CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

WATER SUPPLY PAPER No. 328

GROUND-WATER RESOURCES OF MATSQUI MUNICIPALITY BRITISH COLUMBIA

By

E. C. Halstead

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CHAPTER I

INTRODUCTION

This report deals with the ground-water conditions of Matsqui Municipality in the province of British Columbia investigated by officers of the Geological Survey of Canada during the field season of 1955. Geological mapping of the area was carried out under the direction of J.E. Armstrong; the ground-water investigation was supervised and carried out by the writer who was assisted during the field season by J.D. Stothers and P.L. Strack. Grateful acknowledgement is made to all well owners and drillers for their cooperation and willingness to supply information.

The extensive use of groundwater for domestic and municipal supplies and the rapidly expanding search for irrigation water have resulted in the need of an understanding of the ground-water hydrology of Matsqui Municipality.

The ground-water investigation included an inventory of representative wells and springs. More reliable data have been added from logs of private wells and of test holes drilled since 1955. These logs were obtained by the writer at the drilling site or were submitted at a later date by the drillers. Complete records and logs are filed at the Vancouver office, Geological Survey of Canada, and are available to anyone seeking additional ground-water data.

LOCATION AND EXTENT OF AREA

Matsqui Municipality covers an area of about 85 square miles and extends from the International Boundary north to Fraser River and is bounded on the west by Langley Municipality and on the east by Sumas Municipality.

CLIMATE

The climatic conditions of the Fraser Lowland are highly variable and influenced to a large extent by the mountain relief north and east of the region. This influence accounts for a strong increase in precipitation in both a north-south and west-east direction (see Chapman, 1952, pp. 14-15).

The characteristic feature of the region is a heavy winter rainfall and a summer dry period. About two thirds of the average total precipitation of 59 inches occur from October to March. The growing season from April to September, even in wet years, has too little precipitation for the maximum development and yield of crops.

The heavy, sustained rains that occur during October to March replenish the ground-water reservoirs. During this period, apart from run off, little is lost by evaporation and transpiration, the soil and sediments above the water-tables are kept wet and maximum infiltration results.

INDUSTRY

Agriculture is the principal industry of Matsqui Municipality. Vegetable and small fruit production as well as poultry raising are major sources of income. Dairying and the raising of forage crops are carried out chiefly in Matsqui Valley. Other crops include bulbs, cut flowers and nursery stock.

Abbotsford outwash (see map showing surficial deposits) has provided gravel and sand for the construction industry. Glacio-marine clays exposed along the south side of Fraser River in sec. 27, tp. 14 are strip-mined and used as a source of clay in the manufacture of cement.

TOPOGRAPHY AND DRAINAGE

Matsqui Municipality forms a part of Fraser Lowland. The west half of the municipality is part of the Langley Upland, with a rolling surface that rises in places to elevations of more than 400 feet above sea-level. The southeast part, Abbotsford Upland, is triangular shaped with a belt of north-south trending ridges along the east side that rise 75 to 100 feet above the general flat surface of the upland.

Matsqui Valley occupies the northeast part of the municipality and is bounded on the east by Sumas Mountain. This lowland area has a relatively flat floor which lies at elevations of less than 25 feet above sea-level. Dykes along the south bank of Fraser River protect the valley during flood stages of the river. The east part of Glen Valley is included in the northeast corner of Matsqui Municipality. Like Matsqui Valley, Glen valley has a flat floor with sides rising abruptly to elevations of more than 300 feet.

The northwest quarter of the municipality is drained by Nathan Creek, which flows from the upland to the flats of Glen Valley and into Fraser River. McLennan, Downes and Wilbrand creeks, originating in the upland areas surrounding Matsqui Valley, spill out into natural or man-made drainage channels across the floor of the valley.

In the southeast quarter (Abbotsford Upland) of the municipality almost all the rainfall infiltrates the permeable surface deposits. In this area, the surface of the water in the gravel pits as well as in Abbotsford, Laxton and Judson lakes is an expression of the water-table. Ground-water seepage is also responsible for the discharge of Fishtrap Creek which flows south across the International Boundary.

SELECTED REFERENCES

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CHAPTER II

PLEISTOCENE AND RECENT GEOLOGY

TYPES OF DEPOSITS

The entire municipality of Matsqui is underlain by thick deposits of unconsolidated sediments of Pleistocene and Recent ages. In this report the term Pleistocene refers to that epoch in the earth's geological history when large areas of the earth's surface were covered more than once by great glaciers many thousands of feet thick. The epoch is estimated to have started somewhat less than a million years ago. The last glacial age continued in the Matsqui area to within about five to ten thousand years of the present. The term Recent is used in this report to refer to post-Wisconsin time or present non-glacial time.

The deposits formed during the Pleistocene and Recent periods are shown on the table of surficial deposits accompanying this report and consist of clay, silt, sand, gravel, peat, varved clay and silt; stony, clayey silt, silty clay and related till-like mixtures; and till. The terms clay, silt, and sand as used here are based on the diameter of the constituent particles as follows: clay, less than 0.002 mm; silt, 0.002 to 0.05 mm; and sand, 0.05 to 2 mm. The clays and silts are composed chiefly of rock flour produced by mechanical abrasion by glaciers and only to a minor extent of clay minerals formed by chemical decomposition of rocks. The sands are in a large part quartz but contain in addition many feldspar and rock fragments. The clays and silts and mixtures of the two are mainly off-shore marine deposits, and to a much lesser extent, stream and river deposits, both flood-plain and channel. The sands and also the gravels may be glacial outwash deposits or post-glacial stream and river deposits. Outwash consists of the sediments deposited by streams issuing from glaciers.

The stony, clayey silt, silty clay and related till-like mixtures are in a large part glacio-marine and to a lesser extent normal marine deposits that were laid down in the sea during the advance and retreat of an ice-sheet and during the subsequent uplift of the land. The glacio-marine deposits are marine drift; that is, the stones and part of the fine material were transported by floating ice and the remainder of the fine material was carried by meltwater and sea water. Mechanical analyses of stony clayey silts, and silty clays, show that, exclusive of stones, they comprise about 40 per cent silt, 40 per cent sand and 20 per cent clay.

Glacial till, as used in this report, is a very compact, unsorted mixture of sand, silt, clay and stones deposited directly beneath glacial ice. The only till exposed in Matsqui Municipality is the Sumas till but an older till, the Surrey, has been identified in well records. Mechanical analyses of the fine fraction of representative samples of tills from the lower mainland yielded the following average results: Sumas till, 63 per cent sand, 33 per cent silt and 4 per cent clay; Surrey till, 57 per cent sand, 41 per cent silt and 2 per cent clay.

The unconsolidated sediments in Matsqui Municipality attain a maximum thickness of at least 1,000 feet along the International Boundary and also in Matsqui Valley; whereas on Sumas Mountain such sediments are in the order of a few tens of feet thick.

STRATIGRAPHY AND HISTORICAL GEOLOGY OF PLEISTOCENE AND RECENT DEPOSITS

The table of surficial deposits that accompanies this report shows graphically the complex interrelations and age of the surficial materials. The oldest deposits are shown at the bottom of the table and the youngest at the top. Deposits shown alongside one another indicate that they are of the same general age but were laid down in different environments. Note that the graphic representation illustrates, for example, that Sumas glacial deposits were laid down in part of the area at the same time non-glacial Capilano deposits were laid down elsewhere in the area. A hole drilled in search of water would penetrate the deposits in the order shown from the top of the table to the bottom except where a deposit has been removed by erosion or locally was not deposited.

All ages are relative except in the case of the Capilano. Wood collected at the base of Sumas till and hence part of the Capilano group. was dated as 11,300±300 years. The wood on which the radio-carbon age determination was made was collected from an exposure on Mount Lehman road (sec. 2, tp. 14).

Study of the surficial deposits in Langley and Surrey municipalities, west of Matsqui, indicates that the Fraser Lowland area was subjected to four glaciations. The table of surficial deposits included in this report indicates the Sumas glaciation, which was probably valley glaciation, and one major glaciation, the Vashon, which reached ice-sheet proportions. Two pre-Vashon major glaciations were also of ice-sheet proportion and during their maxima were probably 7,500 or more feet thick over the valleys. During each major glaciation the land was depressed relative to the sea, and this lowering of the land surface probably amounted to at least 1,000 feet in the case of Vashon glaciation. At the maximum of Vashon glaciation the ice rested on the sea floor. Surrey till was deposited beneath the ice. During the retreat of the ice, largely by wasting, the ice thinned and floated and glacio-marine Newton Stony clay deposits were laid down. After the Vashon ice melted and as the land rose above the sea, the off-shore marine Cloverdale sediments were laid down.

Huntingdon gravel deposits underlie Whatcom glacio-marine deposits. They appear to be stream deposits, partly in the form of marine deltas, that were laid down following the retreat of Vashon ice but before the advance of Sumas ice.

During post-Vashon time the Sumas ice advanced westward across Matsqui Municipality. In its initial stages this ice-sheet terminated in the sea and deposited glacio-marine Whatcom deposits in front of and beneath the ice. As the land rose, the Sumas glacier was grounded and advanced and retreated across the Whatcom glacio-marine drift, depositing Sumas till and recessional Abbotsford outwash. At one time during retreat, the Sumas ice remained relatively stationary and ice-contact deposits were laid down between the ice front and the Langley Upland.

Meltwater from the grounded Sumas glacier collected in Matsqui Valley and formed a lake in which silt and silty clay were deposited, with minor sand and gravel rimming the lake.

Following the disappearance of the Sumas ice, prevailing westerly winds blowing across the vast expanse of Abbotsford outwash built sand dunes in and south of Abbotsford village.

The Salish deposits relate to the present sea, river and lake levels and are represented by channel and flood-plain deposits along Fraser River and smaller streams. Slopewash deposits as well as peat bogs and swamp deposits are included here.

DISTRIBUTION OF PLEISTOCENE AND RECENT DEPOSITS

The distribution of the Sumas and younger deposits is indicated on the geological map accompanying this paper. The Salish deposits are confined to the lowlands.

Whatcom glacio-marine deposits appear at the surface over much of the upland area and they in turn are underlain by the lithologically similar Newton stony clays except where separated by the Huntingdon gravel. Sumas till occupies a belt of hills that extend across the Abbotsford Upland and continue northwest to border the Langley Upland. Scattered deposits of Sumas till are mapped elsewhere and it is believed that a thin mantle of this till, deposited over much of the area, has become part of the present agricultural soil zone. Abbotsford outwash deposits are widespread over much of the southeast part of the municipality and these deposits represent the materials that were washed and carried by meltwater beyond the margin of the Sumas ice. Ice-contact deposits extend from the International Boundary to Matsqui Valley along the edge of the Langley Upland area that includes most of the west half of the municipality. Glacio-lacustrine deposits are found on the slopes that rim Matsqui Valley and in places are overlain by slopewash and Fraser flood plain deposits.

The Vashon deposits are not exposed in the municipality but have been positively identified in the deep wells drilled at Clearbrook and have been tentatively identified in other holes. Surrey till is believed to be widespread beneath the Whatcom and Newton glacio-marine deposits throughout the municipality.

CHAPTER III

GROUND-WATER GEOLOGY

GENERAL CONDITIONS

Ground water or underground water is the water that supplies springs and wells. Where the supply of surface water has been inadequate, contaminated or entirely lacking, man has dug wells in search of ground-water supplies. In many places ground water in sufficient quantity can be found to meet the demands of agriculture and industry without constructing large, long pipelines or aqueducts to carry water into an area from distant surface sources. The amount of water replenished annually and the amount available in storage in the ground-water reservoirs are, however, important factors to be considered before undertaking programs of ground-water development.

Source

The source of all ground water is precipitation in the form of rain or snow. An inch of rainfall covering a square mile is equivalent to approximately 14,520,000 imperial gallons. The average rainfall for Matsqui Municipality is approximately 59 inches a year, therefore each square mile of the municipality receives some 856,680,000 imperial gallons annually.

Some of the precipitation is carried away by surface run-off and some of it infiltrates the soil zones. Of the latter, part is absorbed by plant roots, part is lost in evaporation and the remainder percolates downward to the ground-water reservoirs. The amount that will infiltrate the soil zone is determined by such factors as temperature, amount and intensity of the precipitation, slope of land surface and the character and texture of the surface deposits.

Occurrence and Movement

Ground water occurs in the voids, interstices or pore spaces of the unconsolidated surface deposits and in fractures and fissures of the bedrock. In the Matsqui Municipality the unconsolidated surface deposits are in most places 1,000 or more feet thick; therefore, only the occurrences and development of the ground water in these deposits is considered. No bedrock wells are known.

Water occurring in gravel, sand or mixtures of gravel and sand, is free to move under the influence of gravity or water-table slopes. Gravels, sands or mixtures of gravel and sand are said to be permeable or pervious, and water contained in them is readily available to supply springs and wells. Clays and silts consists of minute, closely spaced particles and water occurring between these particles is held by molecular attraction and is not free to supply springs or wells. Clay, silt, and material with a high proportion of clay or silt are, for all practical purposes, impervious.

Ground water moves from recharge to discharge areas at rates measured in feet per day to feet per year. Recharge areas are those areas where the surface deposits are permeable and allow maximum infiltration of precipitation. Discharge occurs naturally, at the surface, by springs and seeps, and artificially by means of wells.

The Water-table

The water-table is defined as the upper surface of the zone saturated by free ground water, and is the level at which water will stand in a well dug into permeable materials such as the Abbotsford outwash. The water-table is generally a sloping surface, having a gradient in the direction of ground-water movement; it is not stationary but fluctuates with variations in amounts of recharge and discharge. In Matsqui Municipality the water-tables are lowered as much as 5 feet during the period April to October but rebound annually owing to the heavier precipitation occurring during the months of November to March.

GROUND-WATER RESERVOIRS

Ground-water reservoirs or aquifers are saturated zones of permeable material from which ground water can be obtained by pumping or natural flow. The complex Pleistocene geology of Matsqui Municipality has resulted in the formation of three main types of ground-water reservoirs, namely, perched, free, and confined ground water.

Perched ground-water occurs in a saturated zone separated from the main body of ground water by impervious strata. In Matsqui Municipality it occurs in Sumas till deposits that overlie Whatcom glacio-marine deposits. In parts of Langley Upland where remnants of sandy Sumas till are thin, water stored under perched conditions is discharged naturally by springs in volumes sufficient to supply several farms. Perched ground-water reservoirs also exist in places where Fraser flood plain deposits are channeled.

Free ground-water reservoirs exist in areas of Abbotsford outwash, Huntingdon gravel, and in the slopewash deposits. The sand and gravel in such areas is porous and allows for maximum infiltration, the water percolating downward under the influence of gravity to the zone of saturation. The water-table comes to the surface at Abbotsford, Laxtone and Judson Lakes and is also exposed in gravel pits in the Abbotsford outwash.

The water in confined ground-water reservoirs does not move under the influence of water-table slopes but is confined by an overlying less permeable or impervious stratum and hence movement is restricted vertically but not necessarily horizontally. In areas where Whatcom glacio-marine clays are present at the surface penetrate the relatively impervious clays and reach, in most places, Huntingdon gravel and sand, which there constitute a confined aquifer. Water in confined aquifers is under pressure and rises in wells to a point above the top of the aquifer and under some conditions over-flows at ground level. Wells in which the water is under pressure but does not rise to the land surface and overflow are non-flowing artesian wells, whereas those in which the water is under sufficient pressure to cause it to rise to ground level and overflow. The height to which the water rises in either flowing or non-flowing artesian wells is a pressure surface, called the peizometric surface. The peizometric surface is not analagous to the water-table that exists in free unconfined ground-water reservoirs.

Confined aquifers underlying less permeable sediments in Glen Valley yield flowing artesian water. The writer believes that similar hydrologic conditions exist in Matsqui Valley in confined aquifers below 500 or more feet of less permeable silt and clay.

CHAPTER IV

TYPES OF WELLS AND WELL DEVELOPMENT

The complete development of wells is the objective of modern well drilling. The purpose of this section is to draw the attention of engineers, drillers, and prospective well owners in Matsqui Municipality to certain fundamental principles of ground-water recovery and well use so that they may know the problems that exist and the corrective measures that are employed elsewhere. Additional information may be obtained from technical journals and from some of the references listed on page of this report.

A well is constructed to tap the ground-water reservoirs to obtain, as economically as possible, the required amount of ground water. Failure to obtain an adequate supply depends, in some cases, not only on characteristics inherent in the formation penetrated, but also on the type of well and the construction or development methods used.

TYPES OF WELLS

Dug, bored, driven and drilled wells are the four main types and each has its special use and function under certain conditions. The factors that determine the types of well are: depth to water, characteristics of the sediments from ground surface to the water, characteristics of the water-bearing sediments, the static level of the ground water, the amount of water required, and the investment that the prospective owner is prepared to make.

Dug wells are of limited usefulness in much of Matsqui Municipality because the available ground water exists in confined aquifers at greater depths than it is advisable to dig wells by hand. Dug wells are a common means of recovering ground water from part of the Abbotsford outwash free ground-water reservoir. In the Langley Upland wells dug into Whatcom glacio-marine deposits are easy to dig but their yield fluctuates seasonally. Most of the water is collected from surface run-off and therefore these wells act chiefly as cisterns.

Bored wells, sunk by means of a hand or power-driven auger, are not widely used but where the stony clays are less than 50 feet thick, power-driven bucket-type augers could be used to penetrate to the underlying water-bearing sediments. Where the underlying water-bearing sediments include running sands or quicksand, boring operations may have to cease. However, at this point, at the bottom of the bored well, a sandpoint driven into the fine sands may yield enough water to make the well a producer.

Driven wells are constructed by driving a casing tipped with a drive point or sandpoint. Although an advantage over a dug well, driven wells are limited in their use to areas of outwash where the sands are medium to coarse grained. On uplands, driving sandpoints through the marine clays to underlying sands is not recommended because of stones encountered in the clays. In Matsqui Valley sandpoints can be used in the coarser grained Fraser flood plain and channel deposits, but the underlying Cloverdale sediments are too fine to give up their water to pumps attached to sandpoints.

Drilled wells are the most effective for development of ground water in a large part of Matsqui Municipality. They may be finished as open-end, screened, or gravel-packed wells, all of which are lined with a casing commonly 6 inches in diameter. Cable tool drilling rigs are in common use but in Glen Valley and in Matsqui Valley wells may be successfully drilled by a jetting or rotary rig. In jetting a well the casing, less than 2 inches in diameter, is forced down during the drilling as the sands and sediments are washed up by means of water forced through the drill stem. These wells may penetrate to depths of 700 feet.

An open-end well allows water to enter through the open end of the casing. No screen or other device is used to keep sand from entering the well and hence failures resulting from plugging with sand are common especially when over-pumping is carried out. All wells drilled by the jetting method are open-end wells.

Screened wells are those in which a screen or strainer is used on the lower end of the casing to permit maximum development of the aquifer. After the screen or strainer has been placed in position, development procedures are carried out to remove the fine material surrounding the screen. The removal of the fine material through the screen leaves coarser material naturally graded and packed around the screen.

To develop an efficient well in an aquifer made up entirely of fine material, a pack of gravel or sand may be placed around the outside of the screen. When this development is anticipated the initial well is drilled with a larger diameter than the final well to allow for the introduction of the gravel and sand pack.

WELL DEVELOPMENT

Wells are developed by means of post-drilling treatments to establish the maximum yield of usable water. To improve the yield, the methods commonly used include surging, over-pumping, backwashing and treatment with acids, or other chemicals. All methods, except the acid treatment, are designed primarily to wash fine sand, silt, and clay from the water-bearing formation immediately surrounding the well screen.

Surging is the method most commonly used where the water-bearing materials contain sand and fine gravel mixed with silt but over-pumping is a satisfactory procedure where coarse sand and gravel make up the aquifer. The surging method involves the use of a surge plunger which is operated up and down in the well casing for the purpose of alternately creating an inward and outward movement of water through the screen. The repeated surging action eventually moves the fine sand up to and through the screen from where it is removed by bailing. After the fine particles have been drawn into the well and removed, the coarser particles left on the outside of the screen have created a new mixture of particles having a high porosity and permeability. The treatment known as backwashing includes operating the pump at its maximum capacity and periodically stopping the pumping and releasing the foot-check valve. The water then rushes back into the well and agitates the sediments around the screen. During pumping the water in a well drops from the static level to the pumping level, and this drop measured in feet is known as the drawdown. As the water in a well drops to the pumping level, the attitude of the water level in the aquifer around the well becomes that of an inverted cone. The size and shape of this cone, known as the cone of depression, is controlled by the rate of pumping, the permeability or water yielding capacity of the water-bearing material and the slope of the water-table near the well. For example, if the pumping rate is high and the water-bearing material is coarse, then the cone of depression will affect a large area of the water-table but the height of the inverted cone will be relatively small. Under these conditions many neighbouring wells may be affected. When the pumping is stopped, the dewatered area normally fills up again.

The specific capacity or yield per foot of drawdown of a well should be determined especially when large flows are demanded. With the advent of the practice of irrigation to produce maximum crop yield it is necessary that wells drilled for this purpose be developed to maximum capacity as they will be subjected to long-term pumping. Most wells drilled for domestic or farm needs do not require extensive development as the initial yield meets the water requirements.

CHAPTER V

GROUND-WATER GEOLOGY OF MATSQUI MUNICIPALITY

The topographic units described below are merely convenient subdivisions for the discussion of the ground-water geology of Matsqui Municipality. The aquifers or ground-water reservoirs are those within 400 feet of the ground surface. These aquifers will yield a constant supply of potable water to properly developed drilled, driven, or dug wells.

LANGLEY UPLAND

Water Reservoirs

Langley Upland includes the greater part of the west and northwest part of the municipality. In the north part of this upland, Sumas till (6) in places mantles Whatcom glacio-marine deposits (5). Ground-water reservoirs in the Sumas till are perched and the free ground-water table slopes east causing springs to issue along the thin boundaries of the till.

Huntingdon gravel deposits (4) that underlie Whatcom glacio-marine deposits are a source of confined ground water. In places where the Huntingdon gravels are thin, lacking, or grade into fine sand, water in sufficient quantities is not available. At such places, however, permeable materials at greater depth below Newton stony clay and Surrey till are a source of confined ground water.

Langley Upland is bounded on the south by Abbotsford outwash, ice-contact deposits (8b) consisting of gravel, sand, and lenses of till, and glacio-marine clayey silt. The lenses of sand and gravel within these ice-contact deposits are discontinuous but favourable aquifers. North of the belt of ice-contact deposits and extending north to the Trans-Canada Highway, the Abbotsford outwash deposits (8a) contain free ground-water reservoirs.

Ground-water Recharge and Discharge

The Whatcom glacio-marine deposits are slightly permeable and allow limited percolation but where these deposits are at the surface the greater part of the precipitation is lost in run-off. Areas of Sumas till and Abbotsford outwash are recharged directly by precipitation and the water is stored under perched or free ground-water conditions.

Ground water is discharged naturally by springs at the margins of the Sumas till and at places from the ice-contact deposits where lenses of permeable sand and gravel overlie impermeable clays.

Recovery of Ground Water

Ground water is recovered by dug or drilled wells and springs. Huntingdon gravel deposits constitute the principal confined aquifer in that part of Langley Upland included in township 14. The Whatcom glacio-marine deposits are in places as much as 300 feet thick and test holes, 100 feet to 250 feet deep, on many farms have not penetrated these deposits to the underlying aquifer, resulting in discouraging results. Wells that have bottomed these deposits have invariably been successful. Some examples are cited below.

In SW. 1/4 sec. 10 a successful well drilled to a depth of 205 feet penetrated the stony clay to reach a water-bearing sand.. A well drilled on the hillside in NE. 1/4 sec. 15, tp. 14 penetrated 135 feet of Whatcom glacio-marine deposits, 20 feet of Huntingdon sand, 70 feet of Newton stony clay and encountered water-bearing gravel at 225 feet. The water in this confined aquifer rises in the well to a point 185 feet below the land surface, or 40 feet above the top of the aquifer. The 20 feet of Huntingdon deposits were either dry along this hillside or too fine-grained to give up their contained water when penetrated by the drill.

Springs along the margin of the Sumas till in the Mount Lehman district, especially in sec. 12 and 13, tp. 14, yield an abundance of water. One spring, in SW. 1/4 secs. 13 yields 80 gallons per minute and supplies seven farms. The community of Mount Lehman and 14 nearby farms are supplied with water by pipeline from a spring in NE. 1/4 sec. 12. Along the western limit of the Sumas till, wells drilled 33, 53 and 41 feet, yield abundant water in SE. 1/4 sec. 14, SE. 1/4 sec. 4, and NE. 1/4 sec. 11, respectively.

The Whatcom glacio-marine deposits are for all practical purposes impervious. Large-diameter wells dug into these clays fill with water during the wet seasons but fail during the summer months. The writer suggests that dugouts could be built in these deposits on those farms needing abundant water for beef and dairy cattle.

The south half of Langley Upland is included in township 13. Along the Trans-Canada Highway wells are drilled to the Huntingdon gravel deposits that underlie 8 to 200 feet of Whatcom glacio-marine deposits. At the Aberdeen school, a well penetrated 133 feet of Whatcom deposits to encounter water-bearing Huntingdon gravel deposits. Sufficient water to supply the school, 10 to 15 gallons a minute, is pumped from the top 6 feet of this aquifer. In places, however, the Huntingdon gravel deposits may be thin or lacking. This condition was found in SW. 1/4 sec. 24 where two test holes were drilled 230 and 258 feet. Only a thin seam of sand, representing the Huntingdon deposits, was found in both test holes at approximately 130 feet.

Discontinuous lenses of sand or gravel, forming part of the Sumas ice-contact deposits (8b), yield water to wells and springs. These supplies, commonly sufficient, are obtained from aquifers of only local extent which probably do not contain water in sufficient volume for irrigation.

Wells dug or drilled 50 feet or less obtain sufficient supplies from the free ground-water reservoir included in the Abbotsford gravel deposits north and west of the belt of ice-contact deposits.

ABBOTSFORD UPLAND

Water Reservoirs

Abbotsford Upland includes an area of approximately 20 square miles that extends south and west from Abbotsford to the International Boundary. This area is underlain by Abbotsford outwash sand and gravel deposits (8a) that vary in thickness from 30 to 100 feet. These deposits constitute a free ground-water reservoir with a water-table 10 to 50 feet below the land surface. The water-table in the Abbotsford outwash slopes to the southwest and during the driest summers drops not more than 5 feet under the present rate of discharge.

Sumas till (6) mantles the Abbotsford outwash along the east side of this upland but in this area the underlying outwash gravel constitutes the principal aquifer.

Huntingdon gravel is also an important aquifer in this upland and in places underlies the Abbotsford outwash and elsewhere is separated from the outwash by Sumas till or Sumas till and Whatcom glacio-marine deposits.

Ground-water Recharge and Discharge

Nearly all the precipitation in this area penetrates the permeable sand and gravel. Evaporation and transpiration account for partial loss of the precipitation that enters the soil zone. Total annual recharge has been estimated by the writer to be at least 5 billion gallons, which provides a safe daily yield of 13 million gallons to supply the required needs.

Ground water is discharged naturally through Fishtrap Creek and springs along the east side of this upland in the adjacent municipality.

Recovery of Ground Water

Water is obtained from wells and large volumes could also be pumped, especially for irrigation use, from gravel pits or from Abbotsford, Laxton and Judson lakes. Wells on the west side of the upland are dug or drilled to depths of 30 to 50 feet. The depth to the water-table increases towards the east and along the east side of the upland wells are 100 to 150 feet deep. Three of the more important wells that together could produce more than a million gallons of water a day are described below.

In SE. 1/4 sec. 1, tp. 13, a well 42 feet deep, 8 inches in diameter was drilled at a central point on the farm. The water-table lies within 17 feet of the ground surface. A screen 10 feet long was placed in the bottom of this well and the casing adjusted as required. Surging operations followed at intervals of 30, 60 and 90 minutes until all fine material capable of passing through the screen was removed and bailed out of the well. When the surging operation was completed, the well was test pumped at a rate of 250 gallons a minute. The drawdown, that is, the distance the water dropped from its static level to its pumping level measured 9 feet with rapid recovery once pumping operations ceased.

In SW. 1/4 sec. 16, tp. 16, a well 8 inches in diameter penetrated 88 feet of windblown sands, Sumas till and glacio-marine deposits to reach underlying Huntingdon gravels and drilling continued to a depth of 132 feet. A screen, 17 feet in length was placed in the well opposite the coarser water-bearing materials at a depth of 111 to 128 feet. Development procedures included surging with a loose surge block followed by pump surging. The pump test over a period of 7 hours included pumping at an initial rate of 100 gallons a minute. A drawdown of 12 feet was observed with recovery in 2 seconds upon cessation of the pumping.

An 8-inch diameter well, 80 feet deep was drilled in NW. 1/4 sec. 5, tp. 16. Eighty feet of outwash gravel was penetrated and the water-table was encountered at 50 feet. The coarse outwash required no further development than cleaning out the well by bailing and light surging. The well was test pumped at a rate of 290 gallons a minute, and therefore supplies sufficient water to irrigate approximately 40 acres in this area.

MATSQUI VALLEY

Water Reservoirs

Matsqui Valley, an area of about 25 square miles in the northeast part of Matsqui Municipality, was formerly occupied by a glacial lake. Silt, clay and sands were deposited in the lake which later drained and the area became successively a meander of the Fraser River and later a back swamp in which alluvial silt, clay, sand ridges and, in places, peat were deposited. The position and extent of confined aquifers in the valley have not been determined, but the geological evidence is such that confined ground-water reservoirs are expected to exist in coarser sediments that underlie the clay, silt and fine sand that fill the valley to depths of possibly 500 feet or more.

In places where the Fraser flood-plain deposits (9) are channeled, ridges of sand store ground water under perched condtions. Precipitation, springs along the valley sides, and creeks that cross the valley floor contribute water to recharge the perched ground-water reservoirs. Water collected in the fine sands and silts penetrates downward to recharge the coarser sediments at depth. Recharge from the Fraser River may be effective during periods when the river is at flood or high-water stage.

Recovery of Ground Water

Ground water is recovered from the perched reservoirs by means of sandpoints and shallow dug wells.

A well drilled in NE. 1/4 sec. 33, tp. 16 penetrated 50 feet of silty clay and drilling continued to a depth of 72 feet into fine-grained sands. A screen was placed in the well opposite the water-bearing sands at a depth of 62 to 72 feet.

Development of this aquifer proved difficult because of the uniform fine-grained sand composition but the well produces 12 gallons per minute. The water is of poor quality and carries fine sand during pumping. No other wells have been drilled in this valley and hence the position and extent of confined aquifers indicated above are conjectural and based on geological interpretation and results of test drilling under like geological environments in valleys in Langley and Sumas municipalities.

GLEN VALLEY

The greater part of Glen Valley is in Langley municipality. That part included in Matsqui Municipality has a relatively flat floor covered with recent flood-plain deposits of Fraser River and in places peat. Perched ground-water bodies are present in terraced sands and gravels at the base of the valley walls as well as in coarser sediments of the surface Fraser flood-plain deposits. Shallow wells and sandpoints are used to recover the ground water from these reservoirs.

Along the outer edge of Glen Valley, bordering Fraser River, drilled wells as much as 150 feet deep encounter confined aquifers, underlying Cloverdale sediments, in which the water is under sufficient pressure to rise to the surface and flow.

SUMAS MOUNTAIN

Sumas Mountain is in general mantled with unconsolidated deposits. Only that part of Sumas Mountain included in township 16 was investigated and there the unconsolidated deposits are, in places, as much as 200 feet thick. Abbotsford outwash gravels from a few inches to more than 75 feet thick overlie till. In places the gravel is thick enough to store water under perched ground-water conditions; this water is yielded to shallow dug wells. Although nearly impermeable, the till does yield small amounts of water to large-diameter dug wells. Some successful wells penetrate the till and obtain water from gravel beneath it.

At the foot of Sumas Mountain, south of Clayburn village in NE. 1/4 sec. 26, tp. 16, slopewash deposits (10) overlying possible glacio-lacustrine deposits (7) and Abbotsford outwash (8a) constitute a free ground-water reservoir. This reservoir is recharged by a creek that carries run-off and ground-water discharge from the upland mountainous area. The writer believes that properly developed wells tapping this aquifer would yield at least 100 gallons a minute. Elsewhere at the base of Sumas Mountain, extending from Clayburn village to Abbotsford, slopewash deposits (10) are favourable areas that warrant test drilling in search of potential water supplies for industry or for other uses where large volumes are required.

USE OF GROUND WATER

Most of the wells in Matsqui Municipality supply water domestic and farm use; many are not required to yield more than 500 gallons a day.

Ground water supplies 400 domestic and 6 industrial users in the Clearbrook area. The principal aquifer at a depth of 90 to 100 feet yields in the order of 60 gallons a minute.

A gravel-packed well at Abbotsford airport developed an aquifer at a depth of 33 feet 6 inches to 38 feet 10 inches. Pumping tests carried out on this well in August 1943 indicated a 12 feet 6 inch draw-down pumping at a rate of 158 gallons a minute, and a 17 feet 6 inch drawdown when pumping at a rate of 219 gallons a minute. Static level in the well is 5 feet.

Three wells have been drilled and developed to supply ground water for irrigation. The drilling and development of these wells has already been discussed. In order to carry out average irrigation practices in Matsqui Municipality, agriculturists suggest that irrigation wells be required to yield about 5 gallons of water per minute per acre under irrigation. Therefore, a well yielding 200 gallons a minute would irrigate a 40-acre farm.

Abbotsford Lake is the source of springs that presently supply the village of Abbotsford.

Surface water in Poignant and Downes creeks is dammed and distributed through 14 miles of pipeline to service 230 domestic and 6 commercial users in Matsqui Valley.

CONCLUSIONS AND RECOMMENDATIONS

Most of the ground water pumped from wells in Matsqui Municipality comes from Aquifers of permeable sand and gravel. Channel, flood-plain and outwash deposits function as recharge areas and storage reservoirs. These reservoirs constitute perched or free ground-water aquifers that yield volumes of from 100 to 300 gallons a minute from individual wells. Elsewhere permeable materials underlying glacio-marine deposits and/or till store ground water under confined conditions and yields of 15 to 50 or more gallons a minute are reported from wells that penetrate to such confined aquifers.

Ground water sufficient to supply the more populated centres is available in the Abbotsford outwash, Huntingdon gravel or slopewash deposits. The most favourable areas for the development of large supplies are those in which Abbotsford outwash or Huntingdon gravel has a maximum thickness, or is overlain by slopewash deposits.

The position and extent of confined aquifers underlying glacio-lacustrine deposits and Cloverdale sediments in Matsqui Valley have not been outlined. It is, however, reasonable to consider test drilling in this area when prospecting for large volumes of ground water.

The average temperature of the ground water is 49°F. It has a favourable quality, is obtainable at reasonable depth where it is needed, and the writer believes it would be found in volumes sufficient to meet the demands of the municipality.

When prospecting for ground water in large quantities, drilling programs should include preliminary test holes in order to determine the conditions existing in the materials to be penetrated and therefore to determine the type of final well and construction methods to be used.

CHAPTER VI

QUALITY OF WATER

Water falling as rain is almost pure. As it penetrates the soils and unconsolidated surface deposits mineral constituents are dissolved and the amount and kind of dissolved mineral constituents determine the water's hardness and other chemical characteristics.

In general, ground water in Matsqui Municipality is low in dissolved materials and is satisfactory for most industrial uses. An analytical report on twenty samples analysed by the Mines Branch, Department of Mines and Technical Surveys, Ottawa, is included in this chapter.

The ground water recovered from those confined aquifers below the glacio-marine deposits is characteristically alkaline with an average pH value of 8 and the concentration of sodium and bicarbonate is higher than that found in water from the perched and free ground-water reservoirs. Chloride salts are readily soluble and practically all ground water contains a certain amount of chloride. In all but four samples analysed the chloride concentration was less than 6 parts per million. The four samples with chloride concentrations of 31.9, 43.0, 48.1, and 86.3 parts per million probably represent ground water from permeable sediments below Whatcom glacio-marine deposits and Newton stony clays. However, the recommended limit of chloride in drinking water is 250 parts per million and for irrigation 355 parts per million.

The soap-consuming property of water is called hardness. Hardnesses have been classified by Thomas (1953) as follows:

hardness of 1 to 60 ppm. as $CaCO_3$ - soft water
hardness of 61 to 120 ppm. as $CaCO_3$ - med. - hard water
hardness of 121 to 180 ppm. as $CaCO_3$ - hard water
hardness of more than 180 ppm. as $CaCO_3$ - very hard water

Of the twenty samples included in the table of analyses, thirteen are in the class of soft water, six are medium to hard and one is hard water.

No analyses were made to determine the parts per million of iron. The concentration of iron is commonly low and where present is within limits that can be removed favourably if the water is to be used for industry. Iron remains in solution and the water is clear until exposed to the oxygen in the air whereupon the iron is oxidized and precipitated. This precipitate causes the brownish or reddish stains that occur on porcelain fixtures, laundry and other materials with which the water comes in contact.

The quality of the water was reported by the well owners, with few exceptions, as being clear and soft.

ANALYSES OF WELL WATERS FROM MATSQUI MUNICIPALITY, BRITISH COLUMBIA
(All figures are in parts per million)

Location	Owner	Sum of constituents	SiO_2 (col)	Ca	Mg	Na	K	HCO_3	SO_4	Cl	NO_3	Hardness as $CaCO_3$		
												Total	CO_3	Non-CO_3
NW.15,tp.13	A. Matschke	130.1	19.0	22.5	5.9	10.5	1.9	115.0	6.5	3.2	4.0	80.4	80.4	0.0
NE.19,tp.13	Aldergrove school	148.1	12.5	17.7	4.4	26.6	4.9	146.0	6.9	1.4	1.6	62.3	62.3	0.0
NE.21,tp.13	Aberdeen school	75.6	19.0	12.8	2.8	4.3	0.7	59.6	2.9	1.1	2.4	43.5	43.5	0.0
NW.21,tp.13	C. Newton	125.0	13.0	17.3	6.5	15.8	3.0	120.0	9.3	0.8	0.2	69.8	69.8	0.0
NW.24,tp.13	C.W. Taylor	358.0	19.0	4.6	3.9	129.0	4.7	305.0	0.0	43.0	0.4	27.5	27.5	0.0
NW.25,tp.13	M. Higginson	282.7	17.0	17.6	6.1	75.2	3.4	178.0	25.8	48.1	1.6	69.0	69.0	0.0
SE.26,tp.13	P.J. Unger	329.0	20.0	4.2	3.0	122.0	4.4	348.0	2.1	1.9	0.4	22.8	22.8	0.0
SW.10,tp.14	J.G. Friesen	402.4	28.0	3.3	2.6	150.0	5.4	382.0	11.5	6.5	1.6	18.9	18.9	0.0
NE.11,tp.14	J.R. Friesen	78.7	12.0	9.6	3.1	10.2	1.2	61.7	3.6	0.8	8.0	36.7	36.7	0.0
SE.14,tp.14	J. Simpson	164.5	18.0	25.7	12.4	11.2	3.2	150.0	18.6	1.2	0.8	115.0	115.0	0.0
NE.15,tp.14	J.J. Froese	267.0	15.0	5.3	5.3	84.2	7.4	197.0	20.0	31.9	0.6	35.0	35.0	0.0

Loc tion	Owner	Sum of constituents	SiO_2 (col)	Ca	Mg	Na	K	HCO_3	SO_4	Cl	NO_3	Hardness as $CaCO_3$		
												Total	CO_3	Non-CO_3
NE.5,tp.16	South Poplar school	97.1	19.0	17.3	3.7	4.4	0.9	65.0	3.9	4.1	12.0	58.4	53.3	5.1
SE.7,tp.16	J.H. Willms	60.4	14.0	10.9	1.6	3.3	0.5	36.2	1.0	2.1	10.0	33.8	29.7	4.1
NW.9,tp.16	R. Ratzloff	84.5	20.0	13.6	2.7	4.6	0.7	51.0	5.1	.7	10.0	45.0	41.8	3.2
SE.19,tp.16	Clearbrock Community Well No. 1	73.3	9.9	12.9	2.4	5.0	1.2	60.3	3.8	5.7	0.6	42.1	42.1	0.0
SW.21,tp.16	LSA Motors	89.5	19.0	15.8	4.5	4.1	1.1	66.3	6.6	3.0	2.4	57.9	54.4	3.5
NE.29,tp.16	Val Krivoskein	103.1	22.0	17.1	5.6	6.2	1.3	85.6	5.5	2.4	1.2	63.6	63.6	0.0
SE.29,tp.16	H.D. Pauls	47.6	19.0	8.7	0.6	5.9	1.8	35.5	5.6	1.6	4.0	24.2	24.2	0.0
NW.29,tp.16	Clearbrook elementary school	211.5	31.0	48.4	11.2	6.8	2.9	221.0	1.0	0.8	0.6	167.0	167.0	0.0
SE.30,tp.16	W.F. Thompson	474.2	27.0	5.4	4.0	164.0	4.8	272.0	42.3	86.3	6.0	29.9	29.9	0.0

COMPILATION OF WELL DATA

The following information and abbreviations pertain to the well records of Matsqui Municipality.

Description of well

Type of well

Dr - drilled, well made by standard drilling rig

Dn - driven (sandpoint)

Dg - dug or hand augered

Sp - spring

Th - test hole, commonly drilled, not developed and completed as a water well

Collar elevation

The elevations are with reference to mean sea-level, and are believed accurate to within 5 feet.

Static level

The static level is the level of the water with respect to the ground level at the collar of the well. Where the level is posititve the water rises above the ground and the well is a flowing artesian well.

Principal aquifers

Depth to top

The depths are the reported depths to the top of the main water-bearing deposits, and are believed to be accurate within 5 feet.

Character of material

The character of the material is that observed by the writer or that reported and believed reliable.

Sd - sand

Gr - gravel

F - fine

Formation

Ab - Abbotsford

Hn - Huntingdon

ST - Sumas Till

GL - Glacio-lacustrine deposits

<u>Water</u>

Use

Dm - domestic

Ir - irrigation

St - stock

Mn - municipal

<u>Yield</u> Gals/hr. imperial gallons per hour.

g.p.m. (imperial) gallons per minute.

Not all the yields reported were measured by the writer; some were reported by the well owners and believed reliable.

REPRESENTATIVE WELL RECORDS OF MATSQUI MUNICIPALITY, BRITISH COLUMBIA

Location			Well No.	Description of Well					Principal Aquifers		Water	Yield		Remarks
Tp	Sec.	¼		Type	Casing diam. (in.)	Depth (ft.)	Collar elev. (ft.)	Static level (ft.)	Depth to top (ft.)	Character of material	Formation	Use	Gals./hr.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
13	1	SE	1	Dr	8	42	170	-17	0	Sd gr	Ab	Ir	—	Well screen placed at 32 to 42 ft; developed well yields 250 gals. a minute; drawdown 9 ft.
13	1	NE	2	Dg	-	25	172	-15	0	Sd gr	Ab	Dm	—	
13	2	NE	1	Dg	-	10	162	—	0	Sd gr	Ab	Dm St	—	Three dug wells, each 10 ft. deep, supply water for 20,000 poultry.
13	3	SE	1	Dg	-	22	145	-10	0	Sd gr	Ab	Dm	—	
13	3	NW	2	Dr	4	105	262	-75	100	Gr	—	Dm St	—	Water in a lens of gravel in ice-contact deposits (8b); supplies approximately 1500 gals. daily.
13	4	SW	1	Dg	36	12	139	-4	0	Sd gr	Ab	Dm St	—	
13	8	SE	1	Dr	4	89	302	-49	70	Sd	Hn	Dm St	—	40 ft. gravel and 30 ft. clay above aquifer.
13	9	SE	1	Dr	4	70	241	-48	—	—	—	Dm St	—	
13	10	SE	1	Dr	—	79	155	—	—	—	—	Dm	—	Well at Peardonville school
13	10	NE	2	Dr	4	109	336	-69	—	Sd	—	Dm St	—	Supplies three farms

REPRESENTATIVE WELL RECORDS OF MATSQUI MUNICIPALITY, BRITISH COLUMBIA

LOCATION			WELL NO.	DESCRIPTION OF WELL					PRINCIPAL AQUIFERS		WATER YIELD			REMARKS
Tp	Sec.	1/4		Type	Casing diam. (in.)	Depth (ft.)	Collar Elev. (ft.)	Static level (ft.)	Depth to top (ft.)	Character of Material	Formation	Use	Gals./hr.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
13	11	NW	1	Dr	4	130	337	--	--	Sd	--	Dm St	--	Bottom 40 ft. believed to be now filled with fine sand.
13	12	NW	1	Dr	8	38	--	- 1	18	Sd	Ab	Dm	--	Well at Abbotsford airport; yields 158g.p.m.
13	13	NW	1	Dg	20	25	172	-20	0	Sd gr	Ab	Dm St	--	
13	13	NE	2	Dg	--	25	182	-22	0	Sd gr	Ab	Dm	--	Penetrated 24 ft. sand and gravel and 1 ft. stony clay.
13	15	SW	1	Dr	4	69	361	--	68	Sd	Hn	Dm St	275	Supplies five homes
13	15	NW	2	Dr	4	77	336	-47	75	Sd	Hn	Dm St	500	Sample collected
13	15	NW	3	Dr	4	67	?	-20	45	Sd gr	Hn	Dm	--	Penetrated 45 ft. clay and 22 ft. sand and gravel.
13	16	SW	1	Dr	4	86	363	-44	63,86	Sd gr	Hn	Dm	--	
13	16	SW	2	Dr	4	112	390	-70	86,101	Sd	--	Dm	700	
13	17	SE	1	Dr	4	85	369	-50	75	Sd	Hn	Dm St	--	
13	20	NE	1	Dg	36	24	359	-21	--	Sd	Ab	Dm	--	Supply failed in 1951.

REPRESENTATIVE WELL RECORDS OF MATSQUI MUNICIPALITY, BRITISH COLUMBIA

LOCATION			WELL NO.	DESCRIPTION OF WELL				PRINCIPAL AQUIFERS		WATER	YIELD			REMARKS
Tp	Sec.	1/4		Type	Casing diam. (in.)	Depth (ft.)	Collar elev. (ft.)	Static level (ft.)	Depth to top (ft.)	Character of material	Formation	Use	Gals./hr.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
13	21	NW	1	Dr	4	81	372	-61	78	Sd gr	Hn	Dm	—	Well at Blue Star Motel
13	21	NW	2	Dr	6	99	389	-79	89	Sd	Hn	Dm	—	See chemical analysis
13	21	NE	3	Dr	5	139	420	-127	133	Sd	Hn	Dm	—	See chemical analysis. Well at Aberdeen school.
13	23	NE	1	Dr	4	118	287	-60	—	Sd gr	Hn	Dm Ir	—	Well at Davidson's Nursery
13	23	NE	2	Dr	4	136	301	—	—	Sd gr	Hn	Dm	—	Supplies four houses
13	23	SW	3	TH	6	225	344	—	90	F Sd	—	—	—	Penetrated sand from 70 to 123 ft. and stony clay from 123 to 225 ft. Some water at 90 ft.
13	23	SW	4	Dr	6	360	369	-80?	159	Sd	?	—	—	Penetrated water-bearing sand 159-161 ft., and marine stony clay from 161-360 ft.
13	23	NW	5	Dr	4	86	348	-52	—	Sd	Hn	Dm St	—	
13	23	NW	6	Dr	6	72	360	-57	61	Sd	Hn	Dm	360	Penetrated glacio-marine deposits for 61 ft. and fine to coarse sand from 61 to 72 ft.
13	24	SE	1	Dr	6	16	197	- 2	—	Gr	Ab	Dm	—	

REPRESENTATIVE WELL RECORDS OF MATSQUI MUNICIPALITY, BRITISH COLUMBIA

LOCATION		WELL NO.		DESCRIPTION OF WELL				PRINCIPAL AQUIFERS		WATER		YIELD		REMARKS
Tp.	Sec.	1/4		Type	Casing diam. (in.)	Depth (ft.)	Collar elev. (ft.)	Static level (ft.)	Depth to top (ft.)	Character of material	Formation	Use	Gals./hr.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
13	24	SW	2	Dr	4	198	260	-20	100, 198	Sd	Hn	Dm	—	On pumping, water carries fine sand; settling tanks are recommended.
13	24	SW	3	TH	—	258	273	—	—	—	—	—	—	Drilled a second test hole 230 ft.; penetrated glacio-marine deposits 60 to 200 ft. Some water at 30 ft. in gravel.
13	24	NW	4	Dr	5	220	306	-43	200	Sd	Hn	Dm St	1,000	See chemical analysis
13	25	NW	1	Dr	4	193	250	-128	190	Gr	Hn	Dm St	400	See chemical analysis
13	25	NW	2	Dr	4	256	280	-139	250	F Sd	Hn	Dm St	—	
13	26	SE	1	Dr	4	129	331	-59	129	Sd	Hn	Dm	—	See chemical analysis
13	26	NW	2	Dr	4	148	335	-63	145	Sd gr	Hn	Dm		
13	27	SE	1	Dr	6	109	400	-90	89	Sd	Hn	Dm St	—	
13	29	NE	1	Dr	4	55	348	-44	52	Gr	Hn	Dm St	360	
13	29	SE	2	Dr	4	83	372	—	80	Gr	Hn	Dm St	—	

REPRESENTATIVE WELL RECORDS OF MATSQUI MUNICIPALITY, BRITISH COLUMBIA

LOCATION			WELL NO.	DESCRIPTION OF WELL				PRINCIPAL AQUIFERS		WATER	YIELD			REMARKS
Tp.	Sec.	1/4		Type	Casing diam. (in.)	Depth (ft.)	Collar elev. (ft.)	Static level (ft.)	Depth to top (ft.)	Character of material	Formation	Use	Gals./hr.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
13	33	NE	1	Dr	4	277	360	-170	—	—	—	—	—	Well drilled in 1948; never used.
13	33	SW	2	Dr	4	80	377	—	78	Sd	Hn	Dm St	—	Reported as hard water
13	34	NW	1	Dr	6	134	380	-118	126	Gr	Hn	Dm St	250	
13	35	SE	1	Sp	36	7	325	0	—	—	ST	Dm	—	Spring supplies school. Temp. of water 51°F.
13	36	NE	1	Sp	—	—	94	0	—	—	GL	Dm St	115	
13	36	NE	2	Sp	—	—	108	0	—	—	GL	Dm St	300	
14	1	NW	1	Dr	4	100	296	-85	—	Gr	Hn	Dm St	—	
14	1	NW	2	Dg	30	51	266	-44	6	Gr	Hn	Dm St	—	Penetrated 6 feet Sumas till and 45 ft. of gravel.
14	4	NE	1	Dr	4	75	318	—	—	Sd	Hn	Dm	—	
14	4	SE	2	Dr	5	33	353	—	30	Gr	Hn	Dm	—	Water in gravel below Sumas till-like material
14	5	SE	1	Dr	6	312	330	-215	310?	Sd	Hn	Dm	—	

REPRESENTATIVE WELL RECORDS OF MATSQUI MUNICIPALITY, BRITISH COLUMBIA

LOCATION			WELL NO.	DESCRIPTION OF WELL				PRINCIPAL AQUIFERS			WATER	YIELD		REMARKS
Tp.	Sec.	1/4		Type	Casing diam. (in.)	Depth (ft.)	Collar elev. (ft.)	Static level (ft.)	Depth to top (ft.)	Character of material	Formation	Use	Gals./hr.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
14	9	SE	1	TH	6	243	384	—	—	—	—	—	—	Penetrated stony clay for 243 feet; some sand at 106 ft.
14	9	SE	2	Dr	5	106	325	-90	106	Sd	Hn	Dm St	200	
14	10	NE	1	Dg	—	52	349	-46	—	Sd	Hn	Dm St	—	
14	10	NE	2	Sp	—	6	349	0	0	Sd	ST	Dm St	—	Supplies two farms
14	10	SW	3	Dr	5	205	374	-145	—	Sd	Hn	Dm St	—	See chemical analysis. Log incomplete.
14	11	NE	1	Dr	4	41	241	-31	—	Sd gr	Ab	Dm	—	See chemical analysis
14	12	NW	1	Sp	—	—	206	—	0	Sd	ST	Dm St	—	Water piped to fourteen houses and farms along Mount Lehman road in sec.'s 11 and 12.
14	13	SW	1	Sp	—	—	200	—	0	Sd	ST	Dm St	4,800	Water supplies seven farms
14	14	SE	1	Dr	4	53	255	—	44	Gr	Ab	Dm St	—	See chemical analysis
14	15	NE	1	Dr	4	255	253	-185	225	Gr	?	Dm St	—	S . See chemical analysis. Penetrated 135 ft. of marine clay, 20 ft. of sand and 100 ft. of a second marine clay above aquifer.

REPRESENTATIVE OF WELL RECORDS OF MATSQUI MUNICIPALITY, BRITISH COLUMBIA

LOCATION		WELL NO.		DESCRIPTION OF WELL				PRINCIPAL AQUIFERS		WATER		YIELD		REMARKS
Tp.	Sec.	1/4		Type	Casing diam. (in.)	Depth (ft.)	Collar elev. (ft.)	Static level (ft.)	Depth to top (ft.)	Character of material	Formation	Use	Gals./hr.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
14	16	NE	1	TH	—	280	472	—	—	—	—	—	—	Penetrated 280 feet of marine clay.
14	21	NE	1	Dr	—	300	470	—	300	Gr	Hn	—	—	Well at Jubilee school
14	21	NW	2	Dg	—	23	33	-18	16	Gr	Hn	Dm St	—	
14	27	SE	1	Dr	2	130	21	+10	130	Sd	?	Dm St	—	Water is sulphurous and hard
16	4	NE	1	Dr	4	114	175	-70	0	Sd	Hn	Dm Ir	—	Irrigates ½ acre of land
16	4	NE	2	Dr	4	100	160	-50	60	Gr	Hn	Dm St	—	
16	4	SE	3	Dr	1½	73	102	- 4	42	Gr	Hn	Dm St	—	
16	4	SW	4	Dr	5	118	254	-110	12	Gr	Hn	Dm St	—	Penetrated 12 ft. Sumas till and 106 ft. gravel.
16	5	NE	1	Dr	4	106	221	-90	—	Gr	Ab	Dm St	—	
16	5	SE	2	Dr	4	104	220	-85	—	Gr	Ab	Dm Ir	—	Irrigates 8 acres
16	5	NW	3	Dr	8	81	184?	-50	—	Gr	Ab	Dm Ir	—	Dept. of Agriculture well; yields 240 g.p.m.

REPRESENTATIVE WELL RECORDS OF MATSQUI MUNICIPALITY, BRITISH COLUMBIA

LOCATION			WELL NO.	DESCRIPTION OF WELL				PRINCIPAL AQUIFERS		WATER	YIELD			REMARKS
Tp.	Sec.	1/4		Type	Casing diam. (in.)	Depth (ft.)	Collar elev. (ft.)	Static level (ft.)	Depth to top (ft.)	Character of material	Formation	Use	Gals./hr.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	6	NE	1	Dg	48	55	195	-50	0	Gr	Ab	Dm St	—	
16	6	NE	2	Dg	30	43	185	-31	0	Gr	Ab	Dm St	—	
16	6	NW	3	Dr	6	36	181	-29	0	Gr	Ab	Dm	—	
16	7	NE	1	Dr	6	82	202	-33	76	Gr	Ab	Dm St	—	6 ft. gravel and 70 ft. Sumas till above aquifer.
16	7	NE	2	Dg	36	43	197	-37	0	Gr	Ab	Dm Ir	—	Can irrigate 2 acres only
16	8	NE	1	Dr	4	80	219	-71	18	Gr	Ab	Dm St	—	
16	8	SW	2	Dr	4	106	206	-60	75	Gr	Ab	Dm St	—	
16	9	SE	1	Dg	40	72	174	-65	30	Gr	Ab	Dm St	—	
16	9	SW	2	Dr	4	94	180	-44	—	Gr	Ab	Dm St	—	
16	9	SW	3	Dr	5	136	218	-46	—	Gr	Ab	Dm St	—	
16	16	NE	1	Dg	42	38	179	-33	0	Sd	Ab	Dm St	—	
16	16	SE	2	Dr	6	90	170	-45	85	Gr	Ab	Dm	—	

REPRESENTATIVE WELL RECORDS OF MATSQUI MUNICIPALITY, BRITISH COLUMBIA

LOCATION			WELL NO.	DESCRIPTION OF WELL				PRINCIPAL AQUIFERS		WATER		YIELD		REMARKS
Tp.	Sec.	1/4		Type	Casing diam. (in.)	Depth (ft.)	Collar elev. (ft.)	Static level (ft.)	Depth to top (ft.)	Character of material	Formation	Use	Gals./hr.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	16	SE	3	Dg	36	17	178	-12	6	Gr	Ab	Dm St	—	
16	16	SW	4	Dg	18	76	224	-61	30	Gr	Ab	Dm St	—	Supplies 26 head of stock
16	16	SW	5	Dg	42	36	196	-25	14	Gr	Ab	Dm St	—	
16	16	SW	6	Dr	4	46	185	-34	38	Gr	Ab	Dm St	—	Top aquifer 38 to 46 ft.; test hole encountered a second aquifer at 70 ft.
16	16	NW	7	Dg	36	25	173	-19	—	Sd	Ab	Dm	—	
16	17	NE	1	Dr	4	54	192	-34	50	Gr	Ab	Dm St	—	40 ft. gravel and 10 ft. Sumas till above aquifer.
16	17	SE	2	Dr	6	82	231	-70	63	Gr	Ab	Dm St	—	
16	17	SW	3	Dg	48	35	212	-33	33	Gr	Ab	Dm St	—	30 ft. gravel and 3 ft. Sumas till above aquifer.
16	17	NW	4	Dr	5	112	208	-56	—	Gr	Hn	Dm	300	Well at North Poplar school
16	18	SW	1	Dr	5	138	231	-70	—	Gr	Ab	Dm St	—	Supplies 22 head stock
16	18	NW	2	Dr	6	25	192	-15	0	Gr	Ab	Dm	600	

REPRESENTATIVE WELL RECORDS OF MATSQUI MUNICIPALITY, BRITISH COLUMBIA

LOCATION		WELL NO.		DESCRIPTION OF WELL			PRINCIPAL AQUIFERS			WATER		YIELD		REMARKS
Tp.	Sec.	1/4		Type	Casing diam. (in.)	Depth (ft.)	Collar elev. (ft.)	Static level (ft.)	Depth to top (ft.)	Character of material	Formation	Use	Gals./hr.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	18	NW	3	Dr	4	29	200	-23	0	Gr	Ab	Dm	—	
16	19	SE	1	Dr	10	103	—	-43	93	Sd	Hn	Mn	3,600	Clearbrook well; see chemical analysis
16	19	NW	2	Dr	6	79	200	+ 1	73	Sd	Hn	D	—	Flows at rate of $\frac{1}{2}$ g.p.m.
16	20	NE	1	Dr	6	73	192	-63	—	Gr	Ab	Dm St	—	
16	20	SE	2	Dr	4	80	210	-68	—	Gr	Ab	Dm	—	Well supplies four families
16	20	SE	3	Dr	6	70	216	-35	—	Gr	Ab	Dm St	—	
16	20	SE	4	Dr	4	104	207	-44	—	Gr	Ab	Dm	—	
16	20	NW	5	Dr	4	40	200	-30	0	Gr sd	Ab	Dm Ir	—	Irrigates one acre
16	21	SE	1	Dr	6	74	—	-25	72	Sd	Hn	—	—	
16	21	SW	2	Dr	6	112	—	-52	70	Sd	Hn	—	—	Well at MSA Motors; see chemical analysis
16	22	NE	1	Dg	36	70	212	-65	—	Sd	Hn	Dm St	—	
16	22	NW	2	Sp	—	18	42	-12	—	Sd	Hn	Dm St	—	

REPRESENTATIVE WELL RECORDS OF MATSQUI MUNICIPALITY, BRITISH COLUMBIA

LOCATION			WELL NO.	DESCRIPTION OF WELL			PRINCIPAL AQUIFERS			WATER	YIELD			REMARKS
Tp.	Sec.	1/4		Type	Casing diam. (in.)	Depth (ft.)	Collar elev. (ft.)	Static level (ft.)	Depth to top (ft.)	Character of material	Formation	Use	Gals./hr.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	22	NW	3	Sp.	—	31	58	-22	—	Sd	?	Dm St	—	
16	23	NW	1	Dr	4	71	225	-59	50	Gr	?	Dm St	480	
16	26	SE	1	Dr	6	140	242	—	—	Gr	?	Dm St	—	
16	26	SW	2	Dg	—	57	212	-51	52	Sd	?	Dm St	—	34 ft. sand and 18 ft. till above aquifer.
16	26	SW	3	Dg	36	45	187	-41	—	Sd	?	Dm St	—	
16	27	SE	1	Dg	36	17	44	-12	—	Sd	?	Dm St	—	
16	28	NE	1	Dg	36	40	171	-20	—	Gr	?	Dm	—	
16	28	SW	2	Dr	4	84	202	-35	—	Gr	Ab	Dm St	—	
16	29	NE	1	Dr	4	133	198	-54	106	Sd	?	Dm St	—	See chemical analysis
16	30	SW	2	Dg	—	40	377	-30	39	Gr	Hn	Dm	—	39 ft. till above aquifer.
16	31	NE	1	Dg	—	16	91	- 6	—	Sd	—	Dm St	—	
16	31	NW	2	Sp	—	—	118	—	—	—	—	—	750	

REPRESENTATIVE WELL RECORDS OF MATSQUI MUNICIPALITY, BRITISH COLUMBIA

LOCATION		WELL NO.		DESCRIPTION OF WELL				PRINCIPAL AQUIFERS		WATER		YIELD		REMARKS
Tp.	Sec.	1/4		Type	Casing diam. (in.)	Depth (ft)	Collar elev. (ft.)	Static level (ft.)	Depth to top (ft.)	Character of material	Formation	Use	Gals./hr.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	33	SE	1	Dg	36	24	146	-10	—	Sd	—	Dm St	—	
16	33	NE	2	Dr	5	75	14	—	—	Sd		St	—	50 ft. silty clay above aquifer; see chemical analysis.
16	35	SW	1	T	4	66	—	—	—	—	—	—	—	Penetrated 15 ft. of Sumas till and 51 ft. of blue clay.
17	12	SW	1	Dr	10	55	16	- 9	37	Sd	GL	Dm	2,400	Well at Naval Station