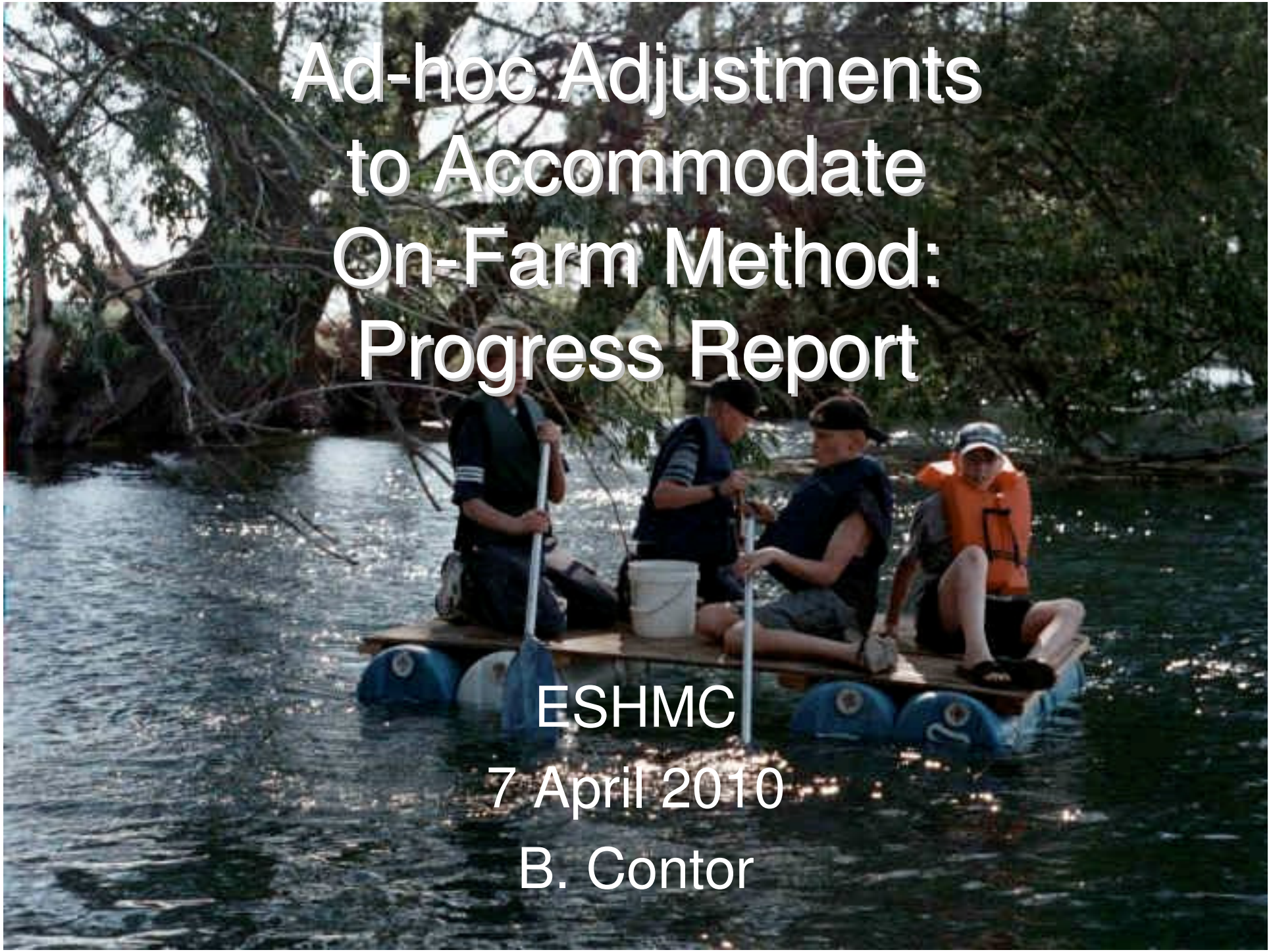


Ad-hoc Adjustments to Accommodate On-Farm Method: Progress Report

ESHMC

7 April 2010

B. Contor

Why we're doing this

- In ESPAM1.1, canal seepage and mixed-source lands refined spatial distribution ***but did not change the water budget.***
- In ESPAM2 w/ "On-Farm" method, these ***change the water budget.***
- Our target date for start of calibration is ***June 2009***....

Why we're doing this

- ***So.....***
- In December 2009 the ESHMC directed a refinement of canal-seepage fractions and mixed-source fractions.
- IWRRI assumed this meant we shouldn't go back and re-do a lot of basic data, but that we should expeditiously make ad-hoc adjustments.

It's a tough pull but I'm working on it....

What do we need from ESHMC?

- 1st round ad-hoc adjustments were mailed out for review
- 2nd round will utilize data from Sullivan response
- 2nd round will be mailed out for review
- 3rd round will utilize any further ESHMC input received
- *We jolly well better quit at three – scheduled calibration start date is June 2009….*

(Slide from February ESHMC meeting)

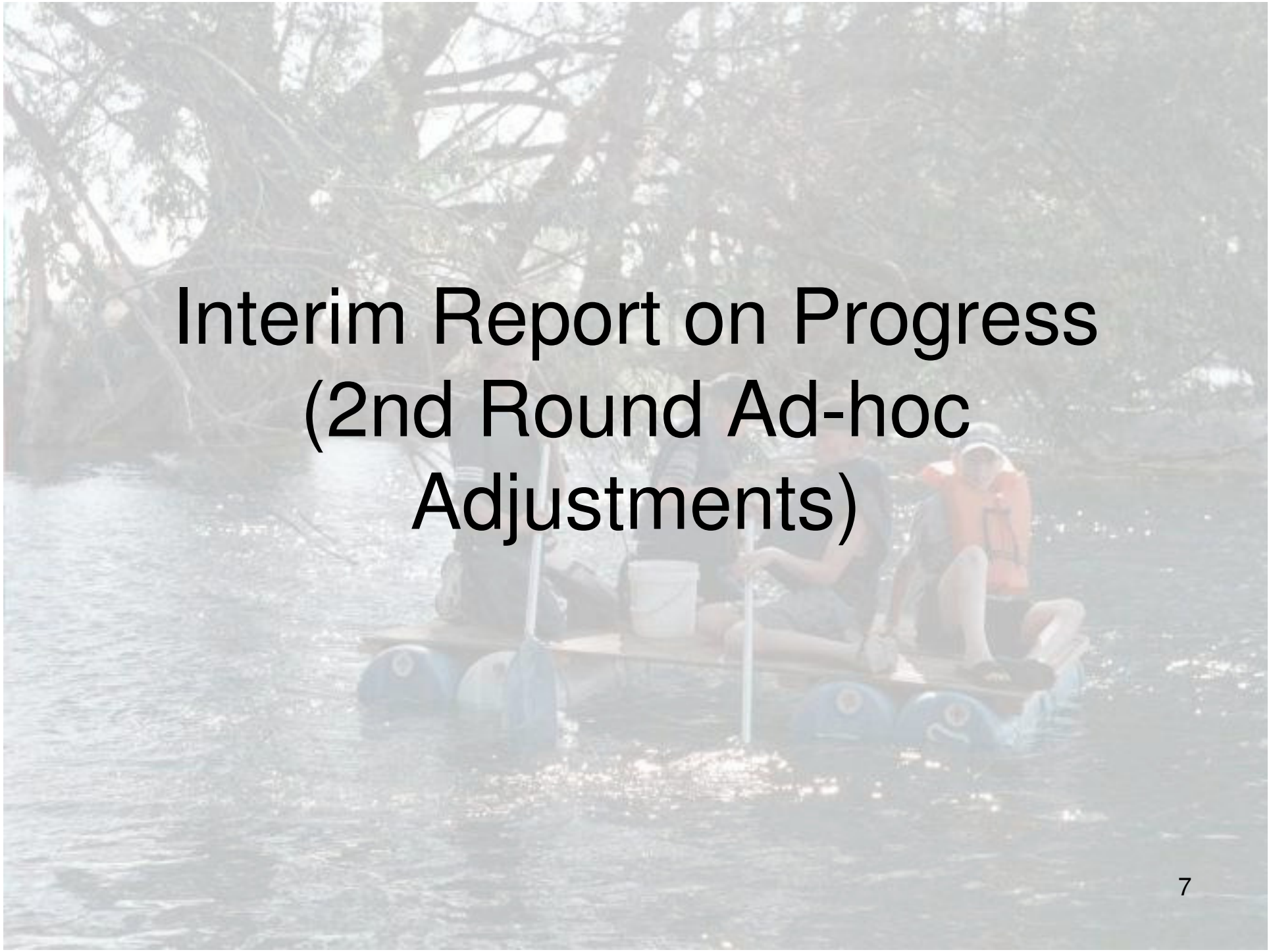
What do we need from ESHMC?

- 1st round ad-hoc adjustments were mailed out for review
- 2nd round will utilize data from Sullivan response
- 2nd round will be mailed out for review
- 3rd round wil
  received
- *We jolly wel*
  calibration s

I'm in the midst of 2nd round, and have not yet considered Sullivan's data.

(Slide from February ESHMC meeting)

I have looked at Sullivan's data...



Interim Report on Progress (2nd Round Ad-hoc Adjustments)

Guiding Principles

Guiding Principles

- Current estimates are best available information
  - ET
  - Diversions
  - Returns
  - Mixed source lands
    - location
    - source fraction
  - Canal seepage

Guiding Principles

- Current estimates are not equally precise
  - ET *+/- 5% to 10%?*
  - Diversions *+/- 5% (watermaster reports), +/- 15% (other methods)?*
  - Returns *+/- 10% (measured), +/- 30% (estimated)*
  - Mixed source lands *??*
    - location
    - source fraction
  - Canal seepage *??*

Guiding Principles

- Attempt to do the least violence to "truth"
  - Example: IESW019 Diversions
    - Diversions are remarkably steady except for the one year when they are near zero
    - Unless we can convince ourselves it is real, we will substitute an estimate for that one year.

We implicitly assume a data problem is more likely than a year w/o diversions; we assume making an estimate is a lesser violation of "truth" than keeping the data would be.

Guiding Principles

- Honor data proportionally to their expected reliability
  - Example: IESW058 Canal seepage
    - Three kinds of data
      - upstream & downstream gauged canal discharge
      - miscellaneous measurements by U of I extension
      - USBOR pre-construction engineering study

The Process

- Entity by entity, stress period by stress period, tabulate depths
  - ET
  - Precip
  - Diversions
  - Returns
- Calculate implied residual fraction

$$\frac{\text{(Diversion + Precip - Returns - ET)}}{\text{(Diversion)}}$$

The Process

- Plot the residual fraction over time, by stress period and by irrigation season.
- Carefully consider "reasonableness" and determine if there is a sensible way to partition the residual into canal seepage and in-field percolation.
- This will give On-Farm the opportunity to adjust ET, percolation and returns, given the most probable correct (Divs - Cnl Seep).

The Process

- If the residual can't be reasonably partitioned there are three possibilities:
  - There is a condition of excess diversion
  - Deficit irrigation occurs
  - There is a data problem

The Process

- If a data problem seems the most probable & reasonable explanation, adjust the data
  - mixed source fraction
- If extreme diversion or deficit irrigation is the most probable and reasonable explanation, let the chips fall where they may

Nuts n Bolts

- Working assumptions:
  - Consumptive use fraction of field-headgate deliveries will be about 0.65
  - Percolation fraction of field-headgate deliveries will be about 0.35
  - This includes effects of field-to-field re-use; system (net) runoff has already been subtracted via use of existing Return Flows

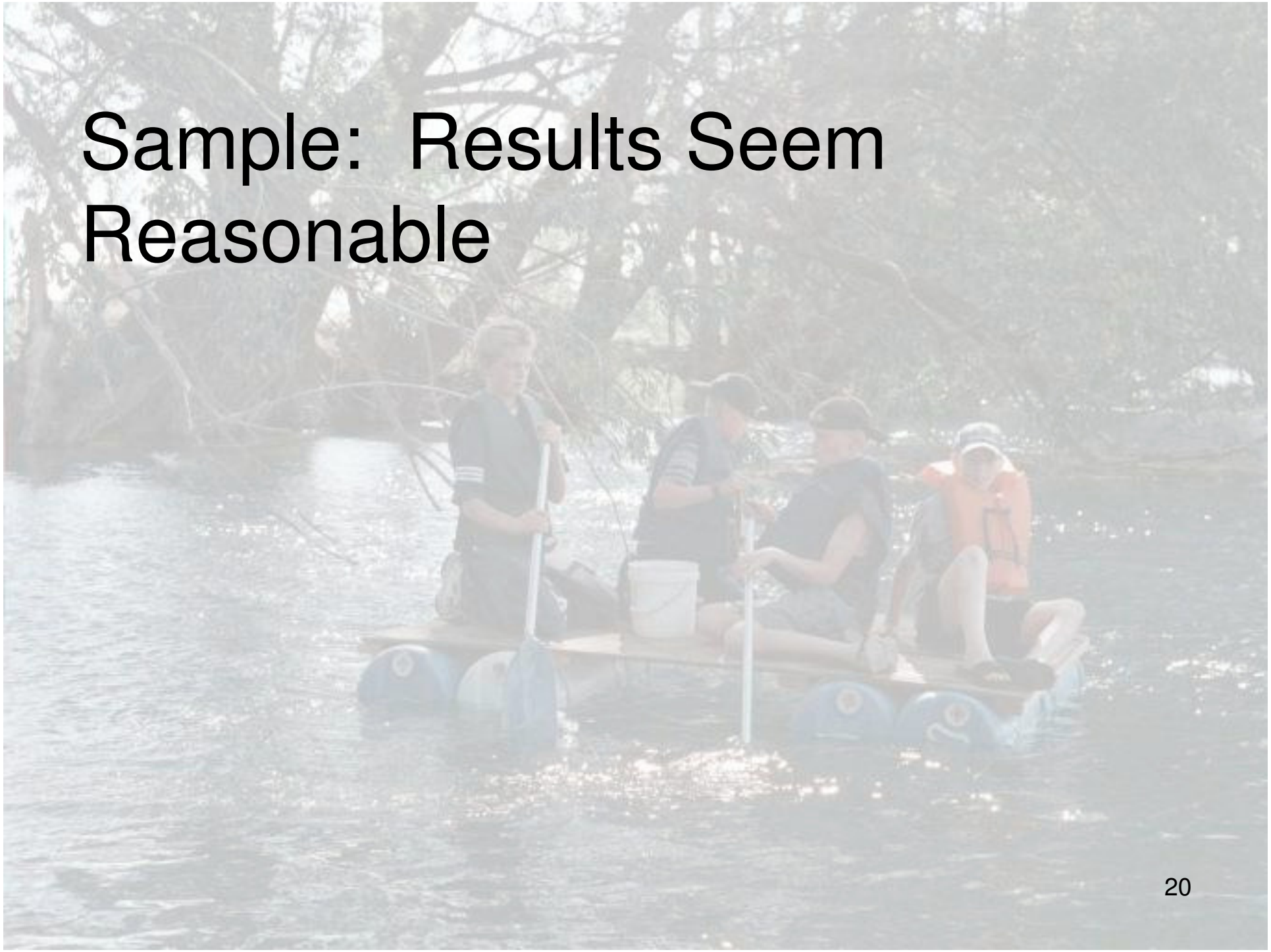
Nuts n Bolts

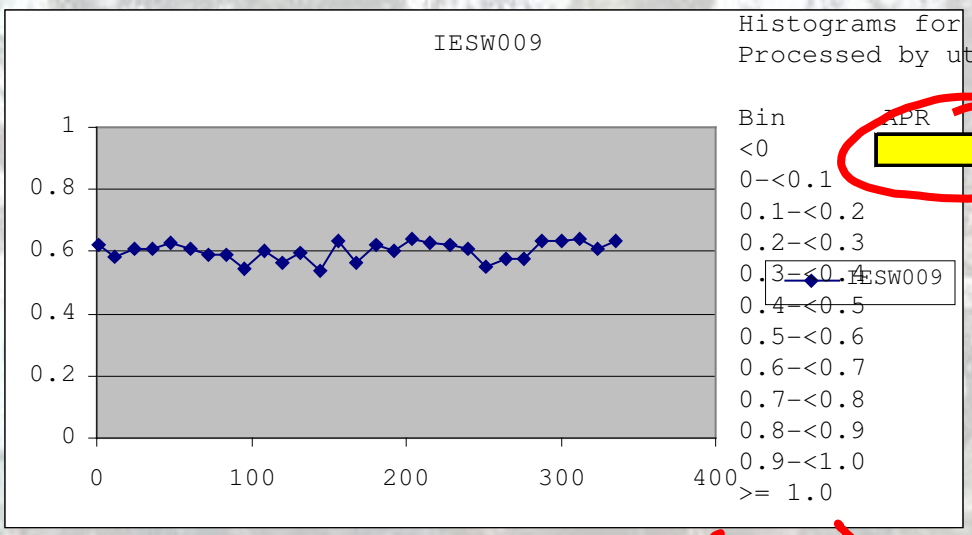
- It turns out that:
  - if RF_{div} (residual fraction of diversions) = $\frac{(Div + Pcp - Return - ET)}{(Div)}$
  - and PF_{field} (percolation fraction of field delivery) = (0.35),
  - then CF_{div} (canal leakage fraction of diversions) = $1.54\ (RF_{div}) - 0.54$

Preliminary Outcomes

- Results seem reasonable
- Mixed-source fraction needs adjustment
- Other data need adjustment
- Miscellaneous issues
  - monthly precision of data
  - geographic extent of entities
  - truly "mixed-source" entities & On-Farm method

Sample: Results Seem Reasonable





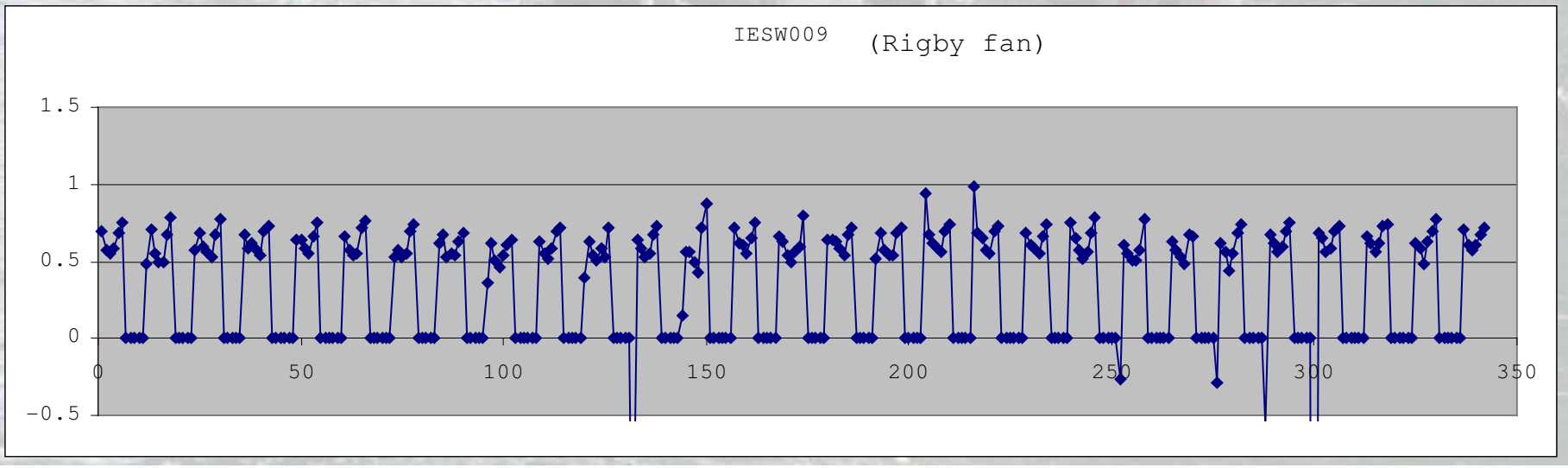
Histograms for L:\CANAL_SEEP_MIXED_SRC_20100211\HISTOGRAMS\NETRESID_009_20
Processed by utility 'VB_BATCH_HISTOGRAMATOR' 3/15/2010 3:06:50 PM

Bin	APR	MAY	JUN	JUL	AUG	SEP	OCT
<0	5	0	0	0	0	0	0
0-<0.1	0	0	0	0	0	0	0
0.1-<0.2	1	0	0	0	0	0	0
0.2-<0.3	0	0	0	0	0	0	0
0.3-<0.4	2	0	0	0	0	0	0
0.4-<0.5	1	0	0	6	3	0	0
0.5-<0.6	2	3	18	22	23	3	0
0.6-<0.7	4	23	11	1	3	23	3
0.7-<0.8	1	3	0	0	0	3	25
0.8-<0.9	0	0	0	0	0	0	1
0.9-<1.0	2	0	0	0	0	0	0
>= 1.0	0	0	0	0	0	0	0

$CF_{Div} = 1.54(0.6) - 0.54 = 0.38$ ✓

BEFORE RED
Entity IESW009

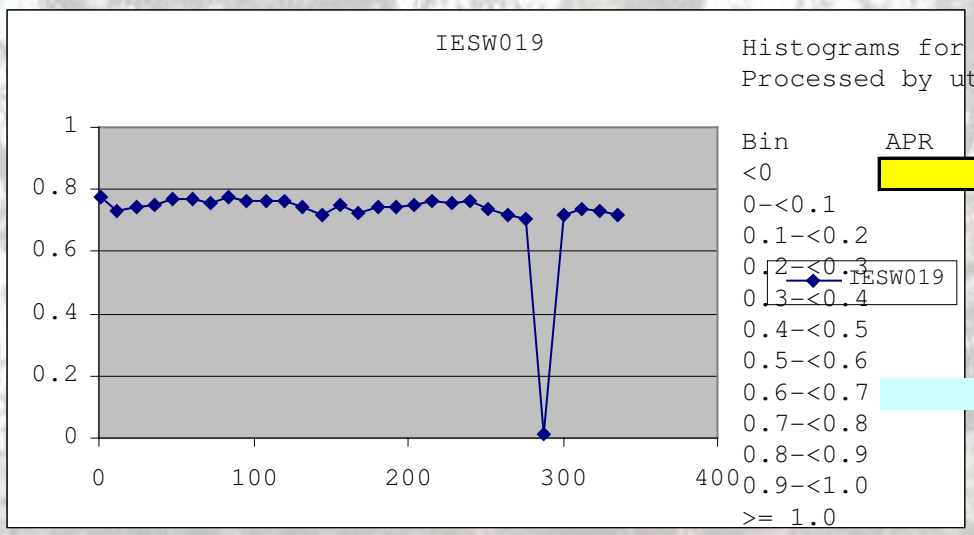
Yr	GW_only	SW_only	Mixed_Net	Mixed_tot	Eff_GW	Eff_SW	MixFrac
Irr_80	0	37690.93	463.661	1585.226	0	38154.59	0.292489
Irr_86	0	33739.76	433.467	1533.452	0	34173.23	0.282674
Irr_92	0	35180.49	431.335	1531.644	0	35611.82	0.281616
Irr_00	0	32321.07	389.232	1412.741	0	32710.3	0.275515
Irr_06	0	24645.64	287.002	1064.623	0	24932.64	0.269581



Sample:

a) Mixed-source Fraction Needs Adjustment

b) Other data need adjustment



Histograms for L:\CANAL_SEEP_MIXED_SRC_20100211\HISTOGRAMS\NETRESID_019_2
Processed by utility 'VB_BATCH_HISTOGRAMATOR' 3/15/2010 3:06:50 PM

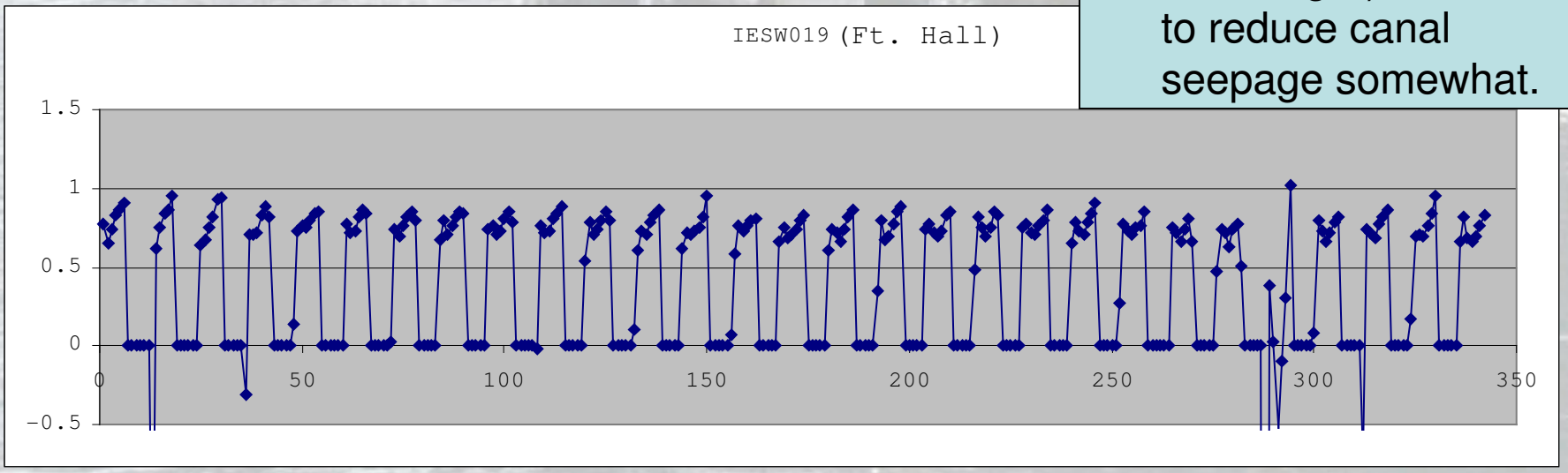
Bin	APR	MAY	JUN	JUL	AUG	SEP	OCT
<0	4	1	0	1	1	0	0
0-<0.1	3	0	1	0	0	0	0
0.1-<0.2	3	0	0	0	0	0	0
0.2-<0.3	1	0	0	0	0	1	0
0.3-<0.4	1	1	0	0	0	0	0
0.4-<0.5	2	0	0	0	0	0	0
0.5-<0.6	1	1	0	0	0	0	1
0.6-<0.7	6	3	7	10	1	0	1
0.7-<0.8	3	21	21	18	18	5	3
0.8-<0.9	0	2	0	0	9	22	17
0.9-<1.0	0	0	0	0	0	1	6
>= 1.0	0	0	0	0	0	0	1

CF_{div} = 1.54 (0.75) - 0.54 = 0.62

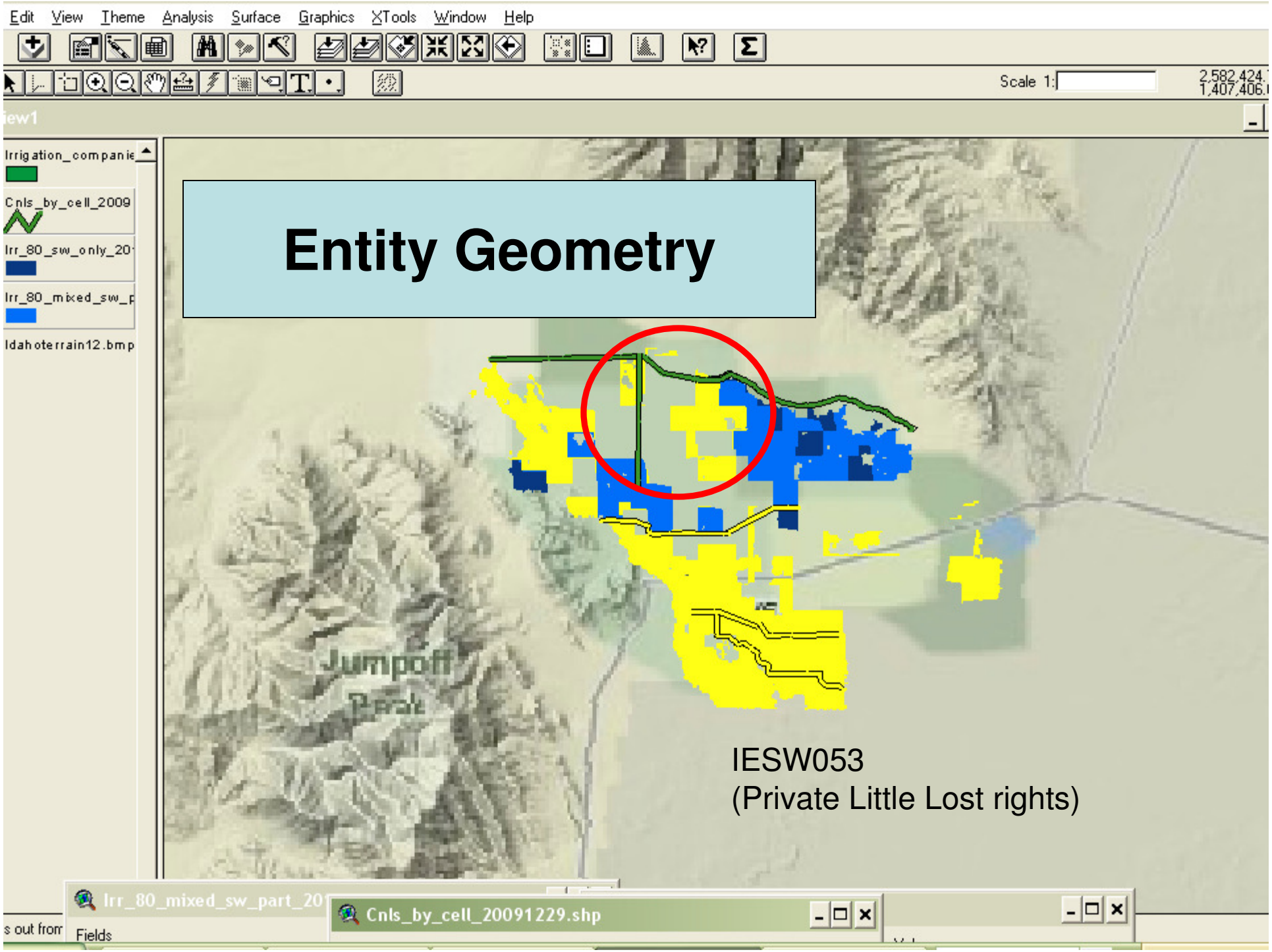
BEFORE RED
Entity IESW019

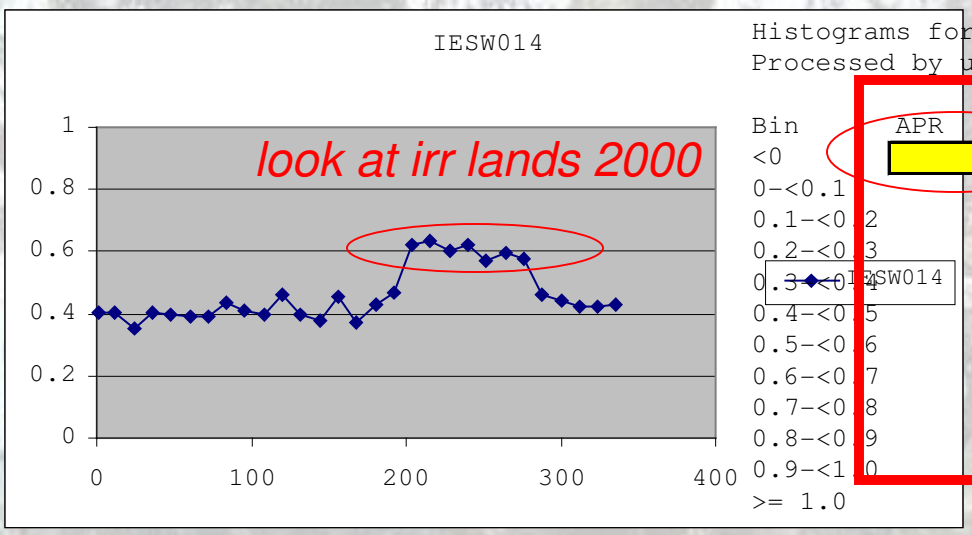
Yr	GW_only	SW_only	Mixed_Net	Mixed_tot	Eff_GW	Eff_SW	MixFrac
Irr_80	0	1184.597	18940.96	22981.53	0	20125.56	0.824182
Irr_86	0	467.395	15894.66	19109.94	0	16362.05	0.831748
Irr_92	0	363.579	18219.51	22191.57	0	18583.09	0.82101
Irr_00	0	257.671	17768.05	21554.97	0	18025.72	0.824313
Irr_06	0	342.744	17444.66	21120.4	0	17787.41	0.825963

- We're checking the one odd year.
- Make GW fraction smaller (MixFrac here larger) to reduce canal seepage somewhat.



Samples: Miscellaneous Issues


Edit View Theme Analysis Surface Graphics XTools Window Help
Scale 1:
Irrigation_companie
Cnls_by_cell_2009
Irr_80_sw_only_20
Irr_80_mixed_sw_p
Idahoterrain12.bmp
Entity Geometry
Jumpoff
Peak
IESW053
(Private Little Lost rights)
Irr_80_mixed_sw_part_20
Cnls_by_cell_20091229.shp
Fields



Histograms for L:\CANAL_SEEP_MIXED_SRC_20100211\HISTOGRAMS\NETRESID_014_2
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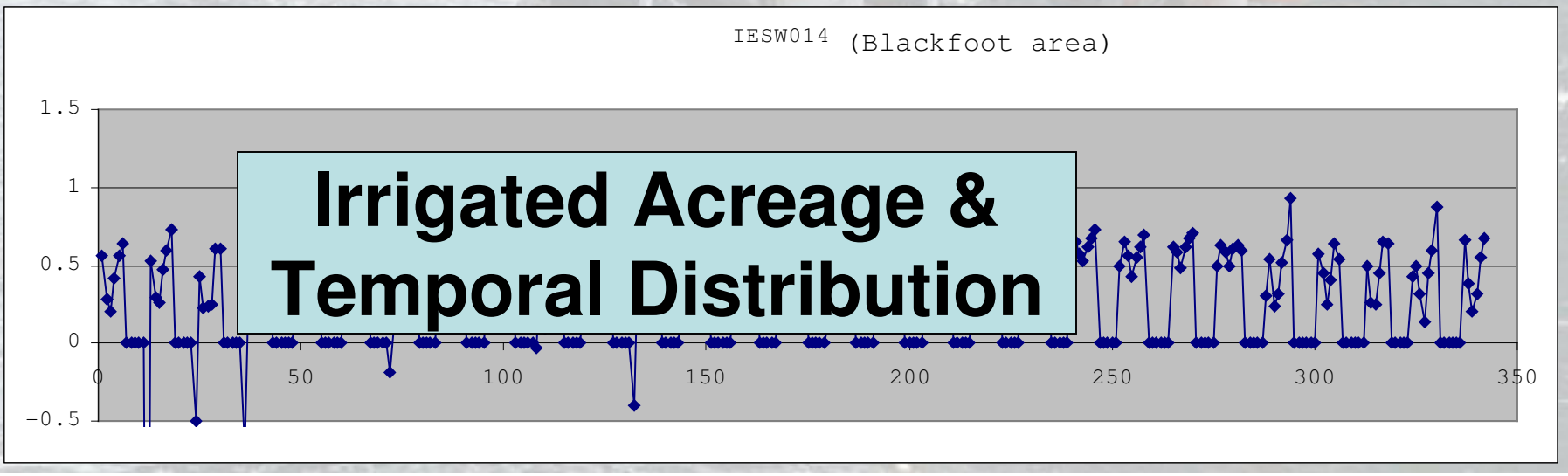
Bin	APR	MAY	JUN	JUL	AUG	SEP	OCT
<0	6	0	0	0	0	0	0
0-<0.1	0	0	1	0	0	0	0
0.1-<0.2	2	1	2	5	0	0	0
0.2-<0.3	0	0	12	13	2	0	0
0.3-<0.4	2	4	5	4	4	0	0
0.4-<0.5	4	7	1	3	10	1	0
0.5-<0.6	3	8	7	4	9	8	3
0.6-<0.7	1	9	1	0	4	19	17
0.7-<0.8	2	0	0	0	0	1	7
0.8-<0.9	1	0	0	0	0	0	1
0.9-<1.0	0	0	0	0	0	0	1
>= 1.0	0	0	0	0	0	0	0

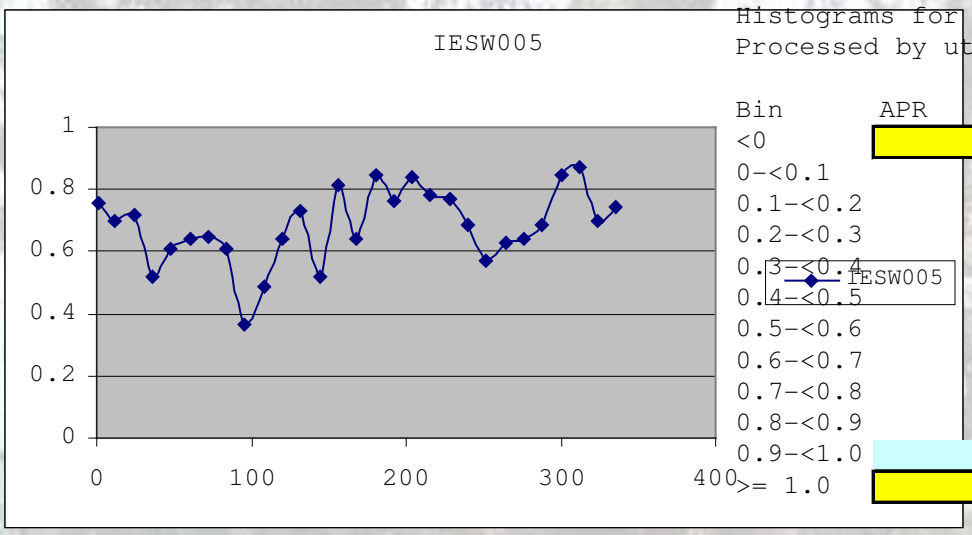
BEFORE RED
Entity IESW014

Yr	GW_only	SW_only	Mixed_Net	Mixed_tot	Eff_GW	Eff_SW	MixFrac
Irr_80	0	9015.697	153.615	2585.333	0	9169.312	0.059418
Irr_86	0	8074.611	141.526	2332.488	0	8216.137	6.07E-02
Irr_92	0	8420.519	151.239	2442.009	0	8571.758	6.19E-02
Irr_00	0	3008.221	152.967	2483.464	0	3161.188	6.16E-02
Irr_06	0	6700.39	136.687	2226.959	0	6837.077	6.14E-02

- CFdiv ~ 0.08
- Reduce MixFrac
- Investigate acreage Irr 00.



Irrigated Acreage & Temporal Distribution



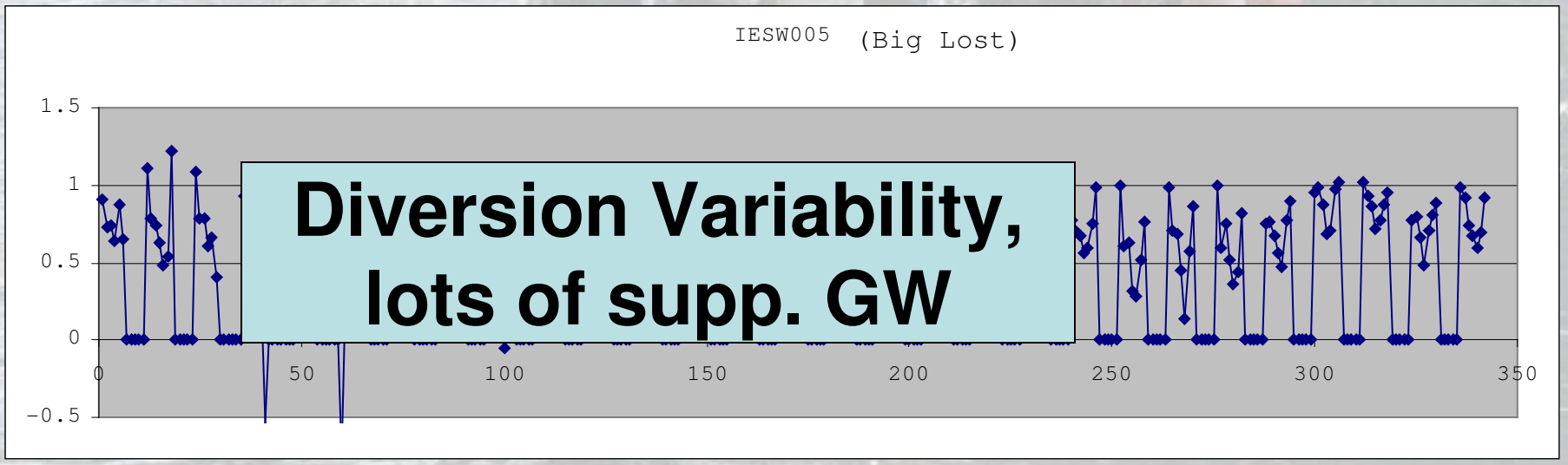
Histograms for L:\CANAL_SEEP_MIXED_SRC_20100211\HISTOGRAMS\NETRESID_005_20
Processed by utility 'VB_BATCH_HISTOGRAMATOR' 3/15/2010 3:06:49 PM

Bin	APR	MAY	JUN	JUL	AUG	SEP	OCT
<0	1	0	0	0	1	1	0
0-<0.1	0	0	0	0	0	1	0
0.1-<0.2	0	0	0	1	1	0	0
0.2-<0.3	1	0	0	2	1	0	0
0.3-<0.4	0	0	0	2	3	2	0
0.4-<0.5	1	3	2	3	4	1	1
0.5-<0.6	1	2	3	5	4	3	0
0.6-<0.7	0	5	8	10	8	7	2
0.7-<0.8	4	11	10	5	7	5	3
0.8-<0.9	3	2	5	1	0	7	7
0.9-<1.0	7	6	1	0	0	2	7
>= 1.0	9	0	0	0	0	0	5

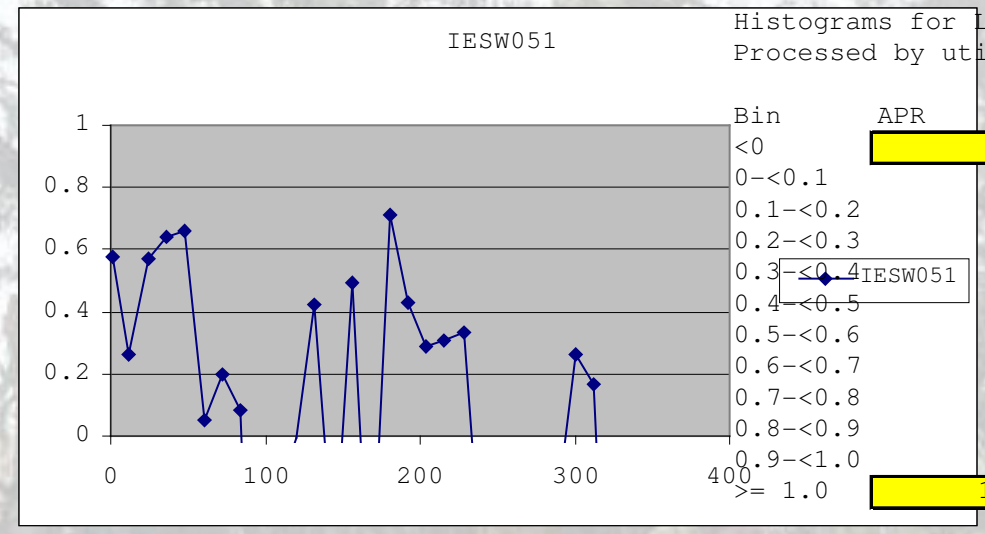
BEFORE RED
Entity IESW005

Yr	GW_only	SW_only	Mixed_Net	Mixed_tot	Eff_GW	Eff_SW	MixFrac
Irr_80	0	18965.06	10181.06	46758.57	0	29146.12	0.217737
Irr_86	0	17021.88	10711.14	47266.97	0	27733.02	0.226609
Irr_92	0	11613.84	9856.311	43698.66	0	21470.15	0.225552
Irr_00	0	9884.817	8778.125	38671.15	0	18662.94	0.226994
Irr_06	0	6801.509	8408.178	36004.46	0	15209.69	0.233532

CF_{div} = 0.08 to 0.69?



Diversion Variability, lots of supp. GW



Histograms for L:\CANAL_SEEP_MIXED_SRC_20100211\HISTOGRAMS\NETRESID_051_2
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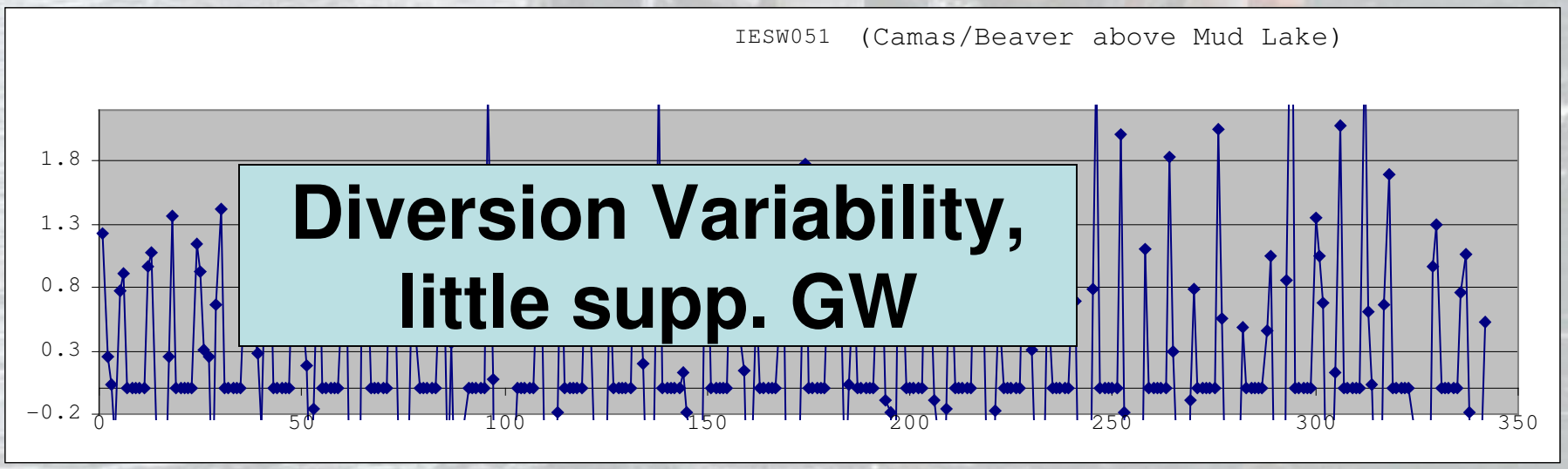
Bin	APR	MAY	JUN	JUL	AUG	SEP	OCT
<0	1	3	18	22	29	14	2
0-<0.1	0	1	1	1	0	1	0
0.1-<0.2	1	0	1	2	0	1	0
0.2-<0.3	0	1	1	2	0	1	0
0.3-<0.4	0	0	2	2	0	1	0
0.4-<0.5	1	1	2	0	0	0	1
0.5-<0.6	0	1	0	0	0	1	2
0.6-<0.7	0	3	1	0	0	4	1
0.7-<0.8	4	2	1	0	0	2	2
0.8-<0.9	1	3	0	0	0	2	2
0.9-<1.0	2	3	1	0	0	1	2
>= 1.0	18	11	1	0	0	1	17

BEFORE RED
Entity IESW051

Yr	GW_only	SW_only	Mixed_Net	Mixed_tot	Eff_GW	Eff_SW	MixFrac
Irr_80	0	14896.72	672.842	2921.45	0	15569.56	0.230311
Irr_86	0	25299.79	480.009	2420.037	0	25779.79	0.198348
Irr_92	0	13253.06	430.744	2556.417	0	13683.8	0.168495
Irr_00	0	17305.77	356.493	2555.933	0	17662.26	0.139477
Irr_06	0	18066.98	458.771	2574.038	0	18525.75	0.17823

CF_{div} = zero to 0.54?



Diversion Variability, little supp. GW

Cross-check w/ Data

- IESW001 (A & B Irrigation District)
  - Sullivan 0.17-0.34
  - Currently 0.15
- IESW010 (Burley Irrigation District)
  - Sullivan 0.35-0.42
  - Currently 0.38
- IESW027 (Milner Irrigation District)
  - Sullivan 0.18-0.20
  - Currently 0.54

New!

Cross-check w/ Data (2)

- IESW028 (Minidoka Irrigation District)
  - Sullivan 0.24-0.35
  - Currently 0.21
- IESW032 (North Side Canal Company)
  - Sullivan 0.33-0.53
  - Anecdotal reports 0.30?
  - Currently 0.31

New!

Cross-check w/ Data (3)

- AFRD#2 (parts of IESW058 & IESW059)
  - Sullivan 0.48
  - Falen 0.69
  - BOR Pre-construction estimate??
  - Currently 0.77 (IESW058; includes seepage on 'pass-through' water)
    0.42 (IESW059, including Wood Rivers diversions)

New!

Reality Check

Plan

- Finish round 2
  - compare w/ Sullivan data
  - compare w/ Milner-Gooding seepage meas.
  - abandon fancy algorithm for canals?
- Circulate round 2 for comment
- Finish round 3 based on comments
- Get Allan a water budget to work with


Discussion

(Start of Backup Slides)

How will we use the Net Residual Fraction?

- Definitions:
  - CU = consumptive use volume from irrigation
  - CNL = canal seepage volume
  - PERC = in-field percolation volume
  - Div = diversion volume
    = CU + CNL + PERC
  - F = field headgate delivery volume
    = CU + PERC
  - R = residual volume
    = (CNL + PERC) = (Div - CU)

How will we use the Net Residual Fraction?

- Definitions:
  - CUF_{div} = consumptive use fraction of diversion volume = CU/Div
  - CUF_{field} = consumptive use fraction of field headgate volume = CU/F
  - PF_{div} = percolation fraction of diversion volume = PERC/Div

How will we use the Net Residual Fraction?

- Definitions:
  - PF_{field} = percolation fraction of field headgate volume
    = PERC/F
  - FF_{div} = field headgate fraction of diversion volume
    = F/Div
  - CF_{div} = canal fraction of diversion volume
    = CNL/div

How will we use the Net Residual Fraction?

- Definitions:
  - RF_{div} = R/Div

How will we use the Net Residual?

- Assumptions:
  - CUF_{field} = 0.65 +/- 0.20
  - PF_{field} = 0.35 +/- 0.20

- Calculations:
  - $CUF_{field} = CU/F$ (D8)
  - CUF_{field} = 0.65 (A1)
  - CU/F = 0.65 --> CU = 0.65 F
  - CU = 0.65 (CU + PERC) (D5)

How will we use the Net Residual?

- Calculations:
  - PERC = [(1-0.65)/0.65] CU
  - PERC = 0.54 CU
  - CNL + PERC = R (D6)
  - CNL = R - 0.54 CU
  - CNL = R - 0.54 (Div - R) (D6)
  - CNL = 1.54 R - 0.54 (Div)
  - CNL/Div = 1.54 (R/Div) - 0.54
  - $CF_{div} = 1.54\ RF_{div} - 0.54$