Canberra Survey Corps Association

Canberra Newsletter

In this issue Number 50 - March 2021

From the Editor/President

Welcome to the first issue of the newsletter for 2021. I have decided to revert to Bob McHenry's earlier convention of numbering newsletters consecutively along with the month and year. I think this makes it easier to recall and find articles. Coincidentally this is the 50th issue of the newsletter which can only continue if I receive articles from you all. Anything of relevance or interest to members is most welcome.

This issue acknowledges the part that RA Svy played in the early days of the US Global Positioning System, commencing with what I believe was the first GPS observations in Australia, forty years ago this week on 11th March 1981. That was part of a satellite ephemeris testing program which was and is still an operational system and is also used to maintain a geodetic system which many computer based applications relies on to provide utility which is now assumed to be essential in our daily activity.

Peter Jensen

Editor/President canberrasvycorpsassoc.pres@gmail.com

Anzac Day 2021

The form of this year's Anzac Day National Ceremony is not known at the moment. Secretary Charlie will let everyone know after he has been advised.

Inquiry into recognition for members and families of members of the ADF who are injured, wounded or killed in or as a result of service

The Editor/President

The Defence Honours & Awards Appeals Tribunal has been directed to inquire into and report on recognition for members and families of members of the Australian Defence Force who are injured, wounded or killed in or as a result of service.

Interested persons and organisations are invited to make a submission to the Tribunal, in accordance with the inquiry terms of reference, by **Wednesday 31 March 2021**, although later submissions may be accepted over the course of the inquiry.

The inquiry terms of reference and further information on how to make a submission can be obtained by contacting the Tribunal, via tel 02 6266 1019, email DHA.Tribunal@defence.gov.au, website www.defence-honours-tribunal.gov.au

If there is sufficient interest in this inquiry from Association members, a submission by the Association may be appropriate. Please contact me: canberrasvycorpsassoc.pres@gmail.com

Aerodist surveys (New Guinea 1964-1966) Hudson reborn

By Peter Jensen

For those of you who were associated with the Adastra Hudson VH-AGS on Aerodist trials in Australia and surveys in Papua New Guinea 1964-1966, you would perhaps be surprised to see it in good flying condition in its Second World War bomber configuration. Last weekend at the RAAF Centenary Air Show at Temora NSW, that Hudson flew in formation with two Australian Boomerang fighters (photograph below). It also gave a solo demonstration but with not as much daring as recounted by a passenger (Noel Sproles) in that Hudson across the Torres Strait in 1966: *Lionel flew AGS so close to the sea that the propellers were drenching the aircraft in the spume that they whipped up. I thought at the time, as I gripped my seat tightly with both hands, that the aircraft was decrepit enough as it was without giving it a coating of corrosive salt water, but Ross McMillan expressed it more succinctly. "What am I doing flying at dot feet across Torres Strait", he said with clenched teeth, "in an aircraft built before I was born and flown by a pilot older than my grandfather".*

About forty aircraft performed including this close formation of two Second World War Spitfires and the new F-35A Lightning II Joint Strike Fighter being led by a Second World War Kittyhawk. And a survey operation workhorse veteran 'Wallaby' (Caribou) on a familiar short-landing approach.

To celebrate the centenary in Canberra on 31 March, there will be a mass flypast of more than sixty past and current aircraft. See:

https://airforce2021.airforce.gov.au/event/spectacular-centenary-flypast

GPS arrives in Australia – 40 years ago today (11 Mar 1981)

By Peter Jensen

Note: I wrote a brief article on the Survey Corps' early involvement in the US NAVSTAR Global Positioning System (GPS) at Smithfield SA, which was published in this newsletter in issues November 2009 and 1/2010. Some of that article is included in this story.

Forty years ago today on Wednesday 11 March 1981, the US Defense Mapping Agency (DMA) (now National Geospatial-Intelligence Agency) and the Royal Australian Survey Corps (RA Svy) jointly commenced a US GPS satellite (NAVSTAR - Navigation Satellite Time and Ranging System) program at Smithfield SA with what I believe to be the first operational GPS receiver of any kind in Australia. Neither Brian Tallman, the DMA geodesist, or myself there on that day could have imagined that forty years later GPS would be considered by many national governments and billions of people worldwide as an essential utility in much of their daily activity.

What is not widely known, is that a small apparently insignificant red brick 'shed' in a sheep field in an old ammunition depot at Smithfield near Adelaide SA, played a very significant part in the development of global geodesy and geodetic and navigation systems as a part of the Defence relationship between Australia and the United States. RA Svy was involved in policy and management of the GPS program for more than 11 years and Corps personnel from 4 Fd Svy Sqn played a key role in day-to-day management and operations of that system.

A bilateral agreement between Australia and the United States for co-operative development of the earlier US Navy Navigation Satellite System (TRANSIT) began in the 1960s and renewed in the 1970s. This allowed for the establishment of a fixed TRANET (Tracking Network) station at Smithfield from whose data precise satellite ephemerides were computed by DMA and distributed to allied countries which were using portable geodetic receivers for military, national or university research purposes. TRANET Smithfield attracted public and parliamentary attention. House of Representatives and Senate Hansard record questions from the Federal Opposition to the Government, then Liberal and National Party coalition in 1977, 1978, 1980, 1981 and 1982 with respect to the purpose of the station and the connection with US Navy fleet ballistic missile submarines. Government responses stressed that early Australian support to TRANSIT, like that for the North West Cape Navy communication station, was supportive of the US deterrent capability of submarine launched retaliatory strike. Government statements also emphasised the value of the on-going activities of the TRANET station for global mapping, charting and geodesy. Of special note is that observation data from the TRANET station contributed to the development of World Geodetic System 1984 (WGS84) which is the Earth reference system used by GPS and indeed all Australian Defence Force geospatial products.

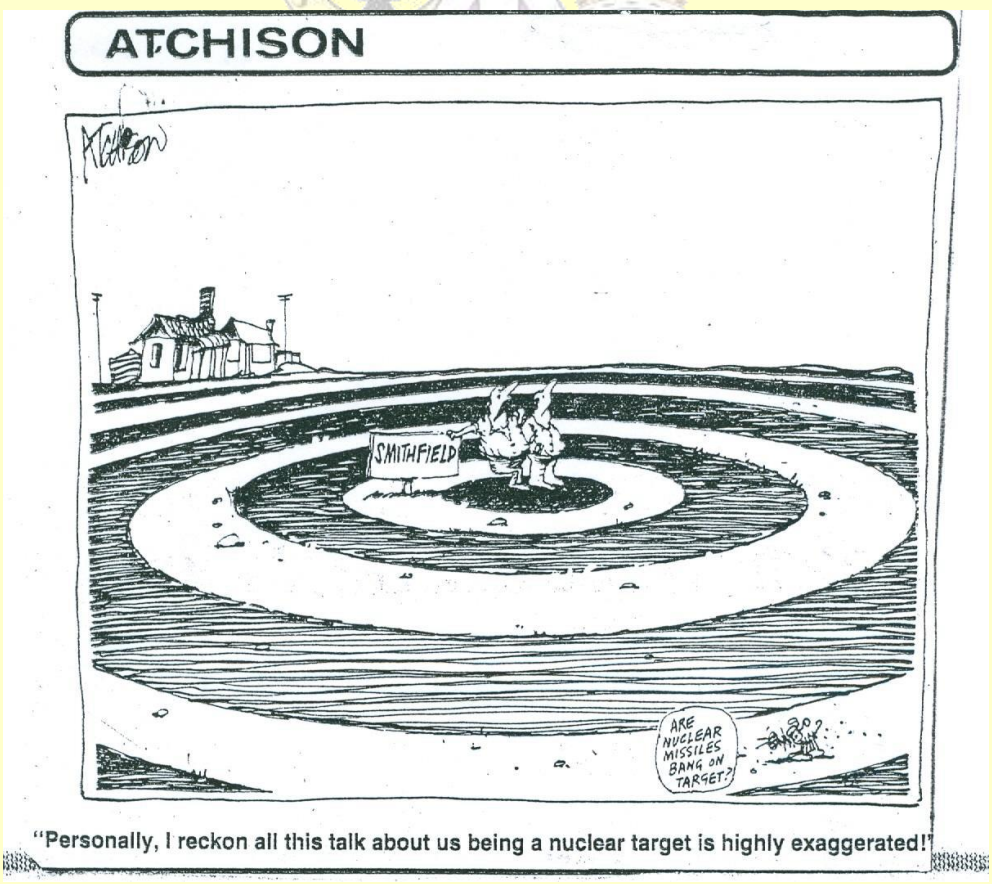
In 1973 the newly formed US Department of Defense began developing what is now known as NAVSTAR GPS. It was intended to broaden navigation by satellite applications and replace TRANSIT which was mainly a Navy system. The then new Defense Mapping Agency became directly involved with GPS in 1974 with development of precise orbit determination and geodetic applications. A major difference between TRANSIT and GPS satellite orbits was that the former were low earth orbiting with an orbit period of about 96 minutes and the latter were high earth orbiting (about 20,200km) with a period about 12 hours. Accurate orbit prediction and post-orbit determination was a different problem with GPS.

In July 1980 Defence Minister Killen agreed to a DMA request for Australia to participate in a collaborative satellite orbit determination testing program, for a period of at least twelve months, of the NAVSTAR test and evaluation constellation, known as Block I. Ministerial

approval to extend the 1980 initial program was to be granted three times over the next seven years. After Ministerial approval in late-February 1981, DMA posted Brian to Smithfield as the US manager of the GPS station to be co-located with the TRANET station. Brian arrived in Adelaide with his family and the GPS equipment on 6 March.

RA Svy was the Defence agency for joint management and operation of the GPS station. In early-1981 I was posted as Troop Officer 4 Fd Svy Sqn with part-time duty, as required, as the GPS Station Australian Project Officer. The NAVSTAR specific equipment was not the small chip size sets of today, but filled a two cabinet frame each the size of a kitchen refrigerator (see photographs following the report below). RA Svy soldiers from 4 Fd Svy Sqn were attached to the station as operators on a rotational basis from early-1982 to early-1992, normally being the sole operator on the lonely late shift operation from 1600hr - 2300hr five days of the week. This was largely an unnoticed and unheralded activity that ensured the high reliability requirements of the station were met.

Installation of the GPS equipment rekindled public and parliamentary interest in the station. Local debate was led by the group *Christians for the City* who pursued the government and opposition for removal of the base as they believed that the station would be a nuclear target in the event of a nuclear confrontation between the US and USSR. The group established a protest at the front gate to the station and camped there for Easter 1981. HQ 4th Military District, on advice from the Intelligence Section, ordered us not to wear uniform or drive military vehicles into the station. Meanwhile our visits there behind a simple chain wire padlock locked gate were looked on with nonchalance by the grazing merino sheep which kept the grass mown. It was a very relaxing place to work. The main Adelaide newspaper *Adelaide Advertiser* took up the issue with columnist comment and a cartoon.



In March 1981 the Government authorised a visit request to the station by the Leader of the Federal Opposition, Mr Bill Hayden, and the Deputy Leader of the Federal Opposition, Mr

Nigel Bowen. Whilst this visit went a long way to appease the questions of the Federal Opposition as to whether the station was a likely nuclear target, it did not bury the debate. In reply to a question from a journalist attending the visit, a senior Department officer said offhandedly that he didn't know why anyone would waste targeting a nuclear weapon on the site, when a hand grenade through the window would be a much cheaper solution. That comment did not go well with us working alone at the station at night, or indeed Commander HQ 4th Military District. The then Commonwealth Police (now Australian Federal Police) heightened security patrols of the area. In March 1982, Dr Blewitt, the member for the Smithfield area, was critical of Minister Killen's response to another question. Dr Blewitt noted that whilst Mr Hayden and Mr Bowen did not view the station as being a nuclear target, 'it is possible, though not likely, that my constituents in Smithfield could depart this world quite suddenly.'

After the first year of operation, RA Svy reported about the station's operation to the Australian National Mapping Council Technical Sub-Committee. That report follows.

2539277

4 Fd Svy Sqn
Keswick Barracks
KESWICK SA 5035

20/1/3

19 Apr 82

Department of Defence (AO) - DSVY A

NATIONAL MAPPING COUNCIL
1982 MEETING OF TECHNICAL SUB-COMMITTEE

References: A. Your SIG AAX SVY 005623 of 152105ZMAR82

B. Your A474-5-43, 037177 dated 17 Mar 82

1. Enclosed herewith the NAVSTAR GPS Report as requested in Ref A, and in the format as requested in Ref B.

(P.A. JENSEN)
CAPT
Admin Comd

Enclosure: 1. Report, NAVSTAR GPS, Data Acquisition Smithfield SA.

NMC: 33rd TSC, Brisbane 1982 5.1.

(RA Svy)

REPORT

NAVSTAR GPS

DATA ACQUISITION SMITHFIELD SA

References: A. Defence Mapping Agency Washington DC, NAVSTAR GPS PROGRAM dated 14 Dec 79.

B. Defence Press Release No 50/81 dated Fri 27 Feb 81.

C. STI - O&M - 8707 dated 7 Dec 79.

INTRODUCTION

1. This report details the activities at NAVSTAR Global Positioning System (GPS) tracking Smithfield SA, as a part of a worldwide satellite ephemeris testing program.

The United States Navy (USN) and United States Air Force (USAF) have pursued the use of space vehicles for positioning and navigation since the early 1960's.

In the late 1960's,USN developed the space borne TRANSIT radio navigational system for worldwide navigation and positioning. The United States Defence Mapping Agency (DMA) recognised the advantages of this system for global positioning,and developed techniques suitable for the Mapping, Charting and Geodetic community, utilizing the TRANSIT Navigational Satellites (NAVSATS).

The TRANSIT system does not provide continuous worldwide positioning capabilities. In Dec 73 the United States Department of Defence (USDOD) authorised NAVSTAR GPS. When operational,GPS will provide suitably equipped military and non military users on or near the earth, with 24 hr instantaneous highly accurate position, velocity and time.

In Aug 74 DMA became a participant in the development of GPS particularly for point positioning geodetic applications.

/DMA,

DMA, Naval Surface Weapons Centre (NSWC) and USAF Joint Programs Office (JPO), are conducting extensive field test programs to evaluate the usefulness of GPS for geodetic applications. In particular they are examining the hardware and software items required to maximise accuracy and precision.

To evaluate the effects of station location, geometry and environment, on the determination of a precise and accurate post-flight ephemeris, DMA and NSWC wished to deploy four semi-portable tracking stations for a period of at least twelve months to Smithfield, Australia; Barton Stacey, UK; Sao Paulo, Brazil and Mahe, Seychelles. These stations are all TRANET stations of the TRANSIT system.

On 27 Feb 81 the Minister for Defence (Aust) Mr D.J. Killen, approved Australia's cooperation in the ephemeris testing program and the siting of the tracking equipment at Smithfield.

The equipment arrived at Smithfield on 6 Mar 81 and tracking commenced 11 Mar 81. The antennae is plumbed (± 5 mm) approx 6 m above the John Hopkins Plaque at Tranet Station 412.

GPS, GENERAL DESCRIPTION

Space System Segment

2. It is proposed that the operational GPS will deploy 18 satellites in three planes, with near circular 10890 nautical mile orbits, inclined at approximately 63 degrees and having 12 hour periods.

The test program commenced on 23 Jun 77 with the launching of Navy Navigation Technology Satellite - 2. Since that date, nine NAVSTARS have been launched and currently five NAVSTARS are used for the test program. Space Shuttle is the proposed launch platform for the operational NAVSTARS. The major elements comprising the navigation payload on the satellites are the pseudo-random noise signal assembly (PRNSA), atomic frequency standard, processor and Link-Band antennae. The satellites transmit Link 1 (1575.42 MHz) and Link 2 (1227.6 MHz) carrier frequencies, modulated by the pseudo-random noise (PRN) ranging signals, which are the basic P (precise) and C/A (coarse/acquisition) ranging codes. Navigation data is encoded from the processor onto the PRN ranging signal.

/Control

The MS's passively track all satellites in view, and pass on tracking data to the MCS where updated ephemerides are computed and passed to the ULS for transmission to the satellites.

User System Segment

4. Users with suitable equipment can passively track and determine pseudo range and integrated doppler to all satellites in view. A navigation solution may be determined using the nav data and a processor. Geodetic solutions will be gained by past track computations of pseudo range or doppler (or both), or possibly the use of interferometric techniques.

5. For the ephemeris testing program all tracking data is recorded and passed to DMA for processing.

EPHEMERIS TESTING TRACKING EQUIPMENT

6. The Smithfield NAVSTAR GPS tracking equipment comprises of the following sub-systems:

a. Receiver;

b. Measurement;

c. Processor/Controller;

d. Recording;

e. Timing;

f. Testing;

g. Power supply;

h. Meteorological.

Receiver Sub-System

7. a. Stanford Telecommunications Incorporated (STI) Model 5010 GPS Receiver. A two channel, spread spectrum, doppler tracking receiver for single satellite tracking of the GPS L1 and L2 frequencies, simultaneously. The

/GPS

GPS receiver receives the L1 and L2 signals, acquires and tracks the C/A code and L1 carrier, resolves bit sync ambiguity, and recovers GPS time, in order to acquire and track L1 and L2 P-codes, and L1 and L2 carriers. The recovered carriers are presented to the GPS Measurement circuitry for precise measurement. The receiver also outputs epoch pulses from the received P-codes and a local epoch generator. These signals are presented to external GPS measurement circuitry for precise measurement of the time of arrival of the received P-codes. The integrated Doppler is over 60 second intervals on L1 and L2, and the two frequency technique provides a first order determination of the ionospheric correction. The measurements of pseudo-range are determined every six seconds on L1, L2. Receiver input aiding requirements for acquisition are, satellite ID number and an initial estimate of received satellite doppler frequency and ionospheric delay. The receiver operates in both manual and automatic mode and from either an internal or external frequency reference. All receiver control signals and information pertaining to the received GPS time (Hand Over Word) and receiver lock status, flow between the receiver and other GPS Sub-systems via a General Purpose Interface Bus (GP-IB). The received GPS Nav Data and accumulated Delta Range Measurements are also transmitted out of the GP-IB.

Measurement Sub-system

a. Full Cycle Counter. Receives the L1 and L2 doppler estimates from the GPS receiver doppler converter, counts the full cycles and presents the signals to the Hewlett Packard 5328A Counters;

/b. HP 5328A

b. HP 5328A Counter. Two similar counters for fractional parts of L1 and L2 doppler;

c. HP 5370A Counter. With both L1 and L2 codes and carriers being tracked, L1 and L2 timing information is transferred from the GPS Receiver via the GPIB, to two similar counters for L1 and L2 time transfer or pseudo range measurement from satellite to receiver antennae.

Processor/Controller Sub-system

9. a. Intel Microcomputer. Controls all communications between sub-systems, controls the tracking program when the receiver is in remote mode, controls data recording and communicates with the operator via a visual display unit;

b. ADM - 3 A CRT. Allows operator control of measuring and data recording sub-systems, allows operator input of tracking program, displays measured and recorded data, and allows access to the operational program;

c. Hewlett Packard 85 Computer. Computes on line, root mean square errors of L1 and L2 doppler fitted to a 3rd order polynomial. As a stand alone device, the HP85 is used to generate data for operational tracking.

Recording Sub-system

10. a. Dylon 1015 B Tape Controller. Controls all instructions and data from the microprocessor to the Kennedy Tapedeck;

b. Kennedy 9800, 9 Track Recorder. Records all GPS data in blocks of one minute of time;

c. Datapoint 2200 Cassette Tape Operating System. Transfers data from the nine track tape to a cassette tape, whose format is suitable for transmission (via Telecom telephone) to the General Electrice Time Sharing data transfer system.

/11. Timing

Timing Sub-system

11. a. Hewlett Packard 5061A Cesium Bearn Frequency Standard Maintains a highly stable time reference for all timing and counting devices;

b. Hewlett Packard 59309A Digital Clock. Maintains GPS time in hours, minutes and seconds for the processor/ controller sub-system;

Testing Sub-system

12. a. STI Model 5001 NAVSTAR Transmitter. Simulates all NAVSTAR signals and data, for system checking and trouble shooting.

Power Supply Sub-System

13. a. STI Power Supply. Supplies stable power to the GPS Receiver, NAVSTAR Transmitter, Intel Microcomputer, ADM - 3A CRT and antennae preamp.

b. Mains Power Supply. Transforms 240 VAC to 110 VAC for most of the sub-systems.

Meteorological Sub-system

14. Continually senses and converts to digital, dry temperature, relative humidity and atmospheric pressure.

SYSTEM OPERATION

15. Simultaneous tracking of the same satellite at Smithfield and Seychelles is achieved by Intel microcomputer control of switching between NAVSTARS 4, 5, 6, 8 and 9. Tracking programs are updated twice weekly at both stations. When more than two satellites are visible, switching is maintained at a twelve minute interval. The current daily tracking program with the five NAVSTARS is about fifteen hours.

Data Checks

16. Tracking data may be checked by the operator for validity and logic in the following ways:

/a. One Minute

a. One Minute Checks. The ADM - 3A CRT may be used to check data as displayed in decimal. This data comprises date, GPS Time in hours, minutes and seconds, temperature, pressure, relative humidity, receiver status, satellite status, satellite number, input aiding doppler estimate, ionospheric delay between L1 and L2, HOW or GPS time of week in octal divided by six, L1 and L2 pseudo ranges in seconds of time, L1 and L2 whole cycle doppler, L1 and L2 fractional cycle doppler.

b. Post Track Check of One Minute Records. The one minute records written on the Kennedy may be examined (post track) on the ADM-3A CRT as a 28 x 16 matrix in hexadecimal. This may only be done with the tape off line. It is time consuming, and so only a small random sample is normally chosen for a logic check.

c. HP 85. Root mean square errors (RMSE) for L1 and L2 doppler are computed in real time. Large RMSE may indicate a fault in the receiver, timing/counting devices or the satellite time reference standard.

Data Despatch

17. Data transferred to cassette, is entered into the General Electric (GE) Time Sharing system, via Low Speed Service using a modern, a Telecom telephone and the Datapoint 2200. Initially the data is stored on files at GE Adelaide. At this stage the GPS Operator may edit file information. Files are then entered into a High Speed Queue for despatch via satellite (not NAVSTARS) to DMA. Files at GE Adelaide are purged by the GPS Operator. Files on the High Speed Queue are automatically purged on receipt at DMA.

Operational Software

18. The Intel operational program written in machine language, and the Datapoint 2200 data transfer program, are updated on instruction from DMA. The following programs written in BASIC on the HP85, assist

/normal system

normal system operation, and at times are revised by station personnel:

a. Alert. Computes the azimuth, elevation and doppler, for any of the NAVSTARS over any time period, for any point on or near the earth. It outputs a graph (azimuth v's elevation) for that part of the twelve hourly orbit, (See Annex A), visible from that particular point;

b. HOW. Computes the Hand Over Word (GPS Time) for any instant of the week;

c. RMSE. Computes on line, the updated root mean square error for the one minute L1 and L2 dopplers;

d. OPPROG. Outputs the UTC, Local Time, Satellite Number and Doppler estimate for the simultaneous observations with the Seychelles station;

Data Recorded

19. To the end of Mar 82, a total of 5360 hr of valid data had been recorded and despatched to DMA. Equipment failures caused 430 hr of loss of data. Although this represents 7.4% of tracking time available, 240 hr down time occurred in the first month of operation. It should be noted that this system is unique, and as such, has very little equipment documentation.

Data Processing

20. The only data processing to be examined closely on site, is the RMSE of L1 and L2 doppler. The magnitude of these data is used to monitor equipment functions. Assessment of data over a long period, has shown that the RMSE of both L1 and L2 doppler is expected to be $\pm$ 0.03 m + 0.02 m. Information returned from DMA confirms this. It must be remembered that the RMSE does not indicate accuracy but internal precision. Magnitudes of greater than approx 5 sigma on satellite elevations above ten degrees, normally indicate an equipment fault. It has become evident that large RMSE's normally reveal drifts in the rubidium frequency standards in the satellites. Note that this tracking station comprises a cesium frequency reference standard.

/CONCLUSION

- 9 -

CONCLUSION

21. As very little information on the data processing is returned from DMA, it is difficult to assess the usefulness of this station in the testing program. The quantity and quality of data collected at this station, should not only assist in determining satellite ephemeris, but also test the concept of highly accurate post-flight ephemeris computations of high altitude satellites, from Northern Hemisphere Monitor Stations only.

(P.A. JENSEN)
Captain
Administering Command
4 Fd Svy Sqn

Annex: A. Alerts for NAVSTARS 4, 5, 6, 8, 9 for Smithfield 30 Apr 82

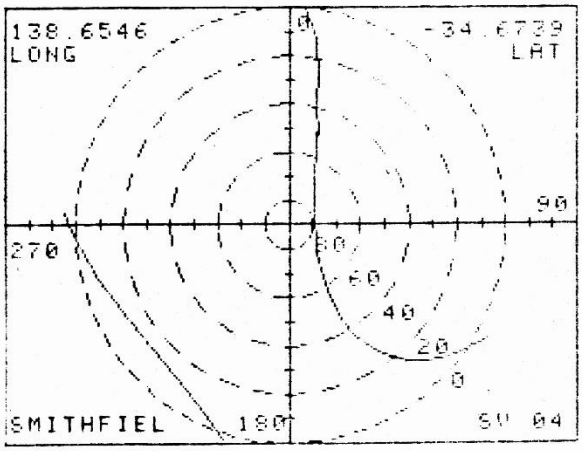
A - 1

ANNEX A TO
RA SVY NAVSTAR REPORT

SATELLITE ALERTS FOR SV 04
EPOCH: Year Day Sec
1981 320 0
SATELLITE ELEMENTS
a 26562.745000 e .002230
i 63.183000 m 12.096000
Ω 185.546000 w 210.763000

SITE COORDINATES
LONGITUDE 138.654631
LATITUDE -34.673959
HEIGHT (KM) .037190

82	120	0: 0	16.9	46.0	3.0
82	120	0:12	19.0	52.5	2.6
82	120	0:24	22.1	59.0	2.2
82	120	0:36	27.0	65.4	1.7
82	120	0:48	35.8	71.5	1.1
82	120	1: 0	52.8	76.5	.6
82	120	1:12	83.0	79.0	.1
82	120	1:24	115.3	77.4	-.5
82	120	1:36	134.3	72.9	-1.0
82	120	1:48	143.6	67.3	-1.4
82	120	2: 0	148.0	61.4	-1.9
82	120	2:12	150.0	55.4	-2.2
82	120	2:24	150.5	49.5	-2.5
82	120	2:36	150.1	43.8	-2.8
82	120	2:48	149.0	38.3	-3.0
82	120	3: 0	147.4	33.0	-3.1
82	120	3:12	145.4	27.9	-3.2
82	120	3:24	143.1	23.1	-3.2
82	120	3:36	140.4	18.5	-3.2
82	120	3:48	137.5	14.2	-3.2
82	120	4: 0	134.4	10.0	-3.1
82	120	4:12	131.1	6.1	-3.1
82	120	4:24	127.5	2.4	-3.0
82	120	4:36	123.8	-1.1	-2.8
82	120	4:48	119.8	-4.5	-2.7



YR	DAY	HR MIN	AZ	EL	KHZ
82	120	14:36	197.7	-2.5	3.1
82	120	14:48	200.7	1.1	2.8
82	120	15: 0	204.2	4.4	2.4
82	120	15:12	208.2	7.3	2.0
82	120	15:24	212.6	9.7	1.6
82	120	15:36	217.4	11.5	1.1
82	120	15:48	222.6	12.7	.6
82	120	16: 0	228.0	13.2	.1
82	120	16:12	233.5	13.1	-.4
82	120	16:24	239.0	12.4	-.8
82	120	16:36	244.4	11.1	-1.3
82	120	16:48	249.7	9.2	-1.6
82	120	17: 0	254.7	6.9	-2.0
82	120	17:12	259.6	4.3	-2.2
82	120	17:24	264.2	1.4	-2.5
82	120	17:36	268.7	-1.7	-2.6
82	120	17:48	273.0	-4.9	-2.7

YR	DAY	HR MIN	AZ	EL	KHZ
82	120	22:12	3.6	-2.3	3.7
82	120	22:24	5.5	2.3	3.9
82	120	22:36	7.1	7.3	4.0
82	120	22:48	8.5	12.5	4.0
82	120	23: 0	9.7	17.9	4.0
82	120	23:12	10.8	23.6	3.9
82	120	23:24	11.9	29.5	3.8
82	120	23:36	13.0	35.7	3.5
82	120	23:48	14.2	42.0	3.2
82	121	0: 0	17.5	48.1	2.9
82	121	0:12	19.8	54.6	2.5

Equipment at GPS Station Smithfield SA in March 1981. Left cabinet from the top – STI Model 5010 GPS Receiver, two HP frequency counters, HP85 Computer, HP 5061A Caesium Clock, power supply. Right cabinet from the top – HP digital clock, meteorologic data displays (pressure, dry temperature, relative humidity for tropospheric refraction correction), STI Model 5001 NAVSTAR Transmitter, 9-track half inch tape recorder, tape controller, power supply on the bottom. The system to translate the weekly data from the 9-track tape to cassette for despatch via Telecom modem is on the bench on the left. If the Telecom/modem line failed, the cassette was taken by hand on Fridays to General Electric Adelaide for despatch to DMA.

The small red brick 'shed' in the foreground housed the GPS Station and TRANET Station 412/545. The GPS antenna is atop the white structure on the left.

After the 1983 shooting down, by the USSR, of the civilian airliner Flight KAL 007, US President Ronald Reagan said that if GPS worked as expected it would be made freely available to everyone for the safety of commercial global navigation. As a consequence of this, the system became jointly managed by US Departments of Defense and Transport in 1996, but it remains owned and operated by Department of Defense. There are now essentially two sides of the system – military and civilian, with the military focus on assuring US and Allies access to the full GPS capability and denying the enemy the use of that system.

In mid-1987 the Minister of Defence approved station participation in the DMA fixed station global network to determine precise ephemerides of operational GPS NAVSTAR's, the first of which was launched in early-1989 having been delayed due to the tragic loss of Space Shuttle Challenger in January 1986. The initial operational satellite constellation was in place by 1994 and the system was declared operational in 1995. Since then the space segment of satellites and signals have been ungraded a number of times to satisfy the civilian and military requirements and commitments.

Just as TRANET Smithfield had supported RA Svy field operations using TRANSIT geodetic equipments from 1974 through provision of precise satellite ephemerides, GPS Smithfield also supported RA Svy GPS geodetic receivers first acquired in 1986 and other GPS geodetic programs of members of the Australian National Mapping Council and Australian Universities.

The land on which the station was located was prepared for disposal in 1995 and the station was moved a few kilometres into the main Defence Science and Technology Organisation area at Salisbury. The new station with the RA Svy nomenclature K906 was connected by GPS to both the Smithfield station and the national geodetic network by 4 Fd Svy Sqn in October 1994.

The GPS Salisbury station continues to operate full-time to contribute to the NGA post-orbit NAVSTAR precise ephemeris program which is publicly and freely available online from NGA a day after the satellite orbit. Data from the GPS station also continues to aid the maintenance of WGS84 to support high accuracy global positioning, navigation and timing solutions. The now unmanned GPS equipment has been upgraded and miniaturised many times since 1981 to ensure compatibility with new and next generation GPS satellite signals.

Our Association Calendar 2021 – the fridge magnet

Sun 25th April 2021	Anzac Day service and lunch
Thurs 1st July 2021	106th Corps birthday lunch
Thurs 11th November 2021	Remembrance Day lunch
Thurs 9th December 2021	Christmas Happy-Hour – The Duxton Bar and Restaurant, O'Connor shops at 5pm
April/May/November/December 2021	SNAGA Survey Golf Day