Norwegian Safety Investigation Authority

Issued September 2025

REPORT AVIATION 2025/10

Serious aviation incident on approach to Svolvær Airport Helle on 22 December 2022 involving a De Havilland Aircraft of Canada Limited DHC-8-103, LN-WIP, operated by Widerøe's Flyveselskap AS

This report has been translated into English and published by the NSIA to facilitate access by international readers. As accurate as the translation might be, the original Norwegian text takes precedence as the report for reference.

The Norwegian Safety Investigation Authority (NSIA) has compiled this report for the sole purpose of improving aviation safety.

The object of the NSIA's investigations is to clarify the sequence of events and causal factors, elucidate matters deemed to be important to the prevention of accidents and serious incidents, and to issue safety recommendations if relevant. It is not the NSIA's task to apportion blame or liability under criminal or civil law.

This report should not be used for purposes other than preventive aviation safety work.

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Photo: Jan Lennart Guldbrandsen

Legal authority for the Norwegian Safety Investigation Authority's activities is enshrined in Section 12-1 of Act No 101 of 11 June 1993 relating to aviation (Aviation Act), cf. Regulations No 906 of 7 July 2016 on public investigations of accidents and incidents in civil aviation Section 3.

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Report on serious aviation incident

Table 1: Data from the incident.

Aircraft:	De Havilland Aircraft of Canada Limited DHC-8-103
Nationality and registration:	LN-WIP
Owner:	Widerøe Asset AS
Operator:	Widerøe’s Flyveselskap AS
Crew/aircraft commander:	2 pilots and 1 cabin crew member, no injuries
Passengers:	29, no injuries
Location:	On approach to Svolvær Airport Helle (ENSH), runway 01
Time of incident:	Saturday 22 December 2022 at 1902 hrs

All times given in this report are UTC time (local time - 1 hour) unless otherwise stated.

Notification

The incident occurred on 22 December 2022 during approach to Svolvær Airport Helle. The crew reported the incident to Widerøe's flight operations duty manager, which reported it to the Norwegian Civil Aviation Authority the same day. The incident was not classified as a serious aviation incident and thus was not sent to the Norwegian Safety Investigation Authority (NSIA). On Tuesday 3. January 2023, the NSIA received an internal investigation report from Widerøe on the incident.

Following a review of the report, the NSIA classified the incident as a serious aviation incident and initiated an investigation.

The NSIA then informed the Canadian Transport Safety Board (TSB), the European Aviation Safety Agency (EASA), the European Commission and CAA Norway in accordance with the International Civil Aviation Organisation’s (ICAO) Annex 13 Aircraft Accident and Incident Investigation.

Summary

During the approach to Svolvær Airport Helle (ENSH) 22 December 2022, local barometric pressure (QNH) was not adjusted, and the plane's barometric altimeter thus gave the wrong altitude indication. This meant that the approach was approx. 213 m lower than the plane's barometric altimeter indicated, the approach was only aborted when the crew received a terrain warning (Enhanced Ground Proximity Warning System – EGPWS). The lowest altitude the plane had before climbing was 292 ft (89 m).

An incorrectly set barometric altimeter on a non-precision approach could in a worst-case scenario lead to a fatal accident following a Controlled Flight Into Terrain (CFIT).

The flight from Bodø to Svolvær was planned with marginal weather conditions in Svolvær. En route, the crew were informed that snow had to be cleared from the runway at Svolvær Airport Helle and that they were cleared to a holding pattern. They started their approach after spending approx. 10 minutes in the holding pattern around the reporting point OSRUL. The crew had forgotten to set the local QNH for the approach and was therefore 700 ft (213 m) below the indicated altitude. When the aircraft was 3.1 NM from the runway threshold, EGPWS calculated the aircraft's geometric altitude to be below the Runway Field Clearance Floor (RFCF) vertical profile and gave an aural 'Too Low terrain' alert. The crew immediately aborted their approach and returned the Bodø, where they landed.

The checklists and procedures used by Widerøe to set correct QNH before landing were thought of as individual barriers. The investigation has shown that the checklists and procedures had some dependencies making them less efficient barriers.

The investigation has shown that there is no single technical system in use in Norwegian airspace that is capable of detecting deviations between reported QNH and the airplane's QNH, and that human barriers alone are not enough to guarantee that local QNH is set. There are ways of displaying an aircraft QNH as part of Surveillance (SUR), provided that Avinor Air Navigation Services (ANS) Norwegian Air Traffic Control System (NATCON) is used as the Air Traffic Management (ATM) system. The air traffic services performed the duties of Aerodrome Flight Information Service *(*AFIS*)* at Svolvær airport Helle. There are currently no procedures in place for this service to be provided by AFIS.

The airplane, LN-WIP, was fitted with a transponder unable to send QNH values. The air traffic services were therefore not able to read QNH.

Based on this investigation the NSIA is of the opinion that an independent system for monitoring aircraft pressure setting, with operational procedures, will increase aviation safety. Avinor ANS has equipped several air traffic control units and flight information units with a monitoring system called SUR. SUR is considered a supporting tool for AFIS and does not change the service provided even where new systems have been introduced.

This incident with LN-WIP occurred due to a combination of technical weaknesses and deficiencies and operational, human and organisational factors.

Widerøe has introduced several measures to help strengthen focus on CRM and workload management for commander training and line checks. As a result, the NSIA does not issue any safety recommendation regarding this.

The Norwegian Safety Investigation Authority issues a total of three safety recommendations.

The NSIA issues one safety recommendation addressed to the Norwegian Civil Aviation Authority (CAA):

The Norwegian Safety Investigation Authority recommends the Norwegian Civil Aviation Authority conduct a new risk assessment to verify that the expected level of safety is maintained for cases with incorrectly set barometric altimeter. The risk assessment must be performed in close cooperation with aircraft operators and the air traffic services. The Civil Aviation Authority is then recommended to establish requirements for any risk-reducing measures in the short term and the use of technological solutions, in the long term, to address national risk challenges in line with the intention of EASA SIB 2023-03.

The NSIA issues two safety recommendations addressed to Widerøe:

The Norwegian Safety Investigation Authority recommends Widerøe's Flyveselskap AS to develop improved procedures for setting and verifying the barometric altimeter (QNH) based on simplification and clarification of what should trigger setting and verification of QNH, and that such setting and verification should be carried out every time regardless of other aspects of the operational situation.

The Norwegian Safety Investigation Authority recommends Widerøe's Flyveselskap AS, with its particularly challenging flight operations, to upgrade the transponders on their aircraft to enable them to transmit pressure settings and thus be part of a system for monitoring aircraft pressure settings (QNH) in Norwegian airspace.

About the investigation

Purpose and method

The NSIA has classified the incident involving an incorrectly set barometric altimeter (QNH) that took place on approach to Svolvær as a serious aviation incident. The purpose of this investigation has been to determine what caused the approach to be being flown 700 ft too low. The NSIA has considered what can be done to improve aviation safety and prevent similar incidents from happening in the future.

The serious aviation incident and the circumstances surrounding it have been investigated and analysed in line with the NSIA's framework and analysis process for systematic safety investigations (the NSIA method[1]).

Sources of information:

- Interviews with the crew.
- Interviews with flight operations management at Widerøe's Flyveselskap AS, hereafter referred to as Widerøe.
- Recording from the cockpit voice recorder.
- Automatic Dependent Surveillance Broadcast (ADS-B) data from the aircraft.
- The company's operating manual (OM).
- Approach charts.
- Radar recording of the flight.
- Safety notices/bulletins relating to altimeter setting.

The investigation report

The first part of the report, 'Factual information', describes the sequence of events, related data and what the NSIA has investigated, and related findings.

The second part, 'Analysis', contains the NSIA's assessment of the sequence of events and contributory factors based on factual information and completed investigations/examinations. Circumstances and factors found to be of little relevance to explaining and understanding the accident will not be discussed in detail.

The final part of the report contains the NSIA's conclusions and safety recommendations.

[1] *See https://www.nsia.no/About-us/Methodology*

1. Factual information

1. Factual information

1.1 History of flight

The below description of the sequence of events is based on the recording from the cockpit voice recorder, data transmitted from the aircraft, the NSIA's interviews with the crew and Widerøe's internal investigation report.

1.1.1 PREPARATIONS FOR DEPARTURE FROM BODØ

The flight commander left his home early morning of 22 Dec December 2022, to start working from Trondheim Airport Værnes (ENVA) with the first officer, who had spent the night in Trondheim. On the day in question, the crew was scheduled to fly Værnes–Brønnøysund Airport Brønnøy (ENBN)–Bodø Airport Hernes (ENBO)–Svolvær Airport Helle (ENSH) and back to Bodø, and then Bodø–Harstad/Narvik Airport Evenes (ENEV) and Evenes–Andøya Airport Andenes (ENAN). Due to minor technical issues, they were behind schedule on arrival to Bodø before departing for Svolvær.

The crew therefore took a shorter than normal meal break in the crew lounge at Bodø Airport. Weather conditions at Svolvær were changing, and the pilots were not sure whether it would be possible to fly straight in and land on runway 01 or whether they would have to circle around to runway 19. They took on board additional fuel in case they had to fly in a holding pattern to wait for suitable weather to start their approach.

The flight from Bodø to Svolvær had flight number WF834, call sign WIF12X, and the aircraft used was LN-WIP, a DHC-8-103 aircraft. The commander was the Pilot Flying (PF), while the first officer was the Pilot Monitoring (PM). After take-off, the crew conducted a Threat and Error Management (TEM) assessment in which they discussed the marginal weather conditions and their intention to approach the flight with a conservative attitude. They started up the engines, completed de-icing and received line-up clearance to runway 25. LN-WIP was carrying three crew members and 29 passengers.

1.1.2 DEPARTURE FROM BODØ AND THE EN ROUTE PHASE

LN-WIP took off from Bodø and climbed to 7,000 ft. Shortly thereafter, they were cleared for FL90 and then cleared to proceed directly to the reporting point OSRUL. On passing FL80, they carried out the pre-level procedure in which the barometric altimeter (QNH) was set to standard pressure (1,013 hPa). Once established at cruise altitude, the pilots discussed the possibility of circling to runway 19 at Svolvær due to the variable wind direction. A few minutes later, LN-WIP was transferred from *Bodø Approach* to the enroute control, *Polaris Control,* to which they reported that they were heading towards OSRUL at FL90. *Polaris Control* cleared LN-WIP to descend to 4,000 ft 'when ready' with QNH 987, which is the local pressure at Svolvær, and to start their approach using GLS (GBAS landing system) towards runway 01. The crew of LN-WIP immediately requested updated weather information for Svolvær and received the following weather update at 1835 hrs:

> *Time 18 surface wind: variable 4 knots, visibility 4,000-meter, light showers of snow and rain, vertical visibility 800 ft, temp -0, dew point -1, QNH 987, remark: wind at 150 feet 290 degrees 11 knot gusting 23 knots variable between 260 and 360.*

The pilots discussed the variable wind direction and whether to circle. Shortly after, AFIS at Svolvær, *Helle Information*, via *Polaris Control,* recommended that LN-WIP use the localizer (LOC) for runway 01. The pilots decided to proceed with GLS and asked to be handed over to *Helle*

Information. On first contact with *Helle Information*, the aircraft was located 26 NM south of the airport. The pilots were informed that runway 01 was to be used and given the following information about the weather at 1838 hrs:

> *Wind 310 degrees, 7 knots, visibility 2,000 meters in showers of snow, vertical visibility 600 feet, temp 0, dew point -1, QNH 987.*

The first officer read back the QNH and enquired about how the showers were developing, and *Helle Information* replied that the weather conditions were suitable for LOC to runway 01. At 1839 hrs, *Helle Information* informed the pilots that snow had to be cleared from the runway and that *Polaris Control* had therefore cleared LN-WIP to fly in a holding pattern around OSRUL. This information and the new clearance were given at about the time when a descent would normally have been initiated. The pilots discussed whether to fly a LOC instead of a Ground Based Augmentation System (GBAS) Landing System (GLS) approach but did not reach a conclusion and then focused on programming the holding pattern for OSRUL in the Flight Management System (FMS).

1.1.3 HOLDING PATTERN

LN-WIP established a holding pattern referenced to OSRUL at FL90, and the first officer reported this to *Helle Information* at 1840 hrs. The crew again discussed GLS versus LOC approach, both directly to runway 01 and circling round to runway 19. They preferred a GLS approach to runway 01 and continued with the setup for GLS.

At 1850 hrs the crew received the following weather update:

> *The weather remains relatively unchanged. Still visibility 2 km, showers of snow, vertical visibility between 5 and 600 ft and wind 270 degrees 4 knots, variable between 260 and 290 degrees.*

After receiving this weather report, the crew discussed visibility requirements for departure from Svolvær.

1.1.4 APPROACH TO SVOLVÆR RUNWAY 01

About a minute later, *Helle Information* reported that snow clearance had been completed and that LN-WIP could start its approach. Without further discussion, the commander informed the first officer that they were setting up for LOC and read out the LOC frequency for runway 01. LN-WIP then immediately received a runway status report from *Helle Information* of Runway Condition Code 2 (RCC), which indicates more than 3 mm of water or slush on the runway. The commander initiated their descent while the first officer took care of the radio communication. LN-WIP left FL90 and started its approach to runway 01 by completing its round in the holding pattern while descending from FL90. LN-WIP then immediately informed *Helle Information* that they were leaving FL90 in the OSRUL holding pattern to begin their approach and requested an update should weather conditions change.

The commander read out the minimum altitudes for the approach, as well as the missed approach procedure. At 1855 hrs the crew received the following weather update:

> *Heavier showers, visibility 1,000 metres and vertical visibility of 600.*

At the same time as this radio communication took place, the pre-level alerts were issued from the barometric altimeter, indicating that the aircraft was 1,000 ft above the set altitude. The pilots discussed the marginal weather conditions and decided to continue the approach. The aircraft was established on the LOC beam for runway 01 and the crew confirmed to *Helle Information* that they were flying a LOC approach. A minute later, they reported that they were established on LOC to runway 01. At 1857 hrs, the first officer initiated the procedure for commencing radio altimeter callouts by saying ‘Radio height’, and the commander replied ‘Checked’. Based on the available information, the NSIA assumes that the barometric altimeter showed an altitude of 3,200 ft and the radio altimeter showed 2,500 ft. During the following two minutes, they deployed the landing gear, set flaps to 15 degrees, received an updated weather report from *Helle Information* and were informed that there was no other traffic on runway 01.

At 1859 hrs, the crew completed the landing checklist and shortly thereafter received an aural alert of ‘500 ft’ from the radio altimeter. The first officer has explained that he, at this time, had a bad gut feeling.

14 seconds after the aural alert from the radio altimeter, the EGPWS gave the aural alert ‘Too Low terrain’. At this time, the aircraft was at a GPS altitude of 312 ft, or 95 metres.

1.1.5 MISSED APPROACH AND RETURN TO BODØ

Immediately after the EGPWS alert, the first officer called ‘Go around’ and started performing his items in the missed approach procedure. He then discovered that the altimeter was set to the standard pressure of 1,013 hPa and not to 987, which was the correct QNH. The commander started performing his items in the procedure by setting power and flaps and retracting the landing gear. Six seconds after the EGPWS warning, the aircraft had achieved positive vertical climb. The aircraft’s lowest altitude before it began to climb was 292 ft (89 m). The first officer notified *Helle Information* via radio that they performed a missed approach. They then followed the established missed approach procedure, climbed to 4,000 ft and headed for the reporting point ABTIK. The crew discussed whether to attempt another approach but concluded that this incident was so serious that they would not make another attempt. In addition, the weather was so bad that they were uncertain about whether they could start another approach.

The crew requested, and was granted, clearance to return to Bodø where they landed on runway 25 at 1924 hrs, taxied to stand 15 and completed the shutdown checklist. They explained to the cabin crew member and passengers why they did not land in Svolvær and instead returned to Bodø. They then secured the recording from the Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR) by pulling the fuses. The commander called the flight operations duty manager and the crew scheduling department to say that the crew did not wish to continue to fly that day. The crew then went to the crew lounge to discuss the incident with the cabin crew member before writing a report. The commander talked to Widerøe’s base manager for Bodø later that evening. The crew were also offered follow-up by a psychologist.

1.2 Injuries to person

The crew on this flight consisted of the commander, the first officer and one cabin crew member. There were 29 passengers on board. No persons were physically injured in the incident.

1.3 Damage to aircraft

None.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 COMMANDER

The commander, 43, began his training at a flying school in the USA in 2021, spent two years there and was issued an American pilot licence. After completing his training, he worked as a flying school instructor where he taught students training for a Private Pilot Licence (PPL), Commercial Pilot Licence (CPL) and Instrument Rating (IR). He worked for Bergen Air Transport from 2005 to 2008 and started working for Widerøe in December 2008. During his time with Widerøe, he was first based in Bodø for 4 years and then at Gardermoen for 10 years. At the time of the incident, he was back at the company's Bodø base after having completed his flight commander course in June 2022. He had logged a total of 153 hours as a commander in Widerøe at the time of the incident, and it was his first winter season in this role. The commander held a valid European Airline Transport Pilot Licence (ATPL) and valid type rating for the DHC-8-100. His most recent Operator Proficiency Check (OPC) took place on 15 September 2022. He held a class 1 medical certificate valid until January 2024.

In an interview with the NSIA, the commander stated that he had slept well before the flight and felt fit and well.

Table 2: Flying experience, commander: Source: Widerøe

Flying experience	All types	Type in question (100, 200 and 300)
Last 24 hours	1:36	1:36
Last 3 days	1:36	1:36
Last 30 days	46:10	46:10
Last 90 days	145:16	145:16
Total	8,831:44	229:41

1.5.2 FIRST OFFICER

The first officer, 35, started his pilot training by taking a private pilot's licence at Notodden. He worked as a flying instructor for a while before he was hired as a first officer by Widerøe in 2013. He started flying for SAS in 2016 but lost his job in SAS due to the difficult situation in the aviation industry resulting from the COVID-19 pandemic. The first officer worked as a pilot for a couple of other companies for short periods before returning to work for Widerøe from the company's Bodø base in January 2022.

The first officer held a valid European Commercial Pilot License (CPL) and valid first officer rating on the DHC-8-100. He completed the first officer course and OPC in June 2022. He held a class 1 medical certificate valid until January 2024. In an interview with the NSIA, the first officer stated that he had slept well before the flight and felt fit and well.

Table 3: Flying experience, first officer. Source: Widerøe

Flying experience	All types	Type in question (100, 200 and 300)
Last 24 hours	2:27	2:27
Last 3 days	6:41	6:41
Last 30 days	47:48	47:48
Last 90 days	127:02	127:02
Total	5,326:29	2,050:42

1.6 Aircraft information

1.6.1 GENERAL INFORMATION ABOUT THE AIRCRAFT TYPE AND STATUS OF LN-WIP

LN-WIP was a De Havilland of Canada Ltd. DHC-8-103 manufactured in 1990. The DHC-8-103 is a twin-engine turboprop aircraft with a pressurised cabin and a maximum capacity of 40 passengers. The aircraft is certified for two pilots and one cabin crew member.

Figure 1: LN-WIP. Photo: Jan Lennart Gulbrandsen

Table 4: Aircraft details. Source: Widerøe

Registration	LN-WIP
Manufacturer	De Havilland of Canada Ltd.
Model	DHC-8-103
Designation	Dash 8
Serial number	239
Build year	1990
Engine type	Pratt & Whitney PW123
Airworthiness Review Certificate (ARC)	Valid until 20 January 2024

1.6.2 BAROMETRIC ALTIMETER

The DHC-8-100 has two separate altimeters in addition to a standby altimeter. They all use barometric pressure to calculate the aircraft's altitude. The locations of the altimeters in the cockpit are shown in Figure 2. The adjustment for local pressure is done by setting the relevant QNH on the altimeter. An alert light and aural alert will notify pilots when the aircraft is 1,000 ft away from the altitude selected (set in Altitude Pre-Select - APS). The light signal is in the form of a yellow light on the altimeters.

Figure 2: Location of the barometric altimeters in a DHC-8-100. Photo and labelling: NSIA

1.6.3 RADIO ALTIMETER

LN-WIP was equipped with a radio altimeter, a system for measuring altitude above ground level. The altitude was shown in the bottom right-hand corner of the Electronic Attitude Director Indicator (EADI). At altitudes above 2,500 ft, it showed four orange lines. If altitude above ground was less than 2,500, the altitude was displayed followed by the letters RA as shown in Figure 3 for a radio altitude of 140 ft. The radio altimeter was used as a data source for terrain warning system; Enhanced Ground Proximity Warning System (EGPWS).

Figure 3: The radio altitude is displayed in the bottom right-hand corner of the EADI. Photo: NSIA / Widerøe

The radio altimeter was to give off an aural alert at the altitudes of 500 ft, 100 ft, 50 ft, 40 ft, 30 ft, 20 ft and 10 ft. The aircraft had a Minimum Equipment List (MEL) that requires one radio altimeter to be operational before departure.

1.6.4 ENHANCED GROUND PROXIMITY WARNING SYSTEM

LN-WIP was equipped with a Honeywell MK VIII 965-1216 EGPWS terrain warning system. The system would warn the crew if it detected that the aircraft was too close to the terrain. What made it an enhanced system was that it used terrain database to calculate terrain conditions in front of the aircraft in its flight path. EGPWS had several modes, and mode 4A gave an alert if the aircraft's altitude above the terrain was too low. Two terrain models were used for approaches, a Terrain Clearance Floor (TCF) model and a Runway Field Clearance Floor (RFCF) model.

Mode 4A also used the aircraft's radio altitude and a calculation of its geometric altitude. The geometric altitude was calculated by taking into account the GPS altitude, barometric altitude, radio altitude and the runway's elevation, as well as the aircraft's speed and its roll, pitch and yaw. The purpose of calculating the geometric altitude using multiple sources of altitude data was to eliminate the possibility that an incorrectly set barometric altitude or temperature correction of barometric altitude could affect the calculation. If the system calculated the aircraft's radio altitude to be lower than the TCF profile or its geometric altitude to be lower than the RFCF profile, then the system would alert the crew by means of a 'Too Low terrain' aural alert and alert light.

Data files from EGPWS were secured after the incident and analysed in the USA by the system's manufacturer, Honeywell, as described in section 1.6.4.3. Their analysis was based on the log file from EGPWS and contained times, barometric altitude, GPS altitude and radio altitude for a 30-second window starting 20 seconds before the 'Too Low terrain' alert and ending ten seconds after. The barometric altitude in the log file had to be corrected for QNH. The log showed that datapoints are stored every second using the alert as a reference, and thus without a global time reference. The time of each datapoint was determined through comparison with data from the voice cockpit recorder and ADS-B data.

1.6.4.1 Terrain Clearance Floor

Software version SW-011 was installed on LN-WIP's EGPWS. In this version, the TCF profile starts with bias factor of 0.5 NM from the runway threshold and then followed the vertical profile as shown in Figure 4.

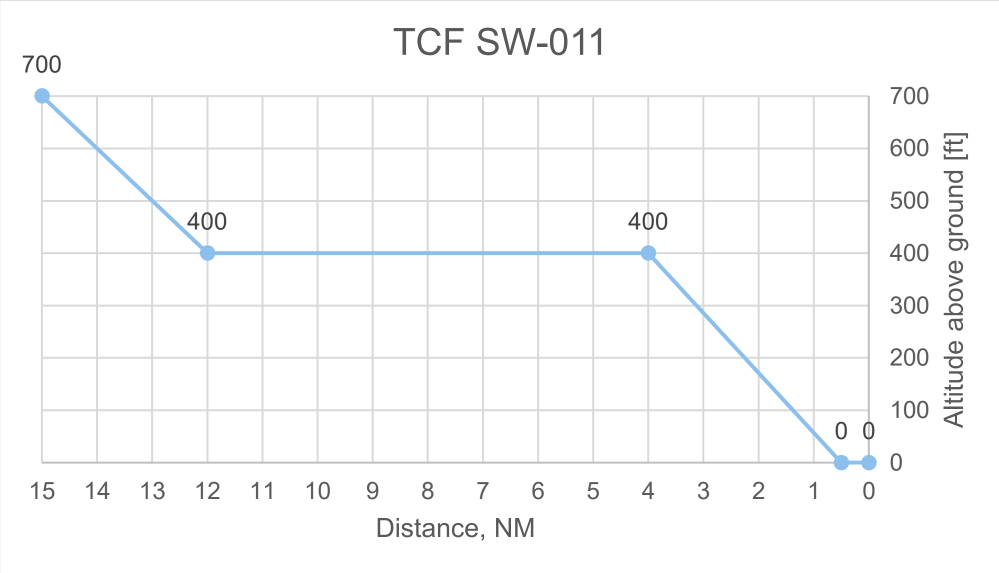


Figure 4: TCF for SW-011. Source: Honeywell EGPWS Pilots guide. Plot: NSIA

Honeywell had a more recent software version designated SW-036. In this version, the TCF profile started with a bias factor of 0.25 NM from the runway threshold and then follows the vertical profile as shown in Figure 5. However, this new software version was not available for the hardware version of EGPWS installed in LN-WIP and other similar aircraft in Widerøe's fleet at the time of the incident. EGPWS had thus been updated to the most recent software version available for the hardware installed.

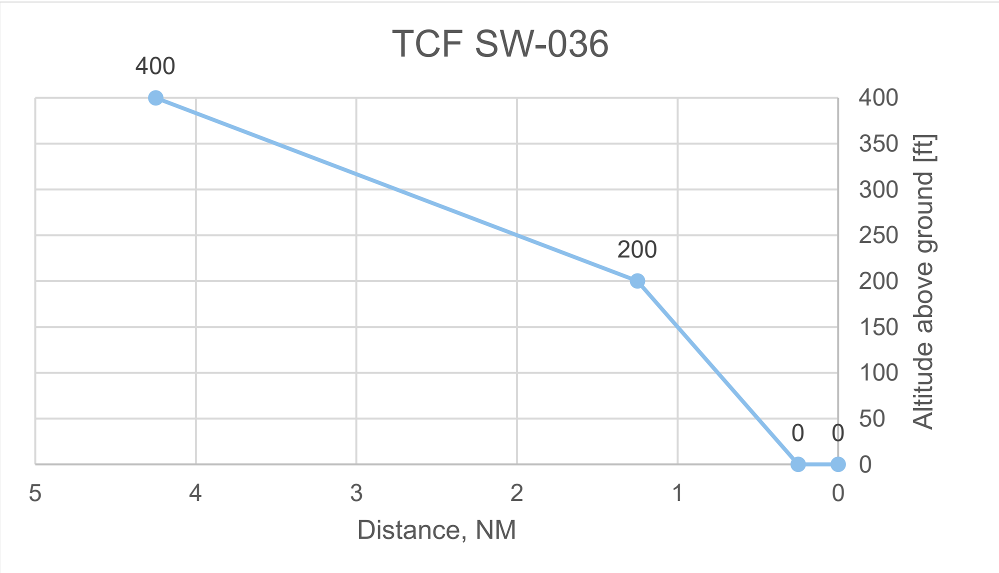


Figure 5: TCF for SW-036. Source: Honeywell EGPWS Pilots guide. Plot: NSIA

1.6.4.2 Runway Field Clearance Floor

Runway Field Clearance Floor (RFCF) was an EGPWS function designed to identify premature descent to a runway. This function used the runway elevation as a reference. Software versions SW-011 and SW-036 both used an RFCF with a vertical profile that had a bias factor of 1 NM from the runway threshold and followed the vertical profile shown in Figure 6.

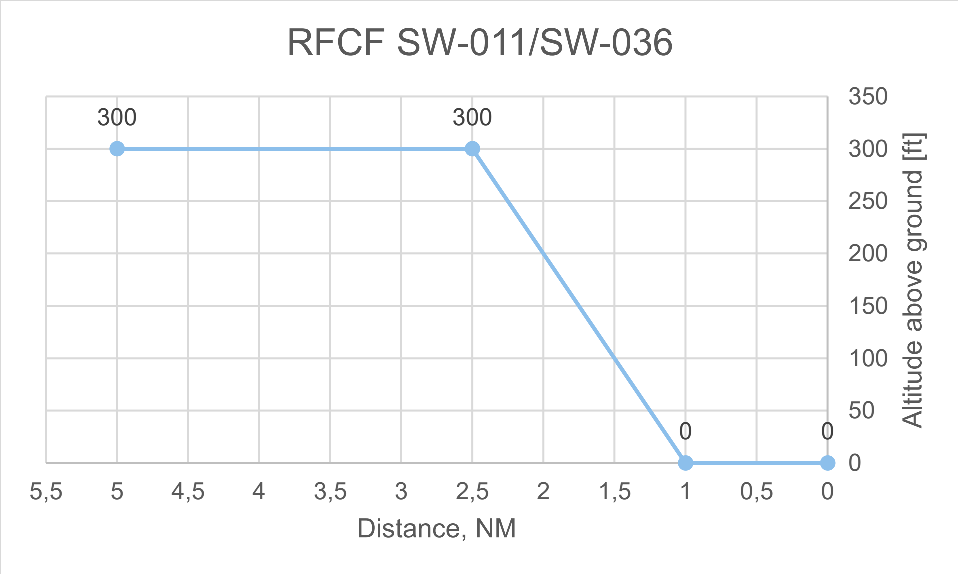


Figure 6: RFCF for SW-011 and SW-036. Source: Honeywell EGPWS Pilots guide. Plot: NSIA

1.6.4.3 Logfile analysis performed by Honeywell

The NSIA requested that the EGPWS manufacturer Honeywell analyse the EGPWS log file. The manufacturer's analysis concluded as follows:

> *Based on our analysis, if the aircraft was equipped with the latest EGPWS MK-VIII software (-036), which requires a newer hardware, a Terrain Clearance Floor (TCF) alert would have been triggered approximately 2 seconds earlier than when the RFCF alert was triggered during the incident flight.*

Table 5: Difference in response between SW-011 and SW-036. Source: Honeywell

	-011 RFCF Alert	-036 TCF Alert
Uncorrected Baro Alt (ft)	1,026	1,052
GPS Alt (ft)	312	336
Radio Alt (ft)	303	319
Geometric Alt (ft)	300	328

The manufacturer produced a graphic presentation of the values retrieved from the EGPWS log file which is shown in Figure 7. The figure shows TCF for SW-011, TCF for SW-036 and RFCF valid for both SW-011 and SW-036. The blue line shows the calculated geometric altitude, while the brown line represents the calculated elevation of the terrain (geometric altitude minus radio altitude). The figure shows when the alert was triggered, but also when it would have been triggered had the EGPWS used the most recent software version.

In the figure below, the following envelopes are drawn to illustrate their relationships:

- SW-011 RFCF
- SW-011 TCF
- SW-036 TCF (the envelope available in the latest software – requires a newer MK-VIII hardware)

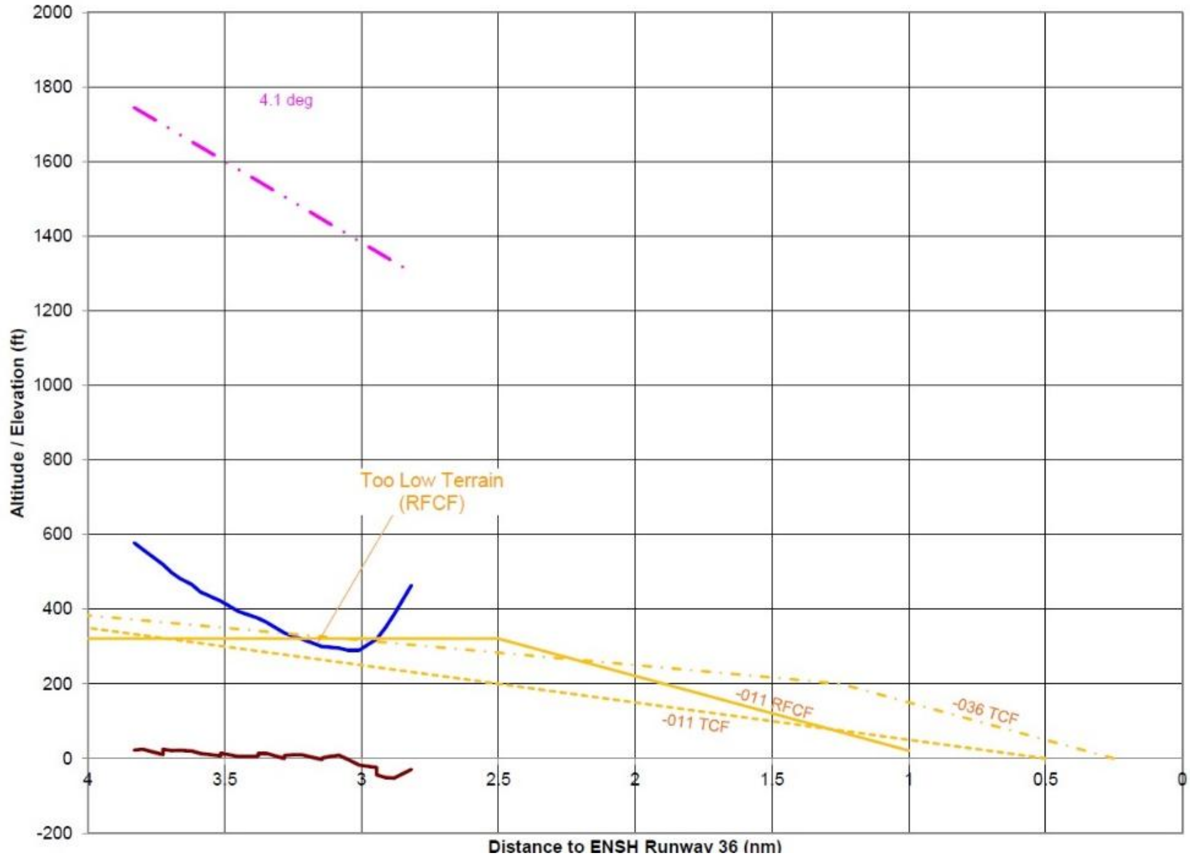


Figure 7: Graphic representation of the EGPWS log. Source: Honeywell

1.6.5 TRANSPONDER

LN-WIP had two Mode S Elementary Surveillance transponders of the type Collins TDR-94D with part number 633-9210-501 installed, and one at a time was operational. These transponders also transmitted flight data automatically (Automatic Dependent Surveillance Broadcast – ADS-B). A ground-based surveillance system (Enhanced Surveillance System – EHS) can obtain further data from an aircraft by requesting or interrogating its transponder to provide content from the transponder's register. If a transponder in Mode S is interrogated by a ground system, it will respond by transmitting the aircraft's ATC identification code, altitude data and its unique address code data. These basic functions are referred to as elementary surveillance and contain data from the transponder's Binary Data Store (BDS) registers 1.0, 1.7, 2.0 and 3.0 but no data from register 4.0.

The transponder that LN-WIP and other similar DHC-8 aircraft was equipped with could not transmit the aircraft's barometric pressure setting, which is found in BDS register 4.0, even if it was to receive an interrogation regarding the content of that register.

The aircraft broadcast ADS-B data throughout its flight from Bodø to Svolvær. The NSIA has received these data from Flightradar24 as well as the data registered by Avinor ANS.

The ADS-B dataset registered by Avinor ANS contained, among other things, times, GPS coordinates (longitude and latitude) and barometric altitude. The datapoints were updated every four seconds, i.e. at a frequency of 0.25 Hz. The dataset contained a total of 452 datapoints, only one of which was rejected from further analysis.

The ADS-B dataset from Flightradar24 contained time, longitude, latitude, barometric altitude, GPS altitude and vertical speed, among other things. The datapoints were updated four times per seconds, i.e. at a frequency of 4 Hz. The dataset contained a total of 8,223 datapoints, 944 of which were rejected from further analysis because of invalid data values.

1.7 Meteorological information

1.7.1 WEATHER REPORT FROM THE NORWEGIAN METEOROLOGICAL INSTITUTE

The NSIA requested the Norwegian Meteorological Institute to prepare an extended weather report. The report provided the following conclusion concerning the overall weather conditions:

> *There were several small low-pressure systems in the area, with the dominant one located over Troms county causing north-westerly wind and intermittent showers towards Nordland. The satellite image shows an almost continuous line of CB clouds stretching west-northwest from Lofoten. This is called a trough, and it could cause persistent heavy snow, even when the weather situation would otherwise indicate showers. The 0 degrees C isotherm was at SFC-0500FT, so showers would come in the form of snow/sleet and possibly graupel.*

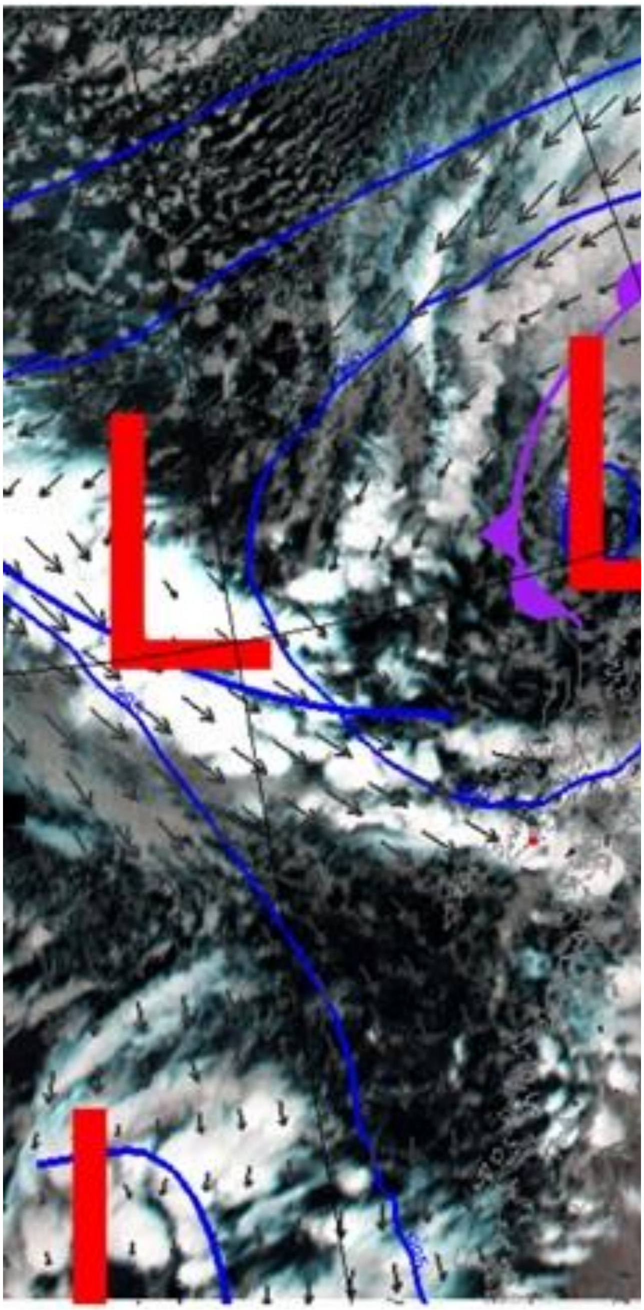


Figure 8: Satellite image over Lofoten at
22 December 2022. Svolvær is indicated by a red dot.
Illustration: Norwegian Meteorological Institute

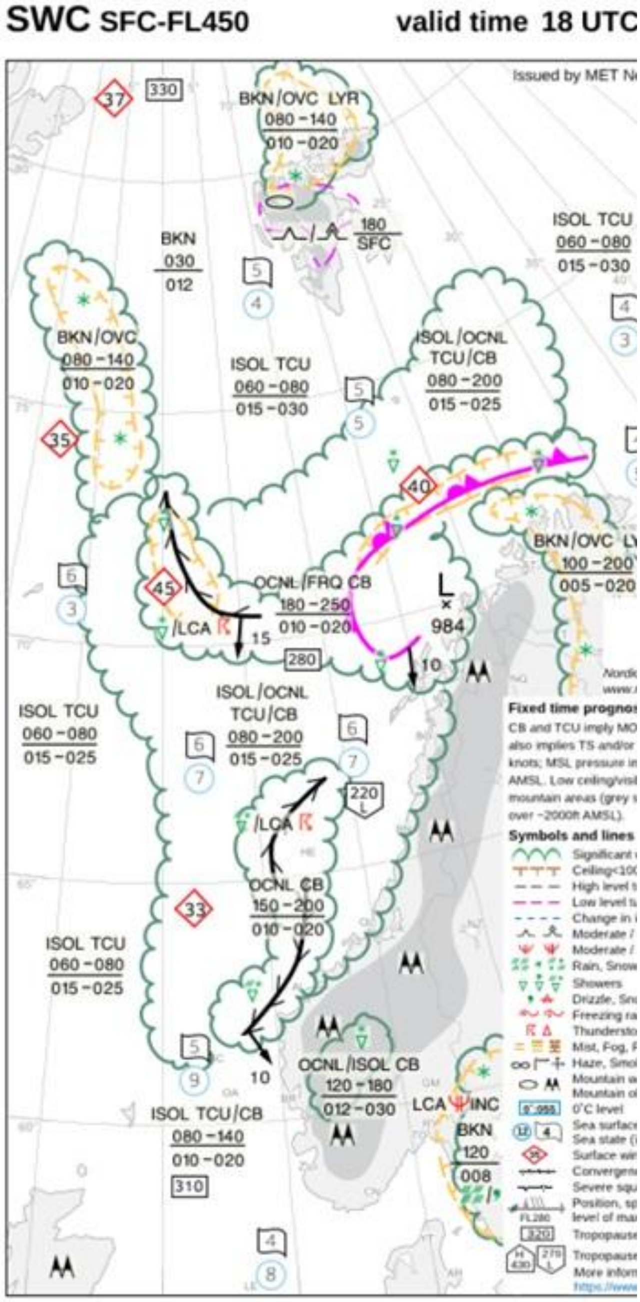


Figure 9: Significant Weather Chart at 18 UTC on
22 December 2022. Illustration: Norwegian
Meteorological Institute

TAF ENSH

221400Z 2216/2223 30008KT 9999 -SHSN FEW015 BKN025 TEMPO 2216/2223 30025G35 0500 +SHSN VV002 TEMPO 2216/2223 SCT020CB=

The Meteorological Aerodrome Reports (METAR) for Bodø and Svolvær for the period from 1620 to 1950 hrs are provided below.

METAR ENBO

ENBO 221750Z 35012KT 9999 FEW038 BKN059 BKN098 01/M03 Q0990=

METAR ENSH
ENSH 221720Z 20009KT 170V240 9999 -SHSN FEW008 BKN018 00/M02 Q0988 RMK WIND 150FT 26010G26KT 200V340

ENSH 221750Z 24006KT 210V280 3000 -SHSN VV013 00/M02 Q0988 RMK WIND 150FT 24008KT 220V280

ENSH 221820Z VRB04KT 4000 -SHSNRA VV008 M00/M01 Q0987 RMK WIND 150FT 29011G23KT 260V360=

ENSH 221850Z 31007KT 260V010 2000 SHSN VV006 00/M01 Q0987 RMK WIND 150FT 30010G20KT 210V350=

ENSH 221920Z 36004KT 310V060 1300 SHSN VV006 M00/M01 Q0987 RMK WIND 150FT 30004KT 230V360=

1.7.2 EN ROUTE WEATHER REPORTS FROM POLARIS CONTROL AND HELLE INFORMATION

The crew received weather updates from *Polaris Control* and later from *Helle Information* as specified in the history of flight described in section 1.1.

1.8 Aids to navigation

1.8.1 LOCALIZER APPROACH TO ENSH RUNWAY 01

A localizer (LOC) approach is a non-precision approach where the aircraft is navigated using a radio beam that indicates the lateral position of the aircraft in relation to the extended runway centreline, usually linked to a system that measures the distance between the aircraft and the runway (Distance Measuring Equipment – DME). The LOC procedure for this approach was published on 1 December 2021 and is shown in Figure 10. The planning and execution of a LOC approach entails a higher workload than a GLS approach. One of the reasons for this is that the vertical profile of a LOC approach is not pre-programmed in the aircraft's Flight Management System (FMS) and that the procedures require more communication in the form of standard phraseology during the approach.

Because the altimeter is used as a source, an incorrectly set altimeter will result in the barometric altitude indicated deviating from the aircraft's actual altitude, even if the altitudes of the approach profile comply with the indicated altitude. In this case, the local barometric pressure was lower than the standard barometric pressure, and a barometric altimeter will therefore show an altitude above the aircraft's actual altitude. The altitude readings could then align with the 'check altitudes' on the approach chart, but the aircraft's altitude will be lower than indicated. The aircraft will be 27 ft lower per hPa of deviation.

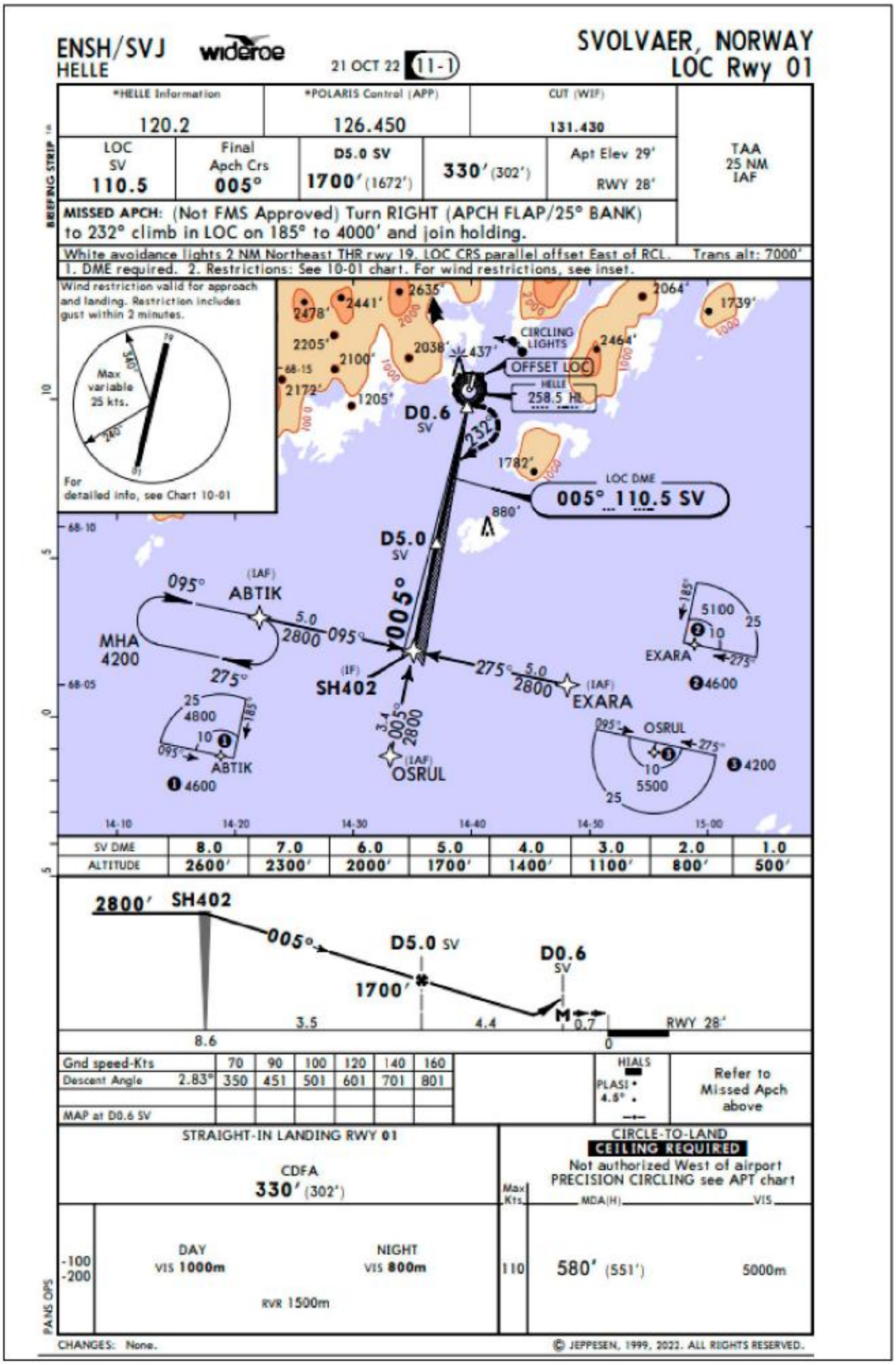


Figure 10: Widerøe's GLS approach chart for Svolvær. Source: Widerøe

1.9 Communications

Communication with the air traffic service functioned normally during the flight from Bodø to Svolvær.

1.10 Aerodrome information

The air traffic service provides Aerodrome Flight Information Services (AFIS) for Svolvær, which has a runway running north to south designated 01 and 19 (since changed to 36 and 18). The threshold of runway 01 had an elevation of 28 ft above sea level.

A Traffic Information Zone (TIZ) has been established around the airport extending from the ground up to 3,500 ft. Air traffic service's aerodrome flight information services for this area are provided by *Helle Information*. Above Svolvær TIZ we find Lofoten Terminal Manoeuvring Area, (TMA) which is a class D airspace in which air traffic control services are provided by *Polaris Control*.

The transition altitude for the area is 7,000 ft. GLS approach and LOC approach were both available for runway 01.

1.10.1 DESIGN CRITERIA FOR LOC AND GLS MINIMA FOR ENSH

The NSIA has asked Avinor how the minima for LOC and GLS approaches to runway 01 at Svolvær Airport Helle were calculated. Avinor replied as follows:

> *The reason why minimum altitudes are lower in the LOC procedure than in the GLS procedure relates to the applicable design criteria for the respective procedures.*
>
> *When designing a procedure with vertical guidance (ILS/GLS/SBAS), a parameter referred to as "height loss" is used. To put it simply, this means that if you follow the procedure's vertical signal (such as a glide path), you will reach the minimum during the descent, and the design criteria then require a height loss buffer to be added to allow for the fact that the aircraft will continue to descend for a while before a missed approach climb is initiated. In a LOC procedure (with no vertical guidance), this height loss component does not apply, as the procedure relies exclusively on lateral protection. If you look at the procedure's profile view, you will see that the gradient between FAF and MAPt appear to be continuous, but as the LOC just has lateral protection, there is no need to add the height loss component here.*
>
> *Lower minima for LOC procedure*
> *You may wonder about the imperative to be "overly conservative" in relation to protection in the best procedures with vertical guidance compared with the exclusively LOC procedure. Procedures with glide path/vertical guidance are not particularly well suited for locations where you cannot proceed straight forward in the event of a missed approach. In principle, the procedure with vertical guidance has tighter protection areas, but there is nothing to gain from this in cases where you will have to turn immediately (as is the case for Svolvær). The GLS procedure is therefore "punished" twice in this case: height loss + a protection area identical to the LOC missed approach procedure due to the immediate turn.*

1.10.2 ATM SYSTEM AND DISPLAY

At the time of the incident, Svolvær Airport Helle had NATCON Distant Flight System Terminals (DFST) for Flight Data Processing System (FDPS), but the airport did not have Surveillance (SUR). The air traffic services at Helle were transferred to the Remote Tower Centre (RTC) as of 1 January 2023. AFIS officers are now providing flight information services from the RTC in Bodø.

1.11 Flight recorders

1.11.1 COCKPIT VOICE RECORDER

LN-WIP was equipped with a cockpit voice recorder (CVR) manufactured by Honeywell, part number 980-6022-001. The unit records sound from four different microphones and stores it in separate channels: the flight commander's microphone, the first officer's microphone, the cabin crew's microphone and the Cockpit Area Microphone (CAM). The crew pulled the fuse of the CVR after landing in Bodø, thereby securing the recording. Widerøe then secured the cockpit voice recorder. The recording was of good quality and has been highly useful during the investigation.

1.11.2 FLIGHT DATA RECORDER

LN-WIP was equipped with a Teledyne Flight Data Recorder (FDR). Data from the FDR were secured following the incident.

1.12 Wreckage and impact information

Not applicable.

1.13 Medical and pathological information

Not applicable.

1.14 Fire

Not applicable.

1.15 Survival aspects

Not applicable.

1.16 Tests and research

Not applicable.

1.17 Organizational and management information

1.17.1 INTRODUCTION

Widerøe's Flyveselskap AS was established in 1934, which makes it Norway's oldest airline. The company's fleet totals 40 DHC-8 (100/200/300 and Q400 series) as well as 3 Embraer E190-E2 aircraft. The company operates flights to several destinations in Norway and Europe. Widerøe's head office is in Bodø, and the company has a total of approximately 2,500 employees across its different bases and offices.

The company holds an Air Operator Certificate (AOC) to operate under the joint European regulations. The company's operations manuals reflect this, and the pilots use only the company's Operations Manuals (OM). These manuals should address and cover the joint European regulations, the aircraft manufacturer's manuals, the regulations specific to Norway and the company's own procedures. In accordance with the joint European regulations, the operations manuals are divided into OM Parts A, B, C and D.

OM A describes the company organisation, its safety management systems and general information about how aircraft operations are to be carried out.

OM B describes how specific types of aircraft are to be operated and includes the aircraft manufacturers and the company's own procedures and limitations.

OM C contains the route manual with the company's navigation procedures and route maps including approach and departure procedures.

OM D describes how the company addresses the official requirements for pilots' training and instruction.

1.17.2 PROCEDURE FOR FIRST CLEARANCE FOR AN ALTITUDE

Below are excerpts from the procedures set out in OM A and OM B for altitude changes and setting the barometric altimeters to local pressure when moving from a flight level to an altitude.

OM A 8.3.4 Altitude Alerting System Procedures

During cruise, the altitude alerting system shall be set to the assigned cruising level.

When descending, the altitude alerting system shall be set to the respective altitude/flight level the aircraft is cleared to descent.

The alerting system (see OM B) gives pre-warnings 1 000 ft before reaching the selected altitude/flight level.

OM B 2.1.3 Altimeter setting procedure

During descent and after the first clearance to an altitude has been received, both pilots shall set QNH and compare altimeter readings.

The below table shows the standard phraseology to be used when verifying that the altimeter settings are correct on descent from flight level to an altitude.

OM B 2.1.2 Standard Callouts

Situation	PF	PM
Descending to altitude, setting QNH	"<QNH> PASSING XXXX FEET"[3]	"SET AND CROSS-CHECKED"

1.17.2.1 Approach checklist

Excerpt from the procedure for descending from flight level to an altitude.

OM B 2.4.1 Descent planning

Accomplish **APPROACH Checklist**

When leaving cruise **and** cleared first QNH altitude, Accomplish APPROACH Checklist.

Laminated copies of the approach checklist referred to in the procedure quoted from OM B are attached to the commander's and first officer's sticks. The procedure consists of three items, the last of which is verification of the altimeter setting ('*Altimeters*'). The checklist is shown in its entirety below.

Normal checklist DH1/ DH2

APPROACH	
Approach Briefing	**Complete PF**
VREF	**PF & PM**
Altimeters	**_____ hPa PF & PM**

1.17.3 PRE-LEVEL PROCEDURE

A procedure is to be used to verify the altimeter setting when descending from flight level to an altitude. Following clearance for an altitude, the crew will set the altitude in the cockpit's Altitude Pre-Select (APS) window. Once the aircraft reaches 1,000 ft above the specified APS altitude, a yellow light will appear in the upper right-hand section of the barometric altimeter and an aural alert will sound. When this light comes on, the crew are to perform the pre-level callout and procedure.

Excerpts from the pre-level callout procedures in OM A and OM B are shown below.

OM A 8.3.4 Altitude Alerting System Procedures

During cruise, the altitude alerting system shall be set to the assigned cruising level.

When descending, the altitude alerting system shall be set to the respective altitude/flight level the aircraft is cleared to descent. The alerting system (see OM B) gives pre-warnings 1 000 ft before reaching the selected altitude/flight level.

OM B 2.1.2 Altitude Awareness

*To confirm level-off at correct cleared altitude and on correct altimeter setting, PM shall call "**PRELEVEL**" 1.000 ft before reaching a cleared altitude / Flight Level, verifying that correct altitude/FL is set in the APS window. The call shall be acknowledged by the PF who checks the arming and replies with the preselected altitude. E.g. "**FL180**".*

*On the first transfer from QNH to FL and vice versa, the call shall also include the confirmation of altimeter setting. E.g. "**PRELEVEL**" "**STANDARD**, **FL180**".*

On non-precision approaches, the pre-level procedure shall not be used once inside the Initial Approach Fix / Waypoint.

The required phraseology to be used when performing the checklist from OM B to verify correct altimeter settings are shown in the table below.

OM B 2.1.2 Standard callouts

Situation	PF	PM
1.000' before selected FL/altitude	**"FLXXX / XXXX FEET"**[2]	**"PRELEVEL"**

1.17.4 RADIO ALTIMETER PROCEDURE

The radio altimeter is normally activated 2,500 ft above ground level. The indication that the radio altimeter has activated is that the EADI is displaying altitudes. There is no light or aural alert. There is a procedure in place to verify the barometric altimeter setting and the altitude indicated by the radio altimeter on activation of radio altimeter. The required phraseology to be used when completing the radio altimeter checklist is shown below.

OM B 2.1.2 Standard callouts

Situation	PF	PM
On first activation of Radio Altimeter	**"QNH XXXX FEET"**[3]	**"RADIO HEIGHT"** **"CHECKED"**

1.17.5 EGPWS ACTIVATION

Widerøe had the following procedure in place for responding to EGPWS alerts.

OM A 8.3.5.2 Response to EGPWS Aural Alerts

The system gives aural alerts in the form of warnings, cautions or advisories.

An immediate and positive response must be made to all EGPWS warning or caution alerts, unless the flight is in VMC daylight and it is immediately obvious to the Commander that the aeroplane is in no danger in respect to configuration, flight manoeuvre or proximity to terrain.

Investigation of the reason for an alert is always secondary to the response action. Pilots are authorized to deviate from the current ATC clearance to the extent necessary to comply with an EGPWS warning or caution alert.

Warnings

The response to any warning is to immediately establish the power setting and attitude that produces the maximum climb gradient consistent with the aeroplane configuration.

The phraseology to be used after receiving an alert from EGPWS is shown below.

OM B 3.5.3 EGPWS Activation

PF	PM
Push Go-Around (GA) pushbutton. Advance power levers towards 80%. Command **"GO-AROUND. FULL POWER"** Rotate aircraft to go-around attitude	Check Condition levers are in the fully forward (MAX) position and advance Power Levers to MTOP. Call **"CONDITION LEVERS, POWER SET."** Monitor radar altimeter and call **"TERRAIN CLOSING"** if separation from the ground is still decreasing.

1.18 Additional information

1.18.1 SIMILAR INCIDENTS

1.18.1.1 Paris (LFPG)

On 23 May 2022, an Airbus A320 carrying 172 passengers operated by Airhub Airlines on behalf of Norwegian Air Sweden performed an RNP approach with LNAV/VNAV minima to runway 27R on Paris Charles de Gaulle (LFPG). The crew had twice received QNH 1,011 from the air traffic service and had adjusted the aircraft's barometric altimeters accordingly. The correct pressure was QNH 1,001. As a result of this error, the approach was flown approx. 280 ft below the vertical profile. The crew carried out a go-around when they reached the decision altitude without being able to see the runway. The radio altimeter later showed that the aircraft's lowest altitude had been only 6 ft above the ground. The crew were given vectors to perform another approach and performed another approach, still with incorrect QNH, with neither the crew nor the air traffic service realising that the altimeter setting was incorrect. On this approach, the aircraft landed after the crew acquired visual contact with the runway. The incident was classified as a serious aviation incident and investigated by the French safety investigation authority (Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile – BEA). BEA published its report[2] on the incident in July 2024 with a number of recommendations.

1.18.1.2 Stavanger (ENZV)

On 11 March 2021, Widerøe's flight WIF533 was cleared for an ILS (Instrument Landing System) approach to runway 18 at Stavanger Airport Sola (ENZV) under Visual Meteorological Conditions (VMC). WIF533 focused on configuring the aircraft to the correct approach speed. Just after their radio altitude showed as 500 ft, the crew received an EGPWS alert. The crew then realised that they forgot to reset the barometric altimeter from standard pressure (1,013 hPa) to local pressure (970 hPa). They adjusted QNH and climbed to 1,000 ft before continuing their approach and landing.

1.18.2 EASA SAFETY INFORMATION BULLETIN 2023-03

On 9 March 2023, the European Union Aviation Safety Agency (EASA) published a Safety Information Bulletin (SIB) entitled *Incorrect Barometric Altimeter setting* that deals with the risks

[2] *https://bea.aero/en/investigation-reports/notified-events/detail/serious-incident-to-the-airbus-a320-registered-9h-emu-operated-by-airhub-on-23-05-2022-at-paris-charles-de-gaulle-ad/*

associated with incorrect QNH. The SIB contains the following recommendations to the Air Navigation Service Providers (ANSP) and operators:

> ***To ANSPs:***
>
> *- Consider introducing procedures to provide aircraft with the QNH (or QFE) when clearing an aircraft for the approach or at first contact with the tower.*
>
> *- Consider the use of the barometric pressure settings that Mode S EHS equipped aircraft downlink to enable timely identification of aircraft operating with incorrect barometric altimeter setting.*
>
> ***To aircraft operators**:*
>
> *- Develop procedures to support pilots in checking the consistency of the QNH (or QFE) with previous settings and other available sources (e.g. ATIS).*
>
> *- Ensure that the latest available software version and the latest terrain and obstacle database are loaded in the Terrain Awareness and Warning System (TAWS).*
>
> *- Investigate methods to identify incorrect altimeter setting with the FDM Programme.*

1.18.3 UK CAA SAFETY NOTICE SN-2023/003

On 28 April 2023, the UK Civil Aviation Authority (CAA) published a safety notice following the incident involving Norwegian in Paris on 23 May 2022 entitled *Risk of Controlled Flight into Terrain during 3D BARO-VNAV and 2D Approaches (Altimeter Setting Procedures)*. This safety notice detailed when an incorrectly set barometric altimeter can result in a situation where the altitudes indicated by the barometric altimeter agree with the approach chart, while the aircraft is actually below the altitude indicated.

It concludes by listing ten items under *Actions to be taken* to prevent incorrect barometric altimeter settings from causing a CFIT.

1.18.4 EUR OPS BULLETIN 2023_001

On 27 July 2023, International Civil Aviation Organization (ICAO) published an EUR OPS BULLETIN entitled *Risks related to altimeter setting errors during APV Baro-VNAV and non-precision approach operations*.

The below text is an excerpt from this document for Air Navigation Service Providers (ANSPs) and operators, respectively:

> ***At aircraft operator's level***
>
> - *Encourage the use of those 3D operations where final segment profiles cannot be impacted by wrong barometric altimeter setting (ILS, RNP APCH down to LPV minima, GLS).*
> - *Consider adjusting the operating minima by taking into account the operational exposure and/or crew experience with approach procedures that are vulnerable to QNH errors.*
> - *Apply Crew Resource Management techniques, such as cross-checking and monitoring.*
> - *Consider altitude callouts, whereby the aircraft's radio altimeter can provide height callouts to the pilot when passing specific values (e.g. 500 ft and 1000 ft), which can be interpreted to assess whether the aircraft is deviating from the intended vertical profile. This mitigation is more effective when the terrain is relatively flat.*

At ANSP level

- *Consider fixed and harmonized transition altitudes/levels which can harmonize the switch from 1013.2 hPa to QNH.*
- *Consider using the barometric pressure settings provided by Mode S EHS (Enhanced Surveillance) and ADS-B equipped aircraft, to enable the timely identification of aircraft operating with incorrect barometric altimeter setting.*

The report also makes some general recommendations and some recommendations concerning training:

a) General recommendations:

- *to ensure that awareness of the risk of altimeter setting errors and their consequences is shared; - to assess the robustness of the mitigation measures described in the previous point, and to consider implementing them, when relevant;*
- *to report all situations that have generated deviations in order to improve the visibility of this type of event, preferably with a perspective of the appropriate treatment in each case;*
- *to contribute collectively to training on this risk, to disseminate best practices and to promote exchanges between domains in order to better understand the limits of the systems;*

b) Recommendations on Training:

- *Initial and recurrent training should address the limits of barometric altimetry, and the impact of incorrect barometric pressure settings on vertical position including those factors outlined in this bulletin.*
- *Training and/or promotional initiatives on altimeter setting procedures, different impacts of QNH errors between geometric and barometric approaches and possible mitigation measures, use of standard phraseologies, adhering to read back and hear back, etc.*
- *Training on 3D operations including the difference between 3D depending on Baro-VNAV and other 3D approach operations, highlighting the critical importance of Barometric setting for Baro-VNAV operations.*
- *Training on 3D RNP operations highlighting the RNP chart layout where LNAV/VNAV and LPV minima co-exist.*

1.18.5 IMPLEMENTED MEASURES

1.18.5.1 Measures implemented by Widerøe following the incident

Widerøe carried out an internal investigation following the incident involving LN-WIP. An excerpt of measures implemented since follows:

- *Pending the removal of the 400 ft minima limitation on GLS, WF has as a mitigating measure raised all LLZ minima to make them equal to or higher than the GLS minima for the relevant approaches. This will serve to make GLS, LPV or LNAV/VNAV preferred procedures.*
- *It was decided in the board meeting in September 2024 that a cockpit upgrade of the company's Legacy DASH-8 aircraft will be undertaken. Following this upgrade, the*

altimeter setting will flash to alert crews if it is set to std when passing TL. The first aircraft are expected to be upgraded by Q3 2026. Fully implemented by Q2 2028. This will include smart call at 2,500 ft.

- *The topic of workload and time management was reviewed as part of OPC 2-23. Both in briefs and articles in the study guide. The simulated flight was from Bodø to Lakselv and involved several factors inspired by the incident involving LN-WIP. In addition, 'correct verification and crosschecking' was emphasised in the brief for OPC/LPC 1-24. The line check and LIFUS forms have been modified with additional focus on altitude awareness and altimeter setting.*
- *Increased focus on crew cooperation and workload management in flight commander training. The training department has updated several chapters on this topic in the Commanders Upgrade Handbook, and more attention is devoted to these topics in the classroom instruction during the commander course.*
- *The Chief Flight Instructor (CFI) has requested that all instructors intensify their focus on work structure and time/workload management with a particular emphasis on flight commander training. In addition, text on Workload Management Training has been added to the instructor guide as a competence-raising measure on the topic and on how instructors can identify and train crew in workload management.*
- *Widerøe has introduced a requirement in its OM A for QNH to be reported in communication with AFIS when approaching AFIS aerodromes.*

1.18.5.2 Measures implemented by Widerøe following SIB 2023-03

Widerøe has implemented the following measures based on the recommendations provided in SIB 2023-03.

- *Change to the procedure for approaches to AFIS in that WF are to declare the altimeter setting.*
- *The Q 400 aircraft's FMS will be upgraded in the near future, after which FMS will give a message when passing the transition altitude.*
- *Introduction of a procedure whereby the relevant QNH will be checked against Metar/ATIS/D-ATIS to address the possibility of misunderstanding QNH given verbally via radio communication.*
- *Incorrect altimeter setting has been established as a Safety Performance Indicator (SPI) for trend monitoring via Flight Data Monitoring (FDM). This has only been established for Q400/Embraer E2 aircraft, as Widerøe does not have the possibility to see the altimeter settings on Dash 8 100/200/300 aircraft via FDM at present.*
- *Separate focus area/briefing item on line check and LIFUS forms. (LIFUS – Line Flying under Supervision). This means that there is a strong focus on altimeter setting procedures during training and checking.*
- *For short sectors and low barometric pressure, Flight Planning will strive to file flights using local rather than standard pressure.*
- *TAWS software versions are updated on a continuous basis to the most recent version available for the equipment the aircraft are carrying.*

1.18.5.3 Measures implemented by Avinor ANS following the incident in Paris (LFPG)

Following the incident in Paris involving an approach with incorrect QNH, see section 1.18.1.1, Avinor ANS took action to have QNH permanently displayed in labels based on mode S on the radar screen of the NATCON-South platform. This was continued for the radar screens of the NATCON North (Bodø) platform in spring 2023. This means that an aircraft's QNH setting would be displayed on the radar screen if the aircraft was equipped with a mode S transponder transmitting its pressure setting.

Figure 11 shows the NATCON radar display at 1840 hrs. WIF12X is at FL90 and has been cleared to OSRUL.

The aircraft at the bottom right of the screen, flight number NOZ328, has been interrogated about its pressure setting and responded with 1,013. This is evident from the flight information overview on the radar screen, where '013' indicates that QNH has been set to 1,013, i.e. standard pressure. This is consistent with NOZ328 flying at FL370. Neither the aircraft involved in the incident (WIF12X) nor another Widerøe aircraft (WIF2M) had a mode S transponder capable of transmitting their pressure setting. This means that their pressure settings were not visible to the air traffic controller.

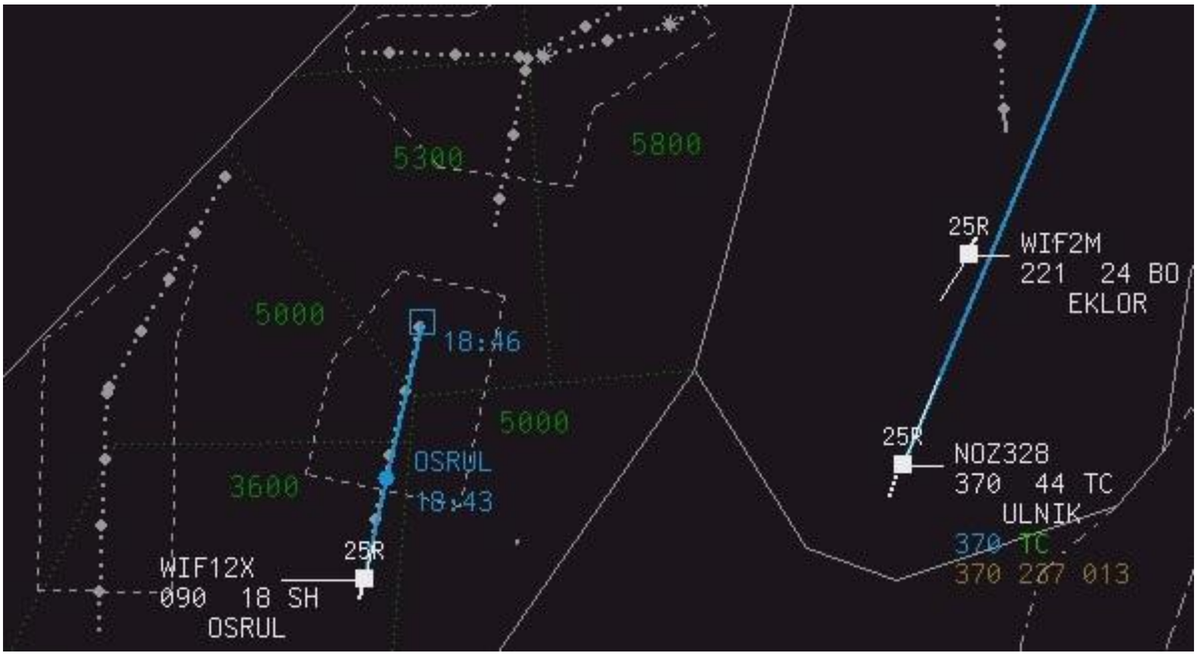


Figure 11: NATCON radar image at 1840 hrs. Source: NSIA / Avinor ANS

1.18.5.4 Measures implemented by Avinor ANS following SIB 2023-03

Avinor ANS's follow-up of the recommendations made in SIB 2023-03 includes the following:

> *ATC will provide QNH when radio contact is established and also when granting clearance for an altitude below transition level. This information is to be read back.*

Avinor ANS also published an operational notice for its business area Tower in June 2023. The notice is reproduced below (text in Norwegian only).

Operativ melding FO tårn, juni 2023

AVINOR
AIR NAVIGATION SERVICES

OPERATIV MELDING 02-23 FO TWR		
QNH i label - NATCON Nord	Laget dato	02.06.2023
	Gyldig fra og med	15.06.2023
	Gyldig til og med	UFN
	Utarbeidet av	[redacted]
	Godkjent av	

BAKGRUNN

Som en konsekvens av en alvorlig hendelse i Paris mai 2022 da en A320 på RNP-innflygning med feil satt QNH holdt på å fly i bakken (lenke til innledende rapport), har vi sett på tiltak som kan være med å redusere faren for at det samme skjer hos oss.

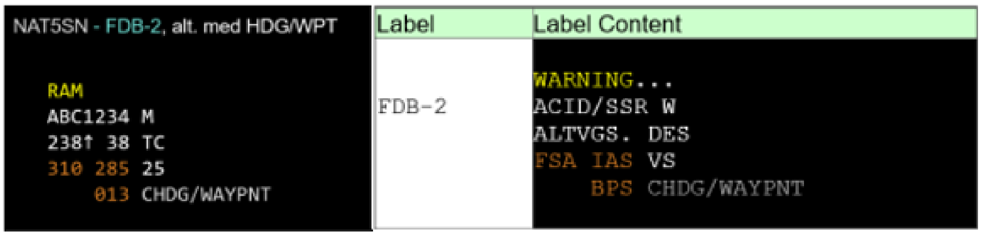
Viktigheten av riktig QNH kan ikke understrekes nok da alle RNP-innflyginger, med unntak av RNP-LPV, er avhengige av riktig QNH for korrekt beregning av glidebane. Som det fremkommer av rapporten, kan konsekvensene av feil satt QNH være dramatiske.

Det er stort fokus på korrekt satt QNH i luftfartsbransjen. For vår del i FO TWR mener vi det er viktig å treffe kortsiktige tiltak som sikrer at vi har en bedre sannsynlighet for å oppdage en feil satt QNH, og vil derfor implementere QNH i label fra AIRAC 15 JUN 2023.

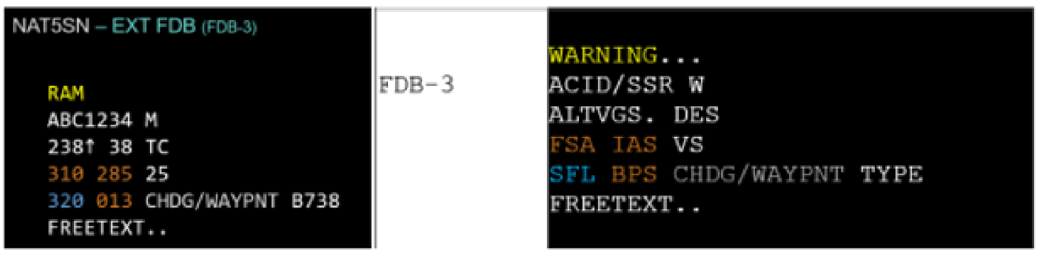
BESKRIVELSE

Dette tiltaket ble implementert allerede tidlig høst 2022 på NATCON SØR-plattform, men det har tatt noe mer tid å bli enige om løsning på NATCON NORD-plattform siden det benyttes ulike arbeidslabler. Fra 15 JUN vil FDB-2 og FDB- 3 ha QNH permanent fremvist.
Den vil vises i fjerdelinje på label – lik dagens plassering i «extended label». Vi gjør denne endringen for at FLL lettere skal kunne oppdage avvikende QNH.

FDB-2 vil se slik ut:



FDB- 3 vil se slik ut:



Med denne endringen har FLL forbedret mulighet til kontinuerlig monitorering av satt QNH i luftfartøy, og kan sannsynligvis i større grad utfordre feil satt QNH når dette er tilfelle.

Det jobbes samtidig videre med systemmessige forbedringer (for eksempel automatisk varsling av QNH mismatch).

BESTEMMELSENE

Bestemmelsene knyttet til informasjon om høydemålerinnstilling er gjengitt i **ATS.TR.140:**

ATS.TR.140 Provision of altimeter setting information
(a) The appropriate air traffic services units shall at all times have available for transmission to aircraft in flight, on request, the information required to determine the lowest flight level which
will ensure adequate terrain clearance on routes or on segment of routes for which this information is required.

(b) Flight information centres and area control centres shall have available for transmission to aircraft, on request, an appropriate number of QNH reports or forecast pressures for the flight
information regions and control areas for which they are responsible, and for those adjacent.

(c) The flight crew shall be provided with the transition level in due time prior to reaching it during descent.

(d) Except when it is known that the aircraft has already received the information in a directed transmission, an QNH altimeter setting shall be included in:
(1) the descent clearance, when first cleared to an altitude below the transition level;
(2) approach clearances or clearances to enter the traffic circuit;
(3) taxi clearances for departing aircraft.

Figure 12: Screenshot of operational notice. Source: Avinor ANS

1.18.6 REPORTED INCIDENTS INVOLVING INCORRECTLY SET QNH

The NSIA has requested an overview from CAA Norway of all reported incidents since 2022 in which incorrectly set QNH was the cause of the report. There was a total of 17 such reports. Seven of the reports concerned incorrect QNH communicated to an aircraft, while ten concerned aircraft that had set the wrong QNH.

1.18.7 TIME CALIBRATION

The timeline was established by compiling data from several sources that did not initially use the same time. The ADS-B dataset recorded local time, UTC time and GPS coordinates. EGPWS only recorded time in relation to an alert, but it also registers GPS coordinates. The CVR recorded a rolling two-hour window.

The timeline could therefore only be established once the time differences between the sources could be synchronized. The 'Too Low terrain' warning is audible in the CVR recording. That allowed the CVR time to be calibrated against the EGPWS time. The GPS coordinates retrieved from EGPWS were then compared with the GPS coordinates in the ADS-B dataset. This allowed a common timeline to be established across the three datasets.

1.18.8 SPECIAL AIRWORTHINESS INFORMATION BULLETIN

On 13 March 2015, the Federal Aviation Administration (FAA) published a Special Airworthiness Information Bulletin (SAIB) that refers to the investigation into the accident involving UPS Flight 1354. The bulletin showed that Honeywell EGPWS with part number 965-0976-0xx[3]-218-218 was not updated with the most recent software version. The newest version of the software could give a 'Too Low terrain' warning at a greater altitude than older versions, which would in turn give more

[3] 'x' means that the SAIB applies to all EGPWS with all part numbers in the sequence from 000 to 099.

time to resolve the situation. The SAIB also referred to the fact that the previous version remains approved for use.

FAA made the following recommendation for Honeywell MK VIII EGPWS 965-1216:

> *The FAA recommends that all owners and operators of airplanes having the subject EGPWS software upgrade to the later version of the software having P/N 965-0976-0xx-218-218 or higher. The following Honeywell EGPWS P/Ns contain this software change:*
>
> *MK VIII – P/N 965-1210/1220-022 or greater.*

LN-WIP was equipped with an older version of the EGPWS hardware that could not be updated with the recommended software version.

1.18.9 TESTING OF LIMITS FOR 'TOO LOW TERRAIN' ALERT

EGPWS was the final technical barrier to prevent CFIT, and in this case it caused the approach to be aborted. The NSIA therefore wanted to assess the robustness of this barrier. In order to do so, a graphic presentation was created, see Appendix A, showing the approach profile and an approach below the profile to simulate an approach with an incorrectly set barometric altimeter. The following scenarios were tested:

Approach 700 ft below the profile with SW-011: LN-WIP was equipped with an EGPWS with software version SW-011 and was 700 ft below the vertical profile. They received a 'Too Low terrain' alert approx. 3 NM from the runway.

Approach 243 ft below the profile with SW-011: If LN-WIP had been 243 ft rather than 700 ft below the vertical profile, the aircraft's radio altitude would be above the TCF profile, and the aircraft's calculated geometric altitude would have been above the RFCF profile. This means that neither the TCF profile nor the RFCF profile would have triggered a 'Too Low terrain' aural alert.

Approach 135 ft below the profile with SW-036: Had the aircraft been 135 ft below the vertical profile, the EGPWS would have triggered a 'Too Low terrain' aural alert. If the aircraft was more than 135 ft below the vertical profile, the TCF profile or the RFCF profile would have triggered a 'Too Low terrain' aural alert.

The NSIA wanted to test whether the area where an EGPWS with software version SW-011 would not give an alert, was consistent with an DHC-8 simulator used by Widerøe. This was tested by initiating an approach with a QNH deviation of 9 hPa, which corresponds to 243 ft below the barometric altitude indicated. EGPWS gave no 'Too Low terrain' alert during any of the approaches, but the radio altimeter counted down from 500 ft.

1.18.10 BAROMETRIC PRESSURE SETTING ADVISORY TOOL

The UK Air Navigation Service Provider (ANSP), NATS Holding Limited, uses a tool to identify deviations between aircraft's barometric altimeter setting and the correct altimeter setting for the area in question for aircrafts below Transition Altitude (TA). This tool is called the Barometric Pressure Setting Advisory Tool (BAT).

Deviations of more than 5 mbar would trigger an alert on the air traffic controller's screen. The alert did not have to be acknowledged by the air traffic controller. The air traffic controllers were encouraged to deal with all such alerts by the aircraft crew reporting and correcting their barometric pressure setting, but this was not a mandatory air traffic controller duty.

The system requires aircrafts to be equipped with a mode S transponder capable of transmitting pressure settings if interrogated by an Enhanced Surveillance System (EHS).

1.18.11 AIR TRAFFIC SERVICES, EQUIPMENT AND RESPONSIBILITIES

According to the Standardised European Rules of the Air (SERA) paragraph SERA.7001 General – *Objectives of the air traffic services (ATS)*, as reiterated in Regulation (EU) 2017/373 as revised by Regulation (EU) 2020/469, the objectives of the ATS are to:

> *(a) prevent collisions between aircraft;*
>
> *(b) prevent collisions between aircraft on the manoeuvring area and obstructions on that area;*
>
> *(c) expedite and maintain an orderly flow of air traffic;*
>
> *(d) provide advice and information useful for the safe and efficient conduct of flights;*
>
> *(e) notify appropriate organisations regarding aircraft in need of search and rescue aid, and assist such organisations as required.*

The NSIA has requested from Avinor ANS an overview of the services provided in controlled airspace in relation to surveillance (SUR) at its airports in Norway. Avinor ANS has informed the NSIA that the air traffic control (ATC) for controlled airspace is divided into enroute control, approach control and aerodrome tower control services.

The primary duties of the ATC is the top three items on the above list, which are to:

> *(a) prevent collisions between aircraft;*
>
> *(b) prevent collisions between aircraft on the manoeuvring area and obstructions on that area;*
>
> *(c) expedite and maintain an orderly flow of air traffic;*

1.18.11.1 Use of surveillance in area control and approach control services

Avinor ANS has stated that the air traffic controllers who provide enroute control and approach control services use Surveillance (SUR) as a primary tool and that their use of SUR is regulated by Regulation (EU) 2017/373 with pertaining revisions, AMC and GM. The below text is quoted from AMC1 ATS.TR.155(a) ATS Surveillance services, point (a):

> *(1) provide ATS surveillance services as necessary in order to improve airspace utilisation, reduce delays, provide for direct routings and more optimum flight profiles, as well as to enhance safety;*
>
> *(2) provide vectoring to departing aircraft for the purpose of facilitating an expeditious and efficient departure flow and expediting climb to cruising level;*
>
> *(3) provide vectoring to aircraft for the purpose of resolving potential conflicts;*
>
> *(4) provide vectoring to arriving aircraft for the purpose of establishing an expeditious and efficient approach sequence;*
>
> *(5) provide vectoring to assist pilots in their navigation, e.g. to or from a radio navigation aid, away from or around areas of adverse weather;*

(6) provide separation and maintain normal traffic flow when an aircraft experiences communication failure within the area of coverage;

(7) maintain flight path monitoring of air traffic;

(…)

1.18.11.2 Use of surveillance in approach control services

Air traffic controllers who provide approach control services also use surveillance (SUR) for duties as set out in Regulation (EU) 2017/373 AMC1 ATS.TR.155(a) *ATS Surveillance services* point (b):

(1) provide vectoring of arriving traffic on to pilot-interpreted final approach aids;

(2) provide flight path monitoring of parallel ILS approaches and instruct aircraft to take appropriate action in the event of possible or actual penetrations of the no transgression zone (NTZ);

(3) provide vectoring of arriving traffic to a point from which a visual approach can be completed;

(4) provide vectoring of arriving traffic to a point from which a surveillance radar approach can be made;

(5) provide flight path monitoring of other pilot-interpreted instrument approach procedure;

(6) in accordance with prescribed procedures, conduct surveillance radar approaches; and

(7) provide separation between:

(i) succeeding departing aircraft;

(ii) succeeding arriving aircraft; and

(iii) a departing aircraft and a succeeding arriving aircraft.

1.18.11.3 Use of surveillance in tower control services

Avinor ANS has stated that as regards air traffic controllers providing tower control services, their primary tool is to look out of the window, and that SUR is used as a supporting tool. Equipment may vary between different towers, and one tower has no access to SUR. The use of SUR is regulated by Regulation (EU) 2017/373 paragraph ATS.TR.155, and the following is quoted from AMC1 ATS.TR.155 *ATS surveillance services* point c (1):

When authorised and subject to procedures and conditions prescribed by the air traffic services provider, ATS surveillance systems may be used in the provision of aerodrome control service to perform the following functions: (i) flight path monitoring of aircraft on final approach;

(ii) flight path monitoring of other aircraft in the vicinity of the aerodrome;

(iii) establishing an appropriate longitudinal and/or distance-based separation based on ATS surveillance systems in between succeeding departing aircraft;

(iv) maintaining separation between succeeding aircraft on the same final approach; and

(v) providing navigation assistance to VFR flights

1.18.11.4 Use of surveillance by the aerodrome flight information service (AFIS)

According to Regulation (EU) 2017/373 paragraph ATS.TR.100 *Objectives of the air traffic services (ATS)*, the aerodrome flight information service's primary duty is to:

(d) provide advice and information useful for the safe and efficient conduct of flights;

The NSIA has requested from Avinor ANS an overview of the services it provides in uncontrolled airspace in relation to surveillance (SUR) in its airports in Norway. In Avinor ANS, some AFIS units use SUR as a supporting tool in addition to the primary tool of looking out the window.

ATS.TR.155(a) *ATS surveillance services* point (d) describes how SUR can be used by the aerodrome flight information service:

> *(d) Functions in the flight information service*
>
> *The information presented on a situation display may be used to provide identified aircraft with information:*
>
> *(1) regarding any aircraft observed to be on a conflicting path with the identified aircraft and suggestions or advice regarding avoiding action;*
>
> *(2) on the position of significant weather and, as practicable, advice to the aircraft on how best to circumnavigate any such areas of adverse weather. When doing so, attention is to be paid to the fact that under certain circumstances the most active area of adverse weather may not be displayed; and*
>
> *(3) to assist the aircraft in its navigation.*

1.18.11.5 Sources of information

Avinor ANS uses the following sensors in the air traffic service (ATS).

<u>Primary radar</u>
Only two of Avinor ANS's radars have primary surveillance radar (PSR) capability: GAR (Gardermoen) and OEL (Ørlandet). The primary radars also have a weather radar module that can display weather data in NATCON. Air traffic controllers can activate high-intensity or low-intensity weather, or both, as required. PSR can also detect aircraft without a transponder. Its range is limited to 80 NM, and it provides a PSR plot only, so with identification procedures and surveillance services this will primarily be relevant in situations where an aircraft experiences transponder failure and increased separation to/from the PSR track is applied. PSR has some operational disadvantages in the form of display of noise/clutter, for example from boats, wind turbines etc.

<u>Secondary radar</u>
A number of Monopulse Secondary Surveillance Radars (MSSR) have been decommissioned in recent years and replaced by Wide Area Multilateration (WAM), but Avinor ANS still has 13 operational and recently upgraded Mode S radars that provides overlapping coverage of most of the en-route airspace. All radars now have Enhanced Mode S capability which enables them to download Downlinked Aircraft Parameters (DAP) from aircraft. MSSR is the surveillance technology most resistant to GNSS interference.

<u>ADS-B</u>
The rollout of WAM infrastructure made it possible to establish ADS-B coverage for most of the controlled airspace in Polaris FIR. Since ADS-B relies on data broadcast from an aircraft's transponder and does not depend on interrogation, coverage will in many areas in practice extend 'down to the ground-level'. The aircraft calculates its own horizontal position based primarily on GNSS, which in some regards makes ADS-B more vulnerable than WAM and MSSR. ADS-B was first introduced for offshore services in the North Sea and more recently also for Oceanic FIR in the form of satellite/space-based technology. Approved ADS-B equipment is mandatory for all traffic with an MTOW of more than 5,700 kg or TAS in excess of 250 kt. Operational Air Traffic (OAT), state aircraft (STATE) and certain special cases (retrofitting etc.) are exempt from this requirement, and MSSR/WAM must be relied on for the detection and surveillance of such aircraft. ADS-B broadcasts a limited number of DAP, and, for technical reasons, IAS cannot be included. Most

aircraft currently broadcast selected altitude and barometric pressure setting (QNH) via ADS-B, but current limitations in ARTAS means that these parameters are not forwarded for display. This will be remedied in the new ARTAS version.

WAM
A number of older radars have been replaced by WAM in recent years, and WAM service volumes have been established for most TMAs in combination with ADS-B and sometimes with MSSR. WAM consists of many ground stations, some of which are interrogators, and positions are calculated based on the time difference between responses from the different ground stations. The final radar to be phased out in favour of WAM will be Tromsø MSSR, which was shut down the summer of 2025.

1.18.11.6 Display

Avinor ANS uses the following display system in its ATS.

NATCON
NATCON is the primary system for aerodrome tower and en route services in Polaris FIR. NATCON is also used by Ålesund (ENAL) and the external SAERCO unit at Kristiansand (ENCN). NATCON displays surveillance data from different sources and technologies via ARTAS multitracker. ARTAS also calculates the quality of track display and displays it using precision symbols for 3 NM, 5 NM or 10 NM in accordance with set threshold values. It is also possible to select individual radar sources for display in NATCON. Enhanced Mode S data display is implemented in NATCON, shown in the label belonging to a track. Selected altitude, indicated air speed and barometric pressure setting are selected from available registers for display. The Mode S fields in the label have a dedicated colour (ochre). There are four different main labels (TWR, APP, ACCx2), all of which have the option to display extended information including Mode S data. The label used for approach services have Mode S data displayed as its default setting. Newly developed QNH advisory functionality in NATCON is scheduled for implementation in autumn 2025.

RaADS
RaADS is primarily an emergency system for traffic management should NATCON fail. In addition, several AFIS units use RaADS for information services. RaADS is also used as an alternative surveillance system for short periods at night during routine updates to NATCON (AIRAC). RaADS does not support ARTAS, but displays MSSR, WAM and ADS-B based on the area's defined system mode mosaic. Enhanced Mode S is not supported by RaADS, and the flight plan information is limited to Code-Callsign (associated with track label) and DEP/DEST (information inherited from NATCON).

1.18.11.7 Opportunities and limitations related to display of QNH in labels

Avinor ANS provided the following information about its opportunity to display an aircraft's pressure setting on its systems. The company replied as follows:

- *There are different systems and tools; the situation is not uniform across Avinor ANS and will differ between units and areas*
- *The possibility of displaying QNH in the label for the air traffic controller to see depends on the following conditions being met:*
  - *NATCON must be used as the ATM system*
  - *The air traffic controller must have activated the extended label or be engaged in approach control services where the dedicated work label is defined with Mode S fields.*

- *The aircraft's transponder must be capable of transmitting BPS with updated settings at all times.*

1.18.11.8 Responsibility for setting the correct QNH

The NSIA has looked into the division of responsibility between air traffic services and flight commanders.

Avinor ANS have stated that the following is correct regarding responsibility for setting the QNH:

- It is ATS's responsibility to communicate the correct QNH.
- It is ATS's responsibility to ensure that the correct QNH is read back by the commander and correct as required.
- It is the commander's responsibility to set the correct QNH and read the QNH received back to ATS.

Avinor ANS have stated that the following is correct regarding responsibility for terrain separation:

- In own navigating using published routes and procedures, the responsibility for terrain separation rests with the commander.
- In connection with vectoring/direct routing outside published routes/procedures, the ATC is responsible for issuing clearances that ensure terrain separation.

1.18.11.9 Surveillance in conventional towers

According to Avinor ANS, the following conventional towers (AFIS) are using SUR with RaADS as their ATM system:

- Mo i Rana Airport Røssvoll (ENRA)
- Florø Airport (ENFL)
- Brønnøysund Airport Brønnøy (ENBN)
- Hammerfest Airport (ENHF)

There are currently no conventional towers (AFIS) equipped with SUR that use NATCON as their ATM system.

1.18.11.10 Surveillance in the RTC

Avinor ANS has stated that all units transferred to the remote tower centre (RTC) have SUR. As of May 2025, the following units have been transferred to the RTC and are controlled from the world's largest digital tower centre in Bodø:

- Vardø Airport Svartnes (ENSS)
- Berlevåg Airport (ENBV)
- Mehamn Airport (ENMH)
- Hasvik Airport (ENHK)
- Svolvær Airport Helle (ENSH)
- Leknes Airport (ENLK)
- Røst Airport (ENRS)

- Sandnessjøen Airport Stokka (ENST)
- Namsos Airport (ENNM)
- Rørvik Airport Ryum (ENRM)
- Molde Airport Årø (ENML)
- Røros Airport (ENRO)
- Sogndal Airport Haukåsen (ENSG)
- Førde Airport Bringeland (ENBL)

Avinor ANS has also informed the NSIA that SUR will be implemented at all Avinor's AFIS units.

RTC's SUR equipment has functionality that meets AFIS's requirements in accordance with CAA Norway's approval (AFIS – aerodrome flight information service). The equipment does not include safety nets such as Short Term Conflict Alert (STCA) and Minimum Safety Altitude Warning (MSAW), but these are not required.

QNH – The applicable value for the relevant QNH area is displayed in RTC/HUD – Heads Up Display, top right-hand corner of the screen (no 10) on the far right and approx. 1.4 metres from the work position. QNH is also shown in HDD in the Automated Weather Observing System (AWOS). It is possible to display QNH in the label, but AFIS uses SUR primarily to develop and maintain situational awareness. The main focus is on monitoring the manoeuvring area and traffic information in their own airspace, Traffic Information Zone (TIZ).

Avinor ANS also states that all forms of flight path monitoring, including Set QNH, are secondary. In order to consider introducing safety nets, it would have to be fairly certain that they would function as intended and not create a false sense of safety. As the main focus is on runway, traffic in TIZ, weather observations, coordination with ground services etc., it is considered less likely that AFIS officers will be able to detect incorrect QNH settings in the label. Avinor ANS is not planning to implement 'Set QNH' in the RTC labels in the foreseeable future.

1.19 Useful or effective investigation methods

No methods warranting special mention have been used.

2. Analysis

2. Analysis

2.1 Introduction

Incorrect setting of a barometric altimeter on a non-precision approach where the altitude indicated by the altimeter is used to verify correct altitude during the approach, could in a worst-case scenario lead to a fatal accident following a Controlled Flight Into Terrain (CFIT).

The risk that an incorrectly set altimeter represents can be reduced by the implementation of good barriers to ensure the setting and verification of altimeter settings, but also by minimising the number of times altimeter settings need to be set and verified in the course of a flight. The altimeter is set when aircraft passes the Transition Altitude (TA). Raising the TA is one way of minimising the number of times the altimeter is set, thus reducing the risk.

The NSIA is of the opinion that the measure with the greatest risk-reducing potential is to contribute to strengthening the barrier for altimeter setting and verification and consequently this measure is the focus in the present report. Once good barriers ensuring correct altimeter setting and verification are in place, the risk represented by incorrect altimeter adjustment could be further reduced by raising the TA.

During the incident described in section 1.18.1.1 that took place on approach to Paris Charles de Gaulle Airport, the minimum altitude was as little as 6 ft. This means that less than two metres separated the aircraft from the ground. In a marginally different set of circumstances, the incident that occurred on approach to Svolvær could have ended up as a similarly serious incident. The NSIA has identified shortcomings in CRM and several barriers that failed during this approach, and these factors will be highlighted in the analysis in chronological order. Other potential barriers that could be reinforced or implemented to reduce the risk of such incidents occurring in future, will also be discussed.

The factual information section mentions that due to minor technical issues, the crew were behind schedule on arrival to Bodø before departing for Svolvær. The NSIA has not found this to have had any significant bearing on the sequence of events, and this factor will therefore not be discussed further.

The analysis comprises the following sections: 2.2. Analysis of the history of flight, 2.3 Analysis of operational factors such as CRM and procedures, and 2.4 Analysis of technical factors that could have prevented the incident.

2.2 History of flight

After departure, the crew made contact with *Bodø Approach* and climbed to the cruising altitude they had been cleared for, FL90. Five minutes later, they received clearance from *Polaris Control* to proceed to the reporting point OSRUL, which is the starting point for the approach to Svolvær. At the same time, the crew received clearance to descend to 4,000 ft and perform a GLS approach to runway 01. The crew requested a weather update from *Polaris Control* and were then informed that *Helle Information* recommended a LOC approach to runway 01. After changing frequencies to *Helle Information*, they were informed that the runway would be closed for snow removal for about 15 minutes. The crew then entered a holding pattern at FL90 at the reporting point OSRUL.

Polaris Control should be expected to be aware of the runway status at Svolvær, provided that they receive information from AFIS. If the crew of LN-WIP had known that the runway would be closed, that would have been useful information before they were cleared to proceed to OSRUL and descend to 4,000 ft. Clearance for the first altitude triggers the pilots to set the altimeters to the local QNH, and when such clearance is granted and the aircraft then remains at FL for a while, there is a chance that the QNH setting may be forgotten.

For the next few minutes, the crew discussed their chances of landing at Svolvær in the prevailing snow showers. They looked at the LOC approach chart and noted that the minima were lower than for GLS but decided to go ahead with GLS and wait for the next weather update. A GLS approach will normally be preferred over the more laborious option of a LOC approach.

After about ten minutes, they received a weather update closely followed by a message that the runway had been opened. The weather had deteriorated somewhat, and the commander therefore decided, without discussing the matter further with the first officer, that they would perform a LOC approach. *Helle Information* then informed them about the new runway status, and the first officer was occupied with the radio communication. At the same time, the commander started the descent from FL90. The NSIA is of the opinion that the first officer was not sufficiently included in the decision-making process, neither concerning the choice of approach nor about starting the descent. The NSIA believes this to have been a contributing factor to the crew forgetting to set the local QNH. The local QNH is normally set as descent towards the first altitude begins, and since this is the trigger for performing the approach checklist, that too was forgotten. The underlying factors are discussed in more detail in sections 2.3.1 and 2.3.2.

The crew experienced a heavy workload once the approach started. Only a few minutes after the commander initiated the descent, they were established on the final segment of a LOC approach to runway 01. The first officer has since stated that he did not feel ready to begin the approach directly from the holding pattern and was somewhat 'caught unawares' by the commander's decision. The heavier than usual workload resulting from the choice of a LOC approach was probably a contributing factor to the failure to complete procedures and checklists, and this is discussed in more detail in section 2.3.1.

The local QNH is to be set once and checked three times before landing. The setting of QNH as part of the altimeter setting procedure is a trigger for performing the approach checklist, which means that, in practice, two more barriers where QNH is to be checked remain after the approach checklist. The crew forgot to set the QNH when initiating the approach, and therefore also forgot the approach checklist, which contains another QNH check. One barrier had thus failed, but two more remained. The first pre-level check for an altitude and also the first radio altimeter reading also involves checking the QNH.

Based on interviews with the crew it becomes apparent that they, and the first officer in particular, experienced a heavy workload throughout the rest of the approach. A LOC approach is more demanding on the crew. It involves more callouts and more continuous checking. Such approaches are less frequent that, for example, a GLS approach, and they also require a more thorough briefing. In this case, no time was set aside for a briefing, and the NSIA believes that the crew was thus 'behind' throughout the approach. This is also discussed in section 2.3.1.

The first point of the approach was OSRUL at a minimum altitude of 4,200 ft. The PM (first officer) was busy with radio communication with *Helle Information* when the pre-level aural and light alerts were activated. This probably distracted the first officer and prevented him from saying 'pre-level' to the PF (commander). Consequently the commander also forgot the check. Pre-level aural and light alerts are frequent on Widerøe's flights, which are often short. In some situations, pilots are not required to respond to these alerts, while in other cases, action needs to be taken. This could also have contributed to the procedure not being performed.

While the aircraft was between reporting points OSRUL (Initial Approach Fix) and SH402 (Intermediate Fix), the aircraft's radio altimeter started to indicate altitudes (2,500 ft). On the first radio altimeter reading, the PM (first officer) was to say 'radio height', and the PF is to answer by giving the QNH set and the altitude shown by their barometric altimeter. In this case, the PF replied simply with 'Checked'. The PM did not correct him, and thus this check was also not performed in accordance with the applicable procedures.

The pre-level check and radio height check are important barriers intended to prevent crew from forgetting to set the local QNH, and both are discussed in more detail in section 2.3.2.

The crew continued the approach. It was dark, they were flying in instrument conditions and they were approaching the ground. When the radio altitude indicated 500 ft, the aural alert 'five hundred' sounded in the cockpit. At this point, the PM began to feel that there was something wrong. A little while later, at 324 ft, EGPWS calculated the altitude to be too low and gave the crew a 'Pull Up, Terrain' alert. The PM reacted instantly and said 'go-around'*.* The crew started its missed approach procedure. Six seconds after the EGPWS alert, the aircraft had a positive climb angle and had only lost 10 ft of altitude. The first officer's sense that something was off after hearing the radio altimeter's aural alert '500 ft' could help to explain why he was so quick to initiate a missed approach.

The crew performed a missed approach, and the first officer soon realised that they had flown with an incorrect QNH setting. Following a brief discussion, they concluded that this incident was so serious that they did not want to attempt another approach. They then headed back to Bodø. After landing, they pulled the fuses of the FDR and CVR and informed the company that they were not available for further flights that day.

The NSIA would like to commend the crew for making these decisions, as well as Widerøe for relieving them of further flight duties and providing good follow-up to both of them over the following days. The NSIA would also like to commend the crew for securing the CVR and FDR and data from them so that important information for understanding the incident was made available to the NSIA.

2.3 Operational factors

2.3.1 CREW RESOURCE MANAGEMENT (CRM) AND DISTRIBUTION OF TASKS IN THE COCKPIT

The NSIA has identified two factors that probably contributed to the crew forgetting to set the local QNH. One is cooperation in the cockpit, including communication between the commander and the first officer, and the other is the workload management.

The crew was informed that they were cleared for 4,000 ft at an early stage while on route to OSRUL. They would normally have started their descent and performed the approach as normal. Because snow had to be cleared from the runway, they were put in a holding pattern at FL90 and remained there for approx. 10 minutes. As the weather situation was changing, they spent that time obtaining information about the weather conditions and runway status to decide whether they would fly a GLS or a LOC approach and whether they would go straight in or circle round. There was a lot of information to process during this period, and the crew initially cooperated well. After the penultimate weather update, they agreed that they would fly a GLS approach and await the final weather update. The cockpit atmosphere was calm and there was no radio activity in the minutes leading up to the next update. The NSIA is of the opinion that the crew should have spent this time preparing a plan B for the eventuality of worsening weather. In this case, plan B could have been a LOC approach, which had lower minima. A LOC approach requires more preparation than a GLS one, making a review in advance all the more important.

Immediately after the final weather update, the commander decided, without discussing it further with the first officer, that they would fly a LOC. When the runway opened, he left FL90 to start the approach. In the NSIA's opinion, this was the moment when the crew experienced CRM failure. The commander has stated that he believed the first officer to be involved in these decisions, while the first officer is of the opinion that he was not included, neither in the decision to fly a LOC nor in the decision to start the descent. The first officer was thus unprepared during a critical phase of the flight. He was engaged in radio communication, and when he had finished communicating with *Helle Information*, he had probably passed the stage where he would normally have set the QNH. The crew lost the thread of their normal workflow and forgot both to set local QNH and to perform the approach checklist.

During the first part of the descent, the first officer had many tasks to perform simultaneously. He was to communicate with *Helle Information* by radio, register weather and runway conditions, consider the choice of runway in relation to the relevant Runway Condition Code (RCC) and weather, calculate updated performance, receive a LOC approach briefing, check the instrument set-up, check the FMS routing and pertaining altitudes, carry out the approach flow, communicate with the cabin crew, communicate with passengers, as well as functioning as PM, monitoring the PF. This required the crew to carry out many tasks separately at times, without cross-checking each other. In an interview, the first officer stated that he believed that they would fly another round in the holding pattern before starting their descent and that he was not prepared and probably not ready when the descent was initiated. However, it is important to point out that the first officer also has a responsibility to ensure well-functioning crew cooperation and that he should therefore have informed the commander that he was not ready.

There were heavy snow showers in the area which may result in a short time-window for a landing before the runway is again closed for snow removal. It is not uncommon for flights to short runways to be flown in challenging weather conditions. In an ideal situation, everything will be planned and briefed before a crew starts their descent for an approach. However, that is not always how things work in practice. The company works with short flights, changing weather conditions and a number of unforeseen factors that can make it difficult to achieve ideal and desirable circumstances. Information received by the NSIA indicates that it is therefore normal to have to plan and brief for an approach after the descent has started. This probably works well in the majority of cases, but could be problematic when the workload becomes excessive, as was the case here.

The NSIA notes that Widerøe has introduced several measures to help strengthen focus on CRM and workload management. According to the company, all instructors have been told to focus more on these topics both in flight commander training and ordinary line checks. As a result of the actions taken the NSIA does not issue a safety recommendation on this.

2.3.2 COMPLIANCE WITH PROCEDURES

Work in the cockpit mostly follows a logical sequence based on where you are in the work process – from tasks carried out before departure to those done after landing. This sequence is referred to as a flow, where a certain state or action serves as a reminder, or a trigger, to remember the next item on the list of tasks. This is a well-known and usually quite effective technique for improving memory. However, it has an inherent weakness: If one misses a state or forgets to perform an action that functions as a trigger for the next item on the list, there is a risk that the related part of the flow will also be forgotten. Adjusting the QNH during descent is the primary trigger for performing the approach checklist, cf. section 1.17.2.1. The following is quoted from OM B 2.4.1:

> *When leaving cruise and cleared first QNH altitude, Accomplish APPROACH Checklist.*

The fact that the altimeter setting procedure, which includes setting the QNH, was not performed, contributed to the approach checklist also being forgotten.

The crew received a weather update with QNH from *Polaris Control* at 1835 hrs, followed by clearance for 4,000 ft. The descent to Svolvær commenced at 1855 hrs. This means that just under 20 minutes passed from QNH and clearance was received to the descent started, which could have contributed to the crew forgetting the procedure and checklist. Moreover, it is not uncommon to fly in a holding pattern in an altitude with local pressure and not, as in this case, at an FL, which may have contributed to making the crew think that the altimeter setting procedure had already been performed. In an interview, the commander stated that this was the case.

It is important to understand the actions of the pilots to recognise the situation they found themselves in at the time. It was dark, and the weather conditions were so poor that it was uncertain whether they would be able to land. The flight was short, which means that the PF and the PM both had a heavy workload. This required the crew to carry out many tasks separately at times, which is normal and necessary – particularly while operating on the network of airports with short runways. The fact that the crew were engaged in other tasks carried out separately may have contributed to them not setting and cross-checking each other's altimeters for QNH when they started the descent.

The crew have stated that the weather was changing and that they had to constantly obtain and process information to make decisions regarding the type of approach (GLS or LOC), whether to go straight in to land or circle round, and regarding the runway status in terms of runway friction, snow clearance, wind, visibility etc. The crew also changed from a GLS to a LOC approach at a fairly late stage, which further increased their workload.

The crew received weather updates with QNH from *Polaris Control* at 1835 hrs and from *Helle Information* at 1838 hrs. The descent to Svolvær commenced at 1855 hrs. The intervening 17 minutes, during which the workload was fairly heavy, may have contributed to the altimeter setting procedure not being performed. In the minds of the crew, this stage of the work process was behind them when they were circling in the holding pattern. What is known as the *Zeigarnik effect*[4] may also have contributed to the crew not remembering to set the QNH at this time. To put it simply, research suggests that incomplete tasks are better remembered than completed ones. If a person defines a task as completed, it will disappear from the working memory sooner.

After the approach checklist, there were another two procedures, the pre-level and radio height procedures, intended to function as barriers and enable detection of, among other things, incorrectly set QNH. The pre-level procedure includes a QNH check. The first time an aircraft moves from an FL to an altitude with a pertaining QNH setting, or vice versa, the PM is to say 'pre-level' when the alert is activated, and the PF is to respond by 'pre-level', QNH value and altitude. The pilots are meant to react to the pre-level alert before the Initial Approach Fix (IAF), but not after passing the IAF. This means that several such alerts are given that they are not supposed to react to, which could make the pre-level alert a weak trigger for checking QNH.

As for the radio height procedure, the PF is supposed to read the QNH and respond to the PM by giving the correct QNH value and altitude. When the radio altimeter comes alive, it starts displaying altitudes on the EADI. There are no other aural or light alerts to indicate that the procedure for initial radio altimeter reading is due to be performed, which could make it difficult to realise that the procedure is to be initiated.

The pre-level procedure was omitted, and the radio height procedure was not carried out properly. Other than interruption by radio during the pre-level alert, the NSIA cannot conclude as to why

[4] *Zeigarnik, B. (1927). Das Behalten erledigter und unerledigter Handlungen. Psychologische Forschungen, 9, 1–85* and *Seifert, C. M., & Patalano, A. L. (1991). Memory for incomplete tasks: A re-examination of the Zeigarnik effect. In Proceedings of the Thirteenth Annual Conference of the Cognitive Science Society (pp. 114–119), Chicago, IL.*

these procedures were missed, but it may seem that the crew focused most of their attention on carrying out the LOC approach, and that the first officer probably had his hands full keeping an eye on altitudes and distances as well as attending to the radio communication.

It is rarely possible to make procedures that fit any situation, so all airlines depend on the situational awareness, decisions and actions of their pilots to ensure safe flights when different considerations must be weighed against each other. It is necessary to be open to the possibility that in some situations, pilots need to be able to make different priorities to maintain safety. A crew must have leeway to decide on the best way of resolving situations with heavy workloads and changing weather and landing conditions. Generally speaking, adaptive expertise and a certain flexibility in the performance of procedures can be useful, and sometimes necessary. At the same time, deviation from standard operating procedures will also bring increased risks. The NSIA is of the opinion that, in order to make the organisation of work in the cockpit more resistant against one or more tasks being forgotten, it is important that procedures for critical elements, such as QNH checks, are simple, clear and standardised, and that they are to be performed in the same way every time.

The Norwegian Safety Investigation Authority recommends Widerøe's Flyveselskap AS to develop improved procedures for setting and verifying the barometric altimeter (QNH) based on simplification and clarification of what should trigger setting and verification of QNH, and that such setting and verification should be carried out every time regardless of other aspects of the operational situation.

The NSIA notes that Widerøe has taken action by introducing changes to OM A in the form of a procedure that requires pilots to report their QNH to the flight information service. The NSIA considers this to be a good measure to prevent incorrect QNH setting.

2.3.3 OTHER POTENTIAL CONTRIBUTORY FACTORS

The operator has updated its Operations Manual (OM) in accordance with relevant updates of official requirements, primarily from EASA. These requirements increase the number of procedures that pilots must carry out even when flying the same aircraft and route. This could have unfortunate consequences, for example in the approach phase of short flights under demanding weather and landing conditions. In a worst-case scenario, this could require a member of the crew to devote his or her full focus to carrying out tasks e.g. on an iPad in a critical phase of the flight when their attention should be on more important tasks. It is particularly important during operations on short-runway airports that the procedures are not too extensive to be perceived as a systematic and helpful aid for pilots dealing with heavy workloads.

Based on the interviews with the crew it is unclear whether the crew has used a standby altimeter as an aid in setting the QNH when given altitude clearance. At the time of the incident, a procedure was in place that allowed the flight commander to set the local QNH on the standby altimeter when receiving it from the air traffic service. Since the incident, Widerøe has updated this procedure to allow the standby altimeter to be set to QNH at the destination airport once METAR has been received. The NSIA considers that pilots should use all available aids to ensure that the correct QNH is noted and set, and that the standby altimeter is a useful tool in this context.

According to the first officer, the crew discussed its limited level of experience before the flight. It was identified as a factor during their TEM assessment, and they agreed to approach the flight with a conservative attitude, particularly given the weather conditions. The NSIA cannot rule out the possibility that their level of experience might have been a factor in the incident, but the pilots were within the airline's own limits as regards experience for this type of flights. The NSIA would like to commend the pilots for identifying this as a factor that needed to be taken into consideration. It nevertheless appears that the crew's lack of experience may have contributed to putting them in an unfortunate situation where the commander made decisions that the first officer was not involved in and the first officer did not speak up about this.

2.4 Technical factors – QNH

Even a seemingly small QNH deviation can significantly impact an approach. At present, it is often up to human vigilance to prevent this from happening. What appears to be minor deviations in QNH could potentially be more dangerous than greater deviations, since ground proximity warning systems will not necessarily detect such deviations when close to the ground. In light of Norway's national aviation strategy, which expects airports to also have conventional ground-based aids to navigation, the NSIA is of the opinion that work should be done to implement technical barriers in addition to human ones that could help to prevent future incidents and CFIT accidents resulting from incorrect QNH setting on a barometric altimeter.

2.4.1 RAISING OF MINIMA FOR LOC APPROACHES

At the time of the incident, Svolvær had both a procedure for LOC approaches and one for GLS approaches established for runway 01. Due to differences in the design criteria for the respective procedures, the LOC approach minima was lower than for GLS. Although this seems sensible based on the design criteria, it did have the unfortunate consequence that the most laborious type of approach could be the only option in bad weather. The NSIA finds that Widerøe's internal raising of the minima for LOC approaches to Svolvær to the same minima as for GLS approaches makes it easier for crews to not push themselves to land under marginal weather conditions by applying a more laborious approach technique.

2.4.2 UPDATED EGPWS

On the flight in question, LN-WIP was equipped with an EGPWS with software version SW-011. FAA, EASA and the manufacturer Honeywell have all issued recommendations to upgrade the EGPWS software to version SW-036.

At the time when EGPWS gave an aural alert, the RFCF profile was above the TCF profile. When the system calculated the aircraft's altitude to be below the RFCF profile, the system gave a 'Too Low terrain' alert. Had the aircraft had an EGPWS with software version SW-036, the system would have used a TCF profile that was higher than the RFCF profile, and the alert would thus have come at an earlier time. According to Honeywell's analysis, the alert would then have come two seconds earlier than the alert the crew received. It would have come when the aircraft reached a radio altitude of 319 ft rather than 303 ft, as it did with SW-011. However, it was not technically possible to upgrade the EGPWS installed in LN-WIP with the most recent software version.

As regards the incident in question, the NSIA considers that LN-WIP could have been further above the ground when the alert sounded if the aircraft had been equipped with another version of EGPWS with SW-036 installed, but that the incident would otherwise most likely have unfolded in much the same way. In some cases, the two extra seconds provided by the EGPWS with SW-036 could mean the difference between a missed approach and an accident. The NSIA is of the opinion that operators must constantly strive to ensure that their safety systems are updated to increase safety margins and that the expected level of safety is maintained.

The NSIA tested the EGPWS for the purpose of determining whether there were situations where EGPWS would not warn of an incorrectly set QNH. This was found to be the case with an approach 243 ft below the vertical profile for a LOC approach to runway 01 at Svolvær. The analysis and subsequent flight simulation confirms that if the QNH is incorrectly set in such a way that the aircraft is 243 ft below the approach profile, the crew will not receive a ‘Pull up Terrain’ warning. The only way in which they can identify such a situation is to respond to the radio altimeter’s aural alerts at altitudes 500, 100, 50, 40, 30, 20 and 10 ft. If pilots fly different aircraft individuals or simulators with different EGPWS software versions, they will not necessarily receive the same alert in the same situation on two different individuals with different EGPWS versions.

All safety systems strike a balance between false alerts and failure to alert of actual hazardous situations. There are thus situations where the EGPWS will fail to provide actual alerts. If pilots train on one version of the EGPWS software and fly with another, that is potentially another complicating factor. In that situation, it will be important to be aware of which version is used at all times, as well as of its strengths and weaknesses. This shows how important it is to have good procedures in place for responding to the radio altimeter’s altitude alerts, even unexpected ones.

2.4.3 BAROMETRIC PRESSURE SETTING ADVISORY TOOL

LN-WIP was equipped with a transponder that broadcasted ADS-B data but was unable to transmit the QNH setting through EHS in response to interrogation. This means that the aircraft could not broadcast its pressure setting. It was thus not possible for the air traffic controller to have the aircraft’s pressure setting displayed on the radar screen via the NATCON system.

The UK air navigation service provider NATS has established a system for monitoring aircraft’s pressure settings. The purpose of this is to manage traffic as smoothly as possible by preventing deviation from assigned altitudes (*level bust*). Incorrect QNH can cause an aircraft to fly above or below its assigned altitude. The system has been operational in several airports since 2010, and NATS has observed a downward trend in cases with incorrect QNH. The system’s main objective is to prevent breaches of separation minima, but the NSIA believes that the system could also have a positive effect on incorrect QNH settings on approach as well as follow up EASA’s recommendation.

If this approach to Svolvær had been flown by an aircraft reporting its pressure settings, to an airport whose air traffic service was equipped to have the altimeter setting received from the aircraft displayed on a screen, the air traffic service could have seen that the QNH set was incorrect. Used in conjunction with a system for monitoring pressure setting data received, such as the Barometric Pressure Setting Advisory Tool (BAT), see section 1.18.5, this could amount to a technical barrier functioning as a safety net for detecting approaches with incorrect QNH settings.

The NSIA takes a positive view of such a system, as it could serve as a safety net providing a technical barrier against the risk of incorrectly set QNH having fatal consequences provided the aircraft sends its pressure setting facilitating participating in such a system. It also requires the Air Traffic Service Provider have tools and procedures in place for handling an aircraft’s pressure setting.

In the NSIA’s opinion, the aircraft’s inability to transmit its pressure setting as part of the EHS data in response to interrogation would not have prevented this incident. In this case the approach was to an airport that was not equipped to have the altimeter setting transmitted by the aircraft displayed on screen. If, however, the approach had been to an airport where the air traffic service was equipped to have the altimeter setting transmitted by the aircraft displayed on screen, this would have given the air traffic service a chance to identify the deviation and ask the crew to confirm the setting of the aircraft’s altimeter.

The NSIA issues a safety recommendation to Widerøe recommending that the company equip their aircraft with transponders capable of transmitting their pressure setting in response to interrogation in accordance with the intentions for operators expressed in EASA’s SIB. Widerøe has decided to carry out a cockpit upgrade on its DHC-8-100, 200 and 300 aircraft. The upgrading is scheduled to start in Q2 2026. The NSIA nevertheless chooses to issue a safety recommendation to follow up Widerøe aircraft's ability to be part of a QNH monitoring system.

> The Norwegian Safety Investigation Authority recommends Widerøe's Flyveselskap AS, with its particularly challenging flight operations, to upgrade the transponders on their aircraft to enable them to transmit pressure settings and thus be part of a system for monitoring aircraft pressure settings (QNH) in Norwegian airspace.

2.4.4 SURVEILLANCE

Avinor ANS already has in place the equipment and procedures required to enable the air traffic service to identify deviations between set and actual QNH. However, this will require the air traffic service to have SUR and use NATCON as its ATM system, and the extended label option must be selected. No alert is given in case of QNH deviations. Moreover, the aircraft must have a Mode S transponder and broadcast their pressure setting in response to interrogation. If RaADS is used as the ATM system, Mode S fields will not be available, and it will not be possible to display an aircraft's pressure setting. There is currently no single system with pertaining operating procedures for monitoring QNH, and RaADS and NATCON coverage differs between different parts of Norway.

SUR is used as a supporting tool for AFIS but does not alter the content of the service. AFIS units perform the same flight information services regardless of the equipment available to them. Consequently, AFIS cannot be expected to be able or willing to provide this service.

Several previously conventional towers (AFIS) have been transferred to the RTC and are controlled from Bodø. An AFIS officer can thus choose to display an aircraft's pressure setting, but this information will not be available in the immediate vicinity of the work position. Nor are there procedures in place for AFIS officers to identify deviations between the actual and set QNH.

As of May 2025, no conventional AFIS towers have SUR with NATCON as their ATM system.

This means that there is a need for a technical system with pertaining procedures for automatically identifying deviations between an aircraft's reported and actual QNH in the area and provide an alert to allow the crew to set the correct QNH. If Widerøe, like other operators of CAT aircraft, installs equipment that can transmit its QNH, it would be appropriate for this to also be used, for example, by SUR at all AFIS airports.

2.4.5 RISK REDUCING MEASURES

Flying with incorrect QNH poses a substantial risk. This risk has been actualized through this investigation. The safety Information Bulletin (SIB) from ICAO and EASA shows that the issue of incorrect QNH is also relevant on an international level.

This investigation has shown that the risk for a serious incident or accident from incorrectly set QNH is high enough to warrant risk reduction measures to be implemented. The NSIA therefore requests a new risk assessment to be performed to determine risk reduction measures commensurate to the risk. This needs to cover both short- and long-term risk reduction.

The functions inherent in the Barometric Pressure Setting Advisory Tool (BAT) and SUR related to the identification of incorrectly set QNH are suitable measures for increase the probability of an incorrectly set QNH being detected.

EASA has confirmed to the NSIA that the intention behind the SIB is for the parties to consider whether technology could be a safety barrier and whether its implementation could help to mitigate risks posed by incorrect QNH setting. This can be done by comparing the aircraft pressure setting, from mode S EHS, and identify any deviation from the actual QNH for an area and react to deviations.

Such a system requires aircrafts to be fitted with a transponder capable of transmitting the QNH set by the crew. Procedures describing how to respond to such deviations between actual and set QNH could also be required for this system to take on the role of a safety barrier.

The NSIA therefore submits one safety recommendation to Norwegian CAA to perform a risk assessment and implement risk reduction measure on short and long term.

The Norwegian Safety Investigation Authority recommends the Norwegian Civil Aviation Authority conduct a new risk assessment to verify that the expected level of safety is maintained for cases with incorrectly set barometric altimeter. The risk assessment must be performed in close cooperation with aircraft operators and the air traffic services. The Civil Aviation Authority is then recommended to establish requirements for any risk-reducing measures in the short term and the use of technological solutions, in the long term, to address national risk challenges in line with the intention of EASA SIB 2023-03.

3. Conclusion

3. Conclusion

3.1 Main conclusion

The flight from Bodø to Svolvær was planned with marginal weather conditions in Svolvær. En route, the crew were informed that snow had to be cleared from the runway at Svolvær Airport Helle and that they were cleared to a holding pattern. They started their approach after spending approx. 10 minutes in the holding pattern around the reporting point OSRUL. The crew had forgotten to set the local QNH for the approach and was therefore 700 ft (213 m) below the indicated altitude. When the aircraft was 3.1 NM from the runway threshold, EGPWS calculated the aircraft's geometric altitude to be below the Runway Field Clearance Floor (RFCF) vertical profile and gave an aural 'Too Low terrain' alert. The crew immediately aborted their approach and returned the Bodø, where they landed.

The checklists and procedures used by Widerøe to set correct QNH before landing were thought of as individual barriers. The investigation has shown that the checklists and procedures had some dependencies making them less efficient barriers.

The investigation has shown that there is no single technical system in use in Norwegian airspace that is capable of detecting deviations between reported QNH and the airplane's QNH, and that human barriers alone are not enough to guarantee that local QNH is set. There are ways of displaying an aircraft QNH as part of Surveillance (SUR), provided that Avinor Air Navigation Services (ANS) Norwegian Air Traffic Control System (NATCON) is used as the Air Traffic Management (ATM) system. The air traffic services performed the duties of *Aerodrome Flight Information Service (*AFIS*)* at Svolvær airport Helle. There are currently no procedures in place for this service to be provided by AFIS.

The airplane, LN-WIP, was fitted with a transponder unable to send QNH values. The air traffic services were therefore not able to read QNH.

Based on this investigation the NSIA is of the opinion that an independent system for monitoring aircraft pressure setting, with operational procedures, will increase aviation safety. Avinor ANS has equipped several air traffic control units and flight information units with a monitoring system called SUR. SUR is considered a supporting tool for AFIS and does not change the service provided even where new systems have been introduced.

This incident with LN-WIP occurred due to a combination of technical weaknesses and deficiencies and operational, human and organisational factors.

Widerøe has introduced several measures to help strengthen focus on CRM and workload management for commander training and line checks. As a result, the NSIA does not issue any safety recommendation regarding this.

The NSIA issues a safety recommendation to the Norwegian CAA to assess the risk posed by incorrectly set QNH and to implement risk-reducing measures. A safety recommendation is issued to Widerøe recommending that the company upgrade the transponders on their aircraft to enable them to transmit pressure settings and thus be part of a system for monitoring aircraft pressure settings (QNH) in Norwegian airspace. A safety recommendation is also issued for Widerøe to review its checklists and procedures for verification of QNH.

3.2 Investigation results

3.2.1 HISTORY OF FLIGHT

A. Inadequate CRM was the reason why the barometric altimeter was not set to local QNH, neither as part of the altimeter setting procedure nor as part of the approach checklist.

B. The barometric altimeter was not set to local QNH as part of the pre-level procedure.

C. The barometric altimeter was not set to local QNH as part of the radio height procedure.

D. It was a good call on the part of the crew not to attempt another approach to Svolvær.

E. The crew made sure that the flight data recorder (FDR) and cockpit voice recorder (CVR) were secured.

3.2.2 OPERATIONAL FACTORS

F. The QNH was not set as part of the altimeter setting procedure. Since setting the QNH functioned as a trigger for performing the approach checklist, QNH was not set through this procedure either.

G. The pre-level procedure is not to be carried out past the IAF, which means that after IAF, the crew will receive the same aural and light alerts with no need to respond to them. A trigger that crew sometimes must respond to and sometimes not could be a contributing factor in the procedure being forgotten.

H. The radio height procedure is performed when the radio altimeter starts to indicate altitudes. There are no other aural or light alerts than this indication. Therefore, the procedure could be forgotten in a hectic situation.

I. The triggers used for checklists and procedures for setting or checking QNH have weaknesses if one has forgotten to set QNH in the altimeter setting procedure.

J. The crew initiated a go-around immediately on hearing the EGPWS alert and achieved a positive climb angle in four seconds. This testifies to a quick reaction on the part of the crew resulting in the aircraft not losing much altitude before starting to climb.

3.2.3 TECHNICAL FACTORS

K. The NSIA is of the opinion that pilots need to be aware of the fact that EGPWS with older software versions may not issue alert in the same place as EGPWS with newer software versions.

L. In locations where AFIS uses Surveillance with NATCON as its ATM system, QNH can be displayed on screen. However, SUR is used as a supporting tool only by AFIS.

M. A system is needed to prevent approaches with incorrect QNH settings from having fatal consequences. This means that aircraft will have to broadcast their pressure settings, the air traffic service will have to display the aircraft's pressure settings, and procedures must be established for situations where the reported QNH displayed differs from the actual QNH below the transition altitude (TA).

4. Safety recommendations

4. Safety recommendations

The Norwegian Safety Investigation Authority submits the following safety recommendations:[5]

Safety recommendation Aviation No 2025/03T

During an approach to Svolvær Airport Helle on 22 December 2022 with a De Havilland Aircraft DHC-8-103, LN-WIP, operated by Widerøe’s Flyveselskap AS, the crew had forgotten to set the local QNH.

The company had an altimeter setting procedure during which QNH was to be set. QNH was then to be verified as part of the approach checklist, pre-level procedure and radio height procedure. Using standard barometric pressure meant that the crew had an indicated altitude that was 700 ft higher than their actual altitude. When the aircraft was 3 NM from the runway threshold, the aircraft's terrain warning system (Enhanced Ground Proximity Warning System – EGPWS) gave a ‘Too tow terrain’ warning and the crew immediately aborted the approach and returned to Bodø. The investigation has shown that the procedures for setting and verifying the barometric altimeter applicable at the time of the incident were not sufficient to prevent the crew from forgetting to set the local QNH. When the crew forgot the first trigger for setting and checking QNH, the procedure and aids in the cockpit were not sufficient to identify the deviation and set the correct QNH. This incident also shows how ambiguity about whether a checklist should be carried out can result in an increased risk of undesirable incidents. It should be made clearer in Widerøe's operations manual and pilot training what should trigger the performance of a checklist.

The Norwegian Safety Investigation Authority recommends Widerøe’s Flyveselskap AS to develop improved procedures for setting and verifying the barometric altimeter (QNH) based on simplification and clarification of what should trigger setting and verification of QNH, and that such setting and verification should be carried out every time regardless of other aspects of the operational situation.

Safety recommendation Aviation No 2025/04T

During an approach to Svolvær Airport Helle on 22 December 2022 with a De Havilland Aircraft DHC-8-103, LN-WIP, operated by Widerøe's Flyveselskap AS, the crew had forgotten to set the local QNH.

The company's checklists and procedures for setting and checking QNH were not implemented in such a way that incorrect QNH was detected. To prevent incorrectly set QNH from leading to a catastrophic accident, the Norwegian Safety Investigation Authority like EASA, believes that an independent system is needed that monitors aircraft in Norwegian airspace and detects deviations between reported QNH and actual QNH. This requires that aircraft can send their pressure setting when interrogated by an Enhanced Surveillance System.

The Norwegian Safety Investigation Authority recommends Widerøe's Flyveselskap AS, with its particularly challenging flight operations, to upgrade the transponders on their aircraft to enable them to transmit pressure settings and thus be part of a system for monitoring aircraft pressure settings (QNH) in Norwegian airspace.

Safety recommendation Aviation No 2025/05T

During an approach to Svolvær Airport Helle on 22 December 2022 with a De Havilland Aircraft DHC-8-103, LN-WIP, operated by Widerøe's Flyveselskap AS, the crew had forgotten to set the local QNH.

The company had an altimeter setting procedure during which QNH was to be set. QNH was then to be verified as part of the approach checklist, pre-level procedure and radio height procedure. Using standard pressure meant that the crew had an indicated altitude that was 700 ft higher than their actual altitude. When the aircraft was 3 NM from the runway threshold, the aircraft's terrain warning system (Enhanced Ground Proximity Warning System – EGPWS) gave a 'Too low terrain' warning and the crew immediately aborted the approach and returned to Bodø. This incident illustrates the weakness inherent in having procedural steps as the only preventive barriers to prevent controlled flight into terrain. The Norwegian Safety Investigation Authority agrees with the opinion expressed by EASA in SIB 2023-03 that in order to prevent an incorrectly set QNH from leading to a catastrophic accident, an independent system is needed to monitor aircraft in Norwegian airspace and identify deviations between reported QNH and actual QNH.

The Norwegian Safety Investigation Authority recommends the Norwegian Civil Aviation Authority conduct a new risk assessment to verify that the expected level of safety is maintained for cases with incorrectly set barometric altimeter. The risk assessment must be performed in close cooperation with aircraft operators and the air traffic services. The Civil Aviation Authority is then recommended to establish requirements for any risk-reducing measures in the short term and the use of technological solutions, in the long term, to address national risk challenges in line with the intention of EASA SIB 2023-03.

Norwegian Safety Investigation Authority
Lillestrøm, 25 September 2025

Abbreviations

Abbreviations

ABTIK – Reporting point in the event of a missed approach to Svolvær runway 01

ADS-B – Automatic Dependent Surveillance Broadcast

AFIS – Aerodrome Flight Information Service

AGL – Altitude above Ground Level

ANSP – Air Navigation Service Provider

AOC – Air Operator Certificate

APS – Altitude Pre-Select

ATPL – Airline Transport Pilot License

BARO-VNAV – Barometric Vertical Navigation

BAT – Barometric Pressure Setting Advisory Tool

BDS – Binary Data Store

BPS – Barometric Pressure Setting

CAM – Cockpit Area Microphone

CB – Cumulonimbus

CDFA – Continues Descend Final Approach

CFIT – Controlled Flight Into Terrain

CPL – Commercial Pilot License

CVR – Cockpit Voice Recorder

CAA – Civil Aviation Authority

DME – Distance Measuring Equipment

EADI – Electronic Attitude Director Indicator

EASA – European Aviation Safety Agency

EGPWS – Enhanced Ground Proximity Warning System

EHSI – Electronic Horizontal Situation Indicator

FAF – Final Approach Fix

FDR – Flight Data Recorder

FL – Flight Level

ft – Feet

FAA – Federal Aviation Administration

GBAS – Ground Based Augmentation System

GLS – GBAS Landing System

GNSS – Global Navigation Satellite System

hPa – hectopascal

Hz – Hertz

IAF – Initial Approach Fix

IR – Instrument Rules

LOC – Localizer

MAPt – Missed Approach Point

MEL – Minimum Equipment List

METAR – Meteorological Aerodrome Report

MSAW – Minimum Safety Altitude Warning

NM – nautical mile(s)

NSIA – Norwegian Safety Investigation Authority

OM – Operations manual

OPC – Operator Proficiency Check

PF – Pilot Flyging

PM – Pilot Monitoring

PPL – Private Pilot License

RFCF – Runway Field Clearance Floor

RNP – Required Navigation Performance

NSIA – Norwegian Safety Investigation Authority

SW – Software

TA – Transition Altitude

TCF – Terrain Clearance Floor

TIZ – Traffic Information Zone

TL – Transition Level

TSB – Transport Safety Board

UTC – Universal time coordinated

Appendices

Appendix A Graphic representation of EGPWS

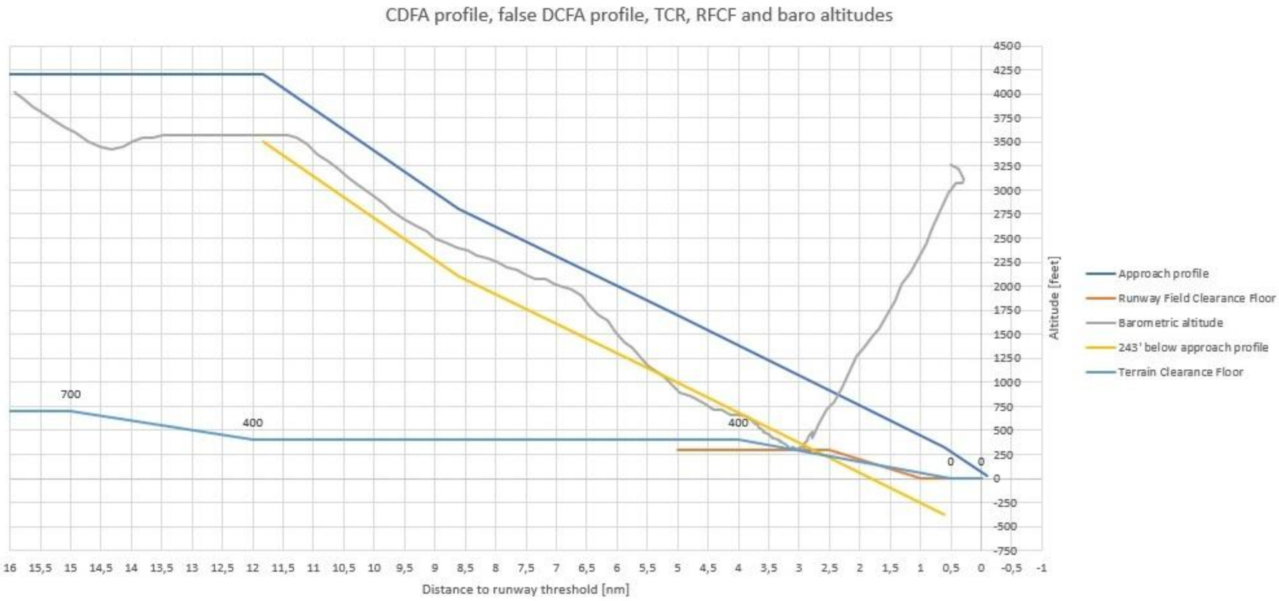


Figure 13: Graphic representation of EGPWS testing. Source: Widerøe. Plot: NSIA

The yellow line represents an approach flown 243 ft below the approach profile. As shown in the figure, the aircraft would not penetrate neither the TCF nor the RFCF profile during such an approach (243 ft lower), and the EPGWS system would not give any warning.