

BROCKWAY
ENGINEERING
P.L.L.C.

Hydraulics

Hydrology

Water Resources

June 3, 2008

Mr. Shelley Keen
Idaho Department of Water Resources
322 E. Front Street
P.O. Box 83720
Boise, Idaho 83720-0098

RECEIVED
JUN 05 2008
DEPT. OF WATER RESOURCES
SOUTHERN REGION

Re: Hanley Dawson – potential groundwater mitigation plan
Project No. 1016-01-2007

Dear Shelley:

Pursuant to your recommendation in our recent telephone call, I am requesting a written response from IDWR on the issues we discussed. Mr. Dawson owns surface water right 37-276F and groundwater right 37-8574. Both rights are appurtenant to the same land, approximately 6.5 acres located on the Big Wood River about 7 miles north of Ketchum. All irrigation water is drawn from the existing well. Mr. Dawson wishes to continue this practice, but also wishes to comply with the general rule of “surface water first” and to protect the surface right from forfeiture due to non-use.

An application to transfer the surface water to the groundwater source is pending, but has been held up due to the hydrologic requirement that 50% of the groundwater pumping must be realized in the river within 24 hours. My initial analyses indicate that this criterion cannot be met with the existing well. Therefore, in lieu of a direct surface-to-groundwater transfer, we wish to explore the possibility of using the surface water right to mitigate for the existing groundwater right, where the mitigation would simply be to leave the water right in the river. A transfer of the surface right from “irrigation” to “mitigation” would be used to accomplish this. Based on the meeting on 5/7/08 with you and the IDWR regional staff, it is my understanding that the “50% in 24 hours” criteria does not apply to mitigation plans, and therefore this approach may be feasible. This structure is similar to the plan approved recently for a new permit acquired by the Blaine County School District for the Wood River Middle School.

In the vicinity of the Dawson property, the hydrologic connection between the aquifer and the river is extremely close – much closer than it is in the vicinity of the Wood River Middle School – and there are no diversions for several miles downstream until just north of Ketchum.

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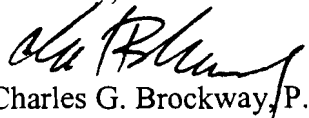
FAX: 736•8506

With the aforesaid as background, I would request a written response from IDWR in answer to the following questions:

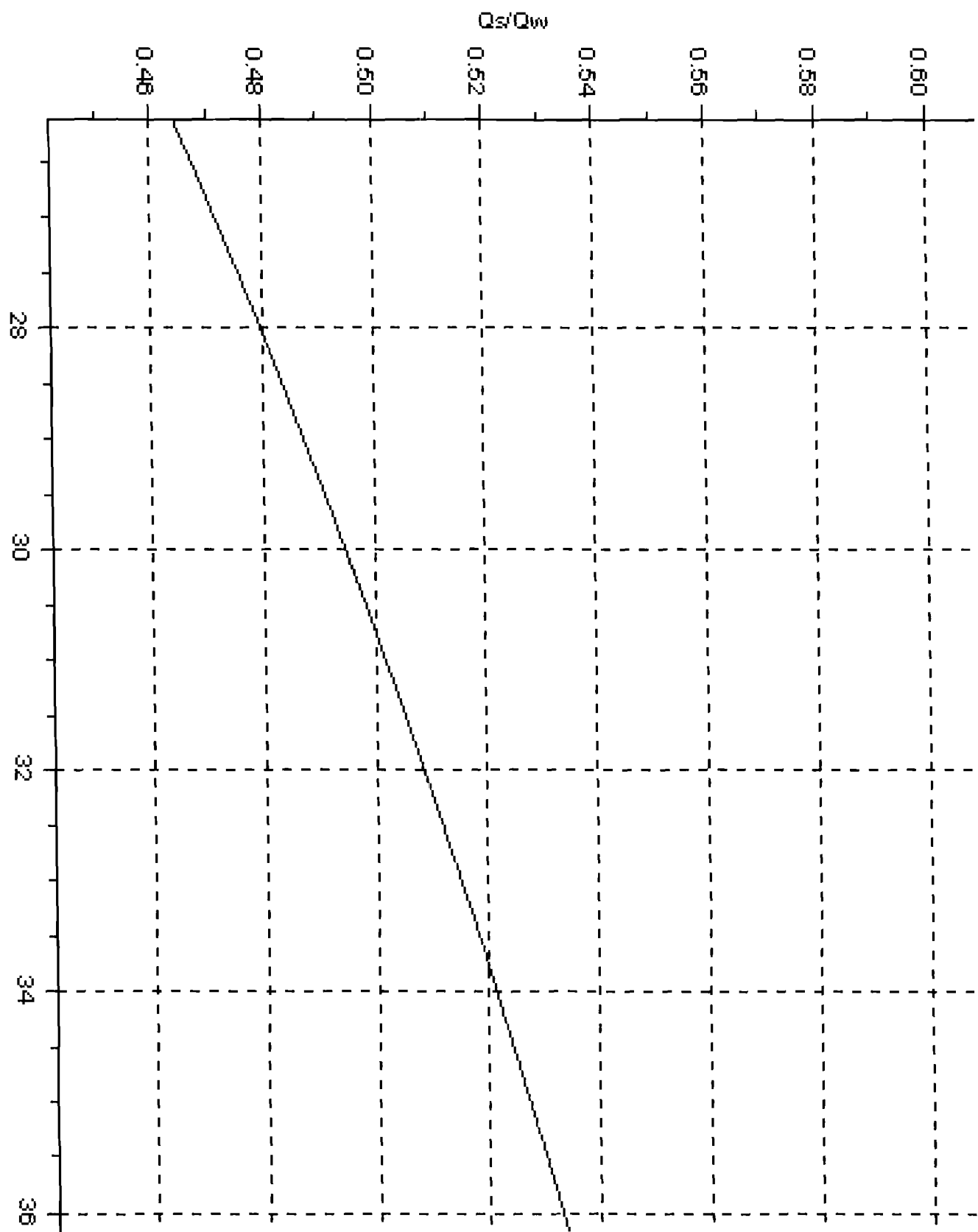
1. Assuming the hydrology is acceptable, can IDWR approve a mitigation plan which proposes to mitigate for an existing groundwater right rather than for a new permit?
2. If such a plan were approved, would protection from forfeiture of the surface right still be achieved under 42-223(10)?

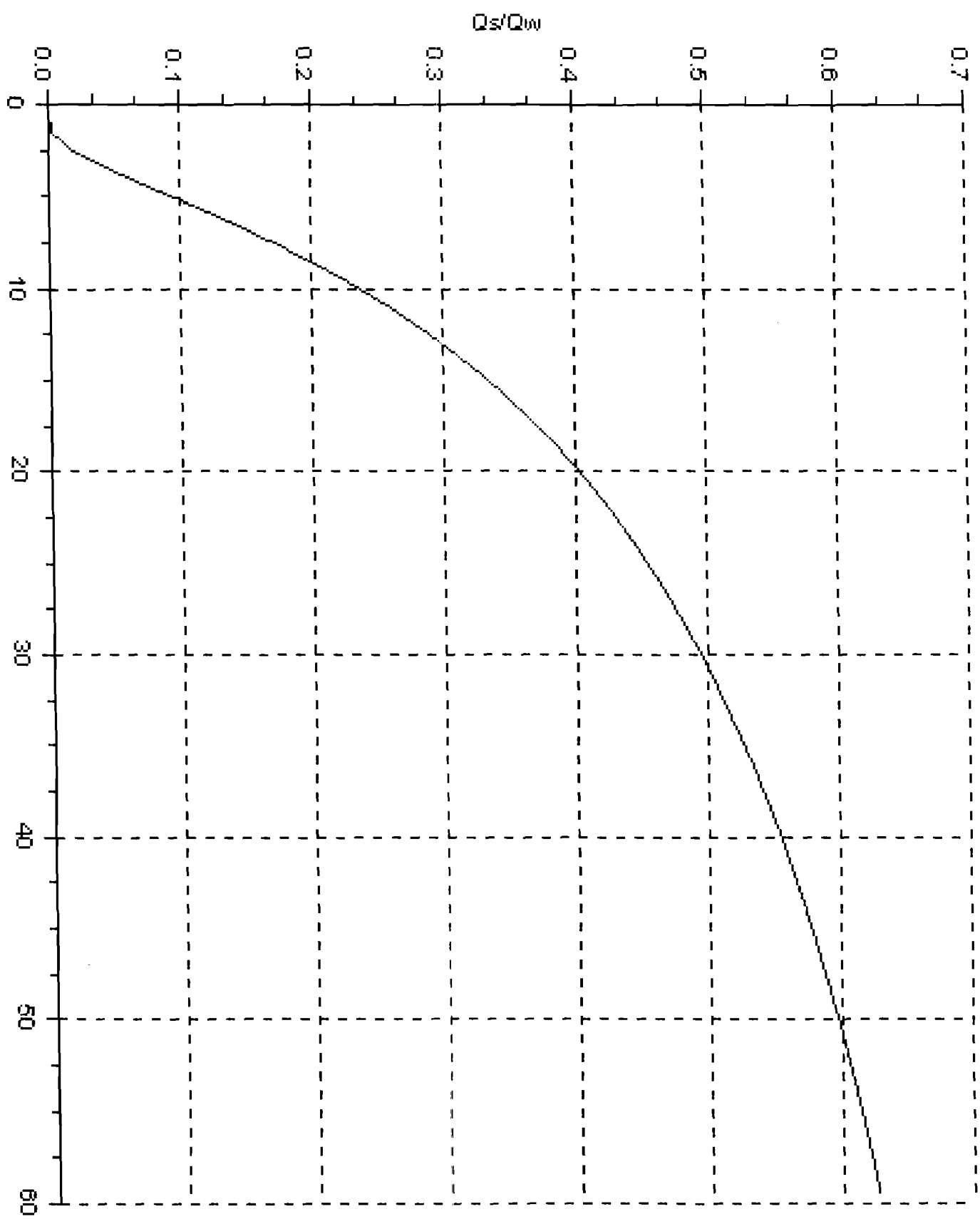
Thank you for your review of this matter, and please do not hesitate to call if you have any questions.

Cordially,


Charles G. Brockway, P.E.

Cc: Hanley Dawson
Allen Merritt – IDWR Southern





recharge on the flow of a nearby stream. Using a two-dimensional ground water flow model of a hypothetical alluvial system, we show how ground water pumping and recharge, aquifer properties, and well locations affect the timing of streamflow depletion. We relate various scenarios to their stream depletion factors (SDF_i) and examine how the SDF_i can be used to guide design strategies that offset surface water impacts due to ground water pumping.

Early Work

Theoretical work on stream depletion goes back to a paper by Theis (1941), who was the first to assess the impacts of pumping on an associated stream. Glover and Balmer (1954) derived a solution to the stream depletion problem in the form of the complementary error function that differed from the earlier integral formulation of Theis. The so-called Glover method (Glover and Balmer 1954) is easier to use. Jenkins (1968a, 1968b, 1968c) generalized the analytical approach by introducing the stream depletion factor.

Both Theis (1941) and Glover and Balmer (1954) assumed the same conceptual model as that of a semi-infinite aquifer. The assumed semi-infinite aquifer has a domain with a constant head boundary along one side, for example, the west side; the domain extends to infinity in the other directions, north, south, and east. The aquifer has uniform properties throughout. A well is situated somewhere within the domain, pumping at a constant rate.

Glover and Balmer (1954) showed that the stream depletion caused by pumping at a constant rate from a well near a river in a semi-infinite aquifer is given by:

$$q_s = Q_w \operatorname{erfc}[a^2 S / (4Tt)]^{1/2}$$

where q_s is the instantaneous stream depletion, Q_w is the pumping rate of the well, erfc is the complementary error function, a is the distance from the stream to the well, T is the transmissivity of the aquifer, S is the storage coefficient (or specific yield), and t is time since pumping started. In the theoretical solution of the boundary value problem, the dimensionless variable, $a^2 S / (4Tt)$, reduces the dimensionality of the solution; this variable is sometimes referred to as dimensionless time.

Jenkins, a pragmatic hydrologist working at the USGS, needed a method to compare the impact of numerous wells on the rivers in both the Arkansas and the South Platte valleys in Colorado. He recognized that aquifer heterogeneity and the limited width of the alluvial aquifers compromised the conceptual model of both the Theis and Glover-Balmer solutions. However, he observed that stream depletion produced by many, if not most, wells generally followed the functional form of the Glover solution. Miller et al. (in press) state:

(Jenkins') basic premise is that the stream response curves in complex stream-aquifer systems can be represented by the mathematically ideal Glover equation; i.e. the shape of the nonideal response curve is similar to the ideal curve ...

Jenkins (1968a, 1968b) defined the SDF as the time at which the ratio $v/Q_w t$ is equal to 0.28, where v is the total volume of stream depletion at time equal to t :

$$v = \int q_s dt \text{ (integrated from 0 to time } t \text{)}$$

and $Q_w t$ is the volume of water pumped to time t . SDF has the unit of time—the unit of time is the unit in which the transmissivity is expressed, for example, days. Jenkins used his definition to determine SDF values for nonideal aquifers, in which aquifer properties varied and in which the aquifers were of finite width. In an ideal aquifer, the SDF is equal to $a^2 S / T$, since $v/Q_w t$ is equal to 0.28 when $tT/a^2 S$ equals 1 on a dimensionless response plot— $v/Q_w t$ vs. $tT/a^2 S$.

We need a technique to express the relative distance of the well from the stream in order to categorize their impacts. In our case, we will use the SDF definition for the ideal aquifer, $a^2 S / T$, and designate it SDF_i, from this point on. The advantage of the SDF approach is that wells in the same aquifer and pumping at the same rate and with the same schedule and the same SDF have identical impacts on the associated stream. This facilitates comparing the stream depletion from a variety of wells.

The impetus for Jenkins' work was the intent of the Colorado State Engineer to regulate wells based on their impacts on streamflow. However, the Colorado Supreme Court did not allow the State Engineer to regulate some wells and not others; they opined that doing so was unfair to some well owners, and therefore Colorado did not use the SDF concept to regulate wells. Even so, Jenkins' concept of categorizing well impacts by SDF is useful, as this article demonstrates.

Recently, Miller et al. (2007) extended the SDF concept to valleys of finite width; they showed how to explicitly modify Jenkins' SDF values for a finite width valley. The SDF values are still used in Colorado for the management of conjunctive use.

Cyclical Pumping

The theoretical basis for the work described previously is based on a well pumping continuously at a fixed rate. Wallace et al. (1990) analyzed streamflow depletion caused by cyclical pumping. They mathematically summed the impact of cycles of pumping superimposed one upon another to obtain a rather elegant general solution. In a semi-infinite aquifer, the stream depletion approaches the rate of pumping asymptotically over time; it takes a long time for the stream depletion to equal the pumping. Wallace et al. (1990) showed that the same is true for cyclic pumping: in a semi-infinite aquifer, the stream depletion approaches the annual rate of pumping asymptotically over time. Wallace et al. (1990) provide type curves for the total quantity of water derived from the stream over each pumping cycle. The type curve integrates the volume of the depletion over each cycle. The Wallace et al. (1990) solution applies only to aquifers of infinite width. The insight provided by the Wallace et al. (1990) solution is quite useful, as we show subsequently.