

HYDRAULICS

COMPANY PROFILE AND
STATEMENT OF CAPABILITIES 2024

CONTENTS

1	COMPANY PROFILE	2
	ABOUT TECHNITAL	2
	<i>Description</i>	2
	<i>Services</i>	2
	<i>Organization and staffing</i>	3
	<i>Quality control</i>	4
	<i>Code of Ethics</i>	4
	<i>Sectors of Specialization</i>	5
2	OUR EXPERIENCE	6
	EXPERIENCE IN HYDRAULICS	6
	APPENDIX A – COMPANY’S EXPERIENCE	31
	WATER SUPPLY AND SEWERAGE	
	RIVER REGULATION AND WATER RESOURCE MANAGEMENT	
	HYDRAULIC AND HYDRODYNAMIC STUDIES	

1 Company Profile

About TECHNITAL

Description

TECHNITAL is a private joint stock company established more than 50 years ago (in 1964) and is one of the oldest engineering consultancy companies in Italy. Thanks to its high level of expertise, its dynamic nature and versatility, management autonomy and efficiency and its sophisticated hardware equipment and software libraries, the Company has been awarded large scale international and national projects by major public and private entities and by international funding organizations.

TECHNITAL's headquarters are situated in Verona, Italy. The organization abroad includes 15 between branches and subsidiaries in Algeria, Armenia, Bosnia & Herzegovina, Croatia, Georgia, Iraq, Kenya, Kosovo, Qatar, Tanzania, Trinidad & Tobago, Tunisia, Uruguay and Zambia and a number of local offices which is continuously changing according to the on-going international projects (at the moment there are 4 local site offices).

Services

TECHNITAL is a dynamic company working in the fields of transport infrastructure (roads and motorways, railways, inland waterways, urban transport, ports and airports), hydraulics (water treatment and desalination plants, dams, aqueducts, sewerage systems, waste water treatment), marine and coastal engineering, environment, energy (incineration and waste to energy plants, hydroelectric plants, solar plants, biogas plants), waste treatment (recycling plants, dump sites), buildings, architecture and urban planning.

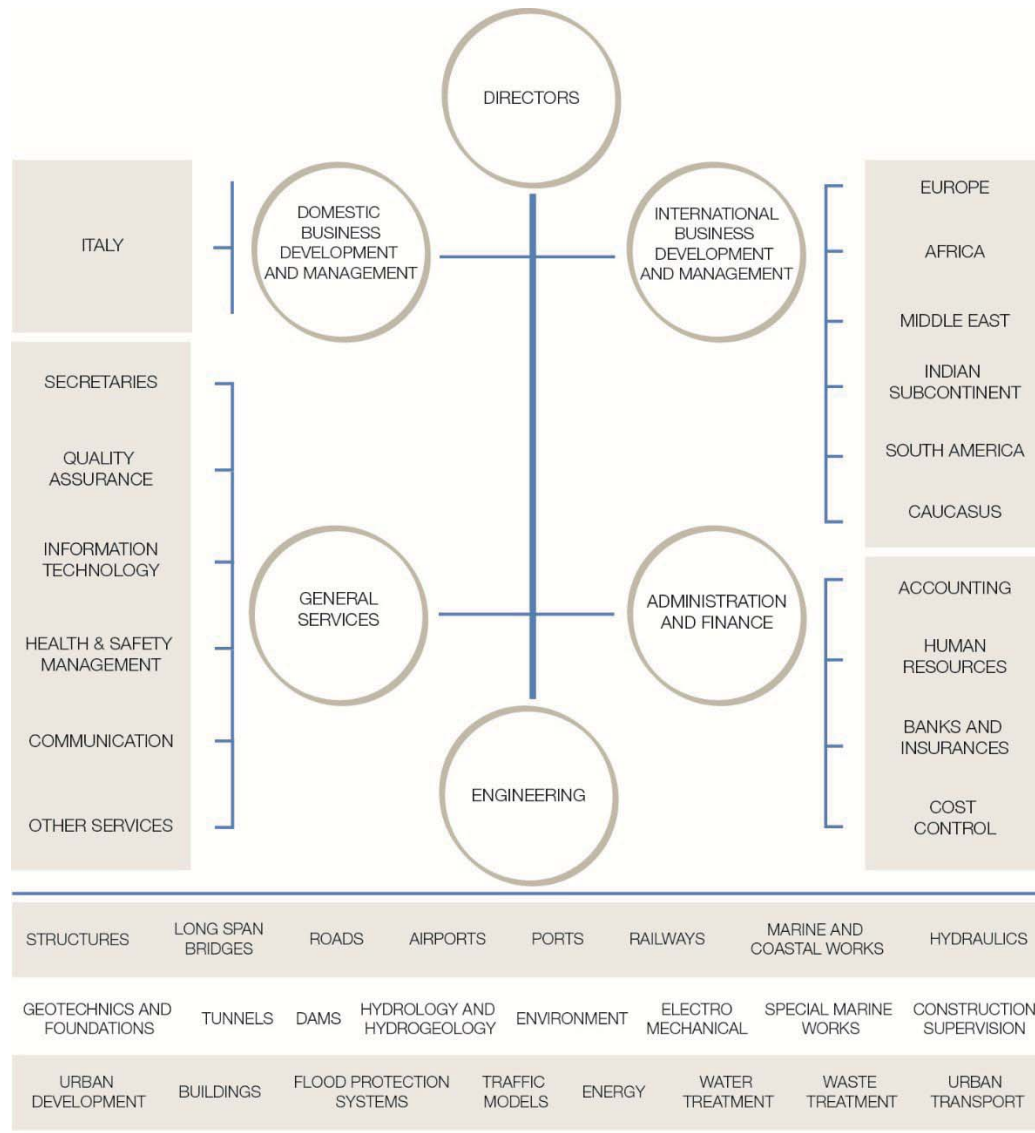
The company covers the full range of services, from planning and feasibility studies through to detailed design, works supervision and technical assistance:

- } project management
- } planning and economic-financial evaluation of investments
- } feasibility studies and technical-economic evaluations
- } all levels of design
- } environmental impact assessment and studies
- } traffic studies
- } procurement and assistance with tenders
- } construction supervision, quality assurance, testing and commissioning
- } co-ordination and supervision of research and laboratory tests
- } development of hydrodynamic and hydrogeological analysis and simulations
- } development and application of analysis methods and computer modelling.

TECHNITAL has worked in several countries world-wide: Afghanistan, Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Bahamas, Benin, Bolivia, Bosnia & Herzegovina, Brazil, Bulgaria, Burkina Faso, Burundi, Cayman Islands, Colombia, Croatia, Cuba, Cyprus, Czech Republic, Democratic Republic of Congo, Denmark, Djibouti, Dominican Republic, Egypt, Ethiopia, Georgia, Germany, Ghana, Greece, Guatemala, Hungary, India, Iraq, Italy, Jordan, Kenya, Kosovo, Libya, Madagascar, Malawi, Malaysia, Mali, Mauritania, Monaco, Montenegro, Mozambique, Nicaragua, Niger, Norway, Panama, Peru, Poland, Qatar, Republic of Haiti, Romania, Russia, Rwanda, Saudi Arabia, Senegal, Slovenia, Somalia, Spain, Sudan, Syria, Tanzania, Togo, Trinidad & Tobago, Turkey, Uganda, Ukraine, U.A.E., United Kingdom, U.S.A., Uruguay, Venezuela, Yemen, Zambia.

Organization and staffing

TECHNITAL's multidisciplinary staff is organized according to the following chart:



TECHNITAL's multidisciplinary staff includes about 250 professional employees covering the various aspects of the engineering services: Transport, Hydraulics, Geotechnical, Marine & Coastal, Environmental Studies & Territorial Analysis, Structures, Electronic Data Processing & Systems Analysis, Quantity Surveying & Cost Estimation, Electromechanics, BIM/CAD/CAE, Works Supervision, etc.

The above staff is integrated by consultants and specialists, both Italian and foreign. Seeking support and advice from colleagues, scientists, and academics all over the world is part of TECHNITAL's policy of excellence.

Given the firm's considerable international experience, TECHNITAL's staff is proficient in the use of international engineering standards (BS, ASTM, AASHTO, ASME, API and the like) and contract conditions (FIDIC and others).

Quality control

TECHNITAL's activity is ISO 9001:2015 Quality System Management certified. The company is also certified ISO 14001: 2015 Environmental Quality Management, ISO 45001:2018 Occupational Health and Safety Management System and SA 8000:2014 Social Accountability Management System.

TECHNITAL has developed a company policy regarding quality control which is constantly being updated and applied, taking into account the costs to be sustained to achieve the objectives of quality and maximum benefit for both the Company and the Client. Thanks to its Quality Control System, TECHNITAL is capable of guaranteeing the quality of its services and of ensuring the Client that these services satisfy the required quality standards.

Code of Ethics

Ethical and responsible decision making is very important for the company in terms of risk management and in order to keep actions within the ethical and legal boundaries.

For that reason, the company is adopting a Code of Ethics (available from the web site of the company) and conduct for its Executives and Directors and for all the Employees able to fulfil requirements for responsible decision taking. Such code aims at reducing the possibility of stepping outside behavioral limits set by the company.

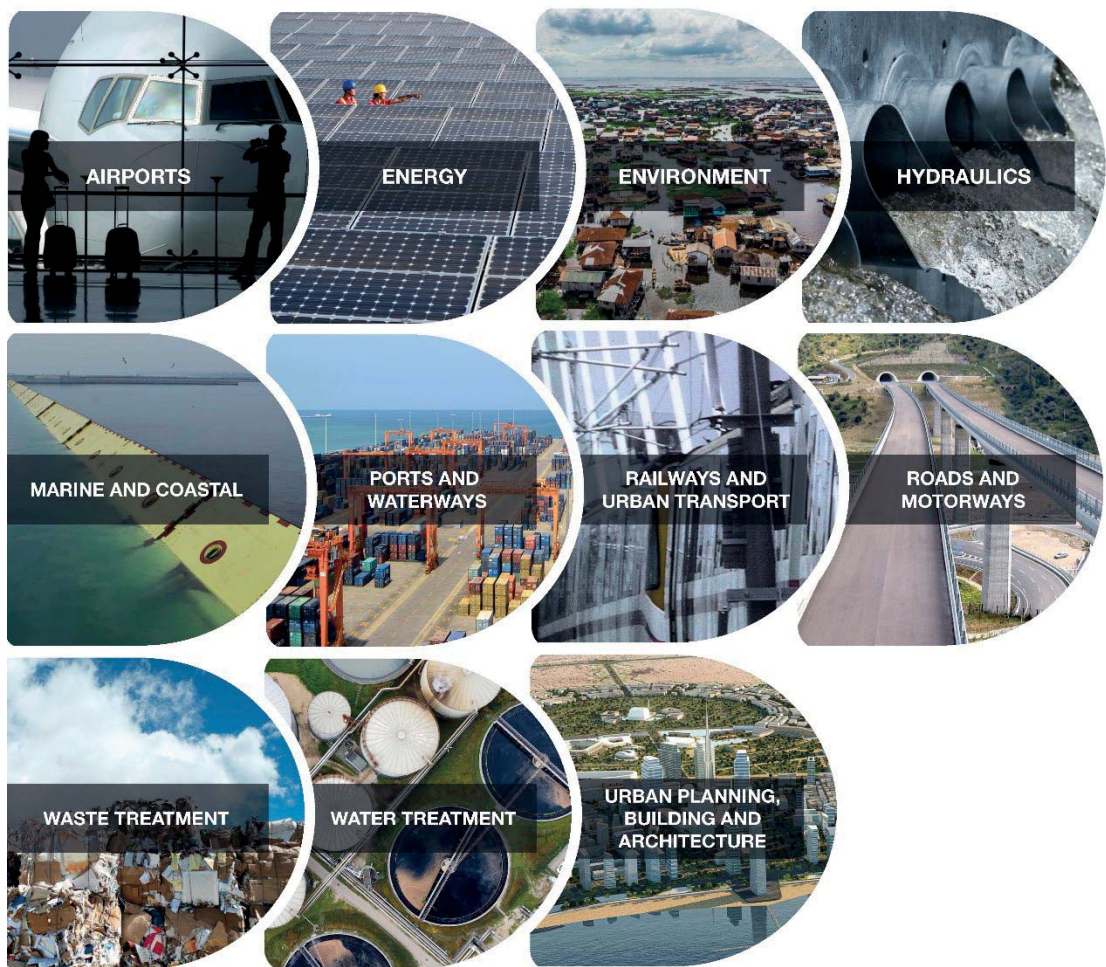
The Code of Ethics the company is adopting also meets the Organization, Management and Control Model pursuant to Italian Legislative Decree n. 231/2001.

Sectors of Specialization

TECHNITAL provides high-quality consultancy services in different areas of specialization: Roads and Motorways, Railways and Urban Transport, Airports, Ports and Waterways, Marine and Coastal Engineering, Environmental Engineering, Urban Planning, Buildings and Architecture, Hydraulic Engineering, Water Treatment, Waste Treatment, Energy.

In each of these sectors, TECHNITAL provides innovative project solutions to Government Agencies, International Financial Institutions and Private Sector Organizations.

Services provided by TECHNITAL include master plans, feasibility studies, techno-economical evaluations, traffic studies, mathematical and physical modeling, all phases of design from concept to detailed design, environmental impact studies and monitoring plans, tender document preparation and assistance in the procurement of works, construction supervision.



2 Our Experience

Experience in Hydraulics

TECHNITAL's activities in the field of hydraulics cover a broad range, from sewerage and water distribution systems, waste water treatment, irrigation systems, dams, rivers regulation, channels and hydroelectric power plants.

In this sector, TECHNITAL, counting on its consistent multidisciplinary operative structure and its technical and electronic equipment, has successfully undertaken and completed some important and difficult hydraulic projects, both in Italy and abroad, particularly where the identification of the best technical solution required the use of experienced experts of different complementary disciplines.

The group of highly specialized hydraulic engineers can in fact be supported by experts and senior engineers with specific know-how in the following fields:

- } hydrology;
- } geology and hydrogeology;
- } geotechnics;
- } topographical surveying and mapping;
- } ecology;
- } agriculture and soil science;
- } mathematical modeling;
- } computerized graphic simulations;
- } quantity computation and cost estimates.

The services provided in this field include, among others: hydrological studies; geological and geotechnical studies; field measurements and monitoring; optimization of resources; preliminary, basic and final design of structures; feasibility studies and cost/benefit analysis; environmental impact assessment; cost estimates; technical specifications and Tender Documents; construction supervision and management.

TECHNITAL has a vast experience in the design of **dams and irrigation canals** which includes several projects: Among others it is worth to mention the **Upgrading of Persano Dam**, the **Rehabilitation of Sciaguana Dam (Sicily)**, the **Sommatino earth dam on the Gibbesi River (Sicily)**; the **Val Taioli rockfill dam** and related hydraulic works for water catchment, and irrigation network; the **Adige-Guà irrigation canal** of 16,3 km; a gravity dam on the Ingagna River, Municipality of Mongrado, with a storage basin of 7 million m³ for the irrigation of an area of 5,400 ha; **works for controlling the Brustolè landslide** at Arsiero which include **a dam on the Posina River**, a diversion channel, a retaining basin utilized for irrigation purposes; and **works for controlling the Spriana landslide** at Sondrio which include **a dam on the Mallerò River** and a diversion channel partly in tunnel.



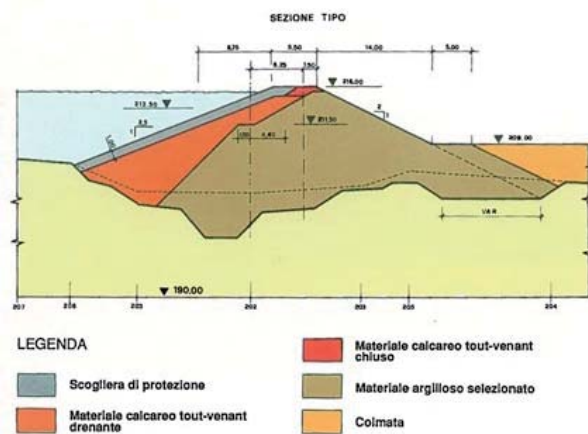
Rehabilitation of Sciaguana Dam (Sicily)



Upgrading of Persano Dam



Morning glory spillway Gibbs Dam



Gibbsi Dam: section

An interesting project covering several aspects of hydraulic engineering has been recently carried out in Afghanistan. The consulting services were in support of the PMO (Project Management Office) established under Nangarhar Valley Development Authority (NVDA) and the Northern Basin Development (NBD).

As far as the NVDA program is concerned, the project has covered a large irrigation scheme related to the entire valley and made of three hierarchic levels. As for the NBD the project has covered several items such as: (i) the 250 main canal structures; (ii) construction of Bangala Weir and refurbishment of Samarkandian Weir; (iii) construction of the flood protection embankment in Yanqi Qala; (iv) construction of gated headworks for the Yetim Tapa irrigation canal on the Amu Darya, and (v) emergency protection works for bank erosion control along selected reaches of the upper Amu Darya.

Technital had to prepare the detailed design and tender documents, assist the client in the bidding procedures for construction and supervise the construction.



Samarkandian Weir

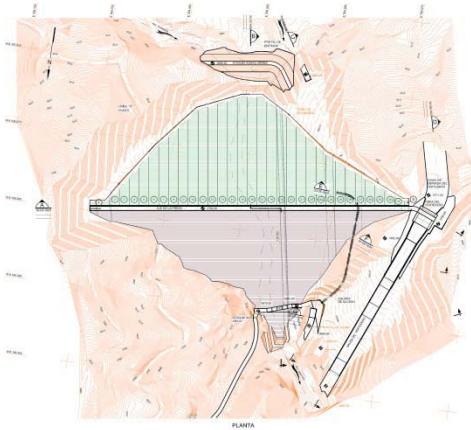


Yetim Tapa Channel Weir



Position of the protection works along Amu Darya

Among the important projects, it is worth to mention the final design of a dam on the Dora Riparia River, including water intake structure, off take channel, and ancillary works for the new Hydroelectric Power Plant of Pont Ventoux, in Val Susa (Italy). The company has carried out the design of an irrigation scheme in the Boghè plain, Mauritania; Identification study and preliminary design of six earth dams for the collection and utilization of surface run-off waters in Senegal; and the Baardheere Dam on the Giuba River in Somalia including a retaining basin of 4 million m³, hydraulic works, electric power generation substation and main irrigation channel. More recently the company has provided hydraulic and geotechnical assistance to the general contractors in relation to the construction of the Miscuni dam, near Cochabamba in Bolivia.



Layout of the works of Misicuni Dam



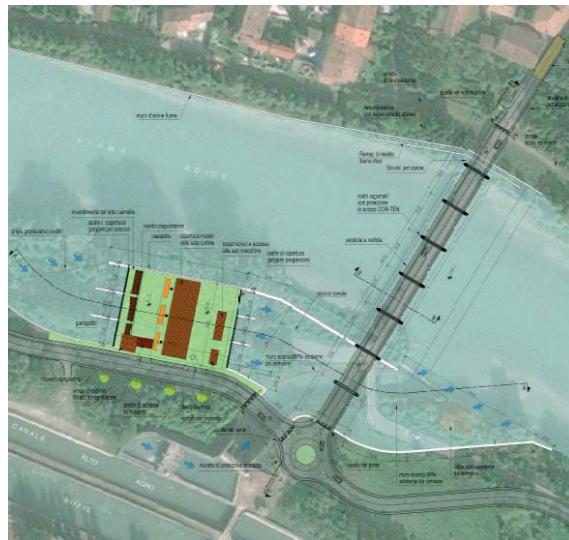
Bottom discharge tunnel of Misicuni Dam

Among the major recent Dam projects it is worth to mention the following:

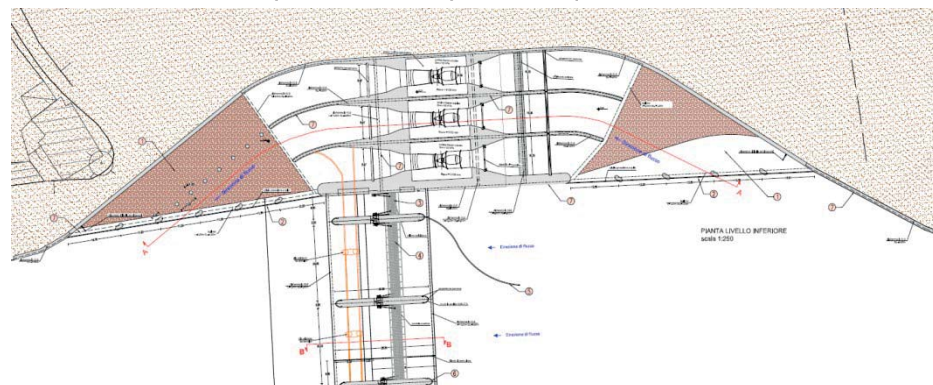
- } Feasibility study and detailed design of a new dam in Casalbuono (Campania) - Italy*
- } Detailed Design of the Maintenance works of the Pertusillo dam – Italy*
- } Detailed Design of the Hydraulic restoration of the Biferno River downstream of the Ponte Liscione dam – Italy*
- } Feasibility Study and Final Design of the Rehabilitation of the Ripaspaccata Dam in the countryside of Montaquila – Italy*
- } Final Design of Fossatella Dam – Italy*
- } Detailed Design of the Assessment of the seismic safety of the dam and existing buildings and Design of the Abutement of the Disueri Dam – Italy*
- } Detailed Design of the Rehabilitation of Poma Dam – Italy*
- } Detailed Design of the Rehabilitation of Sciaguana Dam (Sicily) – Italy*
- } Detailed Design of the Rehabilitation of Villarosa Dam – Italy*
- } Preliminary Design and Detailed Design of the Upgrading of Persano Dam – Italy*
- } Feasibility Study and Detailed Design of the Rehabilitation of Gibbesi Dam – Italy*
- } Preliminary Design of the Rehabilitation/demolition of the High and Low Bunnari Dams (Sassari) – Italy*
- } Preliminary Design of the Consolidation works and upgrade of the instrumentation system for Govossai Dam - Italy*
- } Detailed Design of the Monte Lerno Dam – Italy*
- } Detailed Design of the Assessment of the seismic safety and Maintenance Works Design of the Scanzano Dam - Italy*
- } Final Design of the rehabilitation of Cumbidanovu Dam (Orgosolo) – Italy*
- } Management Plan and Detailed Design of the Rehabilitation of Zaffarana Dam – Italy*
- } Geological, geotechnical, hydraulic and hydrogeological studies of the Misicuni II Project – Dam and ancillary works on the Río Misicuni near Cochabamba: technical assistance - Bolivia*

In the specific field of hydroelectric plants the company can count on a number of projects such as:

- } Preliminary design of the upgrade of 7 hydroelectric plants in the Trentino Alto Adige Region, Italy*
- } Valbona hydroelectric power plant reactivation – Italy*
- } Detailed Design and Construction Supervision of a new hydro-electric plant of Arcè (Municipality of Pescantina) – Italy*
- } Detailed Design and Construction Supervision of a new hydro-electric plant of Settimo di Pescantina – Italy*
- } Due diligence and feasibility study of Pequin hydroelectric plant in Albania*
- } Due diligence and feasibility study of the new hydroelectric plant Janiski Otoke in Republika Srpska*
- } Due diligence for Lukac and Dubrava hydroelectric plants – Bosnia & Herzegovina*



Lay-out of the new hydro-electric plant of Arcè



Lay-out of the new hydro-electric plant of Settimo

As far as **river basin studies and river regulation and management** is concerned, it is worth mentioning the Project for the flood control of the Bisagno River and the Fereggiano, Rovare and Noce Streams in the city of Genova in which the recent flooding has caused a lot of victims. The project involves a series of works aiming to reduce the risk of flood of huge urban areas. In particular, these works include the improvement of the hydraulic section located in the mouth reach, interested by a multiple barrel box culvert; and the realization of a river diversion to reduce the peak discharges flowing in the original riverbed.

The project of the river diversion includes, for the Bisagno river, the following works: a) a river barrage equipped with n. 3 radial gates; b) a tunnel, with a horseshoe section with 9.5 m diameter, able to carry to the Tyrrhenium sea a portion of the flood discharges derived by a lateral weir; the total length of the tunnel is 6,650 m; c) three smaller diversion structures on the streams Fereggiano, Rovare and Noce, connected to the main tunnel through three tunnels 300 m length; d) a sea outfall structure of the main tunnel; e) two service tunnels.



Diversion Scheme



New Gates



Physical model

The project for the Flood Control Works of Agno – Guà River concerns the design of lamination and control works along the mentioned river. The new artificial flooding covers an area of about 30 hectares able to store a volume of about 900.000 m³ of water in connection with another existing flooding area. Works includes also the construction of a connection structure with eight gates allowing the flooding of the lower basin when the upper is full.



Layout of the Agno-Guà flood control works



Eight gates connection structure

A further interesting project of the same field is the Flood Control Works of Bozzente River. It concerns the design of lamination works in an area with a practical total impermeability of the soil and where the infiltration is absent and the speed of the water flow in case of flooding is relevant. The basin of lamination is about 22 hectares for a storing volume of about 1.000.000 m³ of water.



Layout of the Bozzente River flood control works

In addition to the projects already mentioned TECHNITAL has carried out several assignments:

- } river basin master plan studies in relation to major Italian rivers (Lemene, Livenza and Tagliamento rivers);
- } studies of water quality and water resources, water treatment, etc.
 - Piave and Brenta-Bacchiglione rivers
 - River Sarco - Lake Garda - River Mincio - Mantuan lakes system;
- } hydraulic - flood control studies:
 - Feasibility Study for mitigation works for the rivers Sana Nicola and Selingheddu – Olbia - Italy
 - Alpone river and its tributaries, in the province of Verona,
 - basins flood control for the Olona river in Lombardy
 - basins flood control for the Timonchio river in Veneto
 - basins flood control for the Tagliamento river in Friuli Venezia Giulia
 - basins flood control (named Anconetta) for the Fratta Gorzone river in Veneto
 - The Diversion of the Tagliamento river along the Cavrato natural channel, upstream the town of Bibione (Veneto) and works for the safeguard of the flooding along the downstream portion of the river
 - Mella and Grande rivers, in the province of Brescia during the Design of the Valtrompia Motorway.



Discharge works on Olona river

TECHNITAL has also carried out numerous projects of **water supply and sewerage systems** for various clients and municipalities.

Among others it is important to highlight the “**Restructuring of the Gela – Aragona Aqueduct**” in the South of Italy. The Gela – Aragona aqueduct is supplied by a major seawater intake at Gela and by a desalination plant in Gela. The aqueduct is for potable flow of about 500 lit/s up to an elevation of 500 msl. The services were for design and work supervision of renewal of the entire water supply main, replacement of the existing fibreglass piping with a spheroidal cast iron pipe, and the modification of the hydraulic scheme of the main conveyor (81.8 KM), with the introduction of 3 tanks in tunnels along the line and booster type pumping stations instead of the existing ones with multistage vertical axis pumps and collecting tanks.



Detail of the main pipe



Detail of a pumping station



Construction stage

The Company is in charge of the Work Supervision of the **Basento – Brandano water scheme**: a complex water distribution scheme which covers the municipalities of Irsina, Genzano, Palazzo S.Gervasio and Banzi (about 5,200 hectares in the province of Potenza – South of Italy).

The works include a bored tunnel of about 4 km excavated with a TBM, a system of main distribution pipelines of about 12 km with 3 compensation basins connected with each other, and a distribution network of about 320 km.



Detail of the TBM



Detail of a basin



Construction stage



Detail of the main pipe construction

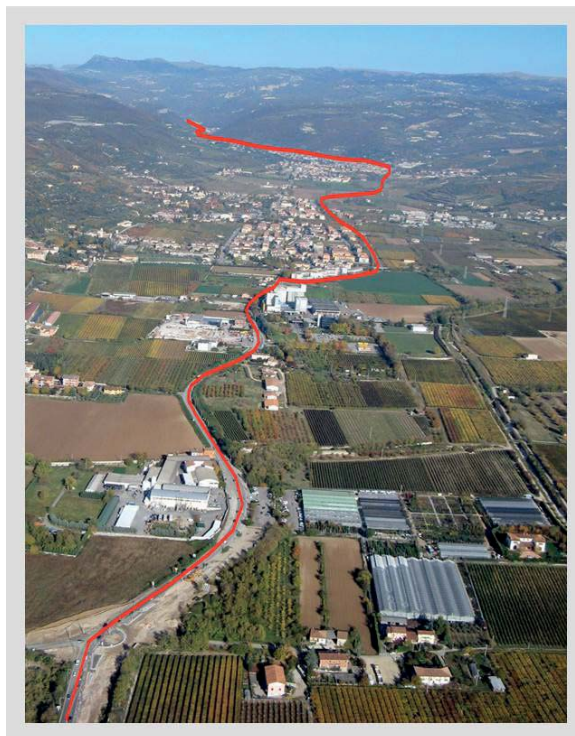
Another relevant project, in the same field of large supply and sewage schemes, is the **“Technical assistance for preparing grant applications and documentation award for regional development project infrastructure water and wastewater in Sibiu in the period 2016-2020 (MEDIAS)”** in Romania. The project addresses especially the rural localities in the area with investments to ensure the supply of drinking water and the establishment of wastewater collection and treatment systems in 4 main Urban agglomerates: Medias, Agnita, Dumbraveni and Seica Mare. The company is involved in design and tender documents preparation as well as work supervision for a quite complex system which covers different items. As far as water supply is concerned, it covers: about 135 km of supply network, 55 km of main conveyors, 7 pumping station, 5 chlorination stations, 3 water tanks, water intake, micro-power plants and other water treatment plants. As far as sewerage system is concerned, it covers about 200 km of sewerage network, about 45 pumping stations.

It is worth to mention also the **“Preliminary and Detailed Design of the Wastewater Treatment System of Ganvié (Benin)”**. The project “Reinventing the Lake City of Ganvié” is part of the Government’s action plan as one of the top priority projects of Benin in the tourism sector. Nowadays, the city of Ganvié consists mainly of stilted houses on the lake Nokoué with a population of around 37.000 inhabitants. The human presence together with presence of animal farms has generated serious conditions of pollution of the water of the lake (brackish water as the lake is in communication with the sea) which has led to deplorable hygienic conditions affecting fishing and touristic activities. The project’s objective is the identification of a wastewater collection and treatment system with reference to the future scenario with a resident population of 73.000 inhabitants plus the tourist population fluctuating around 11.000 people.



Other important projects are:

- *Restoration and improvement of the water supply and sewerage systems in the various towns damaged by earthquakes in both Friuli and Campania Regions;*
- *Sewerage systems of Pellestrina, S. Pietro in Volta and Sottomarina, outlying villages of the Venice Lagoon, in the context of the vast project to safeguard Venice and its lagoon;*
- *Storm water drainage network in the town of Conversano (Bari);*
- *New water supply system for the city of Venice;*
- *Optimization of investments for the management of water resources in the province of Verona;*
- *Sewerage systems and waste water treatment plants of Sorgà and Valpantena (province of Verona) and Trasimeno and Todi (province of Perugia);*
- *Reconstruction of the sewerage system in the port of Naples;*
- *Works to improve the wastewater sewerage system in the lake Garda basin: main collector of the eastern lake: Malcesine – Peschiera del Garda – Italy;*
- *Hydraulic Infrastructures (sewerage, storm water drainage and treated effluent system) for 8 urban districts of the city of Doha - Qatar;*
- *Pre-investment studies for drinking water, sanitation and solid waste management projects in rural areas, catchment basin of Chixoy hydroelectric dam - Republic of Guatemala.*



Valpantena collector

TECHNITAL has also designed hydraulic infrastructures for:

- ‡ *Porto Cervo Resort Village (Sardinia, Italy);*
- ‡ *Tourist Development of Fazenda Caeira in Bahía (Brazil);*
- ‡ *Jeddah Tourist City (Saudi Arabia);*
- ‡ *Biology Department of Padua University (Italy);*
- ‡ *Faculty of Education of the new University of Sebha (Libya);*
- ‡ *new Railway Compound and Workshops in Dammam (Saudi Arabia);*
- ‡ *Umm Salal Phase 1 and Al Udaid Air Base (Qatar).*

For water treatment projects, please refer to “Water Treatment” brochure.

Special hydraulic/environmental projects include:

- ‡ *Hydrodynamic modelling of the lagoon of Venice;*
- ‡ *Extension of the catchment basin of the large lake Trasimeno in central Italy;*
- ‡ *Environmental protection of the River Sarca - Lake Garda - River Mincio - Mantuan lakes system, involving the definition of the principal alternative actions to optimize the water treatment system and the recycling of the treated waste water of the restrictions for water use;*
- ‡ *the Special Project for the Depollution of the Gulf of Naples;*

as well as numerous studies and pilot projects in relation to the program to reduce pollution of the Venice lagoon.

The most recent projects carried out in this field are illustrated more in detail in the following tables and project sheets.

TABLE A – COMPANY’S EXPERIENCE (For titles in **bold** type see project sheets in Appendix A)

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
WATER SUPPLY AND SEWERAGE						
Del Verde Aqueduct- Italy	Pangea Consortium for SASI	10/2023	Ongoing	Detailed Design	351,823	6.800.166
Monterosso Spillway - Italy	Municipality of Monterosso al Mare	06/2023	Ongoing	Feasibility Study, Detailed Design	304,952	11,520,971
Santa Margherita Ligure Spillway - Italy	Municipality of Santa Margherita Ligure	05/2023	Ongoing	Detailed Design	235,010	37,000,000
West Acireale sewer network - Italy	Sole Special Sewage Commissioner	09/2022	Ongoing	Detailed Design, Works Supervision	1,470,250	59,900,000
Water adduction system from Montedoglio reservoir for Valdarno Aretino - Italy	Nuove Acque	05/2022	Ongoing	Feasibility study, Detailed Design	384,351	27,672,523
Update and expansion of the sewage treatment system in the municipalities of Carini, Capaci and Isola delle Femmine - Italy	AMAP S.p.A. - Palermo	03/2022	Ongoing	Masterplan, Fesaibility Study	640,000	70,000,000
Feasibility study of the restoration works of the canal-bridges of the adductor called "Main Channel" of Sele Acqueduct* – Italy	Acquedotto Pugliese	10/2021	Ongoing	Feasibility Study	122.878,35	17,000,000
Design of two submarine discharge pipelines in Rimini - Italy	Heratech s.r.l.	06/2021	Ongoing	Preliminary Design, Works Supervision	397,700	21,000,000
Framework agreement - studies for water derivation for drinking use - Lotto Gallura - Italy	Abbanoa	05/2021	Ongoing	Hydrogeological Surveys	651,157	n.a.
Wastewater Treatment Plant for the Municipality of Benevento – Italy	CdC Commissario Straordinario Depurazione Benevento	11/2020	Ongoing	Preliminary Design, Detailed Design	414,075	22,350,000
Reinforcement of the potable water distribution network in Turin - Italy	SMAT S.p.A.	01/2019	Ongoing	Detailed Design. Works Supervision	371,135	16,489,000

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Construction supervision services for water supply treatment plant and network for Phase 1 Konza Techno City - Kenya	DELMA UK (ICM Group); final Client: KoTDA (Konza Technopolis Development Authority)	08/2018	Ongoing	Works Supervision	2,516,000	41,000,000
Sewerage system of the area Tonnarella - Trasmazzaro and link to the network of Mazzini seafront – Mazara del Vallo - Italy	Municipality of Mazara del Vallo (Sicily)	12/2016	Ongoing	Detailed Design, Works Supervision	1,266,987	18,100,000
Technical assistance for preparing grant applications and documentation award for regional development project infrastructure water and wastewater in Sibiu in the period 2016-2020 (MEDIAS) – Romania	APA TARNAVEI MARI SA	06/2016	Ongoing	Feasibility Study, Detailed Design, Tender Documents, Technical Assistance	1,700,000	106,848,916
Detailed design of the bypass of the 3-rod barrel, at the inlet of the flood protection basin "Anconetta" – Italy	Veneto Region	10/2020	12/2022	Detailed Design	178,000	10,700,000
Wastewater Collection System and Treatment Plant in Garvié – Benin	Agence Nationale de promotion des Patrimoines et de développement du Tourisme (ANPT) - Benin	10/2020	03/2022	Preliminary Design, Detailed Design, ESIA, Tender Documents	1,215,002	27,213,292
Wastewater Network Works of Baqaa Camp in Ain Al Basha Region – Jordan	Water Authority of Jordan	11/2019	11/2021	Works Supervision	753,796	8,980,000
Design consultancy services of primary urbanization works of sector S3 - Italy	Ravenna Port Authority	05/2021	10/2021	Detailed Design	151,753.29	19,999,546
Engineering Design Services for Water supply Treatment Plant and network for Phase 1 Konza Techno City - Kenya	KoTDA (Konza Technopolis Development Authority)	08/2018	07/2021	Concept/Preliminary Design, Detailed Design	1,177,740	41,000,000
Sewerage pressure main from Gorizia to Gradisca d'Isonzo (3rd Lot) - Italy	Irisacqua Srl	11/2019	06/2021	Detailed Design	228,288	7,263,655

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Construction of an underwater outfall of treated wastewater in the municipalities of Bisceglie, Corato, Molfetta, Ruvo and Terlizzi in Torre Calderino - Italy	Igeco Costruzioni S.p.A.	01/2015	02/2021	Detailed Design	225,990	11,773,005
Sewage and water purification systems of the Amalfi coast in the municipalities of Minori and Maiori - Italy	Province of Salerno	06/2018	12/2020	Feasibility Study, Detailed Design. Works Supervision	656,570	14,229,333
Consulting Services To Develop Water Supply and Sanitation Disaster Risk Preparedness Plan - Zambia	Lusaka Water and Sewage Company Ltd	12/2018	12/2019	, Risk Assessment Report, Disaster Risk Management Plan	176,020	n.a.
Basento-Bradano Water Scheme - Acerenza section Distribution - Banzi, Genzano, Palazzo S.F. and Irsinia - Italy	The Authority for the Development of Irrigation and Land Transformation in Apulia, Lucania and Irpinia (E.I.P.L.I.)	08/2013	09/2019	Works Supervision	1,800,000	73,000,000
Vacuum foul sewerage network of the port of Naples, from Calata Beverello to Calata del Popolo (1st stage)- Italy	Port Authority of Naples	02/2004	02/2018	Preliminary Desing, Detailed Design Works Supervision	587,288	5,533,733
Sewerage network and Wastewater Treatment Plant in Vicenza - Italy	Viacqua S.p.A.	09/2015	09/2017	Detailed Design	1,269,000	75,965,000
Upgrading and increasing of the capacity of the aqueduct in the municipality of Palù (Verona) - Italy	Acque Veronesi S.c.a.r.l.	03/2011	06/2016	Detailed Design, EIA, Works Supervision	98,680	1,255,055
Pre-investment studies for potable water, sanitation, and solid waste management of the rural area, including an aqueduct, for the communities located in the reservoir basin of the hydroelectric dam of Chixoy - Guatemala	Banco Interamericano de Desarrollo	08/2014	08/2015	Feasibility Studies, Preliminary Design	72,000	2,303,014
Optimization of sewerage network in the district of Valpantena (Province of Verona) - Italy	Acque Veronesi S.c.a.r.l. (Provincial water authority)	06/2010	08/2014	Feasibility Study; Preliminary Design, Detailed Design, EIA	308,046	12,066,726

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Works for restructuring the Gela-Aragona aqueduct – Sicily - Italy	Sicilia Acque	10/2007	03/2014	Works Supervision	4,261,475	58,987,342
Reconstruction of the sewerage network of the port of Naples from Calata Villa del Popolo to Calata Petroli (2nd stage) - Italy	Port Authority of Naples	02/2004	05/2013	Preliminary Design, Detailed Design	543,390	18,498,796
Stormwater drainage network in the town of Conversano (Bari) - Italy	Municipality of Conversano – local town authority	02/2008	04/2013	Detailed Design Works Supervision	205,847	1,509,171
Wastewater sewerage system in the Lake Garda basin. Collector of the Southern Lake: Brancolino - treatment plant of Peschiera - Italy	Azienda Gardesana Servizi	09/2012	12/2012	Preliminary Design	100,000	30,011,112
Concept Designs of Roads and Infrastructure-Phase 2: drainage works – Doha, Qatar	Urban Planning & Development Authority (UPDA)	04/2009	01/2012	Concept Design,	605,000	1,550,000,000 (overall project)
Drainage system for the external eastern bypass of Milan (T.E.E.M.) - Italy	Concessioni Autostrade Lombarde (Motorway Concessionaire of Lombardy)	07/2009	08/2011	Detailed Design, EIA	639,700	34,487,850
Industrial Interchange, Doha Expressway “D” Ring Road: drainage works – Doha, Qatar	Ministry of Municipal Affairs & Agriculture -PWA – Roads Affairs	08/2006	03/2011	Works Supervision	360,000	150,000,000 (overall project)
Design of revamping and restoration of the pumping system for emptying “medium” dry dock of the Arsenale di Venezia (Venice) – Venice, Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	03/2010	11/2010	Preliminary Design, Detailed Design	160,000	1,810,000
Foul sewerage network in the locality of Sorgà (Verona) - Italy	Acque Veronesi S.c.a.r.l. (Provincial water authority)	03/2010	11/2010	Feasibility Study , Preliminary Design, Detailed Design	52,500	2,814,490
Optimization of investments and management activities of the integrated water service in the Province of Verona - Italy	Acque Veronesi S.c.a.r.l. (Provincial water authority)	11/2009	07/2010	Optimization Studies	188,000	n.a.

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Milan-Bologna High Speed Railway line – Lot 1.4: yard drainage network and culverts – Province of Piacenza - Italy	Grandi Lavori Fincosit S.p.A.	01/2003	12/2009	Detailed Design	150,000	5,542,700
Storm water drainage network for Molini quay, in Marghera industrial port – Venice - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	06/2008	03/2009	Preliminary Design	195,000	1,150,000
Reclamation works in the domain area called the "Third Dyke": hydraulic drainage works – Venice - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	12/2000	12/2006	Preliminary Design, Detailed Design	137,500	12,745,700
Restructuring of the sewerage network of the municipality of Casamicciola, island of Ischia (Naples) – Italy	Sogesid S.p.A. (Rome)	05/2002	01/2005	Preliminary Design, Detailed Design	150,000	12,000,000
Al Udaid Air Base – Infrastructures – Qatar (sewerage and drainage)	Rizzani De Eccher (Main Contractor)	11/2003	12/2004	Master Plan Detailed Design of Lot 1	972,800	60,830,000
Restructuring of Gela-Aragona acqueduct – Sicily – Italy	Special Commissar for the Water Emergency (Sicily)	07/2002	03/2003	Preliminary Design, Detailed Design	2,978,000	17,378,500
Sewerage system for Sottomarina – Venice Lagoon – Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	10/1988	12/2002	Concept Design, Preliminary Design, Detailed Design	85,700	2,685,600
Sewerage system for Pellestrina – Venice Lagoon – Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	06/1987	12/2002	Concept Design, Preliminary Design, Detailed Design	262,000	6,663,000
Umm Salal Phase I in Doha - Qatar	Ministry of Municipal Affairs & Agriculture	10/2001	05/2002	Preliminary Design, Detailed Design, Tender and contract documents	830,000	214,550,000
Shore protection works and storm water drainage system in Chioggia <i>insula</i> – Venice – Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	12/1998	12/2001	Detailed Design	147,600	6,346,000

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
RIVER REGULATION AND WATER RESOURCE MANAGEMENT						
Burana water pump - Cavaliera Plant - Italy	Burana Reclamation Consortium	10/2023	Ongoing	Detailed Design	702,000	n.a.
Feasibility study and detailed design of a new dam in Casalbuono (Campania)- Italy	Vallo di Diano Reclamation Consortium	05/2023	Ongoing	Feasibility Study, Detailed Design	1,388,395	185.000.000
Reservoir on the Vanoi stream and flooding protection for the Brenta reclamation area - Italy	Brenta Consortium	04/2023	Ongoing	Feasibility Study, Detailed Design	912,600	170,000,000
Work supervision of expansion of the Montebello Vicentino flood control basin for serving river Chiampo - Italy	Veneto region	04/2023	Ongoing	Works Supervision	838,179	35,076,684
Feasibility Study for the construction of Mini-Hydropower Plants and upgrading the Multisectoral Water System (SIMR) of North Sardinia - Italy	OIS – Opere Infrastrutture Sardegna	01/2023	Ongoing	Feasibility Study	200,976	6,000,000
Maintenance works of the Pertusillo dam - Italy	Commissioner for Dams by the Southern Apennine Basin Authority.	07/2022	Ongoing	Detailed Design	138,519	5,000,000
Hydraulic restoration of the Biferno River downstream of the Ponte Liscione dam - Italy	Campobasso Province	06/2022	Ongoing	Detailed Design	1,000,928	200,000,000
Design of the hydraulic risk mitigation interventions in Olbia - Italy	Municipality of Olbia	05/2022	Ongoing	Feasibility Study, EIA	1,655,799	151,000,000
New Barrier Against Salt-Water Intrusion at the Estuary of Adige River - Italy	Po Delta Reclamation Consortium	03/2022	Ongoing	Preliminary Design, Detailed Design	370,000	32,400,000
Rehabilitation of the Ripaspaccata Dam in the countryside of Montaquila - Italy	Molise Region	12/2021	Ongoing	Feasibility Study, Final Design	345,577	16,823,215
Final Design of Fossatella Dam - Italy	Molise Region	09/2021	Ongoing	Final Design	980,347	42,701,871

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Assessment of the seismic safety of the dam and existing buildings and Design of the Abutement of the Disueri Dam - Italy	Water and Waste Department, Sicily Region	05/2021	Ongoing	Detailed Design	536,018	88,533,450
Detailed and Final Design of the Restoration of the Po between the Secchia River Mouth and Ostiglia (Mantua) – Cirene Island - Italy	Cave di Quingentole Srl, Granulati Donnini Spa	03/2021	Ongoing	Final Desing, Detailed Design, EIA	530.000	27,000,000
Rehabilitation of Poma Dam – Italy	Water and Waste Department of Sicily	03/2021	Ongoing	Detailed Design	210,010	25,784,000
Rehabilitation of the San Filippo Torrent (Messina) - Italy	Commissioner of Hydrogeological Instability of Sicily	02/2021	Ongoing	Detailed Design	268.867,62	12.784.335
Works supervision and coordination of safety in execution phase for the use of irrigation water from the Adige River through the Leb channel to replace the derivations from the Fratta river in the provinces of Verona and Padua - Italy	Consorzio di Bonifica Adige Euganeo	06/2022	Ongoing	Works Supervision	708,010	25,215,892
Rehabilitation of Sciaгуana Dam (Sicily) - Italy	Sicily Region - Water and Waste Department	10/2020	Ongoing	Detailed Design	247,005	29,000,000
Design of the river defence works of Illasi River (VR) – Italy	Commissioner Tempesta VAIA Infrastrutture Venete Srl	10/2020	Ongoing	Preliminary Design, Detailed Design	159,000	20.636.991
Rehabilitation of Villarosa Dam – Italy	Water and Waste Department of Sicily	08/2020	Ongoing	Detailed Design	185,453	13,274,000
Rehabilitation of Papardo Torrent (Messina) - Italy	Commissioner of Hydrogeological Instability of Sicily	03/2020	Ongoing	Detailed Design	315,000	18,000,000
Stormwater detention basin "Pra' Dei Gai", Italy	Regione Veneto – Flood Protection Department	03/2020	Ongoing	Detailed Design, Works Supervision	900,125	22.604.168
Agno Guà River Storm Water detention basin in Trissino - Italy	Veneto Region	01/2020	Ongoing	Works Supervision	380,985	16,115,343
Upgrading of Persano Dam – Italy	Consorzio di Bonifica Destra Sele	01/2020	Ongoing	Preliminary Design, Detailed Design	388,208	13,446,804

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
River regulation works of Vernazza Stream (Chiappeto) in Genoa - Italy	Municipality of Genoa	09/2019	Ongoing	Detailed Design, Works Supervision	522,752	12,486,000
Vernazza Torrent (Chiappeto) In Genoa - Italy	Municipality of Genoa	06/2018	Ongoing	Detailed Design, Works Supervision	1,274,282	12,883,916
Flood defence measures for the Rio Maltempo in Genoa - Italy	Municipality of Genoa	11/2021	02/2024	Feasibility Study, Detailed Design	490,432	20,718,808
Rehabilitation of Gibbesi Dam - Italy	Water and Waste Department of Sicily	11/2020	11/2023	Feasibility Study, Detailed Design.	306,540	30,000,000
Rehabilitaion/demolition of the High and Low Bunnari Dams (Sassari) - Italy	Municipality of Sassari	06/2022	06/2023	Preliminary Design	281.743	4.680.000
Upgrading of Persano Dam – Italy	Consorzio di Bonifica Destra Sele	06/2018	05/2023	Preliminary Design, Detailed Design	248,749	4,498,540
Consolidation works and upgrade of the instrumentation system for Govossai Dam - Italy	Abbanoa S.p.A.	04/2022	02/2023	Preliminary Design	357,507	10,179,226
Design of the Monte Lerno Dam - Italy	Ente Acque della Sardegna (ENAS)	10/2021	01/2023	Detailed Design	495,043	7,000,000
Flood control works on the Bozzente River - Italy	Infrastrutture Lombarde SpA (ILSPA)	09/2016	09/2022	Concept Design, Preliminary Design, EIA	155,000	8,860,236
Flood diversion channel from Gorzone river to Adige river - Italy	Consorzio di Bonifica Adige Euganeo	10/2019	04/2022	Detailed Design	272,698	25,652,012
Assessment of the seismic safety of the dam and existing buildings and Maintenance Works Design of the Scanzano Dam - Italy	Water and Waste Department, Sicily Region	02/2021	03/2022	Detailed Design	111,444	4,000,000
Design of the rehabilitation of Cumbidanovu Dam (Orgosolo) - Italy	Consortium of Central Sardinia	07/2020	01/2022	Final Design	1,155,338	52,665,358
Preliminary design of the upgrade of seven hydroelectric plants in the Trentino Alto Adige Region, Italy	Hydro Dolomiti Energia S.p.A.	02/2019	12/2021	Preliminary Design	692,000	200,000,000

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Rehabilitation of Zaffarana Dam – Italy	Water and Waste Department of Sicily	12/2020	06/2021	Management Plan, Detailed Design	95,327	1,377,000
Detailed Design and Construction Supervision of Arcè Hydroelectric Plant – Italy	Iniziative Veronesi Srl	10/2017	05/2019	Detailed Design; Works Supervision	1,280,000	17,763,000
Detailed Design and Construction Supervision of Settimo Hydroelectric Plant – Italy	Iniziative Veronesi Srl	04/2017	05/2019	Detailed Design; Works Supervision	1,280,000	20,807,000
Flood Control Works on the Agno-Gua' River – Veneto Region	Veneto Region Authority	06/2018	11/2018	Detailed Design	719,375	16,115,343
Detailed design of the hydraulic by-pass spillway tunnel of Noce stream and of the Bisagno river hydraulic spillway tunnel - Italy	Municipality of Genoa	10/2016	07/2018	Detailed Design	854,776	17,429,244
Design of an alternative option for the mitigation measures for flood and hydrogeological risk of the city of Olbia, Italy	Municipality of Olbia	12/2017	02/2018	Preliminary Design, EIA	145,365	115,881,396
Tadjoura Port Flood Protection Urgent Works Design and Wadi Walwallè and Tributaries Hydraulic Intervention Model to Enhance The Port Area Resilience - Djibouti	Djibouti Port S.A	02/2017	12/2017	Detailed Design	97,170	2,060,552
Consulting Services supporting the Project Management Office (PMO) established under Nangharar Valley Development Authority (NVDA) and Northern Basin Development (NBD) – Afghanistan	ADB – Asian Development bank; Ministry of Agriculture, Irrigation and Livestock – Nangharar Valley Development Authority (NVDA) and Ministry of Energy and Water – Northern Basins Development (NBD)	12/2011	06/2017	Detailed Design, Works Supervision	4,685,893	30,979,939

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Due Diligence and Feasibility Study of Pequin Hydroelectric Plant (5.5 MW) along Pequin-Kavaje canal (Tirana) - Albania	AGSM Verona S.p.A.	11/2015	12/2016	Feasibility Study	39,520	15,000,000
Flood Prevention and Remedation Measures Design for the Tagliamento River	Veneto Regional Authority	04/2015	06/2016	Preliminary Design	360,000	154,000,000
Padua – Venice Waterway – Navigable Channel and Spillway of the Bacchiglione Brenta System	Veneto Regional Authority	04/2015	06/2016	Preliminary Design	700,000	330,000,000
Valbona hydroelectric power plant reactivation - Italy	AGSM of Verona – Veneto Region	09/2015	12/2015	Preliminary Design	146,000	69,100,000
Flood control works on the Olona river – Lombardy – Italy	AIPO (Agenzia Interregionale per il fiume Po)	12/2004	08/2014	Concept Design, Preliminary Design, Detailed Design; Works Supervision	590,000	10,883,200
San Martino drainage canal (lot n. 2) in the municipality of Apricena (Foggia) – Italy	Moteroc Srl	05/2014	07/2014	Final Design	116,000	2,385,859
Due diligence and feasibility study of the new hydroelectric plant Janiski Otok in Republika Srpska	AGSM Verona S.p.A.	03/2014	06/2014	Due Diligence, Feasibility Study	45,000	17,700,000
Flood Control Of The Bisagno River - Genova-Italy	Municipality of Genoa	08/2013	04/2014	Detailed Design, EIA	933,777	39,381,706
Due diligence for the Lukac and Dubrava hydroelectric plants – Bosnia & Herzegovina	AGSM Verona S.p.A.	10/2013	02/2014	Due Diligence	60,840	n.a.
Flood Control Works On The Timonchio River – Veneto Region - Italy	Veneto Regional Authority	11/2010	02/2012	Concept Design, Preliminary Design, Detailed Design Works Supervision	1,115,700	24,882,800
Port of Tadjoura - Flood Protection Works – Republic of Djibouti	Ministry of Equipment and Transport - Republic of Djibouti	11/2010	04/2011	Preliminary Design, Detailed Design	50,000	3,000,000
Misicuni II Project – Dam and ancillary works on the Río Misicuni near Cochabamba: technical assistance - Bolivia	Consorcio Hidroeléctrico Misicuni	09/2009	03/2010	Geological, geotechnical, hydraulic and hydrogeological studies	750,000	58,000,000

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Flood protection works and infrastructures for the urban area of S. Erasmo (Venice) - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	12/1996	12/2009	Preliminary Design, Detailed Design	2,145,300	130,000,000
Flood control works on the Bisagno river and on the Fereggiano, Rovare e Noce streams - Italy	Province of Genoa	03/2003	07/2008	Detailed Design, EIA	2,913,000	153,427,600
New Valtrompia Motorway Link: Hydraulic Works (Dredging, Training, Banks Shaping and Flood Control) on the Mella and Grande Rivers, near Brescia	Brescia Padova Motorways Company	06/2002	10/2007	Concept Design, Preliminary Design, Detailed Design	99,300	6,622,200
Works to protect and re-define the mouth of the River Adige - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	05/1996	04/2005	Detailed Design	165,000	7,593,900
Arsursuyu Valley - Section 2D Gumusova – Gerede of the Anatolian Motorway Istanbul-Ankara - Turkey	Astaldi-Bayindir AS J.V.	12/2000	12/2002	Preliminary Design, Detailed Design	90,000	80,000,000
Extension of the catchment basin of Lake Trasimeno – Italy	Tiber River Basin Authority	04/1998	06/2000	Feasibility Study, Preliminary Design, Detailed Design, EIA	755,240	43,898,800
New ferry terminal at Tremestieri (Messina): hydraulic works - Sicily – Italy	Amadeus S.p.A.	11/1998	04/2000	Detailed Design	130,000	4,637,300
Environmental protection of the River Sarca - Lake Garda - River Mincio - Mantuan lakes system - Italy	Po River Basin Authority	02/1996	02/1997	Concept Design, EIA	126,000	n.a.
Regimentation of the Alpone river and its affluents - Provinces of Verona and Vicenza - Italy	Ministry of Public Works - Water Board - Venice	09/1994	07/1995	Studies for the hydraulic regulation	48,500	51,646,000
Hydroelectric power plant of Pont Ventoux in Val Susa – Italy	Temporary Association of Spie Batignolles, Grandi Lavori Fincosit, Vianini, Condotte & Partners for AEM (municipal energy company) of Turin	06/1992	07/1993	Detailed Design	1,187,800	61,974,800
Protection works against landslides in Spriana - Sondrio, Italy	Ministry of Public Works	07/1987	06/1988	Preliminary Design	144,600	3,615,200

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Master plans for the Livenza, Lemene and Tagliamento River basins – Italy	Hydrographic Office of the Venice Water Board - Ministry of Public Works	01/1984	12/1987	Studies for hydrology, hydrogeology, hydraulics and water quality	456,186	n.a.
Irrigation schemes for agricultural development at Manatali (Mali) and Boghé (Mauritania)	O.M.V.S. - Organisation pour la Mise en Valeur du fleuve Sénégal with Ministry of Agriculture (Mali) and National Development Co. (Mauritania)	01/1982	12/1986	Feasibility Study, Concept Design, Preliminary Design, Detailed Design Tender documents	413,200	n.a.
Study of the possibilities of storing and using surface run-off water for agriculture - Senegal	Ministry of Hydraulics - Senegal (fin. Italian govt.)	01/1983	12/1985	Feasibility Study; Preliminary Design	299,600	10,329,100
Dam on the Gibbesi river in Sicily - Italy	Mazzi S.p.A. for the Sicilian Mines Organization	01/1971	12/1983	Preliminary Design, Detailed Design	433,800	30,987,400
HYDRAULIC AND HYDRODYNAMIC STUDIES						
Consulting and design activities related to waterways in the regional hydrographic network (Padredduri - Tilibbas - minor streams) - Italy	CIPNES - Industrial Consortium of Gallura	11/2022	Ongoing	Feasibility Study, Final Design, Detailed Design	106,500	n.a.
Rehabilitation of Serra del Corvo Dam - Italy	District Basin Authority of the Southern Apennines	07/2021	Ongoing	Feasibility Study	262,116	4,300,000
Consulting services for the preparation of the general plan for the hydrological protection of the territory of Olbia (Sardinia) - Italy	Municipality of Olbia	09/2020	Ongoing	Master Plan	339,783	n.a.
Hydrological and hydraulic analysis of the watercourses belonging to the water reticulum and of the relative civil works of art of bypassing, along the railway network of Ferrovienord - Iseo branch - 30 civil works - lot 3 - Italy	Ferrovienord S.p.A.	04/2021	12/2023	Hydrological and hydraulic analysis	115,714.20	n.a.

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Interventions to mitigate the instability of the hill where the cathedral of Agrigento is located – Italy	Sicily Region	05/2019	02/2020	Detailed Design	424,332	19.224.077
Program for recovering the reservoirs capacity of dams in: Ponte Pià, Caseres, Pian Palù, Ala e Mori - Italy	Hydrodolomiti Energia – Trento	03/2018	10/2019	Analysis of the sediment accumulation and study of their removal	28,750	1,864,976
Groundwater modelling of the “Fusina” industrial area in Venice harbour - Italy	ALCOA TRANSORMAZIO NI S.r.l.	09/2013	09/2014	Groundwater Modelling	79,000	n.a.
Updating of the hydrogeological study of the impact of a containment cut-off wall in the Venice Industrial Harbour of Marghera, Venice – Italy	Venezia Nuova Consortium for MoPW - Water Board - Venice	04/2008	06/2012	Groundwater Modelling	1,130,000	n.a.
Dewatering and control system for the gate location basin on the seaside at Malamocco Inlet, Venice - Italy	Venezia Nuova Consortium for MoPW - Water Board - Venice	02/2011	09/2011	Detailed Design	396,000	n.a.
Master Plan for the morphological and environmental rehabilitation of the Venice lagoon - Italy	Venezia Nuova Consortium for MoPW - Water Board - Venice	01/2003	12/2007	Feasibility Study, EIA, Detailed Design	1,210,000	n.a.
ISAP - Research on the sediments and waters in channels of Porto Marghera and the facing areas of Venice lagoon - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	11/2006	06/2007	Water and Sediment Quality Study	100,000	n.a.
Modelling the hydro-geological impact of a containment cut-off wall in the Venice industrial harbour of Porto Marghera – Italy	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice	12/2003	04/2007	Groundwater Modelling	1,053,130	n.a.
Design and implementation of the pumping system to accelerate the consolidation and settlement of an embankment at Malamocco inlet, Venice – Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	01/2004	12/2005	Design of the dewatering system	500,000	n.a.

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Dry basin at Chioggia inlet for the prefabrication of giant concrete structures to be floated to location for the construction of the flood barriers, Venice - Italy	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice	01/2004	12/2005	Design of the dewatering system	1,500,000	66,500,000
Hydrodynamic models for the study of sea tides in the Venice lagoon and further applications - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	09/2001	09/2004	Hydrodynamic modelling	628,500	1,859,200
Dry basin at Lido inlet for the prefabrication of giant concrete structures to be floated to location for the construction of the flood barriers, Venice - Italy	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice	01/2002	12/2003	Design of dewatering system	4,700,000	58,200,000
Study of the water resources of the Brenta - Bacchiglione rivers for the river basin master plan - Italy	Isonzo, Tagliamento, Livenza, Piave, Brenta and Bacchiglione River Basin Authority	03/1996	09/2000	Water supply study, Concept Desing	72,800	n.a.
Karavasta Lagoon Wetland Management Project - Albania	European Commission - Phare programme	03/1995	12/1996	Technical Assistance	340,000	n.a.
Master Plan for the Piave River Basin: study of the Water Resources: 1st Phase - Italy	River Basin Authority for the Isonzo, Tagliamento, Livenza, Piave and Brenta-Bacchiglione rivers	02/1996	11/1996	Modelling	80,600	n.a.
Study of the water resources of the Piave river for river basin master plan - Italy	Isonzo, Tagliamento, Livenza, Piave, Brenta and Bacchiglione River Basin Authority	02/1996	11/1996	Water Supply Study, Concept Design	80,600	n.a.
Hydrodynamic study of the lagoon of Mar Piccolo for the establishment of a new fish market – Taranto - Italy	Edilfer S.p.A.	03/1990	07/1990	Mathematical Modelling	31,000	n.a.

Appendix A – Company’s Experience

Water Supply and Sewerage

UPGRADING OF THE 'VERDE' AQUEDUCT SYSTEM LOT "FARA SAN MARTINO – CASOLI"

Location:	Province of Chieti (CH), Abruzzo Region, Italy
Client:	SASI S.p.A.
Services:	Final and Detailed Design
Period:	03/2023 - Ongoing
Construction cost:	Euro 6,800,166

Project Description:



The works of the I° Stage "Fara San Martino – Casoli", together with the II° Functional Stage "Casoli – Scerni" and the III° Functional Stage "Potabilizer and interconnections" are part of the 'Verde' aqueduct system upgrading works financed by the PNRR. The new DN500 header is part of an existing hydraulic system consisting of two pipelines (DN750mm and DN1000mm diameter) transporting water from the Verde stream to the Casoli divider, from where, a complementary pipeline will deliver water to the district distribution networks. The new pipeline completes the existing system, upgrading its hydraulic potential and improving the safety/continuity of water supply.

In detail, the works envisaged in this functional section consist in the construction of a DN500mm pipeline of approx. 8448 m in length. The work consists in laying of an underground pipeline and the construction of the ancillary works necessary to system (manholes and connection chambers, regulation and control devices). The aqueduct route runs through the territories of the municipalities of Fara San Martino and Casoli and marginally Civitella Messer Raimondo, all in the province of Chieti. The laying site of the pipeline is located for the most part on countryside and for a minor part on the road.

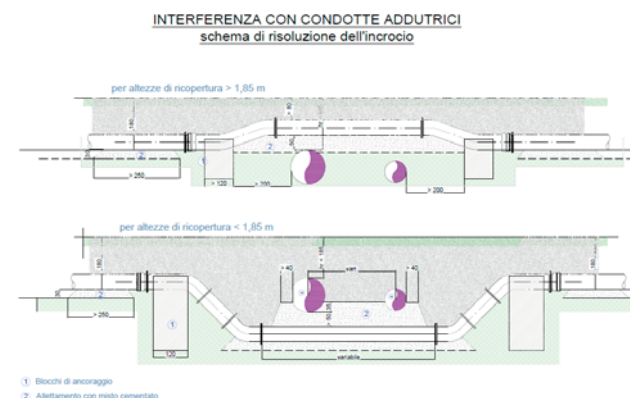
The district served by the existing aqueduct system is made of 42 municipalities with an estimated population of 220,000 inhabitants. At the moment, the stream that feeds the existing 'Verde' aqueduct has enough capacity in terms of nominal flow rate with good supply stability, even generating an excess in many periods of the year which is currently lost. The assessment of the current demand was carried out by applying the calculation of the average and maximum flow rate as a function of water supply and resident and floating population. From the evaluations carried out, the need as design flow rate of 170 l/s to the new DN500 header has been considered: it consists in two contributions (1) 70 l/s assigned to the DN300 with the direct connection of the recovery pipeline to the source plus (2) a flow rate of up to 100 l/s derived from the existing DN750 pipeline at the interconnection junction. The DN300 recovery pipeline will make it possible to collect the contribution that would otherwise be lost. At the design stage, the system therefore has a total transport capacity of 1270 l/s, divided into 1100 l/s on the existing lines and 170 l/s on the new pipeline.

The intake pipeline is 8'448 m long and consists of three characteristic sections:

- a first section, called "recovery pipeline", made of a spheroidal cast-iron pipe with a diameter of DN300 mm and a length of approximately 174.5 m;
- a central section of approximately 7'996.0 m (called the "new DN500 intake pipe") made of spheroidal cast-iron pipe with a diameter of DN500 mm;
- a final section of approximately 278.0 m (called "restitution pipeline"), made of spheroidal cast-iron pipe DN500 mm.

The entire pipeline will be buried and will be laid in a trench at a variable average depth.

In order to optimise the regularisation of the outflow and in order to guarantee the correct delivery of the service for each expected usage scenario, the following components were inserted (i) a flow regulator at node a3 on the connection with the DN750 pipeline that fixes the maximum derivable flow rate at 100 l/s, (ii) three-function relief valves on all cusp pins, (iii) relief valves at the minimum points, (iv) water hammer anticipation and pressure relief valves to prevent the occurrence of varied motion phenomena, (v) an overspeed valve capable of interrupting the flow in the pipeline



1) Blocchi di ancoraggio
2) Abbettamento con malta cementata

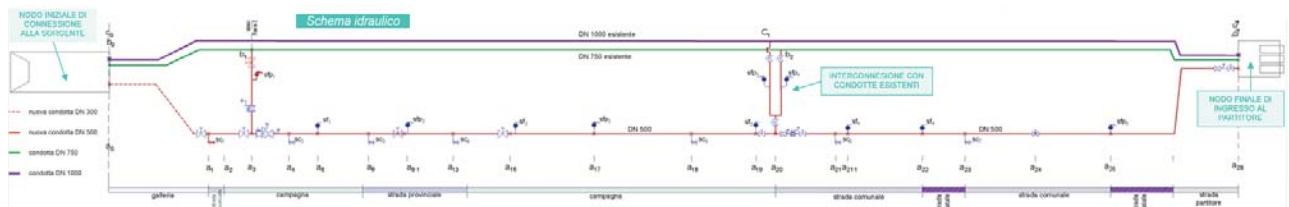
in the event of abnormally high velocities caused by ruptures or large leaks in the pipeline (near node a20), (vi) three flow detectors capable of monitoring the flow value together with three pressure detectors, and (vii) shut-off valves for interrupting the hydraulic flow.

Within the project, particular attention was paid to the management and security aspect of water supply by analysing in detail the demand of the area to be served and verifying the correct functioning of the multiple scenarios envisaged.

To study the behaviour of the new DN500 pipeline, six hydraulic modelling runs were carried out. The processing of the simulations was carried out with the OpenFlows Hammer software. OpenFlows HAMMER enables transient analysis and modelling in water or sewer systems to identify critical points and determine surge control strategies. OpenFlows HAMMER's computationally rigorous engine and user-friendly interface enable the efficient

identification, management and mitigation of risks associated with transients.

The results show that for each predicted scenario the pressure values at the nodes are always compatible with the characteristics of the pipes used and never overstress the pipeline ($p_{max} = 19.1$ bar). The same flow velocity at the nodes never exceeds the values recommended for this type of system ($v_{max} = 0.99$ m/s). Furthermore, observation of the characteristic results of the various sections in the various simulations reveal a residual capacity at the pipeline which, under the same safety conditions, would be able to withstand a flow rate increase of 10%, reaching flow rate values of 195 l/s with a residual load at delivery of 0.6 bar.

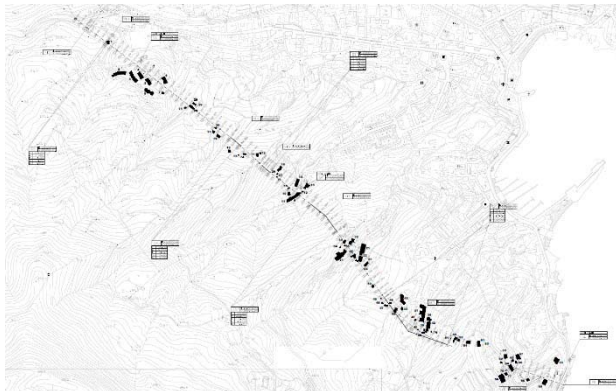


FLOOD CONTROL TUNNEL FOR SAN SIRO CREEK E MAGISTRATO CREEK IN SANTA MARGHERITA LIGURE (GENOA)

Location:	Liguria, Italy
Client:	Commissario di Governo per il contrasto del dissesto idrogeologico nella Regione Liguria – Comune di Santa Margherita Ligure
Services:	Detailed Design
Period:	05/2023 - Ongoing
Construction cost:	Euro 37,000,000

Project Description:

The purpose of the intervention is to remove the causes of the frequent overflows of the San Siro and Magistrato streams, through the construction of a hydraulic tunnel 2.4 km long in the municipality of Santa Margherita, which intercepts, by means of two separate intakes, the San Siro stream and the Magistrato stream and flows into the sea outside the inhabited area (near the water treatment plant).



The implementation of the spillway tunnel envisages the creation of a temporary fill at sea, at the discharge point, during the construction phase, and a coastal nourishment near the Santa Margherita harbour.

The services include executive design and site safety design.

Works mainly include hydraulic and geotechnical works, such as the main tunnel, the two water intakes a weir dam, and reinforced soil slopes to stabilize the slope in proximity of the tunnel entrance.

Tunnel characteristics:

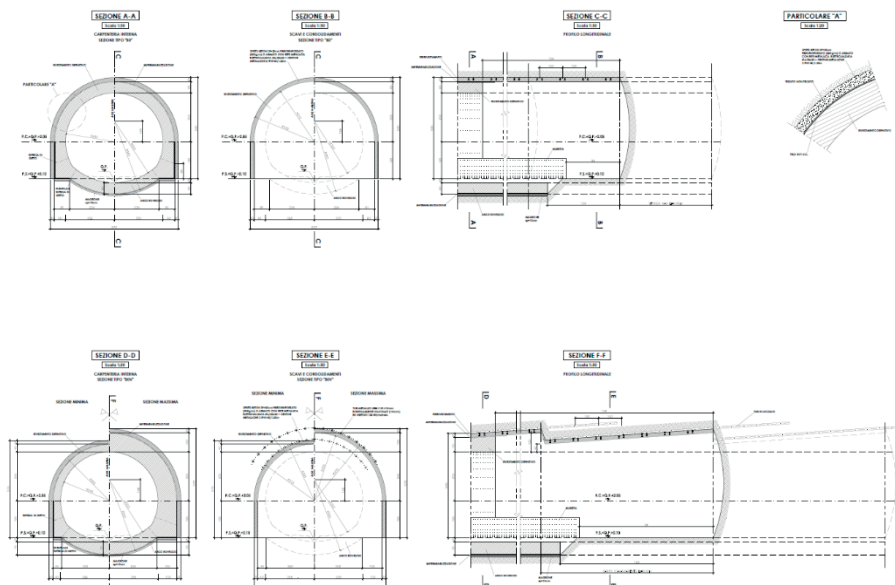
Length: 2.4 km

Hight: 6.1 m (4.5 internal)

Width: 6.7 m (4.7 internal)

The diverted flow portion will be conveyed towards a new outlet to the sea at the rocky promontory south-west of Santa Margherita Ligure, involving interventions of considerable importance both for the structural aspects and for the urban and environmental implications. In fact, although the tunnel solution is characterised by the absence of territorial constraints throughout its development, and this is the essential aspect that led to its adoption, there are nevertheless relevant elements urban and landscape-environmental elements relating to the intake works on the two rivers and to the outlet to the sea, taking into account the site's high environmental and cultural value.

The project was developed in compliance with the construction and public procurement regulations in force in Italy.



WEST ACIREALE SEWER NETWORK

Location:	Catania, Sicily, Italy
Client:	Sole Special Sewage Commissioner
Services:	Final Design, Detailed Design and Construction Supervision
Period:	09/2022 - ongoing
Construction cost:	€ 59.900.000

Project Description:

The extension of the sewerage system in the Central Western Lot (Acireale, Santa Venerina, Zafferana Etnea, Aci Bonaccorsi, Aci S. Antonio, Trecasta-gni, Valverde, Viagrande, Aci Catena, S. Giovanni La Punta, S. Gregorio di Catania) is part of the general work planned by the Extraordinary Commissioner for the urban agglomerations, divided into a total of 3 Lots, which will affect the Acireale (San Girolamo) wastewater treatment plant.

The project includes various works that can be summarised as follows:

- construction of the gravity sewer system (163 km, serving 63.000 Population Equivalent), to be laid using traditional excavations.
- construction of pressure sewers
- construction of 4.465 manholes
- construction of 4 pumping stations
- construction of 2 pipe jackings under the A18 highway

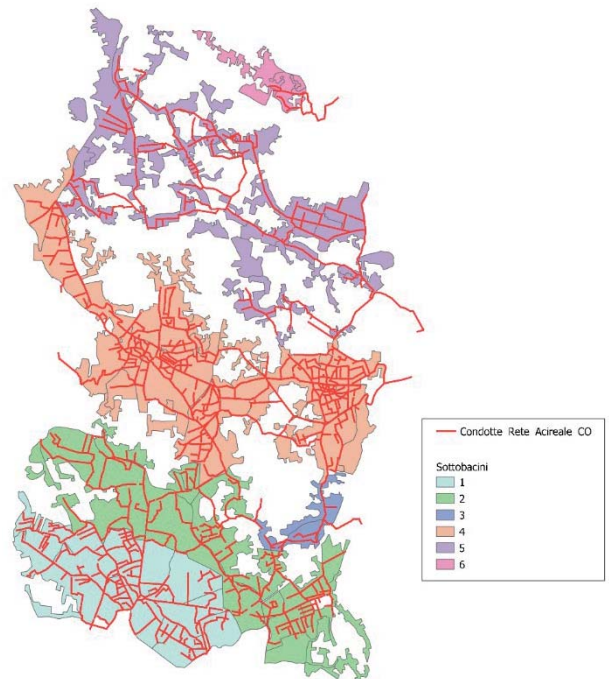
Several preparatory design activities have been developed, such as:

- topographical surveys (traditional systems, GPS, Drone)
- survey and video inspection of the existing sewage system
- geognostic and soil quality surveys
- survey of sub-services by means of georadar system.

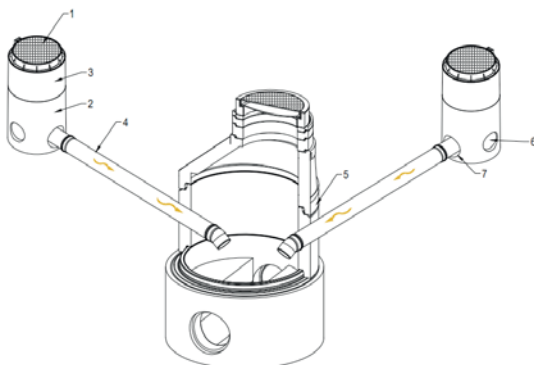
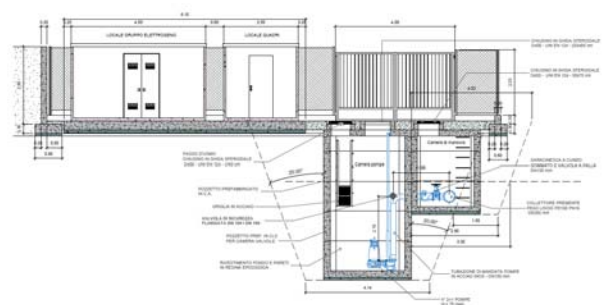
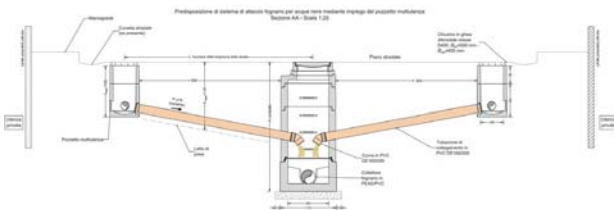
The flow rates for the design sewerage system were defined based on the resident population, spatially distributed street by street, and increased by appropriate coefficients to consider the fluctuating population and industrial loads. Using GIS systems, a specific flow rate was assigned to each project section, resulting in an extremely precise estimate of hydraulic loads.

Specific software for the hydraulic modelling (InfoWorks ICM) and BIM (Revit, Civi 3D) have been used.

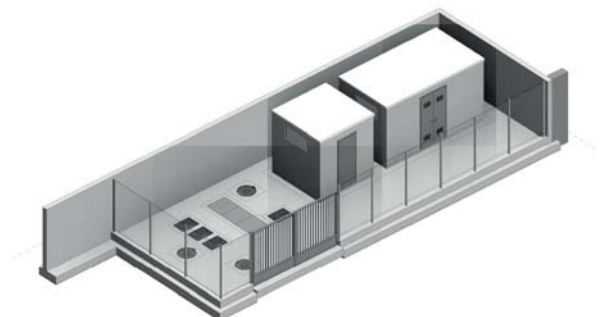
The legal reference of the project is the Italian Procurement Code.



Project Sewage scheme



Users and inspection manholes – Connection details



Main Pumping Station

UPGRADING OF THE SEWERAGE SYSTEM IN THE MUNICIPALITIES OF CARINI, ISOLA DELLE FEMMINE, TORRETTA E CAPACI

Location:	Palermo – Sicily, Italy
Client:	AMAP S.p.A.
Services:	Master Plan, Feasibility Study
Period:	03/2022 – 12/2024
Construction cost:	€ 70,000,000

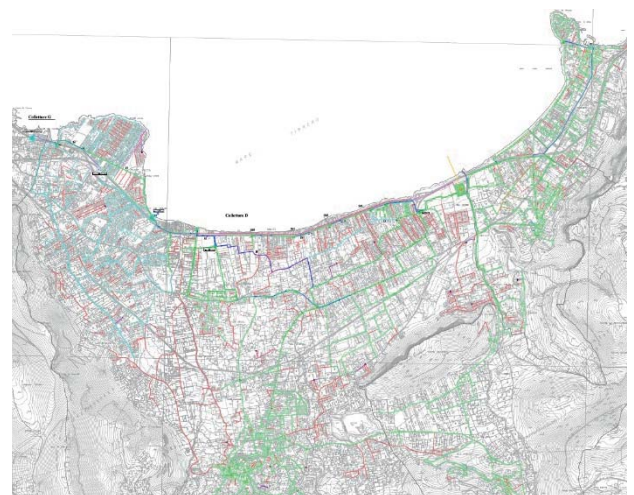
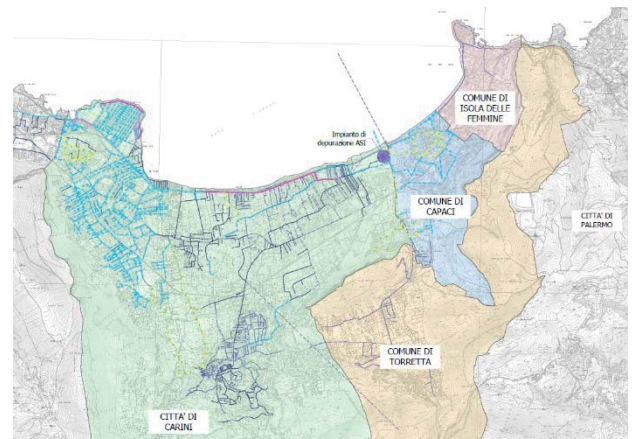
Project Description:

The project concerns the adaptation and upgrading of the sewerage network in the municipalities of Carini, Isola delle Femmine, Torretta and Capaci, using gravity and pressure sewers, lifting stations and no-dig systems.

In total, about 105 km of gravity and pressure sewers are planned, about 1 km of pipelines using trenchless technologies, and the adaptation or new construction of about 17 lifting stations with related spillways.

As far as piping is concerned, most interventions are aimed at upgrading the existing sewerage system, covering those areas that currently have no sewerage system, while a small part is for the adaptation/replacement of sewerage sections that are experiencing problems in their current state.

For lifting stations, on the other hand, the plan is to refurbish all the existing lifting stations and build small lifting stations for those sewer sections that are more depressed than the existing pipelines.



FEASIBILITY STUDY OF THE RESTORATION WORKS OF THE CANAL-BRIDGES OF THE ADDUCTOR CALLED "MAIN CHANNEL" OF SELE ACQUEDUCT

Location:	Basilicata, Italy
Client:	Acquedotti Pugliesi S.p.A.
Services:	Feasibility Study
Period:	10/2021 - Ongoing
Construction cost:	€ 17,000,000

Project Description:

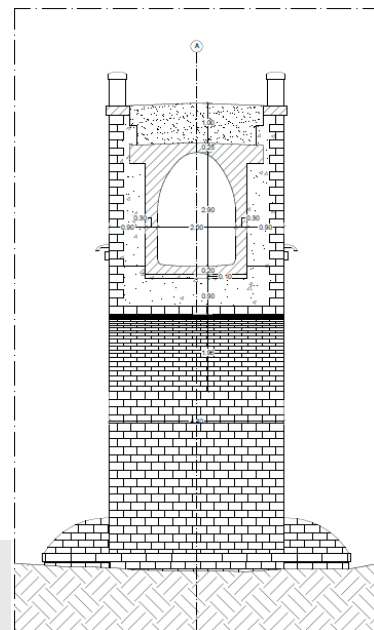
The project focus is the improvement of the hydraulic and structural condition of three canal bridges in operation. Two of the bridges, built around 1910, are on arches (400 and 180 meters) and one is on beams (150 meters), and they transport around 300 liters of water per second.

The project involves the plan and execution of investigations (geotechnical and structural) and surveys, the production of the DOCFAP (evaluations of the possible design alternatives) and the preliminary design. The seismic analysis and design shall be done in accordance with UNI EN 1998 and the technical standards for construction (NTC 2018), with reference to historical buildings with high artistic value.

The team defined structural and geotechnical investigation plans for each bridge. Then a simultaneous specific campaign of survey and visual inspection led to the production of detailed drawings and reports, including a detailed report on damages for each bridge that describes and locates each defect detected outside and inside of the bridges.

The following design phases has required a precise analysis of the surveys, the investigations, and the inspection results, which has led to the formulation and evaluation of possible design alternatives by cost/benefit comparison.

Once selected the optimal solution, the team has provided the design of the works that will stop the leakage and the structural improvement necessary to withstand the seismic actions according to the latest codes and standards.



DESIGN OF TWO SUBMARINE DISCHARGE PIPELINES IN RIMINI

Location:	Rimini, Italy
Client:	Heratech s.r.l.
Services:	Preliminary and Detailed Design, EIA
Period:	06/2021 - 09/2021 (Preliminary Design) Ongoing (Final Design 06/2022)
Construction cost:	€ 21,000,000

Project Description:

The project is about the preliminary and final design of the three submarine pipelines for the discharge at sea of the wastewater of a part of Rimini city. These pipelines represent one of the various interventions on the sewerage network of Rimini aiming at solving the problems of an old and inadequate system.

Specifically, the intervention concerns the realization of:

- n. 2 outfall conduits serving the water collection tanks called Colonnella 1 and Colonnella 2, which are side by side and parallel.
- 1 sea discharge pipeline serving the Rodella basin.

The first part of the pipeline crosses the beach, the remaining part is buried on the sea bottom. The two sites, Rodella and Colonnella, are about 2 km apart.

The southern area of Rimini, where the above-mentioned works will be implemented, is equipped with a mixed sewage system where the urban wastewater and the rainwater are collected.

The adopted solution consists in coated steel pipelines with a nominal diameter (DN) of 2000 mm (external diameter = 2032 mm, thickness = 16 mm) which have, each, a terminal discharge system consisting of inclined nozzles for the diffusion of the collected flows into the sea.

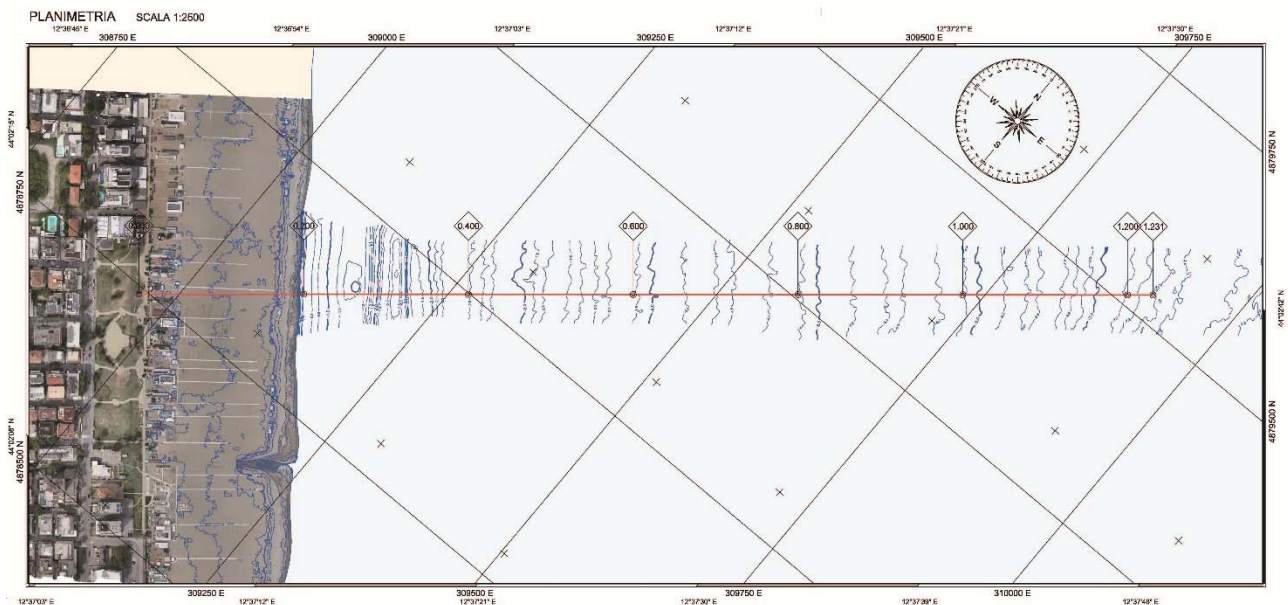
The length of each of the three pipelines in the part on land and on the beach is about 197m. The sea stretches have an extension of about 1151m for the two Colonnella pipelines and a length of 1034m for the Rodella pipeline.

In order not to incur in possible interferences between the discharges for the two parallel conduits of Colonnella, an angular deviation of 30° at about 1076m from the shoreline has been studied in order the conduits to diverge and distance the terminal diffusers of each conduit from each other.

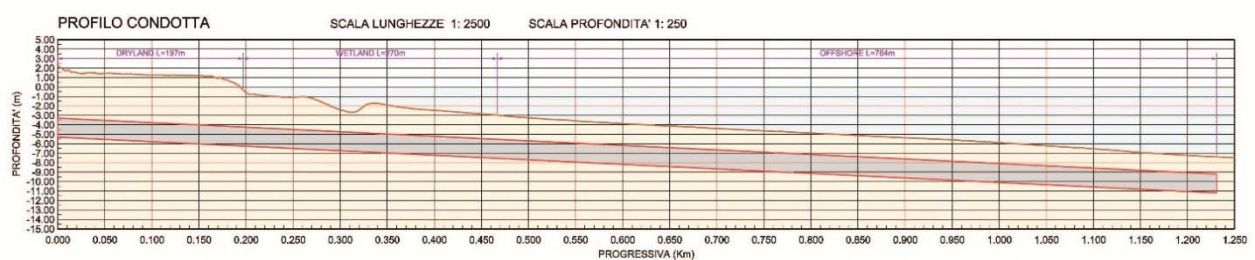
The value of the maximum flow rate discharged to the sea has been estimated in 6 mc/s for each of the two pipelines of Colonnella and 7 mc/s for the pipeline of Rodella.

The pipelines are buried along the entire route, both on the beach and in the sea, with approximately 2m of overburden along the entire length of the pipelines.

The project was prepared in accordance with both current national and local/regional regulations.



Lay out Plan of Rodella discharge



Rodella pipeline alignment section

COMPLETION OF SEWERAGE NETWORK AND ADAPTATION OF PURIFICATION PLANTS IN BENEVENTO

Location:	Benevento – Campania, Italy
Client:	Commissario Straordinario Unico per la depurazione
Services:	Detailed Design
Period:	01/2021 - Ongoing
Construction cost:	Euro 33,000,000

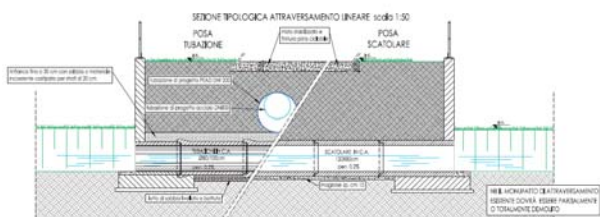
Project Description:

The intervention concerns the collection of a large part of the wastewater produced in the municipality of Benevento to the existing purification plant and to a newly built purification plant.



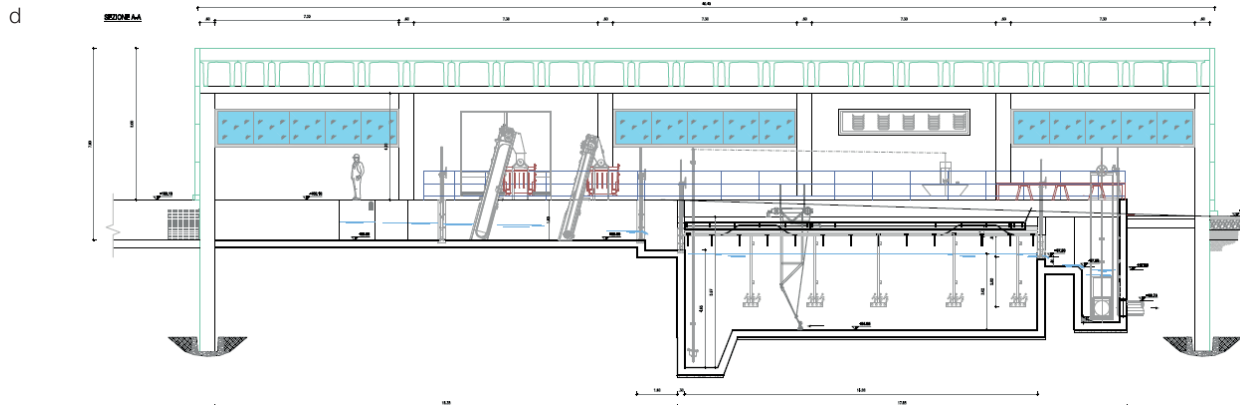
The interventions can be summarised as:

1. Construction of a plant with a capacity of 55,000 AE, in Loc. Contrada Scafa;
2. Decommissioning of the existing Ponte delle Tavole plant;
3. Construction of a new collector sewer for the abduction of wastewater, initially from the Cimitero plant to the Ponte S. Valentino ASI plant.



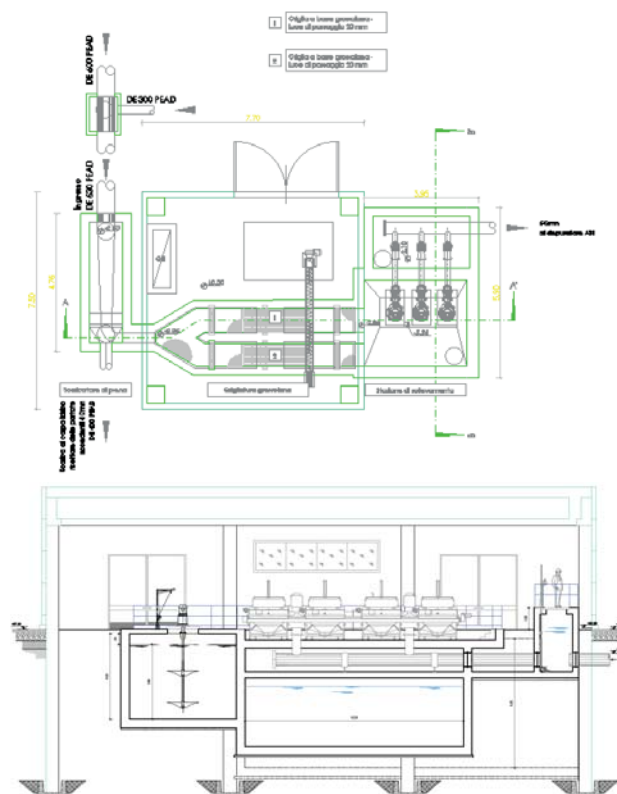
4. Construction of the section of sewerage collector necessary to connect the existing network to the plant under construction in Loc. Contrada Scafa.

5. Construction of screening stations after the overflow of the dilute



black flow.

The planned works are several pressure and gravity sewers for a total of about 12 km, two lifting stations with a spillway scouring plant upstream, and a new purification plant with a capacity of about 55,000 AE.



PRELIMINARY AND DETAILED DESIGN OF THE WASTEWATER TREATMENT SYSTEM OF GANVIÉ

Location:	Ganvié (Sô-Ava), Benin
Client:	ANPT (Agence Nationale de promotion des Patrimoines et de développement du Tourisme)
Services:	Preliminary Technical Study, Preliminary Design, Detailed Design, Environmental and Social Impact Study (ESIA), preparation of Bidding Documents
Period:	10/2020 – 03/2022
Construction cost:	approx. 27,213,292 €

Project Description:

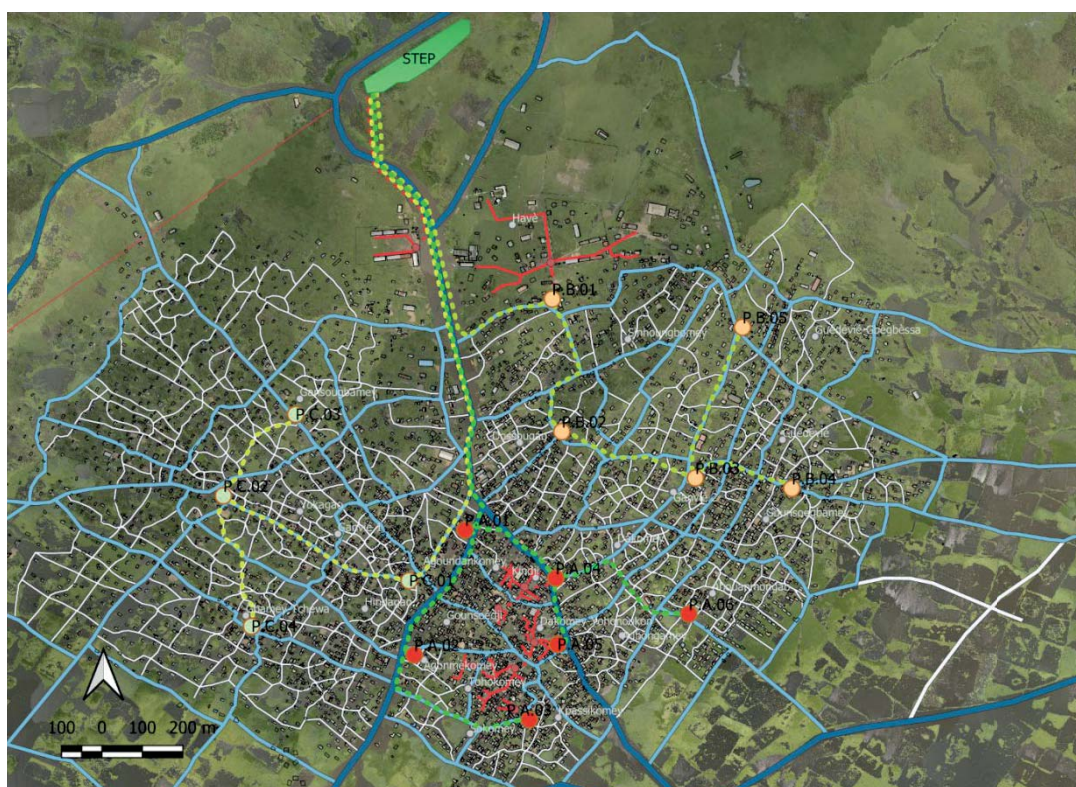
The project "Reinventing the Lake City of Ganvié" is part of the Government's action plan as one of the top priority projects of Benin in the tourism sector. Nowadays, the city of Ganvié consists mainly of stilted houses with a population of around 37.000 inhabitants. The project's objective is the identification of a wastewater treatment system with reference to the future scenario with a resident population of 73.000 inhabitants in 2038, along with a fluctuating tourist population estimated in approximately 11.000 people. The designed works are the following:

Centralised Wastewater Treatment Plant (WWTP): complete treatment system (73.000 PE) with elimination of organic materials and nutrients and final disinfection in compliance with legally binding emission limits. The water line has been designed to minimize the energy consumption and the sludge production. It is structured as follows: Fine screening; Grit removal; Equalisation-homogenization and pumping; Anaerobic treatment UASB; Nitrification, denitrification and dephosphatising with activated sludge; Secondary sedimentation; Chemical disinfection. The sludge line is structured as follows: Pre-thickening; Anaerobic digestion; Post-thickening; Dehydration with belt filter press. The biogas generated through the anaerobic treatment UASB and through the anaerobic digestion of the activated sludge and of the sewage sludge is stored in a gasometer and, after a proper pre-treatment (elimination of humidity, hydrogen sulphide and siloxane), is used for energy recovery (production of electricity and heat) in a co-generation plant.



Collective sanitation system: composed of main collection points (15) equipped with pumping stations which, through successive lifts, are capable to convey the wastewater to the WWTP. The collection points are designed so as to ensure easy construction and adequate integration in the typical local landscape.

Phyto-purification system for individual treatment: including a pre-treatment unit (septic tank) and a treatment unit (phyto-purification with submerged flow, with filter beds or floating beds).



ENGINEERING DESIGN SERVICES FOR WATER SUPPLY TREATMENT PLANT AND NETWORK FOR PHASE 1 KONZA TECHNO CITY

Location:	Machakos County, Kenya
Client:	DELMA UK (ICM Group); final Client: KoTDA (Konza Technopolis Development Authority)
Services:	Concept/Preliminary, Detailed Design (approved for construction)
Period:	08/2018 - 07/2021
Construction cost:	Cost of works: WTP approx. Euro 16 million; water supply network approx. Euro 25 million

Project Description:

The Konza Technology City (KTC) is a project of the Government of Kenya (GoK), implemented through EPCF (Engineering, Procurement, Construction and Finance) by the Konza Technopolis Development Authority (KoTDA), under the Ministry of Information and Communication Technology (MOICT). Konza City will be constructed over a 5000-acre land, located approximately 60 Km south of Nairobi Center. The city is designed to allow phased development, and Phase 1 includes various types of land uses and infrastructures that would support future phases of development. The project, implemented through EPCF (FIDIC Silver Book), concerns the development of a new smart technology city of about 28'000 inhabitants.

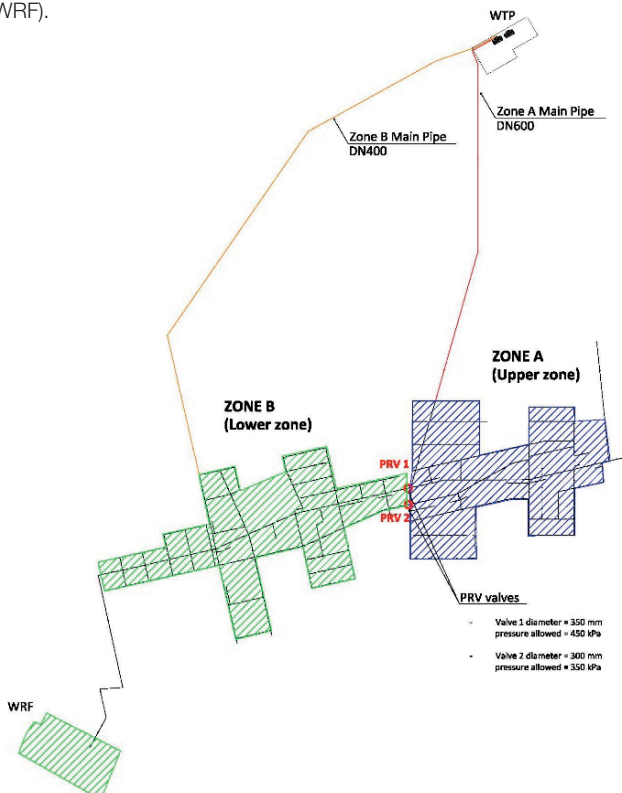
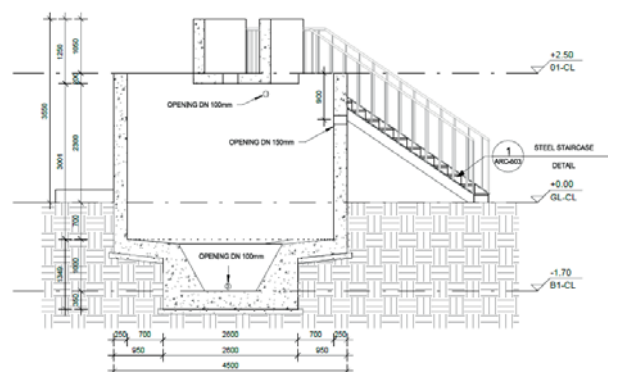
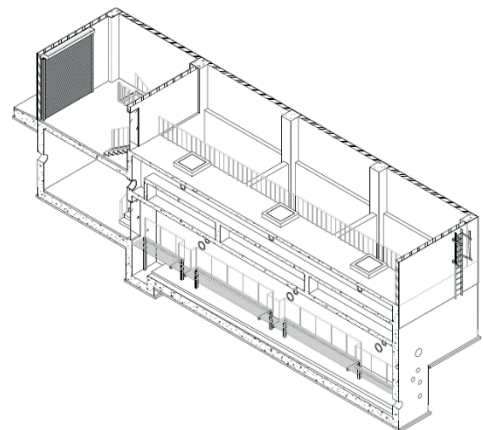
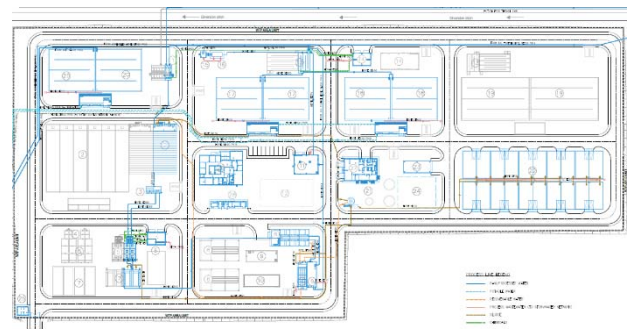
The Water Supply network for Phase 1 comprises two Main Water Lines, from the Water Treatment Plant (WTP), supplying water to the city through approx. 48 km of pipelines spanning from DN160 to DN600 and approx. 2 km of 2" for house connections. Also, it provides water for fire protection too through a widespread network of fire hydrants.

The Water Treatment Plant is designed for Phase 1 (28'000 equivalent population); nevertheless, it allows for future expansion up to the complete development of Konza Techno City (Phase 4 - 182,500 PE). It is designed in compliance with the requirements set out by the National Environment Management Agency (NEMA) in 2006 Kenyan Environmental Management and Coordination (Water Quality) Regulations.

The Water Treatment Plant treats water from different sources: presently from boreholes and Nol Turesh aqueduct, while Thwake Dam will cater for the future development phases. Also, WTP may potentially treat water from the Wastewater Reclamation Facility (WRF).

The WTP includes the following units: preliminary treatment building; pre-sedimentation; coagulation distribution chamber; coagulation; flocculation; coagulant-flocculant storage building; sedimentation; filtration; fresh backwash storage; spent backwash storage; UV disinfection; chemical disinfection; disinfectant storage building; RO feed tank; RO system; potable water storages; non-potable water storage; gravity thickening; sludge drying; dried sludge storage; electrical building; administration building; maintenance & storage buildings; guard house

The instrumentation and control system is integrated into the smart-city concept for Konza.



DETAILED AND FINAL DESIGN OF THE LOW-PRESSURE SEWER FROM GORIZIA TO GRADISCA D'ISONZO (3rd LOT)

Location:	Gorizia Province, Italy
Client:	Irisacqua S.r.l.
Services:	Detailed design
Period:	11/2019 – 06/2021
Construction cost:	7,263,655 €

Project Description:

The rationalization project of the Gorizia sewage system foresees for the centralization of the sewage system, in order to optimize the treatment system managed by Irisacqua and protect the Isonzo river, which falls within the sensitive area "Draining basin of coastal waters and the Marano and Grado lagoon".

The Isonzo river, declared a sensitive area after the approval of the Area Plan (June 2005), is currently not suitable for receiving the final discharges of the water treatment plants of Gorizia and Gradisca d'Isonzo, unless major structural interventions are carried out on the existing plants. The alternative pursued by the project is the definitive diversion and centralization of the discharges.

The preliminary design project was divided in 3 lots: 1) Enlargement and enhancement of the Staranzano WWTP; 2) Low-pressure sewer from Gradisca d'Isonzo to Staranzano; 3) Low-pressure sewer from Gorizia to Gradisca d'Isonzo.

Technital provides the detailed and final design of the new sewer GFRP DN700 mm (about 12 km long). Services include structural analyses and verifications on steel pipe crossings: the crossing of the Isonzo river by clamping the piping to the deck of the existing bridge on the A34 highway and the crossing the discharge channel of a hydroelectric plant by means of a bridge-tube.



CONSULTING SERVICES TO DEVELOP WATER SUPPLY AND SANITATION DISASTER RISK PREPAREDNESS PLAN

Location:	Lusaka, Zambia
Client:	Lusaka Water and Sewage Company Ltd
Services:	Preparation of the Inception Report, Risk Assessment Report, Disaster Risk Management Plan; Completion of final DRMP Report
Period:	12/2018 – 12/2019
Construction cost:	n.a.

Project Description:

Lusaka Water and Sewerage Company Limited (LWSC) is the main water and sewerage utility and service provider for Lusaka Province. The Company's mission is "to provide quality water and sanitation services at commercially and environmentally sustainable levels to the delight of our customers and other stakeholders". The **Lusaka Sanitation Program (LSP)** is financed by four International Financing Institutions (IFIs) focusing on the upgrade and expansion of sanitation facilities within the city of Lusaka. The four IFIs are the African Development Bank (AfDB), the World Bank (WB), the German Development Bank (KfW) and the European Investment Bank (EIB). LSP aims to **increase access to sustainable sanitation services to Lusaka's residents especially the urban poor and strengthen LWSC's capacity to manage sanitation services**. The program aims at addressing one of Zambia's most **binding** constraints to economic growth through infrastructure investment in Lusaka, the rapidly urbanizing capital.

This consultancy is focused on two of the four main components of the program:

Component I: Climate resilient Sewerage Infrastructure Development

Component II: Decentralized Sanitation and Hygiene Education

The **main objective** for water managers is to ensure or maintain an adequate level of service, that is to say, 'service-ability'. Serviceability requires taking into consideration not only the characteristics of flood events (hazard probability and intensity) but also their consequences on the urban receiving environment (vulnerability, elements at risk). The **specific objective** is to prepare the Water Supply and Sanitation Sector Disaster Risk Management Plan, which will strengthen institutions, mechanisms and capacities at all levels, in particular at the community level that can systematically contribute to building resilience to hazards and disasters.



The **scope** of the consultancy will include, but not limited to the following tasks:

- Assess all potential natural hazards and disasters triggered by climate change that are likely to affect the infrastructure and the communities
- Estimate the extent of damage resulting from such disasters to the infrastructure and surrounding communities.
- Identify the various sector institutions and the level of preparedness to deal with the natural hazards and disasters likely to affect the infrastructure and surrounding communities.

- Identify the institutional capacities that require strengthening in order to effectively address the negative effects of climate change.
- If necessary, propose alternative institutional arrangements(including their terms of reference) that can best respond to the disasters especially at a community level.
- Identify the communities which are at higher risk of exposure to these disasters and propose the short and long term interventions necessary to counter the effects.
- Develop a comprehensive Disaster Risk Management Plan (DRMP) that will adequately respond to the identified potential natural disasters.
- Provide a mechanism and an outline of activities detailing how the DRMP will be effectively implemented.
- Develop an integrated disaster risk management information and communication system in order to enhance timely decision making on the project, including emergency communication methods (alert protocols) available and accessible to the Disaster Management Committees (DMCs).
- Prepare a Disaster Management Operations Manual (DMOM) to guide key institutions achieve the best and proactive disaster management practice across the sector.

Description of actual services provided within the assignment:

- Preparation of the Inception Report
- Preparation of The Risk Assessment Report
- Preparation of The Disaster Risk Management Plan
 - Completion of final DRMP Report
- Activities After Risk Measures
 - Calculating residual risks to identify which areas focus when developing the DMOM
 - Conduct Occupational Health and safety training workshop
 - Conduct Domestic Water Treatment Training
 - Conduct DRR Awareness Campaigns
- Activities for Preparation of the DMOM Report
- Submission of Integrated Disaster management and Risk information system
- The services provided include data collection, data analysis, organization of workshops and consultations with the stakeholders, trainings for all the stakeholders (institutions, communities, technicians, etc.).

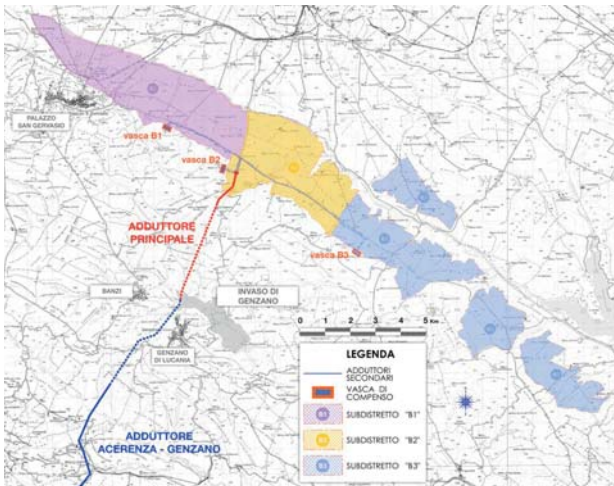
BASENTO-BRADANO WATER SCHEME – ACERENZA SECTION DISTRIBUTION - BANZI, GENZANO, PALAZZO S.G. AND IRSINIA

Location:	Basilicata Region - Italy
Client:	The Authority for the Development of Irrigation and Land Transformation in Apulia, Lucania and Ipinia (E.I.P.L.I.)
Services:	Works Supervision
Period:	08/2013 – 09/2019
Construction cost:	€ 73,000,000

Project Description:

The project concerns the construction of water supply and distribution works for irrigation purposes within the Basento - Bradano water framework and it covers various municipalities of the Bradanese plateau (about 5.200 hectares in the Province of Potenza – South of Italy).

The area is located in the plain of the Basentello valley, on the right bank of the river, starting immediately upstream of the Serra del Covo reservoir, going up to the immediate vicinity of the urban settlement of Palazzo S. Gervasio. The altitude ranges from a minimum altitude of 350 m to l.m.m. at a maximum altitude of 430 m s.l.m.



The works include a bored tunnel of about 4 km excavated with a TBM, a system of main distribution pipelines of about 12 km with 3 compensation basins connected with each other, and a distribution network of about 320 km.

More in details the features of the adduction works included in the project can be divided into the following works:

Main Adduction Works

- Cut and cover tunnel by Acerenza \varnothing 3,200, maximum capacity 10.8 mc / s;
 - Cut and cover tunnel to and from the Genzano reservoir \varnothing 3,200, maximum capacity 10.8 mc / s;
 - Hydraulic distributor Porter and tower in Genzano;
 - Tunnel \varnothing 3,200, maximum capacity 10.8 mc / s;
 - Tower and disconnection tank on the Marascione ditch;
 - Guard house;
 - Steel roof conduit \varnothing 3.000, maximum capacity 10.8 mc / s;
 - Underground conduit. \varnothing 3,000, max. capacity 10.8 mc / s;
- Hydraulic distributor in Marascione.



Secondary Adduction Works

- Adductor B1 to the centrifugal V1- PRFV. \varnothing 800, maximum flow rate 0.407 mc / s;
- Adductor B2 to the centrifugal V2-PRFV. \varnothing 600, maximum flow 0.315 mc / s;
- Adductor B3 to the centrifugal V3- PRFV. \varnothing 900, maximum flow 0.558 mc / s;
- 3 compensation basins for a total of about 50,000 cubic meters
- Pumping stations for the compensation basins.

Distribution works

- Distribution network for the various sub-district for a total of 320 km of minor pipes.

The tunnel has a length of about 4000 m and is characterized by a constant slope of 0.2% which will allow to transport the water collected at the Genzano entrance towards the Marascione entrance for a maximum capacity of 10.8 mc / s. The tunnel is characterized by a variable coverage (Hmax = approx. 140 m) and during operation it will be subjected to an internal hydraulic pressure of about 1 bar. The excavation takes place by means of a shielded TBM.



VACUUM FOUL SEWERAGE NETWORK AND STORMWATER SYSTEM OF THE PORT OF NAPLES

Location:	Naples, Italy
Client:	Port Authority of Naples
Services:	Coordination of all the surveys and investigations (topography, geophysical inspections, tests with tracer flows), Preliminary and detailed design, works Supervision
Period:	02/2004 – 12/2008 (Preliminary and Detailed Design) – 02/2018 (Work supervision)
Construction cost:	€ 5,533,733

Project Description:

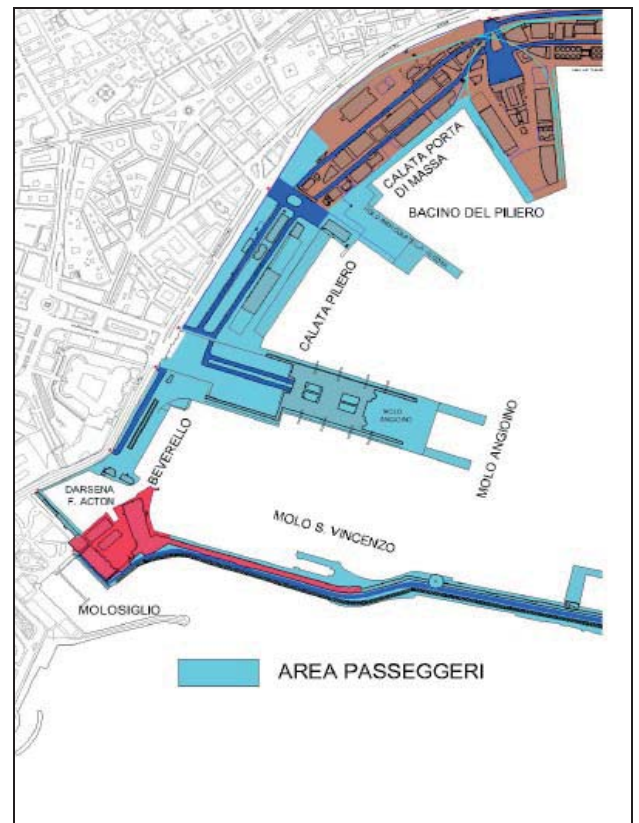
Within the general project of reconstruction of the sewerage network of the Port of Naples, a special project has been undertaken for the first part of the harbour, the commercial and tourist part, which is located between “Calata Beverello” and “Calata di Villa del Popolo”. The project concerns the design of a vacuum foul sewerage system for the area of interest, and the reconstruction/improvement of the existing storm water sewage network.

The vacuum system is composed of a main network of HDPE pipes, with an average operating vacuum of -40 kPa/-70 kPa provided by 3 vacuum pumps placed at the end of the network. The pipes are characterised by positive and negative slopes, in the typical scheme of a water supply network. The main network is connected to a smaller secondary network to which all the houses/offices are connected, through a vacuum valve for every 50 equivalent inhabitants, likewise operating in vacuum regime.

The vacuum valve is placed inside a gathering concrete duck’s nest, which is maintained at atmospheric pressure and in which all the wastewater is conveyed from the building pipes: when the minimum required vacuum of -15 kPa is reached, and when 40 litres of wastewater are gathered in the duck’s nest, a pressure water level pipe activates and opens the valve, so that at least the 40 litres of wastewater are sucked into the network, carrying with them also a volume of air; when the volume of air passes through the valve, the valve itself goes into atmospheric pressure condition, and then closes automatically until the required conditions are re-established.



The gathered wastewater is sent within three minutes to a vacuum station, where normal pumps send it on to the final place of disposal, which is the new wastewater treatment plant designed in the other part of the general project for the reconstruction of the sewerage system of the Port of Naples. The storm water of the commercial/tourist area of the port has been reconstructed or newly designed, in order to partly reuse the existing concrete mixed sewerage network where possible, and to provide new storm water sewer lines in those areas which do not have any.



SEWAGE NETWORK AND WASTE WATER TREATMENT PLANT IN VICENZA

Location:	Vicenza - Italy
Client:	Viacqua S.p.A.
Services:	Detailed Design, EIA
Period:	09/2015 – 09/2017
Construction cost:	€ 75,965,000

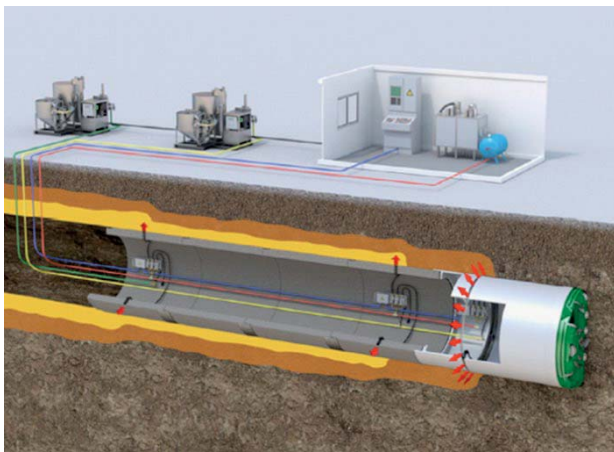
Project Description:

The project is for the rationalization of the sewage system and centralization of the wastewater treatment of the city of Vicenza in the north of Italy.

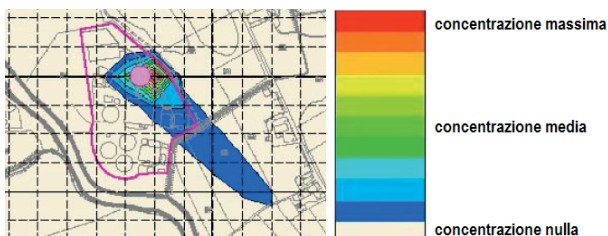
The project includes:

- (i) the expansion of the wastewater treatment plant (WWTP) of Casale (City of Vicenza), from 92,000 equivalent inhabitants to 240,000 equivalent inhabitants;
- (ii) the conversion of the WWTP S. Agostino (100.000 equivalent inhabitants), with adjustment of the electromechanical works of the existing water-pump and the construction of a new interception device for the incoming collectors and a new primary treatment and pumping system (up to $3Q_m = 3,350 \text{ m}^3/\text{h}$) to Casale, and the treatment of overflow water;
- (iii) the connection between S. Agostino and Casale with a 5.5 km pressure forcemains (double pipeline ductile iron DN 600);
- (iv) the decommissioning of n. 6 minor WWTPs (from 1,100 AE to 22,000 AE), with the construction of the same number of pumping stations (plus 3 intermediate) to the existing network: pipelines in ductile iron (6.5 km DN 400 / 500) and in HDPE (5.7 km from DN 200 / 225).

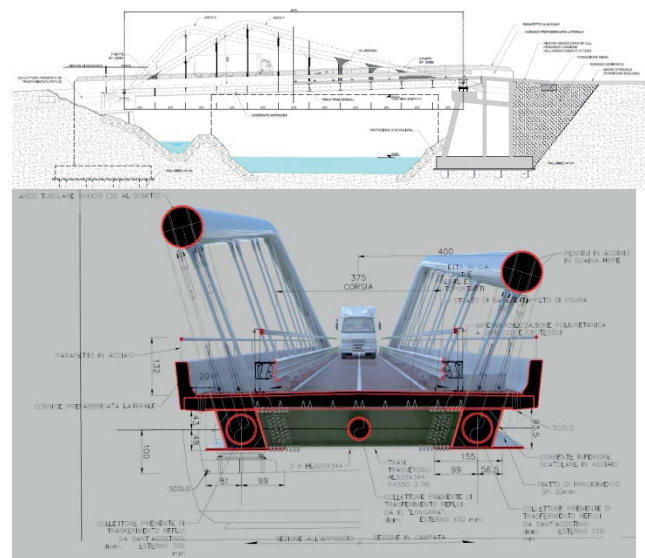
The design has dealt with the physical constraints of the morphology of the territory (8 crossings of watercourses, 770m micro-tunneling DN 2500 mm of the Berici hills, 480m of double DN 600 Horizontal Directional Drilling).



The design has also dealt with the anthropic infrastructures (2 crossings of the A4 motorway, 4 crossings of regional roads and provincial, 2 rail crossings) and resolution of different interferences (storm drainage, sewage, aqueduct, gas, military oil pipeline, liquid oxygen pipeline, telecommunications, power lines).



The main objectives included the optimization of pipeline tracks, in terms of: pipeline length, constraints, expropriation / occupancy charges, access during execution and maintenance, curves and special pieces minimization; technical-economic optimization of pumps / pressures; improvement of hydraulic functioning; analysis of piezometric profiles and water hammer analysis and mitigation.



The company has also carried out the Environmental Impact Assessment (EIA) of the extension of the City of Vicenza WWTP. The EIA has included the programmatic reference frameworks, project reference and environmental reference, with the evaluation of the impacts on the atmosphere, soil and subsoil, surface and underground waters, noise, vegetation, flora, fauna and ecosystems, landscape, socio-economic aspects.

OPTIMIZATION OF SEWERAGE NETWORK IN THE DISTRICT OF VALPANTENA

Location:	Valpantena (Verona) – Italy
Client:	Acque Veronesi – Provincial Water management authority
Services:	Prefeasibility study; Preliminary, detailed and final Design; EIA
Period:	06/2010 – 08/2014
Construction cost:	€ 12,066,726

Project Description:

The district of Valpantena was provided with a primary pipeline of combined sewerage network (length 16 km), which serves the following towns: Dorighi, Bellori, Lugo, Stallavena, Grezzana, Marzana, Quinto and Poiano.



Originally, all the secondary networks were of mixed type, and only Marzana and Quinto were provided with separated foul and surface drainage sewerage systems. The sewage was conveyed to the wastewater treatment plant of the city of Verona.

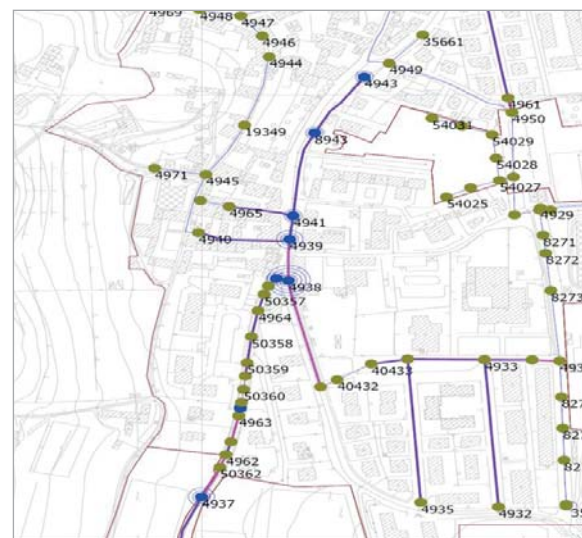
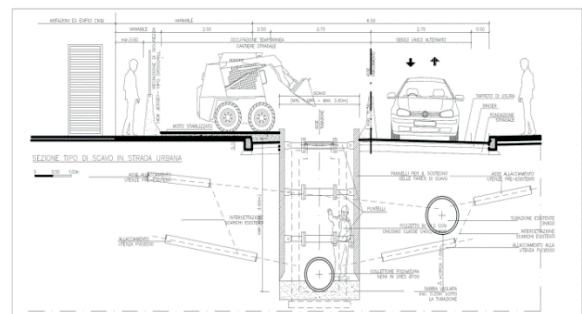
This situation required the optimization of the sewerage network through the study of four design options:

- Option 1: strengthening and upgrading of the existing primary pipeline (Total length of intervention: 13 km);
- Option 2: separation of the two networks, the main collector and the secondary pipelines. Upgrading of the existing network to be used as the new surface drainage sewer and realization of a new foul sewerage network. (Total length of intervention: 48 km)
- Option 3: separation of the two networks, the main collector and the secondary pipelines. Upgrading of the existing network to be used for foul sewage and realization of a new surface drainage sewerage network. (Total length of intervention: 43 km)
- Option 4: separation of the two networks, as follows:

Main Sewer: upgrading of the existing network to be used as the surface drainage sewerage and realization of a new foul sewerage network;

Secondary Networks: upgrading of the existing network to serve the foul sewage and realization of a new surface drainage sewerage network (Total length of intervention: 4 km).

Based on this sensitivity analysis of the facts, the client will choose the solution to be developed in subsequent phases of the project (preliminary, final and detailed design).



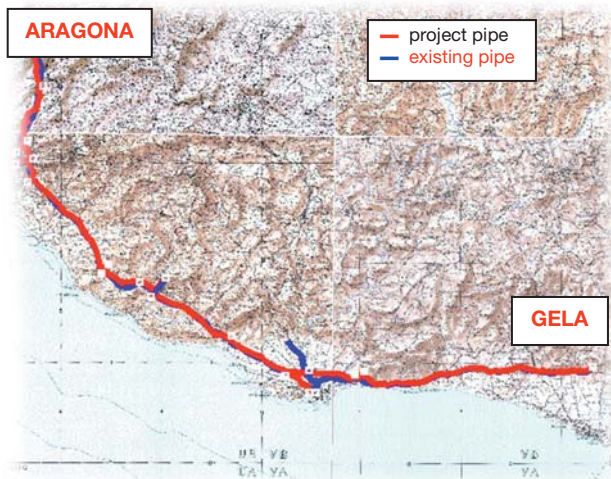
SUPERVISION OF WORKS FOR THE RESTRUCTURING OF THE GELA – ARAGONA AQUEDUCT (89.5KM)

Location:	Sicily, Italy
Client:	Sicilia Acque S.p.A.
Services:	Supervision of Construction
Period:	10/2007 – 03/2014
Construction cost:	€ 86.892.500

Project Description:

The Gela – Aragona aqueduct is supplied by a major seawater intake at Gela. The water is desalinated in the desalination plant inside the Gela petrochemical complex and subsequently mineralised. By means of a series of pumping stations the potable water (approx. 500l/s) is conveyed to Licata, Agrigento and Aragona, at an elevation of +500 m a.s.l.

The project consists in the renewal of the entire water supply main, replacing the existing fibreglass piping with a spheroidal cast iron pipe, and a general modification of the hydraulic scheme of the main conveyor (81.8 km), with the introduction of 3 tanks in tunnels along the line and booster type pumping stations instead of the existing ones with multistage vertical axis pumps and collecting tanks.



The new water supply system, which will also be connected to the water supply system of Favara di Burgio, the Voltano aqueduct and the conduit from the Blufi dam, can satisfy the potable water demands of the entire south-central area of Sicily. The tanks in tunnels, which have a total capacity of over 20,000 m³, can provide not only a daily but a seasonal regulation of the water supply. Moreover, the tunnels allow the temperature regulation of the water supply which tends to be rather high owing to the desalination system (multi flash) used upstream

The booster type pumping stations with revolution gage to control the parallel pump groups permits the optimization of the pumps' operation, minimizing energy waste and protecting the piping against water hammer phenomena due to sudden pump arrests.

The design system offers great reliability in terms of durability of materials (spheroidal cast iron instead of fibreglass), protection against irregular movement phenomena (inverter and revs gage) and general redundancy of the system (interconnection of the conduits and parallel pumps).

Furthermore, for the energy point of the view the operation of the whole system has been optimized, allowing significant savings with respect to the present situation.

Technital executed the services in association with Studio Altieri (lead company), SIS and Omniservice, Technital's share being 50%.



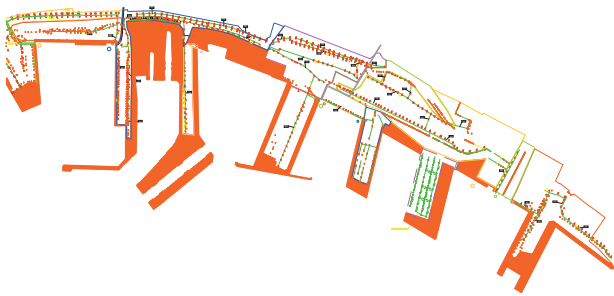
RECONSTRUCTION OF THE SEWERAGE NETWORK OF THE PORT AREA OF NAPLES

Location:	Naples, Italy
Client:	Port Authority of Naples
Services:	Coordination of all the preliminary studies, surveys and investigations, Concept and Preliminary Designs. Construction Supervision
Period:	02/2004 – 05/2013
Construction cost:	€ 18,498,796

Project Description:

The project regards the complete reconstruction of the sewerage network for the port of Naples, from Calata Villa del Popolo to Calata Petroli. The existing sewerage collection system of the port mixes the civil and industrial discharges with the rainwater collected in the gulleys of the roads and yards.

Furthermore, the port area is crossed by some major emergency discharge conduits of the city of Naples, which come into operation when the city's pumping stations cannot handle all the sewage collected in the urban (mixed) sewerage network and convey it to the treatment plants.



The first part of the task entrusted to TECHNITAL consisted in an investigation aimed at defining the present situation of the existing sewerage system, including the layout of the sewers and the location of all the related structures (pits, gullies, tanks, etc.).

This investigation is carried on by site topographical surveys, visual inspections, geophysical investigations e.g., con geo-radar, use of tracer flows.

The second part of the contract concerns the verification of the existing network and, consequently, the design of new networks where the existing one presents some fails. The design network will be divided into a storm water network, which will be based on the existing mixed network shape, and will collect rainwater and discharge the storm water, after de-oiling treatment, into the sea; the foul water network design, instead, will be completely new, and the new network will convey the sewage from all the civil activities to a new treatment plant located in the port.

The contract therefore includes the concept and the preliminary designs of the new, divided sewerage system, which will transform and improve the existing mixed sewerage network into the new storm water sewerage network and will provide a completely new foul sewerage network.

The contract was carried out in association with Acquatecno, Sistemi Integrati and Sisipi Progin. TECHNITAL's share of the contract was 35%.



STORM WATER SEWERAGE NETWORK IN THE TOWN OF CONVERSANO

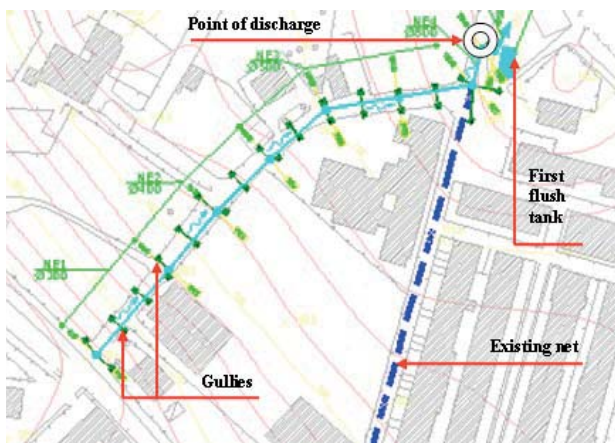
Location:	Conversano (Bari), Italy
Client:	Municipality of Conversano – Local town Authority
Services:	Detailed design, Construction Supervision
Period:	02/2008 – 04/2013
Construction cost:	€ 1,509,171

Project Description:

The town of Conversano was provided with partial storm sewerage network, which was even totally absent in certain parts of the town. The previous system of bar screens, pipelines and gullies directed the storm water towards some drainage wells, arranged in various parts of the town and provided with different diameters and depths. To integrate this situation, it was necessary to design new and more complete parts of the storm sewerage network towards the town.



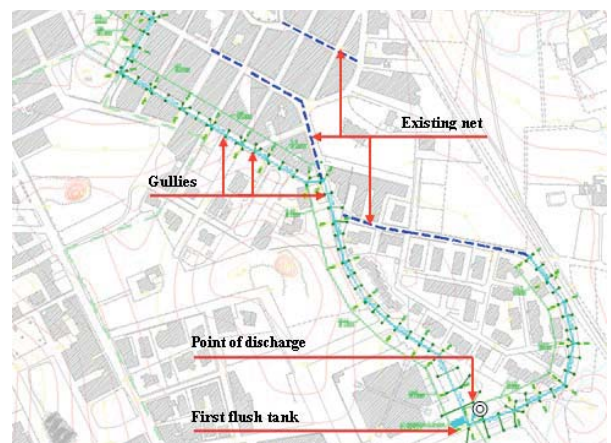
The entire area of intervention was restricted to two main zones, denoted as the "North-East part" and the "West part". In particular, it was necessary to design a completely new sewerage network, thus connecting the main square of the town with these 2 zones, where the new drainage open cuts are supposed to be dug.



Both the zones were designed to host a single pipeline, with gullies disposed along its length every 5-10 meters. Unfortunately, the conformation and the spatial disposition of the streets prevented the laying of secondary pipelines along smaller streets. Both the lines present these common aspects:

- *First-rain collection tank*: water coming from the main pipeline runs through a couple of catch basins, to consequently arrive in the first-rain tank, placed below ground level and covered with a concrete pavement.
- *Floating valve*: this is a particular control setup of the first-rain tank so that, in case of a surplus of storm water coming from the main pipeline, and consequent total filling of the tank, the entrance gate of the tank itself is closed by the valve.
- *Oil-filter tank*: this part of the first-rain tank, situated at the end of it, is designed to separate oils and hydrocarbon compounds from the water.

Drainage open cut: after being separated from oils and other polluting compounds, water arrives in these drainage points, dug quite far from the centre: this decision derives from the need to have enough space to arrange together all the final parts of the network, a target impossible to achieve in the middle of the town. These drainage open cuts, which substitute the previous drainage wells, which were decidedly inefficient, allow water to finally reach the natural ground.



CONCEPT DESIGN OF ROADS & INFRASTRUCTURES - PHASE 2: DRAINAGE WORKS

Location:	Doha, Qatar
Client:	Urban Planning & Development Authority (UPDA)
Services:	Topographic Surveys - Geotechnical Investigations - Drainage Design - Utilities relocation - Specifications and Cost Estimates
Period:	04/2009 – 01/2012
Construction cost:	€ 1,550,000,000 (overall project)

Project Description:

The project scope comprises the full design of eight packages within the State of Qatar with a total area of 30 sq. km. and a *total length of roads equal to approximately 385 km*. The project scope also comprises the assessment of the environmental impacts and the definition of the mitigation measures and of the monitoring activities to be performed in the later design stages.

Packages 7, 8, 11, 14 and 17 are empty areas which have been recently sub-divided into residential areas with small commercial outlets. These areas will require complete infrastructure and roads design.

Packages 9, 12 and 13 are densely populated areas with commercial streets located in the heart of the city and will involve major redevelopment.

The project includes, in general, the following activities:

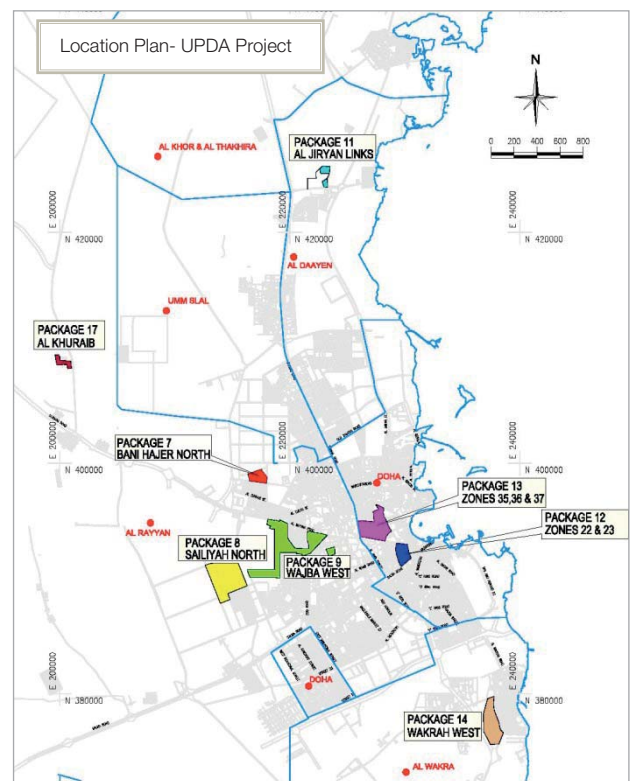
- Master Plan;
- Transportation Master Plan of Qatar and Sub-Area Models;
- General Traffic and Zones Development for 20 years extension;
- Traffic Modelling and Study;
- Hydrological study;
- Study & Evaluation of Foul Sewerage, Treated Sewage Effluent, Storm Water Drainage and Irrigation Systems;
- Topographical and Geotechnical (pavement, materials) Study;
- Environmental Impact Assessment;
- Design of Roads and Infrastructures.

The infrastructure works will consist of urban redevelopment of areas, such as change of the residential area land use from single family villas to multi-storey to higher (G+7) buildings which will induce a remarkable increase in the traffic generation and changes to drainage systems.

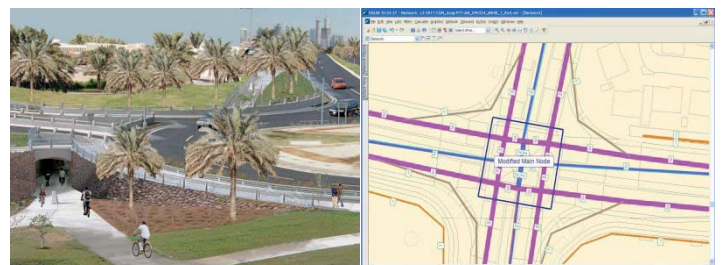
The project is located in 8 different areas across the state of Qatar. The scope of work incorporates the design of stretches of road linking into subdivisions and adaptation to the existing and future requirements and ongoing projects adjacent to the project area. The Project area comprises 2932 ha.

The required works includes the following elements:

- Services investigation;
- Ground investigation;
- Topographic surveys;
- Environmental investigation (air quality, noise, soil and groundwater, terrestrial ecology);
- Traffic surveys/ traffic impact analysis;
- Road network and road corridor plans;



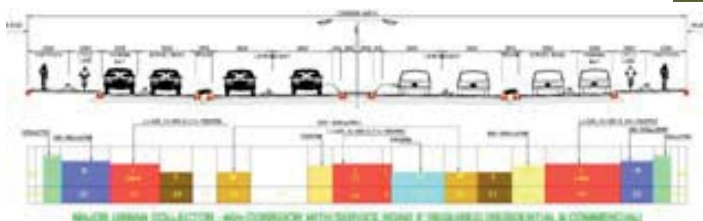
- Detailed Road design;
- Surface water drainage design;
- Foul Sewage
- Treated sewerage effluent (T.S.E);
- Environmental Impact Assessment Study
- Street lighting design and
- Landscaping design.



Grade – separated Roundabout & VISUM Model bikeway crossing

The project is divided into stages:

- Conceptual design Options and presentation of concept options;
- Concept design; and
- Cost Estimates.



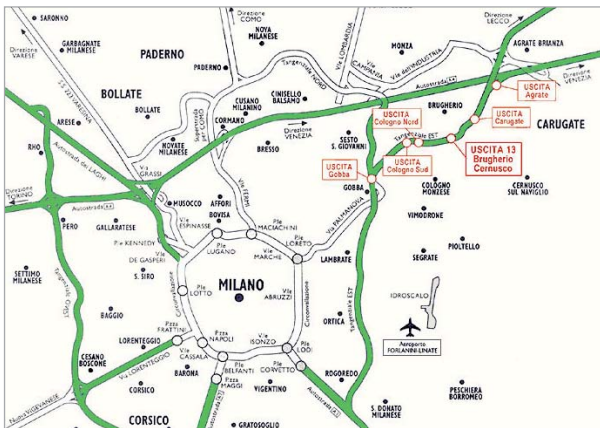
Typical Road Section

DRAINAGE SYSTEM FOR THE EXTERNAL EASTERN BYPASS OF MILAN (T.E.E.M.)

Location:	Milan, Italy
Client:	Concessioni Autostrade Lombarde (Motorway Concessionaire for Lombardy Region)
Services:	Final Design, EIA
Period:	07/2009 – 08/2011
Construction cost:	€ 34,487,850

Project Description:

The storm water drainage system was conceived and designed in order to protect the environmental quality of the precious hydrological system crossed by the design motorway. The surrounding areas are, in fact, crossed by a large drainage network formed by a great quantity of rivers.

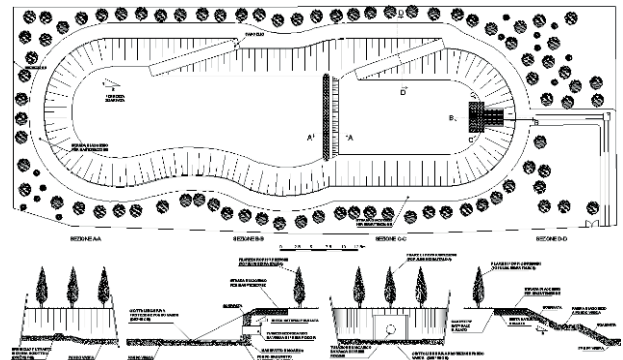


In order not to modify the hydrologic regime and the water quality in the existing rivers, which will host the collected water from the motorway surface, the collection scheme included some first flush treatment plants (approximately one plant every 1 km along the motorway), for the treatment of the polluted first flush of storm water and also for the lamination of the flows conveyed to the final disposal points.

The design was developed with the creation of typical drawings and plans showing the location of all the elements involved in the collection and treatment of the storm water, namely:

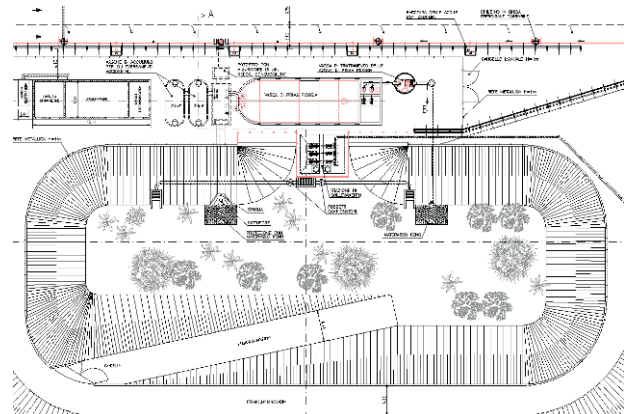
- parts for the collection and conveyance;
- lamination tanks obtained with ground stripping, and connected pumping stations;
- retention treatment tanks for the first flush storm water.

The hydraulic scheme for the collection and conveying of the roadway runoff water changes with the level of the motorway, which means that the scheme for the parts of the motorway in cuttings is different from that of the sections which are on embankments above the average ground level of the surrounding area. In the first case, the sewers collect the entire amount of the surface runoff water through a triangular gutter with area drains placed at fixed intervals, from which the water is conveyed to main pipes below the motorway level. In the lower points of the road profile, flood attenuation tanks were designed, with a bottom lining inside the tank made of stones and plants, thus giving the lamination tank a role similar to phyto-depuration tanks.



The scheme for the embankment parts presents two distinct series of pipes ensuring the perfect division of the first flush from the rest of the rained volumes. The collection structures on the sides of the road are designed to collect only the first flush and direct it to the pipe below the road surface, while the remaining volumes overflow down the embankment through little open culverts to a dispersion trench at the bottom of the levee. Once the first flush is over, the remaining volume raining on the road will be collected into the manholes with spillways in case of overflowing.

Some phyto-depuration basins were designed at the discharge of the first flush treatment plants, in order to enhance the water treatment and improve the water quality conveyed to the final places of disposal, namely the rivers around the motorway.



The contract was carried out in association with S.I.N.A., S.P.E.A., Milano Serravalle, Girpa, and Proiter. TECHNITAL was the lead company in the association and the firm's share of the contract amounted to 40%.

CONSTRUCTION SUPERVISION OF THE INDUSTRIAL INTERCHANGE: DRAINAGE WORKS

Location:	Doha - Qatar
Client:	Ministry of Municipal Affairs & Agriculture - Roads Affairs Department
Services:	Works Supervision and Site and Quantity Surveying
Period:	08/2006 – 03/2011
Construction cost:	€ 150,000,000

Project Description:

The project works are located in Doha city and consist in the upgrading to a 4-level interchange of the existing Salwa Road / East Industrial Road / Al Furousiya Street Junction, otherwise known as the "Industrial Roundabout".



The works include the construction of the following Drainage Systems:

- Surface water drainage (including microtunnelling (approx .length of 2.4m internal dia pipe 9,000m) The pipe is located at average depth of 20m, total volume of excavation is approximately 40,000 m³)
- Earthworks
- Sewerage
- Storm water pumping station.

The construction of the interchange modified the existing utilities of the area, such as foul sewerage, water, electricity, TSE and stormwater. The design focused to replace all the utilities intercepted, and in particular the foul sewerage and storm water systems. For the sewerage all the house connections intercepted were replaced and the collector pipes which gather all the dwellings and dispose to the main trunk.

The project area was not provided with a positive system for the surface water drainage, since the existing system was base on soakway and trench soakway. The surface water use to be drained into the manholes and infiltrated into the ground. Due to the raising of the ground water around Doha, infiltration systems are no longer recommended, and a pipe network system was provided. The interchange storm water network was connected to the Abu Hamour network (ABHO), which was design to drain half of the city. The ABHO disposes into the sea. The construction of the ABHO is not completed yet and the design of the Industrial interchange included the design a 2.4m diameter microtunell, which is part of the main trunk of the ABHO. The surface water network was connected to the main ABHO.

The supervision team for the drainage works consisted of the following:

- 1 Resident Engineer
- 1 Materials Engineer

- 1 Drainage Engineer
- 1 Quantity Surveyors
- 1 Planning and Schedule Engineer
- 2 Site Inspectors (materials, drainage).



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- 1 Planning and Schedule Engineer
- 2 Site Inspectors (materials, drainage).



The services provided by TECHNITAL included:

- a. General supervision, including design checks and the proposal of any necessary alterations to the design
- b. Site supervision, including reviewing and assessing the Contractor's work, preparing all necessary reports, records, cost estimates, variation orders, certificates, etc.

- c. Quality Assurance, including monitoring of laboratory test activities, checking the Contractors' materials and equipment, etc.
- d. Post-Contract Quantity Surveying including monthly checks on works completed, monthly schedules and evaluations, records of materials deliveries, plant and manpower, etc.
- e. Project Management, including dealing with claims and outstanding works during the construction contract maintenance period.

The Contract was administered in accordance to the FIDIC Rules (Red Book). The Consultant's Resident Engineer has assumed the role of "Engineer's Representative, the "Engineer" role being kept by the Director of Roads/Drainage Department of the Ministry.



DESIGN OF REVAMPING AND RESTORATION OF THE PUMPING SYSTEM FOR EMPTYING THE “MEDIUM” DRY DOCK OF THE ARSENAL OF VENICE

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice
Services:	Preliminary and Detailed Design
Period:	03/2010 – 11/2010
Construction cost:	€ 1,810,000

Project Description:

The northern area of Venice Arsenal is a key site for the management and maintenance activities for the MO.S.E. (flood protection) system of Venice lagoon. The area is currently used for ship maintenance and docking operations and is provided with two dry docks (“medium” and “large” dry dock) suitable for the unloading operations of the barriers.

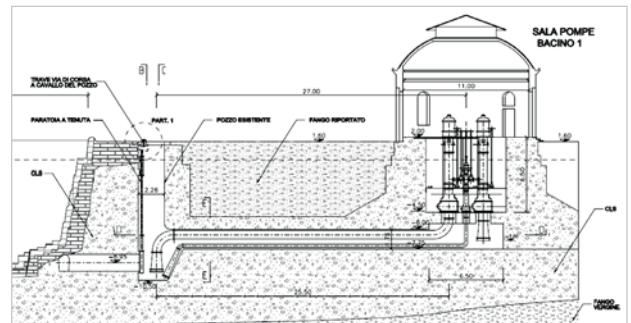


The structures in the northern area of the Venice Arsenal, including the medium dry dock and the pumping system for emptying it, have an architectural and artistic value since they were built in the 19th century.

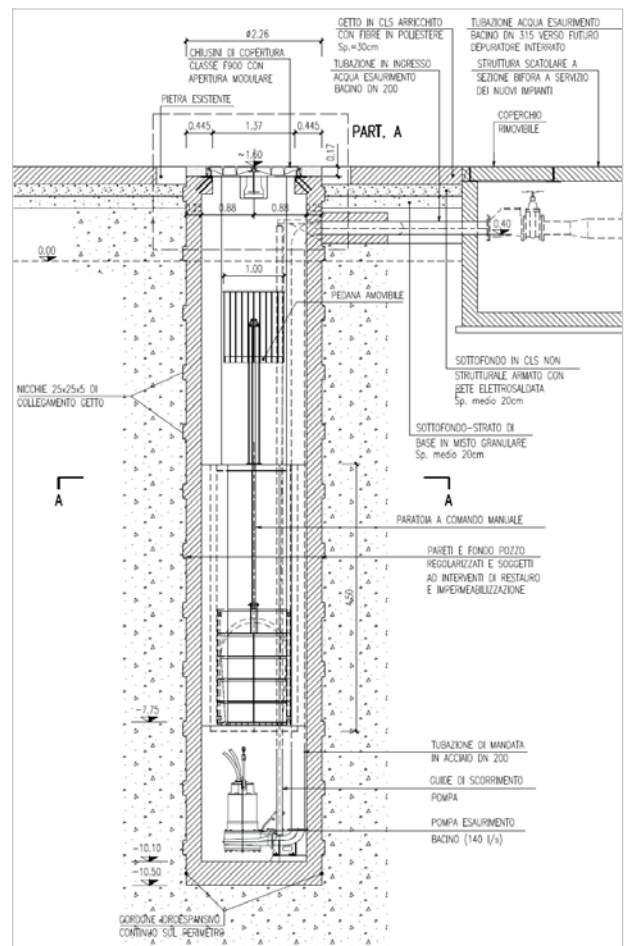
The emptying system of the “medium” dry dock was based on two vertical pumps with a flow discharge of 2,500 m³/h each: by a system of iron pipelines (s =700 mm), the pumps took the water from the bottom of the dry dock (-9.00 m, measured on the mean sea level) to the Lagoon. The pumps and the connected pipes and valves system, installed in the earlier part of the 20th century, had many problems like corrosion, leakages and mechanics frictions that involved a sensible reduction of the pumped flow and hence longer times for emptying operations.

In order to reduce this time and improve the reliability of the system for the medium-long term period, the old pumps and the pipeline system were removed and new vertical pumps with a 5.300 m³/h each flow discharge, were installed. The pumping system was also provided with a small auxiliary pump (350 m³/h) and a vacuum priming pump. Since the pumps had a dry installation, to prevent the surging of cavitations at the impellers when the water level is lower than the impellers (low values of the available NPSH), inverters were provided to control the electric motors revolutions. With this configuration the dry dock could be emptied in less than 3 hours.

The bottom of the sump was -4.5 m below the mean sea level and the walls presented much seepage; to restore the integrity of the walls and ensure their sealing and prevent corrosion of the flanges of the new pumps, the installation of bentonite panels and concrete cast counter walls was provided.



In addition to the restoration of the pumping station, the project also included the installation of a supplementary pump (140 l/s with a head of 21,00 m) within a well in connection with the dock, placed at -11,00 m below mean sea level. This pump not only ensured the completion of the emptying of the dry dock, but also through pressure pipeline (350 m long, DN 315 mm) could send the process water to the treatment plant planned for the area.



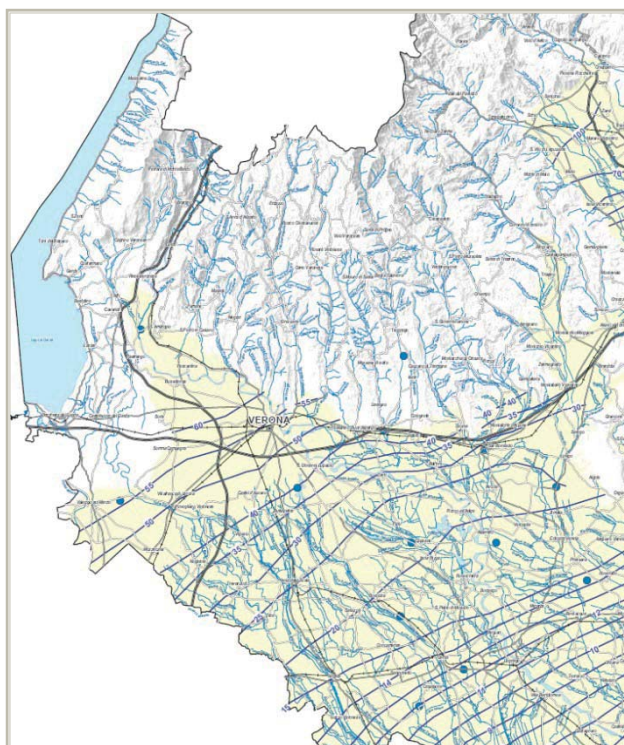
OPTIMIZATION OF INVESTMENTS AND MANAGEMENT ACTIVITIES OF THE INTEGRATED WATER SERVICE

Location:	Province of Verona, Italy
Client:	Acque Veronesi S.c.a.r.l. (Public water authority for the Province of Verona)
Services:	Cognitive studies and analyses; Feasibility studies; Technical and economic advisory services
Period:	11/2009 – 07/2010
Construction cost:	N.A.

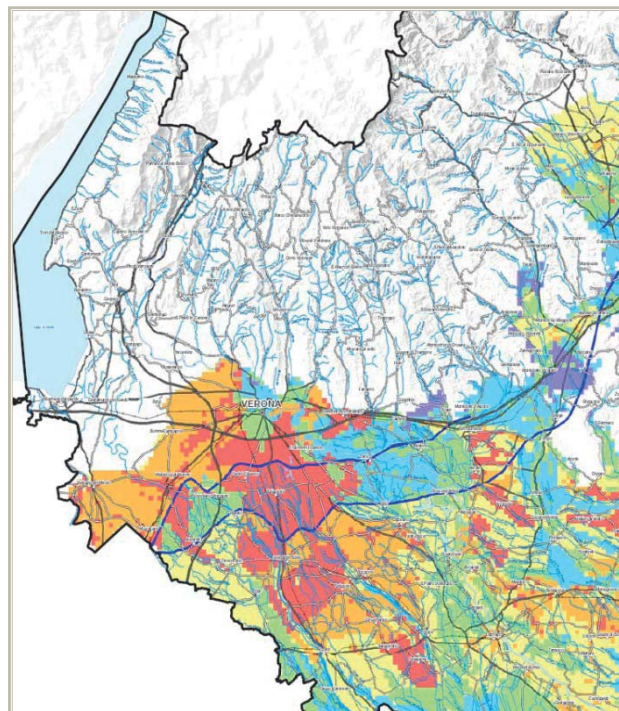
Project Description:

Acque Veronesi S.c.a.r.l. appointed Technital S.p.A. for the support activity in the analysis and planning of all the interventions and designs expected for the future, in the province of Verona.

In particular, this activity concerned the analysis of all the water supply systems, sewerage networks and wastewater treatment plants present in the province of Verona, and the preparation of feasibility studies, in order to define the most urgent interventions.



The analysis activity consisted in the support to the reconnaissance of all the systems studied and the functional analysis of the installed sewerage networks, water distribution systems and wastewater treatment plants: this led to the revision and updating of all the technical information concerning the conditions and the efficiency of the studied infrastructures and, furthermore, to the identification of urgent interventions, such as the improvement of the existing facilities, the provision of new networks, treatment plants and water supply systems, and the optimization of the hydraulic service throughout the province. This analysis activity also led to the definition of an updated and improved plan for the future technical and economic management of all the facilities studied.



The feasibility studies concerned, in a more specific way, the identification of all the critical situations in terms of loss of efficiency, damages or inadequacies, within the above-mentioned infrastructures, in order to identify the most urgent interventions. Once these interventions were identified, a restricted group of them was chosen, depending on the possibility of carrying out the interventions within the year 2010.

The studies concerned mainly on the following topics:

- Priority of a particular intervention;
- Technical and economic feasibility of a particular intervention;
- Analysis of alternative solutions, in order to improve the efficiency of existing infrastructures;
- Definition of the achievable targets with the intervention.

These activities allowed Acque Veronesi to outline the design activity for the whole year 2010 and, furthermore, to plan the entire amount of investments for design activity, infrastructure development and management up to the year 2013.

RECLAMATION WORKS IN THE DOMAIN AREA CALLED THE "THIRD DYKE": HYDRAULIC DRAINAGE WORKS

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice
Services:	Preliminary, Final and Detailed design of shore protection works (physical barrier and drainage system)
Period:	12/2000 - 12/2006
Construction cost:	€ 12,745,700

Project Description:

The project envisaged the reinforcement of the lagoon banks in order to avoid pollutants from the soil being released into the lagoon, by means of a physical barrier around the lagoon, with a shoreline road, and a groundwater drainage system including its conveyance to treatment plants.



Layout of the drainage system of the island

The priority intervention of this reclamation and making safe of the so-called "Third Dyke" area was the reinforcement and protection of the lagoon shore to avoid the seepage of contaminants from the surrounding soil, given that it constitutes the boundary of the Oil Refinery island, one of the most heavily polluted sites in the critical Porto Marghera area.

The physical barrier envisaged consists of a plastic diaphragm, extending the full length of the shore. This diaphragm has a low permeability coefficient serving to intercept the polluted water and is laid on a clayey stratum, thereby impeding any exchange of water between the lagoon and the water table of the island.

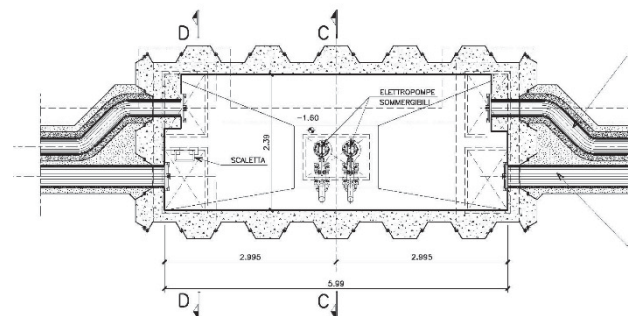
Once it is joined up with the similar works foreseen for the other banks of the island, the whole Oil Refinery Island will be isolated from the lagoon by an impermeable barrier.

To avoid the increase of the island's water table, due to the storm water no longer being able to drain into the lagoon, the project envisaged an articulated drainage network to keep the level of the water table under control, intercepting the contaminated water and conveying it treatment plants.

In the provisional phase of the operation of the drainage system (until August 2008), there was still no final destination for the polluted water but, after it reaches full regime, the polluted water is conveyed to treatment at the Fusina Treatment Plant, one of the most important in Italy, designed by the Veneto Region.

The groundwater drainage system along the Third Dyke is 1011 m long, and consists of perforated drainage conduit in PEAD, nominal diameter 315, laid horizontally at -0.50 m below sea level, surrounded by a gravel layer approximately 15 cm thick to increase the filter surface and wrapped in geo-textile (400 g/m²) to prevent the passage of fine particles. Concrete gullies at regular 25 m intervals, with + 0.20 m overflow threshold, siphon off the excess water into two parallel drains which conveys it to the collecting tank (6.00 x 2.40 m) at the middle of the barrier. The useful volume of the tank is $V_{regime} = (1.30 - 0.50) \times (6.00 \times 2.40) = 11.52 \text{ m}^3$.

One of the two submerged pumps (one is standby) then conveys the water to the treatment plant.



Layout of the collection tank

The gradient of the collector drains has been kept to a minimum (0.064%), to limit excavation in the contaminated soil of the island. The entrances to the collectors and to the conduits are protected by gates.

During the provisional operation phase, the water is conveyed south and discharged into a gully for this purpose on the drainage network of the Vittorio Emanuele III Channel, whence it is periodically removed to a treatment plant. Once the system is fully operative, the water will be conveyed north and discharged into the VESTA network which conveys it to the Fusina treatment plant

RESTRUCTURING OF THE SEWERAGE NETWORK OF THE MUNICIPALITY OF CASAMICCIOLA ON THE ISLAND OF ISCHIA

Location:	Ischia (Naples) - Italy
Client:	Sogesid S.p.A. (Rome) for the Ministry of Public Works
Services:	Specialist support to the preliminary and detailed design, geotechnical and topographic investigations and surveys
Period:	05/2002 – 01/2005
Construction cost:	€ 12,000,000

Project Description:

The existing sewerage system of the municipality of Casamicciola consists of a network of plastic pipes which collect both sewage and rainwater from surface runoff. The networks, which serves less than 30% of the population, is seriously under-scaled and during heavy rain pipes and gullies often burst with consequent flooding of cellars and basement areas.



The purpose of the project is to separate the rainwater and sewage by creating two separate pipe systems: in particular, the existing system, as far as it can be re-utilised, will serve to collect the rainwater and a new network will be built to collect the sewage.

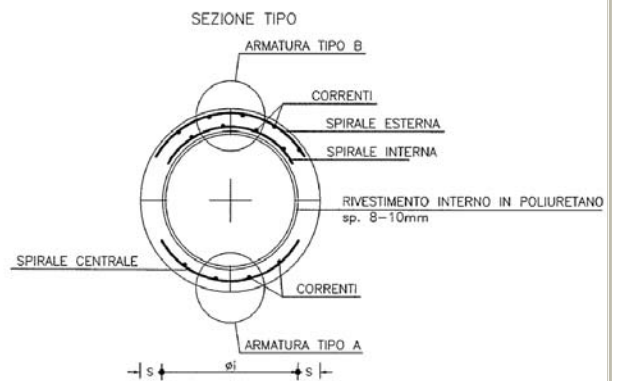


The sewage will be pumped to the nearby municipality of Lacco Ameno where a treatment plant for civil sewage is under construction. The new system will serve almost 80% of the population.

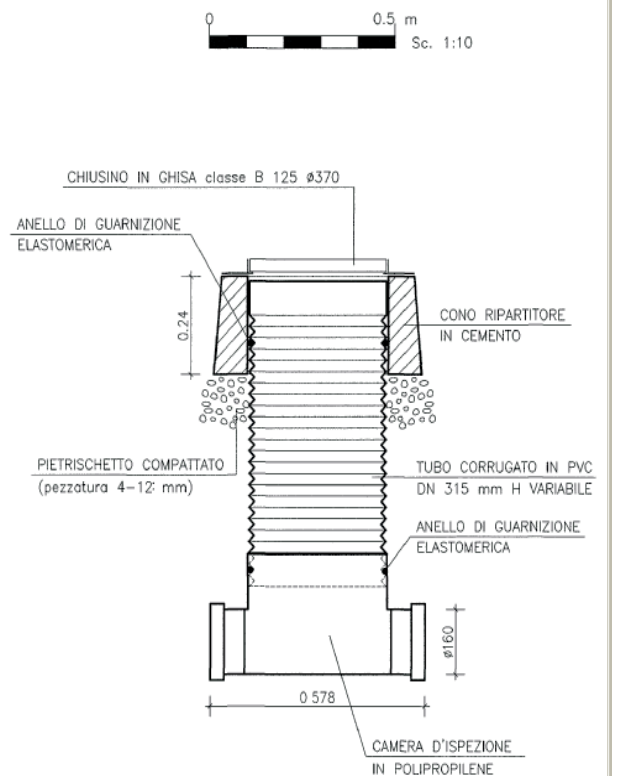
One of the main activities involved was the survey of the present situation carried out using both traditional methods (topographic survey and definition of the levels of the gullies) and modern techniques (video inspections and endoscopic investigations).

The design also took into consideration the question of the thermal waters as Casamicciola has numerous thermal installations which discharge into the municipal sewerage system.

Pipe reinforcement in polyurethane concrete



Detail of gully for user connections



In the project, being carried out in association with Baratta-Majolino (lead company) and Studio Altieri, Technital is providing specialist support for the preliminary and detailed design and related surveys.

INFRASTRUCTURE DEVELOPMENT OF AL-UDAID AIR BASE

Location:	Al Udaid, Qatar
Client:	Rizzani De Eccher (Main Contractor)
Services:	General Master Plan ; Detailed Design of Lot 1
Period:	11/2003 – 12/2004
Construction cost:	€ 60,830,000

Project Description:

The Project includes the General Master Plan and Detailed Design of Supporting Infrastructure and Utilities of the Qatar Air Force Base of Al Udaid.



In particular, the Project includes:

1. Road Network and Paved Areas

- Design of approx. 25 km of single and double carriageway distribution network including junctions, roundabouts and tie-ins;
- Design of road networks within development areas, including parking areas, facility accesses, bus-stops and sidewalks;
- Design of road corridor stormwater drainage;
- Design of traffic signs and road markings;
- Design of combined utilities plans indicating existing and proposed services and proposed diversions and service ducts;
- Design of ducting for street lighting network.

2. Sewerage Network

- Design of approximately 18km of building connections, collector mains, gravity outfalls and pumping mains serving various area of the base;
- Design of four sewage pumping stations and flow balancing facility;
- Design of Septic/Conservancy tanks (if gravity connection to network not viable);

3. Water Distribution Networks

- Evaluation of supply with regards acceptable flow rate, residual pressure and reliable duration;
- Computer modelling to define extensions or reinforcing requirements to the feeder ring main;
- Extensions and reinforcing of existing ring mains;
- Evaluation of ground / elevated storage needs and mechanical plant requirement, to supply domestic and fire flow demands;
- Design of fire mains and domestic networks up To and including supply point at each facility.

4. High, Medium and Low Voltage Electrical Network

- Establish primary sources of power to the site and location of primary supply points within the site;
- Evaluate existing sub-station infrastructure and assessment of their suitability;
- Location and design of sub-stations, including detailed electrical arrangements; and architectural and structural design of housings;
- Detailed design of HV and MV and LV cable network;
- Provision of all detailed drawings, plans, layouts, standard details, supporting calculations, specifications and schedules of quantities as required for the completion of construction works.

5. Street and General Area Lighting

- Design of Street and General Area Lighting including road lighting, general area lighting, parking areas.

6. Site Communications

- Design of a Site Communications Ductbank System to connect the various areas of the base.

7. Surface Water Drainage and Site Grading

- Areas within and adjacent to the various development areas are to be graded to ensure that existing and proposed facilities and works are adequately protected from surface storm water run-off, resulting from a 1 in 10 year storm event. Grading of the above-mentioned sites has been designed to take cognizance of watersheds, storm flow paths and localised depression areas such that run-off is conveyed safely away from development facilities.

DESIGN FOR THE RESTRUCTURING OF THE GELA – ARAGONA AQUEDUCT (89.5KM)

Location:	Sicily, Italy
Client:	Special Commissar for the Water Emergency (Sicily) for Regional government of Sicily
Services:	Preliminary and Detailed Design, Safety Plan, geotechnical and topographic surveys.
Period:	07/2002 – 03/2003
Construction cost:	€ 17,378,500

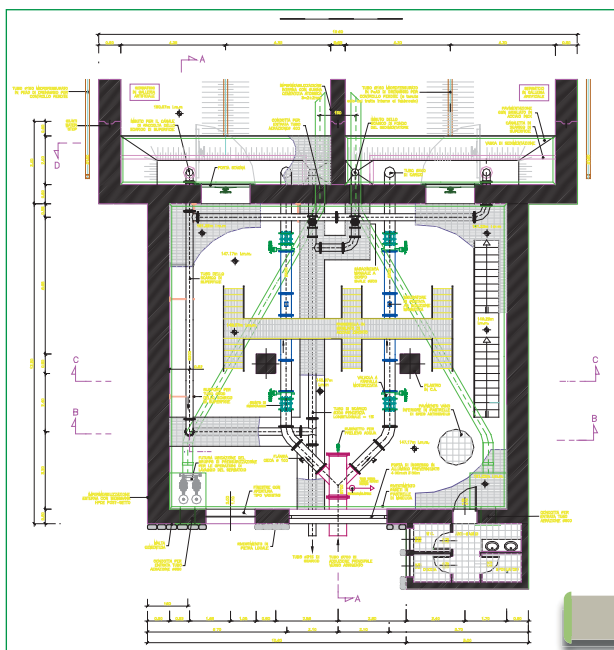
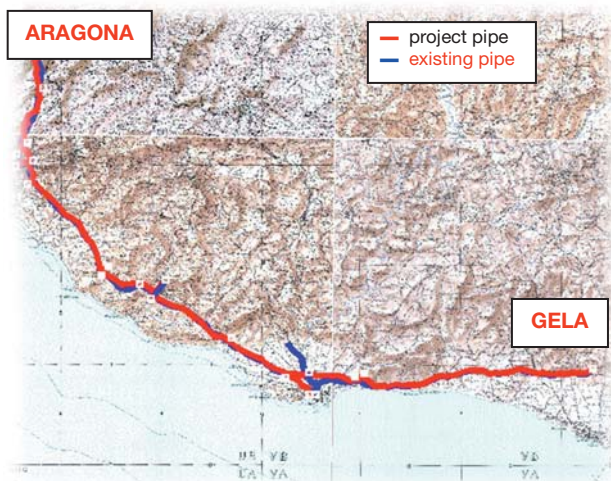
Project Description:

The Gela – Aragona aqueduct is supplied by a major seawater intake at Gela. The water is desalinated in the desalination plant inside the Gela petrochemical complex and subsequently mineralised. By means of a series of pumping stations the potable water (approx. 500l/s) is conveyed to Licata, Agrigento and Aragona, at an elevation of +500 m a.s.l.

The project consists in the renewal of the entire water supply main, replacing the existing fibreglass piping with a spheroidal cast iron pipe, and a general modification of the hydraulic scheme of the main conveyor (81.8 km), with the introduction of 3 tanks in tunnels, which have a total capacity of over 20,000 m³, can provide not only a daily but a seasonal regulation of the water supply. Moreover, the tunnels allow the temperature regulation of the water supply which tends to be rather high owing to the desalination system (multi flash) used upstream.

The new water supply system, which will also be connected to the water supply system of Favara di Burgio, the Voltano aqueduct and the conduit from the Blufi dam, can satisfy the potable water demands of the entire south-central area of Sicily. The tanks in tunnels, which have a total capacity of over 20,000 m³, can provide not only a daily but a seasonal regulation of the water supply. Moreover, the tunnels allow the temperature regulation of the water supply which tends to be rather high owing to the desalination system (multi flash) used upstream.

The booster type pumping stations with revolution gage to control the parallel pump groups permits the optimization of the pumps' operation, minimizing energy waste and protecting the piping against water hammer phenomena due to sudden pump arrests.



The design system offers great reliability in terms of durability of materials (spheroidal cast iron instead of fibreglass), protection against irregular movement phenomena (inverter and revs gage) and general redundancy of the system (interconnection of the conduits and parallel pumps).

Furthermore, for the energy point of view the operation of the whole system has been optimized, allowing significant savings with respect to the present situation.

Technital executed the project in association with Studio Altieri (lead company), SIS and Omniservice.

Technital's share is 25%.

Valve chamber in the tank named "Rocca Corvo"

SEWERAGE SYSTEM FOR SOTTOMARINA IN VENICE LAGOON

Location:	Venice, Italy
Client:	Consorzio Venezia Nuova for Ministry of Public Works – Water Board - Venice
Services:	Concept, basic, preliminary and detailed design
Period:	10/1988 – 12/2002
Construction cost:	€ 2,685,600

Project Description:

TECHNITAL carried out the Preliminary and Detailed design of the sewerage network for the town of Sottomarina in the context of the project to protect Sottomarina from the high tides.

The new sewerage network, consisting of a free surface flow system for mixed sewage, was designed to connect the local sewerage system (prior to the start of the works connected directly to the lagoon by means of sewers having little or no gradient) to the treatment plant operated by the Municipality of Chioggia, thereby achieving the double objective of reducing the discharging of organic waste into the lagoon and preventing the tidal flow from rising up through the rainwater gullies.



The sewage is disposed of by pumps located in 3 pumping stations, either directly into the lagoon (when there is sufficient rainfall to guarantee adequate dilution) or conveyed to the treatment plant (when there are high concentrations of organic wastes).



The project affects the entire historic centre, the system having a total length of 950 m. Ten pumps with a flowrate of 0.3 m³/s were installed, for a total applied capacity of approximately 300 KW.

The works have been completed.



SEWERAGE SYSTEM FOR PELLESTRINA IN VENICE LAGOON

Location:	Venice, Italy
Client:	Consorzio Venezia Nuova for Ministry of Public Works – Water Board - Venice
Services:	Concept, preliminary and detailed design
Period:	06/1987 – 12/2002
Construction cost:	€ 6,663,000

Project Description:

In the context of the project to protect Pellestrina from the high tides TECHNITAL carried out the Preliminary and Detailed Design of the sewerage network for the township of Pellestrina (4200 inhabitants).



The new sewerage network, consisting of a free surface flow system for mixed sewage, is designed to operate for a certain period until the Municipality of Venice sets up a treatment plant connecting the secondary sewerage pipes from the houses and the lagoon. These sewers, which have little or no gradient, are kept clear by the tidal flow.



The system will operate in this period only in occasion of the high tides, when the sewerage outlets into the lagoon have to be closed to prevent the tidal flow from rising up through the rainwater gullies.



The sewage is disposed of by pumps located in 7 pumping stations, which at present convey it directly into the lagoon by means of underwater pipes and diffusers and which in the future, when the new treatment plant has been built, will provide the necessary head to convey the sewage there.

The project affects the entire historic centre, the system having a total length of 2800 m. Twenty-one submerged pumps with sequential operation have been installed, for a total applied capacity of approximately 300 KW.

The works have been completed.



River Regulation and Water Resource Management

RESERVOIR ON THE VANOI STREAM AND FLOODING PROTECTION FOR THE BRENTA RECLAMATION AREA

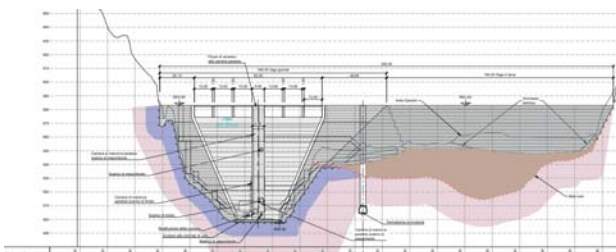
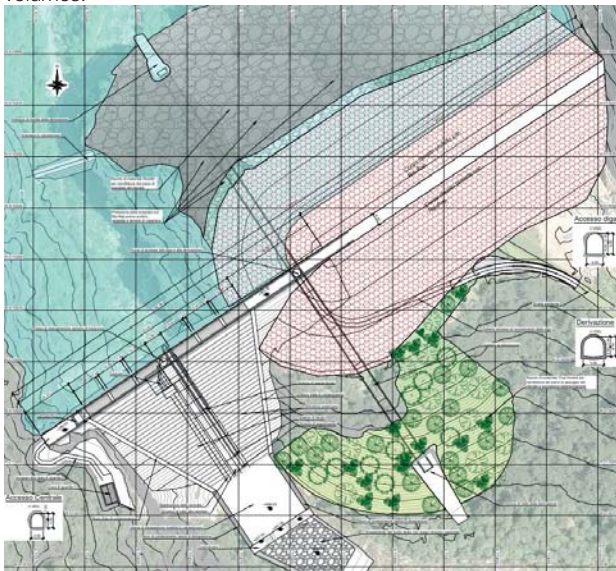
Location:	Veneto and Trentino Region, Italy
Client:	Brenta River Consortium
Services:	Feasibility study (geological study, hydrological and hydraulic analysis, environmental impact analysis)
Period:	04/2023 - Ongoing
Construction cost:	€ 170,000,000

Project Description:

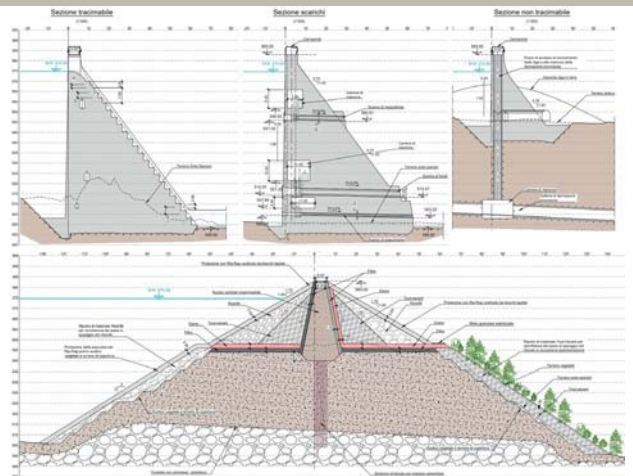
The Vanoi dam is in the municipalities of Lamon and Canal San Bovo on the river of the same name.

The objectives of the work are multiple and related mainly to the negative effects of climate change in recent decades: the primary function is the rolling of the floods, to the benefit of the territory crossed by the Cismon-Brenta, and the use of water for irrigation.

The dam involves a portion of the massive gravity dam in the riverbed and a portion in zoned ground above the plateau on the left bank. The choice of dam type has the intent to incorporate the natural morphology of the valley in this area to the dam infrastructure to strategically optimize processing and required volumes.

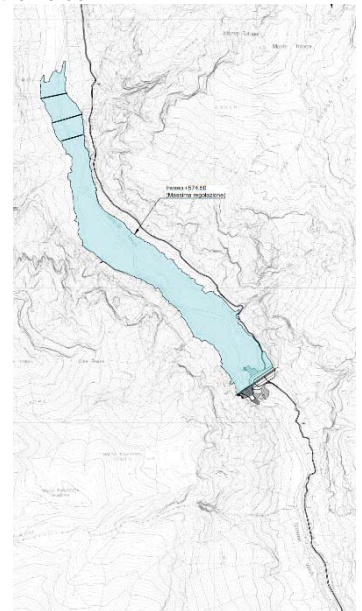


For this reason, the dimensioning of the dam took place based on the morphology and geology of the place. The width of the plateau is in fact dimensioning for the dam in zoned ground since it coincides with its foundation. The available spaces, the morphology of the area and the type of dam (in zoned land) have allowed to reach a maximum regulatory level to ensure a volume of reservoir equal to 20 million m³.



Based on the properties of the foundation materials, to be investigated through more advanced investigations, it will be possible to think on the plateau of the zone 2 to a type of dam slightly different from the dam on earth. A hardfill dam, that is a dam in cemented earth, would allow to increase the slopes of the faces upstream and downstream in favor of a greater height. If the foundation should allow this type of dam the volume of reservoir could be increased up to 25 million m³.

The dimensioning of the dam in zoned ground, in the specific of the reservoir of 20 million m³, took place therefore considering the width of the plateau and an inclination for the face of the dam in earth equal to 1 (V) 1.70 (H) both upstream and downstream. The crown, considered to be 6.00 m wide, reaches 583.00 m asl. The maximum level of regulation was determined at 574.50 m asl, corresponding to a reservoir volume of precisely 20.4 million m³. As a result, the maximum flooded area was calculated at 578.91 m asl., ensuring a franc greater than 3.00 m.



WORK SUPERVISION OF EXPANSION OF THE MONTEBELLO VICENTINO FLOOD CONTROL BASIN FOR SERVING RIVER CHIAMPO

Location:	Municipality of Montebello (Vicenza), Italy
Client:	Veneto Region
Services:	Woks Supervision
Period:	04/2023 - Ongoing
Construction cost:	€ 35,076,684

Project Description:

The area subject to intervention concerns the hydraulic system of the Chiampo-Alpone rivers, characterised by conditions of high hydraulic risk especially near the San Bonifacio junction, where at present flooding requires manual intervention with temporary guards on the embankment tops.

In brief, the project concerns the expansion of the Montebello Vicentino reservoir, so that it will serve also the Chiampo torrent. The additional area involved is of approximately 17 hectares (for a total extension of 155 hectares). It is planned to build two expansion reservoirs, separated by an embankment with a predominant north-south direction and a summit elevation of 66 m msl. The two basins are interconnected by means of a special connection placed in the southern part of the embankment separating the two basins, with the function of allowing the possible transfer of water from the western sector to the eastern sector, and vice versa.

An earth embankment with a length of approximately 2 100 m is planned to delimit the western basin. The height of the top of the embankment is set at 66 m msl, 50 cm above the maximum level of the reservoir and 1.0 m above the maximum level of the west basin.

In addition, the left bank of the Chiampo stream is to be rounded and the top of the embankment widened to make it passable for the entire section adjacent to the west till. The embankment is also adjusted in height for a length of approximately 300 m, bringing the top to a height of 66 m msl. and up to 66.5 m nsl for a length of approximately 50 m straddling the point where the wall delimiting the Chiampo overflow is grafted, the top of which is planned at 66.0 m msl.

The typical cross section of the embankment separating the two sectors, is characterized by a top width of 4.00 m while the embankments have a slope of 1:2, interspersed with banks 4.00 m wide every 5.0 m of vertical drop. In order to guarantee the impermeability of the embankment and to prevent filtration phenomena that could degenerate into dangerous siphonage, the section is also characterized by an internal core of silt-clay laid in successive and well compacted layers starting from a depth of 1.0 m from the top of the embankment and grafting at the base of the embankment up to a depth of 1.5 m from the current ground level. In both areas of the basin, the ground is levelled, giving a uniform slope towards the river discharge point. Since the agricultural use of the areas within the till is preserved, the reprofiling of the till floor includes the restoration of the topsoil for a layer of at least 50 cm.

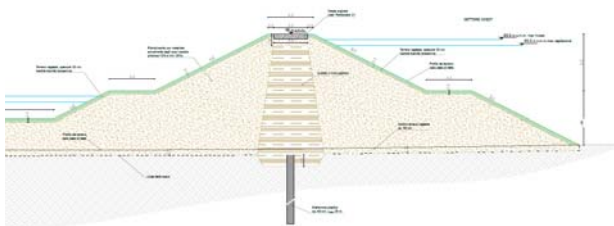


The hydraulic structures are made of:

- intake work;
- weir in the riverbed to support the water level;
- hydraulic interconnection work between the two sectors of the reservoir;
- overflow west sector;
- relief outlet of the west sector;
- overflow outlet of the west sector;
- overflow of the east sector;
- overflow discharge in Chiampo of the east sector.

The works are complemented by environmental interventions of two kind:

- wooded strips, located at the external embankment foot of the lamination basin, on the north side, in two separate areas;
- grasslands, on the embankment slopes.



FEASIBILITY STUDY FOR THE CONSTRUCTION OF MINI-HYDROPOWER PLANTS AND UPGRADING THE MULTISECTORAL WATER SYSTEM (SIMR) OF NOTH SARDINIA

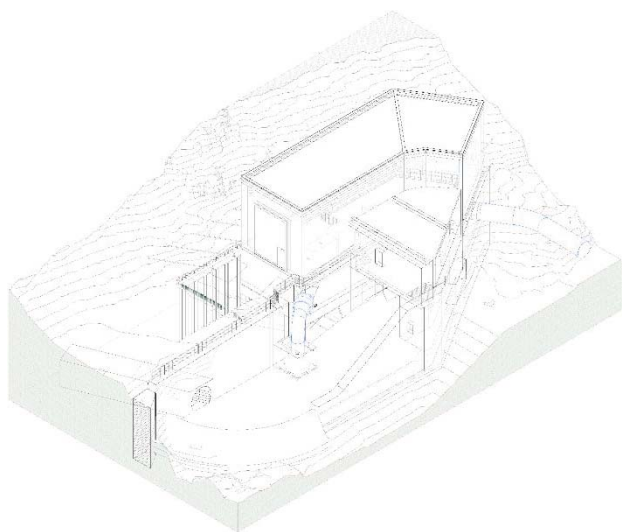
Location:	Italy, Sardinia Region
Client:	OIS – Opere Infrastrutture Sardegna
Services:	Feasibility Study
Period:	01/2023 - Ongoing
Construction cost:	€ 6.000.000 (estimated)

Project Description:

The project focus on three mini hydropower plants in the North of Sardinia. The hydropower plants are located downstream existing dams or along pipelines connecting existing reservoirs. The plants exploit the water released by the dams for different purposes (irrigation, water supply) or transferred from other artificial reservoirs. The aim of the project is to exploit the released water to produce electric energy from renewable energy in order to contribute to the objectives of sustainability of the Regional Development Programme of the Sardinia Region.

The project has been developed for the following sites:

- plant located downstream the Cuga Dam;
- plant located at the Sette Ortas weir;
- plant located along the pipeline between the Alto Temo reservoir and Bidighinzu reservoir.



Plant located downstream the Cuga Dam

The plant located downstream the Cuga Dam exploits the water released by the Cuga dam for irrigation purposes and its level of reservoir in order to produce electricity from renewable sources. In order to do that, the project involves the installation of a hydroelectric turbine located inside a new civil building.

The turbine chosen is type Francis, characterized by a nominal head of 13.50 m and a nominal discharge of 1.3 m³/s.

The annual expected production is 550 MWh/year.

Plant located at the Sette Ortas weir

The plant located at the Sette Ortas weir exploits the water transferred from the Alto Temo reservoir to the Cuga reservoir through a pressure pipeline of 1600 mm diameter.

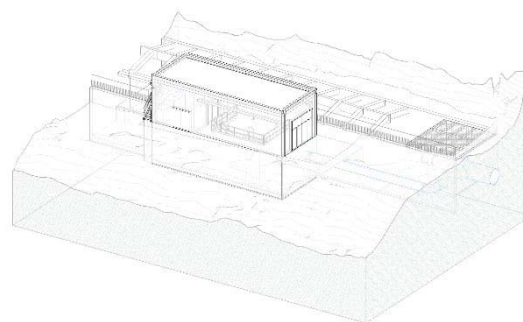
The water is transferred to fill the Cuga reservoir especially during the irrigation season.

In order to produce energy, the project involves the installation of a hydroelectric turbine located inside a new civil building.

The turbine chosen is type Francis, characterized by a nominal head of 44 m and a nominal discharge of 5.3 m³/s.

The annual expected production is 5000 MWh/year.

Plant located along the pipeline between the Alto Temo reservoir and Bidighinzu reservoir



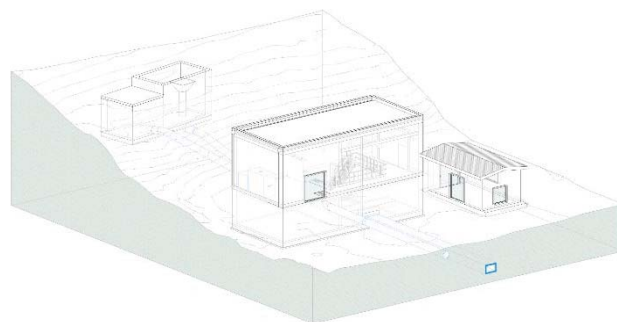
The plant located near the Bidighinzu lake exploits the water transferred from the Alto Temo reservoir to the Bidighinzu reservoir through a pressure pipeline of 600 mm diameter.

The water is transferred to fill the Bidighinzu reservoir especially during the irrigation season.

In order to produce energy, the project involves the installation of a hydroelectric turbine located inside a new civil building.

The turbine chosen is type Pelton, characterized by a nominal head of 95 m and a nominal discharge of 0.35 m³/s.

The annual expected production is 1500 MWh/year.



MAINTENANCE WORKS OF THE PERTUSILLO DAM

Location:	Italy
Client:	Commissioner for Dams by the Southern Apennine Basin Authority
Services:	Final Design
Period:	07/2022 - ongoing
Construction cost:	€ 5.000.000

Project Description:

Final design of the capital maintenance and seismic upgrading works of the ancillary works of the Pertusillo dam, including a surface spillway with 4 metal gates with related works and outlet slab and a control building (to be demolished and entirely redesigned), a bottom outlet and related control building (with major seismic upgrading works).

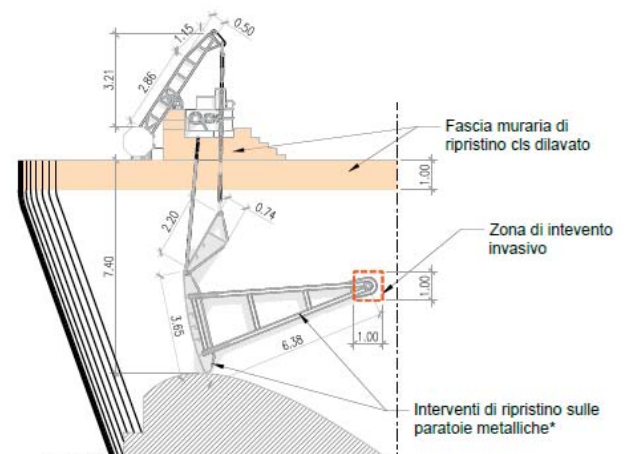
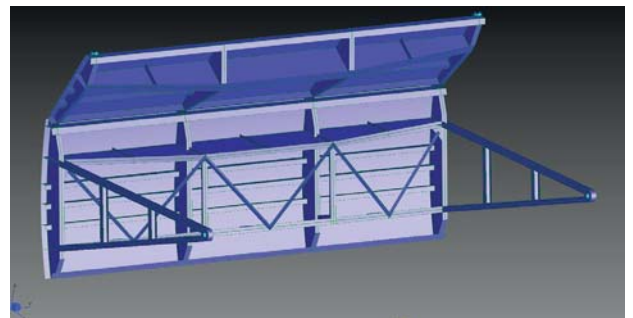
The service, in addition to the design of the retrofitting works based on a previous feasibility study, included in several cases the complete seismic re-evaluation of the work to the actual state, based on available data.

In some cases, major retrofitting interventions were necessary, with the introduction of shear walls and extensive FRP reinforcement, while in others it was possible to achieve seismic safety, both in the SLD and SLV cases, through interventions limited to critical points.

These are point accessory works serving a strategic Italian dam.

The dam is of significant size, and it is in a highly seismic zone.

The final design includes all the necessary deliverables for immediate procurement under Italian Legislative Decree 50/2016.



DETAILED DESIGN OF THE HYDRAULIC RESTORATION OF THE BIFERNO RIVER DOWNSTREAM OF THE PONTE LISCIONE DAM

Location:	Campobasso Province (Molise Region), Italy
Client:	Campobasso Province
Services:	Final Design
Period:	06/2022 - ongoing
Construction cost:	€ 200,000,000.00

Project Description:

The project aims at defining the interventions on the Biferno river envisaged in the General Preliminary Project. The purpose is the sizing all the works necessary to make hydraulically safe the sections of the Biferno river from the Liscione Dam up to the sea. In particular, the planned interventions can be summarized as follows:

- The construction of 12 expansion basins (from Basin A to Basin L), to be built in the section of the Biferno river which develops between the Liscione Dam and the bridge of the State Road 647 called Tanassi overpass;
- The adjustment of the embankment top for approximately 18 km of hydraulic embankment on the left- and right-hand side of the river, between the Tanassi overpass and the sea mouth;
- The creation of drains in the banks of the river, that must be maintained in the banks for the entry of the tributaries into the Biferno river;
- The reprofiling of the ditches in correspondence with three tributaries of the Biferno river (two in correspondence with the Basin A and one in correspondence with the Basin C);
- The excavation of the riverbed in three areas of the Biferno river, in order to reduce the water level in the river;
- The adjustment of the foundations of three bridges over the Biferno river (the old bridge over the railway, the bridge over the SS16 Adriatica and the bridge over the SS16ter);
- Raising the road level of the connecting road between the SS647 and the SS87;
- The creation of a narrowing screen to facilitate the flow transfer from the watercourse towards the expansion basin called Basin A.



The two main interventions for the hydraulic safety of the Biferno river are described in detail below: the construction of the 12 expansion basins and the adjustment of the 18 km of river embankment.

The 12 planned expansion basins will be built along the Biferno river between the Liscione dam and the Tanassi overpass, on a total surface area of approximately 580 hectares (area which includes both the area inside the basins and the encumbrances of the perimeter embankment structures). The total internal useful surface area of the basins, without the embankments, is equal to approximately 490 hectares, while the total surface area of the basins considering the axis of the embankments is equal to approximately 535 hectares.

Furthermore, the embankment structure containing the basins has a total axis length of approximately 35 km, to be built entirely with material coming from the excavations of the areas inside the basins.

The expansion basins will be able to contain, for the return time period of 200 years, a volume of approximately 13.5 million m³. Furthermore, for the return time period of 100 years, the volumes stored in the basins are equal to approximately 5 million m³, while for the return time period of 30 years the volume is equal to only 90,000 m³.

The expansion basins will be governed by an upstream intake element and a downstream discharge element, and in some cases with also the presence of a connection element. An opening of the intake structure of each basin will be protected by floodgates and therefore, even for rain events with a return time period less than 200 years, the basins will be able to store more flow than what has been simulated in the hydraulic model, thanks to the floodgates.

As an example, the project planimetry of Basin A is shown on a side.

Downstream of the Tanassi overpass, and therefore also downstream of the expansion basins, the project includes the adaptation of part of the embankments of the Biferno river. The project therefore envisages:

- Adaptation of the banks of the Biferno river with a total length of approximately 14 km;
- Construction of new embankments with a total length of approximately 4 km.

Both the new embankments and the embankment structures to be adapted will have similar geometry to the embankment structures planned on the perimeter of the planned expansion basins. In particular, embankments have a slope of $dy/dx=1/2$, with a 4.00 m wide top and an intermediate bank when the embankment reaches a height of 3.00 m. The embankments will be built with the material coming from the excavations, divided in:

- Material 1: core of the banks in fine material;
- Material 2: filling material;
- Material 3: drainage at the foot of the banks.

For the evaluation of the hydraulic critical issues in the current state along the branch of the Biferno river under analysis and for the verification of the hydraulic behavior of the system in the project state, a two-dimensional hydraulic model was implemented as part of the project, by using the HEC-RAS software.

The initial tool used for the implementation of the hydraulic models was the Digital Terrain Model (DTM) of the study area. In this case, this DTM, with a resolution of 1×1 m, was provided by the Ministry of the Environment and Protection of Land and Sea.

The project involves a large quantity of excavated material, entirely reused within the construction site for the construction of the embankments. Overall, it results:

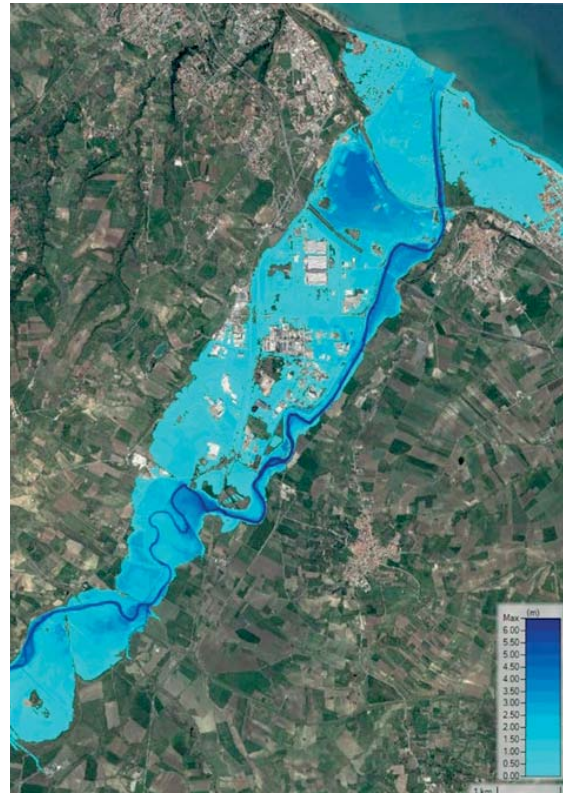
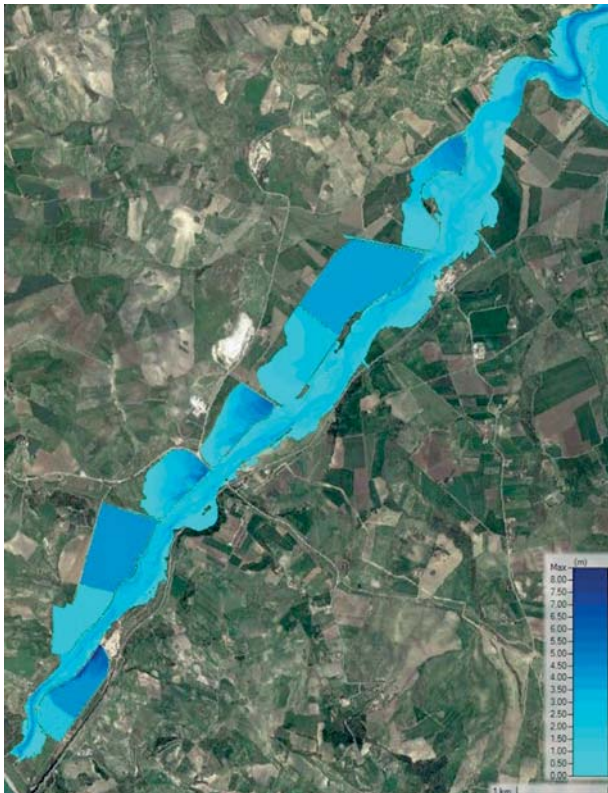
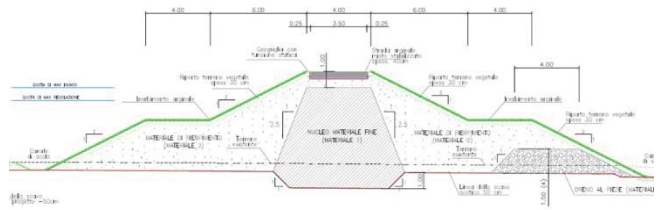
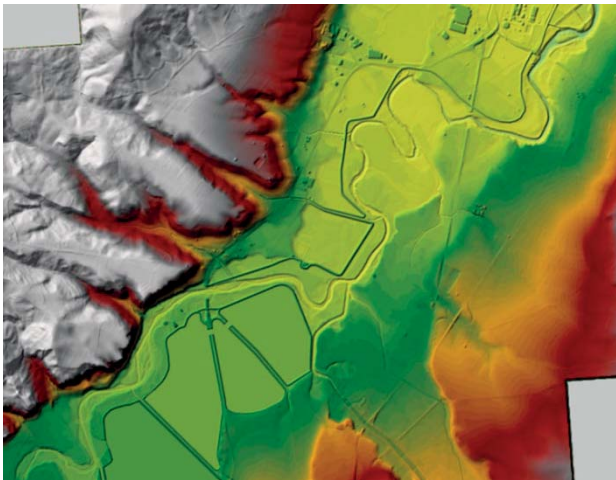
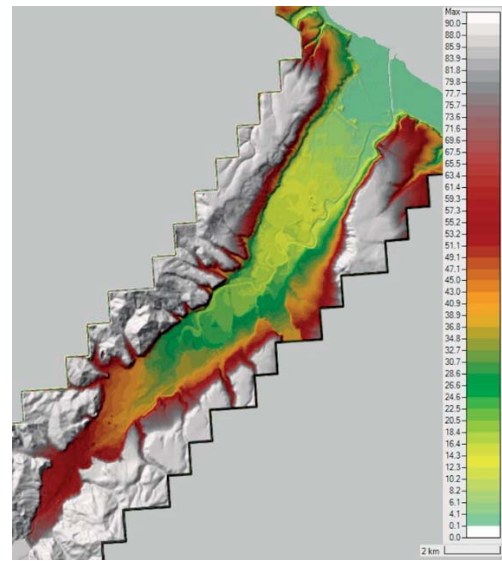
- Total excavation of 6,738,090.60 m³ of which:
 - volume of excavation material: 3,754,297.87 m³
 - superficial volume: 2,983,792.73 m³
- Volume of landfill material: 3,718,384.74 m³
- Excavation-fill difference equal to 35,913.13 m³.

The excess material, coming from the excavation in the Basin I, will be used to rise the road level in the street that connects the SS647 with the SS87, with a volume of approximately 36,000 m³ of material.

Therefore, it can be concluded that the zero balance is achieved, i.e. all the excavated material is reused within the construction site for the planned works.

Furthermore, the environmental studies necessary for the Environmental Impact Assessment were conducted in the project as the intervention in question are included in areas with sites of the "Natura 2000 Network".

In the Environmental Impact Assessment, it was highlighted that the planned intervention has an impact on various areas occupied by natural and semi-natural vegetation of different ecological value, for a total of approximately 188 ha. Therefore, environmental compensation measures have been envisaged through a specific reforestation project.



INTERVENTIONS ON THE IRRIGATION WATER DRAWING FROM THE ADIGE RIVER AND LEB CHANNEL

Location:	(Cologna Veneta – VR; Bevilacqua – PD), Italy
Client:	Consorzio di Bonifica Adige-Euganeo
Services:	Construction Supervision
Period:	06/2022 - ongoing
Construction cost:	€ 25,215,892

Project Description:

The Project consists of the replacement of existing irrigation buried devices along the Fratta river with a new hydraulic pipe, in order to avoid the PFAS (Per and Polyfluorinated Substances) contamination in the irrigated area managed by the Adige-Euganeo Consortium. The new pipe is manufactured in GRP, with variable diameter from 1800 mm to 1000 mm, and it is buried for a length of 19 km. The new pipe draws water from the artificial Leb channel, which collects pure water from the Adige River, and it supplies water for agricultural purposes by means of the derivation chambers provided.

All the pipeline interferences with roads and with the stream network are tackled; n°4 crossings, with maximum length of about 80 m, are solved with jacking pipe. The selected GRP pipe is manufactured using a continuous advancing mandrel process, to guarantee maximum resistance in the circumferential direction. The pipe is embedded in fine sand backfill material up to 70% of the diameter, and the rest with native soil (cohesive material). The pipe trench cross section is rectangular.

The company oversees the Works Supervision; the supervision team includes two Site Managers and a Site Inspector, which ensured that work was done safely and with quality, and on time.

During the works advancements, a review of the original Project was needed because of some unknown issues which have come up: for example, the hydraulic wells near the valve's chambers and the intake structure, the inadequacy of the native soil for the pipe trench backfill, etc.

The Works Supervision Team has visited the GRP pipe factory in Romania (Rorex) and has supervised the pressure tests on a pipe sample.

Work main features:

- Total length of the irrigation buried pipeline: about 19 km (DN1800, L=5.22 km; DN1600, L=6.47 km; DN1400, L=5.15 km; DN1000, L=2.02 km)
- Type of the pipe: GRP pipe, manufactured with continuous advancing mandrel process, PN 6 bar, SN 10000 N/m², coupling with elastomeric gaskets
- Maximum flow in the pipe for irrigation purposes: 2.5 m³/s
- Main structures: the intake structure drawing water from the Leb channel (135 m long); the jacking pipe crossing for four interferences of the pipeline with two roads, one railway, the Fratta river; about n°20 manholes equipped with relief valves and discharge; n°6 chambers for water diversion.

The crossed area is purely agricultural and flat. Particular attention was dedicated to the laid of the backfill material: several proctor tests were conducted to verify the correct density of the backfill material and to ensure acceptable ring deformation after laid (3-5% of the Diameter). Other focus deals with the construction of foundations and special underground works; in particular, n°4 jacking pipes were installed: for each jacking pipe, a thrust and reception pits was executed with diaphragm walls and monofluid jet-grouting columns to prevent uplift failure.



STUDY OF MITIGATION MEASURES FOR FLOOD AND HYDROGEOLOGICAL RISK OF THE CITY OF OLBIA

Location:	Sardinia, Italy
Client:	Municipality of Olbia
Services:	Feasibility study, EIA
Period:	05/2022 - ongoing
Construction cost:	€ 151,000,000

Project Description:

The urban area of Olbia is historically subject to flooding in case of heavy rainfall events. Following the severe flooding event of November 18, 2013, the Basin Authority of the Region of Sardinia undertook a study for Hydrogeological Structure Plan (PAI), to identify interventions for the safety of the hydraulic risk of Olbia. In 2014 the Feasibility Study was drawn up and, based on the results of this Study, the Municipality of Olbia developed the Final Project of the interventions, divided into 4 lots, and the related Environmental Impact Study.

The Region and Institutional Committee of the Basin Authority approved the Project as "Framework of hydraulic risk mitigation works". This Project was subsequently subject to Public Consultation.

The tasks of assignment included a detailed hydrological and hydraulic study for the definition and analysis of alternative solutions of intervention able to combine the objective of hydraulic safety with the critical issues related to intervention in an urban context such as that of the city of Olbia.

The aim of the consultancy was the identification, through a detailed hydrological and hydraulic analysis, of solutions for the safety from hydraulic risk through interventions that reduce the flow rate at the end sections of the watercourses that cross the city, i.e., an optimized combination of several types of intervention: spillway, rolling tanks, recalibration, and renaturation of the valley sections of the watercourses. The proposed solutions have been verified through modelling and maximizing, for the same overall costs, the objectives of hydraulic risk reduction by minimizing the environmental impact on the territory.

The study of alternative solutions has led to the definition of the optimal solution which is the object of the design of this assignment. The solution consists in the construction of three diversion tunnels/channels by-passing the urban center.

Hydrological Study

To analyze the hydrology of the different sub-basins of the city of Olbia, covering an area of 72.5 km², a model able to cover the overall area has been implemented.

The hydrological schematization of the study basins in their current state has been subsequently adapted to include also the different design hypotheses analyzed (expansion tanks, flood spillways, diversions) in order to evaluate in a dynamic and comparative way their effect on the modification of the flood hydrographs with respect to the actual state.

Hydraulic Modelling

The hydraulic analysis of the present situation and intervention options was conducted adopting 1D-2D models, to simulate the evolution of flooding in the riverbed and floodable areas.

For each watercourse studied was reconstructed in its actual state based on cross-sections of the riverbed extrapolated from the LiDAR survey of the Ministry of the Environment and integrated with the topographical survey, data and surveys made available by the Customer, data collected during the inspections carried out on purpose, etc.).

Design of interventions

The project has foreseen interventions to limit the water entering the urban area through:

- construction of a flood diversion tunnels (length 5.3 km, diameter 9 m) capable of intercepting the watercourses surrounding the city of Olbia (Rio Seligheddu, Rio Pasana, Rio Tannaule, Rio Paole Longa), draining the flood water in the Rio Padrongianus.
- construction of a flood diversion tunnels (length 2.1 km, diameter 6 m) capable of intercepting the Rio Abba Fritta, draining the flood water in the Rio Cabu Abbas.
- construction of a flood control channel (length 400 m, width 6 m) capable of intercepting the Rio San Nicola, draining the flood water in the Rio Zozò.

Other interventions were included in the design, regarding the upgrade of existing watercourses through the urban area of the city, described as follow:

- upgrading of the existing river courses in the city area, for a total length of 15 km;
- demolition and reconstruction of 20 road bridges;
- construction of three diversion channels upstream of the existing barrier reaches, to exclude them from their function as receptors of watercourses, since it has been verified that it is not economically, environmentally, and socially convenient to adapt them. Therefore, only sewer water receptors have been provided for culverts.

PRELIMINARY DESIGN

Diversion Tunnels/channel in the extra-urban area:

- 1 – Length 5.3 km, diameter 9 m
- 2 – Length 2.1 km, diameter 6 m
- 3 – Length 400 m, width 6 m

Total length 7.8 km

Inlet structures for the rivers:

Abba Fritta, San Nicola, Seligheddu, Pasana, Tannaule, Paole Longa

Flood diversion channel in the per-urban area:

- 1 – Length 800 m, width 6 m
- 2 – Length 1.2 km, width 4 m
- 3 – Length 400 m, width 5 m

Outfall of the main diversion tunnel towards Padrongianus River.



BARRIER AGAINST SALT-WATER INTRUSION AT THE ESTUARY OF ADIGE RIVER

Location:	Rovigo, Italy
Client:	Po Delta Reclamation Consortium
Services:	Preliminary and Detailed Design
Period:	03/2022 - Ongoing
Construction cost:	€ 32,400,000

Project Description:

The project involves the construction of a barrier against the salt-water intrusion at the mouth of Adige River.

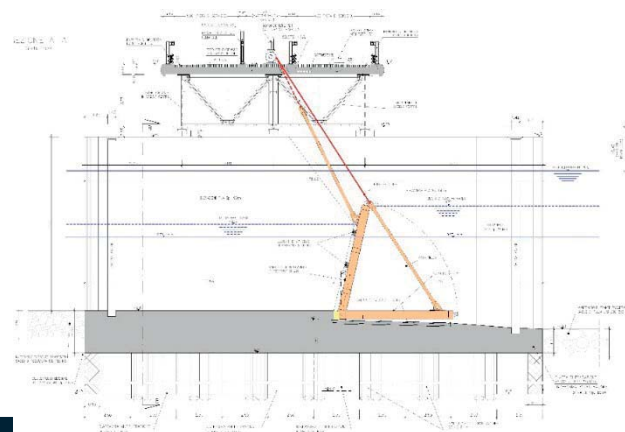
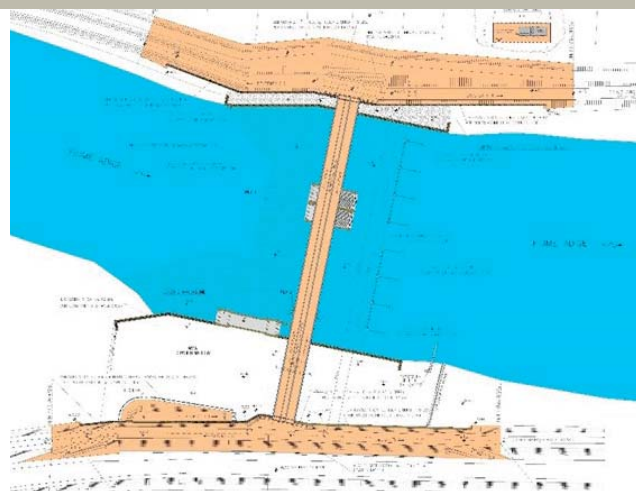
The new barrier consists of a structure equipped with a submerged bottom slab (top elevation at -4.00 m m.s.l.) supporting two piers bearing a walkway, which connects the two banks of the river, and two further additional vertical pillars, thus forming five spans of variable size equipped by steel gates. The walkway deck inner part is at an elevation of +6.00 m m.s.l. in order to guarantee the minimum clearance required in case of flooding. The two riverbanks are also raised up to +9.40 m m.s.l. using concrete diaphragm walls for a length of 230 m on each side.

The two central spans of the barrier, each 8.65 m wide, are equipped with flap gates, hinged on their bottom side, for ruling the upstream hydrometric level.

The side spans of the barrier, 39.50 m, 46.05 m and 6.60 m wide, host the 6 + 7 + 1 retaining gates hinged horizontally at the walkway deck and with opening from below.

The technical room for manoeuvring the gates is in the central part of the walkway's deck (total width of 11.90 m).

The new barrier is completed by a Navigation Lock for small boats and a Control Room.



REHABILITATION WORKS OF THE RIPASPACCATA DAM

Location:	Isernia, Italy
Client:	Molise Region
Services:	Detailed Design
Period:	12/2021 – 02/2023
Construction cost:	€ 16,823,215

Project Description:

Ripaspaccata Dam construction was finished in 1980; it is an embankment dam with impervious upstream face in concrete slabs. The Ripaspaccata is placed on the of the Voltorno riverbed, and it subtends its 228 km² extended mountain catchment.

Main current features:

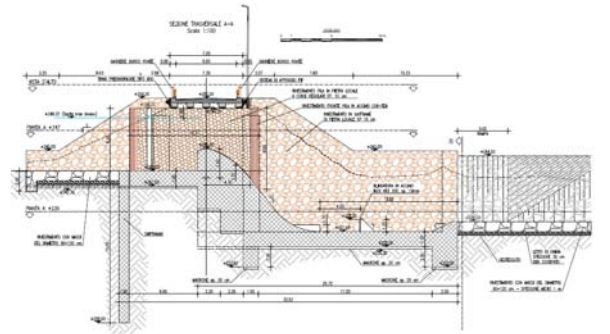
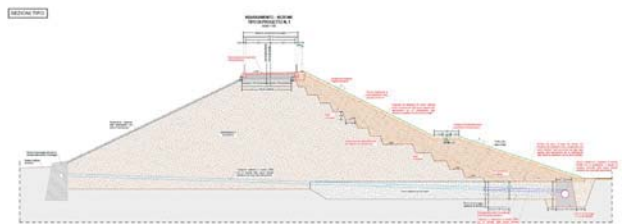
- Type of dam: embankment dam
- Height dam at the crest: 14.7 m
- Height dam at the spillway crest: 9.9 m
- Total storage volume: 3.326 Mm³
- Free board: 1.57 m
- Total volume of Dam structure: 228,000 m³
- Crest length: 593 m
- Max flow over spillway: 132 m³/s
- Max flow at outlet culvert: 299 m³/s.

The functioning of the dam aims only at prevent flooding in the downstream areas, due to the three bottom culverts placed in the discharge structure, in the left of the embankment. Originally, the flood mitigation was designed to reduce the 50 Return Period hydrograph to max 200 m³/s.

The recent hydrological studies developed on the related catchment have assessed a new project hydrograph, which matches to 1000 years Return Period, as required by the current legislation. The new desumed peak flow is greater than the current discharge capability of existing devices: to upgrade the dam devices, a new spillway with 800 m³/s discharge capability has been designed.

The new designed spillway consists of a concrete structure 83.2 m long equipped with Scimemi-Creager profile chute and USBR (type III) downstream dissipator. A new boulder channel is provided to collect the discharge flow downstream from the new spillway to the Voltorno river.

Further design measures are proposed to assure seismic performances of the dam embankment, by providing reprofiling of trapezoidal geometry of the embankment, with a gentler slope of downstream face.



FINAL DESIGN OF FOSSATELLA DAM

Location:	Macchia d'Isernia, Italy
Client:	Molise Region
Services:	Final Design
Period:	09/2021 - ongoing
Construction cost:	€ 42,701,871

Project Description:

The Fossatella storage basin is in the municipality of Macchia d'Isernia (Molise, Italy): it consists of a rockfill dam with bituminous upstream face. The dam is newly built, while the outlet discharge and the spillway with free-flow discharge channel have already been previously built.

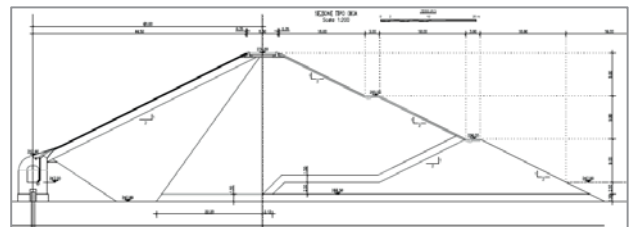
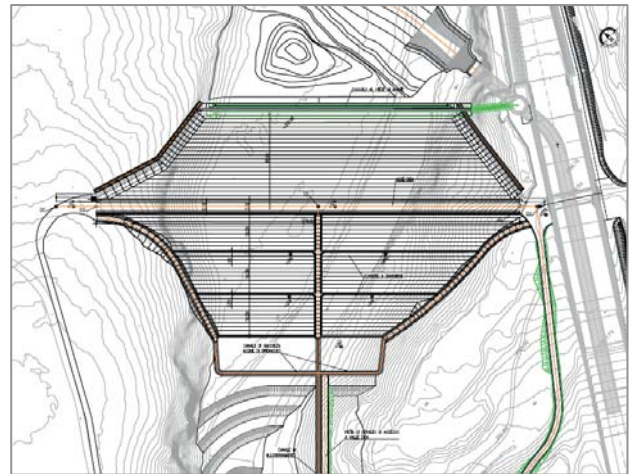
The scope of the assignment consists of:

- the hydrological and hydraulic analysis of the hydrologic basin at the dam cross-section and along 60 km downstream
- the study of the effect of the detention functioned by the storage basin
- the geotechnical and diagnostic evaluation of the site and works, both existing and newly designed.

The dam has a height of 27 m and a volume of about 290,000 m³. The dam structure lies on intensely fractured limestone rock markedly characterized by karst dissolution phenomena. This phenomenon by the presence of minutely diffuse voids and fracture corridors. Therefore, during the geognostic campaign phase, Lugeon tests and pressiometric tests were adopted for the hydraulic and mechanical characterization of the stratigraphic soil since laboratory investigations could not be carried out given the quality of the material.

Particular attention was paid to the design of the cutoff to control filtration paths below the dam body and along the abutments.

The dam basin is designed to reduce the runoff hydrograph up to 100 return period events.



Main features:

- Type of dam: rockfill dam
- Height dam at the crest: 31 m
- Height dam at the spillway crest: 23.6 m
- Total storage volume: 16.22 Mm³
- Surcharge storage: 7.19 Mm³
- Freeboard: 2.7 m
- Total volume of rockfill: 290,000 m³
- Max flow over spillway: 1,134 m³/s
- Max flow at outlet culvert: 251.05 m³/s.



DETAILED DESIGN FOR THE CONSOLIDATION AND SAFETY WORKS OF THE DISUERI DAM

Location:	Sicily Region - Italy
Client:	Water and Waste Department of Sicily
Services:	Detailed Design
Period:	05/2021 - ongoing
Construction cost:	€ 88,533,450

Project Description:

The Disueri storage basin is located in the municipality of Mazzarino (Sicily, Italy): it consists of a rockfill dam, with two spillway, two discharge tunnels, discharge outlet channel and a control building. It was built around 30 years ago, in the Disueri river, under difficult geological conditions: For this reason the Dam never came into full operation. Immediately after the completion of the works, a sinkhole appeared on the left bank, due to the dissolution of the existing rocks (chalks). Because of the sinkhole, the water in the reservoir comes out not allowing the full operation level of the reservoir..

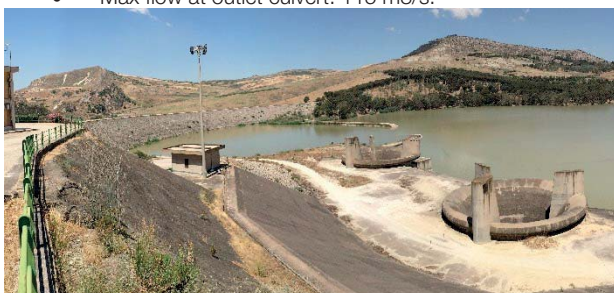
The scope of the assignment consists of:

- Project for the consolidation of the left bank and eliminations of hydraulic leaks
- the hydrological and hydraulic assesment of the two spillway,
- study of the effect of the detention functioned by the storage basin
- geotechnical and diagnostic evaluation of the site and works;
- Seismic reassessment of the Dam and the main concrete services buildings
- reservoir management and sediment removal project
- Design of a Sediment Bypass Tunnel (L= 2,00 km)

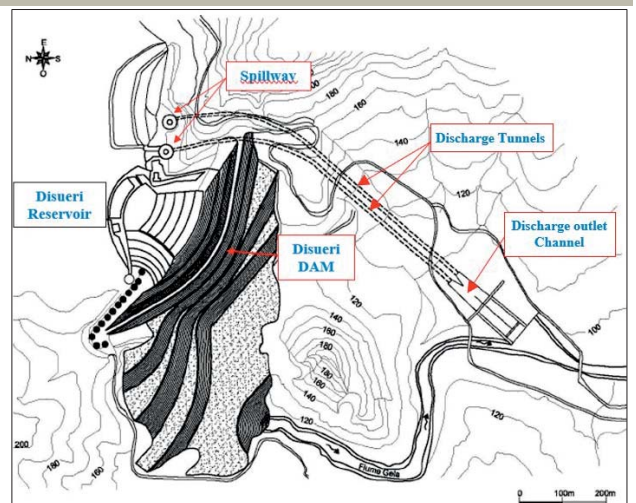
The dam has a height of 52 m and a volume of about 930.000 m³. The dam structure lies on clay rock and on the right side on fractured limestone and chalk rock markedly characterized by karst dissolution phenomena. Therefore, during the geognostic campaign phase, Lugeon tests and pressiometric tests were carried out for the hydraulic and mechanical characterization of the stratigraphic soil.

Main features:

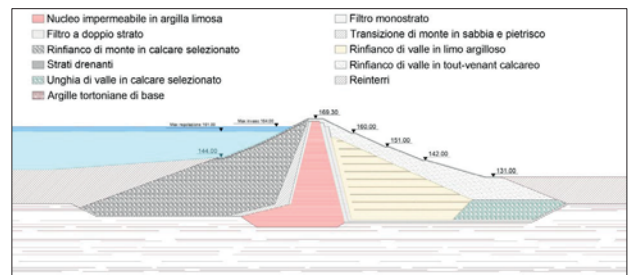
- Type of dam: rockfill dam
- Height dam at the crest: 52 m
- Height dam at the spillway crest: 43 m
- Length: 616 m
- Total storage volume: 23.6 Mm³
- Surcharge storage: 5,2 Mm³
- Total volume of rockfill: 3 M m³
- Max flow over spillway: 1650 m³/s
- Max flow at outlet culvert: 115 m³/s.



Disueri Reservoir (in foreground, the two outlet spillway)



General Plan



Main cross section of the Disueri Dam



The Disueri Dam (downstream view), in foreground, the two outlet tunnels and the discharge Channel

DETAILED AND FINAL DESIGN OF THE RESTORATION OF THE PO BETWEEN THE SECCHIA RIVER MOUTH AND OSTIGLIA (MANTUA) – CIRENE ISLAND

Location:	Italy
Client:	Cave di Quingentole Srl, Granulati Donnini Spa
Services:	Final and Detailed Design, EIA
Period:	03/2021 - Ongoing
Construction cost:	€ 27,000,000

Project Description:

The project concerns the realization of interventions aimed at the morphological redevelopment and the hydraulic safety of the section of the Po River between Camatta and the Ostiglia meander, passing through the Secchia River Mouth. These interventions are to be considered as the first phase of the master plan for the section between the Secchia River Mouth and the Boschina Island.

The main intervention involves the remodeling of the floodplain area on the left bank called Cirene Island, in order to modify the meander of Ostiglia, thus implementing the provisions of the General program for the management of alluvial sediments of the riverbed (PGS) (AdBPo, 2007). This intervention is achievable under Project Financing

The main objective of the project is to improve hydraulic safety in a section of river which appears to be significantly compromised, both due to incorrect anthropogenic interventions and to an intrinsic propensity of the river to erode the foot of the embankments generating settlements (Ostiglia, Revere and also Quingentole).

In addition, the objective is to improve the condition of navigability of a section of the river in an environmentally friendly manner.

To pursue the objectives described above, the following interventions are envisaged:

- the remodeling of the floodplain area at the Ostiglia meander (Cirene Island), including the artificial handling and removal of lithoid material
- the rise of the right main bank of the Po River in the stretch from Quingentole to Revere, having a high risk of overlapping
- the rise of the right main embankment of the Po River in the stretch from the Secchia River Mouth to Sabbioncello
- the rise of the right main embankment of the Po River in the stretch upstream of the Secchia River Mouth, between it and Camatta, as formally requested by AIPo.

The arrangement of the area of the Cirene Island mainly involves the movement of alluvial sediments deposited in the floodplain for a volume of 5.5 million m³.

An additional excavation of about 450,000 m³ is also planned at the Caimani oxbow, divided into an initial dredging to open the oxbow and periodic maintenance dredging, to guarantee the operation of the vessels serving the plant therein available to the Dealer.

The overall duration of the interventions is 12 years.

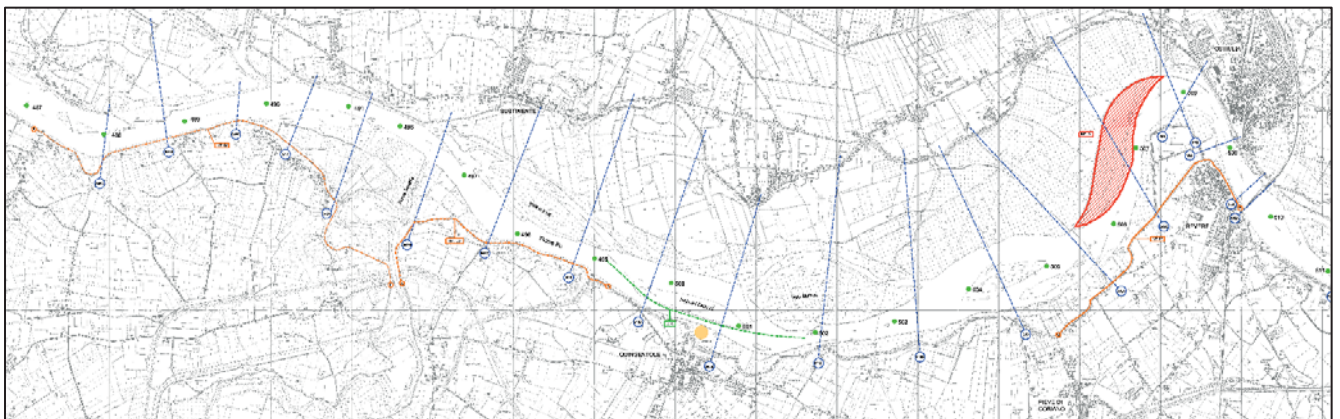
The arrangement of the section of the Po covered by the project is part of a general plan for reducing the hydraulic risk with the contextual renaturalization of the river which provides for the morphological and environmental recovery of the riverbed and riparian areas.

The first relevant intervention consists in the removal of 5.5 million m³ of lithoid material, with the simultaneous handling and relocation of 1.5 million m³ of material, to remodel the floodplain on the left hydraulic River Po, in correspondence with the Ostiglia meander. This intervention will make it possible to modify the field of motion of the flow in approach to the meander, ensuring a more regular entry to the curve and such as to reduce the erosive phenomena at the foot of the Revere embankment. At the same time, the new hydrodynamic configuration that will be obtained will make it possible to make the flow motion downstream of the meander more dynamic where, in the current conditions, instead, there is a large deposit area, both on the right and on the left side.

Finally, from the point of view of hydraulic safety and the restoration of navigability conditions, which are the two objectives of the project, the most relevant effects will be:

- reduction of tangential stresses at the foot of the Revere embankment.
- increase in the carrying capacity of the flow exiting the Ostiglia meander with consequent reduction of the sedimentation effect visible both on the right and on the left side in the areas immediately downstream of the meander.

The project also plans to carry out a specific activity of closing some cavities that represent a significant risk from the hydraulic point of view since they endanger the stability of the embankment: this is the case of the cavity at the foot of the Ostiglia embankment, in Revere and Sabbioncello.



The cavities are filled with part of the material from the excavations of the Cirene Island and from the periodic dredging of the Caimani oxbow. Part of the non-marketable fine material coming from the excavations, located in the upper layer, just below the vegetation cover, is intended to be used for closing the cavities.

In addition, some environmental monitoring activities are planned to be carried out on the Rodi oxbow. The monitoring will consist, first, in the biennial reconstruction of the sections of the emerged part and of the submerged part, using topobathimetric surveys, which will have the purpose of verifying the growth of the deposits or the natural opening in the oxbow. Biennial reports will be produced showing both a sediment balance calculation in the stretch of interest, and the comparison topobathimetric sections associated with the various monitoring phases. The reports will be accompanied by a critical analysis of the evolution in progress which may also make use of mathematical modeling.

In addition, 6 samplings of the deposited lithoid material will be carried out, to reconstruct the granulometric curve and, therefore, to evaluate any variations also in the type of material.

Together with the observations related to the morphology, an analysis of the vegetation will finally be carried out, to evaluate its evolution during the concession period.



REHABILITATION OF POMA DAM

Location:	Palermo, Sicily - Italy
Client:	Water and Waste Department of Sicily
Services:	Detailed Design - Structural and Hydraulic design
Period:	03/2021 - Ongoing
Construction cost:	€ 25,784,000

Project Description:

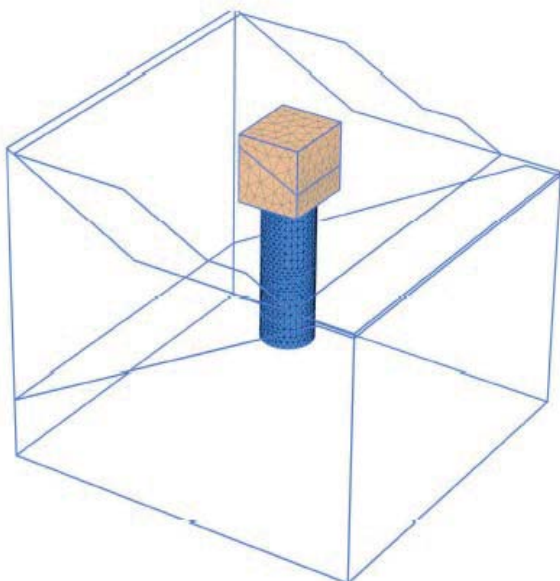
The Poma dam is located on the Jato River in the territory of Partinico (Palermo province) and it was built between 1964 and 1970. It is in loose materials with internal core of seal inclined upstream. The height is 58.60 m, and it generate a reservoir of 3.90 km² (at the height of maximum flood), with a maximum capacity of 78.3 Mm³.

The project consists of the seismic inspections of the dam and ancillary works, geotechnical study, geognostic investigations on reinforced concrete structures and related laboratory tests, study of the hydrological-hydraulic revaluation of the dam.

The analyses consist in the seismic evaluation of the dam and ancillary works in the light of the technical standards for dams (NTD 2014) and the technical standards for construction (NTC 2018).

The services provided are the following: the reassessment of seismic safety, the geotechnical study of the dam with the consequent definition of the interventions to improve the structural conditions from the seismic verification and from other related investigations; hydrological-hydraulic evaluation, seismotectonic study.

The proposed seismic upgrading interventions mainly concern the reinforced concrete works and include for the various works the execution of tie-rods, piles, hooping, reinstatement of concrete cover.



REHABILITATION OF SCIAGUANA DAM

Location:	Enna, Sicily - Italy
Client:	Sicily Region - Water and Waste Department
Services:	Final and Detailed Design,
Period:	10/2020 - Ongoing
Construction cost:	€ 29,000,000

Project Description:

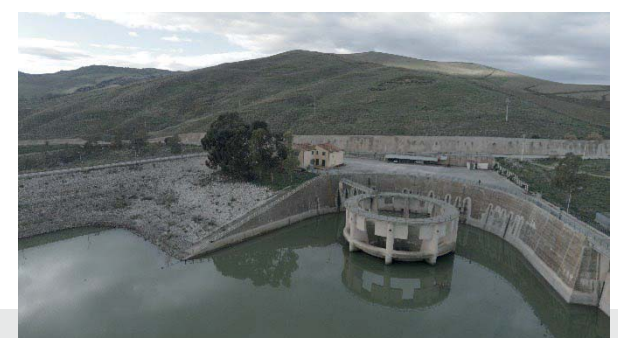
The Sciaguana Dam was built between 1984 and 1992, and it is located between the municipalities of Agira and Regalbuto in the province of Enna. The destination of the reservoir is for irrigation use by the Land Reclamation Consortium 6 of Enna, which takes care of the management of the networks of the distribution to an area of 1665 hectares of irrigated fields. The dam is of the loose material type with a sealing core and has a straight structure and a trapezoidal cross section with a width of 9.00 m at the crown and 258.75 m at the base. The structure tests are still in progress and the relative operations started on 11/03/1997.

The project consists of the seismic inspections of the dam main structure body and ancillary works, geotechnical study, geognostic investigations, tests on reinforced concrete structures, drafting of the final and the detailed design, safety coordination during the design phase of the extraordinary maintenance works on the drains and embankments downstream of the Sciaguana Dam in the municipality of Agira (EN).

The analyses consist of the seismic evaluation of the dam and the ancillary works considering the technical standards for dams (NTD 2014) and the technical standards for construction (NTC 2018).

The following services are provided: the assessment of seismic safety, the execution of the geotechnical study of the dam with the consequent definition of the interventions to improve the structural conditions from the seismic verification and other related investigations. Final and detailed design and safety coordination during the design phase, for the extraordinary maintenance of the bottom outlet plants.

The proposed seismic upgrading interventions mainly concern the reinforced concrete works and include for the various works the execution of tie-rods, piles, hooping, reinstatement of cover irons.



DESIGN OF THE RIVER DEFENCE WORKS OF ILLASI RIVER

Location:	Municipality of Illasi (Verona), Italy
Client:	Infrastrutture Venete S.r.l.
Services:	Concept design, Preliminary Design, EIA, Detailed Design
Period:	10/2020 – 05/2022 (Concept Design) – Detailed Design ongoing
Construction cost:	€ 20,636,991

Project Description:

During the months of October and November 2018, the Veneto Region territory was hit by weather events that caused serious damage to the forest heritage, as well as to public and private property in mountain and coastal areas and near major rivers with strong winds, sea storms, landslides, and mudslides.

The service required the design of hydraulic works to reduce or delete the risk of flooding of the Illasi river.

the catchment area of the river is subject to erosion, which has led to overbanking. During past flood events, many cubic metres of material were transported from the upstream part of the basin downstream.

The height of the riverbed in the section in question is currently higher than the ground level.

The main intervention to reduce the risk of flooding consist in the excavation of the riverbed to remove the overbanking and the sediments and lower the level below ground level.

Design activities:

The service included the following activities:

- Concept and Preliminary design
- Hydrological study carried out with a HEC-HMS model.
- Hydraulic modelling of the river in several scenarios: existing, design scenario for different value of discharge, with a 2D model using HEC-RAS.
- Sediment transport analysis, by model simulation carried out with BASEMENT.



- Topographic survey of the river area included survey of about 100 cross sections of the river.
- Geological survey and investigation of the quality of the ground to excavate.
- Environmental Impact Assessment,
- Traffic study for the disposal of the excavated material.
- Detail design of the river works.

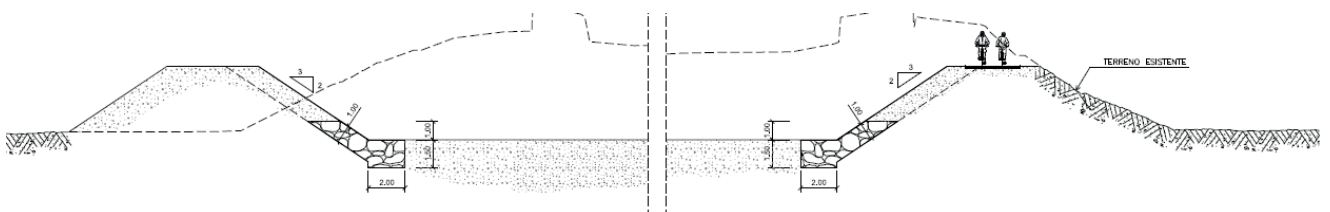
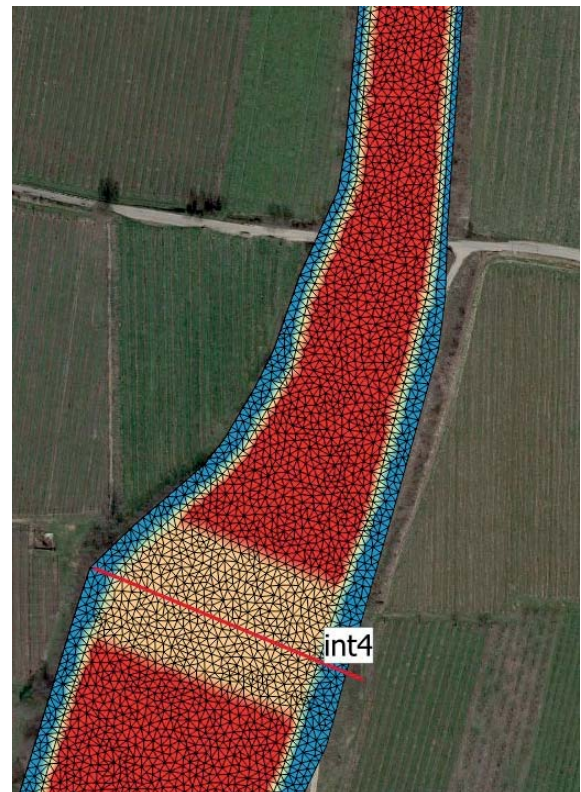
Design criteria:

The river Illasi in its actual condition has a gradient of about 2 % with about 8 weirs with a height from 2 to 8 meters. The width of the river is about 80 m in the upstream section and 30 m downstream.

The hydrological study showed the values of the flow rates for different return periods. The 1 in 200 years period was selected for the dimension of the hydraulic works, as required by the Italian regulation NTC2018 (Norme Tecniche delle Costruzioni 2018).

The excavation of the riverbed necessary to reduce the risk of flooding, has an extension of about 4'400 m and it has a volume of about 1'800'000 m³. Together with the excavation, the intervention required the revetment of both the bank of the river with stones, to avoid erosion of the toe.

Three inline structures, weirs, of about 2 meters height were required to fix the gradient of the riverbed of about 2%.



REHABILITATION OF VILLAROSA DAM

Location:	Enna, Sicily - Italy
Client:	Water and Waste Department of Sicily
Services:	Final and Detailed Design
Period:	08/2020 - Ongoing
Construction cost:	€ 13.274.000

Project Description:

The Villarosa dam was built between 1969 and 1972, and it is located on the Morello Stream, tributary of the Southern Imera River, in the territory of the Villarosa Municipality. The reservoir is intended for irrigation use in favor of the Consortium of Reclamation 6 of Enna, which takes care of the management of networks under the reservoir. The dam is in loose material with a sealing core and has a straight-line structure and a trapezoidal cross section. The dam is 33,40m high, the height of the crest is 396,00m asl, the planimetric development is 450m. The dam volume is 1,56Mm³. The maximum retention quote is 393,71m asl, the maximum regulation 392,50m asl and the minimum regulation 372,00m asl

The activities include the seismic inspections of the ancillary works of the dam, management project of the reservoir, the final and detailed design and safety coordination during the design phase of the interventions of extraordinary maintenance of the discharges of the Villarosa Dam managed by the Sicilian Region.

The analyses consist in the seismic evaluation of the dam and the ancillary works in the light of the technical standards for dams (NTD 2014) and the technical standards for construction (NTC 2018) as well as the reservoir management project.

The following services are provided: the reassessment of seismic safety, the geotechnical study of the dam with the consequent definition of the interventions to improve the structural conditions of the dam, from the seismic verification and other related investigations. Reservoir management project, final and detailed design, and the safety coordination during the design phase, for the extraordinary maintenance of the discharge systems

The proposed seismic upgrading interventions concern the surface outlet with the chutes and regulation gates, the intake tower, the access walkway to the intake tower, the bottom outlet gallery, the guard house, and the dissipation tank.



FINAL DESIGN, DETAILED DESIGN AND SUPERVISION OF WORKS OF THE DETENTION BASIN CALLED “PRA’ DEI GAI”

Location:	Prà dei Gai, Italy
Client:	Regione Veneto
Services:	Final Design, Detailed Design, Works Supervision
Period:	03/2020 – ongoing
Construction cost:	€ 22,604,168

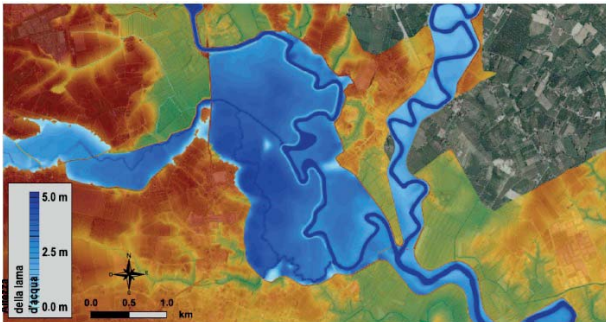
Project Description:

The project deals with a detention basin located at the Prà dei Gai land in the norther-east Italy in Treviso district. The basin aims at temporarily retain floodwater during flood events in the Livenza river, before the confluence of the tributary Meduna.

Scope of the work consists of mitigation of flood damages during high water events and reduce the peak flow downstream.

Livenza river extends 111 km in length and it covers a catchment of approximately 2,200 km². The Cellina and Meduna rivers represent main tributaries, giving the main contribution to flood due to the mountain catchments.

The identified area comprises a 750 ha large countryside, which currently is submerged by water as far as the water level in Livenza increases; nonetheless, when the peak flood flow passes, the basin is already filled, and its volume does not concur to the moderation of flood.



Therefore, the project provides the construction of 6 km long river bank to separate the Livenza river from the Prà dei Gai land and a 150 m long spillway equipped with 10 sluice gates to divert the flood volume into the detention land. This arrangement permits to exploit the Prà dei Gai land for flood control. Other secondary facilities are designed to manage the store of captured volume, i.e. reinforcement of existing banks, and for releasing water flow after the recession of flood hydrograph.

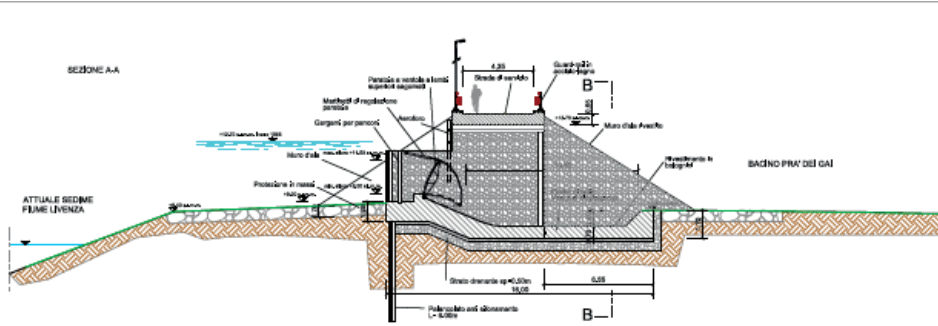


To support the design process, many efforts have been implemented to simulate the propagation of flood wave into the basin land in an accurately manner. In particular, a 2-d numerical model has been applied to investigate the filling process of the detention land and two physical models have been applied for two scopes:

- A physical model in 1:20 geometric scale, implemented in Froude similitude, to simulate the prototype of the spillway structure. The sought data concern the discharge coefficient at the change of gate opening ratio
- A physical model in distorted geometric scale (1:500 horizontal, 1:50 vertical), to simulate the propagation of the captured flow into the detention basin.

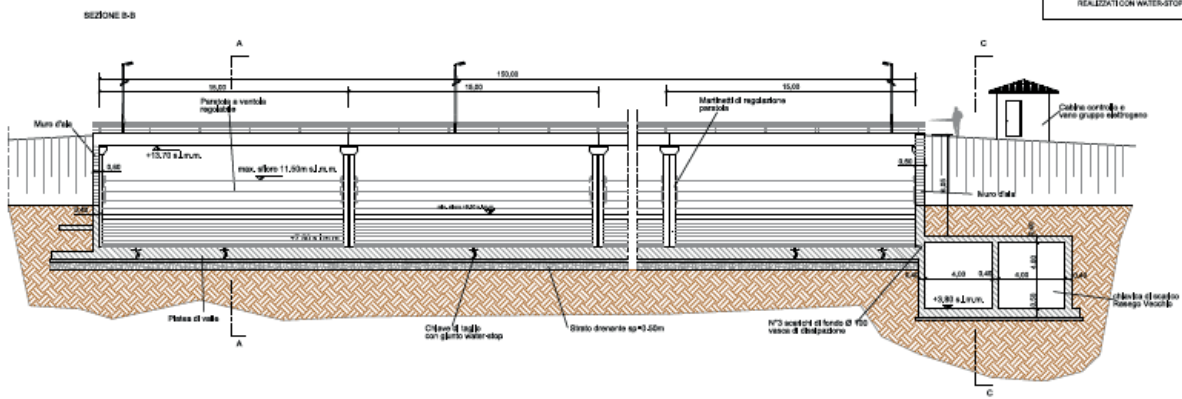
Hydraulic modelling activities implemented during the final design:

- Hydrological Model
- 2-D numerical model for hydrodynamic simulation of flood propagation along the rivers
- 2-D numerical model for flood propagation inside the detention basin
- Physical model in geometric scale 1:20 of the spillway structure at the intake of the detention basin
- Physical model in distorted scale 1:500 (horizontal) and 1:50 (vertical) to simulate the propagation of the floods inside the detention basin.



NOTA: LE QUOTE ALTIMETRICHE DEL TERRENO SONO ESSEZIALI DAL 1980/0 TOPOGRAFICO SVOLTO IN AMBITO DEL PROGETTO GOVERNATIVO

NOTA: I QUANTI DI STAZIONE DEVONO ESSERE REALIZZATI CON WATER-STOP A TENUTA



FLOOD DEFENCE MEASURES FOR THE RIO MALTEMPO IN GENOA

Location:	Genoa, Italy
Client:	Municipality of Genoa
Services:	Feasibility Study; Detailed Design
Period:	11/2021 – 02/2024
Construction cost:	€ 20,718,808

Project Description:

The project aims at reducing the hydraulic risk caused by the Maltempo stream, a steep tributary of the Polcevera river, located in the west part of the city of Genoa. Maltempo stream catchment is divided in a bigger natural part, located upstream, and a smaller highly urbanized part, downstream.

This solution envisages the collection of the discharge peaks of the upstream Maltempo catchment and the transfer to the adjacent and larger Torbella stream, whose flood defenses already needs to be adapted for its design discharge. Moreover, an adaptation of the Maltempo stream manhole, located in the last 600 m before its outlet in the Polcevera river, is designed to let the reduced Maltempo stream discharge flow without reaching its capacity.

The solution is divided in three main sections:

1) Maltempo diversion tunnel:

It is approximately 550 m long and is formed by the following parts:

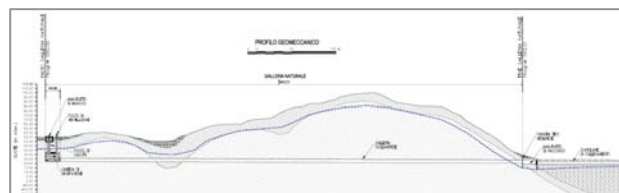
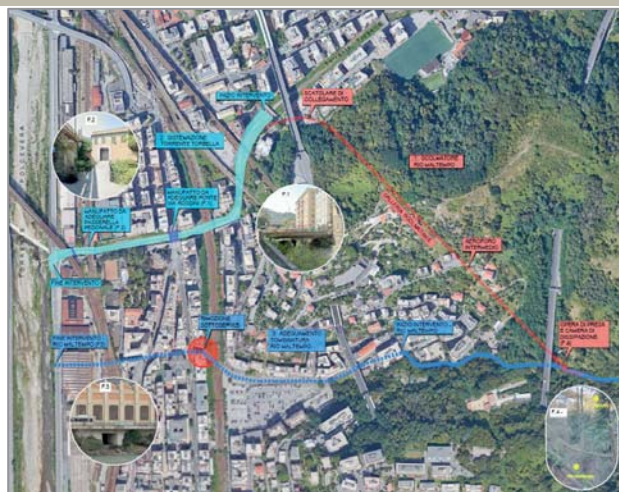
- intake composed by a spillway, a rectangular inlet concrete channel, an entrance structure up to a vortex that leads to a fall well (2.9 m diameter) about 25 m height, a dissipation chamber (9 m diameter) about 15 m long.
- connecting horseshoe tunnel about 535 m long (3.2 m diameter).
- connecting manhole from the tunnel to the outlet in the Torbella stream (approximately 100 m long).

2) Interventions in the Torbella stream:

- lowering of the riverbed and insertion of a protective covering in the part most stressed by the flow.
- demolition and reconstruction of two bridges, which crosses the stream and reduce the flow cross section.

3) Adaptation of the Maltempo stream manhole:

it consists of the removal of several pipelines that crosses the manhole cross sections and reduces the flow area. Without these interferences the discharge can flow without major constraints.



REHABILITATION OF GIBBESI DAM

Location:	Sicily, Italy
Client:	Water and Waste Department of Sicily
Services:	Feasibility Study, Final and Detailed Design
Period:	11/2020 – 11/2023
Construction cost:	€ 30,000,000

Project Description:

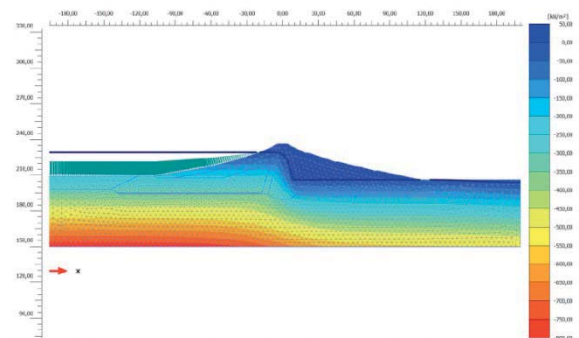
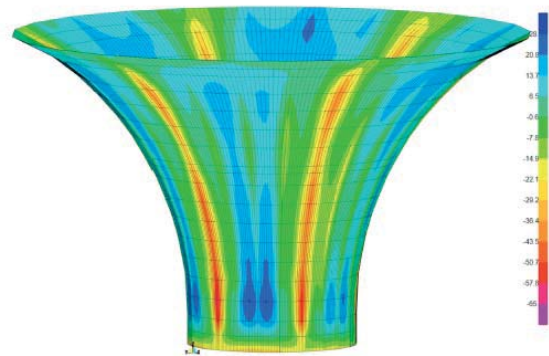
The dam on the Gibbesi torrent was built between 1969 and 1983, it is an earth structure with a vertical central core, immersed in a compact impervious clay base formation. The height of the dam is 30 m (L. 584/94); the volume is equal to 1,72 Mm³. The maximum quote of the reservoir is 231,50, the maximum level of regulation is 229,00 and the minimum level is 219,00. The crown, at an altitude of 236.00 m above sea level, is 607 m long and 8 m wide.

The project is about the seismic evaluation of the dam and of the structural works of the plant, study of the neutral pressures and of the filtration motions in the dam and in the banks, technical and economic feasibility, final and detailed design of the extraordinary maintenance of the connection road between the guard house and the sluice gate well, re-efficiency of the monitoring and control instrumentation of the dam and of the banks of the Gibbesi dam in the territory of the Municipality of Sommatino (CL) managed by the Sicilian Region.

The analyses consist in the seismic evaluation of the dam and ancillary works in the light of the technical standards for dams (NTD 2014) and the technical standards for construction (NTC 2018).

The services provided are the following: evaluation of the seismic safety, the geotechnical study of the dam with the consequent definition of the interventions to improve its structural conditions, starting from the seismic verification and other related investigations. Interpretative study of neutral pressures and filtration motions in the dam and banks, technical and economic feasibility, final and detailed design of the road connecting the guardhouse to the sluice gates, re-efficient monitoring, and control instrumentation.

The proposed seismic upgrading interventions mainly concern the reinforced concrete works and include for the various works the execution of tie rods, piles, hooping, reinstatement of concrete covers.



DECOMMISSIONING OF LOW BUNNARI DAM AND NEW HYDRAULIC TUNNEL BYPASS

Location:	Sassari, Sardinia, Italy
Client:	Municipality of Sassari
Services:	Preliminary Design
Period:	06/2022 – 06/2023
Construction cost:	€ 4,680,000

Project Description:

The low Bunnari Dam is one of the oldest dam built in Italy, and it was executed for water supply to the Sassari settlement. The construction was finished in 1878; it is a gravity dam constructed from stone masonry; it is placed on the homonymous river, and it subtends to a 18 km² extended catchment.

Main current features:

- Type of dam: gravity dam constructed from stone masonry
- Height dam at the crest: 27.50 m
- Height dam at the spillway crest: 26 m
- Total storage volume: 0.456 Mm³
- Total volume of Dam structure: 19,000 m³
- Crest length: 55 m
- Max flow over spillway: 105 m³/s
- Max flow at outlet culvert: 5 m³/s.

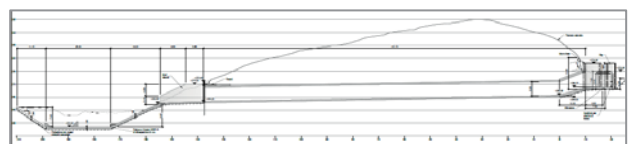
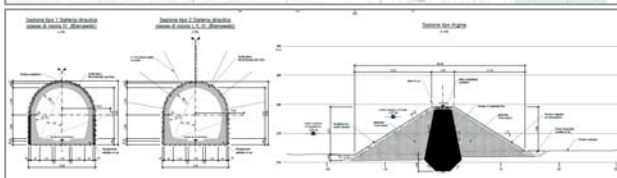
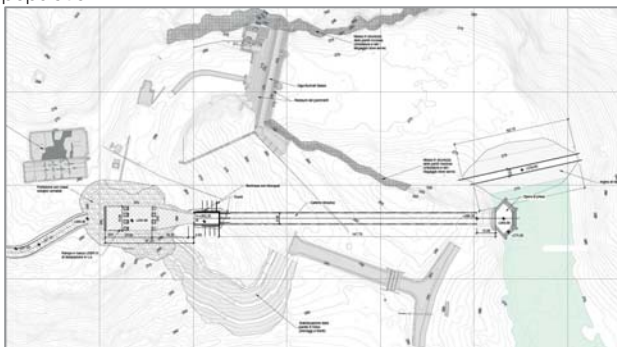
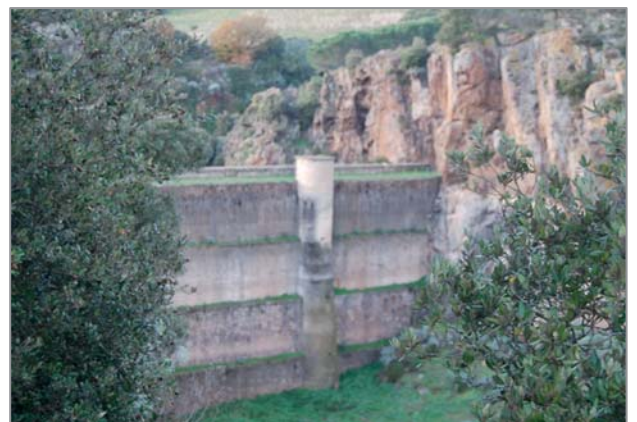
The low Bunnari Dam is not more functioning since 1980 approximately, due to the age of equipped outlet devices and uncertainties about dam stability.

The Operator of the dam has decided to analyze the current performances of the dam and assessed the partial decommissioning of the dam: the main reason arises from the possibility that heavy rainfall can provoke a dam break.

The project starts with hydrological studies of the catchment, the geotechnical and structural studies about the dam masonry: in the current state, the dam is not adequate to manage flooding and to retain the hydraulic thrust with respect to the current legislation. However, the historical significance of the old dam must be preserved, and no dismantle operations have been proposed.

To manage flooding a 150 m long hydraulic bypass tunnel has been provided, designed for 500 Return Period rainfall event. Furthermore, a 7 m high zoned embankment is proposed on the back of tunnel intake to create water level and avoid water thrust on the existing dam.

An environmental impact study has done: the new works asset guarantees the creation of a new wetland in the old water storage zone, with beneficial impact on the existing fauna and flora population.



UPGRADING OF PERSANO DAM

Location:	Campania Region, Italy
Client:	Consorzio di bonifica Destra Sele
Services:	Preliminary Design, Detailed Design
Period:	06/2018 – 05/2023
Construction cost:	€ 4,498,540

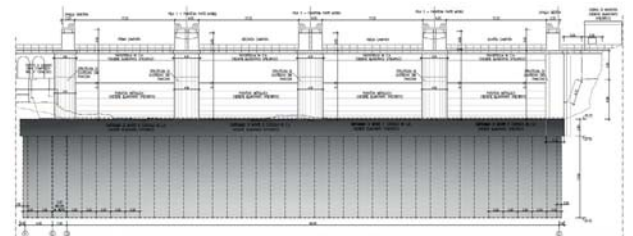
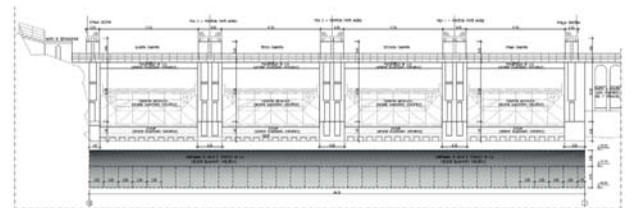
Project Description:

The Persano crosspiece is located at Persano, in the municipality of Serre (SA); the structure is functional for deriving the flows necessary for irrigating the drainage districts crossed by the Sele river.

The structure of the work consists of a fixed part, with static gravity operation, and a mobile part consisting of four sector gates, each measuring 17x6 m. Upstream of the main work, there is also the bottom outlet, capable of releasing the outflowing flow, downstream of the crossbar.

The activities carried out concerned the following:

- the functional verification of the structure and complementary works, such as the bottom outlet and electromechanical works, both in the ordinary state and in the factual state.
- The search for the causes that have generated ageing and damage processes, with exploratory investigations and numerical simulations.
- Identification of adaptation and improvement interventions, with more than one aim:
 - i. Functional restoration of the works, for the benefit of the Customer's management activity and to safeguard the hydromorphological structure of the watercourse.
 - ii. Adaptation to the compulsory regulations DM 26.06.2014 - "Technical Standards for the design and construction of retention barrages (dams and crossbars)".
 - iii. Recognition of the interventions considered a priority, in agreement with the Client, through a SWOT analysis (Strengths - Weaknesses - Opportunities - Threats)



CONSOLIDATION WORKS AND UPGRADE OF THE INSTRUMENTATION SYSTEM FOR GOVOSSAI DAM

Location:	Nuoro, Sardinia, Italy
Client:	Abbanoa S.p.A.
Services:	Preliminary Design
Period:	04/2022 - 02/2023
Construction cost:	€ 10,179,226

Project Description:

Govossai Dam construction was finished in 1950; it is a gravity dam, realized with rock boulders bound with cement mortar. The Govossai dam is placed on the of the homonymous river, and it subtends its 30 km² extended mountain catchment.

Main current features:

- Type of dam: gravity dam
- Height dam at the crest: 33.12 m
- Height dam at the spillway crest: 30.12 m
- Total storage volume: 3.75 Mm³
- Free board: 1 m
- Total volume of Dam structure: 35,408 m³
- Crest length: 122 m
- Max flow over spillway: 427 m³/s
- Max flow at bottom outlet: 7.5 m³/s.

The primary purpose of the Govossai dam fulfills domestic water supply. The operator of the dam is Abbanoa S.p.A., which is the main Authority in Sardinia for domestic water distribution.

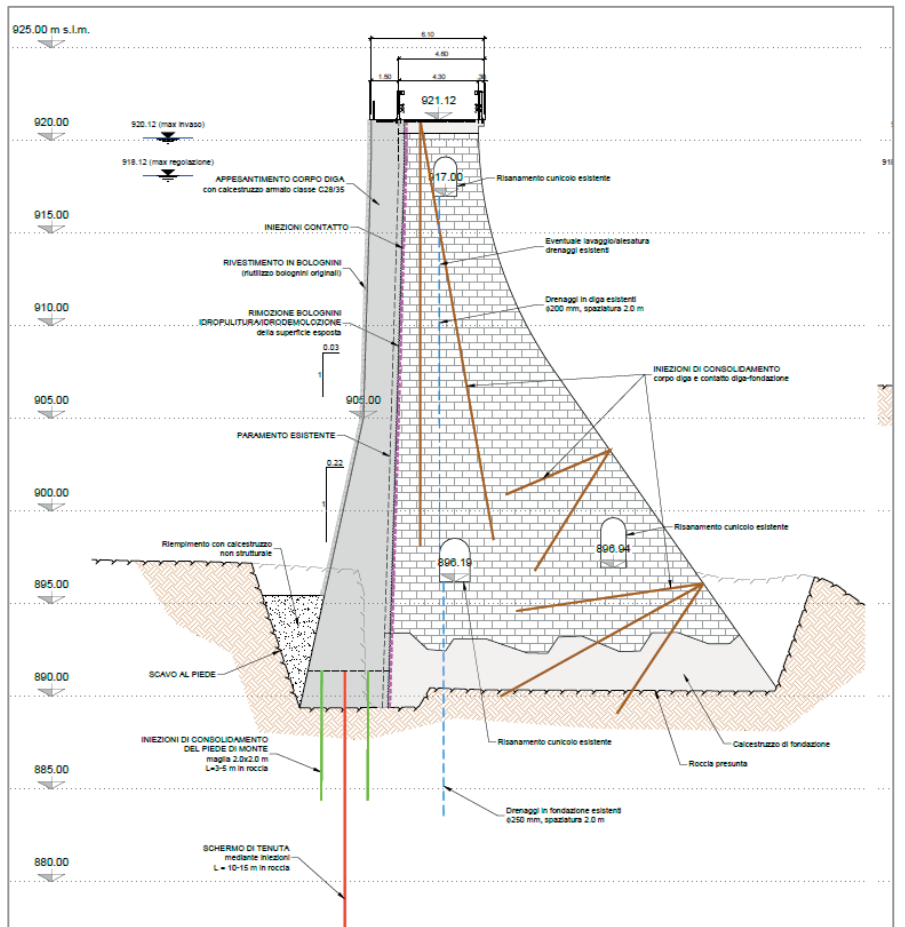
In the past decades, the dam was characterized by large and diffuse water seepage infiltration through the dam structures, which have been monitored and controlled by the installed piezometers system. The Operator decided in the past to execute some specific interventions to solve or limit the seepage in the dam structure and avoid the progressive erosion of cement mortar in the interstices of the rock boulders. Despite of new cement mortar injections, executed in the two past decades, the seepage problem is still occurring. Furthermore, the statics of the dam does not fulfill the current legislation, and a new transversal geometry is required to reach the static equilibrium.

The project starts with a general review of the status of the dam, with the aim of understanding what is need of rehabilitation and improvement to guarantee its future safety and operation capacity. This assessment has been supported by a specialistic geotechnical and structure survey of the dam, with systematic Lugeon tests inside the dam body to evaluate the retaining impervious features.

The intervention consists of a new concrete retaining wall to execute upstream the existing dam with these multiple goals: the achievement of static stability required by the legislation; the achievement of acceptable impervious conditions to avoid water infiltrations.

Ancillary works has been provided to maximize the operation capacity of the dam: rearrangement of the instrumentation system, rehabilitation of the existing spillway and downstream channel, rehabilitation of the bottom outlet and the intake tower for supplying water.





MONTELERNO DAM - SEALING AND DRAINAGE SYSTEM AND STRUCTURAL CONSOLIDATION - FINAL AND DETAIL DESIGN

Location:	Pattada, Italy
Client:	ENAS (Ente Nazionale Acque Sardegna) National Water Authority Sardinia
Services:	Final and Detail Design
Period:	10/2021 - 01/2023
Construction cost:	€ 7,000,000

Project Description:

Montelerno Dam was built between the 1971 and 1980 on the Rio Mannu di Pattada at Montelerno.

In the event of a flood and a sudden increase in the reservoir level occurred in December 2004 and January 2005, a high increase in leakage and underpressure was found under some of the dam's segments, as well as modest displacements both in the transverse direction downstream and in the longitudinal direction.

This event resulted in a limitation in operation to an elevation of 550 m a.s.l. during normal operation and to an elevation of 555 m a.s.l. during flood events. This problem was attributed to an insufficiency of the ascending drainage system associated with a limited functionality of the screen and seams.



The dam on the Rio Mannu di Pattada at Monte Lerno (Sassari), of the ordinary concrete gravity type with a rectilinear planimetric course, is for irrigation and drinking water use, with prior production of electricity at the Ozieri power station.

The dam consists of 15 segments (numbered from 0 to 14, even numbers on the right) of which the three central ones (1, 0 and 2) are overflowable. The distance between the vertical joints separating the segments is 15 m for the bank segments and 16.7 m for the overflow segments.

Main features:

- Type of dam: Concrete dam with segment
- Height dam at the crest: 67.50 m
- Height dam at the spillway crest: 23.6 m
- Total storage volume: 76 Mm³
- Max flow over spillway: 420 m³/s

The scope of the assignment consists of:

The planned interventions aim to remove the current reservoir limitation for the purpose of using the invaded resource to its maximum potential, in full compliance with the dam's safety requirements pursuant to the "Technical Standards for the Design and Construction of Retaining Dam", referred to in Ministerial Decree 14/06/2014 (NTD2014).

Two geological investigation campaigns were conducted in 2017 of the Feasibility Study and as second one conducted in 2022, performed for to the present Final-Detail Design.

The activities carried out in this project are as follows:

- Topographic survey carried out with the aid of static 3D laser scanner instruments, and Lidar from drone, supported by a topographic and GPS campaign aimed at georeferencing the acquired models.
- Hydrological and hydraulic assessment spillway and outfall for different critical events.
- Analysis of the geological data from previous surveys
- The dam consolidation works aimed at re-establishing the level of safety required by the regulations in force regarding the stability of dams.

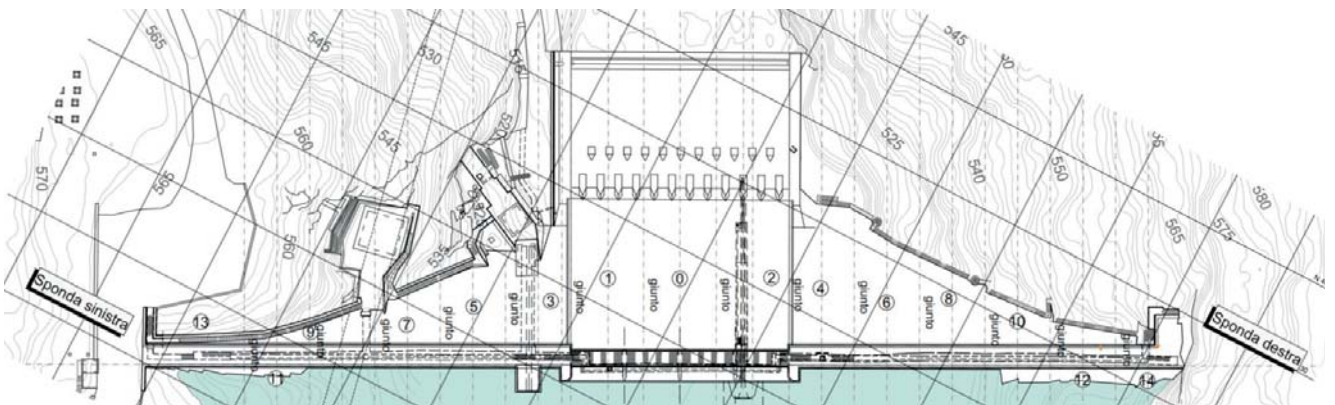
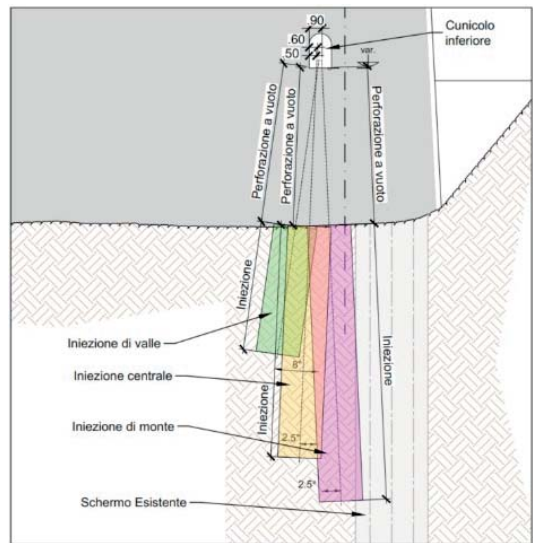
The main interventions proposed consist of a restoration of the sealing screen by means of injections, the construction of a new drainage screen and the consolidation by means of injections of the contact between foundation and rock under segments C4, C6 and C8.



In order to achieve an adequate safety level for the normal regulation and maximum flood levels, structural consolidation work was proposed on the 3 segments characterized by the lowest safety coefficients calculated by means of the dam stability analyses (C4, C6, C8). In order to achieve this objective, it is planned to construct shear keys at the joints between segments C8-C6, C6-C4 and C4-C2, to allow the transfer of shear forces between these segments and thus achieve a sufficient level of safety for the entire dam. The safety intervention is classified as an improvement intervention according to NTD2014.

The injections will be pushed to a depth of 8 m below the dam foundation level and will be carried out partly from the perimeter trench and partly from the downstream face, with different inclinations downstream and upstream to affect the entire volume of rock mass under the foundation, within the above-mentioned intervention depth.

The injections will be carried out under pressure following the GIN control method and injecting separately through each valve using packers. At the highest injection position, the top packer will be positioned 0.5m above the rock-concrete contact (distance measured along the direction of drilling) to ensure that the contact itself will be clogged when open.



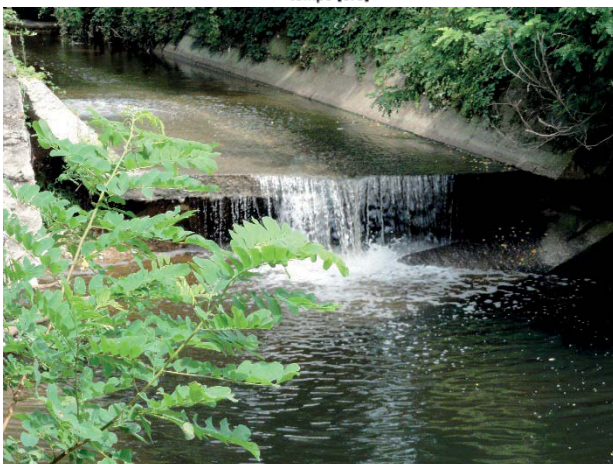
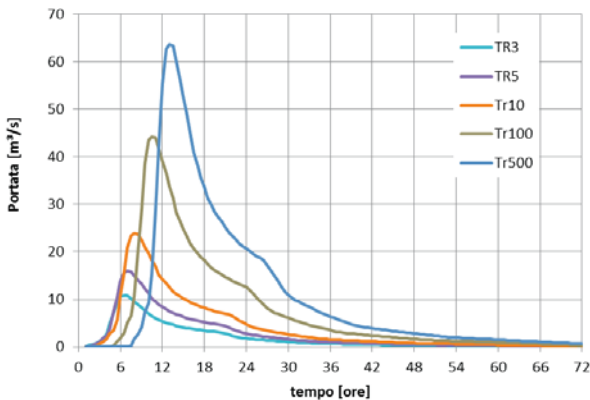
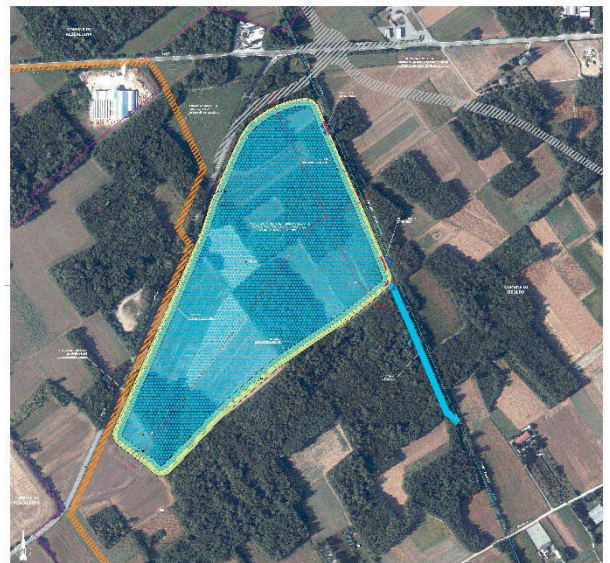
FLOOD CONTROL WORKS ON THE BOZZENTE RIVER

Location:	Italy
Client:	Infrastrutture Lombarde SpA (ILSPA)
Services:	Concept and preliminary design, EIA
Period:	09/2016 – 09/2022
Construction cost:	€ 8,860,236

Project Description:

The project concerns the design of lamination and control works of the floods of Bozzente river, which represents the main artery of a group of water courses, most of which flow through built-up areas. The main problem in these areas is the total impermeability of the pavement, so that the normal infiltration flux through the ground is almost completely absent.

The existing conditions of the river Bozzente allow the flow for about 11m³/s without flooding. This matter required the design and realization of an artificial flood area, to allow the lateral expansion of the river during a flood event, thereby avoiding the increase of the river level and consequent risk of flooding for the neighbouring fields. The area is located on the hydrographic right side.



The area consists of a single basin. The right levee is reshaped to create an overflow which allow the water to fill the basin when the water level into the river rises to the critical level. The maximum discharge allows to flow into the river is limited to about 11m³/s, the extra flow is diverted into the basin. The volume necessary to reduce the pick flow to the above is about 1,000,000 m³. The basin area has an extension of about 22 ha and it is surrounded by an embankments for an extension of about 2,000 m, with an high of maximum 4 m over the existing ground level.

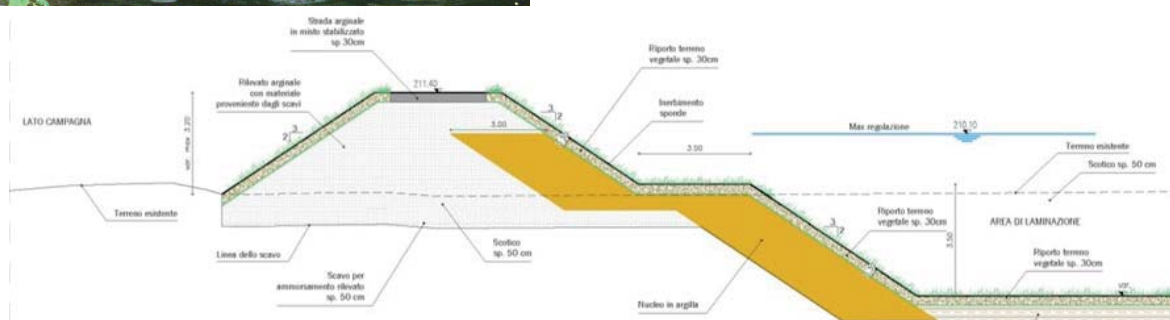
The project data required to dig the ground surface inside the basin, to a depth of maximum 7m, in the upstream side of the basin, to a minimum of about 5m.

A security overflow of about 120 m was designed, reshaping the left river levee.

The outflow is realized with a double box culvert with a cross section of 2 m X 1.5 m, regulated by slice gates. The outflow shall be open when the flood event is ending and the water level into the river is shallow.

The water flowing out of the basin, is discharged into the river reach through a channel which connects the outflow with the river.

The flood control basin is designed for a 1 in 100 years event, in accordance with the results of the hydrological and hydraulic studies.



FINAL AND DETAILED DESIGN OF THE FLOOD'S DIVERSION CHANNEL FROM GORZONE RIVER TO ADIGE RIVER

Location:	Pozzonovo (PD), Italy
Client:	Land Reclamation Authority Adige-Euganeo
Services:	Final and Detailed Design
Period:	10/2019 - 04/2022
Construction cost:	€ 25,652,012

Project Description:

The project deals with the construction of a channel for diversion of floods from the Gorzone river to the Adige River. The Gorzone river crosses the floodplains in northern-east Italy, and it is long about 93 km; its basin covers an area of about 1,350 km², and it is designated to drainage low-lying lands in the surrounding area. At this scope, the Gorzone receives the flow contribution from approximately n° 30 drainage/pumping plants, which discharge in the river approximately 100 m³/s during runoff events.

Despite of that, the Gorzone river has not the flow capacity to tackle the flood coming from pumping plants when long duration precipitations occur. Therefore, local authorities have forbidden discharging in Gorzone during floods, and this causes huge flooding in the upstream countryside.

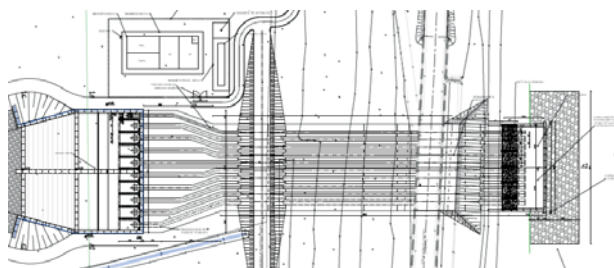
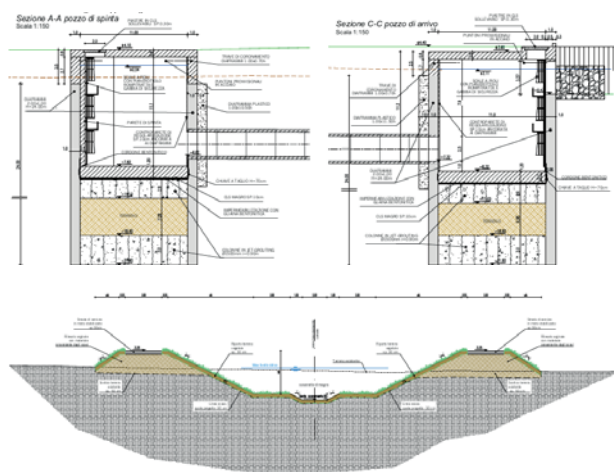
The scope of work concerns the diversion of the flow coming from a pumping plant (named Cà Giovannelli), normally flowing in the Grozone river, in a new stream channel. The new channel carries the flow to a new pumping station, which pumps the water upwards into the Adige River, by surpassing the riverbank with steel penstocks. Two DN2500 concrete conduits are provided for connecting Ca' Giovannelli with the new diversion channel; the conduits under cross the riverbed of the Gorzone river, and are laid with Micro tunnelling (MTBM) technology, for a length of 250 m. Two shafts are provided for launching and receiving the MTBM. They are approximately 12 m deep and about 11m x 12m in plan; they are carried out within 1m thick diaphragm walls, initially used for excavation and subsequently incorporated in permanent station walls.

Downstream the receiving shaft, the new diversion stream channel extends for 2 km from the receiving shaft to the new pumping station. The diversion channel reaches the final pumping plant, which discharges the entire flow in the Adige River. The pumping station comprises n°9+1 pumps and as many pipelines, which are set up on the Adige bank. A new hydraulic facility is provided at the discharge of the pipelines to prevent flow erosion on riverbank.

The required services concern hydrology studies, design of hydraulic and structure works, the geotechnical modeling, and the environmental and mitigation actions.

Main features:

- Total Micro tunnelling Works: two DN 2500, total length L_{tot}=500 m
- MTBM type: slurry earth pressure balanced cutting chamber with slurry soil removal
- Diversion channel: A=30 m²; L=2,000 m
- Pumping station: 8+1 pumps, Q_{tot}=30 m³/s
- Total amount of excavation (totally reused): 210,000 m³
- Diaphragm wall for MTBM shafts: H_{max}=24 m, thickness=1 m
- Jet-grouted bottom sealing barriers for MTBM shafts: H_{max}=7 m
- Penstock: n°9 tubes, L=155 m x 9



UPGRADE AND MAINTENANCE OF THE SCANZANO-ROSSELLA DAM

Location:	Sicily Region, Italy
Client:	Water and Waste Department, Sicily Region
Services:	Detailed Design
Period:	02/2021 – 03/2022
Construction cost:	€ 4,000,000

Project Description:

The Scanzano basin is located in the municipality of Monreale and Piana degli Albanesi (Sicily, Italy): it consists of two rockfill dams (Scanzano and Rossella), a spillway, a tower with bottom discharge intake, a two span bridge for the access to intake-tower, a discharge tunnel of surface flow, a discharge tunnel of bottom flow, a free-flow discharge channel and a control building. The Dam was built around 30 years ago, in the Scanzano river, where very complicated geological conditions were found and for this reason the Dam never came into full operation. Immediately after the completion of the works a landslide appeared, due existing wet clay rocks and start to push against the left bank of Rossella Dam. In this context, for safety reasons was impossible to bring the reservoir to the operating level.

The scope of the assignment consists of:

- hydrological and hydraulic assessment of the spillway, the two Tunnels and the discharge channel,
- study of the effect of the detention functioned by the storage basin
- geotechnical and diagnostic evaluation of the site and works
- seismic reassessment of the Dam and the main concrete services buildings

The dam has a height of 44,80 m and a volume of about 1,55 M m³.

The dam structure lies on a clay and fractured sandstone rock. Therefore, during the geognostic campaign phase, Lugeon tests and pressiometric tests were adopted for the hydraulic and mechanical characterization of the stratigraphic soil.

Scanzano area is characterized by high seismic risk, therefore was also necessary to carry out geophysical investigations and special seismotectonic studies.

Main features:

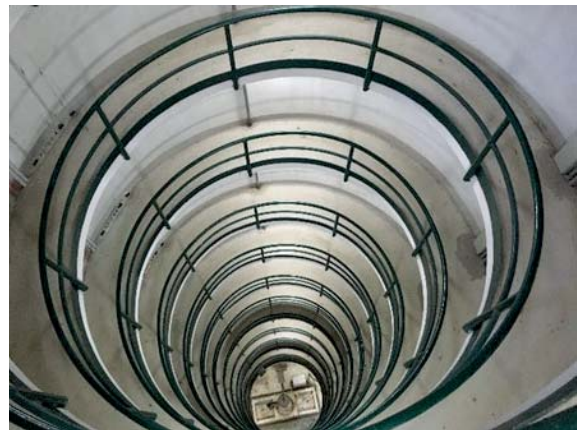
- Type of dam: rockfill dam
- Height dam at the crest: 44,80 m
- Height dam at the spillway crest: 43 m
- Length: 570+320 m
- Total storage volume: 20.4 M m³
- Surcharge storage: 3,13 M m³
- Total volume of rockfill: 1,55 M m³
- Max flow over spillway: 370 m³/s
- Max flow at bottom discharge intake: 298 m³/s.



Scanzano dam - general view (inside the bank)



Intake-tower and access bridge



View of the shaft inside the intake tower (with the helical access ramp and the gate at the bottom)



Spillway



Rossella Dam



Rossella Dam (inside the bank)

DESIGN OF THE REHABILITATION OF CUMBIDANOVU DAM (ORGOSOLO)

Location:	Orgosolo (Nuoro, Sardinia), Italy
Client:	Consorzio di Bonifica della Sardegna Centrale – Nuoro (Land Reclamation Authority of Central Sardinia)
Services:	Detailed Design
Period:	07/2020 - 01/2022
Construction cost:	€ 52,665,358

Project Description:

The Cumbidanovu Dam construction was started in 2006; the execution was abruptly interrupted in 2013, due to a catastrophic runoff event, which caused the flooding of the site. The scope of work covers the design of completion works and the check of the existing ones. Rock excavation of dam abutments was already completed, and the upstream cofferdam too. The Project mainly concerned the design of the gravity concrete dam, the spillway and outlet works, in accordance with ITCOLD recommendations and Italian standards.

The scope of works included the rehabilitation of 40,000 m³ laid concrete of the dam foundation (out of 300,000 m³ to complete the dam); the existing foundation was affected by widespread segregation of concrete, which compromised the hydraulic and static performances of the dam. A detailed investigation was therefore conducted to assess permeability and shear strength of existing concrete which results were used to plan activities required to reach standard performances (i.e. grout injections and reconstruction of joints between adjacent segments). The spillway was designed to manage the runoff flood with Return Time RT=1000 years, and the outlet works to ensure the drawing down of the reservoir in about one day. Due to the absence of temporary hydraulic by-pass, three culverts were conceived in the dam structure, to avoid the overflow of the dam top crest during execution advancement.

The required services ranged from Hydrology studies to design of Hydraulic Works, including the management of irrigation supplying, the geological and geotechnical studies, the design of ancillary works, the handling of earthworks balancing and the detailing of building site and related operations. A Dam-Break modeling was required too.



Main features:

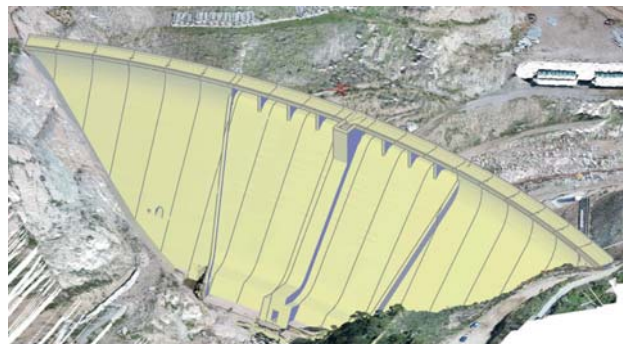
- Type of dam: gravity concrete dam
- Height dam at the crest: 67.17 m
- Height dam at the spillway crest: 65.15 m
- Total storage volume: 12.118 Mm³
- Surcharge storage: 2.20 Mm³
- Free board: 2.02 m
- Total volume of the Dam structure: 290,000 m³
- Crest length: 263.50 m
- Max flow over spillway: 1,237 m³/s

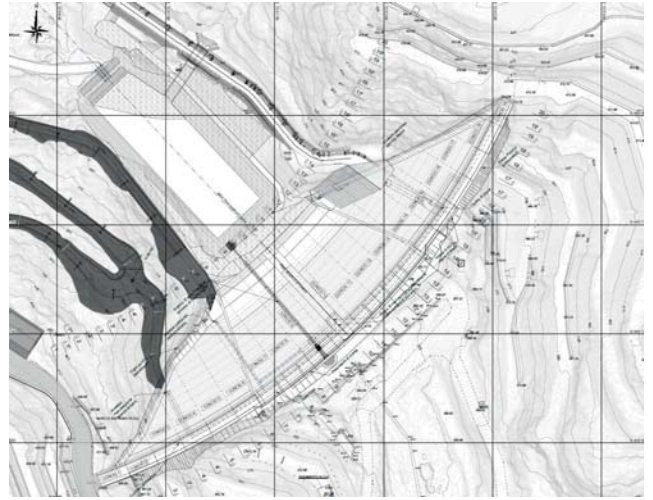
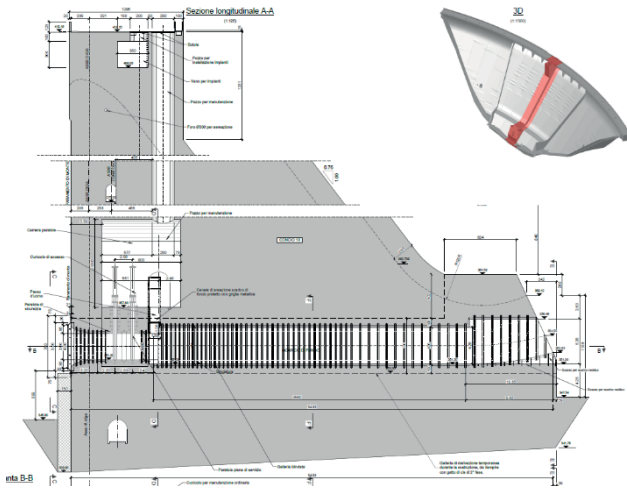
- Max flow at outlet culvert: 185.36 m³/s.



The geological site of dam and the afferent catchment is predominantly composed by granite rock: in case of flood event, the runoff coefficient increases rapidly, and reaches 0.6/0.7 values, causing a prominent peak flood in 3-4 hours, which corresponds to correlation time. These features were taken in account for adequate design of emergency spillway, and for transient events during construction, to arrange hydraulic devices to ensure safety conditions under dam execution.

The Italian Dams norm was compiled for designing the main works (DM 26/06/2014), and the ICOLD recommendations. For ancillary works, the technical norm about constructions was fulfilled.





REHABILITATION OF ZAFFARANA DAM

Location:	Sicily - Italy
Client:	Water and Waste Department of Sicily
Services:	Management Plan, Detailed and Final Design
Period:	12/2020 - 06/2021
Construction cost:	€ 1,377,000

Project Description:

The Zaffarana dam has been included in the National Plan for Dams, which aims to increase the safety of 101 large dams in Italy. Zaffarana dam is in the territory of the Municipality of Trapani. The project concerns the extraordinary maintenance and safety works (i.e. with special emphasis to the dredging for the de-silting of the bottom outlet and management of sediments) and the designing of the Reservoir Management Plan, according to art. 114 of the Legislative Decree 152/2006 and subsequent amendments.



The main characteristics of the reservoir are as follows: Maximum height of the reservoir: 84.30m above sea level; Maximum level of regulation: 82.60m above sea level; Surface area of the reservoir at maximum height: 0,24 Km²; Total volume of reservoir: 1,25 x 10⁶ m³; Reservoir volume: 0.9 x 10⁶ m³; Regulation volume: 0.75 x 10⁶ m³; Laminating volume: 0.35 x 10⁶ m³; Underlying catchment area: 7.6 km²; Maximum design flood flow rate: 225 m³/s

The project includes in the first stage sediments dredging at the bottom outlet (about 20.00 m³) and discharging inside the geotubes located around the lake. The lake is to be emptied, and the bottom and surface outlets will be repaired while maintenance work will be performed. When the special works will end the project envisages the refill of the lake. The second stage of the project is for the dredging of the reservoir (approximately 428.000 m³ of sediments) to recover the original useful volume.

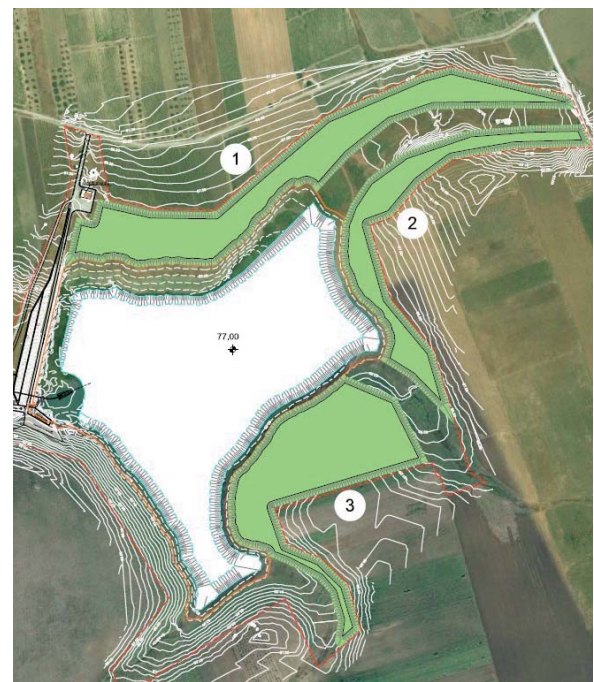
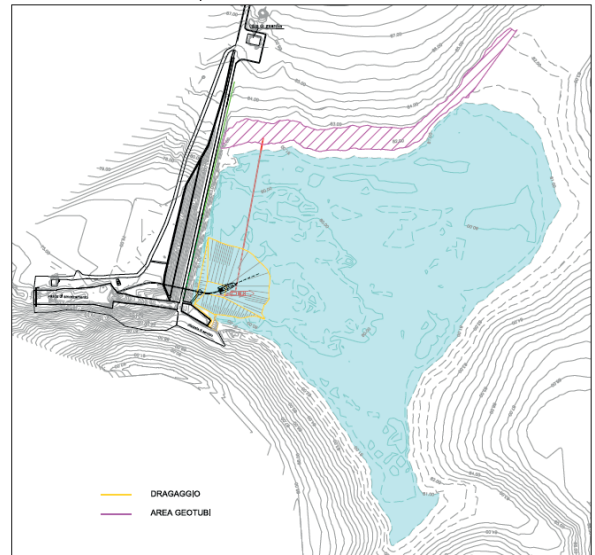
Different sediment management solutions have been compared in terms of cost/benefit:

- Dredging and dumping sediments around the lake to build morphological structures. The new structures, in addition to favoring on-site reuse of sediments, will also prevent soil runoff from the surrounding agricultural lands. This solution will not require land expropriation.
- Dumping of sediment in an agricultural land located around the lake. This solution will require land expropriation.
- restoration of disused quarries. This solution will require the transport of sediments outside the project area and constraint to wait for the formal approval of the Environmental Redevelopment Plan (PRA) of the quarry.

d. transport of the sediments to a landfill. This situation was the worst in terms cost/benefits.

The selected solution was solution a) as it does not require expropriation being built on land owned by the Region of Sicily and maximizes the on-site reuse by storing around the lake as much sediment as possible.

The new morphological structures will also protect the lake by runoff and create a boundary line of the Region's property. The new embankments will be able to accommodate a service road for routine maintenance operations.



DETAILED DESIGN AND CONSTRUCTION SUPERVISION OF ARCE' HYDROELECTRIC PLANT

Location:	Arcè di Pescantina (Verona) - Italy
Client:	Iniziative Veronesi Srl
Services:	Detailed design, works supervision
Period:	10/2017 – 05/2019
Construction cost:	€ 17,763,000

Project Description:

The project is for an hydro-electric plant along the Adige river in the section between Santa Lucia and Arcè di Pescantina.

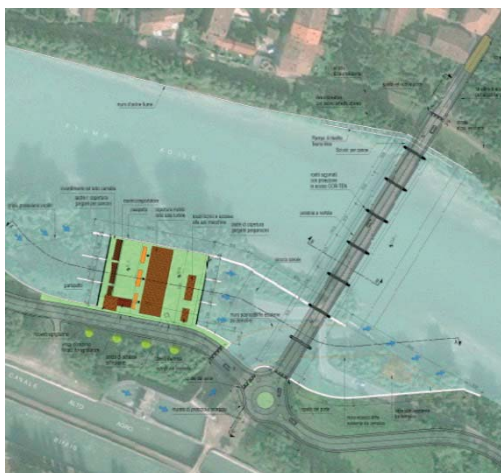
The plant has been designed to have a very low environmental impact, as it immediately returns waters downstream and it exploits just a part of them whereas the outstanding part keeps on flowing freely.

In addition to the works concerning the hydro-electric plant, the project foresees the requalification and strengthening of the bridge called "Arcè di Pescantina bridge" on the Adige river. It allows the road link between Arcè and Bussolengo.

The main project features are:

- a lock with 5 flap gates on the bottom, at the Adige river talweg level, for the purpose of supporting the river level and creating the hydroelectric leap;
- a new bridge supported by 7 new piles in riverbed with deck made up of prefabricated beams each with a 18.00 m span and a prefabricated beam with 20.50 m span;
- a fish ladder on the left bank;
- a canoes slide on the left bank;
- a completely underground hydro-electric plant on the right bank, in the Bussolengo Municipality, with intake upstream of the bridge and outlet immediately downstream;
- road link on the Bussolengo side and access road to the plant area;
- small works of road adaptation and link on the Pescantina side.

The hydro-electric plant will be placed in an uncultivated area along the river on the right bank. The river hydraulic flows intake will be just upstream of the river and the flows outlet will be just downstream.

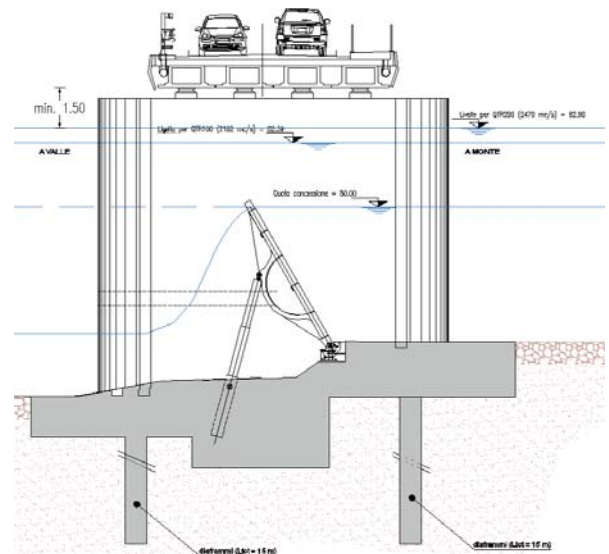


All the hydraulic works related to the plant will be underground and at the same level as the river talweg which is far below ground level.

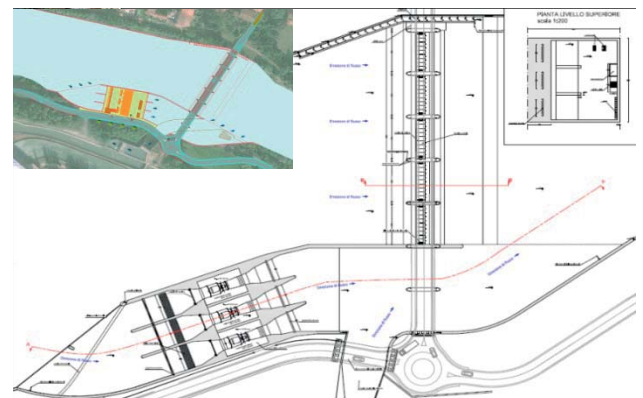
The plant emerging works are just some access works containing the screen remover to clean the intake grids and the equipment delivering the energy produced.

The hydro-electric plant will produce about 3 MW power for an annual total of about 21.2 GWh; the energy produced will be then entering into the grid by a connection with a medium voltage line already existing.

The lock is made up of five spans, each is 16.5 m wide and they are regulated by as many flap gates, with a water retention level of 79.95 m above sea level, i.e. 5 cm less than the higher free surface (80.00 m above sea level.).



Taking into account the dimensions of the lock piles, each of which is 1.5 m, the lock total width is 95.6 m; in addition to such width 15 m length below the first left bridge span is to be added. Such 15 m length is left free for the public equipped area. The flap gates movement is controlled and regulated by a hydraulic mechanism which triggers the two cylinders at the end of each gate. The cylinders are placed at the back of the gates and they are embedded in the riverbed piles in order to avoid damaging the devices during extraordinary floods. The maximum grade of operating gates is 60° horizontally. The hydraulic plant pipes are placed in a water-tight inspection shaft which can be checked. It is closed by ballasted sheets or concrete slabs, and it is placed downstream of the gates. Guide rails have been set upstream and downstream of the gates to close the span by means of mobile boards if it is not possible to carry out otherwise the extraordinary maintenance operations on the mechanical devices. The project envisages along its length an accessible inspection shaft where the hydraulic and electric systems pipes are located.



DETAILED DESIGN AND CONSTRUCTION SUPERVISION OF SETTIMO HYDROELECTRIC PLANT

Location:	Settimo di Pescantina (Verona) - Italy
Client:	Iniziative Veronesi Srl
Services:	Detailed design, work supervision
Period:	04/2017 – 05/2019
Construction cost:	€ 20,807,000

Project Description:

The project is for an hydro-electric plant along the Adige river in the section between Pescantina and Verona.

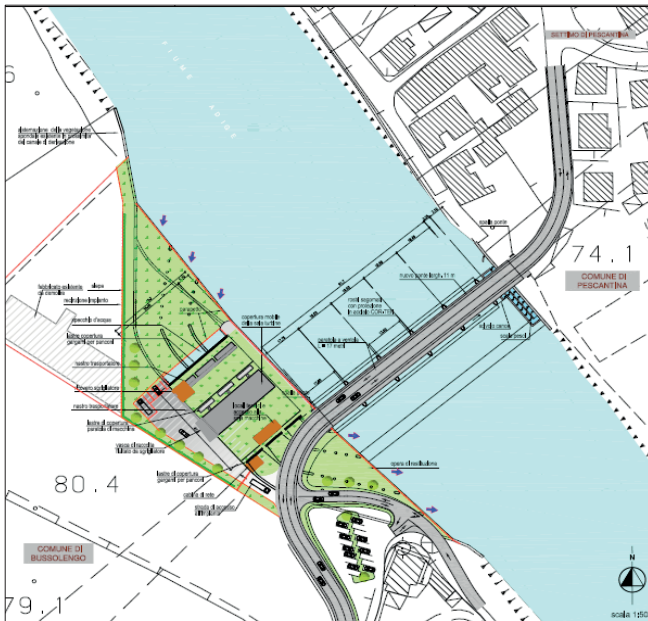
The plant has been designed to have a very low environmental impact, as it immediately returns waters downstream and it exploits just a part of them whereas the outstanding part keeps on flowing freely.

In addition to the works concerning the hydro-electric plant, the project includes the requalification and strengthening of the bridge called "Settimo di Pescantina bridge" on the Adige river. It allows the road link between Pescantina and Bussolengo.

The main project features are:

- a lock with 5 flap gates on the bottom, at the Adige river talweg level, for the purpose of supporting the river level and creating the hydroelectric leap;
- a new bridge supported by 5 new piles in riverbed with deck made up of prefabricated beams each with a 18.50 m span;
- a fish ladder on the left bank;
- a canoes slide on the left bank;
- a completely underground hydro-electric plant on the right bank, in the Bussolengo Municipality, with intake upstream of the bridge and outlet immediately downstream;
- road link on the Bussolengo side and access road to the plant area;
- small works of road adaptation and link on the Pescantina side.

The hydro-electric plant will be located in the area where a plant for the treatment of stones and marbles along the river on the right bank used to be operative. The river hydraulic flows intake will be just upstream of the river and the flows outlet will be just downstream.



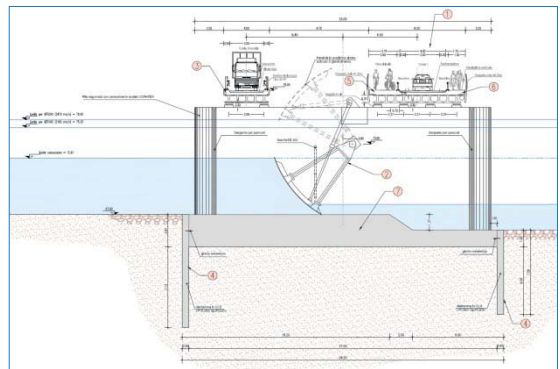
The area occupied by the plant will be about 45 m wide and about 100 m long in parallel with the river. All the hydraulic works related to the plant will be underground and at the same level as the river talweg which is far below ground level. The surface over the plant and the intake and outlet channels will be occupied upstream by a large garden and parking area, downstream of the new road link to the bridge, near the 18th century Corno Church.

The area surrounding said church will be rearranged and improved and even expanded in respect to the existing one.

The plant emerging works are just some access works containing the screen remover to clean the intake grids and the equipment delivering the energy produced.

The hydro-electric plant will produce about 3 MW power for an annual total of about 21.3 GWh; the energy produced will be then entering into the grid by a connection with a medium voltage line already existing.

The lock is made up of five spans, each is 17 m wide and they are regulated by as many flap gates, with a water retention level of 72.56 m above sea level, i.e. 5 cm less than the higher free surface (72.61 m above sea level.).



Taking into account the dimensions of the lock piles, each of which is 1.5 m, the lock total width is 92.5 m; in addition to such width the canoes slide 2.5 m width and the fish ladder total 7.1 m width are to be added. The total width of the works in the riverbed is therefore more than 100 m. The flap gates movement is controlled and regulated by an hydraulic mechanism which triggers the two cylinders at the end of each gate. The cylinders are placed at the back of the gates and they are embedded in the riverbed piles in order to avoid damaging the devices during extraordinary floods. The maximum grade of operating gates is 60° horizontally. The hydraulic plant pipes are placed in a water-tight inspection shaft which can be checked. It is closed by ballasted sheets or concrete slabs and it is placed downstream of the gates. Guide rails have been set upstream and downstream of the gates to close the span by means of mobile boards if it is not possible to carry out otherwise the extraordinary maintenance operations on the mechanical devices. The project envisages along its length an accessible inspection shaft where the hydraulic and electric systems pipes are located.

FLOOD CONTROL WORKS ON THE AGNO-GUA' RIVER

Location:	VENETO, Italy
Client:	Veneto Region
Services:	Detailed Design, Topographic and geotechnical studies and surveys, construction supervision
Period:	06/2018 – 11/2018
Construction cost:	€ 16,115,343

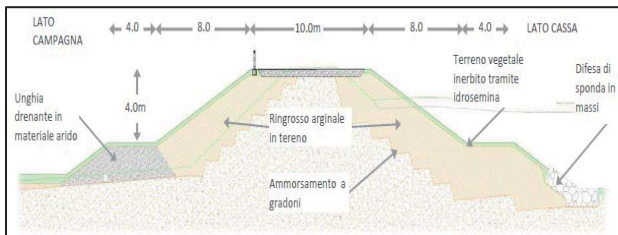
Project Description:

The project concerns the design of lamination and control works of the floods of Agno Gua' river in Province of Vicenza. The continue flooding required the design and realization of an artificial flooding area, to allow the lateral expansion of the river during a flood event, thereby avoiding the increase of the river level and consequent risk of flooding for the neighbouring fields.

The project area has an extension of about 30 hectares. The total volume of water which can be stored in the area is about 905.000 m³.



This flooding Area is strictly connected by another flooding area in the northern part of the river (under construction, realized on the basis of another project), throughout a structure realized in the middle embankment. It is composed of a eight gates, which allow the flooding of the lower basin, when the upper one is full.



Here the left levee of the river has been re-shaped for an extension of about 1300 m, to avoid risks and physically separate the river area from the farmland and urban area of Arzignano. The re-shaped of the levees is both in the internal and external side of the structure. At the toe of the levee there is a protection of stone of 200-500 kg.

The right levee is re-shaped only in the internal side of the basin.

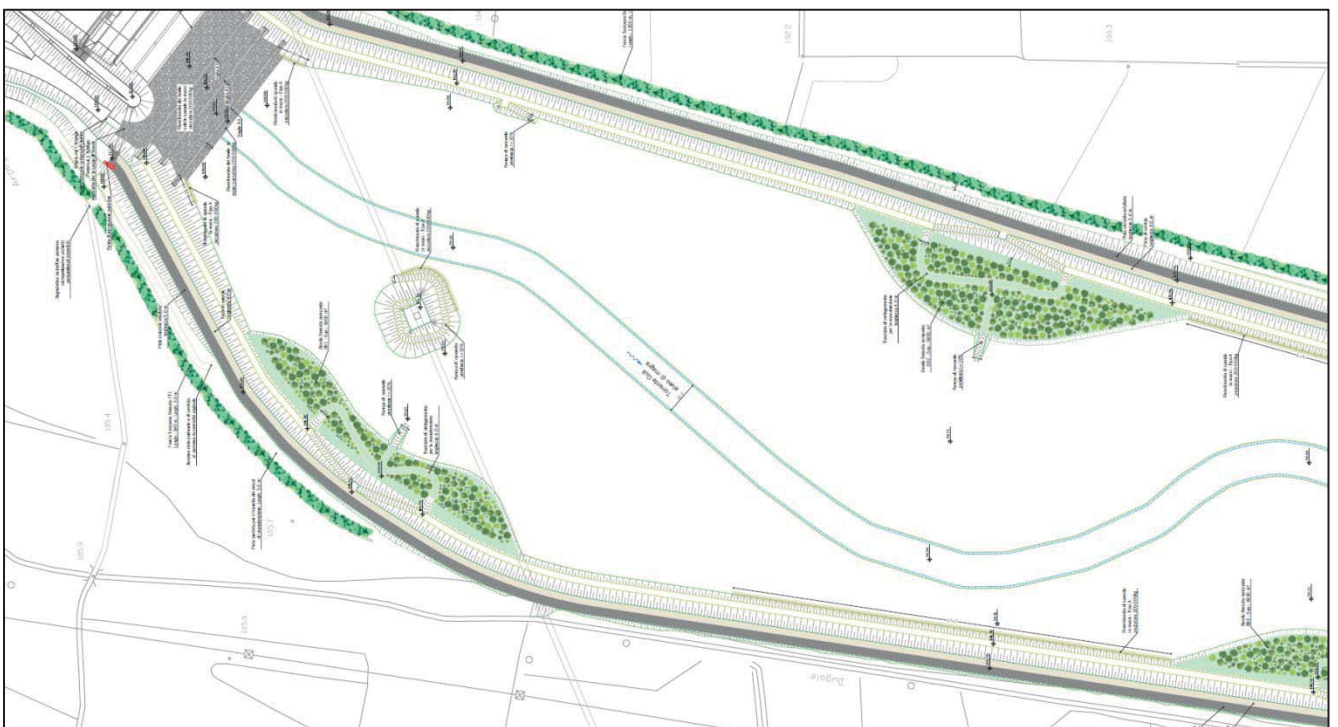
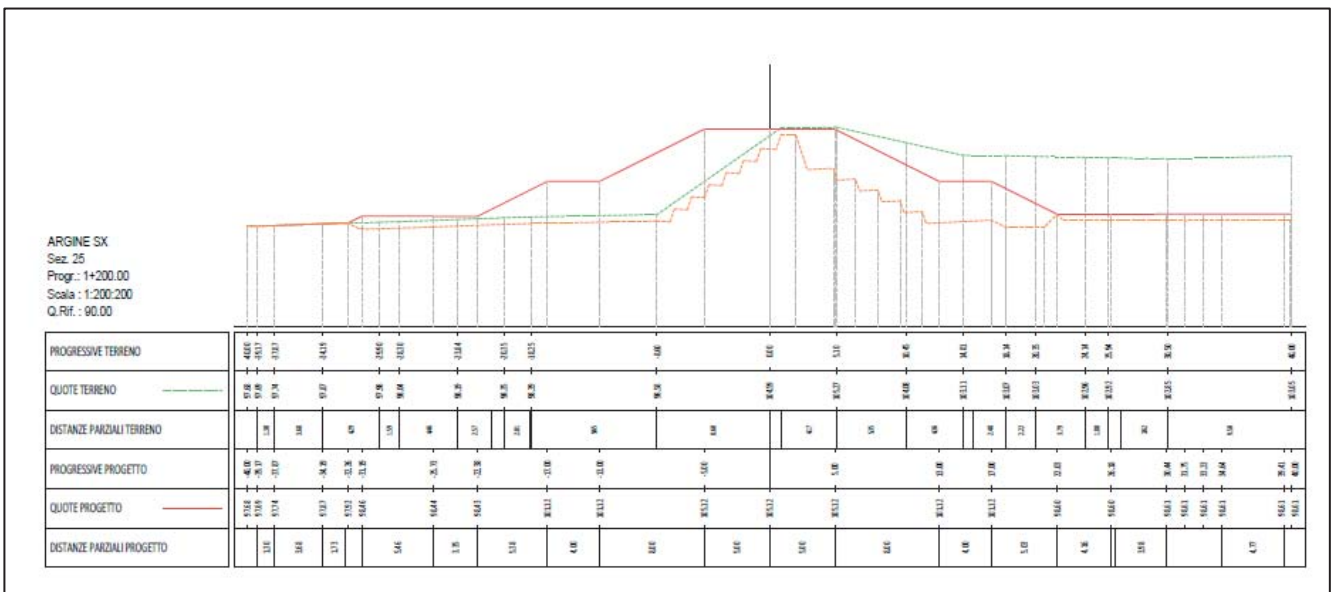
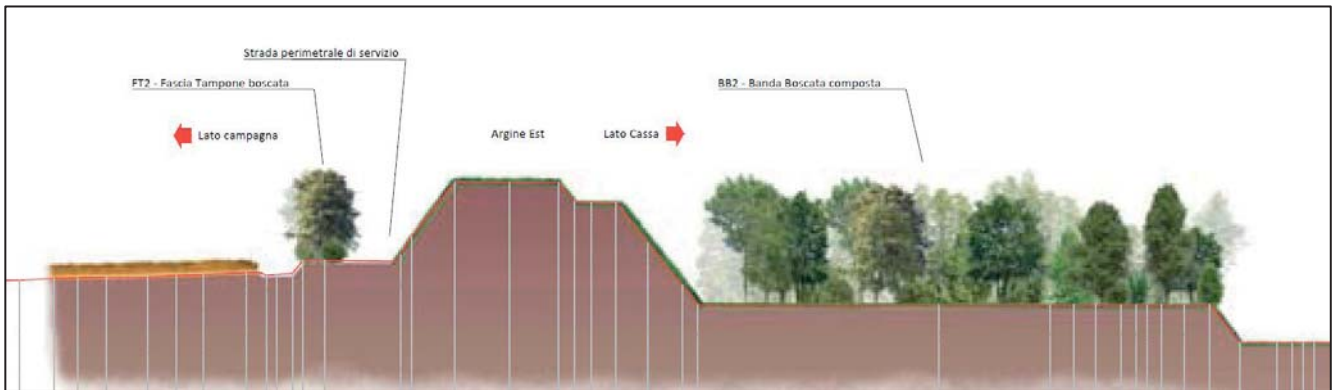
The project also includes the arrangement of two streams (Restena and Dugale) in correspondence of their entry into the new flooding area.



Downstream from the middle embankment, in this project there are two bridges and a stabilization threshold.



The project also includes some environmental interventions, such as the planting of new trees, grassing of the banks, the creation of a cycle path on the top of the embankments.



DETAILED DESIGN OF THE HYDRAULIC BY-PASS SPILLWAY TUNNEL OF NOCE STREAM AND OF THE BISAGNO RIVER HYDRAULIC SPILLWAY TUNNEL

Location:	Genova - Italy
Client:	Municipality of Genoa
Services:	Detailed Design, Tender Specifications
Period:	10/2016 - 07/2018
Construction cost:	€ 17,429,244

Project Description:

The project is related to hydraulic work for the Rio Rovare intake (between the interception structure and the channel of entry to the vortex), and, as far as Rio Noce is concerned, to hydraulic works located between the Delio Repetto school and the Fereggiano tunnel under construction.

The Rio Rovare intake works concern the upper part of the Rio Rovare, i.e., the section between Rio Rovare upstream and the connection with the existing downstream structure. The works envisaged are for a U-shaped interception structure of about 85 m, the partition structure of about 4 m, the entrance structure up to the vortex of about 51, the continuity structure about 99 m long and the ventilation well about 57 m deep. The intervention is located in an urban area, so particular attention has been paid to the construction site and to the interference of the new works with existing buildings by implementing a monitoring system.

The works related to Rio Noce consist in a pipeline of about 375 m realized with micro tunnelling with an internal diameter of 2, 5 m, various wells along the channel, an inlet channel about 35 m long, the drop/work shaft below the Carena shaft, the dissipation chamber of about 22 m, the connecting tunnel of about 234 m, the access structure and the access shaft of about 11.85 m.



DESIGN OF ALTERNATIVE OPTION FOR THE MITIGATION MEASURES FOR FLOOD AND HYDROGEOLOGICAL RISK OF THE CITY OF OLBIA

Location:	Olbia, Italy
Client:	Municipality of Olbia
Services:	Preliminary Design, EIA
Period:	12/2017 – 02/2018
Construction cost:	115,881,396 €

Project Description:

The urban area of Olbia is historically subject to flooding due to rainfall events of a certain intensity. Following the severe flooding event of November 18, 2013, the Basin Authority of the Region of Sardinia undertook a study for Hydrogeological Structure Plan (PAI), in order to identify interventions for the safety of the hydraulic risk of Olbia. In 2014 the Feasibility Study was drawn up and, based on the results of this Study, the Municipality of Olbia developed the Final Project of the interventions, divided into 4 lots, and the related Environmental Impact Study.

The Region, approved the Project as "Framework of hydraulic risk mitigation works", already approved by the Institutional Committee of the Basin Authority. This Project was subsequently challenged and criticized through numerous observations, which also emerged in the public presentation of the Project and the related SIA, so much so that counterproposals with different intervention scenarios emerged.

In the light of the critical issues that emerged for the previous solution and the strong opposition to the implementation of the interventions, the Municipality of Olbia intended to develop, in a direct form, an "alternative" design solution to what the Region has already done.

The tasks of assignment included a detailed hydrological and hydraulic study for the definition and analysis of alternative solutions of intervention able to combine the objective of hydraulic safety with the critical issues related to intervention in an urban context such as that of the city of Olbia.

The aim of the service was the identification, through a detailed hydrological and hydraulic analysis, of solutions for the safety from hydraulic risk through interventions that reduce the flow rate at the end sections of the watercourses that cross the city, i.e. an optimized combination of several types of intervention: spillway, rolling tanks, recalibration and renaturation of the valley sections of the watercourses. The proposed solutions have been verified through modelling and maximizing, for the same overall costs, the objectives of hydraulic risk reduction by minimizing the environmental impact on the territory.

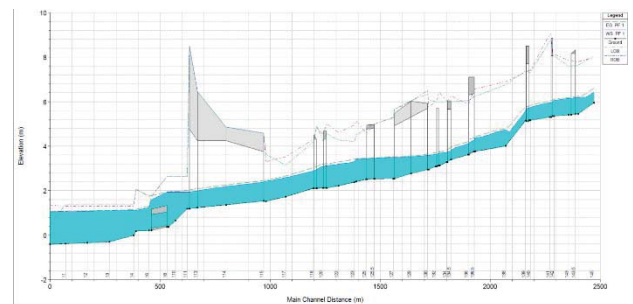
Hydrological Study.

In order to analyze the hydrology of the different sub-basins of the city of Olbia, covering an area of 72.5 km², a single model was implemented in HEC HMS which includes all of them, so that the effects of the proposed interventions can be assessed overall.

The hydrological schematization of the study basins in their current state has been subsequently adapted to include also the different design hypotheses analyzed (expansion tanks, flood spillways, diversions) in order to evaluate in a dynamic and comparative way their effect on the modification of the flood hydrographs with respect to the actual state.

Hydraulic Modelling.

The hydraulic analysis of the present situation and intervention options was conducted using two software: HEC RAS, in 1D configuration, and InfoWorks ICM, in 1D-2D configuration, to simulate the evolution of flooding in the riverbed and floodable areas.



For each watercourse studied was reconstructed in its actual state based on cross-sections of the riverbed extrapolated from the LIDAR survey of the Ministry of the Environment, verified and integrated with the topographic survey carried out by the Writers, data and surveys made available by the Customer, data collected during the inspections carried out on purpose, etc.).



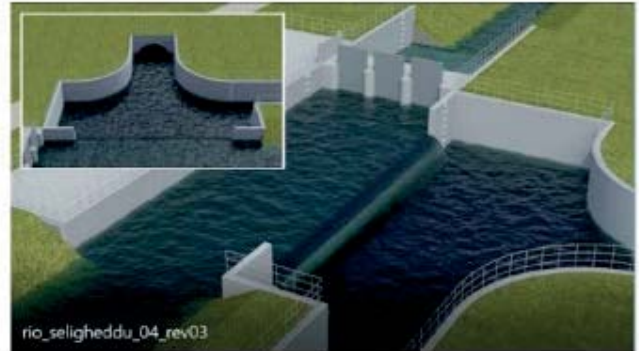
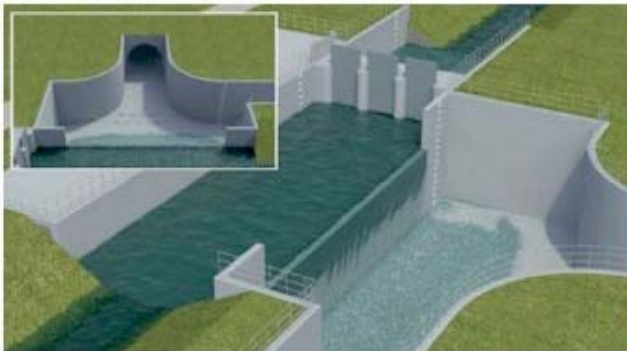
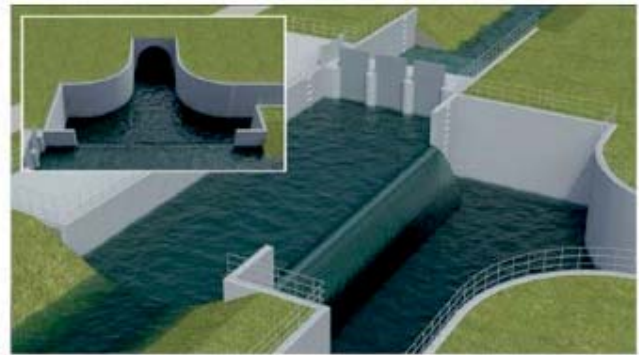
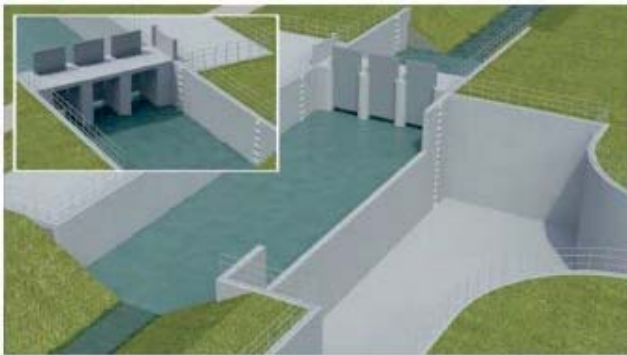
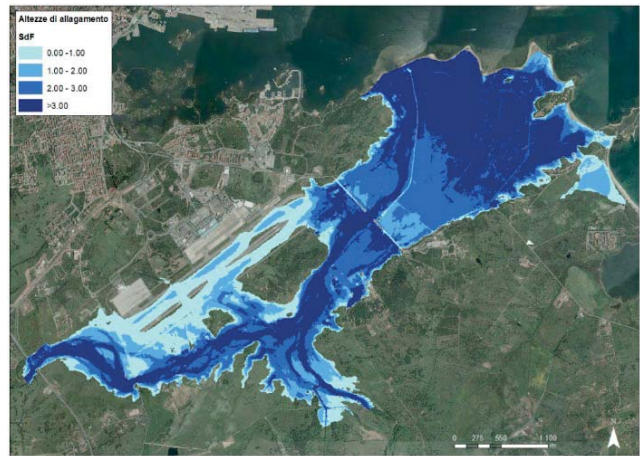
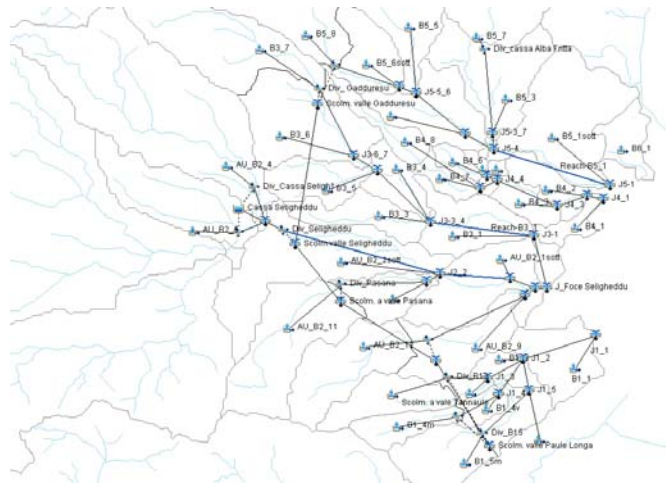
Design of interventions.

The project has foreseen interventions to limit the water entering the urban area through:

- construction of a flood control basin on the Rio Seligheddu with 600,000 m³ of reservoir.
- construction of a flood diversion tunnel (length 11.4 km, diameter from 5 m to 8 m) capable of intercepting the watercourses surrounding the city of Olbia, draining the flood water in the Rio Padrongianu.
- construction of secondary tunnel to connect the several rivers intercepted to the main diversion tunnel.

Other interventions were included in the design, in particular regarding the upgrade of existing watercourses through the urban area of the city, described as follow:

- upgrading of the existing river courses in the city area, for a total length of 15 km;
- demolition and reconstruction of 20 road bridges.
- construction of diversion channels upstream of the existing barrier reaches, in order to exclude them from their function as receptors of watercourses, since it has been verified that it is not economically, environmentally and socially convenient to adapt them.



CONSULTING SERVICES SUPPORTING THE PROJECT MANAGEMENT OFFICE (PMO) ESTABLISHED UNDER NVDA AND NBD

Location:	Mazār-i-Sharīf, Yangi Qala, Jalalabad -Afghanistan
Client:	ADB; Ministry of Agriculture, Irrigation and Livestock and Ministry of Energy and Water
Services:	Detailed design, works Supervision
Period:	12/2011 - 06/2017
Construction cost:	€ 30,980,000

Project Description:

The contract has two components: NVDA (Nangarhar Valley Development Authority) irrigation system (under the Ministry of Agriculture, Irrigation and Livestock) and the MEW NBD (Northern Basins Development) irrigation system and Flood Management (under Ministry of Energy and Water)

The MAIL NVDA Component

The Consortium had to assist the PMO with responsibility for:

- (i) the design, procurement and construction supervision for the rehabilitation and upgrade (R&U) of the NVDA irrigation system;
- (ii) the preparation of a business plan for corporatizing NVDA and improving its profitability;
- (iii) the establishment of Irrigation Associations (IAs), to participate in irrigation management (PIM) and (iv) providing OFWM and improved agricultural practice demonstrations at selected sites.

For R&U of the irrigation system, the services include:

- (i) the preparation of the detailed design for a single international competitive bidding (ICB) contract covering the main, secondary, and tertiary irrigation canals;
- (ii) the assistance to the PMO with the procurement of the civil works services;
- (iii) the supervision to ensure the construction works and to certify progress payments;
- (iv) the assistance to the PMO to assure that safeguards measures in line with ADB's relevant policies are in place;
- (v) the establishment and implementation of a results-based project management, monitoring and evaluation system.

In particular, the Consortium had to prepare the detailed design for all the restoration and upgrading works of the main, secondary and tertiary irrigation canals, include them in the international tender package and, with assistance of the procurement specialist, prepare the tender documents and assist in advertising the work, issuing invitations to bid, responding to queries from prospective bidders, evaluation of bids and carrying out post-qualification of the successful bidder, all in compliance with both MAIL/NVDA procurement procedures and ADB's Procurement Guidelines.

The MEW NBD and Flood Management Components

The contract involves three international competitive bidding (ICB) contracts covering:

- (i) the 250 main canal structures (designs are complete and bidding underway);
- (ii) the construction of Bangala Weir and refurbishment of Samarkandian Weir;
- (iii) the construction of the flood protection embankment in Yanqi Qala, construction of gated headworks for the Yetim Tapa irrigation canal, and on the Amu Darya, and emergency protection works for bank erosion control along selected reaches of the upper Amu Darya



The Consultant had to:

- (i) prepare detailed designs and bill of quantities,
- (ii) assist the PMO procure civil work contracts following the ADB (2010) Procurement Guidelines, as amended from time to time, and
- (iii) supervise construction and act as "the Engineer".



To ensure sustainability, the consultants will assist the PMO to review O&M fund flows, and develop options for O&M financing to be adopted and implemented by MEW. Under this contract the Consultant will:

- review the previous designs of the new Bangala Weir and existing Samarkandian Weir and the cause and extent of the damage the latter suffered in the 2009 flood;
- review best practice in diversion weir and intake design, in dynamic rivers, discuss and agree with the PMO the design procedure, standards, timeline and responsibilities;
- organize and supervise site investigations (soil, topography, hydrology), finalize location of Bangala Weir and its general layout including its intake and flood protection works;
- prepare the hydraulic design of Bangala Weir including arrangements for safe passage of flood flows, energy dissipation and to avoid sedimentation and seepage problems etc;

- supervise the structural design and detailing of Bangala Weir by PMO staff including the preparation of the bill of quantities and construction specifications etc;
- undertake similar activities for the rehabilitation and upgrading of existing Samarkandian Weir and improvement of the operational control of the Samarkandian and Narhi Shahi weirs;
- assist the O&M Engineer to ensure that sound operational guides and an optimal sediment management plan are prepared and implemented for the improved weirs.



FLOOD CONTROL WORKS ON THE OLONA RIVER

Location:	Lombardy, Italy
Client:	Agenzia Interregionale per il fiume Po (A.I.P.O.) – Inter-regional Authority for the Po river
Services:	Concept, Preliminary and Detailed designs; works supervision
Period:	12/2004 – 08/2014
Construction cost:	€ 10,883,200

Project Description:

The project concerns the design of lamination and control works of the floods of Olona river, whose reach is developed through built-up areas.

This situation required the design and realization of an artificial flooding area, in order to allow the lateral expansion of the river during a flood event, thereby avoiding the increase of the river level and consequent risk of flooding for the neighbouring fields.

The concept design included the by two flooding areas, the upstream in the right hand-side while the downstream area in the left hand-side. Heace of them was devided into three smaller basins.



Due to financial availability, the detail design focused only on a the left folloding area, in particular on two of the three smaller basins, the midle and the downstream.

The project area has an extension of about 35 hectares, which is divided in 16 hectares for the middle basins and 19 hectares for the lower one. The total volume of water which can be stored in the area is about 730.000 of m³, divided in 360.000 m³ for the upper and 370.000 m³ for the lower basin..

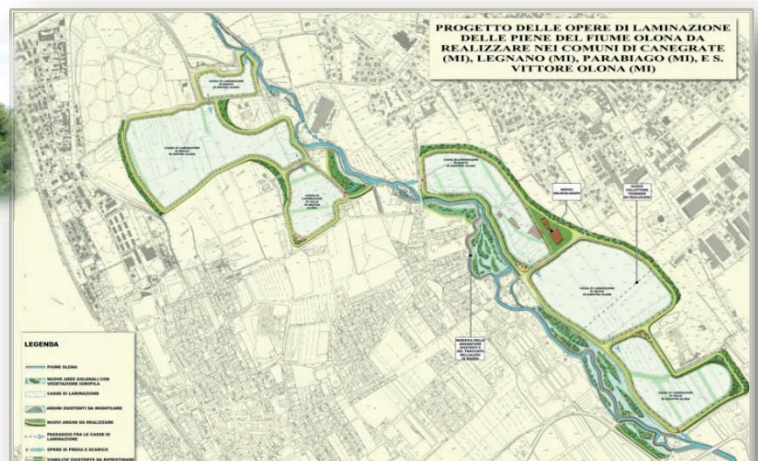


The two areas are located on the hydrographic left sides, connected each other's. The whole flooding area consists of a series of two descending smaller basins: the primary stage, which occurs in the upper basin, concerns the collecting of the surplus water from the main artery of the Olona river. Here the left levee of the river has been re-shaped, in order to avoid risks and physically separate the river area and the flooding area. In the lower basin it has been necessary to continue the re-shaping of the left levee, thus separating the new artificial flood zone from the previous main riverbed. In the lower basin the restitution work was placed. All the project area was surrounded by an embankment to create an artificial basin and contain the flood into the defined area. The total extension of these embankments is about 3850m. The two basins are physically interrupted by an embankment of about 330m, which is roughly located in the middle of the project area.

The connection between the river and the basins is provided by a lateral structure, created in the upstream side of the basins. It is composed by a crested weir regulated by five sluice gates. The total width of the weir is about 13m, divided into five gates.

The connection between the upper and lower basins is provided by a structure realized in the middle embankment. It is composed by a two barrels culvert, regulated by four sluice gates, which are open to allow the flooding of the lower basin, when the upper is full. The connection structure is composed of a 10m overflow.

At the lower point of the project is located the restitution structure, which allow to empty the basins at the end of the critical event



FLOOD CONTROL WORKS ON THE TIMONCHIO RIVER

Location:	Veneto Region , Italy
Client:	Veneto Regional Authority
Services:	Concept, Preliminary and Detailed design; works supervision
Period:	11/2010 - 02/2012
Construction cost:	€ 24,882,800

Project Description:

The project concerns the design of lamination and control works of the floods of Timonchio river, which represents the main artery of a group of water courses, most of which flow through built-up areas.

This situation required the design and realization of an artificial flooding area, in order to allow the lateral expansion of the river during a flood event, thereby avoiding the increase of the river level and consequent risk of flooding for the neighbouring fields. The flooding area was divided in two smaller basins, an upper and a lower one.



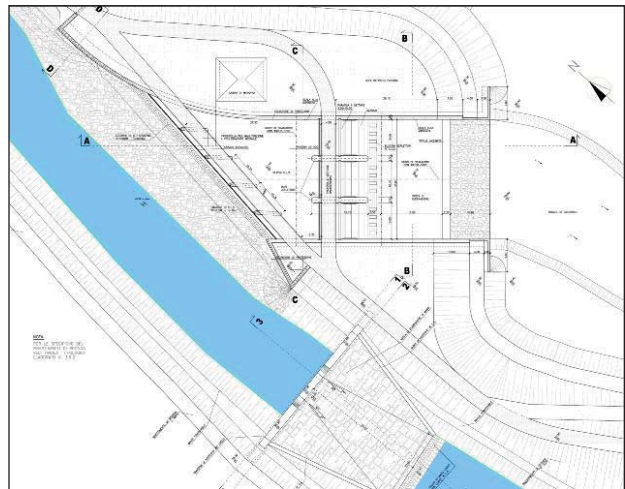
The project area has an extension of about 100 hectares, which is divided into 60 hectares for the upper basins and 40 hectares for the lower one.

The total volume of water which can be stored in the area is about 4.6 million m³, divided into 2.8 million for the upper and 1.8 million m³ for the lower basin.

The two areas are located on the hydrographic left side, connected to each other. The whole flooding area consists of a series of two descending smaller basins: the primary stage, which occurs in the upper basin, concerns the collecting of the surplus water from the main artery of the Timonchio river. Here the left levee of the river has been re-shaped, in order to avoid risks and physically separate the river area from the farmland and urban area of Caldogno.

In the lower basin it has been necessary to continue the re-shaping of the left levee, thus separating the new artificial flood zone from the previous main riverbed. In the lower basin the restitution work was placed, likewise with the re-shaping and reinforcement of the left levee to protect the town and separate it from the flood area. The entire project area was surrounded by an embankment to create an artificial basin and contain the flood into the basins. The total extension of these embankments is about 4400m. The two basins are physically interrupted by an embankment of about 850m, which is roughly located in the middle of the project area.

The connection between the river and the basins is provided by a lateral structure, created on the upstream side of the basins. It is composed by a crested weir regulated by three radial gates. The total width of the weir is about 30m, divided into three gates.



The connection between the upper and lower basins is provided by a structure realized in the middle embankment. It is composed of a four barrels culvert, regulated by four sluice gates, which are open to allow the flooding of the lower basin, when the upper one is full. The connection structure consists of a 100m spillway.

At the lowest point of the project is the restitution structure, which allows the emptying of the basins at the end of the critical event.

The consortium formed by Beta Studio Srl (leader), TECHNITAL S.p.A. (40%) and CSP Srl, has also been awarded the construction supervision which is expected to start during 2013.



FLOOD PROTECTION WORKS OF THE PORT OF TADJOURA

Location:	Republic of Djibouti
Client:	Ministère de l'Équipement et des Transports of the Republic of Djibouti
Services:	Preliminary and Detailed design
Period:	11/2010 – 04/2011
Construction cost:	€ 3,000,000

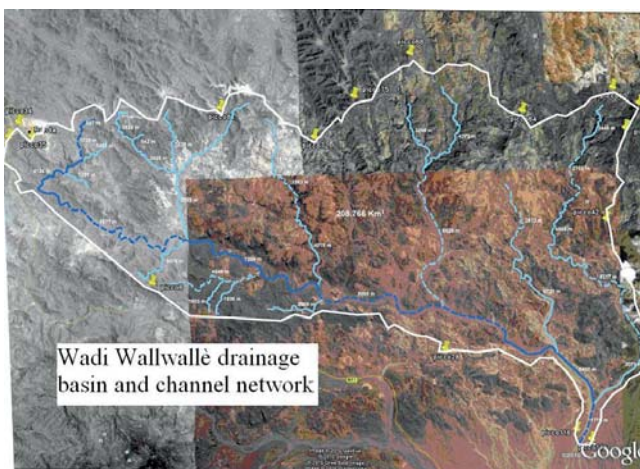
Project Description:

The extension of the port of Tadjoura is part of the Djibouti Government plan to develop the regions of the Country. The project area develops for 1,5 km over the eastern part of the alluvial fan of Walwallè wadi and protection works against floods are necessary.



In arid regions there are no perennial surface flows and the annual runoff volume is usually concentrated in the form of floods of short duration but sizable magnitude. When the intensity of the rainfall is extremely high, flash-floods characterized by rapid rise-times, very high peak-discharges and high sediment transport may occur.

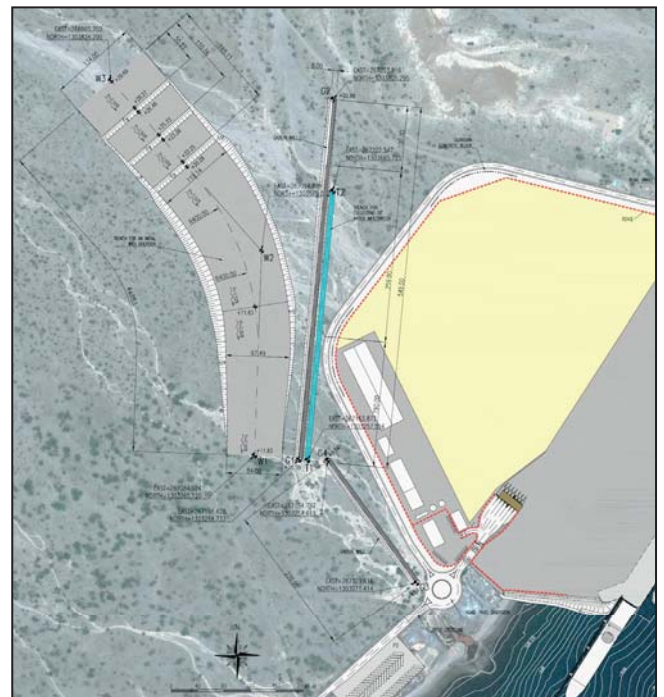
Therefore a study of the whole involved area, focused on the Walwallè drainage network and watershed morphology, was carried out. Information about arid and semi-arid hydrology was taken from other Djibouti wadi data and from literature. Peak discharges and sediment transport capacity were estimated.



Based on those calculations flood protection gabions walls and dug canals were properly designed to achieve the primary objective that is to ensure that the potential for overtopping failure is minimized.

The total height of the protection works, TH, that is the sum of the canal depth, CD, and the wall height, WH, is able to accommodate

variable flowpaths and hydraulic characteristics, including potential sediment deposition associated with canal slope and width reductions.



Hereafter are presented some general criteria that were adopted to design the geometry of the protection works:

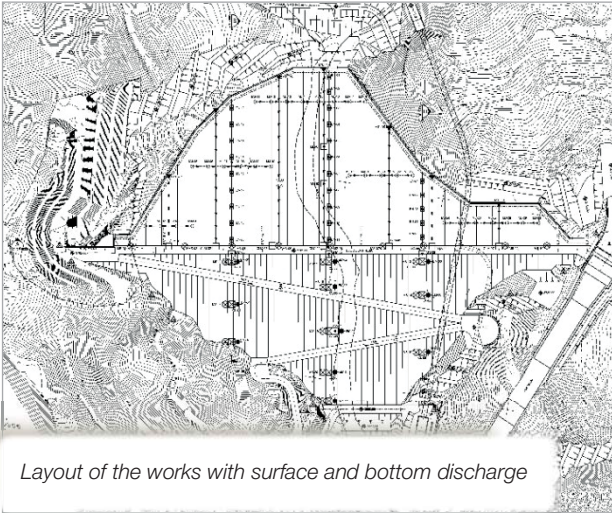
- a single gabions wall, about 550 m long, was designed to address the flow of both wadi Walwallè and a minor tributary. The protection wall anchors extend beyond the lateral limits of the fan, over a geologically inactive area for a length of 100 m. Another gabions wall, 230 m long, is located on the western side of the port to further protect it and convey water to the sea;
- the orientation between the flow directions and the dike alignment is as small as possible taking into account the presence of the port area downstream the wall;
- the gabions wall design height, WH, varies between 4,5 m for the lower bend reach and 2,5 m for the anchor reach and the cross-section area of the wall varies in the range of 11-16 m²/m.
- the canal for the initial diversion of the Walwallè wadi was designed with a bend radius as long as possible. There are three gently sloped steps (about 50 m long each) and a large horizontal bed 225 m long downstream the end of the wall in order to reduce flow velocity;
- the canal is at a minimum distance of about 20 m from the gabions wall in order to prevent toe scour;
- drainage trenches are at the downstream side of the gabions walls since the structures are permeable.

MISICUNI II PROJECT - DAM AND ANCILLARY WORKS ON THE RIO MISICUNI NEAR COCHABAMBA: TECHNICAL ASSISTANCE

Location:	Bolivia
Client:	Consorcio Hidroeléctrico Misicuni
Services:	Geological, geotechnical, hydraulic and hydrogeological studies
Period:	09/2009 – 03/2010
Construction cost:	€ 58,000,000

Project Description:

The project concerns the construction of a 120 m high earth dam on the Rio Misicuni, north of the city of Cochabamba, Bolivia, at an altitude of 3800 m a.m.s.l. The structure will create a reservoir of 185 million m³ of water, which will be the most importante source of potable water for the city of Cochabamba. In successive future phases, the water source will also be used for the generation of electricity.



Layout of the works with surface and bottom discharge

The project envisages a cofferdam and a diversion tunnel which will also be used for the bottom discharge. The surface discharge will be of the ski-jump type with a stilling basin. The upstream face is in concrete slabs. The dam core is in homogeneous material with anti-filtration diaphragms which extend into the abutments.



Geological investigations at the dam location

The peak flow rate considered for scaling the surface overflow is 2300 m³/s, discharge which is attenuated at the rate of 1200 m³/s, while the peak flow rate for the provisional diversion is 180 m³/s.

The Consorcio Hidroeléctrico Misicuni, the group of contractors that was awarded the contract, led by GLF Construction Corporation (USA), contracted TECHNITAL to carry out specialist

geotechnical and hydraulic studies and evaluations to verify the design.



The services carried out by TECHNITAL comprised:

- the supervision of the initial geotechnical-geological investigation works, executed both for the localization of construction materials and for the evaluation of the geology at the dam site;
- the evaluation of the efficiency of the existing design, both regarding geotechnical-geological and hydraulic aspects;
- the identification of new borrow areas with the specific aim of optimizing the design of the dam with alternative solutions;
- the verification of the dimensions of the bottom discharge tunnel and the stilling tank
- the definition of an alternative design solution based on an analytical study and computational analysis.



Bottom discharge tunnel

The main goal was to minimize and optimize the excavations in the light of the additional geological investigations regarding the characteristics of the dam core, and the surface discharge works and stilling tank. These tasks were achieved through specific site investigations, combined with and completed by design computational analysis and evaluations based on the data gathered.

FLOOD PROTECTION WORKS AND INFRASTRUCTURES FOR THE URBAN AREA OF SAN ERASMO

Location:	Venice, Italy
Client:	Consorzio Venezia Nuova for Ministry of Public Works
Services:	Preliminary and Detailed Design
Period:	12/1996 – 12/2009
Construction cost:	€ 130,000,000

Project Description:

In the context of the vast programme of works to save Venice from flooding and restore the natural environment of the Venice lagoon, for which TECHNITAL is the sole designer, are numerous projects to protect the various islands and townships of the lagoon. One of these is regards the locality of S. Erasmo.



The project aims primarily to protect the settlement of S. Erasmo from flooding due to the high tides. The scope of the design has been extended, with the approval of the Municipality of Venice and the Water Board, to include other objectives identified in the Master Plan of the island.



In particular, the works include: the construction of quay walls, urbanisation works for 5 zones, and works to restore the hydro-geological balance of the lagoon and invert the degradation process, eliminating its causes.

To achieve this last objective the following works are envisaged:

- vivification of the canals, today largely filled in, with

appropriate shore protection works in the stretches subjected to stronger currents and therefore more susceptible to erosion;



- halting the process of degradation of the natural and historical features, such as the once coastal beach at the south-western tip of the island;
- reduction of the pollution load in the lagoon deriving from civil wastes by means of constructing of a sewerage system
- interposing septic tanks between the houses and the lagoon;
- reducing the nutrient load discharged in to the lagoon.



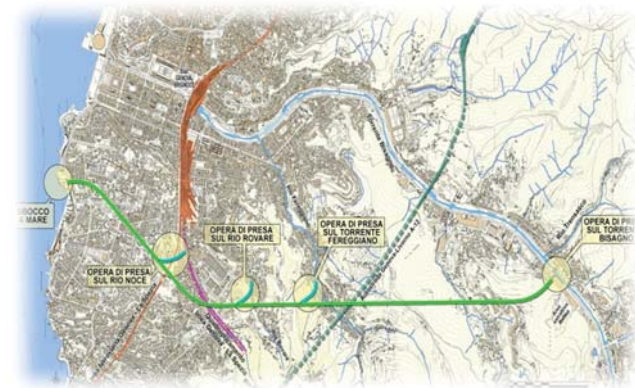
The services performed include surveys and investigation, preliminary and detailed designs of shore protection works, roads, quay walls, sewerage and water treatment systems.

FLOOD CONTROL OF THE BISAGNO RIVER AND OF THE FEREGGIANO, ROVARE AND NOCE STREAMS

Location:	Genoa, Italy
Client:	Province of Genoa
Services:	Detailed design, EIA, physical model studies
Period:	03/2003 – 07/2008
Construction cost:	€ 153,427,600

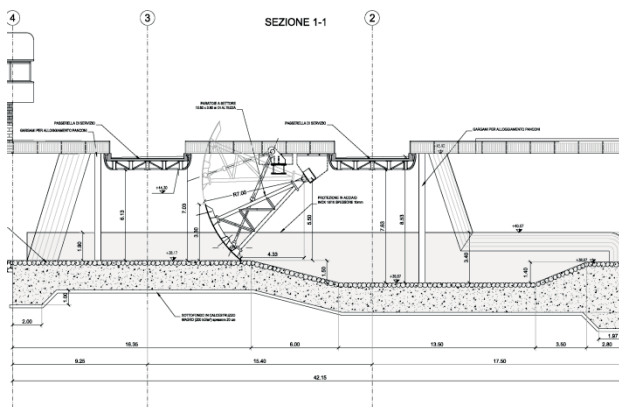
Project Description:

Studies conducted by the River Basin Authority, developed within the Basin Master Plan, underlined the risk of flooding of Genoa by the Bisagno river and the Fereggiano, Rovare and Noce streams. Such risk derives from the strong difference between the capacity of the river itself and the peak discharge with a return period of 200 years.



The project foresees a series of works due to reduce the risk of flood of huge urban areas. In particular, these works include:

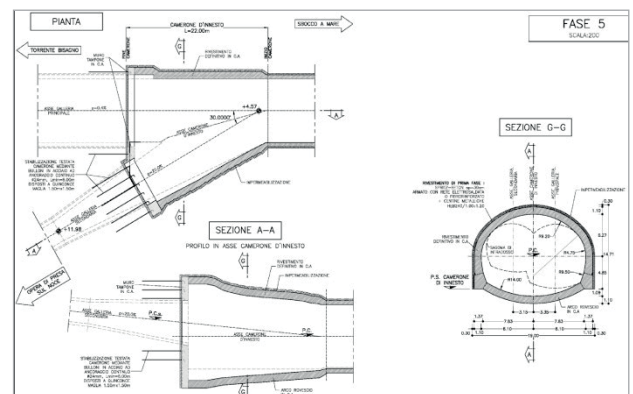
- Improvement of the hydraulic section located in the mouth reach, interested by a multiple barrel box culvert;
- realization of a river diversion to reduce the peak discharges flowing in the original riverbed.



The project of the river diversion includes, for the Bisagno river, the following works:

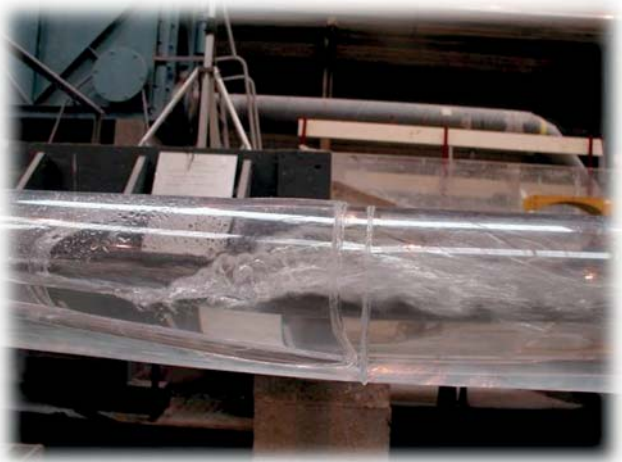
- a river barrage equipped with n. 3 radial gates;
- a tunnel, with a horseshoe section with 9.5 m diameter, able to carry to the Tyrrhenian sea a portion of the flood discharges derived by a lateral weir; the total length of the tunnel is 6,650 m;
- three smaller diversion structures on the streams Fereggiano, Rovare and Noce, connected to the main tunnel through three tunnels 300 m length;
- a sea outfall structure of the main tunnel;

- two service tunnels.



To verify the hydraulic behaviour of the main structures, a series of tests have been performed on n. 6 physical model with regards:

- diversion structures at the Bisagno river and at the Fereggiano, Rovare and Noce streams;
- tunnel confluence between the main tunnel and the tunnel coming from the Fereggiano stream;
- sea outfall structure.



The physical model tests allowed the evaluation of:

- the behaviour of the barrage, of the radial gates and of the lateral weir at the Bisagno barrage;
- the wave field in front of the outfall structure and the jet stream dissipation;
- the stability of the rock revetment at the outfall structure;
- the hydraulic confluence between the main tunnel and the tunnel coming from the Fereggiano stream;
- the hydraulic behaviour of the diversion structures (vortex shafts) located at the Fereggiano, Rovare and Noce streams.

HYDRAULIC WORKS ON THE NEW VALTROMPIA MOTORWAY LINK, ON THE MELLA AND GRANDE RIVERS

Location:	Brescia, Lombardy, Italy
Client:	Brescia – Padova Motorway Company
Services:	River dredging and training, banks shaping and flood control structures - Concept, Preliminary and Detailed Designs
Period:	06/2002 – 10/2007
Construction cost:	€ 6,622,200 (hydraulic works)

Project Description:

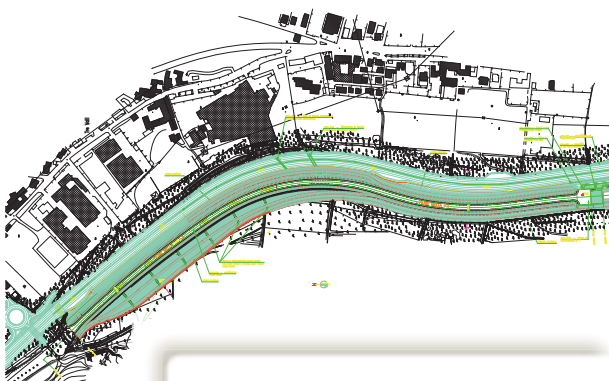
The project concerns the design of river training interventions, banks re-shaping and flood control structures in the crossing sections of the Mella and Grande rivers, which interfere with the construction of the new connection between the Brescia-Padua A4 highway and the valley area called Valtrompia, nearby the city of Brescia.



Bank protection works downstream of the bridge

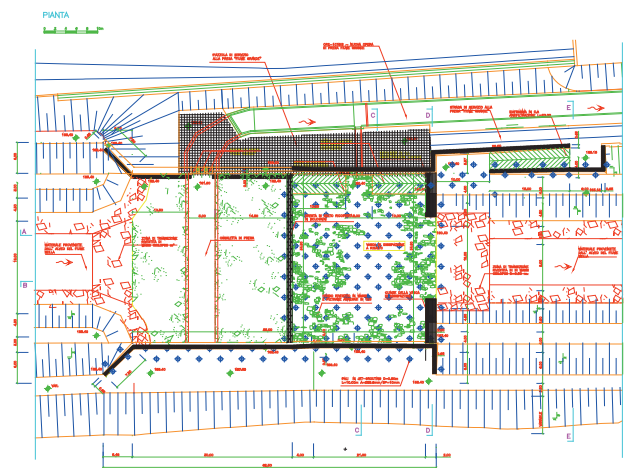
The works designed were as follows:

- New flood plain: in order to provide a floodable area and prevent all the risks to the built-up area of Campagnole di Concesio, a new flood plain has been designed beyond the right bank of the river, obtained by dredging the river bank for a length of approximately 700 m, while the talweg was reinforced with an improved bed made of rocks coming from the lateral dredging;



River training works at Campagnole di Concesio

- Sills for the Collebeato bridge protection: in order to ensure the safety of the deck system of the Collebeato bridge, an existing sill placed before the bridge was reduced by 2 m, while a new one has been designed 200 meters after the bridge: this intervention should reduce the water level by about 2 m under the bridge section;



- Dissipation basins and new intake structures on the Grande River: the Grande River, which flows near the Mella River, has been selected for the intake of water in order to maintain the hydraulic level of the Mella River near the existing sill during the dry season. For this purpose, a couple of dissipation basins in the Grande River near the new intake structures have been designed, in order to increase the water level of the Grande near the structures. A 32 m wide rock-based plateau filled with concrete has been designed, surrounded by vertical straight rock walls filled with concrete; a 2 m high sill and a minor dissipation basin for containing the hydraulic jump have been designed and placed after the first basin.



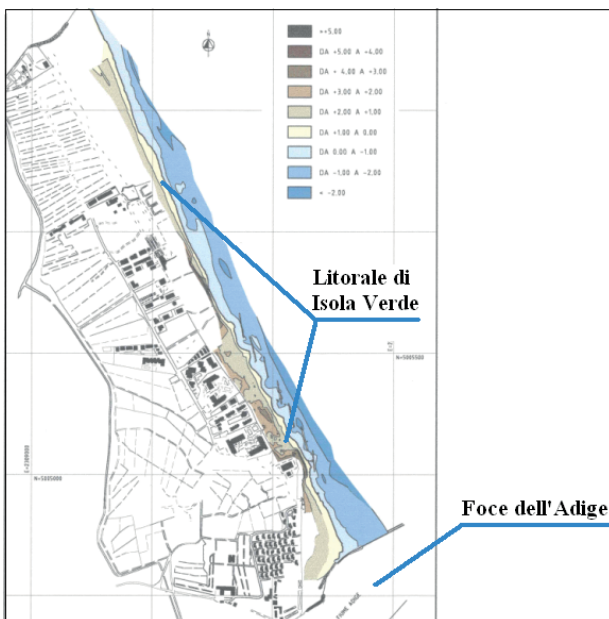
Intake work on the Grande River

WORKS TO PROTECT AND RE-DEFINE THE MOUTH OF THE RIVER ADIGE

Location:	Veneto Region, Italy
Client:	Venezia Nuova Consortium for the Water Board (MoPW) - Venice
Services:	Geotechnical, bathymetric, sedimentological, chemical and microbiological studies and investigations; Physical model studies; Detailed Design
Period:	05/1996 – 04/2005
Construction cost:	€ 7,593,900

Project Description:

The project for re-defining and protecting the mouth of the Adige is part of a larger contract for the protection of Isola Verde littoral which extends for some 2.5 km between the mouth of the Brenta River in the north and the Adige in the south.



The works in the last section of the Adige river were intended to:

- create the minimum flow river bed,
- permit safe navigation through the river mouth,
- foster the dispersion of fresh water from the Adige towards deeper waters,
- reinforce the existing protection works at the mouth
- contain the beach replenishment foreseen for the adjacent littorals.

Field investigations were carried out to determine the hydrodynamic characteristics of the river and the nature of the sediments in the riverbed. Subsequently, model studies were executed to determine the optimal configuration of the river mouth for the dispersion of pollutants carried by the river.

A physical model study carried out of the river mouth and the entire stretch of coast made possible the definition of the best configuration of the left breakwater at the mouth for spreading the pollutants without interfering with river navigation.

Geotechnical, bathymetric, sedimentological, chemical and microbiological studies were carried out by means of bores and surveys and the testing of samples.

The Detailed Design foresaw the realization of seven groynes along the coast of *Isola Verde*, to protect the coastline from erosion.



The river works included:

- extension seawards of the northern breakwater to a depth about -1.5 m
- re-definition of the earthen part of the breakwater
- excavation of the low water flow riverbed to a depth of -4.5 m and re-use of the excavated material for the nourishment of the littoral.

ANATOLIAN MOTORWAY

Location:	Gumusova-Gerede Section, Turkey
Client:	Astaldi-Bayindir AS J.V.
Services:	Preliminary and Detailed Design
Period:	12/2000 – 12/2002
Construction cost:	€ 80,000,000

Project Description:



TECHNITAL has been awarded a contract by the contractors Astaldi-Bayindir AS J.V. responsible for the construction of the Gumusova-Gerede section (Stretch 2D) of the Anatolian motorway (Istanbul-Ankara) regarding the structural design of 3 viaducts across River Arsarsuvu and related seismic isolation system.

In particular the activities entrusted to TECHNITAL include:

- Final and detailed design of 2 viaducts in a seismic area: Viaduct 2 (length 1200 m), Viaduct 3 (400m), including the design of seismic isolation system and dynamic analyses of a further viaduct, Viaduct 4 (700m), in accordance with the American AASHTO standards.

- Hydraulic design & riverbed training: In this case the tasks include the preliminary and final design of hydraulic works along the motorway alignment (approx. 4 km) and the training of Arsarsuyu river and its tributaries.
- Assistance to the Client during construction and supervision of the whole design.



EXTENSION OF THE CATCHMENT BASIN OF LAKE TRASIMENO

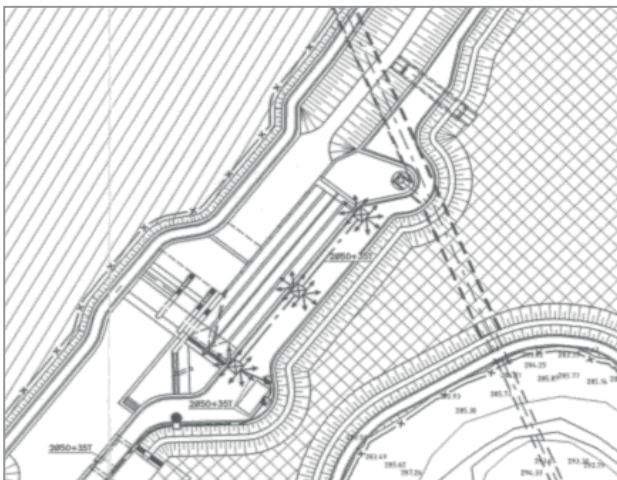
Location:	Umbria Region, Italy
Client:	Tiber River Basin Authority
Services:	Preliminary and Detailed Design
Period:	04/1998 – 06/2000
Construction cost:	€ 43,898,800

Project Description:

Lake Trasimeno is located in the central-western part of Umbria region, near the regional boundary with Tuscany. With its 128 km² surface, it is the fourth largest lake of Italy. It is also a unique swamp environment (maximum depth 6 m) of great natural and landscape significance, which is the home to numerous species of fish and also the natural habitat of a variety of birds.

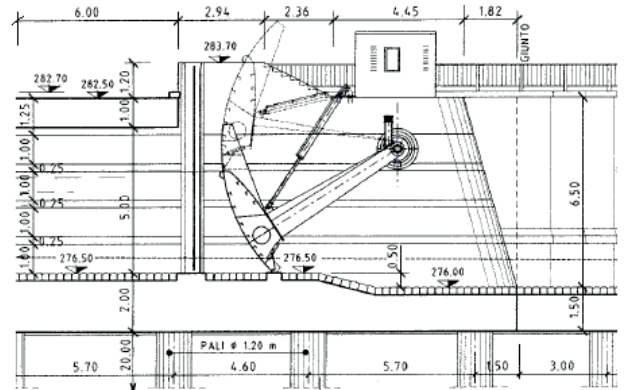


This rich natural environment has been seriously threatened by the depletion of the water in the lake. The steady lowering of the hydrometric level of Lake Trasimeno has been observed since the 1960's, and it became evident that it was necessary to extend its catchment basin, in order to provide a constant afferent water volume to avoid the lowering beneath a certain fixed level.

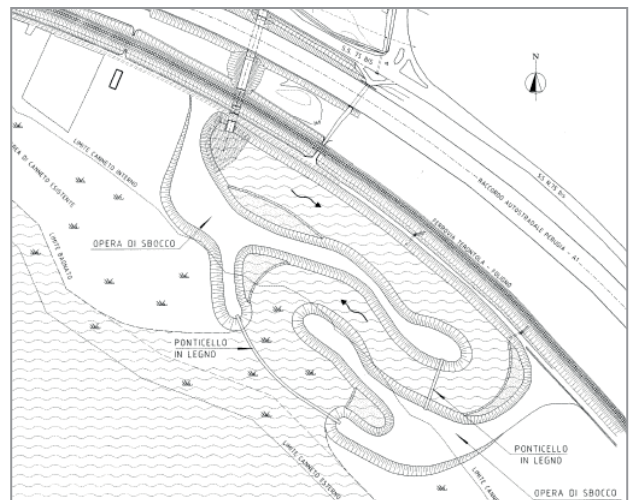


The preliminary design foresaw a work to collect water from the Tiber River. Subsequently, during the Detailed Design phase, it was decided to create a diversion of the Niccone stream, situated 13 km away to the north, and thus obtain the required water volume. The intervention regarded two different parts:

- *Diversion of the Niccone stream:* a stringer was foreseen, to deviate the normal path of the stream's flow, with a sill and two vertical-lift.



- gates, one of which was designed as a spillway gate: these gates will have the role of controlling the water volume by-passing the diversion and continuing in the natural flow course. After the diversion stage, a "collection" stage was established, with a bar screen for the retention of transported raw bed materials, followed by a two-bed settling basin, for the sedimentation of small-granulometry sand; the settling basin is then directly connected with the adduction tunnel. The diversion work required an intervention for the rescaling of both natural levees of the stream.



- *Outfall and entry work in Trasimeno Lake:* this part of the project was given very careful consideration, in order not to modify too drastically the natural environment of the lake shores. In order to achieve this result, the outfall area has been located not directly on the shore (so that it would not be necessary to dig the shore itself), and an artificial "lagoon" was created in a grassy field in front of the lake: a series of smooth bights were designed, from the outfall point of the tunnel to the entry section in the lake, following an "S" profile so that the incoming water volume reaches sub-critical hydrodynamic conditions, and enters the lake basin smoothly.

ENVIRONMENTAL PROTECTION OF THE SARCA RIVER - LAKE GARDA - MINCIO RIVER - MANTUAN LAKES SYSTEM

Location:	Italy
Client:	Po River Basin Authority
Services:	Concept design, EIA
Period:	02/1996 – 02/1997
Construction cost:	N.A.

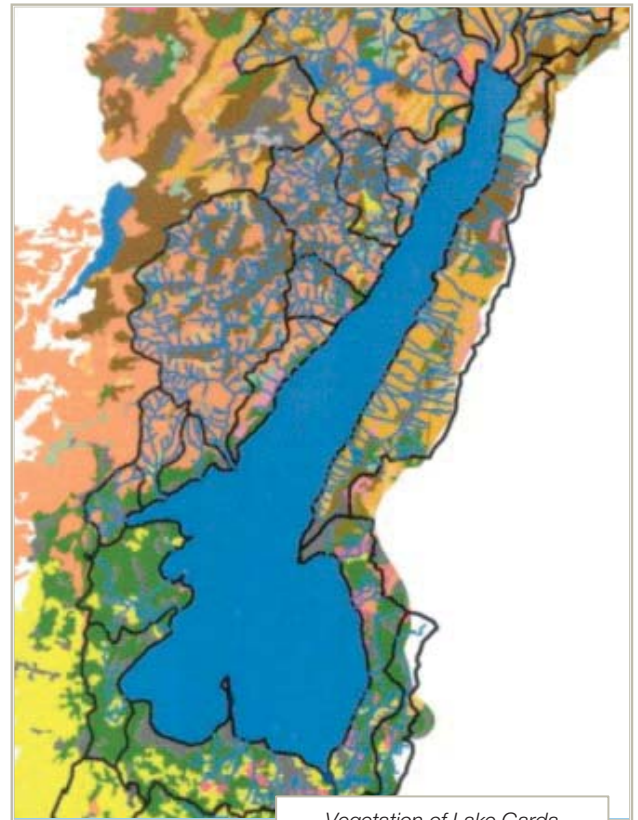
Project Description:



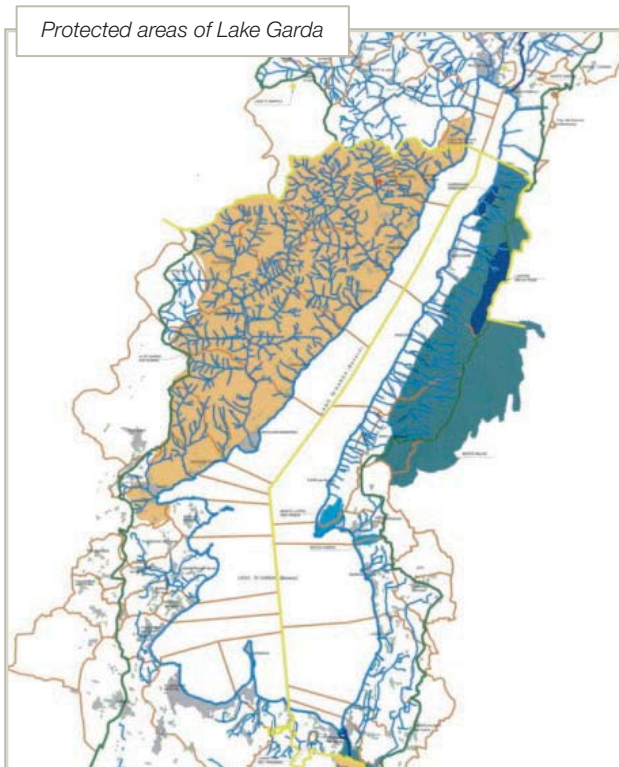
Sarca river

The aim of the study is to define an exhaustive framework of knowledge regarding the environmental quality of the area and to supply the elements needed to:

- define the principal alternative actions to optimize the water treatment system and the recycling of the treated waste water;
- define the restrictions for using both the water and the land, identifying criteria, standards and regulations to reduce the impact of anthropogenic activities on the territory;
- identify the tools required for monitoring the efficacy of the actions.

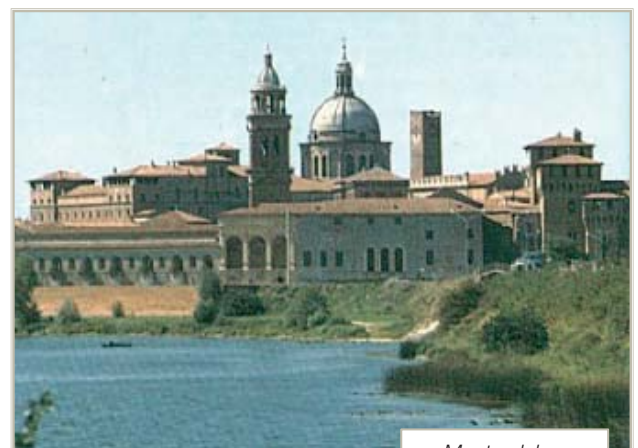


Vegetation of Lake Garda



Protected areas of Lake Garda

- improve the quality of the water in the basin in relation the integrated and optimum use of the water resource, taking into consideration the tourist-recreational prerogative of the area;



Mantua lakes

HYDROELECTRIC POWER PLANT OF PONT VENTOUX IN SUSA VALLEY

Location:	Piedmont Region, Italy
Client:	Temporary Association of contractors (Spie Battignoles, Grandi Lavori Fincosit, Vianini, Condotte) for "Azienda Elettrica Municipale (AEM)" of Turin
Services:	Final design
Period:	06/1992 – 07/1993
Construction cost:	€ 61,974,800

Project Description:

The AEM of Torino has tendered the construction of the new Hydroelectric Plant of Pont Ventoux, in Val Susa, which foresees the partial utilisation of Dora Riparia River waters.

The project was carried out in association with Electricité de France and Coyne et Bellier of France.



The project includes:

- the main diversion structure constituted by a dam on Dora Riparia River, a water intake structure and all ancillary works;
- a free surface offtake canal constructed in tunnel for a length of 14 km and a peak flow of 30 m³/sec.;
- a regulating reservoir in Val Clarea of 560,000 m³ capacity, constituted by a 33 m. high dam and bypass canal;
- pressure tunnel of 2.75 km in length connected to a pressure steel pipeline of 685 m. in length and 2.8 m. dia.;
- electric power plant of 388 GW;
- ancillary works such as access roads and tunnels, restitution canal etc.

Works under construction and after completion



MASTER PLANS FOR THE LIVENZA, LEMENE AND TAGLIAMENTO RIVER BASINS

Location:	Veneto and Friuli Venezia Giulia Regions, Italy
Client:	Hydrographic Office of the Venice Water Board - Ministry of Public Works
Services:	Studies for hydrology, hydrogeology, hydraulics and water quality
Period:	01/1984 – 12/1987
Construction cost:	N.A.

Project Description:

The purpose of the Master Plan of the three river basins is the hydrological and hydraulic protection of the soils, the sustainable socio-economic development of the area, the preservation of natural resources, the depollution of waters and soils.

The area concerned by the study consists of the catchment basins of the rivers Livenza, Tagliamento e Lemene, for a total area of approx. 6.000 sqared km., located in the Veneto and Friuli Venezia Giulia regions.

The Study includes preliminary investigations and collection of existing documentation and data, collection and elaboration of hydrological data, running of mathematical simulation models, geological surveys, measurement and monitoring, analysis.

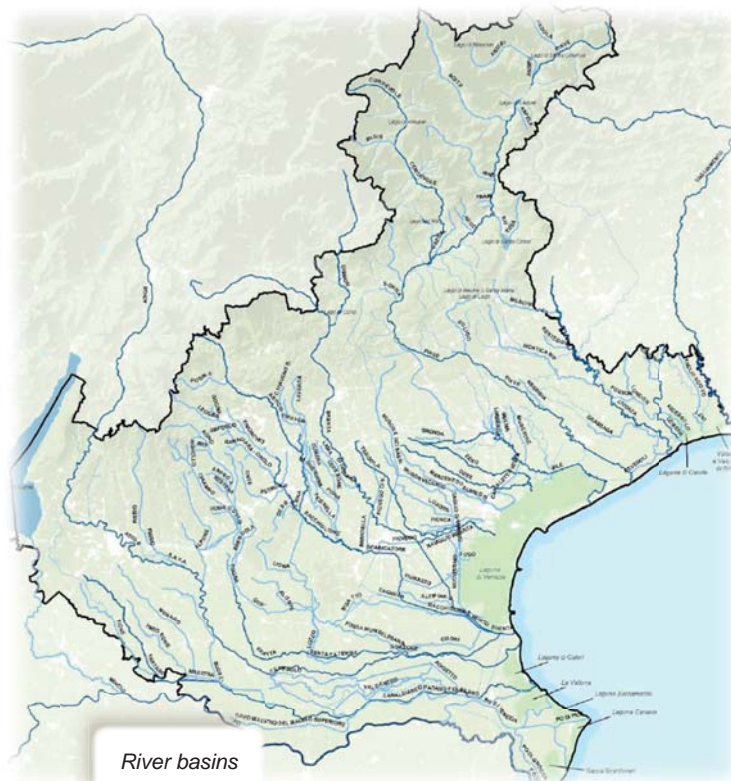
The Master plan is divided in three phases. TECHNITAL, in Joint Venture with Hydrostudio and SGI, has been awarded the 1st Phase of all three river basins and the 2nd Phase for the Livenza river basin.



Livenza river



Tagliamento river



River basins

IRRIGATION SCHEMES FOR AGRICULTURAL DEVELOPMENT AT MANATALI (MALI) AND BOGHE' (MAURITANIA)

Location:	Manantali, Mali – Boghé Mauritania
Client:	Organisation pour la mise en valeur du fleuve Senegal (OMVS) - Ministère de l'Agriculture du Mali - Financing by Italian Ministry of Foreign Affairs.
Services:	Feasibility Study; Concept, Preliminary and Detailed Design; Tender documents
Period:	01/1982 – 12/1986
Construction cost:	N.A.

Project Description:

As the title reveals, two distinct projects are involved under the same contract. Both projects are aimed to implement irrigation schemes in local agriculture with the scope of increasing annual harvest so that agriculture is no longer dependent on the desultory floods.

The engineering services awarded to TECHNITAL included: preliminary research and investigations, mathematical simulation models, topography, hydrological studies, geological surveys, laboratory testing, preliminary and final design of 3.000 ha irrigation scheme, tender documents.



In the case of **Mali**, the areas in question are those along the Bafing River (an affluent of River Senegal), downstream of the Manantali dam, under construction at the time of the project, for a total extension of approx. 3.000 ha. In **Mauritania** the areas concerned are located in the Boghé plains, on the right banks of River Senegal.



STUDY OF THE POSSIBILITIES OF STORING AND UTILISING SURFACE RUN-OFF WATER FOR AGRICULTURE

Location:	Senegal Sardinia, Italy
Client:	Ministère de l'Hydraulique - Senegal, with financing from the Italian Government
Services:	Feasibility study, preliminary design
Period:	01/1983 – 12/1985
Construction cost:	€ 10,329,100

Project Description:

The climatic changes witnessed in the Sahel area over the past twenty years have had serious repercussions also in Senegal, with decreasing rainfall, reduction of agro-pastoral products and consequent droughts.

This Study comes in the context of the Senegalese Government's decision to investigate the possibility of constructing surface water retaining dams and related irrigation schemes, in an area of about 30.000 km².

The Study, awarded to a Joint Venture between TECHNITAL and INC, included:

- identification of all most suitable areas for the construction of retaining dams and irrigation schemes, through a aerial photographs interpretation, site surveys, socio-economic studies and feasibility evaluations;
- identification of six priority sites to be further investigated;
- detailed topographic, pedological and geological surveys on priority sites;
- preliminary design of retaining structures and irrigation schemes for each of the six priority sites.



DAM ON THE GIBBESI RIVER IN SICILY

Location:	Sicily, Italy
Client:	Mazzi S.p.A. for the Sicilian Mines Organization
Services:	Identification studies, Preliminary and Detailed Designs of the hydraulic works and ancillary structures
Period:	01/1971- 12/1983
Construction cost:	€ 30,987,400

Project Description:

The project was launched to foster the industrial development of the Licata plain, thus providing water resources to local inhabitants and industries and to support the agricultural development scheme of 1100 ha. along the Gibbesi river.



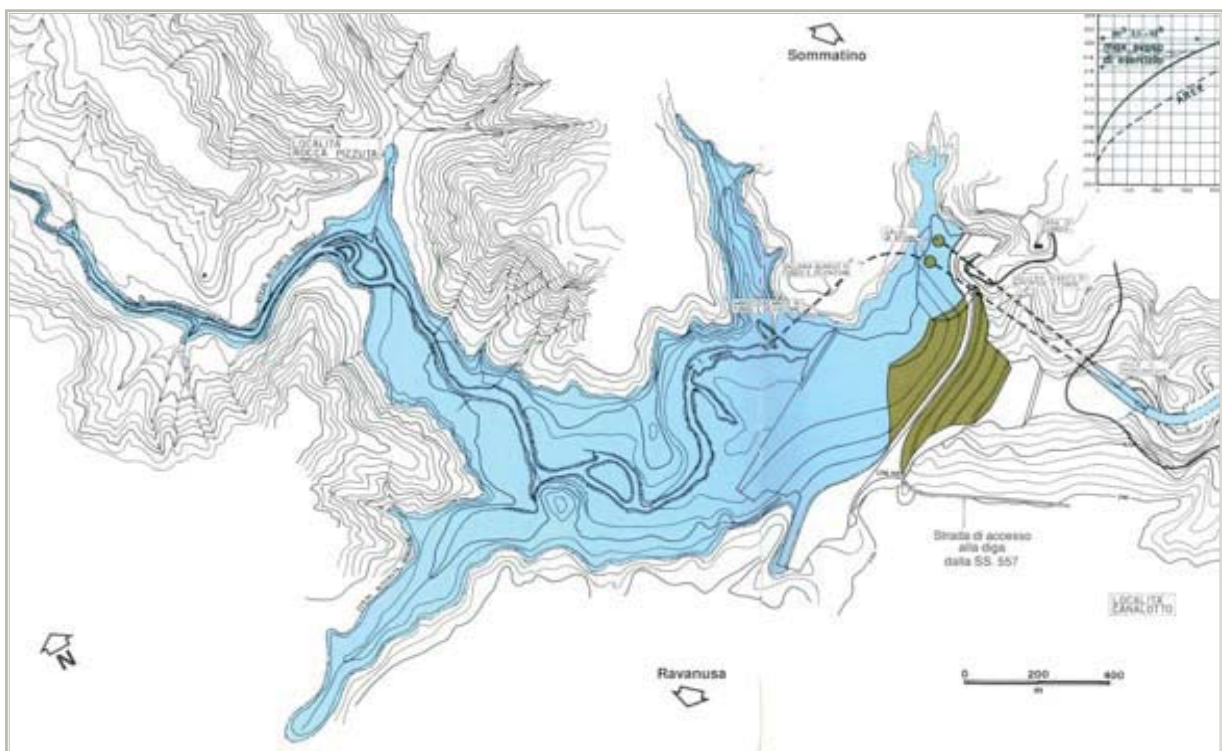
The rockfill dam, located some 4 km from the junction between Gibbesi and Salso rivers, has a length of 607 m. and a maximum height of 46 m. The catchment area, at the dam site, is 116 km² and the reservoir volume obtained is 11,4 million m³.

The project, in addition to the dam, also includes:

- access and internal road network;



- bottom and surface discharge structures: tunnels, shaft spillways, gates, etc.;
- energy dissipation structure and distribution channels;
- aqueduct, 28km long and with a flow-rate of 950 litres/second, from the reservoir to the storage tank of Reppelino in the Licata Plain;
- ancillary works.



Hydraulic and Hydrodynamic Studies

CONSULTING AND DESIGN ACTIVITIES RELATED TO WATERWAYS IN THE REGIONAL HYDROGRAPHIC NETWORK (PADREDDURI - TILIBBAS - MINOR STREAMS)

Location:	Olbia (Sardinia Region), Italy
Client:	CIPNES - Industrial Consortium of Gallura
Services:	Hydrological and Hydraulic Studies for Padredduri Stream, Feasibility Design, Final Design, Detailed Design
Period:	11/2022 - ongoing
Construction cost:	n.a.

Project Description:

The Project is subdivided into 3 sections:

1. Hydraulic compatibility study with the aim to reduce the areas with hydraulic danger along Padredduri Stream in the CIPNES area;
2. Hydraulic compatibility study and the integral design with the aim to reduce the danger areas along the Tilibbas Stream in the CIPNES area;
3. Report pursuant to Art. 8 paragraph 11-bis of the NTA of the PAI for the non-establishment of protection zones along the watercourses belonging to the minor hydrographic network falling within the CIPNES area.

1. Padredduri Stream

In December 2014, CIPNES drew up the hydraulic compatibility study pursuant to article 24 of NTA of the PAI, relating to the entire urban planning district in the CIPNES area.

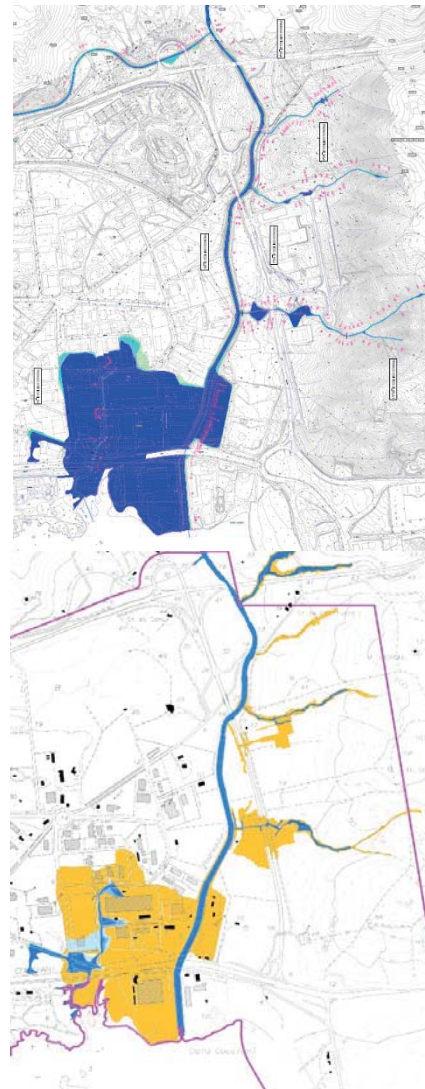
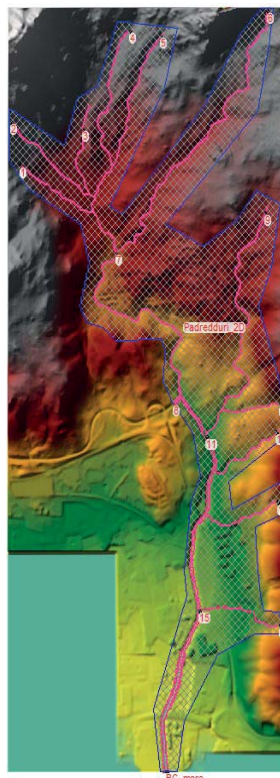
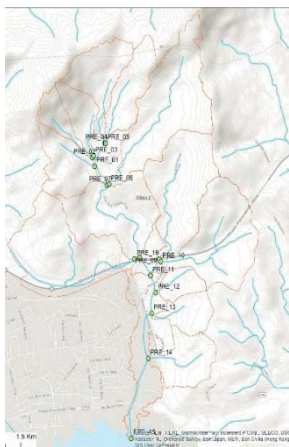
In this study, in particular, the Padredduri Stream was studied and in the study cartography the areas of hydraulic danger were delimited and as regards the Padredduri Stream, a very large extension of surface with high danger was determined in the area of the mouth, near the Cocciani Stream.

The study that is the object of this assignment consists in the re-edition of the hydraulic compatibility study which considers the project interventions conceived and already carried out by CIPNES after the drafting of the 2014 hydraulic compatibility study.

This study aims to re-delimit the danger areas and to reduce their extension, because of the projects and works planned and carried out by CIPNES, after their testing.

The hydraulic analyses, carried out in this study through a 2D modeling of the Padredduri Stream in the configuration following the realization of the works of the aforementioned project, have demonstrated that these works are capable of containing the flooding identified in the current PAI: the entire flood discharge, for all the return time-period considered (50, 100, 200 and 500 years, in compliance with the NTA of the PAI and determined with a specific hydrological study), it never exceeds the present embankments.

In the figure below it is possible to appreciate a comparison between the current danger and the danger recorded in this study. The blue areas indicate high danger, while the orange areas in the figure on the right refer only to a residual danger.



2. Tillibas Stream

The Tillibas Stream has already been the subject of a study conducted by Technital S.p.A. (delivered in November 2019), entrusted by CIPNES, aimed at identifying the possibility of re-proposing to the agency of the hydrographic district of Sardinia (ADIS) the project already approved by the Civil Engineers of Olbia in 2012 to obtain a variant to the PAI and reduction of danger areas. In this study, it was demonstrated that this project approved by the Civil Engineers does not satisfy the hydraulic regulations in force and within the same study a new solution was therefore identified aimed at reducing the Hi4 danger areas, along the Tillibas Stream.

This project, in integrating the report and study already conducted with the cartography and technical attachments necessary by PAI regulations, to obtain formal approval of the identified, implemented, and tested solution in order to proceed with a variant of the PAI relating to the Tillibas Stream.

The activities will consist of:

- Hydraulic compatibility study of hydraulic risk mitigation interventions and reduction of dangerous areas;
- Integral planning (Preliminary Design, Detailed Design and Final Design) of the interventions.

The area subject to intervention develops starting from the crossing structure located approximately 120 m upstream of Via Nilo, near the roundabout on Via Danubio, and up to a section located immediately downstream of Via dei Lidi near the viaduct of SS125. The area is currently partially built up and there are various primary urbanization works.

The project proposal consists in the resecting of the outflow section of the watercourse in the section between the roundabout of Via Danubio and Via Nilo, to obtain a riverbed capable of containing, between its banks, flows with return time-period of 50, 100, 200 and 500 years. For this purpose, an expansion area is also created upstream of Via Danubio, on the hydraulic left-hand side, in order to give the possibility of laminating the flood flow outside the watercourse and thus reducing the flow into the main riverbed.

In addition, it is intended to eliminate the graded section downstream of Via Nilo, with modification of the current route of the stream to create an open-air canal. On this canal, the construction of a crossing structure is planned to allow the transit of the watercourse under the Rotonda Europa junction in the direction of Via dei Lidi.

To verify these works, a two-dimensional hydraulic model is created with the HEC-RAS software, with the aim of verifying and sizing the works described above.

3. Minor Networks

The activities concerning the minor network will be structured according to the following sequence:

- Identification of watercourses and incisions falling within the area of competence of CIPNES as indicated in the PAI regulations;
- Analysis of the conditions of existence of the elements foreseen by the regional legislation necessary for the request for the non-establishment of protection zones along the branches of the regional hydrographic network;
- Drafting of a technical report aimed at demonstrating the existence of the conditions for non-establishment of protection zones relating to the examined watercourses.



REHABILITATION OF SERRA DEL CORVO DAM

Location:	Genzano di Lucania (PZ) and Gravina di Puglia (BA), Italy
Client:	District Basin Authority of the Southern Apennines
Services:	Feasibility Study
Period:	07/2021 - ongoing
Construction cost:	€ 4.300.000

Project Description:

The Serra del Corvo dam is located into the catchment area of the Bradano River and intercepts the Basentello stream at an altitude of 243 m above sea level. It is in the municipalities of Gravina di Puglia (BA) and Genzano di Lucania (PZ).

It was built between 1969 and 1974. It is in loose materials with internal clay core. The height is 41.50 m, and it generates a reservoir with a maximum capacity of 42.65 Mm³.

The project consists of the seismic inspections of the dam and ancillary works, geotechnical study, geognostic investigations on reinforced concrete structures and related laboratory tests.

The analyses consist in the seismic evaluation of the dam and ancillary works in the light of the technical standards for dams (NTD 2014) and the technical standards for construction (NTC 2018).

The core of the dam is made of compacted clay silts of low permeability and crosses the permeable surface formation up to the basement also made of clay. The counter cores are made of coarse-grained materials of high permeability. Between the core and the upstream and downstream flanks there is 1 meter transition zone reaches the nail of the facing.

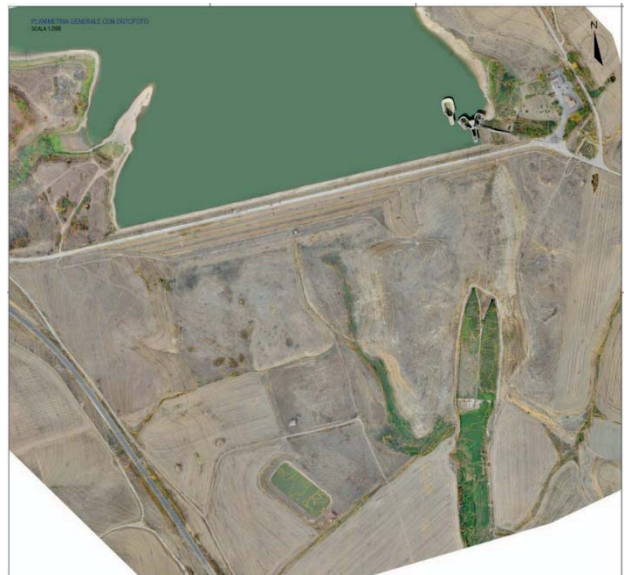
On the upstream facing there is a coating in spliced concrete slabs of the thickness of 30 cm, arranged on a sand and gravel substrate of the same thickness of 30 cm. The abovementioned coating in some areas is unstable.

Main ancillary works are the following:

- Surface spillway n°1: the surface discharge is a free threshold in concrete, with a threshold of 71.00 m, shaped in a U-shape and includes a large tank, also in concrete. It is followed by a connecting chute that leads into tunnel No. 1 of the semicircular vault type. The spillway is equipped with irrigating external buttresses.
- Surface spillway n° 2 and manoeuvring shaft: the work covers the surface discharge and the access shaft to the manoeuvring chamber. The surface spillway consists of 4 spillways, 2 on each side, manned by as many fan gates with automatic operation. The spillways, each 10 m long, are placed on the sides of two converging axis gutter channels, with an angle at the centre of 60°, to make room, in the middle, for the access shaft to the manoeuvring chamber of the sluice gates of the bottom drain. In the middle of the two gutter channels is located the access tower to the manoeuvring chamber of the bottom discharge gates. The tower, triangular in plan, allows you to reach through several flights of stairs the base of the manoeuvring shaft, at an altitude of 49.85 m above sea level.
- Dissipation tanks: the discharge tunnels 1 and 2 flow into two dissipation tanks located downstream of the body. In one to the right, it merges the tunnel n° 1 and has a length of 228.56 m, in the other, further to the left, flows the tunnel n° 2 and has a length of 205.36 m. Laterally the tanks are delimited by gravity walls of variable height: for the first 30 m the walls have a height of 7.50 m from the extrados of the base slab; after a stretch of length 30 m at height. Variable the height of the wall is brought to 4.00 m until the end of the pool.

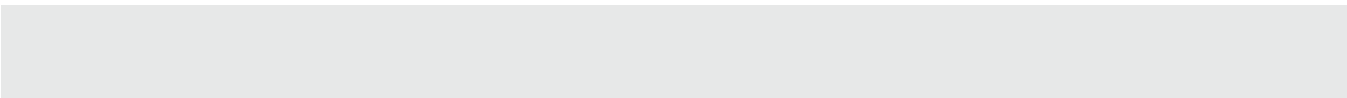
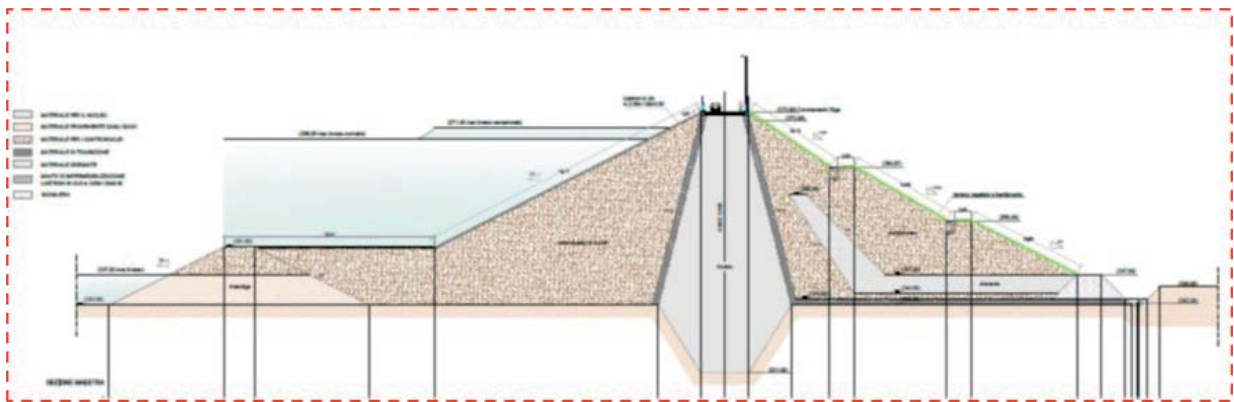
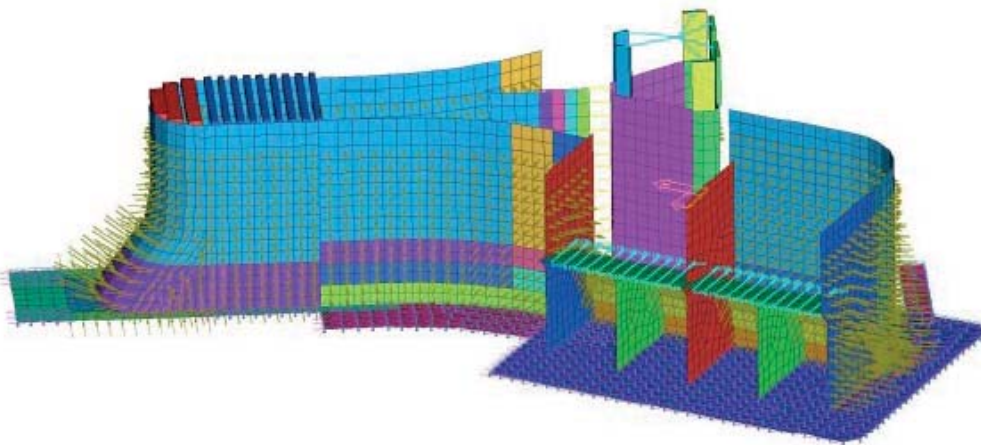
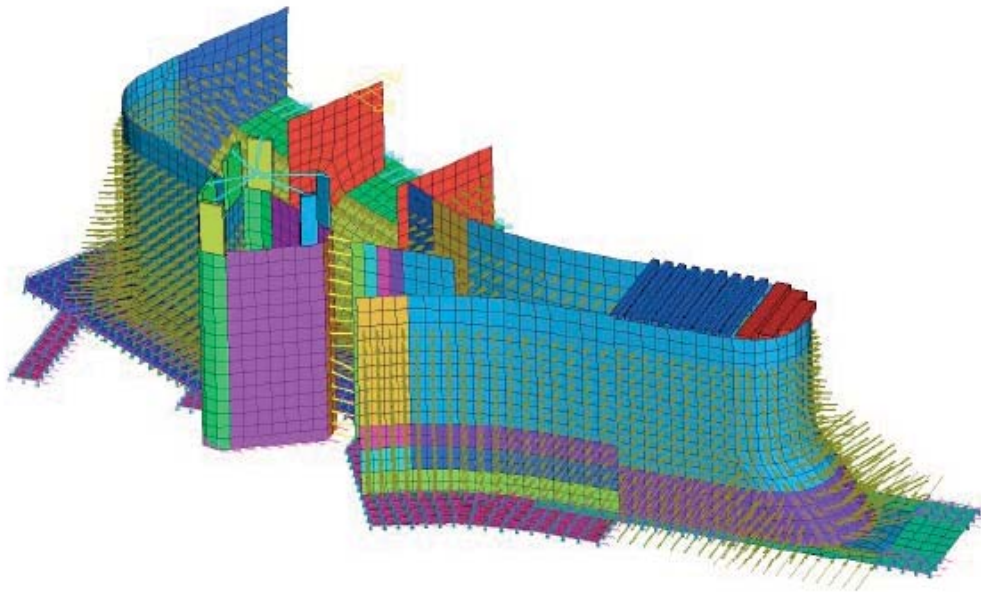
The two tanks are separated from each other by a central gravity wall. The bottom of the tank is made up of reinforced concrete slabs of different sizes and with a constant thickness of 50 cm joined together.

The services provided are the following: the reassessment of seismic safety, the geotechnical study of the dam with the consequent definition of the interventions to improve the structural conditions from the seismic verification and from other related investigations.



The proposed seismic upgrading interventions mainly concern the reinforced concrete works and include for the various works the execution of tie-rods, piles, hooping, reinstatement of concrete cover.





GENERAL PLAN FOR THE HYDROLOGICAL PROTECTION OF THE TERRITORY OF OLBIA (SARDINIA)

Location:	Olbia (Sardinia), Italy
Client:	Olbia Municipality
Services:	General Plan
Period:	09/2020 - ongoing
Construction cost:	n.a.

Project Description:

The project is about the preparation of the PAI (Piano di Assetto Idrogeologico - Hydrogeological Management Plan) technical documents; PAI is the most important urbanistic tool used by the public administrations for the evaluation of the hydrological hazard and risk and the identification of mitigation measures/interventions for the protection of the territory.

The hydrogeological study required the implementation of a full set of hydrological and hydraulic models to assess the flooding and landslide risk/hazard in the territory of Olbia that may occur in case of extreme critical meteorological events.

The territory of Olbia municipality extends over an area of about 400 km² from the coastline to the inner part of the hydrographic basins with the highest altitudes in the order of 800 m. The river network is characterized by 4 major rivers, Riu San Nicola and Riu Seligheddu which cross the urban center of the town and two other major rivers Padrogianus on the southern side of the territory and Riu San Giovanni which flows in the northern part. The river network is characterized by a large set of creeks with small extension but very steep which have the potential to generate dangerous flash floods in the coastal areas. Overall, the extension of the whole river network is about 900 km.

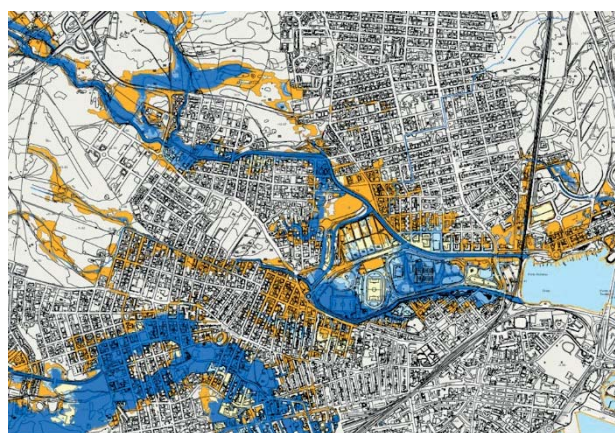
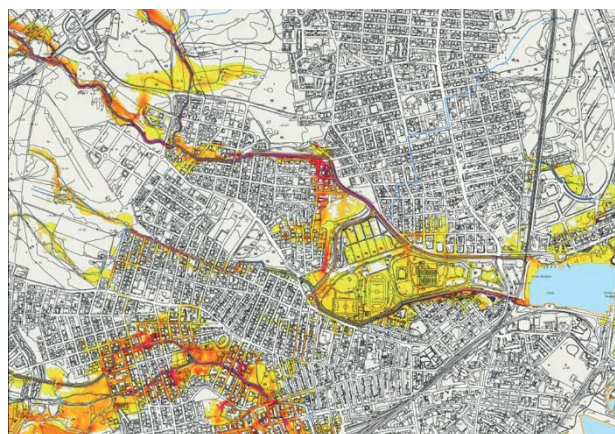
Activities for the study included: in situ campaigns for the survey of bridges/infrastructures along the river network, surveys for the reporting and classification of landslide hazards, the set-up of a large set of numerical models for hydrological analysis, the set-up and development of numerical models for the study of the propagation of floods and the evaluation of inundation areas and hazards.

Overall, a set of 34 hydraulic models have been set-up with the schematization of about 30.0 km of river network ranging from the large urban rivers to the small tributaries and creeks in the inner areas. The numerical models used for the study belong to HEC suite of software (HEC-HMS, HEC-RAS)

Further activities included in the study encompassed the specialistic study for the evaluation of the solid transport along the main rivers, and the study for the assessment of the flood damages in the urban catchments which has considered the magnitude/extension of the flooding and the economic values of civil constructions/buildings.

In the study beyond the use of numerical models for hydrologic and hydraulic studies, GIS tools have been largely and extensively used both to perform geospatial analyses and for the preparation and generation of drawings/maps as part of the study outputs.

The Hydrogeological hazard study for Olbia has been implemented according to the regional and national regulations currently in force.



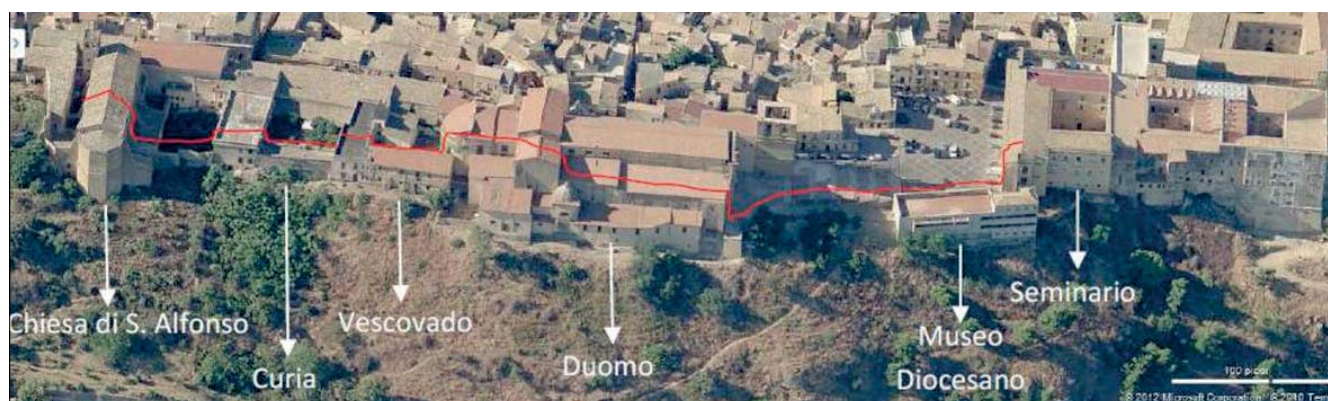
INTERVENTIONS TO MITIGATE THE INSTABILITY OF THE HILL WHERE THE CATHEDRAL OF AGRIGENTO IS LOCATED

Location:	Agrigento – Sicily - Italy
Client:	Sicily Region
Services:	Final and Detailed Design
Period:	05/2019 - 02/2020
Construction cost:	€ 19.224.077

Project Description:

Because of its orographic and hydrogeological conformation, the project area, has been affected for centuries by the instability phenomena involving the Cathedral and the buildings of the diocesan area. The various and numerous interventions adopted over the centuries, mostly of a structural nature, have not stopped the process. The project area includes the site of the Cathedral and the slope that bounds the north side of the city of Agrigento. The Cathedral, whose construction began in the eleventh century, was located on a ridge east-west oriented. The city has developed on the south side, which with a gentle slope descends to the bottom of the valley, while the north side is steep, with a slope between 40 and 50 degrees and height up to 40m. Its instability was manifested along the ridge with a crack that affects the Cathedral, then extends eastward to the church of Sant 'Alfonso and westward to the Diocesan Museum.

The intervention of consolidation of the slope consists in the construction of 5 lines of concrete beams, between 304 and 324 m above sea level, with a total length of about 1,000 m, with micro piles and tie rods. The consolidation work has been studied and conceived minimizing the impact of the works on the site and on its environment. The beam acts both as a walkway and as ditch for the rainwater collection channel. The hydraulic measures adopted for the slope aims at managing the infiltration and regimentation of water, it consists in collection elements, ditches, and channels, to collect water and convey it to the foot of the slope. Inside the crowning beam a channel will be realized on the back of the upstream micro piles, for the collection of water from the slope, which will flow into the collection channel at the foot of the wall in micro piles. It is planned the realization of reinforced micro piles Φ 250 mm, according to three orders for alignment at a distance of 0,50 - 1 m, a crowning beam in reinforced concrete with 2 x 2 m section and anchoring tie-rods, at a distance of 1 m with variable free length in relation to the position of the anchorage and the local stratigraphy, with a foundation of 9 m.



SCHEMA DI DISPOSIZIONE DEGLI ELEMENTI DI DRENAGGIO - PIANTA

0 0.80 1.60 m

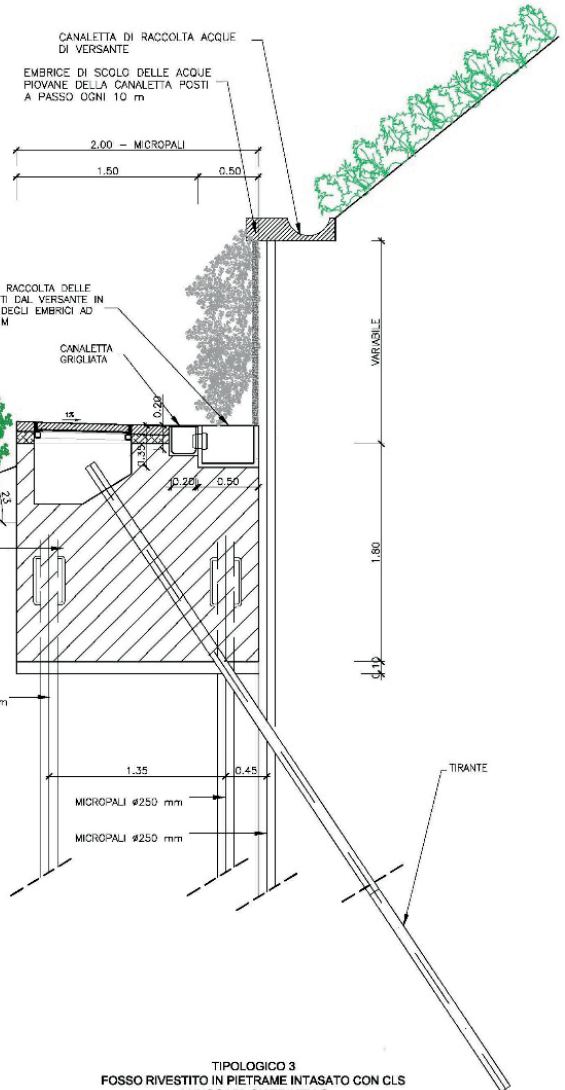


LEGENDA

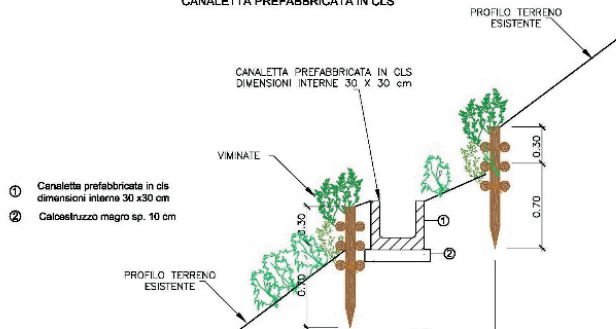
- ① PAVIMENTAZIONE IN TERRA STABILIZZATA NATURALE
- ② CANALETTA GRIGLIATA
- ③ POZZETTO DI RACCOLTA ACQUE DI VERSANTE
- ④ EMBRICE DI SCOLO DELLE ACQUE DI VERSANTE (1-10.00 m)
- ⑤ CANALETTA DI RACCOLTA ACQUE DI VERSANTE

SEZIONE TIPOLOGICA1

0 0.40 0.80 m

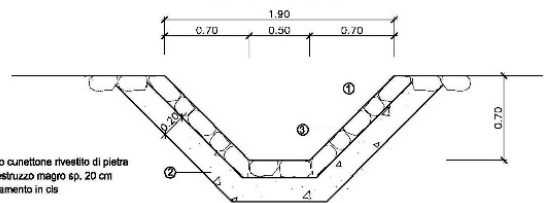


TIPOLOGICO 2
CANALETTA PREFABBRICATA IN CLS



- ① Canaletta prefabbricata in cls dimensioni interne 30 x 30 cm
- ② Calcestruzzo magro sp. 10 cm

TIPOLOGICO 3
FOSSO RIVESTITO IN PIETRAME INTASATO CON CLS
LUNGO VIA GIARDINELLO



- ① Fondo cuneiforme rivestito di pietra
- ② Calcestruzzo magro sp. 20 cm
- ③ Intasamento in cls

PROGRAMME FOR THE RECOVERY AND PRESERVATION OF THE VOLUME OF THE DAM RESERVOIRS: PONTE PIA', CARESER, PIAN PALU', ALA E MORI (Trentino, Italy)

Location:	Trentino, Italy
Client:	HydroDolomiti Energia, TN
Services:	Programme for the recovery and preservation of the volume of the dam reservoirs
Period:	03/2018 – 10/2019
Construction cost:	€ 1,864,976

Project Description:

Programmes for the restoration and conservation of reservoir volumes in the Walnut, Sarca and Adige basins (for the Careser, Pian Palù, Ponte Pià, Ala and Mori reservoirs) and pursuant to Ministerial Decree of 30 June 2004, Circular PAT no. 449612 of 26 September 2016 and subsequent notes and the competent legislation on the subject, concerning the various extended concessions pursuant to Presidential Decree no. 4/98 and subsequent amendments and addendum.

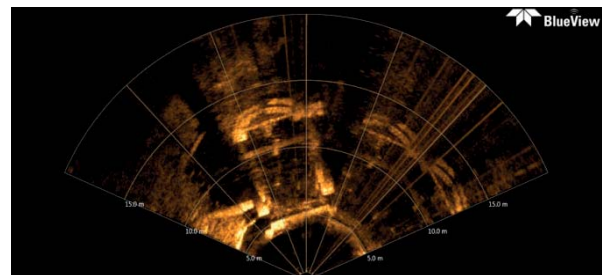
One of the major problems in the management of reservoirs is represented by the burying, that is the progressive accumulation of sediments that reduces the storage capacity and can limit the functionality of watercourses and plants, sometimes to the point of completely precluding it.

The silting up of the reservoir is linked to the sedimentation of eroded soil and rock particles in the catchment area upstream or from the banks of the reservoir.

The deposition of a high solid content has a direct impact on the maintenance, cost and efficiency of hydraulic works and mechanical devices in artificial reservoirs. Burying can also cause serious problems for tributaries and effluents, as well as for the quality of water and its ecosystems.



In order to implement the Plan, each dam was assessed in terms of its territorial framework, and information was gathered on the construction of the dam, as well as of the relative useful volumes, maximum storage and regulation. Quantitative-qualitative descriptions have been made for each basin upstream and downstream of the dams. Climatic data that may have influenced the quantity of material sedimented in the reservoir (flows, rainfall) have been analyzed. Finally, the results of the bathymetric surveys carried out over time were evaluated, with the aim of accurately quantifying the volumes of sediment deposited in the reservoir and in the vicinity of the bottom outlets.



The chemical-physical characteristics of the sediments to be removed were then evaluated and the possible post-excavation management of the sediments was defined.

Each Plan provides for the analysis of all possible sediment management solutions from a BAT (Best Available Technology) and BEST PRACTICE perspective that carefully evaluates potential impacts on the environment, territorial context, costs and benefits. Each management possibility has been analyzed, evaluated and compared with the others in order to identify the best solution for each reservoir and its territory.



Finally, a Monitoring Plan was proposed, where necessary, for the environmental parameters to be carried out before, during and after the sediment's removal operations.

UPDATING OF THE HYDROGEOLOGICAL STUDY OF THE IMPACT OF A CONTAINMENT CUT-OFF WALL IN THE VENICE INDUSTRIAL HARBOUR OF MARGHERA, VENICE

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Groundwater modelling
Period:	04/2008 - 06/2012
Construction cost:	N.A.

Project Description:

This study consisted of the updating of the previous modelling study, concluded in 2007.

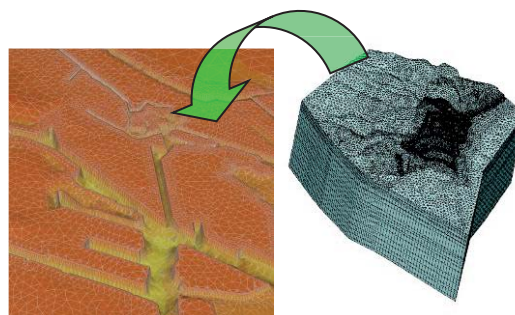
Within the general project of decontamination activities called MISE in the S.I.N. (Site of National Interest) area of Porto Marghera (Venice, Italy), the Italian Ministry of Environment asked the Venice Water Authority, *Magistrato alle Acque* (MAV), to limit the water exchange between the contaminated soils and the lagoon waters within the SIN. MAV, through its concessionary *Consorzio Venezia Nuova* (CVN), has planned construction of a continuous 56.8 km long cut-off wall made of steel sheet piles along the entire harbour channel banks. The diaphragms are driven into the lagoon bottom down to a depth ranging between 15 and 25 m below sea level. Since such a cut-off wall constitutes an impermeable barrier to groundwater flow from the mainland toward the lagoon, CVN commissioned Technital to carry out a study on the expected impact of the cut-off wall on the natural flow regime of the shallowest aquifers.



The modelling study, completed in 2007, based on the geological and hydrological information available to date, was developed to verify the efficiency of the continuous cut-off wall.

Successively, the study was updated with additional data, in order to more accurately describe underground litho-stratigraphy. In particular, 5 new detailed litho stratification sections were reconstructed in addition to the previous 12 sections, which were updated with many new data. A detailed reconstruction of the harbour litho stratigraphy was available from about 2000 boreholes and geotechnical tests. Furthermore, 8 deep litho stratification sections were reconstructed on the basis of data from about 160 artesian wells.

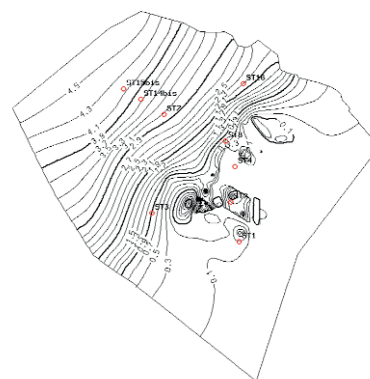
Following the updating of the stratigraphic conceptual model, the hydrogeological conceptual model was also updated with data from about 500 new piezometers and 250 Lefranc tests. The conceptual model of pollution was then updated and various maps showing the concentration of pollutants were prepared.



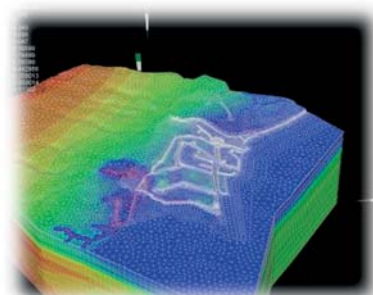
Groundwater flow modelling was performed according to the FEFLOW 6.0 code. FEFLOW solves the classical groundwater flow equation by linear finite elements (triangular prisms) in space and a finite different scheme in time.

The model was completed with the introduction of local hydrography, the drainage system along industrial channels, and artesian deep wells which could allow the connection between deep aquifers and the shallow aquifer system.

The 3-D model was calibrated using the piezometric levels recorded in 2006 in a number of wells scattered across the study area, and then validated by a different data set.



The model allowed the performance of many simulations designed to describe the effect of the planned diaphragms along harbour channel banks and further possible diaphragms at the back of the port area.



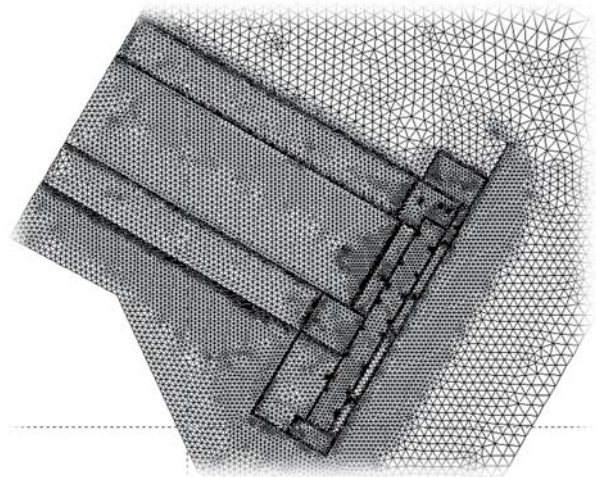
DEWATERING AND CONTROL SYSTEM FOR THE GATE LOCATION BASIN ON THE SEASIDE AT MALAMOCCO INLET, VENICE

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Detailed design
Period:	02/2011 – 09/2011
Construction cost:	N.A.

Project Description:

The construction of the mobile gates at the three port entrances for safeguarding Venice and its lagoon from flooding, and of the complementary works against medium/high flooding and losses of sediments from the lagoon, has been started by the opening of construction sites for about eight years.

On the southern side of the port entrance of Malamocco a basin has been created to provide a site for the location of gate on the sea side; another basin has been created for the location of gate on the lagoon side.

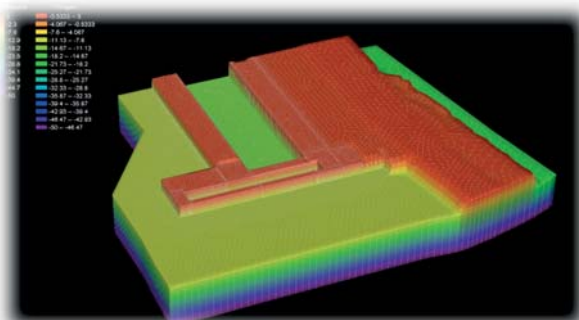
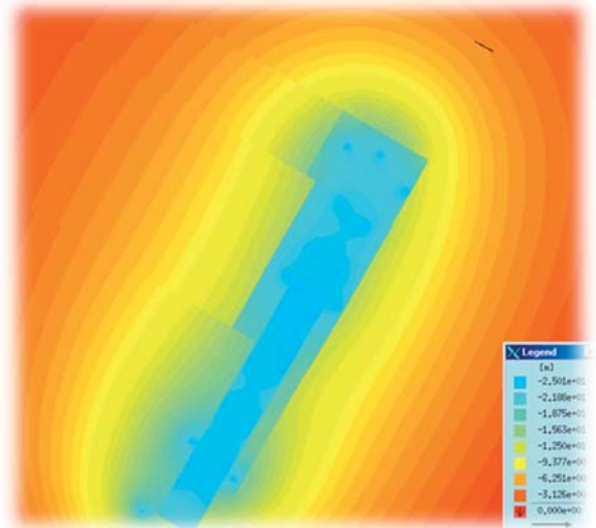


On the basis of the calculation results dimensions of the well system (number, geometry, and location) have been obtained, necessary to guarantee the stability of the excavation ground during works.

The site on the seaside measures 126 m by 14 m; the depth of the basin is about 14 m and it's protected by a metal sheets system. Also the adjacent areas, where other civil works are located, are protected by a metal sheets system.

A study of a dewatering and control system for the location basin of gate on the seaside, has been necessary in order to control underwater pressure and to guarantee the stability of the excavation ground.

On the basis of stratification data and data from hydraulic tests (Lefranc test, pumping tests), a conceptual stratification and hydrogeological model has been implemented, followed by a tri-dimensional finite elements model for defining the size of the well network and of the control under-water pressure piezometers network. Groundwater flow modelling has been performed by the FEFLOW 6.0 code (Diersch, 2010), a software for modelling fluid flow (and transport of dissolved constituents) in the subsurface, in transient or steady state condition.

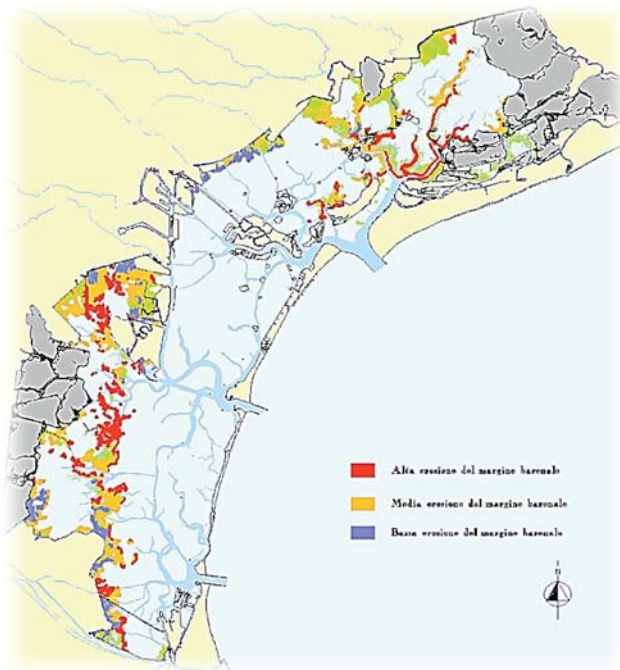


MASTER PLAN FOR THE MORPHOLOGICAL AND ENVIRONMENTAL REHABILITATION OF THE VENICE LAGOON

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Feasibility study, environmental impact assessment. Support activities included land use and GIS studies for mapping of pollution sources. Detailed design
Period:	01/2003 – 12/2007
Construction cost:	N.A.

Project Description:

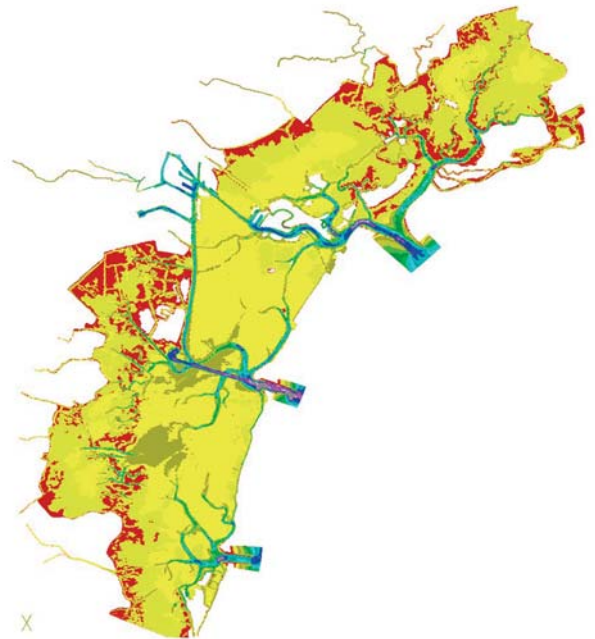
In the context of the Project for the protection of Venice and its Lagoon from the devastating effects of high tides, one of the major problems to be dealt with is that of the conservation of the lagoon ecosystem and its biodiversity, threatened by the human use (fishing, clam harvesting, navigation, urban development) and the present negative environmental conditions (sea level rise, subsidence, erosion).



The Project undertaken by TECHNITAL has as the primary objective the understanding of the causes of morphological and environmental deterioration and the identification of possible interventions to reduce the causes and to preserve and (when possible) restore the natural conditions of the ecosystem to acceptable levels in the shortest time possible.

To this end the following activities were performed:

- creation of a relational data bank and data processing with the aid of GIS for the automatic production of thematic maps
- detailed description of the environmental situation of the lagoon, including aquatic life, vegetation, natural habitats, sediment and water quality, morphological features.
- detailed description of the present human use of the lagoon and their impact on the environment



- preliminary analysis of interventions needed to improve the environmental conditions, by use of mathematical models specifically implemented
- definition of management scheme to control and monitor the lagoon environment.

The main measures proposed to restore and preserve the lagoon environment were:

- Creation of freshwater habitats along the lagoon border to enhance the ecological value.
- Construction of tidal flats and marshlands to restore the lagoon's natural hydrodynamic patterns
- Protection of eelgrass beds for bottom protection
- Preservation and restoration of natural habitats by protecting and planting salt marshes species in areas under stress.
- Definition of guidelines for the practical construction of morphological structures (type of materials, equipment, technical solutions to dispose the dredged material etc.)
- Definition of mitigation measures to reduce the impact of human activities (i.e., clam harvesting)
- Design of pilot interventions.

ISAP PROJECT: RESEARCH ON THE SEDIMENTS AND WATERS IN THE CHANNELS OF PORTO MARGHERA AND THE FACING AREAS OF VENICE LAGOON

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Coordination of water and sediment quality study
Period:	11/2006 – 06/2007
Construction cost:	N.A.

Project Description:

Modeling activities were commissioned as part of the ISAP project to assess the congruency between industrial discharges monitored in the area of Porto Marghera in the lagoon of Venice and the concentrations of pollutants in port waters determined by measurements performed during measurement surveys specifically performed as part of the study.

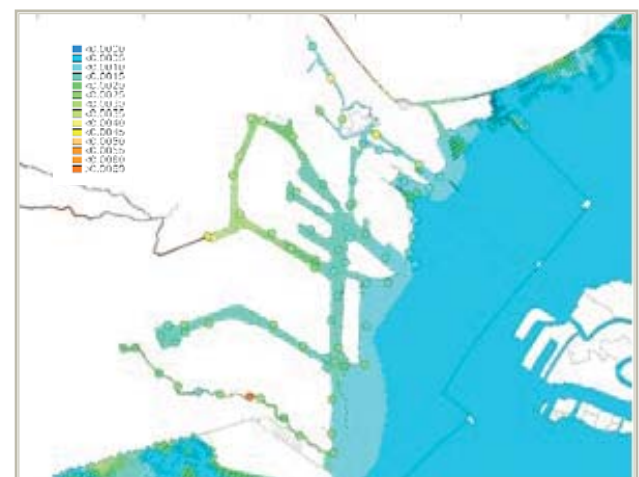


A check of the ability of the model to represent dispersion of the area under examination compared the measured and the calculated salinity values. A test of congruency between measured concentrations and monitored discharges compared calculated and measured concentrations of arsenic, lead and copper.

The study took place in three phases:

1. analysis of water column quality data in the industrial channels of Porto Marghera and determination of the analyses that could be considered as conservative tracers or with decay in the first order;
2. design and testing of the dispersion model which, considering the pollutants coming both from industrial waste and from rivers that discharge in the area of interest reproduces the fields of concentration of the tracers being considered which were then compared with those measured.
3. parametric analysis to determine the expected range of variability of concentration of pollutants considered in relation with various marine-weather scenarios and to assess the “exchange” between the industrial area and the surrounding lagoon areas.

A detailed model of the area under examination, dynamically connected with the overall model of the Lagoon of Venice, was developed to carry out this analysis.



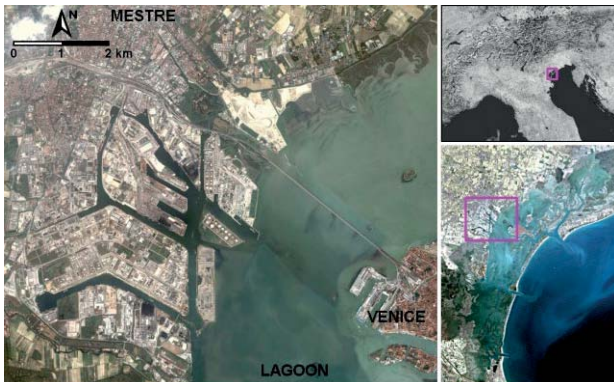
The model showed a good ability to represent dispersion in the area under examination, both in 2-D and in 3-D layouts. It was possible to check that measured concentrations are substantially congruent with declared discharges.

MODELLING THE HYDROGEOLOGICAL IMPACT OF A CONTAINMENT CUT-OFF WALL IN THE VENICE INDUSTRIAL HARBOUR OF PORTO MARGHERA

Location:	Porto Marghera Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Groundwater modelling
Period:	12/2003 - 04/2007
Construction cost:	N.A.

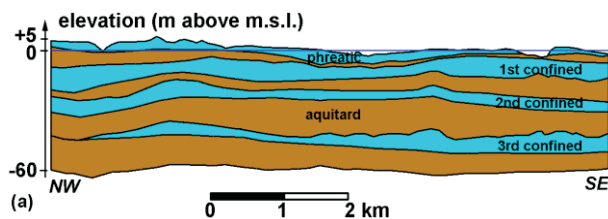
Project Description:

A major source of non-biodegradable organic and inorganic pollutants is represented by Porto Marghera, a port and petrochemical complex on the central-west side of the Venice lagoon. Porto Marghera is classified as "Site of National Interest" (SIN). Within the general project of decontamination activities called MISE, the Italian Ministry of Environment asked the Italian Water Authority (Magistrato alle Acque MAV) to limit the water exchange between the contaminated soils and the lagoon waters within the SIN. MAV, through its concessionary Consorzio Venezia Nuova (CVN), has planned construction of a continuous 56.8 km long cut-off wall made of steel sheet piles along the entire harbour channel banks. The diaphragms are driven into the lagoon bottom down to a depth ranging between 15 and 25 m below sea level. Since such a cut-off wall constitutes an impermeable barrier to groundwater flow from the mainland toward the lagoon a study has been commissioned by CVN to Technital on expected impact of the cut-off wall on the natural flow regime of the shallowest aquifers.

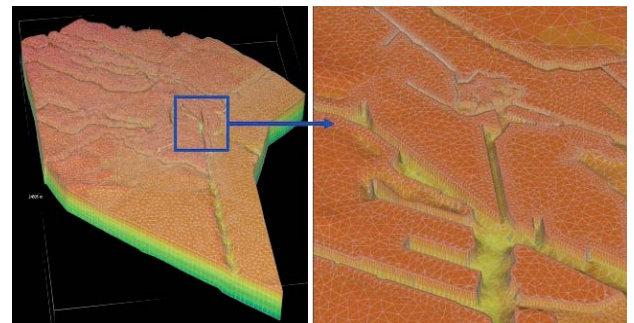


A modelling study based on the geological and hydrological information available to date has been developed to verify the efficiency of a continuous cut-off wall planned along the channels of the Venice industrial harbour to reduce the groundwater discharge into the lagoon. The diaphragm is intended to create an impermeable barrier to the flow of polluted groundwater from the harbour subsurface to the lagoon area.

A detailed reconstruction of the harbour litho stratigraphy is available from more than 1300 boreholes and geotechnical tests, and several electrical resistivity sections have been integrated and used to reconstruct 12 detailed litho stratification sections.



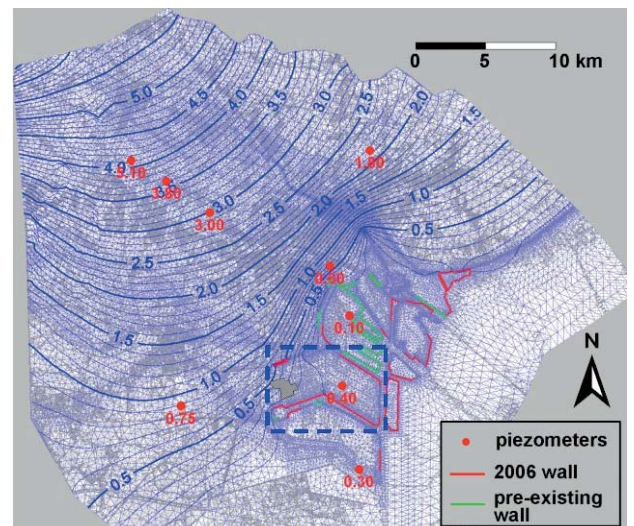
Maps of the depth and the thickness of the geological layers have been created and the spatial variability of the layer geometry has been investigated.



Several pumping tests along with about 350 Lefranc tests have somewhat allowed for the characterization of the hydraulic conductivity k in the various aquifers: k ranges between 10^{-4} and 10^{-5} m/s.

Pumping test interpretation by the traditional Theis-Jacob method provides a specific elastic storage between 10^{-3} and 10^{-4} m⁻¹.

Groundwater flow modelling has been performed by the FEFLOW 5.3 code (Diersch, 2005). FEFLOW solves the classical groundwater flow equation by linear finite elements (triangular prisms) in space and a finite different scheme in time.



The hydrological simulations accurately reproduce the heterogeneous litho stratigraphy in the Venice coastland down to 50-70 m depth below m.s.l.

The model has been calibrated using the piezometric levels recorded in 2006 in several wells scattered across the study area.

DESIGN AND IMPLEMENTATION OF THE PUMPING SYSTEM TO ACCELERATE THE CONSOLIDATION AND SETTLEMENT OF AN EMBANKMENT AT MALAMOCCO INLET

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Embankment seaside for a prefabrication area for the gates elements. Design of wells system to control underwater pressure below the basin, during the prefabrication of the structural elements of the gates
Period:	01/2004 – 12/2005
Construction cost:	N.A.

Project Description:



Since the beginning of the 1900's, high waters have become more frequent and intense. This can be attributed to the combined effect of a rise in a sea level (eustasy) and a drop in land level (subsidence). As a result, urban centres in the lagoon area are today 23 cm lower in relation to sea level than they were at the beginning of the 20th century.

To defend the cities of Venice and Chioggia, other urban areas in the lagoon and the entire lagoon basin from the destructive effects of medium/high tides and the devastating effects of exceptional tides, the MOSE system has been designed. The MOSE system consists of various types of structure with integration between mobile barriers (rows of gates) and fixed elements ("complementary measures") and works together with local measures that raise banks and public walkways (up to 110 cm in Venice).

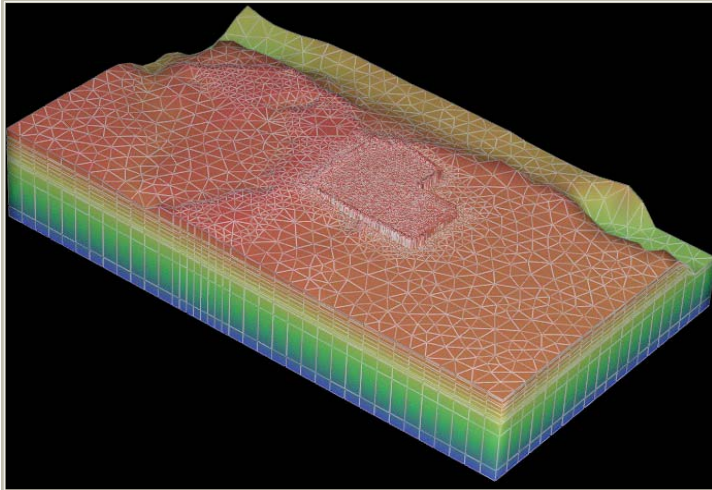
The mobile barriers are the heart of the MOSE system and consist of rows of gates installed in the inlet channels. When inactive, the gates are full of water and lie in caissons on the seabed where they are completely invisible and do not modify exchanges between the sea and lagoon. In the event of risk (high tides), the gates are filled with compressed air which replaces the water, they rotate around the axis of the hinge until they emerge and block the tidal flow entering the lagoon.

The complementary structures on the other hand involve construction of a breakwater outside each lagoon inlet, and raising the bed at Malamocco from -16 m to -14 m.

The construction of the mobile gates at the three port entrances for safeguarding Venice and its lagoon from flooding, and of the complementary works against medium/high floods and losses of sediments from the lagoon, started on 3 April 2003.

On the southern side of the port entrance of Malamocco an embankment area has been created to provide a site for the prefabrication of the gates elements. The embankment is made of sands coming from the nearby excavation activities and measures 450 m by 400 m towards land and 250 m towards the sea. The sand layer reaches 0.50 m above m.s.l. Above the sand layer are several layers of granular material, compacted by an 18-ton roller. The final height is about 2.50 m above m.s.l.





Based on stratification data and data from hydraulic tests (Lefranc test, pumping tests) during the first phase of the project a conceptual stratification and hydrogeological model has been implemented, followed by a tri-dimensional finite elements model for defining the size of the well network and of the control under-water pressure piezometers network.

Groundwater flow modelling was performed by the FEFLOW 5.3 code (Diersch, 2005), a software for modelling fluid flow (and transport of dissolved constituents) in the subsurface, in transient or steady state condition. Several pumping tests and Lefranc tests performed near the construction area have somewhat allowed for the characterization of the hydraulic conductivity k and the elastic specific storage S_e in the various aquifers. Pumping test data interpretation by the traditional Theis-Jacob method provided a specific elastic storage estimation.

Based on the calculation results dimensions of the well system (number, geometry, location) have been obtained, necessary to guarantee stabilization and consolidation of the embankment.

DRY BASIN AT CHIOGGIA INLET FOR THE PREFABRICATION OF GIANT CONCRETE STRUCTURES TO BE FLOATED TO LOCATION FOR THE CONSTRUCTION OF THE FLOOD BARRIERS

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Seaside basin and prefabrication area for the structural elements of the row of gates. Design of wells system for control of under-water pressure below the basin, during the prefabrication of the structural elements of the row of gates
Period:	01/2004 – 12/2005
Construction cost:	€ 66,500,000

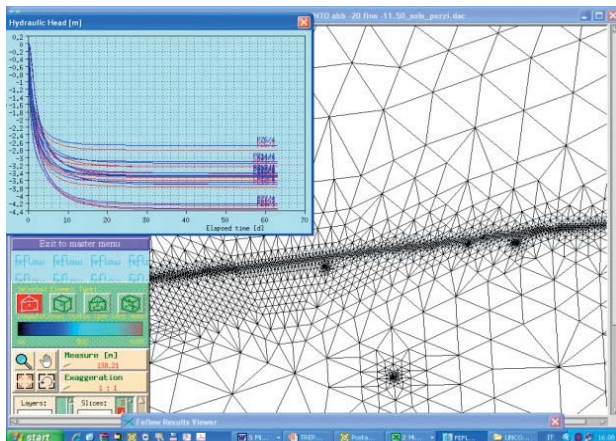
Project Description:

The construction of the mobile gates at the three port entrances for safeguarding Venice and its lagoon from flooding, and of the complementary works against medium/high flooding and against losses of sediments from the lagoon, has started with the opening of construction sites for about eight years.

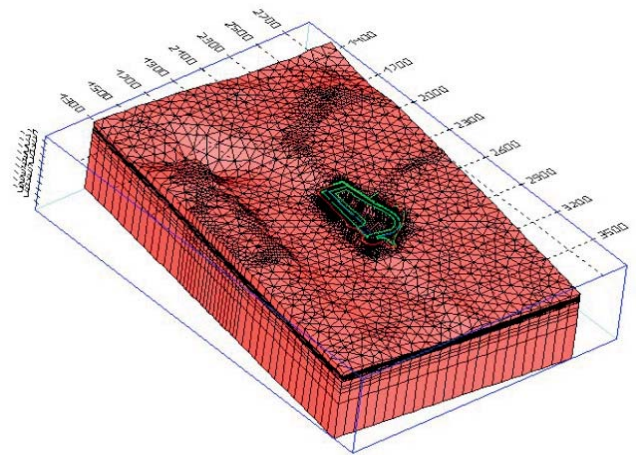
At the Chioggia inlet the excavation site located at the seaside has total surface of about 80.000m², a depth of 12.50m and is protected by a metal sheets system.



On the basis of stratification data and data from hydraulic tests (Lefranc test, pumping tests) during the first phase of the project a conceptual stratification and hydrogeological model has been implemented, followed by a tri-dimensional finite elements model for defining the size of the well network and of the control under-water pressure piezometers network.



Groundwater flow modelling has been performed by the FEFLOW 5.3 code (Diersch, 2005), a software for modelling fluid flow (and transport of dissolved constituents) in the subsurface, in transient or steady state condition.



Several pumping tests and Lefranc tests performed near the construction area have somewhat allowed for the characterization of the hydraulic conductivity k and the specific storage S_s in the various aquifers.

Pumping test data interpretation by the traditional Theis-Jacob method provided for a specific elastic storage between 10⁻⁴ and 10⁻⁵ m⁻¹.



Based on the calculation results dimensions of the well system (number, geometry, location) have been obtained, necessary to guarantee the stability of the excavation ground.

HYDRODYNAMIC MODELS FOR THE STUDY OF SEA TIDES IN THE VENICE LAGOON AND FURTHER APPLICATIONS

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for the Ministry of Public Works
Services:	Hydrodynamic modelling
Period:	09/2001 – 09/2004
Construction cost:	€ 1,859,200

Project Description:

The Water Authority for the lagoon of Venice, decided to develop a hydrodynamic mathematical model of the lagoon. This new model uses a curvilinear grid with a finite differences schematization that can be easily connected to water quality and/or morphological modules, to provide a hydrodynamic base for environmental analysis. Technital was appointed for the calibration of this model for its application in forecasting the tidal events, to protect Venice from the risk of flooding.

To achieve this goal, a number of schematizations of the selected model had to be developed and the model had to be calibrated in the best possible way. The mathematical model chosen to develop the new hydrodynamic model of the lagoon of Venice was Delft 3-D Flow, the hydrodynamic module of a suite of models developed by Delft Hydraulics Laboratory (The Netherlands). In order to implement the model, the Venice lagoon was schematized in three configurations:

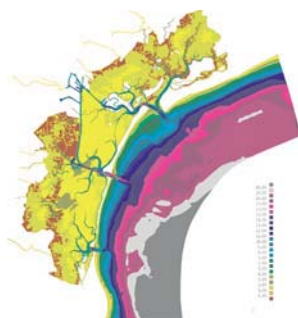
- *Basic Configuration* - the lagoon itself and rivers discharging into it - the extent of the model is limited to the lagoon, with open boundaries at the entrances of the lagoon and the part of the rivers entering the lagoon which are influenced by the tides.

Basic configuration: ~ 75.000 cells



- *Complete System* – the lagoon itself, rivers discharging into it and part of the Adriatic Sea

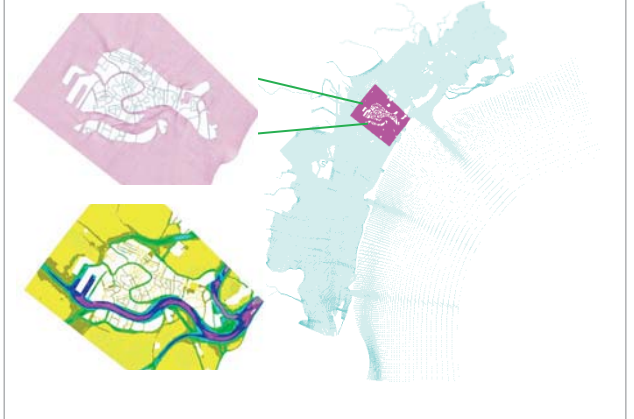
Complete system: ~ 85.000 cells



– the domain of the model is extended by including a part of the Adriatic Sea covering a coastal stretch of approximately 40 km along shore and 15 km cross-shore.

- *Venice town* – a detailed model of the canals of the Venice, where the domain is extended sufficiently far away from the city to include areas of exchanges between the city itself and the lagoon. This model is connected to the general model of the lagoon using the domain decomposition techniques.

Venice town: ~ 40.000 cells



The model is able to reproduce not only water levels at various tide-gauges, but also to represent the flow distribution and velocity field in the main hydraulic nodes in the lagoon; for this purpose, the model was calibrated both on water levels and fluxes. The application of a finite differences hydrodynamic model working on a curvilinear grid allowed the creation of a computational tool to be used as base for the development of future models of Venice lagoon.

The hydrodynamic model base was used to implement other important simulation models for the Venice Lagoon environment, such as an ecological model, a morphological model, and model for the study and simulation of the dispersion dynamics of petroleum derived compounds, which is currently used for the monitoring activity of the petro-chemical district in Porto Marghera, near Venice.

DRY BASIN AT LIDO INLET FOR THE PREFABRICATION OF CONCRETE STRUCTURES TO BE FLOATED FOR THE CONSTRUCTION OF THE FLOOD BARRIERS

Location:	Venice, Italy
Client:	Venezia Nuova Consortium for Italian Ministry of Public Works – Water Board, Venice
Services:	Seaside basin and prefabrication area for the structural elements of the row of gates. Design of wells system for control of under water-pressure below the basin, during the prefabrication of the structural elements of the row of gates
Period:	01/2002 – 12/2003
Construction cost:	€ 58,200,000

Project Description:

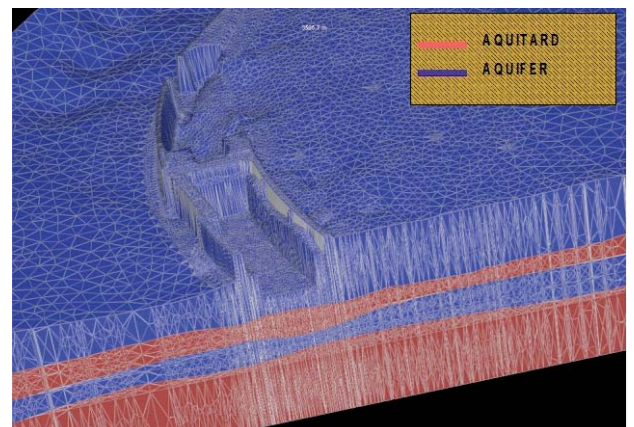
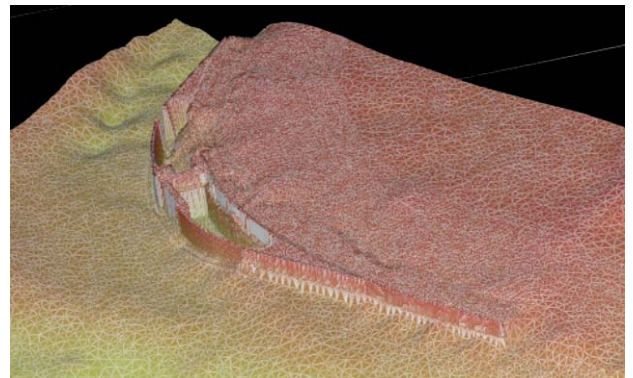
The construction of the mobile gates at the three port entrances for safeguarding Venice and its lagoon from flooding, and of the complementary works against medium/high flooding and losses of sediments from the lagoon, has been started by the opening of construction sites for about eight years.

At the Lido (Treport) inlet the excavation site's total surface is more than 50.000m² with a depth of 12 m protected by a metal sheets system on the seaside and a diaphragm on the land side.



On the basis of stratification data and data from hydraulic tests (Lefranc test, pumping tests) during the first phase of the project a conceptual stratification and hydrogeological model has been implemented, followed by a tri-dimensional finite elements model for defining the size of the well network and of the control under-water pressure piezometers network. Groundwater flow modelling has been performed by the FEFLOW 5.3 code (Diersch, 2005), a software for modelling fluid flow (and transport of dissolved constituents) in the subsurface, in transient or steady state condition.

Several pumping tests and Lefranc tests performed near the construction area have somewhat allowed for the characterization of the hydraulic conductivity k and the specific storage S_s in the various aquifers.



Pumping test data interpretation by the traditional Theis-Jacob method provided a specific elastic storage between 10^{-4} and 10^{-5} m⁻¹.



Based on the calculation results dimensions of the well system (number, geometry, and location) have been obtained, necessary to guarantee the stability of the excavation ground.

MASTER PLAN FOR THE BRENTA - BACCHIGLIONE RIVER BASIN: STUDY OF THE WATER RESOURCES, 1ST PHASE

Location:	Veneto Region, Italy
Client:	River Basin Authority for the Isonzo, Tagliamento, Livenza, Piave and Brenta-Bacchiglione rivers
Services:	Water supply study, proposal of remedial works
Period:	03/1996 - 09/2000
Construction cost:	N.A.

Project Description:

A river basin Master Plan is a programmatic instrument for the hydraulic and hydro-geological protection of soils, the conservation of natural and environmental resources and the promotion of a development compatible with the productive sectors of an area defined by the physiographic limits corresponding to the catchment basin.

The present project concerns the second phase of the development of the Plan in relation to the Brenta-Bacchiglione Rivers, involving a catchment area of some 6000 km².

This phase includes the completion of the framework of knowledge regarding the quantity and quality of the water resources, the development of a mathematical model to analyse the capacity of the basin to satisfy the local water demand, and the application of the model to study various intervention schemes for improving water quality and supply. The study will provide concrete proposals for remedial measures and environmental recovery actions.



KARAVASTA LAGOON WETLAND MANAGEMENT PROJECT

Location:	Albania
Client:	European Commission - PHARE Programme
Services:	Environmental studies and evaluations, hydrological and morphological studies, surveys, design and construction of observation tower
Period:	03/1995 – 12/1996
Construction cost:	N.A.

Project Description:

The project aims at the provision of support to wetland management in the Karavasta Lagoon, along the Albanian coast, which covers 4,330 hectares and borders the southern part of the Divjaka National Park. Immediate and strict protective measures must be taken, notably to safeguard the existing colony of *Pelicanus Crispus* and other endangered bird species.

The programme will foster social development of the wetland making an optimal but sustainable use of the economic potentials of the area for the eco-tourism, fisheries and compatible economic activities involving local inhabitants.



TECHNITAL, in association with *Station Biologique de la Tour du Valat* of France and *Ecotourism Ltd.* of UK, was entrusted by the European Commission, PHARE Programme, to perform, the following activities:

- propose a management plan for the area (future Ramsar site);
- organise and equip the monitoring and enforcement of the rules of the Ramsar site;
- propose a plan for the development of international eco-tourism;
- develop a model of the key hydrological process influencing the

lagoon environment and a propose a plan for remedial actions;

- propose a plan for the improved management and exploitation of the fisheries resources in the lagoon;
- produce a holistic picture of the value of the lagoon system for breeding aquatic birds.

To understand the functioning of the ecosystem as well as the dynamics of the socio-economic system, the project tasks aimed to

- describe the trends of the socio-economic system through a Participatory Rural Appraisal
- analyse the legal and institutional context
- evaluate the potential of the site for ecotourism development and assess the carrying capacity of the site
- evaluate the hydrobiological importance of the channels which connect the lagoon with the sea.
- define measures to improve fishery in the lagoon
- assess the natural value of the site by mapping the flora and fauna habitats and conducting a field survey of the water bird communities.





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