



SOIL  SCOUT



Agriculture



Golf Courses



Sports Stadiums

# Sports Turf & Golf Courses

Your professional partner for permanent below-ground wireless environmental monitoring



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 @Soil\_Scout

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The **Soil Scout** story....

## ‘The first prototype is still buried and beeping 13 years later . . .’

In the year 2000, agrotechnology student and 19th generation farmer Johannes Tiusanen wrote an essay on future farming at the University of Helsinki, in which he stated that farmers in 2025 “will get online reports on underground soil conditions - just like a local weather report.”

He realized the sensors that captured this data would need to be permanently buried, but no one knew why mobile signals attenuated when underground. He answered this question while completing his doctorate, which led to the creation of a new kind of antenna.

With the help of his good friend, Jussi Sirkiä, who had an abundance of experience in power electronics, the pair were able to build a new product that could transmit enormous amounts of radio power while maintaining a lower power state the rest of the time and last for 20 years buried underground. The first prototype is still buried and beeping 13 years later.

Having initially built the product to solve his own problems, Johannes realized the potential of the technology as a commercial solution and founded Soil Scout in 2013. The team solved the final piece of the puzzle - they refined the solution to the point where a person can take their phone out of their pocket and understand what is happening underground in real-time.

Our mission is to give you the insights and data you need to manage your turf in the most efficient and effective ways. Through data, we will safeguard our soils and make them flourish for future generations.



**Johannes Tiusanen**  
Chief Science Officer, Soil Scout  
[#thesoilscoutstory](#)

**“We wanted to help soil professionals get the insights they need from the soils they manage”**

The **Soil Scout** time-



**2000**

Johannes wrote an essay on future farming at University



**2004**

Development of a unique underground antenna



**2005**

Johannes and Jussi produced their first wireless soil sensor



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# Welcome to **Soil Scout**

**S**oil Scout enables land use related water and energy optimization in an unprecedented detail and ease by providing a future-proof below-ground monitoring system.

Soil Scout provides the only wireless sensors capable of transmitting moisture, temperature and salinity data in near real-time out-of-sight performance from up to 2 metres / 6 feet below the surface, for up to 20 years, maintenance free.

Understanding what's happening below the soil surface is critical for many industries. Soil Scout takes monitoring to the next level by providing a detailed view into in-field variation, enabling our customers to expand the Precision Agriculture approach to all land use challenges, be that smart farming, irrigation control or turf quality optimization.

Previous solutions for measuring environmental conditions are based on wires and cables or a single observation pole, which are impractical, inefficient, labor-intensive or unable to assess spatial variability. Soil Scout provides critical insight into data from deep below the surface wirelessly, enabling 24/7 insight and profiling which allows our customers to perform better, understand their operations deeper and reduce water and energy use by up to 50%.



**2013**

Soil Scout is founded and welcomes first Angel investor



**2015**

Release of the latest HYDRA100 sensor



**2019**

Husqvarna becomes the latest to invest in Soil Scout

## Read more

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- 6 What does Soil Scout do?**  
Benefits from using wireless sensor technology under sports turf
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# Why choose **Soil Scout**?

**T**he managed sports turf industry uses in excess of 4.2 billion gallons of water daily, studies suggest that up to 40% of this water is wasted from over watering from irrigation systems and practices.

The effects of over watering lead on and create a devastating trail of after effects.

By using Soil Scouts wireless underground sensors, these issues won't be cured, but you can go a long way to putting it right and gaining significant savings, and dramatically increasing your efficiencies along the way.

As a sports turf professional, your priority is to provide a safe, durable, and high performing surface, for the participants of whichever sector of the industry you are within.

Sustainability is the word on everyone's minds right now, and with the ever increasing costs of all inputs, all involved in decision making within this sector, need to use water (admittedly our most valuable resource) as efficiently as possible.



## The **Soil Scout** story....

**“You can see all the data from your phone instead of going to the field. A golf superintendent is always stressed about the course conditions - now he can stay at home and check the conditions from his app”**

**Tommi Tienhaara**  
Sales, Soil Scout  
**#thesoilscoutstory**

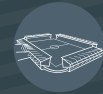




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## Case Study

# The Meadow Club

Fairfax, California

**H**aving in ground sensors from Soil Scout helps us become more efficient and tells us when and where we need the water most at critical times.

The biggest reason for choosing Soil Scout is the not having to fiddle round, taking sensors in and out like our previous sensors. The ability to just put it in the ground and know that it is going to work and then gain credible, accurate data so we can make real time decisions.

Upon opening the packaging and viewing the hardware, I loved it, such exceptional build quality. The flexibility is amazing, if I want to move them I can, plus the customizable nature of being able to add sensors, year on year, as budget allows is great. To have a product with radio signal rather than cellular was a big draw for us, as we don't need to rely on good cellular coverage right across the property, so we can install them where we want rather than where coverage allows.

The ability to build patterns year on year and monitor trends, gives us that chance to learn more about timings of our inputs like fertilizers, and then pesticides, for disease, grubs, etc on our property. We also use the Greensight drone solution, so we can now compare the above ground imagery, with the below ground evidence and really fine tune our actions when we see change happening.

Overall as of yet we have only recently installed the product, but initial feelings are great. The whole process from sales to order then delivery and installation has been simple and straight forward, so it hasn't cost me valuable time at this time of year.

**“With the Soil Scout system installed we saw an ROI on our initial investment within the first 12 months”**



### Kevin Hauschel

Golf Course Superintendent at the Meadow Club 1927, Dr. Alister Mackenzie's first golf course design in the US



@KevinHauschel

### The Soil Scout story....

**“We helped them manage the entire system in a simple way, and they received real information on the value of their soil for the first time. We helped them leverage smart farming techniques”**

### Jalmari Talola

CEO, Soil Scout

#thesoilscoutstory



# What does **Soil Scout** do?

Benefits from using wireless sensor technology under sports turf

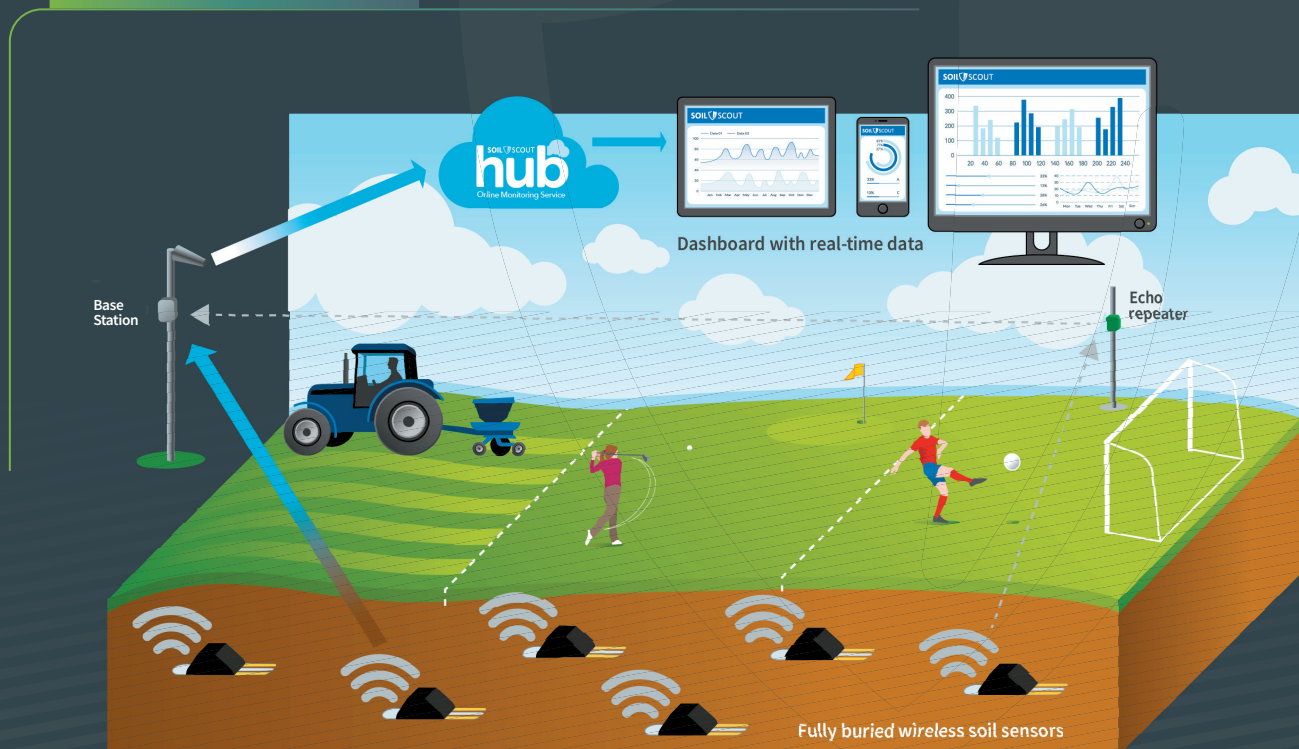


**T**he soil moisture, temperature and salinity are three critical components to monitor, if you are looking to achieve optimum conditions for plant health, and ideal growth.

Historically superintendents / Course managers / Head greenkeepers / Sports turf managers etc have known their own wants, when it has come to what's needed to achieve a top class surface. But now, with our underground soil temperature, moisture and salinity sensor, we can make that job more efficient, and streamlined, from many levels. Increasing ecological sustainability, auditable actions, and simpler, connected management practices.

After learning the interpretation of the data you receive, and how it benefits you and your property personally, it is an added asset to the arsenal to add more playing days, and help enhance player perception of the turfs you manage.

## The **Soil Scout** cycle....





## Key benefits

- ✓ A significant reduction in water usage / or use of same water, but in areas more needy
- ✓ Savings on power / fuel from pumping
- ✓ The ability to lower or increase desired moisture / temperature / salinity levels, from accurate data, according to local / historical knowledge or plant needs
- ✓ Reduce black layer / thatch
- ✓ Gain a knowledge of ideal conditions, for more effective plans on timing of fertilizer applications
- ✓ Forward plan / pre-warning on disease risk
- ✓ Lower labor costs / gain time to do other tasks, by minimizing the use of hand held sensors, also making the hand held more valuable by highlighting specific areas to manually pinpoint problems
- ✓ Automate irrigation / sub-surface air systems
- ✓ Auditable recording of data, to quantify water usage, and other input usages
- ✓ Monitor ever increasing salinity levels



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## Case Study

### A streamlined approach at The Belfry Hotel & Resort

Being able to monitor the various data, can help us become a lot more streamlined with our irrigation usage. Having 56 holes requires a significant amount of water management, so every effort counts. Our water is also recycled city water, so it will be interesting to monitor salinity levels to implement better timings of fertiliser applications.

We are also aiming for GEO accreditation, and having a remote sensor solution like Soil Scout, will help us show evidence that we are cautious with what we do, and also make us more auditable.

#### Angus Macleod

Director of Golf Courses and Estates at The Belfry Hotel & Resort

 @AngusMacleod9





# GAIN A DEEPER VIEW

Soil Scout's VP of International Sales Adam Sedgwick on a recent installation on the Brabazon Course at The Belfry Hotel & Resort.





1



2



3



4



# Wireless underground Sports Turf sensor

Make informed decisions based on accurate and permanent measurements

## Soil Scout

- Integrated Moisture, EC (Salinity) and Temperature sensors
- Transmits from up to six feet underground
- Broadcasts through soil, turf, sand, clay, biomass, snow and concrete
- Nothing on field to interfere with machinery, players or turf growth
- Create a multidimensional picture for subsoil environment

## Features

- Broadcasts every 20 minutes for up to 20 years (other intervals available)
- Data transmitted to a gateway and onwards to the monitoring service
- Water and energy savings up to 50%
- Unaffected by weather, temperature extremes or seasons
- Enables detailed profile to be established continuously over time
- Ability to integrate with 3rd party systems or machinery (irrigation, aeration, moisture removal)

**OVER 200 SATISFIED  
CUSTOMERS - OVER  
3000 ACTIVE  
SENSORS**



## Patented Technology

Regular radio antennas do not work properly if buried in soil because the speed of radio waves varies depending on soil properties. This is why an antenna for a specific wave length would go out of tune when soil moisture changes.

Soil Scout has developed a patented underground antenna that interacts with the surrounding medium in a way that balances the antenna input to the prevailing soil conditions. As a result, the antenna is not very efficient in air, but gains an efficiency exceeding 95% when soil is introduced to the antennas near field.

US9673912B2

## The Soil Scout story...

“Our data enables agronomists to base their recommendations on real life evidence instead of visual evidence from history. This means they can make real-time management decisions, helping them structure their business to be more proactive than reactive - and more sustainable through timely use of resources”

**Adam Sedgwick**

International Sales Manager, Soil Scout

#thesoilscoutstory





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# Expert **Opinion**

A leading industry expert gives his opinion on the Soil Scout solution

## Huge potential to improve how we manage sports turf

The use of remote soil probes has huge potential to improve how we manage sports turf. With regulatory pressure increasing on many turf management products improved understanding of optimum timing is critical.

Recording soil temperatures and moisture levels on a regular basis has become standard practice in many venues now and having the ability to automatically record those over a long period of time will help to give stronger indications of disease outbreaks, timings of insect flights and guide timings of many products.

This kind of technology will in time become a key factor to influence the timings of our management programmes.

**Research manager**

- from the turf industries premium pesticides manufacturer

**“Using Soil Scout will help us to match the managers ambitions and give him the pitch conditions that he wants to play on”**

*Former Premier League club head groundsman*



The **Soil Scout** story....

#thesoilscoutstory

“Soil sensors should be buried in the locations that matter: the good, the bad, the cold, the wet and the average. Only an underground and wireless sensor can be positioned anywhere. Sensors in the correct locations will tell exactly what is happening and help figure out what should be done about it. Overall data is also valuable for detecting how the seasons vary between years but it is the infield variation is the cash crop of soil information for precision agriculture”

**Miira Jääskeläinen**



#UndergroundWeather

# FAQ

Soil Scout answers your frequently asked questions...



## What do we do when we want to do our normal aeration practices?

This is the primary question that we are always asked, as it is another essential part of your turf management strategy. There are numerous ways of overcoming this issue.

- 1 Locate and remove whilst aeration takes place. As you will have learnt, the install is very quick and simple, so removal and replacement is a quick process.
- 2 Install sensors a measurable distance from objects that you normally avoid when aerating.
- 3 Place a field marking whisker (aka tuft or carrot) at the install location.

## Do Soil Scout provide installation services?

We can do by all means, but generally the instructions are simple to follow, enabling the process, to be quick, simple, and comprehensive for a self install.

For all major installs it is recommended to have one of the Soil Scout team on site with you for a smooth, simple installation.

## How many sensors do we need?

To this question, there is no right or wrong answer. There are so many variables and reasons to measure but as a start off rule of thumb we recommend three sensors per green in golf. This allows you to monitor your best area, worst area, and average area, which gives you the ability to average your data out over the three reference points.

In a stadium environment, there are several simple ways to make a decision regarding the amount of sensors, mainly by identifying how many individual sectors the turf field is split into, then either have one or two sensors in each region. If two, the power of data gives a different degree of awareness, as it is very simple to reduce or manage your wetting agent usage by monitoring speed of water through the profile.

## How accurate is the data?

The data is extremely accurate, due to the nature of our patented, permanently retuning, underground antenna, which is constantly reconfiguring to the current soil conditions. The accuracy is all viewable on the tech info page, but briefly summarises as:

- EC (salinity) +/- 0.2dS/m
- Moisture +/- 1% dependant on correct installation and correct soil type entered
- Temperature +/- 0.1degree C



## How often do the sensors need replacing?

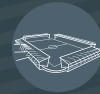
One of our big selling points, is our very long battery life. The sensor is pretty much bury and forget item, with battery life-scale of up to 20 years, dependant on the model and timed transmissions.



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## Case Study

### Changing the way we look at everything pitch related

**S**oil Scout monitoring solution has helped me make many extremely critical decisions on timings. Wasting fertiliser by applying at the wrong temperatures and moistures would cost me around £2,000 per application, and I was able to prevent this from happening thanks to the Soil Scout data.

I have been able to use water more accurately and efficiently and apply irrigation more effectively at the right time. I have gained extra levels of knowledge in every aspect of my grasses and soils. It genuinely changed the way I looked at everything related to our pitches and grounds.

#### Andy Richards

Grounds Manager, Haileybury School,  
Hertfordshire





**“We constantly aim to push our industry forward, both in terms of the technology and processes it uses, but also in terms of the potential ways in which it can help the world”**

# Range Estimation Table

Approximate maximum ranges (yards / metres): USGA Sand

## Receiving Antenna type and height



**Chart One**  
Feet and Inches

|       |      | Omnidirectional Antenna |     |      |      | Directive Yagi Antenna 90 |     |      |      |
|-------|------|-------------------------|-----|------|------|---------------------------|-----|------|------|
| Depth |      | 3ft                     | 7ft | 10ft | 17ft | 3ft                       | 7ft | 10ft | 17ft |
| Dry   | 4in  | 150                     | 290 | 340  | 440  | 150                       | 400 | 490  | 620  |
|       | 12in | 140                     | 270 | 320  | 410  | 140                       | 370 | 450  | 570  |
|       | 24in | 130                     | 240 | 290  | 370  | 130                       | 330 | 410  | 520  |
| Wet   | 4in  | 140                     | 270 | 320  | 410  | 140                       | 370 | 450  | 570  |
|       | 12in | 120                     | 220 | 270  | 330  | 120                       | 300 | 370  | 480  |
|       | 24in | 80                      | 160 | 190  | 250  | 80                        | 220 | 280  | 360  |

## Receiving Antenna type and height

**Chart Two**  
Metres and Centimetres

|       |      | Omnidirectional Antenna |     |     |     | Directive Yagi Antenna 90 |     |     |     |
|-------|------|-------------------------|-----|-----|-----|---------------------------|-----|-----|-----|
| Depth |      | 1mt                     | 2mt | 3mt | 5mt | 1mt                       | 2mt | 3mt | 5mt |
| Dry   | 10cm | 140                     | 270 | 320 | 410 | 140                       | 370 | 450 | 570 |
|       | 30cm | 130                     | 250 | 300 | 380 | 130                       | 340 | 420 | 530 |
|       | 60cm | 120                     | 220 | 270 | 340 | 120                       | 310 | 380 | 480 |
| Wet   | 10cm | 130                     | 250 | 300 | 380 | 130                       | 340 | 420 | 530 |
|       | 30cm | 110                     | 210 | 250 | 310 | 110                       | 280 | 340 | 440 |
|       | 60cm | 80                      | 150 | 180 | 230 | 80                        | 210 | 260 | 330 |

**Note:**

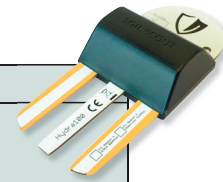
- Estimates are presented for dry soil (20% volumetric moisture) and wet soil (50% vol. moist.)
- Environmental conditions may reduce range temporarily (e.g. wet layer on dry soil or vice versa)
- Tree(s) and/or shrubs between Scout and Base may reduce the range by 50%
- In urban environments, static radio noise may hamper receiver sensitivity and decrease range by 10-20%
- Saline soils (4 dS/m and higher) will attenuate signals and lower achievable depth in wet conditions

**Disclaimer:**

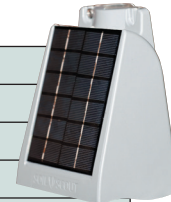
The information in this table is provided as an indicative planning guide, and is not a guarantee or warranty of performance under the stated conditions. Soil Scout Oy accepts no responsibility for errors or the inaccuracy of the information herein.

# Technical Specifications

| HYDRA100 Scout                  |   |
|---------------------------------|---|
| Radio power                     | 27.0 dBm (500 mW) Transmit only   |
| Frequency Variants              | 869.5 MHz (ITU-1) Europe and selected other markets<br>921.7 MHz (ITU-2) Americas, Australia, New Zealand and selected other markets<br>Custom Information upon request |
| Battery capacity                | 3000 mAh, encapsulated primary lithium  |
| Life expectancy                 | Up to 20 years @ 1 cycle per 20 minutes   |
| Encapsulation                   | Black polyurethane molding  |
| Dimensions (L x W x H)          | 129 x 59 x 25mm (5.1" x 2.3" x 1.0")  |
| Sensors                         | Temperature<br>Three-prong integrated Capacitive (moisture content) and Resistive (EC / salinity)   |
| Moisture Accuracy               | ±2% mean error (1% with correct soil type, 1% installation repeatability)   |
| EC Accuracy                     | ±0.2 dS/m mean error, Typical resolution 0.1 dS/m, Range 0 to 20 dS/m   |
| Dielectric Accuracy             | ±2% mean error, Resolution 0.5 to 1.5 ε, Range 1 to 135 ε   |
| Temperature Accuracy Resolution | Range -40 to +80 °C / -40 to 176 °F Accuracy: +/- 0.1 °C / 0.18 °F  |
|                                 | -40 to -11 °C 1.00 °C -40 to 12 °F 1.80 °F  |
|                                 | -10 to +10 °C 0.25 °C -12 to +50 °F 0.45 °F   |
|                                 | +10.5 to +80 °C 0.50 °C +50 to +176 °F 0.90 °F  |



| Base Station                 |   |
|------------------------------|---|
| Receiver RF sensitivity      | -100 dBm, BNC connector                               |
| Frequency Variants           | Same as HYDRA100 Scout                                |
| Operating Voltage            | 8-14 VDC, 300 mA                                      |
| Dimensions (L x W x H)       | 180 x 130 x 100 mm (7.1" x 5.1" x 3.9") <sup>2)</sup> |
| Data interface               | 2G/3G cellular modem <sup>1)</sup>                    |
| Power Supply                 | 100-240VAC with 5m (16'4") lead (included)            |
| Receiving Antenna (External) | Circular of 90° sector pattern                        |



| ECHO Repeater           |  |
|-------------------------|--|
| Receiver RF sensitivity | -100 dBm, BNC connector  |
| Frequency Variants      | Same as HYDRA100 Scout   |
| Radio transmit power    | 27 dBm (500 mW)  |
| Power Supply            | Solar panel charging a 2400 mAh 3.7V Li-ion battery.<br>Mains power supply available as accessory (same as used for Base Station)<br>Optional Repeater variant to enable connection to heavy battery |
| Range                   | 10km / 6-mile line-of-sight from ECHO to Base Station / another ECHO <sup>3)</sup>   |
| Dimensions (W x H x D)  | 190 x 135 x 95 mm (7.5" x 5.3" x 3.7")   |
| Mounting                | 50 mm (2") pole mount / wall mount   |



- 1) SIM card is supplied for most regions.
- 2) Excluding interface ports
- 3) Any obstacles (vegetation, hills, buildings) between the radios will decrease range. Repeaters daisy chain automatically.

Specifications subject to change without notice

# How to find out more

For more information on the Soil Scout solution and to request all relevant pricing options please contact the Soil Scout sales team via email or your nearest reseller.



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