

GE
SMART
ASIA 2018



Locate
#Locate18



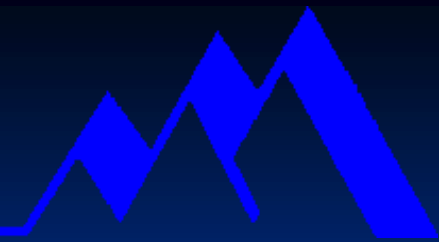
WHEN

9 – 11 APRIL 2018

WHERE

ADELAIDE, AUSTRALIA

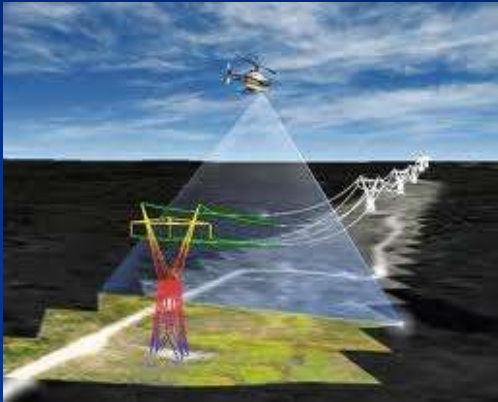
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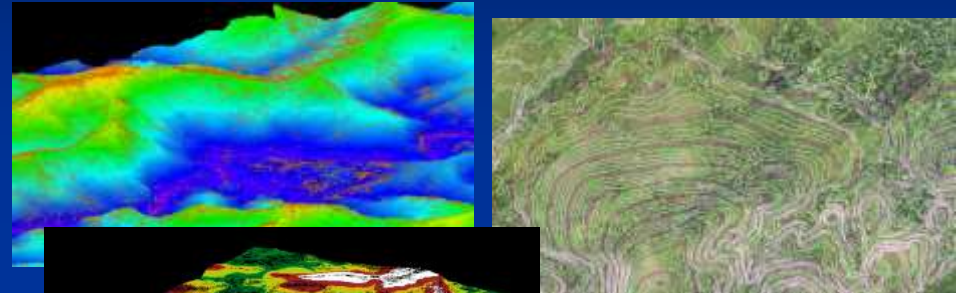
GROUND DATA SOLUTIONS R&D SDN BHD

Co. No-710842-H

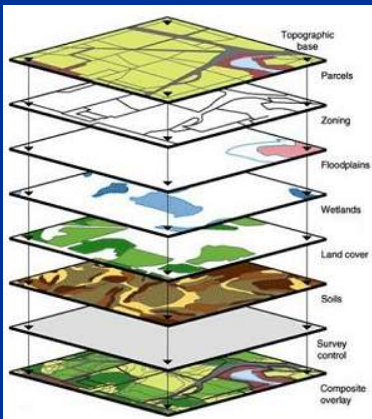
AIRBORNE LASER MAPPING



REMOTE SENSING



GEOGRAPHIC INFORMATION SYSTEM (GIS)



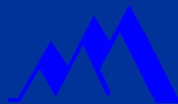
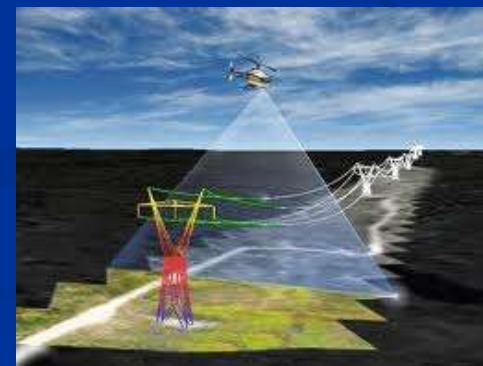
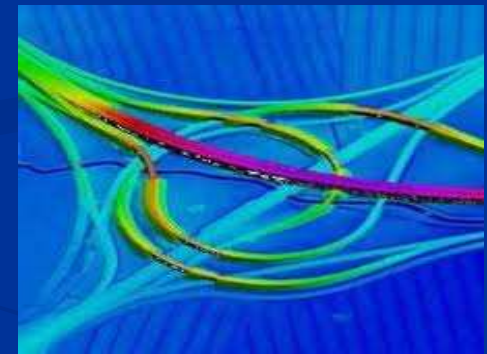
AIRBORNE LIDAR TECHNOLOGY FOR DISASTER MANAGEMENT

ENGINEERING SURVEY



PRESENTATION OVERVIEW

- WHO IS GDS
- GDS' MATRIX SURVEY SYSTEM
- NEWEST SENSORS
- BENEFITS OF GDS' MATRIX SURVEY SYSTEM
- APPLICATION OF GDS' MATRIX SURVEY SYSTEM
- DISASTER MANAGEMENT
 - LIDAR APPLICATIONS FOR DISASTER MANAGEMENT
- SLOPE MAPPING
 - GDS EXPERIENCE LIST IN SLOPE MAPPING
 - CASE STUDIES
 - DISCUSSION
 - ADVANTAGES OF LIDAR FOR SLOPE MAPPING
- FLOOD MAPPING
 - GDS EXPERIENCE LIST IN FLOOD MAPPING
 - CASE STUDIES
 - ADVANTAGES OF LIDAR FOR FLOOD MAPPING
- SOLUTION FOR LIDAR DATA MANAGEMENT
- CONCLUSIONS



TRUDY R. GANENDRA



- **MANAGING DIRECTOR - GROUND DATA SOLUTIONS R&D SDN BHD
PIONEERS IN THE FIELD WITH ONGOING R&D: BUILDS AND
OPERATES OWN LIDAR SURVEY SYSTEMS, UTILIZING THE
LATEST WAVEFORM LASERS AND SENSORS. PROVIDER OF
COMPLETE GEOMATICS AND ENGINEERING SOLUTIONS**
- **M.Eng., M.A. Hons (Cantab), MSc., DIC**
- **14 YEARS OF LIDAR EXPERIENCE WITH 80 PROJECTS COMPLETED**



WHO IS GDS ?

- 100% MALAYSIAN LIDAR SERVICE PROVIDER
- OVER 25 YEARS OF LIDAR EXPERIENCE
- OVER 100 SUCCESSFULLY COMPLETED PROJECTS WORLDWIDE
- PIONEER PROVIDER WHO OWN, BUILD AND OPERATE LIDAR SURVEY SYSTEMS
- ON GOING R&D UTILIZING THE LATEST WAVEFORM LASERS AND OTHER SENSORS
- DATA ACQUISITION AND PROCESSING PERFORMED LOCALLY
- CURRENTLY OPERATING 4 LIDAR SYSTEMS
- PROVIDE TOTAL GEOMATICS AND ENGINEERING SOLUTIONS
- PROVIDE HIGHEST LIDAR AND AERIAL PHOTGRAPHIC RESOLUTION IN SOUTHEAST ASIA
- MULTIMEDIA SUPER CORRIDOR (MSC) STATUS COMPANY
- RECEIVED ISO 9001:2008 CERTIFICATE



EVOLUTION OF GDS

1989

CONTRACTED SERVICES FROM CANADIAN TECHNOLOGY PROVIDER



1991

SET UP 51% MALAYSIAN, 49% CANADIAN JOINT VENTURE WITH EXCLUSIVE RIGHTS IN ASIA



1997

BOUGHT OVER 100% OF THE JOINT VENTURE COMPANY



2002

BOUGHT OVER 50% OF THE CANADIAN TECHNOLOGY PROVIDER



2008

SET-UP MULTIMEDIA SUPER CORRIDOR (MSC) COMPANY



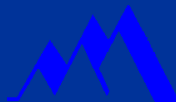
2012

RECEIVED ISO 9001:2008 CERTIFICATION

GDS' MATRIX SURVEY SYSTEM

GDS' MATRIX IS:-

- LATEST AIRBORNE LASER & IMAGERY SYSTEM, DEVELOPED BY MALAYSIAN & CANADIAN TECHNOLOGISTS
- UNIQUE MULTIPLE MOUNTING MAPPING SYSTEM – HELICOPTER AND FIXED WING ENABLED
- “HOT SWAPPABLE” SYSTEM :
 - 6 TYPES OF SCANNER (INCLUDING 4 WAVEFORM LASER)
 - 4 TYPES OF INERTIAL MEASUREMENT UNIT
 - 8 TYPES OF HIGH RESOLUTION CAMERAS
 - 2 TYPES OF HIGH DEFINITION VIDEO CAMERAS
 - 2 TYPES OF HIGH-ACCURACY ONBOARD GPS RECEIVERS



NEWEST SENSORS

RIEGL LMS-Q780 CAMERA

- Full waveform analysis for unlimited number of target echoes
- High laser pulse repetition rate up to 400 kHz
- High ranging accuracy 20 mm



PHASE ONE CAMERA

- Built to meet the exacting needs of aerial photography and streamline capture and processing
- Metric camera Phase One for detailed small and large scale mapping projects
- Camera resolution is up to 80 MP

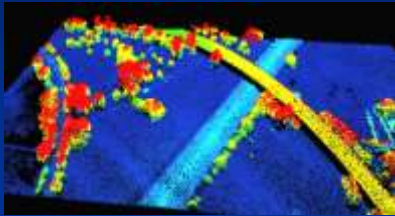


BENEFITS OF GDS' MATRIX SURVEY SYSTEM

- **DESIGNED, BUILT, OWNED AND OPERATED BY MALAYSIANS**
- **UTILIZED LATEST WAVEFORM LASER – UP TO 400,000 HZ**
- **SUCCESSFULLY COMPLETED OVER 100 PROJECTS WORLDWIDE**
- **ROBUST AGAINST WEATHER CONDITIONS, SUCH AS MONSOONS AND LOW LYING CLOUDS**
- **COST: VERY EFFECTIVE FOR MEDIUM TO LARGE MAPPING AREA/ CORRIDOR**
- **TIME: FAST DATA COLLECTION**
- **DISCRETION: NEGLIGIBLE IMPACT ON THE ENVIRONMENT AND NO LAND INTRUSION**
- **DIGITAL IMAGERY: CLOUD FREE IMAGERY: ALLOWS FOR IDENTIFICATION & CLASSIFICATION OF FEATURES & VEGETATION**
- **HIGH DENSITY AND ACCURATE DIGITAL PRODUCTS**



APPLICATIONS OF GDS' MATRIX SURVEY SYSTEM



ROAD SURVEY



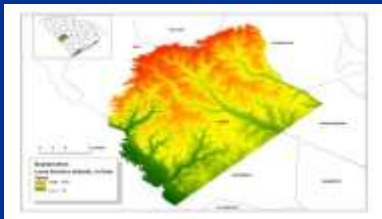
RAILWAY SURVEY



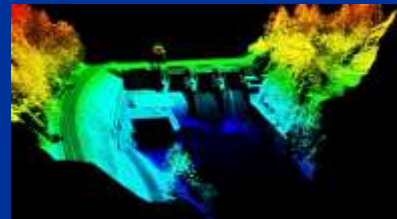
**TRANSMISSION
LINE SURVEY**



PIPELINE SURVEY



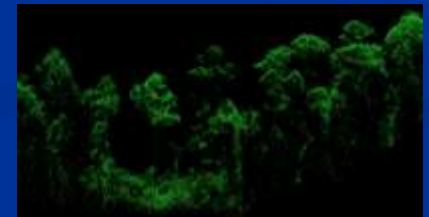
**WATER CATCHMENTS
SURVEY**



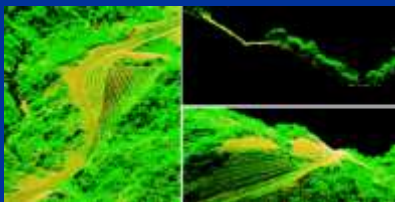
DAM SURVEY



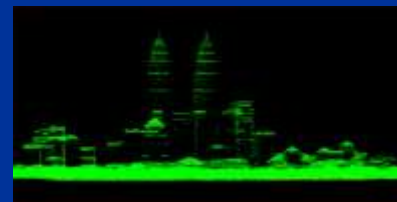
MINE SITE SURVEY



**FOREST/ AGRICULTURE
SURVEY**



**SLOPE STABILITY
SURVEY**



**TELECOMMUNICATION &
URBAN PLANNING**



FLOOD MAPPING



**COASTLINE
MANAGEMENT**

ADVANTAGES OF LIDAR FOR DISASTER MANAGEMENT

- MAXIMIZE ACCURACY AND DENSITY OF TOPOGRAPHICAL AND DIGITAL IMAGERY DATA
- MINIMIZE SURVEY TIME AND COST
- PLAN EFFICIENTLY FOR ANY ENVIRONMENTAL IMPACT
- PROVIDE ACCURATE INFORMATION FOR SLOPE STABILITY ANALYSIS
- AVOIDING LANDSLIDE AREA, CROSSING WATERCOURSES AND CONGESTED AREAS
- ENSURING ACCESS AT ALL POINT OF ROUTE
- FLY-THROUGH SIMULATIONS ON DTM'S PROVIDE A VISUALIZATION OF GROUND CONDITIONS AND HAZARDS THAT OCCUR ON TRAVEL ROUTE
- CAN SURVEY "NON-ACCESSIBLE" SITE SUCH AS SLOPES NEXT TO HIGH TRAFFIC ROADS
- SLOPE STABILITY ZONEITORY
- MORE PRECISE FLOOD PREDICTION AND MANAGEMENT
- DAM BREAK ANALYSIS
- OPTIMIZED FLOOD MITIGATION WORKS DESIGN
- MORE PRECISE EMERGENCY PLANNING RESPONSE & EVACUATION PLANNING
- MORE PRECISE INVENTORY OF WETLANDS AND WATER QUALITY
- MORE PRECISE DRAINAGE STUDIES OF SURFACE WATER AND WATER TREAT
- MAXIMIZES ACCURACY AND DENSITY OF TOPOGRAPHICAL AND DIGITAL IMAGERY DATA
- MOST COST EFFECTIVE DESIGN OF DAM, DAM VOLUME MEASUREMENT
- OPTIMIZES DAM INFRASTRUCTURE DESIGN INCLUDING ACCESS ROUTES
- SEDIMENTATION ANALYSIS



GDS EXPERIENCE LIST

GDS HAS SUCCESSFULLY COMPLETED

- 4 PROJECTS IN SLOPE MAPPING
- 10 PROJECTS IN DAM SURVEY
- 12 PROJECTS IN FLOOD MAPPING

- SPATIAL DATA ACQUISITION BY AIRBORNE LASER SCANNING AND GIS DATA INTEGRATION OF PRODUCING DIGITAL TERRAIN MODELLING AND SLOPE MAPS FOR IKRAM RESEARCH CENTRE
- EAST WEST HIGHWAY PROJECT FOR SLOPE STABILITY STUDY FOR JURUTERA PERUNDING ZAABA CONSULTING ENGINEERS
- AIRBORNE SURVEY AND MAPPING FOR STABILITY ASSESSMENT OF ROCK SLOPE ALONG JALAN DUTA EXPRESSWAY FOR PLUS EXPRESSWAY BERHAD
- RAWANG LANDFILL PROJECT FOR PROJECT MANAGEMENT CONSULTANT
- AIRBORNE LIDAR & DIGITAL IMAGERY SURVEY FOR SUNGAI SELUYUT
- DATA LASER SCANNING (LIDAR) AND DIGITAL IMAGE FOR 'KAJIAN PELAN INDUK SALIRAN MESRA ALAM' (MSMA) FOR TAWAU TOWN, SABAH
- MASTER PLAN STUDY OF KLUANG, JOHOR FOR JPS TEBATAN BANJIR
- DATA LASER SCANNING AND DIGITAL IMAGE FOR KAJIAN PELAN INDUK SALIRAN BANDAR SUNGAI BESI, KUALA LUMPUR AND SERI KEMBANGAN, SELANGOR
- PAPUA NEW GUINEA PROJECT - FLOOD STUDY ON RIVER TEDI (BHP)
- PEMBINA RIVER VALLEY, MANITOBA- LSI
- RIVER PROJECT- LSI
- WINNIPEG RIVER- LSI
- RAINY RIVER RESOURCES- LSI
- SMOKEY LAKE PROCESSING- LSI



CASE STUDY 1

PROPOSED HYDROPOWER DAM DEVELOPMENT PROJECT

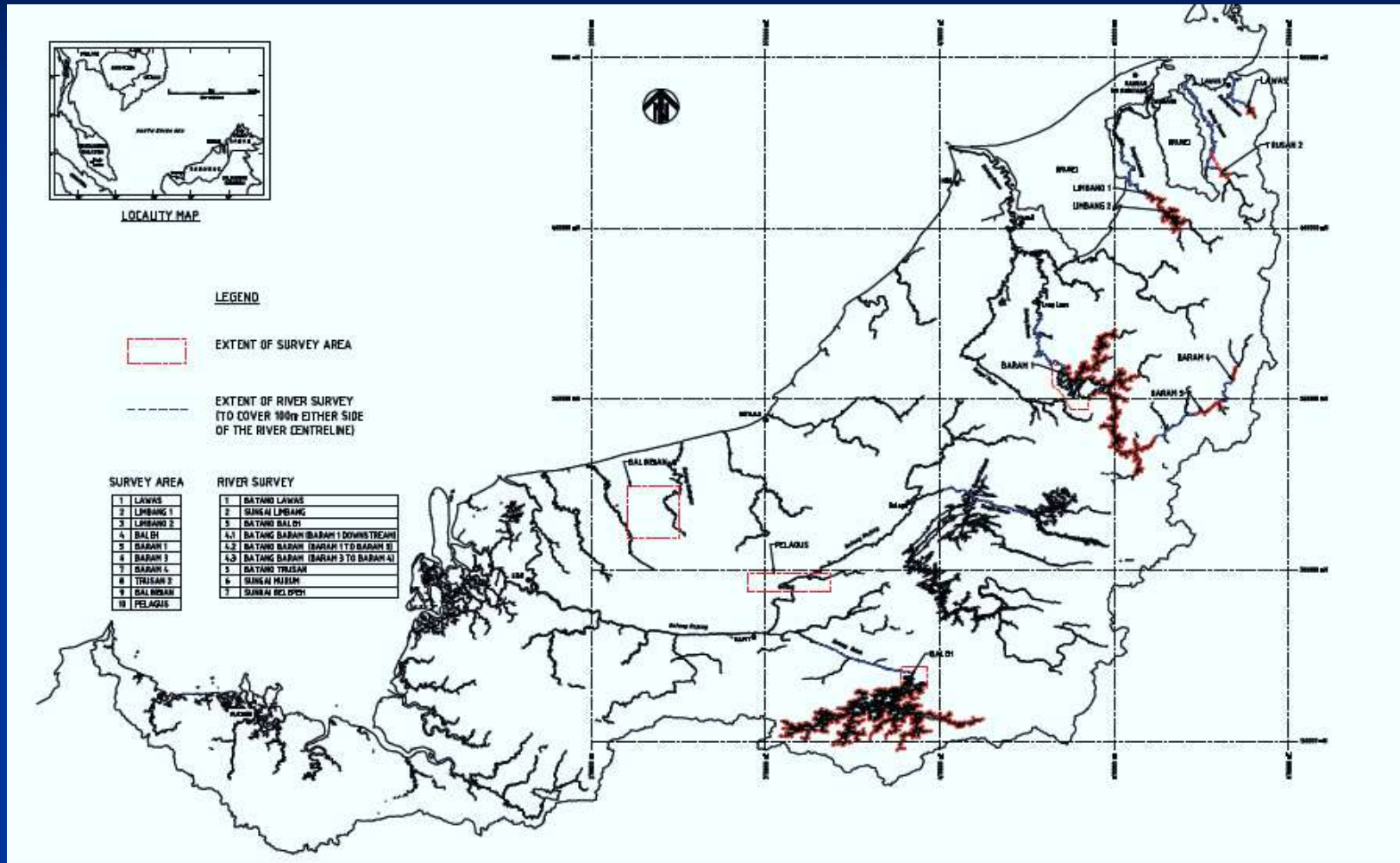
- 2014 PROJECT: LIDAR MAPPING AND AERIAL PHOTOGRAPHY FOR THE PROPOSED BELAGA AND LINAU HYDROPOWER PROJECTS, SARAWAK
- PROJECT AREA: 650 KM²
- GPS STATIC : 10 DAYS
- LIDAR DATA ACQUISITION : 10 DAYS
- DTM/DEM & CONTOUR DELIVERED: 4 WEEKS
- FINAL DELIVERABLES, WATER FLOW / DRAINAGE FLOW: 7 WEEKS

- LIDAR DENSITY :
 - BETWEEN 2,203,996 POINTS (2.20 POINTS / m²) AND > 18 MILLION POINTS (18.55 POINTS / m²) IN 1KM X 1KM
- LIDAR POINTS HITTING THE GROUND :
 - BETWEEN 48,357 POINTS (0.04 POINTS / m²) AND 1,074,977 POINTS (1.1 POINTS / m²) IN 1KM X 1KM
- AVERAGE POINTS SPACING FOR POINTS REACHING THE GROUND LEVEL :
 - BETWEEN 1.0m AND 5m



CASE STUDY 1

PROPOSED HYDROPOWER DAM DEVELOPMENT PROJECT



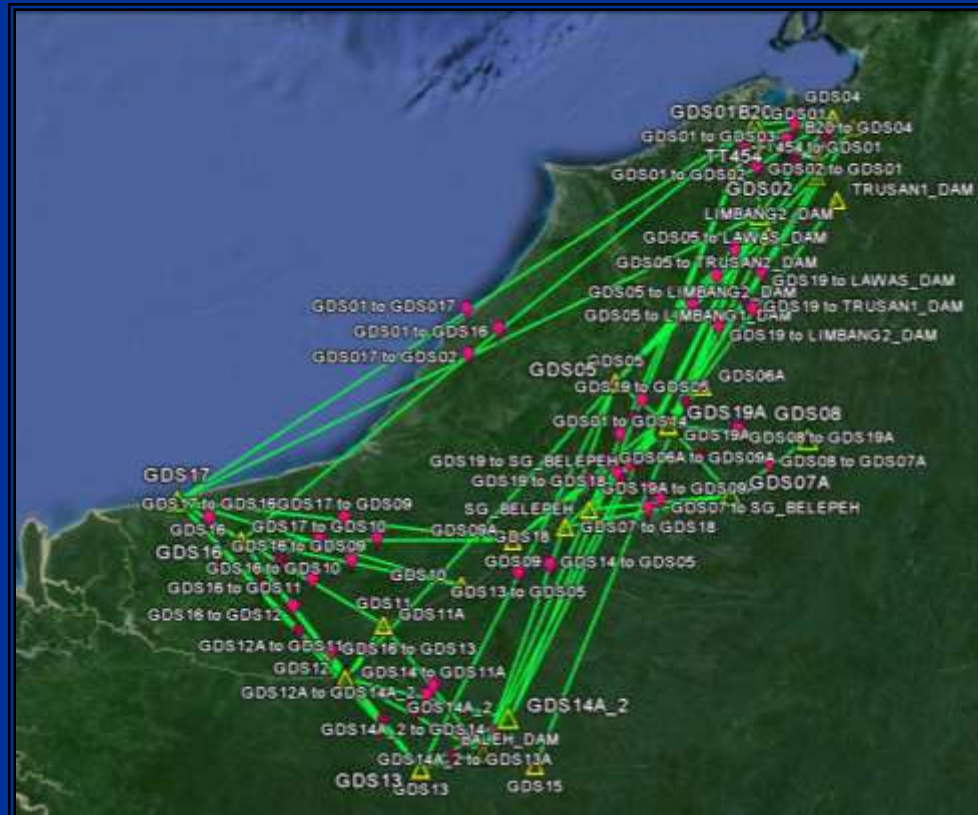
PROJECT AREA OF LIDAR MAPPING AND AERIAL PHOTOGRAPHY FOR PROPOSED HYDROPOWER DEVELOPMENT PROJECTS, SARAWAK



CASE STUDY 1

PROPOSED HYDROPOWER DAM DEVELOPMENT PROJECT

USE OF CONTINUOUSLY OPERATING REFERENCE STATION (CORS) AND LIDAR WAS INSTRUMENTAL IN ENSURING ACCURACY COULD BE MAINTAINED OVER LONG DISTANCES AND OVER SEVERAL YEARS



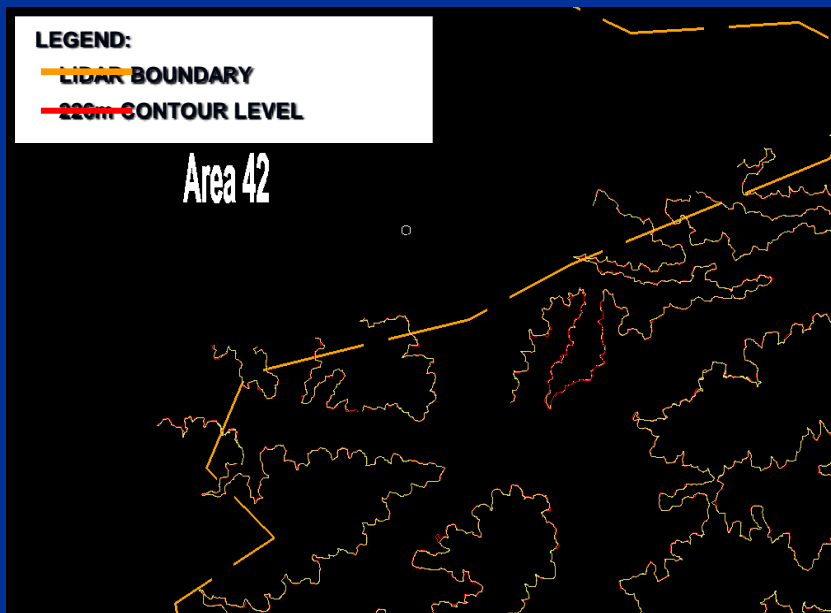
STATIC GPS NETWORK



CASE STUDY 1

PROPOSED HYDROPOWER DAM DEVELOPMENT PROJECT

LIDAR WAS SEEN TO CAPTURE DAM INUNDATION AREA MORE ACCURATELY THAN CONSERVATIVE ESTIMATES USING TOPOMAPS LIDAR THAT SHOWED MANY AREAS THAT WERE PRESUMED OUTSIDE THE DAM INUNDATION AREA, WOULD BE FLOODED, LEADING TO RE-EVALUATION OF LAND COMPENSATION ISSUES



ORIGINAL SURVEY BOUNDARY DERIVED FROM JUPEM TOPOMAP WHICH ESTIMATED THE DAM INUNDATION AREA

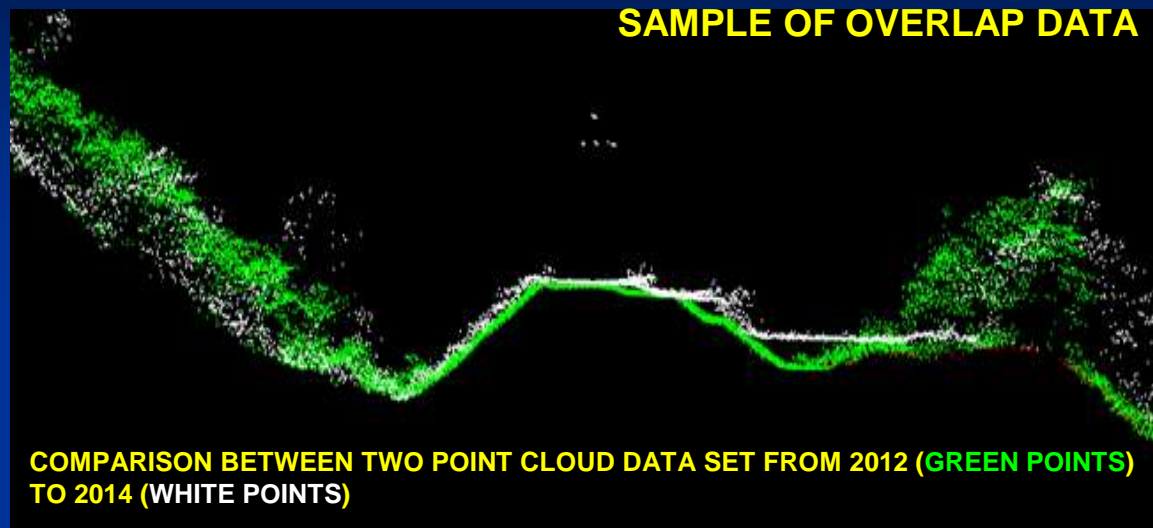


THE ACTUAL INUNDATION AREA CAPTURED BY LIDAR



CASE STUDY 1

SIGNIFICANT CHANGES IN TOPOGRAPHY WITHIN 2 YEARS WERE CAPTURED BY LIDAR



DUE TO SOME OVERLAPPING AREA FOR LIDAR SURVEYS IN 2012 AND 2014, THE OVERLAP AREAS PROVIDE USEFUL CHANGE DETECTION INFORMATION SUCH AS:

- CANOPY HEIGHT MODEL (CHM)
- SOIL EROSIONS
- MAN-MADE AND NATURAL TOPOGRAPHICAL CHANGES

CASE STUDY 1

CHANGES IN TOPOGRAPHY WITHIN 2 YEARS

PROFILE VIEW

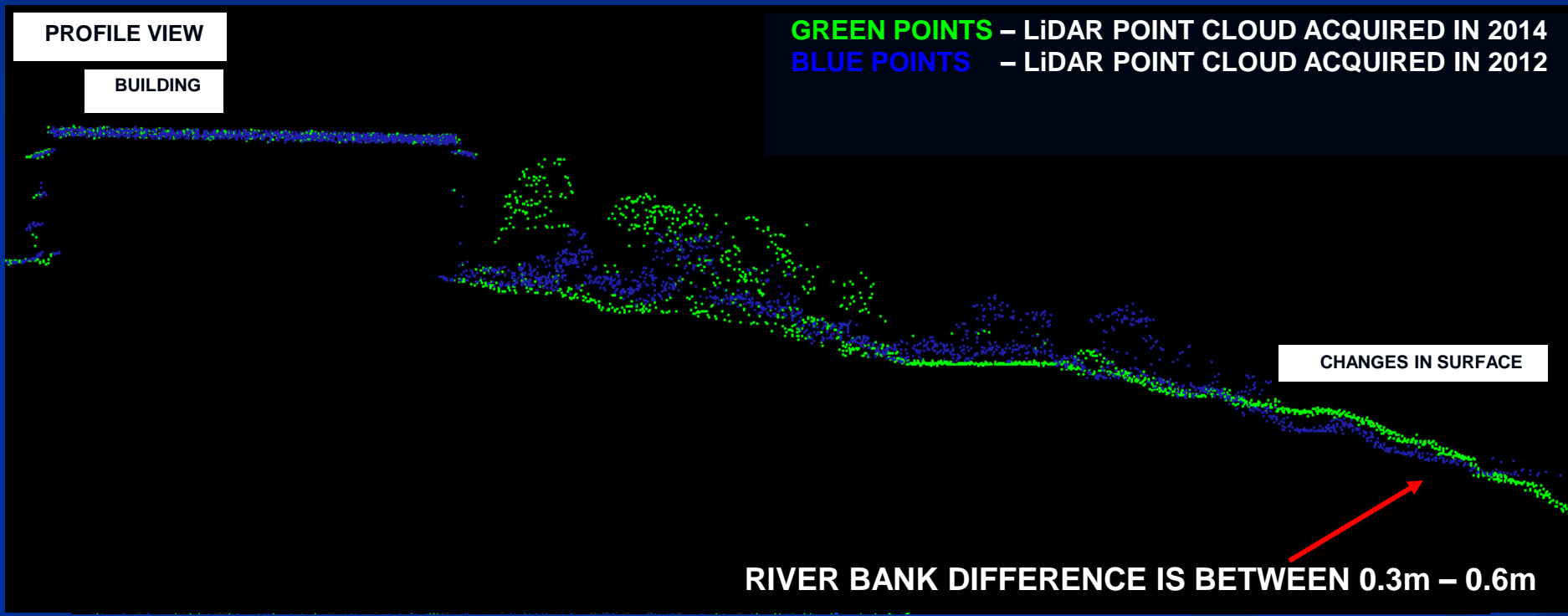
BUILDING

GREEN POINTS – LiDAR POINT CLOUD ACQUIRED IN 2014

BLUE POINTS – LiDAR POINT CLOUD ACQUIRED IN 2012

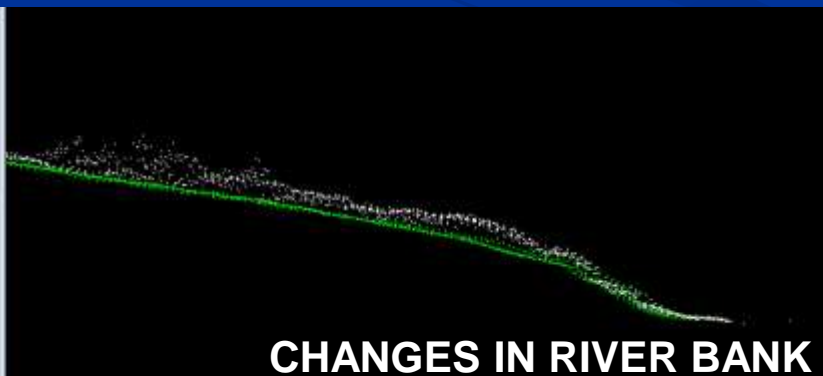
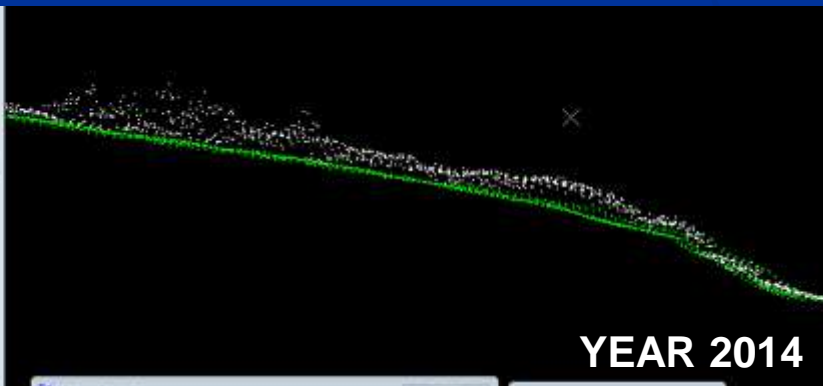
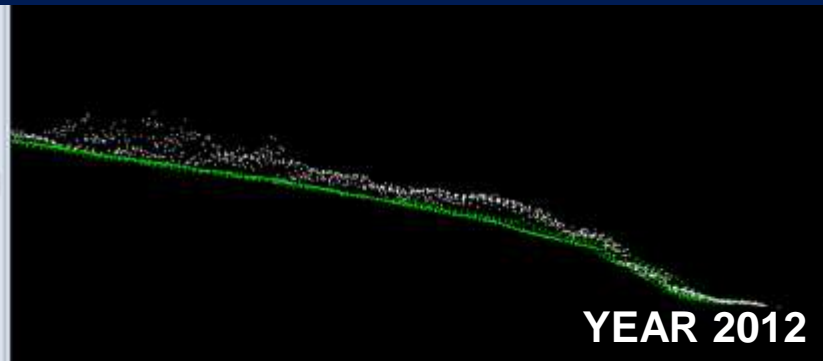
CHANGES IN SURFACE

RIVER BANK DIFFERENCE IS BETWEEN 0.3m – 0.6m



CASE STUDY 1

CHANGES IN TOPOGRAPHY WITHIN 2 YEARS



CASE STUDY 1

CHANGES IN TOPOGRAPHY WITHIN 2 YEARS

SAMPLE OF OVERLAP DATA

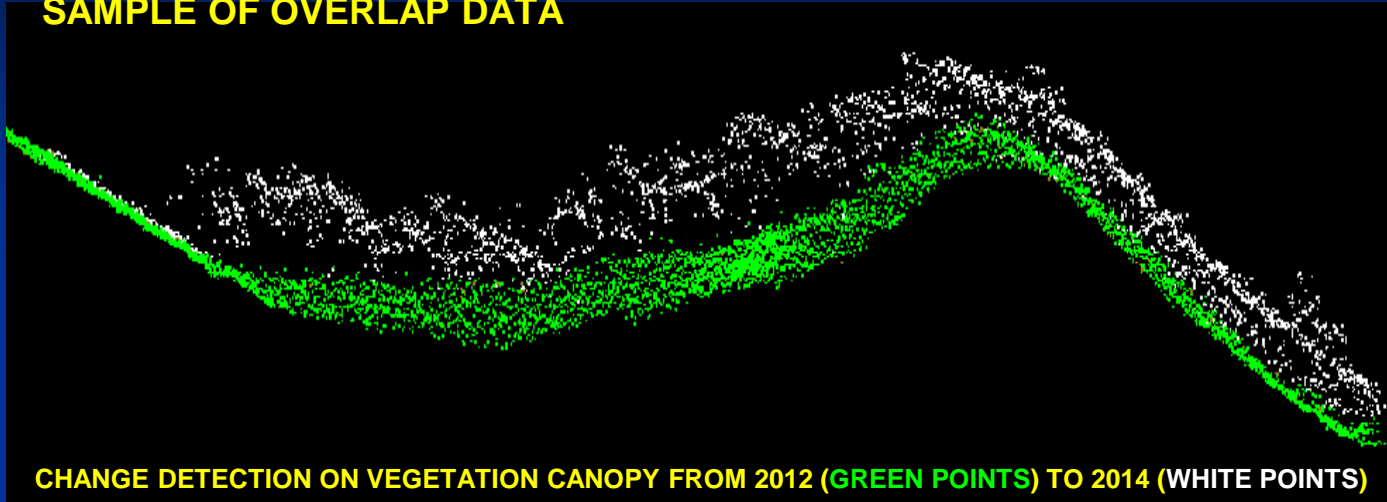


IMAGE CAPTURED IN 2012

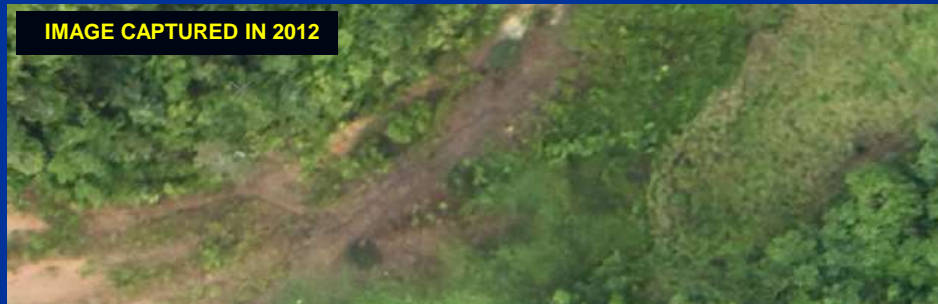
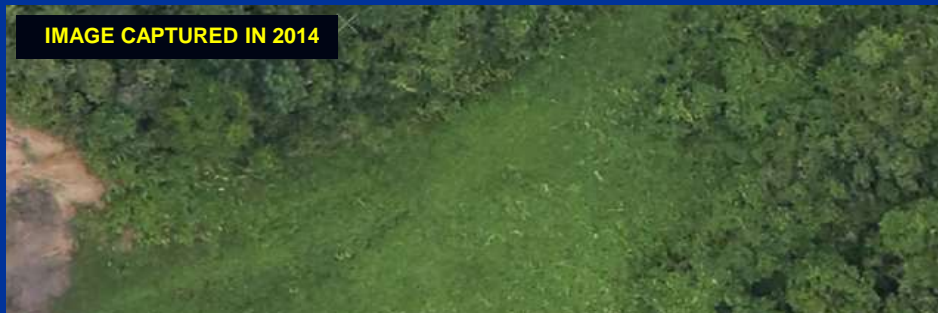


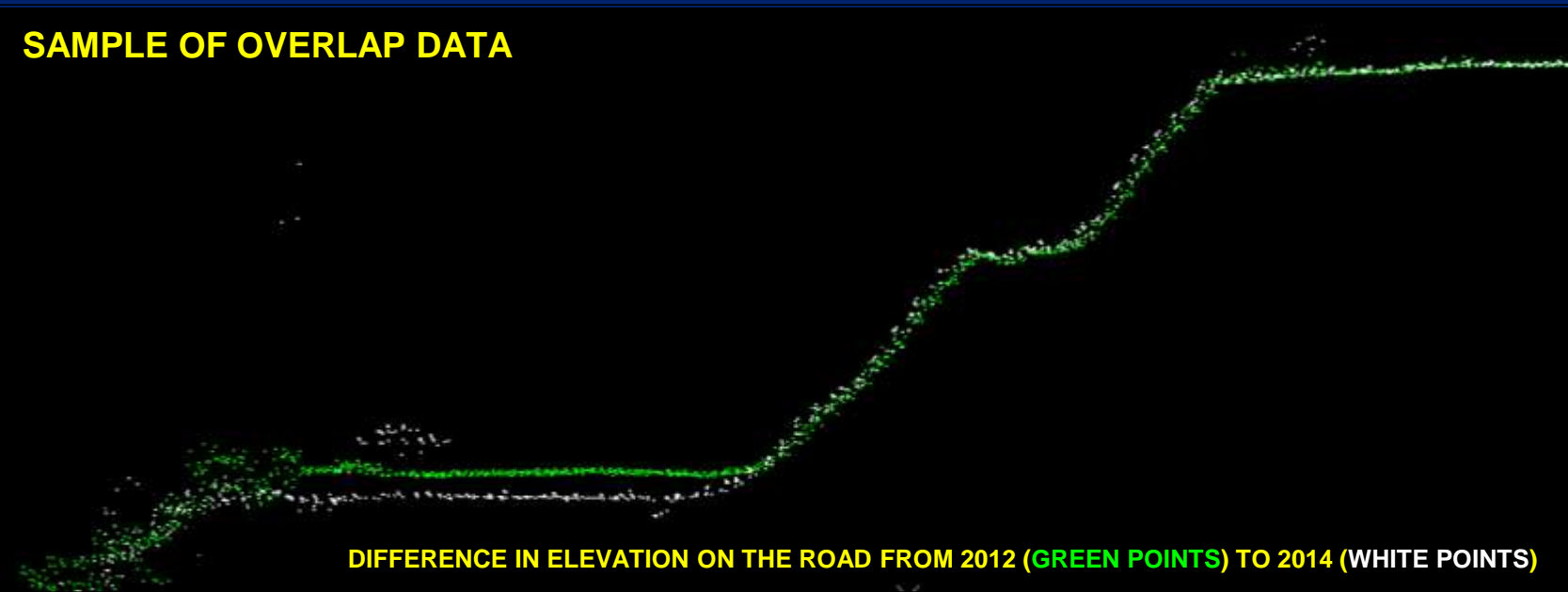
IMAGE CAPTURED IN 2014



CASE STUDY 1

CHANGES IN TOPOGRAPHY WITHIN 2 YEARS

SAMPLE OF OVERLAP DATA



DURING ROAD CONSTRUCTION (2012)



AFTER ROAD CONSTRUCTION (2014)



CASE STUDY 1

PROPOSED HYDROPOWER DAM DEVELOPMENT PROJECT

- VOLUME CALCULATIONS WERE PERFORMED USING TERRA MODELER, VIA THE “COMPUTE QUANTITY” TOOL
- THREE SAMPLES WERE TAKEN FROM THREE DIFFERENT LOCATIONS WITHIN THE PROJECT AREA, AND THE VOLUME CALCULATION WAS PERFORMED USING TERRA MODELER AND MANUALLY
- THE DIFFERENCE IN THE VOLUMES CALCULATED WERE 0.087%, 0.162%, AND 0.015% EACH, INDICATING THAT THE TERRA MODELER CALCULATION IS RELIABLE AND DEFINITELY MUCH FASTER

SOFTWARE	SAMPLE 1 (M3)	SAMPLE 2 (M3)	SAMPLE 3 (M3)
TERRA MODELLER	5,118,595.20	4,749,489.20	2,070,011.50
MANUAL VOLUME CALCULATION AFTER EXCLUDE THE SMALL HILLS	5,114,139.41	4,757,179.55	2,069,697.67
DIFFERENCE BETWEEN MANUAL CALCULATION AND TERRA MODELLER	4,455.79	7,690.35	313.83
DIFFERENCE % (ALL LESS THAN 1% DIFFERENCE)	0.087	0.162	0.015

CASE STUDY 2

SLOPE MAPPING

PROJECT NAME: SPATIAL DATA ACQUISITION BY AIRBORNE LASER SCANNING AND GIS DATA INTEGRATION OF PRODUCING DIGITAL TERRAIN MODELLING AND SLOPE MAPS IKRAM RESEARCH CENTRE

- **PROJECT AREA : 140 km X 1.5km**
 - 140 km FROM JALAN SIMPANG PULAI-KG RAJA LOJING-KG K BETIS
- **GPS STATIC - 5 DAYS**
- **AIRBORNE SURVEY – 24 DAYS**
- **DTM/DEM, GIS AND CONTOUR DELIVERED – 16 DAYS**
- **FINAL MAPPING, ORTHOPHOTO MOSAIC AND GIS**
- **DELIVERED – 37 DAYS**
- **LIDAR DENSITY**
 - MORE THAN 2 MILLION POINTS IN 1km x 1km (2 POINTS / m²)
- **LIDAR POINTS HITTING THE GROUND**
 - MORE THAN 200,000 POINTS IN 1km x 1km (0.2 POINTS / m²)
- **AVERAGE POINTS SPACING FOR POINTS REACHING THE GROUND LEVEL IS 2.2 m**

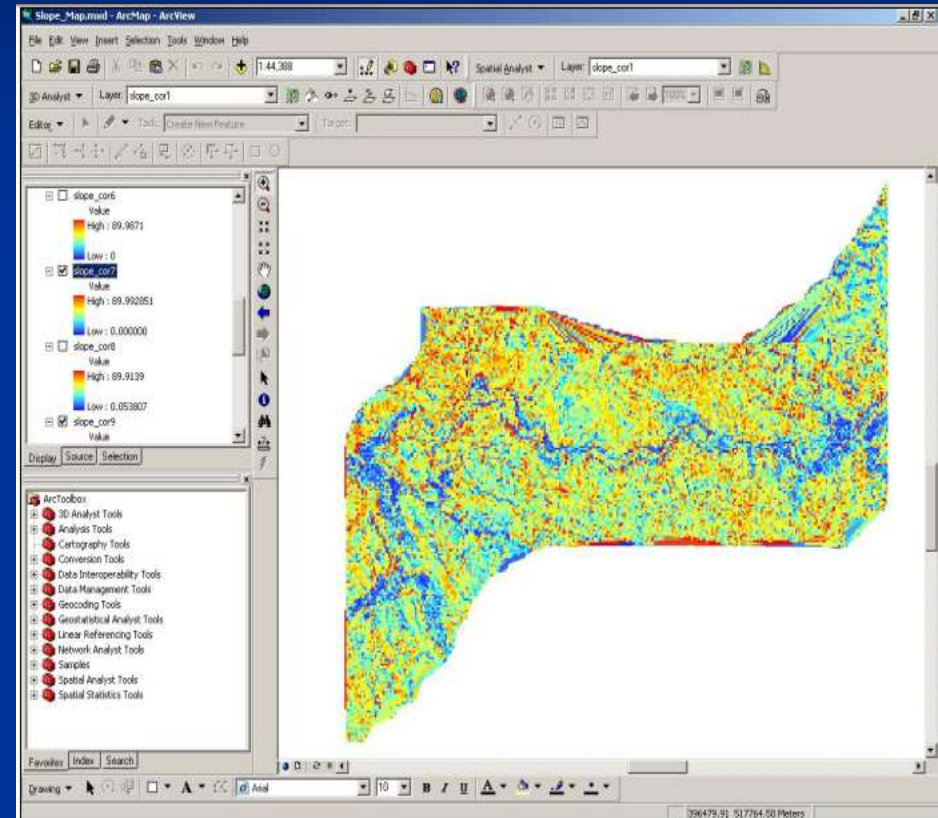


CASE STUDY 2

IKRAM AIRBORNE LIDAR SURVEY PROJECT FOR DTM AND SLOPE MAPS

•PROJECT SUCCESSFULLY USED LIDAR FOR SLOPE MAPPING WHICH IS ONE OF THE IMPORTANT FACTOR FOR IDENTIFYING POTENTIAL LANDSLIDE FOR THAT AREA.

•THE LIDAR AND IMAGERY DATA WAS USED TO CREATE A DATABASE FOR JKR'S SLOPE MONITORING SYSTEM.



SLOPE MAP



CASE STUDY 3

SLOPE MAPPING

- **PROJECT NAME : NORTH-SOUTH EXPRESSWAY (PLUS) – PROPOSED PRODUCTION OF AS BUILT-DRAWING, CONTOURS, LONGITUDINAL PROFILING & CROSS-SECTION PLANS, HYDRAULIC MODELING AND GIS SPATIAL DATA UPDATES USING LIGHT DETECTION AND RANGING SYSTEM (LIDAR) FOR NSE STRETCHES AT SECTION N1, N2 AND NORTHERN PART OF N5**
- **PROJECT AREA : 139.5KM X 1KM**
- **GPS STATIC - 10 DAYS**
- **AIRBORNE SURVEY – 8 DAYS**
- **DTM/DEM AND CONTOUR DELIVERED – 4 DAYS**
- **FINAL MAPPING, ORTHOPHOTO MOSAIC AND GIS DELIVERED – 25 DAYS**
- **LIDAR DENSITY**
 - **MORE THAN 2 MILLION POINTS IN 1km x 1km (2 POINTS / m²)**
- **LIDAR POINTS HITTING THE GROUND**
 - **MORE THAN 200,000 POINTS IN 1km x 1km (0.2 POINTS / m²)**
- **AVERAGE POINTS SPACING FOR POINTS REACHING THE GROUND LEVEL IS 2.2**
- **GIS DATABASE BASED ON TEMAN SYSTEM**
- **FLOOD SIMULATION**

CASE STUDY 3

NORTH-SOUTH EXPRESSWAY (PLUS) LIDAR SURVEY PROJECT

- PRODUCED AN ACCURATE DIGITAL TERRAIN MODEL (DTM), ORTHOPHOTO MOSAIC AND DIGITIZED FEATURES OF THE PROJECT AREA.
- THE ATTRIBUTES DATA FOR ALL THE DIGITIZED FEATURES WAS UPDATED INTO THE GEODATABASE BASED ON TEMAN (TOTAL EXPRESSWAY MAINTENANCE MANAGEMENT SYSTEM) NETWORK REFERENCING SYSTEM WITHOUT RESORTING TO THIRD PARTY DATABASE APPLICATIONS.
- HYDROLOGICAL MODEL IN ARCGIS SOFTWARE WAS USED FOR FLOOD MAPPING AND ANALYSIS



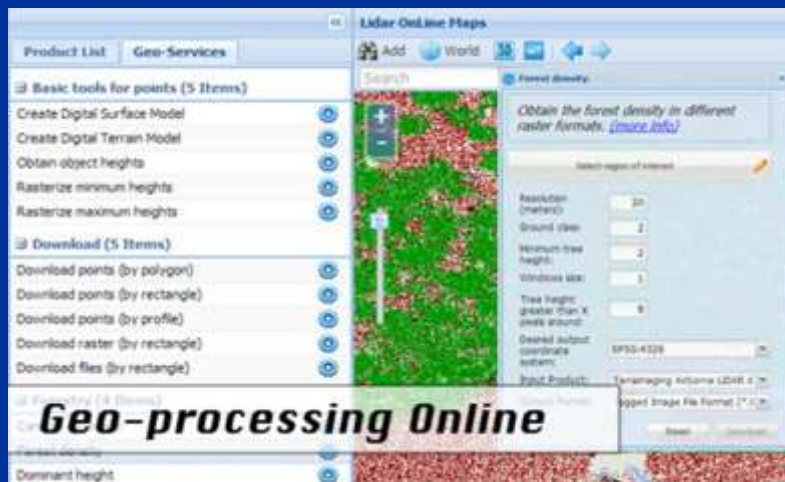
DIELMO SERVER TECHNOLOGY

DIELMO SERVER TECHNOLOGY IS A NEW LIDAR SERVER TECHNOLOGY THAT SUPPORTS:

- **HOSTING UNLIMITED DATA OF LIDAR DATA, GIS, RASTER, VECTOR, AND FILES INFORMATION (DOCUMENTS, PDF , TXT, etc.)**
- **ONLINE LIDAR POINT CLOUD VISUALIZATION IN 2D & 3D**
- **HOST AND SERVE GEOLOCATED FILES (2D MAP)**
- **REMOTE ACCESS FROM ANY WEB BROWSER, MAP VIEWER, GIS CLIENT OR MOBILE DEVICES (OPTIONAL) AT AN INCREDIBLE PERFORMANCE**
- **SECURED DATA SHARING FOR YOUR COMPANY, YOUR CLIENTS OR PROJECTS**
- **TECHNICAL SUPPORT & ONLINE ASSISTANCE**
- **YEARLY ASSISTANCE TO UPDATE THE WEB PORTAL**

LiDAR server- Cloud and Web services for LiDAR

THIS WEB PLATFORM, ALLOWS USERS TO FIND AND VIEW LIDAR POINT CLOUDS IN 3D ONLINE WORLDWIDE WITH NO SPECIALIZED SOFTWARE OR KNOWLEDGE, CREATE PROFILES OF THE DATA ALLOWING MEASUREMENT, EDITING, CLASSIFICATION AND DOWNLOADING AS LAS, CAD AND GIS FORMATS.



- ADD LIDAR/GIS TO YOUR DOCUMENTS.
- MULTIPLE FORMATS (KMZ, SHP...)
- 3D POINT CLOUD DISPLAY ON STREAMING
- DISTANCES MEASUREMENT
- ALGORITHMS AND GEO-SERVICES ONLINE (DTM GENERATION, FORESTRY, ETC)
- ADD HIGH RESOLUTION IMAGERY
- NO NEED FOR GIS SOFTWARE

DIELMO GEO SERVICES

IN GENERAL :

◦EXPORT

- **INPUT PRODUCT(SELECT THE INPUT LAYER TO RUN THE GEO-SERVICE TO OBTAIN THE RESULT)**
- **DESIRED OUTPUT COORDINATE SYSTEM (COORDINATE SYSTEM DESIRED FOR THE RESULT)**
- **RESOLUTION (OUTPUT RESOLUTION IN METERS)**
- **OUTPUT FORMAT(DESIRED FORMAT FOR THE RESULT).**

◦ONLINE DEM and DSM GENERATION

◦ONLINE ALGORITHMS

◦BASIC TOOLS FOR POINT

■ EDITION

- **GROUND CLASS (CLASS NUMBER IN THE LAS FILE ASSIGNED TO THE GROUND)**

■ MEASUREMENT (HEIGHT & DISTANCE)

◦FORESTRY

- **CANOPY COVERAGE**
- **FOREST DENSITY**
- **DOMINATE HEIGHT**

◦MORPHOLOGY

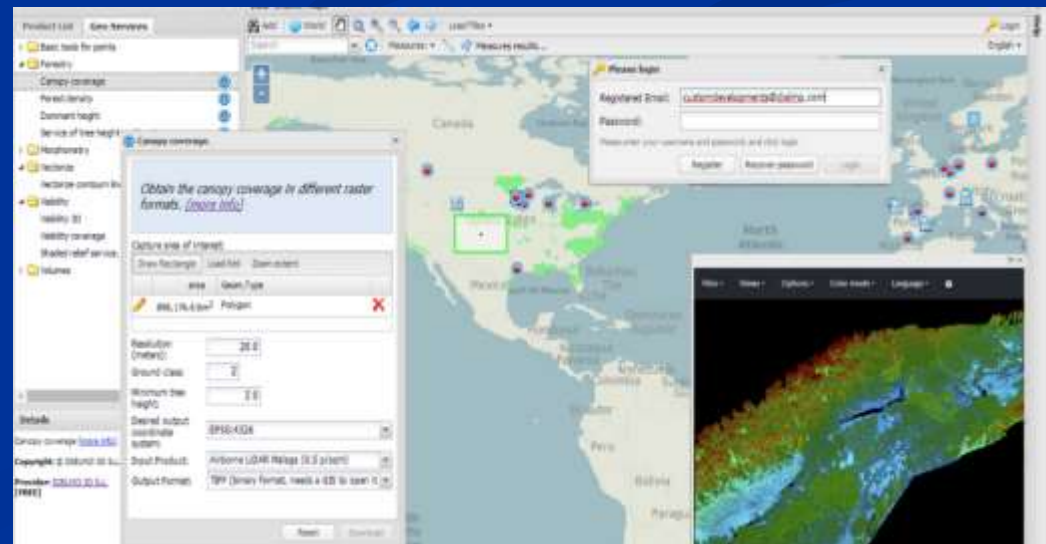
◦VECTORIZE

◦VISIBILITY

- **VISIBILITY 3D**
- **VISIBILITY COVERAGE**

◦VOLUME CALCULATION

◦CUSTOMIZED TOOLS



CONCLUSION

GDS HAS COMPLETED OVER 26 PROJECTS FOR DISASTER MANAGEMENT INDUSTRIES, ENABLING ITS CLIENTS TO ACHIEVE THE MOST COST EFFECTIVE AND SAFEST ANALYSIS, DESIGN, MONITORING AND MANAGEMENT OF POTENTIAL AND ACTUAL DISASTERS THROUGH THE APPLICATION OF AIRBORNE LIDAR AND LEADING SOFTWARE SOLUTIONS IN THOSE INDUSTRIES



THANK YOU



BY
GROUND DATA SOLUTIONS R&D SDN BHD

