Weyerhaeuser Canada Ltd.
Forest Regeneration & Research Centre
St. Annes Road, R.R. 3, Armstrong, B.C. V0E 1B0
Telephone (604) 546-8711 Telex 048-85316

November 21, 1985

MINISTRY OF ENVIRONMENT
3547 Skaha Lake Rd.
Penticton, B.C. V2A 7K2

ATTENTION: Mr. Steve Holmes

Dear Sir:

Enclosed as requested is the final report from Pacific Hydrology Consultants concerning groundwater development at Grandview Nursery.

The hydrologists reference to test drilling and production wells is somewhat confusing. Hopefully, the attached maps and the following description will clear things up.

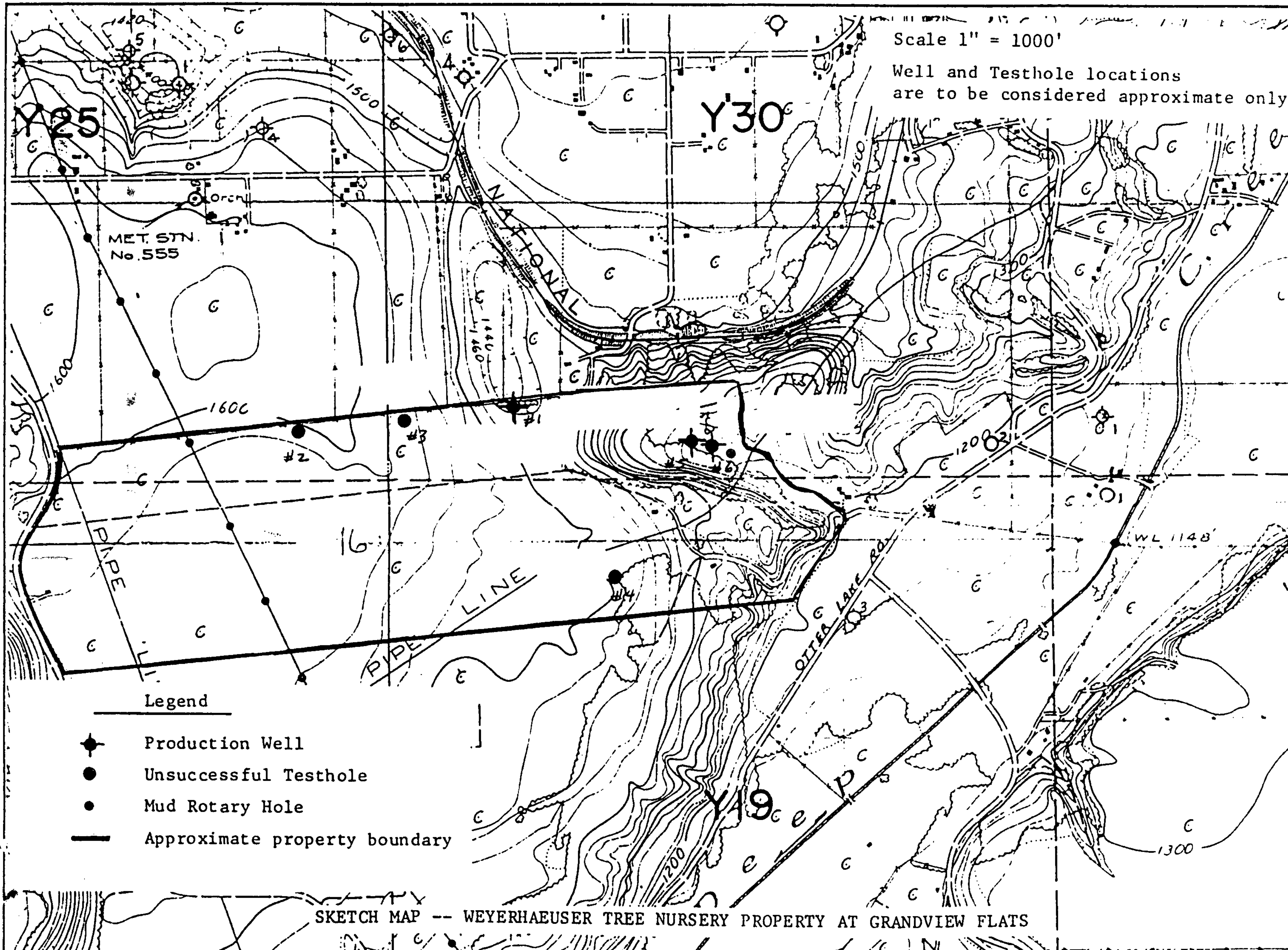
Drill Site	
1	500', Production Well #1
2	116', Bedrock, dry
3	200', Bedrock, dry
4	476', Well abandoned, sand
5	138', Production Well #2
6	296', Well capped, not developed.

Yours truly,
WEYERHAEUSER CANADA LTD.

T.G. Daniels
T.G. Daniels
Nursery Manager

TGD/gw

ENCLOSURES



SKETCH MAP -- WEYERHAEUSER TREE NURSERY PROPERTY AT GRANDVIEW FLATS

E. LIVINGSTON, P. Eng.
A. BADRY

PACIFIC HYDROLOGY CONSULTANTS LTD.

CONSULTING GROUNDWATER GEOLOGISTS

Trudy - Save original for us.

December 8, 1980

Weyerhaeuser Canada Ltd.,
P.O. Box 551,
Armstrong, B.C.
V9E 1B0

Attention: Mr. T. John Drew,
Manager, Forest Regeneration & Research.

Dear Sir,

Re: Groundwater Exploration and Development,
Grandview Flats

The purpose of this letter-report is to record the results of the test drilling program carried out in 1979 and 1980 to obtain a supply of irrigation water for the Weyerhaeuser tree research facility located north of Vernon near O'Keefe. Background information is contained in a number of letters and progress reports. This report includes information taken directly from earlier correspondence. This report is meant to be a complete record of the work carried out.

BACKGROUND

We were contacted in July, 1979 to design and supervise a test drilling project for Weyerhaeuser on a piece of property in the Grandview Flats area north of Vernon. The object of the program was to investigate the availability of groundwater on a parcel of land on which development of a tree nursery was being considered. As much as 1000 gpm was desired for the facility.

From our knowledge of the Grandview Flats area we felt there was a chance of obtaining a moderate quantity of groundwater at the site and that a test drilling program could be justified. The northern part of the property was located on the kettled post-glacial delta in which a well constructed in 1964 for Grandview Flats Improvement District had been successful in locating an aquifer of fairly high capacity. The local hydrology and geology of the Grandview Flats area is discussed in greater detail later in this report.

Two test drilling projects were carried out. The first in 1979 on the upper nursery property, consisted of drilling four test-production wells one of which was completed as an 8" diameter production well. In 1980 a second drilling program was carried out on land adjoining the nursery site on the east. 8" and 10" diameter production wells were constructed along with a 600 ft. exploratory testhole drilled with mud rotary equipment.

A sketch map included in the Appendix shows the approximate locations of all testholes and wells drilled as part of this program. The unsuccessful testholes are numbered consecutively; the production wells are also numbered consecutively according to the order in which they were completed.

TEST DRILLING AND WELL CONSTRUCTION - 1979

The test drilling, with the exception of the mud-rotary exploratory testhole drilled by Okanagan Water Well Drilling Ltd., in 1980, was carried out by Thomas Well Drilling and Pump Sales Ltd., of Lumby, using the cable tool method.

Test-production Well No. 1 (Production Well No. 1)

The first test-production well was completed as an 8" diameter production well. Its log is as follows:

0	-	16 ft.	soil
16	-	48 ft.	sandy clay
48	-	124 ft.	clean gravel
124	-	234 ft.	brown silty sand
234	-	320 ft.	grey silty sand
320	-	390 ft.	grey sandy clay
390	-	415 ft.	compact cemented sand
415	-	425 ft.	sand, water-bearing
425	-	500 ft.	grey fine silt

WTN 41502

The static level in the water-bearing sand is about 276½ ft. below ground.

cont'd... 3

The hole was drilled with 10" diameter casing to 300 ft.; below 300 ft. drilling continued with 8" diameter casing to 500 ft. The well is completed with a ten foot long, eight-inch diameter nominal stainless steel well screen assembly consisting of 0.050" slot screen over 5 ft. of 0.025" slot screen with the bottom set at 425 ft. Plots of sieve analyses used to select a screen are appended. A type K packer is installed at the top (410 ft.) of a five foot riser above the screen; at the bottom is a bail bottom. Well development was carried out by surging and bailing. Following development a pump test was carried out. The pump test is discussed later in this report.

Test-production Well No. 2 (Testhole No. 1)

Following completion of the first production well, the capacity of which was rated at 260 USgpm, further drilling was carried out on the property in an effort to obtain additional water. The second hole was located along the north boundary with the idea of trying to locate an aquifer in the upper deltaic sediments. It was unsuccessful. It was sited about 2500 ft. west of the successful well.

The log of TH 1 is as follows:

0	-	8 ft.	soil
8	-	106 ft.	sand, gravel, clay binder
106	-	116 ft.	bedrock

The presence of rock at such shallow depth was unexpected so a third hole was drilled further east toward the successful well where depth to rock is over 500 ft.

Test-production Well No. 3(Testhole No. 2)

Although the depth to bedrock in the second testhole was somewhat deeper, the hole was unsuccessful in locating an aquifer above rock.

cont'd... 4

The log of the hole is as follows:

0	-	6ft.	soil
6	-	38 ft.	sandy gravel
38	-	92 ft.	gravel
92	-	196 ft.	sand, gravel, clay binder
196	-	200 ft.	bedrock

In an effort to obtain additional water from the valley fill below the deltaic sediments, with the idea of constructing a similar well to Production Well No. 1, a third testhole was drilled in the southeast corner of the property.

Test-production Well No. 4 (Testhole No. 3)

Testhole No. 3 encountered a thin aquifer; sieve analyses of the water-bearing material were carried out and the well was completed with a screen.

The log is as follows:

0	-	8 ft.	soil
8	-	105 ft.	sand and gravel, dry
105	-	430 ft.	silty clay
430	-	465 ft.	very fine silty sand
465	-	476 ft.	fine sand

The hole was drilled to 375 ft. with 10" diameter casing and to 476 ft. with 8" diameter casing.

A screen assembly consisting of 5 ft. of 0.010" slot screen over 5 ft. of 0.020" slot Johnson's stainless steel 8" nominal screen was set from 466 to 476 ft. Development was carried out by bailing and pumping. During pumping however, fine silty material from the unit overlying the aquifer suddenly moved down into the screen and the test pump began pumping sand. We recommended that no further work be done on the well and that the well be abandoned. Past experience has shown that rehabilitation is seldom successful under such conditions. In this situation there were two reasons why rehabilitation efforts were not likely

cont d... 5

to be successful:

1. the aquifer is thin
2. the aquifer is overlain by a thick section of very fine silty sand.

There is no way of assessing the extent of the thin coarser part of the valley fill sediments; the coarser part in which the screen was set is probably a small local lens. The small lens of sand would be put under stress by pumping causing it to collapse and admit fine silty sand from above. This process is very difficult to stop, particularly when the coarser aquifer sediments are so thin.

Conclusions and Options for Additional Water

Following the construction of one production well and the drilling of the three unsuccessful testholes we believed that the exploration program had exhausted the possibilities of obtaining additional groundwater at economic cost on the Weyerhaeuser nursery property. The options for obtaining more water for operation of the tree research facility were:

1. Obtain water from the Grandview Flats Improvement District.
2. Carry out further test drilling east of the property at the foot of the terrace slope.

We suggested that since the property lies within the Grandview Flats Improvement District it might be possible to obtain irrigation water from the District. Even if the District did not have sufficient well capacity there was a good chance for the District to obtain additional water from a well or wells in the general vicinity of the District's present well. We believed that it might be possible to make an arrangement to obtain water from the District and that this option should be considered.

Test drilling east of the property at the foot of the terrace slope was also an option to consider even though there was no information on the availability of groundwater in that area.

cont'd... 6

TEST DRILLING AND WELL CONSTRUCTION - 1980

The decision was made to continue test drilling on property lying east of the original parcel. This drilling got underway in April and was completed in September with the drilling of a 600 ft. mud-rotary testhole. The program resulting in the construction of two additional production wells.

Test-production Well No. 5 (Production Well No. 2)

Drilling of Production Well No. 2 began with 10" diameter casing with the idea of reducing to 8" diameter if necessary. As it turned out the well was completed as a 10" diameter well.

The log of Well No. 2 is as follows:

WTN 45000

0	-	5 ft.	loose top soil and rocks
5	-	12 ft.	brown sand and rocks
12	-	77 ft.	dry brown sand
77	-	108 ft.	sand, water-bearing
108	-	138 ft.	water-bearing fine sand, slot size less than 0.008"

At a depth of about 140 ft. the casing was very tight. The options were:

1. pull the 10" casing back to 108 ft. to test the water-bearing sand between 77 and 108 ft. or,
2. reduce to 8" casing and continue drilling.

The decision was made to pull back to the bottom of the sand and set a screen for testing. The 10" casing was pulled back with power jacks and the hole back-filled with gravel.

In the meantime, sieve analyses of sand samples had been carried out by Interior Testing Services Ltd., in Kelowna. An 8" screen, 10 ft. long, was selected and sent to the job along with a 2 ft. long 7" I.D. riser pipe and an 8" to 10" reducing packer. The top of the packer is at 95 ft. below ground. The well was developed by bailing with the production of very little sand. A turbine

cont'd... 7

test pump was set and the well tested. The maximum pumping rate with the pump intake at about 88 ft., was only about 20 igpm. This was much less than the preliminary estimates based on the character of the aquifer. The pump was removed and the well was surged in an effort to improve performance. Surging produced very little sand and did not seem to improve performance, so the decision was made to remove the installed screen which had .020" slot openings and replace it with a screen with .025" openings in an effort to improve performance.

A bail test immediately after the screen had been set,indicated that the well capacity was higher than previously. The well was then developed by surging for several hours. This brought in more sand than with the finer screen, but not enough to indicate that the screen was too coarse. When surging did not seem to be having any further effect and produced very little sand it was stopped, the test pump reinstalled and pump testing carried out. This is discussed later in this report.

Test-production Well No. 6 (Production Well No. 3)

Following completion of Well No. 2 it was decided to move a few hundred feet in an easterly direction and drill deeper with the idea of looking for a coarser part of the saturated valley fill at a greater depth. Drilling started as 10" diameter to 207 ft. Drilling continued as 8" to about 296 ft. at which depth the casing was getting very tight.

The log of Well No. 3 is as follows: WTN 45688

0	-	66 ft.	brown sand
66	-	98 ft.	grey sand, water-bearing
98	-	116 ft.	clay, sandy
116	-	163 ft.	silt
163	-	296 ft.	fine water-bearing sand

A screen was selected on the basis of sieve analyses of samples collected every few feet in the interval from 280 to 296 ft. A 6" diameter 17 ft. long screen assembly consisting of 12 ft. of 0.015" slot over 4 ft. of 0.012" slot Johnson's stainless steel screen was set from 280 to 296 ft. At the top (279 ft.) is an 8" to 6" reducing type K packer.

cont'd ... 8

Development was carried out by bailing and pumping after which a pump test was carried out. This is discussed later in the report.

Mud-rotary Exploratory Testhole

The drilling of Production Wells No. 2 and No. 3 had shown the difficulty of advancing casing through the fine-grained valley fill materials. The original intention had been to try to drill as deep as 500 ft. into the valley fill. This was considered to be a reasonable depth in which to expect to obtain water of acceptable quality which could be pumped at reasonable cost.

Since there was still a chance that a moderate capacity aquifer could be located within the 500 ft. depth, a number of options to explore for such an aquifer were considered. The decision was made to drill a mud-rotary exploration hole and to E-log it. If such a hole located an aquifer a well construction method could be devised to develop it.

Several contractors operating mud-rotary equipment were contacted and prices were obtained by telephone. Okanagan Water Well Drilling of Vernon quoted rates which were clearly the lowest. They started work on August 20 and completed the drilling and electic log and gamma log the next day. The testhole was drilled to 600 ft. The hole passed through the upper sand aquifer and the lower sand aquifer found in nearby Wells No. 2 and No. 3, and continued to 600 ft. in compact fine silty sand and compact silt. Drilling was started with clear water with only small losses in the two sand aquifers. A standard bentonite type drilling mud was used in drilling the lower part of the hole to prevent caving and to improve the quality of samples.

The driller's log of the rotary testhole is as follows:

WTN 45887

0	-	46 ft.	fine sand, dry
46	-	48 ft.	silty clay
48	-	74 ft.	very fine silty sand
74	-	75 ft.	silty clay
75	-	102 ft.	clean coarse sand, very fresh water
102	-	107 ft.	grey clay
107	-	242 ft.	silt with few layers of grey clay
242	-	258 ft.	very fine silty sand
258	-	422 ft.	compact silt with 50% very fine mica

cont'd... 9

422 -	584 ft.	compact silt, less mica, with clay layers one to two ft. thick every 8 to 10 ft.
584 -	592 ft.	grey silty clay
592 -	600 ft.	fine silty sand

Three logs were run using the contractor's E-logging equipment. Resistivity and self potential logs were run simultaneously. A gamma log was run separately. Copies of the logs are included in the Appendix to this report. We have added a few pencil notes to explain our interpretation of the logs.

There is little doubt from all the logs that the results of the deep drilling are negative. There is no aquifer between the lower sand aquifer and 600 ft. which is capable of yielding a significant amount of water.

PUMP TESTING

Pump testing of each of the three Production Wells was carried out by Thomas Well Drilling after completion. A deep well turbine test pump was used for testing. The discharge rate was measured by means of a standard circular orifice. Water levels during testing were measured by an electric water level indicator. Data collected during testing along with standard straight line plots of the data are included in the Appendix. The data have been plotted on semi-logarithmic paper, drawdown vs. time since starting and for the recovery, residual drawdown vs. the ratio $\frac{\text{time since start of pumping}}{\text{time since pumping stopped}}$.

Test-production Well No. 1 (Production Well No. 1)

Following construction Production Well No. 1 was pumped at a constant rate of 256 USgpm for 1440 minutes. The pumping water level became approximately stable at 374½ ft. below ground after about two hours of pumping and remained stable for the duration of testing.

cont'd... 10

Plots of both drawdown and recovery are curved lines with short straight line segments. We believe that these plots show that the aquifer is a leaky artesian aquifer with significant recharge from the less permeable beds above and below. This is what we would expect in this geologic and hydrologic setting. Without an observation well it is not possible to calculate the aquifer characteristics. Calculation of these characteristics is not necessary.

We feel that the data show that the well is quite efficient, i.e. well losses are quite small. This is indicated by the small drawdown during the first few minutes of pumping. This means that the present well is getting about as much water as is possible at this site. Other wells should not be constructed in this aquifer near the present well in order to avoid well interference.

Drawdown during the test at 256 USgpm was about 95 ft. This gives a specific capacity of 2.7 USgpm per ft. of drawdown.

Test-production Well No. 5 (Production Well No. 2)

Production Well No. 2 was pump tested for 11 hours at about 70 igpm with a total drawdown of about 10.2 ft. The time to fill a 45 igal drum was used to measure the discharge rate. The pumping water level became stable at about 81½ ft. below the top casing, cut off 1 ft. above ground, a few hours after the start of pumping. Early readings of the drawdown are not available as difficulty was experienced in regulating the discharge rate. For this reason the recovery data have been analyzed to obtain aquifer characteristics.

Immediately after the pump was stopped, the water rose quite rapidly because of the rush of water into the well from the pump column. It then fell as this water dispersed and then started a slow rise toward the static level.

A plot of the residual drawdown vs. log of the ratio $\frac{\text{time since pumping started}}{\text{time since pumping stopped}}$ indicates that the transmissivity is about 10^5 USgal/day/ft. This is very high, particularly for a sand aquifer of limited thickness. The specific capacity of the well, which is about 8 USgpm/ft. drawdown, should be much higher for such high transmissivity.

cont'd... 11

The measurement of transmissivity by pump testing is not limited to the section of the aquifer which is screened: in this case, the sand above the 106 foot depth. The underlying very fine sand which is permeable and may be very thick, also contributes to the flow and may therefore be part of the aquifer with very high transmissivity. In such situations it may not be possible to construct efficient wells.

Test-production Well No. 6 (Production Well No.3)

Pump testing of Production Well No. 3 was carried out on July 29th. Pumping started at a rate of 82 USgpm and was increased to 107 USgpm for the last four hours of pumping. At 107 USgpm the pumping water level became stable at approximately 253 ft. below ground. At the initial rate of 82 USgpm the water level draws down very rapidly in the first two minutes of pumping; it then draws down slightly until ten minutes after the start when it becomes approximately stable until 32 minutes when the discharge rate is increased.

The transmissivity of the fine-grained aquifer, calculated from the early part of the plot of the drawdown data, indicates that the transmissivity is the order of 940 USgal/day/ft. This is very low and indicates that moderate to high capacity wells cannot be constructed in this aquifer.

Pumping of Production Well No. 3 at 107 USgpm caused 193 ft. of drawdown. This gives a specific capacity of 0.5 USgpm/ft. of drawdown. The specific capacity of 0.5 USgpm/ft, is about as good as can be expected from the indicated transmissivity.

The more permeable part of the fine-grained valley fill at this location does not respond to pumping in the same way as does the aquifer at the site of Production Well No. 1, also contained within the valley fill. We conclude that the surrounding beds are not able to supply water to the aquifer by leakage as readily as in the case of the aquifer in which Production Well No. 1 is constructed. That is, the fine-grained valley fill becomes less permeable in an easterly direction.

cont'd... 12

Unfortunately the recovery data for Production Well No. 3 are incomplete. Extrapolation of available data indicates an S-type curve. A plastic pipe was strapped to the pump column. The electric well line was lowered through the plastic pipe for taking water level measurements. The pipe became constricted for some unknown reason during recovery and no readings are available after about half an hour after pumping stopped. The next morning when the pump and pipe were pulled a check of the water level showed that complete recovery had occurred.

WELL CAPACITIES

Standard procedure in calculating well capacity is to consider use of 70% of the available drawdown. In some situations either higher or lower factors of safety are applied. In our opinion a 20% factor of safety is adequate in this situation where the wells are to be used for irrigation purposes. It is particularly important in situations where a reduced factor of safety is used, that well head installations include water meters and provisions for measuring water levels. Regular records of consumption along with information on pumping and non-pumping water levels allow well and aquifer performance to be monitored on an ongoing basis.

Table I summarizes various dimensions of the Production Wells used in calculating well capacities. The specific capacity used for calculating the capacity of Wells No. 1 and No. 3 is that calculated during the pumping test at a stabilized pumping level. In the case of Well No. 2 the specific capacity has been reduced to calculate well capacity in order to allow for reduced specific capacity at an increased pumping rate. Table II indicates expected pumping levels at use of 70 and 80% of the available drawdown.

GEOLOGY

In light of this additional drilling on Grandview Flats it is worthwhile to review the geology of this area,particularly as it relates to

cont'd... 13

TABLE II Summary Table - Well Capacity and Expected Pumping Level

Weyerhaeuser Production Wells At Grandview Flats

Well No.	Well Capacity (US gpm) @70% available drawdown	@80% of available drawdown	Est. Pumping Level @ 70% available drawdown	@80% of available drawdown
1	260	297	372 1/2	386 1/2
2	144	165	87 1/2	90
3	77	88	213	235

development of groundwater. The major topography of the area was sculptured by repeated regional ice advances from the north. The ice tended to excavate and deepen existing rock valleysand remove most of the overburden from upland areas. Each ice advance removed older glacial deposits. During each glacial episode, deposition of sand and gravel took place during the time of melting when a large volume of dirty water was produced.

In this part of the Okanagan Valley, the final glacial episode was a rather short event which occurred immediately after the melting of the last regional ice. This event was marked by accumulation of ice in upland areas and rapid advance of local ice tongues down many of the larger creek valleys. These ice tongues usually did not advance out into the main valley, but in a few places they were extensive enough to block major drainage, producing very large lakes. Such a lake filled the Okanagan Valley; the thick, light-coloured silty bluffs are remnants of fine-grained sediments deposited in the lake. The extensive 1600 ft. terraces in the Okanagan Valley show that the lake level remained at this elevation for a considerable period of time before draining of the lake brought the level down to its present elevation of about 1120 ft.

At various places in front of the ice tongues, major deltas were built into the lake. When the lake level dropped, these deltas remained and are referred to as raised deltas. The main terrace making up Grandview Flats is such a raised delta overlying the main valley fill. The sediments of the raised delta were deposited close to the source of sediment and as a result are more coarse grained than the underlying valley fill. The well supplying Grandview Flats Improvement District is constructed in deltaic sediments.

There are a number of kettles in the Grandview Flats-O'Keefe area. Several of these are quite large, the largest being Round Lake. These are all in the extensive 1600 ft. terrace. The presence of the keetles in the 1600 ft. terrace indicates that blocks of ice were buried in the delta at the time of deposition.

The recent drilling programs were not successful in locating an aquifer in the deltaic materials over the valley fill. The transition from the deltaic sediments to the valley fill is difficult to define but in Production Well No. 1 is probably at about 124 ft. below ground. This elevation would fit the conditions at the Grandview Flats well. Testholes 1 and 2 to the west encountered

cont'd... 16

dry deltaic sands and gravels over bedrock. The third testhole to the south encountered 105 ft. of dry sand and gravel of the deltaic sequence over the fine-grained valley fill, confirming that the deltaic sections thins in a southerly direction and is drained because of its relatively high topographic position.

GROUNDWATER RESOURCES - GRANDVIEW FLATS AREA

The foregoing discussion on the geology of the Grandview Flats area makes reference to the two kinds of aquifer in the area. These are the deltaic aquifer in which the Grandview Flats Improvement District well is constructed and aquifers within the underlying valley fill.

The present drilling programs have demonstrated that the productive deltaic aquifer does not extend south as far as the Weyerhaeuser property. The deltaic sequence over the valley fill at this location is drained because of the relatively high topographic position. The maximum thickness of the deltaic aquifer on the Weyerhaeuser property was encountered in Production Well No. 1 where the aquifer extended to 124 ft. below surface.

The exploration program on the Weyerhaeuser nursery property, along with other drilling experience in the Grandview Flats area, has demonstrated that it is possible to construct low to moderate capacity wells in the valley fill. It is not possible to predict the location of more permeable parts of the valley fill other than by test drilling. The character, thickness and extent of these more permeable zones controls the amount of water which wells are capable of withdrawing on a continuous basis. The character of the valley fill surrounding the aquifer at any particular location may also be a constriction, as it controls recharge to the aquifer.

In terms of the total groundwater resource in the Grandview Flats area, the amounts of withdrawal by the Weyerhaeuser wells is insignificant. The very permeable kettled outwash area to the north provides excellent recharge to the

cont'd... 17

regional groundwater flow system moving south toward the main Okanagan Valley via the valley in which Grandview Flats is located. In addition to the main longitudinal component of groundwater flow down the valley, recharge occurs from the sides of the valley.

The Weyerhaeuser wells are constructed in local permeable parts of the main valley fill. There is little likelihood that construction of wells by others to obtain water from the main groundwater flow system in the valley will have an effect on the capability of the system to provide water to the Weyerhaeuser wells. The local nature of aquifers in the valley ensures that interference will only occur between closely spaced wells in the same aquifer.

ADDITIONAL GROUNDWATER

The two recent drilling programs have ruled out the possibility of locating a high capacity aquifer on the Weyerhaeuser property. The deep valley fill aquifer in which Production Well No. 1 is constructed has been shown to be intermittent, has only low to moderate capacity and is expensive to develop. The shallow aquifer encountered near the eastern edge of the property is relatively inexpensive to develop and is capable of yielding a moderate amount of water to wells. If a slightly thicker or deeper part of the shallow aquifer could be located it might be possible to obtain slightly more water, perhaps as much as 200 gpm from a single well.

If more wells are constructed in this aquifer the question of well interference must be considered. Approximate calculations show that a well pumping 250 USgpm at a distance of 250 ft. will cause 3 ft. of drawdown in Production Well No. 2. Although this is highly speculative and is based on several assumptions, 250 ft. is a reasonable distance to move to construct a second production well in the shallow aquifer. Careful testing of such a well will provide more accurate information on which to decide spacing for additional wells.

cont'd... 18

It is now fairly clear that to construct high capacity wells it is necessary to go a considerable distance north of the north property boundary.

WATER QUALITY

Included in the Appendix to this letter-report are chemical analyses of water samples collected from Production Well No. 2, constructed in the valley fill aquifer, and from the Grandview Waterworks District well constructed in the deltaic aquifer.

Both groundwaters are quite hard and quite highly mineralized. The groundwaters may be classed as calcium-magnesium-bicarbonate type waters.

The only significant difference between the two waters is the lower amount of sulphate in Grandview Waterworks District water. It is slightly less hard than the other water. The differences are too slight to speculate very much about the cause but it may be that the groundwater from the Grandview aquifer is from a shallower more rapidly moving flow system. The differences in water chemistry between groundwater from the upper deltaic and lower valley fill aquifer are less than expected.

SUMMARY

1. Three production wells have been constructed as part of a 7 hole exploration program to obtain groundwater for a nursery facility in the Grandview Flats area near Vernon.

2. The three production wells are constructed in a more permeable part of the valley fill aquifer. The deltaic aquifer in which the Grandview Flats well is constructed thins in a southerly direction and is drained on the Weyerhaeuser property.

3. The capacities of the production wells rated at use of 80% of the available drawdown are 300, 150 and 85 USgpm.

cont'd... 19

4. The groundwater is quite hard and quite highly mineralized.

5. The well head installations should include provisions for monitoring production along with pumping and non-pumping water levels. This is particularly important in this situation where the wells are to be utilized at use of 80% of the available drawdown.

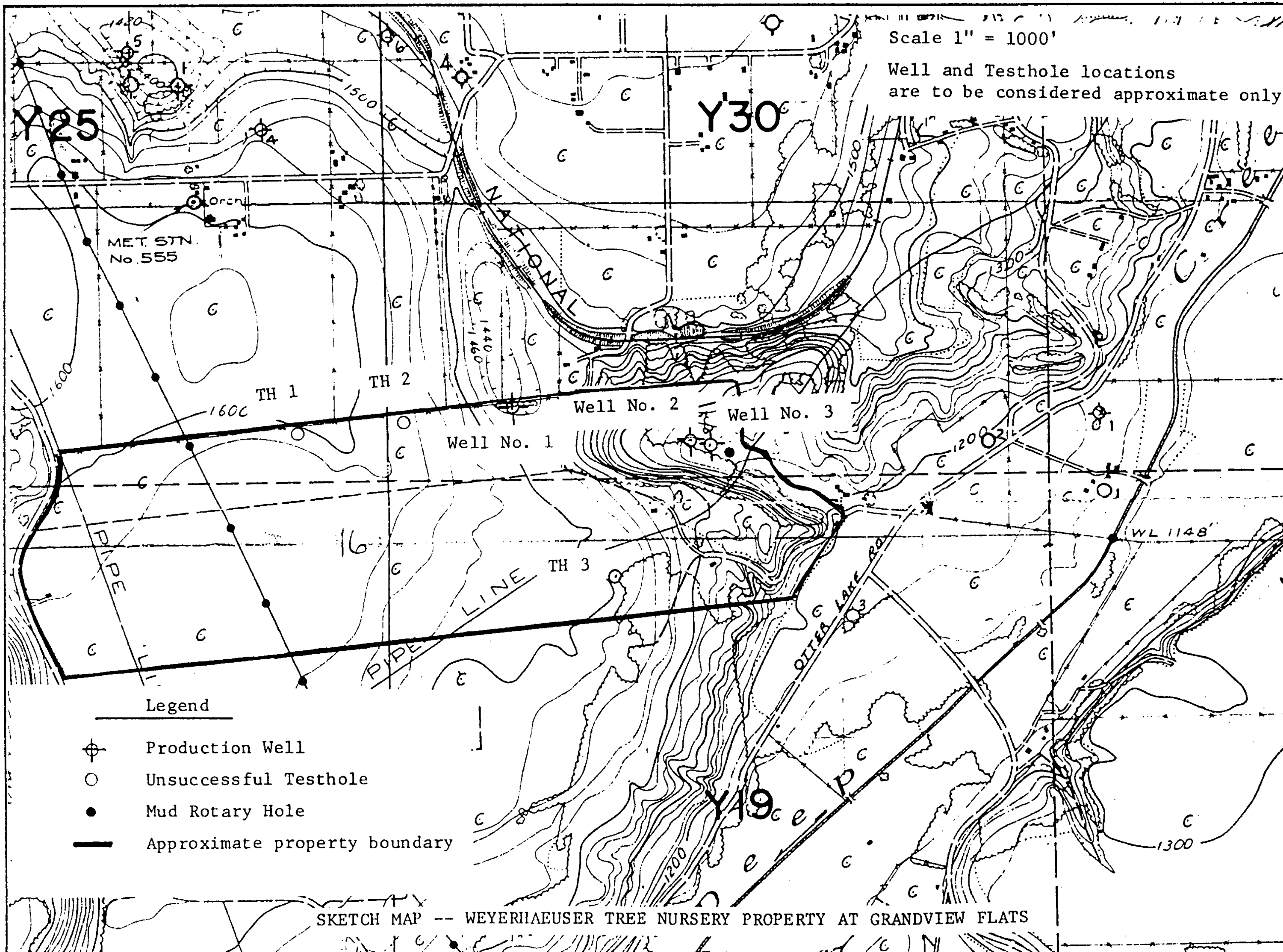
Yours truly,

PACIFIC HYDROLOGY CONSULTANTS LTD.

A. Badry, Geologist

AB:jb

encls.



SKETCH MAP -- WEYERHAEUSER TREE NURSERY PROPERTY AT GRANDVIEW FLATS

Weyerhaeuser Production Well No. 1

Johnson Division
P.O. Box 43118 · St. Paul, Minnesota 55164
Telephone 612-636-3900 · Telex 29-7451
uop Inc.

SAND ANALYSIS (FINE)

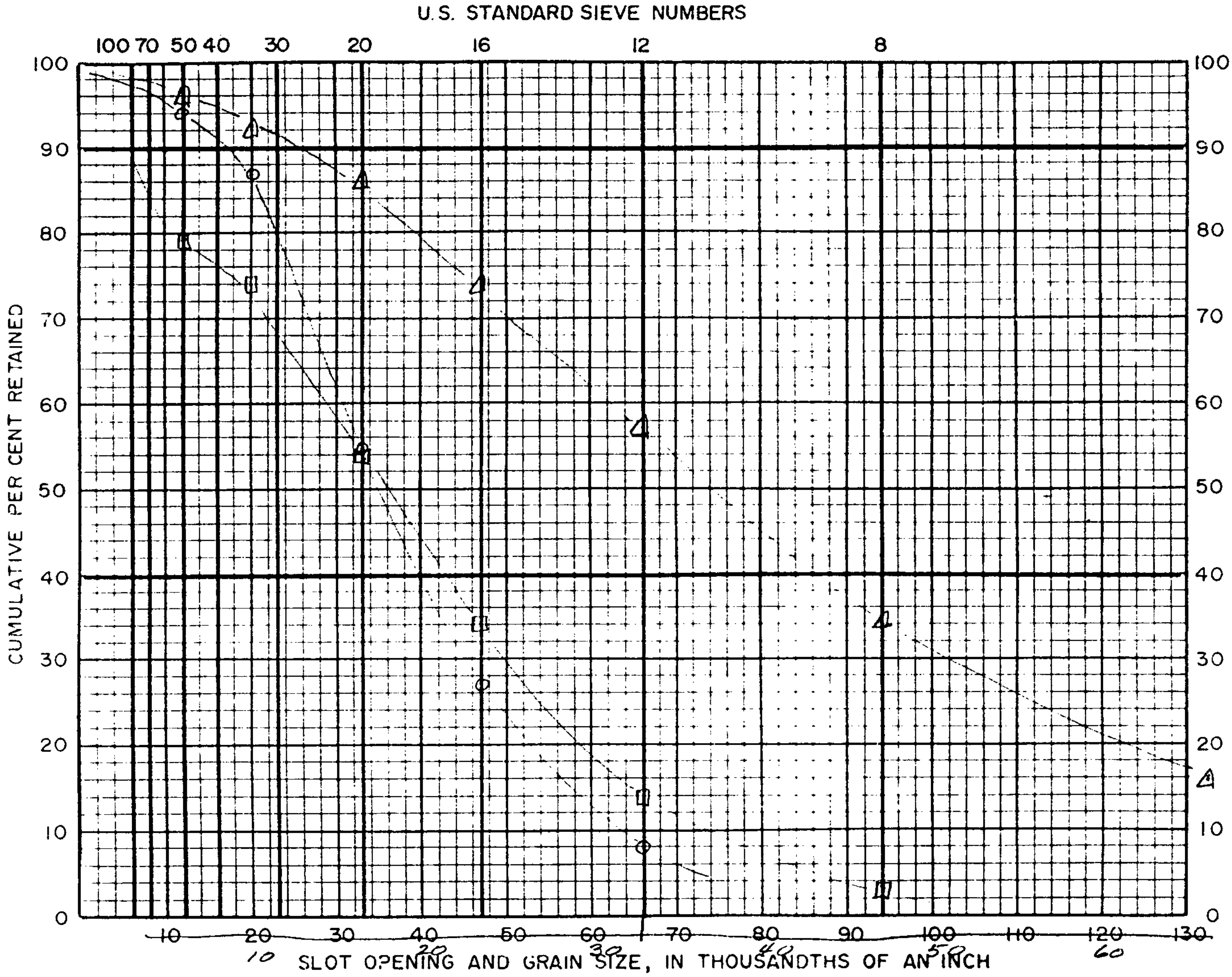
MAILING ADDRESS: P.O. BOX 3118
ST. PAUL, MINNESOTA ■ 55165

Sample sent in by Thomas Dolling

Town ______ State ______ Zip ______ Date Aug/79

From well of Weyerhauser Production Well No. 1

Remarks: Grandview Flats



O423 □425 △415

U.S. SIEVE NO	SIEVE OPENING INCHES	SIEVE OPENING MM.	CUMULATIVE % RETAINED					
6	.132	3.36						
8	.094	2.38						
12	.066	1.68					96	16
16	.047	1.19			5	3	203	34
20	.033	0.84	20	8	25	14	340	57
30	.023	0.60	69	27	62	34	447	74
40	.016	0.42	139	55	100	54	515	86
50	.012	0.30	221	87	137	74	555	92
70	.008	0.21	237	94	145	79	580	96
100	.006	0.15						
			253		184		602	

20(23) 22(25) 45(50)

Notes:

Recommended Slot Opening:

Recommended Screen Dia. ______ in. Length ______ Ft.

By:

Johnson Division
P.O. Box 43118 · St. Paul, Minnesota 55164
Telephone 612-636-3900 · Telex 29-7451
UOP Inc.

SAND ANALYSIS
(FINE)

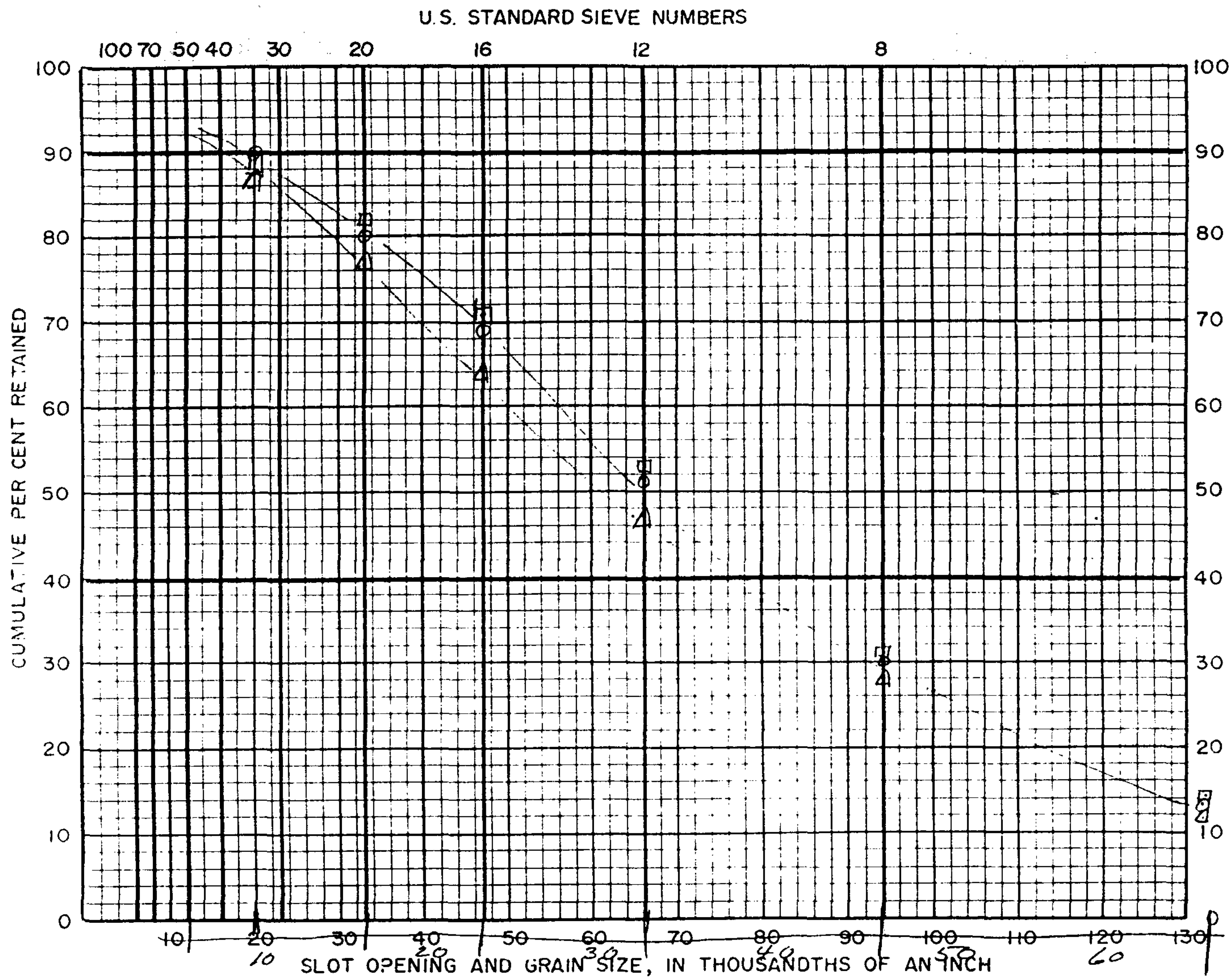
MAILING ADDRESS: P.O. BOX 3118
ST. PAUL, MINNESOTA • 55165

Sample sent in by *Thomas Drilling*

Town State Zip Date *Aug/79*

From well of *Weyerhauser Production Well No. 1*

Remarks: *Grandview Flats*



○ 417 □ 419 △ 421

U S SIEVE	SIEVE OPENING		CUMULATIVE % RETAINED					
NO	INCHES	MM						
6	.132	3.36						
8	.094	2.38						
12	.066	1.68	26	13	67	14	36	12
16	.047	1.19	58	30	143	31	80	28
20	.033	0.84	99	51	249	53	136	47
30	.023	0.60	133	69	330	71	185	64
40	.016	0.42	156	80	383	82	223	77
50	.010	0.30	175	90	416	89	251	87
70	.008	0.21	183	94	439	94	273	94
100	.006	0.15						
		total	194		466		290	

40(45) 40(45) 40(45)

Notes: *Selected screen 5 ft of .040 over 5' of .020. Screen installed 5 of .050 over 5' of .025 EL*

Recommended Slot Opening:

Recommended Screen: Dia. in. Length Ft.

By:

SO MANY CONSIDERATIONS ENTER INTO THE MAKING OF A GOOD WELL THAT, WHILE WE BELIEVE SLOT SIZES FURNISHED OR RECOMMENDED FROM SAND SAMPLES ARE CORRECT WE ASSUME NO RESPONSIBILITY FOR THE SUCCESSFUL OPERATION OF JOHNSON WELL SCREENS.

PUMP TEST -- Production Well No. 1

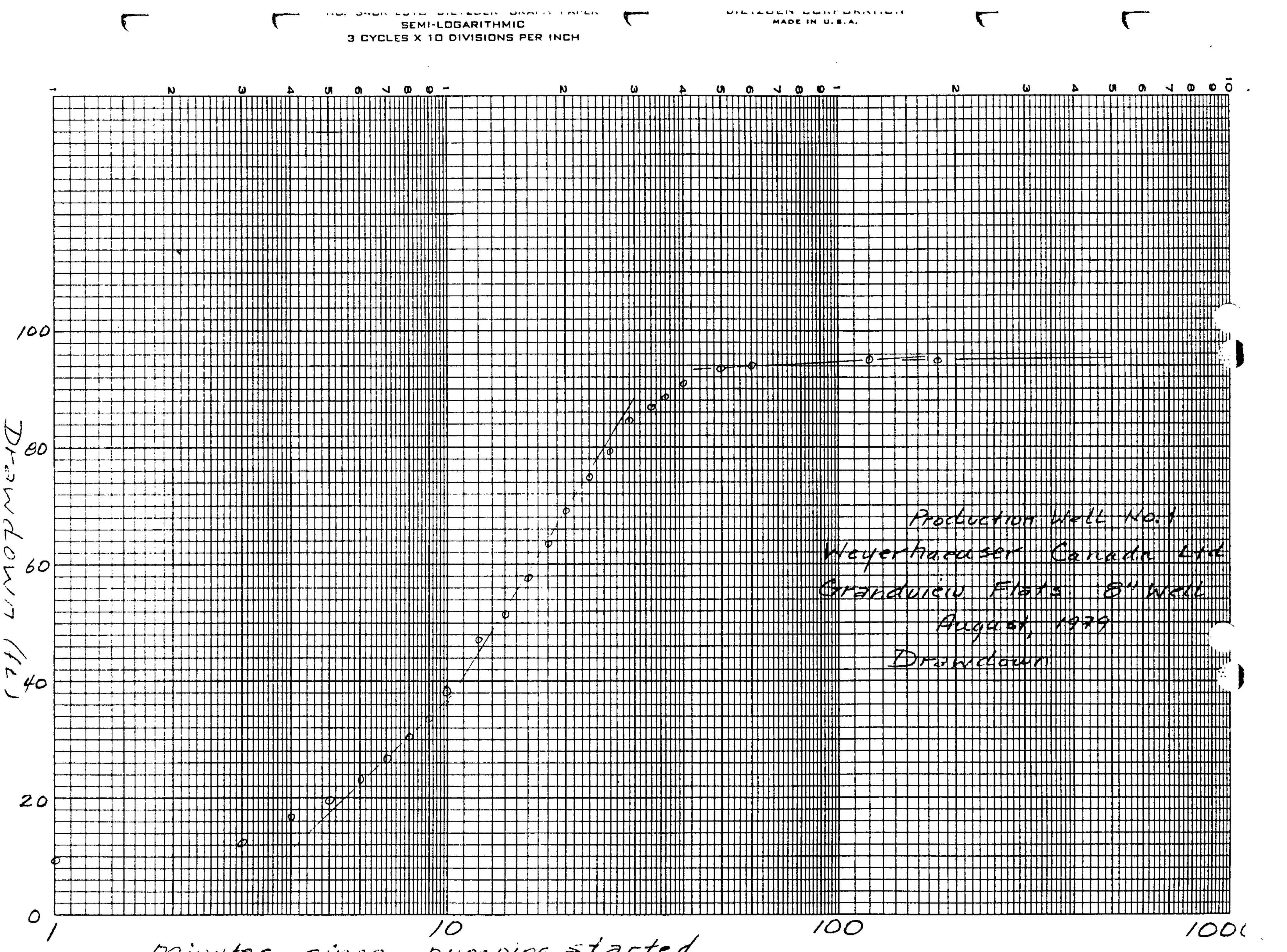
Irrigation Well, Weyerhaeuser Canada Ltd.

Grandview Flats, Armstrong

August 1979

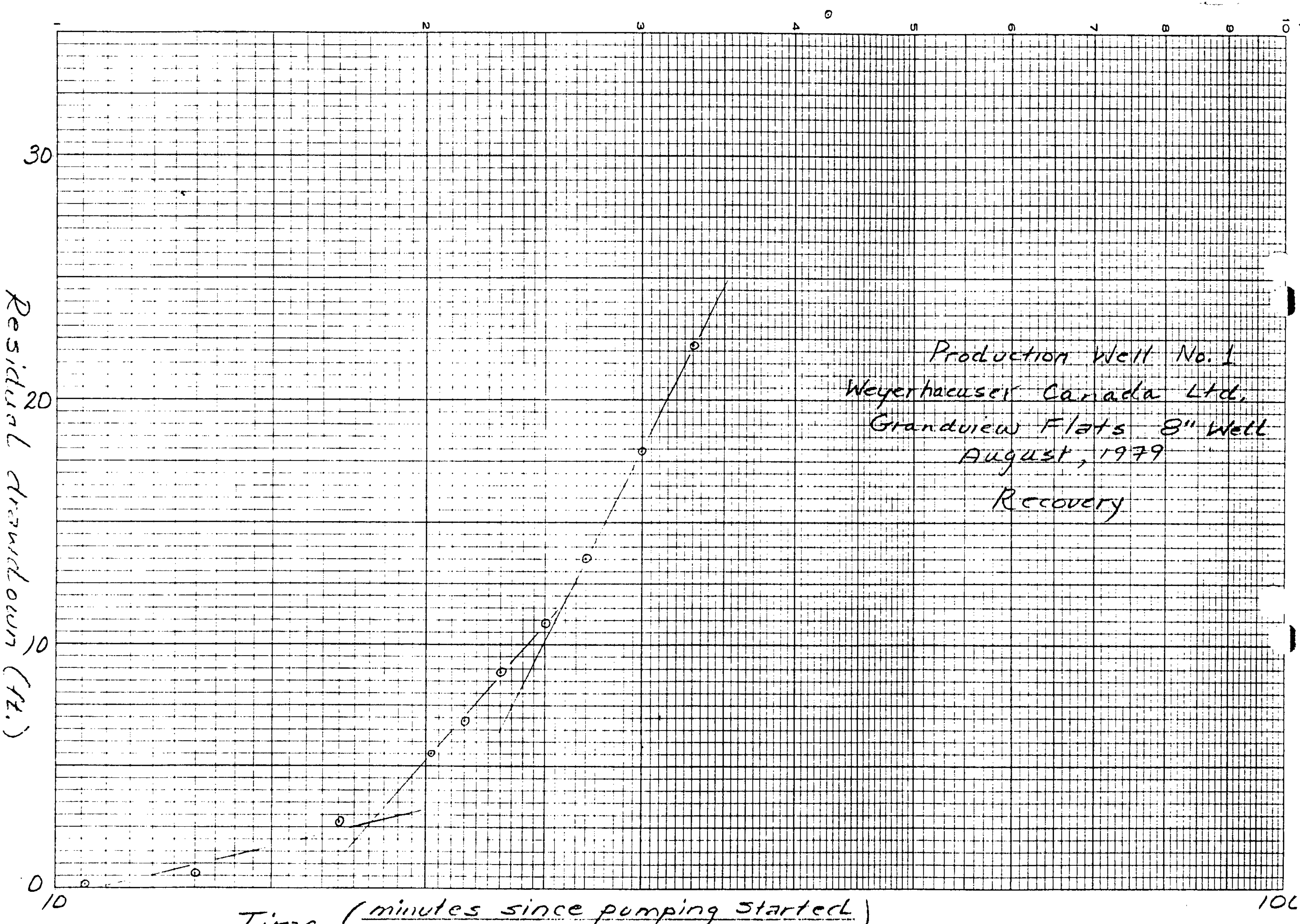
Time	Mins. Since Start	Depth to Water(ft.)	Drawdown (ft.)	Orifice Pressure (in.)	Pump rate (US gpm)	Remarks
06:55		278.50				Static level
07:00						start pump
07:01	1	283.21	4.71	16	256	rate was
07:02	2	287.53	9.03			constant
07:03	3	290.60	12.10			throughout
07:04	4	294.83	16.33			test.
07:05	5	298.00	19.50			
07:06	6	301.42	22.92			
07:07	7	304.72	26.22			
07:08	8	309.00	30.50			
07:09	9	312.35	33.85			
07:10	10	316.60	38.10			
07:12	12	325.72	47.22			
07:14	14	330.13	51.63			
07:16	16	336.21	57.71			
07:18	18	342.78	63.28			
07:20	20	347.64	69.14			
07:23	23	353.32	74.82			
07:26	26	358.14	79.[illegible]			
07:29	29	362.83	84.33			
07:33	33	365.31	86.81			
07:36	36	367.33	88.83			
07:40	40	369.41	90.91			
07:50	50	372.00	93.50			
08:00	60	372.41	93.91			
09:00	120	374.51	95.01			
10:00	180	374.52	95.02			
11:00	240	374.52	95.02			
12:00	300	374.52	95.01			
13:00	360	374.50	95.00			
14:00	420	374.51	95.01			
15:00	480	374.51	95.01			
16:00	540	374.50	95.00			
17:00	600	374.52	95.02			
18:00	660	374.51	95.01			
19:00	720	374.52	95.02			
20:00	780	374.52	95.02			
21:00	840	374.51	95.01			
22:00	900	374.51	95.01			
23:00	960	374.51	95.01			
24:00	1020	374.51	95.01			
01:00	1080	374.51	95.01			
02:00	1140	374.51	95.01			

Time	Mins. Since Start	Depth to Water(ft.)	Drawdown (ft.)	Orifice Pressure (in.)	Pump rate (US gpm)	Remarks
03:00	1200	374.51	95.01			
04:00	1260	374.51	95.01			
05:00	1320	374.51	95.01			
06:00	1380	374.51	95.01			
07:00	1440	374.51	95.01			
			RECOVERY			
				Minutes	t/t	stop pump
07:35	1475	[illegible].42	35.92	35	42.2	
07:45	1485	301.52	22.02	45	33	
07:50	1490	296.41	17.91	50	30	
07:55	1495	292.00	13.50	55	27	
08:00	1600 1500	289.32	10.82	60	25	
08:05	1505	287.34	8.84	65	23	
08:10	1510	285.31	6.81	70	21.5	
08:15	1515	284.00	5.50	75	20.2	
08:30	1530	281.21	2.71	90	17	
09:00	1560	279.01	2.51	120	13	
09:30	1590	278.63	.13	150	10.6	


SEMI-LOGARITHMIC
3 CYCLES X 10 DIVISIONS PER INCH
MADE IN U.S.A.
Production Well No.1
Weyerhaeuser Canada Ltd
Grandview Flats 8" Well
August, 1979
Drawdown
Drawdown (ft)
0
20
40
60
80
100
1
10
100
Minutes since pumping started

SEMI-LOGARITHMIC
1 CYCLES X 10 DIVISIONS PER INCH

MADE IN U.S.A.



can test ltd.

1650 PANDORA STREET, VANCOUVER, B.C. V5L 1L6 • TELEPHONE 254-7278 • TELEX 04-54210

Report On: Analysis of Water Samples

File No. 1968D

Report No.

Reported to: Pacific Hydrology Consultants Ltd.
1401 W. Broadway
Vancouver, B.C.

Date: September 11, 1979

We have tested the sample of water submitted by Thomas Well Drilling on August 22, 1979 and report as follows:

SAMPLE IDENTIFICATION:

The sample was submitted in a plastic bottle labelled:

Weyerhauser *Production Well No. 1*

METHOD OF TESTING:

The analyses were carried out in accordance with procedures described in "Standard Methods for the Examination of Water and Wastewater (14th Edition)" published by the American Public Health Association, 1975.

RESULTS OF TESTING:

(on following page)

RESULTS OF TESTING:

TEST		Weyerhauser
Physical Tests		
pH		8.10
Conductance (umhos/cm)		680.
Color (CU)		15.
Turbidity (JTU)		7.5
Total Dissolved Solids (mg/L)		570.
Total Suspended Solids (mg/L)		2.0
Dissolved Anions (mg/L)		
Alkalinity		
Bicarbonate	HCO_3	315.
Carbonate	CO_3	Nil
Chloride	Cl	L 0.5
Sulfate	SO_4	100.
Nitrate & Nitrite	N	L 0.001
Phosphate	PO_4	0.15
Fluoride	F	0.24
Silica	SiO_2	29.4
Dissolved Cations (mg/L)		
Total Hardness	$CaCO_3$	315.
Calcium	Ca	69.4
Magnesium	Mg	34.4
Sodium	Na	12.6
Potassium	K	7.61
Iron	Fe	L 0.030
Manganese	Mn	0.10
Cadmium	Cd	L 0.001
Copper	Cu	0.001
Lead	Pb	L 0.001
Zinc	Zn	0.005
Others (mg/L)		
Total Iron	Fe	0.82
Total Manganese	Mn	0.11

L = Less than, mg/L = milligrams per liter (or parts per million for drinking water)

REMARKS

The water represented by the sample submitted can be characterized as a very hard water, high in dissolved mineralization. For the parameters tested the sample met the limits set by the Canadian Drinking Water Standards and Objectives, 1968 with the exception of turbidity (limit = 5 J.T.U.) and dissolved manganese (limit = 0.05 mg/L). The water was also noted to be borderline with respect to colour and to be approaching the limit for phosphates (limit = 0.2 mg/L).

The sample was also observed to be high in the total iron and manganese. This is reflected in the high turbidity and colour. High values for these parameters are often associated with new wells.

Colour, turbidity, iron, manganese, and phosphates are limited for aesthetic reasons and are not considered health hazards.

Further examination of the test results indicated the sample to be very high and very high in bicarbonate alkalinity. The excessive bicarbonate concentration may impart an alkaline taste to the water. Hardness and alkalinity at these levels should be of concern because serious economic damage may result due to the formation of incrustations in the water system (pipes, water heaters etc.).

CAN TEST LTD.

Judi M. Mitchell, B.Sc.,
Chemist

/frh

Weyerhaeuser Production Well No. 2

Johnson Di[illegible]on
P.O. Box 3118 • St. Paul, Minnesota 55165
Telephone 612-636-3900 • Telex 29-7451
UOP Inc.

SAND ANALYSIS (FINE)

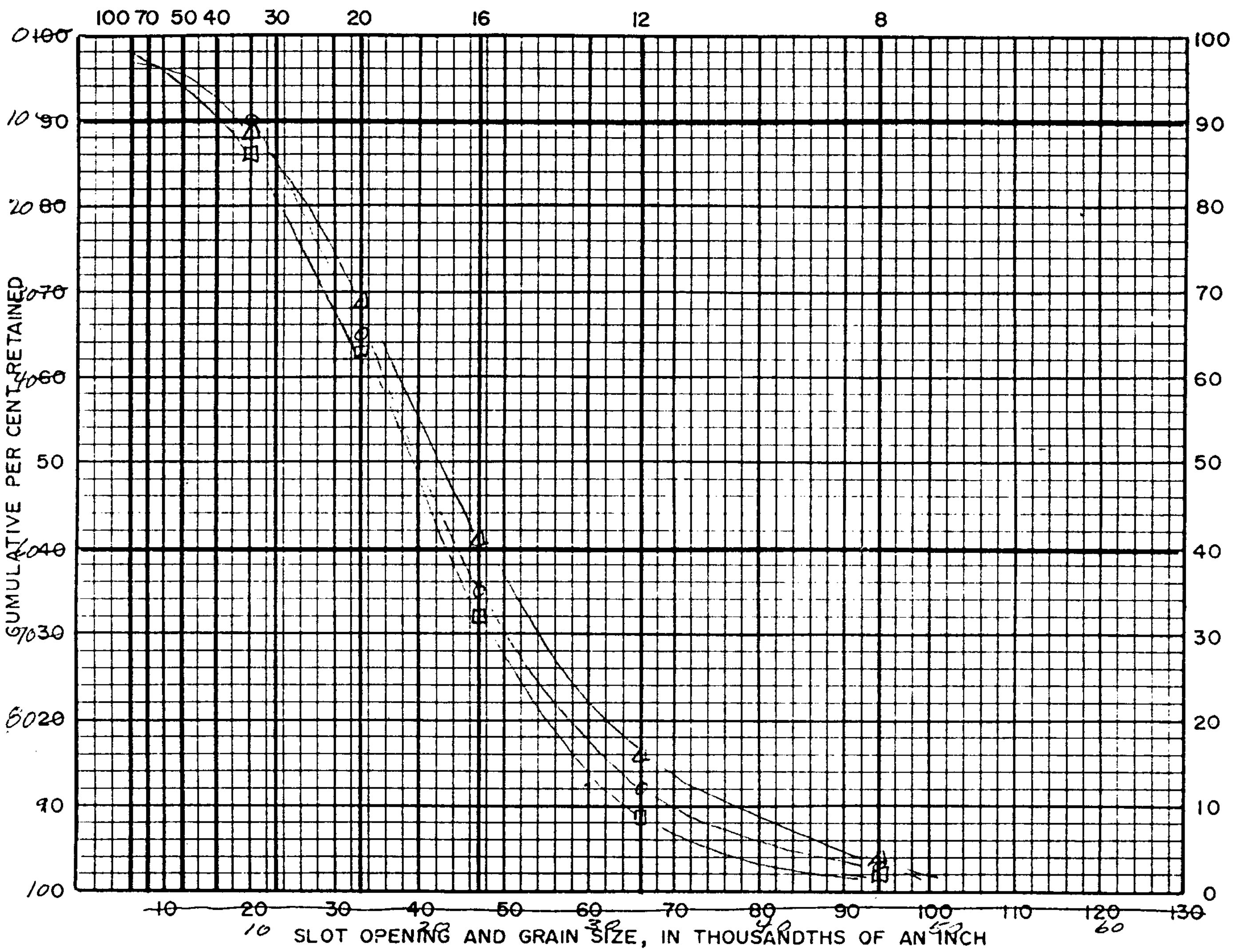
MAILING ADDRESS: P.O. BOX 3118
ST. PAUL, MINNESOTA • 55165

Sample sent in by *John Thomas*

Town ________ State ________ Zip ________ Date *Apr 24/80*

From well of *Weyerhaeuser Production Well No. 2 (TH5)*

Remarks: ________



⊙/02 ⊡/04 △/06

U S SIEVE NO	SIEVE OPENING INCHES	SIEVE OPENING MM.	CUMULATIVE % RETAINED		
6	.132	3.36			
8	.094	2.38			
12	.066	1.68	99		99
16	.047	1.19	97	98	96
20	.033	0.84	88	91	84
30	.023	0.60	65	66	59
40	.016	0.42	35	37	31
~~50~~ 60	.010	0.30	10	14	11
~~70~~	~~.008~~	~~0.21~~	—	—	—
100	.006	0.15	3	7	5
			22 (25)	22 (24)	24 (27)

Notes: ________

Recommended Slot Opening: ________

Recommended Screen: Dia. ______ in. Length ______ Ft.

By: ______

SAND ANALYSIS
(FINE)

Johnson Division
P.O. Box 3118 • St. Paul, Minnesota 55165
Telephone 612-636-3900 • Telex 29-7451
UOP Inc.

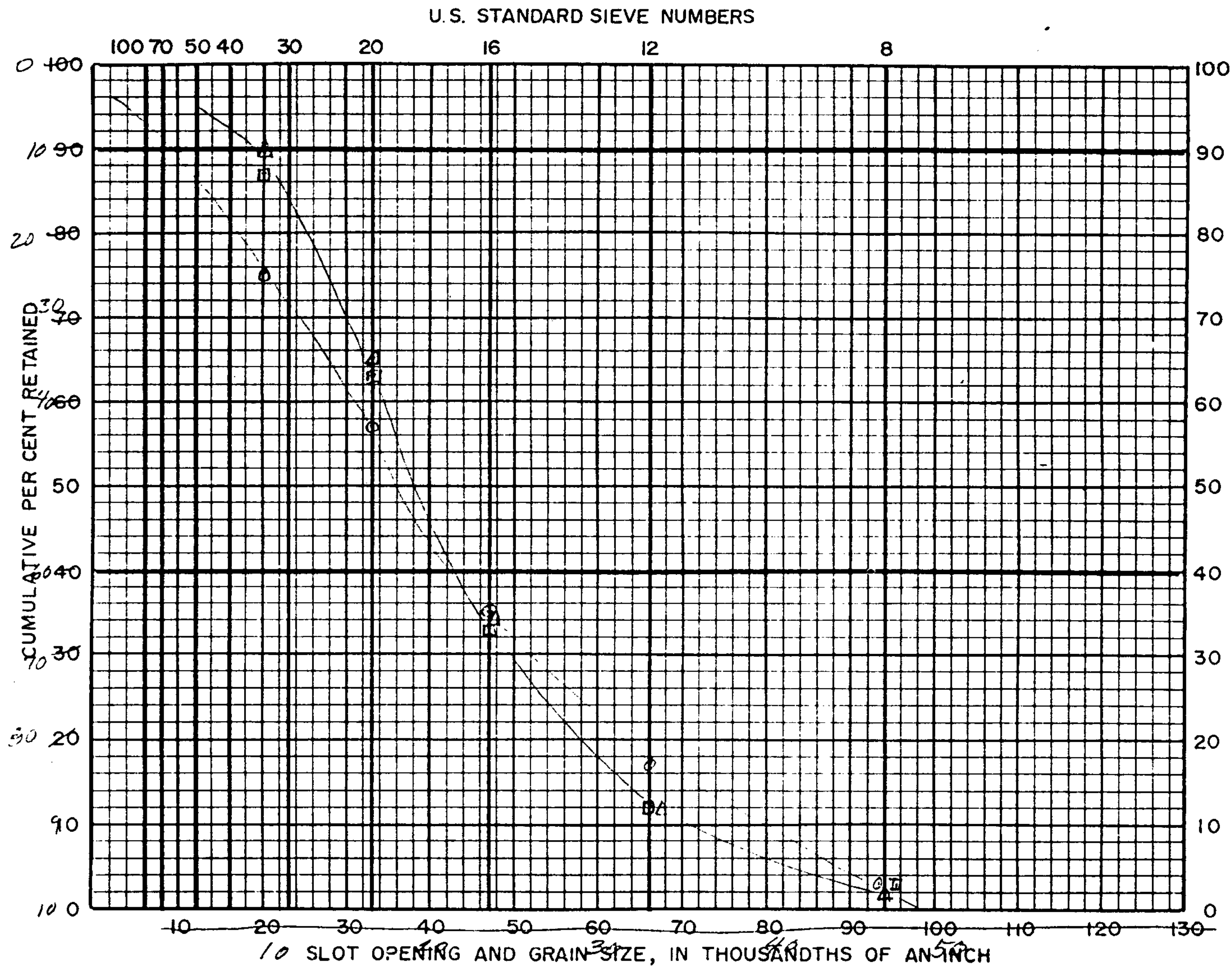
MAILING ADDRESS: P.O. BOX 3118
ST. PAUL, MINNESOTA ■ 55165

Sample sent in by *John Thomas*

Town ______ State ______ Zip ______ Date *Apr 24/80*

From well of *Weyerhauser Production well No 2 (TH5)*

Remarks: ______



086' 096' 100'

U.S. SIEVE	SIEVE OPENING		CUMULATIVE % RETAINED		
NO	INCHES	MM.			
6	.132	3.36			
8	.094	2.38			
12	.066	1.68	99	99	99
16	.047	1.19	97	97	97
20	.033	0.84	83	88	88
30	.023	0.60	75	67	66
40	.016	0.42	43	37	35
~~50~~ 60	.010	0.30	25	13	10
~~70~~	~~.008~~	~~0.21~~			
100	.006	0.15	11	6	4

21 21 21
25 25 25

Notes: ______

Recommended Slot Opening: ______

Recommended Screen: Dia. ______ in. Length ______ Ft.

By: ______

PUMP TEST - PRODUCTION WELL NO. 2

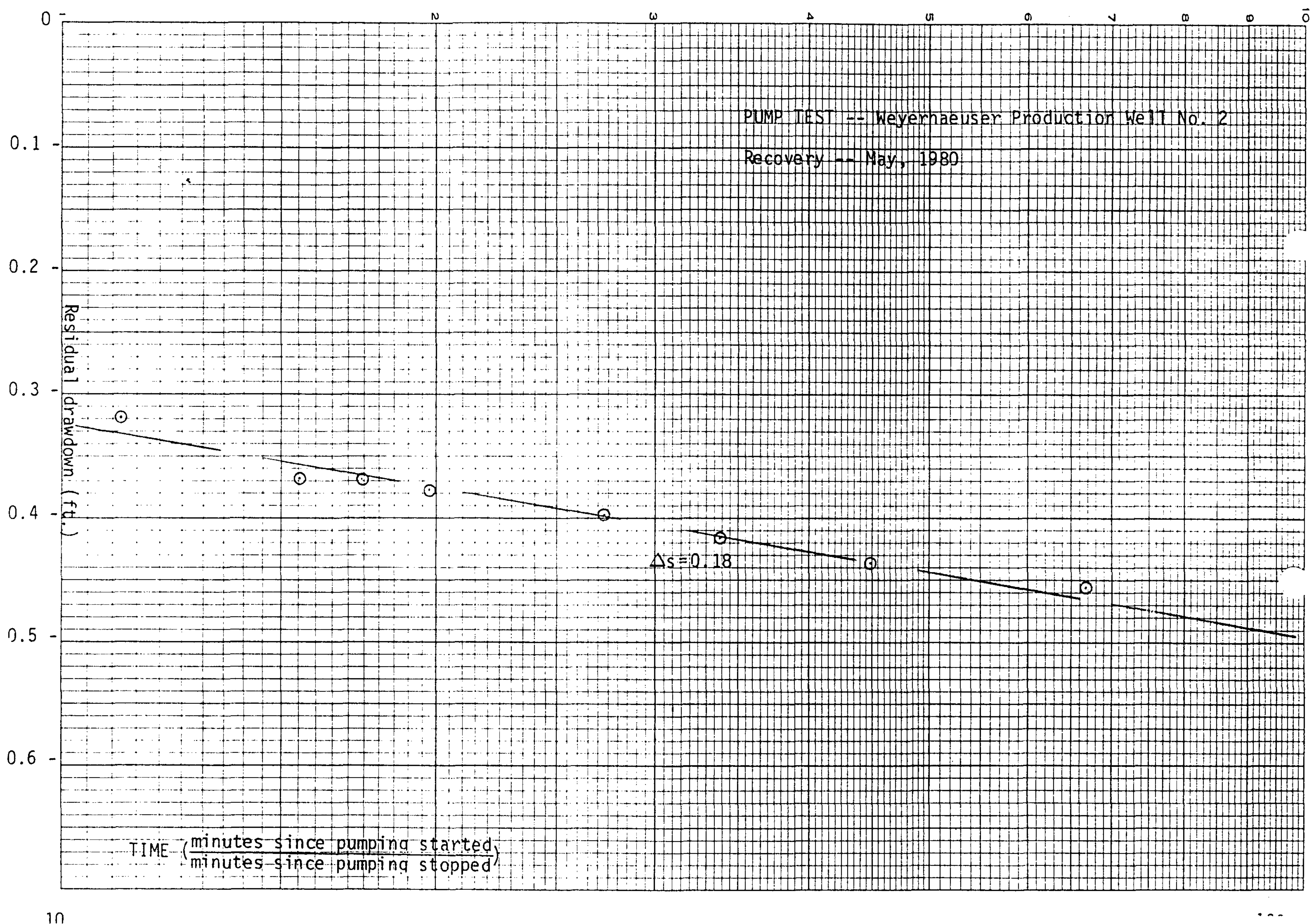
Weyerhaeuser Canada Ltd - Grandview Flats

July, 1980

TIME	MINS. SINCE START	DEPTH TO WATER (ft.)	DRAW-DOWN (ft.)	PUMP RATE (igpm)	REMARKS
08:00		71.33			Static level; start pump.
08:45	45	80.75	9.42	70	Requesting pump
08:50	50	80.92	9.59	70	to 70 gpm during
09:00	60	81.58	10.25	70	first 45 min.
09:10	70	81.71	10.38	70	Readings taken
09:15	75	81.67	10.34	70	1 ft. above ground.
09:25	85	81.67	10.34	70	3" orifice on 6"
09:35	95	82.50	11.17	70	pipe
10:25	145	83.00	11.67	70	
11:00	180	81.67	10.34	70	
12:00	240	81.50	10.17	70	
13:00	300	81.50	10.17	70	
14:00	360	81.50	10.17	70	
15:00	420	81.25	9.92	70	
16:00	480	81.25	9.92	70	
17:00	540	81.75	10.42	70	
18:00	600	81.42	10.09	70	
19:00	660	81.50	10.17	70	Stop Pump.

RECOVERY

TIME	MINS. SINCE START	DEPTH TO WATER (ft.)	DRAW-DOWN (ft.)	MINS. SINCE STOP	t/t
19:10	670	71.79	0.46	10	67
19:15	675	71.76	0.44	15	45
19:20	680	71.75	0.42	20	34
19:25	685	71.73	0.40	25	27.4
19:35	695	71.71	0.38	35	19.8
19:40	700	71.70	0.37	40	17.5
19:45	705	71.70	0.37	45	15.6
19:50	710	71.69	0.36	50	14.2
20:05	725	71.65	0.32	65	11.2


PUMP TEST -- Weyerhaeuser Production Well No. 2
Recovery -- May, 1980
Residual drawdown (ft.)
0
0.1
0.2
0.3
0.4
0.5
0.6
Δs=0.18
TIME (minutes since pumping started / minutes since pumping stopped)
10
2
3
4
5
6
7
8
9

can test ltd.
1650 PANDORA STREET, VANCOUVER, B.C. V5L 1L6 • TELEPHONE 254-7278 • TELEX 04-54210

Report On Analysis of Water Sample

File No. 5875D

Report No.

Reported To Pacific Hydrology Consultants Ltd.
1401 W. Broadway
Vancouver, B.C.

P.O. #

Date May 28, 1980

Attention:

We have tested the samples of water submitted by you on May 12, 1980 and report as follows:

SAMPLE IDENTIFICATION:

The sample was submitted in a plastic bottle labelled:

CTL#5857 - Weyerhaeser
TH #5 (Production Well No. 2)
8th May, 1980

METHOD OF TESTING:

The analysis was carried out in accordance with procedures described in "Standard Methods for the Examination of Water and Wastewater (14th Edition)" published by the American Public Health Association, 1975.

RESULTS OF TESTING:

(on the following page)

REMARKS:

The water represented by the sample submitted can be characterized as a hard water, very high with respect to dissolved mineralization.

For the parameters tested, the sample met the limits set by the "Recommended British Columbia Health Branch Water Quality Standards, 1969", published by the Government of the Province of British Columbia, with the exception of dissolved manganese (limit = 0.05 mg/L)

Manganese is limited for aesthetic reasons and is not considered a health hazard.

CAN TEST LTD.

Judi M. Mitchell, B.Sc.,
Chemist

/cs

Form No. 7 L

File No.	5857D
Page No.	2
Date:	May 28, 1980

RESULTS OF TESTING:

TEST		SAMPLE IDENTIFICATION				
		5857				
Physical Tests						
Ph		8.10				
Conductance (umhos/cm)		580.				
Color (CU)		5.				
Turbidity (JTU)		2.9				
Total Dissolved Solids (mg/L)		529.				
Total Suspended Solids (mg/L)		L 0.5				
Dissolved Anions (mg/L)						
Alkalinity						
Bicarbonate	HCO_3	315.				
Carbonate	CO_3	NIL				
Chloride	Cl	2.60				
Sulfate	SO_4	64.0				
Nitrate & Nitrite	N	0.001				
Phosphate	PO_4	0.08				
Fluoride	F	0.25				
Silica	SiO_2	25.3				
Dissolved Cations (mg/L)						
Total Hardness	$CaCO_3$	283.				
Calcium	Ca	55.7				
Magnesium	Mg	35.0				
Sodium	Na	13.5				
Potassium	K	10.5				
Iron	Fe	L 0.030				
Manganese	Mn	0.20				
Copper	Cu	0.004				
Cadmium	Cd	L 0.001				
Lead	Pb	0.014				
Zinc	Zn	0.030				
Others (mg/L)						
Total Iron	Fe	0.38				
Total Manganese	Mn	0.21				

L = Less than; mg/L = milligrams per liter (or parts per million for drinking water)

Weyerhaeuser Production Well No. 3

Johnson [ ]sion
P.O. Box 3118 • St. Paul, Minnesota 55165
Telephone 612-636-3900 • Telex 29-7451
UOP Inc.

SAND ANALYSIS
(FINE)

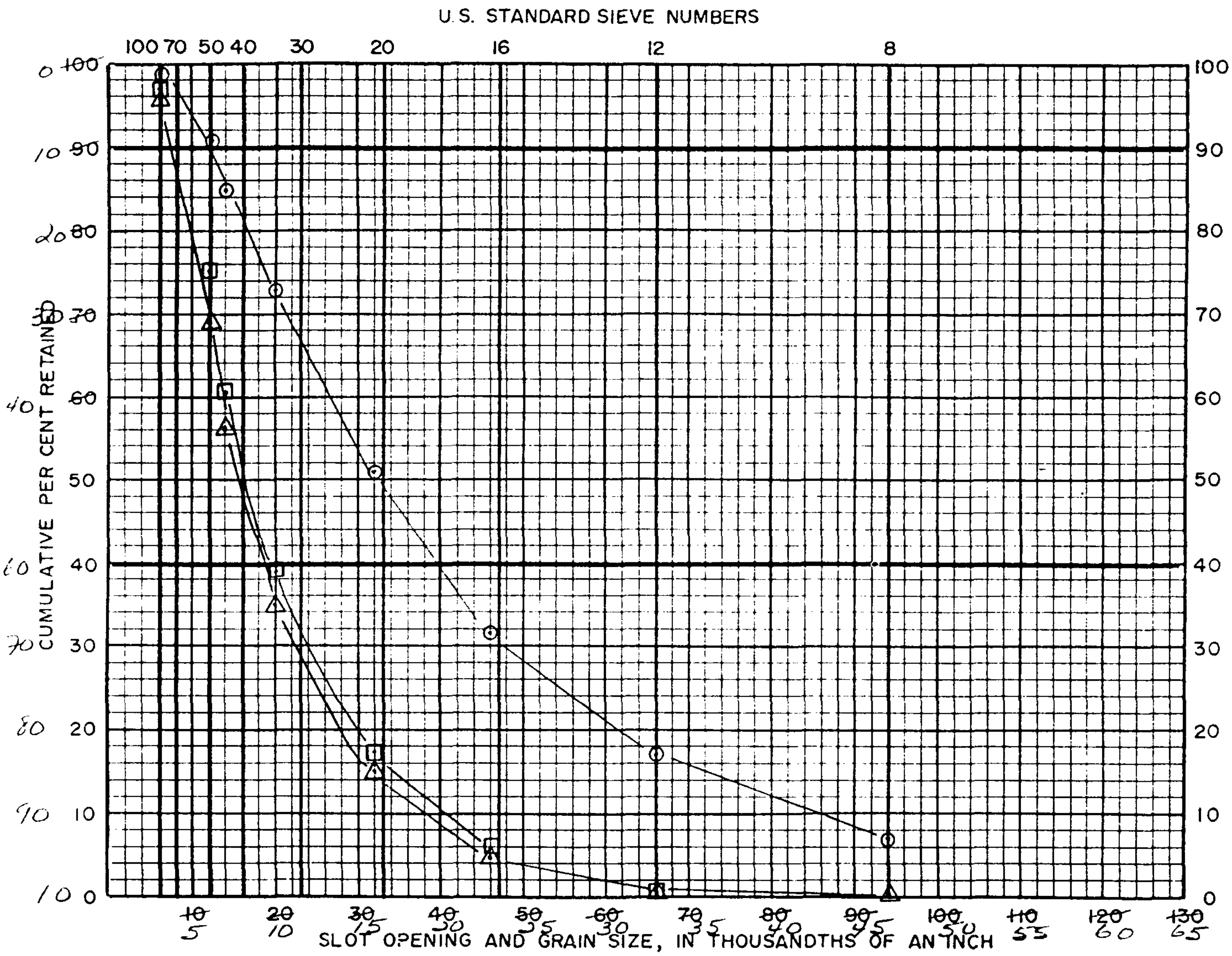
MAILING ADDRESS: P.O. BOX 3118
ST. PAUL, MINNESOTA ■ 55165

Sample sent in by *Thomas Well Drilling & Pump Sales Ltd.*

Town ______ State ______ Zip ______ Date *July/80*

From well of *Weyerhaeuser Production Well No. 3*

Remarks: *Analyses by Interior Testing Services Ltd.*



⊙92 △94 ⊡96

U.S. SIEVE NO	SIEVE OPENING INCHES	SIEVE OPENING MM	CUMULATIVE % ~~RETAINED~~ *Passing*		
6	.132	3.36	*100*		
8	.094	2.38	*99.5*		
12	.066	1.68	*98.1*	*100*	*100*
16	.047	1.19	*93.0*	*99.9*	*99.8*
20	.033	0.84	*83.2*	*99.5*	*98.9*
30	.023	0.60	*68.3*	*95.5*	*94.3*
40	.016	0.42	*49.1*	*85.3*	*82.7*
60	.010	0.30	*27.2*	*65.4*	*60.6*
80	.008	0.21	*15.3*	*44.0*	*39.6*
100	.006	0.15	*9.6*	*30.9*	*25.3*
200	*.003*		*1.3*	*4.3*	*3.3*
			20(24)	*9½(11)*	*10(12)*

Notes:

Recommended Slot Opening:

Recommended Screen: Dia. in. Length Ft.

By:

Johnson ision
P.O. Box 3118 • St. Paul, Minnesota 55165
Telephone 612-636-3900 • Telex 29-7451
UOP Inc.

SA ID ANALYSIS
(FINE)

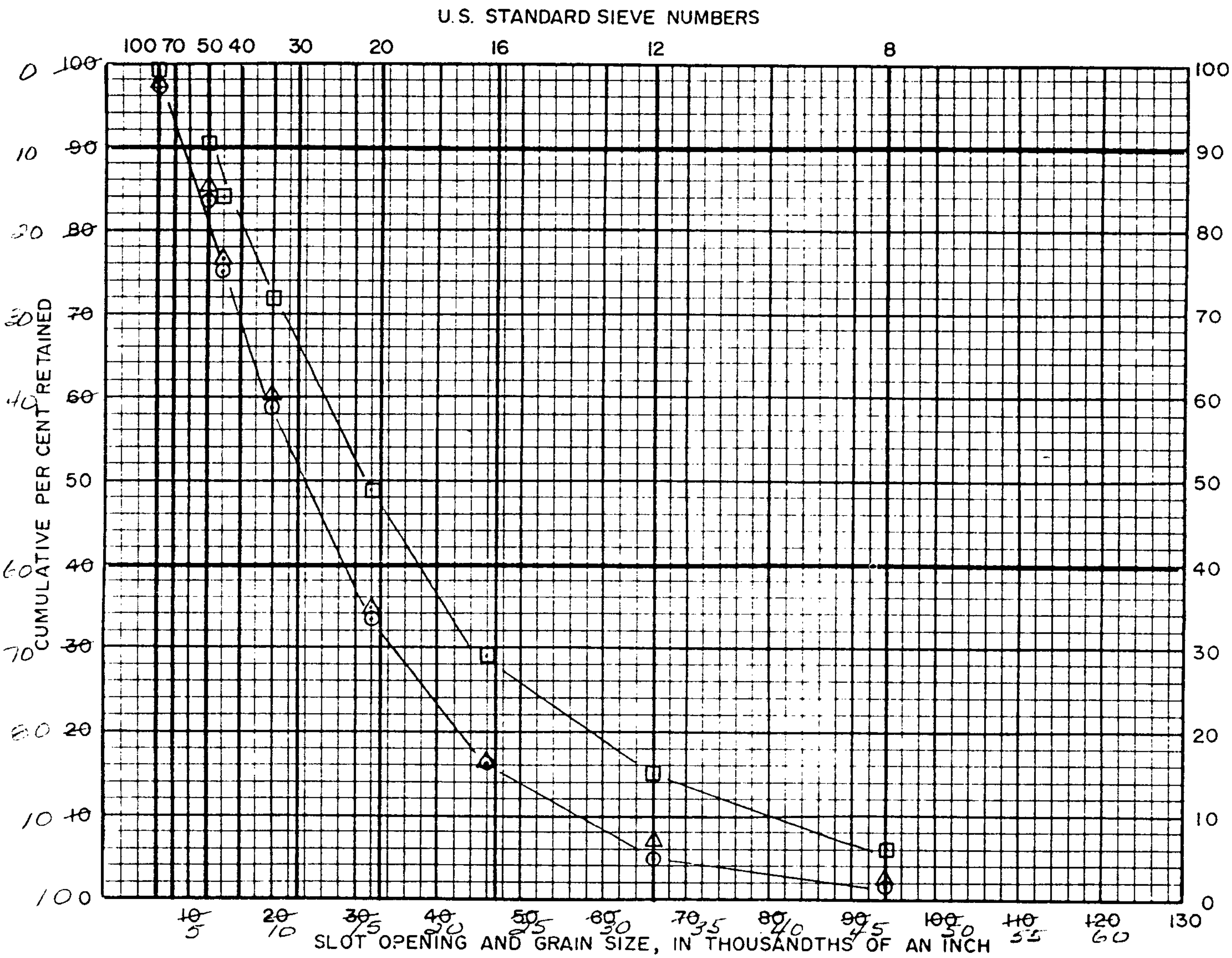
MAILING ADDRESS: P.O. BOX 3118
ST. PAUL, MINNESOTA 55165

Sample sent in by *Thomas Well Drilling and Pump Sales Ltd.*

Town ______ State ______ Zip ______ Date *July/80*

From well of *Weyerhaeuser production Well No. 3*

Remarks: *Sieve analysis by Interior Testing Services Ltd*



⊙86 △88 ⊡90

U.S. SIEVE NO	SIEVE OPENING INCHES	SIEVE OPENING MM	CUMULATIVE % ~~RETAINED~~ *PASSING*		
6	.132	3.36		*100*	*100*
8	.094	2.38	*100*	*99.8*	*99.8*
12	.066	1.68	*99.5*	*99.2*	*98.7*
16	.047	1.19	*98.4*	*97.7*	*94.2*
20	.033	0.84	*95.1*	*93.1*	*85.2*
30	.023	0.60	*83.9*	*83.9*	*70.9*
40	.016	0.42	*66.6*	*65.7*	*51.3*
60	.012	0.30	*41.3*	*39.6*	*28.4*
70	.007	0.21	*25.0*	*23.5*	*15.9*
100	.006	0.15	*16.4*	*14.8*	*9.9*
200	*.003*		*3.0*	*2.5*	*1.4*

14(17) 14(17) 19(22)

Notes:

Recommended Slot Opening:

Recommended Screen: Dia. ______ in. Length ______ Ft.

By:

Johnson Division
P.O. Box 3118 • St. Paul, Minnesota 55165
Telephone 612-636-3900 • Telex 29-7451
UOP Inc.

SAND ANALYSIS
(FINE)

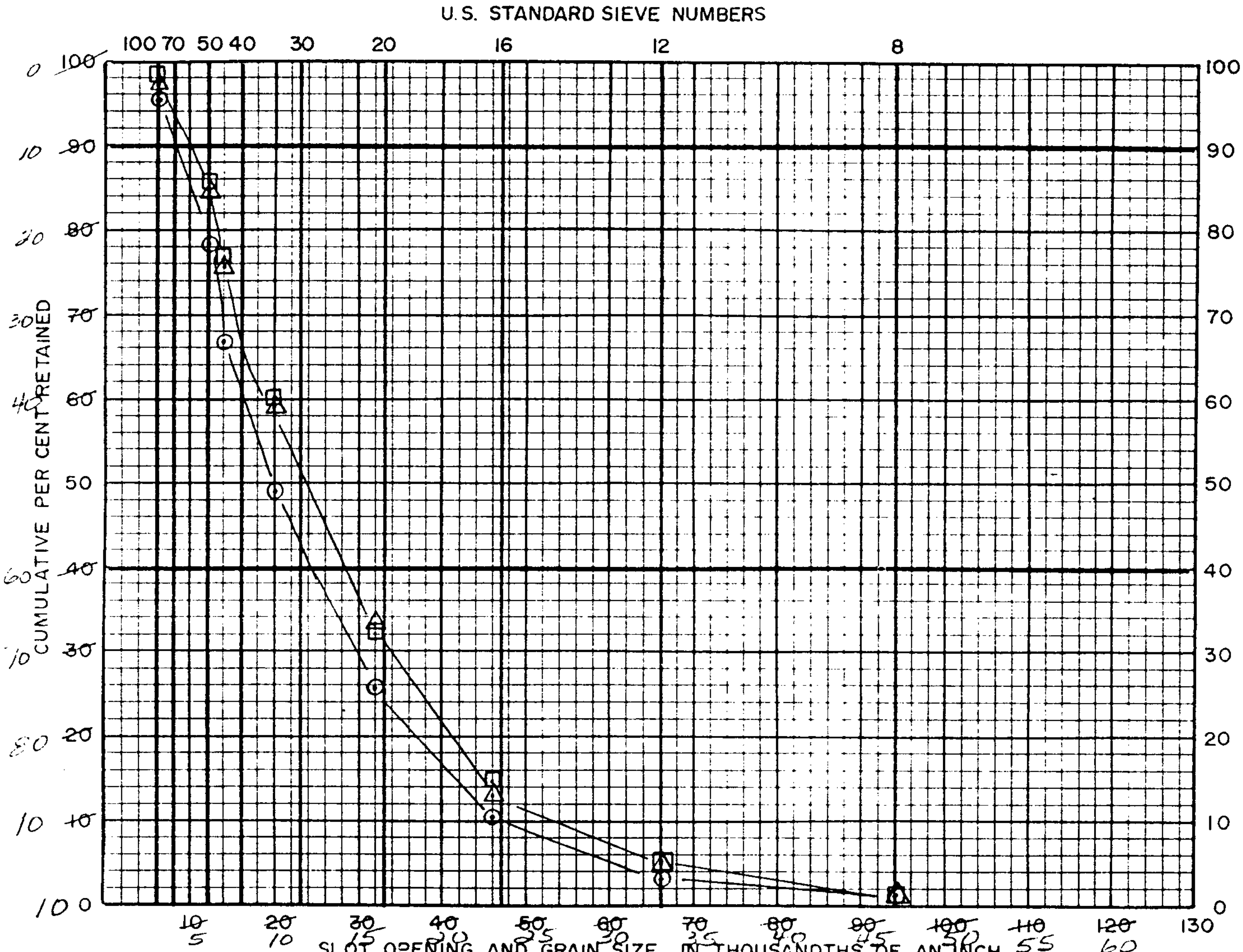
MAILING ADDRESS: P.O. BOX 3118
ST. PAUL, MINNESOTA • 55165

Sample sent in by: Thomas Well Drilling & Pump Sales Ltd.

Town: ______ State: ______ Zip: ______ Date: July/80

From well of: Weyerhaeuser Production Well No. 3

Remarks: Analyses by Interior Testing Services



⊙281 △82 ⊡84 PASSING

U S SIEVE NO	SIEVE OPENING INCHES	SIEVE OPENING MM	CUMULATIVE % ~~RETAINED~~		
6	.132	3.36			
8	.094	2.38	100		100
12	.066	1.68	99.7	100	99.7
16	.047	1.19	99.1	98.9	98.9
20	.033	0.84	96.7	95.2	93.4
30	.023	0.60	89.6	87.1	85.5
40	.016	0.42	74.4	66.8	67.7
60	.010	0.30	51.1	41.2	40.2
80	.007	0.21	33.4	24.5	23.8
100	.006	0.15	21.9	15.8	15.4
200	.003		4.4	2.7	2.3

12(15) 14(17) 14(17)

Notes:

Recommended Slot Opening:

Recommended Screen: Dia. ______ in. Length ______ Ft.

By:

SO MANY CONSIDERATIONS ENTER INTO THE MAKING OF A GOOD WELL THAT WHILE WE BELIEVE SLOT SIZES FURNISHED OR RECOMMENDED FROM SAND SAMPLES ARE CORRECT WE ASSUME NO RESPONSIBILITY FOR THE SUCCESSFUL OPERATION OF JOHNSON WELL SCREENS.

PUMP TEST - PRODUCTION WELL NO. 3

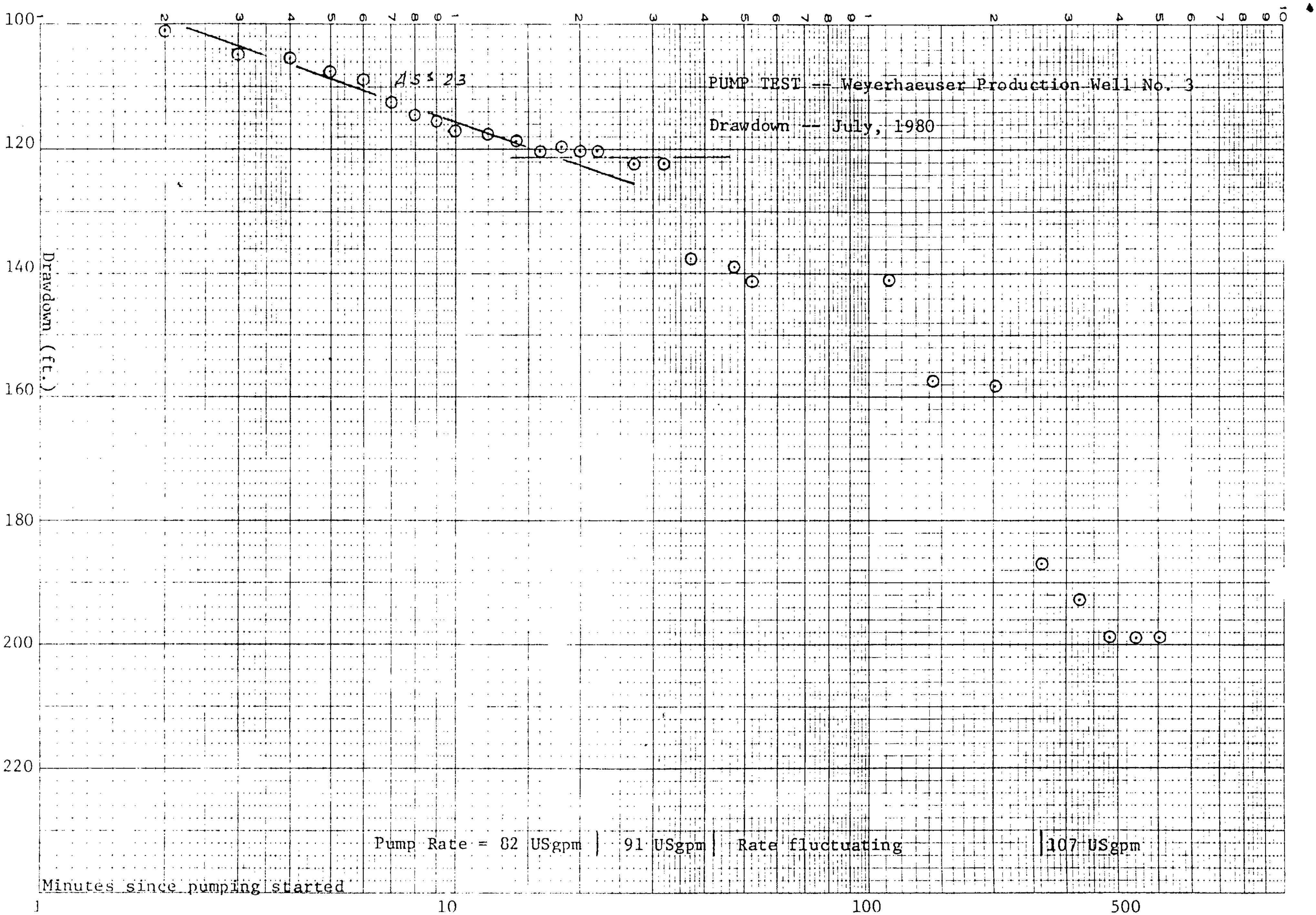
Weyerhaeuser Canada Ltd - Grandview Flats

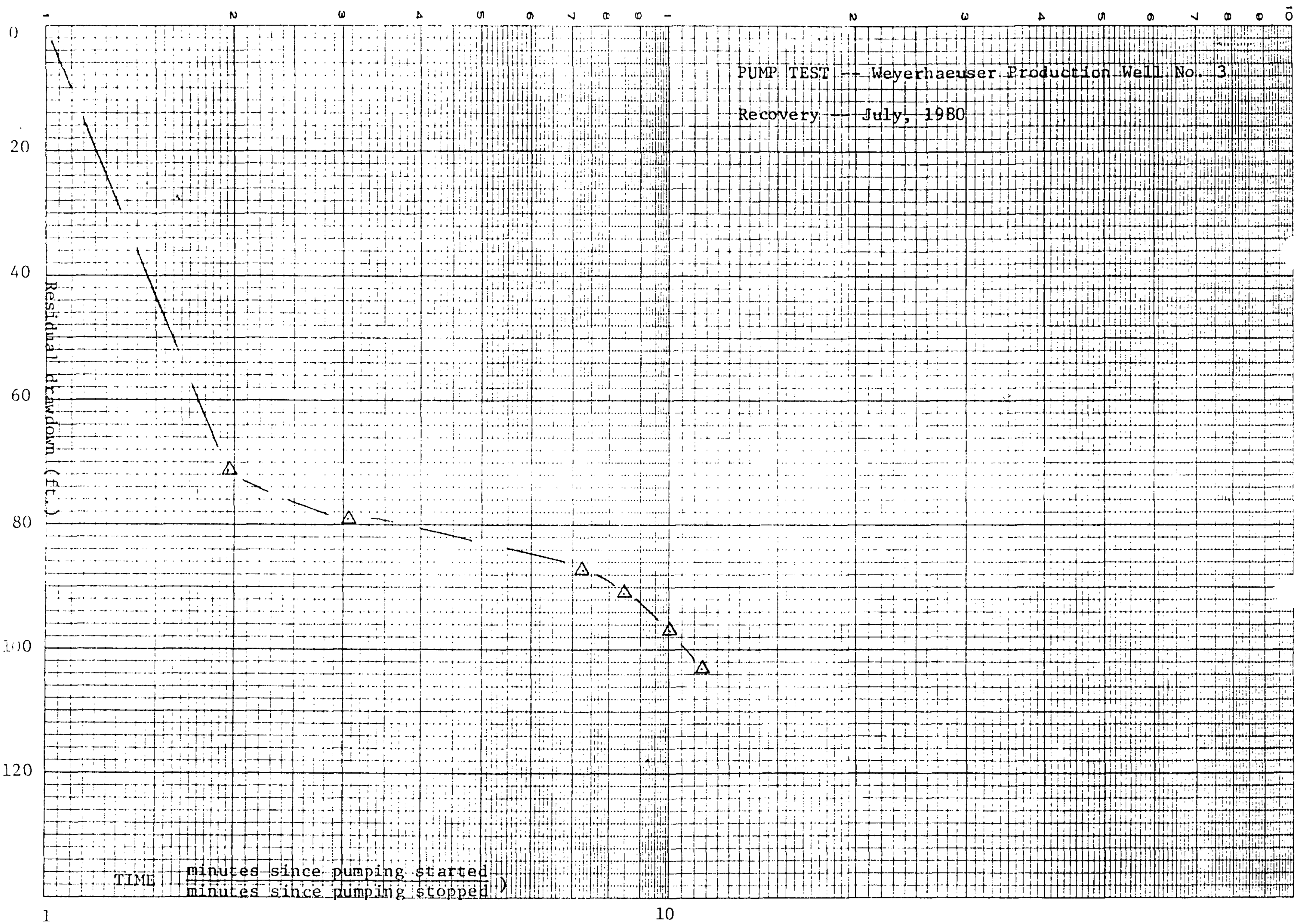
July, 1980

TIME	MINS. SINCE START	DEPTH TO WATER (ft.)	DRAW-DOWN (ft.)	ORIFICE PRESSURE (in.)	ORIFICE RATE (USgpm)	REMARKS
July 29						
15:30		62.83				Static level; start pump
15:32	2	165.83	101.00			3" orifice on
15:33	3	167.67	104.84	6	82	6" pipe
15:34	4	168.46	105.63			Datum for
15:35	5	170.42	107.59			measurements
15:36	6	171.88	109.05			is 3 ft. above
15:37	7	175.21	112.38			ground
15:38	8	177.33	114.50			
15:39	9	178.42	115.59			
15:40	10	180.00	117.17			
15:42	12	180.38	117.55			
15:44	14	181.58	118.75			
15:46	16	183.12	120.29			
15:48	18	182.50	119.67			
15:50	20	182.92	120.09			
15:52	22	183.00	120.17			
15:57	27	185.00	122.17	7½	91	
16:02	32	185.08	122.25			
16:07	37	200.54	137.71			
16:12	42	199.25	136.42			
16:17	47	201.79	138.96			
16:22	52	204.17	141.34			
17:22	112	203.58	140.75	6	82	Adjusted rate
17:52	142	220.42	157.59	8	94	
18:52	202	220.88	158.05	8	94	Increased rate
19:52	262	249.92	187.09	10½	107	
20:52	322	255.67	192.84	10½	107	
21:52	382	255.75	192.92			
22:52	442	255.75	192.92			
23:52	502	255.75	192.92			Stop pump.

RECOVERY

TIME	MINS. SINCE START	DEPTH TO WATER (ft.)	DRAW-DOWN (ft.)	MINS. SINCE STOP	t/t
23:54	504	170.08	107.25	2	252
23:55	505	160.33	97.50	3	168
23:56	506	166.17	103.34	4	126.5
23:57	507	160.04	97.21	5	101.4
23:58	508	153.83	91.00	6	84.67
23:59	509	150.17	87.34	7	72.71
July 30					
00:09	519	141.96	79.13	17	30.53
00:19	529	136.08	73.25	27	19.59


PUMP TEST -- Weyerhaeuser Production Well No. 3
Drawdown -- July, 1980
Drawdown (ft.)
100
120
140
160
180
200
220
As 23
Pump Rate = 82 USgpm
91 USgpm
Rate fluctuating
107 USgpm
Minutes since pumping started
1
10
100
500


PUMP TEST -- Weyerhaeuser Production Well No. 3
Recovery -- July, 1980
Residual drawdown (ft.)
0
20
40
60
80
100
120
TIME (minutes since pumping started / minutes since pumping stopped)
1
10

140