RINA provides a wide range of services across the Energy, Marine, Certification, Transport & Infrastructure and Industry sectors through a global network of 170 offices in 65 countries.

RINA is a member of key international organisations and an important contributor to the development of new legislative standards.
RINA staff has an extended and comprehensive experience in the integrated analysis of geological, geomorphological, geotechnical and geophysical data for site geological characterization. Through the integrated analysis, RINA specialists can support civil engineering design and identify, evaluate and resolve the critical issues of the engineering projects.
GEOLOGICAL, GEOMORPHOLOGICAL AND HYDROGEOLOGICAL STUDIES

Geological, geomorphological and hydrogeological data are required for feasibility, design and construction projects of all man-made structures, from buildings to plants, roads and railway, maritime structures, dams and landfills, and for the analysis of environmental conditions and phenomena that could potentially damage the structures such as landslides, erosion processes and faulting.

RINA offers a high qualified service to plan and perform geological, geomorphological, and hydrogeological survey and mapping. The field surveys are integrated by analysis and interpretation of aerial photography and satellite imagery.

The personnel is equipped with the specialized equipment to perform high level lithological, stratigraphic and structural measurements, classification of soils and rocks, rock mechanic surveys and gained a strong experience in mapping and in the Remote Sensing and Geographic Information System (RS / GIS) sector using personnel skilled in aerial and satellite images elaboration and management of geospatial data and analysis. RS and GIS data are integrated using the most advanced commercial platform such as ENVI, Erdas, ArcGIS (ESRI) and others.

Through an extended academic experience, the highly qualified RINA staff relies on the cooperation of top experts in the field of geology, seismology and tectonics of national and international universities and research centers.
MAIN PROJECTS

HYDROGEOLOGICAL RISK EVALUATION OF S.ELIA OIL WELL
Client: ENI S.p.A. Divisione E&P
Location: Val d’Agri Potenza, Italy
Scope of Work: RINA S.p.A. was appointed to perform a geologic and hydrogeologic study to assess the hydrogeologic and environmental risk for the groundwater down to a depth of about 100 meters related to the activities of drilling of an oil well in Val d’Agri oil field, near Marsico Vetere (Potenza), South of Italy. The study included the analysis of the structural and tectonic framework, a detailed geologic and hydrogeologic survey, the analysis and interpretation of the aerial photographs and a geophysical survey (tomographic electrical prospection).

GEOLOGICAL AND HYDROGEOLOGICAL STUDY OF BARATZ LAKE
Client: Consorzio Sardegna Nuova
Location: Alghero, Italy
Scope of Work: Due to a process of increasing eutrophization of the Baratz Lake near Alghero in Sardinia, a hydrogeological study was conducted to identify the causes and remediate the problem. After a detailed geological and geomorphological survey of the surroundings of the lake, a specific drilling and soil sampling investigation was performed inside the lake and in the coastal zone. A geophysical electromagnetic prospection supported the identification of the preferential direction of the water flow below the coastal dunes from the lake to the sea.

DRIZZAGNO PUMPING STATION PLANT
Client: EON Produzione S.p.A.
Location: Terni, Italy
Scope of Work: E.ON Produzione S.p.A. was planning to realize a new artificial reservoir connected to a power station, named “Drizzagno”, with a capacity of 200 MW. RINA conducted a geological investigation aimed at defining the geological, geomorphological and hydrogeological features and highlighting possible hazards and geological issues of the areas for the projects: the pumping station area in the valley of the river Velino; the area of the first design solution for superior basin at an elevation of 740 m s.l.m and the area of the second design solution at an elevation of 720 m s.l.m.

WATERSHED MANAGEMENT PLAN AND FLOODING HAZARD ASSESSMENT LAVAGNA AND ENTELLA RIVER BASINS
Client: Genova Province Authority
Location: Liguria region, Italy
Scope of Work: RINA was in charge of the development of the water-shed management plans for two river basins in Northern Italy. Among the activities to develop the plans RINA specialists conducted the geological, geomorphological and hydrogeological surveys of the two basins.
MORPHODYNAMIC AND TECTONIC

The morphodynamic processes, such as landslides, erosion, sink holes, and the tectonic activities as faulting, subsidence, etc could represent a concern for the environment and social community and a specific issue in civil engineering design. Following the development of important projects RINA has gained the experience and skills to identify, analyze and characterize these geologic aspects.

Starting with a desk study on published data, literature references and technical reports, RINA staff is able to apply all the methodology and technology necessary to investigate and characterize in detail geologic processes and features as:

- Aerial photography analysis and interpretation
- Satellite images analysis and interpretation
- Geophysical prospecting (seismic, electrical tomography, electromagnetic, etc)
- Boring log and geophysical, inclinometer and hydrogeological downhole tests data
- Rock and soil classification
- Joints measurement and classification
- Microseismicity analysis and interpretation
- Age dating and paleomagnetic techniques

The personnel is equipped with the specialized equipment to perform high level lithological, stratigraphic, structural and tectonics measurements, classification of soils and rocks, rock mechanic surveys.
MAIN PROJECTS

LANDSLIDE STABILIZATION - OIL CENTER INFRASTRUCTURES
Client: Total E&P Italia S.p.A.
Location: Tempa Rossa, Italy
Scope of Work: RINA has performed the geologic, geomorphologic and hydrogeologic evaluation of the characteristics of the landslides and of the slope instability phenomena affecting some infrastructures of Tempa Rossa oil field, in particular the new under construction oil center, two wells (PT1 and TR1) sites, and several interconnection roads to provide the geological and hydrogeological data necessary for the engineering design of the short term and long term remedial solution.

LANDSLIDE STUDY - WIND FARM SCLAFANI BAGNI
Client: ENEL Green Power S.p.A.
Location: Sclafani Bagni, Italy
Scope of Work: Following an extraordinary rainy period a huge landslide affected the stability of two aerogeneretors, in the wind farm of Sclafani Bagni. The geological study of the landslide area was conducted to define its possible evolution with time and the risk level for the stability of other two aerogeneretors close to the landslide. The performed activities included the analysis of the geologic, geomorphologic and hydrogeologic context of the area and a geomorphologic survey carried out to gather the necessary field data to define the landslide features (extension, typology of movement, landslide conditioning or controlling factors etc.).

COTILIA HYDRAULIC POWER PLANT DERIVATION CHANNEL
Client: E.On Produzione S.p.A.
Location: Terme di Cotilia, Italy
Scope of Work: RINA was appointed for the stability analysis of the water derivation channel of the plant. The study included:
- Geologic and geophysical surveys of S.Vittorino plain around the derivation in order to highlight the features that might represent possible hazards and critical issues
- Assessment of channel sectors or volumes resulting non-homogeneous or highly fractured with regard to subsoil or possibly interested by empty spaces connected to karst phenomena or sinkholes development

REVITHOUSA ISLAND FAULT EVALUATION
Client: DEPA S.A. (Public Gas Corporation of Greece)
Location: Saronic Gulf, Greece
Scope of Work: Active fault evaluation and geological hazards assessment for LNG plant through geologic survey, marine geophysical survey and age dating analyses. The age dating was performed by specialized laboratories on undisturbed soil sample collected from fault filling material with the paleomagnetic (Switzerland) and radioactive decay (Belgium) analyses techniques.
GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATIONS

RINA provides high level geological consulting services for geotechnical and environmental investigations supporting the different phases of civil and environmental projects, i.e. from feasibility study to design and construction in civil works and from preliminary assessment to remedial design in environmental projects. Our expertise includes:

- Preparation of technical specifications for conducting field investigations, in line with the state of art and current worldwide standards
- Planning and supervision of borehole drilling and geotechnical in situ tests (SPT, CP, etc)
- Supervision of test pit excavation
- Stratigraphic log
- Water and soil gas monitoring wells installation
- Environmental in-situ tests (PID, FID, gas analyzer, water multiparametric probe)
- Soil and groundwater sampling for laboratory analysis

In order to simulate groundwater dynamics in the aquifers, through the analysis and interpretation of the acquired data, RINA staff routinely applies state-of-the-art 2- and 3-D models including industry-accepted commercial and proprietary codes. Monitoring networks can be developed in conjunction with hydrogeological modeling and mapping, so that there is a feed-back loop that results in a greater accuracy of both monitoring and modeling/mapping.

RINA personnel have extensive knowledge of the regulations, national and international codes and standards (ASTM, BS, US Army AGI, EPA, etc) relevant to the geotechnical and environmental site investigations.
ENVIROMENTAL ASSESSMENT AT NATO AVIANO AIR BASE
Client: U.S. Air Force Center for Environmental Excellence (AFCEE) / U. S. ARMY COE / CH2M Hill
Location: Aviano, Italy
Scope of Work: Since 1995 RINA has carried out environmental assessments through drilling, test pits, and monitoring wells in more than 200 of potential contaminated sites (sites of underground storage tanks, landfills, spills, dry wells) inside the Aviano Air Base and the nine Geographical Separate Units (GSUs) in the central-northern Italy: Ghedi (Brescia), Orsago (Treviso), Ceggia (Venezia), Monte Corna (Brescia), Monte Venda, (Padova), Cima Gallina (Bolzano), Cima Paganella (Trento), Monte Cimone (Modena), Monte Serra (Pisa).

PISA AERPORT PEOPLE MOVER
Client: Pisamo
Location: Pisa, Italy
Scope of Work: RINA was appointed for the geological and hydrogeological investigation for the final design of the connection system project (“people mover”), about 1,800 meters long, between the railway station of Pisa Centrale and the airport terminal Galileo Galilei. To characterize the subsoil of the site, the geotechnical and hydrogeological data of three different campaigns (2008, 2010-2011 and 2013-2014) were considered.

GEOLOGICAL STUDY OF STRATEGIC BUILDINGS IN GARFAGNANA
Client: Regione Toscana
Location: Garfagnana, Lucca
Scope of Work: A geological and hydrogeological study was performed for two strategic buildings in Garfagnana, an hospital and a army barrack, to determine the characteristic of the subsoil for a soil seismic response and amplification analysis. Drillings, well installations, soil sampling and analysis, groundwater measurements and downhole geophysics allowed the detailed geological modeling of the sites.

GEOTECHNICAL INVESTIGATION AT CASE PORALE LANDSLIDE
Client: Comunità Montana Valle Scrivia
Location: Ronco Scrivia, Italy
Scope of Work: Due to the ongoing damaging of two roads produced by an active landslide a geotechnical investigation was conducted to define the characteristics of the movement and to address for remedial operation. The project included geological and geomorphological surveys, an aerial images interpretation, a geotechnical investigation consisting in boreholes advanced with drilling parameter recording (DPR), soil sampling, geotechnical analyses and a geophysical seismic survey.
HYDROGEOLOGICAL INVESTIGATION

In order to study in detail the hydrogeologic characteristics of the subsoil (i.e. aquifer properties, groundwater dynamics) different types of data have to be collected and analyzed (e.g. meteorological, lithological data, etc.). Often some of them have to be acquired through direct and indirect in-situ investigation techniques.

Beyond the capacity to research, analyze and interpret all the necessary hydrogeological data, RINA has the experience and capability to select the best cost-effective techniques of field investigation to acquire important and resolutive hydrogeological information. The field investigation includes:

- Monitoring wells installation
- Down-hole permeability and flow tests
- Springs and wells water testing and sampling for laboratory analyses
- Geophysical survey (geoelectrical and electromagnetic prospecting, down hole logging)

The study and the georeference of all the groundwater piezometric measurements allows the mapping of phreatimetric and piezometric of the investigated region. In order to simulate groundwater dynamics in the aquifers, through the analyses and interpretation of the acquired data regarding groundwater levels and lithological and stratigraphic characteristics of aquifers, RINA staff is capable of developing and calibrating computer models by applying state-of-the-art 2- and 3-D models including industry-accepted commercial and proprietary codes.
MAIN PROJECTS

GROUNDWATER INVESTIGATION AT A POWER PLANT SITE
Client: BG Italia Power
Location: Melfi, Italy
Scope of Work: RINA has conducted a hydrogeological study within a due diligence process for the acquisition of an energy plant. The study included the following activities:
- Soil boring perforation and monitoring wells installation
- Aquifer downhole testing
- Groundwater sampling and analytical results interpretation
- Analysis of geologic and aquifer data

GROUNDWATER MONITORING AT NATO AVIANO AIR BASE
Client: U.S. Air Force Center for Environmental Excellence (AFCEE) / U. S. ARMY COE / CH2M Hill
Location: Aviano, Italy
Scope of Work: RINA has conducted over the past 15 years the program of groundwater monitoring within the Base that required the installation of 23 deep monitoring wells (depth ranging between 70m and 110m) equipped with transducers. The readings of groundwater level data were processed and analyzed to determine water flow direction and evaluate the seasonal impacts on groundwater level fluctuations while the results of the laboratory analysis of water analysis allowed the evaluation of the trend of the groundwater quality with reference to the main constituents of concern.

GROUNDWATER EVALUATION AT DOUKKALA
Client: ENI - Div. Exploration & Production
Location: Doukkala, Morocco
Scope of Work: RINA was appointed for a monitoring investigation to assess whether the anthropogenic activities associated to the planned seismic survey for oil reservoir exploration could impact the groundwater and generate a potential risk to human health or to the environment. With specific reference to the seismic survey plan and the groundwater flow pathway, twelve water wells and four locations along a main water channel were selected for two sampling and laboratory analysis campaigns, one before and the second after the seismic activity.

ENVIRONMENTAL WATER SAMPLING CAMPAIGN IN SICHUAN REGION
Client: ENI S.p.A. Divisione E&P
Location: China
Scope of Work: RINA was appointed to perform a hydrogeological study to assess the hydrogeological and environmental risk for the groundwater related to the activities of drilling of shale gas extraction well in the Sichuan Region in China. The study included the georeferenziation of all the surface water and groundwater sampling locations and the mapping of hydrogeological characteristics of the investigated region.
RINA provides expertise in conducting geophysical prospecting for civil and environmental projects. For the high cost effective performance, the geophysical surveys, as indirect methods of investigation, used independently or in combination, are highly recommended by RINA experts for:

- Lithological, stratigraphic and tectonic characterization
- Environmental contamination assessment
- Hydrogeological characterization
- Identification of underground utilities and structures

**Lithological, stratigraphycal and Tectonic characterization:** Seismic refraction, seismic reflection, electrical tomography and down-hole logging (i.e. cross-hole and down-hole, vs measurements, natural gamma log).

**Environmental Contamination Assessment:** Georadar, electrical tomography and electromagnetic survey.

**Hydrogeological Characterization:** Electrical tomography, electromagnetic survey (VLF) and down-hole logging (i.e. natural gamma log, potential log).

**Underground Utilities and Structures:** Pipe locator, georadar, seismic refraction, electrical tomography and electromagnetic survey.
 MAIN PROJECTS

SITE EVALUATION SAN MICHELE MONDOVI’
Client: Dufenergy
Location: San Michele di Mondovì, Italy
Scope of Work: RINA has conducted an environmental subsoil contamination assessment within a due diligence process for the acquisition of a former wood treatment industrial area (area formerly used for process wastewater lagoons). The assessment included subsoil and geophysical investigations aimed at defining the residual contamination levels in the subsoil and the extension of the buried lagoons. The geophysical investigation consisted in electromagnetic and tomographic electrical surveys.

SITE EVALUATION DALMINE INDUSTRY FACTORY
Client: Sofinpar
Location: Dalmine, Italy
Scope of Work: RINA has conducted an evaluation of the subsoil environmental condition within a due diligence process by carrying out geophysical investigations aimed at defining the presence of subsoil contamination and for the detection of buried structures and underground utilities. The geophysical investigations included:
- Georadar survey
- Electromagnetic prospections
- Underground utilities detection (pipelocator)

VILLA REALE DI MONZA
Client: Ministero per i Beni e le Attività Culturali
Location: Monza, Italy
Scope of Work: For the design of the infrastructures of the new museum of Villa Reale in Monza, a geophysical campaign of electromagnetic and georadar prospections was performed to define the subsoil stratigraphy and to detect the presence of ancient buried tunnels in the subsoil of the green area surrounding the building of the Villa Reale.

ENVIRONMENTAL ASSESSMENT AT NATO AVIANO AIR BASE
Client: USAF
Location: Aviano, Italy
Scope of Work: RINA has carried out a geophysical campaign for an environmental assessment of former Italian hangars area (Zappalà) inside the Aviano Air Base. The geophysical campaign included georadar surveys (Sensors and Software Pulse Ekko), electromagnetic prospections (Geonics EM31), and underground utilities detection (Geometrics Utilocator). Down hole natural gamma logging was also performed inside all the drilled boreholes.