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This is the *category*-article for the **technical guidance on Management of different layers in LPIS** DS-CDP-2015-10, applicable for interaction between LPIS data sets.

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- An revised version, is being circulated as pdf-document in December 2015.
- Important edits since that draft are coloured in maroon colours.
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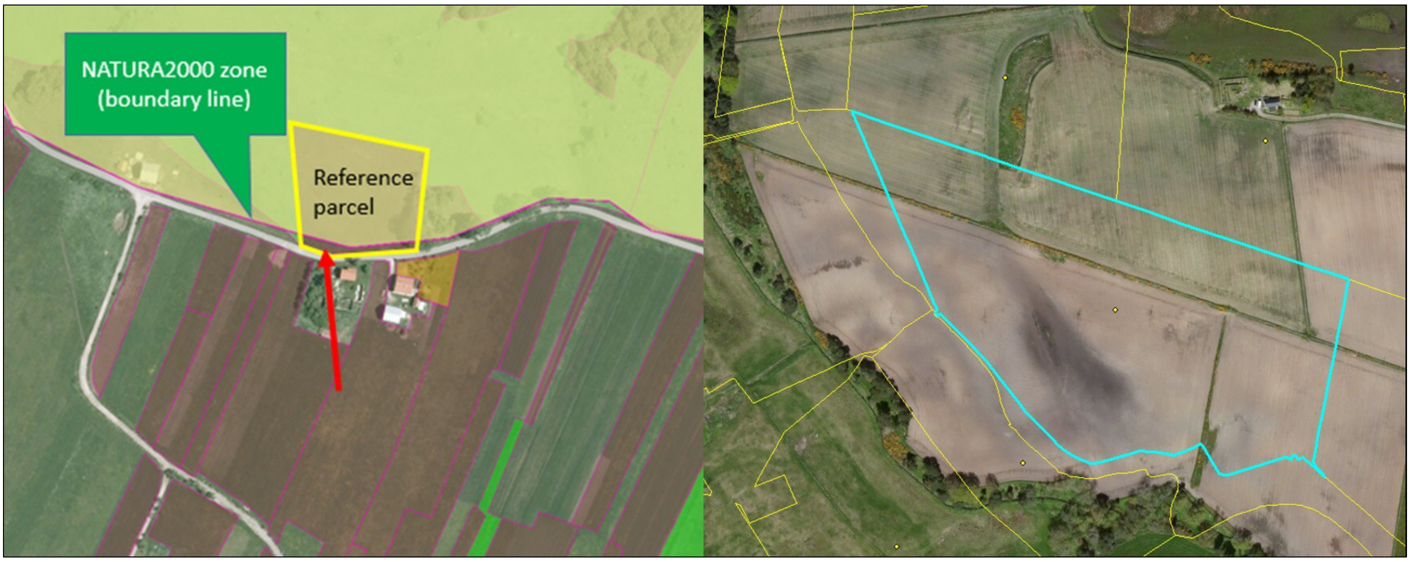

Management of layers in LPIS

Interaction between LPISdata sets

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2015

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Abstract

The Land Parcel Information System is the GIS for the Integrated Administration and Control System of the Common Agricultural Policy. This technical guidance document provides the essential concepts and technical procedures that are considered best practices to store and to use of spatial data in a GIS and applies this to the spatial features and their requirements laid down in the compiled Regulations and DG Agri guidance. Content and rules on spatial features interaction are detailed for use in the thematic layers of the reference parcel, the eligible hectares, the EFA-elements and the landscape features.

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This article is the starting page of **the Management of layers in LPIS guidance**. It provides the fundamental concepts and technical procedures that are considered best practices to store and to use spatial data in a GIS, and applies this to the spatial features and their requirements laid down in the compiled Regulations and DG Agri guidances.

You can print this technical guidance on the fly.

4 Introduction

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4.1 Purpose

The Land Parcel Identification System (LPIS), is the GIS that allows IACS to geolocate, display and spatially integrate its many data. It thus contains many spatial data sets from multiple sources and of different nature. To support the appropriate level of compatibility between these, it is necessary to describe some basic properties of these spatial data sets and how they behave in framework of the IACS. Having in mind the possibilities of technological applications, this document is addressing various appearance and formats of IACS spatial data:

- how to manage and reuse them, once created, for different purposes without creating duplicates nor redundancy,
- how to respect the mix of data and business rules,
- how to enable responsible authorities to communicate across different aid schemes and implementations.

The issue of compatibility and management of different data sets has to be carefully assessed if these come from sources at different scales for they may be incompatible. For example, although GIS provides the technology for overlaying coverages digitised from maps at different scales, as well as vector data measured with the use of GNSS and transferred to a spatial DB, this would not be a very useful exercise due to differences in accuracy, precision and possible generalization. GIS does not limit the use of many type of data related to the same geographical area to perform the analysis. But when a new dataset is brought to the GIS, the system imports not only the data, but also the error that the data contains. Best practices to ensure compatibility within a single system, prefer that data sets should be developed using the same methods of data capture, storage, manipulation and editing. This guidance should help all stakeholders to understand the consequences of capturing spatial data for IACS and the resulting level of their positional/temporal/thematic accuracy.

4.2 Scope

The scope of this guidance is to document the compatibility rules that apply to the spatial processing of individual IACS feature types as well as the business rules that apply to spatial operations (intersections, topology) of the so-called layers of these data. Any information stored in IACS that holds a spatial attribute is affected by these rules. It consists of 3 chapter:

- dealing with data acquisition and storage,
- dealing with data operations by using layers,
- maintaining the positional accuracy of the IACS.

Ultimately, the scope of this guidance is to outline the essential conceptual rules and technical choices to follow in order to respond to the following generic challenges:

- how to combine spatial information from different themes (data sets) represented by layers inside a GIS to obtain consistent and meaningful results, given the limitations of the source data,
- what principles and rules need to be defined and respected to integrate information in a meaningful way and produce results with the required quality,
- what are the conditions for successfully integrating spatial data and correctly determining areas in the scope of IASC/LPIS.

The compatibility of layers elaborated in this technical guidance relies on the spatial attributes of the LPIS data and is very dependent on the absolute positional accuracy of their coordinates. By contrast, standalone non-GIS operations such as OTSC area measurements, depend on relative positional accuracy and such methodologies and their results are not concerned with compatibility of layers.

4.3 References

Article 70. of Regulation (EU) 1306/2013 ? (1) The identification system for agricultural parcels shall be established on the basis of maps, land registry documents or other cartographic references. Use shall be made of **computerised geographical information system techniques**, including **aerial or spatial orthoimagery, with a homogenous standard that guarantees a level of accuracy that is at least equivalent to that of cartography at a scale of 1:10 000 and, as from 2016, at a scale of 1:5 000**, while taking into account the outline and condition of the parcel. This shall be fixed in accordance with existing Union standards. (2) Member States shall ensure that the identification system for agricultural parcels contains a **reference layer to accommodate ecological focus areas**.

Article 33. of Regulation (EU) 1307/2013 ? (1) For the purposes of the activation of payment entitlements provided for in Article 32(1), the farmer shall declare the parcels corresponding to the **eligible hectares** accompanying any payment entitlement.

Article 5. of Delegated Regulation (EU) No 640/2014 ? (5) The GIS shall operate on the basis of a **national coordinate reference system** as defined in Directive 2007/2/EC of the European Parliament and of the Council which permits standardised measurement and unique identification of agricultural parcels throughout the Member State concerned. Where different coordinate systems are used, they shall be mutually exclusive and each of them shall **ensure the consistency** between items of information which refer to the same location.

Data interoperability in the spatial data infrastructures is documented by the INSPIRE Generic Conceptual Model (http://inspire.ec.europa.eu/documents/Data_Specifications/D2.5_v3.4.pdf).

In particular, this technical guidance focuses on object referencing modelling and consistency between data. In the background, the components spatial and temporal aspects and coordinate referencing and units model are briefly touched.

4.4 Terms and definitions

geospatial feature - abstraction of a class of real world phenomena. This acts as the starting point for modelling of geographic information into a digital representation of real world entities/features. In GIS, a feature has spatial/temporal attributes. Examples of spatial features are things that can be placed in time and space, including buildings, parcels, trees, forest, crops, and so on;

agricultural area - means any area taken up by arable land, permanent grassland and permanent pasture, or permanent crops (Article 4. of Regulation (EU) 1307/2013); these eligible hectares represent land cover classes;

agricultural parcel - means a continuous area of land, declared by one farmer, which does not cover more than one single crop group; however, where a separate declaration of the use of an area within a crop group is required in the context of Regulation (EU) No 1307/2013, that specific use shall if necessary further limit the agricultural parcel; the agricultural parcels represents an land use instance;

controlled overlap ? ortho-projected area which is covered by several geometric representations of different features, but not counted more than once and semantically justified by the business rules.

4.5 Abbreviations

- **BPS**: basic payment scheme
- **CRS**: coordinate reference system
- **CwRS**: control with remote sensing
- **DEM**: digital elevation model
- **DN**: digital number

- **DORIS**: doppler orbitography and radio positioning integrated by satellite
- **DTM**: digital terrain model
- **EFA**: ecological focus area
- **EGNOS**: European geostationary navigation overlay service
- **GCP**: ground control points
- **GIO**: GMES Initial Operations
- **GIS**: geographic information system
- **GLONASS**: global navigation satellite system
- **GNNS**: global navigation satellite system
- **GPS**: global positioning system
- **GSD**: ground sampling distance
- **LAU**: land administration units
- **LF**: landscape features
- **LPIS**: land parcel information system
- **MMU**: minimum mapping unit
- **NUTS**: nomenclature of units for territorial statistics
- **PG ELP**: permanent grassland on established local practices
- **RDBMS**: relational database management system
- **RMSE**: root mean square error
- **RP**: reference parcel
- **SAR**: synthetic aperture radar

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5 Sources of spatial data in LPIS

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5.1 Imagery

Photographs and other images taken from airborne or satellite platforms are key means for documenting the surface of the Earth and the state of the environment. Since these images, once acquired, have geometrical distortions caused by the optics and the camera/sensor tilt, as well as the differences of the elevations of the Earth?s surface, they undergo a process of removing these distortions, called ?ortho-rectification?. The resulting specific product is called ?orthoimagery?. There are two major categories of sensors that derive image data depending on the technology used for data capturing ? passive and active. Passive sensors rely on the natural energy (radiation) that is emitted or reflected by the object or scene being observed. Reflected sunlight is the source of radiation measured by passive optical sensors. Active sensors, such as SAR and LIDAR, rely their own energy source for illumination. The sensor emits radiation which is directed towards the target to be investigated. The radiation reflected from that target is detected and measured by the sensor.

5.1.1 Aerial images

The most common source of reliable and up-to-date reference information for the LPIS elaboration and maintenance (upkeep), is the orthorectified image data of the Earth?s surface from passive optical airborne sensors. The current state of technological development of digital airborne sensors (cameras) allows the production of orthoimagery over vast areas in relatively short time, with image content and quality easily compliant with cartographic scale of 1:5.000 or better. Although the digital technology provides better quality in terms of radiometry and detail comparing to the classical analogue technology, there are some specific aspects, regarding the height of the flight and the processing chain. Acquiring aerial photography has also some constraints such as restrictions over military zones and air traffic lanes, as well as cumbersome administrative procedures to obtain flight permission in some countries. Cloud cover is not as restricting for aerial photography as for satellite imagery, due to the flexibility of flight planning and the alternative to fly at lower altitudes, but meteorological conditions are in any case affecting the radiometric quality of the photos.

5.1.2 Satellite images

Orthoimagery, suitable for LPIS purposes can be easily obtained also from very-high resolution (VHR) space-borne sensors, as they can provide the same information content and being of equal quality as the airborne sensors. However, much more attention should be paid during the ortho-rectification process. Contrary to the production of aerial orthoimagery, where the process can be assumed straightforward and the producer is in control of the relevant internal and external conditions, the quality of the satellite orthoimagery is very much dependent of ancillary data (GCPs, DEM) over which the producer often is not having direct control. The image content can be seriously downgraded, if an inappropriate orthoimage production process is or irrelevant ancillary data are used. It has been observed during the CwRS campaigns, that often the orthoimage producers pays usually little attention to radiometric quality, colour balance and the preservation of the image detail, at the expense of thorough check of geometric quality.

5.1.3 Radar images

Synthetic Aperture Radar (SAR) imagery is acquired by the so-called active sensors that capture the fraction of energy emitted by the sensor that is reflected by the Earth surface. SAR imagery is much more difficult to generate and interpret, as the information provided is not natural for the human cognitive perception. However, SAR is sensitive to the structure and alignment of vegetation, as well as to the soil moisture content, thus it can provide different type of information regarding the land cover and land use comparing to optical. One of the strongest points of SAR is that it can acquire and collect data in cloudy conditions; in such case it can be an efficient complementary data source to optical data, especially in areas with cloudy weather. SAR sensor records also some specific characteristic of the signal, such as phase and polarimetry that opens further possibilities with respect to feature detection, especially when full polarimetric, multi-temporal SAR data is available. Combining the information from optical and SAR sensors increases the information available for distinguishing each target class and its respective signature, and thus there is a better chance of performing a more accurate classification.

5.1.4 LiDAR

Lidar is a relatively novel active remote sensing technology that measures distance by illuminating a target with a laser and analysing the reflected light. The popularity of Lidar recently increased due to the ability of the technology to produce high-resolution datasets in various application domains. Lidar can be particularly relevant for the LPIS due to its capacity to extract easily small landscape features and produce highly accurate digital surface models. As radar, Lidar also requires specific skills and expensive software and equipment to manipulate, these factors still limit the broad implementation of Lidar for land monitoring. However, there are already successful examples in some EU Member States, such as Finland, in using Lidar data in the process of LPIS update.

5.2 Ground survey

5.2.1 GNSS

Although not considered primary source of information for the LPIS, data collected on the field using GNSS application, provides valuable contribution for the LPIS upkeep. Most of the field information using GNSS used for the LPIS, is gathered during the classical on-the-spot checks of the farmer declarations. Moreover field inspectors are required to report any findings on the correctness of the reference parcels and the EFA layer. Some EU Member States are also conducting occasionally more systematic field surveying using GNSS. GNSS can be regarded as autonomous geo-spatial positioning system with global coverage provided by satellites. It allows small electronic receivers (portable GNSS equipment) to determine their location (longitude, latitude, and altitude) to high precision using time signals transmitted along a line of sight by radio from satellite. The signals also allow the electronic receivers to calculate the current local time to high precision, which allows time synchronisation. There are several operational GNSS systems, the most common being GPS, GLONASS and DORIS, available at global level. The European system GALILEO and the Chinese BeiDou are still under deployment. To achieve higher precision, GNSS data is often augmented with correction data for network of ground-based GNSS stations for better real-time positioning and for enhancing the measurements for positioning with post-processing. Most EU member states already built such national networks, which are extensively used in GNSS area measurements required for on-the-spot control. The European Geostationary Navigation Overlay Service (EGNOS), currently provides also corrections to the geolocation data provided by GPS.

5.2.2 Classical geodetic surveying

In condition (poor satellite coverage, obstructions of the GNSS signal, mountainous terrain), classical surveying might be a feasible option. Geodetic surveys require the use of sophisticated instruments, accurate methods of observations and their computation with accurate adjustment.

5.3 Third-party data

5.3.1 Cadastral data

Geospatial data from the cadastre is used as a source of information for the LPIS, especially in those EU Member State having their LPIS reference parcel based on cadastre. The purpose of cadastre is primary to the outline the property rights and the usage boundaries of the cadastral parcels. If cadastral parcels represent a good match of the land cover and land use limits of the ground, cadastral registry can be considered as the optimal land management system for LPIS. However, this appears to be not the case in many areas. Use of cadastral systems remain popular due to the following advantages:

- they are available and familiar to the farmers;
- they are very detailed (scale 1:1.000 ? 1:5.000) and can be very accurate;
- they provide reference parcels with a unique reference number;

- they provide readily available gross area and sometimes official land use, almost always in digital format, allowing efficient administrative cross checks;
- they allow possible cross-checks with ownership information, if needed.

In any case for the purpose of the LPIS, cadastral systems need to be used in great care, due to the following drawbacks:

- they may have variable geometric accuracy, use local and/or various CRS;
- ownership boundaries often do not correspond to land cover boundaries;
- they may suffer from heterogeneous quality and date of updating;
- they may originate from ?irregular? map-sheets coverage (format, irregular shape, scales, north orientation);
- they may not be fully available as digital maps in rural areas;
- they are managed by external body with specific update cycle, business rules and quality procedure, over which the MS Administration responsible for IACS doesn?t have direct control.

5.3.2 Other third-party data

Other third party data, available in digital format that interacts with LPIS and can be a potential source for LPIS update is given in the table below. Third party data sets serve as a support to LPIS with various possibilities to identify crop classes or to locate protected, sensitive areas, and other relevant information within the parcels. This information comes from the spatial data sets under custody of other institutions, like Mapping Agencies, Environmental Agencies etc. and have different specifications from LPIS. Note that such use does not require modifying these data to the LPIS accuracy specification.

Dataset	Cartographic scale	Geographic coverage	Usability for the IACS/LPIS
Administrative Boundaries	Varies, depending on the administrative level (from 1:1.000.000 for NUTS levels, to 1:10.000 or even better for LAU levels)	National	Administrative boundaries at local administrative level ? LAU (municipalities, village lands), can be relevant for some of the administrative cross checks related to the 2nd pillar schemes under EU CAP
NATURA 2000	1: 100.000	National	Outline the geographic area where certain agriculture practices or activities can be restricted.
Other protected areas (wetlands, national reverses,...)	Usually also 1: 100.000	National	Outline the geographic area where certain agriculture practices or activities can be restricted.
Soil data	From 1: 250.000 to 1:25.000 in some countries	Local/regional/ national	Used in case when specific agriculture land cover types (mainly permanent grassland) subject to pro-rata that are present only on specific soils. Soil information can be important for the definition of PG-ELP and the correspondent minimum level of maintenance
Less Favoured Areas	1: 100.000?	National	LFAs benefit from area compensatory allowances, and from a number of payments for structural adjustment.
Land cover/land use thematic data (GIO)	Variable (1:100.000 ? 1:10.000)	Local/regional/ national	For cross-checking of the thematic information stored in IACS/LPIS on land cover/land use
Spatial data on servitude buffers along pipelines or high-voltage power lines; servitude zones along roads, water bodies, tailing ponds, dumpsites, or industrial facilities	Variable	Local/regional/ national	These are spatial datasets that define zones in rural areas with restrictions for agriculture activity

Table 1: Third party data in LPIS

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6 Geospatial features in LPIS

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To transfer the observed physical world into a digitized and computerized system as LPIS, we use geospatial features classes as a digital representation in space and time - a class groups features with a common definition, like ?trees?, or ?buildings?. Each LPIS entry (?instance?) is a one-to-one representation of the real object on the ground without making any assumptions in shape and size for the business needs. To associate information to this physical features geospatial feature classes have their properties in form of a geometric representation and alphanumerical information about these objects.

6.1 Feature properties

6.1.1 Geometry (spatial attributes)

Geometries deal with co-ordinates to store location and shape information. In LPIS, a feature type can have one or more basic geometry representation type in a form of Point, Curve or Surface. Each geometric object is associated with a Spatial Reference System, which describes the coordinate space in which the geometric object is defined. Since the objects are being represented in a two dimensional perspective (x, y), a collection of feature classes are corresponding to Points, Lines and Polygons.

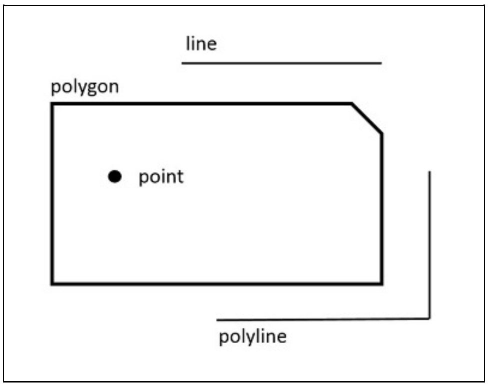


Figure 1: Basic geometry types in LPIS

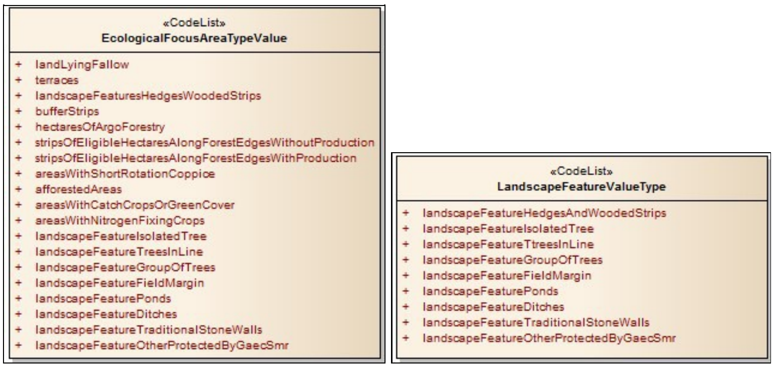
Geometries are selected and acquired according to the common geometric appearance of an object and the need for information about those. E.g:

- the reference parcel is represented as polygon for display on the computer screen and in the pre-established form/map,
- an agricultural parcel can be represented by a polygon where its boundary is an individual spatial feature, but it can ?inherit? the geometry of a reference parcel when occupies that RP completely.

In GIS modelling, a set of specific topology rules between features types and their geometries can be established to model more complex conditions: Two adjacent polygons share a boundary. The ?sharing? of a single line segment prevents the occurrence of gaps and overlaps between the two adjacent real world features. Understanding the rules and restriction that apply to the geometric representation of a spatial feature is essential for the correct application of spatial operations such as the spatial crosscheck.

6.1.2 Alphanumeric attributes

Attributes store information of properties of the feature. A single feature type can set out many attributes to record the id number, area, length, farm id, name, non-coordinate location, etc... In a GIS environment, some of the attribute values associated to a feature can come from a pre-defined code list, an enumeration or can be user defined free text. Values can be entered into the system or derived from the geometry residing inside. Some attribute values (e.g. area values) can be essential for any alphanumeric crosscheck.

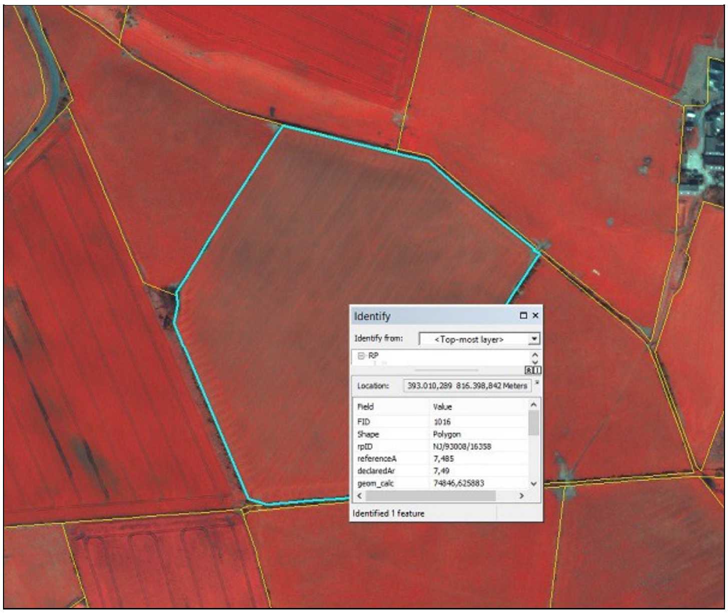

«CodeList»
EcologicalFocusAreaTypeValue

+ landLyingFallow
+ terraces
+ landscapeFeaturesHedgesWoodedStrips
+ bufferStrips
+ hectaresOfArgoForestry
+ stripsOfEligibleHectaresAlongForestEdgesWithoutProduction
+ stripsOfEligibleHectaresAlongForestEdgesWithProduction
+ areasWithShortRotationCoppice
+ afforestedAreas
+ areasWithCatchCropsOrGreenCover
+ areasWithNitrogenFixingCrops
+ landscapeFeatureIsolatedTree
+ landscapeFeatureTreesInLine
+ landscapeFeatureGroupOfTrees
+ landscapeFeatureFieldMargin
+ landscapeFeaturePonds
+ landscapeFeatureDitches
+ landscapeFeatureTraditionalStoneWalls
+ landscapeFeatureOtherProtectedByGaecSmr

«CodeList»
LandscapeFeatureValueType

+ landscapeFeatureHedgesAndWoodedStrips
+ landscapeFeatureIsolatedTree
+ landscapeFeatureTtreesInLine
+ landscapeFeatureGroupOfTrees
+ landscapeFeatureFieldMargin
+ landscapeFeaturePonds
+ landscapeFeatureDitches
+ landscapeFeatureTraditionalStoneWalls
+ landscapeFeatureOtherProtectedByGaecSmr

Figure 2: Pre-defined code lists for EFA type values and LF type value



Identify from: <Top-most layer>

Location: 393.010,289 816.398,842 Meters

Field	Value
FID	1016
Shape	Polygon
rpID	NJ/93008/16358
referenceA	7,485
declaredAr	7,49
geom_calc	74846,625883

Identified 1 feature

Figure 3: Example of attribute information associated to a reference parcel

6.2 Spatial relationships ? geometry rules

6.2.1 Topology

To assure the concept of ?unique area? definition in LPIS, topological relationships must be respected during the digitizing process and data processing. The common topological rules applied for vector data - line and polygon feature types - are: Line errors - dangles, switchbacks and knots, are not acceptable in case one spatial object or its boundary or border is represented by polyline. The resulting geometric length of the line cannot be used to calculate length, perimeter or area of that feature. Polygon errors ? slivers and gaps, create either less respectively more (double counted) areas in the system than there is present in the real world. Within a single data set of ?unique area? in LPIS, topology must be free of these common artefacts. Artefact means that the set of coordinates do not represent (a part of) the feature in the real world.

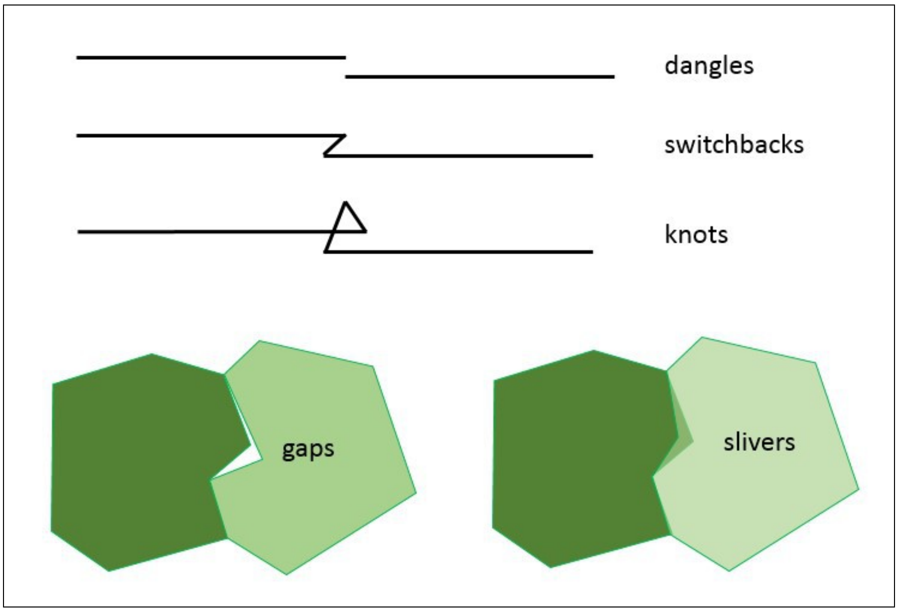


Figure 4: Topological errors

Figure 5: Example of gaps and slivers within the ?RP layer? in the system

To some extent, spatial overlapping between geospatial features from different data sets will be possible and it largely depends on the parcel and landscape feature definition from each individual system. The figure below illustrates a controlled overlap between data sets. The green polygon (1st data set) holds an area, and on the top of it is another yellow polygon (2nd data set) holding its area. The final accounted area is not the sum of the two polygon areas, but the area from the polygon with the biggest extent.

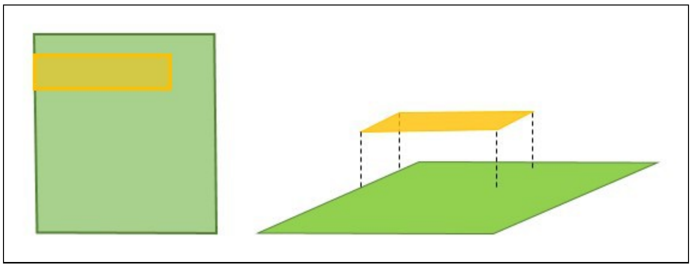


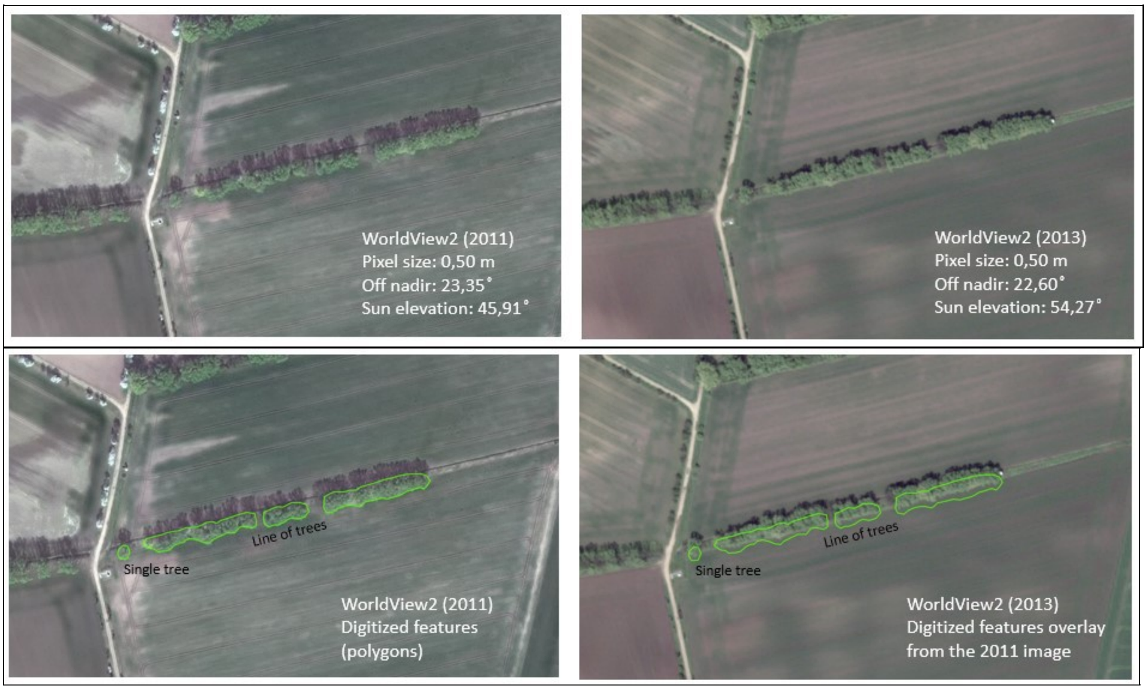
Figure 6: Controlled overlap of two features

Controlled overlap is possible for the eligible features, whose area doesn?t have to be excluded from the maximum eligible area of the reference parcel, but the presence of the feature should be recorded and graphically represented in LPIS. Note that the ?unique area? concept implies a 2-dimensional space: iIn IACS, it is relevant only for features? spatial properties on the ground level. Furthermore:

- ground level (from the DTM) defines the spatial canvas for orthoimagery production,
- eligible hectares such as arable land, permanent grassland are defined by the ground level vegetation.

The unique area concept and subsequent topologic rules are irrelevant between spatial attributes that relate to different levels of representation of one and the same natural phenomenon: For instance, a tree canopy has its largest expansion several meters above ground level, so

- it can easily cover and overlap with arable land below (and possibly obstruct the latter?s visibility),
- its position on orthoimagery will become over-susceptible to perspective displacement.



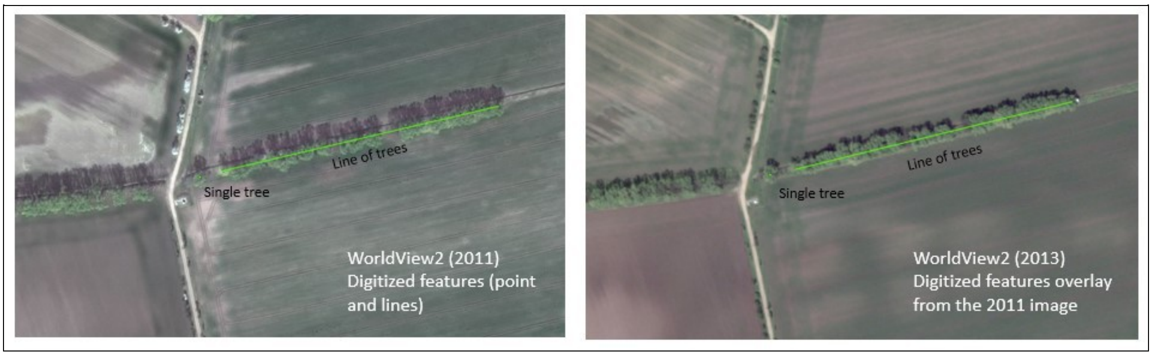


Figure 7: WV2 0.5 m resolution image taken at two different moments with a different off nadir angle.

Figure 7 shows the low positional accuracy of the digitized polygons of the tree canopies visible when viewing them against a later image. The positional accuracy of the digitized lines of the tree trunks is suitable for both images. To deal with the 3 dimensional reality of features and respecting the unique area requirement, some feature types will require multiple geometries, including one for the representation at ground level.

6.2.2 Inheritance principles

Based on the MS?s choice, some features may have common geometry and some of the features might share a common boundaries, Depending on these choices, ensure that at the level of the coordinates that build up these geometries, lines would have to coincide with the polygon edges, points would have to fall along the line feature, or would have to be within the polygon areas, etc. If a particular feature is classified into two spatial feature types (e.g. a hedge is BPS eligible area and EFA element or a crop acts as agricultural parcel and reference parcel), then the corresponding geometry must be common for all feature types. I.e. a common polygon is shared by all instances of that feature.

6.2.3 Consistency

If a spatial or alphanumeric rule applies to one feature, it should apply to all instances of that feature types. Rules cannot be applied on a feature by feature basis but always on the class.

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7 Layers in LPIS

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7.1 Layers in general

The modern GIS stores the geospatial and associated alphanumeric information in specific tabular form, structured and organized according to the rules of the relation databases management system (RDBMS) applied. However, the representation (in the sense of portrayal and display) of the geospatial information is done through the concept of ?layers?. Layer can be considered the visual representation of a geographic dataset in any digital map environment. Conceptually, a layer is a stratum of the geographic reality in a particular area. Every single stratum holds geospatial features sharing common characteristics and properties associated to one or more given feature classes (or types). The layer is more or less equivalent to a legend item on a paper map. On a road map, for example, roads, national parks, political boundaries, and rivers might be considered different layers. Grouping geospatial features with common characteristics into layers allows the user to manipulate each set of features individually. The specific portrayal rules can be defined and applied for each layer making the different features classes well distinguishable. Layers are of key importance for any spatial analysis and data querying, as they provide the interface needed by the user to be able to understand the spatial relationship between the geospatial features and classes represented. Although the notion of the layer in GIS is quite close to the old analogue map production concept, based of overlaying of different ?hardcopy layers? of thematic data, digital layers in GIS do not have the same physical nature, as they are not the ?containers? where the spatial data is stored. Layers can be simply regarded as sets of queries and the rules for representation of particular spatial features that reside (and remain residing) in the geodatabase. Whereas ISO 19128:2005 defines layer as ?basic unit of geographic information that can be requested as a map from a server?, different GIS software use the term for slightly different concepts. Still, but the term ?layer? is mostly used in one of two GIS functionalities:

- for controlling the display and portrayal of sets of spatial features. This use is quite similar to the concept of colour film in the cartographic printing process,
- for organising selected spatial feature in sets in preparation of and storing the results of spatial queries operators such as masking, vicinity analysis, intersections, etc.

There are two technical implementations for organising data in layers; one is raster-based, the alternative is vector-based. Orthoimagery is the raster layer produced from raw sensor images by removing perspective and topographic distortion. It has is no practical vector equivalent.

7.1.1 Raster layer

Raster layer is usually a layer that references a raster as its data source and a raster renderer that defines how the raster data should be rendered, as well as any additional display properties. Any modifications made in the raster layer do not affect the raster data, as they only control the way how it is rendered at the time of viewing. Certainly, any modification of the original raster dataset, would be reflected by the raster layer. The most important viewing properties having direct impact on the photointerpretation for the LPIS purposes are as follows:

- band combination: the image bands selected for visualization and the way they are mapped into the RGB space,
- image data stretch: the function used to position (stretch) the DN values of the image histogram in the given display range,
- resampling: the methods used to resample the image data for display purposes.

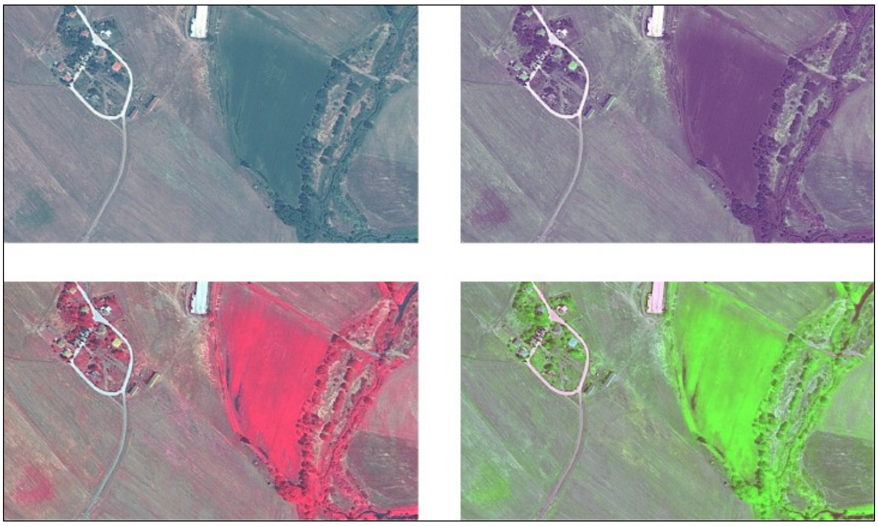

Figure 8: An orthoimage rendered with different mapping of the image bands to the RGB (Red, Green, Blue) space

In order to obtain correct positioning of the image data in the selected coordinate reference system (CRS) of the particular GIS instance (project), it is essential to specify correctly the CRS in which the (ortho) image data is delivered. Although, it seems straightforward, experience shows the different GIS environments uses slightly different descriptions and libraries for the same CRS. They can also differ from the description of the CRS in which the orthoimage was created. This require a careful check of the CRS parameters, such as datum, geographic projections, position of pixel coordinate, any specific shifts, in order to guarantee correct transformation and display of the rendered image data. Another important aspect is the presentation of the original spatial resolution of the acquired images. Not only the resulted orthoimage should have pixel size correspondent to the ground sampling distance (GSD), but the resampling approach for display of screen in the GIS environment, should be selected in a way to preserve the information content. Same is valid for the representation of the DN values of the image pixel on screen, as the correct colour palettes compatible with the radiometric resolution of the image rendered, has to be used.

7.1.2 Vector layer

Vector layer is a layer that references a set of feature data. Such set may include points, lines, and polygons. Similarly to the raster layer, vector layer controls how and which of the feature data is displayed and annotated, without an impact on the actual data content stored in the RDBMS. The most common displaying properties (portrayal rules) are:

- symbology: the map symbols used and rules to rendering your data (colours, line types, fill options),
- labels: the label expressions, label classes, and labelling options for label placement and symbology,
- display order: the way feature data is displayed, while moving in the view.

As a vehicle to hold the spatial attributes of database features, layers have to comply with the following requirements:

- the layer (data sets behind it) must be defined in a well-documented coordinate reference system, appropriate for the purpose of the layer. In particular the Regulation imposes the use of a nationally recognised CRS. If several regional CRS are used within a MS, features of different regions must be transformed (re-projected) into the national CRS. Note: since all CRS involve some kind of distortion an area attribute of the spatial feature calculated from the original geometry, will no longer perfectly match the area of the converted geometry. This is not necessarily an issue.

- positional accuracy of each spatial co-ordinate must be of roughly the same level. Or specified from a cartographic viewpoint, the scale range must be applicable for all features in the layer.
- a different lineage (historic cartographic material, different aerial flights) may cause discontinuities (small coordinate shifts) between different features on either side of the line between lineage. These have to be addressed once and for all for the set of effected features

Topological and hierarchical rules must be respected. In particular,

- layers that are used to represent unique areas within a given theme (e.g. eligible hectares, EFA elements) cannot support overlaps (no ?double slivers?),
    - adjacent features must have a common boundary in the layer (no ?empty slivers?),
    - any hierarchical rule on the geometry of the features must be reflected in the layer. Merely allowing the population process sequence to determine the final result (e.g. ?last one on top? is not a good practice),
    - Tessellation (complete coverage of the layer) is not required; controlled gaps are allowed.

It goes without saying that many of the above rules and conditions should have been considered when the spatial database was made and kept up. In that case, the layer creation process becomes a pretty straightforward extraction.

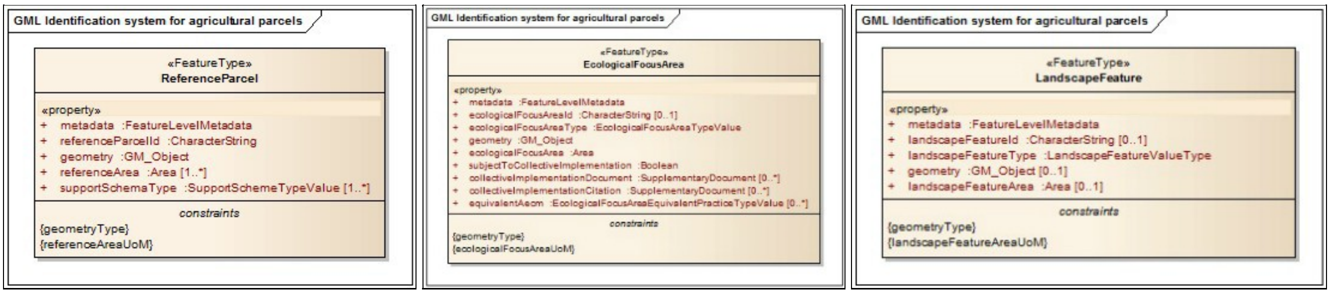

Figure 9. Classes of ?core? LPIS layers ? RP, EFA, LF

7.2 Single feature layers in LPIS

The Reference parcel layer is the oldest and most familiar layer in the LPIS. But in fact it is a single feature layer only in those block systems that combine identification of the land (RPid) and quantification of eligible hectares (reference area). Any eligibility or ineligibility mask represents a layer of consistent land cover observations. For eligibility masks, it groups the various land cover classes of the eligibility profile, the ineligibility mask represents the contrary. The geospatial application produces the feature that populates the agricultural parcel layer. It is an annual layer and although many farmers co-author that layer. Series of automatic crosschecks ensures it meets the above requirements.

7.3 Interacting between different layers

Just like certain conditions apply when a single spatial layer is created from a set of spatial features, a number of requirements need to be respected when two layers are combined for spatial analysis or data processing for the generation of new set of features. To produce useful information, all layers:

- must be defined in a common, appropriate CRS,
- hold features with a compatible positional accuracy or with an compatible range of cartographic scale,
- represent the earth?s surface within a compatible time frame.

An illustration of how critical these conditions are is given by the ortho-rectification process. Indeed the GNSS-surveyed GCPs, the sensor position (from flight navigation system) and the digital elevation model represent three layers from different sources that together produce an orthoimage layer (in the national CRS). The DG JRC has plenty of examples of cases where a small defect in any of the sources causes defective imagery (page 15. ftp://mars.jrc.ec.europa.eu/LPIS/Training_2011/PDF/tallinn2011_ETS_12_final.pdf). Very often, the interaction process directly propagates the spatial errors of each contributing layer in the result and the final quality can at best equal the quality of the poorest layer. Often the result can be even worse. It is therefore essential that the quality of each layer is documented and controlled and the appropriateness of the layer combination is assessed and appropriate action is taken.

7.4 Multiple feature layers in LPIS

Non-Block reference parcel designs use a combination of a cadastral parcel or topographic block with an (in)eligibility mask. This can be a viable option, but a quality problem in either of the combining layer, most likely present in the third party source layer, can make the result substandard. In particular, cadastral parcels can run the risk of being obsolete or have insufficient positional accuracy to represent the actual physical state of the land concerned. In that case, these data should not be considered. On the other hand, if a cadastral index layer does accurately match the current and true situation, it can freely be combined to act as reference parcel even to constitute a hybrid block system because the resulting information has not been subject to degradation. EFA layer is explicitly mentioned in the Regulation but, pending on the implementation choices made by the Member States, it can hold the geometries of a broad range of features, such as landscape features, strips and practices. Compiling a technical EFA-layer is potentially not a simple or straightforward process, because of the heterogeneity of the spatial features that could constitute an EFA-element.

7.5 Area calculation

Area values stored in the different layers of LPIS refer to the ortho-projected area; i.e. the area of the two-dimensional graphic representation of a physical object on Earth in which all the projection lines were orthogonal to the projection plane, defined by the CRS. For objects with well-distinct third dimension (trees, buildings) the considered area is the ortho-projected area of their physical footprint. In the case of tree, it will be the trunk with the associated area; in the case of building, it will be the footprint of its base, and associated area.

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8 Positional Accuracy

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In GIS, among other technical issues, positional accuracy of the coordinates is perhaps the most important as it represent the "raison d?etre" of the GIS. The topic covers concerns for absolute and relative accuracy, error, uncertainty, scale, resolution and precision and affects the ways in which data can be used and interpreted. As digital geospatial data always represents an abstraction and approximation of the reality, there is a certain degree of inherent inaccuracy with respect to the real world. This also stems from the fact that when reality is modelled into a digital representation, there is always a process converting the continuous values that characterize any world phenomenon into the discrete set of values used by the computer systems (quantization). The adverse effects of approximation and quantization can be reduced by information systems with a higher numerical level of detail (see Table 2). So the question always is: how well can digital spatial data represent the real world and how well does the tools or sensors compute or capture (measure) the true values?

For LPIS, minimum accuracy requirement is defined in Article 70. of Regulation (EU) 1306/2013 as at least equivalent to that of cartography at a scale of 1:10.000 and, as from 2016, at a scale of 1:5.000. This translates into:

- a horizontal absolute positional accuracy expressed as RMSE of 1,25m (5.000 x 0,25mm = 1,25m), or the equivalent CE95 value,
- display range and feature type content compatible with a map with a scale 1:5.000 (i.e. topographic maps rather than urban survey maps),
- using orthoimagery <= 0,5m GSD.

The values specified above are also the basis of the the Geospatial Positioning Accuracy Standards of the US Federal Geographic Data Committee (from 1999), where the planimetric (X or Y) accuracy for a mapping scale of 1:5.000, expressed in RMSE is 1,25 meters. In GIS environments, measuring length and surface (area) depends on the geometry coordinates inside a system setting. It is therefore important to work in a unique and common coordinate reference system for the national or regional coverages.

8.1 Coordinate reference system

To be compatible, spatial data sets must be defined in or transformed into a common spatial canvas: the CRS (coordinate reference system). Each national mapping agency will have defined its own CRS for an optimal cartography of the coordinates, but any coordinates can be transformed from one CRS to another if both CRS are properly defined. For this, the CRS contains a geodetic datum (a reference to the earth?s globe) and a coordinate projection system (transforming the idealised globe to the mapping plane). Improper CRS processing will cause problems when data are integrated.

8.1.1 Shifts

Shifts usually occur as an improper implementation of the unique CRS by one or more data sets. In the figure below there is a systematic displacement between reference parcel layer and orthophoto. It is visible that the selected reference parcel is shifted eastwards and a bit northwards (as indicated by red arrow). Shape and area of the parcel is not different than the feature on the orthophoto image it represents. This kind of error is systematic and, when identified, easy to adjust by re-projecting and translating the affected data set(s).

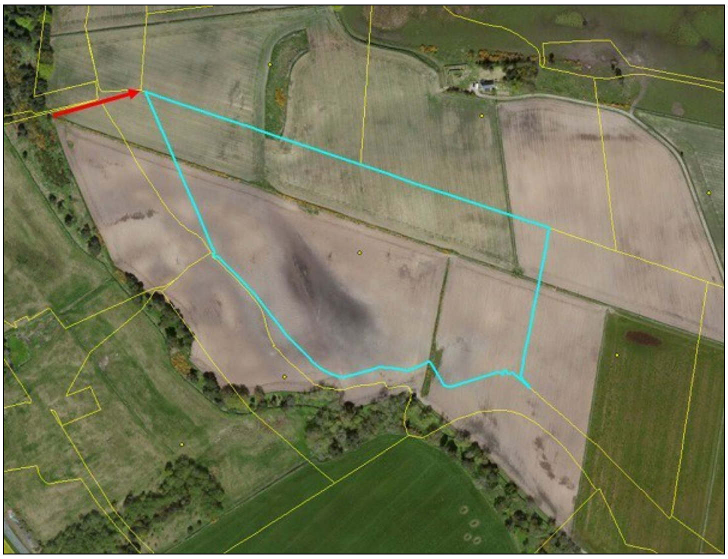

Figure 10: A typical shift between reference parcel layer and orthophoto caused by different use of CRS

A non-systematic shift is more problematic when it occurs within a system. It is usually a legacy issue within the data sets that were converted from old paper maps into the digital format. Some parts within the coverage had a different coordinate system adjusted to the local needs in the past. So, in the process of merging all areas and creating a single seamless digital spatial coverage, some of the feature boundaries are not following the same line on the newest imagery. This kind of error makes a risky quantification of the agricultural areas within the parcels, and have to be addressed on a case by case basis by the responsible authorities.

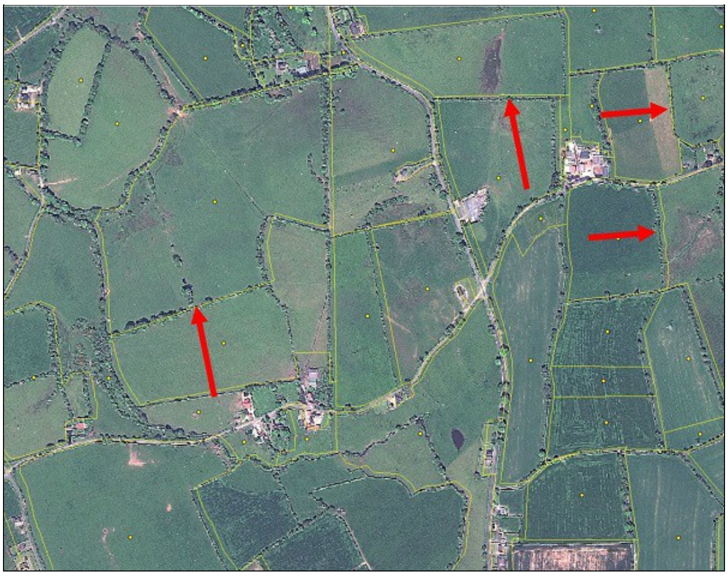

Figure 11: A non-systematic shift between reference parcel layer and orthophoto

The figure above is showing a non-systematic shift. Some of the parcel boundaries are perfectly following the lines of the hedges, while others are displaced unevenly. Spatial discrepancies are up to 15 meters. A localised, parcel based correction is not a solution, as it would not be applied in the same direction for all surrounding parcels. Some parcels would grow into their neighbour. In such a case, a complete revision in a form of mapping adjustment of the data set should be carried out.

8.1.2 Edge-matching

Edge matching is a spatial processing procedure of connecting vector data digitized from separate paper map sheets. Each paper map sheet has been subject to an individual stretch and shrink and separate maintenance processes. Objects on the edge of the map sheet are usually cut in two parts due to the map sheet margin. To assure the continuity over neighbouring map sheets, the object must share common coordinates on both map sheets. In GIS, this operation is called merging within the same feature class (and the same object ID number). Edge-matching is the process to determine which edges (lines) should be linked among candidates. Another common case to encounter happens when it comes to joining different administrative units. The boundaries of the neighbouring administrative units might not coincide. Administrative boundaries are often of a scale much smaller than 1:5.000. Usually, the land inventory is made in such a way that inside of one administrative region, parcels have a homogeneous geography. But along the administrative border, neighbouring parcel might be overlapping. On the figure below there is an example of administrative boundary that doesn?t follow the true physical boundaries of the parcels. Note that yellow and red lines are slightly displaced, hence forming gaps and slivers between neighbouring parcels if not topologically fixed.

Figure 12: A mismatch of administrative boundaries between two bordering municipalities

The geographic homogeneity requirement for the data sets should not be seen too restricted as long as the minimum quality is fulfilled. Best practice to deal with the spatial merger is:

- define homogenous patches,
- bring into target CRS,
- perform edge matching where possible,
- resurvey where needed.

An overall solution for dealing with spatial displacement, regardless of its nature, might be to subdivide the system into smaller homogeneous parts and go from a national to regional based system. The decision should be followed by a careful analysis of all parameters to guarantee consistency in IACS.

8.2 Units and precision

With reference to Article 33(1) of Regulation (EU) 1307/2013 farmer applications shall contain declarations of the parcels corresponding to the eligible hectares accompanying payment entitlement. Hence, hectares are the basic units needed in the system for the payment. Declarations require an area precision of 0,01 hectare. System shall operate on the basis of 1:5.000 map scale, and there are many constraints for the maximum widths for the landscape features and EFA elements expressed in meters. So for technical purposes, it is recommended to express all area values in the system in the square meters with at least 2 decimal places, or hectares with 6 decimal places. All length and distances should be expressed in meters with 2 decimal places. As a rule of thumb, to exclude rounding issues, calculations and operations will be done with a 2 digits higher decimal precision compared to the same recorded in the system (see Table below).

	m2	Ha	m
Parcel area stored in the system	51048,25	5,104825	
Parcel area displayed on the screen	51048	5,1048	
Length of a feature stored in the system			7802,48
Length of a feature displayed on the screen			7802

Table 2: Example of unit precision of areas and lengths in IACS

8.3 Minimum mapping units

In technical terms, the minimum mapping unit (MMU) at a given mapping scale is the size (expressed in area units) below which a feature cannot be reliably identified and reasonably represented by a polygon, or its individual area properly quantified. In the given context, it refers to the size of the smallest feature captured in a vector mode from a raster background. Since LPIS uses 0,5 m resolution orthophotos for all spatial IACS processes (LPIS update, LPIS QA, CAPI in OTSC), setting up the minimum mapping unit in the data capturing process is of key importance. Digitisation in vector mode will be in the function of the display scale of the source orthophoto map. In the figure below there is an example of a pond present on an infrared 0,5 m resolution orthoimagery. Using the GIS tool, the pond is zoomed in and out at a different map scale on the map viewer (screen) for the purpose of photointerpretation and a possible mapping.

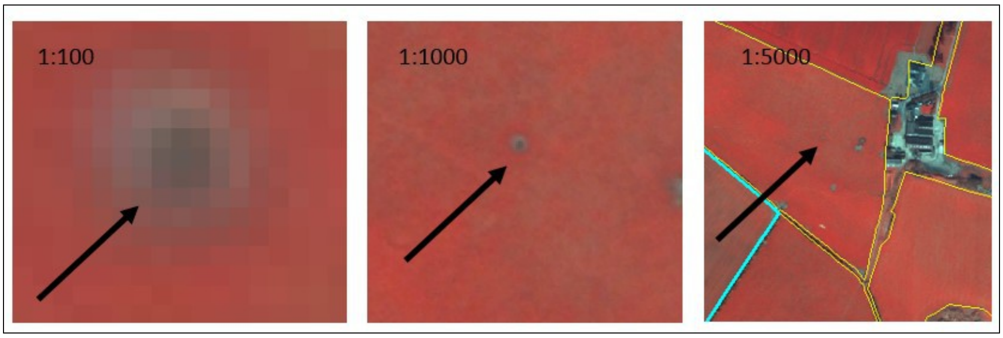

Figure 13: A pond found on an orthoimage represented on the screen at a three different display scales

At a zoom scale of 1: 5.000, the feature is barely visible, but at least its presence can be detected. The zoom at scale 1:1.000 provides sufficient information on the nature of the feature in order to be at least identified as a pond. However, quantification of its area through mapping as polygon is not possible. The zoom at scale 1: 100 makes the feature bigger enough on screen to allow digitization. However, due to the size of the pixel, the pixelisation (quantization) effect prevents the reliable representation of the features as polygon, and consequently correct area calculation. Since neither the identification of the nature of the feature, nor its area quantification is possible at the scale of 1: 5.000, this feature is considered below the MMU and thus should not be represented in the LPIS as individual mapped feature. The example above clearly shows the link between the mapping scale, the spatial resolution (pixel size) and the MMU. In order to be considered suitable for a giving cartographic scale, the pixel size of the orthoimagery should allow both a proper identification of the feature type and correct area quantification. Opposite is also valid: for an image with a given pixel size, the MMU is the size of the smallest object of interest that can be both identified and quantified. As a consequence it can be said, that the size of the minimum mapping unit is a function largely of:

- the cartographic scale of the product ? defining the minimum size of the mappable feature
- the purpose of the product ? defining the features of interest the dataset should contain

For example, MMUs of topographic maps and wetland maps at the same cartographic scale might not be the same. Even within a dataset (for example, land cover map) there might be different MMUs for different land cover classes. There are currently two different functional minimum mapping units in operation in IACS. The 2004 LPIS creation guidance allowed for an MMU on ineligible inclusions up to 0,1 ha or 1.000 m2 for calculating the MEA. This provision directly applicable to all production blocks, whose exterior perimeters were expected to follow agricultural land borders. There was no MMU at production block perimeters. The OTSC specifications required individual accountability for all combined ineligible features larger than 0,01 ha or 100 m2, resulting in an area measured and area determined. To have an idea how large is the 100 m2 compared to previous example with a pond, there is a 10 x 10 meters box drawn (or 20 x 20 pixels; 1 pixel = 0,5 m) around the pond in the figure below.

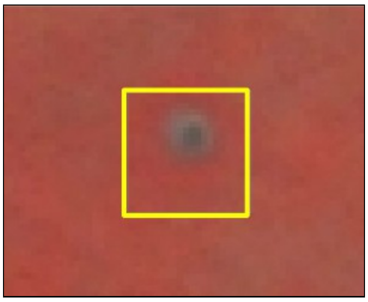

Figure 14: 10x10 meter box around the pond (zoomed at ~ 1:500)

The following table provides a suggestion of the smallest mappable objects, which could be integrated in a 1:10.000 and 1:5.000 coverage as derived from relevant orthophoto, without risk of exaggerating their area or displacing their boundaries.

	1 m pixel size orthophoto		0,5 m pixel size orthophoto	
	Area	**Linear object**	**Area**	**Linear object**
In the field	0,1 ha	10 m width	0,03	5 m width
On the map	3x3 mm	1 mm	3x4 mm	1 mm

Table 3: indicative size of the smallest mappable objects

The table given above, provide information the size of the identifiable objects in relation to the pixel size. Taking also into account some previous studies of JRC, it can be concluded that:

- to detect the presence of a feature, it must be at least 3 x pixel size,
- to identify the nature of a feature, it must be at least 20 x pixel size,
- to map (measure the area of) a feature, it must be 35 x pixel size.

Thus, OTSC can assess presence of a feature with much lower resolution than was required for the original capture in the LPIS. It should be noted also that the nature of the object determines the resolution required.

8.3.1 Minimum parcel sizes

The Regulations and DG Agri guidance specify minimum area dimensions for particular elements that have to be respected in any case.

8.4 Error propagation and final accuracy

8.4.1 Spatial overlay

Information from two different spatial data sets are comparable and can be used together for spatial analysis if their specification is well-know and if their quality (spatial accuracy/precision, temporal accuracy) is well recorded. Quality issues present in the sources layers will certainly affect any results from their integration. Often the result can be of even of worse quality than the worst of the two. Although GIS provides the technology for overlaying any different data sets, as far it respect certain format, combination inconsistencies and errors can occur and jeopardize a meaningful and final information of the result. Different datasets sharing same specification with respect to information content and spatial accuracy can be considered compatible for their integration into any spatial data processing without specific considerations. Otherwise, a careful analysis must be carried out in advance to assess at what extent the datasets can be integrated and what the impact on the final product will be.

8.4.2 Data quality

Error is introduced at almost every step of LPIS database creation. For example, the data may contain measurement inaccuracies, if an inappropriate map source was used. Measurement inaccuracies can occur during data capture, i.e. digitising data from a printed map (very often in conversion of cadastre sheets into the digital format), or errors arising from measurement instruments that is not validated. Further errors may be introduced during data processing or even using inappropriate tools for data analysis. In this paragraph the focus is only on positional error propagation in LPIS, since other error types (related to data content) are a matter of concern in LPIS QA ETS guidance. The usual accumulation of errors in the process of creating the LPIS or derived information is adding up the following:

- data acquisition error,
- data processing error,
- data conversion error,
- data analysis error.

Testing of the final LPIS (positional) accuracy is possible with an independent source of higher accuracy. It can be done on a map of a larger scale and with the use of GNNS and survey data. An estimation of overall accuracy can be achieved by summing up the squares of the computed accuracy of each individual component and taking the square root of the sum. In short, the necessary quality of any spatial data can and should be measured by such tests and computations. It should be documented in the metadata of the data set and consulted before every attempted use.

8.4.3 Interaction of spatial datasets with different specifications

Use of data sets shall be homogeneous with reference to the Regulation. Maps, land registry documents or other cartographic references, as well as aerial or satellite imagery have to be homogeneous **within the set** in order to assure a required level of accuracy. This doesn?t mean that all data sets need to be at the same accuracy level, as long as the combined and resulting information meets the minimum requirement. I.e. some lower resolution imagery could be used to identify the crop pattern (to assign the true crop class), but the actual measurement of the area for that class should be done against the data set that provide the required minimum accuracy. Some third party spatial data sets could have an added value in identifying issues on the parcel level. In such cases and if the level of accuracy isn?t the same, no high level nor accurate positioning or matching of feature boundaries can be carried out between two data sets. The same feature represented on two or more map scales can look slightly different due to simplification and reduction of feature shape complexity by the so called cartographic generalization process. In this process a map operator moves the simplified shape of the features? geometry in order to retain presence of the feature at the expense of the features? true position. In certain cases, the semantic relationship between the thematic information stored in the third party spatial dataset (wetland map, protected areas, and national land cover information) and the LPIS, needs to be assessed prior to any integration. This is especially valid when the difference in the thematic scope between the datasets is of such magnitude that they might be hardly related or compatible. In the figure below is the example of ?Natura2000? zone overlaid with reference parcel layer and orthophoto imagery at the 1:5.000 scale. Since ?Natura2000? data has been digitized from a lower precision map 1:100.000 (see generalized lines along the road), one cannot simply do the cutting to exclude the small southern part of the reference parcel concluding it is not within the protected zone. Hence, it is used only to identify the whole parcel within the protected zone (see that the majority of the land belonging to RP is within the zone).

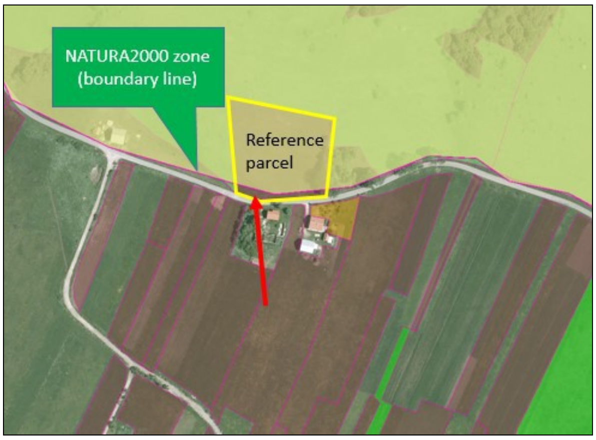

Figure 15: use of two data sets with a different level of accuracy for identification purposes

It is important to point out that determination whether a reference parcel belongs fully inside of the protected area should be a result of a visual interpretation on a case by case basis. It might happen that a big block representing a RP is only partly within the protected zone of ?Natura 2000?. In principle, authorities should develop a spatial analysis method to come up with the best practice how to combine two data sets with a different precision for the identification purposes. An example of the possible spatial analysis scenario with a fictious overlapping % could be:

- perform overlap query between the data sets,
- calculate the geometric area of the RP overlap,
- select all RP?s where RP overlap is < 20% of the reference area and perform a visual check of each RP to enter a flag if fully inside of ?Natura 2000?,
- select all RP?s where RP overlap is > 20% of the reference area and perform a further delineation of each RP (based on 0,5 m resolution orthoimagery taking into account Natura 2000 zone line) to separate and determine protected RP MEA and unprotected RP MEA.

8.5 Spatial interaction between the LPIS layers

The spatial information stored in the LPIS system can be represented by and operated through four ?core? layers:

- layer of the reference parcels (RP), with their unique ID and reference area,
- layer of the Basic Payment Scheme (BPS) containing the main agriculture land cover types (arable land, permanent crop and permanent grassland),
- layer of the various Ecological Focus Areas (EFA),
- layer of Landscape Features (LF) subject to retention according to GAEC standard 7.

The degree of semantic and topologic relationship -overlay rules and spatial hierarchy- between layers is specific for every layer pair and depends on the scope and definition of the feature types represented by each layer. BPS and RP are interdependent as the BPS layer is derived from delineated agricultural land cover within each reference parcel boundary taking into account all necessary exclusions of ineligible features. In some cases (in the farmers block systems and agricultural parcel systems), RP layer and BPS layer will share a single representation, hence only one layer is present in LPIS. EFA layer contains, among others, a subset of the features residing in the LF layer, if such layer exists, thus no features are digitized twice. It should be noted, that for some LPIS systems that are storing the landscape features by alphanumerical recording at RP level, LF layer with individual geometries might not be even feasible to generate. There is no direct topological relation between the EFA and BPS layers, apart from the fact that the presence of certain EFA elements is restricted to the extent of the arable land within the BPS layer. The same is valid for the LF and BPS layers: individual landscape features are not represented in the BPS layer, as they area is dissolved in (or attributed) to the correspondent ?BPS polygon?. The Table below aims to provide an overview of the ?core? layers from LPIS: their content, basic topological rules applied, as well as the most common interactions between them (see also guidelines on EFA document DSCG/2014/31-FINAL).

Layer	Content of the layer	Topological rules in the layer	A possibility of spatial interactions in function of: Area calculation at RP level	A possibility of spatial interactions in function of: Selection and attribution of features to EFA
Reference parcel (RP)	Polygon representations of the reference parcels (management unit of agricultural land)	No overlap between features is allowed. Controlled gaps are allowed	Polygon area - directly from RP polygon	N/A
Basic Payment Scheme (BPS)/Single Area Payment Scheme (SAPS)	Polygon representations of the maximum eligible agriculture land cover types ? arable, permanent crops, and permanent grassland ? found within reference parcels	No overlap between features is allowed. Controlled gaps are allowed.	BPS area (reference area/MEABPS): - through spatial intersection of RP and BPS layers (and the third like ineligible mask)	N/A
Ecological Focus Areas (EFA)	Polygon/line/point representation of the EFA found on the BPS layer	Controlled overlap between features is allowed.-	EFA area ? through: 1) spatial intersection of EFA layer with BPS and RP layers; 2) spatial join of resulted EFAs within intersection; 3) attribution of the total area of resulted EFAs to the given RP	Selection by location of all LFs present on arable land in BPS layer. Copying of geometries and attributes of LFs into EFA layer
Landscape features (LF), if mapped	Polygon/line/point representation of the eligible landscape features subject to retention (GAEC 7) found on the agriculture land of the BPS layer	Controlled overlap between features is allowed	LF area - Through. 1) spatial intersection of LF layer with RP layer; 2) spatial join of resulted LFs within intersection; 3) attribution of the total area of resulted LFs to the given RP	N/A

Table 4: basic characteristics of the core LPIS layers

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9 Conclusion

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For successful data integration and analysis, all spatial features of any given feature type, represented in the specific layer, should be homogeneous and consistent. This means they are subject to the same coherent and standardized processes of creation and upkeep, and compliant with all specifications of the feature type of interest. When these conditions are met, spatial interactions and queries between LPIS layers in the context of IACS/LPIS become fairly straightforward and require not more than the basic GIS software functionalities and applications.

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European Commission
Joint Research Centre - Institute for Environment and Sustainability

Title: Manage of layers in LPIS

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