DRAFT REPORT

Wilson Inlet Groundwater Nutrient Monitoring

Prepared for

Department of Water

South Coast Region

18 December 2007

42906500/654-F8617.0

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Surface/Groundwater
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Date: 18 December 2007
Reference: 42906500/654-F8617.0
Status: Draft

Contents

Executive Summary

The South Coast Region of the Department of Water (DoW) has installed a groundwater monitoring program at potential urban development areas along the foreshore of Wilson Inlet in Denmark. The investigation consisted of a site inspection, groundwater bore installation and water level monitoring, bore hydraulic property tests, groundwater sampling and chemical analysis. These results are being used to evaluate the impact of land use on groundwater quality discharging into the Wilson Inlet.

URS Pty Ltd was engaged by the DoW to provided technical advice on groundwater monitoring and data analysis. The scope of work is limited by the budget. This progress report summarises the monitoring information based on available information. It also provides a recommendation for the on-going and further work.

This report provides only a brief summary of the result, and a general report structure and methodology. There are significant data gaps which should be filled when funds are available.

Section 1 Introduction

Wilson Inlet is a shallow, seasonally closed estuary located in Denmark, on the south coast of Western Australia (Figure 1). The inlet has a surface area of about 48 km^2, about 14 km long from east to west and 4 km wide. The average depth of the inlet is less than 2 m. Huizinga (2003) estimated that Wilson Inlet has a volume of about 90GL at 0 m AHD and 130GL at 1 m AHD.

Wilson Inlet receives discharge from rivers, constructed drains, surface runoff, and groundwater from a catchment of 2280 km^2 (Lukatelich, et al., 1987). The major rivers are the Denmark River and the Hay River, and the minor ones are the Sleeman River, Cuppup Creek and the Little River. Deep drainage systems have been constructed in the Sleeman and Cuppup catchment by the Water Corporation to reduce groundwater recharge and waterlogging. The distribution of surface runoff follows the rainfall pattern. The runoff coefficient (proportion of runoff to rainfall) is in the order of 0.2-0.3 near the coast and decreases markedly inland. Groundwater interacts with the rivers and the inlet.

A sand bar blocks the Inlet from late January to August. The width of the opening at the mouth is between 100 to 150 m. The Inlet is separated into two basins: western and eastern (Hodgkin and Clark 1988). During the summer months, Wilson Inlet becomes stratified and a large influx of nutrients causes eutrophication. It was estimated that the rivers bring over 200 tonnes of Nitrogen and 10 tones of phosphorus into the inlet every year. The ruppia which grows in the Inlet also has a foul smell which becomes offensive to tourists and local residents near the Inlet. In recent years, the bar was artificially opened every September to increase the circulation and outflow and therefore flush out the nutrient-rich water. The bar open can generate over 1 m drawdown in groundwater level based on an experience by the Water and Rivers Commission (1998).

Land use, especially potential urban development along the inlet foreshore causes environmental concern. Yu (1998) has identified some hot spots where high nutrient concentrations were detected in groundwater. The study also estimated that the annual nutrient load discharged from groundwater into the inlet is 498 kg of nitrogen and 35 kg of phosphorous, contributed as diffusive source from the sand dune and weathered granite areas.

The diffuse sources were related to applications of fertilisers on the agricultural land in the upper catchment, while the unsewered commercial activities along the inlet foreshore produced point sources and posed potential threats to the health of the inlet.

The project included a site inspection, drilling and installing monitoring bores, groundwater sampling, and data analysis. Before joining URS, Wen Yu was a Senior Hydrogeologist in the DoW and was involved in providing technical advice to the project. A limited fund was provided to URS for wrapping up the work.

Section 2 Hydrogeological Setting

2.1 Climate

The climate in the study area is typically Mediterranean with mild, wet winters and warm to hot dry summers. Mean annual rainfall at Denmark is around 1200 mm. Highest rainfall generally occur in June and the lowest rainfall in January. About 75 per cent of rain falls during May to October when average monthly rainfall exceeds average monthly pan evaporation. Rainfall isohyets representing average annual rainfall range from 1200 in the west to 600 mm in the east.

2.2 Major Land Use Activities

Residential and commercial activities in Denmark have been carried out mainly on the northern shore of Wilson Inlet, predominantly at the Denmark town site, and to the west of the town. At present over 80 per cent of householders and 51 per cent of commercial premises use septic systems for waste water disposal in the urban areas (Denmark Environmental Centre Inc, 1995).

Areas to the east and south east of the township are predominantly agricultural land where sheep and cattle farming are often incorporated with some oats and barley cropping. The remaining area is covered by native forest. At the south eastern part of the inlet where soils are loamy red earths or sandy peat associated with granite outcrop, potato and fruit and vegetable growing are the main land use activities.

The peninsula on the southern shore of the inlet is largely covered with native forest with limited agricultural and horticultural activities.

2.3 Geology

The study area is situated within the Bremer Basin and is underlain by sediments which are Tertiary to Quaternary in age. Sediments of Quaternary age are found at the coast and on the peninsula to the south of the inlet. These consist of calcareous sand of eolian origin up to 20 m thick, and silty and clayey estuarine sediments. In the valleys of the Hay and Sleeman Rivers, alluvial deposits occur which comprise sand, silty sand, clay and peat. The alluvial sediments overly a thick layer of weathered granite rocks (Figure 2).

The eolian sediments are underlain by sediments of the Werillup Formation of Tertiary age. The formation is comprised of limestone, siltstone, sandstone, peat and basal conglomerates. The distribution of this formation is limited in Rudgyard area. The formation is moderately weathered. It outcrops as isolated limestone caps or as laterite sediments.

The basement rock consists of granitoid rock, granitoid geniss, and / or quartzite. The top portion of the rocks is generally weathered to clayey sand, and clay.

2.4 Groundwater Occurrence

The occurrence of groundwater is determined by geological conditions. There are three main aquifer types around Wilson Inlet: a porous medium aquifer in sand dunes of Quaternary age; localised aquifers within weathered granite of basement rock; and aquifers formed by structural fractures in basement rock. Groundwater flows generally towards Wilson Inlet except in the southern part of the peninsula where a groundwater divide separates flow to the inlet and the ocean. Groundwater levels respond rapidly to the opening of the sand bar at the mouth of the inlet, and it is likely that this feature exerts a strong control on

Section 2 Hydrogeological Setting

the rate of groundwater flow to Wilson Inlet. Groundwater levels vary significantly over the season, responding rapidly to rainfall.

2.5 Groundwater Chemistry

Yu (1998) has carried out a hydrogeological investigation around the inlet. In the sand dune area situated on the southern shore, groundwater is fresh to slightly brackish with TDS (Total Dissolved Salts) ranging from 500 to 1500 mg/L. Water types are either Na-Ca-Cl-HCO_3 or Ca-Na-HCO_3-Cl. The high calcium content is due to the dissolution of calcareous materials in the coastal sediments. Groundwater in the weathered granite area is highly saline with TDS ranging from 10,000 - 50,000 mg/L. The water type is either Na-Cl or Na-Mg-Cl-SO_4. Groundwater in the fractured rock area is fresh with TDS ranging from 130 to 600 mg/L. The water type is Na-Cl or Na-Cl-HCO_3, similar to the rainwater.

Section 3 Installation of Monitoring Bores

A network of 13 monitoring bores (WIG01 to WIG13) were drilled, logged and constructed between 1st and 5th May 2006, the bore logs have been completed and attached is an example of a bore completion report (WIG02). WIG01 & WIG02, WIG03 & WIG04, WIG05 & WIG06 and WIG08 & WIG09 make up four transects of different sections of the aquifer immediately adjacent to Wilson Inlet.

The bore locations were selected based on the land use, geology and the estimated groundwater flow pattern. Drilling was undertaken using a Geo-Probe Direct Push method with 25 mm ID PVC pipe.

Bore strata logs and bore construction details are in Appendix A.

The drilling has intercepted a shallow sediment profile at all sites, which comprise top sandy soil, green clay and the weathered granite. The average thickness of the profile is above 3 to 6 m. Depth to static watertable is between 1 to 4.7 m. Overall, the shallow aquifer saturated thickness is about 2 to 4 m, suggesting a low yield and low storage characteristics.

Slug tests were carried out manually. The tests included short duration pumping tests with drawdown and recovery measurement. The result is in Appendix A. This data can be used to calculate the hydraulic conductivity, K of the aquifer.

Section 4 Groundwater Sampling

The monthly groundwater sampling was carried out by the DoW South Coast Region. The sampling program was designed to obtain data about chemical properties and seasonal variations of the nutrient concentrations. The sampling program is described below:

4.1 Groundwater Level

The depth to watertable (SWL) was measured every month, and the result is shown in Appendix B. Depth to watertable ranges from over 1 m to 4.7 m. Watertable fluctuate with season, and ranges from 0.5 m near the foreshore to over 2.5 m far away from the foreshore. However, watertable in Bores WIG09 to WIG13 show much smaller seasonal fluctuations. Groundwater hydraulic gradients along transects need to be estimated for calculating nutrient loads.

4.2 Sampling

Groundwater samples were collected on a monthly basis. Each bore was purged in order to provide a representative groundwater sample. The purging consisted of removal of three “casing volumes” of groundwater. In some cases, the slotted section of a monitoring bore was in lower permeability strata and the monitoring bore was pumped dry three times prior to the sampling. The sample containers used were 500ml high density polyethylene bottles. The sample bottle and lid were thoroughly rinsed three times with the groundwater before the sample was collected. The sample bottle was filled completely to ensure that no air bubbles were present. The sample bottle was immediately transferred to the cooler box.

Laboratory analysis included major ions, nitrogen (TN, NO2, NO3 and NH4) and phosphorus (TP, PO4), pH and TDS. Appendix B shows groundwater quality diagrams.

4.3 Field Measurements

Field measurements were carried out using colorimetric test kits and portable meters. Conditions and procedures of the measurement were observed in accordance with the instruction manuals. The meters were calibrated against standard buffer solutions before usage. All electrodes of the meters were decontaminated using deionised water after each measurement. The parameters measured by portable meters included electrical conductivity (EC, in µS/cm), redox potential (Eh, in mV), pH and temperature.

4.4 Brief Data Interpretation

Groundwater salinity varies with location and season. WIG02 shows a typical salinity pattern. The salinity level is about 700 uS/cm in September, and is about 1,700 uS/cm between December and May. However, many bores, especially those having fresh groundwater (EC < 1000 uS/cm) in the summer, have stable salinity.

Groundwater pH changes significantly with location and season. It ranges from 4.5 to 6.7 and show very different seasonal trends between the bores.

The background groundwater nitrogen (TN) level is about 5 mg/L, with exception of Bores WIG04 (12 mg/L), WIG06 (6 mg/L), and WIG12 (9 mg/L). Nitrogen levels are generally higher in the winter.

Section 4 Groundwater Sampling

The background phosphorous (TP) level is below 1 mg/L, with exception of WIG04 (1.2 mg/L). TP levels are generally higher in the winter.

Laboratory chemical results are shown in Appendix C. TKN (Total Kjel Nitrogen) and NH4 (ammonium) are generally the major form of nitrogen. TKN and NH4 are normally stable in the reduced condition with low pH and low redox, and indicate the samples are close to the source of nitrogen.

WIG04 has the highest TN level which comprises predominately NO3 which is in the oxidated Nitrogen form.

It is suggested that WIG04 be monitored closely and a duplicate sample should be take in the next round of sampling.

Section 5 Calculation of Groundwater Nutrient Loads

Nutrient load is a quantitative measure that has been used to estimate risk of eutriphication contributed from groundwater. Yu (1998) provided a method to estimate the groundwater nutrient loads.

Estimate of nutrient load discharged from groundwater into Wilson Inlet consists of two steps: the determination of groundwater discharge into the inlet; and the calculation of nutrient load into the inlet from the groundwater discharge.

5.1 Groundwater Discharge into the Inlet

The groundwater discharge rate was calculated based on Darcy's equation. This calculation is based on the difference in hydraulic heads between the two monitoring bores along each transect, the hydraulic conductivity, and the area of the seepage face. Figure 3 illustrates a cross section of an unconfined aquifer and the relevant parameters. Darcy's equation is expressed as

$$Q = W T I$$

where Q = volume of seepage through a section of shoreline, in m^3/day

W = width of the section, in m

I = hydraulic gradient

T = transmissivity of aquifer at the ***representative transect**** for the section, in m^2/day.

T can be calculated as

$$T = B K$$

where B = thickness of saturated aquifer, in m

K = hydraulic conductivity of the aquifer, in m/day

I is calculated as

$$I = (h_1 - h_2) / L$$

where (h1-h2) = the hydraulic head difference between the two piezometers, in m

L = horizontal distance between the two piezometers, in m

The ***representative transect**** was selected to represent a section of the foreshore area within which hydrogeological conditions and land use activities are considered as being uniform.

5.2 Calculation of Nutrient Load

Nutrient load discharged from groundwater into the inlet is calculated based on the volume of groundwater discharged and the representative nutrient concentrations, expressed as

$$TN_A = Q \text{ Cont } 365 / 1000$$

$$TP_A = Q \text{ Cont } 365 / 1000$$

Section 5 Calculation of Groundwater Nutrient Loads

where TN_A = annual total nitrogen load, in kg /year;

TP_A = annual total phosphorous load, in kg /year;

ContN = ***representative total nitrogen concentration****, in mg/L

ContP = ***representative total phosphorus concentration****, in mg/L

The ***representative total nitrogen concentration**** was the total nitrogen concentration of a groundwater sample collected from a bore at a representative transect. This concentration is used as a representative concentration for a section of the foreshore area within which hydrogeological conditions, land use activities and nitrogen concentration in the groundwater are considered as being uniform. For this preliminary study, the concentration was calculated as the average of the two concentrations from each piezometer in each transect, or as the highest concentration in each transect.

It is recommended that the above method be used to calculate the nutrient loads from different land use areas.

Section 6 Recommendation

It is recommended that the following data analysis and reporting be undertaken so that the result of this investigation can be fully interpreted and presented to the community, and incorporated into the DoW / DEC water management plans.

1. Geochemical interpretation on nutrient transformation and movement.
2. Water quality data be plotted to show seasonal variation.
3. Nutrient loading calculation – This will based on groundwater flux and nutrient concentration. A 2-D finite element model can be used to simulate the groundwater flow process. It is a very important environmental indicator for monitoring and assessing land use impacts.
4. Reporting – It is proposed that the result from this investigation be written up as a report. All data and maps will be produced with the URS standard, and the data format will be consistent with the DoW database and GIS.

The above proposed work will require additional funds. An estimated cost is listed below.

Table 1. Estimated Cost for Proposed Scope of Work

Tasks and Project Staff	Role	Hours	Rate	Amount
Wen Yu Principal Hydrogeologist	Project Manager, data interpretation, reporting	30	$180	$5,400
Lindsay Warwick Surface/Ground Water Engineer	Data analysis and reporting	60	$130	$7,800
			Total	**$13,200**

Section 7 References

Denmark Environment Centre Inc (1995). Understanding and reducing urban impacts on waterways in Denmark Western Australia.

Hodgkin, E.P., Clark, R., 1988. Wilson, Irwin and Parry Inlets, estuaries of the Denmark Shire, Environmental Protection Authority, Perth, Western Australia.

Huizinga, L.A. (2003), A breakwater design for Wilson Inlet, UWA B.Sc. Thesis.

Lukatelich, R.J., Schofield, N.J. and McComb, A.J. (1987), Nutrient loading and macrophyte growth in Wilson Inlet, a Bar-built southwestern Australian Estuary. Estuarine, *Coastal and Shelf Science*, Vol 24, p141-165.

Yu, X. (1998), A preliminary investigation of nutrient loads discharged from groundwater into Wilson Inlet, Denmark, Water and Rivers Commission Hydrogeology Report No. 102.

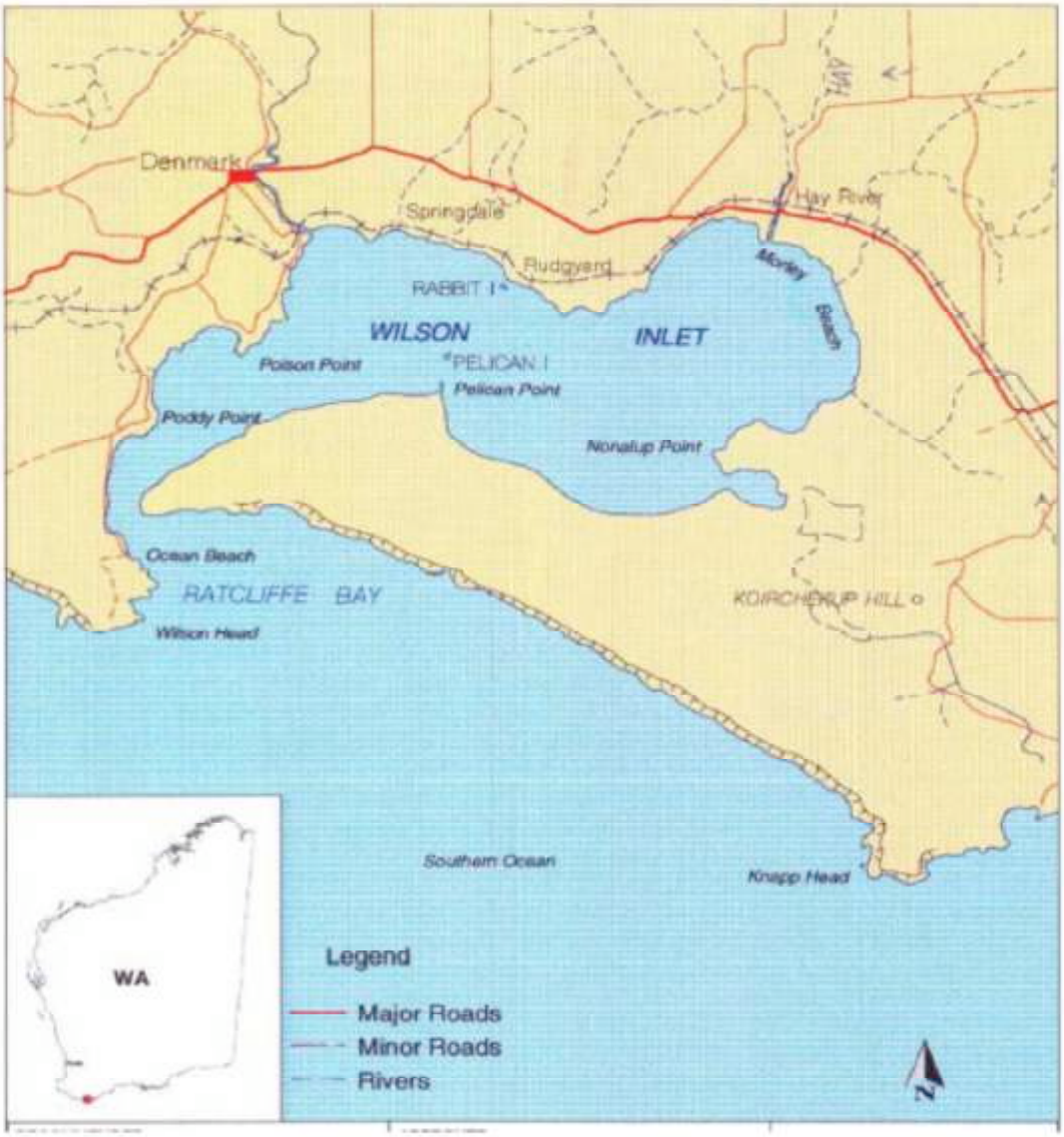
Section 8 Limitations

This report contains information obtained by inspection, sampling, testing or other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessment. The borehole logs indicate the inferred ground conditions only at the specific locations tested. The precision with which conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of conditions as constrained by the project budget limitations. The behaviour of groundwater and some aspects of contaminants in soil and groundwater are complex. Our conclusions are based upon the analytical data presented in this report and our experience. Future advances in regard to the understanding of chemicals and their behaviour, and changes in regulations affecting their management, could impact on our conclusions and recommendations regarding their potential presence on this site.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, URS must be notified of any such findings and be provided with an opportunity to review the recommendations of this report.

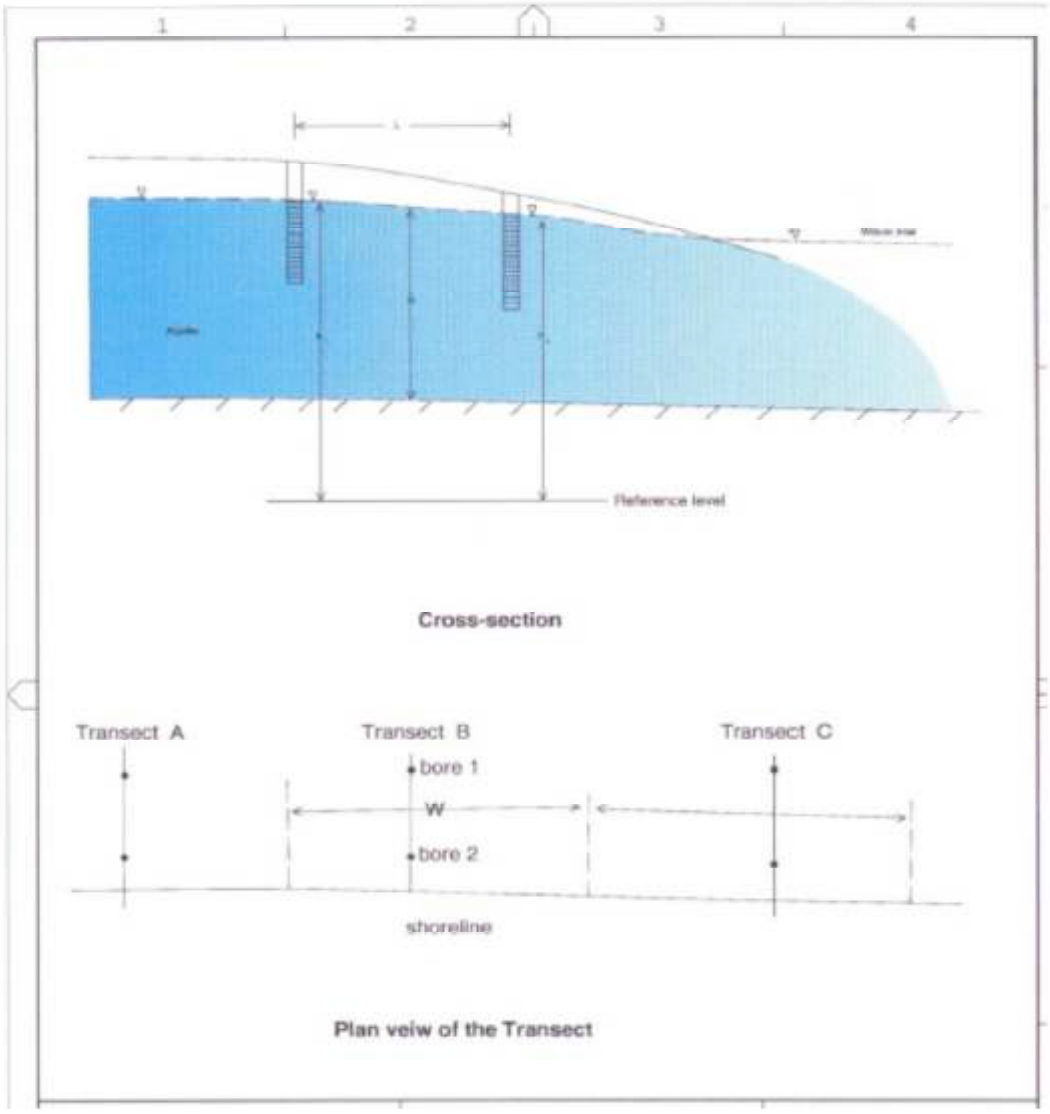
Whilst to the best of our knowledge information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time. Therefore this document and the information contained herein should only be regarded as valid at the time of the investigation unless otherwise explicitly stated in this report.

The project was affected by the budget shortage. This report provides only a brief summary of the result, and a general report structure and methodology. There are significant data gaps which should be filled when funds are available.



Client: Department of Water	Project: Wilson Inlet Groundwater Monitoring			Title: Location Map	
URS	Drawn: WY	Approved: WY	Date: 15/12/07	Figure: 1	Rev. A
	Job No. 42906500	File No.			A4

Client: Department of Water	Project: Wilson Inlet Groundwater Monitoring			Title: Geology Map	
URS	Drawn: DoW	Approved: WY	Date: 15/12/07	Figure: 2	Rev. A
	Job No. 42906500	File No.			A4



Client: Department of Water	Project: Wilson Inlet Groundwater Monitoring			Title: Calculation of Groundwater Flux	
URS	Drawn: WY	Approved: WY	Date: 15/12/07	Figure: 3	Rev. A
	Job No. 42906500	File No.			A4

Appendix A

Bore Completion Report

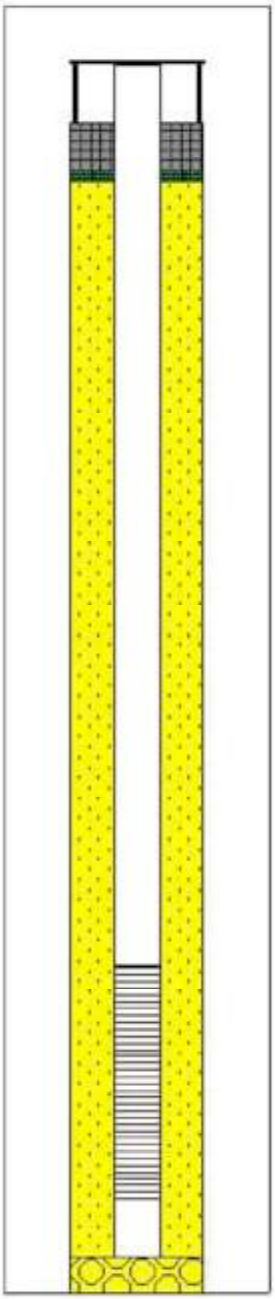
BORE COMPLETION REPORT

URS Australia Pty Ltd
Level 3, 20 Terrace Rd, East Perth WA, 6004
Phone: (08) 9326 0100 Fax: (08) 9326 0296

BOREHOLE **WIG02**

DRILLING COMPANY **DoW**
DRILLING METHOD **Direct Push/Auger**
TOTAL DRILLED DEPTH **10 m**
HOLE DIAMETER
TOTAL CASED DEPTH **10 m**
CASING DIAMETER **25 mm**

PROJECT NAME **Wilson Inlet GW Investigation**
PROJECT NUMBER **42906500** R.L. (COLLAR) ?
CLIENT **DoW** EASTING **530080**
LOCATION **155 Minsterly Road** NORTHING **6126232**
START DATE **03/05/2006**
COMPLETION DATE **03/05/2006**
GEOPHYSICAL LOGGING COMPANY **N/A**
LOGGED BY **DoW**



BORE CONSTRUCTION

Concrete plug
Bentonite Seal
25mm Class 9 PVC Plain Casing
Graded Sand
25mm Class 9 PVC Slotted Casing
Sump
Gravel Pack

LITHOLOGY

DEPTH (m)

DESCRIPTION

GRAVEL: road base
SANDY CLAY: grey
CLAY: with coarse grained quartz sand, white and yellow
WEATHERED GRANITE: clay, white
WEATHERED GRANITE: clay, cream
SANDY CLAY: with minor gravel layers

BORE COMPLETION REPORT

URS Australia Pty Ltd
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Phone: (08) 9326 0100 Fax: (08) 9326 0296

BOREHOLE **WIG02**

DRILLING COMPANY **DoW**
DRILLING METHOD **Direct Push/Auger**
TOTAL DRILLED DEPTH **10 m**
HOLE DIAMETER
TOTAL CASED DEPTH **10 m**
CASING DIAMETER **25 mm**

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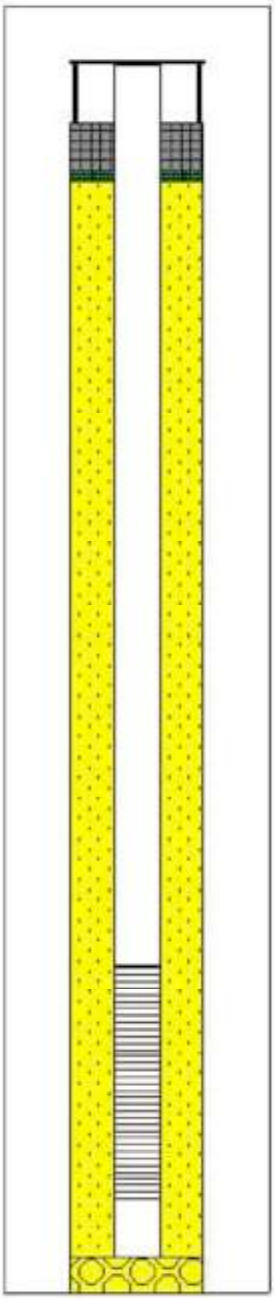
GEOPHYSICAL LOGGING COMPANY **N/A**
LOGGED BY **DoW**



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Graded Sand
25mm Class 9 PVC Slotted Casing
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Gravel Pack

LITHOLOGY

DEPTH (m)

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GRAVEL: road base
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WEATHERED GRANITE: clay, cream
SANDY CLAY: with minor gravel layers

BORE COMPLETION REPORT

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Phone: (08) 9326 0100 Fax: (08) 9326 0296

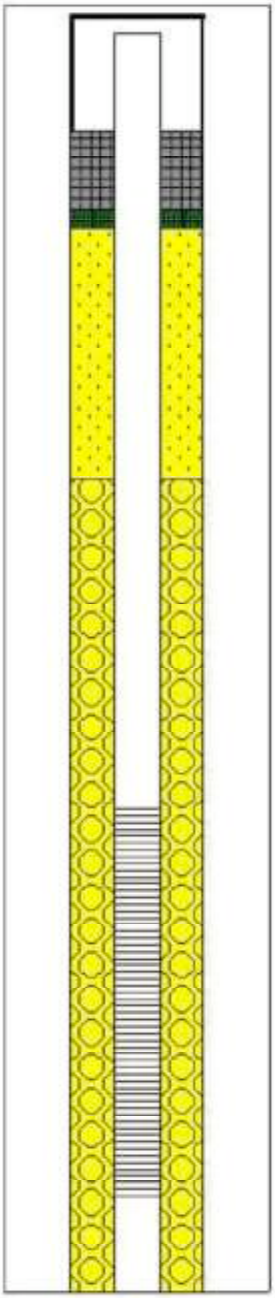
BOREHOLE **WIG06**

DRILLING COMPANY **DoW**
DRILLING METHOD **Direct Push/Auger**
TOTAL DRILLED DEPTH **6 m**
HOLE DIAMETER **?**
TOTAL CASED DEPTH **6 m**
CASING DIAMETER **25 mm**

PROJECT NAME **Wilson Inlet GW Investigation**
PROJECT NUMBER **42906500**
CLIENT **DoW**
LOCATION **170 Minsterly Road**
START DATE **03/05/2006**
COMPLETION DATE **03/05/2006**
GEOPHYSICAL LOGGING COMPANY **N/A**
LOGGED BY **DoW**

R.L. (COLLAR) **?**
EASTING **530482**
NORTHING **6127055**

BORE CONSTRUCTION



Concrete plug
Bentonite Seal
Graded Sand
25mm Class 9 PVC Plain Casing
SWL (2.49 mbgl)
Gravel Pack
25mm Class 9 PVC Slotted Casing
Sump

DESCRIPTION
TOPSOIL
SAND: very fine to medium grained, grey
SAND: fine to medium grained, white
SAND: medium to coarse grained, white
SAND: very fine to fine grained, black
CLAY: with quartz, brown
WEATHERED GRANITE: clay with quartz, cream

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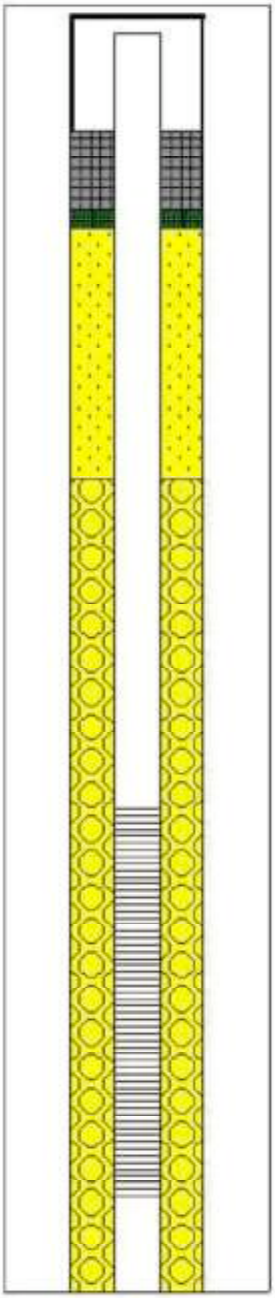

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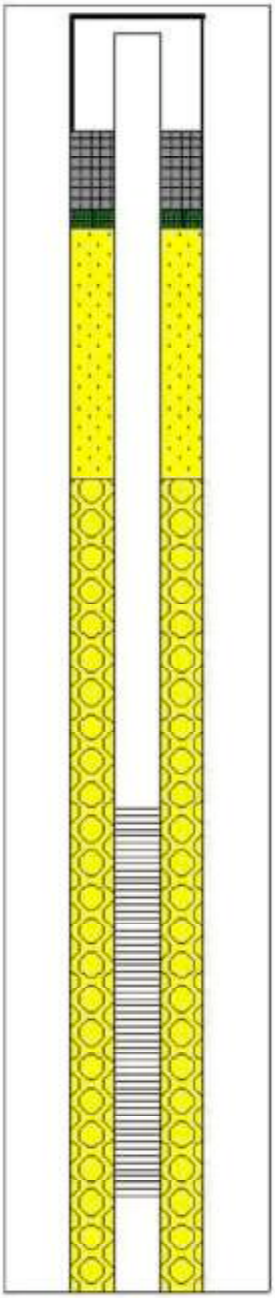

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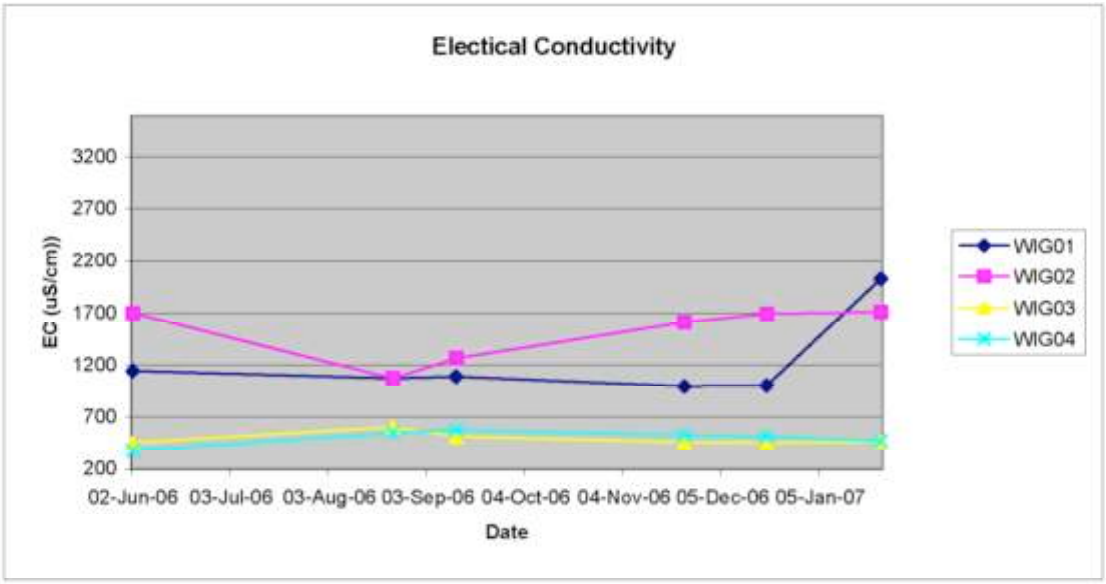
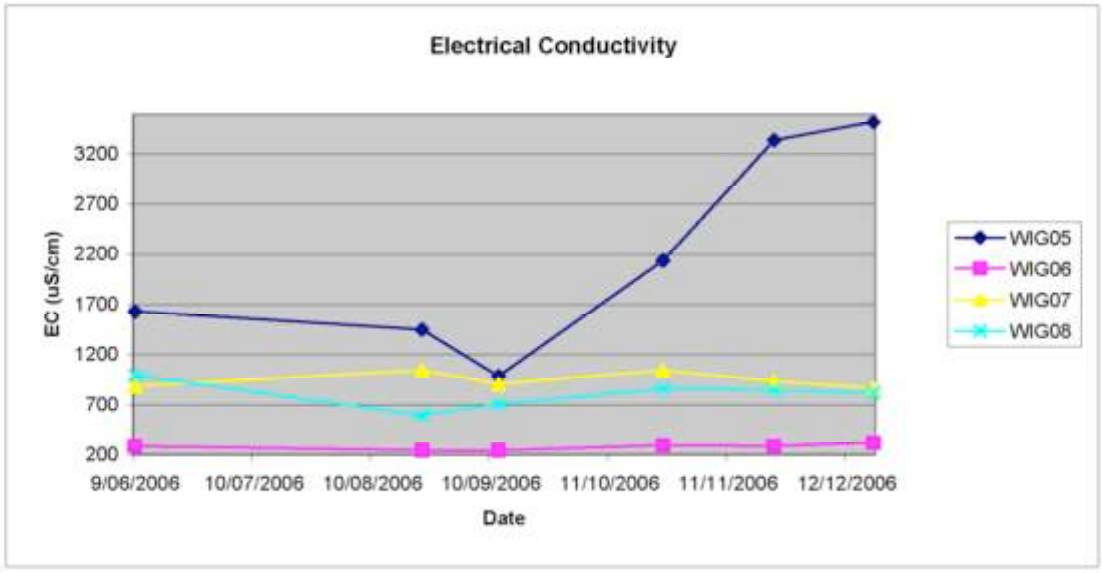
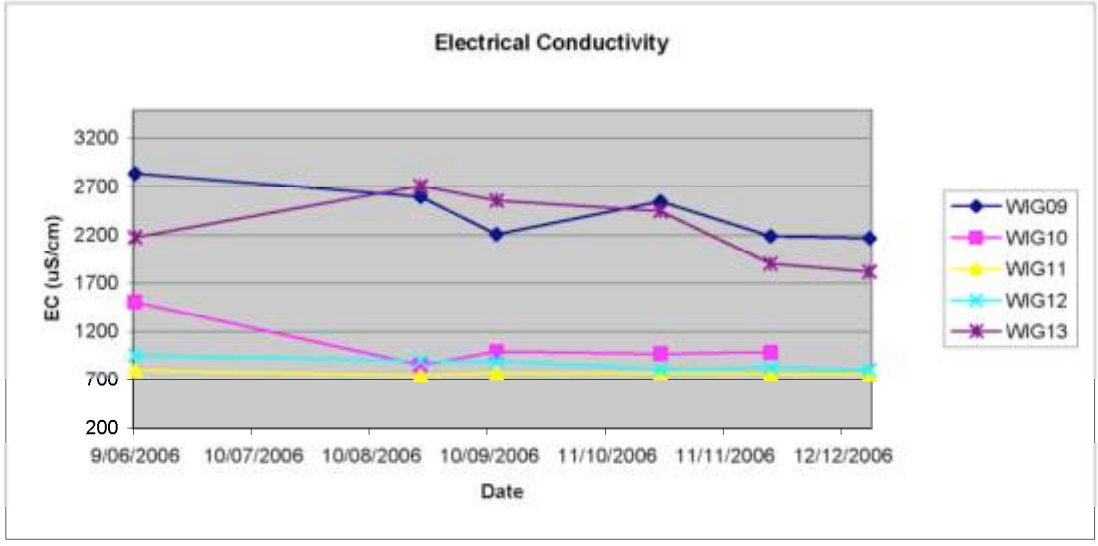
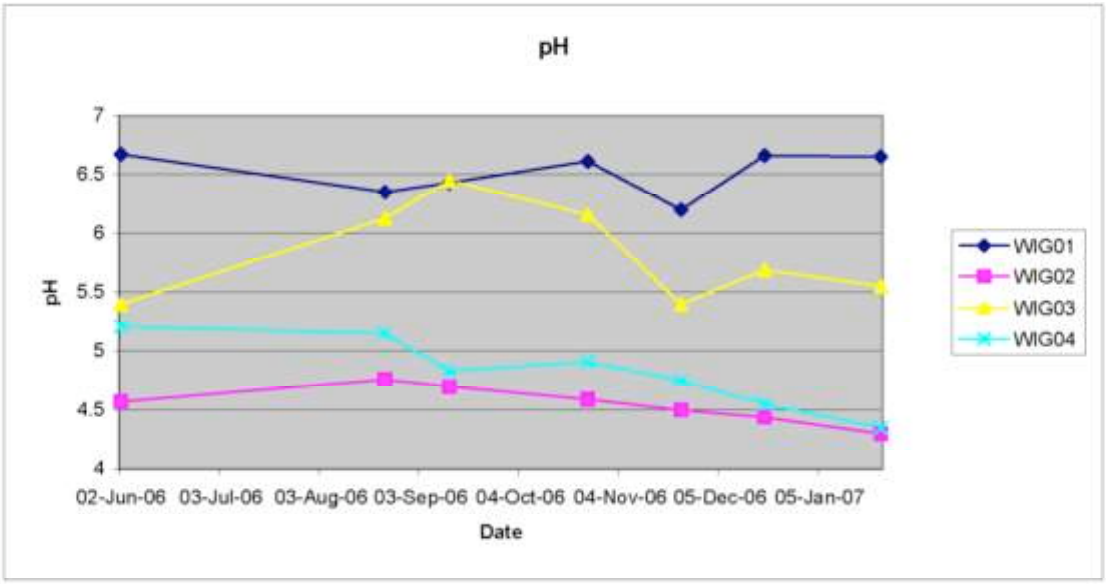
Appendix B

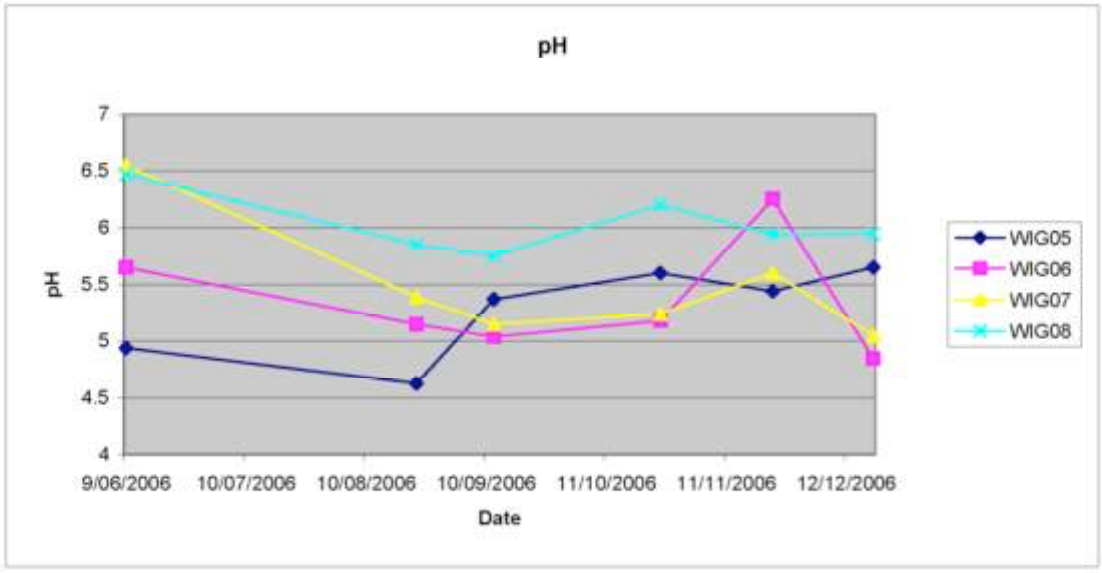
Water Quality Monitoring Results

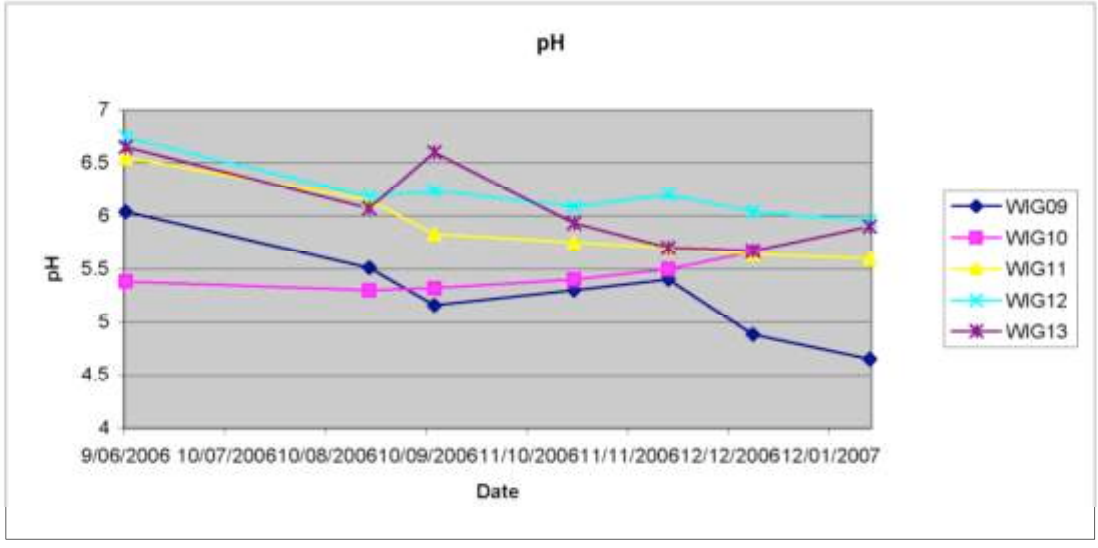

Electical Conductivity
EC (uS/cm))
3200
2700
2200
1700
1200
700
200
02-Jun-06
03-Jul-06
03-Aug-06
03-Sep-06
04-Oct-06
04-Nov-06
05-Dec-06
05-Jan-07
Date
WIG01
WIG02
WIG03
WIG04

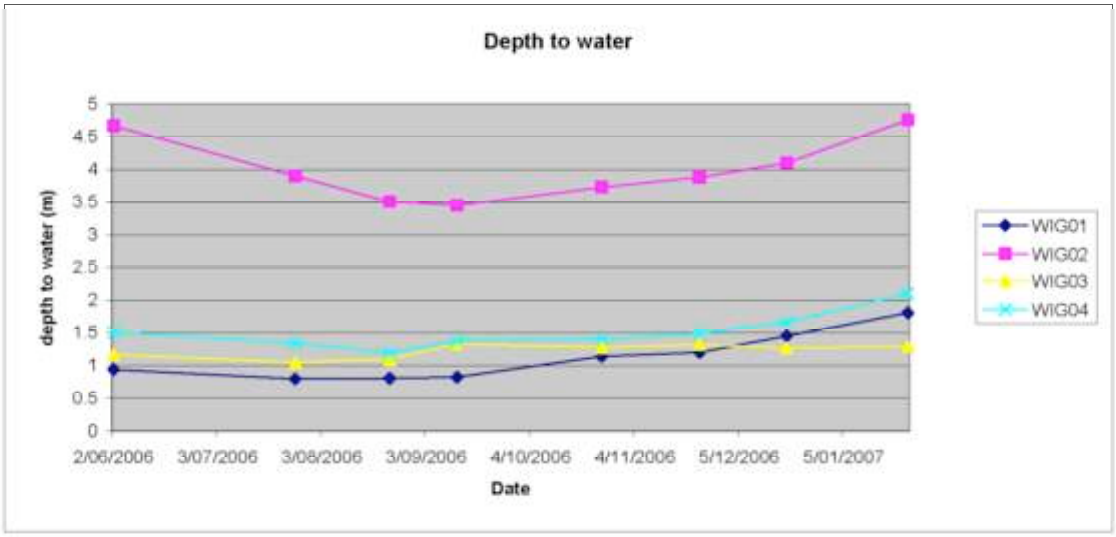

Electrical Conductivity
EC (uS/cm)
3200
2700
2200
1700
1200
700
200
9/06/2006
10/07/2006
10/08/2006
10/09/2006
11/10/2006
11/11/2006
12/12/2006
Date
WIG05
WIG06
WIG07
WIG08

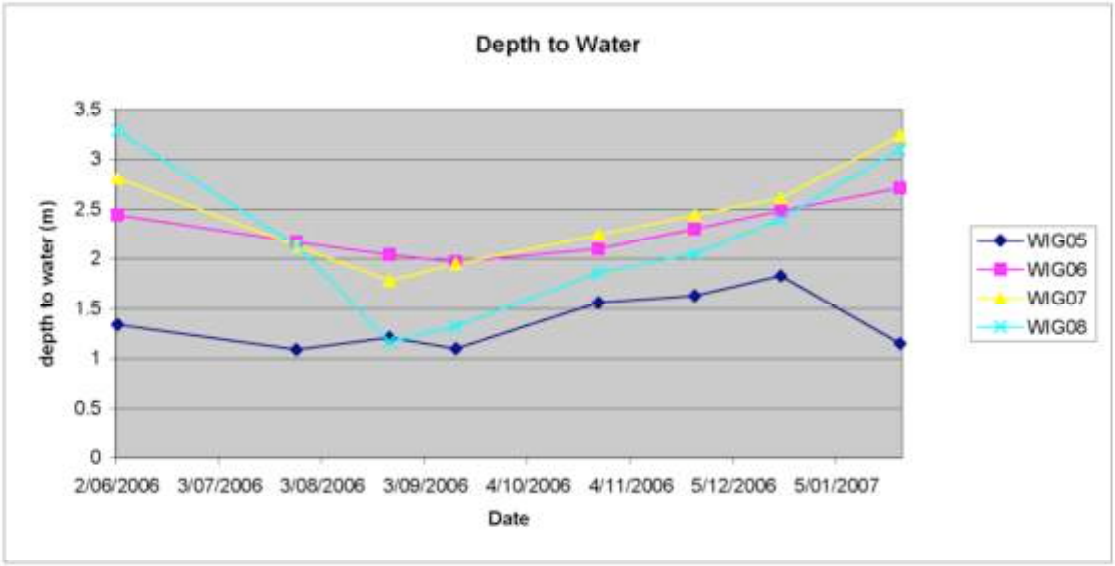

Electrical Conductivity
EC (uS/cm)
3200
2700
2200
1700
1200
700
200
9/06/2006
10/07/2006
10/08/2006
10/09/2006
11/10/2006
11/11/2006
12/12/2006
Date
WIG09
WIG10
WIG11
WIG12
WIG13

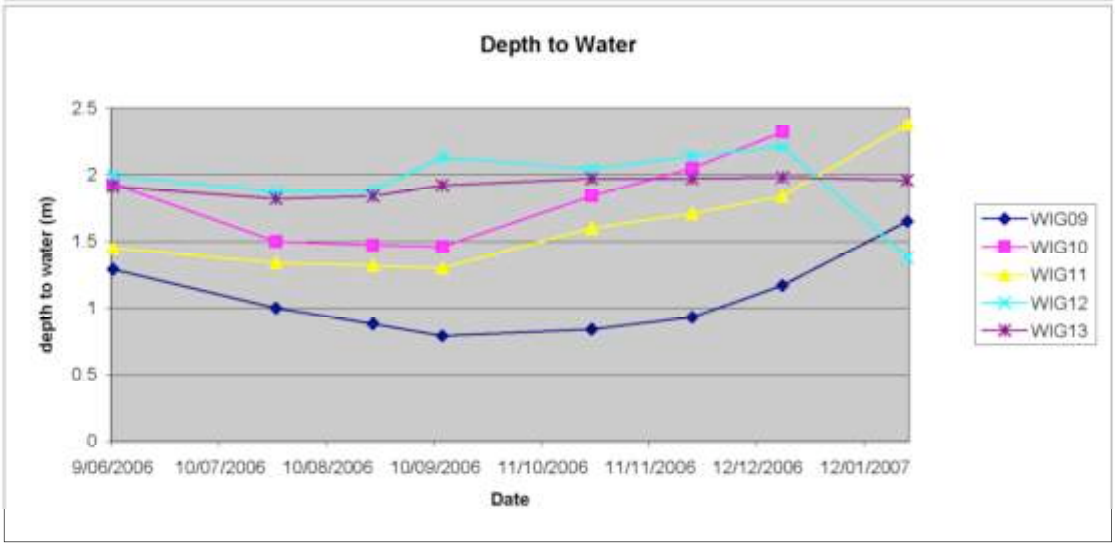

pH
7
6.5
6
5.5
5
4.5
4
pH
02-Jun-06
03-Jul-06
03-Aug-06
03-Sep-06
04-Oct-06
04-Nov-06
05-Dec-06
05-Jan-07
Date
WIG01
WIG02
WIG03
WIG04

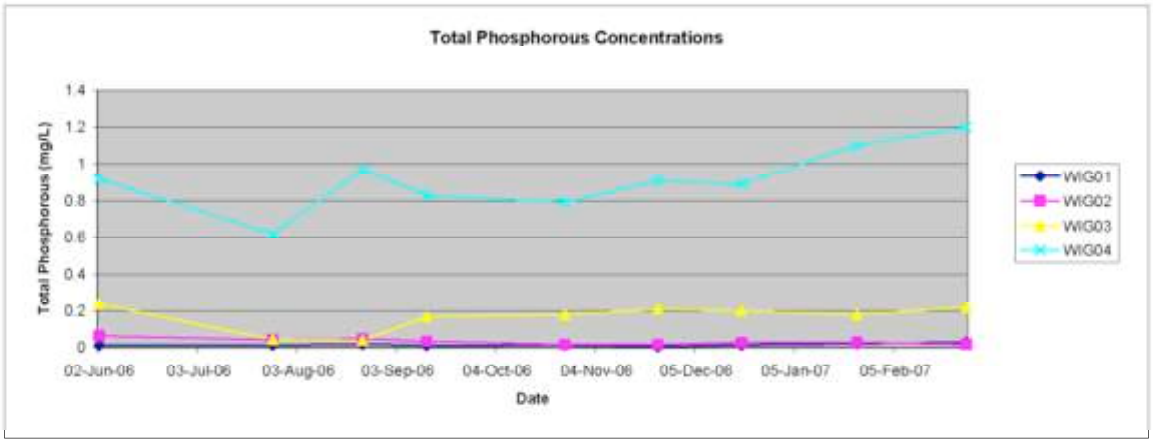

pH
7
6.5
6
5.5
5
4.5
4
pH
9/06/2006
10/07/2006
10/08/2006
10/09/2006
11/10/2006
11/11/2006
12/12/2006
Date
WIG05
WIG06
WIG07
WIG08

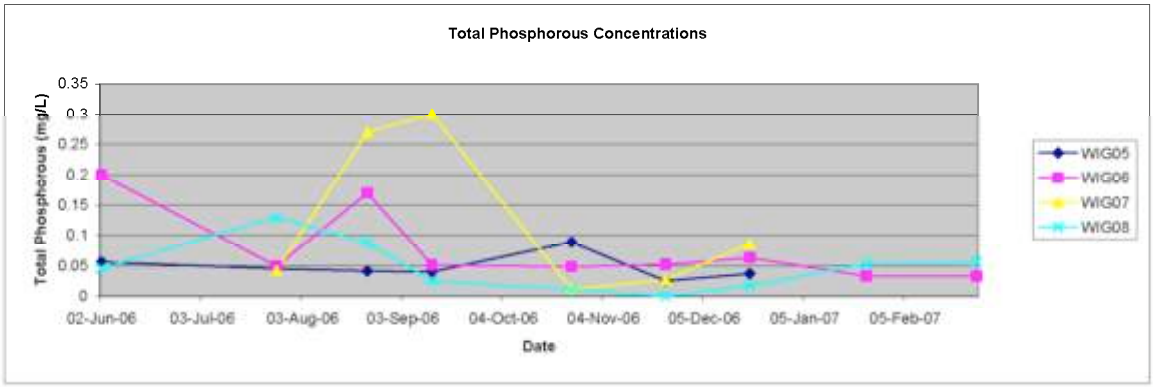

pH
7
6.5
6
5.5
5
4.5
4
pH
9/06/2006
10/07/2006
10/08/2006
10/09/2006
11/10/2006
11/11/2006
12/12/2006
12/01/2007
Date
WIG09
WIG10
WIG11
WIG12
WIG13

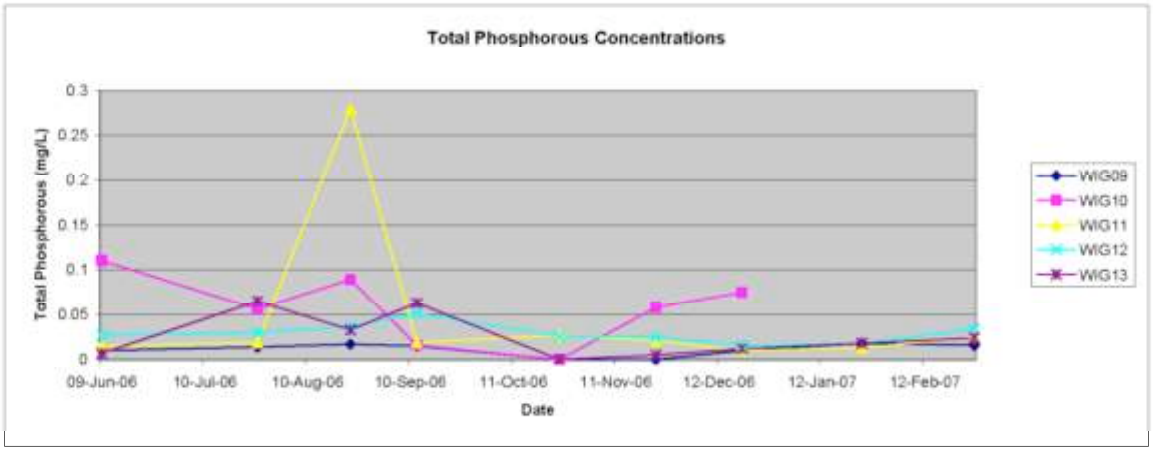

Depth to water
depth to water (m)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/06/2006
3/07/2006
3/08/2006
3/09/2006
4/10/2006
4/11/2006
5/12/2006
5/01/2007
Date
WIG01
WIG02
WIG03
WIG04

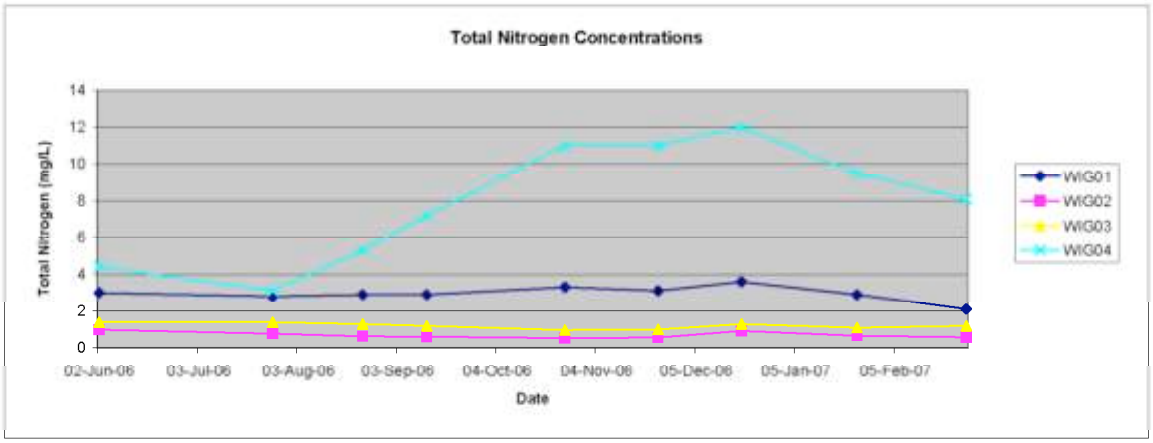

Depth to Water
depth to water (m)
3.5
3
2.5
2
1.5
1
0.5
0
2/06/2006
3/07/2006
3/08/2006
3/09/2006
4/10/2006
4/11/2006
5/12/2006
5/01/2007
Date
WIG05
WIG06
WIG07
WIG08

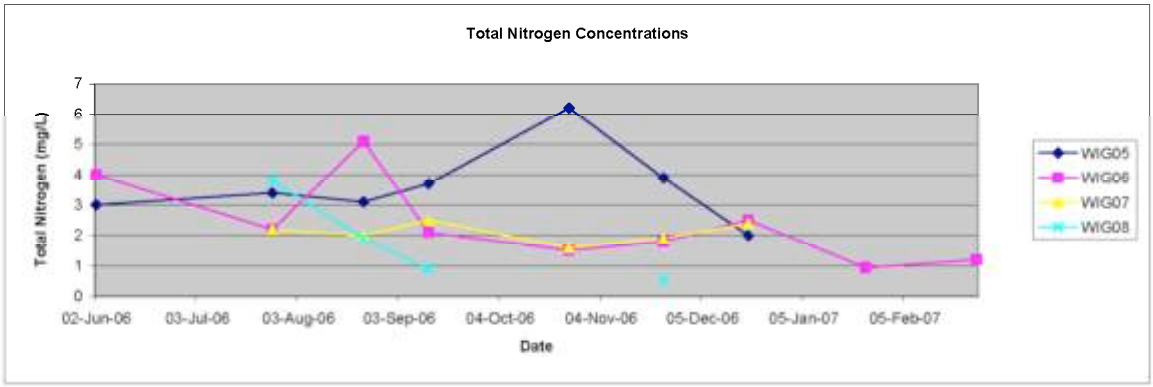

Depth to Water
depth to water (m)
2.5
2
1.5
1
0.5
0
9/06/2006
10/07/2006
10/08/2006
10/09/2006
11/10/2006
11/11/2006
12/12/2006
12/01/2007
Date
WIG09
WIG10
WIG11
WIG12
WIG13

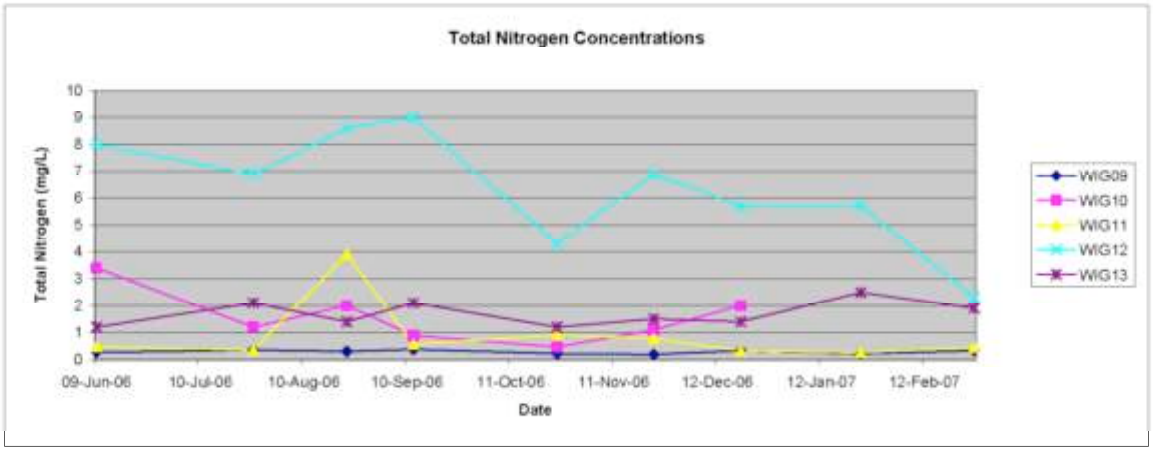

Total Phosphorous Concentrations
Total Phosphorous (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
02-Jun-06
03-Jul-06
03-Aug-06
03-Sep-06
04-Oct-06
04-Nov-06
05-Dec-06
05-Jan-07
05-Feb-07
Date
WIG01
WIG02
WIG03
WIG04


Total Phosphorous Concentrations
Total Phosphorous (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
02-Jun-06
03-Jul-06
03-Aug-06
03-Sep-06
04-Oct-06
04-Nov-06
05-Dec-06
05-Jan-07
05-Feb-07
Date
WIG05
WIG06
WIG07
WIG08


Total Phosphorous Concentrations
Total Phosphorous (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
09-Jun-06
10-Jul-06
10-Aug-06
10-Sep-06
11-Oct-06
11-Nov-06
12-Dec-06
12-Jan-07
12-Feb-07
Date
WIG09
WIG10
WIG11
WIG12
WIG13


Total Nitrogen Concentrations
Total Nitrogen (mg/L)
14
12
10
8
6
4
2
0
02-Jun-06
03-Jul-06
03-Aug-06
03-Sep-06
04-Oct-06
04-Nov-06
05-Dec-06
05-Jan-07
05-Feb-07
Date
WIG01
WIG02
WIG03
WIG04


Total Nitrogen Concentrations
Total Nitrogen (mg/L)
7
6
5
4
3
2
1
0
02-Jun-06
03-Jul-06
03-Aug-06
03-Sep-06
04-Oct-06
04-Nov-06
05-Dec-06
05-Jan-07
05-Feb-07
Date
WIG05
WIG06
WIG07
WIG08


Total Nitrogen Concentrations
Total Nitrogen (mg/L)
10
9
8
7
6
5
4
3
2
1
0
09-Jun-06
10-Jul-06
10-Aug-06
10-Sep-06
11-Oct-06
11-Nov-06
12-Dec-06
12-Jan-07
12-Feb-07
Date
WIG09
WIG10
WIG11
WIG12
WIG13

Appendix C

Laboratory Chemical Results

WMG01

Time	Date	Sample Id	Sample Number	Std Depth	N (tot kjel) {TKN} (mg/L)	N (tot) {TN, pTN} (mg/L)	NH3-N/NH4-N (sol) (mg/L)	NO2-N (sol) (mg/L)	NO3-N (sol) (mg/L)	P (tot) {TP, pTP} (mg/L)	PO4-P (sol react) {SRP, FRP} (mg/L)	TSS (mg/L)	Turbidity (NTU)
9:45:00	02-Jun-06	24004710	200359582	2.500		3	2.3	<0.01	<0.01	0.015	0.01	11	14
10:50:00	26-Jul-06	24018049	200519040	2.500	2.8	2.8	0.75	<0.01	<0.01	0.014	<0.005	7	10
10:10:00	23-Aug-06	24135337	200519380	2.500	2.9	2.9	2.3	<0.01	0.011	0.021	0.011	17	14
10:35:00	12-Sep-06	24045588	200519240	3.000	2.9	2.9	2	<0.01	<0.01	0.013	<0.005	4	6.8
10:20:00	25-Oct-06	24135553	200610401	3.000		3.3	2.3	<0.01	<0.01	0.015	0.009	<1	6.7
9:55:00	23-Nov-06	24135663	200519053	3.000	3.1	3.1	2.1	<0.01	<0.01	0.007	<0.005	57	29
10:30:00	19-Dec-06	24089985	200519066	3.000		3.6	1.8	<0.01	<0.01	0.016	0.005	29	17
10:40:00	24-Jan-07	24103385	200610414	3.000		2.9	1.8	<0.01	<0.01	0.022	<0.005	33	19
	27-Feb-07					2.1	0.97	<0.01	<0.01	0.031	<0.005	94	50

Time	Date	Sample Id	Sample Number	Std Depth	Cond comp 25 deg C (in situ) (uS/cm)	Cond uncomp (in situ) (uS/cm)	Water temperature (in situ) (deg C)	pH ((none))
9:45:00	02-Jun-06	24005131		2.500	1145		15.8	6.67
10:00:00	23-Aug-06	24135433	200519380	2.500	1072		11.3	6.35
10:36:00	12-Sep-06	24045707	200519240	3.000	1089		12.2	6.43
10:21:00	25-Oct-06	24135634	200610401	3.000		940	15.6	6.61
9:56:00	23-Nov-06	24135783	200519053	3.000	995		17	6.2
10:30:00	19-Dec-06	24090344	200519066	3.000	1005		17.8	6.66
10:40:00	24-Jan-07	24134150	200610414	3.000	2030			6.65

Time	Date	Sample Id	Sample Number	Std Depth	N (tot kjel) {TKN} (mg/L)	N (tot) {TN, pTN} (mg/L)	NH3-N/NH4-N (sol) (mg/L)	NO2-N (sol) (mg/L)	NO3-N (sol) (mg/L)	P (tot) {TP, pTP} (mg/L)	PO4-P (sol react) {SRP, FRP} (mg/L)	TSS (mg/L)	Turbidity (NTU)
13:00:00	02/06/2006	24004711	200359583	8.500		0.99	0.052	<0.01	<0.01	0.064	0.009	1060	1100
12:45:00	26/07/2006	24018050	200519041	8.000	0.75	0.78	0.051	<0.01	0.028	0.044	<0.005	1410	870
11:00:00	23/08/2006	24135338	200519381	8.000	0.6	0.63	0.04	<0.01	0.029	0.05	0.006	1430	1300
13:20:00	12/09/2006	24045589	200519241	9.000	0.58	0.61	0.028	<0.01	0.034	0.035	0.02	1080	700
13:50:00	25/10/2006	24135554	200610402	8.000		0.54	0.041	<0.01	0.01	0.018	0.006	1190	670
11:20:00	23/11/2006	24135664	200519054	8.000	0.56	0.56	0.052	<0.01	<0.01	0.017	0.005	972	840
10:45:00	19/12/2006	24089986	200519067	8.000		0.92	0.059	<0.01	<0.01	0.029	0.006	816	580
13:05:00	24/01/2007	24103386	200610415	9.000		0.66	0.044	<0.01	<0.01	0.031	<0.005	602	430
	27/02/2007					0.58	0.052	<0.01	<0.01	0.02	0.007	600	370

Time	Date	Sample Id	Sample Number	Std Depth	Cond comp 25 deg C (in situ) (uS/cm)	Cond uncomp (in situ) (uS/cm)	Water temperature (in situ) (deg C)	pH ((none))
13:00:00	02/06/2006	24005133		8.500	1701		17.2	4.57
11:00:00	23/08/2006	24135434	200519381	8.000	1072		13.7	4.76
13:21:00	12/09/2006	24045708	200519241	9.000	1265		12.8	4.7
13:51:00	25/10/2006	24135635	200610402	8.000		1270	18.8	4.59
11:21:00	23/11/2006	24135784	200519054	8.000	1610		18.2	4.5
10:45:00	19/12/2006	24090345	200519067	8.000	1695		19.4	4.44
11:05:00	24/01/2007	24134151	200610415	9.000	1712			4.3

Time	Date	Sample Id	Sample Number	Std Depth	N (tot kjel) {TKN} (mg/L)	N (tot) {TN, pTN} (mg/L)	NH3-N/NH4-N (sol) (mg/L)	NO2-N (sol) (mg/L)	NO3-N (sol) (mg/L)	P (tot) {TP, pTP} (mg/L)	PO4-P (sol react) {SRP, FRP} (mg/L)	TSS (mg/L)	Turbidity (NTU)
11:25:00	02/06/2006	24004712	200359584	2.500		1.4	0.15	0.015	<0.01	0.24	0.093	193	150
11:50:00	26/07/2006	24018051	200519042	2.500	1.4	1.4	0.025	<0.01	<0.01	0.046	<0.005	146	120
10:15:00	23/08/2006	24135339	200519382	2.500	1.3	1.3	0.051	<0.01	<0.01	0.041	0.019	72	58
10:50:00	12/09/2006	24045590	200519242	3.000	1.2	1.2	0.14	<0.01	<0.01	0.17	0.14	83	77
11:00:00	25/10/2006	24135555	200610403	3.000		0.97	0.093	<0.01	<0.01	0.18	0.14	148	190
10:05:00	23/11/2006	24135665	200519055	3.000	1	1	0.12	<0.01	<0.01	0.21	0.15	281	140
10:55:00	19/12/2006	24089987	200519068	3.000		1.3	0.11	<0.01	<0.01	0.2	0.037	187	170
12:20:00	24/01/2007	24103387	200610416	3.000		1.1	0.16	<0.01	<0.01	0.18	0.081	244	120
	27/02/2007					1.2	0.045	<0.01	<0.01	0.22	0.05	240	80

Time	Date	Sample Id	Sample Number	Std Depth	Cond comp 25 deg C (in situ) (uS/cm)	Cond uncomp (in situ) (uS/cm)	Water temperature (in situ) (deg C)	pH ((none))
11:25:00	02/06/2006	24005135		2.500	456		15.6	5.4
10:15:00	23/08/2006	24135435	200519382	2.500	605		14.5	6.13
10:51:00	12/09/2006	24045709	200519242	3.000	516		10.7	6.45
11:01:00	25/10/2006	24135636	200610403	3.000		386	16.9	6.16
10:06:00	23/11/2006	24135785	200519055	3.000	460		17.3	5.4
10:55:00	19/12/2006	24090346	200519068	3.000	456		19.6	5.69
12:30:00	24/01/2007	24134152	200610416	3.000	462			5.55

Time	Date	Sample Id	Sample Number	Std Depth	N (tot kjel) {TKN} (mg/L)	N (tot) {TN, pTN} (mg/L)	NH3-N/NH4-N (sol) (mg/L)	NO2-N (sol) (mg/L)	NO3-N (sol) (mg/L)	P (tot) {TP, pTP} (mg/L)	PO4-P (sol react) {SRP, FRP} (mg/L)	TSS (mg/L)	Turbidity (NTU)
11:45:00	02/06/2006	24004713	200359585	2.500		4.4	1.1	0.021	2.9	0.92	0.86	182	600
12:00:00	26/07/2006	24018052	200519043	2.500	2.5	3.1	0.47	<0.01	0.62	0.62	0.2	126	560
10:25:00	23/08/2006	24135340	200519383	2.500	2	5.3	0.92	<0.01	3.3	0.97	0.73	131	370
11:05:00	12/09/2006	24045591	200519243	3.000	0.24	7.2	0.2	<0.01	7	0.83	0.73	82	160
11:15:00	25/10/2006	24135556	200610404	2.500		11	0.13	<0.01	9.3	0.79	0.71	32	99
10:15:00	23/11/2006	24135666	200519056	2.500	2.8	11	0.074	<0.01	8.5	0.91	0.89	35	64
10:10:00	19/12/2006	24089988	200519069	3.000		12	0.09	<0.01	8	0.89	0.22	41	75
12:40:00	24/01/2007	24103388	200610417	3.000		9.5	0.13	<0.01	9.2	1.1	0.96	73	86
	27/02/2007					8.1	0.015	<0.01	8	1.2	0.51	71	59

Time	Date	Sample Id	Sample Number	Std Depth	Cond comp 25 deg C (in situ) (uS/cm)	Cond uncomp (in situ) (uS/cm)	Water temperature (in situ) (deg C)	pH ((none))
11:45:00	02/06/2006	24005137		2.500	380		16.4	5.21
10:25:00	23/08/2006	24135436	200519383	2.500	550		11.7	5.15
11:06:00	12/09/2006	24045710	200519243	3.000	578		8.4	4.83
11:16:00	25/10/2006	24135637	200610404	2.500		425	16.3	4.91
10:16:00	23/11/2006	24135786	200519056	2.500	525		17.2	4.75
11:10:00	19/12/2006	24090347	200519069	3.000	511		17.8	4.55
12:40:00	24/01/2007	24134153	200610417	3.000	472			4.35

Time	Date	Sample Id	Sample Number	Std Depth	N (tot kjel) (TKN) (mg/L)	N (tot) (TN, pTN) (mg/L)	NH3-N/NH4-N (sol) (mg/L)	NO2-N (sol) (mg/L)	NO3-N (sol) (mg/L)	P (tot) (TP, pTP) (mg/L)	PO4-P (sol react) (SRP, FRP) (mg/L)	TSS (mg/L)	Turbidity (NTU)
12:30:00	02/08/2006	24004714	200359586	2.500		3	0.14	0.023	0.018	0.056	0.016	130	89
12:25:00	26/07/2006	24018053	200519044	2.500	3.4	3.4	0.06	<0.01	<0.01	0.045	0.005	59	40
10:40:00	23/08/2006	24135341	200519384	2.500	3.1	3.1	0.11	<0.01	<0.01	0.041	0.018	52	28
11:20:00	12/09/2006	24045592	200519244	3.000	3.7	3.7	0.085	0.015	<0.01	0.04	0.014	70	36
11:30:00	25/10/2006	24135557	200610405	3.000		8.2	0.18	0.053	0.22	0.089	0.029	66	38
10:40:00	23/11/2006	24135667	200519057	3.000	3.9	3.9	0.11	<0.01	<0.01	0.025	0.013	116	40
14:10:00	19/12/2006	24089969	200519070	3.000		2	0.2	<0.01	<0.01	0.037	0.008	799	450
14:50:00	24/01/2007	24103389	200610418	3.000			0.23	<0.01	<0.01		<0.005		
	27/02/2007						0.15	<0.01	<0.01		0.006		

Time	Date	Sample Id	Sample Number	Std Depth	Win Comment	Cond comp 25 deg C (in situ) (mS/cm)	Cond comp 25 deg C (in situ) (uS/cm)	Water temperature (in situ) (deg C)	pH ((none))
12:30:00	02/08/2006	24005139		2.500			1632	15.3	4.94
10:40:00	23/08/2006	24135437	200519384	2.500			1451	11.1	4.63
11:21:00	12/09/2006	24045711	200519244	3.000			987	6.7	5.37
10:41:00	23/11/2006	24135787	200519057	3.000		2.14	2140	18.2	5.6
14:10:00	19/12/2006	24090348	200519070	3.000	Very poor rec	3.34	3340	21.2	5.44
14:50:00	24/01/2007	24134154	200610418	3.000		3.52	3520		5.65

Time	Date	Sample Id	Sample Number	Std Depth	N (tot kjel) {TKN} (mg/L)	N (tot) {TN, pTN} (mg/L)	NH3-N/NH4-N (sol) (mg/L)	NO2-N (sol) (mg/L)	NO3-N (sol) (mg/L)	P (tot) {TP, pTP} (mg/L)	PO4-P (sol react) {SRP, FRP} (mg/L)	TSS (mg/L)	Turbidity (NTU)
13:15:00	09/06/2006	24004715	200359587	5.000		4	0.13	0.021	0.045	0.2	0.016	261	560
12:50:00	26/07/2006	24018054	200519045	5.500	2.2	2.2	0.068	<0.01	<0.01	0.049	<0.005	166	700
13:35:00	23/08/2006	24135342	200519385	5.500	5.1	5.1	0.14	<0.01	<0.01	0.17	0.013	1570	3900
13:10:00	12/09/2006	24045593	200519245	5.500	2.1	2.1	0.14	<0.01	<0.01	0.051	0.005	675	620
12:00:00	25/10/2006	24135558	200610406	6.000		1.5	0.04	<0.01	0.03	0.048	0.007	107	560
11:00:00	23/11/2006	24135668	200519058	5.000	1.8	1.8	0.15	<0.01	<0.01	0.052	0.009	130	180
11:30:00	19/12/2006	24089990	200519071	5.000		2.5	0.13	<0.01	<0.01	0.063	0.007	336	290
11:40:00	24/01/2007	24103390	200610419	5.500		0.93	0.16	<0.01	<0.01	0.033	<0.005	227	200
	27/02/2007					1.2	0.12	<0.01	<0.01	0.033	0.008	406	350

Time	Date	Sample Id	Sample Number	Std Depth	Cond comp 25 deg C (in situ) (uS/cm)	Cond uncomp (in situ) (uS/cm)	Water temperature (in situ) (deg C)	pH ((none))
13:15:00	09/06/2006	24005141		5.000	287		16.2	5.65
13:35:00	23/08/2006	24135438	200519385	5.500	246		14.7	5.15
13:11:00	12/09/2006	24045712	200519245	5.500	243		13.8	5.04
12:01:00	25/10/2006	24135639	200610406	6.000		224	13.2	5.18
11:01:00	23/11/2006	24135788	200519058	5.000	295		18.4	6.25
11:30:00	19/12/2006	24090349	200519071	5.000	287		20.2	4.85
11:40:00	24/01/2007	24134155	200610419	5.500	321			4.9

Time	Date	Sample Id	Sample Number	Std Depth	N (tot kjel) (TKN) (mg/L)	N (tot) (TN, pTN) (mg/L)	NH3-N/NH4-N (sol) (mg/L)	NO2-N (sol) (mg/L)	NO3-N (sol) (mg/L)	P (tot) (TP, pTP) (mg/L)	PO4-P (sol react) (SRP, FRP) (mg/L)	TSS (mg/L)	Turbidity (NTU)
15:25:00	09/06/2006	24004716	200359588	4.000			0.37	<0.01	0.013		0.01		
13:00:00	26/07/2006	24018055	200519046	3.500	2.1	2.2	0.11	<0.01	0.066	0.042	<0.005	573	730
11:40:00	23/08/2006	24135344	200519386	4.000	2	2	0.14	<0.01	0.02	0.27	0.062	199	320
12:45:00	12/09/2006	24045594	200519246	4.000	2.5	2.5	0.07	<0.01	<0.01	0.3	0.27	186	260
15:35:00	25/10/2006	24135559	200610407	4.000		1.8	0.26	<0.01	<0.01	0.012	0.008	315	320
14:50:00	23/11/2006	24135669	200519059	4.000	1.9	1.9	0.37	<0.01	<0.01	0.027	0.006	146	97
13:50:00	19/12/2006	24089991	200519072	4.000		2.4	0.39	<0.01	<0.01	0.086	0.008	208	110
16:30:00	24/01/2007	24103391	200610420	3.000			0.39	<0.01	<0.01		<0.005		
	27/02/2007						0.36	<0.01	<0.01			0.007	

Time	Date	Sample Id	Sample Number	Std Depth	Win Comment	Cond comp 25 deg C (in situ) (uS/cm)	Cond uncomp (in situ) (uS/cm)	Water temperature (in situ) (deg C)	pH ((none))
15:25:00	09/06/2006	24005143		4.000	Could only	885		16	6.55
11:40:00	23/08/2006	24135439	200519386	4.000	Slow rechar	1045		14.4	5.39
12:46:00	12/09/2006	24045713	200518246	4.000		906		13.6	5.15
15:38:00	25/10/2006	24135640	200610407	4.000			1020	18.1	5.24
14:51:00	23/11/2006	24135789	200519059	4.000		1046		18.4	5.6
13:50:00	19/12/2006	24090350	200519072	4.000		932		19.1	5.05
16:30:00	24/01/2007	24134156	200610420	3.000		885			5

Time	Date	Sample Id	Sample Number	Std Depth	N (tot kjel) {TKN} (mg/L)	N (tot) {TN, pTN} (mg/L)	NH3-N/NH4-N (sol) (mg/L)	NO2-N (sol) (mg/L)	NO3-N (sol) (mg/L)	P (tot) {TP, pTP} (mg/L)	PO4-P (sol react) {SRP, FRP} (mg/L)	TSS (mg/L)	Turbidity (NTU)
14:30:00	02/06/2006	24004717	200359589	4.500		1.2	0.069	<0.01	<0.01	0.046	0.005	177	380
13:10:00	26/07/2006	24018056	200519047	4.000	3.8	3.8	0.034	<0.01	<0.01	0.13	<0.005	2000	1900
9:35:00	23/08/2006	24135345	200519387	4.500	1.9	2	0.033	<0.01	0.048	0.088	0.005	491	550
12:00:00	12/09/2006	24045596	200519247	4.000	0.89	0.96	0.01	<0.01	0.071	0.025	0.007	131	220
10:00:00	25/10/2006	24135560	200610408	4.500		0.61	0.014	<0.01	0.011	0.011	0.006	109	140
11:45:00	23/11/2006	24135671	200519060	4.000	0.54	0.54	0.014	<0.01	<0.01	<0.005	<0.005	37	31
10:15:00	19/12/2006	24089992	200519073	4.000		0.68	0.021	<0.01	<0.01	0.017	0.005	100	100
14:35:00	24/01/2007	24103392	200610421	4.500		1.1	0.04	<0.01	<0.01	0.053	<0.005	690	130
	27/02/2007					1.3	0.023	<0.01	<0.01	0.056	<0.005	272	100

Time	Date	Sample Id	Sample Number	Std Depth	Cond comp 25 deg C (in situ) (uS/cm)	Water temperature (in situ) (deg C)	pH ((none))
14:30:00	02/06/2006	24005145		4.500	994	15.7	6.47
9:35:00	23/08/2006	24135440	200519387	4.500	596	13	5.85
12:01:00	12/09/2006	24045714	200519247	4.000	706	11.6	5.75
11:46:00	23/11/2006	24135790	200519060	4.000	860	15.3	6.2
10:15:00	19/12/2006	24090351	200519073	4.000	845	16.3	5.94
14:35:00	24/01/2007	24134157	200610421	4.500	817		5.95

Time	Date	Sample Id	Sample Number	Std Depth	N (tot kjel) {TKN} (mg/L)	N (tot) {TN, pTN} (mg/L)	NH3-N/NH4-N (sol) (mg/L)	NO2-N (sol) (mg/L)	NO3-N (sol) (mg/L)	P (tot) {TP, pTP} (mg/L)	PO4-P (sol react) {SRP,	TSS (mg/L)	Turbidity (NTU)
12:40:00	09/06/2006	24004719	200359590	3.500		0.27	0.13	<0.01	<0.01	0.01	0.009	1250	970
15:30:00	26/07/2006	24018058	200519048	4.000	0.36	0.36	0.12	<0.01	<0.01	0.014	<0.005	366	250
11:20:00	23/08/2006	24135346	200519388	3.500	0.3	0.3	0.29	<0.01	<0.01	0.017	<0.005	278	280
14:45:00	12/09/2006	24045597	200519248	3.500	0.38	0.38	0.13	<0.01	<0.01	0.015	0.006	693	280
14:35:00	25/10/2006	24135561	200610409	3.500		0.22	0.12	<0.01	<0.01	<0.005	<0.005	277	270
13:50:00	23/11/2006	24135672	200519061	3.500	0.19	0.19	0.13	<0.01	<0.01	<0.005	<0.005	87	33
9:40:00	19/12/2006	24089993	200519074	4.000		0.33	0.084	<0.01	<0.01	0.01	0.005	302	140
14:05:00	24/01/2007	24103394	200610422	4.000		0.21	0.072	<0.01	0.1	0.018	<0.005	154	49
	27/02/2007					0.33	0.057	<0.01	<0.01	0.016	<0.005	215	100

Time	Date	Sample Id	Sample Number	Std Depth	Cond comp 25 deg C (in situ) (mS/cm)	Cond comp 25 deg C (in situ) (uS/cm)	Cond uncomp (in situ) (mS/cm)	Water temperature (in situ) (deg C)	pH ((none))
12:40:00	09/06/2006	24005147		3.500		2840		15.4	6.04
11:20:00	23/08/2006	24135441	200519388	3.500	2.6	2600		12.9	5.51
14:46:00	12/09/2006	24045715	200519248	3.500	2.21	2210		12.1	5.16
14:36:00	25/10/2006	24135642	200610409	3.500			2.15	16.7	5.3
13:51:00	23/11/2006	24135791	200519061	3.500	2.55	2550		17.3	5.4
9:40:00	19/12/2006	24090352	200519074	4.000	2.19	2190		17.9	4.88
14:05:00	24/01/2007	24134158	200610422	4.000	2.17	2170			4.65

Time	Date	Sample Id	Sample Number	Std Depth	N (tot kjel) (TKN) (mg/L)	N (tot) (TN, pTN) (mg/L)	NH3-N/NH4-N (sol) (mg/L)	NO2-N (sol) (mg/L)	NO3-N (sol) (mg/L)	P (tot) (TP, pTP) (mg/L)	PO4-P (sol react) (SRP, FRP) (mg/L)	TSS (mg/L)	Turbidity (NTU)
15:30:00	02/06/2006	24004720	200359591	4.000		3.4	0.37	<0.01	<0.01	0.11	0.011	5190	360
14:10:00	26/07/2006	24018059	200519049	4.000	1.2	1.2	0.095	<0.01	<0.01	0.056	<0.005	1190	990
11:50:00	23/08/2006	24135347	200519389	3.500	2	2	0.24	<0.01	<0.01	0.089	0.012	1400	980
14:20:00	12/09/2006	24045598	200519249	4.000	0.89	0.89	0.15	<0.01	<0.01	0.016	0.006	291	400
15:25:00	25/10/2006	24135563	200610410	3.500		0.47	0.079	<0.01	<0.01	<0.005	<0.005	337	360
14:30:00	23/11/2006	24135673	200519062	3.500	1.1	1.1	0.16	<0.01	<0.01	0.058	<0.005	678	110
13:30:00	19/12/2006	24089995	200519075	4.000		2	0.22	<0.01	<0.01	0.075	0.005	1600	280

Time	Date	Sample Id	Sample Number	Std Depth	Win Comment	Cond comp 25 deg C (in situ) (uS/cm)	Cond uncomp (in situ) (uS/cm)	Water temperature (in situ) (deg C)	pH ((none))
15:30:00	02/06/2006	24005149		4.000		1507		16.3	5.38
11:50:00	23/08/2006	24135442	200519389	3.500		853		13	5.3
14:21:00	12/09/2006	24045716	200519249	4.000		994		10.9	5.32
15:26:00	25/10/2006	24135643	200610410	3.500			805	16	5.4
14:31:00	23/11/2006	24135792	200519062	3.500		970		16.6	5.5
13:30:00	19/12/2006	24090353	200519075	4.000	Very stong (pungent) H2S	986		18.1	5.66

Time	Date	Sample Id	Sample Number	Std Depth	N (tot kjel) {TKN} (mg/L)	N (tot) {TN, pTN} (mg/L)	NH3-N/NH4-N (sol) (mg/L)	NO2-N (sol) (mg/L)	NO3-N (sol) (mg/L)	P (tot) {TP, pTP} (mg/L)	PO4-P (sol react) {SRP, FRP} (mg/L)	TSS (mg/L)	Turbidity (NTU)
15:00:00	09/06/2006	24004721	200359592	4.000		0.48	0.26	<0.01	0.048	0.015	0.009	104	100
16:00:00	26/07/2006	24018060	200519050	4.000	0.36	0.36	0.091	<0.01	<0.01	0.019	<0.005	115	78
15:40:00	23/08/2006	24135346	200519390	4.500	3.9	3.9	0.12	<0.01	<0.01	0.28	<0.005	2330	1900
15:05:00	12/09/2006	24045599	200519250	4.500	0.54	0.56	0.17	<0.01	0.016	0.019	0.005	173	40
12:40:00	25/10/2006	24135564	200610411	4.000		0.91	0.22	<0.01	<0.01	0.027	0.005	47	29
15:05:00	23/11/2006	24135674	200519063	4.000	0.78	0.78	0.24	<0.01	<0.01	0.021	<0.005	47	12
12:45:00	19/12/2006	24089996	200519076	4.000		0.33	0.13	<0.01	<0.01	0.01	0.005	50	16
13:45:00	24/01/2007	24103395	200610424	4.500		0.25	0.16	<0.01	<0.01	0.013	<0.005	53	8.7
	27/02/2007					0.46	0.13	<0.01	<0.01	0.025	<0.005	64	6

Time	Date	Sample Id	Sample Number	Std Depth	Win Comment	Cond comp 25 deg C (in situ) (uS/cm)	Cond uncomp (in situ) (uS/cm)	Water temperature (in situ) (deg C)	pH ((none))
15:00:00	09/06/2006	24005151		4.000		798		16.4	6.55
15:40:00	23/08/2006	24135443	200519390	4.500	Very slow recharge	745		13.9	6.15
15:06:00	12/09/2006	24045717	200519250	4.500		770		12.1	5.83
12:41:00	25/10/2006	24135644	200610411	4.000			538	17.2	5.75
15:06:00	23/11/2006	24135793	200519063	4.000		770		16.8	5.7
12:45:00	19/12/2006	24090354	200519076	4.000		763		18.3	5.64
13:45:00	24/01/2007	24134159	200610424	4.500		754			5.6

Time	Date	Sample Id	Sample Number	Std Depth	N (tot kjel) {TKN} (mg/L)	N (tot) {TN, pTN} (mg/L)	NH3-N/NH4-N (sol) (mg/L)	NO2-N (sol) (mg/L)	NO3-N (sol) (mg/L)	P (tot) {TP, pTP} (mg/L)	PO4-P (sol react) {SRP, FRP} (mg/L)	TSS (mg/L)	Turbidity (NTU)
14:50:00	09/06/2006	24004722	200359593	3.500		8	0.16	<0.01	7.6	0.027	0.005	462	810
13:05:00	26/07/2006	24018061	200519051	3.500	4.2	6.9	0.087	0.11	2.6	0.03	<0.005	328	420
14:10:00	23/08/2006	24135349	200519391	3.500	1.1	8.6	0.13	0.015	7.5	0.037	0.005	687	920
15:00:00	12/09/2006	24045600	200519251	4.000	0.47	9	0.23	0.029	8.5	0.051	<0.005	782	780
12:45:00	25/10/2006	24135565	200610412	4.000		4.3	0.13	<0.01	4	0.026	<0.005	302	200
15:20:00	23/11/2006	24135675	200519064	4.000	1.2	6.9	0.45	0.012	5.7	0.025	<0.005	903	340
12:55:00	19/12/2006	24089997	200519077	3.500		5.7	0.29	0.063	4.9	0.016	0.005	203	110
16:00:00	24/01/2007	24103396	200610425	4.500		5.7	0.08	0.021	2.3	0.018	<0.005	93	37
	27/02/2007					2.3	0.065	0.02	1.6	0.034	<0.005	1930	120

Time	Date	Sample Id	Sample Number	Std Depth	Cond comp 25 deg C (in situ) (uS/cm)	Cond uncomp (in situ) (uS/cm)	Water temperature (in situ) (deg C)	pH ((none))
14:50:00	09/06/2006	24005153		3.500	952		16.5	6.74
14:10:00	23/08/2006	24135444	200519391	3.500	897		14.1	6.18
15:01:00	12/09/2006	24045718	200519251	4.000	896		11.2	6.24
12:46:00	25/10/2006	24135645	200610412	4.000		673	16.2	6.09
15:21:00	23/11/2006	24135794	200519064	4.000	810		17	6.2
12:55:00	19/12/2006	24090355	200519077	3.500	829		18.9	6.04
16:00:00	24/01/2007	24134160	200610425	4.500	805			5.95

Time	Date	Sample Id	Sample Number	Std Depth	N (tot kjel) {TKN} (mg/L)	N (tot) {TN, pTN} (mg/L)	NH3-N/NH4-N (sol) (mg/L)	NO2-N (sol) (mg/L)	NO3-N (sol) (mg/L)	P (tot) {TP, pTP} (mg/L)	PO4-P (sol react) {SRP, FRP} (mg/L)	TSS (mg/L)	Turbidity (NTU)
15:10:00	09/06/2006	24004723	200359594	4.000		1.2	0.46	<0.01	0.018	0.007	0.006	626	1100
15:40:00	26/07/2006	24018062	200519052	4.000	2.1	2.1	0.16	<0.01	<0.01	0.065	<0.005	459	790
15:55:00	23/08/2006	24135350	200519392	4.500	1.4	1.4	0.27	<0.01	<0.01	0.033	0.006	650	780
16:00:00	12/09/2006	24045601	200519252	4.500	2	2.1	0.2	<0.01	0.05	0.063	0.005	3690	490
12:55:00	25/10/2006	24135566	200610413	4.500		1.2	0.39	<0.01	<0.01	<0.005	<0.005	170	120
15:45:00	23/11/2006	24135676	200519065	4.500	1.5	1.5	0.47	<0.01	<0.01	0.005	<0.005	137	130
12:40:00	19/12/2006	24089998	200519078	4.500		1.4	0.36	<0.01	<0.01	0.012	0.005	106	110
15:30:00	24/01/2007	24103397	200610426	4.500		2.5	1	<0.01	<0.01	0.018	<0.005	263	190
	27/02/2007					1.9	0.81	<0.01	0.014	0.024	<0.005	272	160

Time	Date	Sample Id	Sample Number	Std Depth	Win Comment	Cond comp 25 deg C (in situ) (mS/cm)	Cond comp 25 deg C (in situ) (uS/cm)	Cond uncomp (in situ) (mS/cm)	Water temperature (in situ) (deg C)	pH l(none))
15:10:00	09/06/2006	24005155		4.000			2180		16.6	6.65
15:55:00	23/08/2006	24135445	200519392	4.500	Very slow recharge	2.71	2710		14.4	6.07
16:01:00	12/09/2006	24045719	200519252	4.500		2.56	2560		14	6.6
12:56:00	25/10/2006	24135646	200610413	4.500				2.23	17.2	5.93
15:46:00	23/11/2006	24135795	200519065	4.500		2.45	2450		18.1	5.7
12:40:00	19/12/2006	24090356	200519078	4.500			1903		19.9	5.67
15:30:00	24/01/2007	24134161	200610426	4.500			1822			5.9