Experience in water resources assessment and development

WATER MANAGEMENT CONSULTANTS

Canada: Capilano, Seymour and Coquitlam Watersheds Water Source Capacity Study

Client: Greater Vancouver Regional District

Water Management Consultants was commissioned to assess the water supply capability of a system of linked lakes and reservoirs that supply Vancouver and to determine their current and potential capacity in the light of increasing demands and potential climate change.

The services provided included a detailed study of the hydrology of the watersheds and of current and projected demand for water under conditions of water shortage. WMC developed a spreadsheet-based multiple reservoir simulation model and assessed the reliability of the reservoir system under a range of hydraulic constraints and potential climate change. Options for increasing the supply capacity were identified.

The study and the model will assist the GVRD Planning Department to plan for future delivery of reliable water supplies and maximise the use of existing sources before additional sources are developed.

Optimisation of existing water resources should precede investment in new infrastructure.

Chile: Monturaqui Aquifer Investigation and Development

Client: Minera Escondida Ltda

Water Management Consultants was appointed to manage and implement a comprehensive investigation of the groundwater resources of a recently discovered aquifer in the arid Region II, northern Chile, and to design and install a production wellfield. WMC specified and managed extensive electromagnetic and magnetic geophysical surveys and the drilling of 35 groundwater observation/ monitoring wells, 8 wireline core holes and 40 test production wells.

Because it is out of sight, groundwater is often a poorly understood resource.

More than 45 wells were tested to determine aquifer parameters, production pumping rates, establish pump installation depths and provide pump selection criteria. A site laboratory was established for core testing and analyses, lithological logging, sieve analysis and field water quality testing.

A numerical groundwater flow model was developed to quantify the effect of abstraction and optimise the location and design of the production wellfield so that resource usage is maximised, and operation costs and impacts on groundwater levels in a wetland 60 km down gradient are minimised. WMC has managed the monitoring of the impact of exploitation on groundwater levels in the aquifer and in the wetland since 1995.

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USA: Artificial groundwater recharge

Client: Metropolitan Domestic Water Improvement District, Arizona

Water Management Consultants was appointed to develop an innovative approach to quantify the potential recharge resulting from natural floods in normally dry river beds. This work formed part of a study of the feasibility of a $30M in-channel artificial recharge project. In contrast to previous approaches WMC proposed a method that focuses on the vadose zone and unsaturated flow dynamics. The method tracks the wetting front and changes in soil saturation. This information is used to calibrate a 2-dimensional variably saturated flow model that can quantify infiltration and lateral downstream flow in the aquifer. The method allows for better quantification of pilot project results and improves estimates of recharge from full scale recharge facilities, and could aid in developing optimal recharge strategies.

UK: The hydrological impact of river basin management on fresh water flows into the Severn estuary conservation area

Client: The Environment Agency

Under the European Union's Habitat's and Bird's Directives the Environment Agency is responsible for demonstrating the impact of its permissions on statutory conservation areas. The Severn basin covers 11,000 km^2 and is regulated by two major reservoirs. The basin's water resources are heavily utilised for public water supply and a range of other uses and the estuary is both a Special Area of Conservation and a Special Protection Area under European and UK law.

Water Management Consultants was retained by the Agency to develop an approach that is acceptable to the statutory conservation authority for the assessment of the impact of over 4,500 water abstraction and effluent discharge permissions on the flow of fresh water into the Severn estuary.

The approach developed by WMC was based on hydrological analyses and modelling of the complex water resources system in the lower part of the basin to synthesise estimated actual and naturalised 23-year historic flow series at the entrance to the estuary using only the most significant permissions in the basin. Statistical comparison of the two flow series allowed assessment of the impact of river management on flows into the estuary.

The ecological requirement for fresh water flows in estuaries is an area of considerable uncertainty.

Experience in water resources assessment and development

WATER MANAGEMENT CONSULTANTS

Madagascar: Water Resources Planning for the QMM Project

Client: QIT Madagascar Minerals

Water Management Consultants provided water resources planning expertise for the QMM project in Madagascar for flood control, water supply and environmental assessment.

The work included hydrological and meteorological data collection, assessment of groundwater and surface water resources, watershed studies, probabilistic analysis of inflows, identification of dam and storage opportunities, stochastic analyses of storage alternatives, and hydrodynamic modelling of flood flows and water quality.

A detailed flood inundation map of the estuary area was prepared. Training and technology transfer for water monitoring was an important component of the project.

Water Management Consultants developed a preliminary design and cost estimate for a salinity control structure comprising a dam across an estuary and a spillway capable of passing the Probable Maximum Flood. The salinity control structure will provide freshwater conditions in the estuary upstream for mine water supply and water supply for the community of Fort Dauphin.

Guinea: Koundara Water Supply Project

Client: Société Nationale des Eaux de Guinée.

Water Management Consultants was commissioned to undertake an investigation to assess the feasibility of supplying the town of Koundara from groundwater. Services provided included geophysical surveys, supervision of exploration drilling and computer modelling of the aquifer to assess the sustainability of the resource.

Guinea: Seven Towns Water Supply

Client: Ministère des Ressources Naturelles, de l'Energie et de l'Environnement

This project developed detailed designs for water supply systems for seven secondary towns. Four towns were to be supplied from groundwater and three, Labé, Koundara and Dinguiraye, from new reservoirs. Water Management Consultants was commissioned by the project consultants to evaluate the surface water resources to size the three reservoirs.

A digital rainfall-runoff catchment model was calibrated to nearby gauged watersheds and then transposed to the dam sites to generate long synthetic flow records at each site using observed rainfall and evaporation records. Flow measurements made at the dam sites were used to quality control the synthesised records. Behavioural storage-yield analyses were undertaken using the synthetic records to estimate the reservoir storage capacities necessary to maintain supplies through the 1:50 year drought. Allowance was made in the storage calculations for reservoir sedimentation and climate change.

WMC also estimated peak floods for design of the spillways. A regional flood frequency relationship and an analysis of local extreme rainfalls were combined with the unit hydrograph method to generate design flood hydrographs. Proposals were made for instrumenting the watersheds and monitoring inflows, storage and outflows from the reservoirs.

Experience in water resources assessment and development

WATER MANAGEMENT CONSULTANTS

The Gambia: Coastal Groundwater Resources Assessment

Client: Ministry of Natural Resources and the Environment

Water Management Consultants was appointed to develop a regional numerical groundwater model of the Kombo District coastal aquifer. The model was to assess available groundwater resources over a 10-year predictive period and the risk and extent of saline intrusion under variable recharge/abstraction scenarios for supply to the capital Banjul.

WMC designed the model for use as a resource management tool and for efficient technology transfer. It can be expanded easily as more data becomes available from further investigations.

Recommendations were made for wellfield location and pump schedules to reduce the risk of saline intrusion and the deterioration of groundwater quality.

Western Samoa: Water Resources Master Plan, Phase 1

Client: Western Samoa Water Authority

A series of high volcanic islands located in the South Pacific, Western Samoa has a humid tropical climate. Comprehensive water resources assessments had not been carried out previously. Water Management Consultants provided water resources expertise to the consultant's team for the groundwater component of the study.

All existing data were collated and reviewed. An inventory of boreholes and their characteristics was prepared and operational pumping tests were carried out to assess hydraulic performance and the risk of saline intrusion.

A detailed programme was designed and costed for surface geophysical investigations to map saline intrusion, drilling of exploration and monitoring boreholes, pumping tests and numerical modelling for assessment of groundwater resources. Planned development facilities were appraised and recommendations were made for safe yields.

Training was delivered to government staff in groundwater monitoring. An assessment of further training needs was made and a training programme was designed and costed.

Western Samoa: groundwater overexploitation can result in salinizaton of water supplies.

Libya: EIA, Great Man Made River

Client: Great Man Made River Authority

Water Management Consultants provided expertise for the hydrogeological aspects of the EIA of Phase 2 of the project, the Western Jamahiriya System. The work involved the assessment of the impact on the groundwater system of two wellfields of 484 wells in the Hamada al Hamra basin in the Sahara Desert and of 2.5 Mm3/day delivered to the Jeffara Plain in the north, 80% of which is to be used for large scale irrigated agriculture surrounding Tripoli.