AGRICULTURAL USE PROTECTION POLICY[1]
(Chapter 1, Section 20)

I. Purpose

All surface waters in Wyoming are protected to some extent for agricultural uses. "Agricultural uses" are described in Chapter 1, Section 3 as being either stock watering or irrigation. The standard that applies to the protection of these uses is contained in Chapter 1, Section 20 which states:

> *Section 20.* ***Agricultural Water Supply.*** *All Wyoming surface waters which have the natural water quality potential for use as an agricultural water supply shall be maintained at a quality which allows continued use of such waters for agricultural purposes.*
>
> *Degradation of such waters shall not be of such an extent to cause a measurable decrease in crop or livestock production.*
>
> *Unless otherwise demonstrated, all Wyoming surface waters have the natural water quality potential for use as an agricultural water supply.*

All water quality standards are established for two reasons. The first is to provide a benchmark against which a determination can be made as to whether a waterbody is impaired and requires some kind of corrective action. The second is to provide a basis for establishing permit limits on regulated activities (WYPDES & Section 404 permits). The purpose of this policy is to provide guidelines to be used by the Water Quality Division when translating the narrative goals expressed in the Section 20 standard into appropriate WYPDES permit limits where maintaining agricultural use of the receiving waters is an issue.

Agricultural use of surface water is an opportunistic endeavor. The varying uses as well as the different qualities of the water found in the state are many and the farming and ranching industries have always had to make do with what water is available. The goal expressed in the Section 20 standard is simply to maintain surface water quality at a level that will continue to support the local agricultural uses that have developed around it.

Though the goal is simple, achieving it is not. For the most part, managing water quality for continued agricultural support requires managing the concentration and chemical makeup of dissolved solids. Because of local differences in crop types, soil types and natural water

[1] This policy was finalized in August, 2006 in conjunction with the Triennial Review of the Chapter 1 surface water standards. A modified version of this policy is under consideration by the Wyoming Environmental Quality Council for adoption as an appendix to the Chapter 1 rules. Until a final decision is rendered on that rulemaking, the provisions of this policy remain in effect for establishing effluent limits on discharges that may affect agricultural uses. The only exception is that the formula for calculating SAR limits has been updated to be SAR < ($EC_{dS/M}$ X 6.67) – 3.33.

quality and availability, it isn't possible to establish simple numeric criteria for pollutants such as TDS and SAR that will allow an efficient use of surface water for irrigation purposes. The determination of what is acceptable water quality for irrigation must necessarily involve an evaluation of local agricultural practices and background water quality conditions. For livestock watering uses, it is somewhat less complicated because there are fewer variables to consider.

"Measurable Decrease"

The first part of translating the standard is defining what is meant by *"measurable decrease in crop or livestock production"*. The phrase implies that there is a pre-existing agricultural use of a stream or drainage prior to an application for aWYPDES discharge permit. For livestock watering purposes, a pre-existing use will always be assumed. For irrigation purposes, there needs to be either a current irrigation structure or mechanism in place for diverting water from the stream channel, or a substantial acreage of naturally sub-irrigated pasture within a stream floodplain. Where neither of these conditions exist, there can be no irrigation use, nor loss in crop production attributable to water quality.

Where there are pre-existing agricultural uses, it may often be impossible to measure a loss in crops or livestock that can be attributed to water quality because of the many other factors that will affect actual production. It is also important to be able to predict the probability of a measurable decrease in production rather than relying solely on after-the-fact measurements. Therefore, the implementation of the narrative criteria through WYPDES permits will always involve making reasonable judgments and assumptions.

Effluent limits on historic discharges of produced water will not be affected by this policy in relation to the protection of agricultural uses. Where discharges have been occurring for many years, the permitted quality of those discharges shall be considered to be "background" conditions and be fully protective of the agricultural uses that have developed around them. Therefore, it is not necessary to modify those discharges in order to achieve the goal of "no measurable decrease" in crop or livestock production. It would only be necessary to maintain the existing quality of the discharge. It is important to note, however, that effluent limits on historic discharges may be made where the quality of the discharge is shown to constitute a hazard to humans, livestock or wildlife.

II. Livestock Watering

The basic concept in protecting a livestock watering use is to ensure that water quality is not acutely toxic to livestock or does not contain pollutants in concentrations that would affect growth or reproduction. There are basic effluent limitations provided in the WYPDES permit regulations *(Chapter 2 of the Water Quality Rules and Regulations)* that are intended to ensure that the water is safe for livestock to drink. These limits are:

5000 mg/L TDS;
3000 mg/L Sulfate;
2000 mg/L Chloride;

and each must be achieved at the end-of-pipe prior to mixing with the receiving stream. In addition to the basic effluent limitations the following limits for livestock protection may be incorporated into WYPDES permits when there is reason to believe they may be associated with a discharge:

Selenium	50 µg/L	Total Recoverable
Fluoride	4000 µg/L	Dissolved
Arsenic	20 µg/L	Total Recoverable
Copper	500 µg/L	Dissolved
Cadmium	50 µg/L	Dissolved
Boron	5000 µg/L	Dissolved
Chromium	1000 µg/L	Dissolved
Lead	100 µg/L	Dissolved
Mercury	10 µg/L	Dissolved
Zinc	2500 µg/L	Dissolved

Livestock watering waver

An exception to the limits above may be made whenever the background water quality of the receiving water is worse than the value listed for the associated pollutant or when the livestock producer requests use of the water and thereby accepts any potential risk to his livestock.

III. Irrigation

The interpretation of the Section 20 standard for irrigation is more complex than for livestock watering because there are more variables than just the quality of the water to consider. However, after considering the local circumstances relative to irrigation and crop production, effluent limits can be established on WYPDES permits that will be protected of the pre-existing irrigation uses. The goal is to ensure that pre-existing irrigated crop production will not be diminished as a result of the lowering of water quality.

The basic water quality parameters of concern in regard to irrigation are electrical conductivity (EC) and sodium adsorption ratio (SAR). Protection of irrigation uses where WYPDES permits are involved amounts to deriving appropriate effluent limits for EC and SAR in each instance.

A. Identification and Protection of Irrigation Uses.

Implementation of the Section 20 standard through the WYPDES permitting program involves a sequence of decisions based upon the amount and quality of data that is available to the permit writer. The most basic question is whether a proposed discharge will reach irrigated lands. If the discharge will not reach an irrigated field, either because of natural conditions or water management techniques, it could not affect crop production on that field. For the purposes of this policy, irrigated lands include the following:

1. Artificially Irrigated Lands: Artificially irrigated lands are those where water is intentionally applied for agricultural purposes. Artificially irrigated lands will be identified by the presence of canals, ditches, spreader dikes, spray irrigation systems or any other constructed mechanism intended to divert water from a stream channel for application on adjacent lands.

2. Naturally Irrigated Lands: Naturally irrigated lands are areas of land along stream channels that have enhanced vegetative production due to periodic natural flooding or sub-irrigation. Naturally irrigated lands are those lands where a stream channel is underlain by unconsolidated material and on which the combination of stream flow and channel geometry provides for enhanced productivity of agriculturally significant plants. Naturally irrigated lands may be identified by an evaluation of infra-red aerial photography, surficial geologic maps, wetland mapping, landowner testimony or any combination of that information.

Appropriate effluent limits for EC and SAR will be calculated and applied to WYPDES discharge permits in all instances where the produced water discharge may reach any artificially irrigated lands.

EC and SAR limits will also be applied to WYPDES permits where the produced water discharge may reach stream segments containing sufficient acreage of naturally irrigated land to be considered agriculturally significant. In general, stream segments containing single parcels of naturally irrigated land greater than 20 acres in size or multiple parcels in near proximity that total more than 20 acres shall be considered agriculturally significant. In making this estimation, small drainage bottoms may be excluded from consideration. Two specific criteria which may be used to exclude lands include lack of a persistent active channel and unconsolidated floodplain deposits which are generally less than 50 feet in width.

If there are no pre–existing diversions within reach of a discharge or if the water will be impounded or managed so as not to reach a diversion during the irrigation season, there would be no potential to adversely affect crop production. Likewise, if there are no agriculturally significant, naturally irrigated lands within reach of a discharge there would be no potential to adversely affect crop production. In these circumstances, permit limits would be established to protect other relevant water uses (e.g. livestock watering, wildlife, aquatic life etc.).

B. Data and Information

There is a minimum amount of data that must be collected in every circumstance in order to identify existing irrigation uses and to appropriately set effluent limits on discharges that may affect those uses. Additional information that is beyond the minimum requirements can also be considered to fine tune the permitting decisions in a way that best addresses the various interests for the water.

At a minimum the following information must be obtained:

- Location(s) of irrigation diversions and/or naturally irrigated acreage;
- Crops grown under irrigation;
- Published tolerance values for the most sensitive crop;
- Season of use
- Description of Irrigation Practices

C. Establishing Effluent Limits

A 3-tiered decision making process will be used to establish appropriate effluent limits for EC and SAR whenever a proposed discharge will likely reach irrigated lands. Tier 1 refers to a procedure for setting default EC and SAR limits and is useful in situations where the irrigated crops are salt-tolerant and/or the discharge water quality is relatively good. Tier 2 refers to a process whereby the default limits may be refined to equal background water quality conditions and is intended to be used in situations where the background EC and SAR is worse than the effluent quality. As a final measure, Tier 3 applies where background EC and SAR is better than the effluent quality. The purpose of a Tier 3 analysis is to provide sufficient justification to establish effluent limits that are of a lower quality than the pre-discharge background conditions. Under Tier 3, effluent limits may be established based upon local site conditions and irrigation practices to a level that can be demonstrated to cause no harm to the existing irrigation uses.

1. Tier 1 -Default EC and SAR limits

Default limits for EC and SAR may be used where the quality of the discharge water is relatively good or the irrigated crops are salt-tolerant. The default values shall be based upon the published soil EC tolerance values for the most sensitive crop and shall be calculated as follows:

a. Default EC limits will be based upon 100 percent yield threshold values for soil EC reported by the USDA Agricultural Research Service (ARS) Salt Tolerance Database. In the event that the species of interest is not included in the ARS Salt Tolerance Database, then the following alternative references can be consulted:

(1) Hanson et al. 2006[2]. Agricultural Salinity and Drainage. DANR Pub. 3375, Univ. of Calif. Davis;

(2) Ayers and Westcot. 1985. Water Quality for Agriculture. UN FAO Irrigation and Drainage Pager 29 (revised); and

(3) CPHA. 2002. Western Fertilizer Handbook. 9th Edition. Interstate Pub., Inc., Danville, IL.

The relationship between soil EC values and irrigation water EC values will be: EC (soil) = 1.5 EC (water), i.e., the published soil EC threshold obtained from the appropriate reference will be divided by the soil concentration factor of 1.5 to establish the discharge EC limit.

However, in circumstances where the background water quality of the receiving water(s) is known to be significantly better than would otherwise be required based on a theoretical 100% yield, effluent limits may be set to maintain that higher quality.

b. Default SAR values will be extrapolated from the Hanson et al. (2006)[2] Chart *(see Figure 1 attached)* based upon the default EC value in each circumstance up to a maximum default value of 10. The effluent limit for SAR will be determined in conjunction with EC so that the relationship of SAR to EC remains within the "no reduction in rate of infiltration" zone of Figure 1. The maximum SAR limit is, therefore, set below the line separating the "no reduction in rate of infiltration" zone from the "slight to moderate reduction in infiltration" zone in the Hanson et al. diagram, which is represented by the following equation: SAR < (6.67 x EC) – 3.33[3]. It must be noted that SAR values are tied to the EC concentration and might need to be adjusted to correlate to the actual EC concentration rather than the theoretical maximum.

Use of the Hanson diagram to extrapolate default effluent limits for SAR is capped at a maximum SAR of 10 to minimize the potential for sodium build-up in poorly drained soils. This 10 SAR cap is only intended to apply when utilizing the default procedure and may be modified according to the provisions of section C.2 "Refining EC and SAR Limits", described below.

[2] This reference has been updated to the 2006 version of the Agricultural Salinity and Drainage Manual from the previously cited 1999 version

[3] This Formula has been updated from the previously used SAR < (EC $_{ds/M}$ X 7.10) – 2.48 in accordance with the 2006 Salinity and Drainage Manual.

c. At a minimum, the EC and SAR limits will apply during the irrigation season and when flows are sufficient to support the use. On sub-irrigated lands and passively irrigated lands such as those under spreader dike systems, the irrigation season shall generally be considered to be year-round.

2. Refining EC and SAR limits (Tiers 2&3)

Establishing EC and SAR limits based simply on the most sensitive crop is the most stringent approach and would be protective of the irrigation use in all circumstances. It may be possible to refine those values if additional information is available showing that less stringent effluent limits would be adequately protective. This type of showing can be made by demonstrating that background water quality conditions are of a lower quality than the default values or by demonstrating that because of local soil conditions and irrigation practices there would be no harm to crop production from less stringent EC and SAR limits.

a. Tier 2 - Background Water Quality

If sufficient data is available to demonstrate or calculate that the pre-existing background water quality at the point(s) of diversion is worse than the effluent quality, EC and SAR effluent limits may be based upon those background conditions rather than tolerance values for the most sensitive crop.

(1). Measured Data: Background water quality may be established based upon published pre-discharge historic data. Generally, this data only exists on larger, perennial, mainstem stream channels where historic gauging has taken place. Actual measured data is the most reliable means of establishing background and must be considered on those waters where it is available.

(2). Calculated Background: On intermittent and ephemeral stream channels, pre-discharge water quality data is usually scarce or non-existent and very difficult to collect. In these circumstances, background water quality can be estimated by conducting soil surveys on land that has been historically irrigated from the subject stream.

In the event that soil studies are used as a means to estimate baseline water quality for a given drainage, the following requirements apply:

(i) Sample Site Selection: Soil samples shall be taken at semi-random sites within each contiguous irrigated segment downstream of the proposed discharge. "Semi-random" in this case is intended to mean that the applicant will identify the various major distinguishing terrain zones within each

irrigated segment and select sample sites randomly within each terrain zone. For example, the channel bottom may constitute one terrain zone, the first small terrace above the channel bottom may be another terrain zone, and the adjacent meadow or field may be a single remaining terrain zone, or that meadow / field may actually be comprised of several other known zones such as discharge-affected soils vs. non-affected soils, sub-irrigated reaches vs. non-sub-irrigated reaches, etc..

(ii) Number of Sample Sites: Listed below are the minimum number of soil sample sites required for each of the identified terrain zones (based on zone area) within a contiguous irrigated segment:

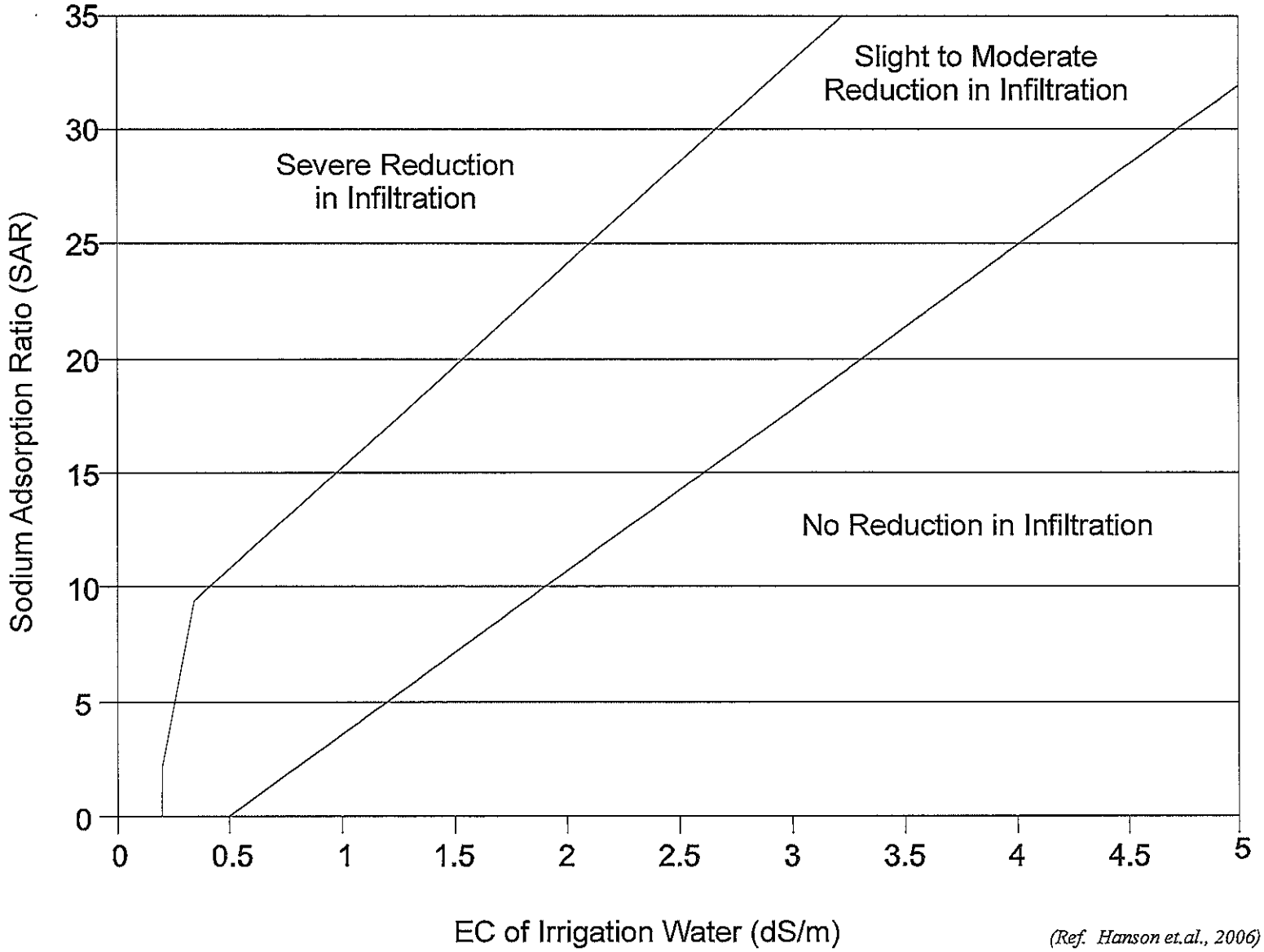
Zone Area	**Minimum Number of Sample Sites**
0 – 5 acres	3
5 - 10	5
10 + acres	7

(iii) Sample Collection: Sample sites must be located a minimum of 50 feet apart from one another. Each sample site shall be sampled at a minimum of four depths (0-12", 13-24", 25-36", 37-48"). If alfalfa is present within the terrain zone, each sample site within that terrain zone must be sampled at a total of 6 depths (at the above-noted depths, plus 49-60" and 61-72"). Each 12-inch depth sample must be analyzed either individually or combined (composited) with other corresponding depth samples from the other sample sites within the same terrain zone (i.e., all 0-12" samples from a given terrain zone bulked together and analyzed as a single composite sample).

(iv) Sample Analysis: At a minimum, a saturated paste extract for each sample shall be analyzed for EC. Though not necessary for the estimation of background water conductivity, it is advisable to also analyze the soil samples for pH, SAR, soil texture and exchangeable sodium percentage (ESP) to avoid having to duplicate the sampling if the results indicate that a "no harm analysis" *(item b. below)* needs to be completed. Percent organic matter shall be analyzed in the surface 0-12 inch samples only. In addition, analyses to identify the clay mineralogy types present in the soils may also be warranted.

Figure 1

Hanson Chart



(Ref. Hanson et.al., 2006)

(v) Soil Report Preparation: At a minimum the applicant shall submit:

i. A map or diagram identifying where each of the soil sample sites were located. At a minimum, the map or diagram must show the basic topography and stream course, irrigation structures *(if present - such as spreader dams or head gates)*, estimated boundaries of the irrigated acreage, surface ownership of the irrigated acreage *(including downstream irrigated areas)* and section / township / range identification. This map must also show any delineated terrain zones, plus elevations of the terrain zones;

ii. An accompanying location table which includes the quarter / quarter, section, township, range, and latitude / longitude for each sample site;

iii. Summary data table showing the analytical results for each of the soil parameters listed above, for each depth, at each sample site.

iv. All associated lab sheets.

b. Tier 3 - No Harm Analysis

The actual effects of EC and SAR on crop production are variable based upon soil type and chemistry and may be mitigated to some extent by managing irrigation practices. EC and SAR effluent limits may also be established based upon a scientifically defensible site specific study that examines local soil characteristics, natural water quality, expected crop yield, irrigation practices and/or any other relevant factor related to crop production.

Because of the very site-specific nature of this approach and the number and complexity of variables that may need to be considered, it is not very useful to specify any particular type of analysis in this policy. When taking this approach, however, there is a burden of proof placed upon the applicant to demonstrate through a comprehensive study that levels of EC and/or SAR higher than either the default values or estimated background water quality would most likely not measurably harm an existing irrigation use. This approach will allow a degree of creativity regarding landowner preferences and management. Refined limits for EC and SAR resulting from a "no harm" analysis should incorporate a reasonable margin of safety to account for variables that cannot be precisely measured or modeled.

c. Irrigation Waiver

An exception to EC or SAR limits established under the Tier 1, 2 or 3 procedures may be made when affected landowners request use of the water and thereby accept any potential risk to crop production on their lands. Irrigation waivers will only be granted in association with an irrigation management plan that provides reasonable assurance that the lower quality water will be confined to the targeted lands.

d. Reasonable Access Requirement

The procedure for establishing default EC and SAR limits is intended to provide the ability to permit the discharge of high quality water without an obligation to conduct site specific studies. In practice, the use of the default procedure will only apply where permitted discharges are of exceptionally high quality. In many applications, appropriate limits for EC and SAR will have to be based on refined procedures rather than default. Because the refined procedures require the acquisition of site-specific data, it is necessary that permit applicants and/or the DEQ have reasonable access to obtain the required information. In circumstances where a landowner chooses to deny access for the purpose of developing a Section 20 analysis, EC and SAR limits will be based upon the best information that can be reasonably obtained and may be less stringent than Tier 1 default limits.

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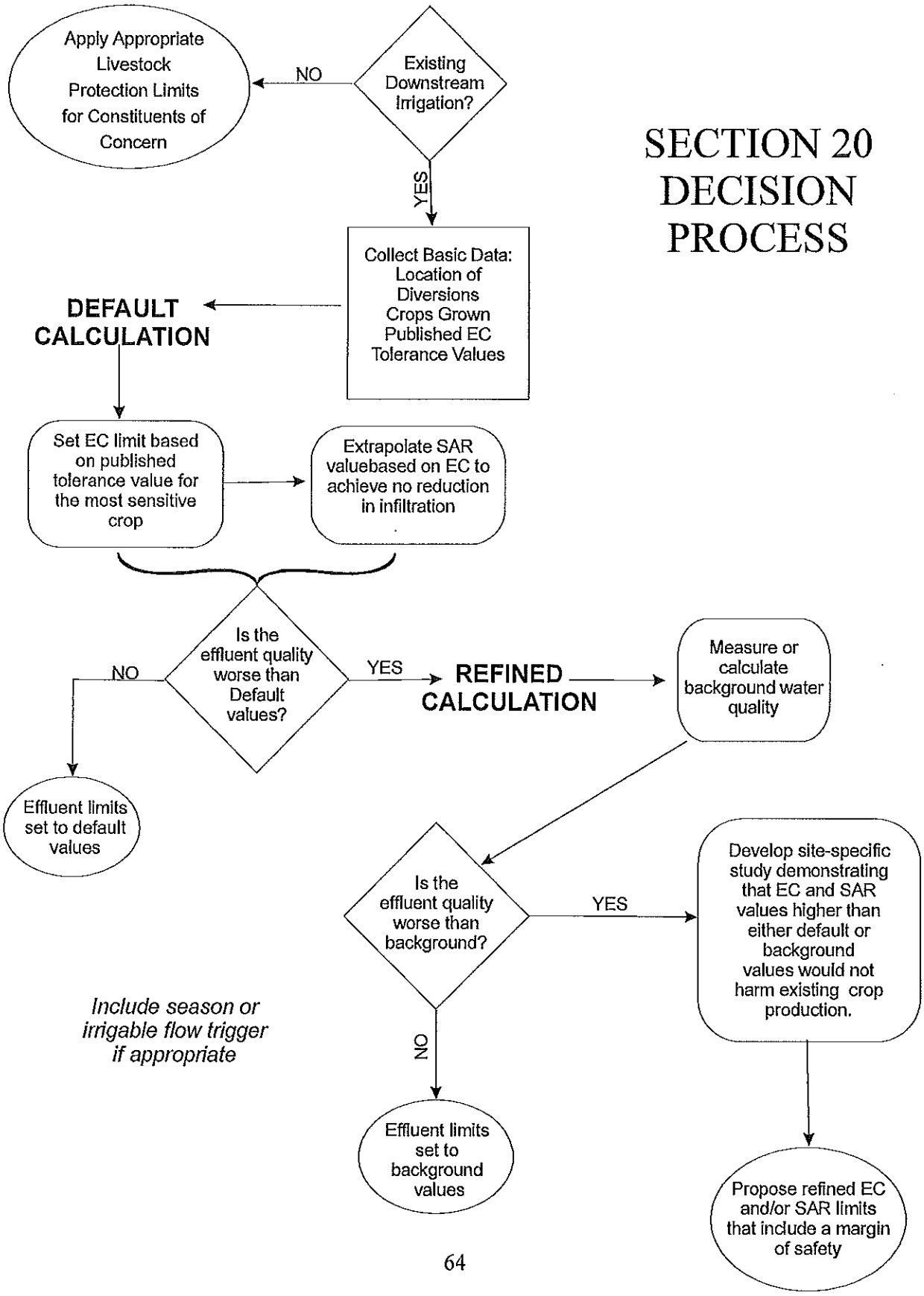
revised 11/20/2008

SECTION 20 DECISION PROCESS



UNIVERSITY
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December 17, 2009

J. Mark Stewart
Davis and Cannon, LLP
422 W. 26th Street
P.O. Box 43
Cheyenne, WY 82003

Re: Expert opinion on Tier-2.

Dear Mr. Stewart:

This letter is a response to your engagement letter of December 8th, 2009. The law firm of Davis and Cannon, LLP is working for the Powder River Basin Resource Council and the Barlows in connection with the Appeal of WYPDES WY0052299. In general, you have asked me to consult with you on the issue of whether the effluent limits established in WYPDES WY0052299, under the Wyoming DEQ Tier 2 methodology are protective of irrigation uses. Specifically, you asked for my expert opinion on two questions:

1) Whether Tier 2 is an appropriate scientific method for establishing numeric effluent limits for EC and SAR that ensure no measurable decrease in crop production; and

2) Whether Tier 2 is a reasonable and scientifically valid method for determining EC of water that can be discharged to an intermittent or ephemeral drainage so that degradation of the receiving water will not be of such an extent as to cause a measurable decrease in crop production.

My responses are as follows:

In general, effluent limits established for WYPDES 0052299 have not been determined using a scientifically appropriate method that results in scientifically defensible or reasonable limits for EC of discharge waters that are protective of agriculture uses. Wyoming DEQ established the effluent limits for the WYPDES 0052299 discharge

EXHIBIT
tabbies
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permit using a procedure outlined in their Agricultural Use Protection Policy. Chapter 1, Section 20 of the Wyoming Water Quality Standards prohibits degradation of waters to the extent that it would result in a 'measurable decrease in production." The Agricultural Use Protection Policy allows for establishing effluent limits for salinity (ECw) and sodicity (SAR, sodium absorption ratio) equal to historic background water quality if the product water does not meet Tier-1 standards. The methodology used in Tier 2 is to sample soils in the area of question and "backout" or calculate historic water quality (specifically electrical conductivity –ECw) from the soil salinity (WY DEQ, 2008). This method was recently evaluated by Scientific Experts hired by the WY Environmental Quality Council (EQC) and found to be scientifically invalid (Hendrickx and Buchanan, 2009).

The movement of water and soluble salts in soils and ephemeral channels in semi-arid climates such as the Powder River Basin of Wyoming are very dynamic. The natural salinity that can be found in many of the soils is not a direct reflection or result of the quality of the water applied, but rather a reflection of the soil characteristics (e.g., texture and chemistry), the climate (high potential evapotranspiration potential), depth to ground water, and irrigation management (Hillel, 1998; Rose, 2004).

In general, as water infiltrates into soils it can accumulate salts from the weathering of the mineral soil. In semiarid climates, salts are continually moving and being redistributed in the soil with the soil water. These salts will often move with the wetting front up and down through soil profiles. To keep salts from accumulating large rainfall events or irrigation applications are necessary to move salts lower in the soil profile away from the root zone. In semi-arid and arid regions, there are often periods without significant downward movement (percolation) of water and no effective leaching, so salts can and often do accumulate in the soil profile (Hillel 1980; Hillel 2000; Hendrickx and Buchannan, 2009). Sampling of soil salinity at any given point in time will not reflect background water quality, but the historic movement of water and salts in the profile in response to rainfall, evaportranspiration, and any irrigation applications. This means that detailed sampling of the soil salinity and sodicity cannot be used to determine historic background or historic water quality.

Response to Question 1:

The assumption in the applied method of Tier-2 of a consistent, direct relationship between soil salinity and background water quality does not exist. This in itself means that the Tier-2 methodology, as it is being applied, is scientifically invalid and can not be used to establish numeric effluent limits for EC and SAR that ensure no measurable decrease in crop production. There is no adjustment or calibration procedure possible that would make the Tier-2 methodology scientifically valid. As stated above, soil salinity in semi-arid regions changes with time and is not a direct reflection of the background water quality. Soil salinity is primarily a result of the soil characteristics, depth to ground water, climate and irrigation management (Hendrickx and Buchanan, 2009; Rose 2004; Hillel, 1998.) It is not a direct result of the background water quality

that has been applied to an area, and cannot be used to determine the quality of the water applied. This fact has also been presented to the WY EQC in oral testimony by me, Dr. Larry C. Munn and Dr. George F. Vance on October 24, 2008. As stated in the report to the WY EQC, Expert Scientific Opinion on the Tier-2 Methodology (Hendrickx and Buchanan, 2009), no evidence has been found in the peer-reviewed scientific literature that will support the methodology of Tier 2 to accurately determine background water quality. It is not an appropriate scientific method to establish effluent limits.

Response to Question 2:

The Tier 2 methodology will not support the establishment of scientifically defensible effluent limits for discharge permits that will not cause measurable decrease in crop production. Tier 2, as it is being applied, is simply scientifically invalid. This fact was well documented by Hendrickx and Buchanan (2009). Tier 2 does not provide a reasonable or scientifically defensible method to determine the quality of the water (ECw and SAR) that historically flowed within a given drainage system. Therefore it is not an appropriate scientific method and cannot be used to support the establishment of limits for discharge permits in that drainage that will not cause a measurable decrease in crop production.

In addition to the responses to your questions above, I have attached a copy of my CV which includes my publications, a list of testimonies and depositions related to CBM water issues and a list of my extension activities over the last 5 years that includes CBM related activities.

Sincerely,

Ginger B. Paige

Ginger B. Paige, Ph.D.
Water Resources Extension Specialist

References:

Dead Horse Creek, Section 20 Soil Investigation, KC Harvey, LLC., August 2007

Hendrickx, J.M.H.; Buchanan, B.A. Expert Scientific Opinion on the Tier-2 Methodology; Report to the Wyoming Environmental Quality Council. May 2009. [http://deq.state.wy.us/eqc/Docket/08-3101%20WQD,%20Chpt.%201,%20Sect.%2020,%20Ag%20Water%20Supply/Consultants%20Final%20Report.Chpt.%201-Sect.%2020.5-09.pdf].

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WYPDES WY0052299, November 25, 2008

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BEFORE THE ENVIRONMENTAL QUALITY COUNCIL

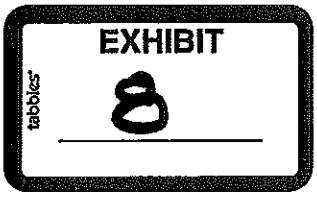
STATE OF WYOMING

Docket No. 09-3807

IN THE MATTER OF THE APPEAL OF POWDER RIVER BASIN RESOURCES COUNCIL, AND WILLIAM F. WEST RANCH, LLC, FROM WYPDES PERMIT NO. WY0094056

DEPOSITION OF GINGER PAIGE, Ph.D.
Wednesday, January 20, 2010
10:03 a.m.

Taken in behalf of the Respondent, pursuant to Notice, and in accordance with the Wyoming Rules of Civil Procedure, at the offices of UW Office Annex, 406 South 21st Street, Laramie, Wyoming, before Merissa Racine, Registered Diplomate Reporter and Notary Public in and for the County of Laramie, State of Wyoming.



APPEARANCES

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Cheyenne, WY 82002

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PROCEEDINGS

GINGER PAIGE, Ph.D.,

having been first duly sworn, was examined and testified as follows, to-wit:

EXAMINATION

BY MR. ESCH:

Q. Could you identify yourself for the record, please.

A. Dr. Ginger Paige.

Q. And where are you employed?

A. University of Wyoming.

Q. And how long have you been employed there?

A. Since October of 2004.

Q. Have you ever been deposed before?

A. Yes, I have.

Q. So you're aware that if you don't understand my questions you can ask me to repeat it or rephrase it, and we can do so?

A. Yes.

Q. Could you please describe your educational background.

A. Yes. I have a Bachelor's degree in political science from the Colorado College. I have a Master's of Science degree in soils physics from the University of Massachusetts, and I have a Ph.D. in watershed hydrology management from the University of Arizona.

Q. How long have you been employed at the University of Wyoming?

A. Since October of -- well, actually since August of 2004.

Q. Do you instruct classes at UW?

A. No, not usually.

Q. What percentage of your work would be research and what percentage -- well, I guess, would be teaching?

A. Well, it's not teaching, it's actually extension.

Q. Okay.

A. Thirty percent of my appointment is research, 60 percent of my appointment is extension.

Q. Have you ever been retained as an expert for any case in front of the Environmental Quality Council before?

A. Yes, but under subpoena.

Q. Subpoena. What case was that?

A. This is a good question. It was the Pumpkin Creek case.

Q. Have you ever testified in front of the EQC in any rulemaking?

A. Yes, I have.

Q. And which rulemakings?

A. The Tier 2 evaluation, evaluation of the Tier 2 methodology. I've appeared under that. I actually appeared once briefly under the beneficial use case before them.

Q. Was it a rulemaking, or was it a case?

A. I guess -- That's a good question. I do not know. That's legal stuff.

Q. All right. I'm going to hand you a document, and I want you to tell me if you've seen that before?

A. Yes.

Q. This is the Notice of Deposition that I sent you; is that correct?

A. This is correct.

Q. And it says that, "Respondent DEQ requests that the deponent bring all documents and any other materials referenced or relied upon for the analysis, conclusions or opinions in or relating to her expert report and her expected testimony at the hearing in this case."

Did you do so in this -- today?

A. For the most part. I'm missing one book.

Q. Okay. I'll mark that as Deposition Exhibit 1. And I also have a second page.

(Thereupon Deposition 1 was marked.)

A. A student has my other book, but -- the book that's cited, and I brought a copy of the evaluation of the Tier 2 method that was done by the expert, and

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those, I believe, are the things that I cited.
Q. I don't know if you might have already done this, but could you identify for me the book that you didn't bring.
A. It's by CW Rose. Title is -- I don't think of these things by title. It's the Rose 2004 book. There's my expert scientific opinion. Yeah, it's Introduction to the Environmental Physics of Soil, Water and Watersheds, was the other book that I used and cited.
Q. Introduction to Environmental Physics?
A. Of Soil, Water and Watersheds.
MS. FOX: It's in her report, Luke.
MR. ESCH: It is.
A. It is. I have the full citation there.
Q. (By Mr. Esch) Well, thank you. Okay. Well, let's get to the expert report. I'm going to hand you a copy of what I understand to be your expert report.
A. See, this would have saved me the trouble of looking it up. Yes.
Q. Would you agree that's an accurate copy of your expert report in this case?
A. Yes.
Q. You can take your time. I'll go ahead and offer this as Deposition Exhibit 2.

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(Thereupon Deposition Exhibit 2 was marked.)
Q. So who retained you in this matter to provide this expert report?
A. Davis & Cannon.
Q. What did they provide you with to review in preparation for your report?
A. Let's see. They sent me a letter requesting that I respond to two questions regarding the permit. They did send me a copy of the permit. They also sent me copies of the Tier 2 evaluation.
Q. Tier 2 evaluation. Could you be a little more specific?
A. I believe it's the -- Oh, no, I can't, 'cause I didn't actually pay much attention to it. It's the evaluation of the background soil and water quality at the West Ranch.
Q. The Tier 2 2006 --
A. Evaluation, the 2006 evaluation.
Q. That was performed by Devon, as you understand it?
A. As I understand it.
Q. Just want to make sure we have the right one. Does your report contain all your opinions on the contested permit?
A. No. My report contains specific answers to the

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questions I was asked.
Q. Okay. What opinions are not contained in your report that you intend to offer to the council?
A. None.
Q. None. So your opinions are confined to your report?
A. Correct.
Q. Okay. I'd like to ask you a few questions now about some of the statements in your report.
A. Okay.
Q. So going through your report, as I understand it, you disagree with the way the methods were developed to arrive at these limits; is that correct?
A. Correct.
Q. Okay. So I refer you to page 1 of your report. It says, "In general, effluent limits established for WYPDES 0094056 have not been determined using a method that results in scientifically defensible or reasonable limits for EC of discharge waters that are protective of agricultural uses."
Could you explain a little bit to me about this statement, what are your bases for this statement?
A. My bases for the statement are that the effluent limits for EC were determined using Tier 2 methodology, sampling the soils within the area, and using the EC of

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the soils to determine background EC limit for the waters.
Q. Okay. And you rely heavily on the findings of Hendrickx and Buchanan for this determination?
A. Yes, as well as my own knowledge in this area.
Q. Okay.
A. I actually made statements to the EQC that this was not a scientifically defensible method before the report came out.
Q. So why is it not scientifically defensible?
A. There's no way to actually determine background water quality from soil samples of EC. It's just -- it's not possible.
Q. Could you explain a little to me about it?
A. Soil physics?
Q. All right.
A. So when water moves through the soils it has a charge, right, polarity. And it actually will pick up minerals and dissolved salts from the soils. So it will actually, depending on the soils and mineralogy of the soils, will actually change in terms of its chemical composition as it moves through the soils. So it's very common, especially in semi arid climates, for water to pick up salts from soil as it moves through. And these salts will end up moving within the soil profile with

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the wetting front. So that means as water infiltrates into the soil, moves down through the soil profile picking up salts, salts will move usually with the wetting front, with the highest sort of water concentration.
Q. Is that what you mean, wetting front?
A. Wetting front.
Q. Okay.
A. And it's also the front part, if you picture a column of water just moving through soil, wetting front is that first part of the water as it moves through, if it's a dry soil.
Q. Okay.
A. So the salts will move with the water, and so if it -- you only have a certain amount of water, it might move maybe, oh, anywhere from 5 centimeters to 30 centimeters into the soil profile, depending upon the amount of water that's applied, or rainfall application or irrigation.
And then when water stops moving into the soil, it's subjected to evapotranspiration forces, and will move up, so you'll actually see water then moving up and down within the soil profile, moving salts within the soil profile, soluble salts.
Q. Okay.

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A. So it's a dynamic process. And this happens with natural rainwater, water that doesn't have high EC or SAR; you see the same phenomena occurring. So you will end up, in a climate like this, a semi arid climate like Wyoming, Arizona, with salts building up in the soil profile. It's a natural occurrence even under very good water -- water quality applications.
Q. So just the natural occurrence in nature, soils will build up in soil profiles?
A. Depending on where you are in a watershed, where you are in the soil, the soil texture, depth to water, where you are in the season, --
Q. Well --
A. -- many factors.
Q. I apologize.
A. But, yes.
Q. You refer to it being a natural phenomena --
A. Correct.
Q. -- and happens. So in an ephemeral drainage, not in Wyoming, but in a semi arid climate it's possible these soils would salinize naturally?
A. Or build up salts, not necessarily become salinized, which -- but will actually end up with layers with salt accumulation, calcic horizon, pedocalcic horizon. It's very common.

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Q. For my benefit what's a calcic horizon?
A. Calcium carbonate dominating the soil horizon.
Q. All right. And I did see in your report that you refer to the Hendrickx Buchanan report, the May 2009 report. I'd like to ask you a few questions about that report.
A. Okay.
Q. Do you have that in front of you?
A. I do.
Q. Well, I made a copy for you just in case.
A. Okay.
Q. And go ahead and offer this one as Deposition Exhibit 3.
(Thereupon Deposition Exhibit 3 was marked.)
MS. FOX: Do you have another one, Luke?
MR. ESCH: I got another one, but I just didn't have a stapler.
MS. FOX: I can take care of that. Thank you.
Q. (By Mr. Esch) I'm going to ask you a few questions about this report, and basically I'm going to pull some sentences, some phrases out of this report, and ask if you agree or disagree with those statements.
A. All right.
Q. I refer you to page 10. And in the first

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paragraph it says, the sentence begins, "On the Contrary, pre-existing background water quality appears to be a minor factor or none at all."
Would you agree with that statement? And you can read the whole paragraph to provide context.
MS. FOX: I'm going to object to the form of that question as being vague.
(Brief pause.)
A. Does that mean I still answer?
MS. FOX: Yeah.
A. Sorry. It is vague. I find it to be a factor. In this case I think they're talking about the fact that it's one of many. That doesn't mean that applying water of bad quality is good, but it means that there's many other factors besides the background water quality that have to be taken into account.
Q. (By Mr. Esch) Okay. And same, similar question, in the second paragraph, says, "The Tier 2 assumption is scientifically flawed for several reasons. Effluent water quality that is better than preexisting background water quality could still cause severe soil salinity." And do you agree with that statement?
A. Yes. In a certain context. Not without caveats thrown in.
Q. Please go ahead and describe some of the caveats

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for me.
A. It's the same thing as why we don't drink distilled water, because drinking distilled water, one has the feeling that it would be great. But what it does is it leaches you more -- leaches all the minerals out of you more than actually replenishing you. So that's the reason that when you buy sort of treated water in a grocery store, they've actually added minerals back into the water, not only because it tastes better, because it decreases the leaching potential of water. So in that context it's very important to know what's going on.
And also I think the context that they're talking about is that it is a complex interaction. So it really depends on soil profile, the amount of water, the chemical composition of the soil, cation exchange capacity of the soil, the amount of sodium, the amount of magnesium will all influence this, but it is true.
Q. Okay.
A. But it has to be viewed within the context of what -- it doesn't mean that all of a sudden bad water is much better, bad quality water. It just means, oh, you have to do it in site specific, application specific.
Q. So it's definitely site specific, there's a lot

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of factors involved?
A. Yeah.
Q. Okay. So --
A. And I also believe it to be sort of a minor caveat.
Q. Could you explain that, a minor caveat?
A. Meaning that in some cases it's true that, you know, applying water with a different chemical composition might infiltrate better, but that's probably not the norm. It's probably the exception, but it's good to know.
Q. So these are very site specific conditions, a lot of factors taken?
A. Yeah.
Q. Okay. Let's go to the next statement then the "effluent water quality that is worse than the preexisting background quality may be used beneficially on artificially irrigated lands." Do you agree with that statement?
A. Again, it depends on the situation specifically, as to whether it will be more beneficial or less.
Q. More managed situation?
A. Whether it's -- No. Whether it's beneficial will depend on the type of management, the type of application, how it's applied, where you are. But, yes,

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I do agree.
Q. Okay. I refer you to page 22 of the same document. And the last paragraph of the page it says, "The use of Tier 1 can be continued since it's conservative and has been accepted by the community." Would you agree with that statement?
A. Oh, in general. I think there are also limitations with the Tier 1 method as it's being applied, but in general I find the method to set the limits to be much better in Tier 1 than they were in Tier 2.
Q. Okay. Would you agree with this statement: "A threshold EC value of 4 decimeters per meter in the root zone is acceptable for alfalfa in Wyoming"?
A. No.
Q. Is alfalfa a sensitive species for EC?
A. It is.
Q. Do you know what type of crops the Wests have on the ranch?
A. No, I do not.
Q. Do you know where the outfalls in this contested permit are in relationship to the Wests' property?
A. No. My understanding is that they're up, upstream, up in the watershed.
Q. Okay. And are you aware that there are

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discharges contained in reservoirs in this permit?
A. I am. Are they lined water -- lined containment or unlined?
Q. They're unlined.
A. So I don't know if that's fully contained.
Q. Okay. Have you discussed this case with any of your colleagues?
A. No, I have not.
Q. Have you discussed the findings of the Hendrickx -- the 2009 May Hendrickx Buchanan report with any of your colleagues?
A. Oh, yes.
Q. Could you identify them for me?
A. Yes. Dr. Larry Munn, Dr. George Vance.
Q. Those are the -- your only colleagues that you've discussed this with?
A. Probably Dr. Ann Hild and Dr. Scott Miller.
Q. All right. Have you discussed this case with any members of the EQC?
A. No, I have not.
Q. Have you discussed this, the findings of the Hendrickx Buchanan May 2009 report with any members of the EQC?
A. Yes, I have.
Q. Who have you discussed it with?

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A. Tim Flitner.
Q. Flitner. So, finally, does this report contain all of your opinions regarding the contested permit?
A. The -- Which report?
Q. Your expert report.
A. It actually contains my responses to the questions I was asked.
Q. So if you were called to testify at the hearing what else would you testify about?
A. I don't know.
Q. You don't have any expected testimony?
A. No, I do not.
Q. This is the opportunity I get to ask you about your opinions in this case, so I am trying to get an idea of what you would testify to so I can ask some questions about that.
A. Okay. Well, actually I was asked to -- for my expert opinion on two questions, and so I offered my expert -- I offered responses, expert question (sic).
Q. So you don't anticipate to testify to anything outside the scope of your expert report?
A. Not that I'm aware of. These are the questions I was asked to offer opinions on, and I did so.
MR. ESCH: All right. Well, that is all I have. Thank you.

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A. Okay.
EXAMINATION
BY MR. SPARKS:
Q. Hi. My name is Bill Sparks. I represent Stevens Energy in this appeal. How did you go about preparing for this deposition?
A. Actually I didn't do a lot to prepare for this deposition. I reread my report that I had sent, and I reread the expert scientific opinion on the Tier 2 methodology last week so that I made sure that it was sort of forefront in my head.
Q. Did you review the permit prior to this deposition?
A. I did not.
Q. Prior to your expert report did you read the permit?
A. I glanced through it, but I did not study it.
Q. Prior to your expert report did you read the Section 20 compliance that Devon prepared?
A. I glanced through it. Again, I did not study it 'cause I was really just asked to -- for my expert opinion on two questions.
Q. So in that regard you did not assist in responding to discovery in this case either, you only answered those two questions?

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A. Correct.
Q. As relates to the permit, you said that you skimmed it. Have you ever visited the three impoundments that are authorized in that permit?
A. I have not visited the impoundments, no.
Q. Have you ever tested soils or water in relation to those three impoundments?
A. I have not.
Q. Have you personally tested water or soil on that west property?
A. I have not.
Q. As relates to those three impoundments, are you aware of any evidence of any breaches, leaks, seeps or any water leaving those impoundments?
A. No, I'm not.
Q. Earlier you said that you -- Mr. Esch asked you a question about if you were aware that the impoundments were fully contained, and you -- what was your response to that again?
A. I asked if the impoundments were lined.
Q. And he advised that they were not?
A. Correct.
Q. And your response to that was?
A. Then they may not be fully contained.
Q. What do you mean by that, can you explain that?

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If they're not lined then how does that equate to not fully contained?
A. Because water will actually infiltrate and leach from the bottom of some of these ponds.
Q. How far, how much? Do you have any --
A. It will actually depend on the surrounding soils, where they are in the watershed, the amount of water, the hydraulic pressure, pore size distribution in the soils, and the chemistry of the water.
Q. Do you know, have you ever -- Do you know any of those types of qualities for these soils or these waters?
A. Not specifically, no.
Q. So you cannot give an opinion on how much the water there will leach?
A. No, I cannot.
Q. Do you know how much water is discharged into the three impoundments?
A. No, I don't.
Q. You said that you had -- you take issue with the methodology that was used to establish the EC for this permit. Do you know what the EC for this permit is?
A. At one point I did. I don't recall.
Q. This is a copy of the permit. We can mark it as Exhibit 4.

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MS. FOX: Could we go off the record for a second?
MR. SPARKS: Sure.
(Off the record discussion.)
MS. FOX: Can we not mark it again?
MR. SPARKS: That's fine. 2600; is that right, Luke?
MR. ESCH: 2680.
Q. (By Mr. Sparks) 2680, does that sound right?
MS. FOX: What page you looking at, Bill?
MR. ESCH: Bottom of page 2.
MR. SPARKS: 2680.
(Brief pause.)
MS. FOX: What was your question, Bill?
Q. (By Mr. Sparks) I was asking you if you knew what the EC limit was?
A. I didn't then, and I do now, I just read it.
Q. That's all I was asking. In your opinion is that limit too low?
A. Too low?
Q. Um-hum. Or is it too high?
A. I'm not at liberty to actually respond directly to the limit. I'm talking about the process of determining the limit.
Q. Okay. Would the limit matter if all water was

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contained in the impoundment?
A. No. If you could prove that all the water was to be contained, no, it wouldn't matter.
Q. Do you have any evidence that for this area, water would go through the bottom of the impoundment, resurface 11 miles downstream?
A. Do I have any evidence that it will do that? Let's see. It's an interesting way to put it. I do not have direct evidence that it will, but probability is that it will if the soils are similar to other impoundments in the Powder River Basin.
Q. Can you explain how that process would work, how would it infiltrate into the soils and then resurface 11 miles away?
A. Water moves into the soil just based on pressure head and the fact that water has polarity and gravity acting on it, and the soils actually have what they call matrix potential. They actually pull water into them, they actually have charge. So that's how water moves into the soil. So if you put enough water on top of soil it will actually move in, unless it's treated to not infiltrate in. It's just what happens.
Q. Okay.
A. As to how it moves through the soil, a lot of our water in Wyoming moves not over the surface but

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subsurface. This is how a lot of our base flow occurs within our drainage systems. Our snow melt will slowly melt into the soils, move through the soil system into our channels and streams and surface water. It's very common. And this moves by a mix of gravity flow and matrix, so it will move both vertically and horizontally, and it will move to the easiest route. So as water moves through, if it meets something that has sort of less infiltration capacity it will actually then move in the direction of least resistance, which is usually downstream. And if it's -- Common here is we have usually coarser texture soils above more infiltration limited soils, so water will often sort of -- sort of build up along that interface, and then move horizontally through the system. It's very common.
Q. Okay. But you've never done any research or sampling or other studies regarding the soils in this area of the Powder River Basin?
A. Not at this specific site, correct.
Q. So you have no opinion on how far, with what rate or other types of actions the water would move --
A. No.
Q. -- at this location?
A. You would have to measure the gradient and the potential.

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Q. But you have not been asked to do that?
A. I have not.
Q. A couple of quick questions on the Hendrickx Buchanan report. Would you agree that this report did not address the issue or the full containment of reservoirs but only the direct discharge of waters into ephemeral streams or tributaries?
A. I believe it was actually addressing discharge on surface water, and not containment or full containment.
Q. It did not address full containment?
A. Correct.
Q. Just so I'm clear, other than water leaching through the soils, would it matter what the EC and SAR is in regards to water becoming surface water into a tributary?
A. Yes, if it can spill over the top. So there's two methods that water can -- discharge water cannot be contained, right? So there's leaching out of the bottom of the unlined pond or there's overflow. So it depends on how large the containment is, and what size storm it's been built for.
Q. So ignoring the possibility of leaching, --
A. Okay.
Q. -- and if water never escaped the impoundment, would it matter what the EC and SAR limits are?

A. If it never escaped there, no. You'd end up with a nice giant saline pond, but, no. Which everybody loves.
Q. And, again, you have no evidence that -- or no knowledge that my client, Stevens, has ever discharged water out of the impoundments?
A. I have no direct knowledge of that.
MR. SPARKS: I think that's all that I have.
EXAMINATION
BY MS. FOX:
Q. I do have a couple of questions for you. You have done no study in the Spotted Horse Creek. Have you done studies related to infiltration in other drainages in the Powder River Basin?
A. Not directly measuring infiltration, but I have looked at areas that have been subjected to CBM water in the Powder River Basin, and I have taken soil and water samples there.
Q. Then are you familiar, generally, with reservoir infiltration patterns in that area?
A. Not through direct measurements of mine but through measurements of my colleagues, yes.
Q. And is it your assumption that -- and do you think it's a valid assumption that a reservoir in the Powder River Basin is likely to result in infiltration

unless it's lined?
A. Yes.
Q. Also relating to this Spotted Horse drainage, do you have any knowledge about other reservoirs or other sources of water in that drainage, other than the three impoundments at issue in this permit?
A. No, I don't have knowledge.
Q. And if there were other sources of water, would you consider that as a factor in the possibility of infiltrated water making its way 11 miles downstream?
A. Oh, absolutely.
Q. Because of the cumulative effects?
A. Absolutely. And we've seen this in other drainages. SA Creek is a drainage where that's absolutely happened.
MS. FOX: That's all I have. Thanks.
MR. ESCH: Nothing further.
(Proceedings concluded 10:42 a.m.)

DEPONENT'S CERTIFICATE

I, GINGER PAIGE, Ph.D., do hereby certify that I have read the foregoing deposition, and that the foregoing transcript and accompanying amendment sheets, if any, constitute a true and complete transcript of my testimony.

_____
GINGER PAIGE, Ph.D. - Deponent

( ) No changes ( ) Changes attached

Subscribed and sworn to before me this _____ day of _____, 2010.

_____
Notary Public

My Commission Expires _____.

REPORTER'S CERTIFICATE
State of Wyoming)
: SS
County of Laramie)

I, Merissa Racine, Registered Diplomate Reporter and Notary Public in and for the First Judicial District, State of Wyoming, hereby certify that there came before me, as hereinbefore noted, GINGER PAIGE, Ph.D., who was by me duly sworn according to law to give testimony relative to the above-captioned cause; that said testimony and proceedings were reported in stenotype by me; that the foregoing 1 - 29 pages, inclusive, constitute a true, correct, and complete transcript of my stenographic notes as reduced to print by means of computer-aided transcription.
I further certify that I am not related to any party herein or their counsel and have no interest in the result of this litigation.
Dated this 21st day of January, 2010.

_____
MERISSA RACINE
Registered Diplomate Reporter