Exhibit A. Stream Depletion Modeling
Arrowhead Farms, Inc.; Westwood Farms, Inc.; and Echo Ridge Farms, Inc.
Surface to Ground Water Transfer Application
April 2008

Introduction

This exhibit included with the water right transfer application submitted by Arrowhead Farms, Westwood Farms, and Echo Ridge Farms (Arrowhead-Westwood-Echo Ridge Farms) presents the results of stream depletion modeling performed by Pacific Hydro-Geology Inc. This modeling was performed to assess if the proposed new wells will affect the surface water source, Deep Lake, similarly to the authorized points of diversion which are located more than 500 feet from the proposed new wells, in accordance with the requirements of OAR 690-380-2130(2)(e). The term "similarly" is defined by OAR 690-380-2130(11)(b) to mean that the use of ground water at the new wells affects the surface water source specified in the water right and would result in stream depletion of at least 50 percent of the rate of appropriation within 10 days of continuous pumping.

Geologic and Hydrogeologic Conditions

According to geologic mapping compiled by Gannet and Caldwell (1998), the area in the vicinity of the Arrowhead-Westwood-Echo Ridge Farms site is underlain by Holocene alluvium comprising the Willamette Aquifer. The deposits of the Willamette Aquifer identified by Gannet and Caldwell (1998) are on the order of about 100 feet thick according to a geologic cross-section in their report (B-B') which runs through the Arrowhead-Westwood-Echo Ridge Farms property.

Based on a review of logs from several wells located near the Arrowhead-Westwood-Echo Ridge Farms site, Deep Lake is formed within a sequence of recent alluvial deposits consisting generally of about 25 to 30 feet of clay, possibly representing the Willamette Silt unit, overlying alluvial gravels having an estimated thickness of 40 to 60 feet. Static water levels reported for the wells completed within the uppermost gravel unit were generally about 20 feet below land surface. The well logs reviewed include MARI 4781, 4787, 4792, 4794, 4800, and 51172. Copies of the well logs are provided in Attachment A-1 to this document. The locations of the wells are shown on Figure A-1, Attachment A-1.

We conducted hand level measurements at the site to estimate the elevation of the water surface in Deep Lake relative to the surrounding land surface. We also sounded the lake in several places from a boat to determine the depth of the lake. Based on these investigations, we determined that at the time of our measurements, the lake level was about 21 feet below the ground surface elevation at the proposed Well 1 site, and the depth of the lake averaged about 12 feet. Based on our measurements, we estimate that the bottom of Deep Lake lies at an elevation that is about 33 feet below the ground surface elevation at the proposed well site. This places the bottom of the lake a few to several feet below the bottom of the clay layer. Therefore it appears that Deep Lake fully penetrates the upper clay layer, and partially penetrates the top of the underlying gravels.

Model Selection

Three analytical models were considered for the simulation: the Jenkins Model (Jenkins, 1968), the 1999 Hunt Model (Hunt, 1999), and the more recent 2003 version of the Hunt Model (Hunt, 2003). The Jenkins model assumes complete penetration of the aquifer by the stream. The 1999 Hunt model represents the condition of a clogged stream channel which partially penetrates the aquifer. The 2003 Hunt Model is configured to simulate the condition of a stream bed partially penetrating a semi-permeable layer of specified thickness which overlies the pumped aquifer. We chose the 1999 Hunt model because it simulates the condition of a surface water body which only partially penetrates the aquifer. We also assumed there is an accumulation of fine-grained material in the bottom of the lake, forming a clogging layer.

Model Parameters

The parameters to be chosen for use in the 1999 Hunt model include the well pumping rates, distance from the well to the stream, stream (or lake in this case) width, aquifer thickness, aquifer hydraulic conductivity, aquifer storage coefficient, streambed (i.e., clogging layer) hydraulic conductivity, and streambed (clogging layer) thickness. The values chosen for each of these parameters are discussed in the following paragraphs.

Pumping Rate: The pumping rate used in the model was calculated based on the assumption that the full allowed duty would be used in an irrigation season. The total acreage of the places of use under Certificates 47856 and 61435 affected by the transfer is 135.6 acres. The pumping rate of 0.7 cubic feet per second (cfs) was calculated based on a duty of 2 ½ acre-feet per acre for the 135.6 acres, assuming that the total volume of water could be discharged from either one of the proposed wells at a constant rate continuously (24 hours/day, 7 days/week) over the 245-day irrigation season. The model was run for 245 days to simulate the impacts of irrigating continuously for the full irrigation season.

Distance to Stream: The distances from proposed Wells 1 and 2 to the edge of Deep Lake were estimated from the transfer application map to be about 1,440 feet and 1,020 feet, respectively.

Lake Width: The width of the lake was estimated to be about 200 feet based on measurements taken from a recent Google Earth satellite photograph which was scaled to overlay on the transfer application map.

Aquifer Thickness: The estimated thickness of the recent alluvial deposits beneath the Arrowhead-Westwood-Echo Ridge Farms site is based on a review of several logs from wells located near the property. These wells included MARI 4781, 4787, 4792, 4794, 4800, and 51172. Copies of the well logs are provided in Attachment A-1 to this document. The locations of the wells are shown on Figure A-1, Attachment A-1.

According to the well logs reviewed, the upper fine-grained layer, generally described as consisting of yellow or brown clay, was present from the ground surface to a depth of between 14 and 35 feet. The two wells closest to the proposed well, MARI 4787 and MARI 4794, indicate clay to depths of 31 and 24 feet, respectively. Of the well logs reviewed, only two, MARI 4792 and MARI 51172, indicated full penetration of the upper gravel zone. MARI 4792 indicates gravels between depths of 35 and 73 feet. MARI

51172 shows gravels from 24 to 85 feet. Based on this information we estimated the thickness of the aquifer (i.e., the uppermost gravel interval) to be about 50 feet. The potentiometric surface in the aquifer is assumed to be at about the same elevation as the water level in the lake, or about 20 feet below ground surface. This is consistent with static water levels reported on logs for nearby wells, and indicates that ground water occurs under confined conditions in the gravel aquifer.

Aquifer Hydraulic Conductivity, Aquifer Storage Coefficient, and "Streambed" Hydraulic Conductivity: The Hunt model was run using the aquifer parameters recommended by the Department for the alluvial deposits of the Willamette Basin. Specifically, these parameter values included 50 ft/day for aquifer hydraulic conductivity (K), 0.0001 for storage coefficient (S) for a confined aquifer, and 0.01 ft/day for "streambed" hydraulic conductivity (Ks). We assume that these values are conservative and appropriate in the absence of site-specific data.

"Streambed" Thickness: When sounding the lake using a heavily weighted cloth tape measure, the weight generally sank about 6 inches into the bottom sediments. Based on this, we estimated that the minimum thickness of the clogging layer was more than 6 inches. It also seemed reasonable to assume that the clogging layer is not more than 4 feet thick. Therefore, the Hunt model was run using three separate scenarios for streambed thicknesses of 2, 3, and 4 feet, while keeping all other parameter the same.

Model Results

When run using the assumptions and parameters discussed above, the Hunt model predicted that the proposed use from Well 1 would result in surface water depletion within 10 days of continuous pumping equal to about 78%, 71%, and 65% of the discharge rate, assuming clogging layer thicknesses of 2, 3, and 4 feet, respectively. For Well 2, the Hunt model predicted surface water depletion of about 79%, 72%, and 66% of the discharge rate, again assuming clogging layer thicknesses of 2, 3, and 4 feet, respectively. All the simulated depletion rates meet the criteria set forth in 690-380-2130(2)(e) and OAR 690-380-2130(11)(b) to establish that the proposed new well will affect the surface water similarly to the original points of diversion. The model input and output data are provided in Attachment A-2 to this document.

References

Gannett, M.W., and Caldwell, R.R. 1998. *Geologic Framework of the Willamette Lowland Aquifer System, Oregon and Washington*. U.S. Geological Survey Professional Paper 1424-A.

Hunt, B. 1999. Unsteady stream depletion from ground water pumping. *Ground Water.* Vol. 37, No. 1: pp. 98-102.

Hunt, B. 2003. Unsteady stream depletion when pumping from semiconfined aquifer. *Journal of Hydrologic Engineering.* Vol. 8, Issue 1: pp. 12-19. January/February, 2003.

Jenkins, C.T. 1968. Techniques for computing rate and volume of stream depletion by wells. *Ground Water.* Vol. 6, No. 2: pp. 37-46.

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

RECEIVED SEP 22 1966 STATE ENGINEER SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)

State Well No. 6/3W-1 P
State Permit No. G-3847

(1) OWNER:
Name EEI CREIGHTON JONES
Address RT. I BOX
GERVAIS, OREGON

(2) LOCATION OF WELL:
County MARION Driller's well number II74
¼ ¼ Section I T. 6S R. 3 W W.M.
Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(5) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(6) CASING INSTALLED:
Threaded ☐ Welded ☒
10" Diam. from TOP ft. to 99 ft. Gage 250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(7) PERFORATIONS:
Perforated? ☒ Yes ☐ No
Type of perforator used MILLS
Size of perforations 2 in. by 3/8 in.
perforations from ft. to ft.
690 perforations from 30 ft. to 99 ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(8) SCREENS:
Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(9) CONSTRUCTION:
Well seal—Material used in seal CEMENT & PUDDLE CLAY
Depth of seal 20 ft. Was a packer used?
Diameter of well bore to bottom of seal I2 in.
Were any loose strata cemented off? ☐ Yes ☐ No Depth
Was a drive shoe used? ☒ Yes ☐ No
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? depth of strata
Method of sealing strata off

(10) WATER LEVELS:
Static level 20 ft. below land surface Date 9/9/66
Artesian pressure lbs. per square inch Date

(11) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☒ Yes ☐ No If yes, by whom? DRILLER
Yield: 600 gal./min. with I9 ft. drawdown after 4 hrs.
" 500 " I4 " 4 "
" 400 " 9 " 4 "
330 gal./min. with 9 ft. drawdown after 4 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

(12) WELL LOG:
Diameter of well below casing
Depth drilled 99 ft. Depth of completed well 99 ft.
Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
TOP SOIL	0	3
CLAY	3	I5
CLAY & GRAVEL TIGHT	I5	34
BLACK SAND & GRAVEL	34	55
BROWN SAND & GRAVEL	55	99
SHALE BLACK & GRITTY	99	?

RECEIVED APR 25 2008 WATER RESOURCES DEPT SALEM, OREGON

Work started SEPT. I 1966 Completed SEPT 9 I966
Date well drilling machine moved off of well SEPT 9 I966

(13) PUMP:
Manufacturer's Name T 10602
Type: H.P.

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME WILLAMETTE DRILLING CO
(Person, firm or corporation) (Type or print)
Address RT. 2 BOX 276 SALEM, OREGON
Drilling Machine Operator's License No. 74
[Signed] Emil O. Beier
(Water Well Contractor)
Contractor's License No. 2 Date SEPT 9 I966, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
WATER RESOURCES DEPARTMENT, SALEM, OREGON 97310 within 30 days from the date of well completion.

LANDOWNER. Branch
LEGAL 3-29-86
NC

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
MAY 26 1978
WATER RESOURCES DEPT.
SALEM, OREGON

6S 3W 2
6S/2W-2

State Well No. .....
State Permit No. .....

MARION 4787

(1) OWNER:
Name Paul Witteman c/o R.M.P.C.O.
Address Box 939 Prudhoe Bay
Anchorage, Alaska 99510

(2) TYPE OF WORK (check):
New Well ☐ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☒ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

CASING INSTALLED:
Threaded ☐ Welded ☒
6 " Diam. from top ft. to 60 ft. Gage .250
..... " Diam. from ..... ft. to ..... ft. Gage .....
..... " Diam. from ..... ft. to ..... ft. Gage .....

PERFORATIONS:
Perforated? ☐ Yes ☒ No
Type of perforator used
Size of perforations in. by in.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☒ No
Manufacturer's Name .....
Type ..... Model No. .....
Diam. ..... Slot size ..... Set from ..... ft. to ..... ft.
Diam. ..... Slot size ..... Set from ..... ft. to ..... ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
"test 45 GPM for a period of 1 hour"
" " " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ..... ft.

(9) CONSTRUCTION:
Well seal—Material used Portland Cement
Well sealed from land surface to 19 ft.
Diameter of well bore to bottom of seal 10 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 6 sacks
How was cement grout placed? poured in from the top
Was a drive shoe used? ☒ Yes ☐ No Plugs ..... Size: location ..... ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

(10) LOCATION OF WELL:
County Marion Driller's well number 2134
¼ ¼ Section 2 T. 6S R. 2W W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 31 ft.
Static level 19 ft. below land surface. Date 3/18/78
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing .....
Depth drilled 60 ft. Depth of completed well 60 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
Topsoil	0	2	
Brown Silty Clay	2	31	
Black Sand and Gravel	31	42	
Blue Clay	42	49	
Brown Sand and Gravel	49	55	
Loose Brown Sand and Gravel	55	60	

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WATER RESOURCES DEPT
SALEM, OREGON
T 10602

Work started 3/18/78 19 Completed 3/18/78 19
Date well drilling machine moved off of well 3/20/78 19

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Dallas L Bees (Drilling Machine Operator) Date 3/20/78 19
Drilling Machine Operator's License No. 752

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name Willamette Drilling Co. (Person, firm or corporation) (Type or print)
Address 1450 Barnick Rd. NE Salem, OR 97303
[Signed] Dallas L Bees (Water Well Contractor)
Contractor's License No. 561 Date 3/20/78, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

RECEIVED APR 25 2008 WATER RESOURCES DEPT SALEM, OREGON

RECEIVED OCT 27 1959 STATE ENGINEER SALEM, OREGON

MAR 4792

WATER WELL REPORT

STATE OF OREGON

File Original and First Copy with the STATE ENGINEER, SALEM, OREGON

State Well No. 6/3W-2F

State Permit No. G1687

(1) OWNER:

Name LaVerne Todd

Address Toledo Ore.

(2) LOCATION OF WELL:

County MARION Owner's number, if any—

¼ ¼ Section T. R. W.M.

Bearing and distance from section or subdivision corner

(3) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐

Irrigation ☒ Test Well ☐ Other ☐

(5) TYPE OF WELL:

Rotary ☐ Driven ☐

Cable ☒ Jetted ☐

Dug ☐ Bored ☐

(6) CASING INSTALLED:

Threaded ☐ Welded ☒

12 " Diam. from 0 ft. to 242 ft. Gage .....

..... " Diam. from ..... ft. to ..... ft. Gage .....

..... " Diam. from ..... ft. to ..... ft. Gage .....

(7) PERFORATIONS:

Perforated? ☐ Yes ☐ No

Type of perforator used

SIZE of perforations ..... in. by ..... in.

..... perforations from ..... ft. to ..... ft.

24 perforations from 40 ft. to 43 ft.

24 perforations from 63 ft. to 65 ft.

240 perforations from 190 ft. to 230 ft.

..... perforations from ..... ft. to ..... ft.

(8) SCREENS:

Well screen installed ☐ Yes ☒ No

Manufacturer's Name .....

Type ..... Model No. .....

Diam. ..... Slot size ..... Set from ..... ft. to ..... ft.

Diam. ..... Slot size ..... Set from ..... ft. to ..... ft.

(9) CONSTRUCTION:

Was well gravel packed? ☐ Yes ☒ No Size of gravel: .....

Gravel placed from ..... ft. to ..... ft.

Was a surface seal provided? ☒ Yes ☐ No To what depth? 70 ft.

Material used in seal— puddled clay

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? Depth of strata

Method of sealing strata off

(10) WATER LEVELS:

Static level ft. below land surface Date

Artesian pressure lbs. per square inch Date

Log Accepted by

[Signed] LaVerne Todd (Owner) Date 10-23-, 1959

(11) WELL TESTS:

Drawdown is amount water level is lowered below static level Drilling Co.

Was a pump test made? ☒ Yes ☐ No If yes, by whom? Willamette

Yield: 675 gal./min. with 26 ft. drawdown after 4 hrs.

" 775 " 35 " 4 "

" 900 " 35 " 4 "

Bailer test gal./min. with ft. drawdown after hrs.

Artesian flow 110 g.p.m. Date 10-15-59

Temperature of water Was a chemical analysis made? ☐ Yes ☒ No

(12) WELL LOG:

Diameter of well 12 inches.

Depth drilled 240 ft. Depth of completed well 246 ft.

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Top black dirt	0	5
brown sticky clay	5	20
brown sandy clay	20	30
black sandy clay	30	35
sand & gravel scattered clay	35	40
clean gravel very little w.	40	45
gravel & silt	45	62
clean gravel v. little w.	62	65
sandy silt & gravel	65	73
black peat	73	84
blue shale	84	130
black silty shale	130	142
gray shale with green stks.	142	148
hard black sand	148	183
black sand & gravel clay	183	223
strike a scattered flow at		
sand & gravel tala & clay & silt	223	229
green shale	229	238
grayish black shale	238	244
grayish black shale with thin layers sandstone	244	246
black shale hard crumbly	244	250

Work started Sept 8 19 . Completed Oct 16 1959

(13) PUMP:

Manufacturer's Name .....

Type: ..... H.P. .....

Well Driller's Statement:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME WILLAMETTE DRILLING CO.
(Person, firm, or corporation) (Type or print)

Address .....

Driller's well number 507

[Signed] Irving Bean (Well Driller)

License No. 8 Date 10-22, 1959

(USE ADDITIONAL SHEETS IF NECESSARY)

T 10602

STATE ENGINEER
Salem, Oregon

State Well No. 6/3W-2F1

County Marion

Application No. .....

Chemical Analysis

OWNER LaVerne Todd OWNER'S NO. .....

ANALYST USGS Address Portland, Oregon

Date of Collection 6-1-60

Point of Collection .....

	P.P.M.	E.P.M.
Silica (SiO_2)	41	
Iron (Fe) Total	.29	
Manganese (Mn)		
Calcium (Ca)	21	
Magnesium (Mg)	13	
Sodium (Na)	21	
Potassium (K)	2.2	
Bicarbonate (HCO_3)	180	
Carbonate (CO_3)	0	
Sulfate (SO_4)	1.6	
Chloride (Cl)	5.5	
Fluoride (F)	.1	
Nitrate (NO_3)	.2	
Boron (B)		
Dissolved Solids	195	
Hardness as $CaCO_3$	107	
Specific Conductance (Micromhos at 25°C)	273	
pH	7.9	
Percent Sodium	29	
Sodium Absorption Ratio (S.A.R.)	.9	
CLASS		

State Printing 80318

T 10602

STATE ENGINEER
Salem, Oregon

4-194
MARION

Well Record

STATE WELL NO. 6/3W-2L
COUNTY Marion
APPLICATION NO. GR-2262

OWNER: Ruel Bradford

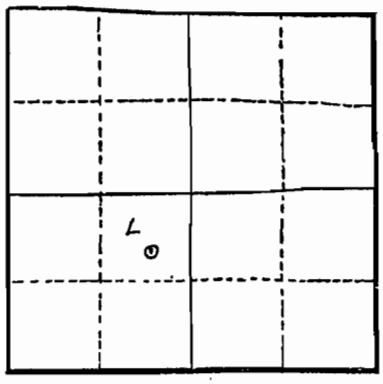
MAILING ADDRESS: Route 1, Box 86

CITY AND STATE: Gervais, Oregon

LOCATION OF WELL: Owner's No. ____

NE ¼ SW ¼ Sec. 2 T. 6 S., R. 3 W., W.M.

Bearing and distance from section or subdivision corner North 50° 30' East 1362 feet from the NW Corner Allanson Beers DLC 38



Section 2

Altitude at well ____

TYPE OF WELL: Drilled Date Constructed 1950

Depth drilled 41 feet Depth cased 41 feet

CASING RECORD:

6-inch

FINISH:

Perforations from 34 to 40 feet

AQUIFERS:

Sand and gravel from 24 to 41 feet

WATER LEVEL:

22 feet below land surface

PUMPING EQUIPMENT: Type Jet H.P. 1½
Capacity 15 G.P.M.

WELL TESTS:
Drawdown 2 ft. after ____ hours Pumping 40 G.P.M.
Drawdown ____ ft. after ____ hours ____ G.P.M.

USE OF WATER Irrigation Temp. ____ °F. ____, 19____
SOURCE OF INFORMATION GR-2262 GR. - 2159
DRILLER or DIGGER Emil Beier
ADDITIONAL DATA:
Log x Water Level Measurements ____ Chemical Analysis ____ Aquifer Test ____

REMARKS:

soil 0 to 2 feet
clay, yellow 2 to 24 feet
sand and gravel 24 to 41 feet

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SALEM, OREGON

T 10602

State Printing 89316

STATE ENGINEER
Salem, Oregon

State Well No. 6/3W-2L
County Marion 2159
Application No. GR-~~2262~~

Well Log

Owner: Ruel Bradford Owner's No.

Driller: Emil Beier Date Drilled 1950

CHARACTER OF MATERIAL	(Feet below land surface) From	To	Thickness (feet)
Soil	0	2	2
Clay, yellow	2	24	22
Sand and gravel, brown, water bearing	24	41	18

T 10602

STATE ENGINEER
Salem, Oregon

MART 4800

Well Record

STATE WELL NO. 6/3W-2-P
COUNTY Marion
~~APPLICATION NO.~~ GR-3327

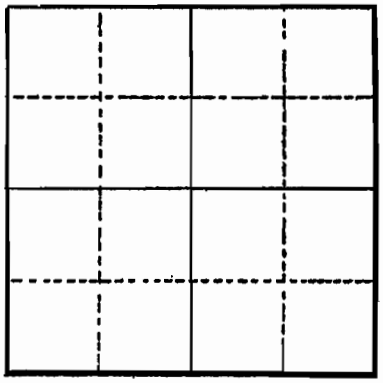
OWNER: Frank Burke (J.)

MAILING ADDRESS: Route 1, Box 85

LOCATION OF WELL: Owner's No. .....

CITY AND STATE: Gervais, Oregon

SE ¼ SW ¼ Sec. 2 T. 6 ~~N.~~ S., R. 3 ~~E.~~ W., W.M.



Bearing and distance from section or subdivision corner S. 34°32' E. 1754.9' thence N. 56°54' E 653.5' from most Westerly corner of Alanson Beers DLC 38

Altitude at well .....

TYPE OF WELL: drilled Date Constructed 1952

Depth drilled 55' Depth cased 55'

Section .....

CASING RECORD:

8"

FINISH:

360 perforations from 30 to 53'

AQUIFERS:

clay, sand, gravel

WATER LEVEL:

20'

PUMPING EQUIPMENT: Type Pomona Turbine H.P. 5
Capacity 100 G.P.M.

WELL TESTS:
Drawdown ..... ft. after ..... hours ..... G.P.M.
Drawdown ..... ft. after ..... hours ..... G.P.M.

USE OF WATER Irrigation Temp. ..... °F. ....., 19.....
SOURCE OF INFORMATION GR-3084
DRILLER or DIGGER .....
ADDITIONAL DATA:
Log x Water Level Measurements ..... Chemical Analysis ..... Aquifer Test .....

REMARKS:

RECEIVED
APR 25 2008

T 10602

State Printing 89816

STATE ENGINEER
Salem, Oregon

State Well No. 6/3W-2P
County Marion
Application No. GR-3327

Well Log

Owner: Frank J. Burke Owner's No.

Driller: Date Drilled 1952

CHARACTER OF MATERIAL	(Feet below land surface) From	To	Thickness (feet)
Topsoil	3	3	
Clay yellow color sticky	18	21	
Clay yellow color sandy	7	28	
Sand medium grain	1	29	
Water Gravel # 2"-	2	31	
Cemented Gravel- Water Bearing	20	51	
Water gravel #2"-	4	55	
Casing undermined @ 55' to allow free passage			
of water below pipe			

T 10602

STATE OF OREGON

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-095)

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12097
SALEM, OR 97309-0067

mari 5172

Start Card # 88819

Instructions for completing this report are on the last page of this form.

(1) OWNER/PROJECT:

WELL NO. 4613

Name Morse Bros. Inc.

Address 32260 Hwy 34

City Tangent State OR Zip 97389

(2) TYPE OF WORK:

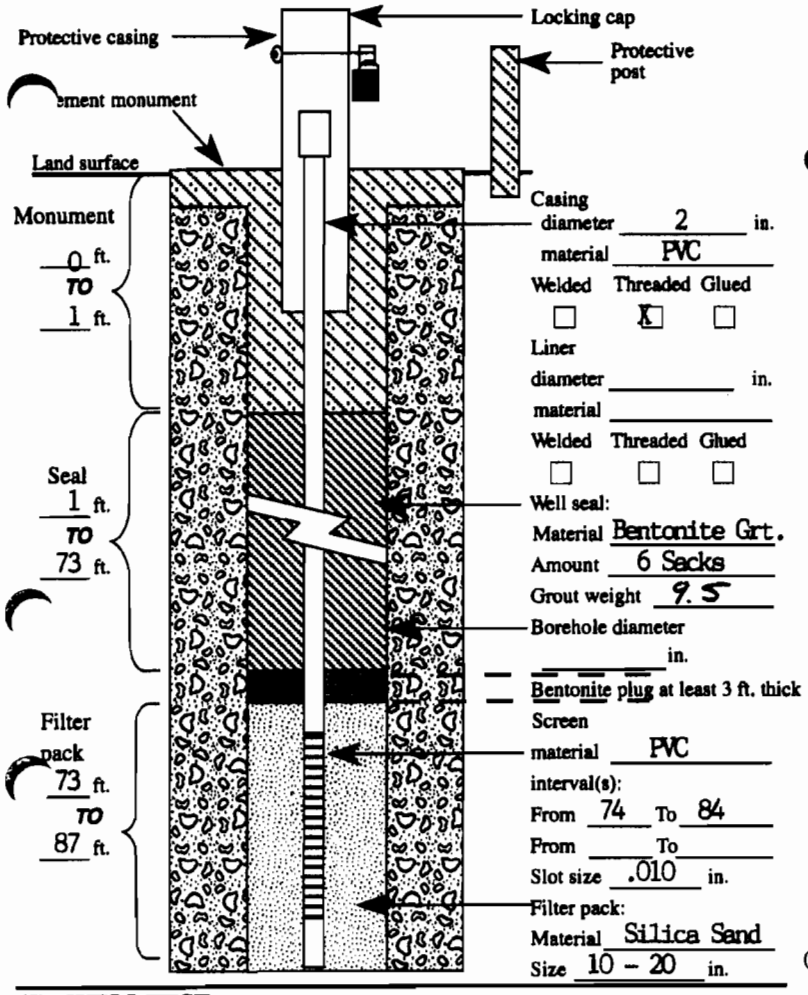
[X] New construction [ ] Alteration (Repair/Recondition)
[ ] Conversion [ ] Deepening [ ] Abandonment

(3) DRILLING METHOD

[X] Rotary Air [ ] Rotary Mud [ ] Cable
[ ] Hollow Stem Auger [ ] Other

(4) BORE HOLE CONSTRUCTION

Special Standards Yes [ ] No [X] Depth of completed well 84.5 ft.



Casing diameter 2 in.
material PVC
Welded [ ] Threaded [X] Glued [ ]

Liner
diameter ____ in.
material ____
Welded [ ] Threaded [ ] Glued [ ]

Well seal:
Material Bentonite Grt.
Amount 6 Sacks
Grout weight 9.5
Borehole diameter ____ in.
Bentonite plug at least 3 ft. thick

Screen
material PVC
interval(s):
From 74 To 84
From ____ To ____
Slot size .010 in.

Filter pack:
Material Silica Sand
Size 10 - 20 in.

(5) WELL TEST:

[ ] Pump [ ] Bailer [X] Air [ ] Flowing Artesian
Permeability ____ Yield 1.5 GPM
Conductivity ____ PH 6.5
Temperature of water 53 °F/C Depth artesian flow found ____ ft.
Was water analysis done? [ ] Yes [X] No
By whom? ____
Depth of strata to be analyzed. From ____ ft. to ____ ft.
Remarks: ____

Name of supervising Geologist/Engineer ____

(6) LOCATION OF WELL By legal description

Well Location: County Marion
Township 6S (N or S) Range 3W (E or W) Section 11
1. NW 1/4 of NE 1/4 of above section.
2. Either Street address of well location Corner of Waconda and Wheatland Road Keizer OR
or Tax lot number of well location 100
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

14.2" Pt. below land surface. Date 11/8/96
Artesian Pressure ____ lb/sq. in. Date ____

(8) WATER BEARING ZONES:

Depth at which water was first found ____

From	To	Est. Flow Rate	SWL
90	100		2

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WATER RESOURCES DEPT.
SALEM, OREGON

(9) WELL LOG:

Ground elevation ____

Material	From	To	SWL
Topsoil	0	1	
Clay brown	1	10	
Clay brown silty	10	14	
Sand brown	14	18	
Sand brown w/gravel sm.	18	24	
Gravel sm w/sand br.	24	30	
Gravel w/silt rusty br.	30	42	
Gravel medium w/sand br.	42	45	
Gravel w/sand & silt blk.	45	52	
Sand blk coarse	52	56	
Gravel & Sand blk.	56	62	
Gravel med to lrg w/sand	62	79	
Sand blk w/gr. sm.	79	82	
Sand blk w/gravel pea	82	85	
Clayblue sandy	85	87	
Clay green soft	97	100	
Bentonite Holeplug used			
from -1 to 19 feet			

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WATER RESOURCES DEPT
SALEM, OREGON

Date started 11/5/96 Completed 11/8/96

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

Signed T 10602 MWC Number ____ Date ____

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

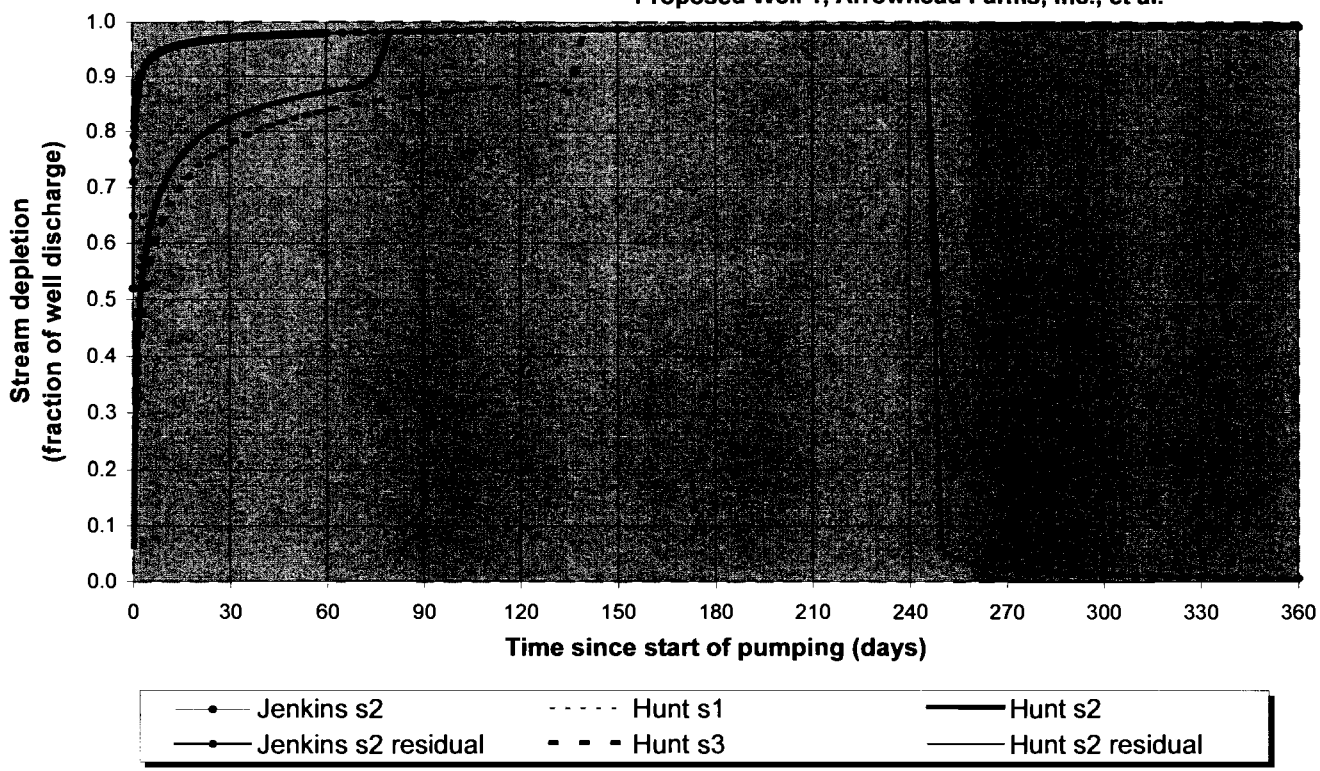
MWC Number 10166

Signed Eugene R. Mack Date 11-13-96

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT
SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

Transient Stream Depletion (Jenkins, 1970; Hunt, 1999)

Proposed Well 1, Arrowhead Farms, Inc., et al.



Output for Hunt Stream Depletion, Scenerio 2 (s2): Time pump on = 245 days

Days	30	60	90	120	150	180	210	240	270	300	330	360
Hunt SD s2	0.822	0.872	0.983	0.985	0.987	0.988	0.989	0.990	0.184	0.124	0.009	0.007
Qw, cfs	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700
H SD s2, cfs	0.576	0.610	0.688	0.690	0.691	0.692	0.692	0.693	0.129	0.087	0.006	0.005

Parameters:		**Scenario 1**	**Scenario 2**	**Scenario 3**	**Units**
Net steady pumping rate	Qw	0.7	0.7	0.7	cfs
Distance to stream	a	1440	1440	1440	ft
Aquifer hydraulic conductivity	K	50	50	50	ft/day
Aquifer thickness	b	50	50	50	ft
Aquifer transmissivity	T	2500	2500	2500	ft*ft/day
Aquifer storage coefficient	S	0.0001	0.0001	0.0001	
Stream width	ws	200	200	200	ft

Streambed hydraulic conductivity	Ks	0.01	0.01	0.01	ft/day
Streambed thickness	bs	2	3	4	ft
Streambed conductance	sbc	1	0.666666667	0.5	ft/day
Stream depletion factor (Jenkins)	sdf	0.082944	0.082944	0.082944	days
Streambed factor (Hunt)	sbf	0.576	0.384	0.288	

General Output:	Name	Scenario 1	Scenario 2	Scenario 3	Unit	
a	a_ft		1440		ft	
	a_m		439.0243902		m	
Qw	Qw_cfs		0.7		cfs	
	Qw_gpm		314.16		gpm	
	Qw_lps		19.82		lps	
b	b_ft		50		ft	
	b_m		15.24390244		m	
d	d_ft		75		ft	
	d_m		22.86585366		m	
Hydraulic conductivity	K_ft	50.00	50.00	50.00	ft/day	= K
	K_gal	374.00	374.00	374.00	gpd/ft*ft	
	K_m	15.24	15.24	15.24	m/day	
Transmissivity	T_ft	2500.00	2500.00	2500.00	ft*ft/day	= K*b
	T_gal	18700.00	18700.00	18700.00	gpd/ft	
	T_m	232.38	232.38	232.38	m*m/day	
Streambed hydraulic conductivity	Ks_ft	0.01	0.01	0.01	ft/day	= Ks
	Ks_gal	0.07	0.07	0.07	gpd/ft*ft	
	Ks_m	0.00	0.00	0.00	m/day	
Stream width	ws_ft		200		ft	
	ws_m		60.97560976		m	
Stream thickness	bs_ft	2	3	4	ft	
	bs_m	0.609756098	0.914634146	1.219512195	m	
Streambed conductance	sbc_ft	1.00E+00	6.67E-01	5.00E-01	ft/day	= Ks*ws/bs
	sbc_gal	7.48E+00	4.99E+00	3.74E+00	gpd/ft*ft	
	sbc_m	3.05E-01	2.03E-01	1.52E-01	m/day	
Stream depletion factor 1 (intermediate calc)	sdf_1	2.07E-02	2.07E-02	2.07E-02	days	= (a^2*S)/(4T)
Stream depletion factore 2 (intermediate calc)	sdf_2	1	0.444444444	0.25		= sbc^2/(4ST)
Stream depletion factor (Jenkins)	sdf	8.29E-02	8.29E-02	8.29E-02	days	= (a^2*S)/(T)
Streambed factor (Hunt)	sbf	5.76E-01	3.84E-01	2.88E-01		= sbc*a/T
Hunt exponential stream depletion term	hsdt	0.00E+00	0.00E+00	0.00E+00		

Transient Stream Depletion Output:		Scenario 1	Scenario 2	Scenario 3		
Transient Stream Depletion (Jenkins) at time, tp	sdj	0.9896	0.9896	0.9896		= erfc SQRT(sdf)
Transient Stream Depletion (Hunt) at time, tp	sdh	0.9896	0.9896	0.9896		= erfc SQRT(sdf)-hsdt

Plot labels:

T 10602

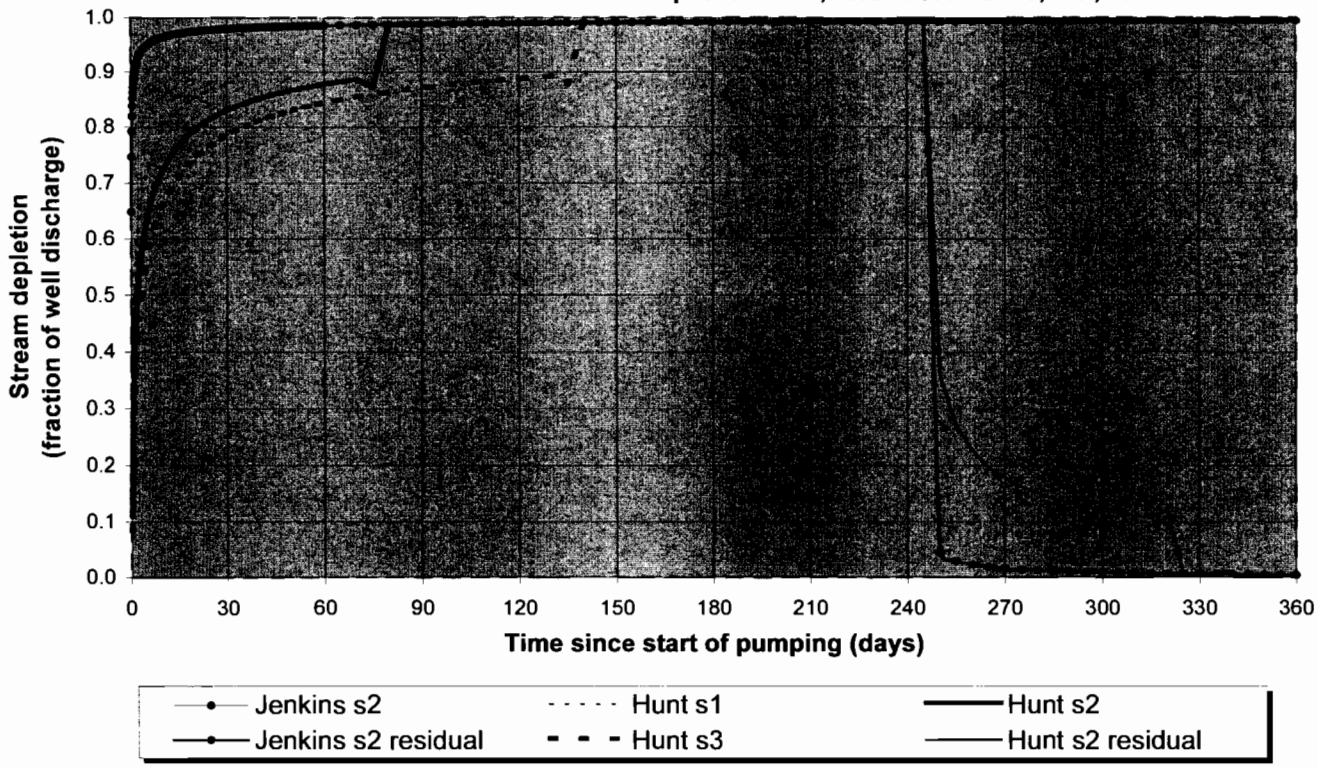
Transient Stream Depletion (Hunt) = 98.96% at 245.00days

Data for Transient Stream Depletion Chart:

Time Since Pump Started [days]	Time Since Pump Stopped [days]	Stream Depletion Hunt s1 sdj s1	Stream Depletion Jenkins s2 sdj s2	Residual Str Depletion Jenkins s2 sdjr s2	Stream Depletion Hunt s2 sdh s2	Residual Str Depletion Hunt s2 sdhr s2	Stream Depletion Hunt s3 sdh s3
0.10	0.0	0.113953191	0.51958349	0.51958349	0.081132683	0.081132683	0.062967311
0.20	0.0	0.198128696	0.648844525	0.648844525	0.144967213	0.144967213	0.114212493
0.30	0.0	0.257008869	0.710036997	0.710036997	0.191640342	0.191640342	0.15261411
0.40	0.0	0.302106129	0.7474574	0.7474574	0.228598885	0.228598885	0.183606493
0.50	0.0	0.338504366	0.773346739	0.773346739	0.259244897	0.259244897	0.20971328
0.60	0.0	0.368900693	0.792622394	0.792622394	0.285427941	0.285427941	0.232322234
0.70	0.0	0.394904318	0.807692116	0.807692116	0.308273751	0.308273751	0.252286551
0.80	0.0	0.417554611	0.819891919	0.819891919	0.32852388	0.32852388	0.270172303
0.90	0.0	0.437562874	0.830030442	0.830030442	0.346693281	0.346693281	0.286376384
1.00	0.0	0.455437582	0.838629555	0.838629555	0.36315565	0.36315565	0.301188948
1.10	0.0	0.471554908	0.846043117	0.846043117	0.378191701	0.378191701	0.314829186
1.20	0.0	0.486200952	0.852520672	0.852520672	0.392017455	0.392017455	0.32746711
1.30	0.0	0.499598404	0.858243928	0.858243928	0.404803158	0.404803158	0.339237483
1.40	0.0	0.511923746	0.863348756	0.863348756	0.416685503	0.416685503	0.350248683
1.50	0.0	0.523319462	0.867939062	0.867939062	0.427775663	0.427775663	0.360590757
1.60	0.0	0.533901886	0.872095847	0.872095847	0.438165722	0.438165722	0.370337341
1.70	0.0	0.543767501	0.875883314	0.875883314	0.44793259	0.44793259	0.379550717
1.80	0.0	0.552996916	0.8793531	0.8793531	0.457141328	0.457141328	0.388283769
1.90	0.0	0.561658258	0.882547266	0.882547266	0.465847165	0.465847165	0.396581808
2.00	0.0	0.569809684	0.88550047	0.88550047	0.47409787	0.47409787	0.404484074
2.50	0.0	0.60445	0.897517872	0.897517872	0.509798206	0.509798206	0.439113899
3.00	0.0	0.631644766	0.906404012	0.906404012	0.538576861	0.538576861	0.467565313
4.00	0.0	0.672261332	0.91889687	0.91889687	0.582856817	0.582856817	0.512325883
5.00	0.0	0.701670611	0.927434112	0.927434112	0.615934689	0.615934689	0.546580813
6.00	0.0	0.724273974	0.933741462	0.933741462	0.641960526	0.641960526	0.574047873
7.00	0.0	0.742366223	0.938646426	0.938646426	0.663179052	0.663179052	0.596788562
8.00	0.0	0.757281707	0.942601908	0.942601908	0.680934489	0.680934489	0.616063567
9.00	0.0	0.769857997	0.945879368	0.945879368	0.696091454	0.696091454	0.632698345
10.00	0.0	[illegible]	0.948652719	0.948652719	[illegible]	0.709236419	[illegible]

Transient Stream Depletion (Jenkins, 1970; Hunt, 1999)

Proposed Well 2, Arrowhead Farms, Inc., et al.



Output for Hunt Stream Depletion, Scenerio 2 (s2): Time pump on = 245 days

Days	30	60	90	120	150	180	210	240	270	300	330	360
Hunt SD s2	0.830	0.878	0.988	0.989	0.991	0.991	0.992	0.993	0.178	0.120	0.006	0.005
Qw, cfs	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700	0.700
H SD s2, cfs	0.581	0.615	0.692	0.693	0.693	0.694	0.694	0.695	0.124	0.084	0.004	0.003

Parameters:		**Scenario 1**	**Scenario 2**	**Scenario 3**	**Units**
Net steady pumping rate	Qw	0.7	0.7	0.7	cfs
Distance to stream	a	1020	1020	1020	ft
Aquifer hydraulic conductivity	K	50	50	50	ft/day
Aquifer thickness	b	50	50	50	ft
Aquifer transmissivity	T	2500	2500	2500	ft*ft/day
Aquifer storage coefficient	S	0.0001	0.0001	0.0001	
Stream width	ws	200	200	200	ft

Streambed hydraulic conductivity	Ks	0.01	0.01	0.01	ft/day
Streambed thickness	bs	2	3	4	ft
Streambed conductance	sbc	1	0.666666667	0.5	ft/day
Stream depletion factor (Jenkins)	sdf	0.041616	0.041616	0.041616	days
Streambed factor (Hunt)	sbf	0.408	0.272	0.204	

General Output:	Name	Scenario 1	Scenario 2	Scenario 3	Unit	
a	a_ft		1020		ft	
	a_m		310.9756098		m	
Qw	Qw_cfs		0.7		cfs	
	Qw_gpm		314.16		gpm	
	Qw_lps		19.82		lps	
b	b_ft		50		ft	
	b_m		15.24390244		m	
d	d_ft		75		ft	
	d_m		22.86585366		m	
Hydraulic conductivity	K_ft	50.00	50.00	50.00	ft/day	= K
	K_gal	374.00	374.00	374.00	gpd/ft*ft	
	K_m	15.24	15.24	15.24	m/day	
Transmissivity	T_ft	2500.00	2500.00	2500.00	ft*ft/day	= K*b
	T_gal	18700.00	18700.00	18700.00	gpd/ft	
	T_m	232.38	232.38	232.38	m*m/day	
Streambed hydraulic conductivity	Ks_ft	0.01	0.01	0.01	ft/day	= Ks
	Ks_gal	0.07	0.07	0.07	gpd/ft*ft	
	Ks_m	0.00	0.00	0.00	m/day	
Stream width	ws_ft		200		ft	
	ws_m		60.97560976		m	
Stream thickness	bs_ft	2	3	4	ft	
	bs_m	0.609756098	0.914634146	1.219512195	m	
Streambed conductance	sbc_ft	1.00E+00	6.67E-01	5.00E-01	ft/day	= Ks*ws/bs
	sbc_gal	7.48E+00	4.99E+00	3.74E+00	gpd/ft*ft	
	sbc_m	3.05E-01	2.03E-01	1.52E-01	m/day	
Stream depletion factor 1 (intermediate calc)	sdf_1	1.04E-02	1.04E-02	1.04E-02	days	= (a^2*S)/(4T)
Stream depletion factore 2 (intermediate calc)	sdf_2	1	0.444444444	0.25		= sbc^2/(4ST)
Stream depletion factor (Jenkins)	sdf	4.16E-02	4.16E-02	4.16E-02	days	= (a^2*S)/(T)
Streambed factor (Hunt)	sbf	4.08E-01	2.72E-01	2.04E-01		= sbc*a/T
Hunt exponential stream depletion term	hsdt	0.00E+00	0.00E+00	0.00E+00		

Transient Stream Depletion Output:		Scenario 1	Scenario 2	Scenario 3		
Transient Stream Depletion (Jenkins) at time, tp	sdj	0.9926	0.9926	0.9926		= erfc SQRT(sdf)
Transient Stream Depletion (Hunt) at time, tp	sdh	0.9926	0.9926	0.9926		= erfc SQRT(sdf)-hsdt

Plot labels:

T 10602

Transient Stream Depletion (Hunt) = 99.26% at 245.00days

Data for Transient Stream Depletion Chart:

Time Since Pump Started [days]	Time Since Pump Stopped [days]	Stream Depletion Hunt s1 sdj s1	Stream Depletion Jenkins s2 sdj s2	Residual Str Depletion Jenkins s2 sdjr s2	Stream Depletion Hunt s2 sdh s2	Residual Str Depletion Hunt s2 sdhr s2	Stream Depletion Hunt s3 sdh s3
0.10	0.0	0.151802396	0.648276461	0.648276461	0.108487918	0.108487918	0.084367642
0.20	0.0	0.238419431	0.747034307	0.747034307	0.17508451	0.17508451	0.13821808
0.30	0.0	0.296848851	0.792270908	0.792270908	0.222119994	0.222119994	0.177234328
0.40	0.0	0.340921212	0.819584877	0.819584877	0.258830315	0.258830315	0.208285121
0.50	0.0	0.376185392	0.838353499	0.838353499	0.289023925	0.289023925	0.234237273
0.60	0.0	0.405468908	0.852267795	0.852267795	0.314684854	0.314684854	0.256599181
0.70	0.0	0.430420448	0.863114057	0.863114057	0.336992408	0.336992408	0.276275431
0.80	0.0	0.452089337	0.871875899	0.871875899	0.356709834	0.356709834	0.293856632
0.90	0.0	0.471185881	0.879145431	0.879145431	0.374363457	0.374363457	0.30975219
1.00	0.0	0.488214171	0.885303231	0.885303231	0.390331008	0.390331008	0.324258917
1.10	0.0	0.50354448	0.890606529	0.890606529	0.404894154	0.404894154	0.337599569
1.20	0.0	0.517457268	0.895236271	0.895236271	0.418269192	0.418269192	0.349946025
1.30	0.0	0.530169838	0.899323936	0.899323936	0.430625525	0.430625525	0.361433952
1.40	0.0	0.541854032	0.902967668	0.902967668	0.442098692	0.442098692	0.372172476
1.50	0.0	0.552647856	0.906242409	0.906242409	0.452798849	0.452798849	0.382250794
1.60	0.0	0.562664065	0.909206507	0.909206507	0.462816777	0.462816777	0.391742407
1.70	0.0	0.571995633	0.911906162	0.911906162	0.472228207	0.472228207	0.400710183
1.80	0.0	0.580720386	0.91437849	0.91437849	0.481097076	0.481097076	0.409206182
1.90	0.0	0.588903845	0.916653703	0.916653703	0.489477563	0.489477563	0.41727534
2.00	0.0	0.596601783	0.918756675	0.918756675	0.497416385	0.497416385	0.424956407
2.50	0.0	0.629278176	0.927308588	0.927308588	0.531731937	0.531731937	0.458584638
3.00	0.0	0.654893143	0.933626795	0.933626795	0.559356847	0.559356847	0.486178277
4.00	0.0	0.693096286	0.942502517	0.942502517	0.601806346	0.601806346	0.529536899
5.00	0.0	0.720722908	0.948563775	0.948563775	0.633479752	0.633479752	0.562682787
6.00	0.0	0.741938593	0.95303994	0.95303994	0.658381423	0.658381423	0.589241674
7.00	0.0	0.758910193	0.956519844	0.956519844	0.678672363	0.678672363	0.611219332
8.00	0.0	0.772895709	0.959325521	0.959325521	0.695644681	0.695644681	0.629840447
9.00	0.0	0.784683894	0.961649886	0.961649886	0.710128482	0.710128482	0.645906074
10.00	0.0	[illegible]	0.963616486	0.963616486	[illegible]	0.722686439	[illegible]

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