

Using a GIS-based Database as a Platform for Cultural Heritage Management of Sites and Monuments in Norway

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Abstract

The Norwegian cultural heritage database for management of sites and monuments consists of archaeological sites, buildings and installations, gardens and parks, and marine sites. It has been running for two years, and is now a fully-grown system for the professional management of cultural heritage data. The paper focuses on a description of database content and various functions, including GIS functionality. Role-based access will be discussed, including: how the various parts and levels of cultural heritage managers and researchers may use and update the content of the database and which tools are available to some or all of them. An overview of the exchange of data, the acquisition and use of maps and thematic data between the Directorate for Cultural Heritage and other sectors' GIS data in the Digital Norway partnership will be briefly discussed.

1 Introduction

The purpose of this paper is to describe the Norwegian database system for managing cultural heritage monuments and sites. This system uses both database and geographic information systems (GIS) functionality, and it aims to integrate all data relating to immovable sites and monuments that are in some way protected by the Cultural Heritage Act of Norway. The paper is divided into six parts that describe the database system:

- Introduction to and the organization of cultural heritage management in Norway;
- Database content and the relationship with the Cultural Heritage Act;
- Database and GIS functions and their uses;
- Description of the role-based access system that allows users to update, modify, and maintain the data and information relating to their own field of responsibilities,;
- The exchange and use of GIS data, both vector and raster, between partners in the Digital Norway partnership.
- Future plans for expanding the database content and for the dissemination of the information stored in the database to new user groups.

At the CAA 2000 conference in Ljubljana, the plan for developing GIS-based databases to maintain national registries of sites and monuments in Norway was presented (Berg 2000). Since then, we have developed a database with GIS functionality, which has been running since 2004. The Norwegian Cultural Heritage database for management of sites and monuments consists of archaeological sites, buildings and installations, gardens and parks, and marine sites. The database has become a fully-grown system for professional management of cultural heritage data (Figure 1). The primary users are from the central and regional levels of cultural heritage management (Figure 2). Museums and research institutions have limited rights to modify the data. Public management, in general, has read-only access.

Technically, the system is three-tiered and is based on an Oracle database with the ESRI software ArcSDE for storing and managing the geometry. Around the database is a Web application, served through an application server and a web-server with the user interface. The application server software is JBoss, while the Web server runs on Apache/Tomcat.

The use of the database is password-protected. For both administrator and normal user functions, the Web interface is used. The goal of the interface is that as many administrator functions as possible should be accessible through the Web interface.

2 Database Content and the Relationship with the Cultural Heritage Act

The relationship between the data and the Cultural Heritage Act is crucial. This Act regulates the protection of sites, monuments, and cultural environments. An English version is available at <http://www.ub.uio.no/ujur/ulovdata/lov-19780609-050-eng.pdf>.

Implementing sections and paragraphs as rules in the database structure ensures the relationship between legal status and relevant dating of sites. This was deemed necessary due to a large number of sites from the former systems for maintaining archaeological sites with no information about age, or wrong or irrelevant dating. Section 4 defines automatically protected sites and buildings, while section 15 deals with Individual Protection Order.

Sections 20 and 22a deal with cultural environments and administrative procedures, respectively. Around automatically protected localities, there is a 5 m security zone, defined on the basis of Section 6 in the Cultural Heritage Act. All single objects belonging to a locality must lie within the boundary around which the security zone is drawn.

The most important point of the Act with regard to the



Figure 1. Hit-List with corresponding map. Transformation errors between the background raster map and the vector points are visible on a small scale.

database is that monuments and sites earlier than AD 1537 are automatically protected. The same applies to Sami monuments and sites that are over 100 years old. Standing structures confirmed at any time as originating in the period between the years 1537 and 1649 are automatically protected by law.

The Ministry of the Environment may protect structures and sites or parts of these that are valuable architecturally or from the point of view of cultural history by Individual Order. The protection order would include a fixed inventory (cupboards, stoves, etc.). Larger pieces of moveable furniture may also be included if there are special reasons, in which case the details of each individual item must be specified separately. Structures and sites that may be protected in accordance with the first paragraph include monuments and sites as described in Section 4, first paragraph, a-j, regardless of their age, special sites such as parks, gardens, avenues, etc., public memorials, and other places with

important historical associations. The State shall have the right of ownership of boats more than 100 years old, ships' hulls, gear, cargo, and anything else that has been onboard, or parts of such objects, when it seems clear under the circumstances that there is no longer any reasonable possibility of finding out whether there is an owner or who the owner is.

The various protection statuses allowed by the Cultural Heritage Act have been implemented as rules in the database. For instance, if a site or a building is recorded as automatically protected, it must be dated according to the rules for automatic protection. If the date given is outside this range, it is impossible to register the automatic protection status. On the other hand, an Individual Protection Order cannot refer to the sections and paragraphs relating to automatically protected sites.

It is possible to register a site without a protection status. This was necessary, since, when exemptions/dispensations

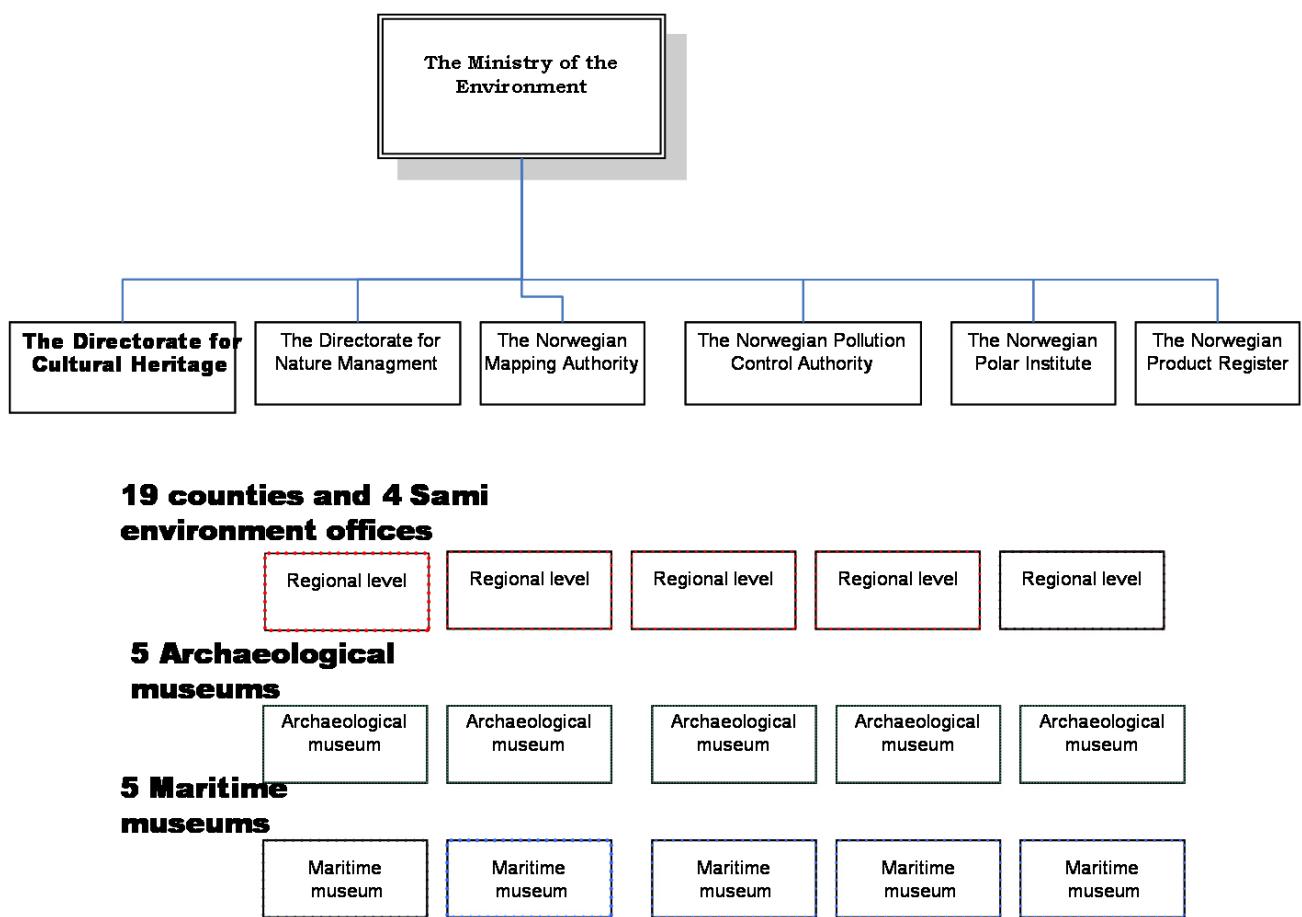


Figure 2. Organization of the Norwegian Cultural Heritage Management.

are given, a site will be excavated, documented, and will physically disappear as a site, but we do not want to remove it from the database. So, we change the protection status, including the decision of dispensation. The goal is that every time an exemption/dispensation is granted, this information is added to the registered site. Protection status is changed only after the excavation is finished. There are also a lot of dispensations originating before the establishment of the database that never were registered with the sites in question, and we need to update these sites with the correct legal status.

Finally, a number of sites too young to be in the range of automatically protected status were registered in the systems preceding our database, and we do not want to lose this information since there is no other place for the information to be stored and disseminated. Especially for the county authorities, sites and monuments like these may be highly important to a local community alongside older and protected sites in planning processes; therefore, they may be registered after the County authority has evaluated them. It is entirely possible to use an Individual Protection Order for this kind of site, although it is rarely used to protect these sites.

The content of the database, as seen in the Figure 1 schematic overview, is placed in an Askeladden database. There are five categories of sites, buildings, and monuments included:

- Buildings protected by order since 1920 and medieval buildings automatically protected since 1905.

- Archaeological sites automatically protected since 1905. Criteria: Older than the Reformation, Year AD 1537, or Sami sites/buildings older than 100 years.
- Churches either automatically protected (medieval), protected by Individual Order, or protected by regulations.
- Marine sites; mainly shipwrecks, but also underwater harbor structures, etc. older than 100 years.
- Other sites: statues, monuments, non-building sites, and installations younger than the Reformation, and not Sami or Marine. Some are protected by Individual Order, most are not. They are recorded in the database because they have local or regional value, and have been evaluated by the regional level as important for local community interests.

There are vast numerical differences between the categories, as demonstrated in Table1. We operate through two levels on all kinds of sites and monuments. The level called locality contains all of the general information about the site, such as county, municipality, locality type, general descriptions, references, and the geometry of the whole site. The information about the legal status for the whole of the locality and its condition is also documented here. The single object level contains all of the information specific to it, such as description, dating, legal status, condition and cause of damage, and the geometry of the single object.

By August 2006 there were 206,549 single objects. These numbers are constantly changing due to the level of activity in the database.

Table 1. Numerical differences between the categories.

Protection Status	Category						Sum
	Other sites	Archaeological site	Building site	Church site	Marine site	Industrial site	
Automatically protected	0	60,520	302	375	296	0	61,493
Removed (aut. fredet)	0	1,205	0	0	1	0	1,206
Protected by Regulation	20	0	367	1	0	9	397
Ongoing protection process	0	0	91	0	0	2	93
Not protected	446	12	11	4	275	3	751
Listed	0	0	1	744	0	0	745
Temporarily protected	0	0	8	5	0	0	13
Status not clarified	3	25,835		42	30	0	25,910
Protected by Individual Order	6	14	1173	5	0	217	1415
Part of protected cultural environment	0	0	156	0	0	0	156
Sum	475	87,586	2,109	1,176	602	231	92,179

At the locality level, the database must contain at least one single object and may, in principle, have an infinite number of them. Practically, more than 50 single objects on one site is a rare occurrence. A single object cannot exist without a locality. If localities become very large, it is often a good idea to split them. If there is more than one, each single object may have different legal statuses and conditions. The strongest protection automatically defines the status of the locality, as well. The single objects within the boundaries of a locality can also be represented by coordinates, points, polygons, or lines. Dating, or the age determination of sites, occurs only at the single object level. Since a locality may contain single objects from different periods, this information cannot be tied to the general level. Thus, the determination of protection status at the single object level is crucial, since this is where the age criteria and the legal status according to the Cultural Heritage Act occur together. A locality must have at least one automatically protected single object for it to be given this protection status.

As mentioned in the presentation for CAA2000, the representation of the content of the database is skewed (Berg 2000:135). This is due to historical causes, both when dealing with archaeological registrations and surveys, and with the object chosen for protection through individual order. In particular, the regional level has recorded more of the archaeological site types hitherto severely underrepresented since the start in 2004, but we have a long way to go before every kind of site or building is equally well represented.

3 Database Functions: Search, Report, and Export

A simple search delivers both a map overview of the selected geographic area, and a hit-list (Figure 1). To view the details of a site, a user can open it either from the map, or from the hit-list; both open the selected registration schema.

In advanced search the user must choose the level first, then the locality or single object. There are a number of search criteria between levels so that a locality search may utilize some search criteria for single objects and vice versa. The advanced search gives a hit-list as a result, which can be shown on the map if the user desires. The results from simple or advanced searches may then be used in a report; we can export the results to either a table that opens in Excel or as a GIS file. For GIS, we have two options: a SOSI file, or SHAPE export. SOSI is a Norwegian format for conversion of geometric data. It depends on standards; if there is no standard for a specific theme, the theme cannot be converted using SOSI. For cultural heritage data, Norway has had an official standard since 1999. The content of the file is the information important for zoning and planning activities at the municipality level, and the user cannot choose attributes for inclusion. However, the user may choose the coordinate system into which the results should be transformed. The file can be used in ArcView, combined with background maps, and/or with other themes.

3.1 Role-based Access

The various parts and levels of cultural heritage management that compose the database, how researchers may use and update the content of the database, and which tools

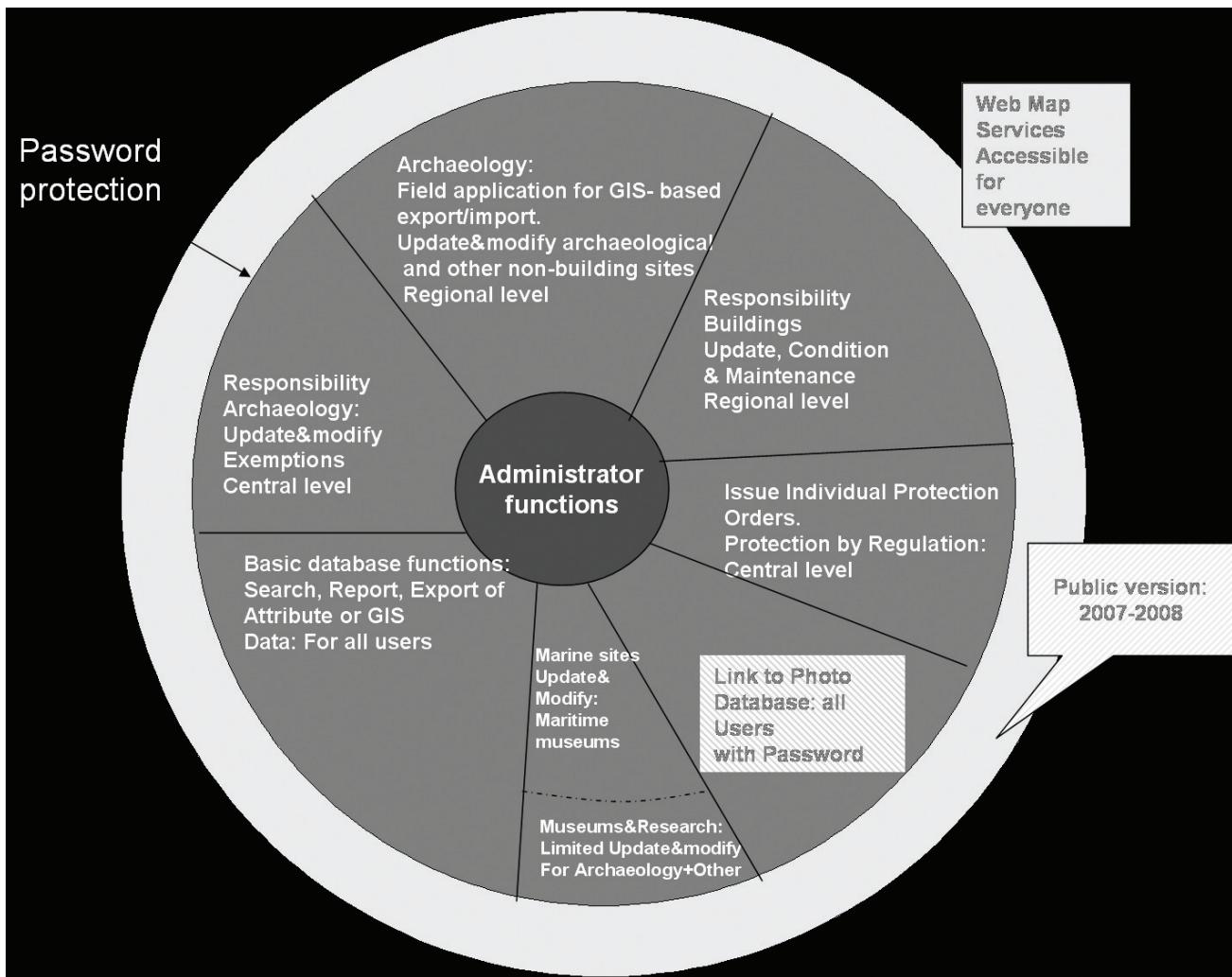


Figure 3. Role-based Access. Principle: Update/modify rights according to role.

are available to some or all users will be discussed below (Figure 3). Central-level cultural heritage management has the overall responsibility of maintaining the database structure, administrating its content, and updating it with new Individual Protection Orders, new Cultural Environment Orders, or Administrative Procedure Protection Orders. Protection Orders for a building or an exemption from the Act are typical tasks for the central level.

Examples of roles and tasks in regional cultural heritage management are to record content on building condition and maintenance schema, to maintain archaeological heritage, and to help the municipalities care for their cultural heritage through planning processes and zoning. In general, they are the first point of contact when the public needs help, advice, or has a complaint. The regional level is crucial when dealing with archaeological registrations and surveys. They also do important work to ensure that cultural heritage interests related to planning and zoning processes at the municipality level are taken care of.

Research institutes and museums have different roles from the central and regional cultural heritage management. The archaeological museums are responsible for excavation and documentation of prehistoric sites following a dispensation according to the Cultural Heritage Act. The maritime museums, likewise, carry the responsibility for excavating

and documenting underwater sites. Regarding the Medieval towns, churches, and cloister remains, the Norwegian Institute for Cultural Heritage Research (NIKU) is responsible for excavation and documentation.

3.2 Update and Modify Attribute and GIS Data

A site may be recorded manually by opening up a new record schema. There are a few mandatory attributes: County, Municipality, Type, and Protection Status. In single objects, Type, Date (prehistoric or historic period), and Protection Status are mandatory. Coordinates can be uploaded and connected to the site as part of the recording process. Metadata for coordinates can be added to, or changed. This last feature has become ever more important since the demands on accuracy in the localization of sites is important to local planners, to people working with tree-felling in the woods, to agriculture in general, and more. The schemas for the various categories differ with regard to content. The attributes for a building compared to an archaeological site are different. Some attributes are common to all categories, such as Protection Status. This is recorded on a separate fan in the schema. Condition has its own fan on the schema and also varies by category. While

the Condition attribute is relatively simple for archaeology, it is, in contrast, very complex for buildings. For buildings, the recording of the condition is crucial for maintenance and necessary repairs, what materials to use, and how. The extent and costs of repairs are therefore calculated as part of the recording process.

Importation of large amounts of data in a single operation has become important since the database started operating. All the institutions with responsibilities according to the Cultural Heritage Act have archive materials that should be registered in the database. We have developed several tools for mass importation of data. One tool uses the SOSI format and is available only to the administrator. It is mostly used for digitizing coordinate data for sites already in the database, but over time the need to use this tool will decrease. Quite a lot of the old material lacked digitized coordinates at the time of conversion into Askeladden. This material is being digitized from scanned maps or paper maps, resulting in a SOSI-file. Askeladden administrator can then upload the file to the database and connect the relevant sites with geometry. This function is restricted, since its application outside the firewall could lead to unfortunate holes in security. For the same reason, accessing the database from ArcView/ArcGIS through the ArcSDE connection option in these programs is restricted to administrator level, within the firewall.

For more general mass importation, a digital field recording system is under development. Version 1 was field-tested in 2005 and is being developed further this year. The basis for this system is a set of import files in the ESRI SHAPE format. Since ESRI software is used by most of the archaeologists in Norway (specifically, those that have a GIS), we decided to use it. In the future we may develop other means of mass importation not depending on this software, if the need arises. This tool, directed mainly at fieldwork, primarily focuses on the registration of new sites. We are also developing a schema for control surveys of existing sites, since this is not covered well enough in the present schema.

Our SHAPE export is, therefore, different from SOSI. It is restricted to users with full update rights (i.e., regional and central level) and also to selected users among the research institutions in cases where they are involved in projects focusing on bettering the quality of the content. A check-out file is exported from Askeladden as a SHAPE file; it can be opened in ArcView and exported to ArcPad. The schema contains a lot more information than the SOSI-file and is constructed in such a way that a user might update both the locality and the single-object level. This function is built as an ArcPad application for use with a PDA or tablet PC. Data from the relevant geographic area is obtained and is used together with background maps during the registration. New sites can be registered, and existing sites may be modified with new information and/or new coordinates. The file is uploaded through Check-in. Here, non-modified sites will not be overwritten, while all updates and new sites are entered automatically.

All this work is done through the Web interface, making the database more secure and less vulnerable to virus infection and other forms of hostile attacks. It also ensures

that all data finally entered into Askeladden conform to the database structure and rules.

4 Exchange and Acquisition of Data

The use of maps and thematic data between the Directorate for Cultural Heritage and other sectors' GIS data in the partnership Digital Norway will be briefly discussed. For many years, one big problem for the entire cultural heritage sector was the availability and costs of digital maps. A couple of years ago, the plans for a partnership between all public sectors who keep and update geographic data were formed. The result was Digital Norway (Norge Digitalt). The Norwegian Mapping Authority runs the planning and negotiating with partners and is responsible for much of the technological infrastructure necessary to realize digital exchange between partners. For the Directorate for Cultural Heritage, the result is that we may finally access map data, both raster and vector, at a price we can afford. In addition to monetary costs, we must make our data available to the other partners. A website with information (only Norwegian, so far) can be found at <http://www.statkart.no/IPS/?template=norgedigitalt>

To facilitate the exchange and acquisition of data, all partners are developing Web-services based on the Web Map Service standard (WMS). These services are available from a website (<http://www.Geonorge.no>) that provides access to search data, metadata, and views of data on maps. Download of data is password-protected to ensure access only to partners. Anyone who wants data, but is not a member, must go through a dealer and pay for the data. Some data from various partners are freely accessible for the public through other channels, especially environmental data. This is due to Environment Information Act from 2003 (not translated to English yet), where environment agencies have to give the public information for free. This also encompasses cultural heritage data. On the website (<http://www.environment.no>), all the environment agencies, including the Directorate for Cultural Heritage, regularly post information about their areas of responsibility. A recent addition to the site is an atlas with maps over environmental data and an interactive map where users may construct their own new maps. The interactive map is based on WMS-services. The cultural heritage part of the interactive map is still under construction. We have released some datasets, while others need more quality updating and cleaning before we can release them. In particular, the archaeological data needs thorough cleaning before we publicize them in such a context. The users of the environment website are all kinds of people, from school children doing projects to local politicians, journalists, and the interested public in general. Therefore, we cannot publicize data with much ambiguity or lacking a large portion of the information needed to make them meaningful and interesting to a general audience.

5 Future Plans for Development

We still have a lot of work to do in various areas. Not all data are yet integrated into the Askeladden database. For instance,

we have a separate Rock-Art database which has been used since 1999/2000 to record conditions on selected rock-art sites. Information about site condition is very extensive and cannot be fitted into our existing condition schema for archaeological sites. This year, we have constructed a rock-art module to contain this information, and we will begin to enter data in the fall of 2006. Due to the necessity for a lot of manual editing, data will not be converted and added automatically, but must be added manually. Ninety percent of the sites in question are already recorded in Askeladden, the rest are new registrations that were never reported to the old Sites and Monuments Registry. This highlights the problems connected with running duplicate systems containing information about the same kind of sites. There will always be lapses in the recording process, and the work and costs required to keep both systems updated is enormous. This problem provides yet another good argument for keeping one database where all information relating to description, protection status, maintenance, and condition is found.

We also have datasets from registrations of post-reformation sites that at the moment have no digital "home." Even if most of these sites are not protected according to the Cultural Heritage Act, we will go through the materials and add them in the category of other sites. Gardens and parks are given special consideration since garden archaeology is becoming increasingly important. As a discipline, it is quite new in Norway, and it is important to record digitally the archival information related to it, and to make this information available.

For now, access to the Askeladden database is restricted. We are working on a plan for a public version of selected parts of the information stored in the database. This will also require staff ready to answer questions and inquiries from the public. The plan is to have a public version ready by 2007/2008.

We will develop more WMS-services, primarily for Digital Norway and the Environment website. We may

also start publication of WMS-services in other contexts, but this is still far in the future. One important wish from the collective of cultural heritage research and management is to be able to access information from both Askeladden and cultural heritage databases owned and operated by the museums together. A common interface where a user may access the all of the cultural heritage and cultural-historical databases available is a future goal that depends on a lot of cooperation between the Directorate for Cultural Heritage and the archaeological museums. The technology is probably the least of the problems; more important is the will to publicize and to change the way they work to produce data. The latter problem is infinitely harder to remedy than purely technological considerations.

Finally, we need to develop our support system for all users with update and modify rights. We have launched a password-protected Web site with discussion forum and uploading and downloading of files. This will be a very important meeting place for discussion and for the distribution of files' updates for the field-recorder. Now we need to strengthen the internal organization at the Directorate for Cultural Heritage, to ensure continuity and that there will always be competent personnel available to answer question and teach courses, in addition to other purely technical considerations. We must also prepare for the organizational changes that a public version of the databases will bring.

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