Creation GIS for Land Reclamation proposes in Russian

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Federal Target Program

- The Government of the Russian Federation accepted the federal target program «Development of agricultural land reclamation of Russia for the period until 2020». The purpose of the program is improvement of the competitiveness, profitability and stability of agricultural output. It requires to emplement complex land reclamation measures along with the methods of adaptive landscape tillage for ensuring food security and preserving future generations of natural resources.
  Federal target program for the development of land reclamation aimed to solving the problem of food security by means of sustainable innovation development of agriculture and the creation of mechanism for effective use of agricultural land and natural resources with methods of integrated land reclamation measures, irrespective of climate change and abnormalities.

Total area of reclaimed lands in Russia,

AFTER IMPLEMENTATION OF THE FEDERAL TARGET PROGRAMM (2014-2020 yy.)

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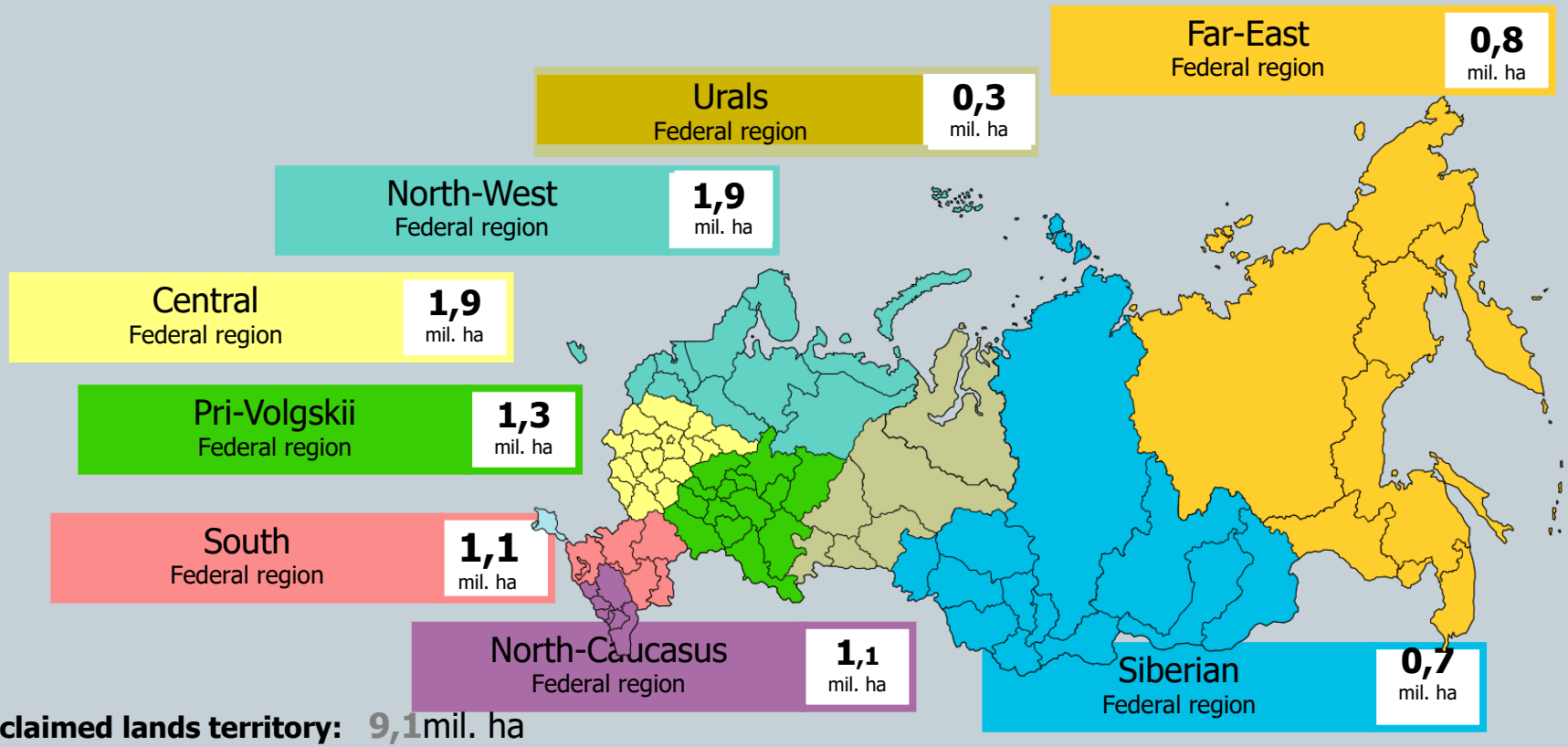

Reclaimed lands territory: 9,1mil. ha

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Irrigation – **4,3** mil. ha;

Drainage– **4,8** mil. ha

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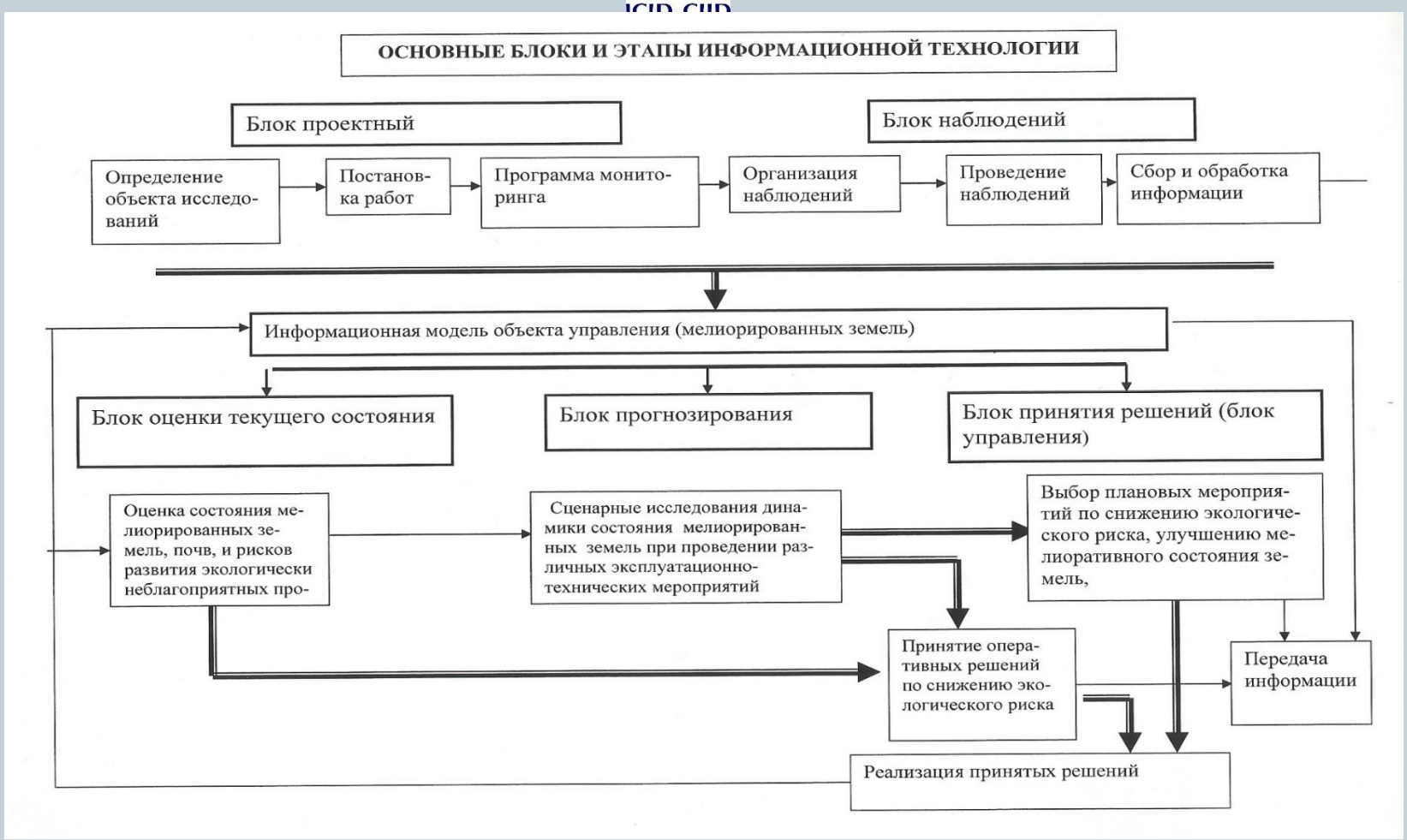
System of State monitoring of agricultural lands

Basic blocks and stages of information technology



Atlas of agricultural lands

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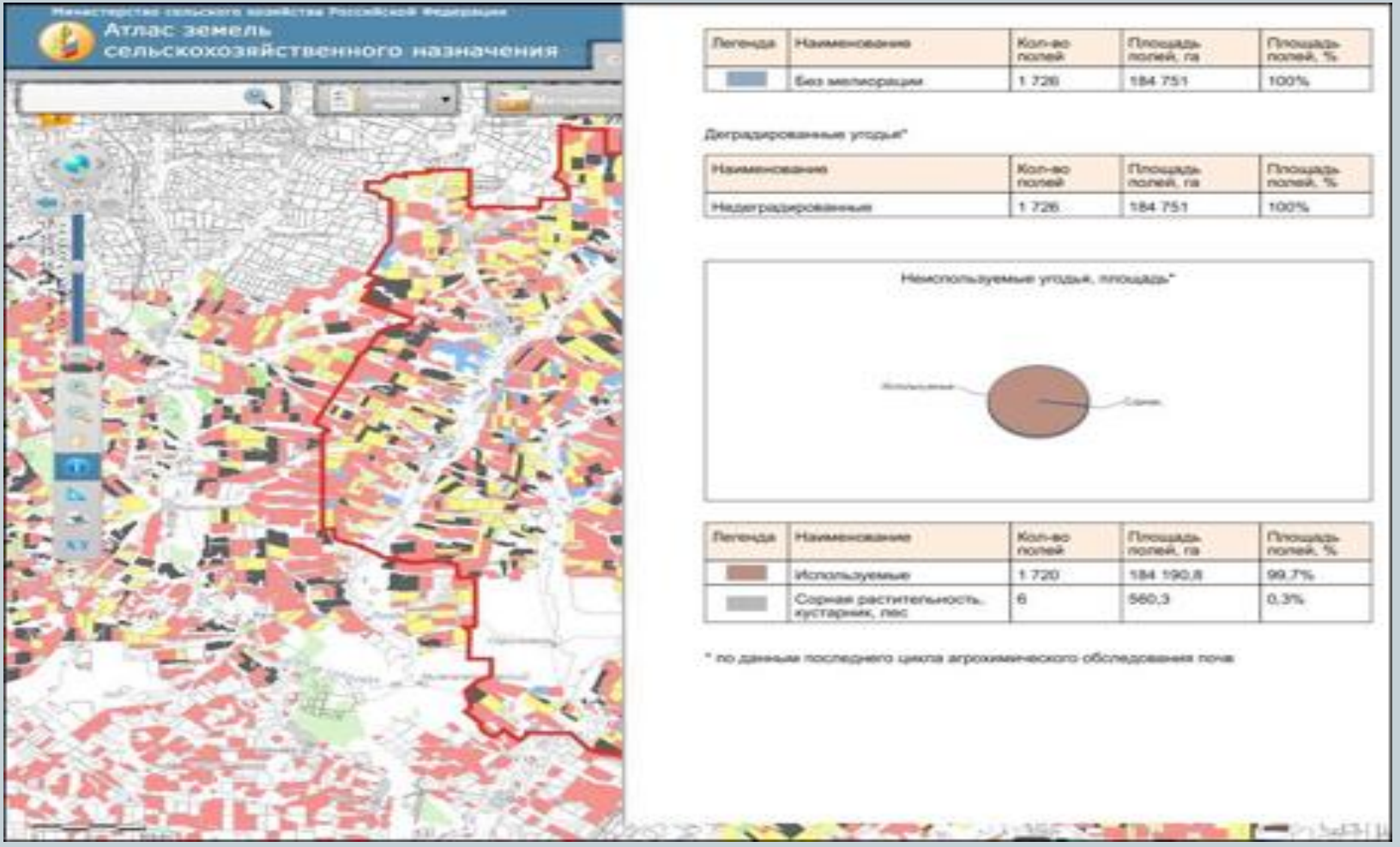


Легенда	Наименование	Кол-во полей	Площадь полей, га	Площадь полей, %
	Без мелиорации	1 726	184 751	100%

Деградированные угодья*

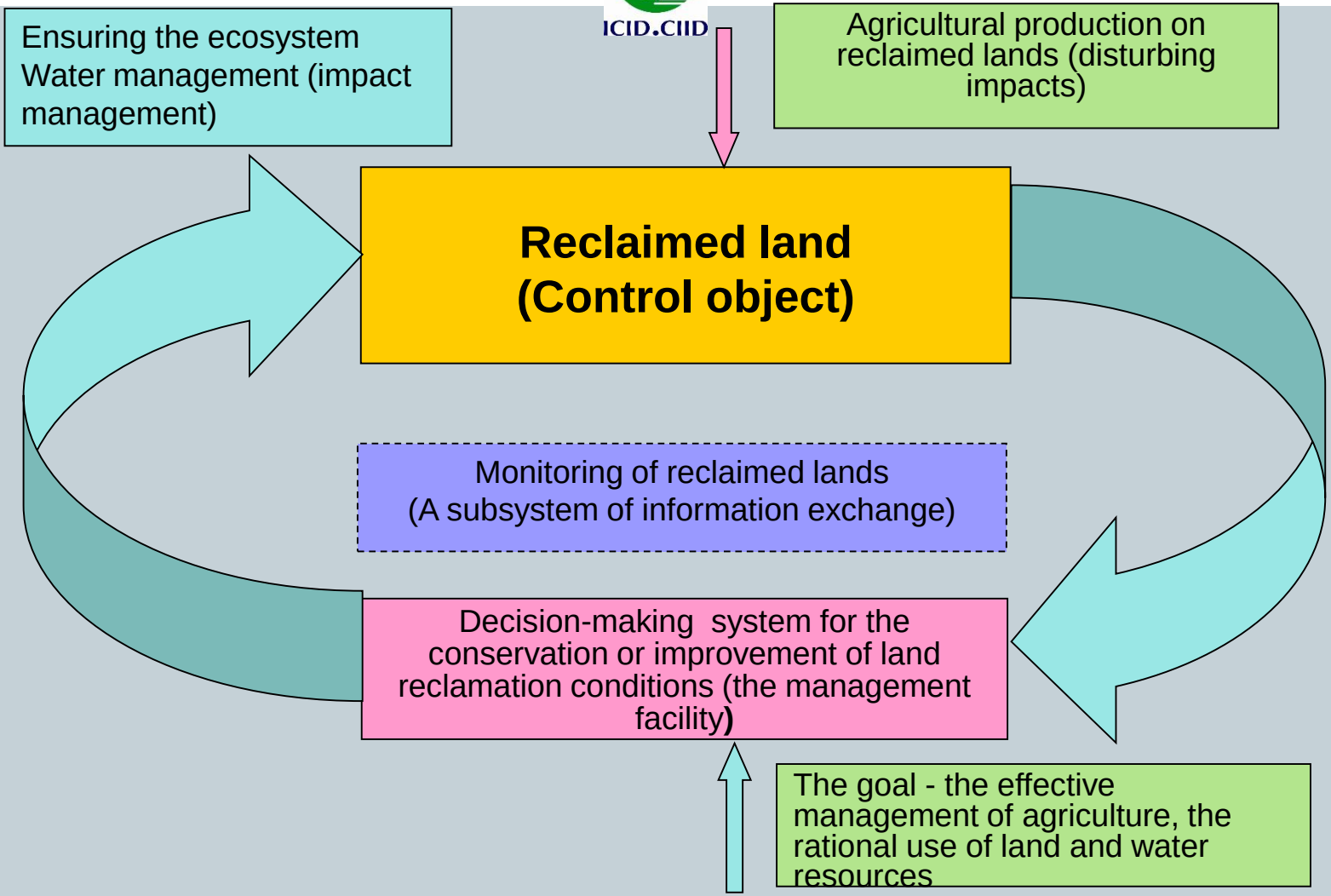
Наименование	Кол-во полей	Площадь полей, га	Площадь полей, %
Недеградированные	1 726	184 751	100%

Неиспользуемые угодья, площадь*

Легенда	Наименование	Кол-во полей	Площадь полей, га	Площадь полей, %
	Используемые	1 720	184 190,8	99,7%
	Сорная растительность, кустарник, лес	6	560,3	0,3%

* по данным последнего цикла агрохимического обследования почв

Management system for reclaimed lands on the basis of monitoring



Information Technology for Reclaimed Lands Monitoring

Organization of observations

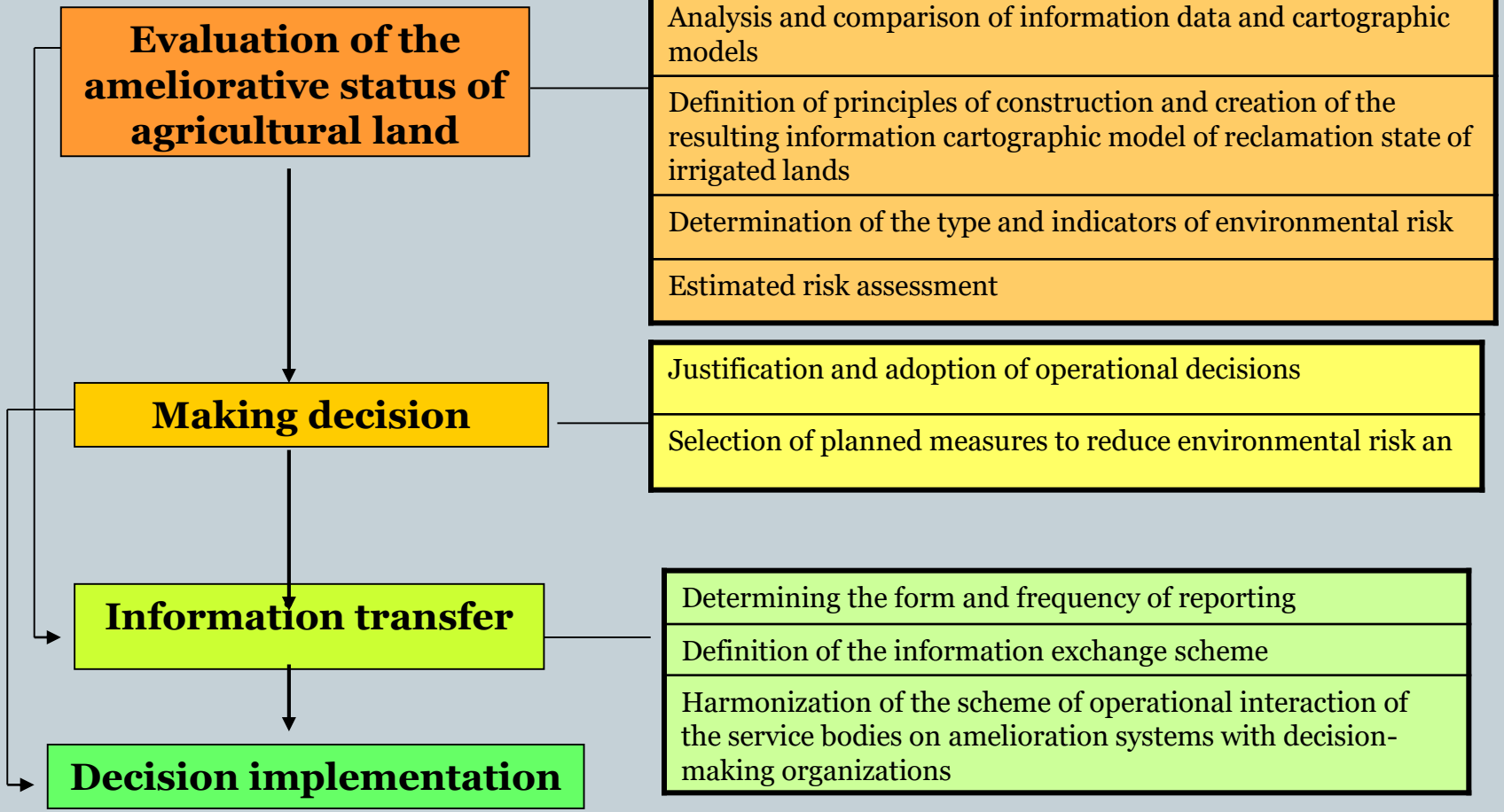
- Refinement of indicators and factors that require observation, assessment and prognosis in monitoring
- Determination of periods and periodicity of observations by indicators and factors
- Development of operational monitoring programs for monitoring objects (groundwater, surface water bodies, soil conditions, land reclamation systems), in experimental areas
- Equipment of the observation network, pilot production areas, placement of measuring devices
- Providing observations, experimental work and obtaining data by methodological basis

Conducting observations

- Carrying out of route observations, on a stationary network, on experimental-industrial sites
- Ensuring the protection of the observation network and equipment
- Periodic assessment of the quality of observations, verification of equipment

Collection and processing of information

- Formation of the base of primary information (data entry, storage, search
- Statistical processing of data
- Using GIS-technologies


Evaluation of the ameliorative status of agricultural land
Rationale for evaluation criteria
Analysis and comparison of information data and cartographic models
Definition of principles of construction and creation of the resulting information cartographic model of reclamation state of irrigated lands
Determination of the type and indicators of environmental risk
Estimated risk assessment
Making decision
Justification and adoption of operational decisions
Selection of planned measures to reduce environmental risk an
Information transfer
Determining the form and frequency of reporting
Definition of the information exchange scheme
Harmonization of the scheme of operational interaction of the service bodies on amelioration systems with decision-making organizations
Decision implementation

Information technology of local monitoring hydro-amelioration systems

Collection of initial data for the monitoring organization: analysis of the ecological situation of the water body for operational and archival information

Formulation of measures, specification of the tasks for surface water monitoring

Definition of objects of observation

Definition of a indicators characterizing the status of a water system and the factors of anthropogenic impact

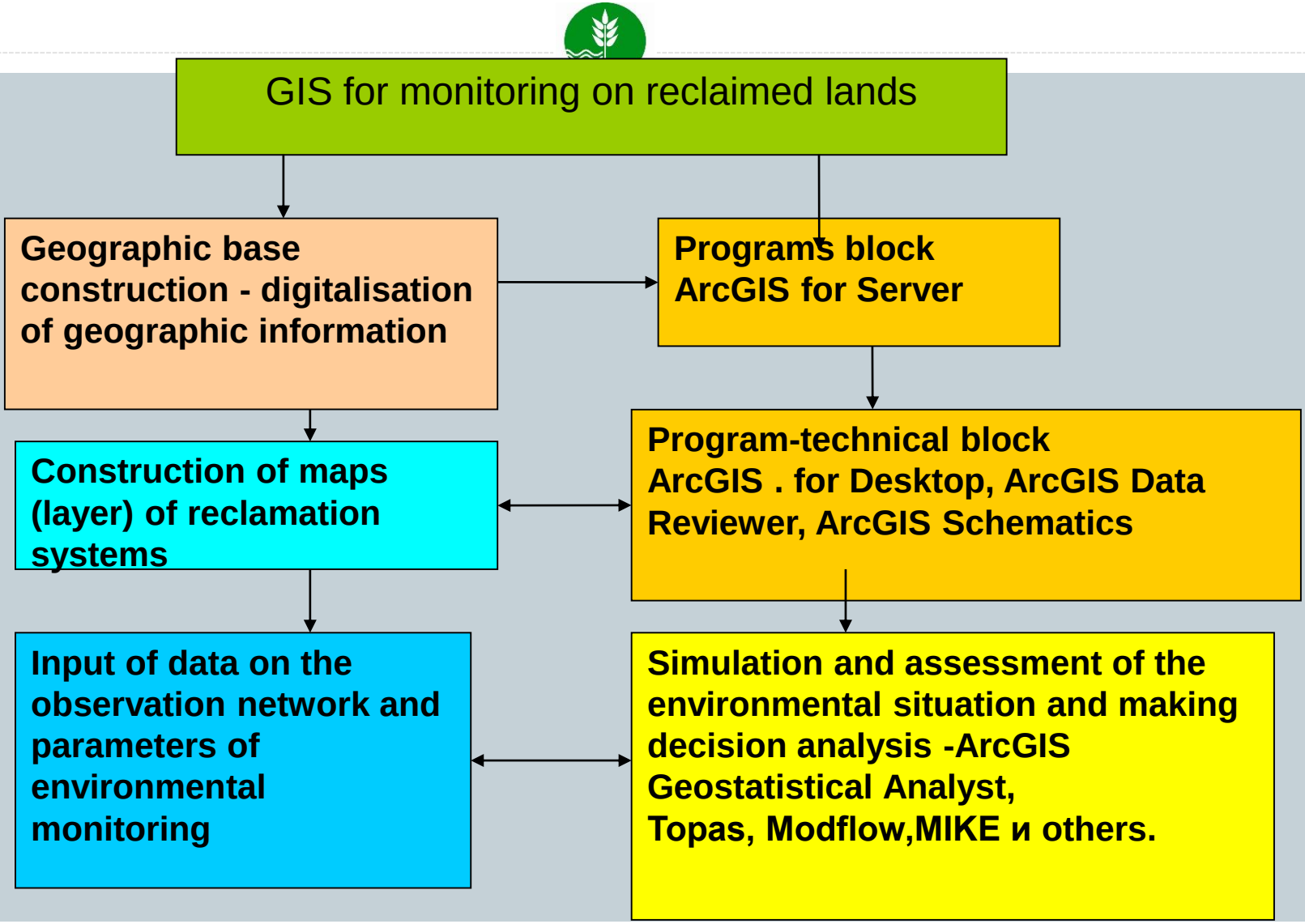
Establishment of alignments, horizons, intervals of observations

Definition of technologies and means of observation of indicators of the water systems

Observations

Creation of a database for observations of the state of watersystems

Scheme of GIS for monitoring

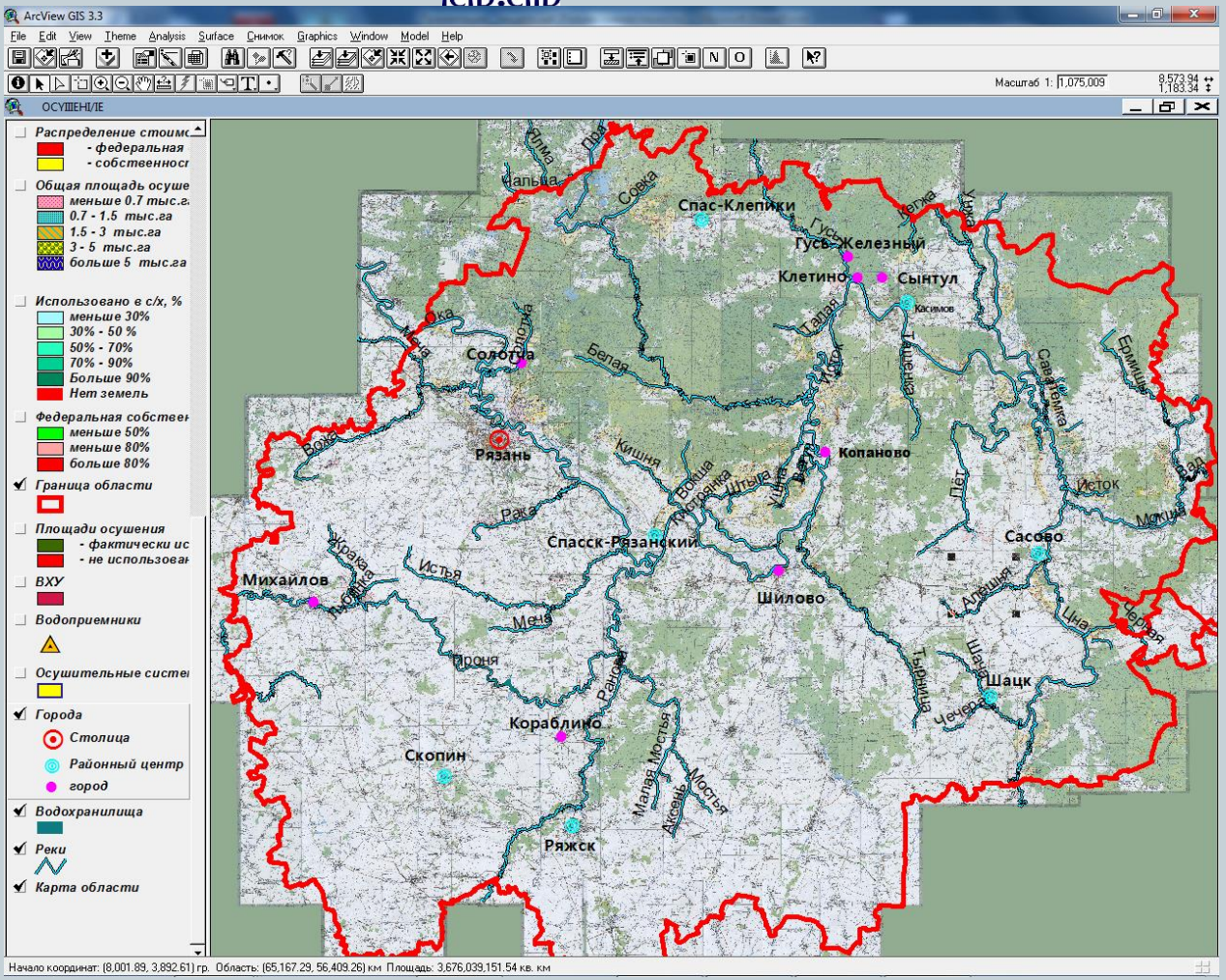


Digitization of the geographical map

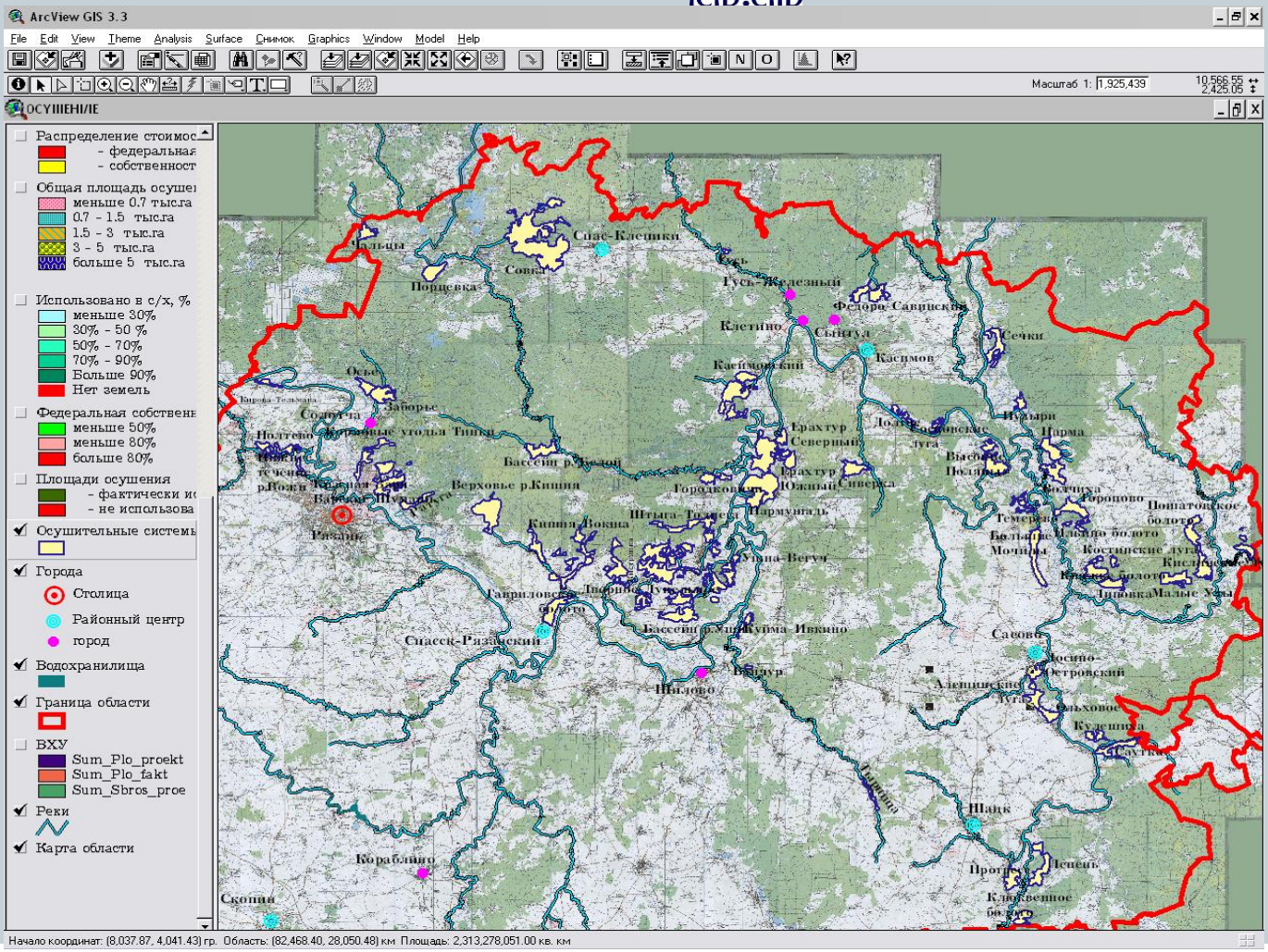
Hydrographic network

Cities

Administrative boundary



Drainage systems



Scientific support of the water management system in agriculture

- Implementation of an interdisciplinary approach to improving the efficiency of water resources management in new climatic conditions;
- Comprehensive scientific justification of water resources needs in water-deficit regions of Russia with preferences for domestic and drinking water supply and taking into account their socio-economic development, global climate changes for the future up to 2050. ;
- Application of the ecosystem approach, which provides for the ecological sustainability of the river basin;
- Creation and use of constantly operating hydrological-geofiltration models of river basin geosystems, which will allow predicting the hydrodynamic, hydrochemical, hydrological situation as a basis for carrying out complex ecological forecasts and planning optimal distribution of water resources among water users on the basis of scenario studies;
- Analysis of forecasts of the dynamics of all affected components of the natural environment (hydrological, hydrogeological, engineering-geological, soil, biotic, etc.) under the influence of anthropogenic factors, global and cyclical climate changes with predictions of social progress, development of industry, agriculture, forestry, fish farming, energy ;
- Assessment and analysis of possible environmental, social, economic damage in the regions;
- Planning actions for managing the situation, preventing or reducing risks;
- Improvement of the system of environmental monitoring, first of all, development and modernization of the observation network for integrated observations of water management systems, water bodies (surface and groundwater), and the state of the adjacent territory, hazardous engineering and geological processes, and on agricultural land – status of drained lands, and soil fertility;

Map of the Water infrastructure of the river Kuban

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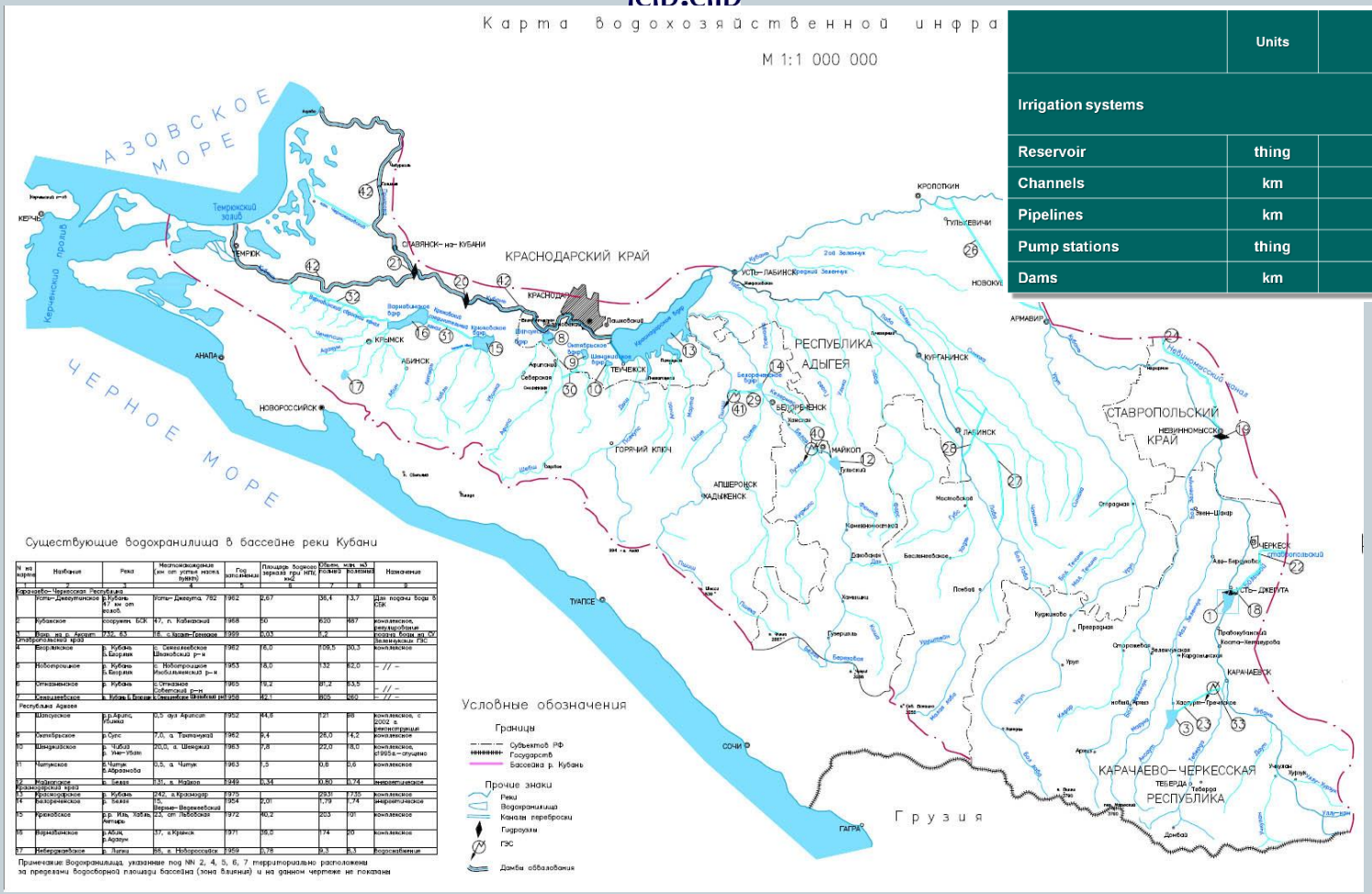


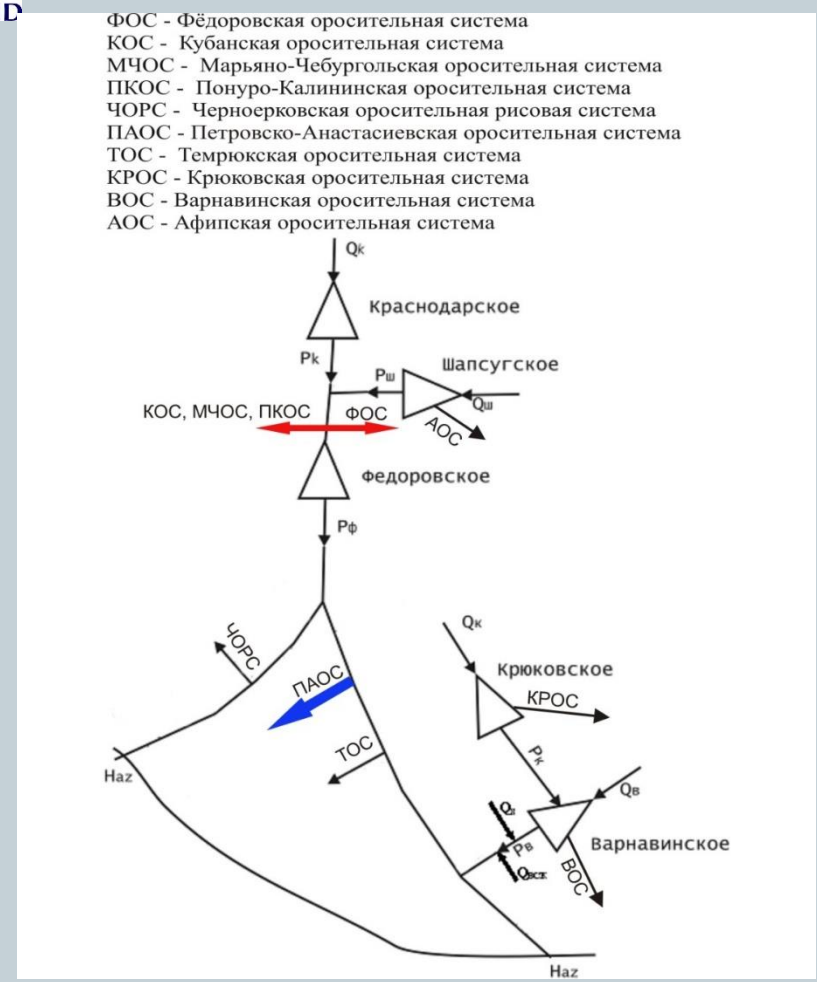
	Units	Amount
Irrigation systems		
Reservoir	thing	34
Channels	km	8013
Pipelines	km	397
Pump stations	thing	301
Dams	km	1124

Scheme of integrated use and protection of water bodies in the Kuban River Basin (19.05.2014 г.)

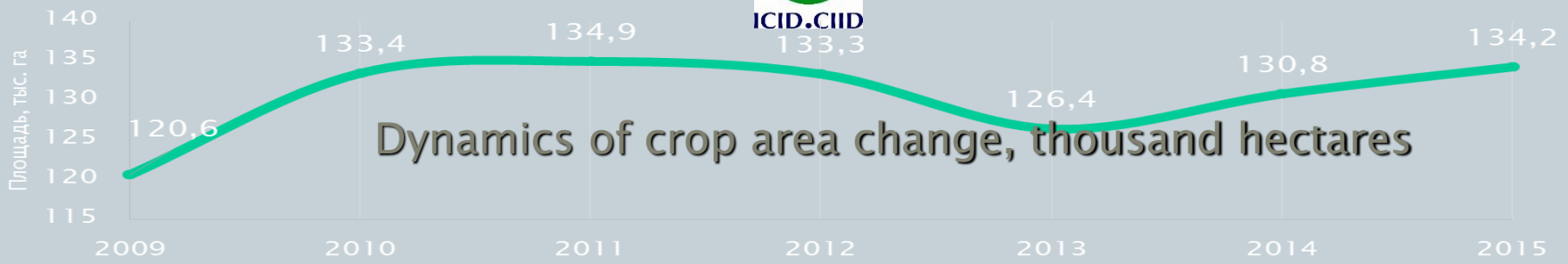
- 1. Restoration and development of the observational network (hydrological models)
- 2. Development of simulation mathematical models (hydrodynamic models, GIS-based models, forecast, water-balance models)
- 3. Development of rules for the use of water resources of reservoirs
- 4. Development of rules, programs, action plans in cases of extreme low water availability and extremely high water content
- 5. Integrated development of the system of state monitoring of water bodies

The scheme of the river network

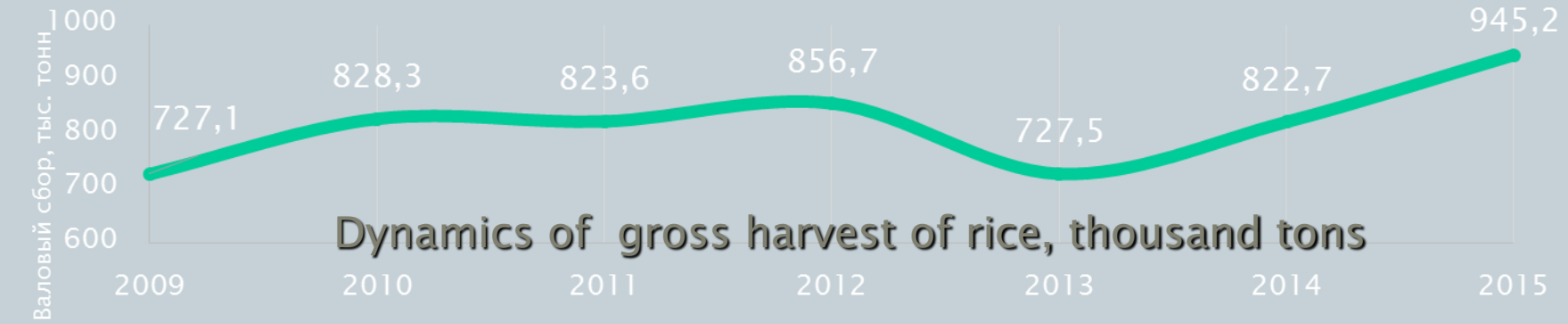
Location of water intake facilities of irrigation and drainage systems in the basin of the Lower Kuban



Indicators of rice production in the Krasnodar region



Dynamics of crop area change, thousand hectares



Dynamics of gross harvest of rice, thousand tons

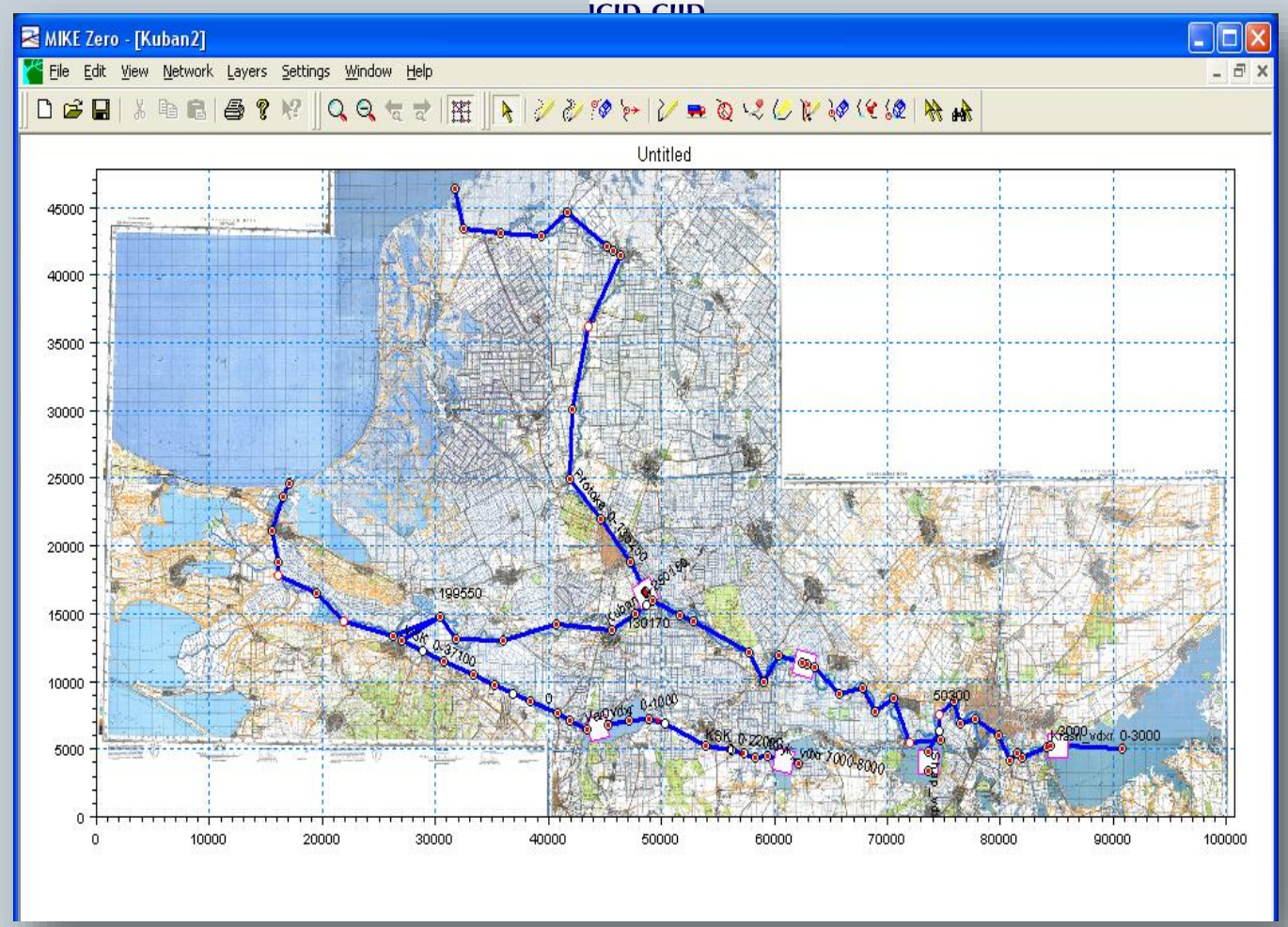
Dynamics of Productivity, centner/ha

Possible directions of savings water resources

1. Reduction of the deformation of the plane of checks (2-3 million m3 at the initial flooding per 1000 hectares)
2. The rate of flooding and dumping of water from checks (0.7 million m3 for saturation of soil, 0.7 million m3 for filtration)
3. Reconstruction of hydraulic structures (change of water supply scheme, reduction of filtration due to channel lining or coating with bentonite clays)
4. Preservation of the project crop rotation (7-8 fields, rice saturation 68-78%)
5. Cleaning of the irrigation and collector network.
6. The dynamics of the network is broken, regime without slope, water releases: at the top - deficit, bottom - flooding.
7. There should be sort of rice with a short, medium and long growing season.
8. Two-stroke regulation between irrigation systems above FGU and below TGU
9. Increase in yield (water volume per 1 ton of rice decreases)
10. Reconstruction of reservoirs
11. Optimal mode of water supply between farms

Flooding of rice checks

Planned position of the river network



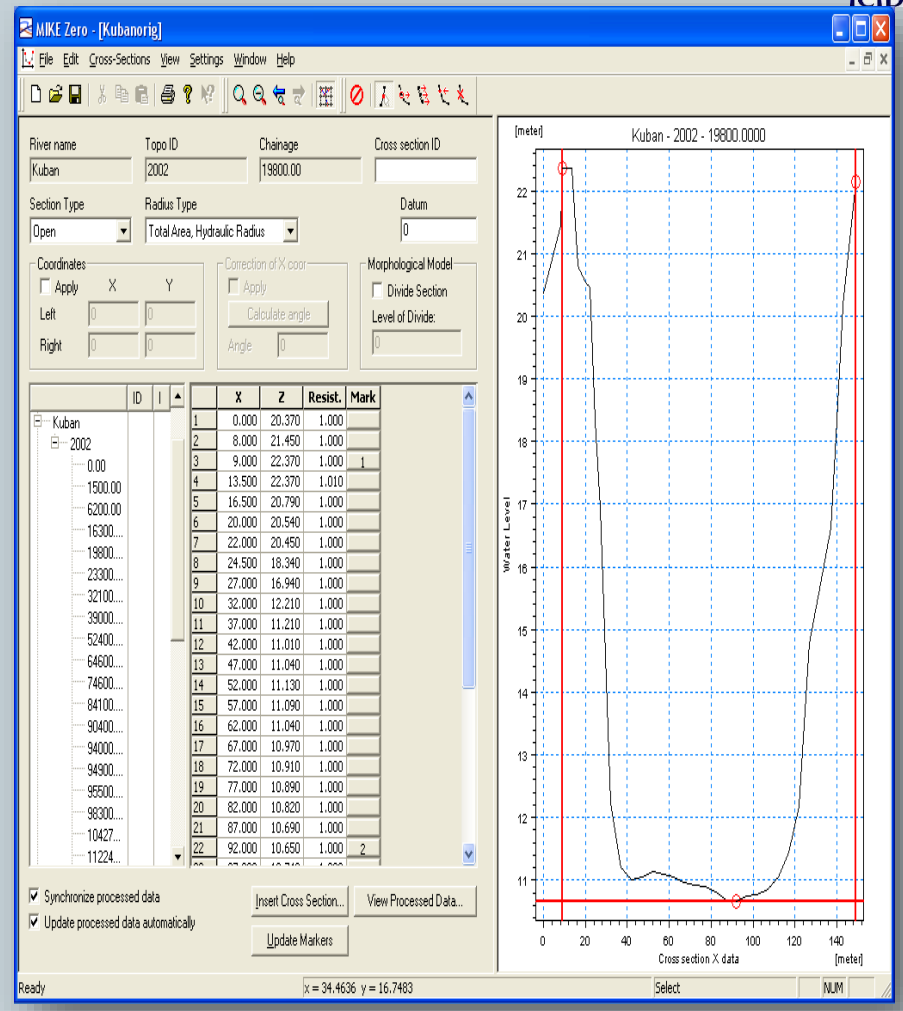
Hydraulic node of Krasnodar reservoir

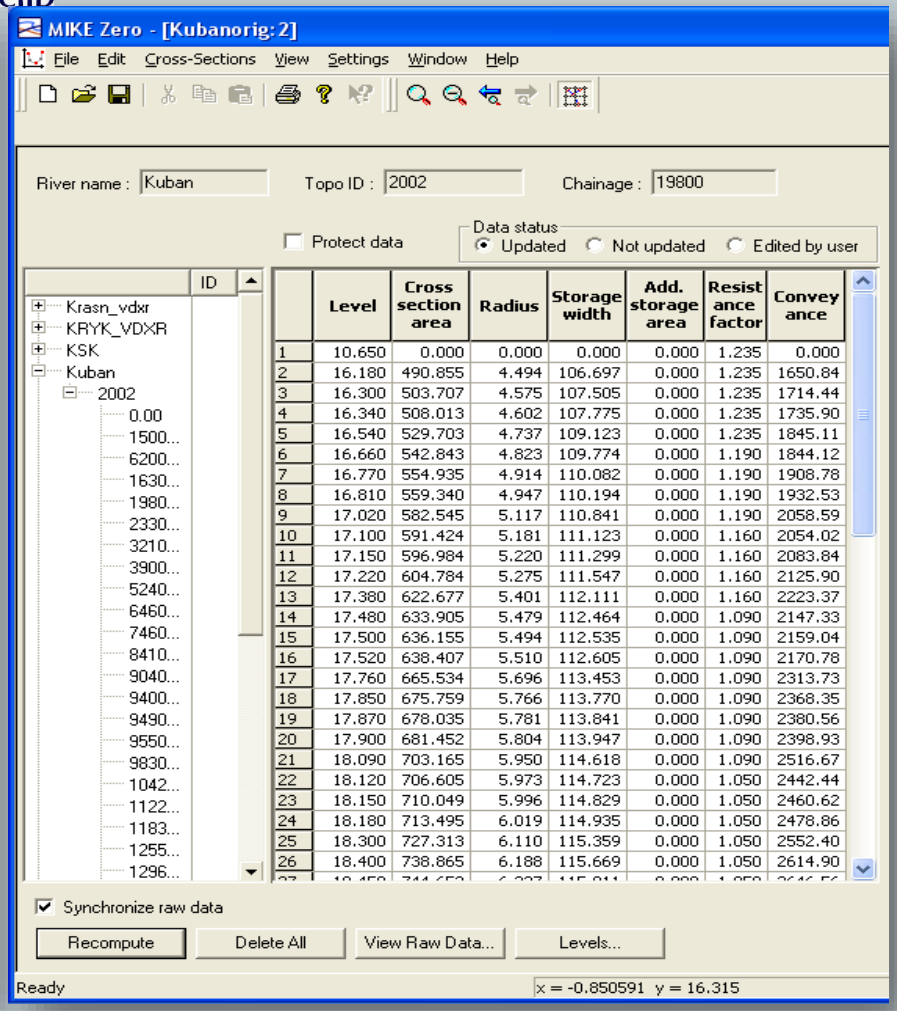
Basic Elements of the Hydrodynamic Model

- The river bed of the Kuban river lower than the Krasnodar reservoir and the branch Protoka before the confluence of the Sea of Azov, dumped all along;
- Krasnodar, Shapsugskoe, Kryukovskoe, Varnavinskoe reservoirs;
- Fedorovsky hydrounit and Tikhov water distributor;
- Kryukovskiy connecting and Varnavinsk discharge channels;
- Water intake and waste facilities of irrigation systems.

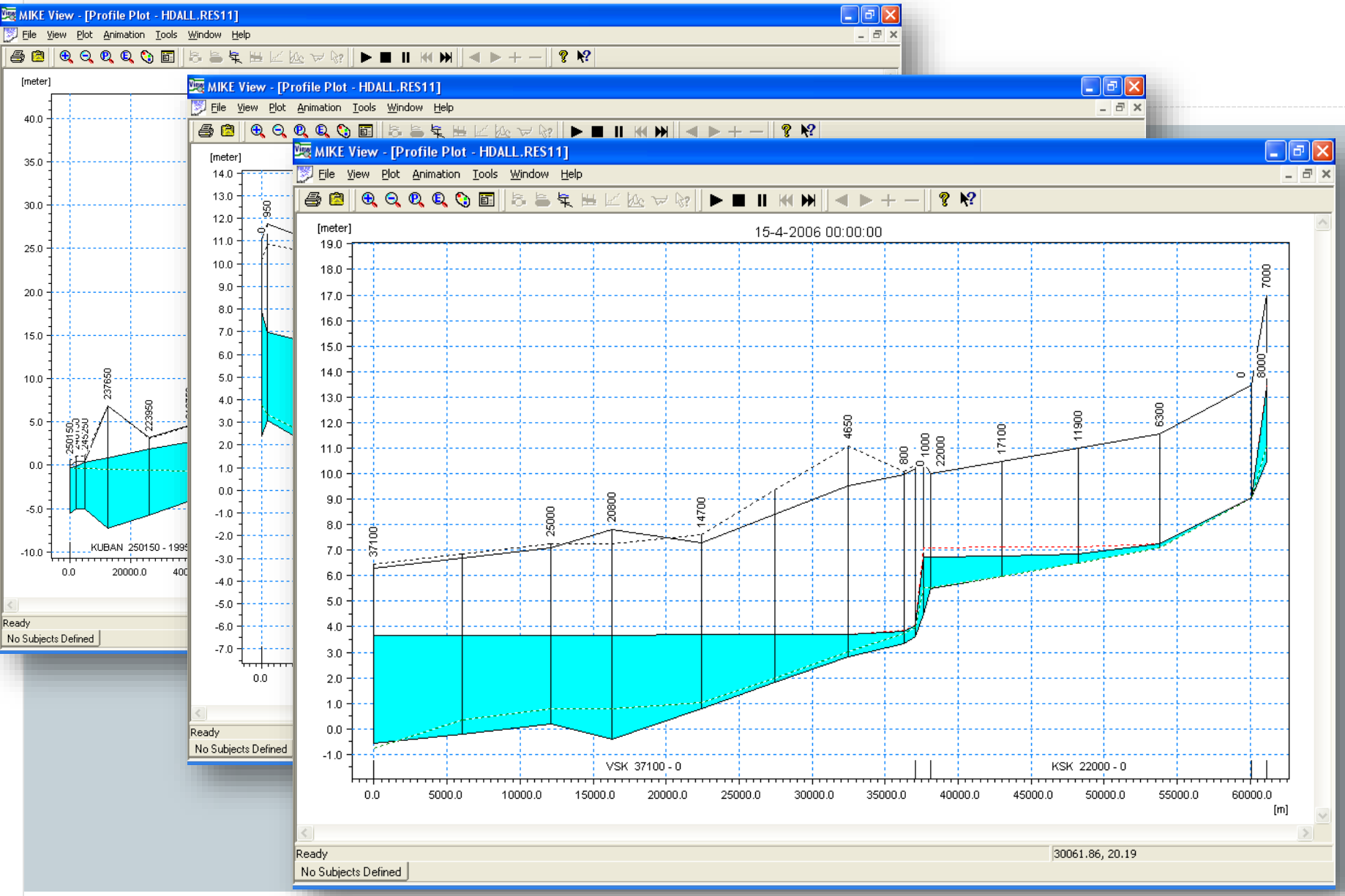
Row data

Processed data





Longitudinal section of the river Kuban&branchs



Area of application of the hydrodynamic model

1. Operational management of water resources:
   water supply on irrigation systems
   protection of territories from flooding
2. Two-stroke control
3. Assessment of the reliability of the dikes of the Lower Kuban
4. Forecast of emergencies
5. Rules for joint regulation of reservoirs of the Lower Kuban based on HD modeling (in addition to release rules)
6. The effect of artificially flooded areas on the reduction of water levels in floods
7. Maximum permissible discharges to the downloads of the reservoirs of the Lower Kuban for the passage of the flood wave without an accident8.
8. Determination of zones of possible flooding in the period of catastrophic floods
9. Passage of a dambreak wave during a hydrodynamic accident at the hydraulic structure (safety declaration)

Operational water resources management in the Lower Kuban (Water supply on the OS, protection of territories)

1. Input parameters
   Data of observations of the water dispatching service
   Short-term, medium-term and long-term forecasts of the hydrological situation
   Modes of operation of pumping stations of irrigation systems, formed on the basis of water users' requirements (agreed irrigation schedules)
2. Modeling result :
   Hydraulic parameters (discharge, levels, speeds, arrival time of the front and crest waves in the flood) are determined for all waterways and reservoirs of the Lower Kuban
   In the automated mode, the "optimal" releases to the downstreams are formed, satisfying the requirements of water users (based on PID algorithms with manual adjustment)

Flow chart of the daily water management

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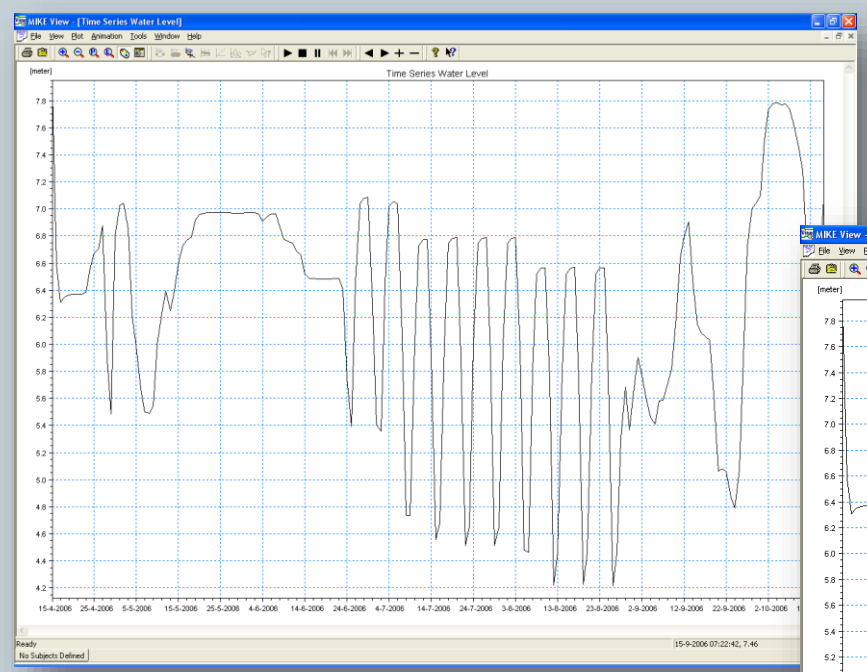
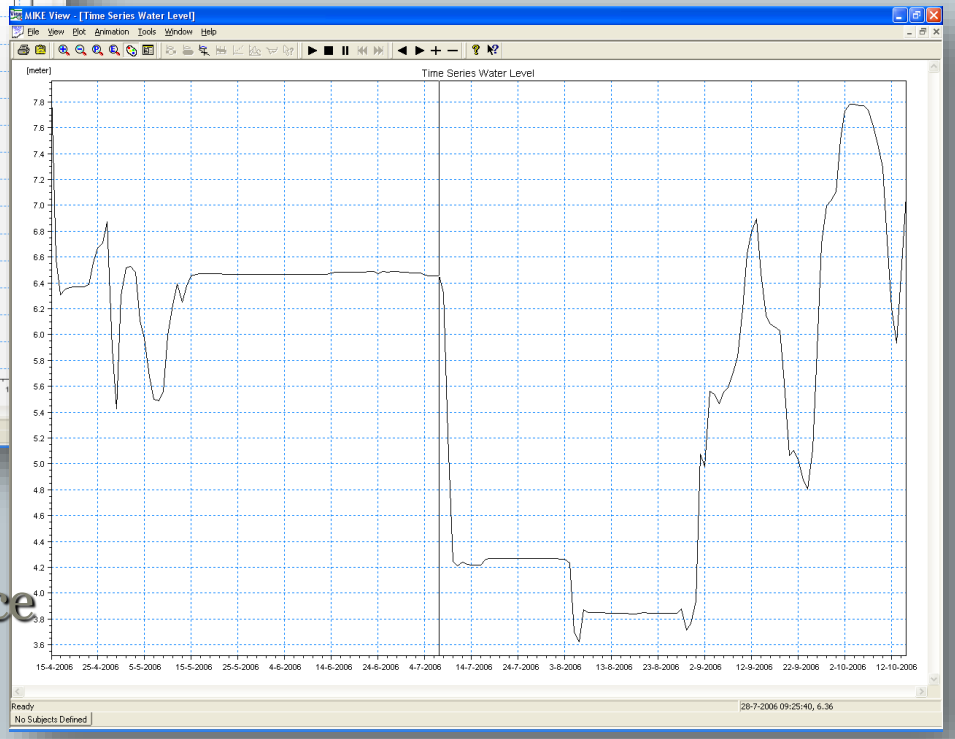
The course of water levels at the headwater intake of the PAOC





Such a scheme of water supply allows to minimize losses of rice yields at low water period

The results of the model Implementation

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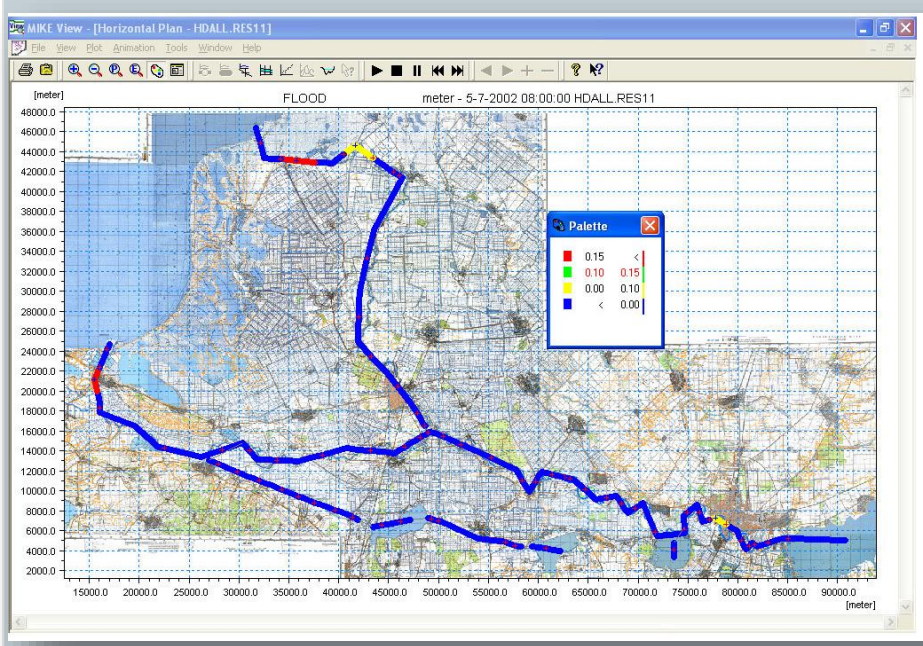
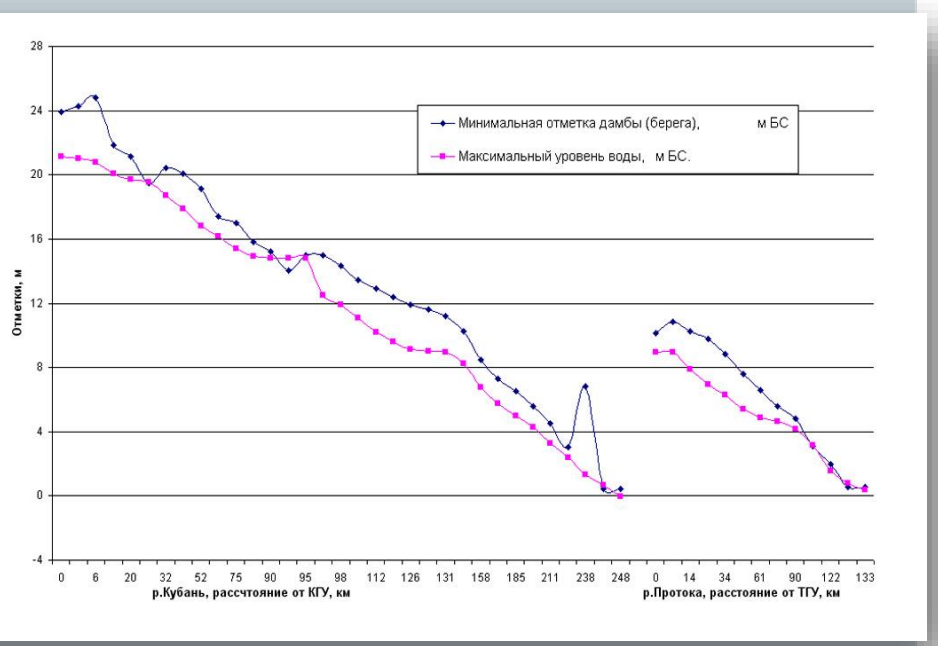
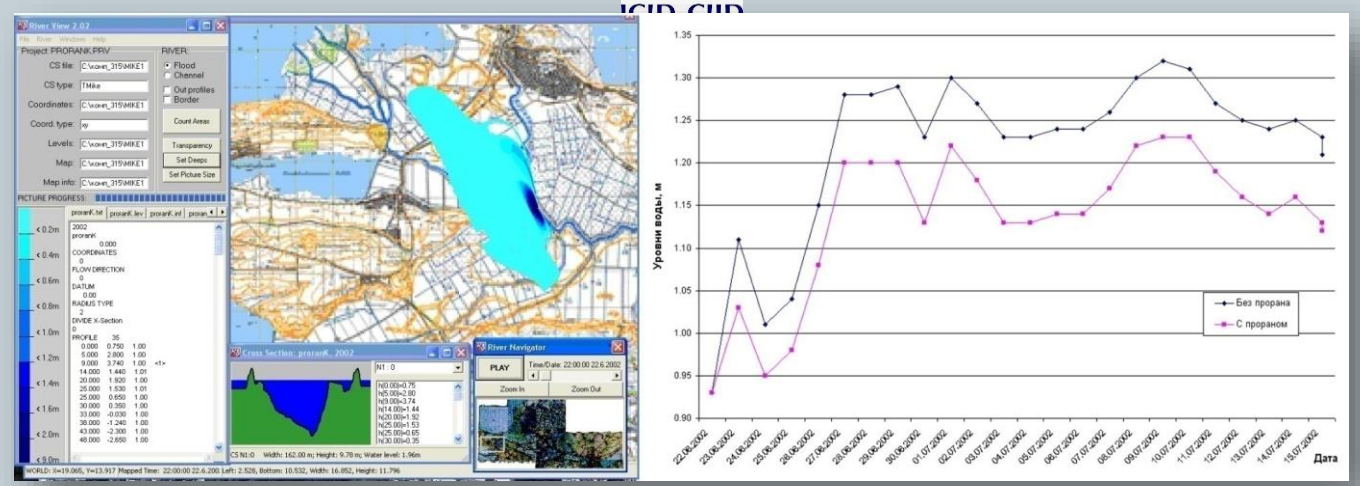




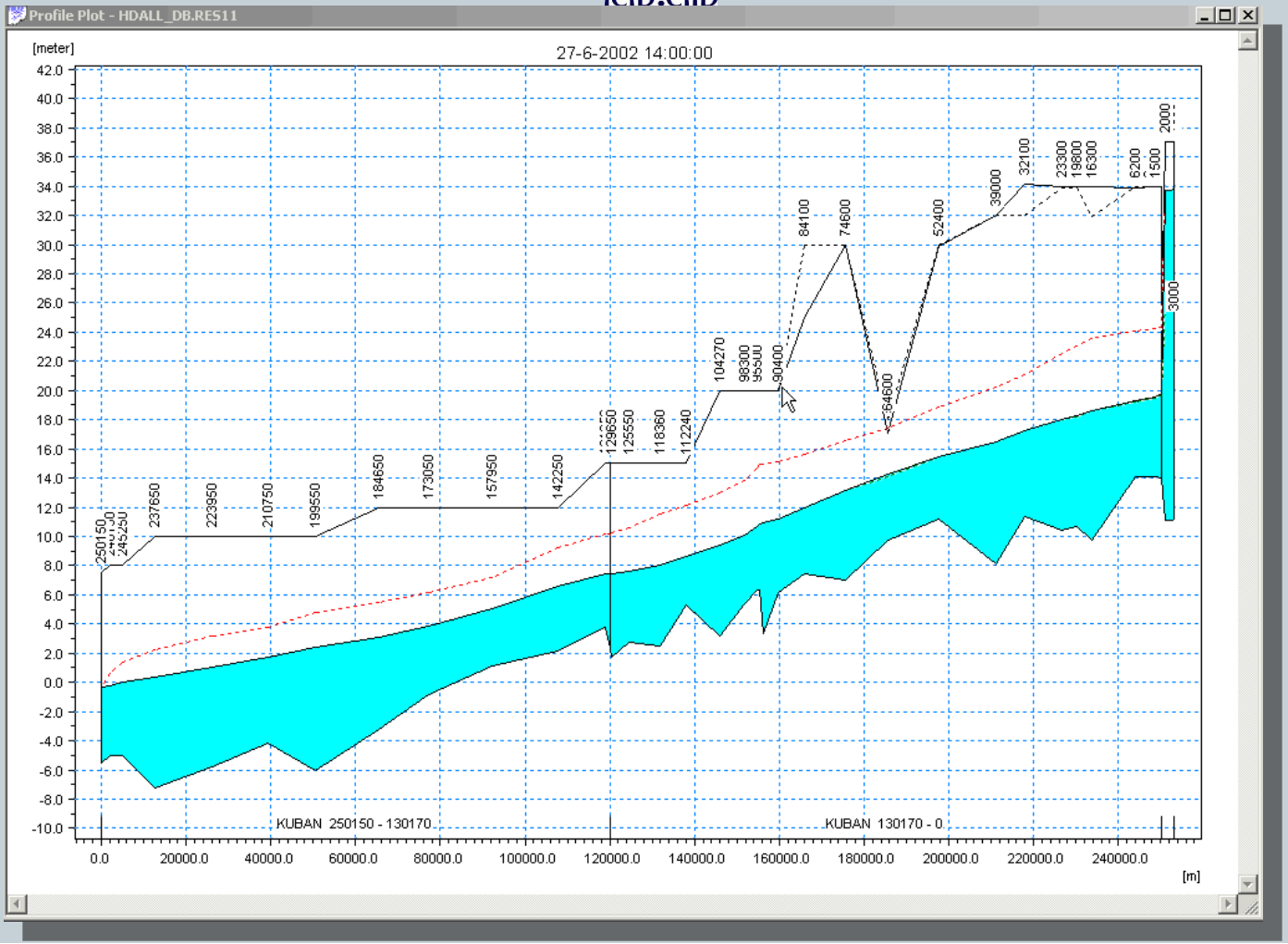
Dangerous sites (places where the water level exceeds the crest of the dams) and Diagrams of exceeding of dams above the maximum level are shown

Results analysis

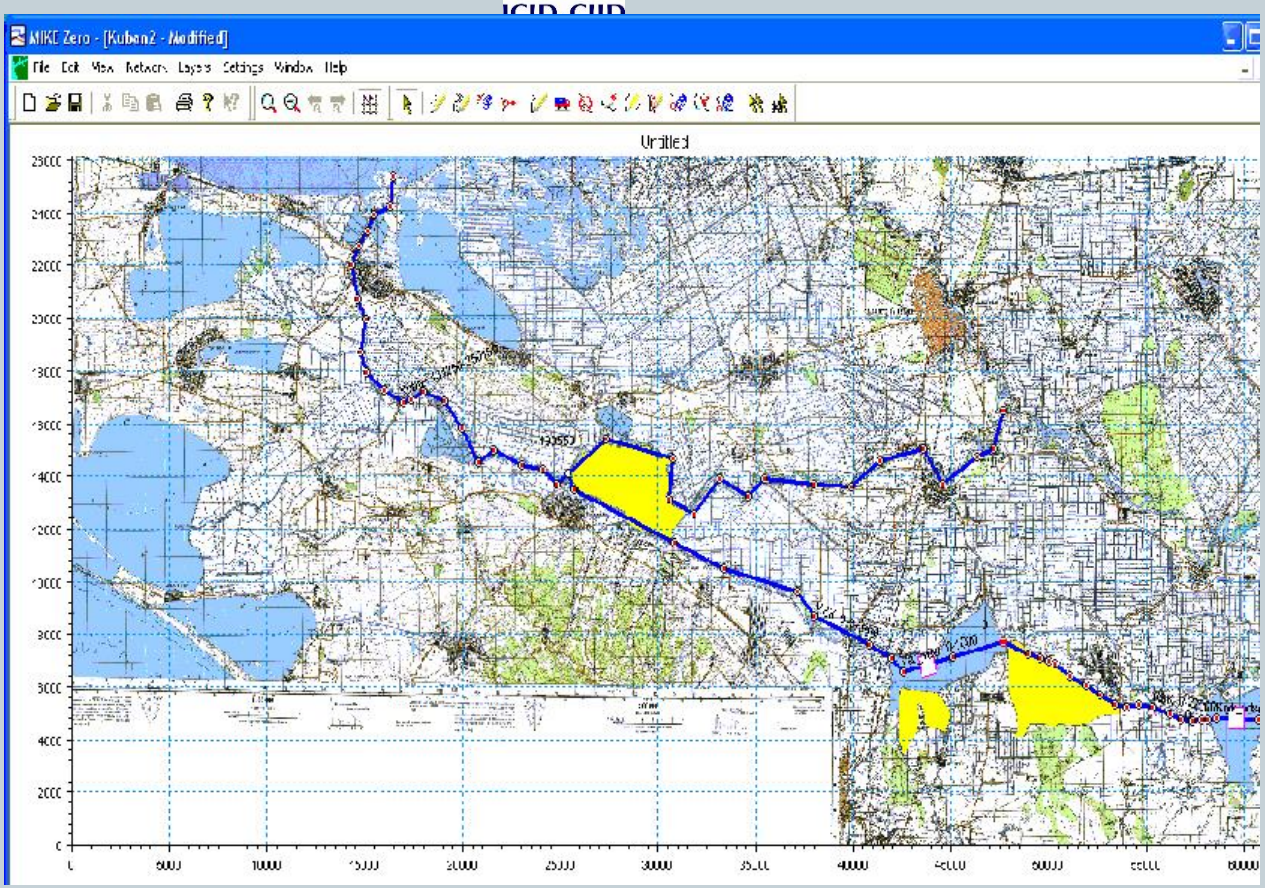


1. The analysis of various scenarios of occurrence of extreme situations and possible destruction of embankment dams on the river Kuban and the branch Protoca is made..
2. The rules for joint regulation of release from the Kryukovsky, Varnavinsky and Krasnodar reservoirs, Fedorovsky and Tikhovsky hydro structure in addition to the release rule are developed.
3. Comparison of water levels in the Temryuk water observation seat before and after the formation of the breach, the flooding zone in the GIS environment RiverView

Longitudinal section of dambreak wave



Impact of artificially flooded areas on the reduction of water levels during the passage of the flood wave



Planned position of the river network. Places of withdrawal of flood wat

DamBreak - wave passage effect

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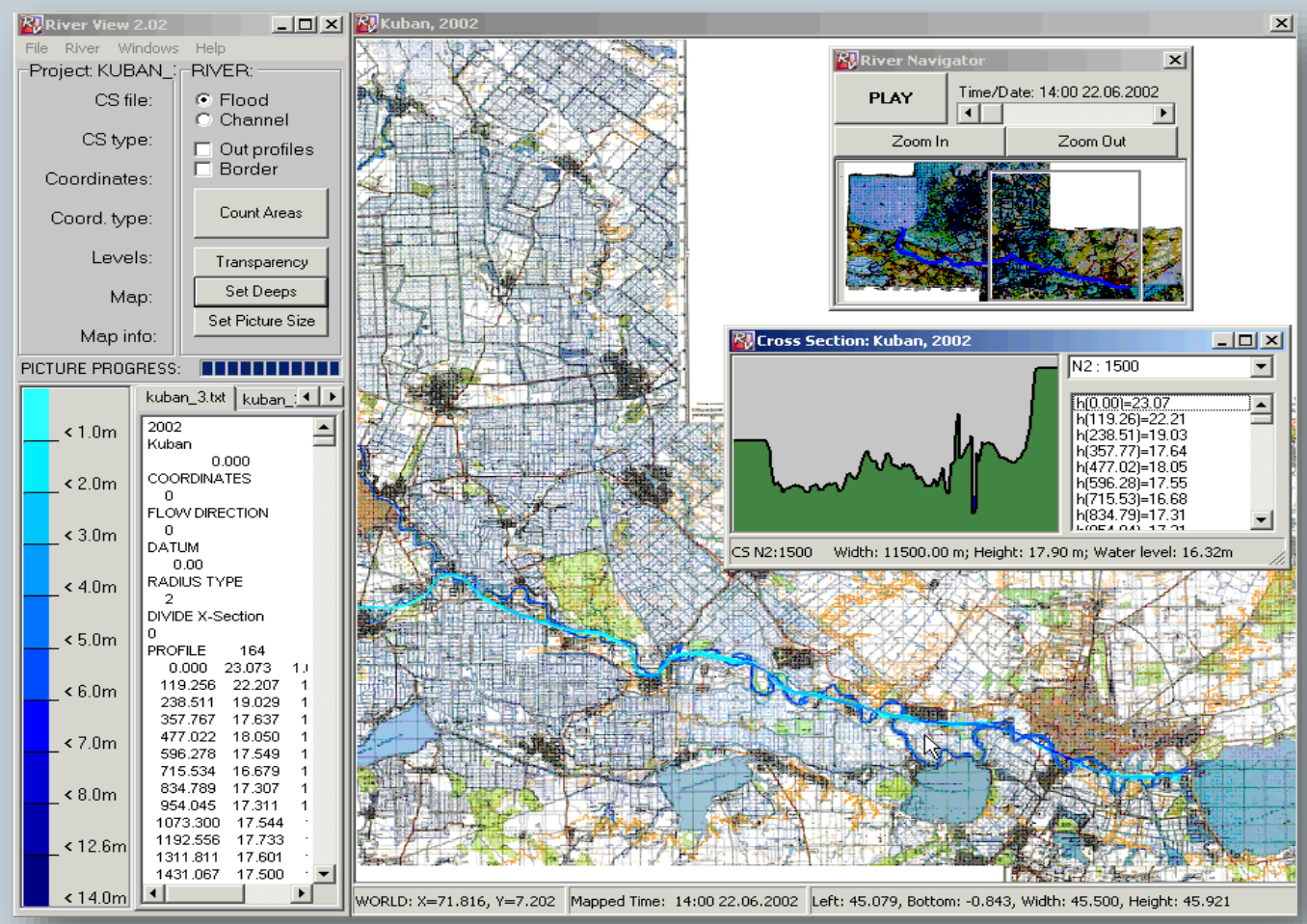

Conclusions

1. The hydrodynamic model provides sufficient justifications for the management of the water resources of the river basin and for making operational decisions in emergency situations.
2. The model can be used to develop engineering solutions at various stages of design, investments in new construction, reconstruction and repair-restoration activities.
3. The model can be used as a tool to justify measures to improve the reliability of engineering protection of regions and populated areas from flooding during Spring or Rain floods, and water supply to irrigation systems in law water periods.

Thank for yours attention