GREEN® SPACES

designed by R3GIS

EFFICIENT MANAGEMENT OF GREEN AREAS

Care and maintenance of urban green spaces and roadside trees

www.r3gis.com/greenspaces

Table of Contents

1. Introduction

GreenSpaces is an integrated and geo-referenced platform for all stakeholders involved in the management, maintenance, and documentation of green areas. Its web technology, simplicity of use, usability in the field, and ease of adding new users with varying roles and privileges, make GreenSpaces the ideal tool for coordinating and documenting all tasks related to green areas.

This document presents the main features of GreenSpaces, with particular attention to the needs of public administrations. Further information is available online at: www.r3gis.com/greenspaces.

Fig. 1: GreenSpaces can be used at fixed workstations and/or in the field, on a tablet or via the app on mobile devices.

1.1 Advantages of GreenSpaces

GreenSpaces is based on web and mobile technology. All users, depending on their role, access a single database using a standard web browser. Or, they can work on site with a tablet or using an application on a smartphone. The main advantages of the software are:

Higher efficiency: Maintenance of green spaces based on accurate, up-to-date information is more cost-effective. Data is always accessible to all users and contains detailed information on the areas managed.

Increased safety: Constant monitoring of trees and equipment in parks helps to reduce the risk of accidents in public spaces. GreenSpaces keeps track of tree assessments, playground inspections and maintenance activities.

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Innovation: GreenSpaces integrates the most advanced data collection technologies, environmental sensors, NFC and RFID tagging solutions available. R3GIS is continually investing in research and development to keep the software up to date.

Integration: Our flexible, open standards-based solutions integrate easily with other IT systems. This lets clients constantly retain full control over their data.

Public participation: Involving the public in green management leads to higher quality standards for green spaces. GreenSpaces makes it possible to keep citizens informed about urban green areas and their environmental benefits.

1.2 Client Categories

GreenSpaces can be configured to meet the needs of various types of clients:

- Public administrations (municipalities, large cities, associations of municipalities, provinces) - for management of green spaces within their jurisdictions.
- Public companies – for management of green spaces of one or more public administrations.
- Private companies – for management of green spaces for multiple clients.
- Tree experts - for management of trees and tree inspections for their clients.
- Playground experts - for management of playgrounds and sports facilities for their clients.
- Infrastructure managers - for management of green spaces adjoining infrastructure (eg. roads, railways).

2. Types of Information Management

GreenSpaces allows comprehensive management of all information on urban green spaces, from tracking of boundaries of various managed areas to individual greening elements (trees, shrubs, hedges, lawns, flower beds, etc.) and street furniture (benches, playground equipment, sports equipment, etc.) to different types of paving, fences, irrigation systems, etc. Data is structured according to the data model described in the document "DATA SPECIFICATIONS FOR THE INVENTORY OF GREEN AREAS 2_1 with ANNEX.pdf "[1].

All these objects form an urban green inventory, which is the basis for the management of GreenSpaces. With the help of the platform, users can manage inventory, plan and monitor maintenance and management activities, create reports or non-compliances, perform Visual Stability Analyses (VSAs) for trees and create inspection sheets for

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[1] The document can be downloaded from the website https://www.r3gis.com/greenspaces.

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recreational and sports equipment). Fig. 2 shows the main functions of the software and the links between them.
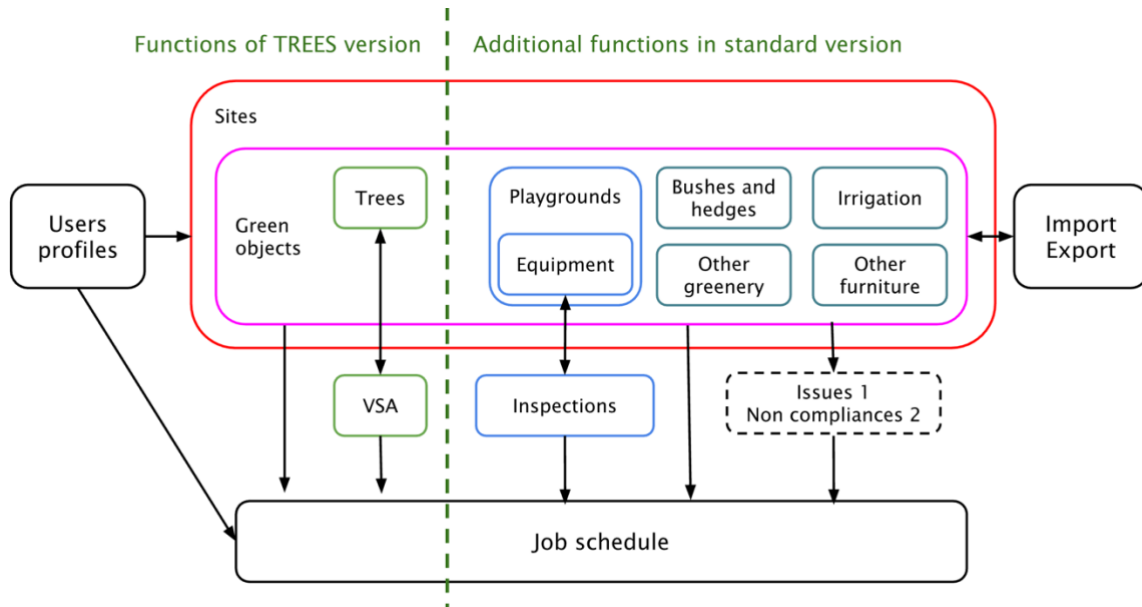

Fig. 2: Diagram illustrating information managed in GreenSpaces according to version.
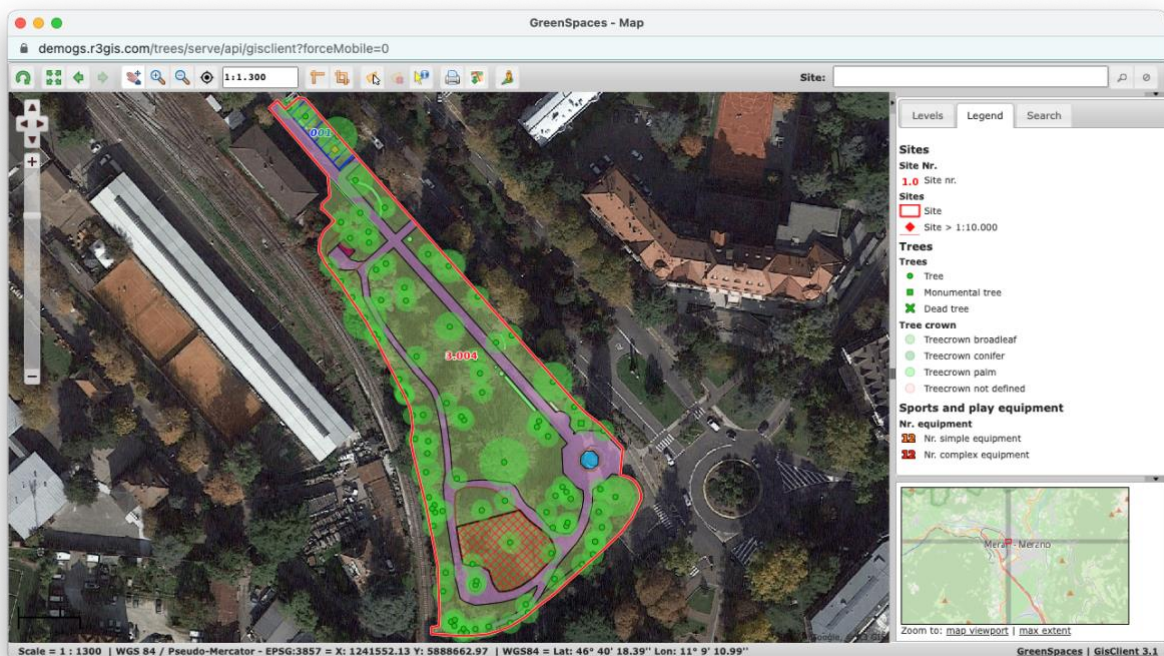

Fig. 3: All data can be displayed visually on the map.

2.1 Trees and Tree Inspections

GreenSpaces provides comprehensive management of all tree information. The tree form contains data on the species, planting site, number and tree tag, location, size, health status, as well as attached photos and documents.

GreenSpaces facilitates the planning and implementation of Visual Stability Assessment (VSA) tree inspections. The tree control form records defects that may affect the stability of the tree, a fundamental aspect for ensuring the safety of managed spaces. The control form is largely configurable, allowing customisation of defects to be checked and menu items.

GreenSpaces allows the assignment of instrument-assisted analyses (drilling resistance meters, sonic tomograph, pulling tests, etc.) to each VSA. Based on problems discovered, a failure probability class is defined, which also determines when the tree should be inspected again. GreenSpaces displays the failure probability classes assigned to the trees in different colours on the map and thus semi-automatically schedules work and retesting, even recalculating dates if they are postponed. The possibility to record several Visual Stability Analysis (VSA) or equipment-assisted checks for each tree over time is essential for maintaining accurate control of the health status of each plant.

Fig. 4: A tree form showing details of the plant, images, and geographical location, one or more tree inspections, work tasks (already performed and planned), and associated documents.

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GreenSpaces can be used for planning and managing maintenance work on trees as well as felling and planting. The "Empty Spaces" module allows the management of replanting and replacement planting.

In summary, GreenSpaces manages all phases of inventory control, tree inspection, validation and re-inspection of a tree and guarantees complete documentation of all interventions. The history of tasks, tree checks and changes are stored in the database and can be viewed at any time.
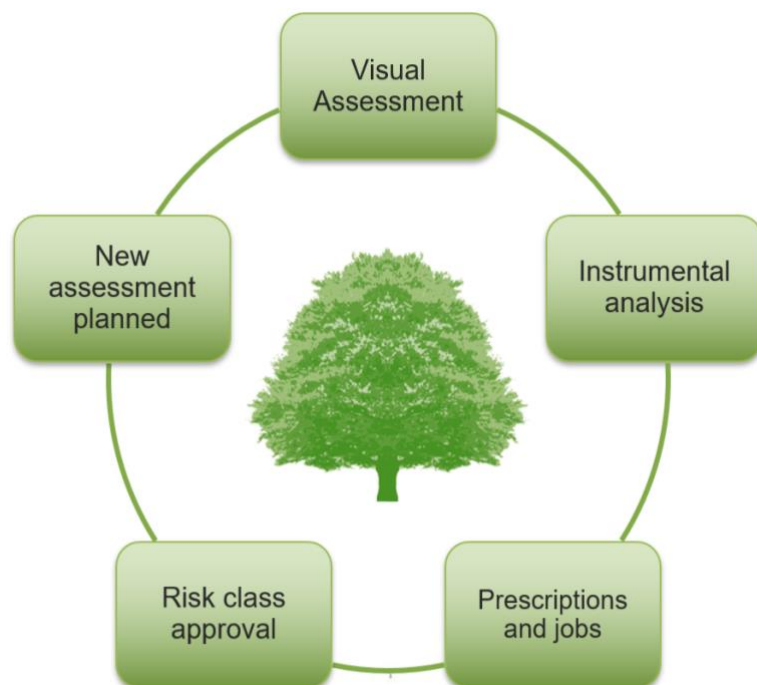
Fig. 5: GreenSpaces manages all phases of surveying, inspection and monitoring of a tree, guaranteeing complete documentation.

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Fig. 6: The VSA form allows users to register and document all information on the visual assessment of the tree and associated instrument checks.

2.2 Care of Shrubs, Hedges and Planters

GreenSpaces enables the management of shrubs, perennial beds and ground cover with specific functions. The same module also manages pots and planters with their specifications. Planter forms allow entry of specific parameters such as container type and size, as well as the assignment of an NFC tag for recognition in the field. Multiple species can also be entered for a given container or shrub, as well as respective insertion and removal dates for each species.

2.3 Management of Recreational and Sports Equipment

GreenSpaces manages all information relating to children's playgrounds including the location and main features of each piece of equipment. The software highlights safety aspects, management of maintenance operations and periodic inspections while also allowing to program work schedules.

Attributes that can be associated with equipment items include type, material, manufacturer, production date, maintenance schedule, age group, drop height, flooring,

installation date, age, new value and current depreciation value, photos and related documents.

Fig. 7: An example of an equipment form with details of inspections, maintenance jobs and related documents.

The historical database also retains records for discontinued play equipment and related information such as inspections and maintenance carried out.

To improve the traceability of inspections, NFC tags can be used to identify play equipment. The inspector can read the tag with a smartphone and record the inspection. This can help reduce liability in case of playground incidents.

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Fig. 8: Registration of inspections of playground equipment using NFC tags.

2.4 Planning and Financial Accounting

The application allows maximum flexibility in managing required work tasks. It is possible to enter different types of work tasks, configure them and set prices. For each work task, it is also possible to define which types of objects are involved.

Once work task types have been configured, they can be applied to various green infrastructure sites. This is done by filling in the work form. Geographical functions of the software allow for instant calculation of quantities and prices based on survey data.

For example, if a user creates a "lawn mowing" type job for a park, GreenSpaces automatically calculates exact quantities based on the green space inventory and applies those to the work task, thereby providing total cost calculation for that particular maintenance activity.
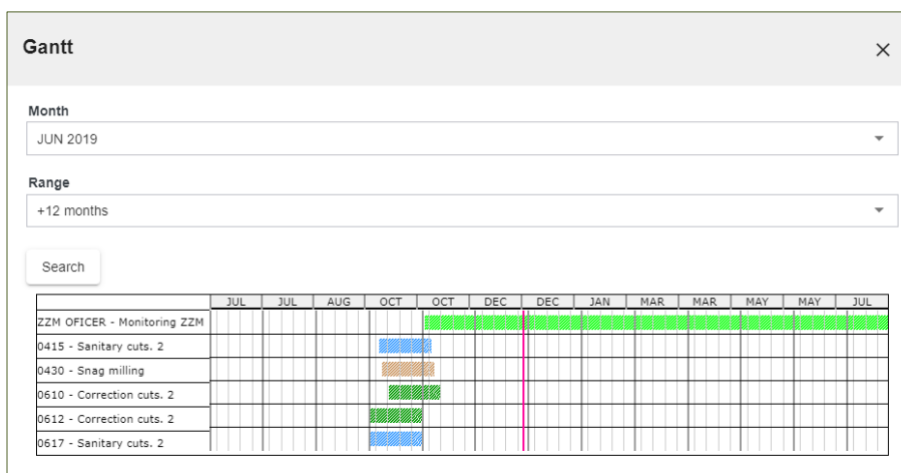
Fig. 9: GANTT chart of activities

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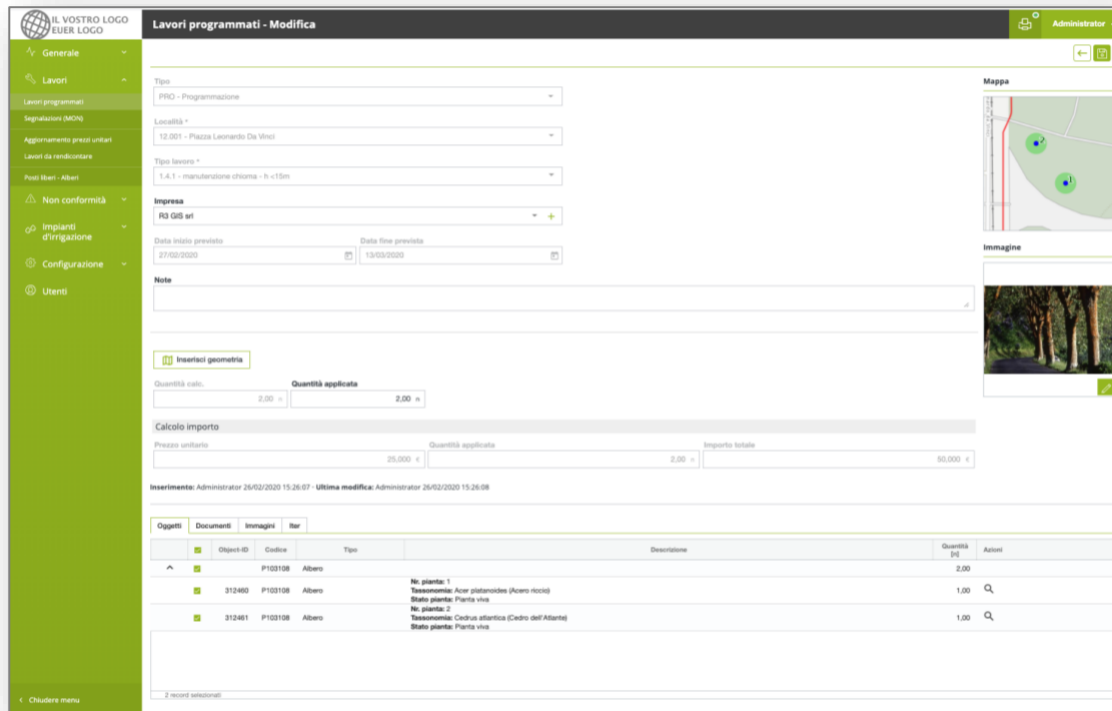
Fig. 10: A Job form for tree care activities on two trees.

For each task, a map is also created, showing individual objects affected by the work. In Figure 10, for example, the trees that are affected by the job are highlighted. This allows fieldworkers to navigate to objects with GreenSpaces Mobile and see exactly which trees need care.

With the help of maps and orthophotos GreenSpaces greatly simplifies job reporting and documentation and investigation of questionable issues and brings an ease to the entire spectrum of maintenance management.

The list of work tasks shows all planned and completed maintenance tasks and offers the possibility to check the details of affected objects. The price for each work task is calculated automatically by multiplying the unit price of the work by the quantities calculated from the objects. The result is a transparent and precise calculation of the costs incurred, allowing accurate and timely reporting.

GreenSpaces allows you to plan maintenance activities for each site and share programming between the different operators and the client in the form of a detailed work list or Gantt chart. All jobs carried out are registered and linked to the object to be maintained (ie. tree, lawn, hedge, etc.) and to the site. All details of each job can be checked afterwards.

In this way, all phases of work - from initial planning to progress monitoring and final payment - are tracked with complete transparency in GreenSpaces.

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2.5 Tracking of Defects and Complaints

The software has special functionality for managing defects and complaints. A user who discovers a problem on site can save the location and take a photo, and then create a notification that can be converted within GreenSpaces into a work task, scheduled for a future date.

Complaints (or Non-compliances), on the other hand, are used to indicate that a job has not been performed correctly. Again, the user can pinpoint the location and object on site, take a photo and select a severity level. Depending on the severity, the contractor can be given more or less time to correct the issue. With this troubleshooting tool, maintenance measures can be closely monitored and their quality ensured.

2.6 Irrigation Systems

GreenSpaces includes a module that allows users to manage irrigation systems and all their components (e.g. controllers, water supply, sprinklers, irrigation sectors). When accessing this menu, users can view all information about the system: controller, brand, model, housing, control, power supply, presence or absence of pumps. It is also possible to view information on irrigation sectors, such as type of irrigation, images, work tasks.
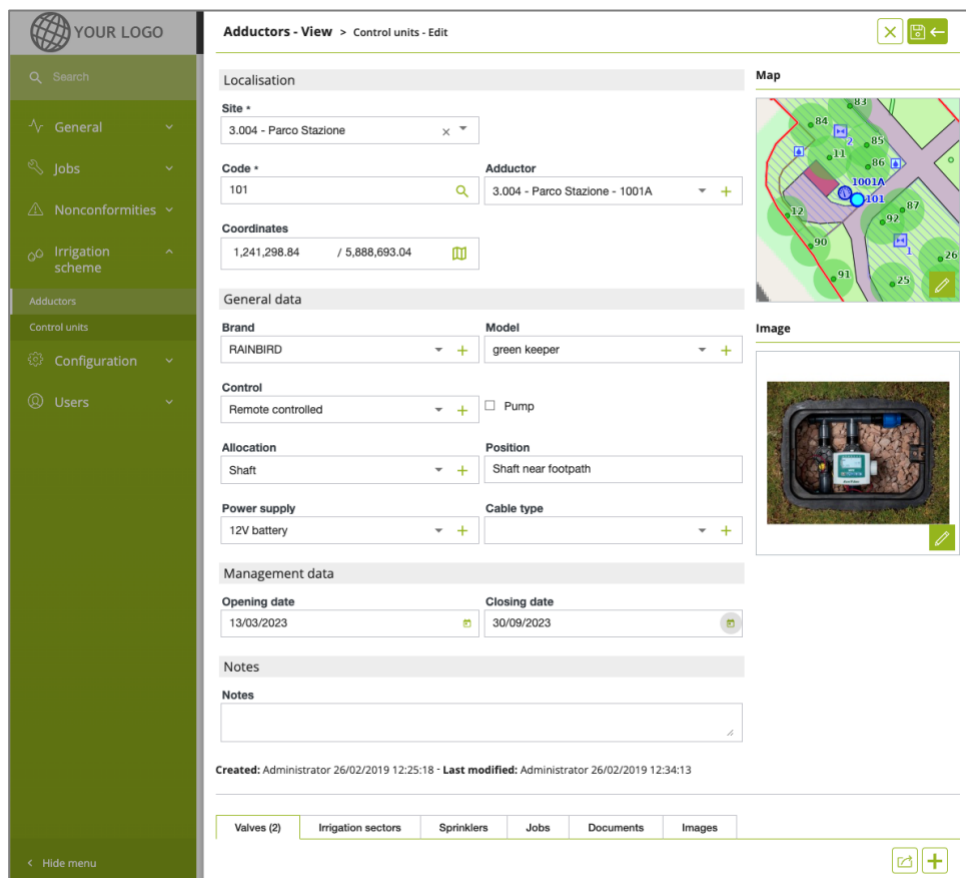
Fig. 11: Information on the control unit of an irrigation plant

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3. GreenSpaces Mobile App

Green space management can take place directly on site. The ability to collect and record information, at the time and place it happens, saves time, and ensures greater accuracy. GreenSpaces Mobile, an app for Android devices, makes it possible to manage maintenance activities directly on site. The app is an extension of the GreenSpaces application, is simple and intuitive and can be used on both tablets and smartphones. And it functions even when no internet connectivity is present (offline mode).

The employee on site can enter issues, carry out tree inventories and inspections, confirm execution of (or reprogram) work planned for that day. The data is stored on the mobile device and can be synchronized immediately while still on site or after returning to the office (or whenever connectivity is restored).

| List of maintenance jobs | Job specifications | Confirm execution | Add a picture of completed job |
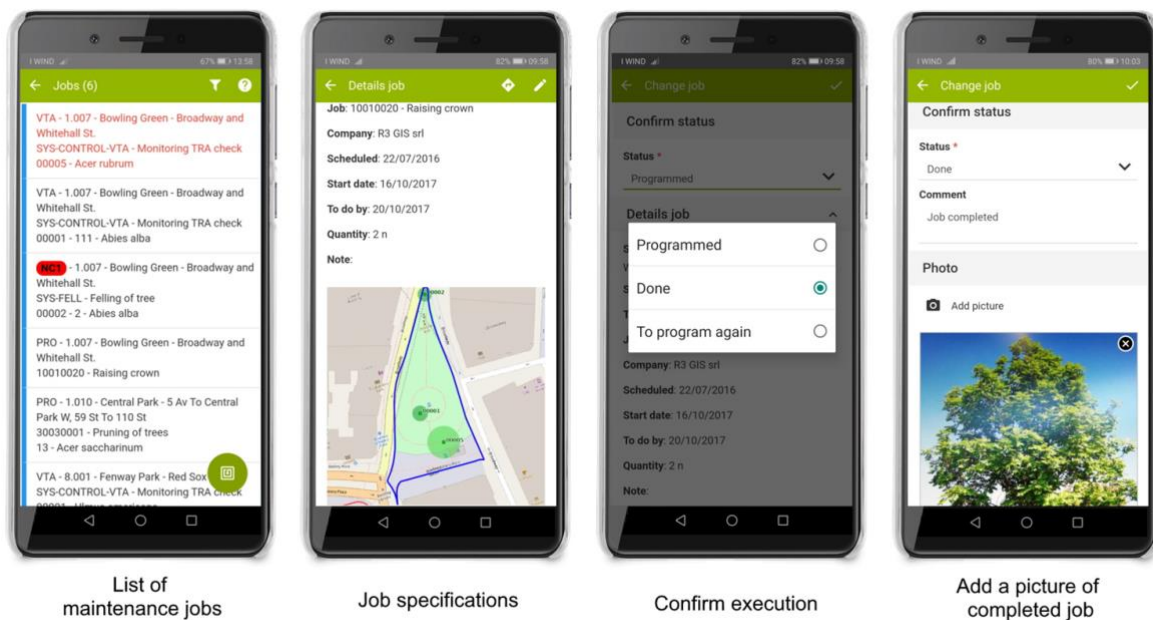
Fig. 12: Managing field work with GreenSpaces Mobile App.

4. Additional Modules

The functionality of GreenSpaces can be extended with various additional modules, depending on the needs of the client. The add-on modules are useful tools for reducing the ecological footprint of green care and maintenance activities and, more generally, for adapting cities to the effects of climate change. Furthermore, they support the important task of involving citizens in urban green issues.

4.1 METEO Module

Care and maintenance activities in the field are highly dependent on weather conditions. This module provides the weather information needed to plan activities more efficiently:

- Weather dashboard with current hourly data and forecasts for precipitation, temperature, humidity, wind, evapotranspiration, and solar radiation.
- Allows download of raw weather data and forecasts
- Evaluation of the current weather data in comparison with the 10-year average (under development, available by end of 2023)
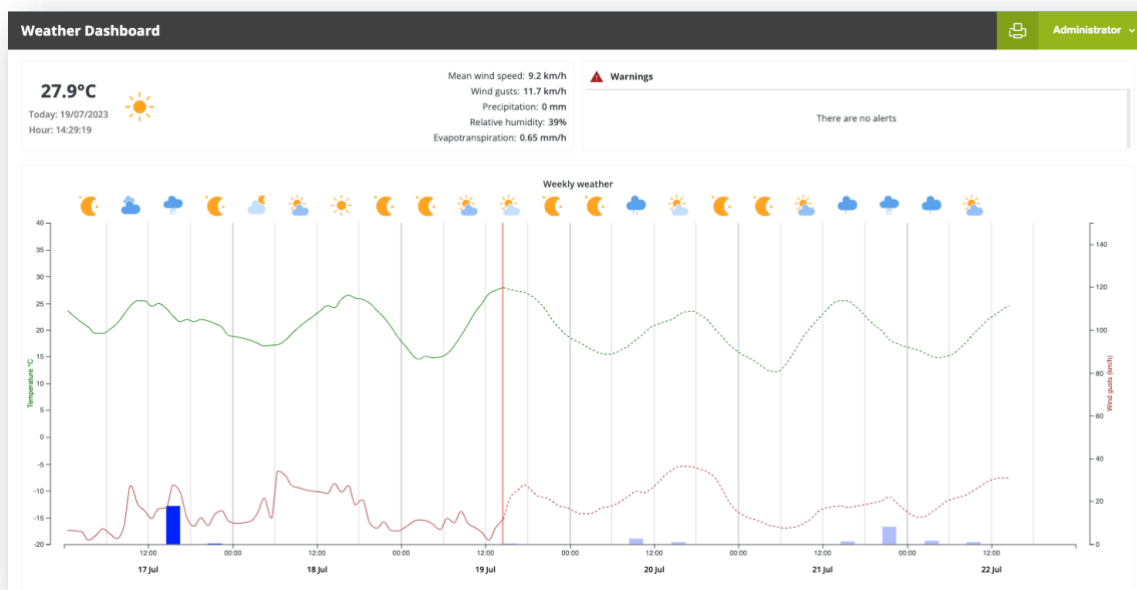
Fig. 13: The most important weather data and forecasts can be viewed at any time (temperature, precipitation, wind gusts, evapotranspiration, solar radiation, etc.) on the weather dashboard.

4.2 BENEFITS Module

Using weather data and algorithms developed by the University of Milan and the University of Florence to calculate the ecological benefits of trees and shrubs, daily ecosystem service values are calculated for a considerable number of tree and shrub species. The ecosystem services calculated are:

- CO_2 absorption, binding and storage:
- Deposition of $PM_{2.5}$ and PM_{10}
- Evaporated water
- Saved energy for cooling.

This module also contains all functions included in the METEO module.

4.3 WATER Module

This module calculates the water requirement for each tree by comparing the transpired water with the water available in the soil and potentially provided for in weather forecasts. This allows GreenSpaces to determine when irrigation is necessary. In calculating this, the WATER module considers the following data:

- Tree characteristics (species, age, planting site).
- Weather data (past data as well as weather forecasts for the next 72 hours).
- Irrigation already carried out.

When a tree needs water, the user is informed and can schedule watering activities in GreenSpaces. The volume of water currently received by the tree is also then considered in calculating water requirements for following days.

This module includes functionalities of both METEO and BENEFITS modules.

4.4 WORKS Module

The WORKS module activates the tools necessary for advanced job management. It provides a weekly calendar allowing detailed work task planning, including specification of date and time of planned execution and assignment of tasks to workers for each job. In combination with the METEO module, the calendar enables optimisation of work planning, with consideration of weather forecasts. In addition, the WORKS module adds the following advanced functions to GreenSpaces:

- Simple and intuitive planning of maintenance and care work.
- Tools to improve the efficiency of work planning, taking into account various factors such as distance between work sites and adverse weather conditions.
- Management and monitoring of teams.
- Flexibility in managing contractors, allowing for different price lists for each contractor.
- Recording of hours spent, materials and machinery, for each job, including break down of expenditure by cost centre.

4.5 GREEN CITY Module

Strategies to adapt the city to increasing numbers of heat waves, droughts, heavy rains, and wind gusts cannot be successful without citizen participation. A public portal shows the most important benefits of urban green spaces in real time and visual information on trees, shrubs, plants, and playgrounds is displayed on an interactive map. Data is based on a detailed inventory and can include the calculation of ecosystem services.

In combination with the BENEFITS module, the public portal displays up-to-date data on ecosystem services calculated on a daily and annual basis for the main tree and shrub species. Without the BENEFITS module, ecosystem services data is calculated using i-Tree as a separate service and is available for all species.

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Some examples:

https://krakow.lifeurbangreen.eu/

https://bozen.verdevale.eu/de/

https://lugano.verdevale.eu/

5. Services

5.1 Software as a Service (SaaS)

The GreenSpaces platform is offered in SaaS mode. To ensure the usability of the application for the client and third parties involved in green maintenance, the server on which the application is installed must be accessible on the internet. The R3GIS SaaS service consists of providing the customer with an instance of the software product in the Cloud, which can be used via a web browser for an annual usage fee. The service includes use of the web platform, use of the mobile app, software updates, support via email, hosting and daily backup of data. R3GIS is ISO27001 certified for the "development, production, maintenance and delivery of software also in SaaS and ASP mode, processing of geodata, design and implementation of spatial data infrastructures (SDI) and WebGIS services, consulting and training, provision of hosting services".

5.2 Set-up Fee and Customisation

The set-up fee includes the initial activation of GreenSpaces with the logo, domain and basic configurations agreed with the client. Uploading client data (custom mapping, importing trees and locations, etc.) or configuring specific user workflows, is carried out as part of prepaid hourly packages. Estimates of work volumes are determined after evaluating data samples supplied by the client.

5.3 Training and Support

The introduction of new tools to organize the maintenance work of green infrastructure, combined with the use of new technologies, requires an adaptation of workflows between the various stakeholders involved in management (owners, operators, contractors, technicians). This, in turn, demands training of users and support to staff in the initial period, so that service can be provided without disruption.

Training covers the following topics relevant to use of the GreenSpaces application:

- User profiling and creation of new users.
- Map interface with search, query and print functionality.
- Site form: Query, update, print.
- Tree form: Query, update, print.
- Playgrounds and playground equipment: query, update, print.
- Management of tree inspections.
- Management of playground equipment inspections.

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- Job planning: configuration, validation, billing, and job reports.
- On-site information management with GreenSpaces Mobile.

6. Versions of the software

There are several versions of GreenSpaces. The functions described above apply to GreenSpaces in its standard configuration. If required, we can also offer simplified versions of the software: GreenSpaces TREES and GreenSpaces PLAY; or the multi-domain version GreenSpaces Enterprise.

GreenSpaces Standard manages all elements of green spaces: Trees, playgrounds, street furniture, lawns, flower beds, hedges, irrigation systems, etc. It has a map based on the client's data, different types of user profiles according to their tasks, a sophisticated work management tool for planning, validating, executing and invoicing activities, tools for managing playground inspections, management of issues and non-compliances. The mobile application can be used to manage trees, tree inspections, playground equipment, maintenance activities and issues directly on site, even without data connectivity. The software makes it possible to manage data of several clients, but with each client able to access only their own data.

GreenSpaces TREES not only manages the tree cadastre, but also tree assessments and the planning of tree maintenance activities. The software allows for an unlimited number of users with various roles, at the discretion of the client. The software is installed and customised for the client. The base map may be a map provided by the client (orthophoto, technical map, topographic database) or Openstreetmap. With the mobile application, trees, tree inspections and tree-related activities can be managed directly on site, even without a data connection. The application can manage the data of several clients, but with each client able to access only their own data.

GreenSpaces PLAY manages not only the inventory of playground and sports equipment, but also information about playgrounds and sports facilities, inspections, and maintenance activities. The software allows for the activation of an unlimited number of users with various roles, at the discretion of the client. The software is installed and customised for the client. The base map may be a map provided by the client (orthophoto, technical map, topographic database) or Openstreetmap. With the mobile application, it is possible to manage playground equipment, inspections, and playground-related activities directly on site, even without a data connection. The application can manage the data of several clients, but with each client able to access only their own data.

GreenSpaces Enterprise allows management of multiple instances of the software and is suitable for companies who manage multiple clients with different configurations and users and who also want to give their clients various modification rights (e.g. the client wants the ability to create issues or validate certain operations). With GreenSpaces Mobile, you can manage all activities directly in the field, even without a data connection.

The table below shows the functionalities of various versions:

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Functions	GreenSpaces Standard	Versions		
		TREES	**PLAY**	**ENTERPRISE**
Any number of users with different roles	X	X	X	X
User groups with differentiated roles	X	X	X	X
Site form with automatic areas, documents, pictures	X	X	X	X
Site statistics	X	X	X	X
Print in PDF format	X	X	X	X
Export as XLS, SHP	X	X	X	X
Openstreetmap as basemap	X	X	X	X
Map interface with customer's basemap	X	X	X	X
Standard cartography tools	X	X	X	X
Installation on customer's server or hosting	X	X	X	X
Field use with interface optimized for mobile tablets	X	X	X	X
Field work management using GreenSpaces Mobile	X	X	X	X
Tree form with documents and pictures	X	X		X
VSA inspections	X	X		X
Instrumental tree analysis	X	X		X
Tree statistics	X	X		X
Management of tree-related jobs	X	X		X
Tree census and VSA using GreenSpaces Mobile	X	X		X
Management of playgrounds and recreational equipment	X		X	X
Equipment form with documents and pictures	X		X	X
Play equipment inspections	X		X	X
Maintenance jobs related to recreational and sports equipment	X		X	X
Equipment census and inspections using GreenSpaces Mobile	X		X	X
Management of all elements of green areas	X			X
Urban furniture management	X			X
Maintenance jobs for all types of elements	X			X
Cost calculation and reporting	X			X
Statistics on all types of objects of green areas	X			X
Photos and documents for all types of objects	X			X
Data import from SHP format	X			X
Management of issues and non-compliances	X			X
Client can have any role (even modify data)				X
Different configurations for each client				X
Different price lists for each client				X

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Additional Modules

Functions	GreenSpaces Standard	Versions		
		TREES	**PLAY**	**ENTERPRISE**
METEO Module	X	X		X
BENEFITS Module	X	X		X
WATER Module	X	X		X
WORKS Module	X	X		X
GREEN CITY Module	X	X		X

More information is available on the website www.r3gis.com/greenspaces.