LAND TENURE CENTER
University of Wisconsin - Madison

Consultancy Services to
The Government of the
Republic of Trinidad & Tobago

LAND USE POLICY AND ADMINISTRATION PROJECT (LUPAP)
LAND SURVEYING COMPONENT

PHOTOGRAMMETRIC CATEGORY REPORT

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Ordnance Survey

Reviewed by Fred Brazier and Charisse Griffith-Charles

2000, March 3

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Contents

1 INTRODUCTION

Grant Vincent photogrammetric consultant of Ordnance Survey GB, has prepared this report as part of the LUPAP consultancy 21 February to 3 March 2000. The documents detail the findings of the consultant and gives the background and basis for the recommendations for amendment to the Land Surveys Act 1996 and Land Survey Regulations 1998 specifically relating to the photogrammetry category of land surveying.

2 SCOPE

The scope of the work is confined to the photogrammetric aspects of the Act & Regulations but there is interface with other land surveying categories. The consultancy also included inputs in geodesy (Ian Wilson) and engineering surveying (David Powell) and for a complete view of the work reference should be made to their reports.

The scope of the photogrammetric work encompasses:-

a) The Lands Surveyors Act – see separate report

b) The lands Surveyors Regulations – see separate report

c) Photogrammetric data capture instruments

d) Revision of the topographic database

e) Interviews with photogrammetrists within Trinidad & Tobago

Although this scope has been agreed, the consultants are working together to ensure that recommendations are complementary.

3 CURRENT SITUATION IN TRINIDAD AND TOBAGO

3.1 Research

Meetings have been held with individuals who have an interest in photogrammetry and related work. During these interviews the impact of photogrammetry and its use within Trinidad and Tobago has been assessed. A full list is at Annex A – Individuals interviewed during research.

In addition to the above meetings with individuals a group meeting was arranged for all professionals in Land Survey who have a interest in photogrammetry. An advertisement was placed in the Trinidad and Tobago Guardian on Saturday 26 February 2000. A copy is at Annex B – Invitation to Meeting; and a list of attendees is at Annex C – Attendees of the Photogrammetric Meeting. An additional presentation was given to Lands and Surveys Division DMPF (Digital Map Production Facility) staff who were unable to attend the group meeting.

3.2 Photogrammetry within Lands & Surveys Division

3.2.1 Analogue Plotting Instruments

It is highly unlikely that the Wild A-8 and A-10 plotting equipments will be required in the future by Lands & Surveys Division and therefore it is **recommended** that this equipment either be sold or scrapped to release the accommodation for other purposes: (7.2)

3.2.2 Photogrammetric Scanner

A Zeiss photogrammetric scanner was installed as part of the initial establishment of DMPF. Although this equipment is currently not utilised it will be essential to future revision operations which should commence immediately following receipt of the new topographic data based on the 1994 photography. It is therefore **recommended** that this scanner be regularly maintained so that it does not fall into disrepair and used occasionally to maintain staff knowledge: (7.3)

3.2.3 Digital Photogrammetric Workstation

It is understood that there is provision to procure a Digital Photogrammetric Workstation (DPW). This will be an important instrument if revision is to be carried out using photogrammetry: (7.5)

3.2.4 Ancillary equipment

The Zoom Stereoscope located in the Richmond Street Mapping & Control Section should be brought into DMPF to aid in photo-interpretation. It is understood that minor repair work - bulb replacement - will be required to achieve full operation of the equipment: (7.4)

3.2.5 Staff training

To facilitate the expansion of DMPF, the stereoplotter operators are currently in transition from analogue to digital methodology. This has resulted in three stereoplotter operators being subsumed within DMPF and analogue equipment being left unused within the old building in Richmond Street.

Stereoplotter operators are currently gaining experience in digital data processing by being involved in data validation of the new topographic dataset. This training and experience is essential if they are to go on to using digital photogrammetric workstations.

3.2.6 Software

The Intergraph software is fully installed and being utilised to quality control the new topographic data which is currently being received from Ordnance Survey. It is important to maintain and increase staff knowledge of the software capabilities. It is **recommended** that the staff are now ready to receive continuation training and that this should be organised prior to receipt of the main data supply from the other contractor: (7.6)

3.2.7 Quality Assurance

As part of the establishment of DMPF, topographical data is being captured by contractors, with only limited interaction with the operators who are doing quality assurance role using SV2 mirror stereoscopes. This process may be facilitated by use of the zoom stereoscope as noted at 3.2.4.

4 THE FUTURE

4.1 The Need for a Photogrammetric Capability

4.1.1 Revision

Currently no revision is being carried out to change intelligence data collected. As the current working photography was taken in 1994 its currency is dated. Revision will therefore become a major aspect of the work following receipt of the topographic data during the next year. Options for revision could include, stereo data capture, mono-plotting, and/or graphic survey techniques. The latter two techniques would require some staff training to be fully efficient. Map revision could also be under taken using field techniques using GPS, real-time kinematic GPS, portable pen computer and graphic survey. Additional consultancy may be required to identify precisely Lands & Surveys Division requirements. (7.9)

Large levels of development are taking place throughout Trinidad, especially around Port of Spain, the East-West corridor and inland from San Fernando. There is also considerable development both planned and under construction in Tobago (Hilton Hotel complex etc).

Planning for the Revision process should start immediately to ensure that the topographic mapping remains useful and that further time lags do not occur. The Lands & Surveys Division will then be well placed to implement revision on receipt of the new topographic data.

At present it seems unlikely that any ground completion will be carried out, this reinforces the need to capture new photography and implement a Revision Policy for maintenance of the new mapping. It is **recommended** that Lands and Surveys Division develops proposals to implement revision processes; and it is also **recommended** that planning is started immediately for the supply of new photography in priority areas of known change. (7.9)

4.1.2 Procurement of a Digital Photogrammetric Workstation (DPW)

It is **recommended** that the purchase of a DPW is commenced immediately assuming Lands & Surveys wish to carry out map revision using photogrammetry. (7.5) Due to the terrain and significant levels of development throughout the Islands since the 1994 photography was captured this is the only realistic method of capturing this new detail.

These conclusions are drawn because:

- although some surveys could be done using ground methods, especially in areas where there is good control and the terrain is relatively flat, it is unlikely that sufficient survey staff could be made available for this work;
- land surveyors do not currently possess the Graphic Survey skills which speed up topographic survey revision and would therefore need to be trained in this skill;
- significant housing and other development has taken place in areas with large height differences and dense vegetation;
- the Division already has available stereoplotter who are keen to carry out the work;

4.2 Staff

There may be difficulties with some of the existing photogrammetric staff due to the recent significant change in work practice and their need to come to terms with this change following, in some cases, a couple of decades of working with analogue equipment.

Specifically:

a) Samson Cadogon should be actively encouraged to take up studies at an advanced level. He has already completed a course at ITC in the Netherlands, but that was some years ago and did not specifically include digital photogrammetry. He has the potential to undertake degree level training, hopefully he is academically qualified to attend such a course. Both academic and practical experience are required. The latter could be covered by equipment manufacturer training, which should be negotiated when further equipment is purchased.

b) Stephanie Elder-Alexander should as manager of the DMPF area at least understand the basics of what the team is required to do. Her understanding of digital photogrammetry is limited, and so therefore some short course should be considered. These should be available at a US / UK university / college. This would give her a deeper understanding of equipment capabilities and allow her to be more authoritative in managing any team or indeed contractor / consultant. Planning production will be an important part of her work so she will need to understand the problems that can arise using this methodology.

During my interviews with professional photogrammetrists they all expressed a wish to work together with Lands & Surveys to promote photogrammetry in T&T. It is believed that Dexter Davis, having recently gained his PhD in digital photogrammetry, would make an ideal candidate to help Lands & Surveys achieve the **recommended** goal of using photogrammetry to carry out some of its map revision in the future (4.1.1).

4.3 Photographic Archive

The current archive of contact prints and film is of high national value and should not be allowed to become fragmented and damaged. This archive will be of immense value in future years in being able to act as a reference to the state of the Nation's land at the time of exposure. GIS and land analysis are becoming increasingly important and the Lands & Surveys Division has a duty to maintain this archive. It is therefore recommended that the prints and film be co-located, indexed and stored in good conditions. Preferably within the current main building in Frederick Street.

4.4 Presence on the Web

With the increasing use of the Web as a source for information it may be beneficial to establish a presence for the Lands & Surveys Division. Land survey information and the information on the Act and Regulations, in addition to related mapping products may be of use in establishing Lands & Surveys Division lead in this area.

4.5 Costs

Where possible costs for have been obtained. These are mainly restricted to hardware costs. To provide an indication of manpower costs estimates of time and skill level have been given. These estimates are given in Annex D – Estimated Costs.

5 THE LAND SURVEYORS ACT 1996 (SECTION 15)

5.1 List of recommended additions, amendments and repeals

The Act has detail relating to Aerial Surveys, which is more appropriate to Regulations. **It is therefore recommended that**:

1. Paragraphs 15.1(1); 15(4); 15(5); 15(6) be removed from the Act.
2. Paragraphs 15(6) contains a definition for Aerial Survey that is appropriate to be included in Section 2.
3. The form of words for Section 2 should be:

   "Aerial Survey" means the collecting of information about land or marine topography or resources through the use of airborne vehicles, equipped with recording devices such as cameras, scanners or other recorders utilising any electromagnetic medium.
4. Following the removal of parts of Section 15 to the Regulations an additional paragraph should be added to Section 64, after 64(g) to read:

   "h) prescribe any matter or thing relating to the provision of topographic mapping using aerial survey"

The following clauses 64 (h)(I) & (j) will need to be relabelled 64 (I)(j) & (k) respectively.

5. At Section 15. (1) of the Land Survey Act 1996 the term "*mapping*" should be deleted and replaced with "*photogrammetry*". This will ensure that the Act is not constrained by future developments by the term mapping.

6. At Section 15. (3)(b) of the Land Survey Act 1996 the use of the term "*or*" needs to be reconsidered. It is **recommended** that this is changed to "*and*".

7. At Section 15. (3)(b) of the Land Survey Act 1996 the term "*or data*" should be added after "*images*".

8. The designation "Land Surveyor (*Major Category*) should be adopted to ensure definition and range of scope of registration. Designation in the case of a registered photogrammetrist would therefore become "Land Surveyor (Photogrammetry)".

9. At Section 15. (4) of the Land Survey Act 1996 the term "*photogrammetrist*" should be replaced by the term "*Land Surveyor (Photogrammetry)*"

5.2 Requirements of the unregistered Photogrammetric Surveyor

For the purpose of satisfying the requirements of the Land Survey Act under Section 15 (1) all aerial survey work undertaken by an unregistered photogrammetrist within Trinidad & Tobago is required to be authorised by the Director of Surveys. Current photogrammetric staff working within the Lands & Surveys Division will obtain this by default as they are directly working to the Director.

5.2.1 Letter of Application

The unregistered photogrammetrist will need to apply by letter of application to the Director of Surveys to conform to the current law. Details of content of the letter of application should be outlined in the Regulations.

5.2.2 Guidelines

For the purposes of satisfying the minimum requirements of the regulations of the Land Survey Act under Section 15 (3) the information contained within the FIG Client Specification Guidelines for Vertical Aerial Photography and Derived Digital Imagery may be used as a guide.

6 THE LAND SURVEYORS REGULATIONS

As part of this Photogrammetric Consultancy a separate document titled "*The Land Surveyors Photogrammetric Regulations 2000*" has been prepared to formalise and clarify the existing Regulations. This work is therefore not detailed within this report.

7 RECOMMENDATIONS

It is recommended that –

7.1 Land Survey Act and Regulations

Recommendations as identified in Section 5.1 should be implemented.

7.2 Wild photogrammetric equipment

The Wild A-8 and A-10 photogrammetric plotters either be sold or scrapped to release the accommodation for other purposes (3.2.1).

7.3 Photogrammetric scanner

The Zeiss photogrammetric scanner be regularly maintained and used occasionally to maintain staff knowledge (3.2.2).

7.4 Zoom stereoscope

The Zoom Stereoscope should be brought into DMPF to aid in photo-interpretation (3.2.4).

7.5 Digital Photogrammetric Workstation

Procurement of a DPW should start immediately (3.2.3).

7.6 Continuation Training

DMPF staff are now ready to receive continuation training (3.2.6)

7.7 Photographic Archive

The current photographic archive including contact prints and film should be co-located, indexed & stored to ensure their use in future years. (4.3)

7.8 Training

Samson Cadogan (degree) and Stephanie Elder-Alexander (short academic course) is detailed. Training of staff in any specific digital photogrammetric equipment that is acquired for DMPF should be part of the procurement, such training should include management staff (4.2).

7.9 Revision Policy

New photography should be commissioned to implement a Revision Policy for maintenance of the new mapping (4.1.1).

A consultancy could be commissioned to review and help implement revision processes. (4.1.1)

7.10 World Wide Web

The Lands & Surveys Division should establish a www page which should include amongst other detail reference to the Land Survey Act and Regulations in relation to photogrammetry.

8. ACKNOWLEDGEMENTS

Thanks are due to all the photogrammetrists, surveyors and technicians within the Lands & Surveys Division who helped me compile this report. In particular I would like to thank. Stephanie Elder-Alexander and her team for their support during my consultancy.

Last, and by no means least, I would like to thank the Director of Surveys, Mr Tyrone Leong and the management team for their co-operation while I was researching material for this report.

9. REFERENCES & WEB ADDRESSES

3D MAPPER

Digital Photogrammetric systems www.3Dmapper.com

ASPRS, 1995

DRAFT Standards for Aerial Photography

Professional **Practice Division Specifications and Standards Committee**

BRAZIER, 1998.

Establishment of a Digital mapping Facility

Ordnance Survey International final report, 25 pages.

BROWN, 1998

DTM Creation on the Photogrammetric Workstation (DPW)

Ordnance Survey GB Internal report, 31 pages.

GALE, 1998.

Establishment of a Digital Map Production Facility – User's Guide

Ordnance Survey International final report, 34 pages.

IKONOS, 2000

World Wide Web site http://www.spaceimaging.com

Web site of the TERRA project International National Aeronautical Space Administration

LH Systems

Socet-Set – Softcopy exploitation Tool www.lhsystems.com

LINZ, 1998.

Accuracy Standards for Geodetic Surveys. OSG Standard 1.

Land Information New Zealand. Office of the Surveyor General.

MASON, 1999.

Lands & Surveys Division strategic Plan 1999-2003.

Ordnance Survey International final report, 77 pages.

NASA, 2000

World Wide Web site http://terra.nasa.gov.

Web site of the TERRA project International National Aeronautical Space Administration

NWG, 1998

Trinidad and Tobago Aerial Triangulation & Adjustment Project. Preliminary Report.

Report produced by North West Geomatics Ltd. Alberta, Canada. (info@nwgeo.com). January 14, 1998.

RICS, 2000

Vertical Aerial Photography and Derived Digital Imagery – Client Specification Guidelines (Draft)

Royal Institution of Chartered Surveyors – FIG specifications

RICS, 1996

The Client Specification Guidelines for Surveys of Land, Buildings and Utility Services at Scales of 1:5 00 and Larger

Royal Institution of Chartered Surveyors – FIG specifications

RICS, 1988

Specification for mapping Scales between 1:1 000 and 1:10 000 (2nd Edition)

Royal Institution of Chartered Surveyors – FIG specifications

VINCENT, G.N., 2000

The Land Surveyors Photogrammetric Regulations 2000

Ordnance Survey International final report, 10 pages.

ANNEX A – INDIVIDUALS INTERVIEWED DURING RESEARCH.

Tyrone Leong,	Director of Surveys
David Stanfield	LUPAP Director
Alan Williams	LUPAP Project Manager
Thakray Driver	Ministry of Agriculture
Francis Charles	Private Practitioner (Ex Director of Surveys)
Dr Dexter Davis	GIS Consultant, Private photogrammetrist
Dr Raid Al-Tahir	Lecturer in Photogrammetry, UWI
Paul Williams	Survair International, Private Photogrammetrist
Alan Lodwig	Town & Country Planning Division
Stephanie Elder-Alexander	T&T Land Surveyor DMPF Manager
Keith Whiteman	Head Cartographer
Clarence Boodoo	Stereo-Operator Technician
Samson Cadogan	Stereo-Operator Technician
Anthony Gilchrist	Stereo-Operator Technician

ANNEX B – INVITATION TO MEETING

Ordnance Survey

Ministry of Agriculture, Land and Marine Resources and
Ministry of Housing and Settlement

NOTICE
Information Circular to Surveyors of Trinidad and Tobago

LAND SURVEYORS REGULATIONS: PHOTOGRAMMETRY CATEGORY

Land Use Policy and Administration Project: LUPAP

Surveyors and persons interested in Land Surveying & Photogrammetry are invited to attend a

Meeting to be held at 4:30 p.m. on Wednesday 1 March 2000 at the Lands and Surveys Division, 118 Frederick Street, POS.

Grant Vincent, a Chartered Land Surveyor who has an MSc in Photogrammetry from University College London, and who has been a land surveyor & photogrammetrist since 1974, will make a presentation on:

"Photogrammetry within Land Surveying"

Topics covered will include:

- Photogrammetry in transition:
  - Analogue-hardcopy to digital-softcopy in Lands & Surveys Division
  - Management of data in the future
  - Integrating photogrammetry with GIS – boundary disputes
- The need for standards; legislation & regulations:
  - contractual documentation & specification
  - guidance on best practice
- Recent developments in Remote Sensing - impact of commercial "Spy" satellites:
  - **Ikonos** sub-metre resolution
  - Digital Elevation Models **(DEM's)** and their uses
  - Where is NASA 's Shuttle?
  - Latest information on **Landsat 7** imagery
  - Impact of **LIDAR** on large scale mapping

Your attendance at this meeting would be very much appreciated to ensure that we are aware of the views of land surveyors and others interested in the use and advancement of photogrammetry within Trinidad & Tobago. For further information contact:

Fred Brazier 633 8948 or 625 0427 email: fbrazier@wow.net

Charisse Griffith-Charles 640 2959 or 662 2002 Ext. 3314 email: charain@tstt.net.tt

ANNEX C – ATTENDEES OF THE PHOTOGRAMMETRIC MEETING

Photogrammetry presentation by Grant Vincent (Ordnance Survey) on 1 March 2000

No	Name	Speciality / Profession
1	Hollis J Eversley	Land Surveyor
2	Stephanie Elder-Alexander	Land Surveyor (L&S)
3	Christopher Rodney	Stereo-Plotter Operator (L&S)
4	Winston Ramcharan	Land Surveyor
5	Khemchand Singh	Engineering Practitioner
6	Richardo White	Student
7	Anesh Gopee	Student
8	Ainsley Charles	Student
9	Keith Miller	Hydrography / Geodesy Lecturer UWI
10	Charles Antoine	Student (UWI)
11	Randy Rhambai	Graduate UWI (Surveying)
12	Alan Lodwick	Town & Country Planning Division
13	Asim Ali	Student / Teaching Assistant
14	Raid Al-Tahir	UWI Lecturer (Photogrammetry)
15	Tarick Hosein	Student / Teaching Assistant
16	Paul Williams	Survair (Licensed photogrammetrist)
17	Andrew Bowles	Land Surveyor (L&S)
18	Lynn A Roopchand	Land Surveyor
19	Tyrone D Leong	Director of Surveys (L&S)
20	Fitz Reyes	Land Surveyor (L&S)
21	Roland Wiseman	Land Surveyor (L&S)
22	Alicia Naimool	Land Surveyor (L&S)
23	Clyde George	L&S
24	Glenn Wilkes	Land Surveyor
25	Mervyn Grant	L&S
26	Jacob Opadeyi	UWI Lecturer
27	Hollis S Coker	Land Surveyor
28	Charisse Griffith-Charles	UWI Lecturer

ANNEX D – ESTIMATED COSTS

Costs are calculated for each recommendation. The costs given are indicative only.

7.1 Land Survey Act and Regulations

Cost Nil

7.2 Wild photogrammetric equipment

The Wild A-8 photogrammetric plotter may have some residual value but due to high cost of dismantling, moving to new site and re-build it is unlikely that any income will be achieved. The University of the West Indies (UWI) may be interested in acquiring this instrument.

Cost Nil

The A-10 due to its condition should be removed from its current location & scrapped.

Cost minimal

7.3 Photogrammetric scanner

Cost Nil Operator training 1 day per month

7.4 Zoom stereoscope

Cost Nil Positive impact in efficiency of working and greater reliability (3.2.4).

7.5 Digital Photogrammetric Workstation

Research & procurement documentation for a DPW system (3.2.3).

There are several low cost Digital Photogrammetric Systems now available on the market running under Win98/NT.

A typical system detailed below will cost (UK price) approximately $280,000TT.

DPW hardware to include the following components:-

- CPW SP700 X 550, 9.1Gb-S2, 256Mb, CD, NT, PS300 (Compaq)
- Pentium III XEON 550/512k processor upgrade
- 256Mb memory module (ECC, 100MHz, Reg, SD RAM)
- Mylex Acceleraid 150 Array
- 9.1 Gb Ultra 2 SCSI drive (10k RAM) X 2
- Cornerstone P1700 21" Monitor X 2
- Keyboard
- LHS hardware---
- Z Screen kit
- 3D mouse kit

- GVX210 Graphics card

DPW software to include :-

SOCETSET software : CORE, STEREO, ORIMA-S

Additional licences/software will be required to support whatever editing system is chosen.

Web addresses (see section 9) provide more details, for example 3D Mapper and LH Systems.

The scope of this consultancy has not included an in-depth review of systems that should be considered by Lands & Surveys Division, this could be provided later if required.

Initial requirements consultancy	5 days	Photogrammetric Expert
Liaison & integration	5 days	Photogrammetric Expert

7.6 Photographic Archive

Cost: 5 days local staff plus racking at local prices (4.3).

7.7 Training

Training of staff in digital photogrammetric techniques should be part of any procurement and should include management staff (4.2).

7.8 Revision Policy

There is a requirement to establish a revision policy, the majority of which is expected to be undertaken using photogrammetric techniques (2d), 4.1.1).

Requirements Study & Management Documentation Consultancy.

Cost	10 days	Photogrammetric Revision Expert

7.9 World Wide Web

Cost: Local skills at 5 days effort (4.4).

ANNEX E – GUIDES FOR BEST PRACTICE

The following documents are part of a series produced by the Royal Institution of Chartered Surveyors (RICS) under the auspices of Federation Internationale des Geometrés (FIG).

E.1. **Client Specification Guidelines for Vertical Aerial Photography and Derived Digital Imagery** (1st Edition, April 2000);

This specification for vertical aerial photography required for photogrammetric mapping, digital mosaicing, orthophotography, land use, habitat surveys and general interpretation. It is not a specification for remote sensing.

The publication recognises, technological advances and experience in using previous specifications under widely differing conditions. The publication recognises the shift away from panchromatic film and photographic products towards colour photography,

E.2. **Specification for Mapping at scales between 1:1000 and :10 000**(2nd edition, 1988);

E.3. **The Client Specification Guidelines for Surveys of Land, Building and Utility Services at Scales of 1:500 and Larger** (2nd Edition 1996).

These publications may be used as they are intended to assist all those connected with the requesting, purchase and production of surveys and mapping material.

The documents are designed for world-wide use as a specification

Although FIG also publish Terms & Conditions of Contract for Land Surveying Services, it is recommended that the advice of a professional surveyor / photogrammetrist should be sought if starting on any such project.

Published by RICS Business Services Limited

a wholly owned subsidiary of

The Royal Institution of Chartered Surveyors

under the RICS Books imprint

12 Great George Street

London SW1P 3AD

http://www.rics.org.uk