PROJECT DESCRIPTION: BILL & MELINDA GATES FOUNDATION HEADQUARTERS

Role of Member Firms

GeoEngineers provided site selection services, regulatory liaison, environmental design and remediation, permitting and construction observation services, and was the geotechnical engineer of record on the project. **KPFF** was the civil and site structural engineer for the project, responsible for the sitework design and permitting, utility relocation design, stormwater management, and planning and design for surrounding roadways.

Role of Other Consultants

NBBJ: Architect
Sellen: General Contractor
Seneca Group: Development Manager
K&L Gates: Environmental Law
Arup: Structural, Mechanical, Electrical, Plumbing; AV/Acoustics, IT
Gustafson Guthrie Nichol: Landscape Architect

Budget and Schedule

Total project cost: $500 million
Total actual cost: $500 million
Entrant's portion of the budgeted costs: $61M
Entrant's portion of the actual costs: $61M
Scheduled completion date: 2012
Actual completion date: 2012

Innovation and Quality and Professional Excellence

The Bill & Melinda Gates Foundation World Headquarters campus is 12 acres of inspiring architecture and landscaping that transformed how the foundation works and changed the fabric of a community. What is less apparent to the casual observer, however, is the infrastructure design below the surface that created a true foundation of collaboration for this world-class project.

GeoEngineers and KPFF worked closely with the foundation over an eight-year period to address a series of significant design challenges, including:

- Some of the most complex **site-selection, right-of-way and land-use negotiations** in Seattle's history had to occur before the project could even break ground
- More than 100 years of industrial use had left a **legacy of environmental damage** so severe that many city officials doubted the sprawling site would ever be redeveloped
- Designers had to plan for, rebuild and reroute **highly sensitive above- and below-grade infrastructure**, including century-old sewer systems and underground and overhead transmission and distribution lines
- The site was one of the **largest single parcels ever developed in the city** and required a massive temporary shoring system extending to depths of 50 feet below grade
- The foundation's **ambitious sustainability goals** called for new age thermal energy storage and unique stormwater-management methods that needed to be engineered into what became the world's largest nonprofit LEED© Platinum - NC building

The incredible campus that grew from these efforts demonstrated that engineering firms can and should be at the table helping clients make their most important decisions about siting, environmental sustainability, public-private negotiations and risk. And just as importantly for the engineering profession, this project confirms that engineers and scientists do more than design structures—they can help clients make a global impact and shape communities.

This large urban brownfield redevelopment included a complex interplay of environmental, geotechnical and sustainable design elements and extensive below- and above-grade infrastructure considerations. The innovative engineering work required to support this project included:

- **Thermal Energy Storage (TES) tank design.** This 750,000-gallon tank optimizes the campus cooling system and required a cylindrical excavation 50 feet in diameter and 65 feet deep. KPFF's designers created a ring of piles to form the perimeter of the tank, removed the soil from the middle and cast the concrete tank's wall as excavation progressed. The resulting tank wall acts with both compression and tension, depending on loading conditions. While many tanks of this type require constructing temporary shoring within which a separate tank is built, KPFF's cost-effective design allowed for the single concrete structure to serve as both. GeoEngineers collaborated with KPFF to develop a highly efficient compression ring shoring system (without ground anchors) to construct the tank and completed the geotechnical design using a three-dimensional finite-element model of the structural elements of the tank, soil and groundwater, and construction sequence. The tank was constructed top-down in a series of six-foot high permanent reinforced shotcrete lifts. GeoEngineers monitored tank displacements throughout construction, using highly sensitive geotechnical instrumentation to confirm that the tank design was performing as anticipated.
- **Advanced numerical modeling.** A 100-year old brick sewer was located 50 feet below the planned basement level of the buildings. GeoEngineers used sophisticated numerical modeling of the planned excavation sequence to estimate how much the sewer would rebound during the deep excavation for the campus basement. The modeling program demonstrated that construction could be completed without adverse risk to this important system.
- **Rainwater storage tank solutions.** A one million gallon storage tank collects rainwater for landscape irrigation, water features and non-potable reuse (last year, the foundation harvested and used 3.5 million gallons of rainwater). The tank was situated in a constrained area of campus, with soils of variable compressibility above a settlement-sensitive storm sewer. GeoEngineers developed foundation solutions for the tank that limited settlements and protected the underlying storm sewer from localized settlement.
- **Structural "sandwich."** Below the central plaza's collection of stone paving, boardwalks and water features is a structural system designed to support the serene landscaping above. KPFF created a detailed system above the campus' basement and below the plaza that included a combination of carefully placed backfill and EPS foam layers to offset the weight of the soil and allow sufficient space for tree roots, site drainage systems, electrical conduits and water piping.
- **Environmental barrier.** GeoEngineers designed a 560,000 square foot gasoline vapor barrier—one of the most complex and largest ever deployed in an urban environment. An 80-mil Liquid Boot membrane was sprayed on all walls and beneath the entire facility to prevent intrusion of gasoline vapors into the subgrade garage and overlying buildings. The vapor barrier system was integrated into a sub-slab drainage and passive venting system and provides ultimate protection from an existing gasoline plume and off-gassing from an in-situ groundwater cleanup system.

The 560,000 square foot vapor barrier was sprayed on all walls and below the entire facility.

- **Tieback demonstration.** Many cities require that tiebacks installed in the city right-of-way be de-stressed at the conclusion of the project. GeoEngineers collaborated with project partners on a demonstration project that severed two stressed sacrificial tiebacks under controlled conditions to simulate future excavation work in the right-of-way. The documented response revealed no significant safety concerns or risk of potential adverse impacts. The team shared the demonstration's results with city officials, developers and design professionals. GeoEngineers also presented a paper about the project at the 2010 ASCE Earth Retention conference.

Site Complexity

This large urban redevelopment required the project team to consider a complex matrix of environmental, geotechnical and sustainable design elements and extensive below- grade infrastructure concerns. The project includes 900,000 GSF of foundation offices and conference center in two six-story buildings connected by a shared basement. In addition, as part of a public/private partnership, the project constructed a 375,000 GSF semi-subterranean public parking garage owned by the City of Seattle that also houses the foundation's 12,000 SF visitor information center. Before all this could be built, GeoEngineers and KPFF had to help resolve many challenges with the site, including:

- **Electrical infrastructure.** The campus is next to a city substation, so the site and adjacent streets were filled with above- and below-grade electrical circuits. The project required temporary and permanent relocation of both overhead and underground distribution and transmission circuits around the campus. More than a mile of 26-kilovolt and 115-kilovolt power circuits was installed underground during multiple phases of construction.
- **Waste infrastructure.** City and county agencies operate several 100-year old sewers that cross the site. KPFF coordinated the reconstruction of one of the sewers, and GeoEngineers, using sophisticated numerical modeling, monitored another brick sewer 70 feet below grade for "heave" as soil loads were excavated from above.
- **Transportation infrastructure.** When campus design began, two transportation projects that adjoin the campus—a deep-bore tunnel beneath downtown Seattle and a widening of a major downtown arterial—were planned but not designed. The north portal of the tunnel has since been undertaken immediately south of the campus, and the arterial-widening project has been designed and is under construction. Both projects required significant coordination between the campus design team and local and state agencies.
- **Remedial excavation.** More than 100 years of industrial use had left a complex legacy of soil and groundwater contamination at the site, including hydrocarbons, metals and PAHs. GeoEngineers led a detailed identification and segregation process that removed 620,000 tons of contaminated soil from four different source areas at the property without delaying tight construction schedules.
- **Complex shoring.** The excavation required a soldier pile and tieback temporary shoring system using 335 soldier piles and more than 600 tiebacks, extending to depths of 50 feet below grade. GeoEngineers' foundation design was tailored to the variable soil conditions at the site, resulting in a design in which the facilities all bear on cost effective shallow foundations.
- **Below-grade tanks.** Two immense water tanks—one to hold rainwater and the other to optimize cooling—were called for in the sustainable design, and each tank required detailed geotechnical analyses and shoring designs to meet stringent performance requirements.
- **Challenging soils and groundwater.** The site contained highly variable groundwater conditions and compressible fill and clay soils, with co-mingled and extensive contamination to depths of more than 60 feet

Transparency and Integrity

Supporting the Project Vision

From the beginning of this project, the foundation put forth an ambitious vision to create a "hub of innovation" that was rooted in the Northwest U.S. and reflected the foundation's global ambitions. The resulting redevelopment turned a large and little-used brownfield into a thriving campus. The foundation's investment and vision transformed a biotech and health-research hub in the nearby South Lake Union neighborhood.

At this intersection of philanthropy, design and community, engineering played a critical role. The elegant structures and greenscapes that replaced the historic city trolley and bus maintenance facility—and more recent parking lot at this site—**simply could not have been built without the important work GeoEngineers and KPFF completed below the surface**, conducting environmental due diligence, rerouting utilities, protecting existing infrastructure, cleaning up historical contamination, supporting sustainable design features, modeling and designing complex shoring and foundation solutions—and convincing regulatory agencies that all of this would be done while protecting public health and safety.

Helping our client realize their vision by setting the foundation—both literally and figuratively—for this important project was engineering at its best. The redevelopment effort demonstrated that **engineering firms can and should be at the table** helping clients make their most important decisions about siting, environmental sustainability, public-private negotiations and risk. GeoEngineers and KPFF's contributions to the campus project confirm that engineers do more than design structures—they can help clients make a global impact and shape communities.

Client Satisfaction

GeoEngineers and KPFF's successful contributions to the foundation headquarters project grew out of a singular focus on client satisfaction and a comprehensive approach to technical and regulatory challenges. The two companies were fortunate to be involved with the project from the very beginning, working side by side with two dedicated client representatives—Lynn Perkins, the foundation's campus project manager, and Bart Heath, project lead for development manager, Seneca Group.

The completed Thermal Energy Storage (TES) tank

Seneca's role as development manager, according to Heath, was to guide the foundation through a series of very complex site challenges and help identify options and mitigate risks along the way. Delivering on this promise "was all about getting ahead of these issues with state regulators, the City of Seattle and Seattle City Light," said Heath. "There were numerous balls in the air to work through, but nothing got in the way of construction. **With guidance from GeoEngineers and KPFF, we stayed ahead of all these challenges and remained on budget and on schedule**. There were simply no surprises."

Perkins recalled the urgency surrounding the project schedule. "The foundation had gone from 300 to 1,300 people in just a couple of years, and we had eight buses shuttling staff around the city to our various leased offices. And in 2006, Warren Buffett's $37 billion gift to the foundation doubled our project load with one stroke of a pen. We desperately needed a new facility to bring our team together and support our mission."

Reflecting on the eight-year project, Perkins has high praise for GeoEngineers, KPFF and the larger project team. "After eight years and multiple project phases, our staff were able to come together on a wonderful campus that aids and abets the work we do," she said. **"The level of engagement and the respect GeoEngineers and KPFF gave the project was amazing.** It was an inclusive, collaborative, mission-focused team, and there was no question that they gave us the very best of their talents. The whole process was remarkable."

Sustainability and Respect for the Environment

GeoEngineers and KPFF helped the foundation incorporate sustainability and environmental awareness into every aspect of the campus development, from site selection to construction. Highlights include:

- **Site selection central to the foundation's sustainable vision.** In 2004, the holding company that the foundation created to select and develop its campus asked GeoEngineers to assess potential risks associated with six different properties being considered as the headquarters site. GeoEngineers undertook a thorough review of the parcels, weighing geological and geotechnical factors, critical-area considerations and potential environmental risks. GeoEngineers' analysis gave the foundation the confidence to purchase this urban site over other "greenfield" sites knowing that its many environmental issues could be resolved.
- **Reducing and reusing rainwater runoff.** Rainwater not absorbed by the campus' extensive green roofs and other permeable surfaces is collected in a one million-gallon, below-grade tank that supplies water for flushing toilets, site irrigation and water features. KPFF integrated the tank into its site stormwater strategy and helped site the tank relative to constraints and underlying infrastructure. GeoEngineers developed foundation solutions for the tank that limited settlements and protected the storm sewer below.
- **Design features support energy efficiency.** The 750,000 gallon TES water storage system minimizes energy used to cool buildings by chilling stored water at night for recirculation during the day. Using air-cooled chillers saves more than three million gallons of potable water each year. See *Thermal Energy Storage tank design* (above) for more detail on our technical contributions to this aspect of the project.
- **Environmental solutions return site to full use and protect the public.** In addition to identifying and mitigating 620,000 tons of contaminated soil, GeoEngineers designed and obtained regulatory approval for a chemical vapor barrier (see *Environmental Barrier* above) and protective cap in areas where residual contaminated soil remained outside the construction footprint. The Washington State Department of Ecology praised GeoEngineers' remediation plans, which the agency called among the most significant ever completed in the state.
- **LEED© goals achieved.** The foundation campus received LEED©-NC (Leadership in Energy and Environmental Design for New Construction) Platinum certification from the United Stated Green Building Council, and is the largest, non-profit LEED©-NC Platinum building in the world.
- **Economic ripple effect.** The project reclaimed and redeveloped urban land for uses that enhance and engage the neighborhood and maximize existing infrastructure. More than $2 billion in investment occurred in South Lake Union after the foundation committed to the location, thereby energizing both the neighborhood and the city.