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The European Union

Environmental Protection of
International River Basins Project
Contract No. 2011/279-66

A project implemented by a
Consortium led by Hulla& Co.
Human Dynamics KG

Term of Reference
Pilot project "Detailed assessment sources of pollution of potable GW sources supplying the "Novinki" region in the territory of Minsk, Republic of Belarus"

I. Background and Objectives

The consultant will assist Human Dynamics to fulfil its requirements under the EU technical assistance contract 'Environmental Protection of International River Basins (EPIRB)' (Terms of Reference given in Annex 1). The overall objectives of the EPIRB project are:

- To improve availability and quality of data on the ecological, chemical, and hydro-morphological status of trans-boundary river basins including groundwater; and

- To develop River Basin Management Plans for selected river basins / sub-river basins according to the requirements of the WFD.

The project is being implemented in six countries (Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine) and five pilot river basins:

- Akhurian Basin District (Armenia),
- Central Kura (Azerbaijan),
- Upper Dnieper Basin (Belarus, Ukraine),
- Chorokhi-Adjaristskali Basin (Georgia),
- Prut Basin (Moldova, Ukraine)

As part of the River Basin Management Plan development process the project will implement selected number of improvement measures from the overall Programme of Measures (PoM), as defined under the Water Framework Directive. The selected measures have been agreed with the beneficiaries in each country and will be executed in accordance with the EC contractual conditions. In the Republic of Belarus the following measures have been chosen:

- Preparation and legislative approval of methodological documents for EU Water Framework Directive compliant hydro-morphological and biological monitoring programmes.

- Detailed assessment sources of pollution of potable groundwater in the well field "Novinki" on the territory of Minsk. This will include the development of a mathematical model to elaborate potential pollution pathways and identification of protection measures to be implemented.

- Flood risk assessment and mapping of the Upper Dnieper basin, including determination most "at risk" areas, field surveying of critical sites, mapping and initial design of protection measures.

The following Terms of Reference are to undertake an assessment of the potential pollution sources of the groundwater in the Novinki well-field in the territory of Minsk and the general over-utilization of GW in the territory.

II. Problem description

Groundwater in Belarus is the main source of drinking water supply. Urban populations are supplied by centralised water supply networks while rural populations utilise central and non-central sources (dug wells), 86 % of the urban population and 57 % of rural population are connected to the centralized water supply systems.

There are twelve well fields which supply domestic and industrial water to the Minsk agglomeration, a population of over 2 million. Each of the well fields consists of dozens of exploitation wells with depths of between 50-200 m. The oldest well fields (Novinki, Petrovschina, Zelionovka, and Drazhnia) were constructed between 1930-1950 and now are located within the territory of the city. Construction activities are sometimes performed very close or even within the wellhead protection zones. Other well fields (Borovliany, Ostrovy, Volma, Vickovschina, Vodopoy, Felicianovo, and Zelenyj Bor) are located from 8 to 25 km from the city in more favourable environmental surroundings.

As well as pollution threats, there are also problems over over-abstraction of GW in the Minsk territory causing the development of depression cones and increasing the risk of pollution. Long-term intensive groundwater abstraction from the inter-moraine, Dnieper-Sozh water-bearing complex has created a huge depression cone with the diameter of 40 km and drawdown of groundwater levels of 25-30 m in the central part of the depression cone. The ssecond most important aquifer used for groundwater abstraction in Minsk city is Upper Proterozoic aquifer. It provides 8-10 percent of total groundwater supply for the city. The aquifer is located at the depth of 160-320 m and is well protected from the superficial pollution. However, intensive exploitation of the isolated aquifer has led to development of a large depression cone with the diameter of 40-70 km and water level drawdown of 20-25 m in the centre of the cone.

The EU Water Framework Directive (WFD) requires that long-term groundwater abstraction should not exceed available groundwater resources, but this is not the case in Minsk. Here uncontrolled groundwater abstraction has had a negative impact on quantitative and chemical status of groundwater bodies and the surface water ecosystems. Noticeably groundwater exploitation has reduced flows in small rivers around the Minsk city. These rivers are feeding the depleted aquifers and as a result losing their flow during the low-flow periods. This phenomenon in Minsk region was first noticed in 1974 when 7 km of Volma River disappeared in summer time and happened 4 years after construction of Volma well field, which abstracts water from Dnieper-Sozh water bearing complex. For the above reasons the groundwater bodies around Minsk city are assigned as being 'At Risk' under the WFD criteria of not achieving good quantitative and chemical status.

Groundwater abstraction also accelerates pollution of productive aquifers. The well field Novinki (figure 1) is the main and one of the oldest well fields in Minsk, having been used for water supply since 1932. Groundwater monitoring has revealed the development of anthropogenic pollution of the aquifers mainly by nitrates. In 1932 nitrates were absent from the groundwater but by 1970 concentrations of nitrates in a number of wells had reached 20–27 mg/l and in 1990 they had increased to 50–65 mg/l (Belarus norm for drinking groundwater is 45 mg/l and European norm is 50 mg/l). Analyses of groundwater samples collected from the well field in 2009 indicated concentrations of nitrates reaching 62–82 mg/l in 9 wells. In 18 wells concentrations of nitrates did not exceed drinking water standard but were above the natural background values. Novinki well field was additionally sampled during EPIRB Joint Field Surveys on 12-14 May 2014. Nitrate concentrations are exceeding EU norm for drinking water (50 mg/l) in 6 sampled wells of Novinki well field.

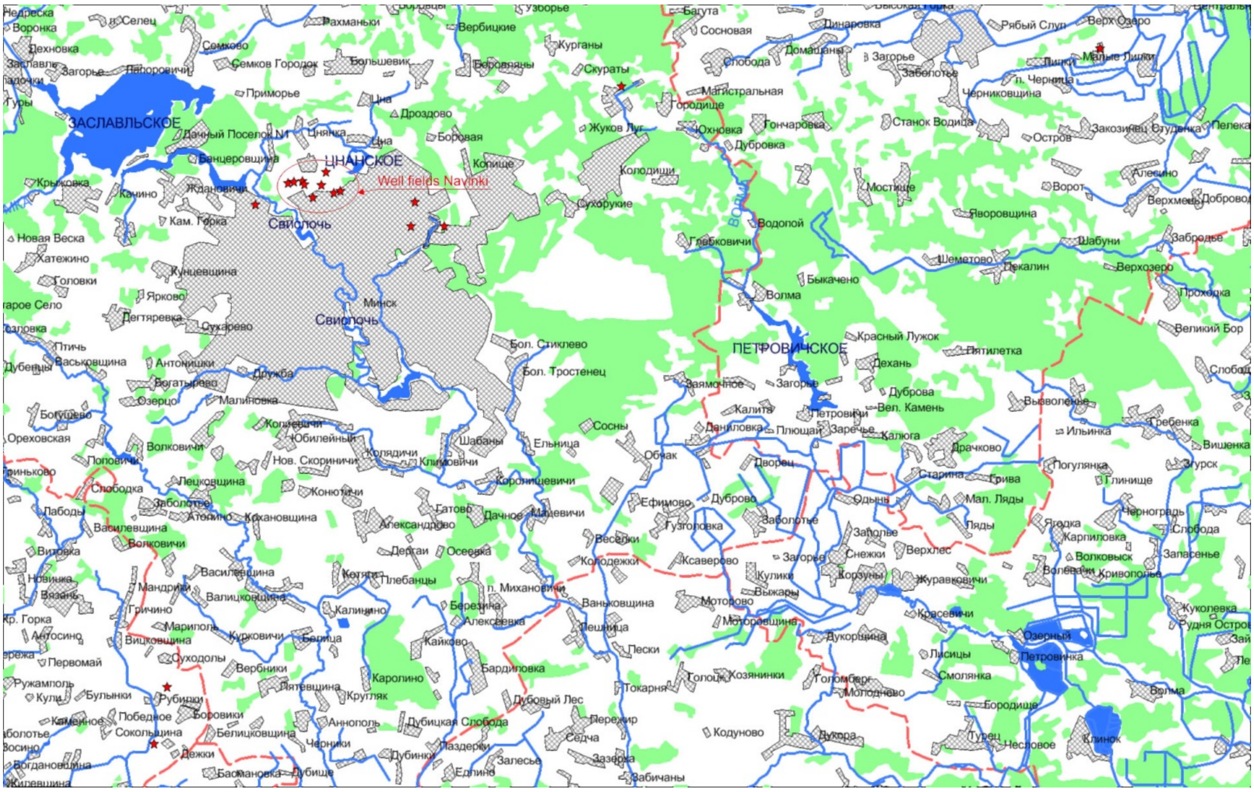

Figure 1. General map of the Minsk and well fields "Novinki"

III. Scope of Works and Deliverables

The major steps are described below:

1. Analysis of available geological-hydrogeological information of the Novinki well field.
2. Evaluation of vulnerability of production groundwater bodies in the Novinki well field .
3. Analysis of point and non-point pollution sources. GIS (MapInfo) mapping of pollution sources (farms; manure spreading fields, buried landfills etc.).
4. Assessment of impact of abstraction on acceleration of pollution.
5. Mathematical modelling of groundwater flow direction and groundwater quality.
6. Control groundwater sampling in Novinki well field (four seasons) for 4-6 boreholes and the following parameters: main pollutants NH4, PO4, Fe, SO4, Cl, NO2 , NO3, F, dry residue , permanganate index, trace elements Boron (B), Barium (Ba).
7. Elaboration of potential pollution pathways and identification of protection measures to be implemented.

The work will be undertaken in five distinct phases.

Inception Phase

Deliverable 1: Inception report, containing implementation strategy and data needs.

Phase 1: Analysis of available geological-hydrogeological information of the well field and evaluation of vulnerability of production groundwater bodies.

Deliverable 2: Analysis of available geological-hydrogeological information for the well field.
Deliverable 3: Report on the vulnerability of groundwater bodies within the well field.

Phase 2: Analysis of point and non-point pollution sources. GIS mapping of pollution sources (farms; manure spreading fields, buried landfills etc.). Assessment of impact of abstraction on acceleration of pollution.

Deliverable 4: Analysis of point and non-point pollution sources and GIS (MapInfo) mapping of pollution sources (farms; manure spreading fields, buried landfills etc.).
Deliverable 5: Report on the impact of abstraction on acceleration of pollution.

Phase 3: Mathematical modelling of groundwater flow direction and groundwater quality. Control groundwater sampling in Novinki well field

Deliverable 6: Mathematical model of groundwater flow direction and groundwater quality using software GMS v 8.1 (ground modeling system, USA).

Phase 4: Elaboration potential pollution pathways and identification of protection measures to be implemented.

Deliverable 7: Final report, including elaboration of potential pollution pathways and identification of protection measures to be implemented and the results of groundwater monitoring.

All reports shall be prepared in the English and Russian languages.

IV. Schedule and Budget

Duration of the assignment is 12 months. The expected commencement date for implementation of the assignment is November 01, 2014, and completion date – November 1, 2015. The assignment is divided into five phases with following general schedule:

	2014		2015										
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Ju	Aug	Sep	Oct	Nov
Phase 1: Analysis of available geological-hydrogeological information of the well field and evaluation of vulnerability of production groundwater bodies. Control groundwater sampling in Novinki well field.													
Phase 2: Analysis of point and non-point pollution sources. GIS mapping of pollution sources (farms; manure spreading fields, buried landfills etc.). Assessment of impact of abstraction on acceleration of pollution.													
Phase 3: Mathematical modelling of groundwater flow direction and groundwater quality.													
Phase 4: Elaboration potential pollution pathways and identification of protection measures to be implemented													

Summary of the work schedule and deliverables is presented in following table:

Deliverable	Language of deliverable	Start date	Due date for draft version	Finalization
Deliverable 1:Inception report	Russian/ English	01.11.2014	30.11.2014	30.12.2014
Deliverable 2: Analysis of available geological-hydrogeological information of the well field	Russian / English	30.11.2014	30.12.2014	28.02.2015
Deliverable 3: Report on the vulnerability of production groundwater bodies	Russian / English	30.11.2014	20.01.2015	28.02.2015
Deliverable 4: Analysis of point and non-point pollution sources and GIS mapping of pollution sources (farms; manure spreading fields, buried landfills etc.)	Russian / English	01.02.2015	31.03.2015	25.05.2015
Deliverable 5: Report on the impact of abstraction on acceleration of pollution	Russian / English	25.04.2015	25.05.2015	15.06.2015
Deliverable 6: Mathematical model of groundwater flow direction and groundwater quality	Russian / English	25.04.2015	25.05.2015	15.06.2015
Deliverable 7: Final report: Elaboration potential pollution pathways and identification of protection measures to be implemented, results of GW monitoring	Russian / English	15.06.2015	15.10.2015	1.11.2015

The project budget is 35,000 euros.

V. Management Arrangements

The activities will be closely coordinated, assisted and monitored by the EPIRB project team members, respective CWM Expert and the project director.
The contractor shall report to the EPRIB Team leader and Key expert on groundwater with regard to the overall deliverables and to the EPIRB Country Water Management Expert (CWME) for day-to-day management issues.

Implementation of the above deliverables will be completed by national hydrogeologist team to be established with representatives from the beneficiary, the contractor and EPIRB project the country water management expert (CWME). The EPIRB CWME will ensure coordination between the EPIRB project team and the REC public involvement strategy team.

Tranche 1: ***15% on acceptance of Phase 1 deliverables***
Tranche 2: ***25% on acceptance of Phase 2 deliverables;***
Tranche 3: ***20% on acceptance of Phase 3 deliverables;***
Tranche 4: ***40% on acceptance of Phase 4 deliverables.***

Drafting, reporting and implementation of above deliverables will be coordinated, advised and monitored by the project team, consisting of the EPIRB project Team Leader and CWME. In addition, the target and other beneficiary institutions, as well as members of the National Coordination Committee (NCC), Regional Committee of the Natural Resources and Environmental protection will assist in collecting data and reviewing of deliverables.

VI. Qualifications and requirements to the service provider/contractor

- Experience in hydrogeology, groundwater mapping and mathematical modeling;

- Experience in basin planning and demonstrated working relationship with the main beneficiary;
- Demonstrated knowledge of WFD and IWRM principles and experience of implementing these principles in the country/region;
- Existence of qualified staff able to fulfill above mentioned tasks and demonstrated commitment to involve other national/international professional consultants.

The assignment shall be implemented by a company or consortia of companies that are NOT representing the project beneficiaries.