

## USER GUIDE

# SOILSIDEKICK PRO

Version -0.4

## SoilsidekickPro Revolution in Agriculture

SoilSidekick Pro isn't just another agricultural tool—it's a technological breakthrough built on four revolutionary patent-protected algorithms that give you an unfair advantage in the market.

1,000 users can now ask questions like... "What's my contamination risk?" or "When should I plant corn?" and get their own custom responses backed by your personalized, sophisticated agricultural analytics.



*USER GUIDE (VERSION 2 - PROTOTYPE)*

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# Introduction

Master SoilSidekick Pro's agricultural intelligence platform with our comprehensive guides. From satellite data interpretation to environmental risk assessment, this document provides everything a new user needs to get started and leverage the full power of the platform.

## SOC 2 Type 1 Compliance & Security

SoilSidekick Pro maintains SOC 2 Type 1 compliance with enterprise-grade security standards. A System and Organization Controls (SOC) 2 report is an independent audit of a

service organization's controls related to data security. Developed by the American Institute of Certified Public Accountants (AICPA), this voluntary compliance framework helps technology and cloud computing companies demonstrate their commitment to protecting customer data. Our commitment ensures your agricultural data is protected through comprehensive security controls including:

- **Data Encryption:** All data, both in transit and at rest, is encrypted using industry-best practices.
- **Access Monitoring:** We continuously monitor access to our systems to detect and prevent unauthorized activity.
- **Audit Logging:** Detailed logs are maintained for all critical system events and user actions.

Our robust security framework ensures your sensitive farm data remains private and secure, giving you peace of mind. For more details, you can refer to our [FAQ on Security Compliance](#).

## Quick Start

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This section provides a high-level overview of the core functionalities of SoilSidekick Pro, designed to get you operational in minutes.

### AlphaEarth Intelligence

**Satellite-powered insights.** Learn to interpret vegetation health, soil moisture, and environmental risk scores derived from Google Earth Engine data. This feature provides a near real-time view of your land from space, enabling proactive management.

### Soil Analysis

**County-level precision.** Master USDA soil data interpretation, including pH optimization and nutrient recommendations tailored to your selected crops. This forms the foundation of your soil management strategy.

### Environmental Assessment

**EPA data integration.** Understand water quality monitoring, detect potential contamination risks, and adopt eco-friendly farming practices. This tool helps ensure your operations are sustainable and compliant.

## Local AI Processing

**Offline agricultural intelligence.** Use Google Gemma models for privacy-preserving AI analysis that works without an internet connection. Your data stays on your device, ensuring complete confidentiality.

## Getting Started

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### Welcome to SoilSidekick Pro

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Your complete guide to agricultural intelligence begins here. Follow these steps to perform your first analysis.

#### 1. Choose Your County

Start by selecting your county using either the search tool or the database lookup. SoilSidekick Pro provides county-level precision for all 3,143 US counties.

**Tip:** Use FIPS codes for the most accurate results. Example: 48453 for Travis County, TX.

#### 2. Review Your Analysis

Get a comprehensive soil analysis with pH levels, organic matter, and nutrient recommendations. Each analysis is enhanced with satellite-based environmental assessments.

**Pro Tip:** Look for the AlphaEarth satellite intelligence section for advanced insights into crop health and moisture.

#### 3. Explore Features

Navigate between the Soil Analysis, Water Quality, Planting Calendar, and Fertilizer Footprint tools. Each provides specialized agricultural intelligence to support your decisions.

**Remember:** All features integrate with real-time EPA and satellite data for accuracy. Local AI processing is available for offline analysis.

## 4. Export & Share

Generate professional PDF reports of your analysis. Pro subscribers get enhanced exports with detailed recommendations and environmental impact assessments.

**API Users:** Integrate data directly into your platform using our REST endpoints for seamless workflow automation.

## Application Tour Guide

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This tour will walk you through the main sections of the SoilSidekick Pro application, using screenshots to familiarize you with the user interface. Each tab provides a focused set of tools and data to help you make informed decisions.

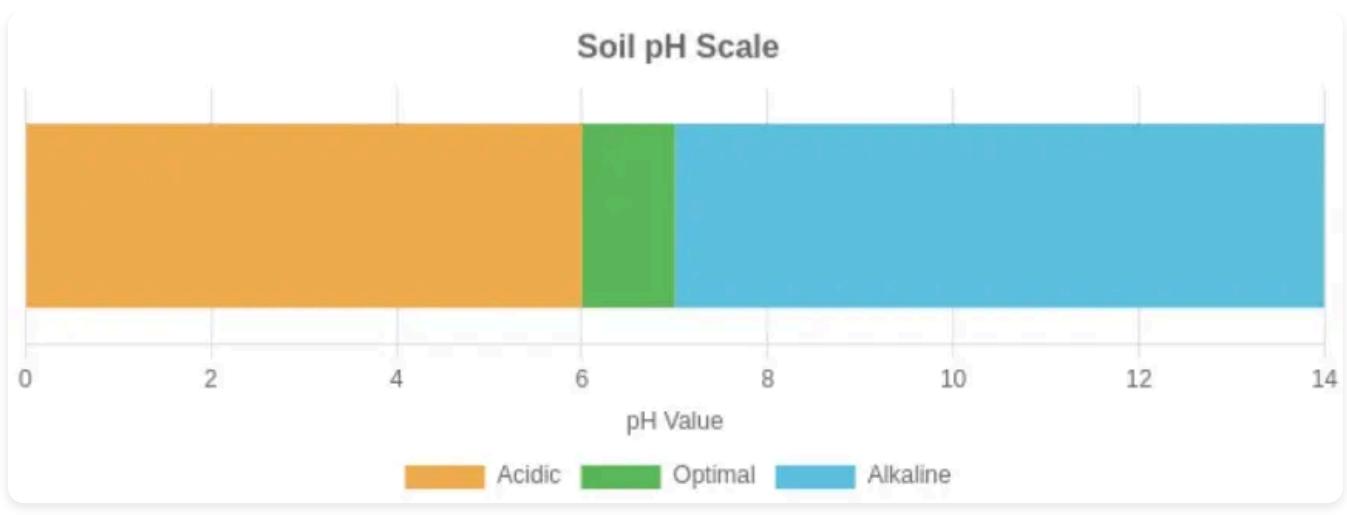
### Soil Analysis Tab

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The Soil Analysis tab is your primary destination for understanding the chemical and physical properties of your soil. Here you can dive into pH levels, organic matter content, and nutrient availability.

#### pH Level Understanding & Optimization

This section provides a visual breakdown of soil pH categories (Acidic, Optimal, Alkaline) and the recommended actions for each. It's designed for quick interpretation and decision-making regarding soil amendments like lime or sulfur.



## Organic Matter & Soil Health

Here, you'll find the benefits of maintaining healthy organic matter levels and strategies to improve it. The interface also provides target levels for different crop types, helping you set realistic goals for your soil management plan.

## Nutrient Management & Fertilizer Selection

This view breaks down the three primary macronutrients: Nitrogen (N), Phosphorus (P), and Potassium (K). It explains their role in plant growth and lists common deficiency signs, allowing you to visually diagnose potential issues in your fields.

## Environmental Tab

The Environmental tab integrates data from the EPA to help you assess and manage your farm's environmental impact, focusing on water quality and runoff risks.

## EPA Water Quality Monitoring

This dashboard component simplifies complex EPA data into an easy-to-understand grading system (A-F). It also highlights key contaminants to monitor, such as Nitrates and Phosphorus, along with their regulatory limits and environmental impact.

## Fertilizer Runoff Risk Assessment

This tool assesses your runoff risk based on factors like soil type, slope, and proximity to water. It categorizes risk as Low, Medium, or High and details the characteristics of each, helping you understand your specific field conditions.

## Eco-Friendly Farming Practices

For areas with moderate to high risk, this section provides actionable advice on sustainable practices. It covers organic fertilizer alternatives and the benefits of using slow-release synthetic options to minimize environmental impact.

## Sensor Setup Tab

This advanced section guides you through integrating your own physical field sensors for hyper-local, real-time data that goes beyond county-level averages.

## Sensor Integration & Installation

This is the main hub for connecting your hardware. It lists compatible sensor systems and provides a step-by-step guide for API integration, from generating a key to enabling live data on your dashboard.

The screenshot shows the 'Soil Sensor Integration & Installation' page. At the top, there are tabs for Getting Started, Alphalabath, Soil Analysis, Environmental, **Sensor Setup**, Webhooks, Dashboard, and Help. Below the tabs, there's a section titled 'Soil Sensor Integration & Installation' with an 'ADVANCED' link. It says 'Connect physical soil sensors to activate real-time data feeds for Soil Health Trends and Weather Forecast'. There are two main sections: 'Compatible Soil Sensor Systems' and 'Required Sensor Capabilities'. The 'Compatible Soil Sensor Systems' section lists Professional IoT Sensors (Davis Instruments WeatherLink, Onset HOBO, Campbell Scientific Research-grade stations, Senixx Unit & Drop), DIY & Arduino-Based sensors (Arduino + DHT22, Raspberry Pi + sensors, ESP32 + soil probes, LoRaWAN networks), and AlphaEarth sensors. The 'Required Sensor Capabilities' section lists requirements for real-time data feeds, API or webhooks, and MQTT compatibility. Below this, there's a 'Configure your sensor system to send real-time data to SoiSidekick Pro endpoints' section with a POST /api/v1/sensor-data endpoint and Authorization: Bearer YOUR\_API\_KEY. A note says 'SoiSidekick Pro pulls data from your sensor API on a scheduled basis.' The 'Required Data Format' section shows a JSON schema for sensor data. At the bottom, there's an 'Integration Steps' section with two steps: 1. Generate API Key: Go to Settings > API Keys in your dashboard. 2. Configure Sensor Output: Set your sensor system to output JSON data.

## Physical Sensor Installation

This guide provides critical safety information and best practices for placing soil sensors and weather stations. It covers proper depth, location, and density for accurate data collection, ensuring your hardware investment pays off.

## Sensor Troubleshooting & Maintenance

To ensure data accuracy, this section provides a visual guide to common issues and a maintenance schedule. It helps you diagnose problems with data flow or inconsistent readings and outlines a routine for keeping your sensors in top condition.

The screenshot shows the Sensor Setup tab with the "Soil Sensor Integration & Installation" section selected. This section includes a sub-section for "Compatible Soil Sensor Systems". Below it are sections for "Physical Sensor Installation", "API Integration & Data Pipeline", and "Sensor Troubleshooting & Maintenance". Under "Sensor Troubleshooting & Maintenance", there are two main categories: "Common Issues" and "Maintenance Schedule". The "Common Issues" section lists troubleshooting steps for data not appearing in the dashboard, inconsistent readings, and professional installation. The "Maintenance Schedule" section provides a breakdown by frequency: Monthly (check battery levels, verify data transmission, clean weather station components), Quarterly (calibrate soil sensors, update firmware if available, check mounting stability), and Annually (replace batteries, inspect cables and connections, update sensor calibration constants). At the bottom of the page are buttons for "Find Installers" and "Request Quote".

## AlphaEarth Tab

The AlphaEarth tab is where you access powerful satellite-powered insights, giving you a bird's-eye view of your farm's health and environmental conditions.

### Vegetation Health Analysis

This screen visualizes the health of your crops on a scale from 0.0 to 10.0. It provides clear definitions for Excellent, Moderate, and Poor health, along with actionable advice for each category, helping you detect crop stress early.

The screenshot shows the AlphaEarth tab with the "Vegetation Health Analysis" section selected. This section defines three categories of crop health: "Excellent (8.0-10.0)", "Moderate (5.0-7.9)", and "Poor (0.0-4.9)". Each category is described with its characteristics and a call to action. Below this, there is a section titled "How to Use This Data:" which provides guidance on monitoring trends, comparing with historical data, using for precision irrigation, and integrating with soil moisture data. Other sections visible include "Satellite Soil Moisture Assessment", "Environmental Risk Scoring", and "Understanding Confidence Scores".

### Satellite Soil Moisture Assessment

Here you can assess soil water content from space. The interface defines High, Moderate, and Low moisture levels and offers actionable insights for irrigation planning, planting windows, and yield prediction.

The screenshot shows the 'AlphaEarth Satellite Intelligence Guide' section of the software. At the top, there are tabs for 'Getting Started', 'AlphaEarth' (which is the active tab), 'Soil Analysis', 'Environmental', 'Sensor Setup', 'Webhooks', 'Dashboard', and 'Help'. Below the tabs, the title 'AlphaEarth Satellite Intelligence Guide' is displayed with a 'NEW' badge. A subtitle reads 'Understand and interpret satellite-enhanced environmental insights'. The main content area is divided into sections: 'Vegetation Health Analysis', 'Satellite Soil Moisture Assessment', 'Environmental Risk Scoring', and 'Understanding Confidence Scores'. The 'Satellite Soil Moisture Assessment' section is currently expanded, showing 'Understanding Moisture Levels' with two categories: 'High Moisture (70-100%)' and 'Low Moisture (0-30%)'. Each category has a description: 'Optimal for most crops. Risk of root diseases if sustained. Good for planting.' for High Moisture and 'Drought stress likely. Irrigation needed. Delayed planting recommended.' for Low Moisture. Below this, 'Actionable Insights:' are listed: 'Plan irrigation schedules based on moisture trends', 'Optimize planting windows for your crops', 'Predict yield potential based on moisture availability', and 'Combine with weather forecasts for precision farming'. The other sections are collapsed.

## Environmental Risk Scoring

This tool evaluates the potential environmental impact of your farming activities. It presents risk categories (Low, Medium, High) and offers a list of specific mitigation strategies you can implement to protect surrounding ecosystems, especially for high-risk areas.

## Understanding Confidence Scores

Data reliability is key. This section explains the confidence score (0-100%) associated with satellite data. It clarifies what High, Medium, and Low confidence means, helping you understand when to trust the data for precise decisions versus general trends.

## Webhooks Tab

The Webhooks section is for advanced users and developers looking to automate workflows by connecting SoilSidekick Pro to other systems.

## What Are Webhooks?

This introductory screen uses a diagram to explain the concept of webhooks as "reverse APIs" that push data to your systems in real-time, eliminating the need for constant polling.

The screenshot shows the 'Webhooks & Integrations' section of the SoilSidekick Pro dashboard. At the top, there are tabs for 'Getting Started', 'AlphaEarth', 'Soil Analysis', 'Environmental', 'Sensor Setup', 'Webhooks' (which is selected), 'Dashboard', and 'Help'. Below the tabs, a header says 'Webhooks & Integrations API' and 'Configure webhooks for real-time notifications, third-party integrations, and automated workflows'. A 'What Are Webhooks?' section is expanded, showing a diagram of a 'Traditional API Call' where 'Your system → SoilSidekick Pro' sends a message 'Give me the latest soil data'. In response, 'SoilSidekick Pro → Your system' sends a message 'Here's new soil data as it happens'. Below this, three categories are listed: 'Agricultural Events' (Soil moisture alerts, Weather warnings, Crop health changes, pH threshold violations), 'System Events' (Analysis completions, Report generations, API rate limit warnings, Data sync events), and 'Integration Events' (Third-party data updates, Equipment status changes, Market price alerts, Carbon credit updates).

## Setting Up Webhooks

A step-by-step visual guide shows the process of setting up a webhook: creating an endpoint, configuring it in the dashboard, and securing it with a signature.

The screenshot shows the 'Setting Up Webhooks' section of the dashboard. It includes a 'Step-by-Step Setup' list with five steps: 1. Create Webhook Endpoint, 2. Configure in Dashboard, 3. Select Events, 4. Test Integration, and 5. Go Live. Below this, there are sections for 'Required Endpoint Properties' (HTTPS only (SSL required), Responds with 200 status, Responds within 30 seconds, Accepts POST requests) and 'Example Endpoint Code' (Node.js Express example). The code handles a POST request to '/webhook', extracts the X-signature header, and payload body, verifies the signature, processes the event, and returns a 200 OK response if successful or 401 Unauthorized if not.

## Webhook Security & Verification

Security is paramount. This screen details the verification process, explaining the importance of using HTTPS and validating the `X-SoilSidekick-Signature` header to prevent unauthorized requests.

The screenshot shows the 'Webhooks & Integrations API' section of the application. It includes a navigation bar with tabs: Getting Started, AlphaEarth, Soil Analysis, Environmental, Sensor Setup, Webhooks (selected), Dashboard, and Help. Below the navigation is a header for 'Webhooks & Integrations API' with a sub-header: 'Configure webhooks for real-time notifications, third-party integrations, and automated workflows'. The main content area has three expandable sections: 'What Are Webhooks', 'Setting Up Webhooks', and 'Webhook Security & Verification'. The 'Webhook Security & Verification' section is currently expanded, showing 'Signature Verification' (with sample code for JavaScript verification) and 'IP Whitelisting' (listing IP ranges: 198.51.100.0/24, 203.0.113.0/24, 192.0.2.0/24). A note states: 'Note: IP ranges may change. Check dashboard for current list.' At the bottom of this section are buttons for 'Regenerate Secret' and 'Test Webhook'.

## Webhook Payloads & Event Types

This view provides examples of the data (payload) you will receive for different event types, such as a new soil analysis. It helps developers understand the data structure they need to handle.

The screenshot shows the 'Webhook Payloads & Event Types' section of the application. It includes a navigation bar with tabs: Getting Started, AlphaEarth, Soil Analysis, Environmental, Sensor Setup, Webhooks (selected), Dashboard, and Help. Below the navigation is a header for 'Webhooks & Integrations API' with a sub-header: 'Configure webhooks for real-time notifications, third-party integrations, and automated workflows'. The main content area has three expandable sections: 'What Are Webhooks', 'Setting Up Webhooks', and 'Webhook Payloads & Event Types'. The 'Webhook Payloads & Event Types' section is currently expanded, showing 'Common Payload Structure' (with a JSON example payload for a soil moisture alert), 'Agricultural Events' (listing events like 'soil.moisture.alert', 'weather.severe.warning', 'crop.health.change', and 'ph.threshold.violation'), and 'System Events' (listing events like 'analysis.completed', 'report.generated', 'api.rate.limit.warning', and 'carbon.credit.update').

## Help Tab

The Help tab is your go-to resource for resolving issues and finding answers to your questions. It's organized into several sub-sections for easy navigation.

## Data Accuracy & Reliability

This section addresses common questions about data sources, such as why satellite data might have low confidence or why EPA data might be unavailable for a specific area.

## Subscription & Usage Limits

Here you can find answers to billing-related questions, such as what actions count towards your usage limit and how to upgrade your subscription plan.

## Technical Issues

This area provides quick solutions for common technical problems, like the county lookup not working or PDF exports failing. It offers first-step troubleshooting actions you can take before contacting support.

## Contact Support

When you need further assistance, this screen provides direct links to contact the support team. It includes options to email support, schedule a call, or view the comprehensive FAQ.

## AlphaEarth Satellite Intelligence Guide

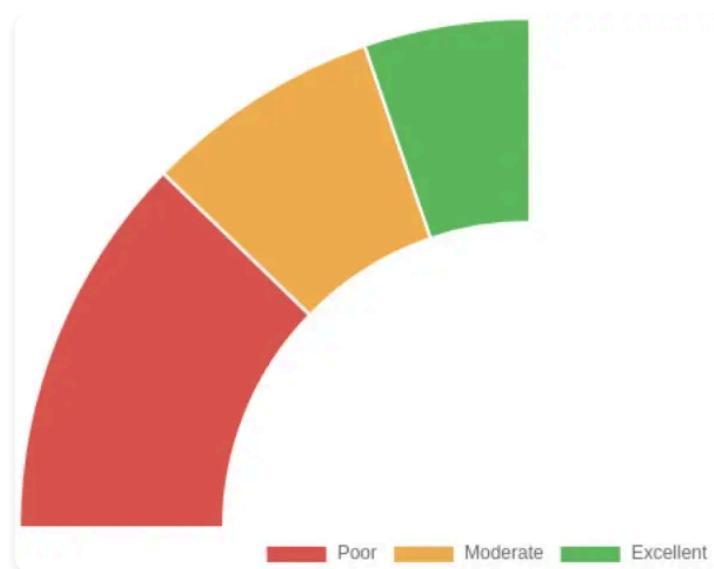
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SoilSidekick Pro integrates Google's powerful AlphaEarth Foundations AI model, which functions like a virtual satellite. It processes petabytes of Earth observation data to provide a unified, detailed view of terrestrial land and coastal waters. This allows for unprecedented analysis of your fields.

## Vegetation Health Analysis

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Vegetation health is scored on a scale of **0.0 to 10.0**, indicating chlorophyll content and photosynthetic activity. This metric helps you identify crop stress before it becomes visible to the naked eye.



- **Excellent (8.0-10.0):** High chlorophyll content, optimal photosynthesis. Crops are thriving with minimal stress indicators.
- **Moderate (5.0-7.9):** Some vegetation stress is present. Consider investigating potential issues with irrigation, fertilization, or pests.
- **Poor (0.0-4.9):** Significant vegetation stress detected. Immediate intervention is likely needed for crop recovery.

## How to Use This Data:

- Monitor trends over time to identify seasonal patterns and the impact of interventions.
- Compare current data with historical averages for your region to spot anomalies.
- Use for precision irrigation and fertilizer application, targeting resources where they are needed most.
- Integrate with soil moisture data for a complete picture of crop health.

## Satellite Soil Moisture Assessment

This assessment provides an estimate of water content in the soil, crucial for irrigation planning and yield prediction.

### Understanding Moisture Levels

- **High Moisture (70-100%):** Optimal for most crops, but be aware of potential root diseases if sustained. Ideal conditions for planting.

- **Moderate Moisture (31-69%)**: Generally adequate moisture. Monitor forecasts and crop water needs.
- **Low Moisture (0-30%)**: Drought stress is likely. Irrigation is needed. It may be best to delay planting until conditions improve.

## Actionable Insights:

- Plan irrigation schedules based on moisture trends to conserve water.
- Optimize planting windows to ensure seeds have adequate moisture for germination.
- Predict yield potential based on available moisture throughout the growing season.
- Combine with weather forecasts for highly precise farm management.

## Environmental Risk Scoring

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This score evaluates the potential for your activities, such as fertilization, to negatively impact the surrounding environment, particularly water bodies.

### Risk Categories

- **Low Risk (0-3):** Minimal environmental impact expected. Standard practices are likely sufficient.
- **Medium Risk (4-6):** Moderate precautions are needed to prevent runoff and nutrient loss.
- **High Risk (7-10):** Significant mitigation strategies are required to protect the environment.

## Mitigation Strategies for High-Risk Areas

- Use buffer strips (areas of permanent vegetation) near water bodies to filter runoff.
- Implement precision application techniques to apply fertilizers only where needed.
- Choose slow-release fertilizer formulations to reduce nutrient loss.
- Time applications based on weather forecasts, avoiding periods before heavy rain.
- Consider planting cover crops to protect and enrich the soil between growing seasons.

## Understanding Confidence Scores

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Confidence scores (0-100%) indicate the reliability of the satellite data based on factors like cloud cover, atmospheric conditions, and data quality at the time of capture.

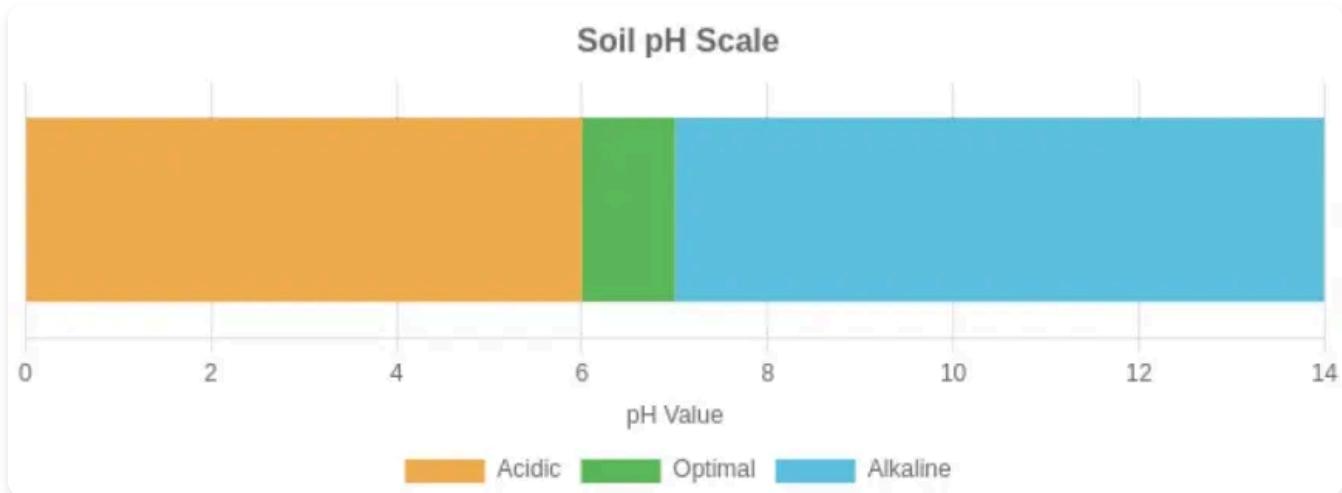
- **High (80-100%):** Clear conditions, data is highly reliable.
- **Medium (60-79%):** Some interference (e.g., light clouds, haze), data is of good quality but should be cross-referenced if possible.
- **Low (0-59%):** Significant interference (e.g., heavy clouds), data should be used with caution and is best for observing general trends rather than making precise decisions.

## Soil Analysis Interpretation Guide

Understanding your soil is the first step toward improving it. This guide helps you interpret the core components of your soil analysis report.

### pH Level Understanding & Optimization

Soil pH affects nutrient availability. Optimizing it is one of the most cost-effective ways to improve crop yield.



- **Acidic (pH < 6.0):** Key nutrients like phosphorus and molybdenum can become "locked out" and unavailable to plants. There is also a risk of aluminum toxicity in very acidic soils.  
**Action:** Apply lime 2-3 months before planting to raise the pH.
- **Optimal (pH 6.0-7.0):** The ideal range for most crops, where essential nutrients are most available.  
**Action:** Maintain with balanced fertilization and regular monitoring.
- **Alkaline (pH > 7.0):** Nutrients like iron, manganese, and phosphorus can become deficient.

**Action:** Add elemental sulfur or incorporate organic matter like peat moss to gradually lower the pH.

## Organic Matter & Soil Health

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Organic matter is the cornerstone of healthy soil, influencing its structure, water retention, and nutrient content.

### Organic Matter Benefits:

- Improves water retention and soil structure, reducing the need for irrigation.
- Provides a slow-release source of essential nutrients.
- Enhances beneficial microbial activity, which helps suppress diseases.
- Reduces erosion and compaction from heavy machinery.

### Target Levels by Crop:

- **Vegetables:** 3-5% organic matter
- **Row Crops:** 2-4% organic matter
- **Pasture:** 2-3% organic matter
- **Orchards:** 3-6% organic matter

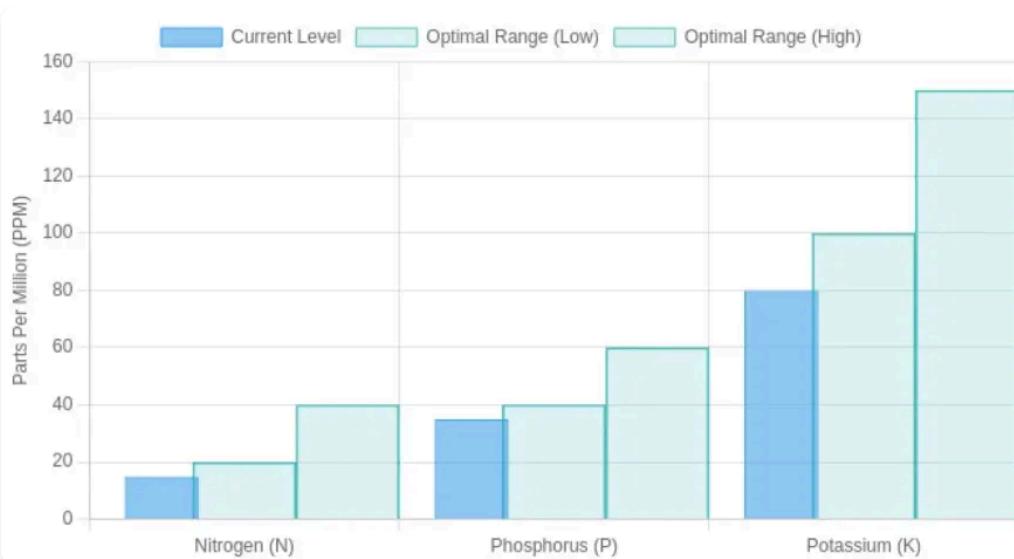
### Improvement Strategies:

- Add compost annually (a 1-2 inch layer is a good starting point).
- Plant cover crops like clover or rye between cash crop seasons.
- Reduce tillage to preserve the natural soil structure and organic matter.
- Use crop rotation, including legumes which fix nitrogen in the soil.

## Nutrient Management & Fertilizer Selection

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The three primary macronutrients are Nitrogen (N), Phosphorus (P), and Potassium (K). Your report will compare your soil's levels to the optimal range for your selected crop.



- **Nitrogen (N):** Essential for leaf growth and chlorophyll production.  
*Deficiency signs:* Yellowing of older, lower leaves and stunted growth.
- **Phosphorus (P):** Critical for root development, flowering, and energy transfer.  
*Deficiency signs:* Purplish leaves and poor root growth.
- **Potassium (K):** Important for water regulation, disease resistance, and overall plant vigor.  
*Deficiency signs:* Browning or yellowing of leaf edges and weak stems.

## Environmental Assessment Guide

This section helps you understand your farm's environmental footprint using integrated data from the Environmental Protection Agency (EPA).

### EPA Water Quality Monitoring

SoilSidekick Pro provides a simplified water quality grade based on local monitoring data.

### Understanding Water Grades

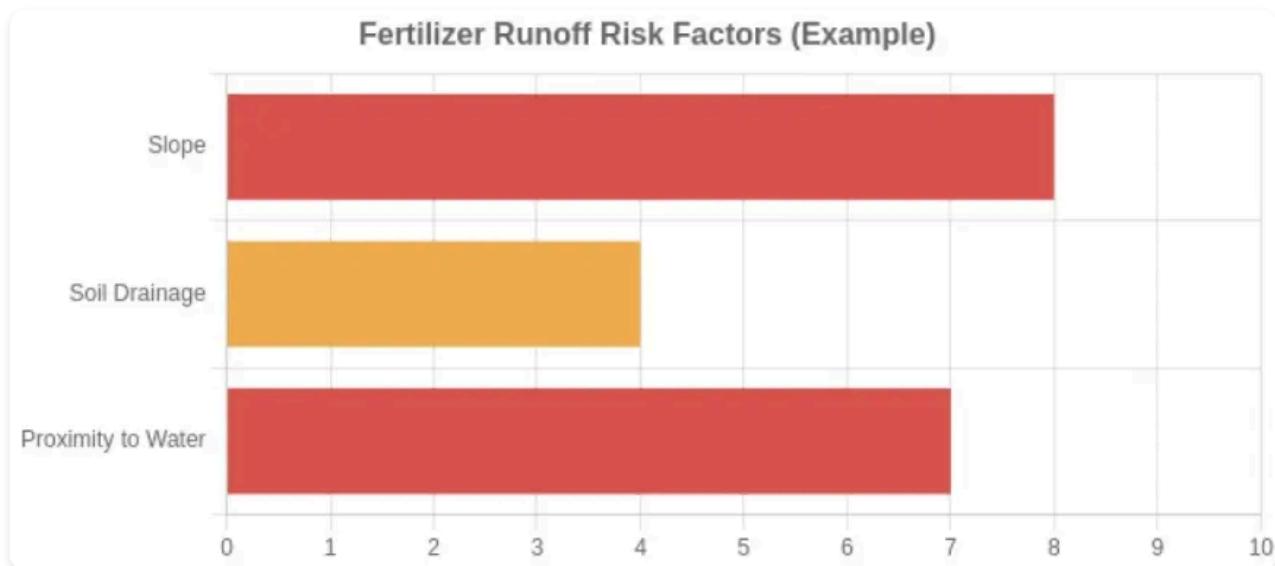
- **Grade A (Excellent):** All monitored parameters are well within EPA guidelines. Low risk to local ecosystems.
- **Grade C (Moderate):** Some parameters are approaching or slightly exceeding EPA limits. Caution is advised.
- **Grade F (Poor):** Multiple parameters are in violation of EPA guidelines. Immediate attention and mitigation are needed to prevent further environmental harm.

## Key Contaminants to Monitor:

- **Nitrate (MCL: 10 mg/L):** High levels often indicate fertilizer runoff and can be dangerous for infants if present in drinking water.
- **Phosphorus (No MCL, but a key concern):** A primary cause of algal blooms in freshwater, which depletes oxygen and harms aquatic life.

## Fertilizer Runoff Risk Assessment

This assessment combines soil type, slope, and proximity to water to estimate the risk of fertilizer runoff.



- **Low Risk:** Characterized by well-drained soils, gentle slopes (<3%), high organic matter, and significant distance (>5 miles) from water bodies.
- **Medium Risk:** Moderate drainage, moderate slopes (3-8%), average soil conditions, and closer proximity (1-5 miles) to water.
- **High Risk:** Poorly drained clay soils, steep slopes (>8%), low organic matter, and close proximity (<1 mile) to water bodies.

## Eco-Friendly Farming Practices

For areas with medium to high risk, consider these sustainable alternatives and practices.

### Sustainable Fertilizer Alternatives

- **Organic Options:**

- Compost and aged manure
  - Fish emulsion and bone meal
  - Legume cover crops (e.g., clover, vetch) naturally fix atmospheric nitrogen.
- **Slow-Release Synthetic:**
    - Polymer-coated or controlled-release granules provide nutrients over time.
    - Split application timing matches crop needs and reduces runoff potential.

## Soil Sensor Integration & Installation

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Integrate real-time data from your own field sensors for the highest level of precision. This allows you to move beyond county-level averages to hyper-local, field-specific insights.



## Compatible Soil Sensor Systems

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SoilSidekick Pro is designed to be compatible with a wide range of sensor systems that can output data via API or webhooks.

### Professional IoT Sensors

- **Davis Instruments WeatherLink:** Combines weather station data with soil moisture.
- **Onset HOBO:** Versatile multi-parameter data loggers.
- **Campbell Scientific:** Research-grade stations for maximum accuracy.
- **Sentek Drill & Drop:** Provides moisture readings at multiple soil depths.

## DIY & Arduino-Based

- **Arduino + DHT22:** For temperature and humidity monitoring.
- **Raspberry Pi + sensors:** Create custom monitoring solutions.
- **ESP32 + soil probes:** For wireless soil monitoring.
- **LoRaWAN networks:** Ideal for long-range field sensors.

## Required Sensor Capabilities:

- **API or webhook output:** Must provide real-time or near-real-time data feeds.
- **JSON/REST compatibility:** For seamless integration with SoilSidekick Pro.
- **Minimum measurements:** Soil moisture and temperature are essential. pH is optional but recommended.
- **Data logging:** 15-minute or hourly intervals are recommended for effective trend analysis.

## Physical Sensor Installation

### ⚠ Installation Safety

- Always call **811** (or your local utility locator service) before digging to locate underground utilities.
- Ensure all electrical components are in weatherproof enclosures and properly grounded.
- Install lightning protection for exposed sensors.

## Soil Sensor Placement

- **Depth:** Place sensors in the primary root zone, typically 6-12 inches deep.
- **Location:** Choose a location that is representative of the entire field, avoiding edges, low spots, or unusual soil types.
- **Density:** For large fields, a density of one sensor per 10-20 acres is recommended for accurate monitoring.

## Weather Station Setup

- **Height:** 5-6 feet (Standard weather measurement height).
- **Open area:** Ensure no obstructions within 30 feet.
- **Radiation shield:** Protect temperature/humidity sensors from direct sunlight for accurate readings.

## API Integration & Data Pipeline

Connecting your sensors is a straightforward process involving generating an API key and configuring your sensor's output.

### Integration Methods

1. **Webhook Integration (Recommended):** Configure your sensor system to send real-time data to SoilSidekick Pro endpoints as it's generated. This is the most efficient method.

```
POST /api/sensor-data
Authorization: Bearer YOUR_API_KEY
```

2. **Polling Integration:** SoilSidekick Pro pulls data from your sensor API on a scheduled basis (e.g., every 15 minutes).

```
GET /your-sensor-api/data
Content-Type: application/json
```

### Required Data Format

Your sensor system must send data in the following JSON format. Ensure all keys are present.

```
{
  "timestamp": "2025-08-18T14:30:00Z",
  "location": {
    "latitude": 40.7128,
    "longitude": -74.0060,
    "field_id": "north_field_1"
}
```

```
 },
  "soil_data": {
    "moisture_percent": 55.2,
    "temperature_c": 18.5,
    "ph": 6.8,
    "electrical_conductivity": 1.2
  },
  "weather_data": {
    "air_temperature_c": 24.1,
    "humidity_percent": 67,
    "wind_speed_mps": 3.2,
    "precipitation_mm": 0.0
  }
}
```

## Integration Steps:

- 1. Generate API Key:** Go to `Settings → API Keys` in your SoilSidekick Pro dashboard.
- 2. Configure Sensor Output:** Set your sensor system to output data in the required JSON format.
- 3. Set Endpoint:** Configure your sensor to send data to our webhook endpoint or prepare your own API for us to poll.
- 4. Test Integration:** Use our API testing tool to verify that data is flowing correctly.
- 5. Enable Live Data:** Toggle "Live Sensor Data" in your dashboard settings to see your data visualized.
- 6. Verify Charts:** Check that the Soil Health Trends charts are displaying your real-time sensor data.

## Sensor Troubleshooting & Maintenance

Regular maintenance ensures your data remains accurate and reliable.

### Common Issues

- Data Not Appearing in Dashboard:**
  - Check API key authentication and permissions.

- Verify the JSON format exactly matches the requirements.
  - Ensure timestamps are in UTC format (e.g., "2025-08-18T14:30:00Z").
  - Check network connectivity for both your sensor and our platform.
- **Inconsistent Readings:**
    - Calibrate sensors according to the manufacturer's schedule (typically quarterly).
    - Clean soil contact surfaces to remove debris.
    - Check for physical damage to sensors or cables.
    - Verify sensor placement depth is correct and in a representative location.

## Maintenance Schedule

Frequency	Tasks
Monthly	Check battery levels. Verify data transmission is consistent. Clean weather station components (e.g., rain gauge, solar panels).
Quarterly	Calibrate soil sensors (moisture, pH, EC). Check for and apply firmware updates. Check mounting hardware for stability.
Annually	Replace batteries as a preventative measure. Inspect all cables and connections for wear and tear. Update sensor calibration constants in the system if necessary.

**Professional Installation:** For large-scale operations or complex installations, we recommend working with certified agricultural technology providers to ensure optimal setup and performance.

## Local AI Processing Guide

SoilSidekick Pro integrates Google's Gemma language models for local, on-device processing. This provides powerful AI insights with complete privacy and offline functionality.

# Gemma Language Model Integration

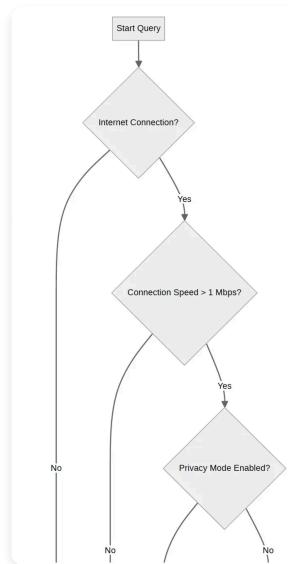
The system intelligently switches between cloud-based models and local Gemma models to provide the best experience.

## Available Models

- **Gemma 2B (Summary Model):** Optimized for quick soil analysis summaries and basic recommendations. It's fast, has low memory requirements (2-4 GB), and is ideal for mobile devices.
- **Gemma 7B (Chat Model):** Powers advanced agricultural Q&A, detailed crop guidance, and complex planning. It offers higher accuracy but requires more resources (8-16 GB RAM recommended).

## Smart Model Selection

The system automatically chooses the best model based on several conditions. You can also manually override this selection in the settings.



- **Auto-Switch Conditions:**
  - **Offline Detection:** Automatically uses local models when no internet connection is available.
  - **Slow Connection:** Switches to local processing when internet speed is below 1 Mbps.
  - **Battery Saving Mode:** Uses efficient local models to preserve device battery life.
  - **Privacy Mode:** Keeps all agricultural data on your device for maximum confidentiality.
- **Manual Controls:**

- **Auto Mode:** Let the system choose the best model automatically (default).
- **Privacy Mode:** Force all processing to stay local.
- **Battery Mode:** Optimize for power efficiency.
- **Cloud Mode:** Always use the most powerful cloud models when an internet connection is available.

## Using Local AI Features

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### Offline Soil Analysis & Chat

1. Enable local processing in `Settings → AI Processing`.
2. Allow the one-time model download (2-8 GB, depending on the model selected).
3. Generate soil analysis summaries and ask questions of the agricultural chat assistant, even without an internet connection.
4. Export reports with recommendations generated by the local AI.

### Privacy & Security Benefits

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- **Complete Data Privacy:** No sensitive agricultural data is sent to external servers when in local mode. All AI processing happens on your device.
- **Offline Capabilities:** Work in remote field locations without internet. Continue analysis during network outages and reduce mobile data usage.

### Performance Optimization

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- **WebGPU Acceleration:** Utilizes your device's GPU for significantly faster processing. This requires a modern browser like Chrome 94+ or Edge 94+. The system will automatically fall back to CPU if WebGPU is unavailable.
- **Model Caching:** Models are downloaded once and cached locally in your browser's storage for persistent use across sessions.

### System Requirements:

- A minimum of **4 GB RAM** is needed for the smaller Gemma 2B model.

- **8+ GB RAM** is recommended for the best performance with the Gemma 7B model.
- You will also need **5-10 GB** of free storage for model caching.

## Webhooks & Integrations

Automate your workflows and connect SoilSidekick Pro to your other farm management systems using webhooks and third-party integrations.

### What Are Webhooks?

Webhooks are automated messages (HTTP callbacks) sent from SoilSidekick Pro to your systems when a specific event occurs. They are often called "reverse APIs" because they push data to you in real-time, eliminating the need for you to constantly poll our servers for updates.

- **Traditional API Call:** Your system → SoilSidekick Pro ("Give me the latest soil data").
- **Webhook:** SoilSidekick Pro → Your system ("Here's new soil data as it happens").

The screenshot shows the 'Webhooks' section of the SoilSidekick Pro interface. At the top, there are tabs for 'Getting Started', 'AlphaEarth', 'Soil Analysis', 'Environmental', 'Sensor Setup', 'Webhooks' (which is highlighted), 'Dashboard', and 'Help'. Below the tabs, the title 'Webhooks & Integrations' is displayed with a small icon and an 'API' link. A sub-section titled 'What Are Webhooks?' is shown with a 'Webhook Basics' box. This box contains text explaining that webhooks are HTTP callbacks sent by SoilSidekick Pro to external systems for real-time notifications. It contrasts this with a 'Traditional API Call' where data is requested from the user's system. Below this are three colored boxes: 'Agricultural Events' (green), 'System Events' (orange), and 'Integration Events' (pink). Each box lists specific event types.

Agricultural Events	System Events	Integration Events
<ul style="list-style-type: none"> <li>• Soil moisture alerts</li> <li>• Weather warnings</li> <li>• Crop health changes</li> <li>• pH threshold violations</li> </ul>	<ul style="list-style-type: none"> <li>• Analysis completions</li> <li>• Report generations</li> <li>• API rate limit warnings</li> <li>• Data sync events</li> </ul>	<ul style="list-style-type: none"> <li>• Third-party data updates</li> <li>• Equipment status changes</li> <li>• Market price alerts</li> <li>• Carbon credit updates</li> </ul>

## Event Types

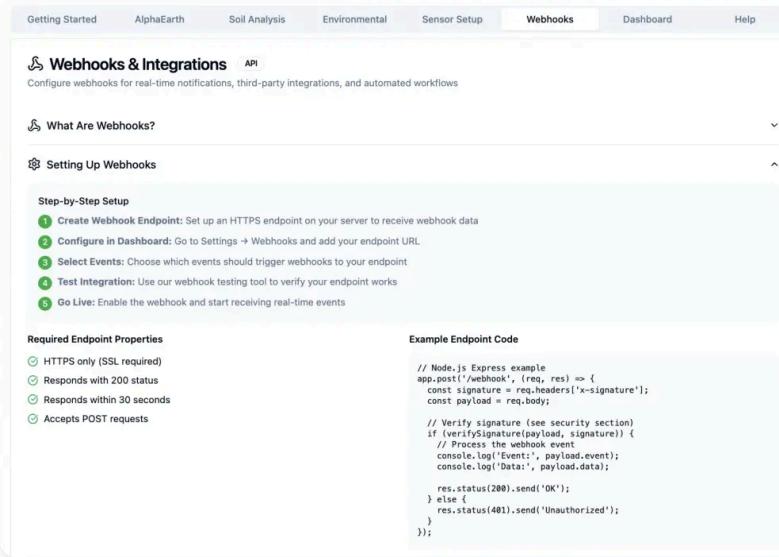
You can subscribe to various events, including:

- **Agricultural Events:** New soil analysis completed, pH level changes detected, environmental risk alerts, fertilizer recommendations updated.

- **System Events:** API quota warnings, data export completions, subscription status changes, account security alerts.
- **Sensor Events:** Live sensor data received, sensor connectivity issues, calibration reminders, battery level warnings.

## Webhook Setup

Setting up a webhook is a three-step process:



### 1. Create a Webhook Endpoint

Develop an HTTPS endpoint in your system that is capable of receiving POST requests with a JSON payload.

```
// Example Express.js endpoint
const express = require('express');
const crypto = require('crypto');
const app = express();

app.post('/webhook/soilsidetick', express.json({
  verify: (req, res, buf) => {
    req.rawBody = buf;
  }
}), (req, res) => {
  const signature = req.headers['x-soilsidetick-signature'];
  const secret = 'YOUR_WEBHOOK_SECRET';
  // Verify signature (in security section)
  if (verifySignature(signature, secret)) {
    // Process the webhook event
    console.log('Event:', req.event);
    console.log('Data:', req.data);

    res.status(200).send('OK');
  } else {
    res.status(401).send('Unauthorized');
  }
});
```

```
const hmac = crypto.createHmac('sha256', secret);
const digest = 'sha256=' +
hmac.update(req.rawBody).digest('hex');

if (!crypto.timingSafeEqual(Buffer.from(digest),
Buffer.from(signature))) {
    return res.status(401).send('Unauthorized: Invalid
Signature');
}

const payload = req.body;
console.log(`Received event: ${payload.event_type}`);
// Process the webhook data
// handleWebhookData(payload);

res.status(200).send('OK');
});

app.listen(3000, () => console.log('Webhook receiver listening on
port 3000'));
```

## 2. Configure in Dashboard

Go to `Settings → Webhooks`, add your endpoint URL, select the event types you want to subscribe to, and copy your unique secret for signature verification.

## 3. Handle Webhook Data

Write the logic in your system to process the incoming data. Always respond with a `200 OK` status code quickly to acknowledge receipt.

## Webhook Security

The screenshot shows the 'Webhooks & Integrations API' section of the software. It includes:

- Signature Verification:** A note that each webhook includes an X-Signature header containing an HMAC SHA-256 signature of the payload.
- IP Whitelisting:** A list of whitelisted IP ranges: 198.51.100.0/24, 203.0.113.0/24, and 192.0.2.0/24. A note says ranges may change.
- Webhook Secret Management:** A note that each endpoint gets a unique secret key for verification.
- JavaScript Verification Code:**

```
// JavaScript verification
const crypto = require('crypto');

function verifySignature(payload, signature, secret) {
  const expected = crypto
    .createHmac('sha256', secret)
    .update(JSON.stringify(payload))
    .digest('hex');

  return signature === `sha256:${expected}`;
}
```
- Action Buttons:** 'Regenerate Secret' and 'Test Webhook'.

- HTTPS Required:** All webhook endpoints must use HTTPS to ensure data is encrypted in transit.
- Signature Verification:** It is critical to validate the `X-SoilSidekick-Signature` header to ensure the request is authentic and from SoilSidekick Pro.
- Idempotency:** Your endpoint might receive the same event more than once. Design your logic to handle duplicate webhook deliveries gracefully.
- Timeout Handling:** Respond to webhook requests within 10 seconds to avoid our system marking it as a failure and initiating retries.

## Third-Party Integrations

Connect directly with popular platforms to streamline your data flow.

The screenshot shows the 'Webhooks & Integrations API' section with various integration examples:

- Farm Management Systems:** Integrate with John Deere Operations Center, Climate FieldView, or custom farm management platforms. Use Case: Auto-sync soil data to update field records. Events: soil.analysis.completed, moisture.alert
- Irrigation Systems:** Connect with smart irrigation controllers for automated water management. Use Case: Trigger irrigation when soil moisture drops. Events: soil.moisture.alert, weather.forecast.update
- Business Intelligence:** Feed data into Power BI, Tableau, or custom analytics dashboards. Use Case: Real-time agricultural KPI monitoring. Events: analysis.completed, carbon.credit.update
- Slack/Teams Notifications:** Send real-time agricultural alerts to your team communication channels. Use Case: Instant alerts for critical field conditions. Events: weather.severe.warning, ph.threshold.violation
- Integration Templates:** We provide ready-to-use webhook integration templates for popular platforms: Zapier Template, Power Automate, IFTTT Recipe, AWS Lambda, Google Cloud.

## Farm Management Systems

- **John Deere Operations Center:** Sync field boundaries and application maps.
- **Climate FieldView:** Import yield data and variable rate prescriptions.
- **Trimble Ag Software:** Share soil analysis data for precision farming.
- **AgLeader SMS:** Export fertilizer recommendations as prescription maps.

## Business Intelligence

- **Microsoft Power BI:** Create custom dashboards with soil data.
- **Tableau:** Build advanced analytics and trend visualizations.
- **Google Data Studio:** Generate automated reporting workflows.

## Notification Systems

- **Slack & Microsoft Teams:** Get soil alerts and share analysis reports in your team channels.
- **Email & SMS Automation:** Send weekly soil health summaries or receive critical environmental risk notifications.

## Dashboard Navigation

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The SoilSidekick Pro dashboard is designed for intuitive access to complex data. Understanding its layout is key to efficient use.



## Main Dashboard Overview

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- **Header Navigation:** Contains a quick county search, tabs to switch between major features (Soil, Water, AlphaEarth, etc.), and the user menu for account settings and billing.
- **Content Area:** The main part of the screen where analysis results, charts, satellite insights, and actionable recommendations are displayed.
- **Tool Panel:** Includes tools for exporting data to PDF, downloading raw data (CSV, JSON), and sharing reports.

## Understanding Data Visualizations

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We use a variety of charts and indicators to make complex data understandable at a glance.

- **Pie & Bar Charts:** Used to show soil composition percentages and compare nutrient levels against optimal ranges.
- **Color-Coded Badges:** Green (low), Yellow (medium), and Red (high) indicators are used for environmental risk scores and vegetation health.
- **Trend Lines:** Track changes in sensor data or satellite metrics over time, helping you visualize the impact of your interventions.
- **Time Series & Heatmaps:** Used for historical satellite data and visualizing spatial variability across a field.

## Customizing Your Experience

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Tailor the dashboard to your specific needs in the Settings menu.

- **Dashboard Preferences:** Set a default county, choose between metric and imperial units, and customize alert thresholds for environmental risks or soil moisture levels.
- **Data Filtering:** Filter results by date range, crop type, or risk level to focus on the information that matters most to you. You can also toggle between different data sources (satellite, sensor, USDA database).

## Troubleshooting & Help

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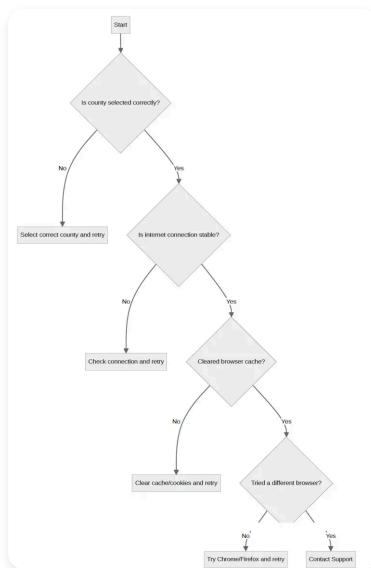
Even the best tools can sometimes present challenges. This section provides solutions to common issues and tells you how to get more help.

## Common Issues

### Analysis Not Loading

**Symptoms:** Blank results screen, a persistent loading spinner, or an error message when trying to load an analysis.

**Solutions:** Follow this troubleshooting flowchart.



1. Verify your county selection is accurate.
2. Check your internet connection stability.
3. Clear your browser cache and cookies, then restart the browser.
4. Try a different browser or an incognito/private window.
5. If using a FIPS code, ensure it is correct for the intended county.

### Incorrect Soil Data

**Symptoms:** The analysis results don't seem to match your known field conditions.

**Possible Causes & Solutions:** Remember that the default data represents county-level averages from the USDA database. For field-specific data, [integrating your own sensors](#) is the best solution. County boundaries may not perfectly align with your specific fields, and recent soil amendments will not be reflected in the annual USDA data updates.

### PDF Export Problems

**Symptoms:** The export process fails, generates an incomplete report, or has formatting issues.

### **Solutions:**

- Check your subscription tier; enhanced PDF exports are a Pro feature.
- Ensure you have completed a soil analysis first.
- Disable any pop-up blockers in your browser for our site.
- Update your browser to the latest version.

## **API Integration Issues**

**Symptoms:** Authentication failures (401/403 errors), data not syncing, or webhook delivery failures.

### **Solutions:**

- Verify your API key is current and has the correct permissions (read/write).
- Double-check your endpoint URLs and request formatting, especially the JSON structure.
- For webhooks, review your signature verification logic and ensure your endpoint is publicly accessible via HTTPS.
- Use API debugging tools like Postman to test requests outside of your application.
- Monitor your API usage limits in the dashboard.

## **Getting Additional Help**

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If you can't solve an issue, we have several support channels available.

- **Email Support:** Reach us at [help@soilsidekick.com](mailto:help@soilsidekick.com) for a response within 24-48 hours.
- **Live Chat:** Available during business hours for Pro subscribers.
- **Knowledge Base:** A searchable library of articles and tutorials at [docs.soilsidekick.com](https://docs.soilsidekick.com).
- **Community Forum:** Connect with other users to share best practices and ask questions.

## **Advanced Troubleshooting**

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### **Browser Compatibility**

- **Supported Browsers:** Chrome 94+, Firefox 90+, Safari 15+, Edge 94+.
- **Required Features:** JavaScript, cookies, and local storage must be enabled. WebGL is required for satellite imagery rendering, and WebGPU is recommended for Local AI performance.

## Network Requirements

- **Minimum Speed:** 1 Mbps for basic functionality. 5+ Mbps is recommended for a smooth experience.
- **Firewall:** Ensure your network allows connections to \*.soilsidekick.com on standard HTTP/HTTPS ports (80, 443).

## Data Accuracy & Sources

- **USDA Data:** Updated annually.
- **EPA Data:** Updated monthly, with some regional variations.
- **Satellite Data:** Refreshes every 3-7 days, depending on weather and satellite passes.
- **Sensor Data:** Real-time, accuracy depends on your hardware and calibration.

## Additional & Future Capabilities

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SoilSidekick Pro is constantly evolving. Here are some additional services we offer and a look at what's coming soon, based on information from our [official website](#).

### Advanced Farm Management

Our advanced farm management solutions are designed to help you streamline your operations and enhance your efficiency. We provide comprehensive services, including farm planning, budgeting, staff training, and performance monitoring. With the Full ADAPT Standard 1.0 API Suite, Multi-Parameter Optimization Endpoints, and real-time bidirectional sync, you can manage your farm operations effectively.

### Precision Livestock Farming

Our precision livestock farming solutions enhance farm management by allowing you to monitor your animals' health, behavior, and productivity in real-time. Utilizing advanced

technologies like sensors, automatic feeders, and cameras, we equip you with vital data to optimize your operations.

## Agricultural Research (TBA)

Our agricultural research services will provide you with the knowledge you need to innovate and succeed. We are conducting research on a range of topics, including advanced crop protection, soil carbon sequestration, and climate-resilient farming, to help you stay ahead of the curve.

## Sustainable Energy (TBA)

We are committed to developing sustainable energy solutions that help you reduce your carbon footprint and save money. We plan to offer solar, wind, and bioenergy solutions tailored to your specific needs and budget, integrated with our farm management platform.

## Appendix: Sample Reports

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The following are examples of the professional reports that can be generated by SoilSidekick Pro. Pro subscribers have access to enhanced versions with more detailed recommendations.

### Sample Soil Analysis Report

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### Sample Water Quality Report

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**SoilSidekick Pro - From Dirt To Data, Better Every Season**

Patent Pending - Application #19/320,727 & #63/861,944

This guide covers the essential features and capabilities of SoilSidekick Pro as of September 2025. For the most current information and feature updates, always refer to the in-app help system and our online documentation at [docs.soilsidekick.com](https://docs.soilsidekick.com).

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Generated on: 2025-09-15

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<https://ravenind.com/products/applications-booms/sidekick-pro-direct-injection>

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[3] Frequently Asked Questions (FAQ) - SoilSideKick Pro

<https://soilsidekickpro.com/f/frequently-asked-questions-faq>