



HGI FACILITIES AND EQUIPMENT

HGI is a small woman-owned business (certified D/WBE in all six New England States, Delaware, and Pennsylvania) that has been providing high-quality consulting services in geology and geophysics since 1993. The company provides innovative solutions to unusual subsurface problems by applying the principals' more than 75 combined years of experience in field and analytical geology and geophysics. HGI's tools include state-of-the-art equipment combined with computer-assisted data acquisition and reduction techniques and proprietary software developed by HGI for specialized tasks. HGI has a staff of 8 professionals, two of them with Ph.D. degrees in their fields.

The President of HGI, Jutta Hager, Ph.D., has over 35 years of experience in the applications of geology and geophysics to environmental, geotechnical and hydrogeological problems. She has been responsible for all aspects of project management, from the proposal to the report stage. She is a Certified Professional Geologist in the states of Delaware, Kentucky, New Hampshire, Pennsylvania, and Wyoming.

The HGI Vice President of Operations, Mario Carnevale, M.S., has over 40 years of professional experience in engineering geology, geophysics, resource evaluation, and computer modeling. He has worked on numerous geophysics projects for both government and industry and specialized in the interpretation of low-frequency GPR, borehole logging, and seismic data. He has provided expertise on projects ranging from GPR surveys in Puerto Rico and Guam to field mapping in Brazil and evaluation of gold prospects in Siberia and Africa. Mr. Carnevale is a Certified Professional Geologist in the states of New Hampshire and North Carolina.

HGI has the facilities and equipment necessary to complete all aspects of geological and geophysical projects. HGI facilities and premises in Woburn, MA are wholly owned by the HGI Principals. Its office is located in a 2-story professional building, with an adjacent Carriage House for meetings and conferences. HGI equipment is stored and maintained in a separate dedicated equipment shed. In-house administrative, computer, and printing/plotting support are also available for all projects.

Ground Penetrating Radar (GPR) HGI's FCC-approved ground penetrating radar equipment includes GSSI SIR 2, 20, 2000, and 3000 GPR systems with ground-coupled mono-static 2000-, 1500-, 900-, 500-, 400-, 300-, and 200-MHz antennas, bi-static 100-MHz and Multiple Low Frequency (80- to 16-MHz) antennas, and 100-MHz Tubewave for projects ranging from concrete to UST, utility and stratigraphic surveys (Figures 1 and 2). Data are collected in continuous, survey wheel, or point mode, which enables signal stacking. Survey wheels attached to the antenna or mounted on a cart provide horizontal distance control. Our multiple low frequency (80-16 MHz) system is one of a handful available in the US and is grandfathered in under the FCC broadband regulations. With this system we have achieved depth penetrations of over 100 feet at some sites.



Figure 1: (top) GSSI MLF antenna configured to 20-MHz transmitting frequency for stratigraphic survey, ME; (bottom) 100-MHz Tubewave antenna for survey in 90-foot lake behind a dam, AL.



Figure 2: Mono-static 200-MHz and Bi-static 100-MHz antennas with survey wheel, NYC.

Electromagnetics (EM) HGI determines metal and ground conductivity with its GSSI GEM-300 multi-frequency EM profiler and Geonics EM-31 and EM-61 systems. The EM61-MK2 high-powered time domain metal detector can stream data directly to HGI's Sokkia GPS system. Examples of the three different EM systems in use by HGI personnel are shown in Figures 3-5.

HGI also owns a Geonics EM16/16R VLF/resistivity meter, for very low frequency (VLF) EM and resistivity data collection, and Schonstedt MAC-51B, Ditch Witch SUBSITE 950R/T and 3M Dynatel 2250 precision utility locators (PUL) for utility surveys.



Figure 3: Mario Carnevale performing an EM-31 survey to map a reinforced concrete bunker tank on Gould Island near Newport, RI.



Figure 4: Joshua King collecting GEM-300 data during an archaeological survey, Phineas Upham House, Melrose, MA.



Figure 5: Alex Buller performing an EM-61 survey for USTs in an urban parking lot, St. Albans, VT.

Seismic HGI owns a Geometrics Geode 48-channel Exploration Seismograph system with vertical and horizontal geophones ranging in frequency from 4.5 to 100 Hertz for refraction, reflection, multi-channel analysis of surface wave and impact echo seismic surveys. Geophones are spiked in the ground or mounted on a streamer array (Figure 6). Seismic sources include a 90-lb propelled energy generator (PEG), Betsy seisgun, Geotomographie P-wave source sparker, and Geotomographie Borehole Impacter Source (BIS) for S-waves. A Polaris ATV assists in data acquisition.



Figure 6: (top) MASW survey with geophones mounted on a land streamer, New Boston, NH; (bottom) impact echo survey with geophones coupled using modeling clay, NYC.

Resistivity HGI uses an L&R MiniRes single-channel unit to conduct ASTM soil resistivity surveys using a Wenner array. For full-scale resistivity and IP profiling, HGI uses its MPT-DAS-1 ERT 8-channel multiplexor system with 64 electrodes. Our DAS-1 is shown in Figure 7 (top) and a 3D resistivity survey setup in Figure 7 (bottom).

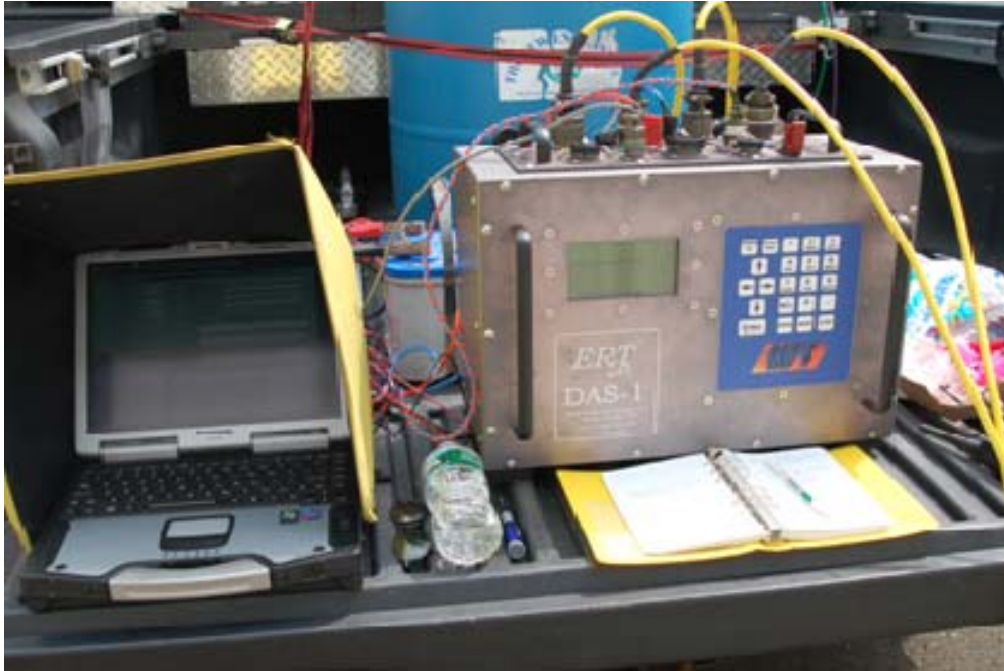


Figure 7: (top) ERT DAS-1 multiplexor; (bottom) 3D data acquisition survey geometry for a survey in Utah.

Borehole HGI owns a Mount Sopris Instruments Company Matrix borehole logging system with 5MXA-1000 Matrix logger, 4MXA-1000 and WNA-1000 winches with up to 2500 feet capability, and the following probes: 2PEA-1000 poly-electric with 2SFA-1000 fluid temperature and resistivity; 2CAA-1000 three-arm caliper; 2PGA-1000 poly-gamma; Advanced Logic Technologies (ALT) ABI40-2G acoustic televiewer (ATV) and Mark-V OBI optical televiewer (OTV); HFP-2293 Heat Pulse Flow Meter (HPFM); 2DVA-1000 borehole deviation probe, and a CVV WC1750 dual view color camera. Benthos AQ-2000 hydrophones and Geotomographie P- and S-wave sparker sources collect data for crosshole surveys. Figure 8 shows a setup for borehole surveys in off-road areas. The ABI40-2G ATV is the second generation acoustic televiewer released in September 2013.

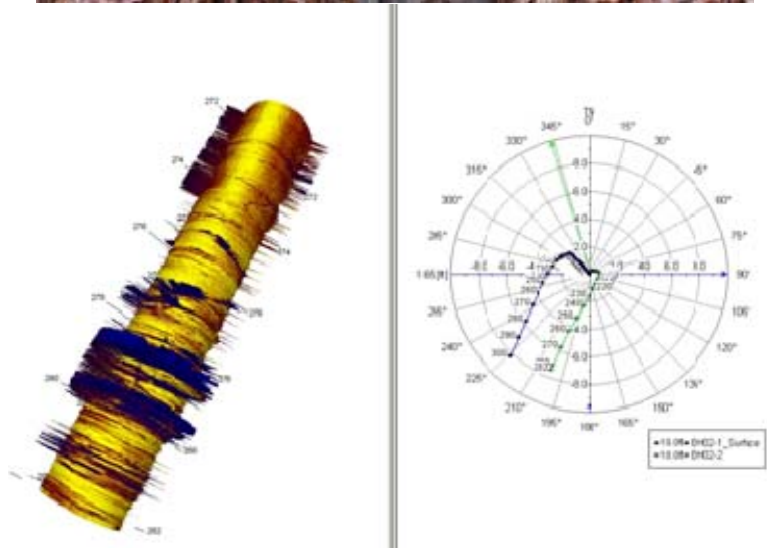


Figure 8: (top) ATV used for borehole logging under difficult conditions, CT; (bottom) typical 3D log and borehole deviation plot from acoustic televiewer survey.

Miscellaneous In addition to its geophysical equipment, HGI owns a Sokkia 2700 ISX RTK Global Positioning System, which it uses to locate survey grids and site features. Its vehicles include a 2013 Nissan NV3500 V8 High Roof cargo van, fully equipped Freightliner Box Truck, Nissan Titan Pick-up Truck, Polaris MV-7 Sportsman ATV, and Porta-Bote folding plastic boat with electric motor and trailer.

Analysis and Processing Software HGI uses the following proprietary software for data processing, analysis, and presentation:

- **GPR:** GSSI's RADAN® 6 and 7, a general purpose GPR data processing program, and RADAN's Structural and Stratigraphic Interactive Interpretation Module®.
- **EM/MAG:** Magmapper for magnetics and the GEM-300; NAVDAT61MK2 for EM-61-MK2 data.
- **Resistivity:** MPT's ERTLab™ *Solver* and *Viewer* for 3D electrical resistivity tomography inversion and analysis.
- **Seismic:** Geogiga Seismic Pro 7.3® for seismic refraction and reflection; KGS SurfSeis® for multi-channel analysis of surface waves; TomTime®, GeoTomCG® and Geogiga Seismic Pro 7.3® for crosshole tomography.
- **Borehole Logging:** MSLog, Matrix®, WellCAD®, and Rockworks®.
- **Tunnel Mapping:** GeoScan-32™ developed by HGI for the MetroWest Water Supply Tunnel Project.
- **Vibration Monitoring:** EVT© and GeoSonics Analysis software.
- **Data Presentation:** Microsoft Office 2013 Excel®; Golden Software's Surfer 9®; Camtasia®; OMNI DAQ; and AutoCAD® Map 3D 2013.