Table H1b1-1. SacWAM Inputs to the Sacramento River HEC-5Q Water Temperature Model

Description	HEC-5Q Record Type; A, B, and C Parts of the DSS Path Name and Controls [a]	SacWAM Link Identification: Added to the DSS Record	SacWAM Link Identification: Subtracted from the DSS Record
Trinity Lake daily storage	ZR SS340 A=Trinity B=TRINITY C=Stor-Res-fit [b]	+trinity_reservoir_storage	
Whiskeytown Lake daily storage	ZR SS240 A=Clear CR B=WHISKEYTOWN C=Stor-Res-fit	+Whiskeytown_Reservoir_Storage	
Shasta Lake daily storage	ZR SS220 A=Sacramento B=Shasta C=Stor-Res-fit	+Shasta_Lake_Storage	
Trinity Dam outflow	ZR QA340 A=Trinity B=TRINITY C=flow-out	+Trinity_Reservoir	
Whiskeytown Dam outflow	ZR QA240 A=Clear CR B=WHISKEYTOWN C=flow-out	+Whiskeytown_Reservoir QMIN 1 [c]	
Shasta Dam outflow	ZR QA220 A=Sacramento B=SHASTA C=flow-out	+Shasta_Lake	
Trinity Lake inflow patterned after historical record	ZR IN340 A=Trinity B=TRINITY C=flow-in-pat	+I_TRNTY_Inflow	
Trinity Lake daily inflow based on historical record [d]	A=Trinity B=Trinity C=flow-in E=1DAY F=Historical_based		
Lewiston Reservoir inflow	ZR IN330 A=Trinity B=LEWISTON C=flow-in	+I_LWSTN_Inflow	-Trinity_Reservoir
Clear Creek above Whiskeytown (excluding Clear Creek Tunnel)	ZR IN240 A=Clear Cr B=WHISKEYTOWN C=flow-in-pat	+Clear_Creek_above_Clear_Creek_Tunnel_Inf	
Trinity Lake inflow patterned after historical record	A=Trinity B=Trinity C=flow-in E=1DAY F=Historical_based		
Shasta Lake inflow patterned after historical record	ZR IN220 A=Sacramento B=SHASTA C=flow-in-pat	+I_SHSTA_Inflow	

Description	HEC-5Q Record Type; A, B, and C Parts of the DSS Path Name and Controls [a]	SacWAM Link Identification: Added to the DSS Record	SacWAM Link Identification: Subtracted from the DSS Record
Shasta Lake daily inflow based on historical record [d]	A=Sacramento B=Shasta C=flow-in E=1DAY F=Historical_based		
SacWAM runoff allocated above Keswick Lake	ZR IN210 A=Sacramento B=RunoffAbvKeswick C=flow-in	+runoff_infiltration_from_a_02_na_to_sacramento_river	
South Fork Clear Creek inflow at Igo - mile 9.4	ZR IN180 A=Sacramento B=Clear Creek C=FLOW-IN >0	+clear_creek_inflow_to_sacramento_river	-Whiskeytown_Reservoir
Sacramento inflows - Churn and Cow Creeks (miles 284.5 & 280.1)	ZR IN178 A=Sacramento B=Cow Cr C=flow-in >0	+cow_creek_inflow_to_sacramento_rm_277	-clear_creek_inflow_to_sacramento_river -keswick_reservoir
Sacramento inflows - Bear and Anderson Creeks (miles 277.3 & 273.5)	ZR IN174 A=Sacramento B=Cottonwood Cr C=flow-in >0	+Cottonwood_Creek_Inflow_to_Sacramento_RM_271	-cow_creek_inflow_to_sacramento_rm_277
Sacramento inflows - Battle Creek (mile 271.3)	ZR IN172 A=Sacramento B=Battle Cr C=flow-in >0	+battle_creek_inflow_to_sacramento_rm_269	-Cottonwood_Creek_Inflow_to_Sacramento_RM_271
Sacramento inflows - Inks Creek (mile 260.5)	ZR IN170 A=Sacramento B=Bend Bridge C=flow-In >0	+swrcb_sac_abv_bend_bridge	-battle_creek_inflow_to_sacramento_rm_269
Sacramento inflows - Paynes Creek (mile 253.3)	ZR IN160 A=Sacramento B=Red Bluff C=flow-in >0	+Sacramento_River_70	-swrcb_sac_abv_bend_bridge
Sacramento inflows - Antelope, Elder, Mill, Thomes, Deer, and Jewett Creeks, (miles 234.3, 230.4, 230.2, 226.0, 219.6, & 218.3)	ZR IN150 A=Sacramento B=below Red Bluff C=flow-in >0	+deer_creek_inflow_to_sacramento_rm_218	-tehama_colusa_outflow_from_sacramento_rm_240
Sacramento River accretions (miles 214–206)	ZR IN140 A=Sacramento B=Glenn Colusa C=flow-in >0	+glenn_colusa_canal_outflow_from_sacramento_rm_207	-deer_creek_inflow_to_sacramento_rm_218
Sacramento inflows – Pine, Big Chico, and Stoney Creek (miles 196, 191.5, & 190.5)	ZR IN1132 A=Sacramento B=Stony Creek C=FLOW-in >0	+swrcb_sac_at_ord_ferry	-glenn_colusa_canal_outflow_from_sacramento_rm_207

Description	HEC-5Q Record Type; A, B, and C Parts of the DSS Path Name and Controls [a]	SacWAM Link Identification: Added to the DSS Record	SacWAM Link Identification: Subtracted from the DSS Record
Sacramento River accretions (miles 184–169)	ZR IN130 A=Sacramento B=Butte City C=flow-in >0	+swrcb_sac_at_butte_city	-swrcb_sac_at_ord_ferry
Sacramento River accretions (miles 159–146)	ZR IN120 A=Sacramento B=Colusa weir C=flow-in >0	+Colusa_weir	-sacramento_river_rm_159
Sacramento River accretions (miles 146–121)	ZR IN118 A=Sacramento B=abv Tisdale weir C=flow-in >0	+Tisdale_weir	-colusa_weir
Sacramento River accretions (miles 119–86)	ZR IN114 A=Sacramento B=Knights Landing C=flow-in >0	+swrcb_sac_at_knights_landing	-Tisdale_weir
Trinity Lake evaporation	ZR QD340 A=Trinity B=TRINITY C=flow-div	+Trinity_Reservoir_Evap	
Trinity Lake evaporation (ZR EV340 control requirement)	ZR EV340 A=Trinity B=TRINITY C=flow-evap	+Trinity_Reservoir_Evap	
Trinity system, Clear Creek Tunnel withdrawal	ZR QD320 A=Trinity B=LEWISTON C=flow-div	+Clear_Creek_Tunnel_0 ADD QMIN[c]	
Total Whiskeytown Lake withdrawal including evaporation [e]	ZR QD240 A=Clear CR B=WHISKEYTOWN1 C=flow-div	+spring_creek_conduit_0 +Transmission_Link_from_Clear_Creek_WTP_to_A_02_PA +Transmission_Link_from_Clear_Creek_WTP_to_U_02_PU +Transmission_Link_from_Whiskeytown_Reservoir_to_U_02_PU +Transmission_Link_from_Whiskeytown_Reservoir_to_U_03_PU +Whiskeytown_Reservoir_Evap	
Component of Whiskeytown withdrawal not delivered to Keswick Lake	ZR QD212 A=Clear CR B=Spring CR PH C=flow-div	+Transmission_Link_from_Clear_Creek_WTP_to_A_02_PA +Transmission_Link_from_Clear_Creek_WTP_to_U_02_PU +Transmission_Link_from_Whiskeytown_Reservoir_to_U_02_PU +Transmission_Link_from_Whiskeytown_Reservoir_to_U_03_PU	

Description	HEC-5Q Record Type; A, B, and C Parts of the DSS Path Name and Controls [a]	SacWAM Link Identification: Added to the DSS Record	SacWAM Link Identification: Subtracted from the DSS Record
		+Whiskeytown_Reservoir_Evap	
Whiskeytown Lake evaporation	ZR EV240 A=Clear CR B=WHISKEYTOWN C=flow-evap	+Whiskeytown_Reservoir_Evap	
Shasta Lake diversion including evaporation	ZR QD220 A=Sacramento B=Shasta C=flow-div	+Transmission_Link_from_Shasta_Lake_to_U_03_PU +Shasta_Lake_Evap	
Shasta Lake evaporation	ZR EV220 A=Sacramento B=Shasta C=flow-evap	+Shasta_Lake_Evap	
Keswick Lake evaporation	ZR QD200 A=Sacramento B=Keswick C=flow-div	+Keswick_Reservoir_Evap	
Sacramento ACID diversion (mile 298.5)	ZR QD180 A=Sacramento B=Clear Creek C=FLOW-Div >0	+Whiskeytown_Reservoir +keswick_reservoir	-clear_creek_inflow_to_sacramento_river
Sacramento River depletions (miles 289–280)	ZR QD178 A=Sacramento B=Cow Cr C=flow-div >0	+clear_creek_inflow_to_sacramento_river	-cow_creek_inflow_to_sacramento_rm_277
Sacramento River depletions (miles 280–273)	ZR QD174 A=Sacramento B=Cottonwood Cr C=flow-div >0	+cow_creek_inflow_to_sacramento_rm_277	-Cottonwood_Creek_Inflow_to_Sacramento_RM_271
Sacramento River depletions (miles 271–260)	ZR QD170 A=Sacramento B=Bend Bridge C=flow-div >0	+battle_creek_inflow_to_sacramento_rm_269	-swrcb_sac_abv_bend_bridge
Sacramento River depletions (miles 260–243)	ZR QD160 A=Sacramento B=Red Bluff C=flow-div >0	+swrcb_sac_abv_bend_bridge	-Sacramento_River_70
Sacramento River Diversion - Tehama Colusa Canal (mile 242.5)	ZR QD158 A=Sacramento B=Tehama Colusa Canal C=flow-div >0	+tehama_colusa_canal_0	
Sacramento River depletions plus Glen Colusa Canal withdrawal (mile 206.3)	ZR QD140 A=Sacramento B=Glenn Colusa C=flow-div >0	+deer_creek_inflow_to_sacramento_rm_218	-glenn_colusa_canal_outflow_from_sacramento_rm_207
Sacramento River depletions including Ord Ferry spills (mile 188.5)	ZR QD132 A=Sacramento B=Ord Ferry C=FLOW-div >0	-swrcb_sac_at_ord_ferry	+glenn_colusa_canal_outflow_from_sacramento_rm_207

Description	HEC-5Q Record Type; A, B, and C Parts of the DSS Path Name and Controls [a]	SacWAM Link Identification: Added to the DSS Record	SacWAM Link Identification: Subtracted from the DSS Record
Sacramento River depletions (mile 184 - 169)	ZR QD130 A=Sacramento B=Butte City C=flow-div >0	+swrcb_sac_at_ord_ferry	-swrcb_sac_at_butte_city
Sacramento River depletions including Moulton Weir spills (mile 159.5)	ZR QD126 A=Sacramento B=Moulton weir C=flow-div >0	+swrcb_sac_at_butte_city	-sacramento_river_rm_159
Sacramento River depletions including Colusa Weir spills (mile 146.5)	ZR QD120 A=Sacramento B=Colusa weir C=flow-Div >0	+sacramento_river_rm_159	-colusa_weir
Sacramento River depletions including Tisdale Weir spills (mile 119.5)	ZR QD116 A=Sacramento B=Tisdale weir C=flow-div >0	+Colusa_weir	-Tisdale_weir
Sacramento River depletions (miles 119–86)	ZR QD114 A=Sacramento B=Knights Landing C=flow-div >0	+Tisdale_weir	-swrcb_sac_at_knights_landing

ACID = Anderson-Cottonwood Irrigation District

DSS = U.S. Army Corps of Engineers' Hydrologic Engineering Center Data Storage System

Smaller reservoirs have constant specified starting storage values that are not listed in this table.

">0" restricts input to positive values.

[a] Record types: "ZR" followed by the control point number a record ID recognized by HEC5Q; "SS" Reservoir starting storage in ACFT; "QA" flow ;"IN" inflow; "QD" diversion: "EV" evaporation in cubic feet per second.

[b] The complete path name would be "A=Trinity B=TRINITY C=Stor-Res-fit D=1DAY F=user specified (e.g., "F=S.base"). "Stor-Res-fit" specifies a cubic spline curve fit of the end-of-month storage volume – allows for storage set automatically on any initial starting date.

[c] QMIN 1" species a minimum flow rate of 1 cubic foot per second. Any flow imbalance is corrected by "ADD QMIN."

[d] Path name containing inflows based on historical data for scaling the monthly inflows to daily inflows (required following "C=flow-in-pat").

[e] HEC5 restricts reservoir diversions to a single value. Therefore, all diversions are allocated to the Spring Creek Tunnel (ZR QD240). Since the diversion links and evaporation cannot flow to Keswick Lake, "QD 212" removes that flow component at the Spring Creek Power Plant.

Table H1b1-2. SacWAM Inputs to the Feather-American River HEC-5Q Water Temperature Model

Description	HEC-5Q Record Type; A, B, and C Parts of the DSS Path Name and Controls [a]	SacWAM Link Identification: Added to the DSS Record	SacWAM Link Identification: Subtracted from the DSS Record
Lake Oroville - reservoir storage	ZR SS490 A=Feather B=Oroville C=Stor-Res-fit [b]	+oroville_reservoir_storage	
Folsom Lake - reservoir storage	ZR SS590 A=AMERICAN B=FOLSOM C=STOR-RES-fit	+folsom_lake_storage	
Lake Oroville - reservoir inflow	ZR IN490 A=Feather B=Oroville c=flow-in-pat	+swrcb_oroville_inflow	
Lake Oroville - daily inflow based on flow records (for scaling monthly inflow) [c]	A=Feather B=Oroville C=flow-in E=1DAY F=Historical_based		
Oroville Dam - reservoir outflow	ZR QA490 A=Feather B=Oroville C=flow-out	+oroville_reservoir	
Lake Oroville - reservoir diversion including evaporation	ZR QD490 A=Feather B=Oroville c=flow-div	+oroville_reservoir_evap +palermo_canal_0	
Lake Oroville - evaporation	ZR EV490 A=Feather B=Oroville c=flow-evap	+oroville_reservoir_evap	
Kelly Ridge power inflow below Oroville Dam	ZR IN482 A=Feather B=Kelly Ridge C=flow-in	+ops_kelly_ridge_powerhouse	
Diversion Dam diversion to the Thermalito Forebay	ZR QD480 A=Feather B=Diversion Dam C=flow-div	+power_canal_0	
Thermalito Afterbay net diversion including evaporation	ZR QD450 A=Feather B=Thermalito C=flow-div	+power_canal_0	-thermalito_afterbay
Thermalito Afterbay evaporation	ZR EV450 A=Feather B=Thermalito C=flow-evap	+Thermalito_afterbay_evap	
Feather River - depletion between Yuba City and Wheatland (miles 29.4–12.4)	ZR QD415 A=Feather B=Weatland C=flow-div >0	+yuba_river_inflow_to_feather_rm_028	-bear_river_inflow_to_feather_rm_012
Feather River - depletion between Wheatland and Nicolaus (miles 12.4 –8.8)	ZR QD410 A=Feather B=Nicolaus C=flow-div >0	+bear_river_inflow_to_feather_rm_012	-swrcb_feather_river

Description	HEC-5Q Record Type; A, B, and C Parts of the DSS Path Name and Controls [a]	SacWAM Link Identification: Added to the DSS Record	SacWAM Link Identification: Subtracted from the DSS Record
Feather River low flow channel - net accretions (miles 66.7–59.7)	ZR IN442 A=Feather B=blw Diversion Dam C=flow-net	+power_canal_0 +power_canal_inflow	-oroville_reservoir -ops_kelly_ridge_powerhouse -thermalito_afterbay
Feather River at Live Oak, mile 44.8 (3.7 miles below Honcut Creek)	ZR IN425 A=Feather B=Live Oak C=flow-IN >0	+honcut_creek_inflow	-power_canal_inflow
Feather River at Yuba City, mile 29.4 (1.9 miles below the Yuba River)	ZR IN420 A=Feather B=Yuba City C=flow-in >0	+yuba_river_inflow_to_feather_rm_028	-honcut_creek_inflow
Feather River at Wheatland, mile 12.4 (1.4 miles below the Bear River)	ZR IN415 A=Feather B=Weatland C=flow-in >0	+bear_river_inflow_to_feather_rm_012	-yuba_river_inflow_to_feather_rm_028
Feather River at Nicolaus - net accretions (miles 12.1–8.8)	ZR IN410 A=Feather B=Nicolaus C=flow-in >0	+swrcb_feather_river	-bear_river_inflow_to_feather_rm_012
Sacramento River below Knights Landing (mile 81)	ZR IN106 A=Sacramento B=Knights Landing C=flow-IN	+swrcb_sac_at_knights_landing	
Sacramento River at Verona - balancing inflow (mile 78.5)	ZR IN98 A=Sacramento B=Verona C=flow-in	+swrcb_sac_at_verona	-swrcb_feather_river -swrcb_sac_at_knights_landing
Folsom Lake inflow	ZR IN590 A=AMERICAN B=FOLSOM C=FLOW-IN	+swrcb_folsom_inflow	
Folsom Dam release	ZR QA590 A=AMERICAN B=FOLSOM C=FLOW-OUT	+folsom_lake	
Folsom Lake diversion including evaporation	ZR QD590 A=AMERICAN B=FOLSOM C=FLOW-DIV	+folsom_lake_evap +folsom_reservoir_diversions	
Folsom Lake evaporation	ZR EV590 A=AMERICAN B=FOLSOM C=FLOW-EVAP	+folsom_lake_evap	
Lake Natoma diversion including evaporation	ZR QD582 A=AMERICAN B=abv NATOMA C=FLOW-div	+folsom_lake	-lake_natoma -lake_natoma_evap
Lake Natoma evaporation	ZR QD580 A=AMERICAN B=NATOMA C=FLOW-DIV	+lake_natoma_evap	

Description	HEC-5Q Record Type; A, B, and C Parts of the DSS Path Name and Controls [a]	SacWAM Link Identification: Added to the DSS Record	SacWAM Link Identification: Subtracted from the DSS Record
American River - net diversion (Sacramento City diversion, mile 7)	ZR QD570 A=AMERICAN B=FAIRBAIRN C=FLOW-DIV >0	+lake_natoma	-swrcb_american_river
American River accretions below Lake Natoma	ZR IN560 A=AMERICAN B=Discovery Park C=FLOW-in >0	+swrcb_american_river	-lake_natoma

DSS = U.S. Army Corps of Engineers' Hydrologic Engineering Center Data Storage System

Smaller reservoirs have constant specified starting storage values that are not listed in this table.

">0" restricts input to positive values.

[a] Record types: "ZR" followed by the control point number a record ID recognized by HEC5Q; "SS" Reservoir starting storage in ACFT; "QA" flow ;"IN" inflow; "QD" diversion: "EV" evaporation in cubic feet per second.

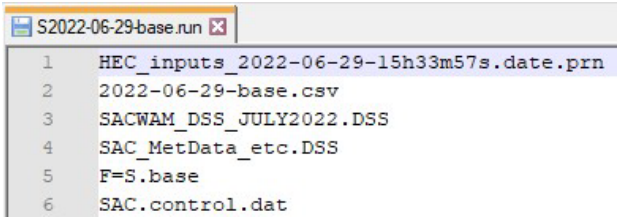
[b] The complete path name would be "A=Feather B=Oroville C=Stor-Res-fit D=1DAY F=user specified (e.g., "F=F.base"). "Stor-Res-fit" specifies a cubic spline curve fit of the end-of-month storage volume – allows for storage set automatically on any initial starting date.

[c] Path name containing inflows based on historical data for scaling the monthly inflows to daily inflows (required following "C=flow-in-pat").

H1b1.1 PowerPoint Slides Describing SacWAM to HEC-5Q Tool

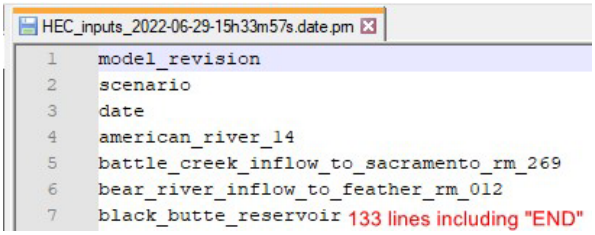
SacWAM to HEC5Q Utility Inputs (1)

Batch run / control file e.g., *S2022-06-29-base.run*
File assignments and controls: (Note that none of the inputs are case sensitive)



Line 1 HEC_inputs_2022 -06-29-15h33m57s.date.prn…. First line of the *.csv SacWAM output file looks like:

After the first line has been copied, transposed and saved as a *.prn file, the resulting file will look like:



SacWAM to HEC5Q Utility Inputs (1 - continued)

Line 2 SacWAM model output. Note that the file cannot be an *.xlsx file since the model output is read by the utility as a comma separated text file.

Line 3 Input DSS output file containing records required by HEC5Q that are extracted from SacWAM output

Line 4 Input meteorology and other data that are required by HEC5Q as well as flow patterns required by the pattering option. These data are copied to SACWAM_DSS_JULY2022.DSS.

Line 5 Output DSS F part that references the SacWAM model. Identifying each scenario allows multiple scenarios in a single DSS file

Line 6 Input file that controls how the SacWAM output is processed to create the individual records required by HEC5Q

To run the SacWAM utility, double click on “SacWAM_HEC5Q.exe” and enter the run file name.

SacWAM to HEC5Q Utility Inputs (2)

Example ZR records and corresponding SacWAM recordscontained in the Sac.control.dat. The “SacWAM.2.HEC5Q.xlsx” file contains all of the control records in a more convenient format.

```
75
76  ZR QD320  A=Trinity    B=LEWISTON   C=flow-div
77  +Lewiston_Lake_Evap
78  +Clear_Creek_Tunnel_0
79  ZR EV320  A=Trinity    B=LEWISTON   C=flow-evap
80  +Lewiston_Lake_Evap
81
82  ZR QD240  A=Clear_CR   B=WHISKEYTOWN    C=flow-div
83  +Whiskeytown_Reservoir_Evap
84  +spring_creek_conduit_0
85  +Transmission_Link_from_Clear_Creek_WTP_to_A_02_PA
86  +Transmission_Link_from_Clear_Creek_WTP_to_U_02_PU
87  +Transmission_Link_from_Whiskeytown_Reservoir_to_U_02_PU
88  +Transmission_Link_from_Whiskeytown_Reservoir_to_U_03_PU
89
```

1. *ZR QD320 record* …. Defines the total diversion (including evaporation) from Lewiston Lake followed by the SacWAM components**
2. *ZR EV320 record* …. Defines the Lewiston evaporation component
3. *ZR QD240 record* …. Defines the total diversion from Whiskeytown**

** The + (or -) in column 1 controls how the components are processed (Plus or minus)

Note that the four transmission links are included in the Spring Creek diversion but are removed for the Rock Creek Siphon

SacWAM to HEC5Q Utility Inputs (3)

Curve fit and flow pattering … add "-FIT" or "-PAT" to the Cpart. Note than any record not beginning in column 1 is ignored. E.g., "Shasta" The PAT options requires a historical record input as a DSS record.

```
    Shasta
ZR SS220  A=Sacramento B=Shasta   C=Stor-Res-fit
+Shasta_Lake_Storage

ZR IN220  A=Sacramento B=SHASTA   C=flow-in-pat
A=Sacramento B=SHASTA  C=flow-in  E=1DAY  F=HISTORICAL_BASED
+I_SHSTA_Inflow

ZR QA220  A=Sacramento B=SHASTA   C=flow-out
+Shasta_Lake
```

+/- partitioning / constraints … by adding the ">0" in beginning in column 71, only positive values will be saved. Note that the signs for the SacWAM records are reversed to distinguish between inflow and diversion

```
ZR IN178  A=Sacramento B=Cow Cr       C=flow-in                    >0
-clear_creek_inflow_to_sacramento_river
+cow_creek_inflow_to_sacramento_rm_277

ZR QD178  A=Sacramento B=Cow Cr          C=flow-div                >0
+clear_creek_inflow_to_sacramento_river
-cow_creek_inflow_to_sacramento_rm_277
```