STAFF REPORT

TO: Council **MEETING DATE:** July 31, 2017

FROM: Andre Boel, Director of Planning
Dave Newman, Director of Engineering **FILE NO:** 3220-20-Gower-377-385

SUBJECT: **Geotechnical and Aquifer review results George Hotel**

RECOMMENDATION(S)

THAT staff's report regarding Geotechnical and Aquifer review results George Hotel be received;

SUMMARY

The location of the George Hotel and Residences project (the George) sits above the sensitive areas of the Gibsons Aquifer that extend throughout the Harbour Area. Throughout 2014 and 2015, during the rezoning process, an extensive geotechnical and hydrogeological review began to evaluate how the foundation of the buildings could be safely constructed. This review was conducted by experts for the George and peer reviewed by independent experts retained by the Town. The process resulted in design changes that included raising the foundations and identifying maximum excavation depths. The Town determined that additional information and investigation would be required before a Building Permit could be issued. This agreement was formalized in the Development Agreement of October 2015 (CA4741913).

Throughout 2016 and 2017 further investigations and peer review continued in an iterative process. This process is now substantially complete and has resulted in a plan for ground improvement that protects the aquifer and provides the basis for the construction of the George. The type of ground improvement is called Deep Mixing and it involves mixing existing soils with grout to create a firm bearing layer. Despite what the name suggests (Deep Mixing), mixing at the George site will actually remain rather shallow, will stay within the layers that lie above the aquifer itself and will be done predominantly in-situ, minimizing the need for excavation. The ground improvement will take place in small increments while extensive monitoring takes place to minimize the depth and to be able to customize the mixing to varying site conditions.

Now that the plan has been finalized and the peer review substantially completed, the George is finalizing the reports and designs as required for the geotechnical and aquifer Development Permits and Building Permit. As per current bylaws, staff will finalize the permits once all the necessary information has been provided and reviewed. A copy of the final Geotechnical Investigation Report will be made available once received and reviewed by staff. The Deep Mixing process itself will start after site remediation (2 – 4 months, see separate staff report) and takes approximately 2 – 4 months, followed by an estimated 26 – 30 month construction process for the remainder of the project. If started this summer as planned, the George could be completed by summer 2020.

PURPOSE

To brief Council on the results of the geotechnical investigations and peer review regarding aquifer protection for the George Hotel and Residences project. Staff is providing this briefing in conjunction with a report regarding site contamination and the proposed remediation for the site.

DISCUSSION

2015: foundation elevated to increase distance from aquifer

Earlier in the process, investigations showed that the initial proposed foundation needed to be raised to maintain more vertical distance to the aquifer layers. With this in mind, the plans were updated by raising the foundations and identifying maximum excavation depths. This was reported on to Council on May 12, 2015.

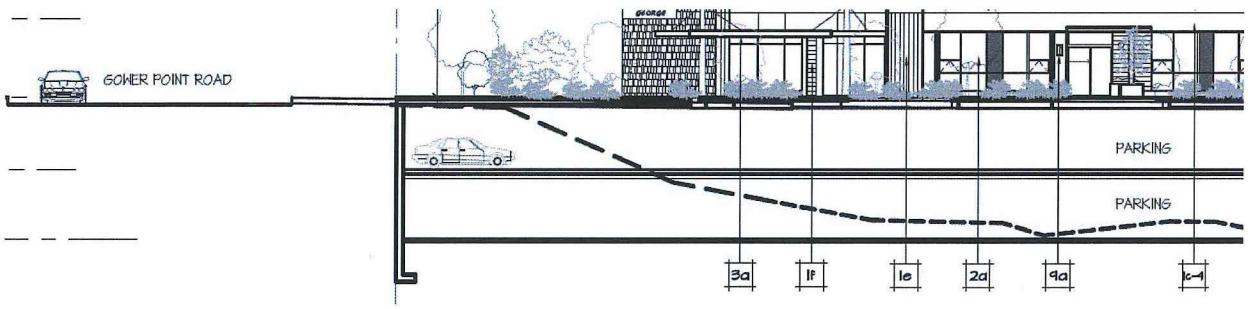

Figure 1: 2014 initial design: two layers of parking below Gower Point Road (drawing 4.0.3.)

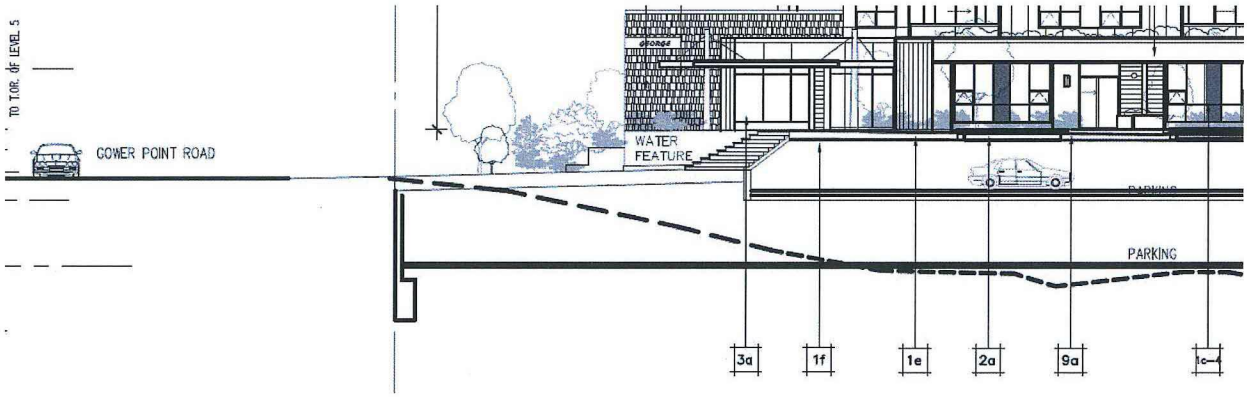

Figure 2: 2015 updated design: 1 layer of parking below Gower Point Road (drawing 4.0.3.)

2016: further investigations by the George

After the rezoning process the George commissioned additional field investigations. Through various drilling and sampling, more information was collected regarding site conditions and the presence of contaminants. The results confirmed earlier findings that conditions at the site are highly variable.

Based on the additional information, the George updated the geotechnical report and proposed construction methods, identifying Deep Mixing as the preferred technique to create appropriate bearing for the buildings. Documentation in support of this was provided at the end of 2016 and forwarded to the Town's experts for peer review.

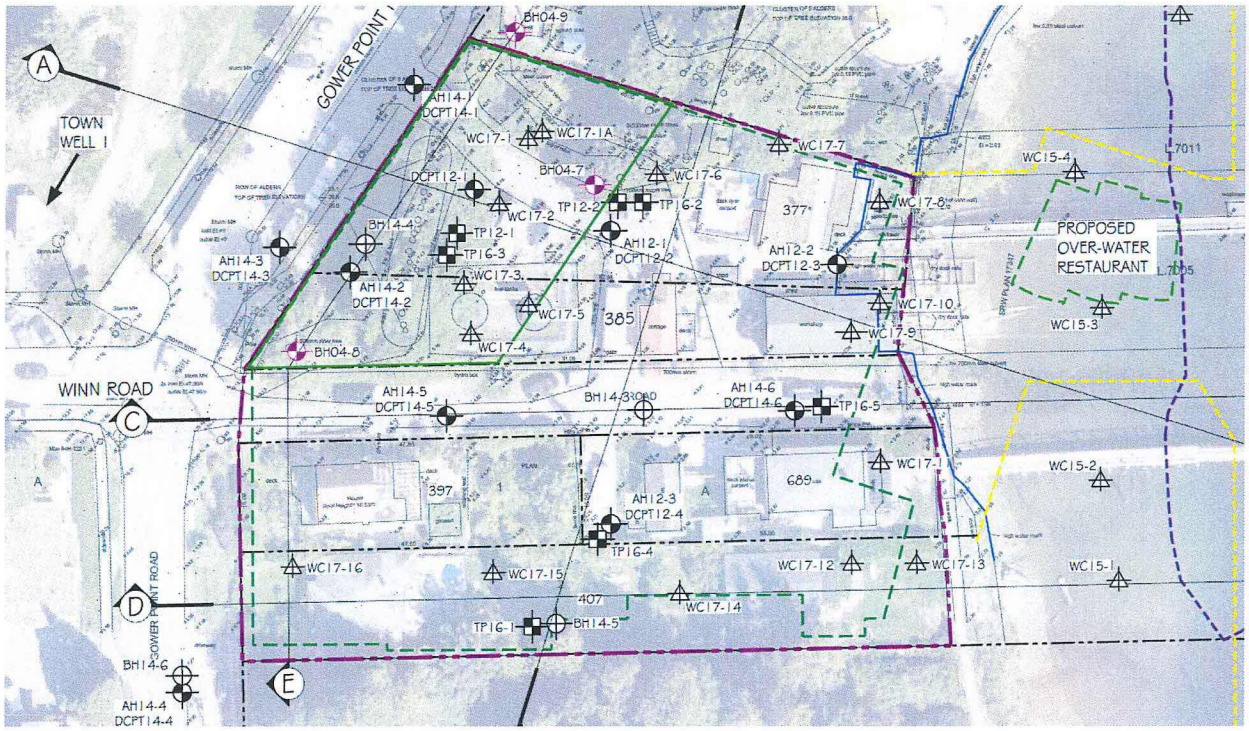

Figure 3. Overview test locations for geotechnical investigations 2012-2017 (Draft Geotechnical Investigation Report, Horizon Engineering Inc. 2017)

2017: peer review results from Town experts

The Town's peer review experts at the start of 2017 were Waterline and WSP (formerly Levelton). Waterline is the Town's specialist for hydrogeological (aquifer related) matters. WSP is an engineering firm and reviewed the geotechnical work done by Horizon Engineering (Horizon), the George's geotechnical engineering firm. The cost of peer review by the Town's experts were re-billed to, and paid for by the George.

The peer reviewers supported the efforts to collect additional information and a number of items identified earlier were addressed through the process. However, a major question remained regarding the protection of the Gibsons Aquifer if a Deep Mixing method was to be employed. Staff and peer reviewers needed to be satisfied that the Deep Mixing would not adversely affect the aquifer or the aquitard.

Further information was provided by the George regarding the proposed Deep Mixing method in order to clarify the process and how risks would be managed. However, due to unfamiliarity with Deep Mixing, the Town's peer reviewers were unable to endorse the conclusions arrived at by Horizon and instead recommended that additional expertise be sought to specifically evaluate the application of Deep Mixing for the George site.

2017: Deep Mixing expertise for the George and for the Town

In response to the remaining concerns of the peer reviewers the Town selected Dr. Donald Bruce from Geosystems, L.P. to continue the peer review with a focus on the Deep Mixing. Dr. Bruce, based in the United States, is a Civil Engineer and Geotechnical Engineer with extensive experience in Deep Mixing / ground improvement.

> *Dr. Bruce formed Geosystems, L.P. and continues to act as President. Geosystems L.P. offers advisory services in the practical and business aspects of specialty geotechnical construction, with a focus on drilling and grouting techniques, anchors, micropiles, deep mixing, cut offs, and in situ reinforcement. The scope of services includes all phases of projects from feasibility assessments to expert witness duties. Dr. Bruce is a member of numerous Boards of Consultants for major projects in North America and elsewhere. Dr. Bruce continues to teach at short courses, seminars, universities and conferences both throughout North America and worldwide, and is active in many national and international technical societies and committees. He also acts as FHWA Principal Investigator for Micropiles and Deep Mixing. (from* **www.geosystemsbruce.com***)*

In addition, the Town required the George to add additional expertise on their design team, specifically for the aspect of Deep Mixing ground improvement. At the Town's request, Dr. Bruce provided a list of qualified professionals with significant experience in Deep Mixing. From this list the George selected Isherwood Geostructural Engineers (Isherwood) an engineering firm based in Vancouver, specialized in ground improvements to join their team.

Based on the input from Dr. Bruce and Isherwood, the George provided additional details for Deep Mixing and also developed a more detailed risk assessment contingency plan. Following an iterative process throughout the spring of 2017 the current proposal for ground improvements at the George site was developed to the satisfaction of both the George team and the Town team.

Outline of proposed Deep Mixing method

There are a range of methods of conducting Deep Mixing, as well as a variety in the types of equipment that contractors use. Through the professional advice and direction from Isherwood for the George and Dr. Bruce for the Town it has become clear what types of Deep Mixing are feasible for the site.

Given that the Gibsons Aquifer is the Town's main drinking water supply, only the most precise and conservative methods of Deep Mixing will be permitted for the George. Horizon and Isherwood have identified methods that have a high accuracy and are combined with an extensive on-site monitoring. Also, a field trial will be held before the actual ground improvement process will start.

The Deep Mixing for the George involves a step by step approach that eventually will cover the footprint of the buildings with improved soils. For each section that has been identified for Deep Mixing treatment, the existing soil (after removal of contaminated materials) is mixed in place with grout to ensure a mix that will cure to the required strength to support the foundation. This mix is expected to cure within a day or two before any adjacent areas are mixed. Horizon Engineering and Isherwood Geostructural Engineers will be responsible for on-going on-site monitoring and supervision of the Deep Mixing process.

Contingency planning for Deep Mixing

Site conditions are known to be variable. Due to the raised foundation level, the technique of shallow ground improvement and extensive monitoring during the work, the risk to the covering layer and the Gibsons Aquifer beneath it is low. However, in order to be fully prepared for eventualities, the Town has insisted on a contingency plan that allows for an immediate and effective response in the case of complications during the ground improvement process.

Key components of the contingency plan are:

- Constant monitoring by qualified experts (Horizon/Isherwood)
- The stand-by availability on-site of equipment to respond to any issues should they arise.

The worst-case scenario for the aquifer involves a disturbance (potential ground heaving in the north west or southwest areas) or a breach (potential waterflow to the surface in the central and east areas). Depending on the situation backfilling would address the issue. In case of a breach, the contingency plan outlines that temporary wells will be drilled in order to locally reduce the pressure of the aquifer to low enough levels so that the leak can be repaired. Once it has been verified that the repair is successful, the temporary wells would be removed, the localized reduced aquifer levels would be allowed to raise back to their normal levels and the ground improvement process would resume.

Relation to site contamination

Staff has provided a separate report regarding site contamination. The pollutants on site and in the foreshore area are limited to shallow depths. A Detailed Site Investigation found that the Gibsons Aquifer groundwater has not been affected. The remediation plan, which has now been approved by the Ministry of Environment, outlines the excavation of all contaminated materials prior to the start of the Deep Mixing process. All contaminated materials will be removed from site and transported to authorized dumping sites.

COMMUNICATION

Given the level of interest within the community, staff will ensure that Development Permits and the final geotechnical report will be posted on the website. Council will be notified when this is complete.

In addition, a third whiteboard video is being prepared that summarizes the results of the geotechnical review and peer review process. This video will be promoted through social media as another tool to inform the public about the review process and results.

For the upcoming construction phase of the project staff will provide regular updates on the site activities through the George page on the Town's website, through Facebook and by requiring on-site informational signage.

PLAN/POLICY IMPLICATIONS

Official Community Plan Implications

Geotechnical Hazards and Aquifer Protection guidelines apply to certain new development as outlined in the OCP's Development Permit Areas #1 and #9. The George information has been reviewed on the guidelines. The issuance of these permits has been delegated to staff (Director of Planning for geotechnical hazards and Director of Engineering for aquifer protection) as per the Development Permit Delegation Authority Bylaw No. 1054, 2007. Based on the current information for the George, staff anticipate that both Development Permits will be issued in August of this year.

RECOMMENDATIONS / ALTERNATIVES

This report is for Council's information only. On page 1, staff recommend receipt of the report.

Respectfully Submitted,

André Boel, RPP
Director of Planning

Dave Newman, AScT
Director of Engineering

CHIEF ADMINISTRATIVE OFFICER'S COMMENTS:

I have reviewed the report and support the recommendation(s).

Emanuel Machado
Chief Administrative Officer