



**CLEARINGHOUSE**  
中欧城市森林应对方案

# CLEARING HOUSE Typology on Urban Forests As Nature-Based Solutions

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## Visualization:

[Visualize with WebVowl](#)

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VERSION 1.0 AS OF MARCH 2021

## Abstract

This deliverable outlines the CLEARING HOUSE typology of urban forests as nature-based solutions (UF-NBS). The typology thus conceptualizes entities relevant to UF-NBS. To do so, elements of the green-blue infrastructure (GBI) are defined in the typology. Contrary to purely textual representations of knowledge, CLEARING HOUSE proposes a definition of GBI elements through traits, i.e., characteristic and defining morphological, physical, functional, and institutional attributes, including for example the composition, spatial grouping and topology of (UF-)NBS elements, and the ecosystem services and benefits provided them. CLEARING HOUSE proposes a semantic approach to express this knowledge, i.e., a formalization of knowledge as an ontology using the Web Ontology Language. Such ontologies are machine-interpretable series of statements of facts to define a taxonomy (a vocabulary). The definitions of GBI elements are embedded within a formalization of overarching concepts, particularly, of urban forest, nature-based solutions (NBS), and of UF-NBS. Here, urban forest is conceptually understood as the entirety of trees within an urban-ecological system. NBS are perceived in CLEARING HOUSE as an overarching concept that embraces natural and semi-natural elements of the GBI such as forests, engineered solutions such as permeable pavements, as well as actions inspired by nature. UF-NBS are then conceptualized as the intersection of the two previous entities, i.e., as the intersection of urban forest and NBS, and thus include any tree-related NBS. The proposed typology will provide the grounding knowledge of the comparative case study analysis to be conducted by CLEARING HOUSE, and will serve as a basis for the development of the CLEARING HOUSE benchmarking tool.

## Introduction back to [ToC](#)

The purpose of the typology is: (i) to define distinct types of UF-NBS; (ii) to devise a systematic taxonomy of UF-NBS types; and (iii) to embed defined types and their taxonomical relationships within a definition of overarching concepts. These overarching concepts include the urban forest concept, the green-blue infrastructure concept, and the concepts of NBS and UF-NBS, respectively. The knowledge that will be formalized in this typology provides the grounding knowledge for the comparative case study analysis of CLEARING HOUSE and will provide one basis for the development of the CLEARING HOUSE UF-NBS benchmarking tool. Please see the [CLEARING HOUSE website](#) for more information.

## Namespace declarations

Table 1: Namespaces used in the document

<b>[Ontology NS Prefix]</b>	< <a href="http://clearinghouseproject.eu/typology/elements#">http://clearinghouseproject.eu/typology/elements#</a> >
<b>owl</b>	< <a href="http://www.w3.org/2002/07/owl">http://www.w3.org/2002/07/owl</a> >
<b>rdf</b>	< <a href="http://www.w3.org/1999/02/22-rdf-syntax-ns">http://www.w3.org/1999/02/22-rdf-syntax-ns</a> >
<b>terms</b>	< <a href="http://purl.org/dc/terms">http://purl.org/dc/terms</a> >
<b>xsd</b>	< <a href="http://www.w3.org/2001/XMLSchema">http://www.w3.org/2001/XMLSchema</a> >
<b>bibo</b>	< <a href="http://purl.org/ontology/bibo">http://purl.org/ontology/bibo</a> >
<b>rdfs</b>	< <a href="http://www.w3.org/2000/01/rdf-schema">http://www.w3.org/2000/01/rdf-schema</a> >
<b>default namespace</b>	< <a href="http://clearinghouseproject.eu/typology/elements">http://clearinghouseproject.eu/typology/elements</a> >
<b>dc</b>	< <a href="http://purl.org/dc/elements/1.1">http://purl.org/dc/elements/1.1</a> >

## CLEARING HOUSE Typology on Urban Forests As Nature-Based Solutions: Overview back to ToC

This ontology has the following classes and properties.

### Classes

- [Action](#)
- [activity](#)
- [Afforestation](#)
- [Allotment Garden](#)
- [Arboretum](#)
- [Atrium](#)
- [Balcony Green](#)
- [bench](#)
- [blue landscape element](#)
- [Botanical Garden](#)
- [building](#)
- [Building-associated Green](#)
- [canal](#)
- [canopy cover](#)
- [Carbon Sequestration and Storage](#)
- [Cemetery](#)
- [Community Garden](#)
- [Courtyard Green](#)
- [Cultural Service](#)
- [Ecosystem Service](#)
- [edible plant](#)
- [engineered element](#)
- [Enrichment Planting](#)
- [Entitlement](#)
- [fitness equipment](#)
- [floodplain forest](#)

- Forest
- Forest Conservation
- Forest Monitoring
- Forest Plantation
- Forest Tree
- Fruit Tree
- functional attribute
- Grass
- grave
- green landscape element
- Green Roof
- Green Verge
- green wall
- Green-Blue Infrastructure Element
- Greening
- grey landscape element
- ground based location
- Group of Trees
- grouping.principle
- Grove
- hedge
- historical garden
- Historical Park
- House Garden
- Implementation Action
- institutional accessibility
- institutional attribute
- Interaction with Nature
- lake
- landscape element
- Lawn
- location not associated with a support structure
- location on building
- location on support structure
- Management Action
- management intensity
- margin
- Meadow
- morphological attribute
- multistorey building
- Nature-Based Solution
- Neighbourhood Green Space
- network infrastructure element
- Network-associated Green
- non forest tree
- non woody vegetation
- Nursery
- object feature
- object grouping
- One-Dimensional Grouping.(1D)
- Orchard
- Orchard Restoration
- Ornamental Tree
- Parks and Gardens
- path
- permanent standing water
- permeable pavement
- pest control

- pest management
- physical attribute
- physical location
- physical process phenomenon
- plantation forest
- Planting Activity
- playground
- Pollution Removal
- pond
- private house
- process phenomenon
- Provisioning Service
- Railroad Bank
- Recreation
- Reforestation
- regular patterns
- Regulation and Maintenance Service
- Restoration Action
- Riparian Forest
- river
- Riverbank Green
- Row of Trees
- sealing
- shrub
- Single Street Tree
- Single Tree
- skate park
- spatial entity
- species diversification
- species diversity
- sports field
- square
- stream
- street
- Street Trees
- Supporting Service
- Survivor Tree
- track
- Tree
- Tree alley
- Tree Monitoring
- tree pruning
- tree watering
- Treed Area
- Two-Dimensional Grouping (2D)
- type of vegetation
- Urban Food Forest
- Urban Forest
- Urban Park
- Urban-Forest as Nature-Based Solution
- Vegetated Pergola
- Veteran Tree
- Water Flow Regulation
- watercourse
- wetland
- Wetland Construction
- Wetland Restoration
- wood



- woody vegetation
- Zero-Dimensional Grouping (0D)

## Object Properties

- aims at
- has entitlement
- has grouping
- has institutional accessibility
- has intended outcome
- has management intensity
- has part
- has physical location
- has species diversity
- is adjacent to
- is affected by
- is composed of
- is enclosed by
- is fully enclosed by
- is part of
- provides the ecosystem service (benefit)
- seeks implementation of
- seeks improvement of
- seeks maintenance of
- seeks provisioning of

## Named Individuals

- Active Recreational Use
- Aesthetical Value
- Air Purification
- application of pesticides
- average
- Biodiversity Conservation
- biological pest control
- Carbon Sequestration
- Carbon Storage
- clustered group
- construction
- Education
- elevated
- evaporation
- evapotranspiration
- flooding
- Food Production
- grass planting
- ground based
- Habitat Provisioning
- Heritage Value
- high
- Infiltration
- irregular pattern
- linear group
- low
- low or monoculture
- Mixed Recreational Use
- monitoring

- Non-Timber Forest Products
- not managed
- on balcony
- on building facade
- on building roof
- on pergola
- Passive Recreational Use
- paved
- pest control
- photosynthesis
- Place Attachment
- Plant Propagation
- private
- pruning
- public
- railroad track
- regular grid
- regular pattern
- Regulation of Air Temperature and Humidity
- restoration
- restricted collective
- restricted private
- Runoff Regulation
- Scientific Value
- selective
- semi public
- shading
- shrub planting
- Social Cohesion
- solitary
- temporally restricted access
- temporally unrestricted access
- Timber Production
- tram track
- transpiration
- Tree Planting
- unpaved
- unrestricted public
- Water Purification
- watering
- weed control

Collapsing filter activated.  
The number of visualized elements has been automatically reduced.  
Use the degree of collapsing slider in the *filter* menu to adjust the visualization.

*Note:* A performance decrease could be experienced with a growing amount of visual elements in the graph.

Got It

## SOLUTIONS

<http://clearinghouseproject.eu/typology/elements#>

Version: --

Author(s): The CLEARING HOUSE project. This project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement 821242.

Language:

en

Search



Export

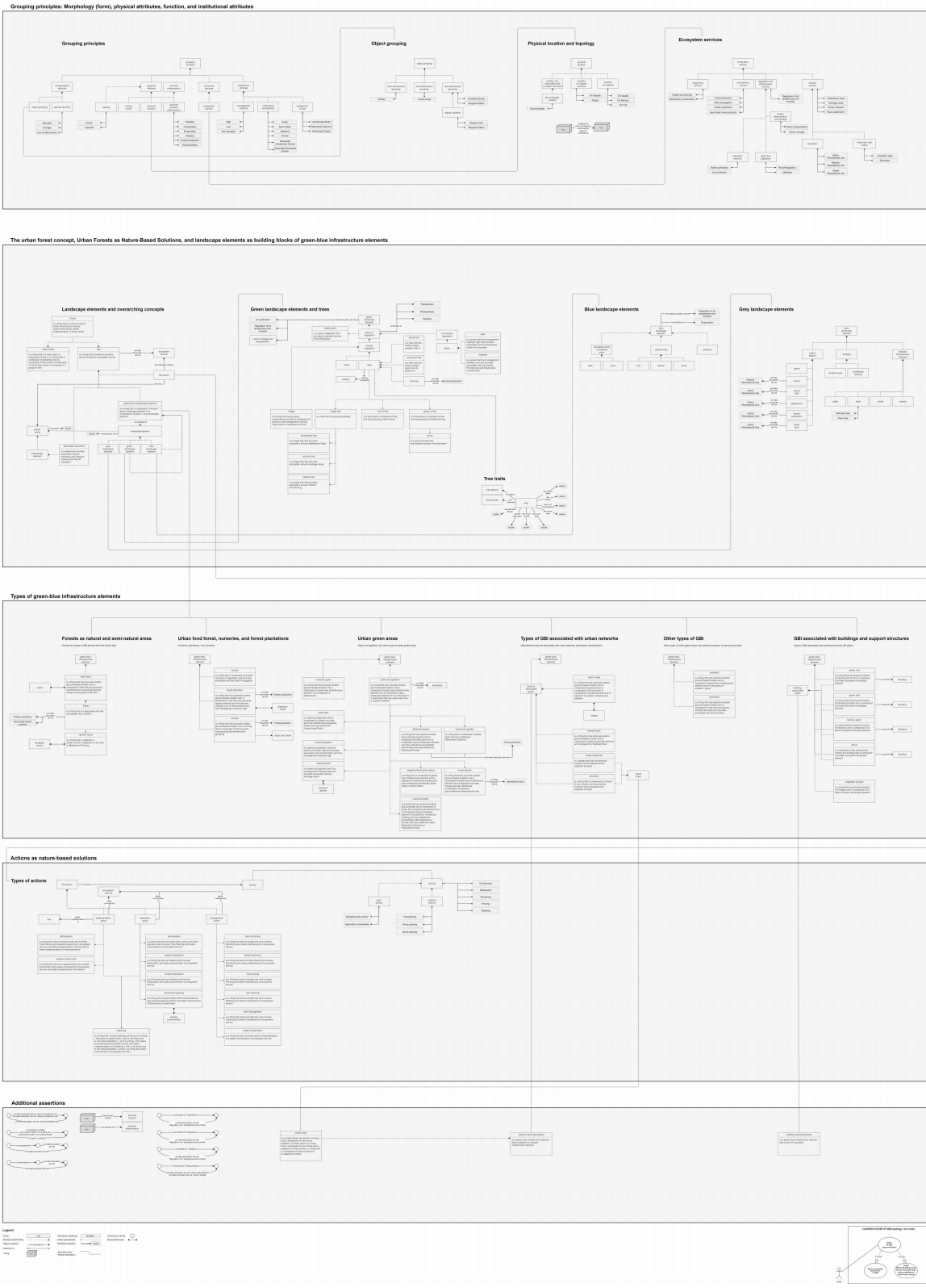
Filter

Options

Modes

## CLEARING HOUSE Typology on Urban Forests As Nature-Based Solutions: Description back to ToC

The following figure provides a draft visualization. A more detailed description for Version 1.0 as of March 2021 of this typology can be accessed under doi 10.5281/zenodo.4649961.



## Cross reference for CLEARING HOUSE Typology on Urban Forests As Nature-Based Solutions classes, properties and dataproperties back to ToC

This section provides details for each class and property defined by CLEARING HOUSE Typology on Urban Forests As Nature-Based Solutions.

## Classes

- Action
- activity
- Afforestation
- Allotment Garden
- Arboretum
- Atrium
- Balcony Green
- bench
- blue landscape element
- Botanical Garden
- building
- Building-associated Green
- canal
- canopy cover
- Carbon Sequestration and Storage
- Cemetery
- Community Garden
- Courtyard Green
- Cultural Service
- Ecosystem Service
- edible plant
- engineered element
- Enrichment Planting
- Entitlement
- fitness equipment
- floodplain forest
- Forest
- Forest Conservation
- Forest Monitoring
- Forest Plantation
- Forest Tree
- Fruit Tree
- functional attribute
- Grass
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- Green Roof
- Green Verge
- green wall
- Green-Blue Infrastructure Element
- Greening
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- Wetland Restoration
- wood
- woody vegetation
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## Action<sup>c</sup> back to ToC or Class ToC

**IRI:** <http://clearinghouseproject.eu/typology/elements#NbsAction>

Actions and Interventions.

is equivalent to

(aims at <sup>op</sup> some spatial entity <sup>c</sup>) and (has intended outcome <sup>op</sup> some Ecosystem Service <sup>c</sup>) and  
(involves <sup>op</sup> some activity <sup>c</sup>)

has super-classes

Nature-Based Solution <sup>c</sup>

has sub-classes

Implementation Action <sup>c</sup>, Management Action <sup>c</sup>, Restoration Action <sup>c</sup>

## activity<sup>c</sup> back to ToC or Class ToC

**IRI:** <http://clearinghouseproject.eu/typology/elements#Activity>

has super-classes

thing <sup>c</sup>

has sub-classes

Planting Activity <sup>c</sup>, pest control <sup>c</sup>

has members

construction<sup>ni</sup>, monitoring<sup>ni</sup>, pest control<sup>ni</sup>, pruning<sup>ni</sup>, restoration<sup>ni</sup>, watering<sup>ni</sup>, weed control<sup>ni</sup>

### **Afforestation<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Afforestation>

Establishment of new forests or forest plantations, i.e., actions involving the planting of trees in currently non-forested areas.

is equivalent to

(aims at<sup>op</sup> some spatial entity<sup>c</sup>) and (involves<sup>op</sup> some { Tree Planting }) and (seeks implementation of<sup>op</sup> some Forest<sup>c</sup> or Forest Plantation<sup>c</sup>) and (seeks provisioning of<sup>op</sup> some Ecosystem Service<sup>c</sup>)

### **Allotment Garden<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#AllotmentGarden>

A leased garden in urban surrounding which serves the user for non-commercial gardening use, in particular for the extraction of horticultural products for his own use and for recreation (Senatsverwaltung f&#252;r Umwelt, Verkehr und Klimaschutz, 2019).

is equivalent to

(has entitlement<sup>op</sup> some { restricted private }) and (has institutional accessibility<sup>op</sup> some { semi public }) and (has physical location<sup>op</sup> some ground based location<sup>c</sup>) and (is composed of<sup>op</sup> some edible plant<sup>c</sup>) and (is composed of<sup>op</sup> some grey landscape element<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>

### **Arboretum<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Arboretum>

Areas planted with a high diversity of trees, for educational purposes (following Cvejić et al., 2015).

is equivalent to

(has physical location<sup>op</sup> some ground based location<sup>c</sup>) and (has species diversity<sup>op</sup> some { elevated }) and (is composed of<sup>op</sup> some Tree<sup>c</sup>) and (provides the ecosystem service (benefit)<sup>op</sup> some { Education })

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>

### **Atrium<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Atrium>

Green area that is considered to be fully enclosed by a building, and planted mostly with ornamental plants (Cvejić et al., 2015).

is equivalent to

(is fully enclosed by<sup>op</sup> only building<sup>c</sup>) and (is composed of<sup>op</sup> min 1 green landscape element<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>



## **Balcony Green<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#BalconyGreen>

Plants in balcony and terraces, planted mostly in pots (Cvejić et al., 2015).

is equivalent to

(has physical location<sup>op</sup> some { on balcony }) and (is composed of<sup>op</sup> min 1 green landscape element<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>

## **bench<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Bench>

has super-classes

object feature<sup>c</sup>

## **blue landscape element<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#BlueLandscapeElement>

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>, landscape element<sup>c</sup>

has sub-classes

permanent standing water<sup>c</sup>, watercourse<sup>c</sup>, wetland<sup>c</sup>

## **Botanical Garden<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#BotanicalGarden>

defined, following Cvejić et al. (2015), as areas planted with a high diversity of plants, for educational purposes, and requiring high human maintenance.

is equivalent to

Parks and Gardens<sup>c</sup> and (has management intensity<sup>op</sup> some { high }) and (has species diversity<sup>op</sup> some { elevated }) and (provides the ecosystem service (benefit)<sup>op</sup> some { Education })

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>

## **building<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Building>

has super-classes

grey landscape element<sup>c</sup>

has sub-classes

multistorey building<sup>c</sup>, private house<sup>c</sup>

## **Building-associated Green<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#BuildingAssociatedGreen>

Parts of the green-blue infrastructure associated with buildings, i.e., that are part of a building. This includes green roofs, green walls, atria, and balcony green.

### **canal<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Canal>

has super-classes  
watercourse<sup>c</sup>

### **canopy cover<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#CanopyCover>

has super-classes  
physical attribute<sup>c</sup>

### **Carbon Sequestration and Storage<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#CarbonSequestrationAndStorage>

Regulation of chemical composition of atmosphere and oceans (CICES).

has super-classes  
Regulation and Maintenance Service<sup>c</sup>  
has members  
Carbon Sequestration<sup>ni</sup>, Carbon Storage<sup>ni</sup>

### **Cemetery<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Cemetery>

Burial ground often covered by lawns, trees, and other ornamental plants (Cvejić et al., 2015).

is equivalent to  
is composed of<sup>op</sup> some grave<sup>c</sup>

### **Community Garden<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#CommunityGarden>

A community garden is defined as collectively used areas for food production and recreation (Cvejić et al., 2015). The Abgeordnetenhaus von Berlin (2018) characterizes them as community-managed gardens in an urban context with a focus on social, intercultural and ecological topics.

is equivalent to  
(has entitlement<sup>op</sup> some { restricted collective }) and (is composed of<sup>op</sup> some edible plant<sup>c</sup>)  
has super-classes  
Green-Blue Infrastructure Element<sup>c</sup>

### **Courtyard Green<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#CourtyardGreen>

Inner courtyard, i.e., an area enclosed by multistorey buildings, featuring a composition of grey landscape elements and one or more green-blue infrastructure elements.

is equivalent to

(has entitlement<sup>op</sup> some { restricted collective , restricted private }) and (has institutional accessibility<sup>op</sup> some { private , selective }) and (has physical location<sup>op</sup> some ground based location<sup>c</sup>) and (is composed of<sup>op</sup> some Green-Blue Infrastructure Element<sup>c</sup>) and (is composed of<sup>op</sup> some grey landscape element<sup>c</sup>) and (is enclosed by<sup>op</sup> some multistorey building<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>

## **Cultural Service<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#CulturalService>

The benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences (Science for Environment Policy, 2015).

has super-classes

Ecosystem Service<sup>c</sup>

has sub-classes

Interaction with Nature<sup>c</sup>, Recreation<sup>c</sup>

has members

Aesthetical Value<sup>ni</sup>, Heritage Value<sup>ni</sup>, Place Attachment<sup>ni</sup>, Social Cohesion<sup>ni</sup>

## **Ecosystem Service<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#EcosystemService>

has super-classes

functional attribute<sup>c</sup>

has sub-classes

Cultural Service<sup>c</sup>, Provisioning Service<sup>c</sup>, Regulation and Maintenance Service<sup>c</sup>, Supporting Service<sup>c</sup>

is in range of

has intended outcome<sup>op</sup>, seeks improvement of<sup>op</sup>, seeks maintenance of<sup>op</sup>, seeks provisioning of<sup>op</sup>

## **edible plant<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#EdiblePlant>

is equivalent to

type of vegetation<sup>c</sup> and (provides the ecosystem service (benefit)<sup>op</sup> some { Food Production })

## **engineered element<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#EngineeredElement>

has super-classes

spatial entity<sup>c</sup>, thing<sup>c</sup>

has sub-classes

permeable pavement<sup>c</sup>

## **Enrichment Planting<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#EnrichmentPlanting>

The reintroduction or increase of rare or missing populations or functional groups through planting, to increase biodiversity conservation (Margueira et al., 2019).

is equivalent to

(aims at <sup>op</sup> some Green-Blue Infrastructure Element <sup>c</sup>) and (involves <sup>op</sup> some Planting Activity <sup>c</sup>) and (seeks improvement of <sup>op</sup> some { Biodiversity Conservation })

has super-classes

species diversification <sup>c</sup>

has sub-classes

species diversification <sup>c</sup>

### **Entitlement<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#EntitlementOfUse>

Concept to express entitlements of use of spaces, e.g., generally unrestricted use, entitlements restricted to a collective/defined group of individuals, or restricted use.

has super-classes

institutional attribute <sup>c</sup>

has members

restricted collective <sup>ni</sup>, restricted private <sup>ni</sup>, unrestricted public <sup>ni</sup>

### **fitness equipment<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#FitnessEquipment>

has super-classes

object feature <sup>c</sup>

### **floodplain forest<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#FloodplainForest>

has super-classes

Riparian Forest <sup>c</sup>

has sub-classes

Riparian Forest <sup>c</sup>

### **Forest<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Forest>

A forest is a treed area having a minimum size of 0.5 ha (FAO, 2018).

is equivalent to

Treed Area <sup>c</sup> and (has area <sup>dp</sup> some )

has super-classes

Green-Blue Infrastructure Element <sup>c</sup>

### **Forest Conservation<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ForestConservation>

Actions to maintain forested areas (Pawar and Rothkar, 2015).

is equivalent to

((aims at<sup>op</sup> some Forest<sup>c</sup>) or (aims at<sup>op</sup> some Forest Plantation<sup>c</sup>)) and (seeks maintenance of<sup>op</sup> some Ecosystem Service<sup>c</sup>)

### **Forest Monitoring<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ForestMonitoring>

The regular and periodic measurement of certain parameters of forested areas.

is equivalent to

(aims at<sup>op</sup> some Urban Forest<sup>c</sup>) and (involves<sup>op</sup> some { monitoring }) and (seeks maintenance of<sup>op</sup> some Ecosystem Service<sup>c</sup>)

### **Forest Plantation<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ForestPlantation>

Forest plantations may correspond to different types of forests, but have in common their deliberate planting or seeding of trees (Evans, 2004). Liu et al. (2018) report that monoculture plantations have been the dominant type of plantation in practice. Goods provided by plantations include timber, but also nontimber forest products, and other ecosystem services (Zhang and Stanturf, 2008). Forest plantations require intensive management inputs (Boyle et al., 2016).

is equivalent to

(has management intensity<sup>op</sup> some { high }) and (has physical location<sup>op</sup> some ground based location<sup>c</sup>) and (has species diversity<sup>op</sup> some { low or monoculture }) and (is composed of<sup>op</sup> some Tree<sup>c</sup> and (has grouping<sup>op</sup> some regular patterns<sup>c</sup>))

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>, plantation forest<sup>c</sup>

has sub-classes

plantation forest<sup>c</sup>

### **Forest Tree<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ForestTree>

A tree that with a tree height at maturity of more than 5m, or a type of tree able to reach this condition in-situ (FAO).

is equivalent to

Tree<sup>c</sup> and (has mature height<sup>dp</sup> some )

has super-classes

Tree<sup>c</sup>

### **Fruit Tree<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#FruitTree>

A fruit- or nut-bearing tree.

has super-classes

Tree<sup>c</sup>

### **functional attribute<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#FunctionalAttribute>

has super-classes

grouping principle<sup>c</sup>

has sub-classes

Ecosystem Service<sup>c</sup>

### **Grass<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Grass>

Non-woody species from the family Poaceae, commonly referred to as grasses.

has super-classes

non woody vegetation<sup>c</sup>

### **grave<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Grave>

has super-classes

object feature<sup>c</sup>

### **green landscape element<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#GreenLandscapeElement>

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>, landscape element<sup>c</sup>

has sub-classes

Group of Trees<sup>c</sup>, Row of Trees<sup>c</sup>, Single Tree<sup>c</sup>, type of vegetation<sup>c</sup>

### **Green Roof<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#GreenRoof>

A vegetated roof (Shafiq and Kim, 2017). This might refer to, e.g., intensive and extensive green roofs.

is equivalent to

(has physical location<sup>op</sup> some { on building roof }) and (is composed of<sup>op</sup> min 1 green landscape element<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>

### **Green Verge<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#GreenVerge>

A green verge, following Foster et al. (2019) also referred to as margin, is defined as ground-based strip of vegetation—i.e., grasses, shrub vegetation or trees planted for ornamental purposes—along patch boundaries (ibid.).

is equivalent to

((is composed of<sup>op</sup> some Grass<sup>c</sup>) or (is composed of<sup>op</sup> some Ornamental Tree<sup>c</sup>) or (is composed of<sup>op</sup> some shrub<sup>c</sup>)) and (has physical location<sup>op</sup> some ground based location<sup>c</sup>) and (is adjacent to<sup>op</sup> some network infrastructure element<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>, margin<sup>c</sup>

has sub-classes

margin<sup>c</sup>

## **green wall<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#GreenWall>

is equivalent to

(has physical location<sup>op</sup> some { on building facade }) and (is composed of<sup>op</sup> min 1 green landscape element<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>

## **Green-Blue Infrastructure Element<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#GreenBlueInfrastructureElement>

Green infrastructure is understood as all interconnected natural, semi-natural and man-made landscape elements that (could) form a green-blue network (Vlaamse Landmaatschappij, 2019). Following Suppakittpaisarn et al. (2019), GBI refers to the natural areas in urban spaces that improve urban ecology and provide social, environmental, and economic benefits.

is equivalent to

(is composed of<sup>op</sup> min 1 blue landscape element<sup>c</sup>) or (is composed of<sup>op</sup> min 1 green landscape element<sup>c</sup>)

has super-classes

Nature-Based Solution<sup>c</sup>, thing<sup>c</sup>

has sub-classes

Allotment Garden<sup>c</sup>, Arboretum<sup>c</sup>, Atrium<sup>c</sup>, Balcony Green<sup>c</sup>, Botanical Garden<sup>c</sup>, Community Garden<sup>c</sup>, Courtyard Green<sup>c</sup>, Forest<sup>c</sup>, Forest Plantation<sup>c</sup>, Green Roof<sup>c</sup>, Green Verge<sup>c</sup>, Grove<sup>c</sup>, Historical Park<sup>c</sup>, House Garden<sup>c</sup>, Neighbourhood Green Space<sup>c</sup>, Nursery<sup>c</sup>, Orchard<sup>c</sup>, Ornamental Tree<sup>c</sup>, Railroad Bank<sup>c</sup>, Riparian Forest<sup>c</sup>, Riverbank Green<sup>c</sup>, Single Street Tree<sup>c</sup>, Survivor Tree<sup>c</sup>, Tree alley<sup>c</sup>, Treed Area<sup>c</sup>, Urban Park<sup>c</sup>, Veteran Tree<sup>c</sup>, blue landscape element<sup>c</sup>, green landscape element<sup>c</sup>, green wall<sup>c</sup>

## **Greening<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Greening>

Greening may be understood as often aesthetics-based interventions, e.g., the planting of trees, or the provisioning of green spaces, e.g., through the greening of vacant lots (Hunter et al., 2019).

is equivalent to

((seeks implementation of<sup>op</sup> some (not (Forest<sup>c</sup>)) and (not (Forest Plantation<sup>c</sup>))) and (seeks provisioning of<sup>op</sup> some Ecosystem Service<sup>c</sup>)) or (seeks improvement of<sup>op</sup> some Ecosystem Service<sup>c</sup>)) and (aims at<sup>op</sup> some spatial entity<sup>c</sup> and (not (Forest<sup>c</sup>)) and (not (Forest Plantation<sup>c</sup>))) and (involves<sup>op</sup> some Planting Activity<sup>c</sup>)

### **grey landscape element<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#GreyLandscapeElement>

has super-classes

landscape element<sup>c</sup>

has sub-classes

building<sup>c</sup>, network infrastructure element<sup>c</sup>, object feature<sup>c</sup>

### **ground based location<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#GroundBasedLocation>

has super-classes

location not associated with a support structure<sup>c</sup>

has members

ground based<sup>ni</sup>

### **Group of Trees<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#GroupOfTree>

Trees that form a clustered group.

is equivalent to

(has grouping<sup>op</sup> some { clustered group }) and (is composed of<sup>op</sup> some Tree<sup>c</sup>)

has super-classes

green landscape element<sup>c</sup>

### **grouping principle<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#GroupingPrinciple>

has super-classes

thing<sup>c</sup>

has sub-classes

functional attribute<sup>c</sup>, institutional attribute<sup>c</sup>, morphological attribute<sup>c</sup>, physical attribute<sup>c</sup>

### **Grove<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Grove>

A group of trees, with a ground-based physical location.

is equivalent to

Group of Trees<sup>c</sup> and (has physical location<sup>op</sup> some ground based location<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>



## **hedge<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Hedge>

is equivalent to

((has management intensity<sup>op</sup> some { high }) and (is composed of<sup>op</sup> some Tree<sup>c</sup>)) or (is composed of<sup>op</sup> some shrub<sup>c</sup>) and (has grouping<sup>op</sup> some { linear group })

has super-classes

woody vegetation<sup>c</sup>

## **historical garden<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#HistoricalGarden>

has super-classes

Historical Park<sup>c</sup>

has sub-classes

Historical Park<sup>c</sup>

## **Historical Park<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#HistoricalPark>

Following Cvejić et al. (2015), similar in character to large urban parks, but with distinct management due to heritage status. Historical parks feature outstanding aesthetic or scientific values from the past, and thus have aesthetic, historic, scientific, social or spiritual values (Nature4Cities, 2018).

is equivalent to

Parks and Gardens<sup>c</sup> and (has management intensity<sup>op</sup> some { high }) and (provides the ecosystem service (benefit)<sup>op</sup> some { Heritage Value })

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>, historical garden<sup>c</sup>

has sub-classes

historical garden<sup>c</sup>

## **House Garden<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#HouseGarden>

Following Cvejić et al. (2015), they can be considered as area in the immediate vicinity, i.e., in adjacency to privately owned or rented houses, cultivated for ornamental purposes, and/or for the non-commercial production of food.

is equivalent to

(has entitlement<sup>op</sup> some { restricted private }) and (has institutional accessibility<sup>op</sup> some { private }) and (has physical location<sup>op</sup> some ground based location<sup>c</sup>) and (is adjacent to<sup>op</sup> some private house<sup>c</sup>) and (is composed of<sup>op</sup> some Green-Blue Infrastructure Element<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>, Parks and Gardens<sup>c</sup>

## **Implementation Action<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ImplementationAction>

Actions and interventions conceptualized to seek the establishment or implementation (construction) of nature-based solutions, to provide ecosystem services.

is equivalent to

(seeks implementation of<sup>op</sup> some Nature-Based Solution<sup>c</sup>) and (seeks provisioning of<sup>op</sup> some Ecosystem Service<sup>c</sup>)

has super-classes

Action<sup>c</sup>

### **institutional accessibility<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#InstitutionalAccessibility>

has super-classes

institutional attribute<sup>c</sup>

has members

private<sup>ni</sup>, public<sup>ni</sup>, selective<sup>ni</sup>, semi\_public<sup>ni</sup>, temporally restricted access<sup>ni</sup>, temporally unrestricted access<sup>ni</sup>

### **institutional attribute<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#InstitutionalAttribute>

has super-classes

grouping principle<sup>c</sup>

has sub-classes

Entitlement<sup>c</sup>, institutional accessibility<sup>c</sup>, management intensity<sup>c</sup>

### **Interaction with Nature<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#InteractionWithNature>

Activities or features that allow to interact, observe, or experience nature.

has super-classes

Cultural Service<sup>c</sup>

has members

Education<sup>ni</sup>, Scientific Value<sup>ni</sup>

### **lake<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Lake>

has super-classes

permanent standing water<sup>c</sup>

### **landscape element<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#LandscapeElement>

has super-classes

spatial entity<sup>c</sup>, thing<sup>c</sup>

has sub-classes

blue landscape element<sup>c</sup>, green landscape element<sup>c</sup>, grey landscape element<sup>c</sup>

### **Lawn<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Lawn>

An area covered by grass(es) that are well-maintained, e.g., at short height, through high human management. Lawns have high value for recreation and aesthetics (Nature4Cities, 2018; Larson et al., 2016).

is equivalent to

Grass<sup>c</sup> and (has management intensity<sup>op</sup> some { high })  
has super-classes

### **location not associated with a support structure<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#LocationNotAssociatedWithASupportStructure>

has super-classes

physical location<sup>c</sup>  
has sub-classes  
ground based location<sup>c</sup>

### **location on building<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#LocationOnBuilding>

has super-classes

physical location<sup>c</sup>  
has members  
on balcony<sup>ni</sup>, on building facade<sup>ni</sup>, on building roof<sup>ni</sup>

### **location on support structure<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#LocationOnSupportStructure>

has super-classes

physical location<sup>c</sup>  
has members  
on pergola<sup>ni</sup>

### **Management Action<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ManagementAction>

Actions and interventions conceptualized to seek the management of green-blue infrastructure elements, for maintaining the provisioning of ecosystem services.

is equivalent to

seeks maintenance of<sup>op</sup> some Ecosystem Service<sup>c</sup>  
has super-classes  
Action<sup>c</sup>

### **management intensity<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ManagementIntensity>

has super-classes

institutional attribute<sup>c</sup>

has members

high<sup>ni</sup>, low<sup>ni</sup>, not managed<sup>ni</sup>

### **margin<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Margin>

has super-classes

Green Verge<sup>c</sup>

has sub-classes

Green Verge<sup>c</sup>

### **Meadow<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Meadow>

A type of grassland with high biodiversity value and limited (low) human management (Bretzel et al. 2016; Janssen & Rosu, 2015).

is equivalent to

Grass<sup>c</sup> and (has management intensity<sup>op</sup> some { low })

has super-classes

### **morphological attribute<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#MorphologicalAttribute>

has super-classes

grouping principle<sup>c</sup>

has sub-classes

object grouping<sup>c</sup>, species diversity<sup>c</sup>

### **multistorey building<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#MultistoreyBuilding>

has super-classes

building<sup>c</sup>

### **Nature-Based Solution<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Nbs>

Following the definition of NBS proposed by the European Commission (2015), and as discussed in Almenar et al. (2021), we conceptualize NBS as entities providing—through natural functions or by design, i.e., inspired by nature—(multiple) ecosystem service(s). IUCN stresses that NBS refers to actions to protect, manage, and/or restore ecosystems (Cohen-Shacham et al., 2016; Hanson et al. 2020). Somarakis et al. (2019) emphasize that NBS subsumes manifold types of actions, and identify the better use of protected ecosystems, more sustainable and multifunctional managed ecosystems, and the design and management of new ecosystems as three main types of NBS interventions. In either case, emphasis is given to the fact that

NBS shall provide (multiple) benefits, to address societal, environmental or economic challenges (Almenar et al., 2021; Hanson et al., 2020). This subsumes green-blue infrastructure elements, as well as engineered elements—e.g., permeable pavements—under the NBS definition. This further includes actions that seek the provisioning, improvement, or maintenance of ecosystem services.

is equivalent to

provides the ecosystem service (benefit) <sup>op</sup> min 2 Ecosystem Service <sup>c</sup>

has super-classes

has sub-classes

Action <sup>c</sup>, Green-Blue Infrastructure Element <sup>c</sup>

## **Neighbourhood Green Space<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#NeighbourhoodGreenSpace>

Neighbourhood green spaces are defined by Cvejić et al. (2015) as areas often vegetated by grass, shrubs, and trees, i.e., composed of various types of vegetation—or by extension blue-green infrastructure elements—in multistorey residential areas.

is equivalent to

(has institutional accessibility <sup>op</sup> some { public , semi public }) and (is adjacent to <sup>op</sup> some multistorey building <sup>c</sup>) and (is composed of <sup>op</sup> some Green-Blue Infrastructure Element <sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element <sup>c</sup>, Parks and Gardens <sup>c</sup>

## **network infrastructure element<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#NetworkInfrastructureElement>

has super-classes

grey landscape element <sup>c</sup>

has sub-classes

path <sup>c</sup>, square <sup>c</sup>, street <sup>c</sup>, track <sup>c</sup>

## **Network-associated Green<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#NetworkAssociatedGreen>

Green-blue infrastructure elements adjacent to network infrastructure elements, e.g., streets, tracks, paths etc.

## **non forest tree<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#NonForestTree>

is equivalent to

Tree <sup>c</sup> and (has mature height <sup>dp</sup> some )

has super-classes

Tree <sup>c</sup>

## **non woody vegetation<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#NonWoodyVegetation>

has super-classes

type of vegetation <sup>c</sup>

has sub-classes

Grass <sup>c</sup>

### **Nursery<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Nursery>

A nursery has the purpose of plant propagation.

is equivalent to

(provides the ecosystem service (benefit) <sup>op</sup> some { Plant Propagation }) and (is composed of <sup>op</sup> min 1 type of vegetation <sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element <sup>c</sup>

### **object feature<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ObjectFeature>

has super-classes

grey landscape element <sup>c</sup>

has sub-classes

bench <sup>c</sup>, fitness equipment <sup>c</sup>, grave <sup>c</sup>, playground <sup>c</sup>, skate park <sup>c</sup>, sports field <sup>c</sup>

### **object grouping<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ObjectGrouping>

has super-classes

morphological attribute <sup>c</sup>

has sub-classes

One-Dimensional Grouping (1D) <sup>c</sup>, Two-Dimensional Grouping (2D) <sup>c</sup>, Zero-Dimensional Grouping (0D) <sup>c</sup>

is in range of

has grouping <sup>op</sup>

### **One-Dimensional Grouping (1D)<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#OneDimensionalGrouping>

Entities grouped in a linear alignment, e.g., rows of trees.

has super-classes

object grouping <sup>c</sup>

has members

linear group <sup>ni</sup>

### **Orchard<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Orchard>

Areas planted with fruit trees, or nut-bearing trees, for the (commercial or non-commercial) production of food.

is equivalent to

(has grouping <sup>op</sup> some Two-Dimensional Grouping (2D) <sup>c</sup>) and (has physical location <sup>op</sup> some ground based location <sup>c</sup>) and (is composed of <sup>op</sup> some Fruit Tree <sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element <sup>c</sup>, Urban Food Forest <sup>c</sup>

## **Orchard Restoration<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#OrchardRestoration>

Restoration or improvement of (degraded) orchards.

is equivalent to

(aims at <sup>op</sup> some Orchard <sup>c</sup>) and (involves <sup>op</sup> some { restoration }) and (seeks improvement of <sup>op</sup> some Ecosystem Service <sup>c</sup>)

## **Ornamental Tree<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#OrnamentalTree>

A single tree planted for ornamental purposes, i.e., having high aesthetical value.

is equivalent to

Single Tree <sup>c</sup> and (provides the ecosystem service (benefit) <sup>op</sup> some { Aesthetical Value })

has super-classes

Green-Blue Infrastructure Element <sup>c</sup>

## **Parks and Gardens<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ParksAndGardens>

A ground-based area composed of elements of the green-blue infrastructure and grey landscape elements, or an area corresponding to treed areas too small in size to be considered a forest.

is equivalent to

(Treed Area <sup>c</sup> and (has area <sup>dp</sup> some )) or ((has physical location <sup>op</sup> some ground based location <sup>c</sup>) and (is composed of <sup>op</sup> some Green-Blue Infrastructure Element <sup>c</sup>) and (is composed of <sup>op</sup> some grey landscape element <sup>c</sup>))

has super-classes

has sub-classes

House Garden <sup>c</sup>, Neighbourhood Green Space <sup>c</sup>

## **path<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Path>

has super-classes

network infrastructure element <sup>c</sup>

## **permanent standing water<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PermanentStandingWater>

has super-classes

blue landscape element<sup>c</sup>

has sub-classes

lake<sup>c</sup>, pond<sup>c</sup>

### **permeable pavement<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PermeablePavement>

is equivalent to

street<sup>c</sup> and (provides the ecosystem service (benefit)<sup>op</sup> some { Infiltration })

has super-classes

engineered element<sup>c</sup>

### **pest control<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PestControl>

has super-classes

activity<sup>c</sup>

has members

application of pesticides<sup>ni</sup>, biological pest control<sup>ni</sup>

is also defined as

named individual

### **pest management<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PestManagement>

is equivalent to

(aims at<sup>op</sup> some Green-Blue Infrastructure Element<sup>c</sup>) and (involves<sup>op</sup> some pest control<sup>c</sup>) and (seeks maintenance of<sup>op</sup> some Ecosystem Service<sup>c</sup>)

### **physical attribute<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PhysicalAttribute>

has super-classes

grouping principle<sup>c</sup>

has sub-classes

canopy cover<sup>c</sup>, physical location<sup>c</sup>, physical process phenomenon<sup>c</sup>, sealing<sup>c</sup>

### **physical location<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PhysicalLocation>

has super-classes

physical attribute<sup>c</sup>

has sub-classes

location not associated with a support structure<sup>c</sup>, location on building<sup>c</sup>, location on support structure<sup>c</sup>

is in range of



has physical location<sup>op</sup>

### **physical process phenomenon<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PhysicalProcessPhenomenon>

has super-classes

physical attribute<sup>c</sup>, process phenomenon<sup>c</sup>

has members

evaporation<sup>ni</sup>, evapotranspiration<sup>ni</sup>, flooding<sup>ni</sup>, photosynthesis<sup>ni</sup>, shading<sup>ni</sup>, transpiration<sup>ni</sup>

### **plantation forest<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PlantationForest>

has super-classes

Forest Plantation<sup>c</sup>

has sub-classes

Forest Plantation<sup>c</sup>

### **Planting Activity<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PlantingActivity>

The planting of different types of vegetation.

has super-classes

activity<sup>c</sup>

has members

Tree Planting<sup>ni</sup>, grass planting<sup>ni</sup>, shrub planting<sup>ni</sup>

### **playground<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Playground>

has super-classes

object feature<sup>c</sup>

### **Pollution Removal<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PollutionRemoval>

Mediation (filtration, sequestration, storage) of wastes and toxic substances (CICES).

has super-classes

Regulation and Maintenance Service<sup>c</sup>

has members

Air Purification<sup>ni</sup>, Water Purification<sup>ni</sup>

### **pond<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Pond>

has super-classes

permanent standing water<sup>c</sup>

### **private house<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PrivateHouse>

has super-classes

building<sup>c</sup>

### **process phenomenon<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ProcessPhenomenon>

has super-classes

thing<sup>c</sup>

has sub-classes

physical process phenomenon<sup>c</sup>

### **Provisioning Service<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ProvisioningService>

Products obtained from ecosystems, such as food or timber (Science for Environment Policy, 2015).

has super-classes

Ecosystem Service<sup>c</sup>

has members

Food Production<sup>ni</sup>, Non-Timber Forest Products<sup>ni</sup>, Plant Propagation<sup>ni</sup>, Timber Production<sup>ni</sup>

### **Railroad Bank<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RailroadBank>

Green space along railroads.

is equivalent to

(has physical location<sup>op</sup> some ground based location<sup>c</sup>) and (is adjacent to<sup>op</sup> some { railroad track })  
and (is composed of<sup>op</sup> some green landscape element<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>

### **Recreation<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Recreation>

Recreational activities and behaviour, such as walking, hiking, sports and other recreational uses (following Schirpke et al., 2018).

has super-classes

Cultural Service<sup>c</sup>

has members

Active Recreational Use<sup>ni</sup>, Mixed Recreational Use<sup>ni</sup>, Passive Recreational Use<sup>ni</sup>

## **Reforestation<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Reforestation>

Intentional restocking of existing forests, forest plantations or of woodlands, i.e., actions involving the planting of trees in currently forested areas.

is equivalent to

((aims at<sup>op</sup> some Forest<sup>c</sup>) or (aims at<sup>op</sup> some Forest Plantation<sup>c</sup>)) and (involves<sup>op</sup> some { Tree Planting }) and (seeks improvement of<sup>op</sup> some Ecosystem Service<sup>c</sup>)

## **regular patterns<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RegularPatterns>

has super-classes

Two-Dimensional Grouping (2D)<sup>c</sup>

has members

regular\_grid<sup>ni</sup>, regular\_pattern<sup>ni</sup>

## **Regulation and Maintenance Service<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RegulationAndMaintenanceService>

The benefits obtained from the regulation of ecosystems, including services such as purification of water, flood control, or regulation of the climate via carbon sequestration (Science for Environment Policy, 2015).

has super-classes

Ecosystem Service<sup>c</sup>

has sub-classes

Carbon Sequestration and Storage<sup>c</sup>, Pollution Removal<sup>c</sup>, Water Flow Regulation<sup>c</sup>

has members

Regulation of Air Temperature and Humidity<sup>ni</sup>

## **Restoration Action<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RestorationAction>

Actions and interventions conceptualized to seek the restoration or improvement of (degraded) green-blue infrastructure elements, thereby improving the provisioning of ecosystem services.

is equivalent to

seeks improvement of<sup>op</sup> some Ecosystem Service<sup>c</sup>

has super-classes

Action<sup>c</sup>

## **Riparian Forest<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RiparianForest>

A type of forest adjacent to a river and subject to flooding, i.e., forests located in floodplains that are seasonally or irregularly flooded by changes in water level (Martin-Smith, 2004).

is equivalent to

Forest<sup>c</sup> and ((is adjacent to<sup>op</sup> some river<sup>c</sup>) or (is adjacent to<sup>op</sup> some stream<sup>c</sup>)) and (is affected by<sup>op</sup> some { flooding })

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>, floodplain forest<sup>c</sup>

has sub-classes

floodplain forest<sup>c</sup>

### **river<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#River>

has super-classes

watercourse<sup>c</sup>

### **Riverbank Green<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RiverbankGreen>

Parks and gardens, i.e., green spaces adjacent to rivers or canals.

is equivalent to

(has physical location<sup>op</sup> some ground based location<sup>c</sup>) and (is adjacent to<sup>op</sup> some watercourse<sup>c</sup>) and  
(is composed of<sup>op</sup> some Green-Blue Infrastructure Element<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>

### **Row of Trees<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RowOfTree>

Trees that form a linearly aligned group.

is equivalent to

(has grouping<sup>op</sup> some { linear group }) and (is composed of<sup>op</sup> some Tree<sup>c</sup>)

has super-classes

green landscape element<sup>c</sup>

### **sealing<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Sealing>

has super-classes

physical attribute<sup>c</sup>

has members

paved<sup>ni</sup>, unpaved<sup>ni</sup>

### **shrub<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Shrub>

has super-classes

woody vegetation<sup>c</sup>

## **Single Street Tree<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#SingleStreetTree>

A solitary tree, ground-based and adjacent to a street.

is equivalent to

Single Tree<sup>c</sup> and (has physical location<sup>op</sup> some ground based location<sup>c</sup>) and (is adjacent to<sup>op</sup> some street<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>, street green<sup>c</sup>

## **Single Tree<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#SingleTree>

A solitary tree. According to Nature4Cities (2018), it corresponds to an individually standing tree irrespective of age, that is managed independently from other vegetation such as that in a nearby urban park.

is equivalent to

Tree<sup>c</sup> and (has grouping<sup>op</sup> some { solitary. })

has super-classes

green landscape element<sup>c</sup>

## **skate park<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#SkatePark>

has super-classes

object feature<sup>c</sup>

## **spatial entity<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#SpatialEntity>

is equivalent to

has area<sup>dp</sup> some double

has sub-classes

engineered element<sup>c</sup>, landscape element<sup>c</sup>

## **species diversification<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#SpeciesDiversification>

has super-classes

Enrichment Planting<sup>c</sup>

has sub-classes

Enrichment Planting<sup>c</sup>

## **species diversity<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#SpeciesDiversity>

has super-classes

morphological attribute<sup>c</sup>

has members

average<sup>ni</sup>, elevated<sup>ni</sup>, low or monoculture<sup>ni</sup>

### **sports field<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#SportsField>

has super-classes

object feature<sup>c</sup>

### **square<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Square>

has super-classes

network infrastructure element<sup>c</sup>

### **stream<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Stream>

has super-classes

watercourse<sup>c</sup>

### **street<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Street>

has super-classes

network infrastructure element<sup>c</sup>

### **Street Trees<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#StreetTrees>

Street trees are single street trees, or entities that are composed of trees and that are adjacent to streets, or are entities that are composed of rows of trees that are adjacent to street, or are entities that are composed of group(s) of trees that are adjacent to streets.

is equivalent to

Single Street Tree<sup>c</sup> or ((is adjacent to<sup>op</sup> some street<sup>c</sup>) and (is composed of<sup>op</sup> some Group of Trees<sup>c</sup>))  
or ((is adjacent to<sup>op</sup> some street<sup>c</sup>) and (is composed of<sup>op</sup> some Row of Trees<sup>c</sup>)) or ((is adjacent to<sup>op</sup>  
some street<sup>c</sup>) and (is composed of<sup>op</sup> some Tree<sup>c</sup>))

### **Supporting Service<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#SupportingService>

These are services, such as nutrient cycling and soil formation, which are needed for the production of all other services (Science for Environment Policy, 2015).

has super-classes

Ecosystem Service<sup>c</sup>

has members

Biodiversity Conservation<sup>ni</sup>, Habitat Provisioning<sup>ni</sup>

### **Survivor Tree<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#SurvivorTree>

Survivor trees are single trees that have witnessed and withstood extreme disturbances and became symbols for communities seeking to respond, recover, and reconnect following a tragedy.

is equivalent to

Single Tree<sup>c</sup> and (provides the ecosystem service (benefit).<sup>op</sup> some { Heritage Value })

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>

### **track<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Track>

has super-classes

network infrastructure element<sup>c</sup>

has members

railroad track<sup>ni</sup>, tram track<sup>ni</sup>

### **Tree<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Tree>

A type of woody plant.

has super-classes

woody vegetation<sup>c</sup>

has sub-classes

Forest Tree<sup>c</sup>, Fruit Tree<sup>c</sup>, non forest tree<sup>c</sup>

### **Tree alley<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#TreeAlley>

Trees planted along roads and paths either solitary or in rows.

is equivalent to

(has physical location<sup>op</sup> some ground based location<sup>c</sup>) and (is adjacent to<sup>op</sup> some street<sup>c</sup>) and (is composed of<sup>op</sup> min 2 Row of Trees<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>, street green<sup>c</sup>

### **Tree Monitoring<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#TreeMonitoring>

The regular and periodic measurement of certain parameters of (single) trees.

is equivalent to

(aims at <sup>op</sup> some Single Tree <sup>c</sup>) and (involves <sup>op</sup> some { monitoring }) and (seeks maintenance of <sup>op</sup> some Ecosystem Service <sup>c</sup>)

### **tree pruning<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#TreePruning>

is equivalent to

(aims at <sup>op</sup> some Single Tree <sup>c</sup>) and (involves <sup>op</sup> some { pruning }) and (seeks maintenance of <sup>op</sup> some Ecosystem Service <sup>c</sup>)

### **tree watering<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#TreeWatering>

is equivalent to

(aims at <sup>op</sup> some Single Tree <sup>c</sup>) and (involves <sup>op</sup> some { watering }) and (seeks maintenance of <sup>op</sup> some Ecosystem Service <sup>c</sup>)

### **Treed Area<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#TreedArea>

A treed area is considered a ground-based area dominated by trees, i.e., an area composed of trees in a two-dimensional pattern, with a tree canopy cover greater than 50% (Janssen & Rosu, 2015).

is equivalent to

(has physical location <sup>op</sup> some ground based location <sup>c</sup>) and (is composed of <sup>op</sup> some Tree <sup>c</sup> and (has grouping <sup>op</sup> some Two-Dimensional Grouping (2D) <sup>c</sup>)) and (has canopy cover <sup>dp</sup> some )

has super-classes

Green-Blue Infrastructure Element <sup>c</sup>, wood <sup>c</sup>

has sub-classes

wood <sup>c</sup>

### **Two-Dimensional Grouping (2D)<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#TwoDimensionalGrouping>

Entities grouped in clusters covering a delineatable area, e.g., groves, forest, etc.

has super-classes

object grouping <sup>c</sup>

has sub-classes

regular patterns <sup>c</sup>

has members

clustered group <sup>ni</sup>, irregular pattern <sup>ni</sup>

### **type of vegetation<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#TypeOfVegetation>



has super-classes

green landscape element<sup>c</sup>

has sub-classes

non woody vegetation<sup>c</sup>, woody vegetation<sup>c</sup>

## **Urban Food Forest<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#UrbanFoodForest>

Elements of the urban forest that provide food, e.g., fruits and nuts. Gori et al. (2019) defined the urban food forest as an edible green infrastructure, or as as an edible, perennial, polyculture system.

has sub-classes

Orchard<sup>c</sup>

## **Urban Forest<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#UrbanForest>

The urban forest is defined to comprise all trees in the urban area (Konijnendijk, 2003), inclusive of individual street trees and clusters of park trees, and peri-urban forests extend to the outer metropolitan area. Within the urban forest, forest types include city parks and urban forests, gardens with trees, trees on streets or in public squares, and any other green spaces with trees, such as riparian corridors, rooftops, and nurseries (Endreny, 2018; Davies et al., 2017). Patarkalashvili (2017) refers to it as the sum of green tissue.

is equivalent to

Tree<sup>c</sup> or (is composed of<sup>op</sup> some Tree<sup>c</sup>) or (is composed of<sup>op</sup> some (is composed of<sup>op</sup> some Group of Trees<sup>c</sup>) or (is composed of<sup>op</sup> some Row of Trees<sup>c</sup>) or (is composed of<sup>op</sup> some Tree<sup>c</sup>))

## **Urban Park<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#UrbanPark>

An urban park is a park area of various size and design, and typically includes different features, i.e., may be composed at least of lawn, and/or (other) grass(es), and/or shrubs, and/or trees, and grey landscape element(s) such as paths or streets or playgrounds etc. Urban parks offer passive, active and/or mixed recreational activities and cater to social needs of the population (Nature4Cities, 2018). We define an urban park as being accessible by the general public, and with unrestricted use by the public.

is equivalent to

Parks and Gardens<sup>c</sup> and (has entitlement<sup>op</sup> some { unrestricted public }) and (has institutional accessibility<sup>op</sup> some { public }) and (is composed of<sup>op</sup> min 1 Lawn<sup>c</sup>)

has super-classes

Green-Blue Infrastructure Element<sup>c</sup>

## **Urban-Forest as Nature-Based Solution<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#UfNbs>

UF-NBS are defined as the intersection of urban forests as conceptual entity, and of the concept of nature-based solution.

is equivalent to

Nature-Based Solution<sup>c</sup> and (Urban Forest<sup>c</sup> or (aims at<sup>op</sup> some Urban Forest<sup>c</sup>) or (seeks implementation of<sup>op</sup> some Urban Forest<sup>c</sup>))

### **Vegetated Pergola<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#VegetatedPergola>

A pergola serving as climbing support for vegetation.

is equivalent to

(has physical location<sup>op</sup> some { on pergola }) and (is composed of<sup>op</sup> min 1 green landscape element<sup>c</sup>)

### **Veteran Tree<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#VeteranTree>

A single tree with high habitat provisioning value, e.g., for birds or bats due to cavities.

is equivalent to

Single Tree<sup>c</sup> and (provides the ecosystem service (benefit)<sup>op</sup> some { Habitat Provisioning })  
has super-classes

Green-Blue Infrastructure Element<sup>c</sup>

### **Water Flow Regulation<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#WaterFlowRegulation>

Hydrological cycle and water flow regulation (CICES).

has super-classes

Regulation and Maintenance Service<sup>c</sup>

has members

Infiltration<sup>ni</sup>, Runoff Regulation<sup>ni</sup>

### **watercourse<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Watercourse>

has super-classes

blue landscape element<sup>c</sup>

has sub-classes

canal<sup>c</sup>, river<sup>c</sup>, stream<sup>c</sup>

### **wetland<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Wetland>

has super-classes

blue landscape element<sup>c</sup>

### **Wetland Construction<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#WetlandConstruction>

Establishment of new wetlands, i.e., actions involving the construction of new wetland areas.

is equivalent to

(aims at <sup>op</sup> some spatial entity <sup>c</sup>) and (involves <sup>op</sup> some { construction }) and (seeks implementation of <sup>op</sup> some wetland <sup>c</sup>) and (seeks provisioning of <sup>op</sup> some Ecosystem Service <sup>c</sup>)

### **Wetland Restoration<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#WetlandRestoration>

Restoration or improvement of (degraded) wetland areas.

is equivalent to

(aims at <sup>op</sup> some wetland <sup>c</sup>) and (involves <sup>op</sup> some { restoration }) and (seeks improvement of <sup>op</sup> some Ecosystem Service <sup>c</sup>)

### **wood<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Wood>

has super-classes

Treed Area <sup>c</sup>

has sub-classes

Treed Area <sup>c</sup>

### **woody vegetation<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#WoodyVegetation>

has super-classes

type of vegetation <sup>c</sup>

has sub-classes

Tree <sup>c</sup>, hedge <sup>c</sup>, shrub <sup>c</sup>

### **Zero-Dimensional Grouping (0D)<sup>c</sup> back to ToC or Class ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ZeroDimensionalGrouping>

Point entities, e.g., single trees.

has super-classes

object grouping <sup>c</sup>

has members

solitary <sup>ni</sup>

### **Object Properties**

- aims at
- has entitlement
- has grouping
- has institutional accessibility
- has intended outcome

- has management intensity
- has part
- has physical location
- has species diversity
- is adjacent to
- is affected by
- is composed of
- is enclosed by
- is fully enclosed by
- is part of
- provides the ecosystem service (benefit)
- seeks implementation of
- seeks improvement of
- seeks maintenance of
- seeks provisioning of

### **aims at<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#aimsAt>

has super-properties  
top object property

### **has entitlement<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#hasEntitlement>

has super-properties  
top object property

### **has grouping<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#hasGrouping>

has super-properties  
top object property  
has range  
object grouping<sup>c</sup>

### **has institutional accessibility<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#hasInstitutionalAccessibility>

has super-properties  
top object property

### **has intended outcome<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#hasIntendedOutcome>

has super-properties  
provides the ecosystem service (benefit)<sup>OP</sup>, top object property  
has sub-properties  
seeks improvement of<sup>OP</sup>, seeks maintenance of<sup>OP</sup>, seeks provisioning of<sup>OP</sup>  
has range

Ecosystem Service <sup>c</sup>

**has management intensity<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#hasManagementIntensity>

has super-properties  
top object property

**has part<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#hasPart>

has super-properties  
top object property

**has physical location<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#hasPhysicalLocation>

has super-properties  
top object property  
has range  
physical location <sup>c</sup>

**has species diversity<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#hasSpeciesDiversity>

has super-properties  
top object property

**is adjacent to<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#isAdjacentTo>

has super-properties  
top object property  
has range  
thing <sup>c</sup>

**is affected by<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#isAffectedBy>

has range  
thing <sup>c</sup>

**is composed of<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#isComposedOf>

has super-properties  
top object property

**is enclosed by<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#isEnclosedBy>

has super-properties  
top object property  
has range  
thing <sup>c</sup>

**is fully enclosed by<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#isFullyEnclosedBy>

has super-properties  
top object property  
has range  
thing <sup>c</sup>

**is part of<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#isPartOf>

has super-properties  
top object property  
has range  
thing <sup>c</sup>

**provides the ecosystem service (benefit)<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#providesEcosystemService>

has super-properties  
top object property  
has sub-properties  
has intended outcome <sup>OP</sup>  
has sub-property chains  
is composed of <sup>OP</sup> o provides the ecosystem service (benefit) <sup>OP</sup>

**seeks implementation of<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#seeksImplementationOf>

has super-properties  
top object property

**seeks improvement of<sup>OP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#seeksImprovementOf>

has super-properties  
has intended outcome <sup>OP</sup>, top object property  
has range  
Ecosystem Service <sup>c</sup>

## **seeks maintenance of<sup>oP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#seeksMaintenanceOf>

has super-properties

has intended outcome <sup>oP</sup>, top object property

has range

Ecosystem Service <sup>c</sup>

## **seeks provisioning of<sup>oP</sup> back to ToC or Object Property ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#seeksProvisioningOf>

has super-properties

has intended outcome <sup>oP</sup>, top object property

has range

Ecosystem Service <sup>c</sup>

## **Named Individuals**

- Active Recreational Use
- Aesthetical Value
- Air Purification
- application of pesticides
- average
- Biodiversity Conservation
- biological pest control
- Carbon Sequestration
- Carbon Storage
- clustered group
- construction
- Education
- elevated
- evaporation
- evapotranspiration
- flooding
- Food Production
- grass planting
- ground based
- Habitat Provisioning
- Heritage Value
- high
- Infiltration
- irregular pattern
- linear group
- low
- low or monoculture
- Mixed Recreational Use
- monitoring
- Non-Timber Forest Products
- not managed
- on balcony
- on building facade
- on building roof
- on pergola
- Passive Recreational Use

- paved
- pest control
- photosynthesis
- Place Attachment
- Plant Propagation
- private
- pruning
- public
- railroad track
- regular grid
- regular pattern
- Regulation of Air Temperature and Humidity
- restoration
- restricted collective
- restricted private
- Runoff Regulation
- Scientific Value
- selective
- semi public
- shading
- shrub planting
- Social Cohesion
- solitary
- temporally restricted access
- temporally unrestricted access
- Timber Production
- tram track
- transpiration
- Tree Planting
- unpaved
- unrestricted public
- Water Purification
- watering
- weed control

### **Active Recreational Use<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ActiveRecreationalUse>

Characteristics or features that enable cooperative or team (typically sports) activities (Nature4Cities, 2018; Ma and Haarhoff 2015).

belongs to

Recreation<sup>c</sup>

### **Aesthetical Value<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#AestheticalValue>

Characteristics or features that enable aesthetic experiences (CICES).

belongs to

Cultural Service<sup>c</sup>

### **Air Purification<sup>ni</sup> back to ToC or Named Individual ToC**



**IRI:** <http://clearinghouseproject.eu/typology/elements#AirPurification>

Removal of pollutants from the air.

belongs to

Pollution Removal <sup>c</sup>

**application of pesticides<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ApplicationOfPesticides>

belongs to

pest control <sup>c</sup>

**average<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Average>

belongs to

species diversity. <sup>c</sup>

**Biodiversity Conservation<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#BiodiversityConservation>

Maintenance (or improvement) of, e.g., genetic diversity or species diversity.

belongs to

Supporting Service <sup>c</sup>

**biological pest control<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#BiologicalPestControl>

belongs to

pest control <sup>c</sup>

**Carbon Sequestration<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#CarbonSequestration>

Sequestration of carbon.

belongs to

Carbon Sequestration and Storage <sup>c</sup>

**Carbon Storage<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#CarbonStorage>

Storage (fixation) of carbon.

belongs to

Carbon Sequestration and Storage <sup>c</sup>

**clustered group<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ClusteredGroup>

belongs to

Two-Dimensional Grouping (2D).<sup>c</sup>

**construction<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Construction>

belongs to

activity.<sup>c</sup>

**Education<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Education>

Characteristics or features that enable education and training (CICES).

belongs to

Interaction with Nature.<sup>c</sup>

**elevated<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Elevated>

belongs to

species diversity.<sup>c</sup>

**evaporation<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Evaporation>

belongs to

physical process phenomenon.<sup>c</sup>

**evapotranspiration<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Evapotranspiration>

belongs to

physical process phenomenon.<sup>c</sup>

**flooding<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Flooding>

belongs to

physical process phenomenon.<sup>c</sup>

**Food Production<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#FoodProduction>

Cultivated terrestrial plants such as crops, grown for nutritional purposes (CICES).

belongs to

Provisioning Service<sup>c</sup>

**grass planting<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#GrassPlanting>

belongs to

Planting Activity<sup>c</sup>

**ground based<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#GroundBased>

belongs to

ground based location<sup>c</sup>

**Habitat Provisioning<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#HabitatProvisioning>

Provisioning of living space, i.e., habitat, for plants and animals.

belongs to

Supporting Service<sup>c</sup>

**Heritage Value<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#HeritageValue>

Characteristics or features that are resonant in terms of culture or heritage (CICES).

belongs to

Cultural Service<sup>c</sup>

**high<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#High>

belongs to

management intensity<sup>c</sup>

**Infiltration<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Infiltration>

Hydrological cycle and water flow regulation through infiltration.

belongs to

Water Flow Regulation<sup>c</sup>

## **irregular pattern<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#IrregularPattern>

belongs to

Two-Dimensional Grouping (2D).<sup>c</sup>

## **linear group<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#LinearGroup>

belongs to

One-Dimensional Grouping (1D).<sup>c</sup>

## **low<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Low>

belongs to

management intensity.<sup>c</sup>

## **low or monoculture<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#LowOrMonoculture>

belongs to

species diversity.<sup>c</sup>

## **Mixed Recreational Use<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#MixedRecreationalUse>

Characteristics or features that involve both active as well as passive recreational uses.

belongs to

Recreation.<sup>c</sup>

## **monitoring<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Monitoring>

belongs to

activity.<sup>c</sup>

## **Non-Timber Forest Products<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#NonTimberForestProducts>

Non-timber forest products for direct use or processing (following CICES).

belongs to

Provisioning Service.<sup>c</sup>

**not managed<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#NotManaged>

belongs to

management intensity<sup>c</sup>

**on balcony<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#OnBalcony>

belongs to

location on building<sup>c</sup>

**on building facade<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#OnBuildingFacade>

belongs to

location on building<sup>c</sup>

**on building roof<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#OnBuildingRoof>

belongs to

location on building<sup>c</sup>

**on pergola<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#OnPergola>

belongs to

location on support structure<sup>c</sup>

**Passive Recreational Use<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PassiveRecreationalUse>

Characteristics or features that enable relatively quiet and low-intensity activities (Nature4Cities, 2018, Keeler et al. 2019).

belongs to

Recreation<sup>c</sup>

**paved<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Paved>

belongs to

sealing<sup>c</sup>

**pest control<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PestControl>

belongs to

activity.<sup>c</sup>

is also defined as

class

### **photosynthesis<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Photosynthesis>

belongs to

physical process phenomenon.<sup>c</sup>

### **Place Attachment<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PlaceAttachment>

Positively experienced bonds, sometimes occurring without awareness, that are developed over time from the behavioral, affective, and cognitive ties between individuals and/or groups and their socio-physical environment (Mihaylov and Perkins, 2014).

belongs to

Cultural Service.<sup>c</sup>

### **Plant Propagation<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#PlantPropagation>

Seeds, spores and other plant materials collected for maintaining or establishing a population (CICES).

belongs to

Provisioning Service.<sup>c</sup>

### **private<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Private>

belongs to

institutional accessibility.<sup>c</sup>

### **pruning<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Pruning>

belongs to

activity.<sup>c</sup>

### **public<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Public>

belongs to

institutional accessibility.<sup>c</sup>

**railroad track<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RailroadTrack>

belongs to

track<sup>c</sup>

**regular grid<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RegularGrid>

belongs to

regular patterns<sup>c</sup>

**regular pattern<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RegularPattern>

belongs to

regular patterns<sup>c</sup>

**Regulation of Air Temperature and Humidity<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RegulationOfAirTemperatureAndHumidity>

Regulation of temperature and humidity, including ventilation and transpiration, e.g., by evapotranspiration (CICES).

belongs to

Regulation and Maintenance Service<sup>c</sup>

**restoration<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Restoration>

belongs to

activity<sup>c</sup>

**restricted collective<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RestrictedCollective>

belongs to

Entitlement<sup>c</sup>

**restricted private<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RestrictedPrivate>

belongs to

Entitlement<sup>c</sup>

**Runoff Regulation<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#RunoffRegulation>

Hydrological cycle and water flow regulation through the (temporary) storage of excess runoff.

belongs to

Water Flow Regulation <sup>c</sup>

**Scientific Value<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ScientificValue>

Characteristics or features that enable scientific investigation or the creation of traditional ecological knowledge (CICES).

belongs to

Interaction with Nature <sup>c</sup>

**selective<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Selective>

belongs to

institutional accessibility <sup>c</sup>

**semi public<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#SemiPublic>

belongs to

institutional accessibility <sup>c</sup>

**shading<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Shading>

belongs to

physical process phenomenon <sup>c</sup>

**shrub planting<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#ShrubPlanting>

belongs to

Planting Activity <sup>c</sup>

**Social Cohesion<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#SocialCohesion>

Aspects such as residential satisfaction, social contact, and the building of trust.

belongs to

Cultural Service <sup>c</sup>



## **solitary<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Solitary>

belongs to

Zero-Dimensional Grouping (0D).<sup>c</sup>

## **temporally restricted access<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#TemporallyRestrictedAccess>

belongs to

institutional accessibility.<sup>c</sup>

## **temporally unrestricted access<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#TemporallyUnrestrictedAccess>

belongs to

institutional accessibility.<sup>c</sup>

## **Timber Production<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#TimberProduction>

Timber products for direct use or processing (following CICES).

belongs to

Provisioning Service.<sup>c</sup>

## **tram track<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#TramTrack>

belongs to

track.<sup>c</sup>

## **transpiration<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Transpiration>

belongs to

physical process phenomenon.<sup>c</sup>

## **Tree Planting<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#TreePlanting>

belongs to

Planting Activity.<sup>c</sup>

## **unpaved<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Unpaved>

belongs to

sealing<sup>c</sup>

**unrestricted public<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#UnrestrictedPublic>

belongs to

Entitlement<sup>c</sup>

**Water Purification<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#WaterPurification>

Removal of pollutants from water.

belongs to

Pollution Removal<sup>c</sup>

**watering<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#Watering>

belongs to

activity<sup>c</sup>

**weed control<sup>ni</sup> back to ToC or Named Individual ToC**

**IRI:** <http://clearinghouseproject.eu/typology/elements#WeedControl>

belongs to

activity<sup>c</sup>

**Legend back to ToC**

<sup>c</sup>: Classes

<sup>op</sup>: Object Properties

<sup>dp</sup>: Data Properties

<sup>ni</sup>: Named Individuals

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