Geotechnics Limited has recently won a major instrumentation project for providing and installing soil monitoring equipment for the London Gateway project at the site of the former Shell Haven refinery near Stanford Le Hope in Essex where land is being reclaimed and developed by DP World into the UK’s first major deep sea container port. It is understood that some 30Mm³ of sand is being dredged from the adjacent river channel, which is being taken to depths of 17m to allow access to large ships, and used to create the new facility.

The instrumentation will allow management of the filling and reclamation work which is being undertaken in two main phases as land becomes available.

The site, which is on the northern bank of the Thames, is underlain by a significant thickness of Alluvium. Some 211 boreholes are being drilled to depths of up to 18m below existing ground level for the installation of vibrating wire piezometers and magnetic extensometers.
EUROCODE 7 – COMPLIANT INVESTIGATION AT STOuRPORT

In July 2010, Geotechnics Limited was awarded a site investigation contract in Stourport on Severn for a highway upgrade related to a proposed development of an approximate 8ha site by Tesco. The investigation was required to comply with the new Eurocodes so that the subsequent design would be Euro-compliant.

In accordance with the requirements of the Highways Agency a Preliminary Sources Study Report (PSSR) was undertaken prior to the main ground investigation. This is the equivalent of the Desk Study of available existing information and site reconnaissance which forms part of most projects these days and is key to the investigation design.

The proposed highway works are to include the up-grade and resurfacing of an existing road and the construction of a new link road running on embankments up to about 2m in height to a design by Arup. This will cross a former factory site and a flood plain and will involve the construction of a new road bridge and footbridge over the River Stour.

The site was believed to be underlain by Alluvium of Recent and Pleistocene age over River Terrace Deposits which lie above the Wildmoor Sandstone Formation. The investigation was designed to comply with Eurocode 7 and the new European and International testing standards and employ a wide range of techniques. These included cable tool and rotary boreholes, window sample boreholes, trial pits, static cone penetration testing (CPT), pressuremeter testing, dynamic cone penetration (DCP) testing and CBR testing. Inspection pits were used to investigate an existing retaining wall and bridge foundations, cores were taken of the existing pavement and exposures of bedrock allowed some simple mapping. The ground investigation was executed under the supervision of Geotechnics’ senior engineers Habib Rehman and Leigh James.

In accordance with BS EN 1997-2: 2007 and BS EN ISO 22745-1: 2006, Class 1 undisturbed samples were required for compressibility and shear strength testing. These were made possible by utilising a piston sampler in soft alluvium and thin walled 100mm diameter open tube samplers in firmer clays. Laboratory testing was undertaken at Geotechnics’ UKAS accredited laboratory in Coventry.

The whole Ground Investigation Report or GIR was drawn together by Trevor Hardie using the protocols embedded in the Eurocodes. The field and laboratory work was reported in two volumes which contained the investigatory hole and laboratory test data together with a summary of the ground and groundwater conditions and derived parameters. These were used in developing values for design.

The project demonstrates the Company’s commitment and capability to comply with Eurocode 7 and address the implications in the geotechnical industry.
Geotechnics Limited recently found that the use of network diagrams was an excellent way to present possible pollutant linkages on a re-development site to assist the client, Northampton Borough Council, to understand the need for and form of the Phase 2 investigation work.

Site Plan
A Phase 1 geo-environmental Desk Study and site reconnaissance undertaken by Geotechnics’ Chris Swainston at a site on the western side of Becketts Park in Northampton assessed the potential risks associated with developing the site for housing. This identified the following potential sources of contamination:

Initial Network
- Hydrocarbons from ash, clinker, coal, lubricants, oils, sleeper preservatives and imported railway embankment materials
- Hazardous Gases from coal, ash and imported embankment materials
- Metals from waste, rolling stock, ash, clinker, sleeper preservatives and imported embankment materials
- Asbestos from brake linings and fittings on rolling stock
- Aggressive chemicals such as acids, cyanides, sulphates from coal and ash
- Hydrocarbons, including gas generation, from a filling station on an adjacent site
- Pathogens from previous historical use of an adjacent site as Livestock Market

Network diagrams created using KeyCSM™ software were considered to be the clearest way to show how the identified potential sources of contamination would affect users, buildings and controlled waters and the results are shown in the accompanying Figures.

Once the data was entered into the program, three network diagrams were created to show the initial model and subsequent ones to illustrate the effects of adopting various options.

The initial network diagram from the Conceptual Model showed all the potential pollutant linkages and assumed that housing would be constructed on the site. Removal of the embankment as a source would remove it from the model and leave fewer remaining linkages as clearly shown in the subsequent network diagram.

Subsequent Network
Two possible sources remained with relatively fewer contaminants, making the model much clearer.

Records indicated that the redevelopment of the Livestock Market site had included extensive testing which showed that no significant Pathogens existed in the soil. This left the Filling Station as the main potential source of contamination to investigate. Liquid hydrocarbons were discounted on consideration of the underlying geology and the recent age of the development.

This left gas as the only potentially significant risk to be investigated along with an analysis of the soil underlying the embankment to determine whether any significant leaching had occurred.

The Network Diagrams provided the basis for clear explanation of the nature of the contamination, for assessing the further investigation which would be required and for providing a justification for any subsequent remediation should this prove necessary.

Geotechnics Limited was shortlisted for the Ground Engineering Award for Technical Excellence for its earthworks instrumentation and remote monitoring project on Weymouth Relief Road at a recent dinner held in London.

The project included the installation of 36 Vibrating Wire Piezometers, 23 UniXial In-Place-Inclinometer (IPI) strings, which comprise a total of 126 sensors, and 2 Hydrostatic Profile Gauges (HPG) to provide data during the construction of embankments along the new Weymouth Relief Road in Dorset. This will significantly improve access to a sailing venue of great world significance in 2012.

Remote monitoring was made possible by installing 5 multi-channel dataloggers equipped with GSM modems which transmitted data to an off-site server. This processed the data and presented it on a website for real-time viewing by Amey, the Consultant Engineer, at their offices in East Sussex.

The awards were presented at the prestigious 5 star Grosvenor House Hotel, on London’s Park Lane and the event was attended by over 200 leaders in consultancy and contracting in the geotechnical engineering industry.
In July 2009 Geotechnics Limited was invited to tender for the Ground Investigation for the proposed redevelopment of Tottenham Hotspur’s White Hart Lane ground. The work required was extensive but a key element was that it would have no adverse effect on match days.

The anticipated geology comprised Terrace Gravels, London Clay, Lambeth Group and Thanet Sands with Chalk at depth. The tender for the work required rotary coring of most boreholes for much of their depth. However, Geotechnics’ experience of rotary drilling in the Lambeth Group and Thanet Sands was such as to lead them to submit an alternative tender with significant cost savings whilst maintaining or even enhancing the quality of the technical output. The Thanet Sands are infamous for the problems they cause during drilling but at this site it was considered practical to use predominantly cable percussive techniques with only two boreholes required to penetrate to significant depths into this stratum.

The Client and the Engineer, Buro Happold, were interested in the alternative and the contract was awarded to Geotechnics Limited. The work also involved dynamic sampling, pavement coring, trial pitting and in situ CBR testing. Instrumentation included shallow standpipes, deep Vibrating Wire Piezometers and water level monitoring transducers for continuous monitoring of shallow ground water levels. Geotechnics Engineers for the project were Rob Webster and Dan Fry and the management of the site work was by Ian Boyle.

Prior to and during site work Geotechnics Limited had to maintain close liaison with both the Highway Authority and the occupants of business units on the site to ensure the minimum disruption. Laboratory testing was undertaken at Geotechnics’ UKAS accredited laboratory in Coventry and a factual report was provided in November 2009. Monthly site monitoring has continued over the twelve month period following the site work.

In February 2010 Geotechnics Limited was invited to prepare a quotation for the Phase 2 works which built on the knowledge gained from the first phase and addressed developing features of the design. Particular attention was given to dynamic sampling as standard equipment had limited success in the dense Terrace Gravels due to limited rates of penetration and instability at depth. In order to overcome these problems and to permit access to the concourse areas, a mini rotary rig with hollow stem auger was mobilised and sampling carried out through this. Site works were successfully completed in May 2010.

This project extends the Company’s track record in the investigation of major stadia in the north London area having undertaken the complex investigations for the new Arsenal Emirates stadium some years ago. We are proud to have contributed to this prestigious scheme and hope that it Spurs the club to greater success in the future!

Kier Construction Limited commissioned Geotechnics Limited to drill a borehole approximately 300m out to sea on the outer knuckle of Queens Pier, Portland Harbour which is to be refurbished and new berthing dolphins constructed.

The 600mm thick concrete pier deck was penetrated using 250mm diameter concrete coring apparatus to enable steel casing to be lowered to the sea bed below. Rotary percussive sampling was then undertaken by driving lined 107mm diameter steel tubes into the ground in 1.50m lengths. When the rotary percussive sampling was unable to penetrate the strata further, the borehole was advanced through the Kimmeridge Clay bedrock using rotary coring techniques to 41.00m below pier deck level. Standard Penetration Tests were undertaken prior to each rotary percussive sample and rotary core run.

To facilitate reinstatement of the pier deck, a 300mm diameter concrete cored hole was partially countersunk over the original 250mm diameter hole creating a 25mm wide rim, enabling a wooden base to be installed to support the concrete which was poured to reinstate the pier deck.
Companies seriously involved in Geotechnical and Geoenvironmental investigations are making use of computer technology to manage their work and to record, transmit and store the data which they obtain. Commitment to this concept gave rise to the establishment by the AGS, in 1991, of a working group of those involved in data production, use and storage as well as software producers and academic and client bodies, to create a means of transferring, storing and using all the data obtained from site investigations in an electronic format. It was established for industry by industry under chairmanship of Len Threadgold. The first document was published in 1992 and the group has continued to maintain and develop what is now known as the AGS Format since that time.

The AGS Format allows direct transfer and receipt of data without the need for a printed interface, provided that the producing and receiving software can export/import data using the protocols embodied in the format. This concept avoids wasteful re-entry of data and allows efficient use of them all and a means to create an electronic archive which can be updated and used in the future. The AGS Format not only embraces geotechnical and geological data but also instrumentation and geoenvironmental data.

The latest manifestation is AGS4 which recognises the need to comply with Eurocodes and QA processes and to accommodate concepts such as bar coding for example. This was launched at a conference held in Birmingham on 25th May 2010 where over 100 enthusiastic practitioners from all over the world presented and discussed the use and development of the Format. It has provided designers, specialist contractors and clients with the potential to make significant savings in costs and time and to make much better, more comprehensive and timely use of the data obtained.

However, whilst it is widely available, research by the AGS and FPS has shown that AGS Format data is not being passed down the supply chain in many cases. Reports in pdf form may well be useful but this is not the same as data in AGS Format. Various educational initiatives by members of the AGS working group and in particular Chris Power are promoting its use to Universities and other bodies.

Jackie Bland, Geotechnics Limited’s IT manager, has been involved with the Format since its inception and now chairs the Data Management Group which has responsibility for maintaining and developing the Format. She follows on from the previous chairmanship of Steve Walthall who led and inspired the continually enthusiastic team up to the production of AGS4.

Jackie wrote Geotechnics’ project management system “GeoCentric” which deals with the whole Site investigation management process from first quotation or proposal, through ordering, site work and laboratory test scheduling to report production and accessible referenced archiving. Her founding principles are “enter it once, use it many times”; data entry is critical and must be a simple process to follow; outputs must be appropriate to the question being asked and easy to use otherwise their value is diminished. She regularly extends the system to accommodate the latest “good ideas”. As would be expected, she has a particular focus on ensuring that reporting outputs of the data are compatible with the AGS Format.

Whilst the Digital Age is unlikely to feature in geological chronology it is one which is very significant to both the understanding and application of the geosciences.
Sensitive Slope Stabilisation

Daniels Mill and the Severn Valley Railway

The historic Daniels Mill to the South of Bridgnorth in Shropshire was hit by the twin disasters of flooding and landslip during extreme rainfall in the area during the summer of 2007. These problems were intimately associated with those of the adjacent Severn Valley Railway which passes to the west of the site on a viaduct over the valley of the stream which serves the mill. This sensitive earthworks project was conceived and directed by Geotechnics Limited to protect this famous Mill and maintain support to the viaduct abutment.

The landslip impacted on one of the outbuildings and stabilisation works were required to address both the slope behind the building and the slopes and buttress associated with the viaduct. The mill is sited in a heritage and conservation area and therefore required innovative and sensitive remediation to recognise the historic environment, access constraints, sustainability issues and the maintenance of stability to the viaduct throughout the construction. Reinforced Soil was seen as providing the optimum solution.

Geotechnics Limited became involved when Len Threadgold, Chairman and Chief Engineer, was asked, on behalf of the Mill owner’s Insurers, to inspect the slope failure and examine causes and potential solutions. Following a ground investigation, failure of the superficial deposits and the weathered Keele Beds, associated with high groundwater levels, was identified and a potential solution involving the construction of a reinforced soil slope analysed by Geotechnics’ Trevor Hardie.

The solution was developed further by Paul Thurwell from P&S Consulting Engineers (PaScoE) who undertook both the detailed design of the reinforced soil wall and slope and close monitoring and supervision of the work on site. This allowed changes to the design and construction to be implemented as the work proceeded following exposure of soil and rock in the slope and minimised the volume of soil to be excavated and exported from the site. It also minimised the volume of imported material required, further adding to the sustainability of the solution. Exposure of the viaduct abutment foundations resulted in changes to the slope profile close to the abutment to maintain the stability.

Specialist environmental contractor, WM Longreach, was appointed to carry out the complex stabilisation works. Due to the access constraints, their solution was to use a long reach excavator for the slope reconstruction, provided from their own long reach plant business, WM Plant Hire Ltd. The machine to be used was selected by Damian McGettrick following his site meeting with Len Threadgold. This was fitted with a tilting bucket attachment and was able to sit in one location to remove the failed material and subsequently place the new fill material in layers. Over 2000 tonnes of material had to be excavated from the failed slope profile, replaced with a structural stone fill reinforced with Heusker geogrid materials and compacted to a high specification. A small excavator was used to level the stone prior to compaction and, using a tensioning system, the geogrid was tightened over each layer to form the new steep slope profile. Topsoil was wrapped in a finer geotextile at the slope face to allow successful vegetation growth through hydroseeding.

The upper slope was reporfiled and dressed in a coir matting to prevent short term erosion during the winter months and facilitate the subsequent establishment of the grass and vegetation in this area. A feature wall, dressed in Wenlock stone, was at the base of the slope to blend in with the mill.

Water from behind the filling and the base of the new slope feature was drained to an outfall downstream of the Mill and the driveway and car parking areas were resurfaced to provide a high quality appearance to the finished works. The Mill owners were delighted with the end result and were complimentary of the attitude, commitment and conscientious approach of the project team in achieving a successful outcome to what was a very challenging and high profile project, with disruption kept to a minimum, despite being done during one of the most severe winters on record.

This work was recognized by the Institution of Civil Engineers West Midlands Region who presented the team with the Geotechnical Award for 2010 at their recent Awards Dinner.
In October 2010, Geotechnics was asked to look at ways of successfully installing a set of inclinometer access tubes into an embankment, along the top of which lies the main A30 road linking Cornwall to the rest of the country. Close to Tedburn St Mary near Exeter, measurement and assessment of embankment instability was required as there are signs of landslipping. Inclinometers were important to allow lateral movements within the slope to be monitored. Instruments previously installed by Geotechnics Limited over two earlier phases included Vibrating Wire Piezometers and standpipes and these were indicating very high groundwater pressures which were concerning the Client, Enterprise Mouchel. Movements were also being identified by reference to marker pegs which the client had placed on the embankment.

A rig capable of drilling through the embankment into natural, stable Carboniferous mudstones into which the inclinometer could be socketted was needed. Accessibility to the desired locations was the main obstacle as the embankment itself is fairly heavily vegetated and slopes down at a gradient of around 1:2. It is locally steeper at the investigation area due to the features of the slip. Further constraints due to land ownership at the base of the embankment meant that access was only available from the top of the embankment, directly off the A30.

Two options were looked at by Geotechnics’ Matt Yates. One involved a slope climbing rig which would travel down the slope to the top of the slip to allow drilling to proceed. However, to ensure that the rig and crew wouldn’t slide down the embankment, the rig would need to be tethered to anchors at the top of the embankment. This risked anchoring into the failing material itself and potentially helping to pull the embankment down.

The option adopted was to mobilise a tracked excavator with a modified boom and a rotary drill attachment. Under a Lane 1 closure the rig, together with compressor, water bowser and support vehicles, was mobilised to site and the rig tracked along Lane 1 into position. The boom reached over the crash barrier down to the proposed borehole position and, using rotary solid-stem augering techniques, the drilling commenced. It was expected that, upon encountering natural bedrock, the drilling technique would need to switch to down-the-hole-hammering. However the auger managed to penetrate to the required depths successfully at the two borehole locations, reaching between 13.5m and 15.5m below surface level.

Once the augers had been removed from the ground, 58mm outside diameter click-lock inclinometer access pipe was placed into the open borehole and filled with water to counteract buoyancy caused by subsequent grouting. This was achieved using a mixture of bentonite powder and cement, mixed on site and pumped into the borehole. The installations were finished with raised lockable barrel covers cemented at the surface. This work was completed in two working days – slightly ahead of schedule – and all plant was removed from site and the Traffic Management removed the following morning, as planned.

Around one week later, three sets of base readings were taken at each borehole using a biaxial inclinometer probe equipped with Bluetooth which transmits data directly to a weatherproof PDA. Data was then taken back to the office and downloaded into In-Site inclinometer software and results shown as tabulated readings and graphs. On-going monitoring of the instruments is being done by the Client.

Geotechnics sees instrumentation as a key means of delivering significant geotechnical benefits and the innovative installation techniques and monitoring used at this site shows its commitment to providing solutions to the access problems which slopes so often pose.
Metrolink commends Geotechnics’ engineer

The previous Geotopics reported on Geotechnics’ involvement in Greater Manchester’s world class Manchester Metrolink project to build several new lines by 2016. This should see great improvement in transport infrastructure for Manchester by considerably reducing car journeys on the local roads.

Geotechnics won the contract to investigate the first phase of work at the main tram maintenance depot in the Trafford area of the city in 2008 and was subsequently approached by MPact-Thales (MPT) – the Thales, Laing O’Rourke & Volker Rail consortium – on behalf of GMPTE to undertake further site investigations.

With the investigation work successfully completed, Geotechnics Limited was invited by MPT to attend an awards dinner held at the Imperial War museum in Salford Quays, Manchester and was delighted to learn that the Highly Commended Individual Award was presented to Geotechnics’ Sarah Edwards in recognition of her effective management of the investigation team through all the various phases of investigation. The Company is pleased to add its congratulations for her achievement.

Phil Mathews has also joined the company as its Health and Safety Officer. He is based at Chester but has Company-wide responsibilities. Phil spent eight years in the Royal Engineers and served at several locations overseas. He also has experience in civil construction, having previously been employed in the piling and ground engineering industry.

If you require more information about any of the articles included in this latest issue of Geotopics or any other matter, or wish to receive your next issue of Geotopics electronically, please email Pam, at pknight@geotechnics.co.uk or give her a call on 01244 671117; she will be delighted to help.

Several intrepid members of Geotechnics’ Chester office decided to go for the big (or should that be deep) one on a recent visit to Boulby mine on the Cleveland coast, Europe’s second deepest mine at 1,200m below ground level. Paul Hayes arranged a visit for a party of engineers (John Booth, Keith Nichols, Stuart McCrae), and guests (Sam Fishburne, Dave Cage and Geoff Booth). Starting with a presentation from Neil Rowley – Health and Safety Manager (Cleveland Potash) – on the history of the mine, local geology, and mining operations and followed by a safety briefing, the team was kitted out in fetching hi-vis yellow/orange kit with several of the less self conscious preferring shorts rather than overalls since the temperature at the working face gets up to around 40°C.

Then it was off to the man-riding cage to descend to the pit bottom. Around the shaft bottom there are stores and work shop areas where all the equipment, vehicles and spares which are brought down the shafts in sections are built and maintained by a team of fitters and electricians. Transportation underground is by transit van or land rover, each vehicle stripped out to reduce weight and fire risk.

Neil Rowley took the team about 7km out under the North Sea along the main mine haulage route. Most of the access tunnels are mined in the lower halite (rock salt) beds because these rocks are more stable than the overlying potash beds. At the current working face, an access ramp takes the haulage route into the potash beds, where a team of miners operates a rotating face cutter, and loads the potash onto dump trucks which take the ore to a primary crusher. The crushed mineral is taken on conveyors for transport to the shaft and then to the surface. At current market rates the potash is ten to fifteen times more valuable than the halite from the lower strata, so potash is mined at two faces for five days a week, and salt from one face at weekends.

The geology and rock mechanics of the potash and halite beds is key to the economic viability of the mine. Horizontal exploration holes are drilled in prospective new areas of mining with drilling commencing in the halite and subsequently angled upwards into the potash. A gamma ray probe tests the quality of the potash with anything over 30% purity considered viable. Hence most future planning of mining operations can be seen to rely heavily on the geologist’s predictions. The drill hole seen by the Geotechnics team was about 250m in length but the core logging looked pretty easy – salt all the way!

Thanks to Neil Rowley and his colleagues at Cleveland Potash for their hospitality and for reminding us of the importance of geology in mining a resource which is vital to the UK economy but hidden from view below the North Sea.

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