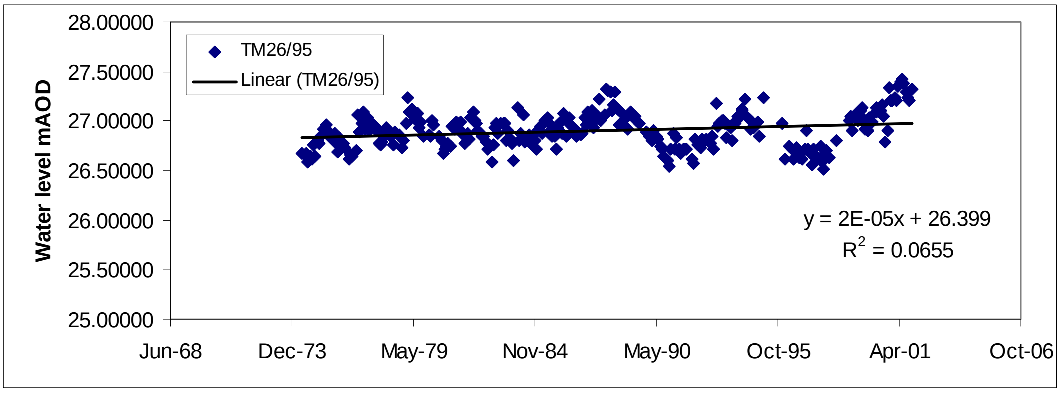
Feb	1979	**Very high**
Mar	1979	**Very high**
Apr	1979	**Very high**
May	1979	**Very high**
Jun	1979	**Very high**
Jul	1979	**Very high**
Aug	1979	**High**
Sep	1979	**High**
Oct	1979	**Average**
Nov	1979	**Low**
Dec	1979	**Average**
Jan	1980	**High**
Feb	1980	**Very high**
Mar	1980	**Very high**
Apr	1980	**Very high**
May	1980	**Very high**
Jun	1980	**High**
Jul	1980	**High**
Aug	1980	**High**
Sep	1980	**Average**
Oct	1980	**Average**
Nov	1980	**High**
Dec	1980	**Very high**
Jan	1981	**Very high**
Feb	1981	**Very high**
Mar	1981	**Very high**
Apr	1981	**Very high**
May	1981	**Very high**
Jun	1981	**Very high**
Jul	1981	**Very high**
Aug	1981	**High**
Sep	1981	**Average**
Oct	1981	**Average**
Nov	1981	**Average**
Dec	1981	**Low**
Jan	1982	**Average**
Feb	1982	**High**
Mar	1982	**High**
Apr	1982	**High**
May	1982	**High**
Jun	1982	**High**
Jul	1982	**Average**
Aug	1982	**Average**
Sep	1982	**Average**
Oct	1982	**Low**
Nov	1982	**Low**
Dec	1982	**Average**
Jan	1983	**High**
Feb	1983	**High**
Mar	1983	**High**
Apr	1983	**High**
May	1983	**Very high**
Jun	1983	**Very high**
Jul	1983	**Very high**
Aug	1983	**High**
Sep	1983	**High**
Oct	1983	**Average**
Nov	1983	**Average**
Dec	1983	**Average**
Jan	1984	**High**
Feb	1984	**Very high**
Mar	1984	**Very high**
Apr	1984	**Very high**
May	1984	**High**
Jun	1984	**High**
Jul	1984	**Average**
Aug	1984	**Average**
Sep	1984	**Low**
Oct	1984	**Low**
Nov	1984	**Low**
Dec	1984	**Low**
Jan	1985	**Average**
Feb	1985	**High**
Mar	1985	**High**
Apr	1985	**High**
May	1985	**High**
Jun	1985	**High**
Jul	1985	**High**
Aug	1985	**Average**
Sep	1985	**Average**
Oct	1985	**Low**
Nov	1985	**Low**
Dec	1985	**Low**
Jan	1986	**High**
Feb	1986	**Very high**
Mar	1986	**Very high**
Apr	1986	**Very high**
May	1986	**Very high**
Jun	1986	**Very high**
Jul	1986	**High**
Aug	1986	**High**
Sep	1986	**Average**
Oct	1986	**Low**
Nov	1986	**Low**
Dec	1986	**Low**
Jan	1987	**Average**
Feb	1987	**High**
Mar	1987	**Very high**
Apr	1987	**Very high**
May	1987	**Very high**
Jun	1987	**High**
Jul	1987	**High**
Aug	1987	**Average**
Sep	1987	**Average**
Oct	1987	**Average**
Nov	1987	**Average**
Dec	1987	**Average**
Jan	1988	**High**
Feb	1988	**Very high**
Mar	1988	**Very high**
Apr	1988	**Very high**
May	1988	**Very high**
Jun	1988	**High**
Jul	1988	**High**
Aug	1988	**Average**
Sep	1988	**Low**
Oct	1988	**Low**
Nov	1988	**Low**
Dec	1988	**Low**
Jan	1989	**Very low**
Feb	1989	**Very low**
Mar	1989	**Very low**
Apr	1989	**Low**
May	1989	**Low**
Jun	1989	**Low**
Jul	1989	**Low**
Aug	1989	**Very low**
Sep	1989	**Very low**
Oct	1989	**Very low**
Nov	1989	**Very low**
Dec	1989	**Very low**
Jan	1990	**Very low**
Feb	1990	**Very low**
Mar	1990	**Very low**
Apr	1990	**Low**
May	1990	**Very low**
Jun	1990	**Very low**
Jul	1990	**Very low**
Aug	1990	**Very low**
Sep	1990	**Very low**
Oct	1990	**Very low**
Nov	1990	**Very low**
Dec	1990	**Very low**
Jan	1991	**Very low**
Feb	1991	**Very low**
Mar	1991	**Low**
Apr	1991	**Average**
May	1991	**Low**
Jun	1991	**Low**
Jul	1991	**Very low**
Aug	1991	**Very low**
Sep	1991	**Very low**
Oct	1991	**Very low**
Nov	1991	**Very low**
Dec	1991	**Very low**
Jan	1992	**Very low**
Feb	1992	**Very low**
Mar	1992	**Very low**
Apr	1992	**Very low**
May	1992	**Very low**
Jun	1992	**Very low**
Jul	1992	**Very low**
Aug	1992	**Very low**
Sep	1992	**Very low**
Oct	1992	**Very low**
Nov	1992	**Very low**
Dec	1992	**Low**
Jan	1993	**Average**

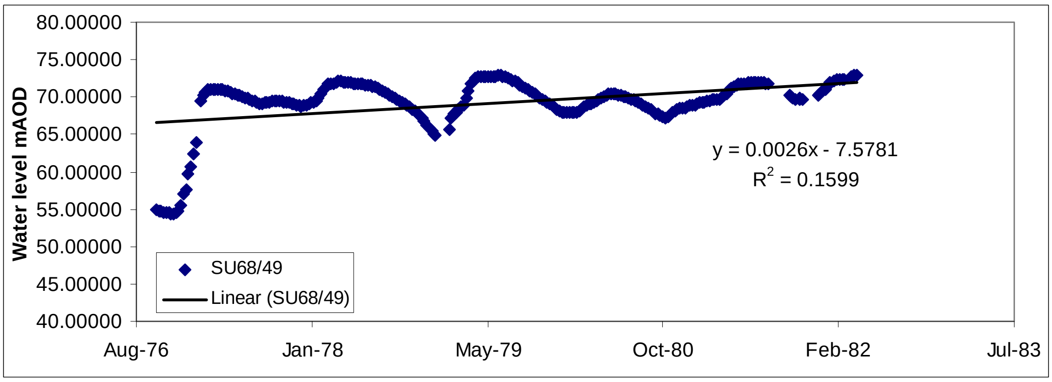
Feb	1993	**Average**
Mar	1993	**Average**
Apr	1993	**Average**
May	1993	**Average**
Jun	1993	**Average**
Jul	1993	**Low**
Aug	1993	**Low**
Sep	1993	**Low**
Oct	1993	**Low**
Nov	1993	**Low**
Dec	1993	**High**
Jan	1994	**Very high**
Feb	1994	**Very high**
Mar	1994	**Very high**
Apr	1994	**Very high**
May	1994	**High**
Jun	1994	**High**
Jul	1994	**Average**
Aug	1994	**Average**
Sep	1994	**Low**
Oct	1994	**Low**
Nov	1994	**Low**
Dec	1994	**Low**
Jan	1995	**Average**
Feb	1995	**Very high**
Mar	1995	**Very high**
Apr	1995	**Very high**
May	1995	**High**
Jun	1995	**High**
Jul	1995	**Average**
Aug	1995	**Low**
Sep	1995	**Low**
Oct	1995	**Low**
Nov	1995	**Very low**
Dec	1995	**Very low**
Jan	1996	**Very low**
Feb	1996	**Very low**
Mar	1996	**Low**
Apr	1996	**Low**
May	1996	**Low**
Jun	1996	**Very low**
Jul	1996	**Very low**
Aug	1996	**Very low**
Sep	1996	**Very low**
Oct	1996	**Very low**
Nov	1996	**Very low**
Dec	1996	**Very low**
Jan	1997	**Very low**
Feb	1997	**Very low**
Mar	1997	**Very low**
Apr	1997	**Very low**
May	1997	**Very low**
Jun	1997	**Very low**
Jul	1997	**Very low**
Aug	1997	**Very low**
Sep	1997	**Very low**
Oct	1997	**Very low**
Nov	1997	**Very low**
Dec	1997	**Very low**
Jan	1998	**Average**
Feb	1998	**High**
Mar	1998	**High**
Apr	1998	**High**
May	1998	**Very high**
Jun	1998	**High**
Jul	1998	**High**
Aug	1998	**High**
Sep	1998	**Average**
Oct	1998	**Average**
Nov	1998	**Average**
Dec	1998	**Average**
Jan	1999	**High**
Feb	1999	**Very high**
Mar	1999	**Very high**
Apr	1999	**Very high**
May	1999	**Very high**
Jun	1999	**High**
Jul	1999	**High**
Aug	1999	**Average**
Sep	1999	**Average**
Oct	1999	**Average**
Nov	1999	**Average**
Dec	1999	**Average**
Jan	2000	**High**
Feb	2000	**High**
Mar	2000	**High**
Apr	2000	**High**
May	2000	**Very high**
Jun	2000	**Very high**
Jul	2000	**Very high**
Aug	2000	**High**
Sep	2000	**Average**
Oct	2000	**Average**
Nov	2000	**Very high**
Dec	2000	**Very high**
Jan	2001	**Very high**
Feb	2001	**Very high**
Mar	2001	**Very high**
Apr	2001	**Very high**
May	2001	**Very high**
Jun	2001	**Very high**
Jul	2001	**High**
Aug	2001	**High**
Sep	2001	**Average**
Oct	2001	**Average**
Nov	2001	**Average**
Dec	2001	**High**
Jan	2002	**High**
Feb	2002	**High**
Mar	2002	**High**
Apr	2002	**High**
May	2002	**High**
Jun	2002	**Average**
Jul	2002	**Average**
Aug	2002	**Low**
Sep	2002	**Low**
Oct	2002	**Low**
Nov	2002	**Average**
Dec	2002	**Very high**
Jan	2003	**Very high**
Feb	2003	**Very high**
Mar	2003	**Very high**
Apr	2003	**Very high**
May	2003	**High**
Jun	2003	**Average**
Jul	2003	**Average**
Aug	2003	**Low**
Sep	2003	**Low**
Oct	2003	**Very low**
Nov	2003	**Very low**
Dec	2003	**Very low**
Jan	2004	**Low**
Feb	2004	**Average**
Mar	2004	**High**
Apr	2004	**High**
May	2004	**High**
Jun	2004	**High**

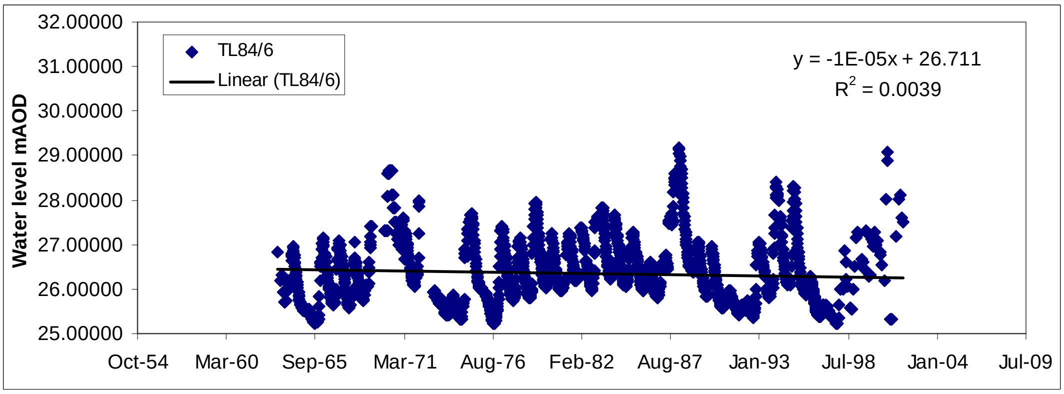
Appendix 8 Chalk – Berkshire Downs and East Anglia

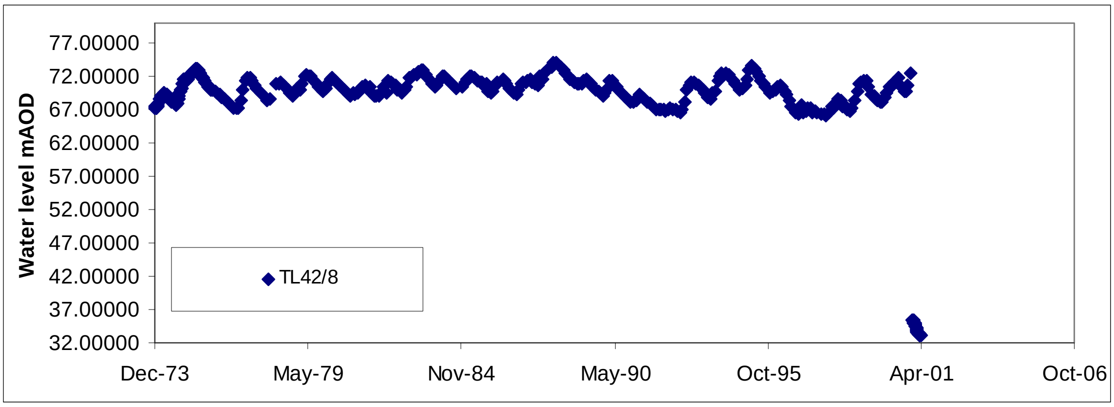
WATER LEVELS ABOVE ORDNANCE DATUM WITH LINEAR REGRESSION CURVE

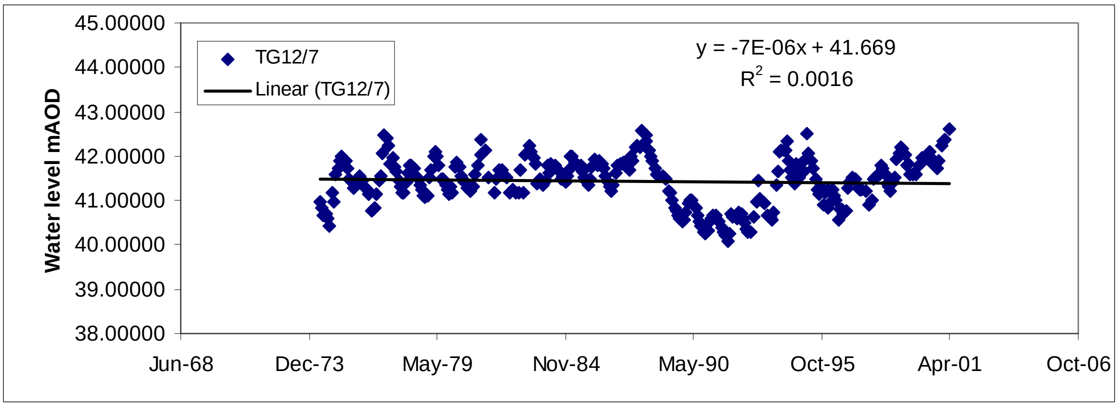


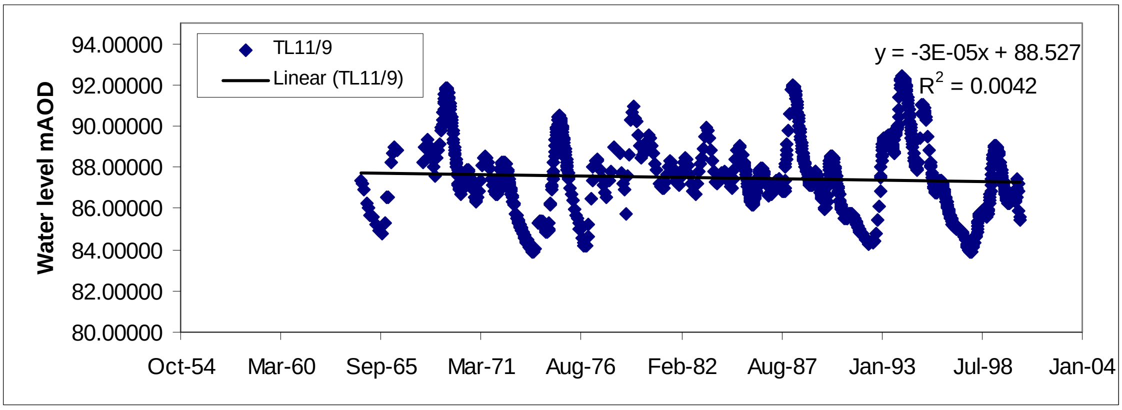


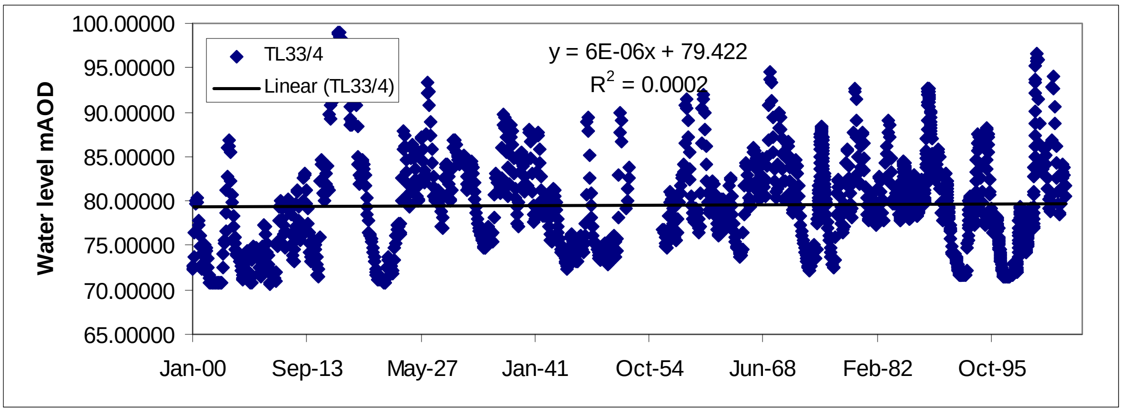


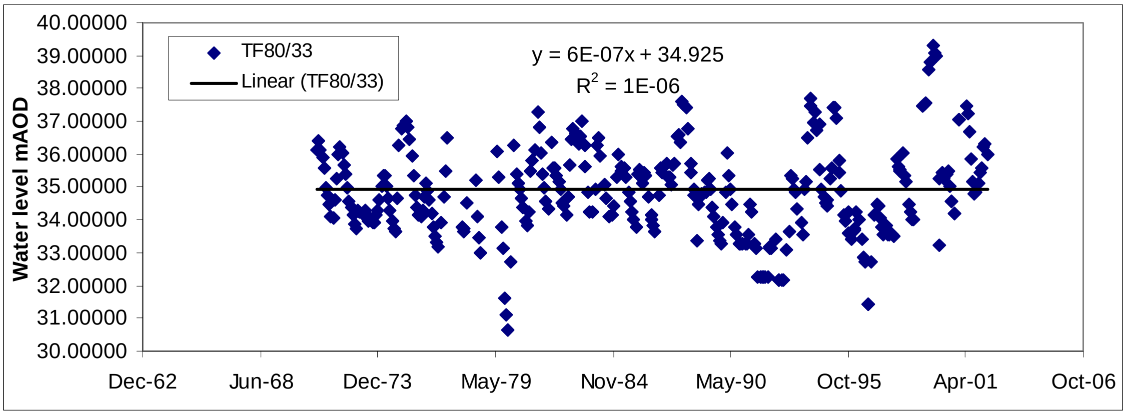


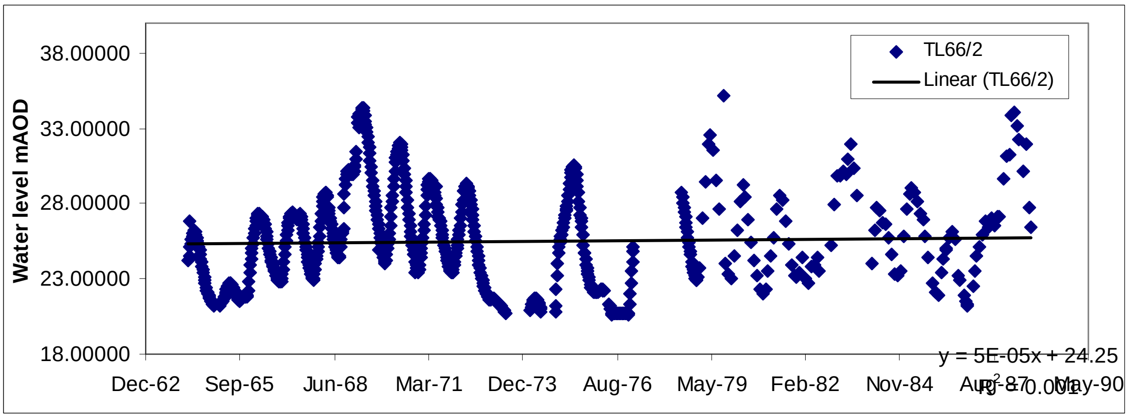

Water level mAOD
77.00000
72.00000
67.00000
62.00000
57.00000
52.00000
47.00000
42.00000
37.00000
32.00000
TL42/8
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06


Water level mAOD
45.00000
44.00000
43.00000
42.00000
41.00000
40.00000
39.00000
38.00000
TG12/7
Linear (TG12/7)
y = -7E-06x + 41.669
R2 = 0.0016
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

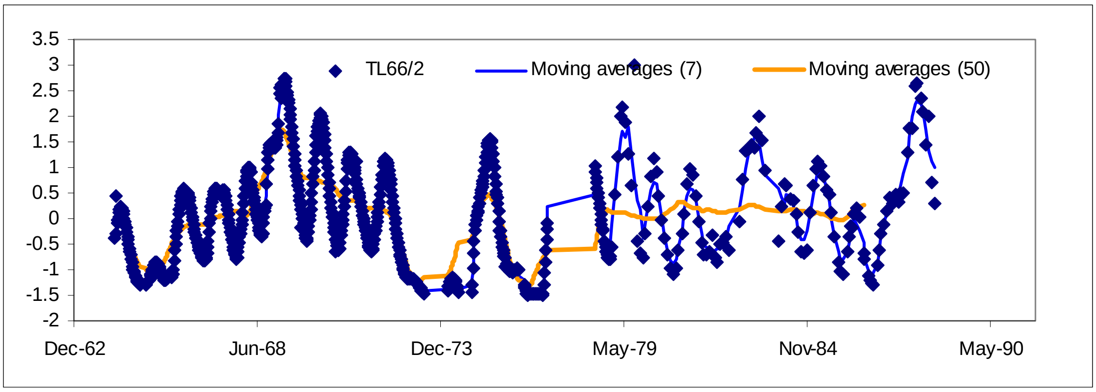

Water level mAOD
94.00000
92.00000
90.00000
88.00000
86.00000
84.00000
82.00000
80.00000
TL11/9
Linear (TL11/9)
y = -3E-05x + 88.527
R2 = 0.0042
Oct-54
Mar-60
Sep-65
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98
Jan-04

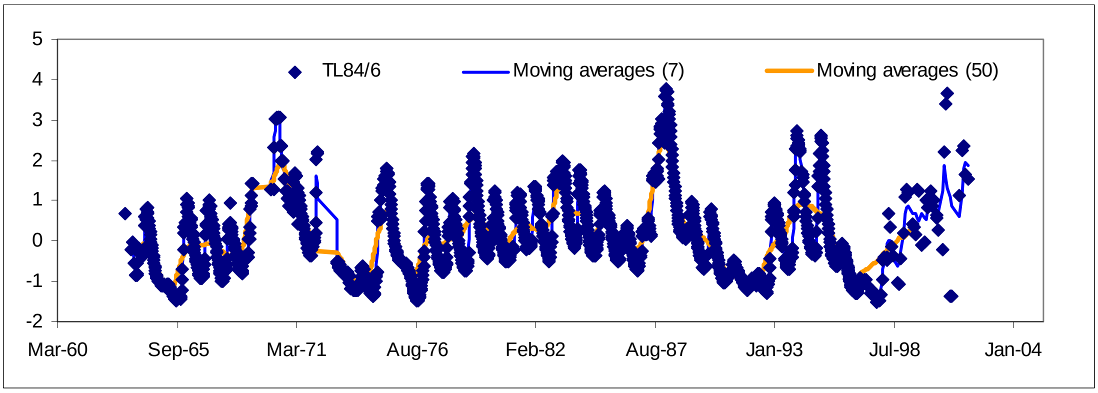

Water level mAOD
100.00000
95.00000
90.00000
85.00000
80.00000
75.00000
70.00000
65.00000
TL33/4
Linear (TL33/4)
y = 6E-06x + 79.422
R2 = 0.0002
Jan-00
Sep-13
May-27
Jan-41
Oct-54
Jun-68
Feb-82
Oct-95

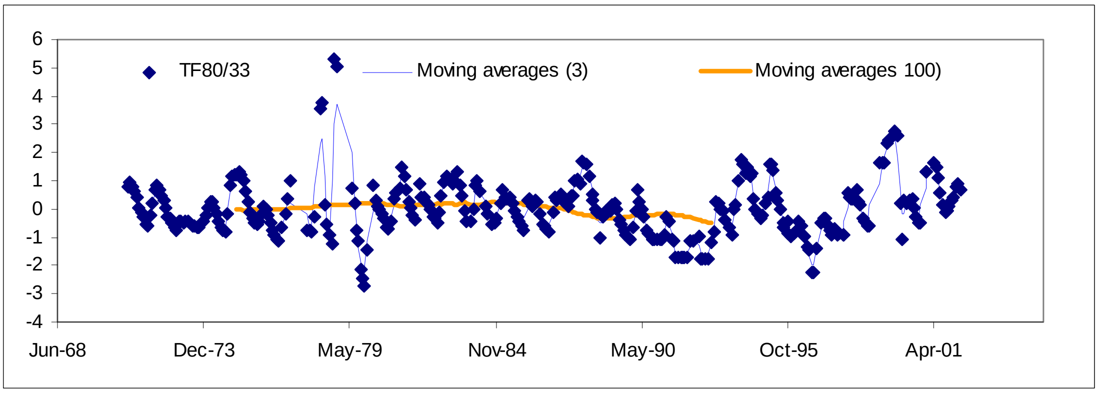

Water level mAOD
40.00000
39.00000
38.00000
37.00000
36.00000
35.00000
34.00000
33.00000
32.00000
31.00000
30.00000
TF80/33
Linear (TF80/33)
y = 6E-07x + 34.925
R2 = 1E-06
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

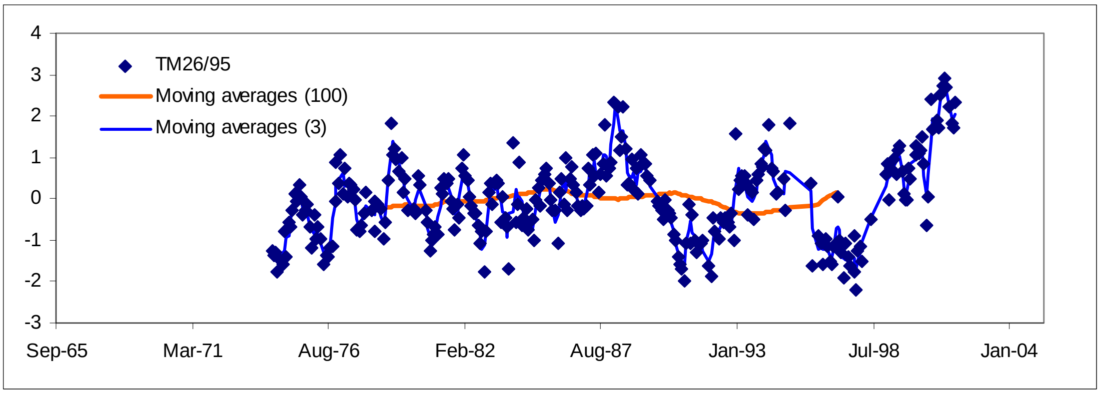

Water level mAOD
38.00000
33.00000
28.00000
23.00000
18.00000
TL66/2
Linear (TL66/2)
y = 5E-05x + 24.25
R2 = 0.001
Dec-62
Sep-65
Jun-68
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90

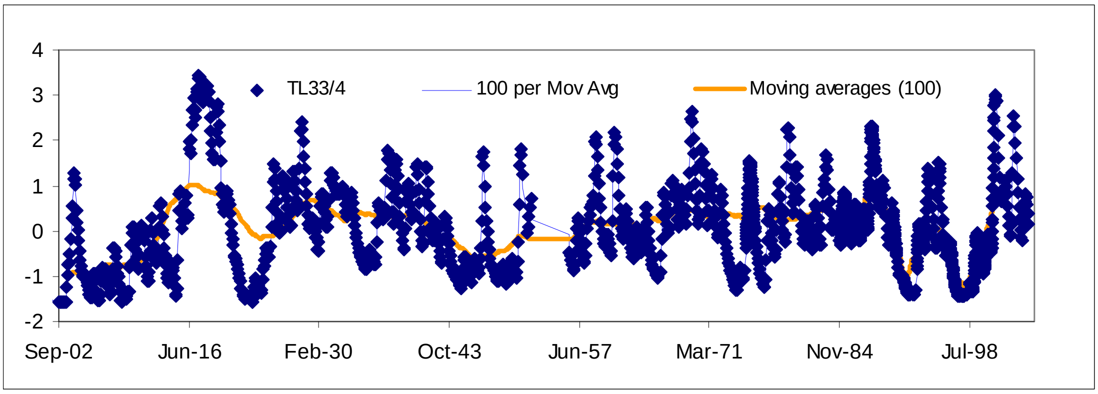
NORMALISED WATER LEVEL DATA WITH MOVING AVERAGES SMOOTHING LINES

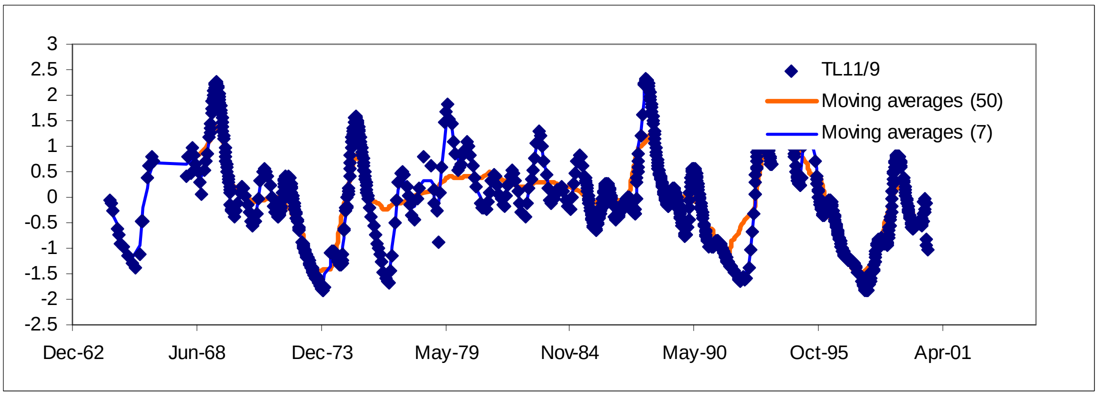


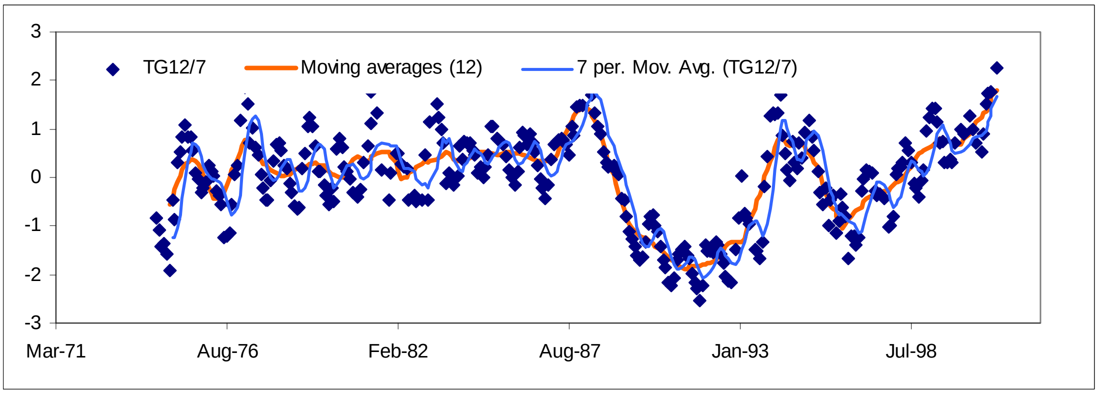


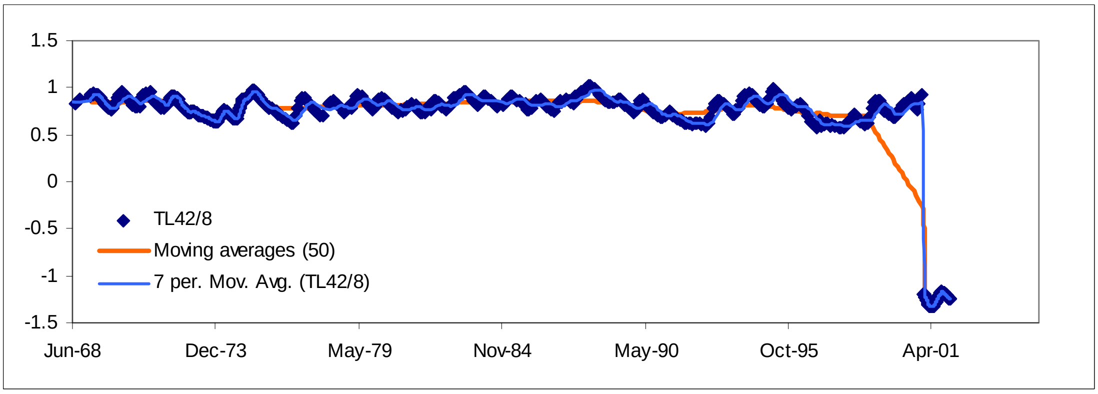


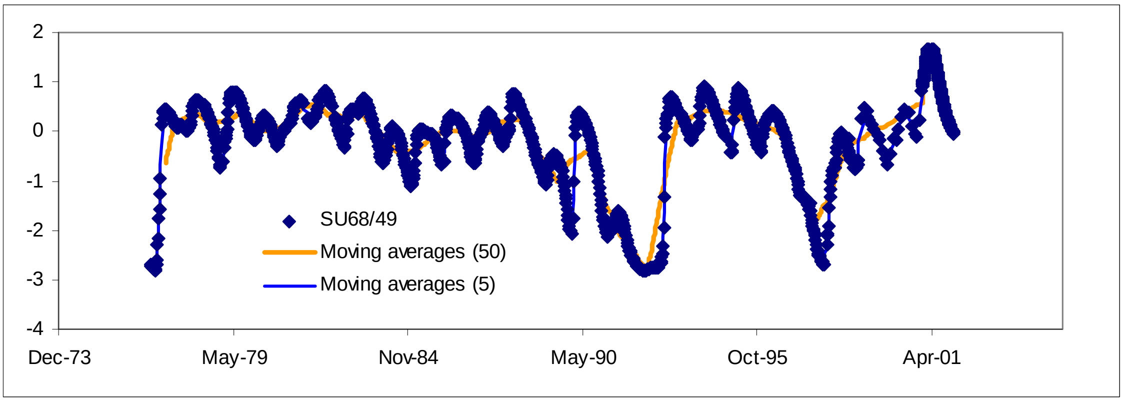


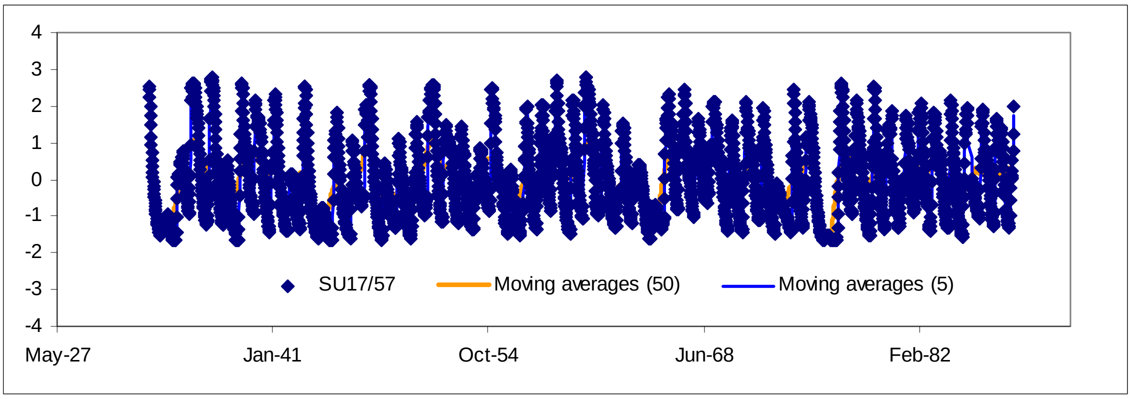

TL33/4
100 per Mov Avg
Moving averages (100)
4
3
2
1
0
-1
-2
Sep-02
Jun-16
Feb-30
Oct-43
Jun-57
Mar-71
Nov-84
Jul-98


TL11/9
Moving averages (50)
Moving averages (7)
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

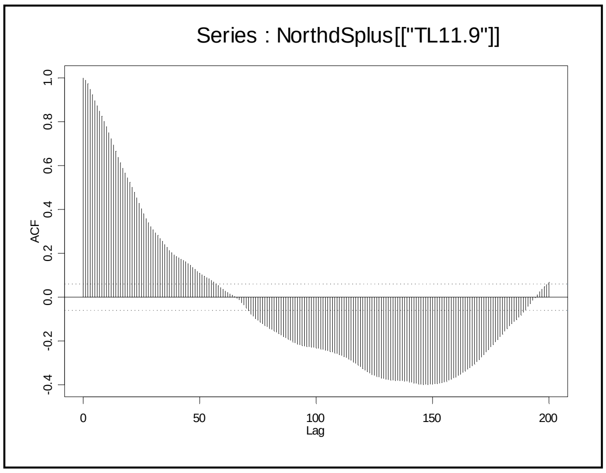

TG12/7
Moving averages (12)
7 per. Mov. Avg. (TG12/7)
3
2
1
0
-1
-2
-3
Mar-71
Aug-76
Feb-82
Aug-87
Jan-93
Jul-98

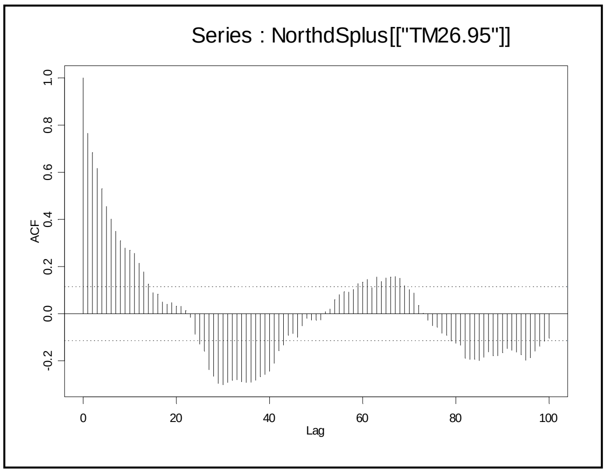

TL42/8
Moving averages (50)
7 per. Mov. Avg. (TL42/8)
1.5
1
0.5
0
-0.5
-1
-1.5
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

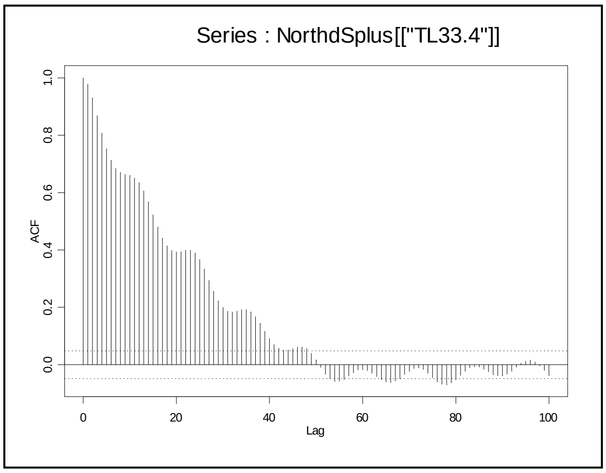

2
1
0
-1
-2
-3
-4
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
SU68/49
Moving averages (50)
Moving averages (5)

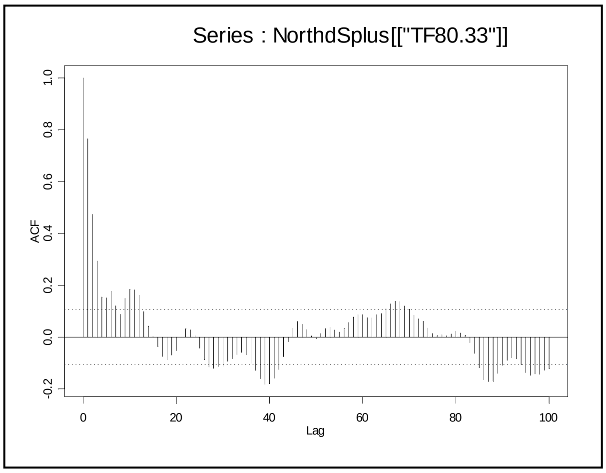

4
3
2
1
0
-1
-2
-3
-4
May-27
Jan-41
Oct-54
Jun-68
Feb-82
SU17/57
Moving averages (50)
Moving averages (5)

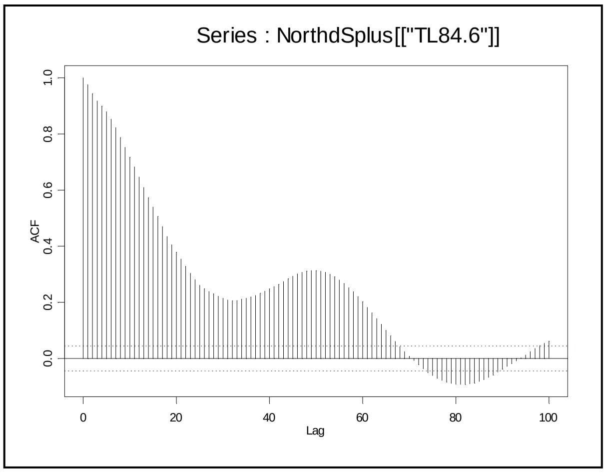
AUTOCORRELATION FUNTION PLOTS

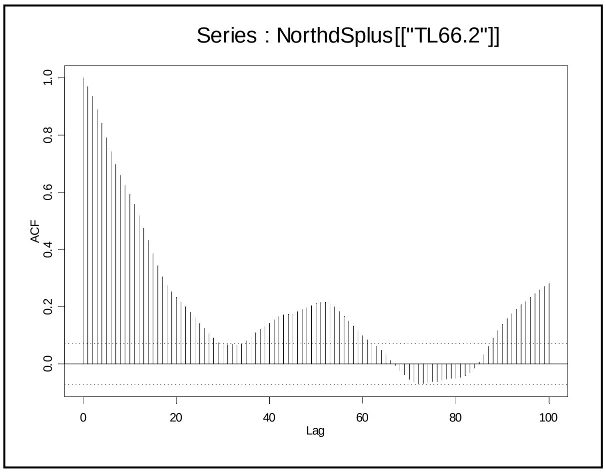


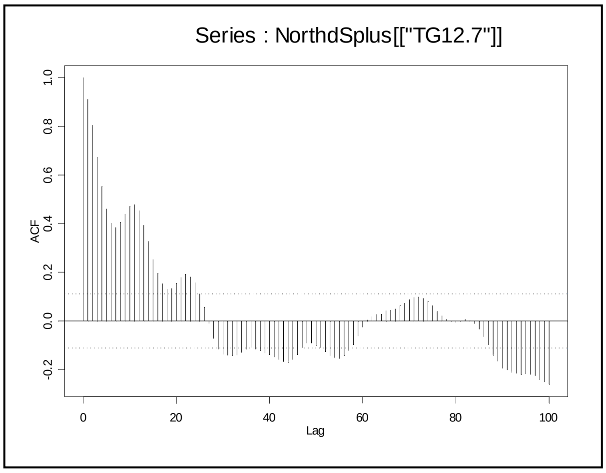








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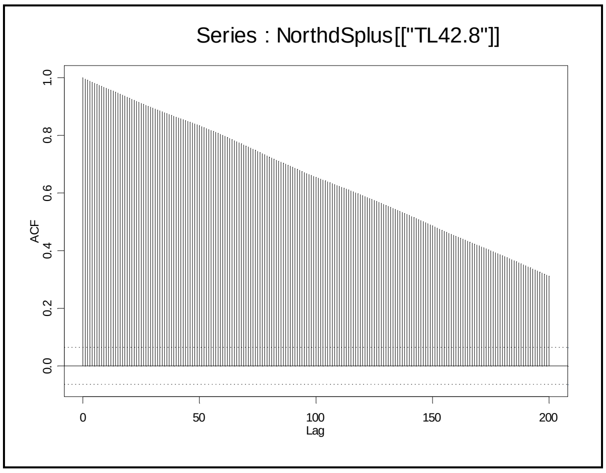
ACF
-0.2 0.0 0.2 0.4 0.6 0.8 1.0
0 20 40 60 80 100
Lag


Series : NorthdSplus[["TL42.8"]]
ACF
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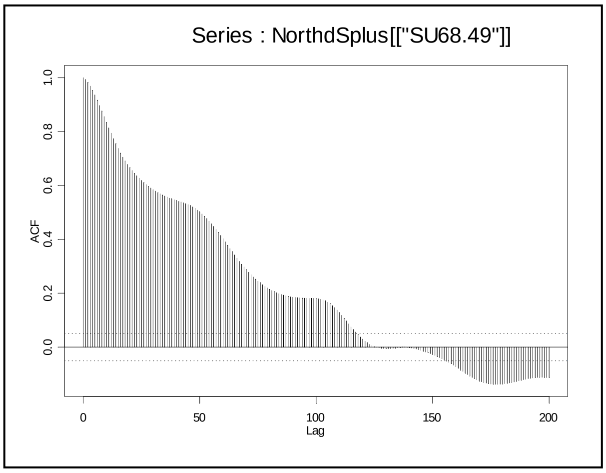
0 50 100 150 200
Lag


Series : NorthdSplus[["SU68.49"]]
ACF
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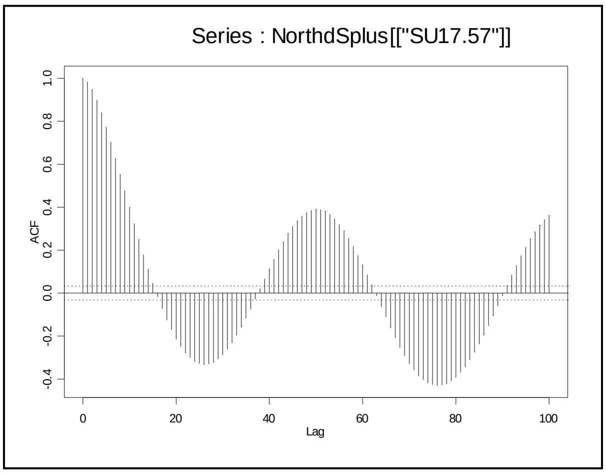
0 50 100 150 200
Lag


Series : NorthdSplus[["SU17.57"]]
ACF
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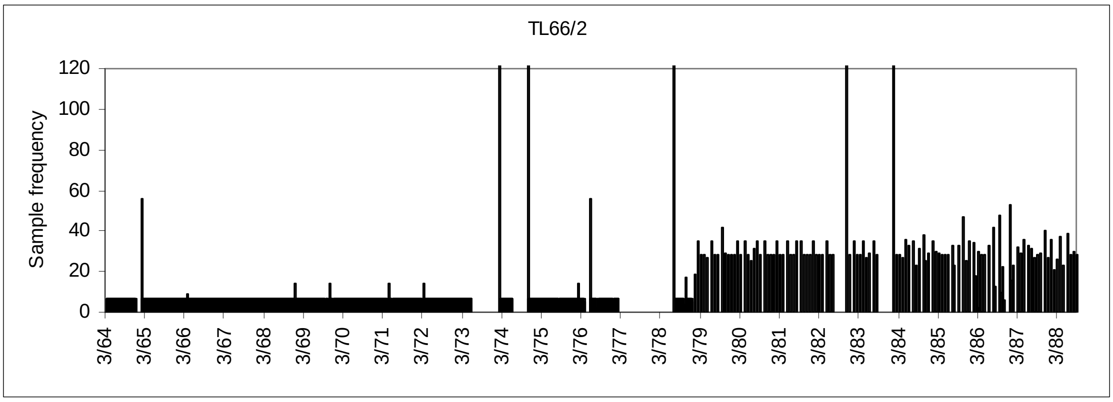
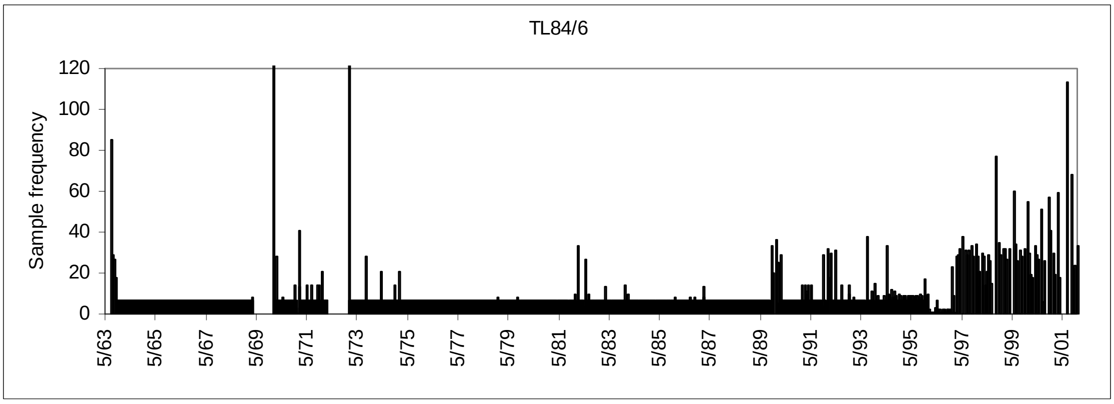
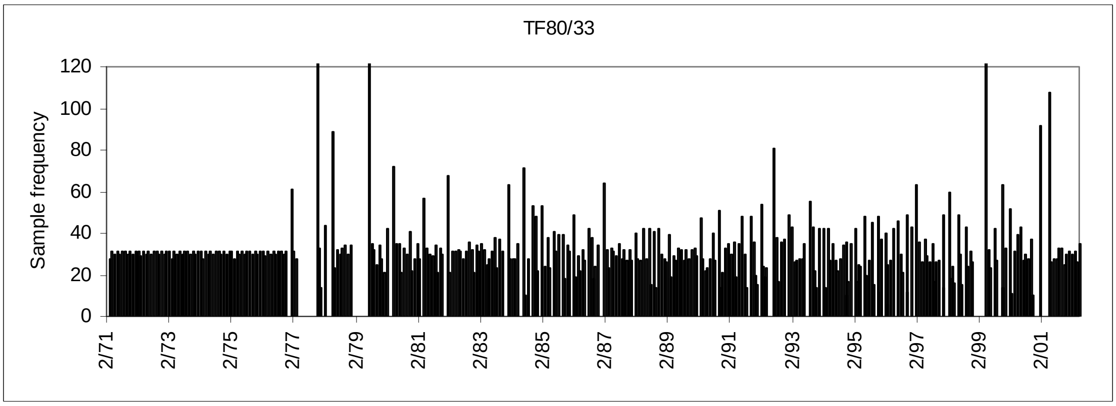
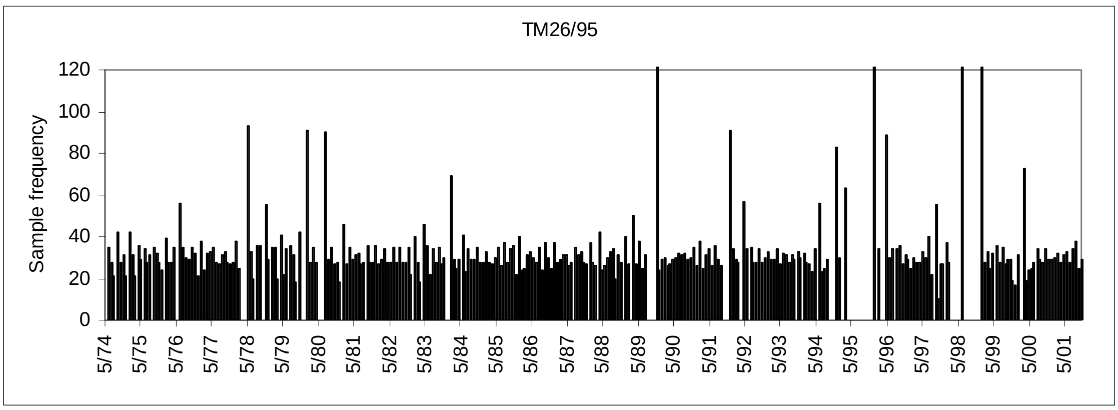
0 20 40 60 80 100
Lag

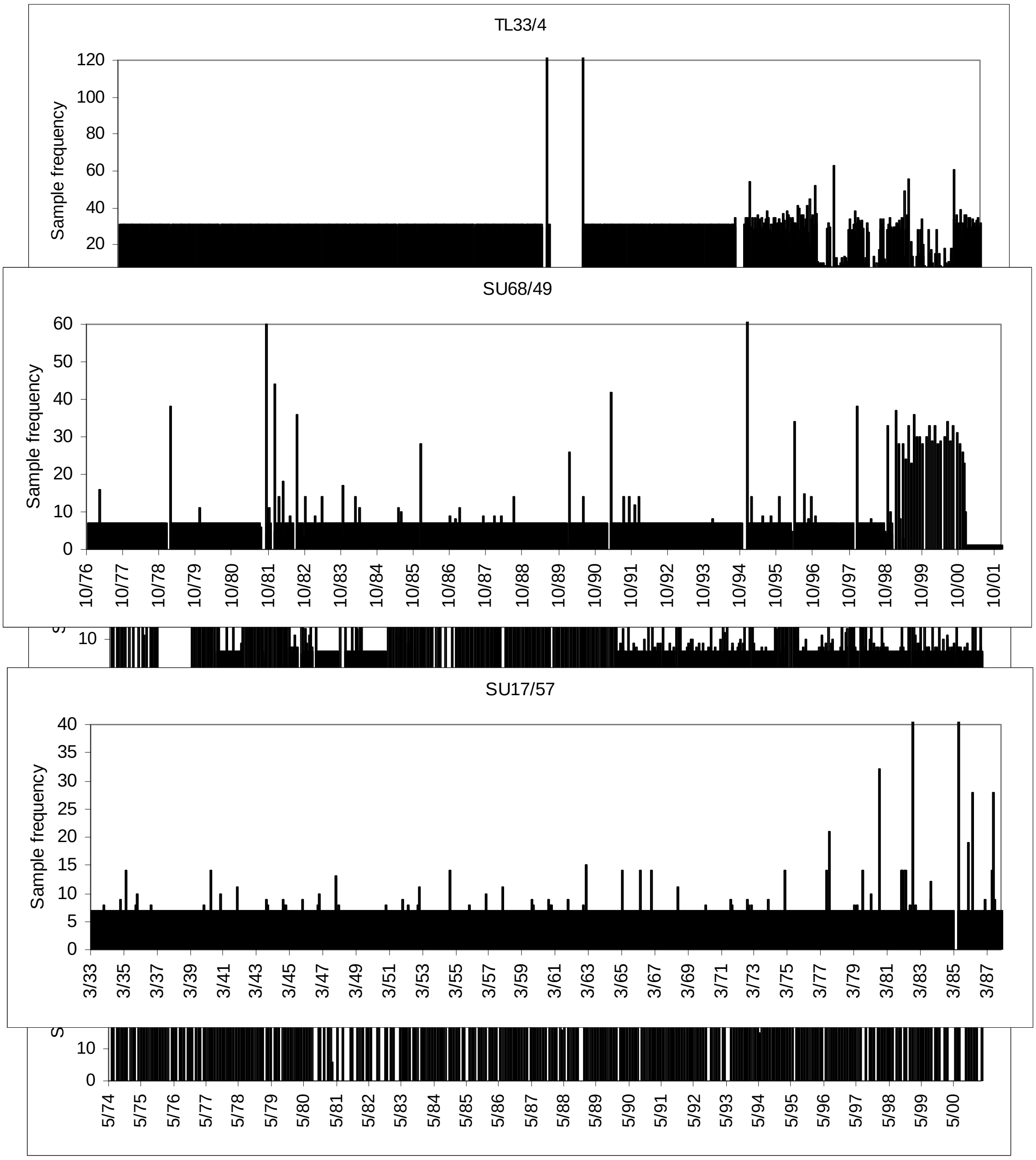
SAMPLE FREQUENCY PLOTS

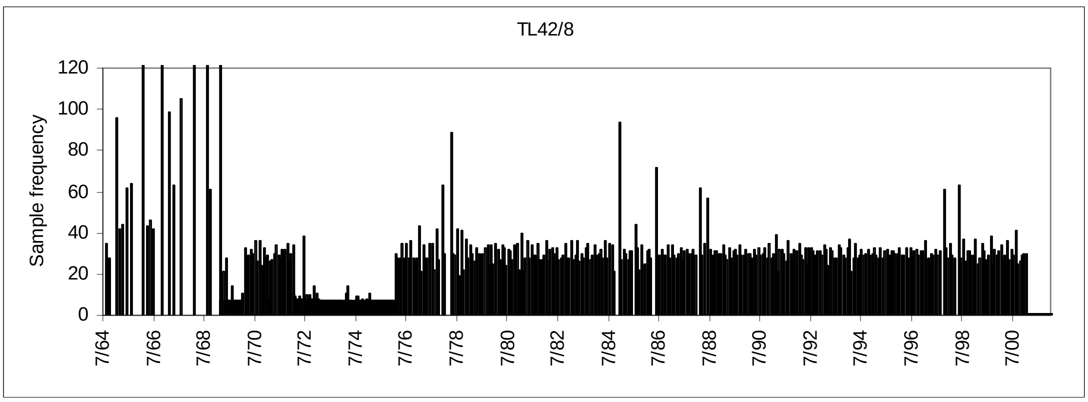









TL33/4
Sample frequency
120
100
80
60
40
20
SU68/49
Sample frequency
60
50
40
30
20
10
0
10/76 10/77 10/78 10/79 10/80 10/81 10/82 10/83 10/84 10/85 10/86 10/87 10/88 10/89 10/90 10/91 10/92 10/93 10/94 10/95 10/96 10/97 10/98 10/99 10/00 10/01
10
SU17/57
Sample frequency
40
35
30
25
20
15
10
5
0
3/33 3/35 3/37 3/39 3/41 3/43 3/45 3/47 3/49 3/51 3/53 3/55 3/57 3/59 3/61 3/63 3/65 3/67 3/69 3/71 3/73 3/75 3/77 3/79 3/81 3/83 3/85 3/87
10
0
5/74 5/75 5/76 5/77 5/78 5/79 5/80 5/81 5/82 5/83 5/84 5/85 5/86 5/87 5/88 5/89 5/90 5/91 5/92 5/93 5/94 5/95 5/96 5/97 5/98 5/99 5/00


TL42/8
Sample frequency
120
100
80
60
40
20
0
7/64 7/66 7/68 7/70 7/72 7/74 7/76 7/78 7/80 7/82 7/84 7/86 7/88 7/90 7/92 7/94 7/96 7/98 7/00

WELLMASTER LOOK-UP TABLE

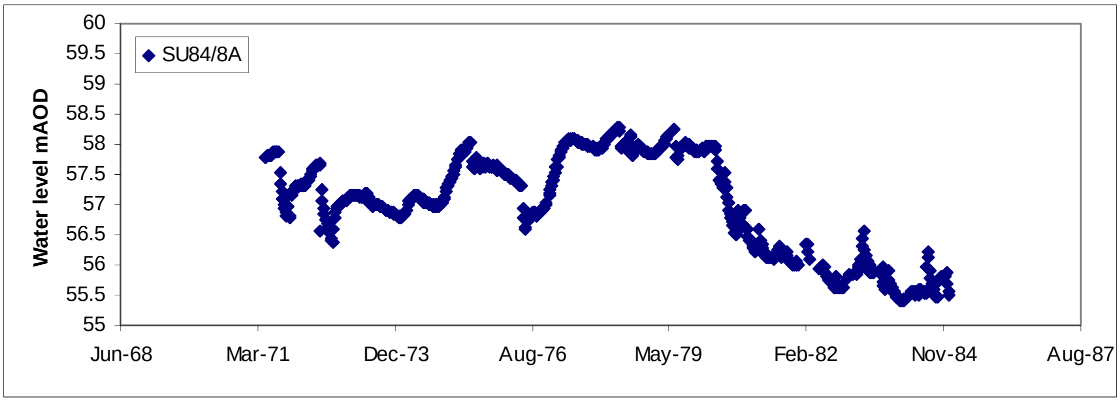
Nov	1963 **Low**	Mar	1968 **Very high**	Jul	1972 **Average**
Dec	1963 **Low**	Apr	1968 **High**	Aug	1972 **Average**
Jan	1964 **Average**	May	1968 **Average**	Sep	1972 **Low**
Feb	1964 **Average**	Jun	1968 **Average**	Oct	1972 **Low**
Mar	1964 **Average**	Jul	1968 **Low**	Nov	1972 **Very low**
Apr	1964 **High**	Aug	1968 **Low**	Dec	1972 **Very low**
May	1964 **High**	Sep	1968 **Average**	Jan	1973 **Low**
Jun	1964 **Average**	Oct	1968 **High**	Feb	1973 **Low**
Jul	1964 **Average**	Nov	1968 **High**	Mar	1973 **Very low**
Aug	1964 **Low**	Dec	1968 **Very high**	Apr	1973 **Very low**
Sep	1964 **Low**	Jan	1969 **Very high**	May	1973 **Very low**
Oct	1964 **Very low**	Feb	1969 **Very high**	Jun	1973 **Very low**
Nov	1964 **Very low**	Mar	1969 **Very high**	Jul	1973 **Very low**
Dec	1964 **Very low**	Apr	1969 **Very high**	Aug	1973 **Very low**
Jan	1965 **Very low**	May	1969 **Very high**	Sep	1973 **Very low**
Feb	1965 **Very low**	Jun	1969 **Very high**	Oct	1973 **Very low**
Mar	1965 **Very low**	Jul	1969 **Very high**	Nov	1973 **Very low**
Apr	1965 **Very low**	Aug	1969 **High**	Dec	1973 **Very low**
May	1965 **Very low**	Sep	1969 **High**	Jan	1974 **Very low**
Jun	1965 **Very low**	Oct	1969 **Average**	Feb	1974 **Low**
Jul	1965 **Very low**	Nov	1969 **Low**	Mar	1974 **Average**
Aug	1965 **Very low**	Dec	1969 **Low**	Apr	1974 **Low**
Sep	1965 **Very low**	Jan	1970 **High**	May	1974 **Low**
Oct	1965 **Very low**	Feb	1970 **Very high**	Jun	1974 **Very low**
Nov	1965 **Very low**	Mar	1970 **Very high**	Jul	1974 **Very low**
Dec	1965 **Low**	Apr	1970 **Very high**	Aug	1974 **Very low**
Jan	1966 **High**	May	1970 **Very high**	Sep	1974 **Very low**
Feb	1966 **Very high**	Jun	1970 **Very high**	Oct	1974 **Very low**
Mar	1966 **Very high**	Jul	1970 **Very high**	Nov	1974 **Low**
Apr	1966 **Very high**	Aug	1970 **High**	Dec	1974 **Average**
May	1966 **High**	Sep	1970 **Average**	Jan	1975 **High**
Jun	1966 **High**	Oct	1970 **Average**	Feb	1975 **High**
Jul	1966 **Average**	Nov	1970 **Low**	Mar	1975 **Very high**
Aug	1966 **Low**	Dec	1970 **Average**	Apr	1975 **Very high**
Sep	1966 **Low**	Jan	1971 **High**	May	1975 **Very high**
Oct	1966 **Low**	Feb	1971 **Very high**	Jun	1975 **Very high**
Nov	1966 **Low**	Mar	1971 **Very high**	Jul	1975 **Very high**
Dec	1966 **Average**	Apr	1971 **Very high**	Aug	1975 **High**
Jan	1967 **High**	May	1971 **Very high**	Sep	1975 **Average**
Feb	1967 **Very high**	Jun	1971 **High**	Oct	1975 **Average**
Mar	1967 **Very high**	Jul	1971 **High**	Nov	1975 **Low**
Apr	1967 **Very high**	Aug	1971 **Average**	Dec	1975 **Low**
May	1967 **High**	Sep	1971 **Average**	Jan	1976 **Very low**
Jun	1967 **High**	Oct	1971 **Low**	Feb	1976 **Very low**
Jul	1967 **Average**	Nov	1971 **Low**	Mar	1976 **Very low**
Aug	1967 **Low**	Dec	1971 **Low**	Apr	1976 **Very low**
Sep	1967 **Low**	Jan	1972 **Average**	May	1976 **Very low**
Oct	1967 **Low**	Feb	1972 **High**	Jun	1976 **Very low**
Nov	1967 **Low**	Mar	1972 **Very high**	Jul	1976 **Very low**
Dec	1967 **Average**	Apr	1972 **Very high**	Aug	1976 **Very low**
Jan	1968 **High**	May	1972 **High**	Sep	1976 **Very low**
Feb	1968 **Very high**	Jun	1972 **High**	Oct	1976 **Very low**

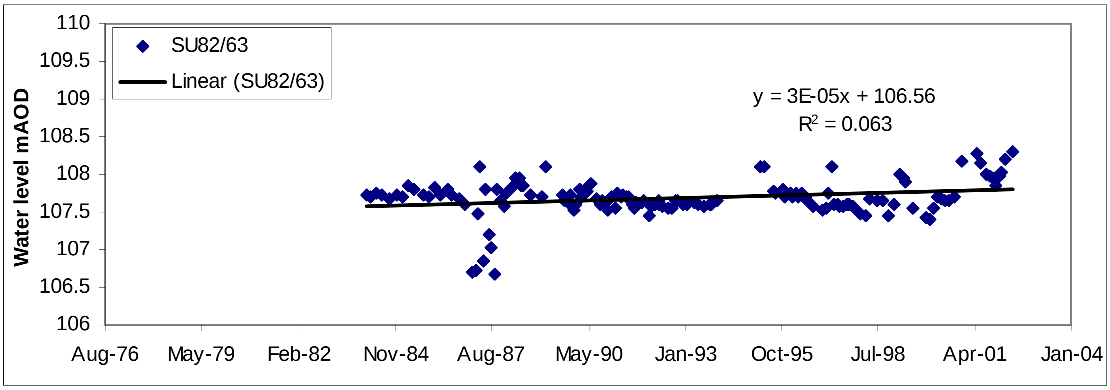
Nov	1976	**Very low**
Dec	1976	**Very low**
Jan	1977	**Low**
Feb	1977	**High**
Mar	1977	**Very high**
Apr	1977	**Very high**
May	1977	**High**
Jun	1977	**High**
Jul	1977	**Average**
Aug	1977	**Average**
Sep	1977	**Average**
Oct	1977	**Low**
Nov	1977	**Low**
Dec	1977	**Low**
Jan	1978	**Average**
Feb	1978	**High**
Mar	1978	**Very high**
Apr	1978	**Very high**
May	1978	**Very high**
Jun	1978	**High**
Jul	1978	**High**
Aug	1978	**Average**
Sep	1978	**Average**
Oct	1978	**Low**
Nov	1978	**Low**
Dec	1978	**Low**
Jan	1979	**Low**
Feb	1979	**High**
Mar	1979	**Very high**
Apr	1979	**Very high**
May	1979	**Very high**
Jun	1979	**Very high**
Jul	1979	**Very high**
Aug	1979	**High**
Sep	1979	**Average**
Oct	1979	**Average**
Nov	1979	**Low**
Dec	1979	**Low**
Jan	1980	**Average**
Feb	1980	**High**
Mar	1980	**High**
Apr	1980	**Very high**
May	1980	**Very high**
Jun	1980	**High**
Jul	1980	**Average**
Aug	1980	**Average**
Sep	1980	**Low**
Oct	1980	**Low**
Nov	1980	**Low**
Dec	1980	**Low**
Jan	1981	**Average**
Feb	1981	**Average**
Mar	1981	**High**
Apr	1981	**Very high**
May	1981	**Very high**
Jun	1981	**High**
Jul	1981	**High**
Aug	1981	**Average**
Sep	1981	**Average**
Oct	1981	**Low**
Nov	1981	**Average**
Dec	1981	**Average**
Jan	1982	**High**
Feb	1982	**Very high**
Mar	1982	**Very high**
Apr	1982	**High**
May	1982	**High**
Jun	1982	**Average**
Jul	1982	**Average**
Aug	1982	**Average**
Sep	1982	**Low**
Oct	1982	**Low**
Nov	1982	**Average**
Dec	1982	**High**
Jan	1983	**Very high**
Feb	1983	**Very high**
Mar	1983	**Very high**
Apr	1983	**Very high**
May	1983	**Very high**
Jun	1983	**Very high**
Jul	1983	**Very high**
Aug	1983	**High**
Sep	1983	**Average**
Oct	1983	**Average**
Nov	1983	**Low**
Dec	1983	**Low**
Jan	1984	**Average**
Feb	1984	**Very high**
Mar	1984	**Very high**
Apr	1984	**High**
May	1984	**High**
Jun	1984	**High**
Jul	1984	**Average**
Aug	1984	**Low**
Sep	1984	**Low**
Oct	1984	**Low**
Nov	1984	**Low**
Dec	1984	**Low**
Jan	1985	**Average**
Feb	1985	**High**
Mar	1985	**High**
Apr	1985	**High**
May	1985	**High**
Jun	1985	**High**
Jul	1985	**High**
Aug	1985	**Average**
Sep	1985	**Average**
Oct	1985	**Low**
Nov	1985	**Low**
Dec	1985	**Low**
Jan	1986	**Average**
Feb	1986	**High**
Mar	1986	**High**
Apr	1986	**High**
May	1986	**High**
Jun	1986	**High**
Jul	1986	**Average**
Aug	1986	**Average**
Sep	1986	**Low**
Oct	1986	**Low**
Nov	1986	**Low**
Dec	1986	**Average**
Jan	1987	**Average**
Feb	1987	**High**
Mar	1987	**High**
Apr	1987	**High**
May	1987	**High**
Jun	1987	**High**
Jul	1987	**High**
Aug	1987	**High**
Sep	1987	**High**
Oct	1987	**High**
Nov	1987	**High**
Dec	1987	**Very high**
Jan	1988	**Very high**
Feb	1988	**Very high**
Mar	1988	**Very high**
Apr	1988	**Very high**
May	1988	**Very high**
Jun	1988	**Very high**
Jul	1988	**Very high**
Aug	1988	**High**
Sep	1988	**Average**
Oct	1988	**Average**
Nov	1988	**Average**
Dec	1988	**Average**
Jan	1989	**Average**
Feb	1989	**Low**
Mar	1989	**Average**
Apr	1989	**High**
May	1989	**High**
Jun	1989	**Average**
Jul	1989	**Average**
Aug	1989	**Low**
Sep	1989	**Low**
Oct	1989	**Very low**

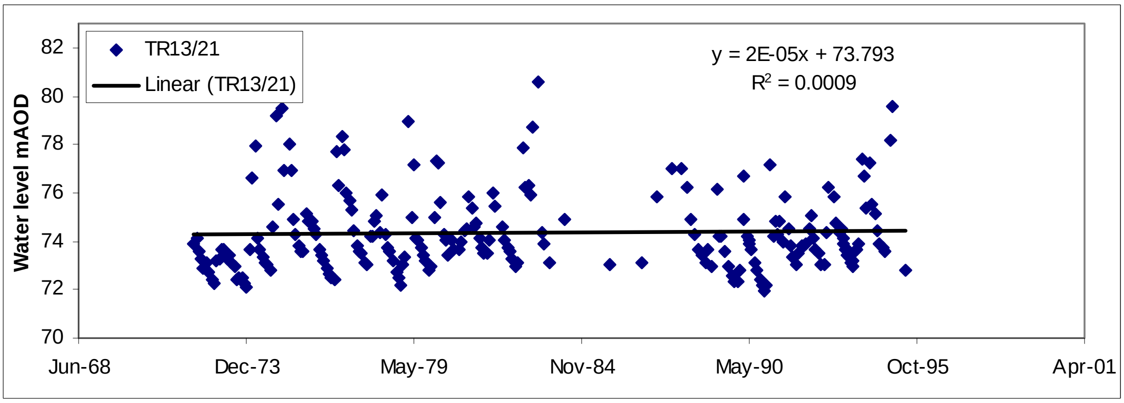
Nov	1989	**Very low**
Dec	1989	**Very low**
Jan	1990	**Low**
Feb	1990	**Average**
Mar	1990	**High**
Apr	1990	**High**
May	1990	**Average**
Jun	1990	**Average**
Jul	1990	**Low**
Aug	1990	**Low**
Sep	1990	**Low**
Oct	1990	**Very low**
Nov	1990	**Very low**
Dec	1990	**Very low**
Jan	1991	**Very low**
Feb	1991	**Very low**
Mar	1991	**Very low**
Apr	1991	**Very low**
May	1991	**Very low**
Jun	1991	**Very low**
Jul	1991	**Very low**
Aug	1991	**Very low**
Sep	1991	**Very low**
Oct	1991	**Very low**
Nov	1991	**Very low**
Dec	1991	**Very low**
Jan	1992	**Very low**
Feb	1992	**Very low**
Mar	1992	**Very low**
Apr	1992	**Very low**
May	1992	**Very low**
Jun	1992	**Very low**
Jul	1992	**Very low**
Aug	1992	**Very low**
Sep	1992	**Very low**
Oct	1992	**Very low**
Nov	1992	**Low**
Dec	1992	**High**
Jan	1993	**High**
Feb	1993	**High**
Mar	1993	**High**
Apr	1993	**High**
May	1993	**High**
Jun	1993	**High**
Jul	1993	**Average**
Aug	1993	**Average**
Sep	1993	**Low**
Oct	1993	**Average**
Nov	1993	**Average**
Dec	1993	**High**
Jan	1994	**Very high**
Feb	1994	**Very high**
Mar	1994	**Very high**
Apr	1994	**Very high**
May	1994	**Very high**
Jun	1994	**Very high**
Jul	1994	**High**
Aug	1994	**High**
Sep	1994	**Average**
Oct	1994	**Average**
Nov	1994	**Average**
Dec	1994	**Average**
Jan	1995	**High**
Feb	1995	**Very high**
Mar	1995	**Very high**
Apr	1995	**Very high**
May	1995	**Very high**
Jun	1995	**Very high**
Jul	1995	**High**
Aug	1995	**Average**
Sep	1995	**Average**
Oct	1995	**Low**
Nov	1995	**Low**
Dec	1995	**Low**
Jan	1996	**Low**
Feb	1996	**Low**
Mar	1996	**Average**
Apr	1996	**Average**
May	1996	**Low**
Jun	1996	**Low**
Jul	1996	**Very low**
Aug	1996	**Very low**
Sep	1996	**Very low**
Oct	1996	**Very low**
Nov	1996	**Very low**
Dec	1996	**Very low**
Jan	1997	**Very low**
Feb	1997	**Very low**
Mar	1997	**Very low**
Apr	1997	**Very low**
May	1997	**Very low**
Jun	1997	**Very low**
Jul	1997	**Very low**
Aug	1997	**Very low**
Sep	1997	**Very low**
Oct	1997	**Very low**
Nov	1997	**Very low**
Dec	1997	**Very low**
Jan	1998	**Very low**
Feb	1998	**Low**
Mar	1998	**Low**
Apr	1998	**Low**
May	1998	**Average**
Jun	1998	**Average**
Jul	1998	**Low**
Aug	1998	**Low**
Sep	1998	**Low**
Oct	1998	**Very low**
Nov	1998	**Low**
Dec	1998	**Average**
Jan	1999	**High**
Feb	1999	**High**
Mar	1999	**Very high**
Apr	1999	**High**
May	1999	**High**
Jun	1999	**High**
Jul	1999	**High**
Aug	1999	**Average**
Sep	1999	**Average**
Oct	1999	**Low**
Nov	1999	**Low**
Dec	1999	**Low**
Jan	2000	**Average**
Feb	2000	**Average**
Mar	2000	**High**
Apr	2000	**High**
May	2000	**High**
Jun	2000	**High**
Jul	2000	**High**
Aug	2000	**Average**
Sep	2000	**Low**
Oct	2000	**Average**
Nov	2000	**High**
Dec	2000	**Very high**
Jan	2001	**Very high**
Feb	2001	**Very high**
Mar	2001	**Very high**
Apr	2001	**Very high**
May	2001	**Very high**
Jun	2001	**Very high**
Jul	2001	**Very high**
Aug	2001	**High**
Sep	2001	**High**
Oct	2001	**High**
Nov	2001	**Average**
Dec	2001	**Average**
Jan	2002	**High**
Feb	2002	**High**
Mar	2002	**Very high**

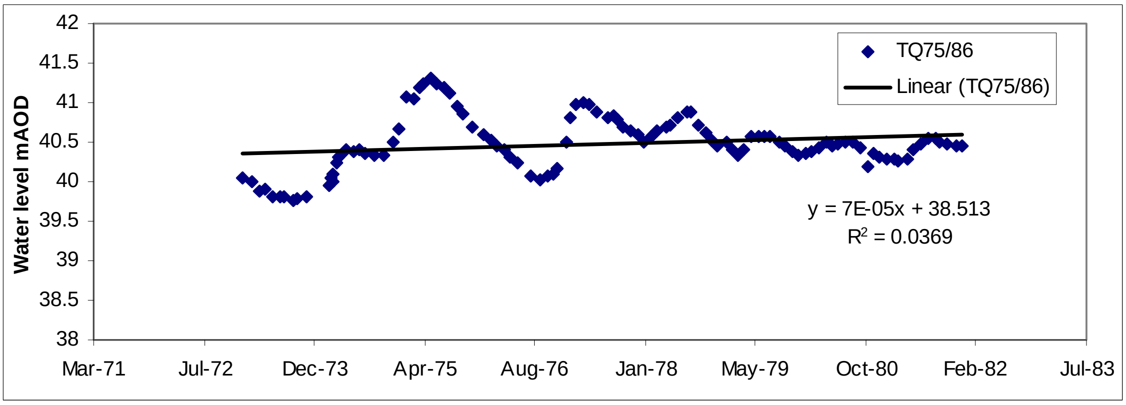
Appendix 9 Lower Greensand

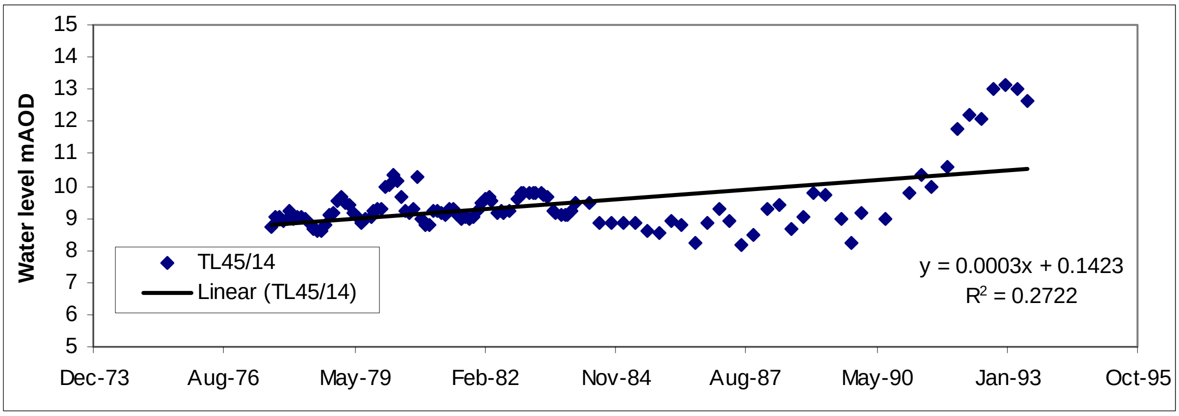
WATER LEVELS ABOVE ORDNANCE DATUM WITH LINEAR REGRESSION CURVE



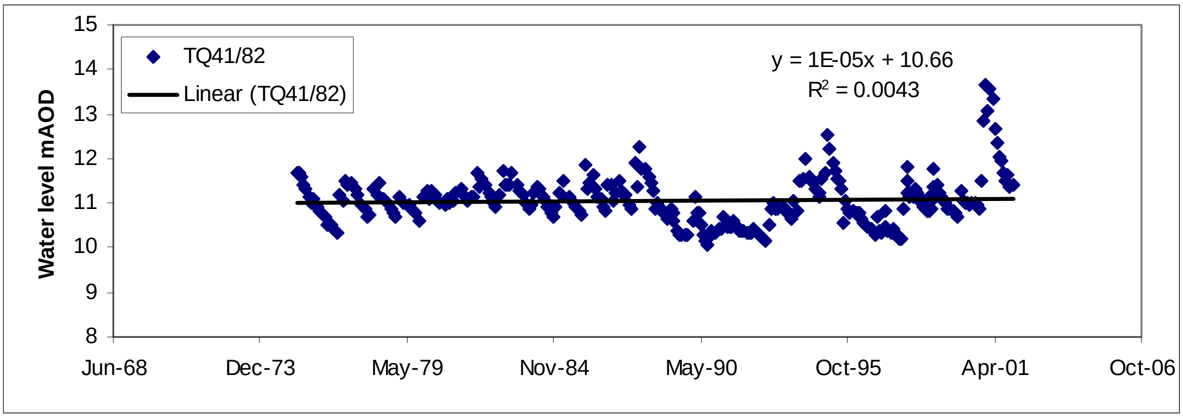




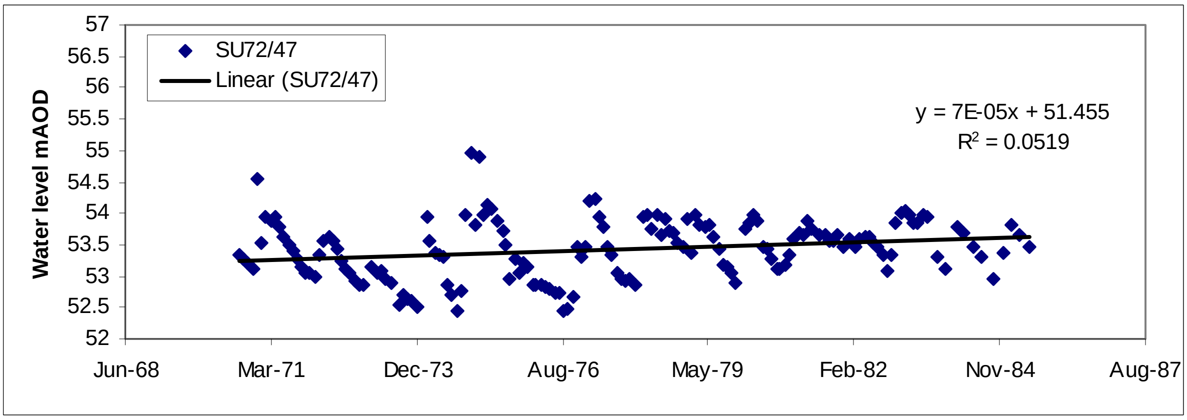




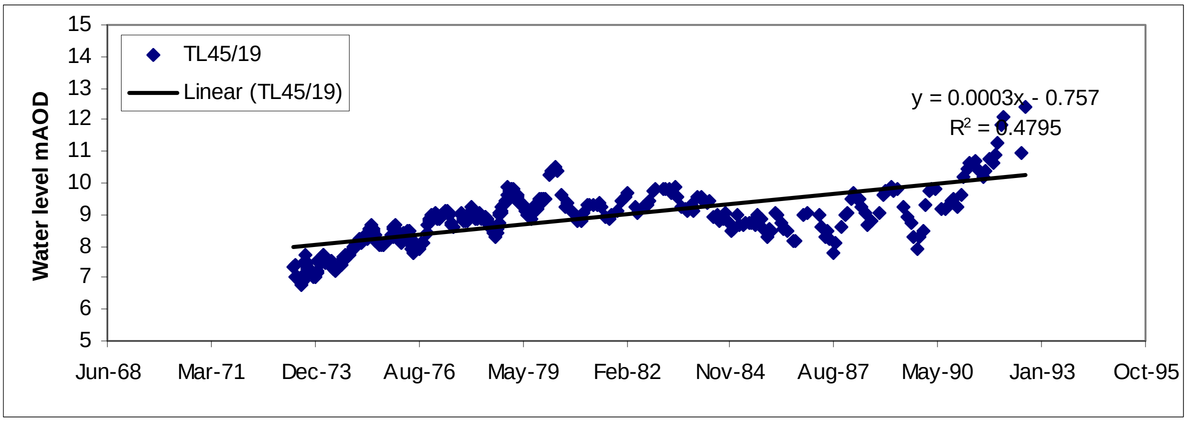
Water level mAOD
15
14
13
12
11
10
9
8
7
6
5
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95
TL45/14
Linear (TL45/14)
y = 0.0003x + 0.1423
R² = 0.2722



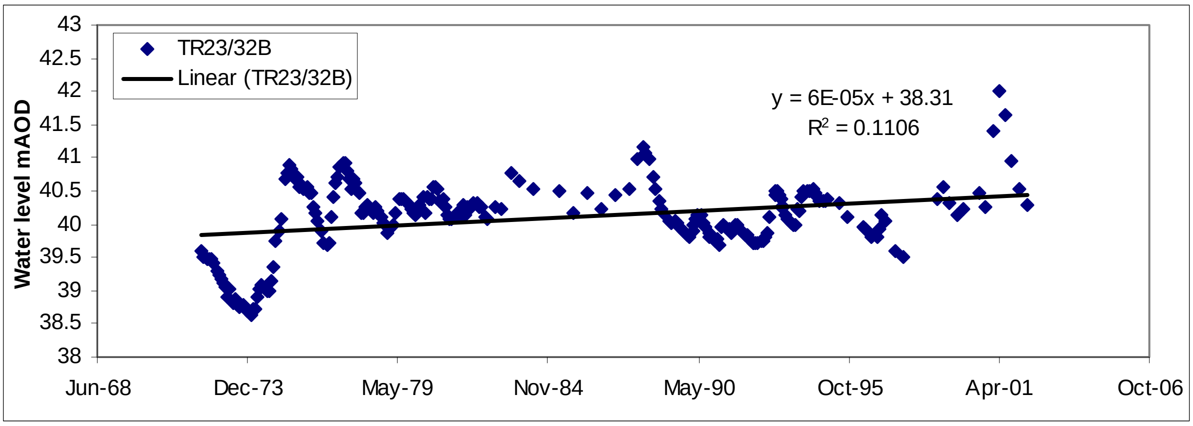
Water level mAOD
15
14
13
12
11
10
9
8
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06
TQ41/82
Linear (TQ41/82)
y = 1E-05x + 10.66
R² = 0.0043



Water level mAOD
57
56.5
56
55.5
55
54.5
54
53.5
53
52.5
52
Jun-68
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87
SU72/47
Linear (SU72/47)
y = 7E-05x + 51.455
R² = 0.0519

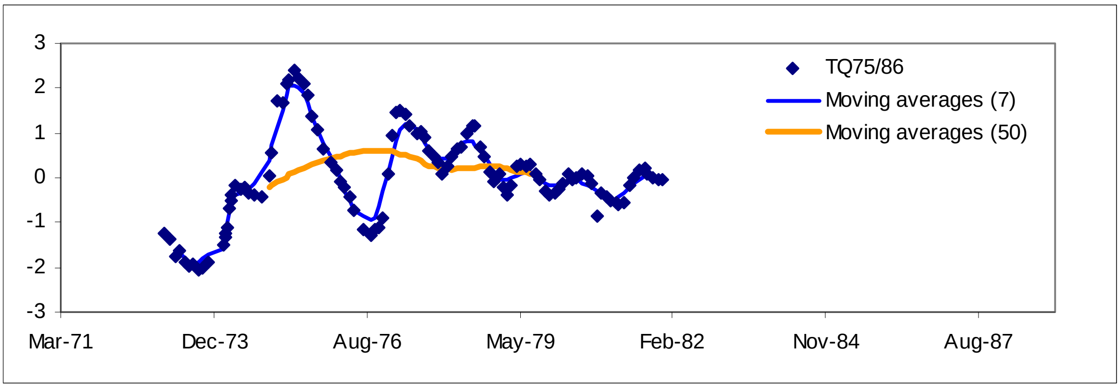


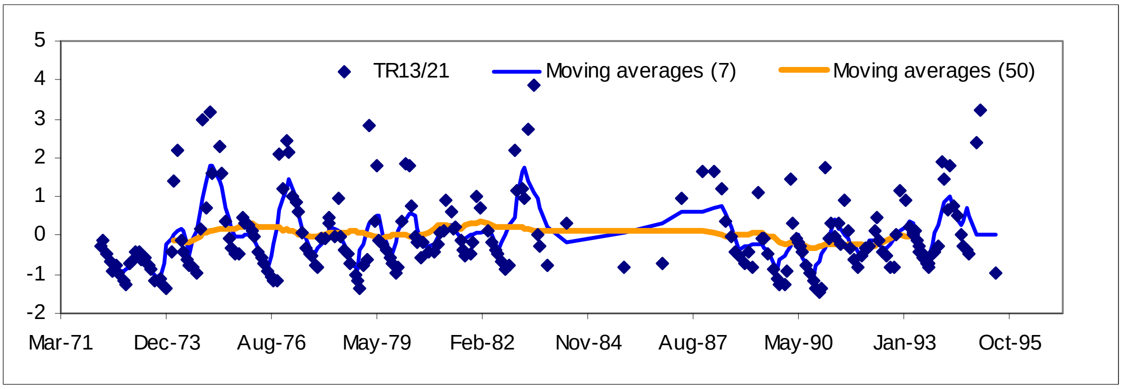
Water level mAOD
15
14
13
12
11
10
9
8
7
6
5
Jun-68
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95
TL45/19
Linear (TL45/19)
y = 0.0003x - 0.757
R² = 0.4795

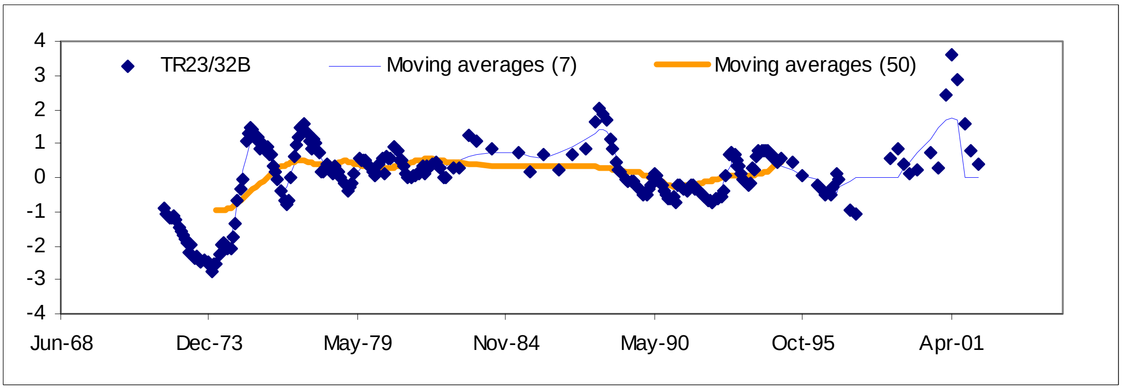


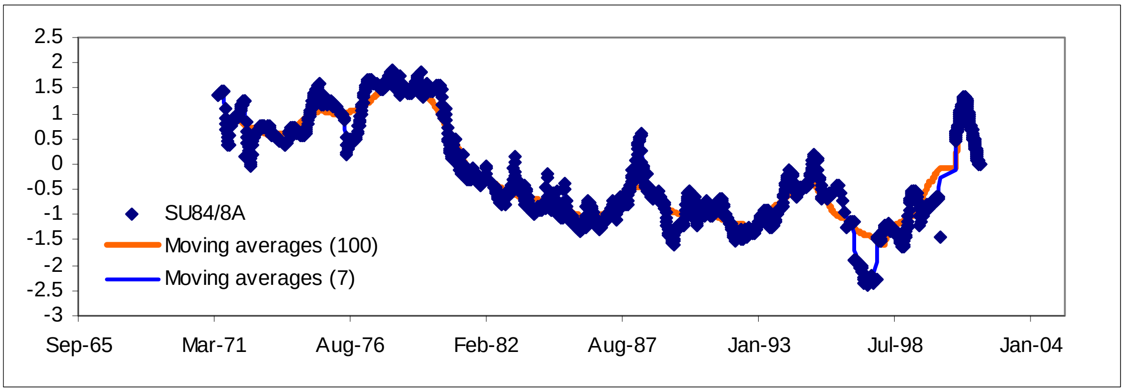
43
42.5
42
41.5
41
40.5
40
39.5
39
38.5
38
Water level mAOD
TR23/32B
Linear (TR23/32B)
y = 6E-05x + 38.31
R² = 0.1106
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

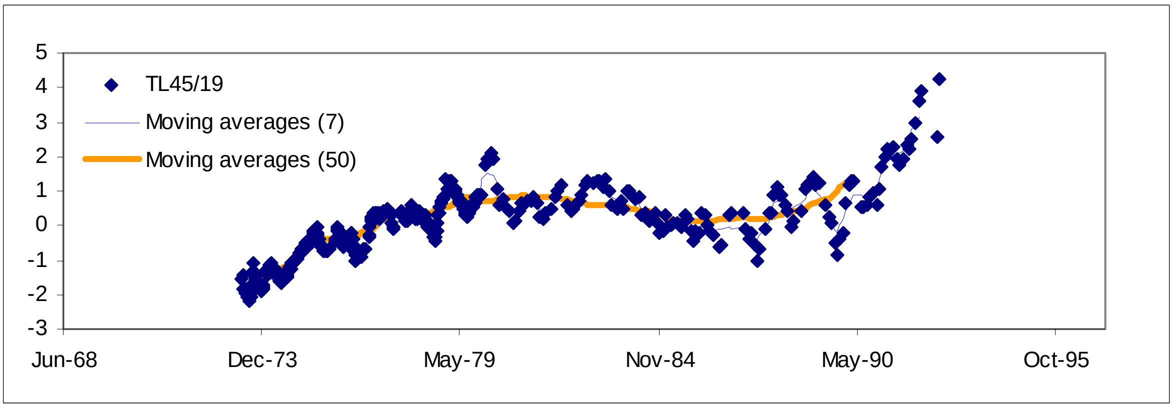
NORMALISED WATER LEVEL DATA WITH MOVING AVERAGES SMOOTHING LINES

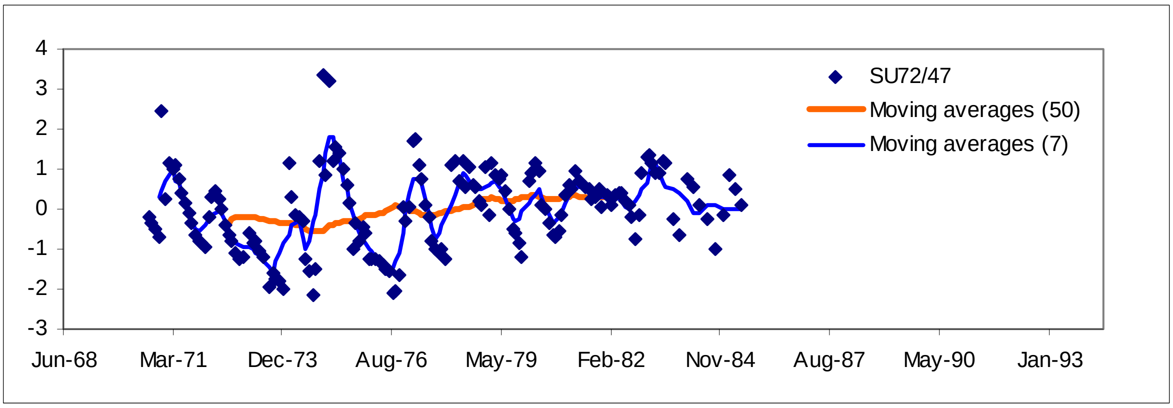


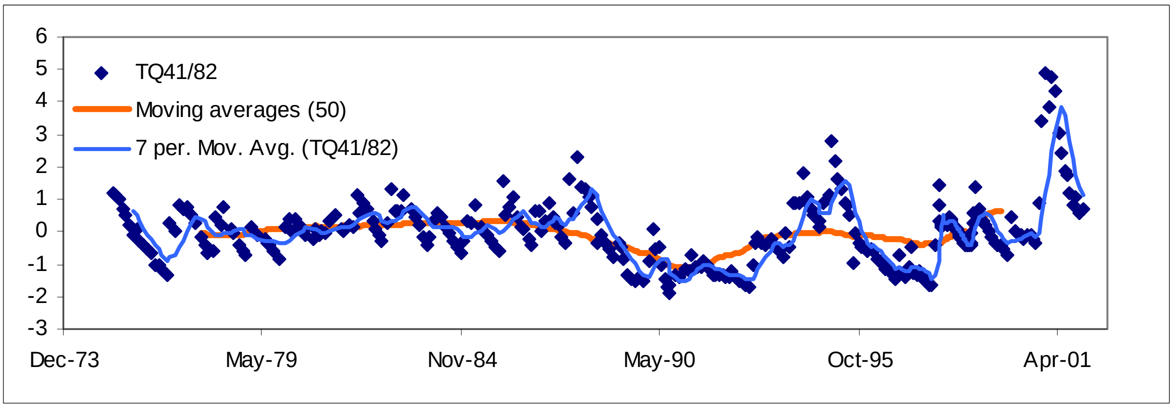


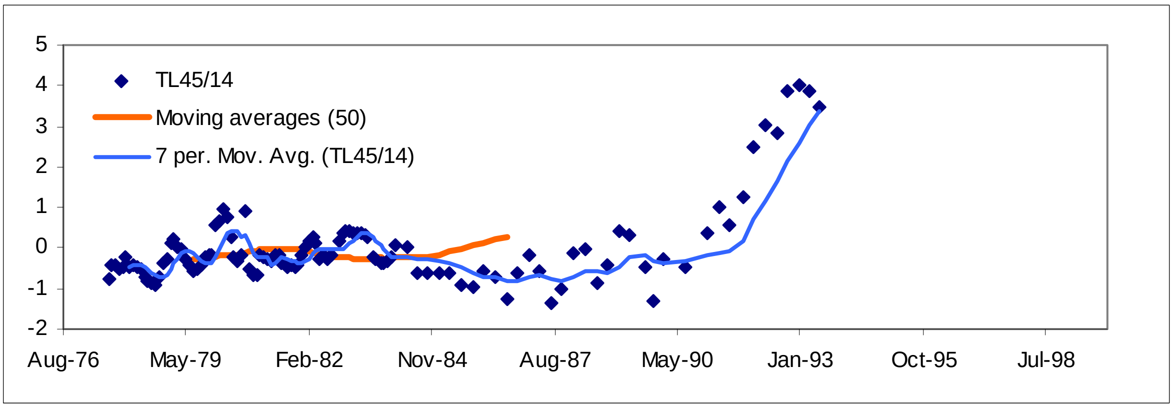


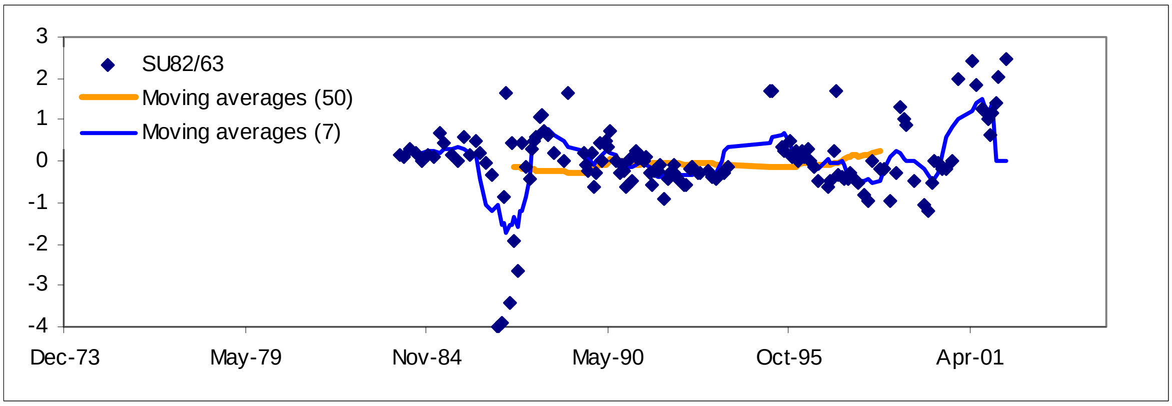



TL45/19
Moving averages (7)
Moving averages (50)
5
4
3
2
1
0
-1
-2
-3
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95

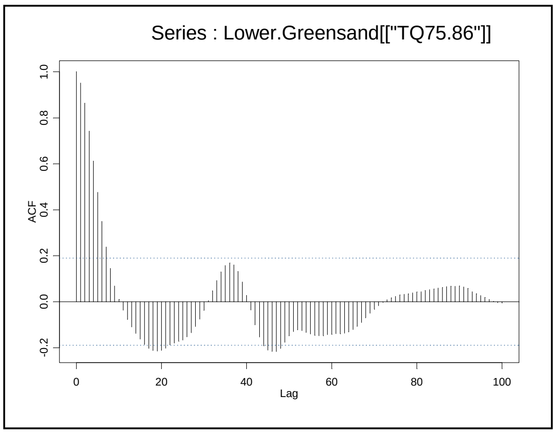

SU72/47
Moving averages (50)
Moving averages (7)
4
3
2
1
0
-1
-2
-3
Jun-68
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93

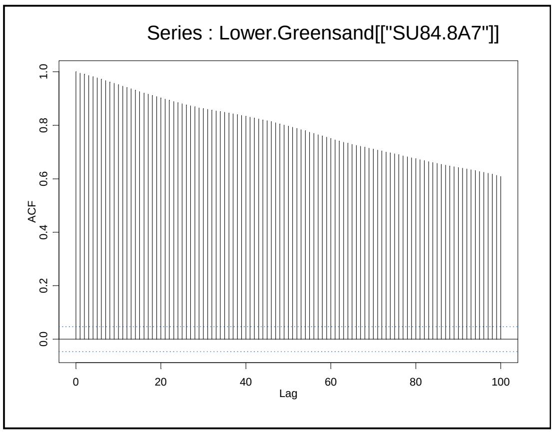

TQ41/82
Moving averages (50)
7 per. Mov. Avg. (TQ41/82)
6
5
4
3
2
1
0
-1
-2
-3
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

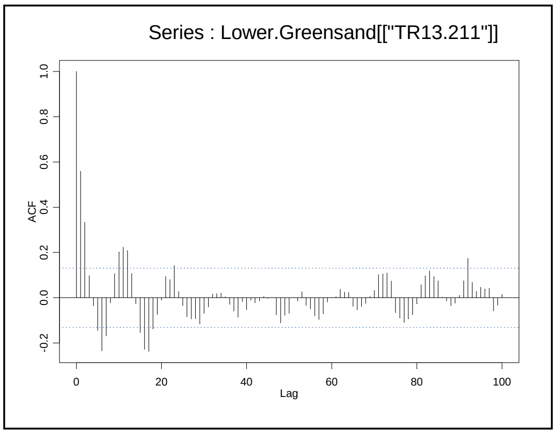

TL45/14
Moving averages (50)
7 per. Mov. Avg. (TL45/14)
5
4
3
2
1
0
-1
-2
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95
Jul-98

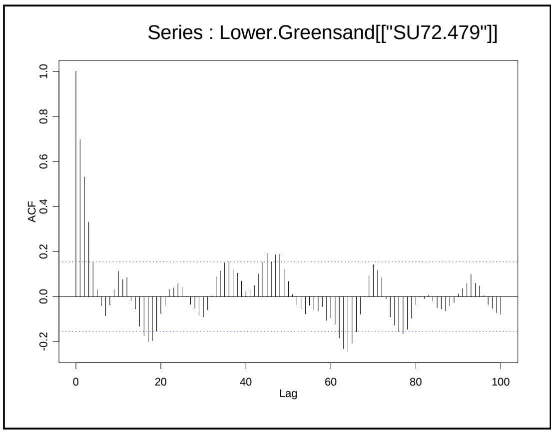

3
2
1
0
-1
-2
-3
-4
SU82/63
Moving averages (50)
Moving averages (7)
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

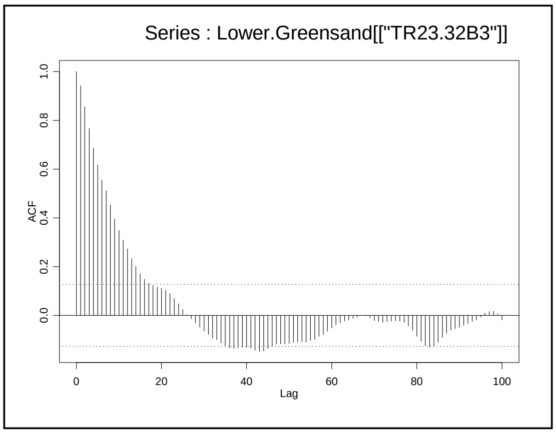
AUTOCORRELATION FUNTION PLOTS

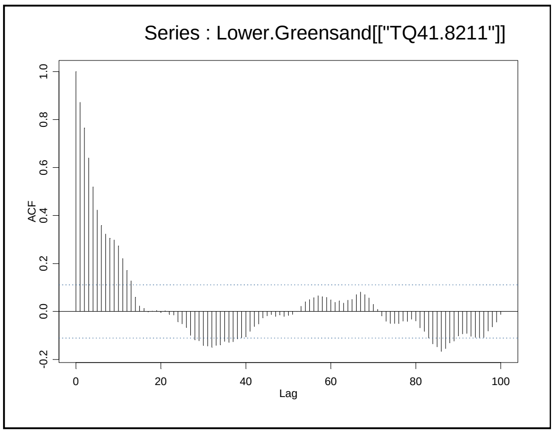


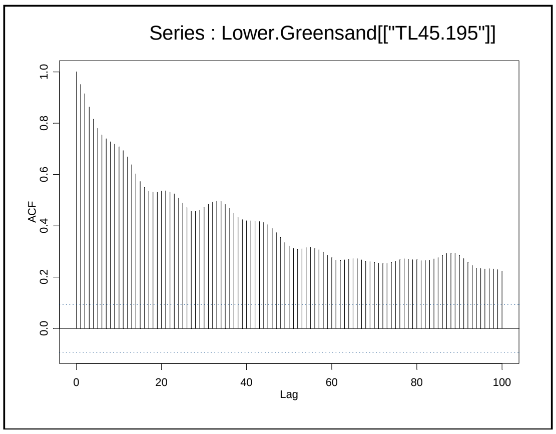


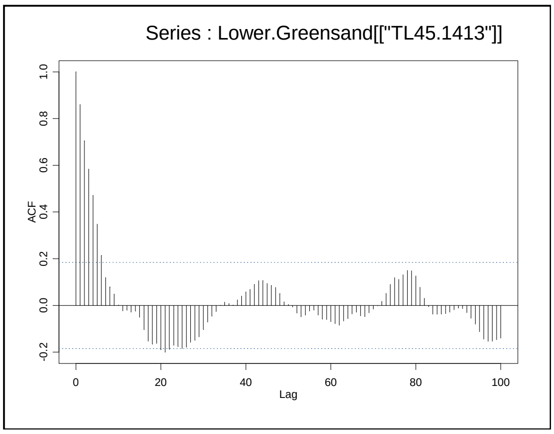


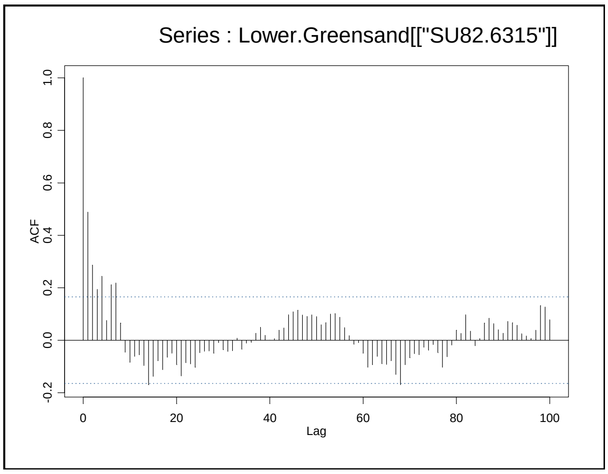




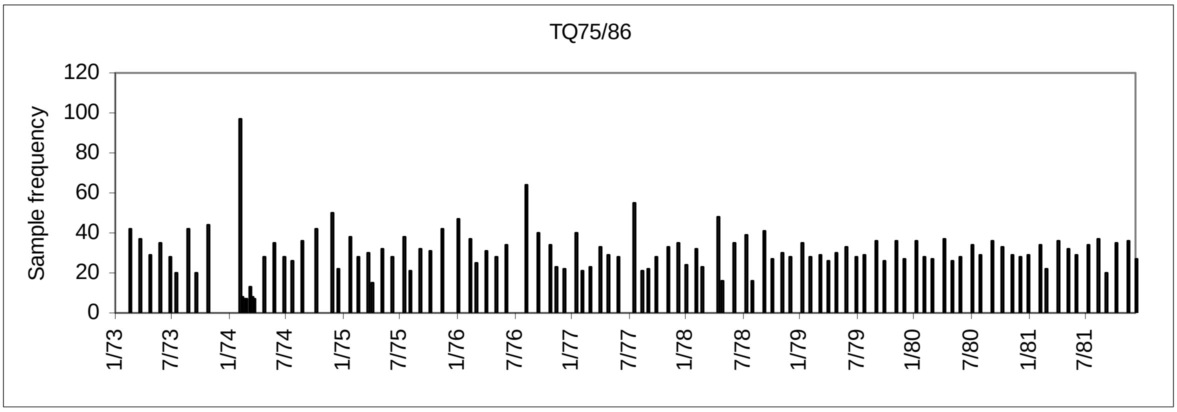


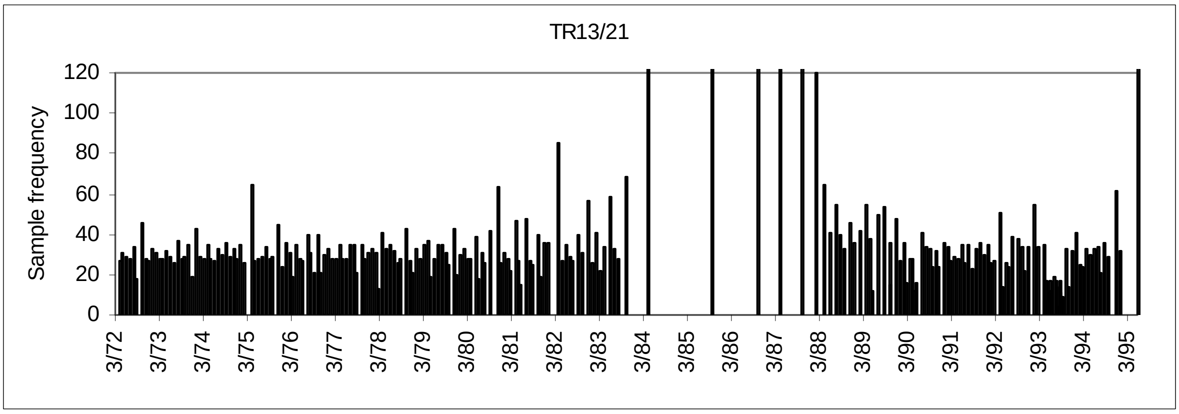


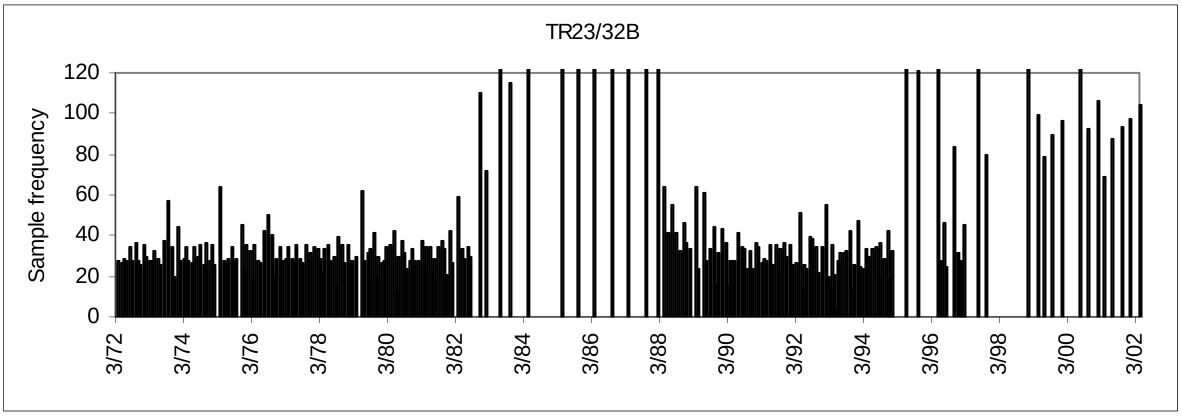


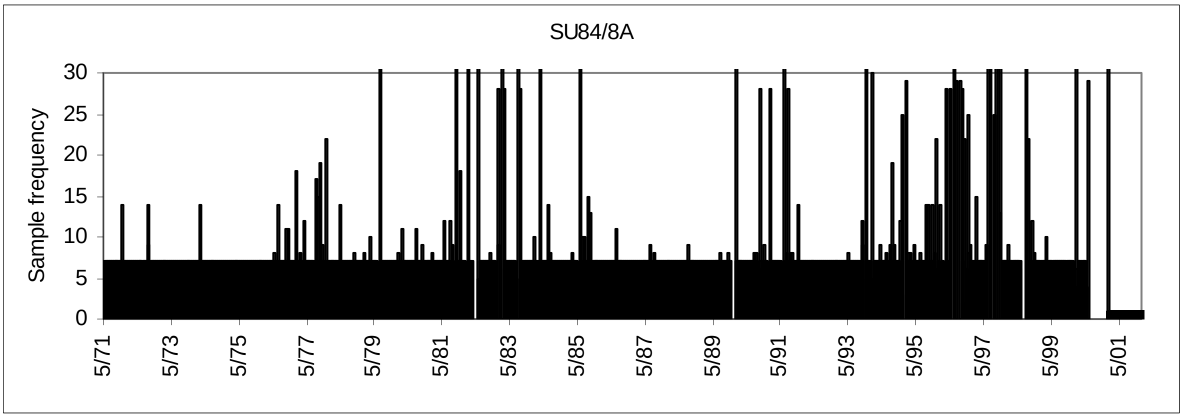

Series : Lower.Greensand[["SU82.6315"]]
ACF
Lag
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100

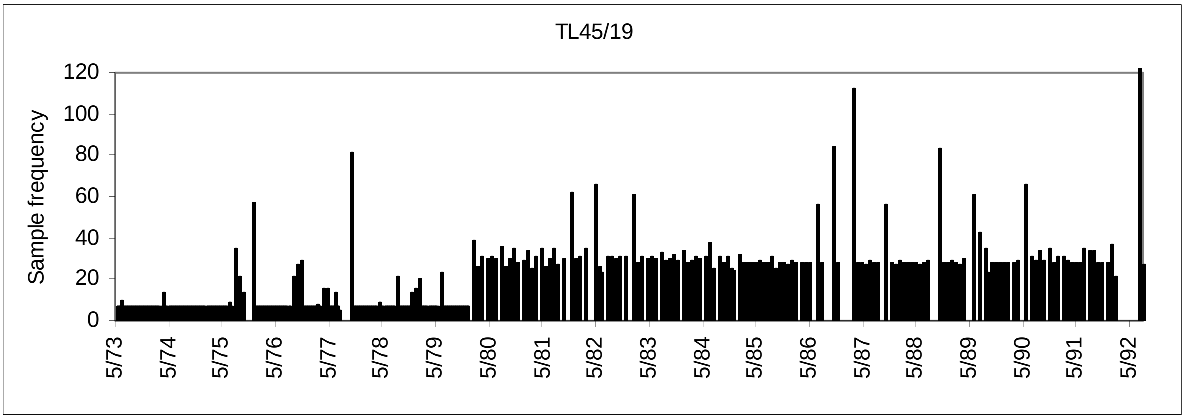
SAMPLE FREQUENCY PLOTS

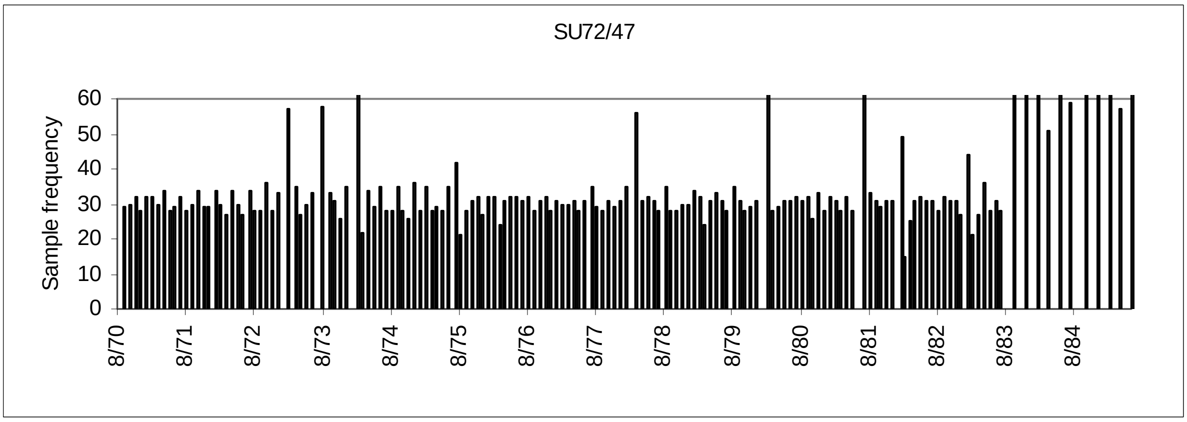


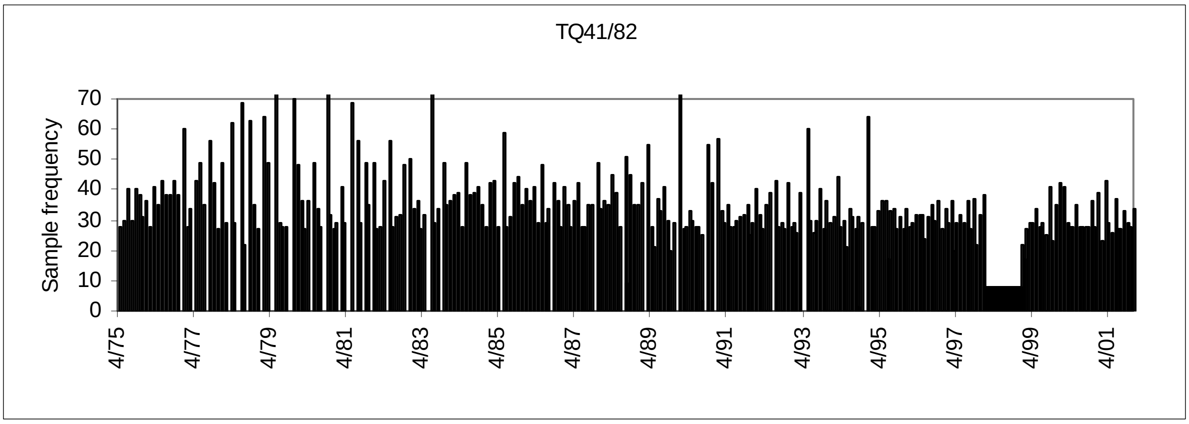


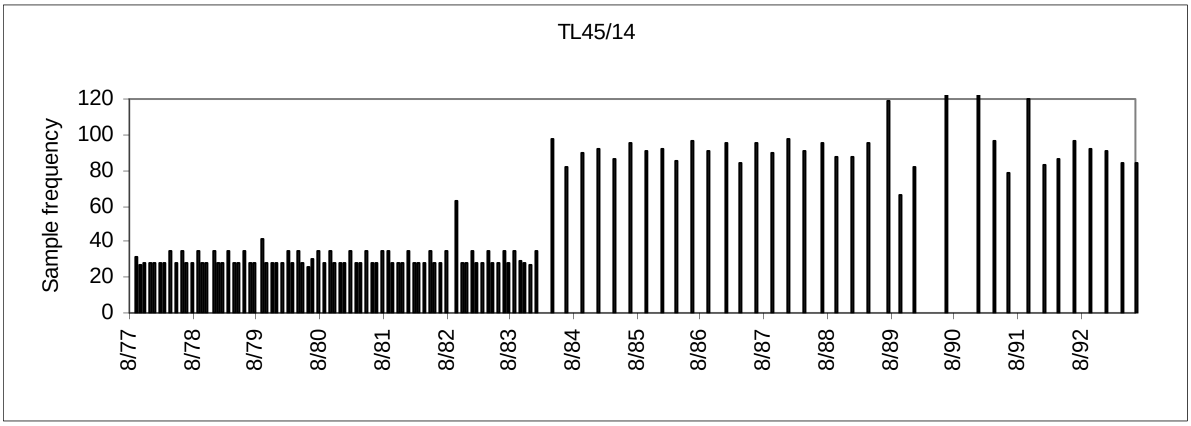


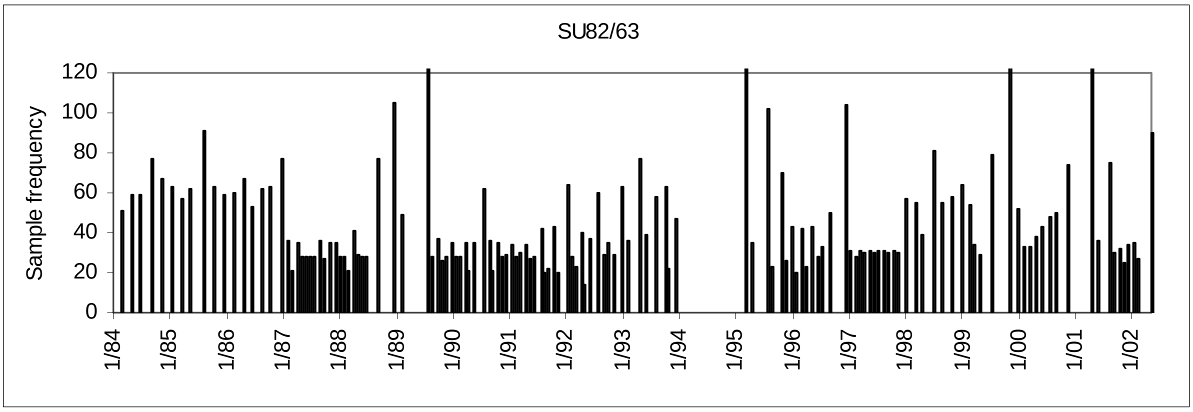



TL45/19
Sample frequency
0
20
40
60
80
100
120
5/73
5/74
5/75
5/76
5/77
5/78
5/79
5/80
5/81
5/82
5/83
5/84
5/85
5/86
5/87
5/88
5/89
5/90
5/91
5/92


SU72/47
Sample frequency
0
10
20
30
40
50
60
8/70
8/71
8/72
8/73
8/74
8/75
8/76
8/77
8/78
8/79
8/80
8/81
8/82
8/83
8/84


TQ41/82
Sample frequency
0
10
20
30
40
50
60
70
4/75
4/77
4/79
4/81
4/83
4/85
4/87
4/89
4/91
4/93
4/95
4/97
4/99
4/01


TL45/14
Sample frequency
0
20
40
60
80
100
120
8/77
8/78
8/79
8/80
8/81
8/82
8/83
8/84
8/85
8/86
8/87
8/88
8/89
8/90
8/91
8/92


SU82/63
Sample frequency
120
100
80
60
40
20
0
1/84
1/85
1/86
1/87
1/88
1/89
1/90
1/91
1/92
1/93
1/94
1/95
1/96
1/97
1/98
1/99
1/00
1/01
1/02

WELLMASTER LOOK-UP TABLE

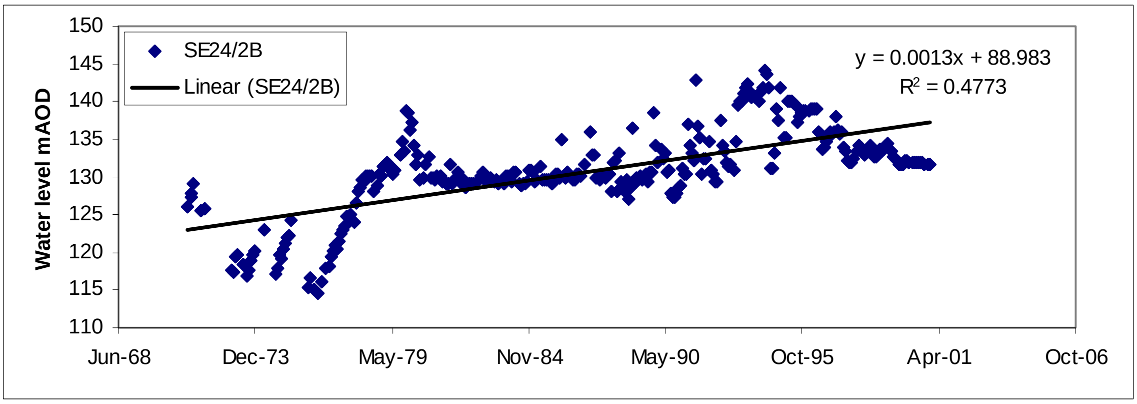
October 15, 1970	**Low**
November 15, 1970	**Average**
December 15, 1970	**High**
January 15, 1971	**Very high**
February 15, 1971	**Very high**
March 15, 1971	**Very high**
April 15, 1971	**Very high**
May 15, 1971	**Very high**
June 15, 1971	**Very high**
July 15, 1971	**High**
August 15, 1971	**High**
September 15, 1971	**Average**
October 15, 1971	**Low**
November 15, 1971	**Low**
December 15, 1971	**Very low**
January 15, 1972	**Very low**
February 15, 1972	**Very low**
March 15, 1972	**Average**
April 15, 1972	**High**
May 15, 1972	**Average**
June 15, 1972	**Average**
July 15, 1972	**Low**
August 15, 1972	**Very low**
September 15, 1972	**Very low**
October 15, 1972	**Very low**
November 15, 1972	**Very low**
December 15, 1972	**Very low**
January 15, 1973	**Very low**
February 15, 1973	**Low**
March 15, 1973	**Low**
April 15, 1973	**Low**
May 15, 1973	**Very low**
June 15, 1973	**Very low**
July 15, 1973	**Very low**
August 15, 1973	**Very low**
September 15, 1973	**Very low**
October 15, 1973	**Very low**
November 15, 1973	**Very low**
December 15, 1973	**Very low**
January 15, 1974	**Very low**
February 15, 1974	**High**
March 15, 1974	**Very high**
April 15, 1974	**Very high**
May 15, 1974	**Average**
June 15, 1974	**Low**
July 15, 1974	**Very low**
August 15, 1974	**Very low**
September 15, 1974	**Very low**
October 15, 1974	**Very low**
November 15, 1974	**Very high**
December 15, 1974	**Very high**
January 15, 1975	**Very high**
February 15, 1975	**Very high**
March 15, 1975	**Very high**
April 15, 1975	**Very high**
May 15, 1975	**Very high**
June 15, 1975	**Very high**
July 15, 1975	**High**
August 15, 1975	**High**
September 15, 1975	**Low**
October 15, 1975	**Average**
November 15, 1975	**Low**
December 15, 1975	**Average**
January 15, 1976	**Average**
February 15, 1976	**Low**
March 15, 1976	**Low**
April 15, 1976	**Very low**
May 15, 1976	**Very low**
June 15, 1976	**Very low**
July 15, 1976	**Very low**
August 15, 1976	**Very low**
September 15, 1976	**Very low**
October 15, 1976	**Very low**
November 15, 1976	**Very low**
December 15, 1976	**Very high**
January 15, 1977	**High**
February 15, 1977	**Very high**
March 15, 1977	**Very high**
April 15, 1977	**Very high**
May 15, 1977	**Very high**
June 15, 1977	**High**
July 15, 1977	**High**
August 15, 1977	**Average**
September 15, 1977	**Low**
October 15, 1977	**Low**
November 15, 1977	**Very low**
December 15, 1977	**Very low**
January 15, 1978	**Very low**
February 15, 1978	**High**
March 15, 1978	**High**
April 15, 1978	**Very high**
May 15, 1978	**High**
June 15, 1978	**Very high**
July 15, 1978	**High**
August 15, 1978	**High**
September 15, 1978	**Average**
October 15, 1978	**Average**
November 15, 1978	**Low**
December 15, 1978	**Low**
January 15, 1979	**Low**
February 15, 1979	**Average**
March 15, 1979	**Very high**
April 15, 1979	**Very high**
May 15, 1979	**Very high**
June 15, 1979	**Very high**
July 15, 1979	**Average**
August 15, 1979	**Average**
September 15, 1979	**Low**
October 15, 1979	**Low**
November 15, 1979	**Very low**
December 15, 1979	**Very low**
January 15, 1980	**Low**
February 15, 1980	**Very high**
March 15, 1980	**Very high**
April 15, 1980	**Very high**
May 15, 1980	**High**
June 15, 1980	**High**
July 15, 1980	**Average**
August 15, 1980	**Average**
September 15, 1980	**Low**
October 15, 1980	**Low**
November 15, 1980	**Low**
December 15, 1980	**Average**
January 15, 1981	**High**
February 15, 1981	**High**
March 15, 1981	**High**
April 15, 1981	**Very high**
May 15, 1981	**Very high**
June 15, 1981	**High**
July 15, 1981	**High**
August 15, 1981	**High**
September 15, 1981	**Average**
October 15, 1981	**Average**
November 15, 1981	**High**
December 15, 1981	**High**
January 15, 1982	**Very high**
February 15, 1982	**High**
March 15, 1982	**High**
April 15, 1982	**High**
May 15, 1982	**High**
June 15, 1982	**High**
July 15, 1982	**Average**
August 15, 1982	**Average**
September 15, 1982	**Low**
October 15, 1982	**Low**
November 15, 1982	**Average**
December 15, 1982	**Very high**
January 15, 1983	**Very high**
February 15, 1983	**Very high**
March 15, 1983	**Very high**
April 15, 1983	**Very high**
May 15, 1983	**Very high**
June 15, 1983	**Very high**
July 15, 1983	**Very high**
August 15, 1983	**High**
September 15, 1983	**Average**
October 15, 1983	**Average**
November 15, 1983	**Low**
December 15, 1983	**Low**

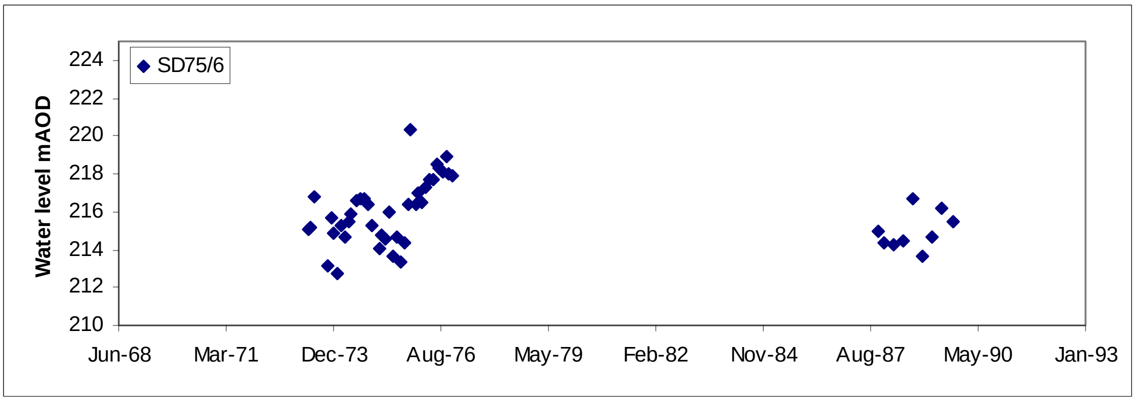
January 15, 1984	**Average**
February 15, 1984	**High**
March 15, 1984	**High**
April 15, 1984	**High**
May 15, 1984	**High**
June 15, 1984	**High**
July 15, 1984	**High**
August 15, 1984	**Average**
September 15, 1984	**Average**
October 15, 1984	**Low**
November 15, 1984	**Very low**
December 15, 1984	**Average**
January 15, 1985	**Average**
February 15, 1985	**High**
March 15, 1985	**High**
April 15, 1985	**Very high**
May 15, 1985	**High**
June 15, 1985	**High**
July 15, 1985	**Average**
August 15, 1985	**Average**
September 15, 1985	**Average**
October 15, 1985	**Low**
November 15, 1985	**Low**
December 15, 1985	**Average**
January 15, 1986	**High**
February 15, 1986	**Very high**
March 15, 1986	**High**
April 15, 1986	**Very high**
May 15, 1986	**Very high**
June 15, 1986	**Very high**
July 15, 1986	**High**
August 15, 1986	**High**
September 15, 1986	**Average**
October 15, 1986	**Low**
November 15, 1986	**Average**
December 15, 1986	**Average**
January 15, 1987	**Average**
February 15, 1987	**Very low**
March 15, 1987	**Very low**
April 15, 1987	**High**
May 15, 1987	**Low**
June 15, 1987	**Average**
July 15, 1987	**Low**
August 15, 1987	**Very low**
September 15, 1987	**Very low**
October 15, 1987	**Low**
November 15, 1987	**Very high**
December 15, 1987	**High**
January 15, 1988	**High**
February 15, 1988	**Very high**
March 15, 1988	**Very high**
April 15, 1988	**Very high**
May 15, 1988	**Very high**
June 15, 1988	**Very high**
July 15, 1988	**Very high**
August 15, 1988	**High**
September 15, 1988	**Average**
October 15, 1988	**Average**
November 15, 1988	**Low**
December 15, 1988	**Low**
January 15, 1989	**Low**
February 15, 1989	**Average**
March 15, 1989	**High**
April 15, 1989	**High**
May 15, 1989	**Average**
June 15, 1989	**Low**
July 15, 1989	**Very low**
August 15, 1989	**Low**
September 15, 1989	**Very low**
October 15, 1989	**Very low**
November 15, 1989	**Very low**
December 15, 1989	**Very low**
January 15, 1990	**Very low**
February 15, 1990	**High**
March 15, 1990	**High**
April 15, 1990	**Average**
May 15, 1990	**Average**
June 15, 1990	**Low**
July 15, 1990	**Very low**
August 15, 1990	**Very low**
September 15, 1990	**Very low**
October 15, 1990	**Very low**
November 15, 1990	**Very low**
December 15, 1990	**Very low**
January 15, 1991	**Average**
February 15, 1991	**Low**
March 15, 1991	**Average**
April 15, 1991	**Average**
May 15, 1991	**Average**
June 15, 1991	**Low**
July 15, 1991	**Average**
August 15, 1991	**Average**
September 15, 1991	**Low**
October 15, 1991	**Very low**
November 15, 1991	**Very low**
December 15, 1991	**Low**
January 15, 1992	**Very low**
February 15, 1992	**Very low**
March 15, 1992	**Very low**
April 15, 1992	**Low**
May 15, 1992	**Low**
June 15, 1992	**Low**
July 15, 1992	**Low**
August 15, 1992	**Very low**
September 15, 1992	**Very low**
October 15, 1992	**Very low**
November 15, 1992	**Low**
December 15, 1992	**Average**
January 15, 1993	**Average**
February 15, 1993	**High**
March 15, 1993	**Average**
April 15, 1993	**Average**
May 15, 1993	**Average**
June 15, 1993	**Low**
July 15, 1993	**Low**
August 15, 1993	**Low**
September 15, 1993	**Very low**
October 15, 1993	**Low**
November 15, 1993	**Low**
December 15, 1993	**Average**
January 15, 1994	**Very high**
February 15, 1994	**Very high**
March 15, 1994	**Very high**
April 15, 1994	**Very high**
May 15, 1994	**Very high**
June 15, 1994	**Very high**
July 15, 1994	**High**
August 15, 1994	**High**
September 15, 1994	**High**
October 15, 1994	**High**
November 15, 1994	**High**
December 15, 1994	**Very high**
January 15, 1995	**Very high**
February 15, 1995	**Very high**
March 15, 1995	**Very high**
April 15, 1995	**Very high**
May 15, 1995	**Very high**
June 15, 1995	**Very high**
July 15, 1995	**High**
August 15, 1995	**High**
September 15, 1995	**Average**
October 15, 1995	**Average**
November 15, 1995	**Average**
December 15, 1995	**Average**
January 15, 1996	**Average**
February 15, 1996	**Average**
March 15, 1996	**Average**
April 15, 1996	**Average**
May 15, 1996	**Average**
June 15, 1996	**Low**
July 15, 1996	**Low**
August 15, 1996	**Low**
September 15, 1996	**Very low**
October 15, 1996	**Very low**
November 15, 1996	**Very low**
December 15, 1996	**Very low**
January 15, 1997	**Very low**
February 15, 1997	**Very low**
March 15, 1997	**Very low**

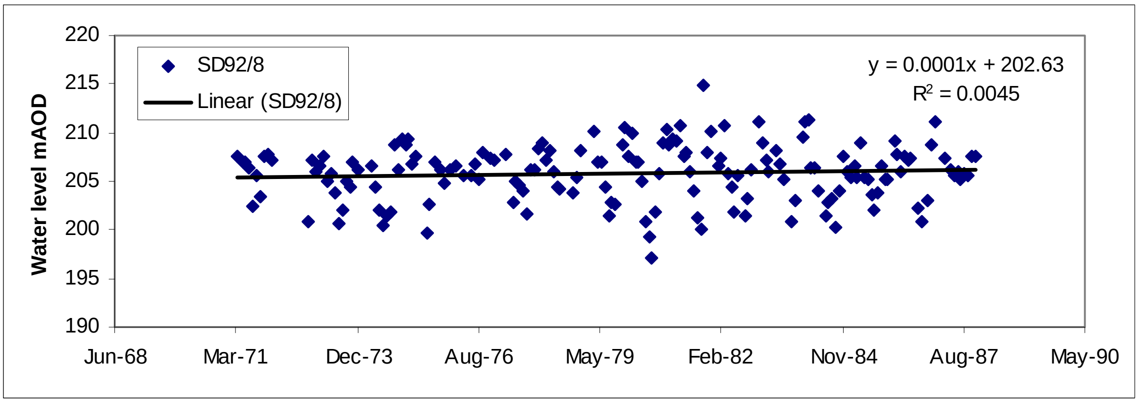
April 15, 1997	**High**
May 15, 1997	**Low**
June 15, 1997	**Very low**
July 15, 1997	**Very low**
August 15, 1997	**Very low**
September 15, 1997	**Very low**
October 15, 1997	**Very low**
November 15, 1997	**Very low**
December 15, 1997	**Very low**
January 15, 1998	**High**
February 15, 1998	**Average**
March 15, 1998	**High**
April 15, 1998	**High**
May 15, 1998	**High**
June 15, 1998	**High**
July 15, 1998	**Average**
August 15, 1998	**Average**
September 15, 1998	**Average**
October 15, 1998	**Low**
November 15, 1998	**Low**
December 15, 1998	**Average**
January 15, 1999	**High**
February 15, 1999	**High**
March 15, 1999	**Very high**
April 15, 1999	**Very high**
May 15, 1999	**Very high**
June 15, 1999	**High**
July 15, 1999	**Average**
August 15, 1999	**Low**
September 14, 1999	**Low**
October 15, 1999	**Low**
November 15, 1999	**Very low**
December 15, 1999	**Very low**
January 15, 2000	**Low**
February 15, 2000	**Low**
March 15, 2000	**Average**
April 15, 2000	**Average**
May 15, 2000	**Average**
June 15, 2000	**Average**
July 15, 2000	**Average**
August 15, 2000	**Average**
September 15, 2000	**Average**
October 15, 2000	**High**
November 15, 2000	**Very high**
December 15, 2000	**Very high**
January 15, 2001	**Very high**
February 15, 2001	**Very high**
March 15, 2001	**Very high**
April 15, 2001	**Very high**
May 15, 2001	**Very high**
June 15, 2001	**Very high**
July 15, 2001	**Very high**
August 15, 2001	**Very high**
September 15, 2001	**Very high**
October 15, 2001	**Very high**
November 15, 2001	**Very high**
December 15, 2001	**Very high**
January 15, 2002	**Very high**
February 15, 2002	**Very high**
March 16, 2002	**Very high**
April 15, 2002	**Very high**
May 15, 2002	**Very high**

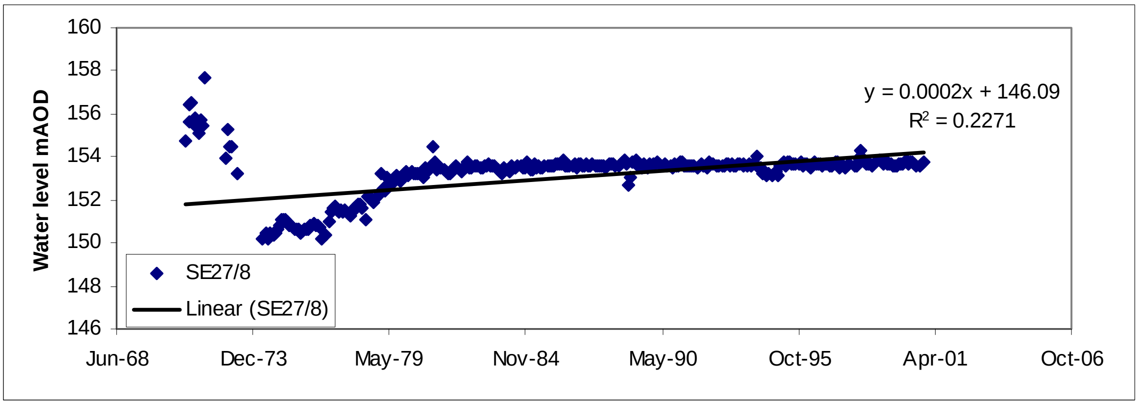
Appendix 10 Millstone Grit

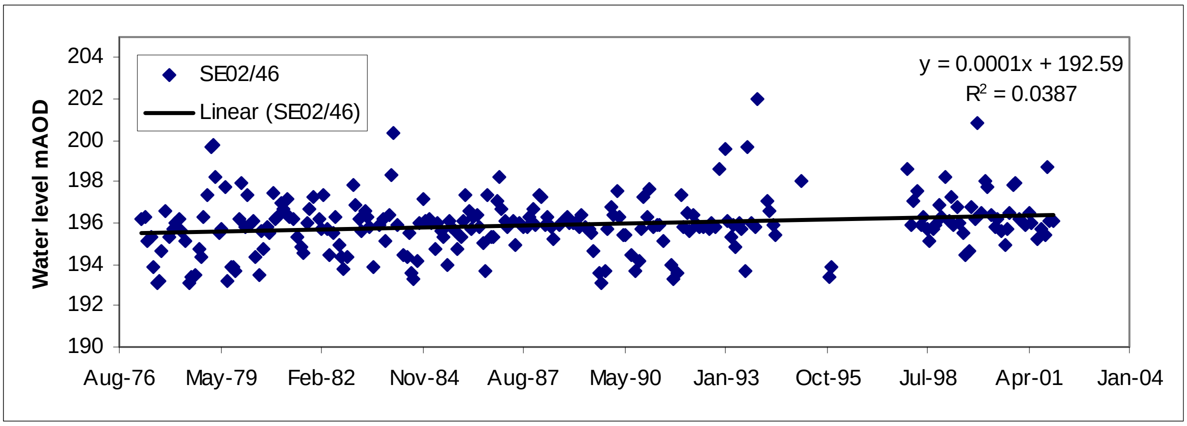
WATER LEVELS ABOVE ORDNANCE DATUM WITH LINEAR REGRESSION CURVE

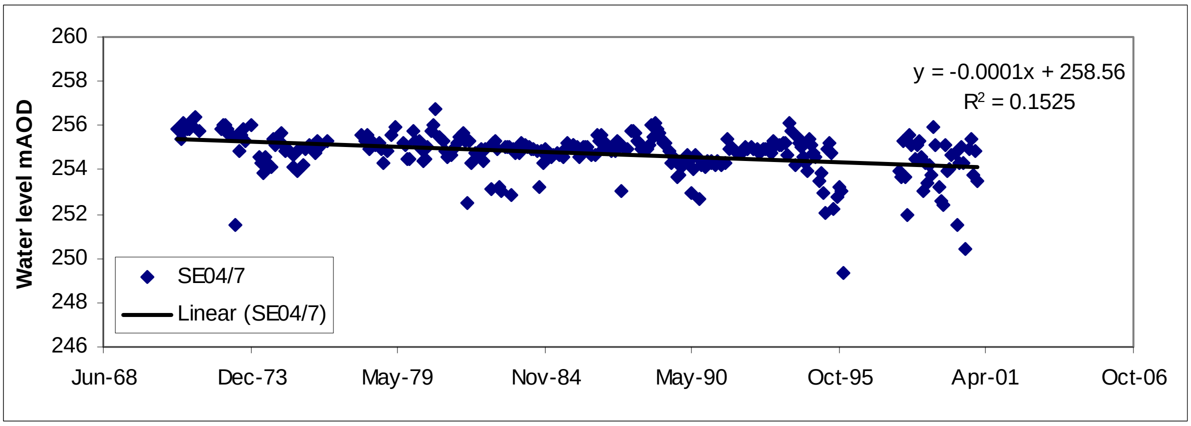


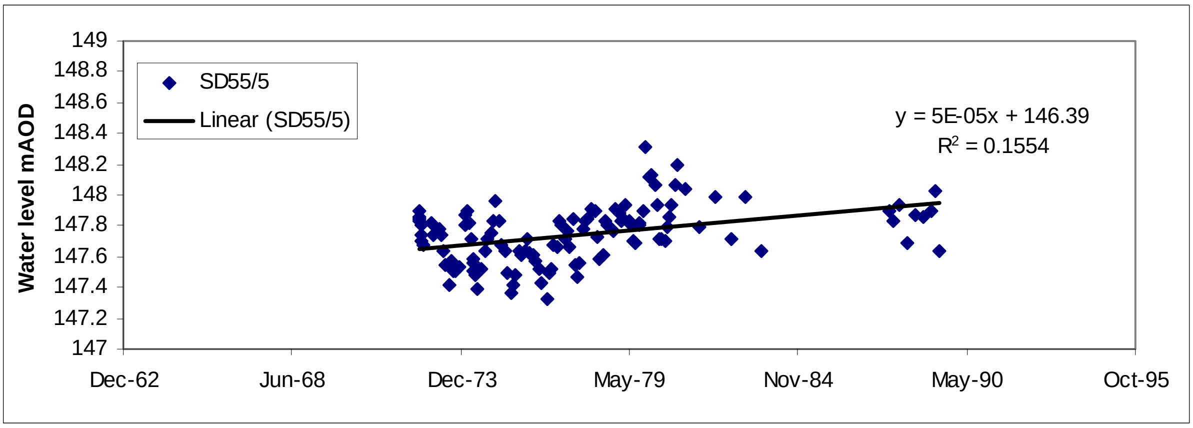


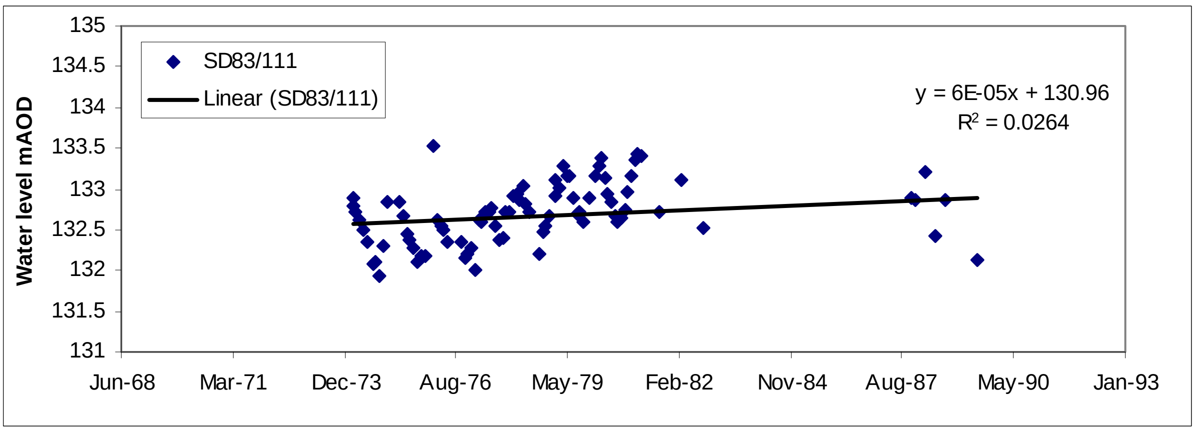




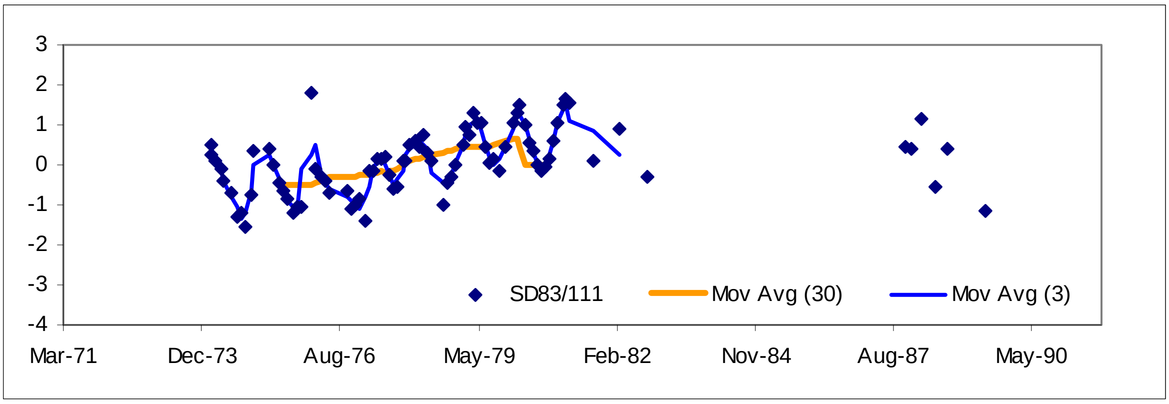

Water level mAOD
204
202
200
198
196
194
192
190
SE02/46
Linear (SE02/46)
y = 0.0001x + 192.59
R² = 0.0387
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93
Oct-95
Jul-98
Apr-01
Jan-04

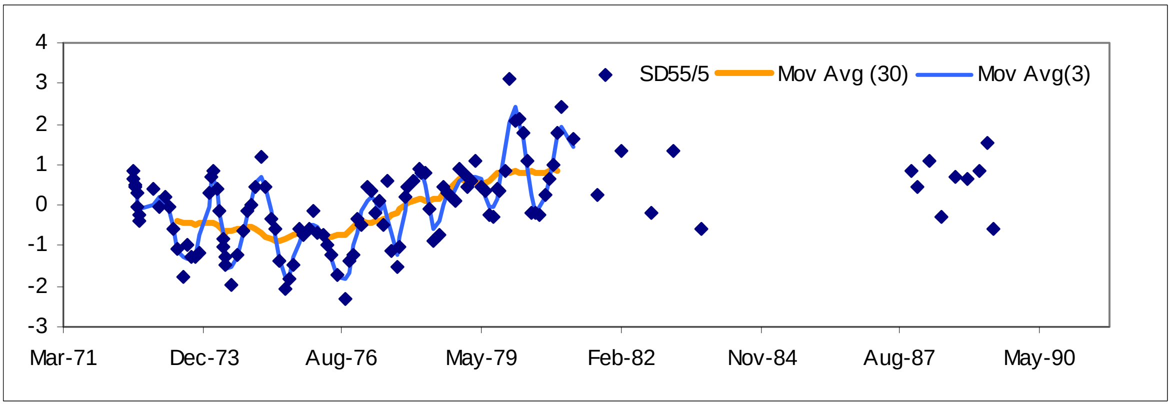

Water level mAOD
260
258
256
254
252
250
248
246
y = -0.0001x + 258.56
R² = 0.1525
SE04/7
Linear (SE04/7)
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01
Oct-06

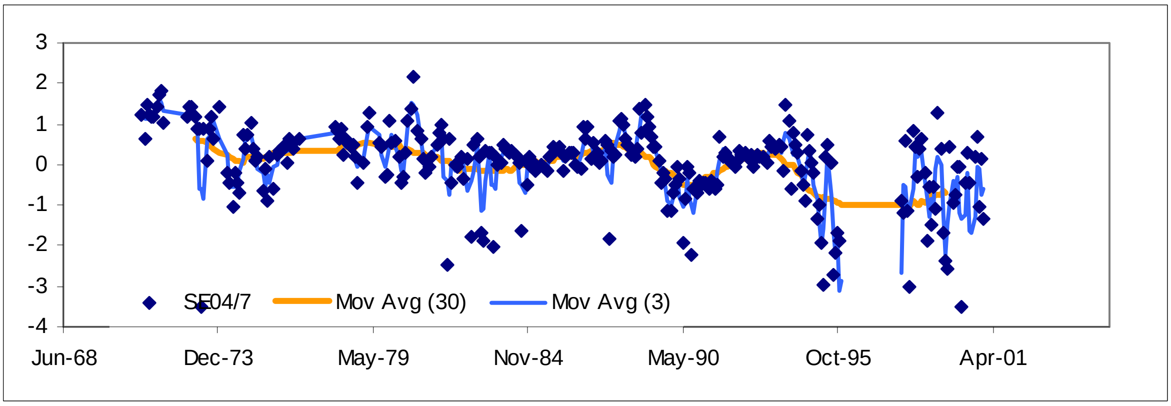

Water level mAOD
149
148.8
148.6
148.4
148.2
148
147.8
147.6
147.4
147.2
147
SD55/5
Linear (SD55/5)
y = 5E-05x + 146.39
R² = 0.1554
Dec-62
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95

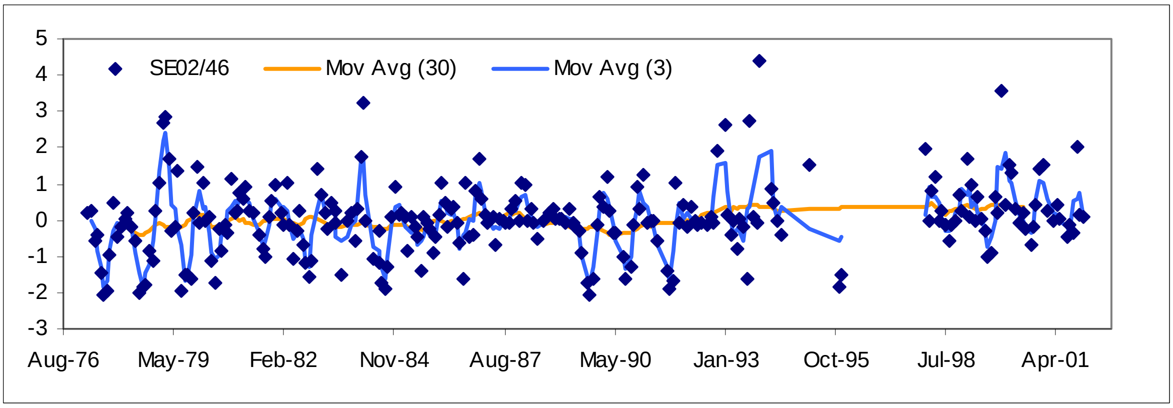

Water level mAOD
135
134.5
134
133.5
133
132.5
132
131.5
131
SD83/111
Linear (SD83/111)
y = 6E-05x + 130.96
R² = 0.0264
Jun-68
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87
May-90
Jan-93

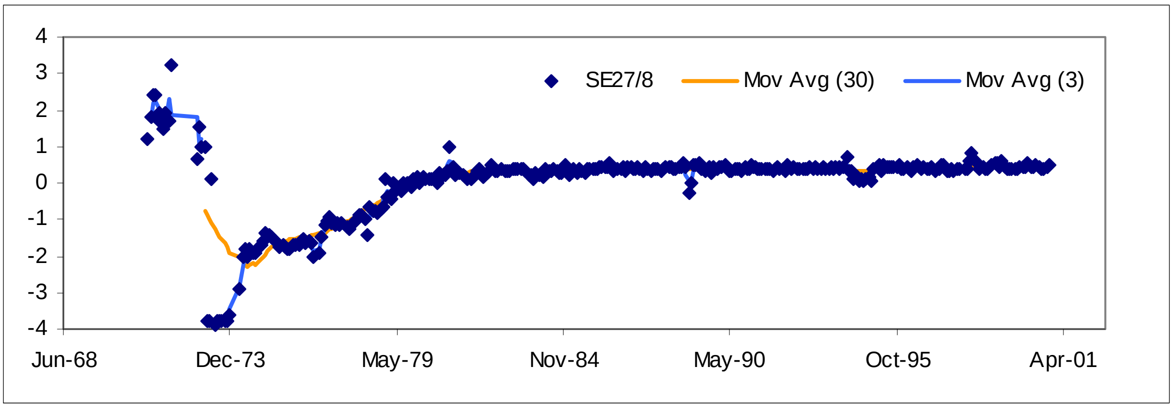
NORMALISED WATER LEVEL DATA WITH MOVING AVERAGES SMOOTHING LINES

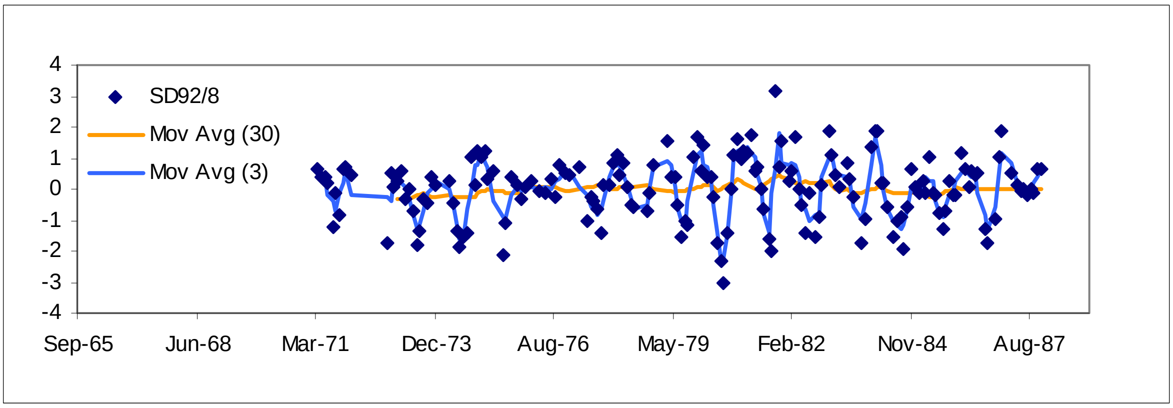


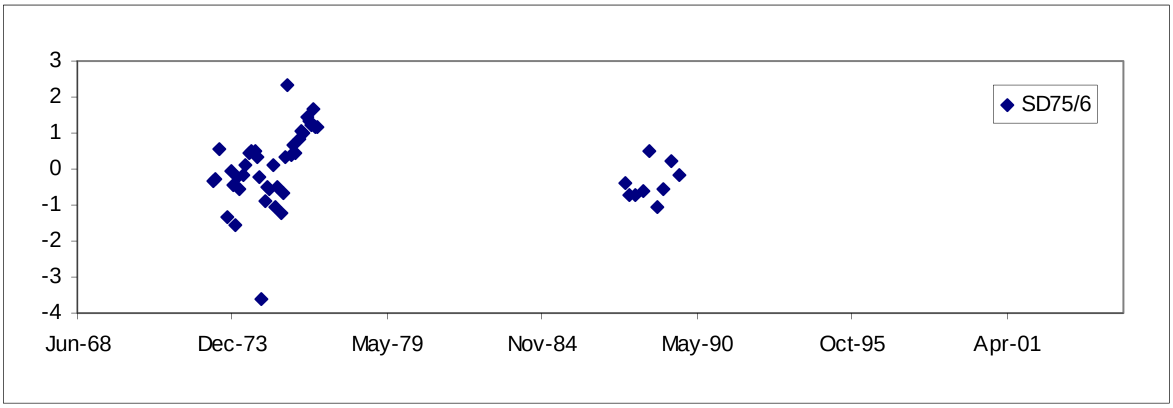


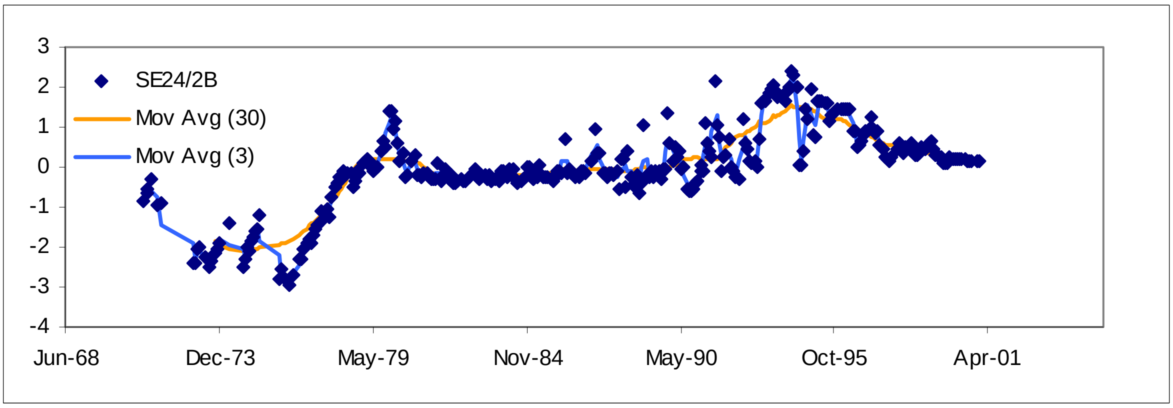




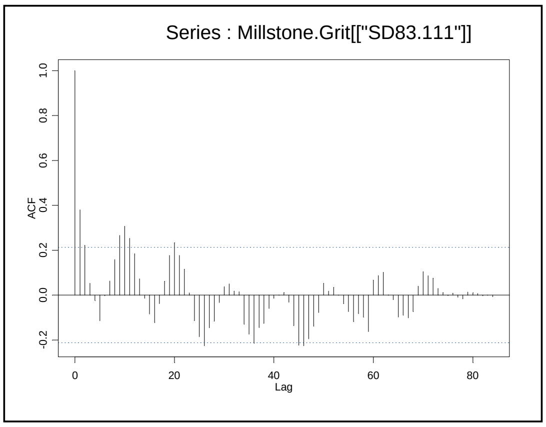

SE27/8
Mov Avg (30)
Mov Avg (3)
4
3
2
1
0
-1
-2
-3
-4
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

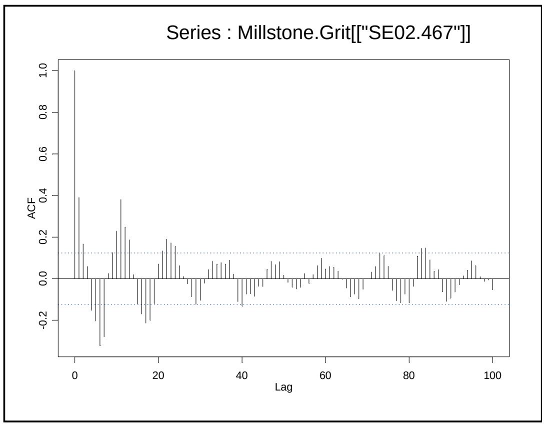

SD92/8
Mov Avg (30)
Mov Avg (3)
4
3
2
1
0
-1
-2
-3
-4
Sep-65
Jun-68
Mar-71
Dec-73
Aug-76
May-79
Feb-82
Nov-84
Aug-87

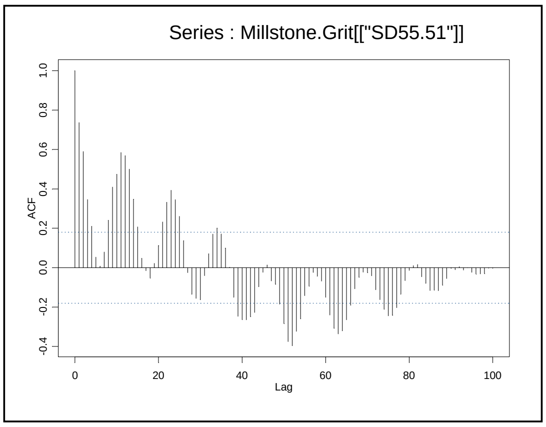

SD75/6
3
2
1
0
-1
-2
-3
-4
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

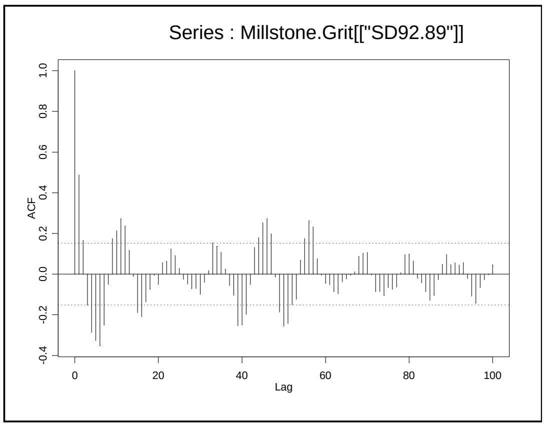

SE24/2B
Mov Avg (30)
Mov Avg (3)
3
2
1
0
-1
-2
-3
-4
Jun-68
Dec-73
May-79
Nov-84
May-90
Oct-95
Apr-01

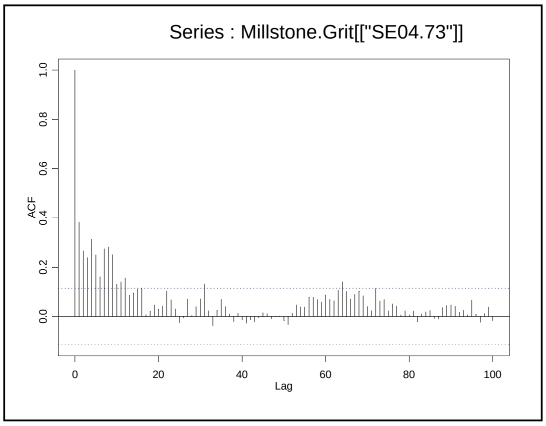
AUTOCORRELATION FUNTION PLOTS

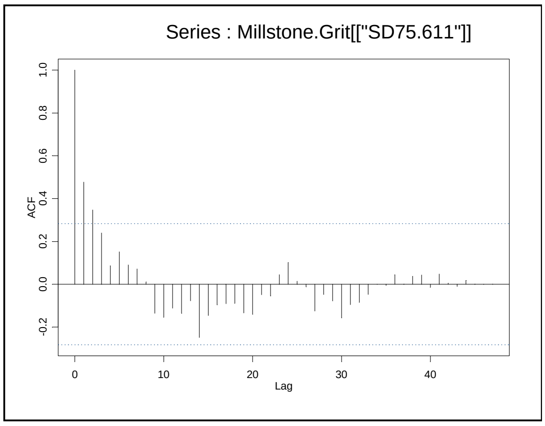


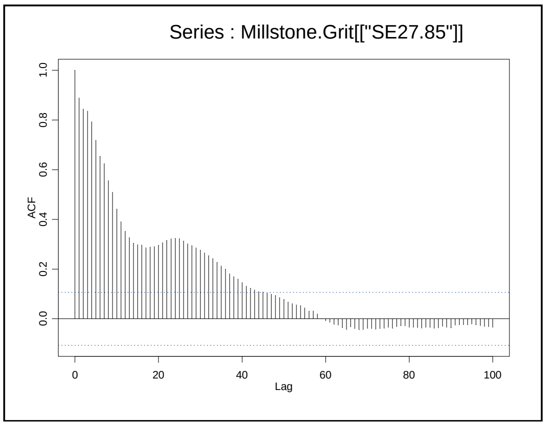


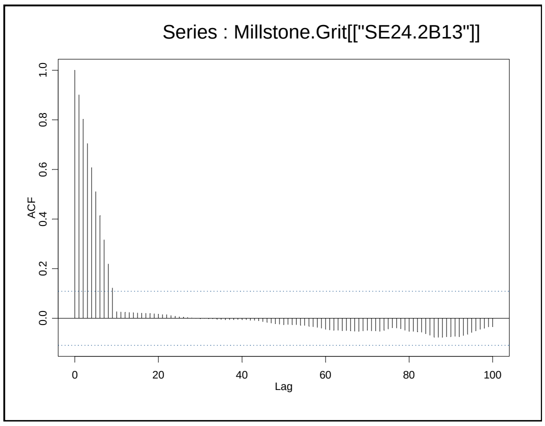




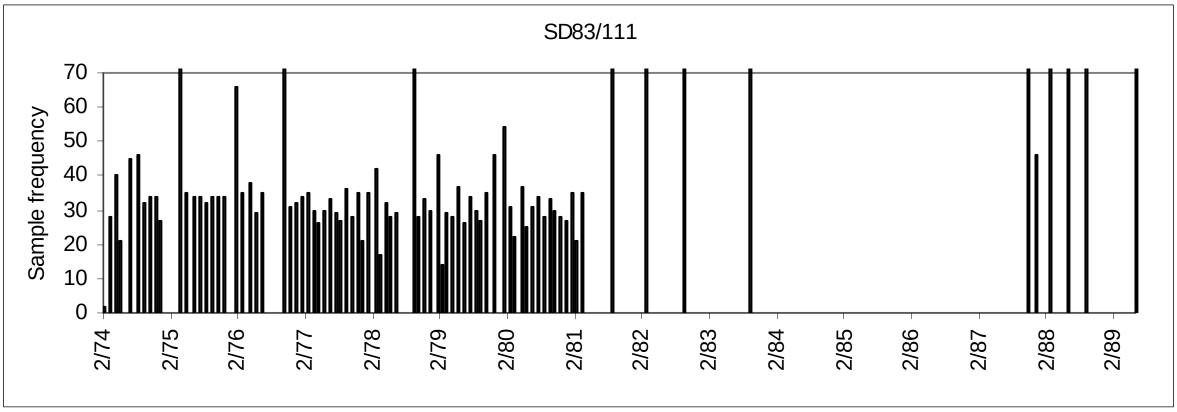


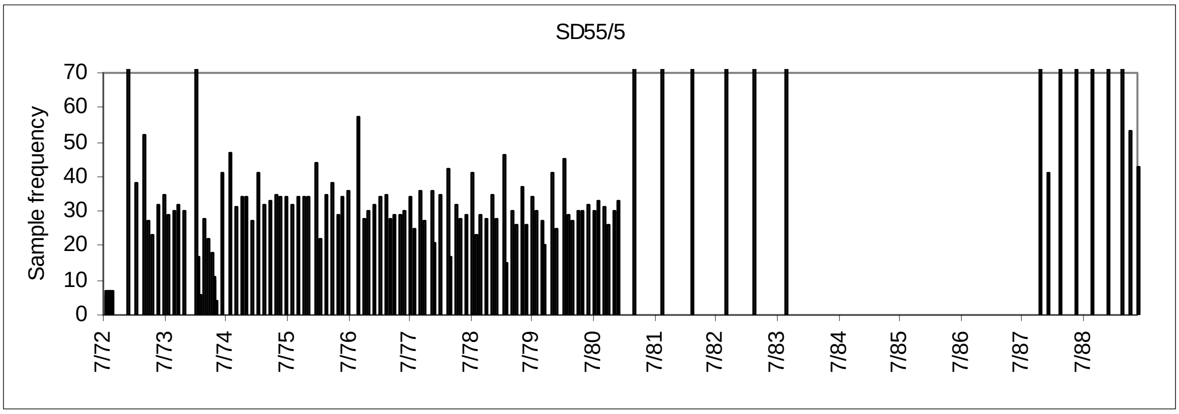


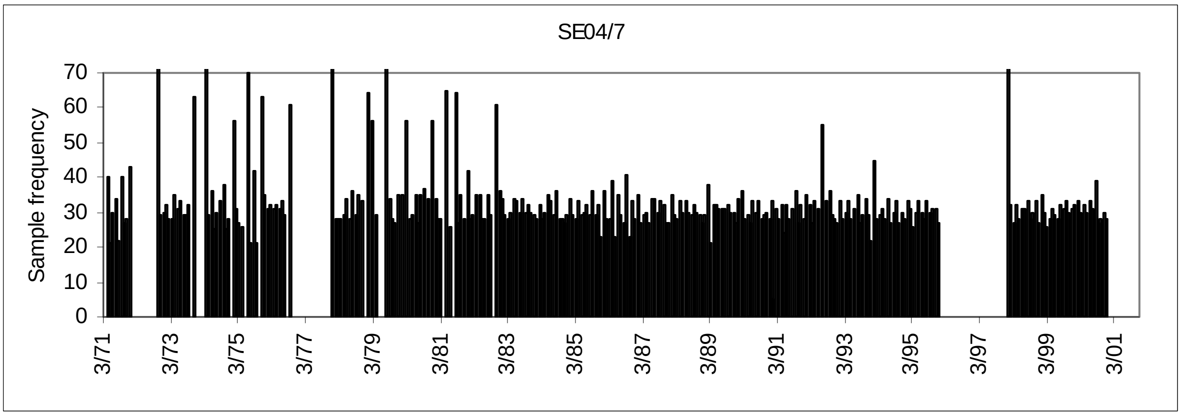


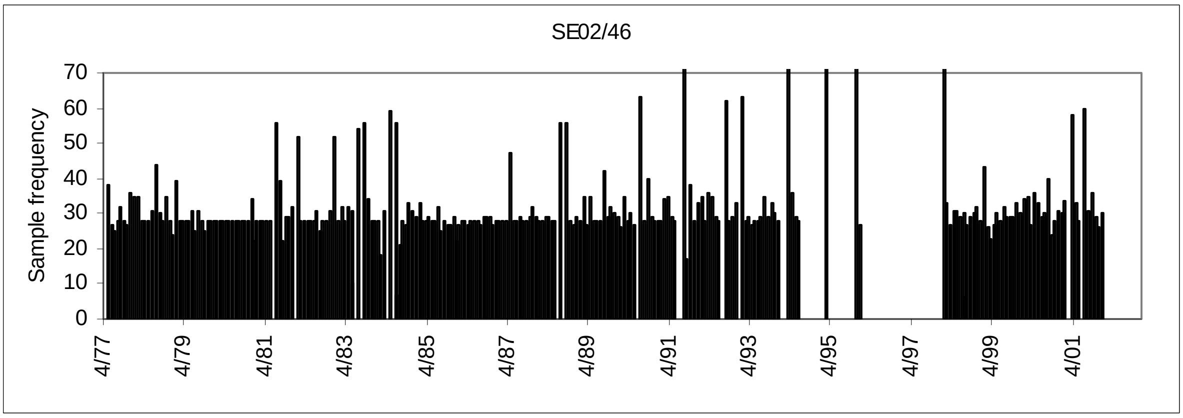


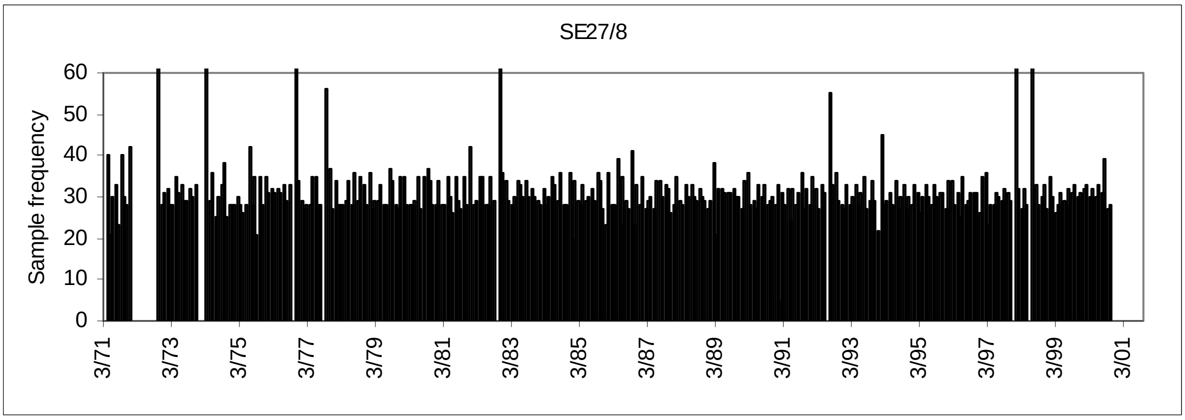
SAMPLE FREQUENCY PLOTS

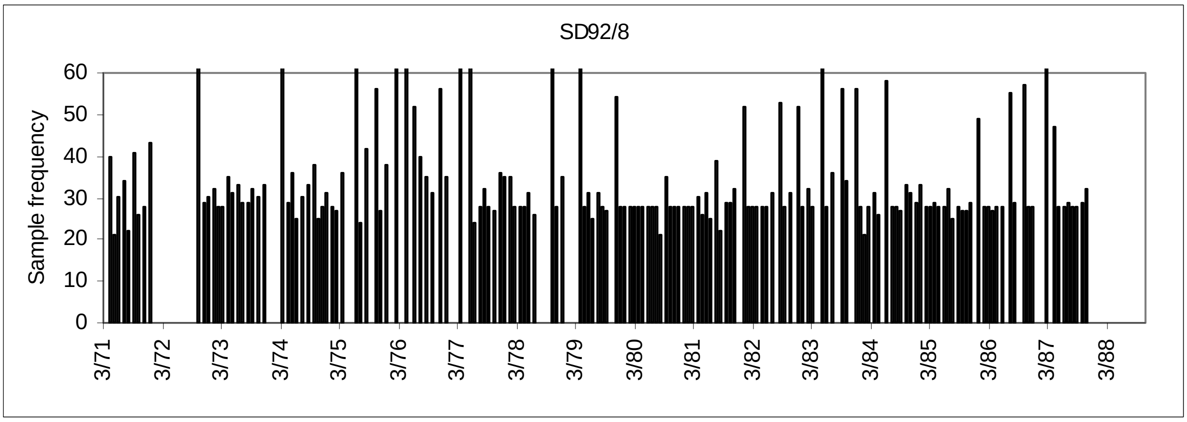


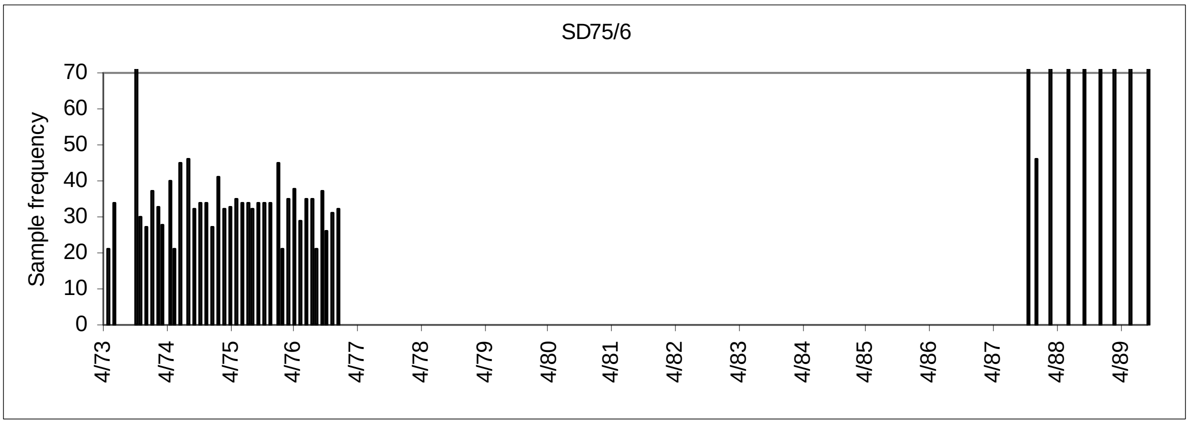







SE27/8
Sample frequency
0
10
20
30
40
50
60
3/71
3/73
3/75
3/77
3/79
3/81
3/83
3/85
3/87
3/89
3/91
3/93
3/95
3/97
3/99
3/01


SD92/8
Sample frequency
0
10
20
30
40
50
60
3/71
3/72
3/73
3/74
3/75
3/76
3/77
3/78
3/79
3/80
3/81
3/82
3/83
3/84
3/85
3/86
3/87
3/88


SD75/6
Sample frequency
0
10
20
30
40
50
60
70
4/73
4/74
4/75
4/76
4/77
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4/83
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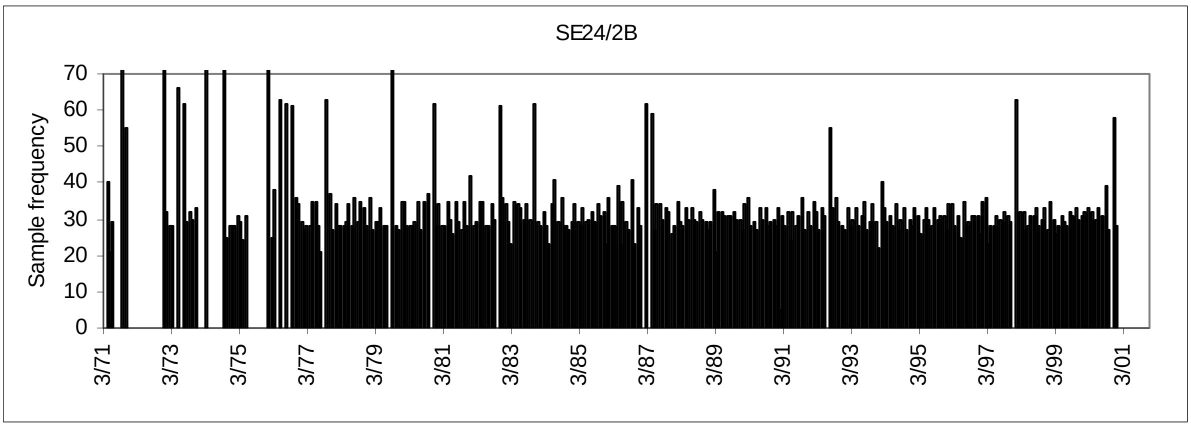
4/86
4/87
4/88
4/89


SE24/2B
Sample frequency
0
10
20
30
40
50
60
70
3/71
3/73
3/75
3/77
3/79
3/81
3/83
3/85
3/87
3/89
3/91
3/93
3/95
3/97
3/99
3/01

WELLMASTER LOOK-UP TABLE

Mar	1974	**Average**	Aug	1978	**Low**	Jan	1983	**Very high**	Jun	1987	**Average**
Apr	1974	**Low**	Sep	1978	**Low**	Feb	1983	**High**	Jul	1987	**Average**
May	1974	**Very low**	Oct	1978	**Low**	Mar	1983	**Low**	Aug	1987	**Average**
Jun	1974	**Very low**	Nov	1978	**Low**	Apr	1983	**Very low**	Sep	1987	**Very low**
Jul	1974	**Very low**	Dec	1978	**High**	May	1983	**High**	Oct	1987	**High**
Aug	1974	**Very low**	Jan	1979	**High**	Jun	1983	**Average**	Nov	1987	**High**
Sep	1974	**Very low**	Feb	1979	**Very high**	Jul	1983	**Low**	Dec	1987	**Average**
Oct	1974	**Average**	Mar	1979	**Very high**	Aug	1983	**Very low**	Jan	1988	**Very high**
Nov	1974	**Low**	Apr	1979	**Very high**	Sep	1983	**Very low**	Feb	1988	**Very high**
Dec	1974	**Low**	May	1979	**High**	Oct	1983	**Low**	Mar	1988	**High**
Jan	1975	**Very high**	Jun	1979	**High**	Nov	1983	**Low**	Apr	1988	**High**
Feb	1975	**Average**	Jul	1979	**High**	Dec	1983	**Very high**	May	1988	**Average**
Mar	1975	**Average**	Aug	1979	**Low**	Jan	1984	**Very high**	Jun	1988	**Low**
Apr	1975	**Average**	Sep	1979	**Low**	Feb	1984	**Very high**	Jul	1988	**Average**
May	1975	**Low**	Oct	1979	**Low**	Mar	1984	**Average**	Aug	1988	**Average**
Jun	1975	**Very low**	Nov	1979	**High**	Apr	1984	**High**	Sep	1988	**High**
Jul	1975	**Very low**	Dec	1979	**Very high**	May	1984	**Low**	Oct	1988	**Very high**
Aug	1975	**Very low**	Jan	1980	**Very high**	Jun	1984	**Very low**	Nov	1988	**High**
Sep	1975	**Low**	Feb	1980	**Very high**	Jul	1984	**Very low**	Dec	1988	**High**
Oct	1975	**Low**	Mar	1980	**Very high**	Aug	1984	**Very low**	Jan	1989	**High**
Nov	1975	**Average**	Apr	1980	**High**	Sep	1984	**Very low**	Feb	1989	**High**
Dec	1975	**Average**	May	1980	**Low**	Oct	1984	**Low**	Mar	1989	**High**
Jan	1976	**High**	Jun	1980	**Very low**	Nov	1984	**High**	Apr	1989	**High**
Feb	1976	**Average**	Jul	1980	**Low**	Dec	1984	**Average**	May	1989	**Average**
Mar	1976	**Average**	Aug	1980	**Low**	Jan	1985	**Average**	Jun	1989	**Low**
Apr	1976	**Average**	Sep	1980	**High**	Feb	1985	**Average**			
May	1976	**Average**	Oct	1980	**Very high**	Mar	1985	**Low**			
Jun	1976	**Low**	Nov	1980	**Very high**	Apr	1985	**High**			
Jul	1976	**Average**	Dec	1980	**Very high**	May	1985	**Low**			
Aug	1976	**Very high**	Jan	1981	**Very high**	Jun	1985	**Low**			
Sep	1976	**Low**	Feb	1981	**Very high**	Jul	1985	**Very low**			
Oct	1976	**Average**	Mar	1981	**Very high**	Aug	1985	**Low**			
Nov	1976	**Low**	Apr	1981	**High**	Sep	1985	**Low**			
Dec	1976	**Average**	May	1981	**High**	Oct	1985	**Low**			
Jan	1977	**Low**	Jun	1981	**Average**	Nov	1985	**Low**			
Feb	1977	**Low**	Jul	1981	**Low**	Dec	1985	**High**			
Mar	1977	**Average**	Aug	1981	**Low**	Jan	1986	**Very high**			
Apr	1977	**Average**	Sep	1981	**Low**	Feb	1986	**High**			
May	1977	**Average**	Oct	1981	**Very high**	Mar	1986	**Average**			
Jun	1977	**Low**	Nov	1981	**High**	Apr	1986	**High**			
Jul	1977	**Average**	Dec	1981	**Very high**	May	1986	**High**			
Aug	1977	**Very low**	Jan	1982	**Low**	Jun	1986	**Average**			
Sep	1977	**Very low**	Feb	1982	**High**	Jul	1986	**Very low**			
Oct	1977	**Low**	Mar	1982	**Very high**	Aug	1986	**Low**			
Nov	1977	**Average**	Apr	1982	**Average**	Sep	1986	**Low**			
Dec	1977	**High**	May	1982	**Low**	Oct	1986	**Low**			
Jan	1978	**High**	Jun	1982	**Low**	Nov	1986	**Very high**			
Feb	1978	**Very high**	Jul	1982	**Average**	Dec	1986	**Very high**			
Mar	1978	**High**	Aug	1982	**Low**	Jan	1987	**High**			
Apr	1978	**Very high**	Sep	1982	**Low**	Feb	1987	**High**			
May	1978	**Average**	Oct	1982	**Very low**	Mar	1987	**Average**			
Jun	1978	**Low**	Nov	1982	**Very low**	Apr	1987	**Average**			
Jul	1978	**Very low**	Dec	1982	**Very high**	May	1987	**Low**			