

GIS Hydrography Management System for Provincial Waters

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Contents

1	Objective of the Studies	2
2	Analysis of Requirements	3
2.1	Functional Requirements	3
2.2	Data Requirements	3
2.3	Nonfunctional Requirements	3
3	Starting Situation	5
3.1	Technology	5
3.2	Exsisting Data	5
3.3	Market Analysis	5
3.4	Conclusions	5
4	Working Hypotesis	6

1 Objective of the Studies

The objective of this project is to develop an information system for hydrography management in the Italian province of Belluno. The system aims to achieve the following goals:

- Know the situation of all the water resources in the province: The system will provide comprehensive information about the water bodies within the province, including lakes and rivers. It will facilitate the understanding of the current state of these water resources.
- Manage inputs of potentially polluting liquids: The system will enable the management and monitoring of inputs that have the potential to pollute the water resources. It will track and control the release of substances into the water bodies to ensure environmental protection.
- Monitor the status of provincial waters: The system will continuously monitor and gather data on the condition of water resources, including parameters like water level, flow, turbidity, temperature, pH, dissolved oxygen, and more. It will enable the province to assess water quality and identify any anomalies or pollution incidents promptly.
- Compliance with European standards: The system will adhere to the relevant European standards for the representation of water networks. It will ensure that the information system follows the prescribed guidelines and formats for accurate and standardized data representation.

By achieving these objectives, the hydrography management system will provide the province with an efficient tool to monitor, manage, and protect its water resources effectively.

2 Analysis of Requirements

2.1 Functional Requirements

- **Import and Export of Data:** The system must support the seamless import and export of data in various standard formats, including shape files. This capability will enable data integration from diverse sources and facilitate interoperability with other systems.
- **Network Update:** The system should allow authorized personnel to update both the geometric and attribute aspects of the water network. It must ensure data consistency by maintaining a comprehensive history of modifications, enabling traceability and analysis of network changes over time.
- **Query System:** A robust interrogation system is necessary, equipped with spatial and alphanumeric filters that can be combined. This will empower users to perform complex queries, extracting relevant information based on specific criteria for data retrieval and analysis.
- **Query Results Export:** Users should have the ability to export query results in compatible formats for further analysis, reporting, or integration with external tools and systems. This functionality enhances data utilization and supports informed decision-making processes.
- **Cartography and Orthophoto Visualization:** The system should provide an intuitive visualization interface, allowing users to overlay cartographic and orthophoto data as a background for analysis purposes. This feature enables the correlation of additional information with spatial context, aiding in decision-making.

2.2 Data Requirements

The system necessitates the following data (with the following characteristics) to fulfill its objectives in the hydrography management system:

- **Required Data:** Comprehensive information regarding water bodies within the province, including spatial attributes (geometry), essential attributes (e.g., name, type), and historical records of network modifications.
- **Data Format:** The system should support multiple data formats for efficient data management and interoperability. Primarily, the system should be capable of working with shape files, which are widely used in the geospatial domain. Shape files provide a standard format for storing both the geometry and attributes of geographic features. This format ensures compatibility with existing datasets and enables seamless integration with other geospatial systems. Furthermore, the system should support commonly used formats for import and export operations, such as CSV (Comma-Separated Values) and GeoJSON (a format for encoding geospatial data in JSON). These formats facilitate data exchange with external systems and enable data analysis using various tools and applications. By accommodating these diverse data formats, the system can effectively handle the information related to the water bodies, ensuring compatibility with existing data sources and promoting data interoperability within the hydrography management domain.

2.3 Nonfunctional Requirements

To ensure the development of an effective hydrography management system, the following nonfunctional requirements must be considered:

- **Use of PostgreSQL DBMS:** The system should leverage the PostgreSQL database management system (DBMS) for efficient data storage, retrieval, and management. The utilization of this reliable and widely adopted DBMS will contribute to the system's scalability and performance. Within PostgreSQL, a powerful plugin for it called PostGIS will be used, so to expand the DBMS capabilities on managing spatial data.
- **Use of FOSS Components:** The system should embrace the use of Free and Open Source Software (FOSS) components during its development. By leveraging FOSS tools and libraries, the system can benefit from community support, cost-effectiveness, and flexibility in customization.
- **Compliance with Applicable Standards:** The system must adhere to applicable national and international standards for hydrography management and data representation. This compliance ensures interoperability, facilitates data sharing, and promotes compatibility with other systems within the domain.
- **Compliance with Rules and Regulations:** The system should conform to all relevant rules and regulations governing water management and environmental protection at both national and international levels. Adherence to these regulations ensures legal compliance and promotes responsible data handling practices.

3 Starting Situation

In order to provide a comprehensive understanding of the project context, it is important to analyze the starting situation, including the existing technology, available data, and market analysis.

3.1 Technology

The Province of Belluno currently operates an IT sector responsible for managing their Management Information System (MIS) using commercial software and the PostgreSQL database management system (DBMS).

However, a specific Geographic Information System (GIS) application tailored for hydrography management is not currently in place: our task is to develop a customized GIS solution to address this gap and fulfill the province's requirements.

3.2 Existing Data

The region Veneto already possesses a topographic database built in accordance with the Italian national standard at the NC5 level. This database provides detailed information about the province's terrain and water features. The data is stored in the ETRF2000 reference system and can be accessed through OGC WMS (Web Map Service) and WFS (Web Feature Service) non-transactional services.

Additionally, orthophotos at a scale of 1:5000, also based on the ETRF2000 reference system, are available for visualization through WMS.

3.3 Market Analysis

Extensive research indicates that there are currently no off-the-shelf or packaged solutions available in the market that adequately address the requirements of the hydrography management system for the Province of Belluno.

This market gap presents an exciting opportunity for our team to develop a tailored solution that precisely meets the province's needs. By creating a custom application, we can ensure the fulfillment of all functional and nonfunctional requirements while complying with the relevant standards and regulations governing water resource management.

3.4 Conclusions

Analyzing the starting situation in terms of existing technology, available data, and market conditions, it is evident that the development of a dedicated hydrography management system is crucial to effectively manage the province's water resources and address the current market gap.

4 Working Hypotesis