

Hydrogeology Report 1995/52

**ABORIGINAL COMMUNITIES DRILLING
PROPOSAL FOLLOWING SITE VISITS
WEST KIMBERLEY
(1995)**

by

S. Varma

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ABORIGINAL COMMUNITIES DRILLING PROPOSAL FOLLOWING SITE VISITS - WEST KIMBERLEY

INTRODUCTION

In July 1995, the Water Authority of Western Australia (WAWA) requested the Geological Survey of Western Australia (GSWA) to carry out preliminary desk studies for potential groundwater supplies at 19 Aboriginal communities in the West Kimberley region. The result of the desk studies was submitted to the Water Authority in Hydrogeology Report 1995/31 in August 1995. On the basis of the report, WAWA requested GSWA to carry out inspections at 5 Aboriginal communities. These communities were recommended for site visits due to the complex hydrogeological environment and required an inspection to appraise the geological features and to peg the sites prior to exploratory drilling. The five communities were visited by helicopter during 24-25 October 1995 by S. Varma (GSWA), N. Cull (WAWA, Kununurra), E. Pucci (WAWA, Broome) and J. Grant (WAWA, Perth).

SETTING

The Jimbalakudunj, Yiyili, Pantijan, Djaworrada and Larinyuwar Aboriginal communities are all located in the West Kimberley region (Figure 1). The Pantijan community is situated about 50 km east of Doubtful Bay on the Kimberley Plateau. Access for the drilling rig to this community would partly be by barge on the Calder River and partly by rough tracks. The Djaworrada community is located at the coast 25 km south of Kuri Bay and the rig access is by sea. The Larinyuwar community is situated at the eastern end of Cone Bay, an inlet in the King Sound, and can be accessed by sea. Access from inland is very rough and will require major road work. The Jimbalakudunj and Yiyili communities are situated along the Great Northern Highway about 125 km northwest and 150 km south of Fitzroy Crossing respectively. All the communities are located within 123°30' to 127°00'E longitudes and 15°30' and 19°00'S latitudes.

The physiography, geology and hydrogeology of the communities have been outlined in the preliminary hydrogeological desk study report by S. Varma (Hydrogeology Report 1995/31). Consequently, this report deals mainly with the findings of the recent field visit.

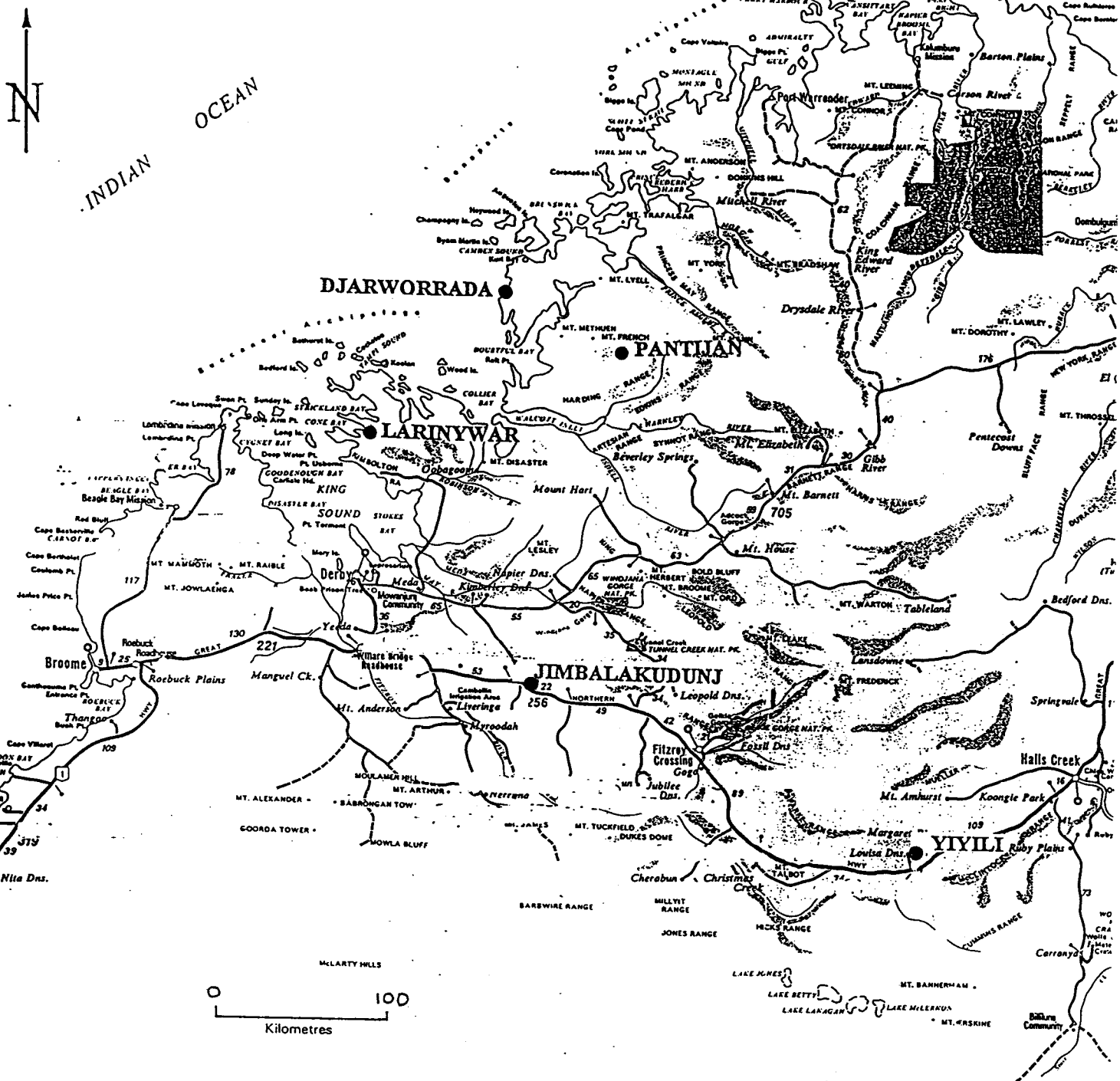
GROUNDWATER PROSPECTS

A total of 4-5 prospective bore sites were pegged at each community during the field visit. Each pegged site is indicated by an alphanumeric symbol (eg. A/95) where the letter indicates the order of pegging at a community and the number indicates the year during which the site was pegged. In order to distinguish the groundwater prospects at each site within a community the following system of ranking is adopted.

- | | |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rank 1 | Indicates that the proposed bore is most likely to produce the required yield with a salinity less than 1500 mg/L TDS. |
| Ranks 2-4 | A bore site is ranked between 2 and 4 if the yield and/or the quality of water cannot be estimated from the available data, but can be roughly anticipated as being able to meet the community's requirements to a level depending on the rank. |
| Rank 5 | A bore site is ranked 5 if the proposed bore is unlikely to yield sufficient water and/or the groundwater is brackish or saline. |

If the prospects at two or more sites are similar, a decimal numeric is used to describe the relative ranking. The ranking of the groundwater prospects of a bore site is intended to be used as a guide for determining the sequence of drilling and does not include factors such as access, distance or any social constraints.

The groundwater prospects at each community are described separately.



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FIG 1. LOCATION

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JIMBALAKUDUNJ ABORIGINAL COMMUNITY

CURRENT WATER SUPPLY

Jimbalakudunj is situated about 125 km northeast of Fitzroy Crossing along the Great Northern Highway (Figures 1 and 2). The current water supply for the community is obtained from the No 3 bore from which a good supply of water is obtained but is of poor quality (Table 1). The community's present requirement is about 40 m³/d of good quality water.

TABLE 1. BORE DATA - JIMBALAKUDUNJ

Bore	Depth (m)	Supply (m ³ /d)	SWL (m bns)	Salinity (mg/L)	Status
No 3	122	216	24	1700	Production

PROPOSED EXPLORATORY DRILLING SITES

Five prospective bore sites were pegged at the community (Figure 2) during the recent field visit and are numbered A/95 - E/95. The drilling target for all pegged sites is fractured sandstone of the Permian Liveringa Formation. Three sites, A/95, B/95 and E/95, were pegged along the main drainage crossing the eastern portion of the community. Site C/95 was pegged about 4 km west-northwest of the community along the axis of the anticlinal fold in sandstone where more fractures along the axis are likely to enhance recharge. Site D/95 was pegged about 1.5 km upslope of the community.

The prospects of obtaining good supplies of suitable quality water are best at sites C/95 and B/95 followed by D/95. The prospects of obtaining larger yields are better at sites A/95 and E/95 but the groundwater may be brackish. It is recommended that drilling be carried out first at site A/95 to test the groundwater salinity close to the community. If the quality is poor at site A/95, then drilling should proceed at site B/95, followed by site C/95 or D/95 depending on the results at site B/95.

The estimated drilling depth, strata and prospects are summarised in Table 2. There is a good access to the community via Great Northern Highway and the proposed exploratory drilling sites require minor site preparation.

GROUNDWATER QUALITY

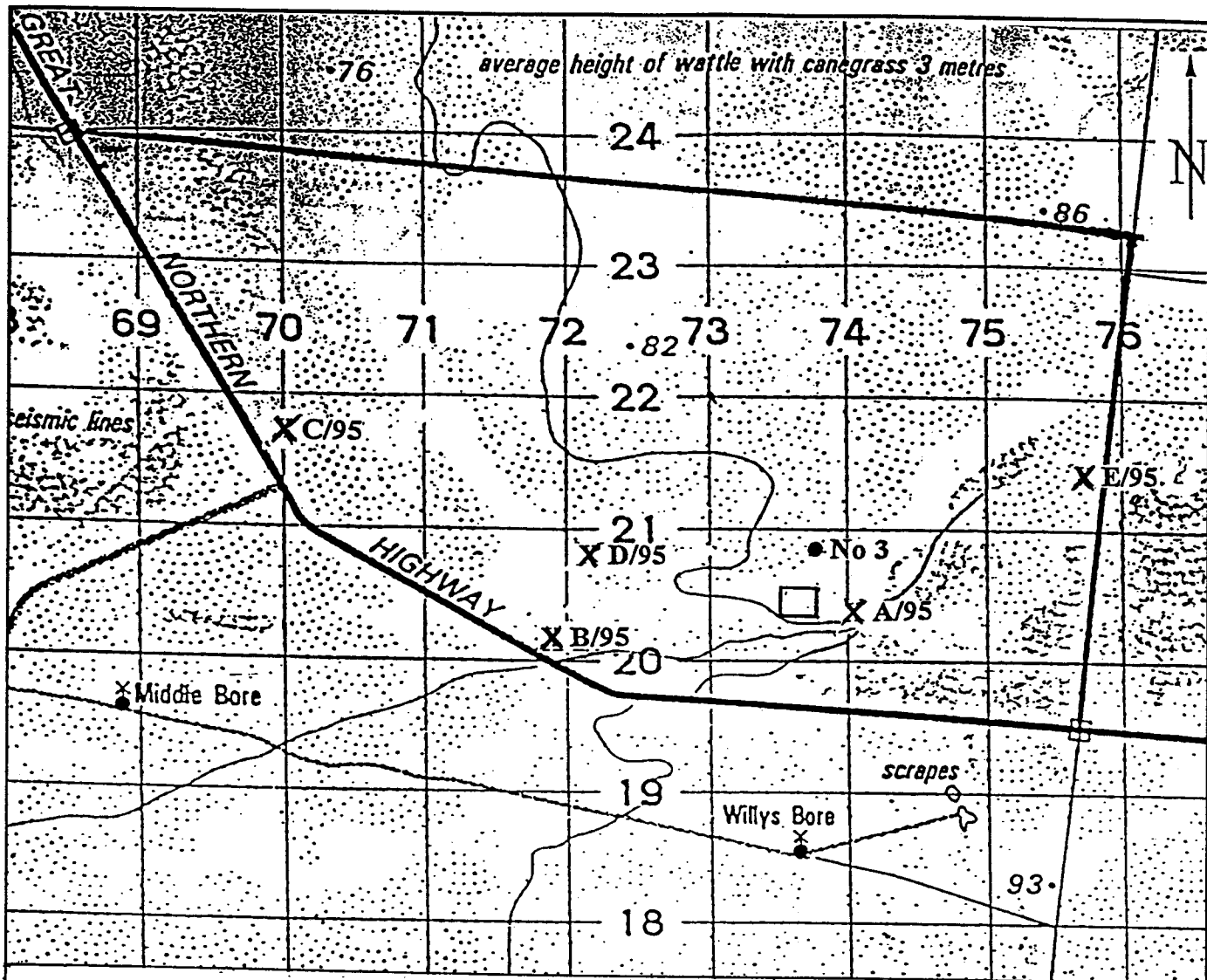
The Liveringa Formation yields fresh to saline water. Groundwater quality in the bores in the proximity of the community is poor with the salinity ranging from 1000 mg/L to 2000 mg/L TDS. The existing production bore (No 3) has a salinity of 1700 mg/L TDS. The proposed bore sites have been selected in areas where recharge may be higher, such as along the main drainage and in fractured areas, to obtain the best quality of groundwater.

DRILLING REQUIREMENTS

All sites should be drilled to at least 60 m. The depth may be increased to 100 m if insufficient supplies, but of suitable quality, are obtained. During drilling the groundwater salinity should be monitored at close intervals and drilling should stop if the salinity exceeds 1500 mg/L. Air rotary drilling with down-the-hole hammer will be needed to drill at the proposed sites.

TABLE 2. PROPOSED BORE SITES - JIMBALAKUDUNJ

Site	Coordinates (AMG)	Airphoto series, run, No	Minimum drilling depth (m)	Est. depth to watertable (m bns)	Strata	Prospects
A/95	673970 E 8020351 N	WA2527,13, 5043-44	60	15-25	Alluvium, fractured sandstone	3.2
B/95	671700 E 8020209 N	WA2527,13, 5043-44	60	15-25	Alluvium, fractured sandstone	2.2
C/95	669920 E 8021708 N	WA2527,13, 5043-44	60	15-25	Fractured sandstone	2.1
D/95	672120 E 8020828 N	WA2527,13, 5043-44	60	15-25	Fractured sandstone	3.1
E/95	675599 E 8021474 N	WA2527,13, 5043-44	60	15-25	Alluvium, fractured sandstone	4.0



0 1 km

- Existing bore
- X A/95 Proposed bore site
- Community
- Boundary of excision area

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FIG 2. JIMBALAKUDUNJ

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YIYILI ABORIGINAL COMMUNITY

CURRENT WATER SUPPLY

Yiyili is located on the southern bank of the Margaret River, about 4 km east of Louisa Downs Homestead. It is about 120 km southwest of Fitzroy Crossing along the old route of Great Northern Highway (Figures 1 and 3).

The community presently obtains water from a borefield situated about 2 km to the east. The community is occasionally supplied by bores (1/89, 1/93 and 4/93) in the neighbouring Ganyini borefield situated about 3 km to the west. The existing bore data is given in Table 3. Yiyili is a large established Aboriginal community and requires about 200-400 m³/d of water to meet the demand. The existing bores are obtaining water from the alluvium and supplies are largely dependent on seasonal recharge.

PROPOSED EXPLORATORY DRILLING SITES

Four potential aquifers occur in the area. The McAlley Shale is a poor aquifer but supplies of 50 m³/d have been reported from sandy interbeds. A total of 23 bores were drilled in the McAlley Shale at the Yiyili borefield, but only five production bores (3/83, 7/83, 3/86, 7/86 and 17/86) were constructed. The Tean Formation consists mainly of sandstone and has a good potential as an aquifer, especially adjacent to the Margaret River where it receives additional recharge. The Tean Formation has not been tested as yet. Limestone of the Lawford beds could be prospective for groundwater provided there is sufficient thickness of saturated sediments. Alluvial deposits near the Margaret River may form a prospective aquifer but the saturated thickness of deposits can fluctuate greatly and the watertable may drop below the basal river gravel after over-pumping or during prolonged drought.

Four prospective sites were pegged up to 5 km from the community during the recent field visit (Figure 3). Sites A/95 and B/95 were pegged about 5 km east of the community and about 3.5 km east of the existing borefield from which a pipeline supplies the community. The drilling target is sandstone of the Tean Formation.

Sites C/95 and D/95 were pegged close to the community and the drilling target is limestone of the Lawford beds and sandy interbeds in the underlying McAlley Shale.

Sites E and F were not pegged but are situated near production bores 1/93 and 4/93 in the neighbouring Ganyini borefield from where a pipeline runs to Yiyili. Bores 1/93 and 4/93 obtain groundwater from alluvium and produce relatively good yields (65-100 m³/d). Additional bores at the Ganyini borefield may overstress the aquifer and cause the watertable to drop below the basal river gravel with prolonged pumping.

In addition, site A/93 which was pegged by P M Thorpe in 1993 (Hydrogeology Report 1993/18) is still considered prospective for exploratory drilling. The site is pegged on a limestone outcrop of the Lawford beds and drilling may intersect good supplies of groundwater if the saturated thickness of the limestone beds is sufficient. The location and groundwater prospects of the proposed bore sites are described in the attached table.

Though site A/95 is the most prospective site for drilling, access to the site may be restricted during the wet season. Drilling should first be conducted at site B/95 up to a depth of 60 m to test the groundwater potential of the sandstone of the Tean Formation. The drilling depth can be increased if the yield is insufficient but water bearing fractures are still intersected. Depending on the drilling results at site B/95, drilling may then proceed at site E, F or A/93. Sites C/95 and D/95 are least prospective and should be drilled only if drilling at other sites has been unsuccessful. The estimated drilling depth, strata and prospects are summarised in Table 4.

GROUNDWATER QUALITY

Groundwater is likely to be fresh throughout the investigation area as indicated by previous exploratory drilling.

DRILLING REQUIREMENTS

Mud rotary drilling may be required at sites E and F if the alluvial deposits are thick. Air rotary with down-the-hole hammer would be required at sites A/93, A/95, B/95, C/95 and D/95.

TABLE 3. BORE DATA - YIYILI AND GANYINI

Bore	Depth (m)	Supply (m³/d)	SWL (m bns)	Salinity (mg/L TDS)	Status
Old Bore	10.5	100	7.2	250-320	Abandoned
New Bore	45.7	<30	7.2	NA	Abandoned
1/83	NA	NA	NA	NA	Abandoned
2/83	NA	NA	NA	NA	Abandoned
3/83	73.0	100	4.3	700	Production
4/83	NA	NA	NA	NA	Abandoned
5/83	NA	NA	NA	NA	Abandoned
6/83	NA	NA	NA	NA	Abandoned
7/83	40.0	43	4.0	850	Production
1/86	50.4	48	6.2	600	Abandoned
2/86	27.4	?dry	NA	NA	Abandoned
3/86	39.8	50	6.4	580	Production
4/86	30.3	12	13.4	400	Abandoned
5/86	36.3	25	6.3	510	Abandoned
6/86	33.3	2	6.2	355	Abandoned
7/86	33.3	16	6.8	310	Production
8/86	24.3	Dry	NA	NA	Abandoned
9/86	33.3	Dry	NA	NA	Abandoned
10/86	29.7	NA	24.4	NA	Abandoned
11/86	33.3	?dry	NA	NA	Abandoned
12/86	30.3	Dry	NA	NA	Abandoned
13/86	30.3	9	2.0	530	Abandoned
14/86	33.3	16	13.1	480	Abandoned
15/86	30.3	8	11.1	410	Abandoned
16/86	30.3	14	NA	400	Abandoned
17/86	42.3	50	6.9	540	Production
1/89	20.2	100	7.2	250	Production
1/90	12.5	<10	7.6	NA	Abandoned
2/90	12.5	10	7.5	NA	Abandoned
3/90	12.5	<10	5.7	NA	Abandoned
1/93	15.6	100	7.55	381	Production
2/93	10.8	Dry	6.7	NA	Abandoned
3/93	7.8	Dry	7.8	NA	Abandoned
4/93	15	65	7.11	410	Production

TABLE 4. PROPOSED BORE SITES - YIYILI

Site	Coordinates (AMG)/ Location	Airphoto series, run, No	Estimated drilling depth (m)	Est. depth to watertable (m bns)	Strata	Prospects
A/93	262703 E 7926344 N	WA 2618, 11, 5119-21	60	30	Karstic limestone of Lawford beds over McAlley Shale	3.4
A/95	268268 E 7930011 N	WA 2618, 10, 5159-61	60	30	Fractured sandstone of Tean Formation	3.1
B/95	268244 E 7928811 N	WA 2618, 10, 5159-61	60	30	Fractured sandstone of Tean Formation	3.5
C/95	261511 E 7928943 N	WA 2618, 10, 5159-61	30	10	Karstic limestone of Lawford beds over McAlley Shale	4.1
D/95	259201 E* 7930820 N* Site is 800 m southeast of site C/95 and 300 m north of old highway	WA 2618, 10, 5159-61	40	15-20	Karstic limestone of Lawford beds over McAlley Shale	4.2
E	200 m northwest of 4/93	WA 2618, 10, 5159-61	20	7-10	Alluvium	3.2
F	200 m west of 1/93	WA 2618, 10, 5159-61	20	7-10	Alluvium	3.3

*Erroneous GPS reading.

PANTIJAN ABORIGINAL COMMUNITY

CURRENT WATER SUPPLY

The community is situated on the western bank of the Sale River at the edge of Prince Regent Plateau, about 210 km northeast of Derby (Figures 1 and 4). At present there is no bore at the settlement. The water supply is obtained from a pool on the Sale River. The present water requirement of the community is 40 m³/d.

PROPOSED EXPLORATORY DRILLING SITES

There are three potential aquifers in the vicinity of the Pantijan community. Good groundwater prospects occur along a north-trending fault in the King Leopold Sandstone and Hart Dolerite. The Hart Dolerite outcrops about 2.5 km north of the community and is likely to underlie alluvium along a creek draining to the south and situated west of the community. The Carson Volcanics are highly weathered basalt and form local aquifers. The formation outcrops in the east of the Sale River.

Five prospective sites were pegged within 1.5 km of the Pantijan community. Sites A/95, B/95 and C/95 are located approximately 300 m, 1.3 km and 900 m north of the community respectively and along a north-trending fault in the King Leopold Sandstone. The sites are at intersections of the fault and photolineaments. The target at these sites is fractured sandstone.

Site D/95 was pegged adjacent a south-draining creek about 1.2 km west of the community. The target at this site is alluvium and underlying dolerite of the Hart Dolerite. Access to site D/95 will be restricted during the wet season. No site was pegged on the outcrop of Hart Dolerite outcrop to the north of the community as the ground was waterlogged.

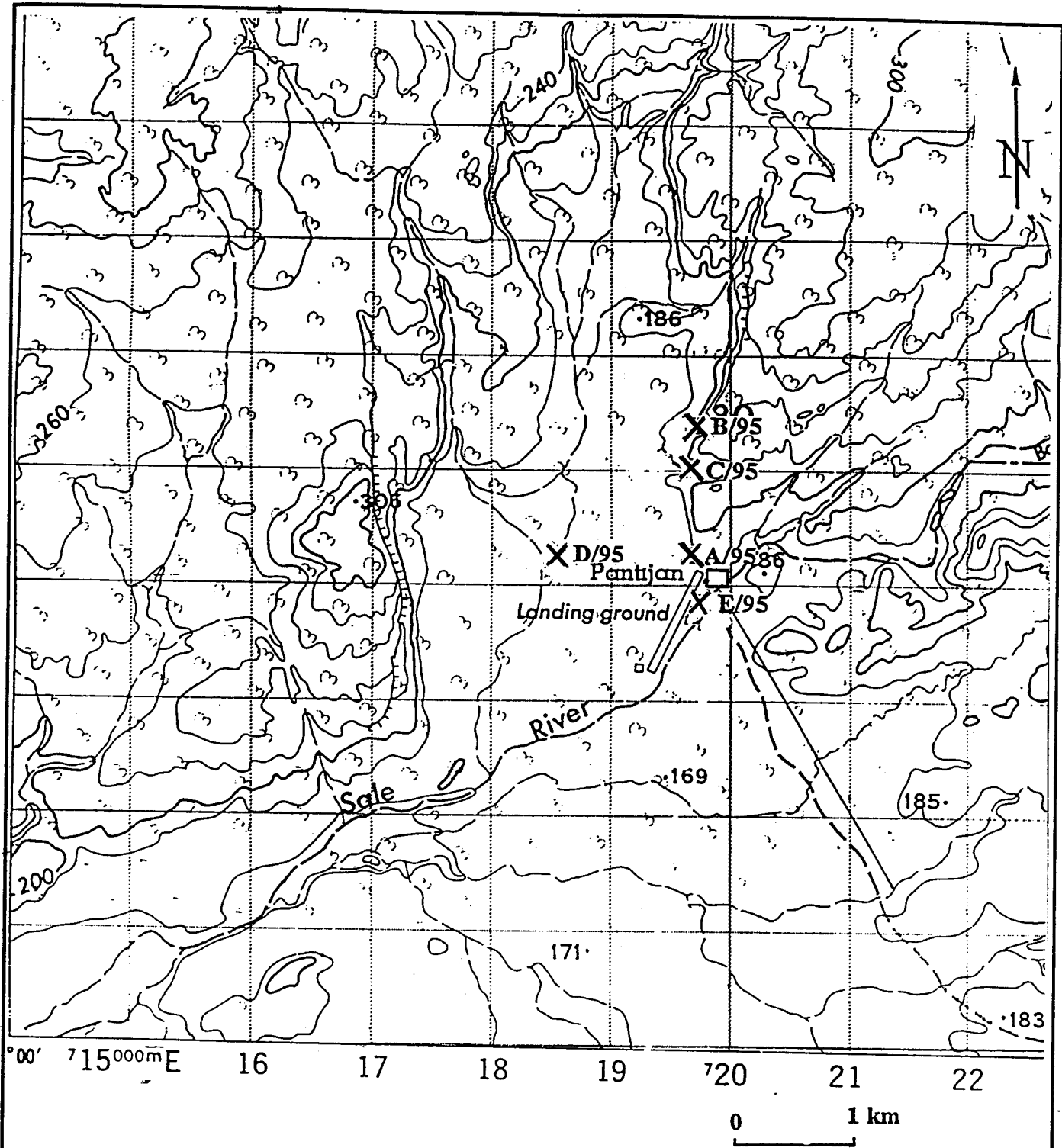
Site E/95 was pegged 150 m south of the community between the airstrip and Sale River and the targets are weathered basalt of the Carson Volcanics and fractured sandstone of the King Leopold Sandstone. The local aquifer may receive additional recharge from the river. Groundwater is likely to be fresh at the community. The estimated drilling depth, strata and prospects are summarised in Table 5.

DRILLING REQUIREMENTS

All bores should be drilled to a minimum depth of 60 m which can be increased further if the yield is insufficient but water bearing fractures are still intersected. Air rotary with down-the-hole hammer drilling would be required at all the sites at the community.

TABLE 5. PROPOSED BORE SITES - PANTIJAN

Site	Coordinates (AMG)	Airphoto series, run, No	Minimum drilling depth (m)	Est. depth to watertable (m bns)	Strata	Prospects
A/95	719600 E 8234750 N	WA3088,17, 5155-57	60	5-10	Fractured sandstone	3.2
B/95	719700 E 8235400 N	WA3088,17, 5155-57	60	5-10	Fractured sandstone	3.3
C/95	719580 E 8235030 N	WA3088,17, 5155-57	60	5-10	Fractured sandstone	3.1
D/95	718583 E 8234227 N	WA3088,17, 5155-57	60	5-10	Weathered dolerite	2
E/95	719620 E 8233848 N	WA3088,17, 5155-57	60	5-10	Weathered basalt, fractured sandstone	3.4



X B/95 Proposed bore site
 □ Community

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FIG 4. PANTIYAN

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DJAWORRADA ABORIGINAL COMMUNITY

CURRENT WATER SUPPLY

The Djaworrada Aboriginal community is located at the eastern end of a small bay between Hall Point and Prior Point about 200 km northeast of Derby (Figures 1 and 5). The surrounding hills are rugged and there is no access to the community from inland.

The community recently relocated and the present water supply is obtained from a small pool about 3 km east of the community. The community requires about 40 m³/d of water to meet its present needs.

PROPOSED EXPLORATORY DRILLING SITES

There are two potential aquifers in the vicinity of the Djaworrada community. The sandstone of the Buckland Point Member of the Proterozoic Kimberley Group may form a minor aquifer. The formation is intruded by the Hart Dolerite which is extensively jointed and could be the most prospective aquifer in the region. Access to outcrop areas of the Hart Dolerite away from the coast and tidal flats would require major access work.

Four prospective sites, A/95-D/95, were pegged along faults and at the intersection of photolineaments on the Hart Dolerite within a distance of 2.5 km of the community. Site A/95 was pegged on a northwest-trending fault. Site B/95 was pegged along a southwest-trending photolineament and is adjacent to a gravel track. Site C/95 is located at the intersection of the northwest-trending fault and a photolineament on the Hart Dolerite. Access to site C/95 will require some minor work. Site D/95 was pegged at the northern edge of the outcrop area of the Hart Dolerite and along a southeast-trending photolineament. The drilling target at all the above sites is fractured and weathered dolerite.

As suggested by the Aboriginal Communities Coordinator-WAWA, no site was pegged on sandstone outcrop due to a very rough terrain preventing access for the drilling rig. The estimated drilling depth, strata and prospects are summarised in Table 6.

GROUNDWATER QUALITY

There is a salt water wedge near the coast and special care is required not to over-pump any bore and induce saltwater intrusion. Groundwater is likely to be fresh further inland.

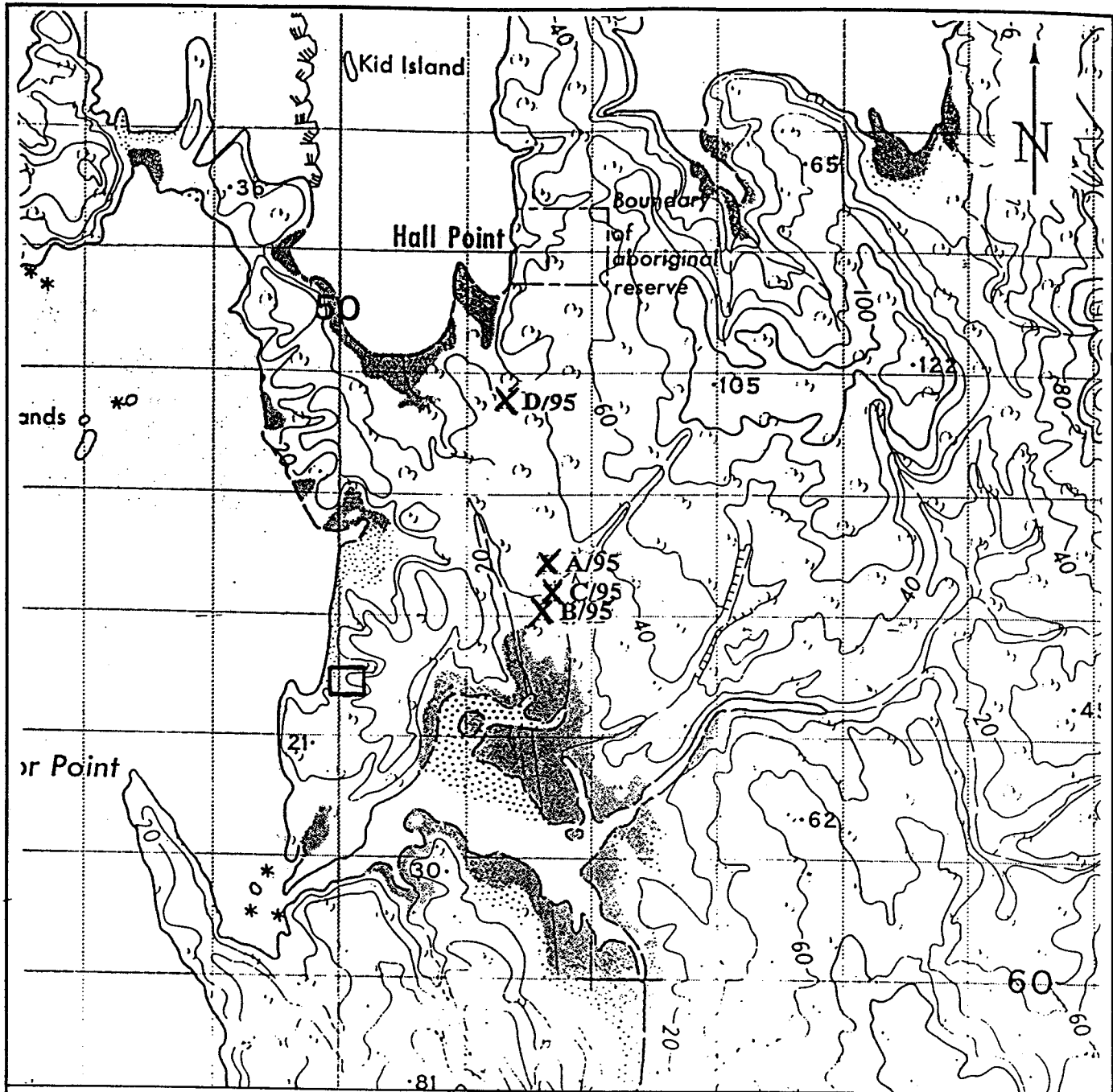
DRILLING REQUIREMENTS

All the proposed sites should be drilled to at least 60 m. Groundwater salinity must be monitored at close intervals during drilling and drilling should stop if the salinity exceeds 1200 mg/L TDS. Air rotary with down-the hole hammer would be required at all the above sites.

All the proposed sites are site-specific and therefore on-site supervision of drilling by a hydrogeologist is highly recommended to assess the results and select additional sites if required.

TABLE 6. PROPOSED BORE SITES - DJAWORRADA

Site	Coordinates (AMG)	Airphoto series, run, No	Minimum drilling depth (m)	Est. depth to watertable (m bns)	Strata	Prospects
A/95	651685 E 8263420 N	WA3103,12, 5095-99	60	10-15	Weathered and fractured dolerite	3.1
B/95	651620 E 8263090N	WA3103,12, 5095-99	60	10-15	Weathered and fractured dolerite	3.2
C/95	651682 E 8263182 N	WA3103,12, 5095-99	60	10-15	Weathered and fractured dolerite	3.4
D/95	651290 E 8264750 N	WA3103,12, 5095-99	60	10-15	Weathered and fractured dolerite	3.3



X B/95 Proposed bore site
 □ Community

0 1 km

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FIG 5. DJAWORRADA

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LARINYUWAR ABORIGINAL COMMUNITY

CURRENT WATER SUPPLY

The Larinyuwar Aboriginal community is situated at the eastern end of Cone Bay, an inlet in the King Sound, about 90 km north of Derby (Figures 1 and 6). Exploratory drilling was already carried out at the community in 1991 (Martin, 1991 and Combs, 1992). Six bores were drilled targeting fractured granite. Only two bores, 5/91 and 6/91, were completed as production bores yielding low supplies (Table 7). The community requires at least 40 m³/d to meet its present demand.

TABLE 7. BORE DATA - LARINYUWAR

Bore	Depth (m)	Supply (m ³ /d)	SWL (m bns)	Salinity (mg/L TDS)	Status
1/91	52.0	Seepage	40.0	206	Abandoned
2/91	50.0	Seepage	15.8	NA	Abandoned
3/91	37.0	Seepage	12.4	NA	Abandoned
4/91	35.0	Dry	NA	NA	Abandoned
5/91	35.0	<5	4.7	980	Production
6/91	54.6	10	4.6	150	Production

PROPOSED EXPLORATORY DRILLING SITES

Four sites, located in two areas, were pegged during the recent field visit and are numbered A/95-D/95 (Figure 6). The drilling target at sites A/95 and B/95 is fractured and weathered dolerite of the Hart Dolerite. The drilling target at C/95 is fractured sandstone of the King Leopold Sandstone, while the target at D/95 is fractured granite. The estimated drilling depth, strata and prospects are summarised in Table 8. There is poor access to the community from Derby. The drilling rig would be required to be brought in by sea on a barge.

GROUNDWATER QUALITY

Previous drilling results have indicated that the groundwater is fresh in the area. No bore site is proposed near the coast as the groundwater may be brackish there.

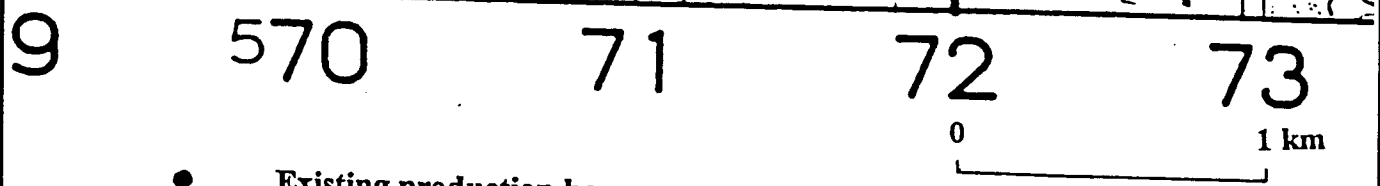
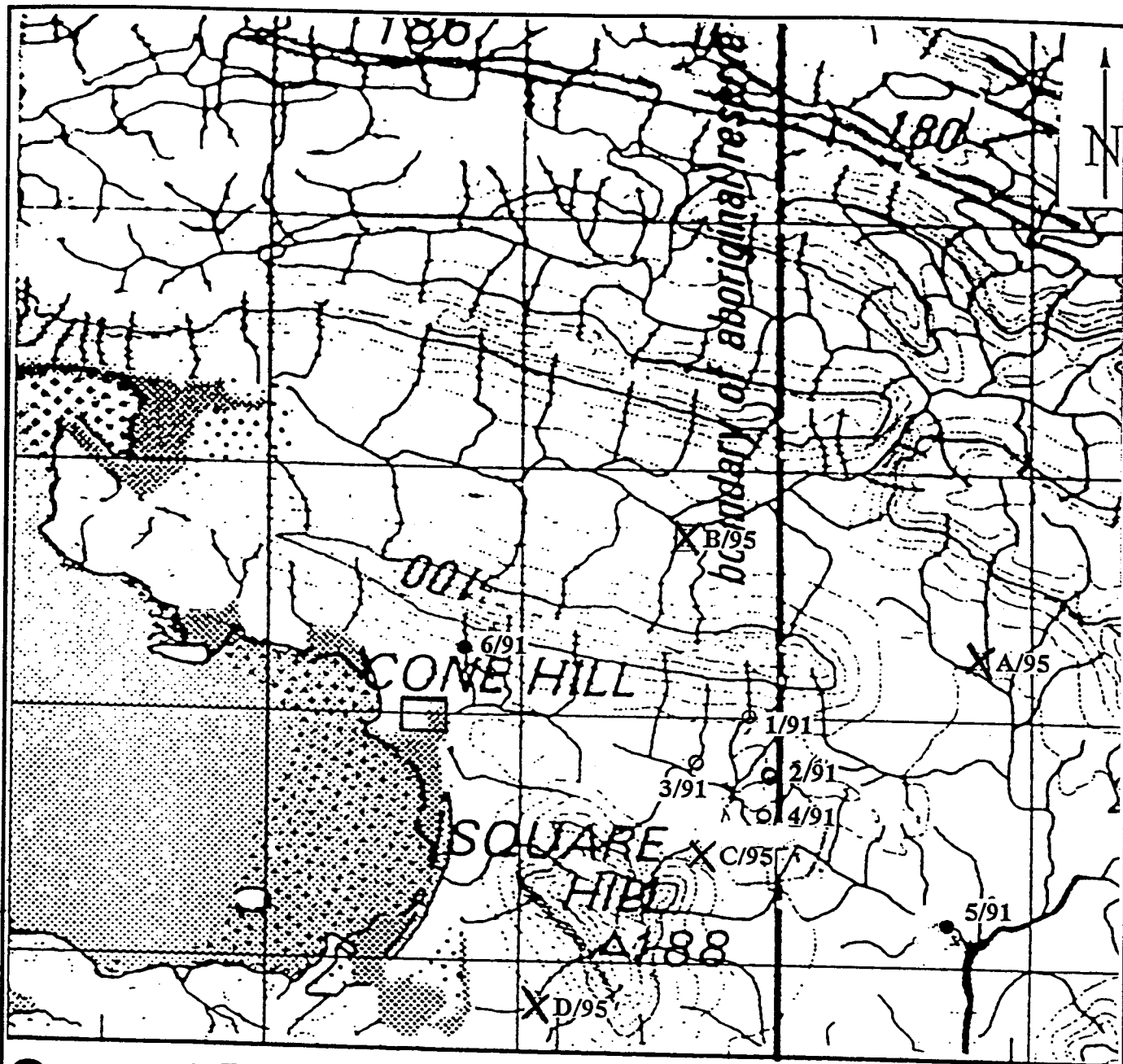
DRILLING REQUIREMENTS

All sites should be drilled to a minimum depth of 60 m. The drilling depth can be increased if the yield is insufficient but water bearing fractures are still intersected. Drilling should stop if the groundwater salinity increases with depth and exceeds 1500 mg/L TDS. Air rotary drilling with down-the-hole hammer will be required at all the proposed sites.

All the proposed sites are site-specific and therefore on-site supervision of exploratory drilling by a hydrogeologist is highly recommended to assess the results and select additional sites if required.

TABLE 8. PROPOSED BORE SITES - LARINYUWAR

Site	Coordinates (AMG)	Airphoto series, run, No	Minimum drilling depth (m)	Est. depth to watertable (m bns)	Strata	Prospects
A/95	572730 E 8177260 N	WA2448,7, 5273-75	60	5-10	Weathered and fractured dolerite	3.2
B/95	571590 E 8177710 N	WA2448,7, 5273-75	60	5-10	Weathered and fractured dolerite	3.1
C/95	571750 E 8176410 N	WA2448,7, 5273-75	60	5-10	Fractured sandstone	4.1
D/95	570915 E 8175590 N	WA2448,7, 5273-75	60	5-10	Fractured granite	5



- Existing production bore
- Abandoned bore
- X A/95 Proposed bore site
- Community

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FIG 6. LARINYUWAR

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