Farm Development Survey in Australia

By R. H. GORDON, (Reprinted from The Australian Surveyor, December 1971)

As an engineering surveyor, I have always approached farm development work from the point of view of a surveyor primarily, although very soon in any given job other ramifications intrude. However, the survey work is so essential and so basic at all times that I look upon it as the most important factor. As work proceeds, I am involved in timber classification, estimates for bulldozing, windrowing, burning, picking up, levelling, ploughing, dam-sinking, fencing, and a dozen other operations relating to the early development work on farmland.

The particular area I refer to in these notes is the upper Great Southern district of Western Australia. This is a fairly elastic term, covering a broad sector of the State beginning about 60 to 70 miles S.E. of Perth and extending, as the great southern proper and even perhaps lower Great Southern, down to Mt Barker and east almost as far as cultivation goes. It is bounded on the west and south by the coastal strip of varying width.

In this area, and the actual South West itself, is the major portion of the State's jarrah forests, merging into the karri in the south.

Farm lands in this area west of the Albany Highway, and for some distance to the east of it, are mostly carved out of jarrah and white gum forest.

My particular job as development surveyor falls into the following approximate headings:

(1) Inspection, of a "virgin" block — which usually means forest land which has been cut over — and re-definition of the boundaries, finding old marks, and generally setting up the lines in accordance with survey information from the Lands Dept and checking the acreage.

(2) Deciding on the most favourable section to begin clearing, and marking this off, probably by blazing of flagging tape hung on trees.

(3) Arranging for prices to be submitted for clearing and preparing for cultivation, and supervising this work to its conclusion.

(4) Setting up a design for the farm, with suggested fence lines, dams — which are decided upon in accordance with their availability, a term which I will explain — and the situation of buildings, access roads etc.

Most of this work is of the "pioneering" pattern, and is not covered in any textbooks. In several instances over the years I have extended my work to actual farm management in its early stages, the stocking of the property, buying and selling sheep, organizing cropping programs and so forth, but although a practical farmer, having worked my own farm in this area, I am never particularly happy once I get away from the development stage, as there is far too much guesswork and sheer blind luck in the actual farming operations which cannot be controlled with a slide rule. This is mainly why I gave up the farm — and I may add at this date, not a moment too soon! — and with my own experience of what actually happened, concentrated on the job of bringing other properties into production along economical lines.

I have found the orthodox farm expert, the agronomist etc, rather a menace during development stages whenever I have been unfortunate enough to run across him. He seldom if ever has any real knowledge of the bush, and tends to involve the landowner in rather far-fetched dreams of tremendous production figures provided scientific methods are used.

This often results in attempts to "telescope" development operations in the eagerness to get things growing, at a most important time when one is battling with stump removal, proper levelling, access roads, and general tidying up.

It is also generally assumed that once the bulldozing is done, one is pretty well home and dried, and farming can proceed apace. This is very far from the truth, and it is the bulldozing that is the easy part, the hard part is just beginning.

It is fitting here to give a brief outline of the short history of the bulldozer, and the associated methods of clearing land in this part of the world. The span of its large-scale operations here is less than 20 years, and it came to its best during the 1960's.

Unfortunately, too much of the work was left to the discretion of the driver. One tends to get punch-drunk, and even lost, jolting around in clouds of dust on a big dozer, with the incessant clamor of the engine and general rattle and bang. I recall one landowner who had selected a good spot for his house, nicely sheltered by a grove of trees near a creek. He took the driver along to show him this spot, and gave him strict instructions not to knock any trees over. This was duly noted by the operator, who set sail well away from the forbidden grove. However, working his way round, he approached the same grove from a different direction — one of the biggest traps in the bush — and not recognizing the landmarks, proceeded to flatten the whole patch.

The damage done by a big dozer — a D9 say — is truly awe-inspiring, and too much care cannot be taken to see that the driver knows exactly where he is at all times.

It is overlooked, sometimes, that those working in the wake of these monsters will be trundling along on farm wheel-tractors, and therefore quite unable to cope with the torn-up shambles left by the big machine's treads, let alone the huge rocks pushed up in many instances.

Some wrong ideas about what are called "bulldozers" persist in the public mind, and often show up in pseudo-technical journals and whatnot.

Strictly speaking, a bulldozer is a crawler or wheel tractor (more about wheel dozers later) with a blade that can move only up and down. An angle-dozer can shift its blade through a small horizontal angle, by means of a central pivot blade and adjustable sidearms. A tilt-dozer, or trail-dozer, can adjust its blade through a vertical plane, the most important move of all perhaps, that is, it can adjust the angle of the bottom edge of the blade makes with the plane of the ground, thus enabling it to dig drains, etc., like a road grader.

The ability of a dozer to angle and tilt, as well as straight-blade, is of considerable importance on many earth-moving projects, and without these functions, it would often be impossible to proceed.

Tree-clearing gear includes various designs of extended arms, suitably reinforced and anchored to the rear trunnions, raised by cable or hydraulics, and with a serrated jaw-bar to grip the tree trunk as the dozer pushes. These tree-bars can be immensely heavy, and depending on their design, anchor points, and controls, can seriously hinder any accurate blade work.

In the place of the solid blade, scrub-rakes are fitted to clear up land after burns: these are 18 feet wide or more and can cover a lot of ground with a skilful man at the helm.

There are two basic ways to clear forest country — which in this part of the world has almost invariably been well-cut over — by simple dozing, and removal of stumps, and later putting a running burn through, or by pushing into windrows, and

later burning. An extension or refinement of the bulldozing can be achieved by chaining. Originally, this technique I think was perfected in the U.S.A. where much of our bulldozer know-how was learnt. This consists of a large heavy ball, in the middle of a long length of heavy anchor-chain, each end pulled by a dozer. Such a chain, which could be two or three hundred feet in length, if pulled by big enough tractors, could and did cover amazing areas in a given time.

It was found that the "hi-ball" as it was called, could be dispensed with, and heavy chain only used, particularly if you had a third machine working independently in the middle, to knock out anything too stubborn for the chain. Later, as a natural result of this, the chain method with two machines only was used to level the land after burning and picking-up.

The limitations of chaining are in its inability to cope with heavy country, and stump removal, but given the right sort of country the chain can get quite a spectacular job done.

Its advantages are in the more complete destruction of scrub and smaller stuff which it is economically difficult to treat with a dozer, the absence of churned up track marks and generally a more acceptable condition for a running burn.

The running burn if successful is still the best from an agricultural point of view. The potash is more evenly distributed, topsoil is not disturbed by being pushed into the bottom of windrows by the scrub-rake, and possibly even more important, the excessive heat factor present in the burning of high-piled windrows is absent. In many cases, extra growth is seen after cultivation over windrows, clearly marking where the windrow was, probably owing to two factors, the concentration of potash and just the right amount of heat. Equally, however, these patches remain barren for several years, or support only rather miserable growth because of the excess heat generated by the fire.

For many years during the early stages of bull-dozing, which of course created a most dramatic development in land clearing here, the importance of aiming at a good seed-bed was overlooked in the general excitement of having clearing done so fast. I remember one instance of this kind of excitement when two contractors I knew rigged up a couple of General Grant tanks, pulling a long length of heavy chain. They had contracted to pull over an area of about 300 acres in light country for a cocky. The first day they pulled in to the property, and arranged to start in the morning, the cocky told them he would be going to town for most of the next day, but would see them again the following evening to see how the job was going. When he got back that night, they were waiting to get paid, the job finished. The staggered farmer wouldn't believe it until he had a look.

However, it was some time before it dawned on landowners that even the ordinary bulldozing which could still knock over 50 and 60 acres a day, was actually the easy part, despite its spectacular performance.

The complete removal of all stumps was not insisted upon, nor the careful levelling of the ground, and many farmers put in subsequent years and much money tidying up after the big machines. As things got progressively more sophisticated — and prices for production dropped — contract requirements became tighter, until today, pretty rigorous standards are called for. To get ready for the plough, with all stumps out, levelled, scrub-raked and picked up, in medium to heavy jarrah and white gum country, the landowner must expect to pay anything up to $40.00 per acre.

Prices do vary, as is the nature of things with a variety of operators, and complete clearing, as well as first ploughing, has been done for as low as $30.00 per acre, but contractors have gone broke, too.

The economics are certainly fascinating: I write of present-day circumstances (1971), with bush land, with plenty of stumps, priced at $20.00 per acre. Sales have been made at this in recent months — some are asking more.

To prepare for the start of cultivation can cost another $40.00 without incidentals like survey and supervision (at least another $1.00). Ploughing costs $2.50 and seeding about the same. One bag of trace element super plus one bag of straight super is a minimum requirement for new land which is basically phosphate deficient, and lacking vital elements in a condition readily available to the plant. There are several methods adopted for sowing down land. One, with grain. If wheat is chosen, urea or similar nitrogen stimulant must be added at rates which vary, with individual inclinations from 56 lb per acre to 112 lb. Oats are not so demanding, but nitrogen helps. Secondly, subterranean clover types, which are most suitable for our particular soils — indeed, over a wide area of the State — and prices for this vary from a few cents per lb to $1.00 — some exotic clovers have been above this.

The operation of first and second ploughing, seeding and harrowing, plus purchase of seed and super, carting, supervision, and incidental expenses leave very little change out of $20.00 per acre, if these operations are done correctly and proper quantities sown.

So that in effect we now have land prior to any actual production which has already cost about $80.00 per acre. The provision of fences, dams, sheds, yards and dwelling add substantially to these initial costs.

Suitable fencing can be approximately costed at $600.00 per mile, dam excavation at 20c to 23c per cu. yd.

For the boundary fencing and subdivision of a 2,000 acre block, into the minimum number of paddocks, a total of some 20 to 25 miles of fencing, costing — with cheaper internal fencing in places — in the vicinity of $12,000 would have to be erected. Assuming ten 2,000 yd. dams, and this size would be the minimum requirement, water supplies without any reticulation system would cost $4,000 and sheds and dwelling anything up to a further $20,000.00.

A picture then emerges something like this:

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Cost of land — 2,000 acres at $20	40,000.00
Preparing for cultivation—area available being 1,500 acres at $40	60,000.00
Sowing down 1,500 acres at $20	30,000.00
Supply fencing, water and buildings, estimate	36,000.00
	$166,000.00

making the value of the property about $83.00 per acre including the untreated bush.

This is rather an over simplification of the scene, but I have knowledge of something very like this happening in practice in more than one instance. Interest at 7 per cent on the capital so far involved would of course be approximately $11,500 per annum. The gross earning capacity of 1,500 acres in this part of the world has not, as far as I am aware, exceeded $20.00 per acre as a regular thing: certain intensive operations may have exceeded it over a short period.

A more realistic picture of gross earnings from 1,500 cleared acres would be nearer $10.00 at the present moment.

It follows then the gross return from the capital involved is not greatly in excess of normal interest rates, but in order to obtain this return, a full year's work and all operating costs and drawings must be set against the calculation. This reduces the sum available by at least 75 per cent if we agree that the landowner must spend about $5,000 a year on his personal expenses, and PN's on machinery etc. and all-in costs approximate a further $7,000. The only way this can make any kind of economic sense is for the landowner to

have achieved massive taxation relief from a big income earned elsewhere. It is fortunate for this area, relatively close to Perth, that there are so many professional men in this position, and able to carry out development work which is manifestly uneconomic from the viewpoint of being able to earn its keep.

The operations of syndicates and sole owners with large amounts of capital available, have played a vitally important role, and it is fervently hoped that all sorts of income from other sources, possibly mineral development for one, will continue to maintain life in agricultural areas. Otherwise the future at this point of time is extremely grim.

Possibly the most vital element in any program of development is water. It is little use preparing land for farming if no water is available.

In these parts, we must rely to a very great extent on conservation of surface water, in dams, or what we call tanks in the trade, since a dam, strictly speaking, is a wall-type dam, across a gully or similar catchment.

Some fairly deep boring has been done, and some bores have been successful, but in the main, this method has to be discarded in any serious program for large-scale water conservation or storage.

Methods used here are test-boring and sinking, after satisfactory material has been proved, by dozer — and scraper if the project is big enough to warrant one.

It is here that the 4-wheel drive rubber-tyred 'dozer proves very useful, although their utility is limited by initial cost and mechanical headaches. They are very fast in action, and do not have the same transport problems as track-type machines. Some very big machines are used in mining projects, indicating that where cost isn't a problem, they are perhaps favoured over the tracks.

I mentioned earlier the "availability" of farm dams. This means, briefly, that if the subsoil can support a good excavation — that is, it won't leak — then there is a dam site available, and with good luck, not only available, but where you want it so.

The paddock design, or fence plan, is dependent upon finding good dam sites, obviously. Material looked for to come up from the test bore is good quality clay with a high plasticity index, and satisfactory colour — in our case, usually white, but good holding clay can also be yellowish, and even tinged with red, but as this last indicates laterite, and possibly porous soil, it is to be treated with caution.

The size, or capacity of the tank, is a matter for the landowner to decide, upon advice he receives.

It is here again that the professional farm expert can give further trouble. He is inclined to work out water requirements for a given number of stock to be carried by that particular area likely to be serviced by the dam in question, and advise the landowner that it is not economical to store more water than these figures indicate.

This is very dangerous and misleading logic, despite what appear to be unanswerable arguments to the contrary.

A fairly bad, almost drought year in these parts a couple of years ago showed up the fallacy of this "economic" dam idea. Small paddocks served by small dams — in one case, sixteen 1-hundred acre paddocks with sixteen dams averaging about 900 to 1,500 cu. yds — were all in bad trouble, with dry dams. One can imagine without explanation in detail, just what would happen to 1,600 acres of heavily stocked paddocks, all worked out on the economics angle, with every dam bone-dry, or nearly so.

The only satisfactory solution to the long-term water problem is the sinking of substantial tanks of 4,000 to 5,000 cu. yd with auxiliary dams of smaller capacity, certainly, and where really good material and adequate catchment area is available — the well-heeled landowner can go to almost any size — and he has done so, in many instances, thus making his property drought-proof.

Care must be exercised in backing up water over large areas, and the pros and cons of covering arable land, or trees, with water and thus putting them out of action, must be considered, but in the normal tank-type operation, few problems exist, and proper by-wash provisions contain the water within the confines of the tank and such sealed downstream wall as may be considered necessary or desirable.

Depth of tank is important, as the loss by evaporation can be 4 or 5 feet a year. Excavation depths of 15 ft are satisfactory.

The strategic placing of wall-type dams across creek beds to control water flow can be used to considerable advantage in many sites, the overflow guided away by contour drains to any chosen location, often quite far from the dam, to spend the excess water across a dry laterite slope or ridge.

In this connection of course, actual soil conservation itself comes into the picture. Seen from the air, newly cleared farm lands after a couple of winters often reveal a most depressing degree of erosion, with more to come. Older farms can show gullies 6 and 8 feet deep across ruined paddocks.

Quite rudimentary working along the contour in the first place can avoid much of this, as well as the preservation of trees and scrub along waterways, or places which the surveyor can see will become waterways after clearing operations — and these are the most prolific cause of erosion.

One gadget I found very handy on my own place was a contour indicator mounted on the front of the tractor. In this, damped movements of the pendulum were transmitted mechanically to a dial facing the driver, calibrated simply "TURN UP" and "TURN DOWN" and indicated by a pointer, with its neutral position central. The driver moved the steering wheel as the indicator directed, and very little deviation from a true contour was found with practice.

A whole separate treatise can be written on contour work, the key-line plan, and so forth, but it will be sufficient here to emphasize that cultivation across slopes, rather than up and down, is the first rule-of-thumb method to avoid erosion, and secondly, the immediate control, by means of dams or contour banks, of any gully likely to be menacing.

Another very useful tool in laying out contours, and drains off the contour, is the water-level, which is much faster than dumpy and staff, for two men.

The provision of access and other work roads is possibly the most neglected aspect of development work, and it is surprising how many otherwise perfectly sensible men continue to bump around the property on rugged tracks.

As an engineering surveyor much of my ordinary work has to do with roadbuilding, for local shires and so on — I was a shire engineer for 15 years — and not unnaturally this struck me as being in the last degree foolish, when with so little comparable expenditure quite reasonable comfort and lasting utility can be achieved.

The location of farm roads is a relatively simple task, mainly because of absence of the need to worry too much about grades, except for those roads that provide direct access for heavy transport. In our part of the world, and I daresay in many others, the landowner is dependent, in the foreseeable future, on the trouble-free movement of motor transport to and from his farm, and this governs the siting of his machinery and shearing sheds and other buildings. These must not be sited in low-lying country likely to get boggy, nor on mountains, and this is frequently the urge on the part of urban types who im-

mediately set about looking for a place with a "view".

Grades not at all applicable to public roads can be safely chosen for the farm Land Rover or ute, with proper consideration for the provision of wide gateways and reasonable routes for the movement of heavy machinery around the property.

The construction of these roads can often make or mar a whole design for the farm itself. This is a personal opinion, but I am firmly opposed to forming up roads except where white gum flats or similar swampy ground necessitates some sort of causeway. All roadmaking technique is diametrically opposed to farming practice — everything you do to make a road is completely antagonistic to cultivating the land, and green hands should be very wary of introducing these techniques, so admirable in theory, because once started they are difficult to control. A built-up road means water tables on each side, means water flow, means culverts, means side or off-shoot drains — all manner of operations completely at variance with cultivation and soil conservation.

One operation leads naturally into another, and the inexperienced landowner is caught up in work which has absolutely no place on a farm.

Where the land lends itself to it, and it is rare to find any that doesn't here, it is better to use the top surface and grade a flat road. This won't prevent machinery being driven across it, and presents no water problems. It can be maintained with a simple two-bladed drag behind a wheel tractor. Wet crossings should be treated with rocks, and no attempt made, unless reasons are very pressing, to put the flow of water through pipes or other apertures which need built-up approaches.

Actual river crossings of course are quite another matter, and the farmer must decide just how far he wants to go with this sort of problem. Most of our "rivers" are part, or completely, dry much of the year, but in floodtime require major bridge-building, something usually out of the question for the individual landowner.

Gravelling can be done anywhere it's needed, for fairly reasonable cost, possibly by hiring machinery and men from the local Shire. This remains a flat road after settling down.

Other things being equal, the location of roads governs the siting of gates, although of course this isn't the case at all times.

Suitable tracks should lead to all points on the farm, so as to avoid as far as possible driving over paddocks, which is not a good practice although indulged in by most. I would estimate the overall cost of road construction along the lines I have indicated at from $40.00 to $150.00 per mile, the rather wide range depending on use of bulldozer in first stages — if you don't have to hire more than a grader, and subsequently knock the road into shape with a drag after a bit of use, a big grader at (say) $10.00 per hour can cover many miles in a good day over suitable grades — the road need only be a blade width for a start, at the most two wipes will produce it, one up and one back.

Assuming that a big grader can be shoved along at an average speed of 3 mph then allowing for turns, lost time, smokos and whatnot, it should be able to cover at least 20 miles in a full 8-hour day. This means 10 miles of farm track graded, given nearly perfect conditions all round. If hire cost $10.00 per hour, track cost would be $8.00 per mile.

In actual practice, all sorts of other factors combine to jack this total up considerably, firstly, of course, the clearing away of bush in the way of a selected route, the possible tyning-up required, and later gravelling, stone carting and raised formation over swampy land. However, once the track is established, the cost of maintenance can be fairly gauged on this estimate of $8.00 with all hired plant, and with the farmer's own plant, it will be correspondingly less, with this type of road.

The dividends paid back in confortable running around, time saved and vehicle wear-and-tear reduced are substantial.

To sum up then, the operations involved in farm development surveying are:

(1) survey and re-setting up of established boundaries by cutting line and pegging with waddies and spikes.

(2) selection of a suitable area for clearing, taking into consideration soil-types, class of timber — which is a guide to soil-type — likely dam sites, having regard for the fat that all cleared land will have to be serviced by water at reasonably close intervals, — and possibly of sites for main buildings with access, as it is almost certain that the landowner will be building on the first clearing, if only a superphosphate shed;

(3) the arranging of contracts for clearing, burning, picking up, levelling the ground, cultivating, etc. depending on how far it is possible to go with one contracting team — (some only do clearing) — and possibly as far as seeding the first crop;

(4) the topographical survey of the land so cleared, measuring areas of bush left standing, and the preparation of a topo map, to scale (usually 10 chains to the inch on big properties). Setting out dams, and general supervision of all this work. Incidentally, the drafting of the various contracts is often one task;

(5) location and design of roads and fences. Some of the road will have got a start by this time with vehicles running in and out, and it is wise to exercise some supervision at an early stage in recognition of this influence. Fence lines are run with a theodolite, plentifully pegged and spiked — a certain amount of line cutting here, I mostly use a chain-saw for this, but it is often possible to clear the line straight away if the dozer's program allows, and put the pegs in afterwards. This means a compass run, and tie-ins to keep straight if there is any quantity of bush. Fence lines can be cleared up to a chain or more wide in good country which will be used for cultivation afterwards.

(6) Siting and design of buildings, yards, loading ramps, tank-stands and so on around the main centre of activity, provision of electric light and power, which involves getting poles from the bush country, and arrangements for, and possible provision of poles to bring in a telephone if this can be arranged.

ED. NOTE: James Alexander McRae, a New Zealand Land Surveyor from the Department of Surveying, Otago University, has recently given a series of lectures to Canadian surveyors, on the role of the New Zealand Land Surveyor. Information supplied announcing these lectures included the following "The New Zealand land surveyor is the principal co-ordinator of all rural/urban land use changes. He plans new residential, commercial and industrial developments within the scope of town planning codes. He then designs the engineering works required, supervises engineering contractors, and finally produces the new cadastral plans as the basis upon which the new land titles are issued."

We are having no contributions to our limerick contest. Here's an oldie.

There was a young fellow named Tate

Who went out to dine at eight eight

But I will not relate

What that fellow called Tate

And his tête à tête ate at eight eight.