# Check reference station coordinates NAM

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**Version:** 1.4

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## Contents



**Attachments**

# 1 Procedure

Since 2006, 06-GPS processes GPS data of three permanent monitor stations near the Waddenzee in a network with six reference stations on a monthly bases, see Fig. 1. The reference stations ‘ 0646’ and ‘veen’ are only used for additional measurements at the Waddenzee near Eemshaven. During processing with GPS software package GNSMART, the coordinates of these reference stations are kept fixed (standard deviation 0.0 mm), whereas the coordinates of the permanent monitor stations get some freedom to move. However, in reality there is always the possibility that the positions of the reference stations change as well.

To deal with this problem, the coordinates of all reference station will be recalculated and eventually updated on a yearly basis (middle of the year). 06-GPS follows the advice of Geo++, the software company who developed GNSMART. The advise was formulated as follow:
“To detect the small moving of the gas field stations you should keep the reference station fixed. We suggest to check periodically the used reference station. In case of detected reference station movements, the coordinates of the reference station must be updated.”

The following procedure is performed ones per year:
1. Recalculate all reference station coordinates; i.e. giving them an a priori standard deviation of 1.0 mm for the horizontal position and 2.0 mm for the height.
2. Change the reference station coordinates for stations with a height deviation of more than 2 mm compared to the existing coordinates.
3. Process the network again with all reference stations fixed to be able to calculate the influence of the new reference station coordinates on the permanent monitor stations.
4. Evaluation of the results.

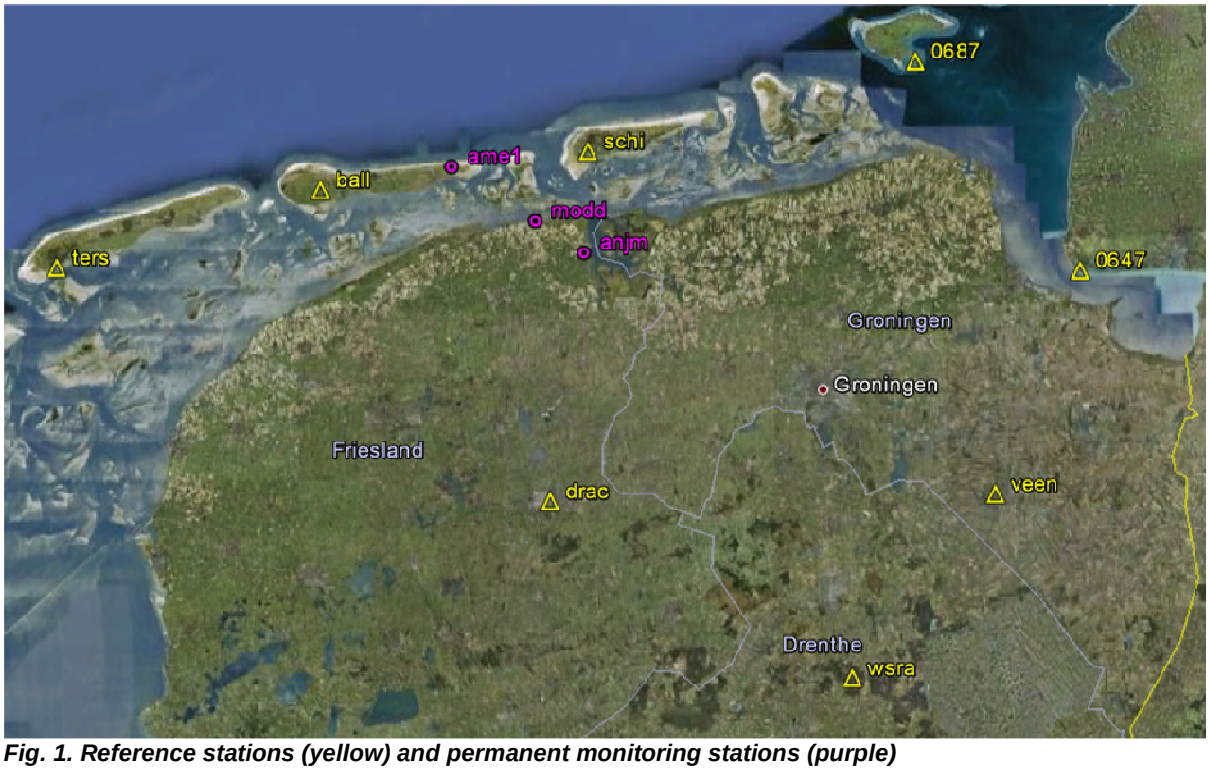


***Fig. 1. Reference stations (yellow) and permanent monitoring stations (purple)***

# 2 Reference checks

## 2.1 Check 2009

Time series: 17-05-2009 until 27-06-2009
Duration: 6 weeks
Reference: coordinates 2006 (see appendix A.1)

The differences between the reference station coordinates of 2006 and the recalculated coordinates is shown in Table 1. Notice that the stations 0687 (Borkum) and drac (Drachten) show a height deviation of more than 2 mm. Drachten has subsided even 6 mm in 3 years.

| Station | dX (m) | dY (m) | dZ (m) |
|---|---|---|---|
| 0687 | 0.0072 | 0.0076 | 0.0031 |
| ball | -0.0001 | -0.0006 | -0.0003 |
| drac | -0.0030 | 0.0027 | -0.0061 |
| schi | -0.0018 | -0.0016 | 0.0006 |
| ters | 0.0005 | -0.0061 | 0.0002 |
| wsra | -0.0036 | 0.0021 | -0.0011 |

***Table 1. Differences between current coordinates and refcheck results.***

New reference station coordinates are calculated for Borkum and Drachten, these can be found in appendix A.2 (Reference station coordinates 2009). All data since May 3th 2009 is processed with the new reference station coordinates for Borkum and Drachten.

Table 2 shows the influence of the new reference station coordinates for Borkum and Drachten on the permanent monitoring stations. Notice the extra subsidence of almost 1 mm at Moddergat and Anjum, while for ame1 the result did not change. An explanation for this effect is that Moddergat and Anjum are located somewhat closer to reference station Drachten (see Fig. 1), that subsided 6 mm relative to most other reference stations. Also the stable station of Westerbork may have contributed in the minor influences on Moddergat and Anjum.

| Station | dx (m) | dy (m) | dH (m) |
|---|---|---|---|
| ame1 | 0.0002 | 0.0004 | -0.0001 |
| anjm | -0.0002 | 0.0019 | -0.0009 |
| modd | -0.0002 | 0.0013 | -0.0006 |

***Table 2. Influence of new coordinates for stations 0687 and drac on the permanent monitor stations***

## 2.2 Check 2010

Time series: 23-05-2010 until 03-07-2010
Duration: 6 weeks
Reference: coordinates 2009 (see appendix A.2)

The differences between the reference station coordinates of 2009 and the recalculated coordinates is shown in Table 1. Notice that all height differences are within the maximum tolerance of 2 mm. This makes it unnecessary to change the reference station coordinates. All stations will maintain the coordinates of 2009, see appendix A.3.

| Station | dx (m) | dy (m) | dH (m) |
|---|---|---|---|
| 0687 | 0.0004 | 0.0012 | -0.0018 |
| ball | 0.0006 | 0.0019 | -0.0011 |
| drac | 0.0006 | 0.0031 | 0.0012 |
| schi | -0.0007 | -0.0007 | -0.0002 |
| ters | 0.0028 | -0.0061 | -0.0015 |
| wsra | -0.0037 | 0.0052 | 0.0004 |

***Table 1. Differences between current coordinates and refcheck results.***

## 2.3 Check 2011

Time series: 17-04-2011 until 28-05-2011
Duration: 6 weeks
Reference: coordinates 2010 (see appendix A.3)

The differences between the reference station coordinates of 2009 and the recalculated coordinates are shown in Table 1. Notice that the stations 0687 (Borkum) and ters (Terschelling) show a height deviation of more than 2 mm. The deviation of station Borkum is most likely related to an antenna replacement on October 20th 2010, in spite of the fact that a new individual antenna calibration file has been used for processing since that time.

| Station | dx (m) | dy (m) | dH (m) |
|---|---|---|---|
| 0687 | 0.0006 | 0.0006 | -0.0037 |
| ball | 0.0013 | 0.0019 | 0.0012 |
| drac | 0.0000 | 0.0050 | -0.0004 |
| schi | -0.0009 | -0.0013 | 0.0010 |
| ters | 0.0033 | -0.0071 | 0.0024 |
| wsra | -0.0039 | 0.0058 | -0.0011 |

***Table 1. Differences between current coordinates and refcheck results.***

The recalculated coordinates are applied for reference stations Borkum and Terschelling, these coordinates can be found in appendix A.4 (Reference station coordinates 2011).

The time series is processed again to calculate the influence of the new reference station coordinates for Borkum and Terschelling on the permanent monitoring stations. Table 2 shows the results. Notice that station Anjum (anjm), which is located closest to Borkum, gets the largest correction.

| Station | dx (m) | dy (m) | dH (m) |
|---|---|---|---|
| ame1 | 0.0002 | -0.0003 | -0.0003 |
| anjm | 0.0000 | 0.0000 | -0.0006 |
| modd | 0.0002 | 0.0000 | -0.0004 |

***Table 2. Influence of new coordinates for stations 0687 and ters on the permanent monitor stations***

All data since May 1th 2011 has been processed with the new reference station coordinates for Borkum and Terschelling.

## 2.4 Check 2012

Time series: 22-04-2012 until 02-06-2012
Duration: 6 weeks
Reference: coordinates 2011 (see appendix A.4)

06-GPS has been asked by NAM to expand the 'refcheck' with stations Veendam (veen) and Emden (0647). These stations, as well as station Drachten (drac), are likely to be within the influence zone of gas and/or salt abstraction. These stations will also be used for comparison with InSAR data. Therefore the coordinates of these three stations are calculated again within the network for an up-to-date accurate solution. During this calculation, coordinates of all other stations were kept fixed. Comparison with results of 2011 give the following differences:

| Station | dx (m) | dy (m) | dH (m) |
|---|---|---|---|
| 0647 | -0.0024 | 0.0012 | -0.0003 |
| drac | 0.0008 | 0.0020 | -0.0009 |
| veen | -0.0037 | 0.0042 | -0.0034 |

***Table 1. Differences between 2011 and 2012.***

The new coordinates of these three stations (see appendix A.5) are used for the actual 'refcheck'. In this calculation, all stations get some freedom to settle. The results should reveal if any other station have been moved over the last year. The results are shown in Table 2.

| Station | dx (m) | dy (m) | dH (m) |
|---|---|---|---|
| 0647 | -0.0007 | -0.0003 | -0.0008 |
| 0687 | 0.0009 | -0.0012 | -0.0010 |
| ball | 0.0021 | 0.0015 | 0.0000 |
| drac | 0.0002 | 0.0013 | -0.0003 |
| schi | 0.0006 | -0.0025 | -0.0016 |
| ters | 0.0015 | -0.0018 | 0.0003 |
| veen | -0.0011 | 0.0015 | -0.0003 |
| wsra | -0.0030 | 0.0053 | 0.0010 |

***Table 2. Differences between current coordinates and refcheck results.***

The refcheck did not reveal deviations more than two millimeter in height, meaning that no other coordinate updates were necessary. The time series is processed again to calculate the influence of the new coordinates of station Drachten (Table 1) on the permanent monitor stations. This influence appears to be minimal, see Table 3. All data since May 6th 2012 has been processed with new coordinates for station Drachten.

| Station | dx (m) | dy (m) | dH (m) |
|---|---|---|---|
| ame1 | 0.0000 | 0.0000 | 0.0000 |
| anjm | 0.0000 | 0.0003 | -0.0003 |
| modd | 0.0002 | 0.0003 | -0.0002 |

***Table 3. Influence of new coordinates for station Drachten on the permanent monitor stations***

## A.1 Reference station coordinates 2006

Transformation to RD/NAP based on RDNAPTRANS2004
Date: 2006

| Station | owner | status | Date | N ETRS89 (° ' ") | | | E ETRS89 (° ' ") | | | ell.h. (m) | ant.h. (m) | ARP (m) | X-RD (m) | Y-RD (m) | NAP(m) | ant.h.(m) | ARP(m) | ser.no.ant. | ant. Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0687 | SAPOS | fixed | 2006 | 53 | 33 | 49.15550 | 6 | 44 | 50.78800 | 54.4070 | 0.0540 | 54.4610 | 245130.1140 | 620587.9950 | 14.2226 | 0.0540 | 14.2766 | 200110 | LEIAT504GG |
| ball | 06-GPS | fixed | 2006 | 53 | 26 | 29.58829 | 5 | 41 | 15.67011 | 54.5499 | 0.1010 | 54.6509 | 174967.3850 | 606186.3570 | 13.7208 | 0.1010 | 13.8218 | 2170556 | TPSCR3_GGD CONE |
| drac | 06-GPS | fixed | 2006 | 53 | 6 | 31.75441 | 6 | 4 | 58.04678 | 56.3542 | 0.1470 | 56.5012 | 201580.5900 | 569339.0570 | 15.0405 | 0.1470 | 15.1875 | 2170593 | TPSCR3_GGD CONE |
| schi | NAM | fixed | 2006 | 53 | 28 | 38.43917 | 6 | 9 | 44.16452 | 50.8109 | 0.1480 | 50.9589 | 206461.0960 | 610405.7140 | 10.3550 | 0.1480 | 10.5030 | 2170643 | TPSCR3_GGD CONE |
| ters | AGRS | fixed | 2006 | 53 | 21 | 45.84903 | 5 | 13 | 9.78826 | 56.1008 | 0.0000 | 56.1008 | 143827.2360 | 597385.4980 | 14.6893 | 0.0000 | 14.6893 | 220193243 | trm29659.00 |
| wsra | AGRS | fixed | 2006 | 52 | 54 | 52.58929 | 6 | 36 | 16.20650 | 82.2751 | 0.3890 | 82.6641 | 236880.5080 | 548192.3070 | 40.7251 | 0.3890 | 41.1141 | 273 | AOAD/M_T |

| Station | owner | status | Date | N ETRS89 (° ' ") | | | E ETRS89 (° ' ") | | | ell.h. (m) | ant.h. (m) | ARP (m) | X-RD (m) | Y-RD (m) | NAP(m) | ant.h.(m) | ARP(m) | ser.no.ant. | ant. Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ame1 | NAM | mobile | 27-6-2009 | 53 | 27 | 51.94272 | 5 | 55 | 16.80630 | 47.9925 | 0.1480 | 48.1405 | 190474.9760 | 608822.4760 | 7.3985 | 0.1480 | 7.5465 | 2170510 | TPSCR3_GGD CONE |
| anjm | NAM | mobile | 27-6-2009 | 53 | 22 | 15.04173 | 6 | 9 | 8.59146 | 45.2720 | 0.0000 | 45.2720 | 205931.1420 | 598546.0390 | 4.6457 | 0.0000 | 4.6457 | 2170642 | TPSCR3_GGD CONE |
| modd | NAM | mobile | 27-6-2009 | 53 | 24 | 19.27159 | 6 | 4 | 2.98542 | 47.4165 | 0.1470 | 47.5635 | 200244.5590 | 602329.7940 | 6.8040 | 0.1470 | 6.9510 | 2170639 | TPSCR3_GGD CONE |

## A.2 Reference station coordinates 2009

Transformation to RD/NAP based on RDNAPTRANS2004
Date: 27-6-2009

| Station | owner | status | Date | N ETRS89 (° ' ") | | | E ETRS89 (° ' ") | | | ell.h. (m) | ant.h. (m) | ARP (m) | X-RD (m) | Y-RD (m) | NAP(m) | ant.h.(m) | ARP(m) | ser.no.ant. | ant. Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0687 | SAPOS | fixed | 27-6-2009 | 53 | 33 | 49.15574 | 6 | 44 | 50.78840 | 54.4101 | 0.0540 | 54.4641 | 245130.1210 | 620588.0030 | 14.2257 | 0.0540 | 14.2797 | 200110 | LEIAT504GG |
| ball | 06-GPS | fixed | 2006 | 53 | 26 | 29.58829 | 5 | 41 | 15.67011 | 54.5499 | 0.1010 | 54.6509 | 174967.3850 | 606186.3570 | 13.7208 | 0.1010 | 13.8218 | 2170556 | TPSCR3_GGD CONE |
| drac | 06-GPS | fixed | 27-6-2009 | 53 | 6 | 31.75455 | 6 | 4 | 58.04662 | 56.3480 | 0.1470 | 56.4950 | 201580.5870 | 569339.0610 | 15.0343 | 0.1470 | 15.1813 | 2170593 | TPSCR3_GGD CONE |
| schi | NAM | fixed | 2006 | 53 | 28 | 38.43917 | 6 | 9 | 44.16452 | 50.8109 | 0.1480 | 50.9589 | 206461.0960 | 610405.7140 | 10.3550 | 0.1480 | 10.5030 | 2170643 | TPSCR3_GGD CONE |
| ters | AGRS | fixed | 2006 | 53 | 21 | 45.84903 | 5 | 13 | 9.78826 | 56.1008 | 0.0000 | 56.1008 | 143827.2360 | 597385.4980 | 14.6893 | 0.0000 | 14.6893 | 220193243 | trm29659.00 |
| wsra | AGRS | fixed | 2006 | 52 | 54 | 52.58929 | 6 | 36 | 16.20650 | 82.2751 | 0.3890 | 82.6641 | 236880.5080 | 548192.3070 | 40.7251 | 0.3890 | 41.1141 | 273 | AOAD/M_T |

| Station | owner | status | Date | N ETRS89 (° ' ") | | | E ETRS89 (° ' ") | | | ell.h. (m) | ant.h. (m) | ARP (m) | X-RD (m) | Y-RD (m) | NAP(m) | ant.h.(m) | ARP(m) | ser.no.ant. | ant. Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ame1 | NAM | mobile | 27-6-2009 | 53 | 27 | 51.94273 | 5 | 55 | 16.80631 | 47.9924 | 0.1480 | 48.1404 | 190474.9760 | 608822.4760 | 7.3984 | 0.1480 | 7.5464 | 2170510 | TPSCR3_GGD CONE |
| anjm | NAM | mobile | 27-6-2009 | 53 | 22 | 15.04179 | 6 | 9 | 8.59145 | 45.2711 | 0.0000 | 45.2711 | 205931.1410 | 598546.0410 | 4.6448 | 0.0000 | 4.6448 | 2170642 | TPSCR3_GGD CONE |
| modd | NAM | mobile | 27-6-2009 | 53 | 24 | 19.27163 | 6 | 4 | 2.98541 | 47.4159 | 0.1470 | 47.5629 | 200244.5590 | 602329.7960 | 6.8034 | 0.1470 | 6.9504 | 2170639 | TPSCR3_GGD CONE |

## A.3 Reference station coordinates 2010

Transformation to RD/NAP based on RDNAPTRANS2004
Date: 3-7-2010

| Station | owner | status | Date | N ETRS89 (° ' ") | | | E ETRS89 (° ' ") | | | ell.h. (m) | ant.h. (m) | ARP (m) | X-RD (m) | Y-RD (m) | NAP(m) | ant.h.(m) | ARP(m) | ser.no.ant. | ant. Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0647 | SAPOS | fixed | 3-7-2010 | 53 | 20 | 14.76816 | 7 | 1 | 38.98468 | 56.9653 | 0.0540 | 57.0193 | 264259.0517 | 595802.0454 | 16.4691 | 0.0540 | 16.5231 | 200082 | LEIAT504GG |
| 0687 | SAPOS | fixed | 27-6-2009 | 53 | 33 | 49.15574 | 6 | 44 | 50.78840 | 54.4101 | 0.0540 | 54.4641 | 245130.1210 | 620588.0030 | 14.2257 | 0.0540 | 14.2797 | 200110 | LEIAT504GG |
| ball | 06-GPS | fixed | 2006 | 53 | 26 | 29.58829 | 5 | 41 | 15.67011 | 54.5499 | 0.1010 | 54.6509 | 174967.3850 | 606186.3570 | 13.7208 | 0.1010 | 13.8218 | 2170556 | TPSCR3_GGD CONE |
| drac | 06-GPS | fixed | 27-6-2009 | 53 | 6 | 31.75455 | 6 | 4 | 58.04662 | 56.3480 | 0.1470 | 56.4950 | 201580.5870 | 569339.0610 | 15.0343 | 0.1470 | 15.1813 | 2170593 | TPSCR3_GGD CONE |
| schi | NAM | fixed | 2006 | 53 | 28 | 38.43917 | 6 | 9 | 44.16452 | 50.8109 | 0.1480 | 50.9589 | 206461.0960 | 610405.7140 | 10.3550 | 0.1480 | 10.5030 | 2170643 | TPSCR3_GGD CONE |
| ters | AGRS | fixed | 2006 | 53 | 21 | 45.84903 | 5 | 13 | 9.78826 | 56.1008 | 0.0000 | 56.1008 | 143827.2360 | 597385.4980 | 14.6893 | 0.0000 | 14.6893 | 220193243 | trm29659.00 |
| veen | 06-GPS | fixed | 3-7-2010 | 53 | 6 | 15.38181 | 6 | 51 | 54.03593 | 65.9273 | 0.1470 | 66.0743 | 253969.3935 | 569622.6727 | 24.9513 | 0.1470 | 25.0983 | 3830189 | TPSCR.G3 TPSH |
| wsra | AGRS | fixed | 2006 | 52 | 54 | 52.58929 | 6 | 36 | 16.20650 | 82.2751 | 0.3890 | 82.6641 | 236880.5080 | 548192.3070 | 40.7251 | 0.3890 | 41.1141 | 273 | AOAD/M_T |

| Station | owner | status | Date | N ETRS89 (° ' ") | | | E ETRS89 (° ' ") | | | ell.h. (m) | ant.h. (m) | ARP (m) | X-RD (m) | Y-RD (m) | NAP(m) | ant.h.(m) | ARP(m) | ser.no.ant. | ant. Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ame1 | NAM | mobile | 27-6-2009 | 53 | 27 | 51.94273 | 5 | 55 | 16.80631 | 47.9924 | 0.1480 | 48.1404 | 190474.9760 | 608822.4760 | 7.3984 | 0.1480 | 7.5464 | 2170510 | TPSCR3_GGD CONE |
| anjm | NAM | mobile | 27-6-2009 | 53 | 22 | 15.04179 | 6 | 9 | 8.59145 | 45.2711 | 0.0000 | 45.2711 | 205931.1410 | 598546.0410 | 4.6448 | 0.0000 | 4.6448 | 2170642 | TPSCR3_GGD CONE |
| modd | NAM | mobile | 27-6-2009 | 53 | 24 | 19.27163 | 6 | 4 | 2.98541 | 47.4159 | 0.1470 | 47.5629 | 200244.5590 | 602329.7960 | 6.8034 | 0.1470 | 6.9504 | 2170639 | TPSCR3_GGD CONE |

## A.4 Reference station coordinates 2011

Transformation to RD/NAP based on RDNAPTRANS2004
Date: 28-05-2011

| Station | owner | status | Date | N ETRS89 (°' '') | | | E ETRS89 (°' '') | | | ell.h. (m) | ant.h. (m) | ARP (m) | X-RD (m) | Y-RD (m) | NAP(m) | ant.h.(m) | ARP(m) | ser.no.ant. | ant. Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0647 | SAPOS | fixed | 28-5-2011 | 53 | 20 | 14.76805 | 7 | 1 | 38.98444 | 56.9575 | 0.0550 | 57.0125 | 264259.0473 | 595802.0419 | 16.4613 | 0.0550 | 16.5163 | 10211016 | LEIAR25.R4 LEIT |
| 0687 | SAPOS | fixed | 28-5-2011 | 53 | 33 | 49.15576 | 6 | 44 | 50.78843 | 54.4054 | 0.0550 | 54.4604 | 245130.1219 | 620588.0031 | 14.2210 | 0.0550 | 14.2760 | 10211024 | LEIAR25.R4 LEIT |
| ball | 06-GPS | fixed | 2006 | 53 | 26 | 29.58829 | 5 | 41 | 15.67011 | 54.5499 | 0.1010 | 54.6509 | 174967.3850 | 606186.3570 | 13.7208 | 0.1010 | 13.8218 | 2170556 | TPSCR3_GGD CONE |
| drac | 06-GPS | fixed | 27-6-2009 | 53 | 6 | 31.75455 | 6 | 4 | 58.04662 | 56.3480 | 0.1470 | 56.4950 | 201580.5870 | 569339.0610 | 15.0343 | 0.1470 | 15.1813 | 2170593 | TPSCR3_GGD CONE |
| schi | NAM | fixed | 2006 | 53 | 28 | 38.43917 | 6 | 9 | 44.16452 | 50.8109 | 0.1480 | 50.9589 | 206461.0960 | 610405.7140 | 10.3550 | 0.1480 | 10.5030 | 2170643 | TPSCR3_GGD CONE |
| ters | AGRS | fixed | 28-5-2011 | 53 | 21 | 45.84880 | 5 | 13 | 9.78844 | 56.1032 | 0.0000 | 56.1032 | 143827.2394 | 597385.4907 | 14.6917 | 0.0000 | 14.6917 | 220193243 | trm29659.00 |
| veen | 06-GPS | fixed | 28-5-2011 | 53 | 6 | 15.38193 | 6 | 51 | 54.03564 | 65.9204 | 0.1470 | 66.0674 | 253969.3881 | 569622.6763 | 24.9444 | 0.1470 | 25.0914 | 3830189 | TPSCR.G3 TPSH |
| wsra | AGRS | fixed | 2006 | 52 | 54 | 52.58929 | 6 | 36 | 16.20650 | 82.2751 | 0.3890 | 82.6641 | 236880.5080 | 548192.3070 | 40.7251 | 0.3890 | 41.1141 | 273 | AOAD/M_T |

| Station | owner | status | Date | N ETRS89 (°' '') | | | E ETRS89 (°' '') | | | ell.h. (m) | ant.h. (m) | ARP (m) | X-RD (m) | Y-RD (m) | NAP(m) | ant.h.(m) | ARP(m) | ser.no.ant. | ant. Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ame1 | NAM | mobile | 28-5-2011 | 53 | 27 | 51.94285 | 5 | 55 | 16.80630 | 47.9812 | 0.1480 | 48.1292 | 190474.9760 | 608822.4800 | 7.3872 | 0.1480 | 7.5352 | 2170510 | TPSCR3_GGD CONE |
| anjm | NAM | mobile | 28-5-2011 | 53 | 22 | 15.04182 | 6 | 9 | 8.59135 | 45.2637 | 0.0000 | 45.2637 | 205931.1395 | 598546.0420 | 4.6374 | 0.0000 | 4.6374 | 2170642 | TPSCR3_GGD CONE |
| modd | NAM | mobile | 28-5-2011 | 53 | 24 | 19.27163 | 6 | 4 | 2.98540 | 47.4103 | 0.1470 | 47.5573 | 200244.5584 | 602329.7957 | 6.7978 | 0.1470 | 6.9448 | 2170639 | TPSCR3_GGD CONE |

## A.5 Reference station coordinates 2012

Transformation to RD/NAP based on RDNAPTRANS2004
Date: 2-6-2012

| Station | owner | status | Date | N ETRS89 (° ' ") | E ETRS89 (° ' ") | ell.h. (m) | ant.h. (m) | ARP (m) | X-RD (m) | Y-RD (m) | NAP(m) | ant.h.(m) | ARP(m) | ser.no.ant. | ant. Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0647 | SAPOS | fixed | 2-6-2012 | 53 20 14.76809 | 7 1 38.98431 | 56.9572 | 0.0550 | 57.0122 | 264259.0449 | 595802.0431 | 16.4610 | 0.0550 | 16.5160 | 10211016 | LEIAR25.R4 LEIT |
| 0687 | SAPOS | fixed | 28-5-2011 | 53 33 49.15576 | 6 44 50.78843 | 54.4054 | 0.0550 | 54.4604 | 245130.1219 | 620588.0031 | 14.2210 | 0.0550 | 14.2760 | 10211024 | LEIAR25.R4 LEIT |
| ball | 06-GPS | fixed | 2006 | 53 26 29.58829 | 5 41 15.67011 | 54.5499 | 0.1010 | 54.6509 | 174967.3850 | 606186.3570 | 13.7208 | 0.1010 | 13.8218 | 2170556 | TPSCR3_GGD CONE |
| drac | 06-GPS | fixed | 2-6-2012 | 53 6 31.75461 | 6 4 58.04664 | 56.3471 | 0.1470 | 56.4941 | 201580.5878 | 569339.0630 | 15.0334 | 0.1470 | 15.1804 | 2170593 | TPSCR3_GGD CONE |
| schi | NAM | fixed | 2006 | 53 28 38.43917 | 6 9 44.16452 | 50.8109 | 0.1480 | 50.9589 | 206461.0960 | 610405.7140 | 10.3550 | 0.1480 | 10.5030 | 2170643 | TPSCR3_GGD CONE |
| ters | AGRS | fixed | 28-5-2011 | 53 21 45.84880 | 5 13 9.78844 | 56.1032 | 0.0000 | 56.1032 | 143827.2394 | 597385.4907 | 14.6917 | 0.0000 | 14.6917 | 220193243 | trm29659.00 |
| veen | 06-GPS | fixed | 2-6-2012 | 53 6 15.38207 | 6 51 54.03545 | 65.9170 | 0.1470 | 66.064 | 253969.3844 | 569622.6805 | 24.9410 | 0.1470 | 25.0880 | 3830189 | TPSCR.G3 TPSH |
| wsra | AGRS | fixed | 2006 | 52 54 52.58929 | 6 36 16.20650 | 82.2751 | 0.3890 | 82.6641 | 236880.5080 | 548192.3070 | 40.7251 | 0.3890 | 41.1141 | 273 | AOAD/M_T |

| Station | owner | status | Date | N ETRS89 (° ' ") | E ETRS89 (° ' ") | ell.h. (m) | ant.h. (m) | ARP (m) | X-RD (m) | Y-RD (m) | NAP(m) | ant.h.(m) | ARP(m) | ser.no.ant. | ant. Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ame1 | NAM | mobile | 2-6-2012 | 53 27 51.94291 | 5 55 16.80625 | 47.9750 | 0.1480 | 48.1230 | 190474.9750 | 608822.4818 | 7.3810 | 0.1480 | 7.5290 | 2170510 | TPSCR3_GGD CONE |
| anjm | NAM | mobile | 2-6-2012 | 53 22 15.04185 | 6 9 8.59128 | 45.2608 | 0.0000 | 45.2608 | 205931.1382 | 598546.0429 | 4.6345 | 0.0000 | 4.6345 | 2170642 | TPSCR3_GGD CONE |
| modd | NAM | mobile | 2-6-2012 | 53 24 19.27163 | 6 4 2.98536 | 47.4073 | 0.1470 | 47.5543 | 200244.5576 | 602329.7956 | 6.7948 | 0.1470 | 6.9418 | 2170639 | TPSCR3_GGD CONE |