Characterisation of subcatchment aquifers in the Liverpool Plains for the purpose of groundwater modelling.

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Abstract

This document reports on the methods and data used to describe the major aquifers existing in the sub-catchments of the Liverpool Plains Region. This work was required as part of CSIRO Land and Water's involvement with the Australian Geological Survey, the Department of Land and Water Conservation and the Liverpool Plains Land Management Committee in the LWRRDC and NRMS funded project No.D6026 "Improving Dryland Salinity Management Through Integrated Catchment Scale Modelling". CSIRO's part in this project was to develop and apply a groundwater model as tools to help explore management options for the control of dryland salinity. The aquifer characterisation described here formed an essential part of the modelling approach taken. The primary data used took the form of historical records of bores constructed by state agencies and private individuals from 1900 to 1995.

The bore data were used in conjunction with spatial information held in a GIS. This enabled us to interpret bore logs in the context of: the bores position in the catchment; the bores proximity to each other and in context with mapped land attributes e.g. streams, elevation and geology.

Introduction

Dryland salinity in sub-catchments of the Liverpool Plains basin has been the subject of a major study entitled "Improving Dryland Salinity Management Through Integrated Catchment Scale Modelling". This study brought together workers from the Australian Geological Survey Organisation, CSIRO and the NSW Department of Land and Water Conservation to combine their skills and knowledge in tackling the problems of rising groundwater and salinity. CSIRO Land and Water's part in this project was to develop a groundwater model as a tool to help explore management options for the control of dryland salinity. The aquifer characterisation described here formed an essential part of the modelling approach taken. The primary data used took the form of historical records of bores constructed by state agencies and private individuals from 1900 to 1995. These data were collected for a variety of reasons, though primarily for groundwater exploration for stock and household water supply. The data were not ideal for our purposes however, with careful interpretation, it did provide useful information and insights into the structure and behaviour of the aquifers. The bore data was linked with spatial information held in a GIS. This enabled us to interpret bore logs in the context of: a bore's position in the catchment; the bores proximity to each other and in context with mapped land features and attributes e.g. streams, elevation and geology.

The Groundwater Systems

In brief, The Liverpool plains have been formed by infilling much deeper older valleys with sediments. The Liverpool Plains are considered to have three aquifer systems of interest (Figure 1). The old valley floor or the bedrock aquifer is the lowest aquifer. However hydraulic conductivities in the rock formations that make up

the aquifer are considered so low that, for the purpose of this study, the bedrock can be thought of as the no flow boundary.

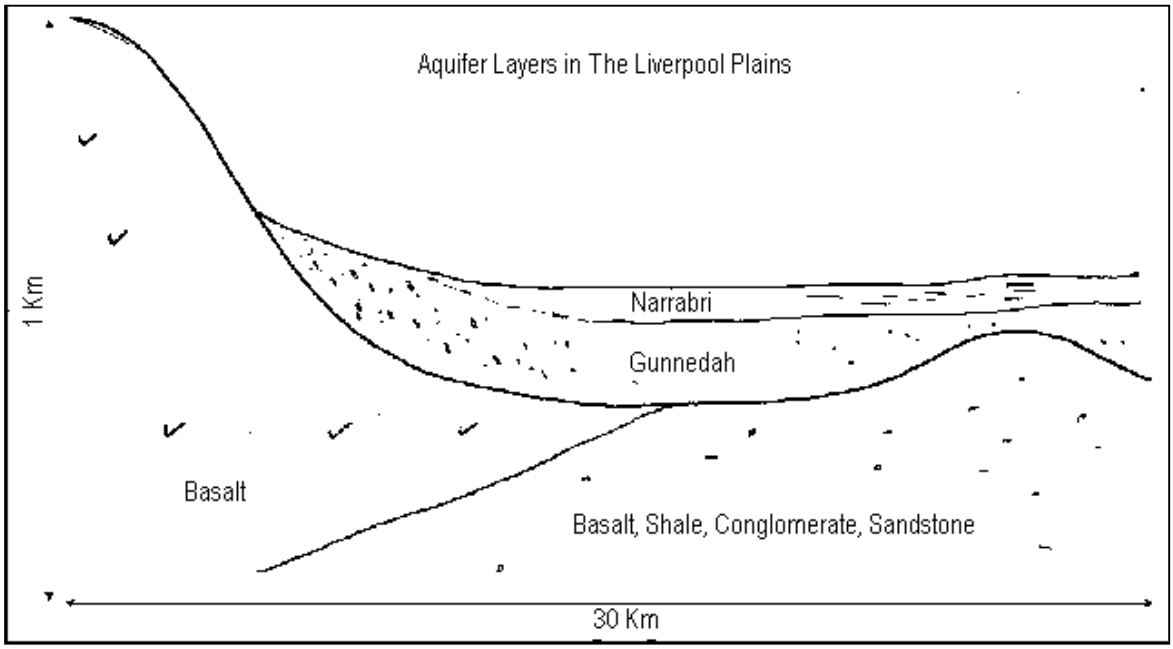

Figure 1 Schematic Diagram of the Aquifers of the Liverpool Plains.

The layer above the bedrock known as the Gunnedah Formation contains coarse sands and gravels, has a high hydraulic conductivity and acts as the main conduit for groundwater under the plains. The third and top layer is known as the Narrabri Formation contains a predominance of clays and caps the Gunnedah Formation. The clay layer's hydraulic conductivity is variable but typically two to three orders of magnitude lower than that of the Gunnedah Formation. A description of the aquifers and the movement groundwater in them appears in Stauffacher *et al.*, 1997 describing the groundwater conceptual model. The goal of our work was to characterise these aquifers by interpreting the bore log database. The aquifers are described in terms of their size, shape, composition, water levels and head differences.

Requirements for Groundwater Modelling

The aquifer studies were undertaken to parameterise the catchment groundwater "FUNNEL" model developed for the study. This model, as described by Dawes *et al.*, 1997, uses a simple linear one dimensional flow system representing the movement of water in an unconfined/semi-confined aquifer comprising a clay layer (unconfined Narrabri Formation) over a gravel aquifer (semi-confined Gunnedah Formation). The simple flow system exists within a valley, being bounded by the bedrock of the buried valley floor and sides. The groundwater behaviour is described in terms of water flow and changes in groundwater head in different sections along the flow system. The model parameters were estimated by constructing vertical cross sections both along and at intervals across the aquifer studied. The longitudinal sections provided the groundwater heads to estimate slope of the groundwater surface and the cross-sections provided information on aquifer composition depth and width with which to estimate cross-sectional area and transmissivity.

Information used.

The aquifer studies used conventional bore databases in conjunction with spatial data in a GIS allowing us to map the bores relative to each other and to themes such as elevation, geology, streams and lakes. This simple process enabled us to filter and identify appropriately positioned bores. In addition, information about bores could be selected and displayed to aid the user in section construction. The databases held information about bore lithology, water levels and aquifer thickness at the bore location.

The Bore Data

Several large bore data sets were combined to provide as much information as possible to produce the aquifer sections. The bore data were supplied by NSW Department of Land & Water Conservation. The data supplied were:

- Liverpool Plains bore Construction and Site data (9,100 records)
- Bore Level data (60,000 records)
- Bore Water Quality (36,000 records)

The quantity of the data necessitated the use of a relational database management system (MS-Access™). Without the power to search, filter and recombine the data within the database the bore investigation work would have been an impossible task. Full descriptions of the database tables appear in Appendix 1.

The Spatial Data

The acquisition and validation of spatial data used in this work was managed by the Australian Geological Survey Organisation who supplied the data requested as part of the NRMS grant conditions. The key data spatial data sets were:

- A digital elevation model (1:250,000 DEM)
- The Geology of the Liverpool Plains Map (1:250,000)
- Bore locations (1:100,000 nominal scale)

These data were supplied as ARC/INFO™ coverages and used as in their original form within our GIS. Also supplied from AGSO were a full set of regional hydrogeology layers for the Liverpool Plains compiled by Andrea Broughton, 1994. These layers combined into a map provided a basis for the development of the conceptual model of regional groundwater system. The map layers were created to suit the production of the regional scale hydrogeological map. The modelling exercise required more detail

than the map could provide so the aquifer investigations utilised the original bore data. Descriptions of the GIS layers appear in Appendix 2.

The Interpretation Procedure.

The Liverpool Plains were first divided into discrete groundwater systems.

The conceptual model, Stauffacher *et al*., 1997 subdivides the Liverpool Plains into 5 surface sub-catchments those groundwater systems are considered to operate independently (Figure2). The sub-catchments were defined as drainage basins using hydrological functions now standard within the GIS to identify catchment watersheds.

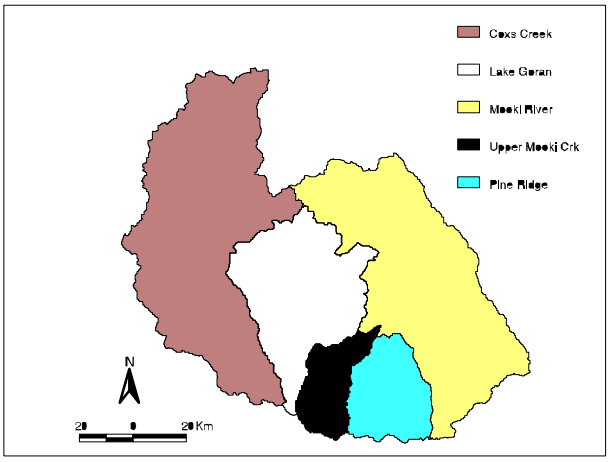

Figure 2 sub-catchments of the Liverpool Plains

Maps of bores reaching bedrock in each sub-catchment were plotted.

For each sub-catchment the bores were then selected according to what information existed in the drillers' logs. The first task was to establish the depth and shape of the ancient valley floor. The valley basement was indicated by the presence of rock in the bottom of the drillers' bore logs.

The bore selection was performed through database queries, an example of which appears below.

```
SELECT DISTINCTROW tblBasinBedrockInt.fldStation,
tblLithDrill.fldStrataCode, tblLithDrill.fldDepthTo INTO
tblBasinBedrockFinal
FROM tblBasinBedrockInt INNER JOIN tblLithDrill ON
(tblBasinBedrockInt.MaxOffldDepthTo = tblLithDrill.fldDepthTo)
 AND (tblBasinBedrockInt.fldStation = tblLithDrill.fldStation)
WHERE (((tblLithDrill.fldStrataCode)="rock" Or
(tblLithDrill.fldStrataCode)="cglm" Or
(tblLithDrill.fldStrataCode)="grnt" Or
(tblLithDrill.fldStrataCode)="lmsn" Or
(tblLithDrill.fldStrataCode)="bslt" Or
(tblLithDrill.fldStrataCode)="sdsn" Or
(tblLithDrill.fldStrataCode)="bdrk"))
ORDER BY tblBasinBedrockInt.fldStation;
```

The above SQL query statement selects bores where the deepest layer on the bore log contains rock strata. Hard copy maps of the selected bores were produced for each catchment. These working copies were used to select transects passing as many of the plotted bores as possible. Transect lines were drawn in to locate section positions. The longitudinal sections down each valley were defined first. These were used to assess the shape and slope of the rock basement and define the piezometric head down the length of each catchment. The longitudinal sections also aided the placement of the transverse sections. Using only bores drilled to bedrock proved limiting as many bores were excluded. However, once the transects were established using the bores with the most information, other bores along the transects were checked and relevant information added. Longitudinal and transverse sections were constructed as scale drawings showing aquifer depths and water levels. The data for each bore along the transect was extracted and used to plot vertical cross sections on graph paper. Bore selection was further enhanced by linking the descriptive and temporal databases to the geographic database. Mapped bore locations could be displayed on computer screen allowing rapid selection and retrieval of the bore information, again displayed on screen.

We constructed transverse sections at equal intervals up the catchments, starting at the mouth each valley. Additional sections were also constructed where the groundwater gradient may indicate some variation in conductivity e.g. a basement high or valley narrowing. The many layers of different textured sediments and rock strata described in each log were plotted out relative to the ground surface and the other bores in the section. These plots were then interpreted and simplified into representations of the two main aquifers. The boundaries between the Gunnedah, the Narrabri and the basement rock aquifers were interpreted on texture of the substrata; depths of different aquifer layers (as defined by the drillers); some aquifer water level data (from time of construction) and some bore some water quality (Na^+, CL^- concentrations). Information about the composition, depth and width of each aquifer was used to estimate the cross-sectional area of each aquifer. Maps and cross-sections for each sub-catchment appear in Appendix 4. Information about the size and structure of the Gunnedah Formation aquifer in each catchment are summarised in Tables 1 to 3 , Appendix 3.

Problems encountered with the data.

Although the Liverpool Plains appear dotted with thousands of bores, the density of bore information for the study areas was quiet sparse and patchy. Most of the bores in the database were sunk in the search of water supplies and the location of the bores is less than ideal for aquifer description. Bores commonly cluster where good water supplies have been found. These sites usually have good drillers' records and historical information. Away from these sites, where bores have been drilled without success of finding water, little data exists apart from the bore location.

Where driller's logs do exist it is common for the drilling to have ceased as soon as a suitable aquifer was found. Commonly this meant that the boreholes do not extend to

the bedrock. This made the assessment of aquifer depth and thickness difficult. Estimates were commonly made by incorporating bore information from locations far above and below the positions of the cross sections.

For the vast majority of the bores, only one piece of water level information exists. This was not dated and we assumed that the water level was recorded at the time of the bore construction. The number of bores with recorded historical water level information is limited to one or two per sub catchment. These bores have been used as monitors of groundwater and yield useful information locally. Of this small set of bores even less have recorded water quality data.

Finally the structure of the bore databases themselves caused some problems in interpretation. Single bores and nested bores are located in the same way, ie they are given a Station number. However, confusion arises where a site has more that one bore or a bore contains more that one pipe screened at different depths. Where temporal records exist, these are referenced only by the 'Station number' and only relate water level record to the site not to the different pipes (in different aquifers) which may exist at that site. The hole and pipe numbers that would identify exactly which records correspond to a physical pipe tapping into an aquifer are commonly missing or the hole and pipe numbers are the same leading to concern about their validity. Also while there is information in the database about aquifers at bore locations, there is no way to relate this to the information about which physical pipe the aquifer records describe. If it were possible, then the hydrographs for the different aquifers at a 'bore station' (location) could be separated. It is of course possible to interpret the information for a selected bore. The bore location, lithology, aquifer records, waterlevels and chemistry can be retrieved and interpreted but it isn't possible

to automate the process or attempt to interpret the relationships between aquifers at different locations over time.

In spite of these drawbacks, the databases did yield enough information when combined with field and groundwater monitoring experience to produce cross sections and information that gives an indication of the structure of the aquifers of the study areas.

Acknowledgments

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Wendy Timms, NSW Department of Land and Water Conservation, Gunnedah
Karla Abbs, NSW Department of Land and Water Conservation, Gunnedah.
Tess McCarthy, CSIRO Land & Water Canberra.

References

Broughton, A.K. Department of Water Resources 199, Liverpool Plains Catchment Hydrologeological Map (1:250 000 scale) Department of Water Resources, New South Wales, Australia.

Stauffacher, M., Walker, G., Evans, L 1997. Salt and Water movement in the Liverpool Plains - What's going on. NDSP Occasion Paper 14/97

Stauffacher, M., Walker, G., Zhang, L., Dawes, W., Dyce, P., 1997. Liverpool Plains Groundwater Modelling. In prep.

Zhang, L, Walker,G., Stauffacher, M., Dyce, P, 1997. Recharge on the Liverpool Plains. Technical Report 10/97, CSIRO Land and Water Canberra.

Appendices

Appendix 1: Department of Land & Water Management Liverpool Plains Bore Database

DLWC_NSW.MDB
.doc created 16/7/97

DATA DESCRIPTIONS

IDENTIFICATION

Title: DLWC_NSW_ed8.MDB
Full Name: Liverpool Plains Bore Data.

Description: This database contains the tables described at the
end of the section.

Purpose: For use in bore investigation for the Liverpool Plains.

Reference:
Owner Organisation: State/NSWDWR New South Wales Department of Water Resources.
Owner Branch
Owner Project
Other Organisations
Authors/collators: Andrea K. Broughton,
Copy? Yes.
Identification Comments

SPATIAL IDENTITY

Spatial Feature(s): Station locations in latitude and longitude
Coordinate Units: decimal degrees.
DATA ITEMS
SPATIAL COVERAGE

General Area: Northeast NSW, Liverpool Plains catchment (1.3 million hectares)
Onshore/Offshore: Onshore.

Future Spatial Coverage
Spatial Cov Comments

TEMPORAL COVERAGE

Time Variant: yes 16/797.
Time Span
Predictive: No.
Temporal Cov Comments

DATASET INFORMATION

Data Form:
Working Media:
Digital Data? .

Software: MS Access 97
Hardware: PC.
Available formats:
This Format: MS Access 97.
˝
Size: 25 megabytes.
˝
Dataset Comments
˝

˝
HARD COPY
˝

˝
Available: yes original
˝
Paper Size:
˝
Scale:
˝
Location: Department of Water Resources, PO Box 3720, Parramatta,
NSW 2124, Australia.

Reference Number:

DATA CURRENCY

Custodian Agency: CSIRO.
Custodian: Peter Dyce.
Data Status: Completed.
Date Commenced:
Date Completed:
Update Frequency
Future Proposals
Archive
Currency comments:
AVAILABILITY

Access: From CSIRO on request.
Output Product(s): database.
Charges:
Supplier: CSIRO .
Postal Address: PO Box 1666, Canberra, ACT 2602, Australia.
Phone: (02) 2465799
Fax: (02) 249 9970

KEYWORDS:

Bore Records, Liverpool Plains.

COMMENTS

LINEAGE/QUALITY

Primary Data
Collection Method(s)
Source Datasets
Positional Accuracy
Compilation Base
Compilation Scale:
Compilation Media
Attribute Accuracy
Logical Consistency
Data Quality Comments

Processing History:

Date 16/7/97
Author Peter Dyce
Process and Purpose: Imported in to Access from files supplied by Jenny Wood Senior Data Officer, Water.Data Services Unit
20th March 1996
Telephone (02) 895 7621
Fax (02) 895 7742

Bore Data Base Table Descriptions

Table: Geology - grid info

Properties

Date Created:	08/04/97 13:13:47	Def. Updatable:	True
Description:	geology codes and descriptions	Last Updated:	08/04/97 13:13:48
RecordCount:	30		

Columns

Name	Type	Size
geology	Text	50
code	Number (Long)	4
geology type	Text	50
Era	Text	50
name	Text	255

Table: LIVERPL1

Properties

Date Created:	26/03/96 16:34:26	Def. Updatable:	True
Last Updated:	26/03/96 16:36:02	RecordCount:	59555

Columns

Name	Type	Size
STATION	Text	8
SAMPNUM	Text	10
DATE	Date/Time	8
TIME	Number (Double)	8
VARIABLE	Number (Double)	8
VALUE	Number (Double)	8
QUALITY	Number (Double)	8

Table: LiverPl1_2

Properties

Date Created:	24/09/96 15:31:12	Def. Updatable:	True
Description:	Most up to date Bore Attribute Time Series Data	Last Updated:	18/02/97 11:08:57
OrderByOn:	False	RecordCount:	59555

Columns

Name	Type	Size
fldStation	Text	8
fldVar#3	Number (Long)	4
fldSample	Number Text	10
fldDate	Date/Time	8
fldTime	Number (Double)	8
fldValue	Number (Double)	8
fldQuality	Number (Double)	8
fldVariable	Number (Double)	8
fldVar#1	Number (Long)	4

Table: LIVERPLN

Properties

Date Created:	26/03/96 16:36:07	Def. Updatable:	True
Last Updated:	16/08/96 17:10:59	OrderByOn:	False
RecordCount:	9166		

Columns

Name	Type	Size
FldStation	Text	8
FldLatitude	Number (Double)	8
FldLongitude	Number (Double)	8
fldPresUse	Text	2

Table: NewCatchmentCodes

Properties

Date Created:	20/09/96 11:40:07	Def. Updatable:	True		
Description:	Bore description spatial attributes extracted from GIS			Last Updated:	20/09/96 11:44:49
OrderByOn:	True	RecordCount:	9165		

Columns

Name	Type	Size
fldStation	Text	255
fldBasinNo	Number (Long)	4

Table: tblAllstat

Properties

Date Created:	27/09/96 14:06:35	Def. Updatable:	True
Last Updated:	27/09/96 14:30:03	OrderByOn:	False
RecordCount:	9165		

Columns

Name	Type	Size
fldStation	Text	255

Table: tblAllStatValidLog

Properties

Date Created:	27/09/96 14:27:59	Def. Updatable:	True
Last Updated:	27/09/96 14:27:59	RecordCount:	9165

Columns

Name	Type	Size
fldStation	Text	255
Vaild	Number (Integer)	2

Table: tblAquifer

Properties

Date Created:	14/08/96 13:40:43	Def. Updatable:	True
Description:	Aquifer description for station	Filter:	((tblAquifer.fldStation="GB021085 "))
Last Updated:	27/08/96 15:03:27	OrderByOn:	True
RecordCount:	10621		

Columns

Name	Type	Size
fldStation	Text	8
fldDepthToTop	Number (Double)	8
fldDepthValid	Yes/No	1
fldThickness	Number (Double)	8
fldthickDesc	Text	4
fldAboveGround	Yes/No	1
fldSwlValue	Number (Double)	8
fldSwlValid	Yes/No	1
fldYeild	Number (Double)	8
fldYeildValid	Yes/No	1
fldYeildDesc	Text	4
FldSalinity	Text	2
fldType	Text	2
fldDateMod	Date/Time	8
fldTimeMod	Number (Double)	8
fldUserMod	Text	8

Table: tblBasinBedrockFinal

Properties

Date Created:	14/10/96 21:27:22	Def. Updatable:	True
Last Updated:	14/10/96 21:27:22	RecordCount:	1303

Columns

Name	Type	Size
fldStation	Text	255
fldStrataCode	Text	6
fldDepthTo	Number (Double)	8

Table: tblBasinBedrockInt

Properties

Date Created:	14/10/96 21:00:31	Def. Updatable:	True
Last Updated:	14/10/96 21:00:31	RecordCount:	3459

Columns

Name	Type	Size
fldStation	Text	255
MaxOffldDepthTo	Number (Double)	8

Table: tblBoreMast

Properties

Date Created:	14/08/96 15:48:32	Def. Updatable:	True
Description:	Bore station description original data 85"))	Filter:	((tblBoreMast.fldStation="GB0210
Last Updated:	10/04/97 11:50:42	OrderBy:	tblBoreMast.fldStation
OrderByOn:	True	RecordCount:	9104

Columns

Name	Type	Size
fldStation	Text	8
fldFinalDepth	Number (Double)	8
fdlTotalDepth	Number (Double)	8
fldMaxOfFinal&TotalDepth	Number (Double)	8
fldCompDate	Date/Time	8
fldComPlacc	Text	2
fldOwner	Text	2
fldMeasCode	Text	2
fldSalinity	Text	2
fldLogAvail	Text	2
fldContractor	Text	2
fldContstruct	Text	2
fldConsMeth	Text	2
fldConstStat	Text	2
fldPropUse1	Text	2
fldPropUse2	Text	2
fldPropUse3	Text	2
fldPropUse4	Text	2
fldPropUse5	Text	2
FldPresUse1	Text	2
FldPresUse2	Text	2
FldPresUse3	Text	2
FldPresUse4	Text	2
FldPresUse5	Text	2
FldDriller	Text	4
FldDateMod	Date/Time	8
fldTimeMod	Number (Double)	8
fldUserMod	Text	8

Table: tblBoresPeriodOfRecord

Properties

Date Created:	04/10/96 11:41:40	Def. Updatable:	True
Last Updated:	04/10/96 13:16:31	OrderByOn:	False
RecordCount:	266		

Columns

Name	Type	Size
fldStation	Text	255
CountOffldValue	Number (Long)	4
MaxOffldDate	Date/Time	8
MinOffldDate	Date/Time	8

Table: tblDepthToBedrock

Properties

Date Created:	14/10/96 21:49:28	Def. Updatable:	True
Description:	All bores with rock at the bottom depth ahd	Last Updated:	14/10/96 21:57:42
RecordCount:	1282		

Columns

Name	Type	Size
fldStation	Text	255
bedrockAhd	Number (Double)	8

Table: tblDwrBores

Properties

Date Created:	20/09/96 11:50:42	Def. Updatable:	True
Description:	Bore description attributes extracted from the GIS	Last Updated:	14/10/96 21:58:36
OrderByOn:	False	RecordCount:	4684

Columns

Name	Type	Size
fldStation	Text	255
fldLongitude	Number (Double)	8
fldLatitude	Number (Double)	8
fldElevation	Number (Double)	8
fldHillYesNo	Yes/No	1
fldGeolCode	Number (Long)	4
fldSlope	Number (Double)	8
fldCombinedCurvature	Number (Double)	8
fldProfileCurvature	Number (Double)	8
fldPlanCurvature	Number (Double)	8
fldAspect	Number (Double)	8
fldBasinNo	Number (Long)	4
fldBasinName	Text	255

Table: tblDwrBoresMk1

Properties

Date Created:	24/08/96 21:10:04	Def. Updatable:	True
Description:	Bore description spatial attributes extracted from GIS	Last Updated:	20/09/96 11:57:58
OrderByOn:	True	RecordCount:	4684

Columns

Name	Type	Size
fldStation	Text	255
fldLongitude	Number (Double)	8
fldLatitude	Number (Double)	8
fldElevation	Number (Double)	8
fldHillYesNo	Yes/No	1
fldGeolCode	Number (Long)	4
fldSlope	Number (Double)	8
fldCombinedCurvature	Number (Double)	8
fldProfileCurvature	Number (Double)	8
fldPlanCurvature	Number (Double)	8
fldAspect	Number (Double)	8
fldBasinNo	Number (Long)	4
fldBasinName	Text	255

Table: tblGeologyGridInfo

Properties

Date Created:	16/05/96 11:07:10	Def. Updatable:	True
Description:	geology codes and descriptions	Last Updated:	14/02/97 14:03:10
RecordCount:	30		

Columns

Name	Type	Size
geology	Text	50
code	Number (Long)	4
geology type	Text	50
Era	Text	50
name	Text	255

Table: tblGoranSeries

Properties

Date Created:	30/10/96 16:47:34	Def. Updatable:	True
Last Updated:	30/10/96 16:47:34	RecordCount:	8

Columns

Name	Type	Size
fldStation	Text	255
fldBasinNo	Number (Long)	4
LastOffldDate	Date/Time	8

Table: tblLithDrill

Properties

Date Created:	14/08/96 16:38:45	Def. Updatable:	True
Description:	Description of bore (drillers log)	Filter:	((tblLithDrill.fldStation="GB037974"))
Last Updated:	31/10/96 9:51:48	OrderByOn:	False
RecordCount:	45857		

Columns

Name	Type	Size
fldStation	Text	8
fldDepthFrom	Number (Double)	8
fldDepthTo	Number (Double)	8
fldStrataCode	Text	6
fldStrataDesc	Text	120
fldRetention	Text	2
fldSource	Text	2
fldBdver4	Yes/No	1
fldDataMod	Date/Time	8
fldTimeMod	Number (Double)	8
fldUserMod	Text	8

Table: tblLivDwrRwl

Properties

Date Created:	22/08/96 13:41:00	Def. Updatable:	True
Description:	Swl Time series data for selected bores	Last Updated:	04/03/97 15:54:39
OrderByOn:	True	RecordCount:	53254

Columns

Name	Type	Size
fldStation	Text	255
fldHoleNo	Number (Long)	4
fldPipeNo	Number (Long)	4
fldValue	Number (Double)	8
fldDate	Date/Time	8
fldTime	Number (Long)	4
fldVariable	Number (Long)	4
fldReducedWl	Number (Long)	4
fldQuality	Number (Long)	4
fldStatus	Text	255
fldSource	Text	255
fldDatemod	Text	255
fldTimemod	Number (Long)	4
fldUsermod	Text	255

Table: tblLpReBore

Properties

Date Created:	12/02/97 14:08:52	Def. Updatable:	True
Description:	Data collected by D Williamson late 1996. This a subset of the data we already had.	Last Updated:	10/04/97 11:50:54
OrderByOn:	False	RecordCount:	654

Columns

Name	Type	Size
ID	Number (Long)	4
fldStation	Text	50
fred	Text	50
fldPipeNo	Text	255
fldMap	Text	255
fldDate	Date/Time	8
fldSWL	Number (Double)	8
fldEC_uS/cm	Number (Double)	8
fldpH	Number (Double)	8
flfTemperature	Number (Double)	8
fldPumping	Text	255
fldComment	Text	255

Table: tblLpRepBores2

Properties

Date Created:	12/02/97 17:14:44	Def. Updatable:	True
Description:	Data collected by D Williamson late 1996. This a subset of the data we already had.	Filter:	((tblLpRepBores2.fldStation="GB021092"))
Last Updated:	10/04/97 11:50:57	OrderBy:	tblLpRepBores2.fldDate DESC
OrderByOn:	True	RecordCount:	15474

Columns

Name	Type	Size
ID	Number (Long)	4
fldStation	Text	255
fldPipeNo	Number (Double)	8
fldDate	Date/Time	8
fldSwl	Number (Double)	8

Table: tblMaxDateLivDwrRwl

Properties

Date Created:	13/02/97 11:41:14	Def. Updatable:	True
Last Updated:	13/02/97 11:41:14	RecordCount:	651

Columns

Name	Type	Size
fldStation	Text	255
fldPipeNo	Number (Long)	4
MaxOffldDate	Date/Time	8

Table: tblMaxDateLpRepBores2

Properties

Date Created:	13/02/97 10:52:05	Def. Updatable:	True
Description:	Data collected by D Williamson late 1996. This a subset of the data we already had.This table used to check dates	Last Updated:	13/02/97 11:49:48
RecordCount:	494		

Columns

Name	Type	Size
fldStation	Text	255
fldPipeNo	Number (Double)	8
MaxOffldDate	Date/Time	8

Table: tblMinSwlAhdHills

Properties

Date Created:	27/08/96 15:35:51	Def. Updatable:	True
Last Updated:	27/08/96 15:35:51	RecordCount:	474

Columns

Name	Type	Size
fldStation	Text	255
fldElevation	Number (Double)	8
MinOfSwlAhd	Number (Double)	8
fldSwlValue	Number (Double)	8
fdlTotalDepth	Number (Double)	8
fldSlope	Number (Double)	8
fldGeolCode	Number (Long)	4
fldBasinNo	Number (Long)	4
fldCombinedCurvature	Number (Double)	8
fldProfileCurvature	Number (Double)	8
fldPlanCurvature	Number (Double)	8

Table: tblSite

Properties

Date Created:	20/08/96 9:55:45	Def. Updatable:	True
Description:	Bore site description Original data from dlwc_nsw	Last Updated:	27/09/96 14:30:10
OrderByOn:	True	RecordCount:	9165

Columns

Name	Type	Size
fldStation	Text	8
fldStationName	Text	55
fldShortName	Text	20
fldMapName	Text	17
fldZone	Number (Double)	8
fldEasting	Number (Double)	8
fldNorthing	Number (Double)	8
fldDecimalLat	Number (Double)	8
fldDecimalLon	Number (Double)	8
fldStationElevation	Number (Double)	8
fldElevationAcc	Text	2
fldStnType	Text	3
fldRegion	Text	8
fldDateMod	Date/Time	8
fldTimeMod	Number (Double)	8
FldUserMod	Text	8

Table: tblSiteZone55

Properties

Date Created:	20/08/96 11:44:41	Def. Updatable:	True
Description:	Bores in zone 55	Last Updated:	27/08/96 15:32:38
RecordCount:	1677		

Columns

Name	Type	Size
fldStation	Text	8
fldEasting	Number (Double)	8
fldNorthing	Number (Double)	8

Table: tblSiteZone56

Properties

Date Created:	20/08/96 11:44:07	Def. Updatable:	True
Description:	Bores in zone 56	Last Updated:	27/08/96 15:32:50
RecordCount:	7489		

Columns

Name	Type	Size
fldStation	Text	8
fldEasting	Number (Double)	8
fldNorthing	Number (Double)	8

Table: tblStationLatLon

Properties

Date Created:	20/08/96 9:12:24	Def. Updatable:	True
Description:	Decimal LatLon used to locate bores in GIS	Last Updated:	27/08/96 15:07:14
OrderByOn:	False	RecordCount:	5824

Columns

Name	Type	Size
fldStation	Text	8
FldLatitude	Number (Double)	8
FldLongitude	Number (Double)	8

Table: tblValidLogs

Properties

Date Created:	27/09/96 13:13:34	Def. Updatable:	True
Last Updated:	27/09/96 14:23:57	RecordCount:	3459

Columns

Name	Type	Size
fldStation	Text	255

Table: tlbLivRWL2

Properties

Date Created:	04/03/97 15:55:31	Def. Updatable:	True
Description:	Swl Time series data with reduced wl calculated from dem elevation in tblDwrBores	Last Updated:	04/03/97 15:59:42
OrderByOn:	False	RecordCount:	36596

Columns

Name	Type	Size
fldStation	Text	255
fldHoleNo	Number (Long)	4
fldPipeNo	Number (Long)	4
fldValue	Number (Double)	8
fldDate	Date/Time	8
fldTime	Number (Long)	4
fldVariable	Number (Long)	4
fldReducedWl	Number (Long)	4
fldUsermod	Text	255
fldStatus	Text	255
fldSource	Text	255
fldDatemod	Text	255
fldTimemod	Number (Long)	4

Table: WQVAR1

Properties

Date Created:	17/04/96 10:47:44	Def. Updatable:	True
Last Updated:	26/09/96 14:37:47	OrderByOn:	False
RecordCount:	1835		

Columns

Name	Type	Size
VARIABLE	Number (Integer)	2
NAME	Text	255
VARQNUM	Text	255
UNITCODE	Text	255
UNITS	Text	255
SHORTNAME	Text	255
COMMENT	Text	255
MAXIMUM	Number (Double)	8
MINIMUM	Number (Double)	8
ACCURACY	Number (Double)	8
DATEMOD	Date/Time	8
TIMEMOD	Number (Double)	8
USERMOD	Text	255

Appendix 2: GIS Layers used for the Aquifer interpretation.

GIS DATA DESCRIPTIONS

IDENTIFICATION

Title: dem2
Full Name: GEODATA 9 Second DEM

Description: The national digital elevation model with nine seconds in latitude and longitude

Purpose: To provide a regional scale digital elevation model for use in groundwater analysis as applicable to the purpose(s) of the Liverpool Plains project.

Reference:
Owner Organisation: AUSLIG
Owner Branch
Owner Project
Other Organisations
Authors/collators:,
Copy? No this produced is subject to licence agreement.
Identification Comments

SPATIAL IDENTITY of SOURCE grid dem2.

Spatial Feature(s): Arcs, polygons. nodes, annotation (as anno.igds) and tics.
Projection Type: Geographic, with spheriod = Clarke1866.
Projection File:
NOTE
This data was reprojected. Pdyce 22/8/96
projection file used was
input
Projection GEOGRAPHIC
Units DD
Spheroid CLARKE1866
Parameters
output
projection ALBERS
units meters
spheroid WGS84
parameters
-30 15 0.000
-31 45 0.000
150 15 0.00
0 0 0.000
0.00000
3500000.00000
end

Coordinate Units: Decimal Degrees.
Grid Size
Cell Size 250m
Grid Type real
Spatial Id comments

DATA ITEMS

Grid Attributes (VAT)
Floating point grid - no attributes
Annotation Attributes:
Data relates
Data Comments

SPATIAL COVERAGE

General Area: Northeast NSW, Liverpool Plains catchment (1.3 million hectares)
Onshore/Offshore: Onshore.
Spatial Description: Hydrogeology Map, Liverpool Plains Catchment 1:250 000
Future Spatial Coverage
Spatial Cov Comments

TEMPORAL COVERAGE

Time Variant:
Time Span
Predictive: No.
Temporal Cov Comments

DATASET INFORMATION

Data Form: raster grid
Working Media: Magnetic disc.
Digital Data? Complete.
Software: Intergraph Microstation, Arc/Info.
Hardware: UNIX/SUNOS using Xterminal Tektronix.
Available formats: arc info grid.
This Format: Arc/Info.
Size: 1.69 megabytes.
Dataset Comments

HARD COPY

Available: .
Paper Size:
Scale: 250 000
Location: AUSLIG,Data Sales PO BOX2 Belconnen ACT .
Reference Number:

DATA CURRENCY

Custodian Agency: AGSO.
Custodian: Robyn Johnston, EGG.
Data Status: Completed.
Date Commenced: 21/6/95
Date Completed: 21/11/95
Update Frequency
Future Proposals
Archive
Currency comments:

AVAILABILITY

Access: From AUSLIG under license.
Output Product(s): .
Charges:

Supplier: AUSLIG,Data
Postal Address: . Sales PO BOX2 Belconnen ACT2616, Australia
Phone: (02) 249 9304
Fax: (02) 249 9970

KEYWORDS:

DEM, Liverpool Plains.

COMMENTS:

LINEAGE/QUALITY

Primary Data
Collection Method(s)
Source Datasets
Positional Accuracy
Compilation Base
Compilation Scale: 1:250 000
Compilation Media
Attribute Accuracy
Logical Consistency
Data Quality Comments
Processing History:

Date
Author
Process and Purpose:

GIS DATA DESCRIPTIONS

IDENTIFICATION

Title: geol2_alb
Full Name: Geology of the Liverpool Plains, in a Albers projection CM 150.15 deg

Description: Mapping of the hydrogeology for the Liverpool Plains Catchment 1:250 000 mapsheet. This is an Arc/Info coverage in DOUBLE coordinate precision. The coverage has been edited using the functionality of ArcEdit.

Purpose: To provide and store information about the geology for use in further analysis as applicable to the purpose(s) of the Liverpool Plains project.

Reference:
Owner Organisation: State/NSWDWR New South Wales Department of Water Resources.
Owner Branch
Owner Project
Other Organisations
Authors/collators: Andrea K. Broughton,
Copy? Yes.
Identification Comments

NOTE
This is the geol2_ll coverage reprojected. Pdyce 22/8/96
projection file used was
input
Projection GEOGRAPHIC
Units DD
Spheroid CLARKE1866
Parameters
output
projection ALBERS
units meters
spheroid WGS84
parameters
-30 15 0.000
-31 45 0.000
150 15 0.00
0 0 0.000
0.00000
3500000.00000
end

SPATIAL IDENTITY of SOURCE coverage geol2_ll.

Spatial Feature(s): Arcs, polygons. nodes, annotation (as anno.igds) and tics.
Projection Type: Geographic, with spheroid = Clarke1866.
Projection File: /d/agso/u/lppa/prj/utm56_ll.prj
Coordinate Units: Decimal Degrees.
Grid Size
Cell Size
Grid Type
Spatial Id comments

DATA ITEMS

Point Attributes (PAT)

Node Attributes (NAT)
Arc Attributes (AAT)

Polygon Attributes (PAT)

Item Name	Definition (width output type)	Description
Area	8 18 F 5 dec. places	
Perimeter	8 18 F 5 dec. places	
Geol2_ll#	4 5 B	
Geol2_ll-id	4 5 B	
Code	12 12 C	Qn = 'Narrabri Formation' Alluvium and colluvium
		Qg* = 'Gunnedah Formation' Alluvium and colluvium
		Tv = Outlier basalt, dolerite, teschenite and trachyte, plugs and sills
		Tb = LIVERPOOL RANGE BEDS Alkali olivine basalt, dolerite, polymictic conglomerate, quartzose sandstone, shale and bole.
		Jp = PILLIGA SANDSTONE Quartzose and quartz lithic sandstone, siltstone.
		Jpu = PURLQWAUGH BEDS Silty sandstone, mudstone, conglomerate.
		Jg = GARRAWILLA VOLCANIC COMPLEX Alkali basalt, basanite, hawaiite, mugearite, soda trachyte flows; and pyroclastic units. Alkali dolerite and microsyenodolerite sills.
		R-Jb = BALLIMORE BEDS Conglomerate, quartz sandstone, shale.
		Rn = NARRABEEN GROUP Quartzose and quartz lithic snadstone, silty sandstone, mudstone-Napperby Beds (Rns). Polymictic conglomerate, lithic and quartz lithic sandstone, mudstone - Digby Conglomerate Rnd).
		Pu = Undifferentiated sandstone, shale, conglomerate, chert, coal, limestone. (Dominantly Black Jack Formation).
		Pug = Undifferentiated hornblende-biotite adamellite and monzonite.
		Ps = Serpentine, mafic and ultramafic intrusives.
		Plg = GUNNIBLE FORMATION. Shale, lithic sandstone and coal.
		Plw = WERRIE BASALT. Amygdaloidal basaltic lava, basaltic tuff, tuffaceous sandstone.
		Pla = WARRIGUNDI VOLCANIC COMPLEX Andesite flows, augiteandesite dykes, dacite dykes and flows,

dioritic intrusions, epiclastic volcanic breccia and pyroclastic breccia.

P-Ct = TEMI FORMATION.
Polymictic conglomerate, lithic sandstone, shale, coal.

P-Cg = BOGGABRI/GUNNEDAH VOLCANICS.
Rhyolite, rhyolite tuff and rhyodacite.

Cmc = CURRABUBULA FORMATION
Polymictic conglomerate, tillite, lithic sandstone, varves, tuffaceous lithic sandstone, siltstone, rhyolitic to andesite pyroclastic and volcanics.

Cme = COEPOLLY CONGLOMERATE
Polymictic conglomerate.

Cmm = MERLEWOOD FORMATION
Lithic sandstone, polymictic conglomerate, siltstone, felsic to intermediate pyroclastic. Pyroxene and hornblende andesites.

Cln = NAMOI FORMATION
Massive mudstones, sandstone and orthoconglomerate lenses.

Cll = LUTTON FORMATION
Siltstone, sandstone, mudstone, andesite, lithic sandstone.

Grid Attributes (VAT)
Annotation Attributes: anno.igds
Data relates
Data Comments

SPATIAL COVERAGE

General Area: Northeast NSW, Liverpool Plains catchment (1.3 million hectares)
Onshore/Offshore: Onshore.
Spatial Description: Hydrogeology Map, Liverpool Plains Catchment 1:250 000
Future Spatial Coverage
Spatial Cov Comments

TEMPORAL COVERAGE

Time Variant: Yes. 1995.
Time Span
Predictive: No.
Temporal Cov Comments

DATASET INFORMATION

Data Form: GIS POLY coverage.
Working Media: Magnetic disc.
Digital Data? Complete.
Software: Intergraph Microstation, Arc/Info.
Hardware: UNIX/SUNOS using Xterminal Tektronix.
Available formats: Intergraph Microstation design (.dgn) file (saved to tape: SONY 112m, D8).
This Format: Arc/Info.
Size: 1.237442 megabytes.
Dataset Comments

HARD COPY

Available: Yes. Published Map.
Paper Size: A0
Scale: 250 000
Location: Department of Water Resources, PO Box 3720, Parramatta,
NSW 2124, Australia.

Reference Number:

DATA CURRENCY

Custodian Agency: AGSO.
Custodian: Robyn Johnston, EGG.
Data Status: Completed.
Date Commenced: 21/6/95
Date Completed: 21/11/95
Update Frequency
Future Proposals
Archive
Currency comments: Original unedited digital database received from K.Day, DWR, NSW. June, 1995.

AVAILABILITY

Access: From AGSO on request.
Output Product(s): Individual coverages.
Charges:
Supplier: Australian Geological Survey Organisation.
Postal Address: PO Box 378, Canberra, ACT 2602, Australia.
Phone: (02) 249 9304
Fax: (02) 249 9970

KEYWORDS:

Geology, Liverpool Plains.

COMMENTS:
LINEAGE/QUALITY
Primary Data
Collection Method(s)
Source Datasets
Positional Accuracy
Compilation Base
Compilation Scale: 1:250 000
Compilation Media
Attribute Accuracy
Logical Consistency
Data Quality Comments
Processing History:

Date 21/11/95
Author LWoodcock
Process and Purpose: Imported digital data into Arc/Info from Intergraph
Microstation design file using IGDS conversion.
Compilation and editing using GIS tools within the functionality of ArcEdit.
Topology building and attribute population.
Projection to real world coordinates - Metres, Latitude/longitude, Albers - as required.
Printed hardcopy product as required for client, coordinator or for educational display.

DLWC_NSW.MDB
.doc created 16/7/97

DATA DESCRIPTIONS

IDENTIFICATION

Title: DLWC_NSW_ed8.MDB
Full Name: Liverpool Plains Bore Data.

Description: This database contains the tables described at the
end of the section.

Purpose: For use in bore investigation for the Liverpool Plains.

Reference:
Owner Organisation: State/NSWDWR New South Wales Department of Water Resources.
Owner Branch
Owner Project
Other Organisations
Authors/collators: Peter Dyce,
Copy? Yes.
Identification Comments

SPATIAL IDENTITY

Spatial Feature(s): Station locations in latitude and longitude
Coordinate Units: decimal degrees.
DATA ITEMS

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC	ALTERNATE NAME	INDEXED?
1	AREA	8	18	F	5		
9	PERIMETER	8	18	F	5		
17	DWRBORES_ALB4#	4	5	B-			
21	DWRBORES_ALB4-ID	4	5	B-			
25	DWRBORES_ALB2#	4	5	B-			
29	DWRBORES_ALB2-ID	4	5	B-			
33	STATION	12	12	C-			
45	X-COORD	4	12	F	3		
49	Y-COORD	4	12	F	3		
53	DEM2	4	12	F	3	ELEVATION_250M	
57	HILL1PLN0	4	10	B		hills/yes/no	
61	GEOL2_ALB-ID	4	5	B		geology id	
65	VALUE	4	10				
69	GEOL2_CODE	12	12	C		geology code	
81	NAR_SWL	4	12	F	3-	narrabri_swl	
85	GUN_SWL	4	12	F	2-	Gunnedah_swl	
89	GRID-CODE	4	8	B	--	basin_no	
93	BASIN_NAME	20	20	C	--		
113	VALIDLOG	4	5	B	--		
117	NAR_DTW	8	8	F	1-		
125	GUN_DTW	8	8	F	1-		

SPATIAL COVERAGE

General Area: Northeast NSW, Liverpool Plains catchment (1.3 million hectares)
Onshore/Offshore: Onshore.

Future Spatial Coverage
Spatial Cov Comments

TEMPORAL COVERAGE

Time Variant: yes 16/797.
Time Span
Predictive: No.
Temporal Cov Comments

DATASET INFORMATION

Data Form:
Working Media:
Digital Data? .
Software: arcinfo
Hardware: sun unix
Available formats:
This Format: arcinfo coverage
Size: 2.7 megabytes.
Dataset Comments

HARD COPY

Available: no
Paper Size:
Scale:
Location: CSIRO Land and Water, Canberra,
ACT 2601, Australia.

Reference Number:

DATA CURRENCY

Custodian Agency: CSIRO.
Custodian: Peter Dyce.
Data Status: Completed.
Date Commenced:
Date Completed:
Update Frequency
Future Proposals
Archive
Currency comments:
AVAILABILITY

Access: From CSIRO on request.
Output Product(s): database.
Charges:
Supplier: CSIRO .
Postal Address: PO Box 1666, Canberra, ACT 2602, Australia.
Phone: (02) 2465799
Fax: (02) 249 9970

KEYWORDS:

Bore Records, Liverpool Plains.

COMMENTS

LINEAGE/QUALITY

Primary Data
Collection Method(s)
Source Datasets
Positional Accuracy
Compilation Base
Compilation Scale:
Compilation Media
Attribute Accuracy

Logical Consistency
Data Quality Comments
Processing History:

Date 16/7/97
Author Peter Dyce
Process and Purpose: Imported in to Access from files supplied by Jenny Wood Senior Data Officer, Water.Data Services Unit
20th March 1996
Telephone (02) 895 7621
Fax (02) 895 7742

Appendix 3: Cross section Descriptions

Table 1 Yarramanbah Creek

Transect †	Width (m)	Av. Depth (m)	Cross-sectional Area (m^3)	Slope watertable
Y1	2000	26.5	53000	0.001
Y2	1850	22	40700	0.0004
Y3	2200	20	44000	0.0016
Y4	5700	19	108300	0.0028
Y5	5800	15	87000	0.0024

Table 2 Pump Station Creek

Transect †	Width (m)	Av. Depth (m)	Cross-sectional Area (m^3)	Slope watertable
P1	1500	20	30000	.0001
P2	1700	10	17000	.0024
P3	1850	22	40700	.0008
P4	1900	20	38000	.0016
P5	7000	12	84000	.0004
P6	4560	10	45600	.0064

† See for location of Transects see maps Appendix 4

Table 3 Big Jacks Creek

Transect †	Width (m)	Av. Depth (m)	Cross-sectional Area (m^3)	Slope watertable
B1	2450	40	98000	0.001
B2	2560	30	76800	0.0008
B3	3750	22	82500	0.0002
B4	5700	20	114000	0.0004
B5	7000	12	84000	0.0018
B6	5000	10	50000	0.0028

Table 4 Upper Mooki Creek

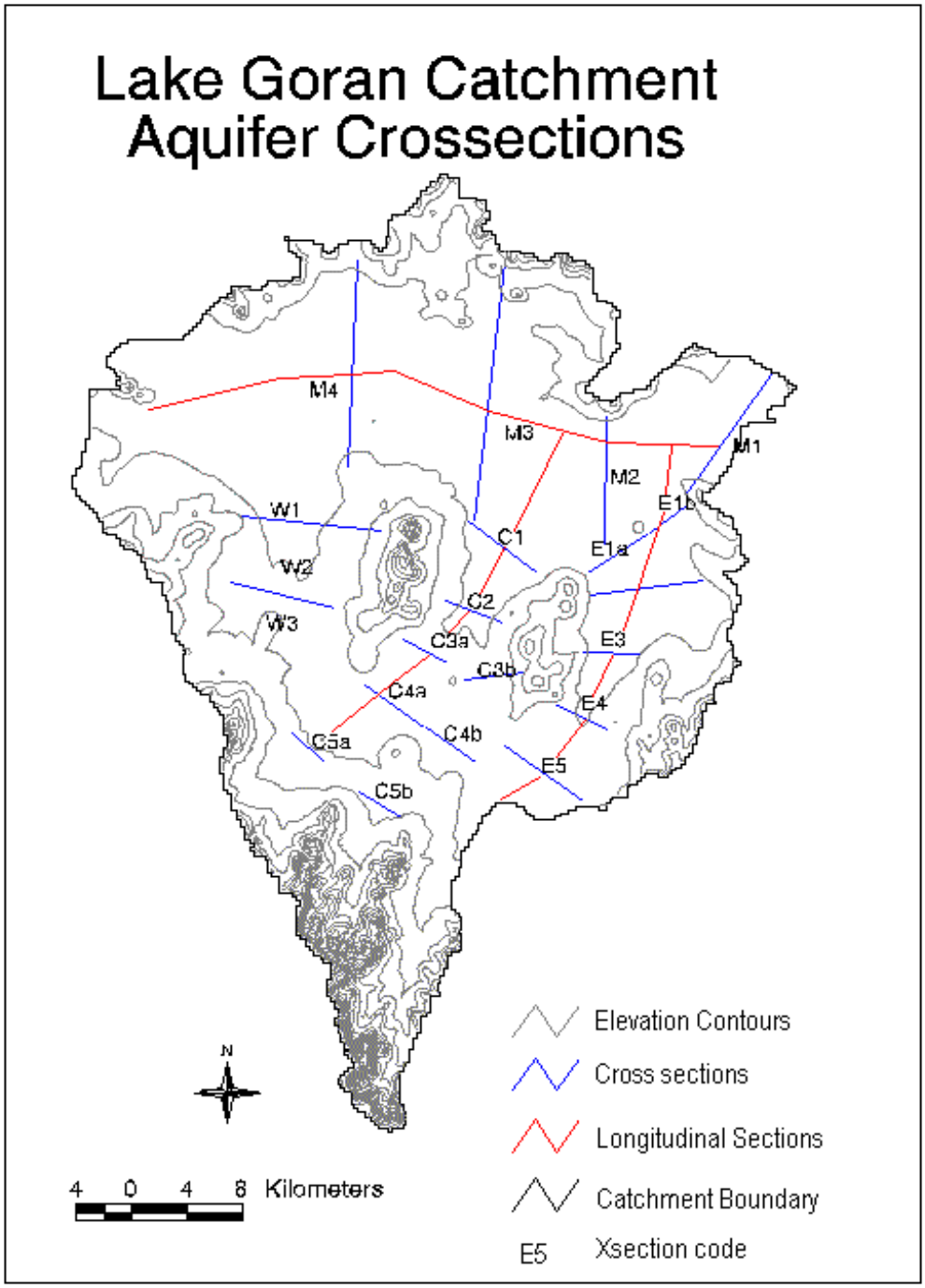
Transect †	Width (m)	Av. Depth (m)	Cross-sectional Area (m^3)	Slope watertable
B1	3500	40	140000	0.001
B2	2550	22	56100	0.001
B3	6400	15	96000	0.002
B4	6500	8	52000	0.002
B5	4975	12	59700	0.004
B6	3000	10	30000	0.01

† See for location of Transects see maps Appendix 4

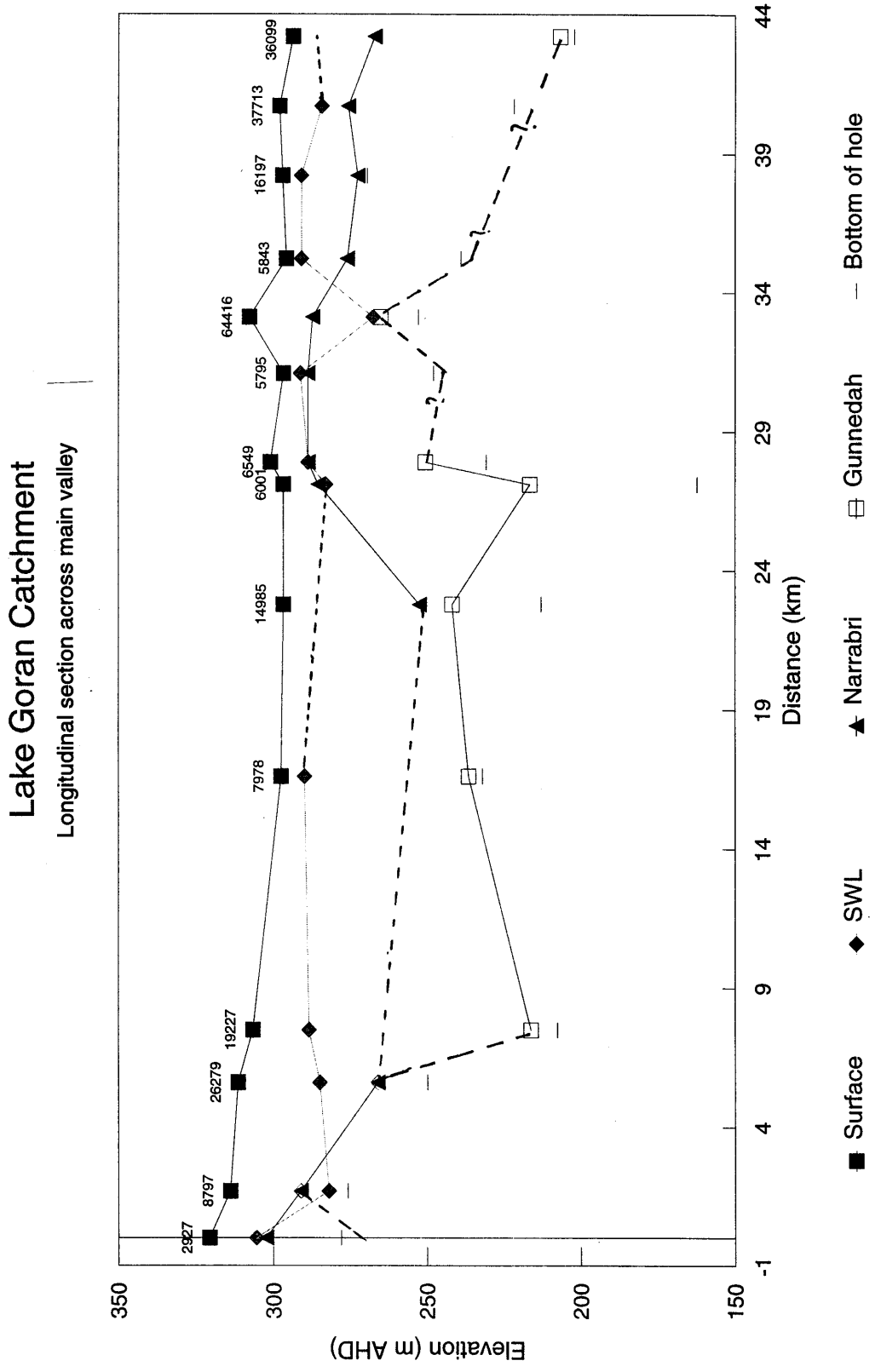
Table 4 Lake Goran

Transect †	Width (m)	Av. Depth (m)	Cross-sectional Area (m^3)	Slope watertable
M1	7000	30	210000	0.001
M2	6000	17.5	105000	0.00075
M3	4900	18	88200	0.00
M4	1100	42	462000	0.00
E1	4000	15	60000	0.001
E1a	2000	5	10000	0.001
E2	8000	4.5	36000	0.0012
E3	4100	22	90200	0.0009
E4	3800	24	91200	0.003
E5	6800	11	74800	0.004
C1	6000	12.5	75000	0.001
C2	4400	3.2	14080	0.003
C3a	3755	9.4	35297	0.004
C3b	2200	10	22000	0.003
C4a	5440	10	54400	0.002
C4b	4500	10	45000	0.002
C5a	3300	10	33000	0.002
C5b	3796	5	18980	0.008
W1	7000	27.5	192500	0.001
W2	5500	13	71500	0.003
W3	3000	10	30000	0.003

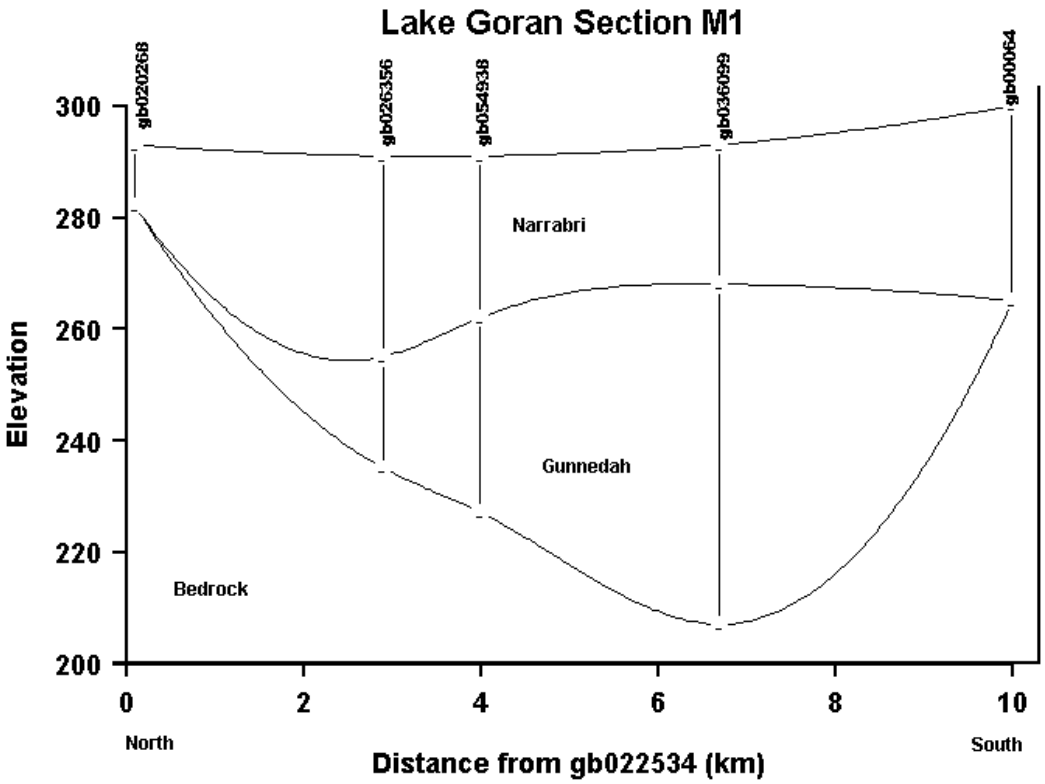
Appendix 4 : Locations of the cross sections mapped by sub catchment.

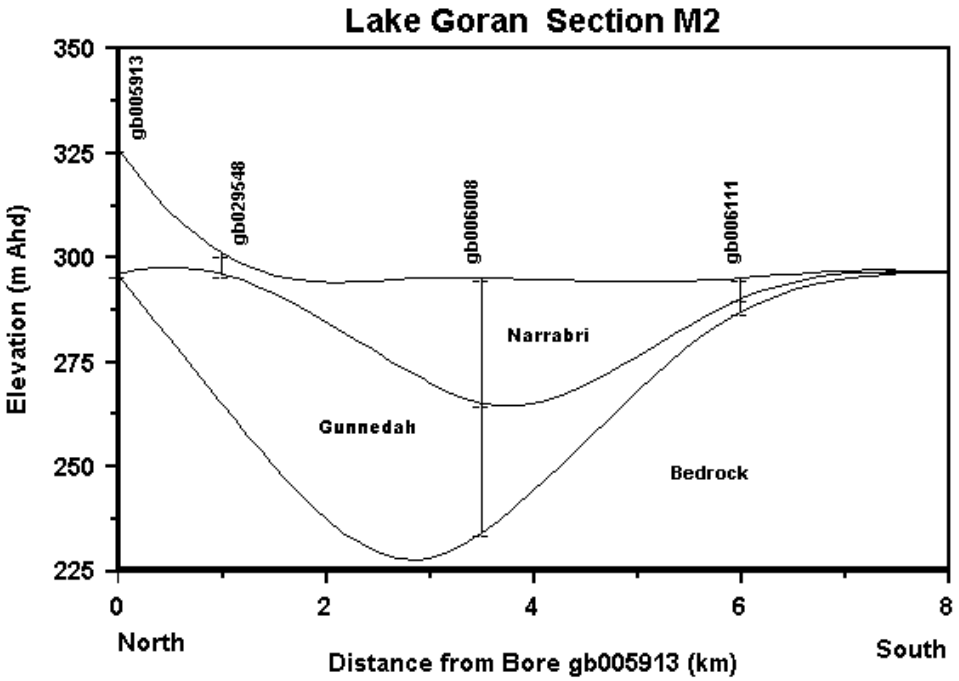


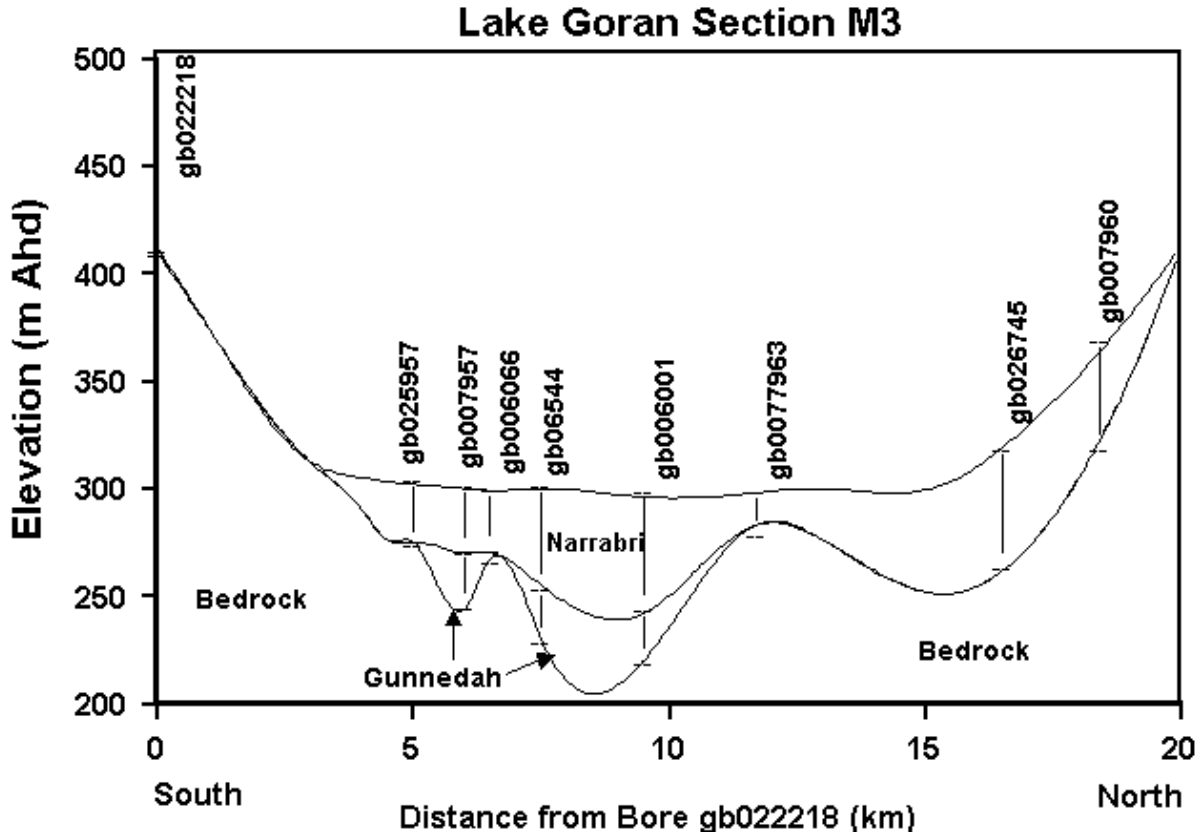
Cross sections of Lake Goran sub catchment

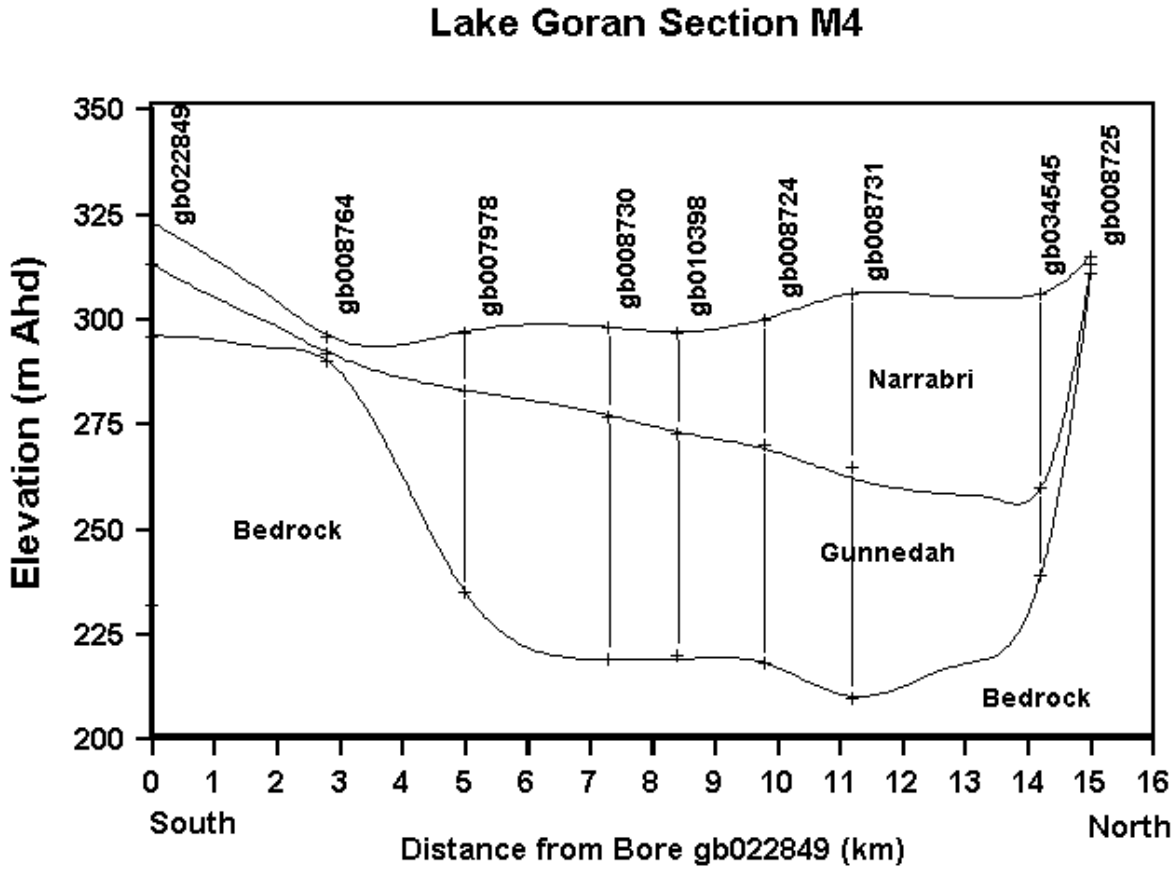


Main Valley

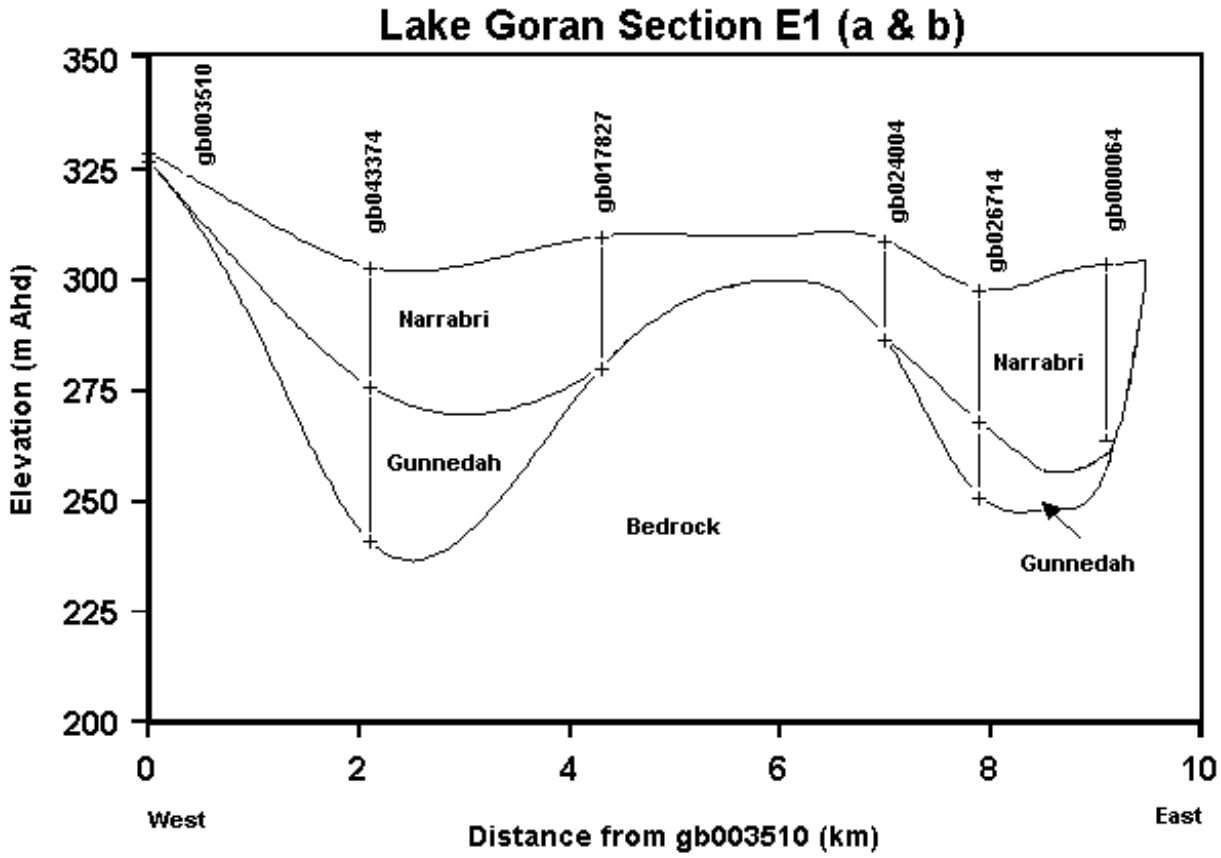

Lake Goran Section M1
gb020268
gb026356
gb054938
gb036099
gb000064
300
280
260
240
220
200
Elevation
Narrabri
Gunnedah
Bedrock
0
2
4
6
8
10
North
South
Distance from gb022534 (km)

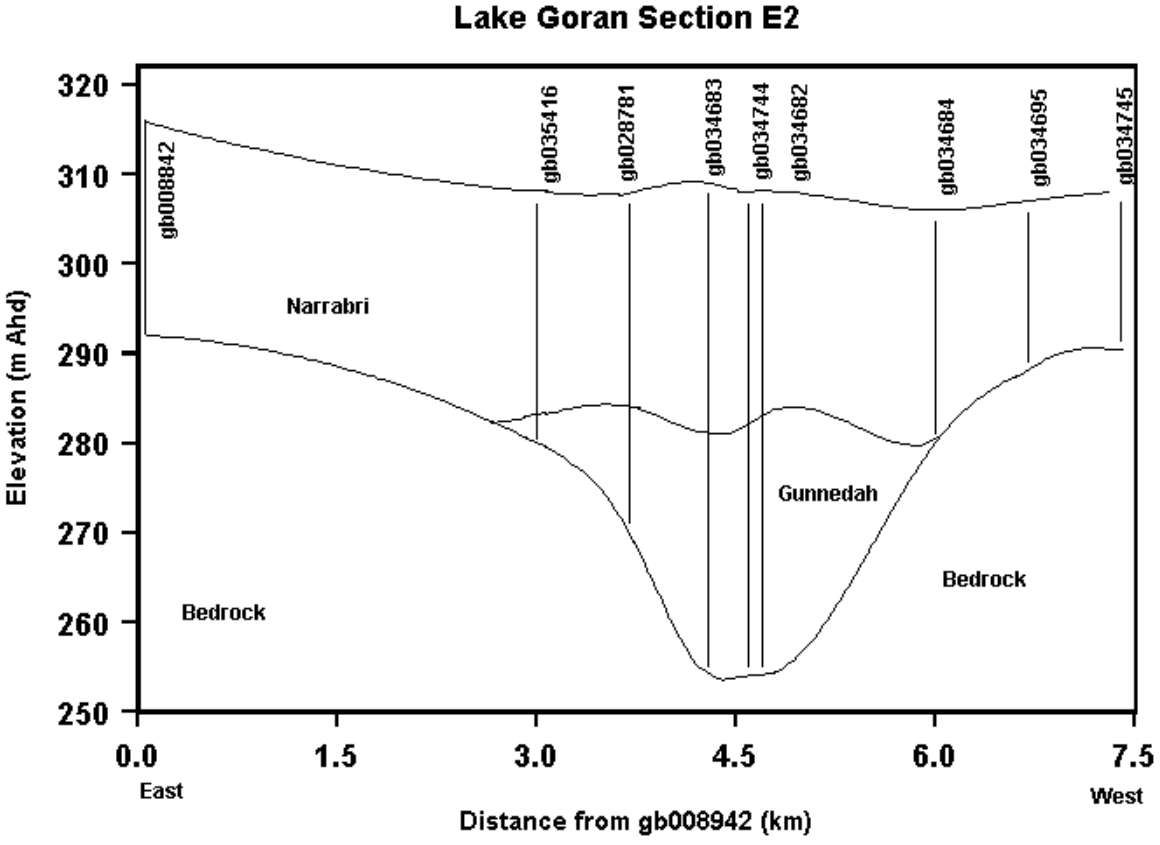

Lake Goran Section M2
gb005913
gb029548
gb006008
gb006111
350
325
300
275
250
225
Elevation (m Ahd)
Narrabri
Gunnedah
Bedrock
0
2
4
6
8
North
South
Distance from Bore gb005913 (km)


Lake Goran Section M3
Elevation (m Ahd)
500
450
400
350
300
250
200
gb022218
gb025957
gb007957
gb006066
gb06544
gb006001
gb0077963
gb026745
gb007960
Narrabri
Bedrock
Gunnedah
Bedrock
0
5
10
15
20
South
North
Distance from Bore gb022218 (km)


Lake Goran Section M4
Elevation (m Ahd)
350
325
300
275
250
225
200
gb022849
gb008764
gb007978
gb008730
gb010398
gb008724
gb008731
gb034545
gb008725
Narrabri
Bedrock
Gunnedah
Bedrock
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
South
North
Distance from Bore gb022849 (km)

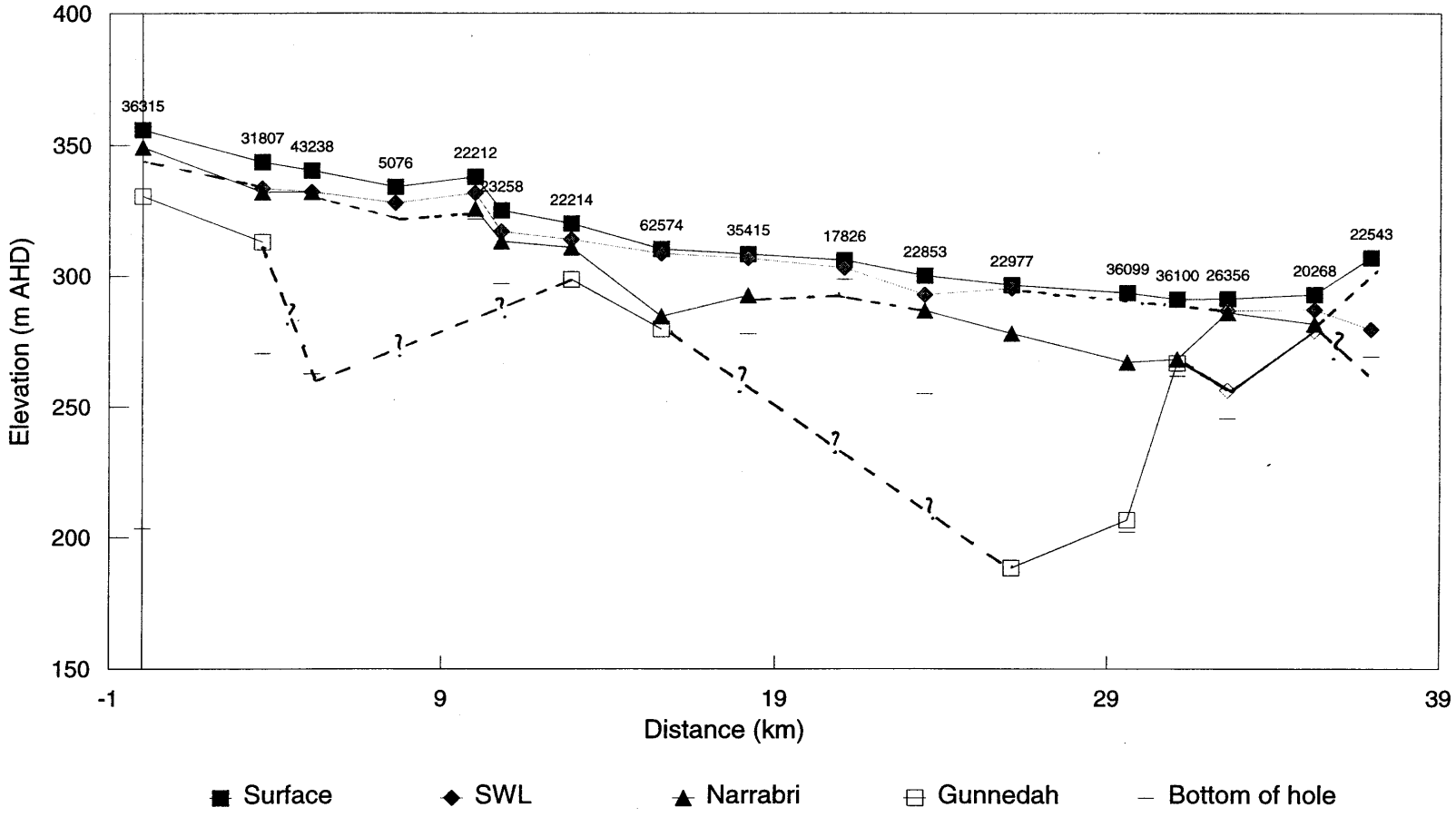
East Valley

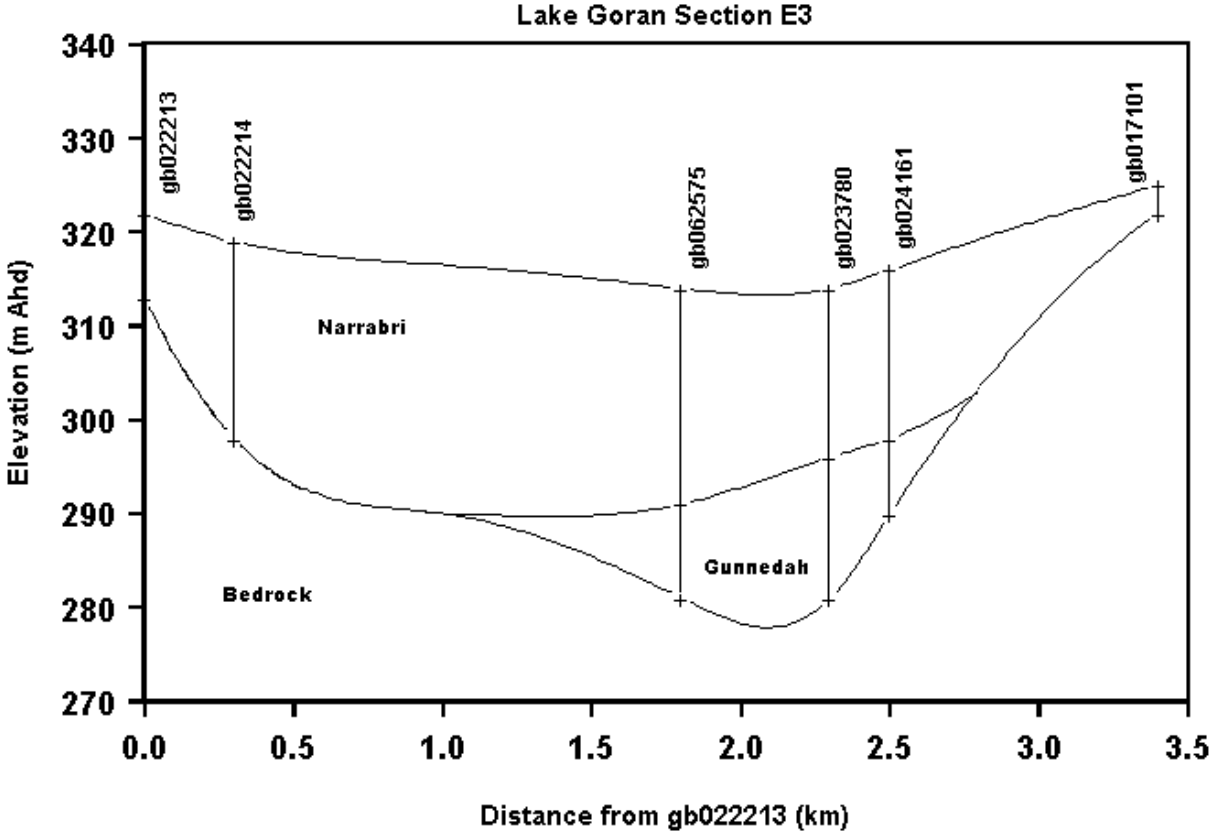

Lake Goran Section E1 (a & b)
Elevation (m Ahd)
350
325
300
275
250
225
200
gb003510
gb043374
gb017827
gb024004
gb026714
gb000064
Narrabri
Gunnedah
Bedrock
Narrabri
Gunnedah
0
2
4
6
8
10
West
East
Distance from gb003510 (km)

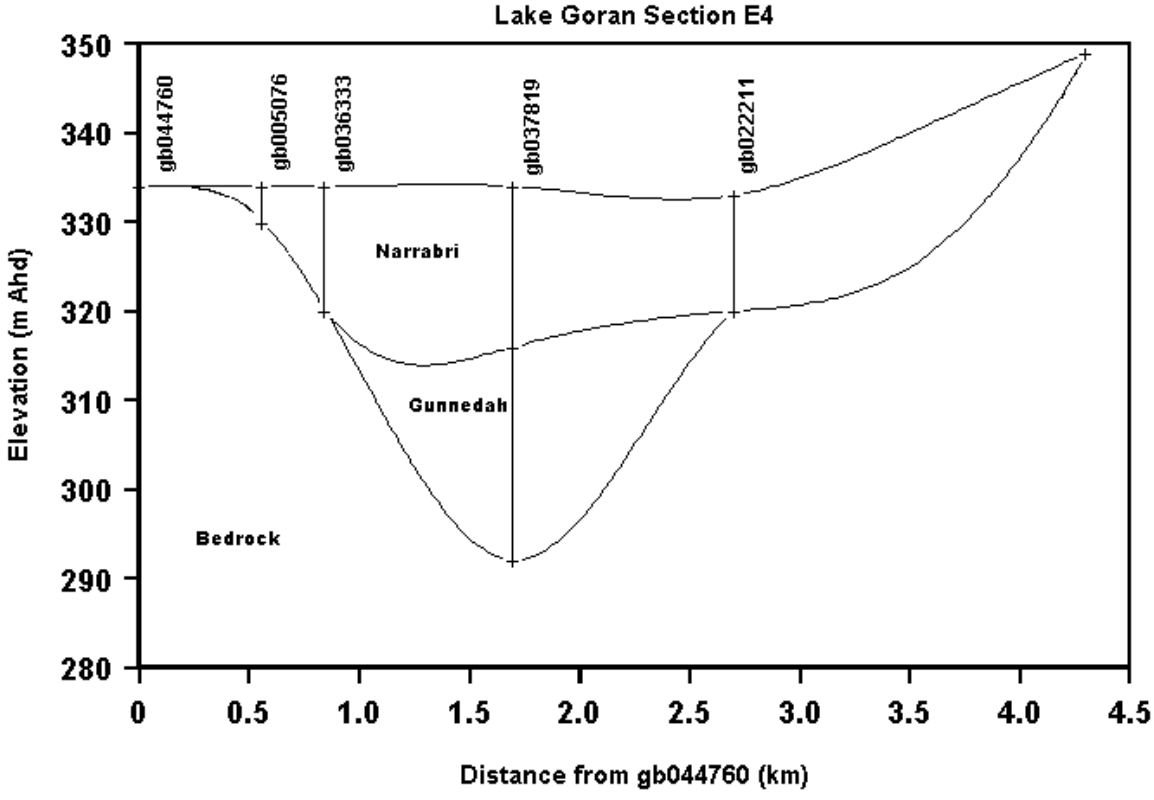

Lake Goran Section E2
Elevation (m Ahd)
320
310
300
290
280
270
260
250
gb008842
gb035416
gb028781
gb034683
gb034744
gb034682
gb034684
gb034695
gb034745
Narrabri
Gunnedah
Bedrock
Bedrock
0.0
1.5
3.0
4.5
6.0
7.5
East
West
Distance from gb008942 (km)

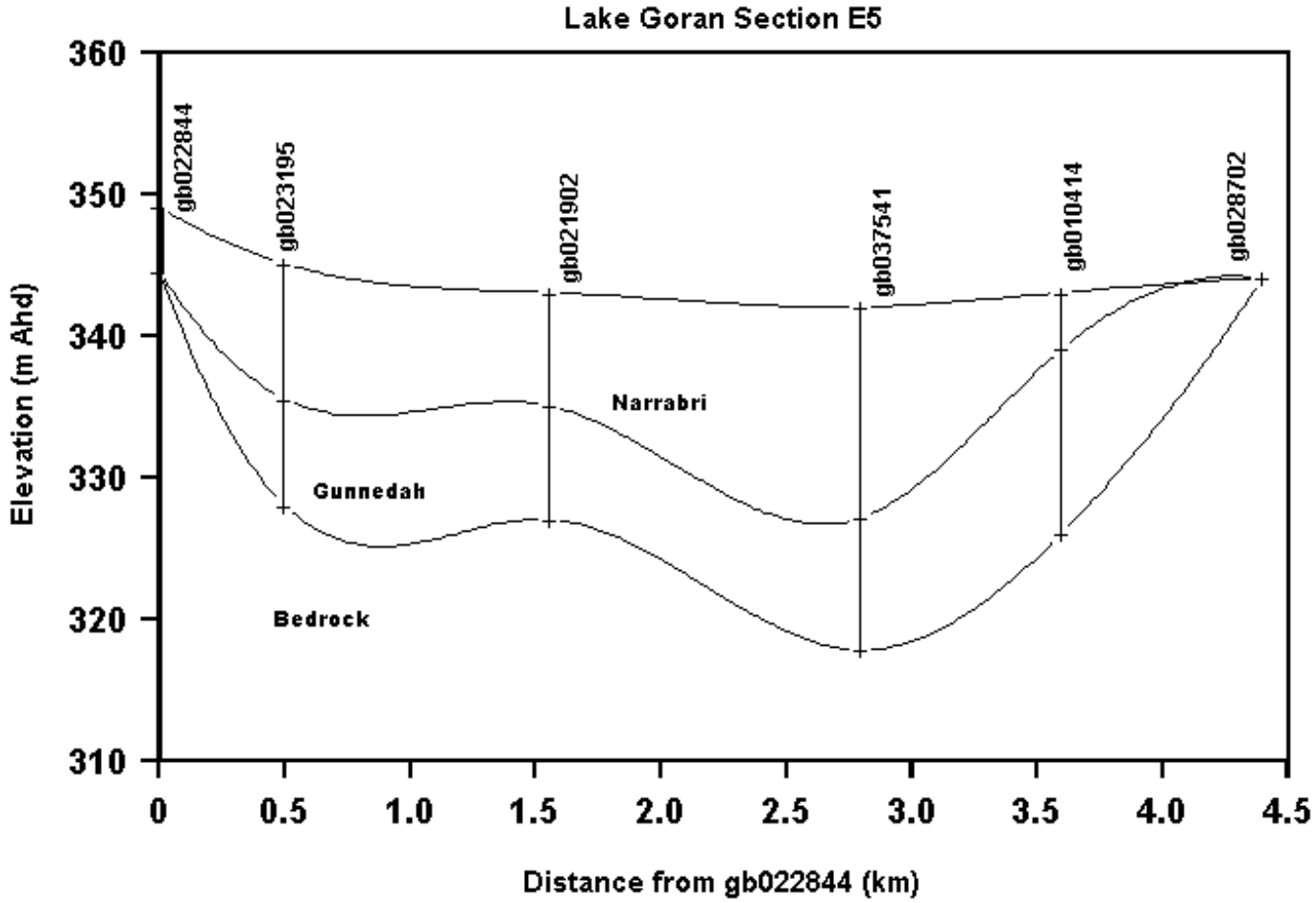
Lake Goran Catchment

Longitudinal section, eastern region

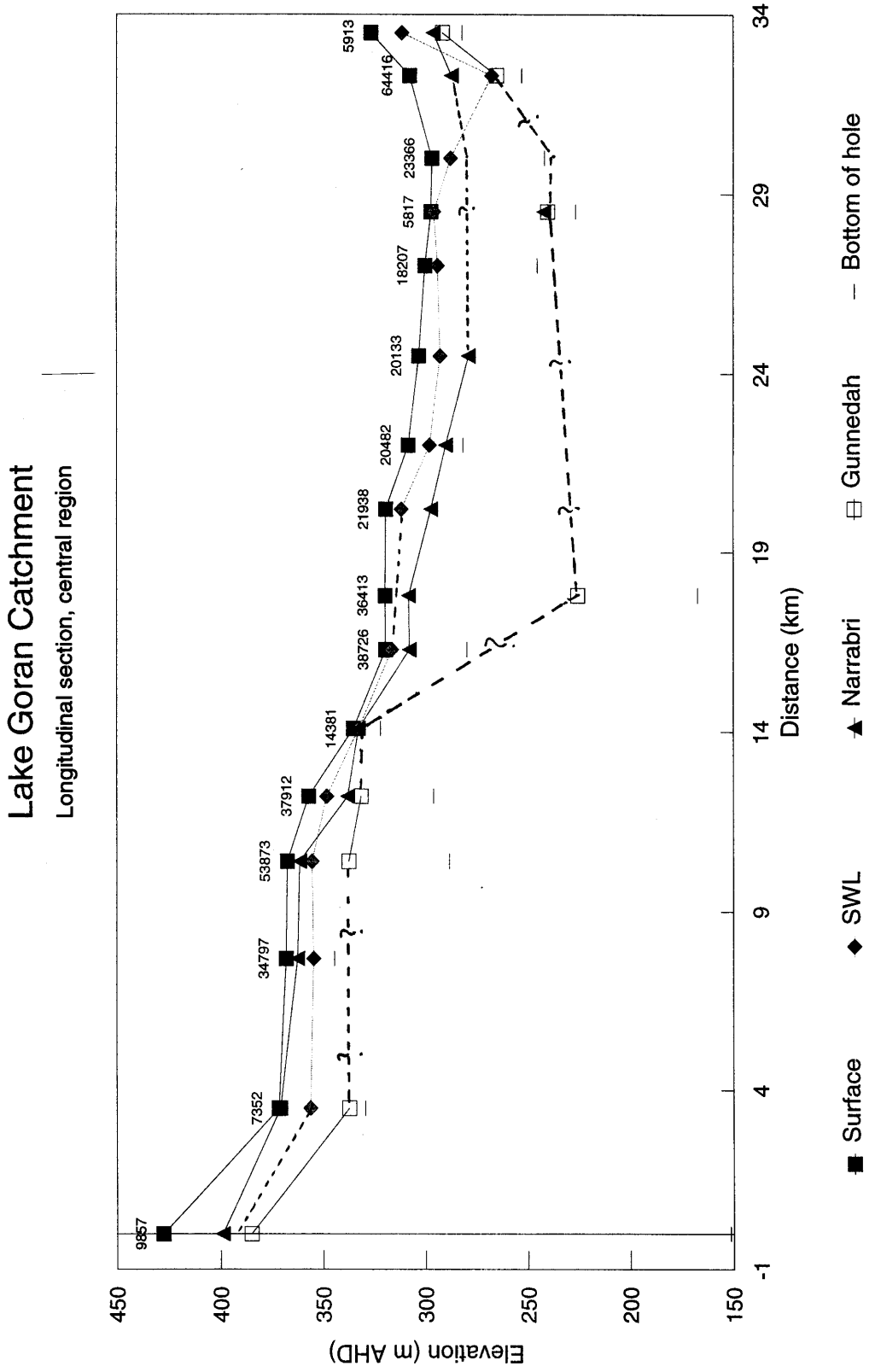


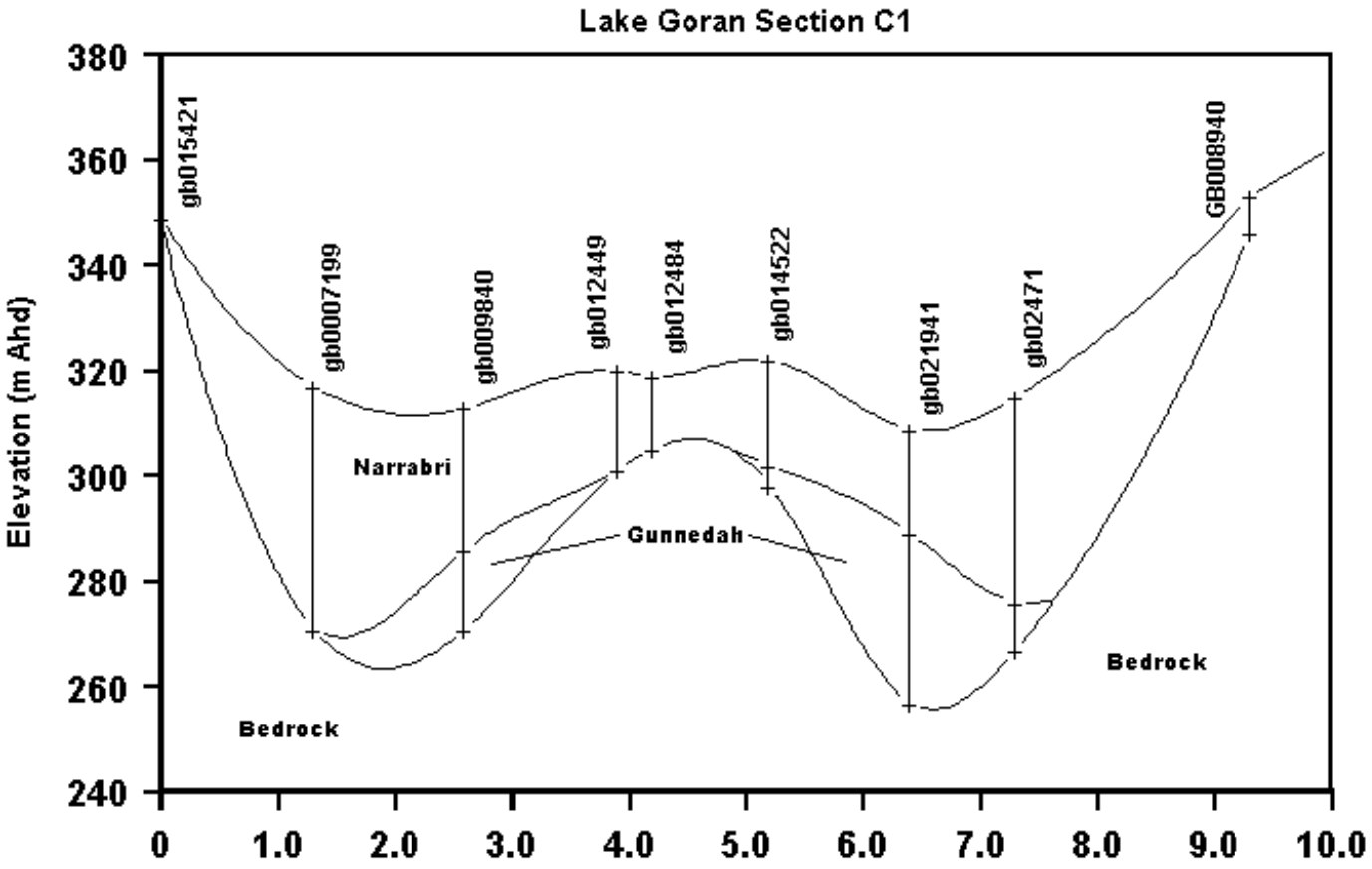

Lake Goran Section E3
Elevation (m Ahd)
340
330
320
310
300
290
280
270
gb022213
gb022214
gb062575
gb023780
gb024161
gb017101
Narrabri
Gunnedah
Bedrock
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Distance from gb022213 (km)

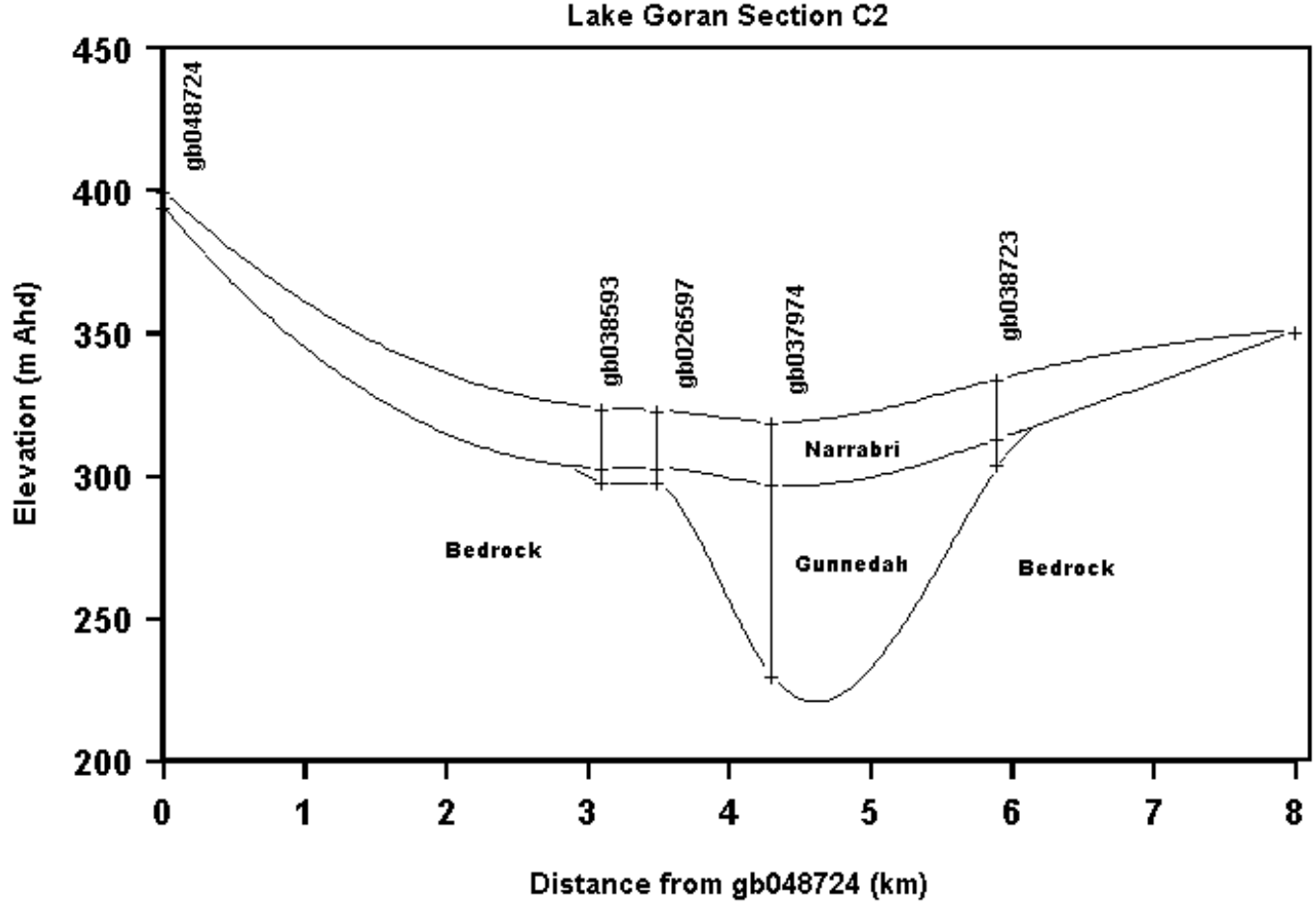

Lake Goran Section E4
Elevation (m Ahd)
350
340
330
320
310
300
290
280
gb044760
gb005076
gb036333
gb037819
gb022211
Narrabri
Gunnedah
Bedrock
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Distance from gb044760 (km)

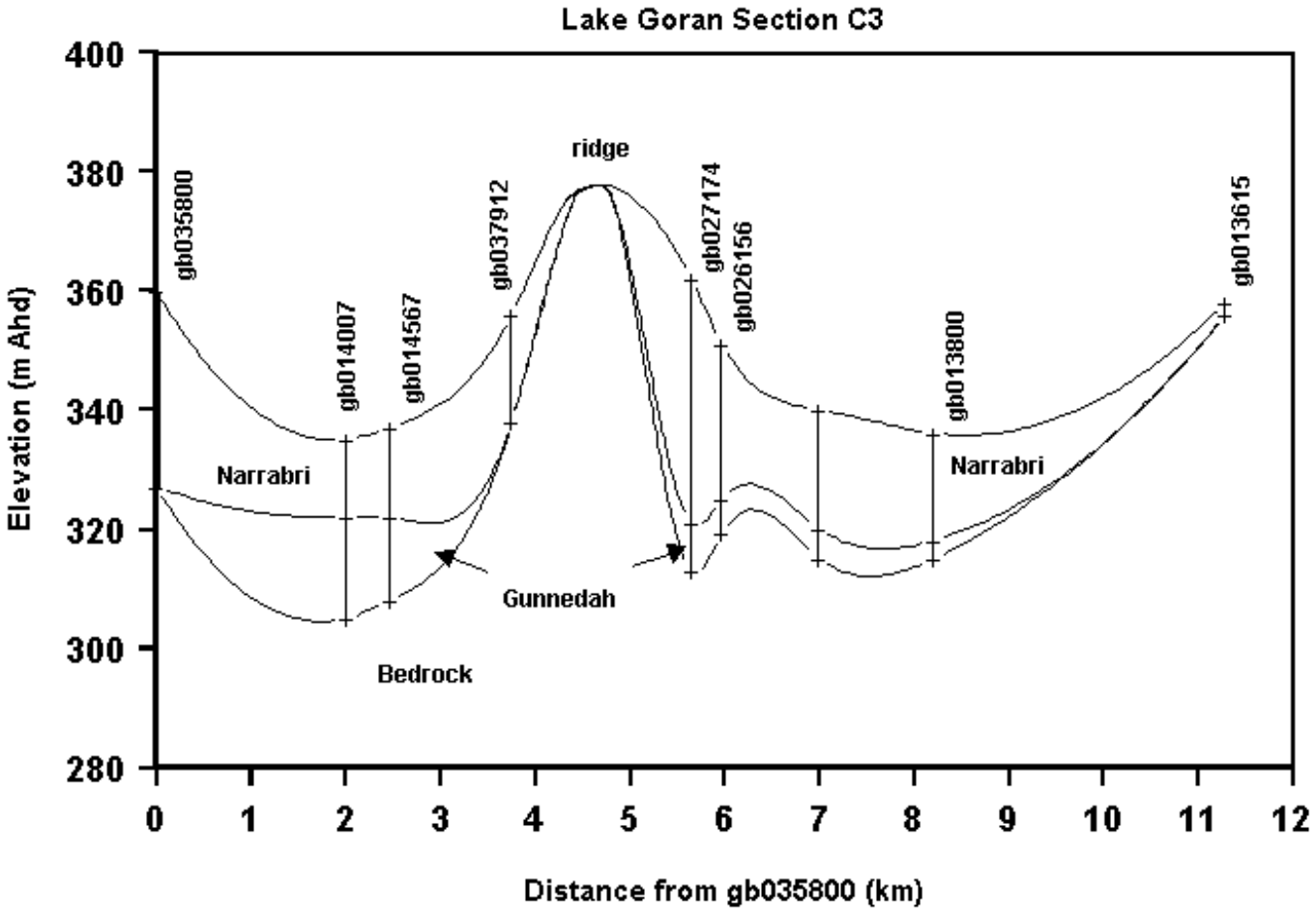

Lake Goran Section E5
360
350
340
330
320
310
Elevation (m Ahd)
gb022844
gb023195
gb021902
gb037541
gb010414
gb028702
Narrabri
Gunnedah
Bedrock
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Distance from gb022844 (km)

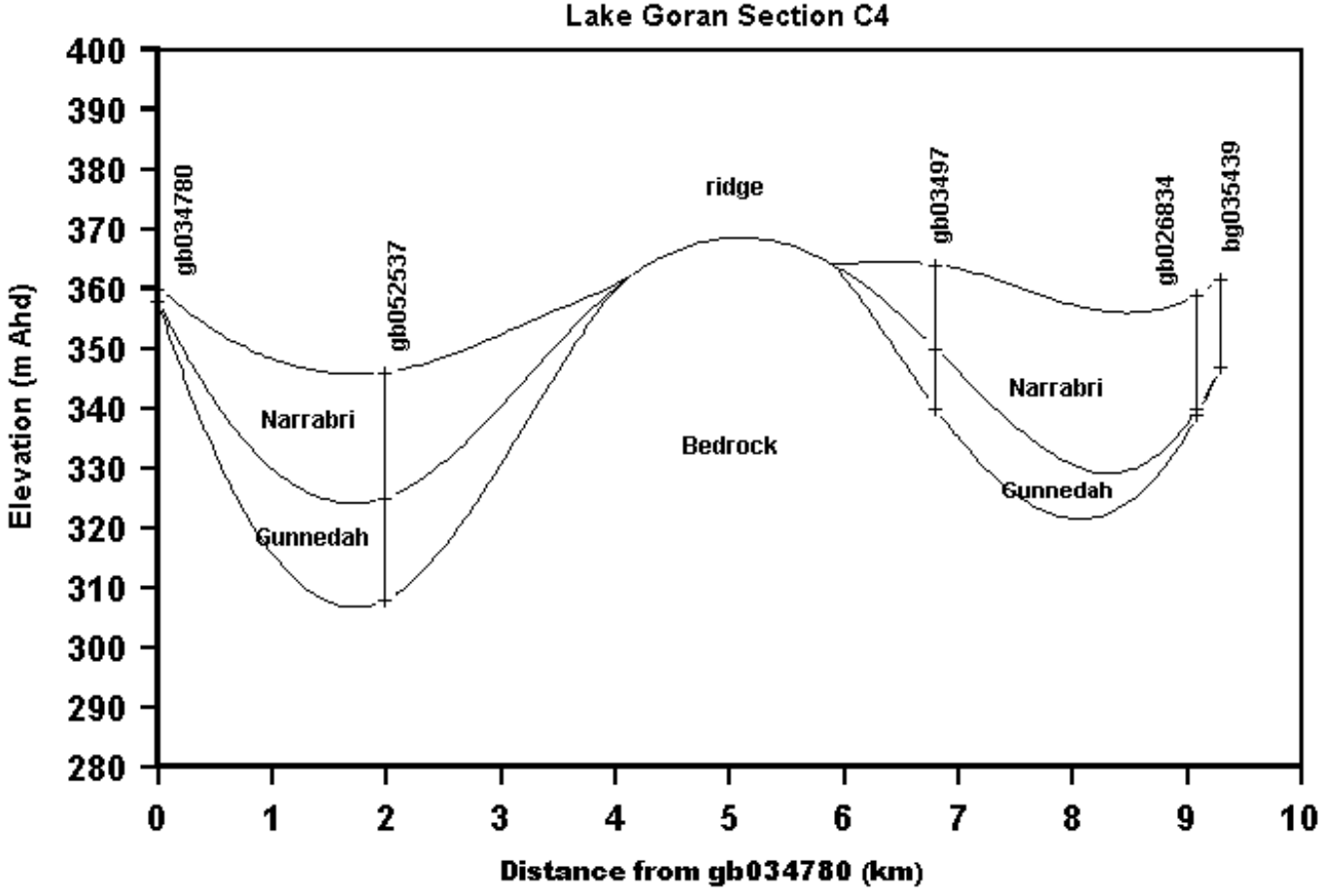
Lake Goran Central valley

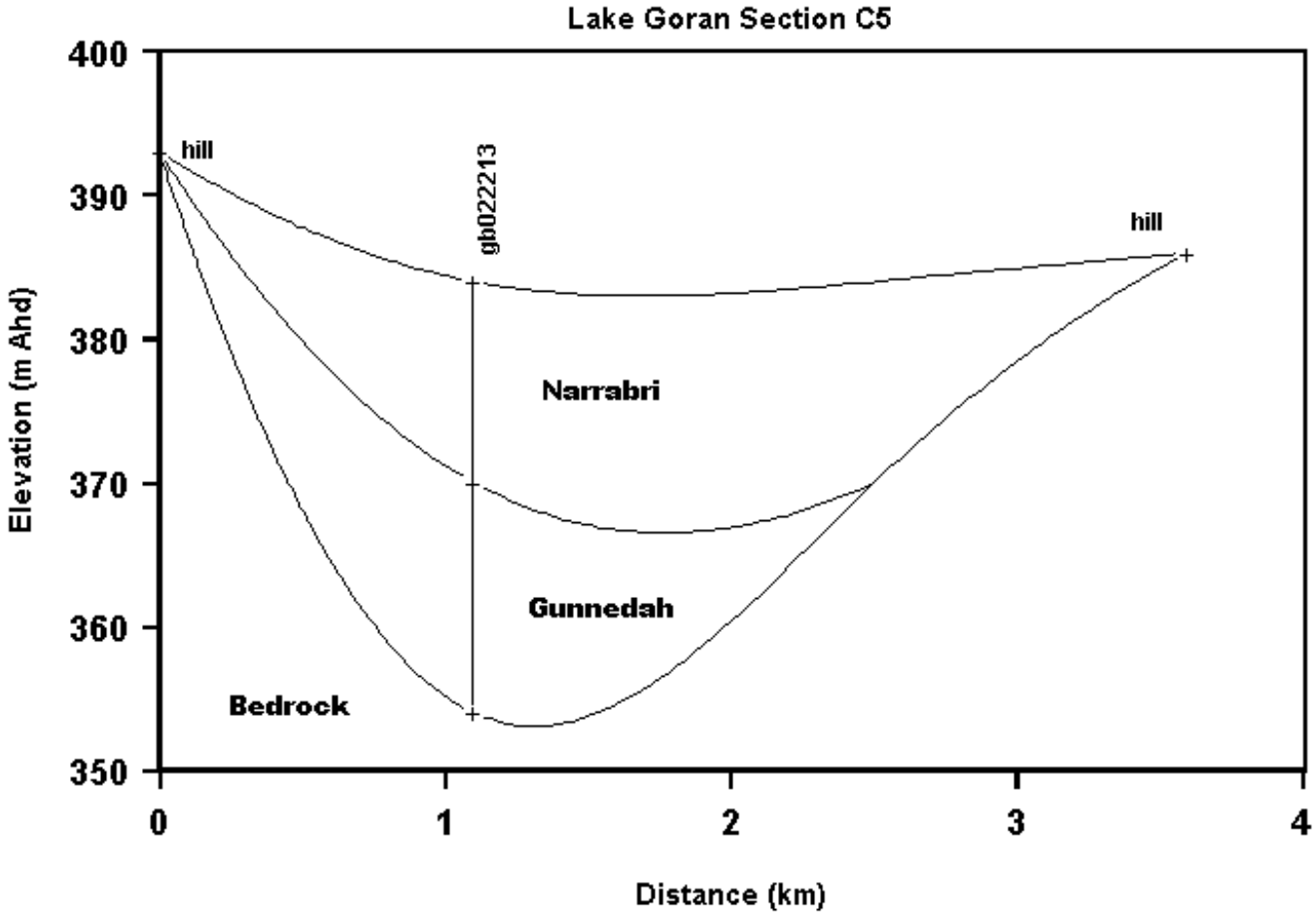



Lake Goran Section C1
Elevation (m Ahd)
380
360
340
320
300
280
260
240
gb015421
gb0007199
gb009840
gb012449
gb012484
gb014522
gb021941
gb02471
GB008940
Narrabri
Gunnedah
Bedrock
Bedrock
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Distance from gb015421 (km)

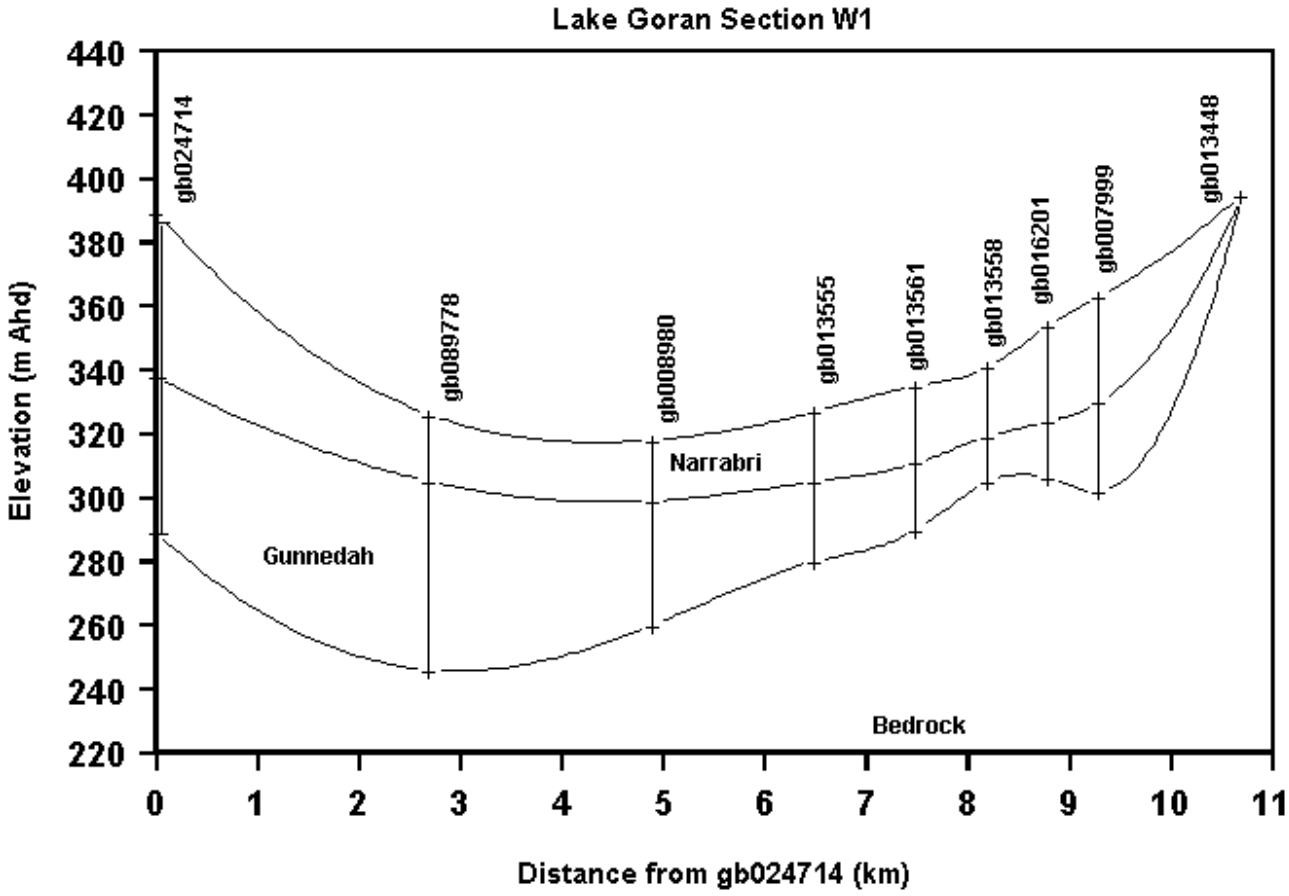

Lake Goran Section C2
Elevation (m Ahd)
450
400
350
300
250
200
gb048724
gb038593
gb026597
gb037974
gb038723
Narrabri
Bedrock
Gunnedah
Bedrock
0
1
2
3
4
5
6
7
8
Distance from gb048724 (km)

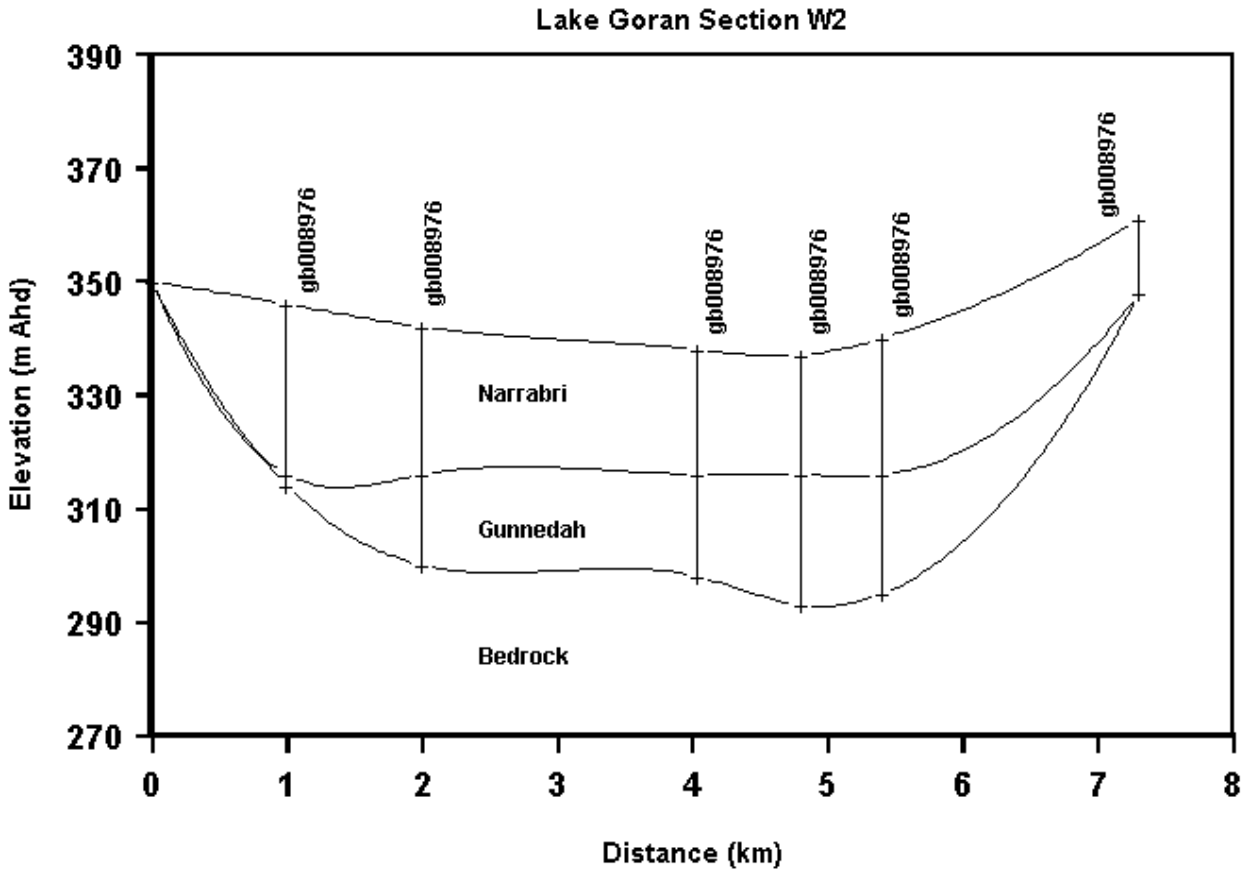

Lake Goran Section C3
Elevation (m Ahd)
400
380
360
340
320
300
280
0
1
2
3
4
5
6
7
8
9
10
11
12
Distance from gb035800 (km)
gb035800
gb014007
gb014567
gb037912
ridge
gb027174
gb026156
gb013800
gb013615
Narrabri
Narrabri
Gunnedah
Bedrock

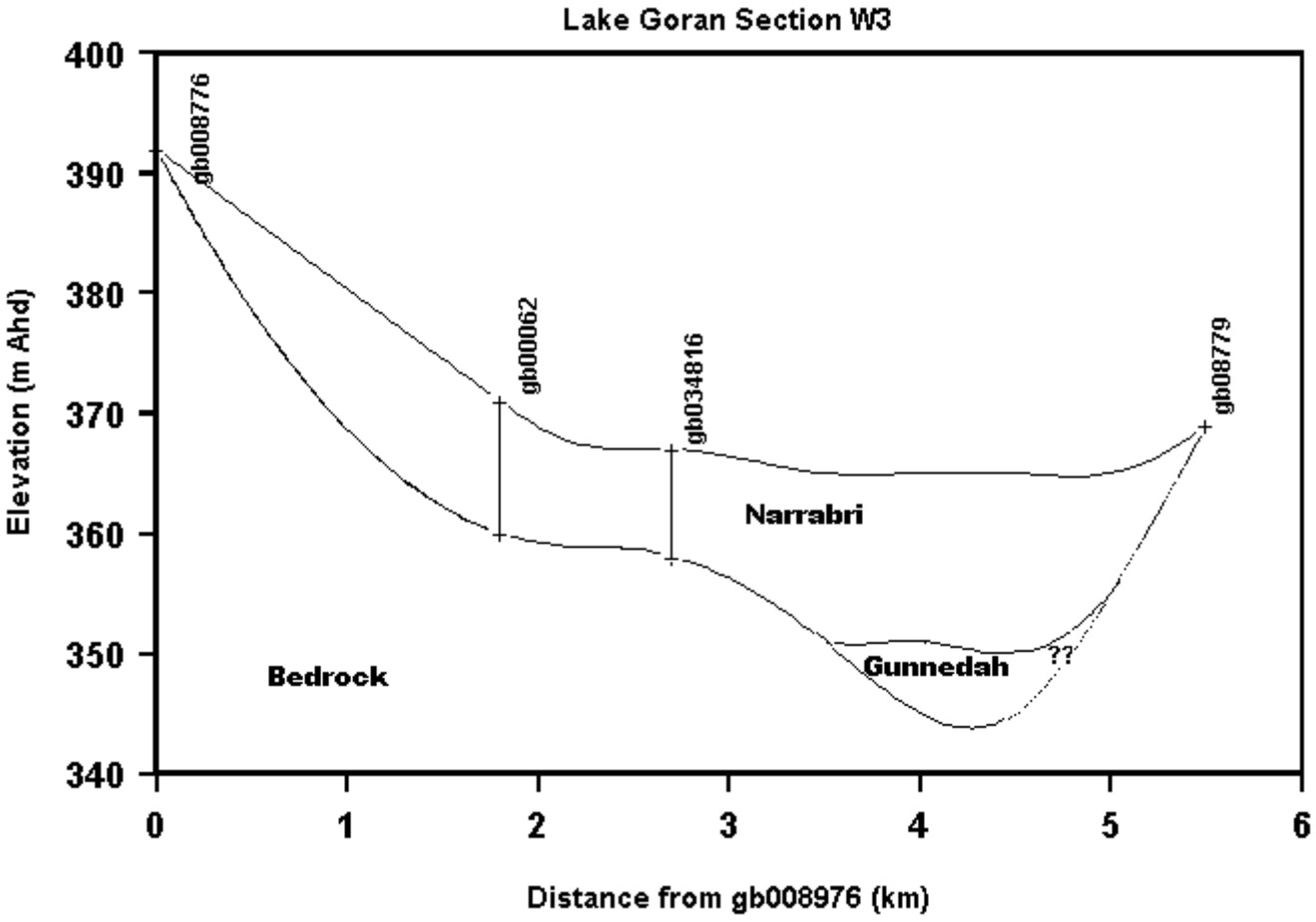

Lake Goran Section C4
Elevation (m Ahd)
400
390
380
370
360
350
340
330
320
310
300
290
280
0
1
2
3
4
5
6
7
8
9
10
Distance from gb034780 (km)
gb034780
gb052537
ridge
gb03497
gb026834
bg035439
Narrabri
Narrabri
Gunnedah
Bedrock
Gunnedah


Lake Goran Section C5
400
390
380
370
360
350
Elevation (m Ahd)
hill
gb022213
hill
Narrabri
Gunnedah
Bedrock
0
1
2
3
4
Distance (km)

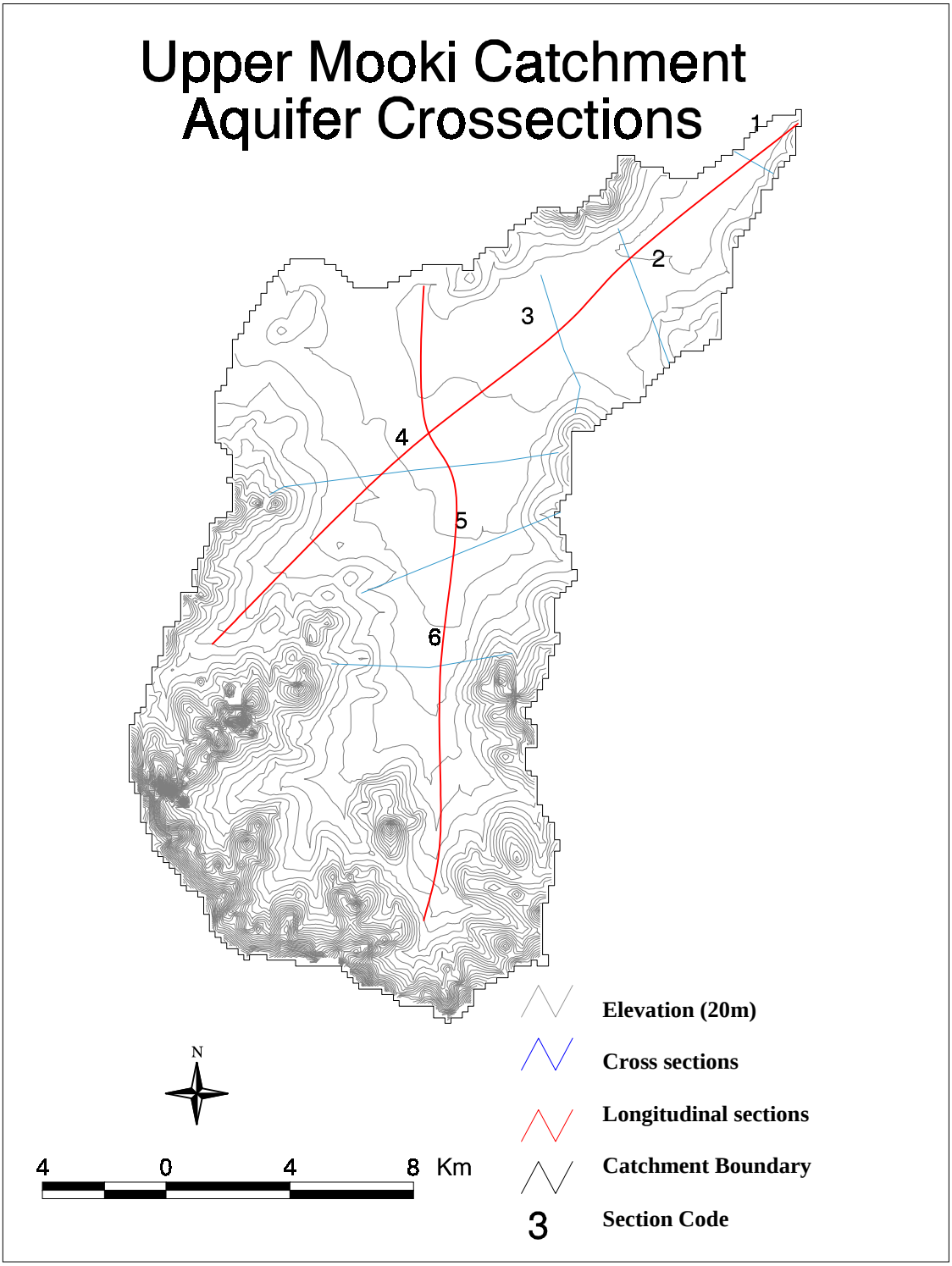
West Valley

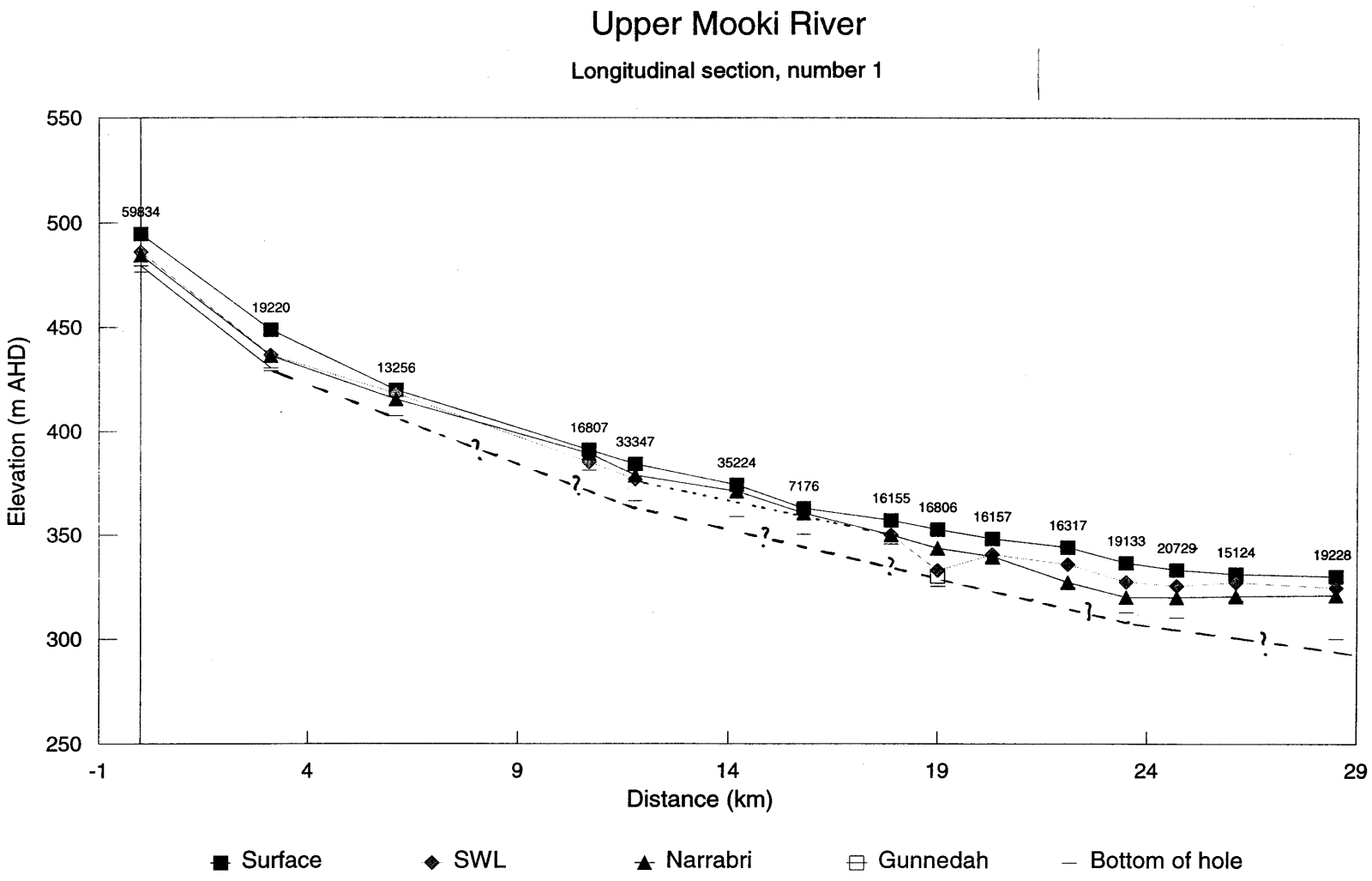

Lake Goran Section W1
Elevation (m Ahd)
440
420
400
380
360
340
320
300
280
260
240
220
0
1
2
3
4
5
6
7
8
9
10
11
gb024714
gb089778
gb008980
gb013555
gb013561
gb013558
gb016201
gb007999
gb013448
Narrabri
Gunnedah
Bedrock
Distance from gb024714 (km)

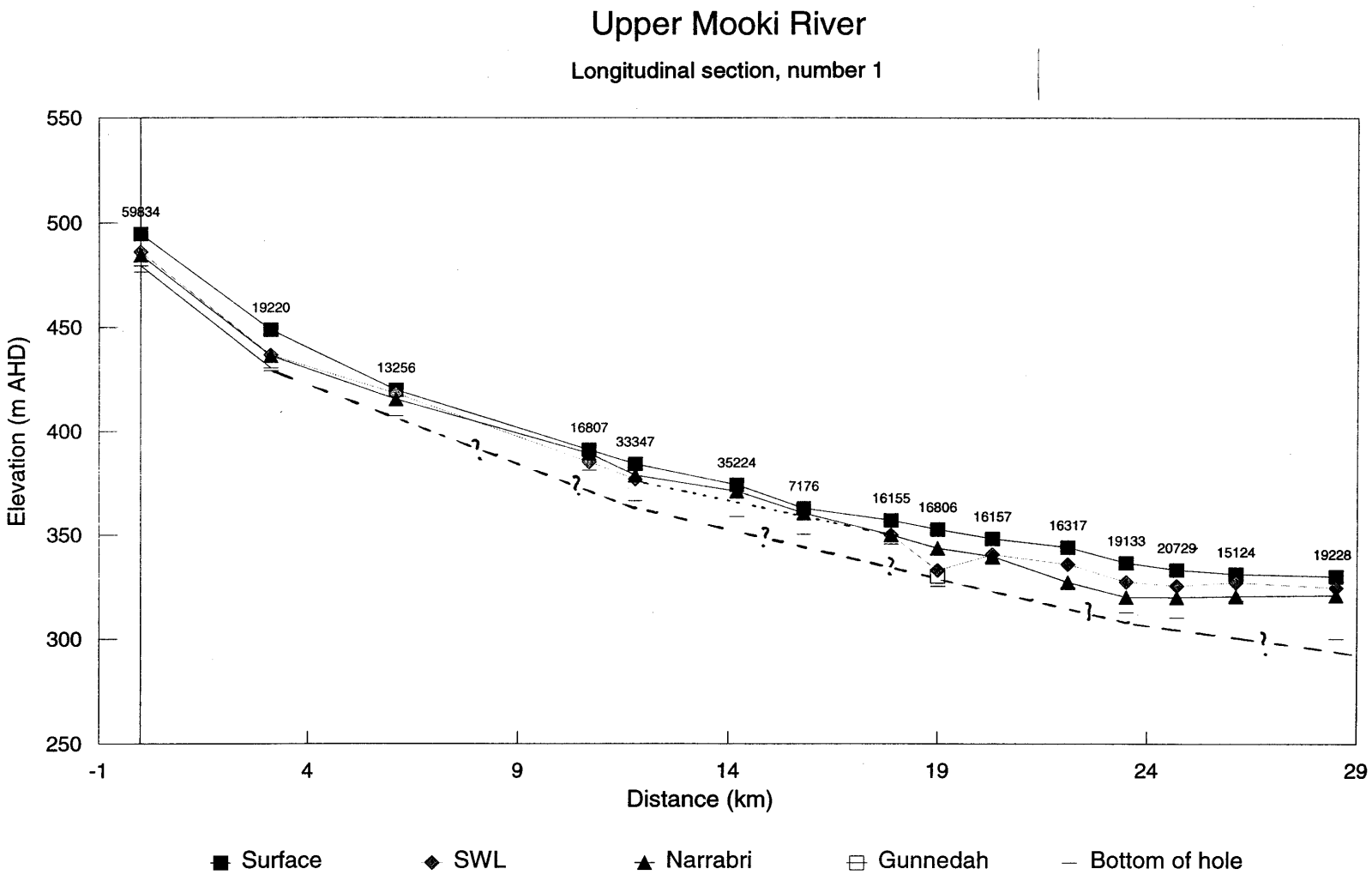

Lake Goran Section W2
Elevation (m Ahd)
390
370
350
330
310
290
270
0
1
2
3
4
5
6
7
8
gb008976
gb008976
gb008976
gb008976
gb008976
gb008976
Narrabri
Gunnedah
Bedrock
Distance (km)

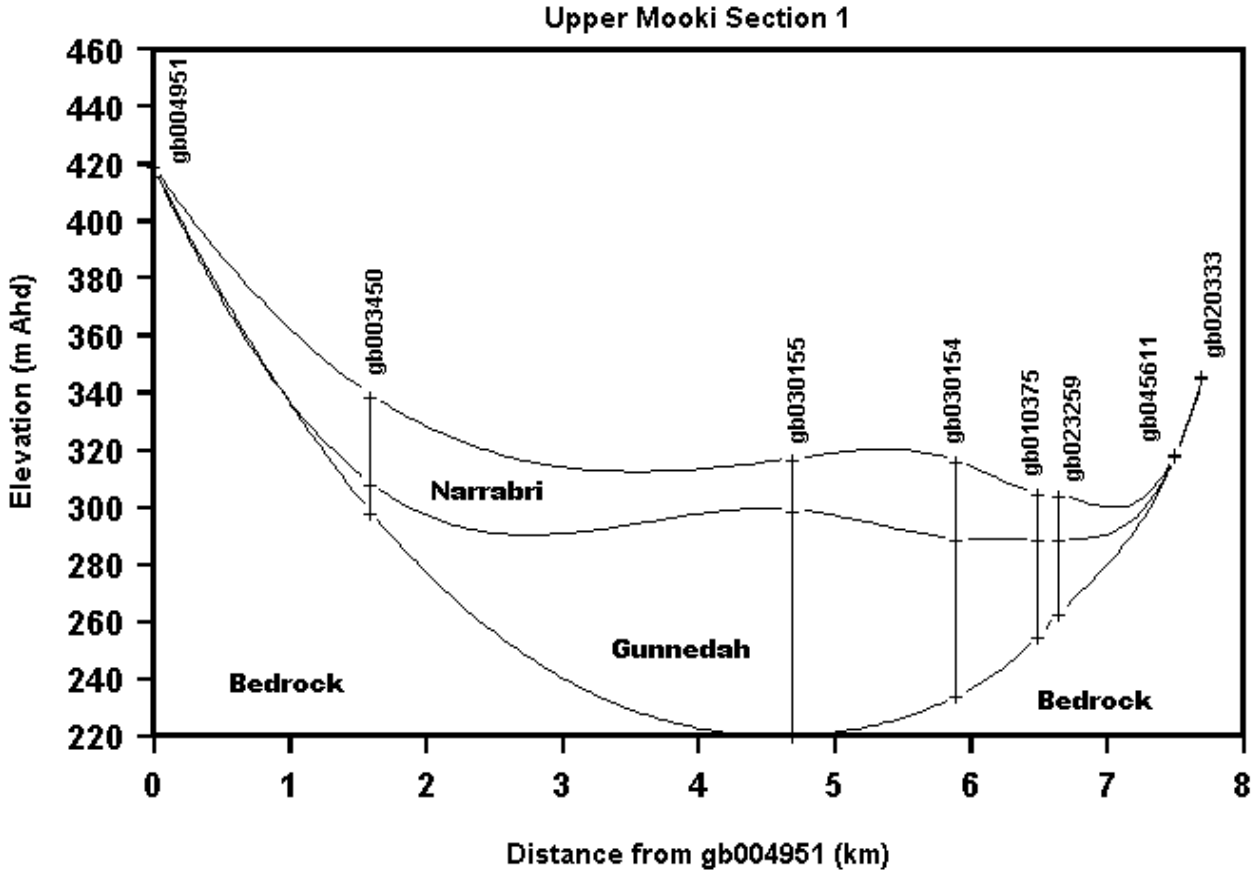

Lake Goran Section W3
Elevation (m Ahd)
400
390
380
370
360
350
340
0
1
2
3
4
5
6
Distance from gb008976 (km)
gb008776
gb00062
gb034816
gb08779
Narrabri
Gunnedah
??
Bedrock

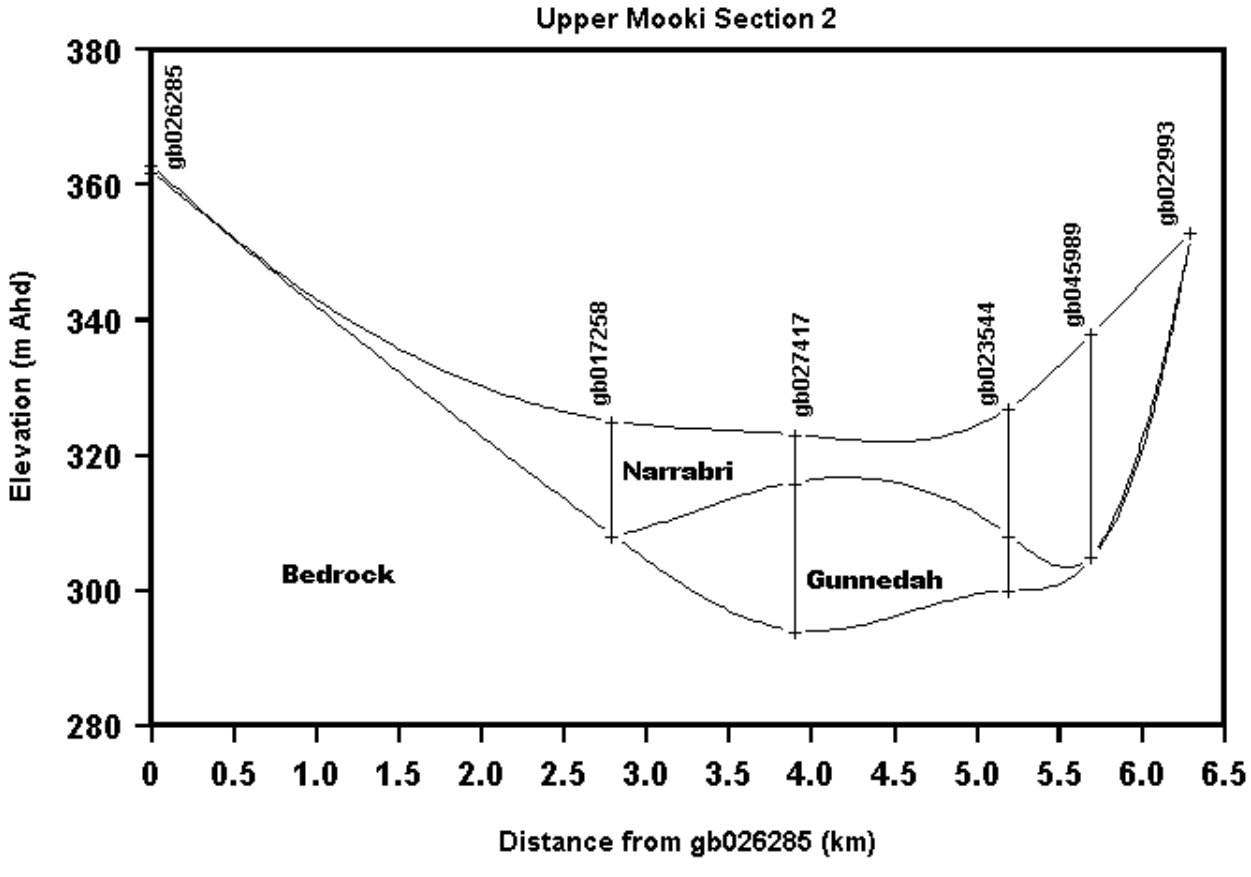
Basin 3 Upper Mooki Creek sub catchment

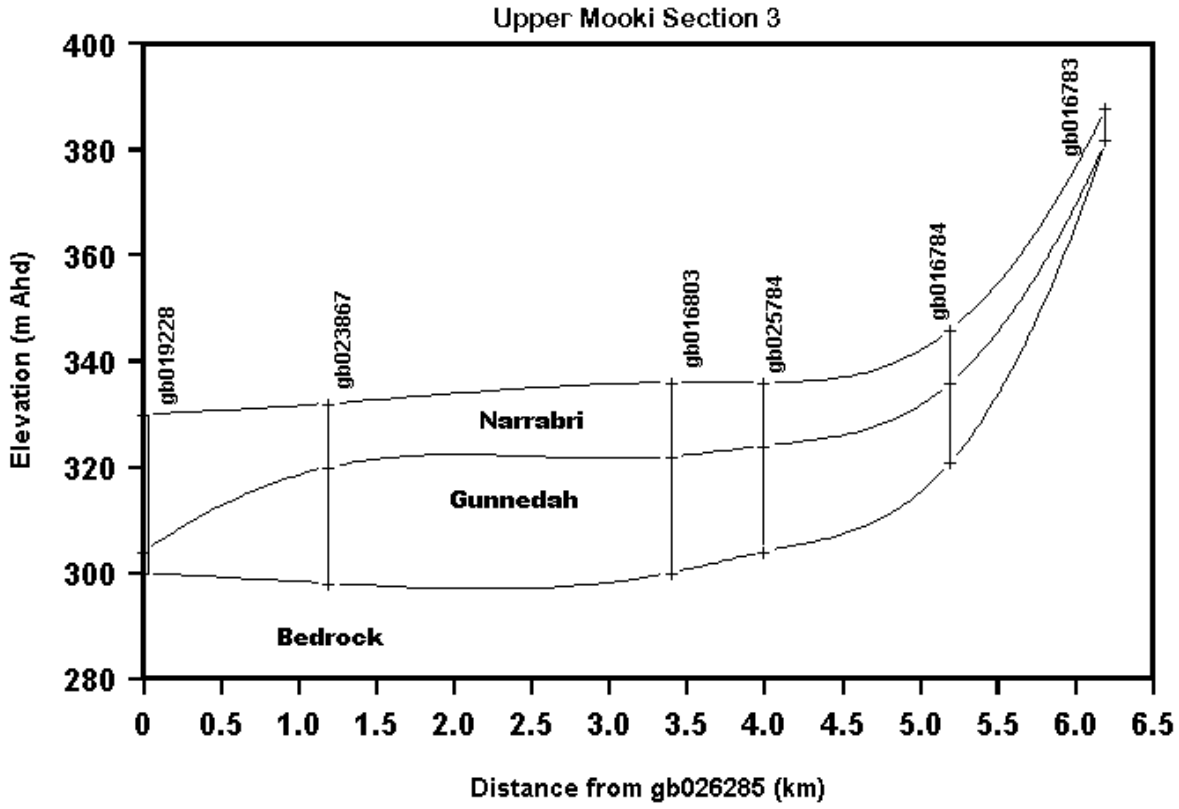


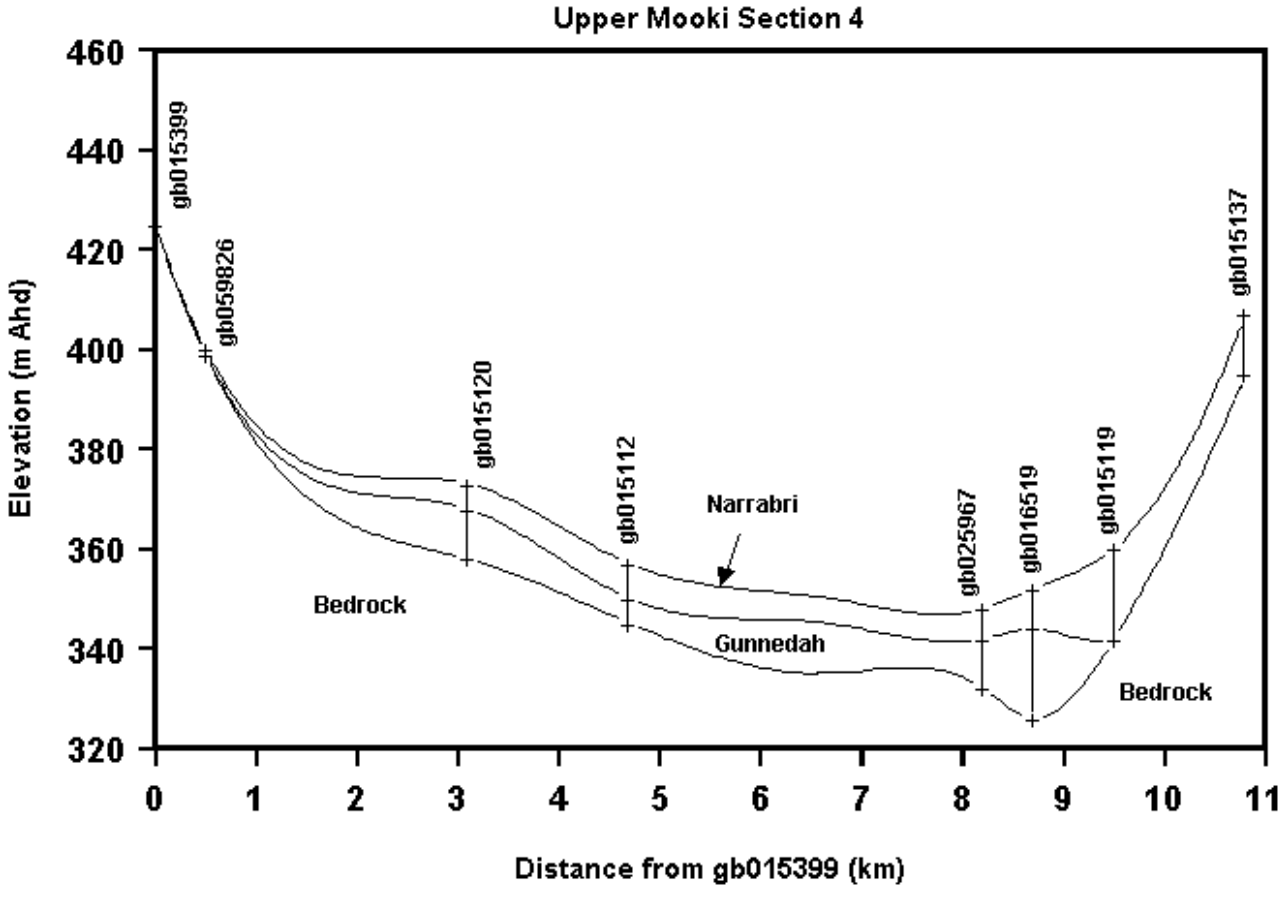

Upper Mooki River
Longitudinal section, number 1
Elevation (m AHD)
550
500
450
400
350
300
250
-1
4
9
14
19
24
29
Distance (km)
59834
19220
13256
16807
33347
35224
7176
16155
16806
16157
16317
19133
20729
15124
19228
Surface
SWL
Narrabri
Gunnedah
Bottom of hole

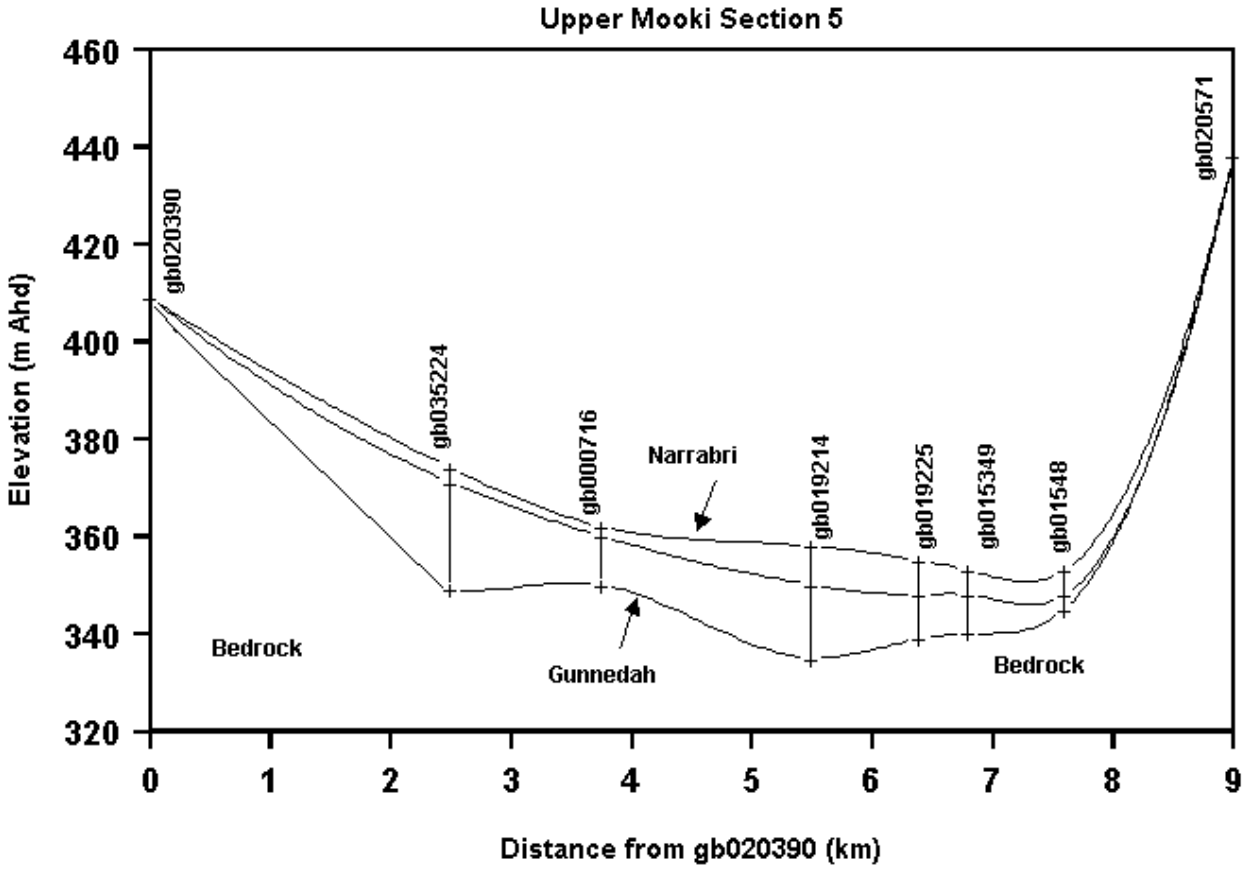

Upper Mooki River
Longitudinal section, number 1
Elevation (m AHD)
550
500
450
400
350
300
250
-1
4
9
14
19
24
29
Distance (km)
59834
19220
13256
16807
33347
35224
7176
16155
16806
16157
16317
19133
20729
15124
19228
Surface
SWL
Narrabri
Gunnedah
Bottom of hole

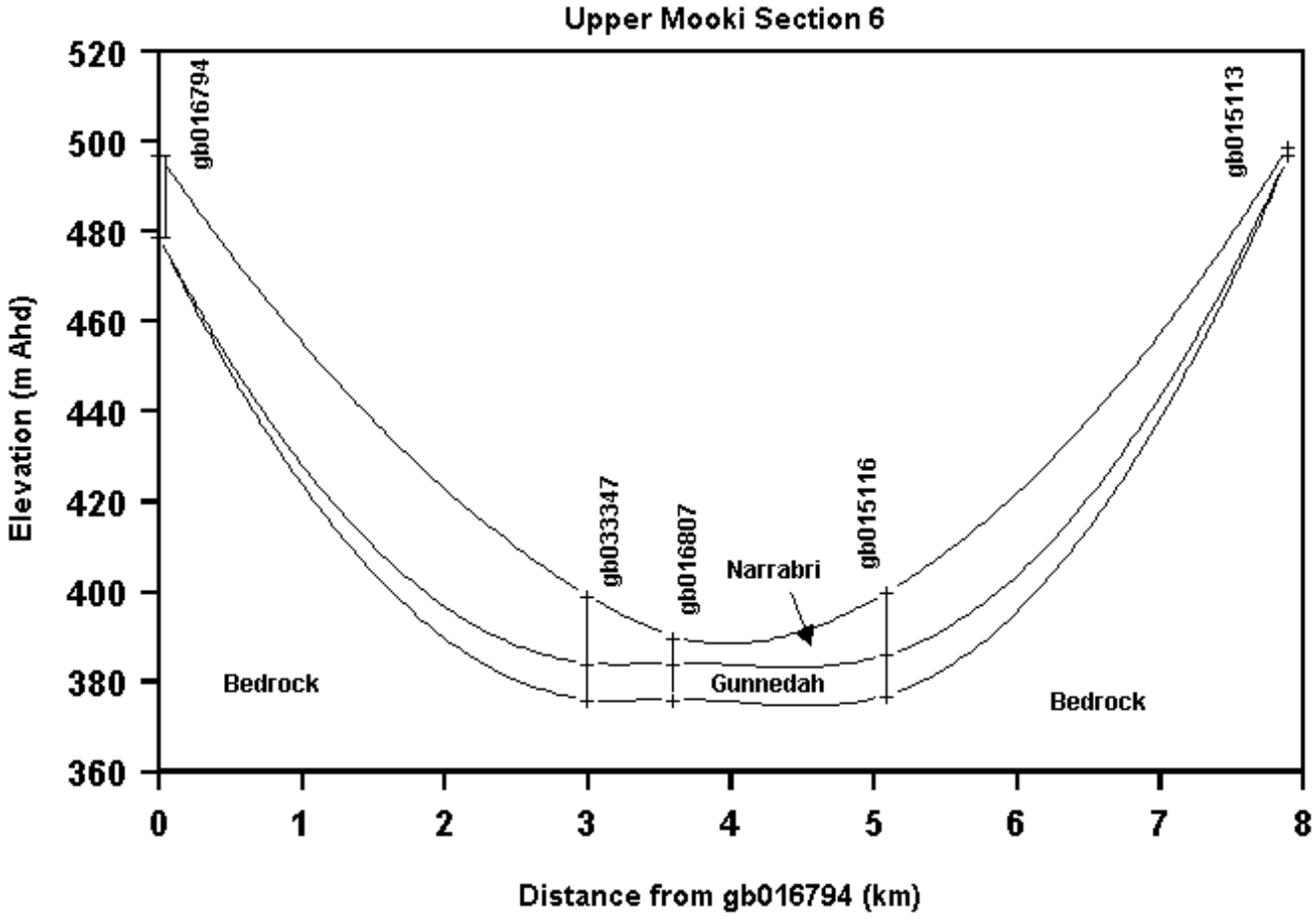

Upper Mooki Section 1
Elevation (m Ahd)
460
440
420
400
380
360
340
320
300
280
260
240
220
0
1
2
3
4
5
6
7
8
Distance from gb004951 (km)
gb004951
gb003450
gb030155
gb030154
gb010375
gb023259
gb045611
gb020333
Narrabri
Gunnedah
Bedrock
Bedrock


Upper Mooki Section 2
Elevation (m Ahd)
380
360
340
320
300
280
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
Distance from gb026285 (km)
gb026285
gb017258
gb027417
gb023544
gb045989
gb022993
Narrabri
Bedrock
Gunnedah

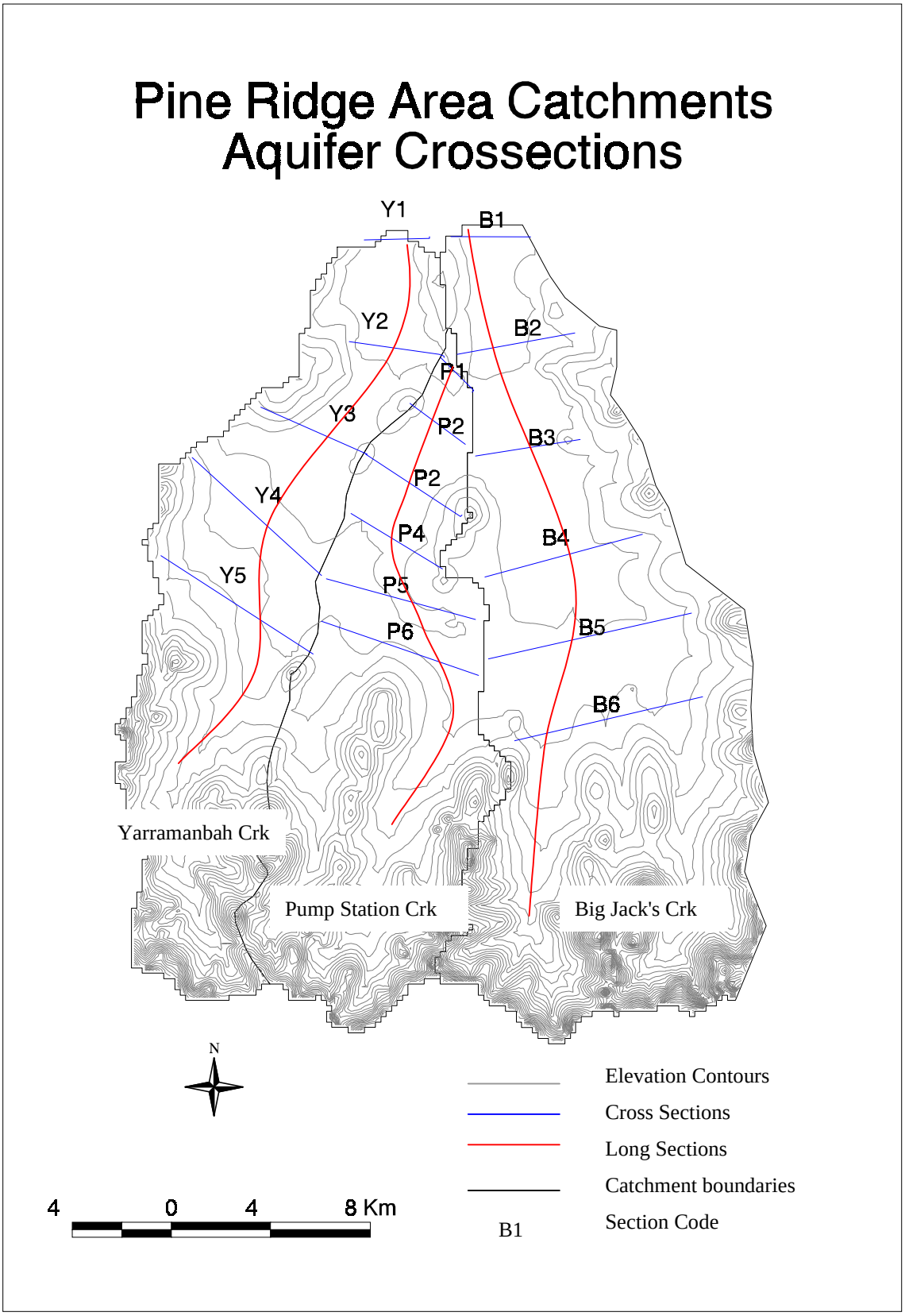

Upper Mooki Section 3
Elevation (m Ahd)
400
380
360
340
320
300
280
gb019228
gb023867
gb016803
gb025784
gb016784
gb016783
Narrabri
Gunnedah
Bedrock
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
Distance from gb026285 (km)

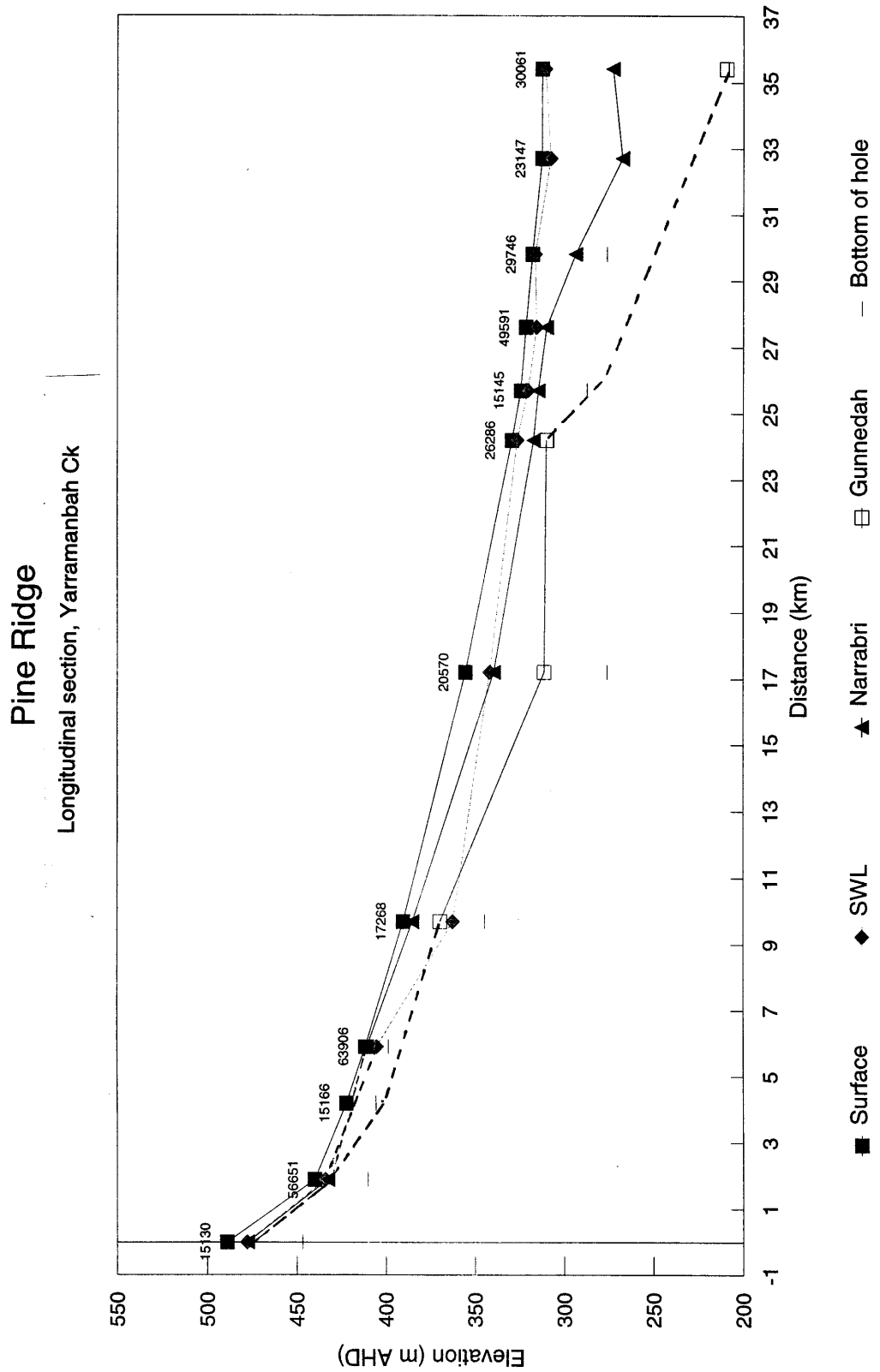

Upper Mooki Section 4
Elevation (m Ahd)
460
440
420
400
380
360
340
320
gb015399
gb059826
gb015120
gb015112
gb025967
gb016519
gb015119
gb015137
Narrabri
Bedrock
Gunnedah
Bedrock
0
1
2
3
4
5
6
7
8
9
10
11
Distance from gb015399 (km)

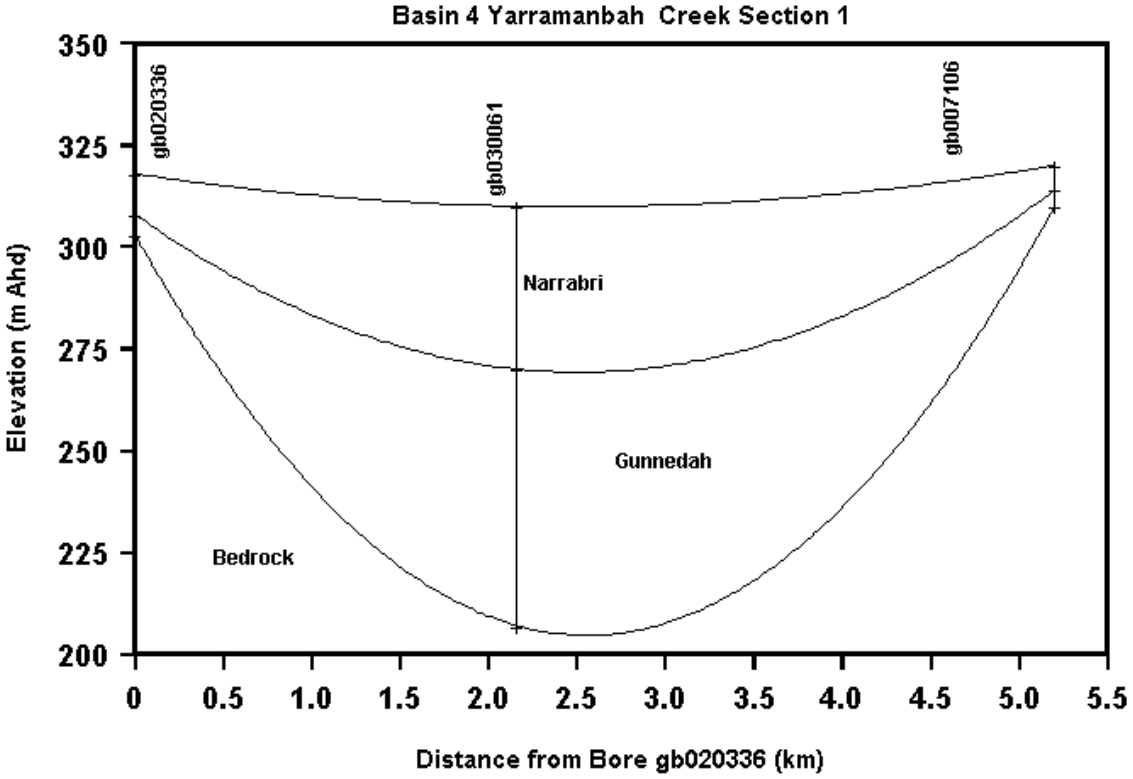

Upper Mooki Section 5
Elevation (m Ahd)
460
440
420
400
380
360
340
320
0
1
2
3
4
5
6
7
8
9
gb020390
gb035224
gb000716
Narrabri
gb019214
gb019225
gb015349
gb01548
gb020571
Bedrock
Gunnedah
Bedrock
Distance from gb020390 (km)

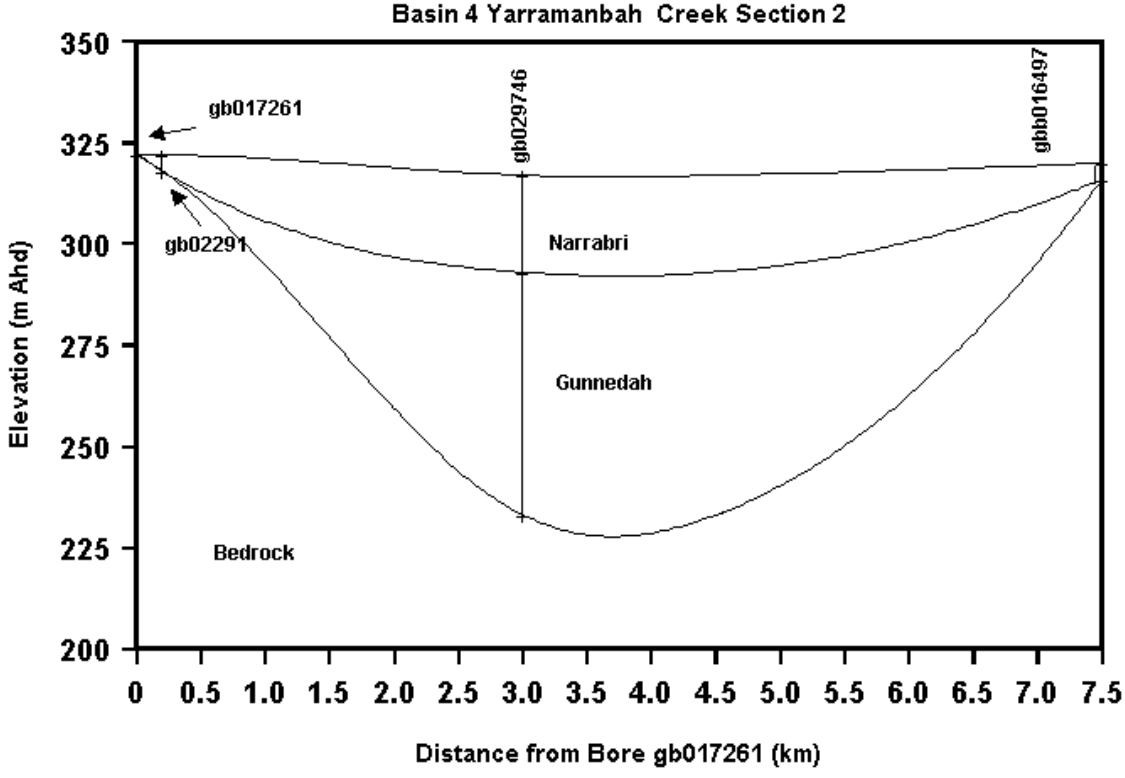

Upper Mooki Section 6
Elevation (m Ahd)
520
500
480
460
440
420
400
380
360
0
1
2
3
4
5
6
7
8
gb016794
gb033347
gb016807
Narrabri
gb015116
gb015113
Bedrock
Gunnedah
Bedrock
Distance from gb016794 (km)

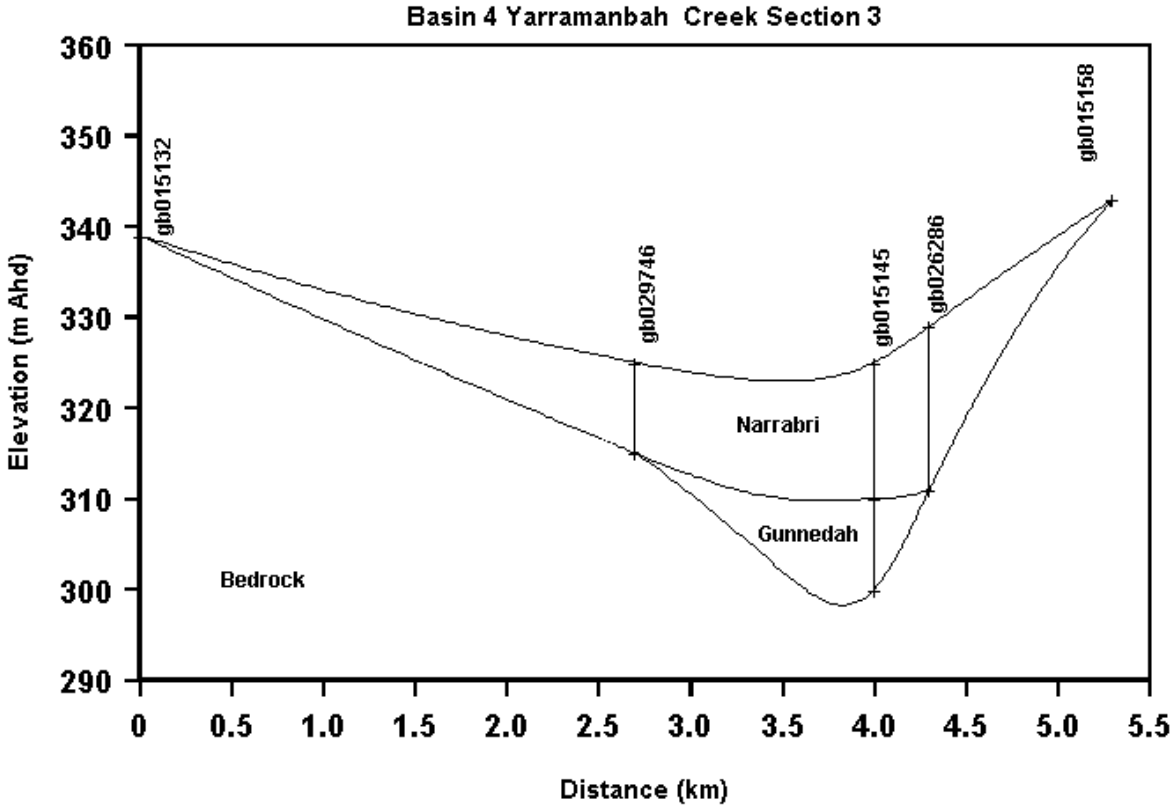
Basin 4 Yarramanbah Creek sub catchment

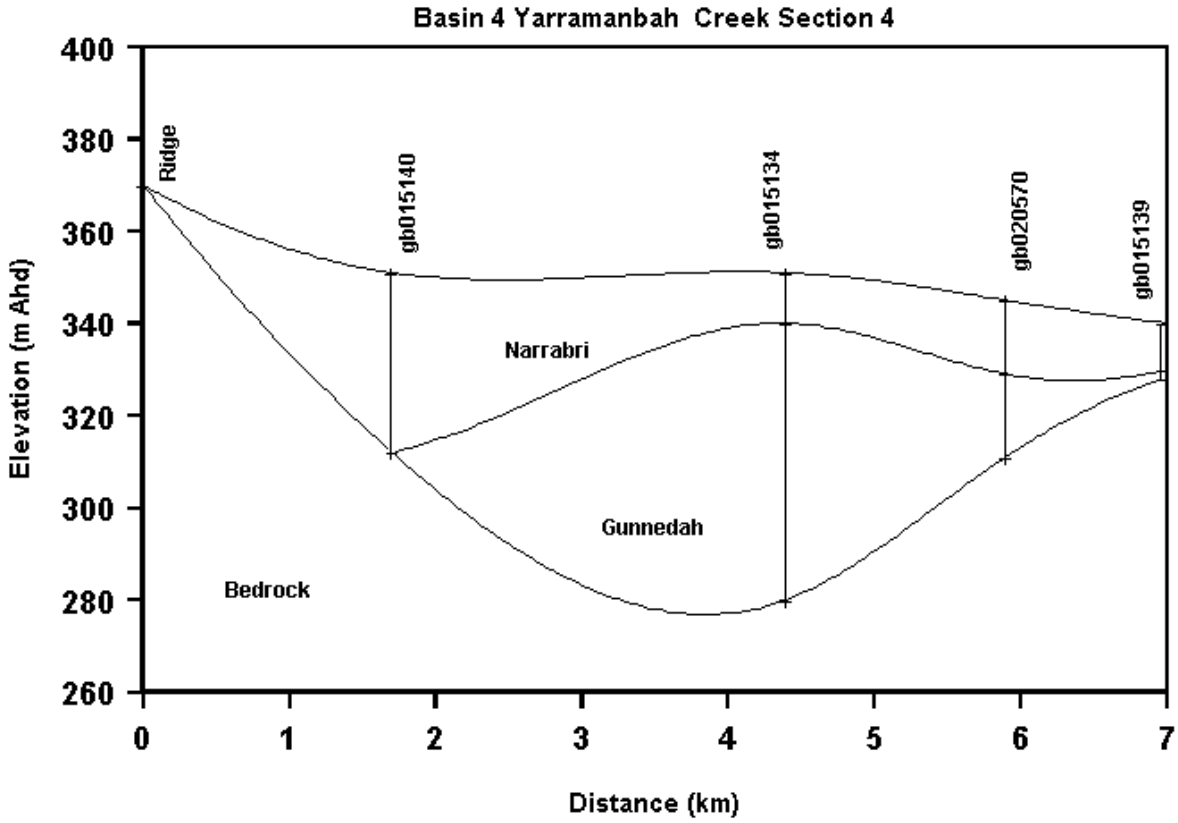


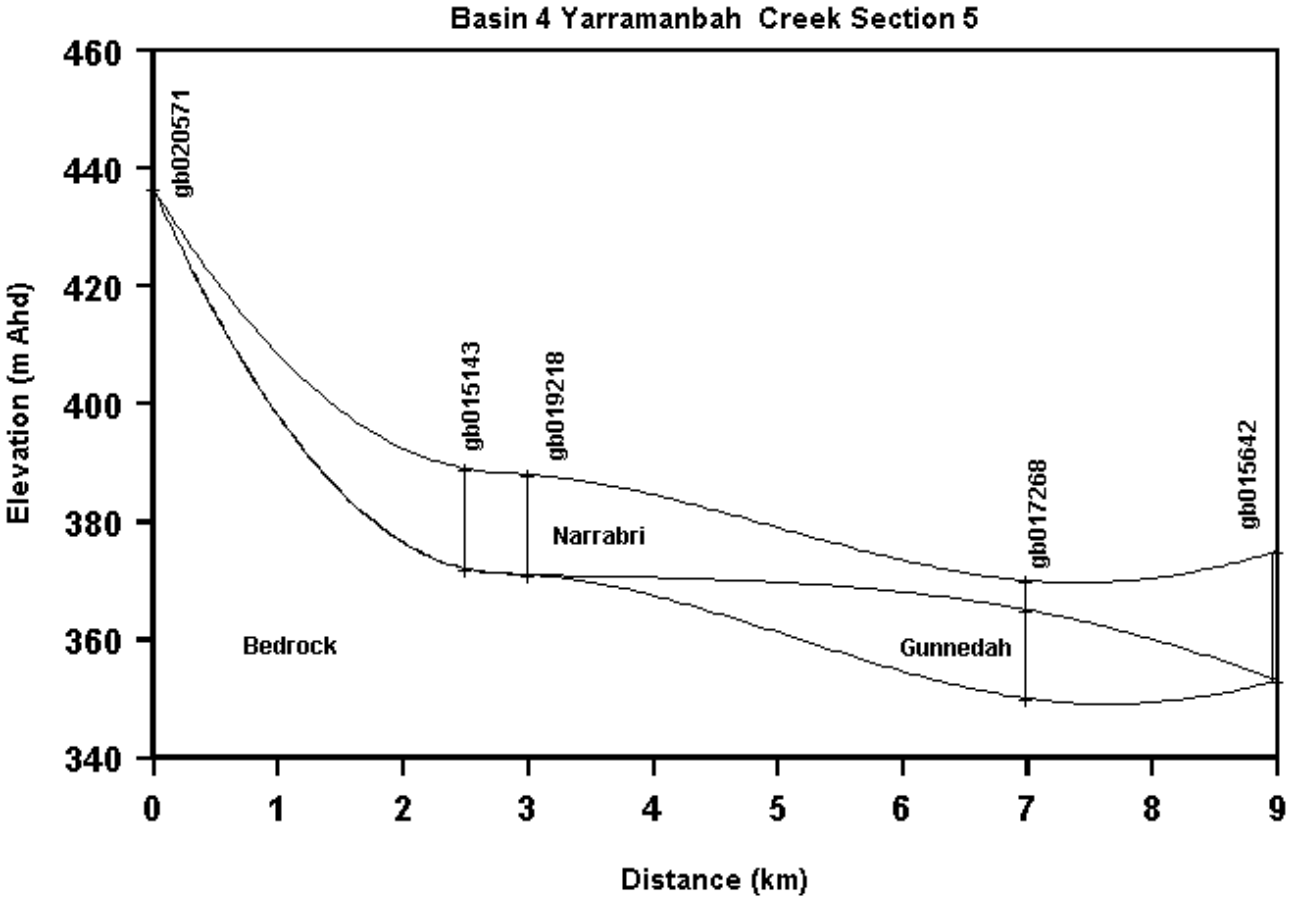

Pine Ridge
Longitudinal section, Yarramanbah Ck
Elevation (m AHD)
550
500
450
400
350
300
250
200
Distance (km)
-1
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
15130
56651
15166
63906
17268
20570
26286
15145
49591
29746
23147
30061
Surface
SWL
Narrabri
Gunnedah
Bottom of hole


Basin 4 Yarramanbah Creek Section 1
gb020336
gb030061
gb007106
Narrabri
Gunnedah
Bedrock
Elevation (m Ahd)
350
325
300
275
250
225
200
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
Distance from Bore gb020336 (km)

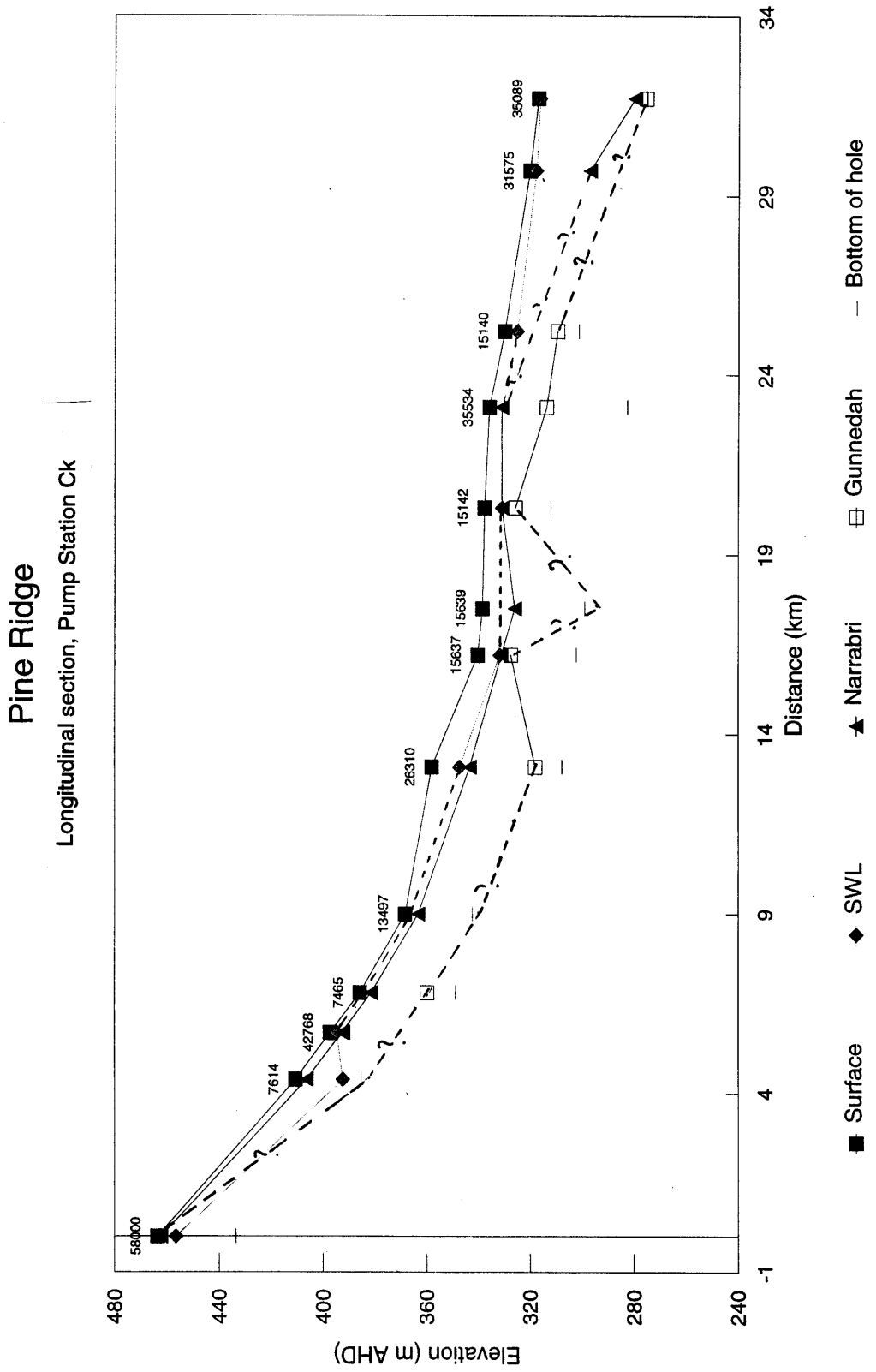

Basin 4 Yarramanbah Creek Section 2
gb017261
gb029746
gb016497
gb02291
Narrabri
Gunnedah
Bedrock
Elevation (m Ahd)
350
325
300
275
250
225
200
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
Distance from Bore gb017261 (km)

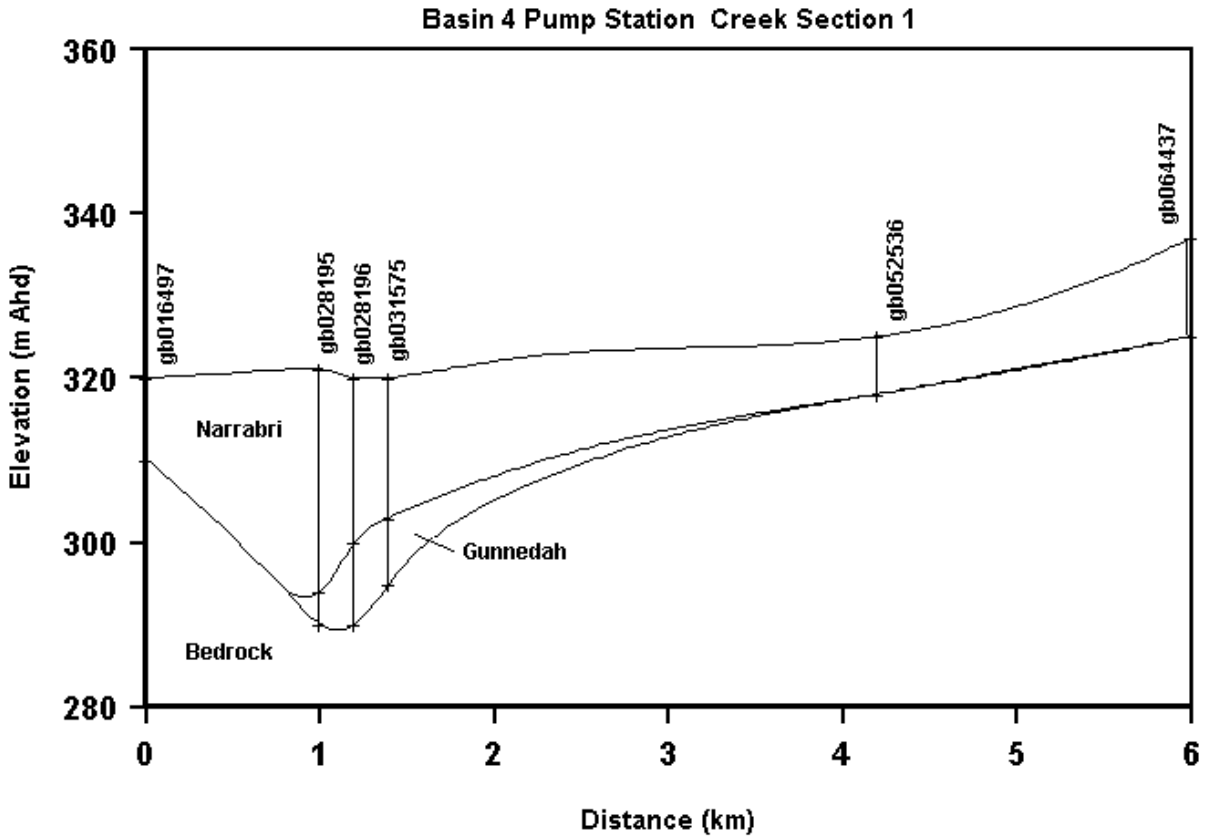

Basin 4 Yarramanbah Creek Section 3
Elevation (m Ahd)
Distance (km)
gb015132
gb029746
gb015145
gb026286
gb015158
Narrabri
Gunnedah
Bedrock

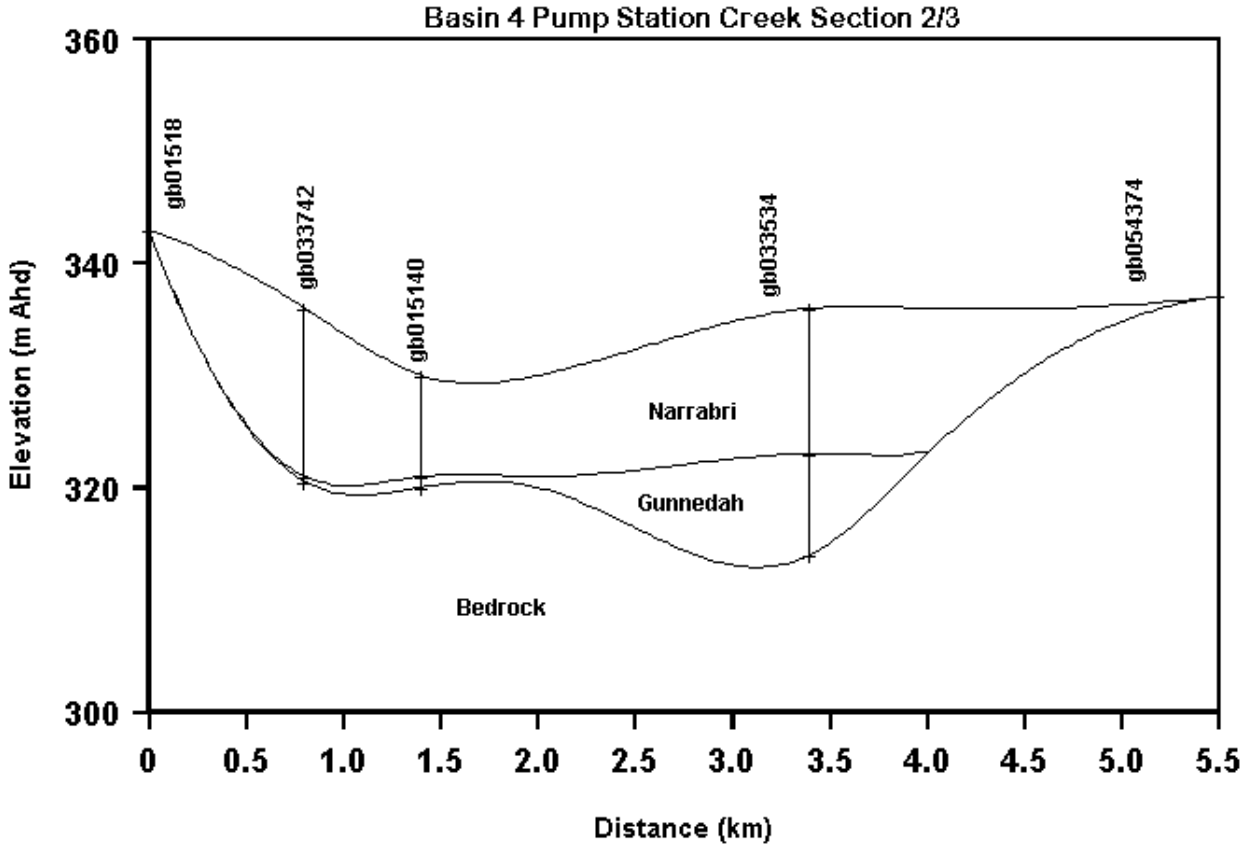

Basin 4 Yarramanbah Creek Section 4
Elevation (m Ahd)
Distance (km)
Ridge
gb015140
gb015134
gb020570
gb015139
Narrabri
Gunnedah
Bedrock

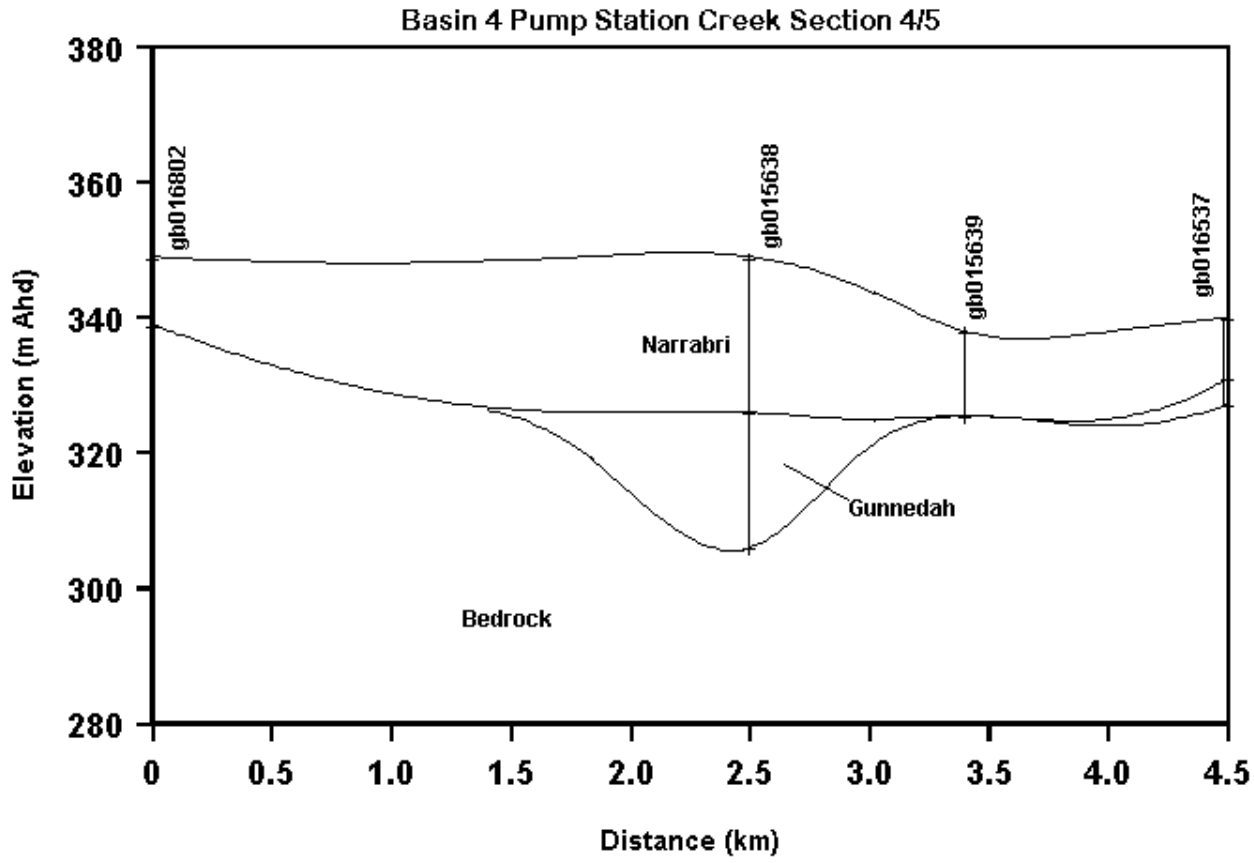

Basin 4 Yarramanbah Creek Section 5
Elevation (m Ahd)
460
440
420
400
380
360
340
0
1
2
3
4
5
6
7
8
9
Distance (km)
gb020571
gb015143
gb019218
gb017268
gb015642
Narrabri
Bedrock
Gunnedah

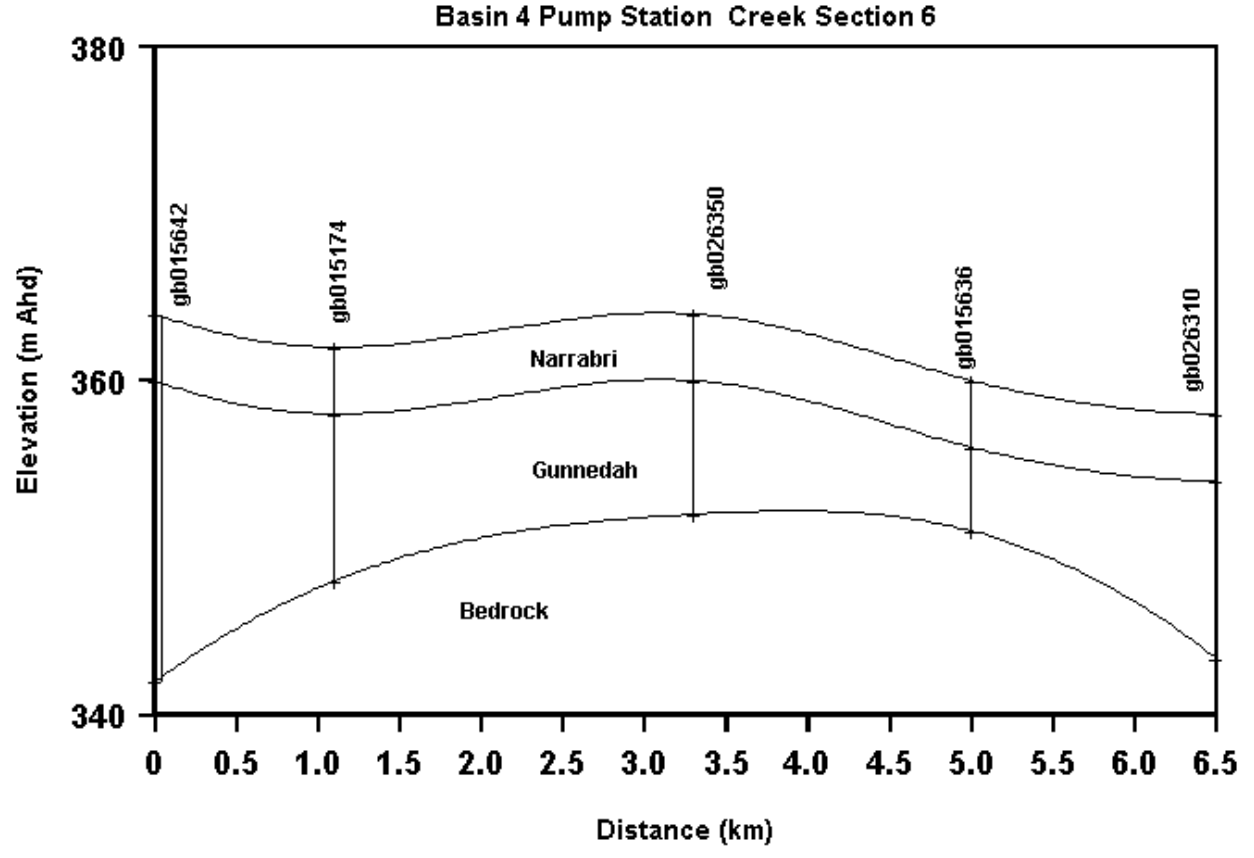
Basin 4 PumpStation Creek sub catchment



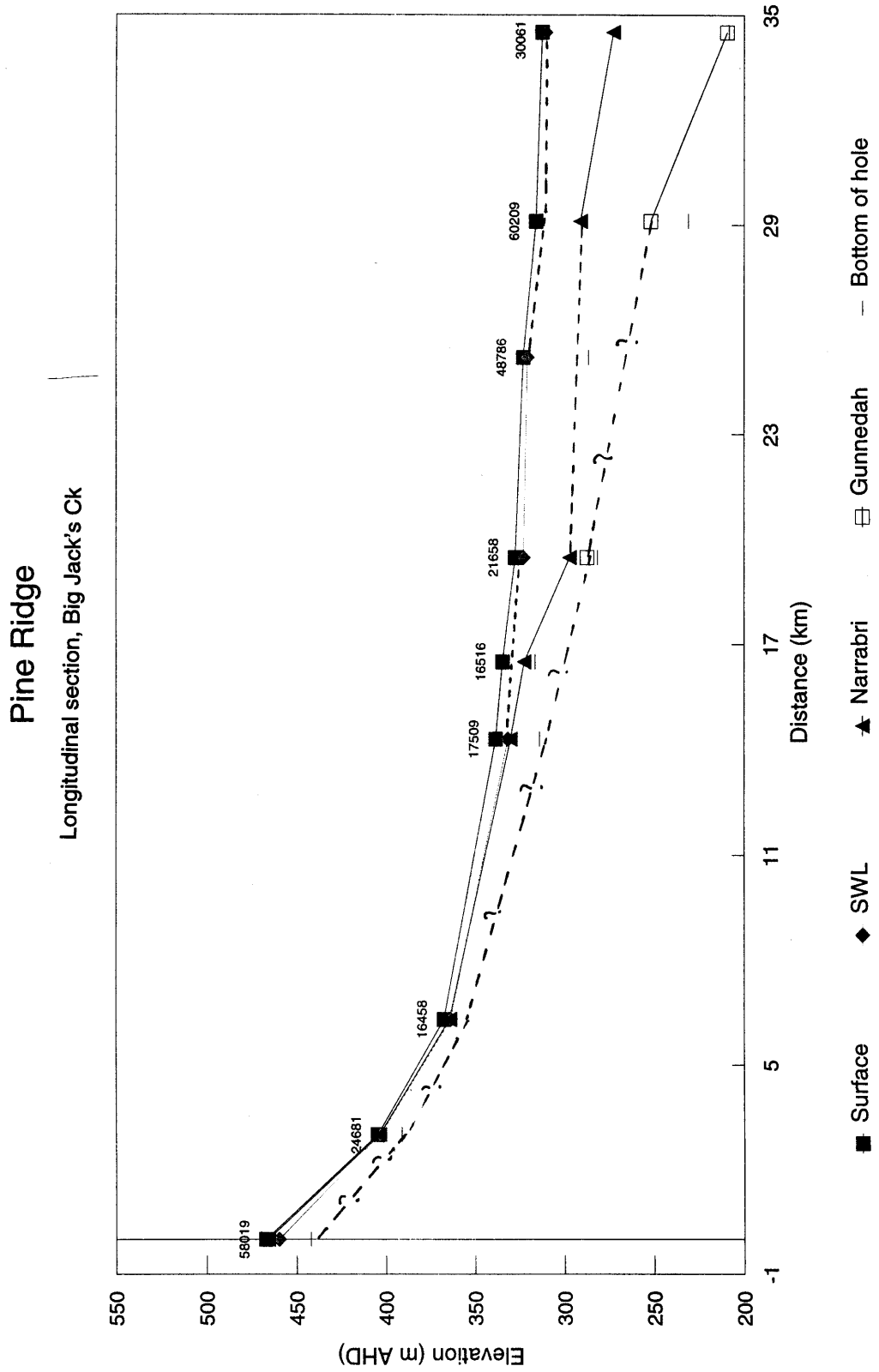

Basin 4 Pump Station Creek Section 1
Elevation (m Ahd)
360
340
320
300
280
0
1
2
3
4
5
6
Distance (km)
gb016497
gb028195
gb028196
gb031575
gb052536
gb064437
Narrabri
Gunnedah
Bedrock

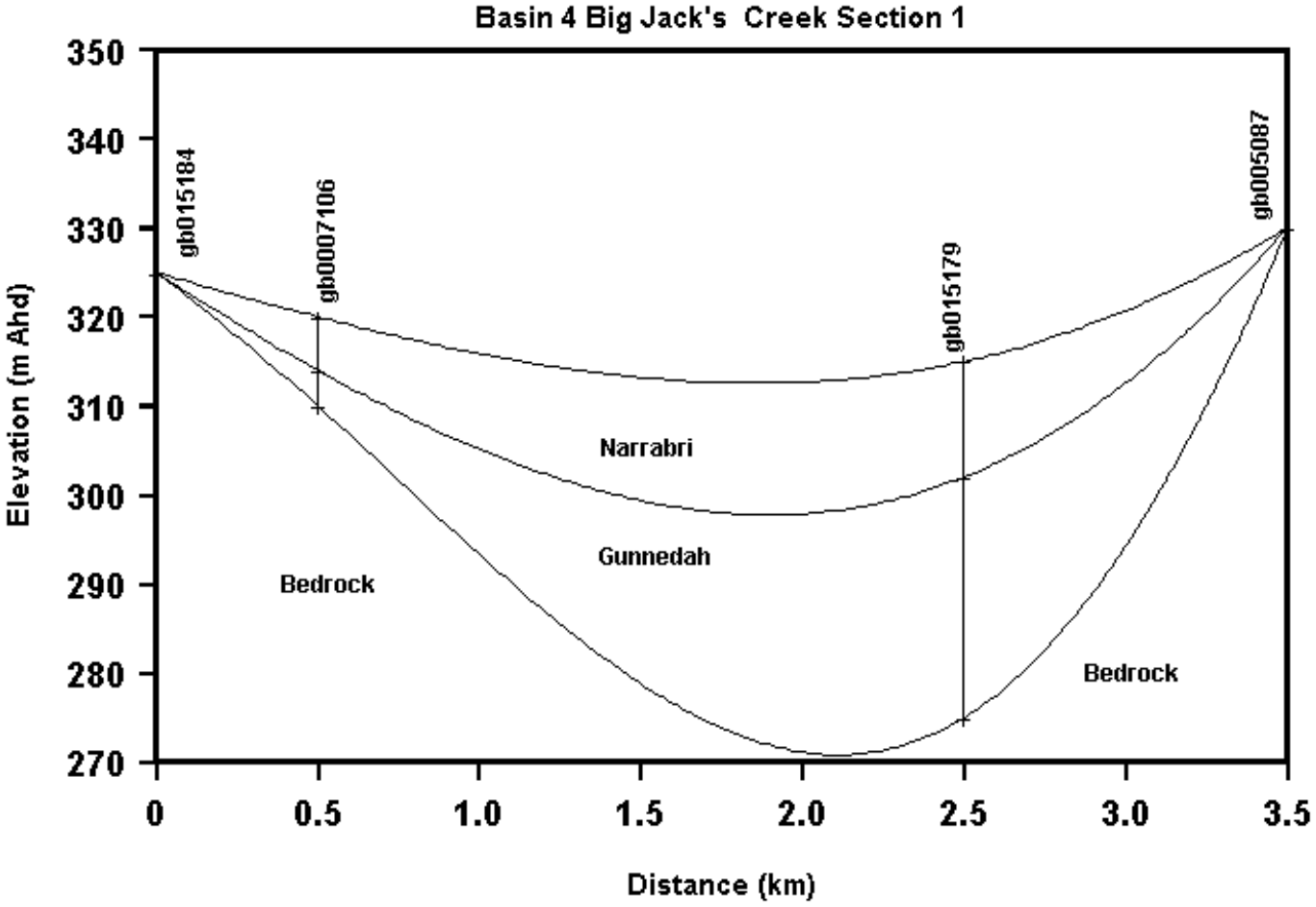

Basin 4 Pump Station Creek Section 2/3
Elevation (m Ahd)
360
340
320
300
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
Distance (km)
gb01518
gb033742
gb015140
gb033534
gb054374
Narrabri
Gunnedah
Bedrock

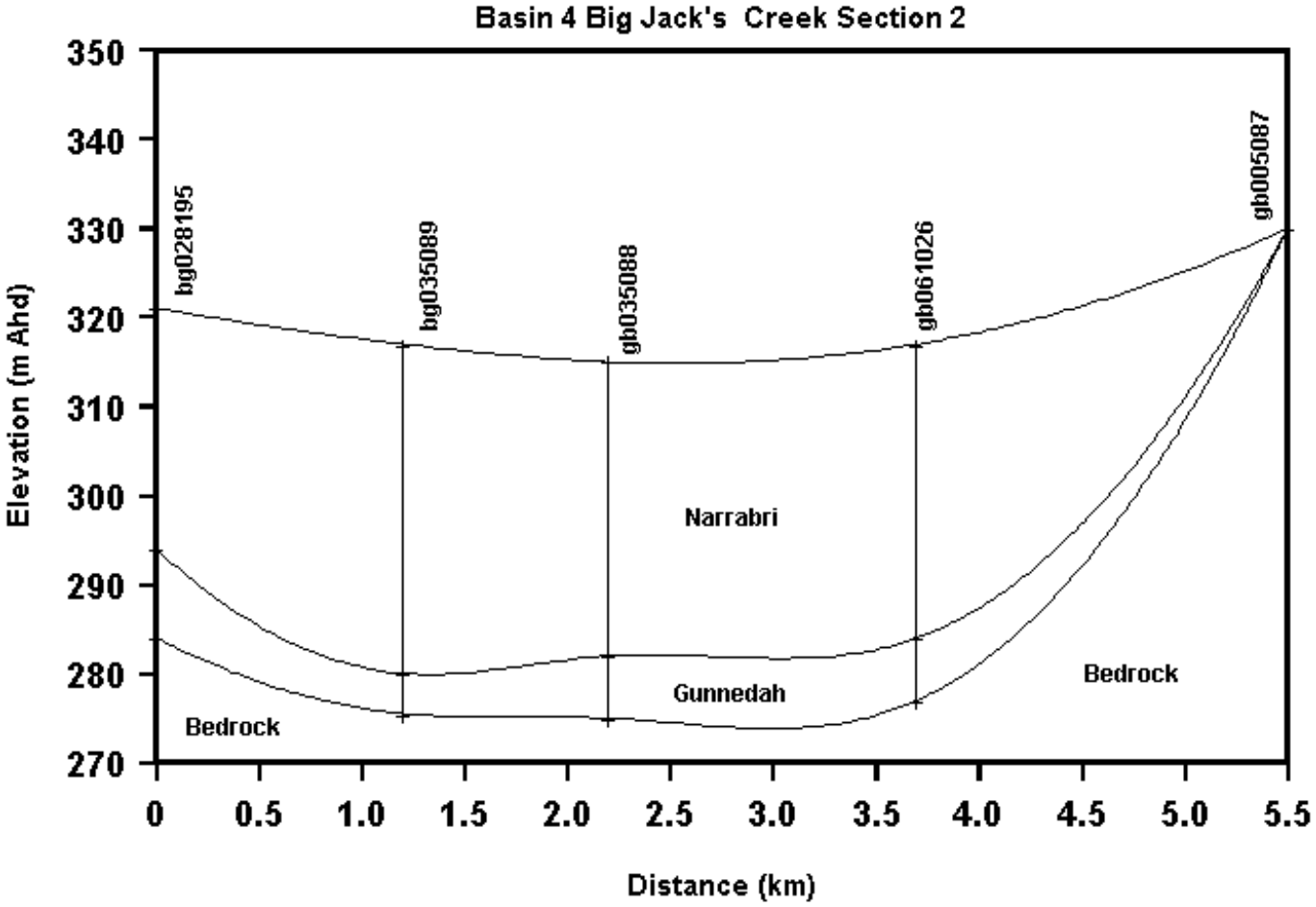

Basin 4 Pump Station Creek Section 4/5
Elevation (m Ahd)
380
360
340
320
300
280
gb016802
gb015638
gb015639
gb016537
Narrabri
Gunnedah
Bedrock
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Distance (km)

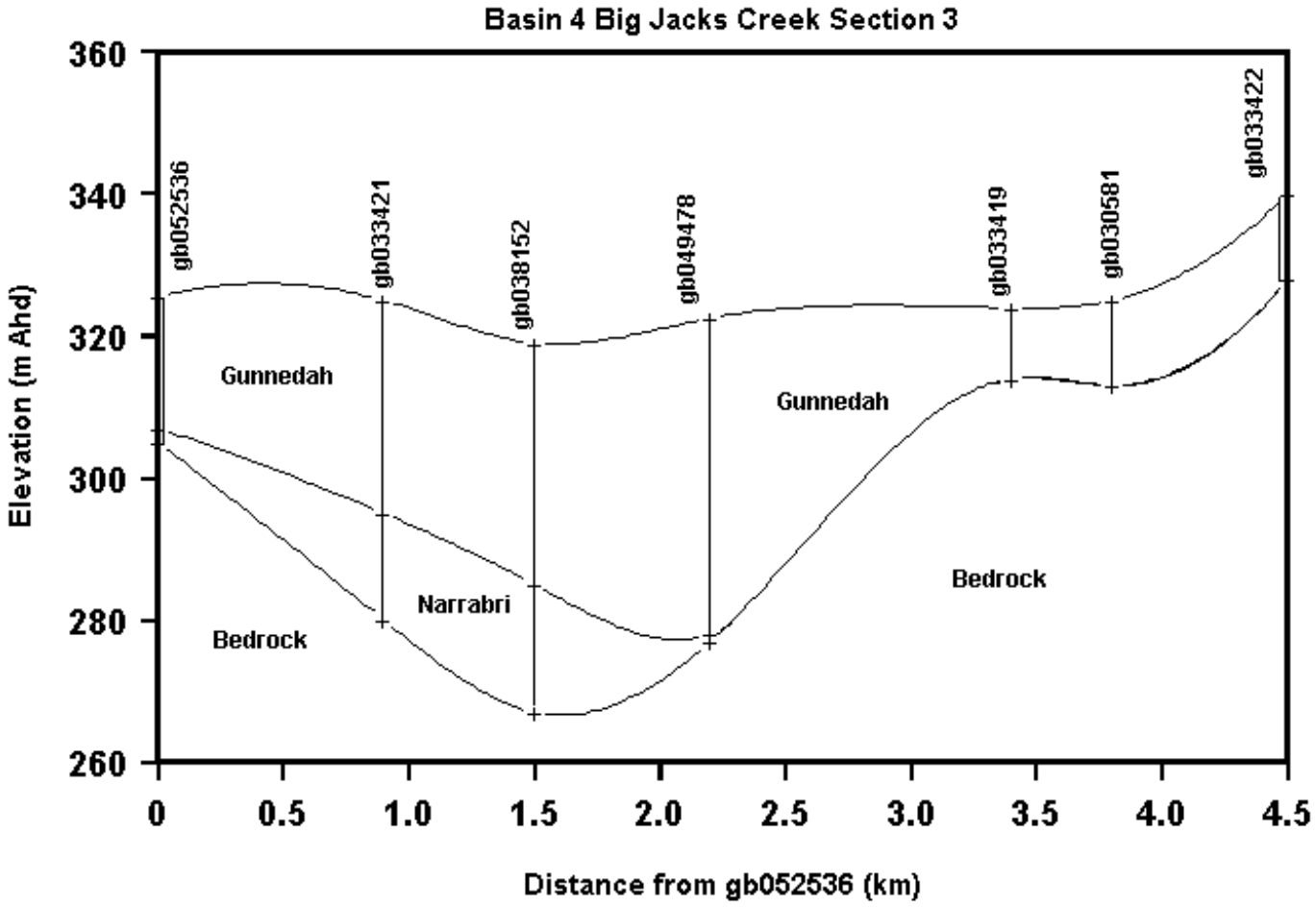

Basin 4 Pump Station Creek Section 6
Elevation (m Ahd)
380
360
340
gb015642
gb015174
gb026350
gb015636
gb026310
Narrabri
Gunnedah
Bedrock
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
Distance (km)

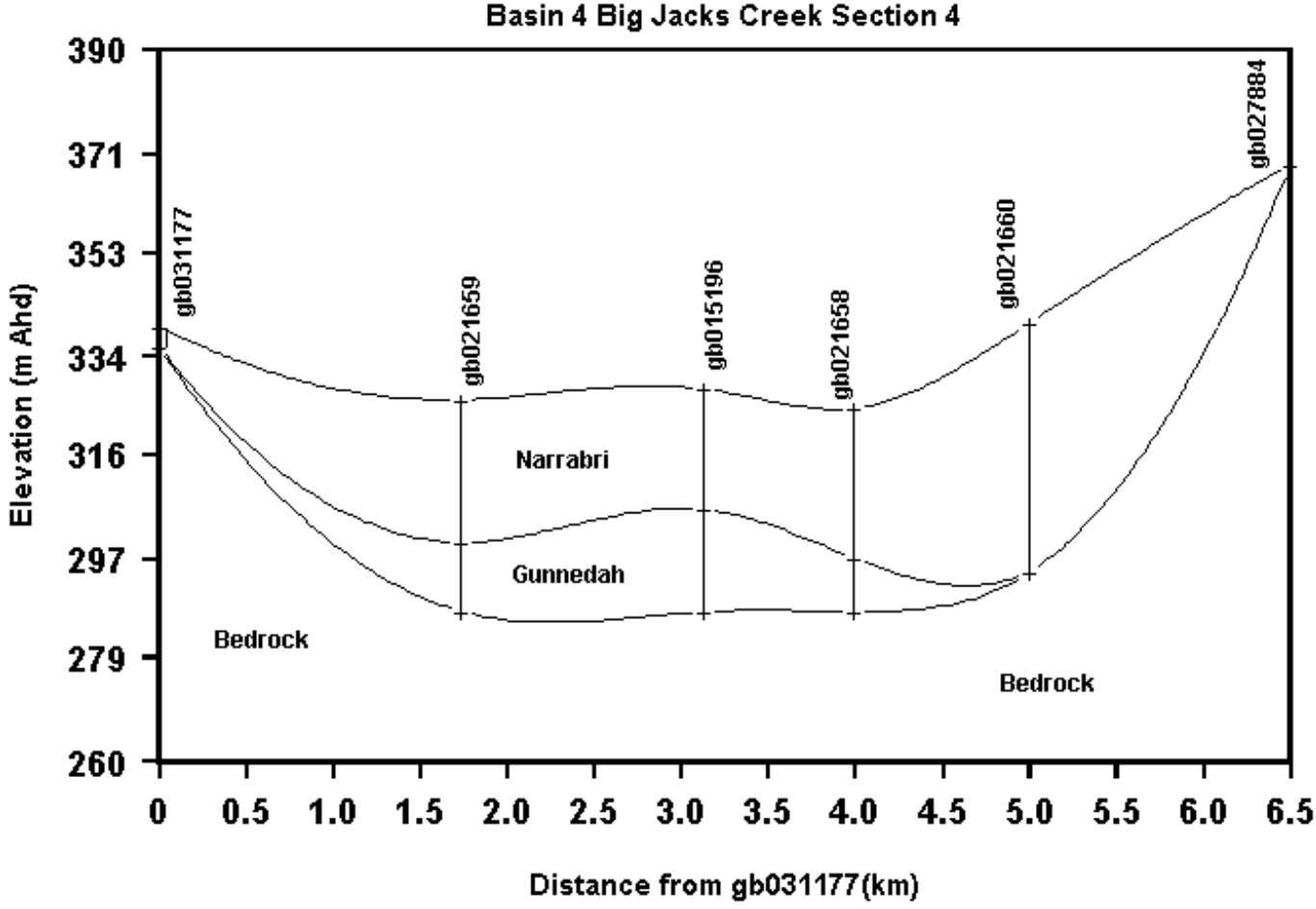
Basin 4 Big Jack's Creek sub catchment

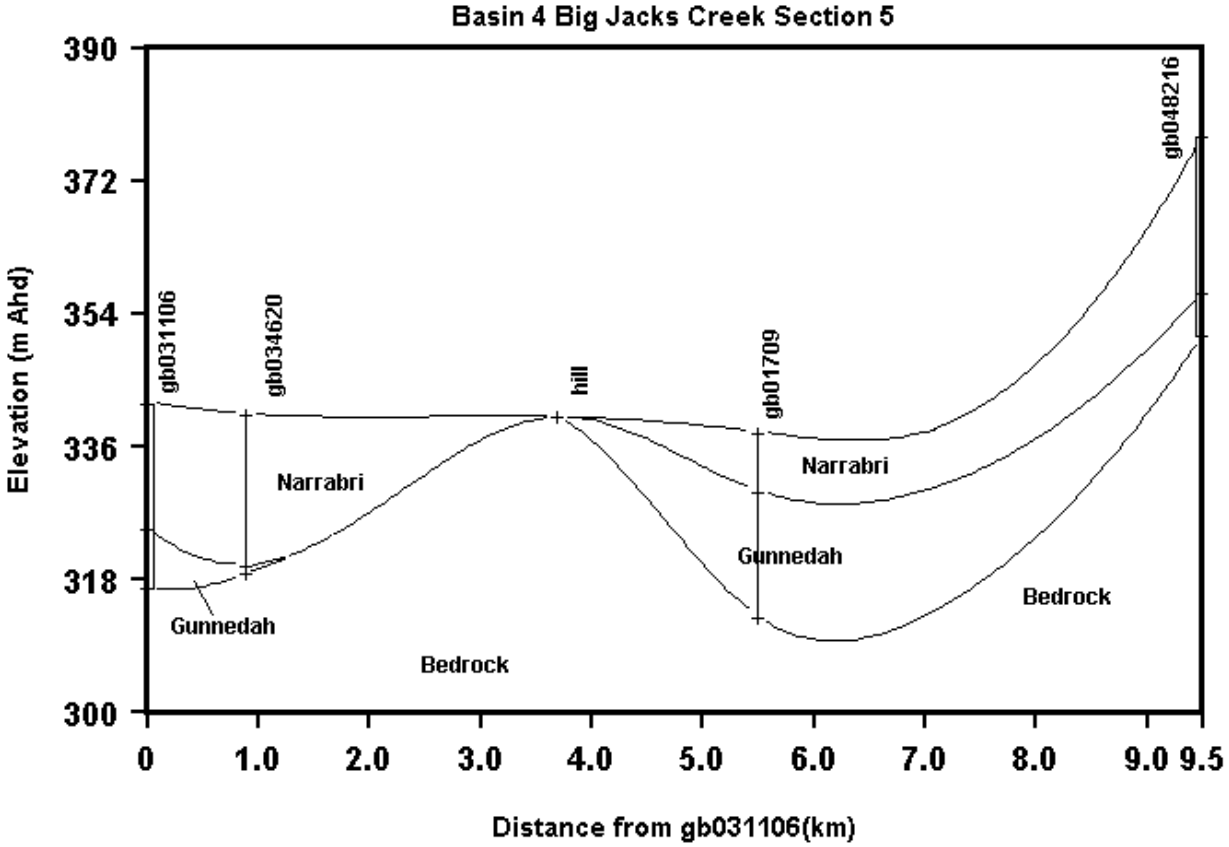


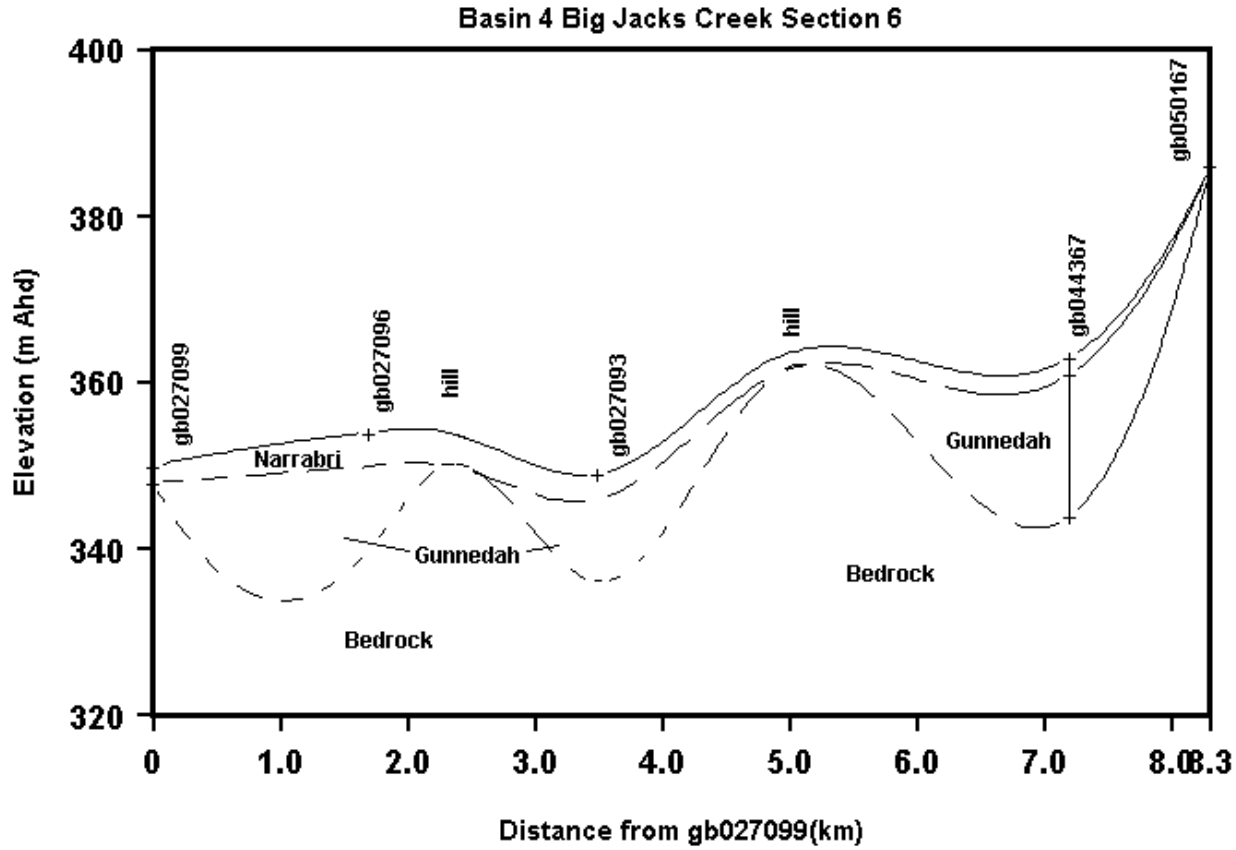

Basin 4 Big Jack's Creek Section 1
Elevation (m Ahd)
350
340
330
320
310
300
290
280
270
gb015184
gb0007106
gb015179
gb005087
Narrabri
Gunnedah
Bedrock
Bedrock
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Distance (km)


Basin 4 Big Jack's Creek Section 2
Elevation (m Ahd)
350
340
330
320
310
300
290
280
270
bg028195
bg035089
gb035088
gb061026
gb005087
Narrabri
Gunnedah
Bedrock
Bedrock
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
Distance (km)


Basin 4 Big Jacks Creek Section 3
Elevation (m Ahd)
360
340
320
300
280
260
gb052536
gb033421
gb038152
gb049478
gb033419
gb030581
gb033422
Gunnedah
Gunnedah
Narrabri
Bedrock
Bedrock
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Distance from gb052536 (km)


Basin 4 Big Jacks Creek Section 4
Elevation (m Ahd)
390
371
353
334
316
297
279
260
gb031177
gb021659
gb015196
gb021658
gb021660
gb027884
Narrabri
Gunnedah
Bedrock
Bedrock
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
Distance from gb031177(km)


Basin 4 Big Jacks Creek Section 5
Elevation (m Ahd)
390
372
354
336
318
300
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
9.5
Distance from gb031106(km)
gb031106
gb034620
hill
gb01709
gb048216
Narrabri
Narrabri
Gunnedah
Gunnedah
Bedrock
Bedrock


Basin 4 Big Jacks Creek Section 6
Elevation (m Ahd)
400
380
360
340
320
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
8.3
Distance from gb027099(km)
gb027099
gb027096
hill
gb027093
hill
gb044367
gb050167
Narrabri
Gunnedah
Gunnedah
Bedrock
Bedrock