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THE JOURNAL OF THE ASSOCIATION OF SURVEYORS OF PAPUA NEW GUINEA

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KEYNOTE ADDRESS AT EIGHTEENTH SURVEY CONGRESS PRESENTED IN LAE ON SEPTEMBER 5, 1983 BY MICHAEL J. LARMER F.A.S.PNG.

When I was asked to present this keynote address to the 18th Survey Congress I had to first ask myself some questions.

1. Why are we all gathered here in Lae at this time?
2. Why are we surveyors?
3. What is a surveyor?
4. What contributions are surveyors making in Papua New Guinea?
5. Are surveyors really needed?
6. Are we too expensive?
7. Are we overtrained or perhaps we are undertrained?
8. Should we broaden our horizons and get involved in allied professional activities or should we concentrate our efforts on surveying as we know it?
9. What is a professional?
10. What is meant by the Congress theme, 'The Challenge of Change?'

My initial answers and I repeat initial answers to these questions are that we the members of the Association of Surveyors of Papua New Guinea and our visitors, who are connected with the surveying profession, even if not actually surveyors, are gathered to exchange ideas, experiences, and hospitality. We are all here in the hope that we will benefit by being in each other's company for the next week or so by reading and listening to the papers that are presented to us and discussing aspects of those papers with the authors and with others, and by just generally mixing with our fellow surveyors in a relaxed atmosphere. It is probably fair to say that none of us would be here unless we thought it would be a rewarding experience in one way or another and now that we are here I think we've all got to put sufficient efforts into our participating in this Congress to ensure that, in fact, we get out of the Congress the maximum benefit of attending.

If a delegate does not get anything out of the Congress he is only wasting his own time and to a certain extent everyone else's time including that of his employer.

In answer to the question 'Why are we surveyors?'
I guess there are various reasons. One has to earn his livelihood in this commercial age doing something. The ideal of many young men is to obtain professional status whether it be surveying, accountancy, architecture, engineering, law or medicine. Why are we surveyors rather than these other professionals can only be answered by the individual but presumably the reasons are;
i) idealistic, such as we are surveyors because we think that it is the best profession or we wanted to work outdoors when we practiced our profession or ii) less idealistically we thought surveying was the easiest way to make a fast buck which of course it is not, or iii) simply because the passmark needed to enter surveying is probably not as high as some of the other professions. That might be the only reason we are in surveying, if so that's a little bit sad.

As to the question 'What is a surveyor?' One dictionary definition I have seen says 'a surveyor is a person who determines the boundaries, the area or the elevations of part of the earth surface by means of measuring angles and distances', whilst 'surveying' is described 'as the measurement of dimensional relationship on the earth surface especially for use in locating property boundaries and mapmaking'. In Papua New Guinea of course the land surveyor is primarily engaged with the boundary surveys of urban and rural land both alienated and customary and also with engineering surveys related to the location, design and construction of roads, bridges, aerodromes and buildings etc.

There are also surveyors in Papua New Guinea engaged in the making of maps but there are not too many people engaged at this point in time in this particular aspect of surveying. With respect to 'What contributions surveyors are making in Papua New Guinea?', it is my personal feeling that probably we are not contributing the amount we should to the society and the people of Papua New Guinea. We can't really blame the Association of Surveyors for this but the fact of life is that surveyors simply don't display a prominent profile in the affairs of Papua New Guinea. Land is probably the most important single issue in the country and really land surveyors ought to be playing a much more visible role in solving the land and problems especially the customary land problems in Papua New Guinea. Unfortunately it's not technical competence that gets recognised in these fields, it is more exposure at a political level. Surveyors really need amongst their ranks many outspoken nationals who are not only qualified surveyors but who take a very deep interest in land and associated problems. If we had enough of these men amongst our ranks, and in fact we have two or three, the profession of surveying would be better known in this country and would be able to make, and be seen to be making a considerable contribution to the development of this country. I think then that any course at the University of Technology should take this into account. I realise it's a difficult one as we are trying to turn out competent professional people not political 'animals' but I'm afraid it is the political 'animals' who are heard in this country and not the unassuming professional, as in reality no one really listens to him at all.

He doesn't speak with a loud voice and of course he is not heard. This then is the main theme of this keynote address, that surveyors are not making anywhere near the contribution they should to the development of Papua New Guinea because they are confining themselves to technical matters in most cases and in a country at Papua New Guinea's stage of development this is not enough. The surveyor needs to use his expertise and his training to make positive contributions to the customary land problem and by that I don't mean simply measuring the land, I mean surveyors should initiate the formulation of a workable policy for the optimum use of customary land. Perhaps only 10% of customary land is being

utilized properly at this time and the figure needs to be much higher if the country is to develop, and it is my opinion that the surveyor has a very important role to play in this area.

On the question of whether or not surveyors are really needed, of course surveyors are needed but really not many of the citizens of this country would realize that and this again all comes down to the low profile which surveyors keep. The only real thing a surveyor has got going for him in this country is that when he is registered to practice as a surveyor he is the only individual that can effect boundary surveys, subdivisions etc, under the Survey Act and this makes him unique in that no other professional can legally determine the boundaries of land.

In respect of engineering surveying many engineers in this country these days dispense with the services of surveyors in the location of roads etc, as they feel they can do it as well if not better themselves. I dispute this and we should impress on people in appropriate places that surveyors are the best people to locate roads as well as of course to survey roads.

If the public at large and particularly potential clients do not realize this then naturally the surveying profession loses out in an area where it really should play the most prominent role. One of the papers to be presented to us later in the week discusses 'The Declining Role of the Surveyor in Urban Design' so it seems we are losing our grip in more areas than one. One of the reasons surveyors are not consulted as much as they should be in some engineering surveys is that the instruction is given in the first instance to the engineering firm. Sometimes a good percentage of the instruction is tied up in the surveying component and the engineers are loathe to give away a big percentage of their work to a subcontractor, in this case a surveyor, so they do the work themselves. In some cases too of course they are competent, but surveyors should never have let this get away from them, they always should have been seen to be the most competent in this particular area and if this was the case the client would insist that the engineer employ a surveyor to locate his roads etc. rather than let them do it themselves.

In answer to the question 'Are we too expensive?' The answer is yes and no. In some areas it would seem that we certainly are too expensive, in other areas we certainly are not. Survey Regulations are such that an enormous amount of work has to go into many surveys and really the end results, from a public's point of view anyway, simply doesn't warrant it. Take the case of a two lot subdivision whether it be an urban or rural area, but particularly a subdivision of a relatively small piece of land in an urban area to which a man has an existing title; the land might be fenced on all four sides. All he wants to do is to put a line down the middle in order to sell off one allotment, retaining the other which contains his residence. All that client wants is to split his existing title in two and one can't blame him for thinking that this task could be performed by a professional surveyor in a short period of time for relatively small fee. Most clients in a case like this don't expect to pay more than a couple of hundred kina for the job. In fact the price is more likely to be a couple of thousand kina and this is because of the provisions of the Survey Directions which require a surveyor to do a enormous amount of work to reinstate boundaries, place PSMs, tie to Grid Datum etc etc. This situation must change. Moves are being initiated in the private sector now to see that infact it does change. That is a prime example of a surveyor being too expensive. On the other hand the hourly rates for registered surveyors in Papua New Guinea at this time, as far as I know, range between some K20 per hour for a young registered national surveyor to perhaps K50 an hour for the most experienced of our surveyors. The equivalent rates for accountants are K45 an hour for a graduate with two years' experience which if anything would make him less qualified than a registered surveyor, through to K150 an hour for senior partners. In other words Accountants charge rates that are between two and three times a surveyor's for what are considered very similar qualifications.

The legal profession is higher again with qualified lawyers with say three years' experience charging around K75 an hour and senior partners in Law Firms charging K200 per hour. All this does of course is to show the relativity between the surveying profession, the accounting people and the lawyers. What is probably more relevant is what a professional is worth to Papua New Guinea in absolute terms. I am not in the slightest doubt that a young accountant with two years' experience or a young lawyer with two or three years' experience is not worth K45 and K75 an hour respectively and I don't care in this case whether he is Papua New Guinean or expatriate. Experience is all important in a profession and there's no doubt at all in my mind that someone with very limited experience is not worth that sort of money. Perhaps the senior accountant could be worth his K150 an hour if the advice he gives saves his client much more than the client pays for it.

There are two important factors in setting fees:-

1. The fee should be commensurate with the work done.
2. The fee must be set to satisfy a supply and demand situation. Professionals are like anybody else in the market place to a certain extent; if they overcharge, clients will not come back to them to do other work or people might not go to them in the first place if they realise what they are going to be charged. It is much better to work eight hours a day at K25 an hour than no hours a day at K200 an hour.

In terms of a fair return, and by this I mean a return fair to the professional and fair to his client, I feel annual remuneration should be set to allow the professional to live in comfortable circumstances in keeping with this position in the community. This of course is provided that he works hard and competently. To work out what this remuneration would be is quite a complicated matter; firstly how do you adequately describe comfortable circumstances? What is comfortable to one person may not be comfortable to another. One man may be happy with a two bedroom fibro house, another man may require a five bedroom brick for himself and his family. One man may be happy with a small Japanese motor car another man may feel his station in life warrants a large German motor car.

Chargeable hours through a year are also very difficult to ascertain. Whilst I believe the professional should generally be available for eight hours a day, six days a week, forty eight weeks of the year, he will find that much of his time will not be chargeable to any clients and must be covered in overheads. For instance if a man only does 200 hours chargeable work a year, to live comfortably he will need to charge a considerably higher hourly rate than a man who does 2000 chargeable hours a year, and it is very difficult to find the right mix. I think the rate ought to be based on something like 1200 chargeable hours a year, but this is hard to attain in practice.

We then have the problems of overheads. One surveyor may work from a little room under his house, another surveyor might wish to set up professional office in one of the major towns and if his office is to be professional he will need a secretary/typist/receptionist who is always in his office when he is, for instance, out on the field.

If this is done of course this second man would have incurred overheads of perhaps K15000 a year more than the first man. The question is should the client be required to pay for a professional man to set himself up in a professional manner as it should enable him to provide a better service.

The other point of view of course is the client would want the best possible value for money, so naturally all other things being equal he will use the man on the lower rate. What does this do for the profession? Certainly very little in terms of image. A professional who works from underneath his house cannot really invite clients to come and discuss matters with him as he has no real office facilities. When this man is out on the field trips and a client rings with queries or with work instructions, there is no one competent to take these instructions, so in other words the first man is not really running a professional practice even though he might be a very professional surveyor. A professional has been described as 'a person who engages in an activity with great competence', so whilst the surveyor may be considerably competent, if he cannot back his competence up at an administrative level by having certain facilities that clients can rely on, then he is not really following through in a professional manner. On the other hand of course are these additional facilities really worth K10 or K12 per hour to a client?

It could be argued that they are not, so there we have a dilemma. I personally find the whole subject of an adequate professional fee a rather difficult one. One thing I do know however is that if the rewards in the surveying profession are not equal to the financial rewards in other professions, surveying will not attract the best people and will continue on a downward spiral in terms of its place in society.

Training again is a very difficult area in that to be a true professional, a surveyor should have a good all round knowledge of all aspects of surveying in practical terms; of course this is impossible. Many of our students in the Surveying Course have only Grade 10 education and four years in the University following the Grade 10 education; not enough to give them a good all round knowledge of surveying theory. I still favour the system where we accept only Grade 12 students, give them four years in the University and teach them the basics of surveying and the basics of professionalism, give them one other year, probably in the middle as is the case now for practical training so we have a five year course following Grade 12 education.

Successful completion of this would make them graduates in surveying There should then be provision for a post-graduate year in certain of the disciplines e.g. photogrammetry, geodetic surveying, cadastral surveying and engineering surveying so that we would have at this post graduate year, a graduate in surveying with a post graduate degree or similar in some specific discipline.

By Post Graduate Degree I mean a man is competent to carry out the specific tasks and has not just passed a theory exam. This of course sounds like a lot of education but if we are to have professionals in the true meaning of the word which as I stated before may be defined as 'a person who engages in an activity with great competence', then these years of training are necessary. There should be another grade of surveyor known as a Technician Surveyor for young men who simply haven't got the academic ability to graduate in the terms that I have just mentioned. It may be possible to accept Grade 10 students into a Survey Technician Course.

They would do two years at the University on basic boundary surveying with some engineering experience but would not touch photogrammetry or any of that specialist type of surveying. They would then do a third or practical year something like as happens at present and if they pass the first two years and performed to a satisfactory standard certain tasks set in their third year they would become Survey Technicians. These men could be utilized for the benefit of the country in work like the survey of customary land. I would generally favour they be under the control of a Registered Surveyor when doing this work and in fact they would be able to do the work to a prescribed standard. The Registered Surveyor would take ultimate responsibility for the survey and both signatures would appear on the survey plan. This may be a little awkward to organize in practical terms in that it would generally be necessary for a Registered Surveyor to visit the site of each survey and unless this was properly organized it could add considerably to the cost and that certainly is not my objective. The objective is to have a professional seal put on a good technical job.

On the question of broadening our horizons this can only be done if surveyors are of sufficient professional competence to be able to confidently enter an allied area and understand what the problems are and take steps to solve those problems. Up until the present time Papua New Guinea has had a fair amount of difficulty in producing enough professionally competent surveyors and it would only complicate matters if they try to learn other disciplines at the same time. Once we have sufficiently professionally competent surveyors we can then look at extending our horizons further. There are several excellent papers on our Congress agenda on sophisticated technology. I refer to papers like the ones on the application of Terrestrial Photography, Geodetic Reference Surfaces and the Nav. Star Global Positioning System. My tiny mind boggles at coming to grips with the theory of some of these things and I suspect many of my Papua New Guinean WANTOKS are a bit the same way.

These subjects must be dealt with only on a post graduate basis and then only by a graduate with exceptional aptitude. This leads us to the Congress Theme, 'The Challenge of Change'.

This theme is a little more subtle than it appears at first glance as I'm sure it refers not only to technological change, of which we have seen a great deal in surveying over the last fifteen (15) years particularly, but other forms of change as well. Not the least of these would be the political change associated with self government and Independence and consequently the changing aspiration of Papua New Guineans. There has been considerable progress made in the localization of senior positions particularly in the Public Service. We have men including our own Surveyor General and our Superintendent of Mapping and most of our Regional Surveyors in positions almost a generation before their time if we were to use Australia or New Zealand as a yardstick. Of course we cannot use Australia or New Zealand as a model, this is Papua New Guinea.

We continue however to use Australian Survey Standards. Perhaps it is time for a change here. Perhaps in the eyes of Papua New Guinean these standards are inappropriate. Does a Papua New Guinean really want or need the security of the Torrens System whereby his boundary can be guaranteed to millimetres because the initial survey has been of sufficient standard to enable this guarantee to be a reality. I doubt it. Look at the cost. I spoke before about a two (2) lot urban subdivision costing K2000. Its ludicrous ladies and gentlemen

In case you think that I'm arguing against myself and of course I may well be, let me say that I do not consider a surveyors professio competence is contingent on him (or her) being able to take precise measurements. This is all very good but is more technical than professional.

I feel that if the Surveying Profession is to make a meaningful impact for the betterment of the Papua New Guinea Society it had better broaden it's horizons with respect to subjects like formulating policy to enable implementation of a coherent Customary Land Registration System. What Papua New Guinea needs is Land Reform. Not necessarily a Title over a piece of Customary Land just to provide security for a Bank loan as most Bank Managers I have spoken to really do not consider that Customary Land offers them much security at all. I repeat, surveyors should dedicate themselves to use their Professional talents and expertise to effect Land Reform in Papua New Guinea.

This is an infinitely more important task for PNG Surveyors than trying to find a 30 millimetre misclose in Milfordhaven Road.

This is the Challenge of the Times, ladies and gentlemen.
This is the Challenge of Change.

INTERNAL STREET PATTERNS IN RESIDENTIAL SUBDIVISION DESIGN

By K. N. Toms, F.I.S.Aust., A.R.I.C.S.

Introduction

For over 2,500 years the street system has formed the dominant feature of urban design. The orthogonal or 'grid-iron' lay-out of ancient Roman city and town bears witness to the importance of communication in urban planning. In today's age of personalised transport in the form of the automobile, the quality of urban and suburban life is dependent to a high degree on the design of the road and street system through which the life stream of communication flows.

This paper is concerned with the internal street patterns of residential areas. It takes as given the major road system which comprises main arterial routes and the principal roads within neighbourhood areas to which residential streets connect. It classifies and examines the various types of street framework which have evolved in suburban design and shows examples of the application of some of these principles to the development of the suburban areas of the Australian city of Hobart.

The Grid-iron Approach

The grid-iron has been the predominant feature in the earlier design and lay-out of Australian and New Zealand towns. In its simplest form the purely rectangular approach (see Figure 1) of grid-iron design resulted in identical sections, identical allotments and a monotonous vista of precisely aligned rows of single-storey dwellings often of the same size design.

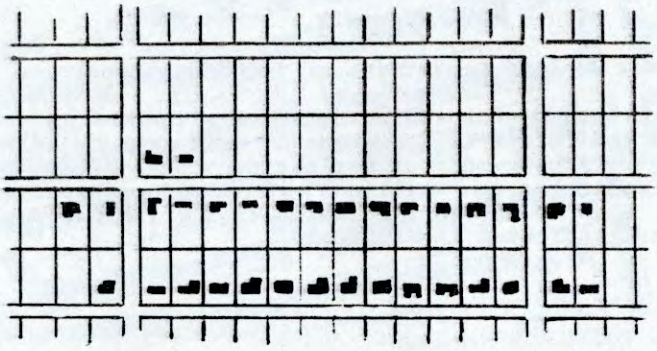


Figure 1

Source: New Zealand Department of Technical Education circa 1958

At first sight, the pure grid-iron approach seems to offer a number of advantages. It is inherently straight-forward. Survey work is reduced to a minimum and there is apparently flexibility of access in all directions except diagonally.

The disadvantages are that it has often been used inflexibly on hilly sites and untavourable contours with unfortunate results; there is great difficulty in differentiating between the relative importance of the streets from a traffic view-point; and last, but not least, the innumerable four-way traffic crossings which can be literally death traps, and the dull monotony or straight streets intersecting at right angles.

The monotony of a grid-iron lay-out may be mitigated to a certain extent and at the same time traffic hazards very much decreased by staggering the cross streets as shown in Figure 2.

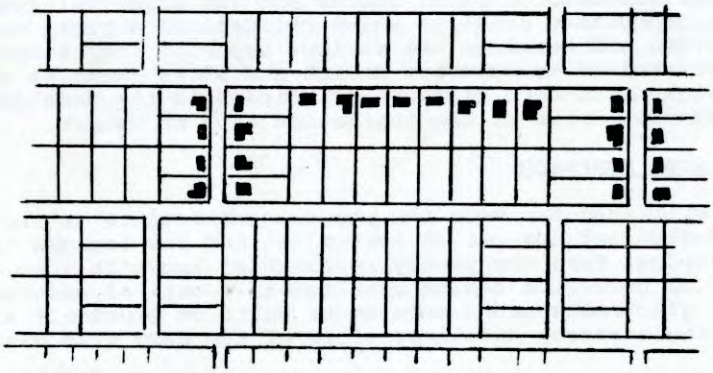


Figure 2.

Source: New Zealand Department of Technical Education circa 1958.

The variation of building set-back alignment is sometimes adopted to ameliorate the sameness of grid-iron building development. Achievement of a pleasing visual effect by set-back variation calls for the skill and vision of an experienced designer. Some of the ways in which this principle may be employed are indicated in Figure 2.

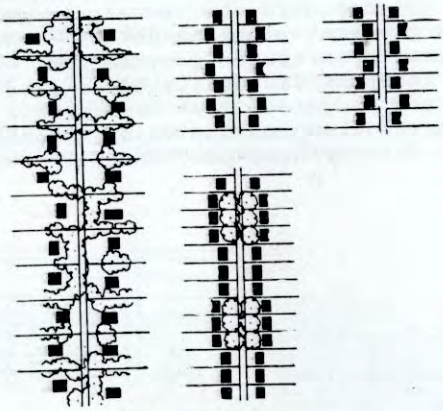


Figure 3.

Source: Keeble, Principles and Practice of Town and Country Planning.

Figure 4 shows an example of older grid-iron subdivision in the Dynnyrne-Sandy Bay suburban area of Hobart. The development demonstrates both a staggered street pattern and a purely random building alignment.

Figure 4.

Source: Southern Metropolitan Master Planning Authority, Hobart.

Figure 5 shows a North American approach to grid-iron design for a large neightbourhood area (670 allotments). As can be seen from the contours the terrain is gently sloping hence street gradient problems do not arise. The peripheral sections and open spaces provide some closure of street vistas. The inherent disadvantages of grid-iron design still remain. Too many dangerous four-way intersections, peripheral allotments fronting on the major neighbourhood road, monotonous vistas in the northern portion of the subdivision, and high road costs.

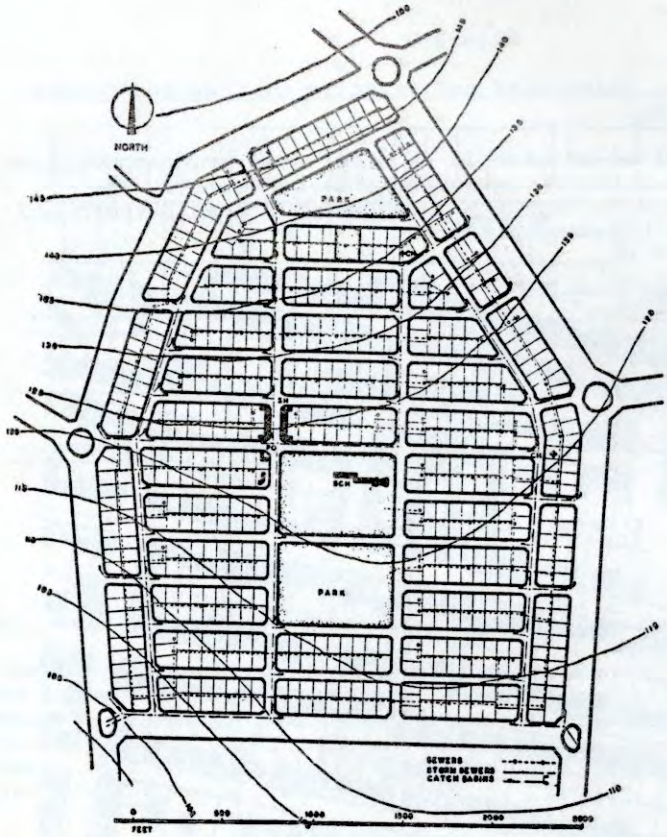


Figure 5.

Source: Kostka, Neighbourhood Planning.

Loop Road Systems

An approximately rectilinear lay-out can be maintained and at the same time a grid-iron lay-out avoided by the use of the 'loop' or 'turned' street. Figure 6a shows a purely rectangular loop pattern which still retains dangerous four-way intersections. Figure 6b shows a staggered loop system in its simplest rectilinear form.

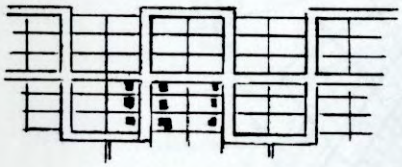


Figure 6a.

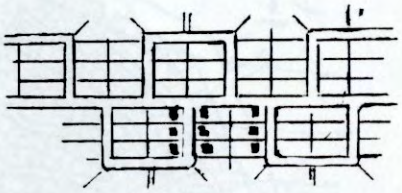


Figure 6b.

When loop roads are adopted, it is by no means necessary and is often undesirable to adhere to rectangular forms. Harmony with topography is the best guide to follow.

Large scale subdivisional design utilising loop roads abutting on open space are shown in Figure 7. The monotony of the grid-iron design of Figure 5 has been largely overcome. An economic disadvantage lies in the 'dead' frontage of the ends of the loops opening onto park-land.

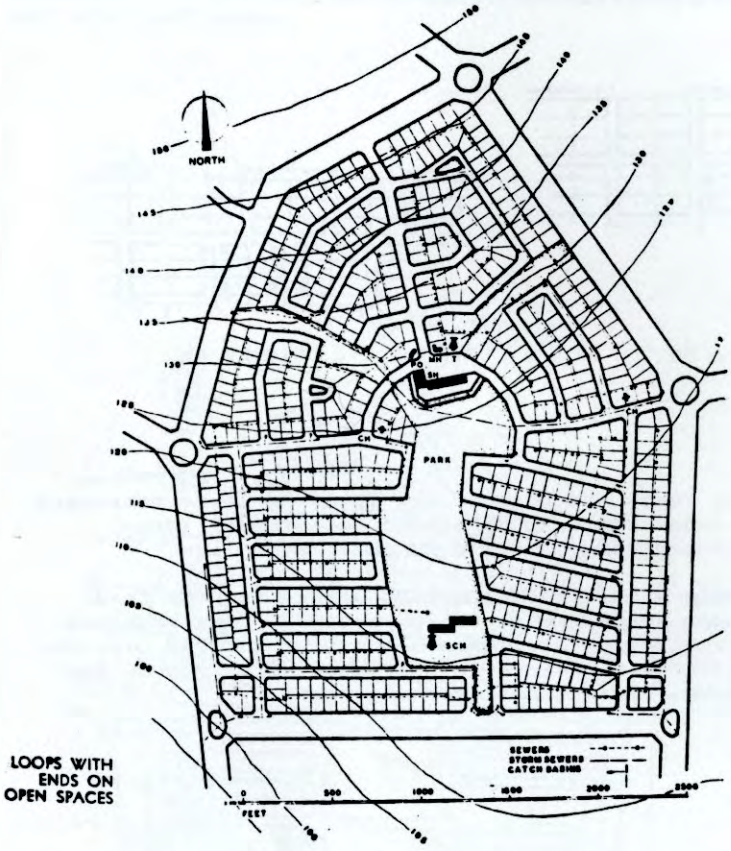


Figure 7.

Source: Kostka, Neighbourhood Planning.

Another variation of loop road design of the same area is in Figure 8. Here, in a more economical approach, there is no unused frontage. All loop streets serve allotments on both sides.

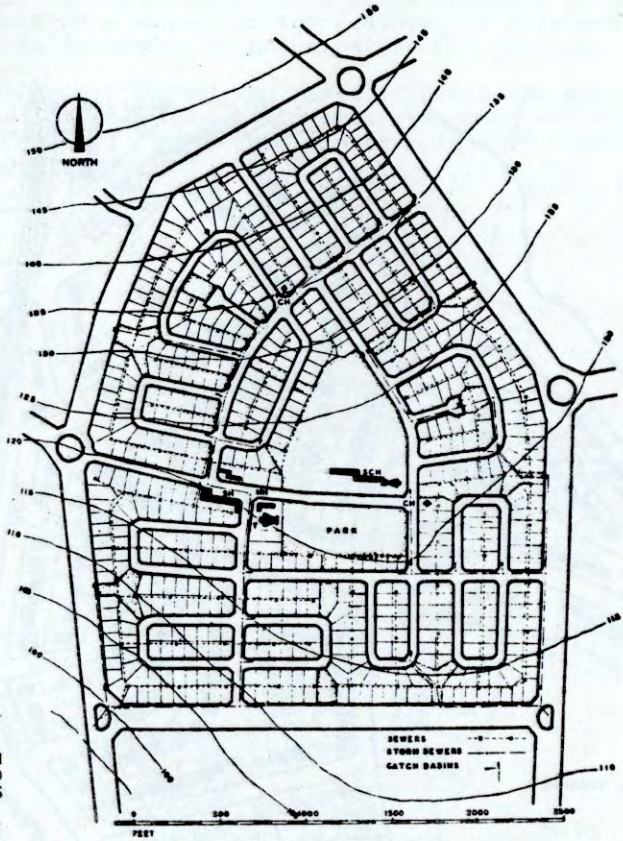


Figure 8.

Source: Kostka, Neighbourhood Planning.

Loop road design is not frequently encountered in Hobart. Figure 9 shows a variation adopted for suburban development in Chigwell.

Figure 9.

Scale 1/4,800

Source: Southern Metropolitan Master Planning Authority, Hobart.

The Cul-de-Sac

The cul-de-sac is a device very frequently employed in modern subdivision design. It is essentially a short blind street leading off a principal residential road and terminating in a circular turning space. It's prime function is to permit the withdrawal of a number of the residential allotments from the disturbing influence of principal traffic routes.

The cul-de-sac formed the basis of Stein and Wright's 'Radburn' design which sought to separate motor vehicle and pedestrian traffic. The underlying principle of Radburn 'super-block' design is shown in Figure 10.

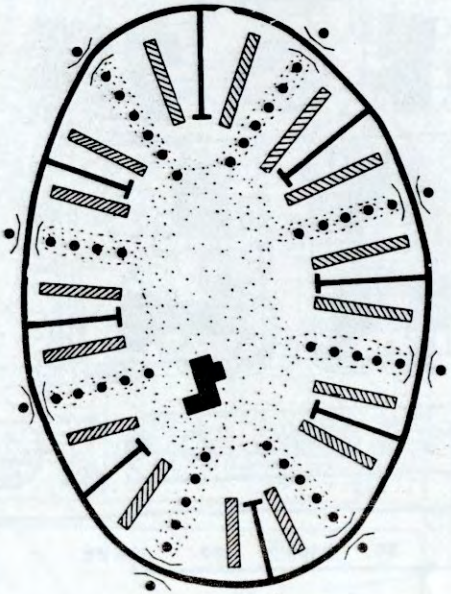


Figure 10.

Source: Keeble, Principles and Practice of Town and Country Planning.

Radburn originally required houses to face into the open space with their rears and garage accommodation facing the cul-de-sac street (see Figure 11).

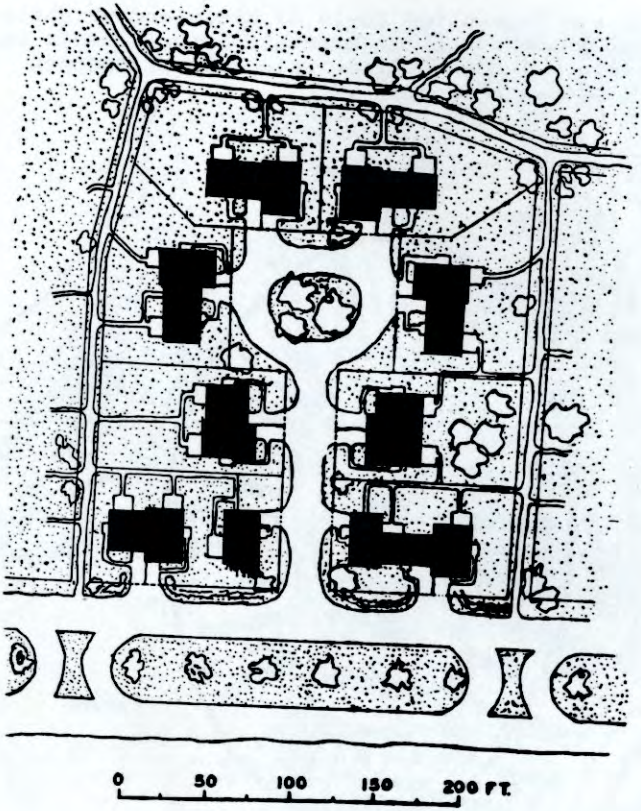
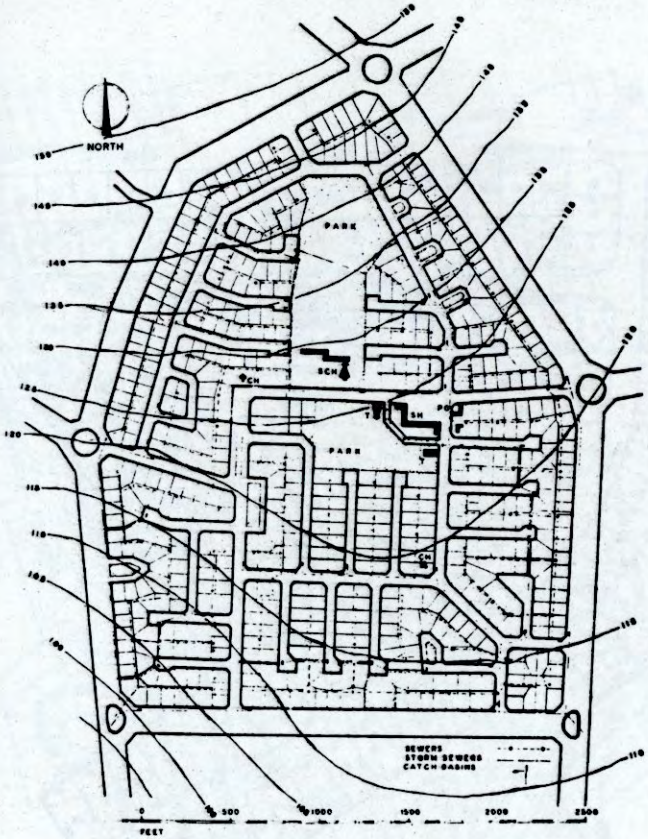


Figure 11.

Source: Kostka, Neighbourhood Planning.

It is common now to adopt the cul-de-sac for ordinary subdivisional design. Note the treatment (in Figure 12) of the area of Figure 8 adopting a cul-de-sac approach.



CULS-DE-SAC

Figure 12.

Source: Kostka, Neighbourhood Planning.

Cul-de-sac lengths should be restricted to 100 m or less. The outer kerb radius should be not less than 16 m if parking in the cul-de-sac is envisaged. As far as possible they should be introduced symmetrically into the design of allotments. Figure 13 shows modern cul-de-sac subdivision in the Hobart area.

Figure 13.

Source: A. V. Jennings Pty. Ltd., Hobart.

The Crescent or Court.

A crescent consisting of a short loop of access road including open space on its concave side is another useful device for segregating dwellings from relatively heavy traffic roads. Figure 14 shows skilful use of the crescent in the design of a subdivision at Claremont, a Hobart suburb.

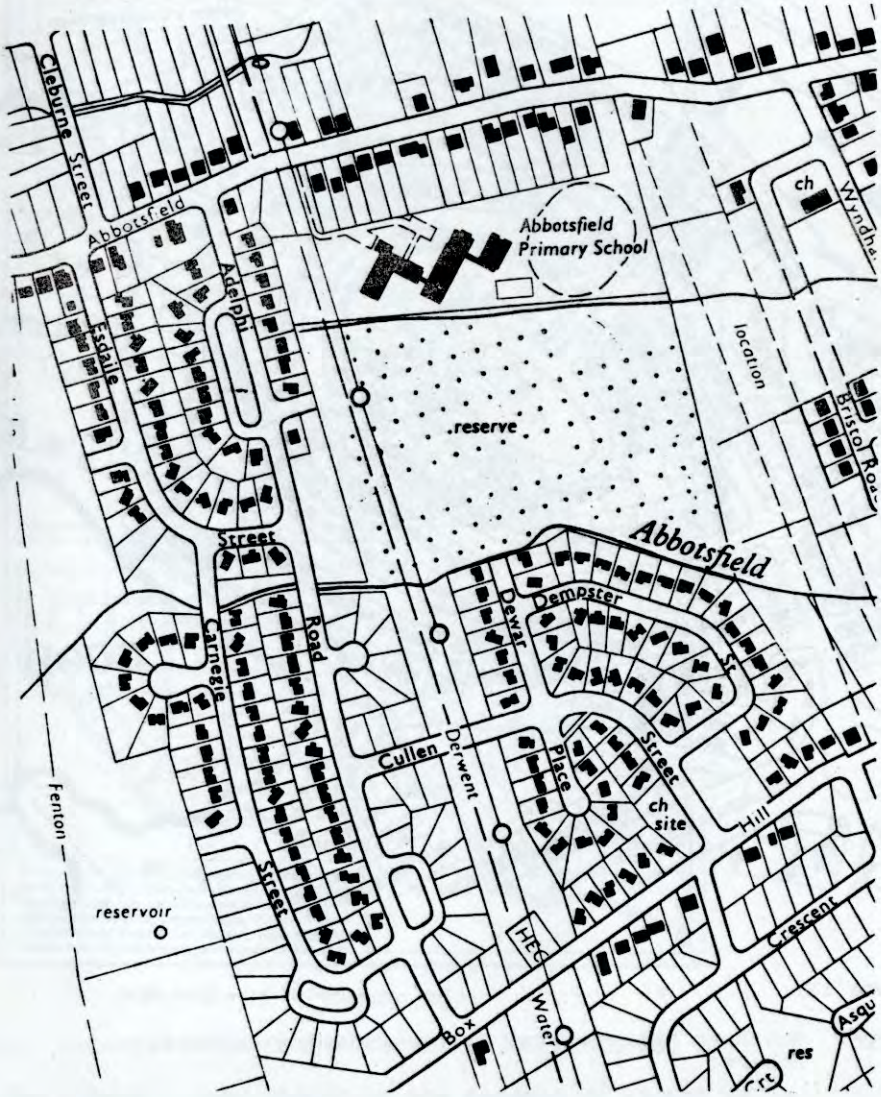


Figure 14. Scale : 1/4,800

Source: Souther Metropolitan Master Planning Authority, Hobart.

Radial Subdivision

Where the topography permits, it is possible to adopt a radial design. An example of this is to be found at Goodwood, in Hobart. (See Figure 15)

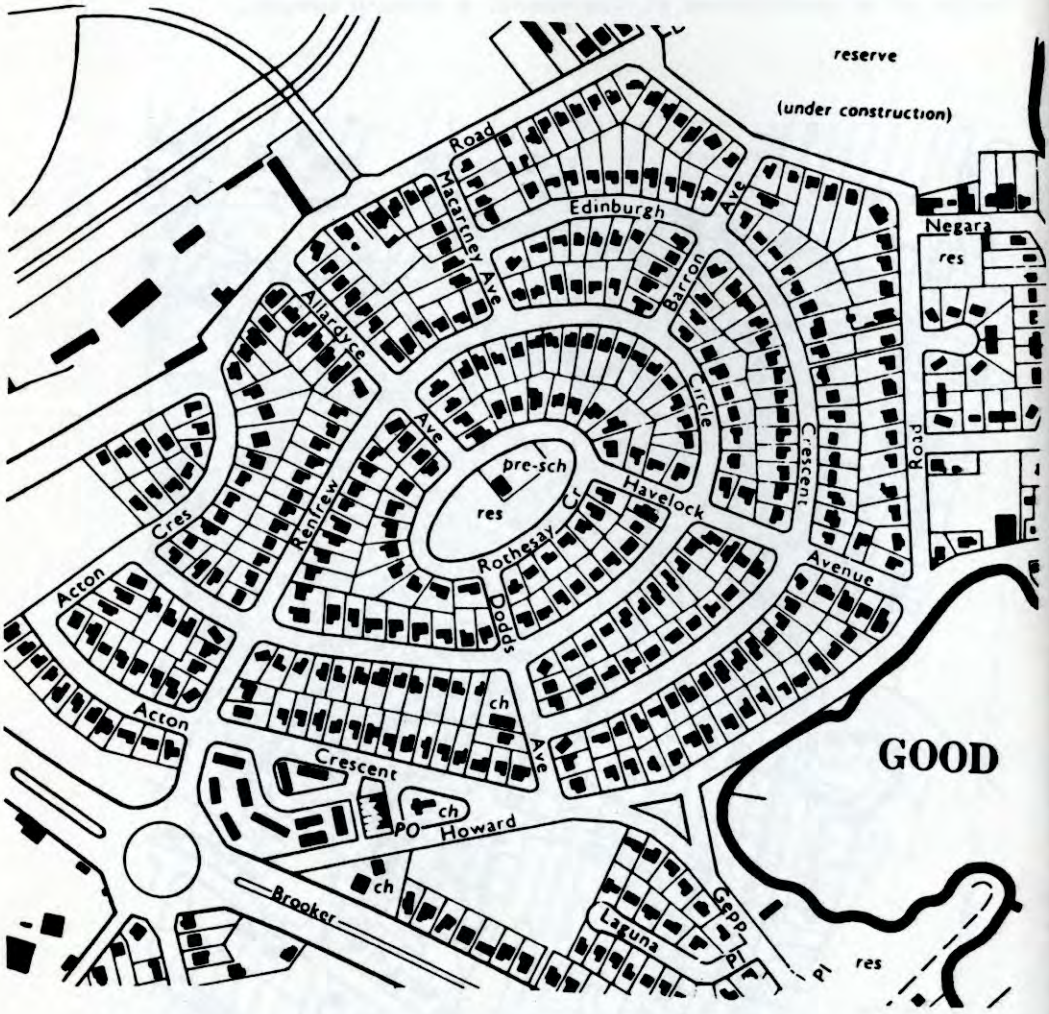


Figure 15. Scale: 1/4.800

Source: Southern Metropolitan Master Planning Authority, Hobart.

Cluster Planning

The cluster concept calls for the planning of small groups of houses sharing the same access road. Figure 16 shows a cluster design compared with more conventional approaches.

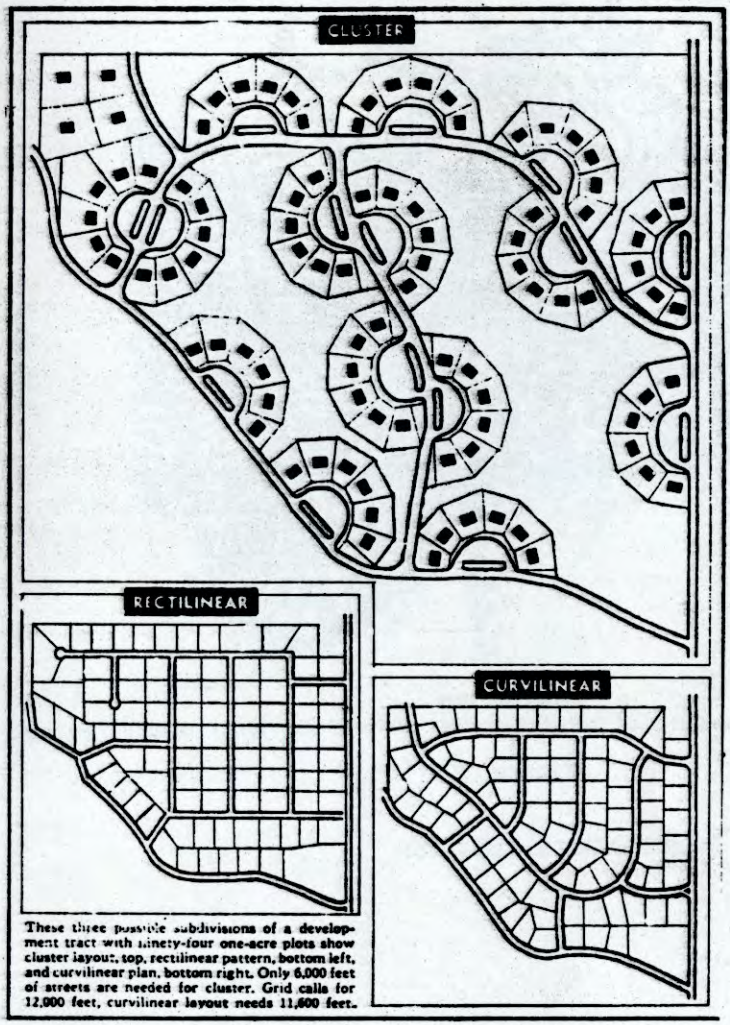


Figure 16.

Source: Urban Land Institute Technical Bulletin No. 40.

The internal road length in the example of Figure 16 is just half that of a grid-iron design for the area. It avoids the 'dead-end' aspect of cul-de-sac design.

Hexagonal Allotment Design

Yet another variation of cluster planning is the Finnish approach to hexagonal lot boundaries which lend themselves to the formation of clusters (see Figure 17).

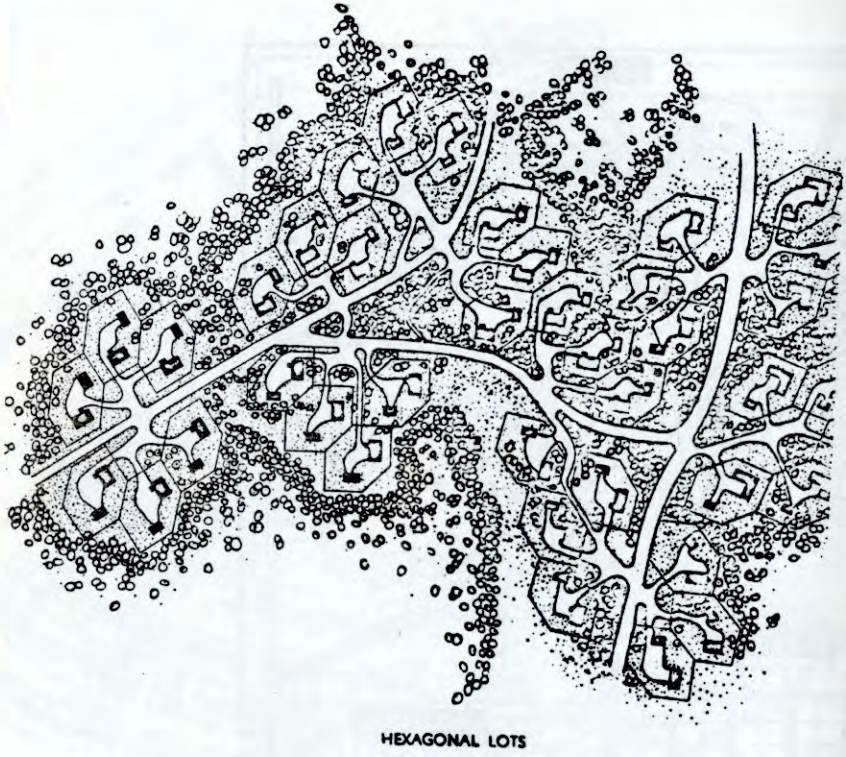


Figure 17.

Source: Kostka, Neighbourhood Planning.

Circular Road Design

Figure 18 shows an unusual approach to radial design of subdivision. It can be strongly criticised on the grounds of economics and traffic problems such as Y intersections and paucity of open space.

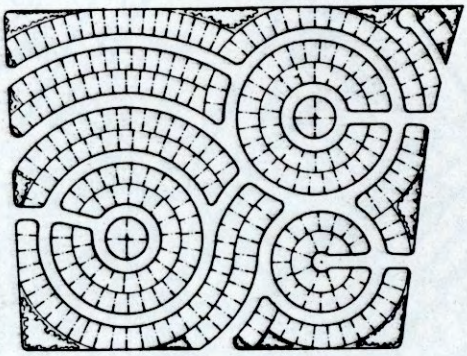


Figure 18

Source: Urban Land Institute Technical Bulletin No. 40.

Steeply Sloping Subdivisions

In cities severely constrained by topography there is a tendency to develop steeply sloping land. Figure 19 shows the subdivision of Mt. Nelson. Problems of landslip and hydraulic gradients for sewerage and stormwater drainage arise. The roads (frequently a single road) must perforce follow the contours if the lots are to be

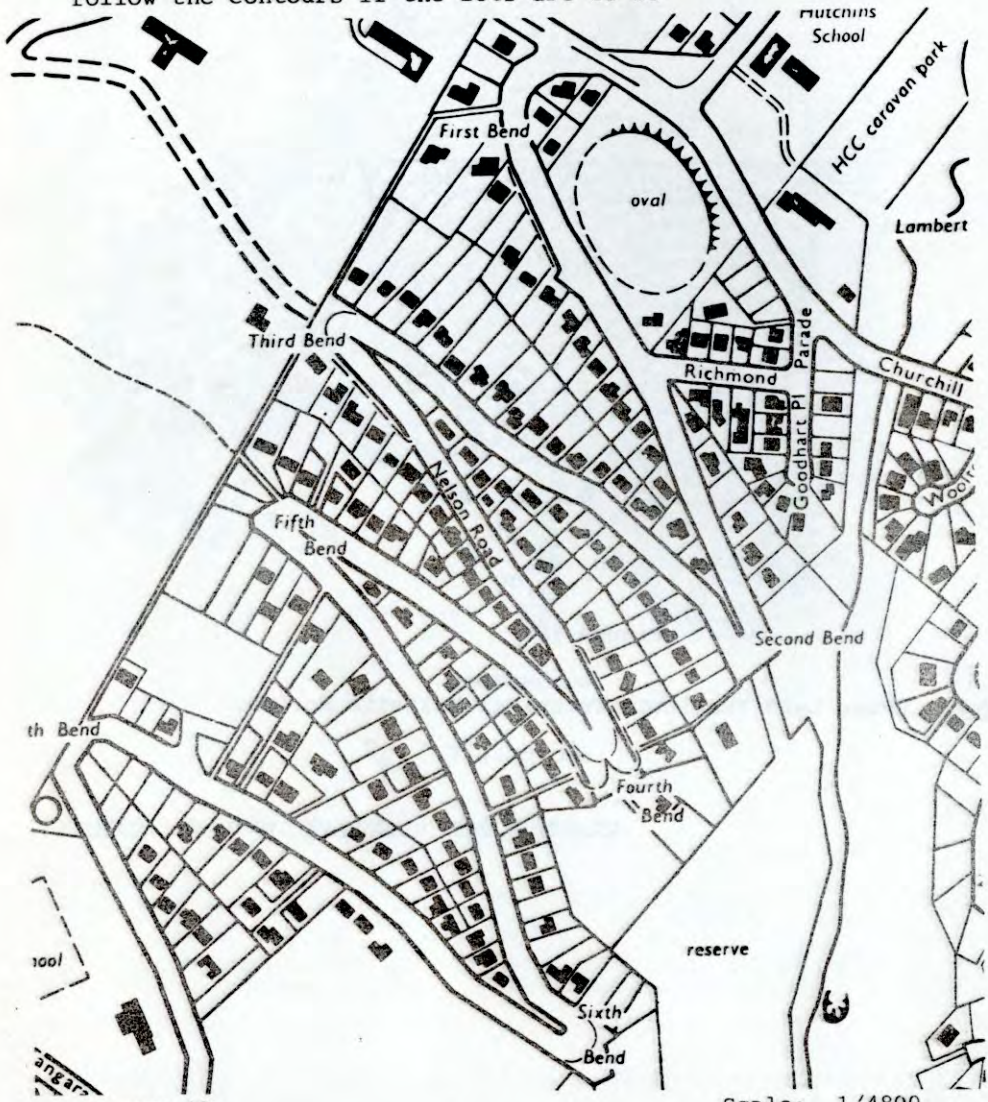


Figure 19. Scale: 1/4800

Source: Southern Metropolitan Master Planning Authority, Hobart.

square to the road boundary and road gradients kept to a minimum.

Figure 19a shows a modern approach to the subdivision of steep land. Roads are run diagonally across the contours at relatively steep grades (1 in 8.5) and varying the shapes and sizes of the lots. The lozenge shapes facilitate access to houses along a contour.

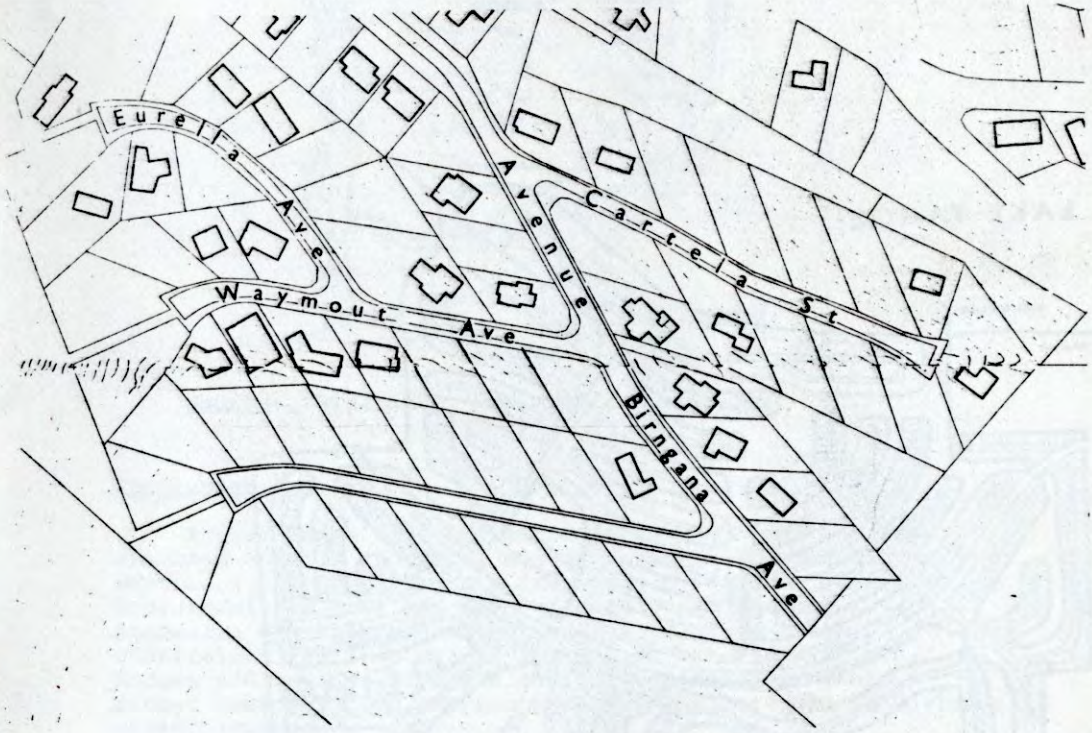


Figure 19a.

Canal and Lakeside Subdivisions

The high demand for waterfront land in affluent Australia has led to the development of large scale canal subdivisions in Queensland and New South Wales. Here the designer must provide street and water access to many of the allotments in the subdivision. Cul-de-sacs are extensively used as they maximise the utilisation of water frontage. An example of an extensive North American canal subdivision is shown in Figure 20.

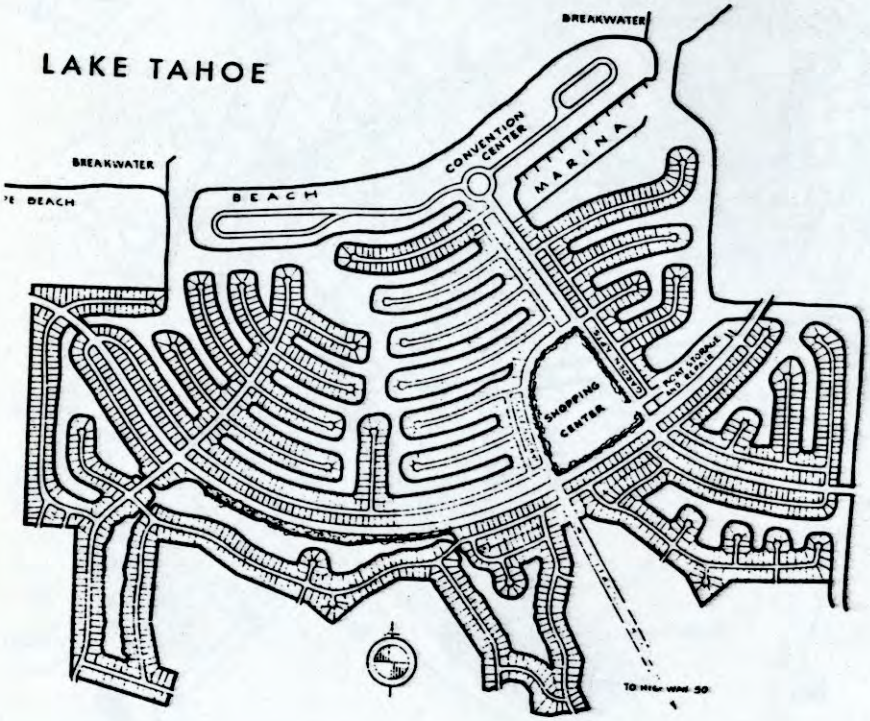


Figure 20.

Source: Urban Land Institute Technical Bulletin No. 40.

Artificial lakes also figure in modern subdivisions aimed at attracting high income purchasers (see Figure 21). Again the cul-de-sac is the predominant feature of the service street design.

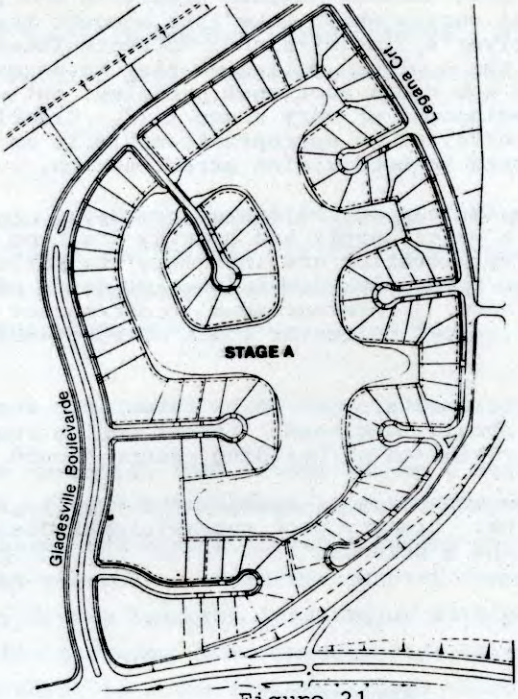


Figure 21.

Source: Hill & Co. Pty. Ltd., Mordialloc, Vic.

Conclusion

A wide range of subdivision street patterns have been examined above. Choice of design form will depend on many factors. Although the grid-iron design form has been used indiscriminately in the days of earlier settlement in Australia the modern designer realises fully well the constraints that topography imposes on his street plans. Ridges and gullies, summits and depressions and other ground features must exert a profound influence on subdivision street location.

The prime topographical consideration is gradient. In modern design it is usual for street alignments to be in harmony with contours. The designer must bear in mind that when streets are laid out parallel to the contours street cross-sections must be levelled.

When perpendicular to the contours the design centreline profile must take into account maximum gradients and provide for smooth vertical curves which take into account traffic factors such as driver's line of sight. Streets located diagonally across the contours will give rise to adjustments of both centreline and cross-sectional profiles, but will facilitate the development of very steep land. Clearly an accurate contour survey at an appropriate scale is an absolute prerequisite to subdivision street design.

Other factors impinge on the design process. Utilities such as a water supply and gravity drainage works usually follow street location and influence its pattern. Traffic engineering principles demand the avoidance of four-way intersections, Y intersections, too frequent intersection of principal collector roads by subdivisional streets.

Aesthetic requirements ought to be taken into account. Street end vistas should be closed. Street design should take into account variation of building groups around them.

Above all, the economics of development must be kept continuously in mind. Clearly good subdivisional design is at once an art and a science.

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SURVEYING STUDIES BY DISTANCE EDUCATION

by

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Abstract

Distance education is a valuable adjunct to the surveying education system in Papua New Guinea. It fulfills a need, as well as providing an alternative teaching mode, and is useful as a tool for analysing present course content.

Foreward

A distance education (DE) scheme can be a useful tool in training Papua New Guinea (PNG) surveyors without depriving employers of skilled labour and without being a burden on the existing educational structure. Complete or part courses can be conducted externally from a learning institution with periodic attendances for specific tuition. More importantly, this teaching mode can allow a student to enter the work force while re-attempting failed subjects needed to complete his qualifications. Individuals wishing to upgrade qualifications or commence study while working as a surveyor's assistant will benefit tremendously from DE, while simultaneously gaining valuable on-the-job experience.

Distance education, sometimes referred to as external studies, can also reduce educational equipment and facilities costs. Students could use equipment already purchased by industry and would be using their own living accommodation facilities. Extra student accommodation and services would then not be required at the learning institution, although a small administrative staff increase is inevitable.

Surveyors and their assistants are needed in isolated and educationally disadvantaged areas where exploration and development are taking place. Others are required to perform their work away from 'home' and possibly away from direct access to an educational facility. Hence, it is arguable that DE courses must be equal to those offered to students studying on a full time basis. This may suggest that internal and external requirements of education must be separate systems that require different treatments. However, while some differences will need to exist, both systems have much in common and can benefit from each other.

Introduction

Full time education will not be discussed as such, as the Papua New Guinea University of Technology (Unitech) has a well structured course that has been fully documented in various publications. The structure and content of each subject will also not be discussed as that itself is a separate topic.

Many educational centres in Australia conduct DE courses or subjects, the availability of these having increased in recent years. The practical or industrial year in the Unitech courses is a PNG example of external study, although not DE in its true sense.

While having some disadvantages for the student, DE has some tremendous advantages over the full time study situation:

- It forces the educator to crystallise his objectives and analyse his work aims as he prepares relevant material.
- It caters for the educationally isolated.
- It is exceedingly inexpensive when the only other solution is for the student to leave his employment and move to an area where full or part time studies are available.
- It tends to attract "self actualisers", i.e. people who are intrinsically motivated and serious about furthering their qualifications.

This paper will attempt to address the following DE related areas:

- An analysis of what the lecturer does in a lecture situation and how to overcome the lack of these benefits in the DE material.

- The concern that too much emphasis can be placed on the design of learning packages as opposed to how the student will react to the material presented to him.
- The problem of providing practical work for a subject such as surveying.

THE DE LECTURER

Although a lecturer prepares his lecture, changes are often made during the presentation to suit the general flow of the lecture. These changes will occur from observation of how the students are responding to the method of presentation or from omission in the material becoming obvious. Lecturers can give full time students the benefit of direct feedback to questions and further explanations, by a different method if their original presentation was not understood.

To compensate for his absence from the DE student, the lecturer must ensure the material sent to students to complete is oriented to the student and his achieving the 'accepted' training level of that subject. If we were to analyse what an average lecturer does we would find that the person -

- is a focal point for the students;
- devises subject objectives for the student to achieve (Young 1979 a and b);
- lectures /teaches/instructs;
- distributes material;
- sets and assesses examinations;
- sets and assesses written assignments and practical projects;
- writes comments on work;
- verbally interacts with students;
- receives feedback and modifies material (Young 1979 b).

The above can be performed with external or internal students, while the following lecturer functions are difficult to simulate with DE:

- Help with misunderstandings and mental obstacles;
- Conduct tutorials or discussion groups;
- Present exactly same material and assignments internally and externally.

- Cope with any problem or question that arises;
- Express nuance and shades of meaning through direct verbal contact and facial expressions;
- Use of body language, verbal skills and group interaction;
- Help students overcome difficulties experienced in their environment, especially the extrinsic motivation to which a student can be subjected at a learning institution;
- Emphasise the more important sections or areas of learning.

The last point on learning emphasis is difficult to overcome. A full time student is readily shown which must be learnt and which is background information (nice to know). For a DE student the dependance, interdependance and independance of various materials is difficult to ascertain. The problem is the student must have a complete set of notes on all aspects of the topic with more notes covering areas dealing with anticipated questions, whether directly related to the topic or not. To a student all the work appears to carry equal importance; this places a tremendous demand on him if he tries to learn it all. If the lecturer was to indicate "examinable" parts, the student would tend to study those aspects only and not truly receive the teaching he should. With suitable instructions from the lecturer, and carefully constructed questions, some of the problems of emphasis can be overcome. Other media, such as video tapes, can help to overcome the lack of direct contact.

DE LEARNING PACKAGES

Before a suitable DE package can be constructed the objectives of the subject and each topic should be considered in minute detail (Braund 1981 and Young 1981 a). Once these are determined, the subject matter should be compiled, the latter being considered in view of assumed knowledge level achieved prior to studying this subject, relevant peripheral information, and probable question areas.

In many cases emphasis on current DE programs has been on the actual package sent to the student and not to its effectiveness. What do we know of what the student does with the package? Does he read the notes and then complete the assignments; or does he study work pertinent only to the assignment? Does he attempt self test questions? Does he seek help when he needs it from the lecturer, a friend, or other text? Is he just doing the assignment or is he actually learning the subject matter and applying that knowledge? Does he find the material presentation suitable for learning from and is this communicated to the lecturer as feedback? These are just some of the questions the package instigator must ask himself and try to exude answers from the subject's participants. Student feedback has a tremendous influence on changes to course material.

A package would normally include a set of notes or text book accompanied by information on administration of the course work, i.e. how to study, how to send off the assignment and accompanied by what other information, etc., is necessary. The information in the package must -

- be complete and current
- be sequentially logical
- have worked examples
- have self test questions
- state objectives and standards of achievement
- contain simple but effective diagrams, charts, etc.
- reflect trends and technological changes

These are the main points to consider. Others are:

- material presentation most suitable for student learning,
- advantage of including audio or audio-visual material with the package,
- feedback questionnaire to augment other feedback forms,
- references to other material,
- consideration of a realistic study program,
- students' need for involvement and recognition,
- possibility of telephone tutorials.

The packages must not be constructed to enable a student to achieve the objectives at the expense of effectively limiting the learning process. He must be encouraged to 'learn to learn' and not simply achieve the subject's objectives for the satisfaction of administrative convenience. Irrelevant package material and nebulous assessments will not only render this teaching mode invalid but undermine the full time study program.

PRACTICAL WORK COMMITMENTS

One of the major problems in teaching surveying by DE is the setting, supervision and assessment of practical work. With Unitech's "industrial year" scheme many of the traditional problems could be overcome. There still remain problems, but as long as the student remains in surveying employment they are solvable.

Practical work in surveying is of fundamental importance and its use far greater than in most other disciplines. While some subjects use practical work simply to supplement the theory, surveying practical work is the basis of the discipline and inseparable from the theory. As such, practical work has objectives in its own right which broadly endeavour to achieve:

- Correct technique in the use of survey equipment;
- Ability of using equipment in specific surveying procedures;
- An ability to assess the most suitable equipment use and surveying procedure for varying tasks;
- acquire, assess and interpret data in preparation for office processing;
- supplement theoretical learning by 'doing' (Young 1979 b).

When assessing practical projects care must be taken to assess the actual

- performing the task.
- reduction of observations.
- evaluation of the observation's suitability.

Assessment of practical work is all too often directed towards the student's report writing ability and associated theoretical knowledge. Assignments involving practical surveying should stipulate -

- objective of the task,
- task specifications,
- type of survey required (indicating accuracies, etc.),
- method or equipment,
- information (report, field notes, plan, etc.) to be submitted as part of the assignment,
- requirement of a suitable supervisor who can authenticate the work as having been done by the student,
- date for submission.

During the compilation of a DE course for surveying, particular care must be taken with the practical component, specifically its provision and assessment. While the 'industrial year' at Unitech has its own particular requirements and structure, the practical content of individual subjects conducted in a DE mode need special attention. Assessment can be performed in any one, or in a combination of, the following:-

- under supervision of an appointed person (industrial tutor);
- at any study centre under supervision of an academic;
- at place of employment;
- at designated survey camps;
- during a teaching/assessing residential school (i.e. at attendance period at the learning institution).
- under supervision of a visiting lecturer.

The Darling Downs Institute of Advanced Education (DDIAE) conducts a DE course in surveying concurrently with a full time course. It is proving successful and popular; there are more students studying by DE than by the full time mode. The combination of practical and theoretical assignments during a subject is proving satisfactory in most cases. Where more, or a greater detailed assessment is required, such as in four subjects, either a one week residential school or survey camp has augmented the other assessments. While these attendance sessions incur expenses on the student (travel and accommodation) the alternative is to leave employment and study full time. This also means that, as well as being deprived of an income, valuable on-the-job training during studies is lost.

SUMMARY

For a developing nation such as PNG there is a great need for training technical people as inexpensively as possible while maintaining an adequate workforce. Conducting DE courses can partly solve problems associated with this requirement. The improving of present courses through the discovery of inadequacies, brought about by detailed compilation of material, will also benefit surveying education and its' cost effectiveness.

Although not imperative, it is highly desirable for a DE surveying student to be in surveying employment. As well as assisting him during his theoretical studies, it will allow the much needed hands-on experience.

Theoretical work in reality can be studied anywhere, so emphasis on a surveying DE course must be on the practical teaching and assessing aspects. The study material and assessment must be carefully compiled and feedback encouraged to enable evaluation of the subject content and, most importantly, the end product - the student's ability.

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MEAN SEA LEVEL AND OCEANOGRAPHICAL OPERATIONS IN TROPICAL WESTERN PACIFIC AREAS

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Abstract

Proposed Oceanographical and Mean sea level operations under Australian auspices in the WESTPAC area are discussed and their human, surveying and economic aspects considered.

Acknowledgement

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1. INTRODUCTION

Year-to-year variations (such as those concerning droughts, occasional floods and oceanic fish availability) in the tropical and subtropical West Pacific region (WESTPAC) are believed to be strongly linked to the interaction between the atmosphere and the very warm sea areas north of Australia. Clearly the human and economic importance associated with any forecasting capability (however limited) is one of great scientific interest. It is especially noticeable that the WESTPAC area, in spite of its apparent influence on climate, has no coherent and extensive oceanographic monitoring network, yet there is no apparent technical difficulty; the methods for obtaining the required oceanographic data are well within the capability of the small nations within the region. Perhaps very signigicant is the lack of any impetus from a technically advanced country; Japan is rather parochial in its monitoring interest, and the region is geographically remote from the U.S. As a result, Australia through the CSIRO Division of Oceanography, is hoping to take the lead in a comprehensive oceanographic monitoring program for the WESTPAC area, a critical part of the international effort being directed towards seasonal climate forecasting. It hopes thereby to involve the developing countries of the region in an exercise of immediate and tangible benefit. For example, it would equip and train key groups to perform the basic physical oceanographic measurements for observation and management of their regional waters; it would provide a practical incentive to relate the observations obtained to locally derived economic data such as fish-catch and rainfall; it would provide an avenue for local expertise to develop on the dynamical peculiarities of regional waters (of which in some cases knowledge is practically non-existent) and it would provide a continuing avenue of international communication between Australia and its neighbours.

2. SOME CLIMATIC AND FISHERY ASPECTS

2.1 It has been established that there are distinct patterns of year-to-year fluctuations of climate on very large spatial scales. For example, Australian readers will need no reminders that in the past century there have been several instances of droughts of several years duration.

A similar phenomenon affects the agriculture of Indonesia, and the equatorial Pacific Ocean islands are particularly subject to this kind of fluctuation. Rainfall variations in all these regions, as well as those in other parts of the world, seem to be closely correlated. The net value to agriculture in the tropical WESTPAC region of even a limited predictive capability for this phenomenon must amount to millions of dollars a year, and the human effects of these droughts are particularly strongly felt in the more underdeveloped parts of the region.

2.2 The phenomenon is part of a global, interannual pattern of climate variation known as the Southern Oscillation (S.O). Rapid progress has been made in recent years towards a proper physical understanding of the S.O.; it appears to involve a positive feedback between the ocean's surface layers, particularly in the region north of Australia, and the atmosphere.

To generalise, anomalously warm surface water near the equator creates updraughts of warm, moist air, and hence low surface pressures. Winds flow towards low pressure regions, so winds are created that tend to drive more warm water into the affected region. This mechanism leads to a coupled instability of the equatorial ocean and atmosphere.

In practice, the driving mechanism of the S.O. seems to be centred on the region of specially warm surface water north of Australia.

At present comparatively little is known about S.O. fluctuations, either from observations or theoretically, to use them reliably for predictive purposes: but there seems a good chance that about ten years of appropriate observational and theoretical work will lead to a marked improvement, with the possibility of rainfall prediction months in advance throughout the tropical WESTPAC region. The C.S.I.R.O. scheme outlines a strategy for ocean observations that ties in with existing observational networks and will, at the conclusion of this project, become a permanent entity, managed jointly by all the countries of the region.

2.3 Tuna fisheries, particularly skipjack, are potentially of major importance to the economies of all countries in the region, particularly the underdeveloped ones. Fuel costs are of course a major obstacle to the development of these fisheries. Nevertheless, a problem faced by all of these countries is the rational management of the fisheries within their 200 mile zones. There are quite strong correlations between year-to-year vatiations in environmental conditions and skipjack landings in Hawaii. Anomalous currents may be partly responsible, but it is also possible that the fish may migrate to regions with particularly desirable temperatures and oxygen concentrations. Whatever the truth, within the tropical WESTPAC region, the biggest prevailing anomalies in all these variables at any one time - current, temperature and oxygen - are likely to be closely related to the Southern Oscillation. Indeed, even though a different fish species was concerned, it may be noted that the biggest fisheries collapse of recent time - that of the Peruvian anchovy in 1972 - was at least in part brought about by a Southern Oscillation-related event.

It thus seems that a proper network of physical oceanographic measurements is a valuable, if not essential, tool for the management of the skipjack and other fisheries of the region; and that a network designed to monitor S.O. - related changes will be highly desirable for fisheries as well as for climatolofical purposes.

3. OBSERVATIONAL TECHNIQUES

3.1 Three types of measurement are proposed:-

(i) tide-gauge observations

(ii) expendable bathythermographs (XBT's) and

(iii) direct measurements of currents near the equator.

This section concentrates on the tide-gauge aspect of the work since this is of most relevance to the geodesist, and to land and sea surveyors. It examines the density of this type of observation in the tropical WESTPAC region compared to the rest of the Pacific Ocean. Serious deficiencies in the present network are identified, the proposed plan to meet these deficiencies is dealt with in the next section. Tide-gauges record sea level at a given location, typically every hour; they are of interest because the actual gravitational tides can be readily removed by a mathematical filtering process. After this is done there remain slow, month-to-month sea level variations of the order of ten centimeters, that have been found in nearly all parts of the world to correlate closely with variations in the heat content of the upper few hundred meters of nearby parts of the ocean. The sea surface temperature is related to the density of zooplankton and higher forms of marine life. This property of tide-gauge records has been used in some of the most important contributions made so far to the present limited understanding of oceanic S.O. - related fluctuations in the Pacific.

The University of Hawaii tide-gauge network gives good coverage over much of the equatorial Pacific; but there is only one permanently maintained gauge in the entire Papua New Guinea-Indonesia region (at Rabaul).

This deficiency could prove critical to further development of our understanding of the S.O.: it may very well be that exchange of warm surface water from the Pacific to the Indian Ocean, through the Indonesian Islands (or sometimes, its absence, or a reverse flow) may play a crucial role in the S.O. phenomenon.

4. THE TIDE-GAUGE PROGRAMME

4.1 For tide-gauges, the overall aim for the four year period of the project is to set up a permanent network of modern gauges in the Indonesia-Papua New Guinea region, with a trained group of scientists and technicians capable of servicing and maintaining the gauges (short of major electronic work), and of processing and analyzing the data. At the time of writing the network positioning is not yet finalised, but a two-tier system is envisaged. So called A-class gauges are to be in locations where it is reasonably certain that a tide gauge will be needed beyond the end of the project; A-class gauges would be constructed of more expensive materials, and would therefore be substantially more durable than B-class gauges. The latter would be maintained for 18 months in Indonesia, then moved for 18 months to P.N.G. In this way, a dense network of gauges would be available in each location for over a year, permitting informed decision-making about location of a few further A-class gauges at the end of the programme.

4.2 Considerations to be taken into account aare:

a. The need to monitor changes in the flow from the Pacific to the Indian Ocean (i.e. tide-gauges must span the gap between Australia and the Asian parts of Indonesia).

b. The need to track coastal trapped waves, particularly along the south coast of Indonesia and along the coasts of the three major islands of Papua New Guinea.

c. The need to extend the measurement of equatorial Pacific sea level gradients westward (tide-gauge in northern Irian Jaya).

d. The need for "good" siting of the gauges (e.g. away from estuarine on other local affects).

e. Placement of tide gauges in Christmas Island and (probably) at Ambon, Indonesia.

Evidently, this plan requires detailed liaison with local authorities, and training of local personnel (see below); it will require an amount of travel by CSIRO personnel, for site choice, installation and maintenance checks.

5. LEVELLING AND SEA SURFACE SLOPES

5.1 A sea surface 'slope' is believed to exist along the Eastern seaboard of Australia. The exact magnitude (and sign) of this effect is in doubt owing to some measure of disagreement between geodesists, surveyors (even amongst themselves) and oceanographers.

For example, considerable anxiety exists over the apparent build-up of systematic error in levelling, even of high order, especially, but not exclusively, in meridional directions, and exhibiting some degree of time variance. Oceanographic methods in levelling (apart from "pipeline" levelling which is irrelevant in this context) fall into two groups, steric and geostrophic. Both are described in most textbooks on physical oceanography. In principle, in steric levelling, temperature and salinity of sea water are measured, and variations in water density as a function of (three dimension) position determined. It is inferred from this information that "columns" of sea water will stand at varying "heights" above some deep (e.g. 1000 or 4000m) reference surface, so exerting a constant pressure thereon, such that it is a "surface of no motion". Maps of "quasi-stationary" sea surface topography (SST) - the word topography being used as analogous to terrestrial topography - may thus be drawn. It is, in principle, necessary to extrapolate such results, obtained in deep waters, across shallower continental shelves towards the coasts. This is done by geostrophic levelling techniques. These rely basically on hydrodynamic concepts involving a balance between Coriolis forces, due to the earth's rotation, and the steady, or geostrophic, surface flow produced by the gradients of SST. (In the Southern hemisphere the geostrophic current flows roughly parallel to the SST contours, such that the "high" SST is to the left of the current direction). This "dynamic" method enables ocean currents to be determined from SST slopes deduced from steric levelling. Conversely, if the velocity has been measured, the SST slope may in principle be determined; thus, in principle, extra-polation across shallow continental shelf areas should yield direct comparison with geodetic levelling results at tide-gauge sites. However, procedures for carrying out this extrapolation appear to have caused some debate amongst the oceanographic ommmunity, as

other coastal forces such as those exerted by bottom topography and long-shore wind stresses may exert significant effects.

5.2 The lack of hydrographic information emanating from Papua New Guinea (PNG) has been commented on by several others.

A particular short-fall has been noted as occuring in the field of reliable tide-gauge observations. In fact at the time of writing it appears that only two tide-gauges are known to be working effectively in the country, at Port Moresby and Rabaul, with some uncertainty about a third, at Kieta (Harvey, private communication) - although in theory more sites should be in operation. The reasons for this gap are many, but the principal one is financial in character - money necessary for the funding of maintenance, personnel training, and for regular visits to the sites by the responsible authority has not been available (Chakumai, private communication.

5.3 The network of modern tide-gauges to be distributed widely throughout the region described above will imply that, probably for the first time, PNG will over the next few years gain reliable coastal information on mean sea level. This information is badly needed since there is at present no adequate height control network and very little spirit levelling has been done. This, combined with the fact that the country and its contiguous waters are mapped and charted on a variety of different datums has led to a situation of no little complexity. (It has been argued that coastal results as determined by the application of steric and geostrophic principles may be at best only within $\pm$ 20 cm of the "instantaneous" SST at the tide-gauge site).

The goedetic/oceanographic disagreement mentioned above is certainly not unique to Australia, but the magnitude of the Eastern seaboard effect there is apparently greater there than elsewhere, even when the effects of

gravity/geopotential are taken into account in the geodetic levelling reductions.

5.4 Continuation of MSL knowledge northward from Queensland has hitherto been limited by the lack of information emanating from areas to the north of Cape York. It would now seem that during the next few years a good deal of informative data may well be forthcoming. This could result coastally from a accurate three-dimensional Doppler translocation fixation of bench marks connected by very short levelling runs to the CSIRO tide-gauge positions. In addition, it is to be expected that required improvements in the resolution of satellite altimetry, associated with improvements in instrumentation, signal-to-noise ratios and geopotential modelling will also contribute significantly to the overall oceanic picture.

It may be noted that the author has not advanced any theory or associated semantics as regards "M.S.L" or "geoid" definitions. Readers are referred to the literature should they wish to pursue this complex aspect in greater detail.

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REMOTE SENSING SOLVES A PROBLEM

by

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ABSTRACT

Cost and time are major influences with problems experienced by a developing nation. One such problem has been addressed and a transient solution formulated.

The HYREGRAPHIC (Hydrographic Reconnaissance Graphic) emanated from a need for up-to-date hydrographic charts and bathymetric detail of Papua New Guinea's waters. As the existing charts and surveying activities are inadequate for meeting present and foreseeable future requirements, an alternative transient low cost and rapidly derived product was conceived as a viability. The existing aerial photographs, topographic map and hydrographic chart data combined with bathymetry derived from Landsat data fulfilled this concept.

BACKGROUND

The ocean area within Papua New Guinea's (PNG) Exclusive Economic Zone (EEZ) is covered with charts, varying from scales of 1:1,700,000 to 1:12,500, the latter for harbours and channel approaches (Young, 1981). Many of the surveyed areas are based on incomplete, erroneous or dated information (Young, 1981) while the charts themselves are based on a variety of spheroids, datums and projections giving rise to errors in position, shape and depth between successive charts. Comparing common points on the 1:100,000 topographic maps and hydrographic charts large inconsistencies in latitude and longitude were detected (Table 1). Figures 1 and 2 portray some of the planimetric variations between the map and the chart while lack of reliable depth information is demonstrated by the warnings found in the Pacific Islands Pilot (Young and Lyons, 1981).

This situation has precipitated an urgent need for current charts (Young and Lyons, 1981) to assist in adequate planning, implementation and monitoring of development in PNG. With PNG's present level of development data are unable to be obtained by conventional methods.

INTRODUCTION

Landsat data can be used to fulfil some of the Hydrographic and bathymetric needs of PNG. Its low cost, rapid acquisition, repetitivenessand accuracy make it a suitable and appropriate technology for the current hydrographic surveying situation. A graphic suitable to the needs of PNG has been produced using information derived from Landsat data, 1:100,000 topographic map repromat, aerial photographs and hydrographic chart information.

Compilation of the HYREGRAPHIC broadly consisted of three phases, the first being the gathering of existing data. The bathymetric data was then generated from Landsat data with the aid of a computer. The final phase was the amalgamating of these two data into the final graphic. Figure 3 is the planned flow of the compilation process.

PLANIMETRIC DETAIL

Aerial photography commenced during the WWII and a complete coverage of PNG now exists in the scale ranges, 1 in 80 to 120,000 with larger scales of about 1:50,000 of specific areas. The photography covers all land areas extending only over close inshore regions (in most instances). These data are still available for the extraction of further detail.

The last 1:100,000 scale map completing the coverage of PNG was printed in 1980. These maps were photogrammetrically compiled, hence depiction of much of the offshore reefs was derived from existing hydrographic charts. This has meant many reefs, shallow water areas and other features have been depicted as location approximate or are not shown at all.

Although the 1:100,000 map series uses two different datums and figures (Young 1982), the adjustment of the control networks produced approximately $\pm$ 1.0m precision in each co-ordinate at 90 per cent confidence level (McLuskey et al 1976). When compared with the variety of datums and projections and the age of the respective hydrographic charts the 1:100,000 map series can provide a superior and more uniform depiction of many coastal and all land features. These maps also cover coastal areas which are not included on the chart series of scales 1:300,000 and larger.

Landsat data can be used for positioning those offshore features (above 20m depth) not already accurately located. Mathematical transformation has been used in determining the planimetric accuracy of the Landsat imagery. With sufficient reliable ground truth, which can be generally obtained from existing 1:100,000 maps if available, or from control specially established for the imagery, the planimetric accuracy meets the minimum plotting requirement (0.5mm) for 1:250,000 mapping (Wong, 1975; Turner, 1976 and DNM, 1976).

BATHYMETRY FROM LANDSAT

Landsat sensors collect the upwelling radiance data over shallow water that is the result of sunlight reflecting from the ocean bottom and the water surface, and the scattering of sunlight in the water and the atmosphere. After separation of the bottom reflection signal from the rest of the observed signal, the variations in the intensity of this data can then be correlated with variations in water depth to produce useful bathymetry. For practical purposes detection of a 22m limit is considered reliable within a 10% RMS accuracy (Young and Lyons, 1981). From the above information it was concluded that bathymetry produced from Landsat data is highly appropriate for the production of a reconnaissance graphic in view of the supporting base data from the 1:100,000 maps.

The depth accuracy of this HYREGRAPHIC does not compare with the accuracies described above. Firstly, the tide level had to be estimated from tidal recording stations some distance from this test area and from dated chart data.

Also, only sparse and scattered ground truth data (depths) of the area were available from the existing hydrographic chart. No field data acquisition was carried out for the project. Analysis of the radiance values of deep water and apparently exposed reef (obtained from inspection of the aerial photography and the hydrographic chart) produced the upper and lower limits of depth detection. From the results of studies (Polcyn et al, 1977; Warne, 1978 and Thomson et al, 1976) the deep sea radiance value was assumed to apply to depths greater than twenty metres. Apparently exposed reef values varied from 92-146 using band 4 while deep sea values ranged from 21-35. For determining parameters of depths between zero and twenty metres available chart depths were used in a correlation of depth to radiance (Figure 4). As the correlation was inconsistent (Table 2), only the deep water signal for 20 metres was considered as a stable parameter. Analysis of the shallow water/exposed reef region also showed many inconsistencies, so the zero depth radiance value was chosen deliberately in the lower half of the determinations. The latter shows the water shallower than it really is, which without reliable ground truth, was considered desirable for general safety reasons.

Final radiance/depth figures were taken from the graph (Figure 4) the only variation being the deep water signal; the radiance value for 20m depth was raised to 35 as lower values showed huge areas of water deeper than 20 metres as shallower than 20 metres.

The radiance values were then fed into the computer program which, through the Photowrite (Optronics P1500 Black and White - Laser Modified), produced the "red", "green" and "blue" images required for the production of the image with its colour assigned depths. The Land and cloud areas were edited such that radiance responses were given a 'colour' within the grey scale range. Bathymetric lines were obtained by tracing around the outer edge of each colour.

HYDROGRAPHIC CRITERIA

The chart and the map are specific purpose graphics portraying particular aspects and areas for particular users. Before examining the criteria of the HYREGRAPHIC the purpose of the hydrographic chart, bathymetric map and topographic map will be summarised.

They hydrographic chart is an information medium and a tool for maritime traffic for the safety and ease of navigation. Broadly the chart contains information on least water depths, nature of the ocean bottom, sea and swell conditions, surface navigational dangers and all other navigationally significant information. The hydrographic chart is a special or single purpose graphic, namely for navigation.

> "The choice of scale is associated with the choice of area and one of the prime distinction between the land map and the navigational chart is that the latter cannot be schemed in a neat rectangular grid. In chart scheming an objective is to include useful reference points such as lighthouses or distinct radar targets, or ports between which he is likely to sail." (Kerr, 1976)

They may also be designed to cover all or part of a particular body of water or section of coast (Ellis, 1978).

In contrast a 1:100,000 topographic map depicts the physical form (in three dimensions) of the surface of the earth and features resulting from man's occupancy, e.g. communication and settlement constructions and land use. The information presented is qualitative as to location and use and quantitative (e.g. area and volume). The format is rectangular (although an extension can be made to include adjacent land areas) and covers 30 minutes of latitude by 30 minutes of longitude, while the 1:250,000 topographic "planning" map covers $1\frac{1}{2}^{o}$ of latitude by 1^{o} longitude. The map's primaryuse is for actitivies on land and geographical study and is not concerned with maritime movement or activities. Any hydrographical detail is either exposed at some time or is close to shore and may be of significance to shore based activities.

Lyons (1977) describes bathymetric maps as the topographic maps of a nation's submerged lands. They do not show navigational information or shipping hazards but depict the shape of the sea floor through the use of isobaths (depths from 0 to 20 metres not being shown). They are primarily used as an aid to scientific studies associated with marine mining, oil and gas exploration, coastal zone management, pollution control studies, boundary and other national and international jurisdictional matters, a variety of engineering and research purposes, and as an indicator of where more detailed hydrographic surveys should take place. They are "a base on which resource information can be portrayed" (Turner, 1974).

As conceived by the author, the HYREGRAPHIC is required to fulfil the following criteria:

- Provide a base map to expedite general charting hydrographic surveys.
- Provide a rapid inexpensive reconnaissance map for planning and selecting suitable priority areas for passage surveys or marine construction.
- Provide an 'aid for navigation' where none exists by 'filling in' uncharted regions and checking the reliability of existing information.
- Provide bathymetry to a maximum depth of 20m with 10% RMS accuracy.
- Plannimetrically position all data to an accuracy suitable for 1:250,000 mapping, i.e. $\pm$ 125m $\pm$ 0.5mm plotting accuracy.
- Be a graphic such that it can be produced and updated rapidly and inexpensively within PNG.
- Be suitable as an environmental monitoring record.
- Be on a standard projection and datum.
- Be part of a series schemed into a specific system.
- Have a suitable and uniform scale.
- Have the general characteristics of a topographic map.
- Show detailed land topography.

- Contain a suitable legend, reliability diagram and data source diagram.

Some of the above information is available but in variety of forms. No single graphic is available in a format suitable to the hydrographers, or other ocean users' needs, in most of the ocean areas around PNG.

APPLICATIONS OF THE HYREGRAPHIC

Such a graphic could have the following applications:

- Provide for safer navigation, especially coastal and inter-island navigation.
- Be used for National and Provincial Government development and environmental planning and monitoring.
- Providing reconnaissance or interim base data for private, Government and military chart users.
- Provide bathymetric data in shallow areas freeing the limited hydrographic surveying resources for other priority tasks and deeper waters.

COMPILATION PROCESS

Although bathymetric maps (of Australia) are usually produced at 1:250,000 scale the HYREGRAPHIC was compiled at 1:100,000 scale for the following reasong:

- Existing topographic map scale is 1:100,000.
- Existing topographic map has been compiled on the UTM grid.
- The intention is only to demonstrate the method; a production graphic would conceivably be required to be reduced to 1:250,000 using standard cartographic and reprographic method.
- The ease of planning in small areas on larger scales.
- The test area considered is small and confined to a specific boundary.
- A facility to compare the graphic with existing aerial photographs with an approximate scale of 1:100,000.

From the 1:100,000 topographic maps a base sheet was drawn containing the area boundary, legend information, shore line, approximate reef areas as depicted and topographic information pertinent to the HYREGRAPHIC.

NAVIGATIONAL INFORMATION

The area under consideration on the hydrographic chart was enlarged from 1 : 300,000 to 1 : 100,000 to compare the reef areas and transfer pertinent hydrographic detail (Figures 5 and 6).

Because of the unreliability of the chart data (Young, 1982) only a limited quantity of nomenclature, depths and navigational information were transferred. Pertinent information from the legend was also transferred to the HYREGRAPHIC.

ADDITIONAL INFORMATION

Due to the nature of the HYREGRAPHIC, warning notices were included relating to the use of graphic, its compilation material, the variety of datums and the type of data portrayed. A reliability diagram was also included to provide an overall view of the general reliability.

SUMMARY AND CONCLUSIONS

The HYREGRAPHIC was conceived as a practical approach and solution to problems where conventional techniques are not economically or expeditiously viable at this chronological period of PNG's development. There is a unique opportunity in PNG to map the shallow water areas by any method and provide information desparately needed. Hence, the main purpose in developing the HYREGRAPHIC was to produce a prototype chart with new types and details of information to improve quality and usefulness of nautical charts in satisfying the needs of various user disciplines.

The HYREGRAPHIC was intended not to supercede existing charts but to be a transient graphic providing reconnaissance information. The graphic produced is a 'first pass' to provide safer access for a survey vessel for the purpose of acquiring ground truth data needed in producing the following generation of HYREGRAPHICS. As a trial map, demonstrating a method, no special effort was made with respect to determining the best methods of depicting data. Consequently, it was produced as a single colour map with convenient symbols and cartography. Symbology suitable to the user and for facilitating integration of the variety of data sources was considered a natural progression from consideration of a production graphic and user evaluation. The major concession considered essential for the HYREGRAPHIC was the inclusion of appropriate warnings regarding reliability, use and information sources. As well as being essential it is desirable because it is a new concept using a new technology, and both techniques will need to be trusted before acceptance of the users of hydrographic information is gained.

Depth information derived from Landsat data would be the most contentious element of the HYREGRAPHIC. It is not as accurate as that from modern shipborne techniques, but the limitation of Landsat to shallow water mapping does not invalidate the technique. In many respects such areas are the most important and are also the most difficult and dangerous to survey. Even if Landsat could do no more than map shallow water regions, it would be a valuable adjunct to conventional surveys. It can be used to provide depth information, position offshore features not previously charted and in checking the reliability of dated information. Not only is using Landsat quicker, safer and cheaper than using surface vessels, the information required has already been sensed and only requires analysis and manipulation to be presented in the desirable format. It is also a valuable tool for chart evaluation of completeness and accuracy, it is also useful for

- Generation of Notice to Mariners reports on new findings.
- Update and revision of charts.
- Detection of change in respect to navigational hazards.

The long term solutions for acquiring hydrographic data are not based on a single technique but on an integration of methods - shipborne, airborne and satellite data collection - aided by an interactive computer analysis system. However, it is concluded that a production operation is now feasible to satisfy immediate charting needs using the technique derived in producing the HYREGRAPHIC. Compilation of this graphic is relatively uncomplicated, rapid and inexpensive.

Although far from the ideal product, the HYREGRAPHIC has addressed the problems of:

- an up-to-date reconnaissance information.
- a base map for expediting shipborne hydrographic charting.
- completing uncharted regions and supplying depth to 20 metres.
- checking the reliability of existing hydrographic information.
- supplying the needed data on one graphic.
- the possibility of having a series with a uniform scale and a standard projection and datum.
- an interdisciplinary graphic.
- a graphic fulfilling the needs of an early developmental process in remote localities.

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CHARTS		ϕ			λ		
GROUP	SCALE	MIN	MAX	MEAN	MIN	MAX	MEAN
1	1:12,500 - 1:75,000	0".2	30".3	9".2	0".4	78".9	22".2
2	1:100,000 - 1:150,000	2".1	80".3	24".7	0".8	81".0	20".4
3	1:250,000 - 1:300,000	1".5	196".6	20".5	0".0	72".0	16".1
4	1:500,000-1:1,000,000	1"	81"	23"	00"	117"	35"
5	1:1,700,000 or smaller	7"	38"	19"	58"	139"	109"

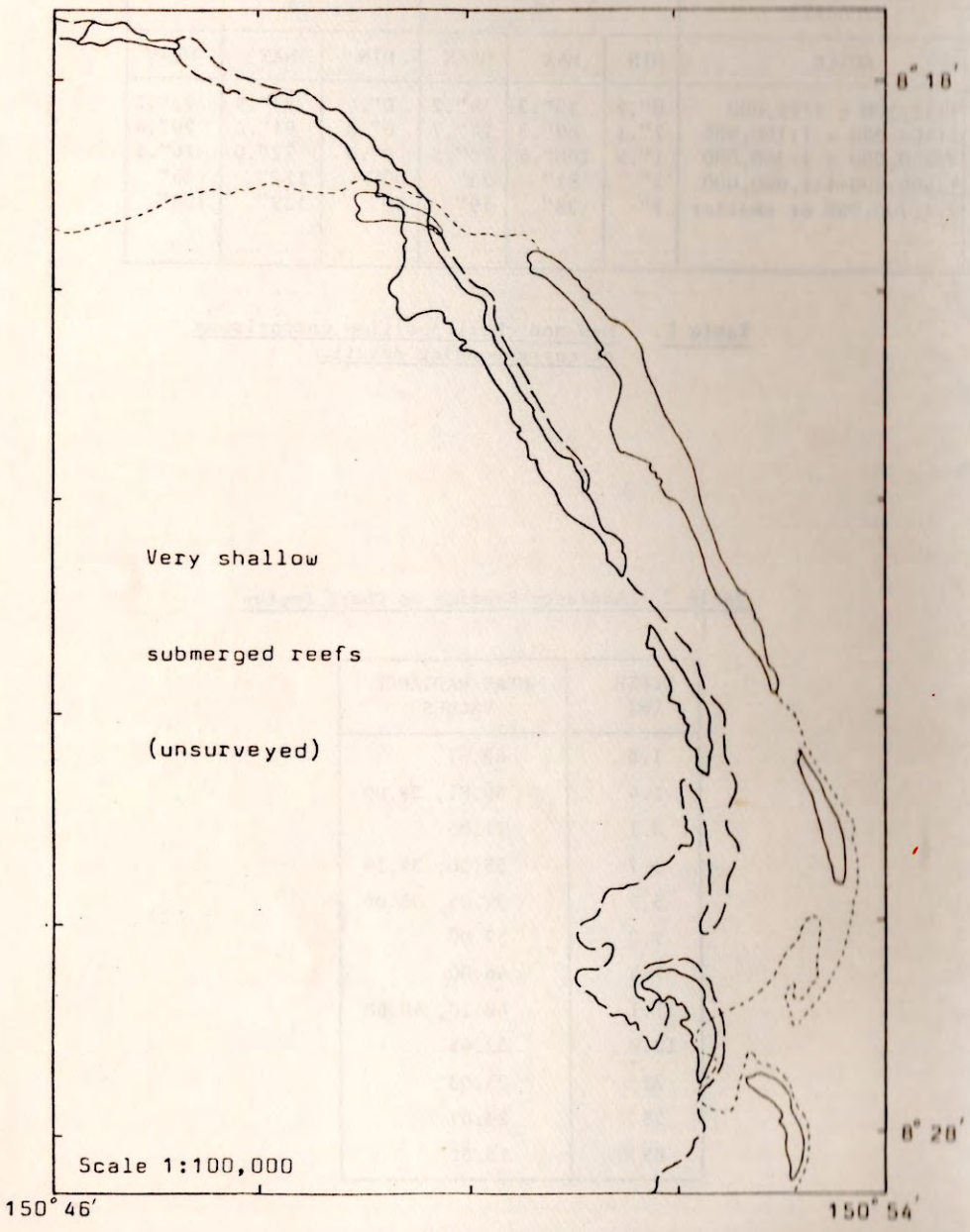
Table 1. Map and chart position comparisons of corresponding detail.

Table 2 - Radiance Reading on Chart Depths

DEPTH (m)	MEAN RADIANCE VALUES
1.8	63.67
2.4	66.81, 39.00
3.1	71.00
3.7	55.50, 39.20
5.5	39.05, 38.00
7.3	57.00
7.4	46.00
11.1	48.20, 40.60
12.9	32.95
32	31.03
58	29.01
85	28.82

FIGURE 1

CHART AND MAP VARIATIONS EXAMPLE



LEGEND

Hydrographic Chart Aus 570 (1:120,000)

Topographic Map Tuma (1:100,000)

Reef boundaries

FIGURE.2

CHART AND MAP VARIATIONS EXAMPLE

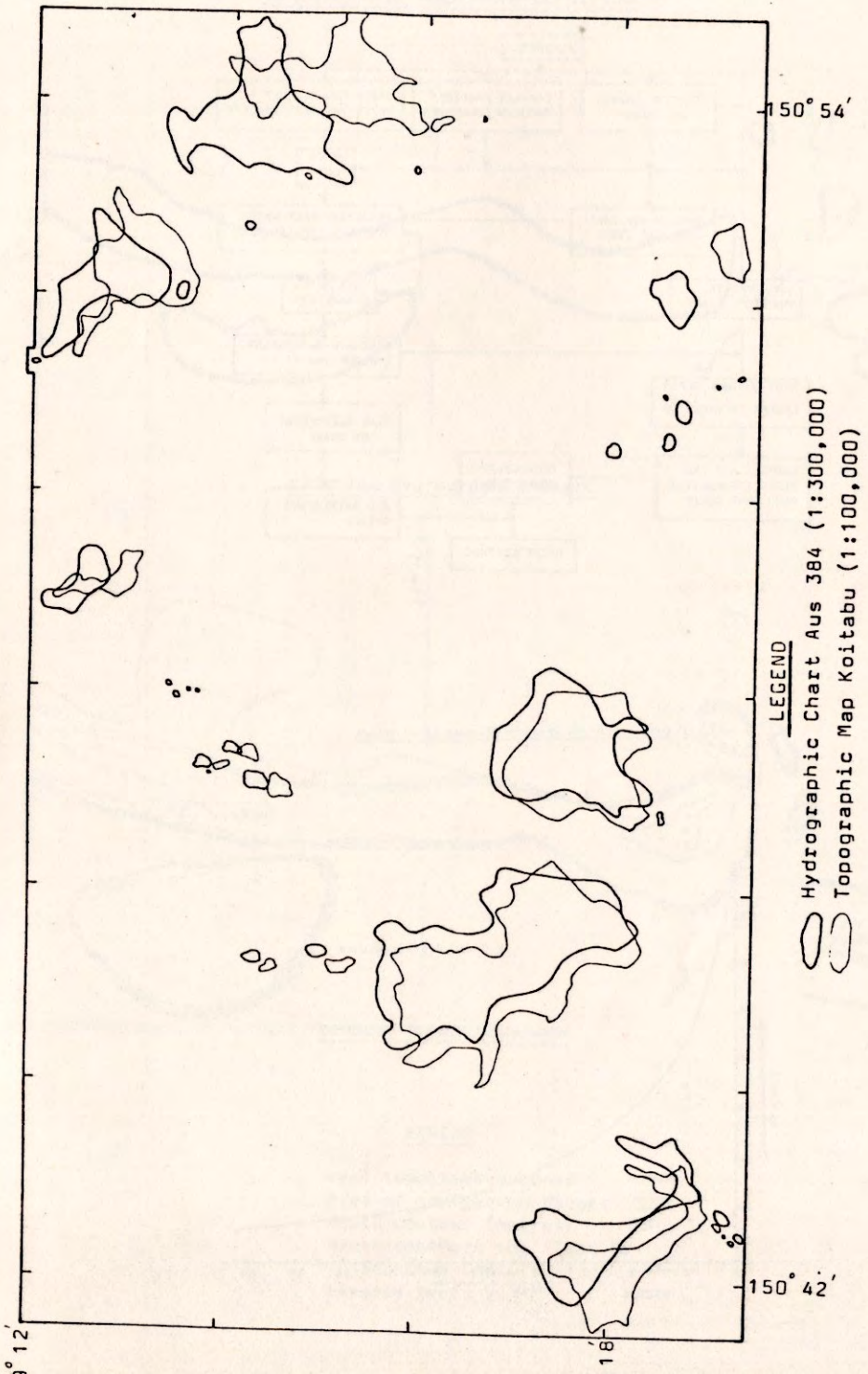


Figure 3 - Compilation Process

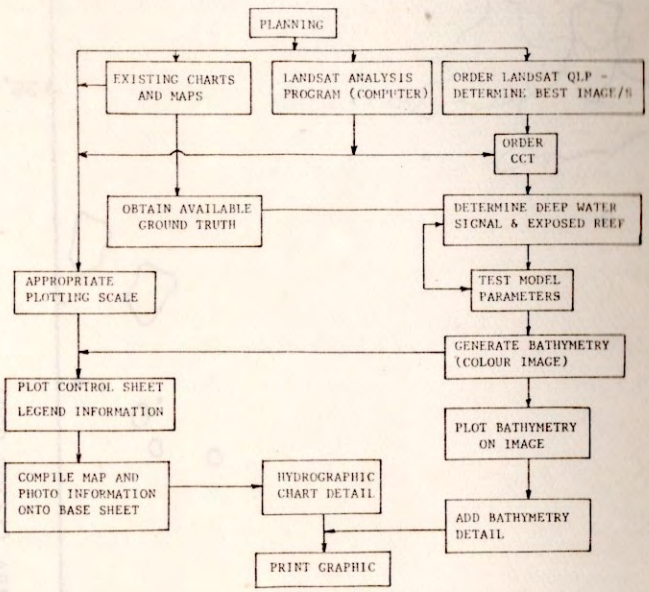


Figure 4 - Depth Density Slicing Level Graph

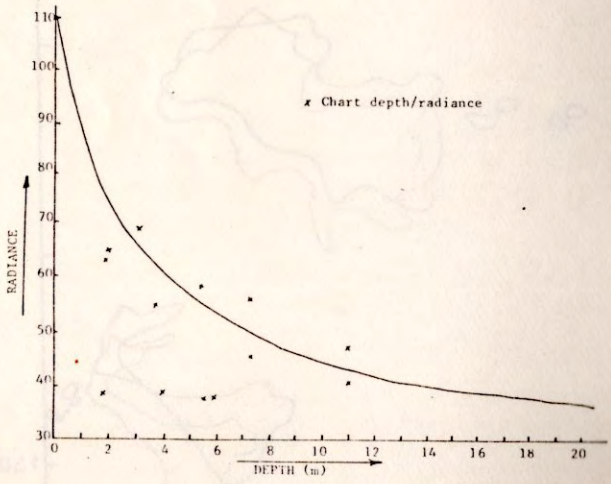
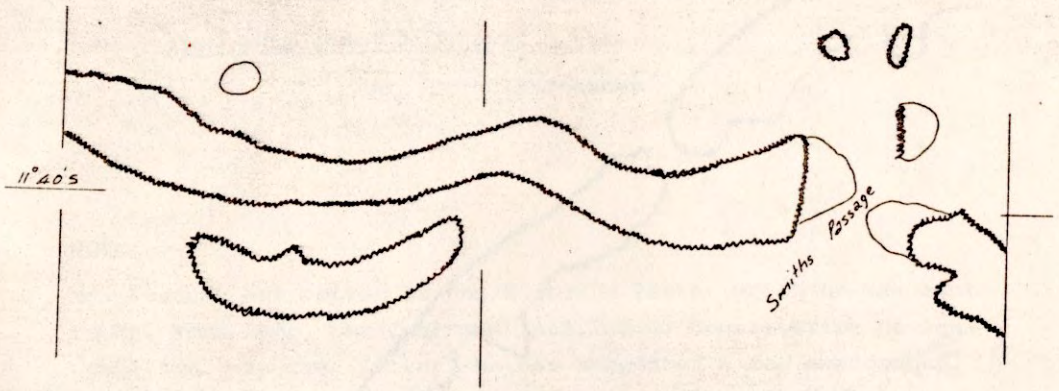
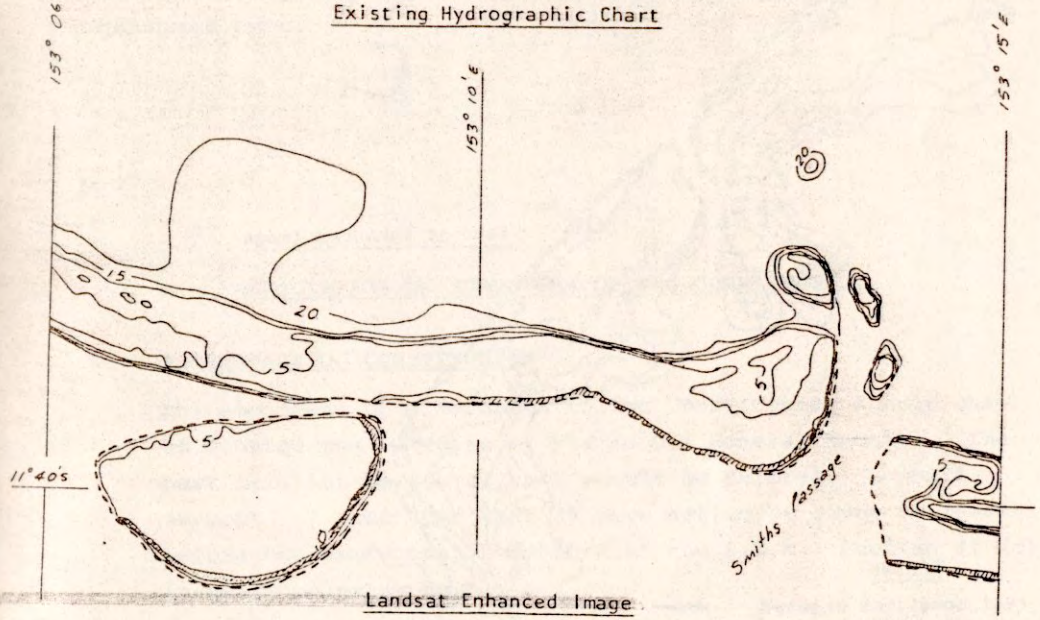


FIGURE 5

COMPARISON OF REEF AREA DEPICTION



Existing Hydrographic Chart



Landsat Enhanced Image

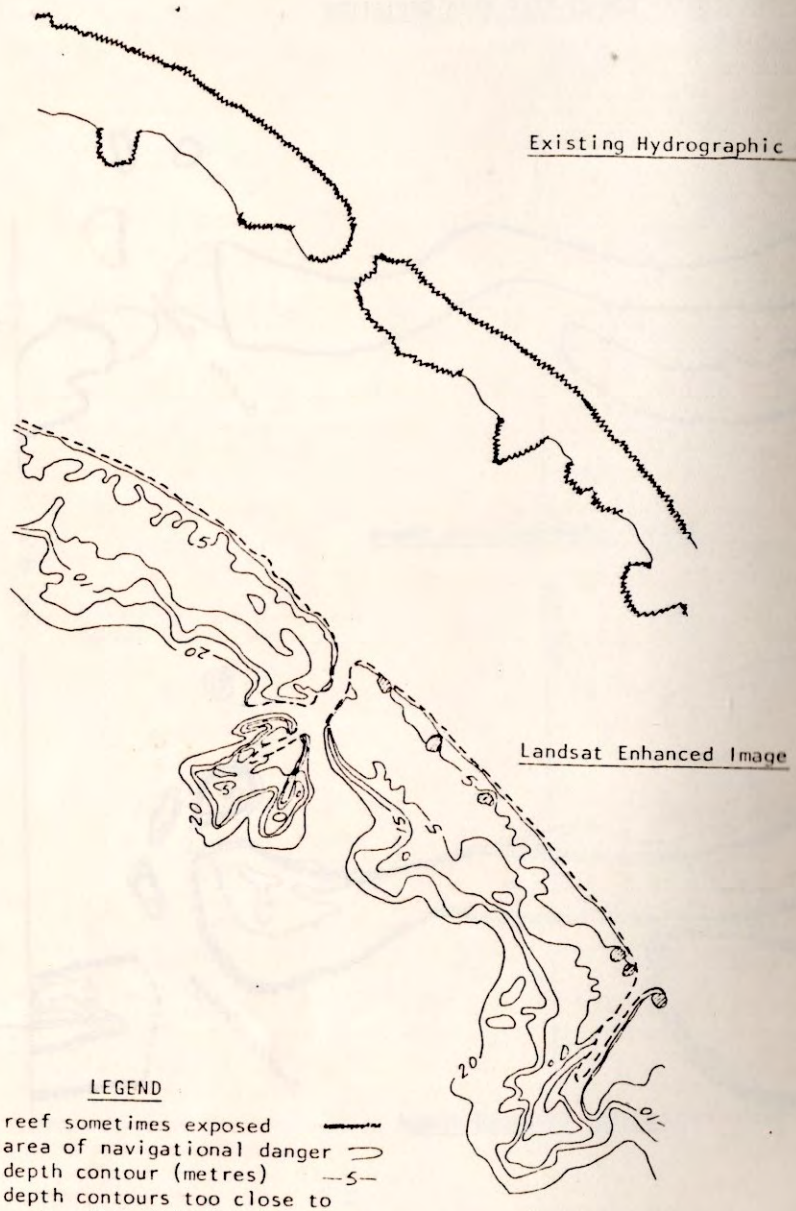
LEGEND

- reef sometimes exposed
- area of navigation danger
- depth contour (metres) —5—
- depth contours too close to be shown individually ---
- exposed reef

(Portion of Chart AUS 282

FIGURE 6

COMPARISON OF REEF AREA DEPICTION



(Portion of Chart AUS 382 reproduced by permission of the Hydrographer, Royal Australian Navy)

CONSTITUTION OF ASSOCIATION OF SURVEYORS OF PAPUA NEW GUINEA

Suggestions for Some Changes

by

Mr. Francis Posanau

Note:

Mr. Posanau has copied to the Editor a letter which he has sent to Mr. Norm Leet, the Chairman, A.S.P.N.G. Constitution Review Committee. In that letter, he has suggested a few amendments to the Constitution, and at his request, his suggestions are reproduced here.

Editor.

ASSOCIATION OF SURVEYORS OF PNG CONSTITUTION

7. ALTERATION OF CONSTITUTION

Any amendment or alteration to the Constitution should only be debated and voted to at the Annual General Meeting. The part relating to postal vote should be deleted. I still support the idea that 30 days' notice be given to members before the amendment is debated at the A.G.M. Section 42 (d) is still relevant here.

I have no comments to make on other sections.

BY-LAWS

1. OK
2. OK
3. OK
4. QUALIFICATION FOR MEMBERSHIP:

(A) Qualification of Fellows:-

(i) OK

(ii) Does "members" mean "members" as defined in By-Laws Section 1. To maintain high standards in our profession I suggest only corporate members be nominated for Council's consideration.

(iii) OK

(B) Qualification of Members:-

(i) OK

(ii) OK

(iii) (a) I propose,

"that he is at least 21 years of age

and

that he holds a certificate of Competency issued by the Surveyor's Board of Papua New Guinea, an Australian State or New Zealand."

The part at the end of where it isindicated that an applicant must be a registered surveyor and that he should at least be practising as a licensed surveyor for 2 years, should be dropped. My intention here is to cater for an applicant, who as soon as he obtains his/her license should be considered for corporate membership immediately, i.e. (it is also not impossible for a diploma graduate, Unitech to obtain his/her licence after only 1 year in the field, due to changes in the course)

or

(b) Delete age part and "that he holds a degree or diploma from University of Technology and that he has been practising surveying for at least 2 years after graduation".

That part at the end concerning exemption is ambiguous and can lead to varied interpretation. Any applicant can be considered only under a), b), c), or d).

(c) I propose, "that he is at least 35 years of age and that he has been trained in a branch of surveying to the satisfaction of the Council,, and that he has been professionally engaged in the practice of surveying for a period of not less than 10 years, 5 years of which shall have been in a responsible officer level, and that he has ----------,

or

(d) OK

(C) Qualification of Honorary Fellows:-

(i) OK

(ii) OK, I support the idea here in giving recognition to other professionals, who have in one way or another assisted us towards achieving our objectives.

(D) Qualification of Associates:-

(i) OK

(ii) (a) "that he is at least 21 years of age, and is a degree or diploma graduate from University of Technology."

Delete the part relating to exemptions as in qualification for membership.

(b) OK.

(c) For those in other allied professions the qualification must be the same or similar to (a) and for those who obtained certificate level must have similar experience and in similar level as in (b).

(d) Delete . Applicant can only be considered under (a), (b) and (c).

(E) Qualification of Technical Associates:-

(i) OK

(ii) (a) OK

(b) Delete. Again as in (d) (ii) (a) above if we intend to improve on the positions of Associates the same should apply to certificate graduates from Unitech, i.e. as soon as they graduated with certificate the door should be opened to apply for Technical Associates. Or is the Association saying, that our graduates have lower surveying education standard and therefore we should give our certificate graduates 5 years of field practice before we can recognise and consider them to this grade?

(G) Interpretation:- OK

However, I would like to suggest that for any sections that are not clear or ambiguous, the Council should be the final body that provides the final interpretation to any unclear sections of the constitution.

(H) Can anyone interpret this particular section for me? I cannot see the relevance of this section with regards to section 4 above.

65. Election of Nominees to Surveyors Board:

To keep in line with the development now taking place in many fronts in an independent PNG, can we now consider that the panel of registered Surveyors submitted to the Minister by the Association should all be national surveyors? This means that only national surveyors will stand for election to the Surveyors Board.