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April 9, 2025
1578-24-002

Town of Gibsons
474 South Fletcher Rd Box 340
Gibsons, BC V0N1V0

Attention: Michelle Lewis, Natural Asset Technician (Infrastructure Services Department)

Dear Ms. Lewis,

RE: Town of Gibsons - 2024 Leapfrog Works Geological Model Update, Revision 1

1.0 INTRODUCTION

1.1 Background

The Town of Gibsons (the Town) has completed extensive well drilling, geological mapping, and geophysical investigations across the Charman Creek, Chaster Creek, Gibson Creek and Soames Creek watersheds, which define the Source to Sea Project Area (Project area; Figure 1). Hydrogeological conditions for the Project Area are summarized in the following reports:

- The 2013 *Aquifer Mapping Study* completed by Waterline Resources Inc. (Waterline; 2013), characterizing the provincially mapped Aquifer 560 (Hammond et al., 2019; Figure 2). Using the three-dimensional (3D) Leapfrog Works geological modelling software, the aquifer was mapped as a single water bearing unit across the Project Area.
- The 2021 *Aquifer Mapping Study Update* (Waterline, 2022), which characterized Aquifer 560 as a composite of three aquifer “lobes” based on updates to the 3D Leapfrog Works geological model. It was determined that fluvial channel deposits within a central basin beneath the Town formed the “Gibsons Aquifer Lobe” of Aquifer 560. Similar fluvial channel deposits were mapped beneath the Chaster Creek watershed, creating the “Elphinstone Aquifer Lobe” to the west, and beneath the Soames Creek watershed, creating the “Soames Aquifer Lobe” to the east.

As the Town obtains all its potable water from the Gibsons Aquifer Lobe, this portion of Aquifer 560 is a natural asset requiring careful management and maintenance for proper functioning of the Town water supply system. As such, the Town has adopted regulations to protect the aquifer from potential impacts that could influence the groundwater quality and deliverability of the water supply. Groundwater monitoring and aquifer protection objectives were developed and are summarized in the Town’s *Official Community Plan* (OCP; ToG, 2015), and more specifically, the Town’s

Development Permit Area No. 9 (DPA 9; ToG, 2015). The DPA 9 protects Aquifer 560 from land use development that could impact the groundwater quantity or quality, by requiring a review of hydrogeological conditions be completed prior to starting any development activities. Any subsurface investigations or drilling activities are regulated through the Town's *Water Regulation Bylaw No. 1192* (ToG, 2018).

Since the last 3D Leapfrog Works geological model update in 2021, new well drilling and shallow subsurface investigations were completed across the Project Area. In 2024, groundwater level data for Aquifer 560 was monitored at well locations across the three aquifer lobes (Figure 2).

1.2 Objective and Scope of Work

To improve/update aquifer protection measures for Aquifer 560 and further define the interconnection of the three aquifer lobes, the Town retained Waterline to update the 3D Leapfrog Works geological model for the Project Area, with a focus on re-defining the model domain. The work performed by Waterline included the following tasks:

- Compiling and reviewing new well drilling and subsurface investigation data for the Project Area, collected between 2021 and 2024 from public and private data sources;
- Integrating the subsurface investigation data into the 3D Leapfrog Works geological model for the Project Area, including expanding the model domain to encompass the entire mapped area of Aquifer 560;
- Creating new model outputs for the Project Area, including interpreted boundaries for the different aquifer lobes of Aquifer 560, and a piezometric surface contour map of the groundwater elevation across Aquifer 560; and,
- Summarizing the work completed, including the methods used to update the 3D Leapfrog Works geological model for the Project Area, the new geological model interpretations, and comments on potential improvements for protection of Aquifer 560.

2.0 METHODOLOGY

2.1 Updates to the Geological Model Conditions

In 2024, the Town's 3D Leapfrog Works geological model was upgraded to the Leapfrog Works software Version 2024.1. The model domain was updated (Figure 2) with new Light Detection and Ranging (LiDar) data provided by the Sunshine Coast Conservation Association (SCCA; Eagle Mapping, 2023) and acquired from LidarBC (BC Government, 2019).

The existing geological mapping data and stratigraphic relationships, developed during the aquifer mapping study update in 2021, were reused. New geological information from numerous subsurface investigations completed since 2021 were integrated into the 2024 model. In total, the upgraded model now contains 461 data locations, of which 39 are new data locations added during the 2024 update (Figure 3). The new data location information was acquired from the following three data sources:

1. The Town's DPA 9 approved projects. Data source references and data locations are listed in Table A1 of Appendix A.
2. Project data from external consultants, including Waterline and Arya Engineering Inc. (Arya). Data source references and data locations are also listed in Table A1.
3. The BC Ministry of Environment's (ENV) Groundwater Wells and Aquifers database (GWELLS; ENV, 2024). New well information from GWELLS is summarized in Table A2.

Geological interpretations for existing data locations were reviewed where the subsurface investigations extended into Aquifer 560. Surficial mapping data from the *Surficial Geology and Sand and Gravel Deposits of the Sunshine Coast* study (McCammon, 1977) was digitized for the Project Area and incorporated into the model to help constrain geological relationships in areas where little ground truthing was available.

2.2 Updates to the Groundwater Conditions

The Town has 12 groundwater wells completed in Aquifer 560, of which four are active water supply wells (WSWs; Figure 2). Adjacent to the Town, the Sunshine Coast Regional District (SCRD) operates and maintains 11 groundwater wells completed in Aquifer 560, of which four are WSWs (Figure 2). ENV has two observation wells (OW), OW497 and OW460, completed in Aquifer 560 (Figure 2), which are part of the Provincial Groundwater Observation Well Network (PGOWN). These 25 groundwater monitoring data points are completed across Aquifer 560 and at varying elevations within the watersheds.

Groundwater levels measured by the Town, SCRD and ENV are part of ongoing monitoring of aquifer conditions and were reviewed by Waterline as part of the 3D Leapfrog Works geological model update. Data from groundwater monitoring data points with non-pumping groundwater levels (21 of the 25 wells) was compiled and georeferenced in the model (see Table B1; Appendix B), providing a "snapshot" of piezometric head elevation across Aquifer 560.

In areas with limited available groundwater level data along the shoreline, Waterline assigned a "zero" groundwater elevation boundary, helping constrain the groundwater flow direction, which is gravity drained and follows surface topography.

3.0 RESULTS AND DISCUSSION

3.1 Geological Conditions

Using the geological data from new subsurface investigations and the reinterpretations of geological data from existing locations, updates were made to the thickness and distribution of the stratigraphic units, which were validated through an iterative process of reviewing the new model outputs against historical interpretations and regional scale geological mapping.

The geological descriptions from individual data locations were kept consistent with the 2021 model (Waterline, 2022), standardized into the following stratigraphically recognized units (Figure 4). From oldest to youngest or deeper to shallower are:

1. Bedrock (sedimentary and intrusive rocks),
2. The pre-Vashon formation (Aquifer 560),
3. The Vashon till formation (Aquitard 560), and
4. The Capilano formation (Unconfined Aquifer/Aquitard System).

The following changes were made to the 3D Leapfrog Works geological model based on the updates performed:

- The upper extent of the Vashon till formation along the southern slopes of Mount Elphinstone was truncated at an elevation of 300 to 400 meters above sea level (masl), using the surficial deposits mapping. This was previously not considered in the model domain, which is now validating the depositional environment of interglacial and postglacial processes operating during the last 30,000 years (Waterline, 2022). It should be noted that Capilano and Vashon units remained unchanged at lower elevations in the model.
- The extent and thickness of the pre-Vashon formation was refined, further distinguishing the three aquifer lobes as follows:
 - Due to the addition of several deeper wells, including OW 497, the Elphinstone Aquifer Lobe now extends northwest along the shoreline and inland towards higher elevations of the Chaster Creek watershed area (Figure 5). The Elphinstone Aquifer Lobe is separated from the Gibsons Aquifer Lobe by several bedrock “highs” (Figure 4);
 - Several wells east of the Town boundary were reinterpreted, resulting in a more realistic distribution of pre-Vashon sediments. The Gibsons Aquifer Lobe now thins to less than 3 metres (m) thick near Gibson Creek, better defining the eastern boundary (Figure 5); and
 - With recent well drilling by the SCR D, newly identified private well locations and reinterpretation of existing data locations, the Soames Aquifer Lobe now extends more inland of the shoreline, paralleling the Soames Creek watershed valley (Figure 5). The aquifer lobe “fans” outward at lower watershed elevations, constrained in the east and west by the Soames Creek and Gibson Creek watershed divides, respectively. These changes support the notion that the Soames Aquifer Lobe may still share a common recharge area with the Gibsons Aquifer Lobe at higher elevations but is hydraulically disconnected at lower elevations (Waterline, 2022).

3.2 Groundwater Flow Conditions

A piezometric surface contour map for Aquifer 560 was created using non-pumping groundwater elevations from 20 groundwater monitoring data points, measured on or calculated for September 10 and 11, 2024 (Figure 6); the contour map excludes the 901 Sentinel Road Well water level. The horizontal groundwater gradient across Aquifer 560 has a shallower slope for inland areas of the

aquifer (Upper Gibsons), which steepens toward the shoreline (Lower Gibsons), as the aquifer becomes confined and is pressurized (Figure 6).

A northwest to southeast (A to A') hydrogeological cross-section was created parallel to Gibsons Aquifer Lobe (Figure 7); the cross-section trace is shown on Figure 6. In viewing the piezometric surface from Upper (School Board Well) to Lower Gibsons (TW3), it is possible to see that the groundwater level is deep, with part of the Gibsons Aquifer Lobe being unsaturated (Figure 7). In Lower Gibsons, the Gibsons Aquifer Lobe exhibits artesian conditions, as the groundwater elevation exceeds the elevation of the pre-Vashon formation (Figure 7). Flowing artesian conditions are observed closer to the shoreline when topography flattens out and the piezometric surface exceeds the ground elevation (see inset map; Figure 6).

Groundwater within Aquifer 560 does not appear to be discharging to the ocean, based on:

- Measured groundwater pressure from drilling, both on land and in the Gibsons Harbour;
- The minor response to tidal fluctuation in adjacent wells; and
- The absence of freshening of sea water in the Gibsons Harbour, as delineated by offshore electrical conductivity readings measured from a boat.

Therefore, Aquifer 560 is modelled as having a constant head boundary near the shoreline.

A depth to groundwater map (Figure 8), generated inside the Town's municipal boundary, shows the difference between the ground elevation and the piezometric surface elevation for the Gibsons Aquifer Lobe. The aquifer pressure is modelled as exceeding the ground surface (0 m Contour) below South Flecher Road in Lower Gibsons (Figure 8). Flowing artesian conditions are also expected past the shoreline and into the Gibsons Harbour. As such, any activity involving subsurface works in Lower Gibsons has the potential to cause depressurization of the Gibsons Aquifer Lobe, if the overlying aquitard (Vashon till) is penetrated without the proper mitigation measures. Conversely, in Upper Gibsons, the depth to groundwater is >40 metres below ground level (mbgl), reaching depths >110 mbgl (Figure 8).

It should be noted that flowing artesian conditions also exist elsewhere along the coastline, for example, the Soames Point area has flowing artesian conditions in the vicinity of Soames Creek, (see inset map; Figure 6).

For enforcement of the Town's protectionary measures under Bylaw 1192, the DPA 9 Lower Gibsons Subarea (DPA 9 Subarea) was created, which includes the areas where the Gibsons Aquifer Lobe could exhibit flowing artesian conditions and a buffer zone, to account for data gaps and uncertainty (ToG, 2015).

4.0 DATA GAPS

The 3D Leapfrog Works geological model for the Project Area is calibrated based on available data points, and therefore, in areas with only shallow subsurface investigations and/or no data, the model is making large interpretations on the extent and thickness of the various geological units,

specifically the pre-Vashon formation. This is similar for the piezometric surface contour map, which requires sufficient groundwater level data, proportionally spaced across Aquifer 560, to produce realistic piezometric contours. Although the new data included in the 2024 update has improved our understanding of the aquifer lobes and groundwater elevations across Aquifer 560, data gaps still exist, including:

- Delineation of the pre-Vashon formation between the Soames and Gibsons Aquifer Lobes, as this area of the model has limited deep well drilling data;
- Delineation of the pre-Vashon formation near the northern extent of the Elphinstone Aquifer Lobe (around Oceanview Drive) and near the shoreline (along Gower Point Road), as these areas also have limited well drilling data;
- Delineation of the pre-Vashon formation in Lower Gibsons around Charman Creek and Goosebird Creek (Figure 2), where the Gibsons Aquifer Lobe has been delineated but could use additional refinement. This area is known to experience flowing artesian conditions, and as such, determining the aquifer extent will be important to further refine the DPA 9 Lower Gibsons Subarea; and,
- Groundwater monitoring locations across the Elphinstone Aquifer Lobe, where the interpretation of the piezometric surface contours is limited, specifically at lower elevations of the aquifer near the shoreline.

5.0 CONCLUSIONS AND RECOMMENDATIONS

In 2024, the 3D Leapfrog Works geological model for the Project Area was updated to encompass a larger model domain. New geological data collected by the Town, external consultants, and ENV was integrated into the model, reusing the existing geological data and stratigraphic relationships developed during the 2013 aquifer mapping study and 2021 update. Static groundwater levels measured at active monitoring wells completed in Aquifer 560 were georeferenced in the model, providing a “snapshot” of piezometric head elevation across the three aquifer lobes.

Updating the model was an iterative process. Using surficial deposits mapping resulted in a more realistic distribution of the Vashon till at a higher elevation in the Project Area. The extent and thickness of the pre-Vashon was improved for the Elphinstone and Soames Aquifer Lobes, due to increased well distribution. In both areas, the pre-Vashon now extends inland parallelling the watershed boundaries. Furthermore, the boundary between the Gibsons and Soames Aquifer Lobes has been interpreted to thin near Gibson Creek, supporting the interpretation that Aquifer 560 is disconnected across watershed boundaries.

A new piezometric surface contour map was generated across all three aquifer lobes of Aquifer 560. The groundwater flow direction follows topography, with the groundwater gradient steepening near the shoreline as the aquifer becomes pressurized and models as a confined system. The modelled depth to groundwater for the Gibsons Aquifer Lobe within the Town boundary shows that the groundwater pressure is equal to or exceeds the ground surface elevation in Lower Gibsons and exhibits flowing artesian conditions.

Currently, the DPA 9 Lower Gibsons Subarea depicts the high-risk area for development, where flowing artesian conditions could be encountered. Thus, the Town's bylaws are accurately being applied, helping reduce the risk from loss of water quantity and degradation of water quality due to potential uncontrolled flow from artesian conditions.

To continue improving the 3D Leapfrog Works geological model for the Project Area, Waterline recommends that the Town:

- Continue collecting and compiling hydrogeological data for any development projects within the Town boundary.
- Drill additional exploration boreholes near the Charman Creek and Goosebird Creek areas. If there is the ability to combine this drilling with other geotechnical, infrastructure or environmental studies, Waterline would provide alternative recommendations for subsurface investigations.
- Continue engaging with the SCRDR, sharing the groundwater level monitoring data for wells completed in Aquifer 560.

6.0 CERTIFICATION

This document was prepared under the direction of a professional geoscientist registered in the Province of British Columbia.

Waterline Resources Inc. trusts that the information provided in this document is sufficient for your requirements. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Respectfully submitted,

Waterline Resources Inc.
EGBC Permit No. 1000669

Reviewed By:

Original Signed

Original Signed

Caleb Isaac, B.Sc., G.I.T.
Project Scientist

Jolene Hermanson, M.Sc., P.Geo.
Senior Hydrogeologist

Original Signed and Stamped

Simon Wing, B.Sc., P.Geo.
Senior Hydrogeologist



7.0 REFERENCES

British Columbia Ministry of Environment Protection and Sustainability (ENV), 2024. Groundwater Wells and Aquifers database (GWELLS). Accessed November 2024. <https://apps.nrs.gov.bc.ca/gwells>.

Eagle Mapping, 2023. West Howe Sound Watershed Report. Submitted to Sunshine Coast Conservation Association (SCCA).

Government of British Columbia (BC Government), 2019. LidarBC. Accessed December 2024. <https://lidar.gov.bc.ca/pages/download-discovery>

Hammond, Z., Hinnell, A., 2019. Aquifer Mapping Report: Aquifer 560. Prepared for the Ministry of Environment and Climate Change Strategy, March 3, 2020.

McCammom, J.W., 1977. Surficial geology and sand and gravel deposits of Sunshine Coast, Powell River; Campbell River areas; BC Department of Mines and Petroleum Resources, Bulletin 65.

Town of Gibsons (ToG), 2018. Water Regulation Bylaw No. 1192, 2014. Adopted: February 4, 2014. Consolidated for convenience October 2018.

Town of Gibsons (ToG), 2015. SMART PLAN – Gibsons Official Community Plan (Schedule A: "Town of Gibsons Official Community Plan Bylaw No. 985, 2005"). Published for the Town of Gibsons March 2015.

Waterline Resources Inc., 2022. Aquifer Mapping Study Update – Re-evaluation of the Groundwater Use Scenarios. Submitted to Town of Gibsons May 30, 2022.

Waterline Resources Inc., 2013. Aquifer Mapping Study Town of Gibsons British Columbia. Submitted to the Town of Gibsons May 13, 2013.

8.0 LIMITATIONS AND USE

The information presented in this document was compiled exclusively for the Town of Gibsons (the Client) by Waterline Resources Inc. (Waterline). This work was completed in accordance with the scope of work for this project that was agreed between Waterline and the Client. Waterline exercised reasonable skill, care, and diligence to assess the information acquired during the preparation of this document but makes no guarantees or warranties as to the accuracy or completeness of this information. The information contained in this document is based upon, and limited by, the circumstances and conditions acknowledged herein, and upon information available at the time of the preparation of this document. Any information provided by others is believed to be accurate but cannot be guaranteed. No other warranty, expressed or implied, is made as to the professional services provided to the Client.

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FIGURES

Figure 1: Location and Watersheds Map

Figure 2: Aquifer 560 and Groundwater Monitoring Location Map

Figure 3: Data Locations for Geologic Model Update

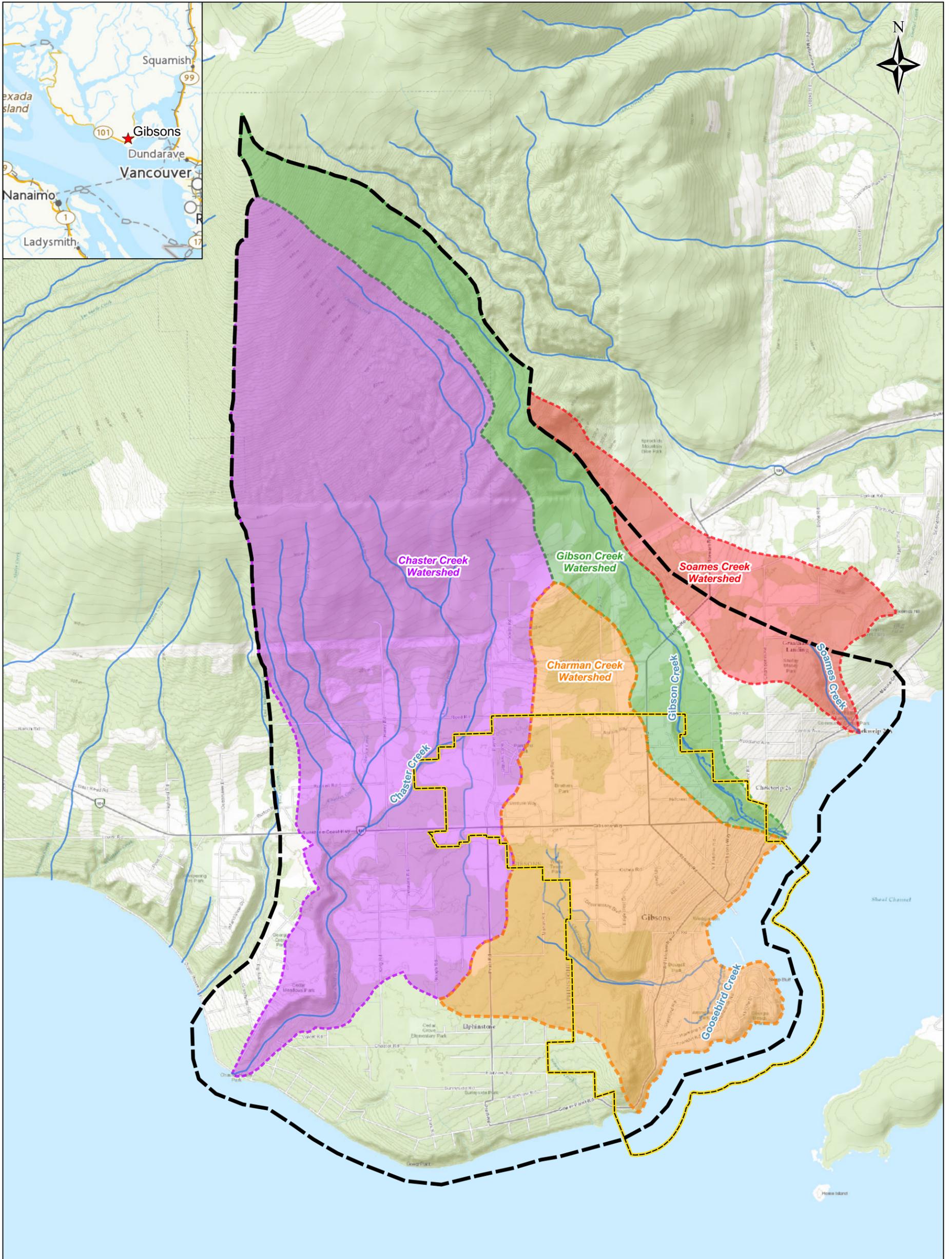
Figure 4: Glacial History and Stratigraphic Sequence

Figure 5: Identified Lobes of Aquifer 560

Figure 6: Piezometric Surface Contour Map for Aquifer 560

Figure 7: Hydrogeological Cross Section A-A' (Northwest to Southeast)

Figure 8: Modelled Depth to Groundwater for Aquifer 560 within the Town of Gibsons



0 250 500 750 1,000 metres

Coordinate System: NAD83 / UTM zone 10N

-  Watercourse
-  Town of Gibsons Municipal Boundary
-  Source to Sea Project Area
-  Charman Creek Watershed
-  Chaster Creek Watershed
-  Gibson Creek Watershed
-  Soames Creek Watershed

References:

Freshwater Atlas Named Watersheds (2022), Town of Gibsons (2022), Urban Systems (2021), Canada Base Map - Transportation (WMS), Esri World Topo Map (WMS)

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**2024 Leapfrog Geologic Model Update
Gibsons, British Columbia
Submitted to the Town of Gibsons**

LOCATION AND WATERSHEDS MAP



Prepared By: Waterline Resources Inc.
Project Number: 1578-24-002
Compiled By: mwine
Date Issued: 2025-Mar-05
Date Revised: --

FIGURE 1



- Provincial Observation Well
- Town of Gibsons Monitoring Well
- Town of Gibsons Water Supply Well
- Sunshine Coast Regional District Monitoring Well
- Sunshine Coast Regional District Water Supply Well
- Town of Gibsons Municipal Boundary
- Source to Sea Project Area
- Aquifer 560
- New Model Domain Extents for Source to Sea Project Area
- Creek

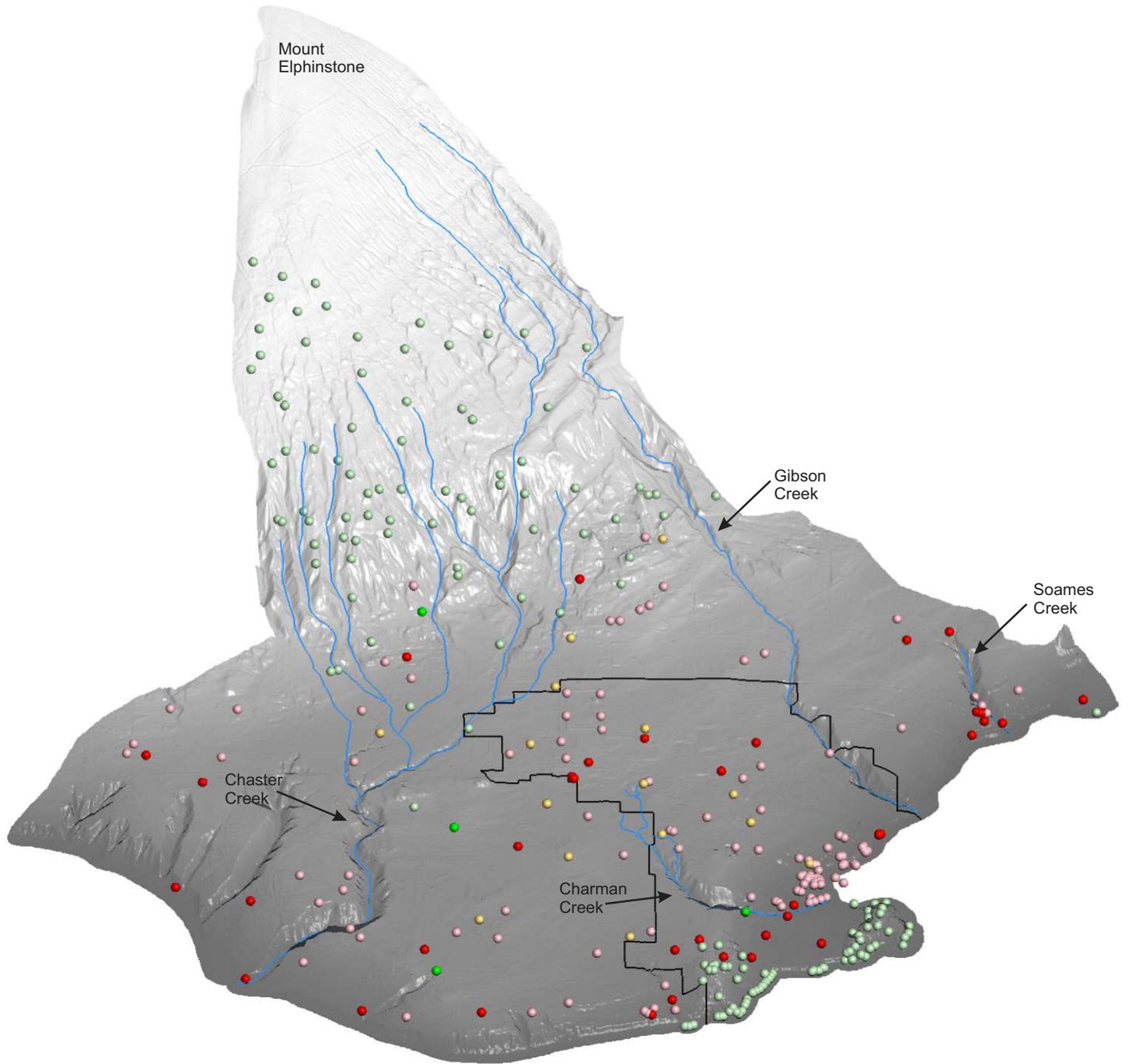


0 0.5 1 1.5 2 km

Coordinate System: NAD83 / UTM zone 10N

References:
 Urban Systems (2016), Esri World Imagery (WMS).
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2024 Leapfrog Geologic Model Update Gibsons, British Columbia Submitted to the Town of Gibsons						
AQUIFER 560 AND GROUNDWATER MONITORING LOCATION MAP						
	FIGURE 2					
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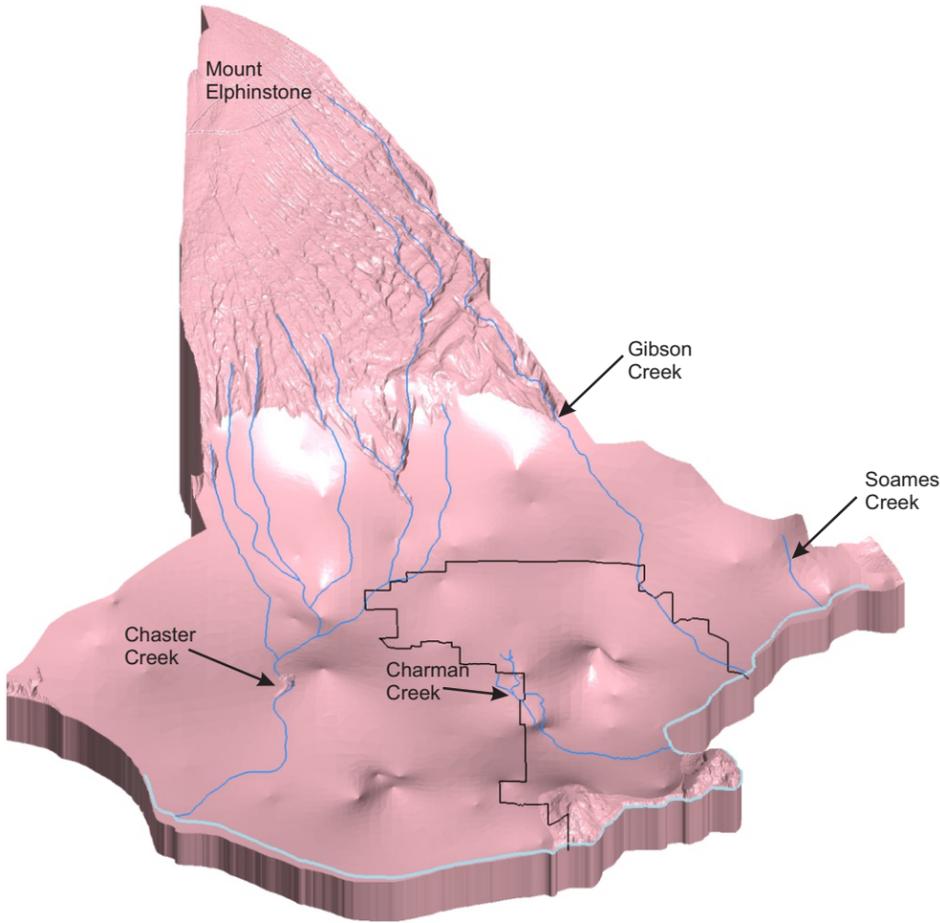
- Existing Data - Field Survey
- New Data (2024) - Field Survey
- Existing Data - Sub Surface
- New Data (2024) - Sub Surface
- Existing Data - Geophysics
- Creek
- Town of Gibsons Municipal Boundary

References: Town of Gibsons (2016, 2021).

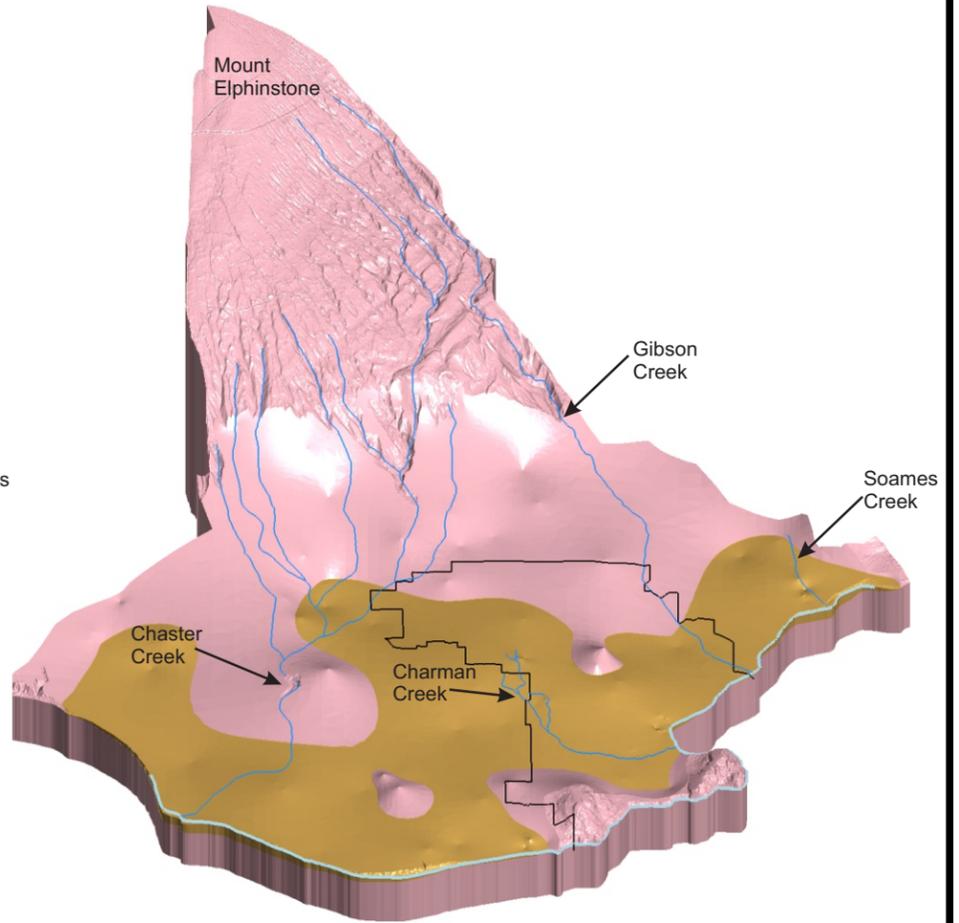
2024 Leapfrog Geologic Model Update Gibsons, British Columbia Submitted to the Town of Gibsons						
DATA LOCATIONS FOR GEOLOGIC MODEL UPDATE						
<table border="1" style="width: 100%; border-collapse: collapse;"><tr><td style="font-size: small;">PREPARED BY: Waterline Resources Inc.</td></tr><tr><td style="font-size: small;">PROJECT: 1578-24-002</td></tr><tr><td style="font-size: small;">COMPILED BY: mwine</td></tr><tr><td style="font-size: small;">DATE ISSUED: March 2025</td></tr><tr><td style="font-size: small;">REVISED: --</td></tr></table>	PREPARED BY: Waterline Resources Inc.	PROJECT: 1578-24-002	COMPILED BY: mwine	DATE ISSUED: March 2025	REVISED: --	FIGURE 3
PREPARED BY: Waterline Resources Inc.						
PROJECT: 1578-24-002						
COMPILED BY: mwine						
DATE ISSUED: March 2025						
REVISED: --						



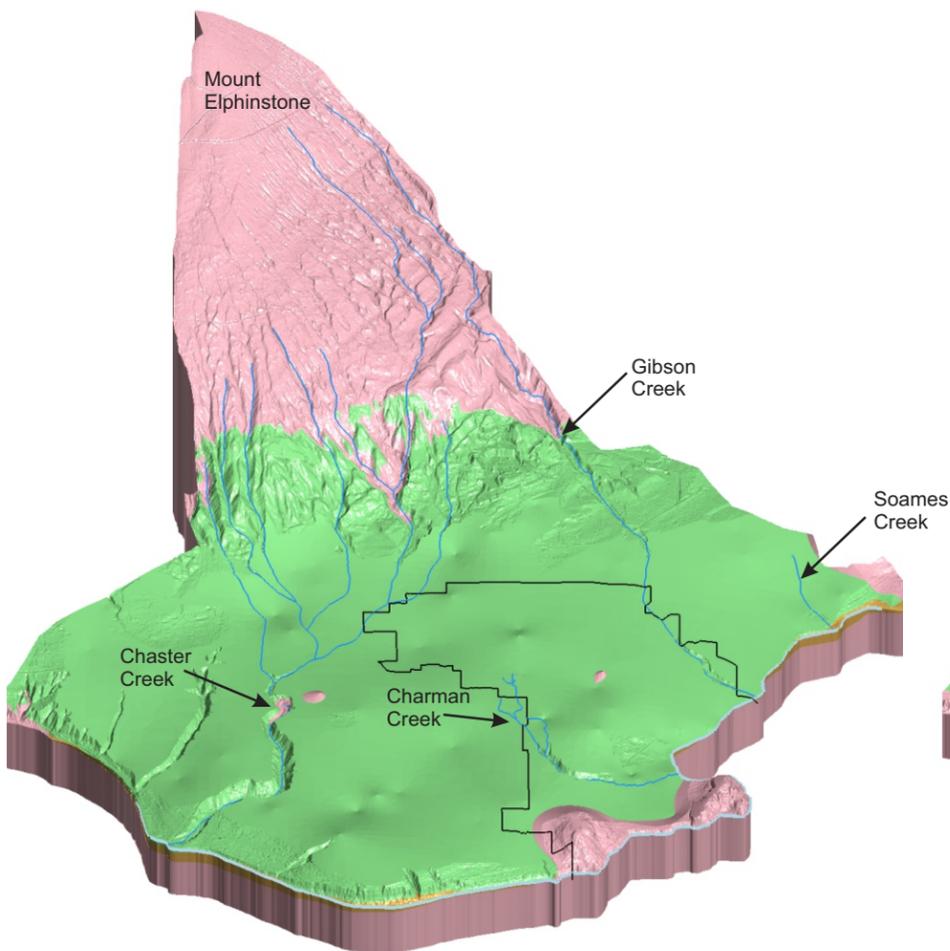
1. Bedrock
(sedimentary and intrusive rocks)



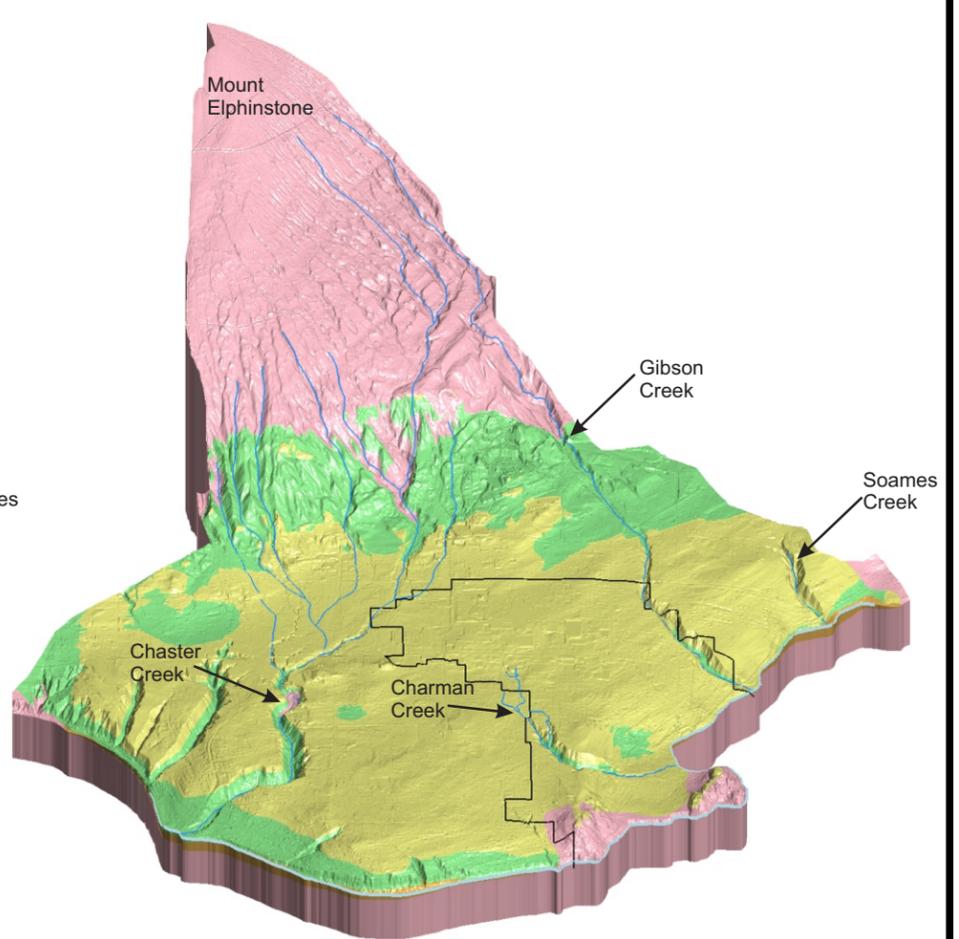
2. The pre-Vashon formation
(Aquifer 560)



3. The Vashon till formation
(Aquitard 560)



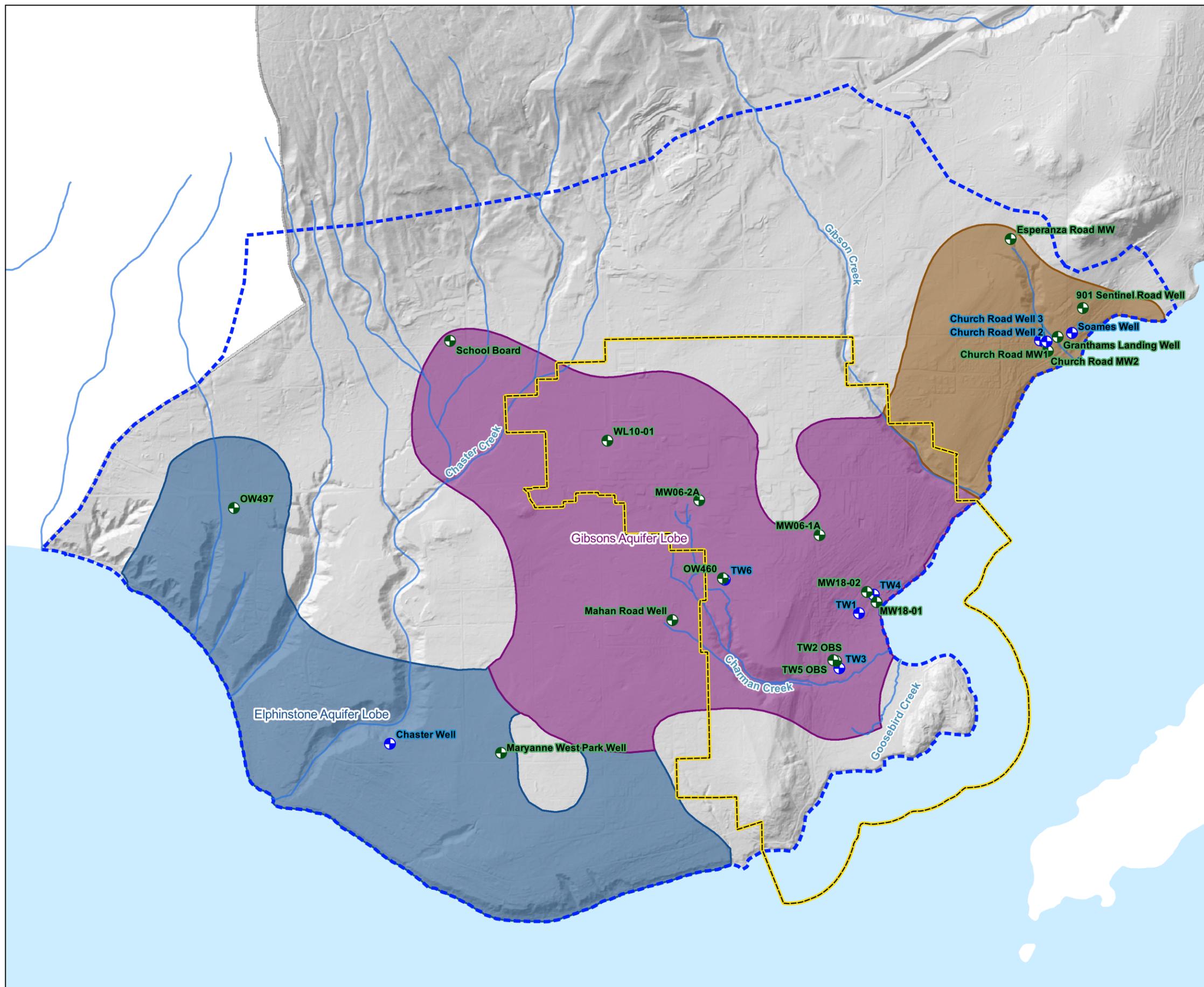
4. The Capilano formation
(Unconfined Aquifer/Aquitard System)



- The Capilano formation (Unconfined Aquifer/Aquitard System)
- The Vashon till formation (Aquitard 560)
- The pre-Vashon formation (Aquifer 560)
- Bedrock (sedimentary and intrusive rocks)
- Creek
- Town of Gibsons Boundary
- Coastline

References:
Government of BC (modified from MoE, 2020; Municipalities, 2016;
modified from FWA, 2017); Town of Gibsons (2016, 2021).

<p>2024 Leapfrog Geologic Model Update Gibsons, British Columbia Submitted to the Town of Gibsons</p>	
<p>GLACIAL HISTORY AND STRATIGRAPHIC SEQUENCE</p>	
<p>Waterline</p>	<p>PREPARED BY: Waterline Resources Inc. PROJECT: 1578-24-002 COMPILED BY: rmline DATE ISSUED: January 2025 REVISED: -</p>
<p>FIGURE 4</p>	



- Monitoring Well
 - Water Supply Well
 - Town of Gibsons Municipal Boundary
 - Aquifer 560 (ENV, 2019)
- Identified Aquifer Lobes (Waterline, 2022)
- Elphinstone Aquifer Lobe
 - Gibsons Aquifer Lobe
 - Soames Aquifer Lobe
 - Creek



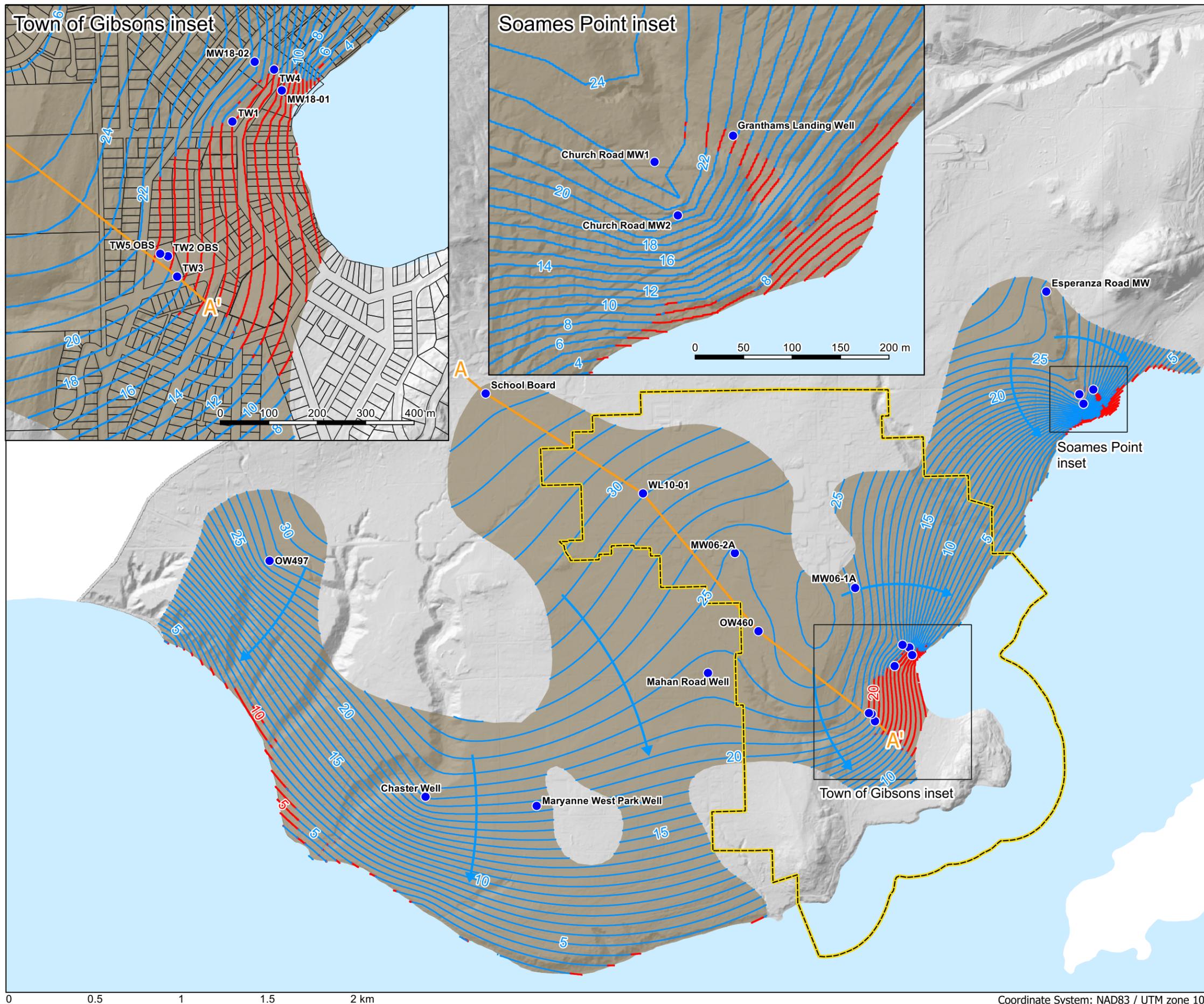
References:
 Urban Systems (2016), ENV (2019), Waterline (2022), Esri World Imagery (WMS).
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2024 Leapfrog Geologic Model Update Gibsons, British Columbia Submitted to the Town of Gibsons	
IDENTIFIED LOBES OF AQUIFER 560	
	FIGURE 5
Prepared By: Waterline Resources Inc. Project Number: 1578-24-002 Compiled By: mwine Date Issued: 2025-Mar-05 Date Revised: --	

0 0.5 1 1.5 2 km

Coordinate System: NAD83 / UTM zone 10N

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- Town of Gibsons Municipal Boundary
- Pre-Vashon
- Water Well used in Groundwater Elevation Interpretation
- Cross-Section Trace
- Interpreted Groundwater Elevation (masl) Below Ground Level
- Interpreted Groundwater Elevation (masl) Exceeds Ground Level
- ➔ Interpreted Groundwater Flow Direction



References:
 Urban Systems (2016).
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2024 Leapfrog Geologic Model Update Gibsons, British Columbia Submitted to the Town of Gibsons	
PIEZOMETRIC SURFACE CONTOUR MAP FOR AQUIFER 560	
	Prepared By: Waterline Resources Inc. Project Number: 1578-24-002 Compiled By: mwine Date Issued: 2025-Apr-08 Date Revised: --
FIGURE 6	

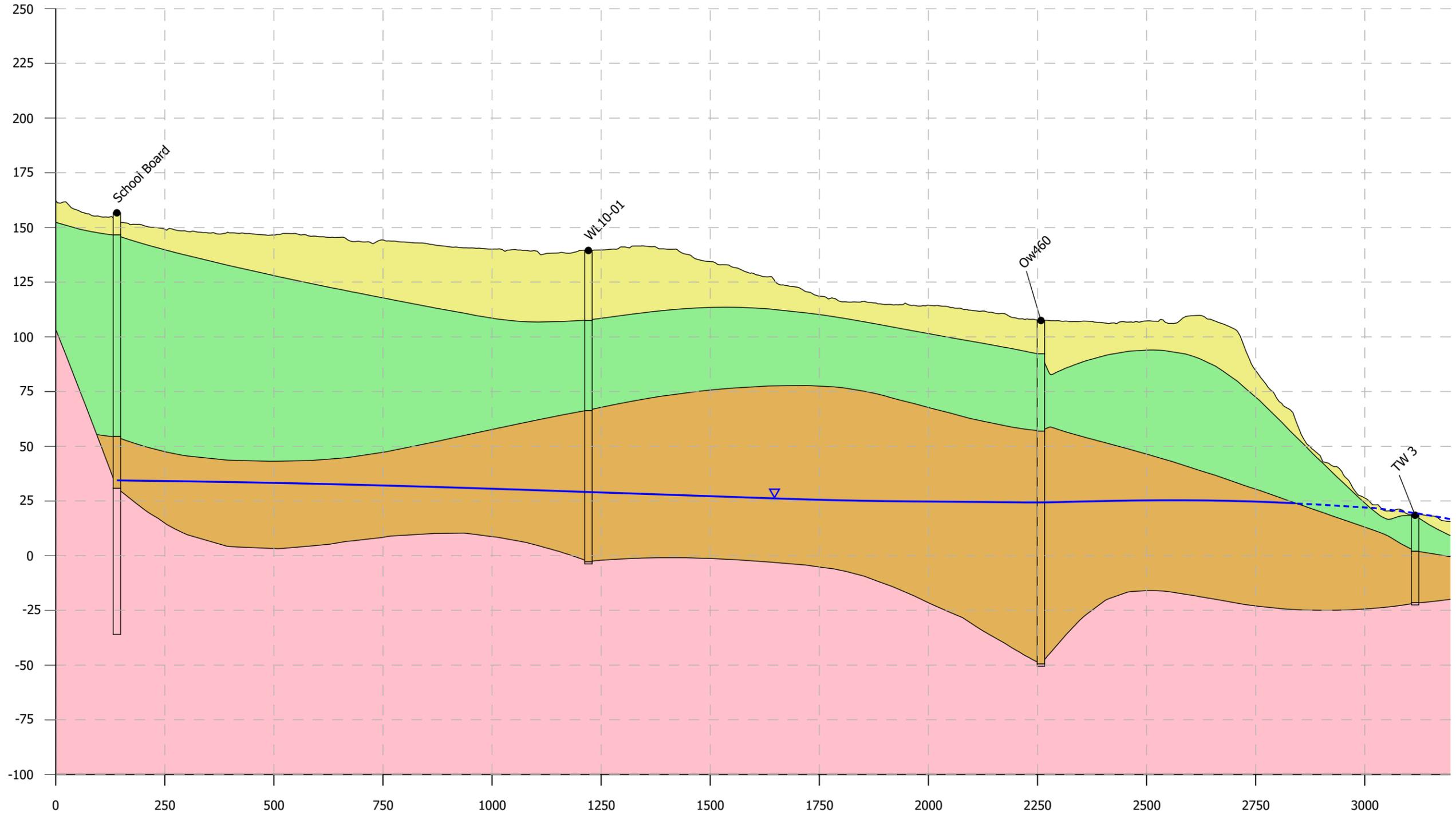
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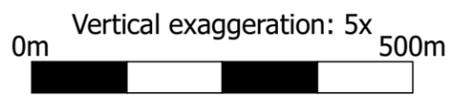
Coordinate System: NAD83 / UTM zone 10N

A (Northwest)

A' (Southeast)

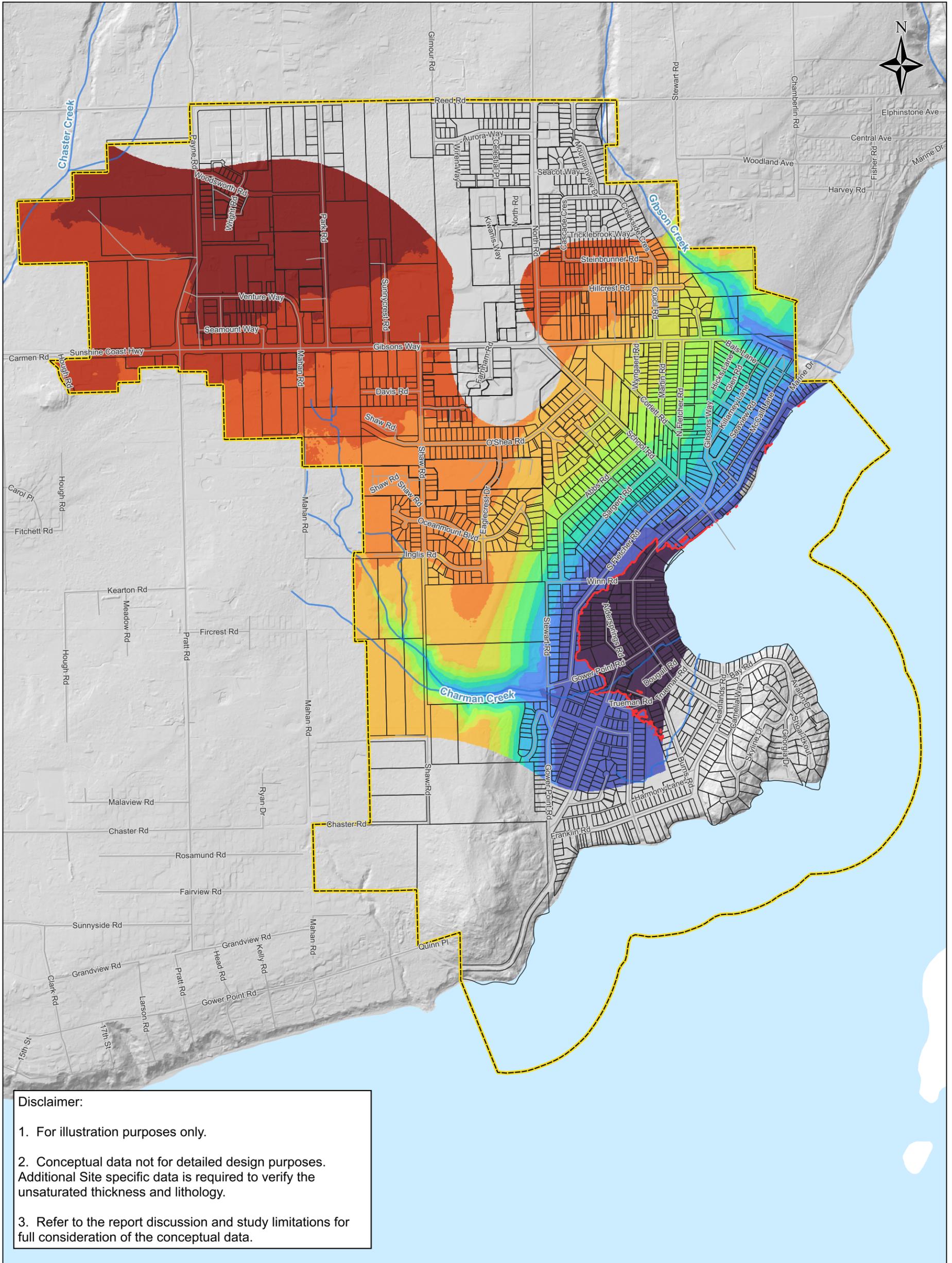


Scale: 1:8,500



- The Capilano formation (Unconfined Aquifer/Aquitard System)
- The Vashon till formation (Aquitard 560)
- The pre-Vashon formation (Aquifer 560)
- Bedrock (sedimentary and intrusive rocks)
- ▽ Interpreted Groundwater Elevation
- Interpreted Artesian Groundwater Elevation

<p>2024 Leapfrog Geologic Model Update Gibsons, British Columbia Submitted to the Town of Gibsons</p>	
<p>HYDROGEOLOGICAL CROSS-SECTION A-A' (NORTHWEST TO SOUTHEAST)</p>	
<p>PREPARED BY: Waterline Resources Inc. PROJECT: 1578-24-002 COMPILED BY: MDW DATE ISSUED: March 2025 REVISED: -</p>	<p>FIGURE 7</p>

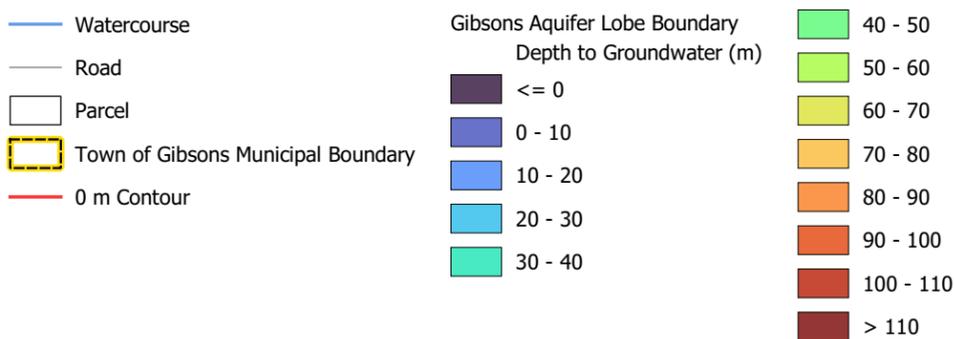


Disclaimer:

1. For illustration purposes only.
2. Conceptual data not for detailed design purposes. Additional Site specific data is required to verify the unsaturated thickness and lithology.
3. Refer to the report discussion and study limitations for full consideration of the conceptual data.

0 250 500 750 1,000 metres

Coordinate System: NAD83 / UTM zone 10N



References:

Freshwater Atlas Named Watersheds (2022), Town of Gibsons (2022), Urban Systems (2021), Canada Base Map - Transportation (WMS), Esri World Topo Map (WMS)

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2024 Leapfrog Geologic Model Update Gibsons, British Columbia Submitted to the Town of Gibsons	
MODELLED DEPTH TO GROUNDWATER FOR AQUIFER 560 WITHIN THE TOWN OF GIBSONS	
Prepared By: Waterline Resources Inc. Project Number: 1578-24-002 Compiled By: mwine Date Issued: 2025-Apr-07 Date Revised: --	FIGURE 8

Appendix A: Leapfrog Model Data Sources – Geological Data

Table A1: Gibsons DPA 9 and Consultant-Provided Data Sources and Data Locations Used in the 2024 Model Update

Data Source				Data Location					
Reference No.	Reference	Author	Publication Date	Location No.	Location Name	UTM (Zone 10)		Elevation (masl)	Depth (mbgl)
						Eastings	Northing		
Gibsons DPA 9 Approved Project Documents									
1	Geotechnical Addendum Letter: Proposed Residential Development - Gospel Rock Village Block 7 DL 842 Group 1 NWD Plan 6755, Gibsons, BC	Kontur Geotechnical Consultants Inc.	2019	1	TP19-06 Gospel Rock	462452	5471174	96.1	5.5
				2	TP19-07 Gospel Rock	462303	5471120	77.35	5.2
				3	TP19-10 Gospel Rock	462599	5471017	92.07	1.2
				4	TP19-14 Gospel Rock	462767	5471181	28.05	0.9
2	Summary of Drilling Activities for Phase II Environmental Site Assessment 1057 Gibsons Way, Gibsons, BC ("Site")	Next Environmental Inc.	2019	5	BH106 1057 Gibsons	461677	5472690	130.08	16.76
3	Proposed Haley Dodge Dealership at 1028 and 1043 Gibsons Way, Gibsons, BC Geotechnical Investigation Report - R1	Horizon Engineering Inc.	2022	6	TH22-01 1028 Gibsons	461764	5472839	135.03	9.1
4	Updated Geotechnical Recommendations Report, Proposed Mixed Use Development 1057 Gibsons Way, Gibsons, BC	Frontera Geotechnical Inc.	2022	7	TH22-07 1057 Gibsons	461665	5472708	130.57	6.7
5	Proposed Development at 835 Gibsons Way, Gibsons, BC Geotechnical Investigation Report - R1	Horizon Engineering Inc.	2022	8	SH22-01 835 Gibsons	462569	5472793	121.9	9.1
6	Borehole and Well Logs, August 2022 Drilling at 528 Marine Drive, Gibsons, BC	Keystone Environmental Ltd.	2023	9	MW22-2	463525	5472477	3.15	2.2
				10	BH22-4	463536	5472485	2.98	1.3
				11	BH22-5	463528	5472484	5.13	1.2
7	Geotechnical Assessment: Proposed Residential Development Lot 15 Bals Lane, Gibsons, British Columbia (PID: 011-955-805)	Arya Engineering Inc.	2023	12	BH23-01	462102	5473061	140.58	7
8	Geotechnical Investigation Report - Proposed Residential Development 718 North Road, Gibsons, BC	Geopacific Consultants Ltd.	2024	13	MW24-01 718 North	462776	5473079	122.03	6.1
Consultant-provided Documents									
9	(19-221-SC) 107 Swallow Road, Gibsons, BC	Arya Engineering Inc.	2019	14	TP-01 107 Swallow	460413	5470641	21.79	1.5
10	(19-226-SC) 1051 Keith Road, Gibsons, BC	Arya Engineering Inc.	2019	15	BH19-02 1051 Keith	461696	5474407	234.61	17.5
11	(19-265-SC) 903 Gower Point Road, Gibsons, BC	Arya Engineering Inc.	2019	16	TP20-01 903 Gower	462291	5470740	33.54	2
12	(20-274-SC) 937 Gower Point Road, Gibsons, BC	Arya Engineering Inc.	2020	17	TP20-02 937 Gower	462168	5470615	23.97	1.2
13	(20-285-SC) 792 Bayview Heights Road, Gibsons, BC	Arya Engineering Inc.	2020	18	FS1 792 Bayview	462725	5471602	40.43	1.5
14	(21-492-SC) 975 Henry Road, Gibsons, BC	Arya Engineering Inc.	2021	19	FS1 975 Henry	460744	5474111	218.93	1.6
15	(21-542-SC) Lot D Chaster Rd, Gibsons, BC	Arya Engineering Inc.	2021	20	AH1 Lot D Elphinstone	460789	5471054	99.05	1
16	(21-570-SC) 463 Pratt Rd, Gibsons, BC	Arya Engineering Inc.	2021	21	TP-01 463 Pratt	461345	5472056	112.16	1
17	Borehole Log BH24-01; Arrowhead Park, Gibsons, BC	Waterline Resources Inc.	2024	22	BH24-01	463188	5471372	9.8	22.9
18	Borehole Log MW24-01; Dougall Park, Gibsons, BC	Waterline Resources Inc.	2024	23	MW24-01	463018	5471743	13.79	10.7
19	Borehole Log MW24-02; Glassford Road, Gibsons, BC	Waterline Resources Inc.	2024	24	MW24-02	462980	5471623	17.39	7.6

Notes: UTM means Universal Transverse Mercator; **masl** means metres above sea level; **mbgl** means metres below ground level.



Table A2: GWELLS Well Information Used in the 2024 Model Update

Location No.	Well Tag Number	Well Name	Address	UTM (Zone 10)		Total Depth Drilled (mbgl)	Well Depth (mbgl)
				Easting	Northing		
1	13963	-	Ocean Beach Esplanade	459273	5471880	-	1.5
2	18775	-	Henry Road	460655	5473787	-	12.2
3	18966	-	North Road	463804	5474781	-	2.7
4	42674	-	Trant Road	464749	5473814	-	15.2
5	115303	-	681 Highland Road	459085	5472893	163.1	163.1
6	118049	Church Road Well 2	Elphinstone Avenue	464107	5473614	59.4	57.9
7	121457	Church Road Well 3	Elphinstone Avenue	464146	5473607	59.4	57.3
8	123003	OW497	1603 Sunshine Coast Highway	459430	5472643	108.2	107.9
9	128281	Esperanze Road MW	Esperanza Road	463936	5474200	104.9	-
10	111372	-	1200 Stewart Road	463679	5474087	156.0	155.7
11	117298	Church Road MW-1	846 Church Road	464129	5473607	60.0	43.9
12	128291	Church Road MW-2	Church Road, Granthams Landing	464153	5473552	46.5	-
13	41551	-	Bonnybrook Trailer Park	459706	5470996	-	32.0
14	41759	-	Gower Point	459729	5471623	-	85.9
15	93321	-	1582 Sunshine Coast Highway	459550	5472868	42.7	39.6

Notes: UTM means Universal Transverse Mercator; mbgl means metres below ground level.



Appendix B: Leapfrog Model Data Sources – Groundwater Data



Table B1: Groundwater Monitoring Locations and Groundwater Level Data for Aquifer 560

Location	Well Tag Number	Well Type	Installation Date	UTM Coordinates (NAD 83)			Ground Elevation (masl)	Non-Pumping Groundwater Level		Method for Groundwater Level Measurement
				Grid Zone	Easting	Northing		Date	Elevation (masl)	
Town of Gibsons Monitoring and Town Well Locations										
MW06-1A	130781	Monitoring Well	2006-12-07	10	462828	5472486	99.20	2024-09-10	24.94	Manual
MW06-2A	130783	Monitoring Well	2006-12-10	10	462130	5472688	121.36	2024-09-10	24.75	Manual
MW18-01	117709	Monitoring Well	2019-01-30	10	463159	5472098	10.03	2024-09-11	12.85	Pressure Gauge
MW18-02	117708	Monitoring Well	2019-01-27	10	463103	5472157	24.15	2024-09-11	18.61	Manual
School Board	-	Monitoring Well	1964-08-01	10	460684	5473611	152.56	2024-09-10	34.38	Manual
WL10-01	130787	Monitoring Well	2010-03-23	10	461597	5473033	139.50	2024-09-10	29.08	Manual
TW1	19896	Water Supply Well	1966-04-01	10	463057	5472034	13.61	2024-09-11	14.69	Calculated
TW2 OBS	33950	Monitoring Well	1975-12-11	10	462924	5471757	18.52	2024-09-10	20.09	Pressure Gauge
TW3	53237	Water Supply Well	1984-08-30	10	462943	5471715	18.69	2024-09-11	19.78	Calculated
TW4	76196	Water Supply Well	2000-09-30	10	463143	5472141	13.44	2024-09-11	14.65	Calculated
TW5 OBS	117705	Monitoring Well	2019-01-31	10	462908	5471762	19.23	2024-09-10	21.28	Pressure Gauge
Sunshine Coast Regional District Monitoring and Water Supply Well Locations										
Chaster Well	23421	Water Supply Well	1970-04-01	10	460335	5471278	92.75	2024-09-11	21.38	Calculated
Church Road MW-1	117298	Monitoring Well	2018-10-05	10	464129	5473607	39.63	2024-09-11	23.81	Calculated
Church Road MW-2	128291	Monitoring Well	2022-06-02	10	464153	5473552	28.85	2024-09-11	23.12	Calculated
Esperanza Road MW	128281	Monitoring Well	1998-10-22	10	463937	5474201	120.50	2024-09-11	26.08	Calculated
Granthams Landing Well	78231	Monitoring Well	1990-08-24	10	464210	5473634	18.37	2024-09-11	20.57	Calculated
Mahan Road Well	117296	Monitoring Well	2018-10-01	10	461974	5471994	107.65	2024-08-21	23.40	Calculated
Maryanne West Park Well	-	Monitoring Well	2020-10-07	10	460980	5471225	100.11	2024-09-11	19.56	Calculated
901 Sentinel Road Well*	70718	Monitoring Well	1989-07-13	10	464356	5473801	52.33	2024-09-11	21.76	Calculated
Ministry of Environment Observation Well Locations										
OW460	113189	Observation Well	2010-04-08	10	462267	5472236	107.50	2024-09-11	24.23	Calculated
OW497	123003	Observation Well	2021-05-14	10	459430	5472643	123.63	2024-09-11	28.27	Calculated

Notes: UTM means Universal Transverse Mercator; masl means metres above sea level; MW means monitoring well; WL means Waterline; TW means town well; OBS & OW means observation well; * indicates that the groundwater elevation was not used for the piezometric surface contour map

