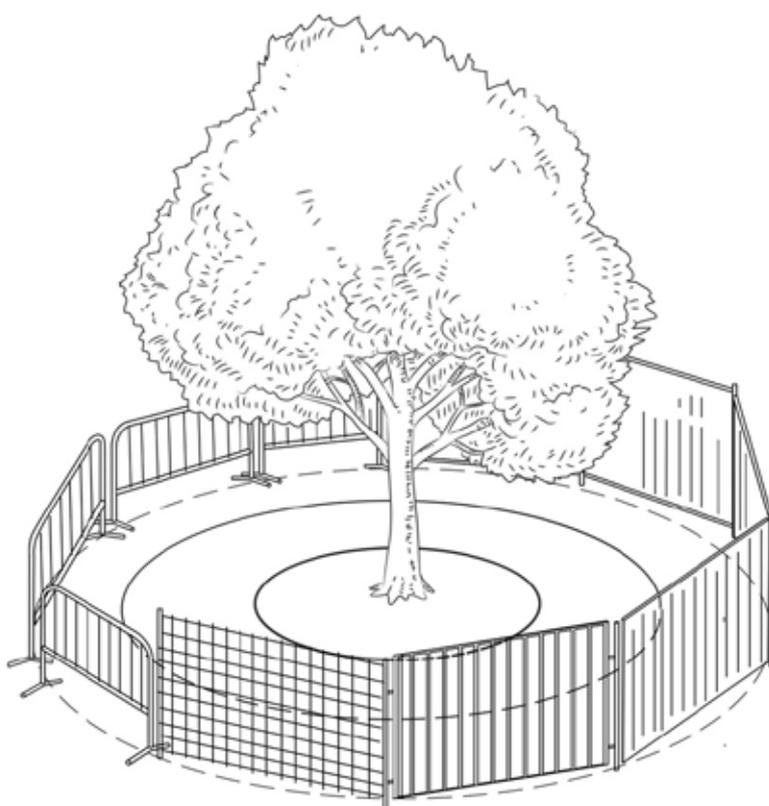


# STANDARD

## PROTECTION OF TREES AND OTHER FORMS OF GREENERY IN THE INVESTMENT PROCESS



**Title:** Standard for the protection of trees and other forms of greenery in the investment process

Standard developed by Fundacja Ekorozwoju and Stowarzyszenie architektury Krajobrazu Fundacja Ekorozwoju Wrocław, pp. 36

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ISBN 978-83-63573-30-0

Issue No.:	Standard code	Implementation date
Wydanie 1	SODiZ 001:2021	01.08.2021

The electronic version of the standard is available on: [www.drzewa.org.pl/standardy](http://www.drzewa.org.pl/standardy)

Standards developed by:



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The publication was issued as part of the LIFE15GIE/PL/000959 project entitled “Trees for Europe’s Green Infrastructure”, co-financed by the LIFE + Program of the European Union and the Voivodship Fund for Environmental Protection and Water Management (WFOŚiGW) in Wrocław.

The views of the authors and the content of the publication do not always reflect the official position of the European Commission and the Voivodship Fund for Environmental Protection and Water Management in Wrocław.

# 1.

## Introduction

# 1. Introduction

Various forms of greenery, such as trees, shrubs, woody vines and perennials, are very important elements of the green infrastructure of our surroundings. Their significance does not just come down to the well-known benefits of the so-called ecosystem services- oxygen production, air purification, noise reduction, regulation of air temperature and humidity, improvement of the microclimate or local climate, creation of habitat for many living organisms or a source of shelter and food. Greenery is essential for the survival of all other forms of life on our planet, including ourselves. It is increasingly visible in the era of climate change that we are witnessing.

However, in order for greenery to play this important role, it must remain alive and healthy. During the investment process, including the stage of preparation, design and implementation (construction works), the stage of putting new facilities into service and their subsequent operation, it is very common to treat greenery, including trees, shrubs and vines, as static elements devoid of life and the resulting needs. While performing multiple technical and engineering activities, people very often tend to forget about special care for trees and other forms of greenery that could keep them in good health, not to mention activities more or less deliberately aimed at putting them to death and eliminating them from the construction site. The negligent treatment of trees, shrubs and vines in the investment process all too often results in a constant deterioration of the quality of existing greenery, as well as its disappearance. It is necessary to bear in mind that damaged tree trunks, branches or roots cannot be put together, glued, mended or painted just like the elements of technical infrastructure. Such damage is usually irreversible, and it often affects the quality and durability of the surrounding nature for many years.

This Standard is a contribution to the efforts made in recent years in Poland by numerous industry groups related to landscape architecture, arboriculture, horticulture and nature protection, to stop the process of destroying greenery during the implementation of investment and construction processes. Greenery such as trees, shrubs and vines, contrary to the commonly known term “permanent greenery”, is not that permanent and it is very easy to devastate or even eliminate it.

The basic principles for the protection of trees and other forms of greenery included in this Standard were developed together with many representatives of sectors related to the protection of greenery. Polish specialists and consultants, who deal with this issue on a daily basis and have extensive knowledge and experience in this area, participated in the development of the Standard. They supported us with their numerous comments (sometimes critical, but always substantive), valuable remarks or corrections, as well as a great deal of kindness and support for our common goal- developing the principles for greenery protection in the investment process. We would like to thank all these people and we look forward to further fruitful cooperation.

We hope that the jointly developed Standard and the methods of action presented in it will be put into practice during the preparation and implementation of construction or renovation investments, thus becoming the real standard for dealing with greenery. However, it should be remembered that this Standard is not a finished work. There are still new challenges and problems to be solved, as well as new technologies and tools for the protection of greenery. By participating in investment processes, we are still gaining new experiences in this area. Therefore, this Standard should and will continue to evolve in the coming years, adapting to changing needs.

## 1.1. Legal basis

### The legal basis of the Standard

In Poland, there is no direct legal basis for the development and implementation of the Standard for the protection of trees and other forms of greenery in the investment process. However, the legal prerequisites for the application of the theses included therein are the provisions of the Act of 16 April 2004 on Nature Conservation (uniform text: Journal of Laws of 2021, item 1098) and its executive acts. According to the provisions of the cited act:

- The conservation of nature consists in the preservation, sustainable use and renewal of resources, creations and natural component, including greenery in towns and villages; tree groups (Article 2, paragraph 1, points 8 and 9)
- The aim of nature conservation is: protection of landscape qualities, greenery in towns and villages, and tree groups (Article 2, paragraph 2, point 5).
- The viability of a tree or shrub is understood as its proper course of basic life processes (Article 5, point 26e).
- Groundworks and other works carried out manually, with the use of mechanical equipment or technical devices, carried out in the area of roots, trunks or tree crowns, or in the area of roots or shoots of shrubs, shall be conducted in a way that is the least harmful to them (Article 87a, item 1).
- Removal of branches constituting more than 30% of the tree crown for purposes other than those specified in paragraph 2 is damage to the tree (Article 87a, paragraph 4).
- Removal of branches constituting more than 50% of the tree crown for purposes other than those specified in paragraph 2 is damage to the tree (Article 87a, paragraph 5).
- The head of the commune or mayor shall impose an administrative fine for: removing a tree or shrub without the required permit; destroying a tree or shrub; causing damage to a tree while performing works within the tree crown (Article 88, paragraph 1, points 1, 3 and 4).

The development and implementation of this Standard is therefore very helpful, and may be necessary for the proper implementation of nature conservation objectives – the protection of trees and other forms of greenery in the investment process.

## 1.2. Standard branżowy – założenia

1. The Standard concerns the protection of all trees, shrubs and other forms of greenery (vines, lawns, grasslands, flowerbeds, etc.) in places where works related to the investment process are planned and carried out.
2. The industry Standard includes the most important arrangements and recommendations for the implementation of given works throughout the country and has been approved by industry organizations.
3. The structure of the Standard relates to the course of the investment process and decisions made at its individual levels: 1. the stage of investment planning (order preparation); 2. the stage of developing a project; 3. the stage of execution of works; 4. the stage of site maintenance (including works performed under warranty).
4. The developed standards relate to works carried out by individual parties of the investment process (see chapter 1.3. 2).

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## Introduction

### 1.3. How to interpret the Standard

1. The provisions of the Standard were developed taking into account the hierarchical arrangement of editing units that include: chapter, sub-chapters (1., 1.1., 1.1.1.), point (1)), letter a)) and hyphen (-), so that each entry has its own editorial address.
2. In this Standard, we presented norms and recommendations formulated in three degrees of downrightness:
  - a. “It is necessary...” applies to arrangements that must be implemented, whereas “It is unacceptable...” - to actions that must not be carried out;
  - b. “It is recommended that...”/ “It is advisable to...” applies to actions that should be implemented;
  - c. “One should consider.../It is worth considering...” refers to additional proposals which can be implemented.
3. In the content of the Standard, we underlined certain phrases in the text in order to mark the introduced definitions and used terms that were defined in other parts of this elaboration.
4. The Standard in the PDF file has interactive links leading to chapters and sources available on the Internet and in lists: contents, figures and tables. A visual list of headings is available in the PDF viewer as “Tabs”<sup>1</sup>.

### 1.4. The most important terms and abbreviations used in the Standard

#### 1. Basic terms

**Standard** – Standard for the protection of trees and other forms of greenery in the investment process.

**Collision (with a tree, shrub, creeper)** – direct or indirect impact of the investment on the plant (its crown, trunk or root system) or impact on its habitat conditions, both at the stage of project and carrying out investment works.

**Investment** – an undertaking assuming the development of new facilities and performing activities in relation to the existing ones (i.e. reconstruction, extension, renovation and demolition), carried out in relation to building structures or green areas.

**Ancient tree** – a tree that reaches an exceptional age as a representative of its species and whose trunk is often extraordinarily thick. In the case of long-lived species, this phase may be the longest phase of a tree’s life. It is possible that some peripheral parts of the crown die, and a secondary crown will grow beneath (crown retrenchment).

**Construction site** – a place where construction works are carried out, together with the space occupied by construction equipment and facilities.

<sup>1</sup> This function is available in all .pdf viewers, e.g. in the following programs: PDFXChange Viewer (ctrl + B) or Adobe Acrobat Reader DC (ctrl + shift + F5)

## 2. Participants of the investment process

**Project designer** – a person responsible for project works, project documentation as well as project solutions.

**Author of documentation** – a person who prepares documentation and who is responsible for its content and adopted solutions.

**Work contractor** – a person or entity responsible for carrying out works.

**Site manager** – a person or entity responsible for site maintenance.

**Commissioning Party** – a person or entity commissioning work on behalf of the investor, site manager or contractor.

**Inspector of greenery protection** – a person supervising the protection of greenery as part of the investment.

## 3. Abbreviations

**OPZ** – description of the subject of the order.

**POZ** – greenery protection project.

**PZT** – land development project.

**SIWZ** – specification of essential terms of the order.

**SOD** – tree protection zone.

**STWiOR** – technical specification of execution and approval of construction works.

## 1.5. Standard – the purpose and scope of use

The aim of this paper is to present the methods of effective protection of trees and other forms of greenery as part of the implemented investment process. In this context, the Standard indicates:

- procedures and methods of greenery protection in relation to investment stages,
- tools for the protection of greenery and methods of their use,
- good practices and recommendations for greenery protection.

The standards apply to the protection of trees and other forms of greenery, and they are addressed to all parties of the investment process: investors (site managers, inspectors), project designers (all industries) and contractors (site and works managers in all industries).

The Standard is applicable in the area of the investment and within its scope.

# 2.

The stage of investment planning and preparation of project elaborations

## 2. The stage of investment planning and preparation of project elaborations

Protection of trees and other forms of greenery begins at the stage of investment planning or order preparation. For effective protection, it is necessary to implement proper activities from the early stages of the investment process, while ensuring adequate financing of works aimed at greenery protection.

### 2.1. Preparation of the investment

It is necessary to include specific conditions and indications ensuring effective protection of greenery in investment documentation and contracts concluded with contractors (e.g. SIWZ, OPZ). It is recommended that persons preparing and coordinating investments on the part of the investor or site manager make the following steps:

- initial identification of terrain and legal conditions concerning the protection of greenery, natural species and habitats (it is worth considering the preparation of a biodiversity inventory);
- coordination of the scope of the order with entities involved in the investment process, especially those responsible for the protection of trees and shrubs;
- including the following requirements in the project:
  - employment of an expert specialising in tree protection in the investment process;
  - complete elements of the greenery protection project (the dendrological inventory, dendrological survey and greenery protection project);
  - including in the executive project technological solutions minimizing collisions with plants and methods of improving habitat conditions after finishing the investment;
  - regular consultation with the Commissioning Party concerning greenery protection – choosing the contractor and verifying them in relation to:
- experience in the scope of performed works (references) and professional qualifications (certificates);
  - technical and technological know-how necessary to carry out the order;
  - professional preparation and experience of persons from the tenderer's team responsible for working with greenery;
  - third party liability insurance for the works performed and the value of the insurance corresponding to them.
- ensuring investor's supervision of greenery protection.

At the stage of investment preparation (planning), it is recommended, whereas at the project preparation stage, it is necessary to develop a dendrological inventory together with the designation of tree protection zones (SOD) – see chapters 2.2.1. and 2.3.

We recommend introducing solutions aimed at preserving biodiversity – they should be taken into account at the stage of investment preparation, in particular in project documentation.

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## The stage of investment planning and preparation of project elaborations

It is necessary to preserve as many trees and shrubs as possible, especially the ancient ones, and this is the purpose which the above indications serve. Therefore, they should be described in the executive project and in STWiOR in detail. Moreover, we recommend introducing the following solutions:

- minimizing activities related to the transformation of the natural landscape and existing habitat conditions;
- improvement of habitat conditions to the extent appropriate to needs;
- designing vegetation and functions in relation to the existing habitat and indicators of land carrying capacity adapted to the protection needs of a given habitat;
- implementing activities related to creating small-scale water retention.

It is necessary that an indication for removal of a tree always be treated as a last resort and preceded by an analysis of the actual collision of the planned land development with the tree, its condition, natural values and the possibility of applying technical solutions enabling its protection and preservation, and the possibility of further proper growth of the tree.

### A. Geodetic measurements and a master map

The site manager or the investor should determine the scope of a map update (a map dedicated to project or opinion-giving purposes), adequately to the greenery protection requirements at the stage of project development.

As part of the map preparation, we recommend checking:

- the ordinates of terrain and existing objects within the projections of valuable tree crowns and trees to be preserved (indicated by the Commissioning Party);
- the characteristic forms of landscape (e.g. steep slopes, hills, embankments, depressions, ditches) and wetlands;
- the ordinates of terrain and objects, in particular:
  - footpaths in the vicinity of trees,
  - the elements of ground infrastructure, especially storm drain inlets, in the vicinity of large trees (with more than 200 cm in circumference or 64 cm in diameter of the trunk);
- greenery in important allocations of local land development plans, especially building lines, road lanes or infrastructure elements.

With regard to geodetic and other measurements, it is necessary to limit the use of paint markings on plants. If it is necessary to mark a measured tree, it is allowed only to make a green dot up to a height of 50 cm from the ground using a non-toxic spray that disappears under the influence of weather conditions.

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The stage of investment planning and preparation of project elaborations

## 2.2. Dendrological inventory, dendrological survey and greenery protection project

A dendrological inventory, a dendrological survey and a greenery protection project are the most important documents that determine the effective management of greenery, taking into account the requirement of its protection. In practice, these elaborations can be edited jointly as part of the documentation containing the sequence of work stages in relation to the progress of works within the project.

As part of investments carried out in a given area with greenery (trees, shrubs, vines and other greenery), it is necessary to develop dendrological documentation in accordance with the scope described below.

### 2.2.1. Dendrological inventory

#### A. Descriptive part of the dendrological inventory

Guidelines concerning the minimum scope of the descriptive part of a dendrological inventory:

a) Basic information:

- an address and cadastral data of the area presented in the elaboration;
- characteristics of existing vegetation and the method of land development/use, as well as a general description of the habitat conditions in the area presented in the elaboration;
- information about the author of the documentation, including information about their education or professional experience;
- information about the master map used and/or other output documents;
- a date of the dendrological inventory, a list of attached drawings and an author's signature

b) An inventory of plants including:

- a plant inventory number, in accordance with the graphic appendix;
- identification of species and possibly the variety of the plant;
- plant dendrometric values:
  - For trees: trunk circumference [cm] measured at a height of 130 cm above the ground, crown diameter [m], tree height [m] (measurement methodology is described in the Standard for Tree Inspection and Diagnostics);
  - For shrubs or groups of shrubs: diameter area [m<sup>2</sup>] and height [m].
  - Trees that can be removed without any permission can be presented and described in the group<sup>1</sup>.
- a brief visual description of the tree.

<sup>1</sup> According to the Nature Conservation Act, for trees whose trunk circumference measured at a height of 5 cm does not exceed the following dimensions: 80 cm (poplar, willow, ash-leaved maple and silver maple), 65 cm (horse chestnut, black locust and london platanetree) and 50 cm (other tree species), it is necessary to provide trunk circumference measurement performed at a height of 5cm (as of September 25, 2020).

If it is necessary to perform a detailed tree inspection for the purposes of the investment, it should be done according to the Standard for Tree Inspection and Diagnostics.

c) Summary of the dendrological inventory including the following information:

- a summary of inventoried plants in terms of the number of species, including strata of trees and shrubs;
- qualifying trees to the following categories in order to improve the management of tree groups:
  - valuable trees and shrubs, along with a description of their values (e.g. landscape, compositional, natural (biocenotic), cultural);
  - trees and shrubs with a short perspective of conservation, qualified for removing due to poor health or threatening the safety of people and their property;
  - trees that require an individual assessment (tree inspection).
- suggesting specific arrangements of trees and/or shrubs (alleys, lanes, solitary trees);
- other conclusions or guidelines depending on the purpose of the documentation created;
- photographic documentation of all trees with particular emphasis on valuable trees and shrubs.

## B. Graphic part of the dendrological inventory

The graphic part of the dendrological inventory is performed on a map for opinion-giving or project purposes, with a scale of 1: 500 or more accurate, and includes:

- a) a background map including boundaries indicated in elaboration;
- b) location and dendrometric data of plants with legible markings of:
  - tree trunk axis position;
  - trunk size – for trees whose trunk circumference exceeds 200 cm (at a height of 130 cm) – a diameter of a circle (a trunk symbol) according to the actual diameter of the trunk;
  - diameter of the tree crown or the extent of area covered with shrubs;
  - plant inventory number.
- c) indicating the zones of tree and shrub protection and possible markings of root collar;
- d) specification of the elaboration, a signature of at least one of the authors and legends.

It is recommended that dendrological elaborations be performed on digital background maps that enable geolocation of plants. In the case of trees requiring thorough diagnostics, a dendrological expertise should be recommended or performed in order to determine further detailed actions.

While preparing dendrological inventories for the purposes of investments that collide with trees, it is necessary that the tree locations be indicated by a geodesist as part of the map preparation for project purposes, or measured with precision tools with accuracy of 10 cm.

# 2.

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# 2.

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## C. Recommendations for the development of a dendrological inventory

Development of a dendrological inventory is necessary at the stage of investment preparation, before commissioning project documentation.

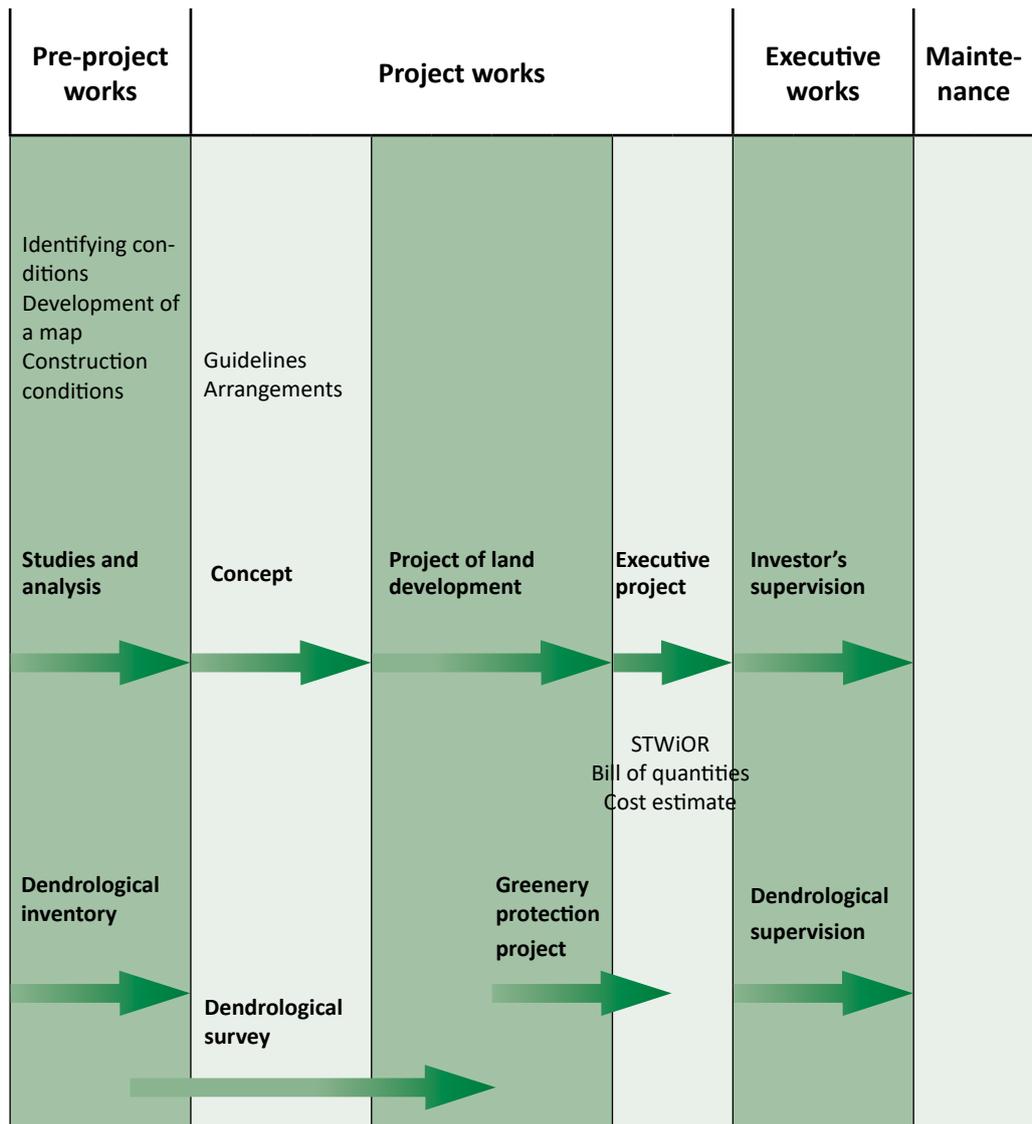
Preparation of a dendrological inventory is necessary for all investments with trees or in their vicinity (up to 1.5 m from the tree crown diameter).

Moreover, it is recommended that the dendrological inventory also include trees located in the vicinity of the investment that may be affected by a given undertaking, in particular:

- plants located up to 5 m from the border of the investment, where land development activities (investment) are performed near the border of the site (e.g. construction of a car park or fence);
- trees protruding with the crown diameter on the investment area;
- places of potential collisions in connection with the construction of hook-ups;
- zones of service routes and access to the investment.

The dendrological inventory is valid for 2 years from the date of its development, whereas the issuance of a permit to remove a tree and works connected with cutting down plants that do not require any consent of authorities may take place on the basis of documentation not older than 12 months.

### Protection of trees in the investment process



The author or manager of the team performing the dendrological inventory should be a person with appropriate qualifications specified in chapter 4. Moreover, the dendrological inventory should be approved and verified with reference to the real situation in the field.

### 2.2.2. Dendrological survey

**A dendrological survey** (a tree and shrub management survey) includes indications regarding the management of trees and shrubs. It is an extension of the dendrological inventory and is carried out in relation to current and planned investment activities, taking into account project documentation (e.g. a land development concept). It is necessary for this elaboration to be developed at the stage of conceptual work so that the project could be corrected and various recommendations concerning tree protection could be included. The implementation of the dendrological survey after developing the construction project significantly reduces the possibility of minimising collisions.

In practice, the dendrological survey should be carried out in at least two stages:

- a preliminary survey – prepared in relation to the initial concept of land development;
- a final survey – developed with reference to the final project; it takes into account all the recommendations presented in the dendrological report.

The main objective of the dendrological survey is to preserve existing trees, tree cover and shrubs in best condition, taking into account the assumptions of land development. The indications of the dendrological survey result from the analysis of the anticipated collisions (based on the project documentation) with trees and shrubs during project implementation, taking into account all their parts: roots, trunks and crowns<sup>2</sup>. The analysis is used to develop guidelines for minimising the effect of such collisions.

The text part of the dendrological survey is analogous to the scope of the dendrological inventory, but the description of the conditions of plants (in special cases), their collisions with planned activities and indications for taking specific measures related to the protection and shaping of greenery may be more detailed. The tabular list of plants is supplemented with the following information:

a. justification for treating or using the plants that are supposed to be removed by providing a detailed description of the condition of the tree or shrub;

<sup>2</sup> Possible collisions may concern:

- a. the root system
  - direct collisions (mechanical damage done to the roots of trees or shrubs): excavations, boreholes, installation of sheet pile walls, etc.;
  - indirect collisions (affecting the living conditions and growth of roots): embankments, lowering the ground level, changing the parameters of soil (soil structure, compaction, changes of groundwater table depths), changing the chemical parameters of soil and groundwater (e.g. pollution, change in pH, oxygenation reduction, salinity), etc.
- b. tree trunks
  - direct collisions (directly damaging tree trunks): direct collisions with the planned land development (cubature structures on and under the ground, the elements of a transport network, other structures), etc.; direct collisions with the trunk result in the necessity to remove the tree;
  - indirect collisions (affecting the health of tree trunks): e.g. resulting in strongly increased insolation that may lead to sunburn in trees with thin bark (e.g. beech or hornbeam) or increased activity of insects living in the wood (e.g. great capricorn beetle in oak trees).
- c. tree crowns
  - direct collisions (directly damaging tree crowns): direct collisions of tree crowns with land development (cubature structures, road or loading gauge, airport zones and other structures), etc., resulting in the necessity to reduce tree crowns;
  - indirect collisions (affecting the health of tree crowns): resulting in a change in insolation, increased dustiness, increased exposure to salt spray in the vicinity of roads, increased exposure to wind gusts, etc.

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b. description of existing and possible collisions<sup>3</sup> of trees or shrubs with the planned investment,

c. indications for the management of trees and shrubs:

- trees to be removed with an indication of a reason (e.g. due to their health, stability, collisions that are impossible to avoid);
- plants to be replanted;
- plants requiring proper care (see Standard for Tree Pruning and Care);
- specimens that require securing or special protection at the stage of investment implementation, according to the greenery protection project, and trees that require detailed inspection or diagnostics<sup>4</sup>.

The summary of the dendrological survey should contain:

- a list of plants to which specific recommendations apply;
- an expected impact of the planned investment on trees and shrubs;
- recommendations for project documentation:
  - proposed project solutions for newly designed trees (see chapter 2.5.),
  - adequate solutions to preserve biodiversity and small-scale water retention;
- proposals for environmental compensation in return for trees and shrubs removed from urban areas.

The graphic part of the dendrological survey is based on a drawing of the dendrological inventory. It presents the assumptions of the land development project and recommendations for tree management: plants indicated for removal, replanting, care or protection.

An annex to the dendrological survey may contain a forecast of statutory fees for the removal of trees and shrubs, that is, a list of administrative fees calculated on the basis of applicable regulations.

The author or manager of the team carrying out the dendrological survey should be a person with appropriate qualifications specified in Chapter 4.

### 2.2.3. Greenery protection project

**A greenery protection project (POZ)** is a set of documents containing a list of measures to protect plants growing in the area of the planned investment, or within its scope, from damage or destruction, and is developed in relation to the arrangements of executive and/or construction projects.

The greenery protection project contains a description of security measures and methods of their implementation in relation to collisions indicated in the dendrological survey. It provides additional details and it is implemented at the latest at the stage of developing executive projects and technology for carrying out works in order to coordinate plant protection with the implementation of the investment. The works resulting from the indications of this document should be included in the work schedule and investment cost estimates.

The graphic part of the POZ should be made taking into account the current detailed documentation (e.g. an executive project).

<sup>3</sup> A collision occurs in a situation when the planned investment interferes with the designated tree protection zone and when it may cause a partial loss of the root system or tree crown, and deterioration of its health.

<sup>4</sup> Detailed tree diagnostics – an assessment of tree condition and risks related to it (e.g. overturning, breaking, fracturing or dieback) performed with the use of specialised techniques.

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**The greenery protection project** indicates recommendations for use at the stage of detailed (executive) projects and during the implementation of construction works, paying particular attention to:

- the way of dealing with trees and shrubs during the investment;
- plant protection guidelines, including (see chapter: 3.3.):
  - methods of plant fencing;
  - principles of tree root system protection (tree protection zone);
- technical recommendations to avoid collisions, e.g.:
  - proposals for changing the technology of carrying out works (e.g. choosing a piling technology that does not interfere with trees),
  - introducing changes to the project that are not significant (after agreeing on them with the author of the documentation),
  - proposed changes to the provisions of the construction organization project.
- recommendations for keeping documentation in the scope of care and protection of trees and shrubs on the construction site;
- recommendations for the protection of plant habitats – in particular soil, air and water conditions.

The author or manager of the team implementing the tree protection project should be a person with appropriate qualifications specified in Chapter 4.

In the case of investments for which a greenery protection project has not been developed, it is recommended that the inspector or the commissioning party develop conditions for tree protection and submit them to the contractor.

## 2.3. Tree protection zone (SOD)

A tree protection zone (SOD) is an area around a tree in which the entire tree (the root system, trunk and crown) and its habitat are protected. The scope of SOD includes<sup>5</sup>:

- a crown diameter zone plus 1.5 m – in the case of trees of natural habit (see figure) or
- a crown diameter zone plus 3 m – in the case of valuable trees with a natural habit;
- an individually designated zone – in the case of:
  - special locations (e.g. for roadside and other trees in intensively developed places or coastal areas) – it is necessary to take into account the actual scope of the root system limited by the infrastructure;
  - a tree with a crown that is shaped, asymmetric, unnatural or columnar – it should be taken into account that the scope of the root system in such cases does not necessarily correspond to the shape of the crown and may go beyond the current crown diameter.

In the case of shrubs, the protection zone is understood as the above-ground shrub diameter plus 1 metre. In the Standard, the SOD abbreviation is also used for shrubs.

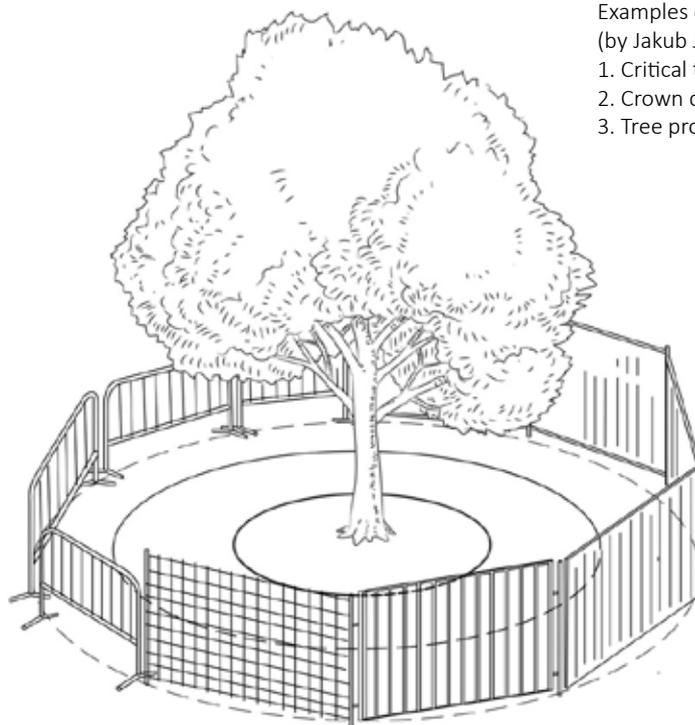
### A. Recommendations for SOD

<sup>5</sup> It should be emphasized that the scope of roots of a freely growing tree often exceeds the crown diameter many times, with the highest density of host roots occurring at the border of the crown diameter (roots taking up water with mineral salts and nourishing the tree). The approved provisions are a compromise aimed at enabling the implementation of the investment while providing trees with a minimum space needed for survival.

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- SOD is determined as part of the dendrological inventory (before developing the project) and is updated at the stage of the dendrological survey and the greenery protection project.



Examples of fencing solutions.  
(by Jakub Józefczuk)  
1. Critical threshold for damage  
2. Crown diameter  
3. Tree protection zone

- The best way to mark the SOD is to build a fence of at least 1.5 m high and exclude SOD from the area of construction or renovation works (see chapter 3.3.1.).
- It is prohibited to interfere with the SOD during the works (see direct and indirect collisions described in chapter 2.2.2.). The rules for issuing a conditional permit to carry out works within the area of SOD are described below.

In the case of protected trees e.g. nature monuments or valuable trees, it is necessary to exclude all potential collisions within the SOD (at the project and implementation stage), with no exceptions.

It is recommended that the SOD for individual trees be marked on drawings in the PZT and executive projects. Also, specific works within the SOD should be performed under supervision. Guidelines for the conduct of supervision are described in chapter 3.5.

One of the good practices is to mark the SOD on the construction site by placing a sign with the following information: “Tree protection zone. No entry, groundworks, storage and disposal of building materials and chemicals. Access only by designated service roads”. Appropriate prohibitions should be introduced depending on the conditions specified in the greenery protection project. Storing and disposing of building materials and chemicals, as well as accessing the site using roads other than designated ones, are prohibited in each case.

## B. Conditional approval of works within the SOD

In exceptional situations, when it is impossible to completely abandon works within the SOD, in order to preserve the tree and avoid removing it, it is necessary to consider permitting the works to be carried out within the SOD under certain conditions of tree protection.

In justified cases (e.g. no possibility of changing project solutions, strictly defined scopes of necessary construction works, renovation of existing infrastructure, demolition

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works), works within the SOD are allowed, provided that they are supervised and the following requirements are met:

- finding no roots on the construction site, recognizing the actual extent of the root system using non-invasive methods (e.g. airspade, ground-penetrating radar, sonic tomograph);
- using trenchless technologies (see chapter: 2.5. D.) at a minimum depth of 130 m (below the main mass of the root system);
- performing an open trench using airspade;
- using point foundations outside the SOD (as an alternative to strip foundations and foundation slabs), ensuring the maintenance or improvement of existing soil conditions within the SOD (a soil structure, access of rainwater and air to roots);
- the designation of service roads for the time of construction works (see chapter 3.3. D.) with the use of methods of tree root protection.

### C. The critical threshold of tree damage

**The critical threshold of tree damage** is an area around a tree in which any interference with a tree root system is prohibited as it may result in permanent damage to the tree and/or loss of its stability in the ground. In this Standard, it is assumed that the area around the tree (measured from the trunk surface) has a radius equal to three times its trunk circumference measured at a height of 130 cm above the ground. In the case of multi-stem trees, this range is calculated on the basis of 150% of the circumference of the thickest trunk. If the tree crown is set less than 130 cm above the ground, the measurement shall be made on the trunk under the base of the crown.

**Regardless of the planned mitigation measures, it is unacceptable to interfere with the root system within the critical threshold of tree damage<sup>6</sup>.** This prohibition does not apply to:

- arranging the elements of underground infrastructure with the use of trenchless technology at a minimum depth of 130 cm from the ground level, after prior consideration of other routes of the system;
- repairs of existing surfaces or other works performed without affecting the root system;

## 2.4. Recommendations for project elaborations

### 2.4.1. General recommendations for the protection of trees at the stage of project implementation

As part of project works, it is necessary to:

1. verify the validity of the background map, especially the correctness of the tree location (see chapter 2.1. A.);
2. take into consideration the dendrological inventory with an indication of tree protection zones (see chapter 2.2.1.);

<sup>6</sup> Interference with the critical threshold of tree damage may cause the tree to die or lose its stability in the ground (which may lead to its overturning) and would be equivalent to the destruction of the tree.

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3. develop different solutions for the protection of habitat conditions, rainwater management and improvement of biodiversity at the stage of implementation of conceptual projects;
4. develop or update the dendrological survey and greenery protection project, and to indicate the most valuable trees that require preservation and protection;
5. indicate the real dimensions of trees in project drawings (especially in executive projects):
  - the real circumference of the trunk as a separate marking for trees with a circumference exceeding 200 cm (at a height of 130 cm),
  - range of root swelling if the investment collides with them,
  - crown diameter and/or the height of its base (cross-section) – to avoid collisions with the traffic route gauge or lighting systems;
6. implement project solutions helpful in greenery protection (see chapter 2.5.);
7. take into account the methods of greenery protection on the construction site in executive projects (see chapter 3.3.);
8. include the costs related to the protection and care of greenery in the bill of quantities, technical specifications and cost estimates;
9. when developing a functional and operational program, it is advisable to include works related to tree protection in the framework of “detailed functional and operational properties” and “requirements of the commissioning party in relation to the project documentation”.

The above recommendations for tree protection shall be verified by the investor or the site manager at the stage of project work implementation.

As part of the project work, it is advisable to:

1. determine the scope of tree root systems with which the investment may collide in order to adjust the location of objects or introduce protective measures (see chapter 2.5. A.);
2. take actions that indirectly contribute to the protection of greenery and improvement of biodiversity, e.g.:
  - create multispecies groups of plants and use ground-cover perennials, low-growing dense shrubs or vines;
  - set up turf areas (a mix of natural grasses, flower meadows) that are extensively kept (mown several times a year); flower meadows and ruderal beds as an alternative to lawns;
  - rationalise care treatments – limit mowing, raking leaves and removal of biomass;
  - leave some dead wood and branches as habitats for insects and a source of food for birds and other animals.

Such methods of managing greenery also help to reduce the costs associated with its maintenance.

3. Retain rainwater using special surfaces (e.g. retention basins, wetlands, rain gardens) and solutions (e.g. retention reservoirs). The collection and retention of rainwater can also be performed by improving the soil structure and landscape (to improve the runoff of rainwater), collecting rainwater from roofs and managing it on biologically active surfaces. Solutions for the distribution, collection and infiltration of rainwater should be implemented according to the principles of protection of plant root systems found in a particular area. Importantly, water retention measures should not deteriorate the habitat conditions of mature trees.

## 2.4.2. Detailed guidelines for selected industry projects

Below we have listed important activities related to tree protection at the stage of implementation of industry projects other than those associated with greenery, as a supplement to the previous guidelines.

### A. Underground networks and lighting systems

Construction and executive projects of all elements of underground networks and lighting systems, implemented in green areas or in the vicinity of trees, should necessarily take into account:

- a dendrological inventory and a greenery protection project;
- the use of trenchless methods (see chapter 2.5. D.);
- indication of tree protection zones in the event of potential collisions (see chapter 2.3.);

When arranging the lighting system alongside footpaths or traffic routes planted with trees, lamp posts should be installed in such a way as to avoid their collision with tree crowns and match the existing greenery composition (e.g. lamp posts should be arranged evenly between trees and should not obscure visual connections and landscape openings).

Another element that must be taken into account in the protection of tree root system is power cables. If a collision with them seems inevitable, it is necessary to apply trenchless technologies.

### B. Footpaths, bike paths, roads and car parks

Projects of traffic routes and accompanying facilities should include:

- a dendrological inventory (see chapter 2.2.1.) prior to the development of the project, including drawings of real trunk circumferences and root swellings of all trees in the vicinity of the designed routes;
- if necessary, information about the scope of the root systems (see chapter 2.5. A.);
- the need to maintain the existing trees in best condition possibly by implementing technologies and project solutions helpful in the protection of greenery (see chapter 2.5. B.);
- rainwater management in green areas;
- shaping favourable habitat conditions for green areas (see chapter 2.5. C.);
- development of a greenery protection project (see chapter 2.2.3.).

In the case of renovation or reconstruction of a road, a pavement or a bicycle path, their width and clearance may be smaller than the standard ones. It is possible owing to the Regulation of the Minister of Infrastructure of August 1, 2019 amending the ordinance on technical requirements to be met by public roads and places where they are located.

### C. Cubature objects and renovation works

It is necessary for land development projects to take into account technologies and project solutions helpful in tree protection (see chapter 2.5.);

## 2.4.3. Verification and approval of project documentation

It is necessary for the commissioning party to verify the project documentation in terms of the use of methods for the protection of trees and other forms of greenery, in particular:

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- correctness of dendrological documentation: a dendrological inventory, a dendrological survey and a greenery protection project,
- various solutions for the protection of greenery and habitat conditions,
- methods of minimising collisions with plants during works and securing greenery for the course of works,
- including tasks related to greenery protection in the bill of quantities, technical specifications and cost estimates.

## 2.5. Technologies and project solutions helpful in greenery protection

### A. Determining the scope of the tree root system

Determining the scope of the tree root system is performed during a field test with the use of one of the following methods:

- inspection openings using compressed air (see chapter 3.3.3.);
- ground-penetrating radar for examining tree roots;
- sonic tomograph with an attachment enabling root examination.

However, it is necessary to take into consideration the limitations of those methods, especially of the indirect ones (a ground-penetrating radar and a sonic tomograph). It is because using them in an urban area, which is full of infrastructure, remains of buildings and debris, does not guarantee certain results. Using compressed air to excavate tree roots is not recommended either as it may damage them, whereas the blown-off soil must be immediately replenished.

The scope of the tree root system should be determined at the stage of developing the dendrological survey or the greenery protection project, when it is expected that planned works might collide with tree roots.

### B. Project solutions

As part of project works, the following technical solutions should be used to minimize collisions with existing trees:

- local narrowing of traffic routes, together with its clear marking in order to limit the amount of paved areas in the vicinity of trees (avoiding the situation in which a paved area is close to the surface of a tree);
- no skirts of traffic routes in the tree protection zone;
- bridge curbs (when their foundation interferes with the root system to a smaller extent);
- point foundations instead of strip ones (e.g. in the case of fencing construction);
- raised (with shallow trenching or without trenching) and point-foundation pavements (suspended pavements);
- creating pavement while maintaining the root system in the structural substrate as the foundation for the traffic route;
- technological channels (cable ducts, urban teletechnical channels) – channels enabling collective running and trenchless service of teletechnical networks and selected power networks (e.g. low voltage and lighting power supply);
- marking of places where trees enter the clearance of traffic route;

- semi-permeable surfaces – including water-permeable hardened ones (made of resin-bonded aggregate), recommended in particular for footpaths and bike paths;
- entry restrictions to green areas (e.g. with low fences of about 40 cm high that limit the access to green areas but are not barriers for small mammals).

### C. Preservation of habitat conditions in the neighbourhood of traffic routes

It is advisable to introduce engineering solutions that allow trees growing in the vicinity of the investment to function in an optimal way. It is necessary to plan the solutions indicated below at an early stage of the investment – in particular at the stage of developing the project and cost estimates.

In the case of new plantings in the vicinity of paved surfaces (e.g. near pavements, in road lanes, on squares, in car parks), it is reasonable to design solutions that improve the habitat conditions for plants:

**Structural substrate** (a mixture of stone and soil) – a type of surface basis that enables the development of root systems by mixing aggregates with fertile soil. The structural substrate should be made of crushed stone with a fraction of 31.5–120 mm and pH 5–7, which meets the construction standards for a given basis. The substrate shall be washed into the prepared basis in the proportion of 0.25 m<sup>3</sup> of substrate per 1 m<sup>3</sup> of crushed stone. The aggregate must not be mixed with the substrate and transported together. The substrate should contain 5–8% of hummus, and the whole process of making it should be closely supervised<sup>7</sup>.

**Anti-compression system** (soil cell) – a structure usually made of modular elements that transfers the loads of the traffic route without soil compaction and allows roots to grow. Such systems are introduced in order to make sure that trees have enough fertile soil and space for the development of their roots. However, it is advisable to design them individually, taking into account conditions of a specific site as well as the requirements of plants and a site manager's budget. At the stage of project and construction, it is necessary to take into consideration the requirements of a system's supplier (e.g. type of substrate, construction supervision, operating and maintenance conditions) in order to maintain its functionality and warranty conditions.

**Root paths** – linear spaces (channels filled with substrate) under the surface of the traffic route connecting biologically active surfaces and enabling the growth of the root system. Root paths should be arranged in such a way as to ensure favourable conditions for the growth of the root system (that is, access to air, water and fertile soil). They should be at least 10 cm wide and 30 cm long, and the way they are performed should take into account the assumed durability and bearing capacity of the pavement. The above-mentioned solutions should be introduced taking into account the access of water and air to the root system. It is a good practice to combine them with a small-scale water retention system.

**Screen-barrier for roots** (the anti-root screen) – a system for shielding underground infrastructure elements and limiting root growth in their vicinity. Such a solution can be introduced if good conditions for the growth of the root system in desirable zones are provided. The screen-barrier for roots should be arranged alongside the infrastructure elements but should not limit the tree root system to a large extent.

**Note:** Root screen-barriers are formally an element of underground infrastructure. After they have been arranged in a given place, it is necessary to add information about

<sup>7</sup> Source: M. Suchocka, Standardy wykonania i odbioru robót budowlanych na terenach zadrzewionych. Drzewa w mieście, Drozdowo 2018, p.10

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their location to the background map. After the warranty period is over, the site manager takes over the supervision of these elements.

The above-mentioned solutions should be chosen individually, whereas their implementation should be the basis for arguments submitted in the request for derogation. In the technical descriptions of the project and STWiOR, particular attention should be paid to the safe methods of work. The commissioning party should be informed at the project stage about the need to implement solutions limiting collisions with infrastructure, in particular when they increase investment costs.

## D. Trenchless technologies

In the event of a collision of the designed infrastructure with the tree root system in the tree protection zone, it is necessary to carry out works using trenchless technologies, such as:

- directional drilling or jacking (apart from SOD, it is necessary to indicate the places of trenches – transmitting and receiving chambers);
- trenchless network repair technologies.

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## 3.1. Formal arrangements between the commissioning party and the contractor

### A. Contract with the contractor

In the contract concluded with the contractor, it is necessary to include the following information:

- methods of protecting greenery by referring to tender documents e.g. greenery protection project;
- scope of care and treatments for existing and new plants;
- consequences for destroying greenery (i.e. trees, shrubs, vines or turf) – e.g. financial responsibility (covering the cost of restoring the green area);
- rules for the restoration of greenery and plants in the event of their damage or destruction;
- works related to the restoration of damaged greenery;
- the need for supervision in the field of greenery protection.

### B. Site lease agreement and site handover for the purpose of works

The site can be handed over for the purpose of works (construction, renovation, demolition) or lease on the basis of a protocol or an agreement. Both of these documents should precisely define the issues related to the protection of greenery in the area in question (described above).

The handover of the site should be preceded by an inspection documented with:

- photographic documentation of trees and other forms of greenery, in particular those that require protection;
- an inspection report describing the condition of the site, in particular trees and shrubs.

It is necessary to secure the green areas on the site before the contractor enters it (see chapter 3.3.).

It is necessary to ensure the protection of greenery:

- near access routes and service roads;
- on the plots neighbouring with the investment site;
- in the vicinity of linear investments.

## 3.2. Prohibitions on the construction site

It is prohibited to carry out any activities that may have a negative impact on the condition of trees and other forms of greenery on the construction site and the neighbouring area. In the tree protection zone, it is prohibited to place or arrange:

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- temporary facilities (e.g. offices, buildings or toilets, etc.);
- parking yards and storage sites for building materials, aggregate, soil and chemicals;
- routes for equipment, machines and vehicles used on the construction site, without adequate protection of the substrate against compaction and interference with the tree root system;
- disposal of waste generated in the construction process, including rinsing and washing machines and tools, as well as residues of chemical substances used in the construction process.

It is unacceptable to mount foreign elements on trees, except for nature protection facilities (e.g. nest boxes, feeders, tree markings). Placing information signs on trees is possible only in a non-invasive way (hanging) and it is necessary to remove them after the work is over.

## 3.3. Methods of greenery protection on the construction site

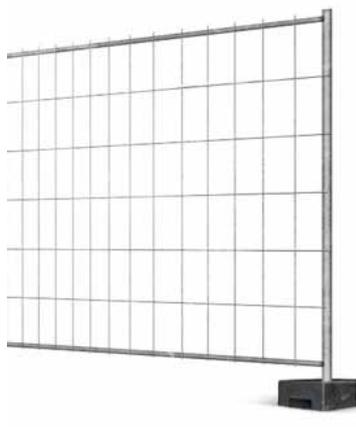
### 3.3.1. Methods of securing trees and shrubs

It is necessary to protect all forms of greenery growing on the construction site that are listed in the dendrological survey, including all their parts: roots, trunks and crowns. It is recommended that the tree protection zone be fenced off (with a fence at least 1.5 m high) and excluded from the construction site. Nature monuments and valuable trees should be particularly protected from harmful effects of the investment. In such cases it is necessary to:

- develop a detailed supervision plan;
- mount piezometers to monitor the groundwater level, especially if excavation works reach the groundwater table;
- conduct works under dendrological supervision and tree condition monitoring.

### A. Fencing off the tree protection zone temporarily

Temporary SOD fencing should be at least 1.5 m high, stable and secured against displacement.



Modular fencing



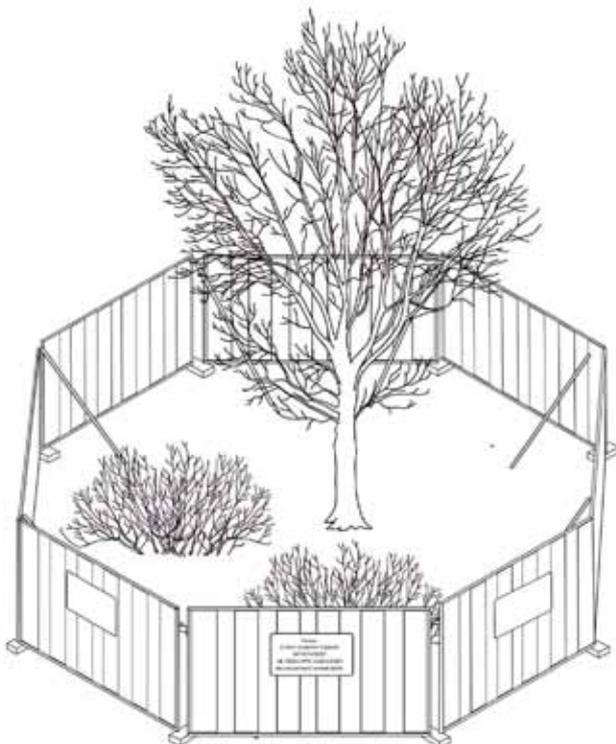
Temporary barriers



Wooden fencing



<https://www.tlcrental.pl/ogrodzenia-tymczasowe/>



Temporary fencing of a tree protection zone  
(Picture by Jakub Józefczuk)

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### B. Securing the trunk with wooden boards

If it is not possible to fence off the tree protection zone or if such a fence does not sufficiently protect the trunk against damage, it is necessary to secure the trunk with boards up to a minimum height of 2 m.

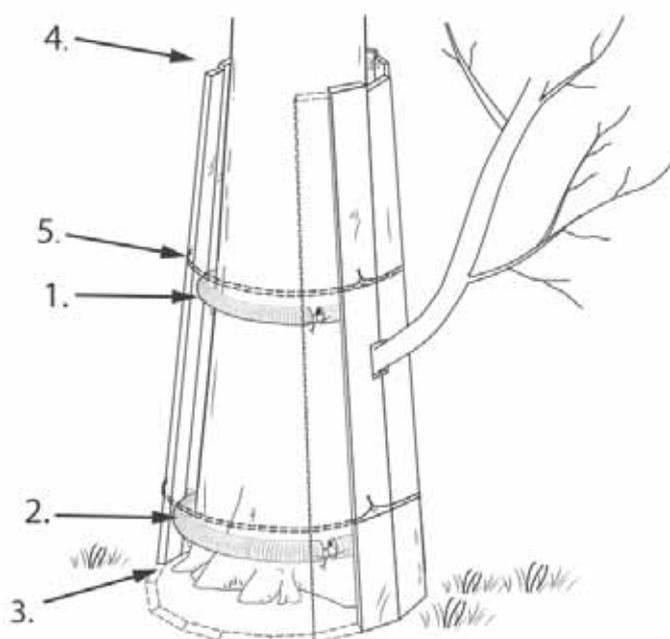
When securing the trunk with wooden boards, it is necessary to adhere to the following rules:

- covering the entire tree trunk surface up to the base of the crown (around 2–3 m high)
- using elements that absorb any impact between the surface of the trunk and wooden boards – a PVC pipe (a so-called conduit) with a diameter of at least 8 cm is recommended;
- wooden boards at least 2 cm thick (they should not rest on the root swelling);
- tying the wooden boards around tightly with a steel tape or wire (or a plastic tape with a tensioner) in order to stabilize them and prevent them from falling out;
- ensuring access to air – there should be spaces of around 1–4 cm between the wooden boards (they should not be arranged too tightly one next to another so as not to chafe the bark and limit the existence of organisms on the bark);

When securing a given tree with wooden boards, it is necessary to make sure that:

- its root collar is not covered with soil
- its root collar does not get damaged while securing the tree.

As for materials used for securing the tree, it is advisable to use recycled ones, such as conduits, boards or wires. Importantly, securing the trunk with wooden boards does not apply to young trees (these should be secured with stakes) and trees with multiple trunks.



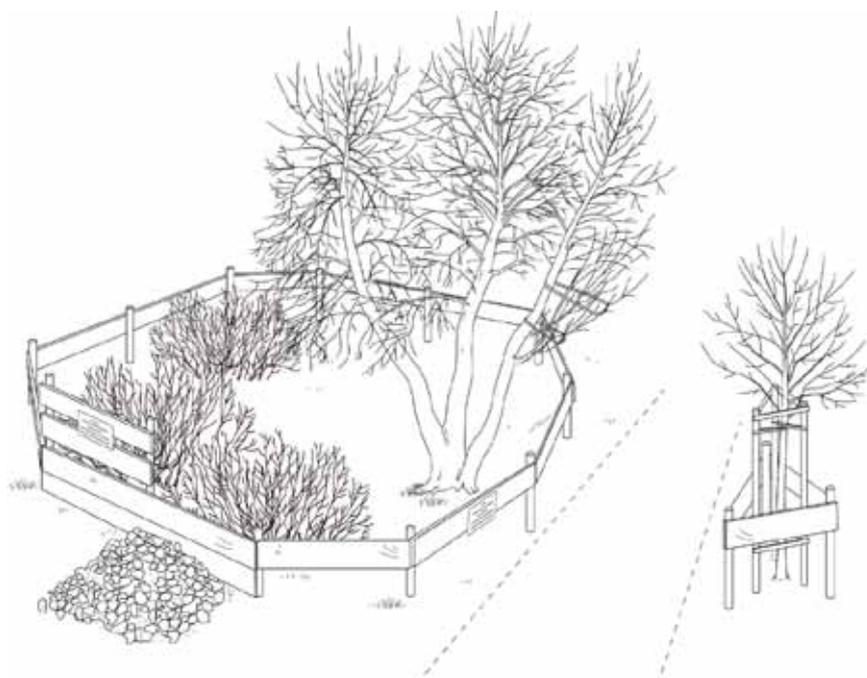
Securing the tree trunk with wooden boards (by Ł. Dworniczak, P. Reda, Fig. J. Józefczuk)

1. Upper cushioning element (tied with wire) at a height of not less than 2/3 of the board cladding
2. Lower cushioning element at a height of approx. 40 cm
3. Wooden boards resting on the ground, away from root swelling
4. Wooden boards do not stick to the trunk and keep a distance of 1–4 cm from it
5. Wooden boards tied with wire at the top and bottom

### C. Fencing of shrubs, young trees and multi-stem trees

**Methods of securing the crown of a tree or shrub** (if it is not possible to fence off the tree protection zone or if such a fence does not sufficiently protect the crown of the tree or shrub from damage by equipment in operation on the construction site – excavators, loaders, cranes, etc.):

- tying limbs and branches temporarily (with caution, so as not to break them), especially those colliding with the zone of equipment or transport operation, and directing them away from it;
- if tying limbs and branches is not possible or sufficient, it is acceptable, after consulting an inspector supervising the protection of greenery, to prune them prophylactically in accordance with the Standard for Tree Pruning and Care, observing the following rules:
  - The place and the method of pruning must be indicated and supervised by the dendrological supervision on the construction site;
  - Pruning should be performed by a specialist or experienced person (an arborist, a gardener, etc.) in accordance with amenity horticulture or arboriculture.
- if there is a risk of excessive dusting of the leaves of a tree or shrub as a result of construction works, it is advisable to install dust screens for plants on the border of the tree protection zone (they can be integrated with the SOD fence), adhering to the following rules:
  - the location and height of the screen must protect the crown of the tree or shrub from excessive dusting;
  - the screen must be air and light-permeable (we recommend using special anti-dusting plastic nets with proper mesh size, permeating air but stopping dust).



Examples of securing shrubs, young trees or multi-stem trees with fencing (Fig. Jakub Józefczuk)

1. Using a fence approximately 120 cm high
2. Increased fencing to protect taller shrubs
3. Additional protection (wooden boards without gaps) in places where materials are stored
4. Tying branches of young trees
5. Service route – clearance of at least 50 cm from the fencing

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### D. Securing roots – service routes

If it is necessary to operate certain equipment, machinery and means of transport in the area of the tree protection zone, service roads should be built in accordance with the following rules:

- protection of soil and roots against excessive compaction;
- the structure and surface of the service road must ensure an even distribution of the point-applied forces of vehicle wheels on a larger area, reducing the unit pressure per unit area;
- the removal of the top layer of soil for the construction of the service road should be minimized (reducing the risk of mechanical damage to the roots) or limited only to the layer of turf;
- the technological road should have a crushed aggregate foundation. It is advisable to use sand or all-in aggregate; no cement or chemicals are allowed;
- it is advisable to separate the intact native soil from the service road structure with a layer of geotextile in order to reduce the mixing of aggregate from the road foundation with the native soil, and to facilitate disassembly of the service road structure after the works are finished;
- the surface of the service road must be easy to disassemble; it is advisable to use precast concrete or reinforced concrete slabs, but poured or wet-laid surfaces (wet concrete or bituminous masses) are best avoided. Of note, the surface made only of compacted aggregate (without a rigid top layer) is insufficient.

#### 3.3.2. Securing vines, turf and beds

##### Securing vines

The optimal way to protect vines is to fence off the root system area. However, this scope should be adjusted individually. For most vines, a minimum distance of 2 m from the root collar is recommended, whereas for the bigger ones (with a trunk circumference of more than 50 cm or height of over 10 m) – 3 m. If vines are attached to the renovated wall or façade with their own adhesive system (using their own adhesive pads or adventitious roots), it is acceptable to detach the plant from the wall and move it on a temporary supporting structure for the course of works. After they are finished, it is essential to bring the vine back on the wall and attach it using temporary solutions so that it can create its adhesive roots again. If necessary, it is acceptable to prune (reduce) the vine in its height, but not more than half of it. If construction works are carried out near a wall covered with vines, and if it is predicted that these works may affect them, the plants should be covered with a net that will protect them against damage while securing access to sunlight and air at the same time.

##### Securing turf

The general principle of protecting turf areas (lawns, grasslands or meadows) is to avoid any vehicles or machines moving on them during construction works. If it is necessary for vehicles or machines to move on them, it should not be done during or immediately after the rain. Appropriate protection of these surfaces should be applied, depending on the type of vehicle and frequency with which it moves around the place:

- no need to apply security measures (for light machines with a total weight of up to 200 kg);
- arranging wooden slabs (for machines with a total weight of up to 1 t);
- placing a layer of wood chips with a minimum thickness of 20 cm on a geotextile and sand bed (for machines with a total weight of up to 3.5 t);

- arranging prefabricated plastic protective slabs (for machines with a total weight of up to 4 tons);
- laying of prefabricated concrete protective slabs on a geotextile and sand bed (for machines with a total weight of more than 4 t);

It is necessary that all the above-mentioned protective measures are treated as temporary solutions and that they are removed when no longer needed. The maximum time of covering the turf in one place should not exceed 1 month.

### 3.3.3. Groundworks performed with compressed air

**Blowing off soil with compressed air** – groundworks consisting in gradual blowing off the top layers of the soil with a stream of compressed air, which does not significantly damage the root system. This method makes it possible to perform excavation to a depth of several dozen centimetres in order to improve the properties of the soil (see 3.4. C.) and protect the roots:

- determining the actual tree root system (control excavation) and adjusting project solutions to the results of this test;
- examining the tree root condition and improving habitat conditions, including fertilization and soil replacement;
- collision-free placing of buildings or preservation of the root system in the structural substrate as the foundation for the traffic route.

After excavating the roots and performing the necessary activities, it is necessary to cover them with the soil (or fertile soil) again and water them immediately.

### 3.3.4. Securing roots in open trenches

Securing roots in open trenches should be performed immediately, preferably on the same day when the works began. Depending on how long the trench is left open, we distinguish the following methods of securing the walls of the trenches and the roots of trees and shrubs:

#### a. Short-term excavations (up to 1 week):

- covering the walls of the trench with a textile that keeps moisture (when the temperature is above zero degrees Celsius) or protects the soil from freezing. For this purpose, it is possible to use agrotexile (at least 100g/ m<sup>2</sup>), a coconut mat or something similar. Regardless of the material used, it should be attached to the walls of the trench with appropriate dowels or pins;
- trench walls, protected with a moisture-retaining textile, should be regularly sprinkled with water during periods of dryness and drought in order to ensure adequate moisture of the soil and roots;

#### b. Long-term excavations (more than 1 week):

- it is advisable to use more durable protection of trench walls by building or arranging e.g.:
  - a temporary wall made of wooden boards;
  - for extensive excavations: the use of construction technologies to protect deep excavations (Berliner walls, tight walls, expansion walls, etc.), which are usually sufficient to protect the roots as they also protect them against drying out;
  - in the case of walls built at the edge of the trench, it is advisable to use an additional layer that allows damaged roots to regenerate (e.g. peat, a peat-sand mixture, fertile soil, compost);

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- while performing linear excavations for underground utilities, it is important to maintain all the roots with a diameter of more than 3 cm intact, if possible, by protecting them against drying out or freezing (e.g. by wrapping them with a agrotexile of 100g/ m<sup>2</sup> or placing a net under them).

If it is necessary to remove some of the roots that collide with the infrastructure or construction, the cuts should be made with a disinfected hand saw or pruner. The wound should be rinsed with water and protected against infections (e.g. with powdered charcoal).

## 3.4. Protecting and taking care of plants during construction works

### A. Taking care of plants during construction works

It is obligatory to take care of:

- all plants on the construction site;
- plants growing outside the construction site but affected by ongoing works.

Basic plant care treatments during construction works include:

- watering in periods of acute drought and drought<sup>8</sup>;
- checking plant health on a regular basis and protecting them against the effects of construction works – every 2 weeks, unless the commissioning party states otherwise;
- improving and repairing plant securing systems on the construction site;
- proper securing of damage done to plants during construction works (under dendrological supervision);
- if necessary, taking appropriate remedial actions.

**Watering** – a treatment consisting in providing the right amount of water, ensuring not only the survival of the plant but also its proper functioning. The decision to start watering should be dictated by drought, and not only acute drought which may lead to plants' death. Also, it is crucial to water plants with a sufficient amount of water each time after planting them, and water them regularly during the warranty period after planting.

**Mulching** – covering the tree root area with mulch consisting of wood chips, bark, fallen leaves or other organic matter, preferably composted. The treatment involves spreading a 5–10 cm layer of composted and deacidified bark or wood chips in the area of the plant root system. It is also a good practice to grind branches that were left after pruning and cutting, and to use wood chips created in this way for this treatment.

**Fertilization** – a care treatment consisting in supplementing the deficiencies of nutrients in soil or improving its chemical properties (e.g. pH). Fertilization changes the chemical and biological balance of the soil, and may destabilize the relationship between the tree and mycorrhizal fungi. Therefore, it is advisable to use fertilizers when there is a clear need to improve the supply of certain minerals or pH of the soil (especially in the case of urban, after-construction and post-industrial soils). Decisions about the composition

<sup>8</sup> Drought – a medium-term lack of rainfall (several weeks) resulting in decreased soil moisture. Acute drought – a long-term lack of rainfall (over a month) resulting in soil dryness.

and dose of fertilizers must result from the laboratory test performed on the mechanical (grain size) and chemical soil profile (reaction, nutrient content – N, P, K, organic substances and macro- and microelements). Before the treatment with fertilizers, the area should be properly marked and users should be informed about planned activities. Importantly, the treatment should not be done on rainy and windy days. Each use of chemical preparations in green areas, including fertilizers, must be in accordance with the recommendations of the manufacturer.

#### B. Cleaning works after construction works and soil remediation

After the completion of the main construction works, it is necessary to clean up the area and carry out remediation treatments adapting the soil to plant cultivation. Depending on the needs, these treatments include:

- removal of all waste and contamination;
- removal of the contaminated top layer of the soil (which should be done with caution and preferably manually so as not to damage the roots);
- loosening of excessively compacted soil with the use of a cultivator; in the case of compacting deeper layers it is advisable to perform ploughing and harrowing; in the area of the tree protection zone, soil loosening must be carried out in a manner that is safe for tree roots – with the use of compressed air or by puncturing the soil;
- if necessary, soil replacement; importantly, in the area of tree protection zone, the soil replacement procedure should be performed in a manner that is safe for tree roots, e.g. using compressed air;
- in case of doubts as to the impact of construction works on the existing greenery, it is advisable to carry out a specialist survey that will determine the multifaceted impact of construction works on greenery in relation to the health of trees and shrubs, the condition of lawns and flower beds, habitat conditions, etc.

#### Habitat conditions – methods of improvement

It is necessary to implement technologies in the field of protection and/or remediation of biologically active surfaces. The improvement of plant habitat conditions involves comprehensive measures adapted to a given site, improving the accessibility of water, air and nutrients for plants, as well as protective measures mitigating anthropopressure to the habitat. Activities related to the improvement of habitat conditions should be planned at the project stage. The improvement of habitat conditions should be preceded by a soil contamination analysis, that is, physical and chemical tests of the soil indicating the scope of fertilization and potential water absorption. After the completion of construction works, it is advisable to perform the basic care procedures such as fertilization, mulching and watering, one more time. In cases of significant contamination of the habitat, it is recommended that the top layer of the soil be replaced (see below: improvement of soil properties). This procedure should be performed limiting the interference with the plant root system (e.g. using compressed air).

#### C. Improvement of soil properties

The basic treatment improving the properties of soil is mulching. In the case of extensive soil degradation or contamination, it is advisable to perform fertilization or replacement of the top layer of soil (at a maximum depth of 30 cm) using compressed air to excavate the root system.

First of all, it is recommended that the physico-chemical properties of soil be examined to indicate an appropriate treatment within the root system:

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- **soil loosening** – aeration of the root system zone to a depth of about 30 cm;
- **soil replacement within the root system zone** – creating a new soil profile in relation to the specificity of a given site;
- **point aeration** – loosening the soil in specific places (e.g. in a square grid every 1 m) – aeration channels (at a maximum depth of 0.5 m) deliver oxygen and water inside the soil.

These treatments are aimed at aerating the soil, enabling the penetration of water and oxygen deep into the soil and creating optimal conditions for the development of plant root hairs. However, it is necessary to bear in mind that they interfere with the root system and may cause partial damage to root hairs and small parts of roots. Therefore, they should be performed only in justified cases and with caution.

#### **Remediation of the soil structure involves the following activities:**

- loosening of the top layer of soil;
- removing the layer of degraded soil from the root system zone using compressed air;
- removal of impurities (e.g. debris) without damaging the root system;
- supplementation of the fertile soil layer;
- mulching or securing the planting area around the tree;
- performing biological treatments to regenerate the soil or improve its biological properties.

However, it is necessary to bear in mind that the effects of the above-described methods have tendency to wane over time. Therefore, it is necessary to supervise and control all the works performed.

## 3.5. Supervision of greenery protection

### 3.5.1. Qualifications of the greenery protection inspector

If any construction or investment works are carried out in the vicinity of trees, it is necessary to appoint a person responsible for supervising the protection of greenery.

It is recommended that greenery protection be implemented as part of investor's supervision.

**The supervision of greenery protection** – supervision that aims at protecting greenery as part of the investment, according to the law, project documentation and industrial standards, and is required in the following cases:

- performing works related to the arrangement of greenery in green areas;
- performing works on the investment site that involve trees and/or shrubs colliding with designed elements (e.g. construction, renovation, reconstruction or demolition)
- performing works that come into collisions with trees and shrubs (collisions in SOD).

Supervision of greenery protection – responsibilities:

- verification of project documentation concerning greenery protection (a construction project, an executive project, a technical specification for execution and approval of works), in particular the dendrological survey and greenery protection project;
- supervision of the correctness of the implementation of tasks resulting from the project documentation, as well as their compliance with the law, contract with the commissioning party, rules applicable in horticulture, arboriculture, landscaping, etc.;

- monitoring and documentation of the health of plants under protection as well their protective measures on the construction site;
- supervision and documentation of works carried out on the protection of green areas, in particular works whose effects tend to wane over time;
- keeping a supervision log;
- formulating recommendations for the protection of trees and shrubs and minimizing collisions with plants;
- participation in technical and coordination meetings as well as construction committees in matters related to the protection of greenery;
- immediately informing the main parties involved in the investment process (the investor, investor's supervisor, construction site manager and works managers) about any significant breaches found, submitting different proposals for greenery protection and in the event of any threats to trees – notifying the works manager of the need to halt the works.
- proposing own replacement solutions or improvement actions.

### 3.5.2. Plant health monitoring

The primary objective of monitoring the health of plants and tree statics on the construction site is not only the current control of their condition but mostly the control of the effectiveness of solutions that are to protect them during the investment process. When examining the health of trees and shrubs, it is necessary to pay attention to the frequency of such activities and a multitude of factors that may deteriorate the health and stability of plants, for example:

- abiotic (environmental) factors: acute drought, excessive soil compaction, mechanical damage (especially damage to roots), sunburn, frost, improper mechanical and chemical soil composition, environmental contamination (of water, soil, air), etc.
- biotic factors: pathogens (viruses, bacteria, fungi), harmful organisms (mainly arachnids, insects, snails and also vertebrates) and parasites (plant and animal).

Plant health monitoring should be commissioned by the site manager or the contractor under the strict supervision of the former.

### 3.5.3. Control of the effectiveness of greenery protection

It is necessary that the greenery protection inspector or the site manager/ commissioning party check the effectiveness of the greenery protection methods applied on an ongoing basis.

In particular, the inspector shall verify all the signs of ineffective greenery protection:

- abrasions, scrapes and other mechanical damage to plants;
- root damage in the tree/shrub protection zone (SOD);
- disturbance of the soil structure (excavations, compaction, traces of vehicle movement or storage of materials) in the tree / shrub protection zone (SOD);
- residues of chemical materials (including cement, concrete, lime, mortars, adhesives, paints, varnishes, solvents, fuels, cleaning and maintenance agents, washings after cleaning tanks and machines, etc.) in the tree/shrub protection zone (SOD);
- placing portable toilets in the tree/shrub protection zone (SOD);
- broken branches and limbs of plants;
- covering the root collar;
- physiological changes or death of plants or their parts.

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In case the applied methods of greenery protection are found to be inadequate or ineffective at all, it is necessary to introduce corrective measures and improve/change these methods.

## 3.5.4. Memoranda and photographic documentation

It is necessary to document the results of plant health monitoring and the effectiveness of greenery protection in the form of memorandum/report/entries into the Construction Log, and also photographic documentation, including the name of its author and the date of creating it.

Also, post-inspection conclusions and recommended corrective actions must be documented (recorded)

# 4. Requirements for investment process participants

## 4.

### Requirements for investment process participants

1) **The dendrological inventory** can be performed by a person who has documented experience in the implementation of similar works and relevant professional qualifications:

- 1 year of professional experience, with a master's degree in the following fields: landscape architecture, horticulture and forestry;
- 2 years of professional experience for:
  - graduates of first-cycle or post-graduate studies in the following fields: landscape architecture, horticulture and forestry,
  - landscape architectural technicians,
  - graduates with a master's degree in natural sciences (environmental protection, biology or ecology).
- 4 years of professional experience – graduates of other studies or professional courses on working with trees.

2) **The dendrological survey** may be performed independently by a person who has documented experience in the implementation of similar works and relevant professional qualifications:

- 2 years of professional experience, with a master's degree in the following fields: landscape architecture, horticulture and forestry;
- 3 years of professional experience for:
  - graduates of first-cycle or post-graduate studies in the following fields: landscape architecture, horticulture and forestry,
  - landscape architectural technicians,
  - graduates with a master's degree in natural sciences (environmental protection, biology or ecology) or others, .....
- 4 years of professional experience – graduates of other studies or professional courses on working with trees.

3) **The greenery protection project and dendrological supervision** can be performed by a person who has documented experience in the implementation of similar works and relevant professional qualifications:

- 2 years of professional experience – inspectors of green areas or tree supervision who have completed a course in this field,
- 3 years of professional experience – graduates with a master's degree in the following fields: landscape architecture, horticulture and forestry,
- 4 years of professional experience – graduates of first-cycle studies or post-graduate studies in the following fields: landscape architecture, horticulture and forestry.

