LPIS Quality Assurance Framework

Based on JRC IES/H04/P/PMI/pmi D(2011)(13519)

ANNEX II

Executable Test Suite (ETS)

Flow of events, related to the inspection of the Reference Parcel, version 5.3

May 2014

Developed in accordance with the LPIS data quality measures listed in Annex I

Release notes (changes/updates from version 5.3 2013):

- After the point VI.2.ii the note has been added – crop measurement
- The new step has been introduced – check whether the parcel has been correctly classified with regard to presence of critical defects (activity diagram has been changed)
- Flow of events – the note in the point VI.3.iii has been added (for landscape features smaller that 2m)
- Initial acceptance of the orthoimage for ETS has been removed from Annex II into Wiki

ANNEX II: Description of the workflow, related to the inspection of the Reference Parcel, version 5.3 (May 2014)

ETS Inspection

1.1 Activity Diagram

The following UML diagram show the activities, related to the inspection of the Reference Parcel:

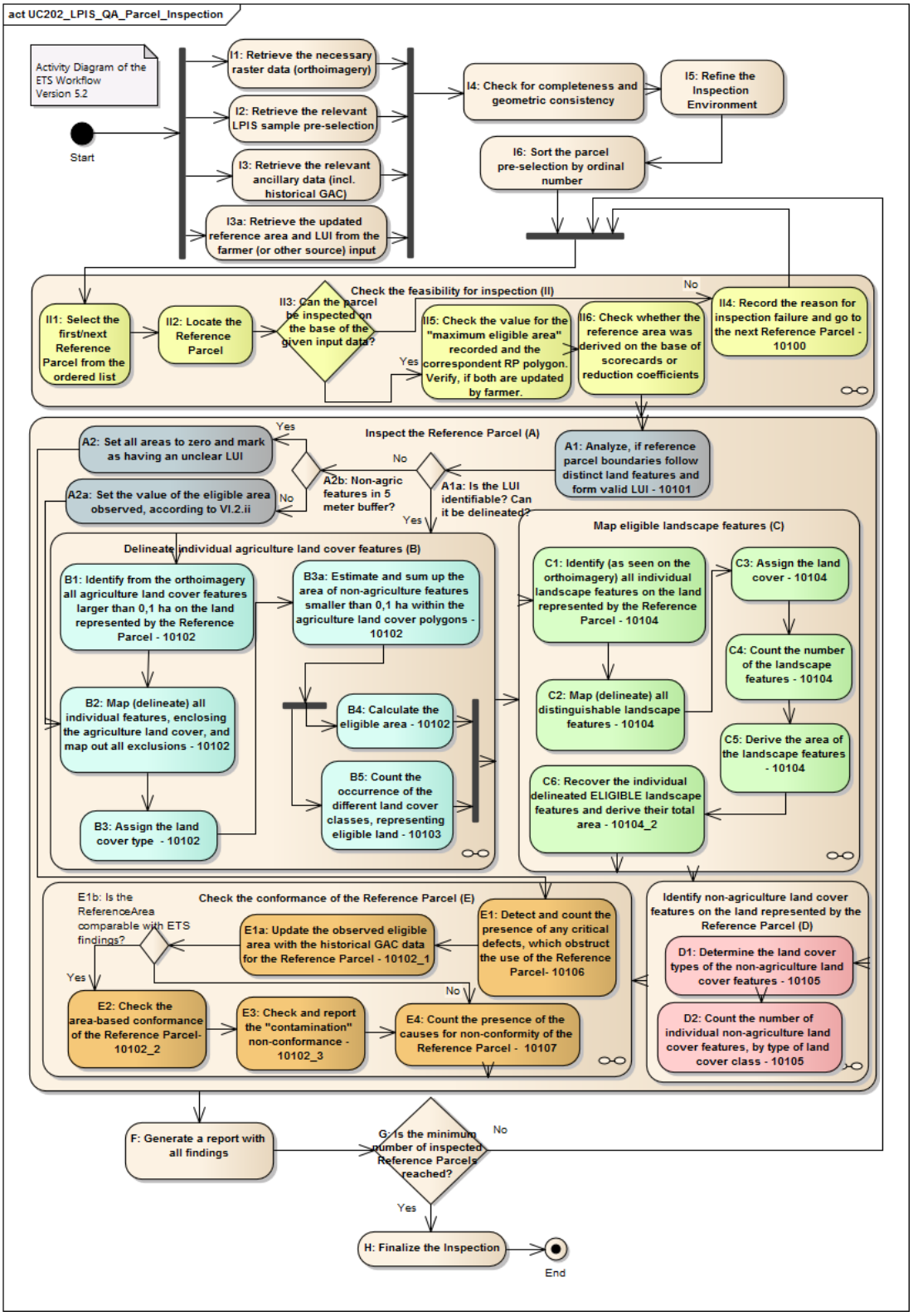

FIGURE 1: LPIS QA framework – Inspection procedure at Reference Parcel level

1.2 Important Notes

1.2.1 The actual land to be inspected and mapped for each reference parcel should be the land represented by the Reference Parcel, according to its definition. It will be named as Land Under Inspection (LUI).

1.2.2 LUI is **not equal** to the land enclosed (clipped) by the reference parcel vector boundary (see Figure 2).

1.2.3 Some (cadastral) systems support multi-polygon cadastral parcels. Derived reference parcels will represent more than one distinct LUI.

1.2.4 Apart from the case under VI.2.ii, the operator ALWAYS re-delineates from scratch the land cover on the area represented by the reference parcel (even in case when the primary visual check doesn't reveal changes on the land in respect to the "quatus quo" recorded in the LPIS.

1.2.5 The operator uses the description of the agriculture land cover classes in the eligibility profile, as the interpretation key for the land cover mapping.

1.2.6 EU Member State Administrations should provide the list of eligible landscape features (subject to Article 34(3) of CommReg1122/2009), together with the mapping instructions and specifications, as a part of the Eligibility Profile.

1.2.7 Landscape elements subject to 2009R1122 art (34)2, with less than 2 meters of width can be considered below the minimum mappable unit for the ETS and thus might not be subject to separate mapping. Their area could be incorporate in the agriculture land cover feature adjacent to them.

1.2.8 The visual scale should be larger than 1: 5 000. Different visual scales could be used depending on the minimum mapping unit, defined for the different land cover features, reference parcel size and local ground conditions. It is not recommended to use visual scale larger than 1:1 000.

1.2.9 The area should be reported in square meters (rounded to a meter).

1.2.10 In this inspection procedure, the quantification of the maximum amount of agriculture land, for given reference parcel, is made through GPS/CAPI area delineation (mapping) of the cover found on the land represented by the reference parcel (LUI). In this respect, reference parcels, with a reference area value that was calculated on the base of different methods/tools (for example, use of scorecards or reduction coefficients applied at individual reference parcel) should be flagged before inspection in order to allow a separate analysis, as the area observed and the area recorded will not be directly comparable.

1.2.11 Reference parcels with non-identifiable limits on the orthoimagery, can be considered suitable for measurements, if additional evidence is provided that these limits are identifiable on the ground. In case the LUI limits are detected and confirmed using GNSS measurements, the land cover mapping should be done either exclusively by field measurement, following the compatible surveying specification applicable in the EU Member States, or by combining GNSS and CAPI measurements, by applying the procedure described in the technical guidance to ensure compatible relative accuracy**.**

1.2.12 The geometric and radiometric quality of the VHR orthoimagery used for the inspection, should be compliant with the **Orthoimage technical specifications for the purpose of LPIS** (http://marswiki.jrc.ec.europa.eu/wikicap/index.php/Orthoimage_technical_specifications_for_the_purpose_of_LPIS)

1.2.13 Any updates of the Reference parcels (that are part of the sample), made one day before the inspection can be taken into account for the ETS, provided that the rules of Article 14 from Regulation 1122/2009 are fully respected.

1.2.14 The inspection cycle (loop) continues until the number of the RP inspected reaches the number required for the DQ_Scope of Quality element 4 (Critical Defects).

1.2.15 At the end of inspection process, an independent operator (different from the one involved in the ETS) should perform a verification and confirmation of at least the ETS observations related to:

- RP Feasibility for inspection (10100)
- RP Feasibility for measurement (10101)
- RP true eligible area (10102)
- correct classification of the presence of critical defects

1.2.16 In case of problem found, the observations in question should be re-performed by the operator responsible for the ETS and will be made available for a new verification and confirmation. The iterative process continues until all observations are confirmed by the independent operator.

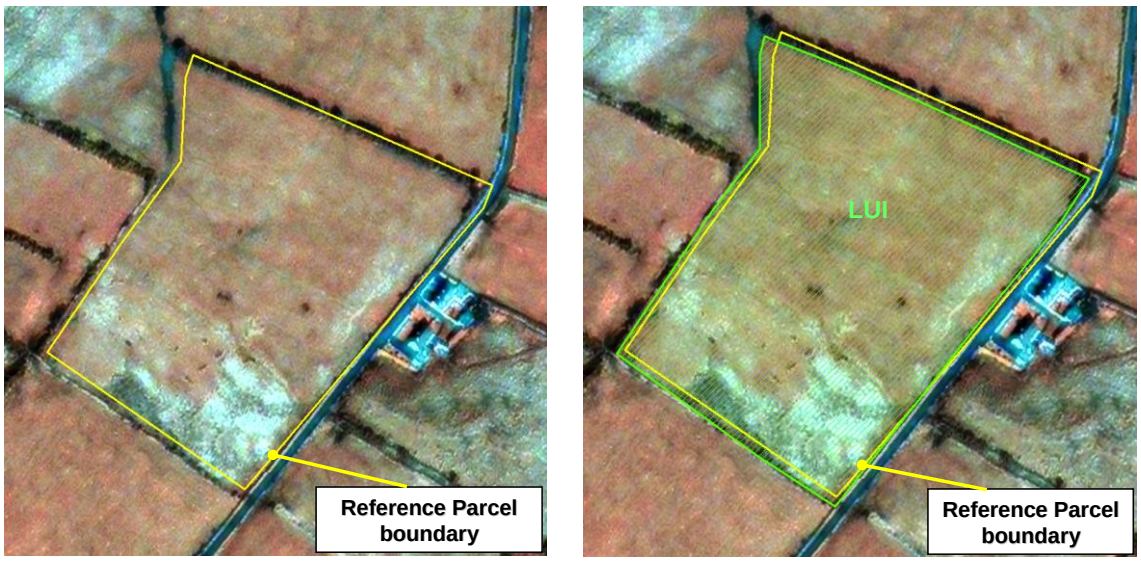

FIGURE 2: Difference between the Reference Parcel boundary and the Land Under Inspection (LUI)

1.3 Flow of events:

I. Data preparation (I1-I3a)
    1. Retrieve the necessary orthoimagery
    2. Retrieve the relevant LPIS sample pre-selection
    3. Retrieve the relevant ancillary data (including any historical GAC data and performed field observations and inspections)
    4. For the Reference Parcels, part of the sample pre-selection, retrieve the up-to-date reference area and the correspondent LUI, as recorded in the LPIS that was:
        i. provided by the farmer at the moment of his application or
        ii. obtained from any other relevant source "in tempore non suspecto".

II. Check for data completeness and geometric consistency (I4)
    1. Check the conformance statement of the ATS and for the availability of the Eligibility Profile in the Implementation Conformance Statement (ICS).
    2. Check the temporal aspect of the reference orthoimagery (is it up-to-date?)
    3. Check for completeness and geometric consistency of the vector and raster data
        i. Navigate through the data (LPIS vectors, orthoimages) using the GIS tools and interface
        ii. Check the vector and raster datasets for the relevant metadata
        iii. Check for completeness of the vector, raster and alphanumeric data (fields and attributes)
        iv. Check for geometric coherence (fit) between the different spatial datasets
        v. Check the orthoimage properties and perform image acceptance (see Chapter 1)

III. Refine the Inspection Environment (I5)
        i. Enhance or change, if necessary, the radiometric and spectral parameters of the orthoimage
        ii. Set the ranges for the visual scale
        iii. Adapt the visual appearance of the graphical data (modify colours, add labels if necessary)

IV. Sort the parcel pre-selection by ordinal number (I6)

V. Check the feasibility for inspection (II1 – II6)
    1. Select the first/next sequential Reference Parcel from the ordered list of the sample pre-selection.
    2. Navigate through the data (LPIS vectors, orthoimages) using the GIS tools and interface, in order to locate the selected Reference Parcel.
    3. Set the appropriate visual scale (see Important Notes).
    4. Check the feasibility for inspection (II3 - II4)
        1) Analyze visually if the area represented by the parcel (LUI) can be inspected based on the available input information.
            i. Check if the Reference parcel ID is persistent in the LPIS (validityStatus)
            ii. Check if the geometry of the Reference Parcel is valid
            iii. Check if the Reference Parcel is fully or partly outside the active area of the image (the active area is the area of the image, which contains meaningful pixel information)

iv. Check for presence of cloud cover or haze, which prevent the inspection of the parcel
v. Check if local radiometric or geometric properties of the image area provide sufficient information for the inspection of the RP. Note: This also includes a check for occurrence of isolated artifacts or temporal phenomenon on the surface.
vi. Check for presence of any force majeure circumstances that prevent the inspection of the RP.

2) Assign a code to the Reference Parcel as a result of the analysis, based on a pre-defined code list.
3) Report additional evidence when field "F1" is true in a separate "Comment" field.
4) If the area represented by the parcel (LUI) is not affected by the above technical issues (all occurrences are set as FALSE),
   - add the parcel to the sample and,
   - proceed with the ETS inspection for that Reference Parcel.
5) Add the parcel to the sample and, flag the Reference Parcel as skipped.

5. Check the value of the reference area (maximum eligible area), as recorded in the LPIS. Verify that the reference area and the correspondent RP polygon are updated with the most recent information from the farmer, related to explicit Reference Parcel change notification or from any other relevant source "in tempore non suspecto".
6. Flag the Reference parcel, when there is a recorded evidence that the reference area, as recorded in the LPIS, was established based on means different from GPS/CAPI area delineation or mapping (for example, use of scorecards or reduction coefficients, specific for each reference parcel).

VI. Inspect the Reference Parcel (A)

1. To check if the LUI can be inspected, perform a visual verification to ascertain all reference parcel boundaries match distinctive land features or follow well identifiable limits of land cover and/or land use. If affirmative, flag it as suitable for measurement and proceed to the next Step VI.3.
2. Else,
   i. if any non-agricultural (ineligible) feature is present within a buffer of 5 meters in case of CAPI and 1 meter in case of GNSS measurements from each side of the displayed boundary of the Reference Parcel (inside or outside the parcel), put the observed eligible area, area declared and the reference area to value zero (as the uncertainty in respect to the location and extend of the LUI would cause ambiguity in the determination of the maximum eligible area observed, this parcel cannot be taken into account to estimate the LPIS_RP_MEA AND LPIS_RP_DCA), Put also both values for RP_CNF(Area Percentage and Area Difference) to zero Go to step VI.6.i and proceed with the instructions.
   ii. if not a single non-agricultural (ineligible) feature is present within a buffer of 5 meters in case of CAPI and 1 meter in case of GNSS measurements each side of the displayed boundary of the Reference Parcel (inside or outside the parcel), consider the RP polygon equal as the polygon that should have been delineated during point 1 of measure

10102[1]. (as there is no uncertainty in respect to the determination of the maximum eligible area observed, this parcel can be taken into account), and continue with step VI.3.iii.

NOTE: In case the visual verification on the orthoimage cannot reveal or confirm the presence of distinct limits, supplementary verification on the field can be optionally made. Field evidence that the FULL perimeter is identifiable and measurable by GNSS needs to be provided. This dataset should comprise: RP vertices measured with GNSS, pictures revealing the existence of these vertices on the ground and any relevant metadata).

NOTE: If crop measurement methodology is applied (instead of 5 meter buffer rule) then if LUI is not identifiable and cannot be delineated then the check for the feasibility for the crop measurement must be performed. If affirmative, the source RP must be substituted with resulting aggregate (expanded to the first visible crop pattern) and continue with the inspection procedure on this expanded LUI (crop item). If crop measurement is not feasible set the feasibility for measurement to false and continue with step VI.6.i

3. Delineate individual agriculture land cover features, which represent eligible land (B)
   i. Individually identify on the orthoimagery all single agriculture land cover features larger than 0.1 ha **on the LUI**. Use the reflectance (pixel grey values), color combination; shape; texture; location; and any other context-related information to determine the agriculture land cover features, based on the pre-defined land cover types and photo interpretation keys, listed in the eligibility profile (for more information see the Annex III). NOTE: In case the LUI limits are detected and confirmed using GNSS measurements, perform the land cover mapping either exclusively by field measurement, following the compatible surveying specification applicable in the EU Member States, or by combining GNSS and CAPI measurements, by applying the procedure described in the technical guidance to ensure compatible relative accuracy.
   ii. Map (delineate) all single features, enclosing the agriculture land cover. Take into account useful permanent features, as rural roads, river banks, limit of forest or build up areas visible on the orthoimage. Consider also the possible visual obstruction of features and boundaries, due to oblique image acquisition (image taken with low elevation angle).
   iii. Identify by visual inspection, map out and exclude from the area of the agriculture land cover, all non-agriculture land cover features bigger than 0.1 ha, as well as all non-agriculture linear features wider than 2 meters. Use the reflectance (pixel grey values), color combination; shape; texture; location; and any other context-related information to determine the non-agriculture land cover features (see the pre-defined list in Table 6 of Annex I). Exclude by mapping (as polygons, lines or points) the area of any distinguishable landscape features from the inner area of the mapped agriculture land cover features. Use the mapping instructions and specifications, defined by the EU Member State Administration in their Eligibility Profile.

[1] The initial agriculture land cover polygon

NOTE: The area of Landscape elements with less than 2 meters of width (below the minimum mappable unit for the ETS) could be incorporate in the agriculture land cover feature adjacent to them.

iv. Assign the land cover type for each agriculture land cover feature.

v. Identify by visual inspection, estimate and sum up the area of the individual non-agriculture features smaller than 0.1 ha identified within the digitized agriculture land cover polygons, if their total area exceeds 3% of the reference area of the Reference Parcel, as recorded in the LPIS. Use the reflectance (pixel grey values), color combination; shape; texture; location; and any other context-related information to determine these non-agriculture land cover features. If considered appropriate (size of feature, visual clarity, image information content, the estimation of the area of these features can be (optionally) done by delineation.

vi. Calculate and sum up the area (in square meters) of the agriculture land cover features (digitized polygons), taking into account any mappable exclusion found (all non-agriculture land cover features, as well as landscape features). This area will be calculated by the GIS using the applicable national projection and ellipsoid. Calculate the eligible area for each of the agriculture land cover feature, using the information from the eligibility profile. Sum up to derive the maximum eligible area for the Reference Parcel).

vii. Deduct the sum of the small non-agriculture areas (estimated in point v.) from the maximum eligible area, calculated in the previous point. Sum up by land cover type, the eligible area of the digitized agriculture land cover polygons.

viii. Count the occurrence of the different land cover class types, eligible for payment **on the LUI.** Use up to two letter abbreviation code from the "User-defined Legend Code" field of the Eligibility Profile.

4. Map (or detect, if already mapped) any landscape features (subject to Article 34(3) of CommReg1122/2009), found **on the LUI** (C)

i. Identify by visual inspection (as seen on the orthoimagery) any individual landscape features **on the LUI**, based on the list of landscape features (subject to Article 34(3) of CommReg1122/2009), as defined by the EU Member State Administration in their Eligibility Profile. Use the reflectance (pixel grey values), color combination; shape; texture; location; and any other context-related information to determine these features. Adjust the visual scale, if necessary.

ii. Map (as polygons, lines and points) all remaining (not yet mapped) distinguishable landscape features **on the LUI**, using the mapping instructions and specifications, defined by the EU Member State Administration in their Eligibility Profile. Take into account useful permanent features, as rural roads, river banks, limit of forest or built up areas visible on the orthoimage. Consider also the possible visual obstruction of features and boundaries, due to oblique image acquisition (image taken with low elevation angle).

iii. Assign the land cover type for each landscape feature.

iv. Count and report the occurrence of the different landscape features types, **on the LUI**.
v. Derive the area in square meters of the landscape features **on the LUI**, using the mapping instructions and specifications, defined by the EU Member State Administration in their Eligibility Profile. This area will be calculated by the GIS using the applicable national projection and ellipsoid.
vi. Select the individual delineated eligible landscape features, found **on the LUI**, which are within OR on the immediate border of the agriculture areas already determined in VI.3. Retrieve their area.
vii. Sum up and report the assigned area (from 3.vi.) by type of the eligible landscape feature.

5. Identify non-agriculture land cover features **on the LUI** (D)
   i. Assign the land cover types of the non-agriculture land cover features, using the pre-defined list given in Table 6 of Annex I. Use the reflectance (pixel grey values), color combination; shape; texture; location; and any other context-related information to determine the land cover type of the non-agriculture land cover features, based on certain pre-defined criteria.
   ii. Count the number of individual non-agriculture land cover features, which has been already identified in Actions B and C, by type of major land cover class.
6. Check the conformance of the Reference Parcel (E)
   i. Detect and count the presence of any critical defects, which obstruct the use of the Reference Parcel. Check for the occurrence of a given critical defect, starting from the first defect listed at the top and going sequentially to the last one at the bottom (see Detailed Description 1 of Annex I).
      - Identify and report on lack of any eligible area **on the LUI**.
      - Report on the occurrence of invalid Reference Parcel perimeter
      - Report on the occurrence of invalid common Reference Parcel boundary
      - Report on the occurrence of incomplete block
      - Report on the occurrence of a multi-polygon reference parcel
      - Report on the occurrence of multi-parcel

      Use the reflectance (pixel grey values), color combination; shape; texture; location; and any other context-related information, as well as the information on the RP type. Use also any data collected on the field revealing the LUI limits that should comprise: RP vertices measured with GNSS, pictures revealing the existence of these vertices on the ground and any relevant metadata).
   ii. If historical GAC limitation is available on the LUI of the Reference Parcel, update the observed eligible area with the historical GAC data. Check and report the area-based conformance of the Reference Parcel in respect to the maximum eligible area recorded. Sum up the area found to be eligible on the orthoimagery, using the values derived in points 3.vii and 4.vi. – Aobs. Then:
      - Divide the result (Aobs) by the area recorded as eligible in the attribute table of the Reference Parcel (Arec). Multiply by 100. Report the value.

- Subtract (Aobs) from the area recorded as eligible in the attribute table of the Reference Parcel (Arec). Report the value (in absolute terms)
- Report the presence of non-conformity (if any), based on the conformance levels given in Table 8 of Annex I (Area purity)

iii. If the Reference Parcel is found to be conformant in respect to quality measure 10102_2, check and report the contamination based conformance of the Reference Parcel in respect to the occurrence of ineligible features as detected in VI.5.ii
- For each occurrence check if the observation violates the relevant general and local ETS condition for each of the three waivers
- Indicate which waiver vindicates the observed contamination, where applicable,
- Flag the parcel as non-conforming, if at least one occurrence of ineligible feature remains "unwaivered".

iv. Detect the causes for the presence of the contained problems in the Reference Parcel, if it is flagged as non-conforming.
- For the given Reference parcel check if at least one of the following statements are true:
  a. it holds a critical defect
  b. the difference between the eligible area observed and recorded exceeds the threshold
  c. its LUI contains unwaivered contaminations with ineligible features
- If yes, assign to each non-conforming Reference Parcel, one or more given pre-defined causes, starting from the first cause listed at the top and going sequentially to the last one at the bottom (see Table 9 of Annex I). Consult ancillary and historical data, wherever is needed.

7. Generate a report with all findings, associated to the Reference Parcel. (F)
8. Check whether you have reached the minimum number of Reference Parcels from the total population, to inspect, according to the Limiting Quality, as defined in quality measure 10205. If not, go to the next Reference Parcel. (G)
9. Else, finalize the inspection and pass the package for verification (see Chapter 3).(H)

2 Ex-post verification of the ETS inspection (four-eye control)

2.1 Description of the activity and measures involved

An independent operator (different from the one involved in the ETS) should perform a verification and confirmation of certain ETS observations for all Reference Parcels belonging to the QC sample. The verification should be made in the same inspection environment used for the ETS and with the same independent standard dataset (reference orthoimagery).

This verification is not considered part of the ETS quality measures and ETS inspection procedure, as it is executed after the ETS. It doesn't report on certain quality aspect of the dataset under inspection, but provides a feedback to the ETS

operator whether the inspection he conducted was performed correctly for a given RP and can trigger re-inspection of certain quality measures. Some of the components of this verification (given in the template bellow) are derived from the Observation Schema laid down in ISO 19156 "Geographic Information – Observations and Measurements".

Observation components	**Value/Example/Description**
phenomenonTime	Date and time of the moment when the verification is performed. The format should be in compliance with the parameter DataTime described in ISO 19103 (for example 1998-09-18T18:30:01).
Result Time	Date and time of the moment when the results of the checks become available (in the majority of cases, it should be the same as the phenomenonTime)
Operator	Person who has performed the checks (Domain code 008 - B5.5 of ISO 19115:2003)
FeatureOfInterest	Reference Parcel ID
Data quality measure	
Measure identifier (measureIdentifier)	20000
Name (Name)	Quality of the ETS inspection
Alias (alias)	ETS_QA
Metaquality (elementName)	Confidence
Basic Measure (basicMeasure)	Correctness indicator
Definition (definition)	Trustworthiness of a data quality result
Description (description)	Synthetic description of the results of the data quality evaluation.
Value Type (valueType)	String
Source Reference (sourceReference)	Technical specifications of the LPIS QA 2012
Example (example)	
Data quality evaluation	
Evaluation method type (DQ_EvaluationMethod)	(001 directInternal, 002 directExternal, 003 indirect) - directInternal
Evaluation method type code (DQ_EvalMethodTypeCode)	001

Evaluation method description (evaluationMethodDescription)	See Flow of events
Evaluation procedure	-
Conformance level (DQ_ConformanceLevel)	All requirements stated in the evaluation procedure have to be fulfilled.
Data quality result (DQ_ConformanceResult)	
Specification	Technical specifications of the LPIS QA 2012
Explanation	The land cover mapping of the Reference parcel was not performed with sufficient quality. The land cover inventory on the LUI for that reference parcels should be repeated. The results from all derived quality measures should be updated accordingly.
Pass	Boolean (1=yes, 0=no)

2.2 Flow of events

1. Get the ETS inspection report and retrieve the necessary data the ETS observations, ETS measurements, Sample pre-selection status, LPIS polygon zero state, Field observations and field inspections and Reference orthoimagery
2. Sort the Reference Parcels from the QC sample by ordinal number
3. For each Reference Parcel from the ordered list and based on the information from the independent standard dataset, check whether:
    a. DQ_Values of "RP feasibility for inspection" is assigned correctly
    b. DQ_Values of "RP feasibility for measurement" is assigned correctly
    c. Land cover features for the calculation of RP_MEA are interpreted and mapped correctly
    d. check whether the parcel has been correctly classified with regard to presence of critical defects
4. If the verification revels that the ETS observations are not correct in at least one of the above-mentioned cases, flag the Reference Parcel for re-inspection. Else, confirm the observations for the given Reference Parcel.
5. Check whether you have reached the end of the ordered list. If not, go to the next Reference Parcel
6. Else, finalize the verification.

NOTE: If the verification reveals that due to erroneous assignment of certain reference parcel as feasible for inspection the minimum sample size is not reached, additional reference parcels from the sample pre-selection should be inspected in order to complement the required sample size.

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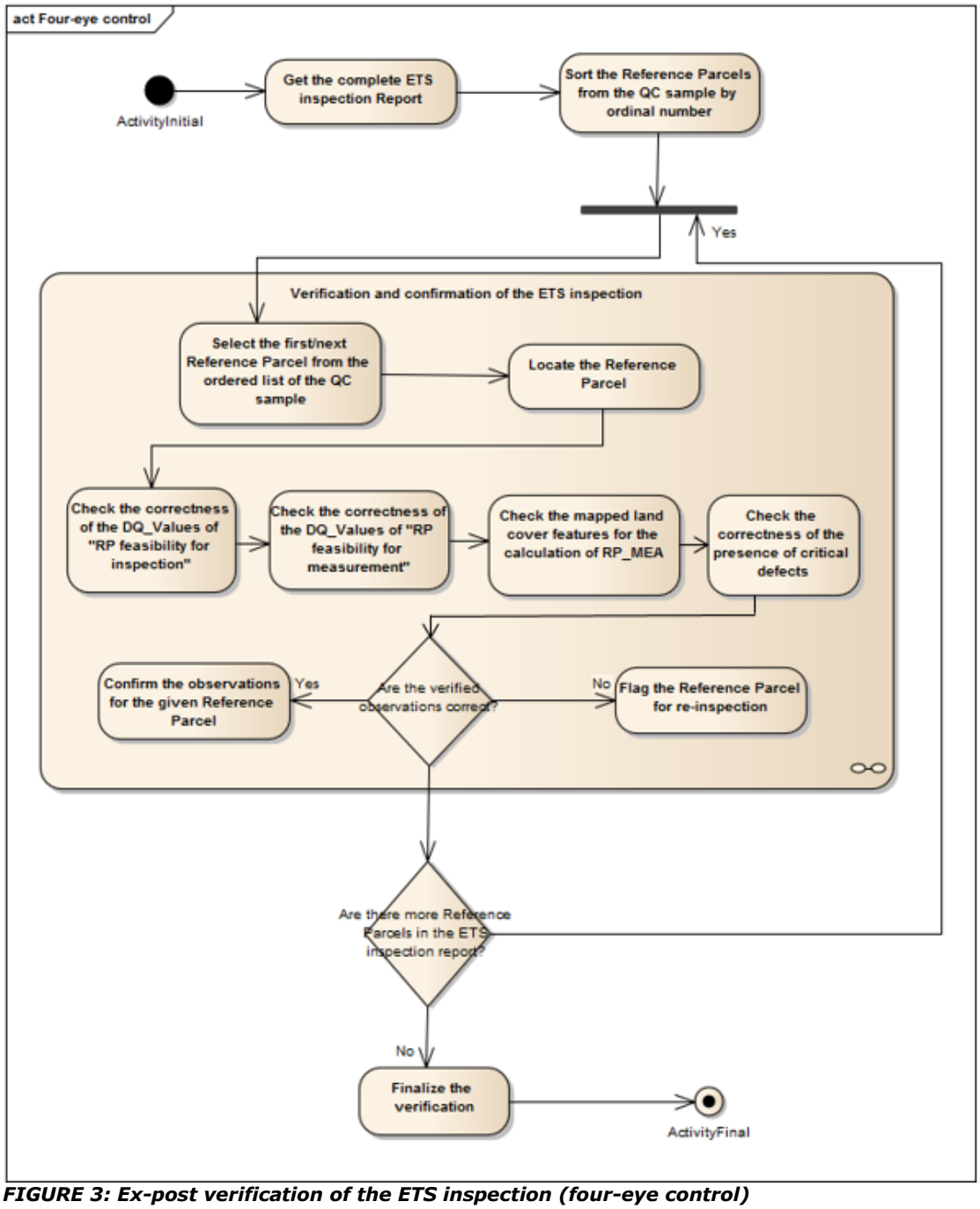

FIGURE 3: Ex-post verification of the ETS inspection (four-eye control)