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## Groundwater study of the Wandering townsite

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Department of Agriculture  
Government of Western Australia



# GROUNDWATER STUDY OF THE WANDERING TOWNSITE

*Shahzad Ghauri*



August 2002



**RESOURCE MANAGEMENT  
TECHNICAL REPORT 260**

**Resource Management Technical Report 260**

**Groundwater study  
of the  
Wandering townsite**

**Shahzad Ghauri**

**August 2002**



Department of Agriculture  
Government of Western Australia



**Rural  
Towns  
Program**



## **Disclaimer**

The contents of this report were based on the best available information at the time of publication. It is based in part on various assumptions and predictions. Conditions may change over time and conclusions should be interpreted in the light of the latest information available.

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## Summary

A groundwater study of Wandering townsite was undertaken in March 2002 to provide technical information to help form the basis of a salinity management strategy through the Rural Towns Program.

Wandering townsite is sited above two groundwater flow systems:

- A large southern system which is influenced primarily by recharge and discharge of the Wandering catchment;
- A small northern system bounded by two gabbro dykes, one that follows the trace of Down Street, the other forming the northern boundary of Wandering catchment.

Groundwater levels in the southern groundwater system are considered to be deep enough not to constitute an immediate salinity risk except for properties located adjacent to, and north of, the main creek (Cheetaning Road). Groundwater levels in this area were around 1 m from the surface while beneath main residential areas they were mostly between 3.75 m and 5.21 m deep.

Infrastructure above the northern groundwater system may become affected by rising watertables, especially immediately north of Down Street and west of Dowsett Street where a closure formed by two dykes has formed an area of higher salinity risk.

Deep and shallow groundwaters display near equal piezometric head except at site 02WR02, where there is 3 m downward vertical head. This is believed to be due to high transmissivity along the margin of a gabbro dyke, allowing groundwater to be transmitted into the townsite at intermediate depth. Low profile permeability has resulted in surface expression of groundwater at this site, and at another site along the dyke margin.

Piezometer yield estimates indicate that only small quantities of water are extractable, and that groundwater pumping will not have great radial influence. If the transmissive zone associated with the Down Street dyke can be delineated then yields are expected to be higher. Test pumping to determine whether dewatering will be effective may then be carried out. A cost/benefit analysis is strongly advised before undertaking such an investigation.

Dam No. 2 located upslope of lined Dam No. 1 may require lining if it is found that the northern groundwater system is rising, or problems near the dyke closure worsen. Leakage estimates by the Water Authority for Dam No. 2 appear significant given the small size of the groundwater system.

To assist in salinity management we recommend that the Wandering Shire should: revegetate public areas above and around the car park; delineate the transmissive zone and devise an economic dewatering strategy; line Dam No. 2; manage surface water in the catchment; rejuvenate the main creek to assist in surface drainage; revegetate areas of dead or dying native vegetation with salt-tolerant trees and shrubs; and reduce recharge on cleared land to the west.

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# 1. Introduction and background

A groundwater study of Wandering townsite was undertaken as part of the Rural Towns Program Community Bores Project which aims to provide the technical basis on which towns can develop their salinity management strategies.

Wandering joined the Rural Towns Program due to concerns over damage to townsite infrastructure, particularly the car park at the community centre. Wandering Shire had already installed a deep closed drain above the car park in an attempt to reduce waterlogging. Other issues were degradation of vegetation south of the town and the possibility of leakage from a water supply dam contributing to groundwater problems.

This report describes the town and its catchment, the hydrogeological investigation characterising groundwater flow systems within the townsite, and recommends actions for managing salinity risk.

## 1.1 The town of Wandering

Wandering is located about 110 km south-east of Perth (see Figure 1-1). It has a population of about 80 people and provides services for around 400 more in the surrounding district. Farming of cereals and livestock is the major industry, with viticulture and tourism becoming increasingly important. A community centre was built in 1986 and new residential land has been developed recently, reflecting community growth trends.



Figure 1-1. Regional setting of Wandering townsite

## 1.2 Description of the catchment

Wandering is located in an elongated, unnamed 540 hectare catchment (hereafter referred to as the Wandering catchment). The catchment extends approximately 4 km westwards from its Wandering Brook discharge point, and is between 1.4 and 1.8 km wide along most of its length. Much of the north-east divide is covered with remnant vegetation. Figure 1-2 shows the location of the townsite and catchment topography.

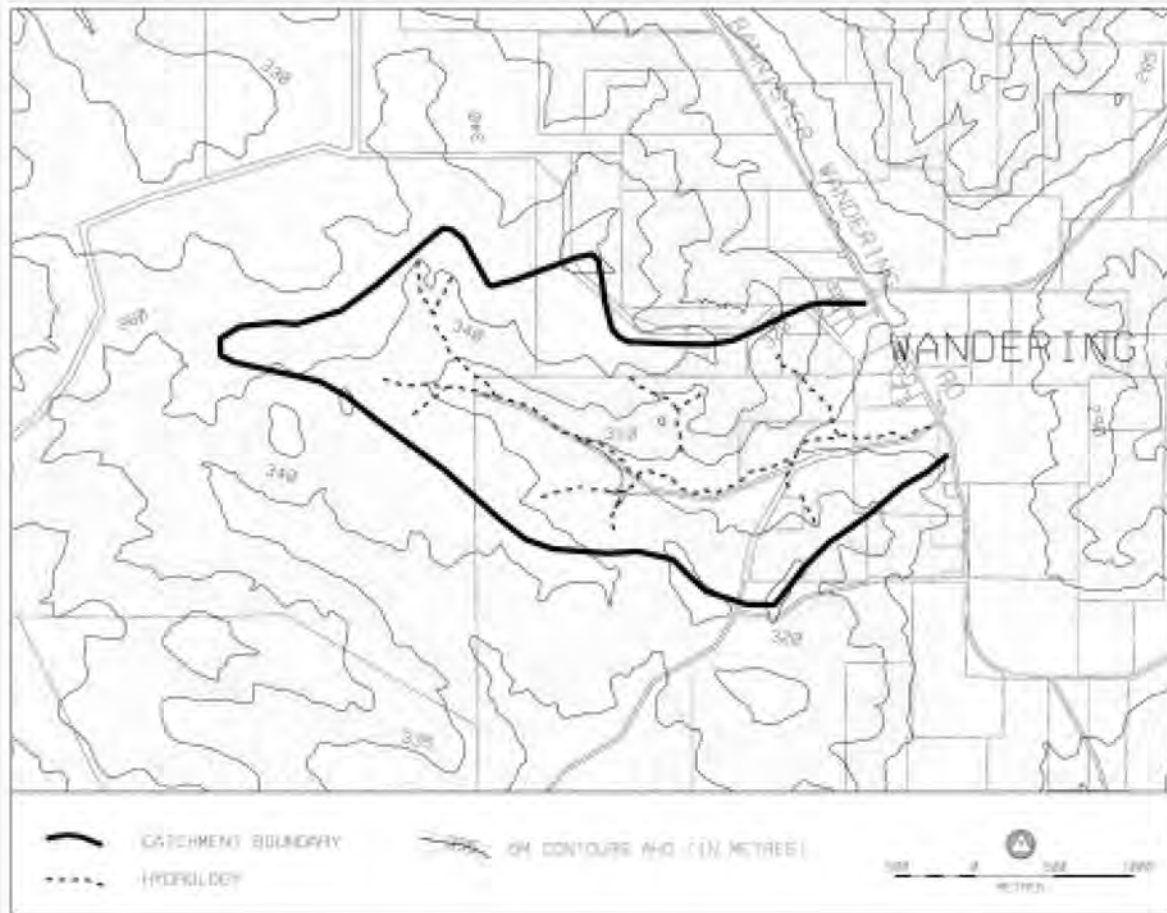


Figure 1-2. Location of the Wandering townsite in its catchment

## 1.3 Geology

The town is underlain by granite bedrock that is relatively homogenous in mineralogy and texture. Rocks are medium to coarse-grained with major minerals being quartz, microcline and biotite. Mapping at 1:250,000 by Wilde and Low (1980) was not at sufficient scale to interpret townsite geology, however does indicate that at a regional level, geology does not vary greatly. Gabbro dykes in and near the townsite have not been mapped previously in published material.



## 1.4 Climate

Wandering townsite has been an official Bureau of Meteorology weather station since 1887 (BOM 2002) therefore accurate data is readily available. Mean annual rainfall is approximately 615 mm, with May to October being the wettest period. Mean daily temperature variation in summer is 13.9 to 31.8°C and in winter 4.2 to 15.2°C. Figure 1-3 shows some long-term climatic data.

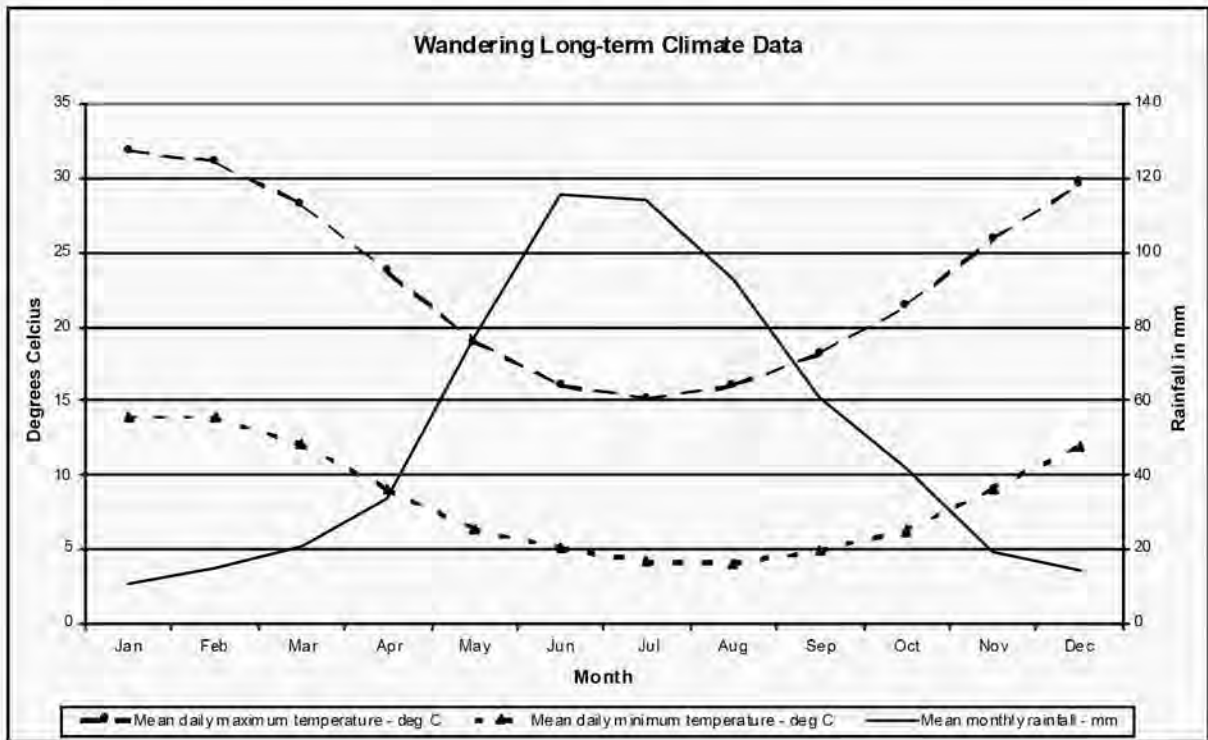


Figure 1-3. Mean monthly temperatures and rainfall for Wandering

## 1.5 Natural drainage

A tributary of Wandering Brook drains the catchment. This tributary is fed by low-density dendritic pattern drainage and appears to follow a linear structure, possibly a fault, prior to passing through the townsite. This structure trends parallel to a nearby mapped dyke.

Wandering Brook flows immediately adjacent to and east of the townsite. It flows into the Hotham River which joins the Murray River and later discharges into the Peel Inlet near Mandurah.

The townsite is located at the confluence of two creeks, with the second draining from east of Wandering Brook. Waterlogging and salinity feature prominently in these creekline areas.

## ***1.6 Town water supply and disposal***

Initial inquiries for provision of reticulated water supplies were made in 1962 and by 1964 a reticulated scheme was operational. Two bituminised catchments (5.9 ha in total) and respective dams (19,840 m<sup>3</sup>) were constructed to meet water demand. In 1994 demand for water was 14,000 m<sup>3</sup>/yr and projected demand is expected to be 25,000 m<sup>3</sup>/yr in 2024 (Dolley and Forrest 1994).

Absence of potable groundwater supplies results in severe water restrictions in some years. Reticulation of private gardens does occur, however the sports oval, which in many towns contributes significantly to recharge, is not reticulated due to water supply limitations. Wandering town is unsewered and operates on septic tank and leach drain systems (Mick Oliver pers. comm.).

## 2. Hydrogeology investigation

Investigation of hydrology aimed to determine and characterise the surface and groundwater processes present in and around the townsite.

### 2.1 Previous investigations

The Dolley and Forrest (1994) report 'Wandering Water Supply Source Review and Assessment' detailed the history of the town water supply, condition of supply infrastructure, water demand and yield analysis. It made recommendations relating to dam losses and potential for a desalinated water supply. Several possible water supply options were reviewed including lining Dam No. 2, and it was determined that immediate construction of a desalinisation plant was the best option for long-term water supply security.

As part of the Water Authority review, eight holes were drilled at six sites identified by the Geological Survey of Western Australia. All holes penetrated to granite bedrock. Water was intersected at only one site (below Dam No. 1) where flow was estimated at 157 m<sup>3</sup>/day at 5214 mg/L TDS. Static water level measurement was not possible due to a hole collapse. Watertable depth was estimated at 12 m during drilling, however this had an accuracy of plus or minus several metres.

Ten piezometers (prefixed RTPWPZ1-10) were installed at six sites in the town during 2001 (Figure 2-1). No records of profile or construction were kept, but static water level time-series data exist. Piezometers were placed near problem areas including the car park. No historic information or local knowledge is available on rising damp at the car park.

### 2.2 Method

Drilling for the Community Bores Project was carried out between 18 and 21 March 2002. Nineteen piezometers (prefixed 02WR) were installed at 11 sites (Figure 2-1). Dykes and other hydrogeological features were investigated and mapped.

#### 2.2.1 Drill site selection

Drill sites were selected on landscape position, hydrogeological importance, infrastructure value, land availability and access. Particular attention was paid to the areas where rising damp was damaging surfaces. The leakage potential of the water supply dams was also considered.

#### 2.2.2 Drilling methods

Sites were drilled using the reverse circulation aircore method with a 123 mm diameter bit.

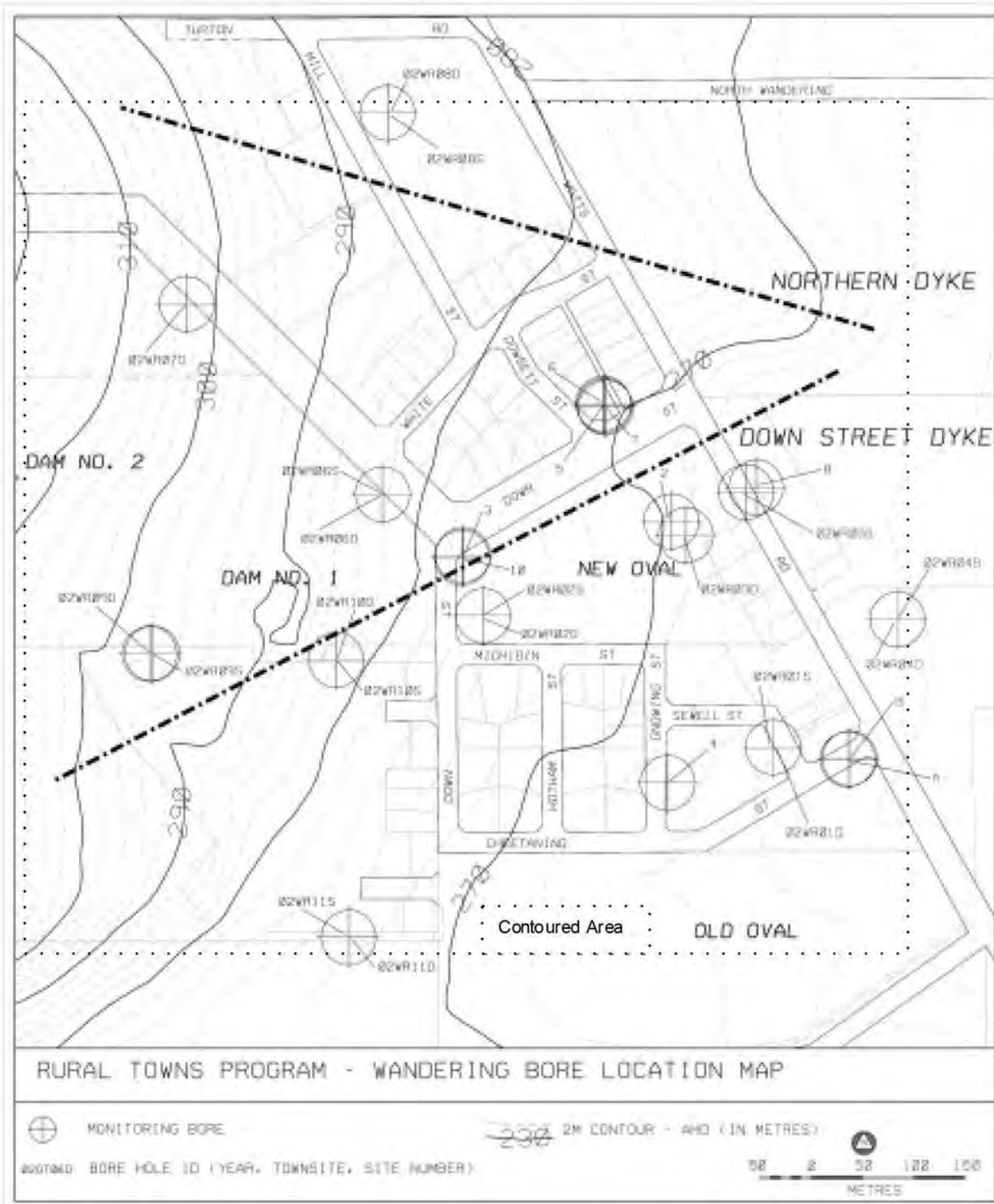


Figure 2-1. Location of piezometers, dykes and other significant features in Wandering townsite (see Figure 2-2 for detailed modelling of contoured area).

### 2.2.3 Piezometer construction

All piezometers were constructed with a 50 mm-diameter, Class 12 PVC casing. Air core drilling allowed piezometers to be installed to full drilling depth. Filter packs were installed to just above the standard 2 m end of hole screen interval, and a bentonite seal placed above the filter prior to backfilling. Drilling depth details are listed in Table 2-1.

#### **2.2.4 Drill samples**

Composite samples were collected at 1 m intervals from a cyclone attached to the drill rig sample hose. One bulk sample was taken per metre from each piezometer as well as chip tray samples. Drill logs are available in the Appendix.

#### **2.2.5 Groundwater monitoring and sample analyses**

Static groundwater levels and electrical conductivity (EC) were measured in all piezometers prior to reporting. Pre-existing data were also examined. The Department of Agriculture will continue monitoring the townsite piezometers.

#### **2.2.6 Surveying**

Locations (easting and northing) and elevations of piezometers were established using a global positioning system which was accurate to  $\pm 0.2$  m horizontally and vertically.

## 2.3 Results

### 2.3.1 Profile descriptions

Regolith in Wandering consists of shallow laterite-derived gravel and/or clay colluvium deposits overlying primarily granite saprolite. All drill holes intersected coarse-grained granite bedrock with only one drilled directly into a gabbro dyke (02WR10). Complete regolith profiles are present to the west of the town. Both gabbro and granite weathered material is present on ridges, and unweathered rock outcrop was only observed at erosional surfaces. The profiles are illustrated in cross-section (Figures 2-3 to 2-5).

A gabbro dyke intersected at 02WR10 was delineated by geological field mapping and aerial photography (Figure 2-1). This dyke strikes WSW-ENE however no dip was measurable. A second dyke striking WNW-ESE forms the catchment boundary and crosses the North Bannister-Wandering Road, outcropping adjacent to Wandering Brook. The dykes appear gabbroic in their centres, though evidence of chilled doleritic margins was found in the field. Both dykes are at least 50 m wide along their traceable lengths.

Colluvium is commonly 1-2 m thick. Soils at several sites (02WR02, 02WR06, 02WR07, 02WR10) have developed in situ on erosional surfaces i.e. no transported material in the vicinity. Site 02WR11 has deep colluvium/alluvium coverage that is 9.5 m thick. It is located along the catchment's main drainage line and derived directly from erosion of an adjacent gabbro dyke.

At all sites, saprolite clay ranged between 12 and 34 m thick. Although granite saprolite was most common, mafic clays/fragments and associated mafic staining was observed at locations 02WR02, 02WR08 and 02WR09 during drilling.

The often transmissive saprock layer ranged from 0.7 to 3.6 m thick but was generally less than 2 m. Quartz and feldspar particles formed 40-60% of this layer and ranged from 1 to 10 mm in diameter, averaging 3-4 mm. In areas where mafic saprolite was encountered this saprock layer was finer grained and had a greater proportion of sheet silicate minerals (e.g. muscovite, biotite). In these areas, lower permeability was expected due to the low quartz content.

Depth to bedrock ranged from about 12.5 to 38.3 m and elevation of the bedrock surface ranged from 289.6 to 245.6 m above Australian Height Datum (AHD). Bedrock was shallowest in the upper and lower slope localities. Middle slope areas had the greatest depth and most of this was in-situ material.

### 2.3.2 Surface and bedrock elevation

Surface and bedrock elevations were contoured from drill hole data (Figure 2-2) and from five bores drilled during the 1994 Water Authority investigation. Drill hole density and distribution were not sufficient to produce accurate contour maps but mapped data show that the bedrock surface differs significantly from the natural surface elevation.

The apparent sump in the bedrock surface is a result of drilling directly into a mafic dyke (02WR10D). As depicted in the cross-sections (Figures 2-3 to 2-5), mafic bedrock will weather to clay more deeply than surrounding felsic bedrock.

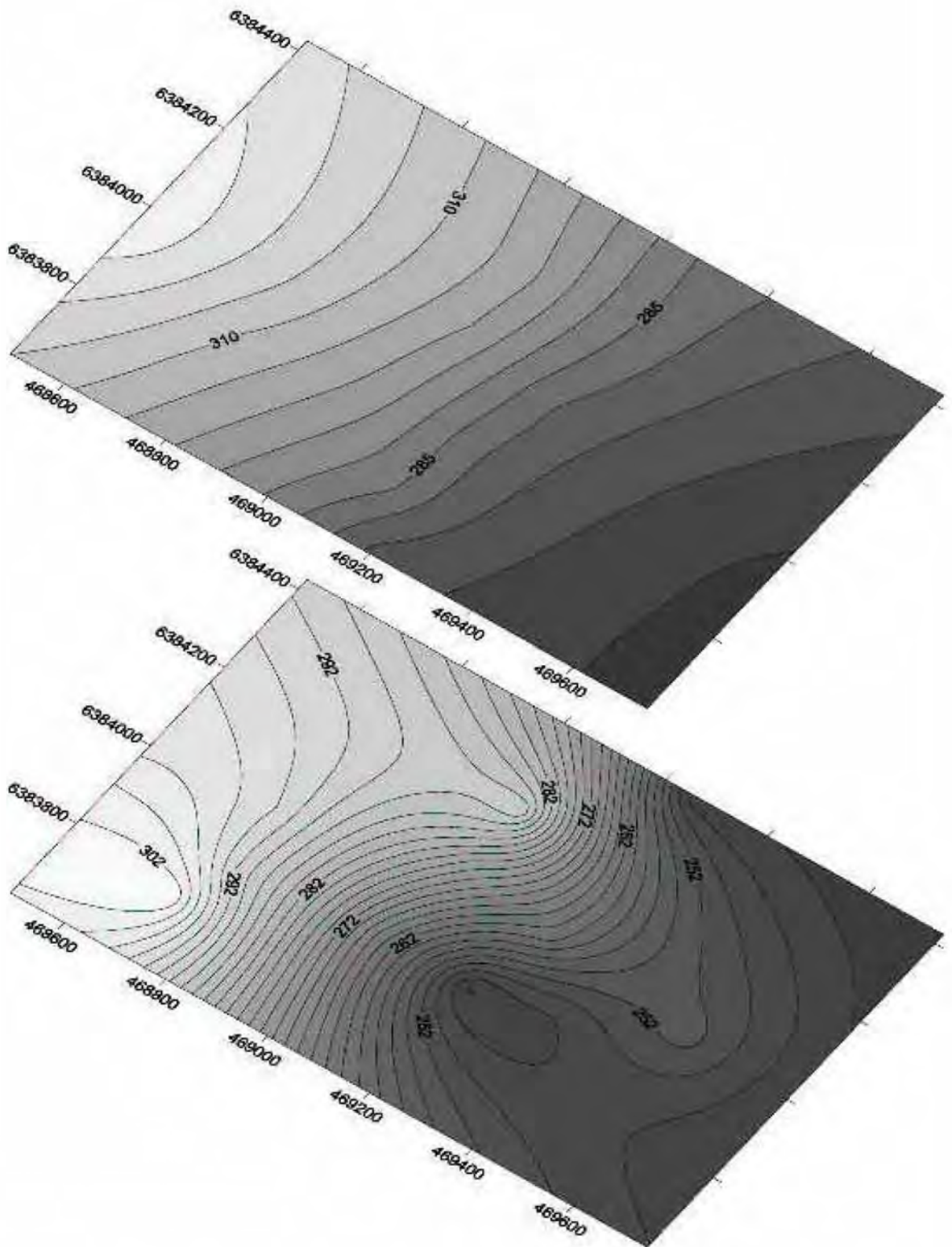


Figure 2-2. Surface topography (top) and bedrock (bottom) elevation contour maps (for contoured area shown in Figure 2-1)

### 2.3.3 Groundwater levels

Table 2-1 lists the groundwater levels in the piezometers as measured on 10 April 2002. Figures 2-3 to 2-5 show how these varied across the townsite. A second set of groundwater measurements was taken on 15 May 2002 but did not provide additional insight into groundwater patterns. For this reason, only the 10 April 2002 data will be discussed.

Groundwater is shallowest in the southern part of town near the creek. Water levels in piezometers near the creek and along Cheetaning and Gnowing Roads are around 1 m from the surface. Of the piezometers drilled in the current program, shallowest water levels were recorded at 02WR01, 02WR02 and 02WR04. Beneath the main residential areas, water levels were 3.75 to 5.21 m deep. Groundwater was about 15 m below the surface in upper landscape positions and only 02WR07 did not have groundwater present.

**Table 2-1. Drilling, construction and electrical conductivity for piezometer sites (10 April 2002)**

Drill hole name	Ground elevation above AHD <sup>#</sup> (m)	Depth drilled <sup>#</sup> (m)	Screen interval AHD <sup>##</sup> (m)	Ground-water depth bgl <sup>###</sup> (m)	Groundwater level elevation above AHD <sup>###</sup> (m)	Electrical conductivity (mS/m)	Estimated yield (L/sec)
02WR01D	265.28	17.70	247.58-249.58	1.19	264.09	1,550	<0.1
02WR01S	265.25	5.59	259.66-261.66	1.20	264.05	1,600	
02WR02D	274.59	26.31	248.28-250.28	4.66	269.93	1,820	<0.05
02WR02S	274.62	8.01	266.61-268.61	1.70	272.91	2,470	
02WR03D	269.16	16.17	252.99-254.99	2.99	266.17	3,080	<0.1
02WR04D	263.60	18.20	245.40-247.40	2.29	261.31	1,630	<0.1
02WR04S	263.49	6.41	257.08-259.08	2.10	261.29	770	
02WR05S	266.25	4.38	261.87-263.87	3.78	262.47	2,330	
02WR06D	281.08	20.30	260.78-262.78	5.06	276.02	1,600	<0.3
02WR06S	281.15	7.48	273.67-275.67	5.21	275.94	1,350	
02WR07D	302.09	12.47	289.62-291.62	DRY			
02WR08D	285.45	38.27	247.18-249.18	10.97	274.48	1,550	<0.2
02WR08S	285.66	10.26	275.54-277.54	DRY			
02WR09D	297.23	31.39	265.84-267.84	15.00	282.23	670	<0.1
02WR09S	297.13	17.95	279.18-281.18	14.96	282.17	1,090	
02WR10D	281.83	36.18	245.65-247.65	4.43	277.40	1,890	<0.1
02WR10S	281.81	6.97	274.84-276.84	4.31	277.50	1,240	
02WR11D	272.91	14.37	258.54-260.54	3.82	269.09	940	<0.1
02WR11S	272.92	5.06	267.86-269.86	3.75	269.17	1,150	

#: equivalent to inserted casing length measured to cm accuracy – no significant hole collapse observed;  
##: AHD – Australian Height Datum; ###: bgl – below ground level



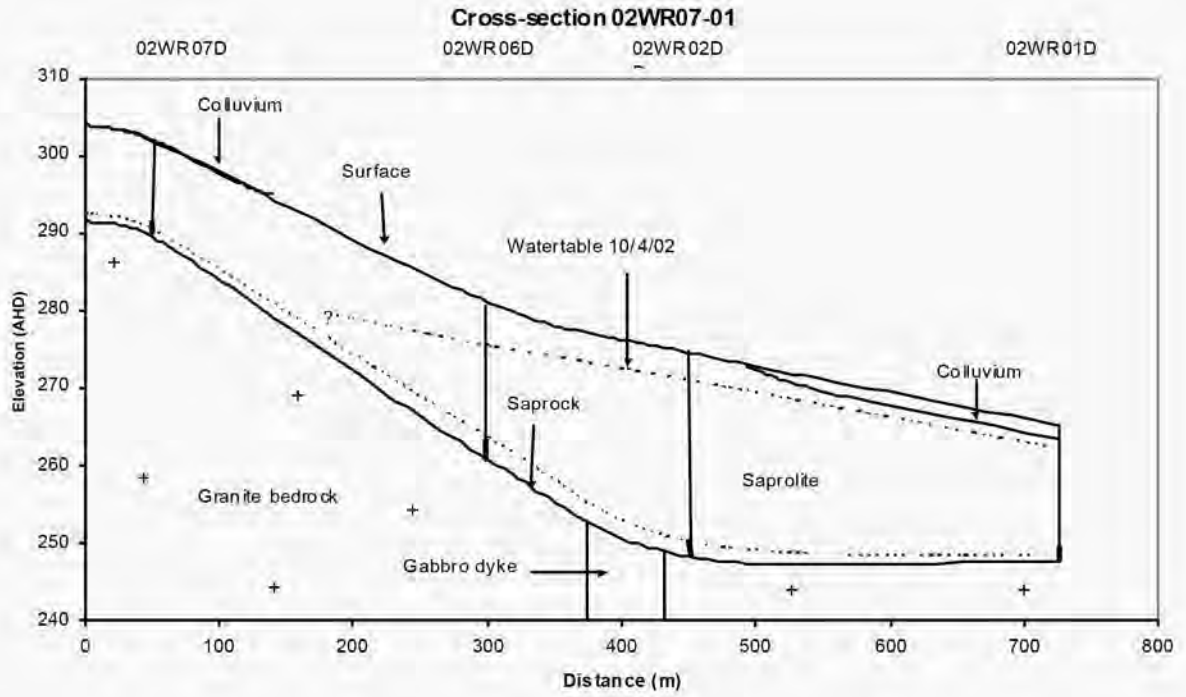


Figure 2-3. Cross-section from drill site 02WR07 to 02WR01

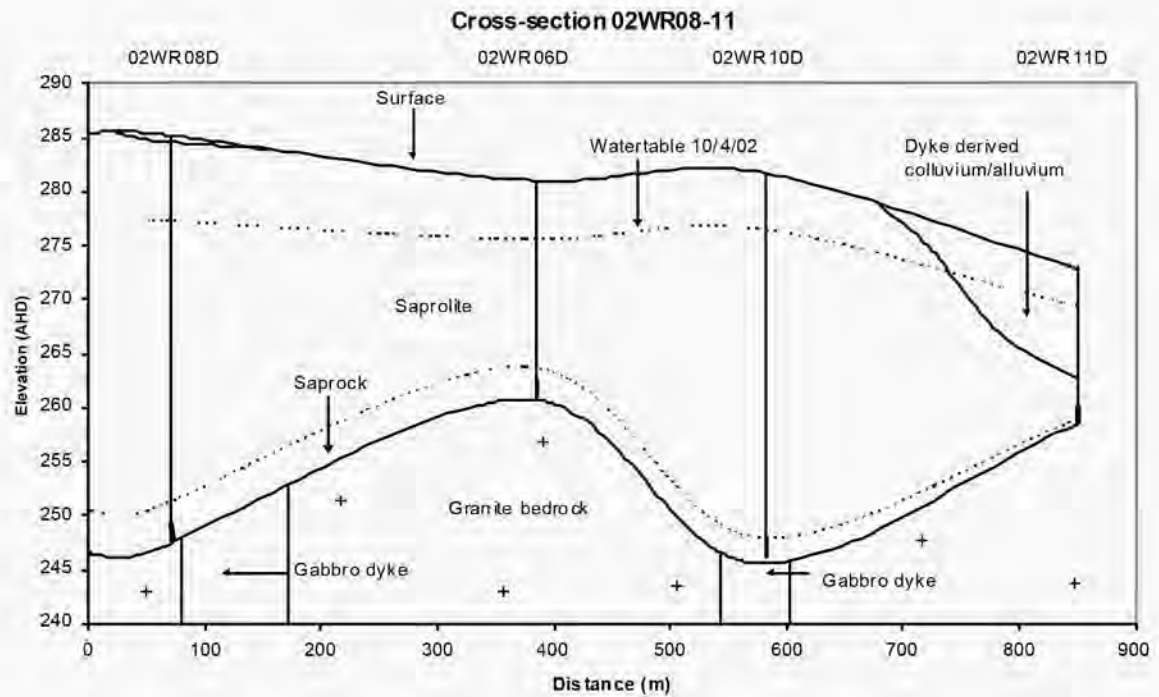


Figure 2-4. Cross-section from drill site 02WR08 to 02WR11

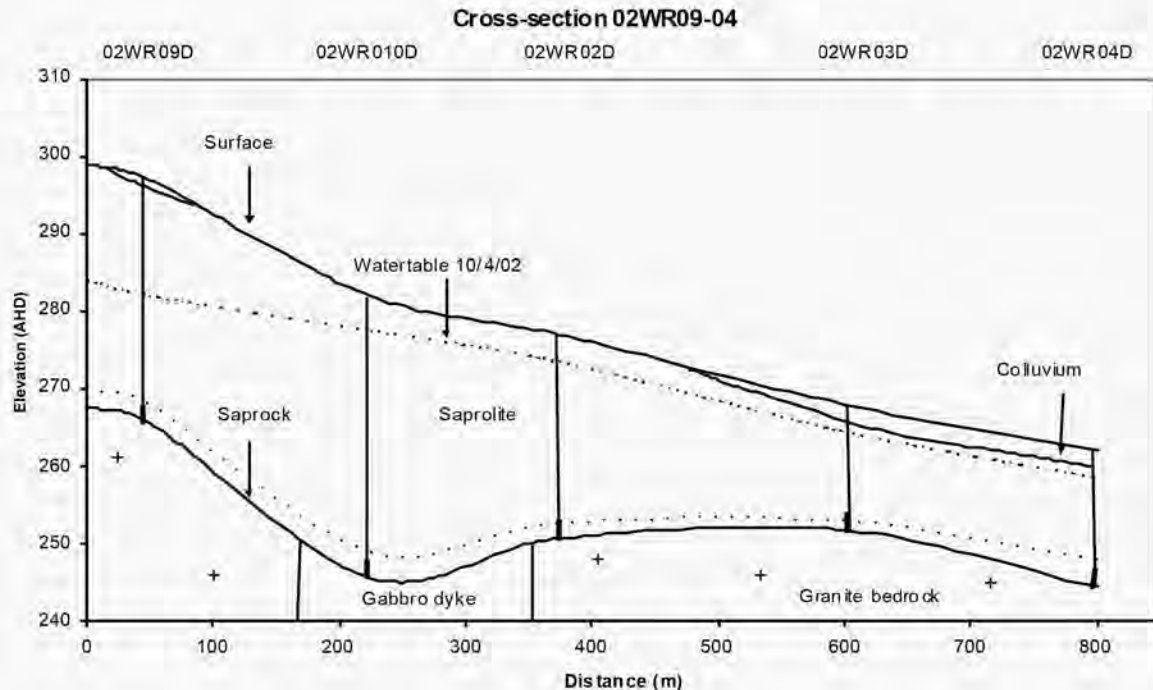


Figure 2-5. Cross-section from drill site 02WR09 to 02WR04

Data show that the deep and shallow piezometers displayed near equal piezometric head except at site 02WR02 where there was a 3 m downward vertical head. Older piezometers established at this site (RTPWPZ3 and RTPWPZ10) indicated that a small upward head of about 0.2 m was present for much of 2001 and in March 2002 between the piezometer drilled to 9.18 m and that drilled to 2.8 m. Pallid zone clay has forced its way into RTPWPZ3 giving the water noticeably greater viscosity. This may be due to poor construction but may also be a symptom of the transmissive dyke margin fluidising clays due to high pore pressure.

An older piezometer (RTPWPZ5) near North Bannister-Wandering Road was drilled to 9.65 m and had a piezometric head above ground level. This site does not have a piezometer drilled to bedrock for comparison, however its nested shallow piezometers drilled to 1.78 and 2.25 m show an upward vertical gradient is present. Water levels measured in all other older piezometers were consistent with the behaviour of those drilled during the current study.

Groundwater gradients were only slightly less than surface gradients, except in upper slope areas where surface gradients have increased significantly due to erosion.

### 2.3.4 Groundwater yields

Airlifting of drilled holes was conducted to develop the installed piezometers and filter packs. From this operation piezometer yields were estimated. Most sites had a low yield. Less than 0.1 L/sec (equivalent rate of 8.6 m<sup>3</sup>/day) was airlifted from the piezometers, with the greatest yields achieved from 02WR08D and 02WR06D, yielding 0.2 L/sec (17.3 m<sup>3</sup>/day) and 0.3 L/sec (25.9 m<sup>3</sup>/day), respectively. This is

significantly less than estimated during the earlier Water Authority investigation. This is probably due to the limited 2 m screen interval of the piezometer.

Slug tests were performed on four shallow piezometers (02WR02S, 02WR06S, 02WR10S, RTPWPZ5) and the Hvorslev (1951) analysis used to estimate the saturated hydraulic conductivity of the screened material (saprolite aquitard). Results of two slug test are shown in Figure 2-6.

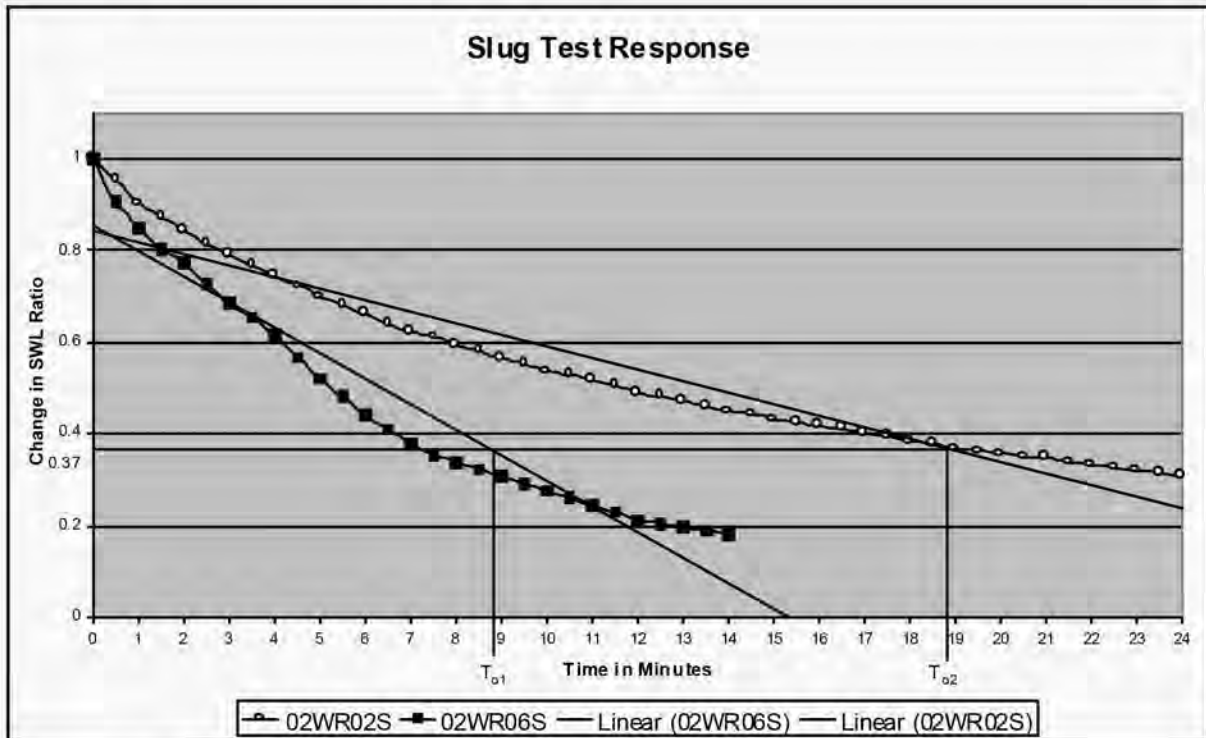


Figure 2-6. Slug test ratio graph showing 02WR06S recovered faster than 02WR02S

Horizontal K was calculated using the equation:

$$K = \frac{r^2 \ln \left[ \frac{L_e}{R} \right]}{2L_e T_o} \quad \text{where:}$$

$K$  = hydraulic conductivity (m/day)

$r$  = radius of piezometer casing = 0.025 m

$R$  = radius of piezometer screen (includes gravel pack) = ~ 0.05 m

$L_e$  = length of piezometer screen = 2.00 m

$T_o$  = time taken for water level to rise 0.37 of initial change (see Figure 2-6)

(The required condition  $L/R > 8$  was satisfied)

$T_o$  values of 8.7 minutes (02WR06S) and 18.7 minutes (02WR02S) were derived from each of the piezometers, resulting in estimated hydraulic conductivities of  $9.5 \times 10^{-2}$  and  $4.4 \times 10^{-2}$  m/day respectively. These values are consistent with average hydraulic conductivities obtained for saprolite aquitards by Briesse (1979) and George (1992).

Piezometer 02WR10S is located in the Down Street dyke and RTPWPZ5 may be located in the dyke saprolite. Slug testing of these bores gave hydraulic conductivities of  $1.9 \times 10^{-2}$  and  $2.86 \times 10^{-2}$  m/day, respectively. Conclusions from the systematic study performed by Clarke *et al.* (2000) identified dyke saprolite as generally having higher hydraulic conductivity ( $2.0 \times 10^{-1}$  m/day) than granitic saprolite ( $9.0 \times 10^{-2}$  m/day). Although the sample size is limited in this study, it appears that in Wandering the dyke saprolite has a lower hydraulic conductivity than the surrounding granite saprolite.

### **2.3.5 Groundwater electrical conductivity (EC)**

Groundwater electrical conductivity values (Table 2-1) ranged from 670 to 3,080 mS/m with most readings between 940 and 1,630 mS/m. Lowest levels were from 02WR04S and 02WR09D (770 and 670 mS/m respectively). Deep groundwater was markedly fresher than shallow groundwater at sites 02WR09 and 02WR02.

## 2.4 Interpretation and discussion of results

### 2.4.1 Recharge

Saprock aquifer potentiometric surface mapping, Water Authority information and field observations indicated that there were three main sources of recharge contributing to the townsite:

1. Cleared land directly west of the town (adjacent to bituminised catchments)
2. Dam No. 2
3. Recharge within the townsite area.

A groundwater recharge/discharge relationship was estimated in accordance with the following assumptions and equation:

Recharge from Dam No. 2 = 3000 m<sup>3</sup>/annum  
 Recharge from rainfall = 3% of 615 mm annual rainfall  
 Area contributing recharge (townsite/cleared land) = 30 ha  
 Thickness of aquifer profile = 25 m (averaged K<sub>s</sub> of 0.2 m/day)  
 Length of discharge into Wandering Brook = 250-500 m

$$Q = -K.A.i$$

Recharge was calculated at 8,400 m<sup>3</sup>/annum whilst groundwater discharge along the length of Wandering Brook was in the range of 13,700 to 27,400 m<sup>3</sup>/annum. The actual rate of discharge is probably less than that calculated due to the hindrance of outflow caused by the lower hydraulic gradient of the Wandering Brook groundwater system. Nevertheless, figures show that recharge is less than discharge, meaning that groundwater equilibrium may have been attained. Monitoring should be continued for several years to substantiate or refute this conclusion.

Shallow watertables are associated with the catchment's main creek and severe waterlogging is evident from air photo and field inspection. Given the proximity to the catchment's discharge point, groundwater systems superimpose on the larger, intermediate scale Wandering Brook groundwater system (see Section 2.4.2). This may hinder outflow from the catchment, further increasing waterlogging and flooding problems.

Recharge within the townsite was inferred to be relatively low, given that reticulation is minimal and the sports oval is not watered. Sealed surfaces and relatively high run-off on the middle to lower slopes combined with natural topography ensure water does not accumulate or infiltrate with ease. Leaking septic systems have recently been noted during excavation work (Mick Oliver pers. comm.) and will contribute to problems in the small northern groundwater system. However, remediation work, including drain rejuvenation, is being carried out.

Vegetated areas immediately upslope of the townsite are not believed to be contributing significant recharge. Under native vegetation in areas of 800 to 1,220 mm annual rainfall, recharge was estimated at 0.05 to 3.7 mm/yr (Williamson *et al.* 1987). This increases to 23 to 65 mm/yr after clearing (Peck and Hurle 1973).

## 2.4.2 Groundwater flow systems

Wandering townsite has two groundwater flow systems:

- A large southern system which is influenced primarily by recharge and discharge of the Wandering catchment
- A small northern system bounded by two gabbro dykes, one of which follows the trace of Down Street, the other forming the northern boundary of Wandering catchment.

The southern system is separated from the northern system by the dyke that follows the trace of Down Street. Waterlogging is causing damage to vegetation south of the town. Increased recharge and run-off volumes since clearing have undoubtedly raised watertables here, making conditions less hospitable for natural vegetation. Flat terrain has also contributed to lateral expansion of salinity. Water is mildly saline and at the upper level for use by existing native vegetation.

Discharge from this system is directly into Wandering Brook, by evaporation from waterlogged/inundated surfaces and to a lesser degree, evapotranspiration by surviving native vegetation. Groundwater salinity is such that the vegetation will preferentially transpire rainfall/run-off and use only smaller quantities of brackish to saline groundwater during the summer months. Lack of fresh water during summer, waterlogging and accumulation of salts in the root zone are causing degradation of vegetation.

The northern groundwater system has a small recharge catchment, most of which is covered with wandoo woodland. This system flows east-south-east and is separated from the southern system by the Down Street dyke which extends westwards into Wandering catchment for at least 1.4 km. The topographic catchment divide, formed by another gabbro dyke, appears also to be a broad groundwater divide to both the northern groundwater system and the Wandering catchment. Water quality varies from brackish to saline.

The northern system does not have any direct natural drainage to Wandering Brook, with most run-off from the catchment flowing along Down Street and through other drains. Prior to settlement, Down Street would have been the natural flow pathway for any run-off from the northern system catchment. At shallow to intermediate depths it seems that the Down Street dyke is acting both as a barrier and carrier of water, helping direct flow downslope. This is because of the dyke's orientation, which is neither perpendicular nor parallel to groundwater contours.

Smaller local groundwater systems (e.g. perched aquifers) are largely absent from the townsite. The thin, predominantly heavy clay soils and lack of permeable material prevent the development of perched systems. Gravelly soils are present on heavily vegetated upper slopes but erosion has truncated these soils limiting their spatial extent, and therefore significance. No seepage areas were visible and any that may exist are thought to dry out relatively quickly.

### 2.4.3 Groundwater resources

Site 02WR01 near the creek yielded significant quantities of water during drilling (1.7 m depth). The groundwater was perched on a clay-rich stratigraphic unit but poor water quality rules it out as a usable resource. Site 02WR04 had a brackish (770 mS/m) 'lens' of groundwater lying over more saline groundwater and this too is thought to be of limited potential. Discussions with the land owner at this site confirmed the presence of fresh to brackish lenses, as his bore became salty after a certain period of pumping fresher water.

Fractured rock aquifers may be present near 02WR09. This is suspected given that deep groundwater (670 mS/m at ~30 m) is markedly fresher than shallow water (1,090 mS/m at ~15 m). Fifteen metres of unsaturated profile lies above the watertable at this location. Recharge is thought to be entering fracture systems where no watertable exists and resurfacing below saline groundwater further downslope. The potential for fractured rock aquifers was investigated during the Water Authority drilling program in 1994. Hammer drilling indicated limited fracturing in one of two basement penetrating holes. Quantifying water resource potential in fractures was not within the scope of this study but may warrant further investigation.

Groundwater yields during airlifting produced poor to average yields at all shallow and deep screened intervals. This indicates that groundwater pumping is probably not viable in the areas tested. Saprock aquifers did not produce significant quantities of water, mainly due to their thinness (<2-3 m). It is possible that by pumping from the transmissive zone associated with the Down Street dyke, groundwater problems may be reduced. Detailed localised drilling and interpretation would be required to delineate the zone, determine optimum screen depth and interval. Even after delineation, test pumping would be required to determine if this strategy would work. A cost:benefit analysis is strongly advised before undertaking such an investigation.

### 2.4.4 Groundwater gradients

Other than site 02WR02, all areas showed insignificant head differentials between deep and shallow piezometers. Potentiometric surface of the deep semi-confined saprock aquifer across the townsite showed that no significant pressure heads have formed in this aquifer. Congruity of potentiometric heads across the boundary of the two flow systems in the saprock aquifer indicated that connectivity between these systems was present at depth, and that the aquifer was coping adequately with recharge. Piezometers not considered vital for determining salinity risk will not be discussed further but on collection of more time series data, may require review to determine their relevance to townsite salinity.

The shallow piezometer at 02WR02 is located close to the Down Street dyke which has been mapped. A 3 m downward vertical hydraulic gradient was evident between the shallow and deep piezometer. A small upward vertical gradient of around 0.2 m between two older piezometers approximately 10 m north of this site suggested that groundwater also moves a smaller proportion of water upwards from intermediate depths. From this evidence it is apparent that a groundwater mound is present at intermediate depth, causing both upward and downward migration of water. The

phenomenon is believed to be due to transmissive zone(s) along the margin of the dyke importing water at intermediate depth. Drill logs present evidence of the dyke margin being nearby in the form of mafic rock fragments. These fragments are likely to be dolerite veins that formed during the intrusion event in small faults and fissures. Contact metamorphism associated with dyke intrusion may also have led to the development of a recrystallised country rock margin. Pre-existing texture variability, followed by heterogeneous weathering, may have left behind preferential pathways or rock fabrics conducive to groundwater flow/accumulation. Dykes have been studied in depth and their potential to act as both barriers and carriers of groundwater has been well documented (Engel *et al.* 1987, McFarlane *et al.* 1987, Lewis 1991, Clarke *et al.* 2000). Groundwater build-up behind the dyke during winter months, and subsequent subsurface flow over the dyke at shallower levels may also contribute to car park damage, however there is no evidence to confirm this.

Piezometers drilled in 2001 showed no abnormal behaviour except for RTPWPZ5, which was displaying an above-ground piezometric head. This piezometer was drilled to a similar depth as 02WR02S and closely follows the trace of the dyke thought to be responsible for a groundwater mound upslope. Unfortunately no deep piezometer is nested in this location and the presence of a similar downward vertical gradient as encountered at 02WR02 would largely validate the stated dyke theory. It would also indicate that a break-of-slope groundwater phenomenon is not the main cause of the mound, as RTPWPZ5 is not located at a break-of-slope position. Anecdotal evidence of prolonged waterlogging and poor surface drainage near RTPWPZ5 supports the theory that the dyke is the cause of groundwater problems at both sites. The Down Street dyke and northern dyke intersect to form a closure at the North Banister-Wandering Road. This merging point is considered a major restriction to groundwater flow in the northern system.

Five alternative theories were discounted as the cause of the intermediate groundwater mounds:

- 1) Leakage from the town water supply (dams and water mains) – piezometer nests placed near Dam No. 1 do not register abnormally high pressure and EC values do not show dilution of brackish to saline groundwater by fresh dam water.
- 2) Perched aquifers contributing groundwater – no stratigraphic unit capable of perching groundwater was logged. The profile was saturated to bedrock and no other shallow piezometers in similar topographic positions registered an elevated pressure head.
- 3) Break-of-slope pressure head development – deep piezometers across the entire townsite are generally in equilibrium with shallow piezometers except those that follow the Down Street dyke trace (02WR02, RTPWPZ3, RTPWPZ5). Other piezometers located near or at break-of-slope positions do not show elevated pressure heads.
- 4) Seasonal reversal of vertical gradients in nested piezometers – minor fluctuations are possible but large downward gradients (-3 m) and surface expression of groundwater at the same point in time appear contradictory. A small upward gradient in nearby piezometers is also present.



- 5) Surface water damage – run-off from roads sometimes forms small pools of water in the damaged area but these do not remain for long periods. Bituminised areas are not easily damaged by run-off and short-term ponding of rainfall.

Slug tests were carried out to determine approximate horizontal hydraulic conductivity values at 02WR02S, 02WR06S, 02WR10S, and RTPWPZ5. This was to determine if any geological fabrics in the screened material are responsible for greater flows. Site 02WR06 is not near the margin of any dyke and has a typical granite saprolite profile.

Hydraulic conductivity values indicated that 02WR02S is screened in material that has lower conductivity than the piezometer located away from the dyke in granitic saprolite. This means that although 02WR02S is screened in low permeability material, the pressure being registered is a function of groundwater influx from a nearby source i.e. inferred transmissive zone related to the dyke. Low permeability has resulted in surface expression of groundwater at this site and at another along the dyke margin (RTPWPZ5). Piezometer 02WR10S is located directly within the trace of the dyke that has low permeability, but shows no influence of the transmissive zone. This suggests water influx occurs only along the dyke margin, or in more localised zones along the margin. Piezometer 02WR06S is screened in more permeable clays and is unaffected by the transmissive zone.

#### **2.4.5 Assessment of salinity risk**

Townsite groundwater levels in the southern groundwater system have near equal piezometric head and are considered deep enough not to constitute an immediate salinity risk except for properties located adjacent to, and north of, the main creek (Cheetaning Road). Groundwater levels in this area were around 1 m from the surface whilst beneath main residential areas water levels were mostly between 3.75 m and 5.21 m deep. This area is prone to waterlogging and salinisation, however if damage to date has been limited, further damage is likely to be minimal as the system is discharging nearby. The new residential land to the west of the town has been prone to waterlogging for many years and the southern blocks of the development are in a higher risk area. Unless adequate drainage systems are installed, leakage from septic systems and run-off from impermeable areas may further contribute to waterlogging.

The intermediate groundwater mound (02WR02) that has developed along the Down Street dyke trace will continue to cause problems. If the 2 m deep closed drain that was installed does not show improvement in the area alternative measures may be necessary. Iron-rich groundwater may potentially reduce the efficiency of the blue metal/perforated pipe system installed. Verification of the exact trend of the transmissive zone and test pumping will determine if any dewatering strategy will be successful.

Infrastructure above the northern groundwater system may become affected by rising watertables, especially those on the north side of Down Street and west of Dowsett Street. The ability of the saprock aquifer to transmit groundwater beneath from the closure of the two dykes here will be a factor on the distance groundwater 'encroaches' westwards. It is not known whether the northern dyke contributes groundwater to this area.

Piezometer 02WR06D is located some 250 m upslope of this area and does not appear to be affected by the dyke closure. Town water supply Dam No. 2 is unlined and leaking at about 3,000 m<sup>3</sup>/yr (Dolley and Forrest 1994). Given that the northern groundwater system is small, this volume of water is considered significant. Current management of the dams involves keeping Dam No. 1 (lined) full and minimising Dam No. 2 volumes. This is the correct form of management, however if rising trends become evident in 02WR06, or problems become worse at the dyke closure, alternative measures may be necessary.

Confirmation of long-term or seasonal groundwater trends cannot be made from this study due to the limited data. Several years of time series data will be required to confirm any trends. Regular monitoring of the piezometer network will indicate if there is a risk of salinity and other problems associated with shallow groundwater occurring in the future.

If groundwater levels are rising, then the identified groundwater barrier preventing groundwater outflow of the northern system will increase salinity risk. Signs of deterioration of the North Bannister-Wandering Road should be checked.

### 3. Conclusions

In general, deep and shallow groundwater levels showed insignificant head differentials, and groundwater levels were considered to deep enough not to constitute an immediate salinity risk. However, localised salinity outbreaks near major infrastructure and waterlogging close to some residences will remain an issue.

1. Two groundwater systems are in operation with deep connection between saprock aquifers of each system. The northern system is small and bounded by gabbro dykes while the southern system is part of the Wandering catchment.
2. Gabbro dykes appear to be importing groundwater into the townsite. A transmissive margin has been identified as a potential carrier of groundwater and elevated piezometric heads are present along the trace of the dyke. This affects car park salinity.
3. Two dykes form a closure near the North Bannister-Wandering Road and further problems in this area are anticipated. Properties on the north side of Down Street and west of Dowsett Street are most likely to be affected.
4. Water levels in piezometers drilled near the main creek and along Cheetaning and Gnowing Roads are about 1 m from the surface. Groundwater has been discharging in this area for some time, and if minimal damage has occurred to date, expansion may be limited. Inundation and waterlogging may increase in frequency.
5. Dam No. 1 (lined) and leaking water mains are not responsible for groundwater problems near the car park. No elevated piezometric heads were recorded, nor abnormal groundwater salinities.
6. Dam No. 2 may require lining if it is found that the northern groundwater system is still rising. Leakage estimates by the Water Authority are significant given the small size of the system.
7. Piezometer yield estimates show only small quantities of water are extractable and groundwater pumping would not have great radial influence. If the transmissive margin can be delineated then yields are expected to be higher. Test pumping could then be carried out to determine the effect of dewatering.
8. Groundwater resources are scarce and only two have been identified as having any potential: brackish water lenses at 02WR04S; and fractured rock aquifer seepage near 02WR09. Both of these resources are thought to be limited.

## 4. Recommendations

Recommendations for areas identified as being at risk of salinity are outlined below. The cost of each measure has not been considered and cost estimates should be obtained before proceeding.

The prime recommendation is that groundwater levels continue to be monitored.

### 4.1 *Car park and dyke closure*

1. Revegetate the public areas above and around the car park. Eucalypts have already been planted, however a greater density of other salt-tolerant vegetation is required. Fencing off and establishment of mid and understorey vegetation would assist.
2. Target the transmissive zones of the Down Street dyke with detailed localised drilling. Interpretation would be required to delineate the dyke margin and determine optimum screen depth and interval. Test pumping would then determine the impact of any dewatering strategy. A cost:benefit analysis is strongly advised before undertaking such an investigation.
3. Siphoning of piezometers installed in the transmissive margin may be an option, however iron accumulation in pipes may reduce efficiency. Inspection of the site would be needed to determine whether flow rates and surface gradient to Wandering Brook are sufficient to allow continuous flow of water. This option also requires investigative drilling outlined above. The Department of Agriculture is currently assessing effectiveness of siphoning as a tool for watertable reduction.
4. Line Dam No. 2 if rising watertable trends become evident at 02WR06 or problems near the dyke closure worsen. This should drastically reduce the estimated 3,000 m<sup>3</sup>/yr recharge that occurs directly into the northern groundwater system.

### 4.2 *Main creek*

5. Manage surface water in the catchment through proper design and construction of earthworks. Water harvesting will reduce run-off flow volumes, thus easing waterlogging problems at the outlet.
6. Rejuvenate the main creek to assist in surface drainage. This would assist Wandering catchment outflow and should reduce the spatial extent and duration of waterlogging impacts on the area. Any structure deeper than 1 m below the surface may require a Notice of Intent to Drain to be submitted to the Commissioner for Soil and Land Conservation.

Revegetate areas of dead or dying native vegetation with salt-tolerant trees and shrubs. If vegetation is not replaced, secondary salinisation will increase in severity.

Currently trees and shrubs provide sufficient coverage to stop direct evaporation of water from the soil surface. Coverage must be maintained to prevent surface salting.

Furthermore, if monitoring indicates that groundwater levels are rising below the town and that cleared land to the west is the major cause, recharge reduction measures (perennial pastures, surface water control, tree-planting) should be considered for the contributing area.

## **5. Acknowledgments**

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- Gina Broun, Hotham Community Landcare Coordinator, for discussions on townsite salinity and data provision.

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<b>Borehole: 02WR01D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469626m/6383806m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 265.9m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
0		<b>Colluvium</b> Brown clay and orange sandy clay. Fe stained.	1.7m water bearing  Intersected watertable, profile saturated	<p>Steel Collar</p> <p>Backfill</p> <p>Bentonite Seal</p> <p>Filter Pack</p> <p>PVC 1mm Screen</p>
2		<b>Saprolite</b> 2-5m tan/yellow clayey sand, minor qtz, fld, rock core (floater)		
5		5-7m light orange clayey sand, minor qtz, fld, rock core.		
7		<b>Saprolite</b> Tan/yellow sandy clay, minor qtz, fld and rock core		
11		<b>Saprolite</b> Tan/yellow clayey sand, qtz and fld crystals to 3mm diameter		
13		<b>Saprolite</b> Tan/yellow coarse clayey sand, qtz and fld crystals 1-10mm, av. 3mm		
17		<b>Saprock</b> Tan/yellow coarse clayey sand, qtz and fld 1-10mm crystals, ave. 2-3mm, biotite present	Saprock aquifer - poor yield during drilling	
18				
19				

<b>Depth Drilled (m):</b> 17.7m (5.59m 02WR01S)	<b>Casing Type:</b> PVC Class 12 50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.6m
<b>Depth to Water (m):</b> 1.19m	<b>Casing Total Length (m):</b> 18.3m
<b>Estimated Yield (L/s):</b> <0.1	<b>Screen (m):</b> Bottom 2m

<b>Borehole: 02WR01D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469626m/6383806m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 265.9m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
20		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite		
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				

<b>Depth Drilled (m):</b> 17.7m (5.59m 02WR01S)	<b>Casing Type:</b> PVC Class 12-50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.6m
<b>Depth to Water (m):</b> 1.19m	<b>Casing Total Length (m):</b> 18.3m
<b>Estimated Yield (L/s):</b> <0.1	<b>Screen (m):</b> Bottom 2m



<b>Borehole: 02WR02D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469342m/6383933m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 275.2m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
0		<b>Pallid Zone</b> Light tan/yellow to cream sandy clay/clay, minor qtz and fld, sericite, limonite alteration. In situ soil development	Intersected watertable, profile saturated, low quantities of water yielded during drilling	
6		<b>Saprolite</b> Light brown to browny green sandy clay, qtz and fld approx 25% of content		
17		<b>Saprolite</b> Light yellowish green (17-19m), orangey brown (10-21m) and greenish grey (21-25m) sandy clays, qtz and fld approx 10% of content		

<b>Depth Drilled (m):</b> 26.31m (8.01m 02WR02S)	<b>Casing Type:</b> PVC Class 12 50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.59m
<b>Depth to Water (m):</b> 4.66m	<b>Casing Total Length (m):</b> 26.89m
<b>Estimated Yield (L/s):</b> <0.05	<b>Screen (m):</b> Bottom 2m

**Borehole: 02WR02D**

**Project:** Rural Towns Program      **Date:** 18-21 March 2002  
**Location:** Wandering      **Easting/Northing:** 469342m/6383933m  
**Hydrologist:** Shahzad Ghauri      **AHD:** 275.2m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
20			Saprock aquifer	<p>Filter Pack PVC 1mm Screen Bentonite Seal</p>
21				
22				
23				
24				
25		<b>Saprock Doleritic</b> Purplish brown sand clay, some granitic/intermediate rock chips, dolerite vein chips evident		
26		<b>Saprock</b> Light purplish brown sandy clay, granitic rock chips, Fe minerals fragments		
27		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite		
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				

<b>Depth Drilled (m):</b> 26.31m (8.01m 02WR02S)	<b>Casing Type:</b> PVC Class 12 50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.59m
<b>Depth to Water (m):</b> 4.66m	<b>Casing Total Length (m):</b> 26.89m
<b>Estimated Yield (L/s):</b> <0.05	<b>Screen (m):</b> Bottom 2m

<b>Borehole: 02WR03D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469540m/6384012m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 269.8m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
0		<b>Colluvium</b> Brown to light brown sandy clay	Intersected watertable, profile saturated	
1		<b>Saprolite</b> light tan/yellow sandy clay		
2		<b>Saprolite</b> Yellow sandy clay, qtz and fld 1-3mm in diameter, approx 20% of content	5-6m yielded well	
3		<b>Saprolite</b> Light greenish white to light brown sandy clay, qtz and fld approx 10% of content		
4		<b>Saprolite</b> Light brown clayey sand, qtz and fld, approx 50% of content	Saprock aquifer	
5		<b>Saprolite</b> Light brown clayey sand, qtz and fld 1-3mm diameter, biotite, rock core at 16m		
6		<b>Saprolite</b> Light brown clayey sand, qtz and fld 1-3mm diameter, biotite, rock core at 16m		
7		<b>Saprock</b> Light brown clayey sand, qtz and fld 1-3mm diameter, biotite, rock core at 16m	Saprock aquifer	
8		<b>Saprock</b> Light brown clayey sand, qtz and fld 1-3mm diameter, biotite, rock core at 16m		
9		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite	Saprock aquifer	
10		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite		
11		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite	Saprock aquifer	
12		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite		
13		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite	Saprock aquifer	
14		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite		
15		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite	Saprock aquifer	
16		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite		
17		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite	Saprock aquifer	
18		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite		
19		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite	Saprock aquifer	
20		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite		

<b>Depth Drilled (m):</b> 16.17m (existing shallow bore)	<b>Casing Type:</b> PVC Class 12 50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.63m
<b>Depth to Water (m):</b> 2.99m	<b>Casing Total Length (m):</b> 16.83m
<b>Estimated Yield (L/s):</b> <0.1	<b>Screen (m):</b> Bottom 2m

<b>Borehole: 02WR04D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469745m/6383930m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 264.2m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
0		<b>Colluvium/Alluvium</b> Light brown and yellowish orange sandy clay/clay	Intersected watertable, profile saturated	Steel Collar
1				
2		<b>Saprolite</b> Orange to light brownish clay, Fe nodules, minor silicious nodules, qtz and fld 1-4mm, approx 20% of content	Quartz veining of limited potential for carrying water	Backfill
3				
4				
5		<b>Saprolite</b> Yellow to light yellow clayey sand and sandy clay, qtz and fld, approx 20-50% of content.	Saprock aquifer - reasonable yield during drilling	Bentonite Seal Filter Pack
6				
7		<b>Saprolite - Quartz Veining</b> Yellow clayey sand, qtz veining and large fragments		
8		<b>Saprolite</b> Yellowish brown clayey sand, qtz and fld, approx 50% of content, minor biotite		
9			Saprock aquifer - reasonable yield during drilling	PVC 1mm Screen
10		<b>Saprock</b> Yellowish brown clayey sand, qtz, fld, biotite, increasing coarse crystal portion with depth		
11				
12		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite		

<b>Depth Drilled (m):</b> 18.2m (6.41m 02WR04S)	<b>Casing Type:</b> PVC Class 12.50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.6m
<b>Depth to Water (m):</b> 2.29m	<b>Casing Total Length (m):</b> 18.8m
<b>Estimated Yield (L/s):</b> <0.1	<b>Screen (m):</b> Bottom 2m

<b>Borehole: 02WR06D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469245m/6384052m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 281.7m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
0		<b>Colluvium</b> Brown to light browny cream sandy clay	Intersected watertable, profile saturated	
1		2-4m yellow sandy clay with indurated nodules		
2				
3				
4	<b>Mottled Zone</b> Cream sandy clay, patched of intense Fe staining			
5		<b>Pallid Zone</b> Cream sandy clay, minor qtz		
6				
7				
8		<b>Saprolite</b> Light tan/yellow sandy clay, fine qtz crystals, approx 5-10% of samples, sericite		
9		15-18m light brown and greenish colours		
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				

<b>Depth Drilled (m):</b> 20.3m (7.48m 02WR06S)	<b>Casing Type:</b> PVC Class 12 50mm
<b>Drill Method:</b> RC Aircore (02WR06S exists)	<b>Casing Above Ground (m):</b> 0.6m
<b>Depth to Water (m):</b> 5.06m	<b>Casing Total Length (m):</b> 20.9m
<b>Estimated Yield (L/s):</b> <0.3	<b>Screen (m):</b> Bottom 2m

<b>Borehole: 02WR06D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469245m/6384052m
<b>Hydrologist:</b> Shahzad Ghauni	<b>AHD:</b> 281.7m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
20		<b>Saprock</b> Light brown sandy clay and clayey sand, qtz, fld, approx 25-40% of samples, biotite and muscovite.	Saprock aquifer	 Filter Pack PVC 1mm Screen
21		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite		
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				

<b>Depth Drilled (m):</b> 20.3m (7.48m 02WR06S)	<b>Casing Type:</b> PVC Class 12.50mm
<b>Drill Method:</b> RC Aircore (02WR05S exists)	<b>Casing Above Ground (m):</b> 0.6m
<b>Depth to Water (m):</b> 5.06m	<b>Casing Total Length (m):</b> 20.9m
<b>Estimated Yield (L/s):</b> <0.3	<b>Screen (m):</b> Bottom 2m

<b>Borehole: 02WR07D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469053m/6384238m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 302.7m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
0		<b>Colluvium</b> Light brown gravelly clay, laterite nodules, some insitu soil development		<p>Steel Collar</p> <p>Backfill</p> <p>Bentonite Seal</p> <p>Filter Pack</p> <p>PVC 1mm Screen</p>
1				
2		<b>Saprolite</b> Yellow sandy clay		
3				
4				
5				
6		<b>Saprolite</b> Yellow sandy clay, minor Fe nodules and staining, indurated clay nodules	7-8m dampness, possible perching on indurated layer	
7				
8				
9		<b>Saprolite</b> Light yellow sandy clay, qtz and fld 1-4mm diameter, approx 15% content		
10				
11				
12		<b>Saprock</b> Light yellow sandy clay, limonite alteration, weathered rock core, qtz, fld 1-4mm, biotite	Saprock zone dry	
13		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite		
14				
15				
16				
17				
18				
19				

<b>Depth Drilled (m):</b> 12.47m (no shallow bore)	<b>Casing Type:</b> PVC Class 12 50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.63m
<b>Depth to Water (m):</b> Bore Dry	<b>Casing Total Length (m):</b> 13.13m
<b>Estimated Yield (L/s):</b>	<b>Screen (m):</b> Bottom 2m

<b>Borehole: 02WR08D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469250m/6384424m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 286.1m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
0		<b>Colluvium</b> Light orangey brown clay, Fe nodules		
1		<b>Mottled Zones</b> Pinkish white clay, indurated clay nodules, Fe staining, ferricrete core at 3-4m		
2				
3				
4				
8		<b>Pallid Zone</b> White kaolin clay, minor Fe staining	intersected watertable, profile saturated	
9				
10				
11				
12				
13				
14		<b>Saprolite Doleritic</b> Dark brown sandy clay, minor qtz, approx 10% of content, dolerite vein chips		
15				
16				
17		<b>Saprolite</b> Light yellow to greenish brown sandy clay, qtz and fld, approx 10% of sample, biotite rich, mafic colours		
18				
19				

<b>Depth Drilled (m):</b> 38.27m (10.26m 02WR08S)	<b>Casing Type:</b> PVC Class 12.50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.63m
<b>Depth to Water (m):</b> 10.97m	<b>Casing Total Length (m):</b> 39.53m
<b>Estimated Yield (L/s):</b> <0.2	<b>Screen (m):</b> Bottom 2m




**Borehole: 02WR08D**

**Project:** Rural Towns Program      **Date:** 18-21 March 2002  
**Location:** Wandering      **Easting/Northing:** 469250m/6384424m  
**Hydrologist:** Shahzad Ghauri      **AHD:** 286.1m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details	
20				<p style="font-size: small;">Bentonite Seal Filter Pack PVC 1mm Screen</p>	
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31			<b>Saprolite</b>		
32			Light greyish brown sandy clay, qtz and fld, approx 20% of content, biotite		
33					
34					
35			<b>Saprock</b>		
36			Light greyish brown clayey sand, qtz and fld, approx 40% of content, biotite, granite core at end		
37					
38					
39					

<b>Depth Drilled (m):</b> 38.27m (10.26m 02WR08S)	<b>Casing Type:</b> PVC Class 12 50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.63m
<b>Depth to Water (m):</b> 10.97m	<b>Casing Total Length (m):</b> 39.53m
<b>Estimated Yield (L/s):</b> <0.2	<b>Screen (m):</b> Bottom 2m

<b>Borehole: 02WR08D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469250m/6384424m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 286.1m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
40		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite		
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				

<b>Depth Drilled (m):</b> 98.27m (10.26m 02WR08S)	<b>Casing Type:</b> PVC Class 12.50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.63m
<b>Depth to Water (m):</b> 10.97m	<b>Casing Total Length (m):</b> 39.53m
<b>Estimated Yield (L/s):</b> <0.2	<b>Screen (m):</b> Bottom 2m

<b>Borehole: 02WR09D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469017m/6383897m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 297.8m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
0		<b>Colluvium</b> Light brown gravelly clay		<p style="text-align: right;">Steel Collar</p> <p style="text-align: center;">Backfill</p>
1		<b>Duricrust</b> Light orange gravelly clay and duricrust nodules		
2		<b>Saprolite</b> 2-5m Yellow sandy clay		
3		2-5m Yellow sandy clay		
4		5-10m Yellow and light purple sandy clay, Fe staining and nodules		
5		5-10m Yellow and light purple sandy clay, Fe staining and nodules		
6		10-14m Yellow and white sandy clay, qtz approx 10% of content		
7		10-14m Yellow and white sandy clay, qtz approx 10% of content		
8		14-18m Yellow to light orangey brown sandy clay, qtz and fd, approx 25% of content		
9		14-18m Yellow to light orangey brown sandy clay, qtz and fd, approx 25% of content		
10		14-18m Yellow to light orangey brown sandy clay, qtz and fd, approx 25% of content		
11		14-18m Yellow to light orangey brown sandy clay, qtz and fd, approx 25% of content		
12		14-18m Yellow to light orangey brown sandy clay, qtz and fd, approx 25% of content		
13		14-18m Yellow to light orangey brown sandy clay, qtz and fd, approx 25% of content		
14		14-18m Yellow to light orangey brown sandy clay, qtz and fd, approx 25% of content		
15		14-18m Yellow to light orangey brown sandy clay, qtz and fd, approx 25% of content	Intersected watertable, profile saturated	
16		14-18m Yellow to light orangey brown sandy clay, qtz and fd, approx 25% of content		
17		14-18m Yellow to light orangey brown sandy clay, qtz and fd, approx 25% of content		
18		14-18m Yellow to light orangey brown sandy clay, qtz and fd, approx 25% of content		
19		14-18m Yellow to light orangey brown sandy clay, qtz and fd, approx 25% of content		

<b>Depth Drilled (m):</b> 31.39m (17.95m 02WR09S)	<b>Casing Type:</b> PVC Class 12 50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.61m
<b>Depth to Water (m):</b> 15m	<b>Casing Total Length (m):</b> 32.01m
<b>Estimated Yield (L/s):</b> <0.1	<b>Screen (m):</b> Bottom 2m

<b>Borehole: 02WR09D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469017m/6383897m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 297.8m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
20		<b>Saprolite</b> Light brown to greenish brown (olive) sandy clay, qtz and fld, approx 25% of content, 1-4mm in diameter, mafic colours		
21				
22				
23				
24				
25				
26		<b>Saprock</b> Light greenish brown sandy clay, qtz and fld, approx 40% of content, biotite	Saprock aquifer	
27				
28				
29		<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite		
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				

<b>Depth Drilled (m):</b> 31.39m (17.95m 02WR09B)	<b>Casing Type:</b> PVC Class-12 50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.61m
<b>Depth to Water (m):</b> 15m	<b>Casing Total Length (m):</b> 32.01m
<b>Estimated Yield (L/s):</b> <0.1	<b>Screen (m):</b> Bottom 2m

<b>Borehole: 02WR10D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469199m/6383892m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 282.4m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
0	[Symbol]	<b>Colluvium</b> Brown sandy clay - Insitu soil development		
1	[Symbol]	<b>Saprolite</b> Homogenous light yellowish brown sandy clay, occasional Fe nodules and mafic fragments.		
2	[Symbol]			
3	[Symbol]	30-31m Dolente rock floater		
4	[Symbol]			
5	[Symbol]		Intersected watertable, profile saturated	
6	[Symbol]			
7	[Symbol]			
8	[Symbol]			
9	[Symbol]			
10	[Symbol]			
11	[Symbol]			
12	[Symbol]			
13	[Symbol]			
14	[Symbol]			
15	[Symbol]			
16	[Symbol]			
17	[Symbol]			
18	[Symbol]			
19	[Symbol]			

<b>Depth Drilled (m):</b> 36.18m (6.97m 02WR10S)	<b>Casing Type:</b> PVC Class 12.50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.62m
<b>Depth to Water (m):</b> 4.43m	<b>Casing Total Length (m):</b> 36.62m
<b>Estimated Yield (L/s):</b> <0.1	<b>Screen (m):</b> Bottom 2m

<b>Borehole: 02WR10D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469199m/6383892m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 282.4m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33		<b>Saprock</b> Light brown sandy clay, visible plagioclase laths in clay weathered material, minor quartz and feldspar, gabbro rock fragments	Mafic saprock aquifer, poor yield potential	
34				
35		<b>Bedrock (Gabbro)</b> Dyke trend traced by geological field mapping		
36				
37				
38				
39				

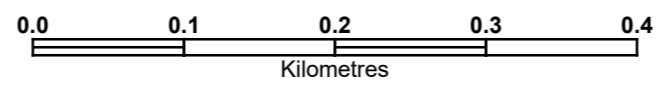
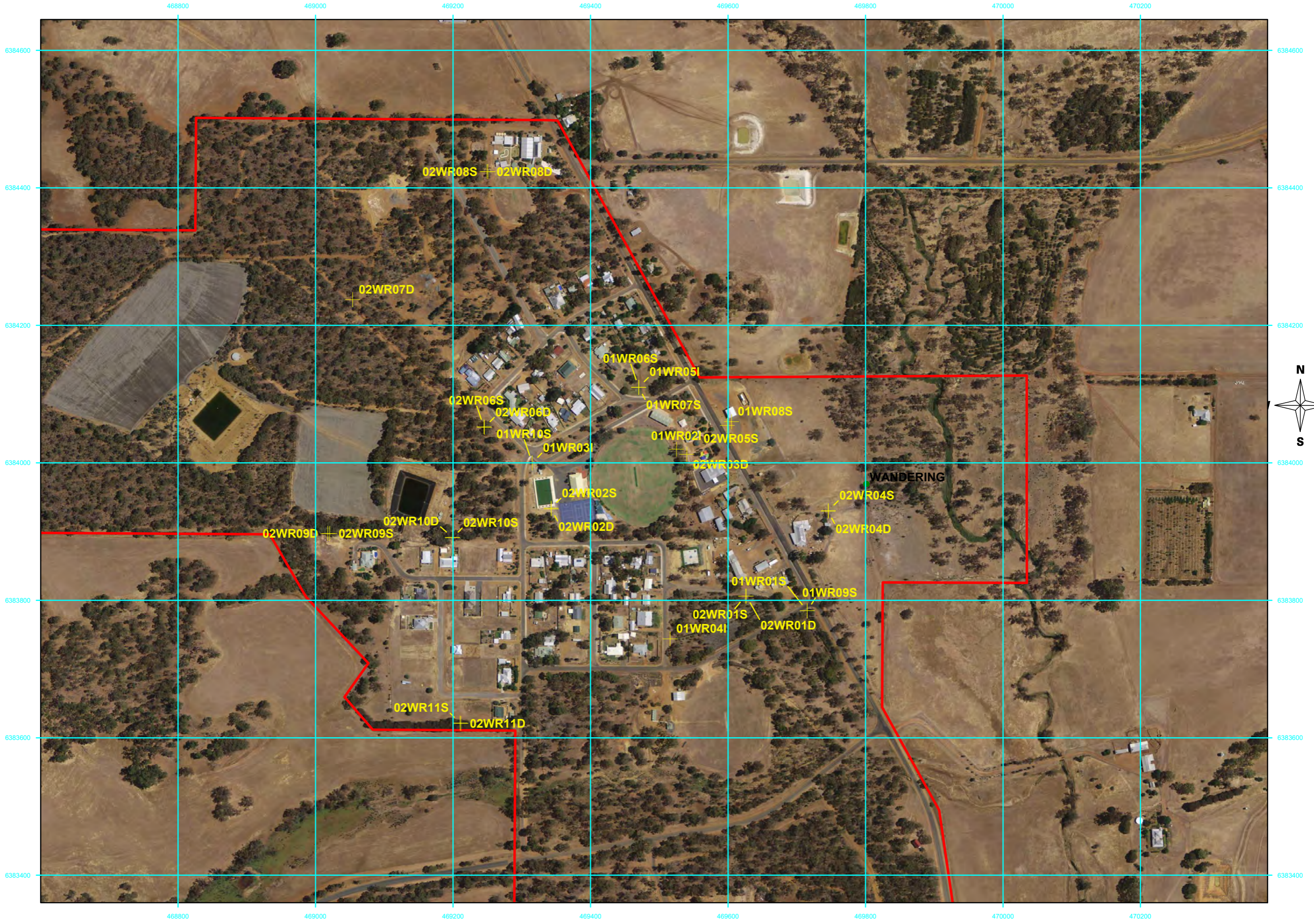
<b>Depth Drilled (m):</b> 36.18m (6.97m 02WR10S)	<b>Casing Type:</b> PVC Class 12.50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.62m
<b>Depth to Water (m):</b> 4.43m	<b>Casing Total Length (m):</b> 36.82m
<b>Estimated Yield (L/s):</b> <0.1	<b>Screen (m):</b> Bottom 2m

<b>Borehole: 02WR11D</b>	
<b>Project:</b> Rural Towns Program	<b>Date:</b> 18-21 March 2002
<b>Location:</b> Wandering	<b>Easting/Northing:</b> 469211m/6388622m
<b>Hydrologist:</b> Shahzad Ghauri	<b>AHD:</b> 273.5m (GDA94)

Depth	Symbol	Description	Hydrogeology	Well Completion Details
0	[Symbol: Dark brown gravelly clay with Fe nodules and dolerite chips]	<b>Colluvium/Alluvium</b> 0-4m Dark brown gravelly clay, Fe nodules, dolerite chips	Intersected watertable, profile saturated	
1		4-9.5m Brown gravelly and sandy clay, Fe nodules, pisolites, minor green clay lumps		
2				
3				
4				
5				
6				
7				
8				
9				
10	[Symbol: Pink sandy clay with 10-20% quartz and feldspar]	<b>Saprolite</b> Pink sandy clay, qtz and fld 1-2mm, approx 10-20% of content	Saprock aquifer	
11				
12				
13				
14	[Symbol: Light yellowish brown sandy clay with 25-60% quartz and feldspar]	<b>Saprock</b> Light yellowish brown sandy clay, qtz fld 1-10mm, av 3mm, approx 25-60% of content, biotite, rock core		
15				
16	[Symbol: Coarse grained granite]	<b>Bedrock (Granite)</b> Coarse grained qtz, fld, bt granite, pegmatite veining		
17				
18				
19				

<b>Depth Drilled (m):</b> 14.37m (5.06m 02WR11S)	<b>Casing Type:</b> PVC Class 12 50mm
<b>Drill Method:</b> RC Aircore	<b>Casing Above Ground (m):</b> 0.63m
<b>Depth to Water (m):</b> 3.82m	<b>Casing Total Length (m):</b> 15.03m
<b>Estimated Yield (L/s):</b> <0.1	<b>Screen (m):</b> Bottom 2m

# RURAL TOWNS PROGRAM BORES - Wandering



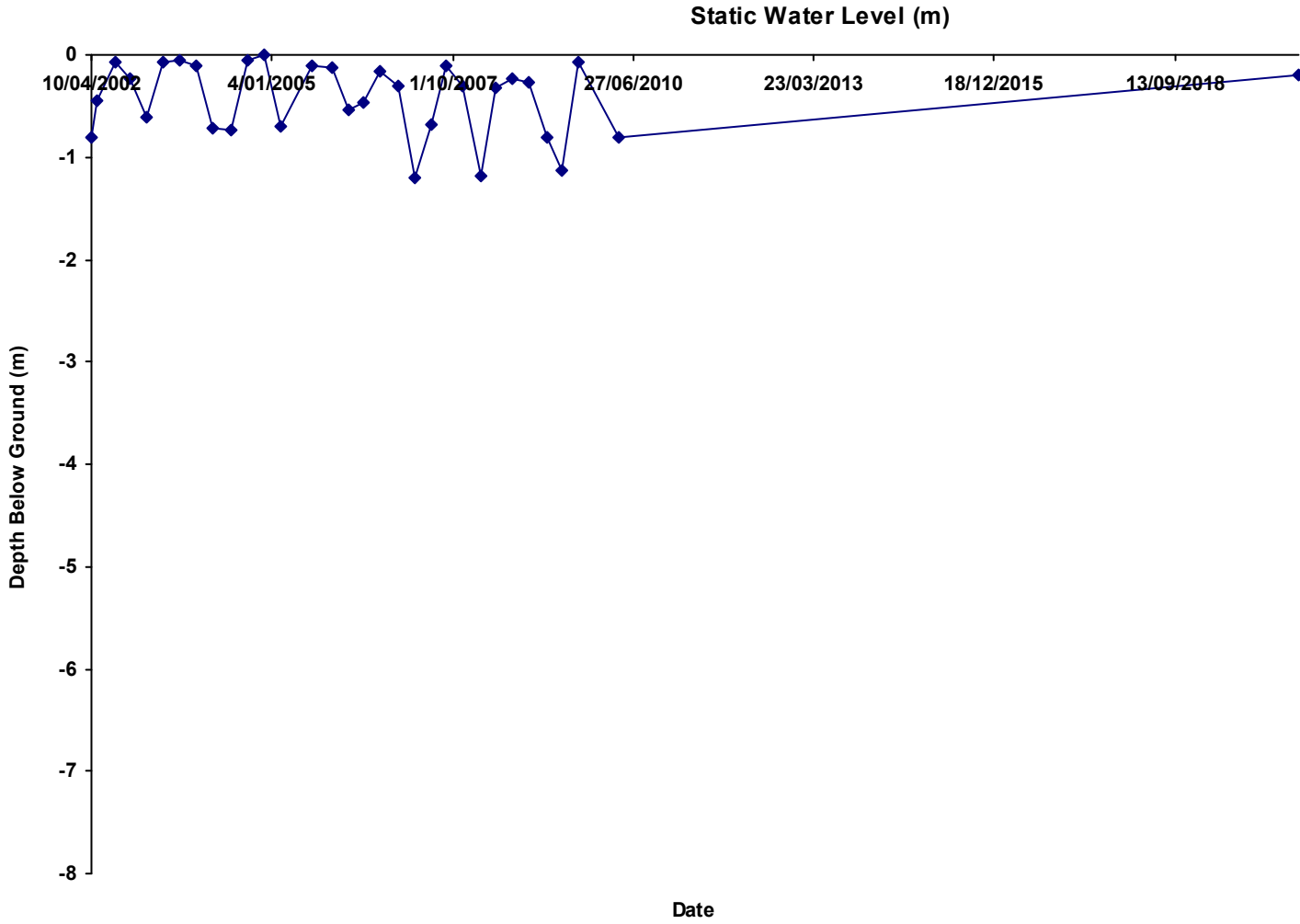


## Wandering bores

	(m)	(m)	(m)	(mS/m)	°C		
Bore	Depth of bore	Ht of PVC	Depth to GW	E.C.	GW temp	pH	
02WR01 D	17.54	0.59					Sewell St.
02WR01 S	5.63	0.61					" "
02WR02 D	26.20	0.62					Tennis courts
02WR02 S	7.96	0.61					" "
02WR03 D	16.11	0.65					Rear of Ag Hall
02WR04 D	17.49	0.63					Rear of Hotel
02WR04 S	7.34	0.62					" " "
02WR05 CB	6.95	0.63					Opp Ag Hall
02WR06 D	20.22	0.62					Cnr Westwood Rd & White St
02WR06 S	8.08	0.48					" " " " " " "
02WR07 D	12.59	0.66					Rear of sawmill
02WR08 D	38.81	0.63					Behind Pimary School
02WR08 S	10.27	0.64					" " "
02WR09 D	31.30	0.63					Rear of new mansion
02WR09 S	17.84	0.67					" " " "
02WR10 D	36.26	0.58					Front " " "
02WR10 S	6.91	0.66					" " " "
02WR11 D	14.27	0.65					off Humes Way (fenced tree line)
02WR11 S	4.98	0.56					" " " " " " "

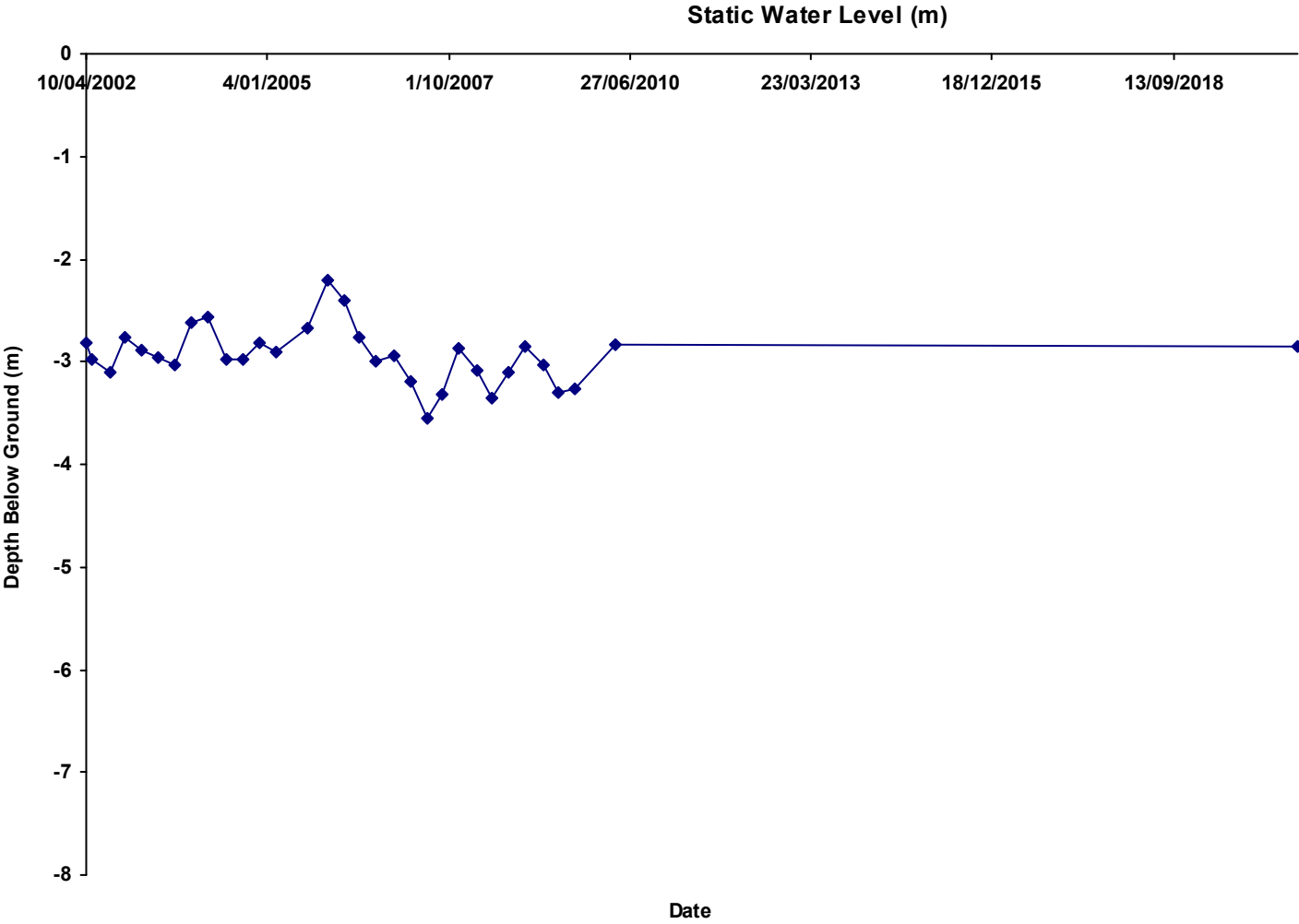
01WR01 S	2.71	0.20					Cnr Watts,Cheetaning & Sewell
01WR02 I	10.87	0.65					Rear Ag Hall
01WR03 I	8.84	0.15					Tennis courts (adj. Site-10)
01WR04 I	8.60	0.60					Gnowing St
01WR05 I	9.19	0.47					Cnr Dowsett & Down St
01WR06 S	1.74	0.52					" " " " "
01WR07 S	1.39	0.44					" " " " "
01WR08 S	5.60	0.70					near CB
01WR09 S	5.53	0.49					Cnr Watts,Cheetaning & Sewell
01WR10 S	2.76	0.20					Tennis courts (adj. Site-3)

Rural Towns Program    *Bore:* 01WR01S    *Project:* Wandering Rural Towns    *Sub Catchment:* Wandering Town    *Soil-landscape:* 253QdBK  
*GDA Coords:* 50    469715    6383785    *AHD (m):*    *Screened to (m):* -2.71



# graph SWL vs Time

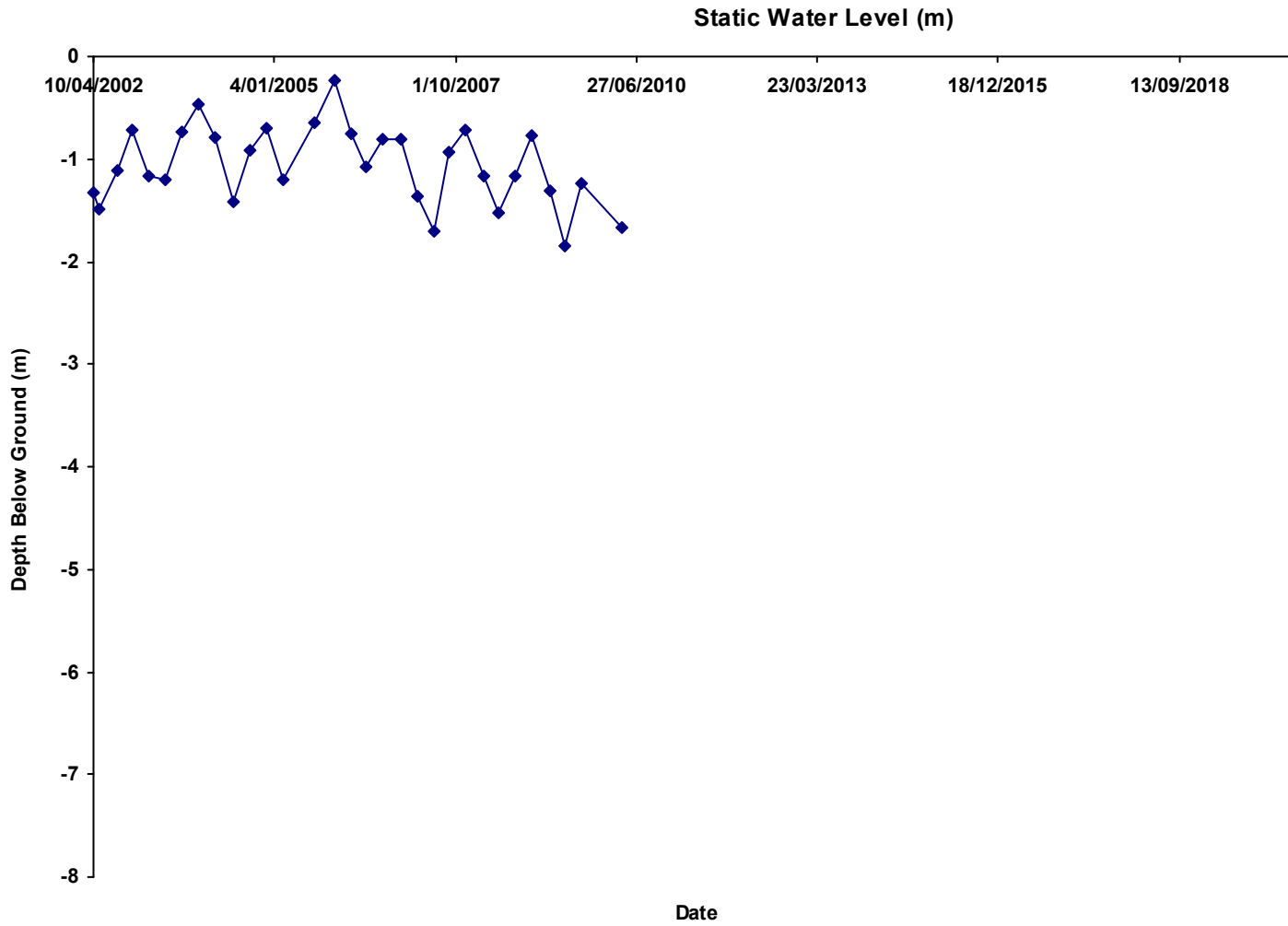
Rural Towns Program    **Bore:** 01WR02I    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50    469525    6384020    **AHD (m):**    **Screened to (m):** -10.87



# **graph SWL vs Time**

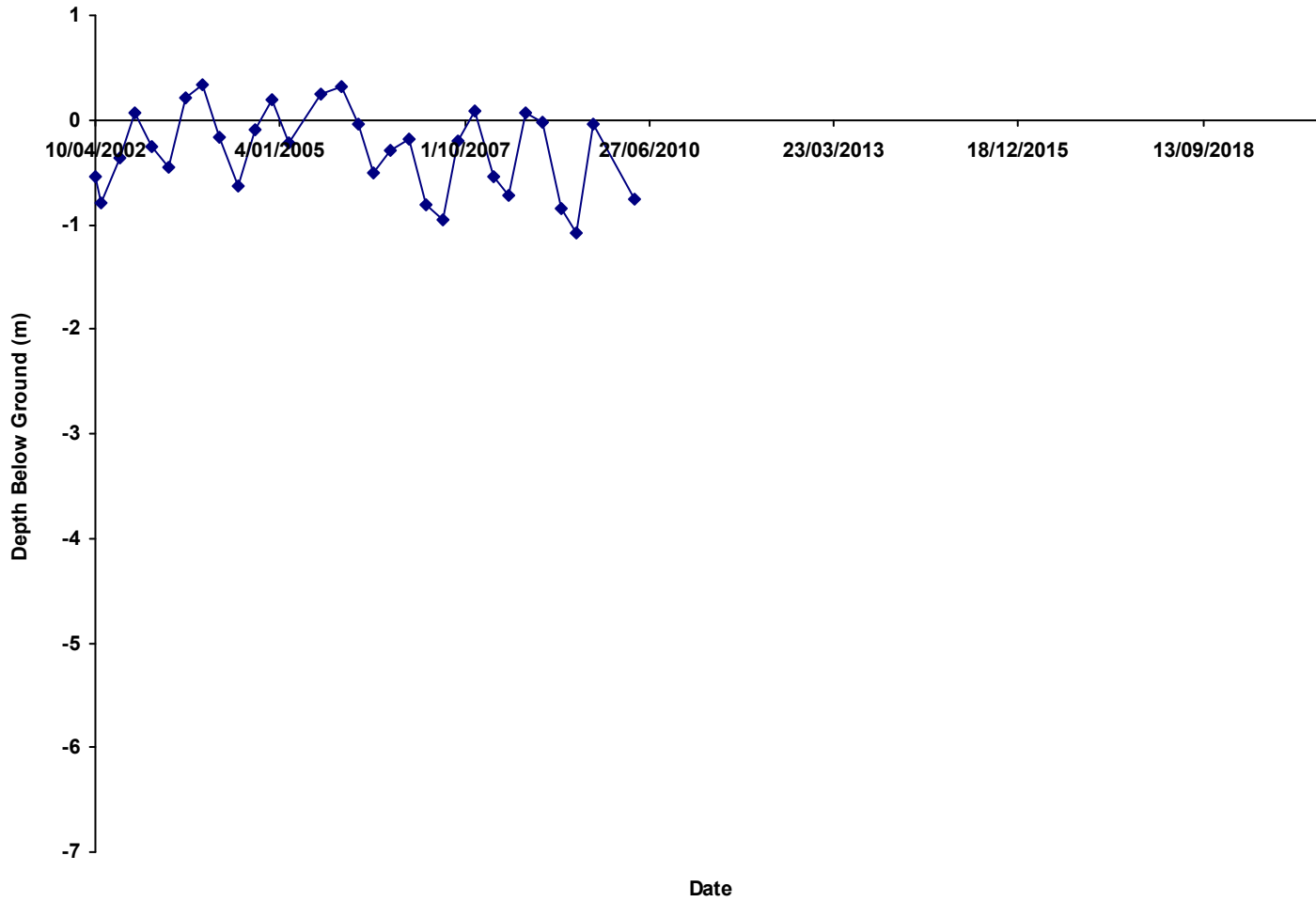
Rural Towns Program     **Bore:** 01WR03I     **Project:** Wandering Rural Towns     **Sub Catchment:** Wandering Town     **Soil-landscape:** 253QdMN

**GDA Coords:** 50     469315     6384000     **AHD (m):**     **Screened to (m):** -8.84



Rural Towns Program    **Bore:** 01WR04I    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50    469516    6383744    **AHD (m):**    **Screened to (m):** -8.6

**Static Water Level (m)**

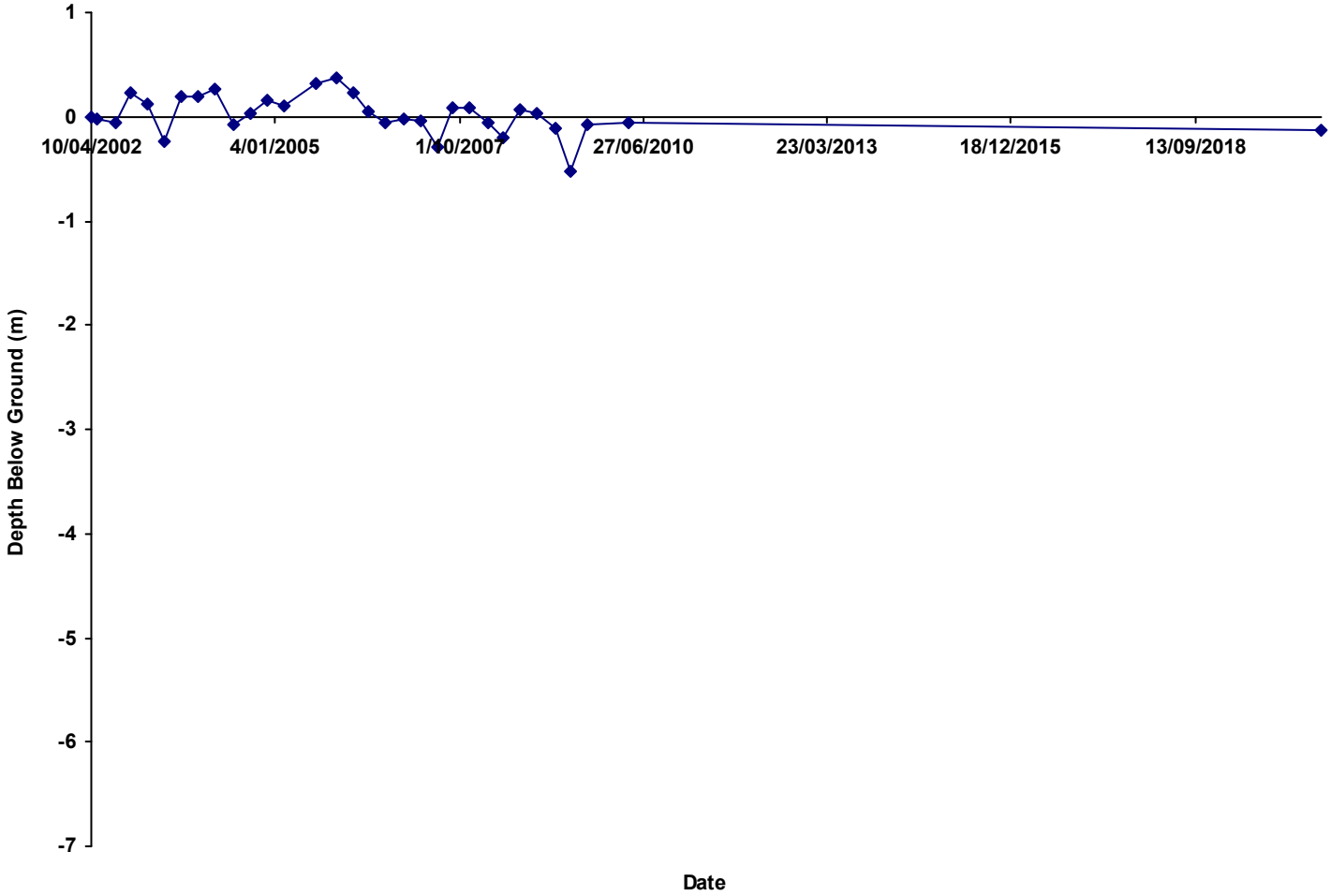


# graph SWL vs Time

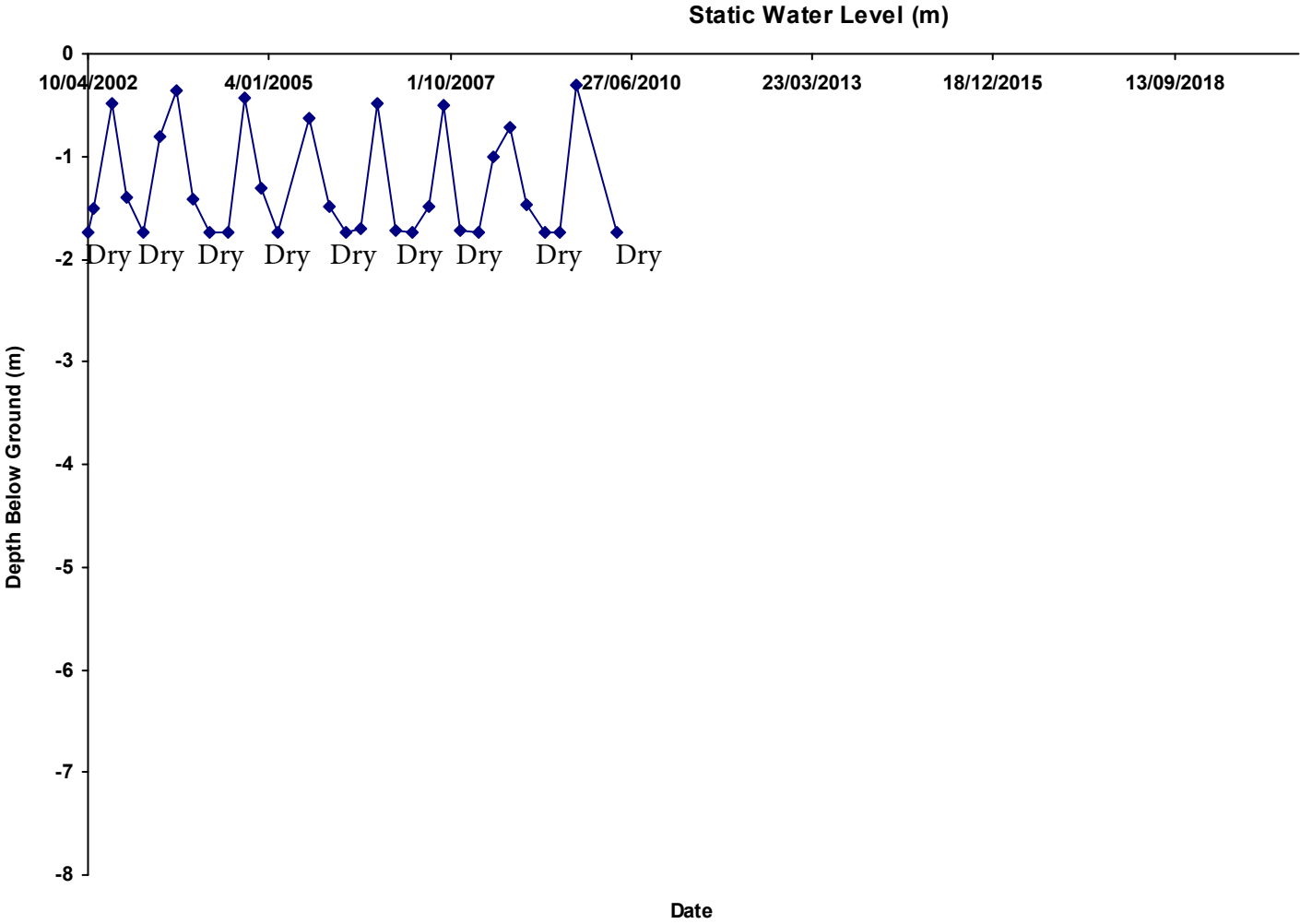
Rural Towns Program      *Bore:* 01WR05I      *Project:* Wandering Rural Towns      *Sub Catchment:* Wandering Town      *Soil-landscape:* 253QdMN

*GDA Coords:*    50      469470      6384110      *AHD (m):*      *Screened to (m):* -9.19

Static Water Level (m)



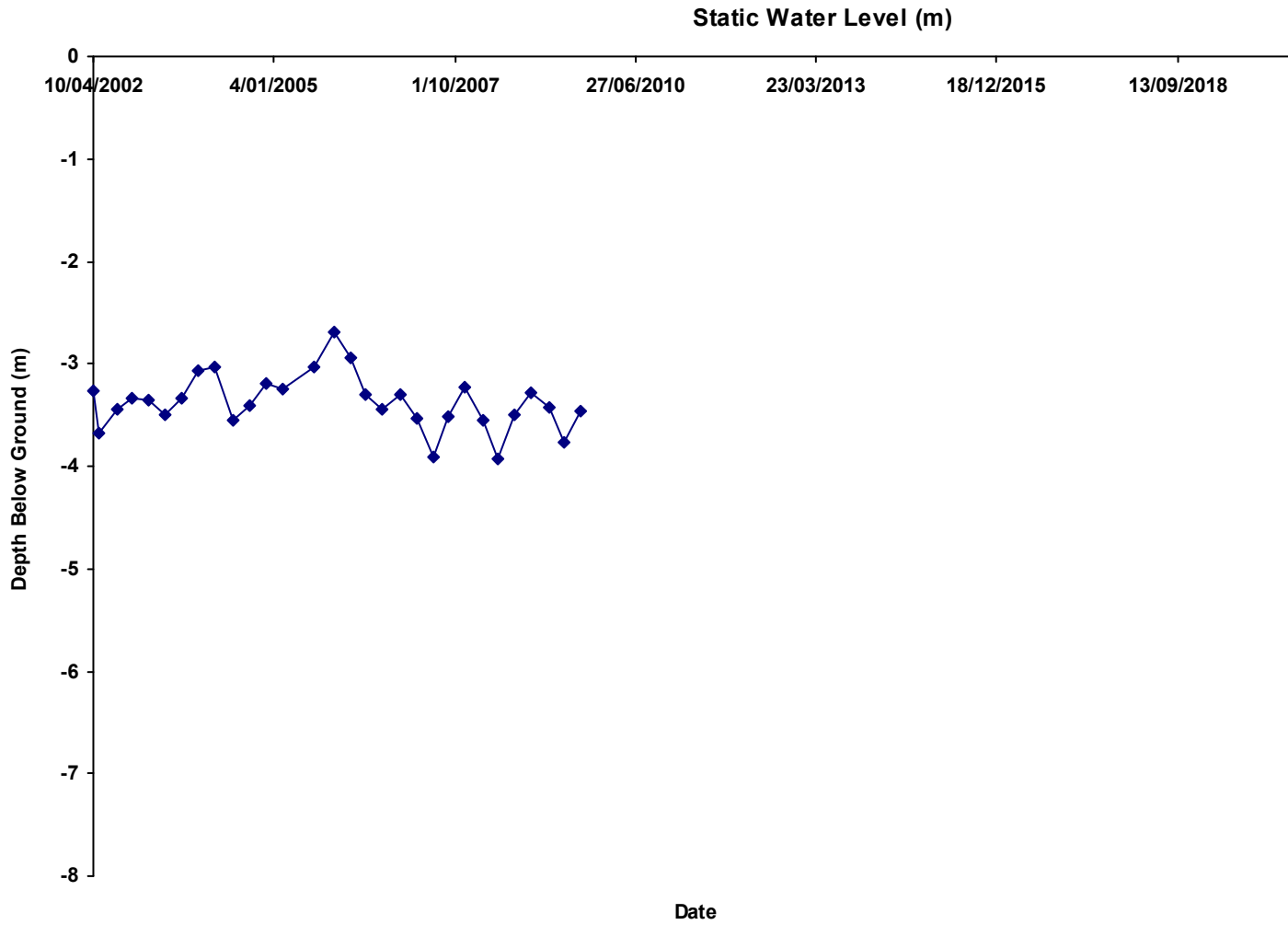
Rural Towns Program    *Bore:* 01WR06S    *Project:* Wandering Rural Towns    *Sub Catchment:* Wandering Town    *Soil-landscape:* 253QdMN  
*GDA Coords:*    50    469470    6384110    *AHD (m):*    *Screened to (m):* -1.74



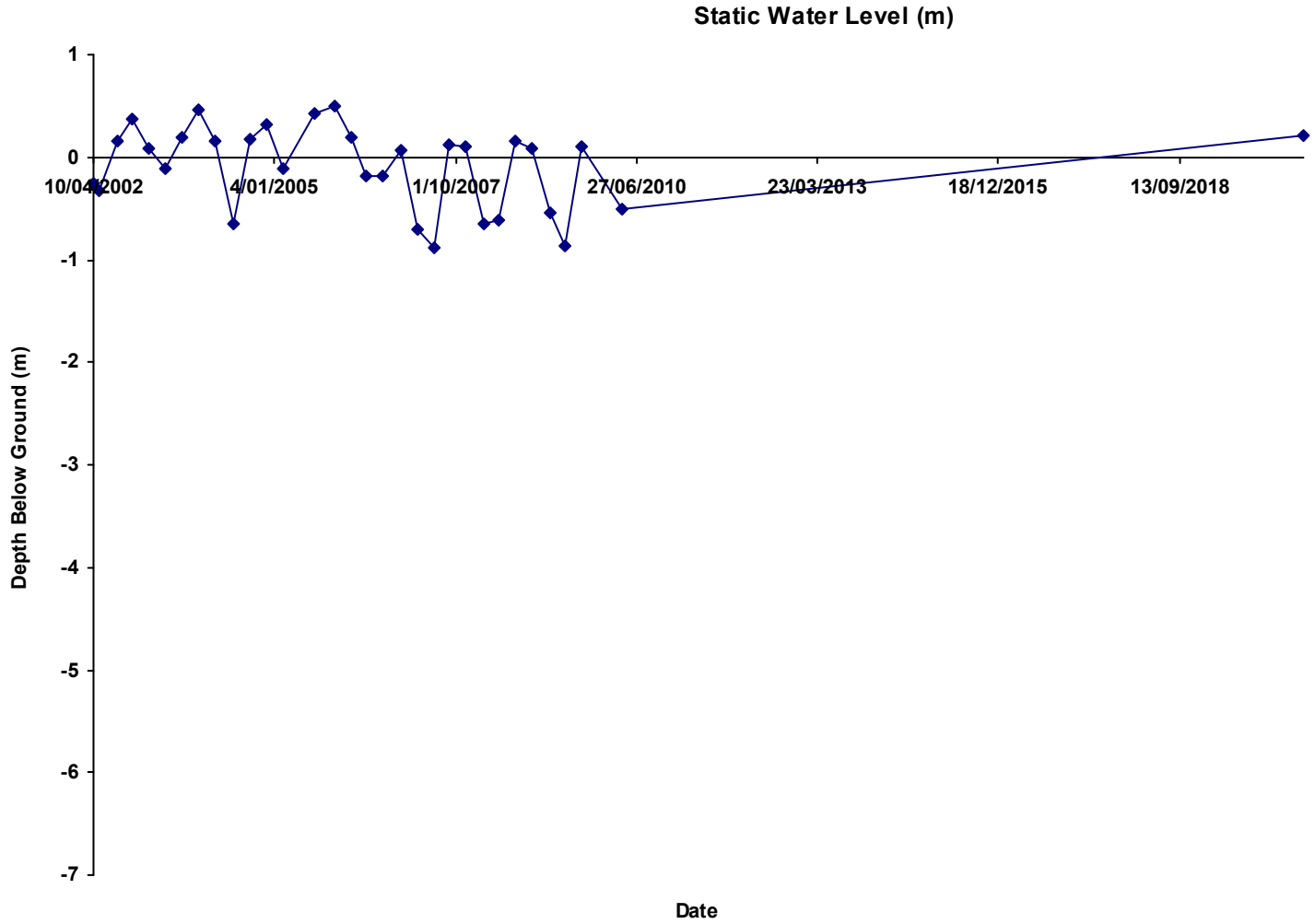




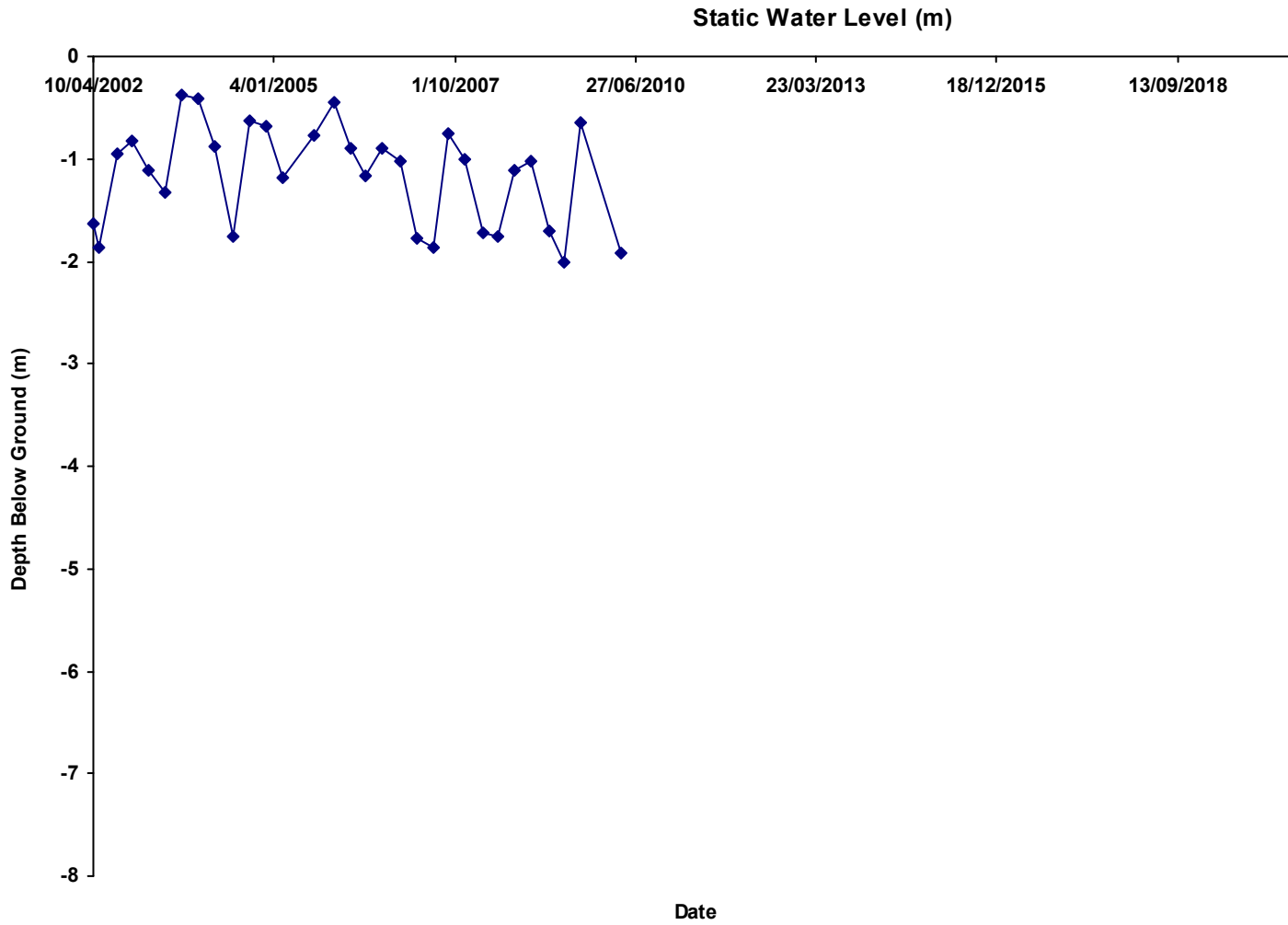
Rural Towns Program    **Bore:** 01WR08S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50    469605    6384060    **AHD (m):**    **Screened to (m):** -5.6



Rural Towns Program    **Bore:** 01WR09S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdBK  
**GDA Coords:**    50    469715    6383785    **AHD (m):**       **Screened to (m):** -5.53

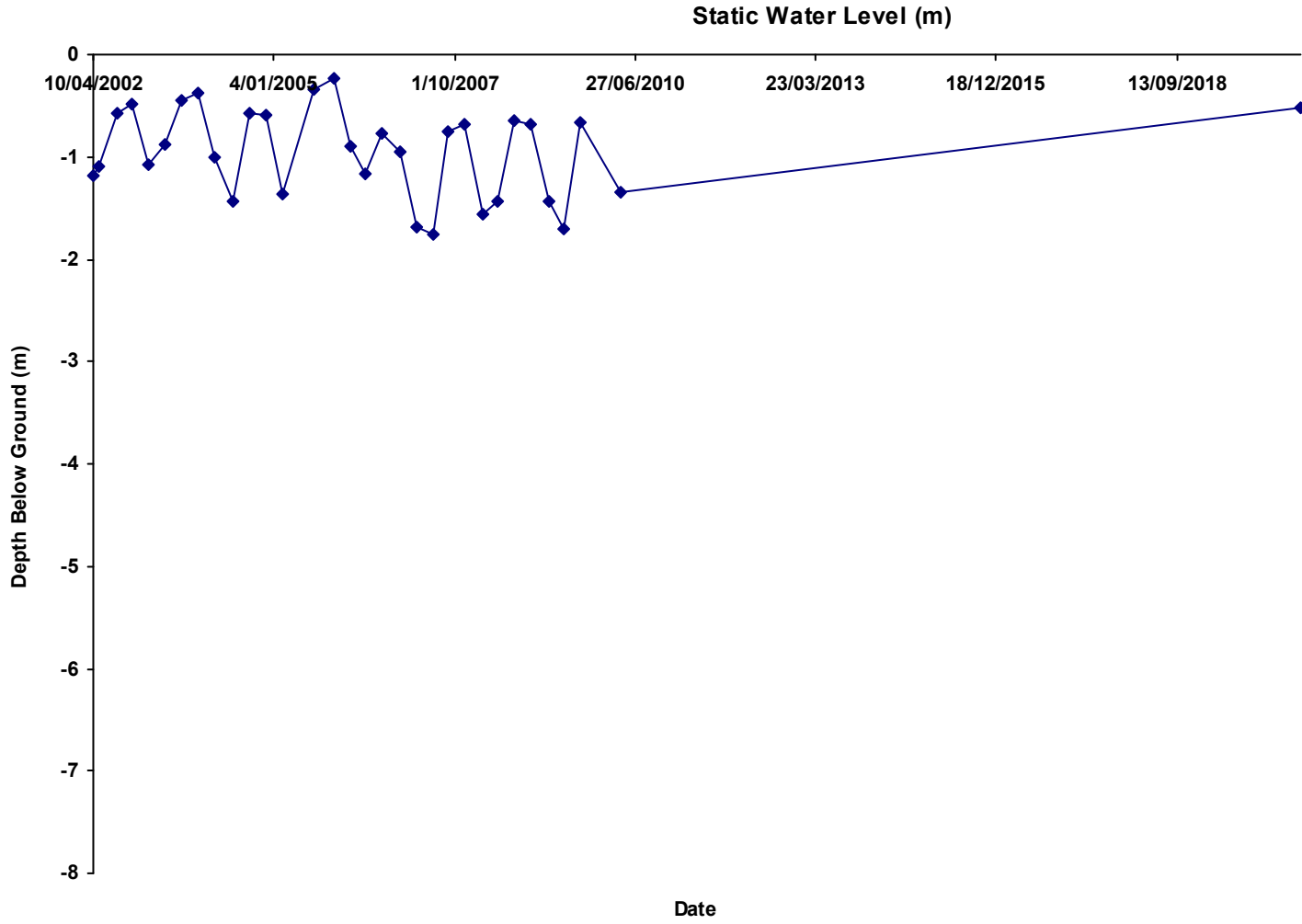


Rural Towns Program    **Bore:** 01WR10S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50    469315    6384000    **AHD (m):**    **Screened to (m):** -2.76



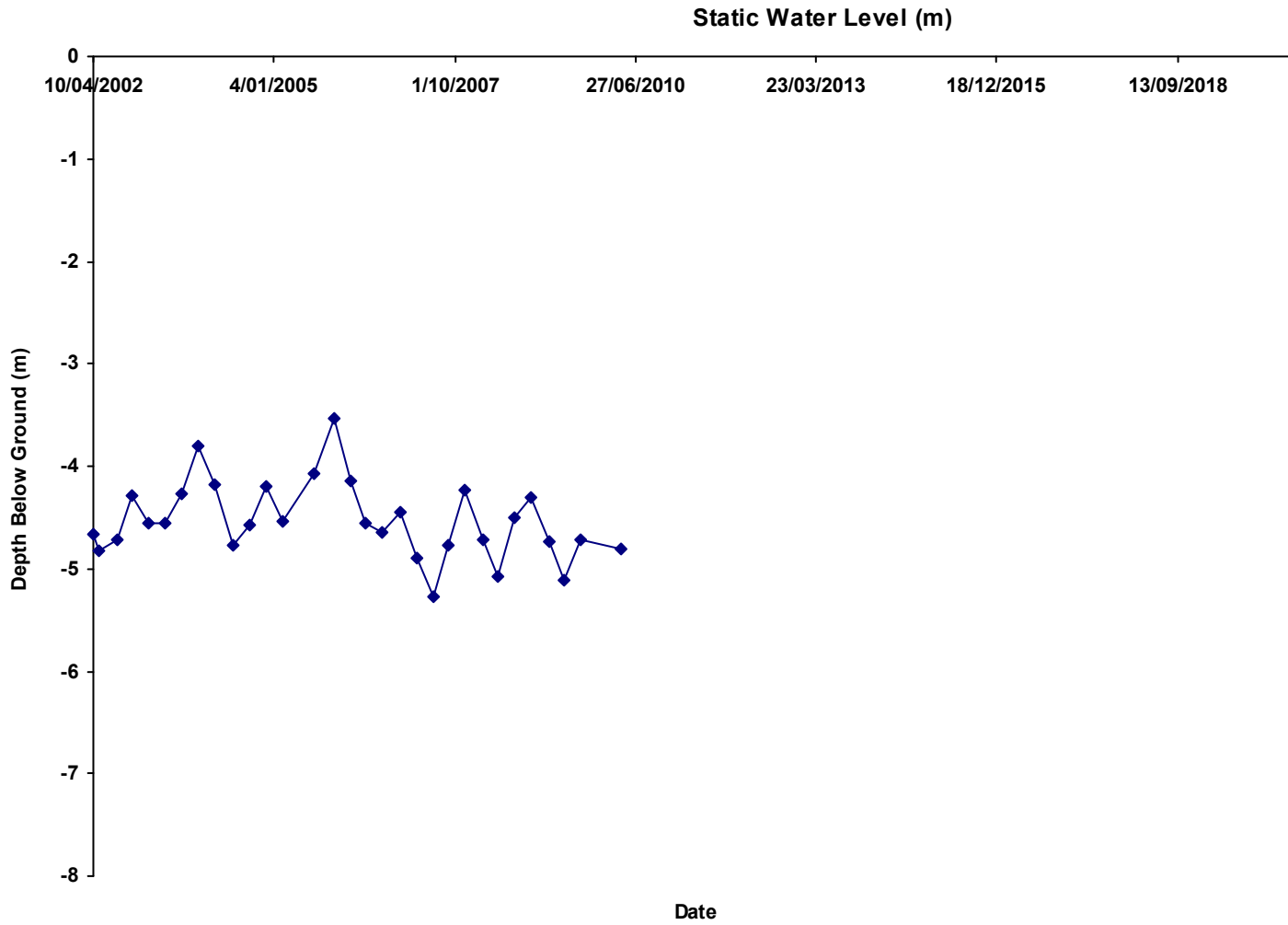
# *graph SWL vs Time*

Rural Towns Program    **Bore:** 02WR01D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdBK  
**GDA Coords:** 50    469627    6383806    **AHD (m):** 265    **Screened to (m):** -17.7



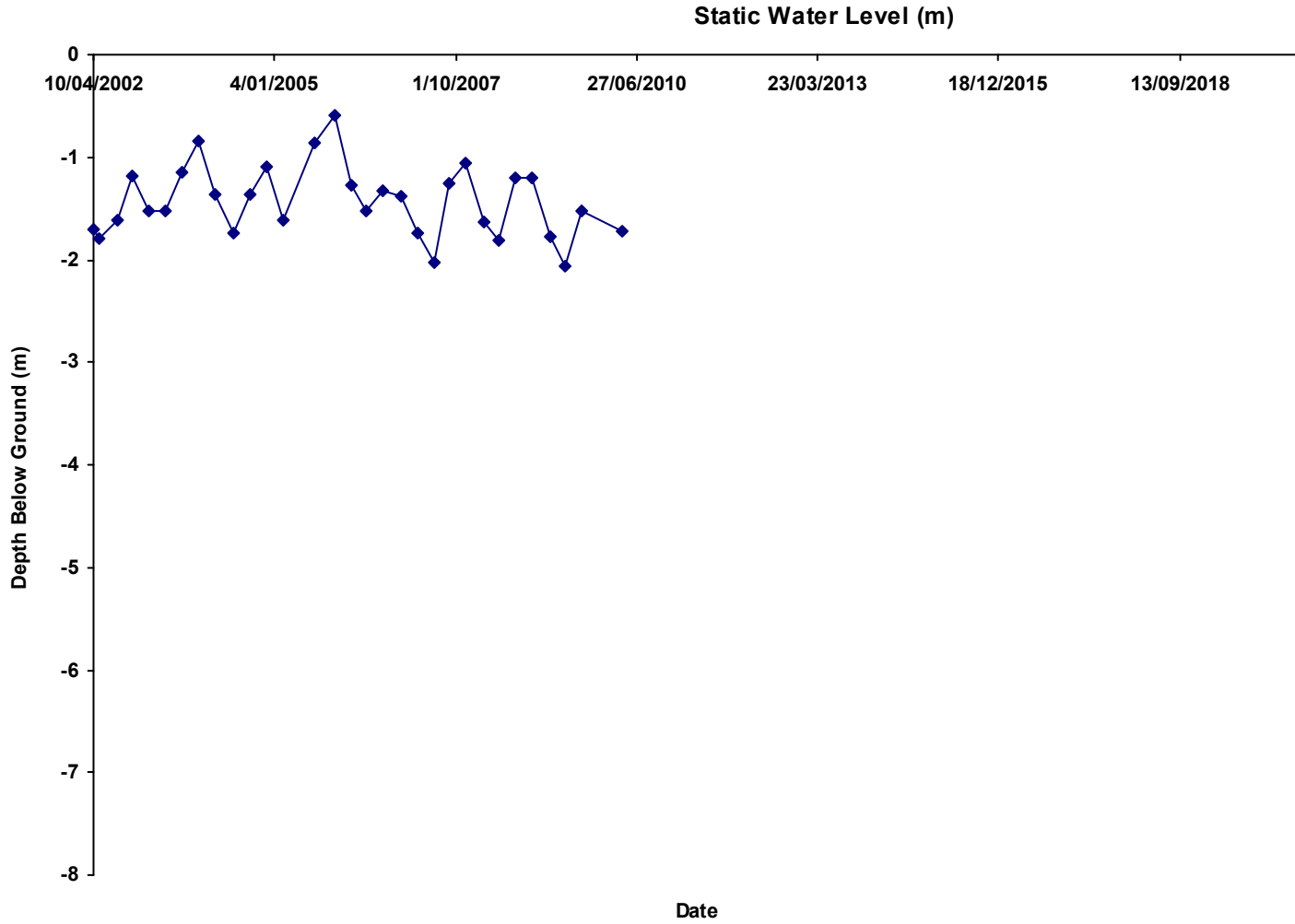


Rural Towns Program    **Bore:** 02WR02D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50    469343    6383933    **AHD (m):** 275    **Screened to (m):** -26.31



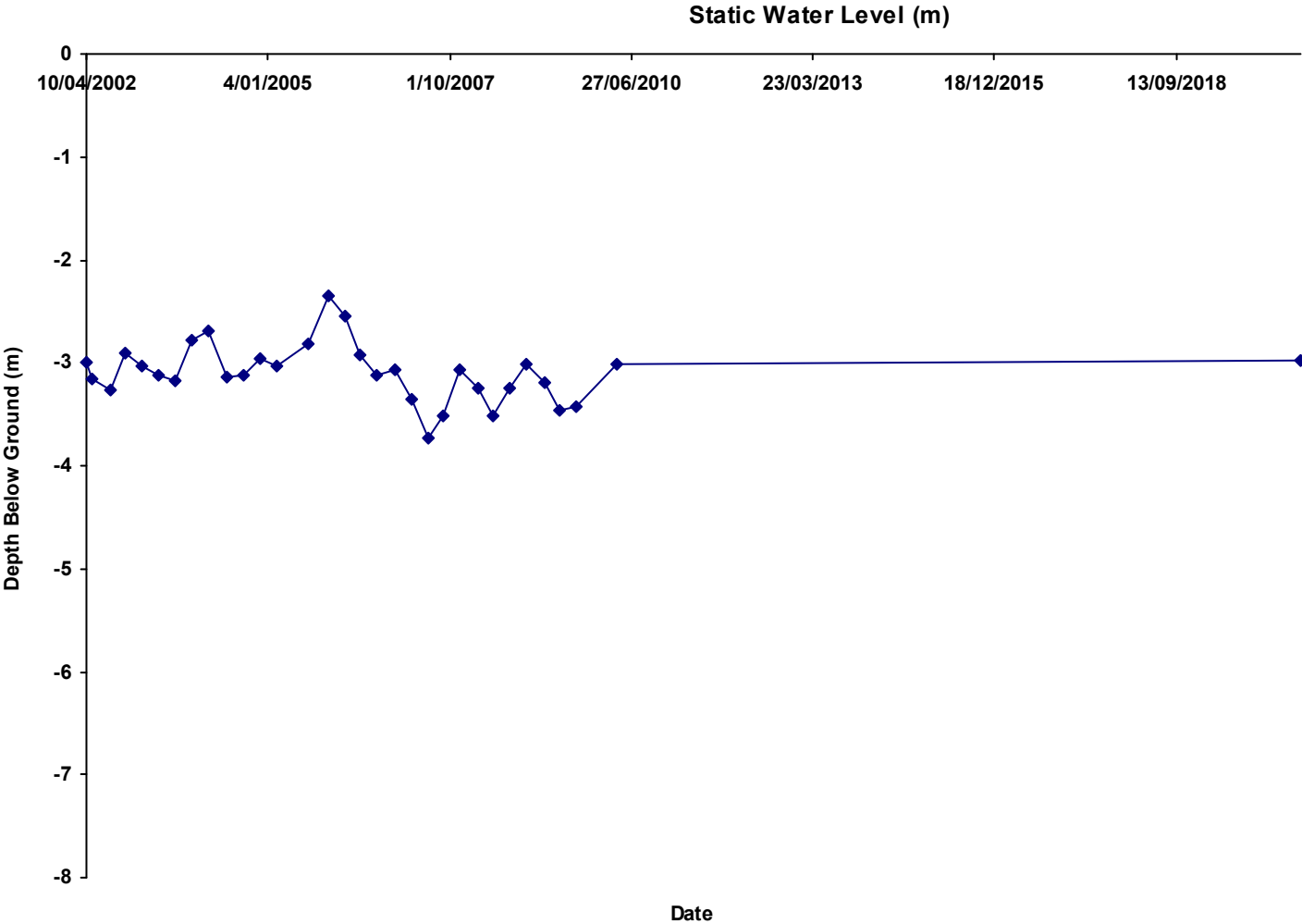
# graph SWL vs Time

Rural Towns Program    **Bore:** 02WR02S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50    469343    6383934    **AHD (m):** 275    **Screened to (m):** -8.01



# graph SWL vs Time

Rural Towns Program     **Bore:** 02WR03D     **Project:** Wandering Rural Towns     **Sub Catchment:** Wandering Town     **Soil-landscape:** 253QdMN  
**GDA Coords:**    50     469540     6384012     **AHD (m):**    269     **Screened to (m):** -16.17

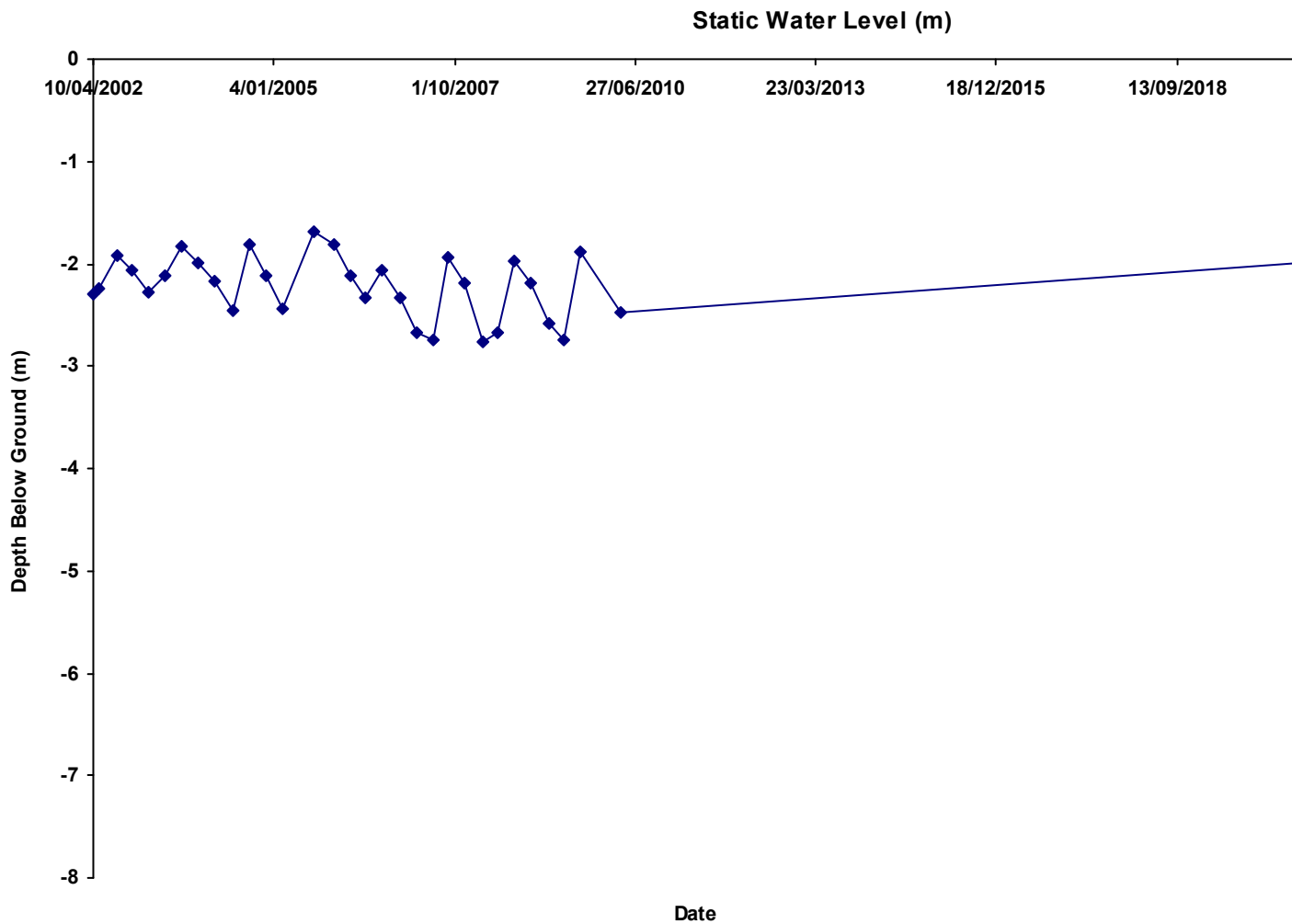




# graph SWL vs Time

Rural Towns Program    **Bore:** 02WR04D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN

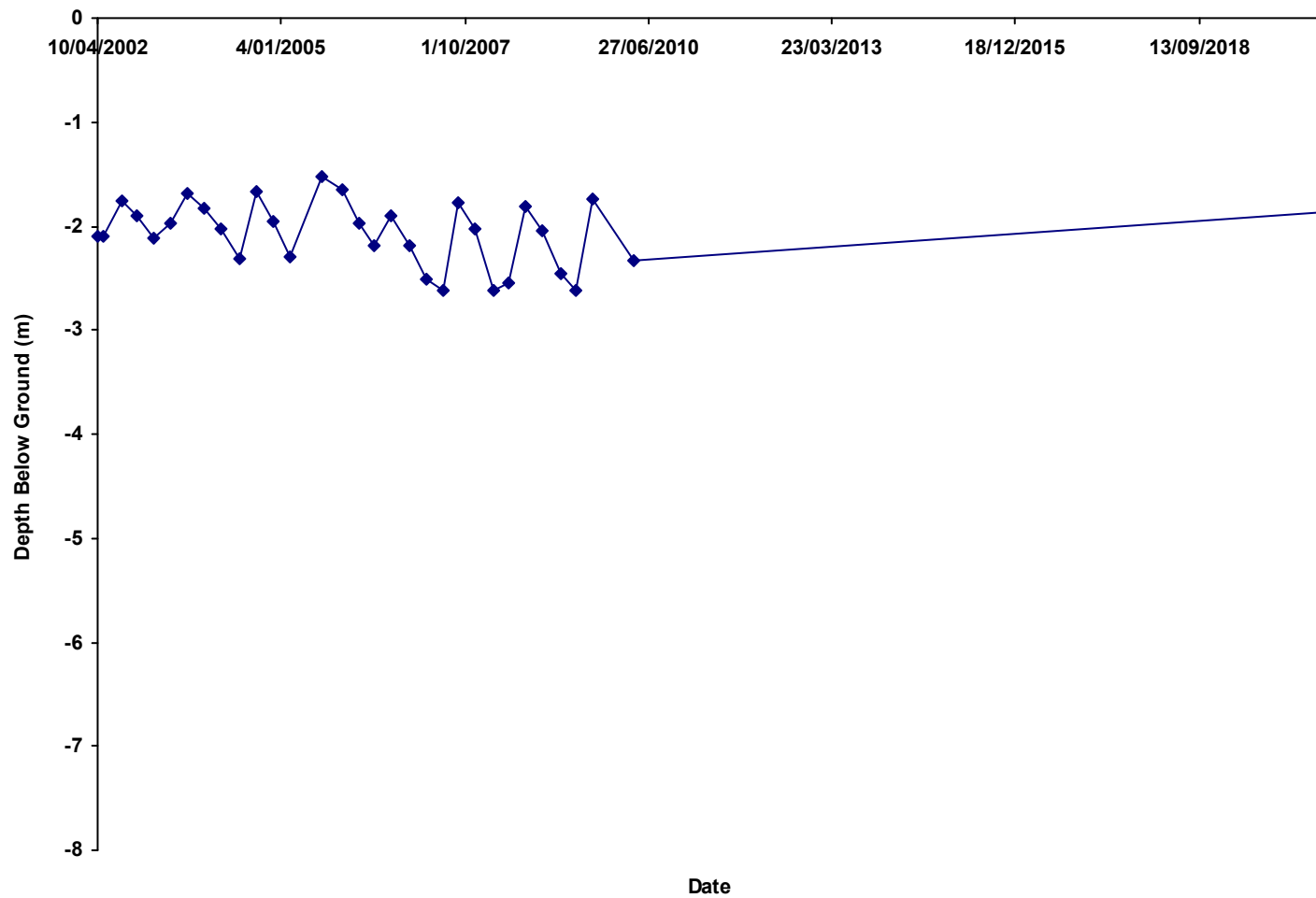
**GDA Coords:** 50    469746    6383930    **AHD (m):** 264    **Screened to (m):** -18.2



Rural Towns Program     **Bore:** 02WR04S     **Project:** Wandering Rural Towns     **Sub Catchment:** Wandering Town     **Soil-landscape:** 253QdMN

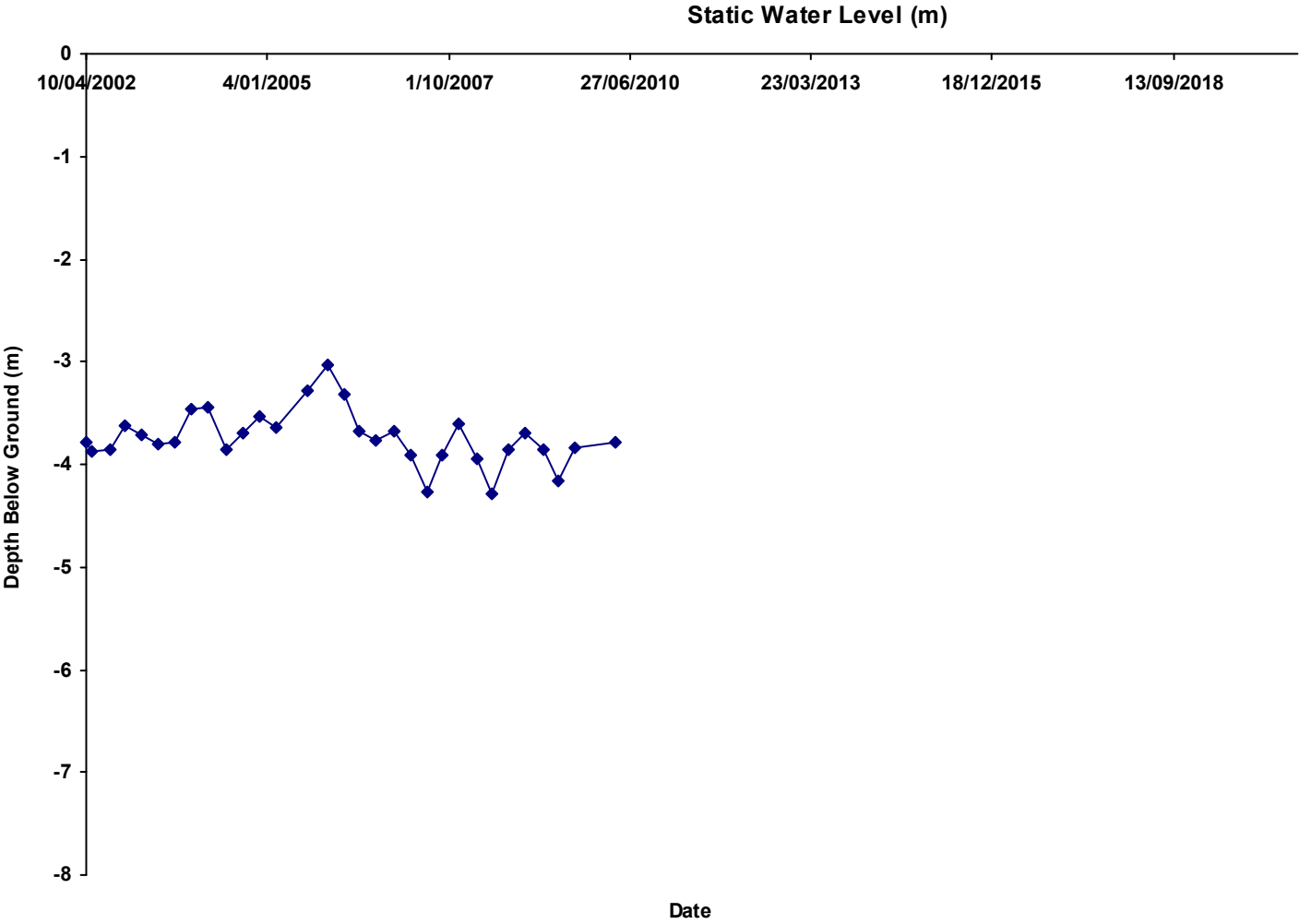
**GDA Coords:**    50        469746        6383931     **AHD (m):**       263     **Screened to (m):** -7.34

Static Water Level (m)

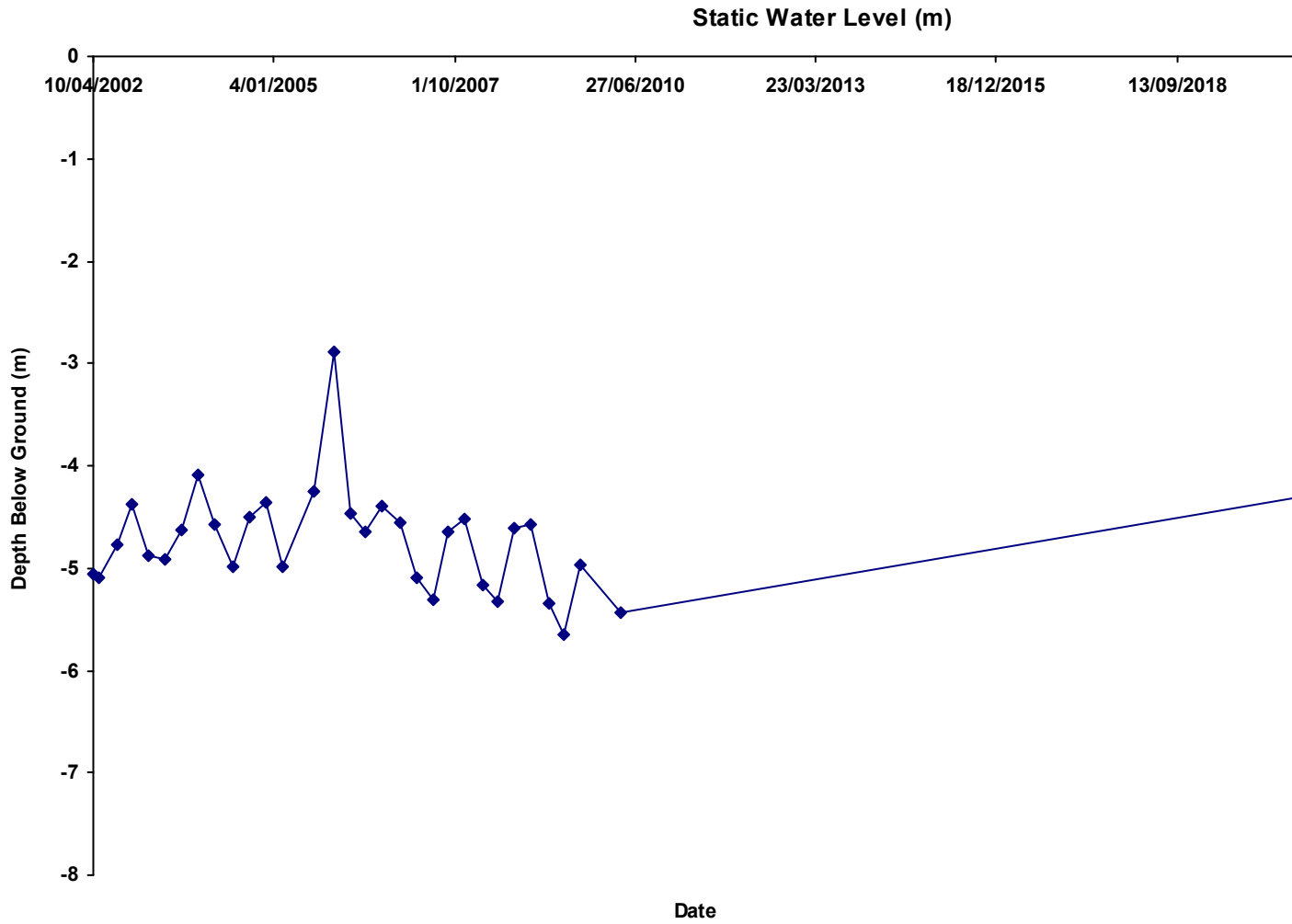


# graph SWL vs Time

Rural Towns Program    *Bore:* 02WR05S    *Project:* Wandering Rural Towns    *Sub Catchment:* Wandering Town    *Soil-landscape:* 253QdMN  
*GDA Coords:* 50    469599    6384054    *AHD (m):* 266    *Screened to (m):* -4.38



Rural Towns Program    *Bore:* 02WR06D    *Project:* Wandering Rural Towns    *Sub Catchment:* Wandering Town    *Soil-landscape:* 253QdMN  
*GDA Coords:* 50    469246    6384052    *AHD (m):* 281    *Screened to (m):* -20.3

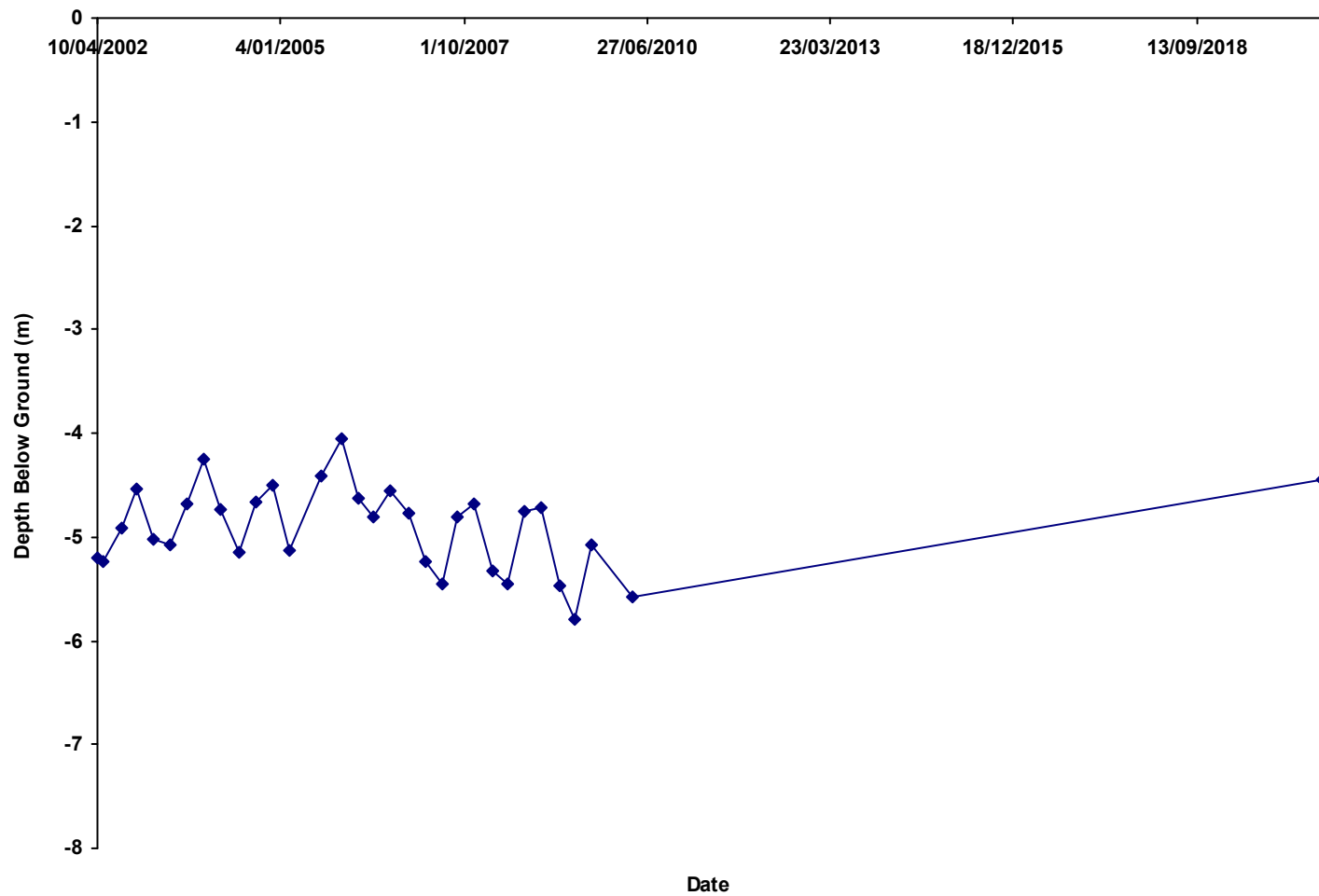


# graph SWL vs Time

Rural Towns Program    *Bore:* 02WR06S    *Project:* Wandering Rural Towns    *Sub Catchment:* Wandering Town    *Soil-landscape:* 253QdMN

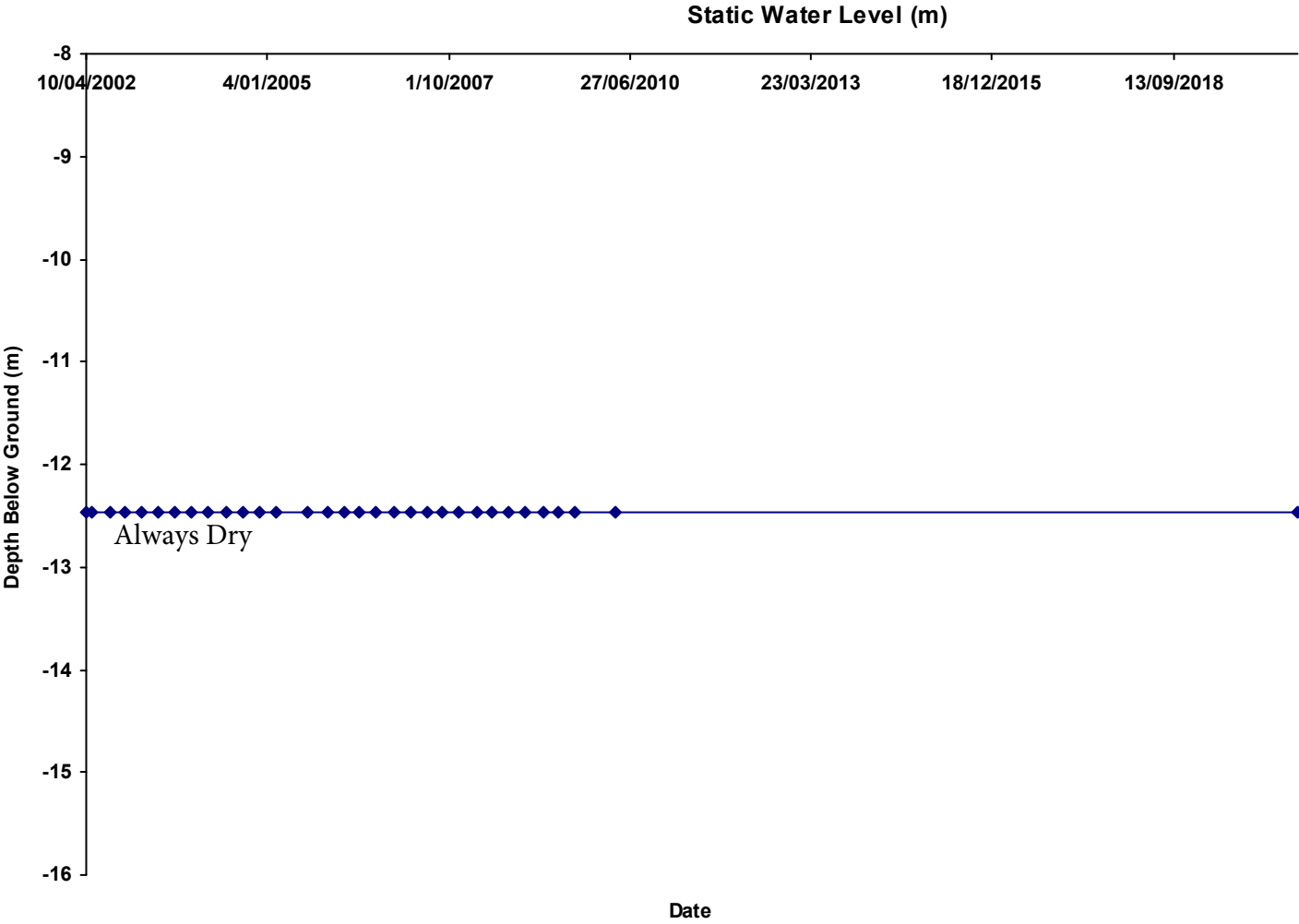
*GDA Coords:*    50    469245    6384053    *AHD (m):*    281    *Screened to (m):* -7.48

Static Water Level (m)



# graph SWL vs Time

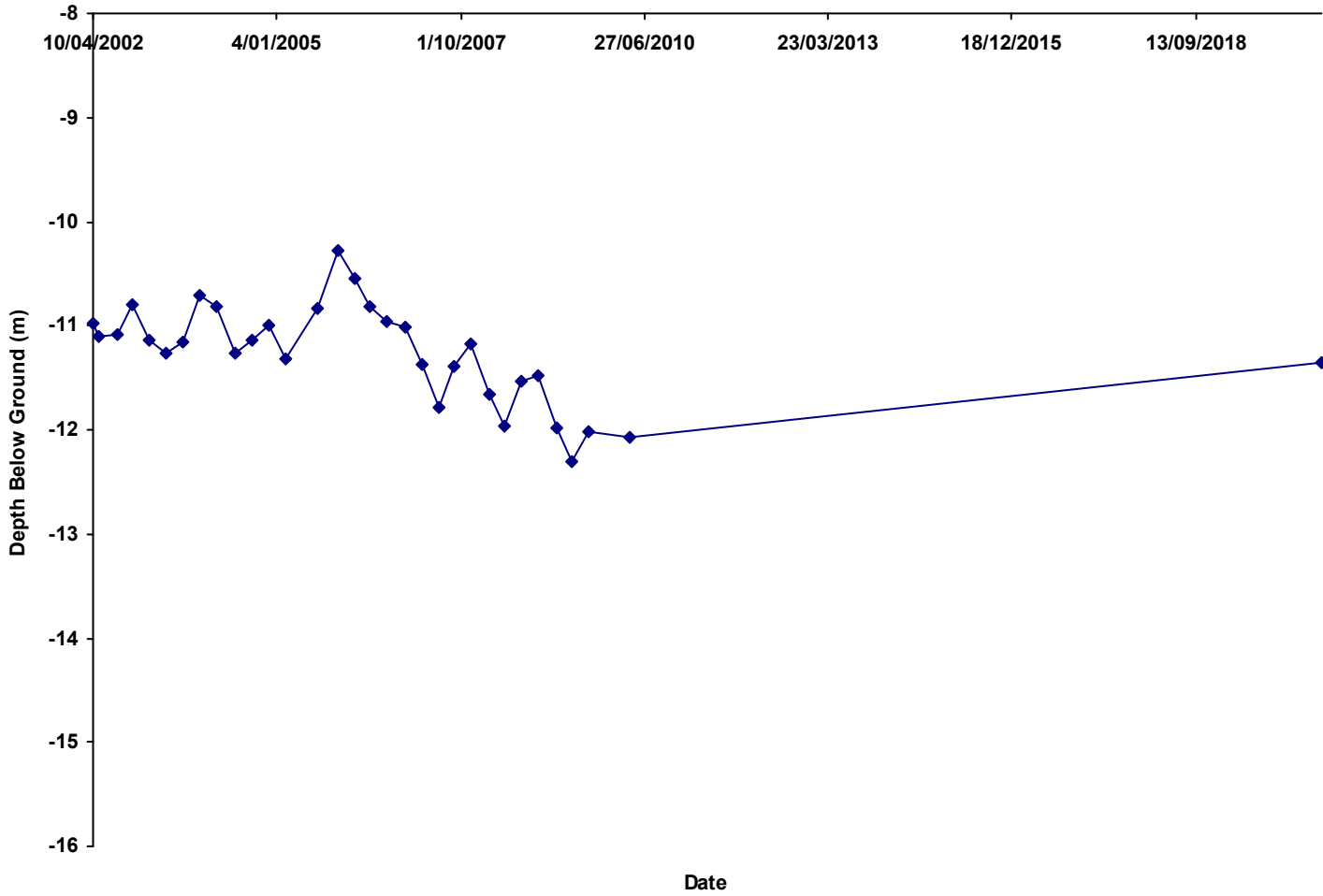
Rural Towns Program    **Bore:** 02WR07D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253MuDW  
**GDA Coords:** 50    469054    6384238    **AHD (m):** 302    **Screened to (m):** -12.47



# graph SWL vs Time

Rural Towns Program    **Bore:** 02WR08D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:**    50      469251      6384424    **AHD (m):**    285    **Screened to (m):** -38.27

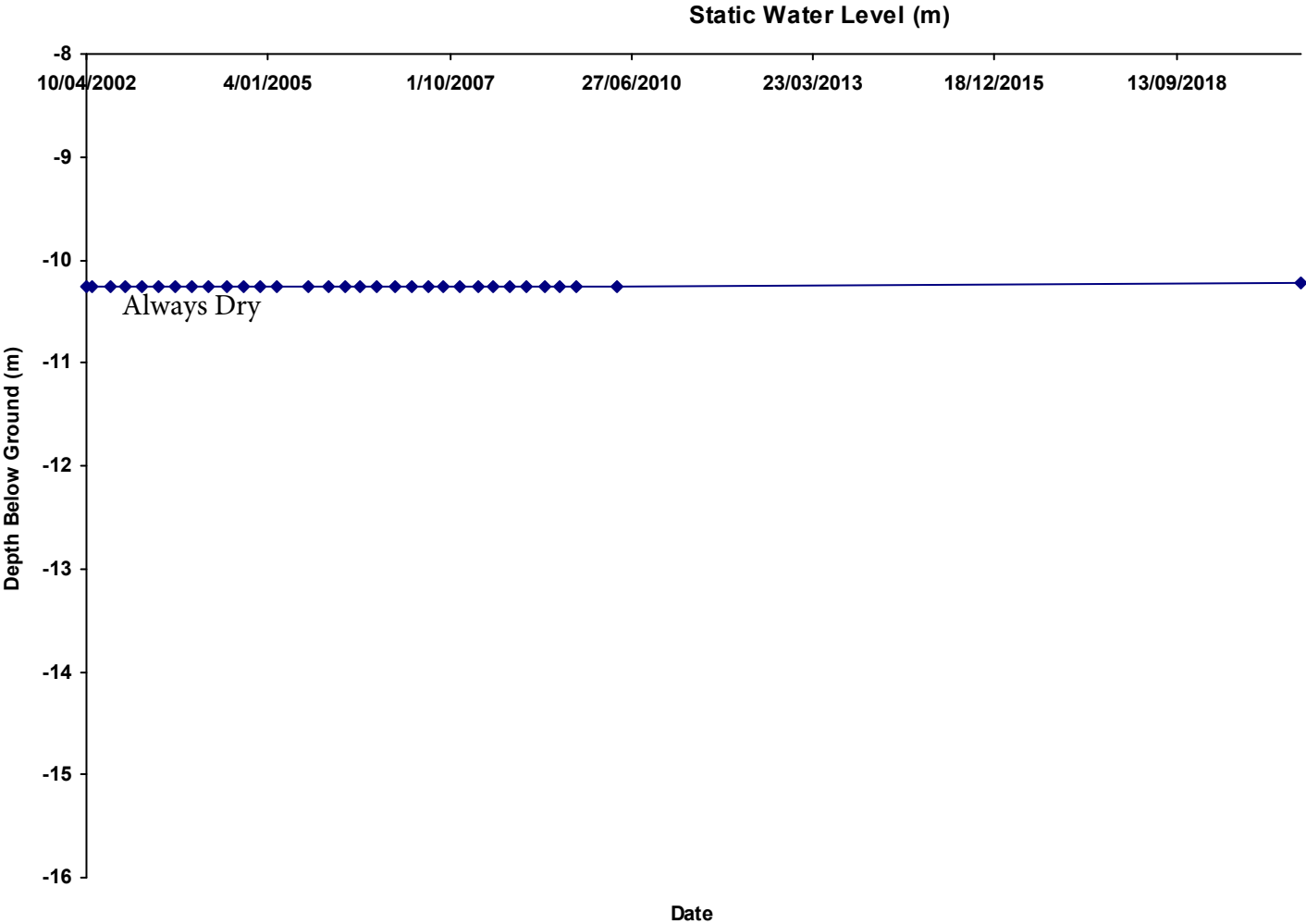
Static Water Level (m)



# graph SWL vs Time

Rural Towns Program    **Bore:** 02WR08S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN

**GDA Coords:** 50    469249    6384424    **AHD (m):** 286    **Screened to (m):** -10.26

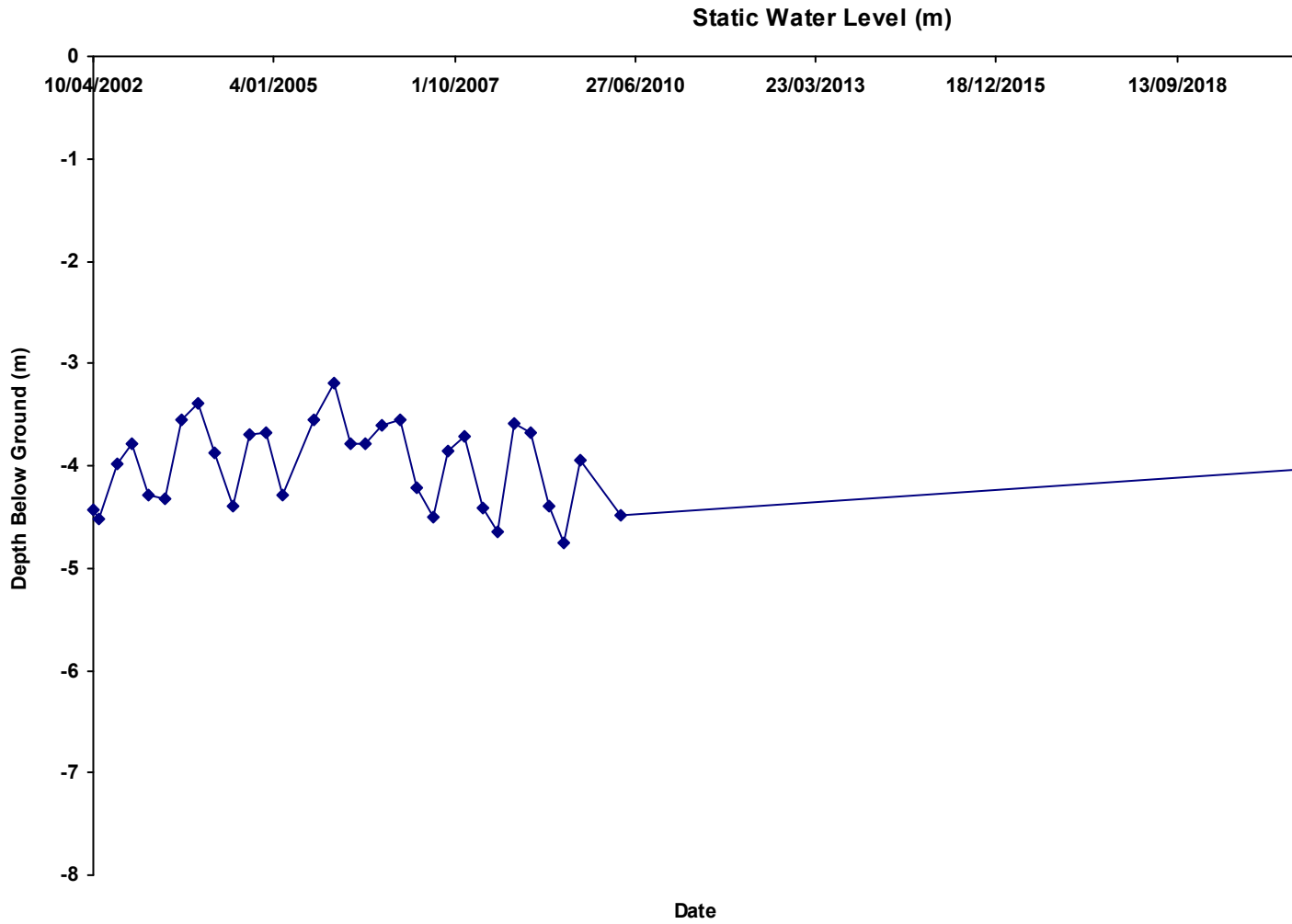








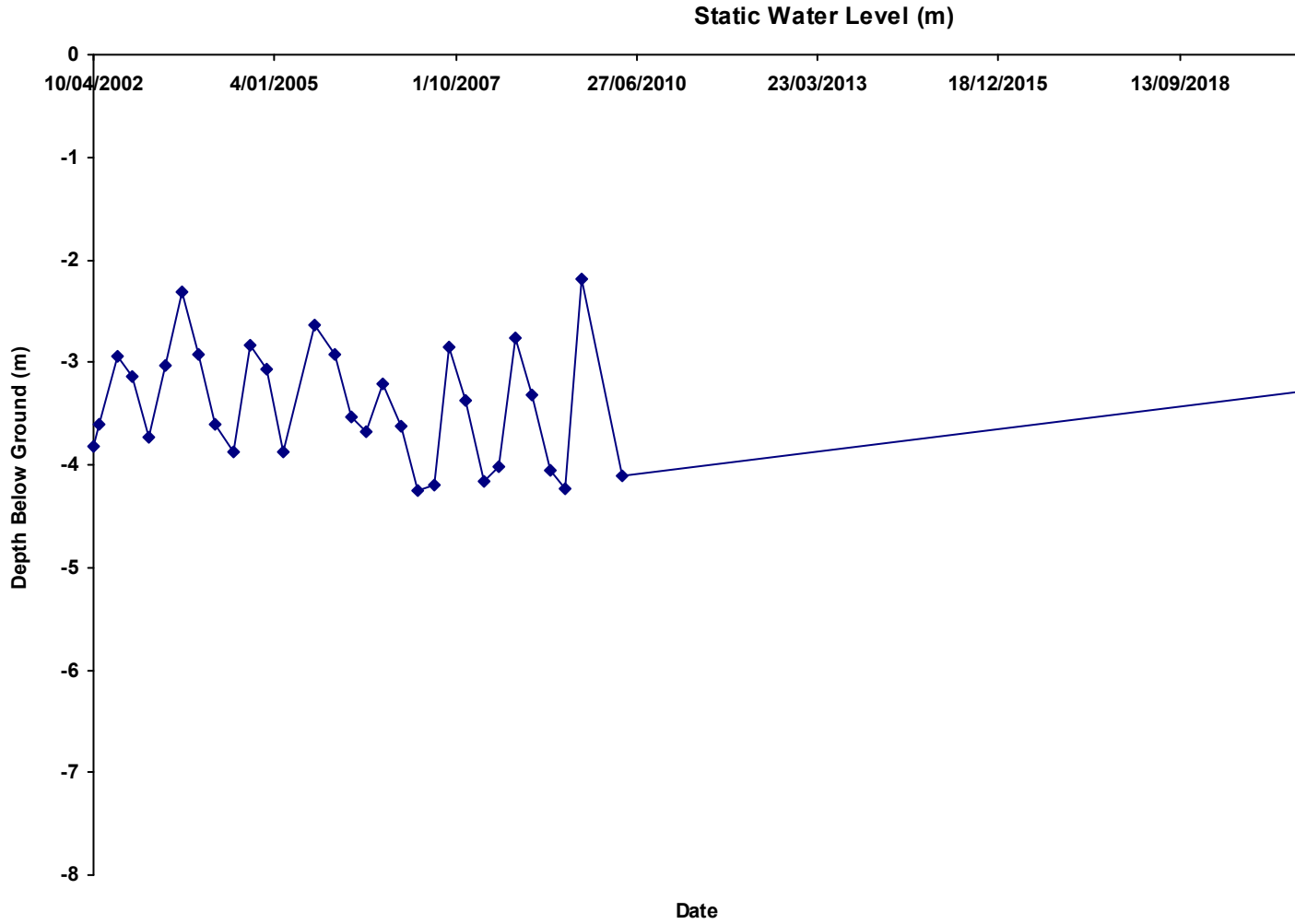
Rural Towns Program    **Bore:** 02WR10D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50    469199    6383892    **AHD (m):** 282    **Screened to (m):** -36.18





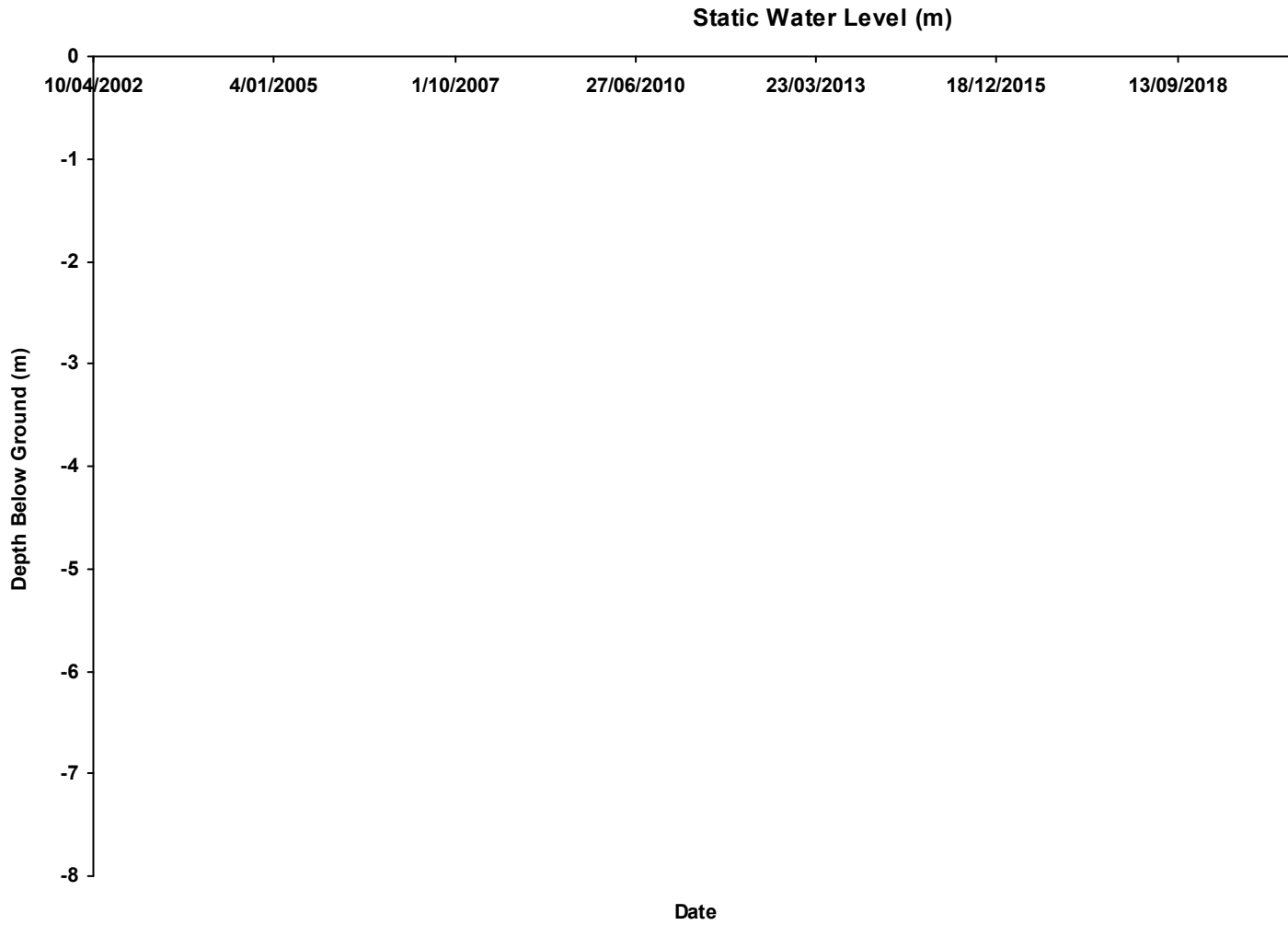
# graph SWL vs Time

Rural Towns Program    **Bore:** 02WR11D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50    469211    6383621    **AHD (m):** 273    **Screened to (m):** -14.37

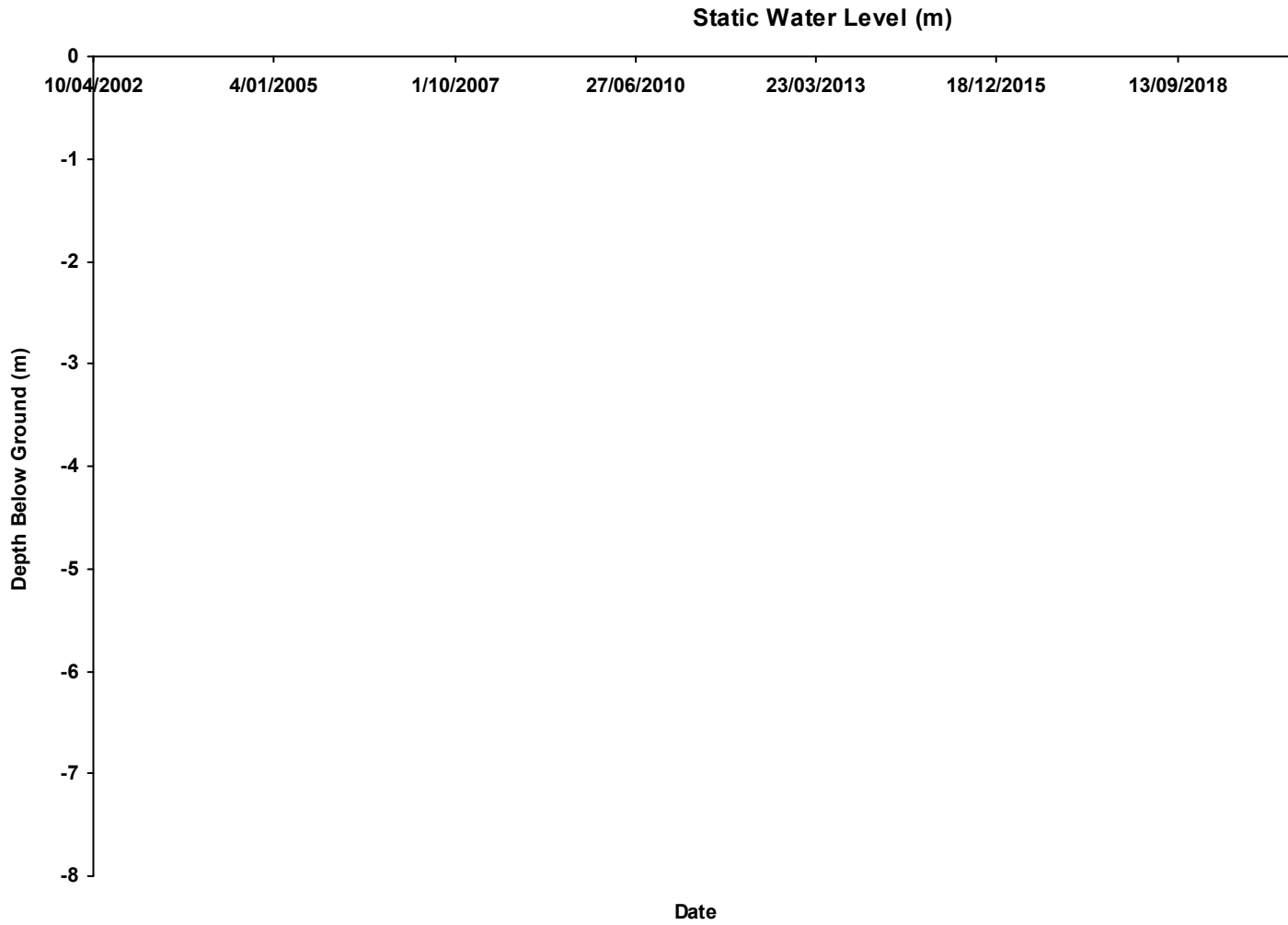




Rural Towns Program    **Bore:** HOTHWAND    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 257PbPG  
**GDA Coords:**    50    491020    6386090    **AHD (m):**    **Screened to (m):**



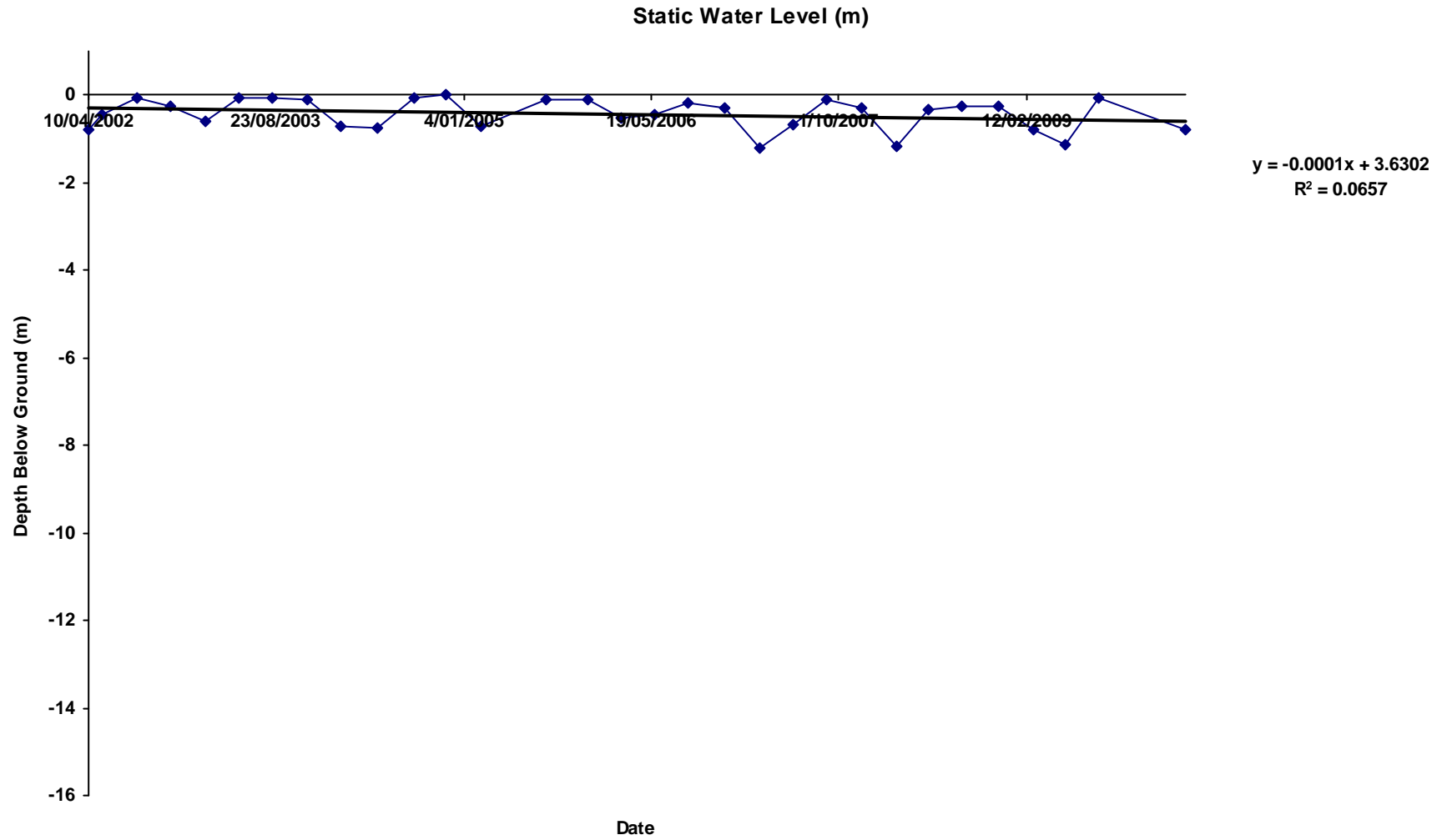
Rural Towns Program    **Bore:** WANDERIN    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdBK  
**GDA Coords:**    50    470200    6382050    **AHD (m):**    **Screened to (m):**





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*graph SWL vs Time*

Rural Towns Program    **Bore:** 01WR01S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:**  
**GDA Coords:** 50    469715    6383785    **AHD (m):**    **Screened to (m):** -3

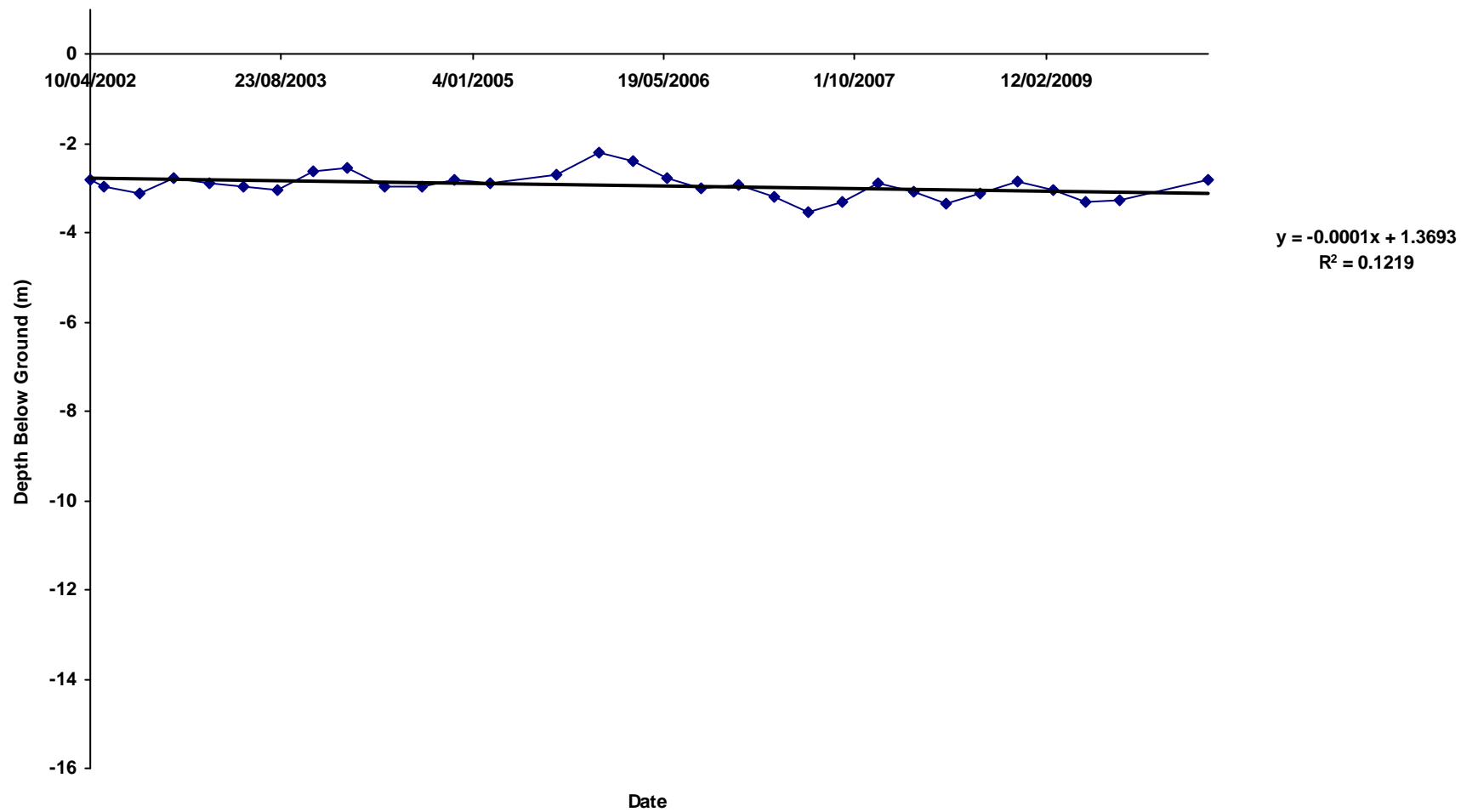


Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 01WR021    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:**

**GDA Coords:** 50    469525    6384020    **AHD (m):**    **Screened to (m):** -11

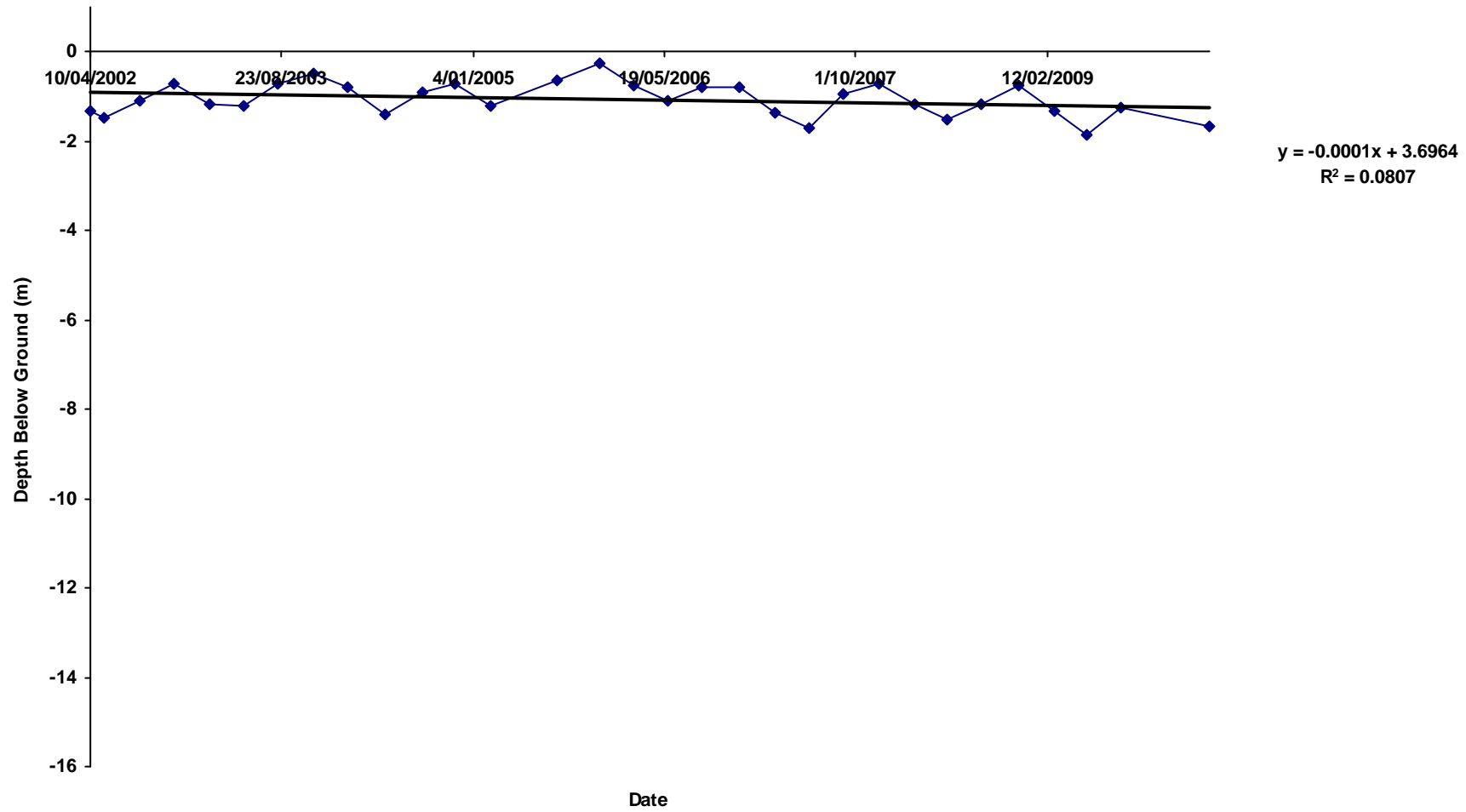
**Static Water Level (m)**



Dept of Ag WA Catchment Hydrology  
*graph SWL vs Time*

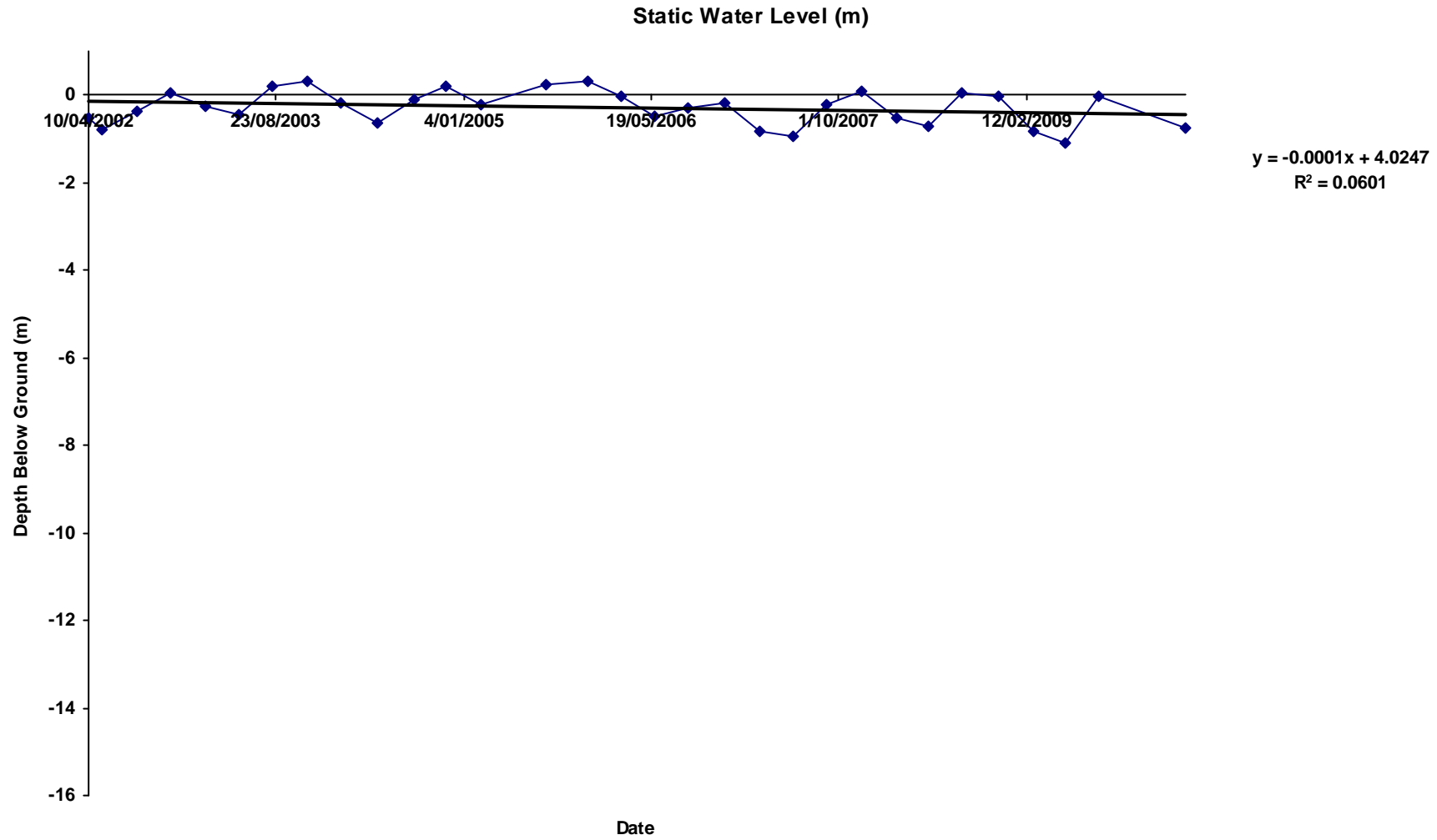
Rural Towns Program    **Bore:** 01WR031    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:**  
**GDA Coords:** 50    469315    6384000    **AHD (m):**    **Screened to (m):** -9

Static Water Level (m)



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**graph SWL vs Time**

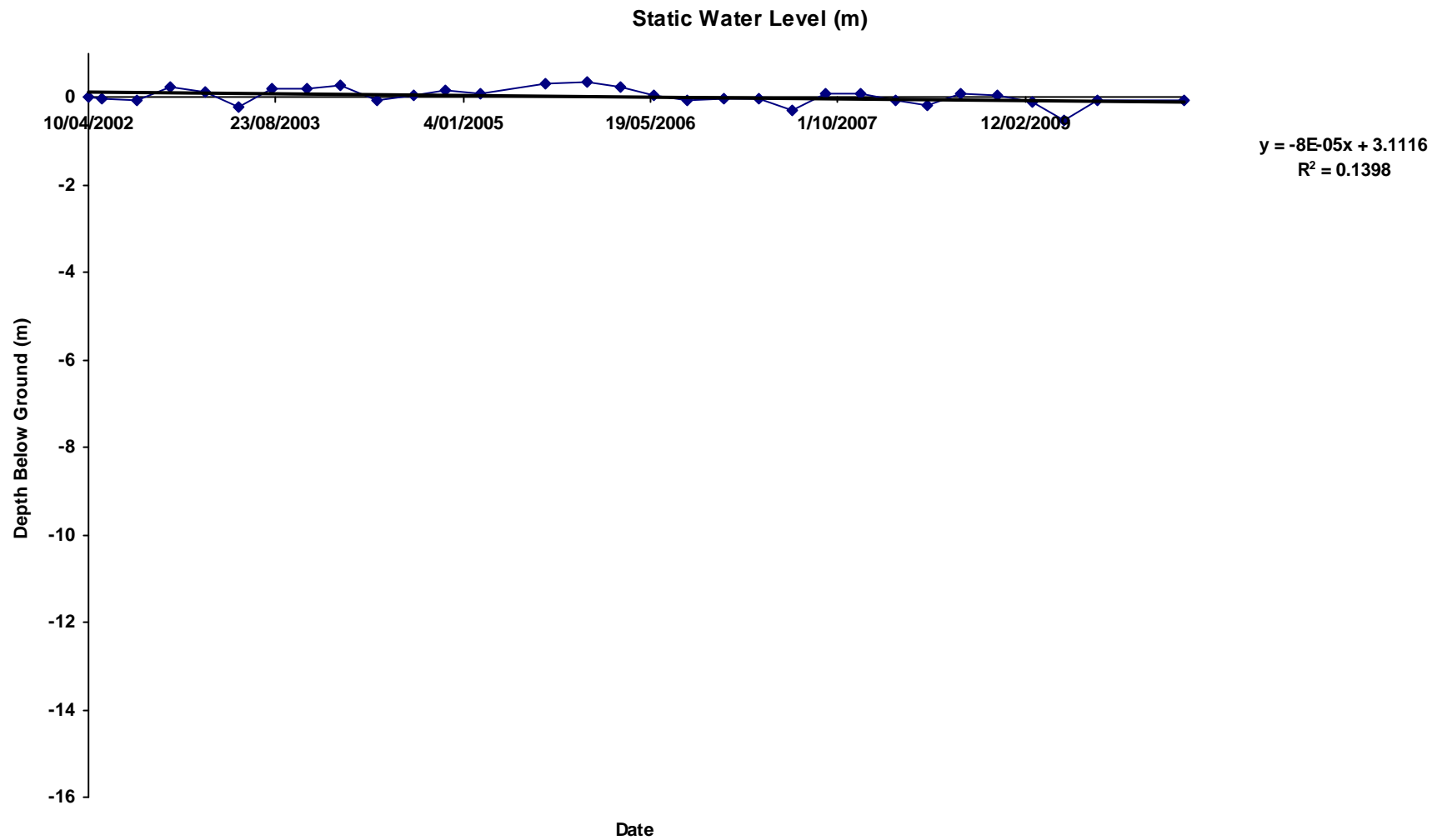
Rural Towns Program    **Bore:** 01WR04I    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:**  
**GDA Coords:** 50 469515.6 6383744 **AHD (m):**    **Screened to (m):** -9



Dept of Ag WA Catchment Hydrology  
*graph SWL vs Time*

Rural Towns Program    *Bore:* 01WR051    *Project:* Wandering Rural Towns    *Sub Catchment:* Wandering Town    *Soil-landscape:*

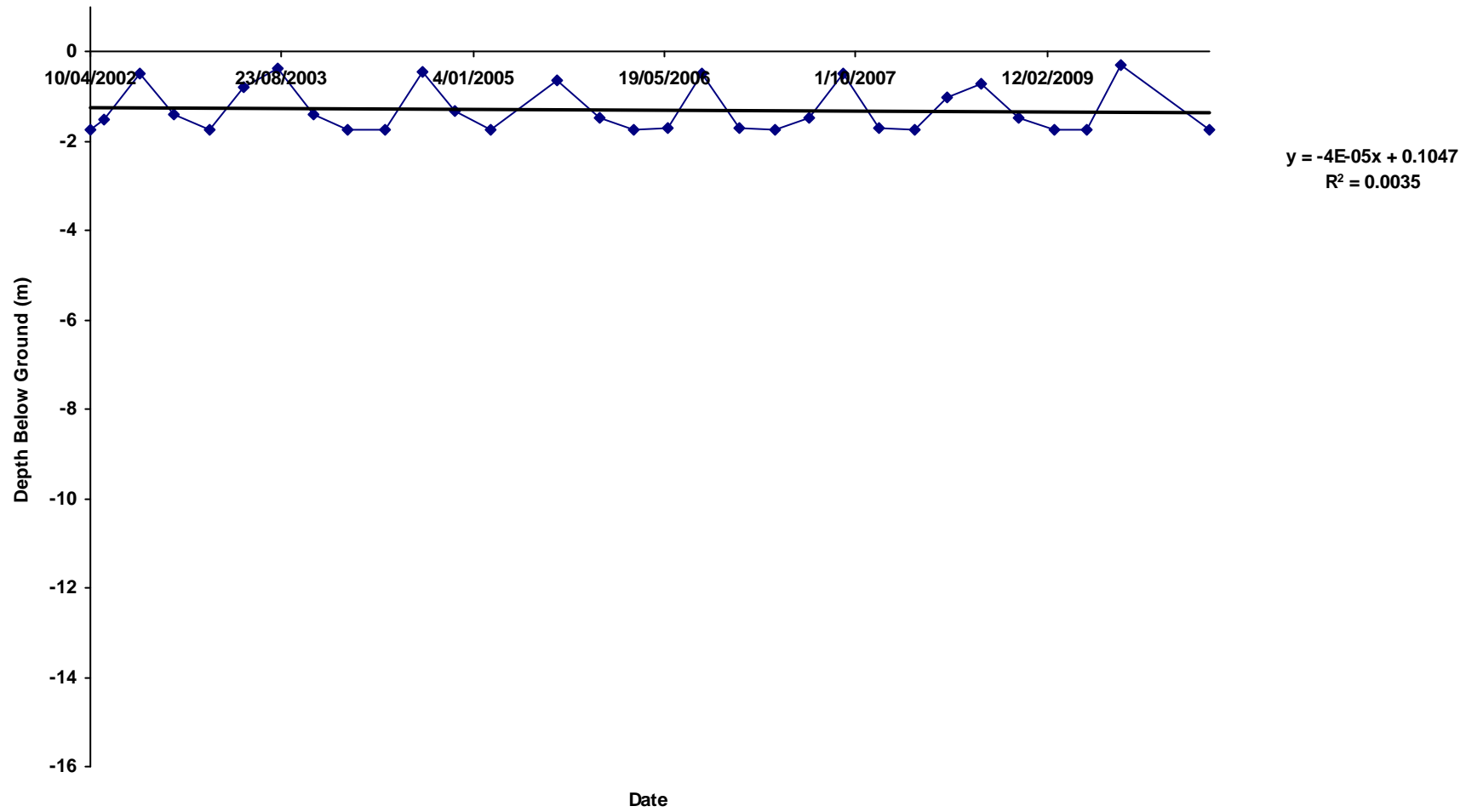
*GDA Coords:* 50    469470    6384110    *AHD (m):*    *Screened to (m):* -9



Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 01WR06S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:**  
**GDA Coords:** 50    469470    6384110    **AHD (m):**    **Screened to (m):** -2

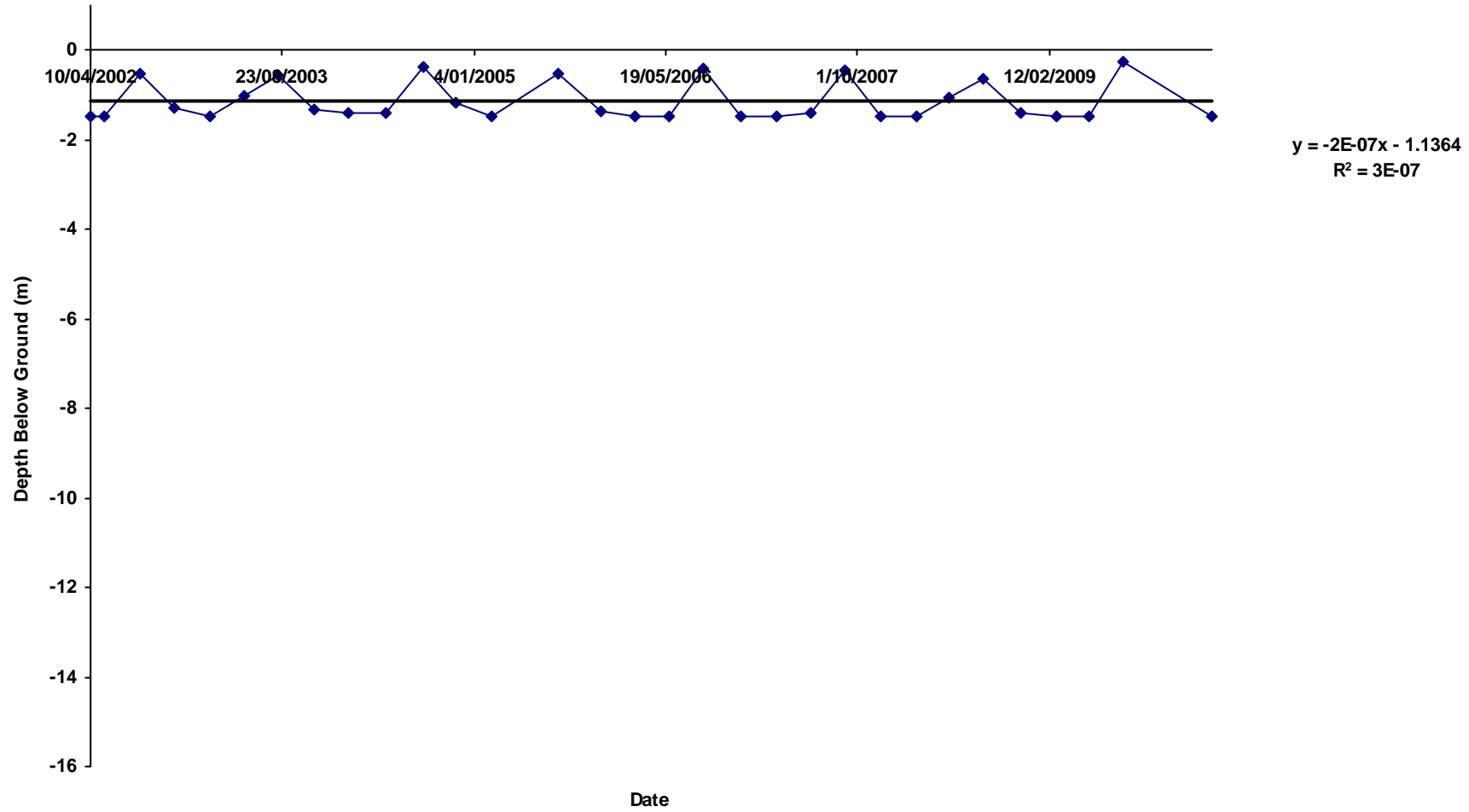
Static Water Level (m)



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**graph SWL vs Time**

Rural Towns Program    **Bore:** 01WR07S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:**  
**GDA Coords:** 50    469470    6384110    **AHD (m):**    **Screened to (m):** -1

**Static Water Level (m)**

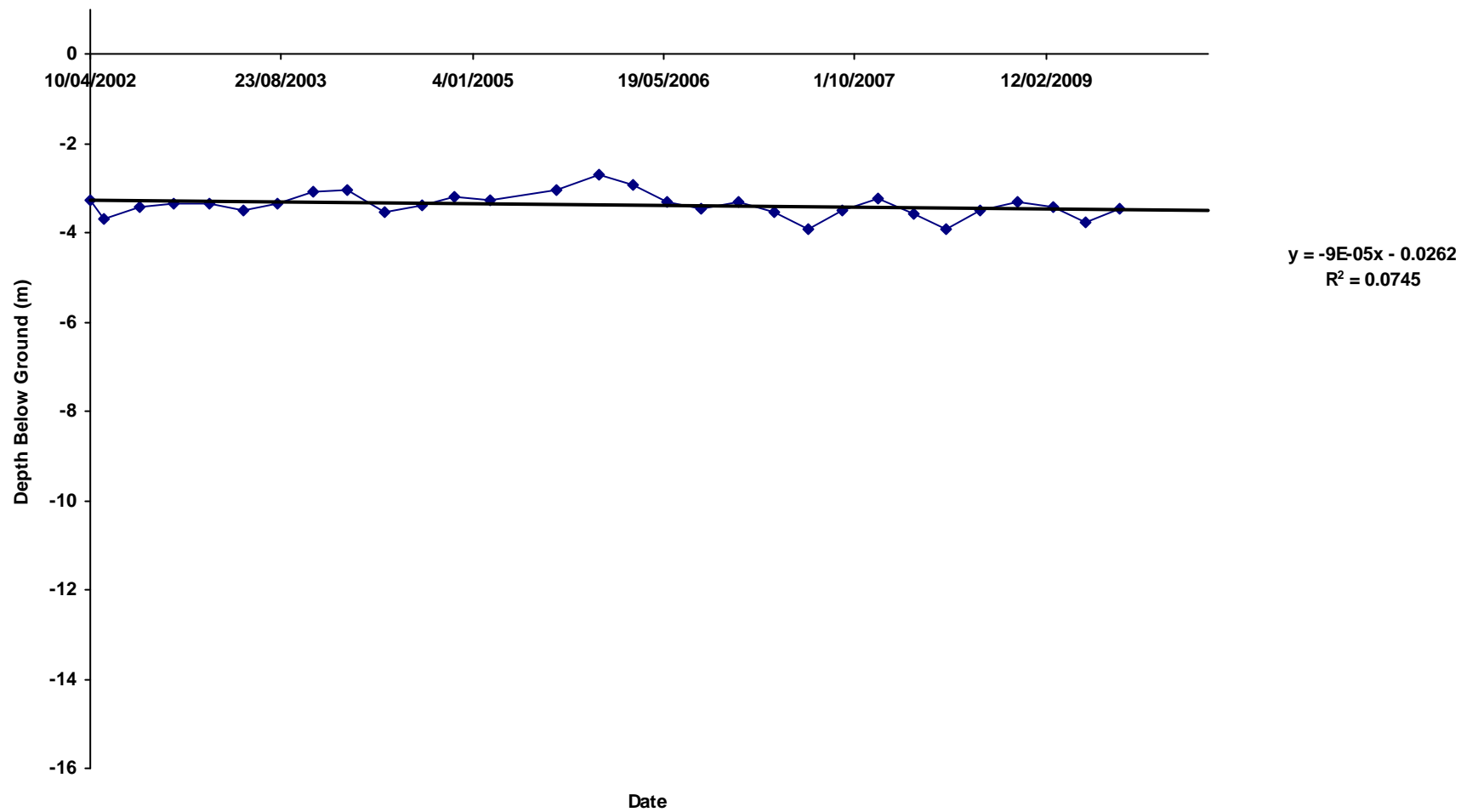


Dept of Ag WA Catchment Hydrology  
*graph SWL vs Time*

Rural Towns Program    **Bore:** 01WR08S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:**

**GDA Coords:** 50    469605    6384060    **AHD (m):**    **Screened to (m):** -6

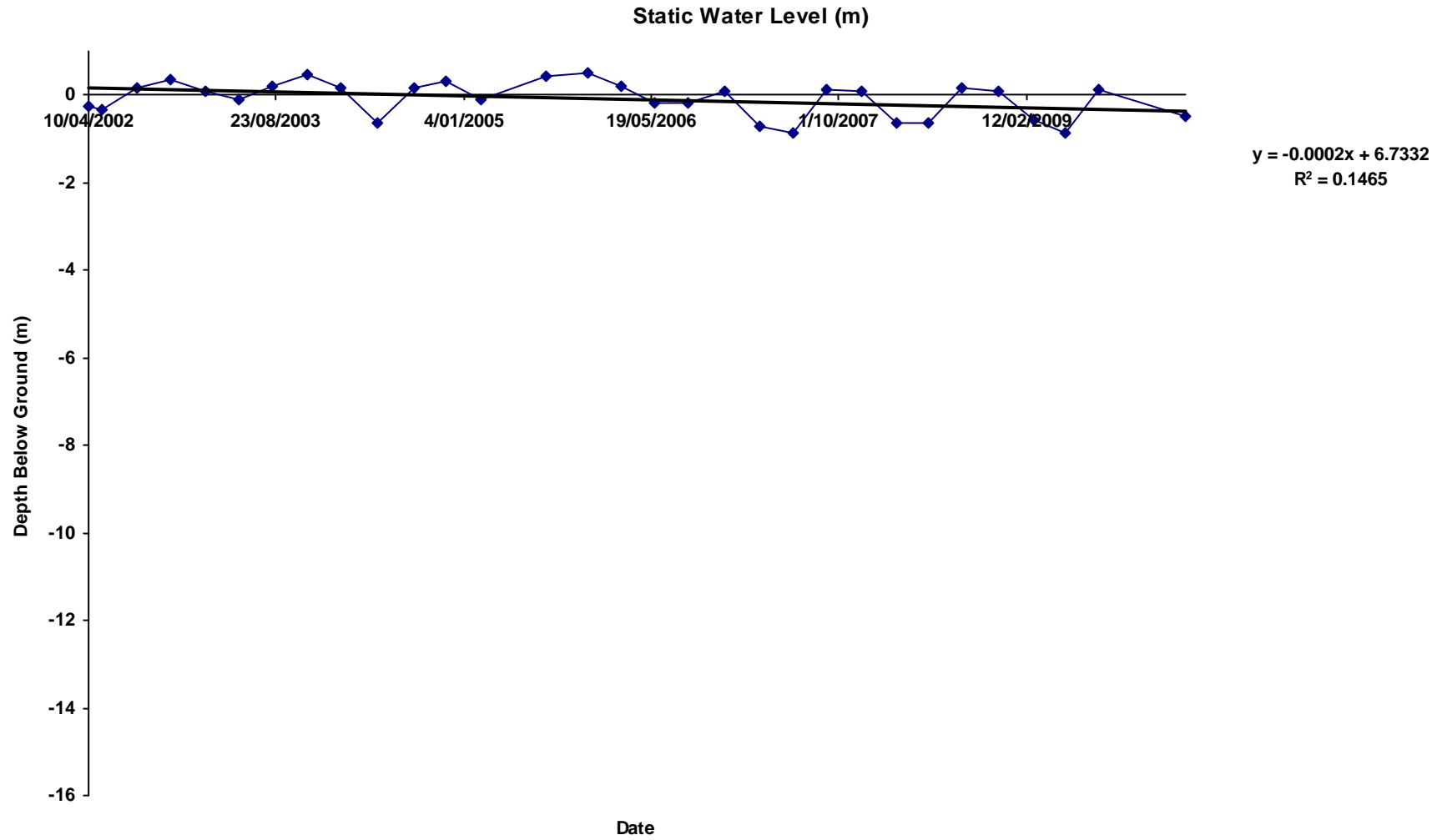
Static Water Level (m)





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**graph SWL vs Time**

Rural Towns Program    **Bore:** 01WR09S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:**  
**GDA Coords:** 50    469715    6383785    **AHD (m):**    **Screened to (m):** -6

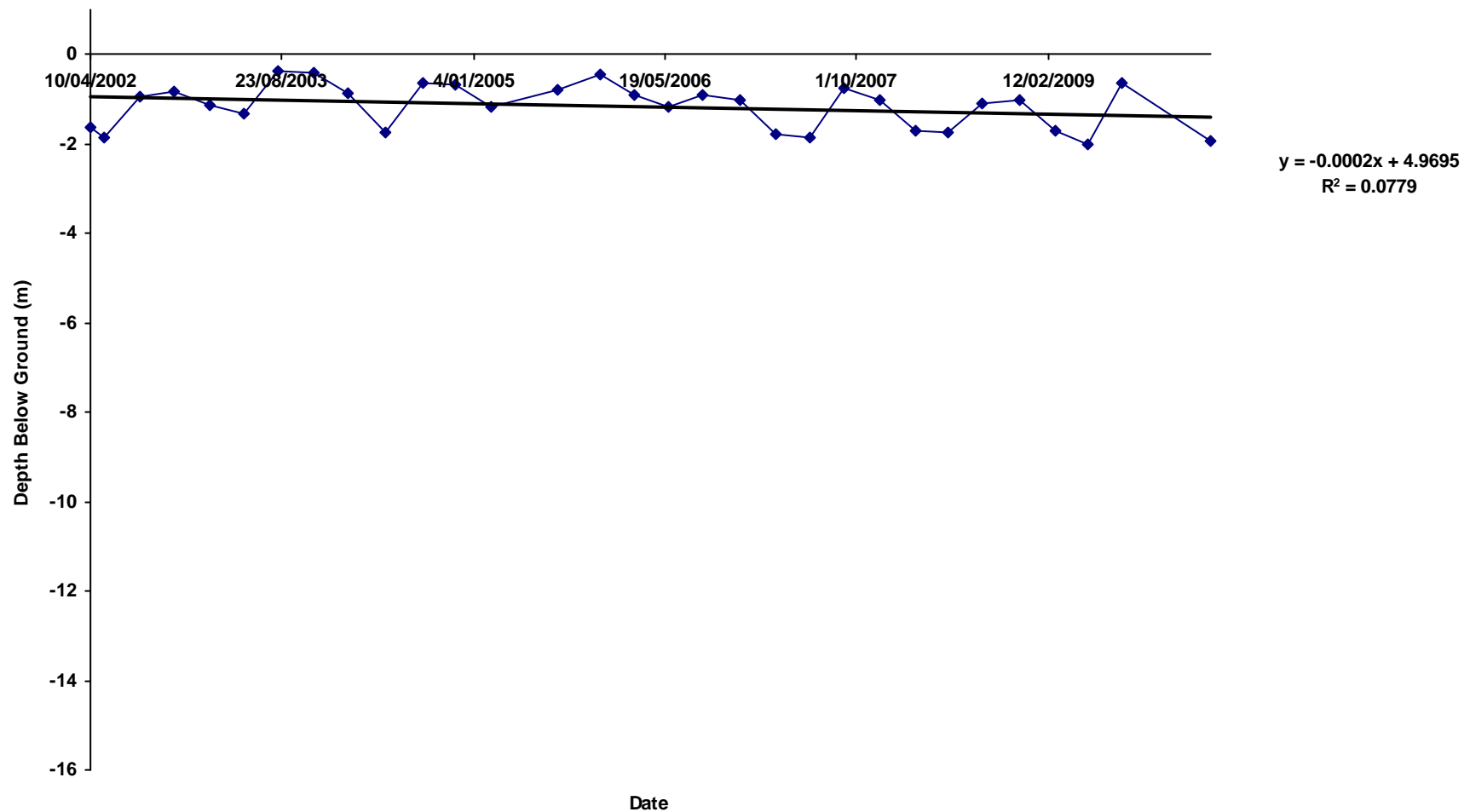


Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 01WR10S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:**

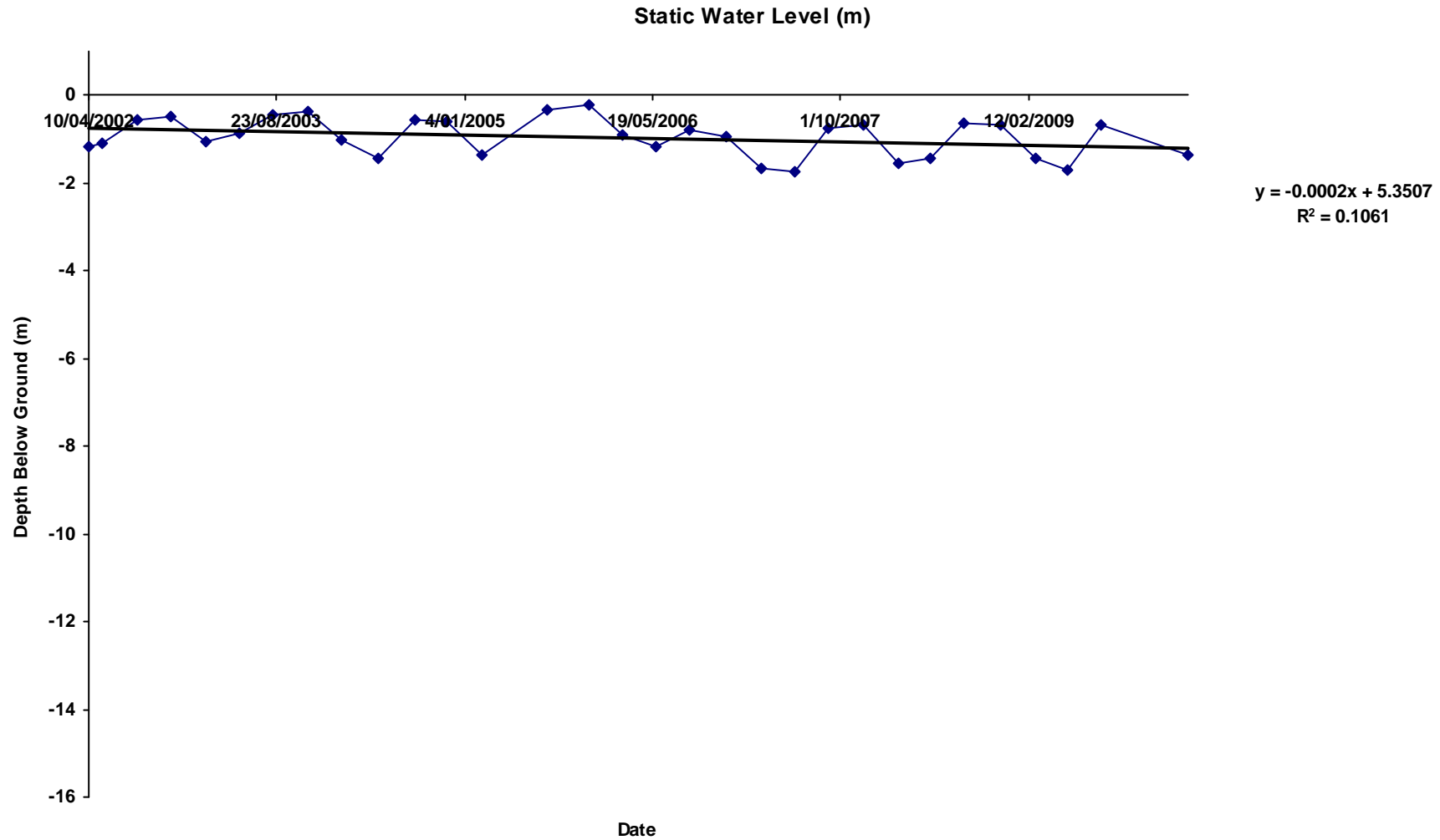
**GDA Coords:** 50    469315    6384000    **AHD (m):**    **Screened to (m):** -3

**Static Water Level (m)**

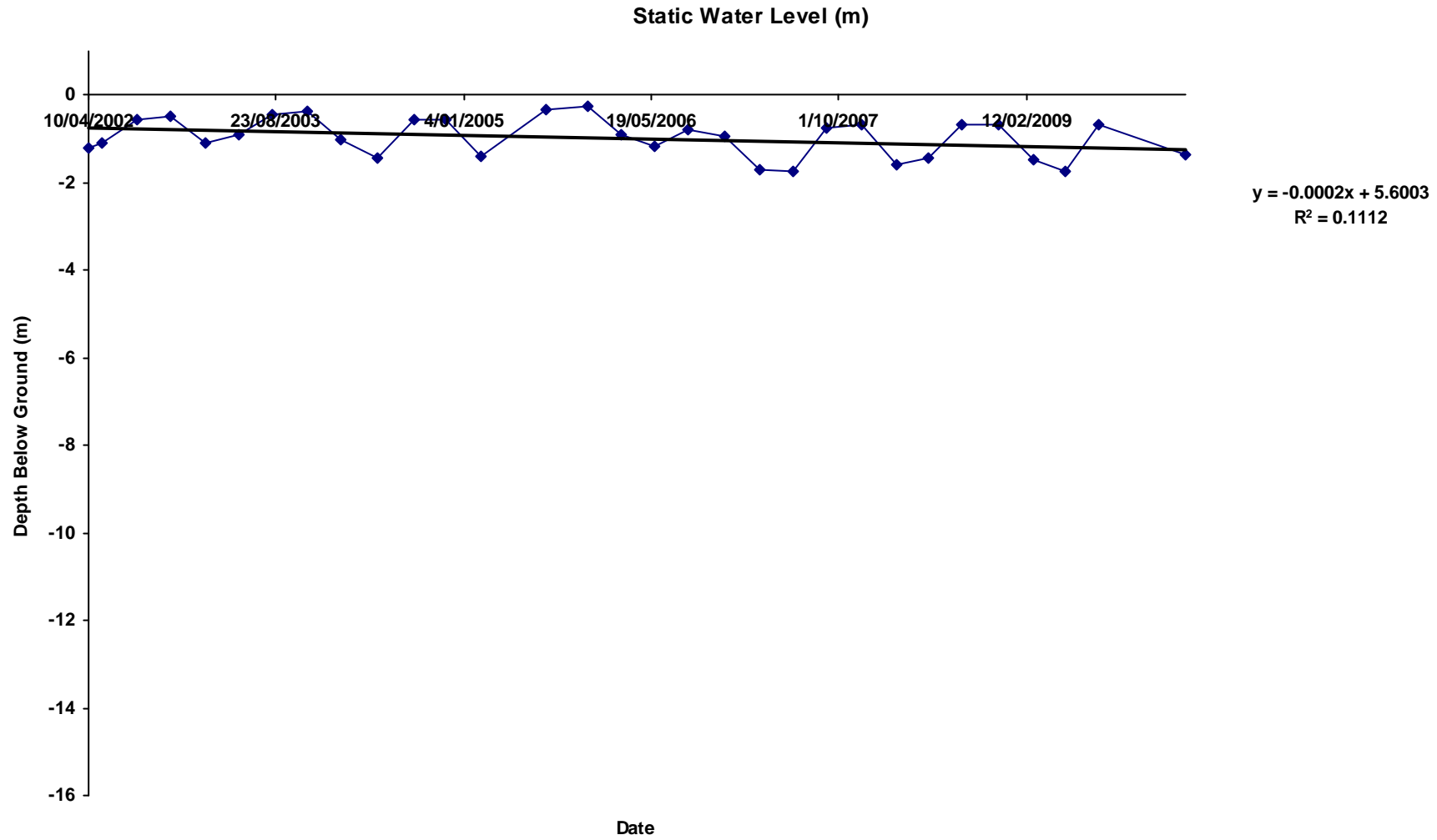


Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR01D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdBK  
**GDA Coords:** 50 469626.6 6383806 **AHD (m):** 265.3    **Screened to (m):** -18



Rural Towns Program    *Bore:* 02WR01S    *Project:* Wandering Rural Towns    *Sub Catchment:* Wandering Town    *Soil-landscape:* 253QdBK  
*GDA Coords:* 50 469625.3 6383806 *AHD (m):* 265.3    *Screened to (m):* -6

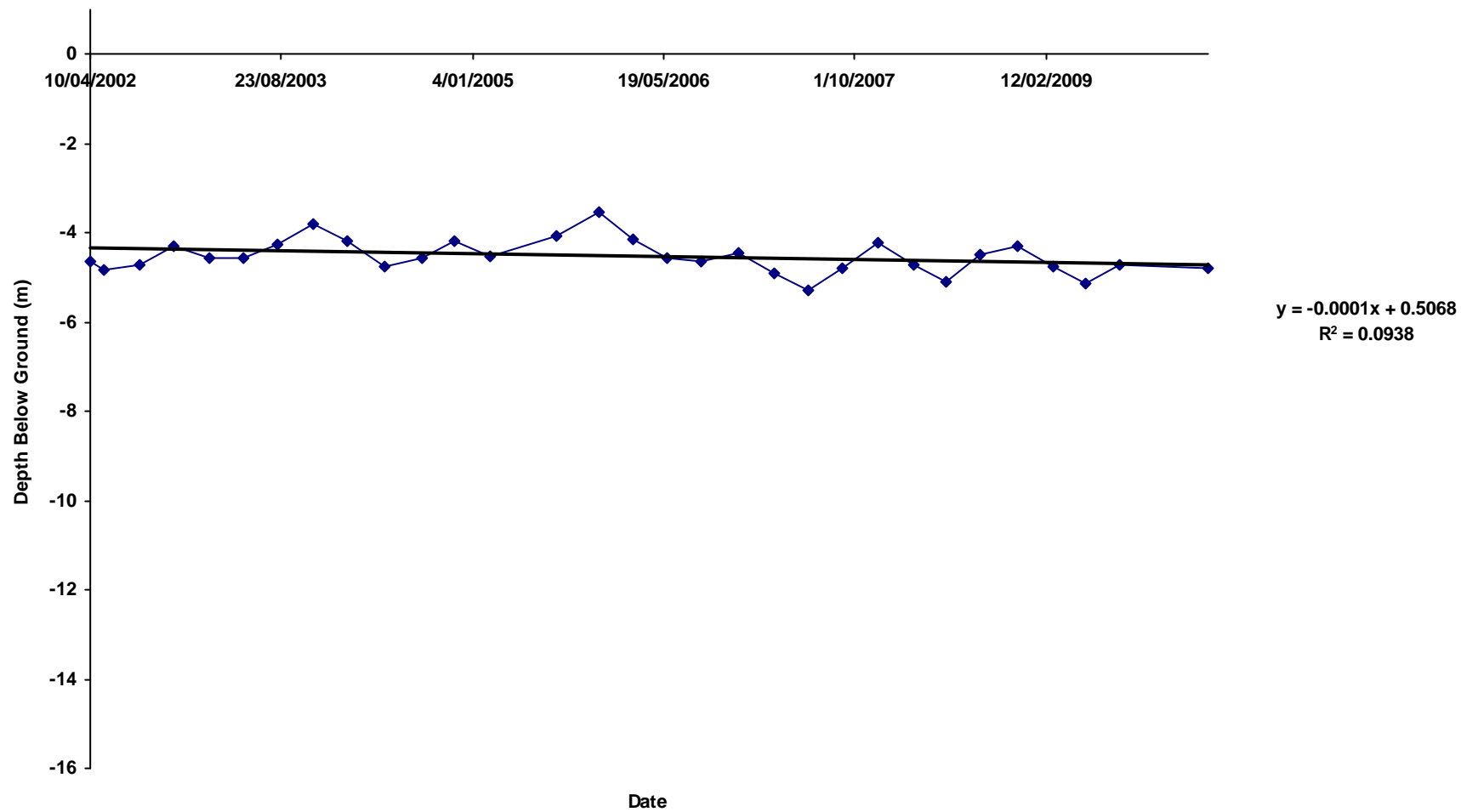


Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR02D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN

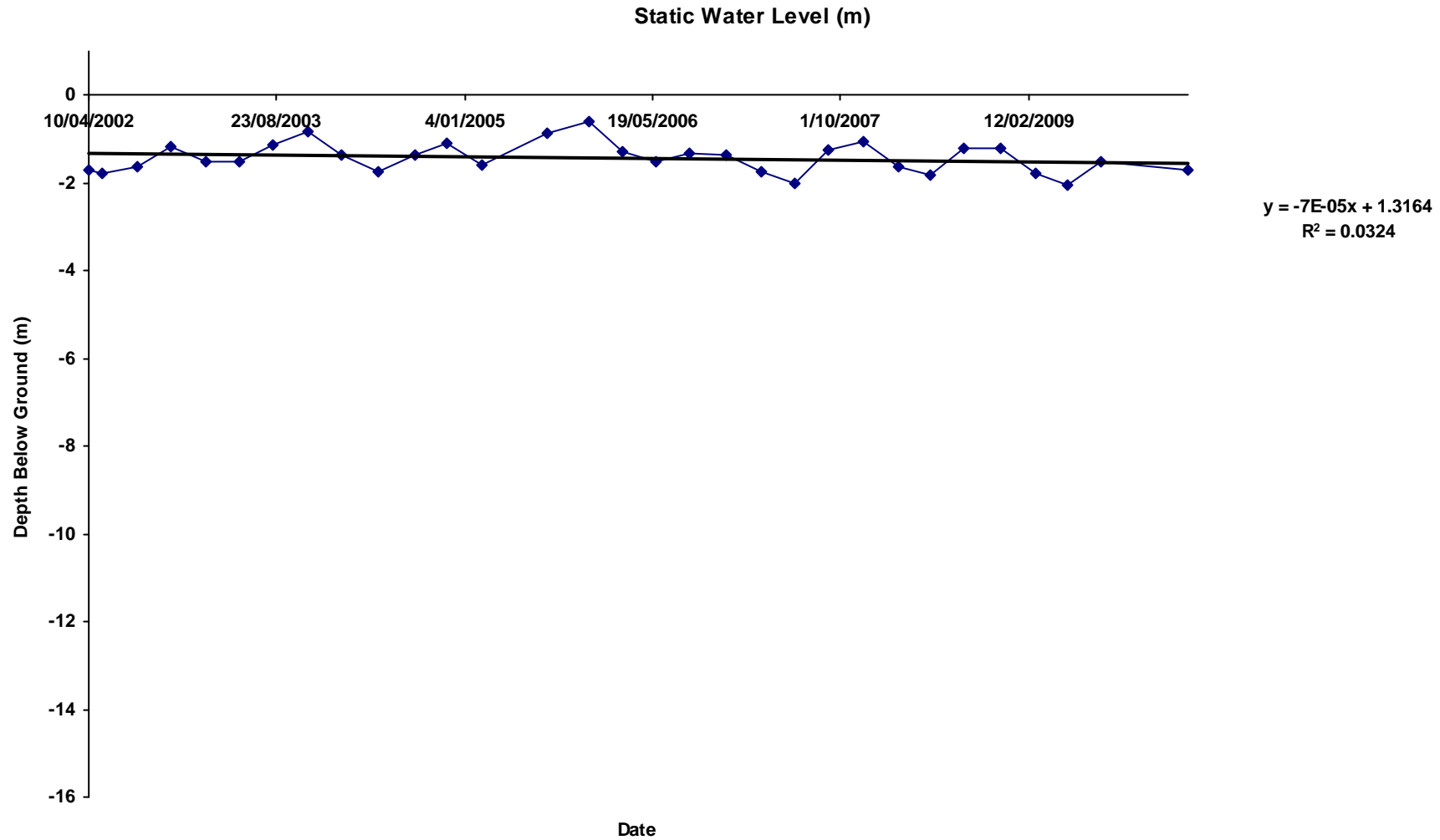
**GDA Coords:** 50 469342.7 6383933 **AHD (m):** 274.6    **Screened to (m):** -26

Static Water Level (m)



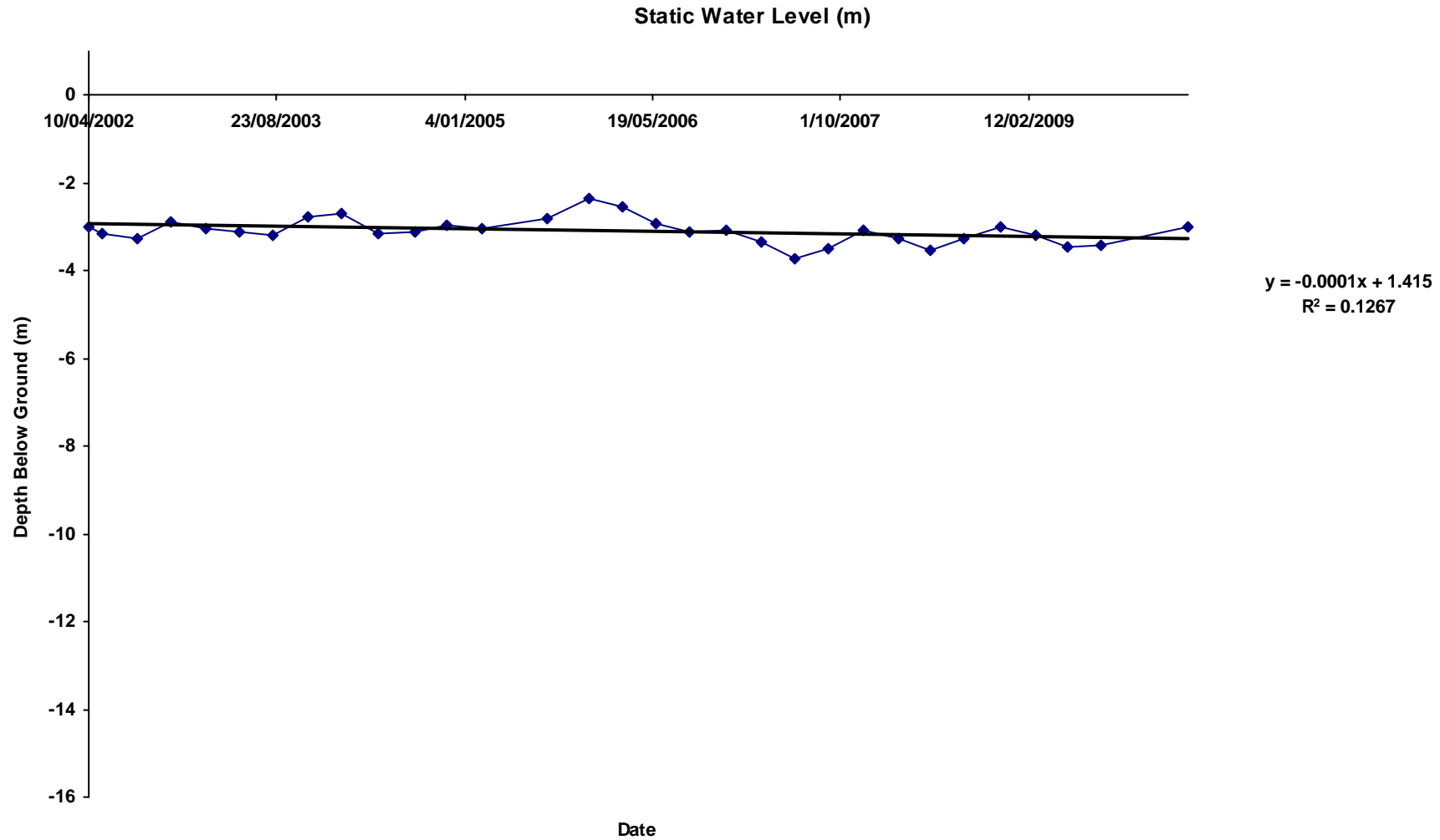
Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR02S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50 469342.6 6383934 **AHD (m):** 274.6    **Screened to (m):** -8



Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR03D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50 469540.1 6384012 **AHD (m):** 269.2    **Screened to (m):** -16

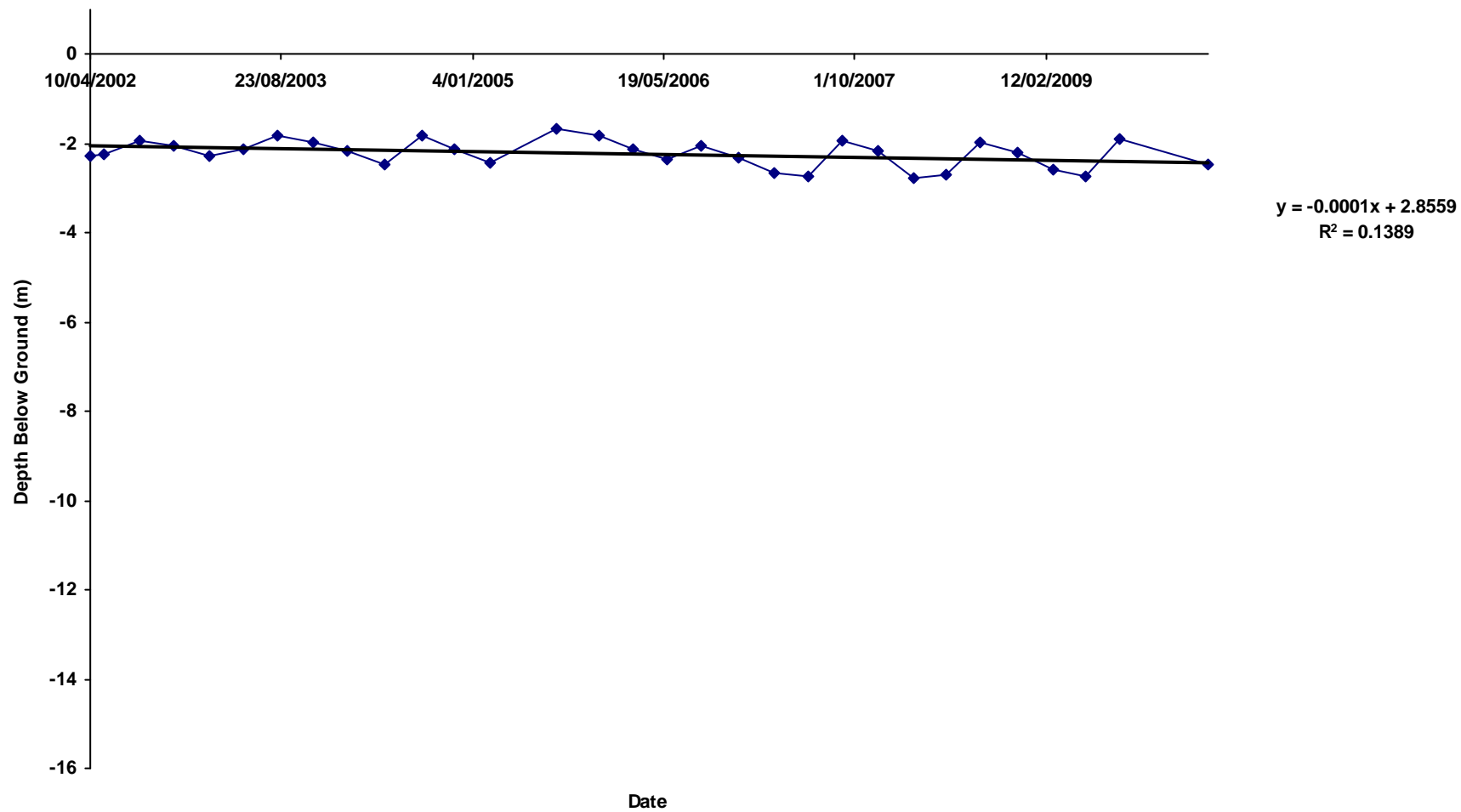


Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR04D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN

**GDA Coords:** 50 469745.5 6383930    **AHD (m):** 263.6    **Screened to (m):** -18

**Static Water Level (m)**



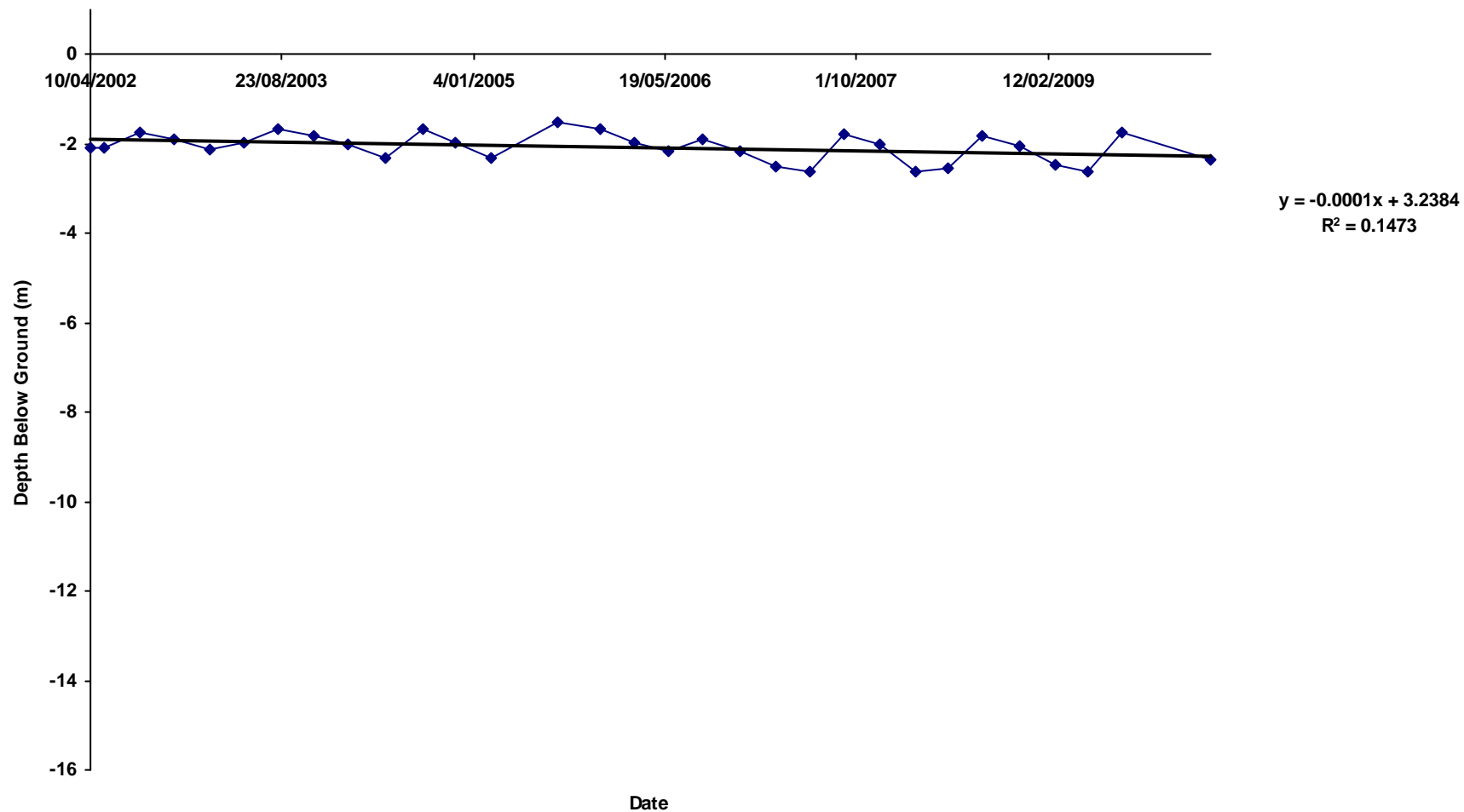


Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR04S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN

**GDA Coords:** 50 469746.1 6383931    **AHD (m):** 263.5    **Screened to (m):** -7

**Static Water Level (m)**

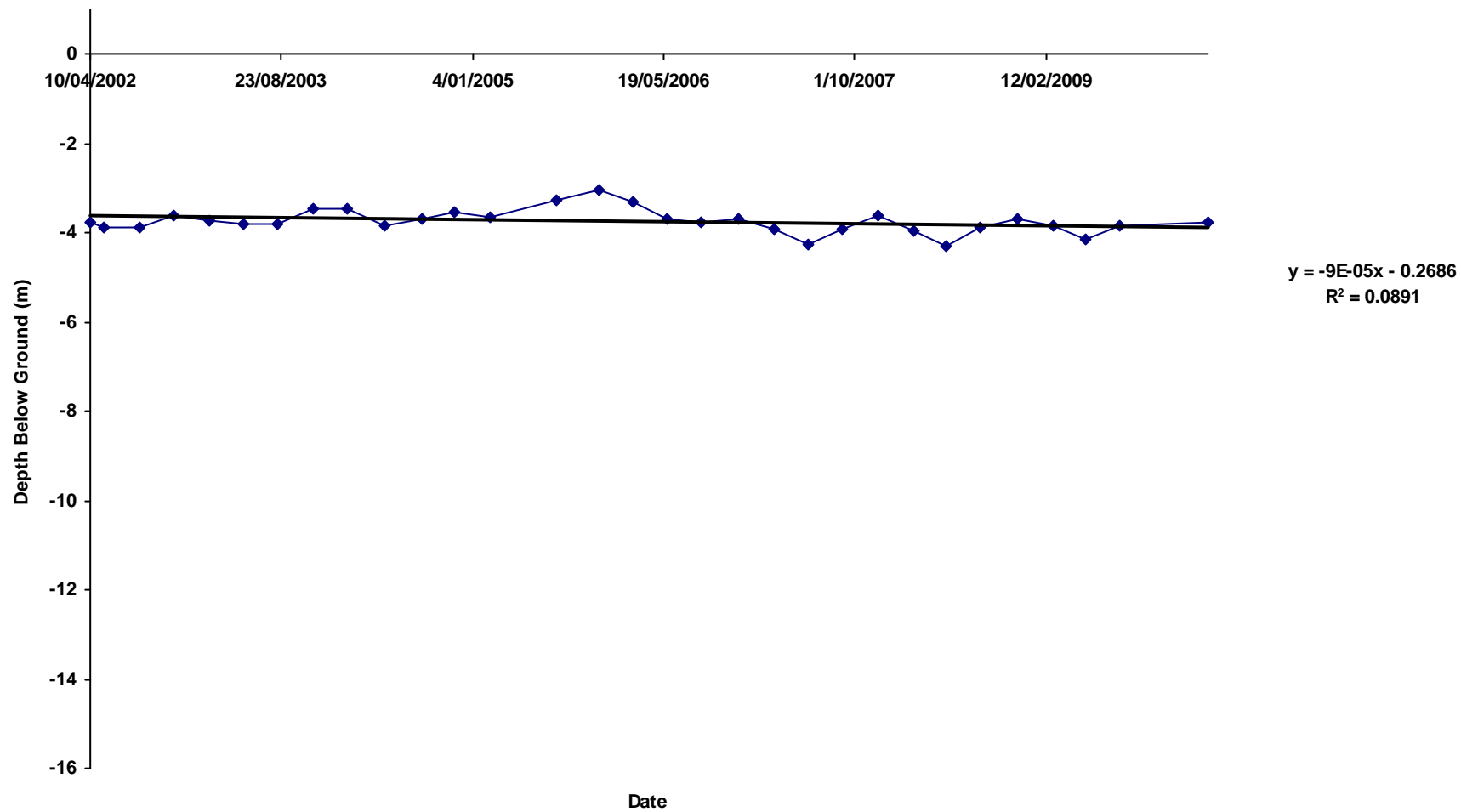


Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR05S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN

**GDA Coords:** 50 469598.8 6384054 **AHD (m):** 266.2    **Screened to (m):** -4

Static Water Level (m)

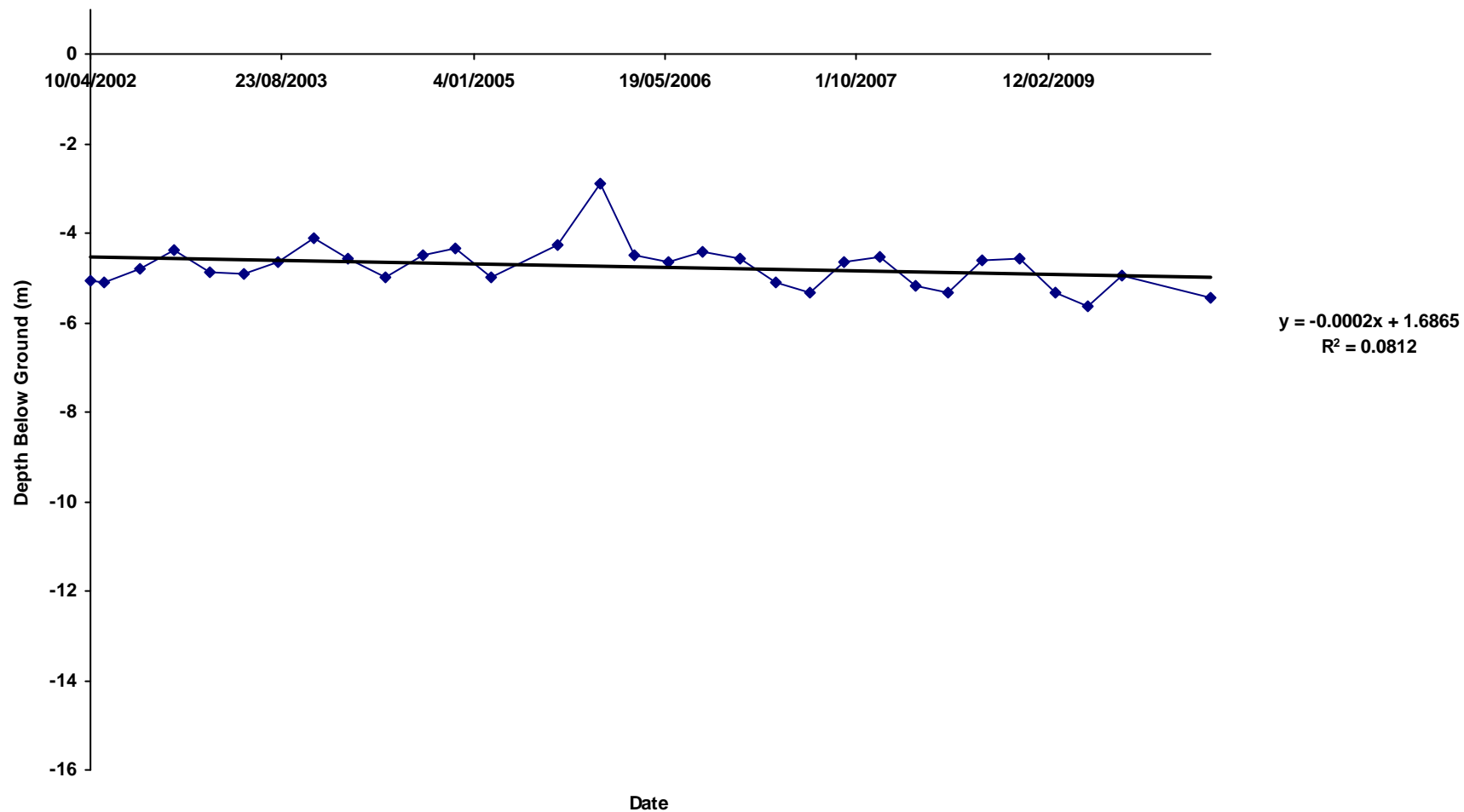


Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR06D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN

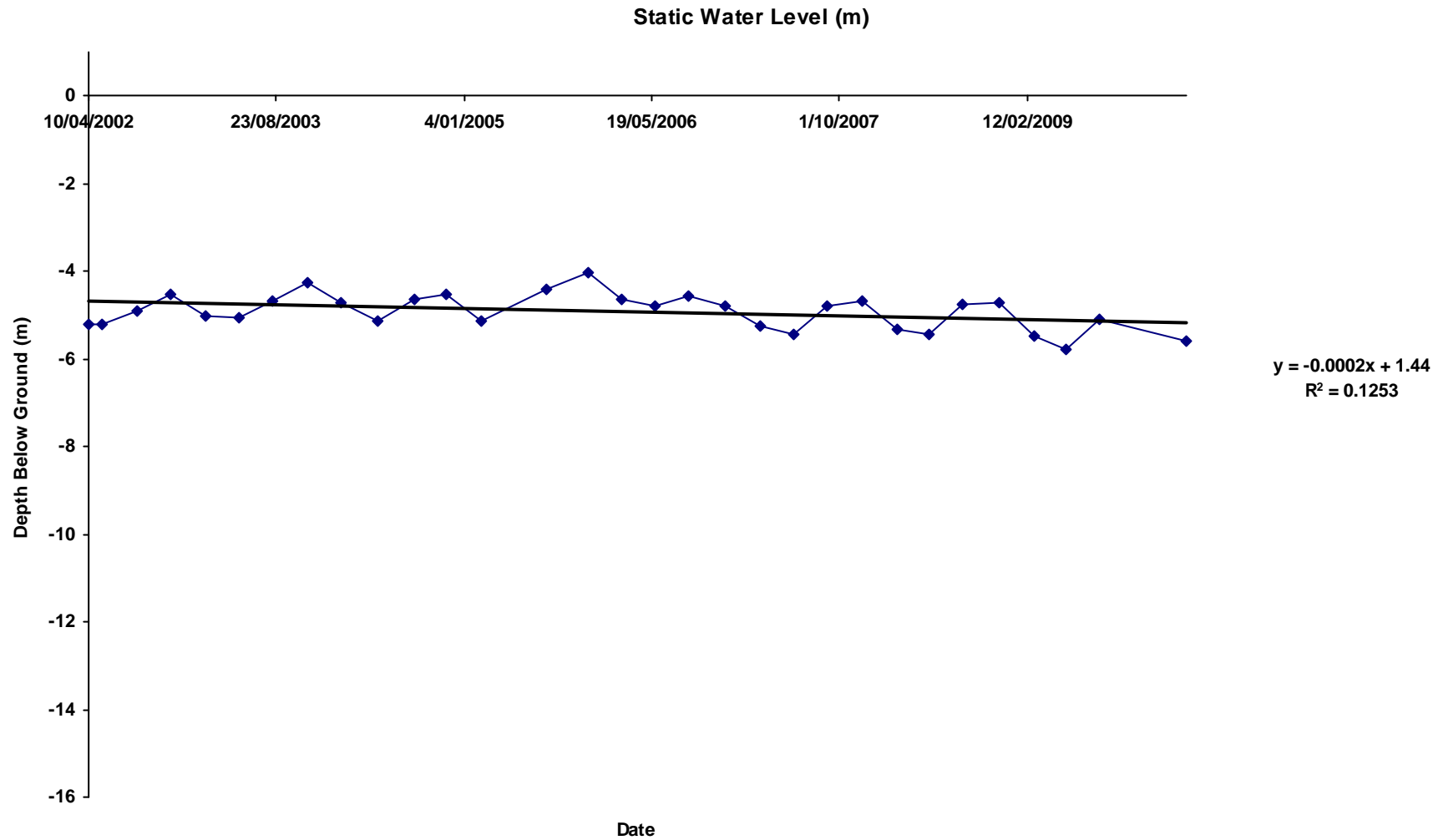
**GDA Coords:** 50 469245.7 6384052    **AHD (m):** 281.1    **Screened to (m):** -20

**Static Water Level (m)**



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**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR06S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50 469244.7 6384053    **AHD (m):** 281.2    **Screened to (m):** -7

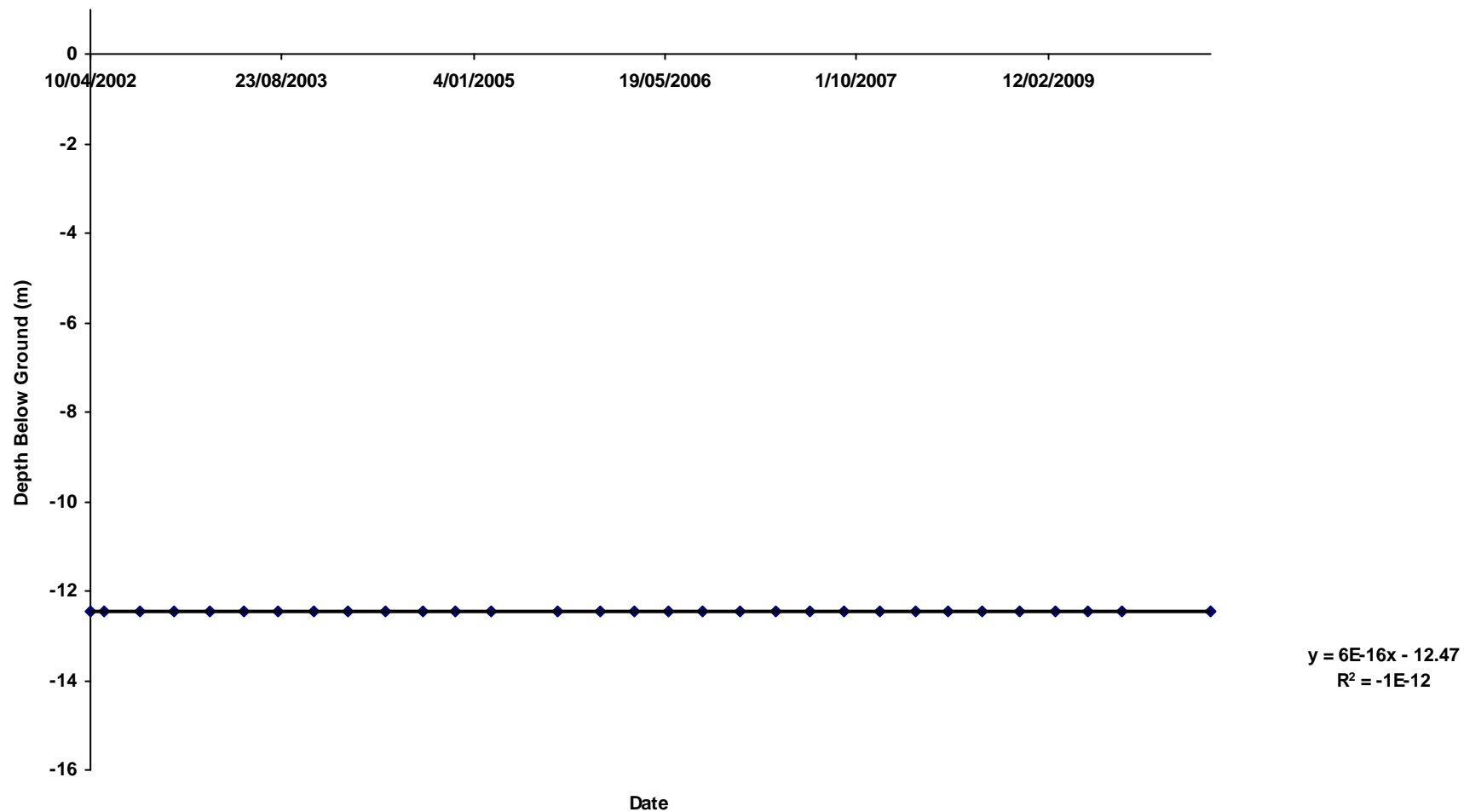


Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR07D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253MuDW

**GDA Coords:** 50 469053.7 6384238 **AHD (m):** 302.1    **Screened to (m):** -12

**Static Water Level (m)**

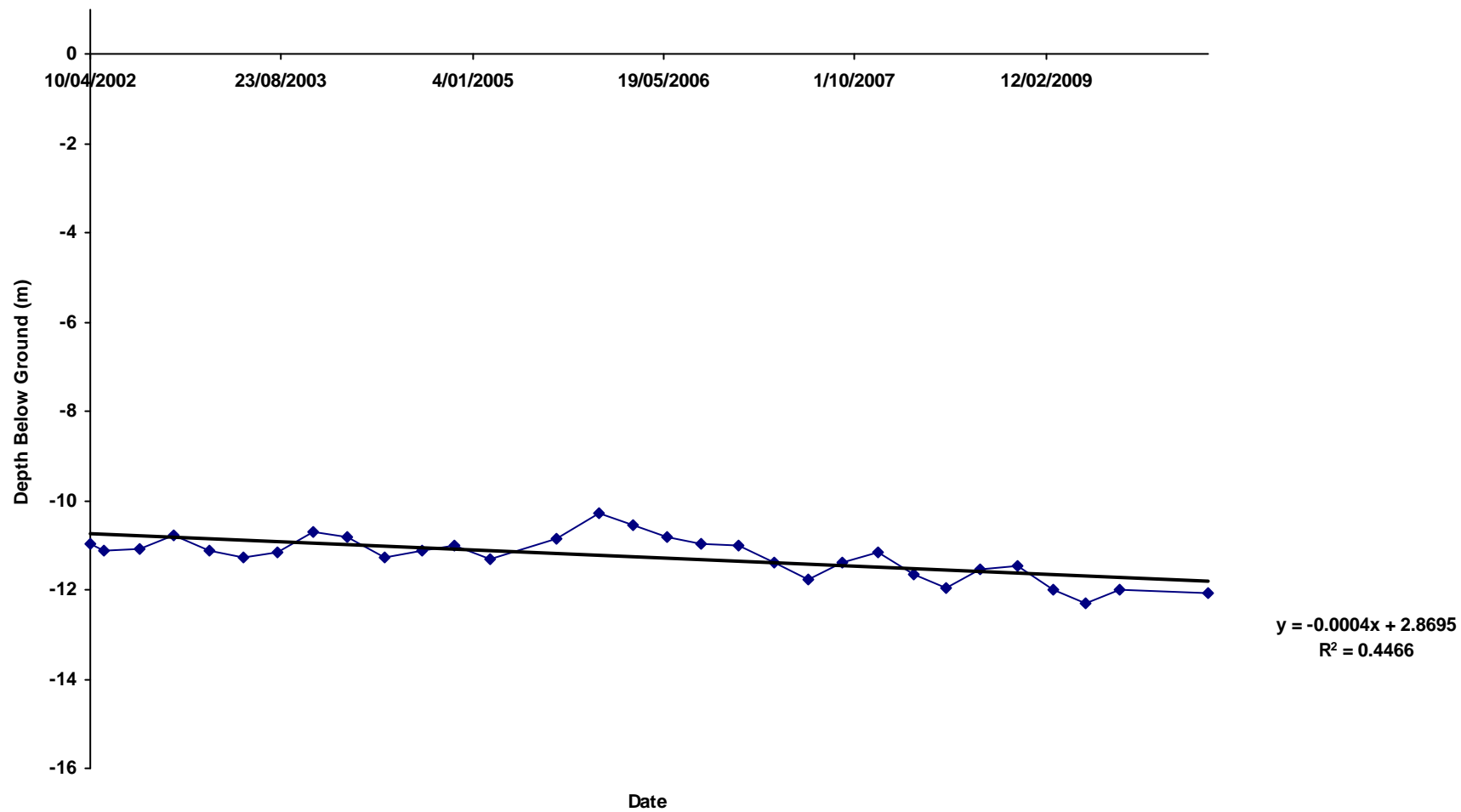


Dept of Ag WA Catchment Hydrology  
*graph SWL vs Time*

Rural Towns Program    **Bore:** 02WR08D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN

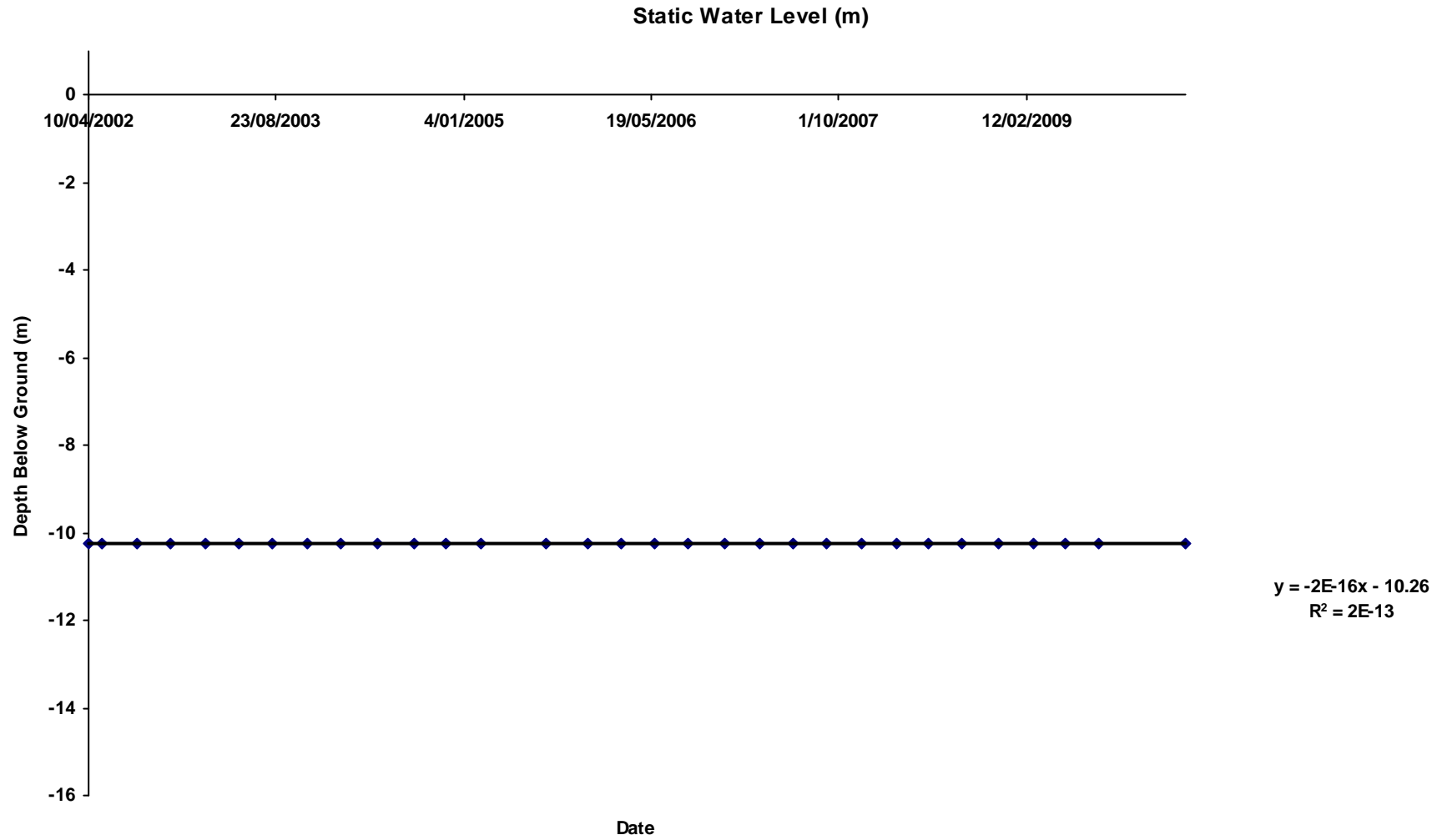
**GDA Coords:** 50 469250.6 6384424 **AHD (m):** 285.5    **Screened to (m):** -38

Static Water Level (m)



Dept of Ag WA Catchment Hydrology  
*graph SWL vs Time*

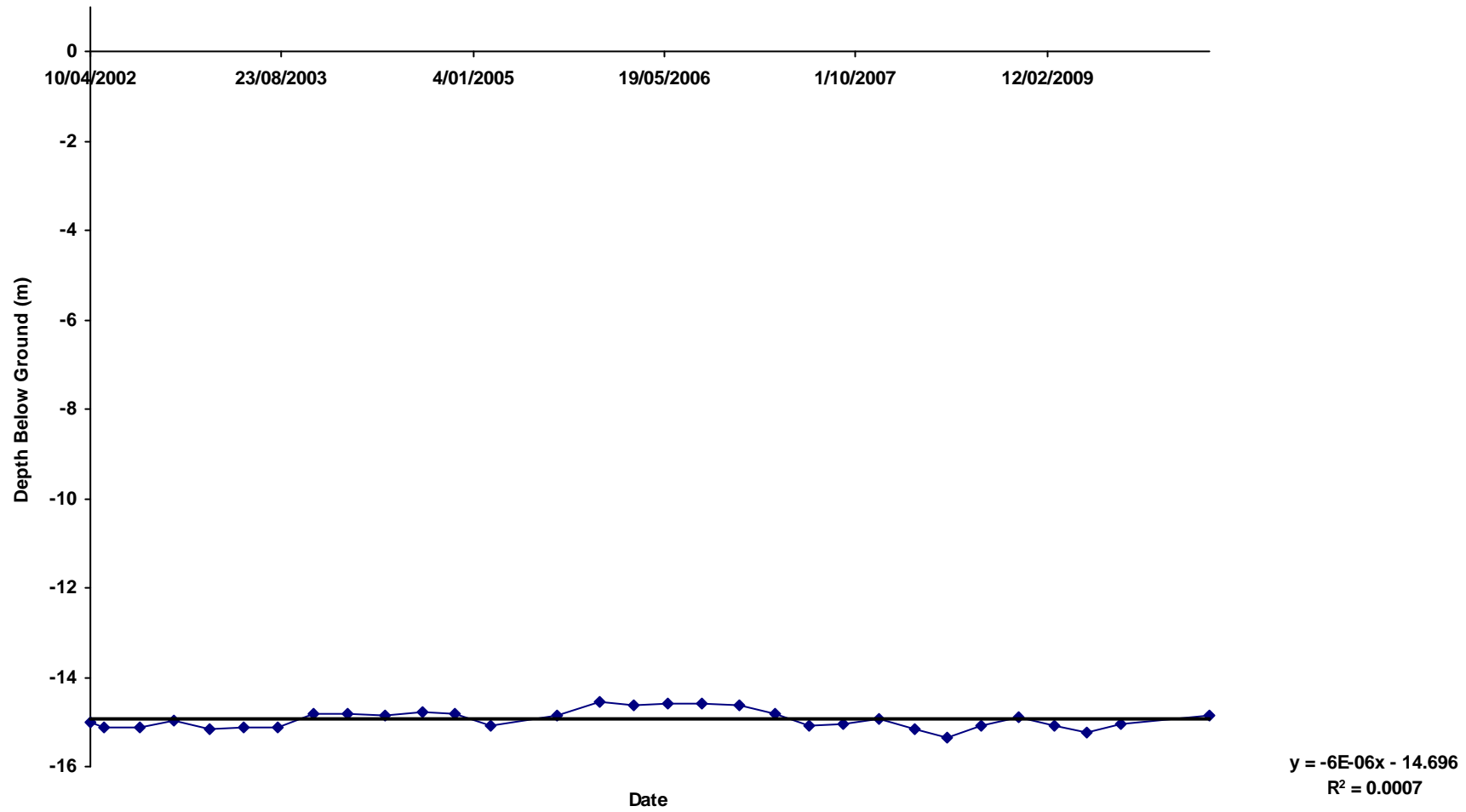
Rural Towns Program    **Bore:** 02WR08S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50 469249.2 6384424 **AHD (m):** 285.7    **Screened to (m):** -10



Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR09D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50 469017.7 6383897 **AHD (m):** 297.2    **Screened to (m):** -31

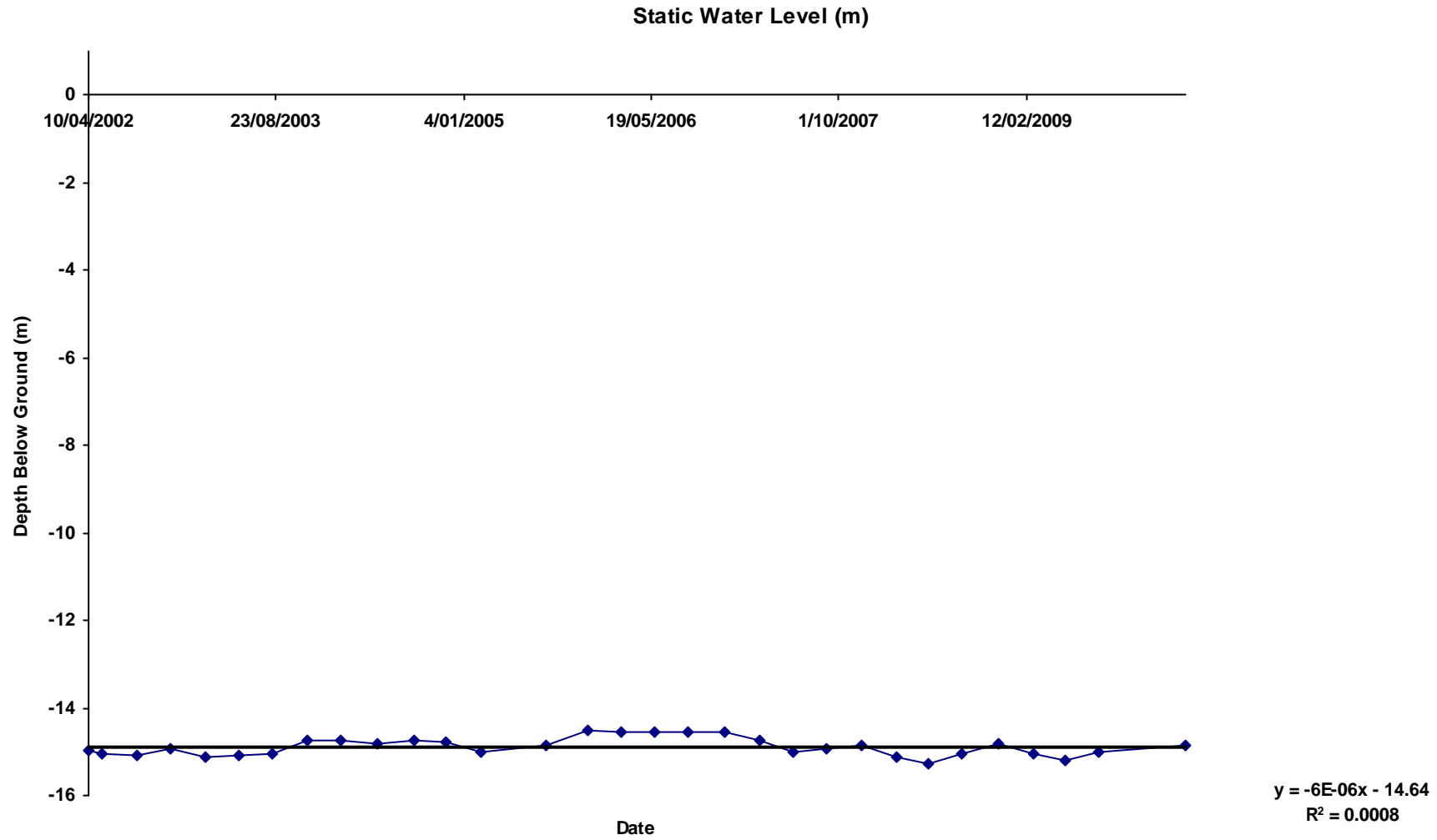
**Static Water Level (m)**





Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR09S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50 469020.4 6383897 **AHD (m):** 297.1    **Screened to (m):** -18

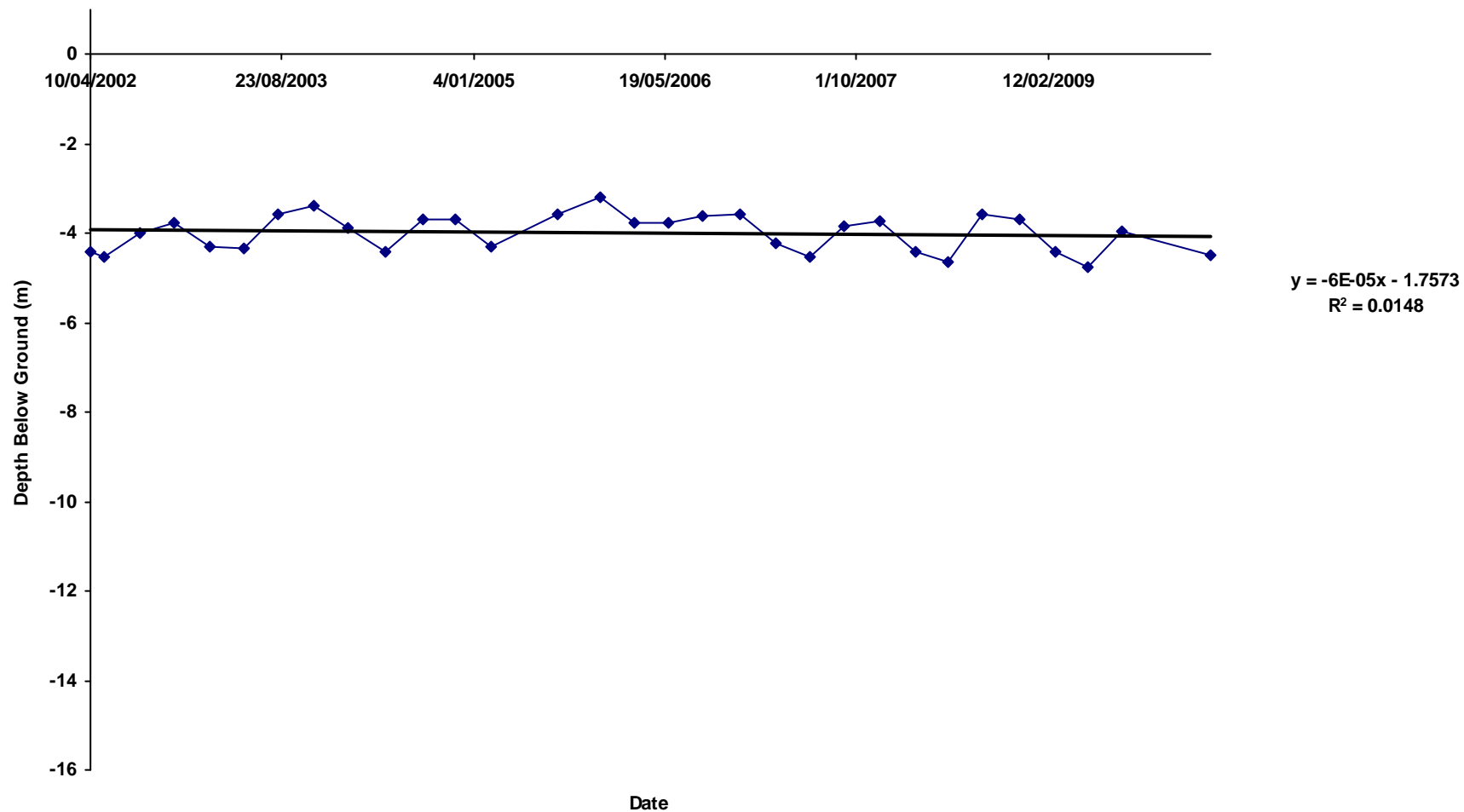


Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR10D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN

**GDA Coords:** 50    469199    6383892    **AHD (m):** 281.8    **Screened to (m):** -36

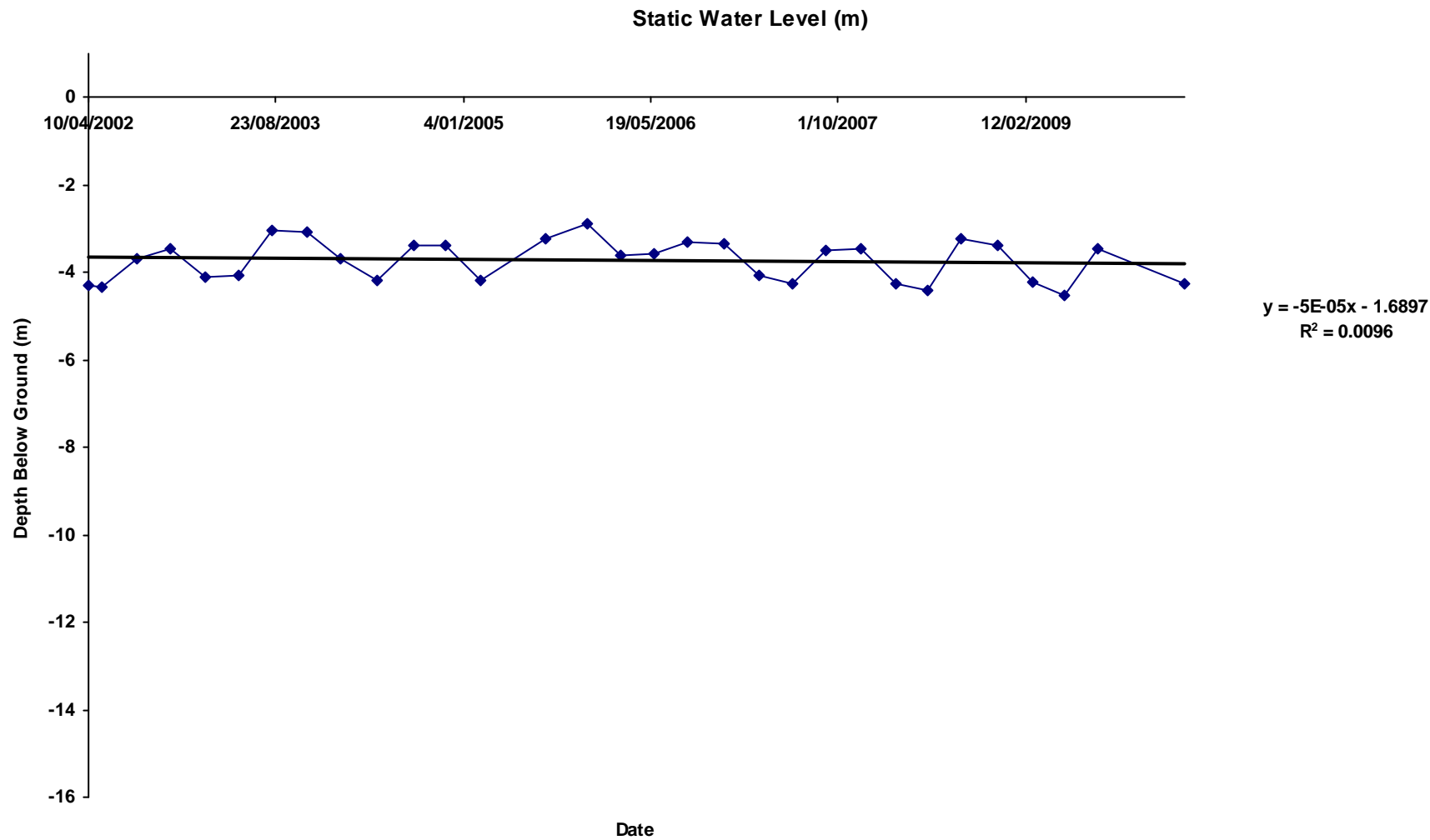
Static Water Level (m)



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**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR10S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN

**GDA Coords:** 50 469199.2 6383891    **AHD (m):** 281.8    **Screened to (m):** -7

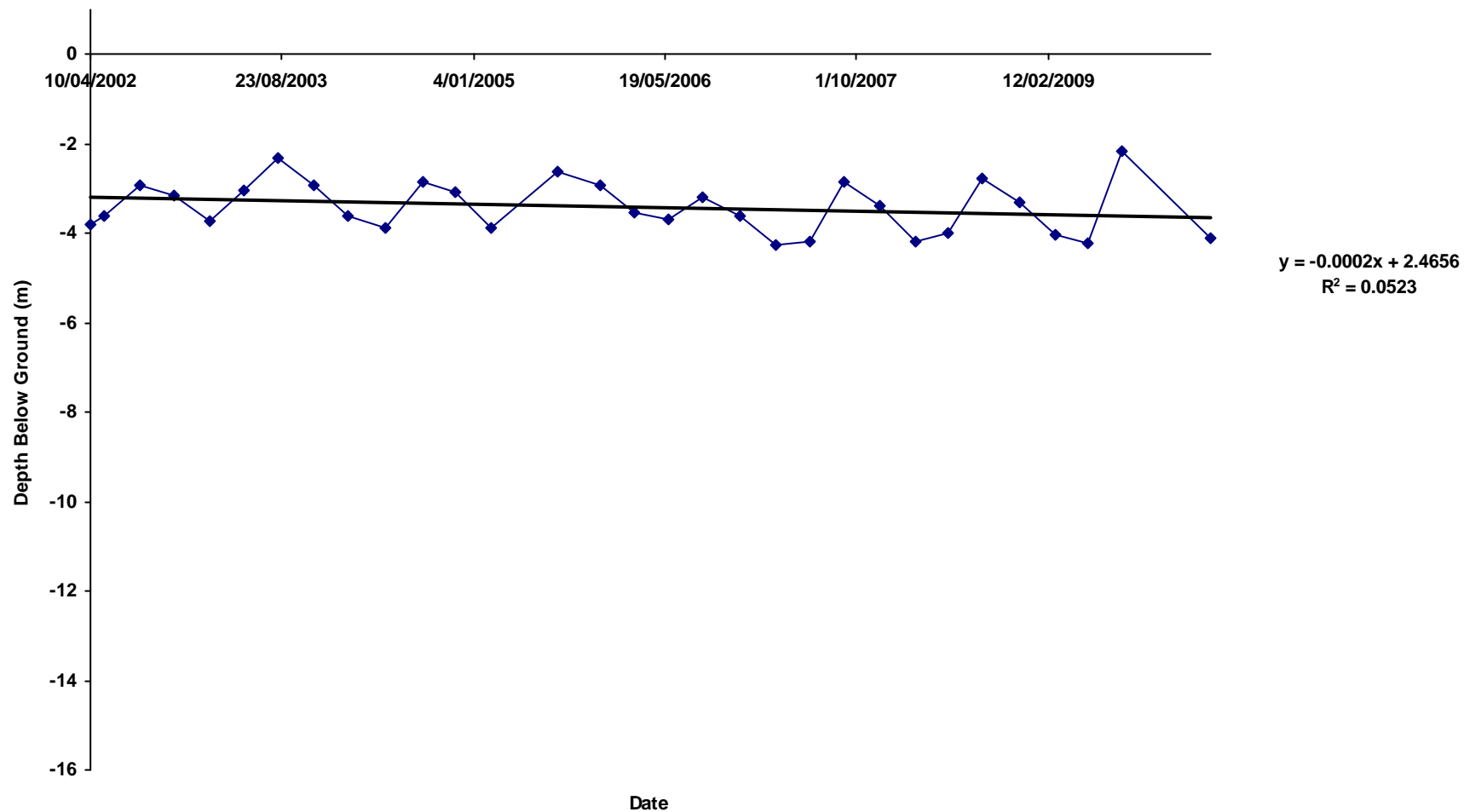


Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR11D    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN

**GDA Coords:** 50 469211.3 6383621    **AHD (m):** 272.9    **Screened to (m):** -14

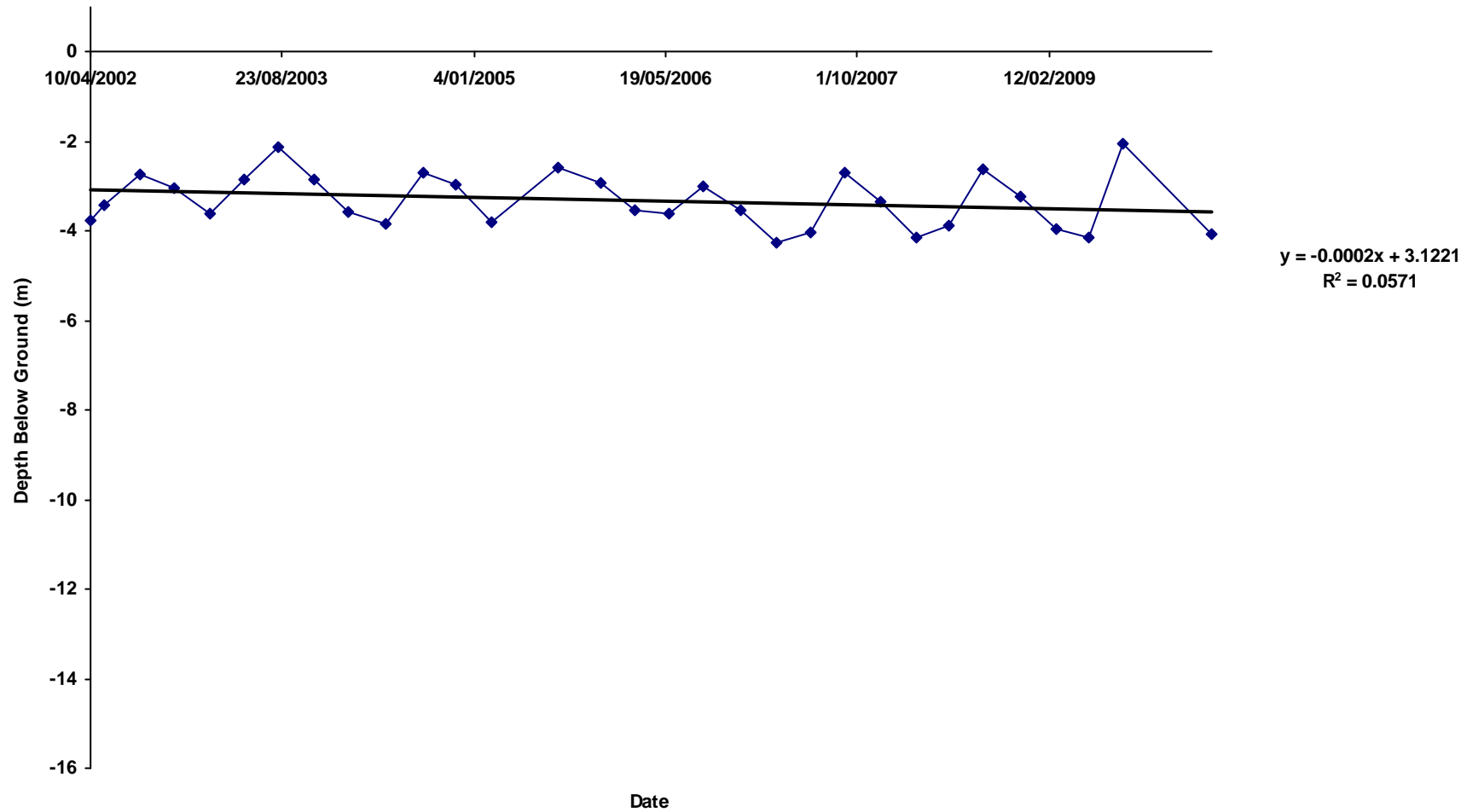
Static Water Level (m)



Dept of Ag WA Catchment Hydrology  
**graph SWL vs Time**

Rural Towns Program    **Bore:** 02WR11S    **Project:** Wandering Rural Towns    **Sub Catchment:** Wandering Town    **Soil-landscape:** 253QdMN  
**GDA Coords:** 50    469210    6383622    **AHD (m):** 272.9    **Screened to (m):** -5

**Static Water Level (m)**



*Dept of Ag WA Catchment Hydrology*  
***graph SWL vs Time***

Rural Towns Program      ***Bore:*** HOTHWAND   ***Project:*** Wandering Rural Towns      ***Sub Catchment:*** Wandering Town      ***Soil-landscape:***  
***GDA Coords:***    50    491020    6386090   ***AHD (m):***              ***Screened to (m):***

*Dept of Ag WA Catchment Hydrology*  
***graph SWL vs Time***

Rural Towns Program      ***Bore:*** WANDERIN    ***Project:*** Wandering Rural Towns    ***Sub Catchment:*** Wandering Town    ***Soil-landscape:***  
***GDA Coords:***    50    470200    6382050    ***AHD (m):***            ***Screened to (m):***