



4th Field Survey Squadron

Operation MIZMAZE 93

Operation Report

A field completion operation
conducted in the
Broome and Fitzroy Crossing regions of
Western Australia

May - June 1993



DISTRIBUTION LIST

LHQ (2)
HQ NORCOM
DSVY-A (2)
DGLWP
DCOORD-A
Army Svy Regt (3)
School of Mil Svy (2)
1 Topo Svy Sqn
1 Sig Regt
1 Avn Regt
161 Recce Sqn
162 Recce Sqn
173 Survl Sqn
7 Log Coy
5 Avn Regt Wksp

For Information:

DC - A
Adelaide Log Bn

Internal:

OC
2IC
OPSO
OPS WO
Ops Spt
Library (2)
File

CONTENTS

	<u>Page(s)</u>	<u>Para(s)</u>
COVER SHEET	i	
DISTRIBUTION LIST	ii	
CONTENTS	iii-iv	
ANNEXES	v	
EXECUTIVE SUMMARY	vi	
INTRODUCTION	1	1
MISSION	1	2-3
AREA OF OPERATIONS	2	4
CONDUCT OF OPERATION	2-4	5-18
General Outline	2	5
Sequence of Events	2	6
Reconnaissance	3	7
Issue of Orders and Instructions	3	8
Phase 1 - Deployment to AO	3	9-11
Phase 2 - Commence Field Checking Broome/ Sandfire Roadhouse	3-4	12-14
Phase 3 - Re-Deployment of Main Base	4	15
Phase 4 - Commence Field Checking Fitzroy Crossing ...	4	16
Phase 5 - Extraction	4	17
Hand Held GPS	4	18
OPERATION RESULTS	4-5	19-22
ADMINISTRATION AND LOGISTICS	5-9	23-45
Operation Manning	5	23
AAAvn Support	5	24-25

	<u>Page(s)</u>	<u>Para(s)</u>
Land Clearances	5-6	26
POL	6	27-28
Vehicle Support	6	29-30
Accommodation	6-7	31-33
Messing	7	34
Amenities	7	35
Medical	7	36
Morale and Discipline	7	37
Finance	7	38
Allowances	8	39
Banking	8	40
Mail	8	41
Remote Locality Leave	8	42
Rest	9	43
Visits	9	44
Public Relations	9	45
COMMAND AND SIGNAL	9-10	46-49
Command	9	46
Communications	9-10	47-49
CONCLUSIONS	10-11	50-55
RECOMMENDATIONS	11-12	56

ANNEXES

- A. Area of Operations
- B. Sequence of Events
- C. Field Completion Report

Appendix:

1. 1:50 000 Scale Map Sheets Field Completed on Op MIZMAZE 93

- D. Aerial Photography Report
- E. Subsequent Aerial Photography Report

Appendices:

1. Supplementary Photography - PENDER
2. Supplementary Photography - BROOME
3. Supplementary Photography - LA GRANGE
4. Supplementary Photography - MOUNT ANDERSON
5. Supplementary Photography - NOONKANBAH
6. Supplementary Photography - MANDORA
7. Supplementary Photography - MUNRO

- F. Operation Manning
- G. AAAn Report - 161 Recce Sqn
- H. AAAn Report - 162 Recce Sqn
- I. AAAn Report - 173 Survl Sqn
- J. RAEME (VM) Technical Report

Appendix:

1. Specific repairs

- K. Communications Report

EXECUTIVE SUMMARY

1. Op MIZMAZE 93 was a field completion survey operation conducted by 4 Fd Svy Sqn in the south-western Kimberley region of Western Australia during the period 1 May to 18 Jun 93. 4 Fd Svy Sqn's mission was to field complete 86 x 1:50 000 scale line maps in the AO. Secondary tasks included the production of Photographic Interpretation Guides (PIGs) and the acquisition of Vital Asset Protection (VAP) photography.
2. Deployment to, and extraction from, the AO was by road. Operations were conducted from main bases established at Broome and Fitzroy Crossing and a forward base established at Sandfire Roadhouse. AAAvn detachments in direct support of 4 Fd Svy Sqn comprised LOH and Nomad aircraft.
3. The mission was achieved with 86 maps being checked. A failure in the Nomad tail structure resulted in the aircraft departing the AO prior to supplementary or VAP photography being acquired. Supplementary photography was obtained at a later stage as a part of Op NERVOSE 93 using the Nomad aircraft deployed on that Operation.
4. For the first time, hand held Global Positioning System (GPS) receivers were used as an aid to navigation and positioning of isolated detail while field checking. The receivers were of tremendous value, saving a large amount of effort and time.

OPERATION REPORT

OPERATION MIZMAZE 93

- References:
- A. LHQ SIC I3A/Z2Y, Op Order 20/93 - Op MIZMAZE 93, of 020404Z APR 93
 - B. LHQ K92-00812 1894/93, Op MIZMAZE 93 Mounting Instruction, dated 15 Apr 93
 - C. DSVY-A 00199/93 A02-29003, Technical Directive to OC 4 Fd Svy Sqn, dated 12 Mar 93
 - D. LHQ SIC Z2Y/IEA, Op MIZMAZE 93 - VAP Photography, of 272321Z APR 93

INTRODUCTION

1. Op MIZMAZE 93 was a field completion survey operation conducted by 4 Fd Svy Sqn in the south-western Kimberley region of Western Australia during the period 1 May to 18 Jun 93. The Operation was conducted in accordance with instructions detailed in References A and B.

MISSION

2. 4 Fd Svy Sqn's mission was to field complete 86 x 1:50 000 scale maps within the West Kimberley region in accordance with References B and C.
3. In addition to the main task of field completion the following tasks, in order of priority, were undertaken:
 - a. upgrade and/or produce photo interpretation guides (PIGs); and
 - b. acquire vital asset protection (VAP) photography for 1 Topo Svy Sqn.

AREA OF OPERATIONS

4. The AO, which is illustrated at Annex A, was covered by the following 1:250 000 map areas:
- a. SE 51-02 PENDER,
 - b. SE 51-06 BROOME,
 - c. SE 51-10 LA GRANGE,
 - d. SE 51-11 MOUNT ANDERSON,
 - e. SE 51-12 NOONKANBAH,
 - f. SE 51-13 MANDORA, and
 - g. SE 51-14 MUNRO.

CONDUCT OF OPERATIONS

General Outline

5. To achieve the mission the Operation was planned and conducted in five phases as follows:
- a. Phase 1 - Deployment to AO.
 - b. Phase 2 - Commence Field Checking Broome/Sandfire Roadhouse.
 - c. Phase 3 - Re-deployment of Main Base.
 - d. Phase 4 - Commence Field Checking Fitzroy Crossing.
 - e. Phase 5 - Extraction.

Sequence Of Events

6. A detailed sequence of events for the Operation is given at Annex B. Significant events are detailed in the following paragraphs.

Reconnaissance

7. No reconnaissance was conducted for this Operation. The Operation was mounted using prior knowledge of the AO, which proved adequate. A reconnaissance would have been useful but was not essential. This statement is made, however, in hindsight and without any major problems being encountered.

Issue Of Orders And Instructions

8. The Operation Order (Reference A) and the Mounting Instruction (Reference B) were issued on 2 Apr 93 and 15 Apr 93 respectively.

Phase 1 - Deployment To AO

9. Vehicles. The road trip from Adelaide to Broome went smoothly except for a UNIMOG radiator leak and the ISUZU truck's clutch failing 300 km short of Broome.

10. Routine. Daily routine started at 0530 hrs with reveille. Breakfast was at 0600 and the convoy moved out at 0700. A day's driving was typically 650 to 700 km which equated to roughly eight hours shared between two drivers. Three stops were usually planned for each day for morning tea, lunch and afternoon tea and coincided with any refuelling stops. The method of having a cook and "cooks trailer" for the trip worked very well. Standard procedure was for the admin vehicle, containing the ADMINO and cook, to move ahead of the convoy after mid-day and conduct a reconnaissance of the overnight locality, carry out any shopping, and meet and marshal the main body into position.

11. Establishment of Base Camp. Base Camp was established on Sat 8 May 93. Facilities at the Broome Police Citizens and Youth Club (PCYC) were adequate for all requirements. On the same day a number of local support agencies were visited.

Phase 2 - Commence Field Checking Broome/Sandfire Roadhouse

12. Field Checking. Field checking in the Broome area, involving the PENDER / BROOME / LA GRANGE map sheets, commenced on 9 May 93. On the same day two field parties deployed to Sandfire Roadhouse to establish a forward base and commence checking the MANDORA / MUNRO areas. Forward base personnel were swapped over the period 17/18 May 93. Field parties deployed independently from base for a period of up to three days after which it was necessary to return and carry out map corrections.

13. Reconnaissance. A reconnaissance of Fitzroy Crossing was conducted on 19 May 93. The reconnaissance party deployed and returned by LOH. The reconnaissance proved very worthwhile with a number of contacts being made. The main result was the selection of a new site for the main base at Fitzroy Crossing. The proposed site for main base at the Tarunda Caravan Park in Fitzroy Crossing was unsuitable due to its small size, exposed location and lack

of facilities. The alternate site at Fitzroy Lodge Caravan Park on the outskirts of town was far superior and negotiation resulted in site rental remaining the same.

14. Nomad Aircraft (Aerial Photography). The Nomad aircraft was grounded on 21 May 93 due to problems with its rear stabiliser. Finally the aircraft was ordered to RTU. The consequences of this are detailed later in this report.

Phase 3 - Re-Deployment Of Main Base

15. The re-deployment of main base was carried out with no problems. A field party was despatched to commence field checking in the MOUNT ANDERSON area enroute to Fitzroy Crossing.

Phase 4 - Commence Field Checking Fitzroy Crossing

16. Field checking in the NOONKANBAH / MOUNT ANDERSON areas commenced on 27 May 93. Operations proceeded very well but due to time constraints it was necessary to deploy a sixth field party using the CPL from Army Svy Regt as the IC with other personnel as available acting as party 2IC.

Phase 5 - Extraction

17. Base Camp at Fitzroy Crossing was packed up on 10 Jun 93. All elements departed by road on 11 Jun 93 and arrived in Adelaide on 18 Jun 93.

Hand-Held GPS

18. For the first time on such an operation hand-held GPS were used to assist with navigation and the positioning of remote, isolated features. With selective availability (S/A) in the Global Positioning System (GPS) active, it was accepted that errors in accuracy up to 180m may be encountered. For this reason GPS was only used for navigation and approximate positioning as a supplement to traditional methods. The GPS model used on this Operation was the Trimble ENSIGN which proved to be reliable and robust.

OPERATION RESULTS

19. Field Completion. The field completion task was successfully completed. A comprehensive report on field checking results is given in Annex C.

20. Aerial Photography. Due to the unserviceability of the Nomad, no aerial photography was produced during the Operation. A detailed report is included at Annex D. Supplementary

photography was obtained later using the aircraft that had deployed on Op NERVOSE 93. A report is at Annex E.

21. VAP Photography. No VAP photography was procured during the Operation. VAP photography was obtained during the subsequent aerial photography phase as detailed in Annex E.

22. PIGs. PIGs were produced in accordance with current technical instructions.

ADMINISTRATION AND LOGISTICS

Operation Manning

23. Personnel who participated in Op MIZMAZE 93 are listed at Annex F. All supporting units are thanked for releasing their members. All support personnel displayed great professionalism and gained valuable experience.

AAAvn Support

24. The following AAAvn support was provided by 1 Avn Regt:

- a. Kiowa LOH. Responsibility for the provision of LOH support for the Operation was split between 161 and 162 Recce Sqns. 161 Recce Sqn operated in the AO from 13 May 93 to 22 May 93 with three LOH; their report is included as Annex G. 162 Recce Sqn arrived in the AO on 21 May 93 with two LOH and departed on 10 Jun 93; their report is included as Annex H. A combined total of 120.8 hrs were flown. The exchange of Sqns occurred with the minimum of disruption, but had the potential to cause major problems.
- b. Nomad. One Nomad was provided by 173 Survl Sqn with 50 task hours of which 8.5 were used initially. The Nomad aircraft had to depart the AO due to airframe problems. Details are provided in the 173 Survl Sqn report at Annex I. A total of 46.7 hrs were later flown in obtaining the supplementary photography at the conclusion of Op NERVOSE 93.

25. The professionalism of all AAAvn members and their willingness to help with other tasks contributed to the success of the Operation.

Land Clearances

26. Responsibility for obtaining land clearances lay with HQ NORCOM. Clearances to enter all but five properties in the AO were obtained before departing Adelaide. Upon arrival in

the AO the Detachment was notified that verbal approval for the remaining properties had been received, with written confirmation to follow.

POL

27. Pre-Positioned Drummed Fuel. Pre-positioning of drummed fuel was carried out by 7 Log Coy in accordance with Reference A.

28. Fuel Drum Recovery. All fuel drums deployed by Det 4 Fd Svy Sqn were recovered to either the distributor in Broome or Fitzroy Crossing (Fitzroy Crossing Enterprises) in accordance with Reference B.

Vehicle Support

29. Vehicles used on the Operation were:

- a. seven LR 110 Truck Survey panel FFR,
- b. two truck cargo MC2 (UNIMOG),
- c. two truck cargo MC4, and
- d. one 1/2 ton trailer.

30. All vehicles performed well on the Operation. The long distance to and from the AO meant that the maintenance of daily vehicle parades was paramount. The harsh environment in the AO placed a great strain on vehicles and drivers. If the VM had deployed on the Operation with his FRV then the expenditure on repairs would have been substantially less. The FRV would have also given the flexibility to repair vehicles during the insertion, during the extraction, and in the field. A report by the VM, including specific repairs, is given at Annex J.

Accommodation

31. Deployment/Extraction. Accommodation while driving to and from the AO was in caravan parks under personal shelters.

32. Broome. In the Broome AO accommodation comprised:

- a. Main base - tentage at Broome PCYC.
- b. Forward base (Sandfire Roadhouse) - tentage plus the hire of a room as needed to carry out manuscript transfers.
- c. Photography Darkroom - Broome Hospital.

33. Fitzroy Crossing. Accommodation in the Fitzroy Crossing AO was under tentage at the Fitzroy Lodge Caravan Park. The photography darkroom at the Fitzroy Crossing Hospital had been arranged for use but was not used for reasons mentioned previously.

Messing

34. All food was purchased locally using Survey Party Ration Allowance (SPRA). The amount of SPRA set aside for the Operation was adequate. Purchases were made from local firms without problems.

Amenities

35. A colour television and video recorder were provided by DC-A, and was appreciated by all for evening entertainment. A limited canteen service was run during the Operation with the majority of stock being transported with the Detachment.

Medical

36. Medical facilities were provided by Broome and Fitzroy Crossing Hospitals. A number of minor ailments were treated at both establishments.

Morale And Discipline

37. Morale throughout the Operation, despite the length and arduous nature of the task, was maintained at a good level. One incident resulted in the member involved being returned to Unit for disciplinary action.

Finance

38. Expenditure was as follows:

- a. Travel and Subsistence - \$10 004
- b. Freight and Cartage - \$1 000
- c. Petty Cash - \$1 067
- d. SPRA - \$15 442
- e. Site rental - \$2 285
- f. Repairs - \$1 145

Allowances

39. The following allowances were paid:
- a. Travelling Allowance (TA). TA was paid as follows:
 - (1) Full TA was paid in advance to all AAAvn elements for insertion and extraction.
 - (2) The meals and incidental element of TA was paid in advance to all members who deployed to the Sandfire Roadhouse forward base.
 - b. District Allowance. District allowance was paid in retrospect at the appropriate rates, depending on member categorisation.
 - c. Field Allowance. Field allowance was paid in retrospect whilst not in receipt of travelling allowance.
 - d. Separation Allowance. After a 14 day qualifying period, separation allowance was paid in retrospect to Cat M members, whilst not in receipt of travelling allowance.
 - e. Flight Duties Allowance. Flight duties allowance was paid in retrospect to RASvy air camera operators.

Banking

40. Banking facilities in the AO were as follows:
- a. Broome - all major banks, and
 - b. Fitzroy Crossing - Commonwealth Bank agent and EFTPOS at the Shell Service Station.

Mail

41. Mail was picked up from the post office daily in Broome and Fitzroy Crossing. Upon arrival in both of these locations a liaison visit was made to the post office to inform them of the Detachment's presence and to ask that Detachment mail be kept separate. Before leaving a locality instructions were left with the Post Office to forward mail.

Remote Locality Leave

42. All participants accrued remote locality leave at a rate of 7/12 days per completed month in the AO.

Rest

43. Members accrued rest days at a rate of one day for each weekend spent in the AO with a maximum of five days. These rest days were taken upon RTU.

Visits

44. The following personnel visited the Operation:

- a. COL D.G. Swiney MBE (RL), Col Comdt RASvy - 14 to 17 May 93.
- b. MAJ A.B. McLeod, OC 4 Fd Svy Sqn - 20 to 23 May 93.

Public Relations

45. The following PR activities took place:

- a. The Detachment OC and OPSWO were interviewed by Maria Mann of the Broome Advertiser resulting in an article published on 20 May 93.
- b. RASvy and AAAn presentation to the Broome Police Rangers Youth Club on 24 May 93.

COMMAND AND SIGNAL

Command

46. No problems were experienced with the command arrangements specified in Reference A.

Communications

47. Rear link. Rear link communications were via telephone and fax as follows:

- a. Broome. The proximity of the offices at the Broome PCYC allowed an extension to be run to the ops tent with the consequence of sharing of a line. The possibility of installing a dedicated line was investigated but would have taken too long and was considered to be of little benefit for the cost involved.
- b. Fitzroy Crossing. The main base location in the Fitzroy Lodge Caravan Park was approximately 400m from the main administration building making it impractical to install a line. Reception was visited twice daily to pick up faxes and outgoing faxes were sent when necessary at a charge by the caravan park. The police also delivered a number of faxes to AAAn elements. A rear link

was also established to 4 Fd Svy Sqn in Adelaide by RAVEN HF radio. A daily schedule was established when both parties would listen out.

48. Radio Net. 1 Sig Regt provided one radio operator for communications support to the Operation who performed in a competent and professional manner. Communications between main base and field check parties were by RAVEN HF radio. Very few communications problems were encountered once it was determined that frequencies in the 9 MHz range were unsuitable and an appropriate antennae configuration was established. Even with new equipment the establishment of communications in the north of Australia requires a large amount of trial and error. Squadron members were found to be inexperienced in the operation of the RAVEN set and in antennae theory. The communications report is given in Annex K.

49. SITREPs. Weekly SITREPs were sent by fax.

CONCLUSIONS

50. Op MIZMAZE 93 was a successful operation. Eighty-six 1:50 000 scale line maps were checked in a five week period. No supplementary or VAP photography was obtained during the Operation due to circumstances beyond the control of the Detachment. The five week period spent field checking involved constant effort from the field parties under arduous conditions. Time constraints meant that no rest periods were available. Overall, personnel on the Operation performed very well and are to be congratulated.

51. Rear link communications were by telephone/fax as stated in the Mounting Instruction. It was necessary at times to utilise third party facilities in order to maintain this form of communication. When such facilities were not available, the establishment of a radio rear-link was utilised. This Unit holds high quality radio equipment capable of such a task. It makes sense to develop radio communications to a point where they are once again the norm.

52. Although mapping photography was relatively recent and interpretation was quite good (refer to Annex C), numerous corrections were still applied to map sheets. One of the major benefits of field completion operations is that the personnel involved are able to gain first-hand knowledge of the environment they must map. This opportunity vastly increases their photo-interpretation skills, professionalism and interest which means that products are produced more accurately and more efficiently. However, it should be noted that the majority of corrections relate to cultural features and as such are under constant change. The most important map features for navigation (relief, drainage and vegetation) are consistently accurate, and the benefit of slightly more accurate cultural detail should be balanced with the additional cost and time of field completion operations and with the disruption to production at Army Svy Regt. Roads are perhaps a feature which need to be verified, and it may be appropriate to undertake a road classification operation prior to plotting. Changes to significant cultural features (eg, townships) could be best monitored and revised by specific VAP mapping tasks.

53. The VM deployed on the operation without an FRV. Fortunately no major breakdowns occurred while in transit to and from the AO. While in the AO local support was of such a nature that repairs were easily carried out. Luckily no breakdowns occurred requiring repair in the field.

54. Hand held Global Positioning System (GPS) receivers were used as an aid to navigation and to position isolated detail while field checking. The receivers were of tremendous value, saving a large amount of effort and time. However caution should be exercised when using these receivers due to the effects that certain system changes have on accuracy. An investigation into the accuracy of the receivers and subsequent production of an SOP would be the next logical step in the introduction of this equipment.

55. Seismic lines can be an important navigational aid in areas of limited natural features. Present portrayal methods do not, however, permit their depiction in areas of clear vegetation. A new method of depiction is necessary.

RECOMMENDATIONS

56. The following recommendations have resulted from Op MIZMAZE 93 and are drawn from the body of the report and annexes:

<u>Recommendation</u>	<u>Recommended Action By:</u>
a. The cost benefit of conducting field completion operations should be investigated.	LHQ & DSVY-A
b. Radio should once again be established as the method of conducting rear link communications.	4 Fd Svy Sqn
c. Operation planning should include the provision of a number of rest days and a time contingency.	4 Fd Svy Sqn
d. The use of hand-held GPS for field checking should be investigated, and an SOP for use be produced.	4 Fd Svy Sqn
e. Every effort must be made to provide a VM with an FRV.	4 Fd Svy Sqn
f. The swapping of AAAvn (LOH) elements in the middle of an operation should be discouraged.	LHQ
g. The content of field check packages should be agreed upon between the producer and user before production actually starts.	Army Svy Regt & 4 Fd Svy Sqn
h. A new field completion SOP should be produced.	4 Fd Svy Sqn

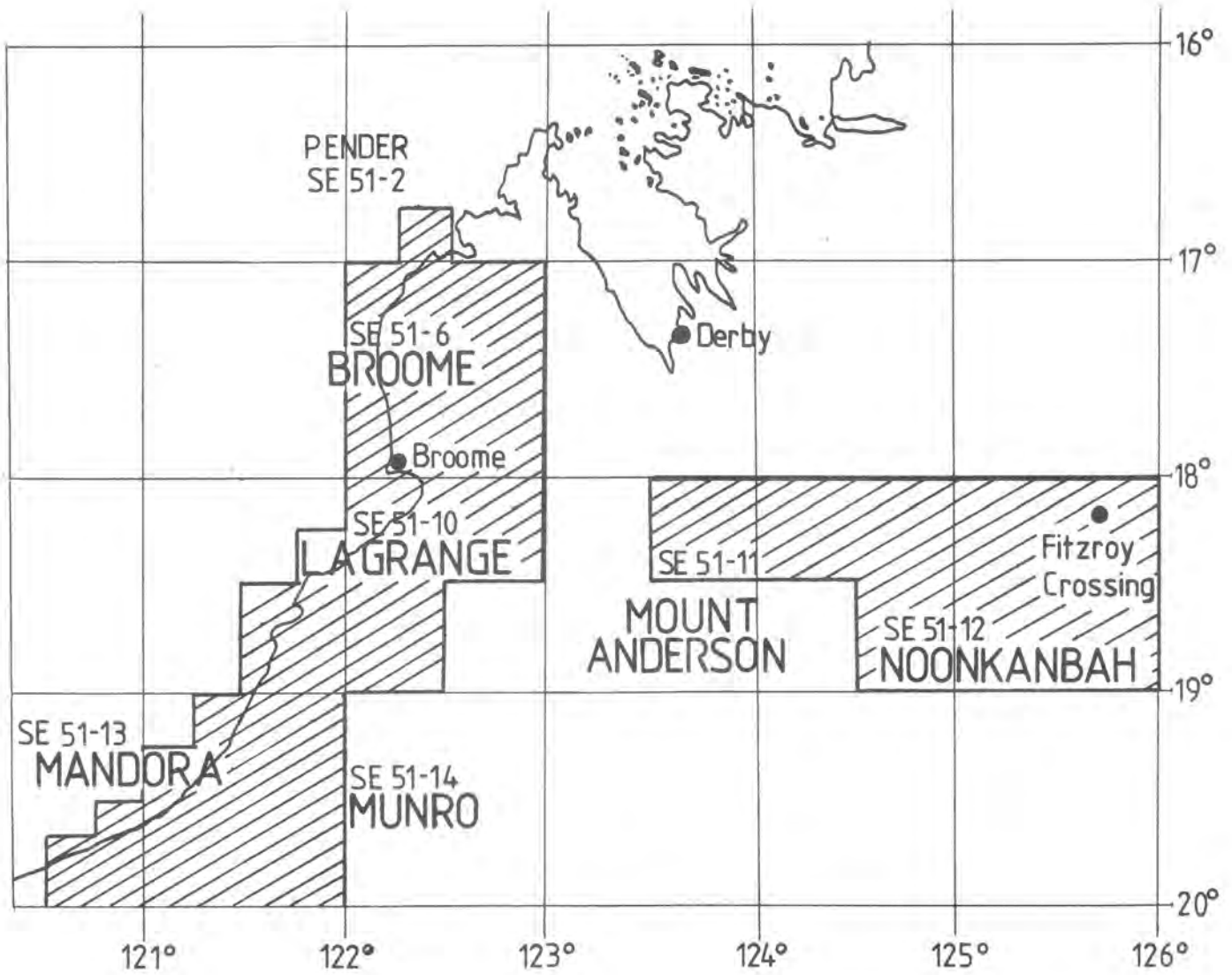
- i. Comprehensive RAVEN training should be given to all unit personnel. 4 Fd Svy Sqn
- j. An alternative method of portraying seismic lines is required to permit their depiction in areas of clear vegetation. Army Svy Regt
- k. The procurement of a more stable medium for field check sheets should be pursued. Army Svy Regt



A.B. McLEOD
Major
Officer Commanding

26 October 1993

OPERATION MIZMAZE 93 AREA OF OPERATIONS



AREA OF OPS
SCALE 1:5 000 000

SEQUENCE OF EVENTS

<u>Ser</u>	<u>Date</u>	<u>Event</u>
1.	30 Mar	Attached Army Svy Regt pers report to 4 Fd Svy Sqn for Pre-Op Training.
2.	31 Mar-8 Apr	Pre-Op Training.
3.	8 Apr	Army Svy Regt pers RTU.
4.	27 Apr	Attached Sig Op Rad from 1 Sig Regt reports to 4 Fd Svy Sqn. Attached Veh Mech from 5 Avn Regt Wksp reports to 4 Fd Svy Sqn. Attached Army Svy Regt pers report to 4 Fd Svy Sqn.
5.	1 May	Road Party departs Adelaide.
6.	7 May	Road Party arrives Broome.
7.	9 May	Commence Field Check (F/C), BROOME-LA GRANGE. Transit to Sandfire Roadhouse (4 pers).
8.	10 May	Commence F/C MANDORA-MUNRO (4 pers).
9.	11 May	AAAvn Nomad support arrives Adelaide for air camera fitting.
10.	13 May	AAAvn LOH(161 Recce Sqn)/Nomad support arrives Broome.
11.	14 May	COL Swiney, Col Comdt RASvy arrives.
	16 May	1 x LOH to Sandfire Roadhouse.
12.	17 May	Personnel changeover at Sandfire Roadhouse (1 x party). COL Swiney departs AO
13.	18 May	Personnel changeover at Sandfire Roadhouse (1 x party).
14.	19 May	Reconnaissance of Fitzroy Crossing conducted. LOH returns to Broome from Sandfire Roadhouse.
15.	20 May	MAJ McLeod, OC 4 Fd Svy Sqn arrives. 1 x LOH to Sandfire Roadhouse.

16. 21 May LOH returns from Sandfire Roadhouse to Broome.
AAAvn LOH (162 Recce Sqn) arrives Broome.
Nomad grounded.
17. 22 May AAAvn LOH (161 Recce Sqn) departs Broome for return to unit.
1 x LOH to Sandfire Roadhouse.
18. 23 May MAJ McLeod departs AO.
LOH returns from Sandfire Roadhouse to Broome.
19. 25 May All Pers return from Sandfire Roadhouse.
Pack stores.
20. 26 May Move base to Fitzroy Crossing.
Commence F/C MOUNT ANDERSON.
21. 27 May Commence F/C NOONKANBAH.
22. 2 Jun Nomad departs AO.
23. 9 Jun Complete F/C.
24. 10 Jun AAAvn LOH (162 Recce Sqn) support departs Fitzroy Crossing.
Pack Stores.
25. 11 Jun Road Party departs Fitzroy Crossing.
26. 18 Jun Road Party arrives Adelaide.

FIELD COMPLETION REPORT

BACKGROUND

Package Construction

1. 4 Fd Svy Sqn plotted and produced field completion packages for 24 x 1:50 000 map sheets in the 1:250 000 area SE 51-12 NOONKANBAH.
2. 4 Fd Svy Sqn plotted and Army Svy Regt produced field completion packages for map sheets in the following 1:250 000 areas:
 - a. SE 51-2 PENDER - 1 x 1:50 000;
 - b. SE 51-6 BROOME - 16 x 1:50 000;
 - c. SE 51-10 LA GRANGE - 18 x 1:50 000;
 - d. SE 51-11 MOUNT ANDERSON - 8 x 1:50 000;
 - e. SE 51-13 MANDORA - 11 x 1:50 000; and
 - f. SE 51-14 MUNRO - 8 x 1:50 000.
3. A list of the 1:50 000 scale map sheets is included at Appendix 1.

Source Data

4. Source data consisted of:
 - a. 1:50 000 field completion packages;
 - b. 1:100 000 existing/published topographic mapping;
 - c. 1:250 000 coverage in NTMS, JOG format and RA Svy R502 Series; and
 - d. numerous miscellaneous town plans and pastoral plans at various scales.

Field Completion Packages

5. Army Svy Regt produced field completion packages containing the following:
 - a. computer generated cultural, drainage, relief and vegetation (CDRV) composite colour paper plots as preliminary maps;

- b. various sheets in assorted colour combinations for use in the production of the guides and to assist in checking specific detail; and
 - c. CDRV composite film positives for use as field completion masters.
6. All but seven field completion packages were available prior to departure to the AO. The remaining packages were delivered to Broome and Fitzroy Crossing throughout the operation.
7. 4 Fd Svy Sqn produced field completion packages containing the following:
 - a. screen printed cultural, drainage, relief and vegetation (CDRV) composite map sheets as preliminary maps;
 - b. colour guides for specific detail; and
 - c. colour separated film positives for use as field completion masters.

Field Completion Colour Guides

8. 4 Fd Svy Sqn produced the various colour guides for all available 1: 50 000 map sheets prior to departure to the AO. The remaining guides were produced in the field upon their arrival.

EXECUTION

General Outline

9. During the first phase of the operation from the main base in Broome, the PENDER, BROOME and LA GRANGE areas were field completed by four field completion parties. Simultaneously, two field completion parties were deployed from a forward base at Sandfire Roadhouse to field complete the MANDORA and MUNRO areas. Upon the completion of these areas, main base was moved to Fitzroy Crossing where six field completion parties were deployed to field complete the MOUNT ANDERSON and NOONKANBAH areas.

Ground Verification

10. Ground verification was undertaken by two-man field parties who remained in the field for up to three days. On their return to main base, corrections were applied to the master field check positives. Homestead owners/managers within the AO were visited and provided valuable assistance on new development, positioning of detail and also placement and verification of nomenclature.

Air Verification

11. At the completion of the ground verification, an aerial inspection was completed to resolve any outstanding queries and to verify any detail inaccessible by road. The air check was completed by the same personnel that did the ground verification. Map sheets in the east of the

MUNRO and LA GRANGE areas required an extensive air check due to these areas being inaccessible by vehicle. Cultural detail in these areas was sparse.

Comments

12. The dates of plotting photography were as follows:
 - a. PENDER, BROOME and LA GRANGE - 1988 and 1989;
 - b. MANDORA and MUNRO - four runs 1988 and the remainder 1992;
 - c. MOUNT ANDERSON - 1988 and 1989; and
 - d. NOONKANBAH - 1988.
13. From the acquisition of photography to field completion, there were minimal changes to the topography.
14. Drainage. The portrayal of the drainage was generally very good. In some instances the drainage portrayal appeared incorrect due to recent heavy rains. In these instances drainage portrayal as plotted was assessed as correct, and consequently not changed.
15. Cultural. The portrayal of cultural information was also good, however in some instances over-plotting occurred. Although this method of plotting is preferable to under-plotting, it was found that many fences plotted were non-existent and many drainage run-offs along the Great Northern Highway were plotted as roads and had to be deleted. Due to seasonal flooding along the Fitzroy River, extensive cultural changes were found where detail had been destroyed and new roads and fences constructed. Mining areas in the South East of NOONKANBAH and the BROOME area also involved many cultural changes.
16. Relief. Relief as plotted was generally correct throughout the AO. Some rocky outcrops were incorrectly identified as pinnacles.
17. Vegetation. Vegetation portrayal was generally good throughout the AO, although seismic lines produced some difficulty. Most seismic lines plotted in the Broome area were found to be neither visible nor navigable at ground level. However, they were often visible from the air and constitute an important navigation feature in some areas (including clear areas where, using current symbology, they are unable to be portrayed). Seismic lines in other areas were neither visible from the ground nor the air and were deleted.
18. Enlargements. Monochrome enlargements from digital source were provided for areas of dense or cluttered information. These enlargements were a valuable aid to field verification, however as they were provided in monochrome only, some problems were encountered in distinguishing line work due to the inclusion of vegetation boundaries and relief. It would be preferable for the enlargements to be in colour, or with selected detail in monochrome.
19. Broome Enlargement. A 1:25 000 scale enlargement of Broome area was also provided and proved to be excellent for field verification of extensive detail in this area.
20. Hand Held GPS. Hand held GPS were used for checking information and positioning new data. Initial results showed 30m accuracy in most instances, however equipment specifications state a user range accuracy in some instances could be as great as 180m. This was considered unsatisfactory for the positioning of detail and as a result, supplementary photography

was flown for positioning all new data. The use of hand held GPS for future operations is strongly recommended for safety in the field, ease of locating position in remote areas and rapid approximate positioning of new detail.

Joins

21. All internal joins were completed in the field. Some problems were encountered with the joins between sheets with AGD84 datum and WGS84 datum. In these instances, all sheets were field completed 200m beyond the neatline. External joins were assessed in the field, however no external joins were completed due to the age of the printed maps. External join problems were logged on the relevant PD sheet.

Nomenclature

22. Nomenclature listings have been completed and will be forwarded to the appropriate authority. Included in the listings are recommendations to change the names of 16 map sheets.

Field Completion Reports

23. Field parties compiled individual Field Completion Reports in 1:100 000 areas for their areas of concern which are appended to the relevant PD folders.

Supplementary Photography

24. Supplementary photography was acquired for detail that could not be positioned accurately during the field completion. A full report on the aerial photography is at Annexes D and E.

Photo Interpretation Guides (PIGs)

25. Photographs for the production of PIGs were taken by all field completion parties whilst in the AO, as stipulated in Reference C.

CONCLUSION

26. The field completion phase of the operation was successfully completed on schedule. The number of maps required for field completion presented problems in the allocated time frame and as a result extensive hours of overtime were required by all field completion parties. This resulted in excessive fatigue in some members and did not allow all edits to be concluded in the field. All personnel involved in the field completion, especially the inexperienced members, gained valuable on the job training in field completion procedures and also familiarised themselves with driving techniques.

27. Generally, field completion parties were satisfied with the quality and quantity of the field completion packages prepared for their use. Some problems were encountered with sheet shrinkage and a more stable medium should be investigated. Field completion package content

varied greatly between map sheets and it is recommended, that for future operations, an SOP be produced.

Sep 93

K.G. TALBOT-SMITH
WO2
Det OPSWO

Appendix:

1. 1 : 50 000 Scale Map Sheets Field Completed on Op MIZMAZE 93

1: 50 000 SCALE MAP SHEETS FIELD COMPLETED ON OP MIZMAZE 93

The following 1: 50 000 scale maps were field completed during Op MIZMAZE 93:

SE51-2 PENDER 1 : 250 000:

3364 2 SLOPER SHOALS

SE51-6 BROOME 1 : 250 000:

3362 1 QUONDONG *

3362 2 ROEBUCK PLAINS

3362 3 BROOME

3362 4 CAPE BOILEAU

3363 1 CARNOT BAY

3363 2 WANGANUT

3363 3 COULOMB POINT

3363 4 BASKERVILLE SHOAL

3462 1 DALGLEISH

3462 2 TAYLORS LAGOON

3462 3 LAKE EDA

3462 4 KILTO

3463 1 LOUISA

3463 2 MOUNT JOWLAENGA

3463 3 COUNTRY DOWNS

3463 4 MUNTZ *

SE51-10 LA GRANGE 1 : 250 000:

3260 1 LA GRANGE

3260 2 PARDA

3260 3 CAPE FREZIER

3260 4 CAPE BOSSUT

3261 2 GOURDON BAY

3261 3 JUSTICE SHOAL

3360 1 WAKELING *

3360 2 GRAHAM

3360 3	BARRIE *
3360 4	BIDDLES
3361 1	ROEBUCK BAY
3361 2	GOLDWYER *
3361 3	CAPE VILLARET
3361 4	PEARL SHOALS
3461 1	O BYRNE
3461 2	ROZEMA
3461 3	LARKIN
3461 4	COOMACOP WELL

SE51-11 MOUNT ANDERSON 1 : 250 000:

3661 1	MOUNT ANDERSON
3661 2	CAMELGOODA HILL
3661 3	WILSONS CREEK
3661 4	FROME ROCKS
3761 1	MOUNT WYNNE
3761 2	NERRIMA
3761 3	MOULAMEN HILL
3761 4	LIVERINGA

SE51-12 NOONKANBAH 1 : 250 000:

3860 1	MOUNT TUCKFIELD
3860 2	MILLAJIDEE
3860 3	MOUNT FENTON
3860 4	KALYEEDA
3861 1	HARDMAN *
3861 2	NOONKANBAH *
3861 3	MOUNT IBIS *
3861 4	PARADISE
3960 1	GAP CREEK
3960 2	PITTSWORTH
3960 3	BUCKNALL
3960 4	DUKES DOME
3961 1	LAUREL DOWNS
3961 2	SHARKHOLE *
3961 3	WARRIMBAH
3961 4	QUANBUN BUTTE
4060 1	PRICES HILL
4060 2	CHRISTMAS CREEK
4060 3	CHERRABUN
4060 4	BRUTEN HILL

4061 1	FOSSIL DOWNS
4061 2	MOUNT PIERRE
4061 3	GOGO
4061 4	FITZROY CROSSING

SE51-13 MANDORA 1 : 250 000:

3058 1	MANDORA
3058 2	MOOGLIE
3058 3	WALLAL
3058 4	EIGHTY MILE BEACH
3158 1	WIDJUBB
3158 2	EIL EIL SPRING *
3158 3	MARDA *
3158 4	NAMBEET *
3159 1	BROLGA
3159 2	NOREEN *
3159 3	MOOJAN

SE51-14 MUNRO 1 : 250 000:

3258 1	WOODS
3258 2	MOUNT MORRIS
3258 3	BEDAROMAL *
3258 4	DIDRAMS *
3259 1	WILLARA HILL
3259 2	ARTHUR *
3259 3	MOUNT PHIRE
3259 4	NITA

* recommendation for name change

AERIAL PHOTOGRAPHY REPORT

INTRODUCTION

1. Op MIZMAZE 93 was a field check operation with air camera support for supplementary and VAP photography acquisition conducted in northern Western Australia.
2. The operation was conducted during the period 13 May - 3 Jun 93 and was based in Broome and Fitzroy Crossing, Western Australia.

AIM

3. The aim of this report is to detail administration, logistic support and problems involved in air camera support of Op MIZMAZE 93.

OPERATION RESULTS

4. Due to circumstances that will be detailed further into the report there were nil results.

CONDUCT OF OPERATION

5. A Nomad aircraft with RC10 camera fitted, departed Adelaide with pilot, crewman and air camera operator on 13 May 93 and arrived at the AO on the same day. Stores for Op MIZMAZE 93 were transported to Broome by the road party.

Aerial Film

6. Processing. All black and white aerial film was developed by the air camera operator using the Zeiss FE 120 Film Developing Outfit after each sortie.
7. Film. Kodak Double X Aerographic 2405 could not be assessed accurately due to the problems detailed in para 9.

Photo Assessment

8. Photo assessment was carried out in accordance with TI 305.

Problems Encountered

9. The following problems had a major impact on the Operation:
- a. Film Magazine. Film magazine No 2627 that was used after the initial test flight allowed light onto the film, causing the film to be exposed whilst photography was taken.
 - b. Exposure Meter. The exposure meter that was used initially could not be set consistently, which resulted in the film being exposed at different exposure rates.
 - c. Aircraft. Due to the grounding of the Nomad, initially for cracks in the horizontal tail, seven days were lost. The new tail arrived and was fitted, then upon inspection further cracks were found in a different part of the tail which resulted in the grounding of the aircraft which was not used for further task hours.
 - d. Developer. After the D19 liquid developer was used initially for developing approximately 30 feet of film, it appeared to be very dark. As the operator had not experienced this before it was believed that the developer may have been contaminated, or the discolouration may have been caused by the anti-hilation backing used in the film. Due to inexperience, the air camera operator could not determine if the developer was contaminated.

ADMINISTRATION AND LOGISTICSPersonnel

10. Personnel utilised for aerial photography on the operation were:
- a. 4 Fd Svy Sqn - CPL P.J. Ball.
 - b. 173 Survl Sqn - LT D. Kemp and CFN R. Shaw.

Photographic Support

11. Broome The darkroom facilities at Broome District hospital were utilised during the first half of the Operation. The darkroom was small, comprising a sink and two benches. The sink was large enough to hold one B5 tank. There was a small amount of blacking out required to stop light entering the darkroom.
12. Initially the hospital could be used during work hours. However, any emergency within the hospital where the darkroom would be needed precluded its use and it was therefore decided to use the darkroom after hours.
13. Fitzroy Crossing Due to the grounding of the aircraft, Fitzroy Crossing Hospital was not utilised. All the stores for developing the film were stored at the hospital, and an inspection of the darkroom facilities was conducted. The darkroom was smaller than that at Broome, with a bench and a sink. Due to the amount of hospital equipment already in this room, and a sink that a B5 tank would not fit into, this area was not suitable for developing aerial film.

Stores and Equipment

14. All stores and equipment taken for the operation were sufficient. Serviceability of equipment was good except for the previous detailed problems associated with the D19 liquid developer and the exposure meter.

CONCLUSION

15. Op MIZMAZE 93 (Aerial Photography) was not a successful operation, due to the unserviceability of the camera aircraft.

RECOMMENDATIONS

16. It is recommended that:

- a. Film magazines be tested for serviceability before being used on operations.
- b. Exposure meter be tested for serviceability before being used on operations.
- c. Fitzroy Crossing Hospital not be used for developing aerial camera film.
- d. For future field check operations the air camera insertion be held back at least 10 days after the field check parties commence checking.
- e. An experienced air camera operator as well as a junior operator be deployed on further operations.

Jun 93

P.J. BALL
CPL
Air Camera Operator

SUBSEQUENT AERIAL PHOTOGRAPHY REPORT

General

1. Supplementary and Vital Asset Protection (VAP) photography was flown during the period 7 Aug to 14 Aug 93 in the Broome and Fitzroy Crossing areas as requested by field completion parties and 1 Topo Svy Sqn respectively. Photography was acquired using a WILD RC10 Camera, Serial No. 1465 with a SWA lens, Serial No. 2006 with calibrated focal length of 88.013mm. The camera was mounted in a military Nomad aircraft, A18-315.

Tasking

2. The following tasks were undertaken:
- a. Supplementary Photography. Approximately 2 000 line km of photography was taken during the operation using 46.7 task hrs. The altitude of the photography was originally planned at approximately 7 200 ft giving a scale of 1:25 000, but was increased to 10 000 ft to give greater coverage due to volume of photography requested. Photography was proved from the negative developed in situ, with bromides being produced at 4 Fd Svy Sqn in Adelaide at the completion of the operation. Flight line diagrams are included as Appendices 1 to 7.
 - b. Vital Asset Protection (VAP) Photography. A request from 1 Topo Svy Sqn for VAP photography of various towns, airstrips, wharves and other vital assets could not be fully realised due to limited flying hours being available. Some of the supplementary photography could be used for VAP if required. VAP photography was forwarded direct to 1 Topo Svy Sqn. The following VAP photography was flown:
 - (1) Three runs of photography at 3 000 ft over Derby, and
 - (2) One run of Willare Bridge, south east of Derby.

Personnel

3. The following personnel were involved:
- a. RASvy;

- (1) 317246 SSGT J.M. Phillips, Army Svy Regt, Air Camera Operator; and
 - (2) 554198 LCPL G.D. Craggs, Army Svy Regt, Air Camera Operator.
- b. AAAvn:
- (1) 329037 LT D. Kemp, 173 Survl Sqn, Pilot;
 - (2) 557248 LT K. Yeats, 173 Survl Sqn, Pilot; and
 - (3) 65155 CFN M. Lillehagen, 173 Survl Sqn, All Trades.

Processing

4. Film processing was originally planned to be performed in the Radiology Dept of the Broome hospital. The facilities at the hospital were suitable but access to the facilities was limited to normal business hours. It was decided to utilise the bathroom of the hotel accommodation as a darkroom to enable all hour access. This proved to be suitable and far more convenient. The hospital personnel were very helpful and thanks were passed for their assistance in any case. B5 Morse Tanks were used for film processing, with no bromides being required to be produced in the AO. A RC520 print drier brought from Army Svy Regt was used for drying negatives. This drier proved indispensable in that it was light and portable, even though it is designed for drying bromides it handled the task far better than manual drying.

GPS Navigation

5. A MAGELLAN GPS NAV 5000 PRO was used for navigation in the AO. No external antenna was fitted but the placement of the GPS receiver in the front of the aircraft proved suitable for two dimensional navigation. The following method was used for navigation with the GPS:

- a. Flight lines planned and co-ordinates noted.
- b. Start and finish co-ordinates of flight lines allocated arbitrary way point codes.
- c. Way points stored in GPS.
- d. Navigation mode selected with pilot indicating to camera operator start and finish points.
- e. Camera operator confirmed GPS position by air to ground navigation.

6. The use of GPS for navigation proved to be instrumental in the operation being completed in the allocated hours. Correct planning and operation of GPS for navigation virtually means all allocated flying hours are used for photography, with minimal time required to confirm the location of photography requests.

Problems Encountered

7. The following problems were encountered:

- a. Kodak 2405 Film. All 2405 film developed in the B5 Tanks had a high base fog. Kodak 2402 film developed under the same conditions and with the same time/temperature tables produced very acceptable results, which concluded that the problem was caused by either of the following:
 - (1) The film was over developed, due to excess time in developer or incorrect developer temperature.
 - (2) The time/temperature charts used for calculating development time are not compatible for 2402 and 2405 film under the same conditions, ie. a different chart is required for each film.
 - (3) The 2405 film used, which had an expiry date of Sep 93, had been degraded due to temperature and condition changes through its life. Kodak 2405 film is susceptible to this type of degradation.
- b. It was considered that the most probable cause of the problem was the quality of the film. Unfortunately this cause was not considered whilst in the AO and hence the film was continued to be used, with the cause being thought to be caused by the time/temperature charts. It must be emphasised that the results produced were still of an acceptable quality for point transfer.
- c. WILD RC10 Serial Number 1465. The camera was fitted in the Nomad at Tindal before deploying to the AO. The following problems were encountered with the camera:
 - (1) The NF2 sight mount and control panel mount were both difficult to install due to incompatible nuts and bolts being supplied. This problem is not as relevant when the camera is installed in Adelaide, but dedicated nuts and bolts should be found that can be easily fitted, that also secure the mounts more stably.
 - (2) The control for the exposure setting was found to be very delicate. Even though it is the camera operators responsibility to constantly check all exposure settings, it was found to be a nuisance when the camera was the cause of intermittent changes.
 - (3) The spiral controlling the overlap behaved inconsistently with constant attention being required. This problem occurred even when wind was negligible. The circuit board controlling the overlap was replaced, but the problem still remained indicating that the problem was more likely to be found in the control panel.

- (4) The fuse controlling the longitudinal tip constantly blew. Manual levelling in this direction overcame the problem easily. It was found that Nomad aircraft have an attitude problem, ie. at an altitude of 10 000 ft the level of the aircraft is approximately one degree nose-up. This amount was considered to be optimistic, with the camera needing to be manually brought up to its maximum extent. This may have caused the problem with the fuse and also the servo motor controlling the tip.
- (5) VAP requests invariably desire photography at varying altitudes. This requires the aircraft to manoeuvre from the supplementary photography altitude of 7 200 ft - 10 000 ft to possibly 3,000 ft. Unless dedicated flying hours are given for VAP then it is unlikely sufficient flying time will be available to complete VAP requests at altitudes over than those used for supplementary photography, ie. 10 000 ft.
- d. Bromide Production. Bromides were produced at 4 Fd Svy Sqn at the completion of the operation. Given the quantity of bromides required, a better and quicker result could have been produced at Army Svy Regt.
- e. Photography Requests. This photography operation was unusual in that it was not carried out in conjunction with the field completion operation but approximately three months later due to aircraft problems during the original operation. This resulted in a vast volume of photography being required in a relatively short time instead of the trickle feed that usually occurs. This compounded a problem that there was insufficient time to critically assess photography requests. It appeared from the volume of photography requested that there was an over dependence on supplementary photography. eg. 1:50 000 map sheets within the 1:100 000 BRUTEN and FITZROY CROSSING map areas were virtually completely re-flown.
- f. Further to the previous problem, was that requests were marked on to 1:100 000 map sheets. This does not cause a problem when the majority of detail portrayed on the 1:50 000 is also on the 1:100 000. Fortunately the use of GPS for navigation negated this problem.

CONCLUSIONS

8. The on job training of junior air camera operators with experienced personnel on Australian identification and supplementary photography tasks proved beneficial. Members given experience on relatively easy tasks such as this are then more confident to tackle future mapping photography missions.
9. All supplementary photography requests were completed in the allocated time.
10. This photography operation was unusual in that it was not carried out in conjunction with the field completion operation but approximately three months later due to aircraft problems

during the original operation. This resulted in a vast volume of photography being required in a relatively short time instead of the trickle feed that usually occurs.

RECOMMENDATIONS

11. The following recommendations are suggested:
 - a. WILD RC10 Serial No. 1465 be serviced to rectify problems mentioned.
 - b. Kodak 2405 Double X film not to be used on future supplementary photography operations, with 2402 Plus X Aerographic to be used in its place.
 - c. Future ident/supplementary photography operations continue to employ a second air camera operator for on job training purposes, at least until a suitable quota of air camera operators at the CPL rank are competent.
 - d. Additional flying hours be allocated for VAP photography.
 - e. A Technical Instruction be written detailing VAP procedures, particularly in the area of oblique photography requests.
 - f. GPS receivers be used for navigation purposes within aircraft to maximise flying hours.

Sep 93

J.M. PHILLIPS
SSGT
Air Camera Operator

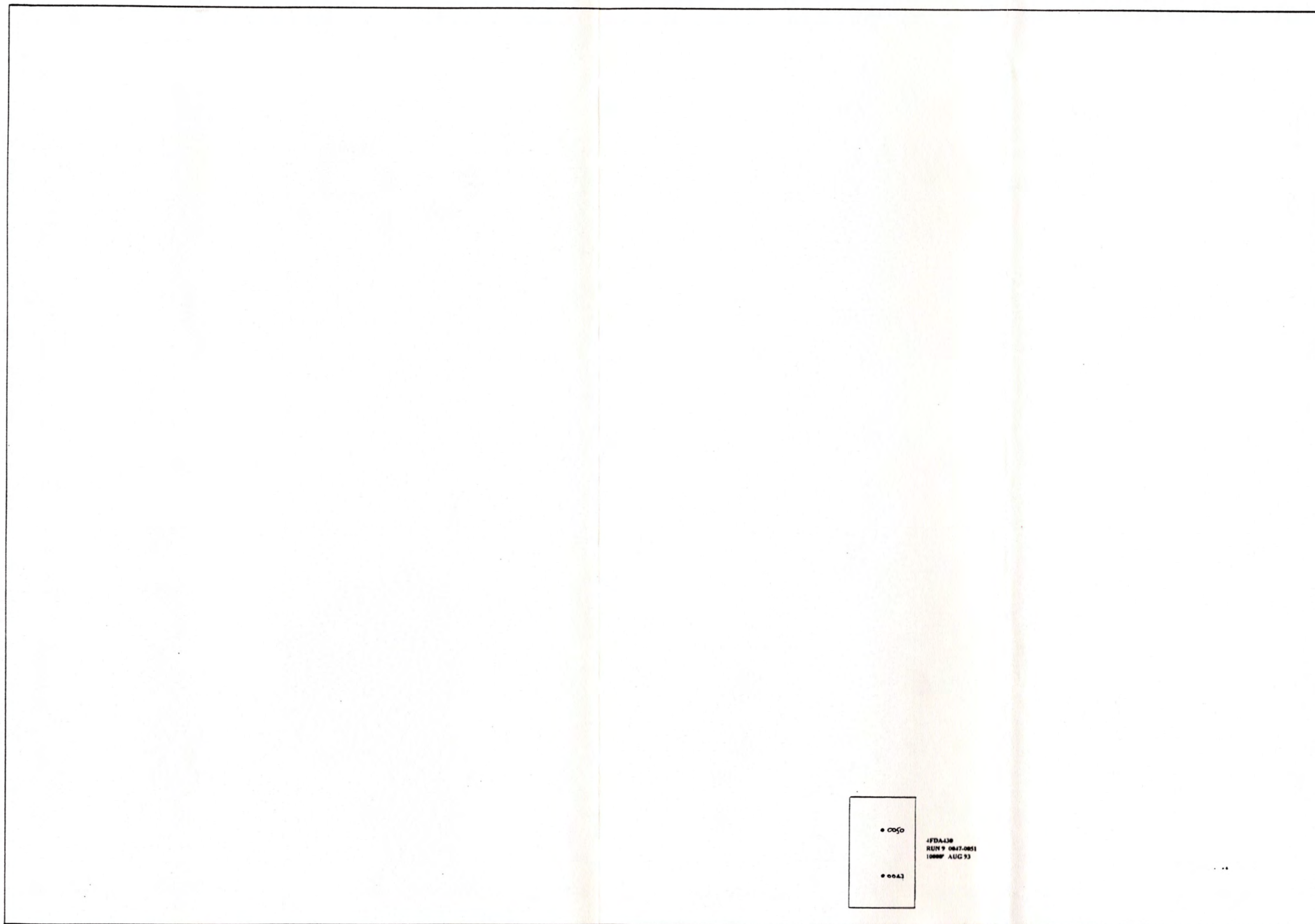
Appendices:

1. Supplementary Photography - PENDER
2. Supplementary Photography - BROOME
3. Supplementary Photography - LA GRANGE
4. Supplementary Photography - MOUNT ANDERSON

5. Supplementary Photography - NOONKANBAH
6. Supplementary Photography - MANDORA
7. Supplementary Photography - MUNRO

SUPPLEMENTARY PHOTOGRAPHY
PENDER

1: 250000

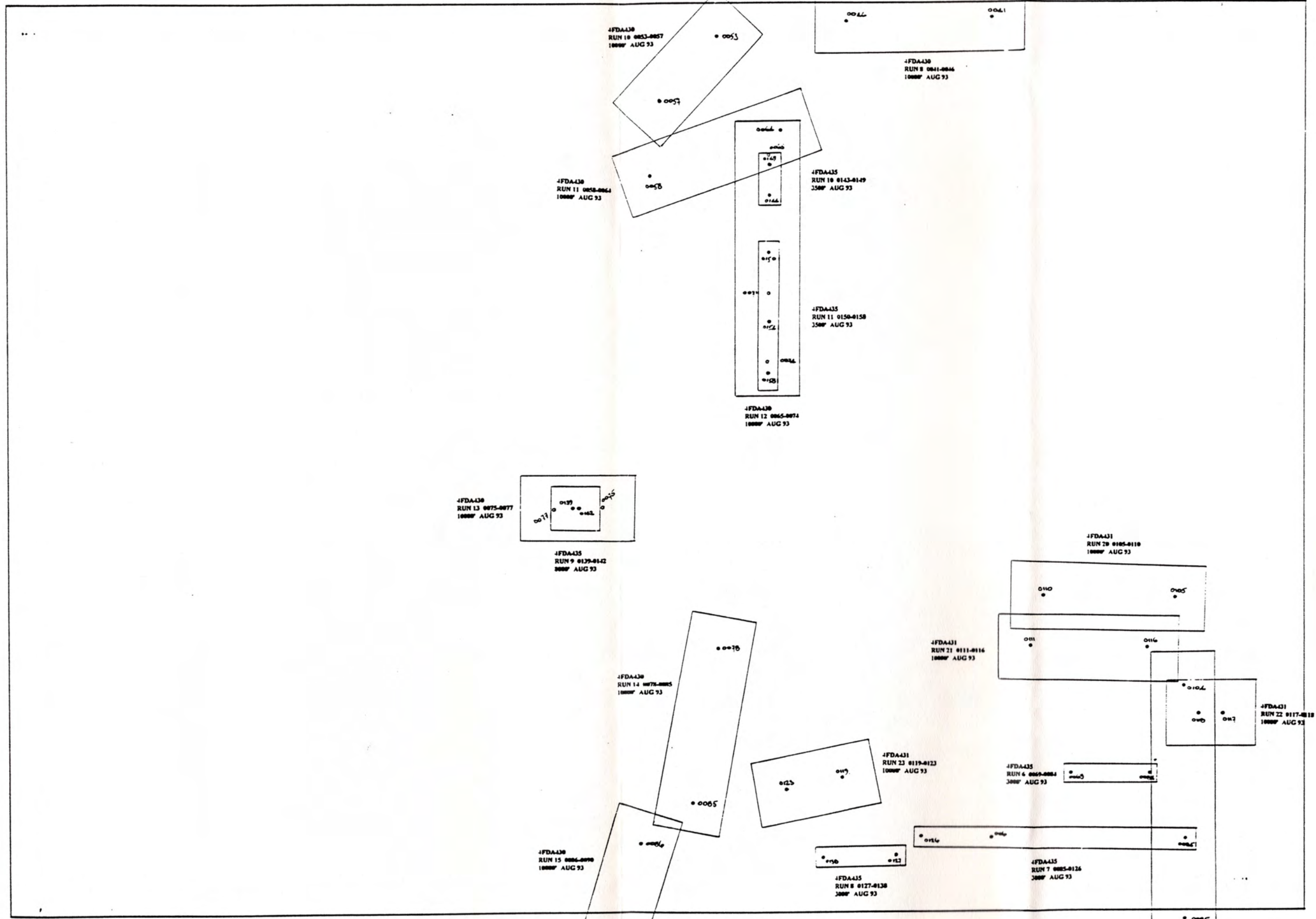


• 0050
• 0043

IFDA38
RUN 9 0847.0851
1999 AUG 93

SUPPLEMENTARY PHOTOGRAPHY
BROOME

1: 250 000



COMPILED: SSGT PHILLIPS *Phillips*

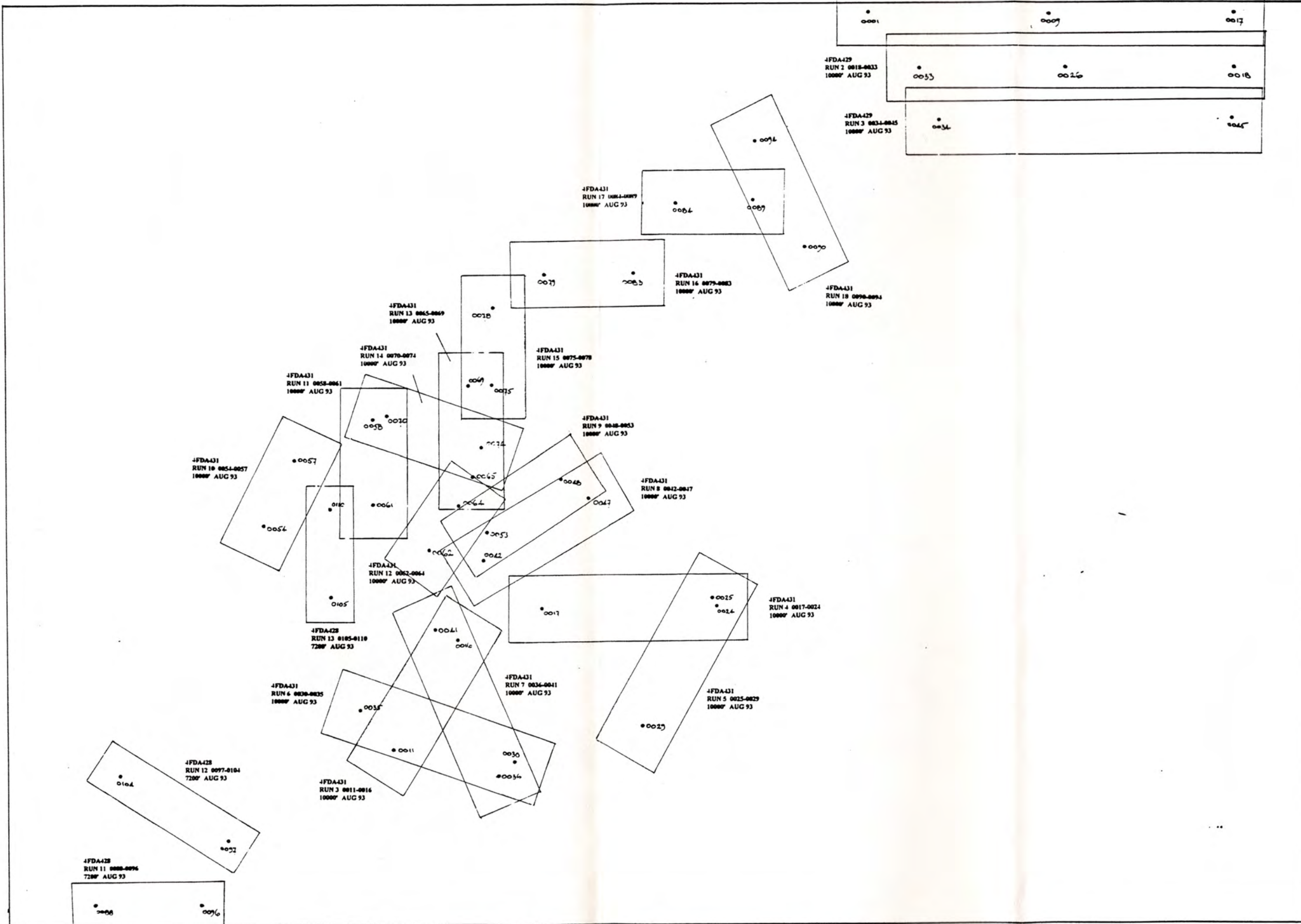
4FDA47
RUN 19 0095-0100
1000W AUG 93

SUPPLEMENTARY PHOTOGRAPHY
LAGRANGE

1:250000

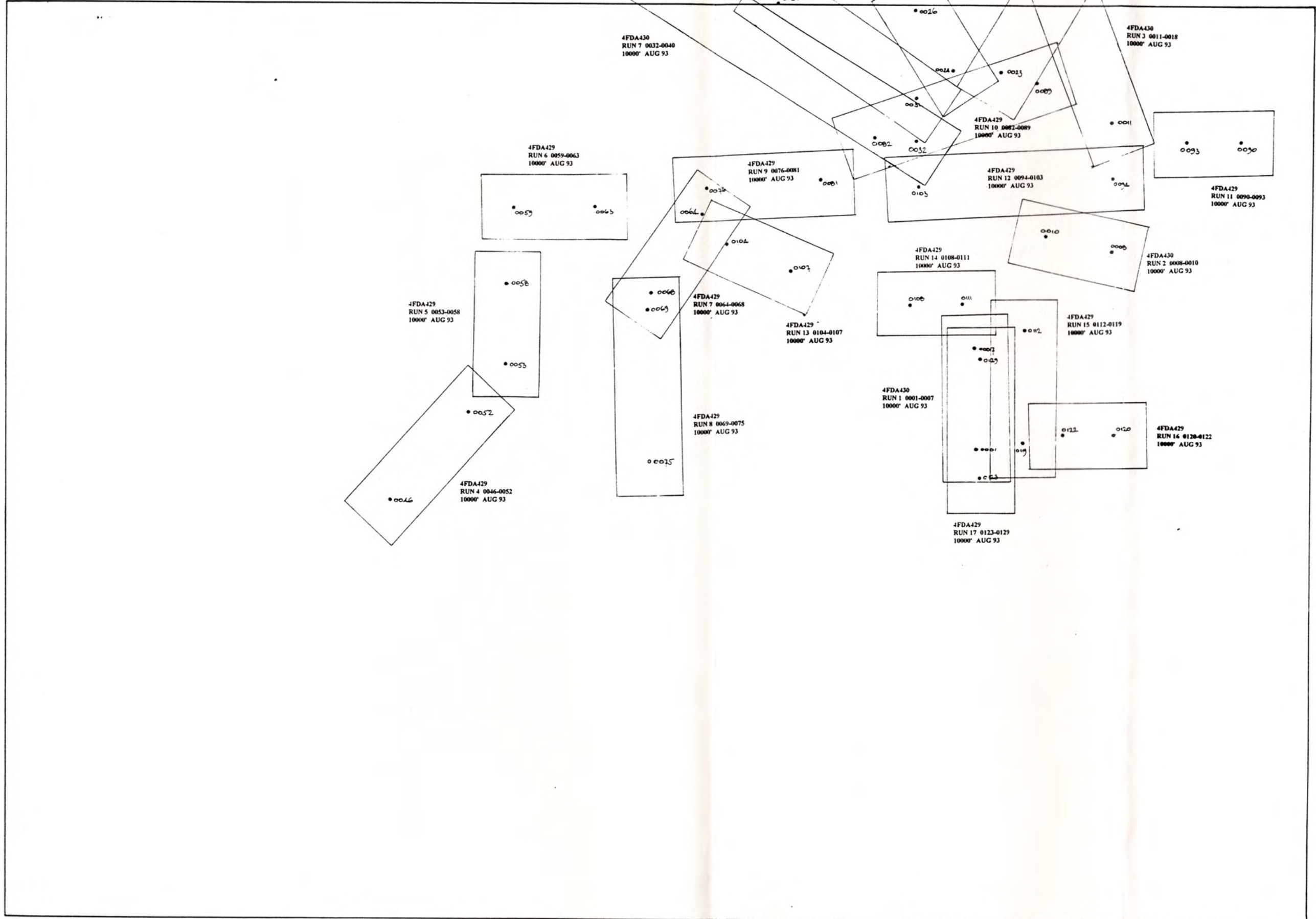
4FDA429
RUN 1 0001-0017
10000' AUG 93

SE 57-10



SUPPLEMENTARY PHOTOGRAPHY
MOUNT ANDERSON

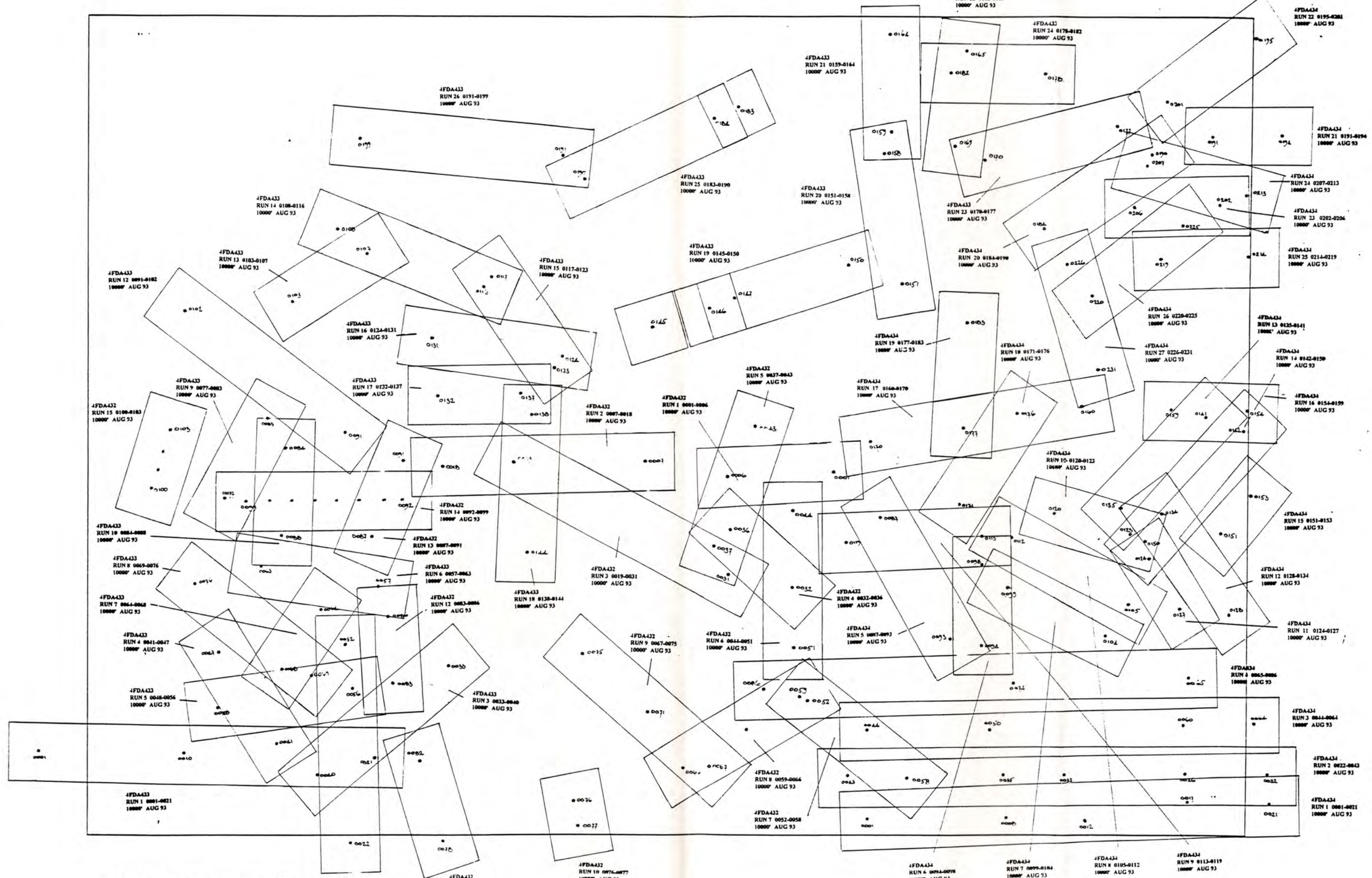
1:250000



SUPPLEMENTARY PHOTOGRAPHY
NOONKANBAH

SE51-12

1:250 000



COMPILED: SSGT PHILLIPS

4FDA433 RUN 2 0022-0032 10000 AUG 93
4FDA432 RUN 11 0078-0082 10000 AUG 93

4FDA432 RUN 10 0074-0077 10000 AUG 93

4FDA432 RUN 4 0059-0064 10000 AUG 93

4FDA432 RUN 7 0052-0058 10000 AUG 93

4FDA434 RUN 4 0094-0098 10000 AUG 93

4FDA434 RUN 7 0099-0104 10000 AUG 93

4FDA434 RUN 8 0105-0112 10000 AUG 93

4FDA434 RUN 9 0113-0119 10000 AUG 93

4FDA434 RUN 2 0022-0043 10000 AUG 93

4FDA434 RUN 1 0001-0021 10000 AUG 93

4FDA434 RUN 3 0044-0064 10000 AUG 93

4FDA434 RUN 4 0065-0086 10000 AUG 93

4FDA434 RUN 11 0124-0127 10000 AUG 93

4FDA434 RUN 12 0128-0134 10000 AUG 93

4FDA434 RUN 15 0151-0153 10000 AUG 93

4FDA434 RUN 16 0154-0159 10000 AUG 93

4FDA434 RUN 14 0142-0150 10000 AUG 93

4FDA434 RUN 13 0135-0141 10000 AUG 93

4FDA434 RUN 25 0214-0219 10000 AUG 93

4FDA434 RUN 23 0202-0206 10000 AUG 93

4FDA434 RUN 24 0207-0213 10000 AUG 93

4FDA434 RUN 21 0193-0194 10000 AUG 93

4FDA434 RUN 22 0195-0201 10000 AUG 93

4FDA434 RUN 19 0177-0183 10000 AUG 93

4FDA434 RUN 20 0184-0190 10000 AUG 93

4FDA434 RUN 21 0185-0192 10000 AUG 93

4FDA433 RUN 22 0165-0169 10000 AUG 93

4FDA433 RUN 24 0178-0182 10000 AUG 93

4FDA433 RUN 21 0159-0164 10000 AUG 93

4FDA433 RUN 20 0151-0158 10000 AUG 93

4FDA433 RUN 19 0145-0150 10000 AUG 93

4FDA432 RUN 1 0001-0006 10000 AUG 93

4FDA432 RUN 2 0007-0018 10000 AUG 93

4FDA433 RUN 18 0138-0144 10000 AUG 93

4FDA432 RUN 9 0067-0075 10000 AUG 93

4FDA433 RUN 3 0033-0040 10000 AUG 93

4FDA433 RUN 26 0191-0199 10000 AUG 93

4FDA433 RUN 25 0183-0190 10000 AUG 93

4FDA433 RUN 15 0117-0123 10000 AUG 93

4FDA433 RUN 17 0132-0137 10000 AUG 93

4FDA432 RUN 6 0057-0063 10000 AUG 93

4FDA432 RUN 12 0083-0086 10000 AUG 93

4FDA433 RUN 5 0048-0056 10000 AUG 93

4FDA433 RUN 14 0108-0116 10000 AUG 93

4FDA433 RUN 13 0103-0107 10000 AUG 93

4FDA433 RUN 9 0077-0083 10000 AUG 93

4FDA433 RUN 8 0069-0076 10000 AUG 93

4FDA433 RUN 7 0064-0068 10000 AUG 93

4FDA433 RUN 4 0041-0047 10000 AUG 93

4FDA433 RUN 12 0091-0102 10000 AUG 93

4FDA432 RUN 15 0106-0103 10000 AUG 93

4FDA433 RUN 10 0081-0088 10000 AUG 93

4FDA433 RUN 1 0001-0021 10000 AUG 93

4FDA433 RUN 2 0022-0032 10000 AUG 93

4FDA432 RUN 11 0078-0082 10000 AUG 93

4FDA432 RUN 10 0074-0077 10000 AUG 93

4FDA432 RUN 4 0059-0064 10000 AUG 93

4FDA432 RUN 7 0052-0058 10000 AUG 93

4FDA434 RUN 4 0094-0098 10000 AUG 93

4FDA434 RUN 7 0099-0104 10000 AUG 93

4FDA434 RUN 8 0105-0112 10000 AUG 93

4FDA434 RUN 9 0113-0119 10000 AUG 93

4FDA434 RUN 2 0022-0043 10000 AUG 93

4FDA434 RUN 1 0001-0021 10000 AUG 93

4FDA434 RUN 3 0044-0064 10000 AUG 93

4FDA434 RUN 4 0065-0086 10000 AUG 93

4FDA434 RUN 11 0124-0127 10000 AUG 93

4FDA434 RUN 12 0128-0134 10000 AUG 93

4FDA434 RUN 15 0151-0153 10000 AUG 93

4FDA434 RUN 16 0154-0159 10000 AUG 93

4FDA434 RUN 14 0142-0150 10000 AUG 93

4FDA434 RUN 13 0135-0141 10000 AUG 93

4FDA434 RUN 25 0214-0219 10000 AUG 93

4FDA434 RUN 23 0202-0206 10000 AUG 93

4FDA434 RUN 24 0207-0213 10000 AUG 93

4FDA434 RUN 21 0193-0194 10000 AUG 93

4FDA434 RUN 22 0195-0201 10000 AUG 93

4FDA434 RUN 19 0177-0183 10000 AUG 93

4FDA434 RUN 20 0184-0190 10000 AUG 93

4FDA434 RUN 21 0185-0192 10000 AUG 93

4FDA433 RUN 22 0165-0169 10000 AUG 93

4FDA433 RUN 24 0178-0182 10000 AUG 93

4FDA433 RUN 21 0159-0164 10000 AUG 93

4FDA433 RUN 20 0151-0158 10000 AUG 93

4FDA433 RUN 19 0145-0150 10000 AUG 93

4FDA432 RUN 1 0001-0006 10000 AUG 93

4FDA432 RUN 2 0007-0018 10000 AUG 93

4FDA433 RUN 18 0138-0144 10000 AUG 93

4FDA432 RUN 9 0067-0075 10000 AUG 93

4FDA433 RUN 3 0033-0040 10000 AUG 93

4FDA433 RUN 26 0191-0199 10000 AUG 93

4FDA433 RUN 25 0183-0190 10000 AUG 93

4FDA433 RUN 15 0117-0123 10000 AUG 93

4FDA433 RUN 17 0132-0137 10000 AUG 93

4FDA432 RUN 6 0057-0063 10000 AUG 93

4FDA432 RUN 12 0083-0086 10000 AUG 93

4FDA433 RUN 5 0048-0056 10000 AUG 93

4FDA433 RUN 14 0108-0116 10000 AUG 93

4FDA433 RUN 13 0103-0107 10000 AUG 93

4FDA433 RUN 9 0077-0083 10000 AUG 93

4FDA433 RUN 8 0069-0076 10000 AUG 93

4FDA433 RUN 7 0064-0068 10000 AUG 93

4FDA433 RUN 4 0041-0047 10000 AUG 93

4FDA433 RUN 12 0091-0102 10000 AUG 93

4FDA432 RUN 15 0106-0103 10000 AUG 93

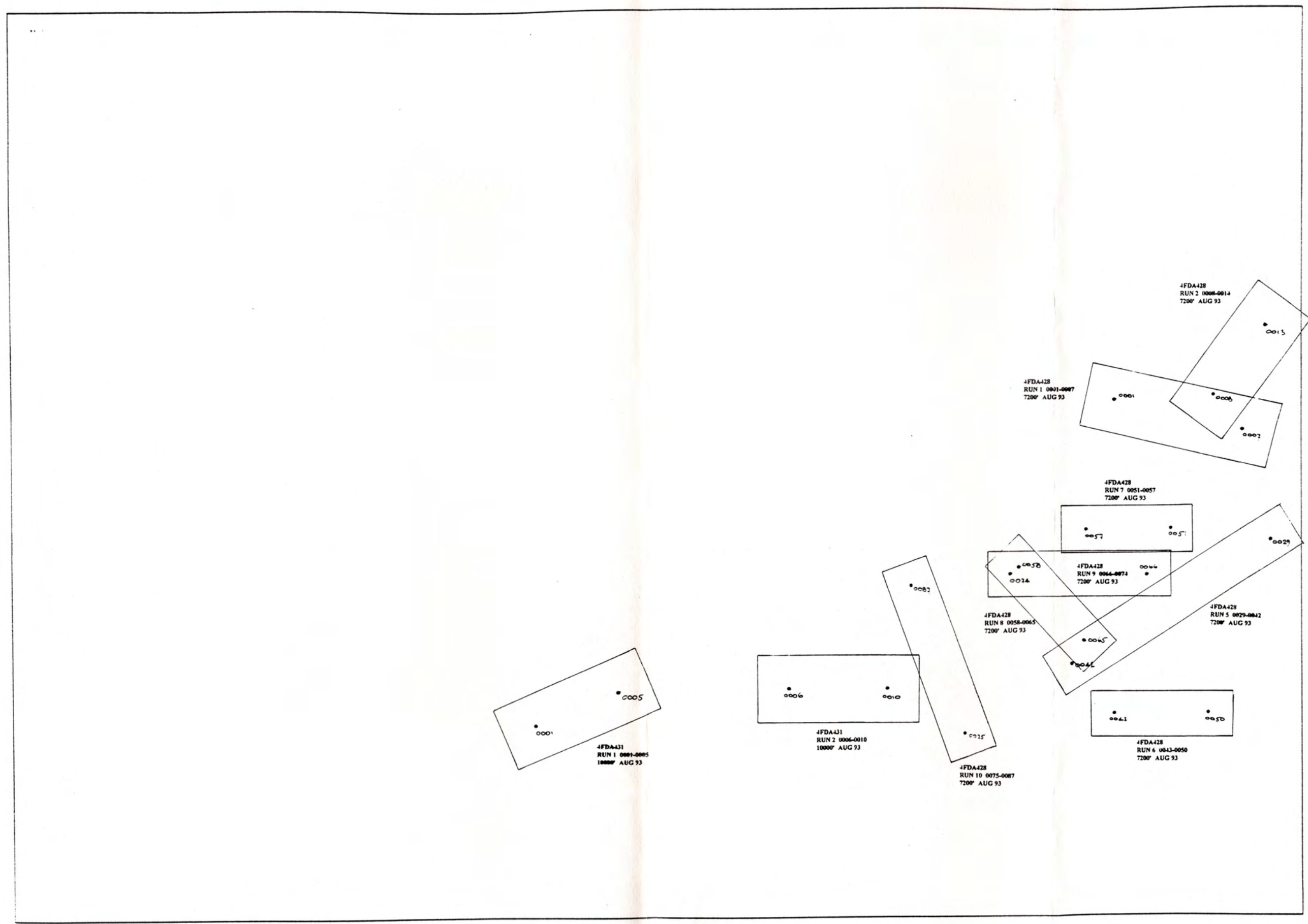
4FDA433 RUN 10 0081-0088 10000 AUG 93

4FDA433 RUN 1 0001-0021 10000 AUG 93

SUPPLEMENTARY PHOTOGRAPHY
MANDORA

1:250 000

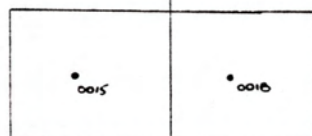
SE 51-13



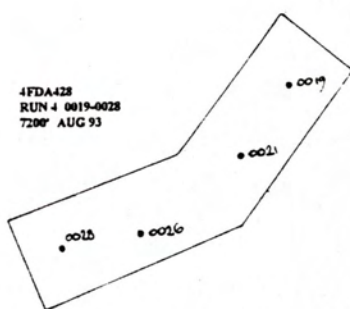
SUPPLEMENTARY PHOTOGRAPHY
MUNRO

SE 51-14

1:250000



4FDA428
RUN 3 0015-0018
7200 AUG 93



4FDA428
RUN 4 0015-0028
7200 AUG 93

OPERATION MANNING

1. 4 Fd Svy Sqn:

182689	CAPT C.J. Topovsek	Det OC
454355	LT A.D. Caudle	ADMINO
45892	WO2 K.G. Talbot-Smith	OPSWO
467710	SSGT E.L. Jacobs	FC Party IC
F312220	SSGT L.M. Johnson	Editor
318818	SGT P.A. Drover	FC Party IC
321968	SGT S.E. McGuinness	FC Party IC
455113	CPL S.G. Adrain	FC Party IC
325734	CPL P.J. Ball	Air Camera Op
230873	CPL G.G. O'Meara	Tpt Spvr
323320	CPL G.T. Weatherell	FC Party IC
3168177	LCPL N.A. Smith	Cook
3804915	SPR M.J. Arnold	FC Party
555441	SPR I.D. Baldwin	FC Party
3804924	SPR D. Miller	FC Party
3804881	SPR C.V. Pearse	FC Party
3804932	SPR G.C. Richards	FC Party
3804882	SPR M.D. Sinderberry	FC Party

2. Army Svy Regt:

F238397	LT M.R. Breen
F329154	CPL J.E. Otto
F4800055	SPR J. Sachs

3. 1 Sig Regt:

5101599	LCPL G.J. Reeley	Sig Rad Op
---------	------------------	------------

4. 5 Avn Regt Wksp:

184308	CFN M. Clayden	Veh Mech
--------	----------------	----------

5. 161 Recce Sqn (LOH):

238010	CAPT D. Lynch	Pilot
237194	CAPT M. Potts	Pilot
240576	LT A. Bezzina	Pilot
239775	LT P. Scullard	Pilot
184849	CPL W. Harper	All Trades
182504	CPL K. Jarret	Fwd Obs

6. 162 Recce Sqn (LOH):

324526	CAPT P. Hogan	Pilot
234418	LT M.T. Hammond	Pilot
239153	LT D.T. Maddocks	Pilot
238115	CPL K.L. Veness	All Trades
238968	CFN D.C.Cooney	All Trades

7. 173 Survl Sqn (Nomad):

329037	LT D.H. Kemp	Pilot
234766	CFN R.L. Shaw	All Trades

AAAVN REPORT - 161 RECCE SQN

Introduction

1. LOH support for Op MIZMAZE 93 was provided by 161 Recce Sqn during the period 14-21 May 93. To maintain two on line acft at all times, three acft were provided with sufficient crews to enable operations to commence and be sustained immediately after arrival in the AO.
2. The hours allocated for the operation were:
 - a. 75 task hours, and
 - b. 100 travel hours.

Pre-Operation Administration

3. The pre-operation administration was adequate to enable a smooth move into the AO. The air party pre-positioned in Broome on 13 May 93 to allow for one rest day prior to the commencement of tasking on 15 May 93. Pre-op direct liaison was conducted and this served to iron out any misunderstandings. The information received describing the type of operation and confirming task details was timely and in sufficient detail to allow a reasonable understanding of the field completion process.

Tasking

4. LOH were used primarily for air checking 1:50 000 map sheets of the designated area. All these sheets needed to be ground checked prior to air checking and this led to some days of light activity for the detachment. Generally, the rate of activity was constant and there was at least one acft airborne on task every day of the operation.

Crew Endurance

5. Initially, it was indicated that the 161 Recce Sqn det would be flying 75 task hours over the seven day period for which they were in support of the operation. Perceived crew endurance problems were catered for by providing four pilots for the operation. This rate of effort was rationalised soon after arrival in the AO but the extra crews allowed greater flexibility when required.
6. The only perceived problem with crew endurance was in the days immediately following the transit into the AO. Each pilot logged 30.3 hours in the transit which took four days. Thus, in the three days after arrival, each pilot was restricted to 9.7 hours total. The rest day assisted in alleviating this problem.

Maintenance

7. Initially, it was planned to bring two tradesmen on the deployment. This would have allowed all servicing to be carried out without having to enlist the assistance of the 173 Sqn all-trades. Unfortunately, sudden sickness meant that only one all-trades was available for the deployment. This put restrictions on some maintenance operations but the availability of a maintenance support acft ensured no disruptions to the operation. Apart from minor servicing, the acft required little work and serviceability was generally good.

Fuel

8. Maximum use was made of the civilian infrastructure by using refuelling facilities at Broome Airport. The fuel that was pre-positioned for the field checking phase was well located to make maximum use of the available acft hours.

Squadron Changeover

9. For whatever reason, it was decided that 161 and 162 Sqn should changeover half-way through the operation. This changeover was cost ineffective, administratively burdening and provided the supported unit with a lack of continuity of support. It is suggested that in future operations of this nature, where possible, one Sqn only (of the same acft type) provide the support. This would alleviate some of the above mentioned problems.

Administration

10. All camp administration on task was a credit to 4 Fd Svy Sqn. Meals were of an exceptional standard and the facilities provided in camp were more than adequate.

Conclusion

11. For all but one member of the 161 Sqn det, Op MIZMAZE 93 served as an introduction to Survey field operations. The information gleaned regarding the production of maps was valuable. A lot of questions were answered and this op was thankfully quite educational.

Recommendations

12. To improve or maintain the quality of support provided to this type of operation, the following recommendations are made:

- a. depending on the task requirements and duration, if possible, provision of a maintenance support acft should be considered; and
- b. for multiple acft tasks such as this, at least two tradesmen, one being an NCO, are necessary for even the simplest servicing. The above maintenance personnel support is a minimum but obviously, if possible, an FRT would be desirable.

May 93

D.A. LYNCH
CAPT
Det Comd
161 Recce Sqn

AAAVN REPORT - 162 RECCE SQN

Introduction

1. Op MIZMAZE 93 was conducted from 1 May to 17 Jun 93 in the vicinity of Broome and Fitzroy Crossing. Support was provided by 161 Recce Sqn and 162 Recce Sqn from 14 May to 10 Jun 93 for a combined total of 150 task hours in the AO. A sqn hand over occurred on 21 May 93.

Squadron Hand Over

2. Three LOH from 161 Recce Sqn provided support from 14-21 May 93 for a total of 50 task hours. Two LOH from 162 Recce Sqn provided support from 22 May - 10 Jun 93 for a total of 100 task hours. The hand over was conducted smoothly with no disruption to the task.

Tasking

3. Op MIZMAZE 93 involved field completion of 1:50 000 scale maps by road and by air. Inaccessible areas were checked by LOH. The LOH provided a good platform for checking vegetation boundaries and hydrographic detail. Each map took, on average, one hour to complete by air. Op personnel worked well with the aircraft; from pre-mission planning/briefing to assisting with refuelling.

Flying Rate

4. The flying rate throughout the Op was not excessive due to the fact that maps cannot be air checked until completed by ground. Flying occurred in short burst of activity rather than as a continuous effort. This was particularly the case when main base moved to the new AO centred on Fitzroy Crossing. A two pilot/two all-trades detachment proved appropriate for the task.

Maintenance

5. During the Op the following servicing/maintenance action was required:

- a. main rotor drive shaft replacement (A17-011),
- b. S2 - aircraft lubrication,
- c. S8 - swashplate uniball friction adjustment,
- d. S11 - engine oil change,
- e. S13 - engine mount retorque,
- f. 2 x engine chips (A17-026), and

g. 1 x swashplate bearing repair (A17-026).

6. The MRDS was replaced IAW STI 276. The message was received by facsimile and the part arrived by air two days later. The only other unscheduled servicings were the swashplate bearing and engine chips. Again, repair parts and equipment were received quickly and efficiently utilising civilian infrastructure. The speed with which parts were delivered and the subsequent repair of downed aircraft is a credit to 162 Recce Sqn TASG and the RAEME tradesmen on the Op.

7. Worthy of note is the assistance provided by the WA police detachment at Fitzroy Crossing. Most messages and facsimiles were received through the police station and hand-delivered to the base camp.

Administration/Logistics

8. All aspects of camp administration and logistic support is a credit to Det 4 Fd Svy Sqn. Positioning of fuel and subsequent drum recovery was timely and well planned.

Conclusion

9. It is a pleasure working for a Unit who knows how to manage and task aircraft effectively and efficiently. Both aircrew gained invaluable experience operating in remote parts of north-western Australia.

Recommendations

10. It is recommended that the LOH detachment continue to consist of at least two aircraft, two pilots and two tradesmen.

Jun 93

M.T. HAMMOND
LT
Det Comd
162 Recce Sqn

AAAVN REPORT - 173 SURVL SQN

Introduction

1. Op MIZMAZE 93 was an aviation bid by 4 Fd Svy Sqn FY 92/93. The task bid was accepted for one Nomad and 50 task hours. The Nomad was tasked for supplementary aerial photography using the RC10 camera.

Execution of Tasks

2. Nomad A18-307 departed Oakey for Adelaide on 11th May, the camera was fitted on the 12th and the aircraft arrived in Broome on the 13th. Tasking was commenced on the 16th, conducting both survey and VAP tasks. A total of five task hours were completed by the afternoon of the 20th, when the aircraft was grounded after the discovery of cracking in the horizontal stabiliser of a Nomad at Oakey. Some days passed before a solution was forthcoming, this consisted of a complete change of the current horizontal stabiliser with one that had been inspected recently. A new horizontal stabiliser was flown to Broome by RAAF C130 on the morning of the 30th and fitted that day. While the aircraft was grounded, a new and unrelated location (the aft most fuselage bulkhead), was found to be cracked in another Nomad. The RAEME crew that came with the C130 found three cracks in this bulkhead on A18-307, the aircraft was deemed serviceable only for flight direct to Oakey, it was flown to Fitzroy Crossing on the evening of the 30th. After co-ordination with 4 Fd Svy, the aircraft left Fitzroy Crossing on the 2nd Jul for Oakey, with the RC10 and it's operator CPL Ball.

Flying Rate

3. A total of 8.5 task hours were flown in the AO.

Logistics

4. Fuel. Bulk fuel was used in Broome, due to the fact that A18-307 was only transiting Fitzroy Crossing on it's way east, no drum stock was required there.

5. Repair Parts. Repair parts and man power were supplied by 173 Sqn as expediently as could be expected taking into account the magnitude of the problem.

Administration

6. All aspects of task administration were very well handled by 4 Fd Svy Sqn, particularly considering the problems arising from the serviceability of the Nomad. The efficient and courteous way with which we were supported is a credit to the members of the squadron involved in this operation.

Jun 93

D.H. KEMP
LT
Det Comd
173 Survl Sqn

RAEME (VM) TECHNICAL REPORT

Deployment

1. The road party consisted of:
 - a. seven L/R 110 FFR,
 - b. two Truck Cargo MC2,
 - c. two Truck Cargo MC4, and
 - d. one 1/2 ton tr.
2. All vehicles were classified task-worthy prior to leaving Adelaide.

Technical Inspections

3. All vehicles had first and last parade checks completed on each day of use. In addition, regular checks of fluid levels in gearbox, differentials, transfer case and CV hubs were carried out, as was the cleaning of air filters and exterior of radiator cores.

Specific Repairs

4. Details of the specific repairs to the vehicles are listed in Appendix 1. All documentation (TGM 146 and TGM 41) for inspection and/or repairs to vehicles by Adelaide Log Bn have been raised and submitted.

Parts Availability

5. Minimal vehicle parts were carried by RAEME support. Parts not held were obtained through local purchase or 4 Fd Svy Sqn. This caused a considerable delay in the arrival of the parts, despite the fact that they were dispatched by the fastest possible means.

Comments and Recommendations

6. Several consistent faults were experienced in the AO, these were as follows:
 - a. door locks failure due to ingress of dust,
 - b. rear differential ball joint failure, and
 - c. rear wheel bearing adjustment.
7. Most of the damages occurring in the AO were a result of the harsh natural conditions in the area and driver inexperience.

8. Future operations of this nature should carry more than the standard number of rear ball joints, 12 volt batteries, steering arms and drag links etc. This will alleviate the problems of obtaining the parts and / or to overcome purchases in the AO.

9. In future operations it is recommended that RAEME (VM) support is provided with an FRV (6x6 GMV). This will greatly reduce operational expenditure on parts and labour by civilian contractors in the AO. If such a vehicle had been available on this Op the majority of repairs required could have been carried out in the AO at no expense.

Jun 93

M. CLAYDEN
CFN
VM

Appendix: 1. Specific Repairs

SPECIFIC REPAIRS

49-169 LR 110 FFR

Weld air cleaner bracket
Pop-rivet roof outer skin
Replace rear ball joint

No parts required
Parts carried
Parts ex-Darwin Motors

49-170 LR 110 FFR

Adjust steering box
Repair vacuum pump oil leak
Panel beat chassis cross member
Pop-rivet roof outer skin

No parts required
Parts carried
Req base wksp repair
Parts carried

49-171 LR 110 FFR

Bleed and adjust brakes
Replace windscreen
Replace L/H mirror glass
Replace L/H disc guard cover
Panel beat R/H disc guard cover
Repair antenna mount
Pop-rivet roof outer skin
Repair L/H/R park light
Repair rear door lock
Replace rear ball joint
Repair spare wheel hoist

Nil parts required
Local purchase
Parts carried
Req base wksp repair
Nil parts required
Nil parts required
Parts carried
Parts carried
No parts required
Parts ex-Darwin Motors
No parts required

49-172 LR 110 FFR

Replace T/case (jumps out of high range)
Replace rear diff ball joint
Pop-rivet roof outer skin
Replace exhaust flange nuts
Replace R/H CV seal

Req base wksp repair
Parts ex-Darwin Motors
Parts carried
Local purchase
Req base wksp repair

49-173 LR 110 FFR

Repair spare wheel hoist
Replace bonnet cable
Replace exhaust flange nuts
Replace rear wheel cylinders

No parts required
Req base wksp repair
Local purchase
Req base wksp repair

Weld air cleaner bracket
 Pop-rivet roof outer skin
 Replace rear ball joint

No parts required
 Parts carried
 Parts ex-Darwin Motors

49-174 LR 110 FFR

Replace steering arm
 Pop-rivet roof outer skin
 Replace L/H CV seal
 Repair rear door lock
 Repair front park lights
 Replace R/H door top

Parts ex-4 Fd Svy Sqn
 Parts carried
 Req base wksp repair
 No parts required
 Parts carried
 Parts ex-4 Fd Svy Sqn

49-181 LR 110 FFR

Replace drag link
 Replace R/H indicator lens
 Panel beat R/H headlight surround
 Replace L/H/F hub cap
 Adjust wheel alignment
 Replace L/H mirror head
 Pop-rivet roof outer skin
 Replace exhaust flange nuts

Local purchase
 Parts carried
 Nil parts required
 Parts carried
 Nil parts required
 Parts carried
 Parts carried
 Local purchase

38-989 UNIMOG MC2 CARGO

Repair radiator bottom tank
 Straighten accelerator linkages
 Adjust accelerator push rod length
 Replace 100 amp generator

Nil parts required
 Nil parts required
 Nil parts required
 Req base wksp repair

46-573 UNIMOG MC2 W/C

Adjust steering wheel position

Nil parts required

91-1238 MITSUBISHI

Replace 12 volt battery

Local purchase

91-1828 ISUZU

Replace clutch and pressure plate

Warranty contractor

176-448 1/2 TONNE TRAILER

Repair brake lights

Nil parts required

COMMUNICATIONS REPORT

INTRODUCTION

1. 1 Sig Regt was tasked to provide communication support to 4 Fd Svy Sqn in the North-West of Western Australia for the period 9 May to 9 Jun 93.
2. The main base was established at the Police and Citizens Youth Club (PCYC) in Broome. A forward base was then established at Sandfire Roadhouse. On 26 May the main base was moved to the Lodge Caravan Park at Fitzroy Crossing.

EXECUTION

General Outline

3. The radio net consisted of a NCS and six field check (FC) parties. The FC parties being deployed throughout the operation area.
4. A HF rear link was also established to 4 Fd Svy Sqn in Adelaide, from both Broome and Fitzroy Crossing. The rear link was used at set times during the day.

Manning

5. The signals detachment comprised of LCPL Reeley. The manning proved more than adequate as 24 hr communications were not required.

Equipment

6. The following equipment was used:
 - a. RT-F100 (RAVEN);
 - b. RAVEN high current power supply;
 - c. CLARK mast;
 - d. RAVEN broad band antennae; and
 - e. RAVEN antennae, lightweight.

Equipment Problems

7. A RAVEN handset was found to have a wiring fault as it worked intermittently when the pressel switch was pressed.

8. A RAVEN RT-F100 was damaged whilst a FC party was moving from one location to another. An attempt to straighten the damaged control knob resulted in the item being broken off.

Communication Problems

9. Initial Problems. Initial problems arose for the following reasons:

- a. local interference in Broome area,
- b. inexperience in the use of the RAVEN equipment by most personnel, and
- c. the inverted 'V' antennae proving ineffective in areas where low vegetation growth did not allow for elevation of the antenna above ground level.

10. The Inverted 'V' Antennae. The problem found with the inverted 'V' antennae was overcome once a sloping wire/long wire antennae was adopted. The antennae was 1/2 wavelength long (27m), laid on the ground pointing towards the direction which communications were required or strung from a high point away from the point of communication such as a tree or vehicle. This antennae proved effective in all types of terrain.

11. Frequency Allocation. Frequency allocation on the Op was good, although the 8 and 9 MHz frequencies had constant interference from local and/or other (foreign) voice communications. The 5 MHz frequency therefore became the primary frequency, having minimal interference and being workable for nearly 24 hrs a day. The 3 MHz frequency was used as an alternate frequency if needed.

12. Rear Link Communications. Communications to Adelaide were first attempted on the 3 to MHz frequencies without success. Allocation of two 18 and one 20 MHz frequency proved successful at various times during the day, with the highest frequency being the most effective.

ADMINISTRATION

13. No administrative problems were encountered.

CONCLUSION

14. Once the 5 MHz frequency and the long/sloping wire antennae (27m long) were found to be the most effective combination, communications were then maintained at a good level for the duration of the Op.

15. 4 Fd Svy Sqn personnel gained valuable experience in the use and operation of RAVEN equipment.

RECOMMENDATION

16. Because of the lack of experience shown by 4 Fd Svy Sqn personnel in the use and operation of RAVEN equipment it is recommended that further training in the following areas would be of benefit:

- a. Use and operation of RAVEN equipment.

- b. Antenna theory and the various antennae that can be used with HF radios.

Jun 93

G.J. REELEY
LCPL
Sig Rad Op