REVIEW OF TOPOGRAPHIC MAPPING SERVICES
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Chairman
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Dear Dr Wilenski

In July 1985 the Board invited me to lead a review of Australia's topographic mapping facilities.

I have pleasure in submitting my report.

Yours sincerely

Jack E. Richardson

Jack E Richardson
Consultant

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Section 1

INTRODUCTION

Terms of Reference

1. Cabinet Decision 3998 of July 1984 requested the Ministers for Defence and Resources and Energy to undertake a complete joint administration review of Commonwealth topographic mapping resources and needs and the way in which those needs could best be met, including alternative mechanisms for meeting strategic mapping needs. The two departments agreed on the Terms of Reference but they were unable to agree on key issues. In April 1985, the two Ministers, Mr Beazley and Senator Evans, agreed that before there could be recommendations on the allocation of responsibilities or resources, it would be necessary to have an independent view of outstanding differences. The departments agreed that the Public Service Board should undertake an independent assessment and complete the review. This led to my engagement in a consultative capacity to lead the review.

2. Appendix A sets out the original Terms of Reference in seven paragraphs. I have not sought to respond to each of them but have taken my task to be that of concentrating on issues in dispute and possible future policies. Inevitably it caused me to examine related matters such as the mapping programs of the States and their abilities to participate in a Federal program.

Areas of disagreement

3. The areas of agreement on substantial issues between the Department of Defence (henceforth usually called Defence) and the Department of Resources and Energy (henceforth usually called DRE) which I was given to understand were extensive turned out to be practically non-existent. There is a long history of unsatisfactory relations between the Royal Australian Survey Corps, known as RASvy, the mapping agency of Defence, and the Division of National Mapping, known as Natmap, the mapping arm of the DRE. It surfaced in 1984 mainly because Defence had decided to embark on a 1:50 000 scale mapping program solely for defence purposes. The unilateral decision was seen by Natmap as violating its traditional role of coordinating Commonwealth topographic mapping programs.

4. With two authorities, one military and the other civil, claiming a right to engage in topographic mapping, a dispute arose as to the respective mapping costs of each. Paragraph 5 of the Terms of Reference required, among other things, identification of the cost structure and productivity of RASvy and Natmap in the production of topographic maps and derived products. The two departments were quite unable to agree on how costs should be assessed and the significance of that disagreement was pressed upon me, particularly in the early stages of my review.

5. At the same time Defence maintained unequivocally that Australia's defence needs meant that there should be a professional RASvy core force capable of meeting military demands for mapping services and assistance in the field if Australia were to be invaded by a hostile military force. The existence of a core force for this purpose provided RASvy with resources also to mount a mapping program of its choice. To this claim Natmap and its parent department reacted by challenging the size of the RASvy undertaking as being in excess of the disclosed defence need.

Other Commonwealth mapping and survey activities

6. Not unexpectedly, in view of the circumstances prevailing in 1984, the Terms of Reference concentrated on the fulfilment of Commonwealth topographic mapping programs for all civilian and defence purposes. As my enquiries progressed it became apparent that in the long run Commonwealth topographic mapping could not continue to be isolated from other mapping and survey activities. The Terms of Reference do not expressly provide for their examination but I have found it impossible to disregard them in formulating submissions at the end of this report.

Progress report

7. Last December, I made a progress report to the two Ministers and the Minister for Finance setting out some of the issues and my attitude to them. In separate letters of response Senator Evans and Mr Beazley made several constructive comments and suggestions and their departments subsequently supplied me with their critical appraisals. As a result of the commentaries and ensuing discussions, I have refined some of the views I expressed tentatively in the progress report but there have not been any fundamental changes in my thinking.

8. The complex issue of costs exemplifies the difference between the progress report and this report which confirms my tentative view last December that RASvy's costs of compiling maps were higher than those of Natmap. Naturally though, this report also brings contributing factors into sharper focus and takes full account of the different map making policies and procedures of Natmap and RASvy not apparent in the progress report. Digital stereoplotting undertaken by RASvy emerges as being more costly than graphic stereoplotting undertaken by Natmap in conjunction with outside contractors. As will be seen, however, it does not follow that one agency is more efficient than the other or that the future shape of the 1:50 000 program should be determined solely by comparison of past costs.

9. The progress report is entirely superseded by this report.

Assistance and expiration of time

10. The review has taken far longer than I expected when I began last October. Among several contributing factors, I should mention two. Firstly, as I have said, it transpired that there was little agreement between the two departments on substantive issues, thus increasing my function. I was to find that the two sides were deeply entrenched on several issues often making it difficult and time-consuming to separate knowledge and facts from partisan glosses on information received. Occasionally I had to go to unusual lengths to test information rather in the manner of Sherlock Holmes without Watson.

11. Secondly for a program of its size my review did not have sufficient support staff. Each Department provided an officer acting primarily in a liaison capacity and the Board made available to me an Executive Officer, Mr W. Egan and a secretary. That was all. Over the seven months which elapsed, the Executive Officer became entirely involved in the task of comparing the compilation and printing costs of RASvy and Natmap, leaving me in effect without the services of an Executive Officer. Most of my time was spent not in leading the review but undertaking it, including most research tasks. My report has a higher personal content than Henry Ford's first motor car.

12. Notwithstanding the troubles mentioned, I believe this report embraces the principal areas of dispute and substantially fulfils what I set out to do. I hope it also fulfils what was expected of me.

13. I should like to acknowledge the assistance of Mr John Baker of DRE and Miss Julienne Boston of Defence. They were always willing and provided essential information frequently not obtainable without considerable effort on their part. I also acknowledge the cooperation of the two departments and staff concerned in what was acknowledged all round as being a difficult task. I thank the Secretaries of each department for their forbearance. The Management Improvement Division of the Public Service Board also made a useful contribution in assessing, at my request, the methodology employed in costing Natmap's operations. My secretary, Ms Lorrence Salter, who also acted as occasional research assistant, provided an invaluable service.

14. I was much assisted by Surveyors-General and Directors of Mapping in the States and the Australian Surveyor-General. As will be seen I was guided by their combined wisdom and experience in several aspects of the Review which required the exercise of informed judgement. I was also in touch with representatives of the private mapping and survey sector.

Subjects not covered

15. Because of restraints of time and resources I was forced to focus on the more crucial issues leaving untouched

some questions on which I should like to have reported. One is about arrangements in RASvy and Natmap for aerial photography.

16. RASvy usually has the services of the RAAF. There is a RAAF proposal to buy two jet aircraft for which a principal use will be to undertake mapping photography for RASvy at an all up cost of about $23 million each. Each aircraft will cost several million dollars more than any aircraft so far used in aerial photography in Australia. No civilian mapping authority, whether Commonwealth or State, uses jet aircraft or aircraft of high capital cost nor is it necessary or economic for them to do so. Natmap owns and operates two Cessna aircraft. I have no doubt that all Australian civilian mapping authorities would regard the RAAF proposal, with its attendant operational costs, as a self-indulgent exercise in extravagance. In the background there is a commercial aviation industry which is competitive both in the charter of aircraft with or without crews and undertaking aerial photography. Such arguments as I saw in support of a successful DRE Cabinet Submission in 1980 to buy new aircraft operated by crew in full time employment with Natmap left me far from convinced that the internal aerial service was cost effective. The principal argument was the high potential cost of paying outside contractors for minimum hours and standing time resulting from such factors as inclement weather. My experience in other areas suggests that a business-like approach to private operators can result in a better contract than one which imposes an obligation to pay for all lay days. Unfortunately the need to enter the lists on compilation and printing costs left me with no time to review aircraft costs.

17. Beyond the ambit of the inquiry, but of concern, is the number of institutions at tertiary level or the equivalent, wholly or partly maintained by Commonwealth funding, which offer training in the craft of map making. RASvy has a School of Military Studies at Bonegilla, staffed by military personnel. It is effective but expensive and, I am informed, not patronised by Natmap. Defence informed me too that it was agreed with DRE that the School of Military Studies should not be included in any cost comparisons.

Natmap staff association representations

18. During my review, representatives of the Professional Officers Association (POA) and the Association of Draughting, Supervisory and Technical Employees Association (ADSTE) staff in Natmap informed the Prime Minister that I was being side-tracked into issues outside what their Associations saw as the crucial question of civilian versus military responsibility for Commonwealth topographic mapping. The principal function of my review is of course, to report upon the most efficient use of Commonwealth resources to meet Commonwealth needs for topographic mapping in the best possible way. There was no question of my review being side-tracked. I should say now, however, that barring completely new and unexpected developments on a

barring completely new and unexpected developments on a national scale, traditional series topographic mapping by the Commonwealth should end with the completion of the 1:50,000 program. The future cannot be put to one side in recommending possible courses of action open to the Commonwealth to achieve the completion of the program expeditiously and economically.

19. In April 1986 an ADSTE representative in Natmap addressed requests under the Freedom of Information Act to Defence, DRE and the Board seeking the supply of all submissions made to my review and any relevant supporting documents. Needless to say this involved me in discussions with the three recipient organisations. ADSTE also issued a telex press release and there were approaches from the media about it but, as far as I am aware, the media did not take up the cause. The two departments have to treat the request on its merits but, as leader of the review, I am not subject to the Freedom of Information Act and the documents and information which the departments have supplied are in my control and not that of the Public Service Board.

Productivity and the management of topographic mapping programs

20. I feel bound to remark on the contrast between the level of activity which long ago I accepted as part of the processes of executive government and the measured atmosphere and apparent lack of urgency in the achievement of Federal mapping programs.

21. In 1965 Cabinet decided that Natmap, with RASvy's assistance, should undertake a 1:100 000 series topographic program to be completed in 10 years. The fact that the program is still to be finished after 20 years has not excited the participants to bring the position to the notice of any later Cabinet. My impression of mapping as a whole by public authorities, both Commonwealth and State, is of little interest in establishing measurements of productivity against which performance is to be gauged. Management also seems to be very low profile and largely in the hands of professional surveyors and mappers untrained in managerial techniques and practices. The necessary indicators of performance cannot be provided here but the review has shown that the private sector operates at lower costs than either RASvy or Natmap not only because of lower capital costs but also because of operational practices. For example, one of the larger companies utilises its photogrammetric and stereoplotting equipment for ten shifts a week which is seldom the case in public sector mapping. The scheduled time for any Commonwealth topographic mapping program should not be allowed to pass merely by bureaucratic condonation. The planned time for a program including the 1:50 000 program should also be tested against its objectives.

22. New equipment enables maps to be assembled from data located somewhere in a digital data base - a technological development not to be denied. Unlike many

other technological developments, however, though it means the production of a more versatile and useful product it has not yet lowered the cost of a map as a product. Equipment and labour should be economically employed according to objective criteria and not to the arrogant demands of remote contingencies. The availability of digital capacity does not mean that alternatively prepared products should be automatically discarded.

Section 2

COMMONWEALTH TOPOGRAPHIC MAPPING

23. Topographic mapping is not a subject of express Federal constitutional power and is far from being an exclusive Commonwealth function. Each State has its own mapping authority and State topographic maps cover all urban areas and the more populated rural areas of Australia. Civilian demand for topographic maps is met principally by the States and not the Commonwealth. Total State map sales far exceed sales of Commonwealth maps.

Early history

24. The first Commonwealth mapping was undertaken by the Army in 1910 and since it was formed in 1915, the Royal Australian Survey Corps has engaged in mapping parts of Australia for defence purposes.

25. On the civilian side in 1909 a Commonwealth survey organisation was established in the Department of Home Affairs. In 1916 land and survey functions passed to a new Department of Home and Territories and it began some mapping in 1921. In 1935 Cabinet approved the appointment of a departmental committee known as the Commonwealth Survey Committee following representations to have accurate maps and co-ordination of surveying for Commonwealth purposes.

26. In 1945, following discussions between the Commonwealth Survey Committee and State Surveyors-General, the National Mapping Council was formed as an advisory body to all participating Governments for the co-ordination of mapping on a voluntary basis. In the same year the Commonwealth Surveyor-General was made Director of National Mapping. The two roles were separated in 1956 by moving the Surveyor-General and his staff to the Department of National Development.

27. In 1951 on the invitation of the Australian Government, Major-General R Brown, Director-General of the Ordnance Survey of Great Britain, visited Australia. The invitation arose from the Minister for the Army's desire to obtain advice on the functions and program of RASvy and on "the task of coordinating all aspects of National development". The letter of invitation expressed an Australian interest in the "alignment of activities in the production of national map series at medium and small scale".

28. Major-General Brown reported that most of the surveys and mapping of Australia considered to be national in character had been undertaken by the Army and not the principal civilian agency in the Department of the Interior. The States' contribution to national mapping was minimal.

29. Major-General Brown recommended an enquiry by an independent body to assess the need for national mapping in the general interest. He also recommended the formation of a single authority responsible for all geodetic topographic survey and mapping required for all Commonwealth purposes. The authority, he said, should be primarily a civilian organisation on a civil vote but it should also employ military personnel on the active list of the Royal Australian Survey Corps. The Corps should be invited to undertake agreed parts of a national survey program.

30. In July 1954 Cabinet decided that the Department of the Interior should be the single authority for all Commonwealth topographic survey and mapping meeting defence as well as civilian needs. It also established a standing advisory committee of three consisting of the permanent head of Interior, a nominee of the Minister for the Army and a nominee selected by the Minister controlling the authority from a panel of names submitted by the Institute of Surveyors-General. When constituting the Department of the Interior as the national mapping and survey authority the Government was aware of the intention to implement a planned program for a national topographic map series at a scale of 1:250 000. Action was not taken to have an independent review of national mapping needs.

31. In 1956 the mapping function of Interior was transferred to the Department of National Development and it now resides in DRE. Natmap's claim to overall responsibility begins with the decision in 1954.

Commonwealth series topographic mapping programs

32. There are three major programs - the 1:250 000 program and a 1:100 000 program for which Natmap is the authority primarily responsible. The third is a 1:50 000 program which Defence has initiated and so far controls.

33. In lay pre-metric terms a 1:250 000 map is 4 miles to the inch. A 1:100 000 map is about 1.6 miles to the inch and in a 1:50 000 map each inch equals .8 of a mile. In metric terms 2 centimetres of a 1:50 000 map equals one kilometre .

1:250 000 Natmap program

34. In 1954 the task of commencing a national program was formidable and the decision was to undertake a preliminary mapping phase at 1:250 000 scale producing uncontoured maps in the first instance with work proceeding in the meantime on a national geodetic survey to provide the framework for eventual basic mapping with more detailed and contoured maps. Natmap shared the work on the original program with RASvy. Natmap produced 240 sheets, RASvy 292 sheets and the States 8 sheets.

35. The full 1:250 000 scale program comprises 544 map sheets and is due for completion in 1988 except for a few

map sheets programmed for completion by RASvy by about 1990. On completion the contributions to the program will be as follows:

Natmap	367 sheets (68%)
RASvy	165 sheets (30%)
States	12 sheets (2%)
Total	544 sheets (100%)

36. Maps in the first series were completed in 1968 and the second series started in 1974. As will be seen, a 1:100 000 scale program began in 1965. It enables the production of 1:250 000 scale maps with data and standards of accuracy appropriate to that scale.

37. Appendix B to this report contains a map of Australia showing the state of the 1:250 000 program as at January 1986. The maps which Natmap produce form part of a national topographic mapping series and are are called NTMS maps: those produced by RASvy are known as Joint Operations Graphic (JOG) maps. The difference between the two is in details most suited to civilian and defence needs respectively. On completion of the program RASvy will also duplicate the NTMS series with the production of JOG maps but Natmap will not produce NTMS maps for the area in which RASvy has worked exclusively.

38. In 1984 the National Mapping Council considered that the production by RASvy and Natmap of their own separate maps was uneconomic. The Council resolved that the objective should be to produce only one 1:250 000 map series of Australia to satisfy both defence and civilian needs. At the same meeting the Council expressed its concern that a mutually acceptable solution should be found to the co-ordination of Commonwealth topographic mapping.

1:100 000 Natmap program

39. In September 1964, acting on a submission from the Minister for National Development, Cabinet approved a program of 1:100 000 mapping of Australia to be completed by the end of 1975. The decision authorised the Department of National Development to organise and enter upon it on the footing of priority being given to the mapping of Northern Australia.

40. In his submission the Minister observed that Natmap was specifically charged with the responsibility for mapping and co-ordination of mapping activities on a national basis and that it was assisted by RASvy which made available resources not required solely for military purposes.

41. The Minister informed Cabinet that the Advisory Committee on Commonwealth Mapping believed that most defence and civilian mapping requirements would be satisfied by 1:100 000 scale maps. Nevertheless, if resources had permitted it would have been proposed to provide a basic map coverage at a scale equivalent to 1:50 000.

42. The Minister rested the case for the new program not only on defence requirements but also the useful purposes it would serve in Australia's development especially in the Northern Territory and assessing Australia's natural resources, including the location of oil and minerals.

43. Natmap has actively pursued the 1:100 000 program since 1965 but the intention to complete the program in 10 years was not fulfilled partly because of insufficient resources but also because of the interest Natmap developed in other mapping tasks. The program should be completed around the middle of 1988, that is in 23 years instead of 10.

44. As early as 1965 Natmap decided it would not be economic to publish maps of the sparsely inhabited central areas of the continent for which there was little demand. It created an area, now well known in mapping and survey quarters as the red line area, inside which maps would be compiled but not published. The red line intrudes into all States except Victoria and Tasmania. It covers more than half of Western Australia, South Australia and the Northern Territory and almost half of Queensland and more than one third of New South Wales. There should be printed maps available in 1988 for the whole of the area falling outside the red line.

45. Naturally enough in view of the defence aspect Natmap has shared the program with RASvy. Natmap also invoked extensive assistance from the States and contributed to the cost of their activities. Payments to the States from 1964/65 until they ceased in 1974/75 totalled $1,365,866. For its own part Natmap has made fairly extensive use of private contractors from whom it has received excellent value for money. In 1984/85 out of an operational expenditure of $5.26M on topographic mapping, payments to private contractors amounted to $810,272.

46. When the program is completed the number of 1:100 000 maps will be 3064, consisting of 1635 compiled and published outside the red line and 1,429 compiled but not published (except for 3) inside the red line. RASvy as expected, has mainly worked outside the red line in areas of high defence priority in northern Australia. Its total contribution outside the red line is 830 maps compared with Natmap's 745. Inside the red line Natmap compilations will total 1,342 out of 1,429. The States have worked almost exclusively outside the red line and when the entire program is completed they will have produced 303 compilations. Figures in detail are as follows:

1:100 000 mapping program outside the red line

Compiling

Natmap	697
RASvy	629
Western Australia	95
South Australia	75
Queensland	60
Tasmania	51
New South Wales	20
Snowy Mountains Hydro-electric Authority	4
Victoria	2
RASvy/Victoria	1
RASvy/Natmap	1
TOTAL	1,635

Printing

RASvy	830
Natmap	745
Tasmania	51
Queensland	2
Natmap still to print	4
Not intended to be printed because of small land content	3
TOTAL	1,635

Compilation inside the red line

Natmap	1,342
RASvy(including orthophoto maps)	87
TOTAL	1,429
Total number of 1:100 000 maps	3,064

Appendix C shows the area delineated by the red line and also records the mapping contributions by other agencies. Appendix D shows the state of the program as at June 1986.

47. Once again RASvy and Natmap have separately published maps at 1:100 000 over the same parts of the Australian mainland. I understand this no longer occurs but it attracted the comment of wasteful duplication from individual members of the National Mapping Council. The overlap is of course in the printing of the maps and not in compilation which is the more expensive process.

Other Natmap topographic programs

48. Natmap has other mapping programs. In topographic mapping the most significant is the International Map of the World (IMW) series comprising 49 Australian sheets at 1:1 000 000 scale. Natmap completed the series in 1978.

Another product is the World Aeronautical Chart (WAC). Natmap also produces thematic maps and atlases.

Natmap's bathymetric program

49. Bathymetric mapping is the marine equivalent of topographic mapping. It consists of the measurement of ocean depths at intervals to determine the topography of an area of the ocean bed and the representation of the topography in the form of a contour map. In 1970 Federal Cabinet approved a 10 year program under which Natmap would engage in bathymetric mapping of the continental shelf, agreeing also to provide additional funds needed for the program. In making its decision Cabinet was influenced by moves of some member countries of the United Nations for the revision of the Convention on the Continental Shelf and for a redefinition of the seaward limits of national jurisdiction. The decision was also based on the potential wealth of Australia's continental shelf.

50. Natmap failed to complete the program in ten years. It will take no less than twenty. At June 1984 survey work was two-thirds completed and map sheets published for about 30% of the total area to be covered. In 1984/85 the operational costs of bathymetric mapping were $3 million compared with $5.26 million for topographic mapping. It is an expensive program and the small demand for the product raises doubts of a cost/benefit kind. In 1984/85 revenue from sales of bathymetric maps was only about 1% of Natmap's total map sales. Apart from the supply of maps to the Naval Hydrographer the main consumers appear to be companies interested in exploiting the resources of the continental shelf. They buy the maps at nominal prices.

The 1:50 000 Defence program

51. As early as 1965, Defence displayed an interest in having 1:50 000 maps but it was satisfied then to have 1:100 000 scale maps as a compromise. As already indicated, RASvy participated extensively in the 1:100 000 Natmap program and it has completed its share of the work.

52. In the late seventies, RASvy began mapping at 1:50 000 scale but even in 1981 when the Moran Committee reported (see section 6 of this report) there was still not much said about a 1:50 000 comprehensive mapping program. Nevertheless one was planned. In 1980/81 and 1981/82 RASvy produced 144 first cover maps of Australia at that scale.

Defence decision to have a comprehensive program

53. In 1983 the Joint Mapping and Charting Group in Defence (JMCG) submitted a 1:50 000 program to the Chiefs of Staff Committee covering more than 60% of Australia including the whole of the area outside the red line. Inside the area of the red line it called for mapping mainly of a corridor running from the Northern Territory through

the inland to South Australia. It divided the parts of Australia to be mapped into six priority areas with most of them containing sub-priorities.

54. Appendix E shows the Defence mapping program according to the six priorities. It will be seen that the highest priority areas are adjacent to, or in the vicinity of, the northwest and northern coastline of Western Australia and the Northern Territory. Areas of low priority are for the most part in the south and south-eastern parts of Australia. Some priorities are allocated according to the importance of an area as a defence corridor. On the map appearing in Appendix E these are prefixed with the letter 'C'. The program was to be completed by mapping priorities 5 and 6 after completion of the tasks for the first four areas. Priority 5 consist of three relatively small areas in the vicinity of Broken Hill, Mount Isa and Alice Springs. Tasmania constitutes priority 6.

55. The program which the Chiefs of Staff Committee endorsed in October 1983, rests entirely on defence. It is based on a strategy which emphasises the need to maintain a defence capability sufficient to contain and ultimately expel hostile armed forces entering Australian territory. The policy is to develop and maintain a Defence force-in-being to meet such contingencies, including a body of fully trained mapping personnel available to serve in the field as the occasion requires to support the military operations.

56. The Government and the Dibb Report have stated that there is no identifiable military threat to Australia at present. Of the possibilities, the least unlikely is that there could be limited hostile operations on a small scale such as raids by small groups. These could, however, be dispersed over a wide geographic area. If such hostile activities occurred, they would most likely be in northern and north-western Australia, including the off-shore islands. Obviously the priority 1 areas are dominant in the Defence mapping program and they are where RASvy has so far concentrated most of its mapping resources.

No Cabinet Decision

57. In contrast to the 1:100 000 program which Cabinet specifically endorsed in 1965 as being in the interests of Australian defence and national development the Defence program was, in effect, implemented following the decision of the Chiefs of Staff Committee. It was a program initiated without regard to Natmap's claim to be the coordinating authority for Commonwealth topographic mapping. It is a program which will cost considerably more to fulfill than the current 1:100 000 program which in 1965 Cabinet considered was the most the country could afford. For its part, DRE alerted its Minister at the time to the Defence decision but it did not take steps to bring the matter before Cabinet.

Number of maps according to priorities

58. The JMCG report to the Chiefs of Staff Committee contained a definitive statement of programs, priorities and the number of maps required for each, with figures for existing mapping contributions to the program at 30 June 1983. According to the report a total of 7,268 maps was needed for all six priority areas. There were 1,656 available maps constituting 23% of the total program leaving 5612 maps to be produced. The 1,656 maps already available included 520 RASvy maps plus 99 RASvy orthophoto maps which were provisionally acceptable. The balance of 1,037 maps came almost entirely from State sources and was for areas of lower priority.

59. In a program deemed to occupy 49 years the required maps as described in the JMCG report were as follows:

1:50 000 MAPS

Priority	Sheets	Previously published			Balance	Proportion %
		Army line maps	Army ortho-photo maps	Other maps		
1	1,519	126	58	0	1,335	12
2	1,211	31	0	0	1,180	3
3	990	40	0	168	782	21
4	3,216	323	41	845	2,007	37
5	188	0	0	0	188	0
6	144	0	0	24	120	17
TOTAL	7,268	520	99	1,037	5,612	23

60. In December 1985 I was advised that the program which the Chiefs of Staff Committee endorsed in 1983 reduced the planning timescale from 49 years to 35 years assessed as follows:

Priority	Time in years	Total years	Year of completion
1	12.1	12.1	1996
2	5.7	17.8	2002
3	4.1	21.8	2006
4	11.0	32.8	2017
5	1.0	33.8	2018
6	1.3	35.1	2019

61. The advice also stated that after taking account of the contributions of other mapping authorities at 30 June 1984 there was an upwards adjustment to the total number of maps required to 5,677 from 5,612, the principal variation being in the priority 4 areas. Details were as follows:

Priority	No of maps
1	1,330
2	1,141
3	751
4	2,114
5	188
6	153
Total	5,677

62. As planned, it will take longer for RASvy to complete its priority 1 mapping than its mapping for priorities 2 and 3 although the latter priorities together require more maps. The explanation, I am told, is that RASvy is also engaged on a range of overseas mapping commitments with regional countries under the Defence Co-operation Program. This work is expected to be completed in the next few years enabling more resources to be concentrated on domestic mapping. Undoubtedly, the 1:50 000 program will be RASvy's principal task for a long time to come.

The Regiment and the Field Survey Squadrons

63. RASvy is equipped with two digital systems known as Automap 1 and Automap 2 which enable the production of maps through digital stereoplotting instead of graphic stereoplotting. The equipment is at the headquarters of the Regiment in Bendigo. Four RASvy field survey squadrons also contribute to the compilation of 1:50 000 maps but by the graphic stereoplotting process, which is the principal way in which Natmap also compiles maps. Plans are afoot to introduce Automap 3 which would give the field squadrons digital stereoplotting capacity. With its effective introduction planned for mid-1989 Automap 3 is forecast to boost RASvy's mapping production by 15%. The cost of Automap 3 exceeds $12 million and procurement has yet to be approved. Its impact will be discussed in section 18 of this report.

Likely completion date for the RASvy program

64. Defence has also informed me that information before the National Mapping Council in 1985 showed that between 1985 and 1990 other mapping programs, principally those of the States, would contribute 565 maps of various scales relevant to the Defence program. If such a level of alternative mapping activity were to continue after 1990 the thirty-five year timescale could be reduced to twenty-five years, giving the following completion dates:

Priority		Year
1	-	1996
2	-	2000
3	-	2003
4	-	2007
5	-	2008
6	-	2008

As Defence has acknowledged the assumption about State programs beyond 1990 may not be correct and my discussions with the States lead me to believe that after 1990 their contributions will be less than before 1990.

65. In my opinion, even assuming the introduction of Automap 3, the RASvy program is more likely to occupy 28-30 years with completion dates being approximately as follows:

Priority		Year
1	-	1996
2	-	2002
3	-	2005 or 2006
4	-	2012
5	-	2014
6	-	2014

66. To have a program based entirely on Australia's defence policy which will take at least a quarter of a century to complete compared with the ten years originally allocated for 1:100 000 mapping seems odd and barely consistent with the claim that there is a real military demand for the entire program. Even the completion of the priority 2 segment is about 16 years off. It must be thoroughly consistent with Australian defence policy to expedite the program, at least if it would not impose an identifiable strain on Commonwealth mapping resources or impose additional overall costs which the community has to bear.

The Royal Australian Naval Hydrographic Service

67. The headquarters of the RAN Hydrographic Service is in Sydney. The staff consists of 16 uniformed personnel and about 100 civilians. The Hydrographer undertakes hydrographic surveys of Australian and adjacent waters and produces nautical charts for Defence and civilian maritime use. The charts contain such data as water depths and obstructions to navigation. The operations of the Naval Hydrographic Service are completely independent of RASvy but the Hydrographer keeps in touch with both RASvy and Natmap. The Service works according to a five-year rolling plan which in its latest guise is called Hydroscheme 1986 covering the period 1986 to 1990.

68. The Hydrographer relies on the Maritime Operations Division of the Department of Transport to ascertain the commercial viewpoint and to evaluate economic advantages

which might arise from hydrographic surveying activities. Much work remains to be done, for example, comprehensive surveys have not been made for more than 60% of the Australian continental shelf.

69. Natmap's bathymetric program is about the topography of the continental shelf but the techniques employed in hydrography and bathymetry are similar. Hydrographic work is more comprehensive and involves the provision of bathymetric data. Although, the Moran Committee in 1981 recommended against combining the two activities, the case for so doing is, in my opinion, strong.

Australian Survey Office

70. The Australian Survey Office (henceforth usually called ASO) is the principal survey agency of the Commonwealth, and it also does some topographic project work, for example in the area of the Great Barrier Reef. Series topographic mapping aside, many of the functions of ASO and Natmap are similar in character.

Section 3

STATE MAPPING

The States as principal mappers

71. All States, as colonies, were heavily involved in survey and mapping before Federation. The early emphasis was on survey rather than mapping work to meet demands for roads and railways and town planning and the provision of public utilities such as water supply. The opening up of land in the colonies for farm use probably created the main demand for topographic maps. Consistently with the constitutional powers State maps and map products have an extensive public consumer demand. For example, total revenue from map and map product sales of the Queensland Department of Mapping and Surveying was $1,301,000 in 1984/85 compared with a Natmap product revenue of $889,000.

72. Topographic map coverage in Victoria and New South Wales is far greater in proportion to total State area than in Queensland, Western Australia and South Australia. Tasmania is something of an exception because it will complete coverage of the island at 1:25 000 scale by 1991.

73. Some idea of the significance of mapping and survey work is gained from figures taken from a consultant's review of the survey and mapping services provided by the Department of Property and Survey in Victoria. The figures, reproduced by courtesy of the Victorian Surveyor-General show that Victorian State departments and agencies at mid 1985 employed a total of 3081 staff on mapping, survey and land information activities. Another 4,636 were employed in agencies which carried out specialised survey functions such as for road construction and the provision of electricity and water.

National Mapping Council

74. Each of the States is represented on the National Mapping Council (NMC) by its Surveyor-General or equivalent officeholder. A principal function of the NMC is to co-ordinate and correlate mapping which it has to achieve through agreement since it is an advisory body without executive powers. The Commonwealth is separately represented by the Director of Natmap, who is chairman, the Commonwealth Surveyor-General, the Director of Survey Army and the Naval Hydrographer. In past years there was a good past record of cooperative endeavour such as support in NMC for the Commonwealth's 1:100 000 mapping program.

75. In recent times NMC has been a less effective force in matters of mapping policy and its future role probably lies more in the technical areas such as gaining uniformity in mapping standards and specifications. It remains however the principal forum for discussion of Commonwealth-State

mapping and survey activities. Its effectiveness would probably increase if its membership were expanded to include representatives from private industry and academic institutions.

Different mapping policies

76. Notwithstanding common interest in NMC, the mapping policies of the States vary markedly. For example, in Queensland the Department of Mapping and Survey uses private contractors extensively and performs little mapping work itself whereas in NSW the Central Mapping Authority of the Department of Lands seldom makes use of private contractors and is itself in the business of competing with them in undertaking mapping work for others including Victoria and the Commonwealth. The areas of high mapping priorities under the Defence 1:50 000 program are for the most part situated in the northern areas of Queensland, Western Australia and the Northern Territory where little topographic mapping has been undertaken except by the Commonwealth. The principal contribution of the States to the Defence program is in the south constituted by New South Wales, Tasmania the southern portion of South Australia and the southwestern area of Western Australia. In each of these States there are areas to be covered by the Defence program not planned to be covered by State programs but in which the States may have some interest.

Queensland

77. The Department of Mapping and Surveying is the main surveying and mapping arm of the State. The head is the Surveyor-General.

78. There are two advisory councils to the Department, one being the Queensland Surveying and Mapping Advisory Council on which major official State map users are represented and the other the Industry Advisory Council. The Surveyor-General is chairman of both Councils.

79. The Department has a total staff of about 630 of whom about half are drafting staff. The number of drafting staff will fall because of diversion of work to the private sector.

80. Queensland is the single exception among the States in not having any series topographic mapping program of its own. The State participated in Natmap's 1:100 000 program and the Department has produced maps of various kinds based on the Commonwealth's 1:100 000 and 1:250 000 topographic maps of Natmap and RASvy giving coverage to most of the State beyond areas which the State has mapped. According to the Surveyor-General there is no demonstrated need in Queensland for a 1:50 000 program. The Department has a limited program of 1:25 000 mapping confined almost entirely to the more populated areas which lie in the eastern coastal regions of north Queensland (Cairns) central Queensland

(Townsville, Mackay) and the south (Gladstone, Brisbane). The principal inland area of 1:25 000 mapping is around Mt Isa. Mapping will continue in the coastal areas but the Department considers there is no need for 1:25 000 mapping over about 80% of the State. Its approach is to provide maps where there is a clear-cut consumer demand but not otherwise.

81. The State also has a Local Authority Cost Sharing Mapping Scheme. Under it local authorities fund 60% of total production costs of maps which range from 1:250 000 scale to 1:25 000 and the Department of Mapping and Surveying provides the rest as well as supervising the work undertaken.

82. Elsewhere in Australia Commonwealth and State public mapping authorities perform most of their mapping work in house but in Queensland up to half of the total activity is undertaken by the private sector, hence the Industry Advisory Council. In 1984/85 the Department paid $2.7 million to private consultants and contractors which is more than three times the amount paid to private contractors in the same year by Natmap. In recent years the private sector in Queensland has sought to develop export markets in the Pacific area and the Department has supported the effort, for example by the creation in 1984 of the Overseas Projects Study Unit.

83. Currently the Department is involved in the computerisation of the State's land boundary framework. Its own production of topographic maps is graphic and not digital but it is committed to the digitisation of maps once produced. The 1:25 000 State maps will contribute to the RASvy defence program. Compilations so far total 103 and about double that number are still to be produced. RASvy has also been active in Queensland and so far has produced 157 maps at 1:50 000 scale covering areas in the vicinity of the coastal areas of the State program. The complete RASvy program will cover about 62% of the State. Queensland will be a substantial beneficiary.

New South Wales

84. In 1985 the Central Mapping Authority of NSW (CMA) headed by a Director, became part of the Department of Lands. In June 1985 CMA had a total staff of 345 officers of whom 207 were engaged on cartography.

85. There is a State Mapping Advisory Committee, of which the Director is Chairman, to advise CMA on programs. The Committee consists of representatives of State map consumer agencies and several Commonwealth agencies, including RASvy and Natmap. For many years CMA has maintained extensive programs at 1:25 000 and 1:50 000 scales. The authority has produced 1:25 000 topographic maps for almost the entire eastern division of the State. The 1:50 000 program has taken in areas further inland known as the central division. Together the two programs have already covered more than half the State.

86. The whole of NSW is now covered by 1:100 000 maps. In the eastern and central divisions they are Commonwealth maps and in the western division the authority has used Natmap base material.

87. Recently CMA received ministerial approval to extend the 1:50 000 series to cover the whole western division. On the assumption that the extension of the 1:50 000 program will be carried into effect within the next ten years RASvy mapping in NSW will be confined mainly to the far west. Together with the RASvy program there will eventually be 1:50 000 coverage of NSW for about three-quarters of the State - the principal area not covered will be the remote north west.

88. CMA devotes extensive resources to the production of other maps including cadastral and property maps and regional touring maps as well as metropolitan large scale mapping. The State's map production resources approximate to those of Natmap. CMA is equipped to perform complete digital mapping although so far most map compilation has been by graphic stereoplotting.

89. CMA does its field survey work using its own aircraft and has undertaken comprehensive mapping tasks for Victoria and the Commonwealth. The Authority does not now use outside contractors and has the capacity itself to participate in the execution of the Defence 1:50 000 program. The Director has expressed his willingness also to supervise the work of outside contractors for the Commonwealth. RASvy has already worked on its program in the State and according to the Director of CMA there will be overlap in programs which could be avoided if effective consultation were to occur between RASvy and CMA.

Victoria

90. The Surveyor-General is the head of the Division of Survey and Mapping in the Department of Property and Services. The Division has a staff of about 330 of whom about 110 engage in topographic mapping. In 1984 and 1985 sales of maps and plans were $364,359 plus $280,610 in sales of aerial photographs. There is also an advisory committee.

91. In 1982 the Victorian Cabinet approved an accelerated mapping program of a program which began in 1976 at a basic scale of 1:25 000. The completion date is 1992 when there will be maps for about 95% of the State. Areas not covered lie mainly in the arid north-west. The Division undertakes most of the map production work itself but small contracts are let to the private sector for different components of map production. The trend is to make greater use of private contractors but the bulk of the work will still be undertaken within the Division.

92. In 1983 a fire destroyed most of the Division's photogrammetric equipment and retarded progress, but the Surveyor-General considers that the 1992 program will be completed by 1992, well inside the time frame of the RASvy 1:50 000 program. The Victoria production rate is about 120 maps a year. The total number of maps to cover the State at 1:25 000 scale is about 1530.

93. The RASvy 1:50 000 program is eventually intended to embrace all Victoria. RASvy would be able to make full use of the State 1:25 000 scale mapping leaving only the dry and low-populated areas of the north-west to be covered. The State Surveyor-General has expressed his willingness to assist using either his in-house resources or by supervising work performed under contract to the Commonwealth.

94. So far the Division has produced mainly graphical products but its new equipment program following the fire is primarily digital and shortly about 70% of the Division's compilation capacity will be digital. The Surveyor-General initiated the program because of strengthening demand from large map users such as public utilities for data in digital form which can be used in association with other computerised materials serving the special purposes of the user.

95. Like its counterpart authorities in other States, the Division services other projects including cadastral mapping at 1:2 500 and 1:25 000 scales in conjunction with a land information project known as Landata. Landata is a survey of the State's legal, fiscal and natural resource systems. The cadastral mapping at 1:25 000 scale is derived from the topographic program.

96. The Division produces specific maps to suit the needs of State instrumentalities, e.g. 1:1 000 000 scale tourist maps and it undertakes project mapping for public authorities. The whole of Victoria has been digitised at 1:1 000 000 scale from an unpublished mapping base at 1:500 000 scale. A wide range of detail can be reproduced from 70 separate overlays e.g. to produce maps with specific features such as lakes and rivers or roads and railways

South Australia

97. The Survey Division of the Department of Lands is the State's mapping and survey authority. It is in the charge of the Surveyor-General.

98. More than half of the State is inside the red line area and State mapping activity has naturally enough concentrated on the more densely populated southern and south eastern part. There are two large scale topographic/cadastral mapping programs at 1: 25 000 and 1:10 000 scale mainly confined to the area east and south east of Spencer Gulf.

99. There is a 1:50 000 State initiated program which also centres upon the gulf area but covers a greater area than the two large scale programs. It amounts to about a quarter of the entire State. The program is almost complete and entails the production of 413 map sheets. According to the Surveyor-General a user survey showed significant demand for maps outside the completed area but the State does not have the resources to extend the cover. The Surveyor-General's Office estimates that about 200 maps at 1:50 000 scale, amounting to about 12% of the State, would remain to be produced covering major transport routes, areas of mineral development and other places of special State interest.

100. The Survey Division compiled 75 maps for the Federal 1:100 000 program. It has since produced an enhanced series of 1:100 000 scale topographic maps derived from the Federal program extending into the red line area.

101. The RASvy program also extends well inside the red line area and embraces about 70% of the State including the entire areas of State mapping. RASvy has so far produced 215 sheets at 1:50 000 in the central area of the State where the State has not produced its own maps.

102. So far the Division has compiled its maps by graphical stereoplotting but it is now equipped with a digital capacity and is using it to acquire 1:25 000 scale first cover. The Division is also implementing a computerised digital cadastral data base. According to the Surveyor-General there are decided overall advantages in digital photogrammetric compilation where maps will be subsequently derived at smaller scales. This is an opinion widely shared by his colleagues in the other States. The Division operates its own aircraft which will do project photography for other Government agencies and private organisations.

103. More recently, as it has proceeded towards the completion of its 1:50 000 topographic mapping, the Division has made increasing use of the principal private contractor in the State. The Surveyor-General has expressed the willingness of his office to assist the Commonwealth to carry out its 1:50 000 program. The limited resources of his Division would restrict assistance mainly to the supervision of private contractors to the Commonwealth but there is some scope for sharing mapping in a few areas.

Western Australia

104. The Office of the Surveyor-General is a Division in the Department of Lands Administration which performs the usual range of State mapping and survey functions.

105. Until a few weeks ago the Department was known as the Department of Lands and Surveys. That Department has been under review by a committee sponsored by the State

Government. It is likely that the office of Surveyor-General will be abolished in favour of a title such as a Director of Mapping and Survey. This is consistent with the pattern in the States of combining mapping and survey functions. In 1983/84 map sales to non-Governmental customers reached $1.2 million.

106. The Surveyor-General is Chairman of the Survey and Mapping Committee. Most of the Division's resources are directed to large scale cadastral mapping and tourist, thematic and special purpose mapping. It engages in series topographic mapping but only over a small part of the State because the greater part is undeveloped and sparsely inhabited.

107. More than half of Western Australia lies within the red line area and is of little, if any, State interest. The complete RASvy program covers about two-thirds of the State and extends well inside the red line. About half of the area to be mapped bears a priority 1 classification.

108. State topographic mapping activity is confined to the urban, agricultural and forest areas in the south west where there are mapping programs at 1:25 000 and 1:50 000. The State does not intend to extend cover to areas of mineral development but relies instead on the Commonwealth 1:100 000 program to which it contributed 95 compilations.

109. The 1:25 000 program covers a segment of the south-west corner of which Perth is the centre. 1:50 000 mapping is more extensive and maps have been produced or are planned for an area extending north, just beyond Geraldton and east to Esperance on the south coast, but even so less than one-sixth of the State will be covered by the State at 1:50 000 scale. If resources are available it is probable that there would be some extension of 1:25 000 and 1:50 000 mapping in the interests of the State, the areas being again in the south-west with some extension of 1:50 000 mapping northwards particularly along the coast line. Even so, the perceived need of the State for 1:50 000 mapping would be less than 20% of the total area and for 1:25 000 mapping about 4%. Hence, the mapping task in Western Australia to meet RASvy's priorities is formidable.

110. The acting Surveyor-General said that the State would assist the Commonwealth in its 1:50 000 program notably in supervising contractors. The Division could provide some aerial photography and aerotriangulation in the north west but otherwise had little ability to assist from its own resources even though some of the areas to be covered were of State interest.

111. RASvy has produced 108 maps at 1:50 000 scale mainly in the south western corner and in the northern part of the State. The State 1:50 000 program should lead to the production of 420 maps leaving 1093 maps outstanding under the entire RASvy program.

112. The Office of the Surveyor-General has digital topographic mapping equipment to which it has been adding, including a digital stereoplotting capability. One of its aims is to develop a comprehensive digital data base of survey marks as part of a geodetic controlled surveying network to support all mapping and surveying and an integrated land information system.

113. The Division undertakes its own aerial photography using an aircraft chartered with pilot from a private company which also provides the back-up facilities. It is likely that the Division will make increasing use of private sector contractors for mapping work.

Tasmania

114. Tasmania is a small State with a small population and a correspondingly small mapping division under the leadership of a Director of Mapping. The Division has a staff of 78 almost entirely committed to mapping and survey.

115. Topographic mapping has loomed large in the Division's work. A 1:100 000 topographic series comprising 49 maps is available. The work was accomplished in concert with Natmap's 1:100 000 program to which Tasmania contributed 51 compilations. The Commonwealth defrayed some of the costs. The Division has completed a 1:100 000 land tenure series consisting of 40 maps giving an overview of the lands managed by various public authorities in Tasmania. The Division has also completed a 1:250 000 map series which normally would require 12 sheets but it has managed to print in 4 sheets.

116. The magnum opus is a 1:25 000 topographic/cadastral series which will consist of 416 sheets and cover the entire State. So far more than half of the island had been mapped at this scale and the maps for the remainder should be completed in 1991. The Director of Mapping has said that the division has the resources to map at 1:50 000 scale to meet Defence requirements but he cannot see that this is necessary since the 1:25 000 series meets all Defence specifications.

117. About 25-30% of the Division's total stereoplotting capacity is now digital and the Division is well aware of an increasing demand for digital information from principal map-using agencies in the State such as the Forestry Commission and the Hydro Electric Commission. The future demand will be for digital topographic information rather than the maps themselves.

118. Other activities of the Division include the production of thematic maps, orthophotomaps and aerial photographs and touring/recreation maps. Map sales totalled $206,451 in 1984/85 and are increasing.

Northern Territory

119. The mapping authority was until recently the Survey and Mapping Division headed by the Surveyor-General in the Department of Lands. The Division is now the Mapping and Information Division under the leadership of a Director and the Surveyor-General has ceased to perform mapping functions. The Division does not engage in series topographic mapping at any scale. Its main functions are to provide a cadastral mapping survey system and undertake engineering and topographic surveys. It also maintains a mapping system for land administration. By reason of its size, spread of resources and sparse population, the Division has a close interest in the development and application of satellite remote sensing technology.

120. The Surveyor-General informed me that the Northern Territory would look to the Commonwealth for series topographic mapping and it would wish to assist to the extent of supervising work carried out by local contractors. To date RASvy has produced 118 maps at 1:50 000 scale. The complete program is to produce 862 maps covering about 43% of the Territory. Most of the areas to be mapped are of high priority.

Section 4

PRIVATE MAPPING SECTOR

121. There is an Association of Aerial Surveyors, Australia (henceforth called the Association) with current membership of 16. This is expected to increase soon to 21 by the addition of 5 small Queensland companies.

122. There are also a handful of mapping and survey companies not members of the Association. The Association includes all major private mapping undertakings. Some of these are actually groups of companies but the group is regarded as one member for Association purposes. Representatives of the Association were anxious from the outset to demonstrate a capacity to undertake much more contract mapping work for the Commonwealth than work they were given.

Defence reservations about private sector performance

123. Defence supplied a written commentary about the ability of the private mapping sector to participate in the 1:50 000 program which distinctly lacked enthusiasm. It stated that the public sector was much more efficient in handling medium scale series mapping. The private sector did not have a substantial digital mapping capability which could supply its systems with compatible digital data. Further it consisted largely of small companies which could only perform small parcels of work in particular phases of map production. The number of companies which would have to be involved created problems of obtaining consistency in the interpretation of map specifications, the remedy for which was to provide unacceptably high levels of supervision. By contrast RASvy was able to allocate to each of its mapping units large tracts of country and the soldiers employed in plotting for the most part also established the controls in their areas of responsibility. Having all been trained at the same establishment Army plotters were consistent in their interpretation of map compilation specifications and there was on the spot supervision, particularly in compilation work.

124. Defence makes some use of outside contractors for mapping services mainly in two areas: firstly, in the charter of aircraft with pilots to undertake airborne profile recording and identification and supplementary photography, using RASvy personnel and equipment; secondly, to perform manual cartography.

125. According to Defence its experience in having aerotriangulation and manual digitising undertaken by contract was less than satisfactory. An invitation to firms to take part in a bench test digital stereoplotting exercise in an area in which RASvy had already done digital stereoplotting itself had produced various results from

those companies which responded, none of them up to the RASvy standard of work. On the other hand I heard from an industry representative that the material which Defence supplied was itself defective and the industry was simply put to an unnecessary expense.

126. Defence noted that the smaller operators tended to submit the lowest contract prices at the expense of well established and more reliable companies and under the existing tender system get the work. Defence submitted that if the private sector were to be used extensively small companies would have to band together and act in unison over an acceptably large area of mapping within a given time frame.

127. It cannot be said that there is no basis for Defence's attitude but the experience of Natmap and ASO is that, with few exceptions, the industry performs well. This is also the view of the Queensland Department of Mapping and Surveying which is the largest user of the private sector.

Industry structure

128. Undoubtedly most of the companies are small. Of the larger operators, two member groups of the Association of Aerial Surveyors of Australia have total personnel averaging between 50 and 60. One is the Associated Surveys Group which appears to consist of two companies. The other is AAM Surveying and Mapping Consultants consisting of a principal company Australian Aerial Mapping Pty Ltd and four subsidiary companies in New South Wales, Victoria, Western Australia and Queensland respectively. One individual member, BHP Engineering, has 48 personnel in a survey department and 12 personnel in a photogrammetric department. BHP Engineering is a branch of BHP Pty Ltd. The next largest organisations are the Qasco Group of companies and Kevron Aerial Surveys Pty Ltd which is a subsidiary of Kevron Photographics Pty Ltd. Most of the rest have a total personnel of less than 10. In all, probably about 500 persons make up the private mapping sector.

129. Private operators are usually not willing to disclose particulars of their turnover but my impression is, after talking to Association representatives, that about 30% of the total income of the industry over the past five years has come from Commonwealth and State Government mapping work. The difficulties I have experienced in obtaining information to some extent reflects a strong cottage streak in the industry. The range of expertise and capacity extends from providers of little more than stereoplotting or cartography services to companies which have resources rendering them capable of providing a much wider range of services. Until the 1960s the industry was primarily involved in land survey work, but during the sixties and early seventies mapping companies expanded rapidly largely as a result of the minerals boom in Australia but also because of an increased demand from Government authorities for mapping services. During the 1970s, the industry was in

decline because of the changed economic environment and several companies went out of business. At the moment, the industry as a whole does not have a high level of confidence but if the public mapping sector would give it the amount of work it believes it deserves because of its lower costs most of the problems would disappear.

Use of the private sector by Natmap and ASO

130. Natmap has used the private sector for a wider range of tasks than RASvy and has advised that it is generally well satisfied with the results. Expenditure for the past three years was as follows:

	$ 000		
	Contracts for compilation	Contracts for other serial work	Total expenditure on private contracts
1982/83	187	253	440
1983/84	140	353	493
1984/85	388	690	1078

131. Information supplied by ASO also shows its use of private contractors for aerial photography and photogrammetric mapping with apparent satisfactory results.

	$ 000		
	Aerial photography	Photogrammetric mapping	Total
1983/84	371	140	551
1984/85	332	150	482
1985/86	326	335	661

The small size of the commercial operations is illustrated by the fact that ASO used 19 different companies for photogrammetric mapping out of a total of 23 available for the work.

Equipment

132. In May 1985 the first Australian Surveying and Mapping Industry Conference known as ASMIC I, was held in Queensland. Mr P M Byrne, of Australian Aerial Mapping Pty Ltd and chairman of a group of four companies providing photogrammetric and surveying services, presented a paper describing the domestic private surveying and mapping industry and the effects of changing technology. He pointed out that although a declining market had adversely affected fortunes, the private sector appeared to have taken on new technology appropriate to its function and to have come to grips with the computer without great trauma. However, the rate of further investment was likely to be slow in the absence of increased demand from public authorities. The paper contained a summary of major equipment items held by

public authorities and the industry under six headings as follows:

(1) Photogrammetric production equipment e.g. stereo plotters and analytical compilers and their associated computers
(2) Computers i.e. standing alone
(3) Computer graphics systems
(4) Aerial cameras
(5) Photographic equipment eg. process cameras
(6) Field equipment e.g. doppler receivers

The particulars given (which I have not sought to verify) were as follows:

Category	Items						Total
	(1)	(2)	(3)	(4)	(5)	(6)	
Natmap	6	2	2	1	4	4	19
RASvy	62	8	18	6	5	10	109
ASO	11	8	8	0	1	2	30
State Lands Departments and Mapping Authorities (including NT)	105	8	20	9	45	2	189
Total public sector	184	26	48	16	55	23	352
Industry	66	19	8	18	23	9	143

133. According to the writer, private investment in new technology was about a quarter of the total of 143 items which was about the same as in the public sector. I think it is less but it doesn't much matter. Measured by the number of items of equipment the industry has a total mapping and survey capacity greater than RASvy or Natmap. It is also prepared to make more intensive use of its equipment than the public sector.

Capacity of the private sector to undertake a 1:50 000 mapping program

134. In October 1985 the Managing Director of Associated Surveys (Aust) Pty Ltd, Mr K Pownall, writing in his capacity as Chairman of the Association informed me that the industry had the capacity to map Australia at 1:50 000 relying on its own resources. The assumption was that the task would be to map about 350 of the 600 sheets covering Australia at 1:250 000 scale because some areas were already mapped at 1:50 000 scale or larger and other areas such as

parts of inland Australia would be excluded in a 1:50 000 program as being purposeless. The total assignment would mean, therefore, the production of about 7,000 map sheets. According to the submission, the industry could complete aerial photography within 12 months at a cost of $6 million. The control cost although difficult to estimate, was put at $21 million and aerotriangulation and plotting into a digital form was estimated at $70 million giving a total cost of $97 million at 1985 prices. The whole program could be accomplished within five years and could be undertaken with little addition to the major items of equipment which the industry already had.

135. According to the Chairman of the Association there was not a big problem in the industry undertaking a mapping program including digital stereoplotting instead of graphic stereoplotting. Some firms already had the capacity and others could, and would, become so equipped if necessary by conversion of existing graphic stereoplotters if this were a contract requirement.

136. The Chairman's submission did not involve industry beyond the compilation stage after which further costs are incurred, mainly for cartography and printing. Nor was the submission made with specific Defence requirements in mind e.g. for the observance of 1:25 000 accuracy specifications.

137. I referred the submission to Mr Byrne for discussion with his colleagues stating what the Defence specifications were. Mr Byrne later advised me that in the the view of himself and his colleagues it was realistic to say that the industry could undertake the requisite mapping up to the completion of compilation for a total cost of $135 million spread over 10 years. There were additional costs involved in the industry equipping itself with greater stereo digitising capacity and being able to use it. Mr Byrne said it would take up to three years for the industry to gain an optimum level of production which would be about 40% more than its existing capacity.

138. The more recent estimate of $135 million is well in line with industry costs as revealed by contracts with Natmap and ASO. Obviously it cannot be firmly stated in this report that the industry has the ability it claims but it has spare capacity at present and would expand that capacity in the event of receiving a firm assurance of Government support over the next few years.

Formation of consortia

139. For some time members of the Association have entertained the idea of forming consortia each with a lead company to enter into contracts with Natmap. From a public authority's standpoint it is advantageous to contract out mapping work in large parcels instead of negotiating individual contracts for small segments. From an industry viewpoint there are cost savings obtained through the

integration of work performed by members of a consortium operating under a single contract.

140. The Association has tentatively proposed to divide its members into three national consortia based in Melbourne, each consortium having a nominated lead contractor for purposes of dealing with Natmap. Natmap will shortly invite tenders for a digital and graphic compilation of topographic maps for two blocks. Tenderers may have to tender for all map sheets required in a block. Natmap intends to invite tenders in this form in the knowledge that consortia are likely to respond.

141. I have not seen any details of the proposed arrangement to divide members of AASA into three consortia but if such an arrangement is made it would be subject to the provisions of the Trade Practices Act 1974. Section 45 prohibits a corporation from entering into an arrangement or understanding which contains an exclusionary provision or has a provision which has the purpose or likely effect of substantially reducing competition. Under section 45B where an arrangement or understanding relates to prices it is deemed to have the effect of substantially reducing competition. Most if not all of the undertakings in the private sector would be trading corporations to which the Trade Practices Act applies. Sections 45 and 45B also apply to any arrangements or understandings, whether the parties are corporations or not, in relation to the supply of goods or services to the Commonwealth or an authority or instrumentality of the Commonwealth. (Trade Practices Act 1974 S.6)

142. An agreement or understanding between mapping companies, whether members of an association or not, to tender only through machinery of a consortium would amount to an exclusionary provision and the formation of consortia for purposes of lodging tenders is prima facie in diminution of competition. So far as an arrangement or understanding deals with tender prices or has an effect on tender prices it would fall within section 45B.

143. It would be possible for the Association to seek an authorisation from the Trade Practices Commission under section 88 to enable the consortia to put the proposed arrangements into effect when tendering for the supply of mapping and survey services to the Commonwealth. I could not predict the outcome.

144. The formation of consortia, where there are many small firms each on their own incapable of responding to Commonwealth invitations to tender, may ultimately improve the competitive structure of the industry as a whole but this would be a matter for the Trade Practices Commission to decide. A further possible effect is that true price competition in the industry will diminish.

145. The Surveyor-General for Victoria advised me that the Victorian based industry had also expressed a wish to divide

itself into two consortia for purposes of mapping contracts with the State. The State has given preference to Victorian contractors.

Usefulness of the private enterprise sector

146. The industry is capable of performing mapping tasks at lower costs than RASvy and Natmap and it is unlikely to price itself out of the Government market. In its present state it lacks sufficient sophistication and maturity to engender confidence that it could be entrusted to take over a major responsibility of mapping Australia to completion at 1:50 000. On the whole its record is one of promoting its own commercial survey interests. As mentioned, in the sixties and early seventies during the exciting era of the discovery and development of Australia's mineral resources, the industry only too readily abandoned Government work for more lucrative work in the private sector. Now with the disappearance of much of that work it seeks again more involvement in public mapping and survey work.

147. It is however in the interest of our defence that there should be a stable private mapping and survey industry capable of augmenting Commonwealth mapping resources in the event of armed conflicts especially big ones. Several companies are also interested in overseas operations and the Association asserts that the development of a flourishing Australian export business in mapping and survey work depends upon having stable domestic industry. I believe the assertion is correct.

148. The Australian Surveying and Mapping Industry Conference (ASMIC I) examined the structure of the industry and some current issues including relationships with Government and ability to adapt to changing technology. In November 1985, a second conference, ASMIC II, had the theme "Export of Expertise Overseas". The conference canvassed initiatives taken by a few companies to obtain a greater share of the overseas market particularly in the Pacific and south east Asian areas. In competing for overseas business, the Australian industry encountered strong competition from the Canadian industry which has the advantage of a strong domestic market for its products. There is also a program to map Canada at 1:50 000 scale in the national interest and most of the work is carried out by the private sector on contract to the Canadian Department of Energy, Mines and Resources. The feeling at ASMIC II was that good opportunities were presenting themselves for greater entry into the overseas project mapping market but it was clear that some firms were hesitant because of the greater risks involved in fulfilling export contracts and their ability to withstand unexpected losses at a time when the industry was struggling to find sufficient markets in Australia.

149. In my opinion, the industry has a sufficient existing potential and capacity for extensive participation in a 1:50 000 program. With some assurance about the likely volume of Commonwealth Government business it should be

capable of performing all the tasks of map production up to the stage of the completion of digital compilations for at least 400 maps annually without imposing stress on its resources. Obviously the extent of its involvement would depend partly on it being able to satisfy stringent Defence requirements As I have said Defence has reservations about the standard of work in the industry but the general level of performance of the industry has met not only Natmap's approval but approval of State mapping authorities all of which, apart from NSW, use its services.

150. There are costs involved in the Commonwealth going to tender and preparing contracts and in the supervision of performance including quality control supervision. Obviously these costs will increase if greater use is made of the private sector but up to the present with the full cost of these functions added to the contract price, as will be seen, industry operates at substantially lower costs than either Natmap or RASvy. If, however, the private sector should cease to be competitive other considerations such as the advantage of having a strong domestic industry to facilitate defence and export capability would not be sufficient to justify a letting out of part of the 1:50 000 program to the private sector. The extent of the employment of the private sector is something which is better determined from time to time throughout the program rather than ab initio.

Section 5

POLICY OF SELF-RELIANCE IN THE DEFENCE OF AUSTRALIAN TERRITORY

Territorial defence

151. Australian strategic defence policy focuses on maintaining a military capability sufficient through independent action to respond effectively to hostile attacks on Australia. The military capability should be able to counter low level incursions with the minimum of expansion, and to act as an expansion base to handle medium or higher levels of conflict. Indicators of a major attack on Australia could be expected many years beforehand but low level contingencies, activated by political factors, could occur with only a relatively short warning time. Even limited scale attacks on Australian territory could be difficult to counter and require a disproportionate response, especially in Australia's most vulnerable areas in the north and north western coastal areas of Western Australia and the Northern Territory. The policy is one of self-reliance in defending our shores. Military attacks on Australia over the next several years are seen as being improbable but the possibility has to be contemplated. The policy does not attempt to embrace the overwhelming situations which could occur in a major war involving the super powers.

Force-in-being

152. The Army has undertaken studies to determine force development objectives and force structures for its field element related to low, medium and high levels of conflict. A low level conflict, however improbable, would be more likely to occur than any other. According to the studies, the Army should develop a force-in-being containing combat ready units to undertake military tasks which may arise at short notice. The force-in-being needs to have an expansion base containing the range and depth of capabilities necessary to enable it to expand to the required size within available defence preparation times. The force-in-being also needs an organisation to undertake a full range of support area functions.

153. The Army has a framework of one regular infantry division and two reserve divisions, together with combat and logistic support forces. Expansion of the Army would initially be by call-out of the Reserves.

Supply of topographic maps

154. No one questions that the Australian Defence Force should have readily available to it, in anticipation of hostilities occurring, an adequate supply of topographic maps at a scale sufficiently large for military purposes . No one has yet challenged the 1:50 000 mapping program as

being in excess of defence needs. The Canadians have a comprehensive mapping program at 1:50 000 which is based primarily on defence needs. To map comprehensively at the large scale of 1:25 000 would not admit of the same justification but I was informed that RASvy wished to employ 1:25 000 specifications when mapping at 1:50 000. Towards the end of my review, the Director of Army Survey said that 1:25 000 accuracy standards would not be mandatory for the greater part of Australia to be mapped at 1:50 000 scale.

Mappers in the field

155. Map making can be either a civilian or military activity. Defence requirements do not, however, cease with the preparation and supply of topographic maps and derived products for use in the field of operations or potential operations. Deployment of the ADF will produce additional demands which Defence has assessed as requiring military personnel trained in mapping and survey to be available in the field as well as at headquarters. Hence, the structure and manning of RASvy in peace time must be matched to its roles and tasks as one of the components of the force-in-being.

156. The force-in-being must have an expansion base to enable its development to a sufficient size and structure to deal with hostilities at levels beyond those which can be handled at its peacetime strength. This means that the RASvy force structure for the force-in-being must not only fulfill readiness requirements but also provide an adequate base for expansion to meet the increased mapping and survey demands of more extended conflicts.

157. RASvy personnel spend their time in a variety of mapping tasks and their range of skills tends to be higher than counterpart civilian cartographers. Although recognised as specialists, they may also serve in other capacities in the Defence Force but they would be withdrawn to serve with RASvy in the case of an emergency.

Size of the "core force"

158. In a letter dated 13 January 1986, the Minister for Resources and Energy, Senator Evans, again stated that the Minister for Defence and he had agreed that there needed to be a Defence mapping "core force" of sufficient size and activity to maintain competence. Senator Evans stated that he hoped it would be possible for me in a final report to provide some precise guidance to Ministers as to the appropriate nature and extent of such a core force.

159. In a letter to me dated 22 January 1986 the acting Deputy Secretary of DRE made the following comment:

> "One of the main issues in the review, as agreed by the Ministers in April, is the size of the core force - in other countries civilian mappers are expected to don uniforms in time of conflict - there were 1700 civilian

mapmakers in uniform by the end of WWII from a 'core force' of about 50. Canada has a core force of about 120 personnel including a number of civilians. The need for a large Australian core force has not been substantiated."

160. There is a vast difference between large scale war such as World War II, for which the Defence Act was invoked for mobilisation of the civilian and military resources, and Australia's current strategic defence policy directed to having the resources to combat hostile forces on Australian territory in situations far short of large scale war requiring general mobilisation. World War II also lasted six years, an unlikely, though not impossible, length of time for a conflict on Australian soil and in that time Australian forces were not solely dependent on their own resources for field mapping. It is also well known that some modern equipment developed since World War II and available to the ADF depends upon digital terrain data to achieve maximum effectiveness. Digital terrain data is used as well in the planning of military operations. RASvy acquires digital terrain data in the course of making maps at 1:50 000 scale.

161. Defence regards membership of RASvy as a military career in itself and takes the view that military personnel trained in survey and mapping are specialists who must practise their craft continuously to maintain the requisite skills and be at readiness if hostilities occur. As specialists, mapping and survey personnel are not usually expected to serve in any other military capacity. Training for the specialty is undertaken by the School of Military Survey at Bonegilla.

162. RASvy has to provide a working rank, skill and trade structure and because its members pursue their careers in the Corps manning levels must also offer adequate career progression. The School of Military Survey offers courses for those seeking advancement.

163. I do not propose to question the underlying assumptions of the Defence position. At the same time I am satisfied in discussions with Natmap staff and private sector mappers and surveyors that mapping and survey skills once gained are not lost when the specialist ceases to work actively in his craft. The skills are technical and can be maintained by refresher courses and a specialist seeking to practise his speciality again can regain proficiency within a matter of weeks.

Matters of military judgement

164. It is easy enough to understand that RASvy support functions to ADF operations fall into the categories of preparation for operations and assistance during operations. It is far from easy even for professional military experts to determine precisely the nature and extent of mapping and survey tasks likely to be required during actual operations

and the number of military personnel needed to perform the tasks. These are matters of military assessment difficult if not impossible for an outsider to examine without being accused of usurping the role of military experts. I can not do more than seek to satisfy myself that there are reasonable grounds for the military judgements in the matters brought to my notice. It does not necessarily follow however that acceptance of RASvy's support role and the structure of RASvy also requires acceptance that all the functions now attributed to RASvy as a Corps have to be performed exclusively by soldiers.

165. According to Defence RASvy peacetime structure and the manning levels required as an expansion base compared with the actual authorised peacetime establishment are as follows:

RASvy

Unit	Peacetime numbers of servicemen required as an expansion base	Authorised peacetime establishment	Current numbers (as at 13.5.86)*
Headquarters Field Force Command (HQ FF Comd)	5	3 (+1*)	3(+1*)
Headquarters 1 Division (HQ 1 Div)	16	16	19
1 Field Survey Squadron (QLD)	51	30	36
2 Field Survey Squadron (NSW)	69	47	51
4 Field Survey Squadron (SA)	42	45	48
5 Field Survey Squadron (WA)	42	45	48
Army Survey Regiment (Bendigo)	313	295 (+19*)	295(+19*)
Map Depot (Bonegilla)	11	11	11
School of Military Survey (Bonegilla)	46	46 (+2*)	43(+2*)
Directorate of Survey (Canberra)	15	15 (+4*)	15 (+4*)
TOTAL	610	553 (+26*)	569(+26*)

* Numbers in brackets refer to civilians, and are additional to the figures outside the brackets.

166. The RASvy units include in their numbers some personnel from other units. Of the peacetime establishment of 551 there are 76 from other corps such as the Royal Australian Army Ordnance Corps (RAAOC) and the Royal Australian Corps of Transport (RACT). There are in addition some civilians employed, including 19 with the Regiment at Bendigo.

The composition of the field force of 225, according to plan is as follows:

Corps affiliations of personnel in combat zone
RASvy units

UNIT	RASvy	RAAOC	AACC	RACT	RAEME	RAAMC	RAE	TOTAL
HQ 1 Div	16							16
Div Topo Svy Tp	32	6	2	2				42
Topo Svy Sqn	142	9	4	6	4	1	1	167
TOTAL	190	15	6	8	4	1	1	225

Abbreviations:

RASvy = Royal Australian Survey Corps
RAAOC = Royal Australian Army Ordnance Corps
AACC = Australian Army Catering Corps
RACT = Royal Australian Corps of Transport
RAEME = Royal Australian Electrical and Mechanical Engineers
RAAMC = Royal Australian Army Medical Corps
RAE = Royal Australian Engineers

Degrees of conflict

168. Information from Defence about RASvy force structure for the force-in-being to meet readiness requirements and provide an expansion base distinguishes between low level conflicts which are considered more likely to occur and medium and high level conflicts. A conflict could, in fact, escalate from low to medium or high level by degrees without any clear line of demarcation.

169. Defence planning also distinguishes between a combat zone, communications zone and an Australian Support Area (ASA) outside the area of hostilities.

RASvy and low level conflict

170. According to military advice a low level conflict involving the deployment of a brigade in an area of 300 kms x 100 kms would require the immediate supply of about 60000 maps in three different scales (1:50 000, 1:100 000, 1:250 000). The deployment of a follow-up force of a second brigade, which is within the contemplation of a low level conflict, would mean a corresponding increase in the demand for topographic maps.

171. In a low level conflict RASvy support in the combat zone would involve the deployment of up to 225 members of RASvy in a force structure comprising:

(a) a divisional HQ survey section of 16;

(b) depending upon the extent of the conflict the elements of a topo survey troop or a complete troop of up to 42 soldiers; and

(c) the elements of a topo survey squadron or a complete squadron of up to 167 soldiers.

172. The field survey squadrons would provide the manpower for the topo survey troop and the topo survey squadron. As can be seen from the table above the combined peacetime strength of the HQ Field Force Command, HQ 1 Division and the four field squadrons is 225. The field survey squadrons would be brought up to strength, though not necessarily full strength, as additional manpower became available and would continue to fulfill their normal support area functions. I am informed that members of HQ Field Force Command would also become part of the RASvy field force and that they too would be replaced

172. The survey staff of the divisional HQ and the topographic survey troop would, in the field, be responsible for:

(a) advising on availability of maps and map products;

(b) distributing of maps and map products;

(c) preparing overlays;

(d) providing survey intelligence and of remotely sensed information; and

(e) providing digital data for use in automated command and control systems.

173. The topo survey squadron is planned as being a self-contained mobile unit to provide field support which includes:

(a) reprinting high usage maps;

(b) provision of rapid response products beyond the technical capabilities of field units;

(c) derivation of large scale products;

(d) revision of situation maps;

(e) terrain analysis;

(f) extension of geodetic networks; and

(g) determination of positions.

174. Engagement in low level conflict does not involve depletion of the Regiment at Bendigo or the School of Military Survey and the Map Depot at Bonegilla. The Regiment would continue to compile and produce maps from all sources of topographic data and as part of an integrated survey support system would continue to acquire and disseminate base data for both the area of operations and other areas of defence priority.

RASvy and medium and high level conflicts

175. The force required to deal with a low level conflict could consist of up to two brigades or more. In the more extended versions of low level conflict that are seen as credible the deployed force could well extend considerably beyond a division. More intense conflict at the medium level and higher, for which the Army retains core-force skills as an expansion base, would require more divisions. All levels of conflict would call upon the Australian Army Reserve, and the more intense levels especially would involve the recruitment of large numbers of civilians.

176. About two-thirds of the force would be deployed in the combat zone and up to one-third of it in a communications zone where RASvy would also have to provide support. The RASvy structure designed for low level operations is also appropriate in working out a supporting structure for a corps of up to three divisions.

177. Though RASvy's tasks in extended and higher level conflicts are similar in nature to those in a low level conflict it would have to perform a greater range of tasks and the tasks themselves would usually be of greater dimension. For example the number of topographic maps required in the first instance would increase from 60,000 to as many as one million map sheets.

178. Appendix F contains a list of potential RASvy tasks applicable to medium and high level conflicts. Obviously they also include tasks in a low level conflict. The list does not differentiate between the tasks to be performed according to location i.e. combat zone, communications zone and the support area.

Combat zone

179. The planned RASvy structure in the combat zone is

(a) a corps headquarters survey section and three divisional headquarters survey sections each of 16 personnel;

(b) three divisional topo survey troops of 42 members each; and

(c) a corps topo survey squadron of up to 167 personnel.

Communications zone

180. There would be a topo survey squadron numbering 167 and a map supply squadron of 102 personnel to hold and distribute maps within the communications zone and forward them to the combat zone.

Support area

181. As in the instance of low level conflict, the Map Depot and School of Military Survey at Bonegilla would continue their normal functions as part of the support area. Similarly the Regiment would continue to make maps and perform limited survey tasks. Its planned strength is 335, the same as for a low level conflict. Four Field Survey Squadrons would still provide survey assistance to the military districts and continue normal survey operations in priority areas outside the area of operations.

Additional Field Squadrons for a high level conflict

182. In the event of high level conflict, the Four Field Squadrons would number 97 each, and continue to provide survey assistance to the four military districts and undertake survey operations in priority areas outside the area of operations.

183. In short, RASvy personnel at the three notional levels of conflict would number as follows:

Low level conflict

Combat zone		255
Australian support area -		
Regiment	335	
Map Depot	11	
School of Military Survey	46	
Directorate of Survey	15	
Fd Svy Sqns	130	
HQ Field Force Command	5	542
Total		767

Medium level conflict

Combat zone	19	
Corps HQ		
HQ 1, 2 & 3 Div	48	
Topo Survey Troops		
1, 2 & 3 Div	126	
Corps Topo Svy Squadron	167	360
Communication zone		
Topo Svy Sqn	167	
Map Supply Sqn	102	269
	Total	1,076

High level conflict

Combat zone		360
Communication zone		269
ASA -		
Regiment	335	
Map Depot	11	
School of Military Survey	46	
Directorate of Survey	15	
HQ Field Force Command	5	412
ASA - Field Svy Squadrons		388
	Total	1,429

Possible reduction in the size of the Regiment

184. As planning moves from low to higher level conflicts, consideration of RASvy's contribution and the numbers required becomes more speculative and calculations cannot be precise. In a low level conflict, Defence planning involves an expansion of RASvy by up to 40% beyond its peacetime strength. In a medium and high level conflict, a much higher proportion of personnel would have to come from external sources, such as the Army Reserve and recruitment of civilians into the Defence Force, depending on the decision of the Government.

185. Defence planning, which has as its objective the provision of up to 225 RASvy personnel in the combat zone, as mentioned, does not involve depletion of headquarters personnel in the ASA. My information was always that the Field Survey Squadrons would bear the brunt of providing mapping and survey assistance in the combat zone though it meant the exhaustion of their numbers. At first the advice conveyed to me did not indicate that the depletion of the Squadrons would be offset, but recently I was informed that replacement of personnel in the Squadrons would give them a combined strength of about 130 in a low level or medium level conflict.

186. Plainly RASvy's peacetime strength would enable it to provide 225 personnel in the combat zone. Even if the Regiment had to provide from its number the 130 to replenish

the Squadrons about 160-165 soldiers would remain at Bendigo to carry out base mapping activities.

187. About 70% of the resources of the Regiment are, or are expected, to be engaged in producing 1:50 000 first cover maps. If the Regiment is divested of first cover 1:50 000 map production it should still be capable of meeting the demands coming from the combat zone for maps and map products and other forms of assistance which it is able to give from its base. Similarly since the Squadrons engage in various stages of map production they would also be able to provide assistance from the ASA. If this were to happen the Squadrons could then remain with much diminished numbers during periods of conflict.

188. It is, however, Defence policy that all headquarters units, including the Regiment, should operate at no less than their peacetime strength and carry on normal mapping functions even though there is a low level conflict involving the provision of as many as 225 RASvy personnel in the combat zone. Such a policy will support the Regiment numbering 335, but to a layman such as myself to have the Regiment and the Field Squadrons continue with first cover topographic mapping program, in these circumstances, is rather like placing wall-to-wall carpet in a coal mine

189. In my opinion all low level combat demands could be met with a Regiment at a peacetime strength of 200. Any shortfall in manpower resources to provide for the continuation of the topographic mapping program could be overcome by engagement of civilian mappers either as soldiers or civilians or by having a civilian mapping establishment at the disposal of Defence.

190. As ~~the~~ the figures previously presented show, in a low level conflict about 200-220 additional personnel would have to be found for RASvy. If the Regiment were to number 200 instead of 295 as at present the number of persons required from external sources would rise to about 300. This does not strike me as posing any special difficulty.

191. There are, however, other relevant factors. RASvy personnel as mapping specialists will, in the main, pursue an Army career within the Corps. A reduction in the size of the Corps by 95 would still leave a peacetime strength of over 550. It would not be sufficient to create a blight on career prospects. Nor should a reduction give rise to problems of relocating personnel. I am informed that they could be readily absorbed in other Army units if this should be necessary.

192. It is Defence policy to have all RASvy personnel serve in the Regiment as part of the continuing training process. A posting to the Regiment for three years is normal. I am informed that the staff turnabout in the Regiment should be about 40 each year. After taking into account, as well, members leaving RASvy altogether, a Regiment of 200 would accommodate such a movement.

193. A necessary consequence of a smaller Regiment is, of course, a reduction in its capacity to produce 1:50 000 first cover maps, possibly about as much as one-quarter, at the present rate of output, if the Regiment were to number only 200 instead of 295. Such a reduction should not affect the output of the Squadrons. The production loss could be completely offset by providing an establishment of civilian mappers such as Natmap, to participate in the program. Nevertheless such an exercise would not produce a net gain even in the wider context of a shared program unless civilian mapping costs were to be appreciably lower than those of the Regiment. This report is later concerned to show that they are.

194. In higher levels of conflict a much greater augmentation of RASvy would have to come from external sources. In these circumstances, the proposed reduction in the size of the Regiment would be proportionately less significant. Sharing of the 1:50 000 program could bring about its completion within about 12 or 13 years. In this event by the time any medium or high level hostilities took place, RASvy would be able to carry out its role without the restraints imposed by a current topographic mapping program. Further, since Australia should receive indications of likely medium and high scale hostilities several years in advance, it should not be a problem to train civilian surveying and mapping specialists, whether located in the private sector or Government agencies, to use their skills in military service.

Dibb review of Australia's defence capabilities

195. The Dibb report to the Minister for Defence this year has stressed the need for up to date maps and charts as a high priority requirement for Australia's defence planning. Far from contemplating any reduction in Defence mapping capability, the report recommended that more resources be applied to reduce the timeframe for the provision of maps and charts in areas of high priority. In this section of the report my task has been to assess whether the present size of RASvy is greater than the core force concept requires. I have concluded that it is. Later I shall show that there are alternative mapping resources available to the Commonwealth which, if suitably employed, will enable areas of high defence priority to be mapped much earlier than planned even though RASvy should be reduced in size as I have suggested.

Section 6

THE MORAN COMMITTEE AND ITS SEQUELS

196. In August 1981 the Moran Interdepartmental Committee reported against any merger of Commonwealth mapping, charting and surveying (MCS) organisations. At the time the predominant series activities were topographic mapping of Australia at scales of 1:100 000 and 1:250 000. In describing the work of MCS agencies, the Moran Report noted that RASvy produced topographic maps at 1:50 000 scale and larger, but if the Committee was aware that Defence intended to embark on a national program at that scale it did not mention it. Disagreements about that program have been the principal source of conflict between RASvy and Natmap.

Insufficient co-ordination

197. According to the Committee, since 1973, when the Advisory Committee on Commonwealth Mapping (ACOCM) ceased to exist, co-ordination and cooperation at the Federal level in respect of the national objective to map, survey and chart on-shore and off-shore Australia appeared to have depended almost entirely on the personal relationships and goodwill between the directors of Natmap, RASvy, ASO and the Royal Australian Navy Hydrographic Service. Among other things, the situation had created difficulties in developing a co-ordinated program of MCS activities. Other identified adverse effects included the making of unilateral decisions by one Commonwealth agency though other agencies had an interest, provision of inconsistent advice to the States and Commonwealth members at meetings of the National Mapping Council not expressing a single viewpoint about Federal policy.

198. Although rejecting any merger of MCS organisations the Moran Committee looked for means to strengthen co-ordination of MCS activities. It recommended the formation of an interdepartmental group with the burdensome name of the Commonwealth Coordinating Group on Mapping Charting and Survey and equally cumbersome call sign of CCGMCS. Representation was to come from Defence, DRE and the Department of Administrative Services and should be below Departmental Secretary level but above the level of Director. In other words those directly engaged in mapping were not to be members. It was also recommended, by majority decision, that the Department of National Development and Energy should chair the committee and provide the secretariat. Defence considered there should be an independent chairman from the Department of the Prime Minister and Cabinet. The majority view rested largely on accepting that national responsibility for mapping rested with the Department of National Development and Energy.

199. The Terms of Reference for CCGMCS were ambitious. One was to co-ordinate at Commonwealth level national MCS activities and another was to endeavour to resolve any conflicts in priorities and activities. Secondary Terms of Reference required the Group to focus on cooperation between the four Commonwealth MCS organisations and the future use of resources available to the Commonwealth, including use of the private sector.

Failure of the advisory group

200. In line with the Moran Committee recommendation CCGMCS was constituted by representation at Deputy Secretary level from DRE and the Department of Local Government and Administrative Services. The Defence representative was the Director-General, Joint Operations and Plans. The Moran Committee considered that the Group should meet at least annually and that there should be meetings of a sub-committee of directors of MCS organisations at about three monthly intervals.

201. From the outset CCGMCS has been ineffective. It met on six occasions in 1982 and 1983 but has not met since December 1983. The Directors did not form a sub-committee as the Moran Committee recommended. Members of the Group were unable to agree on many matters, including the minutes of the last meeting. An eye witness commentary upon proceedings in CCGMCS was that they were characterised by the expression of discordant attitudes which made agreement on anything of significance out of the question. Apart from its dismal record, CCGMCS is at the most a consultative and advisory forum without power to make binding decisions or issue directions. Lacking both, it was bound to fail in the prevailing divisive climate. In looking for a mechanism to ensure that the execution of the 1:50 000 program makes best practicable use of Australian mapping resources, CCGMCS has to be put to one side.

Respondeat superior - who goes where?

202. The Moran Committee had an independent chairman from the Public Service Board, but otherwise its members were representatives of the MCS agencies. My overriding impression is that the decision to leave things as they were and allow the MCS agencies to carry on independently of each other was supported by little more than a catalogue of reasons given by the interested parties.

203. Since 1981 RASvy has been able to undertake series mapping using the most advanced technology. It has the capacity to produce no less than 200 map sheets digitally annually which is greater than Natmap in-house capacity. It is one thing to give Natmap and its parent department a share of a 1:50 000 program including a responsibility for maximising input from the States and the private sector. As will be seem in section 8 of this report, however, Natmap's claim to a dominant role in the co-ordination of topographic mapping has not been matched by performance. It would now

be a case of the tail wagging the dog for Natmap to be given authority over RASvy.

Section 7

DEFENCE CONSULTATIONS WITH DRE AND THE NATIONAL MAPPING COUNCIL

204. Throughout my enquiry DRE insisted Defence did not consult it about implementing the 1:50 000 program. Defence, on the other hand, maintained Natmap was both informed and consulted on pertinent matters and that the program was placed before the National Mapping Council.

National Mapping Council and State mapping agencies

205. I have perused the records of proceedings of NMC and they do not show that the Defence program was ever a specific item on the agenda. References to the program in the minutes occurred only in the course of general discussion. Defence representative informed me that the Department did not regard it as appropriate in any event for Defence priorities on mapping to be aired before NMC. Several State representatives informed me that NMC received insufficient information to form the basis of a productive discussion.

206. State mapping heads also said they had some misgivings about RASvy's mapping ambitions in their bailiwicks. There was room, they thought, for more co-ordination of the RASvy program with State activities and a better cooperative atmosphere would have prevailed had the States been in receipt of adequate information about RASvy's program in the first place. Whether the criticism is valid or not, RASvy's relations with the States could do with some improvement.

Natmap and the CCGMCS

207. If Natmap were informed and consulted as Defence has maintained it must have been on a very informal footing. I am not aware of any document from Defence explaining the program to DRE nor am I aware of any communication to like effect between the respective Ministers. Such evidence as I have seen is to the contrary.

208. One of the Terms of Reference of CCGMCS is to co-ordinate at the Commonwealth level national mapping, charting and survey activities. There is no exemption of the mapping activities carried on by Defence. On 30 March 1982 the Deputy Secretary of DRE wrote to the Chief of Joint Operations and Plans in Defence as follows:

"Whilst I concede that the 1:50 000 requirement is peculiar to your Department at the Commonwealth level, I cannot agree that this eliminates 1:50 000 map production as a topic for IDC consideration, for the following reasons -

- firstly, the resources needed to produce 1:50 000 maps are generally the same as those needed for 1:100 000 maps, and I believe it is rightly the task of the IDC to ensure that available resources are used the most effective way;

- secondly, I believe that the topographic content of the maps at these two scales is often similar enough to warrant further rationalisation, with the aim of avoiding unnecessary duplication of effort."

209. The then Chief of Joint Operations and Plans (Rear Admiral Evans) replied to the Deputy Secretary on 2 April 1982 as follows:

> "Natmap has no requirement or mandate for mapping in this scale. Nor do I accept that Natmap has an 'area of responsibility' in 1:50 000 scale. If we continue to exchange source data between the various mapping agencies, I do not see how 'unnecessary duplication of effort' will result. Accordingly, I do not believe that cooperative arrangements in this scale are an appropriate topic for the IDGMCS."

210. On 6 April 1982 the Deputy Secretary of DRE wrote to Rear Admiral Evans' successor as Chief of Joint Operations and Plans, Rear Admiral Richards, pressing DRE's interest in Defence's 1:50 000 mapping program. DRE's comments were referred to Brigadier Murphy as the Defence representative on CCGMCS. On 30 April 1982 the Defence representative wrote to the Deputy Secretary of DRE as follows:

> "On this matter our views are similar, as it has always been this Department's contention that prior exchange of programmes is necessary with those agencies which have a mapping programme at the same scale. For 1:50 000 this has been readily achieved in the past, through the existing consultative arrangements with the State agencies concerned. Indeed the current arrangements have been fully effective in avoiding duplications of effort. For the foregoing reasons, I do not see a need for a change in this Department's position on this matter, which was outlined to you by Air Vice Marshal Evans in his letters of 5 March 1982 and 2 April 1982."

211. In spite of further efforts DRE did not succeed in having the Defence program listed on any meeting agenda of CCGMCS. It is difficult to avoid the impression that some Defence personnel had an arrogant attitude detrimental to a satisfactory working relationship between RASvy and Natmap. Indeed DRE seems to have been intimidated to the point of being deterred from convening meetings of the Group. For their part some Defence personnel maintained that the Chairman of the Group sought to use the meetings to serve Natmap's particular interests. Certainly State Surveyors-General and others have a basis for believing that the Commonwealth has a divisive topographic mapping policy.

Section 8

DRE's RESPONSIBILITY FOR COMMONWEALTH TOPOGRAPHIC MAPPING

212. The fact that Defence implemented the 1:50 000 program without consultation has been offensive to Natmap and DRE. DRE's stand is that primary responsibility for topographic surveys and mapping required for all Commonwealth purposes vests in it mainly by reason of a Cabinet Decision of the Menzies era in 1954. That decision plainly established its predecessor, the Department of the Interior, as a single authority with full responsibility for surveys and mapping required for Commonwealth purposes and for the co-ordination of survey and mapping with State authorities. Cabinet also stated in 1954 that the Department was to be responsible for training personnel to provide for expansion of its topographic and geodetic survey activities in time of war.

Correspondence between the two Departments

213. In writing to the Secretary of Defence on 4 October 1984 the Secretary of DRE restated the Department's position based on the 1954 Cabinet Decision and said that the Moran Committee had concluded in 1981 that insufficient grounds existed to warrant changes in the division of responsibility.

214. In a response dated 18 October 1984 the Secretary of Defence said that the circumstances of a Cabinet Decision that had not been implemented in thirty years were at best doubtful. He said that the decision of the Government on 26 October 1981 accepting the recommendations of the Moran Committee appeared to have superseded the 1954 decision. The Secretary was referring to the Government's concurrence with the Moran Committee's view for improved co-ordination between the two departments in survey and mapping activities and the establishment of CCGMCS. The Secretary added that Cabinet Decision in July 1984 for the two Departments to jointly review topographic mapping resources also displaced the 1954 decision.

215. On 5 November 1984 the Secretary of DRE wrote to the Secretary of Defence stating that his principal concern was to highlight the fact that "Natmap has the responsibility for the co-ordination of Commonwealth mapping". He added that successive Governments had recognised Natmap's role which was confirmed by the allocation in the Administrative Arrangements Order of "geodesy and mapping" as a principal function of the Department. The current Order No. S30 dated 31 January 1986 is similar.

216. In a letter of reply on 15 November 1984 the Secretary of Defence stated that it was somewhat disquieting

that they were unable to agree on the import of the 1984 Cabinet Decision. He reiterated that Natmap's claim to responsibility for the co-ordination of Commonwealth mapping was at odds with the Cabinet endorsement of the co-ordination arrangements which established CCGMCS. This was the group now charged specifically with the role of coordinating the activities of the four mapping, charting and surveying organisations. As a member of the Group, Natmap shared the responsibility but did not have sole responsibility.

Exchange of views of the two Ministers

217. On 19 April 1985 there was a meeting between the Minister for Defence, Mr Beazley, and the Minister for Resources and Energy, Senator Evans, about the Joint Administration Review of Topographic Mapping. According to a Natmap record the Ministers agreed that Natmap should have overall responsibility for topographic mapping "whatever that meant". Further the Ministers also concluded that a sensible allocation of responsibilities or resources depended on an assessment of costs but any program should recognise the need to accommodate military priorities. According to a Defence note the Ministers agreed that Natmap had a coordinating role but it was not clear what practical options were available. The Ministers agreed that there had to be a substantial military mapping capacity and acceptance of its priorities but the extent to which mapping could be regarded as a military or civilian responsibility depended largely on costs. If Defence costs were prohibitive there should be a greater civilian role. On the Defence view the RASvy program should continue unabated if its costs are comparable with those of Natmap.

218. Following receipt of its comments on my progress report I asked DRE for an unequivocal statement as to how it saw its responsibilities in relation to the 1:50 000 program which Defence had initiated.

DRE's statement of its responsibility

219. DRE furnished me with a statement of formal responsibility for topographic mapping. It re-iterated that the Department through Natmap was the single authority with overall responsibility for programs for all Commonwealth purposes including development and defence. Discharge of that responsibility, among other things, required it to co-ordinate, plan and implement all Commonwealth topographic mapping programs and to monitor new technology and provide leadership in its development and implementation. Responsibility extended to recommending and monitoring the allocation of Commonwealth funds for all geodetic, topographic mapping and aerial photographic programs. Further, the resources of Defence not required for strictly military purposes should be applied to those portions of the Commonwealth program allocated by DRE. Strictly military purposes were restrictively defined as those which did not contribute to the national mapping program, for example the

provision of training area gunnery maps. DRE informed me that its charge of topographic mapping at all scales, as described above, required it -

(1) to evaluate the extent and nature of civilian demand for programs of mapping including 1:50 000 scale;

(2) to assess the requirement for mapping at 1:50 000 scale for defence purposes and the capacity of defence mapping to satisfy civilian demand;

(3) co-ordinate the effective use of Commonwealth and civilian military resources and those of the States and the private sector;

(4) monitor the resources devoted to mapping; and

(5) account to the Government for progress of the overall program

DRE's statement of responsibility is more extensive than the ambit clauses of a log of claims from the Builders Labourers Federation. I did not obtain Defence's specific reaction.

Facts that do not fit the theory

220. Events over the years have undoubtedly eroded Natmap's position. Nothing has happened to invalidate or annul the 1954 Cabinet Decision in any formal sense but the decision stands as one of little, if any, operative effect in recent years. By 1981 it was known to members of the National Mapping Council that RASvy was conducting mapping operations at 1:50 000 scale in its own right but the fact does not seem to have alerted Natmap to consider the implications for its Department in terms of the 1954 decision. By 1982 it was certainly apparent to DRE that there was such a program which had implications for it.

221. In 1982 DRE informed its Minister, then Senator Carrick, that such a program was proceeding and obtained his approval to undertake 1:50 000 mapping in lieu of 1:100 000 scale mapping where there was a military or State Government requirement. To stop short at obtaining the Minister's approval for Natmap to engage in limited 1:50 000 scale mapping is not an action consonant with DRE's claim to complete overall topographic mapping responsibility.

222. I put to DRE that once it became known that RASvy was engaged on a substantial new topographic mapping program, it should immediately have raised the subject with Defence in terms of its fulsome claim to responsibility but it did not. DRE, in view of its claimed role, had a clear responsibility to bring the program to the attention of Cabinet but had not done so. In discussion DRE informed me that in 1982 the Minister had not wished to raise the subject in Cabinet and that the subsequent change of Government and other factors had operated to discourage it

from placing a submission before Cabinet dealing with the 1:50 000 program.

223. Ministers are politically responsible for their departments and insofar as a Cabinet Decision vests responsibilities in a department, the Minister is answerable to his Government and, according to Westminster theory, ultimately to the Parliament for how the responsibilities are discharged. More than that, under the Constitution Ministers are in charge of their departments. The Administrative Arrangements Order, consistent with the constitutional position, recognises that Ministers administer each of the departments listed in the Order not only in the discharge by a department of functions arising under enactments administered by the Minister but also the principal matters such as geodesy and mapping which a department may perform independently of statute. There comes a point when the Minister has to be the spokesman for his department in Cabinet.

224. It is obvious that if DRE were to make its claim to responsibility effective, there should have been a Cabinet Submission about the 1:50 000 program. The fact that it was inhibited by reluctance to go to Cabinet simply means that DRE has not exhibited determination matching its claimed responsibilities. It has to bear the consequences. Meanwhile RASvy has chosen to approach the States separately for assistance in its mapping activities without reference either to Natmap or the NMC.

225. Again, as to the Administrative Arrangements Order, the listing of geodesy and mapping as a principal matter dealt with by DRE is a recognition of Natmap's role. The reference is not open to the construction that it thereby allocates to DRE a dominant role over the mapping activities of Defence undertaken pursuant to the Defence Act 1903 the brief for which is acknowledged in the Administrative Arrangements Order as being with the Minister for Defence.

Absence of a co-ordinated policy for topographic mapping

226. If Natmap is to have a coordinating role in the 1:50 000 program it now has to be pursuant to a specific decision by the Government. At present there is no effective machinery for co-ordination of Federal mapping and survey activities and prevailing concepts of responsibility express the interests of the agencies involved rather than the national interest.

Section 9

NATMAP AND THE CIVILIAN CASE FOR 1:50 000 MAPPING

Natmap operations

227. Natmap has had long and continuous experience as the Commonwealth's principal civilian mapping agency. In 1984/85 its staff totalled 295 of whom 148 were engaged in topographic mapping programs, 42 in special purpose mapping and 34 in bathymetric mapping. Natmap's budgetary expenditure in 1984/85 was $16 million of which $5.26 million was attributable to topographic mapping and $3 million to bathymetric mapping. Expenditure included $766,000 on contracts with the private sector for various phases of topographic mapping.

228. Natmap owns and operates two Cessna aircraft for aerial photography. It engages in all stages of map production. For printing it enters into contracts with the Australian Government Publishing Service. In compilation, the most significant single mapping stage which follows ground control work, Natmap has pursued a policy of graphic stereoplotting. It has some digital stereocapacity but its six stereoplotters with digital attachments are not used to full capacity. By 1987, with the purchase of a raster scanner to scan its work, it will be able to increase the digital component of its work. Natmap prefers to adhere to the policy of graphic stereoplotting but it would move to digital stereoplotting, albeit reluctantly, if required. Its claim is that graphic stereoplotting enables a higher output to be gained than by digital stereoplotting at a lower cost even allowing for the additional cost of raster scanning.

Surplus resources

229. If Natmap does not acquire a substantial role in 1:50 000 mapping the continuing tasks remaining after the completion of the 1:100 000 and 1:250 000 mapping series would not justify the continued employment of staff at its current level. In the course of enquiries, I met representatives from the Association of Draughting, Supervisory and Technical Employees and the Professional Officers' Association, who expressed their concern about the future. Their position was that since Natmap's operations were at lower cost than those of RASvy, this in itself sustained a case for Natmap participation in the 1:50 000 program. Apart from the question of cost, the Association representatives asserted, as Natmap has done, the existence of a substantial demand from Commonwealth departments and statutory authorities for 1:50 000 mapping for non-military purposes.

Natmap in Dandenong - Where should it be?

230. Natmap's functions are carried out in two locations: Canberra, where in June 1986 the staff totalled 198, and Dandenong, Victoria, where there were 89. The Dandenong office is the centre for map producing activities to the completion of compilations. It also arranges contracts with the private sector for graphic and digital mapping. The Canberra headquarters handles subsequent stages of map production including cartography. DRE provides administrative and management support for the Division as a whole. The Dandenong office is situated in a Federal electorate considered politically to be a marginal seat - now held by a Labor minister.

231. The Department has for several years sought the transfer of the Dandenong operations to Canberra because of the technical and administrative advantages which would result. There is at present a duplication of manpower, equipment and effort and extensive communication facilities are maintained because of the distance between the two offices. However, the combined Staff Associations have so far successfully resisted attempts to relocate the Dandenong office. According to a submission from the Associations, surveys indicated that 83% of the Dandenong office staff would be unwilling to accept forced transfer and that even if a greater number were to transfer there would be significant relocation costs which would not be recouped for many years and a loss of production. According to the Department, more than half of the Dandenong staff would transfer to Canberra. Professional mapping staff in Dandenong would find it difficult to obtain alternative skilled employment locally. The Department considers that the transfer costs would be recouped in six years by savings attributable to combining operations in one centre. My view is that the Associations' submission is too conservative in its assessment of the likely number of transferees.

232. For most officers and their families movement to Canberra is undoubtedly disruptive and can impose many problems of a private nature. Social and family factors are not to be gainsaid. Apart from them, the case for remaining in Dandenong seems to rest mainly on proximity to private contractors, easy access to institutions offering training in mapping techniques if officers should choose to use them, and proximity to Moorabbin Airport for use by the aircraft section.

233. Contact with outside contractors is an important aspect of Natmap's work, but if it is to share in the 1:50 000 program, Natmap would be involved, as now, in entering into contracts over the whole of Australia and not just Victoria. Proximity to Victorian contractors is of small significance. There is also an equally well established and serviced airport in Canberra. Nor is there any significant liaison with RASvy in Bendigo and the School of Military Survey at Bonegilla in Victoria. Another

argument put is that whilst the office remains in Dandenong it will be left alone to carry on its topographic mapping without interruption. In Canberra this advantage will disappear. So it should.

234. I will express the view in this report that a 1:50 000 mapping program can be accomplished within a much shorter time-span and at a lower total cost to the Commonwealth if Natmap and private contractors, especially the latter, were to have an appreciable share of the program. At the end of the program, in my opinion, there will be a surplus of Commonwealth topographic mapping resources. This factor, coupled with the desirability of having a shorter time-span for completing the 1:50 000 program, may render it convenient to leave Natmap staff in Dandenong rather than experience the dislocation of production and short term cost penalties of transfer to Canberra.

235. If the Department should wish to persist with the closure of the Dandenong Office the loss in productive capacity which would inevitably occur in the short term is not likely to have such a marked effect on the performance of the 1:50 000 program if shared between RASvy and Natmap as to justify a view that the transfer should not occur at all. I have, however, refrained from concluding that there should be a transfer of the Dandenong operations to Canberra. In the view ultimately taken in this report about co-ordination of Commonwealth mapping and survey activities, however, there would be no place for an outposted operation at Dandenong when the end of the program comes in sight.

Civilian consumer demand - The questionnaire

236. Natmap has sought to strengthen its position by the identification of a recognisable civilian demand for 1:50 000 series mapping. If there is such a demand, the Defence program should not be all-enveloping to the exclusion of civilian requirements. The departmental submission to Cabinet in 1964 about the 1:100 000 program rested the case equally on the defence situation and the value of maps to Australia's national development. The submission referred to the Government's intention to speed up the development of northern Australia and to the use of maps in any programs to exploit potential mineral wealth and water resources.

237. Australia's economic development is far from being at an end and it remains a responsibility of the Commonwealth to ensure a national topographic map coverage at a satisfactory scale. Without doubt, maps at 1:50 000 scale are more useful than maps at 1:100 000 scale, but the question is whether the heavy additional costs of providing 1:50 000 maps is worthwhile if only to provide for civilian demands.

238. Natmap's claim to have a firm civilian demand for 1:50 000 maps rests mainly on the results of a questionnaire

sent, in June 1984, to 24 Commonwealth departments and 31 statutory authorities. Thirty-six of the agencies responded and according to Natmap 73% stated they needed mapping data at 1:50 000 scale. After processing the replies in August 1985, Natmap sought to validate requests by direct contact with the responding agencies.

Deficiencies in the questionnaire

239. The questionnaire to which the agencies responded was, in my opinion, defective. Its overall effect was tantamount to inviting an expression of support for 1:50 000 maps since their advantage over 1:100 000 maps is obvious. The questionnaire did not seek to ascertain why agencies regarded existing 1:100 000 maps as being inadequate or the extent to which their official functions would be impaired unless 1:50 000 maps were readily available. Nor did the questionnaire attempt to assess the strength of the demand for 1:50 000 maps by asking agencies whether they would be prepared to pay a substantial part of the real cost of production as distinct from almost nominal across-the-counter sale prices. In 1984/85 sales of topographic maps recouped only about 11% of Natmap's annual budget costs. One customer prepared to pay full price for its maps is Defence to whom, of course, the questionnaire was not addressed.

240. Perusal of individual responses casts doubts on Natmap's overall assessment of the results. Several respondents expressing a need for 1:50 000 mapping were unaware that maps suiting their purposes were already available from other sources such as the States. Others expressed a demand out of all proportion to the use for which the maps were to be put. For example, valuation branches of the Australian Taxation Office wished to have maps to assist them in identifying properties to be valued for taxation purposes. Other replies were misinterpreted. For example, the Attorney-General's Department response was read as requiring 1:50 000 maps in providing legal advice on jurisdictional limits. Perusal of the response, which was also interpreted as requiring maps for the entire Australian coastline, showed that the Department could be called upon to provide legal advice on State boundaries and other jurisdictional questions in coastal waters. Maps were required only if they revealed relevant features, especially low tide elevations. 1:50 000 scale mapping would not reveal the information the Department sought. This is not to say that the responses as a whole should be disregarded, rather it exemplifies the difficulty of assessing consumer demand so far as it comes from Government agencies.

241. It is convenient to divide requests into areas which lie outside the red line and areas within it. For certain areas outside the red line several agencies requested mapping. Where such is the case it is easier to accept that there is a legitimate official demand justifying an expensive mapping program than where the request comes from

only one or two agencies. Outside the red line, most of the multi request areas are already covered by State maps or are on State mapping programs at equivalent scales. Principal areas of exception are parts of Queensland, which is to be expected since Queensland does not do series mapping, and the Northern Territory.

242. In all, according to Natmap's assessment, there was the equivalent of 493 1:100 000 areas outside the red line for which one or more confirmed requests were received and for which there were no State mapping programs. This is equivalent to about 1970 maps at 1:50 000 scale.

243. Inside the red line, that is in the arid inland areas of Australia, according to Natmap, there were requests covering 420 1:100 000 areas or approximately 1,680 1:50 000 maps. Since Natmap was not proposing to print 1:100 000 maps inside the red line area it is rather surprising that there should be an extensive consumer demand for 1:50 000 maps inside the red line. Examination of the requests, though incomplete, reveals that most of the 420 1:100 000 areas were the subject of a single request and for most of the rest requests came from only two agencies. The principal potential customer was Telecom which sought cover for 314. According to the return of the Supervising Draftsman in the Engineering/Services Branch of Telecom in South Australia topographic maps were required in conjunction with Telecom's digital radio concentrator systems and remote area projects. He said mapping at 1:50 000 scale was preferable but Telecom would appreciate whatever mapping was available. A request from a commercially oriented authority such as Telecom for the assistance of topographic maps, preferably at 1:50 000 scale, in the location of its transmitter receivers and other telecommunications equipment, cannot reasonably be taken to justify the extensive mapping proposed inside the red line.

Matching civilian demand with the Defence program

244. Appendix G is a map of Australia depicting Natmap's interpretation of civilian demand according to the questionnaire. The areas coloured blue are either already mapped at 1:50 000 by the States or RASvy or are on current State programs. The areas coloured yellow are those remaining to be done. Within the red line, areas to be mapped are marked according to the number of requests received. In the Northern Territory and Queensland areas lying outside the red line are also marked according to numbers of requests received. If the entire Defence mapping program is taken into account most of the areas coloured yellow in the map depicted in Appendix G will also be covered by the RASvy program.

245. A civilian program based on Natmap's interpretation of the responses to its questionnaire could be accommodated along with the Defence mapping program for most of the areas coloured yellow, that is to say the areas remaining to be

mapped but not on any official civilian program. In some areas there could be uncertainty or conflict as to the mapping priority accorded an area by Defence and a confirmed Commonwealth civil agency demand. Problems such as these could be resolved as they arise in any future arrangements for sharing the program.

Map revision and digital data

246. Some questions were addressed to the revision of maps and one asked how up to date map information needed to be. Most of the replies ticked the first box meaning that map information should be 1-5 years old and not more. No Government could afford to commit itself to a 1:50 000 program with such a truncated period of revision. In many areas revision would be unjustified at less than a 10 year interval.

247. It emerged from the replies that more than three-quarters of the agencies wanting 1:50 000 mapping also wished to have data in digital form usually to integrate with their own digital thematic data. State Surveyors-General have also noted the growing demand from public authorities and industry for topographic data in digital form.

Conclusions

248. Undoubtedly most of the Commonwealth agencies which responded affirmatively to Natmap's questionnaire would make good use of larger scale maps than are currently available but the demand is incapable of precise specification or quantification. The responses to the questionnaire do not establish a sufficient case for mounting a comprehensive 1:50 000 series program especially within the red line area.

249. In 1965 when Cabinet approved the 1:100 000 program the case did not rest on a specific Government agency demand but on coupling defence needs with those for maps to support a range of national programs which could reasonably be expected for the development and utilisation of Australian natural resources. The need for the maps was seen as being both official and public and this would be true of 1:50 000 maps. The States, judged by their record, would also make use of Commonwealth series 1:50 000 maps . In Queensland and Western Australia the greater part of each is not covered by State topographic mapping programs and there is virtually complete dependence on Commonwealth mapping for the sparsely populated and undeveloped areas. This is true too of the Northern Territory where series topographic mapping is far beyond the resources of the Territorial Government. It would be unique for a country as large as Australia with continuing potential for economic and social development to have a national topographic mapping program resting entirely on the possibility of the invasion of its territory.

250. A careful analysis of Defence's budget submissions seeking approval in 1981 for equipment would have shown that RASvy was about to embark on an extensive mapping program but consideration of the budget papers did not lead to any question about it from any official source. In 1965 the Cabinet Submission for approval of the 1:100 000 program was the work of the Department of National Development. It stated that the Department through Natmap was specifically charged with the responsibility for mapping and for co-ordination of mapping activities on a national basis and that the Minister for Defence had concurred in the proposal. Twenty years later Defence has implemented a much more costly program without regard to any national interest other than its own and without seeking Cabinet approval.

251. In my opinion the program should have been the subject of a specific Cabinet Decision. The fact that it was not was as much the responsibility of the Department of Resources and Energy as the Department of Defence. It does not, however, mean the foreclosure of the issue. The program is in the early stages of accomplishment and on Defence calculations not less than a quarter of a century remains before completion.

252. The development and exploitation of Australia's natural resources has not come to an end. There is a civilian demand for 1:50 000 mapping and changes in economic circumstances or new directions in Australian development could lead to an increased demand for the maps from Commonwealth agencies and interested business and service groups in the community. This is a more likely happening than a military invasion of Australia.

Recommendations

253. I RECOMMEND that a program of 1:50 000 series mapping be submitted to Cabinet for specific approval in the combined interests of defence and national economic and social development. The program should comprise the parts of Australia covered by the six Defence priorities and allow for mapping in additional areas where a clear civilian demand emerges and resources permit.

254. In the four concluding sections of this report, I will suggest different ways of handling the program. All would require Cabinet action. One decision, applicable to all, which I think Cabinet should make, is that the entire 1:50 000 program be completed by 2000.

Section 10

TOPOGRAPHIC MAPPING IN CANADA

Similarity to Australia

255. Canada is in several important features analogous to Australia. It has a relatively small population in a country of large scale geography. The population is unevenly distributed with heavy concentration in southern urban areas and much of the remote parts of the country remains to be developed. Canada is a Federal country and like Australia its written Constitution does not vest the central Government with express mapping and survey powers. The central Government and all provinces engage in mapping.

256. From 1947 to 1967 national mapping in Canada was a joint military and civil responsibility shared by the Directorate of Military Survey and the Army Survey Establishment in the Department of National Defence and the then Department of Mines and Technical Surveys.

National mapping by a civilian agency

257. In 1966, following a conference of map users, Federal and Provincial representatives agreed that there was a need for a national series of topographic maps at 1:50 000 scale to meet an increasing demand for maps for resource development, urban areas and defence. A Federal mapping program then commenced in the charge of the Surveys and Mapping Branch of the Department of Energy, Mines and Resources. The staff of the Branch totalled 907 in 1985/86 of whom 263 were employed in the Topographic Survey Division. The staff is entirely civilian. The operating budget in the same year was $16.8 million of which $2.5 million was allocated towards an aerial survey data base for new mapping and $3 million for new 1:50 000 mapping.

258. The possibility of Canada suffering hostile military intrusions is more remote than in Australia and in defence planning the presence of the United States along the entire southern border of Canada introduces a factor in Canada's favour which has no equivalent in Australia. Nevertheless the Department of National Defense (DND) in Canada is intent upon satisfying NATO's mapping standards and is prepared to accept a civilian product. The maps are being produced at standard 1:50 000 specifications. The national program is far from being completely digital but over the past few years there has been a steadily increasing digital component.

Use of private contractors

259. Almost all the work is now contracted out and little topographic map production is undertaken in-house. Thirty-two aerial survey firms have organised themselves into four

consortia under the umbrella of the Canadian Association of Aerial Surveyors. This apparently suits the Surveys and Mapping Branch (SMB) because it only has to examine four bids before a contract is let and the consortia are regarded as being strongly competitive. In 1985/86 $4 million was spent on contracts with the private sector of which $2.1 million was on topographic mapping. SMB also has its maps printed by commercial printers. To date about two-thirds of Canada is covered by published 1:50 000 maps. In all there will be 13,150 maps at that scale.

Mapping and Charting Establishment in DND

260. DND does not engage in map production except for training purposes in areas of DND interest such as the Arctic Islands. In DND there is a Mapping and Charting Establishment (MCE). MCE has a peacetime establishment of 185 persons: about two-thirds are military and one-third civilian. It is a military unit training in peacetime for its wartime role which is to provide special products required by the Canadian armed forces users not available from other sources and to provide the Army in the field at division level and higher with combat mapping support. MCE is organised into a field-deployable topographic squadron and a base plant. In the event of war, the topographic squadron would be assigned to the Army and join with its military counterpart to form a regiment. Like RASvy, the base plant would continue to operate, reinforced by recruits from industry.

Relationship between the civil and military departments

261. Through the good offices of the Department of Foreign Affairs, I addressed several questions to the two Canadian Departments in an endeavour to ascertain how the arrangements worked. Each advised that full effect was given to Defence needs, for example map design standardisation and specifications, through liaison committees. The committees, most of which were chaired by SMB as the national lead agency, worked well and without any suggestion that one agency was subject to the control of the other. According to the Department of Energy Mines and Resources, there was full cooperation with Defence and no recorded instances of lack of support to Defence by SMB. MCE and SMB are located in the same building in Ottawa. DND confirmed the position, stating that a spirit of cooperation prevailed e.g. the two mapping agencies lent each other equipment and materials. They were continually exchanging ideas and technology.

262. I had heard from RASvy quarters that the Army in Canada had misgivings about the allocation of mapping to a civilian department, but if there are misgivings, neither Canadian Department chose to refer to them. Without doubt, the official Canadian view is that the program is working well. I have the impression that it will be completed at a much lower cost than the Australian 1:50 000 program in the hands of Defence.

Section 11

STEREOPLOTTING - DIGITAL AND GRAPHIC

Competing policies

263. RASvy is prepared to accept State maps for the 1:50 000 program although they may be the product of graphic stereoplotting and it digitises State maps by its raster scanner. At the same time RASvy might want to re-map areas of State mapping when it has completed its first cover mapping. Almost all State maps are for areas outside priorities 1 and 2.

264. Natmap as an exponent of graphic stereoplotting regards maps produced by the process as being adequate for all needs, including defence. This may be so but a printed map no longer meets all Defence's mapping requirements and amongst civilian users especially Government agencies, there are increasing demands for digital topographic mapping data irrespective of the cartographic map. Natmap's answer is that maps compiled graphically with scan digitising in mind and then scan digitised serve the purpose. As mentioned earlier, Natmap is about to incur a further commitment to scan digitising by purchasing a raster scanner and associated equipment

265. At first, Natmap put to me that graphic stereoplotting followed by scan digitising was a generally preferred way of operating. In the end the principal argument was that the total process was cheaper than if maps were produced from digital stereoplotting. Nevertheless, the Director of Natmap also said that his agency would be prepared to embark on more stereodigitising if that were adjudged to be the preferable way to proceed.

Comparison of digital stereoplotting and graphic stereoplotting plus scan digitising

(1) Digital stereoplotting is slower

266. Experience in RASvy has shown that a conventional analogue stereoplotter can plot more photogrammetric models in a given time than a stereoplotter capturing digital data. The latter has more functions to perform. For example, the operator of the digital stereoplotter has to enter commands and responses that control the computer's acquisition processes and also enter a feature code for each feature to be recorded. The operator cannot commence recording a feature until the computer responds indicating it is ready to receive the data.

267. In digital stereoplotting, the operator also performs functions which in a conventional system are performed after the plotting phase, because digital stereoplotting is most

effective when the data being recorded is to a cartographic standard suitable for publication. There is, though, a resulting benefit in the reduction of field inspection and cartographic costs.

(2) Equipment costs

268. Most graphic compilation equipment which Natmap owns is old and well written down in value. Automap 2 will cost about $5.5 million at 1985 prices and in my opinion it was a sound economic decision to install the process. It will be seen in section 14 of this report that the equipment, as a component of the cost of producing a compilation, so far has not been high compared with labour costs. The raster scanner which Natmap will buy plus the requisite interactive editing stations and a verification plotter will cost about $4 million at 1985 prices. The total cost will be lower than Automap 2 would be at 1985 prices but I do not regard the difference in capital costs as being of great moment.

(3) Operating costs

269. Scan digitising is not yet a fully developed process and experience in its use in Australia is short. Not unexpectedly, I have not found it possible to say just how much raster scanning adds to the cost of a graphic compilation. I sought advice from RASvy and some State Surveyors-General. In the end I concluded that at 1985 price levels raster scanning probably adds about 35% to the cost of a graphic compilation. It does not follow that if compilation costs increase that raster scanning will continue to add 35% to the costs since there is a flat rate component constituted by the inbuilt productive capacity of the equipment itself.

270. Section 16 summarises my examination of RASvy and Natmap compilation costs including, for Natmap, total compilation costs where contractors are used. Digital stereoplotting emerges as a more expensive process than graphic stereoplotting followed by scan digitising whether undertaken by RASvy or Natmap. This may not however remain the position. The Central Mapping Authority of NSW (CMA) is in the business of undertaking photogrammetric mapping for State Government agencies. It has both digital and graphic stereoplotting capacity. Its scale of charges for digital compilations are 40% higher than for graphic compilations. If 35% is added for the cost of the scanning process, there would be little difference in the charges.

271. The Director of Mapping of CMA and his colleagues in other States believe that the total cost of a digital compilation, if only one scale of topographic maps is to be produced, will probably remain higher than the cost of a graphic compilation plus scan digitising but not much higher. If it were intended to produce derivative mapping at a different scale from the digitised compilation, the concensus of opinion is that total costs would work out in favour of digital compilation in the first instance. I have no reason to disagree with this view.

(4) Technical superiority of digital stereoplotting

272. The question arises if the program is shared whether Natmap should continue to embark on graphic stereoplotting to the extent that it has done in the past or at all. Defence is opposed to graphic stereoplotting with or without raster scanning. Digitising at the stereoplotter has distinct advantages. It makes an immediate contribution to a digital data base and data can be recorded in three dimensions. Elevation information may be recorded along the entire length of a feature supplementing the normal contour information appropriate to the scale. For example, elevations along a river may be shown and it is possible to extract road and river gradients directly from the digital data rather than having to rely entirely on contour intervals. Raster scanning however, produces data only in two dimensions. If a problem of interpretation of information arises, resolution is accomplished more effectively by viewing a three dimensional model under magnification at the stereoplotter, than at a computer work station looking at digital data produced by raster scanning plus a photograph.

273. When scanned, the recorded image of a document is a matrix of dots known as pixels. Individual features have to be identified and extracted from the pixels, a process known as vectorising. A feature code must then be applied to each of the features, the process being known as tagging. In practice working problems arise in vectorising and tagging, most of them being more readily avoided or resolved by initial digital stereoplotting.

274. Digital stereoplotting in the first instance is slightly more accurate than the graphic equivalent. The employment of scan digitising means that such inaccuracies as exist in a graphic compilation are repeated and of course, the scan digitising process cannot be made entirely error free. When revision of a map is to be undertaken a digital graphic compilation also suffers from a lack of point positioning information.

275. Advantages are not all one way, for example, errors are more easily identified and corrected on a graphic compilation. Nevertheless, I am satisfied that as long as a digital data base is required the better product comes from digital stereoplotting. This is not only the view of RASvy and the Naval Hydrographer but also of State representatives on the NMC.

Future policy for 1:50 000 program

276. At this stage raster scanning should not be rejected as being inadequate. Maps compiled graphically with scan digitising in mind may also eventually ease working problems so far encountered. The situation including Natmap's own

performance in scan digitising should be watched closely over the next three or four years.

277. It is not entirely logical but it would be good policy for the time being to have compilations for all the areas classified as priority 1 or 2 undertaken by digital stereoplotting. If experience shows that scan digitising meets all reasonable requirements it could continue to apply in areas of low priority. Cost savings are not, however, likely to be overwhelming.

Digital data base and access to it

278. Without exception mapping authorities in the States as well as Defence and ASO agree that the Commonwealth should have a comprehensive digital topographic data base which will enable the ready production of maps at different scales containing different varieties of data and providing information in digital form for the computers of specialised map users. The era of digital mapping is undoubtedly with us.

279. Defence is maintaining a digital topographic data base which is continuing to expand as the 1:50 000 program continues. If Defence is to be the principal digital storehouse for Commonwealth topographic mapping it is essential that the information be available for civilian as well as defence use. I understand that Defence has no objection in principle to the release of digital topographic data.

280. It would be fitting to make Natmap the channel through which official civilian demands, both State and Commonwealth, are channeled. As principal civilian mapping authority for the Commonwealth, Natmap could also process non-official civilian demands for digitally stored topographic mapping data.

281. In considering its future role, one suggestion being canvassed within DRE is that Natmap should develop and administer a comprehensive digital cartographic data base which would enable the storing and provision of topographic bathymetric, thematic and census data whether digital, cartographic or geodetic acquired through "Commonwealth-funded" programs. The proposal has implications for mapping and survey work by other Government authorities including ASO and the Naval Hydrographer. The proposed data base would also partly duplicate the role of RASvy's digital data base.

Section 12

COMPARATIVE MAPPING COSTS

The dispute between RASvy and Natmap

282. In reacting to the introduction of the 1:50 000 series mapping program, Natmap not only claimed to have responsibility which RASvy ignored but also that it was entitled to a share of the program because its mapping costs were lower than those of RASvy. Defence did not accede to the Natmap claim.

283. The Terms of Reference as agreed between the Departments required the joint review to identify the cost structure and productivity of the two mapping agencies for the production of topographic maps and derived products and to develop product cost indicators for use in assessing future program options.

284. In a joint letter dated 13 May 1985 to the Chairman of the Public Service Board, the Secretaries of the two departments stated that they had been unable to agree on the important question of a suitable methodology for assessing the true cost of each organisation's operations as a basis for rationalising the resources devoted to the overall Commonwealth mapping effort. Information made available by the two Departments at the time was quite inadequate and did not reveal the ideas which either harboured as to what amounted to true costs.

Annual and total costs

285. The costing issue centres almost entirely on the 1:50 000 mapping program since both smaller scale programs are nearing completion. The cost to the Commonwealth of covering most of Australia with 1:50 000 maps can be looked at from different viewpoints.

286. If RASvy were to have sole control of the program it would in its own good time presumably complete it at more or less similar levels of annual expenditure as now. In this event unless Natmap could find alternative work it could not sustain its existing levels of staffing after the completion of the 1:100 000 and 1:250 000 programs in 1988. Total Commonwealth annual mapping expenditure could thus be reduced by reducing the size of Natmap's staff as the current programs near completion.

287. If Natmap were to have an appreciable share of the program an immediate increase in its total expenditure might be needed. Natmap has suggested a sum of about $2 million to equip itself with more adequate digital stereoplotting facilities and improved photographic capability. Additional annual expenditure would also be entailed if Natmap made greater use of outside contractors than at present.

288. The annual cost to the Commonwealth of the 1:50 000 program cannot diminish unless fewer resources are employed on it. If the cost of producing maps in RASvy is higher than Natmap's costs annual cost savings would be achieved by reducing the Defence effort. This would entail a reduction in RASvy staffing levels commensurate with the extent of the share of the program given to Natmap.

289. If RASvy core force strength should, for one reason or another, be incapable of reduction there would be no savings in Commonwealth annual expenditure by reason of transferring part of the program to Natmap. However, the number of years for completing the program would be less than if RASvy were to undertake it relying only on its own resources. If Natmap should share in the work by reason of having lower map production costs, although total annual expenditure might rise a little, in the end the program should be achieved in a shorter time and at a lower total cost to the Commonwealth.

Confusion as to costs

290. An obvious way to approach the costing task was to compare the costs of the two agencies at each stage in map production. To make such a comprehensive comparative analysis of costs was plainly well beyond the resources available to me. In any event it soon became apparent that though the two agencies were engaged in the similar functions of producing topographic maps quite disparate considerations applied. When Natmap makes a map, it does so as a civilian map producing agency. RASvy, on the other hand, is a military organisation forming part of the Australian Defence Force. At different stages in map production military considerations can have an effect on the process. Natmap referred me to Operation Aright, an extensive control survey which RASvy carried out in the Cape York Peninsula in 1983. Natmap compared the resources it would have employed with those actually employed by RASvy showing a result to its advantage. For example in such an exercise Natmap would have used 20 personnel compared with 91 used by RASvy. Such comparisons overlook the fact that in undertaking field survey work for the production of a map, Army may at the same time utilise the occasion to train other military personnel not directly engaged in professional field process e.g. to give transport drivers experience in difficult terrain. I mention, nevertheless, that in civilian public mapping, ground control work for mapping is a large item comprising about 25% of total production cost of a map at 1:50 000 scale.

291. Other factors render it impractical to compare costs at some stages of the mapping process, at least until the program has reached an advanced stage. Aerial photography for example may be undertaken in large tracts for economic reasons. One result may be a long time lag between the photography and its use in later mapping stages. RASvy is compiling maps from aerial photographs produced three years

before. Further, unless the two agencies engage in aerial photography over similar areas, there may be too many variable factors to enable confident conclusions to be drawn. For instance, aerial photography in northern Australia, where RASVY has operated, is confined to the dry season whereas it may be undertaken year round further south.

292. A comparison of mapping costs according to the working methods of each agency runs the risk of confusing rather than clarifying questions of cost structure and productivity.

Decision to compare compilation costs

293. The complete mapping process can be divided in different ways. One is to divide it into the following phases:

Planning
Field survey
Aerial photography
Photogrammetric triangulation
Data processing
Compilation
Field inspection and completion
Cartography
Printing
Distribution

294. The difficulty of comparing costs of some phases of mapping and the need to conserve resources led my review to see if there could be a satisfactory comparison of the cost of compiling a topographic map in each agency.

295. Aerial photography is undertaken in runs in which each run of photography overlaps the previous run. Completed overlapping aerial photography then undergoes the process of aerotriangulation leading to the production of diapositives which are then viewed stereographically in pairs and selected points marked and measured in relation to each other. The process of compilation ensues.

296. The overlapping pairs of diapositives are set up in a stereoplotter which makes adjustment for inherent errors in aerial photography e.g. due to the tilt of an aircraft or earth curvature. When this operation is carried out a stereoscopic model is formed. The operator can measure horizontal and vertical co-ordinates of topographic detail within the stereoscopic model in relation to a known set of ground co-ordinates. He can then proceed to extract from the model the information required on a map. Information normally extracted includes hydrography (rivers, coastlines etc), culture (roads, buildings etc), vegetation and relief (contours and spot elevations). All information is combined with a grid and geographical projection.

297. In graphic stereoplotting a pantograph attached to the stereoplotter enables the operator to produce on a plotting table a draft map corresponding to the topographic detail evident on the aerial photograph.

298. In digital stereoplotting instead of producing a draft map, the operator digitises the information. In digital stereoplotting there is an attachment to the stereoplotter which enables all the topographic map detail available from aerial photographs to be recorded as digits in a computer instead of being depicted graphically on a draft map. The topographic information is digitised as the operator plots. The data stored digitally may then be produced in graphic form on a verification plotter. This enables errors and inconsistencies to be corrected and subsequently a hard copy graphic may be printed in different colours in the verification plotter for field checking. So far, digital stereoplotting has been more resource intensive than its graphical equivalent. The gap will become smaller as operators grow accustomed to digital techniques, but is unlikely to close.

299. The process of digital compilation accounts for up to 30% of the cost of producing a first cover map. Graphic compilations constitute about 20% of total map production costs. Compilation is a mapping phase more capable of rendering cost comparisons possible than most other mapping phases because particular military considerations do not greatly intrude into performance as they do in some other mapping stages such as field survey. Moreover, it emerged that it was about the only significant mapping phase other than printing in which the information available allowed an assessment of production costs within RASvy with any confidence. Thus I decided to cost the compilation activities of RASvy and Natmap. I was, of course, to find that the different operational procedure of the two agencies became an added complexity but it was possible to reach conclusions as to respective costs.

Printing costs

300. The printing of maps follows the completion of compilation and cartography. Printing comprises about 7 percent of the cost of producing a map and information was readily available to compare costs. RASvy maintains a complete printing establishment at Bendigo and Natmap almost invariably has its maps printed by the Australian Government Publishing Service at pre-determined rates.

Marginal costs

301. It did not emerge for a while that Defence would employ the notion of marginal costs to rebut Natmap's claims to having lower map production costs. The Defence argument was that the raison d'etre for RASvy was to provide military personnel trained in mapping and capable of serving in the field and supporting military operations in the event of hostilities on Australian territory. Good maps were

essential to defence and it made good sense for the Corps in peacetime to engage in productive work such as series map production instead of expending its energies in less useful ways such as map training exercises. The capacity to produce maps and to meet field force requirements could fortuitously be combined in a single force structure. Accordingly, the real cost to the Commonwealth of RASvy producing 1:50 000 maps is not to be gauged from a comparison of either the full or direct mapping costs of the two agencies.

302. Nevertheless, if Natmap's costs are lower than RASvy's, it would have a good case to share in the program as long as it does not preclude RASvy from using in map production in peacetime those resources it needs to have in order to fulfil its military obligations during an armed conflict.

Factors influencing the comparison of compilation costs

303. Because of differences in mapping policies and the fact that the two agencies have different programs it is useful at this stage to outline some of the factors which have to be taken into account in comparing compilation costs.

Stereoplotting

304. I have already discussed digital and graphic stereoplotting in section 11. I need only add that the four RASvy field survey squadrons at present engage only in graphic stereoplotting because they do not have the necessary digital equipment.

Complexity of a map

305. When a map is compiled there is firstly the production of contours and spot elevations depicting the terrain of the area being mapped. Secondly, there is a compilation of information which is depicted on a horizontal plane surface such as hydrography, culture and vegetation. This is known as planimetry.

306. A map may vary in complexity both vertically and horizontally. For example, large parts of inland Australia are flat and have few natural or cultural features. Some areas are mountainous but without culture whilst at the other extreme, there are heavily built-up mountainous regions such as the Blue Mountains in New South Wales. Natmap has a scale of complexity ranging from A for the most complex to E for the simplest and it employs the scale when it invites tenders from the private sector to undertake compilation tasks. Private contractors are familiar with the classification and there is rarely a dispute about its application to an area which is the subject of tender. RASvy also assesses complexity in five categories; these range from 1 to 5. Most of Australia falls into categories D and E (4 and 5). Natmap's compilations examined in the

costing exercise included category C, but, on average, they worked out at category D for contours and planimetry. Defence has accepted that the average complexity of its maps under study in the costing exercise was also category D.

Mapping scales

307. Since a larger scale map requires more detailed treatment of relief and planimetry it will cost more to produce. So far, Natmap has produced only a handful of maps at 1:50 000 scale. The great bulk of its production is at 1:100 000 scale. Most, but not all, maps examined were at this scale. RASvy has been a substantial producer of maps at 1:100 000 scale but henceforth most of its compilations will be undertaken at 1:50 000 scale even if the end in view should be a 1:100 000 printed map. Accordingly, it becomes important to determine how much more costly it is to compile maps at 1:50 000 scale than at 1:100 000 scale.

308. Four 1:50 000 maps are needed to cover the same area as a single 1:100 000 map. In areas of low complexity the disparity in costs as between the two scales is much less than for areas of high complexity. Published cost schedules of the Association of Aerial Surveyors of Australia and some State mapping agencies suggested that on average it would cost about 1.5 times as much to compile four maps at 1:50 000 as one 1:100 000 map. Other estimates by Surveyors-General were up to twice as much for the more complex areas. It was my good fortune that the Central Mapping Authority of New South Wales examined the position in some detail for me. CMA performs work under contract for other agencies at varying scales. The Director, Mr Frank Urban, concluded that for the areas proposed to be mapped at 1:50 000 scale, it would cost on average 1.75 times more to compile maps at 1:50 000 scale covering the same area as a single 1:100 000 map. Other Surveyors-General concurred. RASvy and Natmap have accepted the cost ratio as generally applicable to my examination of respective mapping costs.

Use of private contractors

309. Review of its activities has revealed the heavy dependence of Natmap on the production of compilations by private contractors, a policy which RASvy has largely eschewed. Particulars of Natmap's contracts were available enabling a ready assessment of the performance of private contractors. As will be seen, the private sector is prepared to undertake digital or graphic compilation work under contract at a lower cost than Natmap can do the work in-house.

Accuracy standards

310. RASvy indicated it wished to employ 1:25 000 accuracy standards in much of its future 1:50 000 mapping although so far it had not usually done so. This is a complex subject and I will deal with it in the next section (section 13).

Section 13

ACCURACY STANDARDS : 1:50 000 SCALE MAPPING

Advantages of 1:25 000 accuracy specifications

311. RASvy has compiled several standard maps at the normal standards of accuracy for 1:50 000 scale normal, i.e. +/- 25 metres circular or horizontal accuracy and +/- 10 metres linear or vertical accuracy. After some vacillation Defence decided it should employ 1:25 000 accuracy standards specified for class A mapping in the map Standardisation Agreement of the North Atlantic Treaty Organisation known as STANAG 2215. This means working to +/- 12.5 metres horizontal accuracy, and +/- 5 metres vertical accuracy.

312. Accuracy standards do not dictate contour intervals but it is a rule of thumb that contour intervals will be about twice the figure specified for relief accuracy. RASvy decided at the outset that contours should be expressed at 10 metre intervals. In practice, a contour interval will vary according to terrain. In flat country it might be expedient to express contours at 5 metre intervals and in very hilly country at 20 metre intervals. Natmap's 1:100 000 scale maps employ 20 metre contours, though a normal interval for the scale would be 40 metres.

313. To map at a particular scale using the accuracy specification of a larger scale has the advantage that a map at the larger scale can be produced by capturing further data from the aerial photography as the need arises. It also means that data extracted from the digital data base may be availed of for various purposes on the assumption that 1:25 000 accuracy specifications are employed. Since digital data comprises data on a magnetic tape it is largely independent of scale and can be reconverted to lines at whatever scale the producer requires.

Additional cost of using 1:25 000 standards

314. Substantial additional costs are incurred in mapping to 1:25,000 accuracy standards, arising mainly from having to employ an increased scale of photography. 1:80 000 scale photography is used in usual 1:50 000 mapping but RASvy employs 1:65 000 scale photography to achieve 1:25 000 accuracy standards. Additional costs arise because aircraft must fly from about 1850 line kilometres to about 2500 line kilometres per 1:250 000 block and the number of photographs increases from about 400 to about 660. More survey controls are needed, for example whereas 10 horizontal control points are sufficient for 1:80 000 scale photography, 16 are needed for the higher scale. Aerotriangulation costs rise because of the number of photogrammetric models for a 1:250 000 block increase from 200 to 330. The increase in number of models further means that stereoplotters have to set up 65% more models.

315. RASvy is able to absorb some of the additional costs in aerial photography and ground survey because of the special arrangements it has with the RAAF for aerial photography and the employment in survey operations of radio operators, drivers, cooks, mechanics, pilots and logistic and operational support staff from other parts of the Defence Force in order to gain experience. Nevertheless, the additional costs are real.

316. After conferring with Defence, Natmap and Commonwealth and State Surveyors'-General I concluded that 1:50 000 maps produced according to 1:25 000 accuracy standards would, on average, cost between 1.3 and 1.4 times, say 1.37 times, as much as a map produced according to the usual 1:50 000 specifications. I understand that my conclusion is not challenged by either Defence or Natmap.

317. Photography at a scale of 1:65 000 using a camera fitted with a super-wide angle lens cone means that the aircraft must fly at an altitude of about 5,750 metres (20,000 feet) above the terrain. A question arose as to whether 1:25 000 accuracy specifications could in fact be achieved at this level of operation. Natmap considered that 1:40 000 scale photography should be used. A decision to increase the scale of photography has substantial cost effects. For example, increasing the scale to enable 1:60 000 scale photography would increase the number of photogrammetric models from about 330 per 1:250 000 block to about 430.

318. The optimum scale of photography for a given map accuracy depends on several diverse factors, for example, in the air, atmospheric conditions and camera characteristics and, on the ground, the type of aerotriangulation and stereoplotting equipment used. It is difficult to make a definitive statement on the adequacy of 1:65 000 photography but in Australian conditions the scale of photography which RASvy has adopted is, I believe, close to being marginal but generally adequate. The cost of operating at 1:40 000 scale photography would be quite unwarranted.

Are 1:25 000 standards necessary?

319. The question then arises as to why 1:25 000 specifications are necessary at all in mapping at 1:50 000 scale. Information which Defence supplied initially suggested that Australia had an international defence commitment to employ 1:25 000 specifications. The accuracy standards specified in STANAG 2215 were adopted in a document, QSTAG 546, which prescribed the mapping standards to be observed by agreement between the Armies of the United States, Britain, Canada, and Australia. In my opinion, neither STANAG 2215 or QSTAG 546 is open to the interpretation of requiring the application of higher standard specification to a 1:50 000 scale. If the contrary were true Canada would already be in breach of the agreements to which it is a party.

320. The case for the higher accuracy standard rests mainly on achieving maximum effectiveness from modern weapons. Weapons systems mentioned to me - AUSTACCS, TACTERM, WARCASTER and EWCAPC, were said to require a digital data base to operate them. Defence also advised that digital accuracy equivalent to the 1:25 000 scale was to ensure their maximum effectiveness and that the digital data used in the various weapons systems was of the same order of accuracy as the positioning equipment which would in the future, give the weapons an accuracy of no less than 1:25 000 levels.

321. There can be no doubt about the usefulness of a digital data base for military weapons and field operations. However the information I received was insufficient to educate me into believing that the effectiveness of modern weapons depend on 1:25 000 accuracy standards being employed in 1:50 000 mapping or that field capability will be significantly impaired by observance of normal 1:50 000 standard specifications. In any case, most of Australia included in the 1:50 000 planned coverage belongs to the fourth category of mapping complexity. It is mainly flat with few cultural features. In this kind of country the contours should be at 10 metre rather than 20 metre intervals but it does not require an application of 1:25 000 accuracy specifications to obtain 10 metre contours. The information available to me does not establish that modern weapons or field requirements in these areas of Australia will be appreciably affected if mapping is not undertaken at the higher accuracy standard.

Conclusions

322. My conclusions are that

(1) the case has not yet been established for total observance of 1:25 000 accuracy standards in comprehensively mapping Australia at 1:50 000 scale, and

(2) the employment of the higher accuracy standards is generally unwarranted in areas classified as category D or category E.

323. I acknowledge that I am not cognisant of all of the technical demands of current or likely future weaponry and field operations. If Defence demonstrates that I am insufficiently informed to express a firm conclusion, my further conclusion is that in the areas of Australia of lower mapping complexity, judgement should be exercised from time to time, as the occasion to map arises, as to whether 1:25 000 accuracy specifications are worthwhile having regard to the additional cost.

Section 14

RASVY COMPILATION COSTS

Decision to accept Defence's costing methodology

324. In my progress report last December I wrote that Defence did not accept the Executive Officer's methodology in calculating RASvy's compilation and printing costs. Defence believed that it attributed to map making costs, inputs not solely related to map making. First at issue was the addition of manpower on-costs to operations which arose because RASvy, as part of the Defence Force, had to fulfill military obligations not encountered in a civilian mapping agency. Thus, for example, when RASvy personnel engaged in physical training they did so not because they were engaged in making maps but because they were soldiers. Another area of disagreement, which assumed greater proportion as time went on, arose because Defence considered that the Executive Officer sought to add higher administrative manpower on-costs than were justified. I said in December that if we could not reach agreement we would exercise our own judgement about appropriate overhead costs.

325. Unfortunately disagreement persisted throughout the first three months of 1986 about methodology and statistics. Late in the day, I learnt that the Financial Services and Internal Audit Division of Defence (henceforth called FSIA) had provided a cost analysis and rather than allow further time to elapse, with agreement unlikely in the long run, I chose to accept the Defence statement as providing a sufficient basis for my purpose to compare costs with Natmap. Later, at my request, I received a supplementary expository document. For the sake of reporting, I combined the two documents into one making only adjustments needed for the two to be read uniformly and consistently. The resulting composite document, approved by Defence, appears as Appendix H to this report.

Military costs

326. My decision to use Defence's costing techniques does not imply that costs of a purely military nature should be put to one side. If the issue as to costs were to be directed towards assessing the relative efficiencies of RASvy and Natmap it would be unreasonable to debit RASvy with costs of a purely military nature. This, however, is not a principal objective of the enquiry into costs. Under the Terms of Reference, I must have regard to the most efficient use of Commonwealth resources to meet Commonwealth needs in the best possible way and purely military costs may properly be taken into account in assessing the future direction of the 1:50 000 program.

I have already mentioned that RASvy has to be of sufficient size to provide immediate mapping support to Australian military forces in the field if hostilities occur. If the peacetime size of RASvy is no larger than the core force

concept requires, its mapping costs can be treated as marginal but costs become real if the size of RASvy increases beyond the level of personnel needed to maintain the requisite core force . More to the point, if the Government should decide to accelerate the 1:50 000 program in the interests of defence or lower total mapping costs, or both, the cost of RASvy mapping activities vis-a-vis those of alternative sources of supply may be decisive. Suppose the Commonwealth wants to obtain 100 additional map compilations in a year with either Natmap or RASvy employing 10 extra mapping staff. If Natmap's full compilation costs are not higher than RASvy's production costs the work should go to Natmap. If it were allocated to RASvy it would mean the engagement of soldiers who have military duties not part of the mapping process but which have to be performed and of course at additional cost to the Commonwealth. Employment in Natmap does not entail significant additional costs not attributable to mapping. The reasoning applies equally in deciding whether to share the program between RASvy and Natmap. I will refer to some additional costs which flow from the military aspects of Defence mapping but, as will be seen, they are described separately from production type costs.

The Regiment and the Field Survey Squadrons

328. The Regiment at Bendigo and the four Field Survey Squadrons compile maps but according to different processes. The Regiment's compilations are digital but the Field Survey Squadrons do not have digital stereoplotting equipment and engage in graphic stereoplotting as undertaken in Natmap. The Regiment digitises graphic compilations of the Field Squadrons. The Regiment's work has to be separated from that of the Squadrons. On average, the output of the Squadrons is about one-quarter that of the Regiment.

329. Serious difficulties arose from the outset in seeking to determine the Regiment's compilation costs. Firstly, and surprisingly, separate records are not maintained in the Regiment to enable the costing of its many production activities, making it necessary to estimate the manpower effort required for the activities, including compilation. Secondly, to make an assessment of costs over an appropriate time interval it was practicable only for the year 1982/83. In earlier years, the Regiment's compilations were not wholly digital. In 1982/83 Automap 1 gave the Regiment a digital stereoplotting capacity but in the past three years, the introduction of the more comprehensive Automap 2 has temporarily reduced production.

330. More adequate records were available in the Field Squadrons showing the allocation of internal resources. At Defence's suggestion we confined enquiries to two of the four squadrons; 4 Field Survey Squadron (4 FSS) based in Adelaide and 5 Field Survey Squadron (5 FSS) based in Perth. Defence considered that the two would give an appropriate portrayal of squadron compilation activity. The other two squadrons, for different reasons, could not provide a fair sample of their work.

331. The Field Squadrons are not divided into units and for much of their time work away from their bases. Compilation is undertaken at base for only part of the year. By agreement with Defence we chose February-April 1985 for analysis. This was the period in which compilation formed a major part of the production activities of the two squadrons. In that production time 4 FSS completed the equivalent of 20 compilations at 1:50 000 scale but 5 FSS completed only four.

Compilation costs of the Regiment

(1) Manpower allocation

332. Whatever costing methodology is employed, the allocation of manpower to the functions to be costed has to be ascertained. The Regiment's activities assessed in man days are set out in a table appearing as Annexure D to Appendix H. The table divides the activities of military personnel directly engaged in producing maps into production and non-production activities. Non-production activities accounted for 45,733 man days. Man days spent on production activities were less at 41,867. The processes of plotting, compilation, digitising and editing which constitute compilation for the review's cost comparison, awarded to 13,600 days or 32.5% of total production activities.

333. I need to mention that the total of 87,600 man days for the activities listed in Annexure D is equivalent to 240 staff. In fact in 1982/83 and 1984/85 the Regiment on average consisted of about 295 personnel. The additional 55 persons have to be treated as not being engaged directly in map production. They were mainly commissioned and warrant officers and civilians employed in the Regiment.

(2) Manpower on-costs

(a) Non-effective benefits

334. Defence employs two levels of costing. The first, called direct cost, consists of salaries plus non-effective benefits known as NEBs. NEBs are the usual benefits accompanying employment and comprise retirement benefits (the major component), furlough, recreation leave, re-engagement bounty and annual leave bonuses. During the period under study the NEB rate was 60% of salary for officers and 42% for other ranks.

335. The second level of costing, called full cost, is direct cost plus two rates, one being a base support rate (BSR) and the other a general service rate (GSR).

(b) General service rate

336. The current GSR is $6,558 each serviceman per year. It represents the cost to the Department of providing employees with services of a general nature. They are described in Annexure C to Appendix H and include travel, office requisites, freight, medical services, transfer expenses and rent. There is a separate and lower GSR rate for civilians of $2,635. To both rates a 5% on-cost is added to obtain the full cost. The GSR appears to be reasonable and it does not call for any special comment.

(c) Base support rate

337. The base support rate is a loading applied to service salaries for support costs which include not only activities of a traditional administrative nature but the contributions of manual workers such as cooks and gardeners. The BSR used in the costing was $13,565 per servicemen per annum.

338. Defence advised that the BSR was derived from costing the separate elements of 9 RAAF base squadrons. Attempts to evolve separate BSRs for each service have so far failed partly because it is difficult to separate support elements from front line personnel in the Army and Navy. The decision to apply the RAAF rate as the BSR has, therefore, a substantial element of approximation.

339. The Executive Officer considered that the BSR was far too low. The rate applies uniformly throughout the Army and as FSIA acknowledged there are some Army units, particularly those of a specialised character, which have more administrative support than others. In my opinion the Regiment has a higher level of administrative support than the average for the Army as a whole but how much more I am unable to say. I understand that FSIA offered to undertake costing of the administrative support for the Regiment separately and I can only express my regret that the offer was not accepted. The BSR, which I have accepted for reporting purposes, consists of salaries, general expenses and NEBs. It does not include any part of the GSR.

(3) Average basic service salaries

340. The on-costs so far described are added to basic service salaries. In determining the manpower cost of the Regiment's compilation FSIA used an indicative rank structure of 1 captain, 5 sappers, 4 corporals, 1 sergeant and 1 computer systems officer. It applied the structure to the total number of personnel engaged in the work.

341. The full cost of all soldiers in each rank is first determined. Then the sum of the full costs of all ranks is divided by the total number of soldiers in the ranks to give an average full cost salary. This amount is divided by 250, (being the effective working days per annum) to give an average full cost per man day. From this the total manpower cost of the activity can be expressed in full cost terms. Paragraph 21 of Appendix H describes the process.

342. In 1982/83 the total cost of manpower employed directly at the compilation stage was $2,136,142.

(4) Consumables

343. These were costed at $55,000 for 1982/83. See paragraph 10 of Appendix H.

(5) Capital charges

344. Capital charges for the equipment employed are sufficiently described in paragraph 11 of Appendix H and in notes (3) and (4) of paragraph 21. In calculating capital charges FSIA used a methodology recommended by the Department of Finance specifying the factors for annual apportionment of capital cost depending on the expected life of the asset. Automap 1 was given a life of 15 years. In 1982/83 capital charges were calculated as being $142,400.

(6) Maintenance

345. Maintenance charges were for stereoplotters and Automap 1 and totalled $107,480 in 1982/83. See Appendix H paragraph 13 and note (5) in paragraph 21.

(7) Total compilation costs

346. Total compilation cost for 1982/83 was $2,441,022 as follows:

Cost summary
Compilation stage
Army Svy Regt: 1982/83

Cost component:	$
Consumables	55,000
Manpower:	
Plotting	186,830
Compilation	905,262
Digitising	403,490
Editing	640,560
Capital charges:	
Stereoplotters	10,090
Automap	132,310
Maintenance:	
Stereoplotters	6,480
Automap	101,000
Total	2,441,022

See also Table A appearing in paragraph 16 of Appendix H

347. In costing Natmap, as will be seen, emphasis is on costs in 1984/85 to produce a near current position. With this in mind I sought from Defence an adjustment of 1982/83 costs to take into account the increased salary levels of 1984/1985. The result was to increase the manpower salary bill by $492,161 and the cost of consumables by $15,658. Capital charges remained unchanged. Details of total cost were as follows:

Cost summary
Compilation stage
Army Svy Regt: 1984/5

Cost component	$
Consumables	70,658
Manpower:	
Plotting	229,670
Compilation	1,112,838
Digitising	496,010
Editing	787,440
Capital charges:	
Stereoplotters	10,090
Automap	132,310
Maintenance:	
Stereoplotters	8,325
Automap	101,000
Total	2,948,341

Further particulars of the cost summary appear in Table B at paragraph 17 of Appendix H.

(8) Regiment's compilation output

348. Costs have to relate to production. Troubles occurred in attempting to determine the Regiment's compilation output in 1982/83. Figures first supplied seemed to me not to be consistent with the RASvy progress report on Surveying and Mapping for the period 1 July 1982 to 30 June 1983. I had discussions with the author of that report, the then Director of Survey Col. Hillier, Defence representatives and the Director of Natmap. Eventually a set of production figures emerged which I believe are acceptable.

349. Maps and charts compiled in 1982/83, as in other years, consisted of products of different species and scale. To convert all to an equivalent 1:50 000 scale I employed ratios agreed upon after discussion with Defence. The total production was 358 maps and charts details of which are as follows:

Regiment
1982/1883 compilation output
Adjusted to equate to 1:50 000 scale

Product	Number	Ratio applied	Equivalent number at 1:50 000
Joint Operation Graphic(JOG) (1:250 000)	70	1.5:1	105
JOG (Air) produced from JOG above	66	.1:1	7
1:100 000	16	1:.44	36
1:100 000 (revised edition)	13	1:.44 and .35:1	10
1:50 000	85	-	85
1:50 000 (revised edition)	47	.35:1	16
1:50 000 orthophotomap	230	48:118	94
Miscellaneous	5	-	5
Total	532	-	358

350. Defence enunciated a proposition that I should treat the Regiment's compilation output as also including "a number of reasonably well-defined intangible products". These included trained military mappers for the Defence Force and the Defence Cooperation Program, research and development in the surveying and mapping processes for Defence purposes, liaison and exchange of information with overseas mapping organisations and the provision of practical task oriented experience under field conditions for a variety of non-RASvy personnel.

351. Leaving aside the slight conceptual misgivings I have about producing an "intangible product" or the question whether a surveying member of the Defence Force should be deemed to be a product, I agree that personnel engaged in all phases of map production may acquire skills which can be used elsewhere in Defence. Such benefits as those described defy Benthamitic quantification but there is something more fundamental to be said. The argument imports the desiderata which Defence was at pains to have this review disregard when costing RASvy. Compilation can be performed equally well at Bendigo by civilians who do not incur military type costs. Defence personnel on the other hand only gaze successfully into stereoplotters and go about other

compilation work after acquiring sufficient skill in the first instance in map compilation. In RASvy the skill is usually and largely obtained from training provided by the School of Military Studies at Bonegilla and not at institutions external to Defence.

352. If the benefits of practising map compilation are to be included in production, the cost of obtaining the military personnel to engage in the activity in the first place must be debited against the output. The School of Military Studies is liberally staffed. It numbers 48, which is more than half the number of regimental staff engaged in map compilation. In a cost/benefit study its full cost would weigh heavily against the benefits which flow from practising compilation. To assess benefits arising from the process seems to me, therefore, to be a wholly unproductive exercise. Even Commonwealth civilian mappers possess skills by reason of their work which can be used beyond their immediate employment in Natmap. Compilation is, in any case, a base activity and soldier mappers entering the field of hostilities will leave their stereoplotters behind them.

(9) Average cost of compilation by the Regiment

353. The 358 compilations produced in 1982 cost on average $6,818 each. With salaries adjusted to 1984/85 levels the average cost of each compilation was $8,236.

(10) Military costs

354. At risk of being misunderstood I shall refer to the additional costs involved in having soldiers engaged in map production. Such costs are relevant, as I have said, in deciding whether to allocate part of the 1:50 000 program to a civilian organisation such as Natmap.

355. The table appearing as Annexure D to Appendix H identifies three items as non-production activities which arise purely because of the military nature of RASvy and directly affect the soldiers engaged in compilation. These are non-technical military training, sport and physical training, and other non-technical activities. If the total man days for these were aggregated and apportioned on the footing that 13,600 man days were expended on compilation in 1982/83, the result would be to add 26.8% to the salaries bill. The total cost of the compilation stage would then rise from $2,441,022 to $3,015,245. The resulting average cost for each product would be $8,422 instead of $6,818. A corresponding adjustment would bring the average cost of a compilation in 1984/85 salary terms to $10,209.

Compilation costs of 4 and 5 Field Survey Squadrons

356. FSIA used the same method to calculate FSS costs as it employed for the Regiment and I will not, therefore, describe them again. Details appear in Appendix H.

357. Annexure E to Appendix H specifies manpower allocation in the two Field Survey Squadrons in February, March and April 1985. It shows that 4 FSS expended 951 days in completing its 20 compilations and that in 5 FSS 580 days were utilised in producing four compilations.

Total production costs were as follows:

Cost component	4 FSS $	5 FSS $
Consumables	10,000	8,000
Manpower	202,564	123,540
Capital charges	2,270	1,766
Maintenance	1,793	1,395
Total	216,627	134,701

See also Table D set out in paragraph 19 of Appendix H.

(1) Average cost of each graphic compilation

358. The average cost of a compilation for 4 FSS was $10,831 and for 5 FSS was $33,540. The disparity is partly due to the different ways in which Squadrons go about their work. Compilations for all four Squadrons vary substantially from year to year. Further, 5 FSS produced 12 compilations in 1984/85 but only completed four within the three-monthly prescribed period.

(2) Average cost of a compilation with raster scanning

359. In costing Natmap's graphic compilations in order to provide a proper basis of comparison with the Regiment's digital compilations, I added 35% to the average cost as being a rough estimate of the additional cost of digitising the graphic product. Digitising occurs at Regiment, but so far it is not able to provide advice as to the cost function. In the absence of advice it is appropriate to add the same percentage to the cost of FSS graphic compilations. The addition of 35% raised the cost of a compilation of 4 FSS to $14,622 and of 5 FSS to $45,279.

360. The performance of 4 FSS in producing 20 maps was twice the average squadron output for a similar period over the past five years suggesting that the average cost of compilation for the Squadrons as a whole is about a mean between 4 and 5 FSS costs i.e. about $28,000 - $30,000 a compilation.

Military costs

361. If the military costs I mentioned in costing the Regiment were applied, there would be a further increase in squadron costs. It seems like piling Ossa on Pelion but they would add $1,114 to each compilation of 4 FSS and $4,633 to each 5 FSS map.

Compilation by Field Survey Squadrons - Is it worthwhile?

362. The costs of the Squadrons' products are breathtaking. Yet if compilation activity serves to occupy the Squadrons because there is no worthwhile alternative pursuit, whether productive or unproductive, the costs are marginal and the Squadrons can be left free to plot away. Any output so gained will contribute to a shortening of the 1:50 000 program which in itself is a worthwhile Defence objective.

363. Purely in terms of cost, if the time which the Squadrons put into compilation can be used profitably on alternative work, they should discontinue working on compilations. I am informed, however, that the activity allows members of the Squadrons to maintain a mapping skill of field value during hostilities when members of the Squadrons would be first called upon to provide support. At first sight the argument is attractive but on examination it loses much of its substance. Stereoplotting and associated compilation work is a function performed at base and not in the field. Experience in stereoplotting is also gained by members of the FSS through the policy of rotating them through the Regiment on three-yearly postings. I will make further comments about the role of the Squadrons in section 18 which considers a proposal to install Automap 3 which would give them digital stereoplotting capacity.

Section 15

NATMAP COMPILATION COSTS

Four processes

364. Natmap laid claim to share the 1:50 000 program mainly on the ground of having lower overall map production costs than RASvy. The claim extends to costs of compilation. If its compilation costs are lower without doubt Natmap's total production costs will also be lower. I do not understand it to be in dispute that Natmap's costs for field work and aerial photography are beneath those of RASvy because Defence utilises these two earliest stages of map production also for the wider purpose of training additional military personnel to those normally forming part of the Corps. Further, evidence does not suggest that photogrammetric triangulation and data processing, undertaken before compilation, are any cheaper when performed by RASvy than by Natmap. Two steps in map production follow compilation, namely cartography and printing. The inquiry into map printing costs will be seen to come out substantially in favour of Natmap. As to cartography there is a reservation to be considered later affecting Natmap but any difference in cartographic costs has little bearing on the overall position.

365. As mentioned, Natmap compiles some maps in-house but as much as 80% of its compilation work is contracted out to private industry. All stereoplotting whether undertaken in-house or by contract was graphic until 1982. Since then, Natmap itself or through contractors has employed digital processes in compiling maps at 1:50 000 scale in areas of particular defence or State interest in the course of completing the program of 1:100 000 topographic series.

366. Accordingly, compilations undertaken internally have to be costed separately from those making use of the private sector and digital stereoplotting has to be separated from graphic stereoplotting in both cases.

367. The graphic compilations of Natmap and its contractors are outside a digital program but they can be digitised through either of two processes - table digitising or raster scanning described in section 11 of this report. Natmap will have a much developed raster scanning capacity by 1987. The cost of raster scanning has to be added to the cost of Natmap's graphic compilations both in-house and by contract in order to afford a fair comparison of cost with the Regiment's digital output.

368. If it is accepted that the compilation of maps by digital stereoplotting in the first instance is to be preferred the appropriate cost comparison will be between the cost of digital compilations of RASvy and the cost of first instance digital mapping by Natmap itself or Natmap using private sector contractors.

Approach to Natmap's costs

369. Natmap made available particulars of man days spent per year in stereoplotting and associated compilation work. The records revealed not only the prices paid to contractors in undertaking various compilation processes, but also the costs incurred in the preparation of contracts and supervision of contractor work. Unlike the Regiment's, whose activities were costed in 1982/83 with adjustments being made to cost the 1982/83 output had it been undertaken in 1984/85, Natmap's activities could be costed separately for 1982/83 and 1984/85.

370. The Executive Officer, who undertook the costing of Natmap's operations on my behalf, decided that "stereoplotting" as separately identified in Natmap records constituted Natmap's compilation function and he exercised judgement as to which functions should be included in production and those which should be treated as overheads.

371. It is sometimes a moot point as to where the dividing line lies between a direct production activity and one which should be categorised as a support activity. It occurs in the compilation of maps. The Executive Officer included in support activities functions which I would have included as steps in production, for example, resources spent on compilation development and electronic data processing support for digital operations. His view seemed to Natmap and myself to set overheads at an artificially high level which was inadvisable especially in the light of Defence's own approach to costing. I began a review of Natmap's costs using a broader base but I abandoned the attempt after finding that the records as to manpower utilisation were identified in such a way as to preclude the development of a satisfactory cost structure without much further work which I did not have either the time or capacity to do. I yearned for the services of a cost accountant or person of similar ilk as I embarked on the alien field of statistics. I am fairly satisfied with the results but this type of supererogation used up time which I should rather have spent on formulating recommendations.

372. Since the bulk of Natmap's compilation work is contracted out the number of persons calculated to be involved in production is small by comparison with RASvy. For 1982/83 the Executive Officer identified only 6 personnel directly engaged in compilation and 7 in 1984/85.

373. It came to my notice in the more recent days of report writing, that Natmap separately itemised personnel costs for what was described as "pre-inspection update", a function undertaken after stereoplotting but before field completion. Examination of the activity led me to conclude that it was, in part, equivalent to editing which was included in RASvy's compilation costs and should therefore be included in Natmap's costs. Natmap advised me that the equivalent of 3 persons in 1982/83 and 4 in 1984/85 were engaged in pre-inspection update.

374. Appendix I contains four tables each setting out in summary form Natmap's compilation costs according to its four processes. The tables are as follows:

Table 1 - internal digital
Table 2 - internal graphic
Table 3 - contract digital
Table 4 - contract graphic

The tables do not contain the costing of pre-inspection update. These costs are set out later in this section of the report.

375. It is convenient to deal first with the costing processes for Natmap's internal compilation activity according to the various components identified by this review.

Costing Natmap's internal compilations

(1) Personnel directly engaged in compilation (other than pre-inspection update)

376. As mentioned the equivalent of 6 persons in 1982/83 and 7 in 1984/85 were identified as being directly involved in production.

377. The usual figure of 250 work days per person per year was adopted that figure being 365 less weekends and public holidays. Thus the personnel resources available for direct production activity in 1982/83 were 6 x 250 = 1500 days and in 1984/85, 7 x 250 = 1750 days.

378. The next step was to learn from Natmap's records the personnel resources in fact directly applied to the four earlier described compilation processes, that is to say, graphic compilation in house, graphic compilation using contractors, digital compilation in-house, and digital compilation under contract. In contract work the estimate of resources employed was in the ratio of 2.2 man days for a digital compilation to 1.5 man days for a graphic compilation plus .2 percent in each case for contract administration.

379. Resources were distributed as follows:

Production days	1982/83	1984/85
Internal digital	385	477
Internal graphic	244	458
Contract digital	151	135
Contract graphic	265	260
Total days	1045	1330

(2) Personnel overheads in compilation

(a) General personnel overhead

380. It then became possible to determine a percentage general personnel overhead applicable to all four compilation procedures by taking the difference between the number of days of actual production and the number available. Thus in 1984/85 420 days out of 1750 were non productive constituting an overhead of 31% on the 1330 actual production days. In 1982/83 it was 44%.

(b) Compilation development

381. Natmap's records also showed that in each of the three years costed, the equivalent of a half man year, i.e. 125 days, were expended in each year on compilation development. These were divided equally between internal compilations and contract compilations on the other. The 62.5 days so allocated to each were taken as a percentage of the total number of production days for internal digital and graphic work and digital and graphic contract work respectively. The percentage thus ascertained was added to each process. In 1984/85 this resulted in an addition of 7% in personnel overheads to internal digital and graphic compilations and 16% for digital and graphic contract compilations.

(c) Compilation records

382. The Executive Officer included the equivalent of two persons in the provision of electronic data processing support described below. However, Natmap records showed only one such person and listed the other as providing compilation records support. Accepting Natmap's account, a problem arose as to the allocation of the records support to the four compilation processes. On any approach, there were arbitrary elements. With Natmap's agreement I divided the support equally between internal work and contract work. Then having regard to the fact that digital compilation was undertaken originally at 1:50 000 scale, I proceeded to allocate man days roughly according to whether the compilations were digital or graphic.

383. Applying the formula, I allocated in respect of each of the two years 85 days for internal digital compilation and 40 days for internal graphic compilation. Similarly, I allocated 70 days for contract digital compilations and 55 days for contract graphic compilations. Expressed as percentages on the production days for the four processes the following on-costs have to be added:

	1982/83	1984/85
	%	%
Internal digital	22	18
Internal graphic	21	17
Contract digital	9	7
Contract graphic	23	19

(d) EDP support

384. Natmap also used the equivalent of one person i.e. 250 man days each year, on the provision of electronic data processing support. Naturally these resources had to be added to the personnel overheads for digital compilation whether undertaken in house or by contract but, of course, not for graphic compilations.

385. The Executive Officer assessed 80% of EDP support as being utilised for internal digital work and 20% for contract work. The additional overhead for the two working processes applied according to the actual working days for each. Thus, in 1984/85 the attribution of 200 days to the 477 days expended on internal digital compilation gave a resulting overhead of 42%. In the same year the application of 50 days to the 135 working days for digital contract compilation gave an overhead of 37%.

(e) Total internal personnel overheads

386. The four overheads described under (a), (b), (c) and (d) above were combined to give total personnel overheads for digital compilations undertaken in house and by contract. Three, i.e. (a), (b) and (c) were combined to give a similar result for graphic compilation work. The position was as follows:

	1982/83 %	1984/85 %
Internal digital	128	98
Internal graphic	75	55
Contract digital	104	91
Contract graphic	82	66

(f) Personnel on-costs additional to internal personnel overheads on compilation production

387. There are additional personnel costs within Natmap and its parent department as well as costs external to both, usually described as personnel on-costs. These cover employer superannuation contributions, provision of accommodation and office costs. There are also costs incurred for non-assigned staff, that is staff not specifically engaged in compilation activities but who provide support for staff so engaged. They are mainly involved in management and administration and are in both Natmap and DRE.

388. The Executive Officer assessed total personnel on-costs for the items described as amounting to 75% in 1982/83 and 93% in 1984/85. The assessments are in line with those of other mapping authorities and Natmap informs me that it accepted them.

389. First of all the two percentages must be added to the personnel resources directly ascribed to compilation production the first instance. Thus to take internal

digital production the overheads of 75% applies to the 385 production days identified for 1982/83 and the 93% applies in respect of the 477 production days of 1984/85.

390. The two percentages have also to be added as additional personnel on-costs to the progressive overheads already aggregated for each compilation process. Thus to take internal digital compilation, in 1982/83 the addition of 75% to the progressive total internal personnel overhead of 128% gives a combined overhead of 224%. In 1984/85, the addition of 93% to the 98% for aggregated internal overheads gives a resulting overhead of 189%.

391. Adding the percentages for direct production activity, the total personnel overheads in 1982/83 for internal digital compilation is 224% plus 75% making 299%. For 1984/85 it is 189% plus 93% making 282%. Particulars for the two years are as follows:

	1982/83 %	1984/85 %
Internal digital	299	282
Internal graphic	206	199
Contract digital	257	269
Contract graphic	219	220

(3) Addition of equipment costs

392. In compilation there is use of equipment such as stereoplotters and, therefore, capital and maintenance charges are a component of total production costs. Digital equipment is more costly to provide and maintain than graphic equipment. Digital equipment is also used for activities other than compilation. The Executive Officer assessed that 40% of its use was devoted to compilation of which 32% was assignable to internal work and 8% to contract. Much of Natmap's graphic equipment was sufficiently old to have been written off and maintenance costs were also low during the years under review.

393. The identified capital and maintenance costs were apportioned to the resources directly employed on the four compilation processes. In 1984/85 these added 64% to personnel on-costs for internal compilation, 50% for digital contract work but only 4% for internal and contract graphic compilation. To take internal digital compilation adding 64% to the total personnel overhead of 282% gives the complete overhead of 346%.

394. Details of the equipment overheads in the three years are as follows:

	1982/83 %	1984/85 %
Internal digital	88	64
Internal graphic	9	4
Contract digital	56	56
Contract graphic	9	4

(4) Overall total overheads on production activities

395. Adding all the preceding overheads the total overheads in 1982/83 and 1984/85 were as follows:

	1982/83 %	1984/85 %
Internal digital	387	346
Internal graphic	215	203
Contract digital	313	325
Contract graphic	228	224

(5) Salary costs

396. Working in terms of man days, it was, of course, convenient to assess effective dollar costs in production activity by taking an average daily salary cost. To determine a salary rate the total annual salaries of the topographic mapping personnel were divided by the number of persons and a daily rate struck on the basis of a 250 day working year. The average Natmap salary cost per day was $93 in 1982/83, and $101 in 1984/85. Applying these daily salary rates to the total overheads for the four compilation activities and adding the said salary rates for actual production resulted in effective daily salary costs as follows:

	1982/83 $	1984/85 $
Internal digital	453	450
Internal graphic	293	306
Contract digital	384	429
Contract graphic	305	327

(6) Manpower used for internal compilation

397. Natmap expends more resources on compilations digitally than graphically. The time spent varies according to the complexity of the draft map. According to Natmap, a category D digital compilation requires 26 man days for the completion of contours and 29 days for the planimetry. For a graphic compilation, the man days are 12 and 13 respectively.

398. Figures for the various categories according to Natmap's assessment are set out hereunder.

Estimated man days

		B	C	D	E
Digital	(a) Contours	57	37	26	18
	(b) Planimetry	62	40	29	20
Graphic	(a) Contours	26	17	12	8
	(b) Planimetry	28	18	13	9

399. The Executive Officer accepted Natmap's assessment both in determining the actual number of production days directly used in compilation production and the end costs of the complete compilation process. My feeling was that Natmap had underestimated the number of man days expended on internal digital compilation because the output per man figure is unusually high and higher than the various mapping authorities, including RASvy, led me to expect. I am not, however, in a position to assess the position independently and Natmap has vouched for the accuracy of its records.

Pre-inspection update as a compilation cost

400. As mentioned earlier in this section Natmap carries out this activity on all planimetric compilations whether undertaken internally or received from contractors. In 1982/83 the equivalent of three persons were engaged in updating work and in 1984/85 they numbered four.

401. After discussions with Natmap, I decided that about 65% of the activity was equivalent to editing work undertaken in RASvy as part of compilation and included in its costs.

402. Natmap informed me, and I accepted, that for each 1:100 000 planimetric compilation the following number of man days are expended on pre-inspection update.

	Estimated man days		
	C	D	E
Digital	13	9	7
Graphic	6	4	3

403. Applying the foregoing formula to the number of planimetric compilations emanating from the four sources, the man days attributable to each process were as follows:

	1982/83 man days	1984/85 man days
Internal digital	48	66
Internal graphic	28	86
Contract digital	190	183
Contract graphic	222	257
Total	488	592

404. In seeking to fix overheads, precise identification of on-costs was not possible and hence no purpose is served by detailed itemisation. On my assessment on-costs were as follows:

Item	Units	1982/83	1984/85
Personnel on-costs (as for compilation costs discussed earlier)	%	75	93
Support overheads) Personnel and staff development) Records) Compilation Branch Management)	%	15	15
Total overheads	%	90	108
Natmap average salary costs	$/day	93	101
Natmap average salary costs as applied to total overheads	$/day	84	109
Effective cost of production activity	$/day	177	210

Application of the cost per day to internal digital compilations

405. Natmap only began internal digital compilation in 1982/83 and the scarcity of compilations completed so far precludes the making of a firm prediction about future costs. Not unexpectedly the average cost of a digital compilation is far higher than for an internal graphic compilation, a process which Natmap has employed for many years.

406. The average level of complexity for RASvy compilations was category D. For this category an internal Natmap compilation in both 1982/83 and 1984/85 cost $26,000 for a 1:100 000 compilation. This was equivalent to $7,450 for a 1:50 000 compilation. Details are as follows:

Internal digital
Category D[1]

	1982/83	1984/85
(a)Contours		
No. compiled	6	1
1:100 000	$11,800	$1,700
(b)Planimetry		
No. compiled	1	3
1:100 000[2]	$14,200	$14,300
(c)Total compilation (a)+(b)		
1:100 000	$26,000	$26,000
1:50 000[3]	$7,450	$7,450

Notes

(1) In 1982/83 there were the equivalent of 5 total compilations in category E and 5 planimetric compilations in category C. In 1984/85 there were the equivalent of 9.5 total compilations in category E. Costs were in proportion to their complexity classification.

(2) Includes $1,000 in 1982/83 and $1,200 in 1984/85 for pre-inspection update.

(3) Ascertained by dividing by 3.5

Application of the cost per day to internal graphic compilations

407. Natmap has many years experience in graphic compilation and as would be expected there is a fairly stable pattern of costs.

408. Raster scanning or table digitising is needed to convert a graphic compilation to digital form. Further a graphic compilation is not wholly equivalent to a digital compilation because at the later cartographic stage of map production much more effort is required as a prelude to printing than for a digital compilation. As I have said in section 11, raster scanning, to which Natmap is now committed, enables a graphic compilation to be digitised whereupon the additional costs of largely manual cartography are avoided. In section 11 of this report I said that 35% provides a rough and ready guide to the additional cost involved in converting a graphic compilation to digital form.

409. Natmap's compilations are all at 1:100 000 scale since they form part of the 1:100 000 scale topographic program. An equivalent 1:50 000 cost can be worked out by application of the agreed formula that it costs on average 1.75 times more to compile four maps at 1:50 000 scale than a single map at 1:100 000 scale.

410. Natmap's average costs for category D compilations are as follows:

Internal graphic
Category D (1)

		1982/83	1984/85
(a)	Contours		
	No. compiled	6	3
	1:100 000	$3,500	$3,700
(b)	Planimetry		
	No. compiled	6	14
	1:100 000 (2)	$4,250	$4,550
(c)	Total compilations [(a)+(b)]		
	1:100 000	$7,750	$8,250
(d)	Raster scanning at 35%	$2,700	$2,900
(e)	Total compilations at		
	1:100 000 (3)	$10,450	$11,150
	1:50 000	$4,550	$4,900

Notes

(1) In 1982/83 there were 4.5 and in 1984/85 13.5 category E compilations. The cost was proportionate to category D compilations - about 70% of the cost of the latter.

(2) Includes $450 in 1982/83 and $550 in 1984/85 for pre-inspection update

(3) Determined on the basis that 4 x 1:50 000 maps require 1.75 times the resources to produce a 1 x 1:100 000 map

Costing of Natmap's contract compilations

411. Obviously there are two major cost components when Natmap puts out contour and planimetric work to contract, one being the actual tender price which the agency accepts and the other its costs relating to a contract which include preparing contracts and supervising and examining work of the contractors.

412. Natmap has a complete record of contract prices for the various compilation categories and they show that it is cheaper for Natmap to use contractors than undertake the work internally. Nevertheless whereas the average cost of Natmap's own compilations has remained much the same over

recent years contract prices rose dramatically in 1984/85 particularly for digital work and the difference in costs between wholly internal and contract compilations has greatly shrunk.

(1) Contract prices

413. In 1982/83 the average contract price for a 1:100 000 digital compilation was about $3,400. In 1984/85 the contract price trebled to about $10,900. In the same two years the average contract price for a graphic compilation increased from $2,100 to more than double at about $4,900. There was also unevenness in contract prices: occasionally the contract price for an area of lower complexity was higher than for a more complex category. In a few instances contract prices were almost incredibly low and in some unusually high, for example, in 1984/85 the average cost of three contracts for category D planimetry was a very high $9,700 compared with a low $1,800 in 1982/83.

414. The greater increase in digital contract costs flowed, in my view, from the fact that in earlier years private sector contractors had little experience of the cost of digital compilation compared with graphic where the major resources of the industry lie. By 1984/85 there was a more realistic assessment of the additional cost.

415. Unevenness in contract prices and an occasional lower cost for a more difficult category occurs at times because successful contractors have been unable to tender for further work through the exhaustion of their capacity. In these circumstances, Natmap has had to turn to higher price contractors. It illustrates the small size of several companies.

416. However the sharp increase in all contract prices in 1984/85 is attributable to several circumstances. In 1982/83 most of the industry was struggling for survival in a dwindling market following the end of the minerals boom. Some contractors were prepared to tender at prices well below those of the cost structure of the industry with little regard to their own long term economic stability. Others were making use of old low cost equipment which would eventually require replacement at much higher costs. By 1984 the industry outwardly displayed an awareness of its economic frailty. I have described in section 4 of this report, more recent events in the industry including the proposal to form consortia in dealings with the Commonwealth. Contract costs in 1984/85 reflect the determination of the industry to put itself on a more profitable footing if it can.

417. In my opinion the 1984/85 contract costs are realistic whilst those of 1982/83 belong to the past. Nevertheless in terms of 1984/85 costs Natmap remains a lower cost producer when using the private sector than when undertaking the work itself.

(2) Average complexity of contract compilations

418. Perusal of contract prices for all categories of compilation undertaken in 1982/83 and 1984/85 showed that they averaged about category D in complexity. For 1982/83 the average complexity for graphic compilations was of the order of D- but this does not have a material effect on the situation. Having regard also to an unevenness apparent in some contract prices for particular processes I concluded that the total cost of Natmap using private contractors, that is to say the costs resulting from adding Natmap's overheads to actual contract prices, could best be ascertained by aggregating costs for all categories of work and then determining from the total figures an average cost per compilation in 1982/83 and 1984/85. This is the method I adopted for both digital and graphic compilations performed under contract.

(3) Average cost of digital compilations undertaken by contract

419. The average cost of a digital compilation in 1982/83 at 1:100 000 scale was $6,670. As mentioned earlier, the compilations at this scale were derived from 1:50 000 compilations. In order to obtain an average figure at 1:50 000 scale, with the agreement of Natmap, I divided the 1:100 000 price by 3.5. Thus in 1982/83 the average cost of a digital compilation at 1:50 000 scale including all Natmap's overheads worked out at $1,900. The low average figure comes about as I have said by reason of there being peculiarly low contract prices in that year for digital work. In 1984/85 the average cost of a 1:50 000 digital compilation was $4,220 which I believe will be the order of the future.

420. Particulars of digital contract costs, with added Natmap overheads, for 1982/83 and 1984/85 are set forth in the following table:

Contract digital compilations
Average cost

	1982/83	1984/85
(a) Total number of contour and planimetric compilations	56	50
(b) Total contract price	$94,970	$272,830
(c) Average contract price	$1,700(1)	$5,455(3)
(d) Total Natmap overheads	$57,980	$57,920
(e) Average overheads	$1,035	$1,160
(f) Total pre-inspection update cost for planimetric compilations (only)	$33,630(2)	$38,430(4)
(g) Average pre-inspection update cost	$600	$770
(h) Total Natmap average costs [(e)+(g)]	$1,635	$1,930
(i) Total average cost [(c)+(h)]	$3,335	$7,385
(j) Total average cost of a contour plus planimetric compilation at 1:100 000 scale	$6,670	$14,770
(k) Total equivalent average cost of a complete compilation at 1:50 000 scale (5)	$1,905	$4,220(6)
	say $1,900	say $4,200

Notes

(1) 151 days (Appendix I, Table 3) days at $384 per day (para 396 above)
(2) 190 days (para 403 above) at $177 per day (para 404 above)
(3) 135 days (Appendix I Table 3) at $429 per day (para 396 above)
(4) 183 days (para 403 above) at $210 per day (para 404 above)
(5) Determined by dividing 1:100 000 cost by 3.5
(6) Natmap's total overheads were 36% of the average contract price in 1984/85

(4) Average cost of graphic compilations undertaken by contract

421. Contract prices for graphic averaged $2,460 in 1984/85 compared with $5,455 for digital mapping. In

1982/83 the contract price averaged $1,700 but again as with the digital mapping I think the 1984/85 figure is realistic and the best available guide to future contract performance.

422. The addition of Natmap's contract overheads plus the notional cost of raster scanning brings the average cost of a graphic compilation at 1:50 000 scale to $3,945 in 1984/85. This is not much lower than the total digital contract cost of $4,220 in 1984/85 or Natmap's internal compilations which averaged $4,900 each for category D. Details are as follows:

Contract graphic compilations
Average cost

	1982/83	1984/85
(a) Total number of contour and planimetric compilations	156	158
(b) Total contract price	$161,670	$388,640
(c) Average contract price	$1,035	$2,460
(d) Natmap overheads	$80,825(1)	$85,020(3)
(e) Average overhead	$518	$538
(f) Total pre-inspection update cost on planimetric compilations (only)	$39,290(2)	$53,970(4)
(g) Average pre-inspection update cost	$252	$342
(h) Total Natmap average costs [(e)+(g)]	$770	$880
(i) Total average cost [(c)+(h)]	$1,805	$3,340
(j) Total average cost of a contour plus planimetric compilation at 1:100 000 scale	$3,610	$6,680
(k) Raster scanning at 35%	$1,264	$2,338
(l) Total average cost of a compilation at 1:100 000 scale	$4,874	$9,018
(m) Total equivalent average cost of a complete compilation at 1:50 000 scale(5)	$2,132 say $2,150	$3,945(6) say $3,950

Notes (see table previous page)

(1) 265 days (Appendix I, Table 4) at $305 per day (para 396 above)
(2) 222 days (para 403 above) at $177 per day (para 404 above)
(3) 200 days (Appendix I Table 4) at $327 per day (para 396 above)
(4) 257 days (para 403 above) at $210 per day (para 404 above)
(5) Determined by dividing 1:100 000 cost by $\frac{1.75}{4}$
(6) Natmap's total overheads were 35% of the average contract price in 1984/85

Summary of compilation costs in Natmap

423. Apart from digital compilation costing more overall than graphic compilation, contractor costs for both were lower than Natmap's internal costs. In short form, the resulting cost picture is as below:

Category D or equivalent at 1:50 000 scale
Average costs

	1982/83 $	1984/85 $
(a) Natmap internal graphic (including raster scanning)	4,550	4,900
(b) Natmap contract graphic (including raster scanning)	2,150	3,950
(c) Natmap internal digital	7,450	7,450
(d) Natmap contract digital	1,900	4,200

Section 16

COMPILATION COSTS COMPARED AND QUANTIFIED

Average costs

424. The following tables using rounded figures show the average costs of Natmap, the Regiment and the two Field Survey Squadrons.

Digital compilations
Category D or equivalent at 1:50 000 scale
$
Average cost

	1982/83	1984/85
Natmap internal	7,450	7.450
Natmap contract	1,900	4,200
RASvy - Regiment - production costs only	6,800	8,250
RASvy - Regiment (3 added non-production military items)	8,400	10,200

Graphic compilations (including raster scanning at 35%)
Category D or equivalent at 1:50 000 scale
$
Average cost - 1984/85

Natmap internal	4,900
Natmap contract	3,950
RASvy - 4 FSS - production costs only	14,600
RASvy - 5 FSS - production costs only	45,300
RASvy - 4 FSS - with 3 non-production military items	15,750
RASvy - 5 FSS - with 3 non-production military items	49,900

Compilation costs quantified in a shared mapping program

425. From the compilation cost studies various possible future scenarios emerge and I will take one. It involves an equal quantitative sharing of the 1:50 000 program between RASvy and Natmap requiring each to produce about 2,800 maps. I will use 1984/85 average costs for Category D compilations. For RASvy I will assume that the Regiment would undertake 80% of the work and the Squadrons 20%. Total cost of the 2,800 compilations in RASvy at 1984/85 price levels using production cost figures only would be as follows:

RASvy

Regiment	2,240	at	$8,250	$18,480,000
Squadrons	560	at	$28,000	$15,680,000
Total cost				$34,160,000

426. Total cost of the 2,800 compilations adding on the military type costs described earlier would be as follows:

RASvy

Regiment	2,240	at	$10,200	$22,480,000
Squadrons	560	at	$31,000	$17,360,000
Total cost				$39,840,000

427. For Natmap I will first assume that its share of the work would be undertaken digitally and that it would seek increased contractor performance rather than have a proportionate expansion of its in-house digitising capacity. Again, the calculation will be at 1984/85 prices category D compilations. The position for entirely digital work would be as follows:

Natmap
Digital

Internal	400	at	$7,450	$2,980,000
Contractors	2,400	at	$4,200	$10,080,000
Total cost				$13,060,000

428. If Natmap were to compile 1,400 i.e. one half of its share by graphic stereoplotting, followed by raster scanning and make use of contractors at an increasing rate the position would be:

Natmap
Digital and graphic

1,400 maps compiled digitally by Natmap and its contractors as above				$6,530,000
Internal graphic	300	at	$4,900	$1,470,000
Contract graphic	1,100	at	$3,950	$4,345,000
Total cost				$12,345,000

Thus for compilation alone the total saving to the Commonwealth if Natmap had an equal share of the program could be of the order of $21 million or about $1.9 million annually at 1984/85 prices taking into account production type costs only. If the specified military costs were included the total saving could aspire to $27 million over about a 12 year span.

Section 17

PRINTING COSTS

Natmap's arrangement with the Australian Government Publishing Service (AGPS)

429. Natmap does not print its own topographic maps but it has a standing arrangement with the Australian Government Publishing Service Branch of the Information Services Division of the Department of Sport, Recreation and Tourism (more cluttered nomenclature may be about).

Flexibility

430. As head of the Branch the Government Printer charges standard prices for printing of maps fixed according to the number of copies and number of plates. The charges, reviewed twice a year by the parties, provide for full cost recovery and include the cost of plate making and trimming. They are therefore comparable with RASvy's printing costs as assessed by the Financial Services and Internal Audit Division of the Department of Defence. Administrative costs are almost negligible.

431. Occasionally, because of a flood of work, the Director of Printing in AGPS engages the services of a private contractor to print Natmap's maps but this is not a frequent occurrence. Natmap can change its printing priorities at short notice and have maps printed according to specialised requirements such as non standard colour sheets. According to Natmap the arrangement works well and the review of charges periodically makes it possible to ensure that they are competitive. The scale of charges remained unchanged for the whole of 1984/85. The following table sets them out:

Scale of charges of the Australian Government Printer 1984/85

$

No of Copies	Number of Plates 1	2	3	4	5	6	7	8	9	10
500	257	426	595	765	935	1108	1270	1453	1626	1801
1000	342	513	683	856	1031	1204	1381	1559	1738	1919
2000	514	688	863	1038	1216	1399	1584	1772	1962	2155
3000	666	664	1040	1218	1405	1594	1788	1985	2186	2393
4000	858	1045	1216	1401	1593	1789	1990	2198	2410	2629
5000	1032	1213	1396	1584	1780	1984	2193	2410	2634	2866
6000	1203	1377	1573	1766	1968	2178	2397	2622	2859	3103
7000	1376	1564	1751	1948	2155	2372	2600	2837	3082	3339
8000	1548	1738	1929	2130	2343	2568	2802	3050	3307	3576
9000	1720	1914	2107	2313	2531	2762	3006	3262	3531	3813
10000	1893	2089	2284	2494	2718	2957	3209	3475	3755	4049

Printing by the Regiment

432. The Regiment operates a printery in Bendigo. It prints all the Corps topographic maps and most of the required map products. It also prints charts for the RAN Hydrographer. In 1984/85 the printing troop at Bendigo consisted of 25 soldiers of various ranks and an officer.

Printing - costed for 1982/83 and adjusted to 1984/85 salaries

433. Although RASvy and Natmap agreed to a comparison of printing costs in the most recent complete financial year i.e. 1984/85, the costing exercise which FSIA undertook related to 1982/83 when though the same number of personnel was involved, salaries were lower. As a result, I sought an adjustment of Defence's assessed costs for 1984/85 to provide a fair comparison with Natmap's.

434. In costing the printing stage, FSIA employed methodology similar to costing RASvy's compilation operations. Total printing costs so determined are well below those which the Executive Officer assessed after taking into account a higher level of administrative support than that provided by the application of the general Base Support Rate and the additional costs of a purely military nature incurred because the personnel engaged in map printing at Bendigo were soldiers. Comments I have made earlier about Defence costs thus apply mutatis mutandis to FSIA's costing of printing. Appendix H to this report includes details of costs as determined by FSIA. See in particular paragraphs 8, 9, 10, 12, 19 and 20.

Total printing costs

435. In costing the 1982/83 output, FSIA noted that the Regiment printed 899 map products. Working on an average print run of 3,500 it assessed the average cost of materials for printing 100 map products at $52,800 giving a total of $474,672.

436. The cost of the printing stage as assessed for 1982/83 was as follows:

Cost summary
Printing stage
Army Survey Regiment - 1982/83

Cost component	$
Consumables	474,672
Manpower	660,960
Capital charges for presses	43,758
Maintenance	9,419
Total	1,188,809

437. As mentioned, at my request FSIA expressed the Regiment's 1982/83 costs as though 1984/85 salary levels applied. An upwards adjustment of manpower production and equipment maintenance costs led to an increase in total printing costs to $1,346,010. Particulars were as follows:

Printing costs adjusted to 1984/85 salary levels

Cost component	$
Consumables	474,672
Manpower	816,000
Capital charges for presses	43,758
Maintenance	11,586
Total	1,346,016

Note

(1) In 1984/85 the number of printed map products fell from 899 two years earlier to 865, a drop of 4%. Assuming an average print run in 1983/84 similar to that costed in 1982/83, there would be a proportionate fall in the cost of consumables. As against this, salaries in RASvy increased in the same period by over 12%. For present purposes one factor can be taken to offset the other although the increase in salary levels would more than offset the cost savings of a smaller print run.

Notional comparison of printing costs in 1984/85

438. If AGPS had printed the map products which RASvy printed in 1984/85, particulars of which were available, the total cost would have been $1,046,213 which is 78% of RASvy's printing costs adjusted for 1984/85 by FSIA as above.

439. Details of the RASvy output and equivalent Natmap costs are as follows:

RASvy map products 1984/85	No of Products	Print Run	No of Plates per product	Equivalent Natmap Cost ($)
First edition				
1:25 000	1	1000	5	2,718
1:50 000 (line)	107	(a)	5	176,312
1:50 000 (OPM)	40	3000	7	71,520
1:100 000	38	(a)	6	67,001
1:250 000	29	(a)	5	51,358
RASvy reprints				
1:25 000	2	10000	6	5,914
1:50 000	12	2000	5	14,592
1:100 000	9	4000	6	16,101
1:250 000	7	2000	8	12,404
Civilian map conversion				
1:50 000	1	2000	5	1,216
1:100 000	95	4000	6	169,955
1:1 000 000	7	3000	9	15,302
1:5 000 000	2	5000	9	5,268
RAAF charts				
1:250 000	29	(a)	5	56,622
Long-range Plotting Charts	1	5000	4	1,584
Operational Navigation Charts (ONC)	1	10000	10	4,049
Terminal Charts (b)	96	3000	2	82,944
En-route Charts	71	25000	2	48,848
RAN charts	317	500	4	242,505
Total	865			1,046,213

(a) Various print runs for different parts of the program. Equivalent cost quoted is derived from the sum of individual print runs.

(b) This task consisted of the equivalent of printing light single-sided charts once a month.

Additional military-type costs

440. Like other members of the Corps, RASvy printing personnel are required to engage in non-productive activities associated with their military status and not their professional contributions to map production.

441. Annexure D to Appendix H specifies three categories of non production activities apart from leave, sick leave, weekends and public holidays. If these costs alone were

aggregated and apportioned to printing on the footing that 4,080 man days were expended on printing in 1982/1983 as Annexure D specifies, the result would be to add 27.5% to RASvy printing salary costs in 1982/83. Adjusting those costs to 1984/85 salaries the total printing salary cost would increase by $224,400 from $816,000 to $1,040,400. The total cost of printing for 1984/85 would thus rise from $1,346,010 to $1,570,410. In short, if the specified military manpower costs were added to RASvy's printing costs Natmap's equivalent printing costs in 1984/85 would be two-thirds of RASvy's.

New presses for RASvy

442. With a fairly fixed allocation of staff to printing, RASvy printing costs have an in-built inflexibility about them. I am informed that the printery, given its staff resources, does not have an excess capacity. There is no reason to suppose that in any year production line type costs will ever be as low as those of the Government Printer.

443. There are reasons for RASvy having its own printery. It ensures the continuous production of maps at headquarters providing a capability to meet contingencies if they should occur. Members of the Regiment informed me that the Government Printer could not be relied upon to produce maps within a required time. Natmap itself had the experience of AGPS contracting out its work. In my opinion, however, it would be out of character for the Government Printer not to recognise an urgent military need if one were to arise and he would be capable of meeting any reasonable request for expedition of work.

444. The printing troop at Bendigo will also produce map products which have a security classification but the Government Printer is accustomed to printing documents of a governmental character at least as sensitive as any Defence mapping product.

445. The dominant feature of the printing process is its mechanical nature and resulting uniform product which represents about 7% of total map production costs. In principle there is nothing to disbar AGPS from acting as a printery for Defence and cost savings would occur if it did. A proposal is emerging in Defence to replace three of its aged printing presses with two new five colour presses by 1987/1988 and replace one of the remaining two with a further press in 1989/90. The installation of the first two proposed new presses is estimated to cost $1.8 million out of a program cost associated with their installation of $2.960 million at 1985 prices.

446. The new equipment program is being planned against an assessed demand in 1987/88 of 1,800 map and chart products with each press being worked on a single shift basis. The production of 1,800 products would be vastly in excess of any level of production achieved so far. In my

opinion, the production estimate is open to question. It assumes the installation of Automap 3 and a capacity within RASvy to produce 350 new line maps a year which is also a level of production far higher than in any recent year. A component of the figure of 1,800 is a reported demand from the Naval Hydrographer for 600 charts annually, i.e. one-third of the total production figure.

447. According to a document entitled Army Staff Requirement No. 21.6 a Printing Resources Rationalisation Group established in July 1979 pursuant to recommendations of a special report of the Parliamentary Joint Committee for Publications, recommended that Defence map printing at Bendigo remain in the control of Defence. It also recommended that the Naval Hydrographer should make greater use of contract printers. The Defence document then said "Cognizant of the increasing costs of contract printing, the Naval Hydrographer makes maximum use of Army printing resources when available. In the interests of economy, such utilization is essential." The Defence statement is inconsistent with the outcome of the cost analysis I have undertaken.

Conclusion

448. On the assumption that the Regiment should retain a printing capacity it needs a new five colour press, but that it needs two is far from clear. The Regiment's single shift usage of presses with a capital cost of about one million dollars each when they are capable of multiple shift use, as in AGPS, suggests that any shortfall in printing capacity should be met by contracting work to AGPS where it will be done at lower cost. To engage additional military personnel beyond the necessary size of the core force, as would be the case if there should be an additional Defence demand, would only exacerbate the disparity in printing costs shown to exist by this review.

Section 18

AUTOMAP 3

Automaps 1 and 2

449. Automap 1 gave the Regiment its first digital compilation capability at a cost of $1.41 million in 1976. Automap 2 greatly expanded the capabilities of Automap 1 in data capture computing power and data handling for cartographic purposes. The system is almost totally digital. Under Automap 1 four of the Regiment's stereoplotters were converted to digital data collation. The remaining eight were converted under Automap 2 forming part of an input sub-system designed to collect, store and permit changes to three dimensional co-ordinate data. Two interactive work stations edit the data. There is also a raster scanning sub-system with interactive work stations to scan and vectorise map reproduction material. A graphic edit sub-system creates map compilations derived from the source data produced at the input sub-system and the raster scanning sub-system. Automap 2 also included the procurement of output plotters. Automap 2 will cost about $5.5 million at 1985 prices.

Cost of Automap 3

450. As mentioned earlier the four Field Survey Squadrons undertake their compilations by graphic stereoplotting. RASvy wishes to abandon the process completely and to convert all Field Squadrons with full digital stereoplotting capabilities beginning with the conversion of the Corps' remaining 42 stereoplotters. At the same time it would introduce a similar facility to the School of Military Survey at Bonegilla to train personnel on site in the use of digital stereoplotters. For planning purposes the cost of introducing Automap 3 at 1985 prices is assessed at $12.74 million, a sum exceeding the total capital cost of the stereoplotting equipment of RASvy and Natmap combined.

Reasons for having Automap 3

451. Information supplied by Defence rested the case for Automap 2 on increased production enabling earlier completion of the 1:50 000 program, simplification and economies in training of personnel and more efficient working in the Regiment through not having to divert resources unnecessarily to handling the output of the Field Squadrons. If there are other reasons I was not made aware of them. It has to be acknowledged, of course, that to accord the Field Squadrons digital capability would be a technically sound decision.

452. As to training, digital and graphic stereoplotting are not incompatible techniques. Skill acquired in graphic stereoplotting is an asset and an aid to the attainment of skill in digital work. All members of the Field Squadrons acquire skills in digital stereoplotting through the policy

of rotating members of the Corps through the Regiment where, I am told, on average they spend two years out of five. Training will be simpler if graphic stereoplotting is abandoned and there will be some resultant economies but there is s no evidence that personnel suffer as a result of having to train in, and practise, both techniques. The net benefits are not of such magnitude as to warrant a heavy capital outlay.

453. At present the graphic compilations of the Field Squadrons become digitised by raster scanning a capability which the Regiment acquired as part of Automap 2. The Regiment will continue to raster scan graphic products including State produced maps as part of the 1:50 000 program. However production bottle-necks are occurring.

454. If Automap 3 comes about, production bottle-necks in the Regiment should cease. RASvy has estimated that upon this happening the contribution of the Field Squadrons to the 1:50 000 program will result in a production increase of about 15%.

Automap 3 as an economic folly

455. So far the Field Survey Squadrons' contributions to the 1:50 000 program has been patchy. In some years a Squadron may not undertake compilation work at all. To date the total annual compilation outputs of the Squadrons has usually been below 35 but exact figures are not available.

456. In 1984/1985 the average cost of a 1:50 000 digital compilation undertaken by the private sector by Natmap was $4,200 per year. Using Defence's own calculations at 1984/85 prices the average full cost of a graphic compilation undertaken by 4 FSS and 5 FSS was $14,600 and $45,300 respectively or an average Squadron cost of the order of $28,000-$30,000. Automap 3 in the hands of the Field Squadrons will be costly. The equipment would only be used for a relatively small part of the year whereas for maximum economic exploitation it could be used continuously on a two shift daily basis.

457. The Defence timetable for the 1:50 000 program described in section 2 of this report indicates that if there is a 15% improvement in map production, the Squadron would contribute up to an additional 30 maps a year. If Automap 3 should cost $12.74 million to install, the annual capital cost, assuming an expected life of 15 years and nil residual value for the equipment and using a depreciation factor of .131, would amount to $1.624 million. Adding to this an annual maintenance cost of 10% the total annual cost for the equipment alone would amount to $2.864 million or more than $100,000 per compilation. Obviously Automap 3 does not make economic sense. If it is to be acquired there should be cogent powerful reasons of a non-economic nature. I have not discovered what those reasons are.

Field mobility

458. Automap 3 is stationary equipment not capable of field deployment. The idea of building up expensive stationary capital equipment could be a deterrent to maximising mobile capability which is an essential ingredient of a field force expected to be immediately available if hostile military operations occur. If and when they occur, the digital capability will be left behind and the digital skills of members of the field squadrons will not be practised in the areas of operation. I am informed that eventually mobile digital stereoplotting equipment is bound to be developed. It is then that it will be more realistic to equip the squadrons with the digitising facility.

The Dibb Review of Australia's Defence Capabilities

459. It follows from the foregoing that I do not agree with Mr Dibb's endorsement of the Automap 3 project. I gather that the reason for his support is the fillip it would give to the completion of priority mapping earlier than planned. As I have said the cost of Automap 3 is out of all proportion to the increase in production which will occur. There are alternative means of giving a much greater boost to production at a much lower cost to the taxpayer as my submission of options for future action should show.

Section 19

SHARING THE PROGRAM

460. The events so far described show not only that Defence took the initiative in launching a 1:50 000 series program for its own purposes but also that Natmap failed to assert a claim to control the direction of all Federal topographic mapping programs. Even so, Defence cannot claim a mapping monopoly. There is an actual and potential national interest in 1:50 000 series mapping extending beyond the defence of the Commonwealth. The current program is a logical successor to the 1:100 000 mapping series in which Natmap had the principal role. Further, Natmap has personnel and equipment beyond its needs and the surplus will increase as current topographic and bathymetric programs reach their end.

461. As seen, and as the Dibb report says, it is in the interests of national defence that high priority mapping should be completed earlier than RASvy planned. Under it the Corps would take up to twenty years to cover the first three priority areas. The Dibb suggestion (Report at p18) is to 'increase defence manpower allocated to mapping by up to 50, subject to examination of alternatives such as greater use of civil contract'.

462. Natmap, by its practice of using private contractors for photogrammetric, compilation and cartographic work, is capable of making a much greater contribution than an additional 50 Defence mapping staff. The full production cost only of employing 50 Defence mapping staff would be about of $2.5 million annually. Their contribution to production could, in my opinion, be performed by civilian mapping for half that amount.

RASvy time scales and levels of production

463. The number of maps needed for each of the first three Defence priority areas, RASvy's most optimistic completion dates and my own assessment of likely completion dates if the program remains entirely with RASvy are as follows:

Priority	No. of Maps	Earliest RASvy completion date	My assessment
1	1330	1996	1996
2	1141	2000	2002
3	751	2003	2005/6
Total maps	3222		

464. The position as for the other three priority areas is as follows:

Priority	No. of maps	Earliest RASvy Completion date	My assessment
4	2114	2007	2012
5	188	2008	2014
6	153	2008	2014
Total maps	2455		

465. RASvy intends to produce, on average, only 133 first cover maps a year in completing priority 1 by 1996. Thereafter its output is expected to increase to 190 maps annually. RASvy informed me that about 70% of its mapping effort would henceforth be expended on the program of which about 77% would be diverted to first cover maps initially, gradually declining to 65% as the program neared completion. The decline took account of there having to be a revision cycle for ageing existing maps. The percentages did not sit happily with the output level for priority 1. As mentioned in paragraph 62 of this report the explanation for lower output in the earlier years is the fulfilment of external commitments under the Defence Co-operation Program.

Natmap's future output

466. With sharing of the program in mind, I had several discussions with Natmap to ascertain its likely future output if it were to take over part of the program. It emerged that 65% of its total resources could be available for 1:50 000 mapping in 1987.

467. I have accepted the following projected levels of output as within Natmap's capabilities as from 1987 using private sector contractors at present levels:

(1) If it employed graphic stereoplotting followed by scan digitising the agency could produce about 330-340 complete maps a year.

(2) If 1:25 000 accuracy specifications were employed for all mapping, output as described in (1) would fall to about 260 maps per year.

(3) If all compilation were by digital stereoplotting at standard 1:50 000 specifications output would be about 220 maps annually.

(4) If 1:25 000 accuracy specifications were applied, output as described in (3) would fall to about 160 maps each year.

468. In section 13 of this report I concluded that there was not a strong case for requiring 1:25 000 accuracy specifications generally in the less complex mapping categories D and E. It is a reasonable assumption, if Natmap were to have a share of 1:50 000 mapping, that not more than half of the work would be at 1:25 000

specifications. On this basis Natmap's average annual output could be expected to increase from 160 to not less than 190 maps, which is the equal of RASvy's expected output after 1996.

469. In section 4 of this report I concluded that it was well within the ability of the private sector to produce 300 or more maps a year to the completion of compilation using digital stereoplotting. If the price remains right, as it should, the Commonwealth's interest would be well served by Natmap doubling the amount of work it puts out to contract. Natmap could achieve an annual output of 300 maps using stereodigitising if it were to double the use of contractors without any increase in internal map production beyond 1984/85 levels.

470. A contribution from Natmap of 300 maps per year from the end of 1987 would allow the entire RASvy Defence program to be completed by 2000 with Natmap contributing about 3,600 maps and RASvy about 2,000 if its projected levels of map production are accepted. Suitable maps for priority area 6, Tasmania should be provided by the State under its recently revised program.

Level of expenditure

471. Natmap participation at the level I have just described would involve the Commonwealth in some additional costs. Firstly, a one-off sum of about $1.7 million would probably be needed to enhance Natmap's digital capacity, notably in the creation of digital work stations. About $.3 million is wanted to buy a new camera with a higher resolution system for better quality photography to capture 1:50 000 data. Secondly, there would be an increase in annual operating costs in Natmap constituted by having more contract work performed. A doubling of contract work would require an extra expenditure on contracts of about $.9 million annually at 1984/85 prices. The increased expenditure could, of course, be more than offset through a reduction in the size of the Regiment.

472. The additional costs mentioned are small compared with the total savings which would result from Natmap participation. To take compilation costs again as outlined in section 16, if they are applied to all priority 2 and 3 mapping the total compilation cost of the work in the hands of Natmap would be $9.2 million at 1984/85 prices. The cost of RASvy doing the same compilation task with 75% of the output being from the Regiment and 25% from the field survey squadrons would be $24.9 million at 1984/85 disregarding the additional military costs of having RASvy personnel do the mapping. If the three military costs referred to in sections 14 and 16 were added, the total cost of the RASvy output would be $29.2 million.

Other factors

473. In the foregoing, I have tried to assess the possible respective contributions of the Corps and Natmap rather as production parameters than as definitive statements. Other factors bear upon the position although they would not all pull in one direction.

474. First, there is the question of the size of the Regiment. If the Regiment's strength was reduced by about 95 as I have suggested in section 5 could happen without impairment of the core force concept, it might reduce the Corps' total 1:50 000 output by about 20% - 25%. The effect, considered in isolation, could be to lengthen the completion of the whole program by three years.

475. Secondly, there is Automap 3. If it were introduced it would increase RASvy's production by about 15% with proportional effects the reverse of those just described in the case of the Regiment.

476. Thirdly, there is the question of whether the program should be entirely digital or not. Map production by way of graphic stereoplotting plus scan digitising if widely employed would shorten the program and result in some cost savings. The total end cost would not be so much less, however, as to encourage the continuation of graphic stereoplotting at the expense of digital stereoplotting in the first instance.

477. Fourthly, RASvy output in the first ten years is put at 133 maps per annum. Compared with other mapping authorities, including the States, the output is low. The Corps is handsomely equipped and with more emphasis on positive management, for example to record manpower expended on particular mapping processes, RASvy should not find it difficult to produce 150-160 maps a year in the first ten years with a corresponding improvement in later years.

478. Fifthly, the length of the program depends to some extent on continuing and satisfactory performance by private contractors according to my assessment of its potential capacity in section 4 of this report.

Options for a shared program

479. I have already recommended that the 1:50 000 program should receive Cabinet's specific approval as being in the national interest. It is a demanding program and its real cost will be far greater than any previous series topographic program. Hence, the national interest, defence or development, dictates that advantage should be taken of opportunities for cost savings as well as for accelerating the program. To leave the parties as they are, which the Moran Report recommended in 1981, renders cost savings impossible. The time has come to abandon the laissez-faire attitude enabling RASvy and Natmap to go their separate ways with less regard for wider interests than their own, as through a glass darkly.

480. The observations and conclusions expressed in this report, in my opinion, support four principal options. The first two involve a straight sharing of the program between Defence and DRE and their respective mapping agencies. The third option would graft on to either of the other two a working merger of Natmap and the ASO. The fourth option goes further than the others. It combines topographic mapping in a single authority with the object of attaining more effective management, and greater flexibility in deployment of the Commonwealth's major topographic mapping resources. The four options are described separately in the next four sections of this report.

Size of the Regiment

481. In Section 7 I concluded that the Regiment could be reduced by up to 95 personnel without impairing the planned level of assistance RASvy would be expected to offer in the field if hostilities occur. Since there is no doubt that the Regiment's map production costs are higher than alternative production in the hands of Natmap and private contractors, I suggest that in the interest of reducing total mapping expenditure, steps should be taken to reduce the total size of the Regiment by 70.

482. The four options to be discussed operate whether or not there is a reduction in the size of the Regiment. If it occurs, however, the Commonwealth will have the benefit of a reduction in its annual mapping budget as well as a total cost saving.

Section 20

FIRST OPTION

483. The Government accepts, as I suggest it should, that the 1:50 000 program is in the combined interests of defence and national economic and social development, Natmap has a strong claim to share the program with RASvy. In any case, Defence interest in priorities 4, 5 and 6 is much less than in the other three.

484. The first option involves a high degree of pre-determination of the respective roles of the two agencies and how each should perform. I have not been able to create a satisfactory division of work between the two except by choosing the geography of the priority areas. Fortunately the interests of Defence and likely civilian demands from official and unofficial sources for medium and large scale maps are for the most part in areas to be mapped by the Commonwealth under the 1:50 000 Defence program. There are difficulties in partnerships and this one would certainly have its share, attracting a need for a means to resolve them.

Allocation of mapping between Natmap and RASvy

485. The program should be shared between Natmap and RASvy in accordance with my assessment of their respective capacities in section 19 of this report.

486. In the first instance RASvy should concentrate on mapping the areas in priority 1 and Natmap handle mapping in the areas constituted by priorities 2 and 3. On my assessment, Natmap should complete its mapping responsibilities at least a year before RASvy.

487. It would be easier to postpone the allocation of work in areas of lower priority pending an examination of the progress of mapping in the first three priority areas but I think a determination has to be made now even though it may need revision a few years hence.

488. When RASvy attains its maximum capacity to engage in the 1:50 000 program, i.e. after 1996, Natmap will have the ability to produce about three maps for each two produced by RASvy. Priority 4 requires a total of 2,114 maps, more than for any other priority area. The priority 4 areas are in eastern Australia extending from around Townsville, south through most of New South Wales and the whole of Victoria into most of South Australia. Natmap should undertake up to 1,400 maps with RASvy providing the balance.

489. Priorities 5 and 6 are not a problem As I have said Tasmania itself will supply maps capable of satisfying priority 6. Priority 5 consists of three areas widely separated from each other, two in the north and the other in

the south. They involve only 188 maps. The northern areas could go to RASvy since they are near to priority 1 areas; the southern area, which is adjacent to other lower priority areas, to Natmap. It would not matter if the allocation of the work were to await the concluding stages of the program.

Conditions

490. If the program is to be shared along the lines suggested there has to be a clear understanding of the respective responsibilities of the parties. At least the following conditions should apply:

(1) As earlier recommended, the Government should approve a 1:50 000 program as being in the national interest. It should cover the areas lying within the six Defence priority areas.

(2) The accomplishment of the program should generally observe the order of the priorities which Defence has specified, accepting that these may be subject to some modification in the light of any reassessment of strategic defence policy.

(3) It should be recognised that from time to time official and unofficial civilian demands for 1:50 000 mapping may justify mapping not necessarily in accordance with Defence priorities or possibly in areas of Australia which Defence does not propose to cover. Such mapping should only be undertaken where the need is well established and the cost not out of proportion to likely benefits.

(4) RASvy should concentrate its mapping efforts on completing all the maps needed to cover the areas of first priority at the latest by 1996 and, if possible, at an earlier date by seeking increased production through improved managerial practices and greater effort.

(5) During the initial ten year period Natmap should undertake the first cover mapping required for priority areas 2 and 3, to be completed before 1996.

(6) Upon completing mapping in priority areas 2 and 3 Natmap should commence to map in priority 4 areas. When RASvy has compiled priority 1 mapping it should share priority 4 mapping with Natmap according to the assessed levels of capacity of each.

(7) Although there is demarcation of work in advance of it being performed, RASvy and Natmap must exercise common sense, for example where adjustments are demanded because of variations in Defence priorities, or because one of the parties has extensive mapping experience in a specific area lying beyond its allocation.

(8) Natmap and RASvy should each appoint a liaison officer and the two officers should be in frequent touch. The Director of Natmap and the Director of Army Survey should meet quarterly to review progress. They should submit a joint annual report to their respective Ministers.

(9) Natmap should not increase its internal level of production significantly but should continue to employ outside contractors and seek their increased use as outlined in section 19 of this report.

(10) Natmap should proceed to a progressively higher component of digital mapping. All its mapping in priority area 2 should be by digital stereoplotting.

(11) DRE should be given approval to expand and update its digital equipment and improve its aerial photographic capability, as mentioned in section 19 of this report.

(12) Natmap and RASvy should make use of State mapping authorities where they are willing to undertake available additional mapping at 1:50 000 scale or supervision of the work of contractors at costs which are lower than if either agency were to perform tasks.

(13) If either Natmap or RASvy intends to approach a State for mapping assistance one should first give notice to the other.

(14) The cost of Natmap's activities should be included in DRE's budget.

Working difficulties

491. Obviously Natmap and RASvy will need to confer frequently as the shared program proceeds. I have suggested the appointment of liaison officers and quarterly meetings of the two directors in the hope that the two agencies will see that a common purpose is to be served. Many questions are likely to arise and require resolution. Ten which occur to me are as follows:

(1) Specific military or civilian demands may arise which would justify either agency mapping in an area allocated to the other.

(2) Special factors may also show that the objectives of the program will be best served by occasional mapping by one agency in an area allocated to the other. For example, past mapping activities may place one of the parties in a preferred position. Again in mapping near boundaries of priority areas it may be economic for one agency to extend its work across a boundary into an area allocated to the other.

(3) Application of 1:25 000 accuracy specifications in particular areas, as to which see section 13 of this report.

(4) Management of the digital topographic data base.

(5) Scan digitising performance.

(6) Form, specification and content of published maps.

(7) Approaches to the States for assistance.

(8) Variations of arrangements as a result of adjustment to boundaries of priority areas.

(9) Sharing of equipment and possible pooling of resources for particular projects.

(10) Standard of contractor performance.

Settlement of disputes

492. I should like to think that where questions arise Natmap and RASvy will usually reach agreement but the record does not afford ground for optimism. The Commonwealth Co-ordinating Group on Mapping, Charting and Survey set up in response to the Moran Committee's recommendation as an advisory body to the performing agencies failed completely. Disagreements will occur and a means must be found to resolve them. An advisory body will not work.

493. I propose that in the absence of agreement an issue in dispute be referred to an independent arbitrator whose decision the parties must accept. Either agency should be able to seek an arbitration, subject to first obtaining approval of its parent Department.

494. Arbitration should, I suggest, be vested in the hands of a single arbitrator and he should be able to call upon the parties to produce all relevant information. There would be an obvious advantage in having someone either with a good knowledge of the mapping industry or a broad administrative experience and preferably an appropriate scientific or technical background.

495. I suggest that there should be a panel of arbitrators and where an issue arises for settlement the particular arbitrator be appointed by agreement. A panel of four persons should suffice. Among persons with mapping and survey experience the Victorian Surveyor-General, Mr Holmes, and the Commonwealth Surveyor-General, Mr Sleep, would be suitable. I do not regard it as my function to canvass names of persons outside the mapping industry who would be suitable but two persons, come to mind. One is Dr Farrands, one-time Secretary to the Department of Science and Technology and the other Dr Wild, until recently Chairman of the CSIRO. The four persons mentioned reside in Melbourne or locally.

496. It may be thought that some issues are of such importance or involve policy factors of such a kind not to be entrusted to the decision of a single external arbitrator. It is not out of the question that the parties will not agree on the choice of an arbitrator. In these circumstances I suggest that there be a committee of three senior public servants, at not less than First Assistant Secretary level, one each from Defence and DRE and the third from the Department of Local Government and Administrative Services (DOLGAS). The Chairman of the committee should be the nominee of DOLGAS and the issue in dispute should be determined by majority decision.

497. The existence of arbitral machinery should encourage the respective heads of mapping in Defence and DRE to reach agreement between themselves.

Natmap management

498. If a major share of the program is vested in Natmap, efficient and experienced management is needed to maximise the benefits of the action. I do not doubt that Natmap's senior staff are professionally highly competent but my impression is that managerial experience and skill do not match technical abilities. The history of Natmap's ineffectiveness in asserting its claim to co-ordinate Australia's topographic mapping speaks for itself. The 1:50 000 program requires progressive management not inhibited by past mapping policies and unsatisfactory relationships with RASvy.

499. If the option is to be implemented there will be greater use of outside contractors requiring internal judgements to be made. Opportunities to minimise cost should not be lost. Take, for example the utilisation of State resources. A digital compilation constitutes about 30% of the total map making cost. If a State agency will map an area at an agreed price less than three times the average cost of a compilation at 1984/85 prices as revealed in this report it would be sound management to use the agency. In 1984/85, Natmap's costs associated with the handling of contracts and the work of contractors constituted 35% of the average in-house price for a digital compilation. If a State were prepared to supervise and process a contractor's work for around 20% of the contract price its assistance would be economic and in the interest of good Commonwealth-State relations.

500. Natmap's reverence for past practice, its claims to a dominant position in Commonwealth topographic mapping and its continued adherence to graphic stereoplotting do not encourage me to think that it will be as adaptable in the future as it should be in managing its share of the 1:50 000 program. The situation calls for DRE to involve itself much more in supervising Natmap policies and practices than it has so far done. Whoever should perform such a role within the Department needs to be much more than a professional

bureaucratic administrator and concern himself with the processes of topographic mapping and the purposes that the mapping program are expected to serve.

Advantages of the first option

501. Advantages of the first option include the following:

(1) The arrangement is consistent with recognition of the 1:50 000 series mapping, as a national mapping program and Natmap's role as the principal civilian mapping agency.

(2) More speculatively, it should ensure continuity of employment of mapping staff in Natmap for at least ten years.

(3) More importantly, if the sharing is successful the total program should be completed much earlier than Defence has planned and at a significantly lower total cost without adding much, if anything, to the annual mapping budget of the Commonwealth.

(4) It should enable the production of maps to satisfy Defence specifications without sacrifice of the opportunity to meet future civilian demand and, by vesting in Defence management of the digital topographic data base, enable Defence to produce a full range of mapping products for its purposes.

(5) It should assist in the maintenance of a healthy private mapping and survey industry.

Disadvantages

502. There are disadvantages or risks. The more significant are as follows:

(1) Predetermination of shares of the program is at the cost of flexibility which is a highly desirable ingredient of a program of such cost and magnitude. For example it may be detrimental to gaining maximum benefit from new technology or opportunities for assistance from external sources.

(2) The arrangement does not assist the handling of the problem which will emerge of the Commonwealth having a surplus of topographic mapping resources when the program is completed.

(3) It tends to perpetuate the artificial division of mapping and survey between Natmap and ASO.

(4) There is a risk that RASvy and Natmap will not carry out the spirit of the arrangement though professing to abide by it.

My view is that the advantages outweigh the disadvantages. The first option offers a big advance on the existing position.

Section 21

SECOND OPTION

503. Defence launched the 1:50 000 program. The extent of non military demand for mapping which might be required but does not fit in with the Defence program is far from clear. It is not unreasonable to conclude that defence interests outweigh other factors in mapping in the first two and possibly the third priority area. The second option involves performance of 1:50 000 mapping by Natmap as well as RASvy but it places more emphasis on defence than the first and gives RASvy authority to issue directions to Natmap, except in relation to mapping for civilian purposes.

Components

504. The principal components of the second option are as follows:

(1) As for the first option Natmap and RASvy should share the mapping in accordance with my assessment of their respective capacities in section 19 of this report.

(2) The first objective should be the completion of first cover mapping in priority areas 1, 2 and 3 no later than 1996 and the second objective should be the completion of the entire program before 2000 as outlined in the description of the first option.

(3) However rather than predetermine the areas to be mapped by each agency, but subject to the foregoing, the allocation of work in the first three priority areas should be determined by Defence. The determination could be that RASvy proceed to map in priority 1 areas whilst Natmap assume responsibility for priority areas 2 and 3 but Defence should be able to vary the arrangements if it believes it would be of overall benefit. Subject to overriding defence considerations, in areas of lower priority the execution of work should be as outlined for the first option.

(4) In undertaking its part, Natmap should be subject, if need be, to direction from Defence on matters which arise from time to time, for example as to the nature of data to be captured, mapping processes to be employed, application of 1:25 000 accuracy specifications, mapping of particular areas within a priority and utilisation of State mapping and survey resources.

(5) To the extent that Natmap carries out the program on behalf of Defence, it would be appropriate for the cost to be a charge upon the Defence budget.

However, if the Government specifically approves the 1:50 000 program as being in the national interest the annual cost of its execution could remain in DRE's budget.

Conditions

505. RASvy and Natmap should observe, as appropriate, the following conditions outlined in the first option:

(1) RASvy should concentrate its mapping efforts on completing all the maps needed to cover the areas of first priority at the latest by 1996 but if possible at an earlier date by seeking increased production through improved managerial practices and greater effort.

(2) Natmap should not increase its internal level of production significantly but should continue to employ outside contractors and seek their increased use as outlined in section 19 of this report.

(3) Natmap should proceed to a progressively higher component of digital mapping irrespective of the priority allocated by Defence to an area.

(4) Natmap and RASvy should make use of State mapping capabilities as described in the first option.

(5) Natmap should be given approval to expand and update its digital equipment and improve its aerial photography capability as mentioned in section 19.

(6) DRE should involve itself more in supervising Natmap policies and practices.

(7) Natmap and RASvy should each appoint a liaison officer and the Director of Natmap and the Director of Army Survey should meet regularly and submit a joint annual report to their respective Minister.

(8) RASvy should maintain the digital topographic data base for all 1:50 000 mapping.

Civilian demand

506. Since the authority of Defence to issue directions places Defence in a dominant position, particularly during the first ten years, some provision has to be made to enable Natmap to carry on mapping in the national interest besides defence. That is to say Natmap should not be precluded from meeting genuine and substantial civilian demands which would not be met within a reasonable period, or at all, by the observance of mapping according to Defence priorities or directions. Natmap should be entitled to use up to one-fifth of its productive capacity over a period, say three years, to fulfil such demands without being subject to directions from Defence. At the same time its mapping

should meet Defence specifications as far as practicable with a view to avoiding eventual duplication of mapping effort.

Advantages of the second option

507. (1) Four of the five advantages described for the first option apply to much the same extent to the second option. The exception is that the arrangement does not fit as comfortably with the recognition of the 1:50 000 mapping program as a national mapping program undertaken in the interests of economic and social development as well as defence.

(2) It imports into the arrangements an element of flexibility not possible in predetermining shares of the program as outlined in the first option.

(3) It largely obviates the necessity for arbitration.

Disadvantages

508. There are, however, disadvantages not to be found in the first option. These include the following:

(1) As mentioned the option pays insufficient regard to the broader national interest by giving Defence an ascendancy in carrying out the program.

(2) It restricts Natmap's freedom of activity as the principal civilian mapping authority of the Commonwealth with a consequent risk of affecting internal morale.

(3) The reservation of capacity to enable Natmap to undertake mapping for civilian purposes outside the Defence program could give rise to difficulties in practice, especially in view of the history of the relationships between RASvy and Natmap. It would be possible to provide for arbitration as outlined in the first option to settle disputes where Natmap's desire to undertake civilian mapping were to be seen by RASvy as conflicting with Defence mapping objectives.

(4) Natmap could be subject to pressure from RASvy in the performance of its functions, for example in the selection of contractors and the acceptance of their work.

(5) Like the first option, the arrangement stops short of achieving a co-ordinated mapping and survey policy.

Section 22

THIRD OPTION

509. The Terms of Reference which Cabinet approved in 1984 stated that the joint review of topographic mapping facilities should consider the most efficient use of Commonwealth resources to meet Commonwealth needs in the best possible way. Consequently the Terms of Reference did not specifically embrace the functions of the Commonwealth Surveyor-General or the work of the Naval Hydrographer. As my review progressed I became more aware that skills similar to those exercised in Natmap and RASvy were also employed in ASO and by the RAN Hydrographic Service.

Surveyors-General - Lords of the manor

510. Before Federation the Surveyor-General was one of the principal public servants in each Australian colony. He was called upon to undertake original major mapping and survey programs, for example, the planning of areas of settlement and of road and railway systems. The palmy days of the first Surveyors-General have long since gone and for many years their successors have turned their attention to meeting specialised mapping and survey demands. The isolation of survey from mapping is regarded throughout the industry as being functionally unsound and in each State mapping and survey work continues in a single Department.

511. In 1945 the Commonwealth Surveyor-General was appointed Director of National Mapping in the Department of the Interior. In 1956, two years after the Department of the Interior was authorised by Cabinet to be a single authority for geodetic and topographic surveys and mapping the Prime Minister announced the transfer of the national mapping function to the Department of National Development. The decision in 1956 had a strong flavour of Ministerial expediency about it.

Function of the Australian Survey Office

512. ASO carries out mapping functions employing the same processes as for series topographic mapping. For example, one of its major projects is mapping the region of the Great Barrier Reef which covers an area exceeding 300,000 kms. ASO uses similar equipment to Natmap but is ahead of Natmap in use of computer technology. I believe that ASO also gives more attention to the use of remote sensing as an aid to mapping and survey than Natmap notwithstanding that Landsat is in Natmap's hands. ASO has a staff exceeding 500, much larger than Natmap's, and maintains regional offices in the capital cities of all mainland States and the Northern Territory.

A working merger of Natmap and ASO

513. The location of ASO and Natmap in separate Departments is in my opinion not only functionally unsound but economically wasteful and tends to inhibit those in charge of survey and mapping from a broader appreciation of the Commonwealth's national interests and making optimum use of technological developments. ASO has the resources to assist in series topographic mapping and if it were to be involved an earlier completion of the 1:50 000 program could be expected. At present ASO spreads its resources on a wide variety of topics as, like Natmap, it seeks to maintain an unimpaired existence.

514. More to the point, if the activities of ASO and Natmap were to be co-ordinated in one Department, the Commonwealth should have the benefit of substantial cost savings and there would be a larger base from which to perform the specialised activities not only of ASO but also Natmap. Natmap's engages in thematic mapping and a variety of other specialised functions such as moon tracking for NASA and the provision of a national time scale service. There would also be a stronger case for maintaining a digital data base supplementing the RASvy topographic data base than if Natmap were to remain separate.

515. The Terms of Reference do not specifically state that there should be an examination of the activities of ASO but it is an objective to seek the most efficient use of Commonwealth resources to meet Commonwealth topographic mapping needs. This objective, in my opinion, would be promoted if the Commonwealth were to revert to the earlier position and have Natmap and ASO located in one Department and subject to single direction or management. The suggestion is not intended to operate as a separate option but as supplementary to either the first or second option.

516. There is reason to suppose that relationships between Natmap and RASvy would be less influenced by the past if DOLGAS were to be the parent of the two agencies. If this were to happen in conjunction with the first option the arrangements for arbitration would need adjustment. On the other hand, DRE has a historical claim and it should be able to absorb ASO without too much difficulty. Either Department would be suitable.

Section 23

FOURTH OPTION

517. The single focal point for further first cover series topographic mapping is the 1:50 000 program but it would be a mistake to take the completion of that program as an end in itself.

Future mapping demand

518. I have expressed the opinion that comprehensive topographic mapping will end with the 1:50 000 program. Then the Commonwealth should have at its disposal a digital topographic data base capable of meeting both general and specialised defence and civilian needs. The era of a single map serving all purposes is about to close. Apart from the needs of Defence, future demand will in large part be for maps specific purposes and for digital information for transfer to other computer systems. If there is a demand for 1:25 000 series maps independent of the maps which the States will have provided at that scale or larger, it will be a demand for specific areas of mapping to be done as the occasion requires and not for a concerted comprehensive program. The digital topographic data base, which is largely independent of scale, will provide the basis of any further required series mapping.

Managerial flexibility

519. As digital mapping spreads, there will be a declining demand for some mapping skills, especially in cartography. In the field it is not improbable that developments in remote sensing by satellites will change the nature of ground control work. If it is to be properly managed, the 1:50 000 program should take account of probable redundancies in topographic mapping staff especially as the program reaches its concluding stages towards 2000. As well, it should be sufficiently flexible to accommodate new technology and provide for the acquisition of new skills and the abandonment of old techniques free from the inhibitions of past mapping policies and practices.

520. The first two options involve a sharing of a single program between two separate agencies with the consequential need for the prescription of conditions which each should observe. Yet, the 1:50 000 program is vast and long and may not benefit from having solidified arrangements at such an early stage. More flexibility is desirable in such matters as areas to be mapped, how they are to be mapped and who should do the work. It also calls for managerial skills and judgement to obtain the optimum use of private contractors and State facilities.

521. In my opinion, the 1:50 000 program should be more efficiently managed if its execution were vested in a single

agency. This has led me to suggest a fourth option which would bring the topographic mapping resources of RASvy and Natmap under the umbrella of a single head to whom the Director of Army Survey and the Director of Natmap should be subject in carrying out their shares of the program.

Components of the fourth option

522. The principal components of the option are as follows:

(1) A Mapping and Survey Division should be created in the Department of Defence headed by a Chief at First Assistant Secretary level. The Chief should be responsible for the development and maintenance of the 1:50 000 or other Commonwealth topographic mapping programs in the national interest as described in section 9 of this report. It is essential that the right person be chosen as Chief. Whether a civilian or member of the Defence Force, the Chief must have recognised managerial skills and a ability to lead staff.

(2) The Director of Natmap and members of staff of the Topographic Group and the Series Mapping Branch of the Cartographic Group in Natmap should become members of staff of the proposed Mapping and Survey Division.

(3) There should be two Branches in the Division, one military and the other civilian, of which the Director of Army Survey and the Director of Natmap should be the respective Branch Heads.

(4) The Chief of the Division should be required to discharge his responsibility for the 1:50 000 program to ensure its completion generally in accordance with the objectives and requirements of the first option. Thus, for example,

(a) Mapping of the areas constituted by priorities 1, 2 and 3 should be completed by 1996 and earlier if possible. In principle but subject to variation by the Chief of the Division, RASvy should concentrate on mapping the areas in priority 1 and the civilian Branch direct its attention to mapping the areas within priorities 2 and 3.

(b) Mapping of priority areas 4, 5 and 6 should be completed before 2000 with the work shared between RASvy and the Civilian Branch according to their respective capacities.

(c) In mapping by the civilian Branch the policy of employing outside industry under contract should continue. The increased use of private contractors should be sought as outlined in section 19 of this report.

(d) Available State mapping capacity and assistance should be used where the cost is lower than for comparable internal operations.

(e) Demonstrated civilian mapping demands which do not necessarily coincide with the defence aspects of the program should be recognised and the program of work so arranged as to give effect to them as long as they do not substantially prejudice the execution of mapping in priority areas 1, 2 and 3. The Chief of the Division should ensure that civilian demand from official Commonwealth sources is kept under review.

(f) The digital topographic data base should be available to meet defence and civilian demands.

(5) The bathymetric program and the members of staff involved in it should be transferred to the RAN Hydrographic Service. See however my comments hereunder, about the Naval Hydrographer.

(6) The other functions of Natmap, together with personnel and equipment, should be transferred to the Australian Survey Office.

(7) When mapping is finished for all areas in priorities 1, 2 and 3, the Chief of the Division should, in consultation with the Public Service Board, provide for the redeployment of civilian staff who will not be needed in Defence for other mapping and survey work when the 1:50 000 program is at an end. At the end of the program the Division itself might be dissolved and the Australian Survey Office could appropriately assume responsibility for further civilian mapping.

(8) The Chief of the Division should seek to obtain maximum use of the resources and facilities of the two Branches of the Division by encouraging cooperation between them and allowing each Branch to have access to the resources and facilities of the other.

Naval Hydrographer

523. I have suggested above that the bathymetric program be transferred to the Naval Hydrographer. The functional Division between hydrography and bathymetry is superficial: hydrography encompasses bathymetry. In my opinion, the two programs should not remain apart. The transfer of the bathymetric program to the RAN Hydrographic Service would avoid the duplication of work in the same areas of activity and should make it possible not only to achieve economies of staff but also in the heavy shipping charter costs which are incurred.

524. The Naval Hydrographer maintains contact with RASvy and Natmap. He is a member of the National Mapping Council and participated in the proceedings of the Moran Committee. The Hydrographic Service caters for civilian as well as Defence needs. It would be in the interests of co-ordination of programs to bring the Service into the proposed Division in Defence as a third Branch with the Hydrographer as Branch Head. Such a step would present opportunities for broadly based management to make an input into hydrographic operations including the assessment of civilian demand.

525. The Terms of Reference do not include the activities of the RAN Hydrographic Service but, if they had, I would have included the creation of a third Branch in the proposed Division as a component of the fourth option.

Advantages of the fourth option

526. (1) As for the first and second options the fourth would enable the mapping program to be completed earlier than if RASvy were alone involved and at a much lower total cost with, at most, a relatively small increase in annual costs.

(2) It would bring to an end the saga of discordant relationships between the civil and military mapping agencies and render it unnecessary to have the settlement of disputes through arbitration as suggested in the first option.

(3) By entrusting the mapping program to a separate Division of Defence, opportunities are created for flexible management. The Chief of the Division should be able to make much better use of the combined resources at his disposal than under a formally divided program. As an example, the Chief could decide that it would be efficacious for the Field Survey Squadrons to perform field mapping tasks for the Civilian Branch or for members of the Squadrons to undertake digital compilation work at Bendigo. Efficiently managed, the Division should be able to complete the 1:50 000 program at a lower cost and more expeditiously than under the first and second options.

(4) I have no wish to enter the lists about staffing numbers in these days of restraint on public service growth. However, I have to say that the option opens up the possibility, eventually, of effecting staff economies. Within the proposed Division, co-ordination of the activities of the Branches will increase output. Alternatively, the combined outputs of Natmap and RASvy could be achieved with fewer staff than the two would have as separate agencies. If nothing else, a staff

saving could be made to offset the engagement of a First Assistant Secretary as Chief of the Division. Most of the residual functions of Natmap overlap with those of ASO. If they are transferred to ASO as I suggest in the third option rationalisation should also eventually produce staffing economies

(5) If the Regiment were to be reduced in size as I have submitted in section 19 the consequential adjustment of the mapping program would be achieved more readily under this option than under the first two.

(6) If there were calls upon RASvy for field assistance during hostilities the Civilian Branch would be able to perform the functions which Defence planning, outlined in section 5 contemplates would continue to be performed by the Regiment.

Disadvantages

526. (1) Because of the misgivings and objections of personnel faced with changes affecting long-standing allegiances and through the creation of new lines of authority it would be optimistic to suppose that a new joint military and civilian organisation could be created in Defence without encountering strenuous criticism in some interested quarters.

(2) There is a chance that civilian mapping demands will not receive the attention they deserve because of the location of the Division in Defence.

(3) Because much will depend on the ability, managerial skills, judgement and determination of the person chosen to be Chief of Division the degree of risk is greater than for the first and second options.

Concluding thought

527. No doubt inventive minds will think of further objections but, in my opinion, the advantages of the fourth option far outweigh the disadvantages. They should not be displaced by an aggregation of arguments stemming from antagonists alert in protecting their own interests but less knowledgeable or determined when it comes to an objective pursuit of the national interest. The fourth option is my first preference.

APPENDIX A

REVIEW OF AUSTRALIA'S TOPOGRAPHICAL MAPPING FACILITIES

Terms of reference as agreed between the two Departments

"Having regard to Cabinet's decision that there should be a complete joint administration review of Commonwealth topographical mapping resources and needs, and the way in which those needs could best be met, including alternative mechanisms for meeting strategic mapping needs:

1. Describe current and planned Commonwealth topographical mapping programs for both civilian and defence purposes with respect to:

   (a) authority, objectives and status

   (b) responsible action organisation

   (c) priorities of regions to be mapped

   (d) content

   (e) standards

   (f) scale

   (g) format; and

   (h) agency tasked to undertake work.

2. Describe the topographic mapping programs of the States.

3. Identify the resources currently available to Defence and Natmap for topographic mapping and those required to meet planned programs over a forward three year period and proposals for later years.

4. Identify and describe the nature and extent of Defence specialised topographic mapping needs.

5. Identify the cost structure and productivity of RASvy and Natmap for the production of topographic maps and derived products, and develop product cost indicators for use in assessing future program options. Factors to be taken account of include:

   (a) manpower numbers

   (b) manpower costs including training

   (c) cost of capital equipment and facilities

   (d) operating costs

(e) consultant's/contractor's fees; and

(f) measures of productive output.

(The basis for this cost structure should be agreed between Defence and DRE)

6. Having regard to the most efficient use of Commonwealth resources to meet Commonwealth needs in the best possible way:

> Identify options for rationalisation (if any) between Defence and DRE, assess the benefits and penalties associated with each option and recommend mechanisms for carrying out programs that would meet Commonwealth needs, including the allocation of responsibilities to make the most effective use off available resources.

7. Examine and advise on the scope for better coordinating and implementing Commonwealth topographic mapping programs for all civilian and defence purposes."