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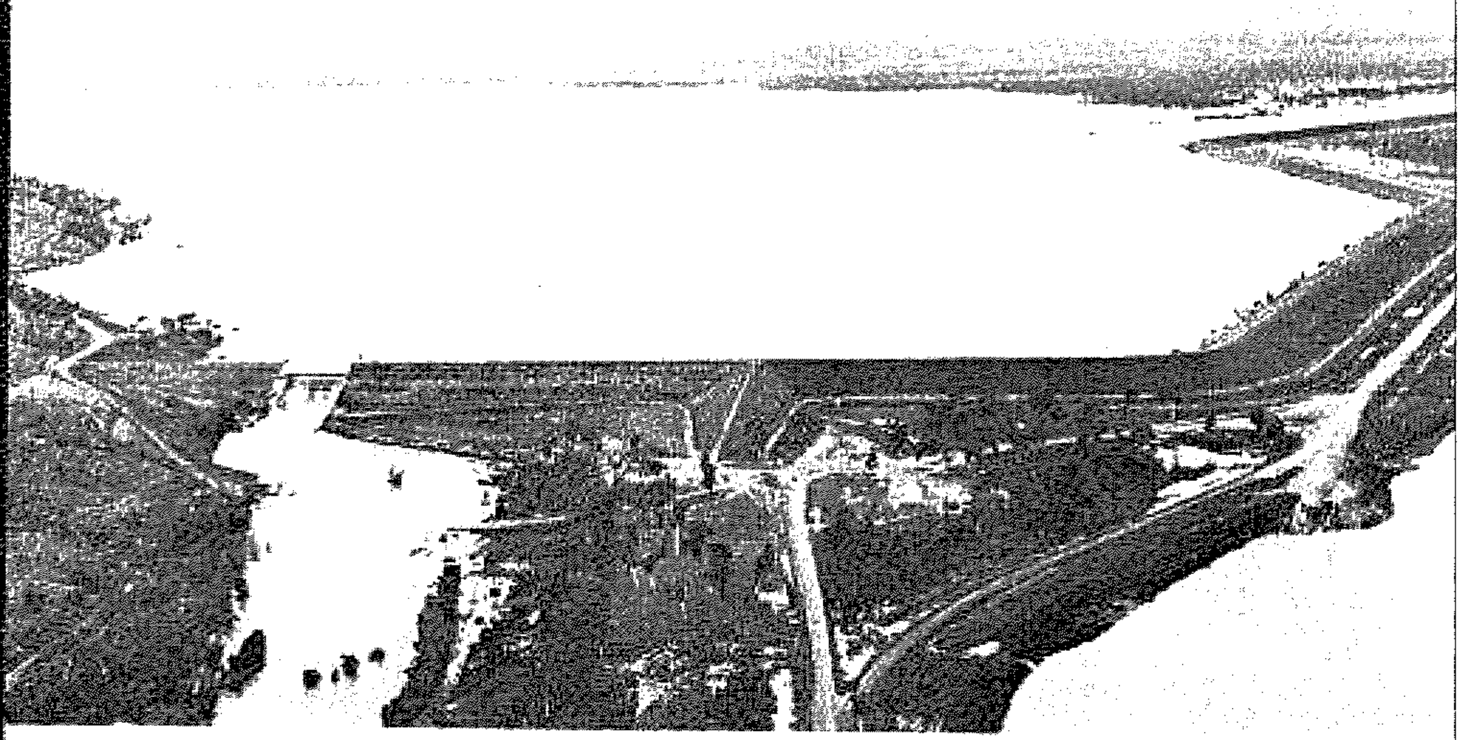

WATER RESEARCH FOUNDATION OF AUSTRALIA

NORTH QUEENSLAND REGIONAL COMMITTEE

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HAUGHTON AQUIFER - CURRENT DEVELOPMENT AND LONG TERM FUTURE

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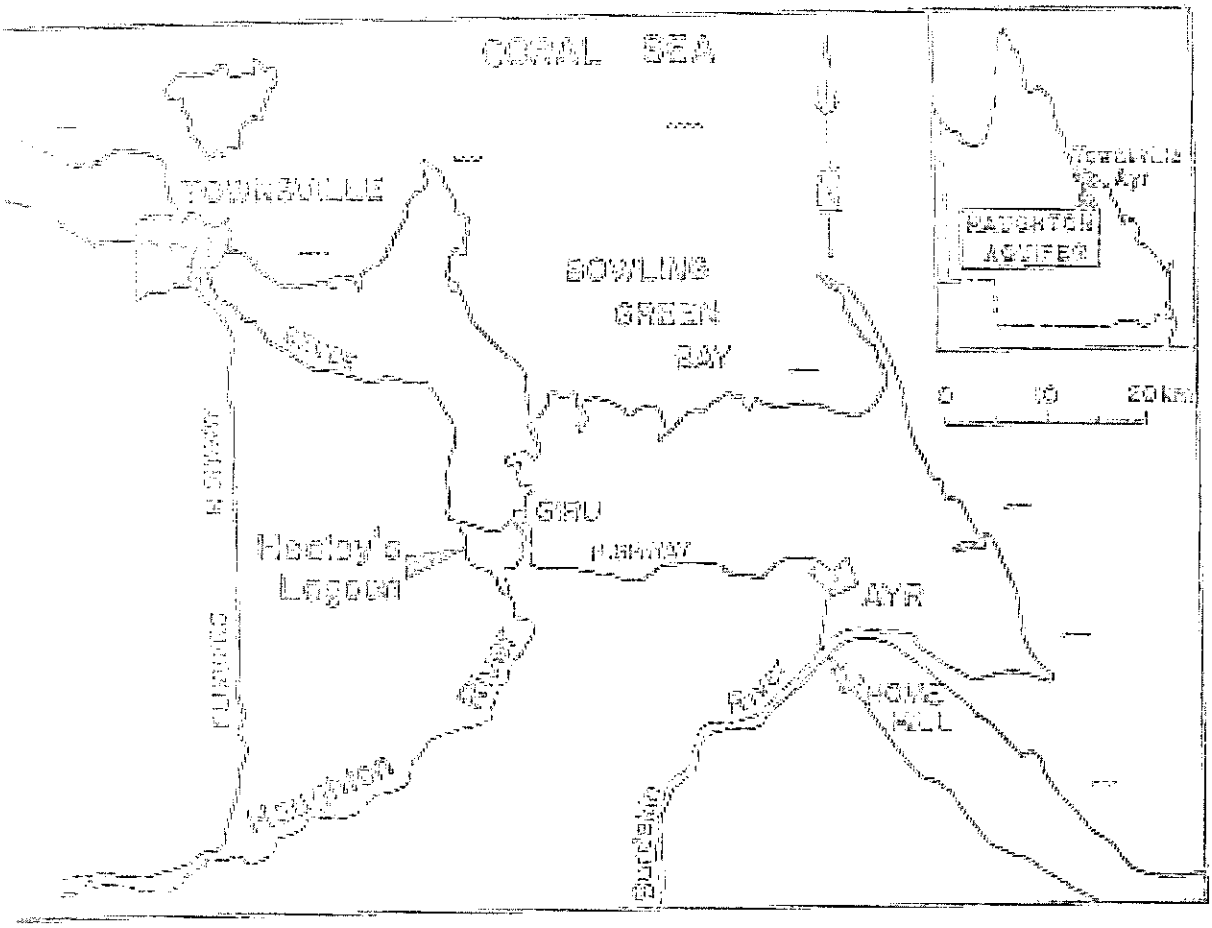
Location

The gravel sands of the lower reaches of the Haughton River comprise the Haughton aquifer. The Haughton River discharges into Bowling Green Bay between Cape Cleveland and Cape Bowling Green (Fig. 1). The focal point of the sugar producing area is the Haughton Sugar Company's Invicta Mill, which is located at the township of Giru some 48 km south-east of Townsville on the North Coast Railway. The Bruce Highway from Cairns to Brisbane bypasses Giru by some three kilometres.

Temperatures in the area range from a maximum of 32°C in January to a minimum of 13°C in July. The annual pan evaporation is 1880 mm. Eighty per cent of the mean annual rainfall of 1296 mm falls in the four summer months, December to March.

Apart from minor beef cattle production, sugar cane growing and raw sugar production are the sole industries of the Giru-Haughton River area. Sugar cane growing began in 1905 and cane was first sent to the Pioneer Mill until crushing began at Invicta Mill in 1920. Until some 30 years ago cane for Invicta Mill came by rail from parts of the Ingham district as well as from the area around Giru. This cane from Ingham is now crushed at Victoria Mill and has been replaced by cane which is transported some 38 km by tramline from the Burdekin Irrigation Areas of Claredale, Millaroo and Dalbeg. The area of 4,000 ha in the Giru area is approximately half the total assignment of 8,100 ha for Invicta Mill.

In the earliest days of sugar production, irrigation was provided by pumping surface water from the Haughton River and from Healey's Lagoon. With increased assignment and production, supplies of water were progressively obtained from underground resources by means of spears. Today, sugar cane production in the Giru area is heavily dependent upon irrigation.



[illegible] Locality Plan

[illegible]

[illegible] Houghton River traverses the northern part of the broad expanse of [illegible] alluvial material which thickens to the east, and is commonly referred [illegible] the Burdekin Delta. The more easterly parts of the Burdekin Delta contain [illegible] aquifer material, which provides irrigation water for the sugar [illegible] in the Ayr, Home Hill and Mona Park districts.

In the vicinity of the Houghton River to the west however, these older [illegible] sediments contain few permeable sand beds, and such groundwater [illegible] is present are too saline for agricultural purposes. The Houghton [illegible] subsequently incised the older alluvials and it is the Recent channel [illegible] deposited by the Houghton River that constitutes the Houghton Aquifer. [illegible] relationship between the Recent sands of the Houghton, the underlying less [illegible] alluvium and the aquifers of the Burdekin Delta to the east, are [illegible] diagrammatically on Figure 2. It should be recognized that the [illegible] aquifer is restricted to present and recent past channels of the [illegible], and is geologically and hydraulically distinct from the sands [illegible] Burdekin Delta.

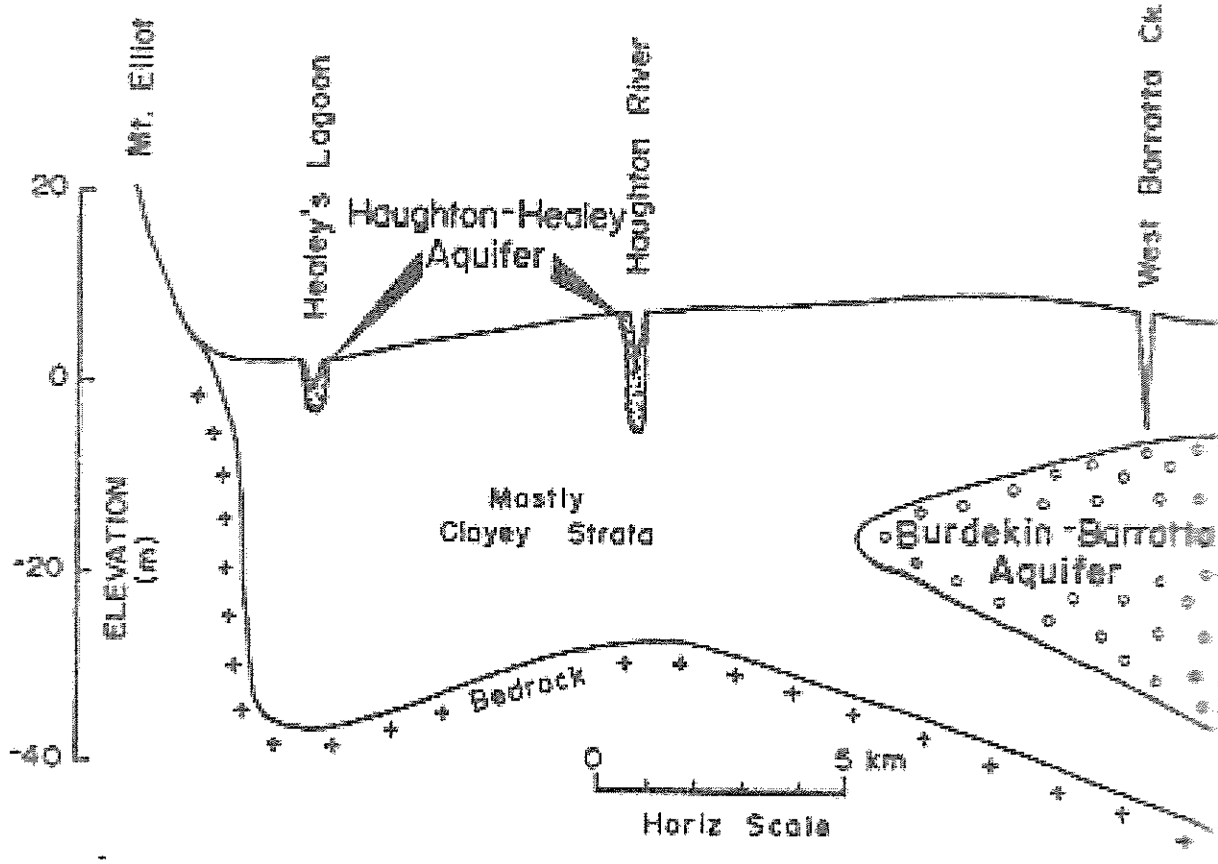


FIGURE 2 Diagrammatic cross-section along Bruce Highway showing the relationship between the Burdekin Delta aquifer system and the Haughton aquifer system.

Figure 3 shows the distribution of the Haughton Aquifer. It may be regarded as comprising two parts:

(a) The Haughton River Section consists of sands along the Haughton River itself and some abandoned channels which leave the river upstream of the North Coast Railway.

(b) The Healey's Lagoon Section is a major abandoned channel to the west of the river. The remnants of the channel still exist as a series of partially interconnected waterholes, the major one of which is Healey's Lagoon.

With the limited distribution apparent from Figure 3, and having an average depth of only 8.5 m, the aquifer clearly has a small storage capac[illegible] While some 18,000 ML are held in storage, the usable storage is only some 13,000 ML. The aquifer is unconfined, and bore yields often exceed 40 L/[illegible]

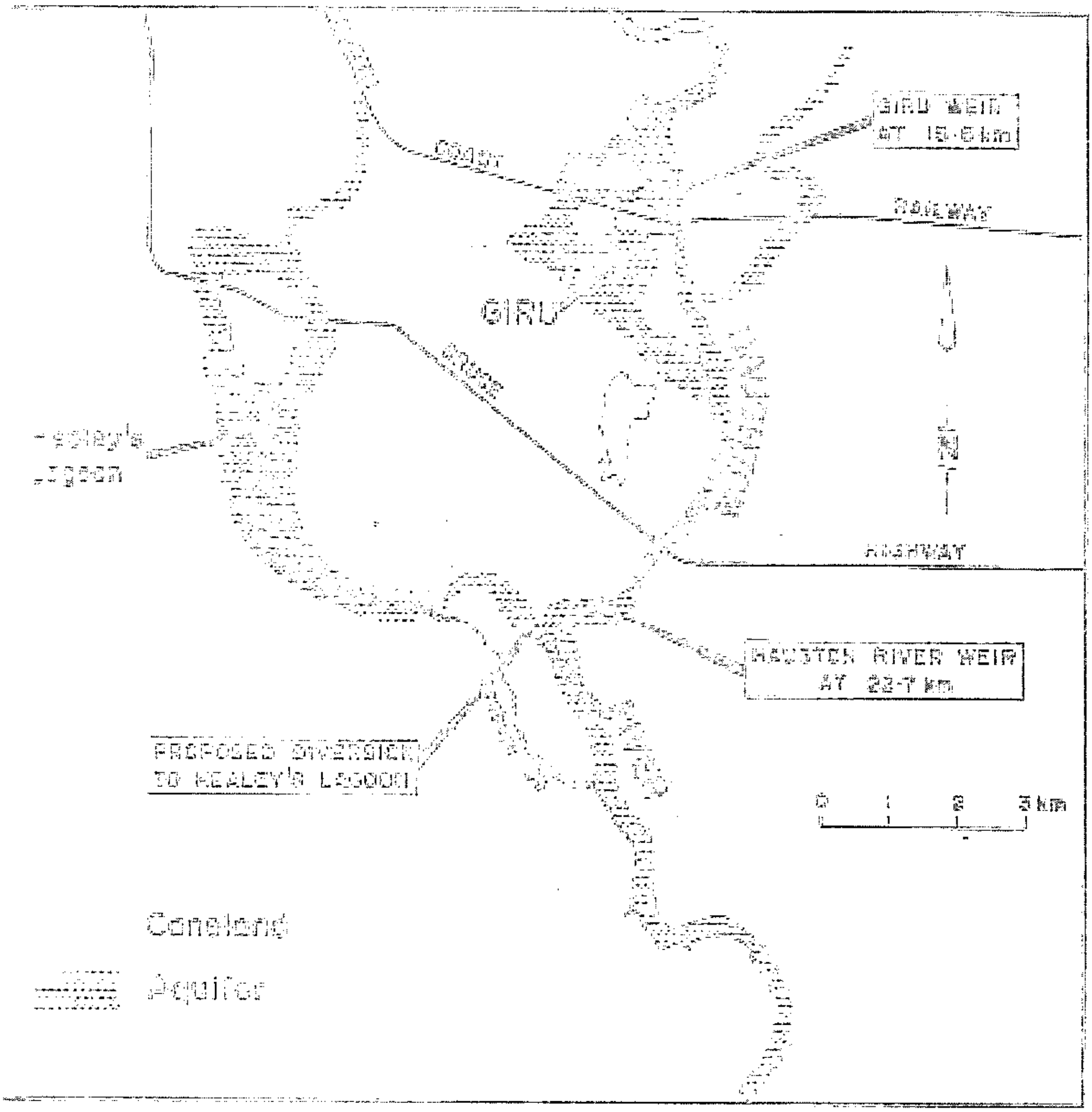


FIGURE 3 Distribution of the Haughton aquifer, supplementation weirs, and caneland.

...ral Replenishment

The principal source of natural replenishment is the Haughton River itself. ...l rises in water levels have been observed throughout the area following ... in the River. As long as flow persists in the Haughton River, the aquifer ... maintained in a full or near full condition. When flow ceases irrigation ... is met from storage, with consequent depletion of this storage. The ... behaviour of the aquifer is therefore closely related to the irrigation ...and and the frequency and duration of periods of no river flow. High flows ... the Haughton River permit diversion of some flow to the Healey's Lagoon

section via Ironbark Creek. A contributary source of replenishment to Heal[...]
Lagoon is run-off from rainfall on Mt. Elliott.

Availability of Water from Aquifer

In 1967 the Commission assessed the reliability of the groundwater res[...] as an irrigation supply (1). The available storage of 13,000 ML was consid[...] sufficient to meet the irrigation needs of the irrigated cane land for a pe[...] of 160 days after the cessation of river flow. Streamflow measurements we[...] available for the Haughton for the period 1952 to 1970. Streamflows were calculated from rainfall records for the period 1926-1952. A study of this data showed that during the 44 years there were 32 periods of no flow in ex[...] of 160 days. Of these, 19 periods exceeded 210 days, and 10 periods exceed[...] 250 days. Significant deficiencies in available irrigation supplies were c[...] sidered likely during no flow periods of 160 to 210 days, and this situati[...] could therefore be expected in most years. Substantial deficiencies were c[...] sidered likely to affect crop production when there is no recharge for 250 [...] or more, a situation which has occurred on an average of once every 4½ yea[...]

Supplementation

The Commission then undertook a study of possible supplementation sch[...] (2). The schemes considered were:

(a) Provision of weirs on the Lower Haughton River.

(b) Provision of weirs and additional offstream storage on the Lower Haughton and in the Giru Area.

(c) Delivery of water to the Haughton River from the Burdekin River.

(d) The possibility of a larger storage further upstream on the Haug[...] River.

The report concluded that two weirs on the Haughton River combined wi[...] diversion to Healey's Lagoon would provide a significant improvement to s[...] in the area. As well as the surface water stored, the weirs would increas[...] storage capacity of the associated aquifers. It was recognized however th[...] the weirs would not completely safeguard supplies in the area under severe drought conditions. The report noted that when water became available fro[...] major storage on either the Haughton or the Burdekin Rivers, the presence [...] the weirs would substantially increase the regulated supply from such a s[...] On the basis of this report construction of weirs at 15.6 km and 22.7 km [...]

the Haughton River has been undertaken (Fig. 3). The lower weir was completed in 1979 making an additional 2,000 ML (surface plus increased groundwater storage) available to irrigators. The upper weir is currently under construction and will make an additional 3,700 ML (surface plus increased groundwater storage) available to irrigators. Detailed investigation and design of the proposed diversion to Healey's Lagoon has not been finalised.

Risk of Irrigation Deficits in Haughton River Weir Area

Selected results of a model study carried out by Henry (3) serve to illustrate the reduced risk of deficits in supply of irrigation water to growers in Haughton River Weir area, resulting from construction of the Weir. This work improved upon previous assessments in that the irrigation requirement and the ability of the store to meet that requirement were calculated under daily historical climatic conditions, rather than being assessed on an average basis using average annual data.

The first stage of the work was to carry out a daily water balance for the soil moisture store in the root zone of the crop. For each day rainfall was added to the store and the moisture requirement of the cane was subtracted. When the level in the store fell below a specified level the store was filled by irrigation. The moisture requirement of the cane used in this calculation was determined from evaporation data, a nominated rate of cane growth, and the stage of development of the crop. Given that practical farming constraints prevent growers from exercising optimal irrigation practice, an irrigation efficiency factor was also employed. When run, the model maintained a record of the volume of irrigation water that needed to be applied to result in a target yield of cane at harvest. This is the irrigation demand.

The second stage of model development was to carry out a water balance daily of the unsupplemented groundwater working storage of 2,000 ML. For each day of the period for which historical data was available, streamflow was added to the store and irrigation demand was subtracted. The model recognized that a proportion of the assigned area was not irrigated. Obviously the streamflow was accepted into the store only until it was full, and irrigation requirement was removed from storage only while the store was not effectively empty. The store was considered effectively empty when it was reduced to dead storage level, the level from below which water could not be effectively pumped. When run, the model maintained a record of the irrigation deficit, or the irrigation requirement that could not be met because the aquifer was effectively empty. The results of this stage of modelling are given on Figure 4, where the risk

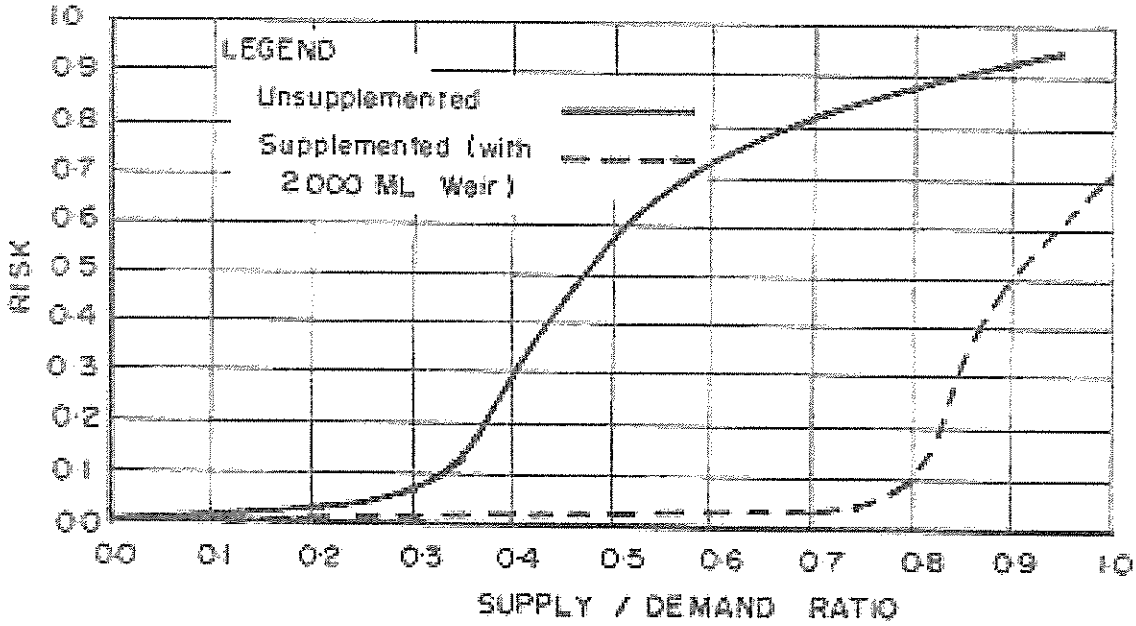


FIGURE 4 Haughton River Weir storage area risk curves, showing the risk of failing to achieve various supply/demand ratios with and without the Haughton River Weir supplementation.

of the aquifer failing to achieve a range of supply/demand ratios is plotted.

This water balance model was then run again, but on this occasion with the size of the store increased by 3,250 ML, to simulate the increased aquif storage and surface storage resulting from a 2,000 ML weir. The risk curve resulting from this model run is also given on Figure 4. The weir currently under construction actually has a surface storage capacity of 2,500 ML.

From Figure 4 it may be seen that for the unsupplemented supply, there i 0.87 risk that a supply/demand ratio of 0.8 will not be achieved. This might alternatively be stated, 'it is probable that in 87 out of 100 years, supply from the aquifer will be less than 80% of the irrigation requirement'. We m compare this situation with the curve for the supplemented supply where we f that there is a risk of only 0.1 that the supply demand ratio of 0.8 will n achieved. The results then indicate that the weir will dramatically reduce th risk of irrigation supply being less than 80% of irrigation demand. From th curves it may be generally inferred that the weir will significantly reduce th risk of small and moderate deficits, but a small risk of large deficits will continue to exist.

Modelling of the Supplemented Haughton-Healey Aquifer System

In 1981 Guppy (4) developed a model of the whole of the Haughton-Healey system. The model incorporates the Giru and Haughton River Weirs. As no final decision has been taken as to the design of the proposed diversion from the Haughton River into Healey's Lagoon, Guppy assumed values for the rate of diversion, and the manner in which the diversion would be operated. The modelling study is similar in principle and was developed from the work by Henry which was described previously.

The model maintains a water balance in the three groundwater/surface water storages which are:

(a) Healey's and other interconnected lagoons, and associated aquifers.

(b) The Haughton River Weir and associated essentially underlying aquifers.

(c) The Giru Weir and associated aquifers.

Recharge and discharge from each store, and the relationship between the stores is shown on Figure 5. The model uses irrigation demands calculated in the manner outlined previously. Recharge to the Giru Weir/aquifer store is essentially overflow from the Haughton River Weir. Recharge to the Healey's Lagoon and associated aquifers is from local run-off and the proposed diversion. It was assumed that a diversion operates only while the Haughton River Weir is overflowing and the Healey's Lagoon system is not full. A variety of diversion rates were modelled, but the results given here are for a diversion of 700 ML/month. A supply restriction was imposed progressively with falling storage level in recognition of the fact that as levels fall, less favourably located irrigation facilities are not able to pump the required irrigation water. As simulated levels fell the supply restriction was progressively imposed, until at the dead storage level the supply restriction was total, preventing any further removal from storage. The model was calibrated using the period for which water levels are available, a period of 16 years. In determining the irrigation demand, the target yield of cane was set at 100 tonnes per hectare. This is approximately the average yield achieved in recent years. The area under cane was set at the 1980 assigned area.

The model was run for the period for which adequate climatic and streamflow data was available, a 26 year period. It was found that the annual

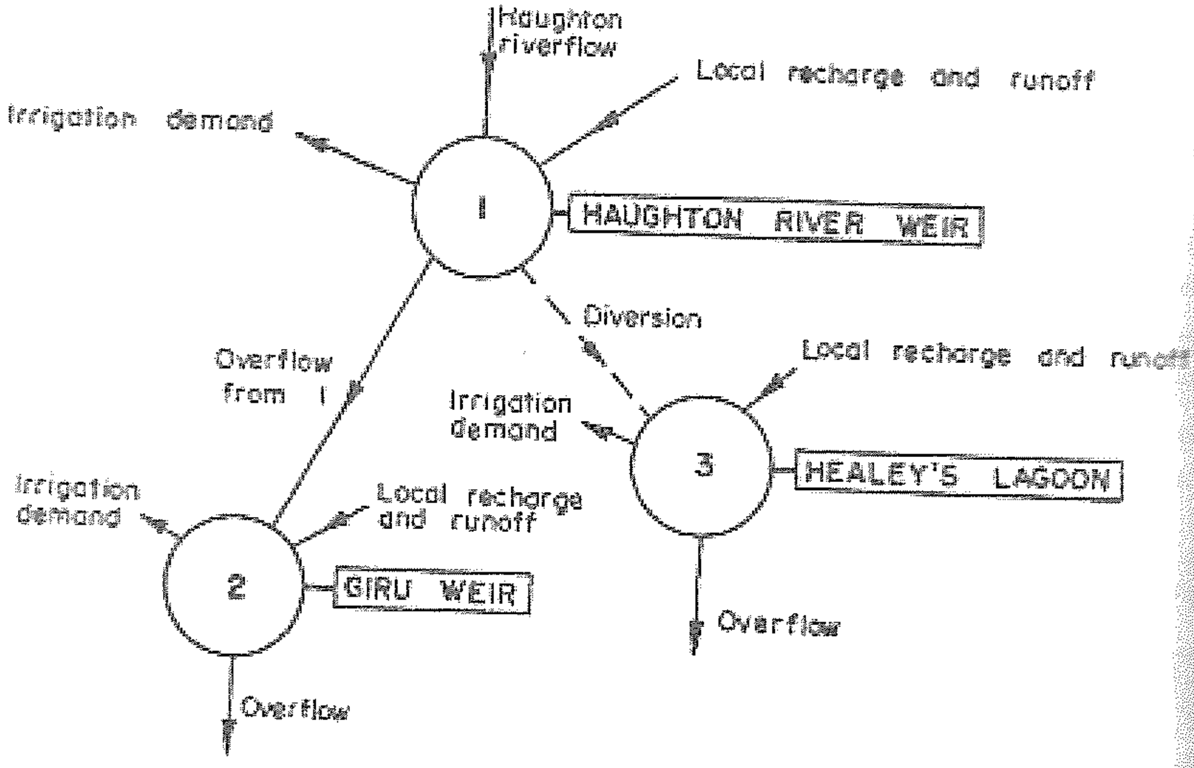


FIGURE 5 The relationship between the three storage areas of the Haughton-Healey supplemented aquifer model, and the inputs to and outputs from each store.

irrigation demand during this period ranged from 341 mm to 761 mm. The abi of the three storage areas to supply demand is given on Figure 6. It can be seen from these curves that throughout the area the risk of a 20% deficit (a supply/demand ratio of 0.8) is less than 0.25 (one year in four). The Haug River Weir area will be more prone to small annual defits than the other storage areas. The study reinforces the previously recognized fact, that with supplementation a significant risk of deficit in supply exists.

Any increase in the area under cane will increase the risk. The model was again run using the maximum area of land suitable for cane production in the three storage areas, as advised by the Invicta Local Assignment Commit The 1980 irrigated area (80% of the assigned area) and the maximum likely irrigated area in the three storage areas is given in Table 1.

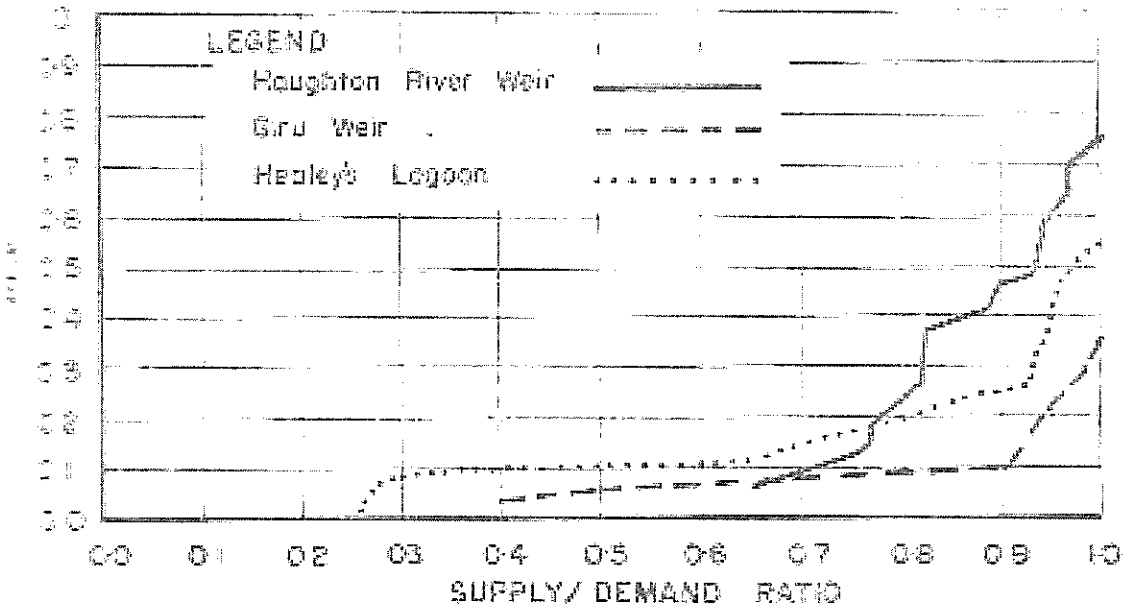


FIGURE 6 Haughton-Healey supplemented aquifer system risk curves, showing the risk of failing to achieve various supply/demand ratios, for the 1980 irrigated area.

TABLE 1

Present and Future Irrigated Areas

	Healey's Area (ha)	Haughton Weir Area (ha)	Giru Weir Area (ha)
1980 Irrigated Area	950	935	985
Likely Maximum Irrigated Area	1,050	1,260	1,300

The results of this model run are given as Figure 7. By comparing Figures 6 and 7 it is seen that the projected expansion in irrigated area will significantly increase the risk of deficits in irrigation supply.

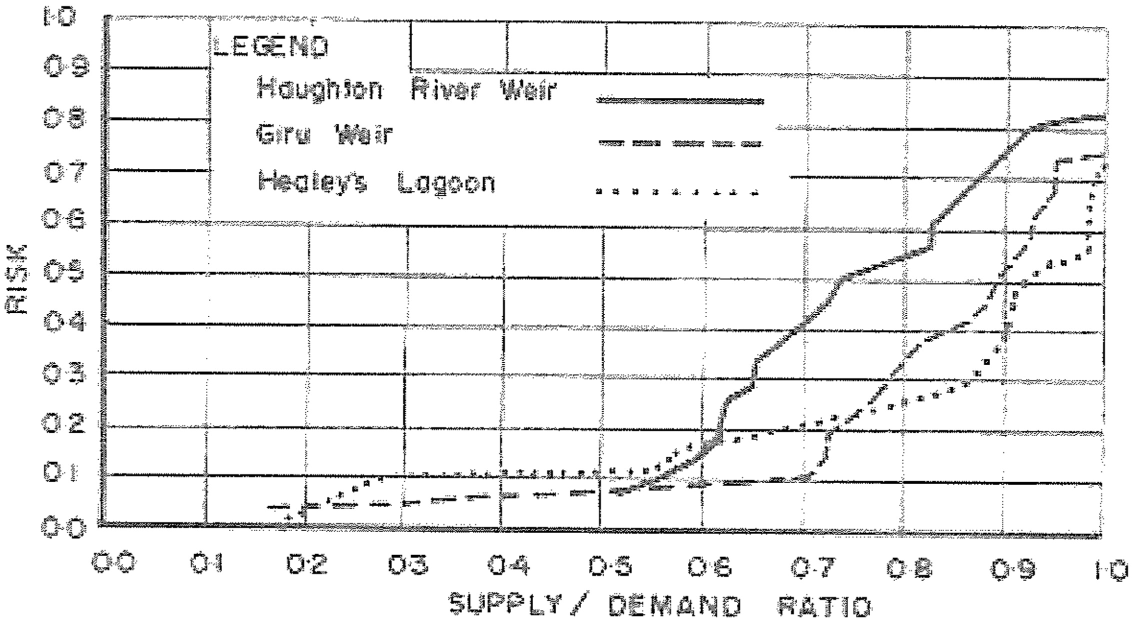


FIGURE 7 Haughton-Healey supplemented aquifer system risk curves, showing the risk of failing to achieve various supply/demand ratios, for the likely maximum area under irrigation (Table 1).

Additional Supplementation

As stated in a previous section, weirs and the diversion to Healey's Lagoon are seen as only the first stage of supplementation and it is proposed to make additional water available to the area as part of the Burdekin River Project. Burdekin River flow, regulated by the Burdekin Dam, will be pumped from a pumping station near Clare into the proposed Haughton Main Channel (Fig. 8). Supplementation of the three groundwater/surface water storages in the Giru area by diversion of water from the Burdekin River will be possible when these works are complete.

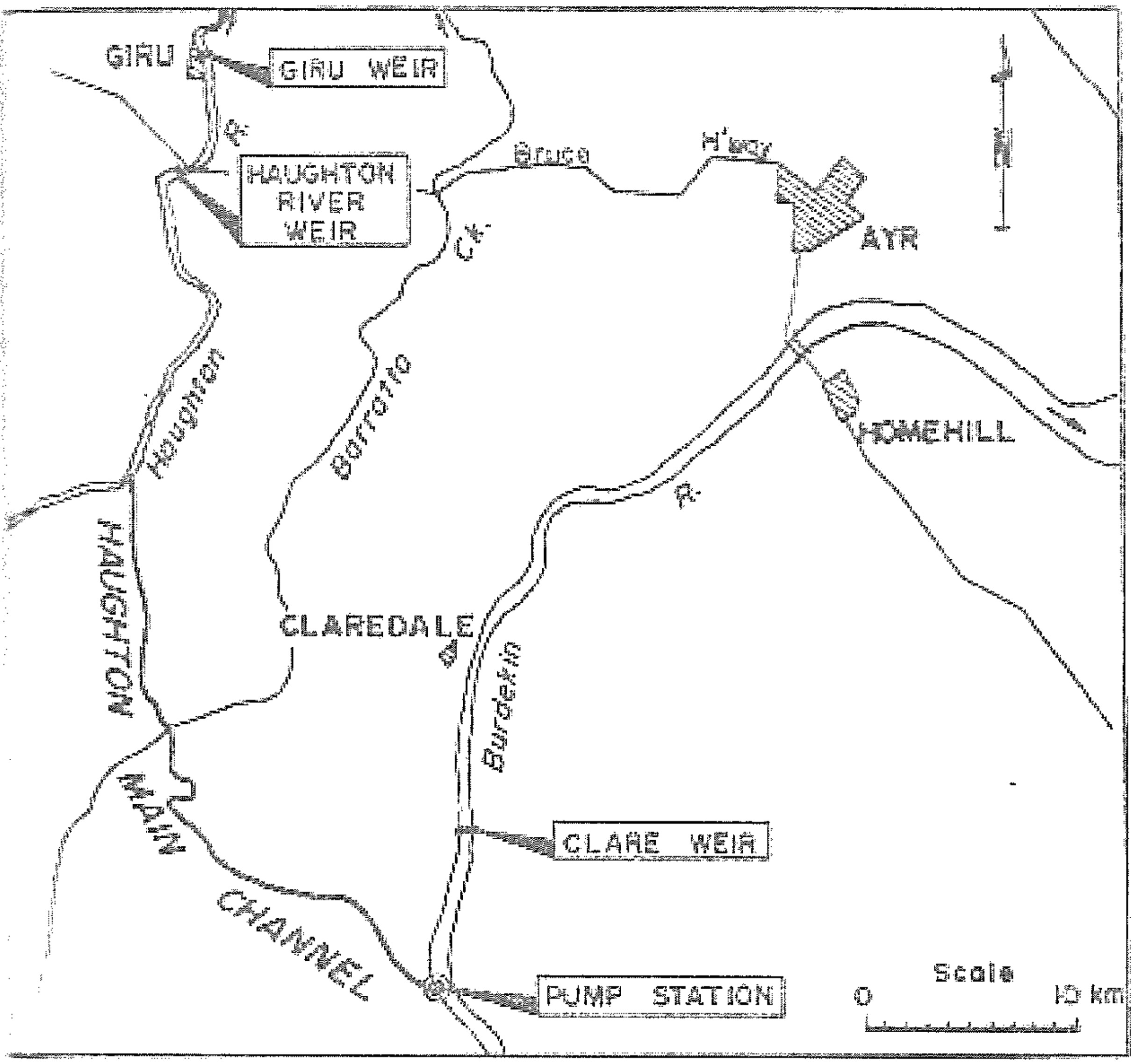


FIGURE 4 Location of the proposed Haughton Main Channel.

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