

holders being estimated by expert authorities at £400 per annum. The assessment made by the Land Board, however, totals but £202 8s. 5d., or equal to the maximum of 6 per cent. allowed by the Act ; the rate per acre varying from .8d. to .93d., or taking the carrying capacity of the land at $2\frac{1}{2}$ acres to a sheep, a maximum charge of 2.32d. per sheep per annum. Put in another way, the cost of the water distributed through the different holdings is .011d. per 1,000 gallons ; the rate paid in Sydney for water (certainly delivered more conveniently in reticulation pipes) is 1s. per 1,000 gallons.

Most of the bores recently put down, in course of construction, or in early contemplation, are however, dealt with under the Water and Drainage Act. The policy of this measure is local government as distinct from central control, Trusts being constituted for the management of the districts commanded by each bore.

PRELIMINARY INVESTIGATION.

Upon a decision being arrived at to form a Trust district under the Water and Drainage Act, a preliminary investigation is made by the District Assistant Engineer, who, from local knowledge and upon personal inspection, outlines the boundaries of a suitable district. Generally speaking, the district embraces the area between two creeks having usually a backbone or ridge down the centre, the bore site being situated at the eastern end to take advantage of the prevailing fall of the country to the west, the area of the district proposed, varying from 50,000 to 90,000 acres, being dependent on the probable flow of the bore.

PLAN OF DISTRICT.

A plan, to a scale of 40 chains to an inch, is then compiled from the parish maps showing the area and holding of each individual settler, so that the surveyor may provide for the watering of each block in such a manner that the boundary of any holding may not be more than 2 miles from a drain, which practical experience shows to be a very reasonable distance for stock to travel to water.

SURVEY.

The object sought to be attained by the surveyor in designing and locating his system of distributing drains is—by contouring—to obtain drains in surface cut of uniform depth with a minimum fall of 9 inches in the mile, and a maximum depth of 1 foot 9 inches, to avoid embankments (always a source of trouble) and to obviate fluming.

The country generally consists of plains, open forests, scrubby ridges, and occasional belts of thick timber. Experience goes to prove that



MUNGYER BORE WATER TRUST DISTRICT.

long stretches of country with uniform surface do not obtain, and what appears at first sight to be an even plain is, upon investigation, found to be frequently intersected with hard patches of ground, perhaps 1 mile by $\frac{1}{2}$ mile, standing from 12 inches to 15 inches higher than the surrounding country.

Ridges are seldom of any great length, and frequently their continuity is broken by low ground caused by flood-waters having cut through, which has to be carefully avoided, whilst oftentimes a "scrubby" ridge has to be skirted to head a water-course or avoid the large "saucer-like" depressions of flooded ground frequently met with from 6 inches to 12 inches deep. It is in such places that the greatest difficulties are experienced in locating drains, this "scrubby" land preventing the surveyor forming any sound idea of the general trend of the country.

To avoid unnecessary expense in elaborate contouring of all the area to be watered, the surveyor usually makes a general inspection of the district and sketches on his map all the leading ridges, stretches of bad ground and water-courses, which, to the untrained eye, can hardly be followed. He is then able to determine the best positions in which to endeavour to locate the main and branch drains to water each holding. Rough trial lines, reading to two or three-hundredths of a foot with about 5 chain sights—the intermediate sight being obtained by holding staff at instrument—are then run, and upon a rough plot being made the best grades to adopt from point to point are determined. The drains are then located by carefully contouring and running out the grades decided upon, the lines being pegged and finally levelled and checked with the temporary B.M.'s put in at the time of running the trial lines. In scrubby country, several trial lines are run in approximately the desired direction, compass bearings taken, and the spot levels plotted. A desirable grade can then be determined upon, and run out as in the more open country.

Whilst in winter longer sights can be taken, yet in summer, owing to the refraction being so great, the maximum reading distance for final levelling is $2\frac{1}{2}$ chains, the instrument being set up midway between the pegs which are 5 chains apart.

Having regard to the fact, that the usual fall is but from 1 to 2 feet in the mile, it can be readily understood what room there is for an engineering surveyor to prove his worth in providing economical and successful designs for distributing works; for the value of the surveyor's work is put to the severe test of the comparative prices subsequently paid to contractors for the actual construction.

PROPORTIONING THE FLOW AND DETERMINING THE SIZE OF DRAINS.

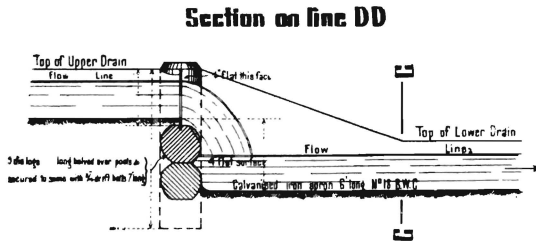
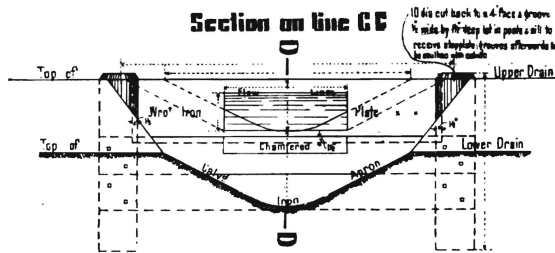
Having laid down the position of drains on the plan, the surveyor then calculates the area to be served by each drain, and determines the proportion such area bears to the total area of the district.

Starting from the distributing tank into which the bore is eventually to discharge, and assuming two drains leading therefrom—as in the case of Florida District—the area to be served by each drain is first ascertained and its proportion to the whole area of district determined, so that the proportionate width of the slot in the stop-plates can be decided upon, the bottom of the slots being placed on the same level to ensure the proportionate discharge into each drain.

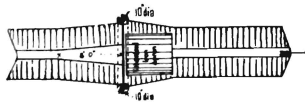
The area of the Florida District taken in calculation is 50,494 acres, whilst the area served by the small easterly drain is taken at 3,177 acres, and the main westerly drain at 47,317 acres. The proportion therefore is .06 to .94, and taking a slot 18 inches wide as capable of discharging the whole flow from bore the respective widths of slots required are $1\frac{1}{8}$ and $16\frac{1}{8}$ inch.

The minimum fall of the main drain, until the first branch is met with, having been determined by the surveyor, the size of the required drain is ascertained from a table of discharges (Appendix A, Tables 1, 2, 3, 4) supplied to him—and calculated by Kutter's formula, taking $N = .025$ the flow line being kept at least 3 inches below surface in cut and 5 inches below top where in bank.

Drop



Sketch Plan

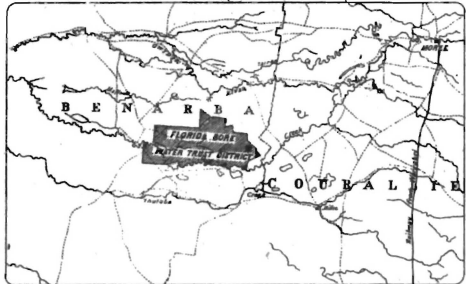


A similar system of proportioning to that adopted for the tank outlets is followed when the first branch drain is met with, viz. : the area to be served by each drain is calculated and the proportionate width of slots in each plate divisors fixed in accordance therewith, which, with

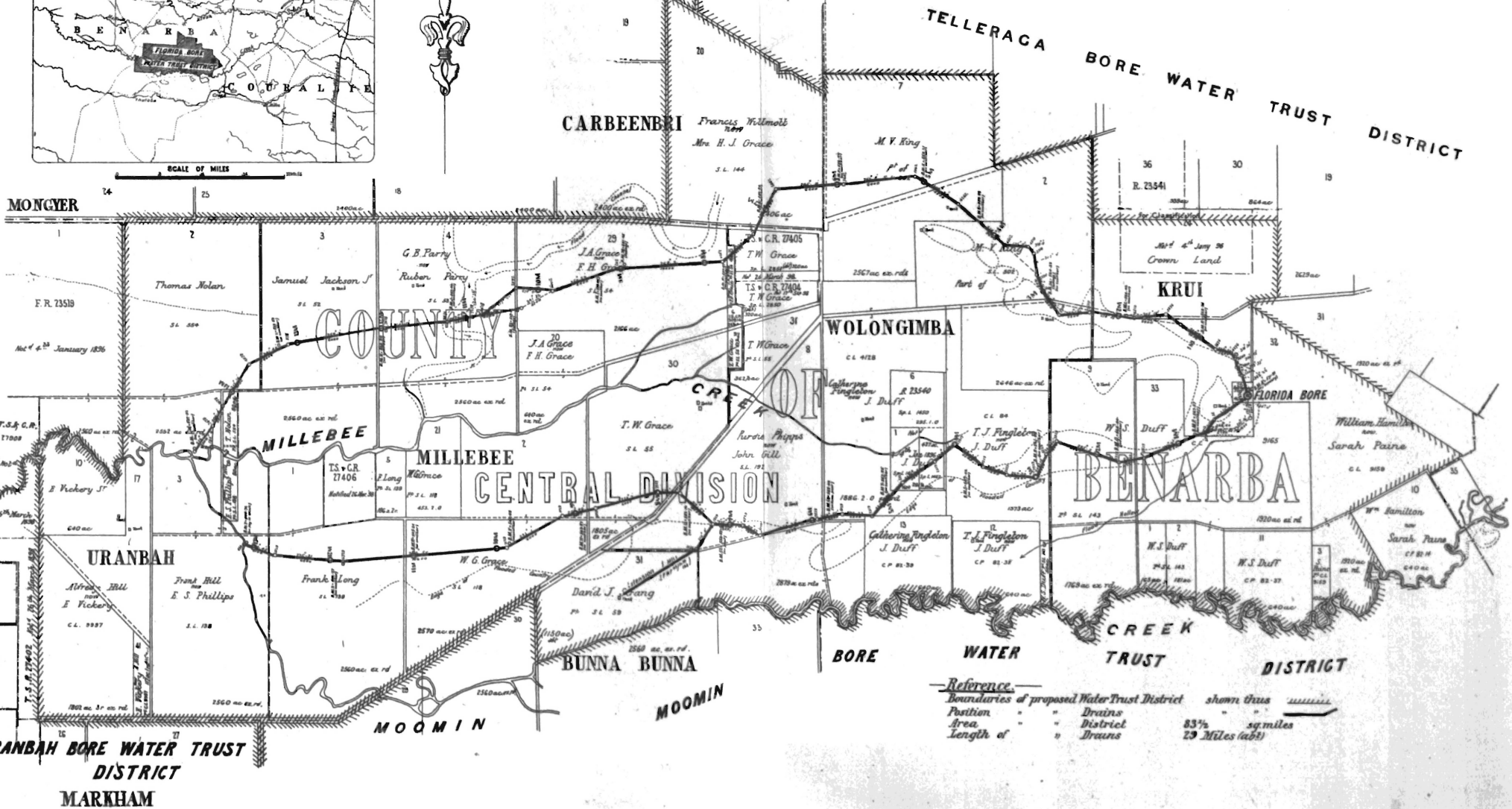
FLORIDA BORE WATER TRUST DISTRICT

PLAN SHOWING PROPOSED BOUNDARIES

LOCAL SKETCH



SCALE OF MILES



Reference

Boundaries of proposed Water-Trust District	shown thus	—————
Position " " Drains	" " " "	—————
Area " " District	83% "	sq miles
Length of " " Drains	29 Miles (abt)	

the free overfall provided for the tail water, ensures the correct proportionate discharge into each drain, irrespective of—as is generally the case—the marked difference in fall of each channel.

The same system is adopted at each subsequent branching, the whole system of proportioning being in relation to the estimated discharge of bore where l = total area of district served and the assumed discharge of bore. Upon the minimum section of each drain being determined, and position of drops—if unavoidable—decided upon, the surveyor grades the section and shows, plotted to a distorted scale of 20 chains horizontal and 8 feet vertical to an inch, the depth of bottom of drain below surface at each 5-chain peg, the area served by each drain with its proportion to the area of the whole district, the estimated quantity of water to be discharged into each drain, the grade and size of each drain, and its calculated discharge on the minimum grade when running with flow at the stipulated depth below surface, and top of bank, respectively.

There is also shown on the section, the character of the country passed through, with cuts of fences, &c., and the number of all the pegs with the chainage distance, which are legibly stencilled on the pegs. B.M.'s are established at half-mile intervals, each chainage peg being marked with an indication stake standing 2 feet out of ground, so that the contractor, to whom no section is given, but a tabulated statement of the depth of drain below surface at each peg, with dimensions of drain, can easily determine his own quantities, and on the ground, pick up any point, and set out the depths for himself, the drains as constructed being located 8 feet on one side of the pegs.

Upon the surveyor's design of distributing channels being approved, and an estimate of cost of bore and distributing works having been prepared, a Trust proposal is gazetted, giving a detailed description of the works, with plan and estimated cost. (Appendix B.)

Assuming that a petition from one-third of the occupiers within the district objecting to the proposal has not been lodged within the stipulated period of eight weeks, or that a petition has been received and the Minister has approved of the Water Conservation Board's recommendations, after public inquiry and a report, a Trust is then constituted, and the conditions of the proposal become binding on the Trust and on the Crown. Action can then be taken to carry out the works.

SYSTEM OF TENDERING FOR SINKING BORES.

Tenders are first invited for the sinking of the bore. For many years it was the practice for contractors to give schedule rates for each

500 feet up to a maximum of 4,000 feet, with the resulting trouble that oftentimes, at different depths, different tenderers were the lowest, so that should it subsequently be found necessary to sink deeper to bed-rock than anticipated, it might happen that the accepted tender would turn out more expensive than had another tender been accepted. To meet this difficulty a new system of tendering (Appendix C) has been introduced, which puts all contractors on an equal footing, and allows of the lowest tender being determined irrespective of depth. This system has given great satisfaction to tenderers, whilst avoiding the risk of the Department's accepting a tender which might ultimately prove more expensive than one rejected.

The practice now is to schedule the different depths and items in the contract with a fixed price for each, leaving it to the tenderers to state whether willing to accept the printed schedule prices, or to give an all-round percentage above or below same at which they are willing to carry out the work.

Whilst undoubtedly in the earlier stages of artesian boring it was sound policy for the Department to supply the contractors with casing, so as to induce greater competition amongst smaller contractors, and ensure the use of suitable casing only, yet, with the great development in boring, and the importing by merchants of reliable casing from different manufacturers, the specifications now stipulate, wherever possible, that the boring contractor must supply his own casing in accord with stipulated tests, which relieves the Department of much business trouble and reduces the risk of claims under the old system.

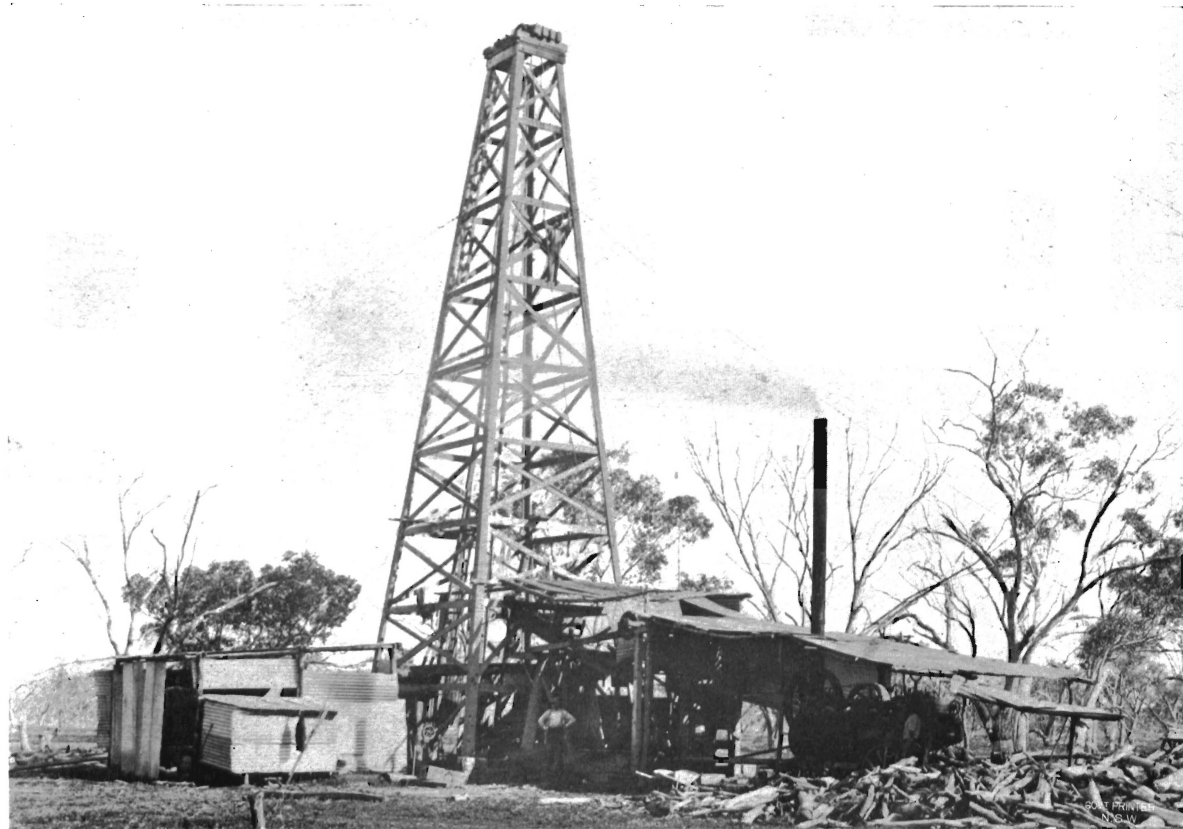
A tender having been accepted for the sinking of bore, the contractor has to start boring within two months of date of acceptance, and usually no time is lost by him in erecting plant.

DRILLING PLANT.

The plant consists of a timber or a steel derrick, a rig, and usually a portable steam-engine.

The rigs in use are cable rigs, Canadian pole rigs, and a combination of the two, the last-named being the more generally used, and it was with a rig of this type that the bore 4,008 feet deep at Boomi was recently sunk, and a short description of this plant is as follows :—

The derrick is of Oregon pine 18 feet square at base, tapering to 4 feet square at top, and 63 feet high, resting on mud sills, the whole



DRILLING PLANT.