TELLUS AIRBORNE GEOPHYSICAL SURVEY

DATA RELEASE

BLOCK A5 (LIMERICK)

15 October 2019

1. BLOCK A5 SURVEY DETAILS

Airborne survey operations over the Tellus A5 (Limerick) Block commenced on 21st August 2018 and were completed on 29th March 2019. The locality of the completed A5 block is shown in Figure 1 and, together with all previously completed data blocks, in Figure 2.

A total of 25,577 line-km of data were acquired in Block A5, covering a total area of 4,649 km^2.

With the completion of Block A5, a total area of 45,035 km^2 has been covered across the Republic of Ireland (although this area does include regions of overlap between neighbouring blocks, and off-shore areas).

The survey technical specifications are listed in Table 1.

Survey specification highlights are:

1) Three geophysical data types collected:

- Magnetics (single sensor: total magnetic intensity).
- Gamma-ray spectrometer (total-count and potassium, equivalent uranium and equivalent thorium concentrations).
- Frequency domain electromagnetics (four-frequencies: 912, 3005, 11962 and 24510 Hz, in-phase and quadrature EM responses and resistivity transforms).

2) Flight-line spacing: 200 m.

3) Flight altitude (ground clearance): nominal 60 m, increasing to 214 m over sensitive areas (e.g., livestock farms) and 305 m over larger population centres.

4) Along-line measurement spacing: nominal 6 m (for magnetics and electromagnetics) and nominal 60 m (for gamma-ray spectrometer).
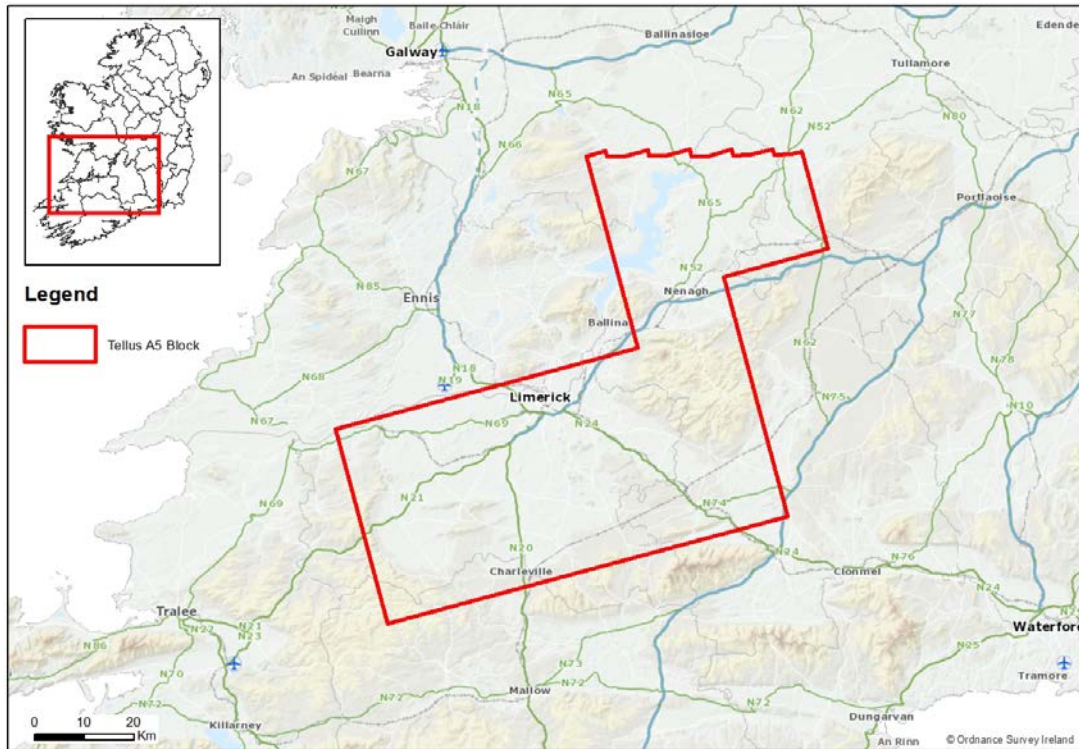
Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

An Roinn Cumarsáide, Gníomhaithe ar son na hAeráide agus Comhshaoil
Department of Communications, Climate Action & Environment

Figure 1. Locality of the Tellus A5 (Limerick) Block. Area of coverage of Block A5 is 4,649 km^2.
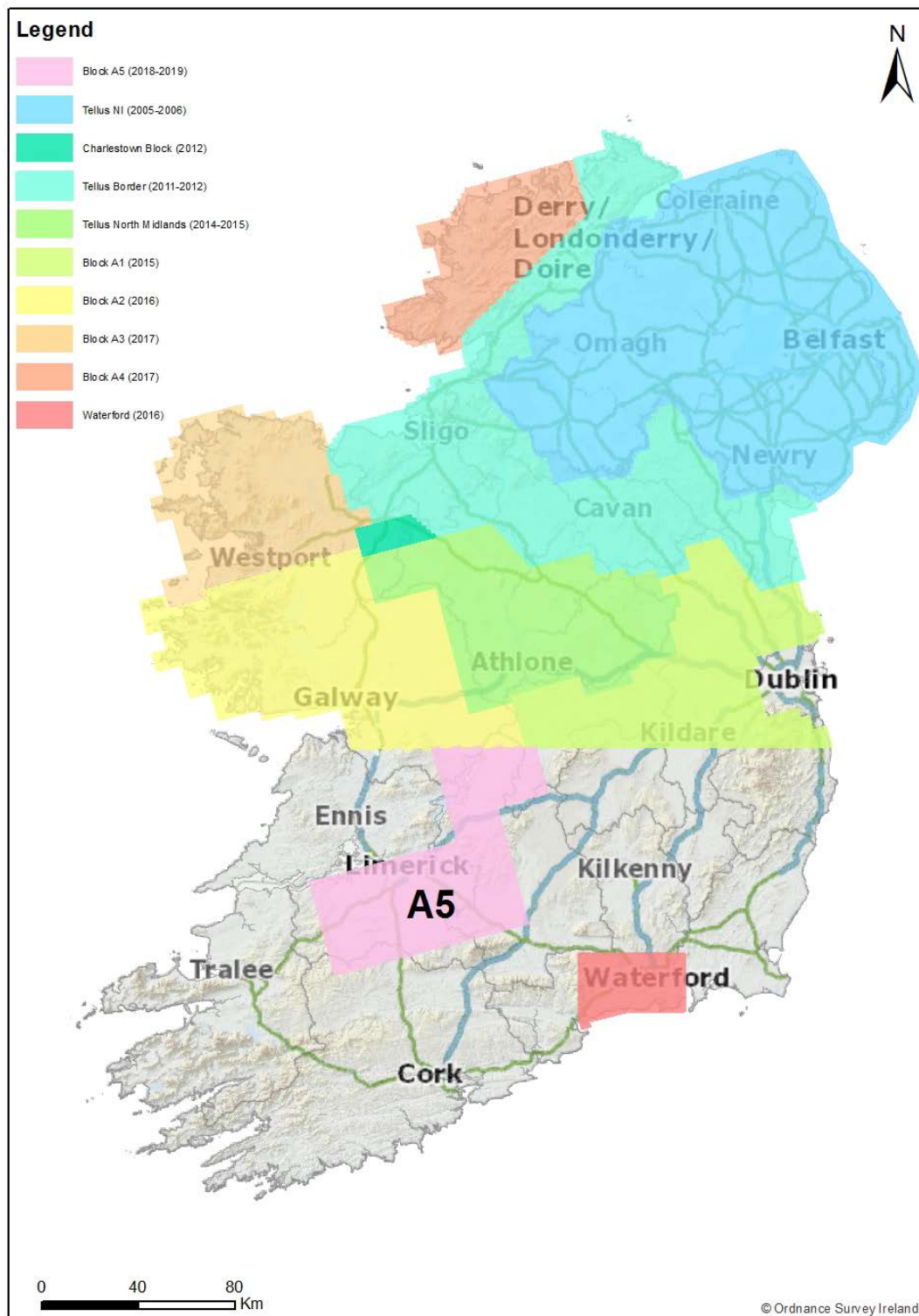
Figure 2. Locality of the Tellus A5 (Limerick) Block, shown with all previously completed data blocks, both in the Ireland and Northern Ireland. The total area of coverage within Ireland (Republic) is 45,035 km^2, including regions of overlap between neighbouring blocks and off-shore areas.

Table 1. Summary of survey technical specifications: Tellus A5 (Limerick) Block.

Geophysical Contractor	Sander Geophysics Limited (SGL)
Survey Start Date	August 21, 2018
Survey End Date	March 29, 2019
Aircraft Type	De Havilland DHC-6 Twin Otter
Total line kilometres	25,577 km
Traverse Lines	
Number of Lines	525
Line Numbers	L5001 to L5525
Line Direction:	N15°W
Line Spacing	200 m
Control Lines	
Number of Lines	41
Line Numbers	T501 to T541
Line Direction	E15°N
Line Spacing	2000 m
Survey Altitude	
Nominal	60 m
Sensitive Areas	214 m
Large Population Centres	305 m
Number of Flights	82
Flight Numbers	001 to 082
Aircraft Ground Speed Nominal	60 m/s
Instruments Carried	
Magnetics	Single sensor (tail-mounted)
Gamma-Ray Spectrometer	Total-count, potassium, uranium, thorium windows
Frequency Domain Electromagnetics	Four frequency: 912, 3005, 11962 and 24510 Hz
Sample Rates	
Magnetics and Electromagnetics	1 Hz (nominal 6 m)
Gamma-ray Spectrometer	10 Hz (nominal 60 m)
Coordinate System	
Datum	IRENET95
Projection	Irish Transverse Mercator (ITM)

2. URLs FOR DATA DOWNLOAD

Line-based (see Section 3 for details) and grid-based (Section 4) versions of the Block A5 data are now available. Data and supporting documentation may be downloaded from the GSI website at the following URLs:

Magnetic line data and grids:
[A5_MAG_DATA_2019.zip] and [A5_MAG_GRIDS_2019.zip]
https://secure.dccae.gov.ie/GSI_DOWNLOAD/Geophysics/Data/GSI_Tellus_A5_MAG_DATA_2019.zip

https://secure.dccae.gov.ie/GSI_DOWNLOAD/Geophysics/Data/GSI_Tellus_A5_MAG_GRIDS_2019.zip

Gamma-ray spectrometer line data and grids:
[A5_RAD_DATA_2019.zip] and [A5_RAD_GRIDS_2019.zip]
https://secure.dccae.gov.ie/GSI_DOWNLOAD/Geophysics/Data/GSI_Tellus_A5_RAD_DATA_2019.zip
https://secure.dccae.gov.ie/GSI_DOWNLOAD/Geophysics/Data/GSI_Tellus_A5_RAD_GRIDS_2019.zip

Frequency domain electromagnetic line data and grids:
[A5_EM_DATA_2019.zip] and [A5_EM_GRIDS_2019.zip]
https://secure.dccae.gov.ie/GSI_DOWNLOAD/Geophysics/Data/GSI_Tellus_A5_EM_DATA_2019.zip
https://secure.dccae.gov.ie/GSI_DOWNLOAD/Geophysics/Data/GSI_Tellus_A5_EM_GRIDS_2019.zip

Survey technical report:
[TR-861A5-002.pdf]
https://secure.dccae.gov.ie/GSI_DOWNLOAD/Geophysics/Reports/GSI_Tellus_TR_861A5_002.pdf

For support and further information at GSI: Dr James Hodgson, Tellus Project Manager,
jim.hodgson@gsi.ie, +353 (0)1 6782742.

3. RELEASE INFORMATION FOR LINE DATA

Line based data for all flight lines are provided in ascii-format files, separately for each data type:

- **Magnetic data:**
  [MAG_A5_2018_2019_WEB.XYZ]

- **Gamma-ray spectrometer data:**
  [RAD_A5_2018_2019_WEB.XYZ]

- **Frequency domain electromagnetic data:**
  [EM_A5_2018_2019_WEB1.XYZ]
  [EM_A5_2018_2019_WEB2.XYZ]

The file format is suitable for direct import into Geosoft Oasis Montaj software or into any other software programme with an ascii, column-based import capacity. The data channel (column) descriptions for each data file are fully specified in the readme.txt files that accompany the data for each data type. For reference, the readme.txt files are included below in Section 5 (magnetic data), Section 6 (gamma-ray spectrometer data) and Section 7 (frequency domain electromagnetic data).

While the line-based data files contain a number of supplementary data channels (providing, e.g., flight altitude, temperature, air pressure, power-line monitor, digital elevation model and geographic coordinate data, as appropriate to each data type), the primary data channels of interest to the data user are likely to be:

- **Magnetics:**
  - o "MAG-MIC" data channel – final microlevelled magnetic field anomaly (in nT).

- **Gamma-ray spectrometer:**
  - o "C_TOT_ML" channel – final corrected Total Count data (in cps).
  - o "C_POTL" channel – final corrected Potassium Concentration (in %).
  - o "C_URA_ML" channel – final corrected Equivalent Uranium Concentration (in ppm).
  - o "C_THOL" channel – final corrected Equivalent Thorium Concentration (in ppm).

- **Frequency domain electromagnetics:**
  Resistivity models (derived using approximate, half-space resistivity transformations)
  - o "ExtendedRes09_GRID", "ExtendedRes3_GRID", "ExtendedRes12_GRID" and "ExtendedRes25_GRID" channels – final microlevelled resistivity model data for 912, 3005, 11962 and 24510 Hz respectively, nulled for flight altitudes greater than 120 m above ground level (in ohm.m).
  - o "ExtendedResSlice10_GRID", "ExtendedResSlice30_GRID", "ExtendedResSlice60_GRID" and "ExtendedResSlice100_GRID" channels – resistivity depth slice at 10, 30, 60 and 100 m respectively, nulled for flight altitudes greater than 120 m above ground level (in ohm.m).
  Electromagnetic response data (for users wishing to model the EM data independently)
  - o "P09lev", "Q09lev", "P3lev", "Q3lev", "P12lev", "Q12lev", "P25lev", "Q25lev" channels – final levelled in-phase and quadrature responses at 912, 3005, 11962 and 24510 Hz respectively (in ppm).

4. RELEASE INFORMATION FOR GRID DATA

Grids of the data are provided for all final data channels and may be located and downloaded at the URLs indicated above. Several file formats are provided: Geosoft Binary (.grd), Grid Exchange (.gxf) and georeferenced TIF (.tif). Data are gridded at a 50 m interval, using an Irish Transverse Mercator projection with IRENET95 datum.

For reference, readme.txt files associated with the grid data are included below in Section 8 (magnetic data), Section 9 (gamma-ray spectrometer data) and Section 10 (frequency domain electromagnetic data).

- **Magnetics:**
  - o "A5_MAG_MIC" grid – Microlevelled Airborne Magnetic Field Anomaly (with IGRF removed) (in nT).
  - o "A5_MAG_MIC_1VD" grid – First vertical derivative of Microlevelled Airborne Magnetic Field Anomaly (in nT/m).
  - o "A5_MAG_MIC_TDR" grid – Tilt derivative of Microlevelled Airborne Magnetic Field Anomaly.

- **Gamma-ray spectrometer:**
  - "A5_RAD_Total_count" grid – Total Counts (in cps).
  - "A5_RAD_Percent_Potassium" grid – Potassium Concentration (in %)
  - "A5_RAD_Thorium_equivalent" grid – Equivalent Thorium Concentration (in ppm).
  - "A5_RAD_Uranium_equivalent" grid – Equivalent Uranium Concentration (in ppm).
  - "A5_RAD_TERNARY" image – Ternary image combination of Potassium, Uranium and Thorium concentrations (available only as .tif file).

- **Frequency domain electromagnetics:**
  - "RES09_EXTENDED", "RES3_EXTENDED", "RES12_EXTENDED" and "RES25_EXTENDED" grids – resistivity models for 912, 3005, 11962 and 24510 Hz respectively (in ohm.m).
  - "RES09_EXTENDED_120CLIPPED", "RES3_EXTENDED_120CLIPPED", "RES12_EXTENDED_120CLIPPED" and "RES25_EXTENDED_120CLIPPED" grids – resistivity models for 912, 3005, 11962 and 24510 Hz respectively, nulled for flight altitudes greater than 120 m above ground level (in ohm.m).

5. MAGNETIC LINE DATA README FILE [MAG_A5_2018_2019_ReadMe.txt]

```
=============================================================================================
This readme file relates to data from file: MAG_A5_2018_2019_WEB.XYZ
Airborne magnetic geophysical data collected during 2018 and 2019 by Geological Survey Ireland, Tellus Project.

Notepad text editor is recommended to read the data correctly.
Data type: The data are raw contractor delivered data from the A5 survey block
Date of collection: Data collected between 21/08/2018 and 29/03/2019.
Geographical extent: The A5 Survey block covers the majority of County Limerick and northern Tipperary, Ireland.
Contractor: Sander Geophysics Ltd
Client:  Geological Survey Ireland (GSI)
Date of data release: 15 October 2019
For data queries please contact: tellus@gsi.ie
The data contain the channels described below:

=============================================================================================


File Name: MAG_A5_2018_2019_WEB.XYZ
```

Name	Units	Description
LINE	-	Line Number
ITM_X	m	X coordinate, IRENET95 ITM
ITM_Y	m	Y coordinate, IRENET95 ITM
DATE	-	Date YYYYMMDD
LONG	degree	Longitude, WGS-84
LAT	degree	Latitude, WGS-84
MSLHGT	m	GPS Elevation above Mean Sea Level
LASER	m	Clearance above Terrain from Laser Altimeter
DEM	m	Digital Elevation Model with respect to Mean Sea Level from Laser and GPS Clearance
MAG-MIC	nT	Microlevelled Airborne Magnetic Field Anomaly (with IGRF removed)

```
=============================================================================================
```

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

An Roinn Cumarsáide, Gníomhaithe ar son na hAeráide agus Comhshaoil
Department of Communications, Climate Action & Environment

6. GAMMA-RAY SPECTROMETER LINE DATA README FILE [RAD_A5_2018_2019_ReadMe.txt]

```
====================================================================================================
This readme file relates to data from file: RAD_A5_2018_2019_WEB.XYZ
Airborne radiometric geophysical data collected during 2018_2019 by Geological Survey Ireland, Tellus Project.


Notepad text editor is recommended to read the data correctly.
Data type: The data are raw contractor delivered data from the A5 survey block
Date of collection: Data collected between 21/08/2018 and 29/03/2019.
Geographical extent: The A5 Survey block covers the majority of County Limerick and northern Tipperary, Ireland.
Contractor: Sander Geophysics Ltd
Client:  Geological Survey Ireland (GSI)
Date of data release: 15 October 2019
For data queries please contact: tellus@gsi.ie
The data contain the channels described below:


====================================================================================================


File Name: RAD_A5_2018_2019_WEB.XYZ
```

Name	Units	Description
LINE	-	Line Number
ITM_X	m	X coordinate, IRENET95 ITM
ITM_Y	m	Y coordinate, IRENET95 ITM
DATE	-	Date YYYYMMDD
LONG	degree	Longitude, WGS-84
LAT	degree	Latitude, WGS-84
MSLHGT	m	GPS Elevation above Mean Sea Level
LASER	m	Clearance above Terrain from Laser Altimeter
DEM	m	Digital Elevation Model with respect to Mean Sea Level from Laser & GPS Clearance
TEMP	degree C	Temperature
BARO	m	Barometric Pressure Altitude
E_HGT	m	Effective Height at Standard Temperature and Pressure
R_TOT	counts/s	Recorded Total Count, de-lagged
R_POT	counts/s	Recorded Potassium Count, de-lagged
R_URA	counts/s	Recorded Uranium Count, de-lagged

R_THO	counts/s	Recorded Thorium Count, de-lagged
C_TOT_ML	counts/s	Corrected Total Count, de-lagged, micro-levelled and minimum limited to 0
C_POTL	%	Corrected Potassium Concentration, de-lagged and minimum limited to 0
C_URA_ML	ppm	Corrected Uranium Concentration, de-lagged, micro-levelled and minimum limited to 0
C_THOL	ppm	Corrected Thorium Concentration, de-lagged and minimum limited to 0

===

7. FREQUENCY DOMAIN ELECTROMAGNETIC LINE DATA README FILE [EM_A5_2018_2019_ReadMe.txt]

===
This readme file relates to data from files: EM_A5_2018_2019_WEB1.XYZ (L5001_L5262) and EM_A5_2018_2019_WEB2.XYZ (L5263-L5525)
Airborne electromagnetic geophysical data collected during 2018_2019 by Geological Survey Ireland, Tellus Project.

Notepad text editor is recommended to read the data correctly.
Data type: The data are raw contractor delivered data from the A5 survey block
Date of collection: Data collected between 21/08/2018 and 29/03/2019.
Geographical extent: The A5 Survey block covers the majority of County Limerick and northern Tipperary, Ireland.
Contractor: Sander Geophysics Ltd
Client: Geological Survey Ireland (GSI)
Date of data release: 15 October 2019
For data queries please contact: tellus@gsi.ie
The data contain the channels described below:

===

File Names: EM_A5_2018_2019_WEB1.XYZ and EM_A5_2018_2019_WEB2.XYZ

Name	Units	Description
LINE	-	Line Number
ITM_X	m	X coordinate, IRENET95 ITM
ITM_Y	m	Y coordinate, IRENET95 ITM
DATE	-	Date YYYYMMDD
LONG	degree	Longitude, WGS-84

LAT	degree	Latitude, WGS-84
MSLHGT	m	GPS Elevation above Mean Sea Level
CLEARANCE	m	Clearance above Terrain from Laser
DEM	m	Digital Elevation Model with respect to Mean Sea Level from Laser Clearance
TEMP	degree C	Temperature
P09lev	ppm	Levelled and filtered in-phase 912 Hz
Q09lev	ppm	Levelled and filtered quadrature 912 Hz
P3lev	ppm	Levelled and filtered in-phase 3005 Hz
Q3lev	ppm	Levelled and filtered quadrature 3005 Hz
P12lev	ppm	Levelled and filtered in-phase 11962 Hz
Q12lev	ppm	Levelled and filtered quadrature 11962 Hz
P25lev	ppm	Levelled and filtered in-phase 24510 Hz
Q25lev	ppm	Levelled and filtered quadrature 24510 Hz
PLM_nT	nT	Power line monitor
ExtendedRes09	ohm-m	Microlevelled extended range resistivity, half-space model, 912 Hz
ExtendedRes3	ohm-m	Microlevelled extended range resistivity, half-space model, 3005 Hz
ExtendedRes12	ohm-m	Microlevelled extended range resistivity, half-space model, 11962 Hz
ExtendedRes25	ohm-m	Microlevelled extended range resistivity, half-space model, 24510 Hz
ExtendedRes09_GRID	ohm-m	Microlevelled extended range resistivity, half-space model, 912 Hz, nulled >120 m
ExtendedRes3_GRID	ohm-m	Microlevelled extended range resistivity, half-space model, 3005 Hz, nulled >120 m
ExtendedRes12_GRID	ohm-m	Microlevelled extended range resistivity, half-space model, 11962 Hz, nulled >120 m
ExtendedRes25_GRID	ohm-m	Microlevelled extended range resistivity, half-space model, 24510 Hz, nulled >120 m
ExtendedResSlice10_GRID	ohm-m	Microlevelled extended range resistivity depth slice at 10 m, nulled >120 m
ExtendedResSlice30_GRID	ohm-m	Microlevelled extended range resistivity depth slice at 30 m, nulled >120 m
ExtendedResSlice60_GRID	ohm-m	Microlevelled extended range resistivity depth slice at 60 m, nulled >120 m
ExtendedResSlice100_GRID	ohm-m	Microlevelled extended range resistivity depth slice at 100 m, nulled >120 m

===

8. MAGNETIC GRID DATA README FILE [MAG_A5_2018_2019_ReadMe_Grids.txt]

===
This readme file relates to grids provided in the file: [A5_MAG_GRIDS_2019.zip]

Date of data release: 15 October 2019

There are three different georeferenced grid formats for the Tellus geophysical data grids:

.grd files are Geosoft grid files and can be opened in: GIS software including Geosoft, ArcGIS (only with Geosoft ArcGIS plugin) and MAPINFO.
.tif files are georeferenced coloured raster files.
.gxf are ASCII grid files and are an interrogatable raster file. This format can be opened in many GIS software programmes. Instructions on how to display the grids with the correct colour ramp in ArcGIS and QGIS are in the [ArcGIS_Colour_Ramp_gxf_InstructionsReadMe.pdf] and [QGIS_Colour_Ramp_gxf_InstructionsReadMe.pdf] files included in this .zip.

Images are intended to be viewed with in the Geosoft Clra 32 colour ramp. Included in this .zip file are an ArcGIS style file [Geosoft.Style] and an QGIS XML Colour ramp [Geosoft_Clra_32_qgis.XML] that contain Geosoft Clra 32 colour ramps.

===

Name	Unit	Description
A5_MAG_MIC	nT	Microlevelled Airborne Magnetic Field Anomaly (with IGRF removed)
A5_MAG_MIC_1VD	nT/m	First vertical derivative of Microlevelled Airborne Magnetic Field Anomaly
A5_MAG_MIC_TDR	-	Tilt derivative of Microlevelled Airborne Magnetic Field Anomaly

===

9. GAMMA-RAY SPECTROMETER GRID DATA README FILES [RAD_A5_2018_2019_ReadMe_Grids.txt] and [RAD_A5_2018_2019_ReadMe_Ternary_Image.txt]

===
This readme file relates to grids provided in the file: [A5_RAD_GRIDS_2019.zip]

Date of data release: 15 October 2019

There are three different georeferenced grid formats for the Tellus geophysical data grids:

.grd files are Geosoft grid files and can be opened in: GIS software including Geosoft, ArcGIS (only with Geosoft ArcGIS plugin) and MAPINFO.
.tif files are georeferenced coloured raster files.
.gxf are ASCII grid files and are an interrogatable raster file. This format can be opened in many GIS software programmes. Instructions on how to display the grids with the correct colour ramp in ArcGIS and QGIS are in the [ArcGIS_Colour_Ramp_gxf_InstructionsReadMe.pdf] and [QGIS_Colour_Ramp_gxf_InstructionsReadMe.pdf] files included in this .zip.

Images are intended to be viewed with in the Geosoft Clra 32 colour ramp. Included in this .zip file are an ArcGIS style file [Geosoft.Style] and an QGIS XML Colour ramp [Geosoft_Clra_32_qgis.XML] that contain Geosoft Clra 32 colour ramps.

===

Name	Units	Description
A5_RAD_Total_count	counts/s	Corrected Total Count, de-lagged, micro-levelled and minimum limited to 0
A5_RAD_Percent_Potassium	%	Corrected Potassium Concentration, de-lagged and minimum limited to 0
A5_RAD_Uranium_equivalent	ppm	Corrected Uranium Concentration, de-lagged, micro-levelled and minimum limited to 0
A5_RAD_Thorium_equivalent	ppm	Corrected Thorium Concentration, de-lagged and minimum limited to 0

===

===
Radiometric Ternary image readme file

The radiometric ternary map shows the variation of potassium, equivalent thorium and equivalent uranium at each location.
The image is created by combining potassium (red), thorium (green) and uranium (blue) to form a single image.
The strength of the three different colours reflects the prominence of the three different elements.
Combinations of colours indicate a combination of relative elements. White and black colours indicate high and low values respectively in all three radionuclides.

Ternary image only available as .tif file (georeferenced coloured raster file).

Data have been corrected for altitude variations
Grids were created using Geosoft Oasis Montaj using the inverse distance weighting method with a grid cell size of 50m.

===

Name	Unit	Description
A5_RAD_TERNARY	-	Radiometric ternary map obtained by combined percent-potassium, equivalent thorium and equivalent uranium

===

10. FREQUENCY DOMAIN ELECTROMAGNETIC GRID DATA README FILE [RAD_A5_2018_2019_ReadMe_Grids.txt]

===
This readme file relates to grids provided in the file: [A5_MAG_GRIDS_2019.zip]

Date of data release: 15 October 2019

There are three different georeferenced grid formats for the Tellus geophysical data grids:

.grd files are Geosoft grid files and can be opened in: GIS software including Geosoft, ArcGIS (only with Geosoft ArcGIS plugin) and MAPINFO.
.tif files are georeferenced coloured raster files.
.gxf are ASCII grid files and are an interrogatable raster file. This format can be opened in many GIS software programmes. Instructions on how to display the grids with the correct colour ramp in ArcGIS and QGIS are in the [ArcGIS_Colour_Ramp_gxf_InstructionsReadMe.pdf] and [QGIS_Colour_Ramp_gxf_InstructionsReadMe.pdf] files included in this .zip.

Images are intended to be viewed with in the Geosoft Clra 32 colour ramp. Included in this .zip file are an ArcGIS style file [Geosoft.Style] and an QGIS XML Colour ramp [Geosoft_Clra_32_qgis.XML] that contain Geosoft Clra 32 colour ramps.

===

Name	Unit	DESCRIPTION
RES09_EXTENDED	ohm-m	Extended range resistivity, half-space model, 912 Hz
RES3_EXTENDED	ohm-m	Extended range resistivity, half-space model, 3005 Hz

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

An Roinn Cumarsáide, Gníomhaithe ar son na hAeráide agus Comhshaoil
Department of Communications, Climate Action & Environment

RES12_EXTENDED	ohm-m	Extended range resistivity, half-space model, 11962 Hz
RES25_EXTENDED	ohm-m	Extended range resistivity, half-space model, 24510 Hz
RES09_EXTENDED_120CLIPPED	ohm-m	Microlevelled extended range resistivity, half-space model, 912 Hz, for gridding, nulled >120 m
RES3_EXTENDED_120CLIPPED	ohm-m	Microlevelled extended range resistivity, half-space model, 3005 Hz, for gridding, nulled >120 m
RES12_EXTENDED_120CLIPPED	ohm-m	Microlevelled extended range resistivity, half-space model, 11962 Hz, for gridding, nulled >120 m
RES25_EXTENDED_120CLIPPED	ohm-m	Microlevelled extended range resistivity, half-space model, 24510 Hz, for gridding, nulled >120 m

==