Boskalis Cambridge Gulf Marine Sand Proposal s38 Referral WA EP Act

Referral Report No. 2 - *Proposal Setting & Existing Environment Descriptions*

ANNEX 10 - AERIAL DRONE LIDAR REPORT - Boskalis Cambridge Gulf.

NOTE: This PDF has interactive features – to use these please open in Adobe Acrobat Reader.

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CAMBRIDGE GULF COASTAL BEACH SURVEY

SENS0388 - NW COASTAL LIDAR SURVEY

Client: **Boskalis**

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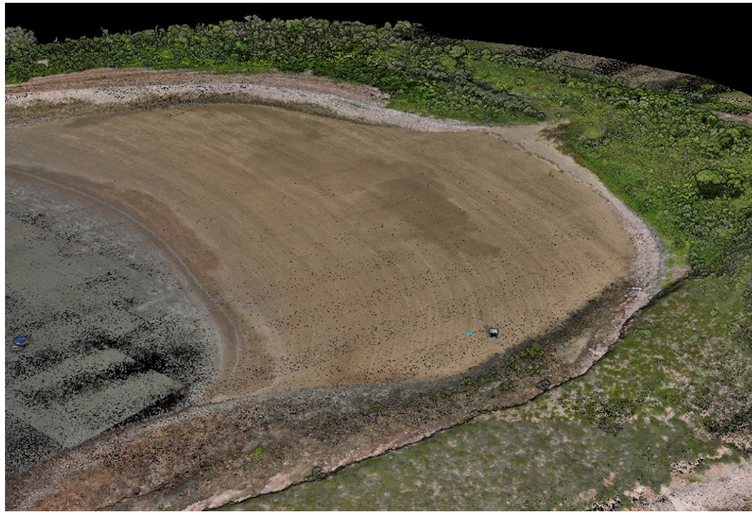
GENERAL PROJECT INFORMATION

Between 22/02/24 – 25/02/24, Sensorem conducted two types of survey, in the form of LiDAR and Photogrammetry, on renowned turtle nesting beaches around the Cambridge Gulf. Data was captured using the DJI Matrice 300 RTK with the Zenmuse L2 payload installed, and flown with RTK corrections for high accuracy.

Between 27/02/24 – 29-02-24, photography and videography was completed on intertidal areas around the Cambridge Gulf.

Orthomosaic of Turtle Bay

Image of Turtle Bay



LiDAR Point Cloud of Turtle Bay

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SURVEY LOCATIONS

The surveys were conducted on 4 beaches around the Cambridge Gulf, renowned for turtle nesting. These beaches were located on Cape Domett, Lacrosse Island and Cape Dussejour.

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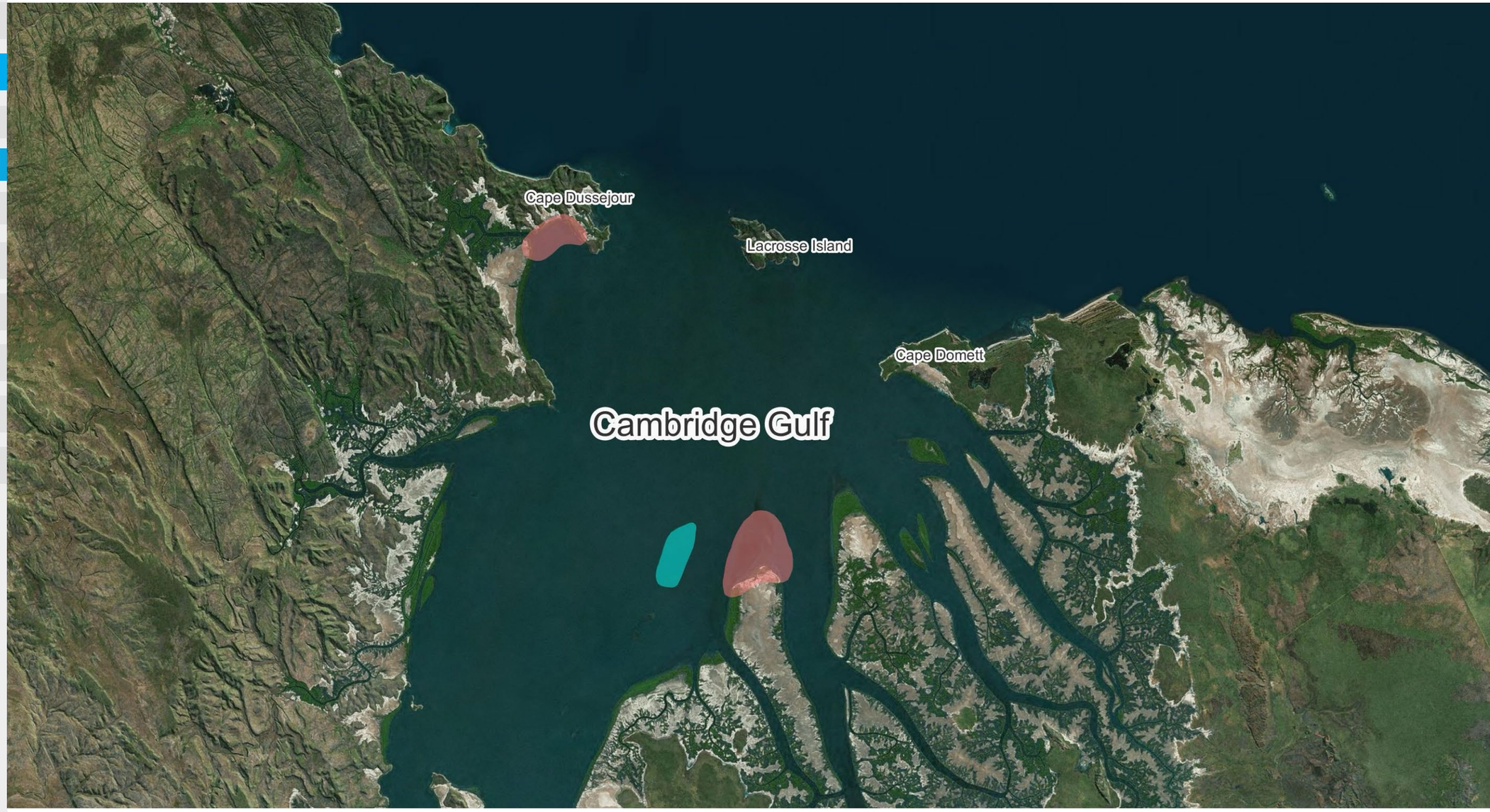
MEDIA CAPTURE LOCATIONS

Media was captured over intertidal areas around the Cambridge Gulf.

Videography Photography



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MEDIA CAPTURE LOCATIONS

Panorama

Hover over for 360°

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SURVEY EQUIPMENT

UNMANNED AERIAL SYSTEM (UAS)

The unmanned aerial system (UAS) used to conduct this survey was the DJI Matrice 300 RTK Drone.
The DJI Zenmuse L2 was used for the photogrammetry and LiDAR survey.

DJI Matrice 300 RTK UAS

- Dimensions: Unfolded, propellers excluded, 810×670×430 mm (L×W×H). Folded, propellers included, 430×420×430 mm (L×W×H)
- Diagonal Wheelbase: 895 mm
- Weight (with single downward gimbal): Approx. 3.6 kg (without batteries). Approx. 6.3 kg (with two TB60 batteries)
- Max Payload: 2.7 kg
- Max Take-off Weight: 9 kg
- Operating Frequency: 2.4000-2.4835 GHz. 5.725-5.850 GHz
- GNSS: GPS, GLONASS, BeiDou, Galileo

DJI Zenmuse L2

Photogrammetry

- Sensor: 4/3 CMOS
- Effective Pixels: 20MP
- Pixel size: 3.3 x 3.3 µm

LiDAR

- Laser class: 1
- Laser Wavelength: 905 nm
- Ranging Accuracy (RMS 1): 2cm @ 150m
- Scan Rate: Single return max 240,000 pts/s, multiple returns max 1,200,000 pts/s
- Field of view: Repetitive scanning pattern 70˚ horizontal, 3˚ vertical

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SURVEY EQUIPMENT

GNSS RECEIVERS

The DJI Matrice 300 RTK Drone was supported by the DJI D-RTK 2 base station system. Ground control was established using the Emlid Reach RS2+ GNSS Receiver

DJI D-RTK 2

- GNSS: GPS+GLONASS+BeiDou+Galileo
- Horizontal RTK positioning accuracy: 1 cm+ 1 ppm (RMS)
- Vertical RTK positioning accuracy: 2 cm+ 1 ppm (RMS)
- Positioning Update Rate: 1 Hz, 2 Hz, 5 Hz, 10 Hz and 20 Hz

Trimble R12 GNSS System

- Positioning performance: Horizontal 2cm RMS. Vertical 5 cm RMS
- GNSS constellations: GPS, GLONASS, BeiDou, Galileo, SBAS, QZSS, NavIC, L-band
- Survey Network: Trimble RTX

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PERSONNEL

OPERATORS TEAM

Cooper Smart Project Manager

Anthony Wu Data Analyst / Report Writer

FIELD OPERATORS

Fred Turley Remote Drone Pilot / Surveyor

Anthony Wu Remote Drone Pilot / Surveyor

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SURVEY METHODS

SURVEY SETUP

At each beach, two known points were surveyed with the Trimble R12 GNSS Receiver. One point was used to set up the D-RTK 2 base station, where RTK corrections would be sent to the DJI M300, so that data was captured to high accuracy. The other point was used as a checkpoint to verify the accuracy of the captured data during processing.

The co-ordinate projection used was GDA2020 MGA Zone 52 and vertical datum AHD71 height.

Area	ID	Type	Easting	Northing	Elevation
			GDA2020 MGA Zone 52		AHD71
Area 1A	SENS-1A	Base Station	433351.260	8361312.314	2.983
	GCP-1A	Checkpoint	433342.645	8361298.064	2.988
Area 1	SENS-1	Base Station	436545.307	8363620.091	2.731
	GCP-1	Checkpoint	436528.294	8363609.877	2.847
Area 2	SENS-2	Base Station	424475.384	8369680.210	0.032
	GCP-2	Checkpoint	424486.519	8369685.056	0.149
Area 3	SENS-3	Base Station	412159.326	8373081.953	0.941
	GCP-3	Checkpoint	412141.084	8373083.371	0.878

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SURVEY METHODS

LIDAR & PHOTOGRAMMETRY SURVEY

The DJI Matrice 300 RTK UAS with the DJI Zenmuse L2 were used to carry out both the LiDAR and photogrammetry survey. Data was captured during low tide to maximise the survey of the beach's surface.

The surveys were conducted with the following specifications:

Location	Area 1A	Area 1	Area 2	Area 3
GSD	1.88 cm/pixel	1.88 cm/pixel	1.88 cm/pixel	1.88 cm/pixel
Point Cloud Density	887 point / m^2	301 point / m^2	887 point / m^2	301 point / m^2
Route Alt	70m	70m	70m	70m
Speed	7 m/s	7 m/s	7 m/s	7 m/s
Side Overlap (LiDAR)	70%	50%	70%	50%
Side Overlap (Visible)	76%	61%	76%	61%
Forward Overlap (Visible)	75%	75%	75%	75%
Margin	30 m	30 m	30 m	30 m
Area	0.19 km^2	0.65 km^2	0.16 km^2	1.14 km^2

Site team at Cape Domett Small Beach

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DATA PROCESSING

AERIAL PHOTOGRAMMETRY

All geo-referenced aerial images were imported to **Pix4Dmapper**. This software identifies common details between the images, to produce an orthomosaic

Location	Area 1A	Area 1	Area 2	Area 3
Images	Median of 56140 keypoints per image	Median of 104954 keypoints per image	Median of 71523 keypoints per image	Median of 61214 keypoints per image
Dataset	1027 out of 1111 images calibrated (92%).	1658 out of 1672 images calibrated (99%).	608 out of 686 images calibrated (88%).	2475 out of 2774 images calibrated (89%).
Camera Optimisation	2.86% relative difference between initial and optimised internal camera parameters.	8.02% relative difference between initial and optimised internal camera parameters.	3.23% relative difference between initial and optimised internal camera parameters.	2.51% relative difference between initial and optimised internal camera parameters.
Matching	Median of 2805.22 matches per calibrated image	Median of 2663.75 matches per calibrated image	Median of 8954.97 matches per calibrated image	Median of 10545.6 matches per calibrated image
Average Ground Sampling Distance (GSD)	1.99 cm	1.93 cm	1.91 cm	1.95 cm
Area Covered	0.22 km^2	0.56 km^2	0.18 km^2	1.21 km^2

1 of 2475 images used to create the orthomosaic at Cape Dussejour beach

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DATA PROCESSING

LIDAR MODELLING

The raw data from the LiDAR unit was processed in DJI Terra software. This software takes satellite observations from our survey base station to georeference, adjust and refine the LiDAR measurements to produce a complete point cloud of the survey area. The exported LAS files from Terra are then brought into Blue Marble Geographics' Global Mapper for further refinement. The steps take in Global Mapper include constraining the model to our surveyed ground control points and point cloud classification where the software can automatically extract feature such as ground, vegetation, and water. These classifications can be selected to generate models such as digital terrain models (DTM) and digital surface models (DSM).

Location	Area 1A	Area 1	Area 2	Area 3
Initial number of LiDAR points	607,058,046	774,618,740	345,446,924	1,354,216,200
Ground LiDAR points after spatial thinning	1,142,905	2,815,230	926,532	13,469,237
Point cloud density (samples/m^2)	54	34	27	18
Georeferencing	RTK with surveyed checkpoint	RTK with surveyed checkpoint	RTK with surveyed checkpoint	RTK with surveyed checkpoint
Minimum/ Maximum elevation	-2.91m/24.69m	-3.26m/48.75m	-3.30m/27.93m	-4.69m/41.32
Area Covered	0.22 km^2	0.56 km^2	0.18 km^2	1.21 km^2
Projected Description	MGA/GDA2020/ meters. AHD	MGA/GDA2020/ meters. AHD	MGA/GDA2020/ meters. AHD	MGA/GDA2020/ meters. AHD

Point Cloud model of Cape Dussejour beach

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DELIVERABLES

DTM AND DSM

The geotiff models have been generated at a spatial resolution of 0.05m with a Bit Depth of 32.

LIDAR POINT CLOUD

The point cloud has been exported as a XYZ ascii file with a 0.5m horizontal and 0.25m vertical spatial resolution.

ORTHOMOSAIC IMAGERY

The aerial imagery is exported as full resolution (approximately 2cm). The compete image for each site is available in a TIFF and a tiled JPG has been provided for quick access.

INTERTIDAL MEDIA

Video footage has been filmed with a 5.1K: 5120×2700@50fps camera and still images with a 20MP 4/3 CMOS sensor. All media includes relevant metadata and GPX positioning data.

Through our partnership with Skand, Sensorem also provides a cloud-based software platform for data hosting and viewing of a range of data formats. For this project we have provided an example dataset of our deliverables of Turtle Bay on Lacrosse Island. Please note the data on SKAND will be available for 3 months from 04/04/2024. To organise an extension, contact info@sensorem.com.au.

Models can be viewed on the platform

Turtle tracks at Cape Domett Seaward Beach