Emlid RS4 as a Base Station for Machine Control

How Straight Up Civil replaced a $6,000/year Network RTK subscription with a single Emlid RS4, simultaneously driving three machines across two manufacturers.

Emlid RS4 base station on site at a residential subdivision, with Cat excavators working in the background

1. EXECUTIVE SUMMARY

NZD $6,000 / yr Previous annual Network RTK cost (replaced)	**NZD $8,299** RS4 one-off purchase price (Ferntech NZ)
3 Machines served simultaneously	**Under 2 years** Estimated return on investment

New Zealand civil contractor Straight Up Civil was paying approximately NZD $6,000 per year for a Network RTK subscription to drive machine control on their fleet. The subscription required modem configuration on each machine and delivered variable accuracy depending on distance to the nearest network reference station.

GeoSurvey, Emlid's local reseller in New Zealand, proposed replacing the subscription with an Emlid RS4 receiver set up as a local base station. At a residential subdivision job site, the RS4 was first run from a survey pole and easily moved around the site as the work progressed, before being given a permanent home on a shipping container once the best location was confirmed. From there it broadcasts RTK corrections over UHF radio to three machines simultaneously: two Cat excavators running Cat GRADE (Trimble-based) machine control, and a Topcon-equipped bulldozer.

The result is a one-off hardware investment that pays for itself in under two years, while delivering more accurate and more responsive corrections than the Network RTK service it replaced. The same base also supplied RTK corrections to third-party survey rovers, making it a single, brand-agnostic base for both machine control and survey work.

2. ABOUT THE CLIENT

Straight Up Civil

Straight Up Civil is a New Zealand civil contracting company operated by Mike Butcher. The company specialises in drainage and earthworks, undertaking typical civil construction projects including site preparation, stormwater and wastewater reticulation, and bulk earthmoving.

The company operates a fleet of machine-controlled plant including Cat excavators with Cat GRADE (Trimble-based) 3D grade control and a Topcon-equipped bulldozer. Accurate, reliable positioning is central to the quality of their work, particularly for drainage grades where small vertical errors can have significant consequences.

Mike Butcher, Owner, Straight Up Civil

3. THE CHALLENGE

For contractors using machine control, the conventional approach to supplying RTK corrections is to subscribe to a Network RTK (NTRIP) service. While functional, this carries a number of limitations:

- Annual subscription costs of NZD $2,000 to $6,000 per year, per supplier.
- Each machine requires its own modem and SIM configuration, adding setup complexity.
- Accuracy degrades with distance from the nearest network reference station, which can be tens of kilometres away on regional job sites.
- Cellular-dependent corrections introduce variable latency, affecting the responsiveness of automatic grade control functions.
- Proprietary base stations from Trimble, Topcon, or Leica cost upwards of NZD $30,000 as an alternative.

For Straight Up Civil, the Network RTK subscription was costing approximately NZD $6,000 per year. With multiple machines running machine control, the per-machine modem setup was an added burden, and the cost was an ongoing overhead the business was keen to eliminate.

4. THE SOLUTION

Equipment

GeoSurvey supplied an Emlid RS4 all-band RTK GNSS receiver, sourced through Ferntech, an authorised Emlid dealer in New Zealand. The RS4 was configured as a fixed base station, broadcasting RTK corrections in RTCM3 format over its built-in UHF radio.

RS4 on site at a residential subdivision

Cat excavator on site with RS4 base visible in background

Physical Setup

When the RS4 was first deployed it was mounted on a survey pole and moved around the site as needed, with its position quickly re-established in Emlid Flow each time it was relocated. This made it simple to trial different positions until the best spot was found. Once that location was confirmed, the RS4 was given a permanent home mounted at height on a shipping container, secured to a standard 5/8-inch threaded mount. The RS4's quick-release system means the unit is removed at the end of each day, taken inside to charge overnight, and clipped back onto the mount the following morning. Once reattached, corrections resume immediately with no additional configuration required by the site team. This flexibility gives contractors two equally workable options: a fixed, semi-permanent base on a structure such as a container, or a movable base that can be set up wherever suits the day's work.

Base Position Configuration

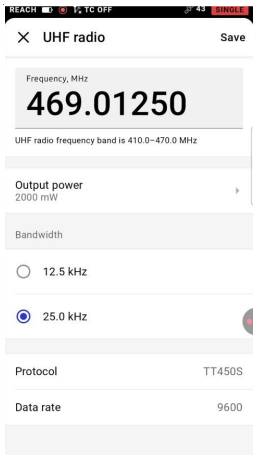
A critical configuration step that is not widely documented was discovered during commissioning: after completing the position average, the Coordinates entry method in Emlid Flow must be switched to Manual mode before saving. Without this, the receiver recalculates the base position from scratch on every restart, shifting all machine positions relative to the design model.

Correct Base Position Procedure

1. Connect the RS4 to a correction input and wait for a fixed RTK solution.
2. Average the base position while in Fix.
3. Once averaging is complete and coordinates appear, switch Coordinates entry method to Manual.
4. The app automatically fills in the averaged coordinates. Save.
5. The receiver will now retain these coordinates across all subsequent reboots.

Radio Configuration

RTK corrections are broadcast over the RS4's built-in UHF radio. A critical finding from commissioning was that a shared, free-to-air UHF frequency caused frequent interruptions to the correction stream. Switching to a dedicated licensed frequency resolved this entirely. Anyone replicating this setup should arrange a licensed frequency through their local spectrum management authority before going to site. The annual fee is minimal and the RS4 can operate on any frequency in the 410-470 MHz band.



Emlid Flow UHF

UHF Radio Settings

Frequency: 469.01250 MHz (free example, not to be used)

Output power: 2,000 mW (2W maximum)
Bandwidth: 25.0 kHz
Protocol: TT450S (TRIMTALK)
Data rate: 9,600 bit/s

Machine Control Integration

The RS4 simultaneously serves three machines on the same UHF frequency and correction stream:

- Two Cat excavators running Cat GRADE (Trimble-based) 3D machine control.
- One Topcon-equipped bulldozer.

Cross-brand compatibility was confirmed without any additional hardware. One non-obvious configuration step was required on the Cat GRADE side: the radio region setting on the machine must be changed from the default 'Rest of World' to 'Europe'. Without this change, corrections were unreliable. Once set to 'Europe', both Cat GRADE systems connected cleanly and held a consistent fix.

Cat GRADE display showing 0.54m fill readings, consistent across all three bucket positions — confirming stable correction lock

Survey Rover Compatibility

The RS4's value as a base is not limited to machine control. On the same site, GeoSurvey used it to supply RTK corrections to two third-party survey rovers, a SinoGNSS unit and a Leica unit, to validate the base for the GNSS survey work the company runs on its other projects.

Both rovers connected to the RS4 and worked from its standard RTCM3 corrections, with no proprietary base infrastructure required. This confirms the RS4 as a single, brand-agnostic base: one receiver that can serve Cat and Topcon machine control alongside SinoGNSS, Leica, and Emlid survey rovers.

5. RESULTS

Cost Savings

The most immediate result is the elimination of the annual Network RTK subscription. At NZD $6,000 per year, the RS4's NZD $8,299 purchase price is recovered in under two years, after which corrections are effectively free for the remaining life of the hardware.

The comparison becomes even more compelling across a fleet. A Network RTK subscription typically covers a single modem; running three machine-controlled machines could require three subscriptions at NZD $18,000 or more per year. The RS4 serves all three machines simultaneously with no per-machine subscription cost.

Accuracy

With the RS4 positioned approximately 300 metres from the working machines, the correction baseline is extremely short. Such a short baseline typically provides the greatest results. Multiple independent check shots confirmed that variation was minimal and consistently better than the Network RTK service had achieved.

Speed and Responsiveness

UHF radio corrections are delivered with negligible latency compared to NTRIP over cellular. Site operators noted that the automatic grade control functions responded faster and more smoothly than they had with the Network RTK subscription.

RS4 base station (foreground) with Cat excavator at work on site

Operational Simplicity

Once the base position is saved in Manual mode, the system requires no operator interaction. The machines start up, find corrections on the licensed frequency, and achieve fix without any intervention from the site team. The daily routine is simply: clip the RS4 onto its mount in the morning, remove and charge it at the end of the day.

6. CLIENT QUOTES

> *"It was very fast. The automatic levelling functions of the machine control worked much better than NTRIP because the radio was giving corrections instantly."*
>
> **— Wayne, Machine Operator, Straight Up Civil**

> *"It should cost more for what it can do. Pretty soon everyone is going to have one once the word gets out."*
>
> **— Mike Butcher, Owner, Straight Up Civil**

7. KEY TAKEAWAYS

- The Emlid RS4 is compatible with both Cat GRADE (Trimble) and Topcon machine control systems over UHF radio using the TT450S (TRIMTALK) protocol.
- A single RS4 can serve multiple machines from different manufacturers simultaneously, with no per-machine subscription or licensing cost.
- The RS4 also works as a base for third-party survey rovers: SinoGNSS and Leica units both ran off its corrections, so one base can cover machine control and GNSS survey work across brands.
- A dedicated, licensed UHF frequency is essential. Shared free-to-air frequencies cause intermittent correction loss on busy construction sites. Contact your local spectrum management authority for a land mobile simplex licence.
- Cat GRADE users must change the radio region setting on the machine from 'Rest of World' to 'Europe' for reliable correction reception.
- After averaging base position, always switch Coordinates entry method to Manual in Emlid Flow and save, to retain the position across reboots.
- A local base station at short range consistently outperforms Network RTK for both accuracy and correction latency.
- At NZD $8,299 versus NZD $6,000+ per year in subscriptions, the RS4 pays for itself in under two years.
- The RS4 works equally well as a fixed base on a structure such as a shipping container or as a movable base repositioned around site. The base location is quick to update in Emlid Flow, so contractors can choose a permanent installation or a movable day-to-day setup to suit the job.

Interested in an RS4 base for your own machines or survey rovers?

Ferntech (ferntech.co.nz), the authorised Emlid distributor in New Zealand, can supply the RS4. GeoSurvey (geosurvey.co.nz) can help with base station setup, configuration and integration with your survey or machine control workflow.