TBT ENGINEERING
CONSULTING GROUP

Statement of Qualifications

Earth & Environmental Engineering

Geotechnical Engineering – Environmental Services – Pavement Engineering & Geological Services

TBT Engineering Limited
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Company Overview

TBT Engineering Limited (TBTE) is a multidisciplinary engineering and consulting firm located in Thunder Bay Ontario, specializing in Material Engineering, Earth and Environmental, Building Sciences, and Infrastructure.

TBTE holds Certificates of Authorization with the Professional Engineers of Ontario, Professional Geoscientist of Ontario, and Association of Ontario Land Surveyors. Our certified materials testing laboratory is qualified to provide services in accordance with CSA, CCIL, MTO-LS, OPSS, AASHTO, and ASTM. We are also members in good standing with associations including PEO, ACEC, CEO, CGWA, IHSA, AOLS, and PGO. We deliver highly personalized services to all clients through all phases of their projects. Our ability to consistently complete projects on time and within budget is demonstrated through high client satisfaction ratings and returning clients, which has resulted in the longevity and success of TBTE.

TBTE is committed to supporting Indigenous groups and communities through engagement and meaningful participation in Partnerships and Agreements with First Nation and Metis communities across Northern Ontario. TBTE is a Corporate Member of the Canadian Council for Aboriginal Business (CCAB) and the Anishnawbe Business Professional Association (ABPA).

Core Competencies and Services

Earth & Environmental Engineering	Materials Engineering	Building Sciences	Infrastructure
Geotechnical Engineering ▶ Foundations ▶ Embankments ▶ Ground Improvement ▶ Earthworks (Slopes, Excavations, Retention) **Environmental Services** ▶ Biological Services ▶ Contaminated Sites ▶ Building Assessments ▶ Radon Gas Testing / Abatement **Pavement Engineering** ▶ Roadway New Construction ▶ Roadway Rehabilitation ▶ Parking Lots **Geological Services** ▶ Aggregate Source Investigations (Pit & Quarry) ▶ Hydrogeological Assessments	Engineering Material Testing Laboratory Field Testing & Inspection Drilling Services Mobile Laboratory Services	Structural Engineering Electrical Engineering Mechanical Engineering Commissioning Project Management	Contract Administration Highway & Roadway Engineering Municipal Engineering Legal Surveys Engineering Surveys

*Statement of Qualifications for remaining TBTE divisions are available upon request.

Vice President of Earth & Environmental and Manager of Geotechnical Engineering

Gordon Maki, P.Eng.

As Vice President of the Earth & Environmental group, Gord provides leadership, guidance, and direction for all employees working within his sector. He ensures a healthy working environment for all staff and is responsible for the coordination of functional managers, development of design recommendations, investigation planning, and senior review. As a Senior Geotechnical Engineer with over 30 years of experience in the industry, Gord specializes in geotechnical analysis and design for foundations, bridges, embankments, slopes, dams, and earth retaining structures within the government, industrial, mining, and commercial sectors. Gord's design experience includes shallow foundations, mat foundations, pile analyses, earth retaining structures, peat boil/mud spot remediation, slope stabilization, finite element modelling, consolidation and direct shear testing, field testing programs, soft and/or weakened clays, and ground improvement (site preloads). Gord is passionate about mentoring team members in the study of geotechnical engineering and enjoys research and development of new and innovative geotechnical technologies.

Geotechnical Engineering

Assistant Manager of Geotechnical Engineering: Steven Seller, P.Eng.

Steven Seller, P.Eng. is the Assistant Manager of the Geotechnical and Foundations department at TBTE, where he is responsible for technical leadership, coordination of project managers, development of design recommendations, analysis, reporting, scheduling, and cost control. Steven has over 20 years of experience in soils analysis, including building foundations, earthen embankments, and bridge foundations. Steven has designed and managed all types of foundation projects through various phases of the project lifecycle, including preliminary and feasibility studies, new construction, and rehabilitation. Steven oversees foundation engineering services for provincial, municipal, and industrial/commercial/institutional clients, as well as First Nation projects throughout Northwestern Ontario.

TBTE Geotechnical Engineering Services

TBTE works to address the requirements of our clients by providing a wide range of geotechnical services. From preliminary studies to detailed design and analyses, we can tailor our services to meet all client needs and budget. We have fully equipped drill rigs and specialized field and laboratory testing equipment to handle almost any ground condition or project requirement. Our staff has extensive technical capabilities and experience in modelling and analyzing geotechnical problems. Our team of geotechnical specialists work in step with the project design team to identify and address potential geotechnical site issues. Project teams consisting of two or more engineers and technologists are established for all of our projects to provide oversite and technical review, as well as to encourage thorough consideration and sound design recommendations.

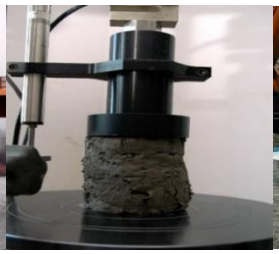
A summary of TBTE's geotechnical services includes:

Geotechnical Services

- **Desktop Studies**
  - Terrain Analysis
  - Comparative Site Assessments
- **Field Investigations**
  - Test Pits / Probes: Hand Vane, Hand CPT, Pocket Penetrometer, Peat Sampler, Modified SPT
  - Boreholes: Auger Samples, SPT, Thin-walled Tubes, Rock Coring, Casing Advancer, Packer Testing, Field and Mechanical Vanes
  - Marchetti Flat Dilatometer Testing, DMT
  - Plate Load Testing
  - Settlement / Movement Monitoring, Slope Inclinometer
  - Digital Ground Resistance Testing (Wenner, Schlumberger)
  - Piezometers: Strain Gauge, Vibrating Wire, Data Logging, Standpipes / Wells)
  - Monitored Test Fills
- **Laboratory Testing**
  - Moisture Content, Gradation Analysis, Atterberg Limits, Proctor Testing, Unit Weight
  - Consolidation Testing
  - Direct Shear
  - Hydraulic Conductivity – Flexible Wall Permeameter
  - Hydraulic Conductivity – Essentially Saturated Peat
  - Unconfined Compression (Soil and Rock)
  - Point Load Testing
  - T-Time Assessment
- **Footings** (Buildings, Bridges, Structural Culverts, Machine Foundations)
  - Bearing Capacity (including Granular Pad Design)
  - Settlement and Stress Distribution Analyses (including Impacts on nearby Structures, Settle3, Finite Element Modelling)
  - Frost Protection, Heated and Unheated Structures
  - Seismic Site Class
  - Liquefaction Assessment (Liquefy Pro)
  - Dynamic Shear Modulus
- **Piles** (Buildings, Bridges, Structural Culverts, Machine Foundations)
  - Pile Types: Driven Steel, Timber, Concrete, Helical, Micro)
  - Axial Capacity (Friction, End Bearing)
  - Rock Socket
  - Downdrag
  - Settlement Analyses (All Pile)
  - Lateral Resistance / Deflection Analyses (All Pile, L-Pile)
  - Pile Groups
  - Porewater Pressure Response
  - Dynamic Analyses (GRL Weap)
- **Caissons**
  - Bearing Capacity
  - Settlement Analyses
  - Skin Friction
  - Base Heave Assessment (Installation)
- **Mat Foundations** (Buildings, Tanks, Reservoirs, Industrial, Machine)
  - Compensated Mats

- Bearing Capacity
- Settlement and Stress Distribution Analyses (including Impacts on nearby Structures, Settle3, Finite Element Modelling)
- Modulus of Subgrade Reaction

- **Highway Embankments, Railway Embankments, Earth Dams**
  - Global Stability (Slope/W), Pseudo Static Analysis
  - Stabilization Analyses (Flanking Berms, Shear Keys, Staged Construction)
  - Settlement and Stress Distribution Analyses (Impacts on nearby Structures, Settle3, Finite Element Modelling)
  - Seepage Analyses (Seep/W)
  - Filter Design
  - Monitoring and Instrumentation Plans
- **Ground Improvement**
  - Site Preloads
  - Soil Replacement
  - Peat Boil / Mud Spot Remediation (Spring Drains)
- **Earth Retaining Structures** (Retaining Walls, Sheet Piles, Braced Excavations)
  - Lateral Earth Pressure Coefficients
  - Lateral Earth Pressure Modelling (including Finite Element Modelling)
  - Stability Analyses (Global, Slide)
  - Rock Anchors
- **Excavations / Earth Cuts**
  - Stabilization Analyses (Flanking Berms, Shear Keys, Staged Construction, Drainage, Granular Sheeting)
  - Seepage Modelling (Seep/W)
  - Base Heave, Instability and Piping
- **Shoreline and Marine Structures**
  - Stability Analyses (Breakwaters, Revetments, Sheet Piles, Wharfs)
  - Foundation Analyses
  - Settlement Analyses
  - Soft Ground Displacement
  - Staged Construction
- **Construction Inspection and Monitoring**
  - Monitoring and Instrumentation Plans
  - Installation of Geotechnical Instrumentation (Settlement Gauges, Piezometers, Lateral Movements Gauges, Thermocouples)
  - Subgrade Inspection
  - Pile Inspection
- **Forensic Studies**
  - Slope / Embankment Failures
  - Construction Issues
  - Foundation Performance Issues
  - Soil / Structure Interaction Assessment

Notable Projects

Transportation

Highway 11 Realignment, MacLeod High Tailings, Township of Ashmore, ON

Realignment of highway over a historical tailings pile overlying peat which was underlain by silt with clay seams. The geotechnical investigation involved an extensive field investigation consisting of boreholes, flat plate dilatometer (DMT) probes, and a test fill to explore porewater pressure response parameters for the peat and tailings subgrade soils. Laboratory testing including consolidation testing and direct shear testing was required to identify settlement performance parameters and shear strengths of the peat, tailings, silt and clay seams.

Geotechnical analyses were carried out to identify limits for peat removal while ensuring stability of the tailings pile perimeter and to establish flanking berm configurations to permit single stage construction. Where the peat foundation had to remain in place, an embankment preload with surcharge fills was designed to expedite settlements and ensure post construction highway settlements meet MTO design criteria. An extensive monitoring and instrumentation plan was implemented to monitor preload performance.

Mile 34.9 HEBA Subdivision, CP Railway Siding Extension, Struthers, ON

Geotechnical investigation and design for the widening of an existing embankment for a new siding. The existing 5 m high embankment was founded over a deep peat deposit underlain by loose to compact sands and silts. Three options were assessed, including staged construction over the peat, full peat removal, and partial peat removal.

Island Drive Bridge, Thunder Bay, ON

At 234 m, the Island Drive Bridge is the longest integral abutment bridge in Canada. As Lead Geotechnical Engineer for the project, Gord Maki oversaw detailed field investigations (both on and offshore), extensive geotechnical laboratory analyses, and advanced geotechnical modelling. Key foundation design issues included:

- Assessment of integral abutment pile deflections and soil stiffness
- Slope stability and consolidation analyses for staged construction for a 10 m high approach embankment over weak clays (assessed for both sub excavation methods and wick drains)
- Determination of lateral soil deflections on adjacent hydro tower piled foundation utilizing finite element modelling
- Constructability assessment for the placement of more than 10 m of fills for three piers to be constructed over soft riverbed sediments

Pinewood River Crossing, Highway 600 Realignment, Township of Tait, ON

A detailed foundation investigation and design report was carried out for a 27 m long single span bridge and the embankment approaches. Foundation recommendations addressed piled foundations, shallow foundations for approach slabs, and embankment stability and settlement performance. Recommendations also addressed challenging foundation soils conditions, including artesian groundwater conditions (up to 5 m head above ground level) and varved clays with the presence of slickensides.

Windsor-Essex Parkway Project, Windsor, ON

Geotechnical design for several staggered bridges and tunnels crossing a new multi-lane highway to be set approximately 10 m below grade. Geotechnical engineering required detailed analyses of pile performance, global stability, and bearing capacity for abutments, piers, and retaining walls. Finite element modelling was carried out to assess settlement/heave predictions for the proposed construction.

McKellar Creek Culvert, Highway 17, District of Thunder Bay, ON

Foundation investigation and design for the replacement of a 5 m timber culvert with an 8.4 m Super-Cor Box Culvert. In addition, the road grade was raised by up to 4 m without extending the current embankment toes. In order to accommodate the raise in grade and offset settlement and stability issues for the low strength and compressible foundation soils, rigid polystyrene fill was utilized to reconstruct the 12 m high embankment.

Overpass Structure, Hawk Lake Subway, Highway 17, Kenora, ON

Foundation investigation for a railway overpass structure. The 26 m long structure required up to 17 m high approach embankments with retained soil systems (RSS) at the integral abutments. Finite element modelling was carried out to assess deformations along the railway embankment.

Institutional

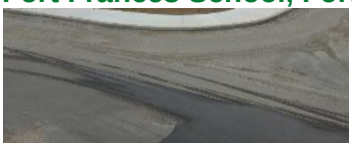
Thunder Bay Consolidated Courthouse, Thunder Bay, ON

A comprehensive geotechnical investigation was requested for the proposed courthouse development, which was to occupy two city blocks. The investigation included extensive boreholes to bedrock and the installation of groundwater monitoring wells. A significant pocket of natural gas was also encountered. In addition to routine geotechnical testing, consolidation tests were carried out to measure the compressibility and rebound properties of the clay foundation soils. Analyses and recommendations were provided for excavations, shallow foundations, and end bearing piles to bedrock.

EMS Station, Dryden, ON

A proposed EMS in Dryden originally to be constructed on shallow foundations. Due to heavy structural loads, a pile investigation and recommendations were also completed. The cost of piled foundations resulted in the design of a site preload to accommodate anticipated settlement, reducing them to acceptable amounts so that shallow foundations could be utilized.

Fort Frances School, Fort Frances, ON



Geotechnical investigation and design of a site preload for a 38,000 sq. ft. elementary school with classrooms, gymnasium, and library. Due to the presence of highly compressible ground conditions, excessive settlements were estimated for the required raise in site grade and the planned shallow foundations. To avoid a costly piled foundation, a fully optimized site preload was designed and carried out to improve ground conditions with respect to settlement performance.

Commercial & Industrial Developments

Hotel and Restaurant Carrick Street, Thunder Bay, ON

Development of a multi-storey hotel and restaurant on the same site. The projects were completed over several years. The hotel report included recommendations for piles and considered the presence of a below grade pool, unheated foundations for an entrance canopy, and the effects of downdrag. The restaurant utilized the same recommendations as the hotel.

Pilatus Corporate Hangar, Thunder Bay, ON

Geotechnical investigation and design of a site preload for a new hangar and associated multi-storey office space. Excessive ground settlements were estimated for the required raise in site grade and the planned shallow foundations. To avoid a costly piled foundation, a fully optimized site preload was designed and carried out to improve the compressibility of the soft, highly compressible subsurface soils.

Four and Five-Storey Wood Frame Apartment Buildings, Pioneer Drive, Thunder Bay, ON

Geotechnical investigation for two multi-storey wood frame apartment buildings. For the heavy foundation loads, extensive foundation analysis was carried out to provide foundation recommendations and capacities for footings founded on bedrock and soil, with the use of a compacted granular pad. Subgrade inspection was required to ensure removal of all loose to compact soils to expose a dense till subgrade.

Proposed Mine Mill, Winston Lake, Pick Lake, ON – Superior Lake Resources

Detailed geotechnical investigation and recommendations for various components of a new mine mill, including a processing plant, coarse ore storage, primary crusher, and conveyor trestles. Geotechnical analyses and recommendations were provided in terms of limit states design (ULS and SLS) for footings and mat foundations on soil, granular pads, and bedrock. For the design of mat foundations, estimates of the effective modulus of subgrade reaction were provided. Recommendations were prepared for frost protection of heated and non-heated structures.

Resolute Sawmill, Sapawe, ON

Geotechnical investigation and design for a new sawmill and kiln. Subsurface soil conditions consisted of fills over peat underlain by sands, silts, and gravels. Geotechnical analyses and design recommendations were provided for shallow footings on soils, footings on bedrock, and rock socketed piles (micro piles).

Secondary Crusher Facility, Lac des Iles Mine, Lac des Iles, ON

The facility included the construction of a secondary crusher plant, transfer tower, and conveyor take-up tower. Given the highly variable depth to bedrock, recommendations were provided for rock socketed piles and shallow footings on bedrock. Recommendations were also provided for structural slabs, slab-on-grade with site preloading, and dynamic properties of the overburden and bedrock.

Infrastructure

110 m High Guyed Bell Tower, Hilly Lake, Kenora, ON

Geotechnical investigation and foundation recommendations for 110 m high guyed communications tower and communications structure. Geotechnical analyses and recommendations provided for rock anchors, footings on soils and bedrock, slab on grade, and frost protection measures for unheated foundations.

Greenwich Lake Wind Farm, Dorion, ON – RES America Development Inc.

Geotechnical investigation and foundation recommendations for 6 wind turbine sites and various other structures. The geotechnical field and laboratory testing programs involved extensive bedrock coring, strength testing, and interpretation of design parameters. Foundation recommendations were provided for both gravity based foundations and/or rock anchor foundations.

Water Pollution Control Plant Upgrades, Geraldton, ON

Geotechnical investigation and design of several buildings, including a 1600 m^3 equalization tank, scrubber pad, valve chamber, and alum tanks. Varying thickness of existing fill and depth to bedrock resulted in several foundation types being designed. Mat foundations, shallow foundations founded on granular soils, footings extending to bedrock, and rock socketed pile were provided.

Proposed New Marina and CDF, Carden Cove, Marathon, ON – Town of Marathon

Geotechnical investigation, preliminary engineering, assessment of options, and costing for a proposed new marina on Lake Superior, including assessment for a potential contaminant disposal facility. Geotechnical engineering included analyses of various foundation options for the proposed breakwater, marina, and CDF.

Indigenous Communities

Three-Storey Office Building, Fort William First Nation, ON

Geotechnical investigation for a three-storey building. Foundation soils included loose silts and sand underlain by complex substrata of highly compressible, massive and varved clays. A significant deposit of natural gas was also encountered with the deep tills and bedrock. Analyses and design recommendations for shallow footings and piled foundations were provided.

Education Centre Feasibility Report and Detailed Design for Pic River First Nation, ON

A site selection investigation was completed for the education centre feasibility study to aid in determining the best location for the proposed centre. The investigation compared the terrain and limited subsurface information, as well as potential foundation and construction issues at each proposed location. Once the site had been selected, a detailed investigation was completed to provide detailed geotechnical design recommendations.

Modification of Windigo Bay Road, Whitesands First Nation, ON

OPG required access along the existing Windigo Bay Road to complete a shoreline stabilization project along the northern shore of Lake Nipigon. A topographical survey of the existing road, a geotechnical investigation of the swamp terrain, and a culvert condition survey were completed for the roadway. Recommendations were provided for a stable roadway through the swamp utilizing geogrids, geotextile, and engineered pavement structure. Roadway embankment stability and cross flow drainage were analyzed for this project.

Sports Arena, Couchiching First Nation, ON

Geotechnical design for a sports arena in the Couchiching First Nation. Two sites were investigated; the first site involved soft clays to great depths and recommendations centered on pile recommendations, the effects of site grade raises and potential downdrag loads on the piles. The second site encountered bedrock just below surface and recommendation for shallow footings placed on bedrock and the other considered foundations on bedrock near surface. The bedrock site was developed and TBTE provided construction recommendations, commentary on frost and frost protection measures along with construction inspection services.

New Band Office, Manitou Rapids First Nation, ON

Investigation to provide geotechnical foundation design recommendations. As the proposed structure was located near the riverbank crest of the Rainy River, a stability assessment was also carried to provide a safe building setback distance from the riverbank.

Environmental Services

Manager of Environmental Services: Doug Steele, M.Sc.

Doug Steele, M.Sc. is the Manager of the Environmental Services department at TBTE, with over 28 years of experience working on a diverse range of environmental research and consulting projects in various geographic locations within Canada and abroad. Doug's focused expertise lies primarily in the areas of environmental site assessments, site inspections, radon gas measurement and mitigation, sediment, soil, groundwater and surface water investigations, solid waste management, site remediation, compliance monitoring and reporting, and regulatory approvals. Doug also manages a variety of biological services, which include baseline studies, natural environment surveys, fisheries and terrestrial assessments, closure plan amendments, environmental impact studies, stream rehabilitation, wetland evaluations, advanced exploration permits, and environmental assessments. Doug is extremely knowledgeable of the provincial and federal environmental legislation and requirements which govern many proposals and permitting processes.

Environmental Services Provided

TBTE's Environmental Services division offers the services of specialists in environmental site assessment, monitoring and remediation, environmental assessments, permitting, and biological sampling. We have a comprehensive understanding of environmental regulations and an excellent relationship with regulatory agencies.

TBTE's Environmental Services division includes professional engineers, scientists, biologists and technologists with demonstrated experience in environmental evaluations during the planning phase of development projects. In support of such evaluations, our team offers the services of specialists in sediment, soil, groundwater and surface water sampling, provincial and federal approvals, archeological assessments, and natural environment biological surveys.

Biological Services

Fish and Fish Habitat Services

TBTE biological staff have experience collecting fish using multiple sampling techniques, including: backpack electrofishing units, fyke nets, seine nets, and minnow traps. Staff are experienced with fish identification through education, background research, on-site training, and having collectively sampled hundreds of watercourses throughout the NW Region. TBTE's environmental team are confident with assessing fish and fish habitat conditions, including identifying sensitive or critical habitat features such as spawning areas.

Terrestrial Services

TBTE biological staff have experience with bird surveys and nest sweeps, bat monitoring, significant wildlife habitat identification, wetland evaluations, invasive species evaluations and other baseline studies. Many of the key personnel have received formal Ecological Land Classification training. TBTE's environmental team have worked on a variety of terrains across the northwest region.

A listing of TBTE's most frequently requested biological services includes:

Biological Services

- Fisheries and Terrestrial Assessments
- Baseline Studies (Mining, Road Building)
- Species at Risk (SAR) and Rare Plant Surveys
- Avian Surveys and Nest Searches/Sweeps
- Environmental Permitting and Planning
- Environmental Impact Statements (EIS)
- Erosion and Sediment Control Plans and Monitoring
- Natural Environment Level 1 and 2 (NEL) Assessments
- Surface Water Assessments
- Fish Rescue Services (including Electrofishing)
- MTO RAQS Prequalification's
    - Fisheries Contract
    - Fisheries Assessment
    - Natural Sciences
    - Archaeology/Heritage
    - Class Environmental Assessment (EA) Process

Notable Projects

Transportation

Ministry of Transportation - Environmental Services on Retainer

This retainer has included hundreds of assignments throughout the Northwest Region. These assignments include the following: Invasive Phragmites; Fisheries investigations of numerous watercourses throughout the region, including brook trout spawning surveys; construction oversight and monitoring; Terrestrial investigations of bridge rehabilitation and replacement projects including SAR and Bird surveys. Bat and Whippoorwill monitoring programs, mitigation plan development for Barn Swallow and Bank Swallow nesting, and project specification development for Heron Rookeries and Caribou Calving grounds avoidance.

Ministry of Transportation – Fisheries Contract Specialist (FCS) Services

TBTE fisheries specialists have provided advice and field-fit recommendations for hundreds of MTO culvert replacement and other in-water works taking place in sensitive habitats. FCS duties have included fish rescue of fish trapped in isolated pools, installation/inspection of erosion and sediment control measures, obtaining scientific collectors licenses from MNRF, field fit recommendations, installation of natural channels and in-stream habitat features, and construction of outlet pools and control weirs.

CP Rail Master Service Agreement

Fisheries and terrestrial investigations for a variety of CP Rail projects. Projects have included the following: bridge and culvert investigations and environmental design; terrestrial investigations of areas requiring tree clearing or infill for new sidings; fisheries investigations of watercourses including fish presence/absence surveys and fish salvage; and terrestrial investigations of bridges including SAR and Bird/nest identification. TBTE developed environmental protection measures and deliverables for dozens of CP Rail infrastructure projects over the past decade.

Aggregate / Quarry Construction - Natural Environment Studies

TBTE was commissioned by the MTO to complete Aggregate Source Investigations and assist with permitting requirements. As part of these assignments, TBTE Environmental completed Natural Environment Assessments. Work Items have included field investigations (natural features and Species at Risk), factual reporting, and consultation with various government agencies.

Mining

Lac de Iles Mine – New Claims Area: Baseline Investigations

Baseline Environmental Monitoring that included biological and physical assessments at key locations, including: bird-breeding monitoring; water-quality monitoring (field and lab analyses); live-release fisheries investigations and fish-habitat assessments; waterfowl monitoring and assessing Significant Wildlife Habitat; SAR (species-at-risk) habitat surveys; and, wetland and forest (upland) ecosite vegetation ground-truthing and mapping. TBTE prepared reports and associated documents for federal and provincial approvals on the project.

Argonaut Gold, Magino Project – Fish Salvage Operations

Extensive fish extraction and relocation activities within Schedule 2 waterbodies in accordance with Fisheries Act Authorization for the Magino Gold Mine Project. Tens of thousands of fish were systematically removed from all streams, ponds, and lakes that were to be destroyed during mine infrastructure creation.

Indigenous Communities

Biigtigong Nishnaabeg – Roadway Improvement Project

TBTE Biologists conducted fish and fish habitat and terrestrial investigations at numerous watercrossing and wetland locations that may be affected by community roadway improvements, including culvert replacements and realignments. This involved extensive consultation with the First Nation community and Fisheries and Oceans Canada (DFO).

Pic Mobert First Nation – Subdivision Development

TBTE Biologists examined large areas planned for the development of a new housing subdivision within Pic Mobert First Nation. The potential impacts to SAR, avian species, and fisheries values were assessed during investigations. TBTE worked with the community to develop appropriate mitigation measures to reduce impacts to the environment from the proposed development.

Contaminated Sites

TBTE is fully established to complete a full range of services including Phase One, Two, and Delineation Environmental Site Assessments (ESAs), ground water monitoring, subsurface environmental investigations, soil and/or ground water remediation supervision, and hydrogeological investigations or environmental audits. We have both licensed professional engineers and licensed professional geoscientists on staff and able to endorse reports, as necessary. Our environmental section has routinely provided contaminant and waste management services to provincial, municipal, federal and private sector clients for over 15 years.

Environmental Equipment

In order to provide a wide range of environmental services that will satisfy the requirements of all projects work associated with this assignment, TBTE can provide the following equipment to be used:

- Multiple in-house drills for all terrain types
- Various augers and sediment probes
- Waterra Power Pump, Peristaltic and Submersible Pumps
- Photo Ionization Detectors
- Interface and water level meters (different sizes and depths)
- Multiple Water Quality (i.e. YSI Multiparameter, Turbidity) Meters
- Various water (e.g. snap samplers) and sediment samplers.

A listing of TBTE's most frequently requested contaminate services includes:

Contaminated Sites

- Spill Site Assessment
- Short and Long-Term Sampling Programs
- Contaminant Delineation
- Fuel Tank Removals and Reporting
- Contaminant Management Plans
- Liaison with Private Property Owners and Enforcement Agencies
- Site Remediation
- Landfill Services
  - Landfill Assessment and Evaluation
  - Landfill Planning
  - Waste Volume Modelling
  - Site Capacity Determinations
  - MOE Environmental Compliance Approvals (ECA) and Amendment Services
  - ECA Compliance Monitoring, Sampling, Data Interpretation and Reporting, and Liaison with Regulators
  - Financial Assurance Calculations

- Environmental Site Assessments (ESAs)
  - Phase I ESAs
  - Phase II ESAs
  - Site Remediation
  - Risk Assessment
  - Record of Site Condition
- Environmental Drilling
  - In-House Drill Equipment with Hollow-Stem Augers
  - Environmental Soil Sampling
  - O. Reg 903 Certified Groundwater Monitoring Well Installations and Decommissioning
  - Well Registration (as per O. Reg 903)

Environmental Building Services

- Designated Substance Surveys (DSS)
- Asbestos Management Plans (AMPs)
- Radon Measurement and Mitigation (C-NRPP)
- Hazardous Materials Surveys
- Air Quality Testing

Notable Projects

Transportation

Ministry of Transportation - Contaminant / Waste Services on Retainer

This retainer includes many assignments throughout the Northwest Region. The assignments that TBTE is currently planning, conducting field programs, and submitting deliverables for include the following: Groundwater sampling and quality control monitoring programs at Pickle Lake Airport, Atikokan Patrol Yard, Beardmore Patrol Yard, and Spruce River Patrol Yard; Phase I/II ESA investigations at Terrace Bay Proposed Rest Area, Manitouwadge Proposed Patrol Yard, Kashchewan First Nation Airport and Attawapiskat First Nation Airport; Webequie First Nation Biocell Baseline Sampling; and various Designated Substance Surveys (DSS) at MTO properties.

Greenstone Gold Mines – Highway 11 Bypass

Hardrock Project Highway 11 Bypass, Preliminary and Detailed Design with Premier Gold/Greenstone Gold, including contaminant investigations at proposed highway routing and decommissioning points. This included drilling, well installations, test pitting and grab sampling at multiple Areas of Potential Environmental Concern (APECs) such as historic tailings and waste rock areas, closed landfill site, maintenance patrol yard, former mine shaft portal area, former gas stations and areas with historic stack emission impacts. TBTE produced environmental screening, ESA and delineation reports for the client and MTO on this assignment. The long term project was initiated in 2014 and continues today.

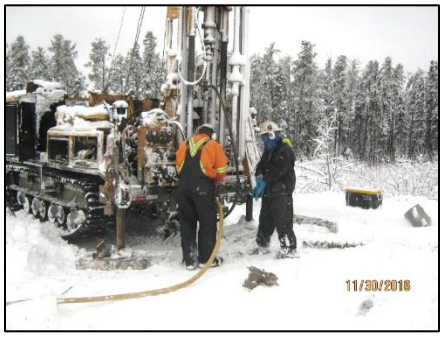
Landfill Studies

Township of Chapple – Shenston Waste Disposal Site

the Shenston Waste Disposal Site Hydrogeological Investigations including installation of 11 groundwater monitoring wells for analysis of both hydrogeological and water quality conditions. The investigation also included soil sampling and surface water sampling. The appropriate size and location of the Contaminant Attenuation Zone (CAZ) was determined based on the findings of the investigation. Topographic survey was also completed for the site using Trimble RTK equipment, including establishment of monitoring well and groundwater elevations.

Subsequent years' work has included ongoing groundwater and surface water monitoring and reporting; as well as developing operational and partial closure plan design amendments.

Landfill Expansion Plan – Conacher Landfill



A hydrogeological assessment including groundwater quality study and a waste capacity study for the determination of current volumes and waste characterization; landfill expansion and landfill life expectancy. Data from the capacity study was used for the modelling for the expansion and closure plans of the existing landfill. The closure plan included identification of fire zones; buffer zones; calculation and appropriate location of the Contaminant Attenuation Zone (CAZ) as per O. Reg 232/98; landfill access; detailed physical settings including topography, hydrogeology and surrounding land uses; and, groundwater monitoring locations.

Environmental Site Assessments

Phase I and II ESA – Commercial Property in Longlac, ON

TBTE conducted a Phase I and II Environmental Site Assessment at a commercial property in Longlac, ON. The residual soil contamination by petroleum hydrocarbons represented an environmental concern to the property. TBTE investigated the subsurface soil and groundwater conditions for the presence/absence of suspect contaminants at discrete Areas of Potential Environmental Concern (APEC). During investigations of the site, TBTE installed three (3) shallow groundwater wells and 12 boreholes, logged the subsurface conditions, collected representative soil and groundwater samples for analytical testing, and interpreted chemical analysis of water soil, and sediment. Based on investigative findings, TBTE completed soil remediation at two areas of concern identified from the Phase II investigation and established a groundwater monitoring program.

Mitaanjigamiing First Nation – Enhanced Property Transfer Assessment

TBTE supported the community to prepare a Phase I ESA. The ESA was for the Enhanced Property Transfer Assessment (PTA) on lands identified as part of the Treaty Land Entitlement (TLE) Settlement Agreement and as part of the Flood Claim negotiation. The project also included a species at risk (SAR) portion. The project identified current Site conditions as well as potential or actual environmental contamination that may be present within the Site or adjacent or neighbouring properties. Sensitive and SAR species that could inhabit the Site were identified during the desktop searches and investigated for their presence during the Site visit. TBTE's diverse team reviewed all aspects of Environmental needs to create a detailed report including recommendations and feedback.

Site Remediation

City of Thunder Bay – Transit Site UST Removal

TBTE conducted an environmental program that included underground storage tank (four USTs) and abandoned piping removal, soil and groundwater delineation and the development of a Contaminant Management Plan (CMP). Based on the results and finding of the UST removal, further delineation of soil and groundwater was completed through boreholes and monitoring well installations. A Contaminant Management Plan was developed as the site continues to operate with fuel handling activities onsite.

Sub-Station Construction – Fuel Spill Contaminant Management Plan

TBTE conducted petroleum hydrocarbon (PHC) contamination delineation sampling following the loss of diesel fuel (approximately 3000L) from a generator to the ground at construction Site. . TBTE drilled 17 boreholes to establish PHC delineation and collected groundwater samples from a monitoring well network designed by TBTE. Bulk contaminated soil was removed using excavators and hydrovac trucks. Backfill was incorporated with Microbiate SG™, which includes 6 strains of bacteria which each degrade hydrocarbons, working synergistically to accelerate the process of bioremediation. TBTE also worked with Geocentric Environmental to install a permeable treatment carbon wall at the Site and continue to monitor site conditions for future reporting purposes.

Designated Substance Surveys (DSS)

Designated Substance Survey – Bingwi Neyaashi Anishinaabek First Nation

TBTE conducted a DSS at the former Grandview Public School, for Bingwi Neyaashi Anishinaabek (BNA) First Nation. The DSS was completed for the development of the former school into a Family Wellness Centre for the First Nation. Based on analytical results, a significant amount of asbestos was identified throughout the school that required abatement prior to renovations. TBTE has completed DSS investigations for dozens of Indigenous communities and organizations throughout Northwestern Ontario.

Designated Substance Survey - the Corporation of the Town of Marathon

TBTE completed a DSS for the Corporation of the Town of Marathon at the Marathon Public Works Site in Marathon, Ontario. The DSS was completed on four buildings within the Site for the purpose of demolition of the Carpenter Shop (A Building), Lunchroom (B Building), Salt Shed (C Building), and Public Works and Water Office (D Building). TBTE has completed DSS investigations for nearly every municipality in Northwestern Ontario.

Pavement Engineering

Manager of Pavement Engineering and Geological Services: Sam Molendijk, P.Eng.

Sam is the Manager of TBTE's Pavement Engineering and Geological Services department. He has over 14 years of pavement and geological engineering experience, working for a diverse range of clients across Northern Ontario. Sam is an approved service provider in MTO's Registry, Appraisal and Qualification System (RAQS) for Medium Complexity Pavement Design under the Pavement Engineering Speciality.

Sam prepares proposals, letters, technical reports, and design studies pertaining to pavement engineering, soils investigations, and aggregate investigations/permitting. He provides technical direction to the engineering office and field staff, and manages the direction, supervision, operation, maintenance, planning, development, health and safety, and administration of the day-to-day operation of projects assigned. Sam liaises with consultants, developers, government agencies, contractors, and industry. In addition to his managerial duties in the Pavement and Geological department, Sam serves as TBTE's Laboratory Supervising Engineer, overseeing all of TBTE's laboratory operations.

TBTE Pavement Engineering Services

TBTE offers a wide variety of pavement engineering services which are capable of meeting or exceeding our clients' requirements. From factual geotechnical investigations and preliminary studies, to detailed design and analyses, we can tailor our services to consistently meet our clients' needs and budget.

TBTE's Pavement Engineering division is approved in MTO's Registry, Appraisal and Qualification System (RAQS).

TBTE has fully equipped drill rigs and specialized field and laboratory testing equipment to handle almost any ground condition or project requirement, and our staff possesses extensive technical capabilities and experience delivering a successful completion of pavement engineering projects. Our laboratory is certified by the Canadian Council of Independent Laboratories (CCIL) for Type A and B (asphalt) and Type C and D (soils and aggregates).

TBTE's team of pavement specialists work in step with the project design team to identify and address potential site issues related to pavement performance. Project teams consisting of two or more engineers and technologists are established for all of our projects to provide oversite, technical review, and to encourage thorough consideration and sound design recommendations.

Prior to advancing field investigations for any assignment or scope of work, TBTE develops a comprehensive Health and Safety, Traffic Control, and Quality Control Plan specifically tailored to the assignment.

A summary of TBTE's most relevant pavement engineering services includes:

Pavement Engineering

- **Desktop Studies**
  - Review Available Surficial Geotechnical Data
  - Review Previous Construction / Contract Package and Data
  - Terrain Analysis including Delineation of Bedrock and Swamp
  - Feasibility / Preliminary Pavement Recommendations
- **Pavement Field Reviews**
  - Complete Pavement Evaluations including Ride and Pavement Condition Rating
  - Review Distortions / Frost Heaves including Probable Causes and Potential Remediation
  - Lateral and Transverse Cracking
  - Surface and Roadside Drainage
- **Field Investigations**
  - Test Pits
  - On-road Boreholes using a Truck Mounted Drill Rig
  - Off-road Boreholes using a Rubber Tire and Track Carrier Mounted Drill Rig
  - Hand Augers
  - Asphalt Coring and Sampling
  - Subgrade Inspections
- **Laboratory Testing**
  - Soils – Moisture Content, Gradation Analysis, Atterberg Limits, Proctor Testing, Unit Weight
  - Aggregates – Coarse and Fine Petrographic Analysis, Freeze Thaw, Micro-Deval, Percent Crushed, Asphalt Coated Particles
  - Asphalt – Percent Asphalt Cement, Relative Density, Percent Air Voids
  - Hydraulic Conductivity of Soil (T-Time Analysis)
- **Roadways (New Construction, Reconstruction, and Rehabilitation)**
  - Pavement Design (Asphalt and Granular Fill Thickness)
  - Rehabilitation Recommendations (Pulverize, Milling, Full Depth Removal, Asphalt Overlays)
  - Life Cycle Costing Analysis
  - Distortion and Frost Heave Treatment Recommendations
  - Construction Material Recommendations (Asphalt Type, Granular Specifications, Reuse of Existing Materials)
  - Construction Recommendations in Rock, Earth, and Swamp
  - Roadway Drainage (Culvert Installation / Replacement, Ditching)
  - Transition Treatments
  - Subgrade Preparation
  - Platform Widening
  - Erosion Protection
  - Traffic Loading Calculation including Equivalent Single Axle Loading (ESAL)
  - Asset Management Plan
  - Aggregate Source Identification

- **Parking Lots**
  - Pavement Design (Asphalt and Granular Fill Thickness)
  - Life Cycle Costing Analysis
  - Rehabilitation Recommendations (Pulverize, Milling, Full Depth Removal, Asphalt Overlays)
  - Distortion and Frost Heave Treatment Recommendations
  - Construction Material Recommendations (Asphalt Type, Granular Specifications, Reuse of Existing Materials)
  - Drainage (Culverts, Storm Sewer, Ditching)
  - Subgrade Preparation
  - Erosion Protection

Notable Projects

Ministry of Transportation Ontario

MTO GWP 128-90-00, Highway 11/17 Four-Laning Construction for 14.8 km (Pearl)

TBTE worked as a subcontractor to Dillon Consulting Group for this project, which included detail design pavement engineering services for the four-laning of Highway 11/17 from 1.5 km East of Highway 587, Easterly for 14.8 km. Field investigations included hand auger borings, test pitting, hydraulic boreholes, and casing and coring of refusal material. The deliverables included a Geotechnical Design Report with supporting Pavement Structure Treatment Charts for the 14.8 km of new construction, new side roads and connections, and the rehabilitation and/or abandonment of the existing highway.

MTO GWP 5119-06-00, Highway 17 Reconstruction (White River Easterly)

The pavement engineering scope of work included detail design pavement engineering services and field investigations, including asphalt coring, hand auger borings, and hydraulic power auger explorations to investigate distressed/distorted sections for remedial treatment. Investigations were completed in accordance with the MTO Pavement Design Investigation Guidelines. The project included Life Cycle Cost Analysis of each pavement reconstruction strategy considered. A Pavement Design Report with supporting Pavement Structure Treatment Charts were provided as part of the deliverables.

MTO GWP 6707-14-00, Highway 11 – 2.2 km East of Michael Power Blvd, Easterly for 30.4 km

TBTE completed detailed design and pavement engineering services for the reconstruction of Highway 11. The basic pavement reconstruction strategy included CIREAM treatment of the existing surface course. TBTE collected asphalt slab cut-outs and supplemental asphalt cores, and oversaw the CIREAM mix design which was ultimately used for the project and included in the Geotechnical Design Report, along with all other pavement and geotechnical engineering design details.

MTO Northwest Region – Geotechnical Services Retainer

TBTE provided geotechnical pavement engineering design and investigation services to the MTO on a retainer basis. TBTE has successfully completed over 30 work items over the past three years. The scope of the work items has varied, from basic investigations and factual reporting to major arterial realignment investigations and detail design services.

Others:

- Highway 17, Steel River Bridge Westerly, New Construction
- Highway 11/17, Nipigon Westerly Four-Laning, New Construction
- Highway 71, from Highway 11 Northerly, Reconstruction and Platform Widening
- Highway 673, Shoal Lake, Highway Realignment and New Construction
- Highway 17, from White River Easterly to Wawa, Reconstruction
- Highway 17, from Pays Plat Easterly, Realignment and New Construction
- Highway 11, from Geraldton to Longlac, Rehabilitation
- Highway 71, from Sioux Narrows Southerly, Rehabilitation
- Highway 11/17, Thunder Bay Expressway, New Construction
- Highway 71, Nestor Falls Southerly, Rehabilitation
- Highway 502, 66 km North of Highway 11, Reconstruction
- Highway 11, Fort Frances Easterly, Rehabilitation
- Highway 594, 601 (Dryden), Reconstruction
- Highway 11/17, Pass Lake Four-Laning, New Construction
- Highway 102, Highway 589 Westerly, Reconstruction
- Highway 17, Ignace Westerly, Rehabilitation

Mining Roadway Projects

Equinox Gold (Greenstone Gold Mines) – Realignment of Highway 11

TBTE completed the geotechnical field investigations and pavement engineering detail design services for the realignment of approximately 4.7 km of Highway 11. The project was completed on behalf of Greenstone Gold Mines (now Equinox Gold) and was initiated to gain access to ore underlying the existing Highway 11 and Micheal Power Boulevard Intersection. The project traversed various geotechnical substrate including sand and gravel deposits, bedrock, low-lying swamp areas and an existing tailings facility.

Geotechnical investigations included hand augers, boreholes and test pit investigations. Final deliverables were provided in the form of a Geotechnical Pavement Design Report which was reviewed, and ultimately approved by MTO.

Evolution Mining (Red Lake) – Bateman Mill Haul Road and Access Road Realignments

TBTE completed the preliminary design and pavement engineering services for the construction of a new Haul Road servicing the Bateman Mill in Red Lake, Ontario. Also included in the project was the realignment of the existing access road at select locations. Field investigations were limited to hand auger investigations to explore subgrade conditions, rock outcrops, and swamp. TBTE utilized the Principles of Haul Road Design and Construction (Thompson, 2015) and the Guidelines for Mine and Haul Road Design (Tannant & Regensburg, 2001) to complete pavement structure design for the haul road which primarily services Volvo FMX 10x4 Tipper hauling trucks with a payload up to 56 tonnes. A Preliminary Geotechnical Design Report was provided as part of the deliverables.

Argonaut Gold – Goudreau Road Realignment, Dubreuilville, ON

TBTE completed the detail design and pavement engineering services for the realignment of Goudreau Road to accommodate mine expansion. Field investigations included test pits and hand auger borings to explore subgrade conditions, rock outcrops, and swamp. A Pavement Design Report with supporting Pavement Structure Treatment Charts was provided as part of the deliverables.

New Gold Rainy River Mine – Highway 600 Realignment and Access Road, Finland, ON

TBTE completed the detail design and pavement engineering services for the realignment of Highway 600 and the construction of an access road for the New Gold Mine operations. Field investigations included test pits, boreholes, and hand auger borings to explore existing highway conditions, subgrade conditions, rock outcrops, and swamp. A Pavement Design Report with supporting Pavement Structure Treatment Charts was provided as part of the deliverables.

First Nations

Mitaanjigamiing First Nation – Roadway Improvements

TBTE completed the geotechnical engineering and detail design for roadway improvements to service the community. A field review was completed to evaluate the existing roadway performance, including surface conditions and drainage. Field investigations included boreholes and hand auger borings to investigate centreline culverts, ditches, and widening areas. A Geotechnical Design Report with accompanying Pavement Structure Treatment Charts was provided as part of the deliverables.

Biigtigong Nishnaabeg First Nation – Roadway Rehabilitation and New Pedestrian Trail Construction

TBTE completed the geotechnical engineering and detail design for the rehabilitation of the roadway networks within the community, as well as for the construction of new pedestrian trails. Geotechnical field investigations included asphalt coring, boreholes, and hand augers. Pavement design recommendations were provided for the rehabilitation of the existing roadways and for the new pedestrian trail construction. A Geotechnical Design Report with accompanying Pavement Structure Treatment Charts was provided as part of the deliverables.

Bingwi Neyaashi Anishinaabek – Road Extension

Geotechnical investigations were advanced to support the detail design of a road extension within the community. Geotechnical field investigations included test pits and hand auger borings. A Geotechnical Design Report was provided detailing the pavement recommendations associated with the construction of the new roadway.

Netmizaaggamig Nishnaabeg First Nation – Residential and Commercial Developments

TBTE completed the geotechnical engineering and detail design for the construction of a new subdivision network within the community. Geotechnical investigations were advanced to evaluate the existing subgrade conditions for pavement design and installation of a new water main. A Geotechnical Design Report was provided detailing the pavement recommendations associated with the construction of the new roadway. Additionally, general commentary was provided related to the suitability of in-situ soils for use in septic design.

Parking Lots

TBTE has completed numerous geotechnical investigations in support of new and reconstructed parking lot projects. Parking lot assignments generally consist of boreholes advanced within the footprint of the parking lots to determine the subgrade conditions and suitability of the existing granular fill for reuse, if applicable. Additionally, commentary related to pavement thickness, subgrade preparation, frost susceptibility, and erosion was provided. A brief list of parking lot projects completed by TBTE is provided below:

- Matawa Education and Care Centre, Thunder Bay, ON
- Matawa Training and Wellness Centre, Thunder Bay, ON
- BGIS – Fire Marshall Building, 640 Mountdale Ave, Thunder Bay, ON
- BGIS – Service Ontario, Ignace, ON
- BGIS – Kenora Jail, Kenora, ON
- OPG – Silver Falls Generating Station, Thunder Bay, ON
- LDSB – Five Mile Public School, Thunder Bay, ON

Geological Services

Manager of Pavement Engineering and Geological Services: Sam Molendijk, P.Eng.
Sam is the Manager of TBTE's Pavement Engineering and Geological Services department. He possesses over 14 years of pavement and geological engineering experience, working for a diverse range of clients in the Northwestern Ontario region. Sam prepares proposals, letters, and technical reports pertaining to geological studies and Aggregate Source Investigations (ASIs). Sam has participated in dozens of ASI projects for both pits and quarries, including the development and oversight of technical reports for test pit and borehole investigations, laboratory testing, site surveys and plan development, summary statements, hydrological reports, decisioning and volumetric assessments, cultural heritage, and environmental assessments.

In addition to his managerial duties in the Pavement and Geological department, Sam serves as TBTE's Laboratory Supervising Engineer, overseeing all of TBTE's laboratory operations.

Geological Engineer and Petrographic Analyst: Leah Cosby, P.Eng.
Leah has 12 years of experience in the fields of geology and water resources including investigations, analysis, and reporting on petrographics, pits and quarries, mines, rock cores, aggregate, groundwater elevations, hydrogeology, dams, and septic design. Leah is a CCIL Certified petrographic analyst who has recently curated a reference library of rock and gravel samples from throughout Ontario. Leah is passionate about developing training documents to bridge understanding between engineering and geology.

TBTE Geological Services

TBTE provides a broad range of geological and hydrogeological services to a wide variety of Clients, including the MTO, Indigenous communities, local municipalities, mining outfits, and private sector clients.

Our state-of-the-art laboratory testing facility is CCIL Type A, B, C, and D certified and capable of completing the majority of aggregate compliance testing for granular, asphalt, and concrete

materials. All material testing work is carried out by a technician, or under the direct supervision of a technician with the appropriate CCIL certification. TBTE currently employs over 15 Type C certified technicians and one CCIL certified Petrographic Analyst.

TBTE is approved in MTO's Registry, Appraisal and Qualification System (RAQS) for the following specialties related to Geological and Aggregate Investigation services:

- Aggregate Resource Prospecting and Evaluation
- Environmental and Natural Sciences
- Archaeology
- Engineering Surveys
- Engineering Materials Testing
  - Soil and Rock (Medium Complexity)
  - Aggregates (Low Complexity)
- Hydrogeological (Low Complexity)

A summary of TBTE's most relevant geological services includes:

Geological Services

- **Desktop Studies**
  - Terrain Analysis
  - Identification of Potential Aggregate Sites
  - Review of well records
- **Geological Services**
  - Bedrock Classification
  - Borehole Drilling
  - Test Pitting
  - Rock Core Logging
  - Unconfined Compression Strength Testing
  - Aggregate Source Investigations
  - Decisioning and Site Volumetrics
  - Physical Material Testing
  - Permit and License Applications for Pits and Quarries
  - Mine Inventory and Closure Studies
  - Coarse Petrographic Analysis (LS-609)
  - Fine Petrographic Analysis (LS-616)
  - Basic Geology Classes and Petrographic Workshops
- **Hydrogeological Services**
  - Monitoring Well Installations
  - Drawdown and Recovery Tests
  - Aquifer Analysis
  - Estimated Groundwater Contour Maps
  - Maximum Predicted Water Table Reports
  - Hydraulic Conductivity of Soil (T-Time Analysis)
  - Septic Wastewater Attenuation Predictions
  - Septic System Design

Further information regarding the prominent Aggregate Source Investigations are provided below:

Aggregate Source Investigations

TBTE has completed hundreds of Aggregate Source Investigations (ASIs) across Northern Ontario for both pit and quarry sources. TBTE regularly works with MTO and MNRF for ASI permits and license extractions, including the development of technical reports and completion of the necessary notification/consultation for the sources.

Technical studies frequently completed by TBTE include:

- Maximum Predicted Water Table Report
- Natural Environment Report (Level 1 and 2)
- Water Report
- Site Plan Development

Additionally, TBTE has a reputable working relationship with sub-contractors who are capable of completing the remaining aggregate source study requirements, including:

- Cultural Heritage Report
- Agricultural Impact Assessment Report
- Noise Assessment Report
- Blast Design Report

Reporting is always completed according to the latest standards of the Aggregate Resource Act (ARA).

Unconsolidated (Pit) Investigations

For unconsolidated sources, TBTE investigates the geological condition and quantity within those sources. Generally, test pits are advanced where samples of potentially suitable material are anticipated. An estimated volume of “oversized” material for potential crushing is also completed.

Field investigations are performed in accordance with the MTO’s Standard Practice for Aggregate Evaluation guidelines (January 22, 2002). Test hole spacing follows the direction provided in this guideline, utilizing a 30 m or 60 m grid pattern, dependent on the targeted resource and actual conditions. TBTE consistently ensures that investigations are completed outside of prescribed setback areas, including private property, residential land use, public roads, highways, and water bodies.

The field staff performing the investigations shall have a minimum of five years of experience in aggregate resource prospecting and evaluation. All sampling, classification, and testing is completed in accordance with approved MTO procedures.

Following field investigations and laboratory testing, TBTE uses conventional techniques to perform decisioning on each test pit, determining usable quantities of aggregate contained within each source. Calculations determine if a particular test hole is considered crushable for processing of Granular ‘A’ or Hot-Mix Asphalt materials, or if it is naturally suitable for use as Granular ‘B’, Winter Sand, Concrete Fine Aggregate, or any other material with a gradation specification.

TBTE then provides a marked-up sketch of each source showcasing:

- Areas of crushable material and quantities;
- Areas of non-crushable material and quantities;
- Percent ranges retained on the 100 mm, 26.4 mm, and 4.75 mm sieves;
- Range of depth of test holes;
- Height of existing pit faces;
- Ranges of depth of stripping required; and
- Presence of silt, clay, or water during test hole investigations.

The suitability of each source to produce granular materials is indicated by standard MTO terms, such as Acceptable, Not Acceptable, Conditionally Acceptable, or Requires Investigation. Standard MTO "Condition" comments, such as "Oversize is to be removed or crushed" against Granular 'B' are used for each product.

Consolidated (Quarry) Investigations

TBTE's drilling equipment is capable of drilling overburden and coring bedrock with BQ or larger sizes (if requested) advancing core length to a depth of 15 m, and accessing unopened deposits. TBTE has several off-road rock drills which are ideal for conducting investigations on rough terrain.

Borehole investigations at quarry locations generally consist of the advancement of diamond drill boreholes to depths of 15 m and spaced approximately 75 m apart. Rock cores are collected in the field, boxed, and returned to TBTE's Thunder Bay laboratory for further evaluation and testing as required. All boreholes are decommissioned in accordance with Ontario Regulation 903.

Once returned to the laboratory, a TBTE Geologist provides commentary on rock type, jointing, physical stability, or chemical concerns. Rock core samples are then crushed for laboratory

testing, including petrographic analysis, Micro-Deval abrasion, absorption and relative density, and freeze-thaw testing to evaluate the suitability of the rock for construction aggregate.

Monitoring Wells

TBTE performs monitoring well installations that are used for dip readings, drawdown and recovery tests, and collection of samples for water quality analysis. Recovery data is examined to estimate aquifer characteristics, drawdown, interference, and well yield. TBTE can estimate a site's groundwater contours using a combination of available mapping and surveyed water elevations in test holes, wells, and nearby surface water features.

The groundwater contours are then used to complete the Maximum Predicted Water Table Report, which details the site and defines the proposed depth of excavation.

All monitoring wells are installed and registered under compliance with Ontario Regulation 903.

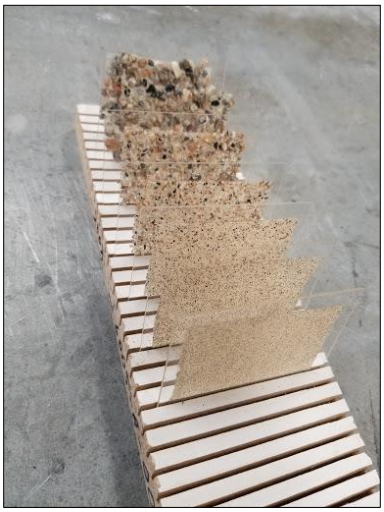
Mine Site Reconnaissance

Historical extraction sites are assessed for safety hazards, on-site equipment, and mining remnants. This information is useful for determining recommendations for closure, rehabilitation, or reactivation. In some cases, the tailings or nearby water is sampled or monitored for parameter concentrations and recommendations are provided.

Core Logging

While core logging is common across the ASI projects, it is also a valuable component in geotechnical design projects. Rock core is assessed in the laboratory, documenting fractures, geology, and quality of the rock sample. This data is required for determining design loads for overlying infrastructure. It can also be used to identify potentially concerning components of the rock mass such as clay seams, high mica content, high sulfide content, and zones of intense weathering that was not observable from the surface.

Petrographic Analysis



Petrographic Analysis is also common across the ASI projects and materials engineering studies. TBTE also performs LS-609 (Coarse Aggregate) and LS-616 (Fine Aggregate) tests requested by the owners of many active pits and quarries throughout Ontario and Manitoba. The laboratory completes gradation analysis on samples received and the relative percentages of the fractions are used in the weighted calculations. For these tests, gravel and sand samples are prepared and examined by a petrographic analyst using a low-powered microscope. The analyst assigns each coarse sample a petrographic number, which is considered when assessing the suitability of a source for various aggregate products. TBTE has also previously completed Part B of the LS-609, reporting on geology and quality of aggregate reclaimed from asphalt.

Hydrogeological Studies

Water Supply and Groundwater Quality Impact Assessment, Northwestern Ontario Resort

This project involved the review of background data, test pitting and drilling, monitoring well installation, water sampling, drawdown and recovery testing, well yield analysis, water quality analysis, and modelling to investigate groundwater impact. Conclusions were provided about the aquifer characteristics and recommendations were made with respect to lot sizes, septic treatment, and adherence to MOECC D-5-4 and D-5-5 guidelines.

Fish Farm Feasibility Study,

In this project, TBTE drilled in the unconsolidated subsurface, recorded soil information, and installed monitoring wells to assess a sandy aquifer layer. Water was pumped from the wells and monitored for drawdown and recovery tests. Water level data was collected using Solinst leveloggers and analysed to estimate aquifer properties and possible flow rates. Water samples were collected and tested for quality to inform recommendations for the proposed fish farm.

Notable Projects

Aggregate Source Investigations – MTO

Since 2009, TBTE has completed hundreds of Aggregate Source Investigations on behalf of the MTO, including both unconsolidated and consolidated sources throughout Ontario. Generally, the MTO will identify a Site which may contain potential aggregate to supply an upcoming capital highway improvement contract. The scope of the projects generally consists of site investigations (test pits and boreholes), natural environment studies, groundwater studies, laboratory testing, cultural heritage assessments, and site plan preparation as prescribed by the Aggregate Resource Act (ARA).

TBTE has assisted MTO in completing several permit applications for various categories of extraction sites including both pits and quarries above and below the established groundwater level.

Aggregate Source Investigations – Private Clients

TBTE has also completed ASI projects for dozens of other Clients including Indigenous Communities, Private Contractors, and Mining groups. Generally, the scope of work remains the same as the MTO ASI assignment described above with exception of when aggregate sourcing occurs on private lands within the Aggregate Resource Act jurisdiction, at which point a License application is required rather than a permit. Prior to the advancement of the technical studies at an identified site TBTE will complete a desktop study evaluation to identify and narrow down possible aggregate sites within reasonable proximity to a proposed project.

New Gold Rainy River Mine – Tait Township Quarry

On behalf of New Gold Mine, TBTE completed technical studies and permitting in support of a Category 12, Quarry Below Water. Technical studies included a Summary Statement, Natural Environmental – Level 1 Assessment and a Hydrogeological Report which constituted TBTE's professional opinion of the groundwater and site conditions evidenced by on-site field reviews and investigations and supplemented by available geological and topographical mapping. The quarry permit application was successful and ultimately provided the construction aggregate for the Highway 600 roadway realignment.

Mitaanjigamiing First Nation – Category 12 Quarry

On behalf of Mitaanjigamiing First Nation (MFN) TBTE successfully completed a Category 12 aggregate permit application for quarry operations to produce and supply aggregates in support of the provincially and federal funded Community access roadway rehabilitation project. The project began with the evaluation of 26 potential sites along the project length. Through various screenings and evaluation, the potential sites were narrowed to one ideal site capable of producing the necessary aggregates while having the lowest Cultural Heritage values to the community of MFN.

Shabaqua Pit Technical Studies

TBTE completed the technical studies supporting Category 9 – Class A Pit Above Water permit application. The technical studies included a Groundwater Summary Statement, Natural Environmental Level 1, Cultural Heritage/ Archeological assessment, Power Equipment Investigation, Topographic Survey and associated Site Plans.