Cartographic Activities in Sweden 2003–2007

Kartografiska

National Report Presented to
the International Cartographic Association´s
14th General Assembly 2007
Moscow, Russia,
by the Swedish Cartographic Society

Contents

Kartografiska

Introduction

The national report of Sweden is written by the Swedish Cartographic Society. The beneficiaries are the delegates of the General Assembly 2007 of the International Cartographic Association in Moscow, Russia.

In Sweden, maps and geographic data are produced by national and local government authorities and institutions, commercial enterprises, scientific institutions, organisations, and individuals. This report focus on cartographic production of map and map series, use of maps and geographic information.

The Swedish Cartographic Society

Background

The Swedish Cartographic Society was founded in 1908, and is most probably one of the oldest of its kind. The Society's goal is to increase the interest in cartography and other topics related to mapping or the use of maps in Sweden and to try to encourage a development in the area.

The one hundred jubilee in 2008 is planned to become a major event that year. The Society has announced the year 2008 as the Year of the Map (see www.kartansar.se). The purpose is to increase understanding and use of maps in Sweden. All map producers and users are expected to take part in this celebration.

The Society is organised in six sections; Cartography, Historical maps, Geographical Information Systems, Photogrammetry and Remote Sensing, Geodesy and Education. Each section has responsibility for its respective disciplines and among other things the sections arrange seminars, exhibitions and study visits.

A main activity of the Society is to organise the annual conference "Map days" (see www.kartdagar.se). The conference is arranged in combination with a trade show that presents products and services from more than 50 companies and authorities. The conference program includes seminars within the areas of Cartography, Historical maps, Geographic Information Systems, Photogrammetry, Visualisation, Geographic Information Technology, Remote Sensing, and Geodesy. The conference also includes a map exhibition, seminars on educations, management, pricing, politics and strategies. Social arrangements are an important part of the conference. In 2007 more than 1,000 individuals took part in the "Map days".

Four times a year the Society publishes the cartographic journal "Mapping and Image Science". One issue a year is focussed on scientific matters. During the last years the number of members in the Society have been about the same. In 2007, the amount of members is some 2,500. Our members are professionals, students, retired, and individuals with a common interest for maps. About one hundred of these are members from abroad. Anyone who wants is accepted as a member of the Society. The annual fee is SEK 150, SEK 100 for retired, and SEK 50 for students.

Committee board

The committee board consists of a president, a vice president, a secretary, a treasurer, seven members, and two deputies. In 2007 the president is PhD Patrik Ottoson and the secretary is Övlt Lennart Bergh

The Society and its six sections are governed by the rules of the Society. The Swedish Cartographic Society represents Sweden in the International Cartographic Association (ICA), and has participated in the General Assemblies of Delegates in Paris 1961, in London and Edinburgh 1964, in New Delhi 1968, in Montreal and Ottawa 1972, in Moscow 1976, in Tokyo 1980, in Perth 1983, in Morelia 1987, in Bournemouth 1991, in Barcelona 1995, in Ottawa 1999, in Durban 2003, and in La Coruña 2005.

The Society will also be represented at the 14th General Assembly in Moscow, Russia 2007. Delegates to this assembly will be PhD Patrik Ottoson and Övlt Lennart Bergh.

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The Historical Section

The Historical Section of the Swedish Cartographic Society consists of a board of four persons, whose main duties are to arrange a session at the annual conference "Kartdagarna" and to acquire papers to the society journal "Kart & Bildteknik". In addition, study visits and excursions are arranged, and occasionally more extensive events like the 1992 three-day course in early mapping techniques which included hands-on practice in plane-table surveying.

Study visits have gone to such obvious sites as the National and the Military Archives and to the Royal Library map exhibition 2006, but also to map repositories in the Royal Palace Archives, the Bernadotte Library, the Skokloster Palace and the Fire Insurance Company which was founded in 1782 and preserves a considerable collection of estate maps and building plans. Excursions might cover such themes as the transition from rural to urban settlement in the Stockholm area in connection with the Cadastral Map project run by the Royal Swedish Academy of Letters, History and Antiquities.

Conference papers tend to be either on the history of cartography proper or on the use of "historic" maps as sources for research within quite diverse fields, from plant genetics and the history of hop cultivation to the history of river logging or minority languages. The current project on Sweden's unique heritage of early cadastral maps is frequently being reported. Conference papers are the main source for journal contributions, but shorter notices from other sources do appear also.

Section members regularly attend the biannual conferences on the history of cartography (ICHC, next time in Bern July 2007), but only rarely the ICA conferences.

Former section chairperson Ulla Ehrensvärd is still the leading Swedish figure in the field with her recently published "The history of the Nordic map: from myths to reality" and as the regional editor for the Chicago-based "History of cartography" project.

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Students´ maps are exhibited during the Map Exhibition in Kartdagarna.

The Cartographic Section

The Cartographic Section of the Swedish Cartographic Society consists of a board of four members, whose main duties are to arrange sessions, map exhibitions and a thematic quiz at the technical exhibition for the annual conference "Kartdagarna". An introductory course in map production has been held during the conference. The section also acquires papers or proposals of papers to the society journal "Kart & Bildteknik". In addition, study visits are occasionally arranged.

One member of the section is now editor of the jubilee book that will document the work of the Cartographic Society over the last 100 years. This national report for the ICA is taken care of by another member and the web site by a third member. Members regularly attend the ICA conferences and the section is responsible for the Swedish contribution to the International Map Exhibition and to the Barbara Petchenik competition for children at the ICC.

The Map of the Year 2007 was a combined chart and orienteering map from Blekinge in Southern Sweden.

One of the childrens´ maps that will be sent to Barbara Petchenik Award in Moscow 2007.

The Cartographic Section puts great emphasis on encouraging education in cartography and making people aware of and more interested in maps. Education in cartography is very limited in Sweden, despite the fact that more and more maps are being used in the different media – newspapers, TV and internet etc. Maps are an ideal method of graphic presentation and indispensable to the media. There is a need to help the public get the most out of these maps and other graphic presentations. Web cartography will in the future become an important area of interest. As a step in this direction, the Swedish Cartographic Society has financially supported the publication of a school book in cartography.

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The Section of Geodesy

The education of surveyors and GIS engineers has changed a lot the last 20 years. New places of education have been established and allow increased possibilities to recruit surveyors throughout the country. The conditions of educating surveyors, geodesists and GIS engineers at the level of Master of Engineering have not changed in the same propitious way and the result is a decreasing number of candidates. It is a very alarming and negative trend in the present situation when so much is developing in the sector. The Swedish Cartographic Society is conscious of the problem and supports efforts in trying to turn this negative trend and create a debate about it. During the last few years the Cartographic Society has altered the program at the annual conferences (Kartdagarna) to be more a kind of education opportunity instead of just a traditional conference. For a few years now the geodetic sector of the association has focused principally on subjects related to geodetic reference system and GPS.

Recently, GPS surveying has, in many cases or perhaps most cases, replaced traditional terrestrial measuring. Static surveying using GPS has become a common tool in many organisations. In Sweden there are by now several hundred users of RTK based on own reference stations or RTK based on the National Land Survey Network-RTK service, named SWEPOS. Hence, satellite based positioning with centimetre accuracy is becoming more and more common. For efficient geodetic surveying and processing of survey data many users are in need of an unambiguous and stable geodetic reference system. Then, using Network-RTK based on SWEPOS there is also a need to have access to GSM and there is still a problem in some areas of not having access to continuous signals. More often the operator (the user of the surveying tool) has the surveying tool integrated in the general working tool, e.g. the excavator or the road grader and staking out as preparation for construction is no longer necessary. Information, such as drawings, maps or other geographical or numerical information is stored digital instead and presented graphically on screen and integrated with the positioning system. Hence, the need for a surveying engineer is reduced and his duty is taken care of instead by the excavator or any other operator, in most cases without specialist surveying knowledge. Consequently, the measurements need to be done unambiguously (e.g. without any alternative solutions) and with great reliability.

The three-dimensional and globally adjusted Swedish geodetic reference system SWEREF 99 replaces more often the old two dimensional RT 90 as well as local systems being used by municipalities. In addition, a new geoidal model combined with a new height system makes it possible to use GPS for reasonably accurate height measurements. This will hopefully lead to a uniform reference system for all kinds of applications in the country.

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The Educational Section

Many factors have influenced the current situation for companies, authorities and organizations to recruit personnel with educated cartographical and related skills. Two examples are new technology and shortage of educated people. Therefore, a new section for educational matters was formed in the Swedish Cartographic Society. The aims of the educational section include working with educational matters on all levels, both nationally and internationally, and act for increased competence development in cartography and related fields in Sweden. Among the activities is an annual conference for lecturers and others where educational matters are treated.

Cartography has long standing traditions in Sweden. Maps are widely spread throughout society and their use is to some extent taught already in primary school. For example, maps are used in many outdoor activities and sports, like hiking, orienteering and rally. Many of the activities have their origin or strong roots in Sweden or Scandinavia at large. However, despite the widespread use of maps, there has never been a chair in the subject at any of the Swedish universities. Cartography is taught at several Swedish universities. A survey including the 61 universities in Sweden showed that 24 of them give courses containing elements of cartography. Among these, there are nine universities which provide courses where the main focus is on cartography (Table 1).

There are also a number of courses where cartography makes up a major part of the total course content (Table 2).

As can be seen from the tables, courses focusing on cartography only are relatively few. However, many universities give courses in earth science, geography, geoinformatics and geomatics that contain elements of cartography. These are, in addition to the universities mentioned above: Chalmers University of Technology, Göteborg University, Jönköping University, Linköping University, Lund University, Malmö University, Mid Sweden University, Mälardalen University,

University	Course name	ECTS	Level
Blekinge Institute of Technology	Computer assisted cartography and presentation	7.5	A
Gotland University	The map I – History of cartography	7.5	A
Karlstad University	Cartography I	7.5	A
	Cartography II	7.5	B
Luleå University of Technology	Cartographic visualization	7.5	A
Royal Institute of Technology	Visualisation techniques	7.5	C
Stockholm University	Cartography and map production	15.0	B
Umeå University	Cartography	7.5	A
University of Gävle	Applied cartography	7.5	A
	Cartography I	7.5	A
	Cartography II	7.5	B
University West	Cartographic visualisation	7.5	A

Table 1. Courses in cartography at the Swedish universities. 7.5 ECTS represents work effort equal to 5 weeks full time studies. A is basic level, B is intermediate level, and C is advanced level on first cycle education (usually Bachelor's programmes).

University	Course name	ECTS	Level
Gotland University	Cartography and geographic information systems	7.5	A
Högskolan Dalarna	Cartography and Geographic Information Systems	7.5	A
Royal Institute of Technology	Web-GIS	7.5	D
Stockholm University	Geographical Information Systems and Cartography	7.5	A
University of Skövde	Geographical Databases and Cartography	7.5	A

Table 2. Courses where cartography constitutes a major part of the total course content at the Swedish universities. 7.5 ECTS represents work effort equal to 5 weeks full time studies. A is basic level on first cycle education (usually Bachelor's programmes) and D is level given on second cycle educational (usually Master's programmes).

Swedish University of Agricultural Sciences, Södertörn University College, University of Kalmar, Uppsala University, and Växjö University.

It should be noted that courses with closely related content, such as map projections or web mapping, have been excluded from this study, since they are more appropriately described as courses in geodesy or application development or programming. Also, there are a few non-university programmes, funded by the Swedish Agency for Advanced Vocational Education, that include basic courses in cartography. Furthermore, practically all introductory university courses on geographical information systems (GIS) include some cartographical issues. A survey over the GIS courses given in Sweden was carried out by Brandt et al. (2006).

Although there are both undergraduate and graduate programmes that include cartography courses, no programme explicitly educates cartographers. However, it is often possible to write a thesis or conduct PhD studies in earth science, geography, geoinformatics or geomatics where the focus is on cartography. It must be pointed out that e.g. a geomatics programme can be very similar to cartographic programmes abroad.

With the introduction of GIS, there has been a general trend of decreasing cartographic skills of students and high-quality maps are getting scarcer. The students have moved from drawing maps by hand to create them in the computer. This has reduced their skills and cartographical understanding, since the software used has limitations in respect to variations of possible symbols, colours, etc. Another reason is that more time is spent on how to use the GIS, whereas earlier, more time was spent on cartographical issues. A survey by Elg (2004) looked into this problem. She concluded that this was indeed the case, but also found that some universities have realised the problem and are trying to include the cartographic training in the more computer-technical GIS courses.

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Elg, M., 2004, En enkät om kartografiutbildning. Kart & Bildteknik (Mapping and Image Science), Vol. 19(3), pp. 18–20. In Swedish.

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Sweden's County Administrative Boards

Organisation

Sweden is divided into 21 counties, each of which has its own County Administrative Board ("Länsstyrelsen") and County Governor.

The function of the County Administrative Boards is to be a representative of the state in their respective counties, and serve as a link between the inhabitants, the municipal authorities, the Central Government, the Swedish Parliament and the central state authorities.

GIS/GIT Activities

Maps and databases are frequently used in many of the legislative tasks, such as permits or recommendations for a proposed expansion of some exploitation request etc., in the day-to-day work carried out by officers at the County.

The County Administrative Boards are both data consumers and data producers. In the day-to-day work officers make extensive use of background data from National Land Survey, the Geological Survey of Sweden, the Swedish Maritime Administration, Swedish Meteorological and Hydrological Institute and many other data providers. Internally produced data, such as various protected areas, are also used in large extent.

Internally produced data are freely distributed throughout service platform "LstGIS" (www.gis.lst.se). Some characteristics of LstGIS service platform include:

Over 1 500 GIS-related layers uploaded and provided by each County (www.gis.lst.se/lstgis)

Over 20 harmonized layers with national coverage (www.gis.lst.se/lstgis/lstsverige). These layers are also provided as OGC WMS WebMapServices (www.gis.lst.se/lstgis/wms.asp)

Approx. *10 GeoServices* in application fields such as WindEnergy, Environment, Crisis Management and Oil Spill recovery Atlas. Some of these webGIS-applications are public, others are password protected.

Metadata are provided using core components from ISO19115.

LstGIS service platform, start page

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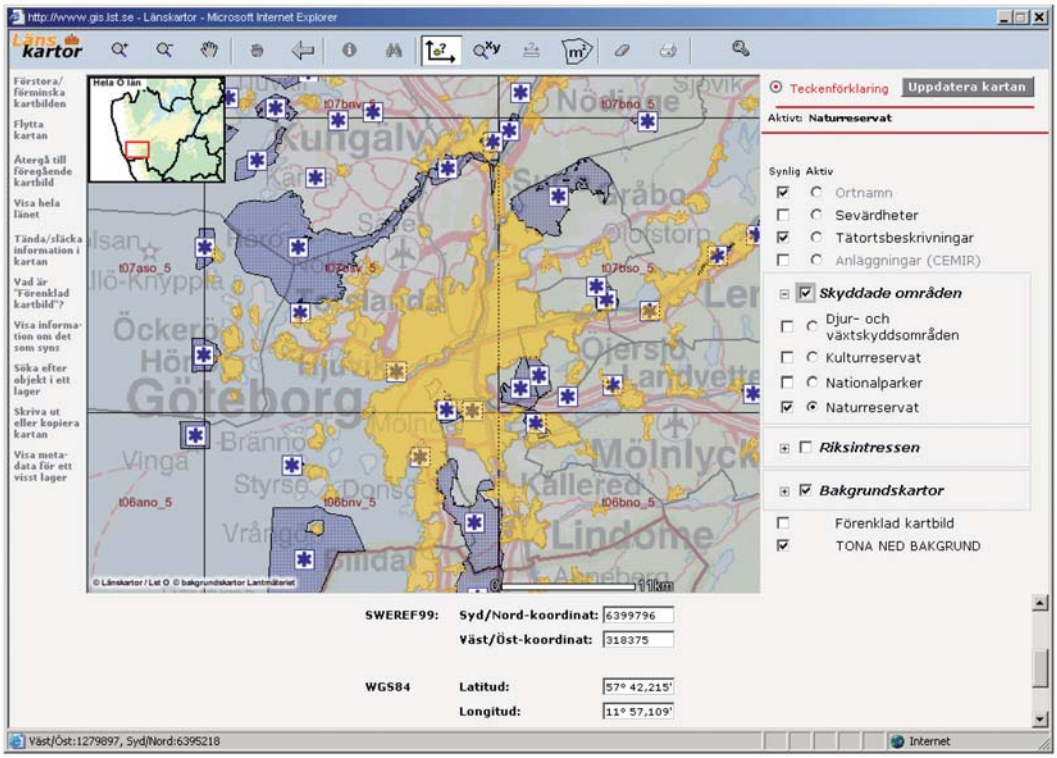
LstGis service platforms where you can find the different organisations involved.

Example of GeoService "Sveriges Länskartor" (general environmental)



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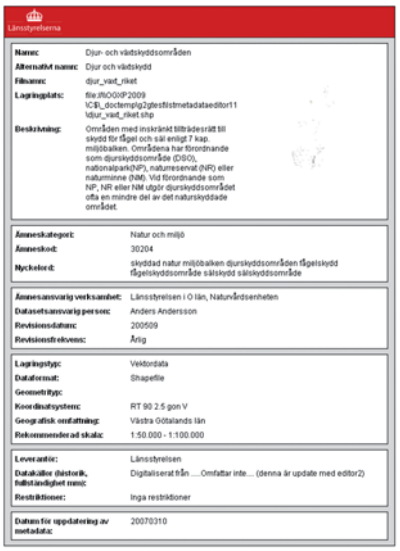
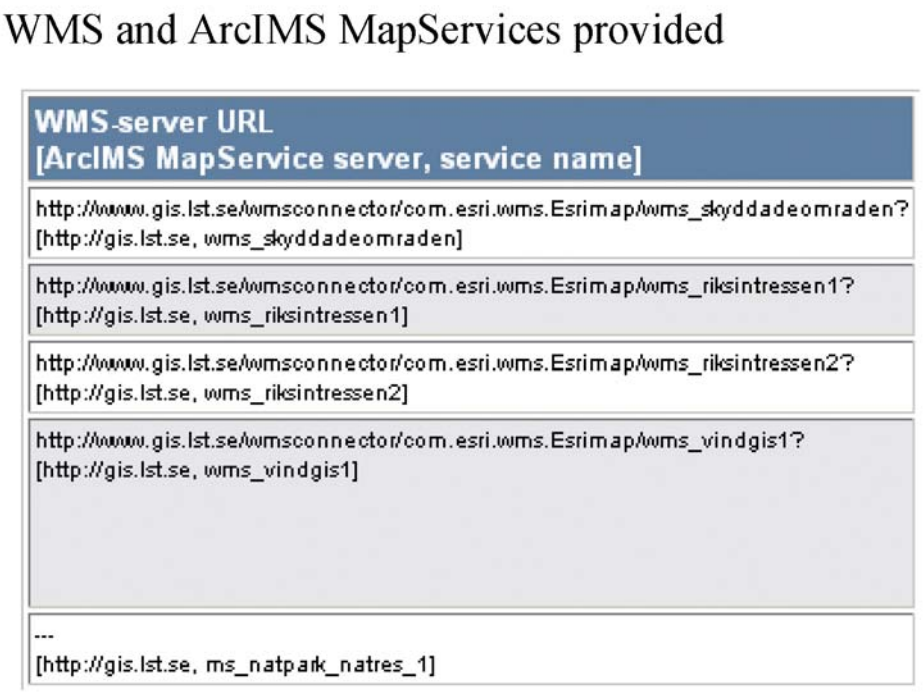
Stylesheet to present ISO19115 core metadata





Since its introduction in 2001, LstGIS download service platform has rendered over 200,000 downloads. Compared to investments made, the cost for each downloaded dataset is approx. 5 SEK (less than 1 US$). The site www.gis.lst.se has some 1,000 unique visitors/day. Approx. 35% of the users are consultants, 25% communities, 20% other authorities, 10% universities and 10% private persons.

The LstGIS service platforms conforms to a large extent to the demands on Network Service outlined in the INSPIRE directive.

Technical Development

Recent technical development includes:

- An enterprise agreement with ESRI, which includes most of the server and client software from ESRI.
- Work with a "standardized" repository for internally produced data in ESRIs ArcSDE database.
- For customisation of GeoServices, both internal and external, we use a set of internally developed JavaScripts.
- Metadata application of core components from ISO19115.
- Database development for various applications.
- Participating in the Planning Portal-project run by the National Board of Housing, Building and Planning. Development here includes publication of WMS and harvesting of ISO XML-based metadata. The Planning Portal-project can be viewed as a pre-test/forerunner to the national SDI.
- Coordination of various regional and national educational programmes. One example is the "StrateGIS"-project (2002-2003, funding approx. 21 million SEK), where the number of participants was 5,000 in the first phase (politicians and decision makers), 1,000 in the second (GI officers) and at least 20,000 in the final phase (end users).

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The Local Authorities

Organisation

The 290 local authorities in Sweden have a well-developed self-governance and are by constitution, autonomic. To perform their tasks, geographical data and maps are used in several ways. There is a considerable need for different maps in a variety of activities and operations.

The role of the local authorities in providing

basic large-scale geographic data becomes more important as its usage increases in a lot of old and new applications, where GIS offers good support. There is also municipal co-operation within regions as well as between the municipalities and the state, in order to provide society with quality controlled geographic data. Most local authorities produce and update geographical databases or maps within their organisation. In most cases, the organisations responsible belong to the town planning committee. Other local authorities purchase the service from commercial companies, and some perform the task in co-operation with other local authorities.

There are 850 000 people employed in the local authorities, which is equivalent to a fourth of the total sum of the employed part of the population.

Co-operation

Most authorities have formed a group for the most frequent internal and external users of maps and GIS data. These groups usually deal with matters of co-operation, technical development and financing.

There is an extensive co-operation between the Swedish Association of Local Authorities and Regions (SALAR) and Lantmäteriet (the Swedish National Land Survey) concerning e.g. collaboration in constructing national databases. A framework agreement on this matter was drawn up in 2001 and has been renegotiated every third year in order to include more data at higher quality in exchange for higher economic compensation. The co-operation concerns addresses, buildings, other topographic objects and cadastral index maps, among other matters. Normative agreements have also been developed that the local authorities may use as a base, while making their individual agreements with Lantmäteriet. There is a similar set of agreements with Vägverket (the Swedish National Road Administration) concerning the road network.

SALAR and Lantmäteriet have developed a common vision for the future co-operation concerning geographic information and cadastral activities. In order to obtain a more efficient Swedish SDI, the vision submits a network-based collaboration for exchange of data in society. The vision describes geographic information as a part of e-government. The same concept was adopted in the National Geodata Strategy produced by Geodatarådet (the high level advisory board) at Lantmäteriet, in which the local authorities are represented.

Co-operation is becoming more and more common. In order to offer map-users harmonious and highly accurate county-covering data, the local authorities in several counties work together with harmonious geographic databases covering the cities. In some regions, Lantmäteriet fills the gaps between the urban areas. The most frequent users are the transport sector, emergency and rescue services and the police force.

"SAM-project", ("the Coop-project") is an informal organisation financed by individual local authorities, Regional Associations of Local Authorities and SALAR. Nearly half of the municipalities contribute financially to the project. The project aims to provide good, basic support to the municipalities within the field of geographic information. The project provides advisory reports and seminars for co-operation, agreements, working processes etc.

Development

E-government has received an introduction into all sorts of activities within the local authorities and the applications increase rapidly. Development of GIS-applications as e-services is constantly in progress. The issue of national specifications of requirements for common functionalities for adoption in various administrations is at present in focus. Also, the discussion of creating a national role-based system for electronic identification is of immediate interest for the municipal administrations.

The GIS-technology has been adopted within most municipalities. Considerable efforts are made while transforming data from CAD-systems, to data suitable for the state-of-the-art GIS-systems.

It is obvious that there are difficulties in spreading GIS technology outside the mapping organisation to other administrations such as schools, social services, and health care. Hinders may consist of poor resources, non-structured datasets, or pedagogical difficulties. Many local authorities have employed a GIS controller in order to stimulate the use of GIS in all sorts of activities within the organisation.

Today the GPS technology is commonly used. Aerial photography, digital aerial images, orthophotos and photogrammetric mapping are often purchased at intervals of several years. Nearly 10 of the 290 municipalities have their own digital photogrammetric software for collecting data from aerial images. As a complementary way of assembling data, some local authorities have adopted the method of laser scanning. This method generates digital terrain models as well as digital surface models at a reasonable cost. Altitude data are used, for example, for three-dimensional city models and for production of orthophotos.

In order to give a high-quality picture of proposals on spatial planning and infrastructure, some

local authorities, have utilised the technology of Virtual Reality. Others are on their way to transforming their data into three dimensions for the purpose of visualising the urban environment in a more natural manner. To facilitate the processes of planning and building permit, oblique aerial imaging systems have been introduced in the largest municipalities.

The GPS-based Network-RTK (Real Time Kinematics) technique has step-by-step been introduced in Sweden. The technique has proved to be an economically advantageous method of determining positioning with a high degree of accuracy. RTK will be established over all inhabited areas of Sweden during 2007. The project is a co-operation between Lantmäteriet, other central governments and local authorities within the regions.

The changeover to SWEREF 99 and RH 2000, which are the Swedish realizations of the European reference systems ETRS 89 and EURS, is in progress within the municipalities. About fifteen municipalities have completed the transition to SWEREF 99 and in another hundred, work proceeds actively. Concerning RH 2000, corresponding figures are five completed respectively 50 actively working.

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Lantmäteriet (The National Land Survey of Sweden)

Lantmäteriet (National Land Survey of Sweden) is responsible for the production of the national map series and geographic databases and is also undertaking a good deal of cartographic work and GIS consulting on repayment basis.

Organisation

The National Land Survey of Sweden, originating from 1628, is a Government agency under the Ministry of the Environment. The mission is to give support for creating an efficient and sustainable use of Sweden's real property, land and water. The organisation has three main activities, which also form the organisational structure: Cadastral services, Land and Geographic Information Services, and Metria, which wholly is working on a competitive, commercial basis. Support for these activities is provided by corporate functions. Swedesurvey is the overseas agency of the National Land Survey of Sweden.

The total staff amounts to 2,000. The headquarter is situated in Gävle. The annual turnover is approximately SEK 1,700 million. SEK 1,300 million are generated through fees and invoiced costs for real property formation, the use of information from databases and for consultancy services; core grants from Government amount to approximately SEK 400 million. Core grant financing is primarily used for producing basic data and managing and maintaining registers and databases.

Cadastral Services

The Cadastral services Division comprises 21 Cadastral authorities (one in each county) and, on the central level, one unit for development and one for management. Most of the Cadastral authorities also have local offices – in total there are 90 offices in the country.

The Cadastral authorities carry out cadastral procedure activities, and provide different types of services, which are closely linked to their official duties. The cadastral services comprise real property formation through formal cadastral survey and maintenance of the real property register. Common tasks are sub-division of land into plots for building houses and recreational homes and reallotment to ensure the availability of land for building roads, railways and public utilities.

At the central level the division of Cadastral services has the responsibility for the supervision of, and to give support to, the regional Cadastral authorities. The most important task is to support the real estate formation process. That includes law amendment, quality control, competence development, and development of techniques and methods in order to shortening the handling of cases and reduce the costs.

Land and Geographic Information Services

This activity, which mainly is carried out at the central office, comprises responsibility for collecting, administering and making available basic land-related data, geoinformation and information on Sweden's 3.2 million real properties. It includes basic geographical databanks, the series of official maps (printed and on CD), information from geodetic and aerial photo archives, the land data bank system, central registers of buildings, apartments and address as well as the credit market (mortgage) system.

The responsibility for all kinds of basic information services includes archives, registers, maps, databases produced by in-house and collaboration resources. This part of Lantmäteriet also holds basic competence for development in geodesy,

photogrammetry, cartography and geographic information systems.

Metria

Metria is the part of the organisation with resources for collection and customization of geographical and real property information, surveying computation, map production, geographic information systems and physical planning. Metria carries out its services on contract and operates in competition with other Swedish and international companies on the national market. Metria is also operating as a vendor and as a production and consultant enterprise in the growing remote sensing activities. Through KartCentrum, Metria is responsible for the publication of the national map series and other map products, as well as for a comprehensive cartographic activity on a contract basis. Metria´s clients are to be found in both the private sector, such as forestry and telecom companies, and in the public sector.

Swedesurvey

The National Land Survey's overseas agency, Swedesurvey, is a governmental company that markets, co-ordinates and provides services in land administration and surveying throughout the world, often in the form of institutional co-operation.

Swedesurvey has been active on the international market since 1980 and has always aimed at providing high quality services based on the requirements of the customer. Swedesurvey's status as a Government company guarantees impartiallity, reliability, quality consciousness and continuity. Swedesurvey has an annual turn over of approximately SEK 100 million and works in about 30 different countries every year.

General Comments on Cartographic Activities

The period 2003–2007 can be characterised by focus on:

- Production of maps and map-related services in new media, such as mobile phones, handheld computers, Internet-based services and GIS applications
- Development of the spatial data infrastructure
- Introduction of a wide range of Internet based services
- Introduction of satellite-based positioning system with centimetre accuracy
- Widened co-operation on the European and Global level
- Establishing of a new national geodetic reference system and a new national height system
- Introduction of a new map index system and accordingly, new map sheets for the national mapping series as a consequence of the new geodetic reference system
- A complete switch to digital sensors for the aerial photo production

Strategy for the Swedish SDI Development

The Swedish Government and Parliament has given Lantmäteriet – the National Land Survey of Sweden – an outspoken role as coordinator of the national spatial data infrastructure (SDI). The responsibility comprises coordination of production, cooperation, dissemination and research and development. The responsibility also includes coordination of the implementation of EC directives related to GI (such as INSPIRE and GMES).

Government has also decided to establish a high level advisory board (Geodatarådet) supporting Lantmäteriet in its coordination role. Furthermore, it has been decided to develop a national geo-data strategy covering all strategic issues related to the handling of geo-data in Sweden. Lantmäteriet is responsible to work out this strategy in close cooperation with the advisory board and other stakeholders. The strategy was presented by end of March 2007 and will then be annually updated.

The strategy is based on detailed investigations on user requirements and provides guidance for all players in the GI field in Sweden. Based on a common concept for the development of the Swedish SDI strategic goals are clearly identified and strategies for achieving the goals formulated.

It is expected that implementation of the strategically most important issues, both national and international, that are given emphasis in the strategy will take place following further work on the details of the action plans for the involved authorities and organisations. The strategic plan should, thus, be the basis for ensuring that such activities are carried out in a coordinated and efficient manner. A requirement is also that the strategic plan should provide the foundation for the coordination and preparatory work for budgetary and other decisions within the government and its offices

An important issue concerning the strategy is clarification of the Swedish position concerning the INSPIRE directive, the development of Global Monitoring of Environment and Security (GMES) and the implementation of the PSI directive for geodata.

The Strategy for the further development of an national infrastructure for Geodata is

to cooperate in a network as a basis for the infrastructure.

The strategic goal is to establish well functioning cooperation between independent organisations – supported by coordination activities, technical framework and explicit agreements.

to create a useful structure of the information.

The strategic goal is to meet basic needs concerning usability, interoperability (between different data themes, different application areas and across boarders) and quality as well as accessibility. The specifications should be established based on a uniform Swedish framework and with full participation from the involved parties, such as other governmental agencies, municipalities and other organizations and enterprises

Lantmäteriet is responsible for setting up an organisation for management of the geodata specifications. Already today there exists a Swedish framework for standardisation of geographic information, which to a large extent is based on international standards (the ISO 19 100 series).

to develope a technical infrastructure which will meet future demands.

The strategic goal is to form a technical infrastructure supporting an efficient cooperation within production, updating and management of geodata as well as giving the users easy access to the data. A national geo-portal will be established to support the users to search, find, look at and download data coming from different sources and being physical stored in different technical environments. Thereby, the geo-portal will also serve as the main node for the Swedish cooperation in Europe according to the INSPIRE Directive.

National metadata catalogue

The strategic goal is to establish the necessary organisation, standards and technical solution in order to give the users easy access to information about available geodata, its quality and conditions for use.

Geodetic reference system

The strategic goal is that all actors who are building up, processing and using geodata shall use a common geodetic reference system and normally without any previous transformation. In Sweden a three-dimensional reference system with high accuracy has been adopted and is now being implemented. Lantmäteriet has already changed to this new system, which is directly related to the global and European reference systems, and is now supporting all other organisations in their changeover.

Research, development and education

The strategic goal for Sweden is to establish a more coherent research and development directed to support the development of the SDI. The R&D activities should emanate from helping to solve real problems and possibilities to cooperate internationally should be used.

Legal framework

The strategic goal is to develop a clear and distinct legal framework regulating the conditions for exchange and use of geodata. It should be based on a commonly accepted balance between the needs to protect important interests in society (such as security, vulnerability, integrity and copyright) and the users' needs of easy access to the actual information.

Financing and pricing

The strategic goal is to achieve benefits from a more efficient SDI with profits for all concerned parties, and to develop efficient models for financing and pricing.

Investments

During the period 2003–2006 investments relating to cartographic production have been of similar volume as during the last period. Most noticeable are the investments made in digital sensors for aerial photography replacing the old traditional cameras, in working stations for digital photogrammetry and in equipment for storage and distribution of geographic data.

Aerial Photography and the Production of Orthophotos

Aerial photography

Aerial photography is mainly carried out in order to meet the needs for aerial photos and orthophotos within the national mapping program, but at the same time the activities are planned with the goal to provide other users (municipalities, forestry companies, etc) with appropriate information. New aerial photos cover approximately 30 percent of Sweden every year.

New digital sensors are now introduced at Lantmäteriet, and two sensors will in 2007 replace the traditional aerial photographic cameras. The new sensors will simultaneously produce black/white, true colour and IRF data sets. They are furthermore the first step in a complete digital production line in the mapping process, ending in digital archives and in further dissemination.

In 2006 an area of 130,000 square km was covered in a mixture of black/white, colour and IRF products in an altitude of 4,600 m. 36 major cities were covered from an altitude of 2,000 m. The use of infrared film (IRF) has been gradually increased.

There is a national coverage of digital orthophotos with 1 m pixel size. In a number of larger cities the resolution is 0,3 metres.

Map Projection and Horizontal Reference System

The national map series are based on the Transverse Mercator projection (Gauss conformal pro-

jection) with the GRS 80 ellipsoid and is based on the national reference system SWEREF 99. The map projection is called SWEREF 99 TM.

The horizontal reference system for the new national grid is called SWEREF 99, the vertical RH 2000, and the reference system for gravitation is called RG 82. SWEREF 99 is globally adjusted to the EUREF specifications and is nationally adjusted to one single UTM zone. The replacement of the old RT 90 and the local systems being used by municipalities by SWEREF 99 will lead to a uniform reference system for all kinds of applications in the country. The replacement at Lantmäteriet took place in January 2007 and was made in all geographic databases and registers as well in the orthophoto production.

National Map Series

Lantmäteriet is responsible for the national mapping at scales of 1:10 000 and smaller. Besides, Lantmäteriet, is responsible for production of property maps and cadastral index maps at large scales.The national map series are

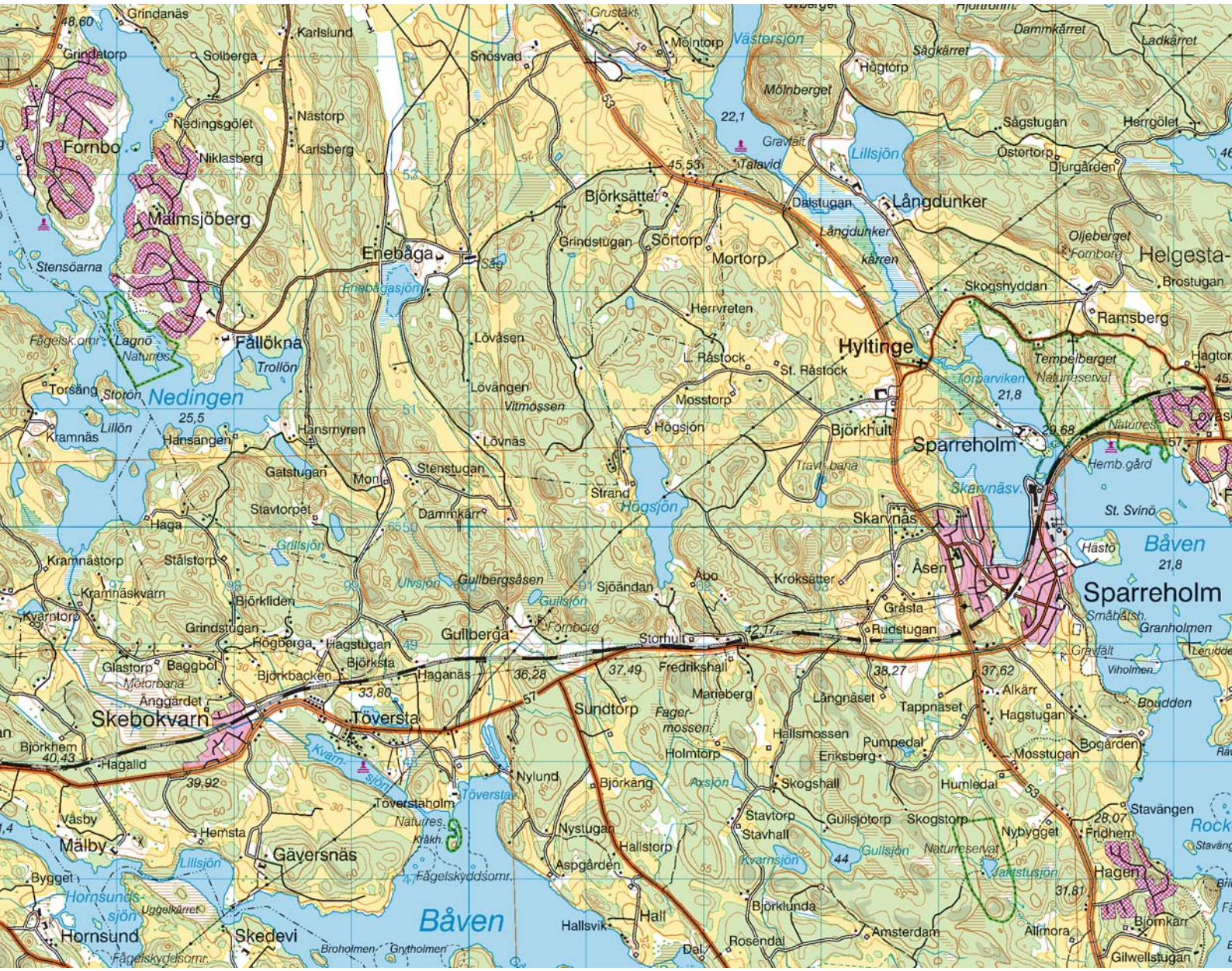
The Property Map (Fastighetskartan)

is produced in the scale of 1:12,500 and is delivered as a print-on-demand product in order to give the customer the most updated information that exists. The map includes:
The orthophoto.
Boundaries, including property boundaries.
Names and register numbers of property units.
Place names.
Line enhanced planimetric details.
Arable land.
Contours at a 5 m interval.

The Topographic Map (Terrängkartan)

series consists of 244 sheets at 1:50,000. It covers the entire country except for some parts in the mountain areas in the northwest of Sweden. The Topographic map gives detailed information

Terrängkartan 1:50,000



Vägkartan 1:100,000

Översiktskartan 1:250,000


Torneträsk
Abisko
Abisko nationalpark
Stordalens naturreservat
Förbjudet område för terrängcykeln
Stordalen
Njulla
Slåttatjåkka
Fågelskyddsomr.
Åbeskosuolu
Miellesuolu
Ruovdenjárga
Čuovžanjárga
Naturreservat
Forskningsstn
Meditationsplats
Vuolle Njáhkájávri
Bajip Njáhkájávri
Njáhkáčavil
Báddosdievvá
Ofterplats
Mielletjohka
Vuoskkojohka
Vuoskkooaivvi
Vaimooaivi
Vaimojohka
Vaimoväggi
Nissonsnuohkki
Nissonjohka
Nissongarsa
Nissonväggi
Nissončorru
Nissonväggijohka
Tjuonatjåkka
Čuonjáčohkka
Čuonjávaggi
Čuonjájávri
Čuonjájohka
Suorojávri
Åbeskojávri
Åbeskojåkka
Åbeskoeanu
Gorsajohka
Gorsaskáidi
Karsajåkka
Renvaktarstuga
Kungsleden
Gironsnuohkki
Tältlägret
Last
Coamohasjohka
Coamohasriehppi
Giron
Tjåmuhas
Coamohas
Kieronstugan
Ballinjohka
Ballinväggi
Ballinsnuohkki
Pallentjåkka
Ballinčohkka
Ballinbogičohkka
Ballinriehppi
Ballinriehppiokeln
Gaskariehppi
Šiellanjohka
Šiellanjunni
Gárddenväggi
Adnjetjårro
Ádnji
Guhkesriehppi
Goalkáščohkka
Honga
Gielasčohkka
Šiellačohkka
Bähkkabahokčohkka
Bähkkabahokčohkjohka
Goalkásjohka
Viddjå
Åhpparbákti
Åhpparjávri
Ribakluokta
Peiggaluoppal
Gahčahaknjárga
Åhpparbohki
Bieggaluoppal
Gahčahaknjohka
Vuopmegeahči
Rautasjaurekåtan
Alisegannu
Suorivarri
Rengärde
Fjällkartan) 1:100,000

Fjällkartan) 1:50,000

about land use, settlements and about all kinds of roads and footpaths.

The Road Map (Vägkartan)

series has been designed to be used as a detailed and up-to-date national road map. The map series consists of 79 sheets in the scale of 1:100,000.

The Mountain Area Map (Fjällkartan)

series is the topographic map at 1:100,000 for the mountain areas of Sweden. The maps have been adapted to cater for mountain hikers. Special information, for example about trails and shelters, is printed in purple. Some sheets in the southern part of the mountain areas are produced in the scale of 1: 50,000

The General Map (Översiktskartan)

consists of 21 map sheets in the scale of 1:250,000.

Small Scale Maps

produced at smaller scales include:
The latest version of Sweden at 1:1 million (Sw. Sverige 1:1 miljon)
A map of Northern Europe at 1:2 million (Sw. Nordeuropa)
Aeronautical Charts-ICAO at 1:500,000 (seven sheets)
Cartographic Activities on a Repayment Basis

KartCentrum

produces a wide range of products based on the national map series as well as town plans, maps for tourism, road maps and road atlases.

The National Atlas of Sweden (Sveriges Nationalatlas /SNA)

Principal for the National atlas of Sweden is The National Land Survey. 18 volumes about national topics and a summary volume were produced in the period 1990–2000. The books were published in Swedish and English. The atlas was also distributed as a PC-atlas/CD-ROM product within this period.

This original part of National Atlas of Sweden include following volumes:
Maps and Mapping – The Forests – The Population – The Environment – Agriculture – The Infrastructure – Sea and Coast – Sweden in the world – Cultural Life, Recreation and Tourism – Work and Leisure – Cultural Heritage and Preservation – Geology – Landscape and Settlements – Climate, Lakes and Rivers – Manufacturing and Services – Geography of Plants and Animals – Public Health and Health Care and the summary volume Geography of Sweden.

In 1999 the first regional atlas Atlas över Skåne was published and had until 2003 been updated and published in new editions.

Being richly illustrated with photographs, drawings and charts, the National Atlas of Sweden differs somewhat from traditional atlases. It has been highly appreciated by academicians, politicians, planners and the general public. Each volume has sold between 13,000 and 25,000 copies, which makes the edition the most successful national atlas in the world, per capita.

A second regional atlas covering the county Västra Götaland was published in 2004.

Since 2004 the policy for future updating of the National Atlas of Sweden is a fully web-based GIS services on Internet, free available at www.sna.se. As a demonstration the volume *Västra Götaland* is now available in the new concept and it will be followed by a new version of "Swedish Geography" in the end of 2007 and after that continually updated.

A third regional atlas about The Stockholm – Mälaren Region is in production and will be published in 2008. Three new national volumes will also be added to book series and to the Web Atlas GIS. The manuscripts for these volumes will be delivered in 2007 and will be published in the two following years. The titles on these productions are Swedish Languages, Swedish Agriculture and Forestry in the last 100 years, and Mining and the Steel and Metal Manufacturing. All of the new book volumes are financed by external sources.
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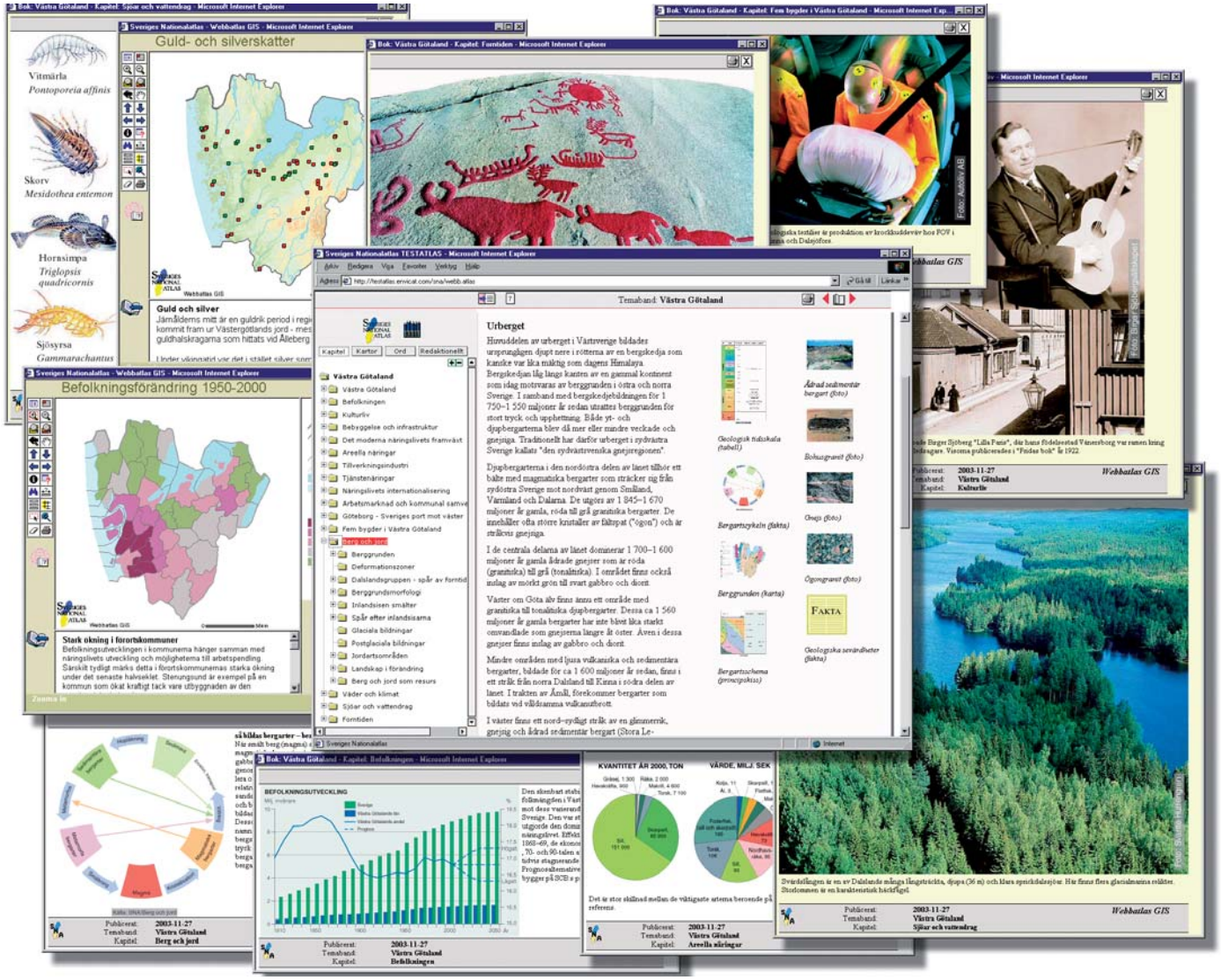

The Swedish National Atlas in WebbGIS

GIS Activities – Geographic Data Sweden

In Sweden there is a large, and increasing, demand for basic geographic data shown on the national maps in database format from a wide range of users. The Land Survey supplies these data, as well as other geographic data, under the generic designation, Geographic Data Sweden (Sw. *GSD*). Most of the databases are complete whereas production of others is in progress.

GSD-Property Map (GSD-Fastighetskartan)

The database contains the main part of the contents of the Property Map and can be used both in GIS and for map production. The database covers all of the country except for the mountain areas.

GSD-Elevation Contours (GSD-Höjdkurvor)

The elevation contours are produced primarily for the mapping series, but are also handled as a separate data base.

GSD-Digital Elevation (GSD-Höjddata)

The database contains height values for a regular 50x50 m grid covering all of Sweden. Some 200 million values are stored. One major use of the data is the generation of control data for the production of digital orthophotos. In the cartographic field some new relief maps have been produced. Hill shading has been calculated from the elevation data and plotted on a laser raster plotter.

GSD-Orthophoto (*GSD-Ortofoto*)
Contains orthophotos in raster format for the entire country.

GSD-Topographic Map (*GSD-Terrängkartan*)
The databases have a vector format and have the same content as the printed Topographic map series.

GSD-Geographical Names (*GSD-Ortnamn)*
This database contains all of the toponyms shown in the national map series.

GSD-Road map (GSD-Vägkartan)

The databases are in vector format for use in GIS and they are produced in connection with production and revision of the Road Map. The databases have the same contents as the maps and are covering the entire country.

GSD-General Map (GSD-Översiktskartan)

The database contains the same information as the printed General Map series. It can also be delivered in raster format.

GSD-Administrative boundaries(GSD-Administrativ indelning)

Information in vector format about the administrative boundaries (county, municipality, parish, etc).

GSD-Land Cover Data (GSD-Marktäckedata)

The database contains a detailed description of land use in 60 classes. The database is available in both vector and raster format.

The Swedish CORINE Land Cover

is build from GSD-Marktäckedata. It meets the European CLC specifications and includes 44 classes,

GSD- Map of Sweden 1:1 million (GSD-Sverigekartan 1:1 milj)

Data in vector format on administrative boundaries, roads and railroads, lakes and rivers, land use, etc.

The Land Survey is also participating in other international co-operation concerning databases, e.g. Euro Regional Map, Euroroads and EULIS

Internet-based services

An e-commerce Internet marketplace giving easy access to all official maps, high-resolution ortophotos, historical maps, property information, etc., has been introduced. The user can have a look at free of charge and – if he wants to use the data – he can directly adjust the product to his needs, order it, download it (or have it sent on CD or in printed form), and pay for the services by credit card. Up to now, the marketplace contains the following services:

PropertySearch contains information about Sweden's 3.2 million real properties from Lantmäteriet's cadastral registers. Searches are made using either the property designation or the address and it is possible to browse and retrieve information about, for example, owner, locality, as well as area and assessed value. Property Search is available in two versions: one for all citizens and one for professional users. The latter version contains more information, but the users have to sign a license agreement and are required to pay an annual fee.

YourMap is based on the official maps of Sweden (in digital format). The users can look at areas of interest, free of charge and they can order – in digital form or as a print-on-demand – the areas of interest.

MapSearch and Geographical names includes the official maps of Sweden as well as approx. 1,000,000 place names

MapStore provides an easy way to find and order maps, nautical charts and tourist guides.

SwedeImages contains orthophotos covering the entire country. These images have a resolution of one metre. Images for which orders have been placed can be downloaded from the Internet, delivered on CD-ROM or as printed copies.

ImageNet contains satellite imagery, which can be ordered by use of the Internet.

Historical Maps contains a great amount of historical maps from all over Sweden. Through the development of scanning and storage technology in recent years, it has become possible to create digital map copies that meet the standards of researchers and other demanding users.

GeoLex is an interactive service on the Internet with current metadata information about Lantmäteriet's maps, databases, and aerial photos.

For more information about these services see www.lantmateriet.se.

Literature

The Land Survey publishes information on research and technical development in a series called Professional Papers (Sw. LMV-rapport), ISSN 0280-5731.

The national mapping programme is presented annually in the booklet Kartplan that includes a complete map catalogue as well as index maps for all series except for the 1:10,000 scale. The present edition of the Kartplan also includes the programmes for the Nautical Charting Division of the Swedish National Shipping Administration, the Swedish Geological Survey, and the Swedish Meteorological and Hydrological Institute. This information is also available on the Internet.

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Swedish Maritime Administration (Sjöfartsverket)

Organisation

In Sweden the Hydrographic Service is represented by the Swedish Hydrographic Office, a part of the governmental Swedish Maritime organisation (SMA, Swe: Sjöfartsverket). The Swedish Hydrographic Office (SHO, in Swedish Sjökarteenheten) is responsible for the official Hydrographic Service in Swedish waters including Hydrographic surveying. The SHO prepares and issue official nautical charts and nautical publications including notices to marines to support maritime navigation safety and marine environment preservation. The SMA Head office is located in Norrköping including the SHO. SHO staff consists of 70 employees. The Swedish Maritime Administration shall, according to its regulations, primarily serve merchant shipping and carry out these activities along commercial lines. The interests of the national Swedish navy, the fishing industry and the leisure craft sector should also be taken into account. The major part of the SMA's activities is financed through dues on ships and cargoes.

The SMA primary goal is safety and environmental protection. Thus the security in shipping, including the use of charts and publications, is regulated by the International Maritime Organisation (IMO), where the regulatory work is the SOLAS (Safety of Life At Sea) Convention.

In Regulation 9 chapter V of SOLAS the following is stated in referring to Hydrographic Service:

1. *Contracting Governments undertake to arrange for the collection and compilation of hydrographic data and the publication, dissemination and keeping up to date of all nautical information necessary for safe navigation.*

2. In particular, Contracting Governments undertake to co-operate in carrying out, as far as possible, the following nautical and hydrographic services, in the manner most suitable for the purpose of aiding navigation:

2.1 to ensure that hydrographic surveying is carried out, as far as possible, adequate to the requirements of safe navigation;

2.2 to prepare and issue nautical charts, sailing directions, lists of lights, tide tables and other nautical publications, where applicable, satisfying the needs of safe navigation;

2.3 to promulgate notices to mariners in order to keep official nautical charts and publications, as far as possible, up to date;

2.4 to provide data management arrangements to support these services.

*3. Contracting Governments undertake to ensure the greatest possible uniformity in charts and nautical publications and to take into account, whenever possible, relevant international resolutions and recommendations.**

4. Contracting Governments undertake to co-ordinate their activities to the greatest possible degree in order to ensure that hydrographic and nautical information is made available on a worldwide scale as timely, reliably, and unambiguously as possible.

** Refer to the resolutions and recommendations of the International Hydrographic Organization.*

The intergovernmental cooperation in hydrography is done through the International Hydrographic Organization (IHO), by the member states Hydrographic Offices and the Bureau (IHB) in Monaco. The Hydrographic Offices cooperate on standardisation, development of exchange format and distribution system in all matters related to Hydrographic surveying, printed nautical charts, electronic nautical charts and other things related to Hydrographic Service in both globally and regionally aspects.

The regional organisations around the Baltic (Baltic Sea Hydrographic Commission, BSHC) and Nordic countries (Nordic Hydrographic Commission, NHC) are very active in international work and analyses and often both prepare and solve issues together. In certain cases activities are co-ordinated between BSHC and HELCOM. HELCOM is the governing body of the "Convention on the Protection of the Marine Environment of the Baltic Sea Area" – more usually known as the Helsinki Convention. A common plan, the HELCOM Hydrographic resurvey plan, has been developed for the purpose of re-surveying major shipping routes and ports of the Baltic Sea. Efforts are being made by the Baltic countries to co-ordinate reference levels for charts and water level information. Although the Baltic Sea is not affected by tides the Scandinavian land mass is subject to post-glacial uplift. Soundings on charts are related to the mean sea level for a given year with instructions for reducing depths according to the relevant land rise coefficient. A co-ordinated reference level would ease the interpretation of depth information. Easy access to water level information coupled to the same reference would be even more useful.

The SHO performs a full range of services from hydrographic surveying to the sale of updated nautical charts and publications. On a national level the SHO supplies merchant shipping, the Swedish Navy and other users with necessary

done manually in the paper charts according to the weekly publication Notices to Mariners. The digital chart information for use on commercial ships in ECDIS is available to the users through a cooperative work between several nations together with PRIMAR Stavanger. The SHO and other HO:s continuously update ENC's parallel to the production of Notices to Mariners by delivery of ER (ENC Revision) to PRIMAR. Consequently, the up-dating work of the digital charts onboard a single ship can very easily be assisted by an Internet based tool or done by radio communication, diskette or CD directly into the navigators own ENC database, e.g. on weekly basis.

Other publications

In spite of the fact that a modern nautical chart contains a large amount of information there is a need of supplementary information in the form of publications, which describes what usually cannot be reproduced in a chart. The following are the essential ones for merchant shipping produced by the Swedish Hydrographic Office:

Swedish Notices to Mariners (NtM, Swe: Underrättelser för sjöfarande, Ufs) gives information as small notices of warnings or for maintenance of printed charts and other information essential for safe navigation in Swedish waters. It is a weekly publication on the internet (www.sjofartsverket.se).
Notices to Mariners volume A (Swe: Ufs A) is a compilation of general information of nautical interest.
Swedish Sailing Directions (Swe: Svensk Lots) are sailing directions covering Swedish territorial waters and harbours. It is mainly intended for merchant traffic, performed in three volumes, A, I and II.
– Volume A, gives general information of fairways, regulations, limits and borders, meteorological information, ice regulation, etc.
– Volumes I and II Gives descriptions of the coast and harbours (Swe: Kust- och hamnbeskrivning) contain sailing information of fairways, approaches, passages, entrances and harbours, etc.
– *Kort 1 / INT 1* contains symbols, abbreviations and terms used on Swedish and international charts.
– *Swedish List of Lights* (Swe: Svensk Fyrlista), which is a register of lighthouses, light buoys, radio beacons etc.
– *NAVTEX Warnings in the Baltic Sea area: As a supplement* to in particular the Ufs, special navigational warnings are broadcasted.

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Sveriges Geologiska Undersökning (Geological Survey of Sweden)

Organisation

The Geological Survey of Sweden (SGU), founded in 1858, is a governmental authority under the Ministry of Industry, Employment and Communications. A Director General and an executive board manage it.

SGU is today a modern, custom oriented organisation with about 280 employees. The majority of these are based at the head office in Uppsala. There are also regional offices in Stockholm, Göteborg (western Sweden), Lund (southern Sweden), and Malå (northern Sweden). The activities can be divided into five main fields – Geology and Minerals, Environment, Research & Development, Consulting services and the Mining Inspectorate. Financing comes dominantly from government grants with the main goal to provide geological information particularly within the fields of environment and health, physical planning, natural resources, agriculture, forestry, and total defence. SGU may also do commissioned work. Activities are carried out in programmes and projects that give the organisation a high flexibility corresponding to changes in demands.

Main Activities

The aim for the geological investigations is to meet society's demand for new knowledge of bedrock, soil, and groundwater in order to create conditions for a good environment, a long-term balanced supply of natural resources, and utilisation of ground and water with consideration taken to natural conditions. Collected geological information will be made available rapidly and in a form suitable for the user.

The Swedish Government has, in 1999, given new targets for geological mapping. This implies that during a 10-year period general geo information will be obtained for the entire country, including the continental shelf. Within the same time period, more detailed geological information will be prepared in urban districts and ore-potential areas. The databases will contain information on bedrock, soil, and on the most important groundwater occurrences.

The present planning period is reaching its end

and SGU has by commission from the Government proposed a direction and goals for the operations subsequent to 2008. Among other things, this will involve an increased focus on end-user requirements in the collection of geological data, a more active and continuously improved administration of data and increasingly customized deliveries of data to end-users. Geological information will be made more accessible and easier to use for the end-users, with the aim to increase the benefits to society. A report presented to the government in February 2007, contains detailed suggestions for a new direction, organization, goals and financing for the period 2008-2012.

Map Production

The main maps produced during the regular activities are described below. All published maps are now also available as digital databases and geological information from ongoing mapping is continuously stored in databases.

Bedrock maps are used in the exploration for natural resources like metallic and non-metallic minerals, dimension stone, and crushable rock as a replacement for natural gravel resources. Bedrock maps are also the basis for planning of building and plant construction, and are used increasingly in environmental conservation contexts. Bedrock maps are produced at scales between 1:50 000 and 1:400 000 and many maps are provided with separate descriptions.

Bedrock quality maps are compiled from regular bedrock maps with the addition of point information. The maps show main structural features, depth to bedrock surface, areas of high radium index in addition to a classification of the bedrock. Technical analyses on point samples include e.g. the Nordic test for studded tyres, Los Angeles test, and point load index.

Quaternary deposit maps are important in physical planning for building and plant construction, environmental conservation contexts, searching for gravel and groundwater, localisation of environmentally hazardous activities, cable- and pipe-laying, and passability. Quaternary deposit maps are available at scales between 1:50 000 and 1:400 000 with separate descriptions provided with many maps.

Groundwater (hydrogeological) maps form a basis, among other things, for water planning and for establishing groundwater protection measures. Maps are available at 1:50 000 and 1:250 000 with separate descriptions to each map. Available digital information includes location and size of larger groundwater reservoirs and usually also classification of vulnerability.

Marine geological maps show the Quaternary deposits of the Swedish part of the continental shelf and provide information concerning dynamic seabed conditions, availability of certain industrial minerals, and environmental monitoring. They are also an important source of information for biological inventories, aquaculture, fisheries, and defence.

SGU supplies two types of *geochemical maps*: biogeochemical and soil geochemical at the scales of 1:250 000 and 1:1 000 000. Biogeochemical maps show variations in heavy metal concentration in the environment, resulting either from natural geological conditions or from human activities. Soil geochemical maps show pH and natural occurrence of elements in till and are used to show surplus and deficiency areas for nutrients and trace elements, as well as state of acidity.

Geophysical maps are used primarily as a basis for geological bedrock mapping, prospecting for mineral resources, and planning purposes. SGU can provide information on the magnetic field, gamma radiation, electromagnetic field, and gravity that can be used to produce interpretations on geological structures, rock type distribution, depth distribution of lithological units, and crush zones and faults. Geophysical maps are produced mainly as print-on-demand products.

The application of new methods in field work and the increasing use of databases has made it possible to produce thematic products which meet the demands of customers from local, regional, and governmental authorities, private enterprises, consultants, scientific institutions, and the general public.

Other Activities

SGUs Mineral Resources Information Office in Malå hosts the national archive of mineral exploration data. The archive contains virtually all the information produced during the long period of government-financed exploration in Sweden as well as information from other organisations. The extensive material covers exploration reports, maps, and digitised geological, geophysical, and geochemical data.

Mining Inspectorate is led by the Inspector of Mines with a Head Office in Luleå and a Branch Office in Falun. This has permitted important improvements in efficiency through new routines, uniform handling of business matters, and a widening of systematic contacts with all parties concerned.

During the last decade SGU has received different new tasks within the field of environment. One is the responsibility to phase out the storages of the national oil stockpile.

Another environmental task that SGU has received is the responsibility of the national environmental goal for *Groundwater of high quality*.

done manually in the paper charts according to the weekly publication Notices to Mariners. The digital chart information for use on commercial ships in ECDIS is available to the users through a cooperative work between several nations together with PRIMAR Stavanger. The SHO and other HO:s continuously update ENC's parallel to the production of Notices to Mariners by delivery of ER (ENC Revision) to PRIMAR. Consequently, the up-dating work of the digital charts onboard a single ship can very easily be assisted by an Internet based tool or done by radio communication, diskette or CD directly into the navigators own ENC database, e.g. on weekly basis.

Other publications

In spite of the fact that a modern nautical chart contains a large amount of information there is a need of supplementary information in the form of publications, which describes what usually cannot be reproduced in a chart. The following are the essential ones for merchant shipping produced by the Swedish Hydrographic Office:

Swedish Notices to Mariners (NtM, Swe: Underrättelser för sjöfarande, Ufs) gives information as small notices of warnings or for maintenance of printed charts and other information essential for safe navigation in Swedish waters. It is a weekly publication on the internet (www.sjofartsverket.se).
Notices to Mariners volume A (Swe: Ufs A) is a compilation of general information of nautical interest.
Swedish Sailing Directions (Swe: Svensk Lots) are sailing directions covering Swedish territorial waters and harbours. It is mainly intended for merchant traffic, performed in three volumes, A, I and II.
– Volume A, gives general information of fairways, regulations, limits and borders, meteorological information, ice regulation, etc.
– Volumes I and II Gives descriptions of the coast and harbours (Swe: Kust- och hamnbeskrivning) contain sailing information of fairways, approaches, passages, entrances and harbours, etc.
– *Kort 1 / INT 1* contains symbols, abbreviations and terms used on Swedish and international charts.
– *Swedish List of Lights* (Swe: Svensk Fyrlista), which is a register of lighthouses, light buoys, radio beacons etc.
– *NAVTEX Warnings in the Baltic Sea area: As a supplement* to in particular the Ufs, special navigational warnings are broadcasted.

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Sveriges Geologiska Undersökning (Geological Survey of Sweden)

Organisation

The Geological Survey of Sweden (SGU), founded in 1858, is a governmental authority under the Ministry of Industry, Employment and Communications. A Director General and an executive board manage it.

SGU is today a modern, custom oriented organisation with about 280 employees. The majority of these are based at the head office in Uppsala. There are also regional offices in Stockholm, Göteborg (western Sweden), Lund (southern Sweden), and Malå (northern Sweden). The activities can be divided into five main fields – Geology and Minerals, Environment, Research & Development, Consulting services and the Mining Inspectorate. Financing comes dominantly from government grants with the main goal to provide geological information particularly within the fields of environment and health, physical planning, natural resources, agriculture, forestry, and total defence. SGU may also do commissioned work. Activities are carried out in programmes and projects that give the organisation a high flexibility corresponding to changes in demands.

Main Activities

The aim for the geological investigations is to meet society's demand for new knowledge of bedrock, soil, and groundwater in order to create conditions for a good environment, a long-term balanced supply of natural resources, and utilisation of ground and water with consideration taken to natural conditions. Collected geological information will be made available rapidly and in a form suitable for the user.

The Swedish Government has, in 1999, given new targets for geological mapping. This implies that during a 10-year period general geo information will be obtained for the entire country, including the continental shelf. Within the same time period, more detailed geological information will be prepared in urban districts and ore-potential areas. The databases will contain information on bedrock, soil, and on the most important groundwater occurrences.

The present planning period is reaching its end

and SGU has by commission from the Government proposed a direction and goals for the operations subsequent to 2008. Among other things, this will involve an increased focus on end-user requirements in the collection of geological data, a more active and continuously improved administration of data and increasingly customized deliveries of data to end-users. Geological information will be made more accessible and easier to use for the end-users, with the aim to increase the benefits to society. A report presented to the government in February 2007, contains detailed suggestions for a new direction, organization, goals and financing for the period 2008-2012.

Map Production

The main maps produced during the regular activities are described below. All published maps are now also available as digital databases and geological information from ongoing mapping is continuously stored in databases.

Bedrock maps are used in the exploration for natural resources like metallic and non-metallic minerals, dimension stone, and crushable rock as a replacement for natural gravel resources. Bedrock maps are also the basis for planning of building and plant construction, and are used increasingly in environmental conservation contexts. Bedrock maps are produced at scales between 1:50 000 and 1:400 000 and many maps are provided with separate descriptions.

Bedrock quality maps are compiled from regular bedrock maps with the addition of point information. The maps show main structural features, depth to bedrock surface, areas of high radium index in addition to a classification of the bedrock. Technical analyses on point samples include e.g. the Nordic test for studded tyres, Los Angeles test, and point load index.

Quaternary deposit maps are important in physical planning for building and plant construction, environmental conservation contexts, searching for gravel and groundwater, localisation of environmentally hazardous activities, cable- and pipe-laying, and passability. Quaternary deposit maps are available at scales between 1:50 000 and 1:400 000 with separate descriptions provided with many maps.

Groundwater (hydrogeological) maps form a basis, among other things, for water planning and for establishing groundwater protection measures. Maps are available at 1:50 000 and 1:250 000 with separate descriptions to each map. Available digital information includes location and size of larger groundwater reservoirs and usually also classification of vulnerability.

Marine geological maps show the Quaternary deposits of the Swedish part of the continental shelf and provide information concerning dynamic seabed conditions, availability of certain industrial minerals, and environmental monitoring. They are also an important source of information for biological inventories, aquaculture, fisheries, and defence.

SGU supplies two types of *geochemical maps*: biogeochemical and soil geochemical at the scales of 1:250 000 and 1:1 000 000. Biogeochemical maps show variations in heavy metal concentration in the environment, resulting either from natural geological conditions or from human activities. Soil geochemical maps show pH and natural occurrence of elements in till and are used to show surplus and deficiency areas for nutrients and trace elements, as well as state of acidity.

Geophysical maps are used primarily as a basis for geological bedrock mapping, prospecting for mineral resources, and planning purposes. SGU can provide information on the magnetic field, gamma radiation, electromagnetic field, and gravity that can be used to produce interpretations on geological structures, rock type distribution, depth distribution of lithological units, and crush zones and faults. Geophysical maps are produced mainly as print-on-demand products.

The application of new methods in field work and the increasing use of databases has made it possible to produce thematic products which meet the demands of customers from local, regional, and governmental authorities, private enterprises, consultants, scientific institutions, and the general public.

Other Activities

SGUs Mineral Resources Information Office in Malå hosts the national archive of mineral exploration data. The archive contains virtually all the information produced during the long period of government-financed exploration in Sweden as well as information from other organisations. The extensive material covers exploration reports, maps, and digitised geological, geophysical, and geochemical data.

Mining Inspectorate is led by the Inspector of Mines with a Head Office in Luleå and a Branch Office in Falun. This has permitted important improvements in efficiency through new routines, uniform handling of business matters, and a widening of systematic contacts with all parties concerned.

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Another environmental task that SGU has received is the responsibility of the national environmental goal for *Groundwater of high quality*.

Printing, Publishing, and Distribution

The regular production of printed maps, map descriptions, research papers, and other reports is complemented by the production of print-on-demand maps and digitally distributed publications (CD-ROM). All publications are distributed by the Geological Survey through its customer service.

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Swedish Meteorological and Hydrological Institute (SMHI)

Organisation

The Swedish Meteorological and Hydrological Institute, SMHI, is a government agency within the Ministry of Environment and the national authority for meteorology, hydrology, and oceanography.

The institute's core activities focus on public requirements for forecasting, early warning, monitoring, research and international co-operation.

One of SMHI's main objectives is to secure a basis for planning and decisions in activities dependent on atmospheric, inland water and sea conditions. SMHI is organised into six departments:

Core Services
Environment & Safety Services
Business & Media Services
Research
IT
Administration

SMHI has 550 employees. SMHI's headquarter is located in Norrköping with branches in Sundsvall, Stockholm/Arlanda, Gothenburg and Malmö. Half of SMHI's income comes from commission work and business enterprise and the rest from government grants.

Operational Mapping

The state of the atmosphere, current and forecasted, is mapped on a daily basis using numerical models and observations from several sources. HIRLAM (High Resolution Limited Area Model) is the most important model. The resulting maps of different weather factors are presented to the public through media and like many other maps described here also on the Internet.

Another mapping on a daily basis is done using the MESAN system (Mesoscale Analysis). MESAN provides gridded map information. The system uses statistical interpolation of observations from different sources with results from the HIRLAM model as a first guess. Among the data sources is information from satellites within the European co-operation EUMETSAT. The system is under development and contains at present several variables describing the lower part of the atmosphere, the ground and sea surface. The grid sizes are 11 and 22 km respectively.

Within oceanography the HIROMB model (High Resolution Oceanographic Model for the Baltic) gives daily forecast maps on sea levels, currents, salt content and water temperature. The HYPAS model (Hybride Parametric Wave Model for Shallow Seas) gives forecasts on wave heights and the BOBA model (Bohai Baltic Sea Ice Model) describes ice formation and ice cover during the winter season.

Hydrologic maps are produced daily based on the results of the HBV model. The maps show the variation of variables such as runoff, snow cover and soil water content. The hydrologic model is also a tool in the production of maps showing the risk of forest fires. Daily forecasts are produced during the summer season. The system is now being developed to include the use of the HIRLAM model and the MESAN system.

Precipitation and cloudiness are mapped daily with a Nordic weather radar network, NORDRAD. The maps are used in presentations of the weather development. They are also used to support the production of meteorological and hydrologic forecast maps.

The weather and water conditions during the past month are mapped and reported in a monthly magazine. The magazine contains hydrologic, meteorological and oceanographic maps. There is also a groundwater map from the Swedish Geological Survey. The magazine is mainly aimed at a use within local, regional or national authorities.

General Mapping

SMHI has created and maintains a number of national maps. Basic maps are those on 30-year averages of precipitation, runoff and evaporation. In addition there are a number of map categories available. Several maps concern climate variables describing averages for the period 1961–990. The number of hydrographical maps is extensive. Examples are the map of water divides for about 11,000 drainage basins, the map of digitised rivers and more than 6,000 lake depth maps.

In 1998 SMHI was commissioned by the Swedish Rescue Service to map flood prone areas along the Swedish rivers. Up to today about 6,000 km of the rivers have been calculated. The maps are mainly required by the municipal rescue services

for the planning of actions before and during high flow situations. They could also be used within comprehensive physical planning. The mapping include the derivation of flooded areas at two flow levels, flows with a 100-year return period and maximum calculated flow. The ambition is to cover about 10 % of the Swedish rivers or about 10,000 km.

The HOME project (Hydrology, Oceanography and Meteorology for the Environment) was introduced to provide officials connected to environmental decisions with maps of physical and biogeochemical conditions. The system is applied to the Baltic, the Kattegat and the Skagerrak and their drainage areas. It includes and combines the results from hydrologic, oceanographic and atmospheric models. MATCH (Multiscale Atmospheric Transport and Chemistry model) being the atmospheric dispersion model, HBV the hydrologic model and SCOBI (Swedish Coastal Ocean Biogeochemical Model) the oceanographic model.

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The LFV Group (Swedish Airports and Air Navigation Services)

Organisation

The Swedish Aeronautical Information Service (AIS), which is organised within The LFV Group (Swedish Airports and Air Navigation Services), has a cartographic group, consisting of six employees, producing aeronautical charts. The National Land Survey of Sweden issues small-scale aeronautical charts in co-operation with LFV. International cooperation takes place within the scope of the ICAO (International Civil Aviation Organisation) activity.

Cartographic Duties

The following international aeronautical charts are published in accordance with specifications, accepted by ICAO, in the Aeronautical Information Publication (AIP-SWEDEN).
Instrument Approach Chart at 1:250,000. Altogether 228 pages, concerning 54 aerodromes.
Visual Approach and Landing Chart at 1:250,000 (51 pages) and 1:25,000 (26 pages) of 51 aerodromes
Aerodrome Chart at 1:5,000 and 1:10,000, 40 pages, covering 40 aerodromes
Aerodrome Obstacle Chart at 1:20,000, 36 pages of 26 aerodromes
Terminal Area Charts at various scales, 12 pages of 28 aerodromes
General Maps of different kinds, showing location of aerodromes, navigation facilities, controlled airspace, restricted and danger areas, search and rescue units, etc, altogether 31 pages.

In addition to the charts mentioned above the following aeronautical charts are published at the request of the Swedish Air Force.
Instrument Approach Chart at 1:250,000, (150 pages) concerning 34 aerodromes
Instrument Approach Chart at 1:400,000 (42 pages), and *Landing Chart* at 1:40,000 (36 pages) concerning 33 aerodromes
Visual Approach Charts at various scales, 58 pages of 23 aerodromes
Terminal Areas Charts at various scales, 4 pages of 16 aerodromes
General Maps of different kinds, altogether 19 sheets

Maps prepared by The LFV Group are usually based on working-plans, rectified aerial photographs or official maps. The basic material is photographically reduced to the drafting scale for each map, usually the same as the final scale. Fieldwork as reconnaissance, levelling and surveying of heights of obstacles is undertaken as a completion of details, etc, most often with the aid of aerial photos, land use and topographic maps etc.

Aeronautical information and fieldwork results are added to the basic material. After checking of the manuscript, the original of text and chart pattern is produced.

A database solution with Oracle 8i and the applications MapInfo and MSWord is in production. The initial population of static data and position data with associated attributes has now ended, and the database is now continuously updated. Next phase will be a system to system connection to the European AIS database and publication of the electronic AIP (eAIP).

As aeronautical information is frequently altered the charts must be constantly revised. Alterations and additions are entered on special revision copies of the different maps. If necessary, field investigations are made. Corrections are made on the reproduction originals and new printing then prepared.

The Administration has its own printing office. In addition to the printed and distributed AIP, the AIP is also published on www.lfv.se as pdf-files.

The charts are printed in one to four colours depending on the range of information provided by the charts.

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Riksantikvarieämbetet (Swedish National Heritage Board)

Organisation

The National Heritage Board (NHB) is the central authority in Sweden for matters regarding the cultural environment and the cultural heritage. Its main objective is to serve as the administrative authority, along with the county administrations and regional museums, to ensure that our entire cultural heritage is both preserved and used.

In the work of fulfilling the parliamentary and governmental decisions concerning the protection, preservation, supervision and use of the cultural heritage, the operations of the Board involves for example heritage management, research & development, education & information and contract archaeology.

Mapping and charting

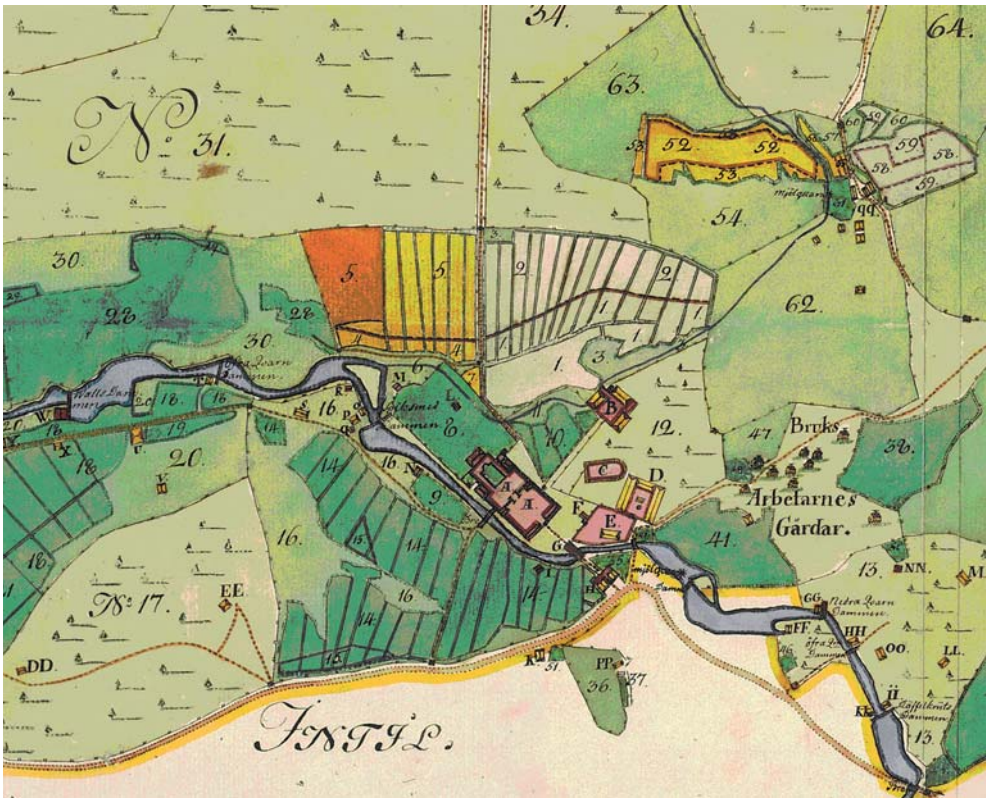
With more than 300 years of field studies, archaeological documentation and inventories the geographical approach has a long tradition in Swedish heritage management. From 1937 a central survey of ancient monuments was co-ordinated with the general mapping of Sweden by the National Land Survey.

Although the NHB is not involved in the actual production of official maps, it is responsible for keeping a national record of ancient monuments, which provides the National Land Survey with basic information for their cartographic products, such as the land use map of Sweden. Today this record contains more than a million geographical objects. As the heritage legislation has a strong position in Sweden the archaeological information recorded at the ancient monuments survey has considerable impact on land use and planning activities.

GIS

Today GIS is an integrated part of the workflow within the organisation and its importance is increasing in analysis, fieldwork, data capture, presentation and visualization. Archaeological documentation has been the main part in the usage of geographical information technology within the NHB, but today GIS has a widened use, for example in the growing field of environmental quality objectives. Also, much effort is being put into the development of analytical methods regarding decision-making in heritage management and environmental protection.

Sweden has several hundred thousand historical maps, containing unique information on environment and landscape development that may



An example of an historical map from 1774 depicting the gunpowder plant of Kloster in middle Sweden. The buildings of the plant are surrounded by arable land, meadows and grazing land.

stretch over almost four hundred years. In co-operation with the National Land Survey substantial contributions have been made to the production of digital copies of historic cadastral maps, in order to facilitate information access and to ensure the preservation of the valuable original documents. The NHB has also had a major role in developing GIS-based methods for analysis, presentation and visualization of digital historical maps.

Much of the GIS related activities in the NHB are based on Standard GIS software packages (such as ArcView/ArcInfo, MapInfo, ERDAS etc). However, the NHB has also developed applications for specialized purposes within the heritage management sphere. Intrasis (Intra-site Information System) is an archaeological information system for recording and managing field data. The system is developed by The NHB, Archaeological Excavations Department and LandFocus IS AB. Furthermore, applications for registration and database search on ancient monuments have recently been developed within the project "Ancient Monument Information" (FMIS). This work took place within the process of an overall digitalization of the Swedish national record of ancient monuments.

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Swedish Road Administration (SRA)

Organisation

The Swedish Road Administration is the national authority assigned the overall responsibility for the entire road transport system. Our task is to co-operate with others to develop an efficient road transport system in the direction stipulated by the Swedish Government and Parliament.

SRA have been commissioned to create a safe, environmentally sound and gender-equal road transport system that contributes to regional development and offers individuals and the business community easy accessibility and high transport quality.

Technical Development

The cartographic tools which are used in the SRA for map production and map dissemination have improved the last years. The internet technology development decreases the need for distributed data on each personal computer and makes it possible to use common data through the web.

An internet site as Google Earth has showed us the power of visualization in general and the use of aerial photos in particular. Many maps on the Internet are transferred quickly to the map consumer without long delays. The user can move seamlessly around the map and zoom in and out with smooth transitions thanks to new internet techniques. In all it demands more of the applications that the SRA provides to internal and external users.

Road navigation equipment has become common to many car drivers. This kind of "spoken" cartography increases enormously the demand of accuracy in the road databases. Route cartography focuses on details and doesn't get the overall perspective as ordinary maps do.

The cartographic challenges remain for visualizing information on a various size of displays. Open Source-solutions has received attention as an option to licensed products in the SRA, but the use of standard products is still dominating.

Development last four years

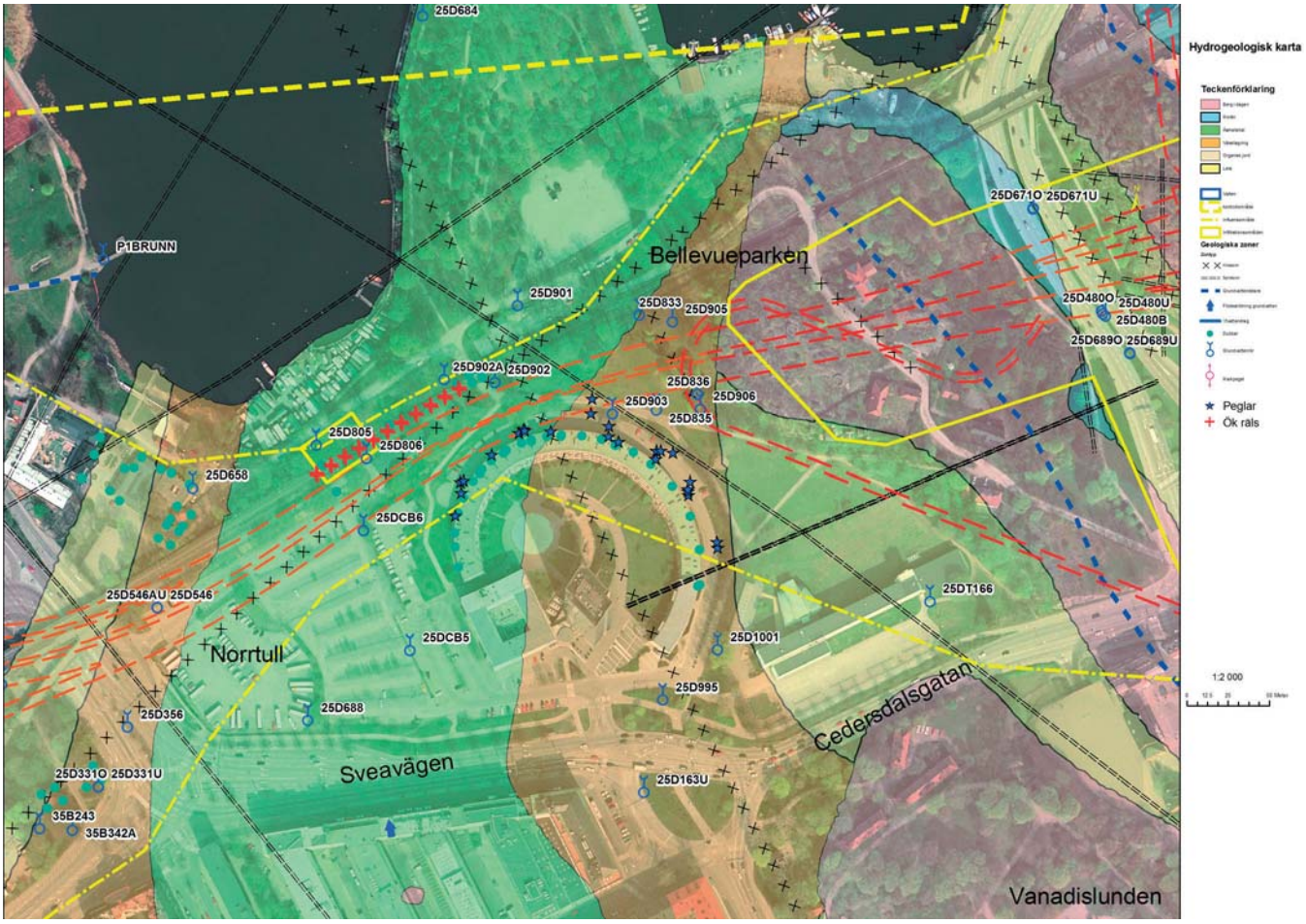
More and more road-related data has been visualized for the last years thanks to geographical databases adapted for GIS. As many of the SRA's databases are rich, objects can be selected with complicated sequences of questions and thereafter visualized.

A general map component has been developed for re-use in many applications. The SRA has improved the public information on the Internet as road and traffic conditions. Some of these services are map-related.

Cartographic Activities

SRA produces printed maps of the public roads for guidance to the transportation sector. One of them focus on bearing capacity classes, obstacles and proposed routes for dangerous goods. Another is intended mainly for handicapped people and shows facilities along the public road network.

Regional maps are also being produced. One example is the road map of Skåne showing roads with contribution from the SRA. Maps are also highly integrated in the road planning process, see example below. Maps can be disseminated as printed paper, but more often as a digital document.



GIS/GIT Activities

The SRA is responsible for building up and maintaining the National Road DataBase, NVDB. The database is of great importance to the information infrastructure of Sweden. Many internal and external GIS-applications are employing the National Road DataBase. The quality of the database are critical when visualizing or analyzing data in GIS.

The SRA is participating in the standardization work within the subject area of geographic information on a national level, particularly in the domain of roads.

The SRA is also active in GIS in the field of environment. The noise dissemination from the roads is to be surveyed for the whole country. Another example of using GIS is when the SRA is giving priority to future bicycle paths along the governmental roads.

Future Activities

One of the challenges for SRA in the future is to ensure the data quality of the National Road DataBase (NVDB) and other related databases. These are used in important internal activities of the SRA as well as for external use.

Some web map services are used from other public organizations, but not as far as could be desirable. Using web map services from the original sources could lead to better basic data for decision-making and save costs for data storage. The SRA will probably provide web map services within a few years for external use containing road and traffic information.

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Liber

Organisation

Liber has a cartographic editorial unit within the Liber Group owned by Wolters Kluwer, Holland. Liber produces and markets maps, atlases and electronic map products for both the domestic and international markets. The department employs at present 13 cartographers with long professional experience.

Our own map products and maps produced for other publishers as well as maps for schools and the consumer market are marketed and sold by a central sales and marketing department within the Liber Group.

Technical Development

Today all maps produced at Liber are ”computer made”. Our editors have a wide variety of sophisticated software in their hands to produce maps. They can experiment with colours, different types of design effects, and layout etc. thus making new types of maps.

The basis for our map production is our own databases. We store our vector databases in Bentley Microstation, pixel data as TIFF files and name databases in Microsoft Access. Besides that we have many small thematically and special maps in Adobe Illustrator format. Liber also produces maps from different commercial GIS databases. By using software as Intergraph Map Publisher and ESRI ArcGis, we are able to design high quality maps and export the data to different file formats.

During the last two years the production of thematic maps from statistical information have been transferred to GIS-production software with the possibilities to integrate information from different sources, choose map projection and make classification more flexible.

In house development has been focussed on automating the process from database to final files. Database driven software now produces the scripts needed to manage the whole process of map making. Several programs have been developed to manipulate data in our databases, both MicroStation and Illustrator. New software has also been developed to make indexes from our name databases. This software is based on the new character sets that are introduced in new operating systems, namely Unicode. It is possible now to take control of all the characters that exist in different languages.

In the last step, we use layout software like Adobe Indesign to make final map design. Normally output to prepress is platform independent Adobe Acrobat PDF files. Data are transferred fast and easy to prepress and printers all over the world with the Internet FTP protocol.

With new large format printers, width 165 cm, we are able to print verification plots of our maps. The new plotters are being colour calibrated, and generates reliable map proofs before sending the pdf-files for printing.

Liber maps can be found in our Internet site at www.liber.se and ordered at several Internet bookstores as well as in any bookstore in Sweden.

Cartographic activities

Liber uses Bentley Microstation for building and maintaining databases in vector format. Intergraph Map Publisher is used for cartographic map design. Vector information from these map databases is also transferred to desktop programs

such as Adobe Illustrator and Photoshop for product definition and design. Page layout and montage is done in Adobe Indesign.

There is a demand on converting existing data into GIS databases. Liber uses software from Safe Software, FME, to accomplish this task. FME also allows us to solve cartographic problems around the GIS platform

The following fully owned databases are used for cartographic production:
Stockholm 1:10,000 – 1:30,000
Malmö 1:10,000
Swedish town plans 1:30,000
Scandinavia 1:650,000
Europe 1:2 – 1:4 M.
Africa, Asia, Australia, North and South America 1:10 million.
The World 1:30 – 1:60 million

Other databases from municipalities and the National Land Survey of Sweden are also used for cartographic production.

Many of the map products, which Liber sells, are designed and produced in collaboration with our clients, with whom we discuss content, map design, and layout. Liber does all the research, editing, origination, and technical production. The final products can be delivered as digital data, CTP-files (Computer to Plate) for printing as well as printed products.

For the *general market* in Sweden and abroad, Liber produces world atlases in different sizes and languages. Other products for both the Swedish and Scandinavian market are road atlases and tourist maps. A number of products are also being produced for petrol companies and tourist organisations.

Within the *schools programme,* Liber produces a variety of school atlases and wall maps for the Scandinavian countries educational publishers. New products are developed in collaboration with each client, who provides information about the educational needs in their own country. The number of thematic maps available for use in atlases and wall maps are approximately 500.

A variety of maps of Stockholm, Gothenburg, and Malmö include taxi maps, tourist maps, and cycle maps are produced and published by Liber.

The production also includes many different map products for promotional purposes for commercial companies, such as world atlases, desk pads, and wall maps.

Future activities

Liber will continue to produce maps as traditional printed products, print on demand-maps and for Internet use. New and alternative techniques are being developed to rationalise the production methods and to produce well-designed cartographic products for educational purposes and general use.

New products for the future will be maps and map related information for interactive whiteboards and computer tests and assessments for teaching geography in all levels of education. GIS for schools is also a new area of product development in coming years.

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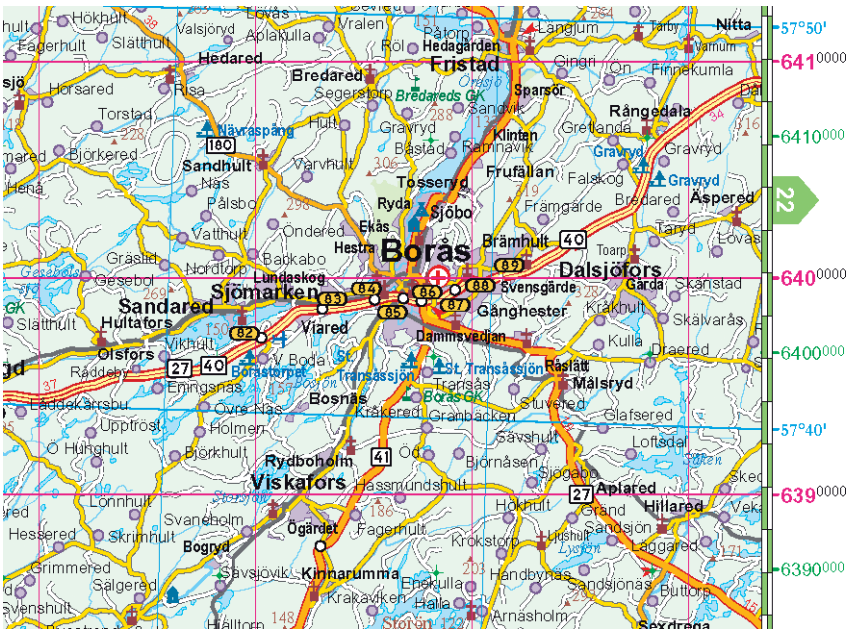

The GPS Atlas of Sweden is a traditional road atlas but at the same time offers users with GPS equipment navigational information that could be used in electronical devices. The mapframe has coordinates in three different systems: latitude/longitude, RT90 (the old Swedish system) and SWEREF 99 (the new Swedish system).

GOLFBANOR

An extensive index with all the names in the atlas is provided with reference to the map pages and with Postal zip-codes and latitude/longitude. The index has more than 50,000 names. There are also two separate index with all the golf links and rest areas in Sweden.

HYDROGRAPHICA

Hydrographica is a highly specialized private company producing nautical charts exclusively for pleasure cruising purposes. Hydrographica charts are complementary to the official Swedish HO charts, in areas where a more detailed product is needed.

Organisation

Hydrographica is privately owned, and employs at present five persons. Three of them are qualified cartographers with a background as lecturers in cartographic education at Stockholm University. Hydrographica was founded in 1983, and is based upon a surveying technique using aerial photo interpretation/photogrammetry in bathymetric mapping.

Chart production

Hydrographica produces charts over marine and coastal areas as well as over inland lakes. Production of inland lake charts are normally initialized by local yacht clubs or communities wanting a professional chart over Swedish inland waters where no ordinary HO chart exists. From 2000 Hydrographica also have a permission from military authorities to survey coastal areas where ordinary surveys are old and/or unreliable. Hydrographica now produces large scale marine charts, and at sea the Hydrographica charts are a parallel to the orienteering maps on land. At present, Hydrographica have produced about 25 Swedish inland lake charts at various scales, and 36 marine charts at a scale of 1:10,000. All charts are planned, produced and published within Hydrographica. The in-house competence spans over the whole production chain. All Hydrographica marine charts are printed on polyart, a synthetic paper with excellent properties for use at sea.

Surveying techniques

Chart production starts indoors with aerial photo interpretation and photogrammetry. Hydrographica have developed a technique where water depth down to 4-5 meters normally can be penetrated and measured with high accuracy through stereoscopic analysis of aerial photos. Bathymetric contours for 2 and 3 meters can be drawn and water depth on separate shoals can be established. All photo interpreted data must be confirmed through field surveys, but the field work can be considerably more efficient since the positions of all shoals are already mapped with high precision. For field surveys Hydrographica owns three boats for shallow water mapping specially equipped with suitable echo-sounders, side scan sonar, positioning tools and other nav-aids.

Cooperation

Hydrographica cooperates with the Swedish Maritime Administration, and supplies data to international chart producing companies such as Garmin, Navionics, C-map a.o. Hydrographica is a MapTech acknowledged partner in producing digital raster versions in BSB-format. Paper charts published by Hydrographica reach the market through a substantial amount of retailers in Sweden, but also through Hydrographicas own website, a system that is highly appreciated and well functioning. Digital versions of Hydrographica charts can be downloaded directly from the website. Hydrographica also cooperates with a nautical publisher in producing guide books for pleasure cruising along the Swedish coast.

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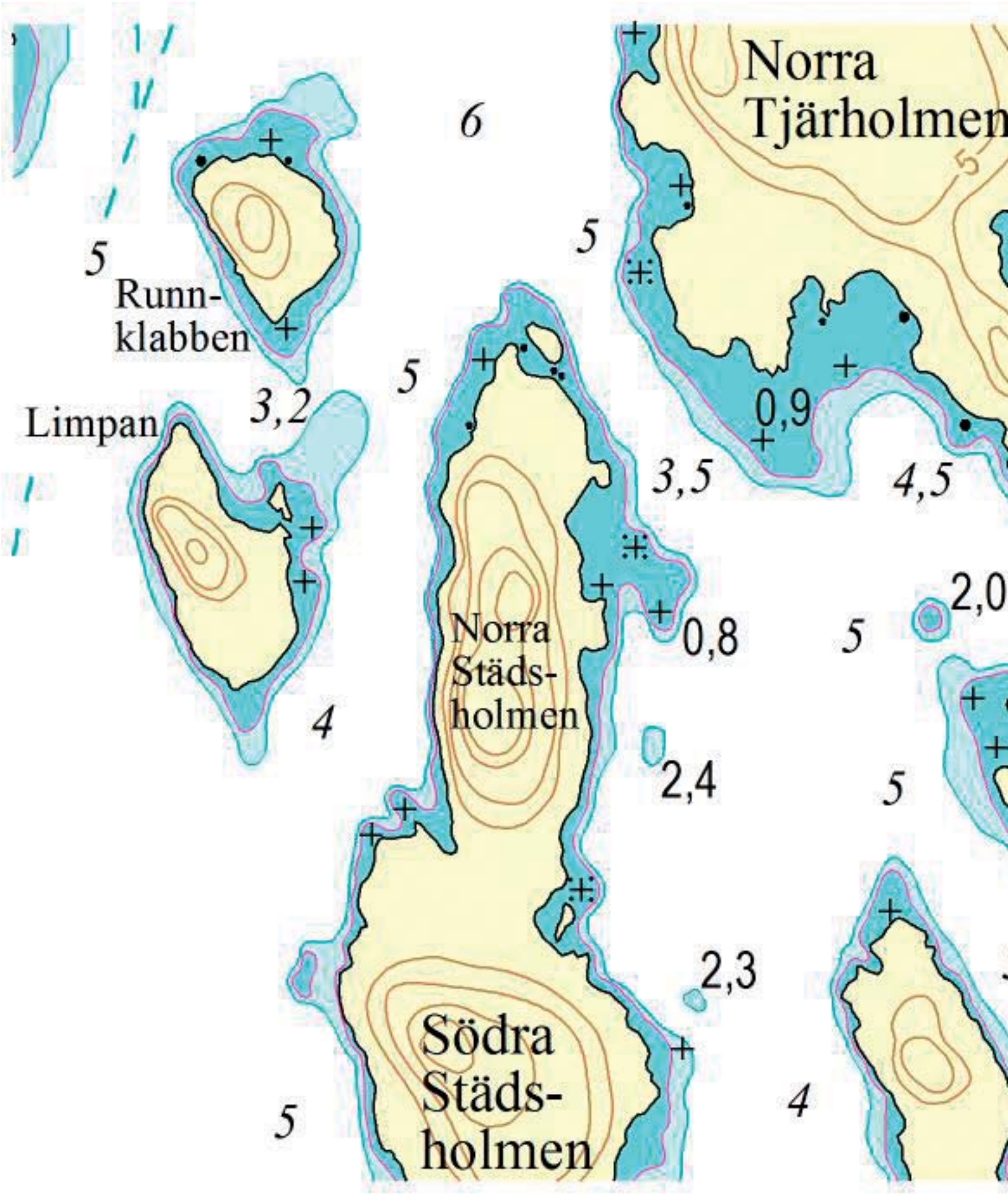
Hydrographica chart at 1:10,000 reveals deep and trafficable water as well as isolated shoals in the same area.



Official chart from Swedish HO at original scale 1:50,000 (enlarged) show large areas as shallow and non trafficable (blue tint).