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- The “3-tiered decision making process” is not a tiered approach at all.

Tier I – Default Limits

- Stated purpose is for “situations where the irrigated crops are salt-tolerant and/or the discharge water quality is relatively good.”

Tier II – Background Water Quality

- Stated purpose is to refine default limits “to equal background water quality conditions and is intended to be used in situations where the background EC and SAR is worse than effluent quality.”

Tier III – No Harm Analysis

- Stated purpose “is to provide sufficient justification to establish effluent limits that are of a lower quality than the pre-discharge background conditions.”

- In reality all that is ever submitted to WDEQ is Tier II studies that purport to show that background water quality is worse than the proposed effluent quality because the rule as proposed encourages submission of nothing else.
- Assuming a soil study could predict background water quality, permitees are not required, in fact there is a disincentive, to provide to WDEQ a study which would show background water quality to be better than effluent quality.

CASE STUDY
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- Agricultural Use Policy implemented due to known irrigation uses below the permit discharges within the Wild Horse Creek Drainage

- Two “Section 20” compliance analyses submitted with earlier permits by other producers used to establish effluent limitations for EC/SAR and for IMPs (Irrigation Monitoring Points).

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Tier II Study

Soil Sampling

- Soil samples analyzed for EC and SAR used to back-calculate a "pre CBM background water quality."
- 45 composited soil samples analyzed for EC were used to establish "average soil EC within the irrigated area."
- For each depth interval, a field was represented by a single sample composited from between 3 and 8 samples.

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Tier II Study

Estimation of Background Water Quality

- Soil EC estimated using a simple average of all depths
- Background EC of water assumed to be ECsoil ÷ 1.5
- "Average soil EC within the irrigated area was measured at 4,220 umhos/cm" with "95% confidence interval of +/- 369."
- For purposes of establishing EC threshold values at Irrigation Monitoring Point, 4,220 umhos/cm was used. ECw = 2,800 umhos/cm.
- For purposes of establishing end of pipe effluent limitations, 3,851 umhos/cm (4,220 – 369) "was assumed to be the actual mean soil EC for the downstream irrigated fields." ECw = 2,560 umhos/cm

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Some Problems With This Approach

- "Average" soil EC is significantly higher than average soil EC in the upper intervals.
- "Average" soil EC is greater than the average EC for 8 of the 11 of the individual fields.
- The calculated "average" discounts the differences in soil type and chemistry

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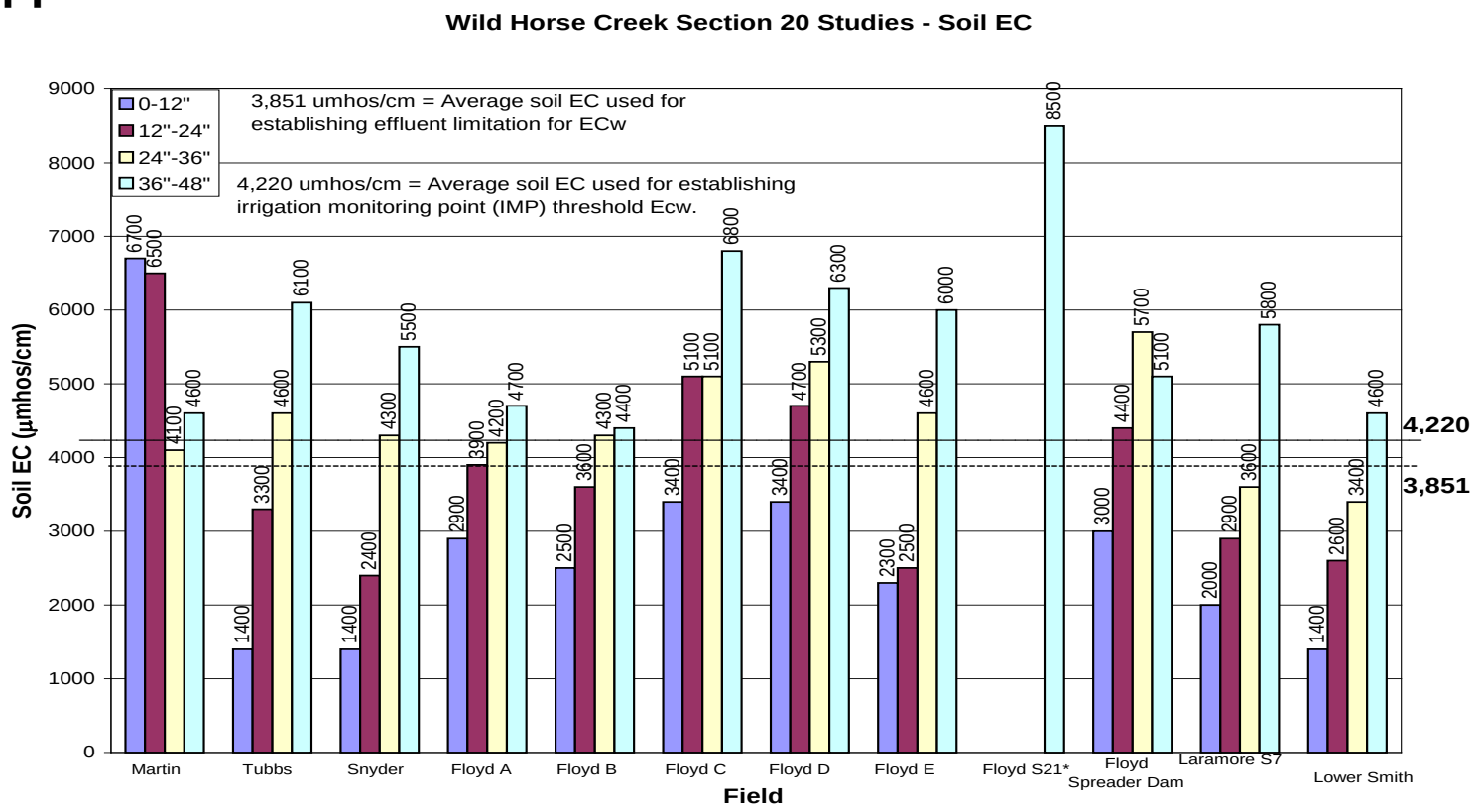
“Average” soil EC is significantly higher than average soil EC in the upper intervals.



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“Average” soil EC is significantly higher than average soil EC in the upper intervals.

- 11 EC values for 0-12” interval – Average for this interval is 2,764 umhos/cm
- 11 EC values for 12”-24” interval – Average for this interval is 3,809 umhos/cm
- 11 EC values for 24”-36” interval – Average for this interval is 4,473 umhos/cm
- 12 EC values for 36”-48” interval – Average for this interval is 5,700 umhos/cm
- 21 of the 33 soil samples from 0-36” had measured EC values below the “average soil EC”

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"Average" soil EC is greater than the average EC for 8 of the 11 of the individual fields.

Field	Average EC (umhos/cm) 0-48"
Martin	5475
Tubbs	3850
Snyder	3400
Floyd A	3925
Floyd B	3700
Floyd C	5100
Floyd D	4925
Floyd E	3850
Floyd S21*	
Floyd Spreader Dam	4550
Laramore S7	3575
Lower Smith	3000

*Only the composite sample from the 36"-48" interval in this field was used in the calculation of average soil EC

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The calculated "average" discounts the differences in soil type and chemistry

- As recognized in the proposed rule, "The actual effects of EC and SAR on crop production are variable based upon soil type and chemistry."

- For the 0-12" interval, the composited samples had various soil textures described as:
  - Clay
  - Silty Clay
  - Silty Clay Loam
  - Clay Loam

- Similar variation in soil types shown in the other intervals as well.

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DEQ Already Knows How to Protect Irrigable Lands

Chapter 11 Water Quality Rules

- Section 55 – Limitations on Irrigation with Treated Effluent

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Chapter 11, Section 55

- Ch. 11, Sec. 55(b)(i) – Indigenous or crop plant species shall be capable of survival and maintenance under the conditions of increased soil moisture, salinity, and alkalinity, the classes of which will be determined by use of Figure 1, Tables 1-3 and a soil textural analysis.

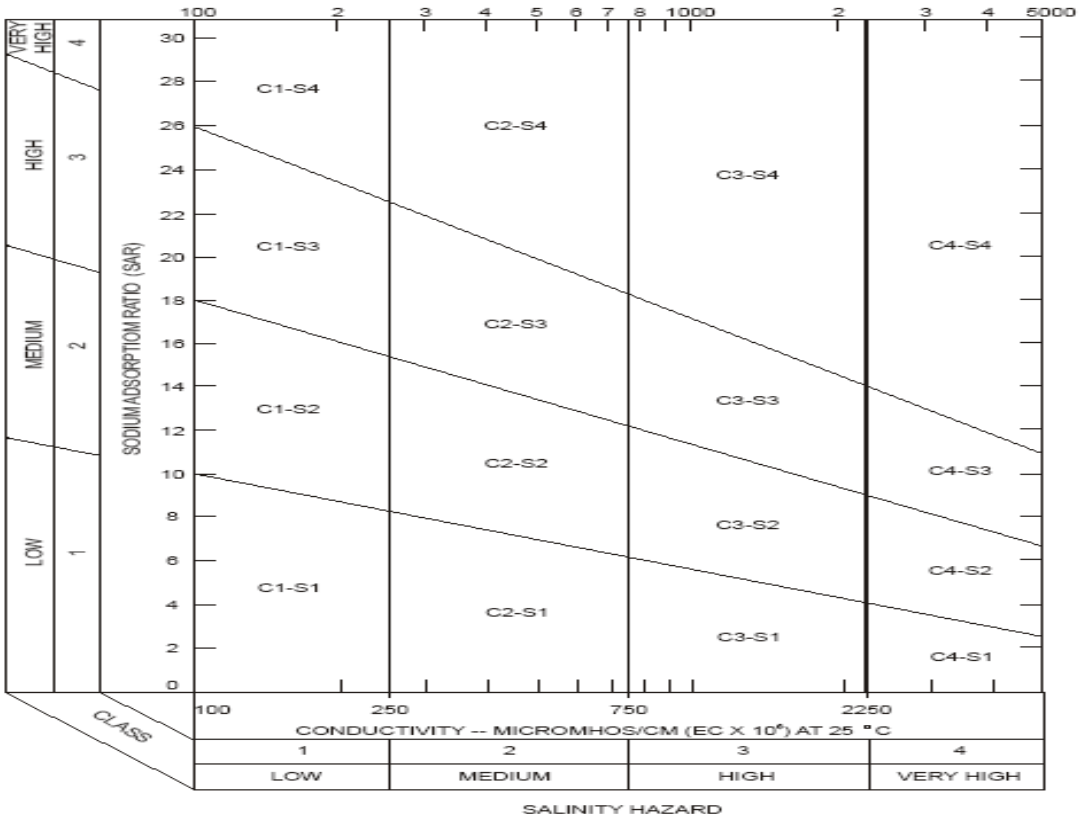

Figure I - Diagram for the classification of irrigation waters

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IRRIGATION WATER QUALITY

Permissibility Classes for Salinity

- Class C1, low salinity: --
  Good water with little or no likelihood of salt accumulation under the leaching provided by average irrigation practices, except where subsurface drainage is inadequate
- Class C2, medium salinity: --
  Can be used if moderate amount of leaching occurs. Plants without moderate salt tolerance can be grown in most cases without special practices for salinity control
- Class C3, high salinity: --
  Cannot be used on soils with restricted drainage. With adequate drainage, considerable excess water must be applied to each irrigation; irrigation must be made more frequently, and plants with good salt tolerance should be selected.
- Class C4, very high salinity: --
  Not useable under ordinary conditions. On very light permeable soils with excellent drainage, water may be useable with a large amount of excess leaching water, frequent irrigations, and very salt-tolerant crops

Ch. 11, Sec. 56, Water Quality Rules and Regulations

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IRRIGATION WATER QUALITY

Permissibility Classes for Alkalinity

- Class S1, low sodium: --
  Good for almost all soils and all Wyoming crops.
- Class S2, medium sodium: --
  Can cause alkali problems on heavy clayey soils, with low leaching, unless gypsum (or equivalent soil amendments) are present or added to the soils.
- Class S3, high sodium: --
  May create harmful levels of exchangeable sodium in all soils and will require special management – good drainage, high leaching, and organic matter additions. Soils containing natural gypsum may not develop alkali troubles. Chemical amendments may be necessary, but are not feasible with waters of very high salinity.
- Class S4, very high sodium: --
  Generally unsuited for irrigation. Special conditions of low salinity water, favorable gypsum content of soils, tolerant crops, and special management may permit use of these waters.

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Effluent Limitations

Electrical Conductivity (EC)	2,560 micromhos/cm (=2.56 dS/m)
SAR	no limit

IMP Threshold

Electrical Conductivity (EC)	2,800 micromhos/cm (=2.8 dS/m)
SAR	< 7.1 x EC – 2.48 (SAR limit = 17.4 at threshold EC)

* WDEQ may re-open the permit to adjust outfall effluent limitations for EC and/or SAR if IMP samples of effluent from this facility exceed the thresholds listed above during four or more sampling months in any calendar year.

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Chapter 11 Sec. 55(c)(i) -

For continuous and unrestricted irrigation of direct consumption crops or of parks, playgrounds, highway rest areas and rights-of-way . . . the following quality criteria shall not be exceeded:

Electrical conductivity, (EC)	750 umhos/cm at 25°C
Sodium Adsorption Ratio (SA)	10
Bicarbonates (HCO_3^-)	Not greater than 50 percent of the total anion concentration in meq/l

Taken from Table 1-3, Ch. 11, WDEQ Water Quality Rules and Regulations

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Produced Water Quality

Table 4. Expected CBNG produced water and blended discharge water quality in the Wild Horse Creek Area. [1,2]

Anaylte	Units	Livestock Watering Criteria	Gates-Wall (S15, T50N, R75W)	Gates-Wall (S10, T50N, R75W)	Gates-Wall (S28, T50N, R75W)	Wyodak (S34, T50N, R74W)
pH	*s.u.*	6.5 to 9	7.7	7.3	7.5	7.2
Electrical Conductivity (EC)	*dS/m*	7.5	2.24	2.09	2.01	2.19
Total Dissolved Solids (TDS)	*mg/L*	5000	1400	1280	1300	1410
Sodium Adsorption Ratio (SAR)		-	17.2	12.9	18.2	16.7
Anions						
Bicarbonate	*mg/L*	-	1590	1500	1440	1600
Chloride	*mg/L*	2000	14	10	10	8
Sulfate	*mg/L*	3000	2	<1	6	1
Cations						
Calcium	*mg/L*	-	41	49	32	39
Magnesium	*mg/L*	-	18	24	14	16
Sodium	*mg/L*	-	525	442	489	488
Metals						
Arsenic	*µg/L*	20	0.4	1.4	2.6	0.2
Boron	*µg/L*	5000	-	-	-	-
Cadmium	*µg/L*	50	<0.1	<0.1	<0.1	<0.1
Chormium	*µg/L*	1000	-	-	-	-
Copper	*µg/L*	500	3	3	3	3
Lead	*µg/L*	100	<2	<2	<2	<2
Mercury	*µg/L*	10	<0.06	<0.06	<0.06	<0.06
Selenium	*µg/L*	50	<5	<5	<5	<5
Zinc	*µg/L*	2500	<10	<10	<10	<10

Notes:

1 Abbreviations used are as follows: s.u. = standard units; dS/m = deciSiemens per meter; mg/L = milligrams per liter; µg/L = micrograms per liter; and nd = analyte not detected at the given reporting limit. "-" indicates the sample was not analyzed for the given parameter.

2 All produced water samples were collected by Williams and analyzed by Energy laboratories, Gillette, WY

3 Livestock watering criteria are from the WYDEQ (2006) an dNational Academy of Sciences (1972 and 1974).

Reproduced from "Supplemental Information For The Section 20 Analysis For Proposed CBNG Produced Water Discharges, Wild Horse Creek, Campbell County, Wyoming KC Harvey Inc., July 31, 2007

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Wild Horse Creek – Summer 2005