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## Introduction

Region Örebro County is a partner in the EU-funded project Baltic Loop, which consists of regions/partners along "The Northern Growth Zone" (Oslo-Örebro-Stockholm-Helsingfors-St. Petersburg).

The project aims at identifying bottlenecks in the transport system and developing solutions to minimize travel and freight times for passengers and goods, as well as contribute to reduce emissions.

The report compiles previously studied bottlenecks and measures in the E18, from Kapellskär to the Swedish-Norwegian border. The report concerns goods and passenger traffic along the E18.

This study consists of a compilation of mainly 13 Measurement selection studies related to the E18. Main proposed measures and have been complied. The compilation is also based on updated information from the Swedish Transport Administration's website, existing county plans and interviews with key stakeholders in the route. Used measurement selection studies are listed in the reference list. In the report, the bottlenecks found on the E18 will be divided by region. Measures will be presented as non-technical solutions (step 1-2) and as technical solutions (step 3-4).

To begin with, a shorter background is described about the European Road E18 and its potential.

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## Background

E18, is a European road that starts in Craigavon in Northern Ireland and ends in Saint Petersburg in Russia. The total distance for the E18 is 1,890 km, of which 512 km in Sweden. In Sweden, the road is extended between the Norwegian-Swedish border to Kapellskär. The journey takes about 6 hours by car. Calculations show that 12% of the total traffic on the E18 between the Swedish-Norwegian border and Kapellskär is heavy vehicles. The speed limit is mostly 110 km/h, but in some parts of the route there are lower speeds.

E18 is a state road and one of the country's most trafficked, which constitutes an important route for passenger and freight transport between Oslo-Stockholm and the connections to the Baltic Sea countries such as Finland. E18 is part of the main road network and is designated for functional priority road network (FPV). The entire route E18 is a national and internationally important route and is also part of the European transport network (TEN-T).

E18 goes through one of Sweden's most populous areas with almost 3.5 million people and goes through cities such as Stockholm, Västerås, Örebro, Karlstad and connects to other places such as Uppsala and Södertälje. These cities are also significant for work and study commuting.

Despite this, E18 have in parts of the day extensive problems. For instance, through Örebro it creates a queue formation with reduced road safety and delays as a result.

On the E18 there are several parts that are not meeting-separated roads and are not highway standard. The goal is for E18 to be traffic-safe and high-capacity traffic lanes for both passenger and freight transport in the Baltic Sea countries.

## Project goals for the corridor

The overall targets of the E18 between Stockholm-Oslo are to:

• Improve the accessibility of the route and thereby contribute to creating a coherent functional region with a positive social development and a competitive business sector.









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• The development of the infrastructure of the route will take place within the framework of the Consideration Goal.

Goals for 2030 are set on the extension of the existing roads in order to:

- Solve bottlenecks in accessibility and road safety.
- Reduce emissions that affect health and living environments along the routes.

#### Goals for 2040 are set on:

- That the roads in the entire route are designed to ensure safety.
  - High traffic safety.
  - A sufficient capacity.
  - o Availability.
- The roads must be fully meeting-separated.1

<sup>1</sup> (Trafikverket 2017/148454)





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## **Overall bottlenecks and measures**

### **Bottlenecks**

- Lack of road safety and accessibility on E18 for both vehicles, walking and bicycle road users.
- The traffic affects health and living environment in the urban areas along E18 pollution in the form of noise, vibration and air pollution.
- Large vehicle volumes of different types of traffic lead to some of the bottlenecks in the route and contribute to large emissions.
- High speeds.

The image below shows the identified bottlenecks between Norwegian-Swedish border to Kapellskär.



Figur 2. Compilation of the designated areas in the Stockholm-Oslo area



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## Non-technical solutions (step 1-2 measures)

Following is a summary of the non-technical solutions proposed in measurement selection studies and interviews with relevant stakeholders:

#### Information and additions to the road

- Marking.
- Signage.
- Signal Portal.
- Safety rumble strips.
- ITS signs.
- Improved traffic information.
- Speed camera.
- Field fence.
- Improved design, eg. lighting, maintenance of green areas.

#### Prohibition/rules/etc.

- Road closures.
- Parking Policy.
- Decreased speed.
- Refer the traffic after situation.
- Leading / prohibiting heavy freight transport.
- Transit traffic.

#### Supervision

- Clearing on the surrounding.
- Deicing.
- Snow removal.
- Improved routines to keep the road clear.
- Increased standard and maintenance of road and walking and bicycle road.

#### Optimization

- Optimize traffic signals.
- Priority of cyclists in crossing.
- Changed new routes for public transport.

#### Mobility management









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- Support to employers for sustainable travel.
- Measures to make more people to choose public transport. Clear information on bus departures etc.
- Ex. adapted times for school starts in the morning, encourage employers to flexible work week (flex time) for more even distribution of going by car to and from work, coordinated product distribution, increased use of travel-free meetings, distance working, etc.
- Marketing/influencing factors to increase public transport and bicycle.

### **Technical solutions (step 3-4 measures)**

#### Interchange

- Reconstruction.
- New overpass interchange.
- New/widening/reconstruction of exit- and entry ramp of the road.
- Signal control.
- New/reconstruction of interchange/roundabout.
- Trimming measures for all types of traffic at the interchange.
- Create interchanges with good visibility.
- Double turning lanes at the exits of the road.
- Localization/parking for heavy traffic.
- Improvement of crossing to c-crossing.
- Offset of c-crossing.

#### Road

- Extension of lanes.
- Reconstruction of roadside to extra lanes.
- Complementary lanes.
- Extension of two-way lanes.
- Adjusting the railings for better visibility.
- Reinforce the road.
- Reconstruction to four-lane.
- Field fence.
- Reconstruction to highway standard.
- Build thoroughfares.







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- Cattle grids.
- Customizable bridges for wild animals.
- Overpasses fauna passages.
- Construction/extension of left turn lane.
- Build a parallel path.
- Climbing lanes.
- Side rails.
- Meeting separation.

#### **Public transport**

- New/upgrading of bus stops.
- Ensure bus access.
- Motorway stops.
- Moving of bus stops.
- Train path for regional trains Stockholm-Oslo.
- BRT system Örebro.
- Railway between Kristinehamn and Örebro.
- New commuter train station.

#### Walking and bicycle

- Traffic-safe passages and lanes for pedestrian and bicycle road users.
- Construction of pedestrian road.
- Build a bicycle highway.
- A coherent cycle road network.
- Extension of the pedestrian and bicycle road network.
- Good connections to public transport stops for pedestrian and bicycle traffic.
- Construction of pedestrian and bicycle tunnel.
- Overpasses for pedestrian and bicycle.
- Pedestrian and bicycle footbridge.

#### Other

- New station.
- Updating the design program.
- Reconstruction of weather-protected walkway.
- Reconstruction / bulidning of new bridges.









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- Queue detectors.
- Reduce noise levels.
- Sustainability assessment and sustainability measures.
- Minor traffic safety measures.









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## **Specific bottlenecks and measures**

## **Stockholm County**

In Stockholm, the traffic situation is complex and there are several bottlenecks. According to an interview with Swedish Transport Administration and information from big scale analysis, the following general bottlenecks and measures have been mentioned:

- Internal parts of the traffic system such as the E4/E18 on the Kista-Norra link.
- At E18 east of Kungsängen there are capacity shortcomings that will also be further affected by the opening of Förbifart Stockholm.
- Measures of bridges for BK4 on E18 for carrying heavy vehicles. Example measures of bridge at Sörentorp traffic area (Solna Police Academy).<sup>2</sup>
- E18 in Stockholm requires capacity increase.<sup>3</sup>

#### E18, Interchange Stäket, reconstruction

Rotebroleden with the traffic areas Stäket (along the E18 in Järfälla municipality) and the E18 traffic area Rotebro aim for increased accessibility, capacity and safety for all road users. No steps 1-2 measures have been noted.

#### Technical solutions (step 3-4 measures)

• Reconstruction of the interchanges.<sup>4</sup>

### Program E18 interchange Jakobsberg–interchange Hjulsta

The Swedish Transport Administration is planning a number of projects along the E18 between Jakobsberg and Hjulsta to strengthen the capacity in the area when E4 "Förbifart Stockholm" opens for traffic. The area around the districts of Barkarby and

<sup>&</sup>lt;sup>4</sup> <u>https://www.trafikverket.se/nara-dig/Stockholm/vi-bygger-och-forbattrar/E18-trafikplats-Staket-ombyggnad/</u>



<sup>&</sup>lt;sup>2</sup> Intervju med Ludvig Elgström, Trafikverket

<sup>&</sup>lt;sup>3</sup> (Storregional systemanalys 2020)







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Hjulsta in northwest Stockholm will experience a major change in the next 15 years. This will affect both the local and regional road network. Traffic space Hjulsta will be a crossroad between the new E4 "Förbifart Stockholm" and E18, making it one of Sweden's most trafficked in 2030. Production is expected to start in 2024.

The program consists of a group of related projects and other activities. The numbers on the map mark the following projects in the program. No steps 1-2 measures have been noted.



Figur 3. Program E18 interchange Jakobsberg – interchange Hjulsta, source: https://www.trafikverket.se/naradig/Stockholm/vi-bygger-och-forbattrar/program\_e18\_trafikplats\_jakobsberg\_trafikplats\_hjulsta/

#### **Technical solutions (step 3-4 measures)**

- 1. Extension to 3 + 3 lanes (2 + 2 lanes today), from Jakobsberg traffic to Hjulsta traffic.
- 2. Interchange Barkarby, new design.
- 3. Police checkpoint in connection with Barkarby traffic area.
- 4. Interchange Hjulsta, bypass 1 extension of two-lane section and new exit ramp from E18 east to E4 Förbifart Stockholm south.
- 5. Interchange Hjulsta, loop 1 new exit ramp from E4 "Förbifart Stockholm" north to E18 west. The project also includes crossing ramps and bridges. 10e









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- 6. Interchange Hjulsta, loop 2 new ramp on ramp from E18 west to E4 "Förbifart Stockholm" south. The project also includes crossing ramps and bridges.
- Interchange Hjulsta bypass 2 new exit ramp from E4 Förbifart Stockholm south to E18 westbound and extension to 3 + 4 lanes, from the traffic area Hjulsta to the interchange Barkarby.

The extent of this program is not yet fully established. The goal is that most projects will be completed before E4 Förbifart Stockholm opens for traffic.<sup>5</sup>

#### E18, Interchange Bergshamra och Stocksundsbron

The traffic area is in need of increased capacity and safety. In May 2018, the Swedish government decided new national traffic plan for the transport infrastructure for planning period 2018 - 2029. As the investment lacks funding, the work on the road plan stops. No steps 1-2 measures have been noted.

#### **Technical solutions (step 3-4 measures)**

• Reconstruction of the interchanges.<sup>6</sup>

#### E18, highway bus stops in municipality Danderyd

New bus stops at E18 at Danderyds school. The proposal is to change and create new routes for the bus lines. This will lead to more increased accessibility for pedestrians and cyclists, as well as traffic-safe passages and lanes. Planned construction start 2022.

#### Non-technical solutions (step 1-2 measures)

• Changed and new routes for the bus lines.

#### Technical solutions (step 3-4 measures)

• New bus stops.

<sup>&</sup>lt;sup>5</sup> <u>https://www.trafikverket.se/nara-dig/Stockholm/vi-bygger-och-forbattrar/program\_e18\_trafikplats\_jakobsberg\_trafikplats\_hjulsta/</u>
<sup>6</sup> <u>https://www.trafikverket.se/nara-dig/Stockholm/vi-bygger-och-forbattrar/e18-trafikplats-bergshamra-stocksundsbron/</u>









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• Traffic-safe passages and lanes pedestrian and cyclist road users.<sup>7</sup>

#### E18, Arninge station

Roslagsbanan at Arninge trade area has a need to increases the need of a change point with the expansion of buildings, operations and infrastructure in the area. The center of Täby and the center of Arninge area seen as a future regional center. Construction is ongoing and will be completed by the end of 2021.

It's being built bus stops at E18 and a new station for Roslagsbanan. It's also being built a weatherproof bridge over E18. Via the bridge, simple and fast exchanges between trains, buses and other types of travel will take place. In the fall of 2019, the construction began. No steps 1-2 measures have been noted.

#### Technical solutions (step 3-4 measures)

- New bus stop.
- Construction of a weatherproof bridge over E18.
- New station.<sup>8</sup>

<sup>8 &</sup>lt;u>https://www.trafikverket.se/nara-dig/Stockholm/vi-bygger-och-forbattrar/e18-arninge-station/</u>





<sup>7 &</sup>lt;u>https://www.trafikverket.se/nara-dig/Stockholm/vi-bygger-och-forbattrar/E-18-busshallplatser-Danderyd/</u>







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## **Uppsala County**

## Interchange Draget



Figur 4. Interchange Draget, source: http://google.se/maps

The traffic area has low accessibility; queues are formed on the exit ramp from Stockholm for traffic towards Bålsta, with increased risk of accident as a result. There is a low standard on the exit from Enköping towards Bålsta. It is an unclear solution and geometry that results in severe braking for vehicles.

The following measures are proposed in the measurement selection study Draget, which has target year 2040.

#### Non-technical solutions (step 1-2 measures)

- Strengthened maintenance of the interchange (0,5-1mkr).
  - Marking.
  - Visibility clearing.
  - Blocking/removal of entrance to parking space that are not to be used.
- Upgrading of the interchange (5-12 mkr<sup>9</sup>).

<sup>9</sup> The price for upgrading also includes reconstruction of lanes and point measures, (step 3 measures).









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- Affect the choice of road through signage.
- Review the signage, for example another type of lightning is required.

#### Non-technical solutions (step 1-2 measures)

- Reconstruction of roadside to lanes.
- Point measures regarding changed priority, signal control or roundabout.
- Complementary lane, widening from ramp. (0,5-1 Mkr).
- Establishment of car parking in connection with building a car service, planned in the immediate area (cost not assessed).
- Changes in the layout of the interchange (10-15 Mkr).
- Extent and design are affected by the development of the boundary area. (depending on the extent SEK 10-30 million).<sup>10</sup>

<sup>10</sup> (Trafikverket 2018/137102)







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## Västmanlands County

#### Västerås



Figur 5. Västerås, designated interchanges, source: (Trafikverket 2013/ 133715)

E18 passes through Västerås where there are eleven interchanges. Large traffic flows passing on E18 often cause traffic disruptions and queues.

The proportion of heavy traffic is significant, E18 provides an important link to strengthen shipping at Mälaren and increase freight flows in Mälarhamnarna. Stockholm Västerås Airport has a high frequency of public transport and is directly adjacent to the E18.

The road needs to have a greater capacity linked to the different interchanges in order to minimize queuing. There is low accessibility for vehicles and pedestrian and bicycle road users, which contributes to preventive accidents. Within 5-10 years,











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capacity problems are forecasted at several interchanges with the risk of a stop on E18 as a result.<sup>11</sup>

E18 is of great importance for local traffic but is a barrier through the city, the interchanges are placed close together which creates problems between long distance and local traffic. The traffic volumes cause environmental disturbances in the form of noise, vibration and air pollution.

In the measurement selection study for Västerås, the measures proposals have been divided into different packages. The recommendation is to first introduce packages 1-2 in the short term. In the long term (with packages 1-2 as a basis) possibly implement packages 4 and 5. In this section we will focus on packages 1-2, because the remaining packages were not considered profitable.

According to the measurement selection study for Västerås, the following measures have been proposed for target year 2018 (short term) and 2028 (long term).

#### Package 1

Walking, bicycle, public transport and transport-friendly community planning. SEK 60-80 million is the cost of measures. It is considered profitable from a socio-economic assessment.

#### Non-technical solutions (step 1-2 measures)

- Reduce the need for car transport ex. locate the habitation.
- Increase pedestrian and bicycle traffic.
- Build bicycle parking.
- Increase the standard and maintenance of the cycle road network.
- Parking policy.
- Prioritization of cyclists in ex. Crossings.
- Marketing/influencing factors to increase public transport and bicycle.
- Technology support for bicycle trips.
- Improved traffic information.
- Support to employers for sustainable travel.



<sup>&</sup>lt;sup>11</sup> (Länsplan Västmanland 2018-2029)







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#### Technical solutions (step 3-4 measures)

- Build bicycle road.
- Build highways for bicycles.
- Crossing measures ex. adjust the railings for better visibility.

#### Package 2

Accessibility through trimming measures. The cost is SEK 110-130 million. It is considered profitable from a socio-economic assessment.

#### Non-technical solutions (step 1-2 measures)

- ITS (Variable Speed) signs.
- Clear signage.
- Possibly reduce the number of interchanges on E18 (refer traffic to interchanges with high capacity). Review the deficiencies and unused capacity on the local road network.
- Refer traffic after situation. Control the use of lanes on E18.

#### **Technical solutions (step 3-4 measures)**

- Review the crossings, the bus traffic must be ensured.
- Trimming measures for car, walking & bicycle at each interchange.
- Optimize/expand Norrleden/Österleden.
- Update the design program.
- Create clear interchanges.
- Reinforce the road and open up lanes. Increase the capacity of the (dagvattensystemet) storm water.<sup>12</sup>

#### Köping-Västjädra

Road E18 has a motorway standard along the entire route except the part between Köping and Västjädra traffic area.<sup>13</sup> Accessibility and road safety on the route is a bottleneck. The road needs to have a highway standard where mostly all exits and enters on the road need to be rebuilt for increased road safety.

<sup>&</sup>lt;sup>13</sup> (Länsplan Västmanland 2018-2029)



<sup>&</sup>lt;sup>12</sup> (Trafikverket 2013/ 133715)







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The proportion of heavy traffic is more than normal, there is no investigation made regarding buoyancy and the road has reached its capacity limit. Diversion of traffic creates safety problems and the diversion routes do not have capacity for the amount of traffic that arises.<sup>14</sup>

The road must be traffic-safe, according to the Road Safety Act as the road is part of the TEN-T road network. According to the measurement selection study for Köping-Västjädra following measures are proposed whit year 2040 in target.



Figur 6. Route Köping-Västjädra, source: http://google.se/maps Non-technical solutions (step 1-2 measures)

- Reduce travel needs by influencing people to choose travel by public transport.
- Improve routines to keep the road clear (SEK 1 million).
- ITS signs (SEK 2 million).









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#### Technical solutions (step 3-4 measures)

- Solve the interchange Västjädra.
- Reconstruct the bridge over Kolbäcksån.
- Change the center rail to the beam.
- Reconstruct to four-lane road.
- Review the need for field fence.
- Review measures for water protection .15
- Bus stops at highway, Köping-Västjädra, investment cost for SEK 856 million.<sup>16</sup>
- Planned/ongoing extension of the road to highway (25 km). The roadmap has been sent for testing of plan in Borlänge for determination.
- In the same time as the reconstruction of highway, a bridge will be built over Kolbäcksån.<sup>17</sup>

### Arboga

In Arboga, the roads E18, E20 and the railways Mälarbanan and Svealandsbanan intersect. Every day, approximately 1,800 people commute to Arboga and 2,300 commute out from Arboga. The following infrastructure measures are the highest priority for E18:

#### Non-technical solutions (step 1-2 measures)

• Diversion of dangerous/heavy goods transport from Arboga city to E18/E20.

#### **Technical solutions (step 3-4 measures)**

- Highway standard between Örebro and Västerås.
- A cohesive bicycle network.
- Extension of the pedestrian and bicycle road network outside urban areas (within 1-10 years).

<sup>&</sup>lt;sup>17</sup> <u>https://www.trafikverket.se/nara-dig/Vastmanland/vi-bygger-och-forbattrar/E18-Koping-Vastjadra/</u>



<sup>&</sup>lt;sup>15</sup> (Trafikverket 2014/7828)

<sup>&</sup>lt;sup>16</sup> (Trafikverket 2017/148454)







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Figur 7. Route Arboga-Reutersberg, source: http://google.se/maps

The E18/E20 highway is underused as the link is not extended. It is over all the heavy traffic that runs through Arboga urban area and old E18 up to Slyte interchange. A long-term solution is to prohibit heavy traffic through Arboga urban area and on towards Örebro on the old E18. The following are simpler measures that can improve the situation in the short term.

#### Non-technical solutions (step 1-2 measures)

- Decreased speed.
- Prohibition of heavy traffic at certain times of the day .<sup>18</sup>

## Örebro County

## Örebro

<sup>18</sup> (Länsplan Västmanland 2018-2029)





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The Örebro region has a strategic location between the three metropolitan regions Stockholm, Oslo and Gothenburg and is crossed by Sweden's largest transport routes for goods, both by road and by rail. There are mainly capacity- and traffic safety problems on E18/E20 through Örebro. There is an opinion on a new highway route outside Örebro.<sup>19</sup>

E18 is used as "local street" and the diversion network, directions and traffic information are lacking. As well as accessibility for pedestrian and bicycle road users, public transport, emergency vehicles and trains is lacking. This would facilitate with a good range for public transport and there are opinions on train stops in Hovsta, Marieberg and Mosås. The traffic generates noise and the distance is sensitive to climate change and especially at Lillån.

The pictures below are sections where bottlenecks and needs are included in the measurement selection study:

<sup>19</sup> (Länsplan Örebro 2018-2029)

















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## E18-E20-50 between interchange116 Munkatorp-112 interchange Karlslundsgatan



Figur 8. Örebro deficiencies, sourse: (Trafikverket 2018/44706)









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## E18-E20-50/E20-50 between interchange 111 Aspholmen/Bista- interchange 109 Marieberg and E18 interchange 110 Adolfsberg-interchange 108 Falltorp



Figur 9. Örebro deficiencies, source: (Trafikverket 2018/44706)

The measurement selection study for Örebro county is ongoing and the information is therefore not completed. The measures have target years 2023 (short term), 2023-2029 (medium term) and 2029 (long term).<sup>20</sup> The following measures are proposed in the measurement selection study:









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#### Non-technical solutions (step 1-2 measures)

- Bus traffic through Örebro-Karlstad.<sup>21</sup>
- Possibly introduce interweaving traffic instead of giving way where Hedgatan connects to E18/E20/Route 50.

#### **Technical solutions (step 3-4 measures)**

- Signal portal and double left turn lanes on the E18/E20 exit, south from the traffic street Hedgatan.
- Detectors for queues on the southern exit E18/E20 in the Hedgatan.
- Pedestrian and bicycle road along Hedgatan.
- It's proposed the crossing at Pilängsgatan/Bistagatan will go through a reconstruction into a circulation site, which reduces the risk that traffic queues out on the ramps from E18.

Below are additional steps 3-4 measures (future construction) that have been discussed/planned for the route

- An investigation starts in 2022 for a conventional railway for regional trains with a maximum speed of 250km per hour between Oslo and Stockholm.
- BRT (Bus Rapid Transit System) will eventually be built in stages. This depends on how Örebro municipality develops its traffic routes. Two lines have been proposed: Brickebacken-Centrum and Centrum-Mellringe/Vivalla. Center-Mellring/Vivalla crosses E18/E20. The cost of the infrastructure is estimated to be between SEK 530-570 million.
- Potential proposed railway (Nobel Railway) between Kristinehamn-Örebro via Karlskoga parallel to E18.
- A commuter train station in Hovsta would improve transport opportunities in the area.

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• There is a proposed pedestrian and bicycle tunnel under E18 at the Mossbergarondellen.

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<sup>&</sup>lt;sup>21</sup> (Trafikverket 2017/148454)







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 The municipality are planning to bridge E20/E18 between Hjärstaskogen and Baronbackarna.<sup>22</sup>



### Karlskoga

Figur 10. Karlskoga designated intechanges, source: (Trafikverket 2014/134124199)

E18 runs straight through the city, which contributes to dividing Karlskoga into north and south.

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There are traffic safety- and accessibility problems along the E18 as well as many and lacking interchanges which, among other things, cause reduced speed. Noise problems, vibrations and emissions are caused because of signal controlled crossings. There is low availability and clarity for pedestrian and bicycle road users, unsafe environments along the E18. The bus stops along the E18 are of low standard, the public transport uses the E18.

There are deficiencies in signage and information on, mostly for the local destinations and traffic areas.

The route through Karlskoga is one of the last "bottlenecks" along the E18. The top priority is the crossing Ekeby. It's a signal-controlled crossing with a lot of traffic, which has been historically accident-prone. This work is ongoing.

According to the measurement selection study for Karlskoga, the following measures are proposed with target year 2020-2030, and beyond 2030.

#### Non-technical solutions (step 1-2 measures)

- Traffic signals are optimized for better flow.
- Speed limit is raised from today's 60km/h. Revision of the division for lanes on E18. Investigation about prohibition for overtaking for heavy traffic on E18 need to be made.
- Better signage for directions on road.
- Mobility management to reduce car dependency.
- Improved design through lighting, more and better management of green spaces and vegetation in a traffic environment. Review of existing pedestrian and bicycle tunnels and its surroundings. Signage, better and more information boards.
- Measures for more people to choose public transport. Clear information on bus departures. Investigation on the location of bus stops.
- Better maintenance of pedestrian and bicycle ways is needed all year round. Better information about existing bike lanes/cycle ways through signage and maps.
- Investigation is done on long-term perspective (beyond 2030) of E18 through/past Karlskoga.
- Choice of coating on road that minimizes emissions of particles to air and reduces noise.









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 Measures to reduce the discharge of uncleaned stormwater to lakes and streams.

#### **Technical solutions (step 3-4 measures)**

- Better design through the city.
- Installation site for heavy traffic.
- Higher standard, better location of bus stops, good connections to bus stops for walking and cycling.
- New and/or improved pedestrian and bicycle lanes along and across the E18.
- Measures are carried out at intersection/interchanges along the entire route.
- The local road network is linked together.
- Measures to reduce noise from E18.<sup>23</sup>
- Passage through Karlskoga. By rebuilding the thoroughfare, better accessibility and increased traffic safety are achieved through the urban area.
- The Swedish Transport Administration has begun to rebulid the crossing at Ekeby to a circulation site, as well as a new pedestrian and bicycle tunnel (starting March 2020 and clear 2021) and next steps (Sommarvägen) they are currently planning.<sup>24</sup>
- An ongoing work is E18, Kristinehamn Karlskoga, fauna passages. The Swedish Transport Administration is investigating how to reduce the barrier effect for clover game. There are no safe passages for animals on the route, and there are many wildlife accidents where the field fence ends. The investigation will be completed in June 2020.

Possible measures for wildlife:

- Field fence.
- Cattle grids along connecting roads.
- Adaptable bridges and gates.
- Overpass fauna passages for medium and large animals (mainly moose).<sup>25</sup>

<sup>&</sup>lt;sup>25</sup> https://www.trafikverket.se/nara-dig/projekt-i-flera-lan/e18-kristinehamnkarlskoga-faunapassager/



<sup>&</sup>lt;sup>23</sup> (Trafikverket 2014/134124199)

<sup>&</sup>lt;sup>24</sup> <u>https://www.trafikverket.se/nara-dig/Orebro/vi-bygger-och-forbattrar/e18-ekebykorset-karlskoga/</u>







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## **Värmlands County**

## Krokvikskorset



Figur 11. Intersection Krokvikskorset, source: (Trafikverket 2014/96732)

In this intersection there are high speeds and regarding to the configuration of the intersection. Slippering has been reported, queues are formed that block other traffic.



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Increased road safety is needed on E18 and for connecting traffic. Improved accessibility for connecting traffic with reduced queuing.

According to the ÅVS for the Krokvikskorset, the following measures are proposed. No step 1 or step 4 measures have been noted.

#### Non-technical solutions (step 2 measures)

- Review of speed: placement of signs and adjustment of signs SEK 20 k.
- Set up ATK (speed cameras) SEK 200 k.
- Anti-slip control review.

#### **Technical solutions (step 3 measures)**

• Build left turn lanes for connecting traffic from Hjälmarsnäsvägen.<sup>26</sup>

### **Karlstad**



<sup>26</sup> (Trafikverket 2014/96732)









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#### Figur 12. Karlstad interchanges, demarcation, source: (Trafikverket 2018/13349)

E18 through Karlstad (approx. 11 km) has a great local significance as an urban highway, which creates both accessibility and barrier problems.

In national infrastructure there are bottlenecks on E18 through Karlstad and Karlstad center constitutes several bottlenecks. The route through Karlstad has a lot of exits and entries (interchanges). It's at the interchanges and connecting roads along the E18 that causes the problems. The problems can be summarized with four keywords: public transport, accessibility (capacity), road safety and barrier. The connecting roads in the primary road network lack the capacity to receive larger flows of traffic and that is where the measures should be made.<sup>27</sup>

There are already some planned or ongoing measures regarding roads, interchanges, public transport and emergency vehicles, that entail some trimming measures, reconstructions and extensions. (See *Trafikverket 2018/13349* for detailed information).

According to the choice of measures study for Karlstad, the following measures are proposed with target years before 2026 (short term), 2026 - 2033 (medium term), 2033-2040 (long term).

#### Non-technical solutions (step 1-2 measures)

- Coordinated development planning and traffic planning. Regional cooperation for sustainable travel.
- Design program, Green infrastructure program.
- Investigate the need for installation site/rest area for freight transport. Freight nodes in the Karlstad region.
- Mobility management: Adapted times for school starts in the morning. Encourage employers to flexible work week (flex time) for more even distribution of car journeys to and from work. Coordinated distribution of goods. Increased use of travel-free meetings, distance work, etc.
- Control, regulation and ITS: Variable speed in-depth investigation. Traffic signals. Overtake prohibition for heavier vehicles.

<sup>&</sup>lt;sup>27</sup> (Trafikverket 2018/13349)









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 Sustainable travel supply: Mobility points. Develop and improve the pedestrian and bicycle road network. The ability to have carry the bicycle on train and bus. Public transport to surrounding municipalities. Carpooling. Innovative transport services.

#### Technical solutions (step 3-4 measures)

- Developed infrastructure vehicle traffic: Sustainability study and sustainability measures at E18.
- Trimming measures: Klaramotet, Rudsmotet, Koppkärrsmotet, for example extensions and remodels. (See *Trafikverket 2018/13349* for detailed information).
- Larger rebuilds: Växtmotet, Älvmotet, Bergmotet, Universitetmotet, Knutpunktbergvik. (See *Trafikverket 2018/13349* detailed information).
- The thoroughfares through Karlstad, by rebuilding the thoroughfare, better accessibility and increased traffic safety are achieved through the urban area.
- An ongoing measures is the conversion of the E18 between Björkås and Skutbergsmotet to 21.5 meter four-lane road. Approximately 4 of a total of 7 km (furthest west) will be added in a new stretch, south of the existing E18. This increases road safety and accessibility on the route, which currently has a high traffic load with a traffic flow of about 14,000 vehicles per day. It also creates a more favorable location for the water supply. Road E18 passes, within parts of the route, the protection area for Sörmon's water supply. The stage is completed and traffic opened in June 2017.<sup>28</sup>

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<sup>&</sup>lt;sup>28</sup> <u>https://www.trafikverket.se/nara-dig/Varmland/vi-bygger-och-forbattrar/Forbattringar-av-E18-mellan-</u> Bjorkas-och-Skutberget/







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#### Grums



Figur 13. Grums, source: (Trafikverket 2017/21374)



Figur 14. Grums, source: (Trafikverket 2017/21374)

The measurement selection study for E18 through Grum's urban area mentions how two European roads (E18, E45) and one national road (Norway/Vänerbanan) run through the area. Gruvökorset is the intersection between E18/E45 and Gruvövägen. Sågverksavfarten is the intersection between E18/E45 and the Timmerleden. The distance in question is 7 km, which is a heavy freight route with a high proportion of goods.

E18 is used for local traffic in Grums municipality. There is low accessibility for traffic and unprotected road users. It's also perceived as an unsafe environment for the unprotected road users. Along the route there are many accidents, as well as accidents due to slipping, many incidents and conflicts as well as red light drivings. There are many stops and starts at Gruvökorset, that contributes to high noise levels and emissions.

There is a risk of collapse along the entire route. There is also short lanes and acceleration fields in relation to speed. Further the bus stops have low accessibility and are not standardized. The magazines at crossing road/rail are too short.









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According to the measurement selection study for Grums, the following measures have been proposed with target years 2023 (short term), 2029 (medium term) and 2040 (long term).

#### Non-technical solutions (step 1-2 measures)

Short term:

- Pedestrian and bicycle strategy for Grums and Slottsbron, which includes description of the pedestrian and bicycle road network, passages, plans for directions, development plans, connection to bus stops etc.
- Mobility management measures for increased cycling.
- Speed is lowered, the intersection is provided with reinforced signage, set up speed cameras on each side of Gruvökorset, that will contribute the drivers to follow the speed-limit in the intersection.
- Snow removal and anti-slip control can be improved.
- Mobility management measures for increased travel by public transport.
- Design program for the entire track through Grums.

#### **Technical solutions (step 3-4 measures)**

Short term:

- Upgrading of existing public transport stops. Standardization of all bus stops that are not appropriate. New route for the bus from Karlstad to Gruvön, possibly with new bus stops.
- Trimming measures for Sågversavfarten:
  - Extension of ramp.
- Review if crossing points/connections:
  - 3 smaller crossing points and direct connections to E18/E45 should be reviewed for current left turn lanes, sight distances etc. They should be designed according to VGU.
- Closing of crossing on Edsholmsgatan for traffic or completely closed crossing:
  - Existing crossing is reconstructed in to a crossing only for walking and cycling. The railings are extended between the road for car and the









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road for cycle. The passage across the road is moved and clarifyed. One smaller pedestrian road will be built.

- An alternative is to remove the intersection and bus stops at Edsholmsgatan and refer to the Gruvökorset for all road users for increased road safety.
- The bridge Slottsbrosundet:
  - Pre-project of pedestrian and bicycle trail bridge.
  - Investigate the type of separation that can replace todays construction foundation.

Medium term:

- Parallel path Nyängen-Timmerleden:
  - Parallel road is built.
- Bridge over Slottsbrosundet:
  - Construction foundations that separate the road for traffic and bicycle lane are replaced with other kind of separation. The west side of the bridge is equipped with a trail bridge for pedestrian and bicycle traffic.
  - The bridges bearing capacity needs to be investigated so that it can carry an trail bridge. (See *Trafikverket 2017/21374* for more detailed information).

#### Long term:

Interchange Gruvökorset included parallelroad:

- New overpass interchange Gruvökorset, retained Sågverksavfart, aproximate SEK 170 million socially economically very profitable.
  - (SEK 150 million interchange + SEK 20 million closed crossing Edsholmsgatan for traffic by car).
- New overpass interchange Gruvökorset, abolished Sågverksavfart, new parallel road, aproximate SEK 205 million - socially economically very profitable.
  - (SEK 145 million interchange + SEK 20 million closed crossing Edsholmsgatan for traffic by car + SEK 40 million parallel road).
  - (Pakage 2 is considered to be the most bebeficial and will provide the highest impact according to the studies and analyzes conducted).
- New overpass interchange Öbergsgatan, retained Sågverksavfart, aproximate SEK 130 million - socioeconomically less profitable.









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- New overpass interchange Öbergsgatan, abolished Sågverksavfart, parallel road aproximate SEK 165 million - socially economically profitable (SEK 125 million interchange + SEK 40 million parallel road)<sup>29</sup>
- Passage through Grums.
   By rebuilding the thoroughfare, better accessibility and increased road safety are achieved through the urban area. <sup>30</sup>

 <sup>&</sup>lt;sup>29</sup> (Trafikverket 2017/21374)
 <sup>30</sup> (Trafikverket 2017/148454)















### **Gruvöns bruk**



Figur 15. Gruvöns bruk, source: (Trafikverket 2014/96718)

This intersection is located between railroad tracks, there are vehicles driving on red light, accessibility problems and queues, experienced high speeds through the intersection and low accessibility and safety for unprotected road users. The aim is for improved road safety, improved accessibility and less queuing.

According to measurement selection study for Gruvöns bruk, the following measures have been proposed with target year 2016.

No step 1 or 4 measures have been noted.



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#### Non-technical solutions (step 2 measures)

- Signal portal 2016 (SEK 800 tkr).
- Review sinage 2014.
- Placing of ATK- cameras 2016.
- Rumble strips 2015 (SEK 40 tkr).

#### **Technical solutions (step 3 measures)**

 Relocated by bus stop, at the earliest 2016 from current location (SEK 1500-4000 tkr).<sup>31</sup>

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### Valnäs

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<sup>31</sup> (Trafikverket 2014/96718)

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Figur 16. Route Valnäs-Grums, source: (Trafikverket 2016/10061)

The route is linked to the Swedish-Norwegian border and also has significance as a regional commuting route. The object is already included as a candidate object for the National Plan 2018 - 2029 and has already produced supporting documents in the form of socio-economic assessment and coarse cost indication. Most of the distance today has a speed limit of 90 km /  $h.^{32}$ 

Measures from the measurement selection study have been packaged in three packages. Focus on short, medium and long term time perspective. The Swedish Transport Administration has primarily chosen to proceed with measures package 1, 80 km / h, minor measures. (See *Trafikverket 2016/10061* for more information).

In retrospect, a meeting-separated road (82 km) is recommended for Valnäs-Töcksfors. Region Värmland has done a supplementary benefit / cost analysis following the measurement selection study (Trafikverket 2016/10061) which shows

<sup>32</sup> (Trafikverket 2017/148454)



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that the most comprehensive package "Measures package 3, 100 km / h and meeting-free road" (a road reconstruction) is also socially economically viable. (The ASEK calculation was updated in 2018 after the measurement selection study was completed. Road safety was upgraded in importance)<sup>33</sup>

Deficiency and bottlenecks for the route are accessibility, not enough possibilities for omkörning, a relatively high proportion of heavy traffic, about 19% of the total traffic volume and in road safety perspective, there is, among other things, obscured visibility.

The measures from the measurement selection study (Trafikverket 2016/10061) in package 1 include 80 km / h with minor measures. The focus is on accessibility and road safety that can be implemented in relatively short term. According to the measurement selection study for Stockholm-Oslo, the route between Töcksfors and the national border has recently been expanded/ reconstructed and therefore no measures are proposed on that route. No changes of speedlimit have been proposed.

The route has been devided into four stages based on accident statistics and traffic volume.

- Stage 1: Töcksfors (Fågelviksvägen) east of Årjäng, approximate 27 km.
- Stage 2: east of Årjäng- Sillebotten (road 522), approximate 20,2 km.
- Stage 3: Sillebotten (road 522) Nysäter (road 175 west), approximate 23,9 km.

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- Stage 4: Nysäter (road 175 west) - Valnäs, approximate 13,4 km. <sup>34</sup>

<sup>33</sup> Interview with Marcus Smedman



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<sup>&</sup>lt;sup>34</sup> (Trafikverket 2016/10061)







European Union European Regional Development Fund

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Figur 17. Stages pakage 1 for measures Valnäs, source: (Trafikverket 2016/10061)

According to the measurement selection study for Oslo-Stockholm, the following measures are proposed for target year 2030 and 2040.

#### Non-technical solutions (step 1-2 measures)

- Three speed limit cameras are proposed along the route to lower the speed of intersections or smaller communities.
- Field fence on both sides along some parts of the route, a total of about 37km
- Rumble strips at almost the entire distance of about 84km. Rumble strips is not suggested where the road passes buildings that can cause noise problems due to the grooves.









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#### Technical solutions (step 3-4 measures)

- The route between Töcksfors and Valnäs it is proposed climbing lanes at suitable uphill's to increase accessibility, as it is a lot of heavy traffic that travels the route. In total, approximately 7.9km is widened by 4.5m with the intention of creating 3 westbound and 4 eastbound climbing lanes.
- To increase road safety, side rails, totaling about 2km, are proposed for minor obstacles and improvement of selected intersections to c-intersections.

The cost for all the above measures: SEK 174 million in price level 2015–06.

• Completed extension of the remaining stages for meeting separation between Valnäs-Töcksfors / national border, (target year 2040).

In the measurement selection study for Valnäs, further measures are proposed (target year 2018-2029) beyond the measures proposed in measurement selection study Stockholm-Oslo for stages 1, 2, 3 and 4:

- Stage 1 (Total cost SEK 48,7 million)
- Stage 2 (Total cost SEK 43,6 million)
- Stage 3 (Total cost SEK 43,4 million)
- Atage 4 (Total cost SEK 27,6 million)

#### Non-technical solutions (step 1-2 measures)

- Overtake prohobition at a short section, at about 180 meters east of road 505 Selen.
- Overtake prohobition at Tenvik, the interchange in to Leverhögen.

#### **Technical solutions (step 3-4 measures)**

- Measures for interchanges.
- Offset C- interchange at road 615. Connections are closed and new parallel roads are added to the new intersection.
- Minor TS-measures. Mountain within the safteyzone. Siderailing. (See *Trafikverket 2016/10061* for detailed information).









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Already planned and ongoing steps 3-4 measures are: replacing the bridge at Järnsjön on E18, Årjäng. This will take place April 13 - May 10, 2020. As well as the exchange of a bridge at the Valnäs traffic stop on road E45, Grums. Time not stated.<sup>35</sup>

<sup>&</sup>lt;sup>35</sup> <u>https://www.trafikverket.se/nara-dig/Varmland/vi-bygger-och-forbattrar/brounderhall-varmland/</u>









### Holmedal



Figur 18. Holmedal, source: (Trafikverket 2015/30304)

The route Töckfors-Årjäng has a lower standard than other parts of E18.

Both intersections have deficiency at left turn lanes and the intersection is perceived to be unsighted. There's lack of passages to bus stops, connecting walkways and platforms. None of the interchanges is lighted.



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Some planning and measures are already ongoing. In the long term, the Swedish Transport Administration plans to convert E18 into a meeting-free road with reference speed - 100km / h. Further expansion of the Töcksfors trading locations is planned, which will result in increased traffic on the E18. The Swedish Transport Administration plans to replace a drum during E18 in connection with the interchange with road 502/613, which could be coordinated with other measures at the interchange.

Road safety at the intersections should be improved, accessibility to public transport stops should be improved, and accessibility of through traffic on the E18 should be maintained.

According to measurement selection study for Holmedal, the following measures are proposed, no steps 1 or 4 measures have been noted.

#### Non-technical solutions (step 2 measures)

- Lower the speed limit at the intersections.
- Automatic traffic safety control (ATK) (speed limit cameras).
- Traffic information (ITS) on the current traffic situation and accident risks.
- Lighting at the intersection with road 502/613.
- Prohibition of transit traffic on road 613.
- Decreased speed limit on road 502 through Holmedal.

#### Technical solutions (step 3 measures)

- Closing the intersection E18 / road 503.
- Extension of left turn lane at intersection E18 / road 502/613.
- Improved standard at bus stops incl. walkways at intersection E18 / road 502/613.
- Road safety measures along road 502 through Holmedal (lower the speed limit, walkway etc.)<sup>36</sup>

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<sup>&</sup>lt;sup>36</sup> (Trafikverket 2015/30304)





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## **Complementary measures**

• Electrify Europe Road 18 for heavy traffic.

Road electrification is still a test activity that shows good results. Therefore, it is planned to be able to propose new objects in upcoming national plans for the transport system. This may be the case on individual routes or routes with continuous freight transport during the time horizon the measures selection study applies to.<sup>37</sup>

<sup>37</sup> (Trafikverket 2017/148454)







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