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RECORDS.

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UNDERGROUND WATER ON MORSTONE STATION, NORTH-WEST QUEENSLAND

by

L.C. Noakes & J.N. Casey

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INTRODUCTION

Morstone Station is situated approximately 50 miles north-east of Camooweal, on the Camooweal 4-mile sheet, North-west Queensland.

The owners of the property, Western Grazing Co. Pty. Ltd., have experienced difficulties in obtaining underground water on part of their property for many years, and have asked for this report because the Bureau's 'Camooweal Party' has spent a considerable time during the present field season (1953) completing the mapping of the Camooweal sheet. A number of geologists have contributed to the mapping of the area, notably Dr. F.W. Whitehouse, but the more detailed mapping and investigation are largely the work of Dr. A.A. Öpik, Senior Palaeontologist, Bureau of Mineral Resources, who is at present expanding the work of previous field seasons.

A number of bores were sited for the Company by K.A. Townley, Bureau of Mineral Resources during a short visit in 1951. Three of his proposed sites correspond reasonably closely to our sites A, B and C.

Recent investigations, in which the writers have shared, throw some new light on problems of underground water supply on Morstone property, but as the work is still in progress the present report deals only with the specific problems on which the Company's representatives have requested urgent advice.

GENERAL GEOLOGY

Morstone is situated on the western margin of a basin of Cambrian sedimentation ~~in~~ the 'Undilla Basin', of which the centre or deepest part appears to be near Undilla Station.

The western portion of the Morstone property is occupied by the older rocks (Camooweal Dolomite) which formed the western shore-line of the Basin, and the eastern portion is occupied by a variety of younger sediments laid down in the Basin under, for the most part, marine conditions. (See geological map). The Camooweal Dolomite, which includes some beds of sandstone and shale, is older than Middle Cambrian, and is probably Pre-Cambrian in age. The strata of the Basin are mainly of Middle Cambrian age, with a discontinuous thin cover of sandstone and shale laid down in Mesozoic time.

The sedimentation within the Undilla Basin seems to have followed the following pattern. The Basin was occupied by sea in Middle Cambrian time and deposition began with a considerable thickness (3,000 to 4,000 feet in places) of limestone and dolomite with interbedded sandstone, calcarenite, etc.; they were washed in from the Camooweal Dolomite. This basal sequence strikes roughly north and dips east in the central and southern portion of the property, but swings to the north-west in the northern portion, where a somewhat irregular synclinal structure is apparent. Dips of up to 40° are found near the contact with the Camooweal Dolomite, but they become progressively gentler towards the east.

The sequence, initially referred to as the Bell Formation in the field, has not yet been formally named.

There followed, after an interruption in deposition, the Mailchange Limestone - only a few hundred feet thick - which now forms flaggy outcrops in blacksoil plains at the head of Bull Creek and around Wim Well. The Cambrian sequence was completed by the deposition of the Split Rock Sandstone, which now outcrops mainly as cappings less than a hundred feet thick on mesas and low ridges towards the head of the O'Shannassey River and at the head of Bull Creek. Both these Formations are sub-horizontal.

After a long period of erosion, the area was again invaded by a transgressive sea in Mesozoic time, and sandstone and shale were deposited. Some of these younger sandstones carry plant remains, distinguishing them from the Split Rock Sandstone with its shelly fossils and trilobites. Later erosion has removed these younger rocks from most of the area, but thin cappings, less than 200 feet thick, remain in the south-eastern corner of the property.

On the map accompanying this report, the geology has been simplified to show only the boundaries of the Camooweal Dolomite, the two main Cambrian units, and the 'desert country' of the south-east corner, where outcrops consist of sandy rocks (Cambrian and Mesozoic) thinly overlying the Cambrian units shown.

PROBLEMS OF UNDERGROUND WATER SUPPLY.

Present problems are concerned with the supply of underground water in the country underlain by Cambrian sediments: the Camooweal Dolomite contains proven aquifers on the property - A, B, C, and Marion Bores - and to the west and north-west provides most of the sub-artesian water supplies of the Barkly Tablelands. On the other hand, lack of adequate supplies of underground water on the eastern portion of the property, despite the drilling of a number of bores - one of which reached a depth of 800 feet -, is impeding pastoral development.

Comparatively recent geological work threw new light on problems of water supply when A.A. Öpik in 1951 recognised the Camooweal Dolomite as older than the Cambrian sediments of the Undilla Basin, and not younger as had previously been thought, and when the Camooweal Party recently recognised that the thick sequence of limestones etc. along the O'Shannassey was the base of the Middle Cambrian sequence and not part of the Camooweal Dolomite.

In effect, this means that the eastern part of the property overlies a much thicker sequence of Cambrian sediments than was known previously. The general easterly dip of these sediments, the existence within the sequence of beds capable of storing water, the undoubted intake areas within the O'Shannassey River system, and an average rainfall of 18 inches per annum, all indicate that the chances of finding sub-artesian water at depth are good, although in most places there seems no way, short of a drill-hole, to determine with any reliability the depth at which aquifers will be struck.

SPECIFIC PROBLEMS

1. North-Western portion of Morstone

An additional watering point is required at Site A, between C and Marion Bores. A bore here can be recommended with confidence: aquifers within the Camooweal Dolomite are already providing good supplies of water (more than 1000 gallons an hour), at depths of 250-400 feet below the surface. It is not possible to determine accurately the depth at which an effective aquifer will be struck at Site A, because there are apparently a number of aquifers within the Formation and because there is probably slight folding within the strata which cannot be mapped for lack of outcrop.

But it can be confidently expected that good water will be struck within the range 250 to 400 feet. The water is under pressure and may be expected to rise considerably in the bore when an effective aquifer is tapped.

SOUTHERN CORNER

Sites B and C have been selected for watering points in the southern corner of the property.

Site B has been located on Camooweal Dolomite because this Formation is more reliable than the basal beds of the Cambrian sequence lying immediately to the east.

The bore may be sited anywhere along the internal fence up to 1¼ miles north-east of the boundary, but the closer to the boundary fence the better.

We suggest that in order to provide a watering point in the south-eastern corner of the property, a bore should be tried in the vicinity of Site C. There are three possible sources of water there: the sandstone which forms the outcrops, the underlying Mailchange Limestone, and the basal beds below the Limestone.

Known outcrops of the sandstone suggest a thickness of only about 150 feet in this area, which seems insufficient to provide more than a small supply, perhaps less than 150 gallons an hour; but a more useful supply is likely towards the bottom of the Mailchange Limestone, at a depth of about 300 feet. If more water is required than this can provide, the bore should be deepened to penetrate the basal sequence, which, on general evidence, is likely to contain more sandstone and sandy rocks in the southern end of the property than are common farther north.

WIM WELL AND YELLOW WATERHOLE AREA.

In this area, the Wim Well provides the only permanent water supply, and the quantity (about 3-400 gallons an hour*) is inadequate. Underground water at Wim Well comes from an aquifer at or near the base of the Mailchange Limestone, struck at 140 feet by the original well, which has a total depth of 150 feet. A further 150 feet were later drilled from the bottom of the shaft, without any increase in water supply. There is evidence in other localities of water supplies towards the base of the Mailchange Limestone - springs in Douglas Creek - and water will probably be found at depths of less than 200 feet in the neighbourhood of Wim and the Yellow Waterhole; but these supplies are likely to be of the order of those available at Wim. Generally, they might be expected to be smaller west and south-west of Wim, but slightly greater east and south-east of the well. However, the yield at Wim is from a well which exposes a very much greater area of aquifer that would a bore hole and consequently, if the aquifer is tight, yields from bore holes may be much less than that from Wim Well. This point can only be cleared up by drilling as there is no data available on the character of the aquifer at Wim.

The only prospect of adequate supplies of underground water (more than 1500 gallons/hour) in this area therefore lies in exploring the basal sequence underlying the Mailchange Limestone.

There can be little doubt that this basal sequence will contain pressure water, but the sequence is likely to be more than 1000 feet thick in the Wim Well area, and, with present knowledge, there is no means of determining at what depth aquifers will be struck. The bore at Wim Well presumably explored about 150 feet of the sequence and found the strata tight, with no water Some of the dry bores drilled on the property must have penetrated the sequence, but no details of these bores are available, nor do we know exactly where they are located. The fact that the Mailchange Limestone is transgressive, and overlaps the basal

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* Exact figure not available in Canberra.

sequence, also complicates the interpretation of sub-surface geology.

In brief, there is reason to expect supplies of pressure water, but at considerable depth - probably not less than 700 feet and possibly over 1000 feet. However, supplies will be sub-artesian and will probably rise to within 300 feet of the surface, so that if an aquifer is penetrated pumping depth is expected to be less than 400 feet.

In providing the permanent water, essential for the development of the area, the Company is therefore faced with three alternatives:*

1. A deep bore to explore the sub-artesian supplies, with, admittedly, some risk involved.

2. Additional watering points using the relatively small supplies near the base of the Mailchange Limestone (Wim Supply)

3. Construction of an earth dam to store surface water.

We are not competent to advise the Company as to which alternative would best suit their purpose, but since the initial costs of deep bore and dam seem likely to be of the same order, and since sub-artesian supply is preferable to surface storage, the risk involved in boring is likely to be a critical factor in making a decision, if a single large supply is required.

Although the problem of depth to water will probably not be solved without sub-surface data from bores, the completion of field work this season may lead to more specific estimates.

Yellow Waterhole and Wim Well have been suggested as possible sites for a deep bore. Yellow Waterhole is slightly the more favourable site of the two, because it is closer to major intake areas and aquifers are likely to be slightly shallower there than at Wim. On the other hand, if Wim is favoured from the point of view of cattle management, serious consideration should be given to deepening the existing Wim bore, and so saving perhaps £1200 in drilling costs. The risk of losing the existing water supply at Wim by vertical drainage in this operation has been mentioned in the field. It is possible that beds which are porous but dry could be penetrated by the bore, with the result that the top water, under hydrostatic pressure, would pass into the dry porous bed. The senior author thinks that the risk of this happening is slight, and in any case, the loss of top water, though inconvenient, would only be temporary. If water is lost in a bore which proves unsuccessful it is standard drilling practice to restore the top water-commonly by withdrawing the casing to a point above the uppermost 'dry aquifer' filling the hole below the casing and sealing with cement grout. If this does happen, the cost of restoring the water would be more than offset by the saving in drilling costs brought about by using the existing 300 feet of hole.

Again, if it is considered essential to guard against loss of top water (which could be pumped from the well for stock during drilling), casing wider than that used in the hole would be sealed-in near the top of the hole to prevent the entry of top water.

Should the Company decide to drill a new bore at Wim, without using the existing hole, the distance between the old and new bores should be not less than half a mile to avoid depleting the present supply at Wim Well.

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* A fourth alternative which is not worthy of serious consideration in this case, is the possibility of improving the supply of water at Wim Well by drilling radial bore holes in the aquifer from the bottom of the shaft. The method is used overseas but is not practised in Australia.

By following the second alternative, development of the area would be based on a number of shallow bores, within the boundaries the Mailchange Limestone, each providing a small supply of the order of that at Wim. It has already been pointed out that the yield from bore holes may be less than that at Wim but test holes would be relatively shallow-150-200 feet.

Development could be planned and executed in stages but, when the cost of equipping each bores is taken into account, this method does not seem likely to be any cheaper than the alternatives. Disadvantages to cattle management may be considerable.

The only investigation of possible sites for earth dams carried out by us was that at Yellow Waterhole, where we concur with the opinions of previous investigators. At this spot about 20 feet of Split Rock Sandstone overlie the Mailchange Limestone, and the porosity of both surface soil and sandstone below would make it difficult to construct a tight storage dam; another site with heavy clay soil would be much preferable.

Finally when drilling begins on any site, the Company is urged to arrange for samples of chippings to be taken every 10 feet in depth.* It is most important that all possible information be obtained to aid in geological interpretation.

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<u>Geologist</u>.

* Small glass bottles are probably the most satisfactory containers for these samples, and should be clearly labelled with depth in feet and name of hole.

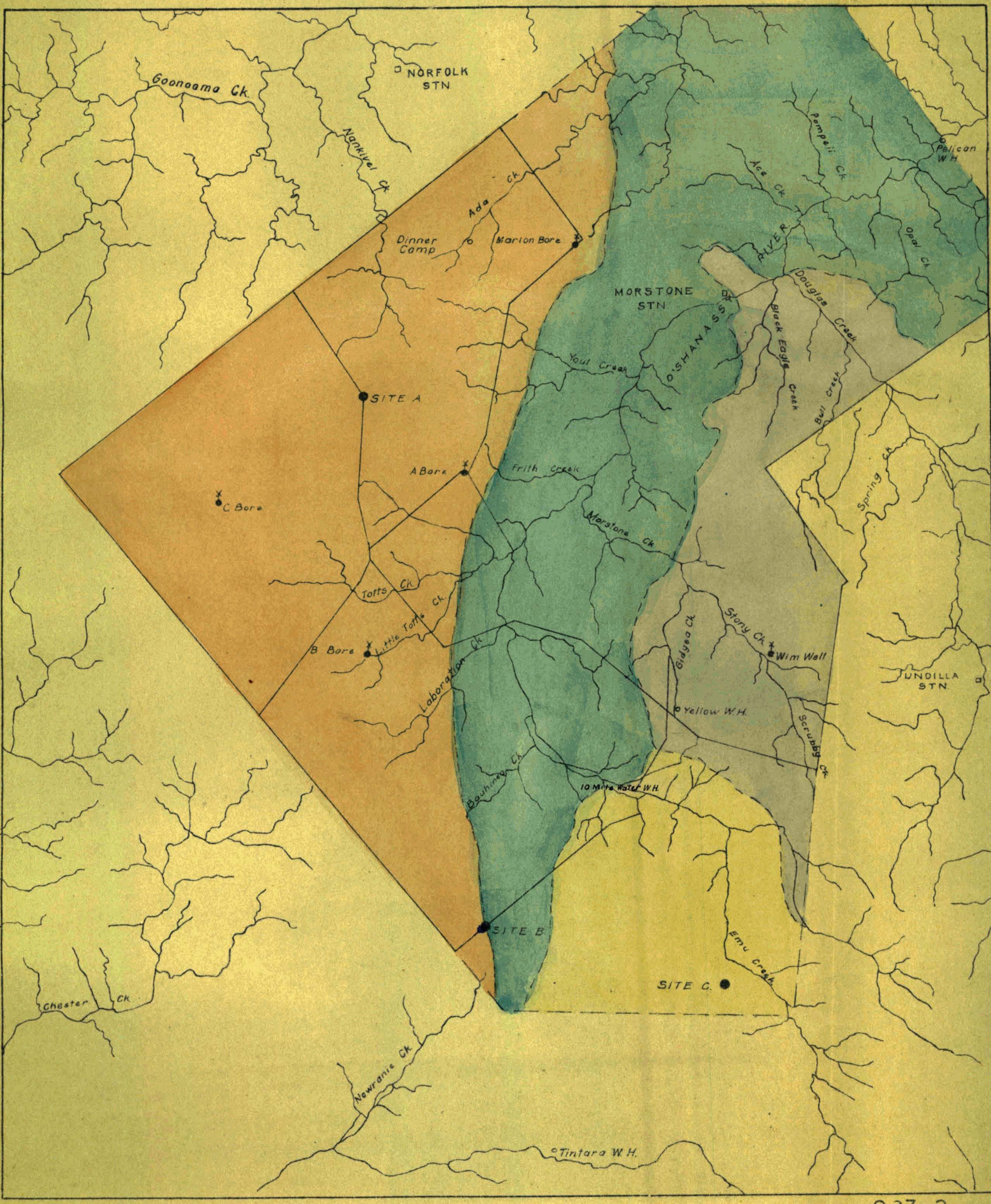
GEOLOGICAL MAP
MORSTONE STATION
WESTERN QUEENSLAND

SCALE
5 0 5 10 MILES

Magnetic N

- Sandstones producing "Desert Country"
- Mailchange Limestone
- Limestone, dolomite, calcarenite and sandstone
- Camooweal Dolomite

- - - Geological boundary (approx. position)
— Fences (approx. position)
Roads and Tracks not shown.



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