
REPORT

CLIENT
BERINOR ANS

SUBJECT
**Screening report for intersections E6 Moelv
- Roterud**

DATE: / REVISION: February 12th 2021 / 01
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REPORT

PROJECT	CE6 Moelv - Roterud	DOCUMENT CODE	MR1-MU-D2-GEGE-GE-REP-GE-0
SUBJECT	Screening report	ACCESSIBILITY	Open
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Table of abbreviations

	Norwegian	English
KDP	Kommunedelplan	Municipality sector plan
BoQ	Mengder	Bill of Quantity
Rv. 4	Riksveg 4	National road 4
GHG	Drivhusgasser	Greenhouse gas
AADT	Års Døgn Trafikk	Annual Average Daily Traffic

Table of definitions

Definitions	
Developer	Nye Veier AS
Contractor	Berinor ANS
Designer	Multiconsult Norge AS
Architect	Selberg Arkitekter AS
AF Gruppen	AF Gruppen

0 Sammendrag

Prosjektet E6 Moelv – Roterud omfatter bygging av firefelts motorvei med fartsgrense 110 km/t og ny bru over Mjøsa. Det utarbeides en reguleringsplan med konsekvensutredning for strekningen i samarbeid mellom Nye Veier og totalentreprenør Berinor ved integrert samhandling. Parsellen E6 Moelv – Roterud går gjennom kommunene Ringsaker og Gjøvik.



Figur 0-1: E6 Moelv – Roterud (Illustrasjon fra planprogrammet [4])

Henvisninger til «kommunedelplan» eller «KDP» i silingsrapporten henviser til relevante deler av følgende vedtatte planer:

- Kommunedelplan (KDP) E6 Moelv – Biri, vedtatt i Ringsaker kommune 20.05.15 og i Gjøvik kommune 28.05.15.
- Kommunedelplan (KDP) E6 Biri – Vingrom, vedtatt i Gjøvik kommune 07.02.13 og i Lillehammer kommune 22.11.2012.

I tillegg foreligger godkjent planprogram som omfatter et utvidet område sammenlignet med KDP. Dette gir prosjektet mulighet til å se på nye løsninger for planlegging av ny E6 inkludert kryssløsning mellom E6 og rv. 4 og kryss på Biri. Multiconsult har sammen med Nye Veier, AF gruppen og Selberg Arkitekter gjennomført en vurdering av ulike alternativer langs strekningen. Silingsrapporten beskriver arbeidet som er gjort for å etablere et beslutningsgrunnlag for valg av kryssløsning mellom rv. 4 og E6 og nytt kryss på Biri.

I møte med fylkeskommunen (9.12.2020) vedrørende kollektivløsninger på strekningen, ble følgende føringer lagt til grunn for utvikling av alternativer; Bussterminalen som er koblet til E6 ved eksisterende bru over Mjøsa må erstattes med en kollektivløsning enten ved krysset mellom E6 og rv. 4 eller på Biri. Kollektivløsningen skal bygges med pendlerparkering for bil og sykkelparkering.

Sammenhengende lokalvei på vestsiden av Mjøsa benyttes også for syklist og myke trafikanter. Lokalveien kan enten kobles på ny E6 ved krysset mellom E6 og rv. 4 eller føres forbi krysset uten kobling til krysset.

I tillegg til kommunedelplanen er det utredet ett alternativ ved Fjordheim (DR 0B), resten av alternativene ligger ved Skulhusodden for kryss mellom E6 og rv. 4;

- Direkteførte ramper ved Fjordheim (DR 0B), ref figure 4-4 til figure 4-7
- Planskilt kryss med rundkjøringer på rv. 4 (DR 2/3), ref figure 4-8 til figure 4-12
- Direkteførte ramper ved Skulhusodden (DR 6), ref figure 4-13 til figure 4-15
- Rundkjøring med rett bru (RK3AN), ref figure 4-17 til figure 4-19

- Rundkjøring med kurvet bru (RK 3AN), ref figure 4-20 til figure 4-22

I tillegg er det tre alternativer som er beskrevet skriftlig, og ikke vurdert tverrfaglig på lik linje med alternativene i listen over.

- Optimalisert ruterkryss med rundkjøringer på rv. 4 (DR 2/3), ref figure 4-25
- En variant av DR 6 med direkteførte ramper ved Skulhusodden (DR 6+), med redusert hastighet ref. kapittel 4.1.4
- Direkteførte ramper, med feltsplit og redusert hastighet (DR 9), ref figure 4-26

For krysset på Biri er det i tillegg til alternativet i kommunedelplanen utredet 3 alternativer;

- Ruterkryss syd på Biri, alternativ B, ref figure 5-5
- To halve kryss, alternativ C, ref figure 5-6
- Toplanskryss syd på Biri, alternativ E, ref figure 5-8

0.1 Beslutningsgrunnlag for valg av kryssløsninger

Beslutningsgrunnlaget er basert på vurderinger som bidrar til å nå Nye Veiers prosjektmål. Multiconsult, AF gruppen og Selberg arkitekter har vurdert fordeler og ulemper for hvert alternativ og sammenlignet med løsningen i kommunedelplanen. Alternativene er vurdert mht. trafiksikkerhet, trafikkapasitet, offentlig kommunikasjon, gående og syklende, SHA, risiko, støy, behov for fravik fra standarder og regelverk, geoteknikk, geologi, konstruksjoner, anleggsgjennomføring, ytre miljø, klimagassutslipp, naturmangfold, kulturmiljø, nærmiljø og friluftsliv, landskapsverdier, naturressurser og byggekostnader.

Som en sentral del av beslutningsgrunnlaget, er det gjennomført forenklede nytte/kostnadsberegninger av alternativene til krysset mellom E6 og rv. 4. Det er også beregnet ulykkeskostnader for vurdering av ulike kryssløsninger mellom E6 og rv. 4.

0.1.1 Tekniske krav

I planarbeidet skal veien dimensjoneres til H3 i henhold til Statens vegvesens håndbok N100. Fra Moelv til Biri vil veien reguleres til 23 meters veibredde. Fra Biri til Roterud planlegges 20 meters veibredde.

Ny E6 planlegges for fire felt som heves slik at gjeldende regelverk for å ivareta samfunnsikkerhet og fremkommelighet tilfredsstilles. Det tas utgangspunkt i Vegnormalens (N200 Vegbygging) krav om å dimensjonere for en flomhendelse med 200-års returperiode.

For å redusere inngrepet i landskapet, i dyrka mark og minimere byggekostnader, er det vurdert å søke fravik fra veinormalene. Dette gjelder:

- Fravik til avstand mellom Moelv krysset og krysset mellom E6 og rv. 4.
- Fravik på horisontalradius ved krysset mellom E6 og rv. 4 fra 800 m til 700 m. Dette vil redusere inngrep i dyrka mark.
- Fravik på horisontalkurvatur fra 800 m til 700 m ved Kremmerodden. Dette for å sikre plassering av ny E6 mellom to naturvernområder og et statlig sikra friluftsområde, samt å redusere fyllinger i Mjøsa.
- Fravik for økning av horisontalradius med 50 % over konstruksjon ved Skulhusodden.

- Vurdere å søke fravik på redusert hastighet på E6 i krysset med rv. 4 for å redusere konsekvenser på landskap, nærmiljø og dyrka mark.

0.1.2 Forenklede nytte/kostnadsberegninger av kryss E6/rv. 4

Investeringskostnad og trafikantnytte er benyttet for å gjøre en forenklet nytte/kostnadsberegning. Modellene er utarbeidet med 40 års beregningsperiode fra veiåpning.

Investeringskostnadene per alternativ er sammenlignet med kostnadene til KDP alternativet (ref. OA) og inkluderer byggekostnader for ny bru over Mjøsa. Kostnadsgrunnlaget for brua baserer seg på 1350 meter lang Mjøsbru ved Skulhusodden, og 1650 meter lang Mjøsbru for alternativene ved Fjordheim.

Nytte/kostnadsberegningene viser kun forskjellene mellom de ulike kryssalternativene.

Beregning av trafikknytte inkluderer kostnader knyttet til reisetid og reiseavstand.

Kapasitetsberegninger basert på kø-lengder og tidsperioder med høyest trafikk er også inkludert i vurderingen av trafikknytte. Resultatene er sammenlignet med alternativet i KDP (ref. OA).

Siden kostnadene ved å lande Mjøsbrua på Skulhusodden er lavere enn ved Fjordheim, viser de forenklede nytte/kostnadsberegningene at alternativ DR 6 med direkteførte ramper kommer best ut, nest best er alternativene med rundkjøring.

Trafitec har gjennomført en kvalitetskontroll av trafiksikkerhetsvurderingene for de ulike kryssalternativene. Trafitec har sammenlignet kostnader knyttet til trafikkulykker. Alternativene KDP OA, DR OB og DR 6 har de laveste ulykkeskostnadene. Vurderingene støtter vurderingene Multiconsult har foretatt i forhold til trafiksikkerhet og kapasitet.

0.2 Anbefalt alternativ for krysset mellom rv. 4 og E6

Det er gjort en vurdering av alle kryssalternativene sammenliknet med kommunedelplanen (Tabell 0-1). Lysblå farge er noe bedre, mørkeblå farge er mye bedre, lys rød farge er noe dårligere, og mørk rød er dårligere enn KDP alternativet.

Tabell 0-1: Oppsummering av kryssalternativer E6/rv. 4

	Ref. KDP 0A	Alt. DR 0B	Alt. DR 2/3	Alt. DR 6	Alt. RK 3AN rett bru	Alt. RK 3AN kurvet bru
Trafikksikkerhet (diskonterte ulykkeskostnader sammenliknet med KDP fra Trafitec mill. NOK)	0	2.2	24.5	1.7	62.7	62.7
Trafikk kapasitet						
Offentlig kommunikasjon						
Gåene og syklende						
SHA						
Risiko						
Støy						
Fravik						
Geoteknikk						
Geologi (syredannede bergarter)						
Konstruksjoner						
Anleggsgjennomføring						
Ytre miljø						
Klimagassutslipp						
Naturmangfold						
Kulturmiljø						
Nærmiljø og friluftsliv						
Landskapsverdier						
Naturressurser						
Forenklet nytte / kostnads tall sammenliknet med KDP 0A						
Anleggskostnad sammenliknet med KDP 0A						

Anbefaling av kryssalternativ er basert på Nye Veier sine mål. Ved å flytte landingspunktet på Mjøsbrua til Skulhusodden, blir brua ca. 300 m kortere og gir mindre fyllinger i Mjøsa. Anleggskostnadene for alle alternativene ved Skulhusodden er lavere enn for alternativene hvor Mjøsbrua lander ved Fjordheim. Forenklet nytte / kostnadsberegninger er også best for alternativene ved Skulhusodden. Dette medfører at alternativ DR 0A ved Fjordheim forkastes.

Alternativ rundkjøring med buet bru (RK 3AN) er det mest foretrukne alternativet ut ifra vurderingene basert på byggekostnader, SHA, geoteknikk, konstruksjoner, anleggsgjennomføring, ytre miljø og landskapsverdier.

I møte med Vegdirektoratet 1. februar 2021, var anbefalingen for kryss på E6 å beholde samme fartsgrense og fire felt for en lang strekning av E6.

Alternativene med rundkjøring har dårligere kapasitet søndag kveld nordfra på E6 sammenliknet med de andre kryssløsningene. Krysset krever fravik for kryssløsning, feltsplit og redusert hastighet på E6. Dette utgjør en stor planrisiko. Rundkjøring er den kryssløsningen med høyest ulykkeskostnad. På bakgrunn av dette er rundkjøringsalternativene (RK 3AN) forkastet.

Alternativ DR 2/3 og den optimaliserte versjonen av DR 2/3 har lavere kost / nytte verdi og høyere ulykkeskostnad sammenlignet med DR 6 og DR 9. Dette alternativet krever også fravik på grunn av rundkjøring på rv. 4, og for redusert radius over konstruksjon på E6. DR 2/3 har i tillegg størst inngrep på jordbruksareal ved Skulhus gård. På bakgrunn av dette er alternative DR 2/3 forkastet.

De gjenværende kryssalternativene er DR 6 og DR 9. Alternativ DR 9 krever fravik for feltsplit og redusert hastighet på E6. Alternativet har mindre inngrep i jordbruksareal ved Skulhus gård. DR 6 krever ikke fravik. Alternativ DR 6 det alternativet som kommer best ut mhp målene til Nye Veier. Anbefalingen er at DR 6 optimaliseres for å redusere ulemper knyttet til landskapsinngrep, beslag av dyrka mark og negative konsekvenser for nærmiljø. Det skal være fire felt på E6. I videre optimalisering vil landingspunktet på Skulhusodden flyttes noe sørover for å redusere omfang av fyllinger i Mjøsa. I videre optimalisering skal DR 6 vurderes både for 110 km/t og for redusert hastighet på E6.

0.3 Krysset på Biri

Det er gjort en vurdering av alle kryssalternativene sammenliknet med kommunedelplanen (tabell 0-2). Lysblå farge er noe bedre, mørkeblå farge er mye bedre, lys rød farge er noe dårligere, og mørk rød er dårligere enn KDP alternativet.

Tabell 0-2: Oppsummering av kryssalternativer på Biri

	KDP	Alternativ B	Alternativ C	Alternativ E
Trafikk sikkerhet				
Trafikk kapasitet				
Offentlig kommunikasjon				
Gående og syklende				
Støy				
SHA				
Risiko for reguleringsplan				
Geoteknikk				
Geologi (syredannede bergarter)				
Anleggsgjennomføring				
Konstruksjoner				
Klimagassutslipp				
Ytre miljø				
Naturmangfold				
Kulturmiljø				
Nærmiljø og friluftsliv				
Landskapsverdier				
Naturressurser				
Anleggskostnad sammenliknet med KDP				

Som det kommer frem av oppsummeringstabellen er alternativ B det beste alternativet sammenliknet med KDP. Alternativ B er et standard motorveikryss, det er lett å lese, og det er det beste alternativet for offentlig transport. Alternativet må optimaliseres ytterligere for å minimere konflikter på begge sider av E6. Alternativ B legger til rette for effektive transportløsninger for buss med pendlerparkering og sykkelparkering innen kort avstand. Ved Biri er det også mulig å legge til rette for en rasteplass, og det er god tilgang til andre servicefunksjoner.

1 Introduction

1.1 Project description

Nye Veiers project E6 Moelv – Roterud includes the construction of a four-lane highway with a speed limit of 110 km / h and design and construction of a new bridge crossing Mjøsa. The total length of the new E6 will be approx. 11.3 km. The project connects to the new intersection on E6 in Moelv with two new ramps, intersection with rv. 4 and intersection at Biri. The project includes local roads, public transportation, rest area, footpaths, under- and overpasses, bridges over Vismunda, constructions in intersections etc.

A complete zoning plan shall be prepared with an environmental impact assessment. The planning process of new E6 is performed through the projects integrated interaction phase. The parcel E6 Moelv - Roterud runs through two municipalities: Ringsaker and Gjøvik.



Figure 1-1: E6 Moelv – Roterud (Illustration from the planning program [2])



Figure 1-2: View north of existing Mjøsa bridge

The project includes searching for optimized solutions according to Nye Veier's performance targets for the project (see chapter 1.2).

1.2 Project performance targets

Performance targets new Mjøsa bridge

- Maximize adaptation to the landscape and surrounding areas.
- Minimize the construction and life-cycle cost.
- Minimize CO₂ greenhouse gas emissions in construction and maintenance.

Performance targets road

- Maximize traffic safety and access for all road users in the construction and guarantee period.
- Minimize temporary and permanent loss of agricultural land.
- An injury and accident-free construction and guarantee period, promoting health and a fair work-life.

1.3 Introduction to the screening report

The aim of this report is to document one recommended alternative for E6/rv. 4 intersection and Biri intersection that will contribute to achieve Nye Veier's performance targets.

Optimizing the E6 from Moelv to Roterud has been part of workshops in October to December 2020 and will continue until March 2021.

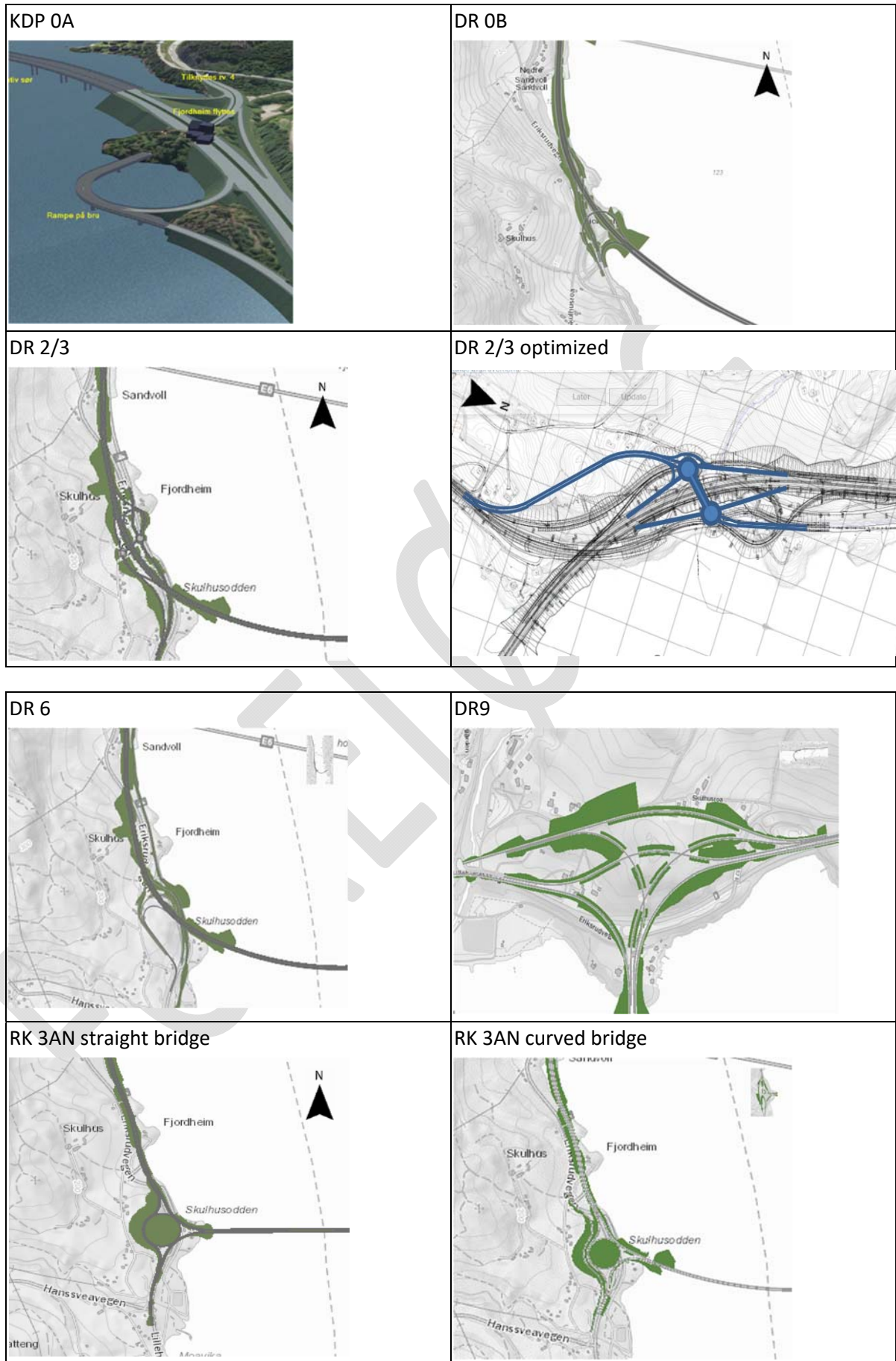


Figure 1-3: Alternative for intersection E6 x rv. 4

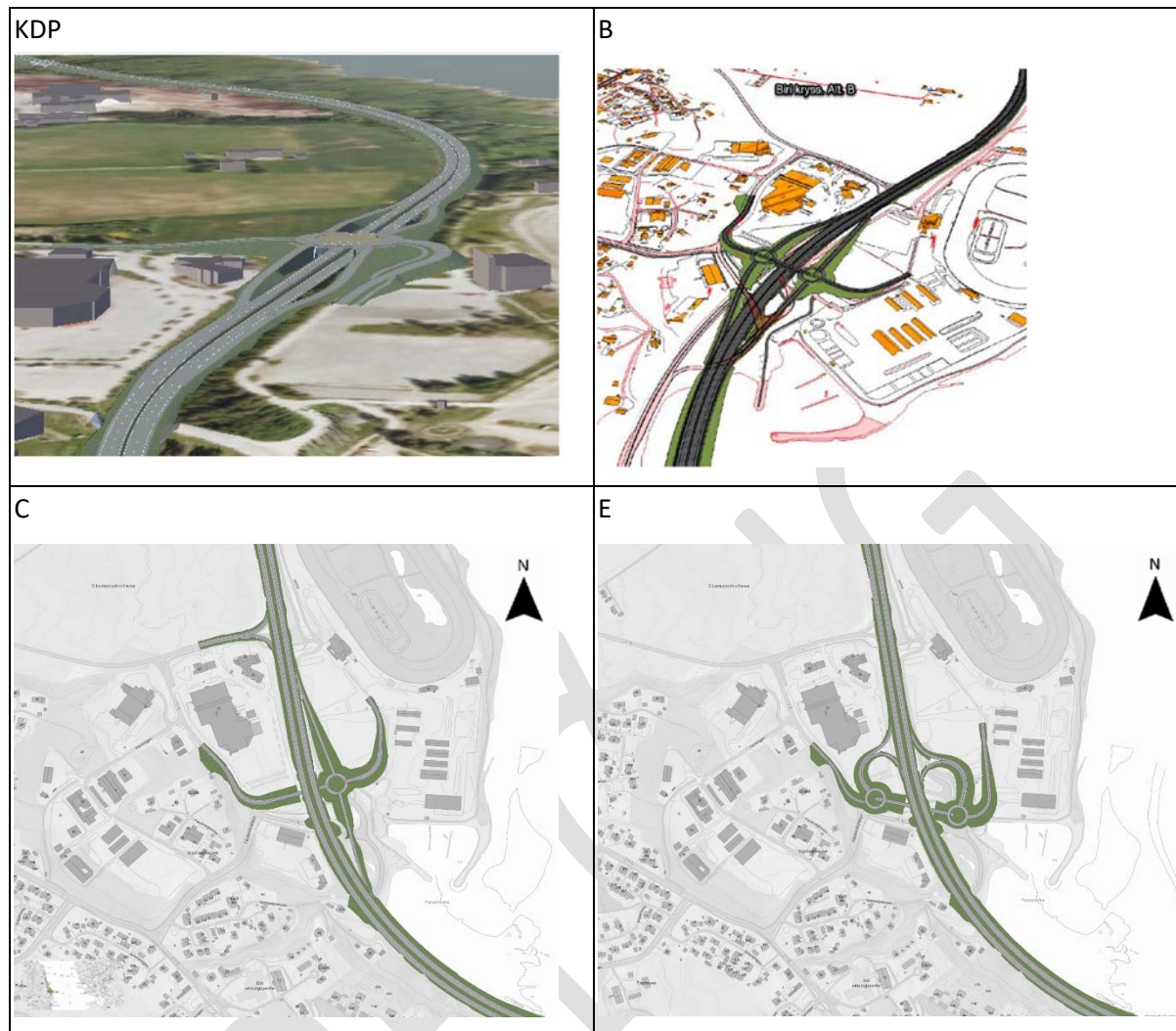


Figure 1-4: Alternative for intersection Biri

1.4 Basis for optimization

There are two municipal sector plans on E6 Moelv – Roterud: E6 Moelv – Biri (dated May 2015) [2] and E6 Biri – Vingrom (dated May 2013) [3]. The Planning Program for E6 Moelv-Roterud (approved January / February 2020), describes what needs to be considered in the zoning plan [4].

The municipal sector plans are based on 100 km/h on E6. Now 110 km/h is the designated speed on E6 Moelv – Roterud.

In the Planning Program, the planning area has been expanded compared to the municipal sector plans, and the existing Mjøsa bridge will be retained. This allows for the possibility of assessing new solutions for E6 and cross-solutions between E6 and rv. 4, and intersections at Biri.

In this report, the goal for Mjøsa bridge is to adapt to the landscape and surrounding areas including the intersections with rv. 4.

In the meeting with the County Council about the bus system, the following guidelines came forward: If the public transport terminal at the existing Mjøsa bridge will not be connected to the new E6, it must either facilitate a public transport terminal at intersection E6/rv. 4, or facilitate a public transport terminal at Biri with commuter parking and bicycle parking.

The local road can either be connected to the intersection with E6 and rv. 4, or laid past the intersection. The local road is used for bikers and pedestrians. The local road will be optimized for the selected intersection.

Having ramps on the Mjøsa bridge is expensive and degrades the aesthetics. The alternatives at Skulhusodden are designed without ramps on the new Mjøsa bridge. A rough cost estimate shows that if the ramps are placed in full length on the bridge, there will be an additional cost of approximately NOK 183 million. It is possible to adjust the intersections so that parts of the ramps come on the bridge. This can provide better cost-benefit and reduce the intervention in the intersection area. Ramps on the bridge may lead to a different length on the bridge span, and the change of width can influence the aesthetics for the new Mjøsa bridge.

Trafitec has made an assessment / quality control of the road safety for the intersection alternatives. Trafitec has suggestions for optimizations of alternative DR 2/3 and proposed a new alternative DR 9 (Report "Assessments / quality control of E6 – rv4 interchange regarding geometry, road safety and time costs"[1]). The report supports the review in this document made around traffic safety and the capacity of the various intersections.

1.5 Interdisciplinary workshops

Multiconsult arranged 5 interdisciplinary workshops from October 15th, 2020 to December 17th, 2020 to find alternatives for the new four-lane E6 including E6 / rv. 4 and Biri intersection. The workshops have been performed with project and engineering manager from AF Gruppen, Selberg Architect and relevant disciplines and managers from Multiconsult to jointly agree upon which alternatives to proceed with. Nye Veier and BERINOR were regularly informed about the development of the work. Nye Veier participated in workshop 4 and 5 to agree on which alternatives for E6 / rv. 4 and Biri intersection to study in this screening report.

- Workshop 1 Biri Intersection and E6 Biri – Svennes
- Workshop 2 E6 between new Mjøsa Bridge and Biri
- Workshop 3 E6/rv. 4 intersection and location of E6 between Moelv and rv. 4
- Workshop 4 Interdisciplinary review of recommended solutions with Nye Veier
- Workshop 5 Additional workshops to agree upon final alternatives to make further interdisciplinary study on for the intersection at Biri and E6/rv. 4.

Some preferred alternatives from the workshops are the basis for the screening process in this screening report.

The rejected intersection alternatives from the workshops are documented in presentations from the workshops.

In addition, Trafitec has suggested two alternatives. They are described in chapter 4.1.8, but not at the same level as the alternatives from the workshops (they are not included in table 4-22).

New alternative intersection E6/rv. 4:

- Alternative direct ramps at Fjordheim (DR 0B), please refer to figure 4-4 to figure 4-7 below. (An optimized version of the alternative from the municipal sector plan to 110 km/h. E6 and rv. 4 are connected using direct ramps.)
- Alternative with roundabouts on rv. 4 (DR 2/3), please refer to figure 4-8 to figure 4-12. (The new Mjøsa bridge lands on Skulhusodden on the west side of Mjøsa. Intersection with ramps connected to two roundabouts on rv. 4. One roundabout includes a local road.)

- Alternative direct ramps at Skulhusodden (DR 6), please refer to figure 4-13 to figure 4-15. (The new Mjøsa bridge lands on Skulhusodden on the west side of Mjøsa. E6 and rv. 4 are connected using direct ramps.)
- Alternative direct ramps at Skulhusodden (DR 6+), please refer to chapter 4.1.4 below, same as DR 6, with lower speed on E6.
- Alternative roundabout with a straight bridge (RK 3AN), please refer to figure 4-17 to figure 4-19. (The new Mjøsa bridge lands on Skulhusodden on the west side of Mjøsa. E6 and rv. 4 are connected by a large roundabout with split lanes.)
- Alternative roundabout with a curved bridge (RK 3AN), please refer to figure 4-20 to figure 4-22. (The new Mjøsa bridge lands on Skulhusodden on the west side of Mjøsa. E6 and rv. 4 are connected by a large roundabout with split lanes.)
- Alternative from Trafitec, optimized DR 2/3 and DR 9, please refer to figure 4-25 and figure 4-26.

New alternatives for Biri intersection:

- Alternative B, diamond intersection south on Biri, please refer to figure 5-5
- Alternative C, two half intersections, please refer to figure 5-6
- Alternative E, full intersection south on Biri, please refer to figure 5-8

1.6 Screening process

The assessments during the screening process have been carried out by managers from AF Gruppen, Selberg Architects and relevant disciplines and managers from Multiconsult. The screening report summarizes the assessments of disadvantages and advantages of each intersection alternative for E6/rv. 4 and Biri.

E6 road line as described in KDP is the reference alternative (named Alternative KDP 0A for E6/rv. 4 and alternative KDP for intersection at Biri).

For new intersection alternatives, all disciplines described the differences between the solutions in KDP 0A/KDP and the new intersection solutions. One exception is two alternatives from Trafitec, who is described in chapter 4.1.8.

The assessments are simplified assessments. The limitations of the influenced area for E6/rv. 4 are shown within the pink lines (figure 1-5).

The influenced area at Biri is shown in figure 1-6.



Figure 1-5: Limitations of influence area for the E6/rv. 4 intersection

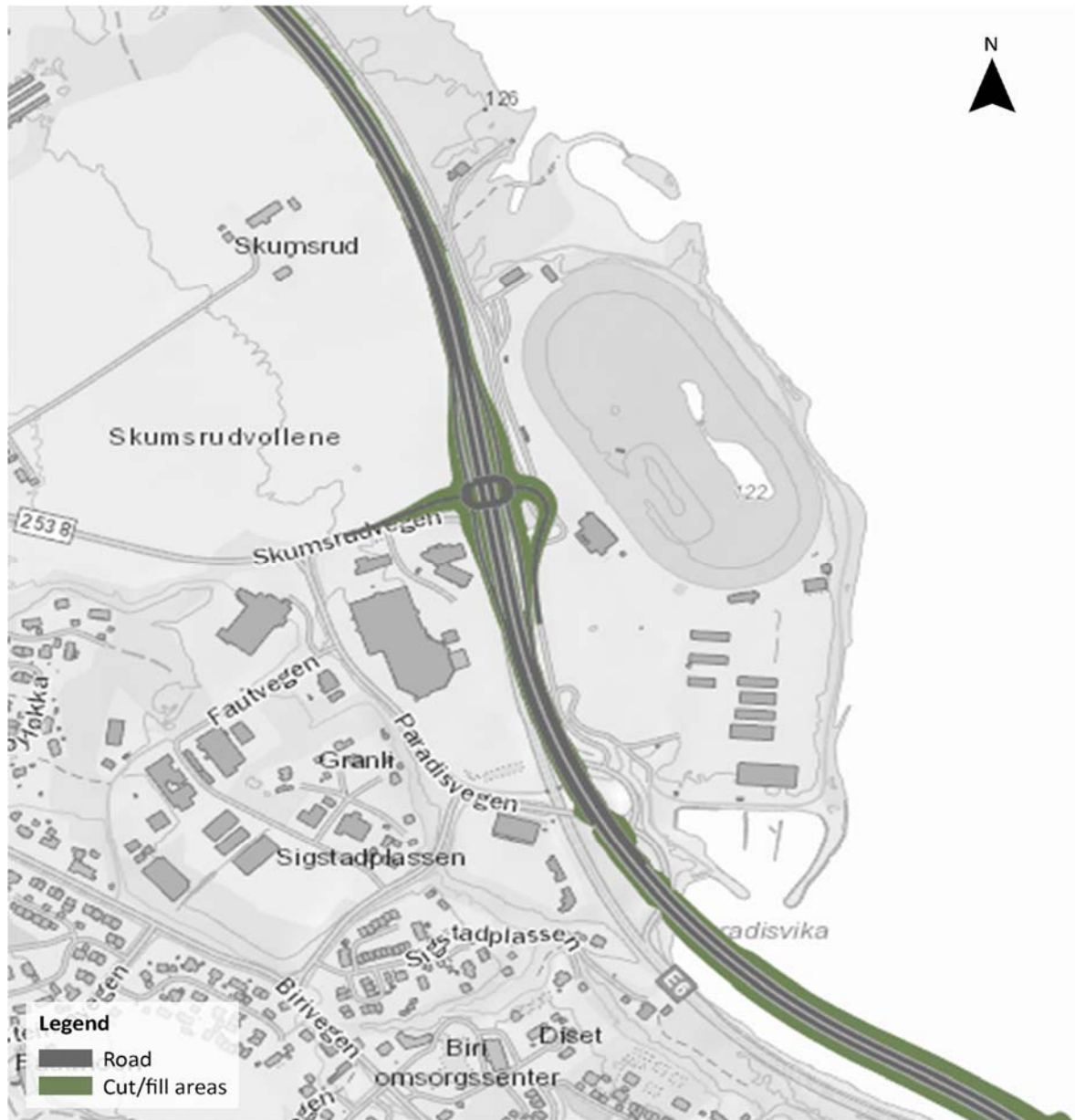


Figure 1-6: Limitations of influence area for Biri intersection

Table 1-1 shows which subject has completed the assessments and how they impact the project's performance targets. The aim of this report is to document one recommended alternative for E6/rv. 4 intersection and Biri intersection that will contribute to achieve Nye Veier's performance targets.

Table 1-1: Subjects where assessments are performed and how different subjects have an impact on the project's performance targets

Performance Objectives	Project analysis	
	Largest impact	Relevant subjects
Maximize traffic safety and access for all road users in the construction and guarantee period	Traffic safety	Traffic safety
	Bus infrastructure	Traffic capacity
	Connection to local infrastructure	Traffic Pedestrians and cyclists SHA
	Traffic safety during construction works	Construction works
Minimize temporary and permanent loss of agricultural land.	Road alignment	Natural resources
	Landscape design to reduce impact of the road	
An injury and accident-free construction and warranty period, promoting health and a fair work-life	SHA	SHA
	Environment	External environment
		Construction works
Maximize adaptation to the landscape and surrounding areas	Fillings in Mjøsa	Landscaping
	Visual impact	External environment
	Road alignment	Natural environment
	Landscape design	Cultural heritage
	Make the shore accessible	Local community / outdoor activity
Minimize the construction and life-cycle cost	Weight of superstructure	Structures
	Approval of deviations	Construction works
	Bridge length	Geotechnology
	Road alignment	Construction cost
Minimize CO ₂ greenhouse gas emissions in construction and maintenance	Materials	Climate Gas Submission
	Bridge length	
	Road alignment	
	Pile design	
	CO ₂ calculations	
RISK	Deviations	Deviations
	Plan risk	Risk assessment
	Ground conditions	
	Fillings in Mjøsa	
Simplified cost / benefit analysis	Simplified cost-benefit analysis	

Assessment score

To visualize how the different intersection alternatives "score" on the various subjects, a color scale has been used. Blue is used where the alternative comes out positively in the assessment, and red where the alternative comes out negatively compared to the KDP alternative. Two shades of each color have been used, where the darkest color means a large positive or large negative effect for the subject.

Table 1-2: Assessment score

Score	Assessment criteria
+2	Much better than KDP alternative
+1	Better than KDP alternative
0	Similar to KDP alternative
-1	Worse than KDP alternative
-2	Much worse than KDP alternative

2 Technical requirements

2.1 Road standard

E6 will be designed according to the Norwegian public road administration standards defined by road manual N100 (110 km/h) [5]. As such, the new E6 will be designed as an H3 road that is a 23m wide 4-lane corridor.

According to Nye Veier input, rv. 4 is to be designed as a two-lane road (H5 road) although resent development indicates that it is to be planned as a small H3 roadway (20m).

2.2 Road width

Resent evaluations on highway width in Norway has opened up for the use of a smaller cross-section (20M) given that the traffic load is below 20 000 AADT (Annual Average Daily Traffic). For E6 Moelv – Roterud this means that a full corridor (23m) will be used from Moelv to Biri and a smaller (20m) corridor from Biri to Roterud.

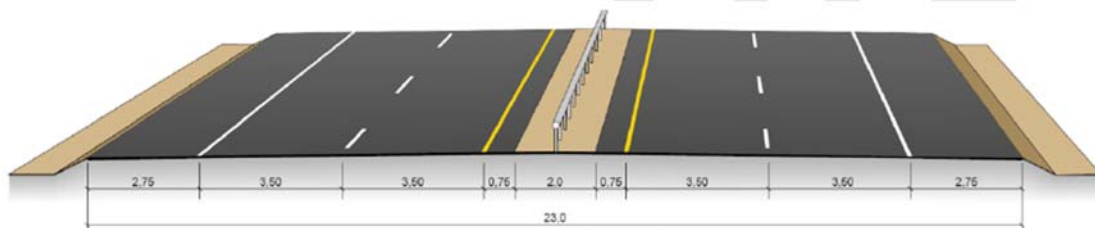


Figure 2-1: E6 from Moelv to Biri, 23 m wide (Illustration from N100 [5])

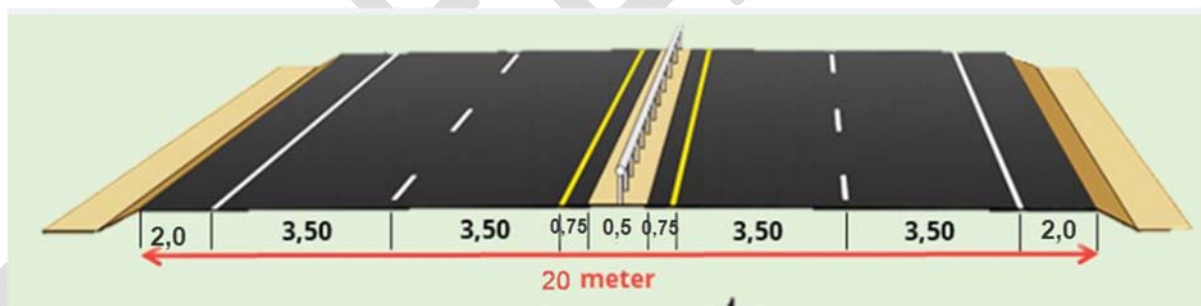


Figure 2-2: E6 from Biri to Roterud, 20 m wide (Illustration from N100 [5])

2.3 Flood evaluations

Flood levels for 200-year flood are higher than the existing E6 roadway which makes it difficult to reuse the existing road. To accommodate for reuse we investigated vertically dividing the north and southbound lanes. By doing this, traffic could be diverted to the raised section (which will be at an elevation higher than 200-year flood levels). This of course means that during severe floods (100-200-years) the corridor will only have 2 lanes open. During the screening phase, the project group decided to plan all four lanes at the same elevation, over 200-year flood level.

New E6 will have four lanes that are raised according to the current regulations to ensure that public safety and accessibility are satisfied. It is based on the requirements for road standard (N200 Vegbygging [7]) to dimension for a flood level with a 200-year return period.

2.4 Deviations

To reduce the impact of a new corridor, various deviations have been assessed.

- A deviation for distance between intersections is needed in all alternatives, as the distance between the new Moelv intersection and a new E6/rv. 4 intersection is approximately 2 km. The Handbook N100 “Veg- og gateutforming” defines 5 km as a minimum distance.
- A deviation at Skulhusodden for the E6/rv. 4 intersection on the minimum horizontal radius (800m) is suggested, as a 700m radius will scientifically reduce the impact on arable land.
- Through Kremmerodden a deviation on the minimum horizontal radius (800m) is suggested as a 700m radius will scientifically reduce the impact in the filling in Mjøsa.
- Alternative DR 2/3 and DR 6 needs a deviation for not having 50 % increase of horizontal radius on construction at Skulhusodden. Without a deviation, a radius 1.200 m is required. A radius 1.200 will have a large impact on Skulhus farm, agricultural land and landscape.

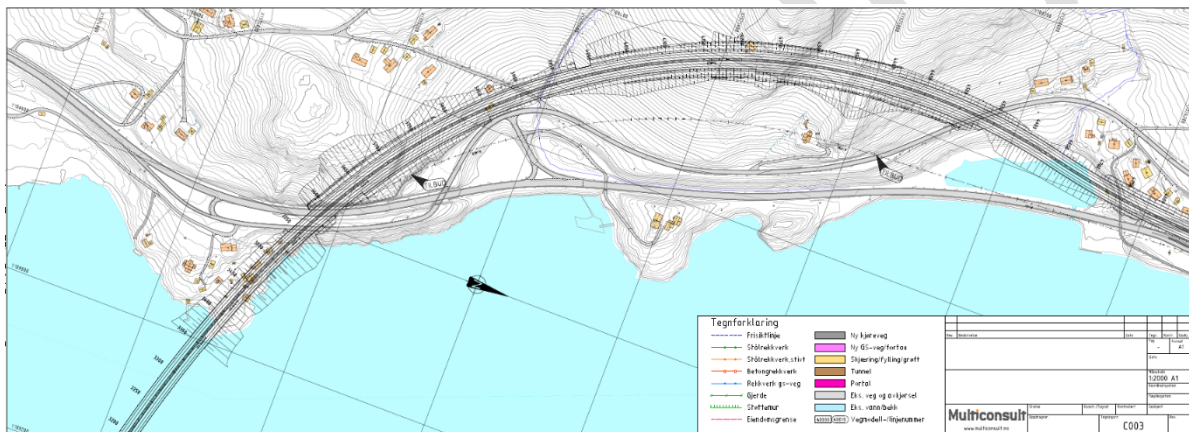


Figure 2-3: E6 without deviation for having 50 % increase on horizontal radius

- Consider a deviation for reduced speed on E6 in the intersection E6 x rv. 4 to reduce impact on agricultural land and local community.

3 Simplified cost-benefit calculations

3.1 Transport user benefits from COWI

Cowi has carried out calculations of transport user benefits for the intersection between E6 and rv. 4 [6]. The calculations calculate travel cost for the users for all the alternatives. In this way, travel time, travel distance and investment cost are priced at the same level. The results for the calculations are compared with the reference alternative KDP 0A. Reduced travel costs lead to increased transport user benefits, while increased travel costs lead to reduced transport user benefits.

The calculations are done for E6 between the east side of the new bridge and the existing intersection between E6 and rv. 4, and on rv. 4 from E6 to the river Skulhuselva.

The speed limit on E6 varies in the different alternatives, based on the design of the intersections. In KDP 0A the speed limit on E6 is 100 km/h, while in DR 0B, DR 2/3 and DR 6 the speed limit on E6 is 110 km/h. In RK 3AN the speed limit on E6 is 110 km/h, but 800 m before the roundabout in both directions the speed limit is reduced to 80 km/h. 200 m before the roundabout the speed limit is reduced to 60 km/h. On rv. 4 the speed limit is 80 km/h in all alternatives. On the ramps the speed limit is 60 and 80 km/h, depending on the curvature of the ramps.

The calculations have not assessed the traffic capacity at the intersections and delays that may occur during peak hours. The calculations have considered two different scenarios in relation to traffic volume. One with new E6 without tolls, and one with new E6 and rv. 4, also without tolls. In the scenario with new E6 and rv. 4, the traffic volume between rv. 4 and Biri is increased by 2400 vehicles and the traffic on E6 from Moelv to Biri is decreased by 2400 vehicles. The traffic volume in the two scenarios can be seen on the figures below.

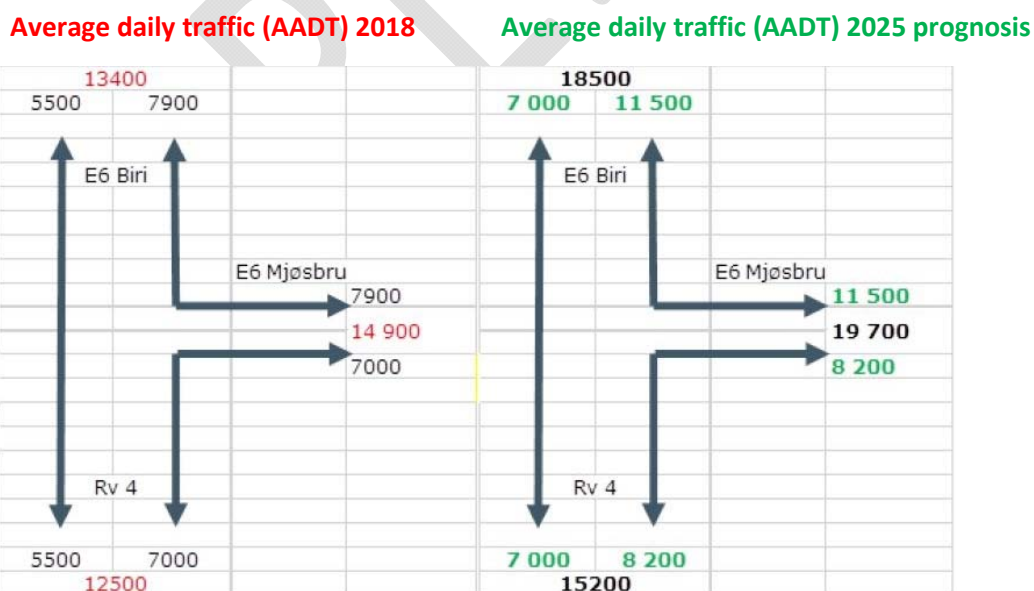


Figure 3-1: Traffic volume in the intersection between E6 and rv. 4, with new E6 without tolls. (Illustration from Cowi [6])

**Average daily traffic (AADT) 2025 prognosis
- including new rv. 4 (four lane road)**

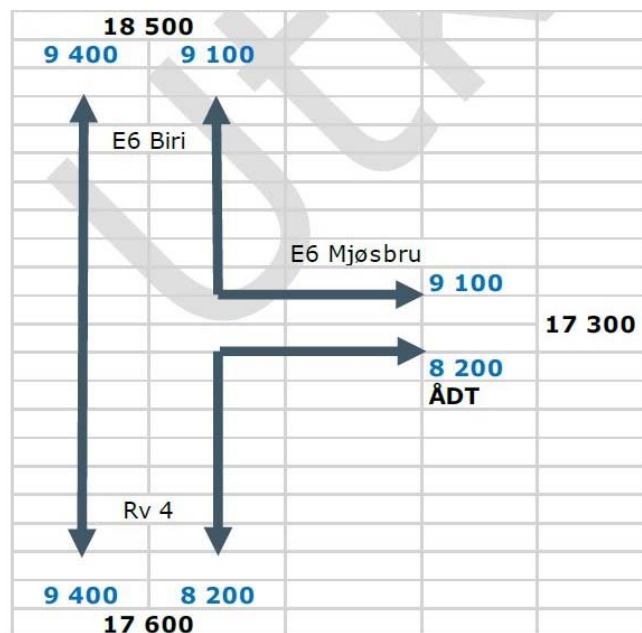


Figure 3-2: Traffic volume in the intersection between E6 and rv. 4, with new E6 and rv. 4, without tolls. (Illustration from Cowi [6])

The results of the calculations show the present value of the benefit over 40 years compared with the KDP. The calculations show that in both scenarios, DR 0B and DR 06 is better than the KDP 0A, while RK 3AN and DR 2/3 are worse than KDP 0A. The results of the calculations can be seen in the table below.

Table 3-1: Results of calculations of transport user benefits for the intersection between E6 and rv. 4, for opening year-2025 with new E6 (without tolls)

Alternative	Benefit over 40 years compared with the KDP (millions Norwegian kroner in 2020).	Vehicle kilometers traveled per day	Vehicle hours traveled per day	Average speed E6	Generalized travel expenses over 40 years (millions Norwegian kroner in 2020)
KDP 0A	0	74121	796	100	3274
DR 0B	142	73167	741	110	3131
DR 6	96	74473	750	110	3178
RK 3AN	-241	72473	918	83	3515
DR 2/3	-311	79124	890	110	3585

Table 3-2: Results of calculations of transport user benefits for the intersection between E6 and rv. 4, for opening year-2025 with new E6 and new rv. 4 (four lane road) (without tolls)

Alternative	Benefit over 40 years compared with the KDP (millions Norwegian kroner in 2020).	Vehicle kilometers traveled per day	Vehicle hours traveled per day	Average speed E6	Generalized travel expenses over 40 years (millions Norwegian kroner in 2020)
KDP 0A	0	71277	776	100	3171
DR 0B	133	70263	726	110	3038
DR 6	117	70993	726	110	3053
RK 3AN	-192	68801	883	83	3363
DR 2/3	-320	75730	878	110	3491

3.2 Capacity calculations

Two alternatives, RK 3AN and DR2/3, are analyzed by using the microscopic traffic simulation tool *Aimsun Next*. Traffic flow data (annual average daily traffic - AADT) for 2025 and 2045 are taken from the traffic report “*Kryssløsninger E6 Mjøsa bru og rv. 4*”, prepared by COWI [6]. AADT is converted to morning (07:00-09:00) and afternoon (15:00-17:00) peak hour volumes, based on data from a traffic count station. Traffic matrices are then developed which are used in *Aimsun Next*.

To take into consideration the hourly variations in traffic volume for the days within a week, eight scenarios for each alternative are simulated and analyzed. Studied eight scenarios are as follows:

- Monday-Thursday, morning peak hour (07:00-09:00), year 2025
- Monday-Thursday, afternoon peak hour (15:00-17:00), year 2025
- Friday, afternoon peak hour (15:00-17:00), year 2025
- Sunday, afternoon peak hour (15:00-17:00), year 2025
- Monday-Thursday, morning peak hour (07:00-09:00), year 2045
- Monday-Thursday, afternoon peak hour (15:00-17:00), year 2045
- Friday, afternoon peak hour (15:00-17:00), year 2045
- Sunday, afternoon peak hour (15:00-17:00), year 2045

For alternative DR 2/3, results show that the off-ramp from E6-Mjøsa bridge has the longest maximum queue length on Friday in the afternoon peak hour (15:00-17:00), year 2045. The queue builds up on this ramp and propagates back to highway-E6. Different mitigation measures have been tested focusing on increasing capacity at the roundabout. By adding a slip lane from rv. 4 to E6 ramp, two circulating lanes in the roundabout and a short lane (30 meters in length) to rv. 4 and E6 ramp, the queue length will be substantially reduced. These measures will increase capacity at the roundabout making it operate at an acceptable level. The change in geometry for the roundabout is illustrated in figure 3-3.

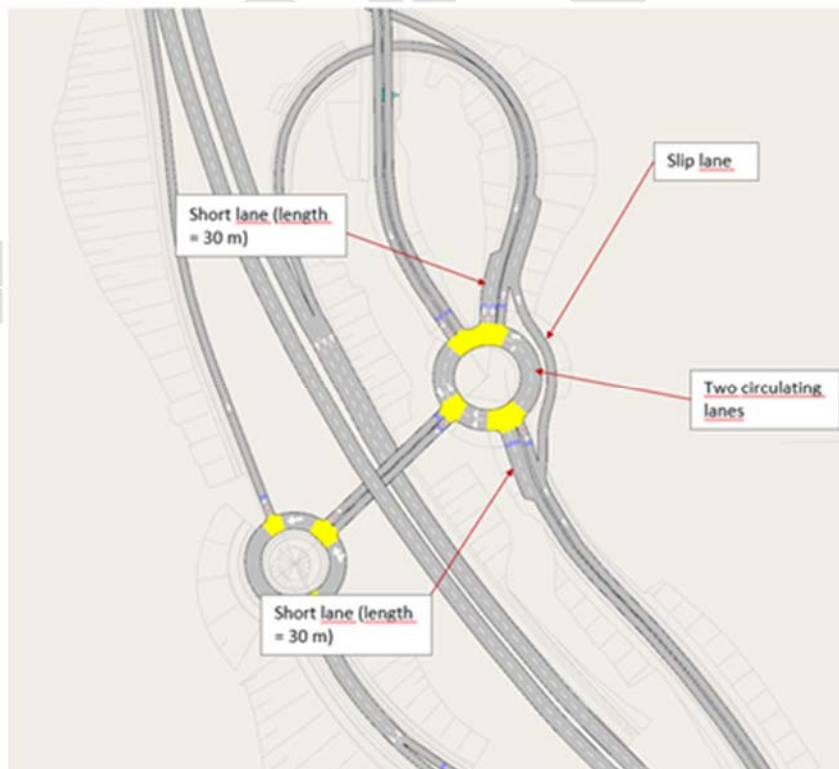


Figure 3-3: Change in the geometric layout to increase -capacity for the simulated roundabout. Illustration from *Aimsun*

For alternative with the roundabout (RK 3AN), the results show that the largest queue length occurs on Sunday during the afternoon peak hours (15:00-17:00), year 2045 for traffic flow from E6-Biri to E6-Mjøsbrua. The queue length from rv. 4 to E6-Biri and E6-Mjøsbrua to rv. 4 is largest on Friday during afternoon peak hours (15:00-17:00), year 2045. The largest queue length occurs in the approach E6-Biri for traffic flow E6-Biri to E6-Mjøsbrua. The calculated maximum queue length for this approach is around 130 meters.

3.3 Cost

Rough estimates on the marginal construction costs for road works and the new Mjøsa bridge have been performed for the different alternatives. Each solution has different marginal quantities for works, rigging costs, schedule impact and indirect costs that have been evaluated.

3.3.1 Mjøsa Bridge

Different alternatives present different bridge lengths and layouts. This results in different numbers and types of foundations, piers, and spans, with consequences for the number of precast segments with overall different quantities of construction materials like concrete, reinforcing steel, post-tensioning, and wood.

The presence of an acceleration/deceleration ramp on the bridge deck also has a huge impact on costs. The wider deck required for the ramps requires significant modifications on the construction moulds for the precast segments, and increased erection equipment capacity.

Cost for full ramps on Mjøsa bridge at Skulhusodden:

The alternative intersections at Skulhusodden do not have any ramps on the Mjøsa bridge.

The alternatives can be optimized with part or full length of the ramps on the bridge.

Ramps on the Mjøsa bridge have a high cost, and will lead to:

- additional direct costs for different number and type of foundations;
- additional direct costs for different number of piers;
- additional direct cost for acceleration/deceleration ramps on bridge-widened deck
- additional other cost for 1.5 months longer construction duration, rigging, indirect and overheads

Mjøsa bridge landing at Fjordheim:

Alternative KDP OA with Mjøsa bridge landing at Fjordheim is 1650m, 300 m longer than the alternative with Mjøsa bridge at Skulhusodden.

For KDP alternative, the Mjøsa bridge has a significant higher cost than a bridge at Skulhusodden and includes:

- additional direct costs for different number and type of foundations;
- additional direct costs for different number of piers;
- additional direct costs for longer superstructure;
- additional direct cost for acceleration/deceleration ramps on bridge widened deck;
- additional other cost for 4 months longer construction duration, rigging, indirect and overheads

3.3.2 Intersection alternatives

Rough cost estimates on marginal construction costs for road works (i.e. without the new Mjøsa bridge) have been performed for the intersection alternatives. In these estimates one has calculated the difference in construction cost for road works between the KDP intersection solution and the other solutions. Here one has considered the stretch from the west abutment of the new Mjøsa bridge up to the roundabout on the west side of the existing Mjøsa bridge.

In these calculations one has calculated costs based on calculation of quantities for blasting, dredging, loose masses, mass transport, areas of different structures like bridges, culverts and retaining walls, and lengths of different types of roads like 4-lane highway, 2-lane local roads, reuse of roads, ramps, and acceleration-/deceleration lanes. There are also added costs for rig, design/engineering and profit.

Table 3-3: Cost differences between KDP OA and the alternative intersections E6/rv. 4 (Mjøsa bridge not included)

Alt. KDP OA	Alt. 0B	Alt. DR 2/3	Alt. DR 6	Alt. RK 3AN straight bridge	Alt. RK 3AN curved bridge
	Approx. same cost as KDP OA	Approx. same cost as KDP OA			

3.4 Simplified method for calculation of monetised impacts

To estimate the differences in net present value it is used simplified calculations with the two most important parameters:

- Investment costs
- Transport user benefits

This means that factors like operator benefits, accident costs, noise and pollution costs and tax funding costs are excluded.

The discount rate is 4%, and the appraisal period is 40 years from road opening. Year of comparison is 2020. Construction period is set to 3 years, and the value is 2020 NOK.

The marginal investment cost differences from chapter 3.3 are used as a basis for the calculations. Proprietor costs are included with a mark-up of 15%, but VAT (valued added tax) is not included.

The net present values calculated with this method are not representative for the net present values that will be calculated for the whole project, but the calculations show important differences between the alternatives with respect to net present value.

Table 3-4: Results from calculations of simplified cost-benefit for different alternatives

Alternative	Simplified net present value compared to alt. OA (KDP)
Alt OA (KDP)	0
Alt OB (KDP opt.)	
Alt. DR-3	
Alt. DR-6	
Alt. RK-3-AN straight bridge	
Alt. RK-3-AN curved bridge	

Accident costs

Trafitec has made an assessment / quality control of road safety for the intersection alternatives (Report "Assessments / quality control of E6 – rv4 intersection regarding geometry, road safety and time costs" [1]). The report supports the review in this document made around traffic safety and the capacity of the various intersections. The report has calculated traffic cost for the different alternatives.

Table 3-5: Accident costs calculated by Trafitec (Mill. NOK)

Alternative	Annual accident cost	Discounted accident cost over 40 years (rate 4%)	Marginal discounted accident cost compared with alt. OA (KDP)
Alt OA (KDP)	2,095	43,1	0,0
Alt OB (KDP opt.)	2,200	45,3	2,2
Alt. DR-3	3,285	67,6	24,5
Alt. DR-6	2,180	44,9	1,7
Alt. RK-3-AN	5,140	105,8	62,7

Trafitec's assessments shows that alt. OA (KDP), OB (KDP optimizes) and DR 6 are quite equal regarding accident cost.

For the other alternatives the following assessments has been made:

- *“Alternative DR 2/3: By using the two tools, multiplying factors and unit price, 1.009 injury accidents per year are estimated to occur in the planning area – equivalent to 3.028 million NOK per year in accident costs (2016 prices). Of the 1.009 injury accidents, about 0.535 accidents will occur on the motorway (E6), 0.061 accidents will occur on the ramps, 0.085 will occur on Rv. 4, and 0.330 will occur at the two roundabouts.*
- *Alternative RK 3AN - By using the two tools, multiplying factors and unit price, 1.579 injury accidents per year are estimated to occur in the planning area – equivalent to 4.738 million NOK per year in accident costs (2016 prices). Of the 1.579 injury accidents, about 0.516 accidents will occur on the motorway (E6), 1.020 accidents will occur on the large roundabout, and 0.044 will occur on Rv. 4.*

This is the alternative with the worst road safety.

- *Normally, a turbo-roundabout like the planned large roundabout for this alternative will have approx. about 40-50 % lower accident frequency compared to a traditional multi-lane roundabout. But because the turbo-roundabout is situated at the end of two motorways, it is expected that the accident frequency will be as for a traditional multi-lane roundabout.”*
- Alternative DR 9 needs deviation for lower speed and split lanes on E6. The alternative DR 9 has not been investigated interdisciplinary to the same level as the rest of the alternatives.

FORELØPPIG

4 E6 /rv. 4 intersection

4.1 Description of alternatives

For the intersection E6 and rv. 4, the alternatives are compared with alternative KDP 0A. Below is a description of alternatives.

The different alternatives require different solutions according to their connection to the local road, to Fjordheim and to the existing Mjøsa bridge. When the intersection is chosen, the team will optimize E6 and the local road from the intersection to the existing Mjøsa bridge.

4.1.1 Alternative direct ramps at Fjordheim (KDP 0A)

Alternative KDP 0A is the reference alternative. It is designed for 100 km/h. The new Mjøsa bridge lands on Fjordheim on the west side of Mjøsa.

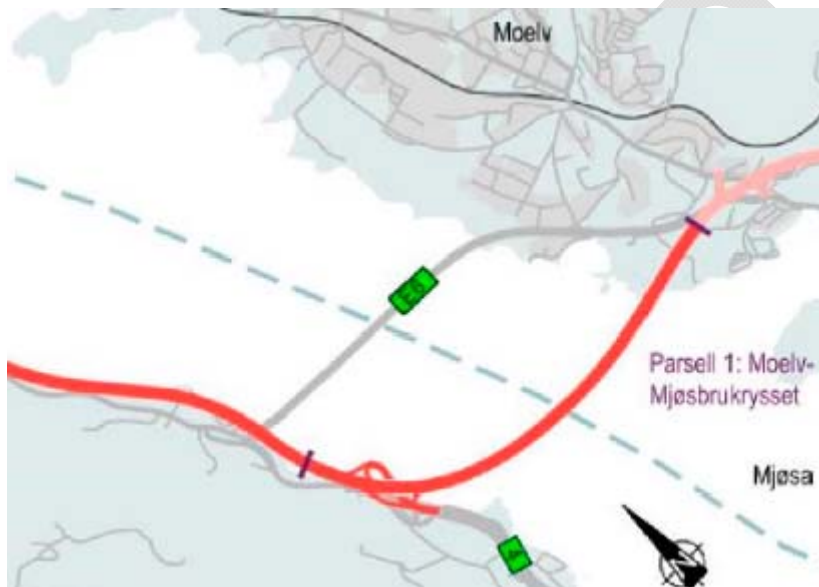


Figure 4-1: Overview of alternative KDP 0A (Illustration from the planning program [4])

Alternative KDP 0A has direct ramps between E6 and rv. 4. This is an intersection according to this highway standard. This intersection is considered safe.

This is an area-intensive intersection. There is little intervention in arable land. Gallery Fjordheim, including the outdoor public area and shoreline, must be redeemed. The alternative is not performing well regarding climate, due to long bridge, ramps on the bridge and large structures in connection with the intersection. The bridge alignment is visually problematic on the west side, it misses Skulhusodden and goes almost parallel to the shore.

It will not be possible to connect the local road or a public transportation terminal to the intersection.

This intersection entails much filling in Mjøsa. Part of the access ramp is in Mjøsa. The exit ramp on E6 from the south is on a bridge in Mjøsa. This is a demanding and expensive construction to build. The intersection involves access ramps on and off on the Mjøsa bridge, which is an expensive element, and can lead to a poorer aesthetic on the bridge.

The alternative has a deficiency of fill.



Figure 4-2: 3D illustration of the KDP OA alternative by Fjordheim ([2])

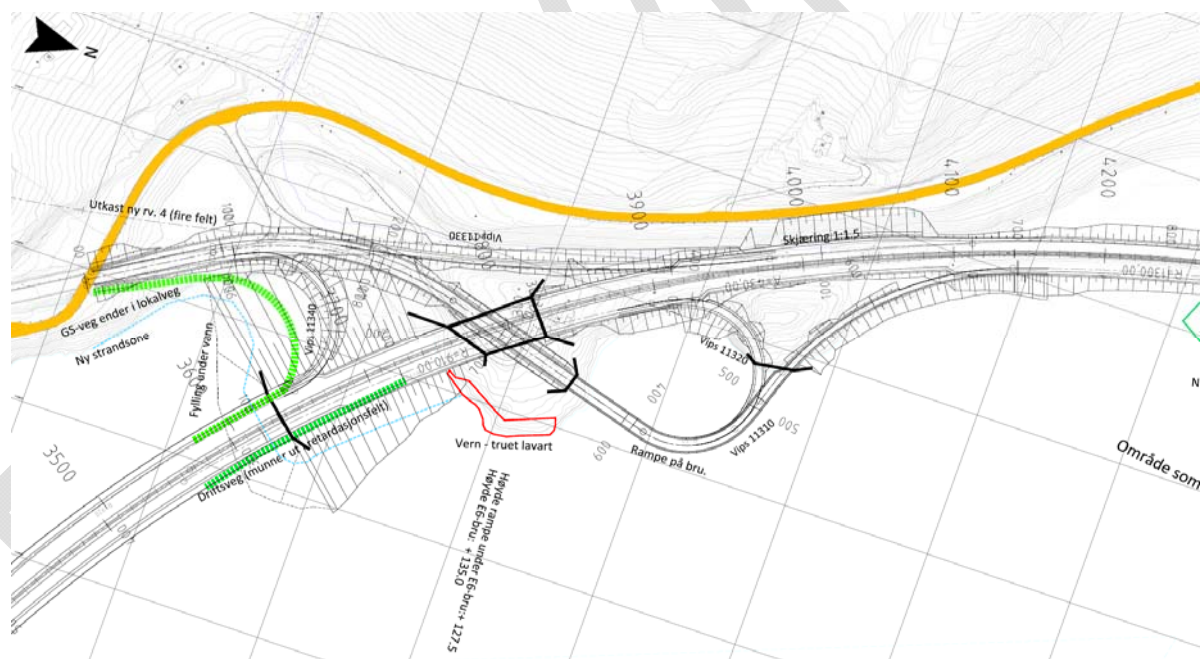


Figure 4-3: Drawing of the KDP OA alternative in the Fjordheim area

4.1.2 Alternative Direct ramps at Fjordheim (DR 0B)

Alternative DR 0B is an optimized version of alternative KDP 0A. It is designed for 110 km/h.

The main difference between alternative DR 0B and KDP 0A is the design of the intersection between E6 and rv. 4 (figure 4-5). This intersection does not have part of the ramp on a construction in Mjøsa like KDP 0A.

Alternative DR OB has direct ramps between E6 and rv. 4. This is an intersection according to this highway standard, and the intersection is considered safe.

This is an area-intensive intersection. It is the same distance between Hamar and Gjøvik as KDP 0A. There is little intervention in arable land. Gallery Fjordheim, including the outdoor public area and shoreline, must be redeemed. The length of the Mjøsa bridge is the same as KDP 0A. The alternative is unfortunate regarding climate due to long bridge, ramps on the bridge and large structures in connection with the intersection.

It will not be possible to connect the local road or a public transportation terminal to the intersection.

This intersection entails much filling in Mjøsa. The intersection involves access ramps on and off the Mjøsa bridge. It is very expensive to change the cross section on a segmental built bridge.

The alternative has a deficiency of fill.

For this option, a local road must be built on the west side of the intersection to get a continuous local road.



Figure 4-4: Overview of alternative DR OB

The figure shows the lack of logic by not landing the bridge at Skulhusodden. It will be much longer and be almost parallel to the shore.



Figure 4-5: Intersection E6/rv. 4 (alternative DR 0B)



Figure 4-6: 3D illustration of alternative DR 0B by Fjordheim

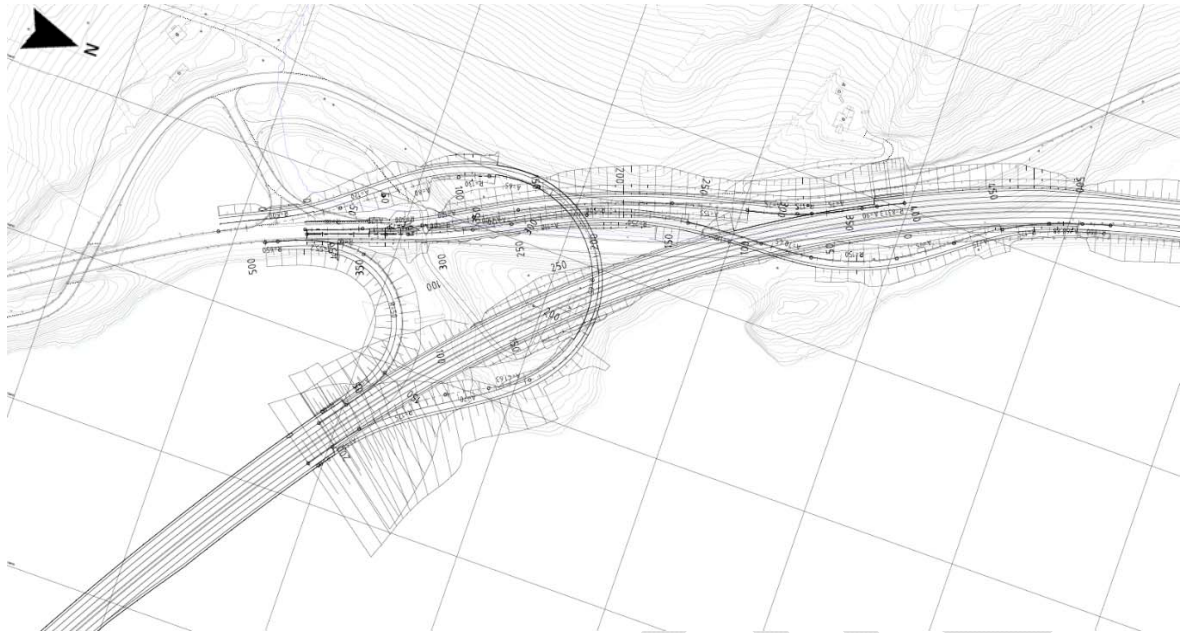


Figure 4-7: Drawing that shows the ramp design for alternative DR 0B in the Fjordheim area

4.1.3 Alternative with roundabouts on rv. 4 (DR 2/3)

Alternative DR 2/3 is an alternative with reduced horizontal radius (700 m).

Alternative DR 2/3 has ramps between E6 and rv. 4 connected with two roundabouts at Skulhusodden. This intersection requires a deviation because of the roundabouts, and for reduced horizontal radius on E6 over the construction.

This is an area-intensive intersection. It is shorter between Hamar and Gjøvik compared with alternative KDP 0A. This is the alternative with most intervention in arable land. Gallery Fjordheim, including the outdoor public area and shoreline, can remain. The area will be deteriorated by roads and ramps coming closer than today. Cabins and houses at Skulhusodden must be redeemed. The Mjøsa bridge will be shorter than alternative KDP 0A.

It will be possible to connect the local road and a public transportation terminal to the intersection. It will also be possible to use Fjordheim as a rest area. Existing rv. 4 is reused as local road north from the intersection. When rv. 4 is developed into four lanes, existing rv. 4 can become a local road south of the intersection.

This intersection entails some filling in Mjøsa. No access ramps on and off the Mjøsa bridge. The intersection has many constructions.

The alternative requires blasting part of Skulhusberget. The mass is needed for fillings in Mjøsa.



Figure 4-8: Overview of alternative DR 2/3



Figure 4-9: Drawing that shows the ramp design for alternative DR 2/3 north of Skulhusodden



Figure 4-10: 3D illustrations of the DR 2/3 alternative. Left: North of Skulhusodden towards the bridge. Right: From the end of the bridge northwards



Figure 4-11: 3D illustration of the DR 2/3 alternative north of Skulhusodden towards the existing bridge.

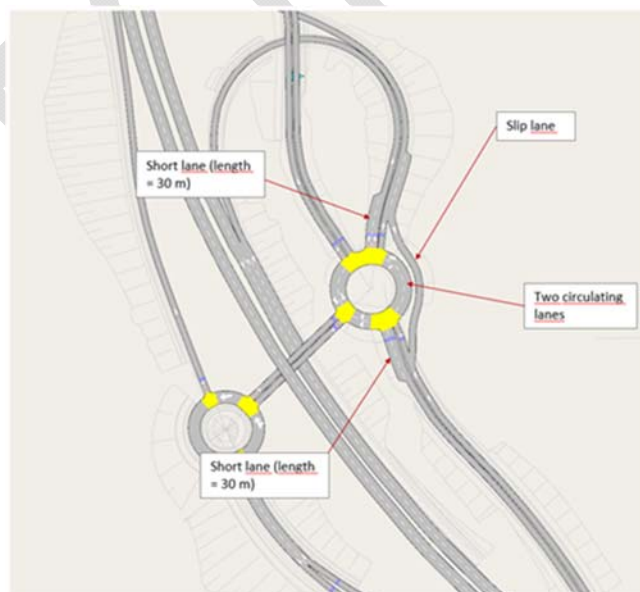


Figure 4-12: Traffical solution for the DR 2/3 alternative. Illustration from Aimsun

The alternative needs some adjustments shown in the figure above to achieve sufficient traffic capacity.

4.1.4 Alternative Direct ramps at Skulhusodden (DR 6)

For alternative DR 6, the Mjøsa bridge is located south of Fjordheim, and lands at Skulhusodden. The Mjøsa bridge is 300 m shorter than the bridge landing at Fjordheim in alternative KDP 0A and DR 0B.

Alternative DR 6 has direct ramps between E6 and rv. 4 at Skulhusodden. This is an intersection according to this highway standard. This intersection is considered safe.

This is an area-intensive intersection. It is shorter between Hamar and Gjøvik compared to alternative KDP 0A. There are some interventions in arable land. Gallery Fjordheim, including the outdoor public area and shoreline, can remain. Cabins and houses at Skulhusodden and some at Skulhusberget must be redeemed. The Mjøsa bridge will be approx. 300 m shorter than alternative KDP 0A.

It will not be possible to connect the local road or a public transportation terminal to the intersection.

This intersection entails some filling in Mjøsa. No access ramps on and off the Mjøsa bridge. The intersection has many constructions.

The alternative requires blasting Skulhusberget. The mass is needed for fillings in Mjøsa.

For DR 6, existing rv. 4 is reused as a local road and gives access to Fjordheim. DR 6 can be connected to future four-lane on rv. 4. The existing rv. 4 will then be a local road. This intersection has capacity for the future with four lanes on both E6 and rv. 4.



Figure 4-13: Overview of alternative DR 6

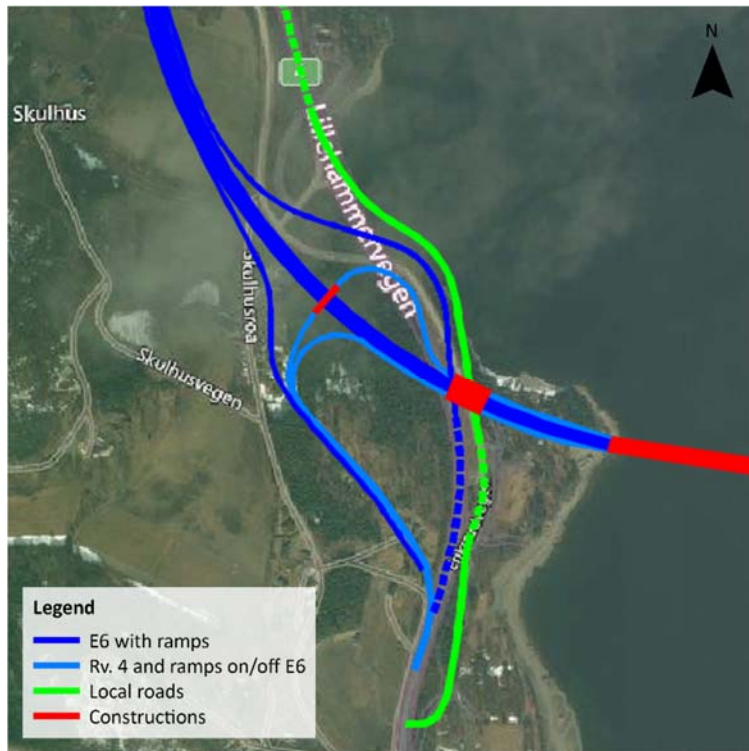


Figure 4-14: Principal solution for intersection E6/rv. 4 of alternative DR 6

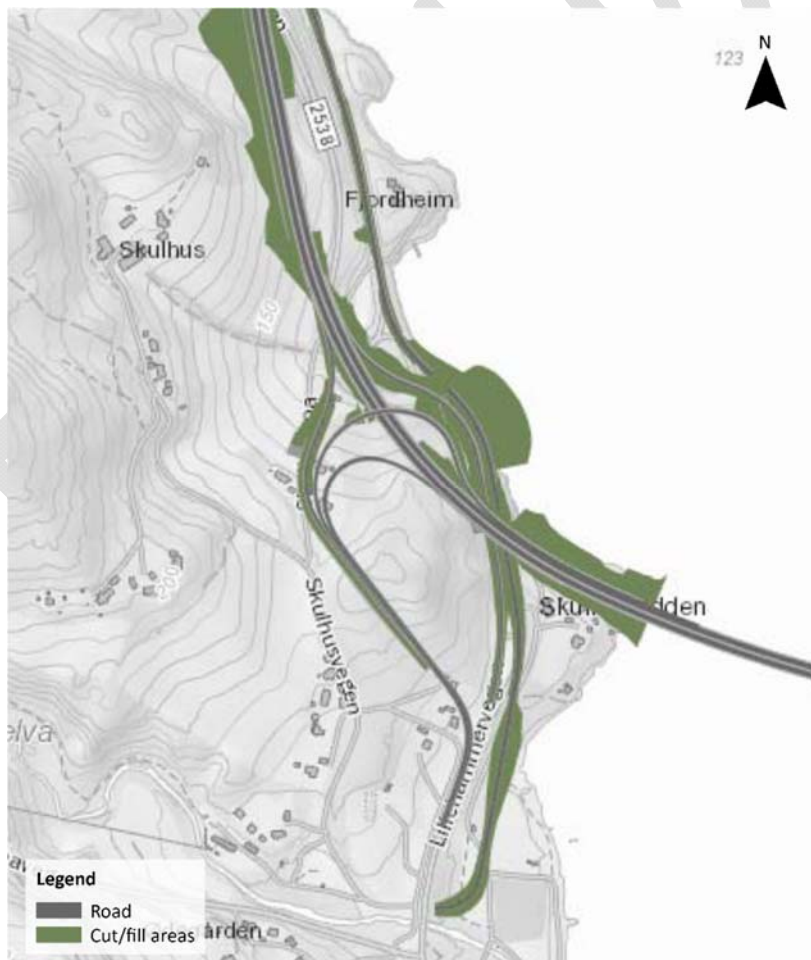


Figure 4-15: Alternative DR 6 intersection E6/rv. 4

Alternative DR 6 needs a deviation for horizontal alignment on E6. A deviation for not having a 50 % increase on horizontal radius on construction (E6) at Skulhusodden.

Alternative DR 6 can be optimized by moving the intersection slightly east towards the Mjøsa bridge. This will result in ramps on the bridge. This is expensive and can lead to a poorer aesthetic quality for the bridge. The advantage can be better cost-benefit ratio.

4.1.5 Alternative Direct ramps at Skulhusodden with reduced speed on E6 (90 km/h) (DR 6+)

One alternative to DR 6, is DR 6+ with reduced speed (90 km/h). The effect of reduced speed minimizes the footprint in general including shorter ramps, and has a smaller footprint effecting agricultural land.

Alternative DR 6+ has direct ramps between E6 and rv. 4 at Skulhusodden. This is an intersection according to this highway standard. This intersection is considered safe.

This alternative is less area-intensive compared to DR 6. It is shorter between Hamar and Gjøvik compared with alternative KDP 0A. There is some intervention in arable land, but less than DR 6. Gallery Fjordheim, including the outdoor public area and shoreline, can remain. Cabins and houses at Skulhusodden must be redeemed. The alternative might save some buildings at Skulhusberget. The Mjøsa bridge will be shorter than alternative KDP 0A.

It will not be possible to connect the local road or a public transportation terminal to the intersection.

This intersection entails some filling in Mjøsa. No access ramps on and off the Mjøsa bridge. The intersection has many constructions.

The alternative requires blasting Skulhusberget. The mass is needed for fillings in Mjøsa.

The cost difference between DR 6 and DR 6+ is minimal. DR 6+ requires deviation for reduced speed on E6. Because of difference in speed between ramps and E6, the alternative might require a barrier between the lanes on the Mjøsa bridge.

In a meeting January 13, 2021, all parts agreed on not pursuing alternative DR 6+ further.

4.1.6 Alternative roundabout with a straight bridge (RK 3AN)

Alternative roundabout with a straight bridge.

The intersection between E6 and rv. 4 in alternative RK 3AN is a roundabout at Skulhusodden. A roundabout as an intersection can work since there are two approximately equal roads that meet. It may also be a "temporary" solution until rv. 4 is clarified.

A main advantage of this alternative is reduced land consumption. It also gives the shortest driving distance between Hamar and Gjøvik. This is the alternative with lowest intervention in arable land. Gallery Fjordheim, the outdoor public area and shoreline, can remain. Cabins and houses at Skulhusodden must be redeemed. The Mjøsa bridge will be shorter than alternative KDP 0A.

This alternative has a new local road on the west side of the intersection. It is not possible to connect the local road and a public transportation terminal to the intersection. There will be access to Fjordheim by an under-/overpass from the local road.

The alternative can connect to a new four lane rv. 4 in the future. The alternative has less capacity than direct ramps and may have to be rebuilt later by making "flyovers".



Figure 4-16: Example "flyovers" in a roundabout solution

This intersection entails the least filling in Mjøsa. There are no access ramps on and off the Mjøsa bridge. The intersection has few constructions.

The alternative requires blasting Skulhusberget. The mass is needed for fillings in Mjøsa.

Two different solutions for roundabouts have been considered. One is a traditional roundabout (figure 4-18). The second is a roundabout with a barrier between the traffic lanes (figure 4-19). For this roundabout there will be direct ramps between the directions Hamar – Lillehammer and Gjøvik – Hamar. Motorists must select lanes heading towards the roundabout.

A roundabout is an untraditional intersection between E6 and rv. 4, and the proposed solution will need a deviation for the roundabout, split lanes and reduced speed on E6.



Figure 4-17: Overview of alternative RK 3AN with straight bridge

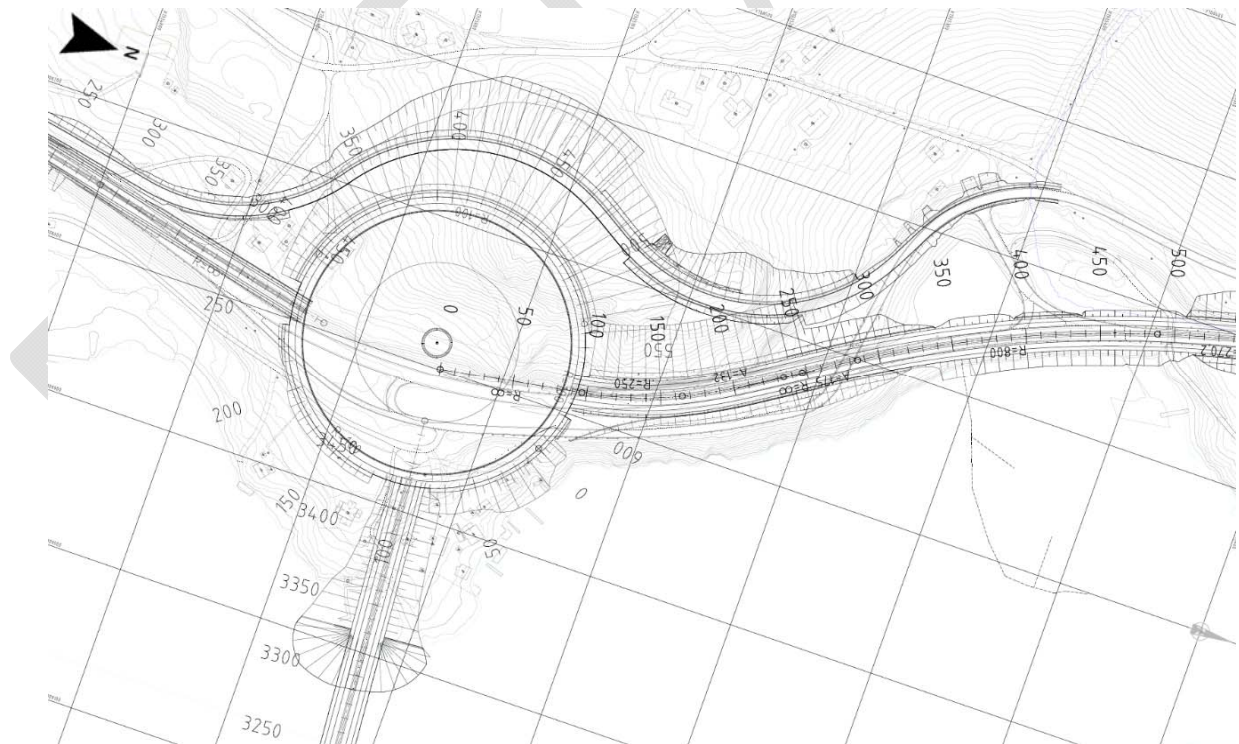


Figure 4-18: Roundabout design, RK3 AN alternative

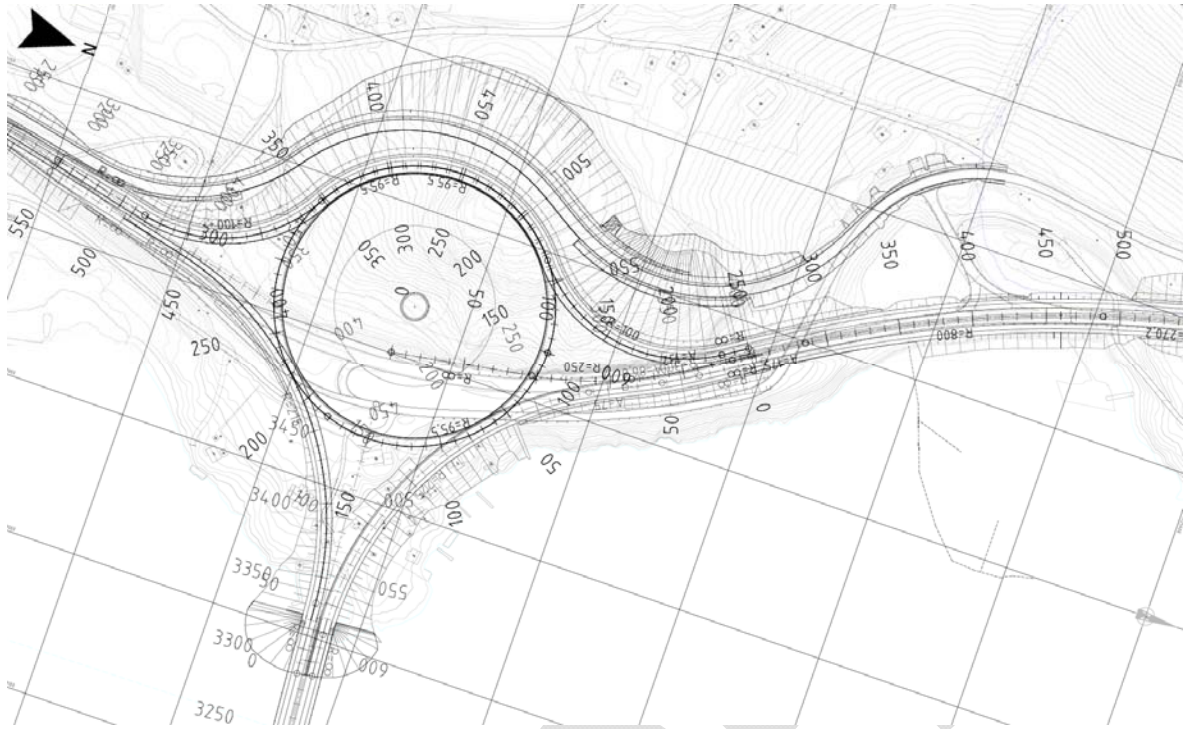


Figure 4-19: Roundabout design, RK 3AN alternative, roundabout with barrier between the traffic lanes

Alternative RK 3AN with straight bridge will come in conflict with grave mound at Moelv, saves only 15m of the length of the bridge, and is not as esthetic as a curved bridge.

4.1.7 Alternative roundabout with a curved bridge (RK 3AN)

This alternative is a roundabout at Skulhusodden with a curved bridge like alternative DR 2/3 and DR 6.

This roundabout is a bit smaller than RK 3AN straight bridge but is in other respects quite equal.

The curved bridge improves the adaptation to the landscape on both sides of Mjøsa and is not in conflict with the mound grave on the east side of Mjøsa. It requires some more filling in Mjøsa on the west side and is considered to cost some more than the roundabout with a straight bridge.



Figure 4-20: Overview of alternative roundabout with a curved bridge (RK 3AN)

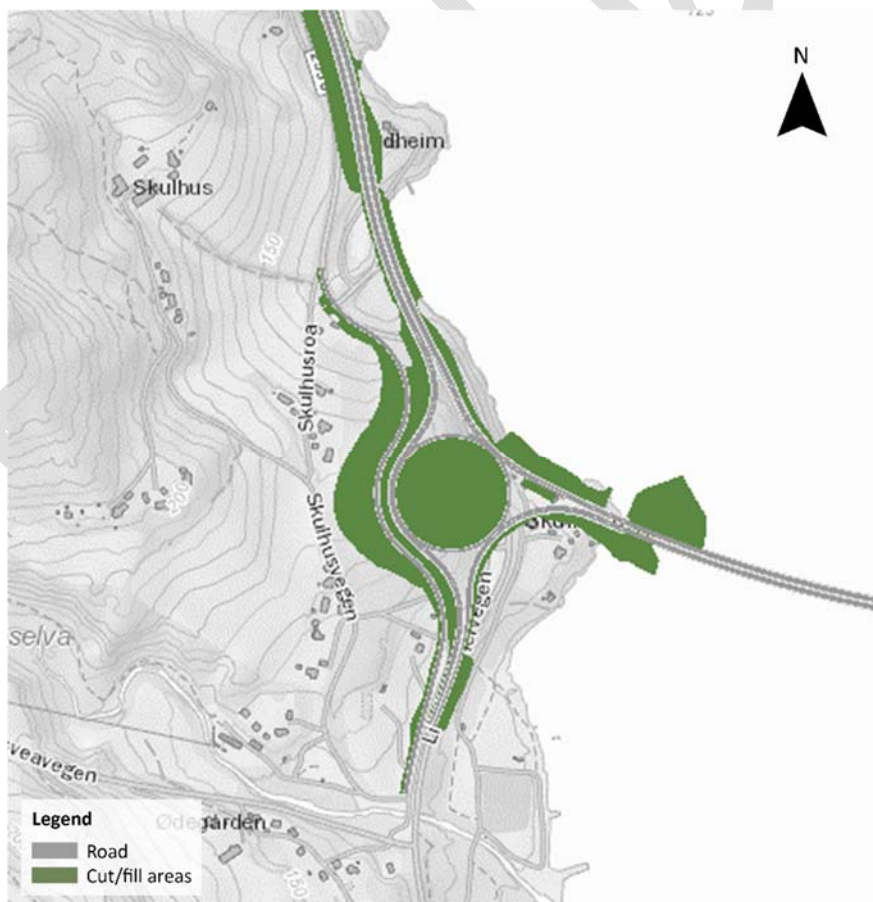


Figure 4-21: Overview of roundabout with a curved bridge (RK 3AN) in the Skulhusodden area



Figure 4-22: Overview of roundabout with curved bridge (RK 3AN) in the Skulhusodden area, shown on photo background



Figure 4-23: Roundabout with “flyovers” if needed when rv. 4 is expanded to a four-lane road

4.1.8 Alternatives from Trafitec, optimized DR 2/3 and DR 9

Optimized DR 2/3

Trafitec has introduced an optimized alternative to DR 2/3 with a diamond intersection with a raindrop-shaped ramp terminal [1].

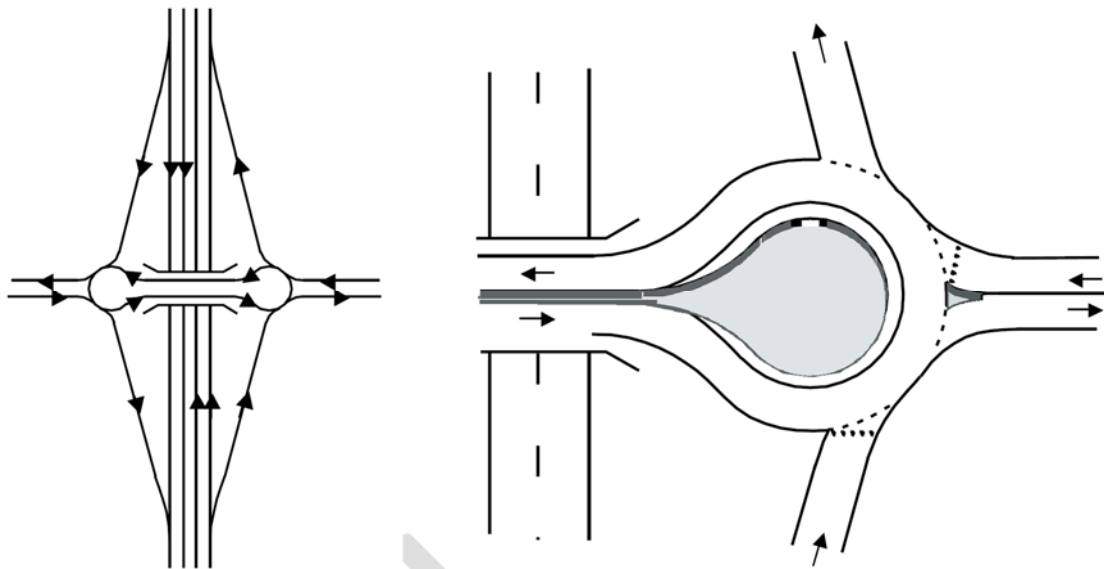


Figure 4-24: Raindrop-shaped ramp terminal – “dogbone”



Figure 4-25: Suggested optimized alternative. DR 2/3. Local road, rv. 4, on- and off-ramps and “dogbone”-shaped ramp terminal are in blue. Illustration from Trafitec.

This intersection will have more conflict points compared to KDP 0A, DR 0B and DR 6. The cost will be about the same as the alternatives with direct ramps. This is the alternative with highest time and distance cost. When rv. 4 expands to a four-lane road, the local road will stop in the roundabout.

DR 9

Trafitec has introduced a new alternative, DR 9. The intersection has split direct ramps in all directions, both on E6 and rv. 4. This means that the left lane on E6 going north continues towards Gjøvik, while the right lane continues towards Lillehammer. In the south direction the left lane on E6 continues towards the new bridge and Hamar, while the right lane continues towards Gjøvik. The right lane on rv. 4 going north continues to the new bridge and becomes the right lane on the bridge. The left lane from rv. 4 continues towards Lillehammer and becomes the left lane on E6. In DR 9, E6 has reduced lanes from four to two through the intersection. It also leads to ramps on three different levels and requires three constructions in the intersection. DR 9 requires building a local road on the west side of the intersection, and a construction from the local road to Fjordheim. DR 9 might get in conflict with the "Pilgrimsled". The speed on E6 and on ramps will be approx. 70 km/h. The alternative is considered to have the same construction cost as DR 6. The horizontal alignment on DR 9 causes little intervention in agricultural land at Skulhus farm.

The intersection that Trafitec has suggested can be seen in Figure 4-27. In addition, DR 9 requires a local road on the west side of the intersection. The local road is not illustrated in DR 9.

Trafitec has calculated accident cost for all the alternatives. The calculations show that accident cost for KDP 0A, DR 0B, DR 6 and DR 9 are almost the same, with KDP 0A as the best. The small differences are within the margin of statistical uncertainty, and these four alternatives should be considered to be at the same level. Trafitec has also calculated time and distance cost for all the alternatives. The calculations show that the DR 9 has the lowest time and distance cost.

The DR 9 intersection is not an intersection in the Norwegian handbooks. In Norway, the standard is to take a ramp on the right side when leaving the highway. Most traffic is usually located in the right lane, especially heavy vehicles. But in this intersection, you have to drive in the left lane on E6 to get to the left in the intersection, and this entails that you have to change your position to end up in the right direction. This will increase the risk of traffic accidents due to lane changes, especially with heavy vehicles that have large blind spots around the vehicle.

In the meeting with Vegdirektoratet February 2, they recommended one speed limit and four lanes for a long stretch of E6. It is also recommended not to reduce speed through an intersection, because there is so much else to pay attention to in an intersection. However, DR 9 has reduced speed and only two lanes on E6. DR 9 requires deviations for 70 km/h and for two lanes through the intersection, and this entails a project risk.

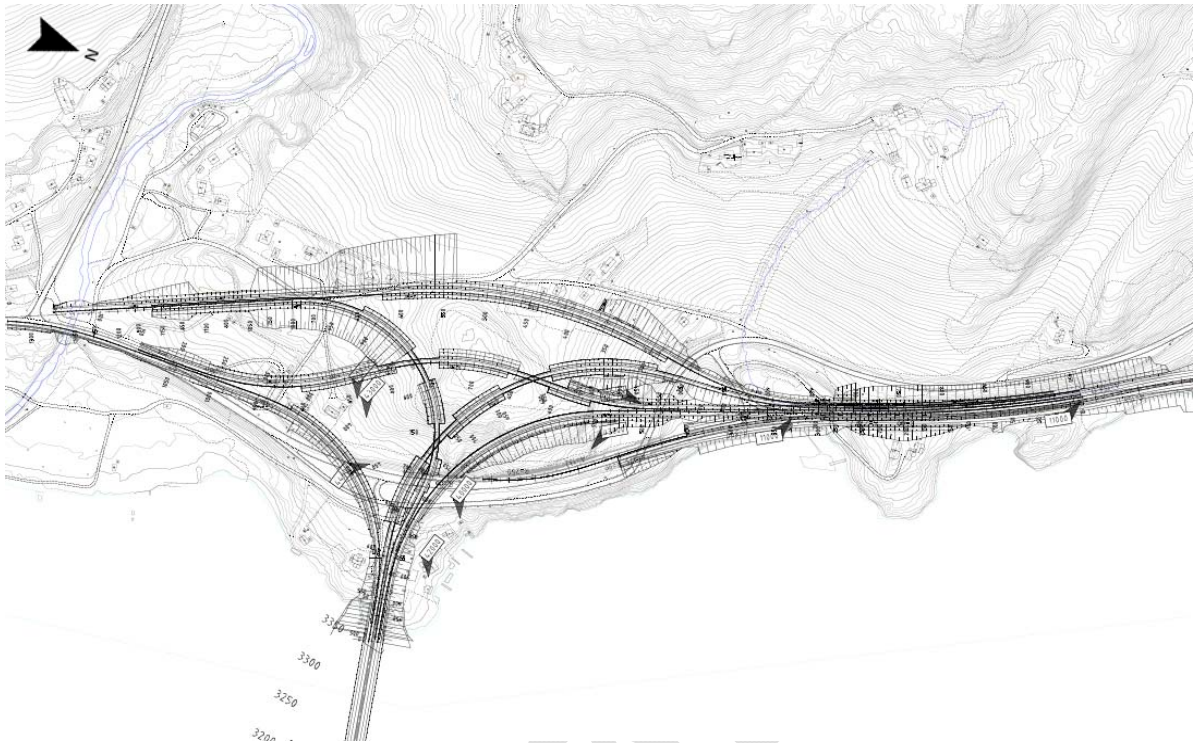


Figure 4-26: DR 9 more detailed (can also be connect to a curved bridge)

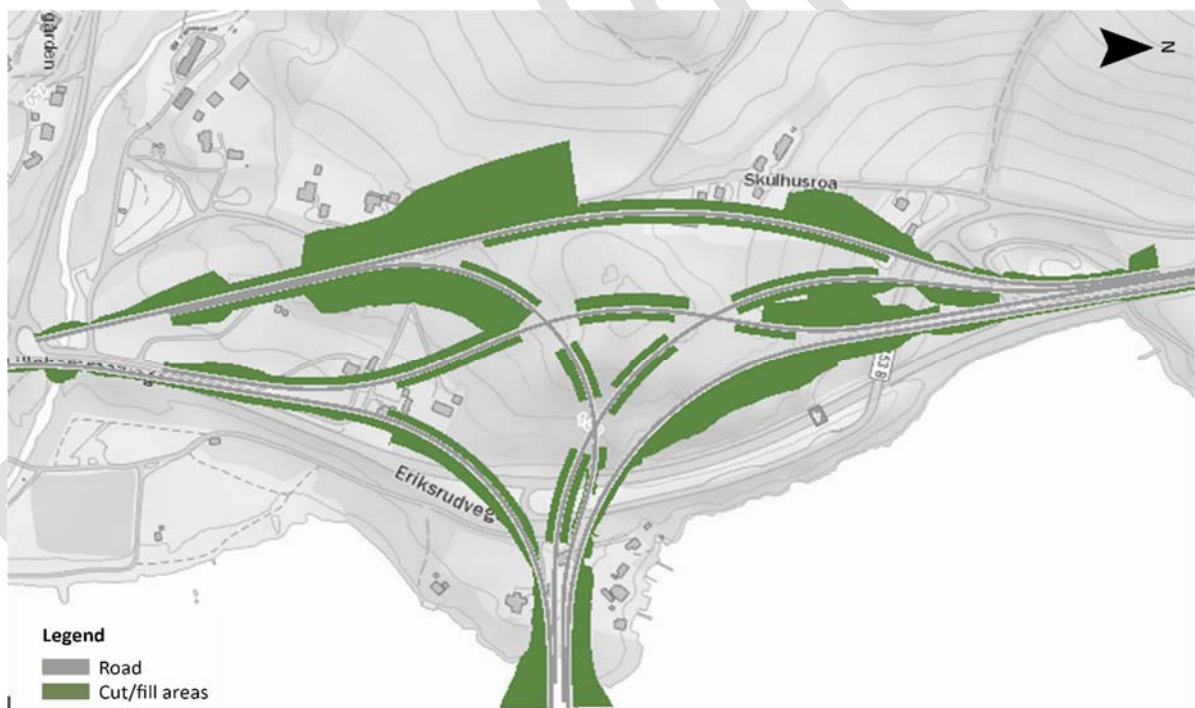


Figure 4-27: DR 9, needs a local road on the west side of the intersection (can connect to a curved bridge)



Figure 4-28: An illustration of an alternative to direct ramps with split lanes and reduced speed

FORRETT

4.2 Summary of each subject

Tables below show the four intersection alternatives and descriptions of advantages and disadvantages per subject compared to alternative KDP 0A.

Table 4-1: Assessments of traffic capacity

Alternatives	Traffic capacity Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	Direct ramps. No conflicts with crossing traffic. Good traffic capacity on both E6 and rv. 4. No queue.
Alt. DR 0B	Same as KDP 0A Advantages: None Disadvantages: None
Alt. DR 2/3	Advantages: None Disadvantages: Traffic on rv. 4 must drive through one or two roundabouts to get on E6. The same for traffic from E6 to rv. 4. A lot of traffic in the roundabout between rv. 4 and ramps (north) from E6. Capacity calculation shows there will be queues back to E6. Calculated average queue length on Friday afternoon in the year 2045 exceeds the length of the ramp of 300 m. In the worst-case scenario the queue propagates back to E6. Because of this, two lanes will be established on the off-ramp from E6 (approximately 30 - 50 m) towards the roundabout, two circulating lanes in the roundabout, two lanes on rv. 4 out from the roundabout towards Gjøvik and a slip lane from rv. 4 to on-ramp on E6 towards Lillehammer. With this design, capacity calculation shows that the average queue length on Friday afternoon in the year 2045 will be substantially reduced and approximately equal to 40 m.
Alt. DR 6	Same as KDP 0A Advantages: None Disadvantages: None
Alt. RK 3AN straight bridge	Advantages: None Disadvantages: Traffic on E6 and rv. 4 must drive through the roundabout. Traffic must reduce speed because of the design of the intersection. Conflict between traffic on E6 and rv. 4. Capacity calculation shows that on Sunday afternoon in 2045 the average queue length is approximately 21 m on E6 from Biri, but in some cases longer. In the worst-case scenario the queue length goes back approximately 128 m on E6 from Biri. On E6 from Mjøsbrua to rv. 4 the average queue length on Friday afternoon in 2045 is approximately 12 m, and in the worst-case scenario the queue length is approximately 58 m. On rv. 4 to E6 Biri the average queue length on Friday afternoon in 2045 is 20 m, and in the worst-case scenario the queue length is approximately 83 m. No mitigation measures are tested which can increase capacity at the roundabout.
Alt. RK 3AN curved bridge	Advantages: None Disadvantages: Traffic on E6 and rv. 4 must drive through the roundabout. Traffic must reduce the speed because of the design of the intersection. Conflict between traffic on E6 and rv. 4. Capacity calculation shows that on Sunday afternoon in 2045 the average queue length is approximately 21 m on E6 from Biri, but the queue length in some cases longer. In the worst-case scenario the queue length goes back approximately 128 m on E6 from Biri. On E6 from Mjøsbrua to rv. 4 the average queue length on Friday afternoon in 2045 is approximately 12 m, and in the worst-case scenario the queue length is approximately 58 m. On rv. 4 to E6 Biri the average queue length on Friday afternoon in 2045 is 20 m, and in the worst-case scenario the queue length is approximately 83 m. No mitigation measures are tested which can increase capacity at the roundabout.

Table 4-2: Assessments of traffic safety

Alternatives	Traffic safety Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	Common design for intersections on highways. Direct ramps, no conflicts with crossing traffic, only vehicles driving from E6 to rv. 4 and from rv. 4 to E6 that must change lanes and only to the right. Ramps in curve over water. No pedestrians and cyclists in the interchange.
Alt. DR 0B	Same as KDP 0A Advantages: Has no ramps in curve over water. Disadvantages: None
Alt. DR 2/3	Advantages: Common design for intersections on highways. Disadvantages: Conflict with crossing traffic in roundabout, can cause traffic accidents with vehicles (Low speed in roundabout, minor damage). Traffic calculations show that there can be some queue on the off-ramp from E6 from Hamar, which can cause rear-end collisions on the off-ramp. Pedestrians and cyclists can use rv. 4 and local road to the intersection. Slightly higher probability of traffic accidents with pedestrians and cyclists but very few pedestrians and cyclists are expected in this area.
Alt. DR 6	Same as KDP 0A Advantages: Has no ramps in curve over water. Disadvantages: None
Alt. RK 3AN straight bridge	Advantages: None Disadvantages: Roundabout is not a common solution on highways. Risk of high speed towards the roundabout. Crossing traffic in the roundabout, 3 points of conflict with potentially high speed towards the roundabout. Traffic accident with high speed gives higher risk of serious personal injury. More need of lane changes gives higher probability of traffic accidents. Risk of rear-end collisions due to vehicles giving way to traffic in the roundabout.
Alt. RK 3AN curved bridge	Advantages: None Disadvantages: Roundabout is not a common solution on highways. Risk of high speed towards the roundabout. Crossing traffic in the roundabout, 3 points of conflict with potentially high speed towards the roundabout. Traffic accident with high speed gives higher risk of serious personal injury. More need of lane changes gives higher probability of traffic accidents. Risk of rear-end collisions due to vehicles giving way to traffic in the roundabout.

Table 4-3: Assessments for public transport

Alternatives	Public transport Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	Direct ramps between E6 and Rv. 4, no connection to local roads in the intersection and no bus stops. Local buses can't get on E6 and rv. 4 in the intersection but must do this at Biri or on rv. 4 south of the intersection. Good connection Gjøvik - Lillehammer (bus line 102 express) and Gjøvik - Hamar (bus line 100 express).
Alt. DR 0B	Same as KDP 0A Advantages: None Disadvantages: None
Alt. DR 2/3	Advantages: Connection with local road. Local buses have access to E6 and rv. 4. Possibility of bus stops that local buses and express buses can use (not many passengers use this stop). Disadvantages: Express buses must drive through the roundabouts and this gives longer travel time than in the KDP-line. The comfort for passenger is not optimal.
Alt. DR 6	Same as KDP 0A Advantages: None Disadvantages: None
Alt. RK 3AN straight bridge	Advantages: Shorter travel time for express bus between Gjøvik and Hamar. Disadvantages: Longer travel time for express buses between Gjøvik and Lillehammer.
Alt RK 3AN curved bridge	Advantages: Shorter travel time for express bus between Gjøvik and Hamar. Disadvantages: Longer travel time for express buses between Gjøvik and Lillehammer.

Table 4-4: Assessments for pedestrians and cyclists

Alternatives	Pedestrians and cyclists Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	Direct ramps between E6 and rv. 4. No bus stops in the intersection. No pedestrians and cyclist in the intersection and on E6 and rv. 4. Pedestrians and cyclists will use local roads.
Alt. DR 0B	Same as KDP 0A Advantages: None Disadvantages: None
Alt. DR 2/3	Same as KDP 0A Advantages: None Disadvantages: None
Alt. DR 6	Same as KDP 0A Advantages: None Disadvantages: None
Alt. RK 3AN straight bridge	Same as KDP 0A Advantages: None Disadvantages: None
Alt. RK 3AN curved bridge	Same as KDP 0A Advantages: None Disadvantages: None

Table 4-5: Assessments of noise

Alternatives	Noise Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	A few houses close to the intersection.
Alt. DR 0B	A few houses close to the intersection.
Alt. DR 2/3	Intersection a bit further away from the group of houses by Skulhusvegen.
Alt. DR 6	Intersection a bit closer to Skulhusvegen and a group of houses. Ramp higher and closer to houses.
Alt. RK 3AN straight bridge	Intersection a bit further away from the group of houses by Skulhusvegen.
Alt. RK 3AN curved bridge	Intersection a bit further away from the group of houses by Skulhusvegen.

Table 4-6: Assessments of geotechnics

Alternatives	Geotechnics Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	
Alt. DR 0B	Advantages: Access ramp on land/rock fill and not as bridge above water level. Hence does not require to establish bridge foundations in lake. Disadvantages: Requires similar amount of rock fillings in Mjøsa, however rock filling in relation to bridge abutment at Fjordheim will likely be more challenging than the fillings at Skulhusodden.
Alt. DR 2/3	Advantages: Access ramp on land/rock fill and not as bridge above water level. Hence does not require establishing bridge foundations in lake. Less rock fillings than KDP option. Disadvantages: None
Alt. DR 6	Advantages: Access ramp on land/rock fill and not as bridge above water level. Hence does not require establishing bridge foundations in lake. Less filling in Mjøsa than KDP 0A, but more than DR 2/3. Disadvantages: More constructions than KDP 0A. Possible large filling just north of Skulhusodden, alternatively large retaining wall. Blasting of Skulhusodden and related excavation of soil masses overlying bedrock.
Alt. RK 3AN straight bridge	Advantages: Access ramp on land/rock fill and not as bridge above water level. Hence does not require establishing bridge foundations in lake. Reduced number of constructions. Least amount of rock fills in lake Mjøsa for the alternatives considered. No or limited dredging required. Less filling at the bridge abutment at Skulhusodden. Disadvantages: None
Alt. RK 3AN curved bridge	The differences on the Moelv side between curved and straight bridge are small. May required larger fillings at the bridge landing Skulhusodden compared to straight bridge option.

Table 4-7: Assessments of geology (acid rock)

Alternatives	Geology (acid rock) Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	
Alt. DR 0B	Comparable to KDP 0A alternative.
Alt. DR 2/3	<p>Advantages: Requires blasting of parts of Skulhusberget. However, the rock at Skulhusberget and the area directly impacted by the E6 / Rv.4 intersection is not considered to be acid-forming. Blasted rock can be used to acquire local fill material.</p> <p>Disadvantages: If a more western road alignment is selected at Kremmerodden, this will result in increased rock cuttings in potentially acid-forming rock. Assessment is based on limited rock samples and further sampling and testing of the shale at Kremmerodden must be conducted to determine the prevalence of the expected acid-forming shale and for correct handling of the material.</p>
Alt. DR 6	Same as for DR 2/3.
Alt. RK 3AN straight bridge	Same as for DR 2/3.
Alt. RK 3AN curved bridge	Same as for DR 2/3.

Table 4-8: Assessments of external environment (ground and water pollution)

Alternatives	External environment Advantages and disadvantages compared to KDP 0A
Ref. KDP 0A	Reference. No consequences per se.
Alt. DR 0B	<p>Advantages: Less constructions in Mjøsa.</p> <p>Disadvantages: Less, but still large fillings in Mjøsa. Negative impact on shoreline and at minimum temporary negative impact on water environment, large risk of pollution during construction phase and operational phase because of closer location.</p>
Alt. DR 2/3	<p>Advantages: Less constructions and fillings in Mjøsa. Access to blasted rocks for filling (short transportation).</p> <p>Disadvantages: Requires blasting of parts of Skulhusberget. Blasting is a source of emission of nitrogen compounds and will cause large areas exposed for run-off temporarily.</p>
Alt. DR 6	<p>Advantages: Less constructions in Mjøsa, less filling in Mjøsa than KDP 0A, but more than DR 2/3. Access to blasted rocks for filling (short transportation)</p> <p>Disadvantages: Many constructions. Blasting of Skulhusberget.</p>
Alt. RK 3AN straight bridge	<p>Advantages: Less constructions in Mjøsa and least filling of the alternatives. Access to blasted rocks for filling (short transportation). Area efficient.</p> <p>Disadvantages: Blasting of Skulhusberget.</p>
Alt. RK 3AN curved bridge	<p>Advantages: Less constructions in Mjøsa and least filling of the alternatives. Access to blasted rocks for filling (short transportation). Area efficient.</p> <p>Disadvantages: Blasting of Skulhusberget.</p>

Table 4-9: Assessments of structures

Alternatives	Structures Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	-
Alt. DR 0B	Advantages: Access ramp on land and not as bridge above water level. Disadvantages.: Relatively long bridges. But still expected to be easier to build than the bridge in KDP because of its need for bridge foundations in the lake.
Alt. DR 2/3	Advantages: All constructions on land. Simpler constructions and foundation methods. Shorter bridges. Lower construction cost due to shorter new Mjøsa bridge. Disadvantages: None.
Alt. DR 6	Advantages: All constructions on land. Simpler constructions and foundation methods. More flexibility in case it's difficult to make landfill in lake for local road. By introducing a retaining wall along northbound access ramp, it's possible to move local road closer to this access ramp. Lower construction cost due to shorter new Mjøsa bridge Disadvantages: None
Alt. RK 3AN straight bridge	Advantages: Lower construction cost due to shorter new Mjøsa bridge Disadvantages: Lower esthetic quality due to new Mjøsa bridge as a straight line.
Alt. RK 3AN curved bridge	Advantages: Lower construction cost due to shorter new Mjøsa bridge Disadvantages: None

Table 4-10: Assessments of climate gas submissions

Alternatives	Climate gas submission Advantages and disadvantages compared to KDP. *
Ref. KDP 0A	<p>Advantages: Has the second smallest GHG emissions of the other intersection alternatives (excluding concern for the corresponding bridge). An estimate for GHG emissions from the intersection is 7 t CO₂e.</p> <p>Disadvantage: Has the longest bridge (1650 m), and therefore the highest emissions of the wood-concrete composite bridge types. An estimate for GHG emissions from the bridge is 56 t CO₂e.</p>
Alt. DR 0B	<p>Advantages: The greenhouse gas (GHG) emissions for the alternative combination of the intersection and bridge alternative are slightly lower than alternative KDP 0A. The difference in emissions is from the difference in the intersection E6/rv. 4, as the bridge is equal to KDP 0A. An estimate for GHG emissions from the intersection is 5 t CO₂e.</p> <p>Disadvantage: Has the longest bridge (1650 m), and therefore the highest emissions of the wood-concrete composite bridge types. An estimate for GHG emissions from the bridge is 56 t CO₂e.</p>
Alt. DR 2/3	<p>Advantages: The GHG emissions for the alternative are evidently lower than alternative KDP 0A. The alternative combination has the lowest total GHG emissions. An estimate for GHG emissions from the bridge is 49 t CO₂e. An estimate for GHG emissions from the intersection is 8 t CO₂e.</p> <p>Disadvantages: The GHG footprint for the intersection part separately is slightly higher than the KDP-alternative.</p>
Alt. DR 6	<p>Advantage: The GHG emissions for the combination of intersection and shorter Mjøsa bridge are slightly lower than alternative KDP 0A. The emissions from the bridge are evidently smaller than KDP 0A. An estimate for GHG emissions from the bridge is 49 t CO₂e. An estimate for GHG emissions from the intersection is 13 t CO₂e.</p> <p>Disadvantage: The GHG emissions from the intersection part alone (excl the new Mjøsa bridge) is the highest.</p>
Alt. RK 3AN straight bridge	<p>Advantage: The GHG emissions for the combined intersection and shorter Mjøsa bridge are evidently lower than alternative KDP 0A. The emissions from the bridge (1335 m) are evidently lower than KDP 0A. An estimate for GHG emissions from the bridge is 48 t CO₂e. An estimate for GHG emissions from the intersection is 10 t CO₂e.</p> <p>Disadvantage: The alternative for the intersection part separately is almost 50% higher than alternative KDP 0A. (Difference in length with curved bridge is 15 m).</p>
Alt. RK 3AN curved bridge	<p>Advantage: The GHG emissions for the combined intersection and shorter Mjøsa bridge are evidently lower than alternative KDP 0A. The emissions from the bridge (1350 m) are evidently lower than KDP 0A, with approx. 49 t CO₂e. An estimate for GHG emissions from the intersection is 10 t CO₂e.</p> <p>Disadvantage: The alternative for the intersection part separately is almost 50% higher than KDP 0A.</p>

*Calculations are performed with different system boundaries for the intersection and bridge separately, and the results are therefore not added together to a total sum. The results are early estimates, and actual GHG emissions from the alternatives may vary.

Table 4-11: Assessments of natural environment (biodiversity)

Alternatives	Natural environment Advantages and disadvantages compared to KDP 0A
Ref. KDP 0A	Reference. No consequences per se. Conflict with habitats and threatened species at Fjordheim.
Alt. DR 0B	Similar to KDP 0A. Conflict with habitats and threatened species at Fjordheim.
Alt. DR 2/3	<p>Advantage: No conflict with habitats and threatened species at Fjordheim.</p> <p>Disadvantage: Lack of basic mapping at Skulhusodden. Larger fills in Mjøsa both at Skulhusodden and south of Fjordheim.</p> <p>The advantage at Fjordheim results in a slightly positive effect, but uncertainty is lack of field survey at Skulhusodden.</p>
Alt. DR 6	<p>Advantage: No conflict with habitats and threatened species at Fjordheim.</p> <p>Disadvantage: Lack of basic mapping at Skulhusodden. Larger fills in Mjøsa which have important areas for birds.</p> <p>The advantage at Fjordheim results in a slightly positive effect, but uncertainty is lack of field survey at Skulhusodden.</p>
Alt. RK 3AN straight bridge	<p>Advantage: No conflict with habitats and threatened species at Fjordheim.</p> <p>Disadvantage: Lack of basic mapping at Skulhusodden. Larger fills in Mjøsa which have important areas for birds.</p> <p>The advantage at Fjordheim results in a slightly positive effect, but uncertainty is lack of field survey at Skulhusodden.</p>
Alt. RK 3AN curved bridge	The differences on the Moelv side between curved and straight bridge are small, and do not have a significant impact for this theme. The two alternatives are evaluated as equal.

Table 4-12: Assessments of cultural heritage

Alternatives	Cultural heritage Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	Reference. No consequences per se. The built heritage at Fjordheim will have to be relocated/removed.
Alt. DR 0B	Similar to KDP 0A.
Alt. DR 2/3	<p>Advantage: the built heritage at Fjordheim can remain in situ/not be removed.</p> <p>Disadvantage: the access to Fjordheim will become difficult.</p>
Alt. DR 6	<p>Advantage: the built heritage at Fjordheim can remain in situ/not be removed.</p> <p>Disadvantage: the access to Fjordheim will become difficult.</p>
Alt. RK 3AN straight bridge	<p>Advantage: Slightly better than KDP 0A on the Gjøvik side. The built heritage at Fjordheim will not have to be removed, but will be very close to new road, and the access will become difficult. Safety measures and noise measures must be included.</p> <p>Disadvantage: Much worse than KDP 0A on the Moelv side. The access to the bridge will come very close (2,5 meters) to the safety zone surrounding two interconnected grave mounds from the Bronze/Iron Ages. The access will spoil the view of the grave mound from its surroundings and Mjøsa and diminish its role as a major cultural heritage element in the landscape.</p> <p>The disadvantage by far outweighs the slight advantage.</p>
Alt. RK3 AN curved bridge	With a curved bridge in alternative RK3 AN, the consequences on the Moelv side will be equal to DR 2/3 and DR 6. In total, the alternative is evaluated as slightly better than KDP 0A

Table 4-13: Assessments of community life/ outdoor recreation

Alternatives	Community life/ outdoor recreation Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	Reference. No consequences per se.
Alt. DR 0B	Negative impacts on Fjordheim as in KDP 0A. Less filling in Mjøsa by existing bridge. Less land acquisitions.
Alt. DR 2/3	The interventions at Fjordheim are less than KDP 0A, but recreation areas within and south of Skulhusodden will be affected by land acquisitions and increased noise levels. These areas are larger and more important recreation areas than the Fjordheim area. Less filling in Mjøsa by existing bridge.
Alt. DR 6	Land acquisitions and increased noise levels in local recreation areas at and around Skulhusodden. Occupies larger areas near the shore than DR3. Less filling in Mjøsa by existing bridge. Only small interventions at Fjordheim, substantially less than KDP 0A. The best solution for this theme if the bridge is to be located at Skulhusodden
Alt. RK 3AN straight bridge	Land acquisitions at Skulhusodden, also occupies most of the forest area behind the shore, but the shore areas south of Skulhusodden remain intact. Less interventions at Fjordheim than alt. KDP 0A. Less filling in Mjøsa near existing bridge.
Alt. RK 3AN curved bridge	The differences on the Moelv side between curved and straight bridge are small, and do not have a significant impact for this theme. The two alternatives are evaluated as equal.

Table 4-14: Assessments of landscape

Alternatives	Landscape Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	Intersection: Reference. No consequences per se. The Bridge: The bridge will be long, it misses Skulhusodden and hits Fjordheim. This will be perceived as an expensive (very long) bridge and with illogical alignment. The interplay with the existing bridge will not be optimal. The ramp with a bridge out into the water will also be negative as seen against the main bridge.
Alt. DR 0B	Intersection: Less impact on the littoral zone around Fjordheim, positive for the landscape values in Mjøsa with no ramps in the lake, but it will have a greater impact on the scenery ashore. The Bridge: This alternative has the same inherent problem as KPD 0A with a very long and illogical alignment of the bridge and not an optimal interplay with the existing bridge.
Alt. DR 2/ 3	Intersection: Significant impact on Skulhusodden, especially on the north side. Greater impact on scenery and road construction will be more dominant in the landscape than in KDP 0A. Less impact on Fjordheim, but the littoral zone south of Fjordheim will still be affected. Skulhusberget will not be very affected because of the alternative. The Bridge: The bridge will have the same logical alignment as in the tender phase and will look at its best.
Alt. DR 6	Intersection: Significant impact on Skulhusodden, especially on the north side. Bigger impact on terrain west and south of Skulhusodden. South of Skulhusodden road construction will be less adapted to the terrain and more dominant than in KDP 0A. Greater impact on scenery than in KDP 0A.

Alternatives	Landscape Advantages and disadvantages compared to KDP 0A.
	<p>The impact will depend on how the terrain is modulated and the way cuttings are done in Skulhusberget. The basis for the evaluations is a landscape integrated solution. It is a great opportunity to use excess masses as land art.</p> <p>The Bridge:</p> <p>The bridge will have the same logical alignment as in the tender phase and will look at its best.</p>
Alt. RK 3AN straight bridge	<p>Intersection:</p> <p>The intersection will have greater impact on Skulhusodden, but less impact on Fjordheim than in KDP 0A. Bigger impact on landscape west of Skulhusodden. A roundabout will be dominant in the landscape. Terrain invasion will be gathered in a more defined area. Road construction builds on the existing lines in the landscape. The alternative builds and enhances the landscape features of Skulhusodden.</p> <p>The impact will depend on how the terrain is modulated and the way cuttings are done in Skulhusberget. The basis for the evaluations is a landscape integrated solution. It is a great opportunity to use excess masses as land art.</p> <p>The Bridge:</p> <p>The alternative shows a bridge with no horizontal curve. This has a greater impact in the terrain on the east side of Mjøsa and lower esthetic values. A solution with a straight bridge will be valued as neutral because of less dynamic alignment and less esthetic bridge.</p>
Alt. RK 3AN curved bridge	<p>Intersection:</p> <p>The intersection will have greater impact on Skulhusodden, but less impact on Fjordheim than in KDP 0A. Bigger impact on landscape west of Skulhusodden. Roundabout will be dominant in the landscape. Terrain invasion will be gathered in a more defined area. Road construction builds on the existing lines in the landscape. The alternative builds and enhances the landscape features of Skulhusodden.</p> <p>The impact will depend on how the terrain is modulated and the way cuttings are done in Skulhusberget. The basis for the evaluations is a landscape integrated solution. It is a great opportunity to use excess masses as land art.</p> <p>The Bridge:</p> <p>The bridge will have the same logical alignment as in the tender phase and will look at its best. By using a curved bridge, the roundabout must be moved to the north. With a curved bridge also in alternative RK 3AN, the consequences will be much better than alternative KDP 0A.</p>

Table 4-15: Assessments of natural resources

Alternatives	Natural resources Advantages and disadvantages compared to KDP.
Ref. KDP 0A	Reference. No consequences per se.
Alt. DR 0B	Similar to KDP 0A. No consequences.
Alt. DR 2/3	Much worse than KDP 0A. Consumption of approx. 25 000 sqm of cultivated land*.
Alt. DR 6	Consumption of approx. 15.000 sqm of cultivated land*.
Alt. RK 3AN straight bridge	Nearly similar to alternative KDP 0A. Consumption of approx. 1 000 sqm of cultivated land.
Alt. RK 3AN curved bridge	As the alternative RK 3AN with straight bridge, this solution will be more or less equal to alternative KDP 0A with respect to natural resources. The differences on the Moelv side between curved and straight bridge are small, within ± 500 sqm seizure of cultivated land.

*For correct calculation of consumption of cultivated land, a part of the main road north of the crossing where the road geometry is affected by the solution for the intersection, is included.

Table 4-16: Assessments of safety, health and working environment (HSE)

Alternatives	HSE Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	Reference. No consequences per se.
Alt. DR 0B	No ramp over Mjøsa lake leading to additional risks. Building of 2 constructions.
Alt. DR 2/3	No constructions in Mjøsa lake. Less complicated filling in Mjøsa. Less transport of masses on public road. Building of 4 constructions. Steep side terrain. Steep seabed. Quartzeous grit on the site. More neighboring houses.
Alt. DR 6	Less impact on existing traffic. No constructions in Mjøsa lake. Less transport of masses on public road. Building of 3 constructions. Steep side terrain. Steep seabed. Quartzeous grit on the site. More neighboring houses.
Alt. RK 3AN straight bridge	No constructions in Mjøsa lake. Less filling in Mjøsa. Less filling by the abutment. Less levels (risk of fall and falling objects). Smaller constructions. Little need of building framework. Simple traffic flow with little need for temporary diversions. Less transport of masses on public road. Steep side terrain. Large extent of blasting. Quartzeous grit on the site. More neighboring houses.
Alt. RK 3AN curved bridge	No constructions in Mjøsa lake. Less filling in Mjøsa. Less filling by the abutment. Less levels (risk of fall and falling objects). Smaller constructions. Little need of building framework. Simple traffic flow with little need for temporary diversions. Less transport of masses on public road. Steep side terrain. Large extent of blasting. Quartzeous grit on the site. More neighboring houses.

Table 4-17: Assessments of construction works

Alternatives	Construction works Advantages and disadvantages compared to KDP.
Ref. KDP 0A	Very demanding traffic flow in a cramped area. There will be a need for several traffic diversions during the construction period. New E6 is built on top of today's rv.4 = challenging Many and large constructions in challenging ground conditions. A lot of dredging and filling work in Lake Mjøsa necessary= Expensive
Alt. DR 0B	Same as KDP 0A
Alt. DR 2/3	Building of 4 constructions, still less m ³ concrete than in KDP 0A. Filling and dredging in Mjøsa necessary, but less than in KDP 0A. Extraction of rock can be adapted to our needs. Traffic management easier than the solution in KDP 0A.
Alt. DR 6	Building of 3 constructions. Less concrete than in KDP 0A. Filling and dredging in Mjøsa necessary, still less than in KDP 0A. Extraction of rock can be adapted to our needs. Traffic management is much easier than the solution in KDP 0A.
Alt. RK 3AN straight bridge	Less challenges with ground conditions in Mjøsa. Probably no need for dredging, and less rock fill in Mjøsa. Simple traffic flow with little need for temporary diversions. No constructions that are favorable for HSE. Provides good access to stone, which is essential for good construction and less transport along public roads.
Alt. RK 3AN curved bridge	Less challenges with ground conditions in Mjøsa. Probably no need for dredging, and less rock fill in Mjøsa. Simple traffic flow with little need for temporary diversions. No constructions that are favorable for HSE. Provides good access to stone, which is essential for good construction and less transport along public roads.

Table 4-18: Calculated simplified net present value compared to alt 0 (mill. NOK, discounted value, for details, see chapter 4.4)

Alternatives
Ref. KDP 0A
Alt. DR 0B
Alt. DR 2/3
Alt. DR 6
Alt. RK 3AN straight bridge
Alt. RK 3AN curved bridge

Table 4-19: Assessments of risk

Alternatives	Risk Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	A lot of dredging and filling work in Lake Mjøsa necessary. Very demanding traffic flow in a cramped area.
Alt. DR 0B	A lot of dredging and filling work in Lake Mjøsa necessary. Very demanding traffic flow in a cramped area.
Alt. DR 2/3	Filling and dredging in Mjøsa necessary, still less than in KDP 0A. Might get an objection because of the consumption of approx. 25 000 sqm of cultivated land*. The most redeem of houses and cabins.
Alt. DR 6	Filling and dredging in Mjøsa necessary, still less than in KDP 0A. Redeem of houses and cabins.
Alt. RK 3AN straight bridge	Might get an objection because of roundabout. Redeem of houses and cabins.
Alt. RK 3AN curved bridge	Might get an objection because of roundabout. Redeem of houses and cabins.

Table 4-20: Assessments of necessary deviations

Alternatives	Deviatons Advantages and disadvantages compared to KDP 0A.
Ref. KDP 0A	Deviation for Mjøsa bridge.
Alt. DR 0B	Deviation for Mjøsa bridge.
Alt. DR 2/3	Deviation for Mjøsa bridge and roundabouts, and for horizontal radius over bridge.
Alt. DR 6	Deviation for Mjøsa bridge, and for horizontal radius over bridge.
Alt. RK 3AN straight bridge	Deviation for Mjøsa bridge and roundabout, reduced speed and split lines on E6.
Alt. RK 3AN curved bridge	Deviation for Mjøsa bridge and roundabout, reduced speed and split lines on E6.

4.3 Complete summary of advantages and disadvantages

All alternatives are summarized in a table, where each subject is highlighted with color scores from the assessments in the table. All alternatives have evaluated the area from Moelv to existing Mjøsa bridge, and parts of rv. 4 (Figure 1-5).

Table 4-21: Assessment score

Score	Assessment criteria
+2	Much better than KDP alternative
+1	Better than KDP alternative
0	Similar to KDP alternative
-1	Worse than KDP alternative
-2	Much worse than KDP alternative

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Table 4-22: Summary of all assessed subjects

Subject	Ref. KDP 0A	Alt. DR 0B	Alt. DR 2/3	Alt. DR 6	Alt. RK 3AN straight bridge	Alt. RK 3AN curved bridge
Quality impact						
Traffic – Safety (discounted accident cost compared with KDP from Trafitec mill. NOK)	0	2.2	24.5	1.7	62.7	62.7
Traffic - Capacity						
Traffic – Public transport						
Traffic – Pedestrians and cyclists						
HSE						
Risk						
Noise						
Deviations						
Cost impact						
Geotechnics						
Geology (acid formed rocks)						
Structures						
Construction works						
Environmental impact						
External environment						
Climate gas submission						
Natural environment						
Cultural heritage						
Local community / outdoor activity						
Landscape values						
Natural resources						
Cost-benefit						
Simplified net present value compared to KDP 0A						
Construction cost compared to KDP 0A						

Table 4-23: Assessments of performance objectives

Nye Veier Performance Objectives	Project analysis			Result
	Largest impact	Relevant subjects	Alternatives from chapter 4.1	Best alternative
Maximize traffic safety and access for all road users in the construction and guarantee period	Traffic safety	Traffic safety	KDP 0A, DR 0B and DR 6	KDP 0A, DR 0B and DR 6
	Bus infrastructure	Traffic capacity Pedestrians and cyclists	KDP 0A, DR 0B and DR 6,	
	Connection to local infrastructure	SHA	-	
	Traffic safety during construction period	Construction works	DR 0B, RK 3AN RK 3AN	
Minimize temporary and permanent loss of agricultural land.	Road alignment	Natural resources	KDP 0A, DR 0B and RK 3AN	KDP 0A, DR 0B and RK 3AN
	Landscape design to reduce impact of the road			
An injury and accident-free construction and warranty period, promoting health and a fair work-life	HSE	HSE	DR 0B and RK 3AN	RK 3AN
	Environment	External environment Construction works	RK 3AN RK 3AN	
Maximize adaptation to the landscape and surrounding areas	Fillings in Mjøsa	Landscaping	DR 2/3, DR 6 and RK 3AN curved bridge	DR 2/3, DR 6 and RK 3AN
	Visual impact	External environment	RK 3AN	
	Road alignment	Natural environment	DR 2/3, DR 6 and RK 3AN	
	Landscape design	Cultural heritage	DR 2/3, DR 6 and RK 3AN curved bridge	
	Make the shore accessible	Local community / outdoor activity	DR 0B	
Minimize the construction and life-cycle cost	Weight of superstructure	Structures Construction works Geotechnology Construction cost		RK 3AN
	Approval of deviations		RK 3AN	
	Bridge length		RK 3AN	
	Road alignment		RK 3AN	
Minimize CO ₂ greenhouse gas emissions in construction and maintenance	Materials	Climate Gas Submission	DR 2/3, RK 3AN	DR 2/3 and RK 3AN
	Bridge length			
	Road alignment			
	Pile design			
	CO ₂ calculations			
Technical and plan risk	Deviations	Deviation	KDP 0A, DR 0B and DR 6	KDP 0A, DR 0B and DR 6
	Plan risk	Planrisk	KDP 0A, DR 0B, DR 2/3 and DR 6	
	Ground conditions			
	Filings in Mjøsa			
Simplified cost / benefit analysis		Simplified cost / benefit analysis	DR 6	DR 6

4.4 Recommended alternative

The screening process is based on table 4-23, which shows which intersection is best in relation to Nye Veier's goals for the project. Nye Veier also considers the design of the local road as important.

Moving the landing of Mjøsa bridge at Skulhusodden makes the bridge approx. 300 m shorter and requires less fillings in Mjøsa. The construction costs for each of the alternatives at Skulhusodden are less than landing Mjøsa bridge at Fjordheim. The simplified cost-benefit calculations are best for alternatives at Skulhusodden. This results in choosing to land the Mjøsa bridge at Skulhusodden. The alignment for the bridge will be optimized and moved a bit more south at Skulhusodden to further reduce fillings in Mjøsa. **This decision results in rejecting alternative DR 0B.**

The roundabout RK 3AN with a curved bridge is the most preferred alternative considering cost, HSE, geotechnics, structures, construction works, external environment and landscape values. The intersection with a roundabout on E6 is not an intersection in the Norwegian handbooks. In the meeting with Vegdirektoratet February 1, they recommended one speed limit and four lanes for a long stretch of E6. It is also recommended not to reduce speed through an intersection, because there is so much else to pay attention to in an intersection. The roundabout RK 3AN requires reduced speed and only two lanes on E6. The roundabout requires deviations due to the type of intersection, reduced speed and two lanes through the intersection. This entails a project risk. The result of capacity calculations shows lack of capacity on Sunday evening. According to traffic safety, the roundabout is the intersection with highest accident cost. **Because of plan risk, high accident cost and lower cost-benefit, the roundabout is rejected.**

Alternative DR 2/3 and the optimized version from Trafitec turn out to have less cost-benefit and higher accident costs compared to DR 6 and DR 9. This alternative also needs a deviation for roundabouts at rv. 4, and for reduced radius over the construction. DR 2/3 has the most impact on agricultural land at Skulhus farm. **DR 6 and DR 9 are considered better than DR 2/3. DR 2/3 is rejected.**

The remaining intersection alternatives are DR 6 and DR 9. Here is the conclusion from discussing DR 6 compared with DR 9 in a meeting February 4:

- DR 6 will be the selected alternative to be taken forward to further development
- The main disadvantages of DR6:
 - Large impact on landscape
 - Intervention of agricultural land at Skulhus farm
 - Need to redeem buildings at Skulhusberget
 - Need deviation for horizontal radius on E6
- DR 6 needs to be further developed with the aim of reducing the identified disadvantages
- Aim is to incorporate some of DR 9's advantages into an optimized DR 6
- Development in two main branches, both with 4-lane E6 throughout:
 - 1) 110 km/h solution
 - 2) Reduced speed solution
- Possible paths of optimization (but not limited to)
 - Adjustment of bridge landing point further south
 - Acceleration / deceleration lanes partially on bridge
 - Mitigating measures for landscaping the cut below Skulhus farm etc. to be worked out going forward

DR 6 is the selected alternative to be further optimized according to the list above.

5 Biri intersection

In addition to the alternative from the municipal sector plan (alternative KDP), there are three different alternatives: B, C and E.

Choosing the right intersection for Biri depends on the intersection between E6 and rv. 4. If the intersection between E6 and rv. 4 is connected to a public transportation area, with commuter parking and bike parking, all the different intersections at Biri are suitable. If the intersection between E6 and rv. 4 doesn't connect to a public transportation area, Biri must have a commuter parking close to the bus stops, and bike parking.

The chosen alternative for E6 / rv. 4 does not have connection to public transportation. The intersection for Biri needs to connect to a public transportation with commute parking and bike parking.



Figure 5-1: View from Biri racetrack

5.1 Description of alternatives for Biri intersection

5.1.1 Alternative KDP

The intersection at Biri in alternative KDP is located north, at the exit to the restaurant and gas station. The intersection has ramps that lead into a big roundabout on a construction over E6. To minimize space the intersection is designed with a concrete wall between ramps and E6. The design with a concrete wall is an expensive solution.

Bus stops are located on the ramps. This intersection has a convenient and comfortable solution for the bus passengers.

The solution has a sidewalk for cyclists and pedestrians on the construction over E6. They must cross two ramps. May require walkway from bus stop to existing walkways.

The solution comes close to the main building for the racetrack and involves encroachment on the parking lot for the racetrack. There is some intervention in arable land. The intersection is close to the gas station and the racetrack which is positive.



Figure 5-2: Overview of KDP alternative



Figure 5-3: 3D illustration of the KDP alternative

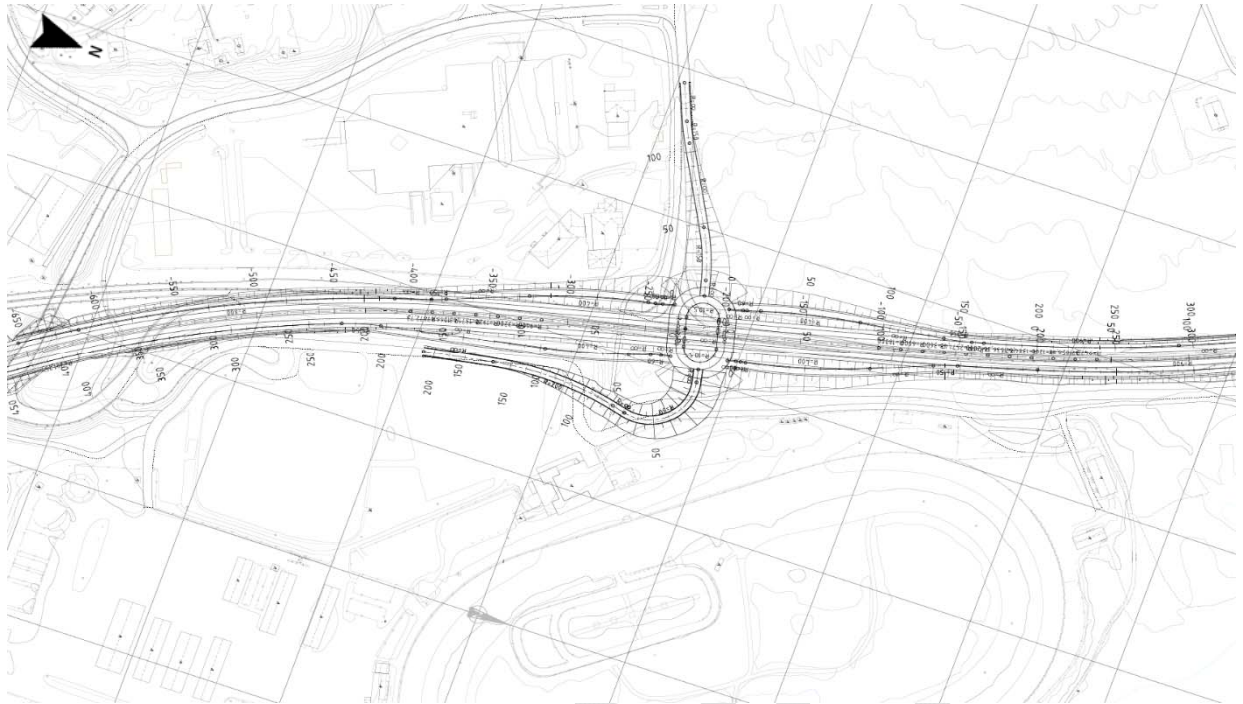


Figure 5-4: Drawing of the KDP alternative

5.1.2 Alternative diamond intersection – full intersection south at Biri (B)

Alternative B is a full intersection (ramps in all directions) located south at Biri. It is an intersection that is easy to understand.

The gas station and restaurant will be further away from the intersection. There will be a new bridge over E6 and a roundabout on each side of E6. This solution is positive for the bus passengers, because the bus can stop on the ramps, and just drive straight through the roundabout, and on to E6 on the ramp. That is comfortable for the passengers.

The solution has a sidewalk for cyclists and pedestrians on the construction over E6. They must cross two (one lane) ramps.

There are four lanes under the bridge.

The solution is located far from the main building at the racetrack, but it involves encroachment on the parking lot for the racetrack. There is no intervention in arable land.



Figure 5-5: 3D illustration of alternative B

An alternative B further south of Biri has been tested. This led to more fillings in Mjøsa, and fillings close to the boat harbour. It also led to conflicts with a technical building. The alternative requires building of more local roads.

Alternative B can have a bridge slightly tilted over E6 to reduce the impact on the east side of E6.

5.1.3 Alternative two half intersections (C)

Alternative C is located both north, at the exit to restaurant and gas station, and south at Biri. It is two half intersections; For traffic from Lillehammer the exit to Biri is located north of the gas station. For traffic from Oslo the exit to Biri is located south of Biri racetrack, the same solution as today. As a driver, it can be difficult to perceive the split solution.

There is little intervention in arable land. Much of the current road system can be retained at the intersection by the gas station and restaurant.

There will be a new bridge over E6 and a roundabout with ramps east of E6 south at Biri.

This solution is not good for the bus passengers, because the bus stops will be located apart from each other. The bus must drive away from E6 coming from the north. Alternative C may require a roundabout in the intersection Skumsrudvegen x Paradisvegen. May require walkway from bus stop to existing walkways.

The solution has a sidewalk for cyclists and pedestrians on the construction over E6. They must cross one ramp.

There are four lanes under the bridge.

The solution is located far from the main building at the racetrack, but it involves encroachment on the parking lot for the racetrack. There is very little intervention in arable land.



Figure 5-6: Overview of alternative C

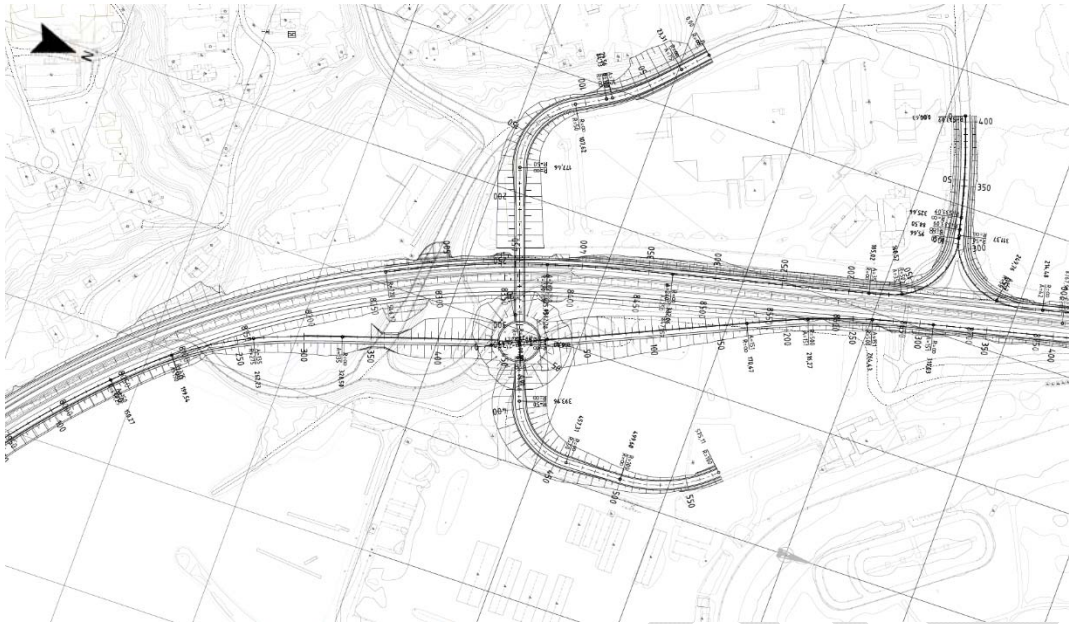


Figure 5-7: Drawing of alternative C

5.1.4 Alternative full intersection south at Biri (E)

Alternative E is a full intersection located south at Biri. It is an intersection that is easy to perceive.

The gas station and restaurant will be further away from the intersection. There will be a new bridge over E6 and a roundabout on each side of E6.

This solution is not good for bus passengers, because the bus has to make sharp turns and go by the roundabout. That is not comfortable for the passengers.

The solution has a sidewalk for cyclists and pedestrians on the bridge over E6. The pedestrians must not cross any ramps.

There are six lanes under the bridge.

The solution is located far from the main building at the racetrack, but it involves encroachment on the parking lot for the racetrack. There is no intervention in arable land.



Figure 5-8: Overview of alternative E



Figure 5-9: Drawing of alternative E

5.2 Summary of each subject

Tables below shows the two alternatives and descriptions of advantages and disadvantages per subject compared to the KDP alternative.

Table 5-1: Assessments of traffic capacity

Alternatives	Traffic capacity Advantages and disadvantages compared to KDP solution.
KDP	Low traffic on ramps at Biri. No capacity problems in the roundabout. Traffic from Lillehammer to Biri must give way to traffic from Gjøvik/Hamar to Biri.
Alternative B	Advantages: Low traffic on ramps at Biri. No capacity problems in the roundabouts. Traffic from Lillehammer to Biri must give way to traffic from Gjøvik/Hamar to Biri in the roundabout west of E6. In the roundabout on the east side of E6, traffic from Gjøvik/Hamar must give way to traffic from Biri to Lillehammer or Biri trotting track. But due to low traffic, it is considered that there is no danger of queue back to E6. Disadvantages: None
Alternative C	Advantages: Few conflicts between crossing directions due to a split intersection. Low traffic on ramps at Biri. No danger of queue back to E6. No capacity problems in the roundabout. No capacity problems for off-ramp from north to Biri, and on-ramp from Biri to E6 south towards Gjøvik/Hamar. Disadvantages: None
Alternative E	Advantages: Low traffic on ramps at Biri. No capacity problems in the roundabouts. Traffic from Lillehammer to Biri must give way to traffic from Gjøvik/Hamar to Biri. Disadvantages: None

Table 5-2: Assessments of traffic safety

Alternatives	Traffic safety Advantages and disadvantages compared to KDP solution.
KDP	Intersection with ramps in straight line on and off E6. Only one roundabout. Few conflicts point. Logical design.
Alternative B	Advantages: None Disadvantages: More conflict points than KDP, due to two roundabouts. But due to low traffic on ramps the risk of a collision is relatively low.
Alternative C	Advantages: Only two conflict points. Disadvantages: Split intersection is illogical.
Alternative E	Advantages: None Disadvantages: More conflict points than KDP, due to two roundabouts. Analyses on traffic safety confirms that this design of the intersection has higher risk of traffic accidents than the design in KDP. But due to low traffic on ramps the risk of a collision is relatively low.

Table 5-3: Assessments for public transport

Alternatives	Public transport Advantages and disadvantages compared to KDP solution.
KDP	Possibility of bus stops on ramps. Good solution for buses that drive on E6. Connection between local road and E6.
Alternative B	Advantages: Same as KDP, possibility of bus stops on ramps. Good solution for buses that drive on E6. Connection between local road and E6. Disadvantages: None
Alternative C	Advantages: None Disadvantages: Buses from Lillehammer to Gjøvik must drive in to Biri to turn to get back on E6. Gives extra travel time for the bus. Bus stop on local road. The bus stops in each direction are separate from each other.
Alternative E	Advantages: None Disadvantages: Buses must drive through the entire roundabout to get back on E6. Less comfort for passengers. A little longer travel time due to the design of the ramps.

Table 5-4: Assessments for pedestrians and cyclists

Alternatives	Pedestrians and cyclists Advantages and disadvantages compared to KDP solution.
KDP	Advantages: None Disadvantages: Pedestrians and cyclists must cross two ramps to get from Biri to the trotting track.
Alternative B	Advantages: None Disadvantages: Pedestrians and cyclists must cross two ramps to get from Biri to the trotting track.
Alternative C	Advantages: None Disadvantages: Pedestrians and cyclists must cross one ramp to get from Biri to the trotting track.
Alternative E	Advantages: Pedestrians and cyclists will use the south side of the bridge over E6. Do not have to cross any ramps in the intersection. No conflicts with vehicles. Disadvantages: None

Table 5-5: Assessments of noise

Alternatives	Noise Advantages and disadvantages compared to KDP solution.
KDP	A few houses close to the intersection.
Alternative B	More houses near the intersection. Not much traffic in the intersections.
Alternative C	More houses near the intersection. Not much traffic in the intersections.
Alternative E	More houses near the intersection. Not much traffic in the intersections.

Table 5-6: Assessments of geotechnics

Alternatives	Geotechnics Advantages and disadvantages compared to KDP solution.
KDP	-
Alternative B	Less complex construction, hence less challenges with foundations. Nevertheless, ground conditions generally favorable, hence geotechnical benefits will be limited.
Alternative C	Less complex construction, hence less challenges with foundations. Nevertheless, ground conditions generally favorable, hence geotechnical benefits will be limited.
Alternative E	Less complex construction, hence less challenges with foundations. Nevertheless, ground conditions generally favorable, hence geotechnical benefits will be limited.

Table 5-7: Assessments of geology (acid rock)

Alternatives	Geology (acid rock) Advantages and disadvantages compared to KDP solution.
KDP	-
Alternative B	No difference to the KDP alternative. Bedrock well below ground surface level, no removal of bedrock expected.
Alternative C	Same as alternative B.
Alternative E	Same as alternative B.

Table 5-8: Assessments of external environment (ground and water pollution)

Alternatives	External environment Advantages and disadvantages compared to KDP solution.
KDP	Reference. No consequences per se.
Alternative B	No clear difference to KDP alternative
Alternative C	No clear difference to KDP alternative
Alternative E	Disadvantage: More area consuming. Close to Paradisbukta. Larger risk of negative influence of water environment/pollution along shoreline.

Table 5-9: Assessments of structures

Alternatives	Structures Advantages and disadvantages compared to KDP solution.
KDP	-
Alternative B	Adv.: Much less complex construction than KDP. One bridge instead of a 4-lane tunnel with oval roundabout on top of it. Fewer dangerous pedestrian crossings of the access ramps. Bridge approx. orthogonal with E6. Disadv.: None.
Alternative C	Adv.: Much less complex construction. One bridge instead of a 4-lane tunnel with oval roundabout on top of it. Fewer dangerous pedestrian crossings of the access ramps. Disadv.: None.
Alternative E	Adv.: Much less complex construction than KDP. One bridge instead of a 4-lane tunnel with oval roundabout on top of it. No dangerous pedestrian crossings of the access ramps. Safe crossing of E6. Bridge approx. orthogonal with E6. Disadv.: None.

Table 5-10: Assessments of climate gas submissions

Alternatives	Climate gas submission Advantages and disadvantages compared to KDP solution.
KDP	Disadvantage: High GHG emissions. The long corresponding bridge alternative has the highest GHG emissions of the alternatives.
Alternative B	Advantages: The GHG emissions for the intersection and bridge are likely lower than KDP alternative. Intersection alternative is probably slightly larger, but not significantly, than alternative C and E. Disadvantage: It is likely not the intersection and bridge combination with the lowest total emissions, but the differences might not be large.
Alternative C	Advantages: The GHG emissions for the intersection and bridge are 14% lower than KDP alternative. The intersection alternative C is approx. 18% smaller than KDP alternative. The 1350 m bridge is approx. 10% smaller than KDP alternative. Alternative C and E are somewhat the same in magnitude.
Alternative E	Advantages: The GHG emissions for the intersection and bridge are 13% lower than KDP alternative. The intersection alternative is approx. 14% lower than the KDP alternative. The 1350 m bridge is approx. 10% smaller than the KDP alternative. Alternative C and E are somewhat the same in magnitude.

Table 5-11: Assessments of natural environment (biodiversity)

Alternatives	Natural environment Advantages and disadvantages compared to KDP solution.
KDP	Reference. No consequences per se.
Alternative B	No difference to the KDP alternative.
Alternative C	No difference to the KDP alternative.
Alternative E	This solution is closer to Paradisbukta, but isolated no more negative consequences on biodiversity. A subsequent move of the harbour into important bird habitat may cause a negative impact.

Table 5-12: Assessments of cultural heritage

Alternatives	Cultural heritage Advantages and disadvantages compared to KDP solution.
KDP	Reference. No consequences to known, or known potential for, cultural heritage.
Alternative B	Similar to KDP alternative, no consequences to known, or known potential for, cultural heritage.
Alternative C	Similar to KDP alternative, no consequences to known, or known potential for, cultural heritage.
Alternative E	Similar to KDP alternative, no consequences to known, or known potential for, cultural heritage.

Table 5-13: Assessments of community life/ outdoor recreation

Alternatives	Community life/ outdoor recreation Advantages and disadvantages compared to KDP.
KDP	Reference. No consequences per se.
Alternative B	Less interventions on trotting track area than KDP. Road line and roundabout closer to Paradisvika than KDP, but better than the situation today. Some impacts on Biri center west of new E6, but this has no significant effects for outdoor activity.
Alternative C	Less interventions on trotting track area than KDP. Road line and roundabout closer to Paradisvika than KDP, but better than the situation today. Minor impacts on Biri center west of new E6, quite similar to the situation today.
Alternative E	Less interventions on trotting track area than KDP. Road line and roundabout closer to Paradisvika than KDP. More impacts on Biri center due to new roundabout and ramps west of new E6.

Table 5-14: Assessments of landscape

Alternatives	Landscape values Advantages and disadvantages compared to KDP.
KDP	Reference. No consequences per se. This alternative is a negative solution by ramps and fillings in an open flat landscape dividing the horse race arena from the rest. The solution will be intrusive.
Alternative B	All alternatives will create a barrier in the landscape because of the raised elements. KDP alternative is a bit more compact but the road south of Paradisvika will have a bigger impact on the littoral zone if not adjusted a little to the north. This alternative gives a bit more impact west of E6 compared to alternative C. The roundabouts are closer to Paradisvika than in KDP but are ranged better because the total impact on Paradisvika will be smaller
Alternative C	The alternative will create a barrier in the landscape because of the raised elements. KDP alternative is a bit more compact but the road south of Paradisvika will have a bigger impact on the littoral zone if not adjusted a little to the north. In alternative C roundabout is closer to Paradisvika than in KDP but is ranged better because the total impact on Paradisvika will be smaller.
Alternative E	Bigger impact on Paradisvika than KDP alternative because of terrain invasion and road filling towards Paradisvika. The evaluation of alternative E is dependent on further development and modification to avoid fillings in Paradisvika by moving the roundabout somewhat to the north and achieving a straight crossing over E6 with a shorter bridge. Alternativ E will be the least intrusive.

Table 5-15: Assessments of natural resources

Alternatives	Natural resources Advantages and disadvantages compared to KDP solution.
KDP	Reference. No consequences per se. Consumption of cultivated land.
Alternative B	Better than KDP alternative. No consumption of cultivated land.
Alternative C	Better than KDP alternative. No consumption of cultivated land.
Alternative E	Better than KDP alternative. No consumption of cultivated land.

Table 5-16: Assessments of safety, health and working environment (HSE)

Alternatives	HSE Advantages and disadvantages compared to KDP solution.
KDP	Reference. No consequences per se.
Alternative B	Easier alteration. Less construction. Less building framework. Less complicated traffic management. Area demanding (rigs, temporary roads for construction etc.)
Alternative C	Easier alteration. Less construction. Less building framework. Less complicated traffic management.
Alternative E	Easier alteration. Less construction. Less building framework. Less complicated traffic management. Area demanding (rigs, temporary roads for construction etc.)

Table 5-17: Assessments of construction works

Alternatives	Construction works Advantages and disadvantages compared to KDP solution.
KDP	Somewhat more challenging traffic flow, especially for cyclists and pedestrians who lose the intersection under E6. Requires a long temporary detour outside the construction area which also seizes agricultural land. Large construction with a lot of work in height. (HSE-) Expensive.
Alternative B	Significantly less construction work than KDP solution. Traffic management: Requires some temporary width extension of new ramps. Alternatively, the current E6 traffic can be retained until a new lane is built. Will then require some traffic diversions for smaller periods.
Alternative C	In total, significantly less new road area than in KDP and alternative E Significantly less construction work than the KDP solution. Traffic management: Requires some temporary width extension of new ramps. Alternatively, the current E6 traffic can be retained until a new lane is built. Will then require some traffic diversions for smaller periods.
Alternative E	Requires about 150 meters with 2 lanes interim road, about 120 meters with width extension of new ramp (Access Northbound). Requires temporary roundabout as access to Biri. Larger construction than alt. C, but less than KDP. OK for pedestrians, can use today's culvert under E6 to cross E6.

Table 5-18: Assessments of risk for zoning plan

Alternatives	Risk for zoning plan Advantages and disadvantages compared to KDP solution.
KDP	Consequence for Racetrack.
Alternative B	Consequence for Racetrack, and industry.
Alternative C	Consequence for Racetrack.
Alternative E	Consequence for Racetrack, and industry.

5.3 Complete summary of advantages and disadvantages

All road concepts are summarized in a table, where each subject is highlighted with color scores from the assessments in chapter 5.2.

Table 5-19: Assessment score

Score	Assessment criteria
+2	Much better than KDP alternative
+1	Better than KDP alternative
0	Similar to KDP alternative
-1	Worse than KDP alternative
-2	Much worse than KDP alternative

Table 5-20: Summary of all assessed subjects

Subject	KDP	Alternative B	Alternative C	Alternative E
Quality Impact				
Traffic – Safety vehicle				
Traffic - Capacity				
Traffic – Public transport				
Traffic – Pedestrians and cyclists				
Noise				
HSE				
Risk for zoning plan				
Cost Impact				
Geotechnics				
Geology (acid formed rocks)				
Construction works				
Structures				
Environmental impact				
Climate gas submission				
External environment				
Natural environment				
Cultural heritage				
Local community / outdoor activity				
Landscape values				
Natural resources				
Cost-benefit				
Construction cost				

Table 5-21: Assessments of performance objectives

Nye Veiers Performance Objectives	Project analysis			Result
	Largest impact	Relevant subjects	Alternatives	Best alternative
Maximize traffic safety and access for all road users in the construction and guarantee period	Traffic safety	Traffic safety	KDP, B and C	B
	Bus infrastructure	Traffic capacity	-	
	Connection to local infrastructure	Pedestrians and cyclists Public transport	E	
	Traffic safety during construction period	SHA Construction works	KDP, B B and C	
Minimize temporary and permanent loss of agricultural land.	Road alignment	Natural resources	B, C and E	B, C and E
	Landscape the design to reduce impact of the road			
An injury and accident-free construction and warranty period, promoting health and a fair work-life	HSE	HSE	B, C and E	KDP, B, C and E
	Environment	External environment Construction works	KDP, B and C B and C	
Maximize adaptation to the landscape and surrounding areas	Fillings in Mjøsa	Landscaping	E	C
	Visual impact	External environment	KDP, B and C	
	Road alignment	Natural environment	-	
	Landscape design	Cultural heritage	-	
	Make the shore accessible	Local community / outdoor activity	B and C	
Minimize the construction and life-cycle cost	Weight of superstructure			B and C
	Approval of deviations	Structures	B, C and E	
	Bridge length	Construction works	B and C	
	Road alignment	Geotechnology	-	
		Construction cost	-	
Minimize CO2 greenhouse gas emissions in construction and maintenance	Materials			B, C and E
	Bridge length	Climate Gas Submission	B, C and E	
	Road alignment			
	Pile design			
	CO2 calculations			
Technical and plan risk	Deviations	Deviations	-	KDP, B and C
	Plan risk	Risk assessment	KDP, B and C	
	Ground conditions			
	Fillings in Mjøsa			
	Cost cal.			

5.4 Recommended alternative

In the meeting on January 7, Nye Veier, Berinor, AF, Knut Selberg and Multiconsult decided to continue to recommend alternative B.

In the summary table, this is in total the best alternative compared to KDP. Alternative B is a standard highway intersection, it is easy to read, and it is the best alternative according to public transportation. The alternative is located around the same area as the existing intersection.

Alternative B needs to be optimized to the E6 alignment. It has been tested to move the intersection either north or south to avoid conflict with transport terminal and office buildings. Moving the intersection south resulted in more fillings in Mjøsa, and conflict with the boat harbor. The alternative further south also required building more local roads and came in conflict with existing buildings.

Alternative B will be optimized approx. in the same area as shown in chapter 6.2 according to the E6 alignment.

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6 Referencelist

- [1] Trafitec, "Assessments / quality control of E6 – rv4 interchange regarding geometry, road safety and time costs", January 2021.
- [2] Gjøvik kommune og Ringsaker kommune, "E6 Moelv – Biri, Kommunedelplan med KU for ny Mjøsbru», approved May 2015.
- [3] Gjøvik kommune, "E6 Biri – Vingrom, Kommunedelplan», approved February 2013.
- [4] Nye Veier, "Planprogram E6 Moelv – Roterud", dated December 2020, approved January/ February 2020.
- [5] Statens vegvesen, «Håndbok N100 Veg- og gateutforming», dated 2019.
- [6] Cowi, "Kryssløsninger E6 Mjøsbrua og rv. 4", dated December 2020.
- [7] Statens vegvesen, «Håndbok N200 Vegbygging», dated 2018.

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