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**Technical report**

Mikael Lundberg, Björn Flood, Peter Follo, Per-Olov Frölind, Anders Gustavsson, Tommy Jonsson, Björn Larsson, Gunnar Stenström, and Lars M. H. Ulander

# CARABAS-II Campaign Vidsel 2002

# Ground Report

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CARABAS-II Campaign Vidsel 2002. Ground Report.


**Abstract (not more than 200 words)**

During late May and early June 2002, an airborne radar data collection was conducted with the Swedish CARABAS-II system. The area over which the data were collected is located between Vidsel and Jokkmokk in the north of Sweden. Data collection was carried out for the purpose of receiving data from forest clutter and targets deployed in different configurations.

This report contains the documentation of the ground activity during the radar data collection. It gives a description of the data collection area, the targets and each of the different deployments of the targets.

Photos were taken of each target in the different deployments. These pictures are available in digital form on a CD issued by FOI. The content of the CD is summarized in Appendix A of this report.



**Keywords**

Ground truth data, terrain vehicles, SAR, VHF, CARABAS-II, Vidsel

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CARABAS-II Flygkampanj Vidsel 2002. Markapport.


**Sammanfattning (högst 200 ord)**

Under slutet av maj och början av juni år 2002, gjordes en flygburen radardatainsamling med det svenska CARABAS-II-systemet. Området där data samlades in är beläget mellan Vidsel och Jokkmokk i norra Sverige. Data samlades in för att erhålla data från såväl markklotter som mål som var uppställda i olika konfigurationer.

Den här rapporten innehåller dokumentationen av markaktiviteten under flygkampanjen. Den beskriver markområdet, målen och de olika måluppställningarna.

De enskilda målen dokumenterades genom fotografering för varje måluppställning. Dessa foton finns sammanställda i digital form på en CD som kan erhållas från FOI. I appendix A i denna rapport finns en sammanställning av innehållet på CD-skivan.



**Nyckelord**

Markdata, terrängfordon, SAR, VHF, CARABAS-II, Vidsel

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# Table of contents

1 INTRODUCTION ..... 1

2 DATA COLLECTION AREA ..... 1

3 TARGET SPECIFICATIONS ..... 5

3.1 TGB 11 ..... 5
3.2 TGB 30 AND TGB 40 ..... 6
3.3 VOLVO V70 ..... 11

4 TARGET DEPLOYMENTS ..... 12

4.1 GPS POINTS ..... 13
4.2 DEPLOYMENT GUSTAV (F2/A5) ..... 17
4.3 DEPLOYMENT ERIK (F1) ..... 19
4.4 DEPLOYMENT JOHAN (F3/A6) ..... 21
4.5 DEPLOYMENT SIGISMUND (A1) ..... 23
4.6 DEPLOYMENT KARL (A2) ..... 25
4.7 DEPLOYMENT FREDRIK (A3) ..... 27
4.8 DEPLOYMENT ADOLF-FREDRIK (A4) ..... 29
4.9 DEPLOYMENT MARGARETA ..... 31
4.10 REFLECTORS ..... 33

5 REFERENCES ..... 35

A APPENDIX CD CONTENTS ..... 37

A.1 TARGET DEPLOYMENT GUSTAV ..... 39
A.2 TARGET DEPLOYMENT ERIK ..... 43
A.3 TARGET DEPLOYMENT JOHAN ..... 45
A.4 TARGET DEPLOYMENT SIGISMUND ..... 49
A.5 TARGET DEPLOYMENT KARL ..... 53
A.6 TARGET DEPLOYMENT FREDRIK ..... 57
A.7 TARGET DEPLOYMENT ADOLF-FREDRIK ..... 61
A.8 TARGET DEPLOYMENT MARGARETA ..... 65
A.9 NAUSTA VILLAGE ..... 67
A.10 TRIHEDRALS ..... 69

# 1 Introduction

During late May and early June 2002, an airborne radar data collection was conducted with the Swedish CARABAS-II VHF-band SAR system. The area over which the data were gathered is located between Vidsel and Jokkmokk in the north of Sweden. The campaign was carried out for the purpose of receiving data from forest clutter and targets deployed in different configurations in support of a change detection study.

By using VHF-band frequencies both targets in the open as well as concealed by foliage may be detected. These detections occur with high probability and with a low false-alarm rate. VHF-band SAR is able to detect hidden targets because both foliage attenuation and clutter backscatter is small. The clutter is further repressed through the use of change detection, thus significantly reducing the false-alarm rate. Change detection techniques are well suited for VHF-band SAR since temporal decorrelation is small at these large wavelengths [1].

This report contains the documentation of the ground activity during the radar data collection. It gives a description of the data collection area, the targets and each of the different deployments of the targets. Along with the report, a CD (Compact Disc) containing pictures in digital form of the targets from the different deployments is available from FOI. The content of the CD is summarized in Appendix A.

In addition to this report, three other reports providing information concerning the flight campaign in Vidsel 2002 have been written. These three reports include [2] explaining the airborne activity, [3] giving a detailed evaluation of the forest vegetation and [4] presenting the analysis and results obtained from the collected radar data.

# 2 Data collection area

Data were collected at RFN (“Robotförsöksplats Norr”) Vidsel, a military test range located south-west of *Jokkmokk* in the north of Sweden (figures 1 and 2). RFN Vidsel is a large, restricted and well-monitored proving ground primarily used for fire practicing and testing of airborne and surface launched missile systems. Two forest sites in the area, called Forest 1 and Forest 2 (figure 3), were mainly used to deploy the targets in.

Forest 1 is located near the village *Nausta*. This site was used for the target deployments named Gustav (F2/A5), Johan (F3/A6), Fredrik (A3) and Adolf-Fredrik (A4).

Forest 2 is located about 2 km north of Forest 1 and was the site for target deployments Sigismund (A1) and Karl (A2).

In addition to these two sites, an open field in Nausta village was used for deployment Erik (F1) and an adjacent forest parcel for Margareta.

The foliage in the area consisted mostly of Scots pine with diameters of roughly 25-30 cm. A more complete description of forest parameters is documented in a separate forest report [3].

**Figure 1. The lower yellow marking shows the location of the flight restriction area over the RFN Vidsel test range in northern Sweden.**
**(Map: http://www.neat.se/geography_&_maps/index_geography_and_maps.shtml)**

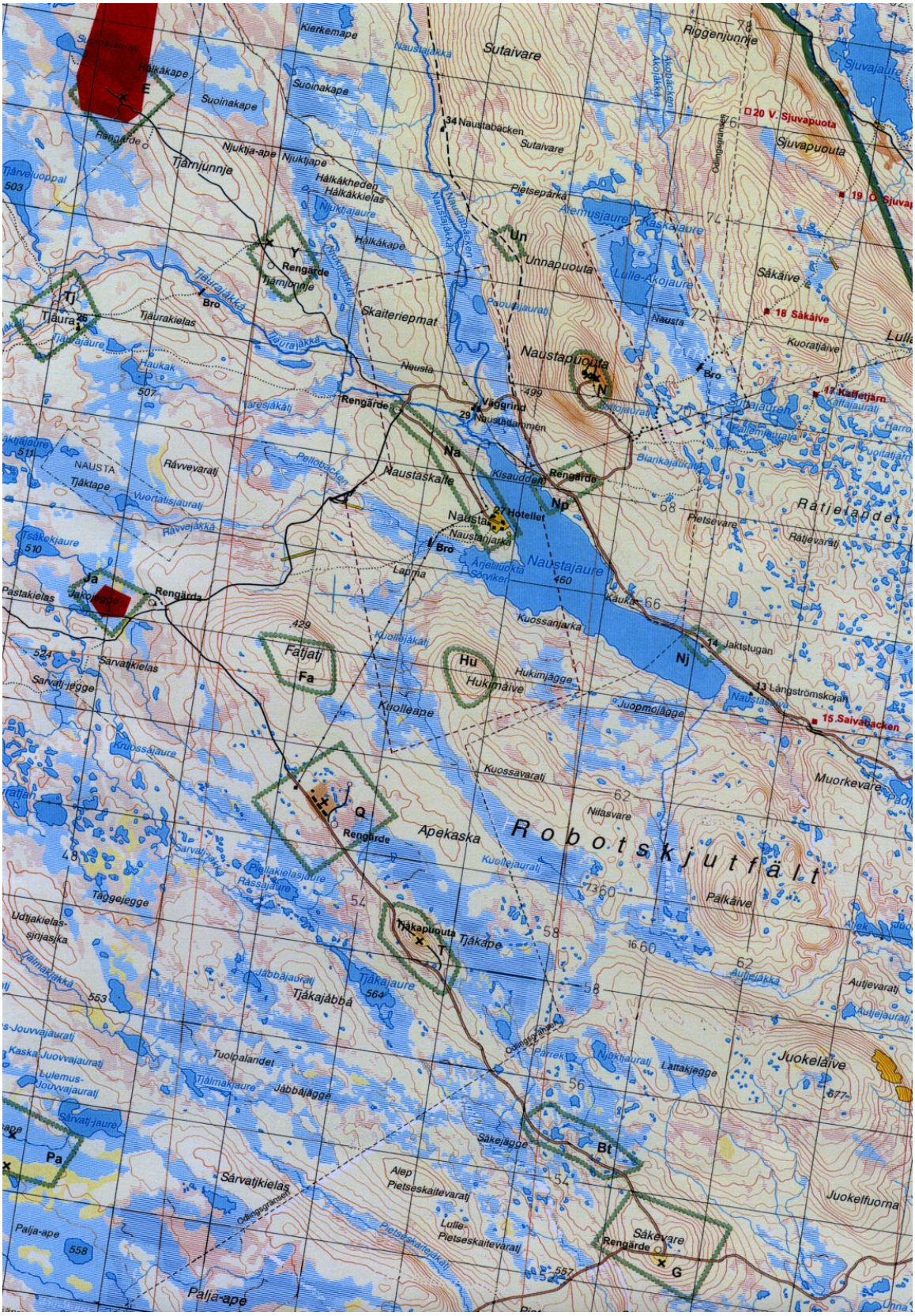


**Figure 2. Detailed map of the vicinity of the data collection area. The shown ground segment is located in the eastern part of the test range. Each grid square is 2 km. (Copyright map: Lantmäteriverket 2001. Ref. nr. L2002/308)**

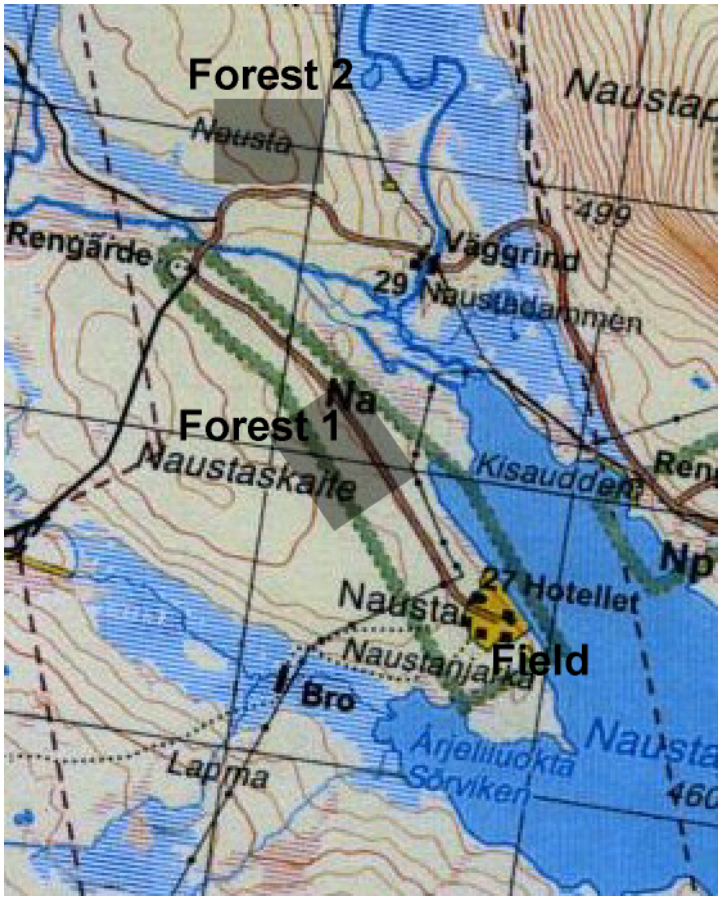


**Figure 3. Map over the surroundings of Nausta village. The locations of Forest 1, Forest 2 and the open field at Nausta village are overlaid. The ground segment shown in this figure corresponds to the core area mapped by the CARABAS-II VHF SAR sensor from different look directions and at different incidence angles during the campaign. (Copyright map: Lantmäteriverket 2001. Ref. nr. L2002/308)**

# 3 Target specifications

During the campaign a number of vehicles were deployed in the open and in forests in the surroundings of Nausta village. The main targets consisted of 25 military terrain vehicles; ten TGB 11s, eight TGB 30s and seven TGB 40s. Along with these 25 targets, two Volvo V70 cars were used. This chapter gives a description of the vehicles used in the radar campaign. Table 1 shows a list of all terrain vehicles and their corresponding license number and configuration.

**Table 1. Vehicle type, license number and configuration.**

| Type | License no. | Configuration |
|---|---|---|
| TGB11 | 112633 | Standard |
| TGB11 | 112662 | Standard |
| TGB11 | 112776 | Standard |
| TGB11 | 112820 | Standard |
| TGB11 | 112832 | Standard |
| TGB11 | 113335 | Standard |
| TGB11 | 113337 | Standard |
| TGB11 | 113375 | Standard |
| TGB11 | 113414 | Standard |
| TGB11 | 113428 | Standard |
| TGB30 | 330280 | Booth |
| TGB30 | 330308 | Cover |
| TGB30 | 330338 | Standard |
| TGB30 | 331052 | Cover |
| TGB30 | 331120 | Cover |
| TGB30 | 331201 | 2 fuel tanks on platform |
| TGB30 | 331774 | Standard |
| TGB30 | 331777 | Standard |
| TGB40 | 340095 | Booth |
| TGB40 | 340255 | Booth |
| TGB40 | 340278 | Booth |
| TGB40 | 340323 | Booth |
| TGB40 | 340785 | Standard |
| TGB40 | 345005 | Platform without sides |
| TGB40 | 345009 | Standard |

## *3.1 TGB 11*

Ten of the targets used in the data collection were smaller terrain vehicles called TGB 11. The dimension of these vehicles is:

- Length – 4350 mm
- Width – 1900 mm
- Height – 2170 mm

Figure 4 shows a picture of one of the TGB 11s.

**Figure 4. Terrain vehicle TGB 11, primarily used for transportation of personnel.**

## *3.2 TGB 30 and TGB 40*

The primary role of the TGB 30 and TGB 40 is the transportation of troops or goods but can also be used to tow artillery guns both on and off-road. The main difference between TGB 40 and TGB 30 is that TGB 40 has three wheel axles in contrast to TGB 30, which has two.

There are three configurations of TGB 30; the standard configuration, with a cover or with a booth. Among the eight TGB 30s used here, there were four of standard configuration, three with cover and one with a booth. One of the standard TGB 30s had two fuel tanks on the platform.

TGB 40 has two configurations; the standard configuration and one with a booth. The TGB 40s used in the campaign consisted of three of standard configuration and four with a booth. One of the standard configuration TGB 40s had no sides on the platform.

Figures 5-9 show drawings of the different configurations of the two vehicle model types with the dimensions given in millimeters [mm]. Figures 10-14 show illustrative pictures of each configuration.

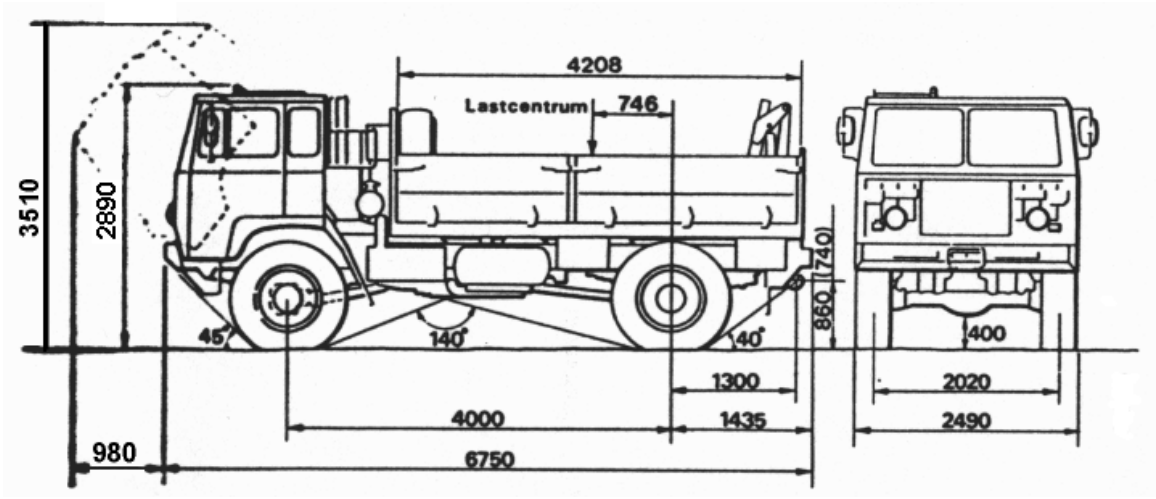


**Figure 5. Terrain vehicle TGB 30, standard configuration.**

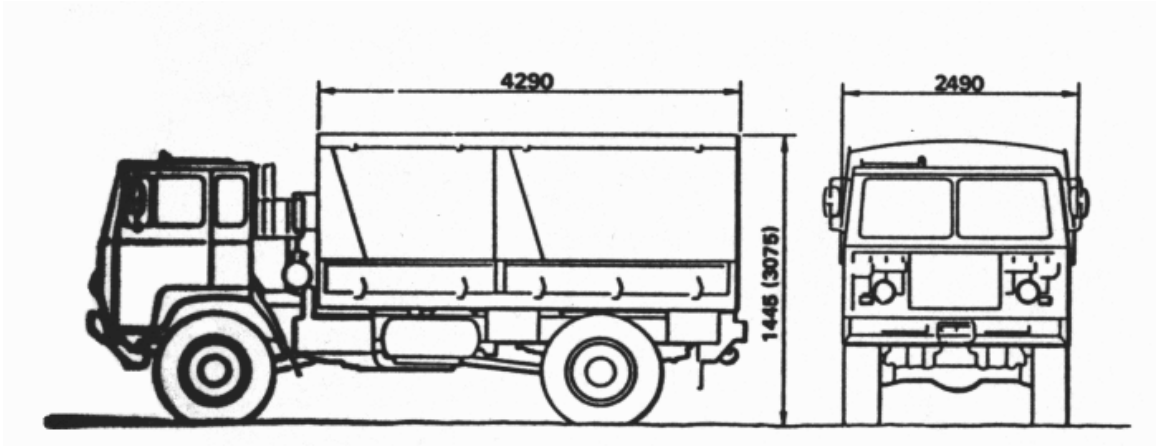


**Figure 6. Terrain vehicle TGB 30, with cover.**

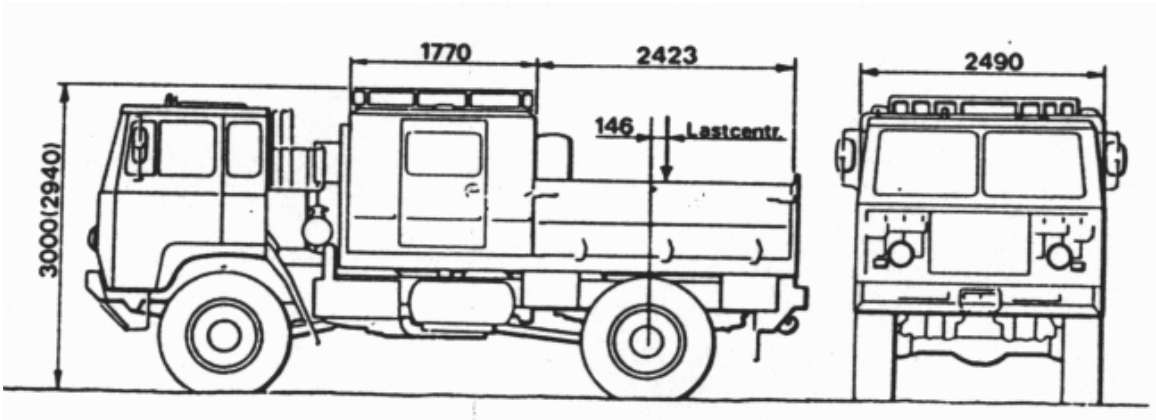


**Figure 7. Terrain vehicle TGB 30, with booth.**

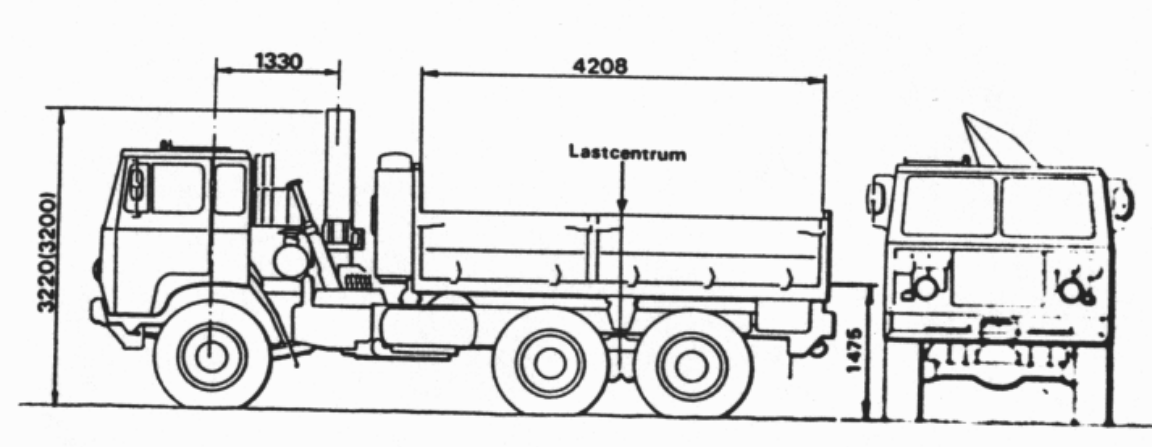


**Figure 8. Terrain vehicle TGB 40, standard configuration.**

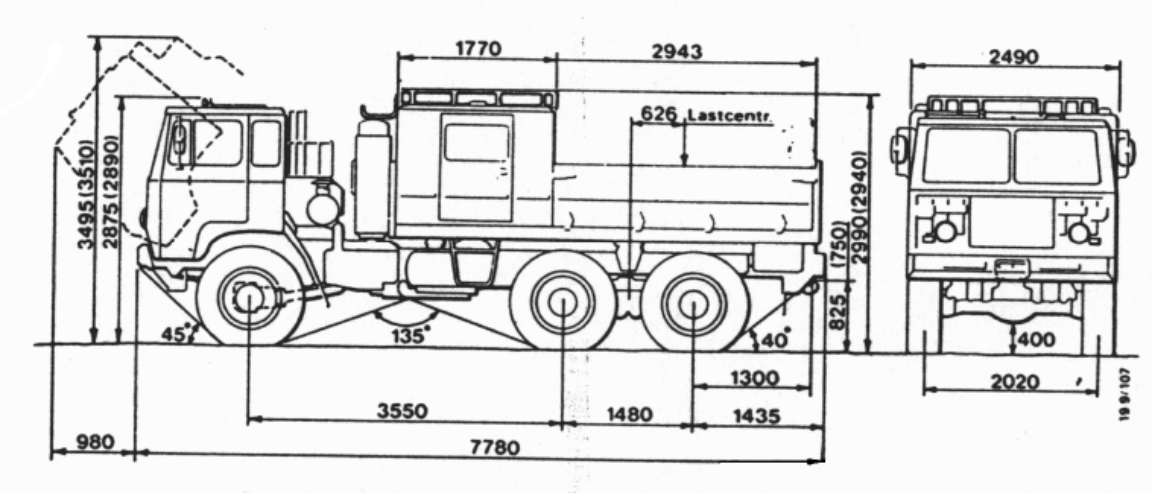


**Figure 9. Terrain vehicle TGB 40, with booth.**

**Figure 10. TGB 30, standard configuration.**

**Figure 11. TGB 30, with cover.**

**Figure 12. TGB 30, with booth.**

**Figure 13. TGB 40, standard configuration.**

**Figure 14. TGB 40, with booth.**

## 3.3 Volvo V70

Two Volvo V70s were also used as targets. These are regular station wagons; with length 4.8 m, width 1.8 m and height 1.5 m. Figure 15 shows a picture of one of the deployed cars.

**Figure 15. Volvo V70 car.**

# 4 Target deployments

This chapter describes the different target deployments implemented during the experiment and imaged by CARABAS-II. Each of these deployments is described with a sketch that shows the location of the targets and a table presenting the data of every target. The tables include:

- ID – Target ID in the deployment. This number is also shown in the sketch.
- License no. – The license number of the vehicle.
- Type – Vehicle type.
- GPS ID – The ID of the GPS position.
- GPS position – (Lat, Long, Height – represented in the WGS84 datum). [degrees, degrees, meter]
- Backward, Forward, Right, Left – Indicate how the vehicle is positioned relative to the measured GPS position and defined with respect to its heading, i.e. Forward = 1.5 and Right = 1.0 means that the vehicle is moved 1.5 m forward in the direction of the heading and 1.0 m to the right. [meter]
- Heading – Direction of vehicle relative (magnetic) north. Increases in clockwise direction. [degrees]
- Pitch – Positive pitch when the front of the vehicle leans upward. [degrees]
- Roll – Positive roll when the vehicle leans to the left when seen from back. [degrees]

Time is given in local time (GMT + 2 hours), i.e. Swedish standard summer time including a daylight savings offset of 1 hour.

The purpose of the chosen deployments is to evaluate the following situations:

- Deployments Gustav and Johan.
  *Targets under trees placed in random directions. The Johan deployment differs from Gustav in that the targets are moved to new positions. Some targets are moved approximately half the vehicle length and the rest are moved far from their old positions.*
- Deployment Erik
  *Targets are placed in an open field*
- Deployments Sigismund and Karl
  *Targets under trees, all placed in the same direction. The Karl deployment differs from Sigismund in that the targets are moved to new positions and rotated by 90°.*
- Deployments Fredrik and Adolf–Fredrik
  *Targets under trees, all placed in the same direction. The Adolf-Fredrik deployment differs from Fredrik in that the targets are moved to new positions and rotated by 45°.*

## 4.1 GPS points

In each of the two forest sites 50 positions served as points above which the center section of the individual targets was placed. Hence, in some cases the same point is used in several deployments. Each point was measured with a GPS receiver and the post-processing is based on carrier-phase differential GPS techniques. Figure 16 shows two aerial photos of the forest sites where each GPS measurement and its corresponding identification number are overlaid. The spacing between adjacent target positions is approximately 50 meters. Tables 2 – 4 list the measured GPS positions at each site. Coordinates are given in both the WGS84 coordinate system and the Swedish reference system RR92. The tables include:

- GPS ID – The ID of the measured GPS position.
- GPS position – (Lat, Long, Height – WGS84 & RR92).
- RMS – RMS error of measurement.

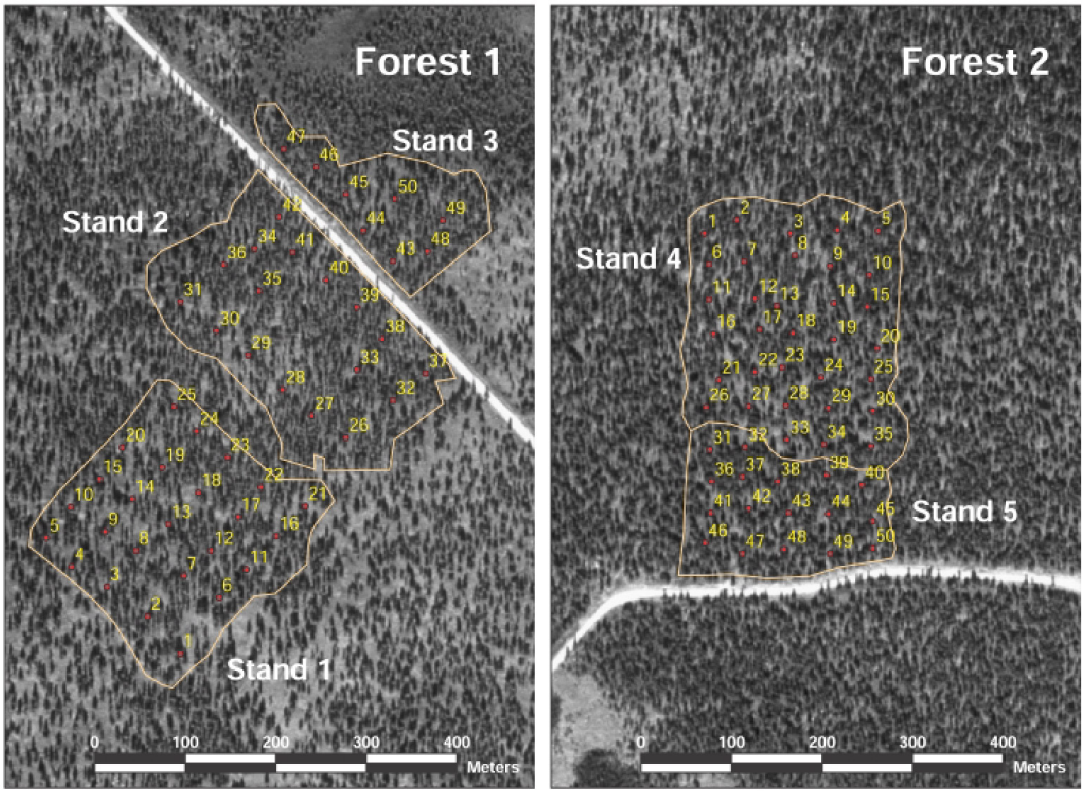


**Figure 16. Aerial photos of the two forest sites but acquired well before the experiment period. At each site 50 positions were used to deploy targets at. The location of each position was measured using differential GPS. These measurements and the corresponding identification numbers are marked in the photos above. Note that the GPS measurement of position 34 in forest 1 has a substantially large RMS error (see table 3). The actual position is in fact located between positions 33 and 35 but closer to the latter one. (Copyright aerial photos: Lantmäteriverket 2001. Ref. nr. L2002/308)**

**Table 2. GPS positions from the open field at Nausta village.**

| GPS ID | N | E | Height | RMS | N RT90 | E RT90 | H RH70 |
|---|---|---|---|---|---|---|---|
| 1 | 66,3628 | 19,2812 | 509,7 | 0.741 | 7366994 | 1655534 | 476 |
| 2 | 66,3630 | 19,2810 | 509,4 | 0.757 | 7367014 | 1655521 | 475 |
| 3 | 66,3632 | 19,2806 | 509,8 | 0.567 | 7367034 | 1655506 | 476 |
| 4 | 66,3634 | 19,2804 | 509,8 | 0.833 | 7367053 | 1655492 | 476 |
| 5 | 66,3636 | 19,2800 | 510,2 | 0.498 | 7367078 | 1655476 | 476 |
| 6 | 66,3638 | 19,2797 | 511,0 | 0.490 | 7367100 | 1655460 | 477 |
| 7 | 66,3640 | 19,2795 | 511,1 | 0.555 | 7367123 | 1655448 | 477 |
| 8 | 66,3627 | 19,2819 | 509,8 | 1.172 | 7366979 | 1655566 | 476 |
| 9 | 66,3629 | 19,2817 | 510,4 | 0.643 | 7367002 | 1655554 | 476 |
| 10 | 66,3631 | 19,2814 | 509,7 | 0.976 | 7367024 | 1655542 | 476 |
| 11 | 66,3633 | 19,2812 | 508,7 | 1.418 | 7367047 | 1655530 | 475 |
| 12 | 66,3635 | 19,2810 | 509,6 | 1.017 | 7367069 | 1655518 | 476 |
| 13 | 66,3638 | 19,2807 | 510,2 | 1.050 | 7367094 | 1655505 | 476 |
| 14 | 66,3631 | 19,2825 | 508,5 | 0.766 | 7367021 | 1655588 | 475 |
| 15 | 66,3633 | 19,2821 | 507,8 | 0.807 | 7367043 | 1655573 | 474 |
| 16 | 66,3635 | 19,2818 | 509,4 | 0.786 | 7367065 | 1655558 | 475 |
| 17 | 66,3637 | 19,2815 | 509,6 | 0.907 | 7367087 | 1655542 | 476 |
| 18 | 66,3632 | 19,2831 | 508,4 | 0.635 | 7367036 | 1655615 | 474 |
| 19 | 66,3634 | 19,2827 | 508,7 | 0.561 | 7367060 | 1655597 | 475 |
| 20 | 66,3636 | 19,2824 | 508,9 | 0.577 | 7367081 | 1655581 | 475 |
| 21 | 66,3638 | 19,2820 | 509,7 | 1.289 | 7367103 | 1655564 | 476 |
| 22 | 66,3633 | 19,2837 | 507,8 | 0.447 | 7367050 | 1655643 | 474 |
| 23 | 66,3635 | 19,2833 | 507,6 | 0.468 | 7367076 | 1655624 | 474 |
| 24 | 66,3638 | 19,2830 | 508,1 | 0.841 | 7367100 | 1655608 | 474 |
| 25 | 66,3640 | 19,2827 | 508,8 | 0.565 | 7367123 | 1655591 | 475 |

**Table 3. GPS positions in Forest 1.**

| GPS ID | N | E | Height | RMS | N RT90 | E RT90 | H RH70 |
|---|---|---|---|---|---|---|---|
| 1 | 66,3704 | 19,2557 | 533,8 | 0.518 | 7367769 | 1654347 | 500 |
| 2 | 66,3707 | 19,2550 | 534,0 | 0.572 | 7367809 | 1654311 | 500 |
| 3 | 66,3711 | 19,2540 | 532,7 | 0.511 | 7367843 | 1654266 | 499 |
| 4 | 66,3713 | 19,2531 | 533,3 | 0.714 | 7367864 | 1654226 | 499 |
| 5 | 66,3716 | 19,2526 | 532,0 | 0.467 | 7367897 | 1654199 | 498 |
| 6 | 66,3709 | 19,2567 | 528,9 | 0.652 | 7367830 | 1654389 | 495 |
| 7 | 66,3711 | 19,2559 | 532,9 | 1.249 | 7367854 | 1654351 | 499 |
| 8 | 66,3714 | 19,2547 | 530,6 | 0.792 | 7367883 | 1654298 | 497 |
| 9 | 66,3716 | 19,2540 | 530,4 | 0.627 | 7367903 | 1654263 | 496 |
| 10 | 66,3719 | 19,2532 | 529,4 | 0.760 | 7367930 | 1654225 | 495 |
| 11 | 66,3712 | 19,2574 | 527,9 | 0.540 | 7367862 | 1654419 | 494 |
| 12 | 66,3714 | 19,2566 | 530,1 | 0.534 | 7367882 | 1654381 | 496 |
| 13 | 66,3716 | 19,2556 | 529,7 | 0.550 | 7367911 | 1654334 | 496 |
| 14 | 66,3719 | 19,2547 | 531,1 | 0.642 | 7367939 | 1654294 | 497 |
| 15 | 66,3721 | 19,2540 | 526,1 | 0.463 | 7367961 | 1654258 | 492 |
| 16 | 66,3715 | 19,2582 | 523,6 | 0.575 | 7367898 | 1654452 | 490 |
| 17 | 66,3717 | 19,2573 | 526,6 | 0.592 | 7367919 | 1654410 | 493 |
| 18 | 66,3720 | 19,2564 | 524,8 | 0.472 | 7367947 | 1654367 | 491 |
| 19 | 66,3722 | 19,2555 | 523,8 | 0.632 | 7367974 | 1654327 | 490 |
| 20 | 66,3724 | 19,2546 | 525,1 | 0.509 | 7367996 | 1654283 | 491 |
| 21 | 66,3718 | 19,2590 | 522,9 | 1.944 | 7367932 | 1654485 | 489 |
| 22 | 66,3720 | 19,2579 | 522,2 | 0.606 | 7367952 | 1654436 | 488 |
| 23 | 66,3723 | 19,2571 | 522,8 | 0.612 | 7367985 | 1654399 | 489 |
| 24 | 66,3726 | 19,2564 | 520,9 | 0.806 | 7368015 | 1654364 | 487 |
| 25 | 66,3728 | 19,2559 | 522,1 | 1.373 | 7368042 | 1654340 | 488 |
| 26 | 66,3724 | 19,2601 | 517,3 | 0.846 | 7368007 | 1654530 | 483 |
| 27 | 66,3726 | 19,2593 | 526,1 | 3.697 | 7368031 | 1654492 | 492 |
| 28 | 66,3729 | 19,2586 | 518,4 | 0.745 | 7368061 | 1654460 | 484 |
| 29 | 66,3733 | 19,2578 | 518,1 | 0.718 | 7368098 | 1654421 | 484 |
| 30 | 66,3735 | 19,2570 | 516,7 | 2.669 | 7368126 | 1654387 | 483 |
| 31 | 66,3739 | 19,2562 | 515,0 | 1.126 | 7368158 | 1654347 | 481 |
| 32 | 66,3728 | 19,2613 | 520,1 | 1.330 | 7368049 | 1654582 | 486 |
| 33 | 66,3731 | 19,2604 | 515,5 | 0.789 | 7368082 | 1654541 | 481 |
| 34 | 66,3743 | 19,2581 | 538,5 | 10.000 | 7368217 | 1654429 | 504 |
| 35 | 66,3739 | 19,2581 | 518,5 | 8.911 | 7368170 | 1654434 | 484 |
| 36 | 66,3742 | 19,2573 | 516,9 | 0.664 | 7368199 | 1654394 | 483 |
| 37 | 66,3730 | 19,2621 | 514,4 | 0.627 | 7368079 | 1654618 | 480 |
| 38 | 66,3734 | 19,2611 | 514,1 | 1.530 | 7368117 | 1654569 | 480 |
| 39 | 66,3737 | 19,2605 | 514,0 | 0.613 | 7368151 | 1654542 | 480 |
| 40 | 66,3740 | 19,2598 | 514,7 | 1.339 | 7368182 | 1654508 | 481 |
| 41 | 66,3743 | 19,2590 | 514,8 | 1.049 | 7368213 | 1654471 | 481 |
| 42 | 66,3746 | 19,2587 | 516,0 | 1.315 | 7368251 | 1654456 | 482 |
| 43 | 66,3741 | 19,2615 | 512,0 | 0.962 | 7368202 | 1654582 | 478 |
| 44 | 66,3745 | 19,2608 | 511,3 | 0.625 | 7368237 | 1654549 | 477 |
| 45 | 66,3748 | 19,2604 | 509,4 | 0.597 | 7368276 | 1654530 | 475 |
| 46 | 66,3751 | 19,2597 | 509,7 | 0.935 | 7368307 | 1654496 | 476 |
| 47 | 66,3753 | 19,2589 | 512,6 | 1.195 | 7368326 | 1654460 | 479 |
| 48 | 66,3742 | 19,2623 | 511,6 | 0.871 | 7368214 | 1654620 | 478 |
| 49 | 66,3745 | 19,2628 | 508,0 | 0.791 | 7368247 | 1654637 | 474 |
| 50 | 66,3748 | 19,2616 | 510,4 | 0.794 | 7368272 | 1654583 | 476 |

**Table 4. GPS positions in Forest 2.**

| GPS ID | N | E | Height | RMS | N RT90 | E RT90 | H RH70 |
|---|---|---|---|---|---|---|---|
| 1 | 66,3914 | 19,2429 | 534,7 | 0.028 | 7370079 | 1653646 | 501 |
| 2 | 66,3915 | 19,2438 | 532,2 | 0.541 | 7370094 | 1653683 | 498 |
| 3 | 66,3914 | 19,2450 | 534,9 | 1.208 | 7370080 | 1653742 | 501 |
| 4 | 66,3914 | 19,2462 | 526,4 | 1.570 | 7370083 | 1653793 | 492 |
| 5 | 66,3913 | 19,2472 | 528,0 | 0.663 | 7370082 | 1653838 | 494 |
| 6 | 66,3911 | 19,2430 | 536,3 | 0.494 | 7370046 | 1653652 | 502 |
| 7 | 66,3911 | 19,2439 | 535,8 | 0.411 | 7370049 | 1653691 | 502 |
| 8 | 66,3911 | 19,2451 | 533,3 | 0.511 | 7370056 | 1653747 | 499 |
| 9 | 66,3910 | 19,2460 | 532,7 | 0.448 | 7370043 | 1653786 | 499 |
| 10 | 66,3909 | 19,2469 | 530,8 | 0.529 | 7370034 | 1653829 | 497 |
| 11 | 66,3907 | 19,2429 | 536,9 | 0.359 | 7370007 | 1653651 | 503 |
| 12 | 66,3907 | 19,2441 | 536,0 | 0.577 | 7370007 | 1653703 | 502 |
| 13 | 66,3906 | 19,2446 | 533,8 | 0.763 | 7370000 | 1653727 | 500 |
| 14 | 66,3906 | 19,2460 | 531,8 | 0.830 | 7370003 | 1653790 | 498 |
| 15 | 66,3906 | 19,2468 | 531,2 | 0.594 | 7369998 | 1653827 | 497 |
| 16 | 66,3904 | 19,2430 | 538,0 | 0.652 | 7369968 | 1653657 | 504 |
| 17 | 66,3904 | 19,2442 | 536,5 | 0.666 | 7369973 | 1653708 | 502 |
| 18 | 66,3904 | 19,2450 | 535,1 | 0.781 | 7369970 | 1653745 | 501 |
| 19 | 66,3903 | 19,2460 | 533,3 | 0.652 | 7369962 | 1653790 | 499 |
| 20 | 66,3902 | 19,2470 | 533,8 | 0.726 | 7369952 | 1653838 | 500 |
| 21 | 66,3899 | 19,2431 | 537,6 | 0.545 | 7369918 | 1653663 | 503 |
| 22 | 66,3900 | 19,2440 | 536,5 | 0.607 | 7369927 | 1653703 | 502 |
| 23 | 66,3900 | 19,2447 | 537,8 | 0.625 | 7369932 | 1653733 | 504 |
| 24 | 66,3899 | 19,2456 | 537,0 | 0.689 | 7369921 | 1653775 | 503 |
| 25 | 66,3899 | 19,2468 | 535,5 | 0.666 | 7369919 | 1653831 | 501 |
| 26 | 66,3897 | 19,2427 | 536,2 | 0.394 | 7369888 | 1653648 | 502 |
| 27 | 66,3897 | 19,2438 | 535,0 | 0.704 | 7369889 | 1653696 | 501 |
| 28 | 66,3897 | 19,2447 | 535,1 | 0.393 | 7369889 | 1653736 | 501 |
| 29 | 66,3896 | 19,2458 | 535,4 | 0.554 | 7369887 | 1653784 | 501 |
| 30 | 66,3895 | 19,2468 | 536,7 | 0.507 | 7369883 | 1653832 | 503 |
| 31 | 66,3893 | 19,2428 | 536,7 | 0.667 | 7369841 | 1653652 | 503 |
| 32 | 66,3893 | 19,2436 | 536,8 | 0.366 | 7369844 | 1653692 | 503 |
| 33 | 66,3893 | 19,2447 | 535,9 | 0.526 | 7369851 | 1653737 | 502 |
| 34 | 66,3893 | 19,2456 | 536,7 | 0.515 | 7369847 | 1653778 | 503 |
| 35 | 66,3892 | 19,2467 | 534,8 | 0.241 | 7369845 | 1653831 | 501 |
| 36 | 66,3889 | 19,2428 | 538,3 | 0.526 | 7369806 | 1653655 | 504 |
| 37 | 66,3890 | 19,2435 | 534,9 | 0.590 | 7369810 | 1653689 | 501 |
| 38 | 66,3889 | 19,2444 | 538,2 | 0.227 | 7369806 | 1653727 | 504 |
| 39 | 66,3889 | 19,2456 | 536,1 | 0.690 | 7369812 | 1653782 | 502 |
| 40 | 66,3888 | 19,2465 | 536,6 | 0.785 | 7369801 | 1653821 | 502 |
| 41 | 66,3886 | 19,2427 | 534,1 | 0.625 | 7369771 | 1653654 | 500 |
| 42 | 66,3887 | 19,2436 | 535,3 | 0.446 | 7369776 | 1653695 | 501 |
| 43 | 66,3886 | 19,2446 | 534,6 | 0.536 | 7369770 | 1653740 | 501 |
| 44 | 66,3886 | 19,2456 | 537,6 | 0.483 | 7369770 | 1653783 | 504 |
| 45 | 66,3885 | 19,2467 | 533,2 | 0.537 | 7369761 | 1653833 | 499 |
| 46 | 66,3883 | 19,2425 | 530,7 | 0.023 | 7369737 | 1653648 | 497 |
| 47 | 66,3882 | 19,2434 | 532,8 | 0.458 | 7369725 | 1653689 | 499 |
| 48 | 66,3882 | 19,2445 | 533,1 | 0.571 | 7369731 | 1653735 | 499 |
| 49 | 66,3882 | 19,2456 | 533,5 | 0.566 | 7369726 | 1653786 | 499 |
| 50 | 66,3882 | 19,2466 | 531,2 | 0.491 | 7369732 | 1653833 | 497 |

## *4.2 Deployment Gustav (F2/A5)*

Date of deployment: 2002-05-31 – 2002-06-03
Site location: Forest 1
Note: The deployment was ready 2002-05-31 at 11.00, and removed on 2002-06-03 after 09.30.

Compare this deployment to deployment Johan to evaluate the change detection performance in a situation where targets under trees placed in random directions are moved far from and close to the earlier positions. The targets with numbers 1, 2, 4, 8, 9, 12, 14, 17, 18, 20, 21, 24 in this deployment are moved slightly from their original positions. The rest are moved to completely new positions.

**Table 5. Target data of deployment Gustav.**

| ID | License no. | Type | GPS ID | N | E | Height | Heading | Pitch | Roll |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 112662 | TGB11 | 26 | 66,3724 | 19,2601 | 517,3 | 278 | 0 | 0 |
| 2 | 113337 | TGB11 | 27 | 66,3726 | 19,2593 | 526,1 | 298 | 0 | 2 |
| 3 | 112633 | TGB11 | 28 | 66,3729 | 19,2586 | 518,4 | 190 | 2 | 3 |
| 4 | 113335 | TGB11 | 29 | 66,3733 | 19,2578 | 518,1 | 20 | -2 | 1 |
| 5 | 112832 | TGB11 | 30 | 66,3735 | 19,2570 | 516,7 | 340 | 2 | -2 |
| 6 | 112820 | TGB11 | 31 | 66,3739 | 19,2562 | 515,0 | 158 | 3 | 5 |
| 7 | 331777 | TGB30 | 32 | 66,3728 | 19,2613 | 520,1 | 212 | 2 | 0 |
| 8 | 331201 | TGB30 | 33 | 66,3731 | 19,2604 | 515,5 | 276 | 0 | 0 |
| 9 | 113428 | TGB11 | 34 | 66,3743 | 19,2581 | 538,5 | 90 | -1 | -1 |
| 10 | 113414 | TGB11 | 35 | 66,3739 | 19,2581 | 518,5 | 158 | -1 | 7 |
| 11 | 113375 | TGB11 | 36 | 66,3742 | 19,2573 | 516,9 | 291 | -4 | 1 |
| 12 | 330338 | TGB30 | 37 | 66,3730 | 19,2621 | 514,4 | 284 | 2 | -5 |
| 13 | 330308 | TGB30 | 38 | 66,3734 | 19,2611 | 514,1 | 142 | 0 | 5 |
| 14 | 331120 | TGB30 | 39 | 66,3737 | 19,2605 | 514,0 | 244 | 2 | -4 |
| 15 | 331774 | TGB30 | 40 | 66,3740 | 19,2598 | 514,7 | 102 | -1 | 0 |
| 16 | 331052 | TGB30 | 41 | 66,3743 | 19,2590 | 514,8 | 60 | 0 | 1 |
| 17 | 330280 | TGB30 | 42 | 66,3746 | 19,2587 | 516,0 | 152 | 0 | 4 |
| 18 | 340785 | TGB40 | 43 | 66,3741 | 19,2615 | 512,0 | 152 | 0 | 2 |
| 19 | 112776 | TGB11 | 44 | 66,3745 | 19,2608 | 511,3 | 70 | -3 | 4 |
| 20 | 345005 | TGB40 | 45 | 66,3748 | 19,2604 | 509,4 | 150 | 3 | 2 |
| 21 | 340323 | TGB40 | 46 | 66,3751 | 19,2597 | 509,7 | 238 | 3 | -2 |
| 22 | 345009 | TGB40 | 47 | 66,3753 | 19,2589 | 512,6 | 264 | 2 | -2 |
| 23 | 340255 | TGB40 | 48 | 66,3742 | 19,2623 | 511,6 | 138 | 1 | 3 |
| 24 | 340095 | TGB40 | 49 | 66,3745 | 19,2628 | 508,0 | 68 | -2 | 3 |
| 25 | 340278 | TGB40 | 50 | 66,3748 | 19,2616 | 510,4 | 76 | -3 | 5 |

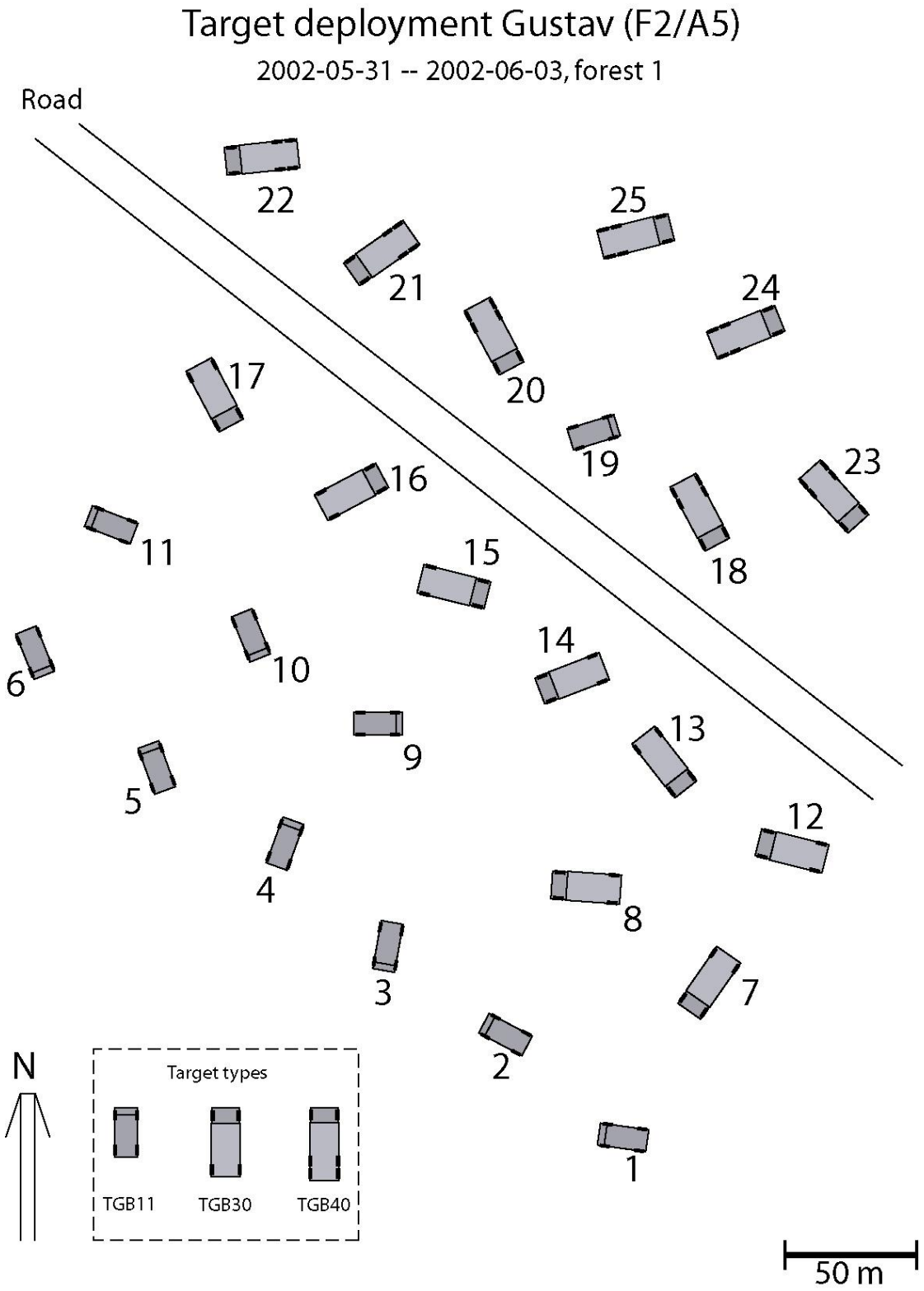


**Figure 17. Sketch of deployment Gustav.**

## *4.3 Deployment Erik (F1)*

Date of deployment: 2002-06-03 – 2002-06-05
Site location: Field at Nausta village
Note: This deployment was ready 2002-06-03 at 11.10. On 2002-06-04 targets with numbers 2, 5, 6, 7, 8, 9, 11, 13, 15, 17, 18, 22 were removed and placed at deployment Johan. The reconfiguration started at 11.30 and was completed by 13.00 (TBG 11 finished by 12.00, TGB 30 by 12.30 and TGB 40 by 13.00).

Use this deployment to evaluate signatures from targets placed in an open field.

**Table 6. Target data of deployment Erik.**

| ID | License no. | Type | GPS ID | N | E | Height | Heading |
|---|---|---|---|---|---|---|---|
| 1 | 112820 | TGB11 | 1 | 66,3628 | 19,2812 | 509,7 | 322 |
| 2 | 113337 | TGB11 | 2 | 66,3630 | 19,2810 | 509,4 | 350 |
| 3 | 112832 | TGB11 | 3 | 66,3632 | 19,2806 | 509,8 | 24 |
| 4 | 112633 | TGB11 | 4 | 66,3634 | 19,2804 | 509,8 | 58 |
| 5 | 113428 | TGB11 | 5 | 66,3636 | 19,2800 | 510,2 | 80 |
| 6 | 112662 | TGB11 | 6 | 66,3638 | 19,2797 | 511,0 | 108 |
| 7 | 113335 | TGB11 | 7 | 66,3640 | 19,2795 | 511,1 | 144 |
| 8 | 331201 | TGB30 | 8 | 66,3627 | 19,2819 | 509,8 | 332 |
| 9 | 330280 | TGB30 | 9 | 66,3629 | 19,2817 | 510,4 | 332 |
| 10 | 330308 | TGB30 | 10 | 66,3631 | 19,2814 | 509,7 | 332 |
| 11 | 331120 | TGB30 | 11 | 66,3633 | 19,2812 | 508,7 | 332 |
| 12 | 331052 | TGB30 | 12 | 66,3635 | 19,2810 | 509,6 | 332 |
| 13 | 330338 | TGB30 | 13 | 66,3638 | 19,2807 | 510,2 | 332 |
| 14 | 113375 | TGB11 | 14 | 66,3631 | 19,2825 | 508,5 | 328 |
| 15 | 340785 | TGB40 | 15 | 66,3633 | 19,2821 | 507,8 | 328 |
| 16 | 345009 | TGB40 | 16 | 66,3635 | 19,2818 | 509,4 | 328 |
| 17 | 340095 | TGB40 | 17 | 66,3637 | 19,2815 | 509,6 | 328 |
| 18 | 340323 | TGB40 | 18 | 66,3632 | 19,2831 | 508,4 | 324 |
| 19 | 113414 | TGB11 | 19 | 66,3634 | 19,2827 | 508,7 | 324 |
| 20 | 340278 | TGB40 | 20 | 66,3636 | 19,2824 | 508,9 | 324 |
| 21 | 331777 | TGB30 | 21 | 66,3638 | 19,2820 | 509,7 | 324 |
| 22 | 345005 | TGB40 | 22 | 66,3633 | 19,2837 | 507,8 | 324 |
| 23 | 112776 | TGB11 | 23 | 66,3635 | 19,2833 | 507,6 | 324 |
| 24 | 340255 | TGB40 | 24 | 66,3638 | 19,2830 | 508,1 | 324 |
| 25 | 331774 | TGB30 | 25 | 66,3640 | 19,2827 | 508,8 | 324 |

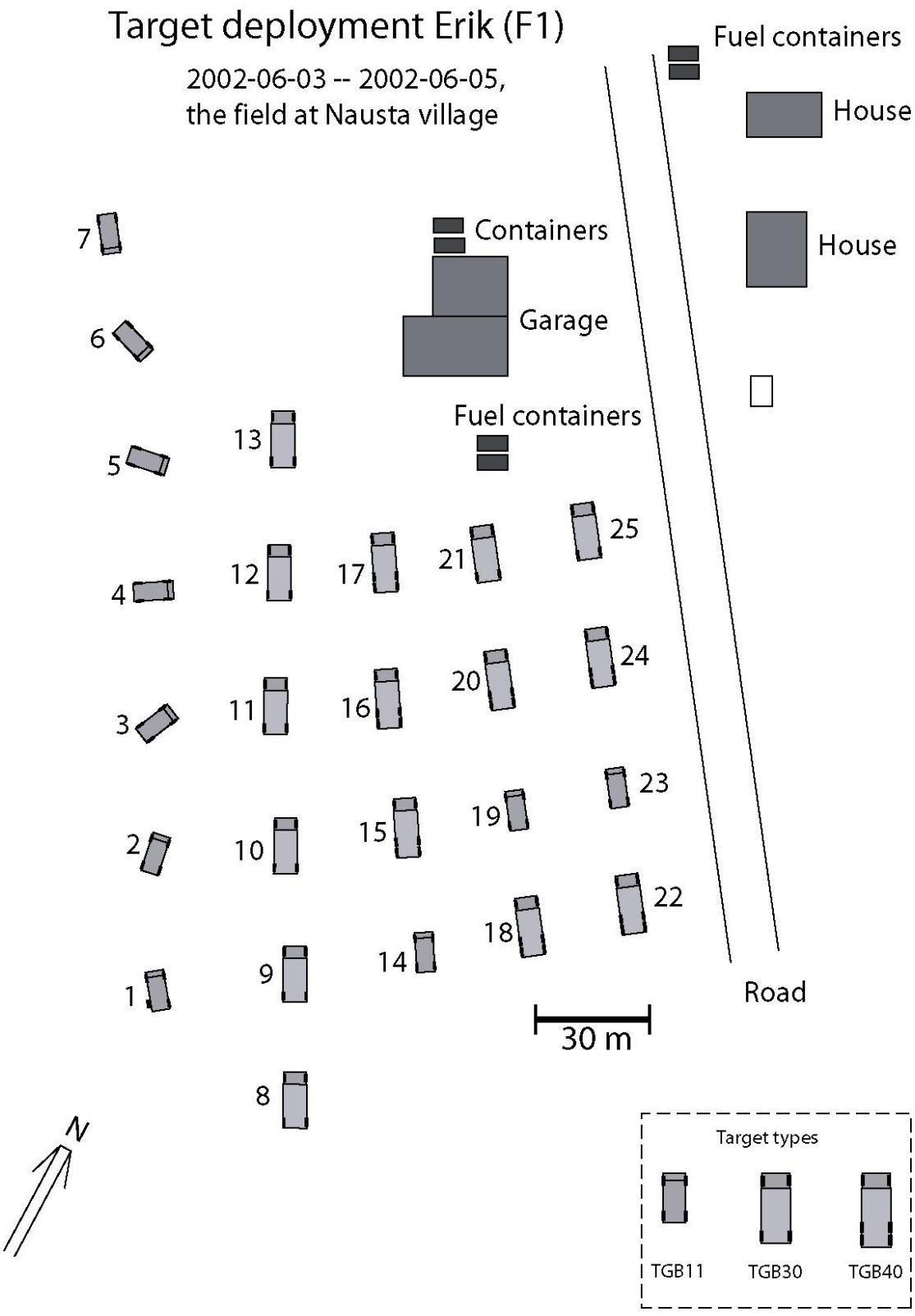


**Figure 18. Sketch of deployment Erik.**

## *4.4 Deployment Johan (F3/A6)*

Date of deployment: 2002-06-04 – 2002-06-09
Site location: Forest 1
Note: This deployment was partially complete 2002-06-04 at 13.00 (ID 14-25, see deployment Erik for more details), and fully complete 2002-06-05 at 21.00. During 2002-06-06 targets with numbers 14, 15, 17, 18, 19, 20 were used as moving targets between 10.00 and 14.00, and then returned to the same position and heading as before.

Compare this deployment to deployment Gustav to evaluate the situation when targets under trees placed in random directions have been moved far from and close to the earlier positions. The targets with numbers 14-25 in this deployment have moved slightly backward or forward relative to their original positions (center points) in deployment Gustav. The rest have moved to completely new positions.

**Table 7. Target data of deployment Johan. A missing value in the backward and forward columns means properly positioned in compliance with the GPS measured center point.**

| ID | License no. | Type | GPS ID | N | E | Height | Backward | Forward | Heading | Pitch | Roll |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 112633 | TGB11 | 1 | 66,3704 | 19,2557 | 533,8 | | | 43 | 0 | 0 |
| 2 | 112776 | TGB11 | 2 | 66,3707 | 19,2550 | 534,0 | | | 194 | 0 | 1 |
| 3 | 112820 | TGB11 | 3 | 66,3711 | 19,2540 | 532,7 | | | 106 | -1 | 1 |
| 4 | 112832 | TGB11 | 4 | 66,3713 | 19,2531 | 533,3 | | | 40 | -2 | 4 |
| 5 | 113375 | TGB11 | 5 | 66,3716 | 19,2526 | 532,0 | | | 251 | -1 | -3 |
| 6 | 340278 | TGB40 | 6 | 66,3709 | 19,2567 | 528,9 | | | 160 | 0 | 4 |
| 7 | 330308 | TGB30 | 7 | 66,3711 | 19,2559 | 532,9 | | | 212 | 3 | -6 |
| 8 | 331777 | TGB30 | 8 | 66,3714 | 19,2547 | 530,6 | | | 166 | 3 | 5 |
| 9 | 331052 | TGB30 | 9 | 66,3716 | 19,2540 | 530,4 | | | 230 | 3 | -4 |
| 10 | 113414 | TGB11 | 10 | 66,3719 | 19,2532 | 529,4 | | | 32 | -3 | 0 |
| 11 | 331774 | TGB30 | 13 | 66,3716 | 19,2556 | 529,7 | | | 348 | -2 | 0 |
| 12 | 340255 | TGB40 | 14 | 66,3719 | 19,2547 | 531,1 | | | 114 | 0 | 5 |
| 13 | 345009 | TGB40 | 15 | 66,3721 | 19,2540 | 526,1 | | | 54 | -4 | 4 |
| 14 | 112662 | TGB11 | 26 | 66,3724 | 19,2601 | 517,3 | 1,60 | | 272 | 3 | -1 |
| 15 | 113337 | TGB11 | 27 | 66,3726 | 19,2593 | 526,1 | | 2,40 | 288 | 2 | -2 |
| 16 | 113335 | TGB11 | 29 | 66,3733 | 19,2578 | 518,1 | 2,00 | | 22 | -2 | -3 |
| 17 | 331201 | TGB30 | 33 | 66,3731 | 19,2604 | 515,5 | 2,90 | | 270 | 0 | -1 |
| 18 | 113428 | TGB11 | 34 | 66,3743 | 19,2581 | 538,5 | | 1,80 | 82 | 0 | 1 |
| 19 | 330338 | TGB30 | 37 | 66,3730 | 19,2621 | 514,4 | 2,30 | | 280 | 0 | -5 |
| 20 | 331120 | TGB30 | 39 | 66,3737 | 19,2605 | 514,0 | 2,70 | | 242 | 2 | -3 |
| 21 | 330280 | TGB30 | 42 | 66,3746 | 19,2587 | 516,0 | | 2,60 | 146 | -2 | 2 |
| 22 | 340785 | TGB40 | 43 | 66,3741 | 19,2615 | 512,0 | 3,00 | | 152 | 0 | 2 |
| 23 | 345005 | TGB40 | 45 | 66,3748 | 19,2604 | 509,4 | | 4,80 | 144 | 4 | 3 |
| 24 | 340323 | TGB40 | 46 | 66,3751 | 19,2597 | 509,7 | 3,70 | | 228 | 2 | -2 |
| 25 | 340095 | TGB40 | 49 | 66,3745 | 19,2628 | 508,0 | 2,30 | | 68 | -2 | 2 |

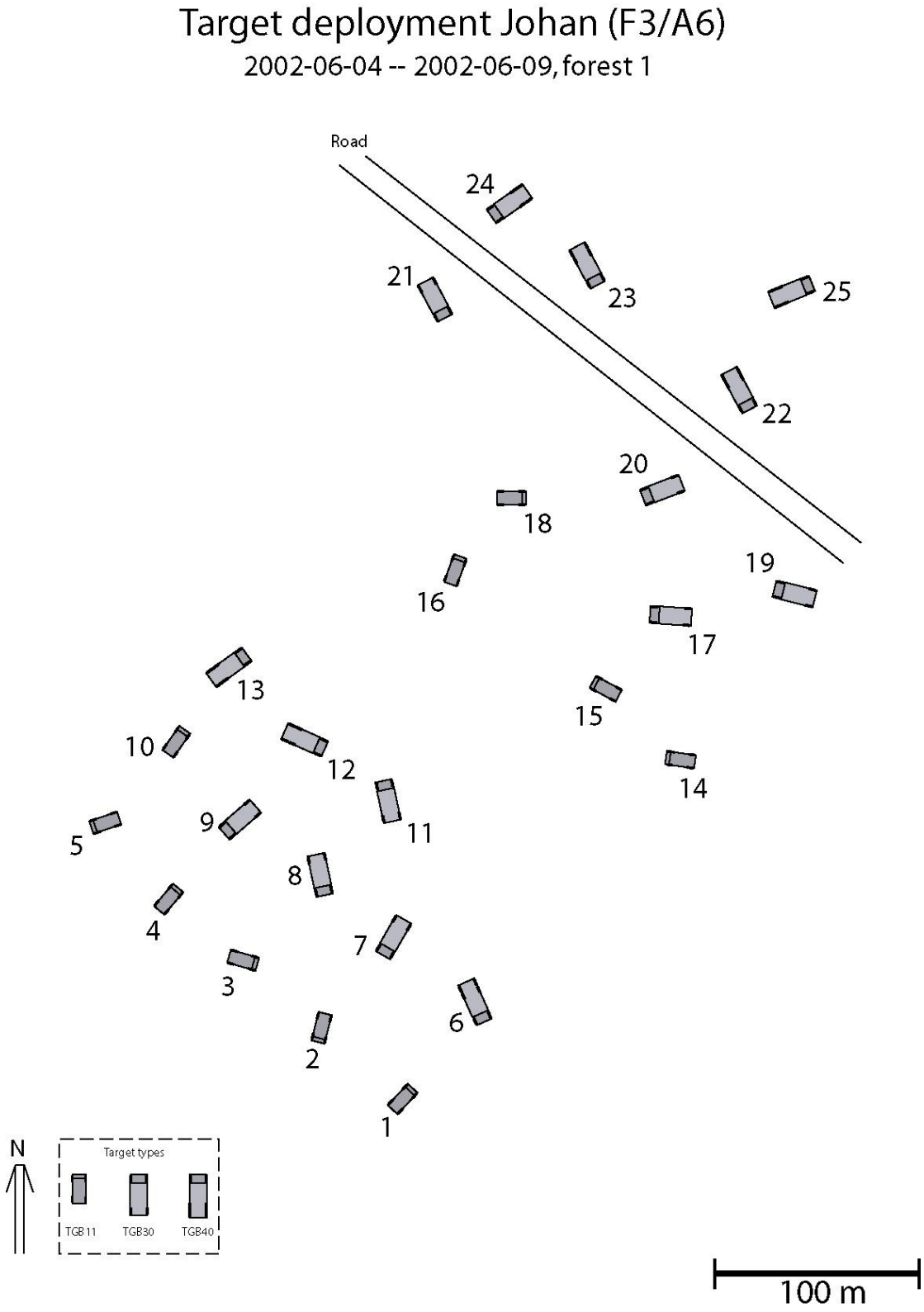


**Figure 19. Sketch of deployment Johan.**

## *4.5 Deployment Sigismund (A1)*

Date of deployment: 2002-06-10
Site location: Forest 2
Note: The deployment was ready by 10.30, and reconfiguration to deployment Karl started around 12.45.

Compare this deployment to deployment Karl to evaluate the situation when targets under trees, all placed in the same direction, are moved to new positions far from the earlier positions and placed in a direction of 90° from their original direction.

**Table 8. Target data of deployment Sigismund.**

| ID | License no. | Type | GPS ID | N | E | Height | Heading | Pitch | Roll |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 112776 | TGB11 | 26 | 66,3897 | 19,2427 | 536,2 | 225 | -2 | 3 |
| 2 | 112820 | TGB11 | 27 | 66,3897 | 19,2438 | 535,0 | 222 | 0 | -1 |
| 3 | 112832 | TGB11 | 28 | 66,3897 | 19,2447 | 535,1 | 222 | -1 | -1 |
| 4 | 112633 | TGB11 | 29 | 66,3896 | 19,2458 | 535,4 | 220 | -1 | -1 |
| 5 | 113375 | TGB11 | 30 | 66,3895 | 19,2468 | 536,7 | 224 | 1 | 1 |
| 6 | 113414 | TGB11 | 31 | 66,3893 | 19,2428 | 536,7 | 222 | -1 | 4 |
| 7 | 112662 | TGB11 | 32 | 66,3893 | 19,2436 | 536,8 | 226 | -1 | -2 |
| 8 | 113335 | TGB11 | 33 | 66,3893 | 19,2447 | 535,9 | 224 | 2 | 2 |
| 9 | 113428 | TGB11 | 34 | 66,3893 | 19,2456 | 536,7 | 220 | -2 | 1 |
| 10 | 113337 | TGB11 | 35 | 66,3892 | 19,2467 | 534,8 | 224 | 3 | 2 |
| 11 | 331120 | TGB30 | 36 | 66,3889 | 19,2428 | 538,3 | 220 | -3 | 4 |
| 12 | 330280 | TGB30 | 37 | 66,3890 | 19,2435 | 534,9 | 222 | 0 | -1 |
| 13 | 331052 | TGB30 | 38 | 66,3889 | 19,2444 | 538,2 | 224 | -2 | 0 |
| 14 | 331774 | TGB30 | 39 | 66,3889 | 19,2456 | 536,1 | 220 | 1 | -1 |
| 15 | 331777 | TGB30 | 40 | 66,3888 | 19,2465 | 536,6 | 218 | 1 | 0 |
| 16 | 340255 | TGB40 | 41 | 66,3886 | 19,2427 | 534,1 | 218 | -3 | 0 |
| 17 | 340278 | TGB40 | 42 | 66,3887 | 19,2436 | 535,3 | 222 | 1 | -2 |
| 18 | 330338 | TGB30 | 43 | 66,3886 | 19,2446 | 534,6 | 220 | -2 | -2 |
| 19 | 330308 | TGB30 | 44 | 66,3886 | 19,2456 | 537,6 | 224 | 0 | 0 |
| 20 | 331201 | TGB30 | 45 | 66,3885 | 19,2467 | 533,2 | 226 | 0 | 4 |
| 21 | 345009 | TGB40 | 46 | 66,3883 | 19,2425 | 530,7 | 222 | -3 | 4 |
| 22 | 345005 | TGB40 | 47 | 66,3882 | 19,2434 | 532,8 | 222 | -4 | 2 |
| 23 | 340323 | TGB40 | 48 | 66,3882 | 19,2445 | 533,1 | 220 | -4 | 5 |
| 24 | 340095 | TGB40 | 49 | 66,3882 | 19,2456 | 533,5 | 224 | -2 | 5 |
| 25 | 340785 | TGB40 | 50 | 66,3882 | 19,2466 | 531,2 | 224 | -1 | 5 |

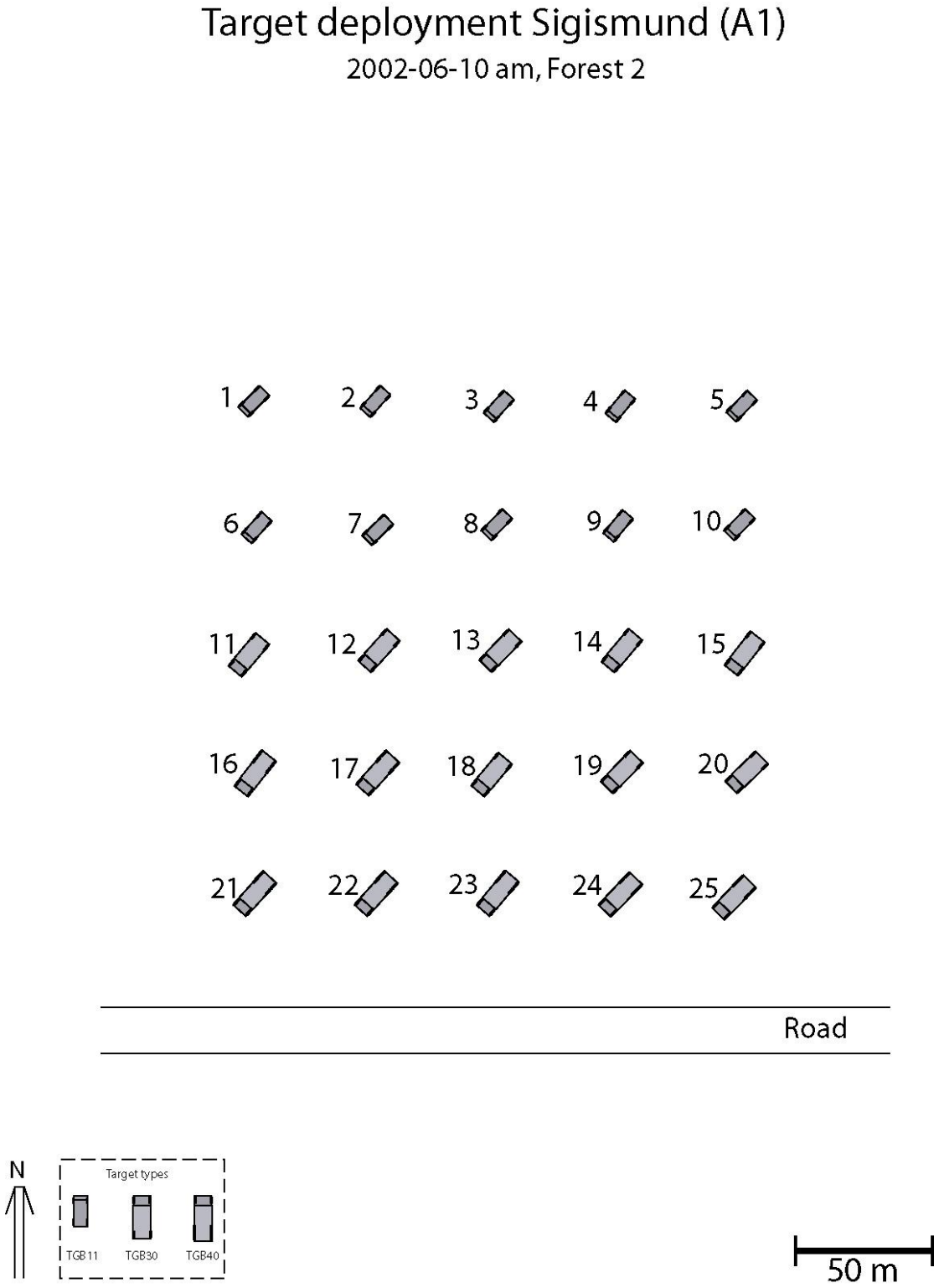


**Figure 20. Sketch of deployment Sigismund.**

## 4.6 Deployment Karl (A2)

Date of deployment: 2002-06-10
Site location: Forest 2
Note: The deployment was ready by 14.00.

Compare this deployment to deployment Sigismund to evaluate the situation when targets under trees, all placed in the same direction, have been moved to new positions far from the earlier positions and placed in a direction of 90° from their original direction.

**Table 9. Target data of deployment Karl.**

| ID | License no. | Type | GPS ID | N | E | Height | Heading | Pitch | Roll |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 112820 | TGB11 | 1 | 66,3914 | 19,2429 | 534,7 | 320 | -5 | -1 |
| 2 | 112776 | TGB11 | 2 | 66,3915 | 19,2438 | 532,2 | 316 | -1 | -2 |
| 3 | 112832 | TGB11 | 3 | 66,3914 | 19,2450 | 534,9 | 320 | -3 | -6 |
| 4 | 112633 | TGB11 | 4 | 66,3914 | 19,2462 | 526,4 | 314 | -1 | 2 |
| 5 | 112662 | TGB11 | 5 | 66,3913 | 19,2472 | 528,0 | 314 | 1 | -4 |
| 6 | 113414 | TGB11 | 6 | 66,3911 | 19,2430 | 536,3 | 318 | -3 | -2 |
| 7 | 113337 | TGB11 | 7 | 66,3911 | 19,2439 | 535,8 | 316 | -3 | 0 |
| 8 | 113428 | TGB11 | 8 | 66,3911 | 19,2451 | 533,3 | 320 | -1 | -1 |
| 9 | 113375 | TGB11 | 9 | 66,3910 | 19,2460 | 532,7 | 312 | -2 | -6 |
| 10 | 113335 | TGB11 | 10 | 66,3909 | 19,2469 | 530,8 | 312 | 3 | -5 |
| 11 | 331120 | TGB30 | 11 | 66,3907 | 19,2429 | 536,9 | 320 | 0 | -2 |
| 12 | 331774 | TGB30 | 12 | 66,3907 | 19,2441 | 536,0 | 316 | 0 | -2 |
| 13 | 330280 | TGB30 | 13 | 66,3906 | 19,2446 | 533,8 | 310 | 0 | -3 |
| 14 | 331052 | TGB30 | 14 | 66,3906 | 19,2460 | 531,8 | 320 | 0 | -1 |
| 15 | 331777 | TGB30 | 15 | 66,3906 | 19,2468 | 531,2 | 312 | 3 | -3 |
| 16 | 340255 | TGB40 | 16 | 66,3904 | 19,2430 | 538,0 | 310 | 2 | -2 |
| 17 | 340095 | TGB40 | 17 | 66,3904 | 19,2442 | 536,5 | 310 | -1 | 0 |
| 18 | 330338 | TGB30 | 18 | 66,3904 | 19,2450 | 535,1 | 306 | 1 | -4 |
| 19 | 330308 | TGB30 | 19 | 66,3903 | 19,2460 | 533,3 | 316 | 0 | -6 |
| 20 | 331201 | TGB30 | 20 | 66,3902 | 19,2470 | 533,8 | 310 | 2 | -6 |
| 21 | 340278 | TGB40 | 21 | 66,3899 | 19,2431 | 537,6 | 312 | -1 | -1 |
| 22 | 345005 | TGB40 | 22 | 66,3900 | 19,2440 | 536,5 | 316 | 1 | -2 |
| 23 | 340785 | TGB40 | 23 | 66,3900 | 19,2447 | 537,8 | 310 | 2 | -2 |
| 24 | 340323 | TGB40 | 24 | 66,3899 | 19,2456 | 537,0 | 312 | -2 | 0 |
| 25 | 345009 | TGB40 | 25 | 66,3899 | 19,2468 | 535,5 | 316 | -2 | 0 |

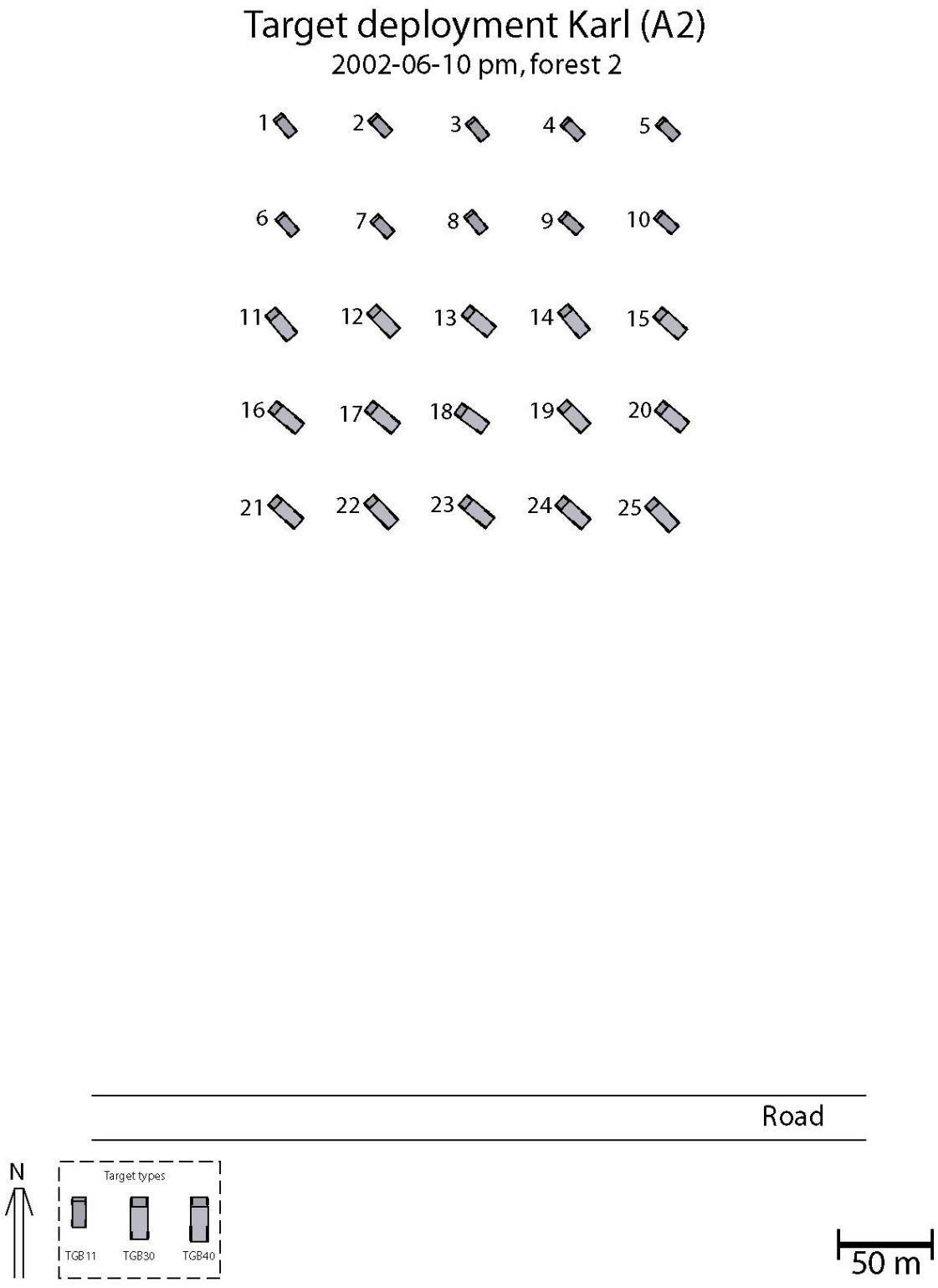


**Figure 21. Sketch of deployment Karl.**

## 4.7 Deployment Fredrik (A3)

Date of deployment: 2002-06-11
Site location: Forest 1
Note: The deployment was ready by 10.30, and reconfiguration to deployment Adolf-Fredrik started around 12.45.

Compare this deployment to deployment Adolf-Fredrik to evaluate the situation when targets under trees, all placed in the same direction, are moved to new positions far from the earlier positions and placed in a direction of 45° from their original direction.

**Table 10. Target data of deployment Fredrik.**

| ID | License no. | Type | GPS ID | N | E | Height | Backw. | Forw. | Right | Left | Heading | Pitch | Roll |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 112633 | TGB11 | 26 | 66,3724 | 19,2601 | 517,3 | | 0,5 | | | 225 | -1 | 0 |
| 2 | 113337 | TGB11 | 27 | 66,3726 | 19,2593 | 526,1 | | 0,5 | | | 230 | -1 | -1 |
| 3 | 112832 | TGB11 | 28 | 66,3729 | 19,2586 | 518,4 | | | | | 224 | 2 | 0 |
| 4 | 113428 | TGB11 | 29 | 66,3733 | 19,2578 | 518,1 | | | 0,5 | | 228 | 0 | 3 |
| 5 | 113335 | TGB11 | 30 | 66,3735 | 19,2570 | 516,7 | | 0,5 | | | 224 | -1 | -2 |
| 6 | 113375 | TGB11 | 31 | 66,3739 | 19,2562 | 515,0 | | 0,5 | | | 230 | 4 | -1 |
| 7 | 330280 | TGB30 | 32 | 66,3728 | 19,2613 | 520,1 | | | | | 226 | 3 | -1 |
| 8 | 331774 | TGB30 | 33 | 66,3731 | 19,2604 | 515,5 | | | | | 224 | 2 | -1 |
| 9 | 113414 | TGB11 | 34 | 66,3743 | 19,2581 | 538,5 | | | | | 230 | -2 | 5 |
| 10 | 112776 | TGB11 | 35 | 66,3739 | 19,2581 | 518,5 | | | | | 222 | 4 | 2 |
| 11 | 112820 | TGB11 | 36 | 66,3742 | 19,2573 | 516,9 | | | | | 228 | -3 | 0 |
| 12 | 331052 | TGB30 | 37 | 66,3730 | 19,2621 | 514,4 | | | | | 230 | 4 | 1 |
| 13 | 331120 | TGB30 | 38 | 66,3734 | 19,2611 | 514,1 | 0,5 | | 0,5 | | 230 | 1 | -5 |
| 14 | 331777 | TGB30 | 39 | 66,3737 | 19,2605 | 514,0 | | | | | 222 | 4 | -1 |
| 15 | 331201 | TGB30 | 40 | 66,3740 | 19,2598 | 514,7 | | 0,5 | | | 222 | 1 | 0 |
| 16 | 330308 | TGB30 | 41 | 66,3743 | 19,2590 | 514,8 | | 0,5 | | | 228 | -1 | -2 |
| 17 | 330338 | TGB30 | 42 | 66,3746 | 19,2587 | 516,0 | | | 2,0 | | 226 | 0 | -3 |
| 18 | 340255 | TGB40 | 43 | 66,3741 | 19,2615 | 512,0 | | | 3,0 | | 224 | 2 | 0 |
| 19 | 112662 | TGB11 | 44 | 66,3745 | 19,2608 | 511,3 | | | | | 224 | 4 | -1 |
| 20 | 340323 | TGB40 | 45 | 66,3748 | 19,2604 | 509,4 | | | 3,0 | | 220 | 3 | -2 |
| 21 | 345005 | TGB40 | 46 | 66,3751 | 19,2597 | 509,7 | | 1,0 | | 1,0 | 226 | 3 | -2 |
| 22 | 340278 | TGB40 | 47 | 66,3753 | 19,2589 | 512,6 | | | 2,0 | | 226 | 3 | -1 |
| 23 | 340785 | TGB40 | 48 | 66,3742 | 19,2623 | 511,6 | 1,5 | | | | 224 | 3 | -1 |
| 24 | 340095 | TGB40 | 49 | 66,3745 | 19,2628 | 508,0 | | 1,0 | | 0,5 | 228 | 2 | -2 |
| 25 | 345009 | TGB40 | 50 | 66,3748 | 19,2616 | 510,4 | | | 2,0 | | 220 | 2 | 0 |

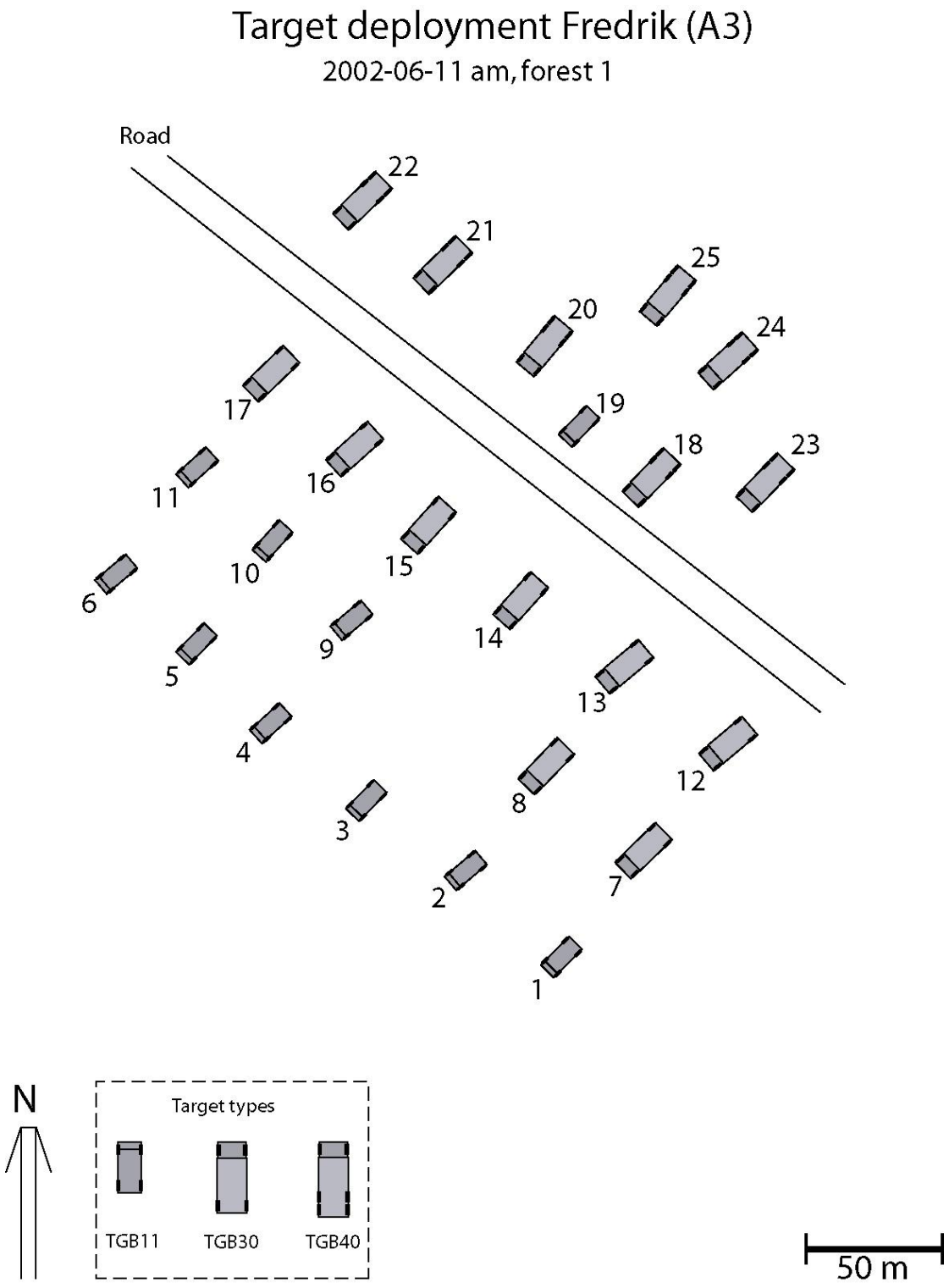


**Figure 22. Sketch of deployment Fredrik.**

## *4.8 Deployment Adolf-Fredrik (A4)*

Date of deployment: 2002-06-11
Site location: Forest 1
Note: The deployment was ready by 14.00.

Compare this deployment to deployment Fredrik to evaluate the situation when targets under trees, all placed in the same direction, have been moved to new positions far from the earlier positions and placed in a direction of 45° from their original direction.

**Table 11. Target data of deployment Adolf-Fredrik.**

| ID | License no. | Type | GPS ID | N | E | Height | Backw. | Forw. | Right | Left | Heading | Pitch | Roll |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 112633 | TGB11 | 1 | 66,3704 | 19,2557 | 533,8 | | | | | 270 | -2 | 2 |
| 2 | 113337 | TGB11 | 2 | 66,3707 | 19,2550 | 534,0 | | | | | 266 | -1 | 0 |
| 3 | 112832 | TGB11 | 3 | 66,3711 | 19,2540 | 532,7 | | | | | 270 | 0 | -1 |
| 4 | 113428 | TGB11 | 4 | 66,3713 | 19,2531 | 533,3 | | | | | 266 | -1 | -1 |
| 5 | 113335 | TGB11 | 5 | 66,3716 | 19,2526 | 532,0 | | 0,5 | | | 268 | -2 | -2 |
| 6 | 112820 | TGB11 | 6 | 66,3709 | 19,2567 | 528,9 | | | | 2,0 | 278 | 2 | -3 |
| 7 | 113414 | TGB11 | 7 | 66,3711 | 19,2559 | 532,9 | | | | | 272 | 2 | -4 |
| 8 | 112776 | TGB11 | 8 | 66,3714 | 19,2547 | 530,6 | | | 0,5 | | 268 | -2 | -4 |
| 9 | 113375 | TGB11 | 9 | 66,3716 | 19,2540 | 530,4 | | 0,5 | | | 260 | 4 | -6 |
| 10 | 112662 | TGB11 | 10 | 66,3719 | 19,2532 | 529,4 | | 2,0 | 0,5 | | 264 | -1 | -5 |
| 11 | 331777 | TGB30 | 11 | 66,3712 | 19,2574 | 527,9 | | | | | 272 | 3 | -3 |
| 12 | 331052 | TGB30 | 12 | 66,3714 | 19,2566 | 530,1 | | | | | 266 | -1 | 2 |
| 13 | 331120 | TGB30 | 13 | 66,3716 | 19,2556 | 529,7 | 1,0 | | | | 268 | -1 | -3 |
| 14 | 331774 | TGB30 | 14 | 66,3719 | 19,2547 | 531,1 | | 0,5 | | | 274 | 0 | -8 |
| 15 | 330280 | TGB30 | 15 | 66,3721 | 19,2540 | 526,1 | | | | | 270 | 3 | -3 |
| 16 | 340095 | TGB40 | 16 | 66,3715 | 19,2582 | 523,6 | 0,5 | | | | 268 | 2 | 0 |
| 17 | 340323 | TGB40 | 17 | 66,3717 | 19,2573 | 526,6 | | | | | 270 | 1 | -3 |
| 18 | 330338 | TGB30 | 18 | 66,3720 | 19,2564 | 524,8 | | | | | 276 | 3 | -3 |
| 19 | 331201 | TGB30 | 19 | 66,3722 | 19,2555 | 523,8 | | | 0,5 | | 268 | 0 | -5 |
| 20 | 330308 | TGB30 | 20 | 66,3724 | 19,2546 | 525,1 | | | 1,0 | | 270 | 2 | -1 |
| 21 | 345005 | TGB40 | 21 | 66,3718 | 19,2590 | 522,9 | | | | | 268 | 3 | 0 |
| 22 | 345009 | TGB40 | 22 | 66,3720 | 19,2579 | 522,2 | | | | | 270 | -1 | -1 |
| 23 | 340278 | TGB40 | 23 | 66,3723 | 19,2571 | 522,8 | | | | | 268 | 5 | -3 |
| 24 | 340785 | TGB40 | 24 | 66,3726 | 19,2564 | 520,9 | | | | | 264 | 0 | -5 |
| 25 | 340255 | TGB40 | 25 | 66,3728 | 19,2559 | 522,1 | | | 0,5 | | 264 | 4 | -4 |

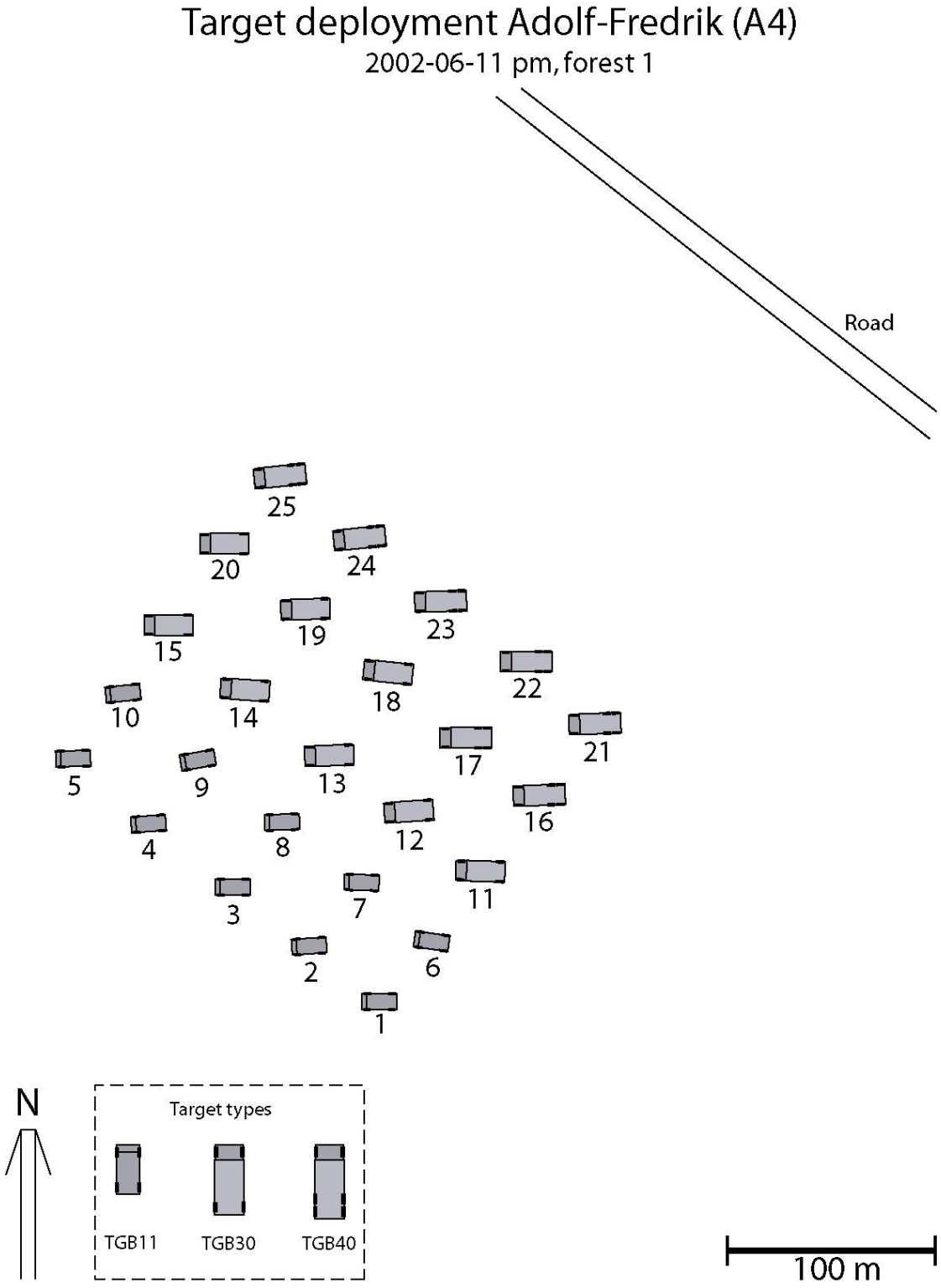


**Figure 23. Sketch of deployment Adolf-Fredrik.**

## *4.9 Deployment Margareta*

Date of deployment: See table 12
Site location: In foliage near the field at Nausta village

**Table 12. Target data of deployment Margareta.**

| Date | Time | ID | Type | Heading | N | E | Height |
|---|---|---|---|---|---|---|---|
| 2002-05-31 | 11.00 - 16.30 | 1 | V70 | 290 | 66,3645 | 19,2774 | 513,4 |
| 2002-05-31 | 11.00 - 13.30 and 15.30 - 16.30 | 2 | V70 | 300 | 66,3647 | 19,2775 | 512,4 |
| 2002-06-02 | 03.00 - 08.00 (ca) | 1 | V70 | 290 | 66,3645 | 19,2774 | 513,4 |
| 2002-06-11 | 15.00 - 17.00 | 1 | V70 | 60 | 66,3645 | 19,2774 | 513,4 |

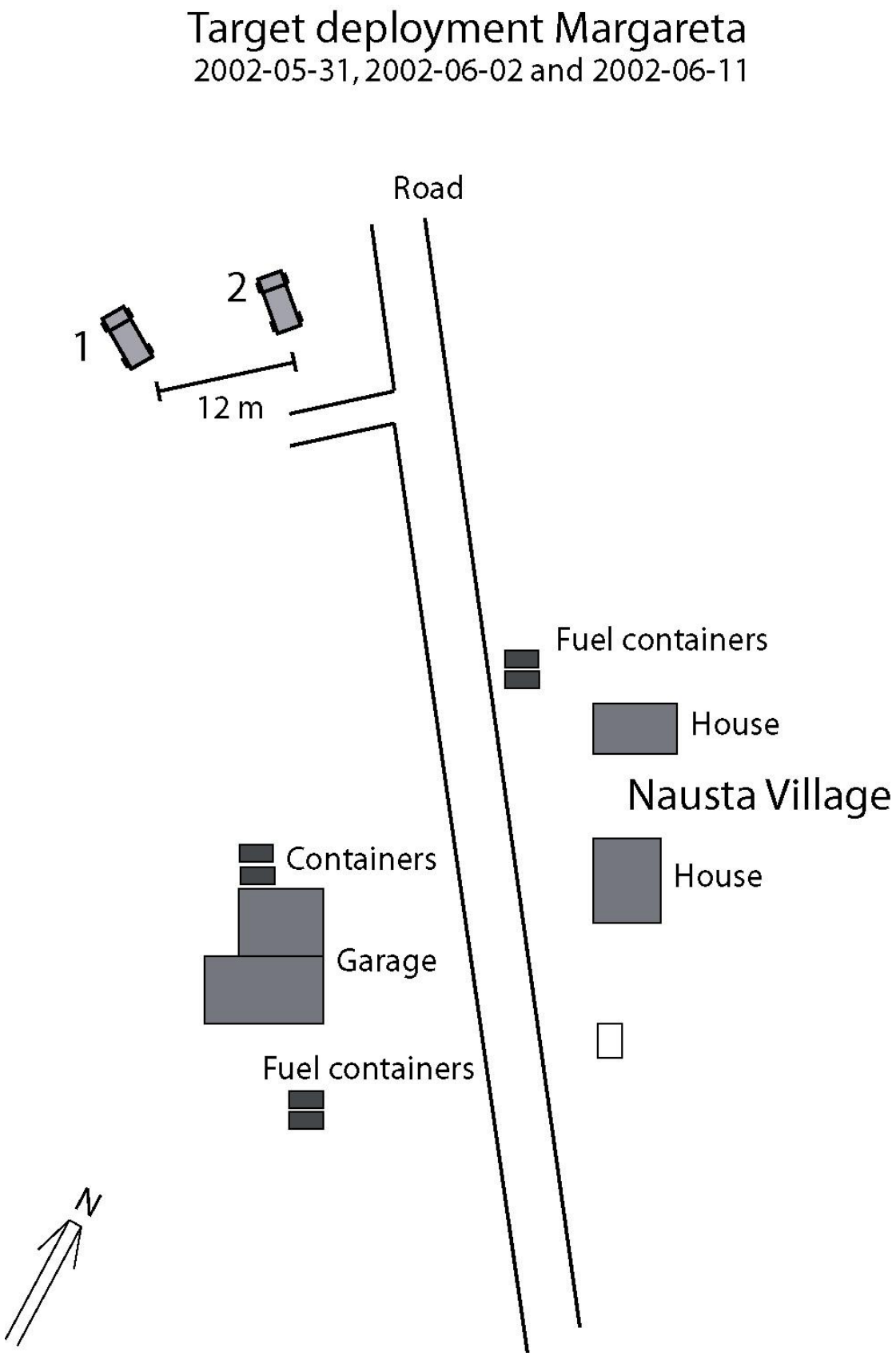


**Figure 24. Sketch of deployment Margareta.**

## 4.10 Reflectors

A set of trihedral reflectors were deployed in the area as reference targets. Figure 25 shows the location of the reflectors. Each location is marked with a number and a yellow circle. The locations are; 1 – Naustadammen, 2 – Nausta airfield and 3 – the field at Nausta village. One reflector was placed at each of the three locations. The reflector placed in the field at Nausta village was rotated to be orthogonal for each flight track. The other trihedrals were stationary throughout the whole campaign. Figure 26 shows a picture of one of the trihedrals.

**Table 13. Data of the trihedrals.**

| ID | Location | N | E | Height | N RT90 | E RT90 | H RH70 | Heading |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 - Naustadammen | 66,3858 | 19,2634 | 499,2 | 7369502 | 1654594 | 465 | 240 |
| 2 | 2 - Nausta airfield | 66,3643 | 19,2145 | 509,1 | 7366992 | 1652542 | 475 | 224 |
| 3 | 3 - Nausta village | 66,3658 | 19,2827 | 502,5 | 7367322 | 1655582 | 469 | Rotated |

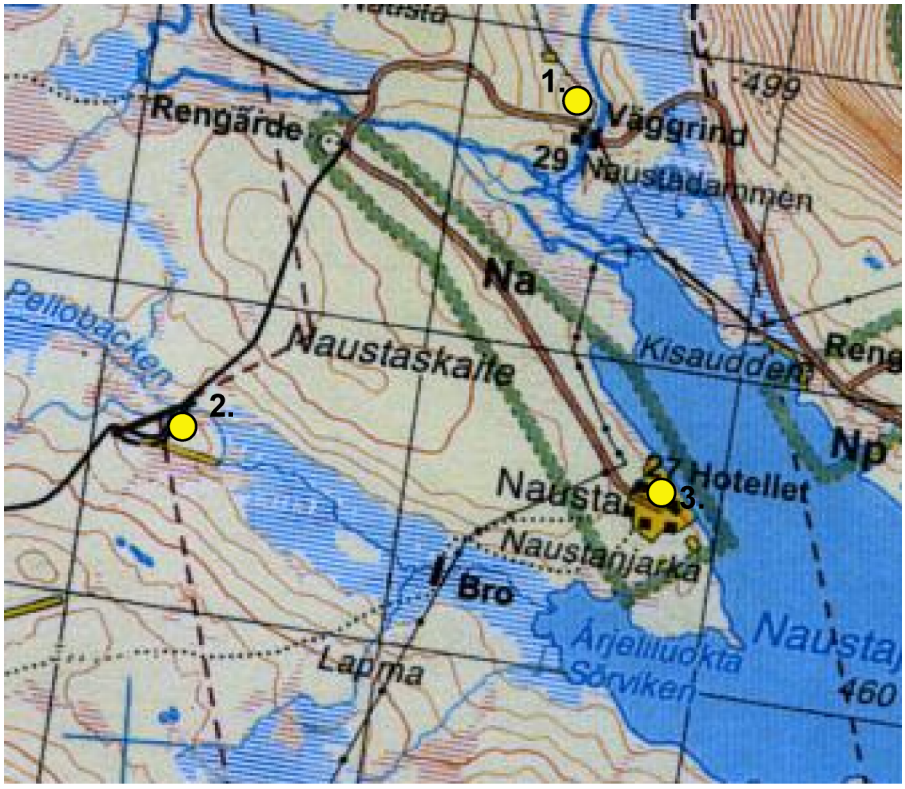


**Figure 25. Map over the surroundings of Nausta village, showing the locations of the reflectors. (Copyright map: Lantmäteriverket 2001. Ref. nr. L2002/308)**

**Figure 26. Trihedral radar reflector with short side of 5 m. (ID = 1)**

# 5 References

[1] L.M.H. Ulander, P.-O. Frölind, A. Gustavsson, H. Hellsten, and B. Larsson, "Detection of Concealed Ground Targets in CARABAS SAR Images Using Change Detection," Proc. Algorithms for Synthetic Aperture Radar Imagery VI, held in Orlando, FL, 5-9 April 1999, SPIE vol. 3721, pp. 243-252, 1999.

[2] L.M.H. Ulander, B. Flood, P. Follo, P.-O. Frölind, A. Gustavsson, T. Jonsson, B. Larsson, M. Lundberg, and G. Stenström, "CARABAS-II Campaign Vidsel 2002. Flight Report," FOI-R--1002--SE, 2003.

[3] F. Walter, "CARABAS-II Campaign Vidsel 2002. Forest Report," FOI-R--0962--SE, 2003.

[4] L.M.H. Ulander, B. Flood, P. Follo, P.-O. Frölind, A. Gustavsson, T. Jonsson, B. Larsson, M. Lundberg, W. Pierson, and G. Stenström, "Flight Campaign Vidsel 2002. CARABAS-II Change Detection Analysis," FOI-R--1001--SE, 2003.

# A Appendix CD Contents

In addition to this report, a CD containing pictures and drawings documenting each target and reflector deployment is available from FOI. The photos in digital form include acquisitions from different views of the individual targets.
This appendix lists the files with the full path to each picture available on the CD.

CD-ROM: FOI_VIDSEL02_B

Nomenclature of the files on the CD:
/Vidsel02_target_pictures/DEPLOYMENT_NAME/TARGET_ID/file.JPG

## *A.1 Target Deployment Gustav*

/Vidsel02_target_pictures/Gustav/configuration_gustav.jpg

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## *A.2 Target Deployment Erik*

This deployment was located on the open field in Nausta village without any foliage obscuration of the individual targets. Only a few picture examples were captured in this case to illustrate the typical surface roughness of the ground covered by grass.

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## *A.3 Target Deployment Johan*

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## *A.8 Target Deployment Margareta*

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## *A.9 Nausta Village*

The sequence of ten overlapping pictures gives an omnidirectional view of the environment acquired from a position in the center part of Nausta village.

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/Vidsel02_target_pictures/Nausta_village/P6020036.JPG
/Vidsel02_target_pictures/Nausta_village/P6020037.JPG
/Vidsel02_target_pictures/Nausta_village/P6020038.JPG
/Vidsel02_target_pictures/Nausta_village/P6020039.JPG

## *A.10 Trihedrals*

/Vidsel02_target_pictures/Trihedrals/nausta_airfield.JPG
/Vidsel02_target_pictures/Trihedrals/nausta_dammen.JPG
/Vidsel02_target_pictures/Trihedrals/nausta_village.JPG