

maßarbeit

Geospatial data – our world



maßarbeit

Geospatial data are digital information that can be used to pinpoint specific spatial locations on the earth's surface.

They can be either geospatial reference data, which are generally supplied by Surveying Authorities, or thematic geospatial data from thematic (e.g. environment, transport, local authority) geographic databases. Official geospatial reference data from the Bavarian Administration for Surveying offer comprehensive coverage, are very up to date, and are consistent in their quality.



Contents



Cadastre and land ownership



Public utilities and sustainability



Planning and construction



Safety and emergency management



Mobile services and navigation



Leisure and recreation



Environment and conservation



History and heritage

Words of welcome	
Bavarian State Minister of Finance Dr. Markus Söder, Member of the Bavarian Parliament	06
State Secretary of the Bavarian Ministry of Finance Franz Josef Pschierer, Member of the Bavarian Parliament	07
President of the Bavarian Agency for Surveying and Geographic Information Dr. Klement Aringer	09
Cadastre and land ownership	10
Going to the boundaries day in, day out	
Public utilities and sustainability	14
Useful for utilities	
Planning and construction	18
Building the future	
Safety and emergency management	22
Plans that help plan	
Mobile services and navigation	26
Know where you stand	
Leisure and recreation	30
All mapped out	
Environment and conservation	34
Bavaria is beautiful. Naturally.	
History and heritage	38
Bringing history to life	
Organisational structure	42
In figures	43
Picture credits	45
Publication details	46

Words of welcome

Dr. Markus Söder

Member of the Bavarian Parliament
Bavarian State Minister of Finance



For more than 200 years the Bavarian Administration for Surveying (Bayerische Vermessungsverwaltung) has been gathering comprehensive geospatial reference data for the whole of Bavaria for use by individuals, businesses and public bodies, as required by law.

In 2008 the Bavarian State Parliament passed the Spatial Data Infrastructure Law with the aim of making state geospatial data available over the internet. The Bavarian Administration for Surveying is responsible for coordinating cooperation on a spatial data infrastructure with the relevant departments. This brochure presents many of the results of this cooperation, for example the Energie-Atlas Bayern and the services providing online data relating to the environment and the protection of historic monuments. The Association of Bavarian Chambers of Industry and Commerce has set up the SISBY system using official geospatial data, to provide information on locations for businesses. Public authorities are also currently working on making development plans accessible online.

Ownership of land is safeguarded by both the German and the Bavarian constitution. The property cadastre compiled by the Cadastral Offices documents more than 10 million parcels of land, including details of their location, size and type. This, together with the land register, safeguards the ownership of this land. The parcel boundaries are indisputably defined; this is assured by the Administration for Surveying in collaboration with its special volunteers, the "Feldgeschworene".

The Bavarian Administration for Surveying holds consistently high-quality geospatial reference data for the entire state, making them available in standardised, common formats. These data are used as a basis for spatial planning and projects of all kinds, including private residential construction, the construction and operation of utility networks, development planning by local authorities in urban and rural areas, and regional policy processes, to name but a few. The private sector also makes wide use of geospatial reference data, with the range of applications here growing rapidly with the rise of navigation systems and mobile communication devices.

The Bavarian Administration for Surveying has a high capacity for innovation, and as a result is one of the Free State's most cutting-edge public authorities. In this brochure we would like to show you what the various surveying bodies of the state of Bavaria do for you.

Dr. Markus Söder
Member of the Bavarian Parliament
State Minister

Franz Josef Pschierer

Member of the Bavarian Parliament
State Secretary of the Bavarian State Ministry of Finance



As Chief Information Officer, the IT representative of the Bavarian State Government, it is my job to ensure that our online offering is continually expanded and improved for the benefit of both individuals and businesses. To help us achieve this, we have updated Bavaria's eGovernment concept and renewed our eGovernment pact with the Local Government Central Associations. The need to make Bavaria an attractive location internationally means that, in addition to providing drop-in services, we also need to offer individuals and businesses public authority services that are not tied to specific locations, opening times or individuals and must make the work of public authorities more transparent. The Open Data Initiative of the Bavarian State Government means that in future we will be able to create added value for people and companies by giving them better access to public data.

The Bavarian Administration for Surveying has been at the cutting edge of eGovernment for many years.

The Bavarian Spatial Data Infrastructure makes location-based information (geospatial data) from the various specialist divisions and levels of public administration available to users via online services. The Administration for Surveying is also coordinating the further development of this project. With the help of this initiative we want to develop Bavaria, including rural regions as an attractive location for innovative companies.

The Bavarian Administration for Surveying is an indispensable partner for numerous eGovernment projects. Its high-tech work processes and lean structure allow to supply geospatial data and surveying services for the whole of Bavaria, despite receiving the lowest per-capita state funding of any organisation of its kind in Germany.

Franz Josef Pschierer
Member of the Bavarian Parliament
State Secretary

Words of welcome

Dr. Klement Aringer
President of the Bavarian
Agency for Surveying and Geographic Information



There is a proper measure in things

"Maßarbeit: Geospatial data – our world". We chose this as the title for our brochure because geospatial data and the related services are an integral part of our everyday personal and professional lives. The aim of this brochure is to highlight the contribution that the Bavarian Administration for Surveying, by collecting and distributing geospatial data, makes to the world, and how these data can help individuals, businesses and public authorities. Many services and planning and construction projects would barely be possible today without geographic information, and many common devices such as route planners and navigation devices would simply not exist. Geospatial data can also be used to simulate planning projects, and so play an important role in keeping citizens informed about these.

The Bavarian Agency for Surveying and Geographic Information (Landesamt für Vermessung und Geoinformation) and the 51 State Cadastral Offices (Staatliche Vermessungsämter) are responsible for collecting geospatial reference data, making them available to users on servers, and providing metadata of them on publicly-accessible information systems. Already, geospatial data can be viewed and acquired at short notice via Bavaria's spatial data infrastructure.

This brochure presents a selection of ways in which official geospatial reference data from the Administration for Surveying and the Cadastral Offices can be used. In addition to direct applications, e.g. by local authorities and at county level, geospatial reference data can also be

linked with thematic data from other public authorities and enhanced by specialised companies, increasingly internet businesses. The Bavarian Agency for Surveying and Geographic Information provides the technical and organisational basis that allows the interoperable use of, and access to, geospatial data and geospatial data services from a range of different sources.

The 51 State Cadastral Offices in Bavaria fall under the auspices of the Bavarian Agency for Surveying and Geographic Information. For me it is of particular significance that, in collaboration with our Cadastral Offices, we are able to offer citizens a comprehensive range of first-class field surveying services for the whole of Bavaria, from major cities to the most remote rural areas. We combine the geographic information that we collect in this way – encompassing some 10 million parcels of land and 8 million buildings – with other geospatial data collected by us, for example elevation data obtained by laser scanning, to create new products containing yet more information.

I hope that this brochure, "Maßarbeit: Geospatial data – our world", will spark new thoughts and give you new insights into the fascinating world of geospatial data.



Dr. Klement Aringer
President



Cadastre and land ownership

“Knowing where your boundaries are is essential if you want good relations with your neighbours.”

Margit Obermeier, housewife, mother of 2 children

Going to the boundaries day in, day out

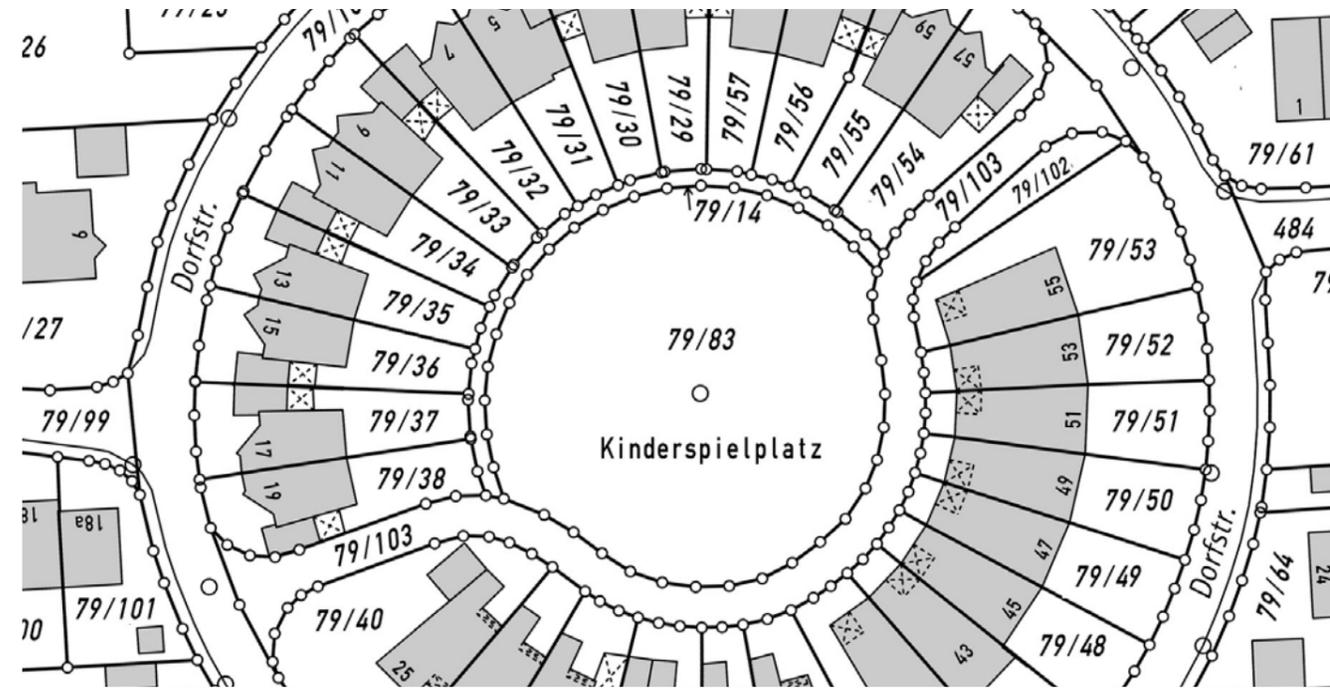
**We are responsible for ensuring
that the property cadastre –
the comprehensive record of every
parcel of land in Bavaria – is kept
permanently up to date.**

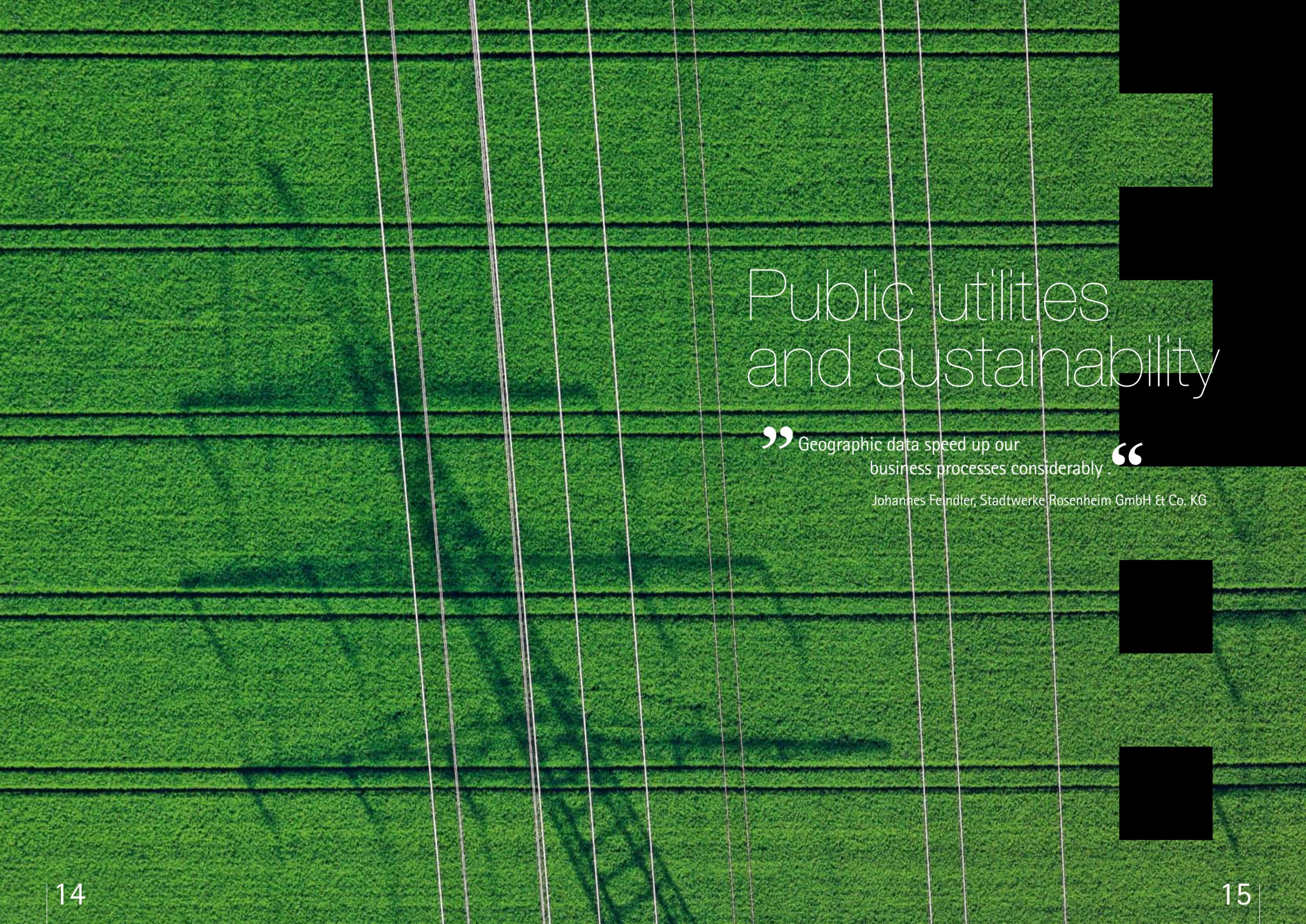
Land ownership rights – whether in relation to residential or rural parcels of land – are held in high esteem. Land is often passed down through many generations, and can stir strong emotions. The right to land tenure is therefore given very special protection in the German Constitution. Property boundaries are defined and safeguarded by given very special protection in the German Constitution. Property boundaries are defined and safeguarded by cadastral surveys, which need to be carried out if a parcel e.g. is to be divided up for construction purposes, if the boundaries in a particular location are no longer visible, or the landowners are unsure about the position of the boundary.

Each year the surveying teams of Bavaria's 51 State Cadastral Offices perform around 80,000 cadastral surveys, come rain or shine. They check the existing parcel boundaries, repair or replace boundary markers, or, for official subdivision surveys, insert and mark new boundaries within the existing property boundaries, according to the owners' specifications – among other things. Unlike other German Federal states, Bavaria uses "Feldgeschworene", volunteers who are generally locally well-known and respected individuals, to assist in carrying out these surveys. The post of "Feldgeschworener" is one of the oldest known voluntary positions in Bavaria that still exists to this day.

The results of the surveys by the Cadastral Offices form the basis for the record in the land register, with the names of the parcels being taken from the property cadastre. In addition to the 10 million-plus parcels, more than 8 million buildings in Bavaria are also described in the property cadastre, and depicted visually in the official cadastral plan. In this way the State Cadastral Offices ensure on a daily basis that the property cadastre is kept up to date, and so forms a complete record of all parcels in Bavaria, with no omissions.

Many people dream of building their own house with a garden. To obtain a construction permit to build a house, it is necessary to obtain a current extract from the property cadastre, among other things. This extract should include details of parcels and ownership for both the building site in question and the parcels surrounding it. Now, however, people intending to building their own house no longer need to go to the responsible Cadastral



An aerial photograph of a lush green field, possibly a golf course or agricultural land, with several power lines running vertically across it. The lines are thin and white, contrasting with the vibrant green grass. The overall scene is bright and clear, suggesting a sunny day.

Public utilities and sustainability

” Geographic data speed up our
business processes considerably . “

Johannes Feindler, Stadtwerke Rosenheim GmbH & Co. KG

Useful for utilities

Our geospatial reference data are used as a basis for planning processes in the field of utilities and sewerage.

The perfect planning, operation and repair of electricity, water and gas networks calls for accurate, current geospatial data. These data come into their own when a water mains bursts, for example, and a quick response is needed. With the help of these data, the local water company can quickly bring in its excavators, inform the landowner, then dig in just the right place to remove the earth from around the pipe in order to repair it. But the water company can only do this so efficiently because it has access to accurate maps showing the exact locations of the pipes. This information about the location of the water company's supply and sewerage networks is based on geospatial reference data from the Bavarian Administration for Surveying.

Utility companies route their pipes in relation to geodetic control points, the coordinates of property boundaries, and building corners – all data taken from the official property cadastre. These are therefore important base planning data for all utility and sewerage companies. That also includes companies that operate electric power lines, sewer lines, gas and district heating networks, and broadband internet networks.

After all, reference data from the Bavarian Administration for Surveying play a valuable role in supporting not just maintenance and repair work, but also planning activities. For example for a power network operator planning a new overhead power line. They can quickly and conveniently download the geospatial reference data they need from the internet. This is only possible thanks to standardised geospatial reference services that are networked with one another in the background, to allow the necessary geospatial data to be supplied on demand. By developing this spatial data infrastructure (SDI), the Bavarian Administration for Surveying ensures that its geospatial data are accessible to the largest possible number of users from the public and private sectors.

geospatial data. The Energie-Atlas combines information on climate protection with geospatial data in order to give users a substantial depth of information relating to energy conservation and energy efficiency. In this case as decision-making aids in planning and selecting locations for energy facilities, official geospatial data therefore contribute significantly to promoting the necessary transition to renewable energies.

www.energieatlas.bayern.de

A subject that is particularly topical today is the question of how to secure a sustainable, climate-friendly, affordable, safe supply of energy. Where are there already solar heating facilities, wind farms and biogas plants? Where are the conditions optimal for constructing a new plant? Where in Bavaria are renewable energies particularly conveniently accessible? Location analyses require intelligent maps linked with thematic regional policy information. Aerial photographs and topographic maps allow information to be presented in a geospatial context and in an attractive way, and are conveniently available in the Energie-Atlas Bayern, an interactive website powered by official

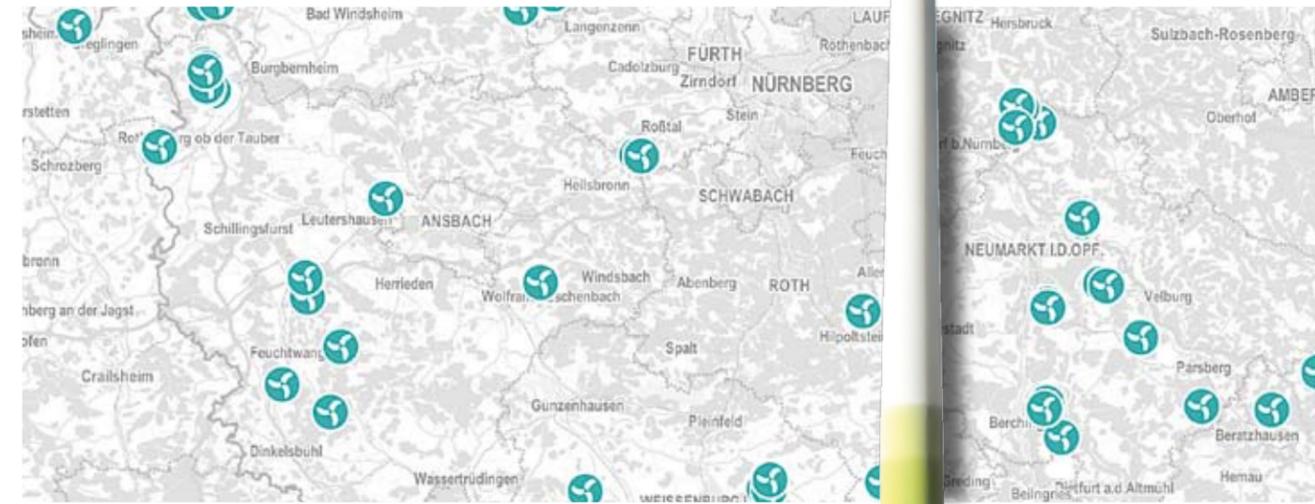


Energie-Atlas Bayern: Location of wind turbines

The Isar 1 hydroelectric power station, Munich



Helmeringen solar park



An aerial photograph of a city, likely Munich, Germany, showing a large stadium with a distinctive white, textured facade. The stadium is surrounded by a complex highway interchange and various urban buildings. In the background, a city skyline is visible under a clear sky.

Planning and construction

“ Geospatial data coupled with decision-relevant information form the basis for the planning and coordination of construction projects. ”

Peter Driessen, Chief Executive Officer,
Association of Bavarian Chambers of Industry and Commerce

Building the future

The construction of roads, bridges, tunnels and buildings requires extremely precise calculations. Our geospatial reference data and services provide engineers with a basis for the design of infrastructure projects.



Where would we be without a decent road and rail network? The answer soon becomes clear when we find ourselves in the middle of a traffic jam. The starting point for planning any modern infrastructure project – whether it is a bypass, railway line or shopping centre – must always be current, highly accurate geospatial data. What routes are possible? Which route would be best for the environment? Which one uses the least land? With the help of aerial photographs, a cadastral plan, digital landscape models and elevation data, planners can prepare a number of possible designs and variants and use these to check how environmentally friendly the various options are before construction work begins.

Aerial photographs are vertical shots of the earth's surface that provide all kinds of information. They show the landscape exactly as it is, and are easy to interpret for the layperson. Aerial photographs can be processed to make digital orthophotos which, like maps, can be used for measuring distances and areas. They can also be merged as required with other geospatial data, for example from the digital landscape model. In the orthophoto, possible road routes can be highlighted, or contours shown, for example. These orthophotos are therefore indispensable for planners who want to visualise future construction projects in a realistic way.

Adding a third dimension extends the possibilities for visualisation and analysis yet further. Thanks to state-of-the-art laser scanning technology, very precise elevation information with high coverage is available, allowing the terrain to be represented stereoscopically. Planned structures can be inserted into the topography before they are built, for simulation purposes. The resulting 3D image creates a realistic impression and immediately highlights the effect of the planned work. How well does it fit into the landscape? Where is it visible from? Is there a hill blocking the view?

During construction, engineers can monitor the work carried out using the precise coordinates of geodetic points and benchmarks. Extremely precise networks of control points must be established and maintained in order to create the kind of consistent spatial reference system that is required for the continuous surveying of the structure, and the monitoring of nearby buildings and areas, during the course of construction. In this way any subsidence, movements or sliding of surrounding buildings or terrain can be detected at an early stage, and measures taken to counteract this if necessary.



Our earth is not homogeneous inside. The mass in the earth's interior is distributed unevenly, and this creates dents and bulges in its gravitational field which, when presented in a highly exaggerated form, give it the shape of a potato, as on the cover of this brochure. To obtain very precise elevation data, which are very important specifically in construction projects, it is necessary to gather gravity data so that the local variations in the earth's gravitational pull can be taken into account. Only then will water indeed always flow from the "top" (largest height value) "downwards" (i.e. to a point with a smaller height value).

Constructing complex structures such as roads, tunnels and buildings requires very high accuracy. GPS, which is used in car sat nav systems, can only determine positions within around 10 m. For construction projects, this is not enough. The SAPOS® satellite positioning service from the German National Survey, on the other hand, can be used to determine horizontal and vertical positions within a matter of centimetres on the basis of correction values, which are transmitted to users via mobile and internet.

An aerial photograph being used in the planning of civil works





Safety and emergency management

” Geospatial data help us coordinate our assignments. “

Dietmar Löffler, State Commissioner, Federal Agency for Technical Relief

Plans that help plan

Our geospatial reference data make a valuable contribution to enabling emergency services to reach their destination swiftly, and provide efficient, coordinated assistance to victims of emergencies.

When major fires, accidents or flooding strike, police and other emergency services must be sure that they can find the street and house number immediately. For this, the address of every house in Bavaria must be linked to its precise coordinates. Only then will sat nav systems work reliably and take the emergency services quickly and accurately to the scene of the emergency.

But that is not all that is required. Action plans are also needed, to coordinate the emergency services and so guarantee rapid on-site assistance to victims of emergencies. This must include information on all of the factors that could affect the assignment. That information, combined with official geospatial reference data from the Bavarian Administration for Surveying such as a cadastral plan, house coordinates, aerial photographs, a digital terrain model and building models, form the basis for the preparation and continuous updating of action plans of this kind.

Precise coordinates for houses: vital for providing rapid help



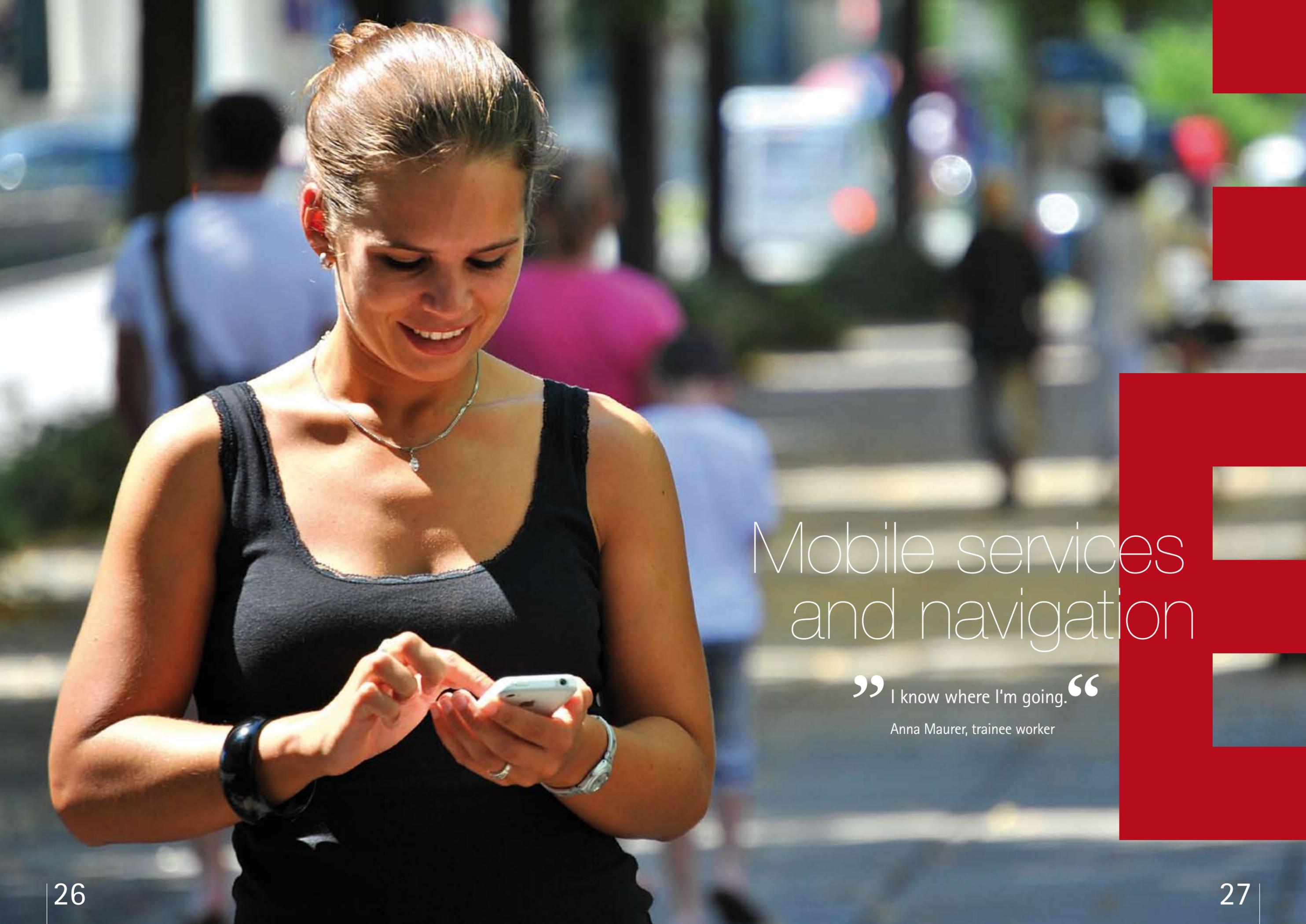
Every year, Bavaria falls victim to millions of euros of damage from flooding. Anyone who has been affected by flooding themselves will know just how destructive water can be. It is also enormously damaging to the economy. It is therefore well worthwhile to identify areas at risk and take effective flood prevention measures. The EU Floods Directive requires that all EU countries prepare flood risk maps by 2013. In order to plan and construct retention basins, create flood zones, and implement mobile, modular flood prevention measures, it is necessary to have a precise knowledge of the surface of the land.

Landslide susceptibility maps need to be prepared for regions such as the Bavarian Alps where there is a risk of the repeated occurrence of natural phenomena such as landslides and rockfalls. The high-precision digital terrain model from the Bavarian Administration for Surveying, created using laser scanning, serves as a basis for risk prevention strategies and for responding to climate change. Exchange of DEM data with Austria means that, in the Alps, even cross-border risk management is possible.



Simulated flood: Passau with the river 9 m above its normal level





Mobile services and navigation

” I know where I'm going. “

Anna Maurer, trainee worker

Know where you stand

Our geospatial reference data are always up to date, comprehensive and accurate, which is why they are used today as base data for everyday devices such as route planners and navigation systems.

Talking on the phone and surfing the internet while on the move has become an integral part of everyday life, particularly for young people. Deciding spontaneously by mobile where and when to meet and what to do is well and truly "in". Location-based services and apps on smartphones give users a wealth of ideas for how to spend their free time, and navigation services and digital maps then take them straight to where they need to be in the city. With social media sites such as Facebook and Twitter they can then instantly share locations with friends. This allows users not only to find their way around new cities easily, but also introduces them to new venues in the places they already know.

This is all so normal to us today. But without the up to date, accurate geospatial data that mobile providers need to plan and optimise their networks, none of it would be possible. They need precise models of the surface of the earth, and information on the positions and shapes of buildings. The Bavarian Administration for Surveying regularly collects these data for the whole of Bavaria. In the process, different types of geospatial reference data are combined with one another, creating new information for use in various everyday applications. For example, laser scanning data and the highly accurate building floor plans



Geospatial data allow smartphone users to navigate while on the move



The GIOVE-A GPS satellite

Three-dimensional building model: available for the whole of Bavaria



from the cadastral plan can be used to create a three-dimensional building model of Bavaria, which serves as a basis for analysing network coverage for mobile voice and internet users.

Day in, day out, devices such as route planners and sat navs require up to date, accurate data about the routing and types of roads. The structured data in the Bavarian Administration for Surveying's digital landscape model meet just these criteria, and for this reason are popular among geospatial data providers who supply data for navigation systems. The digital landscape model faithfully depicts the landscape and includes well over 100 different types of topographic objects, for example roads and paths, and hence provides a very high density of information. Local authorities can use these geospatial data for e.g. optimising bus routes, in the process not only saving time and money, but helping to protect the environment as well.

Digital landscape model: provides structured information on e.g. roads, towns and villages, still and running water, vegetation





Leisure and recreation

” It’s about getting, without a hitch,
to where you want to be. “

Josef Klenner, President
of the German Alpine Club

All mapped out

Our range of leisure maps showing cycle paths, walking routes and suggested tours mean you will always have a reliable guide to hand on your next biking or hiking trip.

Time for some time out? "Rest gives relish to labour", according to the ancient Greek writer and philosopher Plutarch. Everyone has their own favourite relish for livening up food, and tastes differ at least as widely in the world of leisure activities. Some head straight for the sofa, others fire up the barbecue, while others head for the hills, either on foot or on their bike. Those who favour the great outdoors need to make sure they can find their way around, and for that they need good maps. The Bavarian Administration for Surveying offers a wide range of paper and digital maps for walkers and cyclists. It also offers walking and cycle paths around Bavaria with a total length of some 200,000 km; these are ideal for viewing on mobile devices, and can be downloaded free of charge for personal use.

www.geodaten.bayern.de

Whether you prefer them on paper or on your mobile, the Bavarian Administration for Surveying's maps are all up to date, comprehensive, and easily legible. And each one has its own benefits: The printed paper leisure map, for example, needs no batteries and is the only one that also presents details of the surrounding area, and gives an overview of the region. Digital maps have the major benefit that they can be installed on a mobile phone, which users would usually be carrying with them anyway, and in this way a mobile can be turned into a mobile navigation device.

Fans of paper leisure maps will appreciate our Amtliche Topographische Karte (ATK) on a scale of 1:25,000, with its highly detailed information, notes for tourists, and current network of walking and cycle paths. The special feature of this map is the fact that, apart from the state capital, Munich, every town and city in Bavaria appears in full on one map sheet only.

Supplementing the topographic maps, the Umgebungs-karten (UK) include leisure information for geographically-related regions (e.g. Bavarian Forest National Park), mainly on a scale of 1:50,000. This makes them ideal for walkers and cyclists. They have been developed in close cooperation with the various rambling clubs and tourist offices in the region, in order to give users relevant and trustworthy cultural and leisure information. Whatever your interests

– museums, stately homes, castles, churches, swimming, dry tobogganing, sites of natural interest, viewpoints, serviced mountain huts – virtually nothing has been left out. And with the help of the overlaid UTM coordinate grid, walkers can use a GPS device to precisely determine their position on the map within just a few metres.

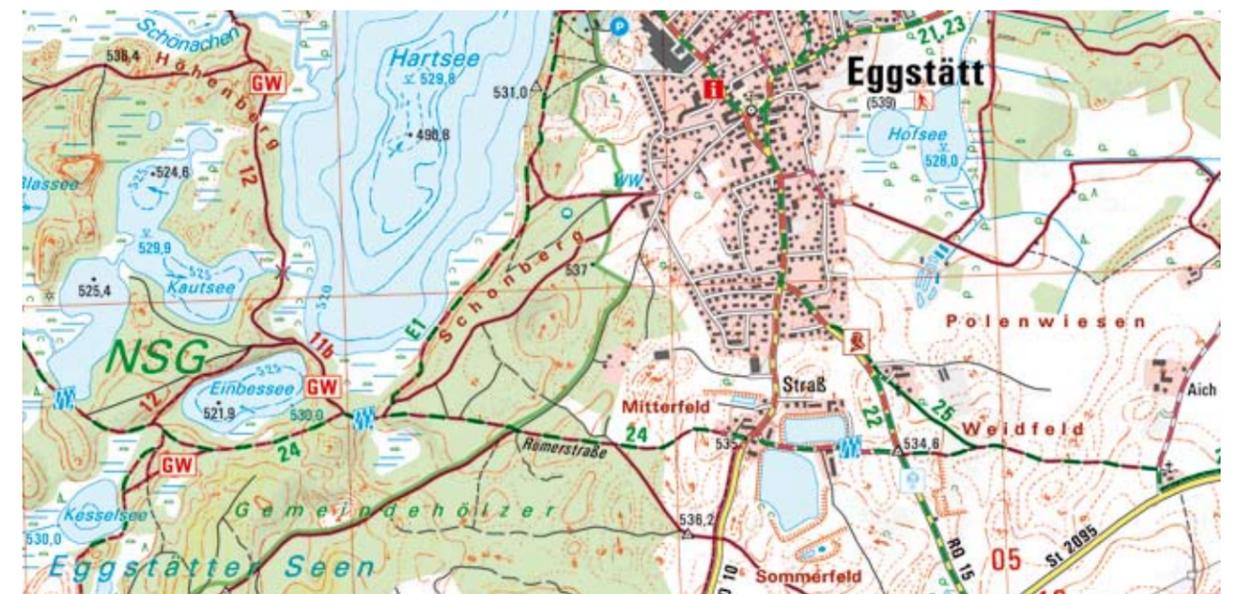
Those who prefer to travel with a PDA or smartphone can plan their trip at home before they leave using the Top50 DVD, then transfer the maps to their mobile device. The path profile and terrain section functions show where the particularly steep sections are going to be. Because the maps also show the mountain huts, walkers can plan their breaks before they leave as well. All manner of other functions are available, for example a place search function, and the possibility of combination with GPS tracks and routes. After your trip is over, you can relive it with an animated 3D flight. And with TopMaps Bayern, users can view the same landscape again from another perspective: either as a 1:25,000 topographic map, a historical map ("What did Bavaria look like 150 years ago?"), or as a current aerial photograph.



Incidentally, much of the Bavarian Administration for Surveying's geospatial reference data is available free of charge. For a bird's-eye view of your home, for example, or to see topographic and historical maps for a specific place or address, go to BayernAtlas:

www.bayernatlas.de

Extract from the 1:25,000 Amtliche Topographische Karte





Environment and conservation

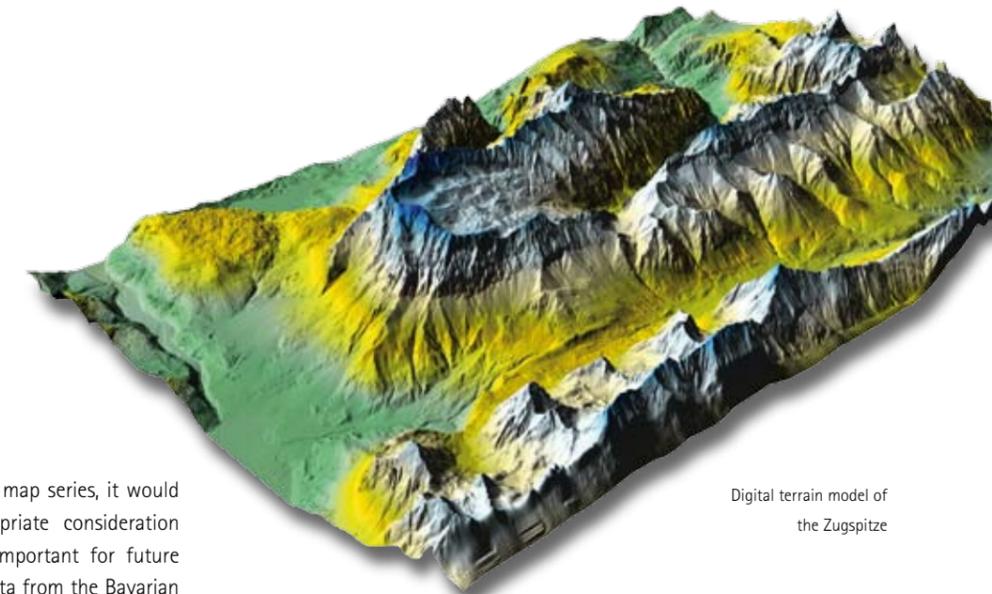
” Geospatial data help conserve resources
and safeguard the future for our children. “

Claus Kumutat, Director of the Bavarian Environment Agency

Bavaria is beautiful. Naturally.

Our geospatial reference data help in the analysis of environmental issues. In this way they make a significant contribution to maintaining the richness and beauty of our landscape.

Bavaria today has a rich natural heritage, shaped by many centuries of human activity. Bavaria's land, water and air form the basis for the life, and serve as a common habitat, for its people, animals and plants. As people's awareness of the need to pass this precious environment on to future generations has grown in recent decades, greater emphasis has been placed on the environment, conservation and climate protection. However, globalisation has meant that businesses, cities and transport infrastructures are increasingly competing with nature conservation areas for space, which is becoming an ever scarcer resource. As a result we now face the challenge of bringing the many, often mutually opposed, claims to our common habitat into harmony with one another.



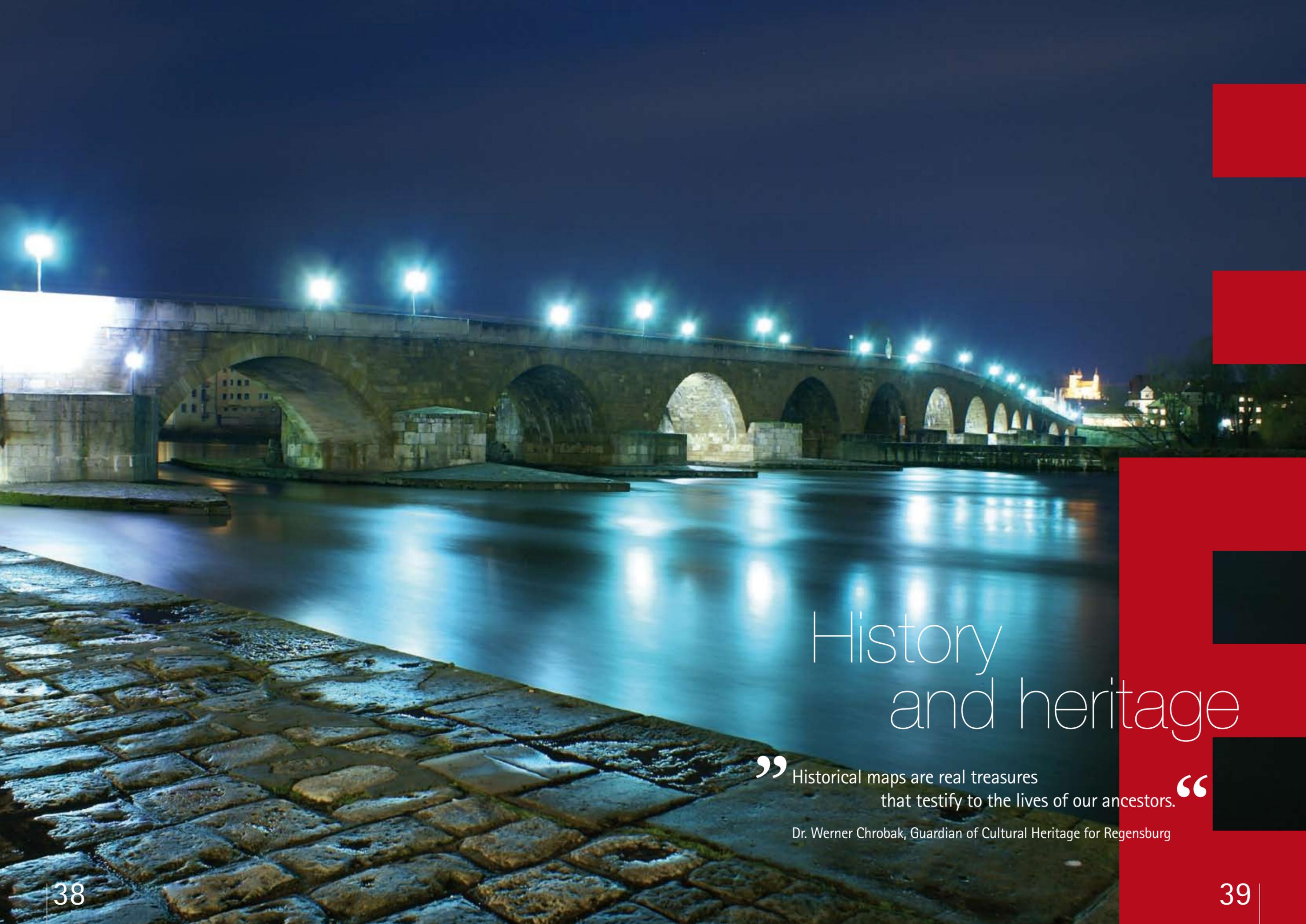
Digital terrain model of the Zugspitze

Without up to date, comprehensive map series, it would hardly be possible to give appropriate consideration to these decisions, which are so important for future generations. Geospatial reference data from the Bavarian Administration for Surveying therefore make an important contribution to ensuring the sustainable use of natural resources. In combination with data from specialist bodies, these data form the basis for all spatial decision-making. Especially in relation to environmental issues, combining the data in this way using digital maps is particularly important, because it is only when the various data are overlaid on one another that it is possible to grasp the often complex environmental and spatial interrelationships involved. This is essential in order to obtain new insights, develop possible solutions, and take optimal decisions.

Geospatial data are used in finding the answers to very everyday, but very important questions relating to the environment. For example: where should the boundaries of drinking water protection areas be in order to prevent our drinking water sources from being contaminated? How high are the ozone concentrations in my city, and what affects how high they are? Where are the boundaries of the high risk area for ticks? Where in Bavaria is there higher (or lower) rainfall today than there used to be? What is the rate of glacier melt in the Alps? How many trees fell in the last major storm due to bark beetle attack? Where in Bavaria do threatened or endangered animal species live? How can I avoid sensitive habitats in the mountains when walking or skiing? Geospatial reference data can form the basis for finding the answers to these and many other similar questions.



Colour infrared aerial image: forest damage (turquoise trees at right-hand edge of picture)



History and heritage

” Historical maps are real treasures
that testify to the lives of our ancestors. “

Dr. Werner Chrobak, Guardian of Cultural Heritage for Regensburg

Bringing history to life

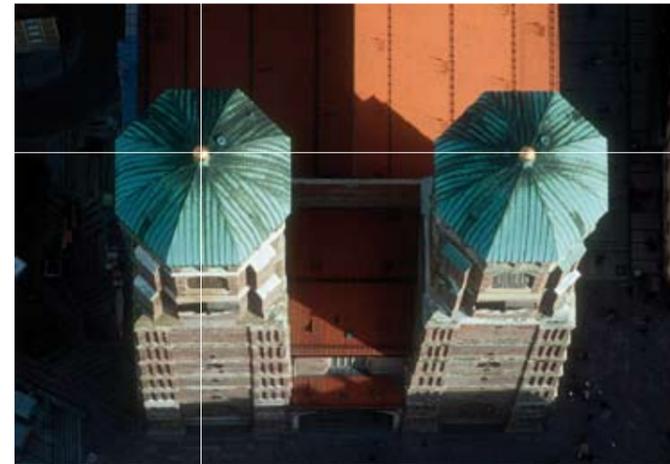
Our historical cadastre plans and hand-drawn topographic field sketches showing Bavaria's towns, villages, fields and ways testifying the state's rich history.

"Napoleon ist an allem schuld". This film title, which translates as "Napoleon is to blame for everything", is also partly true for the origins of surveying activities in Bavaria. When Munich was occupied in 1800, the commanding general of the French Army of the Rhine, Decaen, ordered the making of an "astronomically and geographically correct map" of Bavaria. After the French had retreated, the prince-elector of Bavaria, later to become King Max I. Joseph, continued this undertaking by founding the "Topographic Office" in 1801. He wanted to make a topographic atlas of Bavaria on a scale of 1:50,000, with maps that would be usable not just for military, but also civilian purposes.

Thus from 1801 onwards, Bavaria was spanned with a network of triangles made up of fixed – or trigonometric – points, which would allow the measurement of angles and distances. Apart from two control lines in Franconia and the Palatinate, the 21.653 km-long baseline, measured by Charles Rigobert Marie Bonne using 5 m-long wooden poles, was the only line used. Modern measurements using cutting-edge instruments differ from this original measurement by only approximately 70 cm, in other words just 3 cm per 1 km of baseline. Given the technical equipment available at that time, this measurement was a truly masterful achievement.

Because land tax was the state's main source of income, in 1808 King Max I. Joseph set up the Commission for Taxation and ordered the systematic surveying of all land, in order to ensure that citizens were taxed fairly. The individual parcels of land were measured using a plane table. Not only were landowners pleased with the results, but the resulting measurement effectively served as a tax return for them. By the time this work came to an end, in 1865, more than 21 million tracts had been surveyed across the entire kingdom including the Palatinate. This included determining their type of use, productiveness, area and owner, entering them in the cadastral registers of 8,493 taxpaying communes, and recording them graphically on 25,764 plane table sheets – the so-called "Uraufnahmen" or "original surveys" – on scales of 1:5,000 and 1:2,500.

It was a happy coincidence that exactly the scientists and inventors who were needed to make this gargantuan task possible all coincided in Bavaria at the start of the 19th



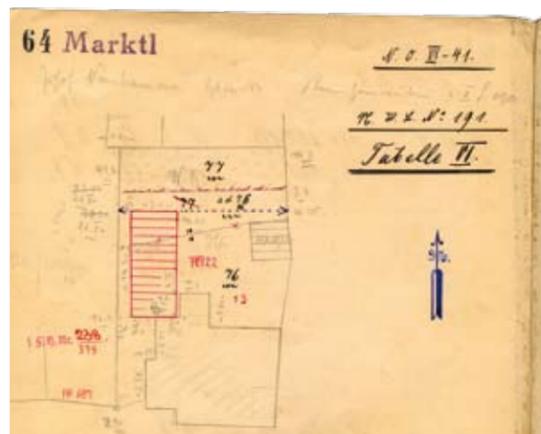
The origin of the Soldner coordinate system: the North Tower of the Frauenkirche in Munich

century. There was Soldner, for example, who devised the Soldner coordinate system whose origin is the pole on top of the North Tower of the Frauenkirche in Munich; Fraunhofer, who manufactured high-quality optical lenses which could be used in the development of surveying instruments; Reichenbach, who built telescopes with a device for measuring distances; Utzschneider, who excelled in finance and economics; Schiegg, who organised the cadastre and the divisions of the cadastre plan; and Senefelder, who invented lithography, which was used for duplicating the cadastre plans. The roughly 26,000 plates of lithographic stone used for this are still in existence today, and jointly form the unique "Steinbibliothek", or "stone library", which is housed and available to view in the basement of the Bavarian Agency for Surveying and Geographic Information. The cadastre was met with great respect internationally, particularly as nothing of its kind had been done before on which Bavaria could base its work. However, its importance was far wider-reaching than that: by safeguarding land ownership, and thus opening up the possibility of transactions in land, it was an essential step towards the establishment of a modern political system that would benefit public bodies, businesses and individuals in equal measure – and which continues to do so to this day.



Field sketch of "Pope Benedict House", MarktI cadastral district

Extract of the original historical field map of MarktI from 1824, scale: 1:5,000, house number 13 ("Pope Benedict House")



Organisational structure

In figures

It was more than 200 years ago that the Commission for Taxation was established, and the order issued to survey all land in Bavaria, so that citizens could be taxed fairly. This is one reason why, today, the Bavarian Administration for Surveying falls under the auspices of the Bavarian State Ministry of Finance. The Bavarian Agency for Surveying and Geographic Information, which is based in Munich, acts as the central contact for all matters relating to official land surveying in Bavaria, while the State Cadastral Offices are responsible for the continuous updating of Bavaria's property cadastre.



Our surveying teams are on the ground in all weathers, surveying some 30,000 parcels of land every year in order to safeguard property boundaries for the citizens of Bavaria.

Details of building ownership are also kept constantly up to date in the property cadastre, with some 50,000 building surveys being carried out every year.



70,550
Total area of Bavaria in square kilometres

2,705
Total length of the Bavarian border in kilometres

12,538,696
Population of Bavaria in 2010

177,73
Population of Bavaria per square kilometre

51
Number of Cadastral Offices in Bavaria providing comprehensive surveying services for the citizens of Bavaria

75,251
Number of parcels of land surveyed by the State Cadastral Offices in Bavaria in 2010

270,925
Number of boundary markers surveyed by the State Cadastral Offices in Bavaria in 2010

1801
Founding year of the Bavarian Administration for Surveying



Topometer
Ertel und Sohn
Munich, 1912

Picture credits

Cover picture:	The world as a potato: the Geoid, German Research Centre for Geosciences, Potsdam
Pages 10 and 11:	Village street, Klaus Leidorf
Page 12:	Property boundaries, Anton Scholz
Page 13:	Cadastral plan, Bavarian Administration for Surveying
Page 13:	Draft development plan for Markt Markt Indersdorf
Pages 14 and 15:	Shadows from power lines, Klaus Leidorf
Page 16:	Isar 1 hydroelectric power station, Stadtwerke München GmbH
Page 16:	Helmeringen solar park, Stadtwerke München GmbH
Page 17:	Wind turbine, © DeVlce - Fotolia.com
Page 17:	Energie-Atlas Bayern, Bavarian State Ministry of the Environment and Public Health
Pages 18 and 19:	Panorama of Munich, Klaus Leidorf
Page 20:	Land surveyor, Leica Geosystems GmbH
Page 21:	Froschgrundsee Viaduct, Deutsche Bahn AG
Page 21:	Schwarzenberg roundabout on the B309, Kempten State Building Office
Pages 22 and 23:	Flooding in Passau, Herbert Stolz
Page 24:	2011 floods, Ralf Thees
Page 24:	House coordinates, Bavarian Administration for Surveying
Page 25:	Fire services in action, Charly Höpfl
Page 25:	Flood simulation for Passau, Bavarian Administration for Surveying
Pages 26 and 27:	The smartphone era, Robert Haas
Page 28:	LoD1 building model, Bavarian Administration for Surveying
Page 29:	Navigating with a smartphone, Robert Haas
Page 29:	GIOVE-A GPS satellite, ESA
Page 29:	Digital landscape model, Bavarian Administration for Surveying
Pages 30 and 31:	River Lech, Klaus Leidorf
Page 32:	Out and about with the bike, Robert Haas
Page 33:	View from the summit, Kurt Straßgütl
Page 33:	The 1:25,000 Amtliche Topographische Karte, Bavarian Administration for Surveying
Pages 34 and 35:	Eggstätt-Hemhofer lake district, Klaus Leidorf
Page 36:	River in grassland in Bavaria, Flickr.com
Page 37:	Digital terrain model of the Zugspitze, Bavarian Administration for Surveying
Page 37:	Colour infrared aerial image of the Rachelsee, Bavarian Administration for Surveying
Pages 38 and 39:	Steinerne Brücke in Regensburg, Matt Keyworth
Page 40:	Field sketch for „Pope Benedict House“, MarktI cadastral district, Bavarian Administration for Surveying
Page 41:	Towers of the Frauenkirche in Munich, Klaus Leidorf
Page 41:	Original historical field map of MarktI from 1824, Bavarian Administration for Surveying

Publication details

maßarbeit

An information brochure from the Bavarian Administration for Surveying

Publisher:

Bavarian Agency for Surveying and Geographic Information
in cooperation with the Bavarian State Ministry of Finance

Editing and design:

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Printing and copyright:

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