THE STATUS
OF
THE GEODETIC INFRASTRUCTURE
FOR JAMAICA

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Contents

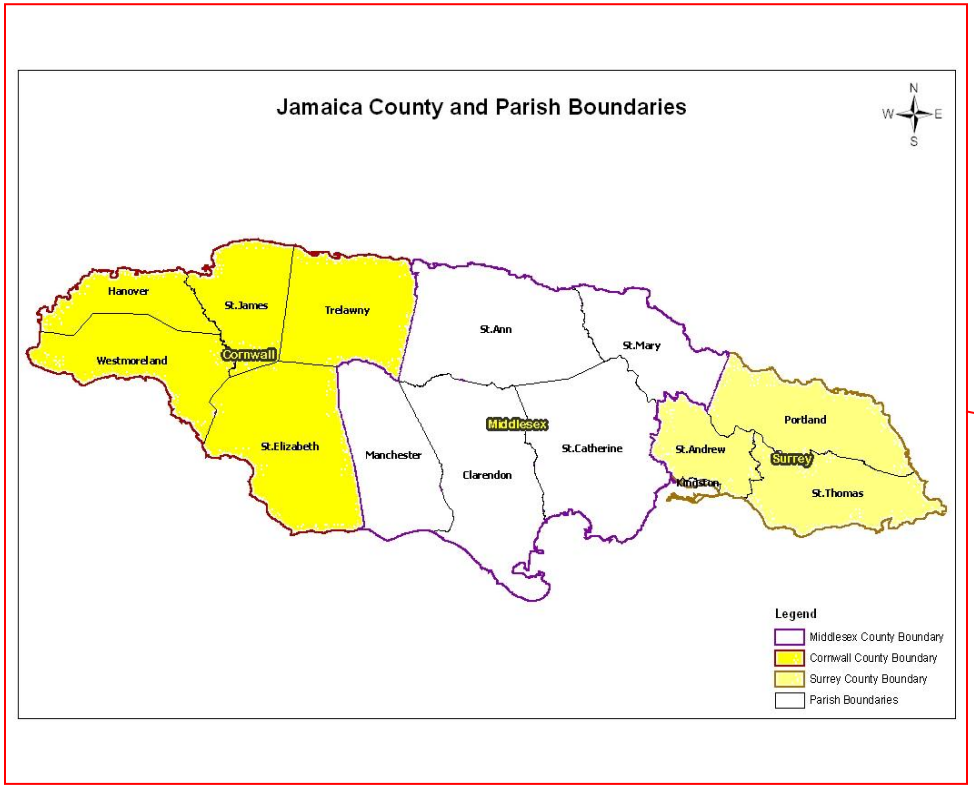
- Introduction
- The National Triangulation of Jamaica (Primary Network)
- The Jamaica Datum 1969 (JAD 69)
- The Impact of GPS Technology on the Jamaica Geodetic Infrastructure
- Jamaica Datum 2001 (JAD 2001)
- Status of the Infrastructure
- Challenges and Action Plan
- References

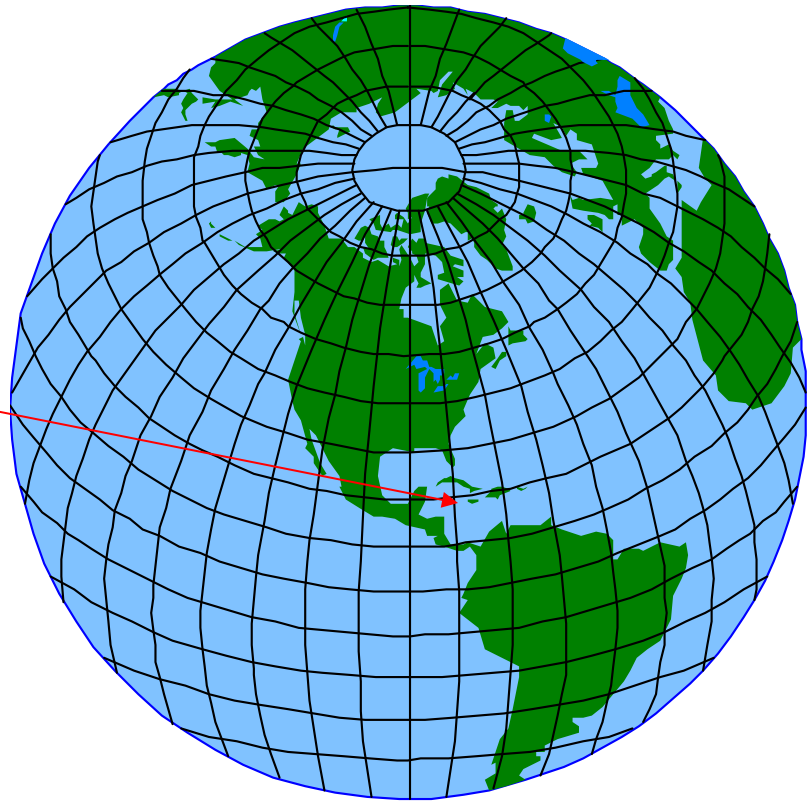
Introduction

Jamaica is the largest of the English Speaking Caribbean islands

- Geographical location: Latitude 18° N and Longitude 77° W
- Highest point on the island: 2256 metres (7402 ft.)
- Size: 11,424 km² (4,411 square miles), about the size of the Province of Panama (11,442.62 km²)
- East-West/North-South extent: 243 kilometres (146 miles) from east to west and its greatest width from north to south is 80 kilometres (51 miles)
- Map coverage: Fully mapped at scales 1/250,000, 1/50,000 and 1/12,500

Introduction (cont'd)





Introduction (cont'd)

Over the last 76 years, Jamaica's Geodetic Datum has been changed three times, namely:

- The Datum for the National Triangulation of Jamaica (Primary Network)
- Jamaica Datum 1969 (JAD 69)
- Jamaica Datum 2001 (JAD 2001

The National Triangulation of Jamaica (Primary Network)

- Jamaica's first geodetic datum, a non-geocentric datum, was based on the Clarke 1866 reference spheroid
- The realization of the geodetic reference frame – the National Triangulation Network came about when the datum point for the network and the triangulation stations were established in relation to the geodetic datum
- The datum point was coordinated from astronomical observations connecting it to the United States Navy Department's 1873 network of points

The National Triangulation of Jamaica (Primary Network) (cont'd)

- 44 Primary stations were established – 38 in 1937 and a further 6 by 1944
  - One base line in the network was measured and all the other lines calculated
  - The azimuth of one line in the Network was determined, using astronomical observations
  - The stations were heighted from simultaneous reciprocal observations of vertical angles and connected by spirit levelling to a mark, which was reportedly heighted by the British Admiralty in 1886
- The Network had a computational error of -10.39 seconds of arc in azimuth

The Jamaica Datum 1969 (JAD 69)

In 1969 the datum for the Primary Network was changed to the Jamaica Datum 1969 (JAD 69) a non-geocentric datum based on the Clarke 1866 reference spheroid. The old network was recomputed on JAD 69 to bring about a new realization of the reference frame:

- The computational error of -10.39 seconds of arc in azimuth that affected the triangulation network was reduced to an error of +1.1seconds of arc in azimuth, which was deemed acceptable
- The height values were improved over the heights obtained for the Triangulation network through two height points adjustments:
  - A 1970 Least Square adjustment of the trigonometric heights using more accurate Mean Sea Level data and
  - A further height points adjustment in 1985 using additional height points

In 1996 a GPS campaign was executed in the Caribbean and Latin American (CAR/SAM) region, which highlighted the need for a GPS compatible datum for Jamaica

The Impact of GPS Technology on the Jamaica Geodetic Infrastructure (cont'd)

The 1996 Global Positioning System (GPS) campaign

- The GPS campaign was executed to coordinate international airports in the CAR/SAM region
- The campaign was to satisfy the international civil aviation requirement that the geodetic datum to which navigation elements must be referred is the World Geodetic System - 1984 (WGS-84)
- The National Geodetic Surveys (NGS), USA, established geodetic control marks referred to the North American Datum of 1983 (NAD 83) at:
  - Norman Manley International Airport in Kingston
  - Sangster International Airport in Montego Bay

The Impact of GPS Technology on the Jamaica Geodetic Infrastructure (cont'd)

In 1997 the Survey Department (now the Surveys and Mapping Division, National Land Agency) signed a Technical Cooperation Agreement with the Civil Aviation Authority, Jamaica, to foster:

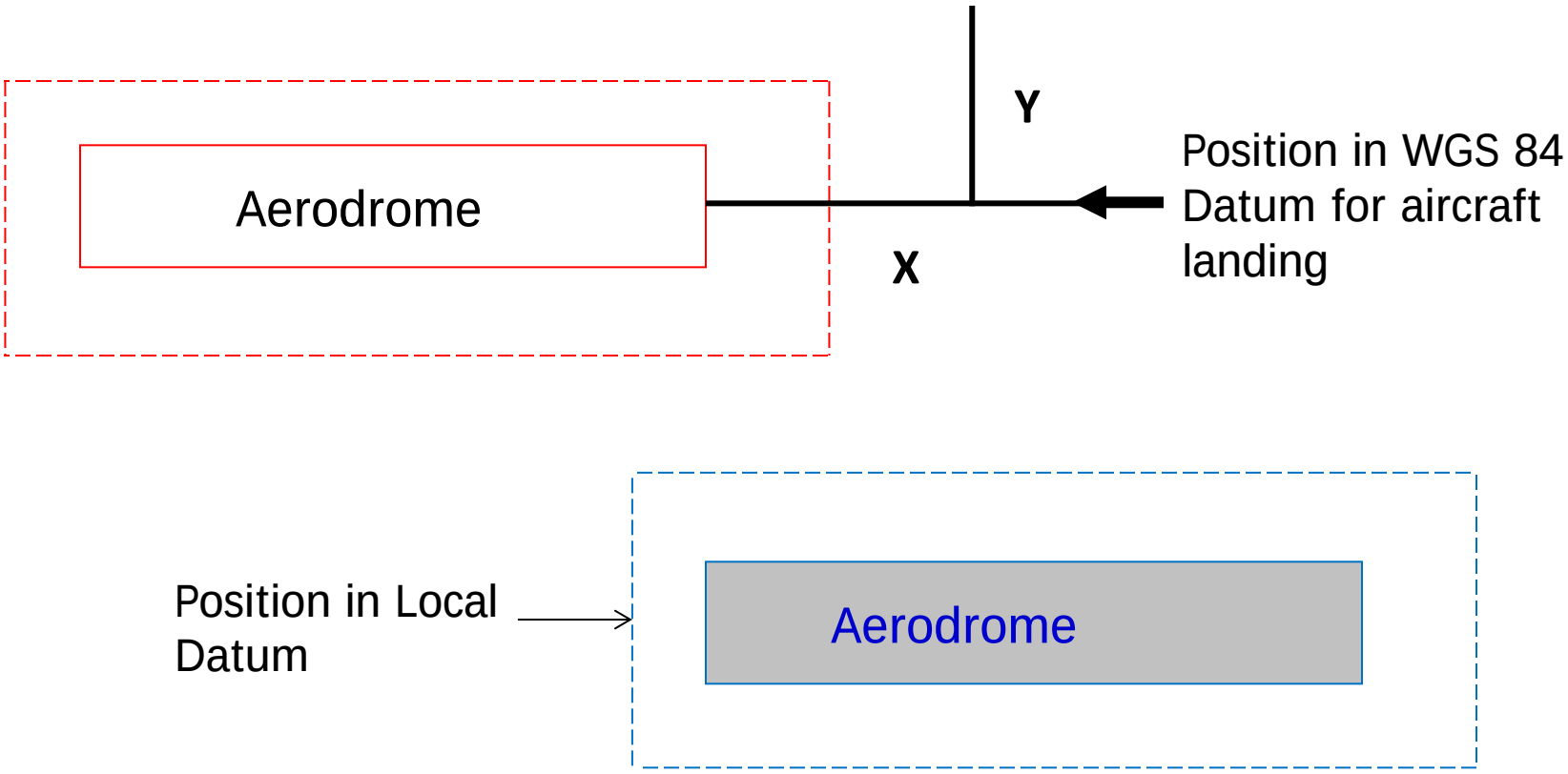
- The implementation of WGS 84
- The standardized production of aeronautical charts in the CAR/SAM Region

The Impact of GPS Technology on the Jamaica Geodetic Infrastructure (cont'd)

- Effect of the Agreement:
  - Survey of aerodromes
    - Reference point
    - Runway thresholds
    - Appropriate taxiway centre line points
    - Aircraft stands
    - Significant obstacles
    - Position of navigation radio aids sited in the aerodrome
- Purpose:
  - To satisfy ICAO requirements that became effective January 1, 1998

The Impact of GPS Technology on the Jamaica Geodetic Infrastructure (cont'd)

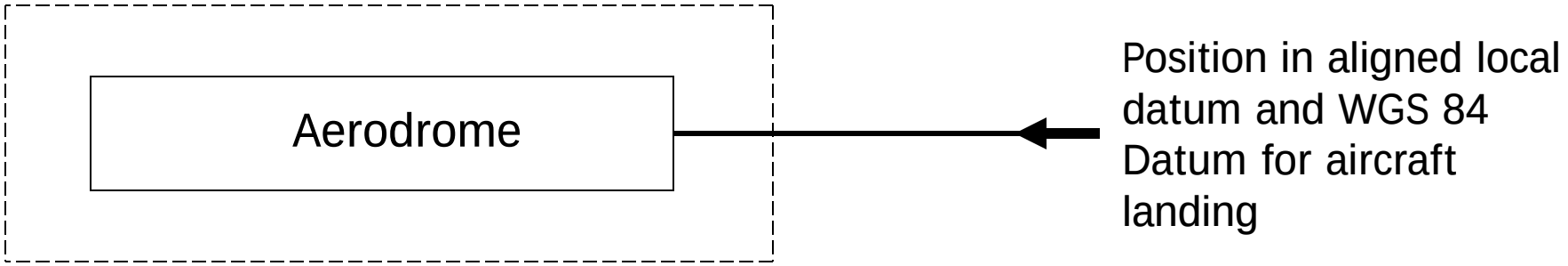
Effect of Datum on Aircraft Navigation



The Impact of GPS Technology on the Jamaica Geodetic Infrastructure (cont'd)

ICAO goal - To make Local Datum aligned to WGS 84 making Air Navigation safer

Effect – Precursor to establishing Jamaica Datum 2001



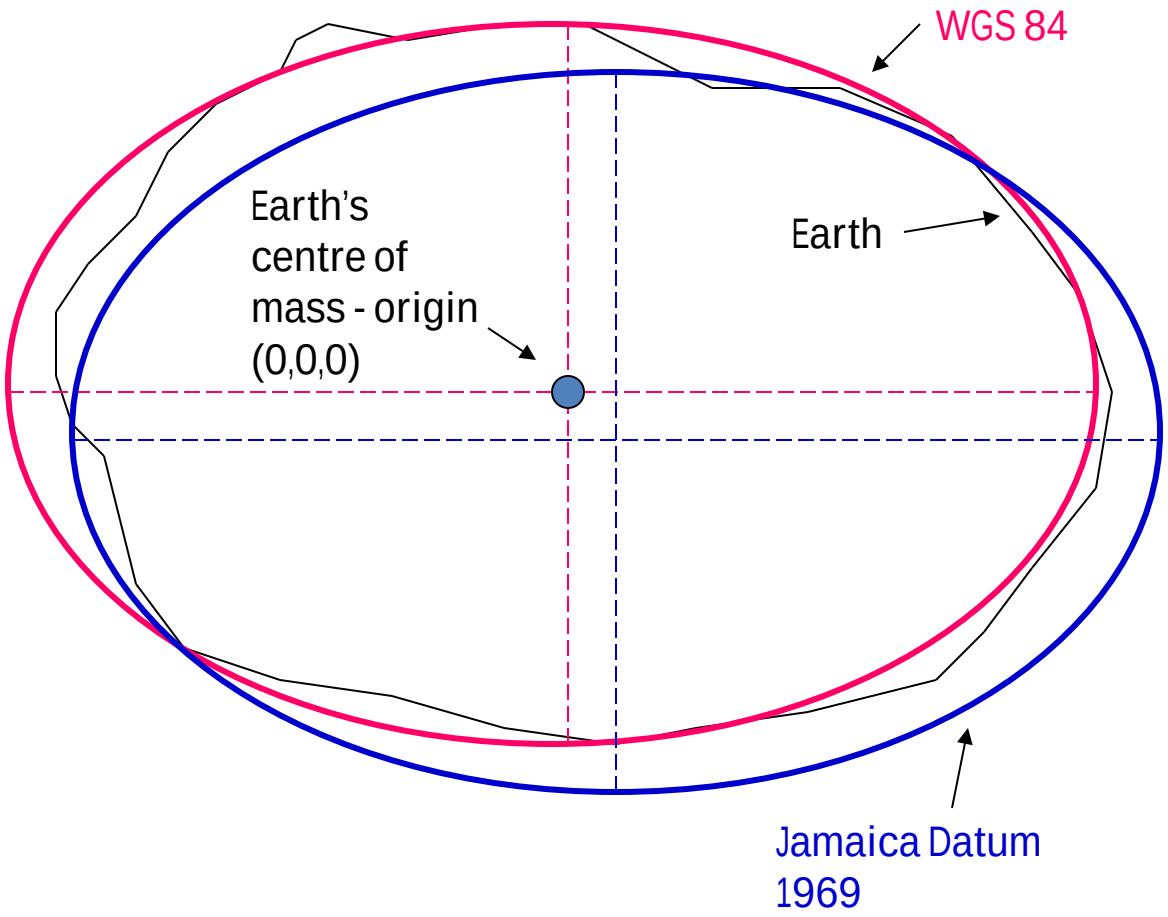
Jamaica Datum 2001 (JAD 2001)

New Datum Definition

- Satellites orbit around centre of mass of earth

WGS 84:

- Consistent global, geocentric, 3-D Reference System
- Geodetic reference for GPS



Jamaica Datum 2001 (JAD 2001) (cont'd)

New Datum Definition

- **JAD 2001**
  - a = 6378137 m (Semi-Major Axis)
  - 1/f = 298.257223563 (Reciprocal flattening)
  - Coordinate System Origin:
  - Latitude = 18 00 00 N
    Longitude = 77 00 00 W

Jamaica Datum 2001 (JAD 2001) (cont'd)

New Datum Definition (JAD 2001)

- **False Coordinates of Origin (Mapping); UTM Coordinates of Origin (Charts):**

  Mapping:

  – Northing = 650 000 m
  – Easting =750 000 m
  – Projection : Lambert Conical Orthomorphic with one standard parallel (18° N)

  Hydrographic and Aeronautical Charts:

  – UTM Coordinates of Origin
  – Northing = 1991327.9727 m
  – Easting = 288239.7295 m
  – Projection: Universal Transverse Mercator (UTM)

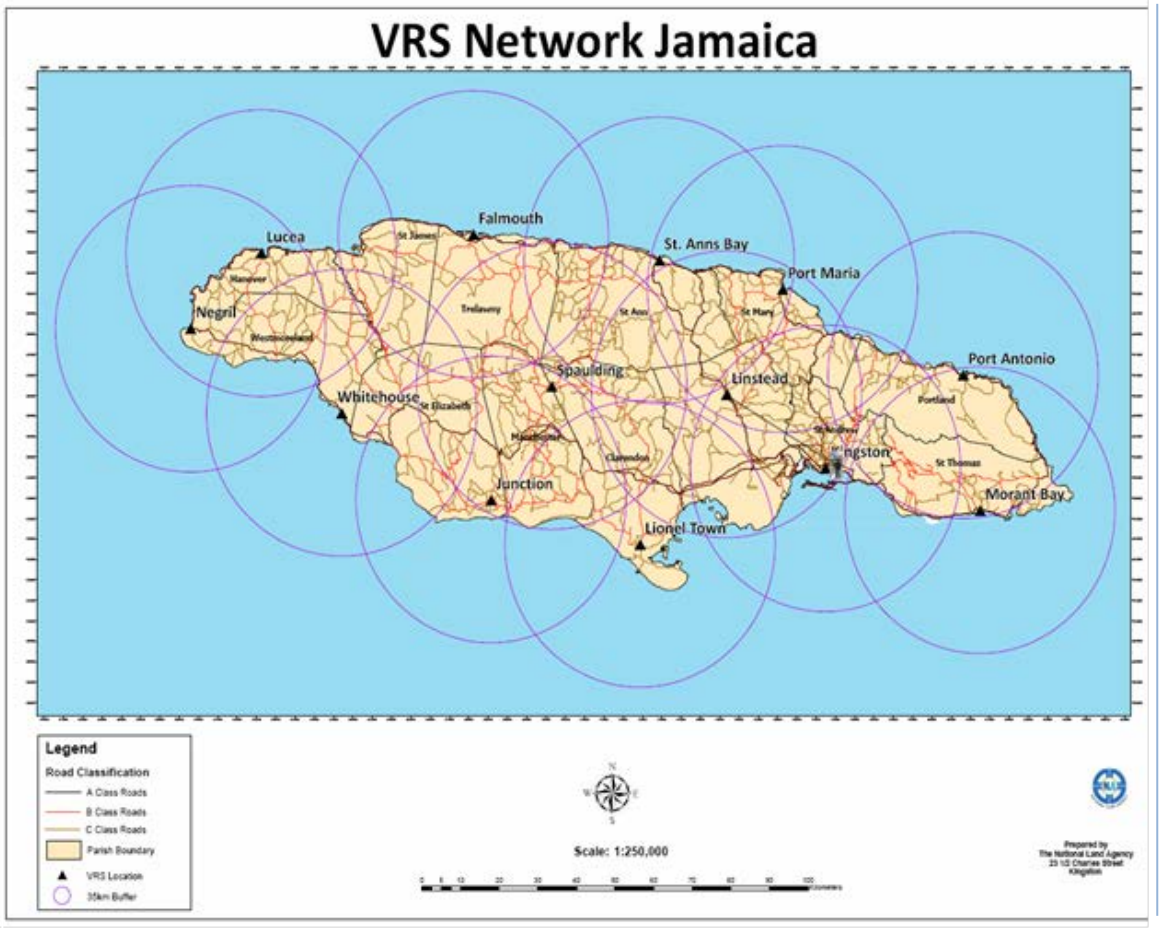
Jamaica Datum 2001 (JAD 2001) (cont'd)

- Established in 2001
- Aligned to WGS 84 via Primary Control marks established by National Geodetic Surveys, USA in 1996
- Use of JAD 69 phased out
- Coordinate Transformation Parameters (7-Parameter Similarity) for Jamaica determined by G. Newsome adopted
- Conversion of geographical data from JAD 69 to JAD 2001 commenced

Status of the Infrastructure

Active Network in place

- VRS Network of 13 GPS Stations operating 24 hours per day 7 days per week
- Network accuracy is <3cm static and <5cm kinematic



Status of the Infrastructure (cont'd)

- VRS Control Centre is located at NLA Charles St, Kingston Office
- VRS: Efficient use of GPS
  - Data capture, positioning, tracking, crustal monitoring, navigation and building a modern National Spatial Data Infrastructure (NSDI)
- Passive Geodetic Network : 8,384 control marks
- Photo Points: 4,353
- National Calibration Network: 10 control marks for calibrating survey equipment, including GPS
- 180 Control Marks observed annually using GPS for horizontal position and spirit levelling/trigonometric heighting for orthometric height determination

Status of the Infrastructure (cont'd)

- Control marks coordinated in JAD 69 are being checked and re-coordinated in JAD 2001
- 1200 control marks are entered in the Digital Control Database annually
- Bi-directional Transformation Parameters: JAD 69/JAD 2001 are in place
- Legislation:
  - Mandatory to refer cadastral mapping to JAD 2001
  - Will soon be mandatory to refer all cadastral surveys to JAD 2001

Challenges and Action Plan

Challenges:

- VRS firmware and software licences are very expensive to maintain
- VRS user community is small
- All the VRS antennae are mounted on buildings, which makes it difficult to secure or take them down in the event of a hurricane
- No Geoid Model in place
  - Using only traditional heighting methods in the Jamaican topography is too expensive and time consuming
  - Many control marks not yet heighted
- A business model for VRS commercial operations has not yet been implemented
- 6 of the 13 VRS Receivers need upgrading to take advantage of remote operation capability and GNSS to expand the range of satellites available for faster and better position fixing

Challenges and Action Plan (cont'd)

Action Plan For A Sustainable Geodetic Infrastructure

- The National Land Agency (NLA) will pursue public sector/private sector partnership to fund, manage and maintain the VRS
- NLA will encourage surveyors to maximise the use of the VRS
- NLA will seek expert assistance to build a Geoid model for Jamaica
- NLA will implement a Business Plan (user pay model) and effective marketing strategies for the VRS services to ensure long term sustainability of the network
- NLA will insure the VRS against damage or lost

THANK YOU

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