Groundwater workshop

Nordic WFD meeting, Vaasa

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2019-05-22

SGU
Sveriges geologiska undersökning

Session 1

Urban monitoring project in Sweden (SE)

Groundwater flooding (DK)

Monitoring, grouping in monitoring, and coverage of monitoring (FI, SE, NO)

Session 2

Exemptions (especially disproportionate costs) (All)

Quantitative status assessment (All)

Trend assessment and threshold values (All)

Groundwater bodies in Sweden

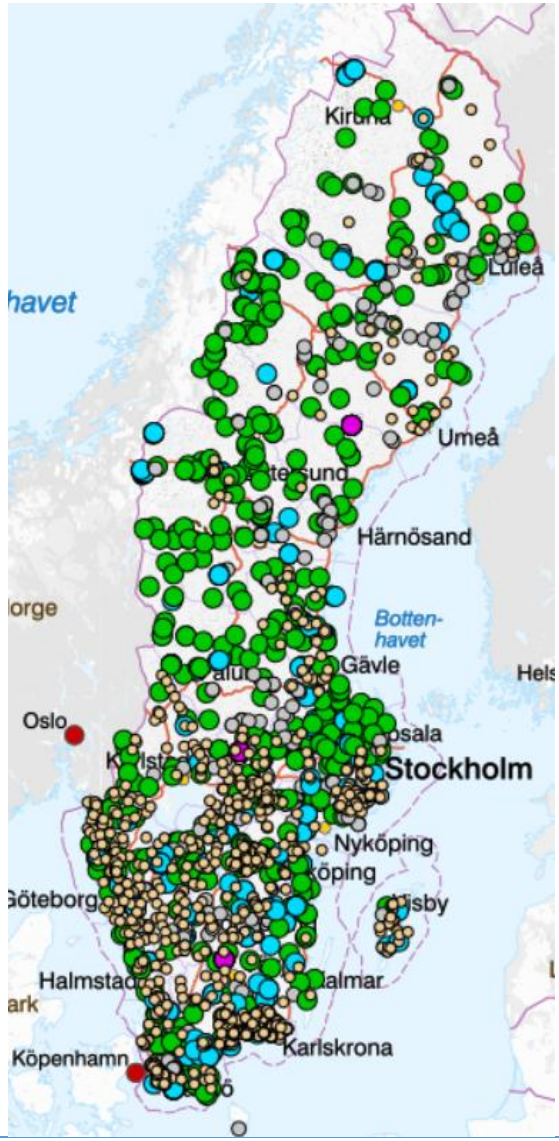
3 700 groundwater bodies

Geological formation

- Quaternary deposits (sand/gravel, 2900 eskers)
- Crystalline bedrock (500)
- Sedimentary bedrock
- Other, e.g. moraine

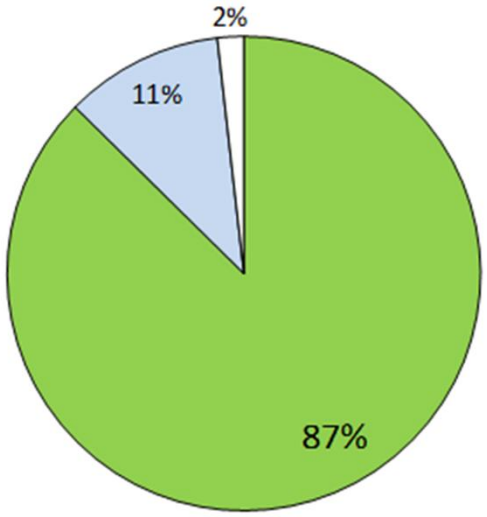
Monitoring in Sweden

- Trend station (2-4 times/year) (357)
- Integrated monitoring (30)
- Station analysed 1/6 year (444)
- Other monitoring (414)
- Regional monitoring (1651)

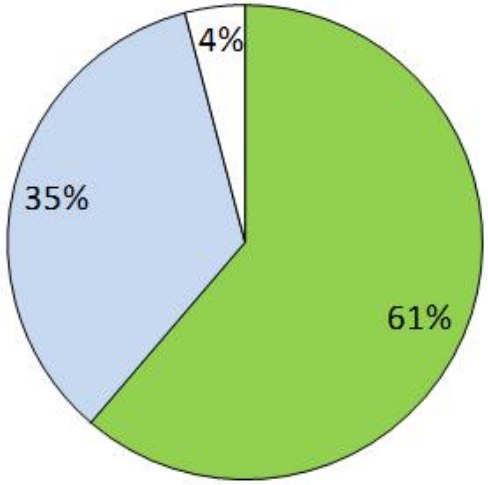


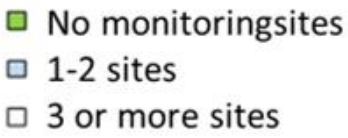
Monitoring surveillance

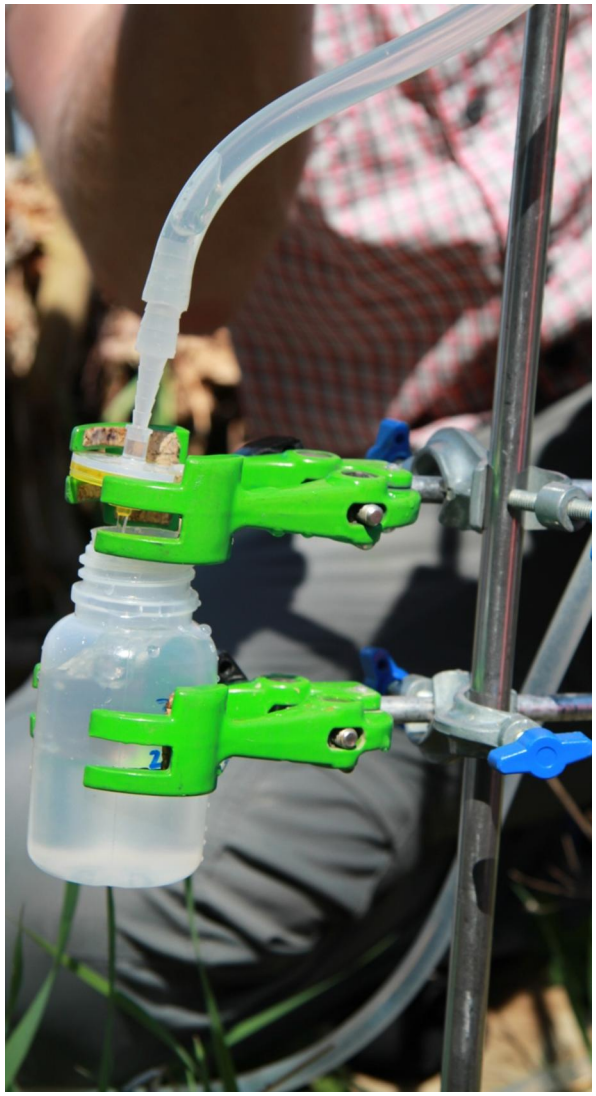
Monitoring 2016



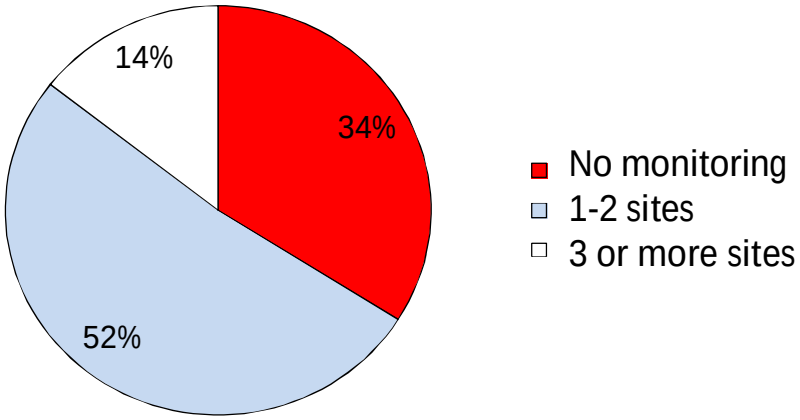
Monitoring 2016 including monitoring in water used for drinking water



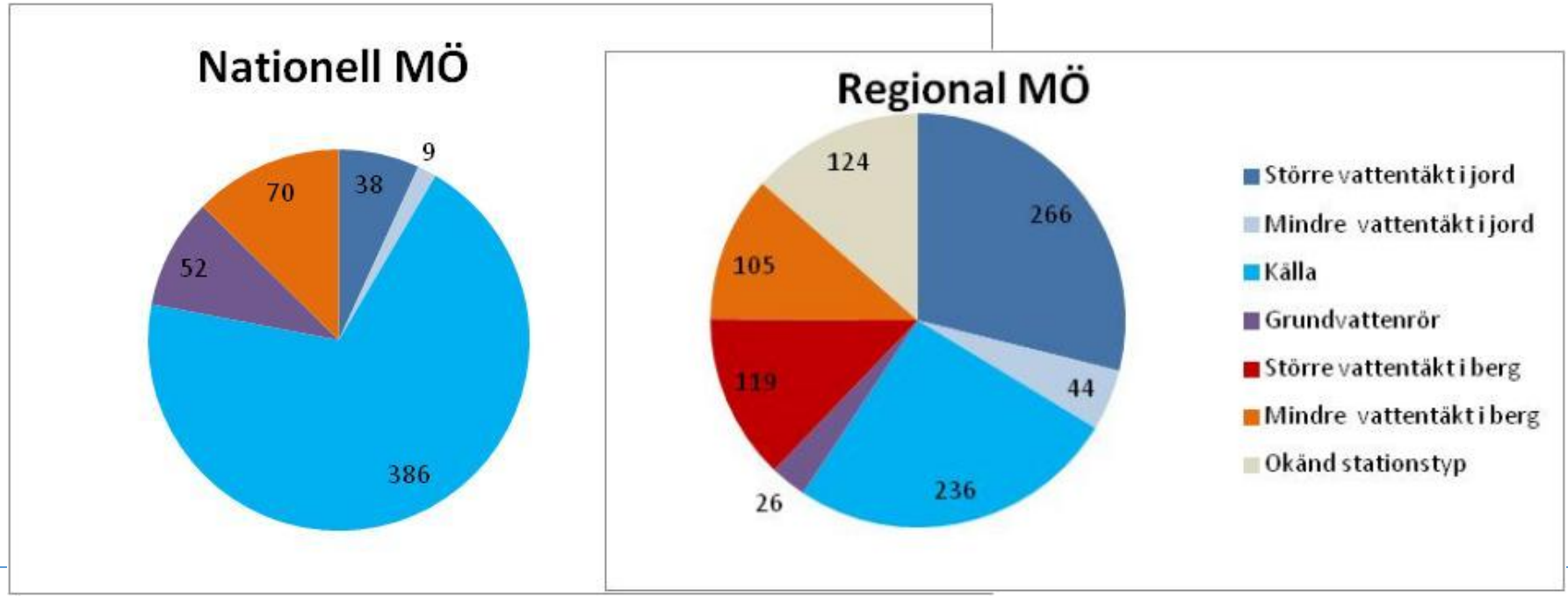




Monitoring operational



Antal stationer i nationell och regional MÖ 2007-2012



Recommendations from EU COM

“The knowledge base on groundwater should significantly be improved in Sweden. Enhanced and robust groundwater monitoring should be established based on WFD requirements. WFD based methodologies should be used to assess groundwater status correctly. “

Brussels, 26.2.2019 SWD(2019) 57 final COMMISSION STAFF WORKING DOCUMENT Second River Basin Management Plans – Member State: Sweden Accompanying the document REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL

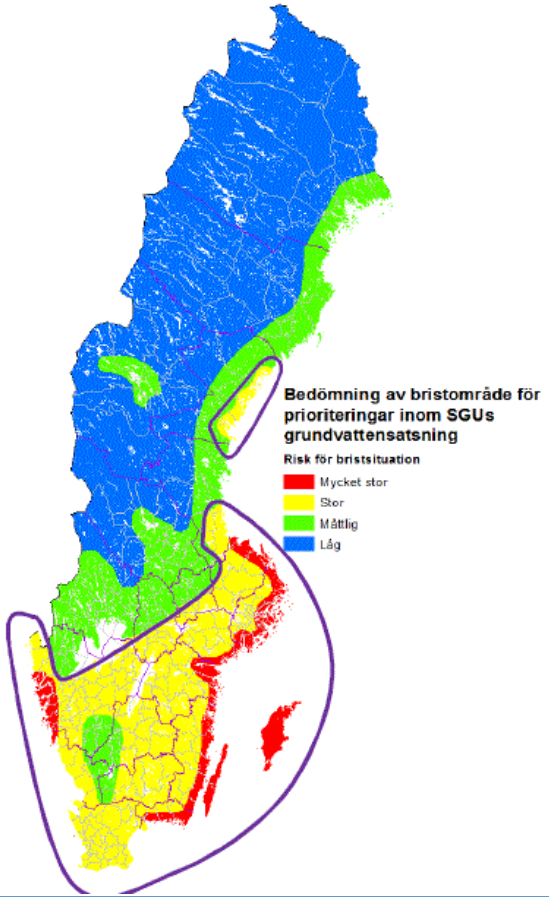
From Day 1:
Progress in chemical groundwater monitoring

- A recent inventory of new monitoring stations in GWBs at risk resulted in 250 monitored locations and 30 established new stations in the national monitoring programme.
- Screening performed of pharmaceuticals and hazardous substances in urban water supplies (see *SGU-Rapport 2019:02*). Hazardous substances were found at low concentrations in many of the 77 wells (above limit of quantification in 400 out of 11000 analyses)
- Ongoing project on further screening of hazardous substances in GWBs at risk
- Theoretical monitoring programme (without funding solved) recently published
- Grouping of groundwater bodies partly revised (ongoing)

From Day 1:

Progress in quantitative groundwater monitoring

- Ongoing project to introduce new groundwater stations for increased measuring of groundwater levels (about 300 stations in 110 areas); objective to improve decision support and groundwater prognoses and to include e g urban areas in the network. Focus on south-eastern Sweden with recent drought issues
- Ongoing project on 3D characterisation and modelling of groundwater levels (local scale)
- New grouping of groundwater bodies according to quantity established
- Extra funding (2018-2020) for groundwater mapping in areas with risk of water shortage; locally important small GWBs, aquifers underlying fine sediments, coastal (bedrock) aquifers.



Grouping

CIS Guidance no 2.
Surface water bodies or bodies of groundwater may each be grouped for the purposes of assessing the risk of failing to achieve the objectives set for them under Article 4 (pressures and impacts)(refer to WFD CIS Guidance Document No. 3). They may also be grouped for monitoring, reporting and management purposes where monitoring sufficient indicative or representative water bodies in the sub-groups of surface water or groundwater bodies provides for an acceptable level of confidence and precision in the results of monitoring, and in particular the classification of water body status (refer to WFD CIS Guidance Document No. 7).

CIS Guidance no 7.
Key principle Groundwater bodies may be grouped for monitoring purposes provided that the monitoring information obtained provides for a reliable assessment of the status of each body in the group and the confirmation of any significant upward trends in pollutant concentrations.

Grouping for chemical monitoring

Surveillance monitoring, GWD not at risk, no significant impact source

CIS Guidance no 15
Where groundwater bodies are determined to be not at risk according to the Article 5 review process, bodies may be grouped if they are sufficiently similar in terms of aquifer characteristics, pathway susceptibility(ies), pressure(s) and confidence in the risk assessment(s).

Grouping for chemical monitoring, surveillance

Step 1. Geological formation

- Other (moraine)
- Glacifluvial (sand/gravel, eskers)
- Sedimentary bedrock
- Bedrock

Grouping for chemical monitoring

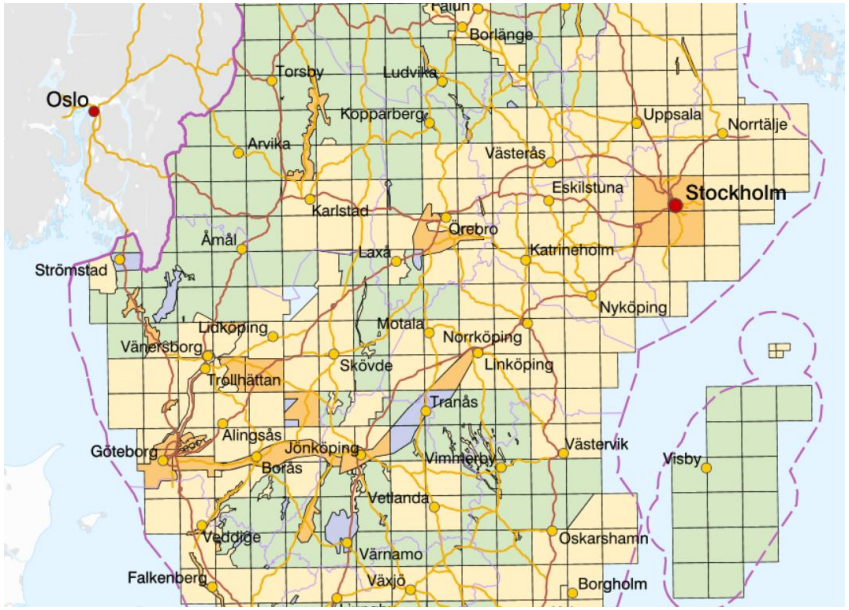
Step 2. Different geographic locations

A= Sydsveriges sedimentära berggrundsområde
B= Sydsvenska höglandet
C= Delad, se O resp. V.
D= Mellansveriges sedimentära berggrundsområde
E= Mellansvenska sänkan
F= Upplands kalkpåverkade område
G= Norrlandskusten
H= Sedimentära berggrundsområden i Dalarna och Jämtland
I= Urbergsområden inom Norrlandsterrängen ovanför högsta kustlinjen
J = Fjällen
O= Sydostkusten
V= Västkusten

Grouping for chemical monitoring

Step 3. Permeability

- Dense material (> 90 % low permeability)
- Permeable (>80 % high permeability)
- Partial (other than above)



Grouping for chemical monitoring

Step 4. Districts

- Five RBMP districts in Sweden

Step 5.

- One monitoring station every 30 km.

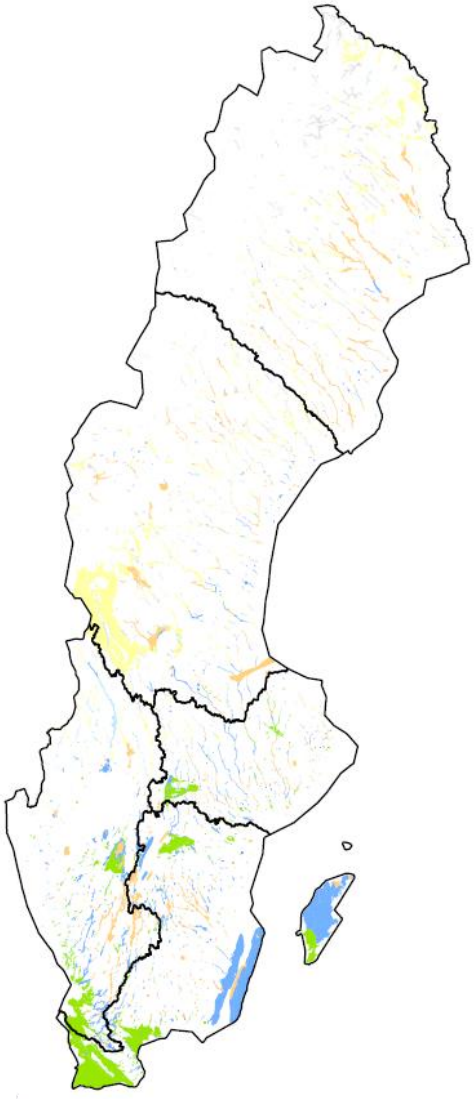
Reporting to EU

More useful

Three added land use maps

- Agriculture and modelled nitrate concentrations
- Woodlands
- Urban areas

Agriculture

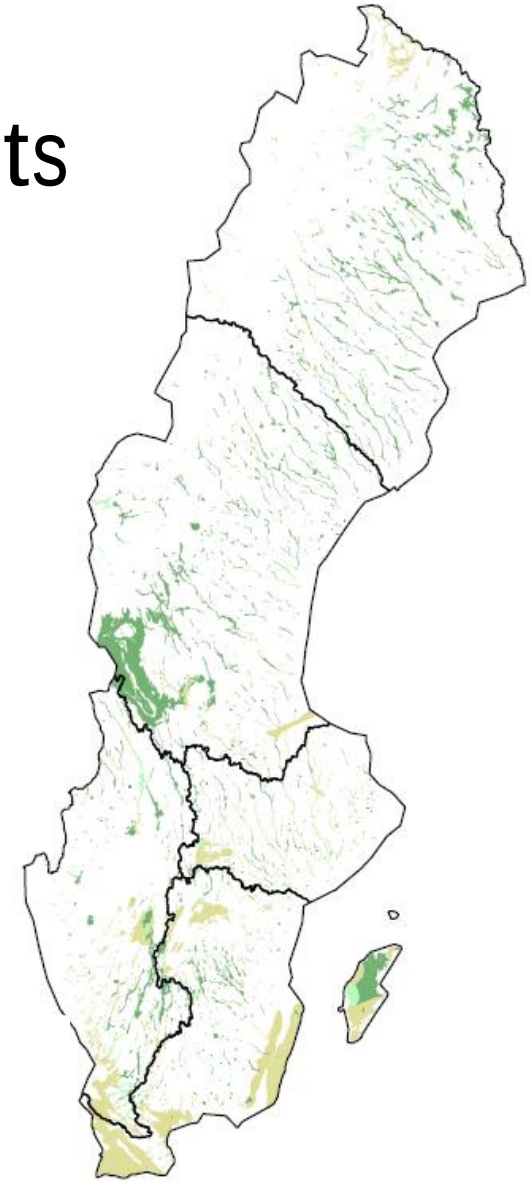


Jordbruksmark och nitrathalt inom grundvattenförekomst

Arealandel jordbruksmark inom grundvattenförekomst

- > 50 % och > 10 mg/l nitrat
- > 50 % och < 10 mg/l nitrat
- 20-50 % och > 10 mg/l nitrat
- 20-50 % och < 10 mg/l nitrat
- < 20 % och > 10 mg/l nitrat
- < 20 % och < 10 mg/l nitrat
- Jordbruksmark saknas

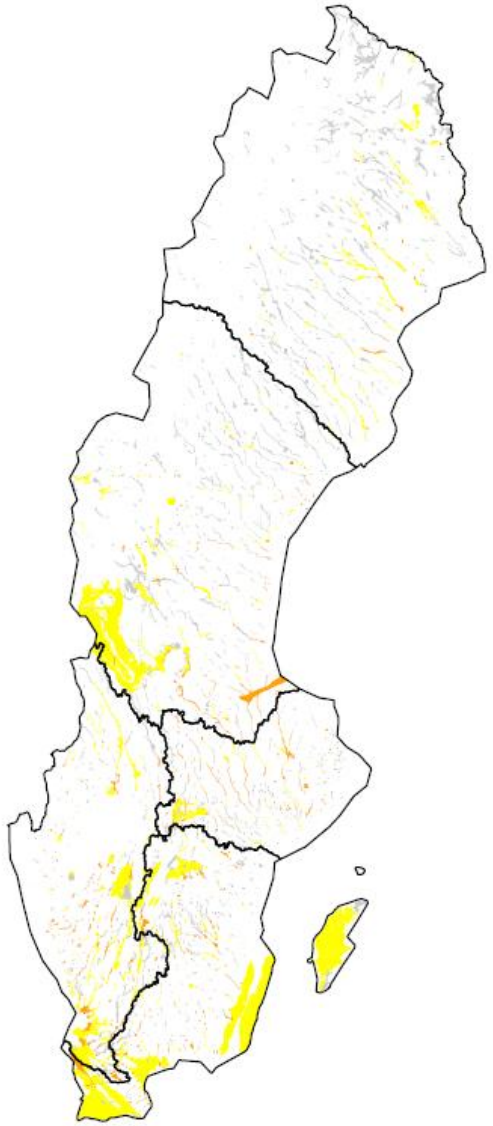
Woodland / forests



Arealandel skogsmark
inom grundvattenförekomst

- > 50 % enbart lövskog
- > 50 % Skog, varav > 50 %-enheter barrskog
- > 50 % Skog, varav < 50 %-enheter barrskog
- < 50 % Skog
- Skogsmark saknas

Urban areas



Andel urban markanvändning inom grundvattenförekomst

- Urban markanvändning saknas
- < 10 % urban markanvändning
- > 10 % urban markanvändning

Grouping for chemical monitoring

Operational monitoring

CIS Guidance no 15
Where groundwater bodies are determined to be at risk according to the Article 5 review process, bodies may be grouped if they are sufficiently similar in terms of aquifer characteristics, pathway susceptibility(ies), pressure(s) and confidence in the risk assessment(s).

Grouping for chemical monitoring, operational

- Monitoring in every gwb

Grouping gwb with significant impact from

- Transport and infrastructure
- Agriculture
- Transport and infrastructure and agriculture

Grouping for quantitative monitoring, surveillance

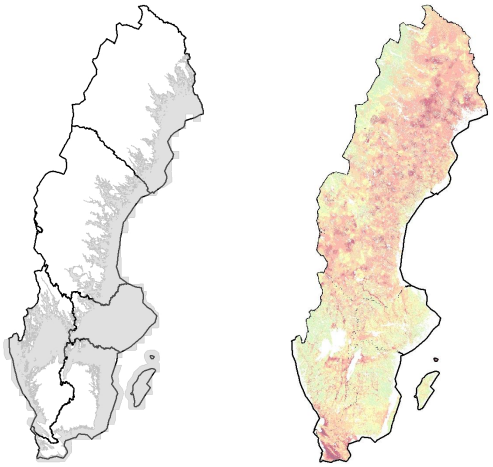
Step 1. Geological formation

- Other (moraine)
- Glacifluvial (sand/gravel, eskers)
- Sedimentary bedrock
- Bedrock

Grouping for quantitative monitoring, surveillance

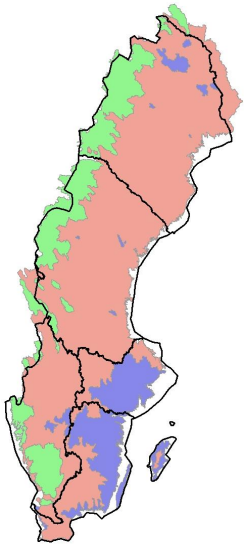
Step 2.

- Groundwater recharge (not bedrock)
- Highest coastline (sedimentary bedrock)
- Soil depth (bedrock)

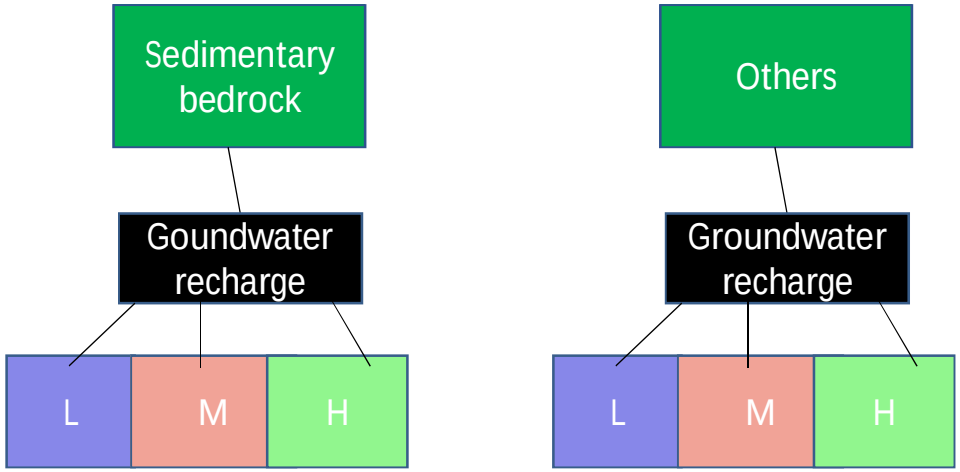


Groundwater recharge,
grundvattenbildning

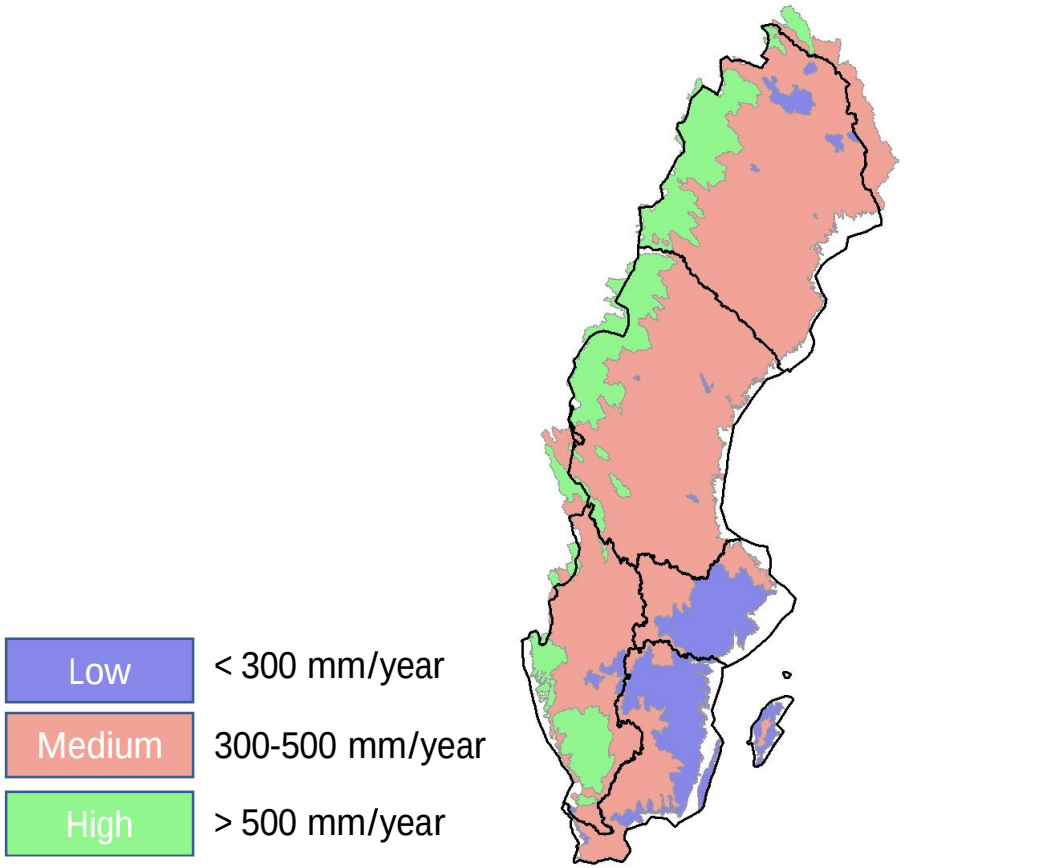
Low	< 300 mm/year
Medium	300-500 mm/year
High	> 500 mm/year



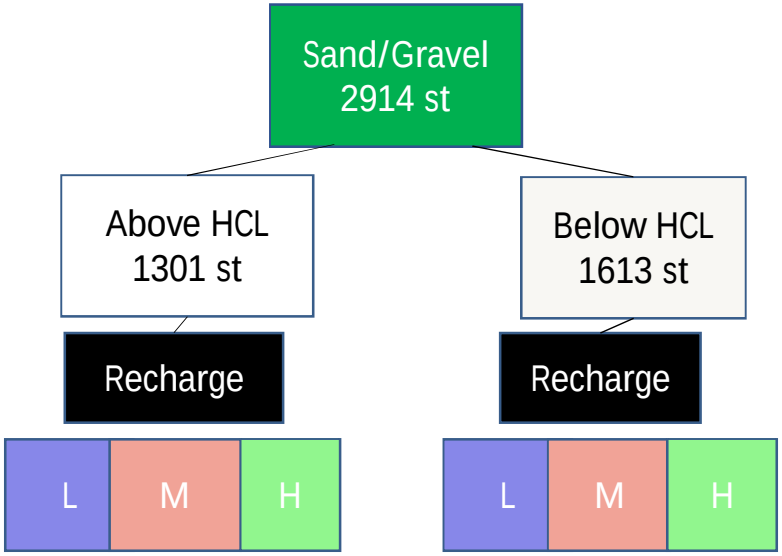
Grouping for quantitative monitoring, sedimentary bedrock and other



Groundwater
Recharge / grundvattenbildning

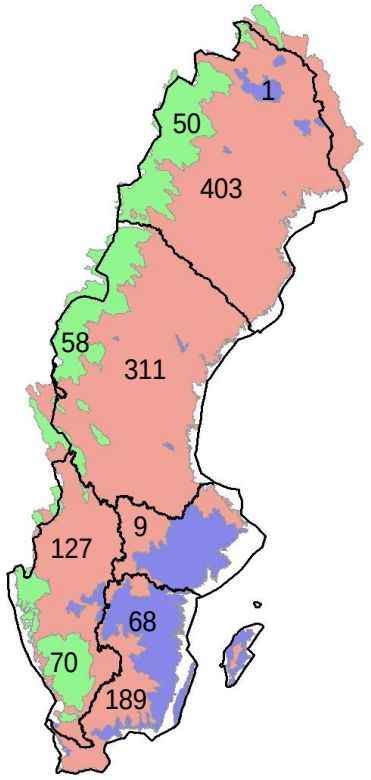


Grouping for quantitative monitoring, eskers

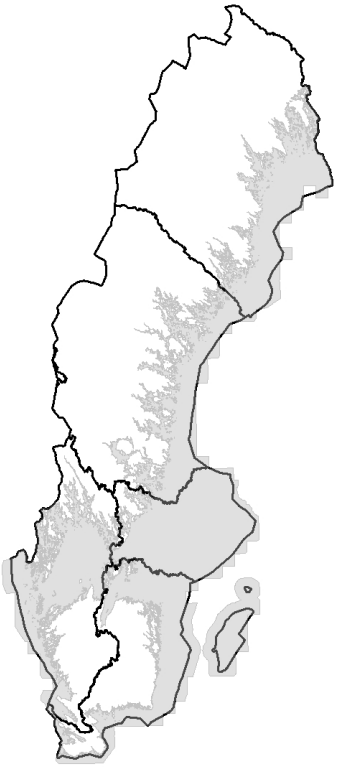


Low	< 300 mm/year
Medium	300-500 mm/year
High	> 500 mm/year

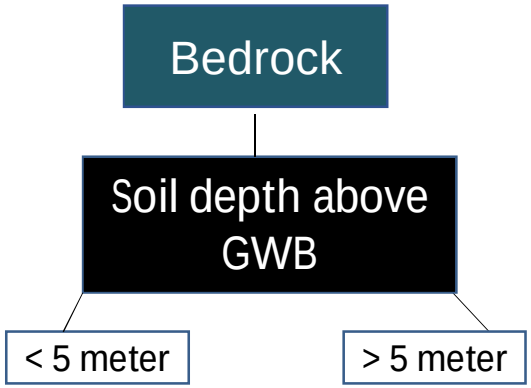
Groundwater Recharge,
grundvattenbildning

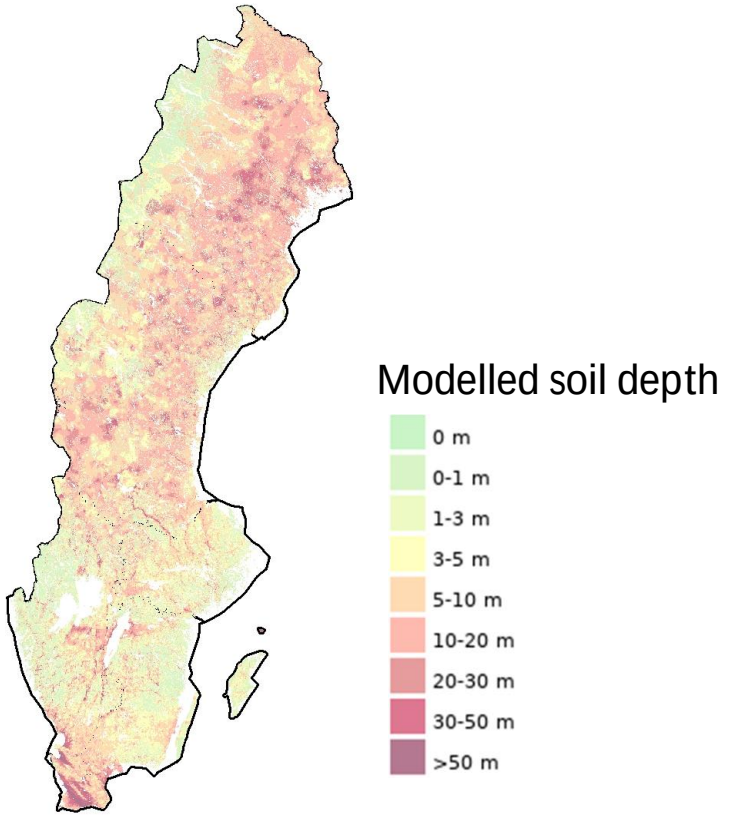


Highest coastline



Grouping for quantitative monitoring, bedrock





Exemptions

COM recommends SE to reduce number of exemptions

“The justifications provided for disproportionate costs, for both Article 4(4) and 4(5), are textual/qualitative and often rather vague and thus difficult to assess.”

Presently governmental investigations/inquires to elaborate on the use of exemptions, and SWAM is preparing a national guidance on disproportionate costs

Art 4.4 Until now (nearly) only **time exemptions** for groundwater.

Now: Time exemption beyond 2027 - natural conditions, justified if banned substance and downward trends (e.g. BAM)

Art 4.5 Now more use of **less stringent objectives** (art. 4.5). Justification/motivation needed

“Socioeconomic needs” behov och samhällsviktig verksamhet – definition

Costs/ benefits , disproportionate costs (assessment by water authority)

Exemptions

Art 4.7 New modifications / alterations (of groundwater level)

Not applied yet. Recent change in the Swedish national env. act to implement art. 4.7 exemptions. Clearly states that the permitting process must consider environmental objectives (miljökvalitetsnormer) when giving permits, i.e, no exceedance allowed.

The permitting authority assesses disproportionate costs (different process!)

If a municipality wants to apply exemptions, the water authority will leave statement/advice (yttrande)

Disproportionate costs

'Disproportionality', as referred to in Article 4.4 and 4.5, is a political judgement informed by economic information, and an analysis of the costs and benefits of measures is necessary to enable a judgement to be made on exemptions (CIS 20).

- Willingness to pay
- Value of water
- Costs and benefits

Where/when are assessments of disproportionate costs made already?

1) General rules of consideration in the national env code (miljöbalken). In ch. 2.7 MB

-benefits of protective measures and other precaution compared to costs

2) Measures financed on state/governmental level (assessment of cost/benefit already made). Preventive measures (floods protection, agricultural measures)

A socioeconomic analysis (may) include an assessment on how measures affects sectors (on a society level).

The socioeconomic assessment of when costs are disproportionate is made from the identified ”pressure types” and in some cases these correspond to sectors.

socioeconomic needs -

Important “activities for society” samhällsviktiga verksamheter

- Fishing industry (harbours)
- Culture - and nature conservation
- Valuable minerals (mining)
- Industrial production
- Water supply (plant)
- Energy production (hydropower and power plants)
- Communication infrastructure (rail, roads, airports, harbours)
- National defence (airports, harbours, shooting ranges)

Areas of national interest, other

Sewage treatment plants
Drinking water supply resources (water resource)
Floods protection

Pressure, driver, methods for assessments of disproportionate costs

Påverkanstyp	Drivkraft	Antal undantag	Teknisk möjliga åtgärd definierade	Möjlig metod för orimlig kostnad	Lagrum för nationellt samhällsviktig verksamhet	Tillförlitlig kedja av underlag i beslut 2016	Tillförlitlig kedja av underlag inför beslut 2021	Länens prioritering
1.5 – Punktkällor - Förorenade områden eller övergivna industrier	Föroreningar som orsakas av övergivna industrier eller områden förorenade av tidigare industriverksamhet, olaglig dumpning av industriavfall eller föroreningsolycka och som kan identifieras som en punktkälla. För diffusa källor, se nedan "Diffusa källor – Förorenade områden eller övergivna industrier". Denna kategori täcker inte pågående verksamhet.	35	x	Rimlighetsavvägning MB 2:7 Prioritering i statlig finansiering	Kap. 10 MB Förorenade områden	x	x	1
1.6 - Punktkälla – Avfallsanläggningar/Deponier	Tätortsbebyggelse	0	x	Rimlighetsavvägning MB 2:7				4

Which criteria for natural conditions (time exemptions beyond 2027) do you apply? Banned substances, water level recovery, other?

What conditions allow for less stringent objectives?

-how do you define socioeconomic needs?

-disproportionate costs?

-do you apply general sector specific approaches to cost assessments? Which sectors?

Quantitative status assessment

Problems in SE concerning quantity

1) Few monitoring stations for quantity (2 % of GWBs, COM recommendations)
2) Lack of data. Risk and status assessment are not based on changes in water levels. Few conceptual models are available to assess water flow.
3) Assessments are based on indications rather than water balance calculations. Difficult to decide when there is risk and when there is poor status.
4) Assessment may be based on trends in a single well. How representative is this well for the GWB as a whole? Local abstraction may be a local problem.

Quantitative risk and status 2016

Risk	Poor status
Temporary lowering of grw table or changes in flow due to anthropogenic pressure, not causing saltwater intrusion or damage to ecosystems	Recurring/permanent lowering of grw table or changes in flow due to anthropogenic pressure
GWBs with many or large abstraction volumes compared to recharge (need of extended monitoring). Caution in coastal areas	The sum of abstraction is 90% or more of the average recharge. Or / and water balance is not sustainable in the long run
Once/seldom occurring water shortage, use indications; dry wells, irrigation bans, water transported to households, dry springs	Recurring/permanent water shortage, indications, dry wells, irrigation bans, water transports
Slightly elevated concentrations of chloride, cond, sulphate? (caution)	Recurring elevated concentrations of chloride, cond, sulphate caused by abstraction
Temporary elevated concentrations of other intruding compounds	Recurring/permanent elevated concentrations of other intruding compounds caused by lowered gw table of flow changes
A water balance calculation gives that the sum of all abstraction is 50% or more of the average groundwater recharge and there are associated aquatic ecosystems or terrestrial ecosystems dependent on the outflow	Damage on associated aquatic ecosystems or terrestrial ecosystems dependent on the outflow

Risk	Poor status
Temporary lowering of grw table or changes in flow due to anthropogenic pressure, not causing saltwater intrusion or damage to ecosystems	Recurring/permanent lowering of grw table or changes in flow due to anthropogenic pressure
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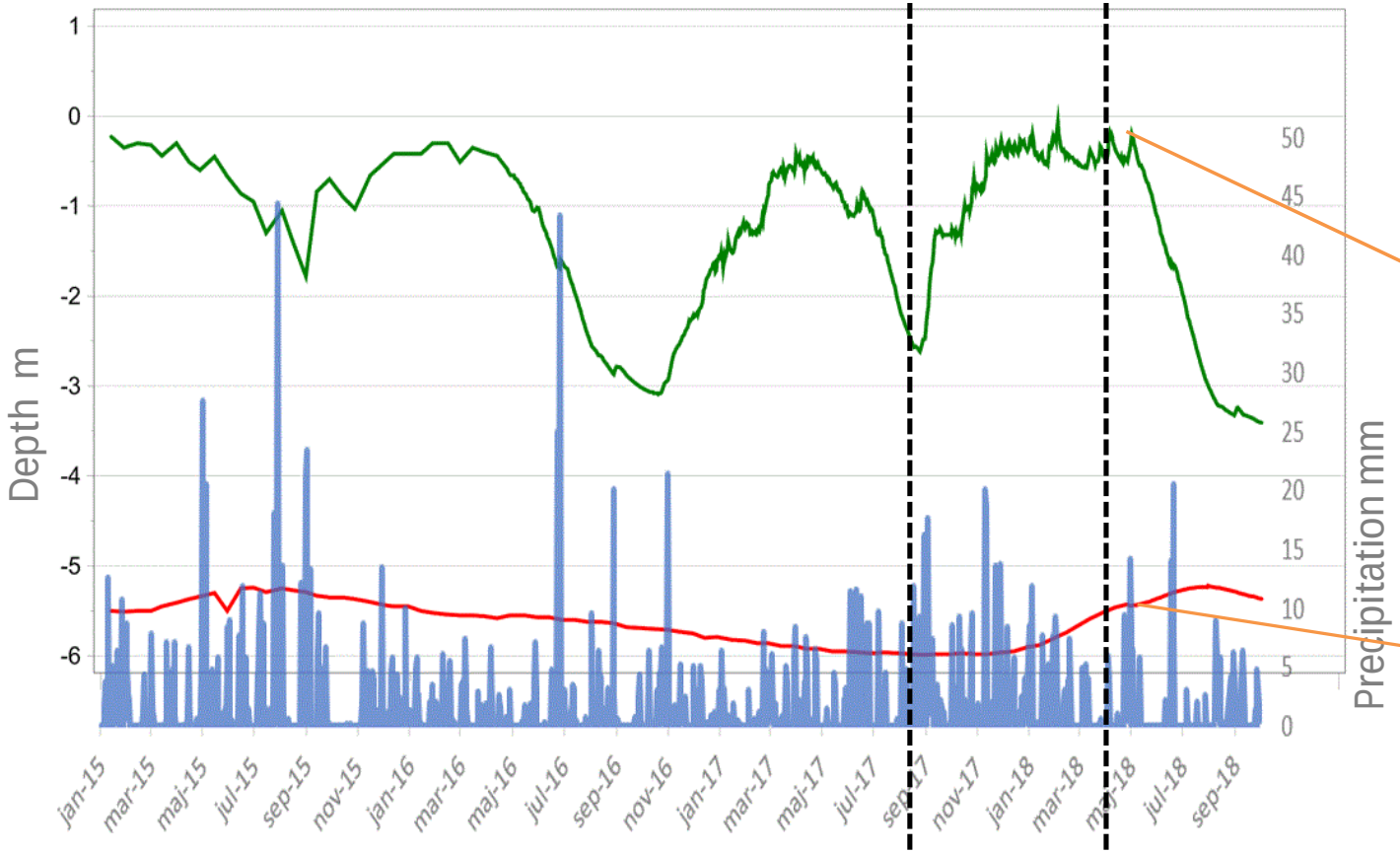
A water balance calculation gives that the sum of all abstraction is 50% or more of the average groundwater recharge and there are associated aquatic ecosystems or terrestrial ecosystems dependent on the outflow	Damage on associated aquatic ecosystems or terrestrial ecosystems dependent on the outflow

Time of impact determinant
- define temporary, recurring?

Type of aquifer?



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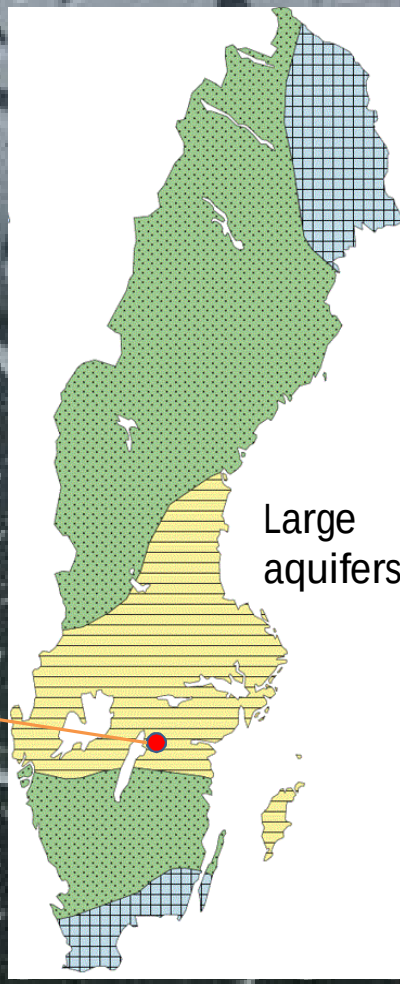
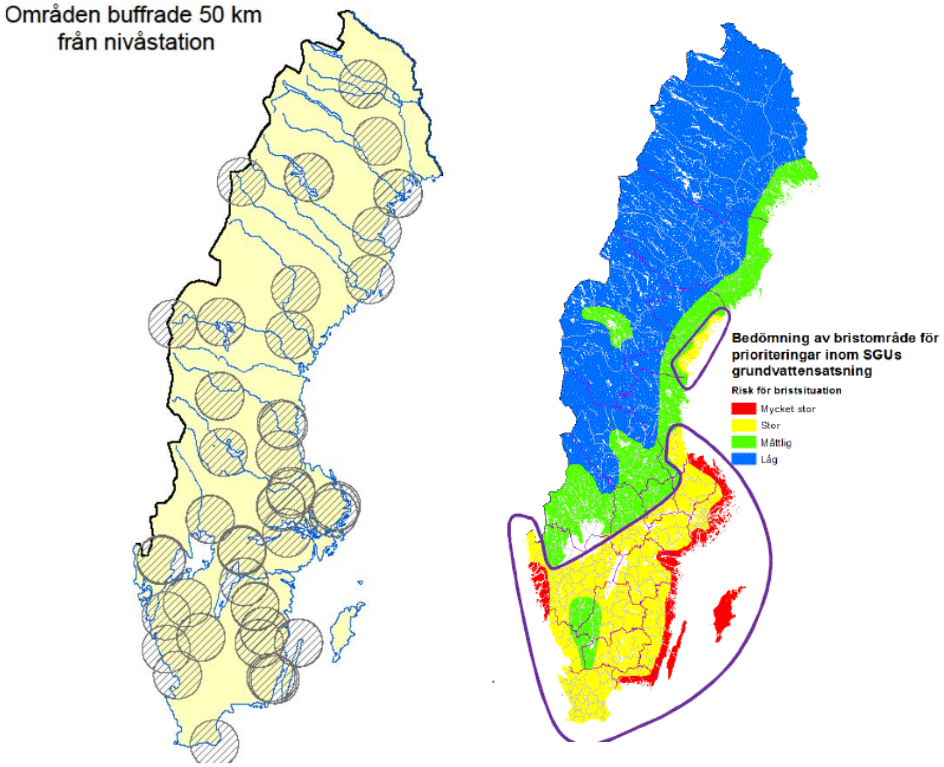


How to define anthropogenic downward trends from natural trends due to low precipitation/droughts?

Compare to the national stations under undisturbed (ie low abstraction) conditions

- if corresponding aquifer type

Need of quant monitoring in areas with abstraction pressure



Effects on quantity - % abstracted water compared to total recharge

% of recharge used	Pressure	Comment
<10	Very low	
10-20	Low	Acceptable if no effects on soil stability or ecosystems
20-50	Apparent	May be acceptable if no effects on soil stability or ecosystems
50-90	High	Risk of damage to wetlands and surface waters
>90	Very high	High risk of damage, need of extensive monitoring

Abstraction pressure in the GWB

Must be determined locally - only the water that is **available**, i.e. contributing to the abstraction well (catchment area) should be part of the water balance calculation (ongoing case)

Important for large GWBs – it should not be possible to justify a large discharge by claiming that the overall pressure in (the whole) GWB will be low. Investigations needed to measure the actual catchment area needed (with water balance calculations considering all use; water supply, irrigation, bedrock pits, tunnel constructions etc (vattenföretag))

Threshold values

Regulations 2013:2 from Geological Survey of Sweden

Mostly drinking water standards

Generella riktvärden för grundvatten på nationell nivå och utgångspunkter för att vända trender

Tabell. Riktvärden för grundvatten på nationell nivå[1] och utgångspunkter för att vända trender.

Parameter	Enhet	Riktvärde för grundvatten	Utgångspunkt för att vända trend
Nitrat	mg/l	50	20
Nitrit	mg/l	0,5	0,1
Fosfat	mg/l	0,6	0,1
Aktiva ämnen i bekämpningsmedel inkl. metaboliter, nedbrytnings- och reaktionsprodukter	µg/l	0,1 0,5 totalt	Detekterat
Klorid	mg/l	100	50; Västkusten 75
Konduktivitet	mS/m	150	75
Sulfat	mg/l	100	50
Ammonium	mg/l	1,5	0,5
Arsenik	µg/l	10	5
Kadmium	µg/l	5	1
Bly	µg/l	10	2
Kvicksilver	µg/l	1	0,05
Trikloreten + Tetrakloreten	µg/l	10	2
Kloroform (Triklormetan)	µg/l	100	50
1,2-dikloretan	µg/l	3	0,5
Bensen	µg/l	1	0,2
Benso(a)pyrene	ng/l	10	2
Summa 4 PAH:er, Benso(b)fluoranten Benso(k)fluoranten Benso(ghi)perylen Indeno(1,2,3-cd)pyren	ng/l	100	20

Zn, Ni, Cu, Cr and PFAS 11 are added

Phosphate

Threshold values only in GWBs associated to surface water

Local threshold values

GWBs with high natural concentrations

- Arsenic
- Chloride
- Sulphate
- Conductivity
- Lead

The local threshold values will be same as the background level, no ”point of trend reversal”

Local threshold values

Criteria:

- Concentrations above threshold levels
- No significant impact source
- Stable concentrations for many years
- No problem with quantitative status
- Check bedrock and other results from monitoring