4.5.2 Canning

4.5.2.1 Regional Hydrogeology

The entire Canning Basin is an enormous sedimentary basin occupying approximately 506,000 km^2, of which 430,000 km^2 are onshore Western Australia. Hydrogeological surveys for the purposes of identifying large scale water supplies are limited to a single investigation performed over approximately 3,500 km^2 on the western margin of the basin, by the Geological Survey of Western Australia (GSWA) from 1973 to 1979 (Leech, 1979). The proposed water supply for the Spinifex Ridge Project will consist of a single borefield located on the eastern side of study area (**Figure 4-15**).

Regionally there are three units of Mesozoic age identified within the Canning Basin that are hydrogeologically relevant to the proposed borefield location. These are; the Broome Sandstone, Jarlemai Siltstone and Wallal Sandstone. These sediments are interpreted to unconformably overlie the Muccan Batholith or Gorge Creek Group both of Archean age. Overlying the entire area are Quaternary alluvium and aeolian sands. Of these units the Wallal Sandstone has been identified as an aquifer capable of supplying the required water supply.

4.5.2.2 Local Aquifer Characteristics

The Broome and Wallal Sandstones are the identified aquifers in the western margin of the Canning Basin. For a majority of the area the Wallal Sandstone is confined beneath the Jarlemai Siltstone, while the overlying Broome Sandstone is unconfined. In the western extent of the basin the Broome Sandstone is found to unconformably overlie the Wallal Sandstone. All units are interpreted to dip at less than 1 degree to the north and no post deposition folding or faulting events are believed to deform the sediments.

Broome Sandstone (Unconfined Aquifer)

The Broome Sandstone is correlated as part of the Callawa Formation (Williams, 2004) and outcrops as isolated mesas of cross-bedded sandstone and conglomerate across the basin. The unit is largely comprised of poorly consolidated interbedded sequences of fine to coarse grained sub-angular to rounded quartz grains with weak ferruginous cement, minor bands of shale or siltstone may also occur (Leech, 1979). The unit disconformably overlies the Jarlemai Siltstone and for a majority of the basin. With the exception of the basin margins, where the thickness of the Jarlemai Siltstone thins and the Broome Sandstone may overlie the Wallal Sandstone or unconformably sit against the Archean Basement. In the West Canning Basin area the Broome Sandstone is unconfined and has been encountered at thicknesses up to 62 m. Measured hydraulic conductivities range between 3 and 15 m/day. The unit is recharged by direct percolation of rainfall and water levels are observed to fluctuate with heavy rainfall events. Specific Yield measurements for the Broome Sandstone have not been measured in the project area; however estimates have been made of between 10 and 30% by Leech for the determination of a possible resource. Within the project area it is assumed that the Broome and Wallal Sandstones are hydraulically separated by the Jarlemai Siltstone.

Wallal Sandstone (Confined Aquifer)

The Wallal Sandstone is an extensive unit and is present within a majority of the Canning Basin. It is typically confined by the Jarlemai Siltstone with the exception of the basin margins where it may be unconfined. Recharge to the unit occurs in the south-east, south of Jarlemai subcrop where the unit is unconfined and is likely to occur via direct percolation. A water level response to rainfall is not expected to occur for a majority of the aquifer and may only occur in the unconfined zones subject to direct recharge (south-east area of the basin). Groundwater discharge is expected to occur off-shore with the exception of a few small springs near Pardoo Station (Leech, 1979). Bores drilled into the Wallal on the coastal plain are typically artesian with head pressures up to 30 m above ground level.

The Wallal typically consists of a fine to coarse grained sandstone that ranges from poor to well-sorted and is typically unconsolidated. The aquifer thickness within the west of the basin range from 20 to 200 m and exceed 200 m off-shore and to the east of the project area. Measured hydraulic conductivities range from 1 to 140 m/day. The groundwater flow direction has been measured to flow from south-east to north-west (Leech, 1979).

- **Table 4-7 Selected Hydraulic Test Results for the Canning Basin Area (Leech, 1979)**

Bore ID	Lithology	Aquifer Type	Type of Test	Analysis Method	T (m^2/day)	K (m/day)	Sy or *S*
16B	Broome Sandstone	Unconfined	8 hr Constant Rate	Theis Curve	222	6.5	N/A
17B	Broome Sandstone	Unconfined	8 hr Constant Rate	Theis Curve	854	15	N/A
25D	Broome Sandstone	Unconfined	8 hr Constant Rate	Theis Curve	250	5.2	N/A
3A	Wallal Sandstone	Confined	8 hr Constant Rate Pump	Hantush - Jacob	145	8.1	
7A	Wallal Sandstone	Confined	8 hr Constant Rate Pump	Hantush - Jacob	204	8.5	
17A	Wallal Sandstone	Confined	8 hr Constant Rate Pump	Hantush - Jacob	142	5.9	
20D	Wallal Sandstone	Confined	8 hr Constant Rate Pump	Hantush - Jacob	720	42.9	2x10-4
25C	Wallal Sandstone	Confined	8 hr Constant Rate Flow	Hantush - Jacob	130	5.4	

NOTES: T – Transmissivity, K – Hydraulic Conductivity, Sy – Specific yield, *S* – Storativity, na – not available

4.5.2.3 Groundwater Chemistry

The groundwater quality for the Broome and Wallal Sandstones is not similar. Water quality data is limited to samples taken from pastoral wells and bores (Broome Sandstone) and bores completed as part of the West Canning Basin GSWA investigation (Leech, 1979).

Groundwater quality is available for the Broome Sandstone and Wallal aquifers. A total of 30 bores have been sampled. The chemistry of the groundwater obtained from the Wallal and Broome aquifers are typically potable (between 300 to 1000mg/L TDS) and pH of between 7 and 8 for a majority of the bores sampled. The water quality from the Broome aquifer is more consistent spacially across the basin, while the Wallal water quality shows some increase in Total Dissolved Solids (TDS) towards the north-western margin of the basin, ranging from 300 to 500 mg/L TDS (Leech, 1979).

The Expanded Durov Diagrams (**Figure 4-16** and **Figure 4-17**), show the chemical typing of the two respective aquifers. Typically the Broome Sandstone is Na^+ and Cl^- dominated indicating groundwaters are likely to be end point waters. The Wallal Sandstone Aquifer is dominant with Na^+ and Cl^- ions, indicating end points waters with an increasing concentration of Na^+ and Cl^- ions towards the discharge (north-west).

4.5.2.4 Other Groundwater Users

The WINSITES database of monitoring sites indicates that there are 129 recorded groundwater sites located within the Canning Basin up to 50 km from the proposed borefield. These vary from bores, wells and meteorological recording stations.

The operational status of the groundwater sites is not recorded for the majority of the water sources. However, according to the WINSITES database, 43 bores or wells are operational, eleven bores are abandoned or decommissioned, two wells and five meteorological stations are recorded as non-operational and the status of the remaining groundwater sources is not recorded. The majority of the bores are shown as being used for livestock watering and are completed in the Broome Sandstone or Tertiary sediments. The known groundwater user who abstract from the Wallal Sandstone is BHP Iron Ore Pty Ltd, who operate the Shay Gap Borefield as a water supply for their Yarrie Minesite.

The livestock bores are fairly shallow, varying from 6.67 mAHD to 26.86 mAHD. It appears that a number of these livestock bores are shallow hand-dug wells. One of these wells is Maydee Springs Well which is postulated to be a groundwater expression of the Wallal Sandstone leaking though the Jarlemai Siltstone.

A majority of the wells drilled into the Wallal Sandstone with the exception of the Shay Gap Borefield were completed as part of the Canning Basin investigation between 1973 and 1977 (Leech, 1979). Recently (2007) eleven of the artesian bores have been rehabilitated by the Department of Water to reduce up to 3.7 GL/yr of uncontrolled discharge (DoW, 2007).

MOLY MINES LIMITED

Spinifex Ridge Project
Western Australia

Figure 4-15
Canning Basin Borefield Location Map

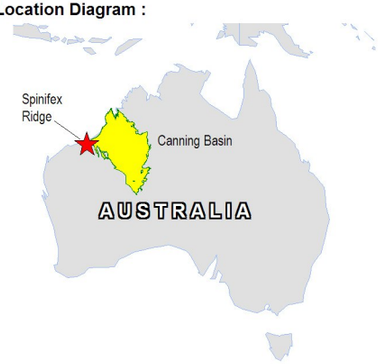
0 30km

Map Projection: Longitude / Latitude (Australia GDA94)

Compiled: 5 / 7 / 2007 Compiled by: MOL
Updated : 05 / 07 / 2007 Checked by : MOL
Plan No : Revision No : A

File: j:\3100 spinifex ridge mo\14 gis\user working data\per\per_figure_4.15 - A3.wor

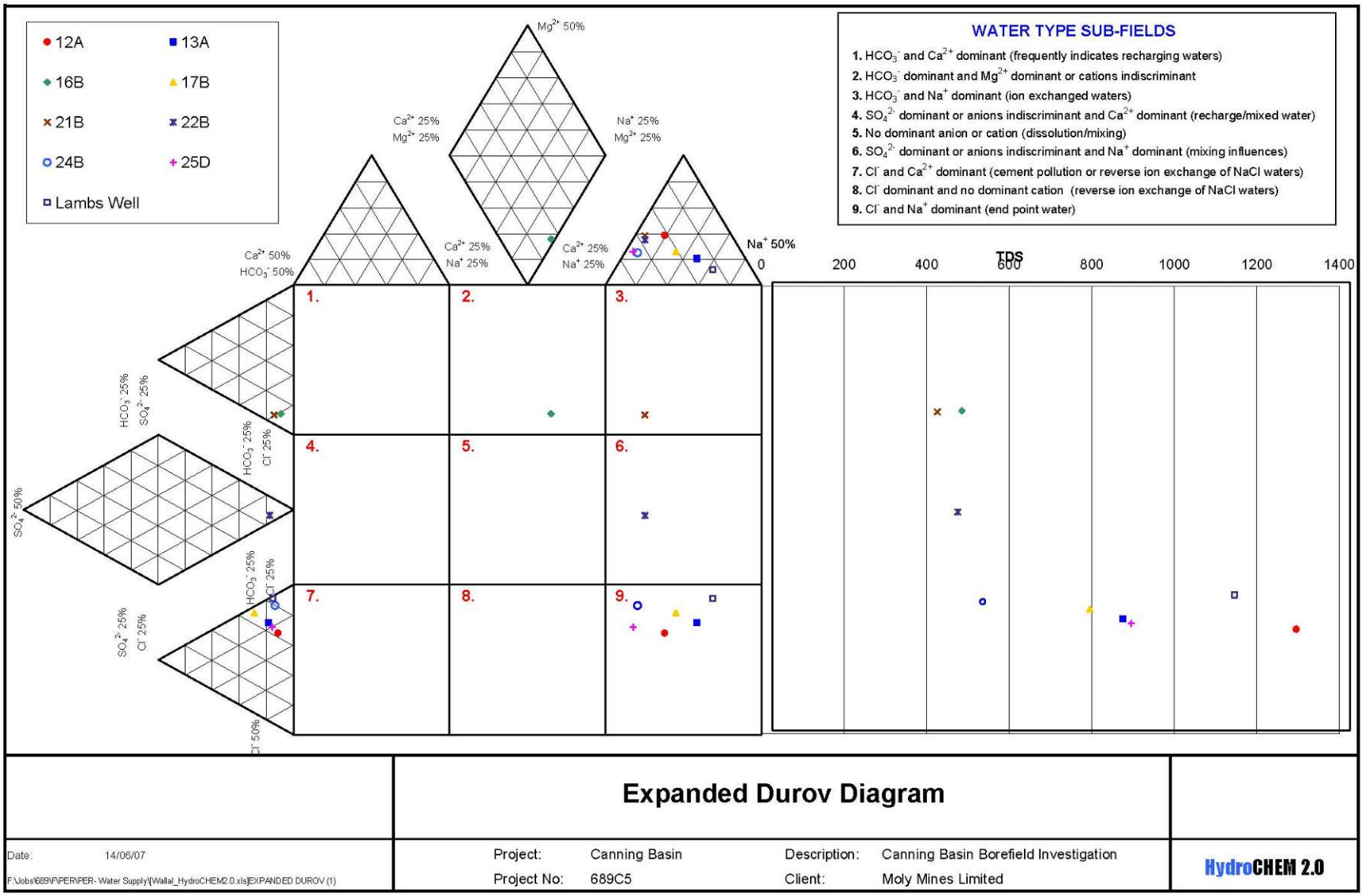
Location Diagram :



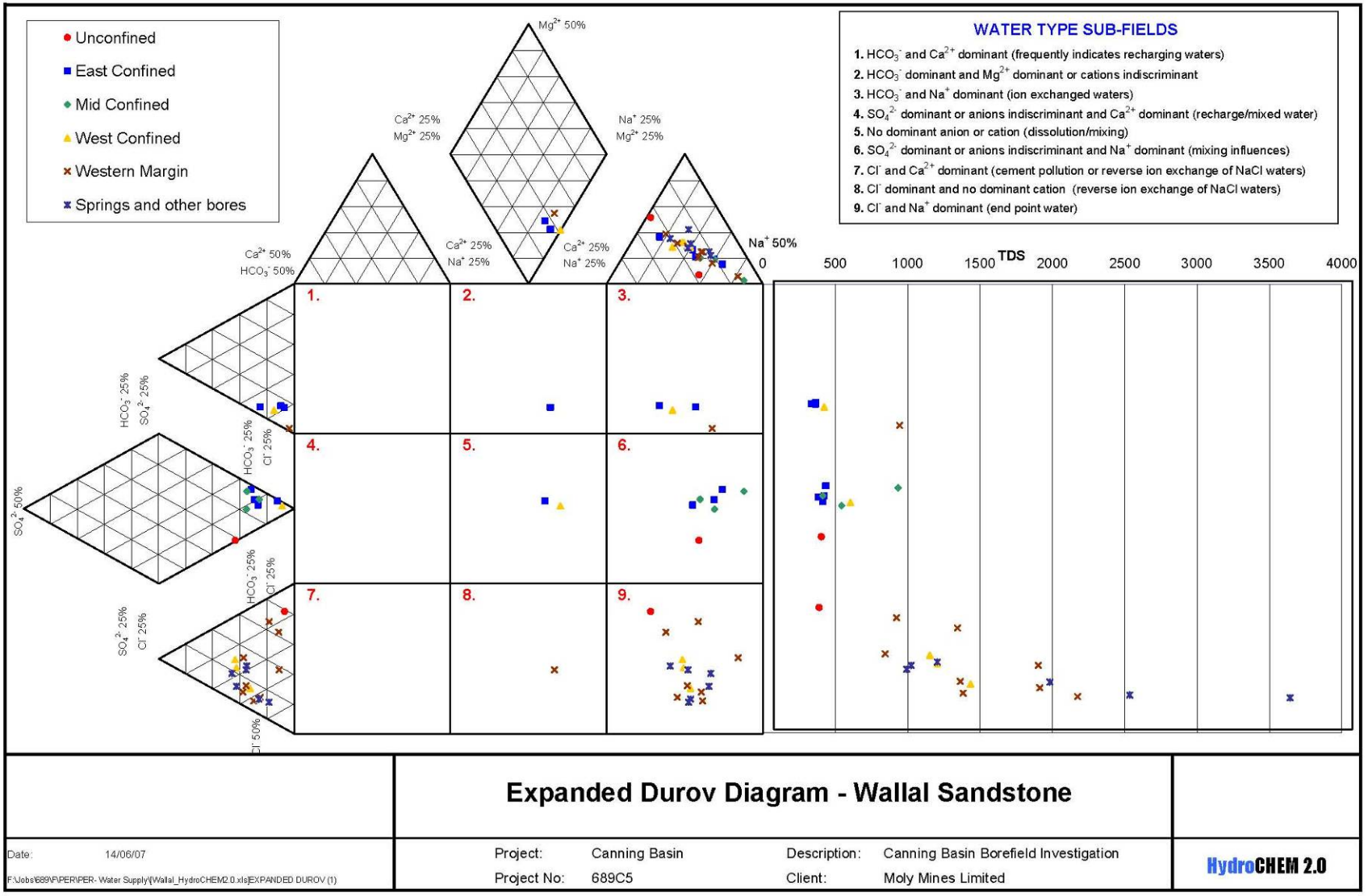
Map Legend :

- Spinifex Ridge Mineral Tenements
- Major Road
- Minor Road
- Telfer - Port Hedland Gas Pipeline
- WINSITES within 50km of Canning A borefield
- 50km buffer from centre of borefield
- Pipeline route from Canning A to Spinifex Ridge Plant Site.

INDIAN OCEAN
Cape Keraudren
Red Point
Mt Blaze
Ylbalgul Hill
Merrimerica Hill
Shoonta Hill
Warree Hill
Red Hill
Great Northern Highway
Borefields Rd
Canning A Borefield Tenement
Pyramid Hill
Mt Goldsworthy
Shay Gap
Black Hill
Mt Woodhouse
De Grey River
Pear Creek
Coongan River
White Quartz Hill
Muccan - Shay Gap Rd
Telfer Gas Pipeline
Mulgundoona Hill
Warrawagine Rd
Oakover River
Mt Cecelia
Iron Hill
Marble Bar Road
Spinifex Ridge Project Tenements
Doolena Peak
Bamboo Creek
Rd
Five Mile Hill
Talga Peak
The Pinnacles
Chimingadgi Hill
The Sisters
Talga Hill
Yandicoogina Creek
Nullagine River
Yilgalong Creek
Gossan Hill
Koongaling Hill
Mt Newdegate
Hill Y
Bullgarina Hill
MARBLE BAR
119° 45.0 E
120° 00.0 E
120° 15.0 E
120° 30.0 E
120° 45.0 E
121° 00.0 E
20° 00.0 S
20° 15.0 S
20° 30.0 S
20° 45.0 S
21° 00.0 S



- **Figure 4-16 Expanded Durov Diagram – Broome Sandstone**



- **Figure 4-17 Expanded Durov Diagram – Wallal Sandstone**