# *Mull 2007 APRS report*

*Prepared by Jim Andrews, G1HUL*

## To start off…

*Without a doubt, 2007 was the most successful Tour of Mull APRS provision!*

In the seven years RAYNET has been providing APRS services to the event, both the equipment and our understanding of APRS have come on in leaps and bounds, with a number of step-changes along the way.

The event is a huge team effort getting everything sorted, rigged, looked after and retrieved again - A big THANK YOU to the Team!!!

Many of you haven't been in Control during the rally to see how much it is really used and appreciated by both the Police and the 2300 club. For most of the rally, they rely entirely on the APRS information to know how the event is progressing, making minute-by-minute decisions. The quality of information provided this year made their job that bit easier.

During the extraction from stage 15, control was able to give the stage start accurate details on the convoy progress, which helped both the marshals and the Police manage its passage more effectively.

### *So what was different?*

In short, quite a lot of things!

#### Tracker Units

All trackers are now OpenTrackers, instead of TinyTrak's.

- Significantly better RF-proofing
- Precise beacon transmit control (time-slotting)

Time-slotting gives us the ability to control exactly when they transmit (synchronised by the GPS clock), thus eliminating collisions with each mobile having its own 5 second slot.

#### Intelligent pathing

The Digipeaters were configured to pass information towards control, but if a mobile beaconed close to control, it was not passed outwards. This significantly reduced the amount of RF flying around the island and, therefore, the chances of collisions.

Beacons were also set to travel a maximum of 2 hops, as no position on the island needs more than this to reach control.

#### iGates

Some areas of the island (Loch Scridain, Glen More and Tobermory sea font) relied on the Internet to get the beacon traffic to control, rather than radio paths that are known to be less than reliable.

### *Downside of the changes*

#### Monitoring

The system cannot now be monitored by radio to get the full picture, as a significant amount of traffic is passed on the Internet and the reduction in Digipeater hops means beacons don't travel as far.

#### Internet

Use of the Internet is always a danger, as there are (many!) things that are out of our control, however the Digipeaters can be reconfigured remotely to give a greater RF service, albeit with a reduced integrity of the information received.

## Digipeaters

### *Overall coverage*

Road coverage was 100%.

A couple of changes were made this year.

- Infill just East of Bunessan, for Friday night.
- Infill for Tobermory seafront.
- Slight position adjustment at Dervaig.

### *Dervaig*

Was deliberately placed on the lower (closer to the road) hillock to see what the coverage was going to be like. Much the same as before, but the path to control was weaker.

If Lettermore is to be dropped, and no in-fill iGate is placed in Dervaig, this must return to the upper hillock to ensure the path to Control.

**Action for 2008**

Confirm that current arrangements for rig / switch-on / retrieval are still acceptable as, along with Ensay, these are very time and hill-walking intensive.

Consider if rig + switch-on can be done in one visit to save time.

### *Lettermore*

No signal to control, so no idea what it was able to hear this year!

### *Dhiseig*

As ever, a superb location!

Concern has been expressed (internal to the team) about this being next to a footpath and unfenced.

**Action for 2008**

Consider the need for fencing.

### *Ensay*

Stunning coverage over a large part of the island, in line with 2006.

**Action for 2008**

Confirm that current arrangements for rig / switch-on / retrieval are still acceptable as, along with Dervaig, these are very time and hill-walking intensive.

Consider if rig + switch-on can be done in one visit to save time.

### *Duart*

Coverage much as before.

### *Bunessan*

New location to provide infill for the Ardtun stage, feeding data to the Kinloch iGate.

Proved to be very successful and just “did its job”!

### *Direct reception at control*

Coverage was good, with interesting cover into Glen Aros, yet signals to the wooded areas in that area were poor. RF can be a funny thing!

## Issues arising from the 2007 event

Specific problems were experienced as follows:

- No path from Lettermore or Duart, to Salen
- TX digi volt drop
- Incorrect battery voltage reporting
- Equipment vandalism in Tobermory

### *Lettermore path problems*

Very early on, it became apparent that no signals were being received from Lettermore, nor could management contact be made with the TNC.

Considering equipment failure, a replacement TNC was programmed and the complete kit changed, save for the aerial and feeder, but the latter were thoroughly checked.

No fault was found with the equipment and it was locally observed (and heard via a scanner) to be functioning correctly, yet nothing was received at control.

Signals to the MSA link station in the South end of Glen Aros (also woodland-based) were very poor and fluctuating, at times almost non-existent. The aerial system at control was checked (MSA as well as 4m) and found to be in working order.

When the replacement radio was installed, the frequency was left incorrectly set (400 instead of 350). This was corrected after the mistake was realised late Friday evening.

**Conclusion**

Radio conditions were such that a very poor path existed into the woodland areas of the lower Glen Aros area. There has been significant tree growth in the area, which may have contributed to the problem.

Confusion still exists over where the digi is to be positioned, with it initially being placed lower than normal, then moved to a different lay-by to see if it made any difference.

**Action for 2008**

Consider if we need Lettermore at all, as coverage in Glen Aros was solid. One option is to install but not switch on, instead watching coverage early on the Friday evening. If it is installed, ensure it's in the correct location and give the mast some extra height.

Make sure everyone knows what frequency we are using and publish it on the paperwork!

### *Duart path problems*

When analysing the logs after the event, it was found that no RF beacons were received from Duart, with everything being routed via the Isle of Mull Hotel iGate.

The path from Duart to Salen is known to be poor, with many beacons historically going via Lettermore before being received at control. With the intelligent pathing the Lettermore route will not now work, unless the amount of RF is increased again.

*Installation of the radio at the IoM Hotel was last-minute and just an experiment to see what it could hear. It turned out to be the savour of coverage for the entire south east area!*

**Action for 2008**

Formalise arrangements for the iGate at the Isle of Mull Hotel, possibly with an external aerial.

### *Incorrect battery voltage reporting*

Ensay and Dervaig consistently reported very low battery voltages (0.28v and 2.53v respectively) which were clearly wrong.

In testing after the event, the monitoring leads were showing the correct voltage at the TNC. Further investigation is required to establish the reason for the erroneous readings as it appears to be a TNC issue.

### *Digipeater TX volt drop*

The Digipeaters that did correctly report their voltage occasionally exhibited a large voltage drop (up to 1v), believed to be the reading whilst the equipment was in transmit.

On checking the power leads it has been found that the master switches used in the cases have a drop of between 0.6 and 1v when under a small load (2A). Considering these are 10A rated devices, it's somewhat poor!

**Action for 2008**

The switches have already been removed from the cases!!

### *Equipment vandalism in Tobermory*

Some time on Saturday morning, the mast outside the Masonic Hall was vandalised by kids, leaving the equipment strewn around the garden area. Fortunately no equipment was actually damaged.

The mast was temporarily re-erected by the results staff at the Hall, who also got a message to us about the damage.

After an assessment by MM0AZQ, it was decided to move the aerials inside the building and experiment with coverage from there, as the station was only intended as an infill for Tobermory seafront.

**Conclusion**

Although there is a noticeable drop-off in the wider reception range, the aerials achieved their purpose from inside the building, with no further vandalism problems.

It had been possible to put the aerials inside, as the windows had been replaced with new uPVC double-glazed units, as opposed to the older "church window" leaded type shown on a 1999 photograph we had used as the "survey" for rigging purposes.

**Action for 2008**

Put the aerials inside the hall windows.

### *Equipment security*

Sometime during the Sunday morning daylight hours, Strathclyde had a talkthrough stolen from the picnic site (just south of Tobermory). Only the radio was taken; case, mast and all other bits were left.

This is probably the most public of the radio locations, as no where else can you just drive past the site and see the equipment in full view.

**Action for 2008**

Although our equipment is in more obscure and off-road locations, or inside buildings, we need to consider what, if any, security measures ought to be taken.

## ADSL provision

ADSL lines were utilised at four locations and, once set up, proved to be 100% reliable.

### *Salen Hotel*

Complete confusion reigned over this!

In 2006 the rally had exclusive use of an ADSL line. Although I was not aware of the arrangements, we were able to use the line from Friday morning right through to Sunday with no interruptions.

This year, all we were able to establish was that it must have been shared with Gerry (hotel owner) and he didn't remember giving anyone the login details last year.

This meant we didn't have use of the line until late Friday afternoon (ideally needed it from Thursday morning) and had to give it up at various points so he could check e-mail etc.

Once this had been sorted, the router supplied by Strathclyde did the job and we were able to quickly establish the APRS server for the other iGates to connect to.

**Action for 2008**

Approach the 2300 club for short-term ADSL provision on the hotel payphone number. The club are now also relying heavily on this for both results and web progress updates so would benefit them as well.

### *Kinloch Hotel*

Charles was, as ever, very helpful in providing the ADSL line for our use.

An issue arose with the phone extension he was using to move the line into the downstairs lounge causing the ADSL connection to fail, however this was overcome by providing a long Cat5 cable instead and leaving the router in the upstairs office.

**Action for 2008**

Kenny, GM1MMK is investigating a permanent aerial at the Hotel, plus network cabling to a couple of locations in the building.

We should still plan for the same as 2007, with any new installation being a bonus.

### *Masonic Hall, Tobermory*

Line was arranged by and for the 2300 club results team (via Graham Marshal) which we were able to connect to, and provided a solid service.

**Action for 2008**

The Masonic Hall was a new location for the results service, so need to ensure it will be there again next year, or make other arrangements as appropriate.

### *Isle of Mull Hotel*

After the Wireless dropout problems in 2006, we planned a few options involving putting our own wired network on the back of their WiFi.

On the day the new manager was more than helpful, allowing us to pretty much do what we wanted with their system (including plugging directly into the switch, had we needed to!).

A convenient wired connection was found in the (now unused) downstairs office and this provided us with a 100% reliable connection with which to run the iGate and D-Star kit.

**Action for 2008**

Ensure we have sufficient cable to run from the office.

## Log analysis

### *History*

Looking back through the logs since 2001 when we were playing with APRS for the first time, three major changes stand out as making the biggest improvements in the reliability of information received at control.

- 2002 – Decent aerial at control
- 2005 – Duplicate packet issue resolved
- 2007 – Time slotting, intelligent digi pathing & iGates

In addition, the 2004 Digipeater location changes made a big improvement in coverage in the Loch Scridain and Calgary / Torloisk areas, although overall loss remained consistent.

### *Percentage of beacons lost*

**2001 55%**
First trial, control RX relied on local (small-masted) digi

**2002 32.4%**
Good aerial at control, more digi's using TNC's, better system configuration

**2003 30.5%**
Switch to Ascoms

**2004 31.1%**
Killiemore moved to Pennycross, Ensay moved to top of the hill

**2005 23.9%**
Duplicate packet issue resolved

**2006 28.9%**

**2007 4.8%**
Time slotting, intelligent digi pathing + iGate usage to reduce RF

Yes, the figure for 2007 is correct, less than 1 in 20 beacons were lost!!!

Full analysis of the beacon loss is in Appendix A

## Battery power usage

Detailed below is the power usage for all digi sites for 2006 and 2007.

Prior to 2007 the capacity was checked using a simple voltage switch-off timer, the 2007 readings us the West Mountain Computerised Battery Analyser. The higher 2007 figures are assumed to be an inaccuracy in previous measurements.

| ***Site*** | ***2006*** | ***2007*** | |
|---|---|---|---|
| Ensay | 26 Ah | 32 Ah | |
| Dhiseig | 33 Ah | 46 Ah | |
| Bunessan | | 5 Ah | New digi for 2007 |
| Lettermore | 19 Ah | 47 Ah | |
| Duart | 24 Ah | 41 Ah | |
| Dervaig | 26 Ah | 30 Ah | |
| Pennycross | 50 Ah | | No longer used. Higher usage due to Thursday switch-on |

## APRS "Service" and remote internet connections

### *Service*

The reliability of the equipment meant that the service teams were not called upon this year, with their presence being called into question by the 2300 club (on the basis of them being an amateur resource that could be used elsewhere).

The raising of this as an issue was rather disingenuous, considering there have been past (and repeated) calls for all voice talkthrough units to be manned and far more "attendance" of equipment in case of failures.

If anything does fail, the rally organisers will be the first ones to criticise the loss of information, so although not a busy duty, it is very important!

**Action for 2008**

Ensure these duties are covered, with consideration of any dual-function they may be able to perform for the voice net.

### *Data links*

We were loaned two pairs of 23cm D-Star radios, which were used for wireless internet connections at the service points in Craignure and Tobermory. This enabled the "APRS service crew" to monitor the entire system.

These links proved very successful and the recommendation is we continue with this arrangement for 2008.

Strathclyde have kindly loaned the equipment to us over the winter (four ID-1's and an ID-RP2D 23cm data repeater) so we can get up to speed with its capabilities.

## Manning

### *Setup phase*

We had 10 people involved in setting up, which due to the geography and scattered nature of the installations is about right.

### *Rally phase*

Apart from service cover, control monitoring and checking the Kinloch iGate on Friday evening (not planned for 2008), no other APRS duties exist as there is little we can do during the rally.

This potential resource has been mentioned by the 2300 club, who understandably want best value for money from those attending, without asking too much. The voice net was short of operators in 2007, so the question was not unreasonable.

Unfortunately there was an administrative problem with the main operator lists and a couple of the ARPS team were allocated voice net tasks without first checking they were available (which they weren't) and if they were happy to do the duty, having never operated voice on Mull before.

**Action for 2008**

Establish if there will be a formal request for voice net operators in 2008 and pass this on to the team, leaving members to make their own decision.

### *Strip-out phase*

Some initial co-ordination was done on Sunday morning and all the equipment was recovered within the day.

## Recommendations / Actions / Suggestions for 2008

### *Digipeater locations*

Coverage is about as good as it will get, so no plans to move any of the digi's save for Dervaig possibly returning to the upper hillock.

### *iGates*

The position of the iGates is about right for "listening" coverage.

Some packet loss was experienced in the Dervaig area and this could benefit from an additional iGate, which would also mean even less RF traffic as the Dervaig digi would become a single-hop unit.

**Action for 2008**

Investigate possible locations in Dervaig and make arrangements for installation.

### *Bunessan digi*

**Action for 2008**

Formalise arrangements with the landowner.

### *Extension of tracking to other Doctor, Rescue and Recovery vehicles*

A couple of recovery Units (Saltire 3 and Shire) and Dr. Shippey have indicated they wish to be tracked next year. In addition there are other units who are Amateur licensed and, if approached may be interested in being "on the map".

**Action for 2008**

We need to contact all rescue and recovery units to establish exact numbers and ensure we have sufficient equipment.

This will rely on commitment from the crews in terms of provision of some equipment (aerial and GPS) and to a guaranteed standard.

The new time slotting system allows for expansion without impacting on the update rate of the course cars, with each new vehicle adding 35 seconds to the support vehicle cycle.

### *Isle of Mull Hotel*

**Action for 2008**

Outside aerial for the iGate.

Depending on where this is positioned, two laptops may be required to maintain the lounge display as well.

### *Replacement radios*

Investigate the Motorola MC-Micro's as a replacement for the Ascom sets.

The Ascoms can be quirky and are proving to be rather unreliable. Of the 36 sets available to us, 12 have faults. There are also a few more unmodified ones that could be pressed into service if needed. Whilst the numbers are not a problem at present levels, any increase in vehicles tracked will leave us with few spares.

The MC-Micro's have been donated (removed from a working PBR scheme) and are single channel E-band (68-88MHz) units. We have about 40 sets which, if they work satisfactorily, will enable us to replace all Ascoms.

### *System monitoring / Use by others*

Now the data is available on the Internet, it is possible for anyone with an internet connection to monitor the vehicle positions. This can be done simply in the field with a GPRS connection from a mobile phone and a laptop running UI-View.

**Action for 2008**

Investigation should be carried out as to the feasibility of making this information available for, particularly, MSA radio controls to utilise.

### *Internal team communications*

Concern has been expressed about the reliance on mobile phones for team communications and a suggestion that we ought to be making more use of radio.

**Actions for 2008**

Phone coverage is good and is probably the best method of contact over a wider area, but we should all listen to a common channel, be it 2m or 6m, plus the appropriate main voice net frequency for the area.

Team phone numbers to be given out at the start of the weekend, not when most stuff has already been rigged…!

### *Digipeater test equipment*

The problems at Lettermore highlighted how difficult it is to actually know if the system is working or not, without having a complete packet station in the car.

Digipeaters can actually be monitored locally via the TNC serial port and, whilst it won't conclusively prove the radio side is OK, at least it will give a good indication.

**Action for 2008**

Look at serial connections for PDA's to use as a quick-connect monitor.

Ensure anyone with a laptop has an appropriate serial lead.

## Appendix A

# *Tour of Mull APRS Beacon Analysis*

### *Lost beacons - 2007*

| *35 Second rate* | | *Expected* | *Lost* | | | |
|---|---|---|---|---|---|---|
| GM0RAY | (Car 00) | 2443 | 132 | 5% | | |
| GM4SRL | (Chief Safety) | 2657 | 77 | 3% | | |
| GM6LEZ | (Chief Marshal) | 3493 | 140 | 4% | | |
| GM7GXI | (Stage Setup) | 2494 | 148 | 6% | | |
| GM7NOA | (Road Closing) | 2589 | 91 | 4% | | |
| MM3MGX | (Road Opening) | 3664 | 252 | 7% | Average loss: | **4.8%** |

| *175 Second rate* | | *Expected* | *Lost* | | | |
|---|---|---|---|---|---|---|
| GM1LTK | (Earl Recovery) | 507 | 16 | 3% | | |
| MM0PFR | (Piper 1 Recovery) | 415 | 11 | 3% | | |
| MM1CMV | (Castle Recovery) | 594 | 32 | 5% | | |
| MM1ECR | (Stoke Rescue) | 450 | 79 | 18% | | |
| MM3AWC | (Dr. Harrington) | 550 | 18 | 3% | Average loss: | **6.4%** |

### *Lost beacons - 2006*

| *30 Second rate* | | *Expected* | *Lost* | | | |
|---|---|---|---|---|---|---|
| GM0RAY | (Car 00) | 2052 | 729 | 36% | | |
| GM4SRL | (Chief Safety) | 3276 | 872 | 27% | | |
| GM6LEZ | (Chief Marshal) | 3019 | 814 | 27% | | |
| GM7GXI | (Stage Setup) | 3184 | 959 | 30% | | |
| GM7NOA | (Road Closing) | 1452 | 411 | 28% | | |
| MM3MGX | (Road Opening) | 3313 | 859 | 26% | Average loss: | **28.9%** |

| *300 Second rate* | | *Expected* | *Lost* | | | |
|---|---|---|---|---|---|---|
| GM1LTK | (Earl Recovery) | 221 | 58 | 26% | | |
| MM1CMV | (Castle Recovery) | 278 | 67 | 24% | | |
| MM1ECR | (Stoke Rescue) | 126 | 39 | 31% | | |
| MM3AWC | (Dr. Harrington) | 211 | 59 | 28% | Average loss: | **27.3%** |

### *Lost beacons - 2005*

| *30 Second rate* | | *Expected* | *Lost* | | | |
|---|---|---|---|---|---|---|
| GM0AGR | (Clerk of Course) | 1870 | 442 | 24% | | |
| GM0RAY | (Car 00) | 1382 | 429 | 31% | | |
| GM4SRL | (Chief Safety) | 2796 | 750 | 27% | | |
| GM6LEZ | (Chief Marshal) | 2506 | 453 | 18% | | |
| GM7GXI | (Safety) | 2424 | 894 | 37% | | |
| GM7NOA | (Road Closing) | 2242 | 566 | 25% | | |
| MM3MGX | (Road Opening) | 2282 | 331 | 15% | | |
| MM1ECR | (Stoke Rescue) | 1723 | 256 | 15% | Average loss: | **23.9%** |

| *300 Second rate* | | *Expected* | *Lost* | | |
|---|---|---|---|---|---|
| GM1LTK | (Earl Recovery) | 215 | 48 | 22% | |
| MM1CMV | (Castle Recovery) | 148 | 18 | 12% | Average loss: **17.2%** |

## *Lost beacons - 2004*

| *30 Second rate* | | *Expected* | *Lost* | | |
|---|---|---|---|---|---|
| GM0RAY | (Car 00) | 1344 | 413 | 31% | |
| GM1LTK | (Earl Recovery) | 3667 | 1089 | 30% | |
| GM4SRL | (Safety Officer) | 3380 | 1184 | 35% | |
| GM6LEZ | (Chief Marshal) | 2567 | 907 | 35% | |
| GM7GXI | (Dr. Cowan) | 3171 | 2175 | 69% | |
| MM1ECR | (Stoke Rescue) | 3021 | 446 | 15% | |
| MM3AWC | (Dr. Harrington) | 3316 | 703 | 21% | |
| MM3FOR | (Forest Recovery) | 2337 | 596 | 26% | |
| MM3MGX | (Road Opening) | 4248 | 819 | 19% | Average loss: **31.1%** |

## *Lost beacons - 2003*

| *30 Second rate* | | *Expected* | *Lost* | | |
|---|---|---|---|---|---|
| GM1LTK | (Earl Recovery) | 2316 | 779 | 34% | |
| GM1PST | (Road Opening) | 1348 | 282 | 21% | |
| GM4SRL | (Safety Officer) | 2315 | 775 | 33% | |
| GM6LEZ | (Chief Marshal) | 2666 | 681 | 26% | |
| GM7GXI | (Dr. Cowan) | 2405 | 982 | 41% | |
| GM7NOA | (Road Closing) | 1864 | 814 | 44% | |
| MM1CMV | (Castle Recovery) | 2650 | 405 | 15% | Average loss: **30.5%** |

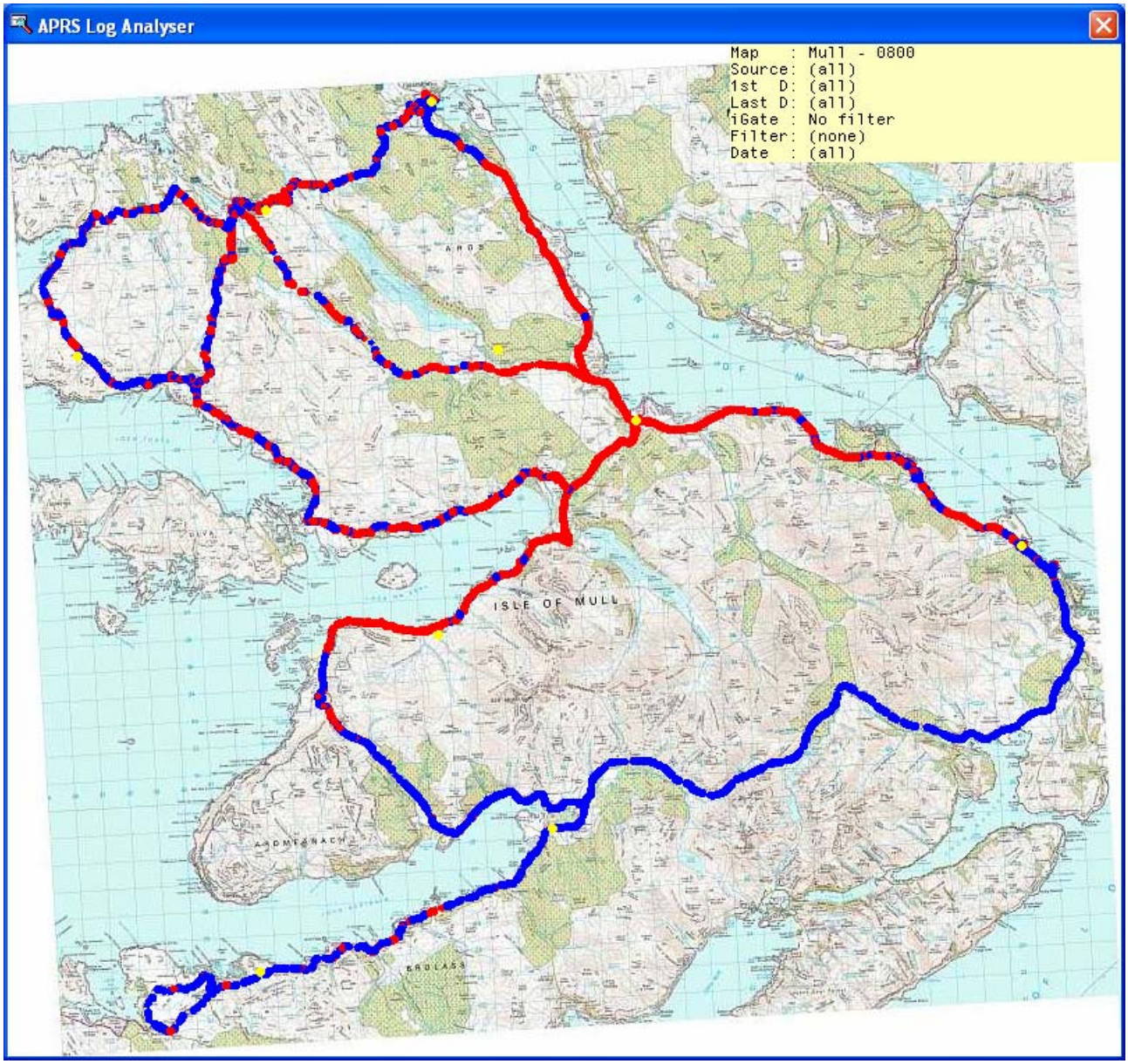
## *Lost beacons - 2002*

| *30 Second rate* | | *Expected* | *Lost* | | |
|---|---|---|---|---|---|
| GM1PST | (Road Opening) | 719 | 198 | 28% | |
| GM4SRL | (Safety Officer) | 1483 | 496 | 33% | |
| GM6LEZ | (Chief Marshal) | 1709 | 508 | 30% | |
| GM7GXI | (Dr. Cowan) | 659 | 356 | 54% | |
| GM7NOA | (Road Closing) | 1983 | 342 | 17% | Average loss: **32.4%** |

## *Lost beacons - 2001*

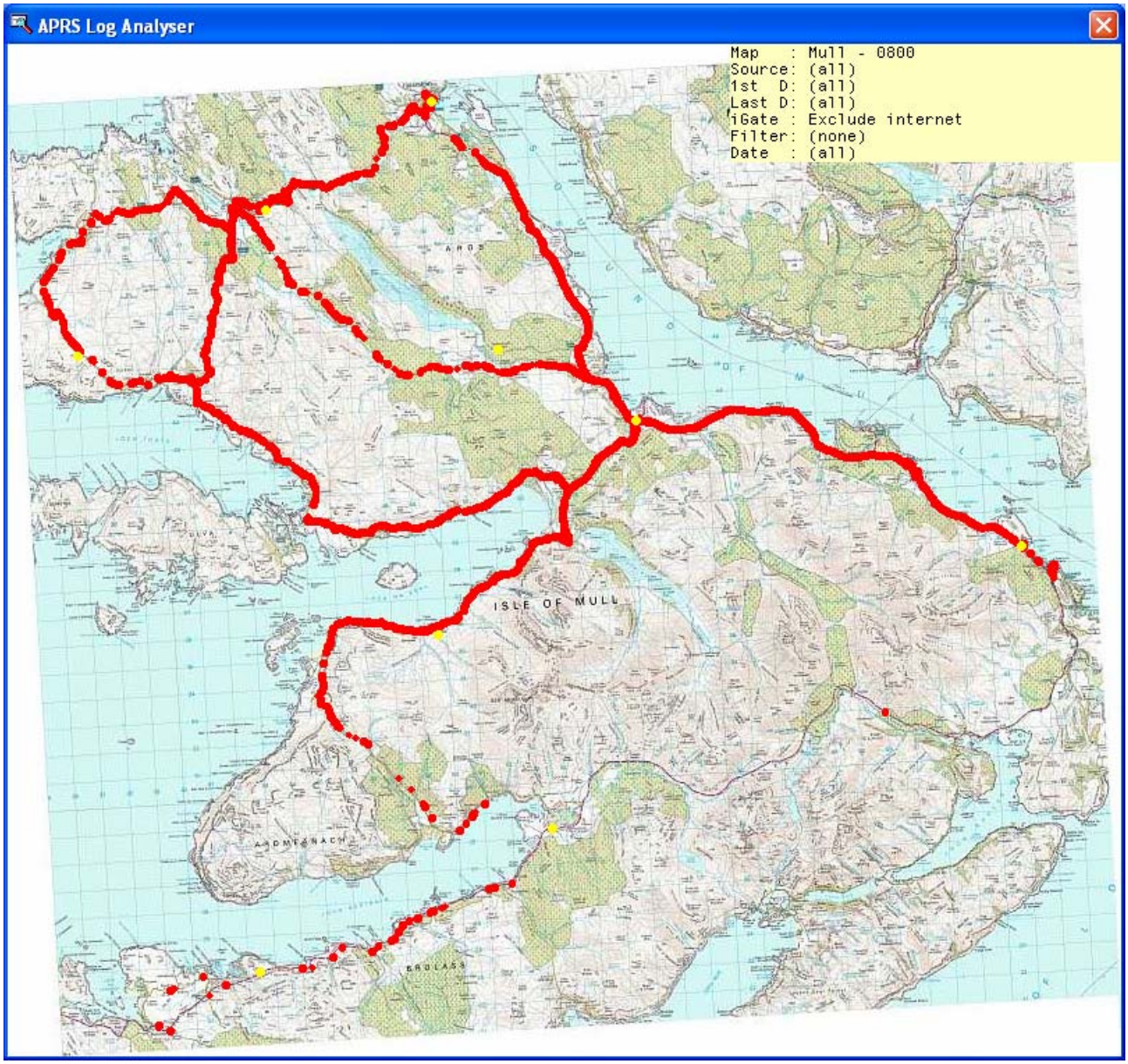
| *90 Second rate* | *Expected* | *Lost* | | |
|---|---|---|---|---|
| CHFMAR | 638 | 366 | 57% | |
| CLOSE | 281 | 144 | 51% | |
| CMO | 442 | 293 | 66% | |
| DOCTOR | 749 | 401 | 54% | |
| OPEN | 670 | 374 | 56% | |
| SAFETY | 854 | 393 | 46% | Average loss: **55.0%** |

## Appendix B

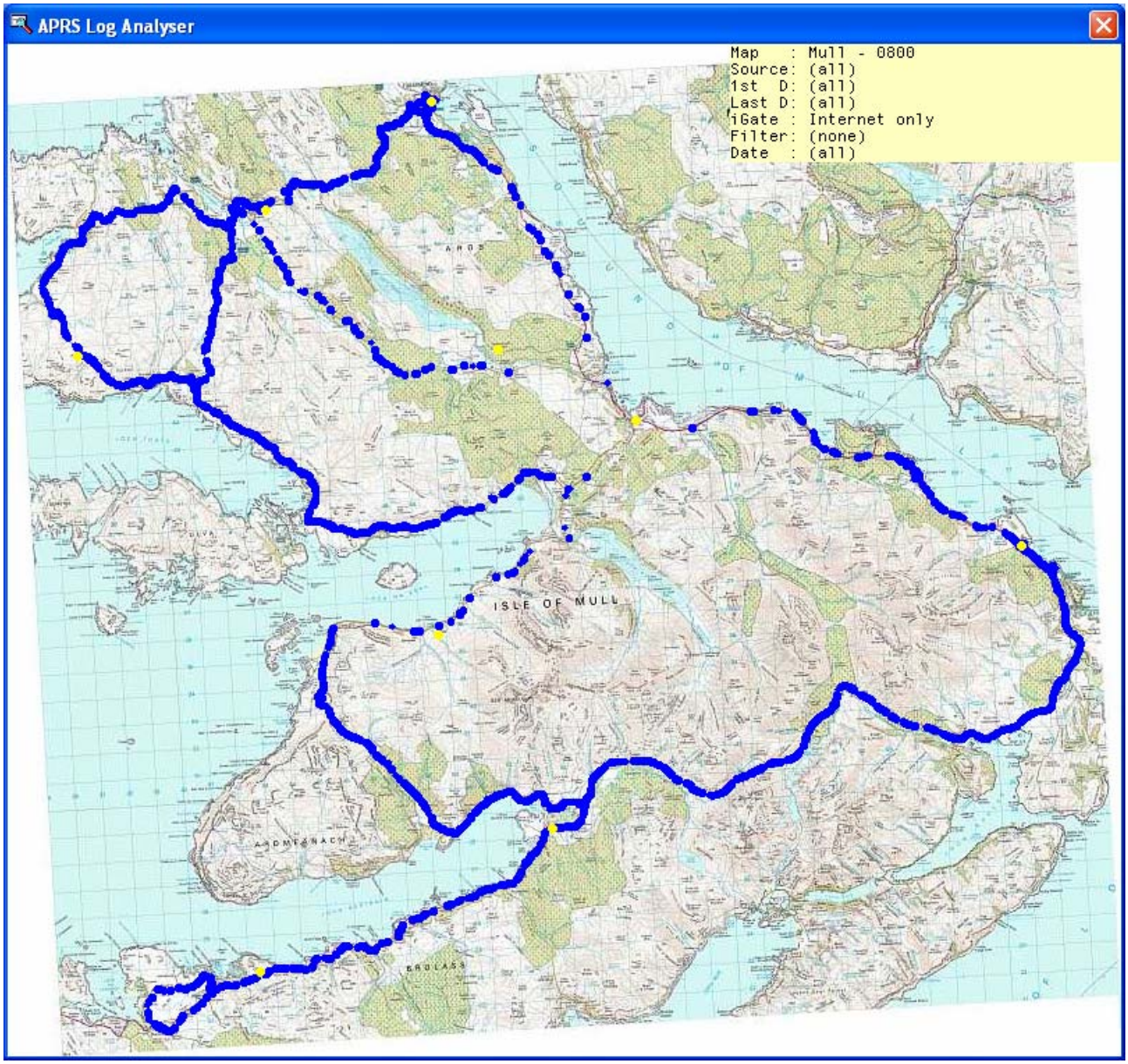



**Route for first beacon to be received at control**

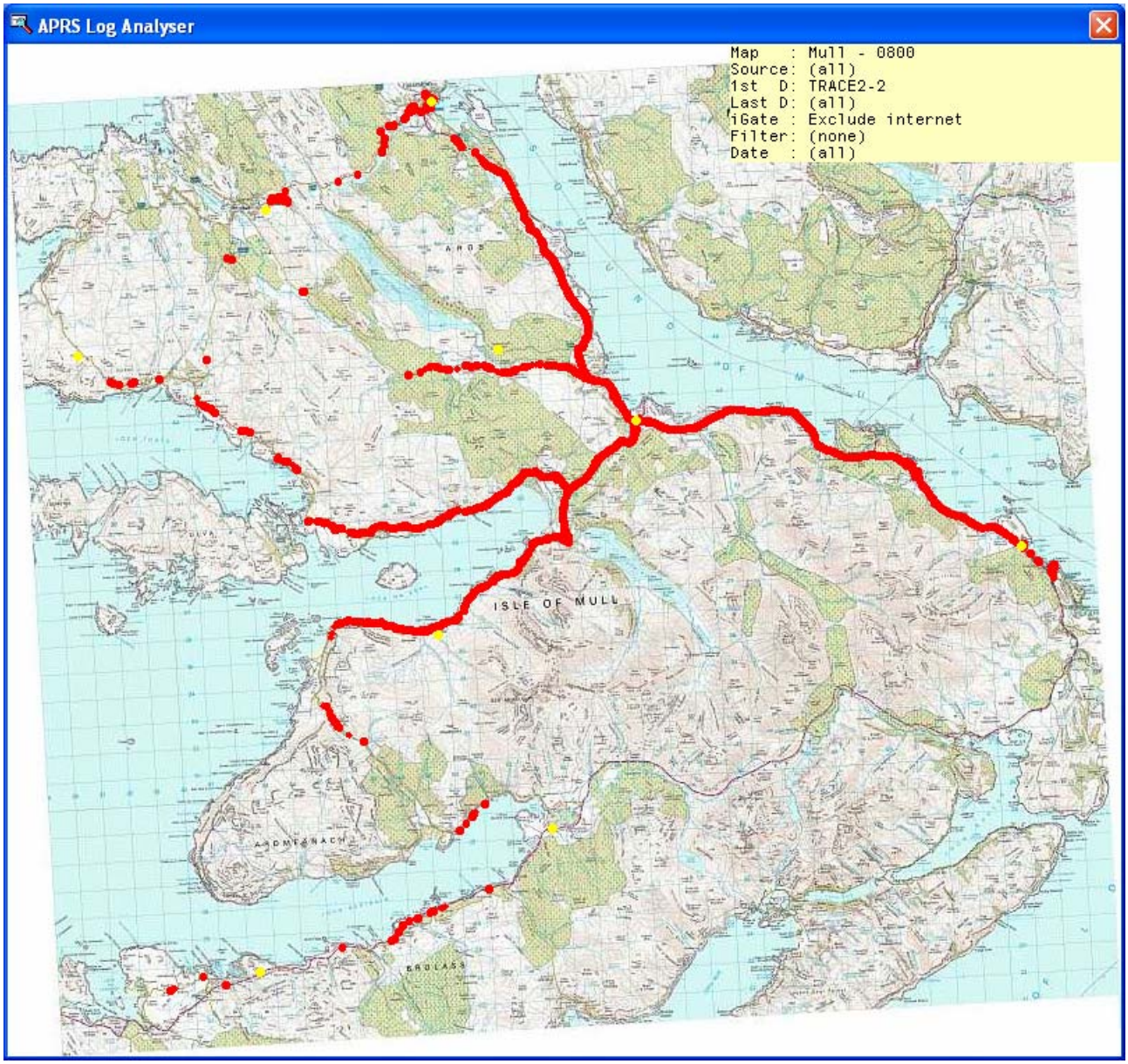
**Red** **RF**
**Blue** **Internet**



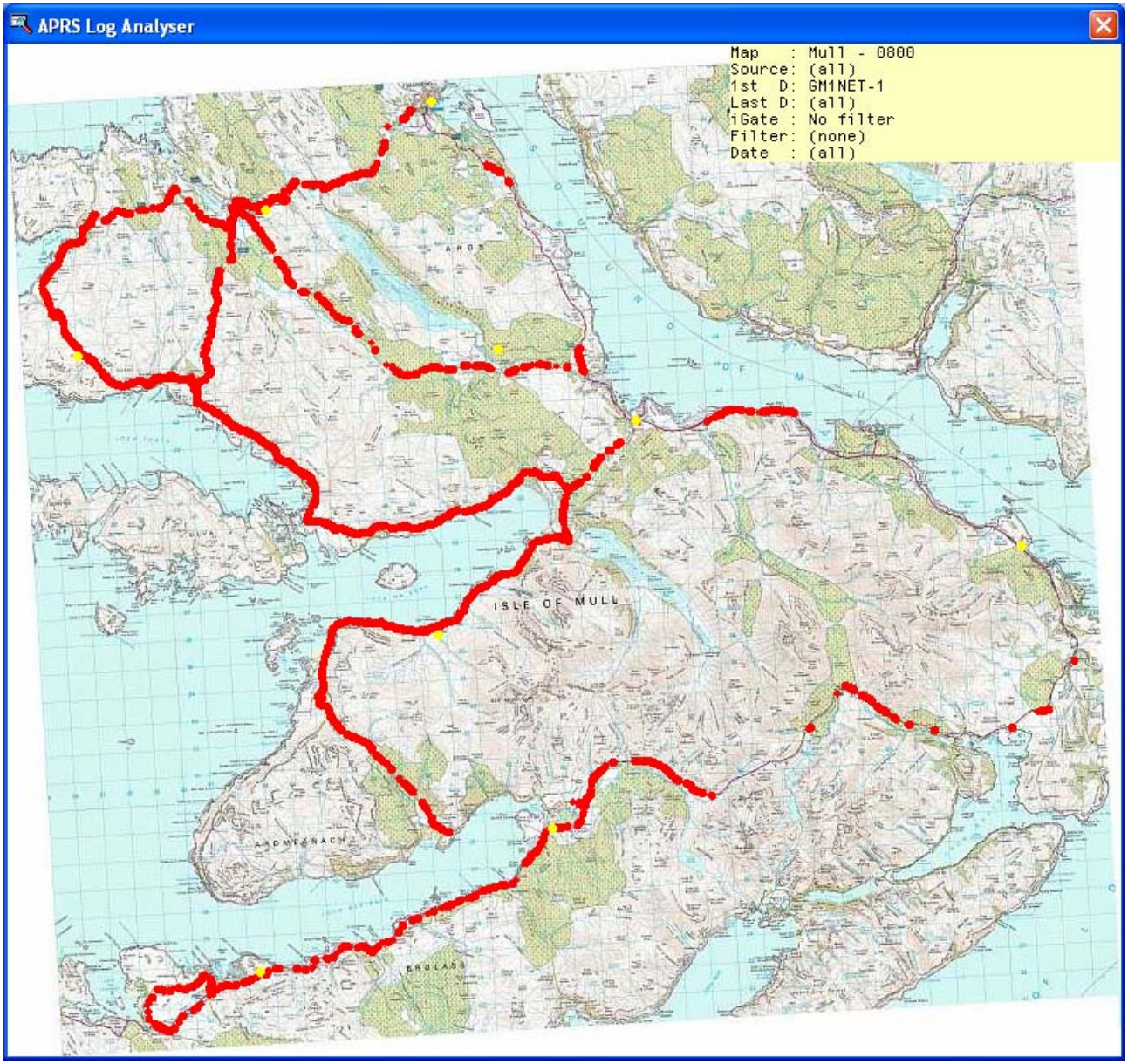

## RF Beacons received at control



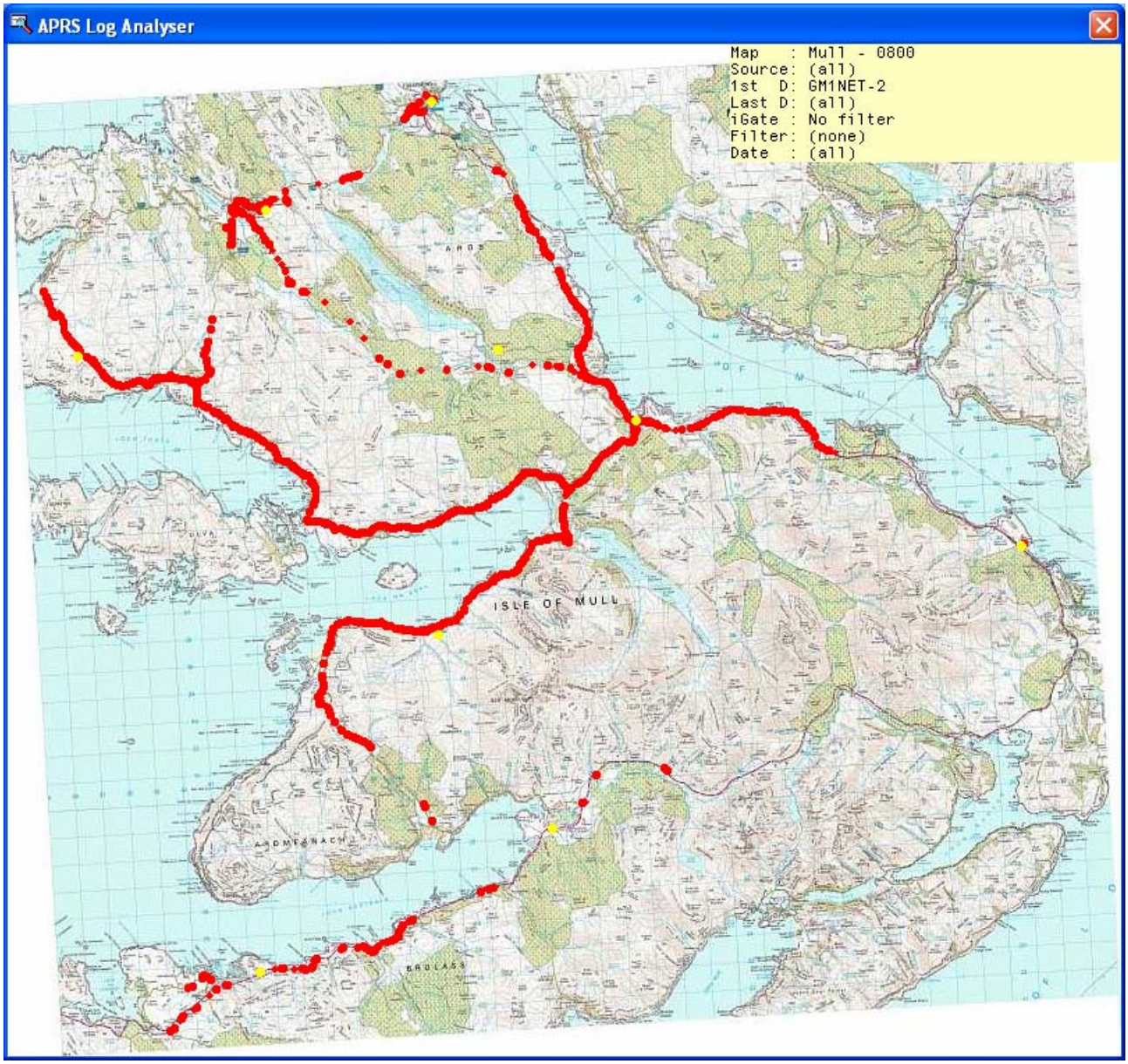

## Internet beacons received at control



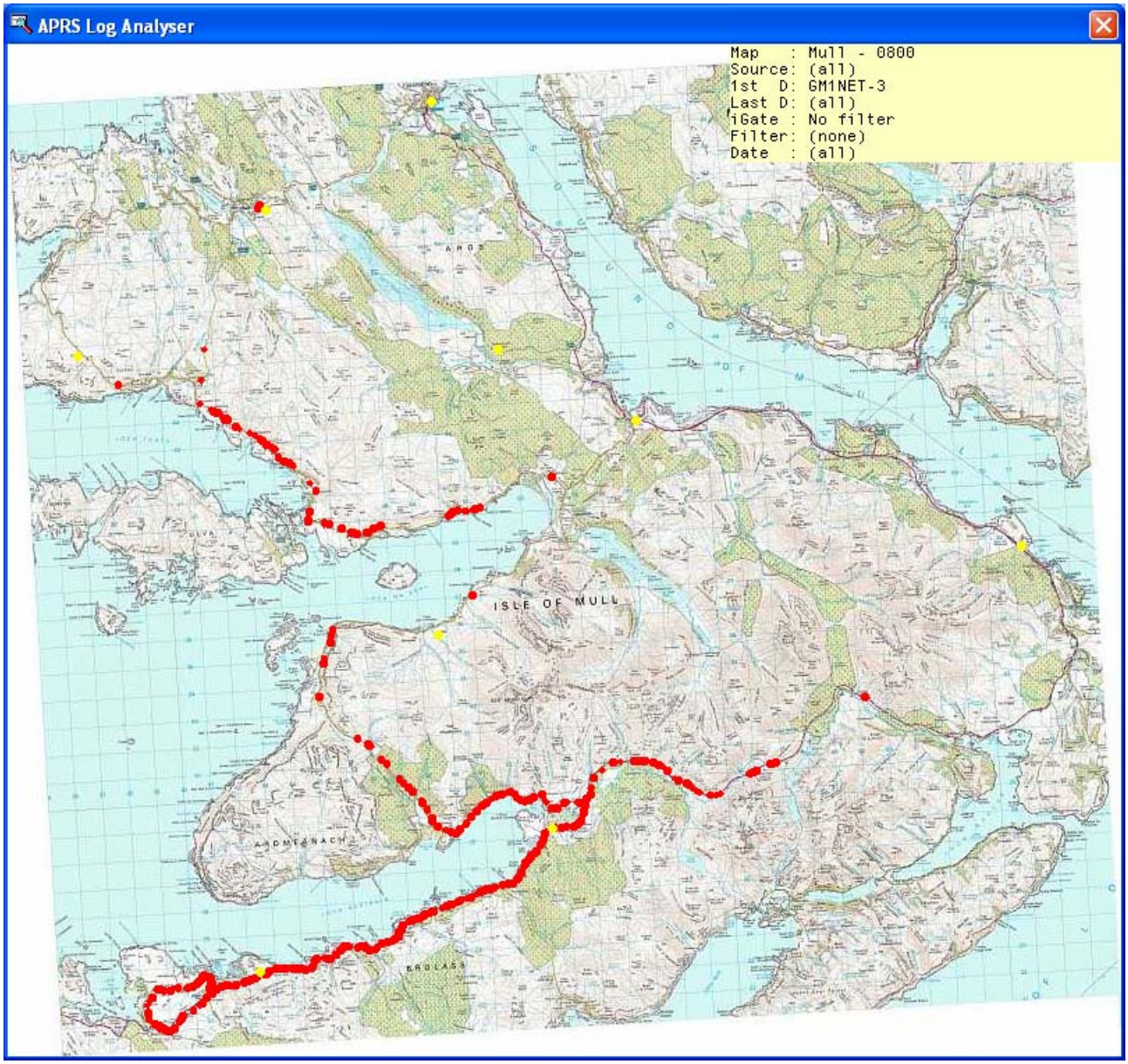

## Radio coverage from Control



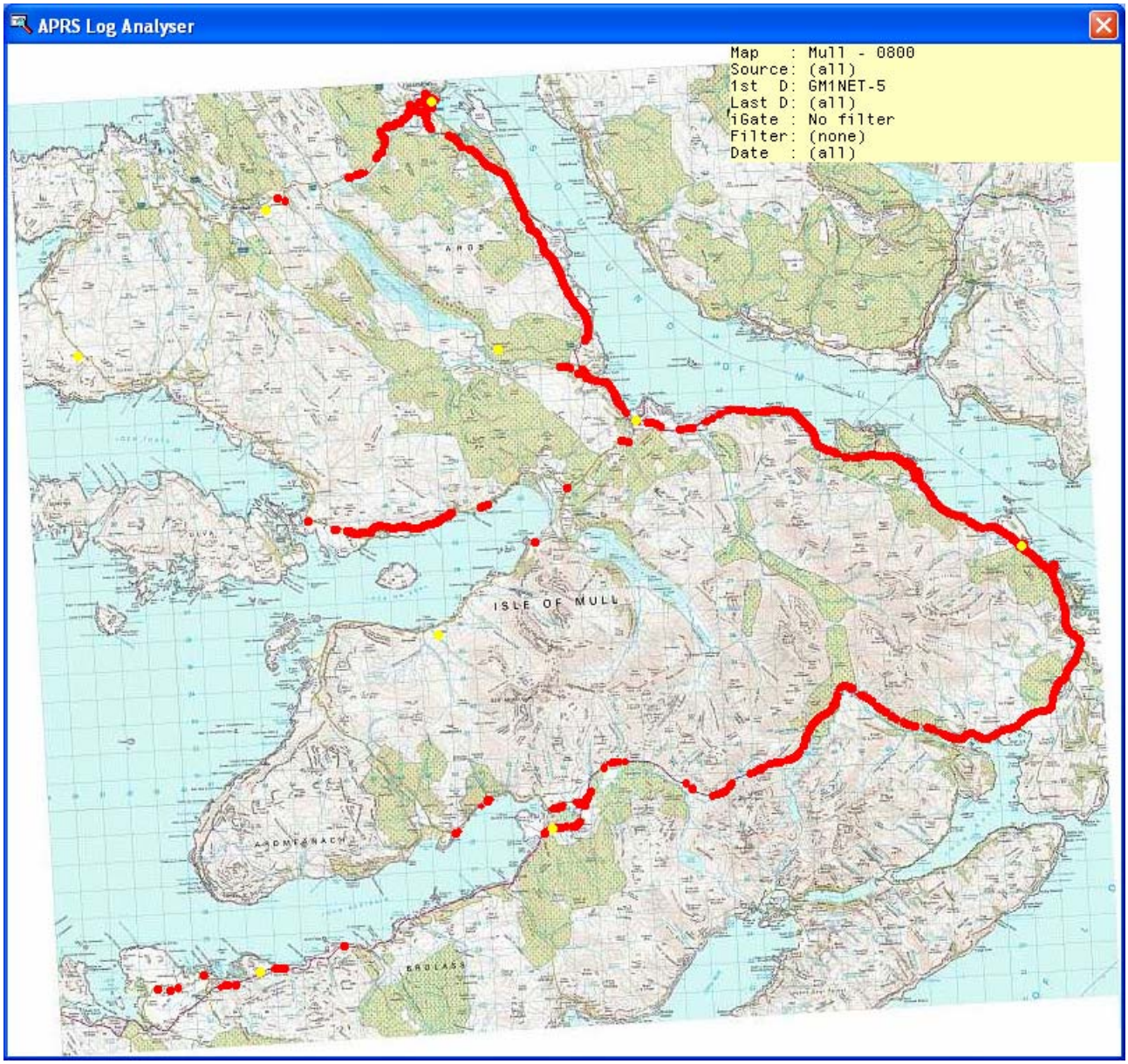

## Radio coverage from Ensay



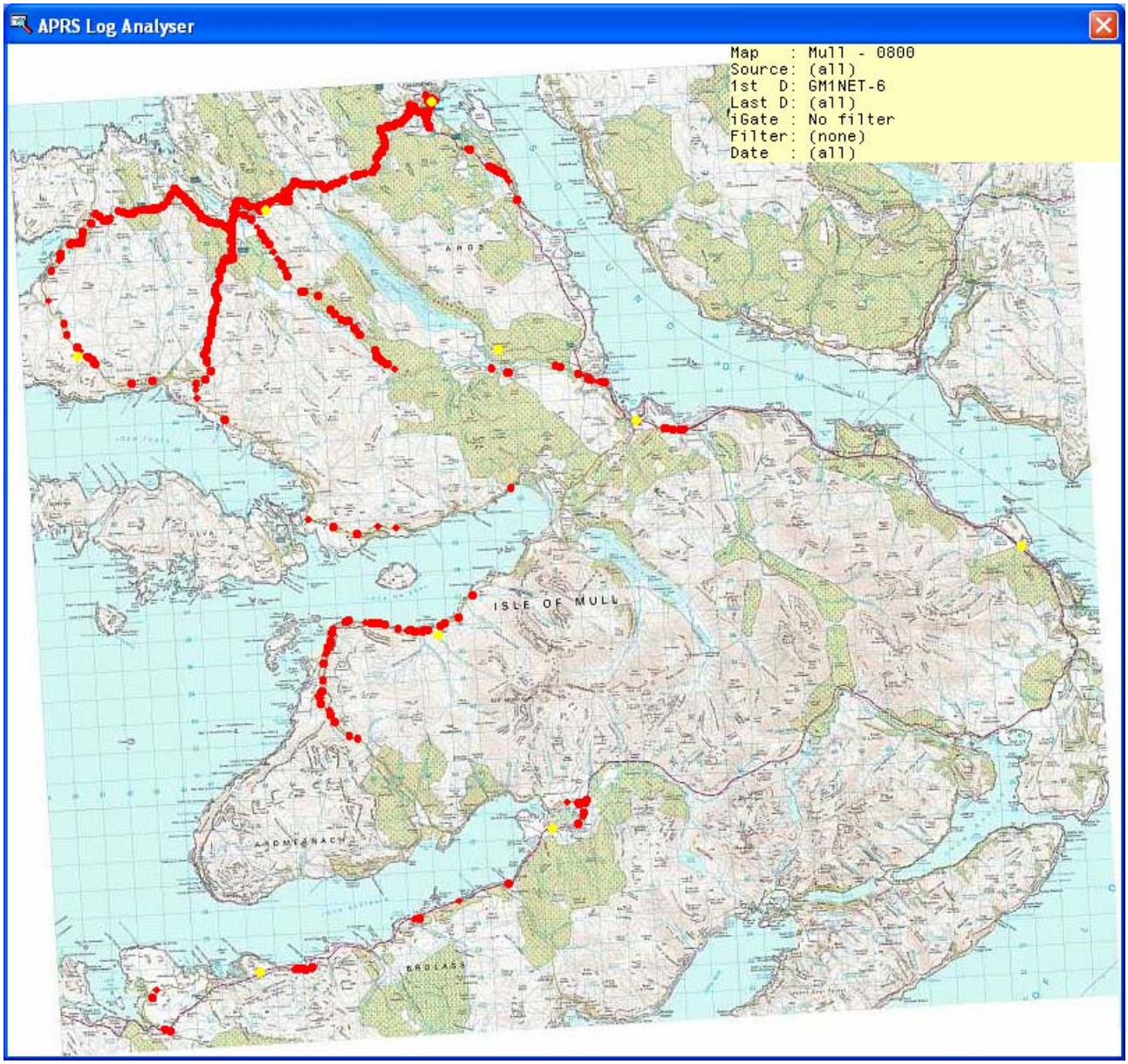

## Radio coverage from Dhiseig



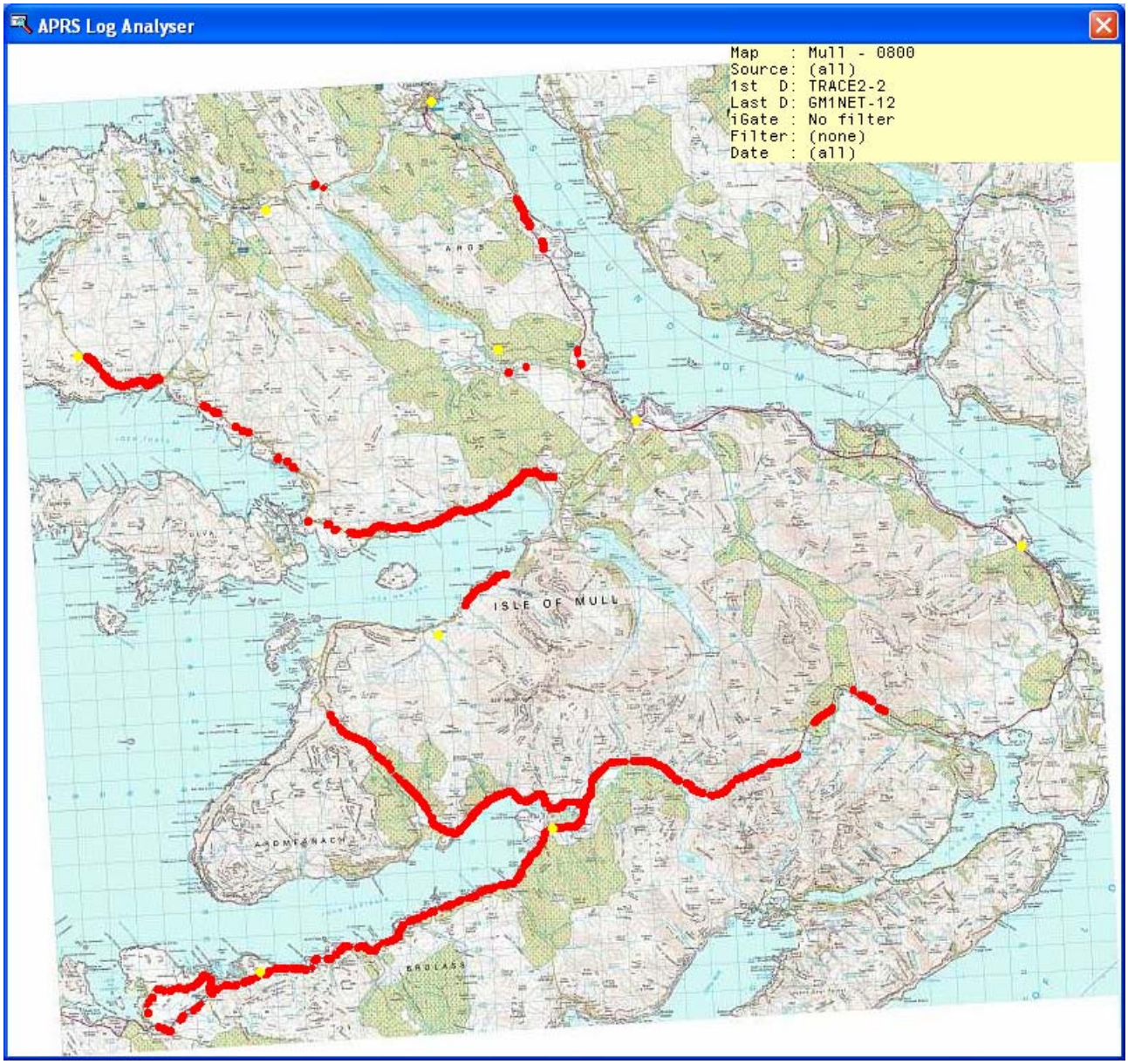

**Radio coverage from Bunessan (Friday night infill for Ardtun)**



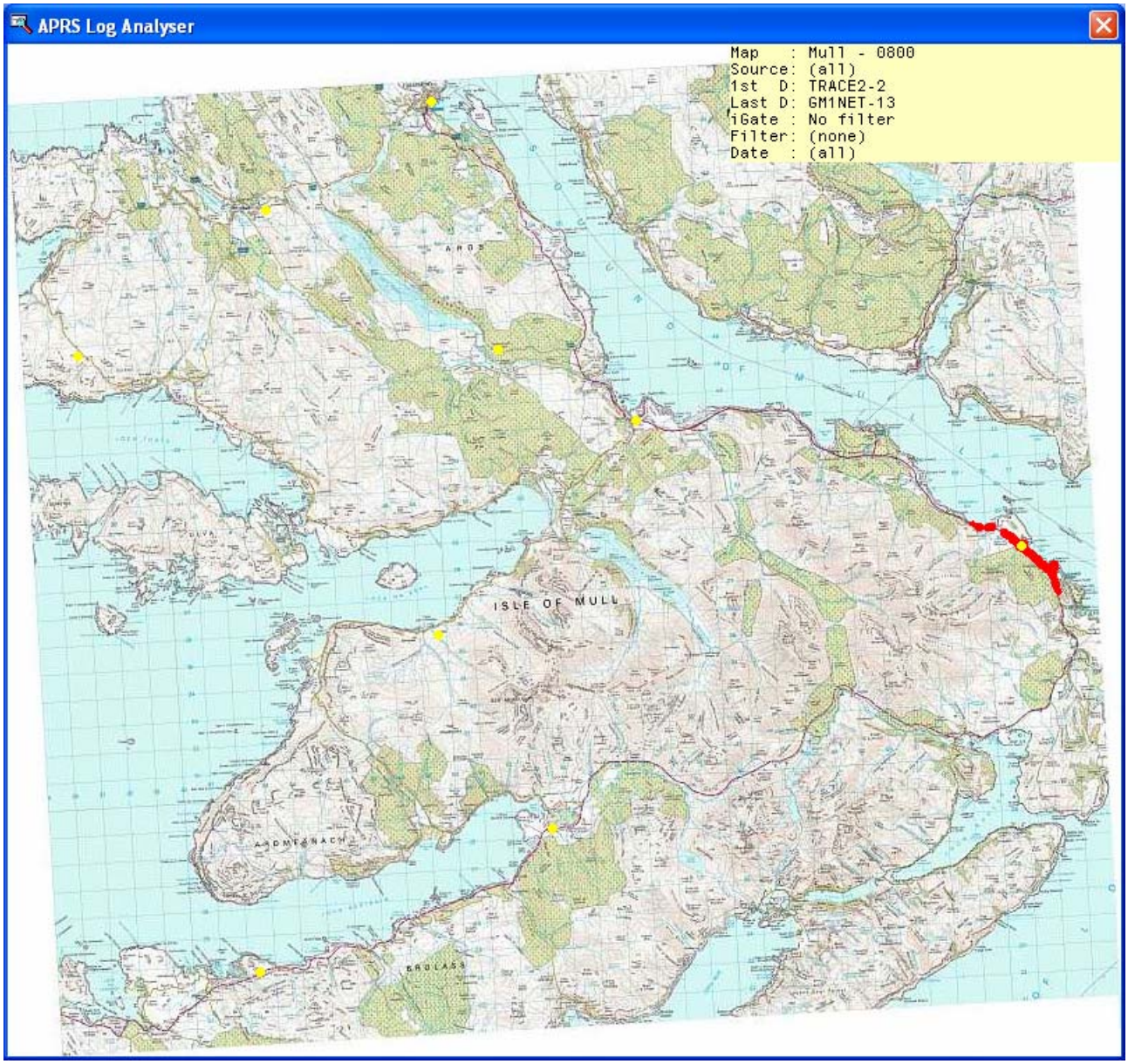

## Radio coverage from Duart



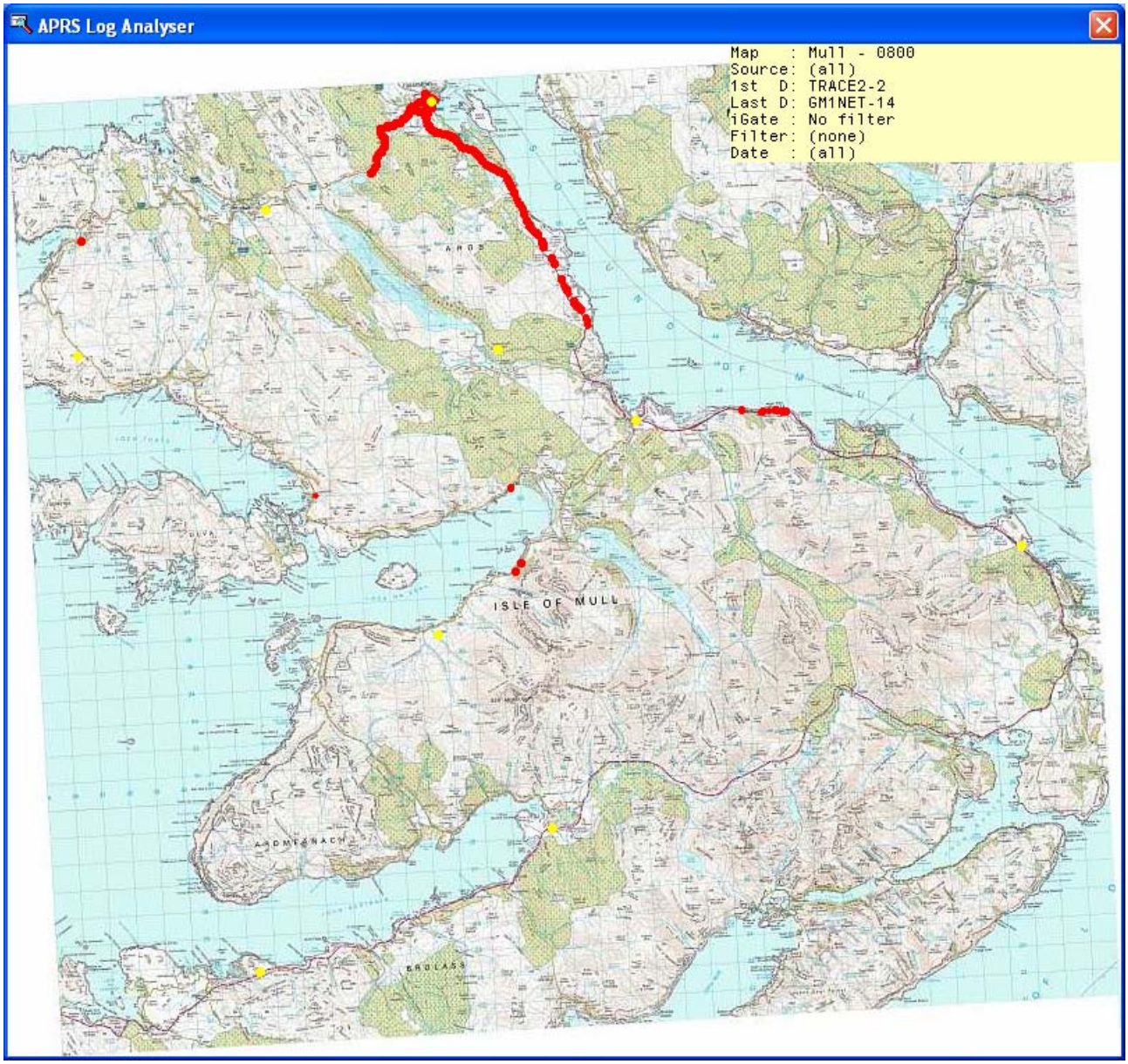

## Radio coverage from Dervaig



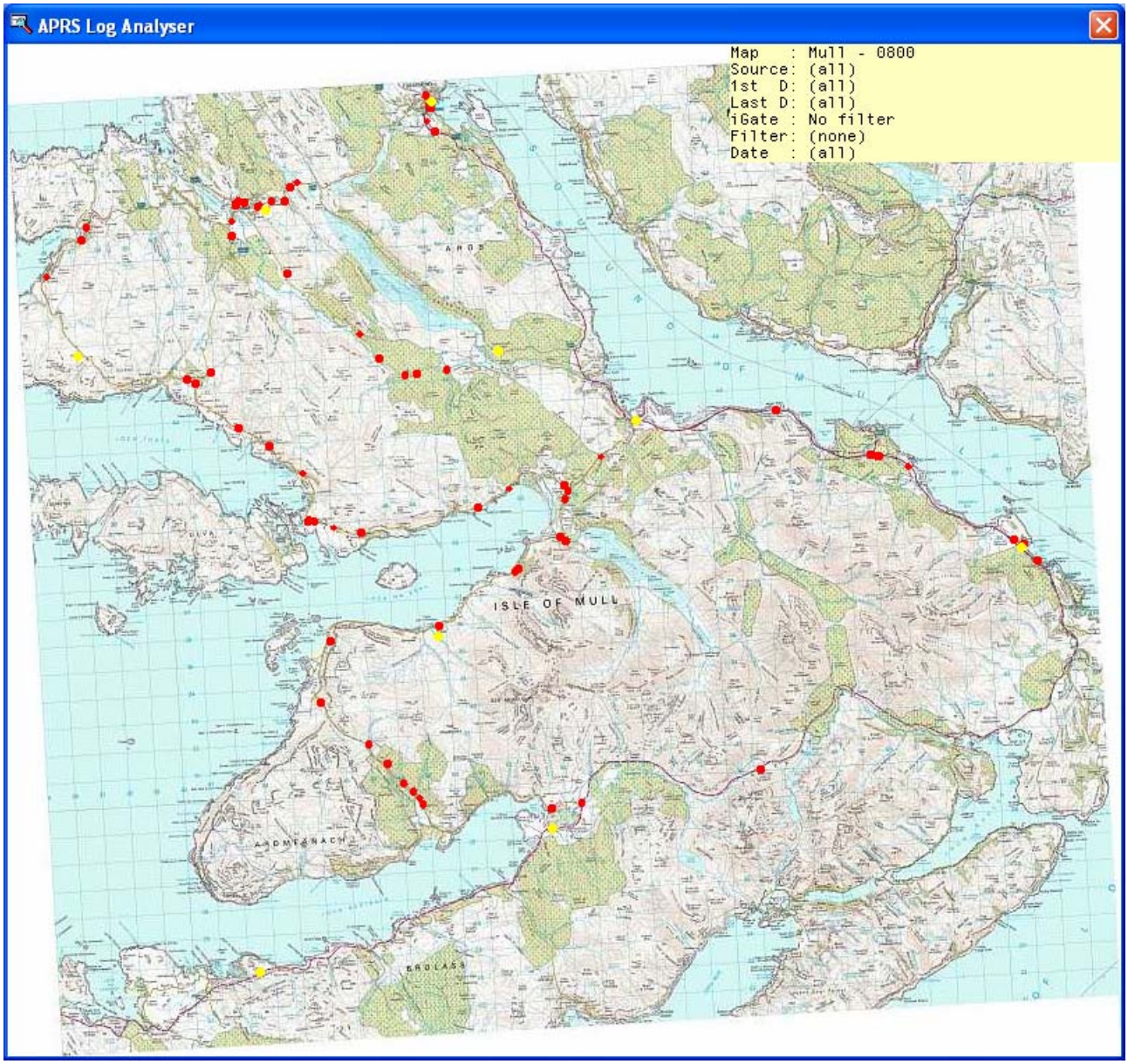

**Radio coverage from Kinloch Hotel iGate**




**Radio coverage from Isle of Mull Hotel iGate**




## Radio coverage from Tobermory iGate




## Locations where 2 or more beacons were missed