LakeData.txt

This file contains lake properties for **outlet lakes** with specific data available. Properties defined here override the properties and generic parameters given in GeoData.txt and par.txt. If you want to use a generic parameter from par.txt for a particular lake in *LakeData.txt*, use -9999 as parameter value for that lake in *LakeData.txt*. Lake depth from GeoData.txt may also be kept by using -9999 for the value in *LakeData.txt*. Lake properties include physical characteristics, e.g. depth, and outlet rating curve, regulation routine parameters, sediment management, and parameters concerning nutrient cycling within the lake. In *LakeData.txt*, two regulation regimes can be defined; constant flow and seasonally varying sinus-wave shaped flow. For more regulation options, use DamData.txt, which extends the regulation options provided here.

Outlet lakes in HYPE can cover a fraction of a subbasin or the whole subbasin. Large lake systems can be split into several subbasins themselves. Each such subbasin's olake is then a lake basins of the **multi-basin lake**. This allows for different properties in different lake basins (e.g. depth). Flow between lakebasins of such a multi-basin lake is not defined in LakeData (outflow parameters should be zero). Outflow parameters for a multi-basin lake are defined only for lake basin which has an outlet to the outside of the multi-basin lake. The main outlet leaves by the last lakebasin, while additional outlets leaves through branches of upstream lakebasins. Maximum five outflows of a multi-basin lake is allowed.

Lakes that are not multi-basin lakes may have **two outlets** defined in LakeData.txt (see model description). These outlets are defined by `ldtype` 5 and 6 for the main outlet and the branch outlet. For lakes with two outlets defined in *LakeData.txt* only the downstream subid of the branch need to be given in BranchData.txt.

LakeData.txt is a tab-separated file located in the modeldir folder. Lakes and lake basins are listed row-wise. The first row contains a column header with variable names. Variable names are not case-sensitive (max. 10 characters, no spaces). Columns with headings unknown to HYPE are skipped while reading the file, but the column heading must not be longer than ten characters. Columns containing character strings, e.g. descriptive data, must not exceed a length of 100 characters. The columns may be in any order. A value must exist for all columns which cannot be alternatively defined in par.txt, see column description in table below. A row with data is skipped if ldtype is zero and the lakedataid is not found in GeoData (e.g. is zero). This can be used to temporary not use the specific lake properties on a row.

Example snippet of a *LakeData.txt* file structure, showing an unregulated single basin lake, and a regulated lake with two lake basins:

```
LAKEDATAID LAKEID LDTYPE LAKE_DEPTH  AREA W0REF QPROD1 DATUM1 REGVOL RATE
EXP ...
         1      0      1        3.6  5000  7.67      0      0      0   40
2 ...
         2      1      7        6.9  4000     0      0      0      0    0
0 ...
         3      1      7          5 30000 21.94   13.5    401    200  155
0.3 ...
       ...    ...    ...        ...   ...   ...    ...    ...    ...  ...
... ...
```

The table below describes all *LakeData.txt* columns read by HYPE.

Variable ID	Unit	Type	LdType	Description
`lakedataid`	-	*general*	*1/5/7*	lake/lake basin ID (integer), used to connect lakes/lake basins to subbasins in GeoData.txt (mandatory). Only main outlet of lake with two outlets have lakedataid. The second outlet should have lakedataid=0. Otherwise the lakedataid must be a unique positive integer.
`lakeid`	-	*general*	*5/6/7*	lake ID (integer), used to connect lake basins to its multi-basin lake and outlets of a lake with two outlets to that lake. Use unique positive integer for these lakes, but for simple outlet lakes (`ldtype` = 1) an arbitrary number can be used, e.g. 0.
`ldtype`	-	*general*	*all*	code for lake data type, integer (mandatory): **1** - simple outlet lake **2**, **3**, **4** - not used anymore **5** - lake with two outlets, main outlet **6** - lake with two outlets, second outlet **7** - lake basin of multibasin lake that will have a equal water level
`lake_depth`	*m*	*physical property*	*1/5/7*	water depth below threshold for outlet lake (mean depth), can also be defined in GeoData.txt (must be > 0). Not used for second outlet of lake with two outlets.
`area`	m^2	*physical property*	*1/5/7*	lake or lake basin area, optional, used for check the fraction of the subbasin covered by the outlet lake for simple outlet lakes (compared with SLC class fraction in GeoData.txt)
`w0ref`	*m*	*general*	*1/5/6/7*	reference water level to be added to simulated water level before print out, for lake outflow threshold. This column has a different meaning for ldtype=6, where it is used as the relative difference to the threshold (w0ref) of outlet 1. Only for the last lakebasin of multi-basin lake, the other use the same reference.
`rate`	-	*general/regulation*	*1/5/6/7*	parameter for specific rating curve of unregulated lakes or for spillway flow of regulated lakes above threshold (`w0ref`), equation $q = rate\ (w - w0)^{exp}$.
`exp`	-	*general/regulation*	*1/5/6/7*	parameter for specific rating curve of unregulated lakes or for spillway flow of regulated lakes above threshold (`w0ref`), equation $q = rate\ (w - w0)^{exp}$
`deltaw0`	*m*	*regulation*	*1/5/6/7*	difference in lake threshold for regulation with two rating curves (m). Determines the lake threshold for regulation period 2 (`w0=w0ref + deltaw0`), see `datum1` and `datum2`
`qprod1`	m^3/s	*regulation*	*1/5/6/7*	parameter for regulated olake, constant production flow down to lowest allowed waterstage for regulation period 1

Variable ID	Unit	Type	LdType	Description
qprod2	m^3/s	*regulation*	*1/5/6/7*	parameter for regulated olake, constant production flow down to lowest allowed waterstage for regulation period 2
datum1	-	*regulation*	*1/5/6/7*	parameter for regulated olake, start of regulation period 1 (if not defined only one period is used) (4 character month-day string *mmdd*)
datum2	-	*regulation*	*1/5/6/7*	parameter for regulated olake, start of regulation period 2 (4 character month-day string *mmdd*)
qamp	-	*regulation*	*1/5/6/7*	parameter for regulated olake, seasonally varying flow in regulated volume. Variation defined in form of a sinus wave with this amplitude (as fraction of current qprod: 0-1), where the minimum of the sinus wave occurs for day number qpha
qpha	-	*regulation*	*1/5/6/7*	parameter for regulated olake, seasonally varying flow below the threshold. Default is qpha = 102.
regvol	10^6 m^3	*regulation*	*1/5/6/7*	regulation volume for general regulation routine. Determines lowest water stage for production flow (*wmin*). (must be less than lake depth * lake area). Value for multi-basin lake is set on last lakebasin row.
wamp	*m*	*regulation*	*1/5/6/7*	regulation amplitude. Usually larger than water depth given by regvol. Used for scaling computed water stage variation (below threshold) similar to variation of observations. Set to -9999 for not to use. Only for last lakebasin of multi-basin lake.
maxQprod	m^3/s	*regulation*	*5/6*	maximum allowed production flow. Usually larger than daily production flow. Will reduce the number of spill occations and the spill flow. Only used for lakes with 2 outlets.
minflow	*- or* m^3/s	*regulation*	*1/5/6/7*	For ordinary and multibasin lakes (1/7): minimum flow. For lakes with two outlets (5/6): flag for minimum allowed flow, if set to one, a minimum flow will be determined by production flow parameters.
obsflow	-	*regulation*	*6*	flag for using wanted water transfer flow for second outlet, 0=no (default), 1=yes. Only used for lakes with 2 outlets.
limqprod	-	*regulation*	*1/5/7*	water level below which there is reduced production flow from a dam (fraction of regulating volume), the flow reduction is linear to zero at *wmin* (lowest water stage for production flow). Can also be defined in par.txt
w0adjdays	*days*	*regulation*	*1/5/6/7*	number of days over which a change in seasonal threshold for number of days over which a change in seasonal threshold for regulation with two rating curves (deltaw0) is to take place. Can also be defined in par.txt

Variable ID	Unit	Type	LdType	Description
builddam	-	*regulation*	*1/5/6/7*	date (yyyy-mm-dd) when the dam with `regvol` was built, before this date only the rating curve will be used for calculating outflow and at this date the lake threshold will be increased
removedam	-	*regulation*	*1/5/6/7*	date (yyyy-mm-dd) when the dam with `regvol` will be removed, after this date the lake threshold will be lowered (lake depth will be reduced) and only the rating curve will be used for calculating outflow
Qmean	*mm/y*	*physical property*	*1/5/7*	initial value for calculation of mean flow, can also be defined in par.txt
prodpp	*m/d*	*nutrient cycling*	*1/5/7*	parameter for internal load of Part-P
prodsp	*m/d*	*nutrient cycling*	*1/5/7*	parameter for internal load of SRP
tpmean	*mg/l*	*nutrient cycling*	*1/5/7*	mean concentration of total P, used for production if P is not simulated. Also used as initial value of particulate P concentration in lakes. Can also be defined in par.txt
tnmean	*mg/l*	*nutrient cycling*	*1/5/7*	mean concentration of total N (mg/l), used as initial value N concentration in lakes. Can also be defined in par.txt
tocmean	*mg/l*	*nutrient cycling*	*1/5/7*	mean concentration of OC (mg/l), used as initial value of OC concentration in lakes. Can also be defined in par.txt
sedon	*m/d*	*nutrient cycling*	*1/5/7*	sedimentation rate for ON in lakes. Can also be defined in par.txt
sedpp	*m/d*	*nutrient cycling*	*1/5/7*	sedimentation rate for PP in lakes. Can also be defined in par.txt
sedoc	*m/d*	*nutrient cycling*	*1/5/7*	sedimentation rate for OC in lakes. Can also be defined in par.txt
sedss	*m/ts*	*nutrient cycling*	*1/5/7*	sedimentation rate for SS in lakes. Can also be defined in par.txt
sedsi	*m/ts*	*nutrient cycling*	*1/5/7*	sedimentation rate for algae silica (AS) in lakes. Can also be defined in par.txt
wprodn	*kg/(m^3 d)*	*nutrient cycling*	*1/5/7*	production/degradation in water for N. Can also be defined in par.txt
wprodp	*kg/(m^3 d)*	*nutrient cycling*	*1/5/7*	production/degradation in water for P. Can also be defined in par.txt
wprodc	*kg/(m^3 d)*	*nutrient cycling*	*1/5/7*	production/degradation in water for OC. Can also be defined in par.txt.
wprodsi	*kg/(m^3 d)*	*nutrient cycling*	*1/5/7*	production/degradation of algae silica in water. Can also be defined in par.txt.
denitwl	*kg/(m^2 d)*	*nutrient cycling*	*1/5/7*	parameter for denitrification in lakes. Can also be defined in par.txt
muptn	*kg/(m^2 d)*	*nutrient cycling*	*1/5/7*	macrophyte uptake of IN in lake water. Can also be defined in par.txt
muptp	*kg/(m^2 d)*	*nutrient cycling*	*1/5/7*	macrophyte uptake of SP in lake water. Can also be defined in par.txt
t2mix	-	*physical property*	*1/5/7*	switch for using mixed lake T2 temperature on outflow of lake (0/1). Can also be defined in par.txt

Variable ID	Unit	Type	LdType	Description
sm_resop	*0-4*	*sediment management*	*1/5/7*	reservoir operation mode, used for sediment density; 1=sediment always submerged or nearly submerged, 2=normally moderate to considerable reservoir drawdown, 3=reservoir normally empty, 4=riverbed sediments
sm_mode	*0-3*	*sediment management*	*1/5/7*	reservoir sediment management methods, decision; 0=no flush, 1=flushing based on reservoir fill up, 2=flushing based on day of year, 3=flushing based on last lakebasin fill up
sm_apply	*0-1*	*sediment management*	*1/5/7*	reservoir sediment management methods, removal; 0=whole lake, 1=last lakebasin
sm_dest	*0-1*	*sediment management*	*1/5/7*	reservoir sediment management methods, fate; 0=flushed material removed, 1=flushed material added to flow going downstream
sm_start	*-/days*	*sediment management*	*1/5/7*	threshold to start sediment flushing. For sm_mode=1 fraction of initial storage volume. For sm_mode=2 day of year.
sm_duradays	*days*	*sediment management*	*1/5/7*	parameter to regulate the rate of flushing, number of days over which to flush. For sm_mode=1 and 2.
sm_caprest	*-*	*sediment management*	*1/5/7*	parameter to regulate the rate of flushing, the fraction of the reservoir storage capacity that will be restored. For sm_mode=1 and 2.
sm_yfreq	*years*	*sediment management*	*1/5/7*	number of years between flushing. For sm_mode=2 only.