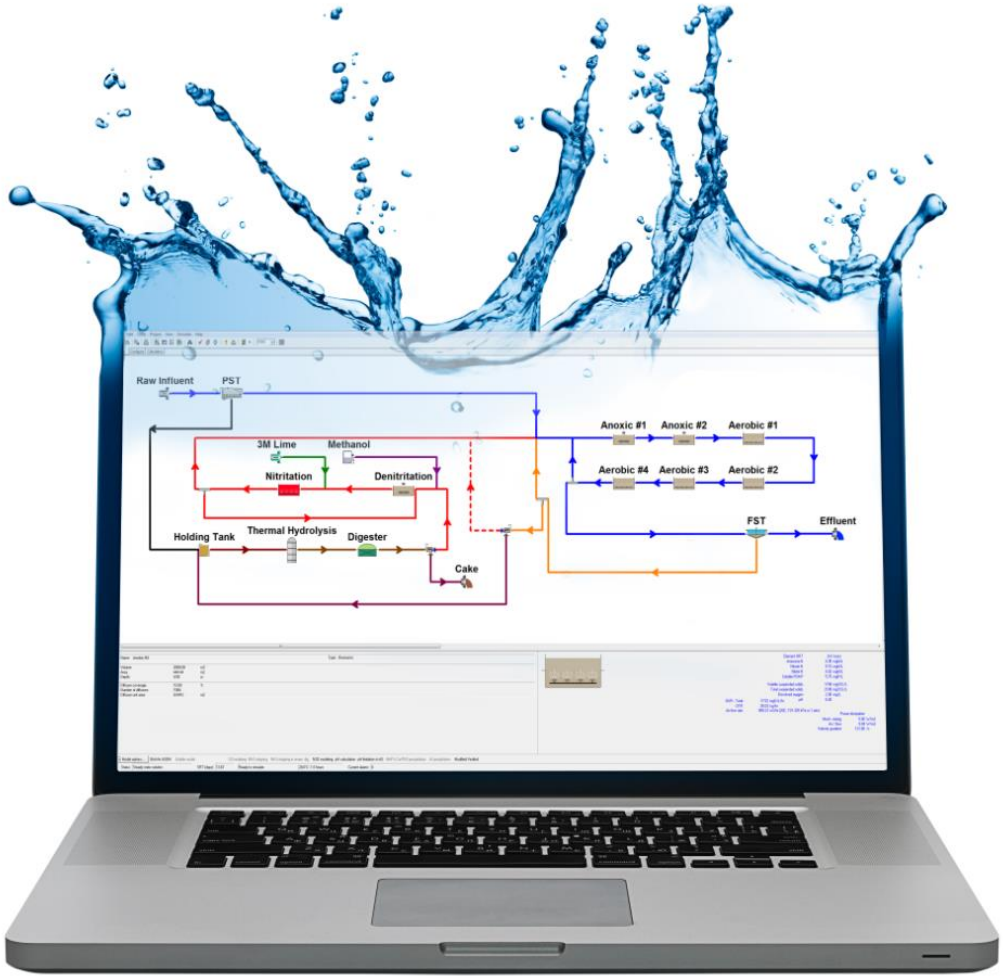
What's New in BioWin 6.0



EnviroSim ASSOCIATES LTD.

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Introduction

This document provides a quick overview of new features in BioWin 6.0

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- Sulfur (Biological, RedOx, *etc.*)
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The BioWin Manual is provided in two forms:

- As a PDF (default install location is C:\Program Files(x86)\EnviroSim\BioWin 6.0\Manuals)
- In "Windows Help" format from within BioWin

To Use PDF

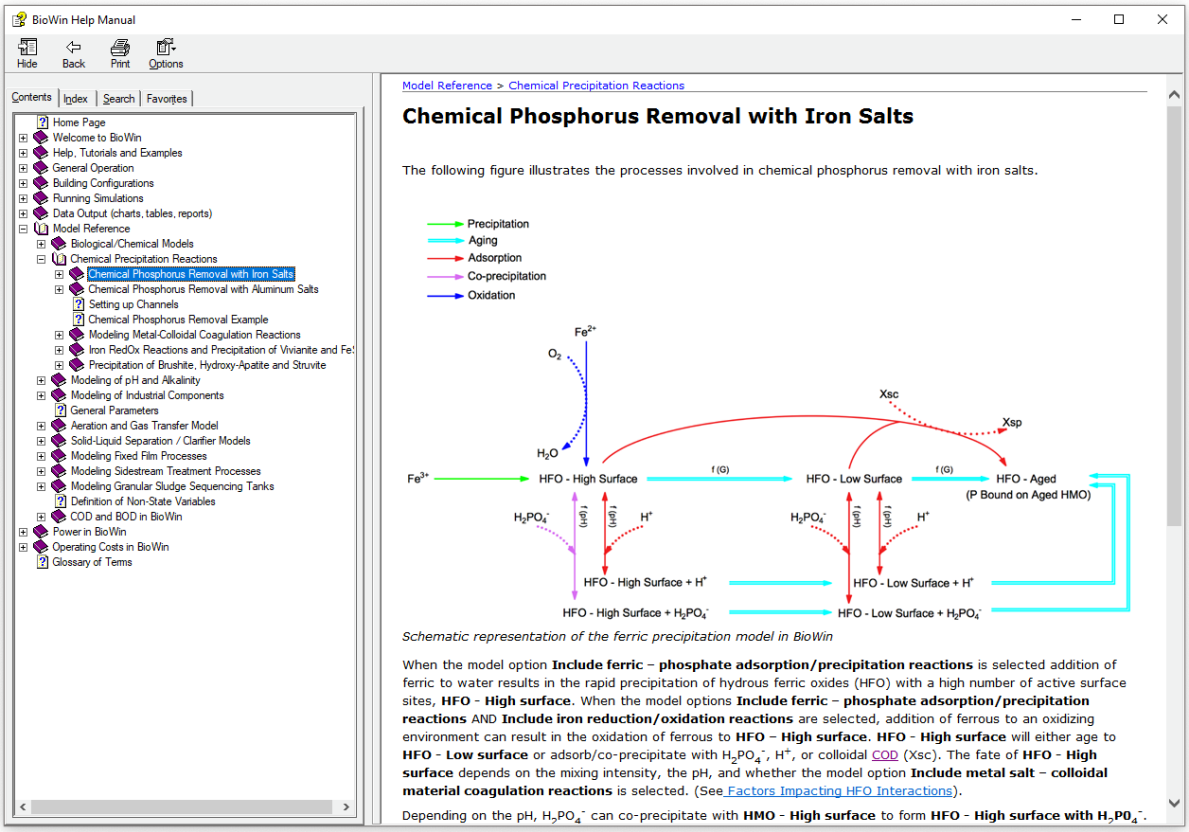
- Open it from directory above
- Or copy it to any other location of your choice (*e.g.* Desktop, My Documents)

To Use Windows Help

- Select Help > Contents & Index
- Click Help button
- Press F1 key on your keyboard (context-sensitive method; will open a relevant topic in the manual)

Example Manual reference:

For more details on topics, references to relevant sections of the BioWin Help Manual are provided



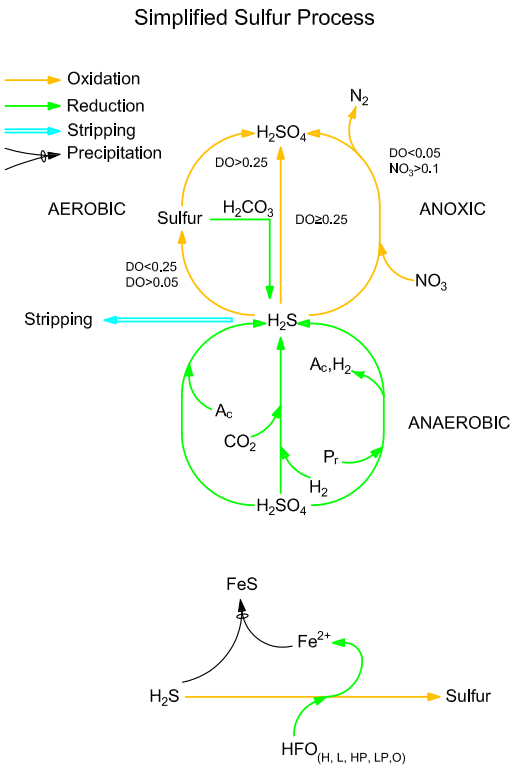
MODEL REFERENCE :

Chemical Precipitation Reactions > Chemical Phosphorus Removal with Iron Salts

Model Addition – Sulfur

Extension of what has been in PetWin for several years

- Sulfide-oxidizing bacteria
- Sulfate-reducing bacteria (multiple types)
- Potential hydrogen sulfide stripping
- Iron-sulfide (FeS) precipitation
- Model iron addition for H_2S control



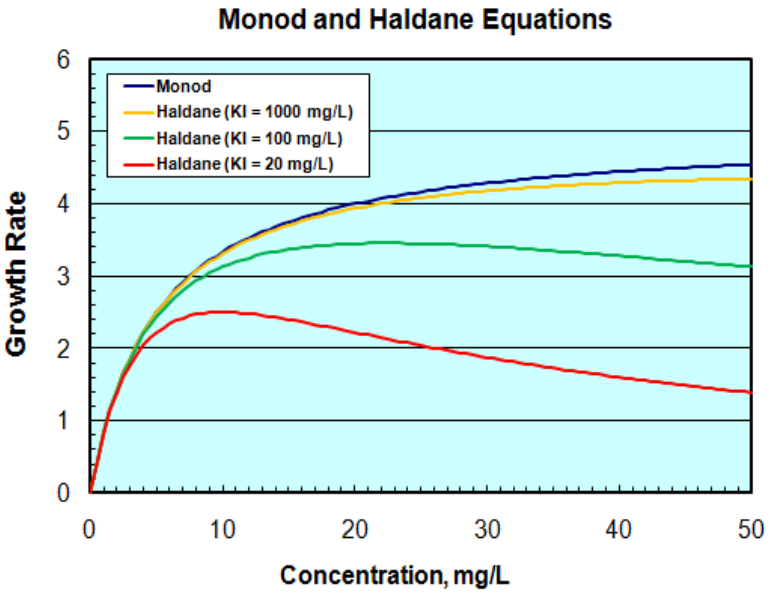
MANUAL REFERENCE :

Model Reference > Biological/Chemical Models > Sulfur Modeling

Model Addition – Industrial Organics

Based on original Alison Baker PhD (~1994, McMaster)

- Four new state variables for industrial components
- Mixed removal pathways – stripping and/or biodegradation
- Default settings for industrial components mimic xylene, phenol, benzene, and toluene
- Biodegradation according to inhibitory Haldane kinetics



$$\mu = \mu_{max} \cdot \left[\frac{S}{K_S + S + \frac{S^2}{K_I}} \right]$$

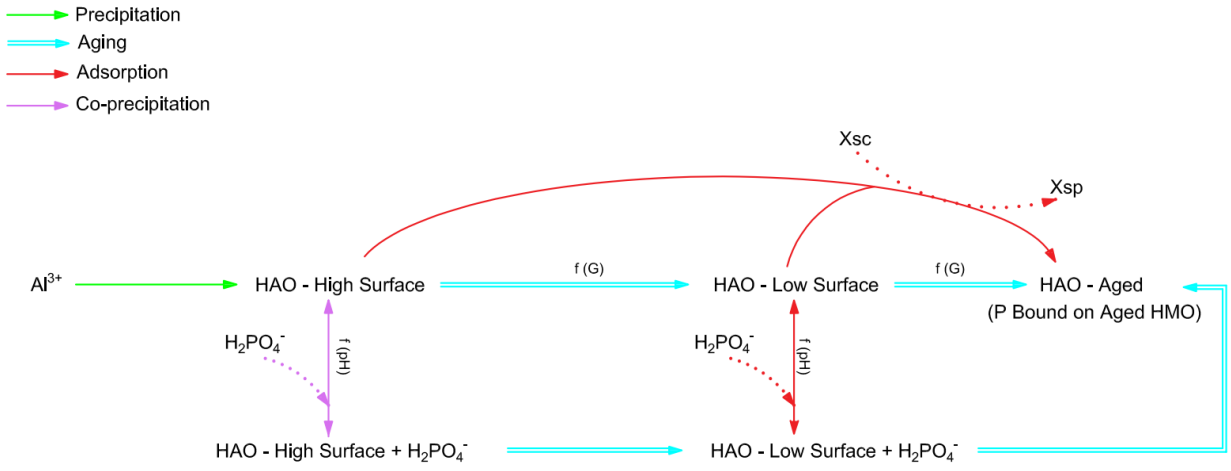
MANUAL REFERENCE :

Model Reference > Modeling of Industrial Components

Model Addition – Chemical Phosphorus

New P removal mechanisms (hydrated metal oxides)

- Based on EnviroSim-sponsored research
- Extensive calibration for wastewater systems
- Overcomes weaknesses of old “WEF model” (e.g. fixed Me:P stoichiometry)
- Can have simultaneous ferric / ferrous / alum inputs

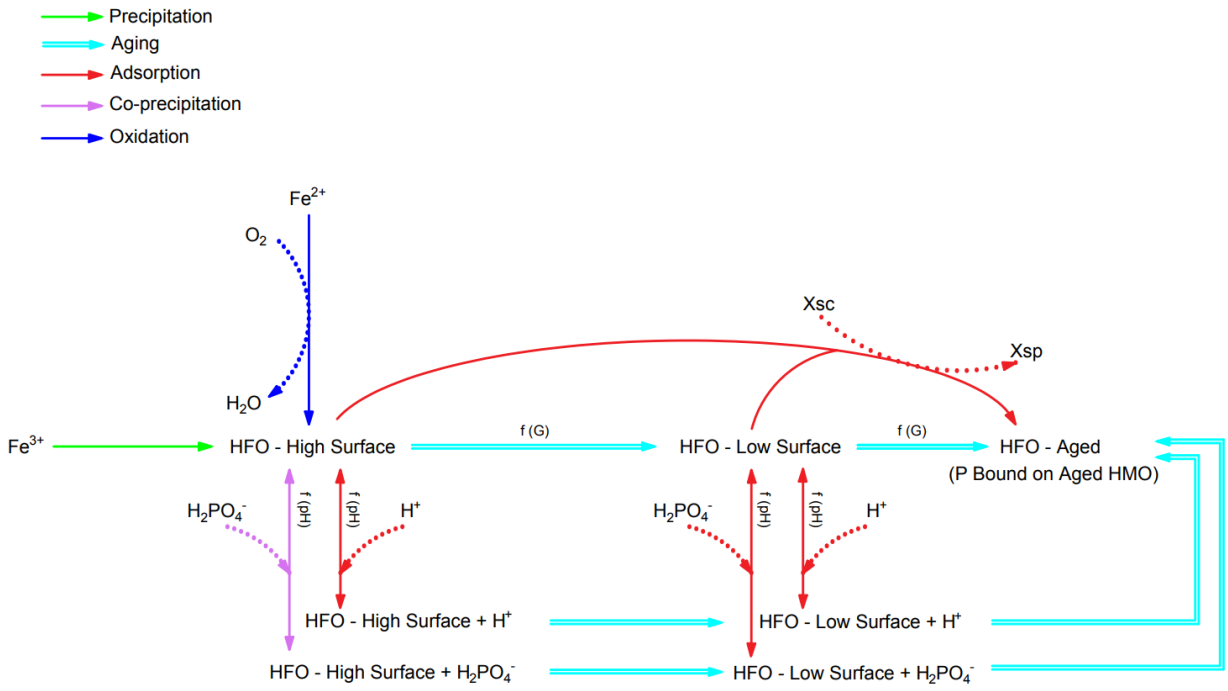


MANUAL REFERENCE :

Model Reference > Chemical Precipitation Reactions > Chemical Phosphorus Removal with Aluminum Salts

Model Addition – Chemical Phosphorus

Updated P removal mechanisms (hydrated metal oxides)



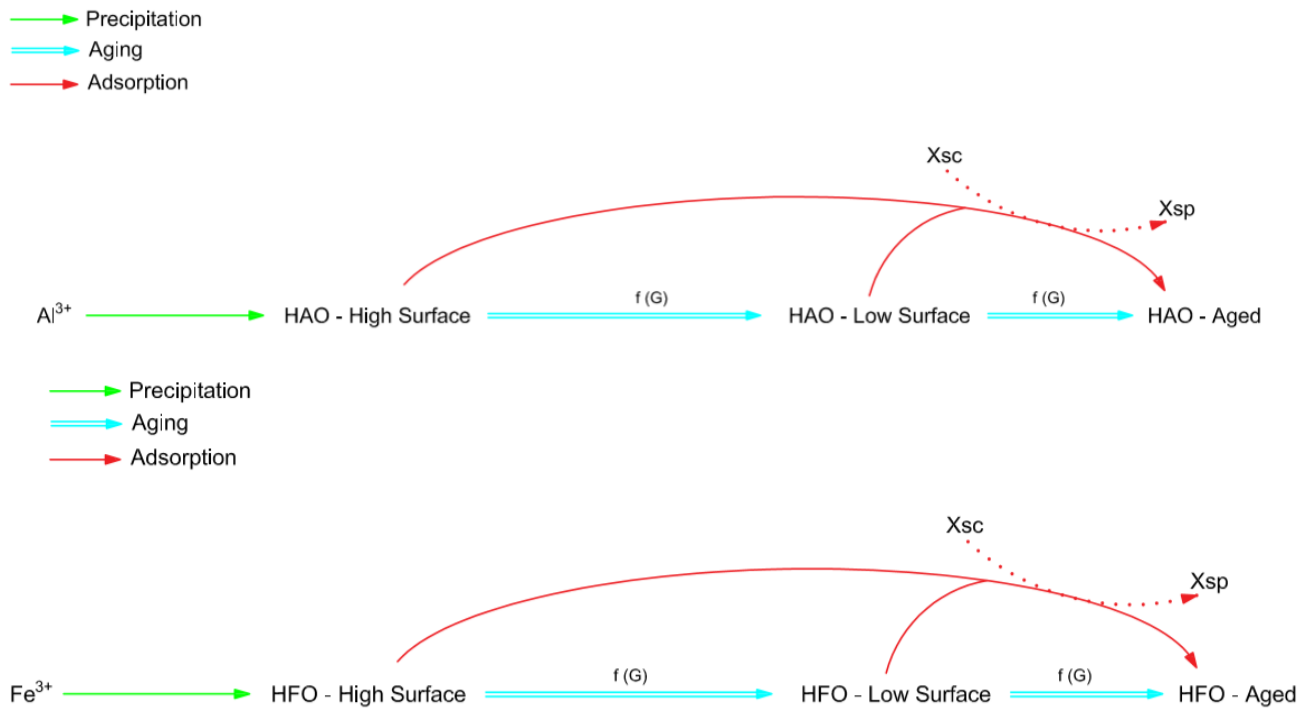
MANUAL REFERENCE :

Model Reference > Chemical Precipitation Reactions > Chemical Phosphorus Removal with Iron Salts

Model Addition – CEPT

Option to model colloidal COD / metal interactions

- Model can convert non-settleable colloidal COD to settleable particulate COD in the presence of hydrated metal oxides (HMO)
- Process will also reduce potential adsorption of P on HMO
- Ideal or model clarifier can then be used to mimic increased solids and BOD removal



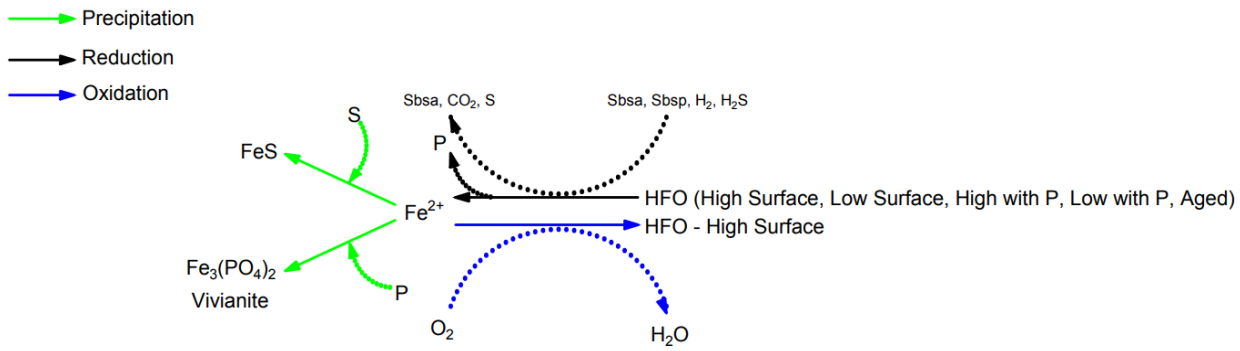
MANUAL REFERENCE :

Model Reference > Chemical Precipitation Reactions > Modeling Metal-Colloidal Coagulation Reactions

Model Addition – Iron RedOx

Option to model iron oxidation / reduction reactions

- New ferrous input (as either ferrous chloride or ferrous sulfate)
- Ferrous oxidized to ferric in aerobic environments
- Ferric reduced to ferrous in anaerobic environments
- Option to track iron-based precipitates {*i.e.* FeS and vivianite [$Fe_3(PO4)_2$]}



MANUAL REFERENCE :

Model Reference > Chemical Precipitation Reactions > Iron RedOx Reactions and Precipitation of Vivianite and FeS

Model Addition – Options for P Recovery

Improved tracking of Ca^{2+} and Mg^{2+}

- Previously Ca^{2+} and Mg^{2+} only available throughout the flowsheet *via* input of soluble influent concentrations
- Underestimated the amounts entering digesters *via* solids streams limiting the amounts of potential precipitates
- Model updated to include Ca^{2+} and Mg^{2+} in biomass (taken up as part of "synthesis ISS") and influent degradable solids (X_{SP})

Additional sinks for P

- Vivianite formation
- Struvite formation as in previous versions of BioWin but no longer Mg^{2+} limited!
- Calcium phosphate precipitate (as Brushite)
- ***Lowers return stream soluble PO4 to levels typically observed***

MANUAL REFERENCE :

Model Reference > Chemical Precipitation Reactions > Precipitation of Brushite, Hydroxy-Apatite and Struvite

Model Addition – Cellulose

Cellulose tracking

- Influent unbiodegradable particulate material split into two components: cellulose and non-cellulose
- Separate COD:VSS ratios for each
- Helps to fine-tune sludge production and digester performance
- Enables modelling of cellulose recovery

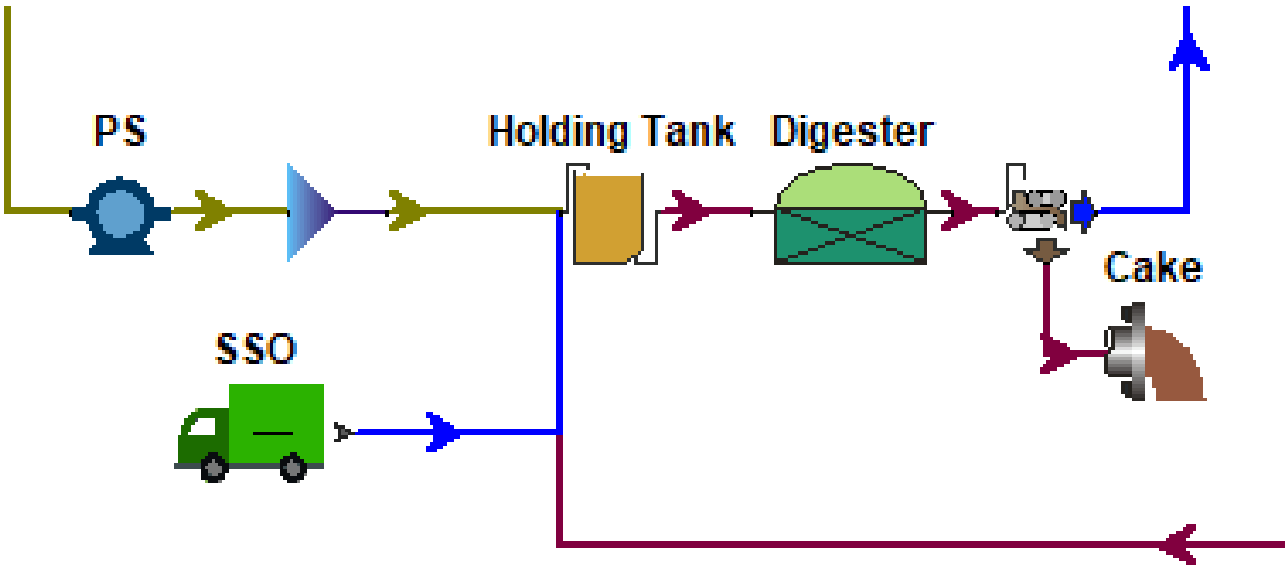
MANUAL REFERENCES :

1. Model Reference > Biological/Chemical Models > Activated Sludge Processes > Growth and Decay of Ordinary Heterotrophic Biomass > Stoichiometric Parameters
2. Model Reference > Definition of Non-State Variables

Model Addition – SSO

New input for SSO

- State variable (COD_P-X_{EO}) for adding particulate degradable COD (*e.g.* Source Separated Organics)
- ***Has specific COD:VSS;*** added as a separate input to avoid conflicts with municipal wastewater characteristics
- Option to include N and P
- Constant or time-varying, as with any BioWin input

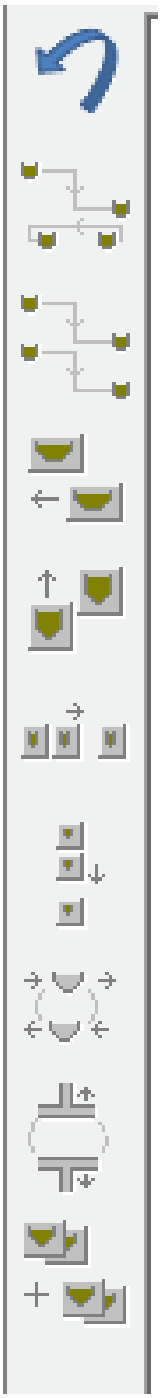


MANUAL REFERENCES :

1. Model Reference > Biological/Chemical Models > Hydrolysis, Biological adsorption, Ammonification and Assimilative denitrification
2. Model Reference > Definition of Non-State Variables

Usability Upgrade – Drawing Toolbar

- **UNDO** button!! Use for accidental element deletion, moving, *etc.*
- Buttons for copying pipe format from one pipe to others
- Buttons for aligning flowsheet elements (vertical or horizontal centers)
- Buttons for spacing flowsheet elements evenly (vertically or horizontally)
- Buttons for flipping flowsheet element images (horizontally or vertically)
- Button for copying selected element(s)



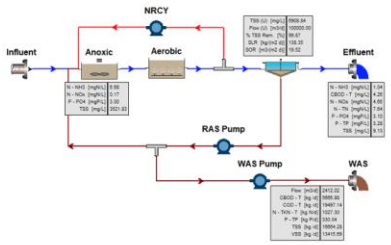
MANUAL REFERENCE :

General Operation > Main Simulator Window > Toolbars > Flowsheet Tools

Usability Upgrade – Report to Excel

- Automatic rapid generation and export of data, charts, *etc.* to Excel
- Ideal for generating Mass Balance tables to use in PFDs
- Preconfigured templates are customizable
- Can incorporate "post-BioWin" calculations (*e.g.* MLVSS/MLSS, COD/BOD) using Excel formulas
- Option for including both steady state and dynamic simulation databases
- Can include BioWin charts – these are converted to Excel charts with data
- Report to Word still available

BioWin Mass Balance Summary



BioWin Tankage Summary
Volume Units: m3

Reactors	Name	Volume
	Aerobic	40,000.0
	Anoxic	10,000.0
	Group Total	**50,000.0**

Secondary Clarifiers	Name	Volume
	Clarifier	20,000.0
	Group Total	**20,000.0**

Total Volume for All Units 70,000.0

		Mass Rate									
Pipe Name	FLOW m3/d	COD kg/d	cBOD kg/d	TSS kg/d	VSS kg/d	TKN kg/d	NH4-N kg/d	NOx-N kg/d	TP kg/d	PO4-P kg/d
F-01	100,000.0	50,000	24,521	22,271	19,771	4,000	2,640	0	650	325
F-02	497,588.0	2,066,615	606,634	1,752,419	1,413,482	110,671	3,325	86	35,265	1,491
F-03	497,588.0	2,044,829	592,708	1,742,104	1,402,492	107,991	516	2,314	35,265	1,545
F-04	197,588.0	811,984	235,359	691,775	556,918	42,882	205	919	14,003	613
F-05	97,588.0	3,652	416	891	717	291	101	454	320	303
F-06	100,000.0	808,332	234,943	690,884	556,201	42,591	104	465	13,683	310
F-07	100,000.0	808,332	234,943	690,884	556,201	42,591	104	465	13,683	310
F-08	97,588.0	788,835	229,276	674,220	542,785	41,564	101	454	13,353	303
F-09	2,412.0	19,497	5,667	16,664	13,416	1,027	2	11	330	7
F-10	2,412.0	19,497	5,667	16,664	13,416	1,027	2	11	330	7
F-11	300,000.0	1,232,845	357,349	1,050,329	845,575	65,109	311	1,395	21,262	931
F-12	300,000.0	1,232,845	357,349	1,050,329	845,575	65,109	311	1,395	21,262	931

BioWin Reactor Summary
All airflows reported at 20 deg C and 1 atm

Bioreactor

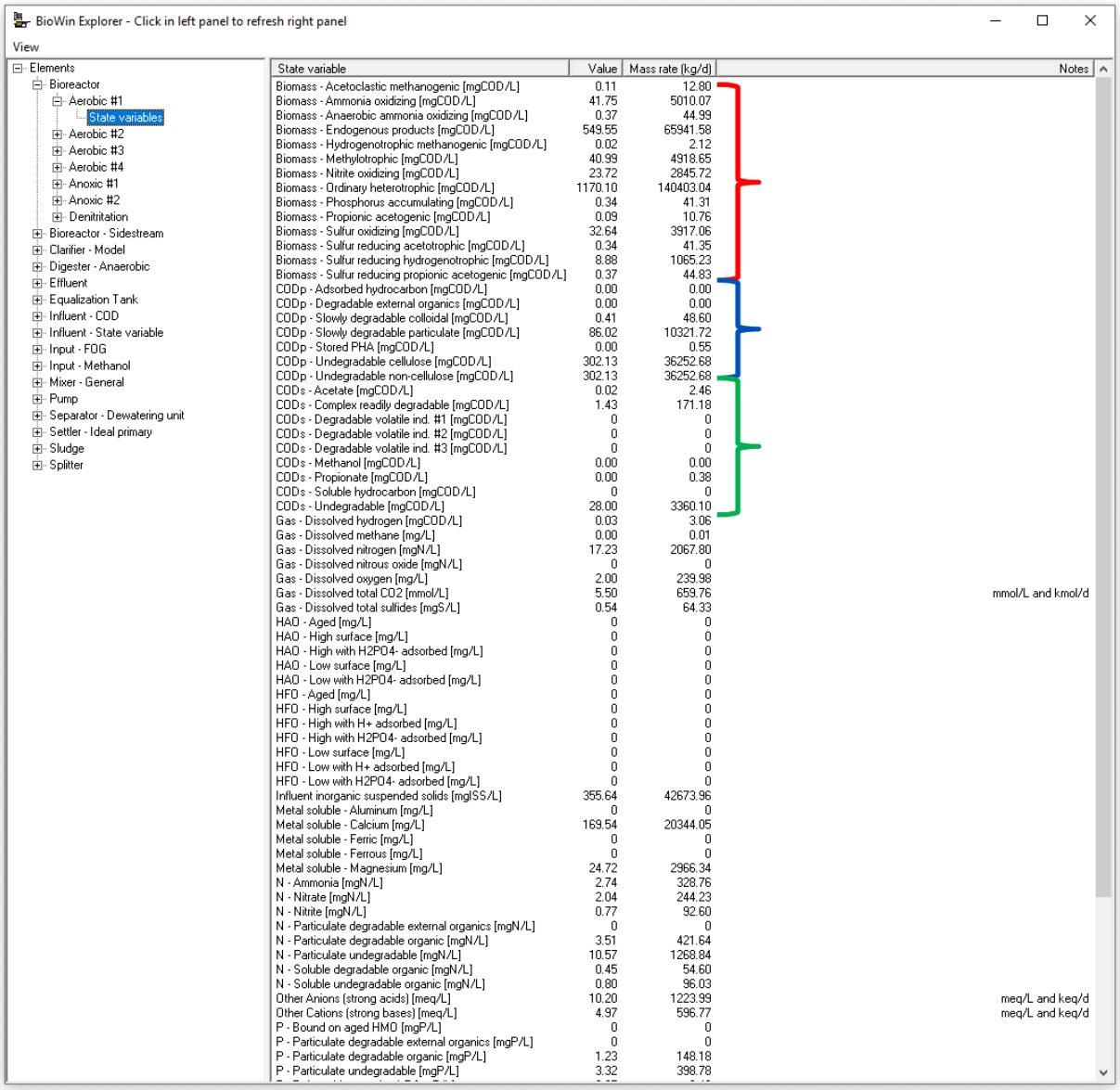
Tank Name	AREA m2	DEPTH m	VOLUME m3	DIFFUSERS #	AIRFLOW m3/hr (20C, 1 atm)	DO mg/L	SOTR kg/hr	SOTE %	OTR kg/hr	OTE %	OUR mg/L/hr	MLSS mg/L	MLVSS mg/L	NH4-N mg/L	NO3-N mg/L	NO2-N mg/L	NOx-N mg/L	PO4-P mg/L	pH ---	TOTAL MASS kg	MLVSS / MLSS ---
Anoxic	2,222	4.50	10,000.0	0	0	0.0	0	100.0	0	100.0	0.0	3,522	2,841	6.7	0.0	0.2	0.2	3.0	6.99	35,218	80.7%
Aerobic	8,889	4.50	40,000.0	21,680	49,292	2.0	4,195	30.5	1,393	10.1	33.8	3,501	2,819	1.0	0.3	4.3	4.7	3.1	6.86	140,044	80.5%
Average					49,292	2.0	4,195	30.5	1,393	10.1	33.8	3,511	2,830	3.9	0.2	2.2	2.4	3.1			80.6%
Total	11,111		50,000.0	21,680	49,292		4,195		1,393											175,262	

MANUAL REFERENCE :

Data Output (charts, tables, reports) > Creating Project Reports > Creating an Excel Report

Usability Upgrade – Variable Naming & Sorting

- Variables and parameters renamed for improved consistency
- Allows for simpler alphabetical sorting



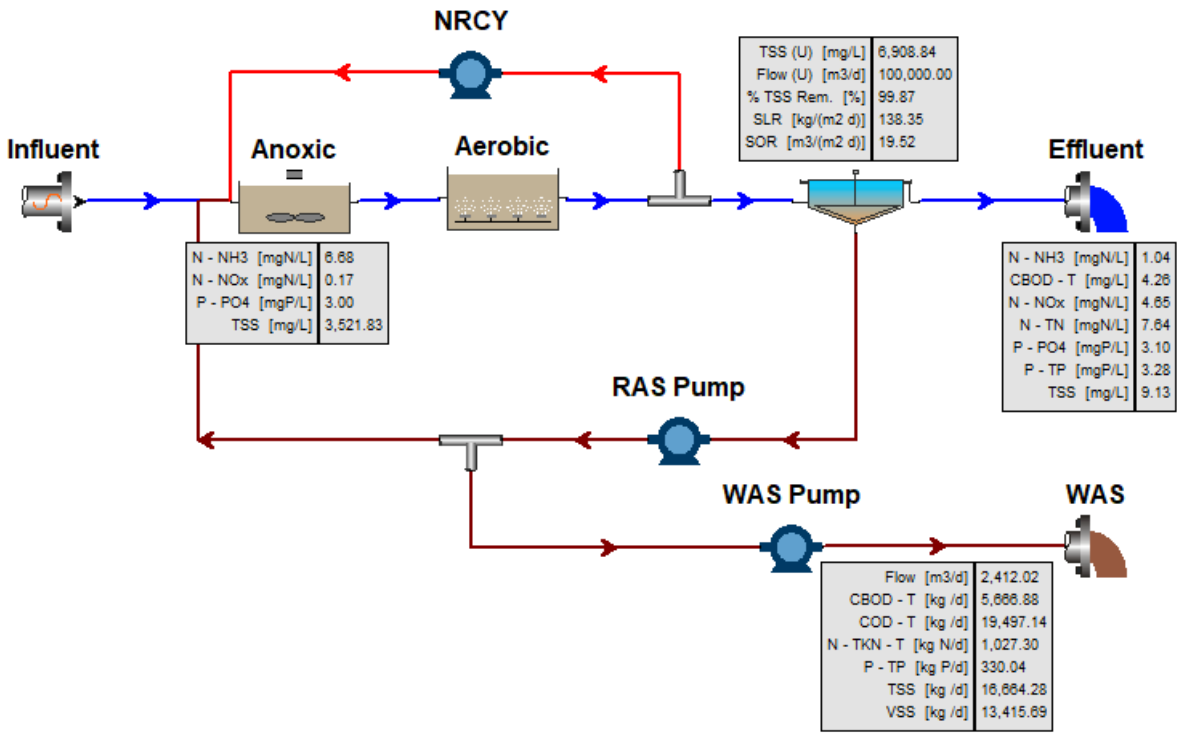
MANUAL REFERENCE :

Model Reference > Definition of Non-State Variables

Usability Upgrade – Flowsheet Tags

Customizable element-specific information

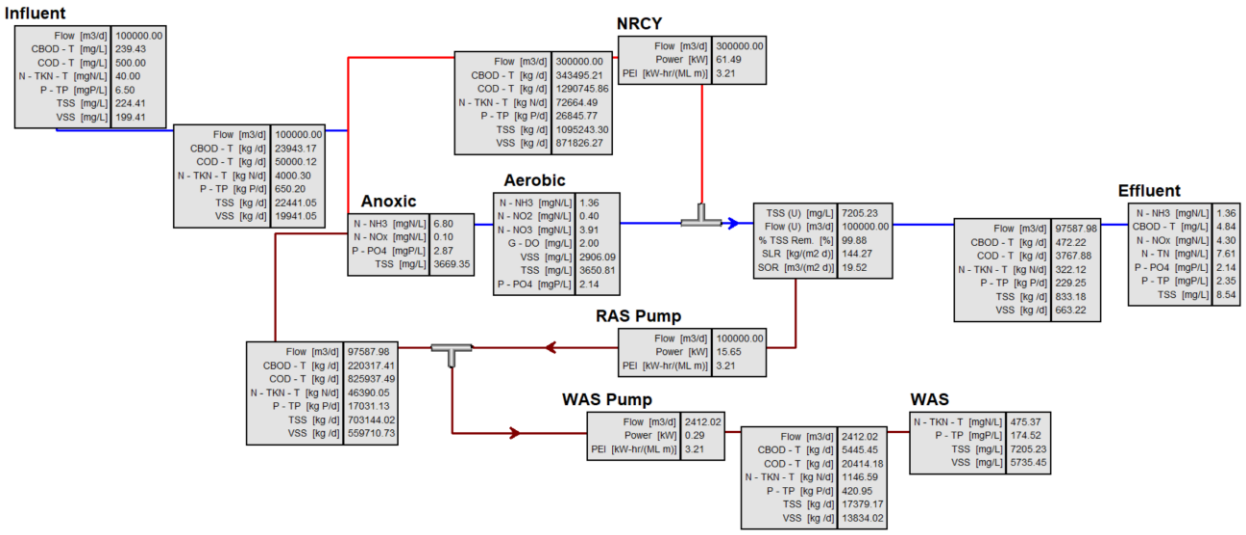
- Information updates with simulations
- Can contain state, combined, and element-specific variables



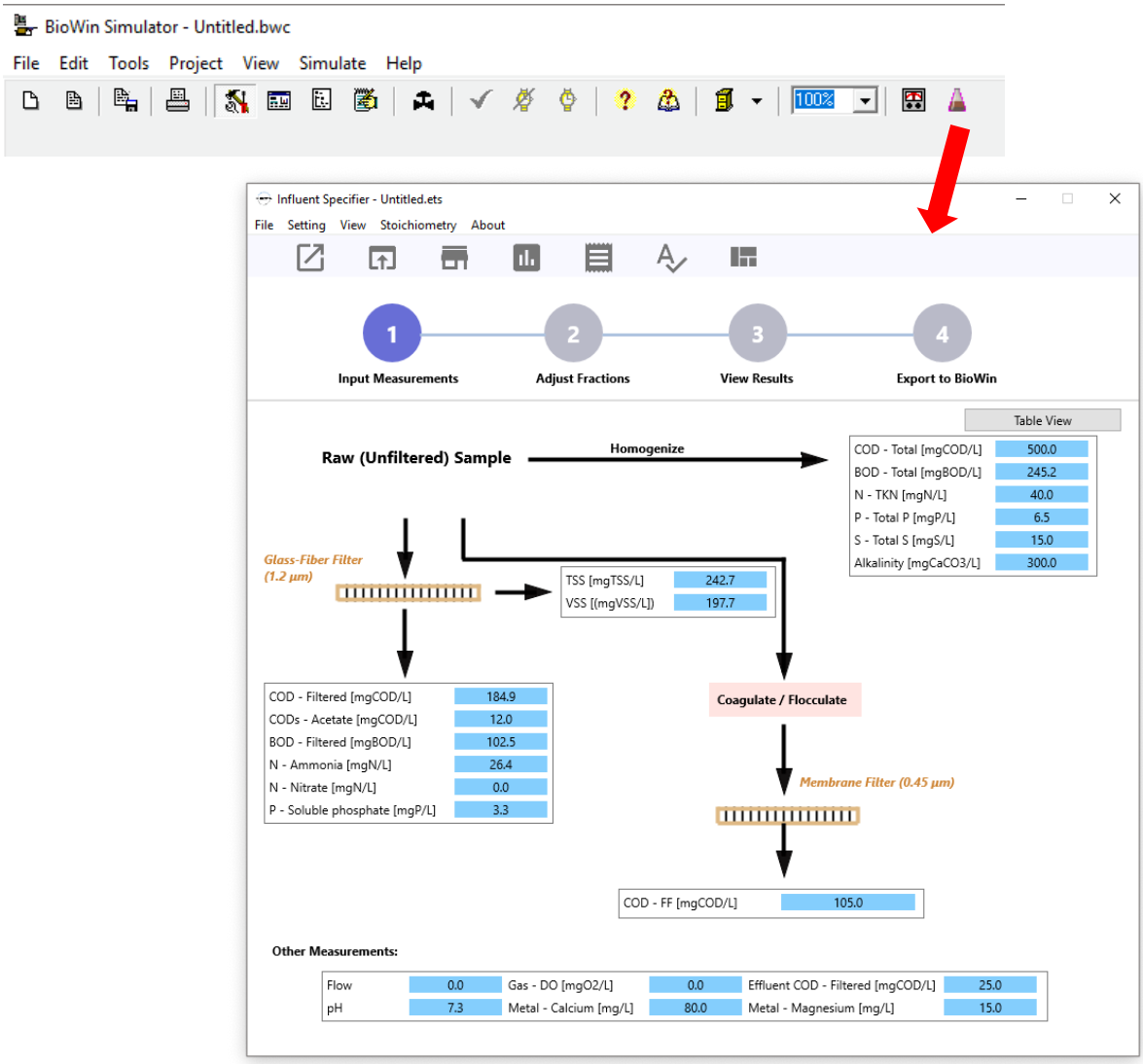
MANUAL REFERENCES :

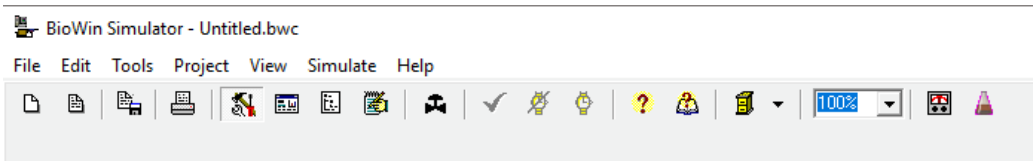
1. General Operation > Customizing BioWin > Customizing the Project Appearance > Drawing Board
2. General Operation > Customizing BioWin > Customizing the Work Environment > Default tags
3. General Operation > Managing BioWin Projects > Setting Project Options > Drawing Board Options

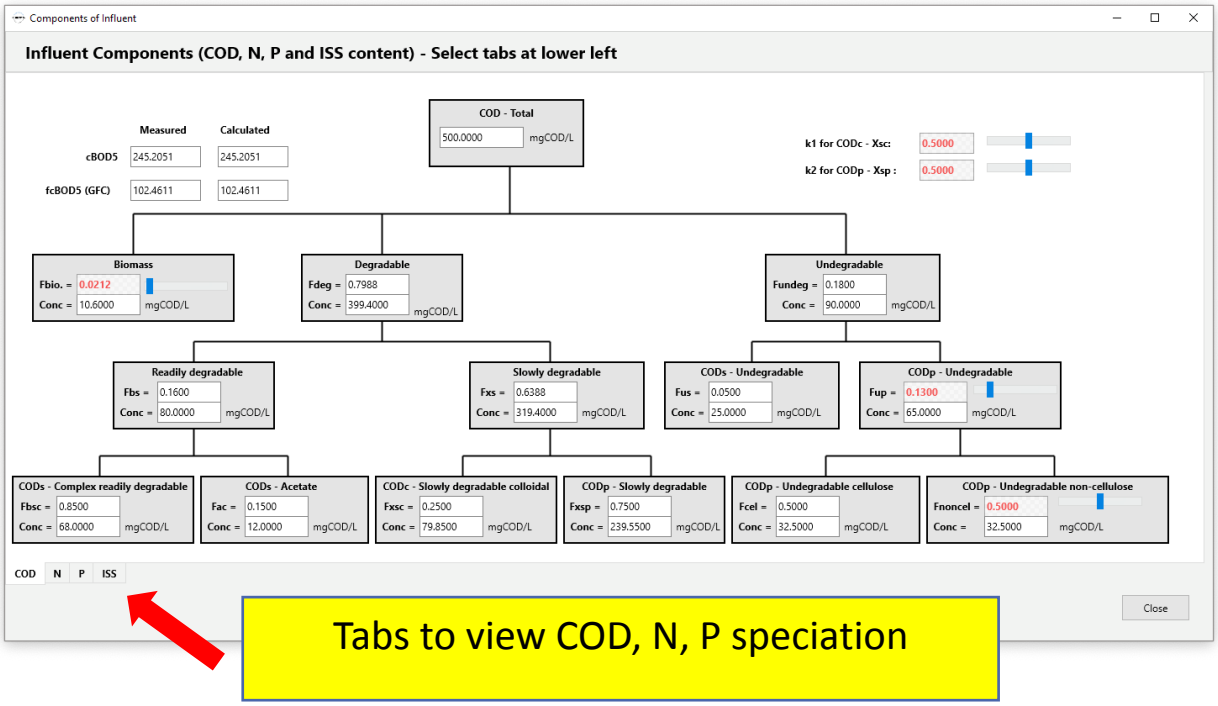
- Can control location (above, below elements)
- Can replace flowsheet icons if desired



Usability Upgrade – Integrated Influent Specifier

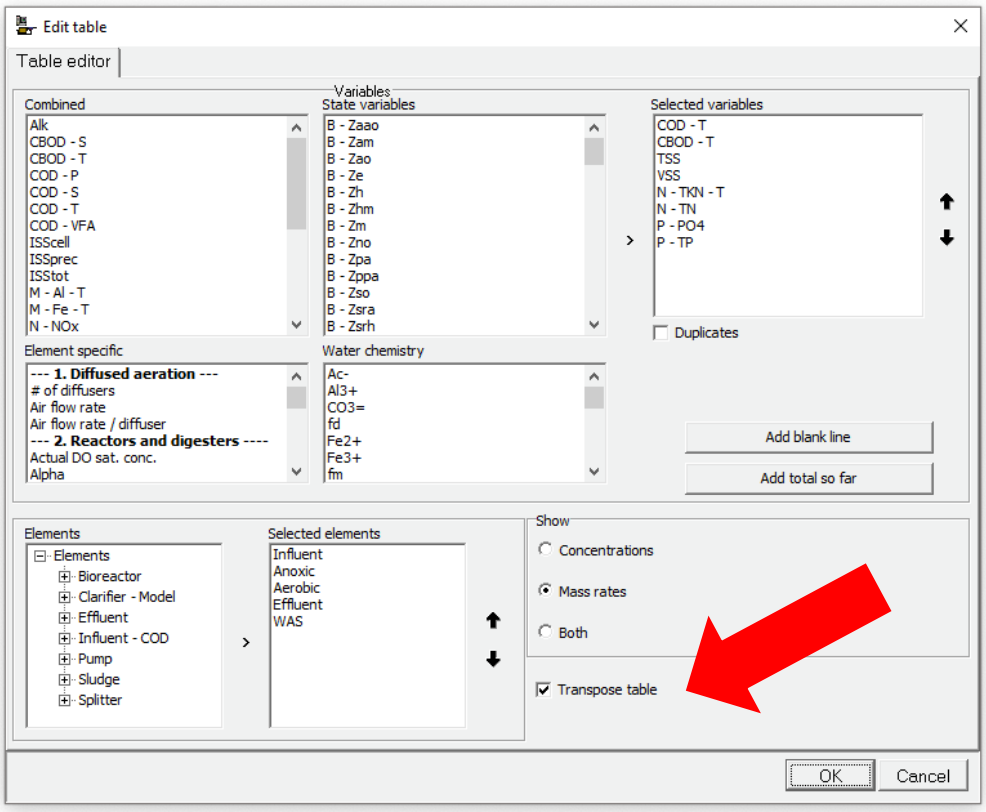



BioWin Simulator - Untitled.bwc
File Edit Tools Project View Simulate Help
100%


Components of Influent
Influent Components (COD, N, P and ISS content) - Select tabs at lower left
Measured
Calculated
cBOD5
245.2051
245.2051
fcBOD5 (GFC)
102.4611
102.4611
COD - Total
500.0000
mgCOD/L
k1 for CODc - Xsc:
0.5000
k2 for CODp - Xsp :
0.5000
Biomass
Fbio. = 0.0212
Conc = 10.6000 mgCOD/L
Degradable
Fdeg = 0.7988
Conc = 399.4000 mgCOD/L
Undegradable
Fundeg = 0.1800
Conc = 90.0000 mgCOD/L
Readily degradable
Fbs = 0.1600
Conc = 80.0000 mgCOD/L
Slowly degradable
Fxs = 0.6388
Conc = 319.4000 mgCOD/L
CODs - Undegradable
Fus = 0.0500
Conc = 25.0000 mgCOD/L
CODp - Undegradable
Fup = 0.1300
Conc = 65.0000 mgCOD/L
CODs - Complex readily degradable
Fbsc = 0.8500
Conc = 68.0000 mgCOD/L
CODs - Acetate
Fac = 0.1500
Conc = 12.0000 mgCOD/L
CODc - Slowly degradable colloidal
Fxsc = 0.2500
Conc = 79.8500 mgCOD/L
CODp - Slowly degradable
Fxsp = 0.7500
Conc = 239.5500 mgCOD/L
CODp - Undegradable cellulose
Fcel = 0.5000
Conc = 32.5000 mgCOD/L
CODp - Undegradable non-cellulose
Fnoncel = 0.5000
Conc = 32.5000 mgCOD/L
COD
N
P
ISS
Close
Tabs to view COD, N, P speciation

Usability Upgrade – Transpose Tables

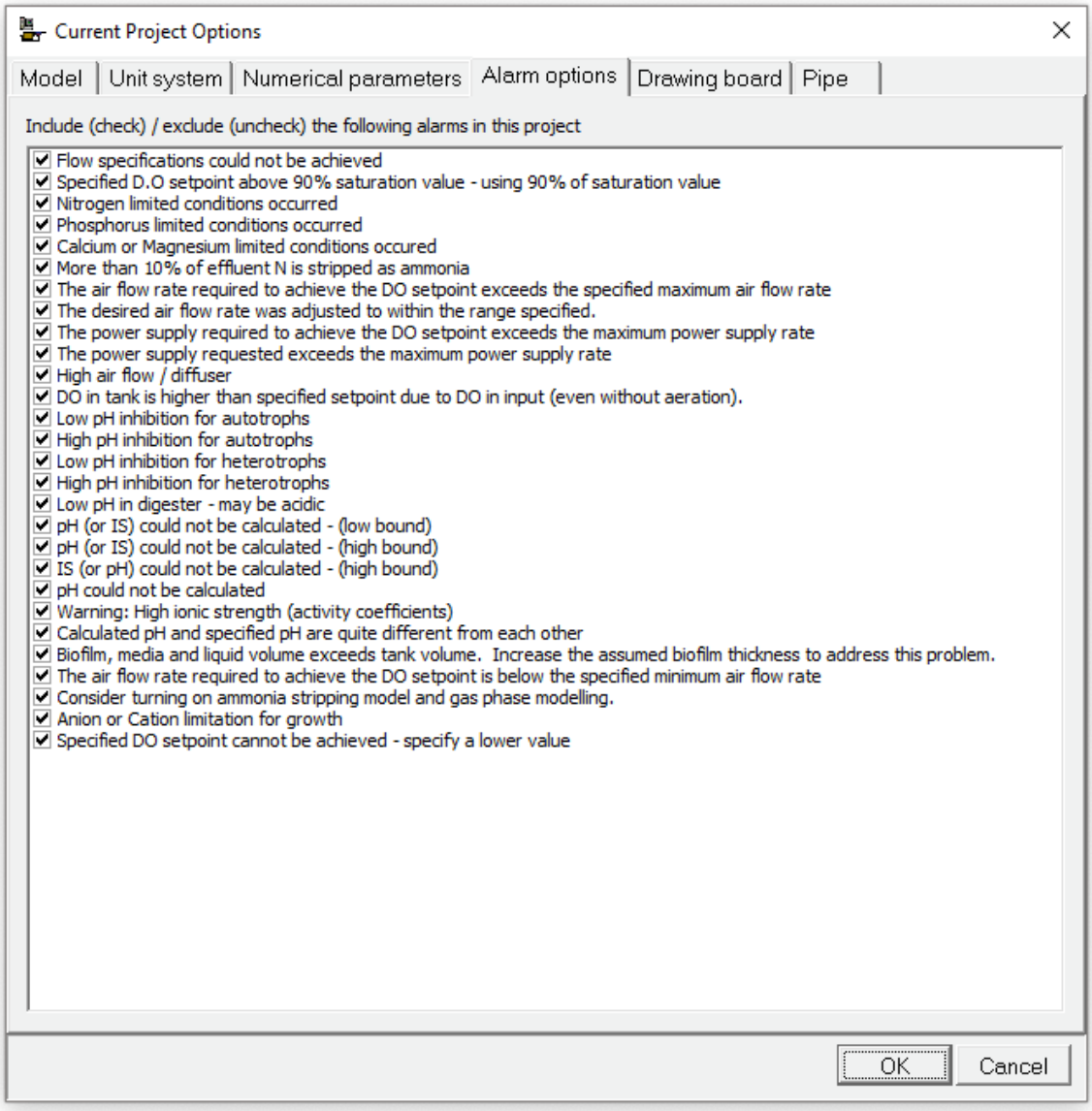
Elements	COD - Total [kg /d]	BOD - Total Carbonaceous [kg /d]	Total suspended solids [kg /d]	Volatile suspended solids [kg /d]	N - Total Kjeldahl Nitrogen [kg N/d]	N - Total N [kg N/d]	P - Soluble PO4-P [kg P/d]	P - Total P [kg P/d]
Influent	50,000.12	24,520.56	22,271.22	19,771.22	4,000.30	4,000.30	325.10	650.20
Anoxic	2,066,615.31	606,633.78	1,752,419.23	1,413,482.37	110,671.03	110,756.71	1,491.33	35,265.05
Aerobic	2,044,828.86	592,708.01	1,742,104.19	1,402,492.50	107,991.14	110,305.17	1,544.55	35,265.05
Effluent	3,652.17	416.10	890.51	716.91	291.45	745.29	302.92	320.16
WAS	19,497.14	5,666.88	16,664.28	13,415.69	1,027.30	1,038.52	7.49	330.04



Elements	Influent	Anoxic	Aerobic	Effluent	WAS
COD - Total [kg /d]	50,000.12	2,066,615.31	2,044,828.86	3,652.17	19,497.14
BOD - Total Carbonaceous [kg /d]	24,520.56	606,633.78	592,708.01	416.10	5,666.88
Total suspended solids [kg /d]	22,271.22	1,752,419.23	1,742,104.19	890.51	16,664.28
Volatile suspended solids [kg /d]	19,771.22	1,413,482.37	1,402,492.50	716.91	13,415.69
N - Total Kjeldahl Nitrogen [kg N/d]	4,000.30	110,671.03	107,991.14	291.45	1,027.30
N - Total N [kg N/d]	4,000.30	110,756.71	110,305.17	745.29	1,038.52
P - Soluble PO4-P [kg P/d]	325.10	1,491.33	1,544.55	302.92	7.49
P - Total P [kg P/d]	650.20	35,265.05	35,265.05	320.16	330.04

Usability Upgrade – Optional Alarms

- As part of the project options, select which alarms are active

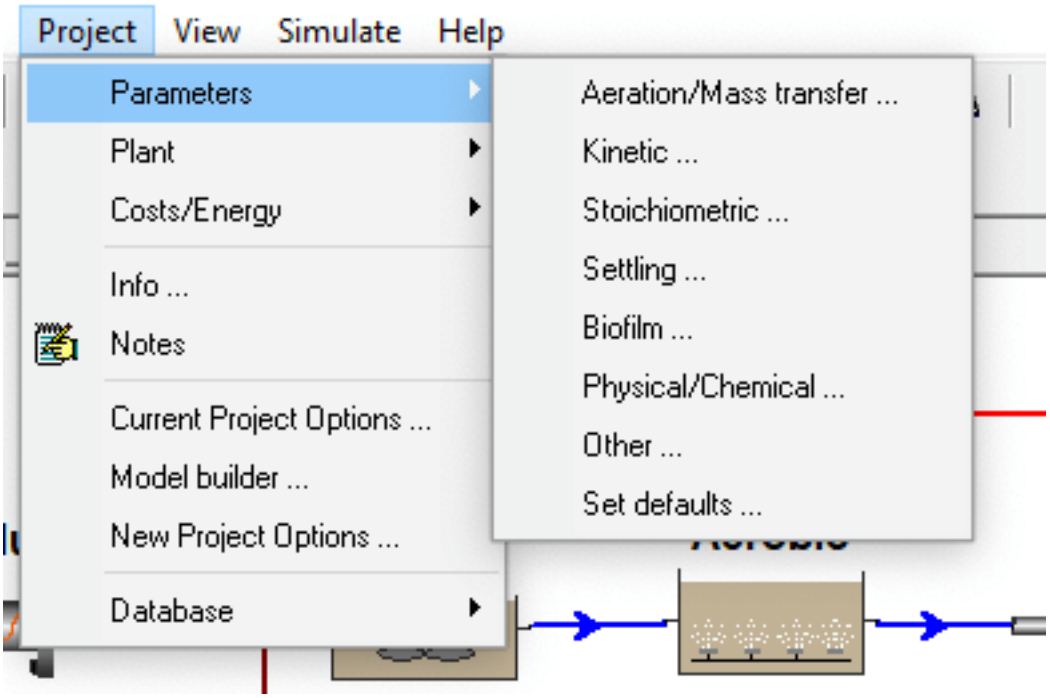


MANUAL REFERENCE :

General Operation > Managing BioWin Projects > Setting Project Options > Alarm Options

Usability Upgrade – Set All Parameters to Default

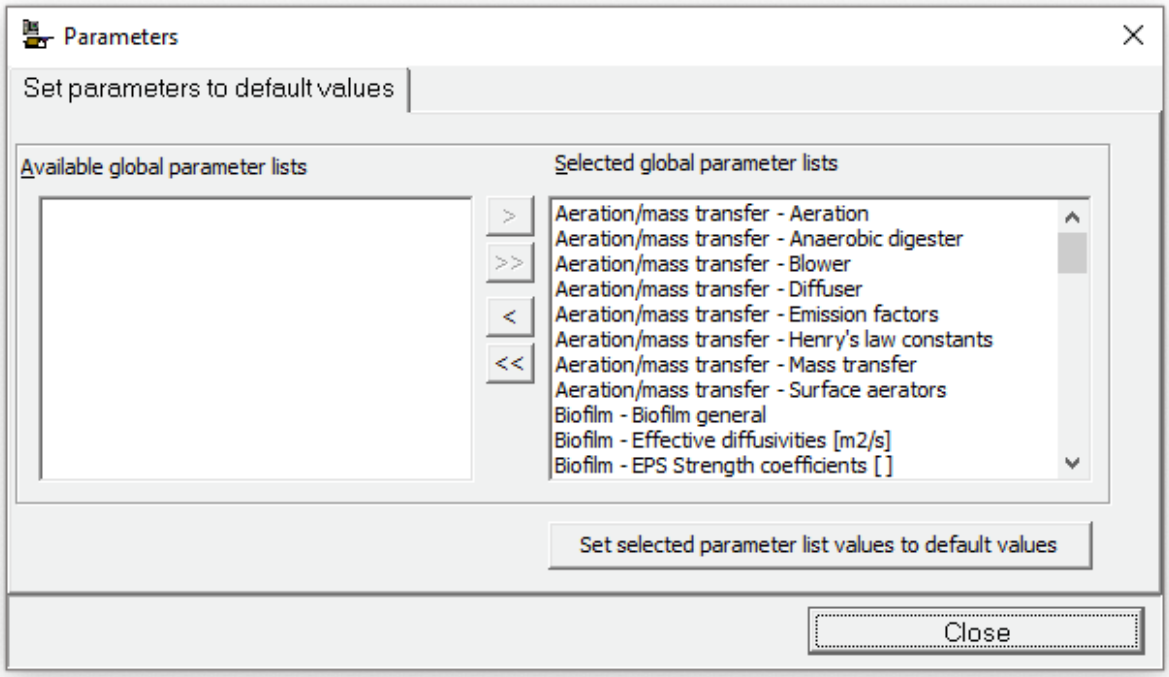
Use to upgrade older models to Version 6



MANUAL REFERENCE :

General Operation > Managing BioWin Projects > Specifying Project Model Parameter Values

Specify which parameter sets to update

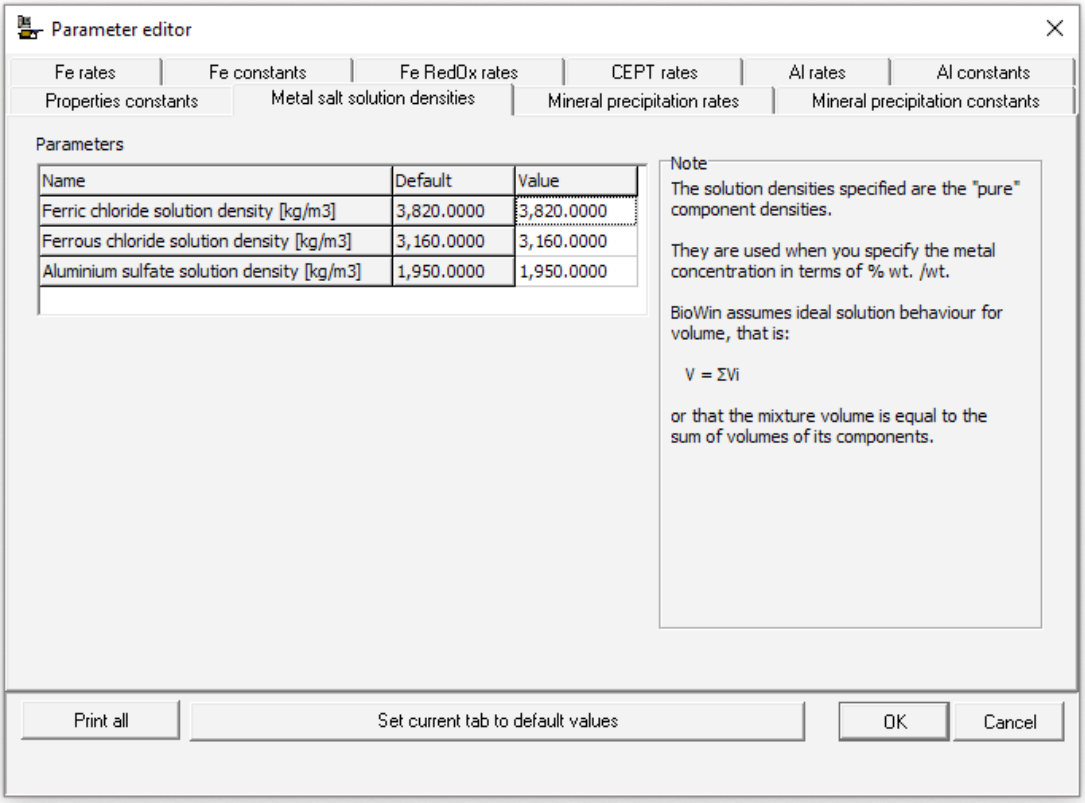


Usability Upgrade – Solution Densities

MANUAL REFERENCE :

Model Reference > Chemical Precipitation Reactions

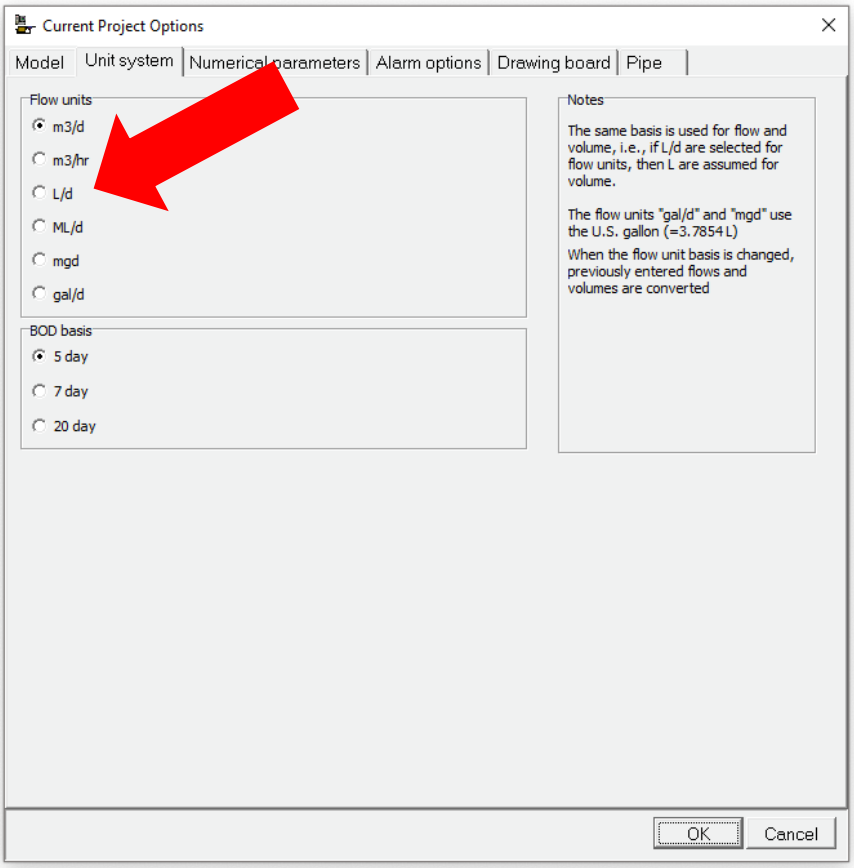
For metal salt input streams



Usability Upgrade – Additional Flow Units

MANUAL REFERENCE :

General Operation > Managing BioWin Projects > Setting Project Options > Unit SystemCubic meters per hour option for smaller systems

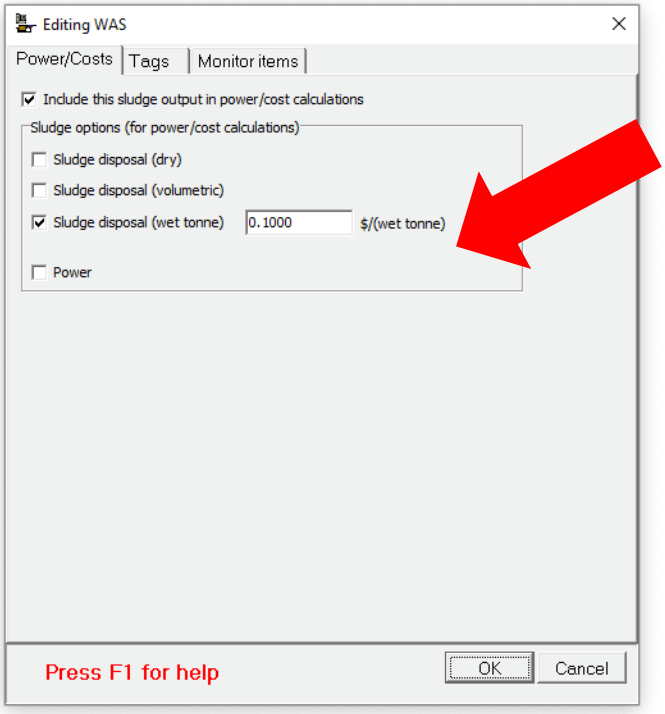


Usability Upgrade – $ per wet tonne sludge costs

MANUAL REFERENCE :

Operating Costs in BioWin > Operating Costs > Sludge

Third sludge disposal cost option added



Usability Upgrade – More Examples

BioWin Cabinet reorganized and greatly expanded with additional examples