European Environment Agency

Methodological support on datasets to be used under Article 8 of the Nature Restoration Regulation

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1. Identification of Urban Ecosystem Areas

The urban ecosystem area of a city is the part of the city where the Nature Restoration Regulation (NRR) will be applied. According to Article 14(4) NRR, the urban ecosystem area of a city or of a town and suburb shall include:

(a) the entire city or town and suburb; or

(b) parts of the city or of the town and suburb, including at least its urban centres, urban clusters and, if deemed appropriate by the Member State concerned, peri-urban areas.

Table 1 Summary of the data needed, baseline year, frequency of the updates, type of data, and expected release date

NRR term	Dataset and link	Latest available	Update frequency	Type of data	Release date	Best baseline?
1. Local Administrative Units	Local Administrative Units boundaries	2024	Yearly	Vector polygons	Q4 2025	This is the dataset that should be used for NRR implementation. 1:100k scale version is available through Reportnet 3 - Dataflow help
2. Local Administrative Units: cities, towns and suburbs	Local Administrative Units "Degree of Urbanization" classification	2024	Yearly	Tabular	Q4 2025	This is the dataset that should be used for NRR implementation

3. Urban centres and urban clusters	Urban centres and urban clusters	2021	Every 10 years	Raster Resolution 1,000 m	Q4 2024	This is the dataset that should be used for NRR implementation
4. Urban green spaces	CLC+ Backbone *note new notation:* CLCplus Backbone	2023	Every two years	Raster Resolution 10 m	Q2 2025	This is the dataset that should be used for NRR implementation.
5. Tree canopy cover	CLMS High Resolution Layer Tree Cover Density product	2024	Yearly	Raster Resolution 10 m	Q2 2026	This is the dataset that should be used for NRR implementation
6. Tree canopy cover – Supplementary data	CLMS High Resolution Layer Woody Vegetation Layer	2021	Every three years	Raster Resolution 5 m	Q3 2025	**2021**: may be used for the draft NRPs **2024**: available in Q3 2026 (This is the dataset that may be used for final NRPs) Guiding script for calculating NRR Urban Tree Canopy Cover with HRL WVL

To identify LAUs classified as cities, towns and suburbs, in accordance with the NRR, Member States should refer to the LAU 'degree of urbanisation' classification based on the 2021 census population grid (Box 1).

Box 1: The total **population grid** is a dataset, produced by the European Statistical System (ESS) and disseminated by EUROSTAT, composed of 1 km² grid cells covering the territory, containing spatial information on the number of inhabitants per grid cell. By dividing total population by the available land surface population density can be reported. The most updated population grid, which is the basis for the 'degree of urbanization' classification, refers to the census year 2021 (Released 26/07/2024). This is the data set that must be used for the purposes of the NRR implementation.

Table 2 list of data shared with MS

Data	Description	Type of data
1. Local Administrative Units – classified as cities towns/suburbs	Local administrative boundaries classified as cities towns and suburbs. Dataset created linking the LAU (1. in Table 1) and the degree of urbanisation (2. in Table 1)	shape file
2. Urban centres and clusters	Urban centres and clusters data recoded.	raster
3. Share of urban centres and clusters	share of Urban Centres and clusters at the LAU level	table
4. Share of tree canopy cover	share of tree canopy cover at the LAU level and only within urban centres and clusters	table
5. Share of urban green	share of urban green at the LAU level and only within urban centres and clusters	table

Option (a): The entire city or town and suburb

As "entire city or town and suburb", the NRR refers to the whole territory of a Local Administrative Units (LAU) classified as either a city, a town or suburb, according to the "degree of urbanization" classification. LAUs are low-level administrative subdivisions of the NUTS 3 regions covering the entire economic territory of the Member States (EUROSTAT, 2003 – Regulation (EC) 1059/2003). The countries' administrative units equivalent to LAUs are set out in Annex III of the Regulation 1059. The 'degree of urbanization' classification is based on the geographical contiguity of population grid cells (Box 1), which describes the distribution of population in space. Each LAU can only be assigned to one of these three classes: 1) Cities, 2) Towns and suburbs and 3) Rural. In the scope of Article 8 of the NRR, only LAUs classified as cities and as towns and suburbs are considered. These are defined in art. 4b of the above referenced legal act and in the corresponding implementing Regulation (EUROSTAT, 2019a - (EU) 2019/1130) as follows:

- Cities: densely populated areas where at least 50% of the population lives in one or more urban centres, where urban centres (or high-density clusters) are identified as groups of grid cells with a population density of at least 1,500 inhabitants/ km² and collectively a population of at least 50,000 inhabitants
- Towns and suburbs: intermediate density areas where less than 50% of the population lives in an urban centre and at least 50% of the population lives in an urban cluster- (moderate-density cluster): a cluster of contiguous grid cells of 1 km² (including diagonals) with a population density of at least 300 inhabitants per km² and a minimum population of 5,000 inhabitants.

Option (b): parts of the city or of the town and suburb, including at least its urban centres, urban clusters and, if deemed appropriate by the Member State concerned, peri-urban areas

b.1. Grid typologies: urban centres and clusters

Cells of the 1 km^2 population grid (Box 1) are classified as described in art. 4b of the above referenced legal act and in the corresponding implementing Regulation into **urban centres and clusters**, on the

basis of specific characteristics of population density and geographical contiguity (EUROSTAT, 2003, EUROSTAT 2019a).

- **Urban centres,** also named high-density clusters, consists of contiguous grid cells with a density of at least 1,500 inhabitants per km^2. An urban centre has population of at least 50,000 inhabitants.
- **Urban clusters,** also termed moderate-density clusters, consist of contiguous grid cells with a density of at least 300 inhabitants per km^2 and a population of at least 5,000 inhabitants in the cluster.

For option (b), urban ecosystem areas can be identified by considering at least all the urban centres and clusters falling within the LAUs classified as cities, towns and suburbs.

Urban centres and clusters are updated every 10 years based on official census data (Table 1). The nomenclature used on the website is slightly different compared to the one used in this document (Table 3). **This 2021 data set defining the urban centres and urban clusters is the set that must be used for the NRR.**

Table 3 urban centres and clusters nomenclature

Cluster version	Feature type	Coordinate reference	Geo TIFF	description
Urban 2021	Raster	ETRS89/LAEA	ZIP	Urban centres in this document
High Density 2021	Raster	ETRS89/LAEA	ZIP	Urban Clusters in this document

From the website both urban centres and urban clusters should be downloaded. The two datasets should be combined because together they delineate the total area of urban centres and clusters.

The boundaries of the LAUs and the attribute 'degree of urbanization' classification are updated every year (Table 1). Therefore, to establish the final baselines Member States will need to use the data for 2024.

Further details on Eurostat methodologies for defining territorial typologies can be found in the dedicated manual (EUROSTAT, 2019b)

b.2. Peri-urban areas

Seeing as Member States are free to establish their urban ecosystem area (UEA) boundaries anywhere within the LAU - *as long as the UAE consists of at least the urban centres and urban cluster* – there is no obligation to set any specific peri-urban area (at 1 km, or any other distance). We would, however, strongly recommend that a peri-urban area is included around the built-up area of the city to avoid any unwanted displacement of development to an area just outside the current built-up area.

2. Identification of urban green spaces

For the implementation of the NRR, the reference dataset to identify the baseline and for the monitoring of urban green spaces is the Copernicus Land Monitoring Service (CLMS) CLCplus Backbone (Table 1). The 2023 version should be used assess the baseline levels of urban green spaces. Furthermore, it is used to identify where the share of urban green space in the urban centres and

urban clusters exceeds 45 % for urban ecosystem areas to be exempted from the no-net loss rule (together with information on urban tree canopy cover as described below).

This dataset is at high spatial resolution (pixel size 10 m x 10 m), pan-European wall-to-wall layer containing 11 thematic classes. Urban green spaces are defined by the NRR as the total area of the following classes: trees (classes 2, 3 and 4), bushes, shrubs (class 5), permanent herbaceous vegetation (class 6), lichens and mosses (class 8), ponds and watercourses (class 10).

Note that the indicator data and exemptions of the pre-existing data for each Member State is available through Reportnet 3 Dataflow help.

3. Identification of urban tree canopy cover

For the implementation of the NRR, the reference dataset to identify the baseline and for the monitoring of urban tree canopy cover is the CLMS High Resolution Layer Tree Cover Density (HRL TCD) product (Table 1). The 2024 version should be used to assess the baseline levels of urban tree canopy cover. Furthermore, it is used to identify where the share of urban tree canopy cover in the urban centres and urban clusters exceeds 10 % for urban ecosystem areas to be exempted from the no-net loss rule, if they also present more than 45 % of urban green spaces. The layer provides the percentage of tree cover for every 10 m x 10 m pixel. The total amount of urban tree canopy cover in an urban ecosystem area can be calculated by computing the total percentage of all the pixel values within the urban ecosystem area. It is important to consider that the reporting for urban tree canopy cover should be made for each of the individual urban ecosystem area, rather than at national level such as in the case for urban green spaces.

Note that the indicator data and exemptions of the pre-existing data for each Member State is available through Reportnet 3 Dataflow help.

4. Use of appropriate ‘supplementary’ data

Art. 3(20,21) provides definitions of urban green spaces and urban tree canopy cover. The official datasets, as specified in the NRR, to measure and monitor urban green spaces and urban tree canopy cover are produced and maintained by the Copernicus Land Monitoring Service (CLMS). However, if deemed appropriate, MS can also use supplementary data. Supplementary data should be used to **improve or complement the information already included in the official datasets**.

In general, supplementary data should:

- **Ensure temporal consistency**: available in 2024 (baseline), 2030 and be maintained for future monitoring
- **Ensure spatial consistency**: the data should be maintained to ensure continuous coverage of the relevant area over time and throughout all stages of the regulation's implementation. Different forms of spatial coverage include:
    - At national level: across all urban areas in a MS in case there is already in place a monitoring system at national level for urban green spaces and/or tree canopy cover that provides more accurate and reliable data than official datasets.
    - At urban ecosystem level: when there are monitoring systems in place in some cities or towns.

- At site level: when there are systematic trees inventories that can provide more accurate data on tree locations.

In all cases, supplementary data should be derived from systematic monitoring in which the methodology can be clearly described.

Allow an increase of data quality in terms of:

- **Precision**: In the case of urban green space or urban tree canopy cover data, identified with a higher spatial resolution.
- **Accuracy (reliability)**: Accuracy refers to how close a measurement is to the true value. It measures the correctness and reliability of geospatial data in relation to real-world values.

The use of the supplementary data should be justified, and spatial data should be provided in all cases to ensure consistent reporting aligned with real spatial data. If different local datasets are used Member States must compile all this information and present it as a single unified and fully justified data set within the uniform format of the National Restoration Plans. Multiple local data sets are not acceptable. The increased quality of the assessment should be quantified with respect to the information provided by the official data.

4.1 Top-down or bottom-up inventories/datasets.

Supplementary data can either be top-down inventories/datasets or bottom-up inventories:

- **Top-down inventories/datasets** are very detailed datasets derived from aerial or satellite imagery. Many studies exist describing methodologies and applications to derive extremely detailed datasets of urban forest or urban greenery. The studies use high resolution remote sensing data to identify and classify urban trees (Vizzari et al. 2025; Münzinger et al. 2022). Many other studies use remote sensing indices (such as NDVI) to measure greenness (Corbane et al. 2018; Zulian et al. 2022; Garber et al. 2024). In any case supplementary data created with the above-mentioned methodologies must be validated and maintained over time.
- **Bottom-up inventories** are generated by primary data from on-the-ground inventory methods. Many cities have urban trees or urban green inventories to inform urban forest management (Ma et al. 2021). Inventories can be very useful to monitor new plantations or to integrate specific green features, such as green roofs that won't be captured by the official data.

Once the urban ecosystem area is identified, spatial information should be reported following the instructions included in section 8 (8.1.2 and 8.1.3) of the uniform format for national restoration Plans.

4.2 Pan-European supplementary data from the CLMS

In addition to the CLMS HRL Tree Cover Density dataset, CLMS also provides the High Resolution Layer Woody Vegetation Layer (No. 6 in Table 1). Member States may use this dataset as a supplementary source where justified.

However, HRL WVL remains classified as supplementary data. As with national supplementary datasets, its use requires the "beyond Copernicus" field in the Uniform Format to be set to "yes" (8.1.3.1), which necessitates the provision of Additional Information III.

Accordingly, the "within Copernicus" option (8.1.3.1 = "no") applies only when using the two designated CLMS datasets: CLCplus Backbone and HRL Tree Cover Density.

5. Overlaying datasets and extract required information for Art. 8

Article 8 requires the processing of the following data: LAU boundary maps, urban centres and urban cluster, urban green space and tree canopy cover. Processing of these datasets requires some previous knowledge of the use of Geographical Information System (GIS) software. Any GIS software of choice would be adequate (e.g. for beginners QGIS or ArcGIS and GRASS GIS for more advanced users). Alternatively, processing can be done in scripted environments using R or Python following the same procedure.

Below, a step-by-step guide with recommendations on how to obtain the maps and the tabular data to visualize and elaborate the information necessary to inform the National Restoration Plans can be found. In case different datasets for mapping urban green spaces and tree canopy cover are chosen, a different approach might be necessary.

Import in the GIS environment of choice the datasets:

- The LAU boundary shapefile (and, if option (b) of the urban ecosystem area is selected, also the “urban” and “high density” raster files for the urban centres and clusters raster datasets);
- The LAU ‘degree of urbanization’ classification tabular dataset;
- CLCplus backbone raster;
- Tree Cover Density raster

Pre-process the datasets:

- All the datasets should be processed under the same projection and datum to avoid computational issues. The Lambert Azimuthal Equal Area Projection (LAEA) with the European Terrestrial Reference System 1989 (ETRS89) is recommended (e.g. EPGS Code:3035). Within GIS software, various reprojection tools are available.
- Perform an attribute tabular join of the LAU boundary shapefile with the LAU ‘degree of urbanization’ classification tabular data, on the basis of the ‘GISCO ID’ field (unique identifier), to couple the shapefile boundary with information on the degree of urbanization. Then, it would be possible to select only the LAU corresponding to classes 1 and 2 of the "degree of urbanization” field (i.e. cities and towns and suburbs).
- In case option (b) is selected, combine the urban centres and the urban clusters rasters. Then, it is recommended to reclassify the raster, assigning a value of 1 to all the pixels to facilitate the calculation of the areas.
- The following classes of the CLC+ backbone raster should be considered for urban green spaces: trees (classes 2, 3 and 4), bushes, shrubs (class 5), permanent herbaceous vegetation (class 6), lichens and mosses (class 8), ponds and watercourses (class 10). It is recommended to reclassify the raster, assigning a value of 1 to these classes and null (no data) value to the others.
- It is not necessary to pre-process the tree cover density dataset
- In case the peri-urban area is included in the definition of urban ecosystem area, an area equal to at least 1 kilometre from the boundary of the urban centres and clusters will have to be

estimated. To do so, a vector buffer zone should be computed in the GIS environment (e.g. using the "buffer" algorithm). It is important to consider that if the buffer zone crosses (i.e. is bigger than) the LAU boundary, the extent is in any case limited to the LAU boundary (e.g. "clip" algorithm must be used additionally to restrict to the respective LAUs under consideration).

Estimate the amount of tree cover and urban green spaces inside the urban ecosystem areas:

- Compute the amount of urban green spaces and tree canopy cover within the entire city or town and suburb – for urban green spaces, perform a zonal statistic (sum of the pixels) of the reclassified CLC+ within the polygons of the LAU classified as cities towns and suburbs. Then, multiply the obtained value by 100 (the area in square meters of each pixel) to derive the total area in square meters. Since the Regulation requires to derive the total national area of urban green spaces, it will be necessary to sum up all the urban green spaces areas in each LAU. For tree canopy cover, the same procedure of urban green spaces can be applied, with the exception that it will be necessary to derive the tree canopy cover area in each LAU and not at national level.
- Compute the amount of urban green spaces and tree canopy cover within the urban centres and clusters: this step will be necessary in case option (b) (parts of the city or of the town and suburb, including at least its urban centres, urban clusters and, if deemed appropriate by the Member State concerned, peri-urban areas) is chosen as urban ecosystem area. To do so, it is necessary to combine the urban green space binary raster map with the LAUs and the urban centres and clusters raster map. To do so many GIS techniques are available, depending on the used software. Then, the amount of urban green space pixels that are occurring inside the urban centres and clusters raster, will have to be aggregated at national level to derive the area of urban green space. The tree cover density layer will be multiplied by the urban centres and clusters raster (which pixel values are equal to 1 and null). Then, a raster with values of tree cover density inside the urban centres and clusters will be obtained. It will be then possible to compute a zonal statistic with the obtained raster within the LAU boundaries (as explained in step 1.1) to estimate the tree canopy cover area within each LAU.

References

European Union's Copernicus Land Monitoring Service information – CLC + Backbone. Available at: https://land.copernicus.eu/en/products/clc-backbone

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Applying the degree of urbanisation manual - Statistics Explained (europa.eu)