

# Development of a Unified Database of Spatial and Attribute Data for Information Systems of Ministry of Ecology of RB

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## Abstract<sup>1</sup>

This article considers process of informational interaction between information systems of Ministry of Natural Resources and Environment of the Republic of Bashkortostan, shows generalized structure of data required of natural resource management on the territory of RB, shows the need of development of a unified database of a spatial and attribute data for information systems of the Ministry.

## 1. Information systems of Ministry of Ecology of RB, using spatial information about geographically distributed natural objects

The most important aim of Ministry of Natural Resources and Environment of the Republic of Bashkortostan (henceforth referred as Ministry of Environment of RB, the Ministry) is the effective management of natural resources of the Republic. Its achievement requires information about the objects of control: natural resources, their environment, natural resource users, environmentally dangerous objects, potentially flooded area during spring floods, etc.

While performing its duties the Ministry creates and manages the national fund of information on natural resources, environmental protection and ecological security, establishes exchange, transfer and dissemination of this information, participates in the creation of

information systems for the needs of environmental management, environmental protection, environmental safety and conservation of biological diversity.

In the process of the development of information support of the Ministry, the number of tasks that can be accomplished using spatial information about the geographically distributed natural and technological objects, such as water or natural resources is increasing.

The peculiarity of these objects is their substantial length and distribution over the territory of the Republic of Bashkortostan. Availability of information on the exact location of objects, their mutual arrangement and the relationship affects quality of management decisions, so using GIS technology is necessary for creating an integrated information system of Ministry of Environment of RB. In this case, all information blocks should include both descriptive (attribute) information (name, quantitative characteristics, administrative affiliation, etc.), and spatial information indicating the location of an object on Earth's surface.

Today, the Ministry has the following information systems (Fig. 1):

flood situation development monitoring information support subsystem (GIS 'Flood');

oil products polluted territories registration automated system (AIS 'polluted territories registry');

regional waste inventory maintenance and establishment information system for the territory of RB (IS 'Waste Inventory');

Information System 'Inspection Activities';

several local GIS systems:

GIS 'Protected Areas';

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GIS 'RB Hydraulic Structures Location';

GIS 'Fishing Grounds Location';

GIS 'RB groundwater location inventory card'

GIS 'Deposits and Areas of Groundwater proved reserves'; as well as local information system of territorial departments of Ministry of Environment of RB.

Almost all of the above information systems have heterogeneous information being processed, in addition, from time to time there is a need to exchange data between different systems, but as a rule, this problem becomes a difficult task: the information can be stored in different formats, and data from one system can not be simply imported into another, making it difficult to project a unified information space. Also, each separate information system of the Ministry includes its own database, which has structured information associated with one or another aspect of the ministry, while some of them use information from the databases of other information systems: for example, attribute data of natural resource users, stored in information system 'Waste Inventory' and 'Inspection Activities', or general geographic data used by GIS 'Flood' and AIS 'polluted territories registry'.

Forming a single holistic view of geographically distributed objects requires unified formal description of spatial information, which is heterogeneous (type, format and descriptions), distributed (by the territorial location of storage (ministry departments) and belonging to existing information systems). For its unification and representation heterogeneous spatial data obtained (produced) in the regions of RB, obviously, must be standardized, i.e. have common data model and database. Because of this urgent task is to integrate heterogeneous spatial data in existing information systems into a single database of Ministry of Environment of RB and the subsequent development of an integrated information system of Ministry of Environment of RB.

## 2. Generalized structure of data required of natural resource management on the territory of RB

A detailed study and analysis of the needs of Ministry of Environment of RB and its territorial departments in the attribute and spatial data for the use and management of natural resources allowed to develop generic data structures necessary for natural resources management on the territory of RB (Fig. 2).

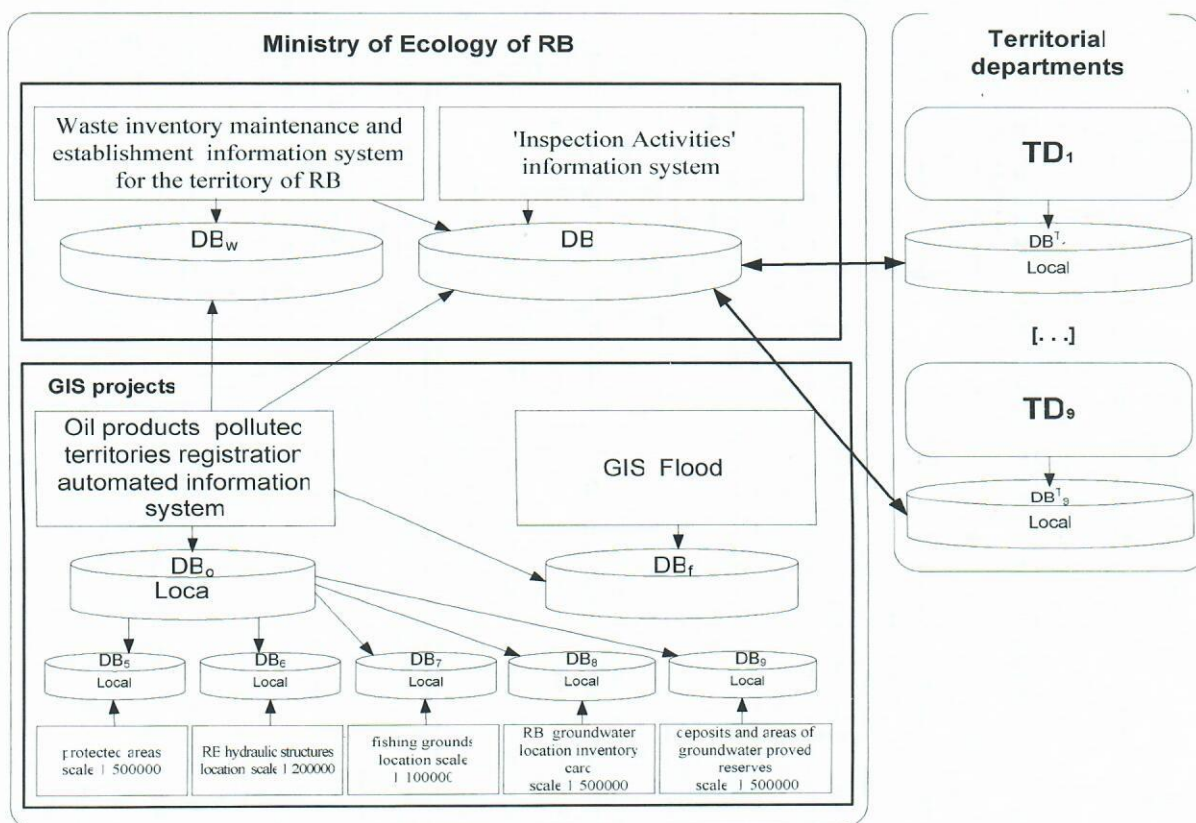


Fig. 1. Scheme of information communication between information systems of territorial departments and central office of Ministry of ecology of RB

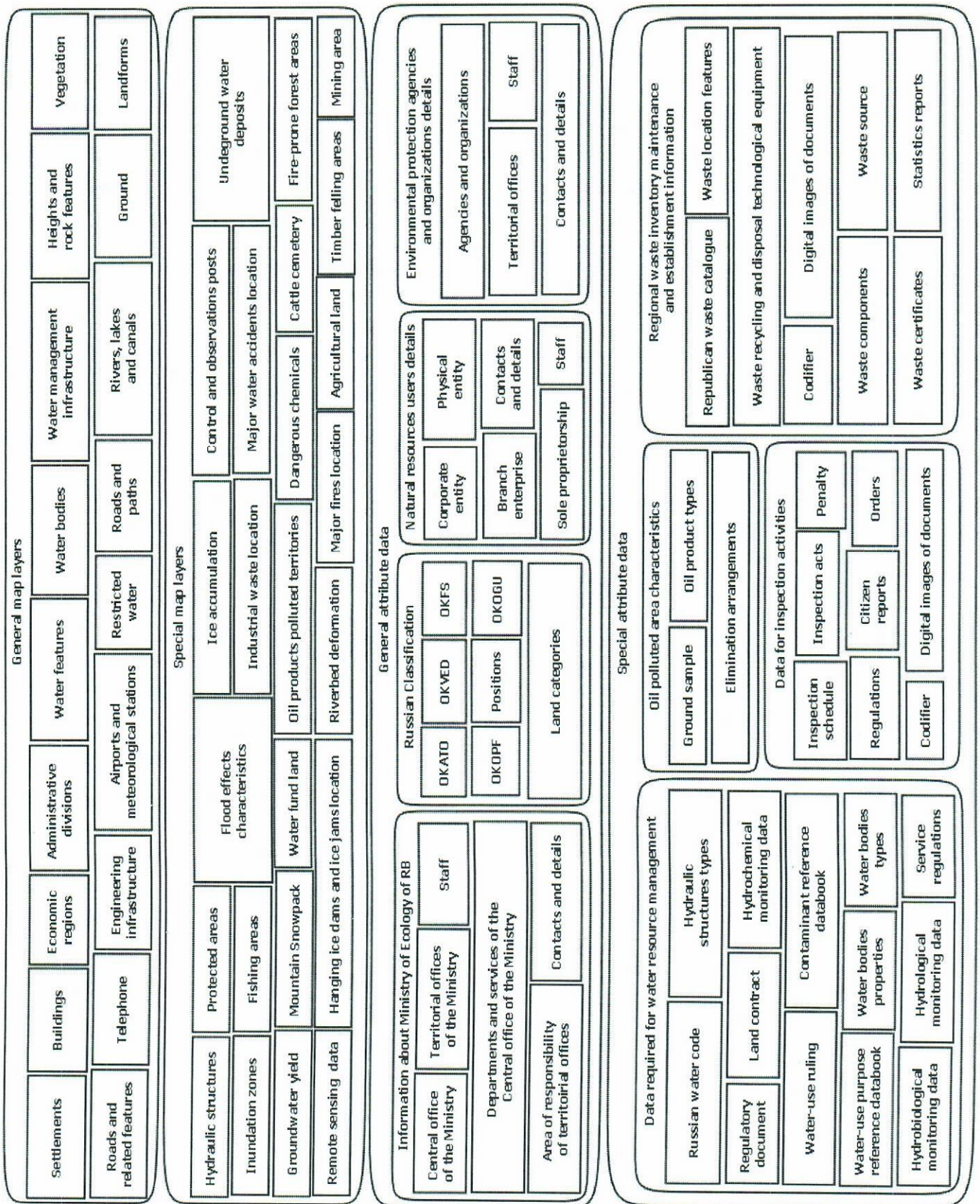


Fig. 2. Generalized structure of data required of natural resource management on the territory of RB

On the scheme various information blocks are highlighted according to the objectives and functions of information systems:

– spatial data:

- geographic map of the Republic of Bashkortostan scale 1:100000 (it contains layers of settlements, the administrative-territorial division, neighboring regions of Russian Federation, highways, industrial buildings, topography, etc.);
- water bodies map (rivers, lakes, marshes and reservoirs);
- special objects of the environment map (specially protected natural areas, fauna habitats, endemic plants locations; fishing areas);
- environmental monitoring objects infrastructure (hydro meteorological and hydro chemical observations posts);
- map of environmental pollution, environmentally hazardous areas and potentially dangerous for the population areas (the territory polluted by oil products, waste disposal facilities, cattle cemetery, flood inundation zone).

– attribute data:

- natural resource users info: their contacts, details and staff;
- environmental agencies and organizations info (including departments and Central Office of Ministry of Ecology of RB);
- waste management info (National waste directory, background information on waste disposal facilities and technologies of their processing / recycling);
- implementation of inspection activities info (orders on the implementation of inspections, check regulations and check records , administrative penalties regulations);
- documentary information (reports of natural resource users in the form 2TP (waste), 2TP (air), 2TP (bowels), images of documents, licenses, contracts).

A key feature of a generalized data structure is possibility of its use by all information systems of the Ministry.

The data structure can be used to create a unified database of spatial and attribute data needed for management of natural resources and environment in the Republic of Bashkortostan.

### 3. Process of joint use of heterogeneous data in information systems of Ministry of Ecology of RB

Consider the process of joint use of heterogeneous data according to algorithm (Fig. 3) through the example of the operational search of information about potential perpetrators of oil spillage near protected areas and water bodies.

Using oil products polluted territories registration automated system polluted area is located on the electronic map scale 1:100000, its characteristics (time of occurrence, duration, volume of spilled oil product) are set, nearby water bodies (in this case, the pond and the river) are also located (see Fig. 4). Then, using GIS 'Protected areas' nearness of polluted area to protected objects of the environment (nature reserves, natural monuments) is estimated.

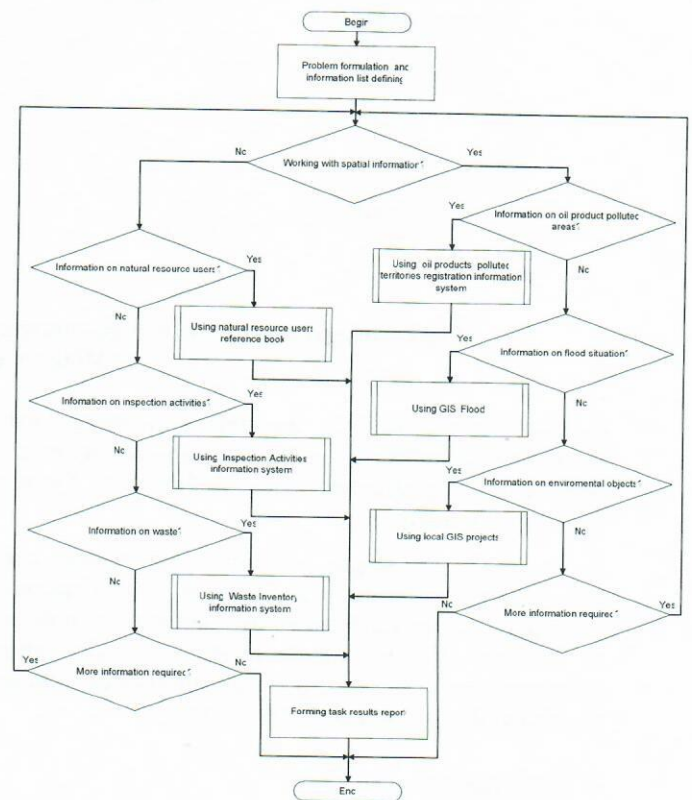
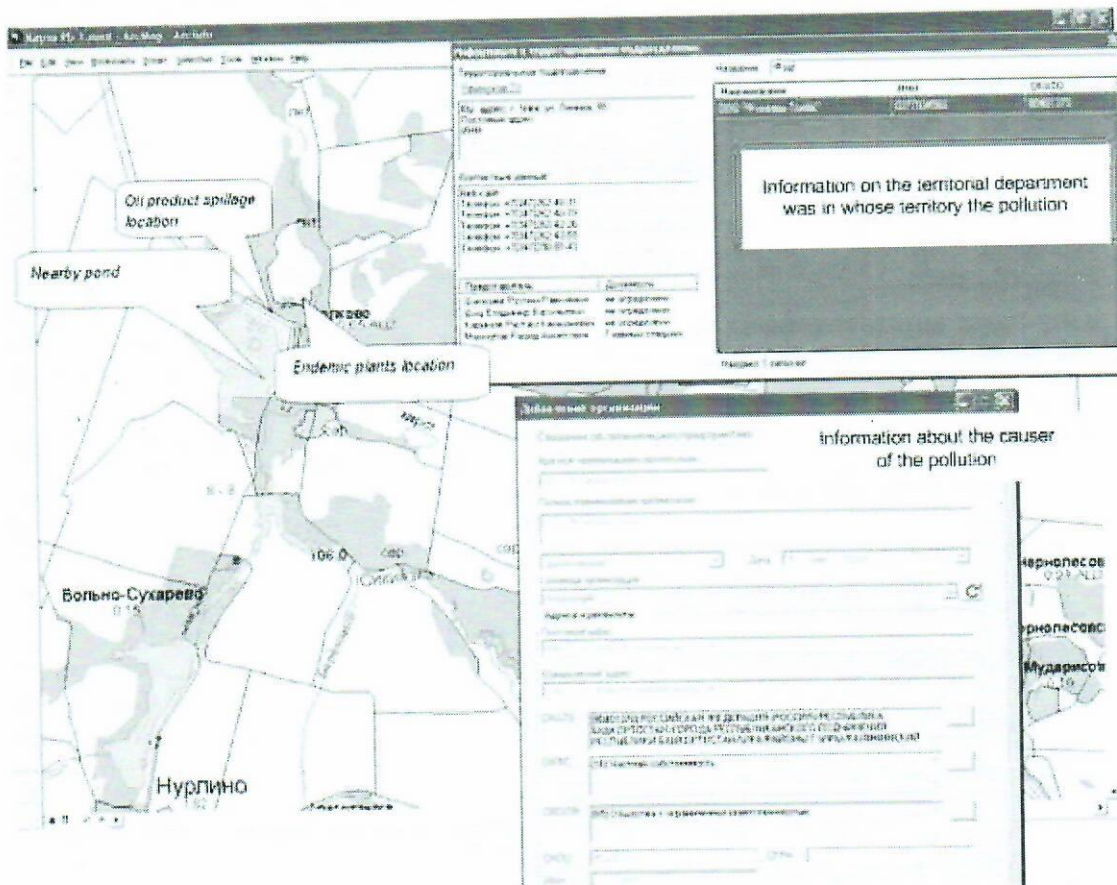


Fig. 3. Block diagram of the spatial and attribute information use algorithm in information systems of Ministry of Ecology of RB

Obviously, for the rapid elimination of pollution and its consequences, it is necessary to send information about the perpetrator to appropriate services. In order to do this, using a single natural resource users reference book, we can obtain current information about the organization – perpetrator of accidental spillage of oil products.



**Fig.4 – Integration of heterogeneous spatial and attribute data in information systems of Ministry of ecology of RB**

enceforth, monitoring of the state of polluted land, revegetation activities, as well as the responsibility of the perpetrator, is performed using Information System 'Inspection Activities'.

As a result, all stages of occurrence, course and consequences of situations involving accidental spillage of oil products, are reflected in these information systems of Ministry of Environment of RB. Similarly, other information on a variety of other situations of concern of the staff of the Ministry can be processed.

#### 4. Conclusion

Thus, the development of a unified database of spatial and attribute data allows its use by all information systems of the Ministry for the operational management of natural resources and environment. This reduces the processing time of information improves its completeness and relevance, ensures the timely receiving of necessary data by all Ministry staff, including specialists of the territorial departments.

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