Estimation of Non-Federal Reservoir Evaporation

Basic Input Files:

  2005_resevoirs_final.shp   (*digitized reservoir surface acres*)
  fed_lakes.shp (*Five Federal lakes in the basin*)
  nfr_evap.shp   (*A total of 643 non-federal reservoirs in the NE portion of the basin*)
  Repub_AboveHarlan.shp (*Republican River basin above Harlan County Lake*)
  union_blw_gage_subs.shp (*Sub-basins*)

Methodology:

For a total of 643 non-federal reservoirs inventoried in the Republican River Basin within Nebraska, each reservoir has attributes of decimal longitude and latitude, storage and surface area at spillway elevation, and the digitized area, and etc.

A shapefile of five federal reservoirs with evaporation measurements was created. The nearest one of the federal reservoirs in Republican River basin to those 643 non-federal reservoirs was determined. The net evaporation rate [in inches] of the nearest federal reservoir was assigned to those corresponding non-federal reservoirs.

Evaporation loss [in acre-feet] of each non-federal reservoir was computed as a product of its presumed surface area or digitized area and net evaporation rate of the nearest federal lake. GIS analyses were used to locate each non-federal reservoir to its corresponding RRCA sub-basin.

Finally, the calculated non-federal reservoirs' evaporations were summarized by sub-basin.

Computation Steps:

1. In ArcMap, update the net evaporation rates for 5 federal reservoirs (see **Fed_ResNetEvap05.xls**) by editing **fed_lakes.shp** file; If necessary, update **nfr_evap.shp** file if there are new non-federal reservoirs are identified.

2. In ArcCatalog, export following two shapefiles into coverages:
   fed_lakes.shp → fed_lakes_cov
   nfr_evap.shp → nfr_evap_cov

   Tips: if there are errors in converting a shapefile to coverage, load it into an ArcMap project first, and then re-export it. This would make the shapefile ArcGIS friendly.

3. In ArcToolbox, select Coverage Tools → Analysis → Proximity → Near

    Input Coverage = nfr_evap_cov
    Near Coverage = fed_lakes_cov
    Output Coverage = NFR_nrLake
    Feature Type = POINT
    Search Radius = 3000000 ft   (*Just set large enough to find a nearby lake*)

4. Start an ArcMap Project, add following files into it:

    nfr_nrlake point <coverage>
    fed_lakes.shp
    2005_resevoirs_final.shp)   2005_nfr-final . shp
    Repub_AboveHarlan.shp
    union_blw_gage_subs.shp

5. In ArcMap, right click on **nfr_nrlake** and select Joins and Relates → Join
    (*Join federal lake's net evaporation rate into the table*)

    What do you want to join to this layer? Join attributes from a table.
    Table to join is **fed_lakes**; the fields based on are FED_LAKES_COV# and
    FED_LAKES1.

6. Right click on **nfr_nrlake** again and select Joins and Relates → Join
    (*Join the current year's digitized reservoir surface areas*)

    What do you want to join to this layer? Join attributes from a table.
    Table to join is 2005_reservoirs_final; the fields based on are point:Evap_ID and
    EVAP_ID. *Also click on the "Advanced" button and check the "Keep only
    matching records" option.*

7. Select only those reservoirs within the basin above Harlan County Lake by
    Location. Selection → Select By Location. Right click on nfr_nrLake, Selection
    → Create layer from the selected features. , Export it to nfr_AbvHrlan

8. In ArcToolbox, select Analysis Tools → Overlay → Identity

    Input Feature = nfr_AbvHarlan (nfr_nrLake)
    Identity Feature = union-blw_gage_subs
    Output Feature = **NFR_Sub.shp**

9. In ArcMap, add **NFR_.shp.**
    Save the ArcMap document (Near_Join2_Identity.mxd)!!!

10. Rename previous year's NFR_evap.mdb as NFR_evap2004.mdb. Import the *NFR_sub.dbf* into the database.

11. Use *qry1ForMeaningfulFields* to query out those meaningful data fields in NFR_sub table. (*Becareful in selecting the right fields*!!!)

12. Use *qry2DetermineArea* to assign presumed surface area for each non-federal reservoir.

    If a reservoir's normal storage is greater than 200 AF, use its surface acre at normal level;

    For a reservoir with a storage capacity less than 200 AF, ~~the presumptive average annual surface area equals to 25% of its surface area at the principal spillway elevation. If the area at principal spillway is not available,~~ the digitized acre is used.

13. Use *qry3CalculateEvap* to calculate each reservoir's evaporation as a product of the determined reservoir area and the net evaporation rate at the nearest federal reservoir.

14. Finally, use *qry4NFR_evap_bysubbasin* to summarize total non-federal reservoir evaporation for each sub-basin. Export the query results into an Excel file.

All files are located in C:\RRCA2006\NFR2 directory on PC29007.

Estimates of Non-federal Reservoirs Net Evaporation in 2004
(Whole Republican River Basin in Nebraska)
[acre-feet]

Sub Basin Name	Net Evaporation
Beaver Creek	23.44
Buffalo Creek	21.69
Driftwood Creek	8.21
Frenchman Creek	244.05
Lower Republican River	57.11
Mainstem Rep Riv & N F abv Guide Rock	2331.19
Mainstem Republican River blw Guide Rocl	339.87
Medicine Creek above Gage	233.16
Medicine Creek below Gage	3.56
Prairie Dog Creek	17.36
Red Willow Creek	155.39
Rock Creek	64.03
Sappa Creek above Gage	22.31
Sappa Creek below Gage	7.30
Total	**3528.67**

Estimates of Non-federal Reservoirs Net Evaporation in 2004
(Republican River Basin Above Harlan Co. Lake in Nebraska)
[acre-feet]

Sub Basin Name	Net Evaporation
Beaver Creek	23.44
Buffalo Creek	21.69
Driftwood Creek	8.21
Frenchman Creek	244.05
Mainstem Rep Riv & N F abv Guide Rock	1165.93
Medicine Creek above Gage	233.16
Medicine Creek below Gage	3.56
Prairie Dog Creek	17.36
Red Willow Creek	155.39
Rock Creek	64.03
Sappa Creek above Gage	22.31
Sappa Creek below Gage	7.30
Total	**1966.44**

Estimates of Non-federal Reservoirs Net Evaporation in 2005
[acre-feet]

Sub Basin Name	Net Evaporation
Beaver Creek	58.54
Buffalo Creek	20.98
Driftwood Creek	1.75
Frenchman Creek	390.57
Mainstem Rep Riv & N F abv Guide Rocl	1494.20
Medicine Creek above Gage	309.94
Medicine Creek below Gage	7.15
Prairie Dog Creek	21.20
Red Willow Creek	202.70
Rock Creek	81.59
Sappa Creek above Gage	42.80
Sappa Creek below Gage	5.20
Total	**2636.61**

Estimates of Non-federal Reservoirs Net Evaporation in 2005
[acre-feet]

Sub Basin Name	Net Evaporation
Beaver Creek	58.54
Buffalo Creek	20.98
Driftwood Creek	1.75
Frenchman Creek	390.57
Lower Republican River	24.52
Mainstem Rep Riv & N F abv Guide Rock	2450.02
Mainstem Republican River blw Guide Rocl	136.86
Medicine Creek above Gage	309.94
Medicine Creek below Gage	7.15
Prairie Dog Creek	21.20
Red Willow Creek	202.70
Rock Creek	81.59
Sappa Creek above Gage	42.80
Sappa Creek below Gage	5.20
Total	**3753.82**