AVINOR

ZONING PLAN FOR PARTS OF BERGEN AIRPORT, FLESLAND

PROPOSER'S PLAN DESCRIPTION AND IMPACT ASSESSMENT

REVISED FOR 2ND READING
DATED 30 MARCH 2012

ZONING PLAN (DETAIL PLAN) W/ IMPACT ASSESSMENT FOR BERGEN AIRPORT, FLESLAND, LAND NO. 109, TITLE NO. 14 ET AL.

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1 BACKGROUND AND REASON FOR DRAFT PLAN - SUMMARY

Avinor hereby submits a proposal for a zoning plan for parts of the landside at Bergen Airport Flesland. Implementation of this plan ensures that Bergen Airport, Flesland will not be a limiting factor in the positive development for citizens, public activities as well as business and tourism in Bergen and the Western Region. The plan furthermore facilitates increasing the public transport share of traffic to the airport by the construction of a light rail transit (LRT) station at the airport, integrated in the air terminal. The plan is to open the new air terminal and the LRT to Flesland simultaneously at the turn of 2015/2016.

The Sector Plan for Avinor in the National Transport Plan was submitted on 7 April 2011. The plan warns of a doubling of travellers by 2040. This entails significant investment challenges in the years ahead.

Avinor has a comprehensive responsibility to society and faces significant social obligations. The company combines these considerations with the requirements that its activities are to be operated in a safe, efficient and environmentally sustainable manner, within a financially responsible framework. It is also essential that growth is handled without increasing greenhouse gases.

Avinor has two primary business segments, operating a nationwide network of airports and air navigation services for civil and military aviation. This encompasses 46 airports in Norway, as well as control towers, control centres and other technical infrastructure for safe air navigation. Twelve of the airports are operated in cooperation with the Armed Forces. In addition to flight operations, commercial earnings are facilitated through airport hotels, parking facilities, duty-free shops, dining and other services for air passengers. Avinor's goal is to facilitate safe, efficient and environmentally friendly aviation in all parts of the country. Financially, overall operations are operated as a *single* unit where commercially profitable airports finance unprofitable airports. The air navigation service is self-financing in that the services are priced according to a cost principle. Shares in Avinor AS are 100 per cent owned by the Norwegian state through the Ministry of Transport and Communications. The Ministry manages the state's ownership of Avinor and stipulates e.g. the tasks imposed on the Group to safeguard the general interests of Norwegian society, the required rate of return and dividends. In addition, the Ministry of Transport and Communications regulates the aviation fees. The Ministry of Transport and Communications is the highest authority for Norwegian aviation and also stipulates the Civil Aviation Authority's regulations, which have consequences for Avinor's operations.

Aviation's social significance can be summarised under the following headings:

- *Accessibility and overall contribution to the social structure:* Two of three Norwegians have access to an airport within an hour's journey. 99.5% of the population is able to travel to Oslo and return the same day. The aviation industry safeguards important social functions such as public administration and the Armed Forces, and enables national and international activities in such areas as business, tourism, health care, culture and sports.

- *Employment:* Aviation contributes 60,000 – 65,000 jobs. Its significance is particularly great in rural areas. The overall effect of aviation is equivalent to 4% of Norway's GDP.

- *Significance for the oil and gas sector:* 13% of all domestic flights are related to this sector. 550,000 helicopter trips annually to offshore installations. A significant portion of the country's economic growth is connected to this sector and is linked to Western Norway.

- *Tourism:* 34% of all tourists to Norway arrive by plane, and this form of transport is increasing the most. Spending by air tourists in Norway totals approximately NOK 13 billion. 227 connections between Avinor's airports and abroad (summer 2010). There is considerable focus on increasing national and international tourism, particularly in Western Norway (Bergen/the fjords), on board the Hurtigruten (Coastal Express liner) and in Northern Norway. A significant portion of the country's economic growth is connected to this sector and linked to Western Norway.

- *Patient trips:* 400,000 patients are carried by scheduled flights annually. A total of 30,000 movements annually by air ambulance, including emergency flights (incl. burn injury flights to Haukeland) and donor transport.

- *Escort assistance:* (e.g. for children travelling alone and for the elderly and sick): Includes over 250,000 trips annually.

- *Reliability:* Regularity: 97.4 %; punctuality: 89 % (2010 figure).

- *Globalisation:* The sector is a key component of steadily increasing *globalisation*

Alternatives to air transport exist to a small extent. With the current infrastructure, no more than 6 to 8 per cent of passenger traffic by air could be replaced with other modes of transport.

The Sector Plan states that the development and financing of a national network of airports requires the major airports to handle the expected traffic growth. Bergen Airport, Flesland is Norway's second largest airport. It serves as the main airport for Western Norway, with many direct domestic and international routes and serves most of Hordaland County, in addition to functioning as a western hub for regional flights in Sogn og Fjordane and parts of Møre og Romsdal.

The population of Norway is expected to increase to 6.1 million in 2040. The centralisation of population around the main cities, especially towards the major urban areas in southern Norway, will continue. These areas are expected to grow by about 40 per cent by 2040. It is estimated that in the period 2010 to 2040 the City of Bergen will grow by 160,000, which is equivalent to the entire population of Trondheim. This means that the growth in demand for air travel will also be strongest at major airports and particularly at Bergen Airport, Flesland. General income growth means increased travel, longer trips and strong growth in the leisure market. Increased globalisation will lead to major changes in the world's industrial structure, and increased demand for travel, sometimes over long distances.

The forecasts show an average annual growth in air traffic of 2.3 per cent. This is equivalent to 78 million passengers in 2040, i.e. almost a doubling from 2010.

New regulatory requirements, backlog and expected traffic growth entail significant investment needs and Avinor faces major investments. One of the largest single projects (involving several billion kroner) during this period includes investment in airside and a new terminal at Bergen Airport, Flesland, which will cost several billion.

The current terminal is more than 20 years old and was built for just under three million travellers. Rapid expansion is needed. Today, the airport must unfortunately reject requests for traffic and other operational activities due to the limitations of the current terminal. After a few years of decline/stagnation, traffic from the air terminal increased from 2003 to 2010 by approximately 40%, from 3.6 million 5.1 million passengers. It is expected that traffic at the airport terminal will increase further in the future, see more about this under Section 4 Background for planning.

The high traffic numbers have so far resulted in both large investments (about NOK 850 million) and major changes in the airport's airside infrastructure. These include new centre lights on the runway, new aprons for aircraft, new exits and entrances from/to the runway and the relocation of 3,000 metres of taxiway has increased both capacity and safety. There are also construction plans for a new de-icing platform costing more than NOK 100 million. The capacity of the terminal functions and the airport's central landside must now be increased to meet current and future service requirements and needs. The current terminal building has long since reached its capacity limit. Furthermore, due to the design of the building, the terminal cannot be extended in a way that provides an acceptable long-term solution.

This is the summarised reason for Avinor's need for a new landside zoning plan for further expansion.

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In 2009 Avinor held a plan and design contest for the expansion of the terminal building at the airport.

Narud Stokke Wiig Arkitekter og Planleggere AS (NSW) won the competition with the design "Vingespenn" (Wingspan). The winning project forms the basis for Avinor's proposed zoning plan.

The zoning plan is based on a terminal with both an airside (apron areas, etc.) and a landside (traffic forecourt with associated parking), which can cover 10 million passengers. Under the proposal, the new terminal will be built south-east of the existing terminal and will not intervene in its structure, or in the road system and parking facility serving the current terminal. The new terminal consists of a central building, an office part and a pier. In addition, the existing terminal will be connected to the new one.

The proposed location of the terminal is ideal in relation to the aprons. It is important to emphasise that the chosen solution enables the development of an airport that will and must be in full operation during the construction of the new terminal.

An important principle for the road system in the plan is that there must be "terminal-related" one-way traffic in front of the terminal via an upper and a lower traffic forecourt. The plans call for building the terminus for the LRT underneath the lower traffic forecourt.

Based on Avinor's and aviation, cargo and transport companies' need for internal functions as well as commercial evaluations, there is a basis and need to locate a new commercial complex on the east side of the terminal, in connection with the traffic forecourt. This part of the development is called "Airport City". The reason that Avinor wants to include this in its expansion plans, is both the need to relocate existing functions that must give way for the new terminal and new aprons, and the need to prepare more land for airport-related commercial development close to the airport.

Accommodating good airport-related businesses close to the airport will be an important contribution to industrial development in the municipality. Such development will leverage the synergies provided by their proximate location, both as a contribution to a modern and flexible airport and providing the municipality with high-quality commercial space and commercial activities at the terminus of the LRT system. The plan also paves the way for a minor expansion of the existing hotel at the airport.

North of the current terminal and the hotel lies an area with terminals for helicopter traffic, hangars and workshops for helicopters, large aircraft and small aircraft belonging to flying clubs and private parties. Several air cargo companies, freight forwarders and catering companies have also established operations at the airport. The current zoning plan provides very detailed guidelines for use of these areas in the plan and the new proposal offers more leeway.

The measure will entail the following changes to the current terrain:

- Lønningstjern pond must be filled in to accommodate expansion of aircraft parking
- Lilandshaugen hill must be blasted back (eastward) some 300 metres to accommodate the new terminal with traffic forecourt and Airport City

Development in accordance with the zoning plan means that east of the terminal much of Lilandshaugen, and the entire Kongshaugen hill, must be removed. Since it will be difficult to dispose of these masses during the time that is available until the new terminal is completed in 2015/16, development in two stages is proposed. Development Stage 1 will be the construction of a terminal for 7 million passengers. In this situation, the road system may be slightly different than the road system shown in the zoning plan. Reference is made to the illustration plan marked "Development Stage 1". The road system shown in the development plan will be built during Development Stage 2, which involves further expansion of the terminal and/or development of Airport City.

An impact assessment has been prepared for the zoning plan according to the regulations on impact assessments. According to Section 1 of the regulations, the purpose of the provisions on impact assessments.

(IA) is to ensure that environmental and social considerations are taken into account during the preparation of plans or measures, and when deciding whether and on what terms, plans or measures can be implemented.

The impact assessment has revealed undesirable effects relating to road traffic noise, natural environment/biodiversity and cultural heritage.

With respect to homes that will be exposed to increased/new road traffic noise, these are already located by the airport with the inconveniences that entails. The social benefit of the new road system and the expansion of the airport is very high. It must therefore be regarded as unacceptable to not implement the measure to prevent an increased noise level among a few homes. Mitigation measures in the form of facade measures have, however, been included as a consecutive ordering provision.

With respect to cultural heritage and cultural environment, the undesirable effects are associated with the fact that the Lønningen country house estate must be removed. The cultural heritage authorities are basically negative to relocation and have requested a thorough study where e.g. alternative development scenarios for the planning area are reviewed. The present impact assessment provides answers to this. Based on our assessment and the heritage authorities' clear emphasis on the overriding importance the context has for the Lønningen country house estate as a cultural monument, none of the options could preserve the value of the Lønningen estate. In three of the options we have looked at, the country house itself could be preserved, but the surroundings would be changed to such an extent that its value would be diminished. This is true not only of its intrinsic value as part of a cultural landscape, but also to a large degree its empirical and utilitarian value. Because of the major changes in the surroundings, the view would be degraded and noise from the airport would make it very difficult for the building to function very well as an attraction and venue. Since preservation of the facility is in direct conflict with the need to expand the airport, the developer promotes the option that allows for expansion in accordance with Avinor's needs. The social importance of maintaining and developing a functional airport in Western Norway must be weighed against the preservation of the Lønningen country house. In our opinion, the former must be accorded the greatest weight. As a mitigating measure, the country house will be moved to a different, more suitable site, and will have value as a historical narrative when used in conjunction with leisure and cultural activities in, for example, Ytrebygda.

With respect to the natural environment, red-listed species of lichen on courtyard trees in front of the Lønningen country house estate have been found and several older, hollow oak trees, a priority habitat, have been recorded in an old parkland close by. If it had been possible to preserve the country house estate, several of the trees in question could be left standing. Here too, the social importance of expanding the airport is more weighty than preserving the aforementioned natural values.

Regarding the other subjects, no undesirable effects on the environment and society of crucial importance have been uncovered. A number of adjustments have been made to the draft plan for addressing the various considerations.

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In summary, it is Avinor's assessment that the plan can and should be conducted in accordance with the expansion volume, etc. that has been assumed here and the conditions for development as proposed here.

With expansion in accordance with the proposed plan, Bergen will get an airport by which the city and Western Norway will be well served. The region will also be assured the functions of a large airport that the region must have. Travellers will be greeted by a modern and well-functioning terminal area in appealing surroundings. The LRT system will be a particular advantage for the airport.

Avinor now requests that the draft plan be submitted for public review and hopes for a quick, effective and constructive dialogue with affected parties before a final plan proposal is discussed.

It is important to underline the relationship between the extension of the LRT system and the upgrading of the airport. Both measures rely on joint progress and completion and there will therefore be a corresponding need to maintain good concurrent progress in the two zoning plan processes currently under way.

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3 KEY INFORMATION

District	Ytrebygda
National grid no. (address in centre)	Lønningen
Land no./title no.	Land no. 109, title no. numerous
Current planning status (zoning/municipal (sector) plan)	• Zoning plan: Ytrebygda, land no. 109, title no. 14, Bergen Airport, Flesland, P 18390000. • Zoning plan for Lønningen South, plan no. 1515.00.00. • Some smaller areas in the municipal plan's ANR area and I/K/L area
Proposer	Avinor AS
Land owner (central)	Avinor AS
Planning consultant	Norconsult AS
Designing architects	Narud Stokke Wiig Arkitekter og Planleggere AS
Subconsultant landscape architecture	Bjørbekk & Lindheim AS
Main purpose of new plan	Airport purposes
Planning area's area in decares	1150
Degree of utilisation	Commercial activities: 3000 m^2 available area Combined purpose: 30 000 m^2 available area Petrol station. 40% built area ratio LA 1 and LA2: 40 and 50% built area ratio Other areas: 100% built area ratio
No. of new housing units/new commercial space (available area)	35 000 m^2 available area
Relevant issues (noise, building height, and the like)	Cultural monuments, landscape, nature, hiking trails, noise
Has an objection been notified (y/n)	Y
Impact assessment obligation (y/n)	Y
Announcement start-up, date	8 August 2010
Complete draft plan received, date	
Information meeting held (y/n)	N

4 BACKGROUND FOR PLANNING

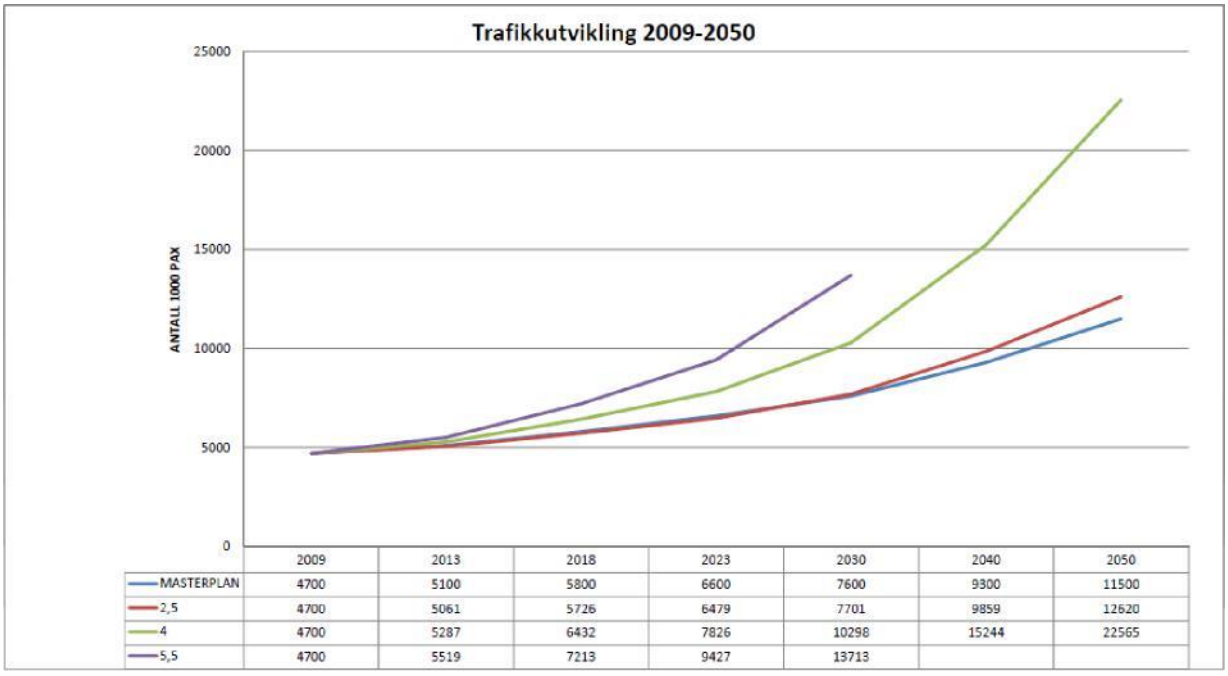
The proposed zoning plan with impact assessment for Bergen Airport, Flesland is hereby submitted.

Bergen Airport, Flesland is a public airport and it is therefore assumed that the zoning plan can be submitted as a public detailed zoning plan, where the rules concerning time limits (5 years) for commencement of facilities and measures pursuant to Section 12-3, fifth paragraph of the Planning and Building Act will not be applied.

The airport is the only trunk airport in Hordaland and Sogn og Fjordane counties. With its extensive domestic and international traffic, it is an essential communications element in the region. In 2010, 5.1 million passengers travelled via the airport, of which 234,000 by helicopter. The airport is thus the second largest in the country. In 2010, aircraft movements totalled 95,505, of which 15,948 were by helicopter. The runway measures 2550/2795 m, long enough to handle most types of aircraft. The terminal building opened in 1988 and, following some additions, now totals 20,650 m^2. 250 m north of the air terminal lies the helicopter area with its own terminal for serving traffic to and from the North Sea.

The main reason why there is now a need for a new zoning plan and development of the airport, is the service level of the current terminal, that current traffic must be limited and future traffic growth. The traffic had a relatively steady increase over time, averaging around 5% annually from 1980 to 2000. After a few years of decline/stagnation, traffic from the air terminal has again risen from 2003 to 2009 by almost 30%, from 3.6 million to 4.6 million passengers. The existing terminal was originally built for 2.8 MPPA and, although some adjustments have been made, it is already basically too small. It is expected that traffic at the airport terminal will increase further in the future:

- The number of passengers in 2010 is expected to be higher than 5 MPPA (million passengers per annum)
- The number of passengers in 2020 is expected to be higher than 8 MPPA
- The number of passengers in 2025 is expected to be higher than 10 MPPA



	2009	2013	2018	2023	2030	2040	2050
MASTERPLAN	4700	5100	5800	6600	7600	9300	11500
2,5	4700	5061	5726	6479	7701	9859	12620
4	4700	5287	6432	7826	10298	15244	22565
5,5	4700	5519	7213	9427	13713		

Traffic development 2009-2050 – TOTAL 1000 PAX

To meet future needs, the airport's various elements must be expanded, such as access, baggage handling, check-in areas, security areas, car parks, terminals, aprons and rail system as well as buildings for administration, operation, hangars, cargo etc.

The zoning plan is based on a terminal with both an airside (apron areas, etc.) and a landside (traffic forecourt with associated parking), that can handle 10 million passengers.

Based on Avinor’s own need for internal functions and operators’ commercial evaluations, there is a basis and need to locate new commercial buildings on the east side of the terminal, in connection with the traffic forecourt. This part of the development is called "Airport City". The reason that Avinor wants to include this in their expansion plans, is both the need to relocate existing functions that must give way for the new terminal and new aprons, and the need to prepare more land for good, airport-related business and industrial spaces close to the airport.

Accommodating good airport-related businesses close to the airport will be an important contribution to industrial development in the municipality. Such development will leverage the synergies provided by their proximate location, both as a contribution to a modern and flexible airport and by providing the municipality with high-quality commercial space at the terminus of the LRT system.

Bergen Airport, Flesland also comprises terminals for helicopter traffic, hangars and workshops for helicopters, large aircraft and small aircraft belonging to flying clubs and private parties. Several air cargo carriers, freight forwarders and catering companies have established operations at the airport. The former military Flesland air station lies north of the civilian area. Although the air station is closed, the Armed Forces still owns the land on which the former air station stands, and also has some activities there, mainly warehousing.

The current zoning plan provides very detailed guidelines for the use of the areas in the plan. Because it provides very little flexibility, there is therefore a desire to adapt the new plan better so that it only sets the guidelines that are necessary.

The zoning plan proposal for Bergen Airport, Flesland is covered by the regulations on impact assessments. The planning programme, which details the planning process and the assessments that are to be carried out, was approved by the city government on 23 June 2011.

5 PLANNING PROCESS

5.1 Notification of start-up, consultation on the planning programme

Notification of start-up and the proposed planning programme was circulated on 8 February 2010 and the start-up was announced in Bergens Tidende and Fanaposten newspapers, with a deadline before Easter 2010 for comments. Since then, an expansion of the planning area has been announced. The notification of expansion was sent to those who were considered to be affected by the expansion.

Fourteen statements were received from public and private consultative bodies and five comments from neighbours. These are summarised and commented on in the final planning programme.

5.2 Stipulation of planning programme

The planning programme was considered by the city government on 23 June 2011, where the following resolution was adopted:

1. Pursuant to Section 12-9 of the Planning and Building Act, the following proposal for the planning programme is stipulated:
   Ytrebygda, land no. 109, title no. 14 et al, Bergen Airport, Flesland, Zoning Plan, dated 050810.

2. The planning programme shall be stipulated with the following changes:
   A. Requirements will be included regarding alternative assessments (medium, high and the 0 alternative) in relation to the development east in the planning area by Lilandshaugen.
   B. A point about the relationship to the Armed Forces' interests and a possible cargo port at Flesland under report topics in chapter 7.

After the decision the planning programme was revised so that it was in accordance with what had been adopted.

5.3 Public review

The zoning plan proposal was approved for public review, by delegated decision of 4 November 2011. The plan was circulated for public review in the period 6 November 2011 – 20 November 2011. Eighteen statements from public and private consultative bodies and seven comments from neighbours were received. These are summarised and commented on in a separate memorandum.

6 CURRENT PLAN STATUS AND OVERRIDING GUIDELINES

6.1 Acts and national policy guidelines

- ***Planning and Building Act***

The draft plan shall be processed according to the rules in the Planning and Building Act**.**

- ***Cultural Heritage Act***

Under Section 9 of the Cultural Heritage Act, the county authority is subject to a duty of mandatory inquiry in relation to automatically protected monuments during the zoning plan process.

- ***Nature Diversity Act***

For decisions affecting biodiversity it follows from Section 7 of the Nature Diversity Act that the principles in Section 8-12 shall be used as guidelines and that it shall be stated in the decision how these principles are considered and emphasised in the matter.

- ***National policy guidelines for coordinated land use and transport planning (Circular letter T-5/93, Ministry of the Environment and Ministry of Transport and Communications 1993):***

The objective for the guidelines is that larger workplaces are to be located in areas with good public transport services, and that a concentration of workplaces at public transport hubs is particularly desirable.

- ***National policy guidelines for strengthening the interests of children and young people in planning:***

National policy guidelines for strengthening the interests of children and young people in planning were granted by Royal Decree of 1 September 1989. The national policy guidelines for strengthening the interests of children and young people in planning shall:

- Manifest and strengthen the interests of children and young people in all planning and discussion of building projects under the Planning and Building Act.
- Give the municipalities a better basis for integrating and safeguarding the interests of children and young people in their ongoing planning and processing of building projects.
- Provide a basis for evaluating cases in which the interests of children and young people conflict with other concerns/interests.

The guidelines set a number of requirements for the municipal planning process and physical design. There is a requirement for municipalities to organise the planning process so that views concerning children and young people as interested parties are heard, and that different groups of children and young people are given the opportunity to participate.

6.2 County sector plans

- ***County sector plan for Hordaland***

The county sector plan states e.g.: *"Bergen Airport means a great deal for business and tourism in Fjord Norway and Hordaland County. There must be a focus on further development of infrastructure, increased terminal capacity and land for a future second runway" (page 5).*
"Transport strategies" states the following: *Strengthen the regional involvement in the development of Bergen Airport. Secure development with increased terminal capacity, better safety equipment and future second runway. Work for more international flights from Bergen, e.g. through reduced fees.*
Item 1.5 in the land use policy guideline states: "*Adequate land for future expansion of airports shall be secured".*

- ***County sector plan for new cargo port in the Bergen area - ongoing planning work***

Work is under way on the county sector plan for a new cargo port in the Bergen area. According to decisions about the planning programme (last decision of the county executive board of 25 August 2009), the following location alternatives will be examined further:

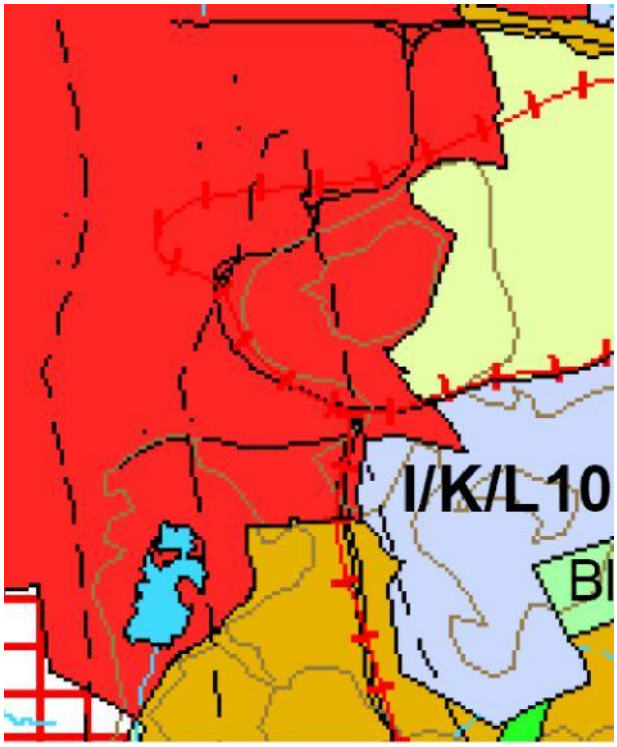
- *"Combination alternative based on the current port, with increased use of Mongstad and CCB*
- *Flesland*

Both alternatives will be assessed against the 0 alternative, the current port at Dokken".

In the planning programme the cargo port is shown on the northwest side of the airport. As there is limited space for storage and space for containers and ro-ro units in this area, a solution has been outlined with a road tunnel under the airport and storage of containers on the east side of the airport. See also Section 9.15 on the status of the work.

Illustration from the discussion document planning programme, New cargo port in the Bergen area

6.3 Municipal plan's land-use part



Section from the municipal land-use plans from the City of Bergen's website.

In the municipal plan, the main part of the draft plan is shown as public purpose.

However, the draft plan also includes:

- Parts of the industrial area south of the airport area, shown as a construction site in the municipal plan.
- Smaller portions of the area southeast of the airport area set aside as industrial/office/warehouse space (I/K/L10).
- Smaller portions of the Agriculture, nature and outdoor recreation area east of the airport.

The municipal plan shows noise zones around the current runway and around a future runway 2.

The municipal plan contains a number of themed plans. These affect the planning area as follows:

- The topic map "green structure" shows no affected points
- The topic map "Strategic Map" shows that both the main road system and adopted public transport system (LRT) lead to the area. At the southern end of, and south of the planning area, a site for possible commercial development is shown.
- The topic map "Shoreline 9800 years before present day shows that the southern part (around Lønnestjørna) was shoreline 9800 years ago

- The topic map "archaeological overview" shows the planning area as an area with need for archaeological clarification

- The topic map "Social infrastructure" shows that the closest schools and kindergartens are in Liland and in Blomsterdalen.

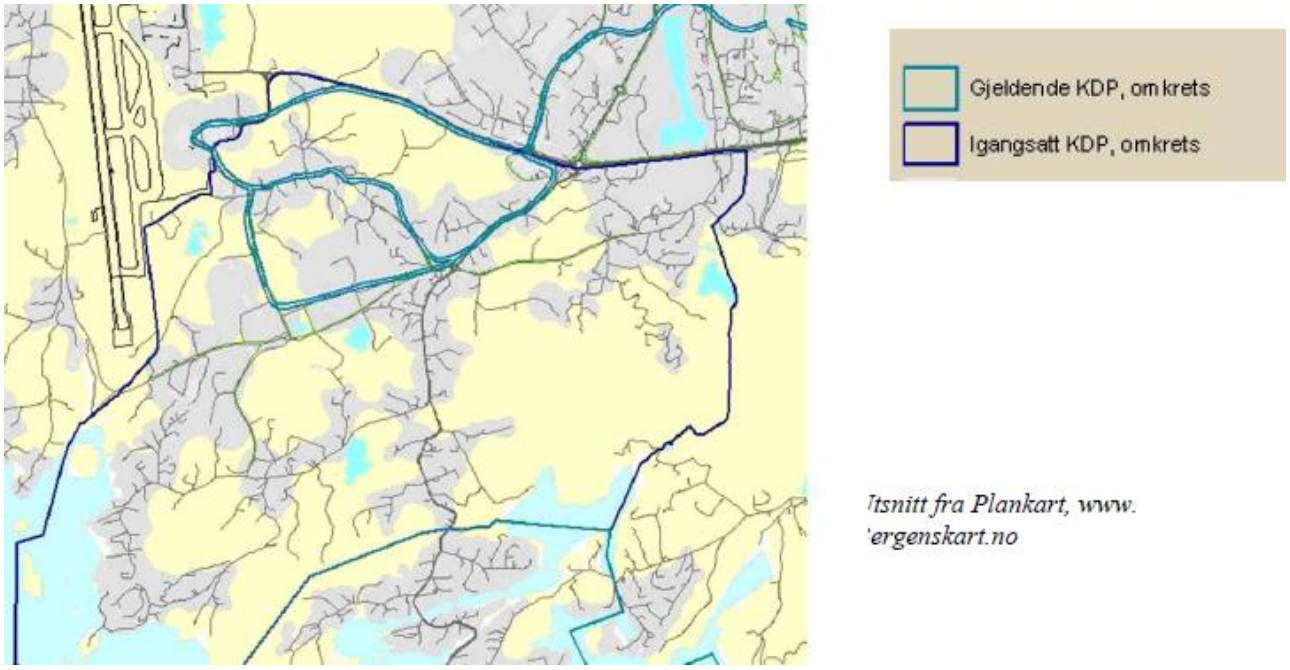
The municipal plan's land-use part is currently under revision.

6.4 Municipal sector plans

The current municipal sector plan for the LRT system affects the area. A zoning plan for the LRT is now in the making for the Rådal-Flesland stretch. This will provide further clarification.

Ongoing work on the municipal sector plan for Birkeland, Liland, Espeland affects the eastern parts of the planning area.

The current and ongoing municipal sector plans are shown in the illustration below.

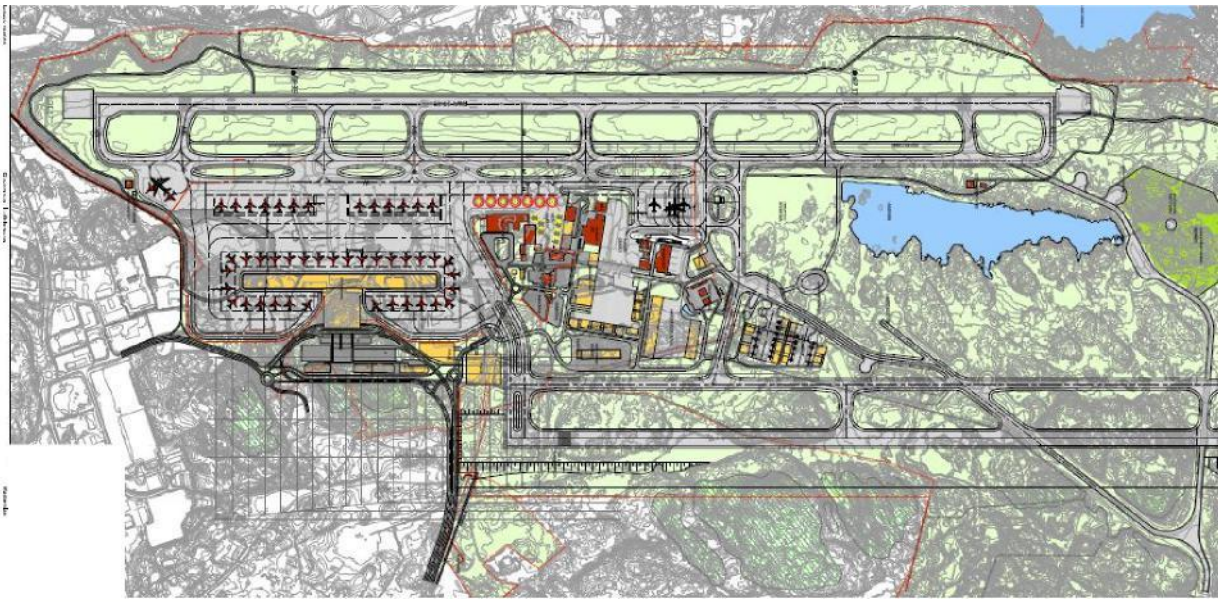


Current municipal sector plan, circumference
Commenced municipal sector plan, circumference
Section from planning map, www.bergenskart.no

6.5 Master plan for Bergen Airport, Flesland - Avinor AS

The Master Plans are Avinor's own plans. The Master Plans take shape following a comprehensive participation process in which the municipality, Armed Forces, County Governor and county authority participate.

The Master Plan for Bergen Airport, Flesland, describes the staged expansion of the airport until the year 2060, however, the most detailed for the first 10 years. The need for such a long time horizon is present because land close to the airport is attractive for business and industrial activities, while at the same time the airport must secure land for expansion so that future traffic will be managed satisfactorily. The need for a very long planning horizon has been reinforced since the Armed Forces has wanted to dispose of large parcels in the area that will be reserved in the event of a new runway 2, and which will rapidly come into demand as business and industrial areas.



Master Plan for Bergen Airport, Flesland: Illustration showing the planned future design of the airport, completed by the year 2060

At all times, the Master Plan shall be both a tool for Avinor in the budget process and a satisfactory tool for the detailed planning of the various measures. The document also accounts for factors outside the airport area (noise, building and height restrictions, etc.) that the municipality and the county will use in their land use planning. An annual review of the master plan is therefore planned.

Avinor requires that the Master Plans are the basis for the airports' development. They will also provide input for Avinor's long-term investment plan, and are thus also a contribution to the National Transport Plan (NTP).

Emphasis is placed on anchoring the plan with local and regional businesses, customers, employees, the local community and with other partners, including the Armed Forces. Furthermore, it is assumed that it will be a contribution to local and regional planning and decision making. An annual review of the master plan is required, emphasising that the plan shall be a tool for:

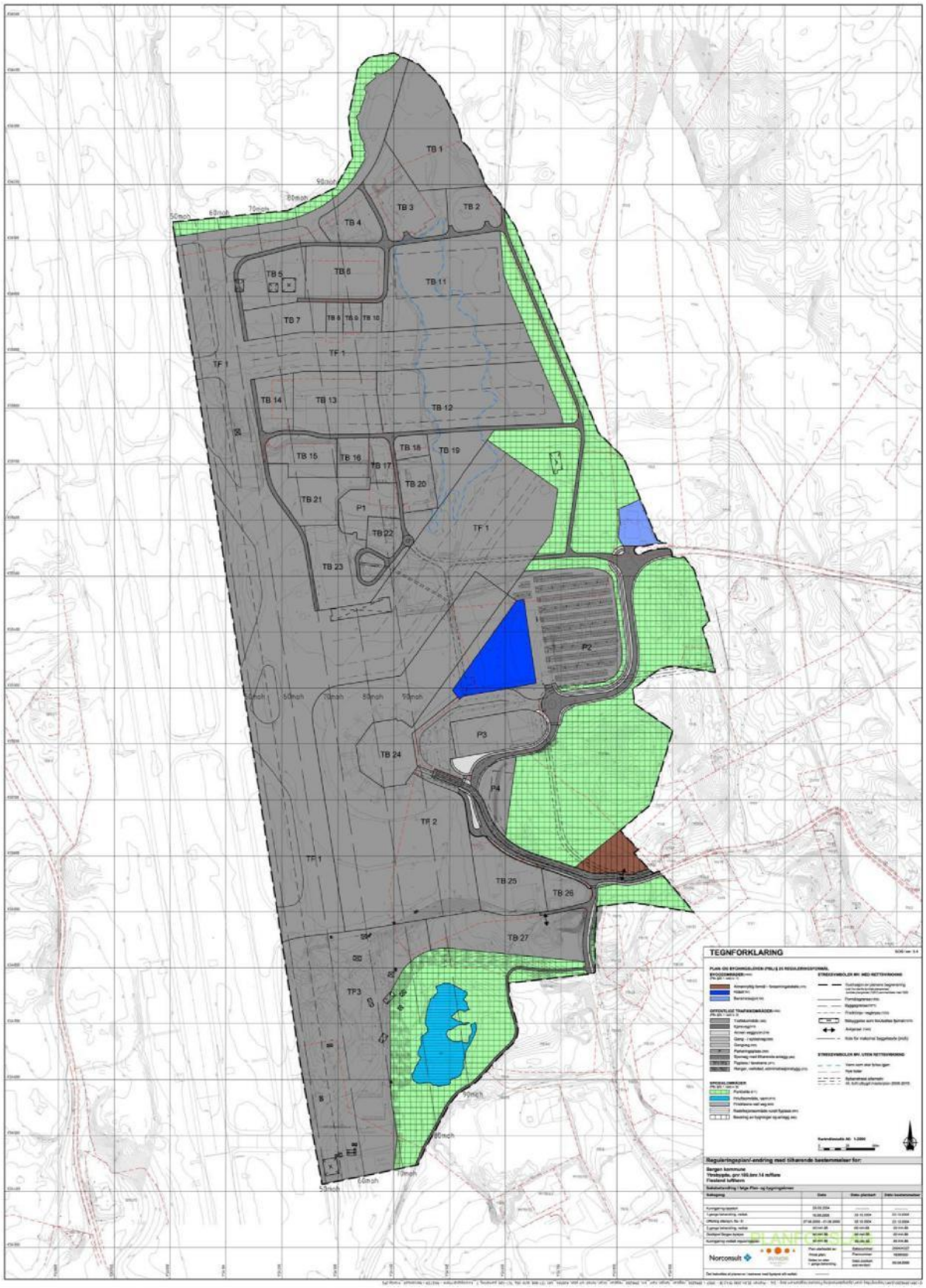
- the airport's stakeholders and the City of Bergen to secure areas for necessary future expansion (to prevent becoming hemmed in by surrounding development)
- mapping Avinor's investments in necessary infrastructure to handle expected traffic in a satisfactory manner, also in the long term.

In 2005, a broad social impact assessment was carried out on the need for expansion of the airport. Consequences of increasing capacity in line with demand were assessed against a situation of limited capacity. The purpose has been to illustrate the negative effect it will have on the region's economic development in general and the labour market in particular, if the airport is not permitted to expand. Conversely, the positive effects this development will have on the local community and region are shown. This work has been updated and incorporated into the current Master Plan from 2011.

The airport is aware that development must be sustainable, and environmental impacts of further development are therefore discussed in the plan.

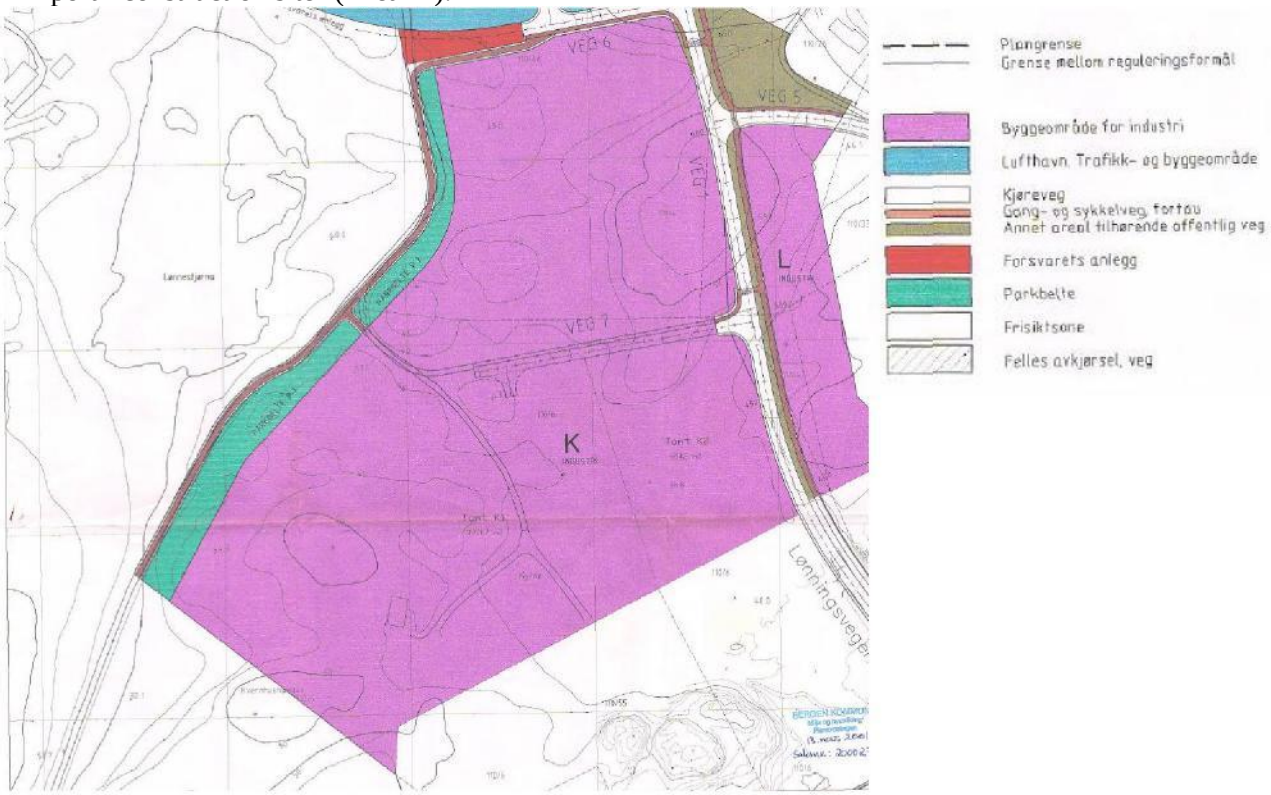
6.6 Zoning plans

The current zoning plan for parts of the airport's area is the zoning plan for Ytrebygda, land no. 109, title no. 14, Bergen Airport, Flesland, P 18390000, approved by the Bergen City Council 23 October 2006.



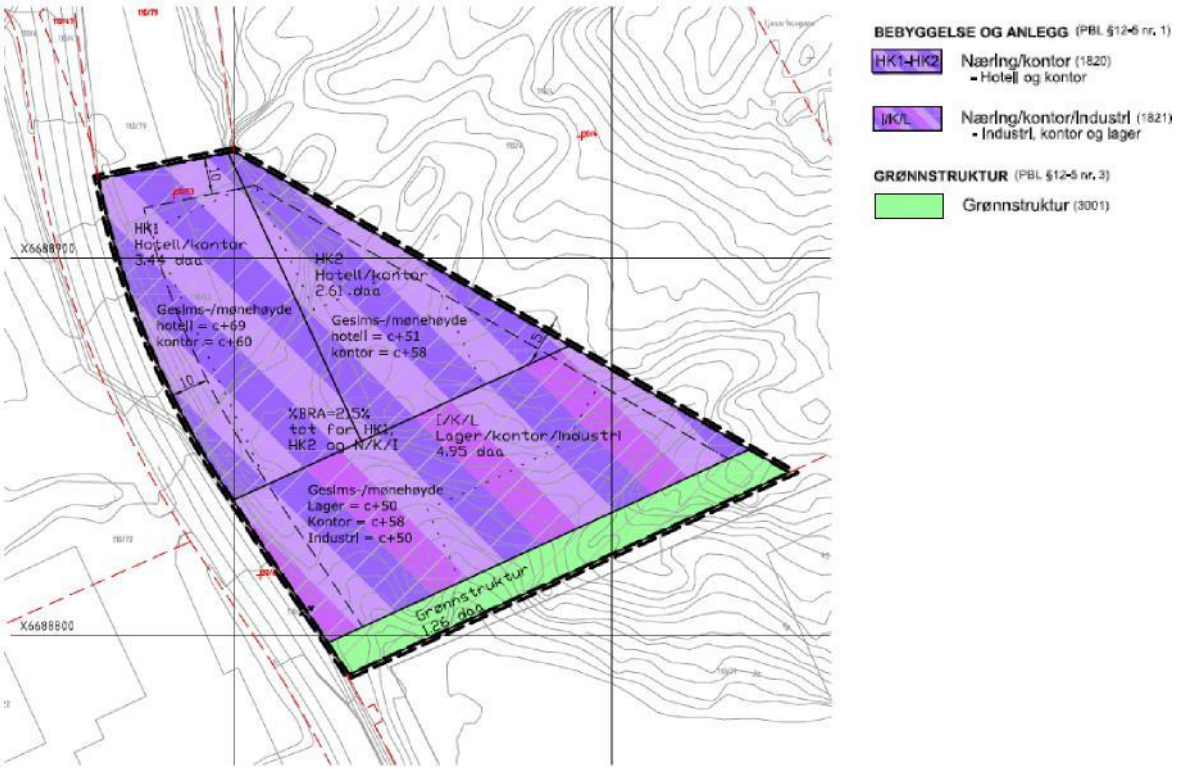
Current zoning plan for the area

The expansion of the zoning plan for Flesland airport affects a current industrial plan in the southeast, "Zoning plan for Lønningen South, plan no 1515.00.00". The area in question in this plan is shown as "Airport - construction site" (Area M).



Section of zoning plan 1515.00.01, obtained from BRA plan (www.bergenskart.no)
Plangrense = Plan border, Grense mellom reguleringsformål = Border between zoning purposes, Byggeområde for industri = Building area for industry, Lufthaven Traffic- og byggeområde = Airport Traffic and building area, Kjøreveg = Road, Gang-og sykkelveg, fortau = Pedestrian and bike path, sidewalk, Annet areal tilhørende offentlig veg = Other land for public road, Forsvarets anlegg = Armed Forces' facilities, Parkbelte = Green belt, Frisiktsone = Free view zone, Felles avkjørsel, veg = Common exit, road

On 25 May 2010, a zoning plan was approved for commerce - hotel, office, industry on the east side of Lønningsvegen road (plan no. 6077.00.00).



Section of zoning plan 6077.00.00 BEBYGGELSE OG ANLEGG = BUILDINGS AND FACILITES, Næring/kontor = Business/offices, Hotell og kontor = Hotel and offices, Næring/kontor/industri = Business/offices/industry, Industri, kontor og lager = Industry, offices and warehouses, GRØNNSTRUKTUR = GREEN STRUCTURE

In the northeast, the planning area affects Ytrebygda, LRT Rådal-Flesland, plan no. 6117 00 00. The plan shows the LRT from Rådal (Lagunen) to Bergen Airport, Flesland. A terminus for the LRT will be established at the airport. The adopted plan shows two alternatives; one under the ground which can be integrated in the new planned terminal and an above ground option that is independent of the new terminal.

Section of zoning plan 6117.00.00, obtained from BRA plan (www.bergenskart.no)

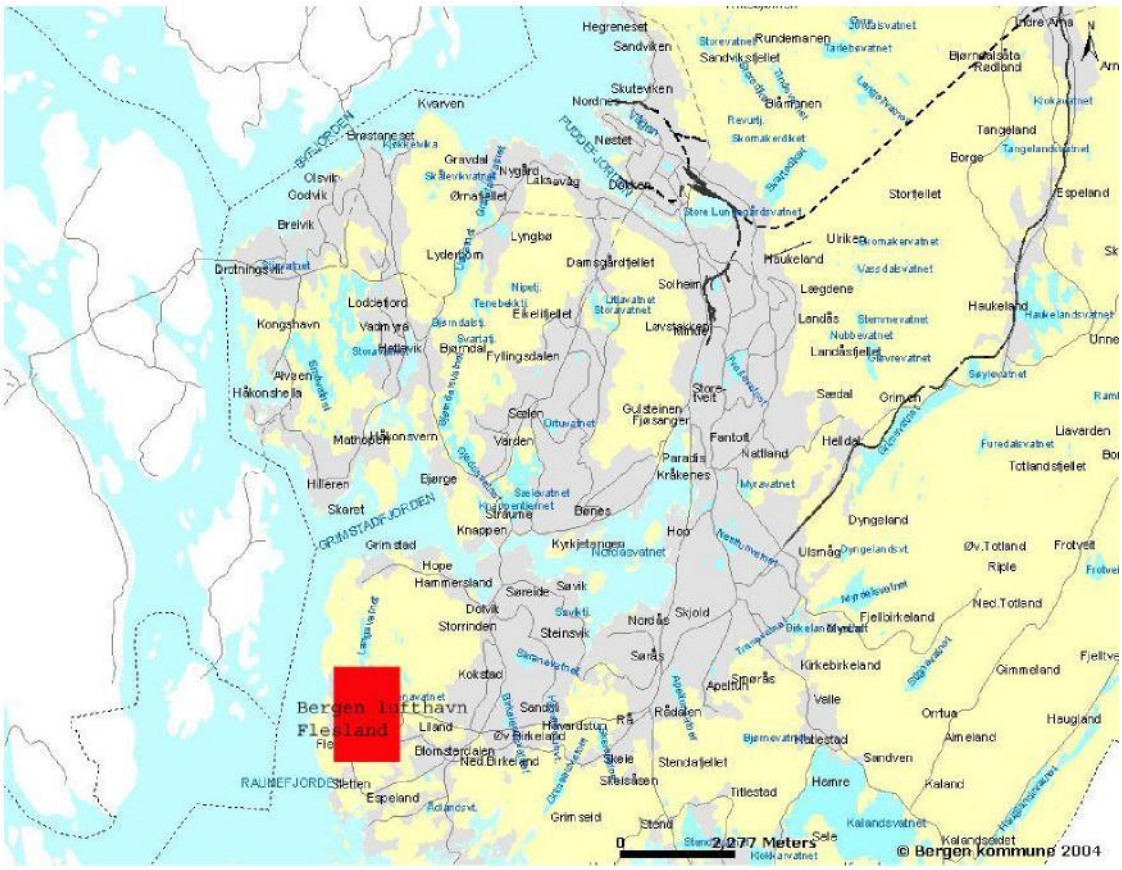
Ongoing zoning plan work in the area includes:

- Ytrebygda, workshop and depot for the LRT, plan no. 61180000. Commencement of planning for an area south of the airport (area A) was adopted 18 March 2010 and a planning programme for this area was approved on 30 June 2010. However, on 24 March 2011, the start-up for an area east of the airport (area D) was also approved, a new start-up was notified and consultation on a new planning programme was undertaken. A new planning programme was approved by the city government on 28 June 2011. This planning programme states that the impact of both options shall be assessed, one option shall be selected, and the selected area shall be zoned. Area D has been selected and the draft plan has been submitted for public review. The zoning plan for Bergen Airport, Flesland does not assume that the workshop and depot for the LRT shall be located south of the airport (area A).
- Ytrebygda, part of land nos. 33, 34 and 111, Kokstad West and Storrinden. Plan no. 6082 00 00; the planning area includes area IKL11 in the municipal plan. The purpose of planning is to facilitate a new business and industrial area, as well as protect outdoor interests on Storrinden.
- Ytrebygda, land no. 110, title no. 5, Lønningen West (Kvernhusbakken), plan no. 1880 00 00. The draft plan has been submitted for public review. The planning area is located just southwest of the planning area for Bergen Airport, Flesland and is entirely overlapped by the planning area for the workshop and depot for the LRT. The purpose of planning is to develop a new business and industrial area.

7 DESCRIPTION OF THE PLANNING AREA

7.1 Location

Bergen Airport, Flesland lies in the City of Bergen approx. 17 km southwest of the centre of Bergen.



The total planning area totals approximately 1,450 decares (362 acres) and mainly includes the terminal area and part of the airport area.

The zoning plan proposal is based on Avinor's Master Plan for Bergen Airport.

The primary purpose of the zoning plan is to ensure Western Norway a safe, functional, value-creating and efficient main airport for the present and future.

7.2 Delimitation

The planning process aims to rezone current plans, and to regulate new areas east of this to protect the airport's needs.

7.3 Use/status of adjacent land

- In the west the planning area borders the runway at the airport
- In the north and northeast, the planning area borders nature areas located within the airport grounds
- In the east, the planning area borders an agricultural and forestry area at Liland, characterised by scattered farmsteads
- In the south, the planning area borders existing and planned (Kvernhusbakken) business and industrial areas at Lønningen

7.4 Existing buildings

Located at the access zone to the civilian airport are car parks and multi-storey car parks, the terminal itself and a terminal hotel (Clarion Hotel Bergen Airport). Otherwise, the area contains hangars and workshops for helicopters, large aircraft and small aircraft belonging to flying clubs and private parties, and several air cargo carriers, freight forwarders and catering companies have established operations at the airport. A number of building projects have been implemented in accordance with the approved zoning plan.

7.5 Topography/landscape features

Reference is made to Chap. 9.4 Landscape of the impact assessment. Only a short summary is given here.

General

The typical feature for Ytrebygda toward Flesland is the long and highly fragmented shoreline combined with the hilly interior landscape. The landscape experience relates largely to the alternation between open landscape and more enclosed landscape where terrain forms or forests lie close to roads and limit the view.

Located northeast of the airport, Storrinden, 153 meters above sea level, is a key silhouette.

The planning area

Locally, Lilandshaugen serves as an important protective buffer and silhouette line between the open, low landscape at the airport and the cultural landscape of Liland and Blomsterdalen. Lilandshaugen is characterised by a cut to the west towards the airport area, but is otherwise wooded. Kongshaugen, a somewhat smaller hill, lies south of Lilandshaugen.

South of the airport is a small wooded area where Lønningstjern pond is the focal landscape element. The pond is affected by the steep banks of the airport. The woods are dense around the pond and a hiking trail passes by it. A brook, Kvernhusbekken, flows south from the pond. The hiking trail and the stream lead south towards the fjord. Solbakken, a farm characterised by overgrowth, also lies along the hiking trail/stream.

7.6 Sun conditions

The planning area is relatively flat and is therefore sunny. The current terminal shades the current traffic forecourt from the evening sun.

7.7 Vegetation, animal life and other natural conditions

Reference is made to Chapter 9.6 Natural environment and biodiversity of the impact assessment. Here, we give only a brief summary of the current situation:

The following areas with natural features are found within the planning area:

- Lilandshaugen and the area north of this hill: Lilandshaugen is mostly covered by relatively young forest dominated by oak, aspen and birch. There are also some hazel, maple and holly and a scattering of spruce trees. Just north of Lilandshaugen is a small mound of cultivated pastures and some young trees. A deer migration route has been recorded in a north-south direction north of Lilandshaugen and the woodland is part of a larger landscape ecology, especially for deer.
- Lønningen/Liland gardens: The garden surrounding the Lønningen country house and land no. 111/8 contains several old oak, beech and sycamore trees. There are 13 registered oaks with a circumference of over 2 m, and these thus have status as a priority habitat type: hollow oaks. Two red-listed species of lichen have been found on a sycamore in front of Lønningen country house and there is potential for more red-listed species in the area.
- Kongshaugen hill: Vegetation consists mostly of young oak forest with some hazel birch and aspen as well as some large spruce trees. The area east of the mound is characterised as land used for gardening by homes.
- Lønningstjern: A bog pond with several wooded floating islands. The lake has a thin population of trout in good condition and with annual recruitment. The rotifer Keratella paludosa, a zooplankton registered in the pond, is the only known registration in Norway. Registrations of bird fauna at Lønningstjern have been made on several occasions, but major changes in the surroundings have reduced the natural values and made it less attractive for birds.

- Lønningsbekken brook: There are supposed to be small trout in the brook. However, upstream movement of sea trout has not been confirmed.

7.8 Green interests, children and young people

Reference is made to Chapter 9.5. Local environment, outdoor recreation, formative environment of children and young people of the impact assessment. Here, we give only a brief summary of the current situation:

The following areas in or near the planning area are considered to be of particular relevance for the subject:

- A hiking trail along Lønningstjern pond in the south runs south towards the sea
- Lilandshaugen and Kongshaugen. Forested hills that may be in use or have potential for use for hiking or for play.

7.9 Agriculture

Reference is made to Chapter 9.7. Agriculture of the impact assessment. Only a brief summary of the current situation is given here.

The following agricultural areas lie within the planning border for the existing zoning plan:

- A small area toward the petrol station which is defined as cultivated pastures in the soil type map. The area is zoned for green belts in the current plan and thus already reallocated for other purposes
- Lilandshaugen with very high site quality and therefore good suitability for forestry, but not used for the purpose. The area is zoned for green belts in the current plan and thus already reallocated for other purposes
- A small area just east of Kongshaugen defined on the soil type map as cultivated pasture, but which in reality is more gardening land in conjunction with homes. In the municipal plan the area is laid out as a commercial area.
- Just east of the main house on the Lønningen estate is a small ANR area now within the new planning borders. The area consists of several buildings surrounded by forest, but has no value as infield land.

7.10 Cultural heritage values

Reference is made to Chapter 9.8. Cultural monuments and cultural environment in the impact assessment. Only a brief summary of the current situation is given here.

The following cultural heritage values are found within the area:

- Archaeological registrations and findings have been made on an area containing cultural monuments from the pre-modern period. A Middle Ages church is also said to have been in the area according to the report, "Rådal-Flesland light rail route assessments zoning plan, technical feasibility study". It was previously believed that it may have stood on Lilandshaugen or Kongshaugen. No findings of church ruins were made during in the archaeological investigations carried out by Hordaland County Authority in the autumn of 2011.

- Lønningen country house (land no. 110, title no. 1) contains two buildings from the 1700s surrounded by gardens. The main house is a typical midarch house from the Rococo Period and stands today in relatively good condition. The outbuilding is described as an original cottage from the 1700s. This building is in poor condition.
- Two bunkers from the Second World War.

7.11 Road and traffic conditions

Reference is made to Chapter 9.9 in the impact assessment. Only a brief summary of the current situation is given here.

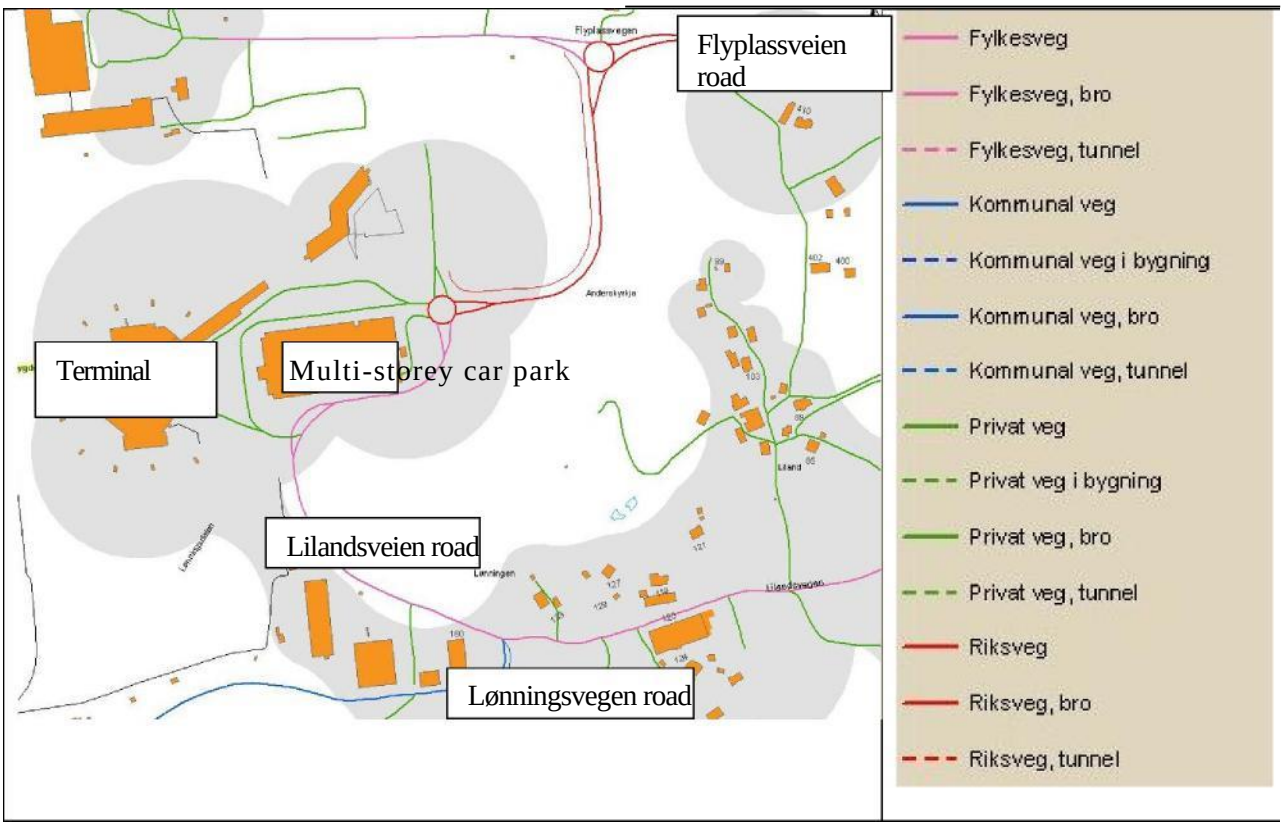
The road system at Flesland consists of rv (state highway) 580 Flyplassveien road, which comes in from the east and proceeds to the roundabout by the Statoil station. Flyplassveien road then continues up to another roundabout in front of the terminal and the multi-storey car park at the forefront of this. According to the National road databank, Flyplassveien road has a yearly average traffic load of 14,000 vehicles per day. The stretch up to the Statoil station has a speed limit of 60 km/h followed by a 50 km/h zone.

The arm of the roundabout to the south is county road 176 Lilandsvegen. The 2 other arms of the roundabout are private internal roads at the airport. One leads north to parking spaces in this area, while the other leads west to the terminal and the multi-storey car park in front of this. Traffic from the multi-storey car park connects back to the same approach road into the roundabout, while the return traffic from the terminal is linked to Lilandsvegen road on the south side of the multi-storey car park. From this point northwards up to said roundabout Lilandsvegen road has a yearly average traffic load of 6,500 vehicles per day.

South of the terminal, Lilandsvegen road has a yearly average traffic load of 3,000 vehicles per day until it meets the municipal Lilandsvegen road by Lønningen industrial park. The traffic on Lilandsvegen road eastward from this point has only a yearly average traffic load of 600 vehicles per day.

The speed limit on Lilandsvegen road and Lønningsveien road is 50 km/h.

All of the aforementioned public roads have two lanes, one in each direction.



From: *www.bergenskart.no*
Legend: Fylkesveg = County road, Fylkesveg, bro = County road, bridge, Fylkesveg, tunnel = County road, tunnel, Kommunal veg = Municipal road, Kommunal veg i bygning = Municipal road in building, Kommunal veg, bro = Municipal road, bridge, Kommunal veg, tunnel = Municipal road, tunnel, Privat veg = Private road, Privat veg i bygning = Private road in building, Privat veg, bro = Private road, bridge, Privat veg, tunnel = Private road, tunnel, Riksveg = State highway, Riksveg, bro = State highway, bridge, Riksveg, tunnel = State highway, tunnel

Along Flyplassveien road, a pedestrian/bike path is currently under construction from Kokstadkrysset junction by the Kokstad business and industrial area in the east, and up to the northern roundabout. A pedestrian/bike path currently runs between the two roundabouts. Further south, a sidewalk runs along Lilandsvegen road up to the exit from the terminal south of the multi-storey car park. There is no separate system for pedestrians or cyclists on the stretch farther south up to the intersection with Lønningsvegen road. However, there is a pedestrian/bike path along Lønningsvegen road.

7.12 Public communications/public transport share

Reference is made to Chapter 9.9 of the impact assessment. Only a brief summary of the current situation is given here:

Two airport express buses and three local bus routes currently (2010) stop at Bergen Airport, Flesland. There is an airport express bus from the centre of Bergen as well as the Mongstad express, which is a bespoke route from Mongstad via Knarvik and Åsane. The local bus routes are route 23 to Loddefjord and Storavatnet and routes 56 and 57 to Nesttun.

In addition, express boats serve:

- Stord - Haugesund - Stavanger
- Austevoll - Sunnhordland
- Austevoll
- Rosendal

7.13 Noise

Reference is made to Chapters 9.10 and 9.11 of the impact assessment. Only a brief summary of the current situation is given here:

The areas around the airport are exposed to air traffic noise. Noise zones are incorporated into the municipal plan. In conjunction with the Master Plan, Avinor has drafted noise calculations according to T-1442 for the different phases outlined by the Master Plan.

A noise analysis for road traffic noise, which also shows the current situation, has been prepared in connection with the planning process. There are homes along Flyplassveien road that are exposed to road traffic noise.

7.14 Water and sewer

Reference is made to a separate water and sewer framework plan, enclosed with the draft plan.

7.15 Energy

The site is located within the licence area for district heating. See also Chapter 9.13 Energy consumption and energy solutions in the impact assessment.

7.16 Private and public services

Air traffic at the airport itself constitutes a service. The terminal also offers restaurants and cafes, kiosks and other businesses. A hotel lies within the planning area.

7.17 Risk and vulnerability

Reference is made to Chapter 9.14 Risk and vulnerability in the impact assessment.

7.18 Private-law obligations

Not relevant

8 DESCRIPTION OF DRAFT PLAN

8.1 Introduction

Need

As stated in Chapter 3, heavy traffic growth is expected at Bergen Airport, Flesland. There is therefore a need to expand the capacity of terminal functions, landside and airside, to meet future needs. The current terminal building has reached its capacity limit and the design of the building also means that it cannot be expanded in a way that provides an acceptable long-term solution.

On this basis, Avinor held a plan and design contest for the expansion of the terminal building at Flesland. Narud Stokke Wiig Arkitekter og Planleggere AS (NSW) won the competition with their design "Vingespenn" (Wingspan). The winning project has formed the basis for the work that has led to the draft plan. The zoning plan is based on a terminal with both an airside (aprons, etc.) and a landside (traffic forecourt with associated parking) that can handle 10 million passengers.

Based on both Avinor's own need for internal functions and commercial assessments, there is a basis and need to locate new commercial buildings on the east side of the terminal, in connection with the traffic forecourt. This part of the development is called Airport City.

North of the current terminal and the hotel is an area with terminals for helicopter traffic, hangars and workshops for helicopters, large aircraft and small aircraft belonging to flying clubs and private parties. Several air cargo carriers, freight forwarders and catering companies have also established operations at the airport. The current zoning plan provides very detailed guidelines for the use of these areas in the plan. Because it provides very little flexibility, there is therefore a desire to adapt the new plan somewhat better so that it only sets the guidelines that are necessary.

The zoning plan does not assume that the workshop and depot for the LRT system will be located south of the airport.

Technical thrust of the plan

The main thrust of the plan is linked to the need for a new terminal/expansion of the terminal. The forthcoming expansion of the terminal will take place in a period when the theoretical capacity is far exceeded. It is therefore of the utmost importance that the measures that are taken cause minimal disturbance to the airport's operation. An operating airport is thus a crucial parameter for the choice of solution. We therefore propose a new terminal with a landside and airside that can be built independently of the current terminal area.

It has been proposed to build the new terminal south-east of the existing terminal and it will not intervene in its structure, or in the road system and parking facility serving the current terminal. The proposed location of the terminal is ideal in relation to the aprons and construction at an airport in full operation. The new terminal consists of a central building, an office part and a pier. In addition, the existing terminal will be linked to the new one. It will be converted for international traffic as well as various operating functions.

An important principle for the road system in the plan is that there should be "terminal-related" one-way traffic in front of the terminal via an upper and a lower traffic forecourt. A terminus for the LRT is planned underneath the lower traffic forecourt.

Since there is only to be terminal-related one-way traffic in front of the new terminal, a new north-south county road must be built east of the airport and the terminal building.

The solution provides good expansion opportunities through extension of the central building, pier and airside. The proposed solution also provides long-term expansion opportunity ("beyond ultimate") beyond a capacity of 10 million passengers per year.

Different locations of the central building were assessed. The location is evaluated relative to aprons, expansion opportunities, access systems and disruption of operations. The choice of solution is based on that it can be implemented with little disruption of ongoing operations, it provides an efficient and flexible terminal solution, it provides short and simple aircraft movements and provides good traffic solutions on the landside for cars, buses and the LRT.

Other elements in the plan are parking and Airport City. In addition to that it is functional to have parking as close as possible to the terminal, such a solution also provides space, light and air in front of the new terminal. A central building like this should have these elements to be noticeable in the landscape. Airport City is proposed as a row of lamellar buildings along the new county road and cut in Lilandshaugen. This will provide a more natural transition between the terminal and traffic forecourt on one side and the county road and Lilandshaugen on the other.

Development in two building stages
Development in accordance with the zoning plan means that east of the terminal much of Lilandshaugen, and the whole of Kongshaugen must be removed. Since it will be difficult to dispose of these masses during the time that is available until the new terminal is completed in 2015/16, development in two stages is proposed. Development Stage 1 will be the construction of a terminal for 7 million passengers. In this situation, the road system may be slightly different than the road system shown in the zoning plan. Reference is made to the illustration plan marked "Development Stage 1". The road system shown in the development plan will be built during Development Stage 2, which involves further expansion of the terminal and/or development of Airport City.

8.2 Zoning purposes

The draft plan has these land use purposes

Buildings and facilities
- Business and industrial activities
- Hotel/accommodation
- Petrol station/road service facility
- Combined building and facility purposes (Industry/business)

Transport facilities and technical infrastructure
- Roads
- Pedestrian and bike path
- Other road ground – green space
- Route for tram/other suburban railway
- Stop/platform
- Other railway ground – technical facility
- Airport
- Airport - Landing/taxiways
- Airport - Terminal building
- Airport – Hangars and administration building

Green structure
- Hiking trail
- Vegetation shield

Use and protection of sea and waterways
- Nature area in sea and waterways

The draft plan otherwise has zones requiring special consideration for unobstructed view, fire and explosion risk and reservation pursuant to the Cultural Heritage Act.

Purpose (smaller areas not included):	***Area (decares)***
Airport hangars/administration building	
LA1	413.1
LA2	3.9
Airport-landing/taxiway LL1	473.2
Airport-terminal building	
LT1	44.5
LT2	28.9
Airport	
LH1	91.9
LH2	10.4
LH3	4.7
LH4	19.4
Petrol station/road service facility BS1	6.7
Business and industrial activities N1	12.1
Hotel/accommodation H1	13.4
Combined buildings and facilities 1 Industry/business	4.5
Combined buildings and facilities 2 Industry/business	5.8
Combined buildings and facilities 3 Industry/business	6.0
Total combined land including road land and other road ground	1150

8.3 Buildings

The following new buildings are planned in the planning area:

- New terminal. This building will lie within the area shown with the purpose "Transport facilities and infrastructure- Airport- terminal building"
- Traffic system (ramps) and parking facility. These will lie within the area shown with the purpose "Transport facility and infrastructure" - Airport
- New commercial complex: Airport City. These will lie within the area zoned for "Buildings and facilities – Combined purpose industry/business" and Buildings and facilities- Business activities.
- Expansion of existing hotel. This will lie within the area zoned for the purpose "Buildings and facilities- hotel/accommodation".
- New building in the area north in the plan, cf. the area zoned for "Transport facilities and infrastructure, Airport- hangars-administration building".

In addition, the current petrol station is zoned, but no concrete expansion plans are known.

"Transport facility and infrastructure- Airport- terminal building"
It is assumed that the existing terminal will remain standing as today and is therefore zoned with the current contour line height.

The new terminal is located south-east of the existing facility. The new terminal consists of:

- A pier with gates (arrivals and departures) and dining/food service and retail areas. There will be a bridge connection here and culvert connection with the existing terminal.
- Two office blocks

- A central building with a departures hall on the upper level and arrivals hall on the lower level

New terminal, section perspective west- east, from outline project
Existing terminal Passenger bridges Pier Office block Arrivals hall, level D Departures hall, level F
Light Rail Transit (LRT) system Traffic forecourt

The new terminal is planned with a contour line height of 72, i.e. approx. 20 metres above the current ground level.

Since the existing and new terminals will cover most of the land set aside for the purpose "Transport facilities and infrastructure- Airport- terminal building", the built area ratio is set at 100%.

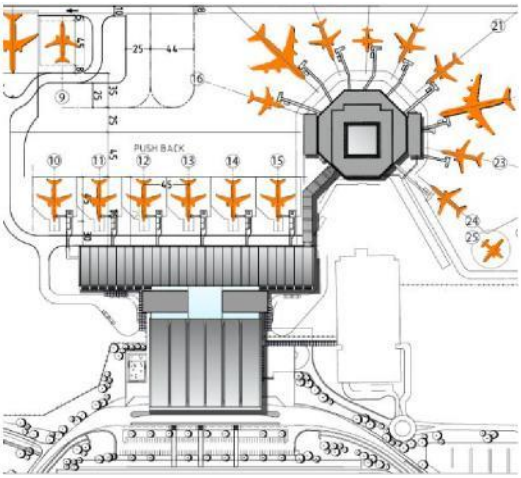
Approximate available area for the terminal area at full development will be:

- New terminal approx. 78 000 m^2
- Satellite/Current terminal: 22 000 m^2
- Total: 100 000 m^2

Development Stage 1 will provide a capacity at the terminal of 7 million passengers per year (MPPA), Development Stage 2 (full development according to the zoning plan) will provide a capacity at the terminal of 10 MPPA.

The terminal can also be expanded more gradually with several building stages, but for the sake of simplicity we differentiate in the zoning plan only between Development Stage 1; 7 MPPA, and Development Stage 2; 10 MPPA.

In Development Stage 1, a relatively compact facility with a short pier will be built. In Development Stage 2 the pier will be extended southward. The central building will also be expanded somewhat.



Illustration, Development Stage 1: 7 MPPA

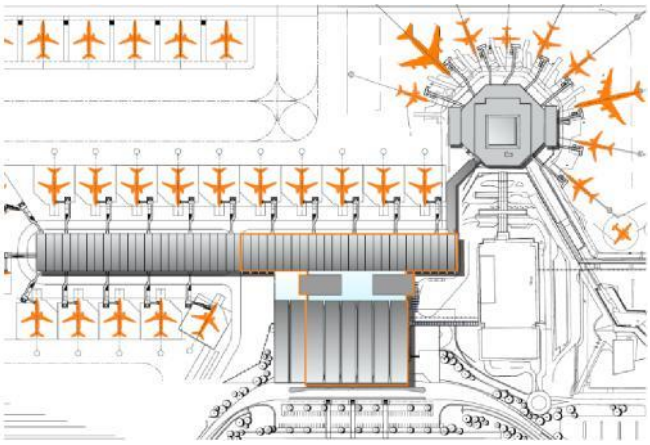


Illustration principle, Development Stage 2: 10 MPPA

To further improve capacity, the existing terminal and multi-storey car park could also be demolished and the pier could be extended northwards. However, because this is so far into the future, and such an uncertain solution, this solution is not zoned at this time.

The illustrations in this chapter are taken from NSW's outline project. The further description of aesthetics is based on these illustrations even though the zoning plan itself (plan and provisions) does not tie up all these aspects. This is to emphasise that the aesthetic considerations will be safeguarded in the implementation of the plan.

New terminal, elevation toward east facade- building stage 1

Reference is made to the illustration plans that follow the draft plan. The facades follow a principle of openness towards east and west. Presented to the east is the landside and characteristic rolling Western Norway landscape. Presented to the west is the airside, skerries and the sea beyond. This is compatible with the passengers' main movement from landside to airside at departure and in the opposite direction on arrival. Simplicity and overview are thus created while the target for the passengers' movement is clear.

New terminal, Upper traffic forecourt

The east facade of the main building is the terminal's show window towards the landside. This is where passengers leaving on airplanes will meet the terminal. The facade and access zone will be protected by the central building's large cantilevered roof. This creates a common protected access zone over several levels with the light rail station as the "bottom of the valley". A glass facade slanted like a "hillside" is planned to tie together all of the levels of the arrivals zone. The facade will be inviting and highlight the functions of the main building for departing passengers. Arriving passengers will be presented with a beautiful landscape, unique to the area and Bergen, changing weather and seasons. The facade will capture a large amount of light while providing an overview and orientation. The transparency and visibility will help passengers make the choices they have to make. The pier's west and east facades shall have the same openness and function. The gable walls in the main building will primarily be solid - to direct passengers to the light. Lighting that follows the lines of the main beams is planned at the top of the gables. The outer main beam toward the gable in the north and south is to function as sun shading and spread diffuse daylight into the check-in hall. The middle part of the pier's west facade comprises the central building's delimitation toward aircraft and aprons. This facade is thus the aim of the departing passengers' movement toward the gates and will be kept open with a lot of glass. The view to the west with islands, islets and reefs and the sea in the background will then be preserved.

The pier is planned with a "back" to the east and openness towards the west. The west facade is therefore treated somewhat differently than the east facade. The pier's facade to the north and south should follow the same principles as for the central building with solid end walls with openings for views down to the departure level. The goal is to create a highly functional solution that satisfies travellers, airlines and the airport operator while developing architecture of the highest class.

"Transport facilities and infrastructure" - Airport

Area LH1 will include a traffic system (including ramps) garage facility and LRT stop. A prerequisite is the establishment of a traffic forecourt in front of the new terminal with one-way access roads on two levels where the upper level (ramp) leads up to the departures hall and the lower level leads to the arrivals hall. Traffic is led in from the north and out of the south. Parking will be possible in conjunction with the traffic forecourt, cf. illustration plan. The LRT will have its stop under this system.

Area LH2 is the existing multi-storey car park east of the existing terminal. An option to increase from + 58 metres above sea level to + 65 metres above sea level has been continued from the current zoning plan.

Area LH3 provides for the construction of a new multi-storey car park up to + 57 metres above sea level.

LH4 provides for offices, warehouse/cargo and/or ground parking/garage. Avinor needs both parking and spaces for storage/cargo as existing spaces for such use will no longer be available after the expansion of the terminal. Avinor wants flexibility in the plan as there are different needs at different times and several possible purposes in the area are envisioned. For the area, the maximum built area ratio for parking at and below ground level is 100%. A building could cover a maximum of 70% of the area (built area ratio 70%) as it is considered that a single building aesthetically should not cover the entire surface. For aesthetic reasons, a building limit has also been included that ensures that a possible building remains in the north-south direction in the same way as "Airport City". The building limit also ensures that one does not get too close to the planned road system. The building height is set at + 65 metres above sea level, which is the same height permitted in area LH2 and slightly lower than the hotel.

For the number of parking spaces in the LH areas, see the subject “parking”.

Transport facilities and infrastructure- Airport- Hangars/administration building
Minor changes to current zoning are proposed in this area. In the current zoning plan, the area is divided into many small areas. In the present proposal these will be combined to only two areas. In reality, however, this means few changes. Utilisation degree and building heights are about the same as before.

For LA 1 the maximum building height, measured in meters above sea level, is + 70, maximum land utilisation, measured as the built area ratio of the field (BYA) is 40%.

LA 2 shall be used for the control tower. The maximum building height, measured in metres above sea level is +100. Maximum plot utilisation measured in built area ratio of the field (BYA) is 50%.

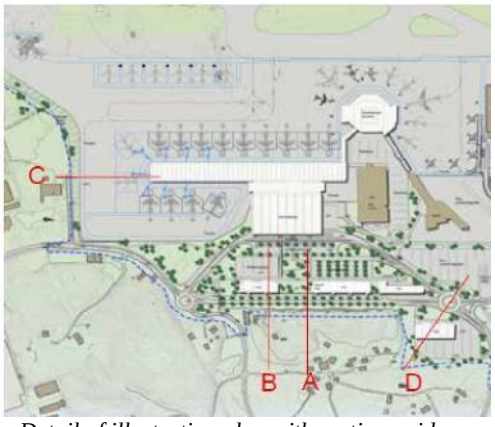
Continuous development of the airport is taking place in these areas.

Buildings and facilities – Combined purpose industry/ business (Airport City)
Airport City is proposed as an area of mixed commercial purposes: industrial, office, hotel, business, services. The buildings are proposed as lamellar buildings along the road network and rock cut in Lilandshaugen. The buildings are envisioned as a shield against the county road and will provide a more natural finish to the landscape.

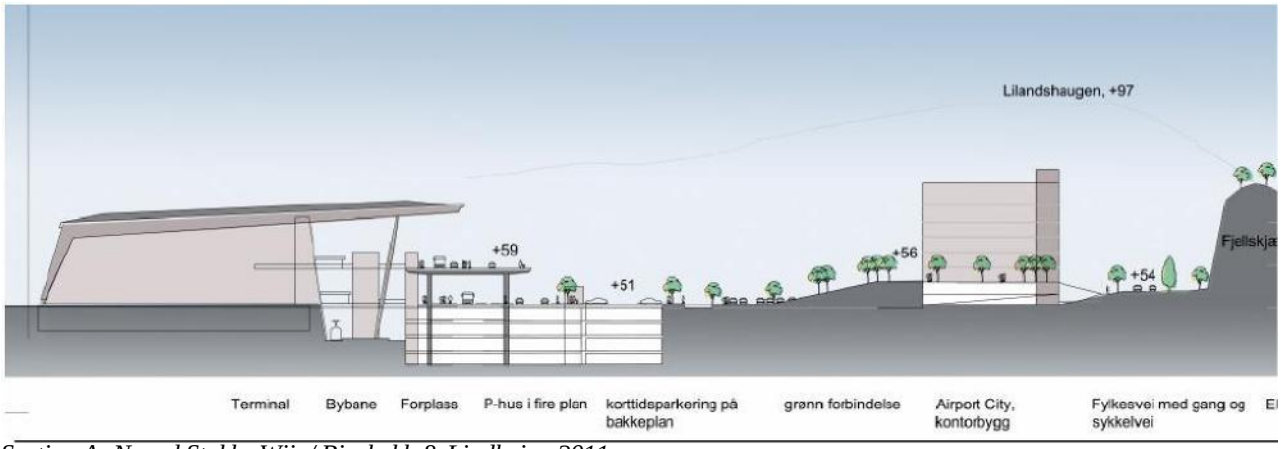
The zoning plans permits the construction of 2 levels of parking above ground level, with a common "green lid" over a base that binds the building masses together. The lid ensures safe passage between and around buildings, while creating good outdoor spaces and opportunity for lush gardens between the buildings with access to the commercial areas.

A direct bridge connection can be established between Airport City and into the upper level of traffic and departures hall. It will be possible from the arrivals level and lower traffic forecourt to establish a green passage or small park that ends in a central position between the buildings in Airport City. With the other communications axes this will visually tie the whole facility together with the terminal building.

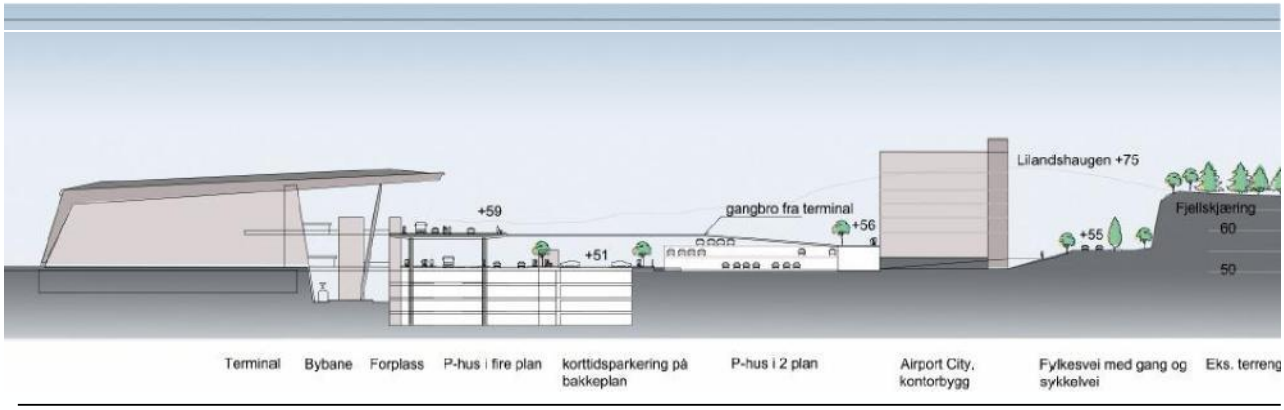
The buildings shall be built with their back against the rock wall with technology and cores, but an openness towards the terminal area and traffic forecourt. The buildings' height variations and the distance between them should be capitalised on so that Airport City is not perceived as a new wall but a more natural transition in the landscape around Lilandshaugen. Provisions have therefore been made to ensure this.



Detail of illustration plan with section guide, Narud Stokke Wiig/ Bjørbekk & Lindheim, 2011



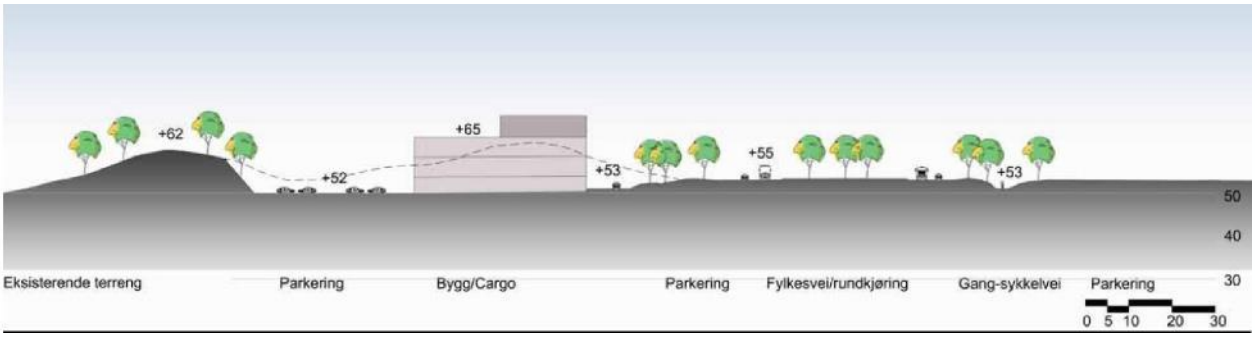
Section A; Narud Stokke Wiig/ Bjørbekk & Lindheim, 2011



Section B; Narud Stokke Wiig/ Bjørbekk & Lindheim, 2011

Buildings and facilities – Business activities

This is an area that is primarily intended for businesses such as cargo or the like requiring more space. This is a general need at the airport, but a special need arises because the expansion of the terminal means the buildings currently used for cargo must be removed. The area can also be used for parking.



Section D; Narud Stokke Wiig/ Bjørbekk & Lindheim, 2011

For N1 the following applies:

- Maximum building height is + 65 metres above sea level
- Maximum available area is 3000 m^2.
- Parking on and below ground level will be permitted throughout the field up to + 53 metres above sea level.

Buildings and facilities- Hotel/accommodation

Maximum building height, measured in metres above sea level, + 70. Maximum plot exploitation ratio, measured in built area ratio of the field (BYA) is 100%.

The field size and exploitation ratio is the same as in the current plan, the building height is lowered somewhat.

There are specific plans to expand the hotel by approx. 100 rooms.

Buildings and facilities- petrol station/road service facilities
The area is shown as in the applicable zoning plan with some minor adjustments of the delimitation. The utilisation ratio and building height are as previously; built area ratio max. 40% and maximum contour line height 60 m.

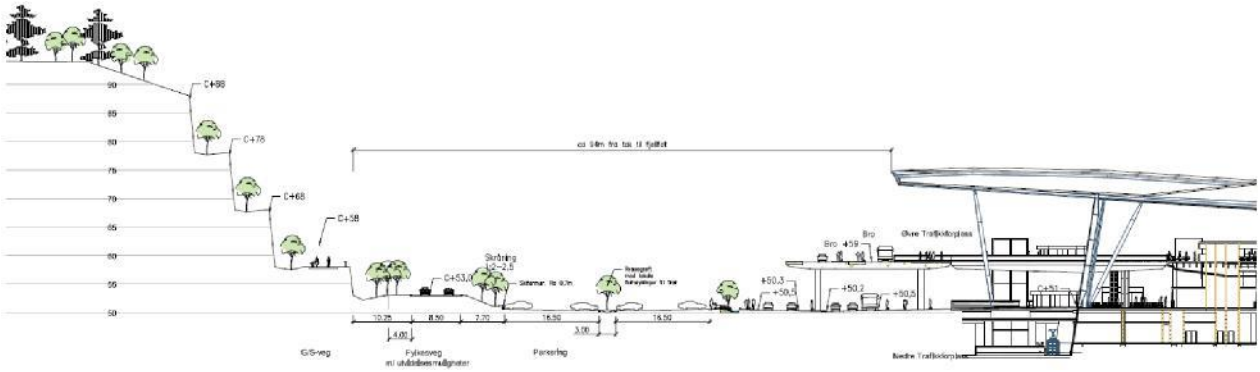
8.4 Green areas/Green considerations

Inside the airport area
The green areas inside the airport area are not detail zoned in the plan as this provides little flexibility in implementation. The intention for the airport area, however, is to create a park-like landscape between the terminal and the rock cut in Lilandshaugen where road system, car parks and "Airport City" are integrated. The lateral terrain to the access roads will be rounded off, seeded with grass and planted with trees in groups. Pedestrian and bike paths will be built throughout the area that will be connected with the system outside. Rows of trees will be the main constituent of the green structure along the passageway and the car parks between the terminal and Airport City.

Pedestrian/bike path system
Both inside and outside the airport area, emphasis is placed on creating a continuous pedestrian/bike path system, where one, from the system along Flyplassveien road in the north, may choose to either walk or bike along the new county road (public system) or via the airport grounds. In the south, one can connect to the existing pedestrian/bike path system along Lønningsveien road or choose to follow the zoned hiking trail to the sea (Slettepollen). See more about the pedestrian/bike path system in Chapter 8.6.

Green structure- Vegetation shield
An area has been set aside for the "Vegetation shield" on the upper edge, i.e. east of the cut in Lilandshaugen, Cf. the provisions, new vegetation shall be planted here to re-establish the silhouette. The vegetation shall be natural, i.e. not park-like.

The illustration below shows a preliminary sketch of the possible design of the cutting of Lilandshaugen in Development Stage 1. The sketch shows that the terrain can be terraced so that vegetation can be planted on each level. Such terracing also provides the slope with better stability. In principle, it will also be possible to design the cut in a similar manner in Development Stage 2.

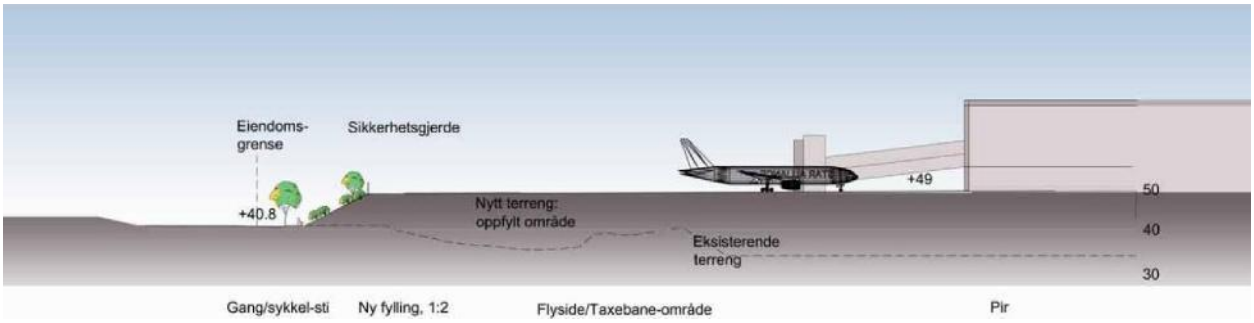


Section that shows cut, new county road (or rv - state highway if applicable) and new terminal.

An area for a vegetation shield has also been set aside east of the area for business activities (N1). According to the provisions, mounds are to be established and planted here to provide shielding between the cultural landscape at Liland and the new development.

The demarcation of the areas zoned for this purpose is based on the need to include sufficient space for vegetation shielding, to include all of the areas zoned in the current zoning plan and concurrently limit entering the municipal plan's ANR area as much as possible. The border is therefore somewhat "jagged".

Green structure hiking trail
The existing hiking trail from Lønningen to the sea (Slettepollen) is zoned where it lies on the border to the airport grounds. In the plan, the hiking trail is somewhat altered as a result of infilling of Lønningstjern and expansion of the airport grounds. However, only a minor adjustment has been made. An embankment will run along the north side of the trail up to the security fence at the airport. This is to be planted, cf. the provisions.



Section C; Narud Stokke Wiig/ Bjørbekk & Lindheim, 2011

Other road land
Spaces for "other road land" are set aside along the public road system. These areas will be seeded and planted.

8.5 Parking/garage(s)

The air terminal
The air terminal's parking need at full development (Development Stage 2) is limited to 9,000 spaces. This is set as a maximum limit in the zoning plan. For the reasons for the parking coverage, see Chapter 9.9 of the impact assessment.

Within the airport grounds there are currently 4,260 parking spaces that are used by the public and employees working at the air terminal.

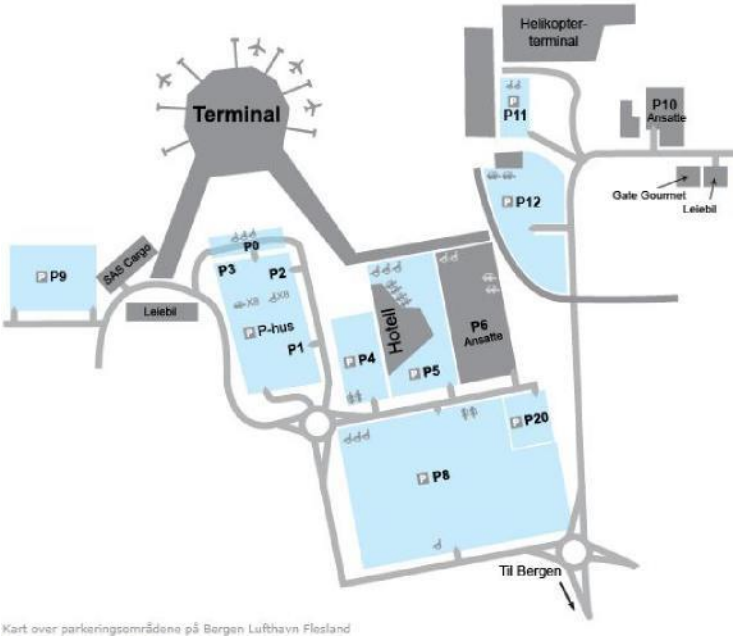
Some parking spaces will be eliminated due to the expansion:

- Reduction P8/ P20 -300
- P9 -600

TOTAL reduction: -900

After the expansion, 3,360 of the current spaces will therefore remain.

There is therefore a need to create 5,640 *new* spaces to cover the need in the zoning plan.



Kart over parkeringsområdene på Bergen Lufthavn Flesland

This can be resolved in the following ways:

- Skjenavatn: A. 1,900 spaces (applied for now)
- Traffic forecourt in front of new terminal: A. 245 spaces
- Expansion of current multi-storey car park by two new levels: A. 700 additional spaces
- New multi-storey car park in LH3 area on zoning plan: A. 1,200 spaces
- New multi-storey car park in LH4 area on zoning plan: A. 1,500 spaces
- Underneath Airport City: A. 1,100 spaces**
- Area N1 A. 300 spaces

** Requires then 6 levels with 250 spaces on each, but approx. 400 parking spaces should not be counted since they are to cover Airport City's own needs.*

This amounts to more than the need, but this is because Avinor wants flexibility within its areas. Some of the areas can be used for other purposes. Building parking garages underground is very expensive so it is uncertain whether it will be possible to realise this.

Other areas

The other areas in the plan: the hotel, petrol station, airport area for hangars/administration building and "Airport City" contain activities covered by the municipality's ordinary parking provisions. For these areas, we assume coverage stated in the notes from the mediation between the County Governor of Hordaland and the City of Bergen concerning the land-use part of the municipal plan on 12 September 2011.

Hangars are in principle storage for aircraft and we believe that the parking provisions for storage buildings should be used for this type of building.

8.6 Traffic area

As mentioned in the introduction, Avinor believes it is necessary to expand the road system in two stages. The text below describes the traffic system as shown in the zoning plan. The road system for Development Stage 1 is described under Section 8.10 Provisions for consecutive ordering.

Roads

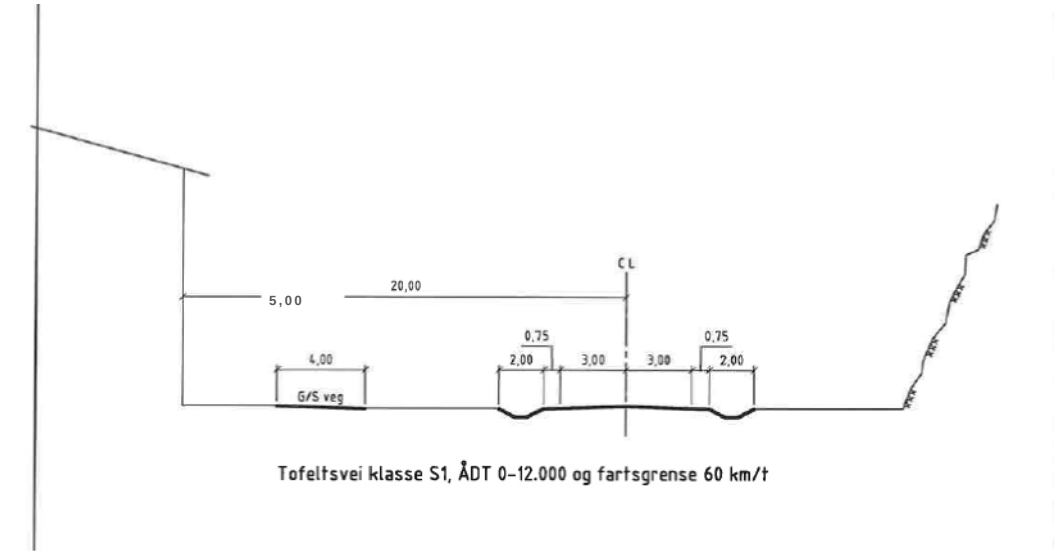
The starting point for the proposed road system shown in the zoning plan is the airport's need for a separate internal road system. Only "terminal-related" traffic will drive in towards the terminal via an upper and a lower traffic forecourt (see illustration plan and Chapter 8.2). The system is one-way from north to south.

The internal road system is included in the airport purpose on the zoning plan and is therefore not detail zoned.

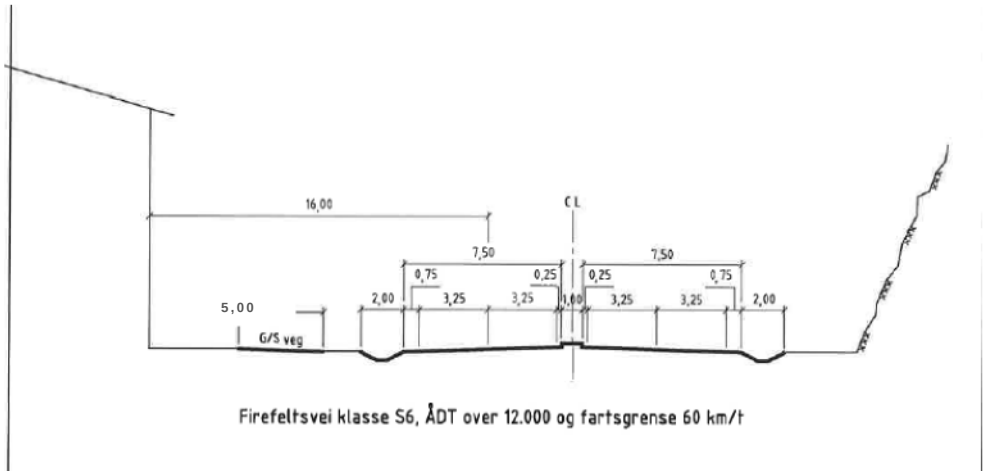
The internal system is connected to the public road system at two roundabouts:

- one to the north by Flyplassveien road
- one to the south by Lønningsveien road/Lilandsvegen road.

Since the traffic inside the airport will be internal traffic a new public system must be established outside the airport. A public road is therefore zoned between the two roundabouts. The roadway between the two roundabouts is two-way. The road is zoned as a four-lane road (S6 road in NPRA's 017 road standard), but because of the expected traffic volumes as a result of airport expansion, only a consecutive ordering provision is related to the development of a two-lane road (an S1 road in NPRA's 017 road standards).



Tofeltsvei klasse S1, ÅDT 0–12.000 og fartsgrense 60 km/t



Firefeltsvei klasse S6, ÅDT over 12.000 og fartsgrense 60 km/t

Two-lane road class S1, yearly average traffic load 0-12,000 per day and speed limit 60 km/h
Four-lane road class S6, yearly average traffic load 0-12,000 per day and speed limit 60 km/h

The north roundabout has four arms:
- one arm towards Flyplassveien road in the east
- one arm toward the northwest. Cf. the illustration plan this arm will lead to the area for hangars and the administration building, to the hotel and to parking areas. This road arm will also provide access to the petrol station.
- one arm to the southwest. Cf. the illustration plan, this leads to the terminal building, to parking areas and to the new commercial "Airport City" complex
- one arm to the south to the new two-lane county road along the Lilandshaugen cut.

The south roundabout also has four arms:
- one arm with exit from the terminal area
- one arm north to the new two-lane road along the Lilandshaugen cut
- one arm toward Lilandsvegen road to the east
- one arm toward a slightly rerouted Lønningsvegen road toward the south.

Kongshaugen will be blasted away as a result of the land needed for the facility.

For the capacity of the system see Chapter 9.9 of the impact assessment.

Pedestrian/bike paths
The pedestrian/bike path system that is being built north of Flyplassveien road, will be connected to:
- an internal system at the airport
- an external system that follows a new county road.

In the south both systems will be reconnected before they are connected to the existing pedestrian/bike path along Lønningsvegen road. The pedestrian/bike path is 5 m wide so that there is room for both a bike lane and sidewalk. The exception is the pedestrian/bike path along Lønningsvegen road. This is shown as 3 metres in width. This is in line with the width of the pedestrian/bike path that currently follows Lønningsvegen road.

Along Lilandsveien road a sidewalk of 2.5 m is shown. This is in line with recommendations for an S2-road in the 017 road standard. The sidewalk will be connected to said pedestrian/bike path system by building a bridge over the main road that runs between the two roundabouts.

The pedestrian/bike path systems are designed according to the principles of universal design.

Public transport solution
The route for the LRT will be laid in a tunnel up to the terminal building. The station will be located underground between the traffic forecourt and the east facade of the central building with good vertical connections up to the departures and arrivals levels. This is in line with the proposed zoning plan for the LRT, which has been submitted for public review. Several meetings have been held to coordinate the two planning processes.

The development of the LRT will be coordinated with the development of the terminal with the intention of opening them simultaneously.

On the traffic forecourt in front of the main building, cf. the illustration plan, there will be two lanes at each level; the outer lane for private cars and the innermost for buses and taxis. The traffic forecourt, which will be 170-180 m long according to the plans, will be designed to receive a sufficient number of taxis and buses for 10 million passengers. There is room for up to eight buses on each level. In comparison, Gardermoen Airport has a somewhat longer forecourt, 190 m, and serves 17 to 18 million passengers, albeit with a slightly lower taxi percentage than would be expected at Bergen Airport, but with about the same bus percentage.

In addition, a separate area for a bus and taxi depot is planned.

8.7 Noise measures

Cf. the zoning provision, a consecutive ordering requirement is set for noise protection of the facades of the homes closest to the new road system. See otherwise Chapter 9.10 of the impact assessment.

8.8 Waste management/recycling station

Separate areas have not been set aside for waste management/a recycling station. This is handled internally in the airport's area.

8.9 Risk and vulnerability

Reference is made to Chapter 9.14 of the impact assessment.

8.10 Provisions for consecutive ordering

Cf. the zoning provision, provisions for consecutive ordering have been incorporated related to:

- Development of the road system:
    - During implementation of Development Stage 1, i.e. a new terminal with an available area of 70,000 m2, the public road system shown on the illustration plan marked "Development Stage 1", will be carried out before new buildings can be put into service. This applies to both roads and pedestrian/bike paths.
    - During further expansion of the terminal and building of Airport City, the public road system shown in the zoning plan, i.e. both roads and pedestrian/bike paths, will be completed before the buildings can be put into service. However, two lanes between the two roundabouts are sufficient.
- Relocation of the Lønningen country house estate. No intervention in Lilandshaugen can take place before such relocation has been carried out or implementation has been ensured. See more about this in Chapter 9.8.
- Rockfall protection of cutting toward Lilandshaugen/Kongshaugen before a start-up permit can be granted for buildings near the cut
- Water/sewer framework plan and detail plan for handling clean and contaminated surface water. Approved water/sewer framework plan for the area must exist before new measures can be approved within the planning area.
- Hiking trail: The hiking trail in the south shall be established and gravelled and the vegetation shield towards the airport (VS3) shall be planted, before a new airport fence on the land use boundary can be put in place.
- Noise shielding along new road system, cf. above.

About Development Stage 1

The road system for Development Stage 1 is based on the same principles as the finally zoned system with terminal-directed traffic in the north-south direction on two levels (to departures hall and arrivals hall), and an independent public system east of the terminal with traffic in both directions. However, instead of building a new roundabout in the north, this solution is based on the use of the existing roundabout here. Furthermore, a new road will be built to the south that will be connected to the current Lønningsvegen road. Lilandsvegen road to the east will be lowered somewhat in the terrain and linked to the new road in a T-intersection. The exit from the terminal will be connected to Lønningsvegen road in a new T-intersection about 170 metres south of the terminal.

From Lønningsvegen road there will also be an entrance to Cargo and the parking area south of the terminal.

The hotel and the current multi-storey car park will have access from the northern roundabout via the approach road that runs directly to the west. This will also, as today, provide access to the hangars/administration building areas to the north. Like today, the petrol station will have a separate exit to the roundabout to the north.

With respect to the pedestrian/bike path system, the public system means that the existing pedestrian/bike path will be channelled into the pedestrian crossing across Flyplassvegen road and south along the east side of the new county road, where it will connect with the existing pedestrian and bike path by Kongshaugen. The pedestrian and bike path will be laid on the first ledge of the rock cut approx. 6 m

higher than the county road.

With respect to the pedestrian/bike path system up to the terminal, the route for this is not locked in the development plan, but the illustration plan for Development Stage 1 shows how this can be routed in a good way (see this). The zoning provision requires that there must be a functional pedestrian/bike path system right up to the terminal.

The new pedestrian and bike paths will be built with a width of 5 metres divided into a 3 m bicycle lane and 2 m sidewalk.

8.11 Universal design

The provisions state that the planning area must place particular emphasis on universal design.

Universal design is based on the following principles:

- Equitable use
- Flexible use
- Simple and intuitive orientation
- Understandable information
- Tolerance for error
- Low physical effort
- Sufficient size
- Space for access and use

The outline project for the new terminal building specifies that there shall be special emphasis on universal design. A special group comprised of the City of Bergen, Avinor, representatives from disability organisations and planners will be established to monitor engineering and universal design in the terminal. It will work specifically on:

- Passenger bridges: special emphasis on gradients
- Lifts: lifts by all steps. The lifts will be spacious and equipped with tactile signs, voice alarm and according to the recent recommendations for universal design
- HC toilet: visible, spacious and with recommended accessories in connection with all toilet cores
- Resting and quiet rooms
- Guide lines and stair markings
- Light, contrasting colours and acoustics: optimised for all user groups
- Acoustics: reverberation, background noise, speech intelligibility

8.12 Mass handling

Since the planning proposal means that parts of Lilandshaugen and the whole of Kongshaugen must be removed, these masses must be handled.

With Development Stage 1 there will be approximately 1 million m3 of solid mass. Approximately half of this mass will be put in Lønningstjern. The other half will be used in part to fill up Skjenavannet, while the rest of the mass will be used to build noise barriers on the west side of the rail system, i.e. there will be virtual mass balance in Development Stage 1.

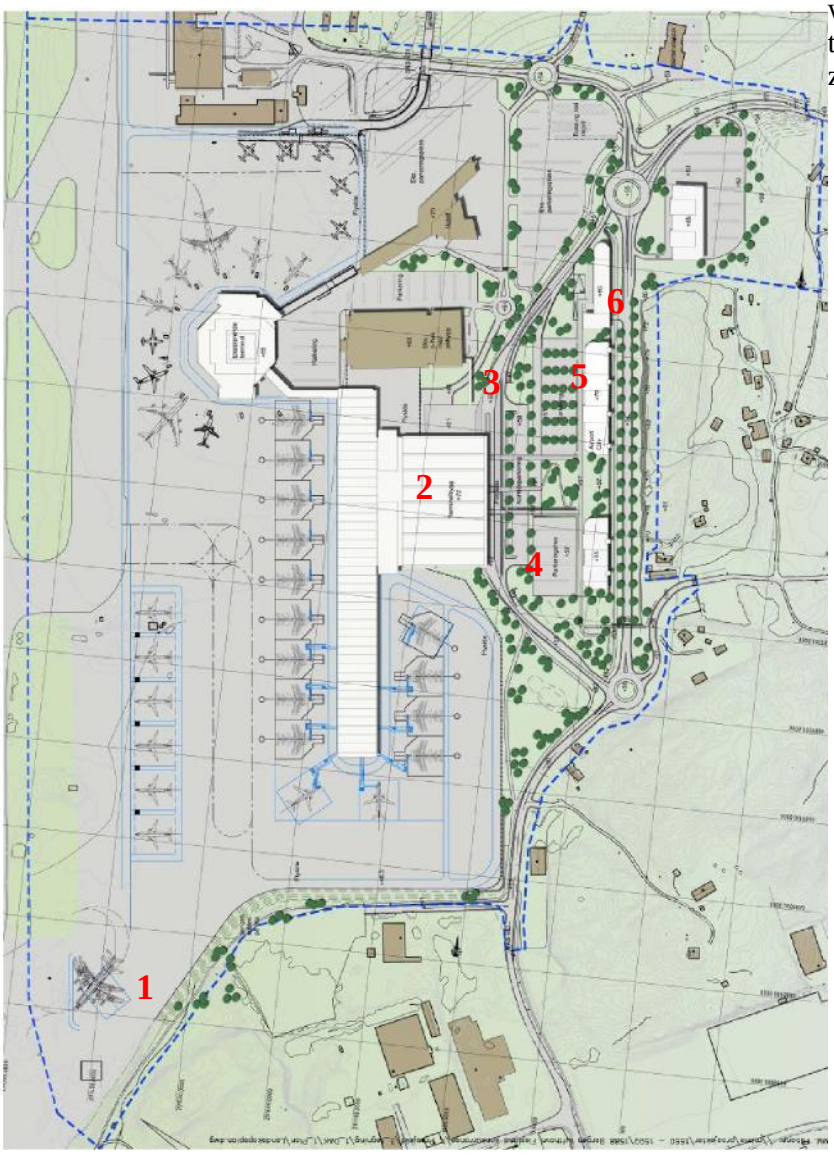
Development Stage 2 will likely total around 800,000 m3 of mass. This development stage is further into the future and how this mass is to be handled has therefore not been planned in detail. What is known is that there will be room for this mass in connection with development under the Master Plan, i.e. in the area the Master Plan covers. This whole area is not zoned at present. The alternative would be to haul the mass out of the area. Although we are aware today that the Bergen area has a surplus of mass, this may change in the time leading up to the start-up of Development Stage 2.

9 REPORTS IN ACCORDANCE WITH THE REGULATIONS RELATING TO IMPACT ASSESSMENTS

9.1 Delimitation of impact assessment

The impact assessment examined the impact of the zoning plan, i.e. full development according to the plan (Development Stage 2). Development Stage 1 is not referred to here as a rule. The exception applies to the subject of parking. Topics that are considered important for the environment and society are examined. The assessments are based on decision-relevant information based on existing and new knowledge. Obtaining new knowledge is limited to the issues and topics that are relevant for consideration of the zoning plan.

Regarding the relationship with the current zoning plan, the impact assessment only deals with the changes that the new plan represents in relation to this. Conditions that the applicable zoning plan allows, but have not been implemented, are therefore not a subject for the report. The area for the impact assessment will therefore be the same as the illustration planning area and will not deal with the area to the north (hangar and administration area) as no changes will take place here in respect of the current zoning plan. Nor are the consequences of the expansion of the hotel and expansion of existing multi-storey car parks emphasised within the illustration plan area as these are measures that the current zoning plan permits.



New measures permitted by the zoning plan, and that are topics for the impact assessment:

1. Expansion of runway/ apron area to the south and east.
2. New terminal
3. New traffic system within the airport (only for airport traffic)
4. Parking in multi-storey car park, below and at ground level
5. New business and industrial area in east “Airport city” approx. 35 000 m2 available area.
6. New main road system outside the airport

For further description, see Description of the plan, Chap. 8.

Figure: Overview of measures to be impact assessed

The measure will cause the following changes to the current terrain:

- Lønningstjern pond must be filled in to make room for the expansion of aprons, cf. measure 1
- Lilandshaugen hill must be blasted back (eastward) approx. 300 metres to make room for measures 2, 3, 4, 5 and 6

9.2 Subject of the report

According to the planning programme, the following subjects shall be impact assessed

- Landscape
- Local environment, outdoor recreation, formative environment of children and young people
- Natural environment and biodiversity
- Agriculture
- Cultural monuments and cultural environment
- Ground pollution/run-off
- Energy consumption and energy solutions
- Traffic (vehicle, rail, pedestrian/bike)
- Noise
- ROS analysis

9.3 Methodology

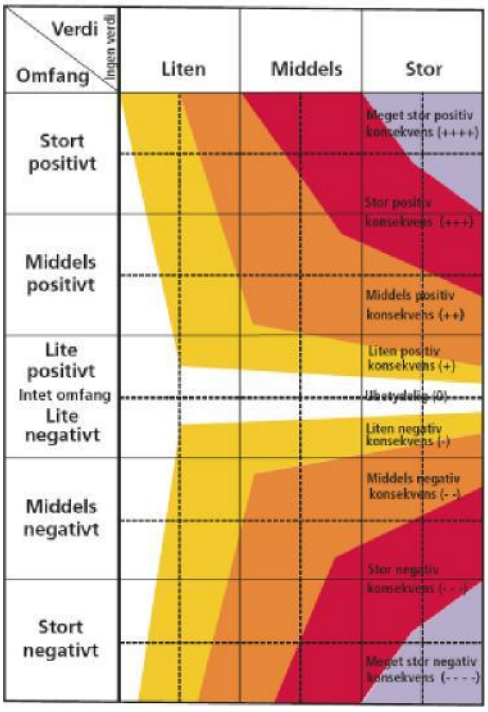
For the value subjects:

- Landscape
- Local environment, outdoor recreation, formative environment of children and young people
- Natural environment and biodiversity
- Agriculture
- Cultural monuments and cultural environment

Norwegian Public Road Administration (NPRA) Manual 140, Environmental Impact Analyses, is used to assess the impact of proposed measures. The methodology is somewhat simplified and consists of determining the planning area's value for each subject, the scale (degree of intervention) and the impact of the measure. The impacts emerge as the ratio of the area's values and scope of the proposed measures, see the impact fan to the right. For each subject, the manual has guidelines for how to determine the value and how the scope shall be established.

In the present impact assessment, the methodology is largely used as described in the manual for all value subjects except landscape. For these subjects, a value and a scope are given in accordance with the scale and then an impact using the impact fan to the right. For the landscape subject, a value is given, but the scope and impact are more "verbally" described without using the impact fan to the right. The guidelines the manual recommends are nonetheless used in the "verbal" presentation.

Other methods are used for other subjects. The methods that are used are described under the relevant topics. Finally, the impact assessment gives an overall assessment of the impacts.



Impact fan from Norwegian Public Roads Administration Manual 140, Impact Assessments. See translation on page 45.

9.4 Landscape

9.4.1 Introduction

The main issue in the planning programme is described as follows:
Levelling Lilandshaugen will result in a change of the landscape in the area. Today, the airport lies relatively sheltered behind the hill. Removing the hill will open up and make the airport more visible. The infilling of Lønningstjern will result in changes of the landscape, albeit more locally. A hiking trail runs along the south side of the pond, which has aesthetic value for the hikers on the trail. The new terminal area will provide new built-up elements in the landscape that will affect the landscape situation.

The planning programme further describes that an alternative assessment (the medium, high and 0 alternative) is to be made in relation to the development at the eastern end of the planning area by Lilandshaugen. This was included as a result of decisions in connection with adoption of the planning programme by the city government on 23 June 2011.

A separate report "Impact Assessment for Landscape Bergen Airport, Flesland" prepared by Bjørbekk and Lindheim landscape architects is enclosed with the draft plan. This contains a general description of the landscape in and around Bergen Airport, a valuation of the landscape and a scope and impact assessment of the selected proposal. The impact assessment below provides a summary of the report, but also provides a simple impact assessment of the rejected alternatives: the 0 alternative and the "medium" alternative.

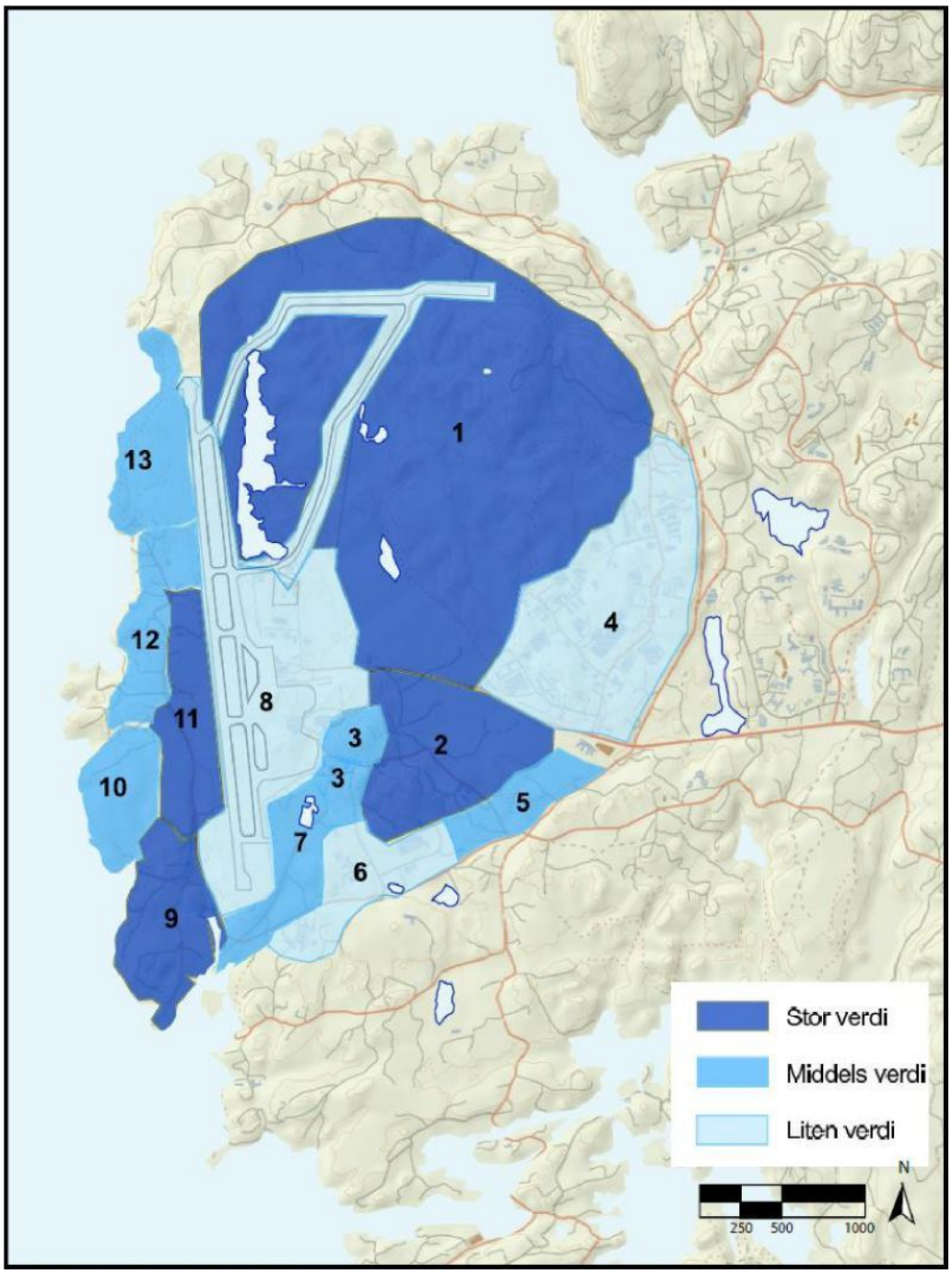
9.4.2 General about the landscape

The typical feature of Ytrebygda towards Flesland is the long and highly fragmented shoreline combined with the hilly interior landscape. The landscape experience largely relates to the alternation between open cultural landscape and more enclosed landscape where terrain forms or forests lie close to the roads and limit the view. Storrinden, 153 meters above sea level, lies northeast of the airport, and is an important silhouette to the northeast, and here there is a magnificent view of the entire airport, Raunefjorden and Sotra.

Locally, the wooded Lilandshaugen between the airport and Liland are important as a shielding buffer and silhouette line between the open, low landscape at Flesland and the cultural landscape at Liland and in Blomsterdalen valley. South of the airport is a small wooded area with Lønningstjern pond and Solbakken farm. The pond is affected by steep banks from the nearby airport.

9.4.3 Value assessment and vulnerability

An analysis area 3-4 km from the measure is defined in the impact assessment. This area is divided into 13 sub-areas on the basis that they have different landscape features: Within the area are forest areas, agricultural areas, business and industrial areas, residential areas and the airport area. The 13 areas are then assigned a valuation, see next page:



Stor verdi = High value Middels verdi = Medium value Liten verdi = Low value Translation of impact fan from page 43 → 	Scope	Value	Low	Medium	High
	High positive				Very high positive impact (++++) High positive
	Medium positive				impact (+++) Medium positive
	Low positive No scope Low negative				impact (++) Low positive impact (+) Insignificant (0) Low negative impact (-) Medium
	Medium negative				negative impact (- -) High negative
	High negative				impact (- - -) Very high negative impact (----)

	Sub-area	Category	Brief description	Value	
1	Storrinden	Forest landscape	Larger hilly area with coastal pine forest	High	
2	Liland	Agricultural landscape	Rolling cultural landscape with great variation. Characterised by overgrowth.	High	
3	Lilandshaugen/ Kongshaugen	Forest landscape	Wooded hill bounding Bergen Airport from its surroundings to the east. The Lønningen country house estate lies on the south side of the hill.	Medium	
4	Ytrebygda	Business and industrial area	Large commercial and office buildings in hilly woodland	Low	
5	Storaåta	Residential area	Villas in wooded hills	Medium	
6	Hesthaugen	Business and industrial area	Flat area with large commercial buildings towards the airport	Low	
7	Lønnestjørna pond	Wooded area	Flat wooded area with small pond just below the southern part of the runway	Medium/low	
8	The airport	Airport	Flat land with runways, terminal buildings, roads and parking	Low	
9	Sletten	Residential area	Wooded hill with villas and cabins overlooking the fjord. Inlet area with bays and straits.	High/ Medium	
10	Setevika	Wooded area	Smaller wooded area overlooking the fjord	Medium	
11	Storhaugen/ Masterhaugen	Agricultural area	Rolling landscape with cultivated fields, pastures and a few farms	Medium/ High	
12	Flesland	Residential area	Villa area wedged between the airport and the fjord.	Medium	
13	Kvitura	Wooded area	Wooded hill overlooking the fjord along the runway in the north	Medium	

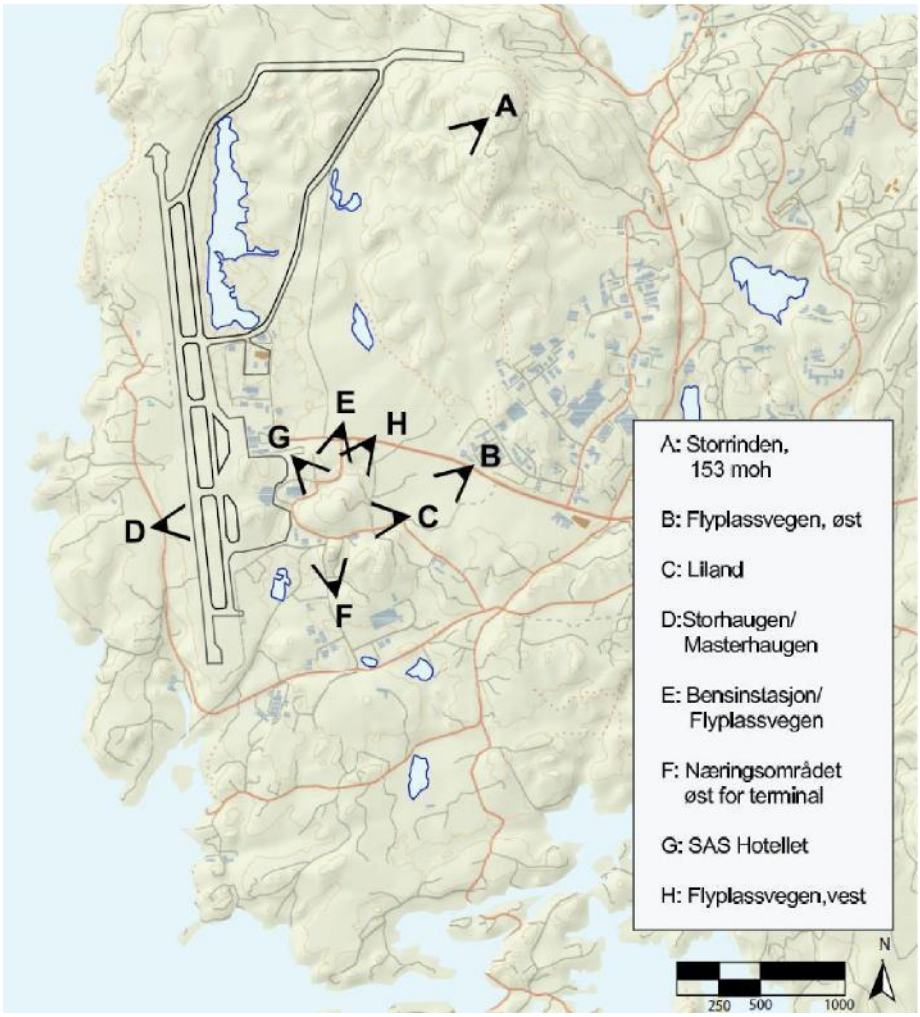
From Lilandshaugen

From Liland

From Sletten

The small-scale mosaic makes the landscape very vulnerable to large-scale interventions, particularly where they run across the directions of the terrain and vegetation structures in the landscape. Hills and silhouettes are highly vulnerable to intervention, especially in edge zones. Examples of sensitive areas are Lilandshaugen, Kongshaugen, Ljosarhaugane and the cultural landscape of Liland. The Lønnestjørna, Gåstjørna, Skjenavatnet and Langavatn lakes and their shore zones are also vulnerable landscape elements. To the west, the hilly landscape with cultivated fields, groves and small-scale buildings facing Raunefjorden is vulnerable

9.4.4 Scope and impact assessment of the selected alternative



It was decided to display the extent and impact the measure will have by showing two overview illustrations (west and east) and then illustrations from selected positions in the surroundings around the airport, cf. A-G in the illustration to the left.

Both the current and future situation is shown.

On the illustrations from positions A-G, the illustrations of the future situation show the original terrain/silhouette marked with a red dashed line.

A: Storrinden, 153 metres above sea level
B: Flyplassvegen road, east
C: Liland
D: Storhaugen/Masterhaugen
E : Petrol station, Flyplassvegen road
F: Business and industrial area east of the terminal
G: SAS Hotel
H: Flyplassvegen road, west

The airport seen from the east

Current situation: The distinct and wooded Lilandshaugen hill in the middle and the somewhat smaller Kongshaugen hill to the left form a prominent shield toward the airport and are important landscape elements. The areas west of the hills are characterised by the airport's activities while areas to the west are characterised by continued farming. The hills represent a transition zone between two very different landscapes.

Future situation: The new terminal and row of buildings in Airport City will create a whole new urban landscape. Much of Lilandshaugen and the whole of Kongshaugen is removed. The pasture-like areas of Lilandshaugen facing east will be left to form something of a shield towards the airport. Airport City is organised with buildings in a straight line towards Lilandshaugen and will "replace" the hill as a boundary of the landscape space outside the terminal. The linear row of buildings forms a neat and tight wall in the new landscape space between the terminal and Airport City. According to the illustration plan, this space features parking, infrastructure, vegetation and a strip of park that cuts across and connects the terminal with the terrain in the east. The strip of park maintains contact and the view towards Lilandshaugen: a glimpse of the landscape. In the northeast, part of the terrain was removed to make room for houses and a levelled area related to the airport. As a result of the intervention, the northern agricultural buildings behind Lilandshaugen will lose much of their shield towards the airport. It is important that hills/vegetation remaining in the narrow belt between the farms and the airport are retained.

The airport seen from the west

Model photo from the west, existing situation: Also seen from the west, the slanted image shows the prominent Kongshaugen and Lilandshaugen hills. The hills are important landscape elements which shield the airport from the agricultural areas to the east. The dense vegetation on the hills, which also stretches north and encircles the parking area up to Flyplassvegen road, is an important boundary and frames the airport. To the south are large undeveloped areas used for parking and business and industrial activities.

Model photo from the west, future situation: The situation is described under the airport seen from the east (Figure 18). From the west the steep cuts in Lilandshaugen are visible, and Kongshaugen has been removed in favour of a roundabout and road system with greenery. The linear structure of Airport City, parking facilities and the new terminal appears tidy. The structure stretches out into the terrain in a north-south direction and forms a flat area in the otherwise hilly landscape around the current airport. The long pier with aprons is prominent and a significant addition to existing buildings. Use of vegetation is important to break up and soften the impact of the many grey surfaces and large building volumes.

A) Outlook from Storrinden, 153 metres above sea level

Current situation: The views are magnificent over Raunefjorden and Sotra in the west. The airport and other buildings are subordinate to the landscape, and forests cover large areas and frame the terminal area to the north and east. Lilandshaugen is the wooded hill in the rear left of the multi-storey car park. The hill borders the airport to the east and also forms part of the forest picture seen from Storrinden.

Future situation:

The expanded terminal area with more and larger building volumes will be more visible and prominent in the forest picture, and the airport will be perceived as more massive in the landscape. The buildings will cover up the views of some agricultural land west of the airport, but the views toward Raunefjorden and the islands will remain unchanged. Much of Lilandshaugen is removed and the amount of forest that surrounds the airport is reduced.

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B) Outlook from Flyplassveien road in the east

Current situation: The hilly agricultural landscape near Stokkhaugen is bounded and visually shielded from the airport by the Ljosarhaugen, Kongshaugen and Lilandshaugen hills.

Future situation (red dashed line marks the current situation): The middle hill (Kongshaugen) is removed and part of the hill to the right in the picture (Lilandshaugen) is lowered toward the north. This changes the silhouette seen from Flyplassvegen road in that the hills are lowered somewhat. In the large landscape picture the changes are not large, and the area will still be shielded from the airport. The silhouette can be re-established by planting new vegetation.

C) Outlook from Liland

Current situation: Lilandshaugen to the right in the picture is a valuable landscape element in the agricultural landscape at Liland. The hill frames the landscape to the west, forming a buffer against the airport located just behind. The lush deciduous vegetation is a valuable part of the pasture-like landscape, where vegetation creates diversity and variety. Kongshaugen is the small hill to the left in the image.

Future situation (red dashed line marks the current situation): Lilandshaugen is lowered slightly to the north (on the right in the picture) and the silhouette is changed. Kongshaugen is also slightly lowered. In the large landscape picture the changes are not large, and the area will still be shielded from the airport. The vegetation on Lilandshaugen is retained while it is removed on Kongshaugen, where new vegetation should be established. The vegetation belt against the airport can be strengthened locally where it is open.

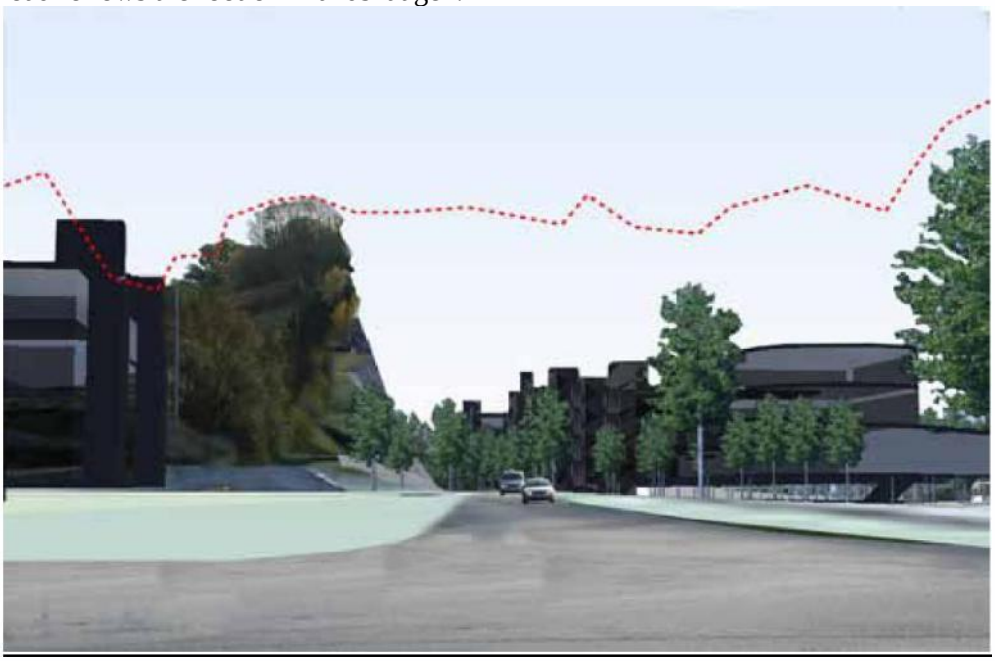
D) Outlook from Storhaugen/ Masterhaugen

Current situation: The view of the airport is very good, and Lilandshaugen in the middle of the picture and Kongshaugen on the right are pronounced hills bounding the airport to the east. Livarden forms the mountain silhouette in the distance. Seen from this angle the existing buildings are not backed by the hills.

Future situation (red dashed line marks the current situation): Removal of Lilandshaugen and parts of Kongshaugen will change the landscape seen from this angle. The natural walls of the landscape space to the east have been removed, and the new terminal building will form a new and built wall in the landscape. The buildings will partially get rear coverage in the terrain, but appear in silhouette until vegetation has become established on the remnants of Lilandshaugen. Livarden will become more prominent as a remote end of the landscape space. The new terminal building is a large, elongated volume. It contrasts with the existing buildings, that are more fragmented and complex. It will be felt as if the landscape has been stretched out into an east-west direction.

E) Outlook from petrol station on Flyplassveien road by the entrance to the airport

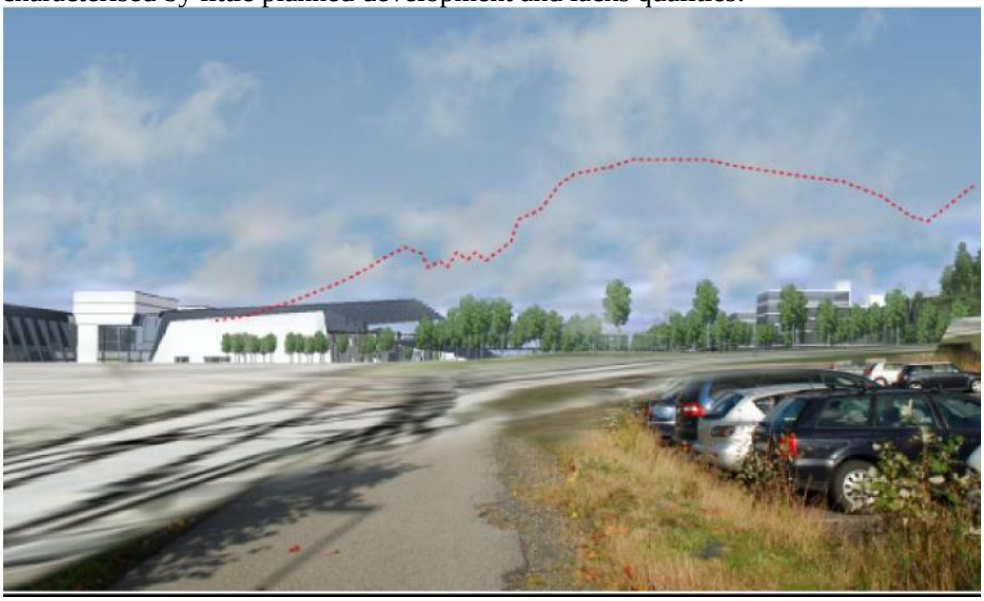
Current situation: At the entrance to the airport, Lilandshaugen is a wall in the landscape and a part of the airport. The wall in the east forms a natural end and the frame around the terminal area. The access road follows the foot of Lilandshaugen.



Future situation (red dashed line marks the current situation): Removal of Lilandshaugen will create a completely new situation and an openness in the landscape situation around the terminal and Airport City. The natural element formed by the hill is gone, and only a steep cutting remains. Revegetation of the remnants of Lilandshaugen and especially of the silhouette is important to repair the landscape. The row of buildings in Airport City to the right and an airport-related building to the left are now prominent. This is what one sees on arrival at the airport. Scattered trees and tree groups will help mitigate the impact of the many large buildings. A natural part of the current airport area is replaced by a built landscape.

F) Outlook from Lønningen business and industrial area

Current situation: Kongshaugen is prominent seen from the southern part of the airport area. The hill is a natural element shielding the airport from the industrial and parking area to the south. The area is characterised by little planned development and lacks qualities.



Future situation (red dashed line marks the current situation): By removing Kongshaugen, the airport with the new terminal area and Airport City will be exposed to the business and industrial area in the south. The buildings in Airport City are placed in a line towards Lilandshaugen vis-à-vis the terminal building. Between the two building complexes will arise a wide, open and defined space filled with car parks, roads, meeting points and vegetation. Rows of trees and tree groups are important for mitigating the impact of the large buildings and anchor the development in the surroundings. Above street level is a walkway from the departures terminal over to Airport City. What remains of Lilandshaugen should be revegetated where possible, and it is especially important to plant the silhouette so that Airport City can get a certain amount of rear coverage and be rooted in the landscape. Since the terminal area will be more exposed to its surroundings, the currently little-planned industrial area in the south will appear untidy if left the way it looks today.

G) Outlook from the hotel north of the terminal

Current situation: Lilandshaugen is a natural "wall" in the airport landscape. It is a natural element and is perceived as near and present in the terminal area. Lilandshaugen is dominant from the terminal for airport buses and taxis, from the multi-storey car park and from the SAS hotel, where this photo was taken.

Future situation (red dashed line marks the current situation): Much of Lilandshaugen is removed and a wall in the landscape is gone. Viewed from this standpoint by the hotel the changes seem major. The wall in the landscape to the east is replaced with the buildings in Airport City, which form a built end of the landscape space outside the terminal. The heights of the buildings remain just below the silhouette of the remaining part of Lilandshaugen. It is important that the ridge is revegetated so that the silhouette effect is ensured. Scattered tree groups in the car park and along roads help soften the effect of many large buildings in the terminal area.

H) Outlook from Flyplassvegen road to the west

Current situation: Lilandshaugen in the centre of the picture and the northern part of Lilandshaugen extending into the Flyplassvegen road form a good visual shield against the airport. The dense deciduous forests on the hill form a dense volume even in winter. The hilly pasture landscape at Liland is clearly visible from here, but the expansion of Flyplassvegen road eats into the fields. The entrance to the terminal is seen to the right of the hill.

Future situation (red dashed line marks the current situation):
The northern part of Lilandshaugen with a vegetation shield and pastures will be gone, and the airport with a new airport-related buildings and car park in the foreground, Airport City in the background and the SAS hotel to the right in the photo will be exposed to the surroundings and Fleslandvegen road to the east. The new access situation differs from the current situation where the airport is not visible until you reach the roundabout. Towards the agricultural landscape and farm buildings at Liland, two smaller hills that will be preserved will shield the building and car park. Supplemented with new vegetation the measure will not be very exposed to the southeast.

I. Aerial photo of Lønningstjern pond

Current situation:
Lønningstjern pond is sandwiched between the airport and the parking area to the south. Nevertheless, it constitutes a landscape element and part of a green structure extending from Gitlapollen past Lønningstjern towards Lilandshaugen. The pond lies in a small grove of trees, and a little farther south lies Solbakken, an abandoned farm. Sections of the hiking trail past Solbakken and Lønningstjern consist of a well-grown tree-lined road. The area has qualities, although its proximity to the airport and industrial area is felt when one passes through the area.

*Future situation***:** The expansion of the terminal area to the south will entail the infilling of Lønningstjern pond. The landfill will be comprehensive and cover large parts of the green structure surrounding the pond. The green structure in this area will be interrupted. Further south it will be possible to preserve Kvernhusbekken stream and the green strip further south towards Gitlapollen. A walkway has been established past the landfill that follows the foot of it and joins an existing walkway through the green strip. From the footpath, the landfill rises eight metres and has a gradient of 1:2. The landfill should be planted so that it can become a green hillside along the footpath.

Summary
The consequences of the measure relate primarily to the removal/lowering of Lilandshaugen and infilling of Lønningstjern pond. It is the local effect of the measures that will cause the greatest impacts, and particularly the experience of the landscape seen from the terminal area. Removal of large parts of Lilandshaugen and all of Kongshaugen will become more striking when seen from the new terminal area than from Liland, where the hills are still perceived as a shield against the airport. The removal of Lilandshaugen will also change the landscape experience from the new roundabouts at the entrance to the airport in the north and south. The new row of buildings in Airport City is located towards Lilandshaugen and replaces the hill as a boundary in the landscape space outside the terminal. The natural element that particularly Lilandshaugen currently represents as a frame/boundary around the airport to the east, is replaced by the row of buildings in Airport City, infrastructure facilities and parking. Rows of trees and clusters of trees are planted in connection with parking and roads, and break up large, hard surfaces.

Airport-related activities toward Flyplassvegen road in the northeast, open the airport to the surroundings in this direction. From the agricultural landscape at Liland, the remaining parts of Lilandskollen will still shield the airport from view.

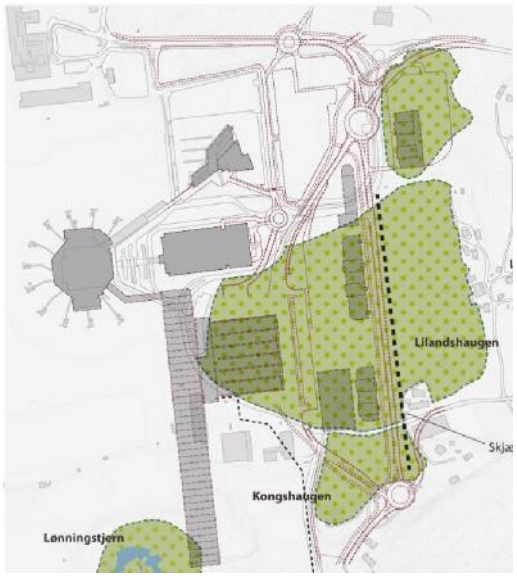
Viewed from points in the terrain further away from the airport, for example, from Storrinden, Flyplassvegen road and the agricultural area at Liland, the visual impacts are not major.

9.4.5 Impact assessment of the 0 alternative and "medium" alternative

In assessing the 0 alternative and the "medium" alternative, we concentrate on the consequences for Lilandshaugen hill as this is what is stated in the planning programme. The consequences for the other landscape elements are not commented on.

The 0 alternative:
The 0 alternative is generally an expression for the situation one can imagine or extrapolate if a planned measure is not implemented. If the development measures desired in the zoning plan for Bergen Airport Flesland are not undertaken, Lilandshaugen will remain as at present. There will be no scope and no impact on the landscape.

For Bergen Airport Flesland, the 0 alternative - no new development – will mean that the terminal functions will be overwhelmed and it will not be possible to offer an airport that covers the region's needs. As mentioned by way of introduction, aviation safeguards important social functions such as public administration and defence, and enables national and international activities in such areas as business and industry, tourism, health care, culture and sports. These needs will no longer be satisfactorily met and Bergen and Western Norway will weaken as a region.



As it is Lilandshaugen that is the focus, we choose in addition to look at a 0 alternative that means no intervention on Lilandshaugen. For landscape, this will, as mentioned, involve no scope and no impact.

For Bergen Airport Flesland this will entail that:

- Planned new terminal with adjacent traffic forecourt cannot be built
- "Airport City" cannot be built along with important functions for the airport

We refer to the illustration to the left.

This means in effect that a new terminal cannot be built at Bergen Airport Flesland. This is because a new terminal can only be built south of the existing one.

To the west of the current terminal are the runways, and a location to the west is therefore not feasible. To the east lie the hotel and multi-storey car park. Building a new terminal north of the existing terminal is also not applicable as this will make it impossible to use the existing terminal in the future. A new terminal located to the north will block the option for aircraft to taxi from the existing terminal up to a new runway 2. A new terminal must therefore lie in the south as shown.

The functions in "Airport City" could in theory find space outside Bergen Airport's area, but many of the functions include airport-related businesses (offices, cargo, etc.) that need easy access to the airport. Not being able to build "Airport City" will therefore weaken the airport. (If a new terminal is not built there will nonetheless be less need for Airport City as some of the businesses here are businesses that must make way for the new terminal. There is also less need for the development of airport-related businesses with lower activity at the airport.)

The "Medium" alternative:
As the "medium" alternative we have chosen to show an option that requires some intervention in Lilandshaugen, but considerably less than the selected alternative, see sketch on the next page. This is a sketch that was drawn at an early stage of the work on the new terminal, but was rejected early on. The alternative shows a new terminal south of the existing one; as in the selected option. Here, parking is envisioned partly on the ground floor and partly as underground facilities built inside Lilandshaugen. Here, the public road system outside the airport can run through a tunnel to the east (not included in the sketch).

The impact on the landscape in this alternative would be that a cutting would have to be established in Lilandshaugen that would be about as high as in the selected alternative. In the selected alternative, the cut will made east of the peak of Lilandshaugen (the peak will be removed), while in the "medium" alternative the cut would be to the west and preserve the highest point.

It is the impacts seen from the airport itself that will be the greatest. From here you will look into a cut (about 10-15 m high) and the vegetation-covered peak of Lilandshaugen in the rear. The cut will come relatively close to the terminal area. From Liland, Lilandshaugen, as in the selected option, will act as a shield against the airport. However, in this alternative, more of the natural terrain and vegetation are retained; in this alternative it will be virtually possible to experience Lilandshaugen as currently seen from Liland.

For the airport's part, this alternative will:

- Involve a total rearrangement of the terminal development as currently planned
- Not provide sufficient space for the functions that are required. Among other things, there will be neither room for the functions that must move as a result of the terminal development, nor the possibility of new functions/businesses as a result of increased activity at the airport.
- Provide a worse solution in purely aesthetic and spatial terms: Aesthetically speaking, there will be very little space around the new terminal. Instead of meeting openness and a future-oriented airport and commercial area when exiting the terminal, one will look right into an opposing rock face.
- Be expensive (because of the need for both a road and parking facility in the mountain)
- Provide an inflexible solution during construction where the existing terminal will remain and be in operation. With limited space available, it will be difficult to achieve good solutions for cars, buses and taxis in this period, which could take several years.

PLAN M= 1:1000
100 PLASSER KORTTIDSPARKERING
BUSS
TAXI
BYBANE
PARK

Conclusion/ summary:
In assessing the 0 alternative, "medium" alternative and selected alternative, consideration for the landscape must be weighed against the airport and community needs. Cf. conclusion in Chapter 9.4.4., the negative impact of the selected option on the landscape will be minimal. The difference seen from Liland between the selected option and the 0/medium alternative is not great (see photomontages). Seen from the airport/west side, the difference between the selected option and the 0/medium alternative will be a choice between a developed and more open landscape toward the airport and a more natural and terrain-dominated landscape.

Based on the needs of the airport and society, the 0 alternative is out of the question.

Nor will the "medium" alternative provide a satisfactory situation for the airport. Since the impact assessment for the selected proposal shows that the landscape will not be very negatively impacted by the desired development, it is difficult to defend the "medium" alternative, which does not cover the land needs, is expensive and inflexible and leaves little spatiality and development opportunities around the airport. Achieving a good and future-oriented airport must be prioritised in such a comparison.

9.4.6 Overall impact assessment - Landscape

In summary, the purpose of this report subject is to consider whether the chosen proposal adequately takes account of the aesthetic values of the landscape and surroundings. Our conclusion is that no such undesirable consequences of the chosen solutions have been uncovered that indicate that the plan cannot be implemented.

Mitigation measures in the sense of the impact assessment are defined as the adjustments made to the draft plan to ensure that the proposal adequately safeguards the interests of the aesthetic values of the landscape and surroundings. As far as possible, the buildings are positioned and adapted in the best way possible to meet these objectives. Further action is also incorporated in the provisions such as requirements regarding:

- Reestablishment of vegetation on Lilandshaugen
- Finishing of Lilandshaugen cut
- Finishing of filling toward hiking trail in the south
- Mounds in the northeast

We find there is no need for further mitigating measures.

9.5 Local environment, outdoor recreation, formative environment of children and young people

9.5.1 Main issue

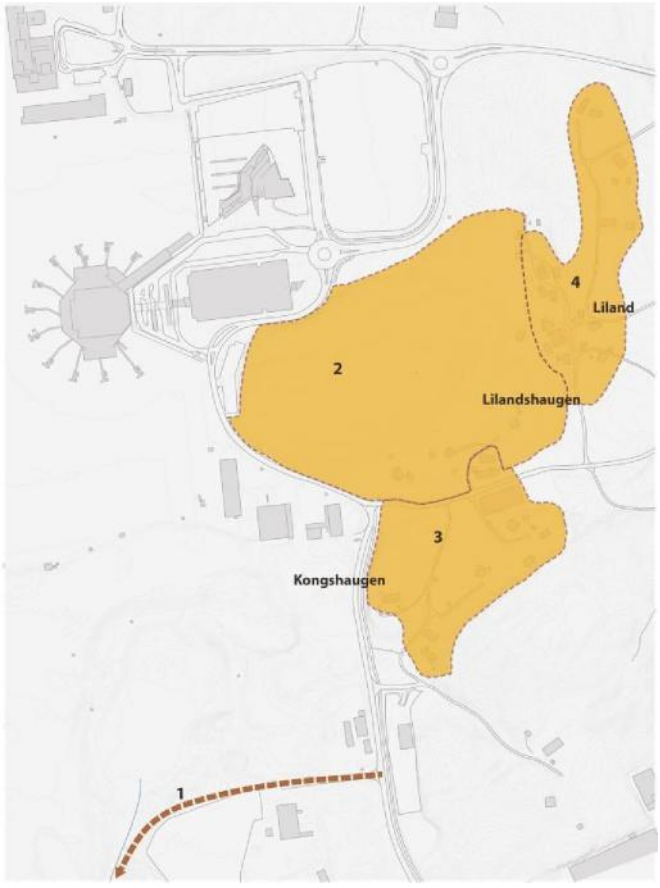
Local environment and outdoor activities are defined in Manual 140. The local environment is defined as people's daily environment. Outdoor recreation is defined as spending time and being physically active during leisure time with the aim of experiencing a change of environment and nature. Both definitions describe spending time and being physically active outdoors in connection with residential areas - and local outdoor areas. Children and young people are particularly emphasised.

In the adopted planning programme the main issue of the zoning plan for Bergen Airport Flesland is described as:

"The infilling of Lønningstjern pond will affect the experience of walking on the hiking path on the south side of Lønningstjern. It is possible that the hiking path must be rerouted. Aircraft noise affects the experience along the hiking path. The use of Lilandshaugen for outdoor activities is believed to be limited, but municipal cartography registers a path leading up the hill from the east side. If the peak is a hiking destination one will, by levelling the hill, remove it."

In addition, some existing residential communities may be affected by the measure.

9.5.2 Value assessment



Illustration, Norconsult 2011

The following areas in or near the planning area are considered relevant for value assessment in relation to the subject Local environment, outdoor recreation, formative environment of children and young people:

1. Hiking trail along Lønningstjern pond
2. Lilandshaugen hill
3. Kongshaugen and built area (mixed function area) east of the hill
4. Built area (farm buildings) east of Lilandshaugen

In assessing the value of local environment and outdoor recreation one shall, according to the manual, emphasise the intensity of use and time spent, place identity and empirical qualities and attributes. Visual qualities are considered under the landscape subject.

1) Hiking trail along Lønningstjern pond

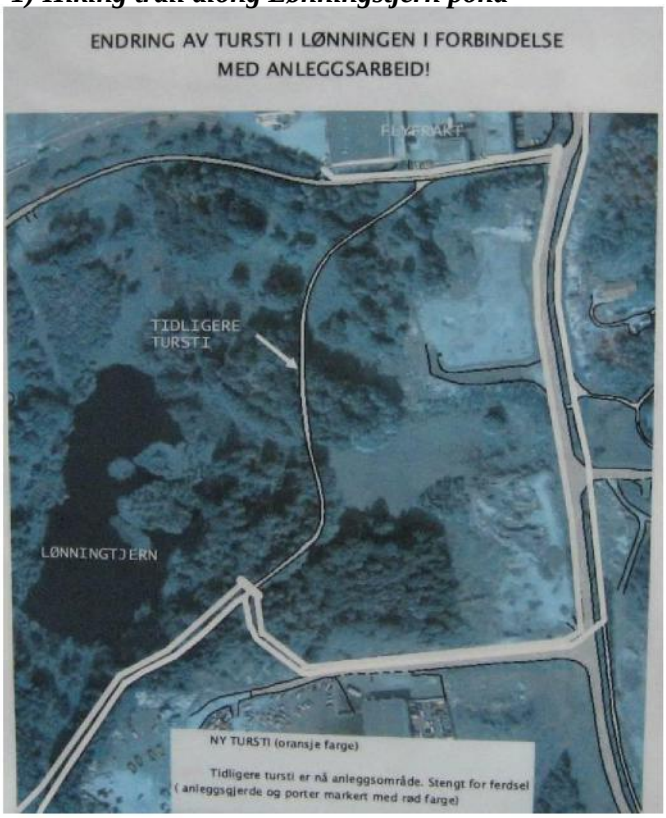
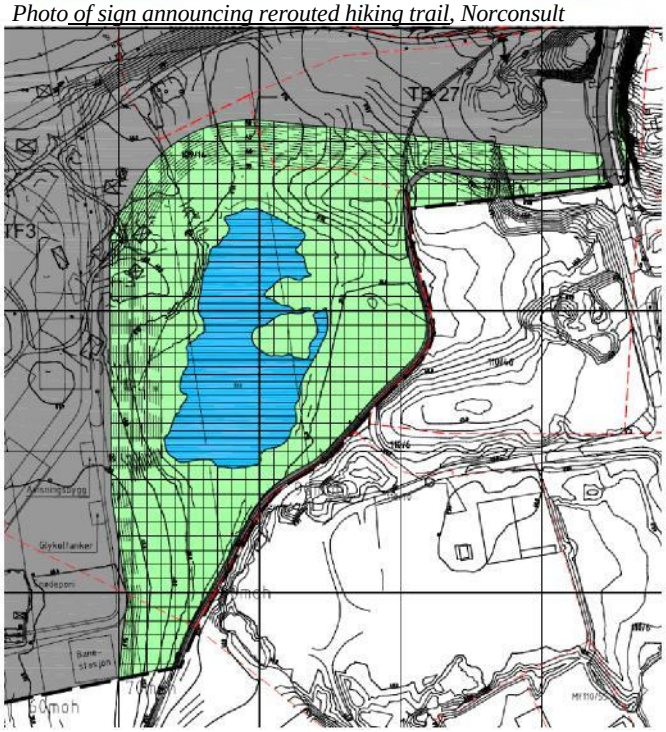


Photo of sign announcing rerouted hiking trail, Norconsult



Section of current zoning plan for the area

A former trail on the east side of Lønningstjern pond is now gone as a result of construction work (see photo of sign). A sign informs hikers to walk on the south side of the pond. The current zoning plan for Bergen Airport Flesland shows a hiking trail on the east side of the pond, but with access from Lønningsveien road a little farther south than originally. A zoned solution is assumed for the 0 alternative.

Despite the fact that the hiking path is flanked by the airport on one side and the business and industrial area on the other, one experiences walking in a relatively secluded nature area. This is due to dense vegetation on both sides. One has some visual access to Lønningstjern from the hiking path, although the vegetation is relatively dense. The pond, along with the brook and farmyard farther south, creates variation along the hiking path, increasing its enjoyment value.

The enjoyment value along the hiking trail is affected by noise from the airport, but users of the site are local and thus used to the noise since they reside and live near the airport. Nor is aircraft noise a continuous phenomenon. Departures and arrivals generate noise for a few seconds followed by long periods of virtually no noise.

Photo of hiking trail, Norconsult 2010

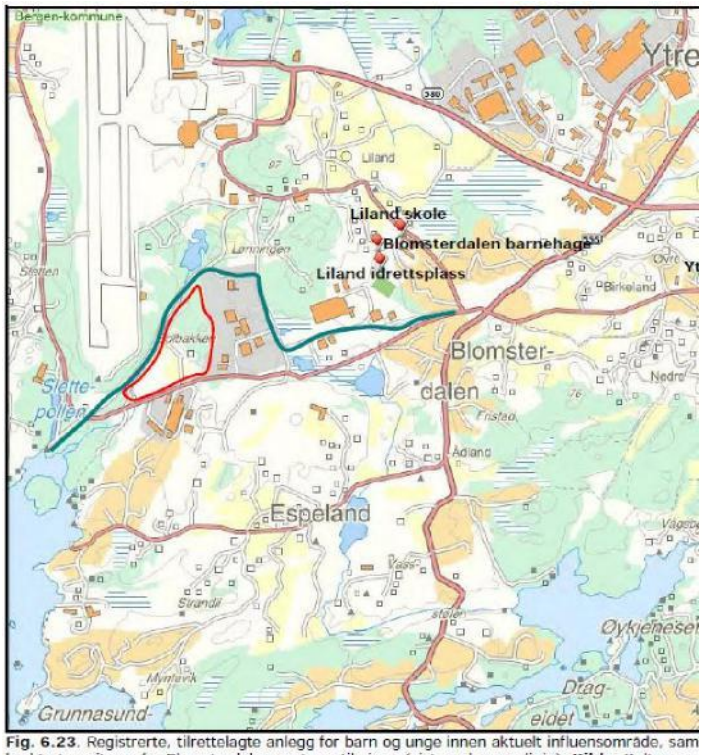


Fig. 6.23. Registrerte, tilrettelagte anlegg for barn og unge innen aktuelt influensområde, samt brukte turveitrase fra Blomsterdalen sentrum til sjøen (vist med grønn linje). **Kilde:** Kultur og kirkedepartementet. Idrettsanlegg.no 2009.

The trail is relatively widely used by locals according to the NNI's 2009 impact assessment for Kvernhusbakken business and industrial area. It is used as a hiking trail and access to the sea from schools, kindergartens and residential areas at Liland. The hiking trail is also used as bridle way by Bergen riding club, which has an office in Sletten. In addition, we assume that the hiking trail is used as a school route, pedestrian and bike path and shortcut between functions. For this reason, the hiking trail is important to adults, children and young people.

Since the hiking trail is relatively widely used, leads to central destinations (the sea) and is part of a continuous route, its value is set as medium.

Detail of impact assessment prepared by Norwegian Nature Information (NNI), zoning plan with impact assessment for Kvernhusbakken business and industrial area, 2009.

2) Lilandshaugen

Lilandshaugen has relatively good qualities, with a beautiful view. A path/farm road runs up to Lilandshaugen from the farms at Liland in the east along with a path up from the Lønningen estate in the south. The Lønningen estate may have an identity-creating meaning that can be associated with the hill. The hiking trail from the Lønningen estate is the most natural gateway to the public, from here one can walk to the top of the hill and down the north side. This trail is not well-trodden and since there are also few homes nearby the area is believed to be used sparingly. Lilandshaugen is also a relatively undemarcated area and will thus not constitute a hiking area per se. In principle, it would be natural to assume that any children residing nearby use the site to some extent to play since it is a natural area, but no concrete evidence of this has been found and there are also not very many homes in the vicinity of the hill.

On this basis its value is set as low.

Kongshaugen and built area east of the hill

Kongshaugen is small and thus little suited for outdoor recreation/spending time outdoors. The name of the hill suggests that it may have an identity-creating function. The west side of the hill has been blasted away and there is a steep cutting here. The approach from the east side is steep. It is possible that any children residing nearby use the site to some extent to play since it is a natural area, but no concrete evidence of this has been found and since the approach is also steep/inaccessible the area is less suitable. The buildings east of the hill are mixed and consist of residential and commercial buildings. Housing density is low.

On this basis its value is set as low.

Farm buildings at Liland

The area has a low density of housing. Its value is set as low.

9.5.3 Scope and impact assessment

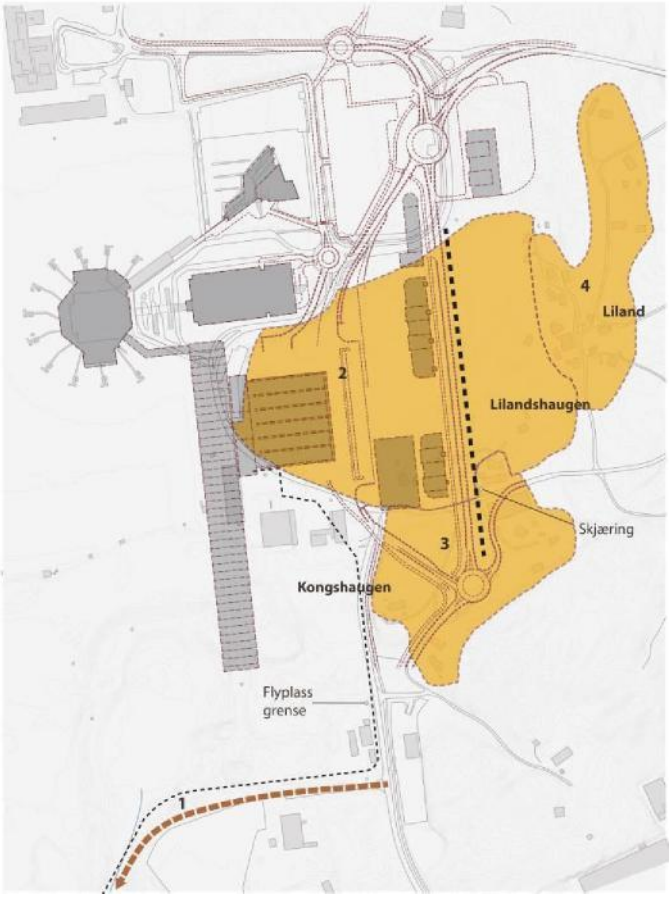


Illustration Norconsult 2011

Implementation of the measure will entail the following specific changes for the areas of importance to local environment, outdoor recreation and children and young people:

- The hiking trail will be rerouted and the surroundings along the hiking trail will be changed in that e.g. Lønningstjern pond will be infilled
- Parts of Lilandshaugen will be levelled
- The entire Kongshaugen will be levelled

According to Manual 140, the scope shall be assessed on the basis of the following criteria: barriers to passage and adventure, attractiveness and identity-creating importance.

1) Hiking trail at Lønningstjern pond

As a result of the measure the hiking trail will be rerouted somewhat in relation to the zoned solution. The new solution will be very similar to the one that exists at present, but with one minor adjustment. In a future situation there will be a planted slope leading up to the airport area on the north side of the hiking trail. On the south side, the hiking trail will run directly along the business and industrial area at Lønningen for a distance of about 200 m. Regarding the rest of the trail that is included in the planning area there will also be vegetation on the south side. There is natural vegetation here today and the vegetation is also secured in that the land is zoned for green belts in the current zoning plan for the area (zoning plan for Lønningen, plan 1515.00.01, see Chapter 5.6). However, a rezoning process has been started to be able to establish a workshop-depot for the LRT in the area (this is one of two possible locations being considered) and this planning process could change the zoned park belt. Further south, outside the planning area, there is vegetation along the hiking trail. There are many indications that this will be maintained when the area is zoned for LNF in the municipal plan and a relatively wide buffer in the draft plan for the area has also been proposed; zoning plan for Kvernhusbakken, which has been circulated for public review and is now being prepared for a second reading.

The empirical value along the hiking trail will be reduced slightly by the infilling of Lønningstjern.

In summary, the measure will not change the use opportunities or entail any barriers since the hiking trail as a function is maintained. The measure will make the area somewhat less attractive and to some extent impair the area's identity-creating importance. A limited stretch of the hiking trail will still be affected by the measure. On the basis, the scope is set at low to medium negative. With medium value and low to medium negative scope, the impact will be low to medium negative.

2) Lilandshaugen

Half of Lilandshaugen will be removed as a result of the measure. The Lønningen estate will be removed and thus also the trail up from the south. Even though the east side of the hill will be preserved, the measure will to some extent reduce the uses of the area and make the area less attractive. The scope is set to medium negative. With low value and medium negative scope the impact is low negative.

3) Kongshaugen and built area east of the hill

The entire Kongshaugen will be removed as a result of the measure. This measure will reduce/destroy the uses in the area, to some extent create barriers in the form of roads and make the area less attractive. Removing Kongshaugen will also degrade some of the area's identity-creating importance. The scope is thus medium to large. With little value and medium to large negative scope the impact is low negative.

4) Farmsteads at Liland

The area is sheltered behind the remainder of Lilandshaugen. The measure will not affect its uses, attractiveness or the identity of the area or create barrier effects of great extent. The scope is low. With little value and small scope, the impact is low negative.

Overall impact assessment Local environment and outdoor recreation

Hiking trail- Lønningstjern	Low to medium negative
Lilandshaugen	Low negative
Kongshaugen	Low negative
Farmsteads at Liland	Low negative
Overall assessment	*Low negative*

In summary, the purpose of this report subject is to consider whether the proposal adequately protects the interests of the local environment, outdoor recreation and children and young people. Our conclusion is that such undesirable consequences of the solutions have not been uncovered that would indicate that the plan cannot be implemented.

Mitigation measures in the impact assessment sense are defined as the adjustments made to the draft plan so the proposal adequately safeguards the interests of the local environment, outdoor recreation and children and young people. The preservation of the hiking trail to the south is the most important measure in this regard. We assume that there is no need for further mitigation measures.

9.6 Natural environment and biodiversity

9.6.1 Main issue

The main issue is to clarify the biological values found in Lønningstjern pond and Lønningsbekken brook and how the measure will affect the situation. It must also be clarified whether there are any biological values on Lilandshaugen.

The plan borders are somewhat extended in relation to the existing zoning plan for Bergen Airport, and in addition it is desirable to change the zoning purpose for portions of the existing plan. The biggest plan changes in relation to the natural environment are that it is desired that Lønningstjern is infilled and that Kongshaugen and most of Lilandshaugen are removed.

9.6.2 Value assessment

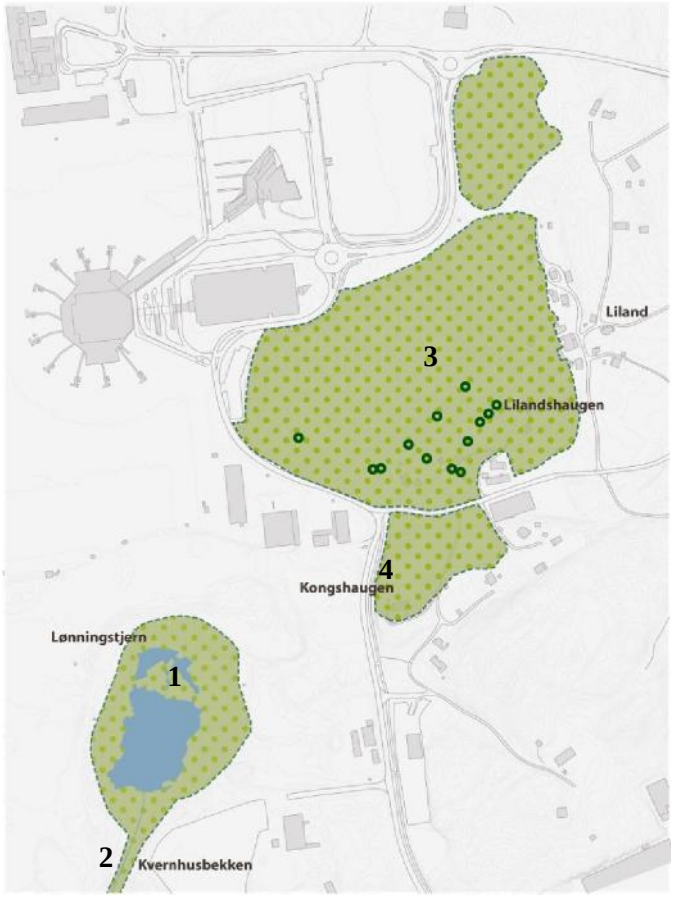


Illustration Norconsult 2012. The illustration shows the 4 areas described in the text. Oak trees with diameters of more than 2 m, classified as hollow oaks, are shown with green circles.

The following areas in or by the planning area are considered relevant for valuation in relation to the subject of natural environment and biodiversity:

1) Lønningstjern pond
2) Kvernhusbekken brook
3) Lilandshaugen hill, including the area north of the hill.
4) Kongshaugen hill with neighbouring areas.

The valuations are based on any registered natural assets in the planning area and influence area. According to naturbase.no, no priority habitats have been recorded in or near the planning area. Nor were areas of this nature registered on inspection.

The species database records some observations primarily of birds surrounding Lønningstjern. Some of these are defined as threatened and near threatened in the Norwegian Red List, which was revised in 2010. These are categorised with medium value. In connection with the zoning plan work for Kvernhusbakken business and industrial area bordering the zoning plan for Bergen Airport and which partially includes Kvernhusbekken,

a relatively comprehensive impact assessment was made including with regard to flora and fauna. In that work, only one Red List species (elm) was found. Based on the valuation in Manual 140, habitats for species defined in the Red List as critical (CR) or endangered (EN) should be given great value. Habitat for species that are registered as vulnerable (VU) or near threatened (NT) shall be given medium value.

0 situation

The impact assessment will be based on the zero situation and existing plan status. The planning provision for the current plan states the following:

Section 4.1 Park belt in industrial areas
The areas are to be used as a buffer zone around the airport. These areas should appear as natural elements with a low degree of technical intervention or landscaped like a park.... Lønningstjern pond and associated shore zone shall not be changed or infilled.

Section 4.4 Outdoor recreation area in sea and waterways
The area shall be used as an outdoor recreation area. Interventions that could harm the nesting site for birds are not allowed.

Based on the specification of the planning provisions, the zero situation for Lønningstjern and the surrounding park belt will be based on the existing natural state. For Lilandshaugen, the existing plan contains an option to make existing natural areas more park-like and thus acceptance for changing the current state of nature.

Expansion of the planning area will include smaller areas around Kongshaugen and the Lønningen estate and possibly along Kvernhusbekken. The areas south of Lilandsvegen road are designated as commercial spaces (I/K/L 10) and a small area north of Lilandsvegen road is an ANR area. The upper part of Lønningsbekken brook is included in the park belt around Lønningstjern pond. Further toward the sea the brook lies mostly in an ANR area except for a small area where it passes under Fleslandsvegen road and is partially piped in and at an industrial area.

1) Lønningstjern pond
Lønningstjern can be described as a swamp pond with peat moss mats along the banks. The lake is located below the marine limit. There are also several wooded islands floating in the water that based on aerial photographs have actually moved a bit in the last few years.

In a report prepared by the Rådgivende Biologer in 2007, the lake is described as medium nutrient-rich. The concentration of copper was very high. The lake has a thin trout stock in good condition and with annual recruitment. The low density is due to limited spawning area. The zooplankton community is comparable to that found in nutrient-rich lakes. The rotifer Keratella paludosa is a zooplankton that has been registered in the pond. This is said to be the only known recording in Norway. No rotifers are located in either the international or Norwegian Red List. The 2011 overview of species diversity in Norway cites that there are 350 species of freshwater rotifer living in Norway. It is believed that there are about 100 more species, cf. Nordic overviews and that Keratella paludosa is perceived as a natural species in Norwegian fauna. The knowledge level about rotifers in Norway is considered fairly good. The species is found in several other northern European countries. An Estonian report notes that Keratella paludosa is an indicator species for dystrophic ponds. Environmental assessments of the infilling of Lønningstjern are the subject of a comprehensive report prepared in 2010 (*Miljøvurderinger, Gjenfylling av Lønningstjern, Multiconsult).*


Aerial photo of Lønningstjern pond 2005 and 2009.

Recordings of bird fauna have been made at Lønningstjern pond on several occasions. Most observations were made before the major fills around the pond were established and thus as part of a larger ecological context. The major changes in the surroundings around the water have reduced the natural values in the area and also made it less attractive for birds. The pond is still an important ecological element in the Lønningen watercourse.

Lønningstjern pond

One individual of the Red List species water rail, which is defined as vulnerable (VU), was recorded at Lønningstjern each winter from 2000 to 2004 but has not been recorded since. Swift (NT) was registered in 2000 and hen harrier (VU) in 2006. Gull (NT) was registered in 2009 and this species came in as a new Red List species in 2010. Otherwise, species directly related to water and waterways - goldeneye, Eurasian teal, tufted duck, mallard, dipper – have been recorded. None of these are registered as red-listed species.

There are no records indicating that the Red List species observed at Lønningstjern nest in the area. Most records of red-listed species also date back to before the landscape surrounding the pond was changed and this will affect the valuation. It is still possible that ducks nest here.

Lønningstjern and the remaining surrounding nature is representative of the district and does not stand out. The site does not contain priority habitats, and Red List species that would be appreciably harmed by any infilling have not been recorded. However, the pond is an important ecological element in the watercourse. Based on the criteria applied, Lønningstjern is assessed as having low to medium value.

2) Kvernhusbekken

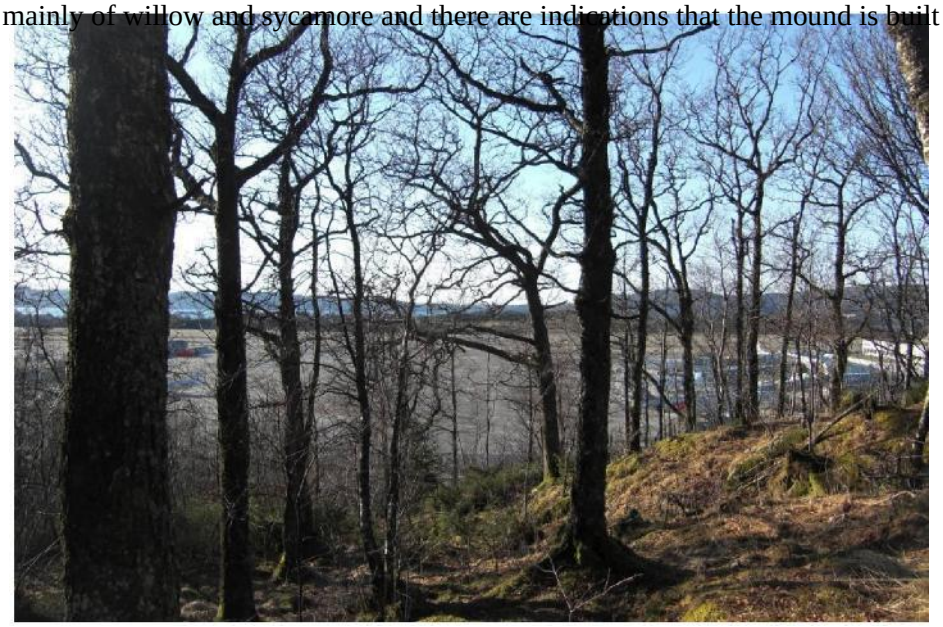
Kvernhusbekken brook is shown as a narrow zone with an ANR area. This status is maintained in the proposed municipal plan that has recently been circulated for comment. The stream flows through old infields and older spruce plantations.

There are said to be small trout in the brook and the lower 150 m at Lønninghavn is registered as having usable spawning capacity for sea trout. However, upstream travel of sea trout has not been confirmed, but the brook is on the list of trout streams in the City of Bergen (City of Bergen, 2002). Other natural values in and along the brook have not been recorded. The brook has ordinary ecological qualities as a landscape. Based on the criteria applied, the brook is assessed as having low value.

3) Lilandshaugen

In the southern part of the area around Lønningen country house and land no. 111/8 there are old gardens with several old oak trees with a diameter of more than 2 metres. These are classified as a priority habitat type, hollow oaks. Even though there is just a hint of holes in some of the trees, these trees have the potential to become hollow. The large courtyard trees outside the Lønningen estate are sycamores. Two Red List species that have status as vulnerable (VU) have been registered on one of those trees. This applies to elegant sunburst lichen, which has only one other known locality in Bergen, and Pachyphiale carneola. The site is mostly covered by relatively young forest dominated by oak, aspen and birch. There are also some hazel, maple and holly trees. Spruce trees are scattered. In the shrub layer, bilberries and mosses dominate. There is relatively little forest in Bergen dominated by oak and Lilandshaugen is a fairly large site in this respect in an area where forests are otherwise dominated by pine and spruce planting.

Just north of Lilandshaugen is a small mound of infield pastures and some young trees. The forest consists mainly of willow and sycamore and there are indications that the mound is built up of new earth.



Lilandshaugen

A deer track is recorded in north-south direction north of Lilandshaugen and the woodland is part of a larger landscape ecological context, especially for deer. In the consultation draft of the new municipal plan, Lilandshaugen is defined as "green structure".

Based on the criteria that is applied, the Lilandshaugen area as a whole is rated as having medium value.

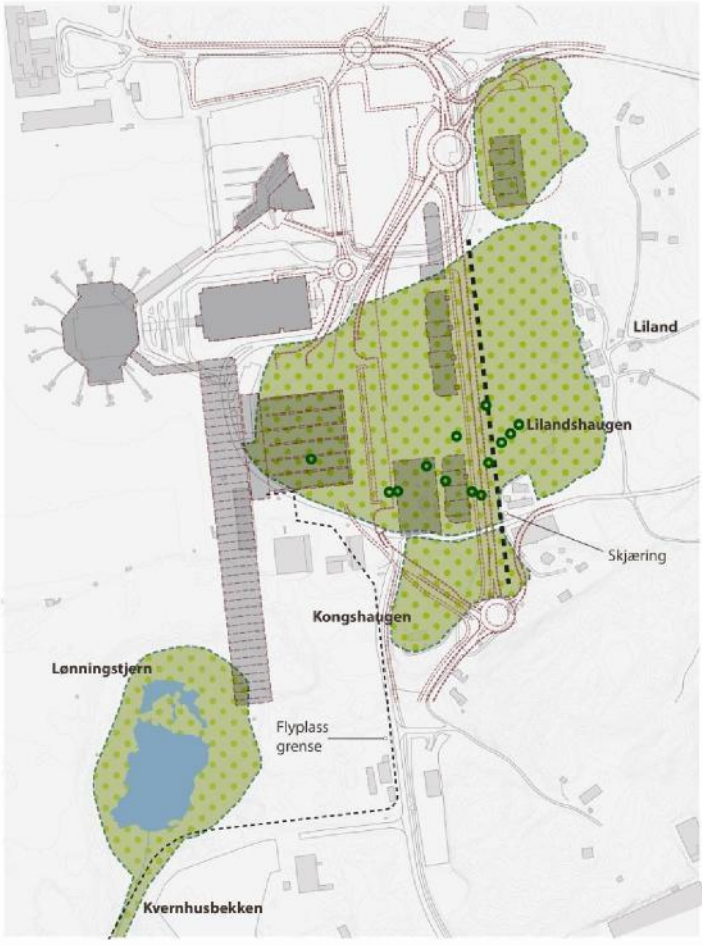
4) Kongshaugen and nearby areas.

The vegetation consists mostly of young oak forest with some hazel birch and aspen as well as some large spruce trees. The bottom layer is dominated by great wood rush. The area east of the hill is characterised as garden plots for dwellings. Half the hill has already been removed to make way for road construction. No natural values have been registered in the area. The value is considered low.

Kongshaugen

9.6.3 Scope and impact assessment

Description of the measure in relation to the natural



Implementation of the plan will result in the following specific changes for the areas that are important for the natural environment:

- Lønningstjern will be infilled
- Parts of Lilandshaugen, as well as the entire area north of the hill, will be levelled
- The park landscape south of Lilandshaugen will be levelled
- The entire Kongshaugen will be levelled

Illustration Norconsult 2012. Oak trees with diameter greater than 2 m, classified as hollow oaks, are shown with green circles.

1) Scope and impact – Lønningstjern pond

Some ducks that occasionally spend time in the pond may have slightly reduced grazing. Although the trout stocks in the pond will disappear, it will not affect the biological diversity in a somewhat broader context. The ecological landscape relationships in the area are already severely degraded, and filling in the pond will further reduce the remaining ecological qualities of the watercourse. The ecological landscape values are to be viewed as ordinary.

As the surroundings have already been heavily modified, both value and scope will be affected by this. Filling in of the entire Lønningstjern is considered to have low to medium negative scope in relation to natural values. With low to medium value, the impact is thus low to medium.

2) Scope and impact – Lønningsbekken brook

Filling in Lønningstjern could negatively impact water quality and water flow in Lønningsbekken both during the construction phase and afterwards. A mitigation measure will be to channel surface water to the waterway, but additional impervious surfaces in the watershed will lead to the reduction of water during dry periods. Scope in relation to natural resources is considered to be low negative and the impact is considered low for Lønningsbekken.

Mitigating measures Lønningsbekken: At the start of the planning process, consideration was given to including the entire Lønningsbekken in the new zoning plan for Bergen Airport. However, a planning process for Kvernhusbakken west of the business and industrial area at Lønningen has been started. This planning area includes Lønningsbekken from the present planning limit for Bergen Airport and south to Fleslandsvegen road. In the draft plan submitted for public review, the area along the river is shown as a recreation area. The municipal plan also shows the entire stream down to the sea as an ANR area. The provisions of the municipal land-use plans contain a 50-metre building ban along the waterways. In relation to the natural environment it thus appears that existing plans and planning proposals take sufficient account of the remaining parts of the watercourse and that it will not be necessary to secure land along the stream in the zoning plan for Bergen Airport. However, the plan for Bergen Airport should take into account how the supply of water to the river system is handled. If Lønningsbekken is supplied with sufficient water even after Lønningstjern pond is filled in the stream will be able to function virtually as it does today. As a result of changes already made in the watershed, precipitation already quickly flows into the stream and out to sea. A further increase in the percentage of impervious surfaces will increase this tendency and it may thus be difficult to maintain a steady flow of water to the stream. With the development of Kvernhusbakken Industrial Area, the percentage of impervious surfaces will increase further. Mitigation measures are further described in the report *Miljøvurderinger, Gjenfylling av Lønningstjern, Multiconsult (2010).* See otherwise the water and sewer framework plan enclosed with the draft plan.

3) Scope and impact - Lilandshaugen

The existing zoning plan permits a park-like design of Lilandshaugen. The park landscape around Lønningen country house and land no. 111/8 has several high-value old oaks and also red-listed lichen. All the trees will disappear if the plan is carried out. The scope is assessed as medium negative and impact as medium negative.

4) Scope and impact - Kongshaugen

The existing zoning plan permits a park-like design of Kongshaugen and the consultation draft of the new municipal plan refers to the area as a "green structure". Expansion of the planning area includes areas set aside for commercial space and a smaller area of residences in the ANR area. The measure is considered to have low negative scope in relation to the natural environment. With low value the impact will be low negative.

Overall impact assessment Natural environment

Lønningstjern	Low to medium negative
Lønningsbekken	Low negative
Lilandshaugen	Medium negative
Kongshaugen	Low negative
Overall assessment	Low to medium negative

In summary, the purpose of this report subject is to consider whether the proposal adequately safeguards the interests of the natural environment. The greatest impact is the removal of old oaks and old courtyard trees with red-listed lichen and infilling of Lønningstjern pond. Our conclusion is that no undesirable consequences of the solutions have been revealed that would indicate that the plan cannot be implemented.

Mitigation measures in the impact assessment sense are defined as the adjustments made to the draft plan so that the proposal adequately safeguards the interests of the natural environment. We assume that there is no need for further mitigation measures.

9.6.4 Assessment according the Nature Diversity Act

The assessments pursuant to the Nature Diversity Act must be viewed in connection with the impact assessment carried out.

Section 8 Knowledge base
The Naturbase and Norwegian Biodiversity Information Centre databases have been checked out, and previous, more thorough studies of Lønningstjern pond also exist. The park landscape south of Lilandshaugen contains several large oak trees classified as selected habitat type hollow oaks. There is no evidence of Red List species of lichen and moss on the trees but they are good recruits with the capacity to become hollow oaks in the future.

The databases have no information about Red List species or valuable habitats in the area but on inspection, two Red List species of lichen were found on one of the courtyard trees by Lønningen country house. One of the species, elegant sunburst lichen, has been recorded only once before in Bergen. Sycamore is moreover an introduced species.

Section 9 Precautionary principle
The precautionary principle means that avoiding possible significant harm to biodiversity shall be the aim. The zoning plan looks at several options for saving the Lønningen estate, which is located immediately next to the park landscape. It has not been possible to find alternative development solutions.

Section 10 Cumulative environmental effects
The area is located close to the airport and surrounding areas have gradually been covered with buildings. It is likely that there will be further development of the airport area. The cumulative environmental effect is therefore great, and it is hard to imagine maintaining natural areas, both because the areas will be too small, and because of the interference from the activity at the airport.

When it comes to hollow and ancient oaks, there is no information about the situation in general in the municipality and in the county, but we know that there are few environments with oak forests in Bergen.

Section 11 User-pays principle
Mitigation measures, more studies or monitoring related to the zoning plan have not been proposed.

Section 12 Environmentally sound techniques and methods of operation
Alternative localisation is an option for avoiding damage to biodiversity. This is considered in the zoning plan.

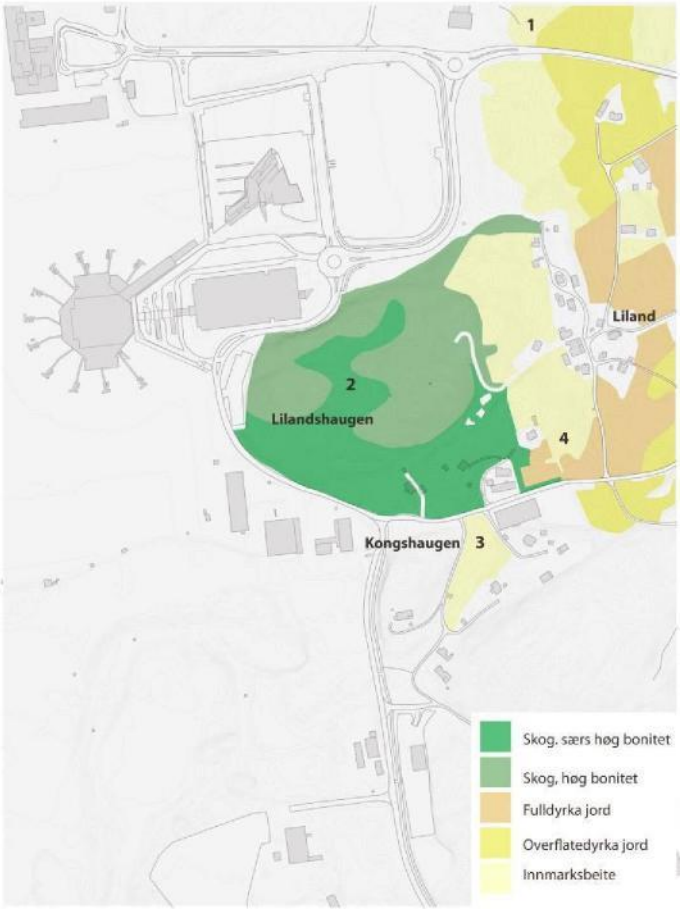
9.7 Agriculture

9.7.1 Main issue

The planning area touches agricultural land to some degree. Most of this has already been rezoned for other purposes, some smaller areas have the status Agriculture, nature and outdoor recreation purposes in the land-use part of the municipal plan. It must be clarified whether some of these areas have value in an agricultural context and whether the measure may have consequences for agriculture.

9.7.2 Value, scope and impact assessment

The following areas are relevant to assess against agricultural values:



1. Within the plan border for the existing zoning plan is a smaller area by the petrol station that is defined as infield pasture on the soil type map. The area is, however, zoned as a park belt and the area no longer belongs to an agricultural property.
2. Lilandshaugen has very high site quality and is therefore well suited for forestry. Aside from a few scattered spruce trees, its forestry potential has not been tapped to any extent. Since the area is already zoned as a park belt, its real agricultural value is assessed as zero.
3. Just east of Kongshaugen is a smaller area defined on soil type maps as infield pasture. This land is more of a horticultural nature attached to housing in the area and is laid out in the municipal plan as commercial space. The area therefore no longer has any agricultural value.
4. Just east of the main house at Lønningen is a smaller ANR area now within the new plan borders. The area consists of several buildings surrounded by forest, but has no value as infield.

Illustration Norconsult 2011

However, it should be noted that most of the park belt buffer located inside the existing plan toward the farmsteads at Liland will disappear in the new plan. This would still not have a direct impact on land use outside the planning area. On the whole, the assessment of the situation is that there are no agricultural values within the planning area.

As there are no agricultural values within the planning area there is accordingly no scope and no impact.

In summary, the purpose of this report subject is to consider whether the proposal adequately addresses agricultural interests. Since no agricultural values have been registered it is concluded that there are no undesired impacts related to the subject.

9.8 Cultural monuments and cultural environment

9.8.1 Main issue

Implementation of the zoning plan will lead to major changes in the local landscape, part of which is natural and part of which is cultural. The changes affect cultural landscapes, cultural environment and cultural monuments in the area.

***Modern period (post 1500 to more recent times)/cultural landscape**:* The planning area affects cultural heritage environments at Lønningen on land no. 110 and at Liland on land no. 111 in the City of Bergen. The main house on the Lønningen estate was built as a bower in the 1700s, the facility also includes an outbuilding (an old cottage) and gardens. There are also other structures within the area such as war remains and old paths, stone walls, traces of roads etc.

Pre-modern period (pre-1500s): It has been assumed that an old church ruin lies within the planning area. The age of the properties at Liland and Lønningen indicate that the area may have potential for further discoveries of previously unknown older cultural monuments. Hordaland County Authority has therefore undertaken cultural history registrations and research in the area.

9.8.2 Methodology

The starting point is the methodology in Norwegian Public Roads Administration Manual 140, where value, scope and impact are assessed. Possible mitigation measures are also assessed.

Modern period (post 1500 to more recent times)/cultural landscape
Modern period cultural monuments within the planning area relate to country house and farm buildings and war relics. Within the influence areas, the starting point is SEFRAK registrations and information from the local history of Fana and descriptions in "Bergenske lyststeder" (Bergen country houses) by Bjørn Trumpy.

In addition, assessments have been made of some structural elements in outfields that are not present in these registers. These are registrations Hordaland County Authority has made in the field in conjunction with cultural history registrations.

The influence area is considered to be the area that either is directly affected or whose surroundings will be changed as a result of the measure. Areas not affected by the measure, i.e. the expansion of the zoning plan are not considered. This applies, for example, to building environments on the western and southern side of the airport.

Pre-modern period (pre-1500s)
Studies have been carried out in accordance with Section 9 of the Cultural Heritage Act, as on the basis of topography and previously known cultural monuments in the area, one could expect to find traces related to prehistoric farming settlements in the planning area. During the registration process, excavators were used to search the surface for visible cultural monuments. See separate report (Report 57/2010 Hordaland County Authority), attached to the draft plan for further details.

Sources for basic information
- Askeladden
- SEFRAK registrations
- LRT, Rådal - Flesland route assessments, zoning plan, technical feasibility project. N- 007-AV-Kulturminner og kulturmiljø (cultural monuments and cultural environment), Asplan Viak 2010.
- Fana local history
- ”Bergenske lyststeder” (Bergen country houses) B. Trumpy

Criteria for value assessment
Value assessment has been undertaken according to the criteria in Norwegian Public Roads Administration Manual 140.

9.8.3 Description of cultural monuments and cultural environment

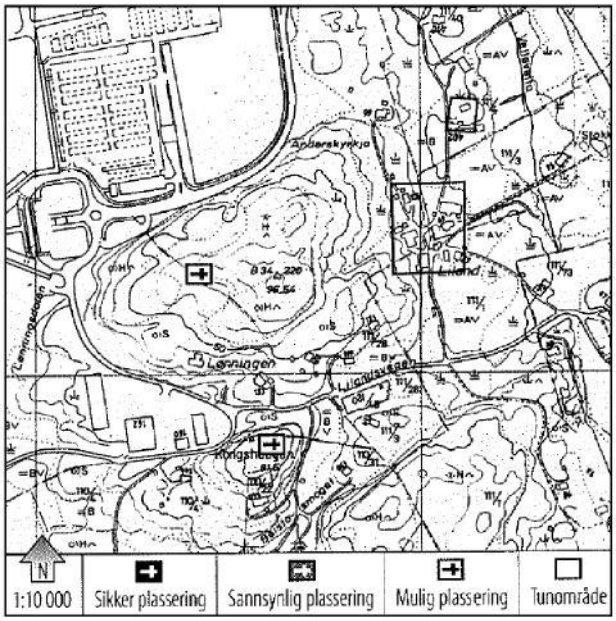
In connection with "LRT Rådal- Flesland route assessments zoning plan, technical feasibility project" an expert report was prepared describing the cultural monuments and cultural environment east of the airport at Lønningen and Liland. This describes two cultural heritage environments that border the planning area for Bergen Airport, Flesland: Lønningen and Flesland.

Hordaland County Authority has done cultural history registrations and studies in the area, this work is summarised in the report "Cultural registrations. Zoning plan for Bergen Airport, Flesland," enclosed with the draft plan. (The report (in Norwegian) is numbered 57/ 2010).

Kulturlandskapet på Liland. Lilandshaugen og Anderskykja midt i bildet. Kongshaugen litt til venstre.

Pre-modern period

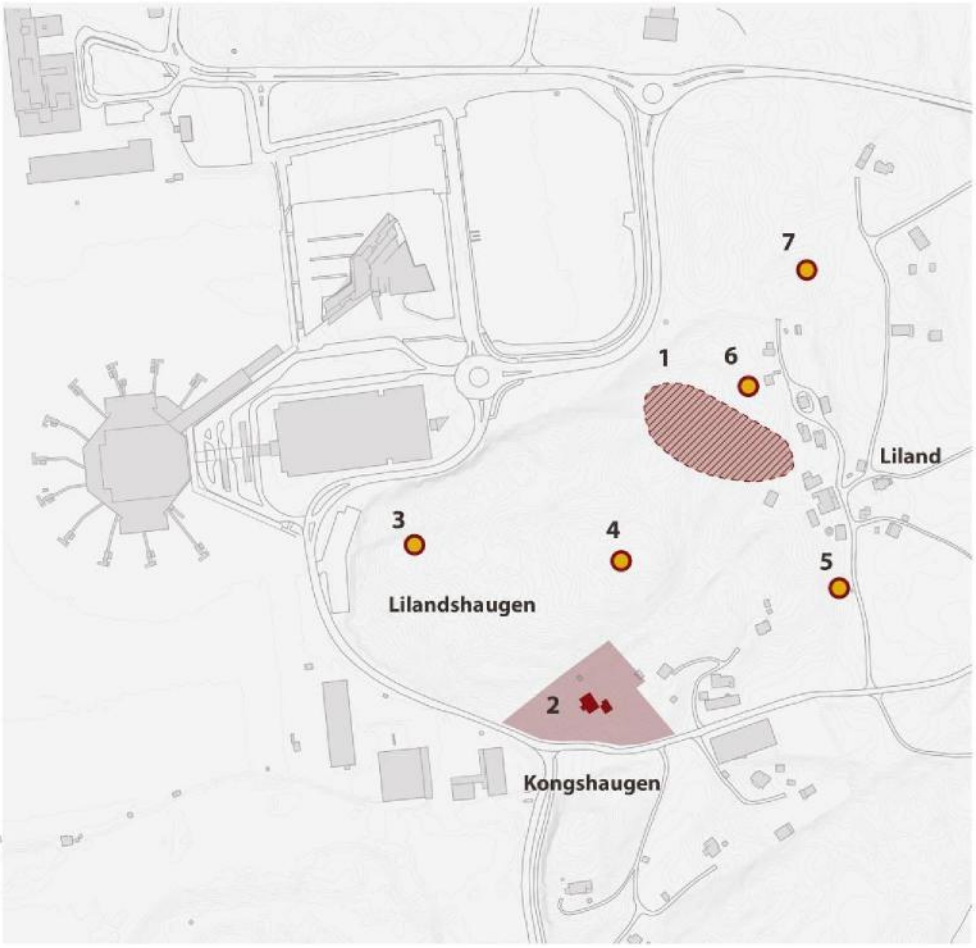
Archaeological examinations have been undertaken within the planning area and findings have been made of an automatically protected agricultural locality in the area which the registration map on the following page shows as site 1. The automatically protected locality consists of several phases of prehistoric cultivation and three structures; a hearth/cooking pit, a trench and an embedment. See more details in said report from Hordaland County Authority.



Mulige lokaliseringer av kirkestedet på Liland. Kilde, Buckholm 1998.

According to the report "LRT Rådal- Flesland route assessments zoning plan, technical feasibility project" the area is also said to contain a medieval church, but its location is uncertain. It was previously assumed that it may have stood on Lilandshaugen or on Kongshaugen.

No church ruins were found in the archaeological examinations carried out by Hordaland County Authority in the autumn of 2011.



Cultural monuments from pre-modern period:

1. Area where findings were made of pre-modern period cultural monuments

Cultural monuments from modern period:

2. Lønningen country house with gardens
3. Bunker from Second World War
4. Bunker from Second World War
5. Milk collection point
6. Cobbled road
7. Cobbled road

The map illustration shows registered cultural monuments in the area.
Source: Hordaland County Authority, report 57/2010

Modern period
Cultural monuments from the modern period have been registered in the planning area, shown on the registration map as locality 2 to 7.

Locality 2 is the country house at Lønningen (land no. 110, title no. 1), which contains two buildings from the 1700s and is surrounded by gardens.

In "Bergenske lyststeder" (Bergen country houses) by Bjørn Trumpy we read that the Lønningen estate belonged to Munkeliv Monastery estate until 1661. In 1732, the estate was taken over by H. H. Formann. His son Rasmus Lindegård Formann took over in 1772. He was a merchant who lived in Bergen and built the house in the 1780s as a bower for himself and his family. Rasmus Lindegård Formann's widow lived on the estate. The main building is a typical midarch house from the Rococo period and is in relatively good condition. The house's facade facing west is symmetrical with a midarch. The building has the original rooms and details such as mouldings and doors are largely intact. A number of changes have been made, e.g. the windows have been replaced, new floors have been laid inside, the kitchen has been replaced etc. There have also been some water leaks, but these have been repaired. The main impression is a well-preserved building with good architectural qualities. The building has served a number of different functions such as a "boys' home." It is not in use today.

The outbuilding lying right behind the country house is registered together with the house in the SEFRAK registry and dated to the 1700s (SEFRAK Id 1616001 and 1616002). The outbuilding is described as an original cottage from the 1700s. This building is in poor condition.

Main house with gardens at Lønningen seen from the northwest.

Main house with gardens at Lønningen seen from the southwest.

Main house at Lønningen, main facade to the west.

Main house and outbuilding at Lønningen seen from the east.

Main house with gardens at Lønningen seen from the northwest.

Main house and outbuilding at Lønningen seen from the north.

All photos were taken by Norconsult in February 2011.

There are also several traces of the old agricultural landscape on Lilandshaugen: fields, old roads, brickwork, stone walls and ruins. The traces are found in the courtyard area up towards Lilandshaugen in the north and in the draw which extends eastward toward the old farmyard area at Liland. The two bunkers from the Second World War on Lilandshaugen and milk collection point and remnants of roads are described in the report "Cultural registrations. Zoning plan for Bergen Airport, Flesland", enclosed with the draft plan (The report (in Norwegian) is numbered 57/ 2010).

Country houses in the Bergen area

Until the 1900s, Bergen was heavily concentrated in what today is the historic centre core. Until the Reformation, the church owned large land properties in and around Bergen. After the Reformation, the king took over the properties. In the period from 1660 to 1679, the king sold a number of properties to rich senior public servants and merchants to prop up the treasury after the war with Sweden. Country houses were eventually built on a number of these properties.

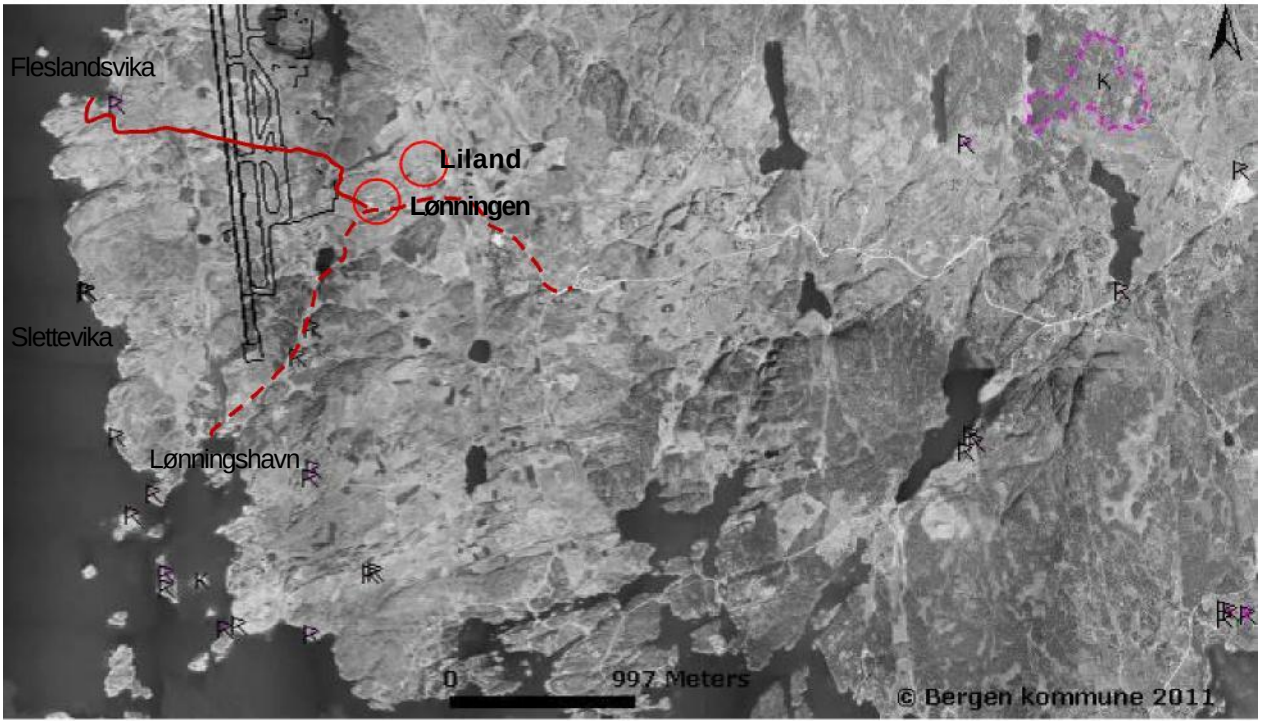
The country houses were built around the city mainly in the period 1750-1850, a prosperous time for shipping and trade. The country houses were built by senior public servants and merchants for enjoyment and entertaining. In the early 1800s there were around 70 larger freestanding patrician houses around Bergen.

The Lønningen country house - transport, location and relationship to landscape

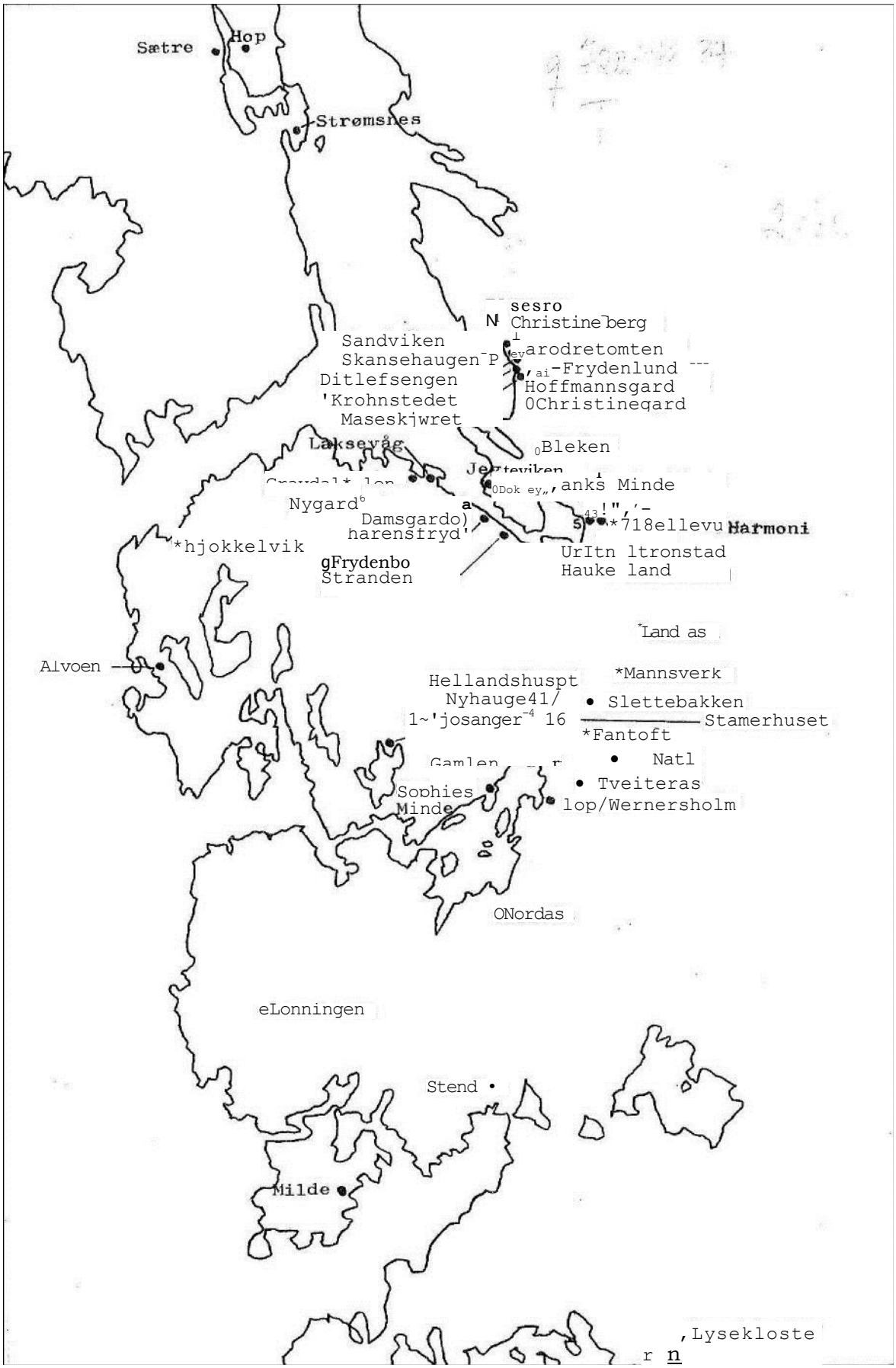
Journeys to the country houses were by boat, on foot and/or horse. The vast majority of the country houses lie close to the city centre and waterfront so it did not take too long to get there. One could use the place for Sunday outings and festivities without having to stay overnight. Lønningen is thus one of the country houses located farthest from the city. The journey here took place by boat, probably to Fleslandsvika or Lønningshavn and by horse or on foot up to the estate. Visitors came to the place by sea, and its location in the landscape with respect to the impression one experienced on arrival and the view from the country house was important.

The attention paid during the Age of Enlightenment to natural resources affected the location, design and use of the country houses. Their location in the terrain was very deliberate, often with the main house perched on a hill, often with sea views. The place was to be beautiful and simultaneously show the owner's position and status. Gardens and buildings were composed and built simultaneously, very often with symmetry as an overarching principle. A tree-lined avenue leading up to the main building was very common, and at Lønningen it curved around the building to the main entrance. Lønningen is nestled in its setting and somewhat secluded, but affords wide views of Raunefjorden and Korsfjorden.

Ortho photos from 1951 show the terrain before Flesland airport was developed. Earlier routes from the sea and up to Lønningen have been drawn in.



Ortho photos from 1951 show the terrain before Flesland airport was developed. The routes are shown: the solid line is the certain location from 1850, the dashed line is a likely route. Source: Cultural Heritage Management Office in the City of Bergen.



The map illustration shows country houses in Bergen. Source: "Bergenske lysteder" (Bergen country houses) by Bjørn Trumpy.

9.8.4 Value assessment

Cultural monuments from modern period
The automatically protected cultural monuments are representative of the era/function and are part of a context or environment with some time depth. Their value is assessed as medium.

Cultural monuments from pre-modern period
Lønningen is one of the country house estates in Bergen and an important part of Bergen's architectural and cultural history heritage of the 1700s. The main house with gardens is well-preserved and has great value. The building with its original features has great value as part of a cultural heritage environment that partly lies in its original context, i.e. in relation to its location in the landscape. The main building also has intrinsic value because of its age, architectural quality and authenticity. The gardens are partially preserved, but the changes in the surroundings such as altered views and noise have degraded the country house's empirical and utilitarian value. One of the most important features of country houses was their location on a height, and in this case overlooking the sea.

In the current zoning plan for Flesland Airport, Plan no. 18390000, the Lønningen estate with its two buildings and gardens is zoned for special area conservation. Due to their age, both buildings are subject to reporting requirements under Section 25 of the Cultural Heritage Act.

The war remains in the area are a common sight and considered low value.

The Lønningen estate is considered to have great value.

9.8.5 Scope and impact assessment – various alternatives

The plans for expanding Flesland airport are in conflict with regard to cultural monuments of great value. The developer has therefore looked at alternative uses of the area that include the country house estate, both based on the extent of conservation area in the current zoning plan and also based on more extensive conservation of the landscape around the estate.

Here, we present the options that have been considered in the process, what consequences they would have for the measure and for cultural heritage.

It should be noted that it is only feasible to site a new terminal south of the existing one. The runways lie to the west of the current terminal in an area that is already cramped, so that such siting is not an option. To the east lie the hotel and multi-storey car park. Nor is siting a new terminal north of the existing terminal applicable as this will make it impossible to use the existing terminal in the future. A new terminal located in the north will make it impossible for aircraft to taxi from the existing terminal up to a new runway 2. A new terminal must therefore lie to the south as shown.

On this basis, the following options were considered:

- Alternative 1: Limited development of Flesland airport by retaining much of the existing landscape with Lilandshaugen and the terrain around the gardens and the Lønningen country house.

- Alternative 2: Limited development of Flesland airport by retaining parts of Lilandshaugen and joining them with the preserved part of the terrain around the gardens and the Lønningen country house, creating a "peninsula". Access to the rear via the existing road.

- Alternative 3: Limited development of Flesland airport by retaining parts of Lilandshaugen and part of the grounds around the gardens and the Lønningen country house, establishing a "terrain island". The county road in a cutting in the terrain to the rear. Access via short-term parking on existing road.

- Alternative 4: Relocating the Lønningen estate to a different plot, preferably in Ytrebygda. A check of possible stakeholders and location has been carried out.

Alternative 1

Short description of the alternative

Limited development of Flesland airport by retaining much of the existing landscape with Lilandshaugen and the terrain around the gardens and the Lønningen country house. Parking partially out in the open and partially in a garage facility inside Lilandshaugen. The public road system is assumed to run through a tunnel to the east (outside the sketch).

Sketch alternative 1. Bjørbekk & Lindheim 12 June 2010.

Scope and impacts

For cultural monuments from pre-modern period:
The measure does not affect known pre-modern period cultural monuments and thus has no impact on cultural monuments from the pre-modern period.

For cultural monuments from modern period:
Cultural monument 3, a bunker from the Second World War must be removed. To some degree, the measure will conflict with the Lønningen country house, and the airport facility will come closer to the gardens and cultural landscape. The two buildings on the Lønningen country house estate and the garden can be kept, but parts of Lilandshaugen will be removed. Overall expansion of the landside of the airport and new road systems with a roundabout will cause the country house to be more exposed and have a view of the terminal area and airport grounds south of the terminal.

The scope is set at low to medium, since the measure will reduce historical legibility and weaken the connection between the country house and its surroundings. The overall value of the cultural heritage environment is high. The impact is thus low to medium negative.

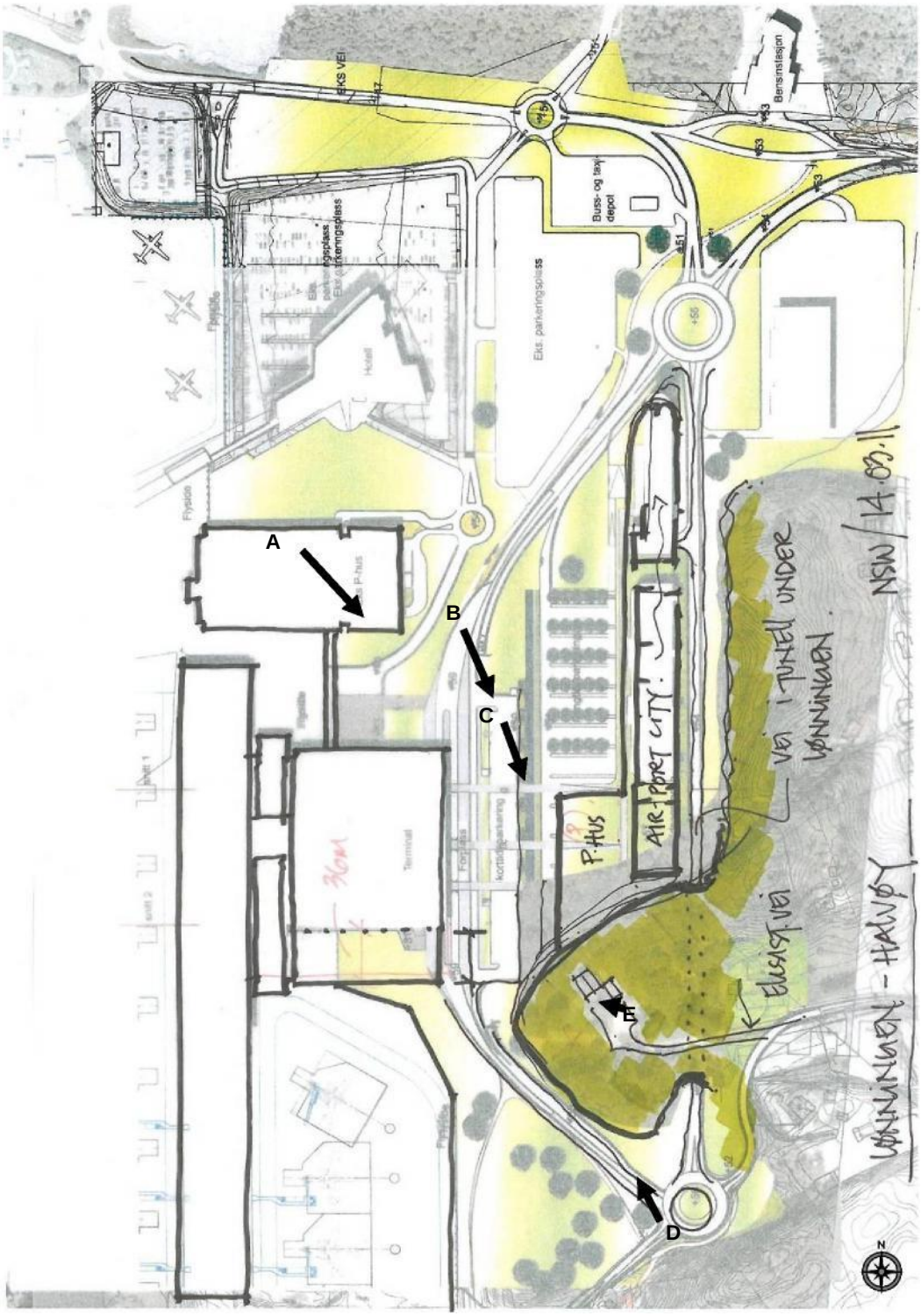
For the measure: Expansion of Flesland airport
For the airport's part, this alternative will:

- Involve a total rearrangement of the terminal project as currently planned
- Not provide sufficient space for the functions that are required. Among other things, there will be neither room for the functions that must move as a result of the terminal project, nor the possibility of new functions/businesses as a result of increased activity at the airport.
- Provide a worse solution in purely aesthetic and spatial terms with regard to a new terminal: Aesthetically speaking, there will be very little space around the new terminal. Instead of meeting openness and a future-oriented airport and commercial area when exiting the terminal, one will look straight into an opposing rock face.
- Be expensive (because of the need for both a road and parking facility in the mountain)
- Provide an inflexible solution during construction where the existing terminal will remain and be in operation. With limited space available, it will be difficult to achieve good solutions for cars, buses and taxis in this period, which could take several years.

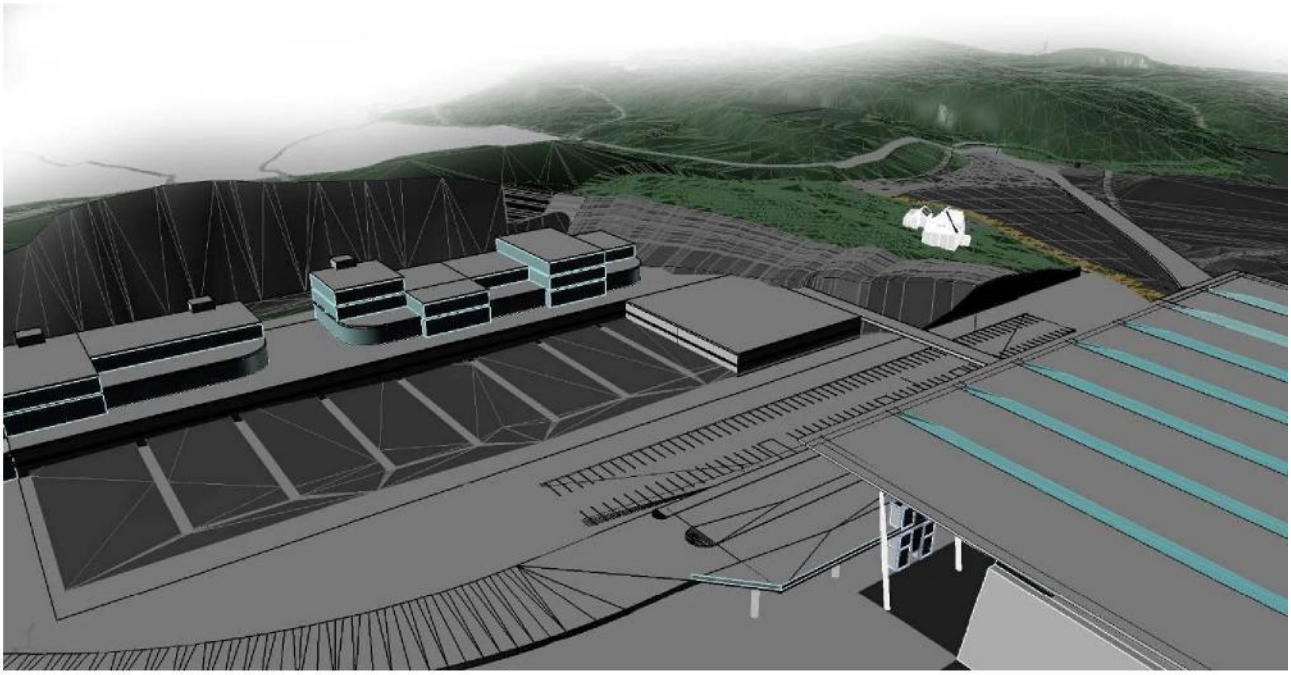
Summarised:
This alternative will not be considered due to space requirements, construction sequence and functionality. The alternative does not provide sufficient space for the functions to be included in the measure that is zoned.

Alternative 2

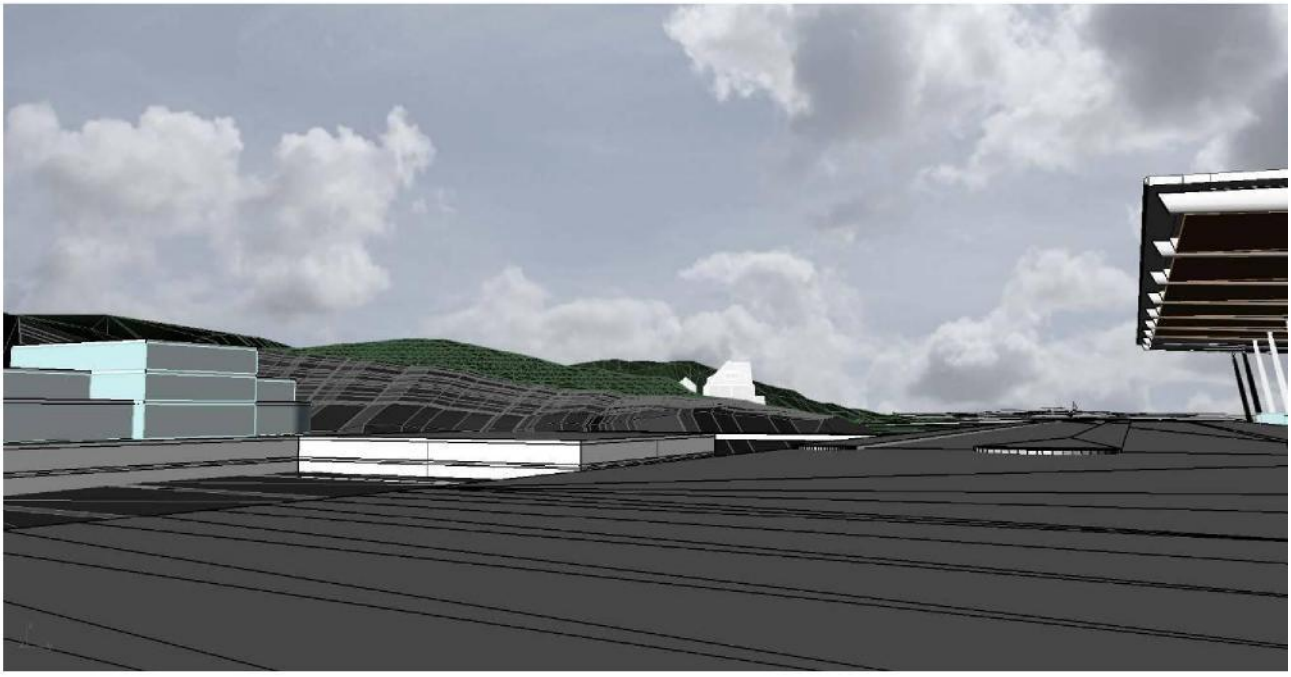
Short description of the alternative
Limited development of Flesland airport by retaining parts of Lilandshaugen and joining them with part of the terrain preserved around the gardens and the Lønningen country house, i.e. creating a "peninsula" in the terrain.



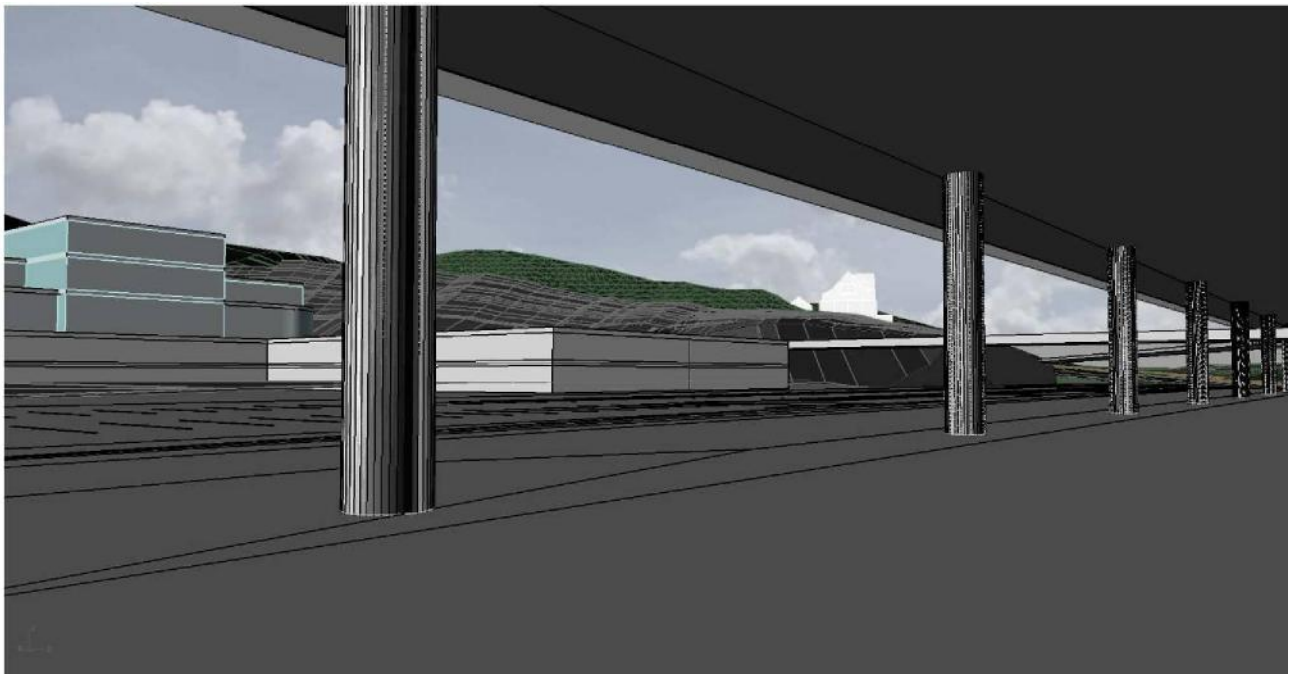
Sketch alternative 2. Standpoint for images in 3D model is shown. Narud Stokke Wiig 14 March 2011.



3D modelling of alternative 2. Bird's-eye view from the northwest, standpoint A. Narud Stokke Wiig 24 March 2011.



3D modelling of alternative 2. Seen from terminal building, standpoint B. Narud Stokke Wiig 24 March 2011.



3D modelling of alternative 2. Seen from parking facility, standpoint C. Narud Stokke Wiig 24 March 2011.

Scope and impacts

For cultural monuments from pre-modern period:
The measure will lie close to the registered and automatically protected agricultural locality and parts of the automatically protected cultural monument will lie within the area set aside for a vegetation shield. Intervention that will affect the locality shall not take place. The scope is low negative since automatically protected cultural monuments will not be destroyed. This yields low negative impact.

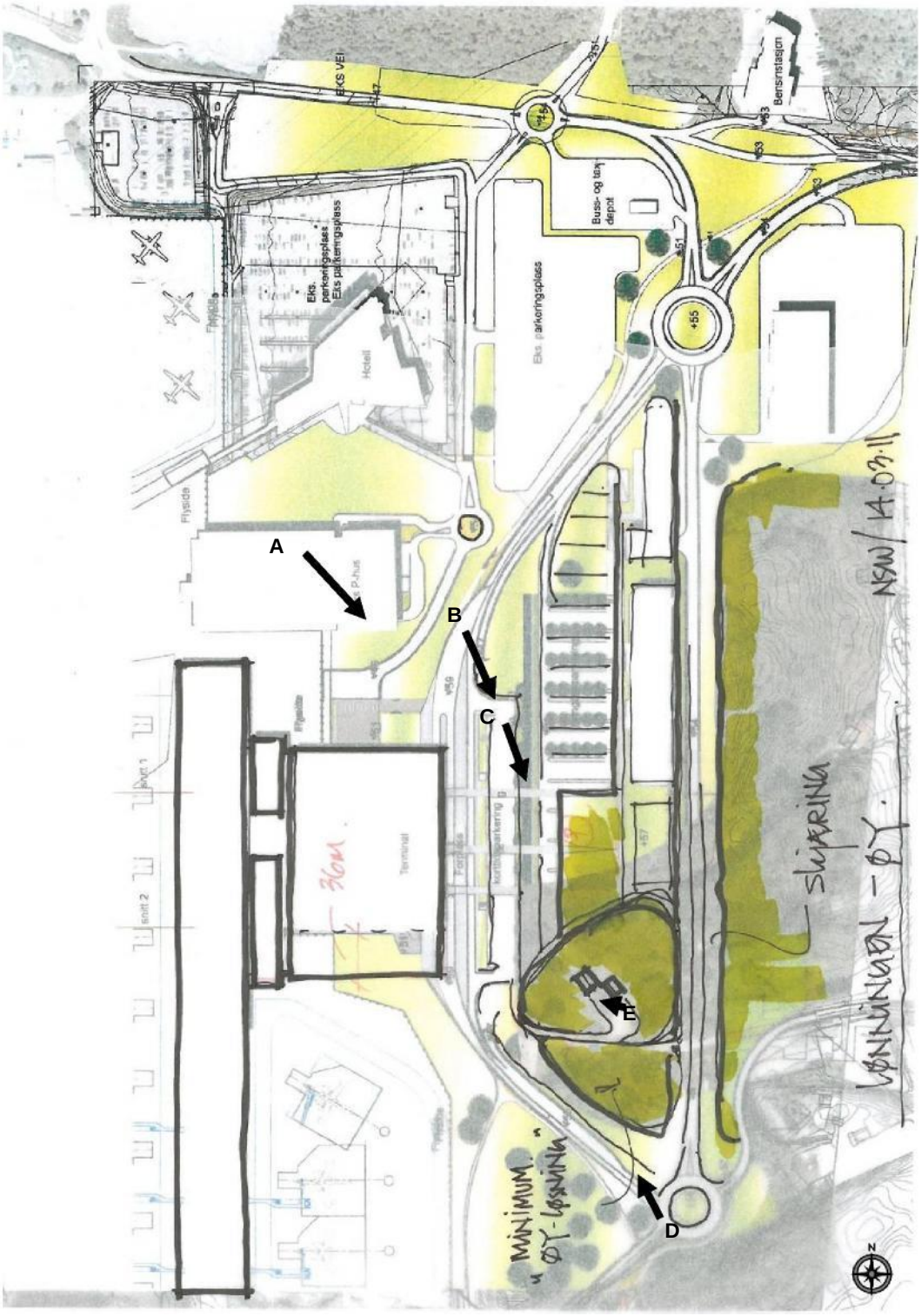
For cultural monuments from modern period:
Cultural monuments 3 and 4, bunkers from the Second World War must be removed. The measure would not be in conflict with the Lønningen country house in such a way that the two buildings or gardens must be removed. The buildings will be surrounded by cuts on all sides except the east. The highest cut will be to the north. The country house will have visual access - and be exposed to – the terminal area, the road system including the roundabout in the south and the expanded landside of the airport and new road system with roundabout. It will also be exposed to noise, making it difficult to find a good use for the facility. The country house will have little relation to the landscape it has been a part of, as this will largely be removed. Its empirical and utilitarian value will be sharply reduced.
The scope is considered medium negative, as the measure will greatly reduce historical legibility and weaken the relationship between the country house and its surroundings. The impact will be medium to high negative.

For the measure: Expansion of Flesland airport
Such a development will entail a reduction of the Airport City area and reduce the parking area/traffic forecourt in front of the terminal. The new landscape space formed by cutting both to the east and south gives rise to a closed and unattractive space for the new functions. It also provides little flexibility for the development and adjustment of this during the process. Overall, this alternative sets limits on the possibilities for creating a functional and comprehensive facility with good flexibility and spatial quality.

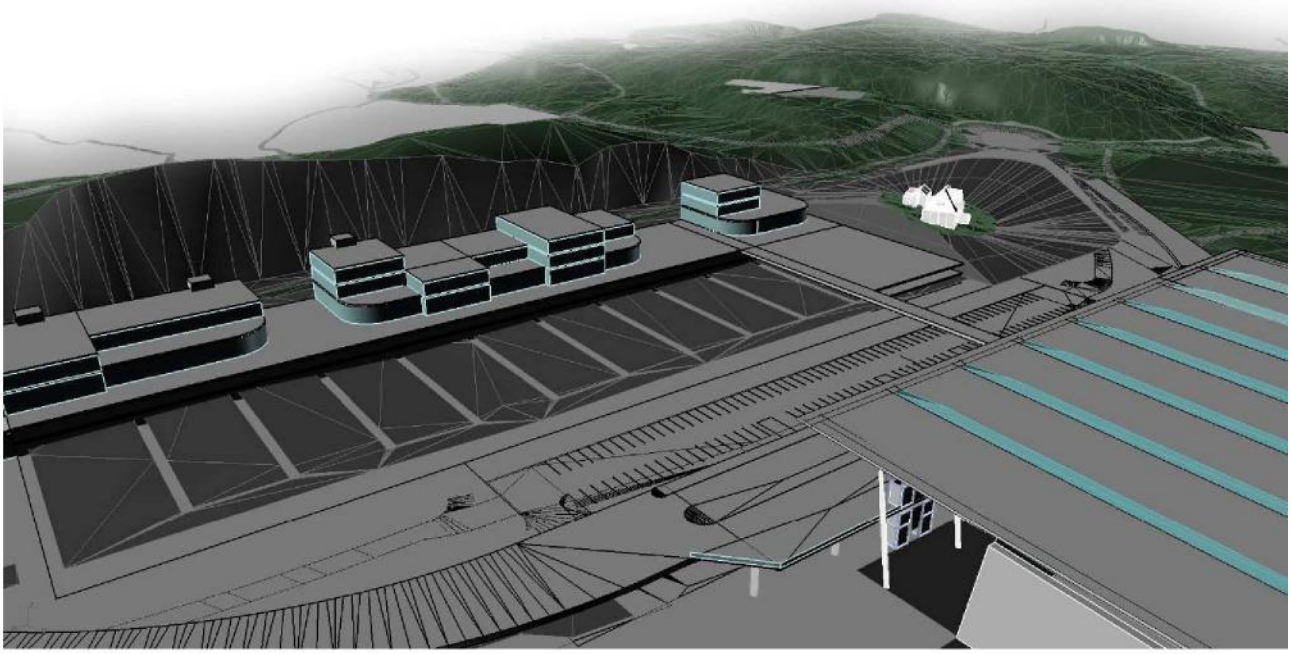
Summarised:
This alternative will not provide preservation of the landscape space as a cultural heritage environment so that it retains its value. It is precisely buildings and cultural landscapes as a whole that give the Lønningen estate great value. Since the alternative neither preserves the value of the cultural heritage environment nor provides space for all the functions to be included in the measure that is zoned, this alternative does not appear to be very feasible.

Alternative 3

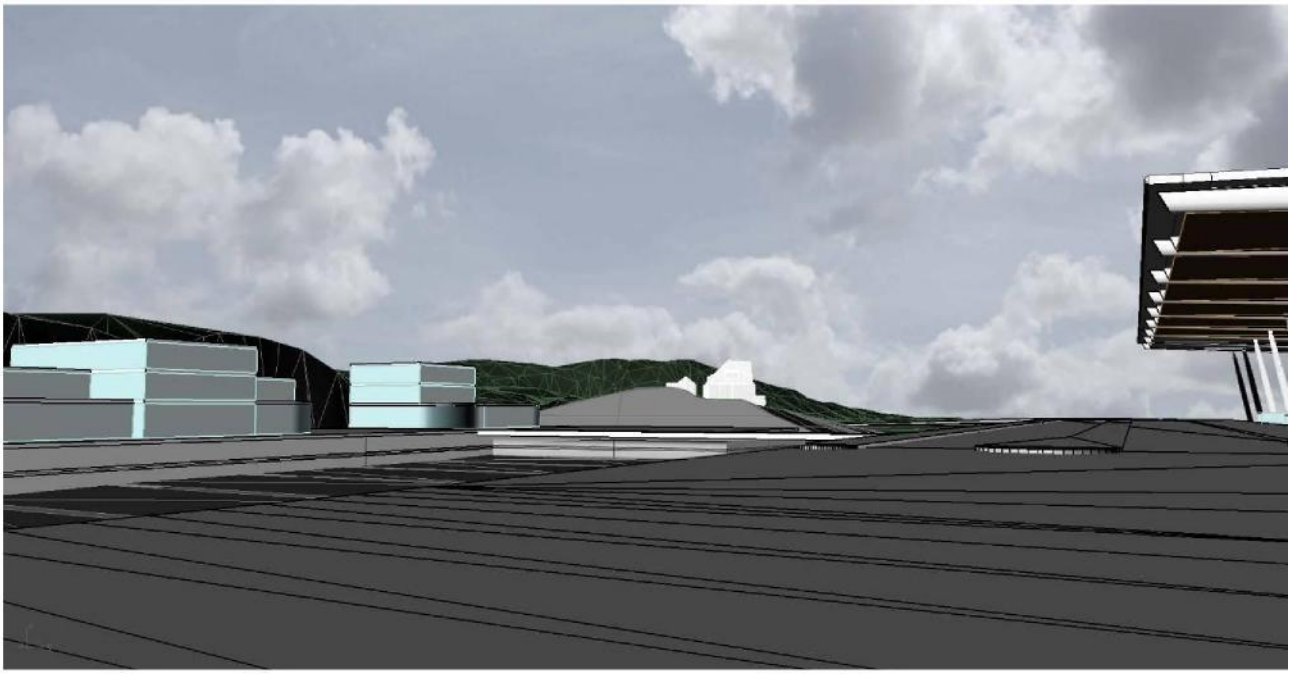
Short description of the alternative
Limited development of Flesland airport by keeping parts of Lilandshaugen and some of the terrain around the gardens and the Lønningen country house, creating a "terrain island".



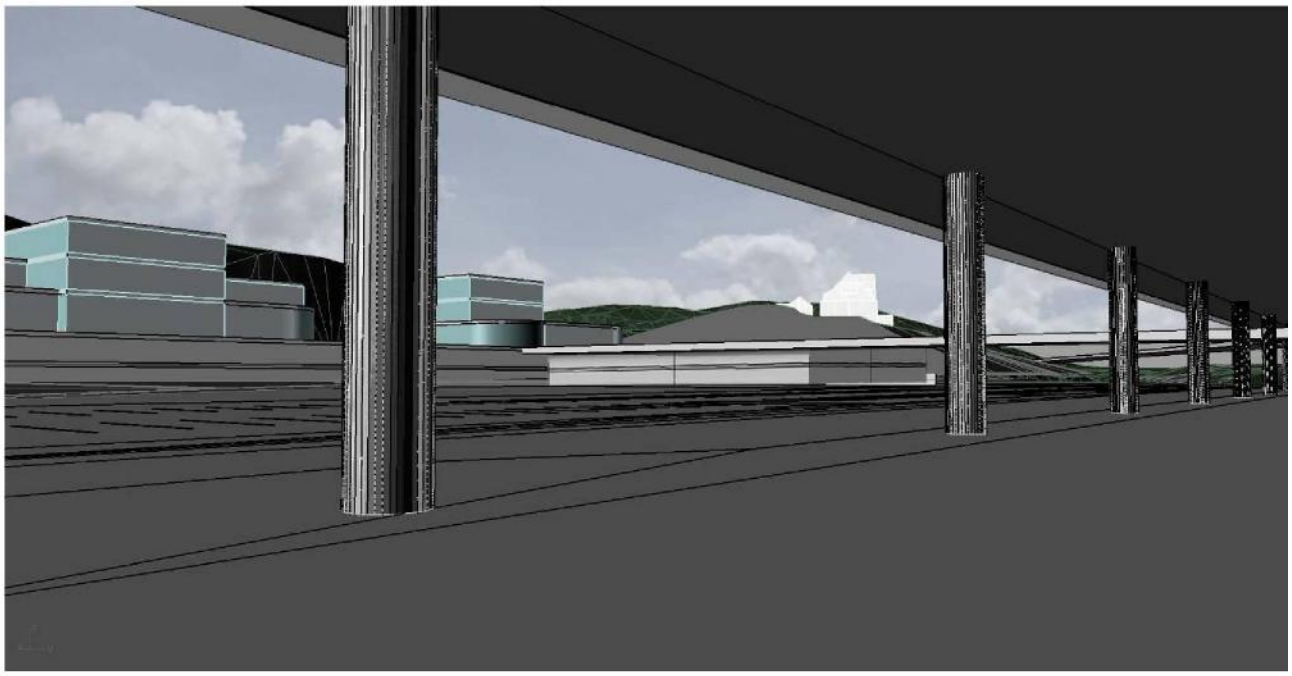
Sketch alternative 3. Narud Stokke Wiig 14 March 2011.



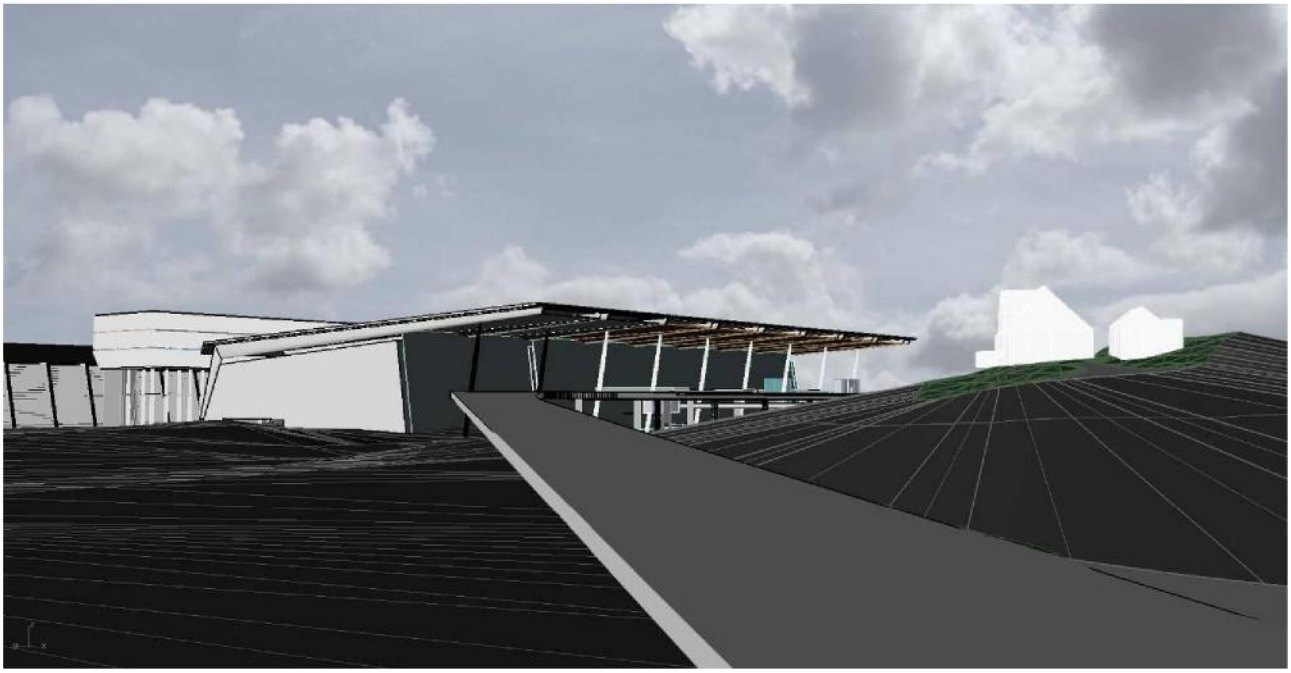
3D modelling of alternative 3. Bird's-eye view from the northwest, standpoint A. Narud Stokke Wiig 24 March 2011.



3D modelling of alternative 3. Seen from terminal building, standpoint B. Narud Stokke Wiig 24 March 2011.



3D modelling of alternative 3. Seen from the parking facility, standpoint C. Narud Stokke Wiig 24 March 2011



3D modelling of alternatives 2 and 3. Seen from ramp for road system in the south, standpoint D. Narud Stokke Wiig 24 March 2011

3D modelling of alternatives 2 and 3. Seen from the Lønningen country house toward the terminal facility, standpoint E. Narud Stokke Wiig 24 March 2011

Scope and impacts

For cultural monuments from pre-modern period:
The measure will lie close to the registered and automatically protected agricultural locality and parts of the automatically protected cultural monument will be within the area allocated for a vegetation shield. Interventions that will affect the locality will not take place. The scope is low negative since automatically protected cultural monuments are not destroyed. This yields low negative impact.

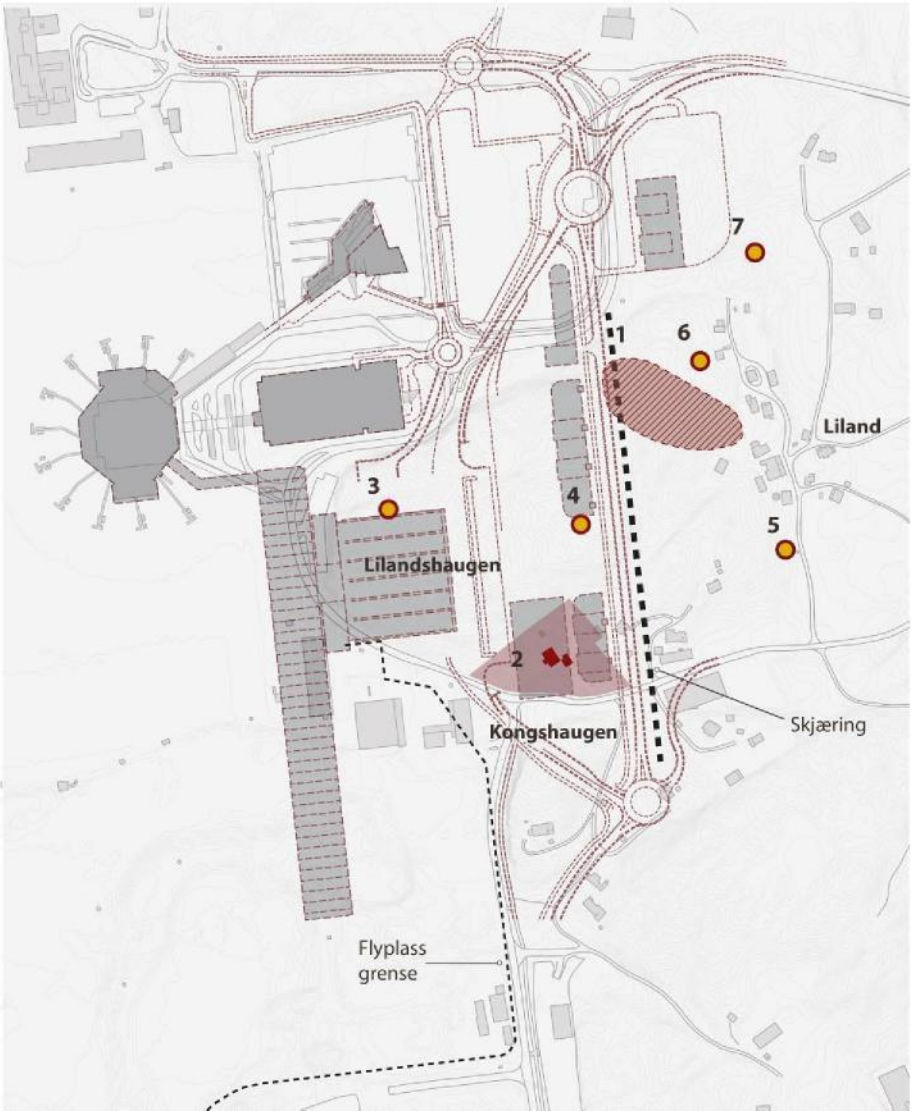
For cultural monuments from modern period:
Cultural monuments 3 and 4, bunkers from the Second World War must be removed. The measure would not be in conflict with the Lønningen country house in such a way that the two buildings or gardens must be removed. The buildings will be surrounded by cuts on all sides and remain as an island in an area that will be characterised by new functions. The country house will have visual access - and be exposed to – the terminal area, the road system including the roundabout in the south and the expanded landside of the airport and new road system with roundabout. It will also be exposed to noise, making it difficult to find a good use for the facility. The country house will have very little relation to the landscape it has been a part of, as this will largely be removed. Its intrinsic, empirical and utilitarian value will be sharply reduced.
The scope is considered high negative, as the measure will greatly reduce historical legibility and sever the relationship between the country house and its surroundings.
The impact will be high negative.

For the measure: Expansion of Flesland airport
Such a development will entail a reduction of the Airport City area and reduce the parking area/traffic forecourt in front of the terminal. The new landscape space formed by cutting both to the east and south gives rise to a closed and unattractive space for the new functions. It also provides little flexibility for the development and adjustment of this during the process. Overall, this alternative sets limits on the possibilities for creating a functional and comprehensive facility with good flexibility and spatial quality.

Summarised:
This alternative will not provide preservation of the landscape space as a cultural heritage environment so that it retains its value. It is precisely buildings and cultural landscapes as a whole that give the Lønningen estate great value. Since the alternative neither preserves the value of the cultural heritage environment nor provides space for all the functions to be included in the measure that is zoned, this alternative does not appear to be very feasible.

Alternative 4

Short description of the alternative
This alternative is the measure as it appears in the draft plan. The measure is described in Chapter 8.1.



Cultural monuments affected by the measure:

Cultural monuments from pre-modern period:

1. Area where findings have been made of pre-modern period cultural monuments. Road cuts will lie close to this area.

Cultural monuments from modern period directly affected by the measure:

2. Lønningen country house with gardens
3. Bunker from Second World War
4. Bunker from Second World War

The map illustration shows registered cultural monuments in the area together with a sketched illustration of the measure.

Impacts for cultural monuments from pre-modern period
The measure will lie close to the registered and automatically protected agricultural locality and parts of automatically protected cultural monuments will lie within the area set aside for a vegetation shield. Interventions that will affect the locality shall not take place. The scope is low negative since automatically protected cultural monuments will not be destroyed. This yields low negative impact.

Impacts for cultural monuments from modern period
The measure is in direct conflict with cultural monuments and the cultural landscape at Lønningen in that the western part of Lilandshaugen must be removed. The Lønningen country house with its two buildings and gardens must be removed with the implementation of the measure. The country house has great cultural heritage value, the scope is great and the impact on the cultural monuments at Lønningen is high negative.

The measure is also in direct conflict with two Second World War bunkers located on Lilandshaugen. They must be removed with implementation of the measure. These cultural monuments are assessed as having low value, the scope of the measure is great and the impacts on these cultural monuments is medium negative.

The overall impact on pre-modern and modern period cultural monuments in the planning and influence area is high negative.

Mitigating measures:
Relocation of the buildings on the Lønningen estate to a different plot, preferably in Ytrebygda, has been promoted as a proposed mitigation measure. There has been contact with stakeholders, in part to consider whether the Arboretum at Milde may be a good option. The developer wants to work actively with cultural heritage authorities to find a good solution. The building has a design that is suitable for moving, it has great intrinsic value and can also have value as a historical narrative when used in conjunction with leisure and cultural activities in Ytrebygda.

9.8.6 Summary/conclusion

The impact assessment reviews four alternatives that were assessed during the process and the impacts these will have on the cultural monuments and the measure:

Alternative	Overall value for cultural monuments in the influence area	Scope	Overall impact on cultural monuments	Summarised impact in relation to the measure
1	High	Low-medium negative	Low - Medium negative	The alternative is not recommended due to lack of space for the functions to be included in the measure that is zoned.
2	High	Medium negative	Medium - High negative	Since the alternative neither preserves the value of the cultural heritage environment nor provides space for all functions to be included in the measure that is zoned, this alternative does not seem very feasible.
3	High	Medium-high negative	High negative	Since the alternative neither preserves the value of the cultural heritage environment nor provides space for all functions to be included in the measure that is zoned, this alternative does not seem very feasible.
4	High	High negative	High negative	The alternative enables development in accordance with the need for expansion. At the same time, the alternative, through mitigation measures, could ensure the safeguarding of the buildings on the Lønningen estate, through relocation and changed use.

Alternative 4 is the only alternative that enables development in accordance with the requirements set for the expansion of Flesland airport.

Based on our assessment and the cultural heritage authorities' clear emphasis on the overriding importance that the context has for the cultural monument that is Lønningen country house, none of the alternatives will be able to preserve the Lønningen estate's high value. In the first three alternatives, the country house itself could be preserved, but its surroundings would change to such an extent that its value would be degraded. This applies to its intrinsic value as part of a cultural landscape, but also its empirical and utilitarian value to a large degree, which will be very important for both the developer and the general public. Because of the major changes in the surroundings, the view would be degraded and noise from the airport would make it very difficult to find a good function for the building.
Since preservation of the facility is in direct conflict with the need for expansion of the airport, the developer submits the alternative that enables expansion according to the needs of the airport.

The overall impact of the draft plan on pre-modern and modern period cultural monuments is high negative.

In summary, the purpose of this report subject is to consider whether the proposal adequately addresses cultural monument and cultural environment interests. Undesired impacts have been uncovered, mainly related to the fact that the measure affects pre-modern period cultural monuments and that the Lønningen country house must be removed. The Hordaland County Authority has indicated that the cultural monuments from the pre-modern period will likely be released. With respect to the Lønningen estate, the proposer proposes moving the main house at Lønningen to a suitable location as a mitigation measure. This mitigation measure is included in the draft plan by the consecutive ordering requirements in the expansion project.

9.9 Traffic (vehicle, rail, pedestrian/bicycle)

9.9.1 Main issue

Traffic at the terminal increasing from 5 million passengers to 10 million passengers and the development of Airport City will entail increased vehicle, public transport and pedestrian/bicycle traffic up to the area.

The draft plan calls for a reorganisation of the road system at the airport compared to today. There is a need to assess whether the existing and new road system has an appropriate design for efficiency, management and road safety. This applies both to vehicles and pedestrian/bicycle traffic. It must also be examined whether public transport/environmentally friendly transport solutions are adequately facilitated and the parking coverage is properly dimensioned.

9.9.2 Impact assessment

Traffic capacity

Starting point

Reference is made to traffic analysis, Ramboll 2011, submitted together with the draft plan. The analysis, along with the discussion below, constitutes the impact assessment for traffic capacity.

Two future scenarios were looked at in the traffic analysis:

Alternative 0	Alternative 1	Alternative 2
• Keep Bergen Airport Flesland in its current form with associated traffic and road network. • Current zoning plans are the basis.	• Starting point in alternative 0 • Development of new terminal at Bergen Airport Flesland • Development of Airport City • Cargo/technical/depot	• Starting point in alternative 1 • Additional development of industrial and commercial areas Lønningen I and II + Espehaugen I and II • Development of IKL 10 and IKL 11, which have been set aside for commercial purposes in the municipal plan

Alternative 1 entails full development according to the zoning plan. The City of Bergen requested the assessment of alternative 2.

Two development scenarios were examined for each of the alternatives:

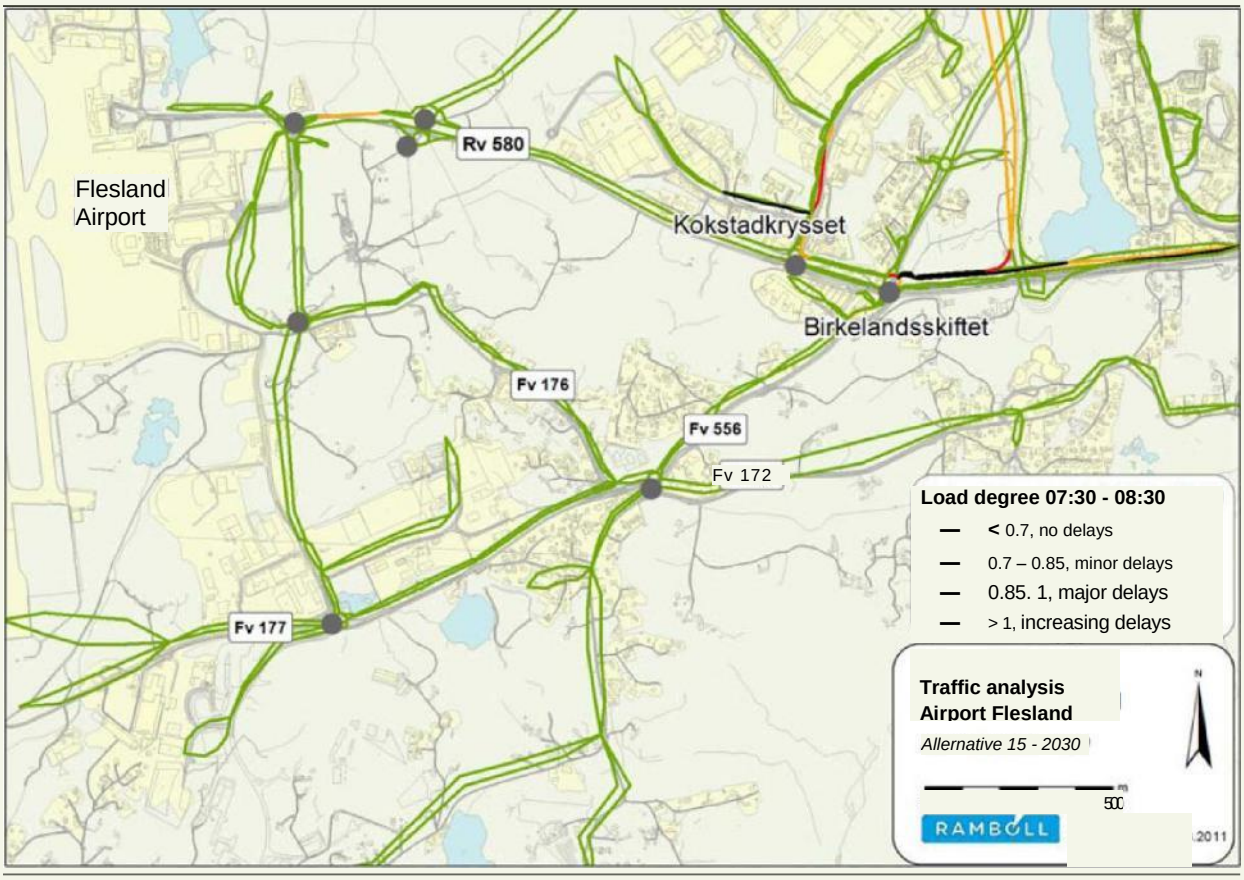
A) The current transport division: 25% public transport share (bus)
B) Target of 50% increase of the public transport share to 37.5%.

With the extension of the LRT to Flesland we consider a public transport increase of 50% to be realistic compared to the current situation, as described in calculation B. We therefore assume scenario B in the assessments below. Alternative A would be a worst-case scenario that can be used as a reference.

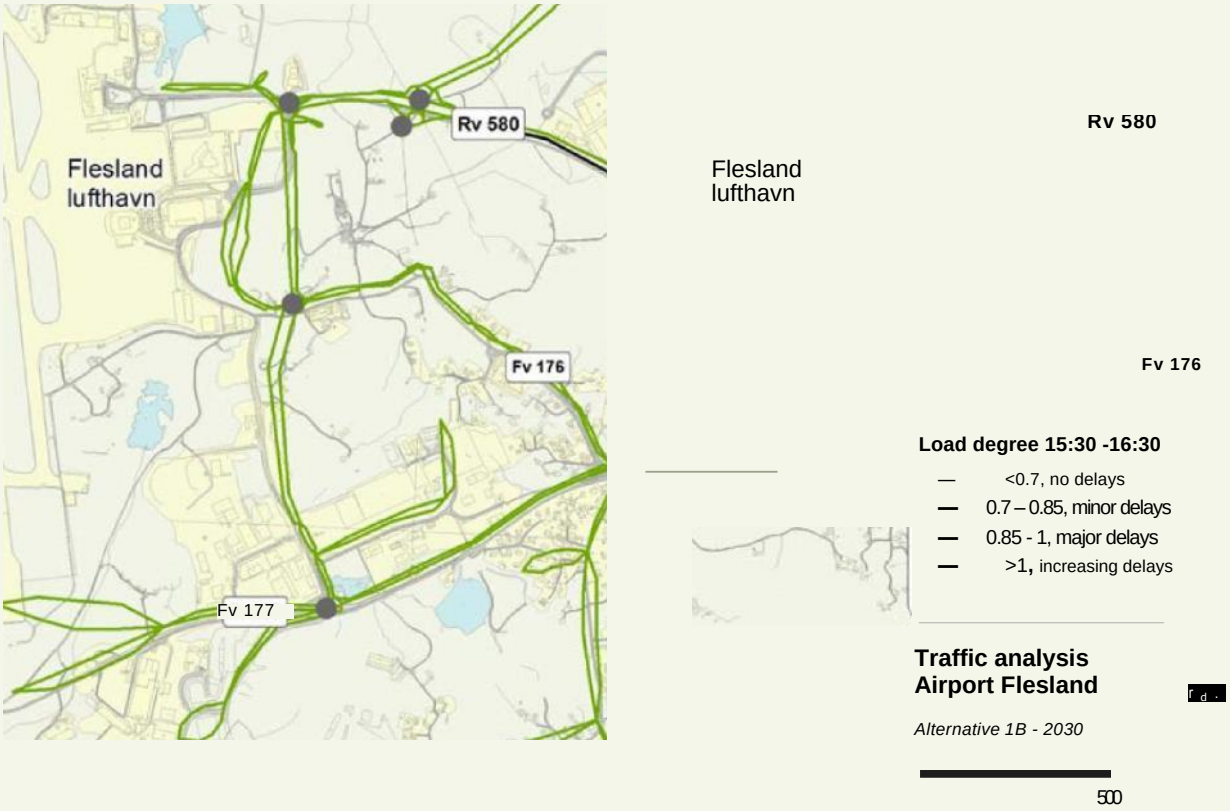
In the impact assessment, we will examine whether the zoned traffic system has sufficient capacity for future traffic.

Impact assessment

The traffic analysis concludes that with full development of the measures in the zoning plan there will, with an increase in the share of public transport (ref scenario B), be sufficient capacity on the public road system between the two roundabouts, cf. the zoning plan. The zoned solution, with 2 lanes on this section will therefore have sufficient capacity for all development in the zoning plan.



Load degree, peak hour 07:30-08:30- alternative 1B



Loading degree, peak hour 15:30- 16:30- alternative 1B

At a later stage, with the development of area IKL10 (cf. municipal plan) and possibly densification in Lønningen and Espehaugen there may, according to the traffic analysis, be a need for increased capacity on the section and thus a third lane, possibly a joint use lane in the northbound direction. Sufficient space is therefore set aside in the proposed zoning plan for such a third lane, and also a fourth lane - for further future needs (see description of the plan, Chapter 6).

The third lane is not zoned in the plan. This is partly because we have been informed that in connection with planning for the municipal sector plan for Birkeland, Liland and Espeland, it may be appropriate to look at a solution where current and possible future business and industrial areas at Liland and Espehaugen are served by a system farther east on Flyplassveien road. Since it is possible that the municipal sector planning work may come up with other highway systems to accommodate the aforementioned traffic flows it seems inappropriate to take a possible increase in traffic into account now by zoning in an optional lane that may prove to be unnecessary. For this reason we have only zoned in two lanes on the road between the two roundabouts.

As regards Flyplassveien road, the analysis concludes that with scenario 1B there will be increasing delays and congestion on Flyplassveien road up to Kokstadkrysset junction from the west during the peak hour 15:30-16:30. This is because the traffic on Flyplassveien road must yield to heavy traffic on Kokstadveien road, consisting mainly of commuters. The problems are therefore largely related to capacity problems in Kokstadkrysset, and commuting from Kokstad, and not the traffic on Flyplassveien road. During the peak hour in the morning from 7:30 to 8:30 there are no such delays on this stretch in Scenario 1B. Flyplassveien road is a trunk road that should be able to take traffic up to an airport regardless of the size of the airport. It is therefore not appropriate to connect any future congestion problems along Flyplassveien road to measures at the airport. Reasonableness considerations also imply that one cannot associate capacity problems/road projects far away from the airport with the airport.

Conclusion: The road system shown in the zoning plan is designed with sufficient capacity to cater for the expected traffic development will entail according to the zoning plan.

Public transport/environmentally friendly transport

Starting point
The statistics for today's traffic is as follows:

- Bus 26%
- Taxi 25%
- Car, drive self 17%
- Car, passenger 26%
- Rental car 3%
- Other 3%

Current public transport services (2011) consist of two airport buses and three local bus routes that stop at Bergen Airport, Flesland (Skyss, the airport bus, 2011). In addition, boat routes run south in the county:

Airport bus - Type 1	First departure from the city centre is at 3:50. On weekdays, buses depart from the centre every 15 minutes from 06.15 to 21.45. From the airport, buses depart every 15 minutes until 23:00. Last departure from the airport is adapted to the current flight services. The bus follows two current routes to the city centre (On Saturdays all buses run via Fjøsanger): • Via Fjøsanger • Via Oasen/ Fyllingsdalen
Airport bus - Type 2	The airport express service Mongstadekspressen runs four times a day from Mongstad and 4 times a day from Flesland as long as passengers have booked seats. The route serves Knarvik, Flatøy, Åsane terminal, Eidsvåg, the Norwegian School of Economics and Sandviken hospital before it goes directly to the airport.
Local bus routes	These buses stop at the airport: • Route 23 to Loddefjord and Storavatnet from which there is also correspondence to Sotra (Straume). This route provides relatively good coverage to the airport in the morning (until 07.45 from Storavatnet). Afterwards, there are long waiting times for changing buses and long travel time. There is also good coverage for returning in the afternoon. The route therefore appears to be adapted to local commutes in the vicinity of the airport and not necessarily

air traffic.

- Route 56 from Espeland quay, via the airport, to Birkelandskrysset junction. However, the route goes via the airport only twice a day on weekdays - 4 on Saturdays. For other departures a switch to route 57 at Birkelandkrysset is necessary to get to/from the airport (a number of departures correspond with route 57, but not all).
- Route 57 from the airport to Birkelandskrysset. From Birkelandskrysset buses go to Hjellestad, Sandsli, Nesttun etc. The extent of correspondence to the various routes has not been examined. Route 57 mainly runs from the airport to Birkelandskryssset only in the morning; from Birkelandskrysset to the airport buses run the whole day until 1747, see below:

Route 57:

Frå Flesland	Måndag – fredag													
Turnr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Flesland snuplass	5.37	6.07	6.34	7.03	7.58	8.57	10.32	12.37	14.27	15.07	15.37	16.07	16.37	17.07
Bergen lufthavn.....	5.47	6.17	6.46	7.16	8.11	9.09	10.42	....	14.39	....	....	....	....	....
Birkelandskrysset term..	5.52	6.22	6.52	7.22	8.17	9.17	10.47	12.47	14.47	15.17	15.47	16.17	16.47	17.17

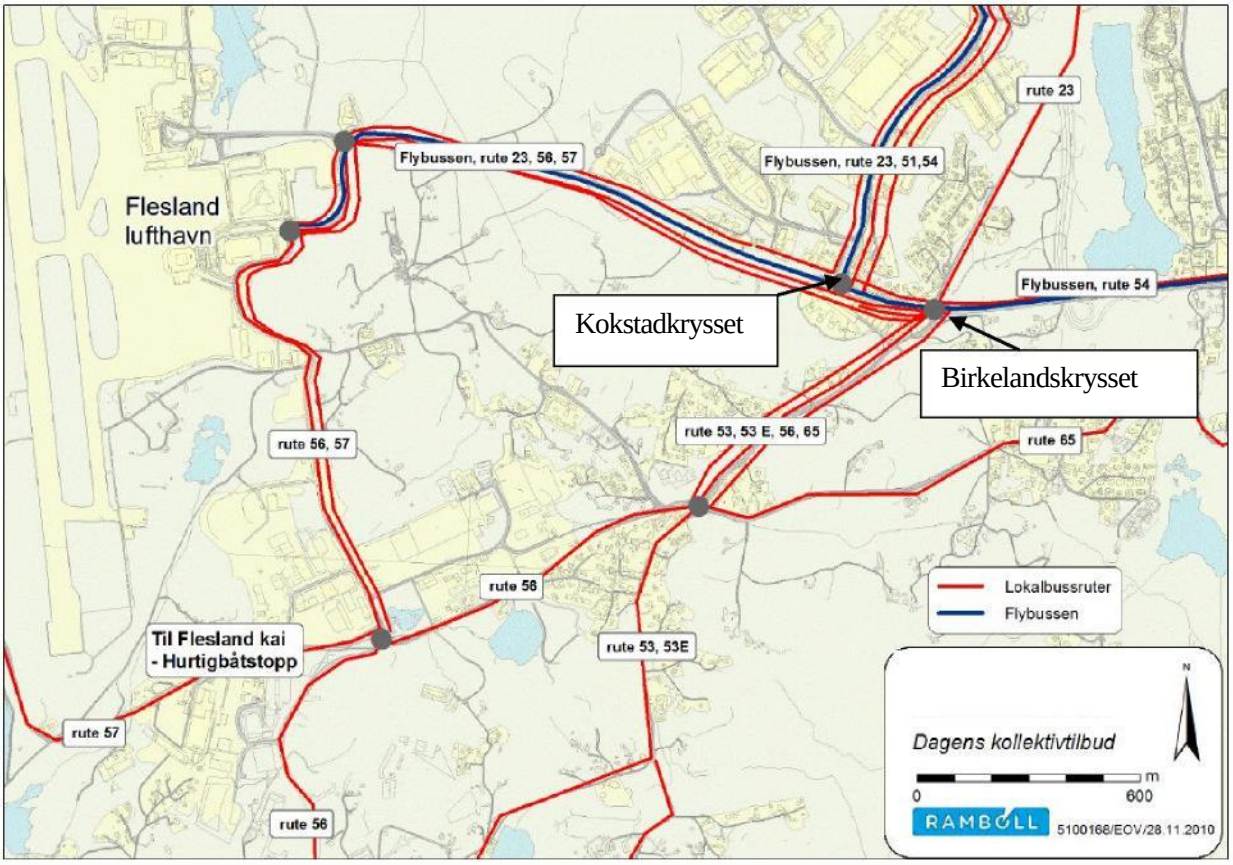
Frå Birkelandskrysset	Måndag – fredag											
Turnr.	15	16	17	18	19	20	21	22	23	24	25	26
Birkelandskrysset term..	6.41	7.42	8.41	10.16	12.16	13.50	14.50	15.20	15.50	16.20	16.50	17.47
Bergen lufthavn.....	....	....	8.46	10.21	12.21	14.00	14.55	15.25	15.55	16.25	16.55	17.52
Flesland snuplass	6.51	7.52	8.56	10.31	12.31	14.15	15.05	15.35	16.05	16.35	17.05	18.02

It is also possible to walk from Birkelandskrysset to Kokstadkrysset to take the airport bus to the airport. It is a few minutes' walk

Boat

Express boats run from Flesland quay to:

- Stord- Haugesund- Stavanger (on weekdays: 4 times a day)
- Austevoll- Sunnhordland (weekdays: 4 times a day)
- Rosendal (on weekdays: twice a day, three times on Fridays)



Bus routes to/from Bergen Airport, Flesland, 97 *Illustration Rambøll/ Norconsult 2011.*

Apart from the airport bus to/from the city centre, it seems reasonable to conclude that the public transport services to/from Bergen Airport, Flesland are not the best.

Hordaland County Authority has, cf. the 2010 report on public transport, a goal to achieve a 50% passenger increase on public transport in the Bergen area. In the impact assessment we will examine whether it is possible to reach this goal with the zoned solution.

Impact assessment

The LRT will cover more places than the airport express bus currently does, including the major workplace concentrations at Kokstad and Sandsli. When the LRT is extended to Flesland in addition to bus services, there is good reason to assume a significant increase in the share of public transport compared to today. It is believed that in the future the LRT will claim about 25% of the traffic to/from Flesland. Of this it is believed that about 10% will be taken from car traffic, about 8% from buses and 7% from taxis. This will yield the following estimated distribution of travel means:

LRT	25%
Bus	17%
Taxi	16%
Car, drive self	15%
Car, passenger	21%
Rental car	3%
Other	3%

With the extension of the LRT to Flesland it will, on the basis of these assessments, be possible to achieve a public transport share of 42%. This is somewhat higher than a 50% increase in the public transport share, and is thus in line with Hordaland County Authority's goal in the 2010 public transport report.

Achieving a further increase in the public transport share depends on better transport. This is Hordaland County Authority's responsibility. As described above, there is room for improvement in this respect. The larger villages near the airport (such as Loddefjord, Straume, Kleppestø) should for example be able to have more options than today.

Oslo Airport Gardermoen has a public transport share of 60%. The high proportion of public transport at Gardermoen is largely due to train services, with the Airport Express from Drammen, and with less than 20 minutes' journey from Oslo Central Station to Gardermoen. The Airport Express offers significantly shorter travel times than competing means of transport.

Moreover, the densely settled Oslo area is largely concentrated around train axes.

Trondheim Airport Værnes also has a relatively high public transport percentage, 42%, which is largely attributable to train services. Other airports in Norway have a lower share of public transport.

Conditions around Bergen Airport, Flesland are somewhat different than at Gardermoen. Outside the rush hours, the LRT will take longer between the airport and the city centre than a bus or taxi. With the exception of the LRT axis, which is relatively short, clear public transport axes with dense population concentrations such as those connected with Gardermoen do not exist. The population is relatively dispersed both in the municipalities surrounding Bergen and more peripheral regions which also belong to Flesland (Sogn og Fjordane, Hardanger and Sunnhordland). Large segments of Norway's population live in places without particularly public transport coverage and where it is not realistic to assume that good public transport will become a reality in the future. Based on the sparse settlement, it does not seem appropriate to reduce the parking coverage at Flesland to encourage more people to take public transport, either. High percentages of users will depend on being able to drive to the airport and passengers who drive from these places should not encounter full car parks. Other measures to increase public transport coverage will be more suitable and also more effective for Bergen Airport, Flesland. The zoning plan facilitates:

- LRT stop in new terminal at Flesland
- Better accommodation of buses at the airport, see the description in Chapter 8 of the draft plan. In combination with a possible improvement in bus services, this will yield a higher bus percentage.

Parking for electric cars will also be available in the parking facilities. Spaces for bicycle parking will also be allocated, and with a good cycle path network in the area, this should contribute to increased environmentally friendly transport to the airport.

Conclusion: Public/environmentally friendly transport: Implementation of the zoning plan will help to increase environmentally friendly transport use to the airport. Achieving more than a 50% increase of the public transport share in line with the objective in the 2010 Hordaland County Authority report on public transport is considered realistic.

Car parking

Starting point
The City of Bergen has no parking regulations and/or - standards for airports. The impact assessment therefore examines what should be the correct dimensioning of parking for the airport terminal for Bergen Airport, Flesland. The other areas in the plan; the hotel, petrol station, "airport area for hangars/administration building" and "Airport City" include establishments covered by the municipality's ordinary parking regulations. For these areas, we assume the coverage noted in the minutes of the mediation between the County Governor of Hordaland and City of Bergen about the land use part of the municipal plan on the 12 September 2011.

The public and employees who work at the air terminal currently have access to the following parking spaces in and around the area:

	Area	Total no. of parking spaces
1	Parking for the air terminal (Avinor rep. by Europark):	4260 *
2	Smartpark Flesland	315
3	Liland parking	180
4	Flesland parking	700
5	Lønningsv 39	150
	Total in the area:	**5605**

** Europark also operates 150 parking spaces associated with the hotel, but as mentioned, these are not included.*

Around **400** of these spaces are in use at all times by employees associated with the air terminal (obtained from Avinor's list of parking cards in use). 5,200 spaces then remain for use by the public.

In addition, the hotel, petrol station and areas in the north (airport hangars/administration building) have separate car parks, but these are kept as mentioned out of the impact assessment.

Car rental spaces (currently 350), taxi parking and bus spaces do not count as parking in the further impact assessment.

Impact assessment

In the Master Plan for Bergen Airport Flesland 2012 -2016 (with perspective sketch for a time horizon to 2060), forecasts have been prepared for the need for public parking spaces, but these are based on some assumptions other than those made in the zoning plan (including lower public transport share). We have therefore developed new forecasts based on the current number of parking spaces, including parking spaces in the vicinity.

It is stated in the Master Plan that total occupancy on the airport's grounds relatively frequently reaches close to 90%. To avoid unfortunate parking, dimensioning a reserve of around 10% is recommended. That means that current car parks, i.e. *both Avinor's and private car parks outside the airport* meet current needs and that reserves are no greater than they should be. As explained above in the paragraph on public transport, reducing public parking spaces to coax travellers to take more environmentally friendly transport is not recommended. Our starting point is therefore that one should maintain the same coverage as today in relation to the quantity of travellers.

The public transport share among the public is expected to rise from 26% to 42% when the LRT is extended, cf. the above impact assessment for the public/environmentally friendly transport subject. The LRT is expected to open in 2015-2016. However, there is some uncertainty related to the opening date and we also assume 42% will not be reached until after the LRT has been in operation for some time and the public has adapted to the system. We therefore believe one cannot assume 42% public transport coverage in 2016, but that this can probably be reached in 2020. Based on the 26% share of public transport in the years up to 2020, and the estimates for annual growth in the number of travellers cited in the Master Plan, we arrive at the following table:

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Annual growth		3.5%	3.5%	3.5%	3.5%	2.6%	2.6%	2.6%	2.6%	2.6%
Total need for public parking spaces	5,200	5,382	5,570	5,765	5,967	6,122	6,281	6,445	6,612	6,785

(The last 4-5 years in the table are not quite right since the public transport coverage will then increase slowly from 26% and up to 42%, but to avoid making overly complex calculations we have only assumed 26% for these years).

With 5.5 million passengers in 2012 and the growth rates projected in the Master Plan, 7 million will be reached in 2020/21, i.e. in **Development Stage 1** there will be a need for ***about 6,785*** public parking spaces connected with the air terminal.

After 2020, we expect a public transport share of 42%, i.e. that the share who arrive/leave in cars (driving themselves or taking a taxi) will be correspondingly reduced, i.e. by 16%. With an assumption that the parking coverage will then fall correspondingly, the public need for parking will then be the 2020 need for parking minus 16%. We then arrive at the following table:

Period	2020 (-16%)	21-25	26-30	31-35	36-40	41-45	46-50
Annual growth		2.2%	2.2%	1.9%	1.9%	1.7%	1.7%
Total need	5,700	6,355	7,085	7,785	8,553	9,305	10,124

10 million passengers are assumed, according to the projections of the Master Plan, to be reached in the year 2038. There will then be a need in **Development Stage 2** for **approximately 8,550** public parking spaces connected with the air terminal.

The above figures concern the *total* need for public parking spaces. If the 1,350 spaces outside the airport are removed, the entire need must therefore be met within the zoning plan area. Based on signals from the municipality, we assume that such a removal will take place. We therefore propose that the above figures be used as ceilings for the number of public parking spaces in the zoning plan.

When it comes to the employees, there are currently 400 parking spaces for the 2,100 employees at the air terminal. At full utilisation of terminal, Development Stage 1, there will be 2,250 employees. To have the

same coverage as today, 430 parking spaces should therefore be reserved for employees at Development Stage 1. We believe there should be good reasons for this in Development Stage 1 before the LRT is in place/has been running for a while and before the rest of the public transport network to the airport has improved. The employees who have a parking space/parking card are largely employees who start work at inconvenient times when there is no public transport coverage, or employees who live in areas with poor public transport coverage. Apart from public transport coverage to the city centre, coverage to/from the airport is rather poor, cf. above. For Development Stage 1, we therefore propose that 430 parking spaces be reserved for employees.

At full utilisation of Development Stage 2, an estimated 2,400 people will be working at the terminal. With the same coverage of work parking spaces as in Development Stage 1, there will be a need for about 460 work parking spaces. In Development Stage 2, somewhat better public transport coverage is assumed, so that the figure can be lowered to 450 parking spaces.

This provides a total number of 9,000 parking spaces connected with the air terminal when it is fully developed.

In comparison, Oslo Airport Gardermoen has 16,000 parking spaces for 18.1 million passengers (2009). In addition, there are also several private parking companies around the airport. The public transport percentage is 60%. Trondheim Airport Værnes has 4,500 parking spaces and 3.5 million passengers (2008). The public transport percentage is 42%.

This provides the following overview:

Airport	***Air passengers (mill)***	***Parking spaces***	***Factor (parking spaces per million***	***Public coverage***
Oslo Gardermoen-today	18.1 (year 2009)	16,000	884	60%
Trondheim Værnes-today	3.5 (year 2008)	4,500	1,285	42%
Bergen Flesland-future	10	9,000	900	42%

Cf. the above table, the parking coverage at Gardermoen is only 16 spaces fewer per million passengers than is currently facilitated at Flesland. This despite the fact that Gardermoen has and will continue to have, significantly higher public transport coverage than Flesland. In addition, Gardermoen has a number of private car parks outside the airport. Whether these will be discontinued, as is the plan at Flesland, is not known.

For Værnes, which has the same public transport coverage that Flesland will assumedly have, the parking coverage per air passenger will be significantly higher than at Flesland.

Conclusion: The number of parking spaces proposed to provide adequate parking provision at the airport should be facilitated.

Bicycle parking

Basis

While there are no figures for the number of cyclists to the airport today, a survey of the distribution between buses, taxis, private cars, rental cars and "other" has been conducted, see impact assessment for public/environmentally friendly transport subject. The "Other" - category, which may include cyclists and pedestrians, is currently 3%.

The impact assessment considers the level of bicycle parking coverage that should be planned at the airport.

Impact Assessment

The 2010-2019 Bicycle Strategy for Bergen states that the overall cycling share in Bergen in 2008 was 4%, and that it is a major goal to get 10% of all trips to take place by bicycle by 2019. However, it appears that it expected that Bergenhus and Årstad will take a higher percentage of this than the other boroughs.

Bergen Airport Flesland is relatively peripheral to the major residential concentrations and a lower bicycle share must therefore be assumed here. If we base the number of bicycle parking spaces on an estimate that an increase to 5% can be achieved with full utilisation of Terminal-Development Stage 1, this would, in our opinion, be a more realistic level. If we assume that no more than half of the employees are at work simultaneously, there will then be a need to set aside about 60 bicycle parking spaces.

With full utilisation of the final construction stage, roughly 2,400 people will be working at the terminal. If an increase to a bike coverage rate of 6% is assumed in construction stage 2/3, there will be a need for approximately 70 bicycle parking spaces (up 10 from construction stage 1).

It will be difficult for travellers to use bicycles as people normally have luggage with them when flying. For the few travellers who wish to cycle we will assume that the bicycle parking set aside for employees can also cover their need.

Traffic safety and pedestrian/bike path system

Basis

The issue of traffic safety is two-fold

1) Safety for "hard" road users in relation to avoiding car accidents
2) Safety for "soft" road users

In the impact assessment we will consider whether the zoning plan safeguards traffic safety for the two road user groups and assess whether the proposed pedestrian/bike path network is an expedient and efficient system.

Impact assessment

Given the low speed limit on the system within the airport, the risk of accidents for hard road users will be low in this area. The public road system consists of two roundabouts with a road in between. Such a system also has a low speed since motorists will not regain their speed after a roundabout before having to slow down again. For this reason, the risk of serious traffic accidents within the planning area will be very low. All necessary visibility also is also secured in the draft plan.

When it comes to soft road users, a pedestrian and bike path is being built up to the airport along the north side of Flyplassveien road. In the draft plan this system will be connected to:

- an internal system at the airport
- an external system that follows a new county road.

In the south, both systems will be connected together before they are connected to the existing pedestrian/bike path along Lønningsvegen Road. A cohesive, uninterrupted network, separated from car traffic is thus planned. Any safety issues must therefore lie in the intersections with the vehicle traffic system. All such crossing will take place via underpasses except for two places;

1) At the entrance to the petrol station in the north. Speeds will be very low as this is a turnoff situated between two roundabouts. Crossing should therefore happen without a high degree of risk of accidents.
2) When connecting to a pedestrian/bike path along existing Lønningsvegen road south. Lønningsvegen road has a speed limit of 50 km/h and the intersection in question is very open. Here too, it should be possible to cross without a high degree of risk of accidents.

Candidates for using the pedestrian/bike path network will be residents in the immediate area or employees of companies at Lønningen/Espehaugen and at Kokstad/Sandsli. Some pedestrian/bike path links towards residential areas are currently missing, but are under planning (cf. including the new pedestrian/bike path to Hjellestad). With the new pedestrian/bike path along Flyplassveien road, the commercial areas will be well covered. The draft plan emphasises a system that provides the most direct access to the airport from both north and south. This provides an expedient and efficient system and will also help to improve road safety as there is no risk of people crossing the road system to make better time.

Conclusion: Traffic safety is safeguarded in the draft plan and an expedient and efficient pedestrian/bike path system is facilitated.

Overall impact assessment of traffic

Conclusion: The impact assessment has shown that the existing and new road system has an appropriate design for efficiency, traffic management and road safety, that the draft plan sufficiently facilitates public transport/environmentally friendly transport solutions and that parking coverage is properly dimensioned. Undesirable consequences of the selected solution compared with the objectives have not been revealed.

9.10 Aircraft noise

9.10.1 Main issue

In planning programme the issue is stated to be:
Avinor has, in conjunction with the master plan, prepared noise calculations according to T-1442 for the various phases outlined in the master plan. The noise map thus takes account of increased air traffic (due to increased capacity of the terminal), but since the levelling of Lilandshaugen is not included in the master plan the effect of such levelling is not examined.

9.10.2 Impact assessment

SINTEF, which conducted the noise studies at Bergen Airport, Flesland, was contacted. They state that the levelling of parts of Lilandshaugen does not necessitate new noise maps. The calculation of the noise maps are made with a resolution of 512 feet (about 156 metres), and in addition, the noise contour lines are subject to some smoothening. The levelling of parts of Lilandshaugen will thus barely be visible on the map.

Noise sensitive buildings are already point calculated separately (i.e. in addition to the calculation of noise maps). Depending on how much of the hill remains with shielding effect, it is conceivable that any noise-sensitive buildings in the area "behind" the hill are exposed to more noise from taxiing and take-offs and that a new point calculation should be performed. However, the contact person at SINTEF doubts that this may be necessary as relatively much of the hill remains.

The “guide for Chapter 5 of the pollution regulations relating to noise” (Chapter 2.6.3 in the guide) reads: The assessment of possible measures under the pollution regulations is a continuous process that for aircraft noise is carried out simultaneously with the updating of the noise zone map for the individual airport. The results shall be reported to the pollution authorities every five years. If the survey at an airport in the reporting for 2007 shows that there is one or more homes where there is a risk that the limit value will be exceeded in the course of the coming five-year period, the assessment of possible measures shall be submitted in 2008. Experience with implemented anti-noise measures shows that the resulting indoor noise level is in part considerably lower than the limit value. The expected development in aircraft and aircraft traffic is not expected to entail any special increase in indoor noise levels in buildings covered by the pollution regulations.

Since neither the removal of Lilandshaugen nor development in aircraft and aircraft traffic will cause a particular increase in the noise level, implementation of the plan will not entail particularly higher aircraft noise. Measures against aircraft noise are otherwise also safeguarded through a continuous process, cf. quote from the guide above.

Conclusion: The impact assessment has shown that the implementation of the zoning plan has no/little impact on aircraft noise levels. Aircraft noise is also safeguarded through a continuous process regardless of the zoning plan. Aircraft noise is therefore not considered a relevant topic that must be addressed in the zoning plan.

9.11 Road traffic noise

9.11.1 Main issue

The implementation of the zoning plan may cause traffic noise near the new road system that is to be built. Vehicle traffic on Flyplassveien road up to the area will also increase as a result of implementation of the draft plan. This could lead to an increased noise level along Flyplassveien road. The increase in the noise level and assessment of any mitigating measures in this regard are examined in the impact assessment.

9.11.2 Impact/noise analysis

A separate noise analysis has been prepared that examines the noise impact of the new road system at the airport as well as increased traffic on Flyplassveien road. It follows the draft plan as a separate attachment. Only the conclusion is outlined here.

The Ministry of the Environment's guidelines for treatment of noise in spatial planning, T-1442, is the basis for the assessment of traffic noise. In the guidelines, noise levels are divided into two noise zones:

- Red noise zone: Indicates an area that is not suitable for noise-sensitive purposes and erection of new noise-sensitive buildings must be avoided.
- Yellow noise zone: Assessment zone where noise-sensitive buildings can be built if mitigation measures provide a satisfactory noise ratio.

The guide for T-1442, TA-2115 says that a noise assessment shall be conducted if the noise level of existing buildings increases noticeably (> 3dB) following a change in existing roads or construction of new ones. This noise assessment shall ensure the buildings access to outdoor living areas below the lower limit for the yellow noise zone and indoor noise level according to the limit values set in NS 8175. If the construction of new roads/modification of existing ones does not lead to a noticeable noise increase, but the recommended noise limits had already been exceeded for existing noise-sensitive buildings, mitigation measures should also always be carried out. Based on these criteria, a list of those who need an assessment of measures has been drawn up:

Land no./title no.	**Alt 1B L_{den} [dB]**	**Alt 0 L_{den} [dB]**	**ΔL_{den} [dB]**
111/106*	61	50	11
111/27*	59	54	5
111/28*	58	54	4
111/4	58	57	1
111/40*	67	64	3
111/47	59	57	2
111/5*	57	55	1
111/52	72	69	3
111/53	72	70	2
111/7	61	59	2
114/119	69	67	2
114/123	70	67	3
114/174	56	54	2
114/175	56	54	2
114/179	56	54	2
114/18	56	48	8
114/186	59	54	5
114/187	57	53	4
114/88	68	68	0
114/89	70	68	2
114/90	61	58	3
114/92	58	55	3
Lilandsvegen 93	60	58	2

**Lies near the new road system. The rest lies along the existing Flyplassveien road.*

** Ligger nær det nye vegsystemet. De øvrige ligger langs eksisterende Flyplassvei.*

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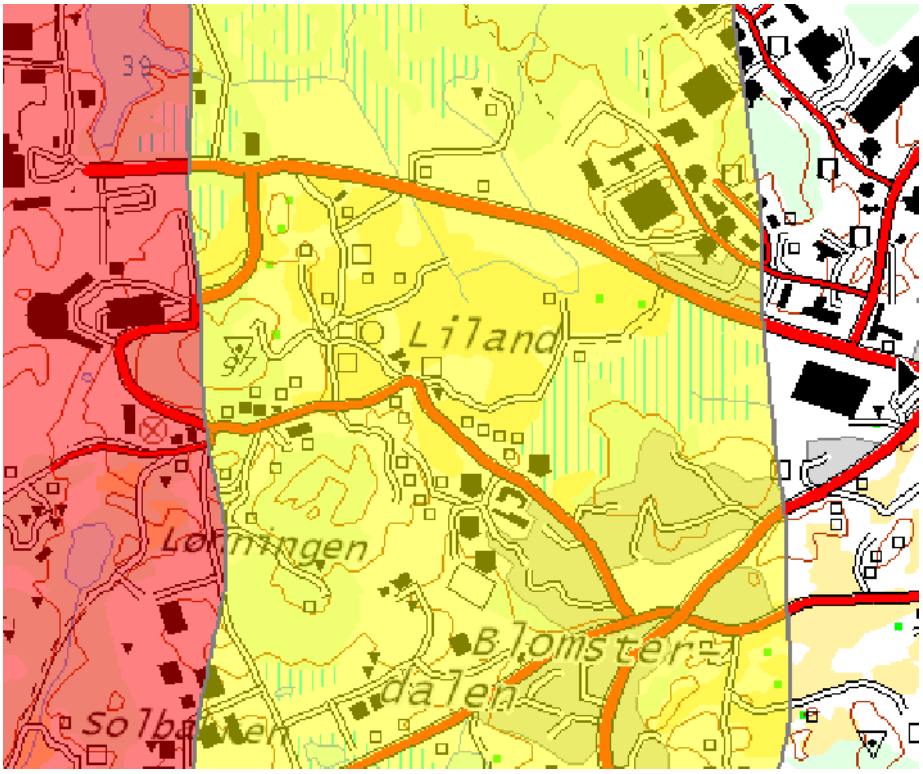
All of these will coincide with requirements for noise abatement on the basis of aircraft noise, see map below. If noise from air traffic proves to provide more stringent requirements for facade insulation than noise from road traffic, air traffic data shall be used for designing measures.



Section of aircraft noise map for Bergen Airport, Flesland, obtained from www.avinor.no

Provisions to ensure noise abatement for homes along the new road system before the road system is in use (cf. properties marked with * above) are included as mitigating measures. Noise abatement is only related to indoor noise as in any case the noise level outdoors exceeds the recommended limit due to aircraft noise and it is not possible to shield outdoor areas against aircraft noise. As regards facade measures, the provisions stipulate that if noise from air traffic proves to provide more stringent requirements for facade insulation than noise from road traffic, air traffic data shall be used for designing measures.

No consecutive ordering provisions on airport development-related noise abatement have been set along Flyplassveien road. This is because this is an existing road where homes are entitled to noise abatement measures from the facility owner, the NPRA, if the indoor noise level in the home exceeds 42 dBA. (Airport noise may however be decisive, cf. above). This is handled through separate legislation and therefore considered not natural to link to the zoning plan.

Conclusion: The impact assessment has shown that the implementation of the zoning plan will produce undesirable effects in the form of road traffic noise in homes/increased road traffic noise in housing compared to today.

As mitigating measures, the zoning plan includes consecutive ordering provisions for noise abatement in homes near the new road system that is to be built.

9.12 Pollution/Run-off (This chapter has been shortened considerably)

According to the planning programme, the impact assessment shall meet the following needs:

- *"Description of plans and systems for handling clean and polluted surface water in connection with the future development of the airport.*
- *Capacity calculations and modelling of precipitation with impact on watercourses within the planning area in connection with the future development of the airport. Ratings of mitigation measures*
- *Overview of possible areas of ground pollution and report on possible handling of any contaminated soil."*

Given that, cf. Chapter 8.14 of the ROS analysis, no contamination of the soil has been recorded within the planning area, no further consideration is given to this subject. The impact assessment concentrates on run-off issues related to both clean and contaminated surface water.

A water and sewer framework plan has been prepared that is enclosed with the draft plan. This is deemed sufficient as an impact assessment for this subject.

The water and sewer framework plan/impact assessment shows that the issues listed in the planning programme may be resolved in a satisfactory manner.

Conclusion: The impact assessment has not uncovered undesirable effects on the environment with regard to pollution/run-off

9.13 Energy consumption and energy solutions

9.13.1 Main issue

A focus on reduced energy consumption and use of renewable sources of energy at Bergen Airport, Flesland is important to Avinor.
In connection with the outline project for the new terminal at the airport (Architects: Narud Stokke Wiig), which constitutes the majority of the development in the zoning plan, the following was considered:

- Energy concept for the terminal building
- The possibility of supplying the airport with thermal energy

The impact assessment contains a somewhat abbreviated presentation of these studies.

9.13.2 Impact assessment for the terminal building

The new terminal shall be designed as an example building both in terms of energy use, energy supply and sustainability. A strategy of an integrated energy design that is based on a comprehensive view of building structures and technical systems is emphasised, and is based on the Kyoto pyramid, where the initial focus is to satisfy regulatory requirements according to TEK-10. The next focus is to minimise energy needs. Measures that are cost-effective compared to reductions in environmental impact are emphasised.

TEK -10
Energy calculations have been carried out to verify that the new terminal will meet the requirements of the Building Regulations (TEK 10).

The energy requirements of the technical regulations of the Planning and Building Act were revised in 2010 (TEK 10) and entered into force on 1 July 2010. As a minimum, new spaces at the airport must meet those requirements. Two alternative methods can be used to meet energy use requirements. Either one can use the energy measure model (Section 14-3), where a number of individual measures must be satisfied, or one

can use the energy framework model (Section 14-4), which sets requirements for total net energy consumption for the type of building in question. The minimum requirements in the regulations (Section 14-5) must never be exceeded in any case.
For a construction project as complex as T3, the documentation method with fulfillment of the energy framework requirements will be most appropriate. Required use of local cooling also rules out the use of the measures model. Achievement of the requirements described in the list of measures will nevertheless provide assurance of goal achievement.

Energy measures

Energy measures in buildings shall satisfy the following level:

- Total glass, window and door areas: maximum of 20% of the building's heated (available area).
  Our assessment: Analyses of our model show a glass area between 15 and 17% for the buildings in combination. Areas in PMZ and technical floor, level E, are then included in the heated available area.
- U-value outer wall: 0.18 W/m^2 K.
  Our assessment: Requires 25 cm insulation, depending on outer wall design. This will be continued as a minimum in our concept.
- U-value ceiling: 0.13 W/m^2 K.
  Our assessment: Requires 30-35 cm insulation, depending on design. This will be continued as a minimum in our concept.
- U-value floor on ground and toward outside: 0.15 W/m^2 K.
  Our assessment: Requires 10 cm insulation (EPS). This will be continued as a minimum in our concept.
- U-value glass/windows/doors: 1.2 W/m^2 K as the average value including casing/frame.
  Our assessment: Large glass surfaces mean that the frame area is little related to the glass area. Glass quality is thus the most important factor. U-value requirements will likely entail that triple-glazed windows with argon filling must be selected. To reduce the cooling burden while permitting intake of energy during the cold months, quantitative assessments of glass quality are done via dynamic simulations. This optimisation process will continue to be performed in the pre-project phase. We have assumed triple-glazed glass with argon filling, U-value of 0.8 on overall glass/frame area. Glass with good light transmission factor and SPF is used.
- Normalised thermal bridge value should not exceed 0.06 W/m^2 K, where m^2 is specified in heated available area.
  Our assessment: We will have a special focus on transitions, fastening details etc., as well as any plans for good thermal bridge switches.
- Air resistance: 1.5 air changes per hour at 50 Pa pressure difference.
  Our assessment: This requires a basic building form and continuous channelling of windproofing continuously over transitions between wall/ceiling etc. See also description under item "Building shell". Our ambition is to exceed the requirement. Our starting point will be 1.0 air changes per hour in the energy model.
- Annual mean temperature efficiency for heat recovery in ventilation systems: 80%.
  Our assessment: We will use systems resulting in an annual mean temperature efficiency of over 80%.
- Specific fan power in the ventilation system, SFP factor (specific fan power): 2.0/1.0 kW/m^3 s (day/night)
  Our assessment: Simple and spacious conduits shall be planned. The real average power requirement will be reduced by demand managing ventilation airflows.
- Measures to eliminate the building’s needs for local cooling
  Our assessment: Emphasis will be placed on finding good and effective shading solutions and a combination of automatic and fixed systems that are robust and reliable. There will still be a need for some local cooling due to high internal loads at the airport
- Possibility to lower indoor temperature at night and on weekends
  Our assessment: This requirement may be disregarded because of form of operation, with almost continuous operation.

Energy framework

In evaluating the energy framework, the building's expected net energy consumption is calculated and compared with the framework requirement for the relevant building type, specified in the regulations (Section 14-04). The framework requirement calculation takes the building's shape into account and the more complicated the shape, the harder it is to meet the framework requirements.

Flesland Airport does not neatly fall into any of the building categories defined in TEK 10, but is rather a combination of several different categories. The framework requirements for the applicable categories are given in the table below.

Building category	**Framework requirement for heated available area**
Office building	150 kWh/m^2 per year
Commercial building	210 kWh/m^2 per year
Light industry/workshops	170 kWh/m^2 per year

The energy requirements are considered met if the net energy need for the building is not greater than a stipulated framework requirement.

Minimum requirements

For the building to meet the regulations, U-values and leakage figures must remain below the limits in Section 14-5. These requirements are met by a wide margin through the energy measures described above. In addition, the following requirements must be met:

- U-value for glass/windows/doors including casing/frame multiplied by the percentage of window and door space of the building's heated available area shall be less than 0.24.
  Our assessment: This corresponds to a window area of 30% of heated available area with a U-value of 0.8 W/m^2K. Increased glass area cannot be compensated for with other measures!
- Total sun factor for glass/window (g_t) shall be less than 0.15 on sun-burdened facade, unless it can be documented that the building does not have a need for cooling.
  Our assessment: The pier's west facade is the most sun-exposed facade. Double façade solution with intermediate automatic sun shading is planned. Because of the solar angle (mainly low solar angles) on this façade, a monitor filter is recommended. The filter is available in your choice of colour and perforation degree. In this way, intake of daylight and views with activated filter can be optimised against the intake of solar energy.

Energy supply

There are requirements that the building shall facilitate that a minimum of 60% of the energy demand for hot water and heating of rooms (including heating of ventilation air) can be covered by energy supplies other than electricity and/or fossil fuels at the end user.

Where the plan requires connection to a district heating system under Section 27-5 of the Planning and Building Act, new buildings shall be equipped with heating so that district heating can be used for space heating, ventilation and hot water.

Our assessment: Capacity and energy coverage by renewable sources is considered in Chapter 4, which deals with thermal energy. Total annual production of heat energy is estimated to be 10,000 MWh. Of this, 8,000 MWh is produced by heat pump/refrigerating machine. The necessary electricity for the operation of machines is 2,800 MWh. 65% of the heat demand is obtained from seawater. In addition, 2,000 MWh comes from district heating.

Assessment of fulfilment of requirements

The purpose of the energy calculation is to verify that the planned building will achieve a net energy need that meets the requirements of the Building Regulations (TEK 10).

Calculations are performed in the programme SIMIEN, version 4.505. SIMIEN is a dynamic calculation programme validated in accordance with NS-EN 15625:2007. The calculations against TEK 10 are made according to the rules in NS 3031:2007. This means that standardised input data is used for energy needs for lighting, technical equipment and hot water, the Oslo climate, operating times and set point temperatures.

Flesland Airport is considered according to the energy framework method. As described under the chapter on energy limits above, the building in question is divided into three zones and evaluated according to its representative building category. The division is justified by the fact that the different building components have very different internal heat gains. According to NS3031:2007, the building shall then be divided into zones based on the different functions. The service blocks (Level G, H and I) are considered office buildings and baggage handling (PMZ) on Level D of the pier as light industrial/workshop, while the rest of the buildings (approximately 80% of available area) are considered commercial buildings. Each part of the building/zone must separately meet regulatory requirements.

The results for each building component are presented in the table below:

Building part	Calculated net energy need [kWh/m^2/year]	Framework requirement for heated available area [kWh/m^2/year]
Service block	124	150
Terminal	184	210
PMZ	126	170

The requirement for energy efficiency according to the technical regulations is thus met.

The specific energy requirement calculated above with standardised input data, will differ from the real energy need, calculated using actual operating hours and Bergen's climate.

When rehabilitating the existing terminal building, it is likely that requirements in the applicable technical regulations will guide the work. Prioritisation and evaluation of measures to achieve the energy framework requirement will be based on profitability considerations based on LCC analyses. The integrated design process will also provide opportunities and constraints in terms of efforts and measures in the various building components and technical facilities.

Optimisation of energy use

It should always be a goal to utilise the buildings' passive properties before using technology.
Good, energy-correct buildings are created by allowing energy factors to set the agenda early in the design process. The building's geometry and facade design should largely safeguard the good passive energy properties. Thoughtful integrated technical installations will further optimise the building's overall energy characteristics.

In this concept, the building shell's energy-related technical characteristics interacting with technical solutions are evaluated through dynamic simulation models. This insight into thermal properties has been crucial for the design of facades and technical solutions.

Design of glass spaces may allow the use of daylight-compensated lighting. Energy gains could be substantial if glass spaces are optimised for daylight. This is further evaluated against thermal load and a shading system. The glass areas are assigned properties, both thermally and in terms of daylight transmission, which allows substantial proportions of glass in facade as well as in ceilings.

<u>Building shell</u>

The climate screen's qualities have a great impact on the annual energy demand of new building elements at the airport. We have chosen a level with a minimum of the characteristics described under the measures model, described in the section on energy measures.
Beyond this, we have chosen to use glass qualities that are far better than the requirement in TEK10. This reflects the relatively large glass areas and the need for good functionality in relation to solar transmission and daylight transmission. The technological development of glass suppliers has been considerable lately. Low U-values and low emission treatment ensures that the heat loss is minimised. Along with an active solar shading system, an optimally balanced building can be achieved with regard to aesthetics, architecture, daylight utilisation and energy demand.
Furthermore, building geometries allowing structures with low air leakage through the climate screen have been selected. This is achieved by continuously windproofing the transitions between wall/ceiling etc. The concept is beneficial in relation to the requirement. Challenges lie in infiltration loss by passenger bridges, doors/gates for goods and luggage transport, main entrances and fastening details for, e.g., glass/window fields. Especially when it comes to the main access roads, it is essential that the climate screen is not punctured. The outlined internal heights of the central building will create significant drivers of infiltration if the screen is punctured. The effect is enhanced with falling temperatures. In our opinion, revolving doors provide the most functional safeguarding of an airtight climate screen.

<u>Solar study</u>

Orientation of new building parts and the sun's path around them are shown in the figure below.

The solar curves show that the new façades of the pier are exposed to low-angle solar radiation much of the year. Solar shading on these facades is thus important. On the central building, the overhang on the east facade will provide shading for high angle solar radiation in the summer. Low-angle solar radiation is utilised during the winter months and can provide significant contributions during the heating season.

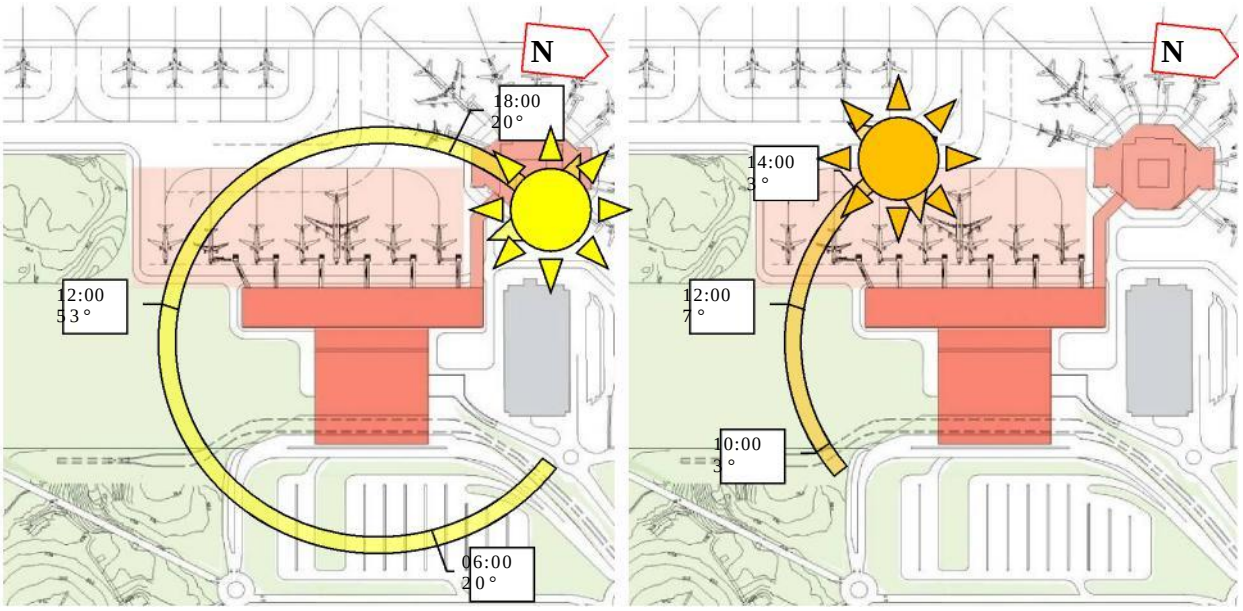


Illustration. Path of the sun and solar angles summer and winter

At the highest sun path (June) the sun rises at about 3:00 and sets at 21:00. The highest solar angle (to the south) is 53°. Direct solar radiation against the pier's west facade will be at a solar angle of about 50° at 13:00 and down to 0°.

At the lowest solar path (December) the sun rises at about 9:30 and sets at 14:30 p.m. The highest solar angle (to the south) is 7°. Direct solar radiation against the pier's west facade will be at a solar angle of about 5° at 13:00 and down to 0°.

The solar angle against the west façade of the pier will be about 35° when the sun normally faces the facade (16:00).

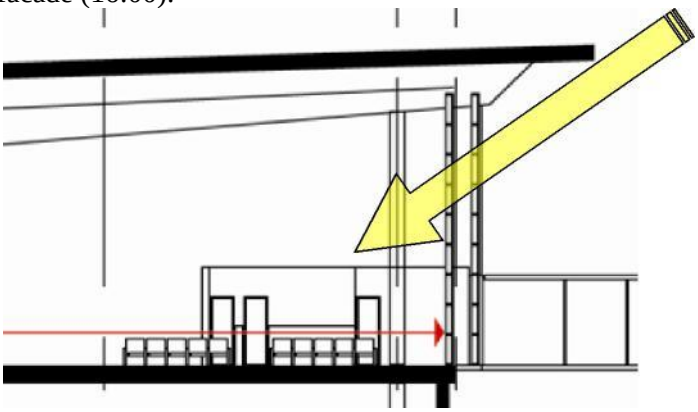


Illustration. Solar angle against west facade when the sun normally faces the facade

Dynamic climate shell – Utilisation of solar energy and daylight

Large glass areas provide major architectural benefits and increase daylight, reducing energy demand for artificial lighting. Glass, however, has much poorer properties than the wall structures in terms of heat transmission. Poorly planned glass areas can lead to overheating of the thermal indoor climate in the summer, while the available solar energy is not utilised during the cold months of the year.

We will therefore optimise the design of glass areas with dynamic simulation methods. In that context we have considered the following benefits:

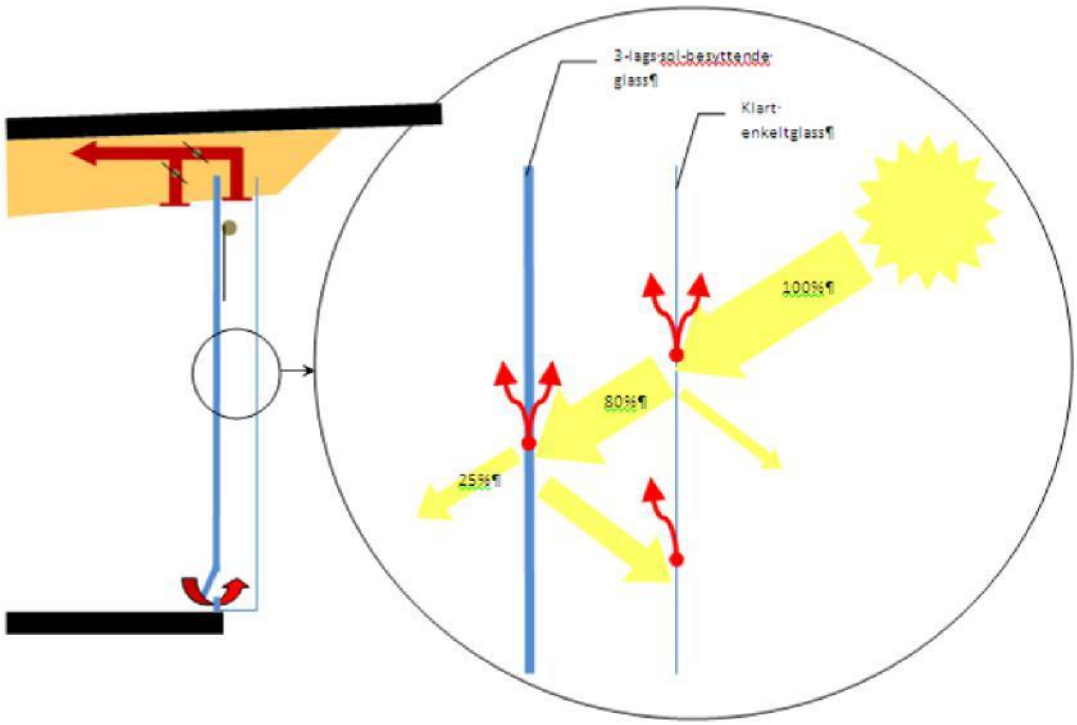
- Winter operations: Reduction of heat loss and maximum utilisation of solar energy
- Summer operations: Increase the transmission loss and minimise sun burden

- Minimise glare from direct sunlight
- Create an architecture that changes and adapts to external conditions and creates varying visual impressions from inside and outside

With good planning of glass areas in the climate screen, it has been shown that the energy demand for air conditioning can be reduced by up to 30% compared with standard building practices.

The west facade is finished as a double façade, where shading is part of the volume between the facades. This will protect the shading system, both against wind and the other climatic influences, and the wall will have very good acoustic properties. One of the results is longer operation of the screening system during periods of strong sun and wind.

To further utilise the double facade, both for climate and energy gains, this is actively exploited as part of the ventilation system. Ventilation is established inside the double volume, in addition to outside, and gaps between the large volumes and the double volume. In this way, we can draw off the air through the double volume when the temperature here is higher than in the ambient air, for example, during sun and shading at the bottom in the winter.



The illustration shows how solar energy is reduced towards the lounge zone, and how this can be exploited for energy purposes. The illustration is based on triple-glazed solar control glass in the inner glass layer. With activated shading, the solar input will be further reduced (down to 4-5%). The difference will be transferred to the volume between the glass layers and will be recovered during periods when the building has to be heated. The properties of the individual layers (outer glass, shading, inner glass) should be analysed further to optimise the system's properties with respect to sun factor energy recovery and daylight intake.
Illustration. Solar energy through the double façade. Triple glazed sun-protecting glass. Clear single glass.

During the summer season solar heat can be rejected by the active solar shading system and glass' low SPF. Surplus energy is removed via the ventilation system. The glass' light transmission properties can also be used in conjunction with the solar shading system to reduce the need for artificial lighting. The solution will considerably reduce the need for both cooling and artificial lighting.

Lighting system

Lighting equipment normally accounts for more than 20% of the energy demand at an airport. We have therefore chosen to focus on control principles and efficient light sources and fixtures to reduce the energy demand for lighting. Daylight compensation of the lighting system is used in all public areas where daylight is available. The climate screen is designed so that it will apply to much of the public areas. In darker areas like corridors and toilets, etc., where daylight is less available, various forms of presence detection are chosen. It is also possible to control the lighting directed at timetables to ensure that the lighting system operates only in areas where there is activity. In sum, these measures will provide substantial savings in the energy demand for lighting.

Passenger transport

Constant operation of transport installations such as escalators, moving walkways and lifts requires significant amounts of energy over the year. We have therefore chosen systems with motion detection and demand control of escalators and moving walkways so that they are only in operation when required by the flow of passengers.

Regenerative lifts that generate electricity when they descend have been chosen. This power is fed back into the building, thereby reducing the annual energy demand for operating lifts.

Choice of materials

Both the Central Building and the Pier have been built of materials with low emissions to indoor air. We can thus design air quantities for low material load, which in turn provides a good contribution to reducing energy costs for air conditioning.

Demand-controlled air conditioning and heat recovery

Occupancy loads vary significantly throughout the day in an airport. As a precondition, we have therefore stipulated that the air conditioning equipment shall adapt its output to the actual loads in the respective areas at all times. All air volumes shall be demand managed by relevant control parameters. Air volumes are to be adapted at all times to the occurring demand. The same applies to systems for heating and cooling. This principle provides significant savings in terms of reduced costs for climate control of air and spaces, as well as transport of air, cooling and heating mediums.

We have also planned highly efficient heat recovery in air treatment units, which may have a temperature efficiency of more than 80%. Increased recovery is achieved with deeper rotors, thus increasing the time the air stays in the rotor. The pressure loss increases slightly compared with traditional rotors, resulting in somewhat higher energy costs for fan operation. Our experience suggests, however, that energy savings on the thermal side far exceed the increase in fan operation.

Energy monitoring

The systems are equipped with thermal and electrical gauges so that the buildings can be divided into energy blocks on the basis of the respective spaces' energy characteristics and operating and usage patterns. In this way, development can be more easily monitored via the SD plant's energy monitoring system, and deviations are more easily revealed when the consumption history is broken down into several zones/units.

Division into energy blocks will also facilitate efforts to optimise operations and uncover potential for streamlining operations.

Resulting energy demand
Energy calculations have been carried out using the SIMIEN calculation programme, to document the building's expected net energy use. Installations with significant energy demands that are not addressed in the simulation model are gate heating at aprons and traffic forecourt, aircraft climatisation, cooling/el. for large IT/ICT rooms, baggage handling and commercial areas. Baggage handling is to some extent included in the calculations (internal load as a light industrial/workshop). Energy budget – table:

Energy item	Energy demand (kWh)	Specific energy demand (kWh/m^2)
Room heating	488 287	8.8
Ventilation heat (heating coils)	459 408	7.7
Hot water (tap water)	779 345	12.7
Fans	938 361	15.6
Pumps	115 683	2.0
Lighting	2 954 737	49.8
Technical equipment	1 297 314	18.7
Room cooling	73 466	1.3
Ventilation cooling (cooling coils)	331 628	5.5
Total net energy demand	7 438 226	122.1

9.13.3 Impact assessment: Thermal energy supply

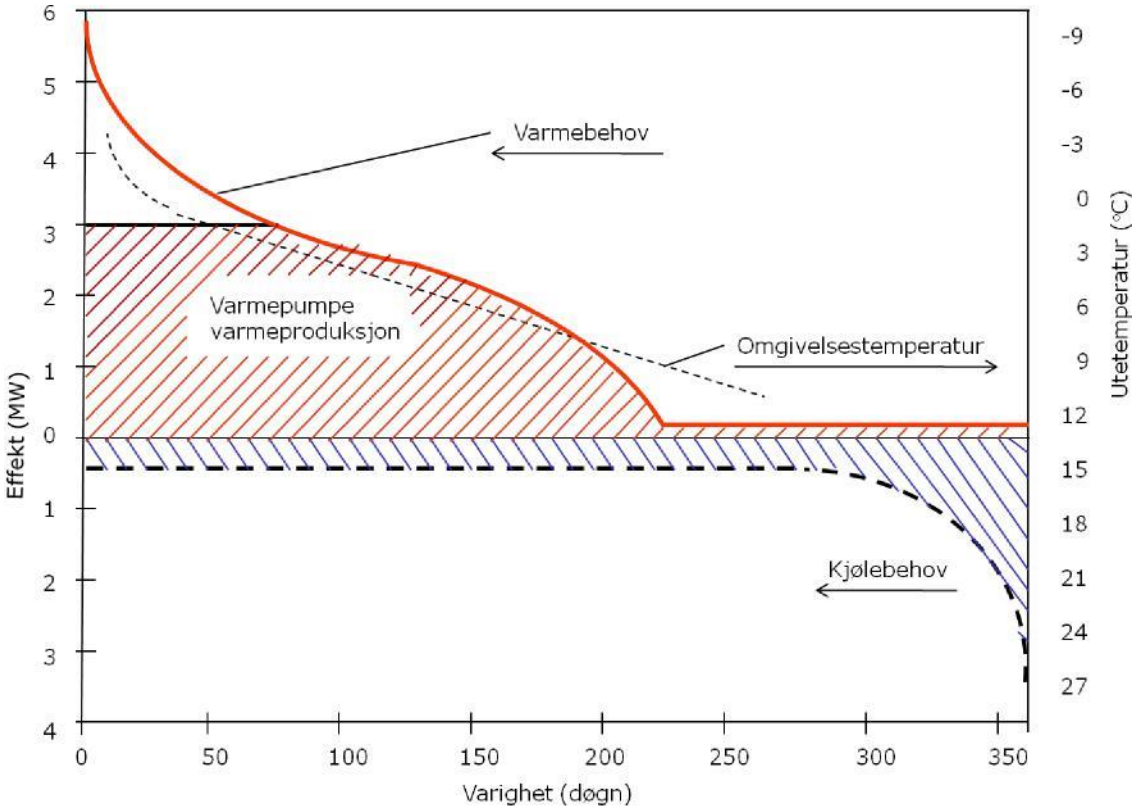
Introduction
Bergen Airport, Flesland lies right by the sea, which can be a good source of heating and cooling for the buildings. The purpose of this chapter is to assess a seawater-based heat pump for heating and cooling at Flesland Airport.

Heating demand
The following table shows the output and energy demands for heating and cooling at Flesland Airport, with a total floor area of 90,000 m^2. The heating demand also includes an 8,000 m^2 snow melt system. Provision is made for specific energy demand of about 100 kWh/m^2 per year for both room heating and the snow melt system.

Table: Heating and cooling demand

	Heating demand		Cooling demand	
	Output (kW)	Energy (MWh/year)	Output (kW)	Energy (MWh/year)
Demand	7 000	10 000	4 400	4 000

The figure on the following page shows the output-duration diagram for heating and cooling systems at Bergen Airport, Flesland.



Output-duration diagram for heating and cooling systems at Bergen Airport, Flesland
Diagram: Effekt (MW) = Output (MW), Varmepumpe varmeproduksjon = Heat pump heat production, Varmebehov = Heat demand, Omgivelsestemperatur = Ambient temperature, Kjølebehov = Cooling demand, Utetemperatur = Outside temperature, Varighet (døgn) = Duration (24-hour period)

Assessment of seawater-based heat pump

Various energy supply solutions for Bergen Airport, Flesland have been previously studied. The following alternative energy systems have been considered:

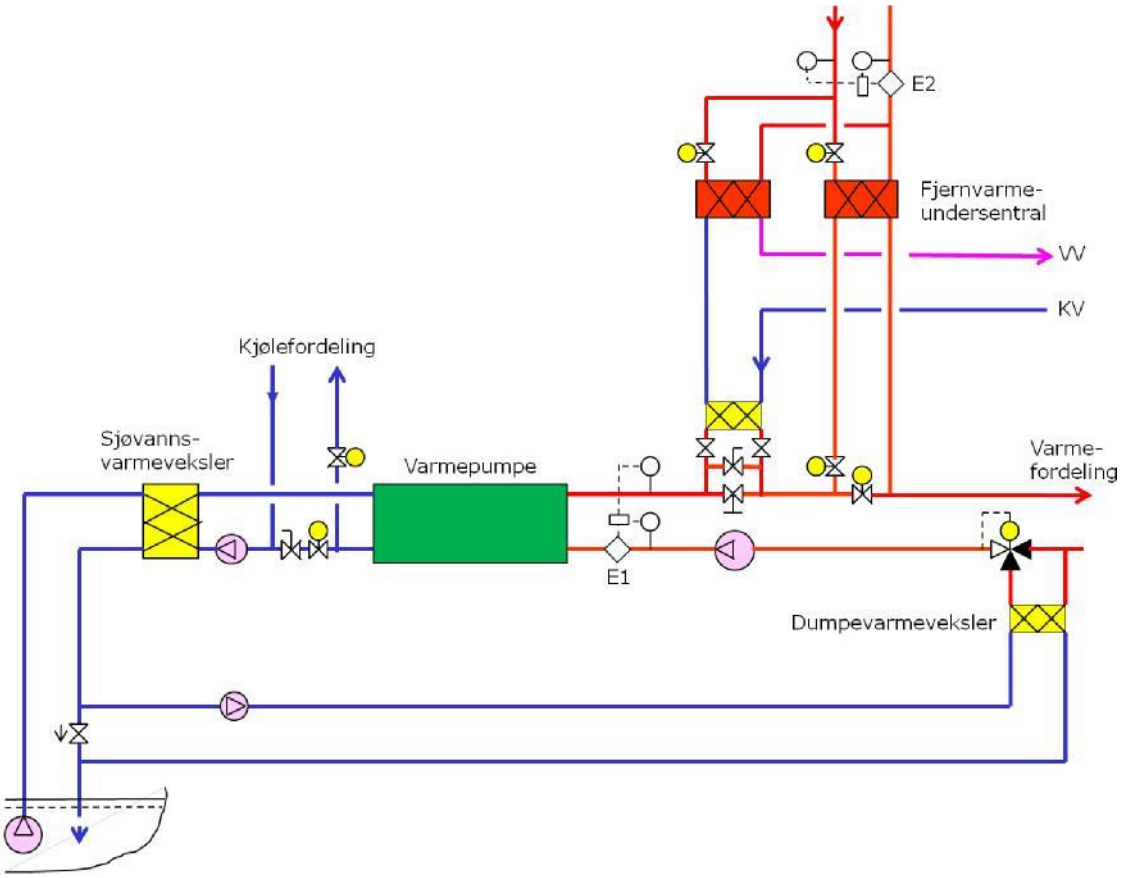
- Central bioenergy plant and decentralised cooling units
- Air-based heat pump and decentralised cooling units
- District heating and decentralised cooling units
- Central cooling unit used as air-based heat pump during the winter

The study recommends that Avinor Flesland focus on a common central energy plant with heat pump and cooling unit. It is assumed outdoor air will be used as a heat source and heat outlet for the heat pump/ cooling unit.

Bergen Airport, Flesland is located right by the sea, and the sea can be a good alternative to outdoor air as a heat source and heat outlet for the heat pump. In this memorandum, a seawater-based heat pump for heating and cooling at Flesland Airport has therefore been compared with an air-based heat pump system.

<u>Heat pump system solution</u>

The figure below shows in principle the pipe system for a seawater-based heat pump system for both heating and cooling.



Flow chart seawater-based heat pump system.
Diagram: Sjøvannsvarmeveksler = Seawater heat exchanger, Kjølefordeling = Cooling distribution, Varmepumpe = Heat pump, Fjernvarmeundersentral = District heating substation, Varmefordeling = Heat distribution, Dumpevarmeveksler = Dump heat exchanger

The heat pump uses seawater as a low temperature heat source and heat uptake from seawater occurs indirectly via a titanium plate heat exchanger and a water circuit which will also serve as a cooling water circuit. The cooling water out to buildings is taken out after the heat pump and the return cooling water is supplied to the front of the seawater heat exchanger as shown above. In this way, the cooling water is first pre-cooled by direct heat exchange with seawater, and then subsequently cooled to the desired temperature by the heat pump.

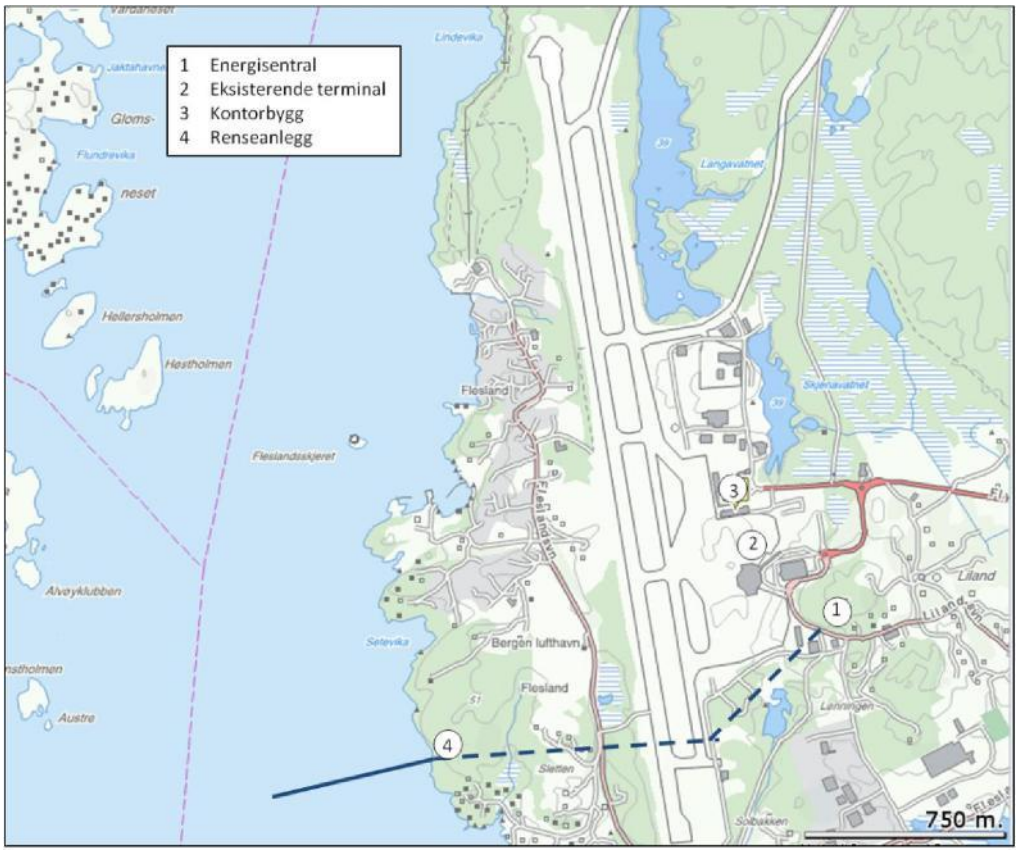
On the hot side, the return water from the buildings is first heated by the heat pump. If the heat pump fails to cover the maximum power demand, the water is reheated by the additional heat source. If Bergen District Heating lays district heating pipes up to Bergen Airport, district heating will be used as additional heat. Alternatively, gas boilers and/or electric boilers can be used as an additional heating plant. Domestic hot water is preheated by the heat pump and reheated by the additional heat source, as shown in the figure.

A plate heat exchanger has been installed in the return line of the heating circuit to dump excess heat from the heat pump plant into the sea, when it is run as a cooling system in the summer.

Ammonia is stipulated as a working medium for the heat pump.

Assessment of seawater system

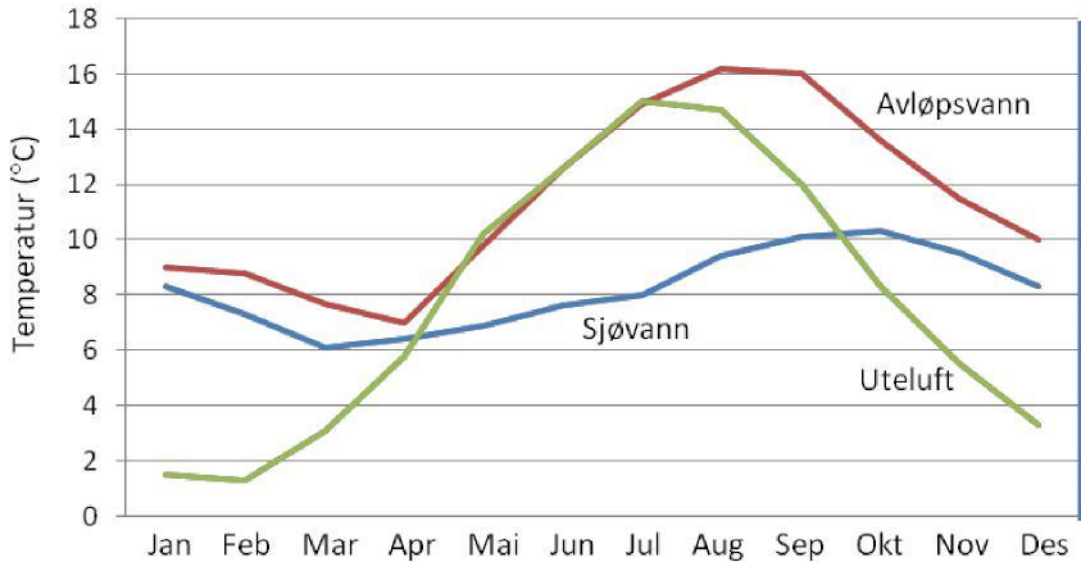
The figure on the following page shows a map of the airport area with the sea outside. The location of the central energy plant has not been finally determined.



Map of the area with route for seawater pipe. 1 Energy centre 2 Existing terminal 3 Office building 4 Treatment plant

The seawater pipeline from the terminal area to the seaside is clamped to the sewer tunnel wall. A pumping station has been established on the edge of the sea and an intake pipe has been extended 5-600 m into the sea.

There is a wastewater treatment plant at the end of the tunnel, and it is also possible to utilise wastewater as a heat source for the heat pump. Figure 4 is a comparison of monthly mean outdoor air temperature, seawater temperature and wastewater temperature. The figure shows sea temperature measurements from a depth of 40 m in Byfjorden (2), while the wastewater temperatures are mean values from the central RA-2 treatment plant in Lillestrøm from the years 2000, 2001 and 2002.



Comparison of monthly mean temperatures from outdoor air in Bergen, seawater from depth of 40 m in Byfjorden and wastewater from the central RA-2 treatment plant.
Temperatur = Temperature, Avløpsvann = Wastewater, Sjøvann = Seawater, Uteluft = Outdoor air

The figure above clearly shows that wastewater has the highest temperature throughout the year and thus it is the best heat source for heat pumps. The seawater temperatures range from 6 °C as the lowest temperature in March and 10.5 °C as the highest temperature in September/October. In August, the average seawater temperature is 9.5 °C, while the wastewater is as high as 16 °C. In summer, however, the energy unit is used for cooling and then the wastewater is too hot to be able to meet the cooling demand through free cooling. During the heating season from October to April/May, the wastewater temperature is only 1-2 °C higher than the seawater temperature, and there is relatively little difference. There is greater uncertainty associated with heat absorption systems from wastewater than from seawater. Assuming that the sea depths and sea temperatures in Raunefjorden outside Flesland are as shown in the figure, we recommend seawater as a heat source for the heat pump.

Designing the size of the heat pump

The heat pump is normally designed to cover a portion of the maximum heat demand. The heat pump will be a base load plant, while peak loads on the coldest days of the year shall be covered by district heating or by a furnace. With a heating demand as calculated for Bergen Airport, a heat pump with 3 MW thermal power as drawn on the power-duration diagram in Figure 1 is appropriate.

When the heat pump also needs to cover the cooling demand at Bergen Airport, Flesland, the heat pump with free cooling must cover the maximum cooling demand.

Design cooling water temperatures for the primary network are set to t_{supply}/t_{return} = 7/15 °C. The maximum cooling requirements are expected to occur in June, July and August. In these months we have the highest sea temperature in August, and this may rise to 10 °C. With such a sea temperature in the seawater heat exchanger we can pre-cool the cooling water from 15 to 11 °C, while the heat pump must be designed to recool water from 11 to 7 °C. That is, the cooling demand can be met by 50% free cooling and 50% mechanical cooling from the heat pump.

The heat pump's cooling output: $P_0 = 4\ 400\ kW \cdot 0.5 = 2\ 200\ kW$.

Assuming that the heat pump works with a power factor of $C_{VP} = 4$, the heat output will be:

HP heat output: $P_{HP} = 2\ 200\ kW \cdot 4/3 = 2\ 930\ kW$.

A heat pump of 3 MW combined with free cooling is thus large enough to cover the cooling load at Bergen Airport. The power characteristics for such a heat pump are shown in the output-duration diagram in Figure 1. The shaded area represents the energy ratio for heating (top) and cooling (bottom) of the heat pump.

Control and regulation of heat pump system

With heat pump operations, a distinction is made between heating and cooling operations, or between winter and summer operation. Manual switching from summer to winter operation is proposed.

Winter operations: With winter operations the heating demand governs the heat pump capacity.

The heat pump system will be controlled by an external signal from an outdoor compensation system, which controls the supply water temperature from the heating plant as a function of the outside temperature. The heat pump should cover the base load and the heat pump will normally operate at full capacity before additional heat is engaged. A signal from the heat pump for full allowance must be fully interlocked against the additional heat source so it does not engage until the heat pump is running at full capacity. In addition, the heat pump must be fitted with a safety thermostat that adjusts the capacity of the heat pump down when it exceeds the maximum allowable temperature, e.g. 68 ºC.

Summer operations: During cooling operations, the cooling demand is primarily covered by seawater. Only when the seawater temperature is too high to meet the cooling demand through free cooling, will the heat pump meet the cooling demand. The cooling water circuit will be connected to the heat absorption circuit after the heat pump's evaporator. The cooling water will then be pre-cooled by seawater and recooled by the heat pump.

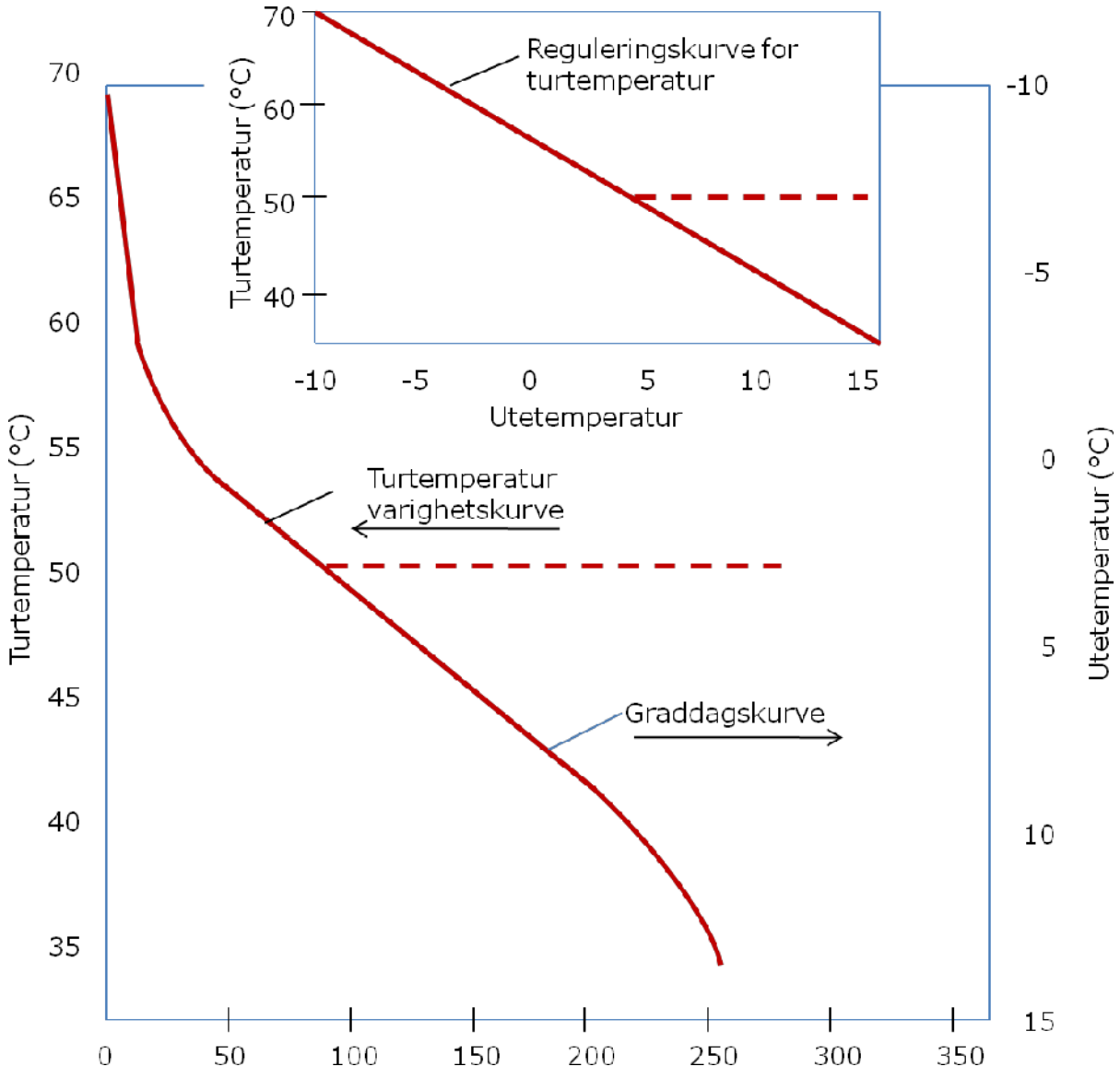
When the heat pump is in cooling mode, the capacity of the heat pump is adjusted to maintain a constant cooling water temperature of for example 7 ºC in the supply line out to the substations. Excess heat from the heat pump condenser is dumped into seawater via the dump heat exchanger as shown in Figure 2. This is done by a temperature sensor in the return line into the heat pump maintaining a constant return

temperature of, e.g., 60 °C by controlling valves that lets heat out against the dump heat exchanger.

Temperature level in the heating system

The design supply/return temperature in the water-borne heating system is set a 70/35 °C. It is assumed that the supply temperature can be compensated for outdoors. The top of Figure 5 shows an example of a possible control curve for the heating system. Here, the supply temperature is reduced linearly from 70 °C at DUT = -10 ºC to 35 ºC at +15 ºC. To preheat hot water, it may be advisable to limit the supply temperature to, e.g., 50 °C as the lowest value as shown by the dashed line.

The bottom of Figure 5 shows the duration curve for the supply water temperature for the given control curve. We see that at an outside temperature of +5 °C the supply temperature will be 50 °C. In a normal year the supply temperature in the heating system will be above 50 °C for 100 days. At an outdoor temperature of 0 °C, the supply temperature with the given control curve must rise to 56 °C and for approx. 50 days the outdoor temperature can be lower than 0 °C, i.e., the supply temperature must be higher than 56 °C for approx. 50 days in a normal year.



Control curve (top) and supply temperature duration curve (bottom)
Diagram: Turtemperatur = Supply temperature), Graddagskurve = Degree day curve, Turtemperatur varighetkurve = Supply temperature duration curve, Utetemperatur = Outside temperature, Reguleringskurve for turtemperatur = Control curve for supply temperature

It is assumed that ammonia will be used as a working medium for the heat pump. In order to meet the temperature requirements in the heating system, a two-stage ammonia plant will be required on the coldest

days.

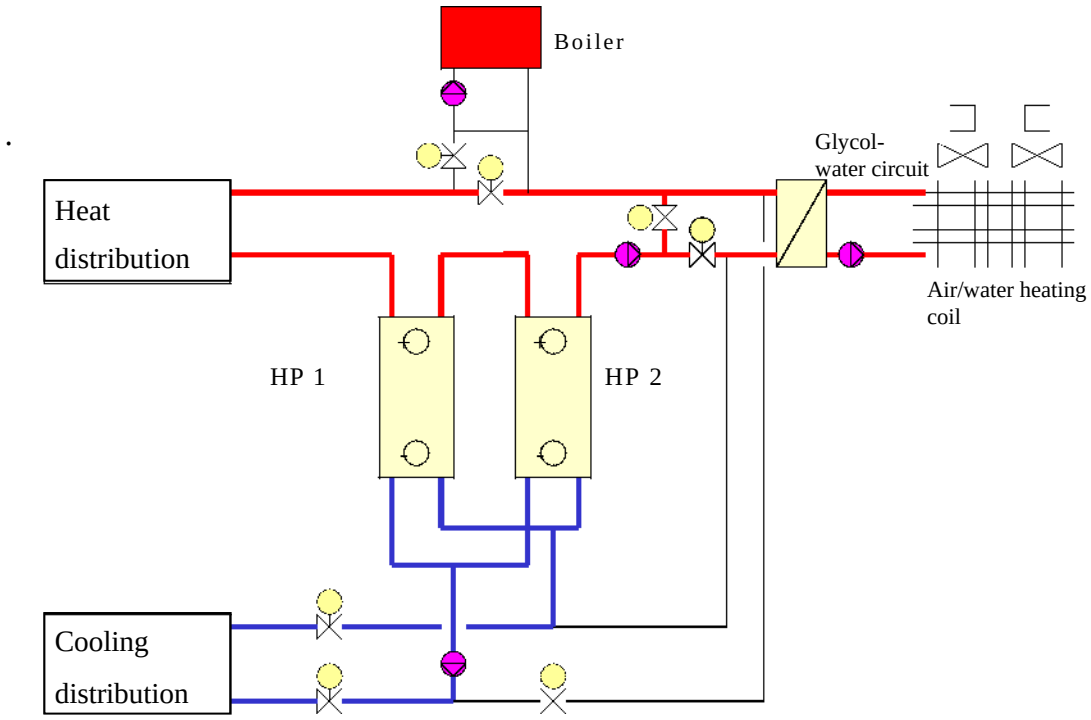
Investment in seawater-based heat pump

Water/water HP:	NOK 10 000 000
Seawater system:	NOK 7 000 000
Machinery room with land:	NOK 3 000 000
Pipe system, el. + automation:	NOK 5 000 000
Substation district heating for additional heating:	NOK 1 000 000
Total investment in central energy plant:	NOK 26 000 000

Air-based heat pump

Air-based heat pumps can be constructed in various ways. A water/water heat pump with heat absorption via a dry cooler is assessed here because the heat pump must be built to supply the maximum cooling demand of 4.4 MW in summer. An ice water system with a dry cooler on the roof to dump the condenser heat is by far the most common cooling method for such large climate cooling systems.

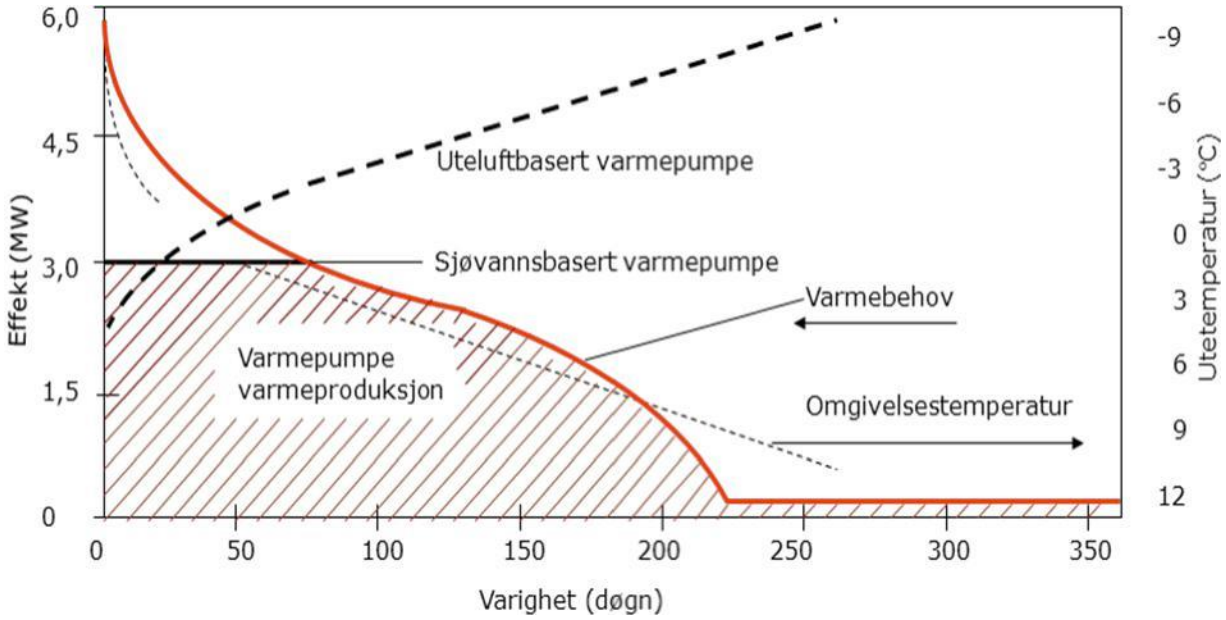
The figure below shows in principle the pipe system of a water/water heat pump with heat absorption and heat output from/to the air via a dry cooler. Such an air-based heat pump system solution will cover both heating and cooling demand simultaneously, but in terms of control a distinction is made between heating and cooling mode (or winter and summer operation). In the summer, the heat pump will primarily cool an ice water circuit, and excess heat will be dumped via dry coolers. In the winter, the heating demand is dominant and low temperature heat is then absorbed from the outdoor air, from the same dry coolers, i.e. indirect heat absorption from the outside air as shown on the schematic diagram in the figure. When the outdoor temperature is lower than 4-5 ^{o}C, frost will form on the dry coolers, and these must be defrosted periodically. Defrosting should preferably take place by shutting off the dry coolers one by one and heating them with hot liquid (glycol water).



Ice water

Water/water HP with heat absorption via dry cooler

It is assumed here that the heat pump system will be built as a two-stage NH_3 – heat pump. The heat pump can operate down to design outdoor temperature. The dry coolers must be built with wide slat distance so that the coils can withstand a certain frost layer before defrosting. In these assessments, the same type of heat pump is assumed as for seawater, but the air heat pump must have twice the cooling capacity, 4400 kW, because there is no free cooling effect in the middle of summer. In the figure above, the output-duration curve for the heating system is shown with the output characteristics for the two-stage heat pump using seawater and ambient air, respectively, as a heat source.



Output-duration curve for the heating system with two different heat pumps
Effekt (MW) = Output (MW), Varmepumpe varmeproduksjon = Heat pump heat production, Varmebehov = Heat demand, Omgivelsestemperatur = Ambient temperature, Varmebehov = Heat demand, Uteluftbaset varmepumpe = Outdoor air-based heat pump, Utetemperatur = Outside temperature, Varighet (døgn) = Duration (24-hour period)

Assuming that a water/water heat pump with a dry cooler can be in operation down to a design outdoor temperature of approx. -10 ºC, the air-based heat pump can cover about as much of the annual heat demand as a seawater-based heat pump. The heat pumps will cover approximately 80% of the energy demand for heating, while the additional heating system must cover approximately 20%.

Investment in air-based heat pump

Water/water HP:	NOK 20 000 000
Dry coolers:	NOK 8 000 000
Machinery room with land:	NOK 3 000 000
Pipe system, el. + automation:	NOK 5 000 000
Substation district heating for additional heat:	NOK 1 000 000
Total investment in central energy plant:	NOK 37 000 000

Technical/economic assessment
In the table on the following page, the following heat pump system solutions are compared:

1 Seawater-based heat pump – 6 °C seawater temperature
2 Water/water heat pump with heat absorption from air via dry coolers

Table: Technical economic comparison of alternative energy systems

Alternative Heating	1 Seawater-based HP	2 Outdoor-air-based HP
Technical data		
Heat production		
- Heat pump (MWh/year)	8 000	8 000
- Additional heat (MWh/year)	2 000	2 000
Total heat prod. (MWh/year)	10 000	10 000
Cooling prod		
- Free cooling (MWh/year)	3 000	0
- HP/Cooling unit (MWh/year)	1 000	4 000
Total cooling prod. (MWh/year)	4 000	4 000
Total energy prod. (MWh/year)	14 000	14 000
Energy consumption		
Electricity		
- HP heating operation (MWh/year)	2 800	3 360
- HP cooling operation (MWh/year)	330	1 330
- Additional heat (MWh/year)	2 100	2 100
- Pump consumption (MWh/year)	180	180
Total energy cons. (MWh/year)	5 410	6 970
Economic data		
Investment		
- Construction costs (NOK)	26 000 000,-	37 000 000,-
- Engineering and unforeseen (NOK)	5 000 000,-	5 000 000,-
Total investment (NOK)	31 000 000,-	42 000 000,-
Annual costs		
Capital costs (NOK/year)	2 926 400	3 964 800
Service/maintenance (NOK/year)	520 000	740 000
Energy cost (NOK 0.8/kWh) (NOK/year)	3 428 000	5 576 000
Total annual costs (NOK/year)	7 774 400	10 280 800
Spec. energy price (NOK/kWh)	0.56	0.73

The following preconditions are assumed for the economic calculations:

- Economic lifetime is set at 20 years, and real interest is 7 % per year.
- Service/maintenance costs are set at 2% of construction costs
- Both of the heat pumps cover 80% of the heat demand
- The seawater heat pump has an annual heat factor of $\varepsilon = 3.0$
- The air heat pumps have an annual heat factor of $\varepsilon = 2.5$
- Heat loss in the local district heating network is 5% of the heat demand, and this is taken into account in that 5% energy consumption is added to all heat generators
- The electricity price is set at NOK 0.8/kWh

As seen from Table 2, the specific heat price for energy delivered to the central energy plant is substantially lower for a seawater-based heat pump system than for an outside-air based-heat pump system.

Conclusion
Seawater-based heat pumps for district heating and district cooling at Bergen Airport, Flesland emerge with a significantly lower annual cost than outdoor air-based heat pumps. We recommend that Avinor adopts seawater-based heat pump systems as base load plants for cooling and heating for the following reasons:

- Experience with seawater-based heat pumps is far better than with air-based heat pumps. Large seawater-based heat pumps usually last much longer than 20 years, while large air-based plants are usually taken out of service before they are 10 years old.
- The seawater system of the seawater pump can be designed for expansions for more than 20 years in the future, and the heat price delivered from a large seawater-based heat pump will be reduced by expansions of the plant. For air-based heat pumps, the price will increase proportionally with the size.

9.13.4 Overall impact assessment

The impact assessment has shown that the new terminal at Bergen Airport, Flesland could be an energy efficient building. TEK-10 is met, but there is an ambition level beyond this. Measures such as the following are emphasised:

- Building geometries allowing structures with low air leakages through the climate screen.
- Awareness around design of glass areas in relation to the sun:
    - Winter operations: Reduction of heat loss and maximum utilisation of solar energy
    - Summer operations: Increase the transmission loss and minimise the solar burden
    - Minimise glare from direct sunlight
- Emphasis on efficient light sources and fixtures to reduce energy demand for lighting and management principles such as daylight compensation of lighting system and presence detection.
- Emphasis on systems with motion detection and demand control of escalators and moving walkways and regenerative lifts that generate electricity when they descend
- Use of materials with low emissions to indoor air so that the air volumes can be designed for low material stress, which will in turn provide a good contribution to reducing energy costs for climate control.
- Demand-controlled climate control and heat recovery
- Energy monitoring

In addition, the impact assessment shows that the establishment of environmentally friendly energy supply in the form of heat pump systems is possible at Bergen Airport, Flesland, where a seawater-based heat pump is recommended.

Conclusion: The impact assessment has shown that there is a good basis for environmentally friendly energy supply and energy use at Bergen Airport, Flesland.

9.14 Risk and vulnerability analysis (ROS)

9.14.1 Introduction

General
A risk and vulnerability analysis has been carried out in connection with the impact assessment for Bergen Airport, Flesland Zoning Plan. The zoning will facilitate the expansion of Bergen Airport to cover future needs due to passenger growth in coming years. The airport's various elements such as access, parking, terminals, aprons, rail system, buildings for administration, operations, hangars, cargo etc. must therefore be extended.

Section 4.3 of the Planning and Building Act (PBL) requires the completion of risk and vulnerability analyses in all planning: *When preparing development plans, the planning authority shall make sure that a risk and vulnerability assessment is carried out for the planning area, or shall itself carry out such an assessment. The assessment shall show all the risk and vulnerability factors of significance for determining whether the land is suitable for development purposes, and any changes in such factors as a result of the planned development. Areas where there is a danger, risk or vulnerability shall be indicated in the plan as areas requiring special consideration, see sections 11-8 and 12-6. In land-use plans, the planning authority shall adopt such provisions regarding development in the zone, including prohibitions, as are necessary to prevent damage and loss.*

The regulations on impact assessments stipulate that an assessment of accident risk and the need for emergency preparedness shall be conducted in accordance with Section 4.3 of the PBL.

The aim of this assessment is to provide an overall, representative presentation of the risk of harm to the life and health of third parties, material assets and the environment in connection with future disposition of the planning area.

The analysis is part of the basis for identifying the need for risk reduction measures (prevention and preparedness).

Preconditions, limitations and assumptions
The following assumptions have been used for this risk and vulnerability analysis:

- The analysis is qualitative.
- It is limited to the topic of civil protection as described by the DSB - Directorate for Civil Protection and Emergency Planning.
- It is assumed that construction work performed in the future complies with relevant laws and regulations, including safety measures and the like.
- The assessment is limited to those elements that are new compared to the existing zoning plan in the area. For planning map - see main document for site plan.
- The analysis does not consider independent, concurrent incidents.
- The analysis covers the finished solution, not an assessment of risk in the building and construction phase.
- The analysis does not include incidents related to unforeseen acts (sabotage, terror and the like).
- The assessments and assumptions in the analysis are based on the existing documentation about the project and the actual and planned use of the surrounding area.

Definitions

Table - Definitions

Term	Definition
Impact	Possible result of an undesirable incident. Impacts can be expressed in words or as a numeric value for the extent of harm to people, the environment or material assets. (NS5814)
Risk	Expression of the combination of probability of and impact of an undesirable incident. (NS5814)
Risk analysis	A systematic approach to describing and/or calculating the risk. The risk analysis involves the identification of undesirable incidents and the causes and impacts of them. (NS5814)
Risk reduction measures	Measures that affect the probability or impacts of an incident.
Vulnerability	Inability of an object of analysis to withstand the effects of an undesirable incident and to restore its original condition or function after the incident. (NS5814)
Probability	To what extent it is probable that an incident might occur. Can be expressed in words or as a numeric value (NS5814)

Governing documents for the project

Table – Governing documents for the project

Ref. no	Description	Issued by/source:
1.1	NS 5814:2008 Requirements for risk assessments	Standards Norway
1.2	Circular T-5/97 Land use planning and development in danger areas	Ministry of the Environment
1.3	Act relating to planning and the processing of building applications (the planning part)	Ministry of the Environment
1.4	Guidelines for the County Governor's use of objections in planning matters under the Planning and Building Act, September 2010.	DSB - Directorate for Civil Protection and Emergency Planning
1.5	Civil protection in land-use planning (Rev. Jan. 2010)	DSB - Directorate for Civil Protection and Emergency Planning

Supporting documentation

The analysis is based on information contained in the following documents and drawings:

Table – Supporting information

Intern ref.	Name	Date	Publisher
2.1	Planning programme proposal	10 Aug	Norconsult
2.2	Various consultative statements		Miscellaneous
2.3	T3 Bergen Airport, Outline project summary	1 Dec 2010	Narud Stokke Wiig
2.4	Traffic analysis Flesland Airport	6 Dec 2010	Rambøll
2.5	Various illustrations		Narud Stokke Wiig
2.6	Mapping of extreme wind conditions in the City of Bergen	23 May 2006	City of Bergen. Prepared by the Meteorological Institute
2.7	Preparation of thematic map for precipitation	2006	City of Bergen. Prepared by Storm Weather Center AS

Other references

Table – Other references

Intern ref.	Name	Published by
3.1	Acceptance criteria for use in ROS analysis work in land-use planning and any other planning work. (12 Jan 2010)	County Governor of Hordaland
3.2	Requirements and expectations for emergency preparedness considerations in social planning, including ROS analyses (26 May 2009)	County Governor of Hordaland
3.2	SIGVe-guide	County Governors of Rogaland, Hordaland and Sogn og Fjordane, DSB and the Norwegian Mapping Authority.

9.14.2 Description of the analysis object

For detailed information about the airport, see the plan description chapter on the basis of the planning process. The planning area's acreage of 1,450 decares (362 acres) includes mainly the terminal area and parts of the airport area, but with some expansions to the south and east. Among other things, the expansion entails a major intervention in Lilandshaugen and the possible infilling of Lønningstjern pond in the south. This ROS analysis describes new elements in this zoning plan and does not deal with matters unchanged from the existing zoning plan. The analysis object includes the expansion of the terminal with traffic forecourt (taxis, buses, getting on/off), the establishment of aprons (south), a new traffic system and the establishment of a new commercial area to the east ("Airport City".)

9.14.3 Methodology

The methodology entails an introductory identification of hazards and subsequent vulnerability assessment of selected, roughly defined incidents. Based on this vulnerability assessment, the need for a more detailed risk analysis will be assessed. The analysis of the risk to human life and health, material assets and the environment is based on the main principles in NS 5814:2008 Requirements for risk assessments (ref. 1.1), where risk is defined as:

"Expression of the combination of the probability and impact of an undesired incident."

Risk is related to undesired incidents, i.e. incidents that basically should not occur. Uncertainty is therefore connected to both whether the incident will occur (probability) and the scope (impact) of the incident if it does occur. The analysis also follows the guidelines of DSB's guide "Civil protection in land use planning" (ref. 1.5).

Categorisation of probability and impact

How often an undesirable incident could occur, is expressed using the concept of probability (incident frequency). Probability and impact assessment of incidents is based both on experience (statistics), trends (e.g. climate) and professional judgment.

A ROS analysis related to the land-use proposal and its associated impact and probability categories was not carried out in the current municipal plan. Nor has it been possible to find acceptance criteria for the municipal planning[1].
The following categories[2] for probability and impact are therefore used in the analysis:

[1] The City of Bergen will review the land-use part of the municipal plan in parallel with a process to audit the municipality's ROS analysis. In this context acceptance criteria that will be politically anchored in the municipality will be prepared.

[2] The categories are based on analyses conducted by Norconsult in connection with zoning plans for several municipalities. The categories also take account of guidance material for the subject prepared by DSB.

Table Probability categories

Probability category	Description (frequency)
1. Improbable	Less than one incident per 1000 years
2. Moderately probable	On average one incident per 100 – 1000 years
3. Probable	On average one incident per 10 – 100 years
4. Quite probable	On average one incident per 1 – 10 years
5. Highly probable	More often than one incident per year

The following impact categories are used:

Table Impact categories

Impact category	Description
1. Very little impact	No bodily injury Negligible environmental damage Material damage < NOK 100 000/no damage to or loss of societal values
2. Little impact	Bodily injury Local* environmental damages Material damage NOK 100 000 -1 000 000/negligible damage to or loss of societal values
3. Medium impact	Serious bodily injury Regional** environmental damage, recovery period of up to 1 year Material damage NOK 1 000 000 - 10 000 000/short-term damage to or loss of societal values
4. Large impact	Fatal injury, one person Regional environmental damage, recovery period of up to 10 years Major material damage NOK 10 000 000 - 100 000 000/damage or loss of societal values of some duration
5. Very large impact	Fatal injury, several persons Irreversible environmental damage Major material damage > NOK 100 000 000/permanent damage to or loss of societal values

* Local environmental impact means the impact on the spill area or immediate vicinity of the discharge point.
** Regional impacts include impacts on the surroundings in the municipality

Assessment of risk
The undesirable incidents are assessed in relation to possible causes, probability and impacts. Risk reduction measures will be considered.

In a rough analysis, the undesirable incidents are placed in a risk matrix determined by the incident's probability and impact. The risk matrix has three zones:

GREEN	Acceptable risk – risk reduction measures are not necessary.
YELLOW	Acceptable risk – risk reduction measures must be assessed.
RED	Unacceptable risk – risk reduction measures are necessary.

The acceptance criteria for risk are given by the coloured zones in the risk matrix below.

Table Risk matrix

	IMPACT				
PROBABILITY	1. Very little	2. Little	3. Medium	4. Large	5. Very large
5. Highly probable	GREEN	YELLOW	RED	RED	RED
4. Quite probable	GREEN	YELLOW	RED	RED	RED
3. Probable	GREEN	GREEN	YELLOW	RED	RED
2. Moderately probable	GREEN	GREEN	YELLOW	YELLOW	RED
1. Improbable	GREEN	GREEN	GREEN	YELLOW	YELLOW

Risk reduction measures

Risk reduction measures means probability-reducing (prevention) or impact-reducing measures (emergency preparedness) that help reduce the risk, for example, from the red zone to the acceptable yellow or green zone in the risk matrix. The risk reduction measures mean that the classification of risk for an incident is displaced in the matrix.

Red incidents – risk reduction measures are necessary

Incidents located in the red area of the matrix are incidents (with associated probability and impact) that we cannot accept on the basis of the criteria. These are incidents that must be followed up by action. This especially includes measures that target the causes of the incident, thus reducing the probability that the incident will occur.

Yellow incidents – measures should be assessed

Incidents located in the yellow area are incidents that are not directly an exceedance of requirements or acceptance criteria, but that require a continuous focus on risk management. In many cases these are incidents that cannot be prevented, but where action should be taken as far as practicable in cost/benefit terms.

Green incidents – acceptable risk

Incidents in the green zone in the risk matrix involve acceptable risk, i.e. the risk reduction measures are not necessary. However, if the risk for these incidents can be further reduced without requiring significant use of resources, implementing measures for these incidents should also be considered.

9.14.4 Hazard identification and vulnerability assessment

Introductory identification of hazards

Hazard means situations that can lead to specific, localised incidents. A hazard is not localised and may represent "group incidents" with great similarities. The following table is based on DSB's guide *Civil protection in land use planning*, and our review of the ROS checklist from the SIGVe-guide. The purpose of the initial risk assessment is to identify the factors that are relevant when assessing the vulnerability of the planning area.

Table Introductory identification of hazards

Hazard	Assessment
NATURE-BASED incidents are limited to the natural local circumstances that mean that the area can withstand or limit the impacts of undesirable incidents	
Landslide/unstable ground (snow, ice, rock, clay, soil)	The measure includes large fills, buildings with several floors below ground level as well as major cuts in mountains. Through planning work this will require thorough site examinations and safety assessments of the cuts that are established. *For this reason there is no further assessment of these topics in the analysis.* The area is not considered vulnerable to avalanche.
Flood in waterway	While Lønningstjern pond is located in the planning area, the measure contains plans to fill in the pond. Assessments related to the Water Resources Act are not done in this analysis. **Run-off from the area will be assessed together with the topic of extreme precipitation.**
Flash flood	The measure will not be subject to flash flooding, *the topic is not assessed.*
Wind/extreme precipitation	**The topic is assessed.**
Sea-level rise	The measure will not be subject to future sea-level rises, *the topic is not assessed.*
Forest/heath fire	Larger forest areas that could represent a major hazard have not been located in or near the planning area. *The topic is not assessed.*
Radon	The area is not mapped in terms of the risk of radon radiation. Technical regulations set high standards for the prevention of radon radiation in new buildings (applies to workplaces, housing, etc.) whether radon is proven or not. For this reason *there is no further assessment of the topic.*
OPERATIONS-BASED incidents are limited to the conditions that are relevant to established operations in the vicinity that could have an impact on the proposed land use.	
Fire/explosion at industrial facilities	The plan facilitates the expansion of the apron area for aircraft, **the topic is assessed.**
Chemical spills and other acute pollution	The plan facilitates expansion of the apron area for aircraft, **the topic is assessed**.
Transport of hazardous goods	Through this planning measure (extension of passenger terminal, commercial area, etc.) the development of undertakings that will generate increased transport of hazardous goods to and from the site will not be facilitated. An expansion of capacity at the airport from 5 million to 10 million passengers will consequently generate increased transport of hazardous goods to the airport (aviation fuel). **The topic is assessed.**
Contamination of the soil	No contamination of the soil has been registered east of the current terminal building and southeast of the current apron area for aircraft (area around Lønningstjern pond). *There is no further assessment of the subject.*

Hazard	Assessment
Electromagnetic radiation	Pylons that will cause electromagnetic radiation in the planning area have not been registered. *The topic is not assessed.*
INFRASTRUCTURE	
Water and sewer pipeline network	A separate water and sewer framework plan will be prepared for the project. The plan will assess related issues. *For this reason the topic is not assessed further in this analysis.*
Traffic safety	The topic is addressed under other traffic reports that will have to be done in the planning process. *The topic is not assessed further in this analysis.*
Ship traffic	Not a relevant topic for this planning measure. *The topic is not assessed.*
Electrical supply	**The topic is assessed.**
Potable water supply	The measure will not affect surface sources. The measure might affect a well drilled in rock. **The topic is assessed.**
VULNERABLE OBJECTS include facilities, buildings, nature and cultural areas that are vulnerable to intervention and damage.	
Health and care institutions	No such objects have been located in the vicinity of the planning area. *The topic is not assessed.*
Important public buildings	No important public buildings other than the airport itself have been located in or in the vicinity of the planning area. *The topic is not assessed.*
Cultural monuments	This is a separate topic in the impact assessment. *The topic is not assessed in further detail here.*
Nature	This is a separate topic in the impact assessment. *The topic is not assessed in further detail here.*

On the basis of preliminary hazard mapping, the following topics are thus considered relevant for further consideration in subsequent chapters:

- Wind/extreme precipitation
- Fire/explosion at industrial facilities
- Chemical spills and other acute pollution
- Transport of hazardous goods
- Electricity supply
- Potable water supply

Vulnerability and measure assessment

In NS 5814:2008 Requirements for risk assessment, the term vulnerability is defined as follows:

> *"Inability of an object of analysis to withstand the effects of an undesirable incident and to restore its original condition or function after the incident."*

In this analysis, we understand the term vulnerability to mean the natural, local conditions that enable areas in the zoning plan to withstand or limit the effects of undesirable events.

In this analysis, vulnerability is classified as follows:
- highly vulnerable
- moderately vulnerable
- not very vulnerable
- not vulnerable

Wind/extreme precipitation

The Norwegian Meteorological Institute has surveyed extreme wind conditions in the City of Bergen (ref. 2.6). Measurements made by the weather station at Flesland Airport show that the planning area may be exposed to strong winds. Both medium winds and gusts. However, the planned measure is not considered very vulnerable to this because such stresses will be part of the basis for design.

Annual normal precipitation at the weather station at the airport is approximately 1800 mm. Based on research on future climate changes, about a 20% increase in precipitation compared to current levels can be expected in the Bergen area towards the year 2100 (ref. 2.7). These are factors that must be considered in connection with major development projects such as this. The plan envisages infilling a large area that is currently a green area of marshes, ponds and outfields. This will entail, inter alia, increased surface runoff. Infilling of Lønningstjern pond also means that natural retention found in the area today will be reduced. The planning area is considered moderately vulnerable to extreme precipitation.

Requirements have been imposed on the preparation of a water and sewer framework plan through consultative statements to the planning programme. This will be prepared concurrently with the draft plan. In the plan, the issues pertaining to infilling of natural drainage areas, future increases in precipitation and runoff in Kvernhusbekken stream will be explored in detail. For this reason the topic will not be considered in more detail in this analysis.

Fire/explosion at industrial facilities

The *expansion of the terminal building* measure will facilitate airport-related commerce and reorganisation of the traffic area/car parks. There are no plans to establish industries in the area with a specific risk of fire/explosion. Nor have businesses been located in the vicinity that endanger future airport operations to the south and east. However, operation of the airport itself constitutes a risk of fire/explosion, but this zoning plan does not change the aircraft-related operations at the airport. The plan facilitates more aprons in the southeastern part of the area. This is not considered to result in significantly increased vulnerability to fire/explosion.

Detailed reviews of major accidents in connection with the airport, plane crashes etc. have not been done in this analysis as these must have been undertaken in earlier development phases of the airport. Globally, aviation has in general seen a positive trend in the number of accidents per million take-offs and landings.

Chemical spills and other acute pollution

The planned expansion eastwards (new terminal building) and establishment of industrial areas are not considered to pose a significant risk of chemical spills and other acute pollution. While minor discharges associated with parked cars in car parks may occur, the potential is considered negligible. Regarding the establishment of aprons in the southeastern part of the area including taxiways, this is considered moderately vulnerable to the occurrence of acute pollution.

Transport of hazardous goods

Increased activity at the airport will not result in increased transport of hazardous goods on the road network in the area. Deliveries of e.g. jet fuel, de-icing fluids etc. come via pipeline from the sea. (stated in email from Avinor dated 8 February 2011). On this basis, the area is assessed as not vulnerable with regard to the transport of hazardous goods.

Electricity supply

The measure will most likely affect existing infrastructure for power supply in the area. This must be mapped in detail in connection with the further planning of measures to be implemented in the area. In this context, capacity in existing supply networks must also be assessed in relation to the needs that a new terminal building will have. The area is considered not very to moderately vulnerable to the influence of power supply infrastructure.

Potable water supply

In the national ground water database *Granada – Nasjonal grunnvannsdatabase* cited in the map service *Arealisdata på nett*, a well drilled in rock has been registered that will lie within the planning area. The well is located on *Lilandshaugen*. Implementation of the plan will entail a major cut in this hill, and this will most likely affect this well. The status of this well is uncertain at present. Based on information from Granada the well is 80.5 metres deep and was drilled in 1975. The well's use is unknown. The planning area is considered highly vulnerable to the negative impact of existing wells in the area. The status of this well is to be clarified in further planning work.

Selection of incidents in ROS analysis

On the basis of the completed vulnerability assessment, a decision has been made to consider the following incident in a more detailed incident-based risk analysis.

- Chemical spills and other acute pollution.

The other incidents emerge with low vulnerability. They will be sufficiently examined and dealt with through the subsequent detailed planning of the area or in other parts of the impact assessment.

ROS analysis: Chemical spills and other acute pollution:

Discussion of probability:

Through the measure a larger area in the southeastern part of the planning area will be infilled. This area will be used for aprons with associated taxiways etc. This area will be exposed to both minor operational emissions associated with refueling, repairs, de-icing fluid used on the runway etc. Such discharges are considered operational discharges handled through the airport's IK-HSE system. (Such discharges are also assessed in the water and sewer framework plan with establishment of an oil separator etc.)

This incident is therefore defined as larger acute spills, for example, larger fuel leaks, leaks e.g. from tank lorries, collisions with subsequent spills etc. The probability of such emissions in this area is assessed at an average of one event every 10 - 100 years.

Discussion of impact:

Life and health: The incident is not assessed as having an impact on life and health.
Exterior environment: This part of the airport will consist of impervious surfaces. Surface water from here will go through oil separators since oil contaminated water could occur in this area due to smaller operational discharges. Accordingly, larger acute spills will also go through established oil separators. Large acute spills may cause operational problems for oil separators and contaminated water could be discharged to the environment. The runoff from here will flow toward Kvernhusbekken brook and the area adjacent to it. The impact is considered to be small - local environmental damage.
Material assets: The material damage is considered to be related to a potential clean-up of spills. Such emissions are not considered to inflict airport shutdowns. The impact is considered to be small.

Summary:

	Probability					Impact					Risk		
Value	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**GREEN**	**YELLOW**	**RED**
Life and health			X			X					X		
Exterior environment			X				X				X		
Material values			X				X				X		

9.14.5 Conclusion ROS analysis

The assessed part of the planning area emerges as not very vulnerable to the assessed risks. A need was identified to assess a single event - chemical spills and other acute pollution - in a more detailed analysis. It showed that the incident emerges with acceptable risk and that additional measures will not be necessary beyond the usual considerations arising from a detailed design phase.

Regarding the registered groundwater well in the area, clarifications with respect to its status will be made through further planning of the development. Furthermore, the future demand for power and capacity in today's grids must be looked at.

Future handling of surface water and runoff from the area that is to be infilled is handled in the water and sewer framework plan prepared in parallel with this plan.

9.15 Relationship with Armed Forces' interests and a possible cargo port at Flesland

9.15.1 Main issue

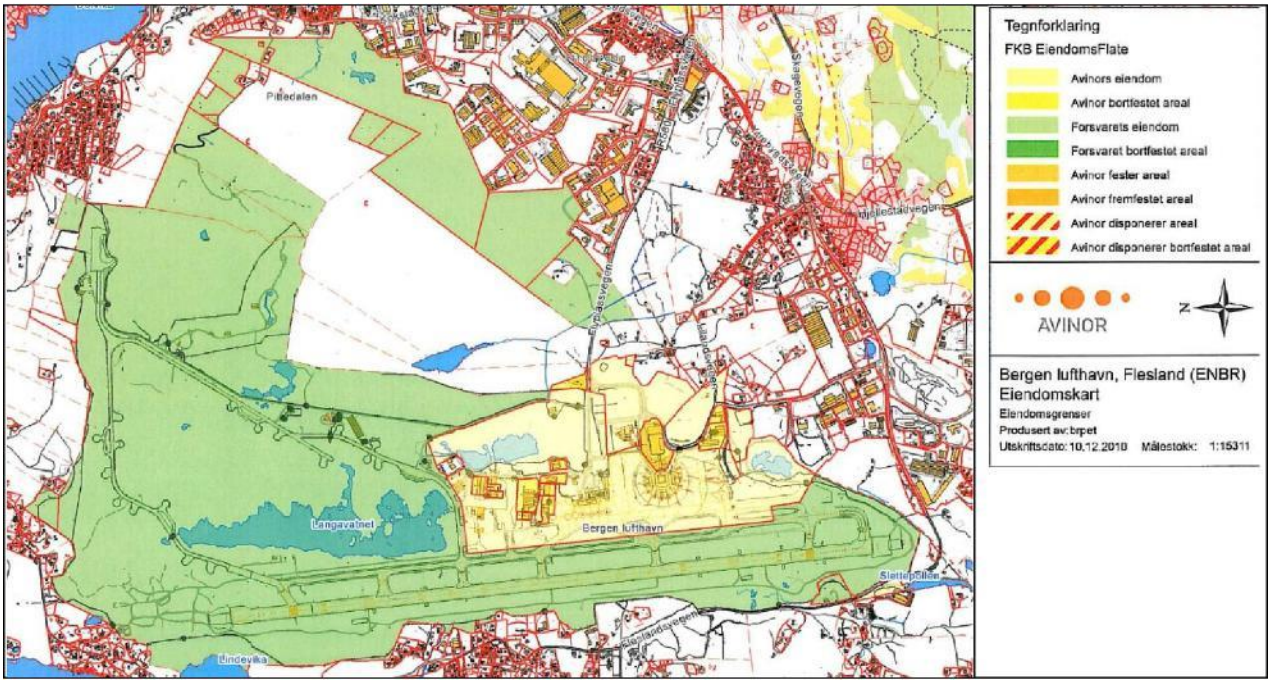
In the planning programme the issue is stated to be:
"There are some national and regional interests around the airport:

- *The Armed Forces have operations in the area.*
- *Work is taking place on a county sector plan for a new cargo port in the Bergen area. It may be appropriate to locate it by Flesland Airport.*

Clarifications might therefore be necessary about whether the planning work will have an impact on and/or is in conflict with those interests."

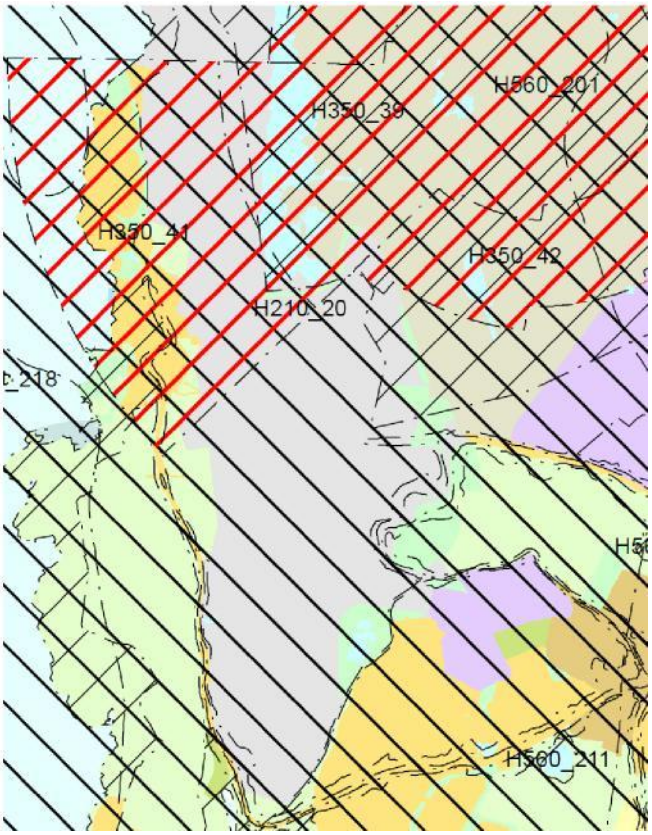
9.15.2 Impact assessment

Armed Forces' interests
The map below shows which areas are owned by Avinor and which are owned by the Armed Forces. The Armed Forces own the areas including the runway and parallel taxiway and larger areas north and east of the civilian construction area. The Framework Agreement between the Ministry of Transport and Communications and the Ministry of Defence about the distribution of responsibility and expenses for the state's airports etc. states that, *"in general, the ownership circumstances should be maintained for property in the so-called common areas, which essentially means runways and taxiways, but at Flesland the Civil Aviation Authority (now Avinor) shall be responsible for all investments in these areas."*



Only smaller parts of the zoning plan now submitted are located inside the Armed Forces' properties. This applies to areas in the far north and areas completely in the southwest. In the zoning plan, both areas are proposed zoned for runway/taxiway. This corresponds to current use and also the use these areas are zoned for in the current zoning plan for the area. Cf. above it is also Avinor that is responsible for investments in these areas. Zoning of these areas should therefore not entail any conflict.

The Armed Forces' areas otherwise have a network of taxiways and other operational facilities for the former Flesland air station. However, all activities as a military air station have ceased and the area is currently only mainly used to store materials and for exercises with small units. Exercise activities on the site are



Section of proposed new municipal plan, considered by the environment and urban development committee on 9 June 2011

scheduled exercises. It is not expected that the air station, as regards ordinary air station activity, will become operative again. Personnel traffic is coordinated with civil air traffic and is operated entirely from the Armed Forces' terminal at the civilian airport.

However, military operations currently take place in several buildings and facilities (hangars, workshops, warehouses) at the airport. In line with the delimitation in the new proposed municipal plan (considered by the environmental and urban development committee on 9 June 2011), a fire and explosion safety zone has therefore been proposed around the Armed Forces' facilities. With this, the interests of the Armed Forces are considered safeguarded.

Conclusion: The draft plan is not in conflict with the interests of the Armed Forces.

Cargo port Flesland

Starting point

A memo dated 11 January 2011 from the county executive to the county transport committee summarises the status of work on a new cargo port in the Bergen area. The work consists of three parts:

1. General subject reports
2. Concept sketches
3. Impact assessments (IA)

The first two sections are completed and attached to said memo. However, the IA report has not been published or processed to date as far as we can see.

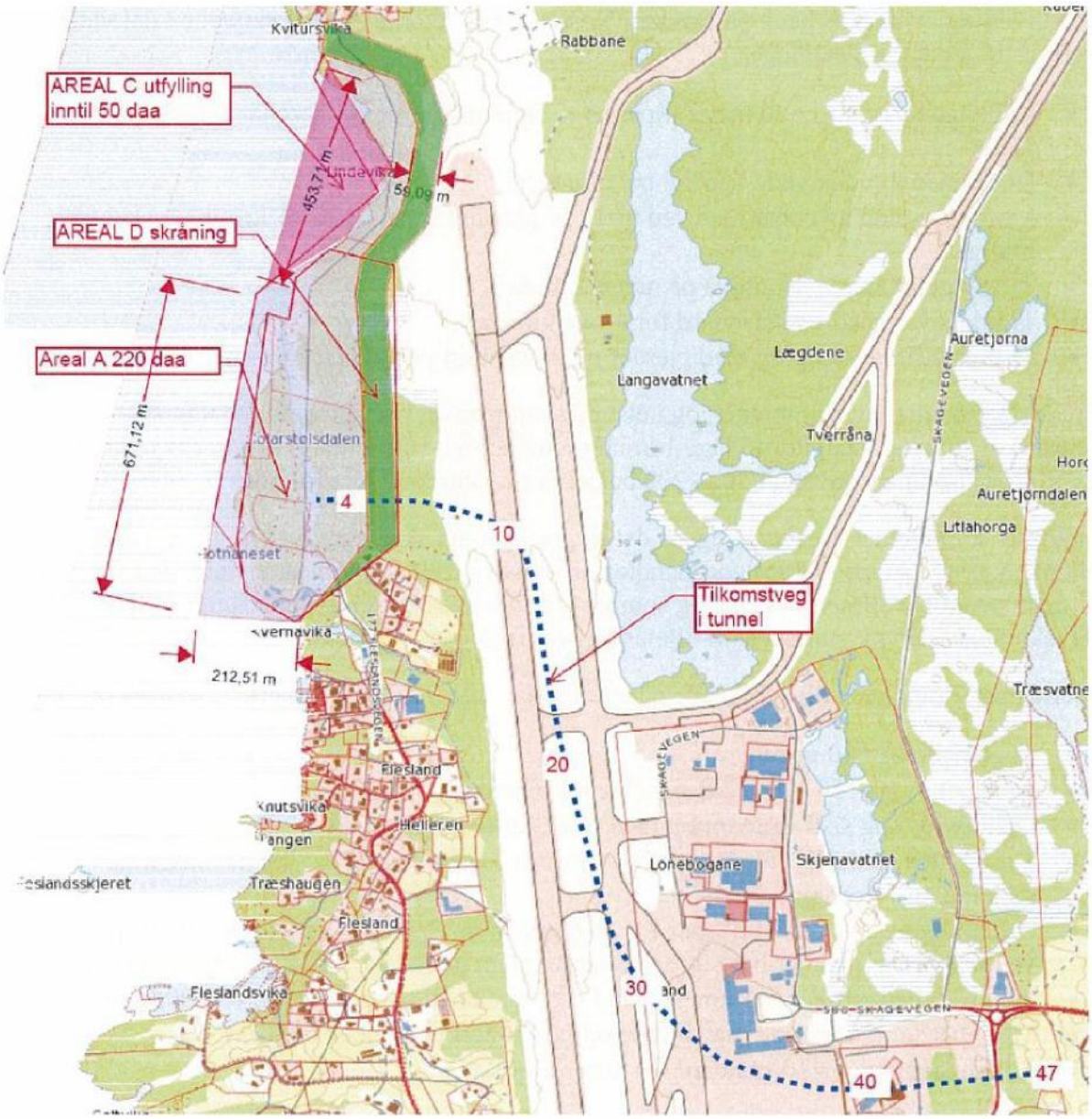
Concept sketches have been made for the "combination alternative" (combination between CCB and Mongstad) and for the "Flesland alternative". The concept sketch for Flesland is designed with two alternative rear areas; one on Storrinden (Kokstad Vest) and one in the Liland area. Avinor has prepared a report on aviation safety related to the proposal for a port northwest of the runway. For this reason Avinor discourages the localisation of a port at Flesland. Nevertheless, the county executive wants to go ahead and assess the impact of all the different localisation options in a comprehensive IA report.

The concept sketches at Flesland assume a port on the northwest side of the airport and a cargo terminal with rail on the east side of the airport; either at Liland or on Storrinden. However, it is stated that a railway terminal on Storrinden will be technically difficult to achieve.

Furthermore, the best possible link between the railway terminal and the port is assumed. Such a connection should be with roads that can be closed to general traffic. There are three possible principal solutions for a road to the port: north of the airport, south of the airport and in a tunnel under the airport.

In the concept sketches, the only physical contact point with the "proposed zoning plan for Bergen Airport" is a possible access road underneath the airport. In purely technical terms, a tunnel

underneath the airport is the most demanding, but such a solution is probably necessary if the port is to have a good connection to a railway terminal. The floor of the tunnel will be 20-40 metres below the runway level. There is some uncertainty about soil mechanics. The project should, according to the "concept sketch memo," not be based on a tunnel if there is no assurance that it will run in mountains with adequate cover and quality throughout.



Sketch of the Flesland alternative port, obtained from "Physical concept sketches for cargo port in Bergen area," attached to memo from the county executive to the country transport committee 11 January 2011
Tilkomstveg i tunnel = Access road in tunnel, Areal A 220 daa = Area A 220 decares, AREAL D skråning = AREA D slope, AREAL C utfylling inntil 50 daa = AREA C filling in up to 50 decares.

Assessment:
Any conflicting interests in the two planning works would have to apply to the parking facility below ground level and a possible road in a tunnel as discussed. However, at the depth the tunnel is to run (20-40m), this cannot be a conflict. It is also assumed that the route for the road is not locked in and can be adjusted (for example, be laid somewhat farther north where underground parking is not feasible in any case)

Conclusion: There is no conflict between the work on a new cargo port in the Bergen area and the proposed zoning plan for Bergen Airport Flesland.

Overall conclusion: The impact assessment has shown that there are no conflicts relating to 1) the Armed Forces' interests in the area or 2) Work on a possible new cargo port in the area.

9.16 Overall impact assessment – all topics

Cf. Section 1 of the regulations on impact assessments (IA), the purpose of the provisions on impact assessments (IA) is to ensure that environmental and societal considerations are taken into account during the preparation of plans or measures, and when deciding whether, and on what terms, plans or measures can be implemented.

The impact assessment will thus provide decision-relevant information as a basis for making a decision on:

- Whether the plan can and should be carried out
- On which basis the plan can be realised

The impact assessment has revealed undesired effects related to the topics road traffic noise, natural environment and cultural monuments and cultural environment.

Regarding homes exposed to increased/new road traffic noise, these are already located close to the airport with the inconvenience this entails. The benefits to society of a new road system and expansion of the airport are substantial. Not implementing the measure to prevent increased noise level for the few homes that are involved here must therefore be regarded as unacceptable. Mitigation measures in the form of facade measures are however included as a consecutive ordering provision.

With respect to cultural monuments and cultural environment, the undesirable effects are mainly related to the fact that the Lønningen country house estate must be removed. The cultural heritage authorities are basically negative to removal/relocation and have requested a thorough examination where, among other things, the alternative development options for the planning area are to be reviewed. The present impact assessment provides answers to this.

Based on our assessment and cultural heritage authorities' clear underlining of the overall significance that the context has for the cultural monument that the Lønningen country house is, none of the alternatives will be able to preserve the high value of the Lønningen country house. In three of the alternatives we have looked at, the country house itself could be preserved, but the surroundings would change to such an extent that its value would be diminished. This applies to its intrinsic value as part of a cultural landscape, but also its empirical and utilitarian value to a large degree. Because of the major changes in the surroundings, the view would be diminished and noise from the airport would make it very difficult to find a good function for the building. Since preservation of the facility is in direct conflict with the need to expand the airport, the developer promotes the alternative that permits expansion according to the airport's needs. In this case, the importance to society of maintaining and developing a functional airport in Western Norway must be weighed against preservation of the Lønningen country house. In our assessment, the former must be accorded the greatest weight. As a mitigation measure, the country house will be moved to another, more suitable place, where it will have value as a historical narrative when used in connection with leisure and cultural activities in Ytrebygda.

With respect to the natural environment, red list species of lichen have been found on courtyard trees in front of the Lønningen country house and several mature oaks that are a priority habitat type - hollow oaks - have been registered in an old park landscape in the immediate vicinity. Had it been possible to preserve the country house, several of the trees in question could remain standing. The importance to society of further developing the airport is considered more compelling than preserving the natural values mentioned here.

Regarding the other topics, no undesirable effects of decisive importance to the environment and society have been uncovered. A number of adjustments have been made to the draft plan for addressing the various considerations.

In summary, our assessment is that the plan can and should be implemented in accordance with the development volume etc. assumed in this case and the development conditions stipulated here.

10 IMPACTS OF DRAFT PLAN

10.1 Principal plans and decisions

The draft plan is essentially in line with the current municipal plan. Some land can be considered to be in conflict with the municipal plan because it encroaches on agricultural, natural and recreational lands. However, the border in the municipal plan between ANR and the building area is "jagged" as it follows the property boundary. In the draft plan, the border has been straightened out and adapted to the situation. The land areas reallocated from ANR are very limited areas. The land areas in question have no agricultural value.

10.2 Existing zoning plans

The current zoning plan for the airport R. 1839.00.00 shall be amended in its entirety, see Chapter 7 of the plan description for further details.

The zoning plan in the south, Zoning plan for Lønningen South, plan no. 1515.00.00 shall be amended in the northern part in that the hiking trail will be rerouted and the green belt will be reduced. The building area set aside for airport purposes in the plan will mainly continue to have this purpose. Some land will be rezoned for road purposes.

10.3 Aesthetics

Reference is made to Chapter 9 of the impact assessment - subtopic landscape.

10.4 Impacts on neighbours

The neighbours of the new road system will be subjected to more noise than before.
The homes that previously lay "behind" Kongshaugen hill will be exposed to the airport and have a changed view and more visual access.

Reference is made to Chapter 9 of the impact assessment - subtopic local environment, outdoor recreation and interests of children and young people.

10.5 Traffic and parking

Reference is made to Chapter 9 of the impact assessment - subtopic traffic.

10.6 Cultural monuments

Reference is made to Chapter 9 of the impact assessment - subtopic cultural monuments and cultural environment.

10.7 Outdoor activities, natural areas, interests of children and young people in the local environment

Reference is made to Chapter 9 of the impact assessment - subtopic natural environment and biodiversity and subtopic local environment, outdoor recreation and interests of children and young people.

10.8 Private and public services

Services in the local community will be increased by the increased services at the airport. The topic is otherwise not considered relevant.

10.9 Risk and vulnerability

Reference is made to Chapter 9 of the impact assessment - subtopic risk and vulnerability analysis.

10.10 Infrastructure (road/water/sewer, electrical system etc.)

Reference is made to the draft water and sewer framework plan attached to the draft plan.

10.11 Impacts on commercial interests

Since the ANR areas that will be sequestered have no agricultural value the draft plan has no impacts on agriculture-related enterprises.

The draft plan otherwise accommodates new commercial areas connected with major transport arteries such as the airport and the light rail transit (LRT) system. These are attractive commercial areas that can generate higher economic growth in the municipality.

10.12 Legal/economic consequences for the municipality

The land areas covered by the plan are mainly owned by the proposer (Avinor). There are some land areas adjacent to the road system in the southeast that lie on other parties' land. Avinor is in dialogue with landowners and it seems likely that it will be possible to achieve amicable agreements with them.

11 PARTICIPATION

A combined information meeting for neighbours has not been held in connection with the draft plan although they have been informed of the ongoing process via Avinor's web pages.

Avinor has good contact in general with its neighbours.

Several meetings have been held with the municipality (office for building projects and private plans and office for plans and geodata) and the Norwegian Public Roads Administration has also been present at several of the meetings.

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