MEMORANDUM

To: ESPAM2 Files
Fr: B. Contor
Date: 27 April 2010

Re: Ad-hoc adjustments to canal seepage, mixed-source fractions and irrigated lands.

BACKGROUND

With the adoption of the On-Farm method for calculating recharge incidental to irrigation, the representation of canal seepage and mixed-source lands can change the water budget. Canal seepage changes the water budget because canal seepage is subtracted from gross diversions before calculating the volume of water available to be partitioned into evapotranspiration, percolation and return flows. Treatment of mixed-source lands change the water budget because the On-Farm method calculates an effective diversion depth before partitioning the residual, and the partition made is controlled in part by the depth of diversion.

The underlying estimates for canal seepage and mixed-source lands were made with the ESPAM1.1 paradigm in mind, where the estimates only changed spatial distribution of recharge. With the new ability of these values to influence the water budget, the ESHMC concurred in December 2009 that IWRRI should make an effort to double check and refine canal seepage and mixed-source fraction.

A first round of refinements were e-mailed to the ESHMC early in 2009, and discussed in ESHMC meetings in February and April 2009. Based on input received by e-mail and at the April 2009 ESHMC meeting, IWRRI has completed a second round of adjustments. This memo describes in detail the Round 2 adjustments. It accompanies files “Cnl_Data_Rnd2_Notes_20100419.ppt,” “NET_RESID_FRAC_GRAPHS_LINKED_20100312.xls” and “CNL_SEEP_CALCS_20100312.xls.”

The Round 2 adjustments will be incorporated into an interim data set for initial calibration work. We invite ESHMC and IDWR input on all Round 2 adjustments. All input will be considered as the Round 3 adjustments are made.

ON-FARM METHOD

IWRRI proposes the following:

1. The soil-moisture storage algorithm should be enabled in the On-Farm code. This may correct timing issues with early and late months, observed in many entities.

2. IDWR should obtain an independent evaluation of the On-Farm code, to be sure that the proposed algorithms are appropriately implemented. IWRRI and IDWR must be absolutely certain what the code is doing and how it is performing its calculations, so that input data are correct and the output well term is as anticipated.

SUMMARY OF ADJUSTMENTS

Table 1 summarizes the modifications made in Round 2, the canal-seepage fraction determined, and notes whether the On-Farm method should be set to produce zero returns.

Some entities should have zero returns to correspond to the physical reality of the system. Others should have zero returns to correspond to the fact that the diversion data are calculated from surface-water mass balance of reach inflows and outflows, and are implicitly net of any returns that have occurred.

Table 1 includes the new common names for entities that were e-mailed to the ESHMC on 27 April. The slides use older common names or entity descriptions.

Some entities have no canals represented and therefore have no canal-seepage fraction listed in Table 1.

Table 1
Summary of Round 2 Adjustments

ENTITY	Canal Seep Fraction	Zero Returns	Mixed-Source Adjusted	Irrigated Lands/ Boundaries Adjusted	ET Adjusted
IESW000 Null	-	X		IESW031 and IESW041 are merged into IESW000	
IESW001 A&B	0.15				
IESW002 AbSpring	0.62				
IESW005 Big Lost	0.23	X	X		

ENTITY	Canal Seep Fraction	Zero Returns	Mixed-Source Adjusted	Irrigated Lands/ Boundaries Adjusted	ET Adjusted
IESW008 BlaineCo	0.30	X	X	See IESW053	
IESW009 Burgess	0.38				
IESW010 Burley	0.38				
IESW011 ButteMrk	0.15		X		
IESW012 Canyon	0.08	X		See IESW056	
IESW014 Blckfoot	0.15		X	Year-2000 dataset repaired	
IESW015 Dewey	0.30	X			
IESW016 Egin	0.60				
IESW018 Falls	0.10	X	X		
IESW019 FortHall	0.50		X		
IESW020 Harrison	0.38				
IESW022 Idaho	0.30		X		
IESW025 LitlWood	0.40	X	X		
IESW027 Milner	0.40		X		
IESW028 Minidoka	0.35		X		
IESW029 MudLake	0.05	X			X
IESW030 NewSwedn	0.21				
IESW031 Marysville	-			Merged into IESW000	
IESW032 Nrthside	0.31				
IESW034 Peoples	0.42				
IESW035	0.31		X		

ENTITY	Canal Seep Fraction	Zero Returns	Mixed-Source Adjusted	Irrigated Lands/ Boundaries Adjusted	ET Adjusted
Progress					
IESW036 Liberty	0.30				
IESW037 Reno	0.22	X	X		
IESW038 Rexburg	0.42				
IESW039 Chester	0.30		X		
IESW040 Oakley	0.34	X	X		
IESW041 Twin Falls	-			Merged into IESW000	
IESW044 Monteview	0.20	X			X
IESW051 Dubois	-	X	X		
IESW052 Small	-	X	X		
IESW053 Howe	0.30	X		See IESW008	
IESW055 Labelle	0.31				
IESW056 Sugrcity	0.60			See IESW012	
IESW057 Blk_Chub	0.37				
IESW058 AmFalls2	0.77	X			
IESW059 Good_Rch	0.42	X	X		

DETAIL OF ADJUSTMENTS BY ENTITY

IESW000 – Null entity

Observations IESW000:

1. This entity includes all the small parcels not otherwise assigned to a surface-water entity. Canal seepage is not explicitly represented, and in most locations we believe returns are essentially zero.

2. IESW000 diversion depths are based on an estimate of annual diversion depth, arbitrarily partitioned to individual months.
3. Current annual depths allow for reasonable partition of diversions to canal seepage and field headgate delivery, and reasonable partition of field headgate delivery to percolation and evapotranspiration.
4. Month-to-month match between evapotranspiration (ET) and diversions is poor.
5. IESW031 and IESW041 also use estimated annual diversion depths, with similar results and issues.

Round 2 Modifications IESW000:

1. The time series of irrigation requirement depths (defined as ET minus precipitation) from tab "IRR_REQ" of file "CNL_SEEP_CALCS_20100312.xls" will be used to define monthly gross diversion depth. Diversion depth will be (irrigation requirement depth)/(0.52), which will be compatible with the following assumptions:
    a. Either returns are zero, or the diversion estimates represented are net diversions (i.e. diversions minus returns).
    b. Implicit canal seepage is 0.20 times (net) diversions.
    c. Field headgate delivery is 0.80 times (net) diversions.
    d. Percolation is 0.35 times field headgate delivery.
    e. ET is 0.65 times field headgate delivery.
2. IESW031 (a small portion of the irrigated lands in the Ashton area) and IESW041 (a small portion of the irrigated lands in the Twin Falls Canal Company) will be added to IESW000 and those two entities will be eliminated. In both cases, the bulk of the irrigation under those entities occurs outside the study area. In ESPAM1.1 we attempted to assign a fraction of the diversions to the part of the service area that is within the model, but because not all our irrigated-lands maps cover the entire service area, this was problematic. In Round 1 of ESPAM2, we estimated diversion depths for IESW031 and IESW041 rather than try to arbitrarily partition diversion volumes. Since this is the same approach as taken in IESW000, it seems reasonable to combine all three entities. This will simplify calculations and improve transparency.
3. Source Fractions and Mixed-source Lands will not be adjusted.
4. The only leaky canal in the reformulated IESW000 is the Twin Falls Canal, which is represented explicitly in the Perched Seepage data set. There is no entry for IESW000 in the ESPAM2 canal-seepage table.
5. The On-Farm algorithm should be set to produce zero returns for this entity.

IESW001 – "A" division of A & B Irrigation District

Observations IESW001

1. Implied canal-seepage fraction of diverted water is 0.15. This compares to estimates of 0.17 to 0.34 provided by Greg Sullivan of Spronk Water

Engineers, representing the City of Pocatello. Sullivan's response to Round 1 adjustments was mailed to the ESHMC on 14 January 2010, in a document titled "Comments on Adjustments to Canal Seepage Fraction.pdf."
2. Round 1 adjustments included mapping as "mixed source" of lands near irrigation wells with water-rights in the name of The United States of America.
3. As with many entities, there are some odd implied residual fractions in early and late months.
4. We assume there are very few surface returns in this entity. The On-Farm algorithm should be adjusted to produce no returns.

Round 2 Modifications IESW001
1. No modifications were made.
2. Canal seepage is set to 0.15.

IESW002 – Aberdeen-Springfield Canal Company

Observations IESW002
1. Implied canal-seepage fraction of 0.62 is reasonably compatible with reports from canal management.

Round 2 Modifications IESW002
1. No modifications were made.
2. Canal seepage fraction is set to 0.62 in ESPAM2 data.

IESW005 – Big Lost River

Observations IESW005
1. Because of inclusion of groundwater pumping in watermaster records for part of the calibration period, diversions in IESW005 are not obtained from watermaster records. Instead, the net disappearance of water between the Mackay Gage and the Arco Gage is interpreted to be the sum of net delivery of water to irrigation and percolation in the river bed.
2. The residual fraction (fraction of diversions available for canal seepage, returns and/or percolation) is highly variable in this entity. We believe this reflects the fact that many of the mixed-source parcels in IESW005 are truly mixed source. In wet years they may be 100% surface-water irrigated and in dry years they may be 100% groundwater irrigated. In any year they may be 100% surface-water irrigated in the spring and 100% groundwater irrigated in the fall.

Round 2 Modifications IESW005
1. To accommodate the actual practice of mixed-source irrigation, without invoking the On-Farm algorithm's reduction of ET, we have set the groundwater fraction to 0.99 on all mixed-source parcels. While this may

produce net diversion depths that appear nonsensical in wet periods, it will allow the appropriate water-budget calculations of recharge in wet months and imputed pumping in dry months.
2. Canal seepage fraction is set to 0.23 in ESPAM2 data.
3. Because diversions are net, the On-Farm algorithm should be set to produce zero returns for this entity.

IESW008 – Blaine County Canal Company, Little Lost River

Observations IESW008

1. This entity also is an area where mixed-source parcels are truly managed as mixed source.
2. There are no surface returns in this entity; therefore the On-Farm algorithm should be set to produce no returns.
3. The irrigated lands circled in slide 22 are assigned to IESW053 (Private Little Lost River), but based on canal locations it appears that perhaps they should be in IESW008. Figure 1 shows the irrigated lands prior to Round 2 modification:

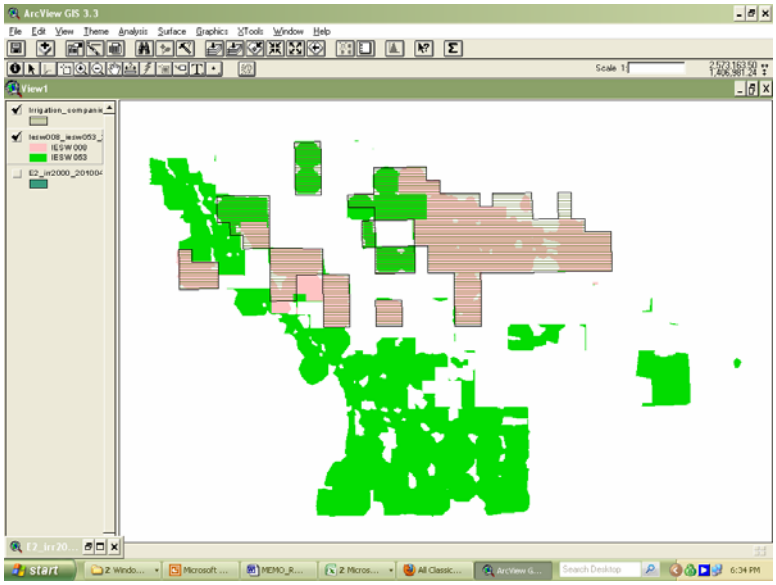

Figure 1. Pre-modification assignment of irrigated lands in the Little Lost basin. Pink lands are IESW008 irrigated lands, green lands are IESW053 lands, and the horizontal lines represent the most recent IDWR map of Blaine County Canal Company service area.

Round 2 Modifications IESW008

1. Groundwater fraction is set to 0.99 on all mixed-source parcels.
2. Canal seepage fraction is set to 0.30, to avoid imputing unreasonable moisture stress on the few surface-water-only parcels, in periods when supplemental groundwater is likely to be used on all mixed-source parcels.
3. Entity assignments are adjusted to match current service-area maps, as shown in Figure 2.

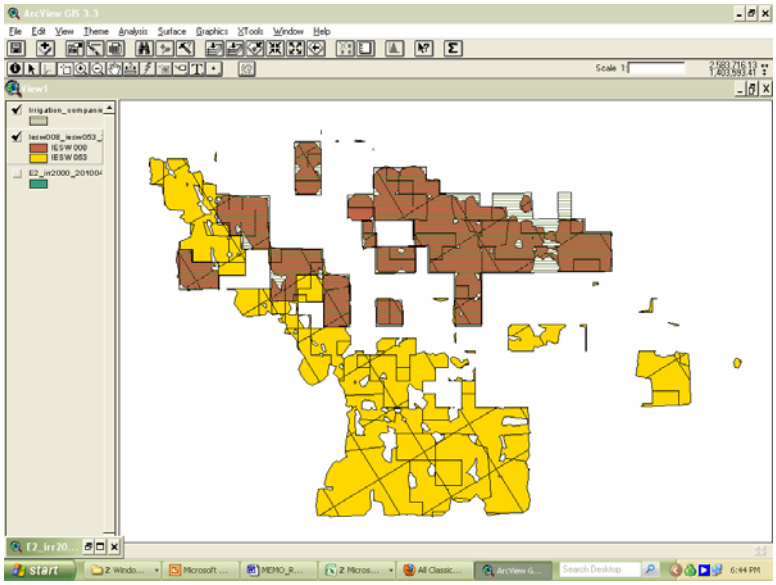

Figure 2. Round 2 adjustment to entity IESW008 (brown) and IESW053 (yellow) boundaries. Horizontal lines represent the IDWR service area for Blaine County Canal Company.

IESW009 – Burgess, Rigby Fan

Observations – IESW009

1. The canal-seepage fraction is in the range expected.
2. The year-to-year constancy of residual fraction is consistent with senior water rights and adequate supplies, which characterize this area.

Round 2 Modifications – IESW009

1. No modifications were made.
2. Canal seepage fraction is set to 0.38.

IESW010 – Burley Irrigation District

Observations – IESW010

1. The implied canal-seepage fraction of 0.38 is in the range expected; Sullivan's estimates range from 0.35 to 0.42.
2. The year-to-year constancy of residual fraction is consistent with generally adequate supplies.

Round 2 Modifications – IESW010

1. No modifications were made.
2. Canal seepage is set to 0.38.

IESW011 – Butte Market Lake Canal

Observations – IESW011

1. The implied canal-seepage fraction (0.08) seems unreasonably low.

2. There is an odd dip in the residual fraction in the approximate range of stress period 250 through 285. However, this does not correspond to a single irrigated-lands data set, so it does not seem likely that irrigated-lands data are the root of this anomaly.

Round 2 Modifications – IESW011

1. We checked diversion data and found that the dip in residual fraction is supported by data indicating a dip in diversion volume in those years.
2. The low implied canal-seepage fraction likely indicates that supplies are limited and therefore it is likely that irrigators take full advantage of supplemental wells. We set the groundwater fraction to 0.99 on mixed-source lands to allow the On-Farm method to reproduce the water-budget effects of full supplemental irrigation.
3. Canal seepage is set to 0.15, based on lack of a reasonable explanation for the low implied fraction of 0.08.

IESW012 – Canyon Creek

Observations – IESW012

1. The low canal seepage fraction (0.08) is probably reasonable; informal observation indicates significant pipeline delivery in this entity.
2. The map of irrigated lands looked odd, so we considered the newest IDWR service-area maps. Figure 3 illustrates the entity boundaries and service area prior to Round 2 adjustments.
3. We believe there are no returns from IESW012.

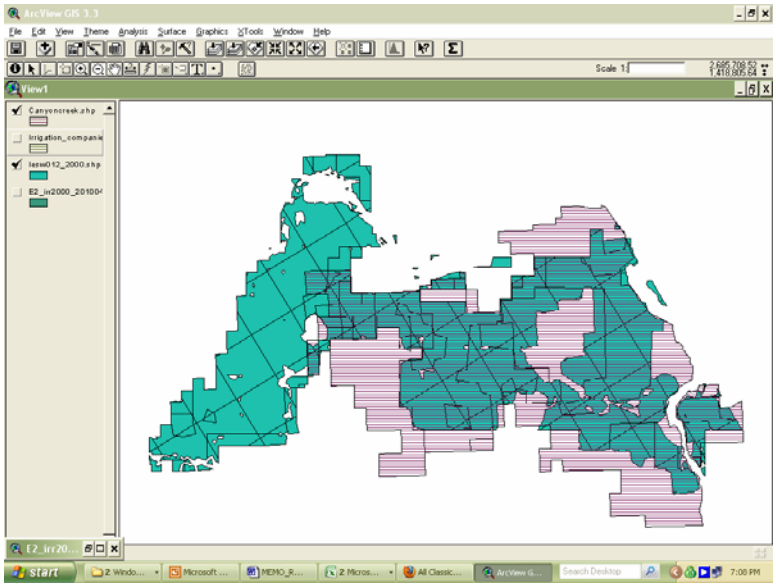

Figure 3. Assignment of lands to IESW012 before Round 2 adjustment. Blue-green lands are IESW012 irrigated lands; horizontal lines represent current IDWR service areas.

Round 2 Modifications – IESW012

1. Canal seepage is set to 0.08.
2. We reassigned the western lands to IESW056, as shown in Figure 4.
3. Corresponding to the change in boundaries, we moved diversion file 130484.75a (Enterprise Canal) from IESW012 to IESW056.
4. The On-Farm method should be set to produce zero returns.

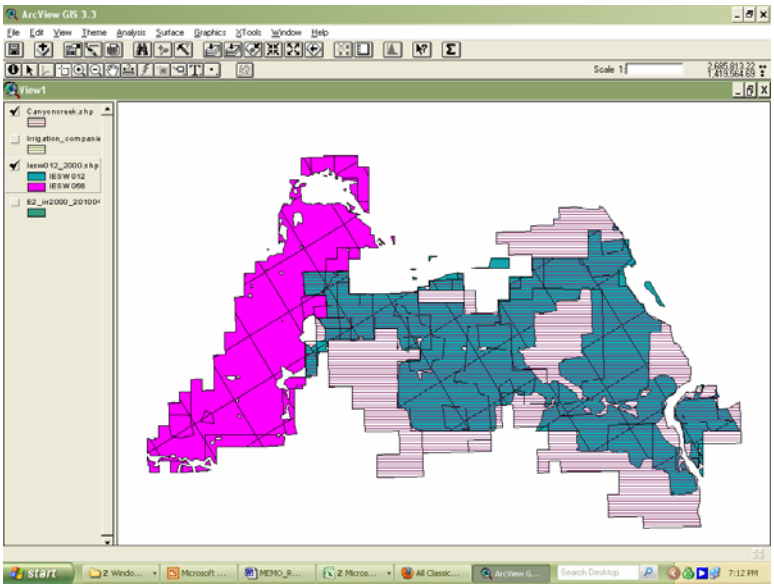

Figure 4: Round 2 adjustment of irrigated lands assignments. Pink lands are IESW056 (Henrys Fork), blue-green lands are IESW012.

IESW014 – Blackfoot Area, east side, irrigated from Snake River

Observations – IESW014

1. Implied canal seepage fraction of 0.08 seems unreasonably low.
2. The odd change in residual fraction from stress period 201 through 285 corresponds exactly to one irrigated-lands data set.

Round 2 Modifications – IESW014

1. We found that an intermediate GIS file had been damaged in processing, so we repeated the processing of the year-2000 irrigated lands data set.
2. We adjusted the groundwater fraction on mixed-source lands to 0.99.
3. Canal seepage is set to 0.15, based on lack of a reasonable explanation for the lower implied value.

IESW015 – Dewey Canal

Observations – IESW015

1. Residual fraction and diversion depths are very large.
2. Implied canal seepage fraction is 0.85, which is very high.

Round 2 Modifications – IESW015

1. We confirmed with Dale Swensen, manager of Fremont-Madison Irrigation District, that this entity is a wildlife refuge and is managed as ponds and wetlands. Swensen indicates that there are no surface returns, and that no surface water from IESW015 supplements any other canal system.
2. The On-Farm algorithm should be adjusted to produce no returns.
3. Canal seepage fraction was set to 0.30, to allow adequate water to be imputed as seepage in the wetlands and ponds, as we believe occurs.

IESW016 – Egin Bench

Observations – IESW016

1. Implied canal seepage of 0.69 seems high, but this is sandy soil with anecdotal indication of high seepage.
2. There is no anecdotal or informal observation of historical deficit irrigation or chronic water shortage.

Round 2 Modifications – IESW016

1. No modifications were made, though slide 37 does indicate we contemplated adjusting groundwater fraction on mixed-source lands.
2. Canal seepage was set to 0.60, which is approximately in line with the implied calculation. It is set somewhat lower than the calculation to possibly prevent inadvertent imputation of deficit irrigation if there is some temporal mismatch in the diversion and ET data.

IESW018 – Falls Irrigation District

Observations – IESW018

1. The implied canal seepage fraction ranges between 0.08 and 0.23. The lower end of this range seems unreasonable.
2. This entity has supplemental wells owned by the District. The year-to-year variability of residual fraction is consistent with operation of supplemental wells.
3. We believe returns are zero.

Round 2 Modifications – IESW018

1. Groundwater fraction on mixed-source lands was set to 0.99, to allow full application of supplemental pumping in dry periods, without inappropriately triggering imputation of deficit irrigation.
2. Canal seepage was set to 0.10, to allow sufficient surface water to supply any surface-only parcels that may exist, in dry periods. In wet periods this may distort spatial distribution of recharge, but it avoids distorting the water budget in dry periods.
3. The On-Farm method should be set to produce zero returns for this entity.

IESW019 – Ft. Hall/Michaud

Observations – IESW019

1. The implied canal seepage fraction of 0.62 seems high.
2. The residual fraction is very stable except for one year when it is unreasonably low.

Round 2 Modifications – IESW019

1. We found and corrected a problem in diversion data. This removes the concern about one very low residual fraction.
2. The groundwater fraction on mixed-source lands was set to 0.05 by the following calculations:
    a. Assume 4 feet field headgate requirement.
    b. (4 ft) x (500 acres) = 2,000 acre feet required for surface-water-only lands.
    c. From worksheet "ESPAM2_DIV_11_10_09_Sumry" of file "CNL_SEEP_CALCS_20100312.xls," average gross diversion volume is about 260,000 acre feet and return-flow volume about 33,000 acre feet per year.
    d. (260,000) x (0.50) = 130,000 acre feet approximate canal seepage volume.
    e. (260,000) – (2,000) – (130,000) – (33,000) = 95,000 acre feet for mixed-source lands.
    f. (95,000) / (4) = 23,750 acres of mixed-source lands that could be supported by typical diversions, with the above assumptions. This is very near the total mixed source acres; therefore groundwater fraction should be set very low.
3. Canal seepage fraction is set to 0.50. This does not seem unreasonable, and is the assumed value used in the mixed-source-lands calculations.

IESW020 – Harrison Canal, Rigby Fan

Observations – IESW020

1. Residual fraction is stable year-to-year, consistent with reliable supplies.
2. Implied canal seepage fraction is 0.38, which seems reasonable.

Round 2 Modifications – IESW020

1. No modifications were made.
2. Canal seepage is set to 0.38.

IESW022 – Idaho Canal

Observations – IESW022

1. Residual fraction is generally stable, but declining over time.
2. Implied canal seepage fraction is 0.23, which seems a little low.

Round 2 Modifications – IESW022

1. Groundwater fraction on mixed-source lands was set to 0.99 by the following calculations:
    a. Assume 4 feet field headgate requirement.
    b. (4 ft) x (50,000 acres) = 200,000 acre feet required for surface-water-only lands.
    c. From worksheet “ESPAM2_DIV_11_10_09_Sumry” of file “CNL_SEEP_CALCS_20100312.xls,” average gross diversion volume is about 385,000 acre feet and return-flow volume about 100,000 acre feet per year.
    d. (385,000) x (0.30) = 115,500 acre feet approximate canal seepage volume.
    e. (385,000) – (200,000) – (100,000) – (115,500) = -30,000 acre feet for mixed-source lands.
    f. This calculation suggests with 30% canal leakage and current return-flow estimates, no water remains for mixed source lands. Therefore groundwater fraction should be set very high.
2. Canal seepage was set to 0.30.

IESW025 – Little Wood near Carey

Observations – IESW025

1. IDWR diversion data for this entity are the same for every year, with a notation that this is an assumed constant rate.
2. Implied canal seepage fraction is 0.54, which seems high.
3. Returns are assumed to be zero.

Round 2 Modifications – IESW025

1. Groundwater fraction on mixed-source lands was set to 0.60 by the following calculations:
    a. Assume 4 feet field headgate requirement.
    b. (4 ft) x (8,000 acres) = 32,000 acre feet required for surface-water-only lands.
    c. From worksheet “ESPAM2_DIV_11_10_09_Sumry” of file “CNL_SEEP_CALCS_20100312.xls,” average gross diversion volume is about 90,000 acre feet and return-flow volume is zero.
    d. (90,000) x (0.40) = 36,000 acre feet approximate canal seepage volume.
    e. (90,000) – (32,000) – (36,000) = 22,000 acre feet for mixed-source lands.
    f. (22,000) / (4) = 5,500 effective acres of mixed-source lands that can be supported.
    g. (5,500)/(9,000) = 0.61 approximate groundwater fraction on mixed-source lands.
2. Canal seepage was set to 0.40.
3. The On-Farm algorithm should be set to produce zero returns.

IESW027 – Milner Irrigation District

Observations – IESW027

1. Residual fraction is stable, suggesting reliable supplies.
2. Implied canal fraction is 0.54, which seems a little high. Sullivan's estimates were 0.18 – 0.20.
3. The mixed-source acreage is large relative to the surface-only acreage.

Round 2 Modifications – IESW027

1. Groundwater fraction on mixed-source lands was set to 0.65 by the following calculations:
    a. Assume 4 feet field headgate requirement.
    b. (4 ft) x (400 acres) = 1,600 acre feet required for surface-water-only lands.
    c. From worksheet "ESPAM2_DIV_11_10_09_Sumry" of file "CNL_SEEP_CALCS_20100312.xls," average gross diversion volume is about 58,000 acre feet and return-flow volume is 2,600 acre feet.
    d. (58,000) x (0.40) = 23,200 acre feet approximate canal seepage volume.
    e. (58,000) – (1,600) – (2,600) – (23,200) = 30,600 acre feet for mixed-source lands.
    f. (30,600) / (4) = 7,650 effective acres of mixed-source lands that can be supported.
    g. (7,650)/(12,000) = 0.64 approximate groundwater fraction on mixed-source lands.
2. Canal seepage was set to 0.40, which is still higher than Sullivan's estimates.

IESW028 – Minidoka Irrigation District

Observations – IESW028

1. Residual fraction shows a declining trend.
2. Implied canal seepage fraction is 0.21, vs. Sullivan estimates of 0.24 to 0.35.
3. Mixed-source acreage is small relative to total acreage.

Round 2 Modifications – IESW028

1. Groundwater fraction on mixed-source lands was set to 0.05 by the following calculations:
    a. Assume 4 feet field headgate requirement.
    b. (4 ft) x (72,000 acres) = 288,000 acre feet required for surface-water-only lands.
    c. From worksheet "ESPAM2_DIV_11_10_09_Sumry" of file "CNL_SEEP_CALCS_20100312.xls," average gross diversion

volume is about 340,000 acre feet and return-flow volume is 15,000 acre feet.
    d. (340,000) x (0.35) = 119,000 acre feet approximate canal seepage volume.
    e. (340,000) – (72,000) – (15,000) – (119,000) = 134,000 acre feet for mixed-source lands.
    f. (134,000) / (4) = 33,500 effective acres of mixed-source lands that can be supported. This exceeds available mixed-source acres; therefore assume groundwater fraction on mixed-source lands is low.
2. Canal seepage was set to 0.35 per Sullivan estimates.

IESW029 – Mud Lake

Observations – IESW029

1. Residual fraction is low and variable.
2. Residual fraction is too low to support canal seepage with assumptions of full ET and 65% in-field consumptive use fraction of applied water.
3. Informal observation indicates no incidence of deficit irrigation.
4. ET reflects ET adjustment factors, but concerns with both cloudy days and the Monteview AGRIMET site cast some doubt on underlying METRIC ET.
5. This area is an ancient lake bed, and canal seepage is expected to be very low.
6. All the remaining gravity-irrigated parcels are border irrigated and irrigator skill in this area is generally very high.
7. Nearly all sprinkler-irrigated parcels are pivot irrigated.

Round 2 Modifications – IESW029

1. Canal seepage is arbitrarily set to 0.05.
2. ET Adjustment Factors are set to 0.82 for both gravity and sprinkler, as follows:
    a. Average diversion volume approximately 80,000 acre feet.
    b. Acreage is approximately 33,000 acres.
    c. (80,000 acre feet) x (0.95) = 76,000 acre feet available for field headgate delivery.
    d. (76,000) / (33,000) = 2.3 feet field headgate delivery.
    e. Because of unique irrigation conditions, consumptive use fraction of field-applied water is expected to be very high. For this calculation an estimate of 0.85 is used.
    f. (2.3) * (0.85) = 1.96 feet of irrigation requirement that may be supported.
    g. Average requirement (tab “IRR_REQ”) is 2.07 feet.
    h. ET Adjustment factors in the pre-Round-2 data were 0.89 (sprinkler) and 0.85 (gravity). Assume average is 0.87.
    i. (2.07) / (0.87) = 2.38 average unadjusted ET.

j. (1.96) / (2.38) = 0.82 new average adjustment factor. Because of well-managed border irrigation on leveled fields, the same factor is applied to sprinkler and gravity lands.

3. This entity has no nominal mixed source lands, so no groundwater fraction on mixed source lands is calculated.
4. The On-Farm algorithm should be set to produce zero returns.

IESW030 – Osgood and New Sweden

Observations – IESW030

1. Residual fraction is somewhat variable and declining over time.
2. There are few mixed-source lands in this entity.
3. The implied canal seepage fraction is 0.21.
4. We have little anecdotal or other information about canal seepage.

Round 2 Modifications – IESW030

1. No modifications were made.
2. Canal seepage was set to 0.21.

IESW031 – Marysville

Please see discussion for IESW000. This entity has been eliminated and these lands incorporated into IESW000.

IESW032 – Northside Canal Company

Observations – IESW032

1. Residual fraction is reasonably stable over time.
2. Implied canal seepage fraction is 0.31, compared to manager reports of approximately 0.30 and Sullivan estimates of 0.35 – 0.53.

Round 2 Modifications – IESW032

1. No modifications were made.
2. Canal seepage was set to 0.31.

IESW034 – People's Canal

Observations – IESW034

1. Residual fraction is stable over time.
2. Implied canal seepage fraction is 0.42. This corresponds well with reports of high seepage rates from neighboring Aberdeen-Springfield Canal Company.

Round 2 Modifications – IESW034

1. No modifications were made.
2. Canal seepage was set to 0.42.

IESW035 – Progressive Irrigation District

Observations – IESW035

1. Residual fraction is fairly stable over time. However it shows an increasing trend, which is different from many entities.
2. Implied canal seepage fraction is 0.31.

Round 2 Modifications – IESW035

1. No modifications were made.
2. Canal seepage was set to 0.31.

IESW036 – Liberty area (Sunnydell Canal, Reid Canal and others)

Observations – IESW036

1. Residual fraction is fairly stable over time.
2. Implied canal seepage fraction is 0.15, which seems low, especially in light of nearby entities.

Round 2 Modifications – IESW036

1. Groundwater fraction on mixed-source lands was set to 0.99 by the following calculations:
    a. Assume 4 feet field headgate requirement.
    b. (4 ft) x (21,000 acres) = 84,000 acre feet required for surface-water-only lands.
    c. From worksheet "ESPAM2_DIV_11_10_09_Sumry" of file "CNL_SEEP_CALCS_20100312.xls," average gross diversion volume is about 200,000 acre feet and return-flow volume is 78,000 acre feet.
    d. (200,000) x (0.30) = 60,000 acre feet approximate canal seepage volume.
    e. (200,000) – (84,000) – (78,000) – (60,000) = -22,000 acre feet for mixed-source lands.
    f. Diversions are inadequate to support any mixed-source lands at the field headgate delivery depth, canal seepage, and return-flow levels. Therefore mixed-source lands must be primarily supplied by groundwater.
2. Canal seepage was set to 0.30.

IESW037 – Reno Ditch

Observations – IESW038

1. The highly variable residual fraction probably reflects reality. There was a major infrastructure change in about 1987 that significantly improved reliability. There were also transfers of out-of-the-basin surface rights into the entity, which increased average supply.

2. There are supplemental wells that were used regularly in the early part of the calibration period.
3. Implied canal seepage (using more recent-year values) is 0.60.
4. There are no return flows in this entity. The irrigated lands are many miles from the water source (Birch Creek) and any runoff that occurs percolates before reaching the creek.

Round 2 Modifications – IESW037

1. Groundwater fraction on mixed-source lands was set to 0.99 by the following calculations:
    a. Assume 4 feet field headgate requirement.
    b. (4 ft) x (3,000 acres) = 12,000 acre feet required for surface-water-only lands.
    c. From worksheet "ESPAM2_DIV_11_10_09_Sumry" of file "CNL_SEEP_CALCS_20100312.xls," average gross diversion volume during the first five years was about 7,700 acre feet.
    d. Early diversion volume is not even adequate to supply field headgate requirements on surface-only lands. This probably reflects reality; it is likely that severe deficit irrigation occurred in early years. The On-Farm method should reflect this by reducing ET.
    e. This also implies that groundwater fraction should be set very high.
2. Canal seepage was set at 0.22 by the following calculation:
    a. Excluding the first ten years, average gross diversion volume is 17,000 acre feet per year.
    b. (17,000 acre feet) / (3,300 SW-only acres) = 5.15 feet.
    c. (5.15 feet) – 4 feet assumed headgate delivery = 1.15 feet canal seepage.
    d. (1.15 / 5.15) = 0.22.
    e. The seepage was set by the last years of the data series to represent more current conditions. This should allow the On-Farm algorithm to apply full ET in recent periods, which is consistent with recent informal observations of no apparent moisture stress on growing crops.
3. The On-Farm algorithm should be set to produce zero returns.

IESW038 – Rexburg

Observations – IESW038

1. Residual fraction is reasonably stable over time.
2. Implied canal seepage fraction is 0.42, consistent with gravely soils and reasonably similar to nearby entities.

Round 2 Modifications – IESW038

1. No modifications were made.
2. Canal seepage was set to 0.42.

IESW039 – Chester, Idaho area (Curr, Silkey and other ditches).

Observations – IESW039

1. Residual fraction is somewhat stable over time.
2. Implied canal seepage fraction is 0.15. This seems low for this area.

Round 2 Modifications – IESW039

1. Mixed-source fraction was set to 0.99 by the following calculations:
    a. Assume 4 feet field headgate requirement.
    b. (4 ft) x (1,600 acres) = 6,400 acre feet required for surface-only acres.
    c. From worksheet "ESPAM2_DIV_11_10_09_Sumry" of file "CNL_SEEP_CALCS_20100312.xls," average gross diversion volume is about 18,500 acre feet and returns are 7,000 acre feet.
    d. (18,500) x (0.30) = 5,550 acre feet canal seepage.
    e. (18,500) – (6,400) – (7,000) – (5,550) = -400 acre feet for mixed source lands.
    f. Since supply is inadequate to serve mixed-source lands, we presume mixed-source lands are predominantly irrigated by supplemental groundwater and the groundwater fraction should be set very high.
2. Canal seepage was set to 0.30 to better correspond to expectations, nearby entities, and the mixed-source calculations.

IESW040 – Oakley Fan

Observations – IESW040

1. Residual fractions are variable. This corresponds to a hypothesis of chronic supply problems and active use of supplemental groundwater, as with IESW005 and IESW008.
2. Implied canal-seepage fraction ranges from 0.08 in water-short years to 0.42 in wet years.
3. Some surface-water deliveries in this entity may be piped.
4. We believe there are no surface-water returns in this entity.

Round 2 Modifications – IESW040

1. Groundwater fraction on mixed-source lands was set to 0.99 to allow full use of supplemental groundwater before invoking reduction of ET by the On-Farm algorithm.
2. Canal seepage was set to 0.34 by the following calculations:
    a. We assume that in most years, supplies are adequate for at least the surface-water-only acres. Were it not so, acres would have left production or supplemental groundwater would have been developed.

b. From inspection of the residual fraction time series in slide 73, we select the 1992 (the 12th year) as a "low" year that is not the lowest. We assume full use of supplemental groundwater but no deficit conditions on surface-water-only acres.
c. Surface-only acreage in 1992 was 2,900 acres.
d. Field headgate requirement was (2,900) x (4) = 11,600 acre feet.
e. Diversions in 1992 were 17,500 acres feet.
f. Canal seepage = (17,500) – (11,600) = 5,900 acre feet.
g. Seepage fraction = (5,900/17,500) = 0.34

3. The On-Farm method should be set to calculate zero returns for this entity.

IESW041 – Twin Falls Canal Company

Please see IESW000. IESW041 was dissolved and its lands incorporated into IESW000.

Note that leakage from the small part of the Twin Falls Canal that is within the model has been applied in the Perched Seepage data set.

IESW044 – Monteview Canal Company, Jefferson Irrigation District and Producers Canal Company

Observation – IESW044

1. This is a groundwater-only entity, but all groundwater is pumped in offsite wells and delivered to the service areas via canals. READINP (and presumably MKMOD) require representation as a surface-water entity to accommodate offsite pumping and canal seepage.
2. Offsite pumping was initially estimated from approximations of ET.
3. Residual fractions were constructed using Offsite Pumping in place of gross diversions.
4. Residual fractions are reasonably steady, but too low to accommodate canal seepage.
5. The last few values of offsite pumping data are missing.
6. This area is affected by the same ET considerations as IESW029. It also has very similar soil types and irrigation practices and management.
7. Informal observation suggests that moisture stress and deficit irrigation do not typically occur in this entity.
8. There are no returns to surface water from this entity.

Round 2 Modifications – IESW044

1. For consistency, ET adjustment factors were set to 0.82, to correspond to adjacent entity IESW029.
2. Canal seepage was set to 0.20. While the parts of the canal system within the irrigated lands are analogous to IESW029 canals and are expected to

have low seepage, parts of the canals cross basalt lands between the wells and the canal service area.

3. Revised offsite pumping volume is 105,000 acre feet per year:
    a. Field headgate delivery is assumed to be 4 feet. This should provide adequate depth to avoid invocation of deficit irrigation and ET reduction by the On-Farm algorithm. (4 feet) x (21,000 acres) = 84,000 acre feet.
    b. Since canal seepage fraction is 0.20, field headgate delivery fraction is 0.80 and pumping volume is (84,000/0.80) = 105,000 acre feet.
    c. Based on the upper left figure in slide 77, the existing assignment of pumping to months is modified slightly to increase April and October pumping, but to retain the typical pattern of residual fraction seen in other entities.
    d. Note that as long as the deficit-irrigation adjustment is not invoked by the On-Farm algorithm, net impact on the aquifer will be represented by ET data set. The offsite pumping and canal seepage will simply refine spatial distribution of pumping and return of pumping via canal seepage and in-field percolation.
4. The On-Farm method should be set to produce zero returns.

IESW051 – Dubois area (Camas Creek above Mud Lake)

Observations - IESW051

1. This entity is mostly small parcels near streams, with short ditches. Water rights are junior to the US Fish and Wildlife Service refuge at Camas. Variable supplies and chronic water shortages are common.
2. The few supplemental wells that exist are likely used as true supplemental wells.
3. The highly variable residual fractions in slide 79 are consistent with these observations.
4. We believe there are minimal returns in this entity.

Round 2 Modifications – IESW051

1. Groundwater fraction on mixed-source lands is set to 0.99 to allow full use of supplemental groundwater.
2. The On-Farm algorithm should be set to produce zero returns.
3. No canal seepage fraction is supplied.

IESW052 – Small, Idaho area (Medicine Lodge Creek)

Observations – IESW052

1. This is a small stream with no storage.
2. There are no returns to surface water.
3. No canals are represented; all parcels are near the stream.
4. The residual fraction is highly variable over time.

Round 2 Modifications – IESW052

1. Groundwater fraction on mixed-source lands is set to 0.99 to allow full use of supplemental groundwater.
2. The On-Farm algorithm should be set to produce zero returns.
3. No canal seepage fraction is supplied.

IESW053 – Private Rights (i.e. not Blaine County Canal Company) in the Little Lost River basin

Observations – IESW053

1. See IESW008 for discussion of discrepancies in irrigated lands maps.
2. This entity comprises the senior and more reliable rights in the basin.
3. The residual fraction is stable over time.
4. Canals are small and hosted in gravelly soil.
5. There are no returns to the river.

Round 2 Modifications – IESW053

1. See IESW008 for changes in entity boundaries.
2. Canal seepage fraction was set to 0.30.
3. No changes were made to mixed-source lands.
4. The On-Farm algorithm should be set to produce zero returns for this entity.

IESW055 – Labelle, Idaho area (Rigby Fan)

Observations – IESW055

1. Residual fraction is stable over time.
2. Implied canal seepage fraction is 0.31.

Round 2 Modifications – IESW055

1. No modifications were made.
2. Canal seepage fraction was set to 0.31.

IESW056 – Sugar City, Idaho area (Henrys Fork, east side)

Observations – IESW056

1. See IESW012 for discussion of discrepancies in irrigated lands maps.
2. Residual fraction is stable over time.
3. Implied canal seepage fraction is 0.69.

Round 2 Modifications – IESW056

1. See IESW012 for changes in entity boundaries.
2. Corresponding to the change in boundaries, we moved diversion file 130484.75a (Enterprise Canal) from IESW012 to IESW056.

3. Canal seepage fraction was set to 0.60, corresponding to nearby entity IESW016.

IESW057 – Blackfoot- Chubbuck

Observations – IESW057
1. Residual fraction is reasonably stable over time.
2. Implied canal seepage fraction is 0.37.

Round 2 Modifications – IESW057
1. No modifications were made.
2. Canal seepage was set to 0.37.

IESW058 – AFRD#2 above Wood Rivers

Observations – IESW058
1. The canal seepage calculated for this entity needs to represent the seepage associated both with its own diversions and with seepage associated with water delivered to IESW059, below the entity.
2. The residual fraction was stable and large.
3. Implied canal seepage fraction is 0.77. Note that IESW059 implied seepage fraction is 0.42.
4. For the Milner Gooding Canal, including both IESW058 and IESW059 flows, Sullivan's estimate was 0.48. U of I extension specialist Christi Falen provide seepage-study data indicating 0.69.
5. Diversions were determined by differencing upstream and downstream gages in the canal; therefore the reported value is the net of any returns that may occur.

Round 2 Modifications.
1. No modifications were made.
2. Canal seepage fraction was set to 0.77.
3. The On-Farm method should be set to produce zero returns.

IESW059 – Gooding and Richfield (AFRD#2 below IESW058 and Wood Rivers below Carey)

Observations
1. Due to difficulty in correctly identifying returns data, diversions in this entity are estimated in the same way as IESW005; the surface-water balance from upstream inflows and downstream outflows gives a net disappearance of water from the reach. Part of this is assigned to Perched River Seepage and the rest is applied as net diversions.
2. The residual fraction shows some variability. The dips are probably real representations of reduced diversions in dry years.
3. The implied canal-seepage fraction is 0.42.

Round 2 Modifications

1. To allow full use of supplemental groundwater in dry years, the groundwater fraction on mixed source lands was set to 0.99.
2. Canal seepage was set to 0.42.
3. The On-Farm algorithm should be adjusted to produce zero returns for this entity, since the diversions in the data are net diversions.