

GIO Land Monitoring 2011 – 2013 in the framework of regulation (EU) No 911/2010

Pan-EU Component

Grant Agreement 3541/B2013/R0-GIO/EEA.55296

Final Report

Malta

Tasks:

1. Verification of products (HRLs – high resolution layers)	Y
2. Enhancement of products (HRLs – high resolution layers)	Y
3. New Corine Land Cover inventory (2012)	Y
4. Dissemination of final products	Y

1. Background

MEPA serves as the “National Reference Centre on Landcover” for the European Environment Agency (EEA). In this function the Agency supports European institutions dealing with land cover, land monitoring and land use.

MEPA has been working on issues like European wide homogeneous data sets emphasising on land cover topics for several years. Land cover plays an important role for environmental spatial and territorial analysis. As MEPA is composed of both the land-use planning and environmental agencies, it has a wider responsibility in having up-to-date data about landuse and landcover at very high detail, nominally at 1:2500 and 1:1000. In view of such detailed-scale usage, maps at scales required by CLC are rarely used due to the generalized product that is not used for local consumption.

MEPA has also been responsible for the production of the CLC2000, CLC1990 and CLC2000 updates as well as the CLC2006 product. Since it also hosts the NFP, MEPA’s role is twofold, ensuring delivery of all datasets as well as the production of all environmental spatial data and information systems. In effect CLC products will be incorporated within its generalized dissemination process as an example of international datasets Malta is party to.

Although Malta does not employ the CLC products for its national needs, it was however committed to produce the CLC2012 products for its EU obligations. However, the use of CLC outputs has been generally consigned to generalized interpretation of maps for such products as SOER and peripheral use in other projects; however any interpretation is mostly linked to EEA or other EU agencies' queries.

This said, Malta has still delivered the products based around the CLC2012 TOR and has also concluded the change analysis from 2006-2012. This process would allow users to gain further knowledge of the two CLC products and change issues as seen within an EU wide context.

In addition this grant agreement covered the processes of Verification and Enhancement of 5 HRLs (high resolution layers) as per the terms of reference for GIO Land monitoring 2011-2013. The aim of this task was to identify systematic classification errors that are eligible for improvement/enhancement.

The themes covered by the HRL Verification and Enhancement processes included: -

- Degree of imperviousness
- Tree cover density
- Forest type
- Grassland cover (Enhanced verification only)
- Wetlands
- Permanent water bodies

For each theme the necessary verification and enhancement guidelines were provided in order to produce the required outputs. At each stage of the process the drafted outputs were uploaded, review and approved using the GIOLAND online country delivery progress -

<https://gaur.eea.europa.eu/gioland/country/mt>

2. Organisation of work at national level

The resources at National level were mainly focussed on two tasks, CLC 2012 and the verification and enhancement of the HRL layers, both of which were handled by the team members working in the Information Resources Unit at

the Malta Environment and Planning Authority. The main steps covering both tasks are illustrated by the following points: -

CORINE land cover 2012 (CLC2012)

- National preparations including the collation of the in-situ data required and the assignment of staff to be working on both tasks. In-situ data included 1:1000/1:2500 scale basemaps and ortho-rectified imagery acquired in 2012 through the ERDF156 project headed by MEPA. This preparatory work took place during the period January 2012 to June 2012
- CLC training was not requested since the national team consisted of the same team members that had worked on previous CLC and HRL soil sealing runs and thus were deemed to have enough background experience and GIS knowledge for the tasks.
- Project management was taken up by the NRC who is responsible for the Information Resources Unit within MEPA and who also coordinates the national priority deliveries as part of the NFP Team;
- Progress meetings were carried out internally to ensure that all required datasets and hardware infrastructure and software are available at MEPA. These meeting also ensured that QA/QC was carried out at various stages of the project.
- The software utilised for both the CLC update and Verification/Enhancement exercises was successfully deployed and staff earmarked for this project reviewed the relevant procedures as per guidelines provided. Satellite image data acquired earlier through the European Space Agency (as stipulated in the contract agreement) had a technical issue of misalignment and thus the commencement of the tasks was delayed until the issue was rectified by the same agency (ESA). Once this technical issue was resolved the Malta CLC team was able to start the production of the CLC2012 outputs.
- The provision of the rectified CLC 2012 satellite image occurred in November 2013; the national team moved ahead and initiated the identification of the changes that occurred since the production of the CLC2006. During this stage the three main outputs where produced using the software and guidelines provided by the EEA. These outputs included the following spatial databases: -
 - Revised CLC2006 database
 - CLC change layer 06-12
 - CLC2012

- The internal quality controls of the CLC outputs were performed by members of the Information Resources Unit Team overseen by the project manager. Following approval of the CLC 2012 outputs these were forwarded to the EEA which subsequently approved the results and published the final CLC verification report in January 2014 thus completing the CLC 2012 task.

Verification and Enhancement of 2012 HRLs

In Malta's case it was deemed best to apply a complete coverage methodology rather than verifying specific area samples. Areas identified in the HRLs provided verified utilising in-situ Orthoimagery and the CLC database (for the same reference year-2012).

A complete coverage photo interpretation method was applied to identify wrongly classified areas (Commission) or for completely omitted areas (Omission). This way all major errors were identified and thus provided a more comprehensive overview of the changes required for the enhancement stage of the HRL. All the major errors identified, plotted, coded and categorised as "Commission" or "Omission" error types as per guidelines provided for each HRL theme. Subsequently the identified vector areas were converted to raster, and integrated with the original HRL layers to produce the final enhanced layers at 20m x 20m resolution in both local and European projections.

Summary of evaluation results for each HRL at Verification stage: -

IMD – Degree of Imperviousness - Overall evaluation – Good

The major error areas were clearly identified, however a reasonable amount of areas were omitted particularly in strip development areas or in isolated built-up areas surrounded with agricultural or green areas.

TRC – Tree Cover Density – Overall evaluation – Good

The major error areas were clearly identified, most of them being "commission errors" in very close proximity to built-up areas. Omission errors were minimal and mostly being areas also in close proximity to urban zones.

FTY – Forest Type – Overall evaluation – Insufficient

Not all the major errors were clearly identified. Most of the errors identified were of the "commission" type, particularly those located adjacent to built up areas. A certain amount of omitted areas were identified. Their proximity to the urban areas contributed to the misinterpretation.

GRL – Permanent Grassland – Overall evaluation – Insufficient

The major error areas were clearly identified. Most of the errors were of the "commission" type particularly those adjacent sclerophyllous vegetation. Low lying vegetation contributed to the misinterpretation.

WET – Wetlands – Overall evaluation – Good

The major error areas were clearly identified, however two significantly sized areas were omitted, possibly due to the acquisition time period of the images utilised for the HRL production.

PWB – Permanent Water Bodies – Overall evaluation – Good

The period/season in which HRL data was taken may have contributed to the misinterpretation of the water body areas as being permanent. Also the agricultural reservoirs scattered in the rural areas interfered with the interpretation.

Summary of evaluation of the improvements achieved for each HRL at Enhancement stage: -

IMD – Degree of Imperviousness - Overall evaluation – Good

Most of the errors were rectified, however some level of detail (compared to the local level of detail) was lost due to the generalisation required to comply with the MMU required for the project.

TRC – Tree Cover Density – Overall evaluation – Good

As with the previous HRL most of the errors were rectified, however in order to maintain the MMU required for the project some detail was lost when compared to the local level of detail.

FTY – Forest Type – Overall evaluation – Good

As with the Tree Cover Density HRL most of the errors were rectified, however in order to maintain the MMU required for the project some detail was lost when compared to the local level of detail.

GRL – Permanent Grassland – Overall evaluation – Not applicable

The major error areas were clearly identified and plotted into a separate vector file, however it was agreed that a more in-depth enhancement process needs to be applied in the case of Permanent Grassland HRLs and falls outside the scope of this exercise. Hence it was agreed that an intermediate enhancement layer will be supplied by the contractor at this point.

WET – Wetlands – Overall evaluation – Excellent

All error areas rectified and HRL layer updated accordingly.

PWB – Permanent Water Bodies – Overall evaluation – Good

As with previous HRL all error areas were rectified and HRL layer enhanced.

For each of the HRL layers the respective guidelines provided by EEA were followed however rather than opting for a sample based verification/enhancement, in the case of the Maltese Islands it was deemed more feasible to apply a complete coverage methodology. Hence all the areas

identified in each HRL were verified (and enhanced where needed) visually utilising in-situ Orthoimagery and the CLC database (for the same reference year-2012) When considering the physical area of the Maltese Islands and the land cover characteristics of the built-up areas, applying this method of photo interpretation, resulted in a more adequate verification of the HRL layer giving a more detailed result. In the case of the Forest type and Permanent grassland HRLs the results obtained were insufficient and a significant number of errors were identified. Most of these misinterpretations were attributed to the "mixed" biotopes concentrated in small sized areas and close to spider web shaped urban areas. Further detail on each error type for each HRL can be found in the respective Verification and Enhancement reports.

Acknowledgements are due to Mr. György BÜTTNER Senior advisor - Copernicus land services and Mr. Gergely Maucha head, Environmental applications of Remote Sensing Institute of Geodesy, Cartography and Remote Sensing, Hungary for their support in creating the Enhanced HRL layers.

Overall the HRL layers provides a generalised view compared to the level of detail that is normally utilized locally (1:1000). Even so, they provide a good representation of each theme and can still be deemed acceptable for the parameters/requirements of this exercise.

3. Ancillary data used in the project

- CLC 2006, CLC2012 , CLC changes 06-12 data bases
- Local topographic base maps 1:1000
- Ortho-photos 2004 and 2008 (MEPA Mapping Unit)
- Ortho-photos 2012 (*as acquired through the ERDF156 project*)
- National Designated Areas 2014 (CDDA)
- Biotope habitat maps in Natura 2000 sites 2011
- Inland water bodies database 2014
- Google Maps (used for double checking)

Other input to the verification of the Forest type HRL verification included local expertise and knowledge of local biotopes.

4. Deliverables

Malta produced the following products, as per the list mentioned in the "GMES Initial operations (GIO) Land Monitoring 2011-2013 in the framework of regulation (EU) No911/2010 – TOR document":

Product 1 – Verification HRL reports

Product 2 – Enhanced HRL reports and layers

Product 3 – Corine land cover changes 2006-2012 and Corine land cover map 2012 and revised CLC2006 (if produced)

Product 4 – Report on in-situ data access

Product 5 – Dissemination services and summary report on dissemination activities

Product 6 – Final Technical Implementation Report (In Malta's case this is included as part of the Final Report after the completion of the verification/enhancement of the HR layers.)

Progress report (submitted June 2013), according to EEA template provided;

Final report – following the completion of the verification of the HR layers (containing status of work, problems encountered/solutions adopted, financial aspects of the work carried out, etc.);

Below is a summary of the results achieved in the CLC layer production for Malta: -

CLC-changes 06-12

In Malta's case there was only one change recorded between CLC06 and CLC12. As per the CLC technical guidelines provided by EEA only changes that are larger in area than 5 hectares are to be taken into consideration and hence this resulted in a single change significant enough to be recorded. The area in question is the local landfill area known as "Il-Maghtab"/ "Ta' L-Ghallis". Not all the area is still actively used as a landfill however even though most of the area is being re-engineered into a green area it is still a work in progress. The overall area has increased in size by 50% between 2006 and 2012. This can be seen in Figure 1 below.

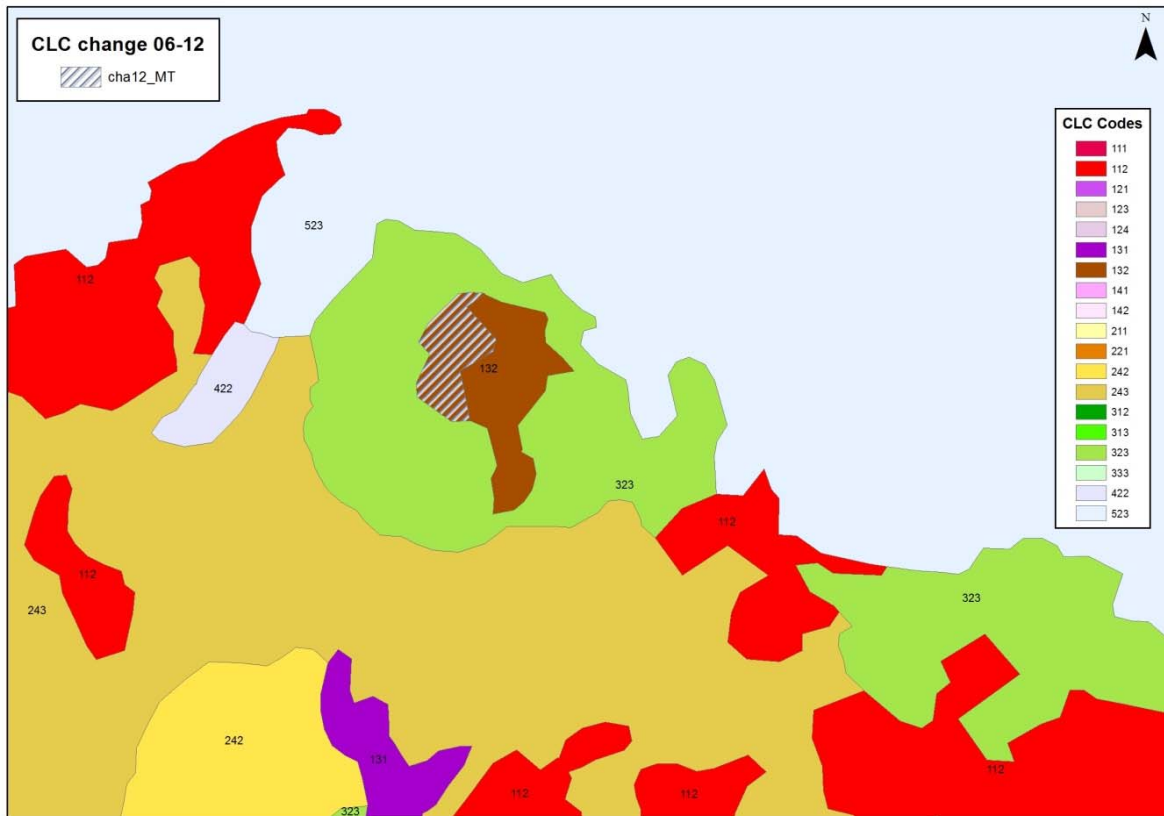


Figure 1 – CLC Change 2006 to 2012

CLC2012

Combining the single change between CLC runs and the minor revision of a typo error in CLC2006 the final CLC2012 layer was created as per guidelines provided.

No major area changes resulted from the previous runs. This is mainly due to the generalised nature of the scale with which CLC is created vis-a-vis the relatively small size of the Maltese Islands. Below is a graph summarising the areas in hectares of each CLC category and a map showing the final map.

CLC 2012 Areas (Ha)

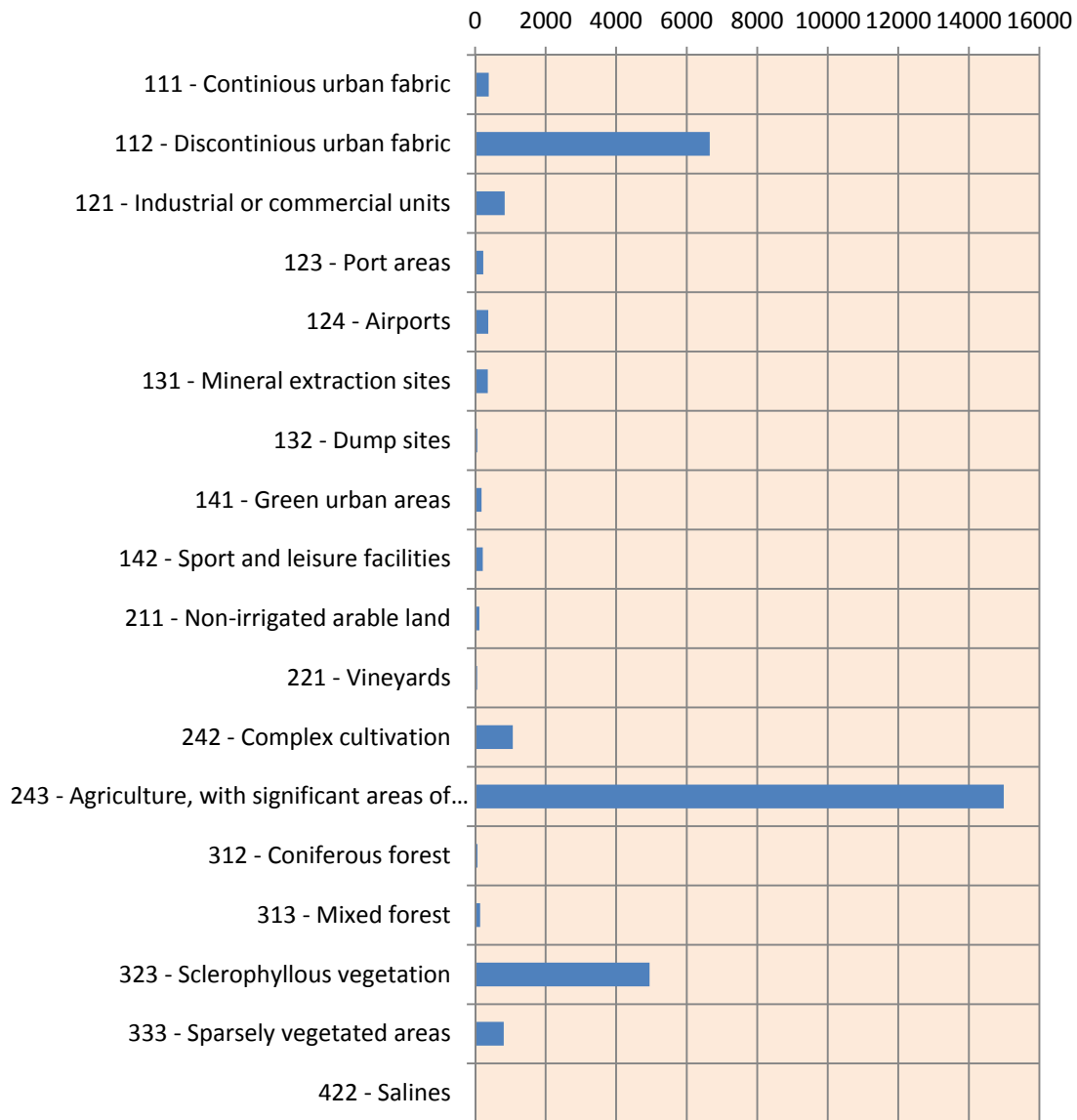


Figure 2 – CLC 2012 Areas for the Maltese Islands

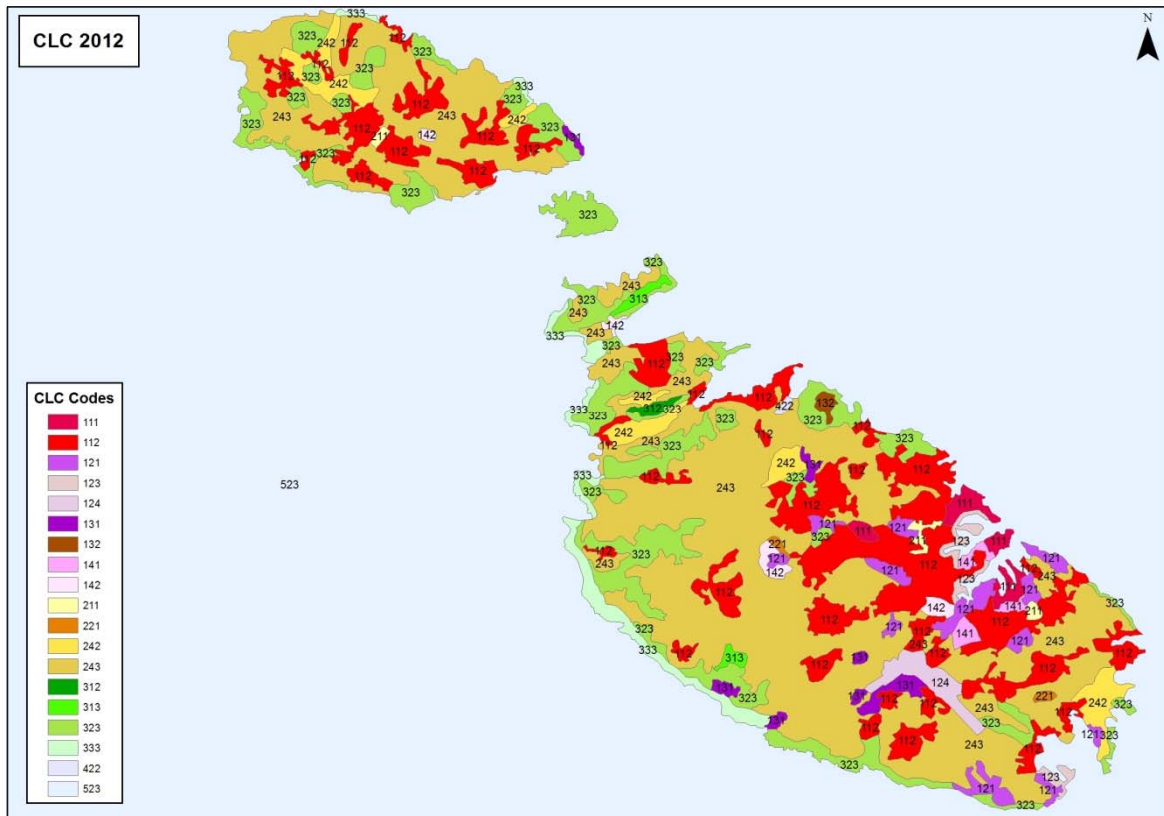


Figure 3 – CLC 2012

Revised CLC2006

As mentioned earlier only one minor typo error was identified and rectified in the CLC2006. Using the CLC support package software and guidelines, as provided by EEA, the final revised layer was produced.

The error identified is highlighted in Figure 4 below. An area known as “Delimara” where the current national electrical power station is located was erroneously coded as 131 – Mineral extraction sites rather than 121 – Industrial and commercial units. Given the similarity of the numbers it was deemed to constitute a genuine typo error.

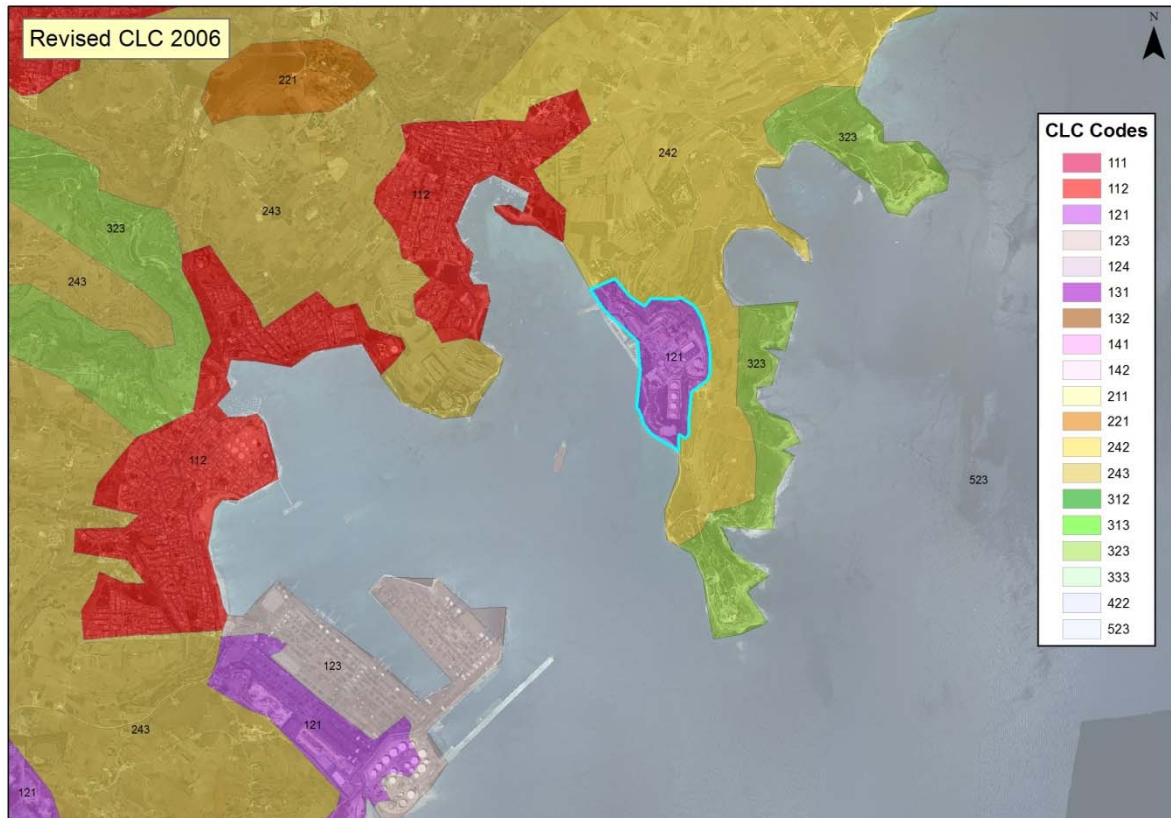


Figure 4 – Revised CLC2006 – Correction of highlighted area code

Enhanced HR Layers

As outlined in section 2 of this report 6 HRL enhanced outputs were produced by Malta. For each of the HRL theme the respective EEA guidelines were followed by the national CLC team however it was deemed more feasible to adapt the verification/enhancement methodology to analyse all of the Maltese territory rather than opting for a sample based approach. Using the in-situ data identified in section 3 coupled with local expertise and valuable technical support from the GIOLAND team the 6 HR layers were completed successfully.

Details on access to these layers as well as the parameters for each theme can be found on the Dissemination services and summary report on dissemination activities submitted in conjunction with this report.

In addition the INSPIRE compliant metadata for each of the CLC deliverables (CLC change 06-12, CLC2012 and Revised CLC2006) is included in Annex 1 of this report.

5. Conclusions

All CLC deliverables were effected through the EEA CDR dataflow system. HRL verification and enhancement outputs effected through the EEA GIOLAND online delivery system. Datasets are being used for EU reporting as per Directive requirements. Note that as per grant agreement requirements the revised 2006 layer, the 2006-2012 change map and clc2012 layers were concluded. For details on how to access/download the deliverables kindly refer to the final dissemination report.

6. References

- CLC2006 Technical Guidelines
- CLC2012 Addendum to CLC2006 Technical Guidelines
- CLC2012 Support package – InterChange 3.1 User Manual
- CLC 2012 Support Package – InterCheck 3.1 User Manual
- GMES Initial Operations (GIO) Land Monitoring 2011 – 2013 in the framework of regulation (EU) No 911/2010 Pan-EU Component Terms of Reference and template for national project plan
- Guidelines for Verification of High-Resolution layers produced under GMES/Copernicus Initial Operations (GIO) land monitoring 2011-2013
- Guidelines for Enhancement of High-Resolution layers produced under GMES/Copernicus Initial Operations (GIO) land monitoring 2011-2013

Drafted at Malta Environment and Planning Authority (MEPA), Malta

Date: 15th December 2014

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Annex 1

CLC-Changes, CLC2012 and revised CLC2006 (if produced) metadata¹

¹ Metadata compliant with the EEA Metadata Profile (INSPIRE compliant metadata with some extended elements) available at http://forum.eionet.europa.eu/nrc_land_covers/library/gio-land/corine-land-cover-clc/technical-guidelines/metadata/country-level-metadata