



Planned updates

Excel application

- Input of measured reduction efficiencies of filters in gully pots (Swedish: "brunnfilter") (October 2015), however in September 15 they were added to the data base which can be downloaded;
- Updated reduction efficiencies of Swedish retention basins with filters (EcoVault), from monitored data 2015 (October 2015);
- Updated data of the effects of vegetation in wet ponds (October 2015);
- Updated methods for the calculation of design flow (& other updates) in accordance to the planned Swedish water publication P110 (in preparation and released directly with the release of P110).

Webb application

- Adding a possibility of combining two files into one result report, e.g. to present pollutants before and after exploitation (October 2015);
- Adding functionality to the boxes "Biofilter/raingarden & ditches/swales" (October 2015);
- Adding functionality to the box "Retention basin & filter" (November 2015);
- Adding a possibility to calculate facilities in a serie (November-December 2015)
- Adding more substances (December 2015).

StormTac updates, v. 2015-09

No.	Update description	Comments (sheet, cell)
Excel application		
1	Adjustments regarding cost calculations of wet ponds.	Sheet Costs
2	Adjustment regarding the design of structural soil	Sheet Ditches
Webb application		
1	Design of filter strip for treatment of stormwater is implemented, incl. calculated reduction efficiency.	Box Filter strip
2	Addition to the wet pond % wetland design; adding a possibility to reduce or delete the flow detention volume Vd1 in order to get lower detention depth.	Box Wet pond & wetland

StormTac updates, v. 2015-07

No.	Update description	Comments (sheet, cell)
Excel application		
1	Updated standard concentration data for blocks (apartment houses without roads) with local treatment within the block area.	
2.	Revised equation for calculation of flow and load from atmospheric deposition from surface water.	
Webb application		
1	Revised equation for calculation of flow and load from atmospheric deposition from surface water.	
2	Presentation of calculated design rain duration (min) at the design flow and at the design detention volume in the result report.	
3.	Minor adjustments in the flowchart.	
4.	Revised presentation of sewer dimension in the flowchart, now presenting the exact input inner dimension (mm).	
5.	Complemented with the design of transport ditches and channels (enhanced with more examples of Manning's roughness coefficients and with new	

	pictures, not included in the Excel application).	
6.	Updated with 13 new land uses (now the Web application includes all land uses included in the Excel application).	
7.	Reports: Presentation of designed ditch or channel.	

StormTac updates, v. 2015-06

No.	Update description	Comments (sheet, cell)
Excel application		
1	Updated standard concentration data for blocks; apartment roofs and inner yards (apartment houses without roads)	
Webb application		
1	Addition of a result report for the Recipient model	
2	Addition of input data and results in the result reports 1 and 3.	

StormTac updates, v. 2015-04

No.	Update description	Comments (sheet, cell)
Excel application		
1	Updated and improved design of infiltration and percolation basins for flow detention with exfiltration to the surrounding ground.	Box Detention facility
2	Addition of the Flow reduction factor in the input data box.	Box Detention facility (before only in the sheet Detention)
3	Revised minimum traffic intensity of 0 vehicles per day	Box Density
Webb application		
1	Added explanation of values in flowchart	
2	Adding a possibility of grouping and copying of projects	

StormTac updates, v. 2015-01

No.	Update description	Comments (sheet, cell)
1	Added design of desired return time (N) for calculating design flow and flow detention volumes (V_d), i.e. not only for N=1, 2, 5, 10, 50 and 100 years, but also for another desired return time, e.g. 20 years or 3.5 years..	Box Design flow, sheet Detention and chart of detention volumes.
2	Updated sub models for designing open ditches/swales and retention basins with or without filters.	Flowchart (sheet Stormtac).
3	Updated calculation of reduction efficiencies from open ditches, swales, biofilters (open bioretention basins), gravel ditches (infiltration trenches), retention basins without filters and retention basins with filter.	Calculations of reduction efficiencies as an empirical function of area or volume functions between the facility and the (reduced) watershed area. Flowchart, box Reduction efficiency and sheet Reduction efficiency.

StormTac updates, v. 2014-11

No.	Update description	Comments (sheet, cell)
1	Added design of biofilters (open bioretention basins) and gravel ditches (infiltration trenches), for flow, flow detention and treatment, including calculation of reduction efficiencies.	A result of the Vinnova project about grey-green solutions (focusing on local treatment and flow detention facilities such as rain gardens and curb extensions).
2	Updated design of green roofs and filter strips.	Included in the flowchart (simpler iterative design).
3	Added design and calculation of reduction efficiencies for serial facilities	Tables to present, B300:AC320. Information on how to design facilities in a serie; please read the notes in the sheet Tables to present, cell A300.
4	Updated standard concentrations for roofs and green roofs. These land uses are now presented among the standard land uses.	Improved comparison of the effect of green roofs on stormwater quality.

5	Added 6 new land uses with standard concentrations for multifamily houses and office areas with local treatment in biofilters and street areas with trees and skeletal soil.	
6	Added cost data from 4 Swedish underground detention basins..	Costs, D207. Cost can be calculated from facility area as a function of reduced watershed area (m^2/h_{red}).
7	Added sewer materials (cast iron, steel and PVC) valid for calculation of flow capacity of stormwater sewers.	Box Sewer, flowchart.
8	Added Manning's numbers for designing channels and ditches, also numbers for calculating flow from natural ground.	Detention, D284
9	Added data regarding the holding capacity (rain depth) of green roofs.	Green roofs, A6:A7.
10	Updated standard concentrations for recycling centers	After comparison to data frpm Bromma and Lövsta, Sweden.

StormTac updates, v. 2014-06

No.	Update description	Comments (sheet, cell)
1	Added 6 new land uses with standard concentrations, e.g. gravel and square areas.	

StormTac updates, v. 2014-01

No.	Update description	Comments (sheet, cell)
1	Added sub model for the retention effects of green roofs (yearly and for different design storms)	New sheet Green roof. Calculation of runoff coefficients as a function of rain depth. 5 different roofs with different materials and Pedestrian and cycle path. Based on new published reviewed data.
2	Updated standard concentrations for stormwater, the land use Pedestrian and cycle path.	Very large changes for e.g. Zn after comparison of the data to similar land uses.
3	Revised model for calculation of the effect of detention volume (emptying time) on the reduction efficiency.	Changed to linear function for better function for larger emptying time than around 80-90 hours (not so large change for smaller and more normal design emptying time, around 12-24 h).
4	Updated reduction efficiencies of different types of stormwater treatment facilities, e.g. biofilters, swales and floating wetlands.	New data from literature studies added in the data base of StormTac. However, the calculated reduction efficiency of wet ponds have not been changed (except for a new function of detention volume, see above).
5	Updated cost-benefit calculations for more substances	Sheet Costs, now functions not only for P.
6	Climate factor also for calculation of future increased yearly runoff flow (i.e. not only design flow)	Increase the yearly precipitation by multiplying with a annual climate factor, e.g. 1.1. See comments in the cell with the yearly precipitation data (default 636 mm/year).
7	New default rain return time.	N=10 years instead of 2 years, since most projects nowadays use N=10.
8	The function for calculation of the climate factor for design flow is now added also for calculated design flow, not only for design of detention volume.	The calculation includes functions based on rain return time and rain duration. The climate factor, e.g. around 1.15-1.2 for a design 10-year storm can be set manually form the box Design flow, flowchart, but if the user would like help to calculate a factor for a certain return time and a specific design rain duration, the function can be used by changing the number "0" to "1" in the Sheet Detention, cell C19.
9	Corrected information (however not affecting the calculations) of the presented base flow area from the flowchart for cases when the base flow area is differs from the watershed area.	Flowchart, cell G12.

StormTac updates, v. 2013-09

No.	Update description	Comments (sheet, cell)
1	Updated conditional formatting (grey cells) of calculated pollutant concentrations if greater than stormwater criteria concentrations.	Tables to present, cells B311:N311, accessed from the flowchart (Stormtac sheet), clicking on the symbol "Result table", cell I27.

StormTac updates, v. 2013-08

No.	Update description	Comments (sheet, cell)
1	Updated parameter values for calculation of reduction efficiencies in wet ponds and wetlands.	Regarding area and volume correlations, vegetation% and inlet concentrations. Resulted in changed reduction efficiencies for P, N, metals, SS, oil, PAH and BaP.

StormTac updates, v. 2013-07

No.	Update description	Comments (sheet, cell)
1	Updated standard concentrations for COD and BOD, and 6 new land uses.	5 different roofs with different materials and Pedestrian and cycle path.
2	Revised/updated recipient model.	Makes it possible to use measured concentrations before exploitation and calculate changed concentrations based on these measured data after exploitation (Recipient model, row 80-82, explanation in cell A80)
3	Revised runoff calculation for upstream surface water areas.	Total load from wet and dry deposition on the surface water area is still included based on the total precipitation, but the runoff from the surface water area is reduced with evaporation from the area.
4	Revised calculated part of vegetation in wet ponds or wetlands.	Based on the shallow zone of the facility. A constant value (25%) was used in earlier versions due to a deleted link, from v. 2013-06 the link with an equation is in function again. This affects the calculated reduction efficiency of the facility.
5	The base flow (groundwater) area is presented below the box base flow in the flowchart.	The groundwater area can be different from the runoff area, the presented value highlights this.
6	Complemented literature data of particle sizes, including particle settling velocities.	(Ref tables, rows 517:542).
7	Revised choice of different runoff coefficients for different sizes of watershed areas, for calculating flow from natural areas.	(More results, A243:C320)
8	Added Manning's constants for different materials, for designing ditches and channels.	Ref: Vägverket, 2008.

StormTac updates, v. 2013-02

No.	Update description	Comments (sheet, cell)
1	Revised detention facility model.	Reduced design outflow and optional input maximum inflow (Detention, B19 and B7).
2	Revised recommended climate factors for calculating design flow.	Optional consideration to rain duration and re-occurrence time (Detention, C19).
3	Reoccurrence time N (years) only input in box Design flow.	In previous versions N was also set in box Wet ponds & wetlands (Flowchart).
4	New table for calculating mean water velocity for the quantification of design flow	Input different transport distances with different design water velocities (Detention, Q14).
5	Added possibility to overwrite calculated design flows Q_{dim} for each rain duration, for the calculation of detention volume.	Furthermore, as before optional rain durations can be chosen, overwriting the default data in yellow input data cells (Detention).
6	Added graph presenting rain depth r_d (mm) as function of rain duration t_r (min) for different N.	(Diagrams to present, A413).
7	Updated land use specific standard concentrations for substances of priority according to the EU Water Framework Directive, in storm water and base flow.	The updates are also presented in the file "standard conc.xls", to be downloaded from www.stormtac.com .
8	Revised model for calculating pollutant concentrations of >70 substances from roads with different traffic intensities.	New functions between concentration and traffic intensity.
9	Storm water criteria is also presented in the result table for reduction efficiencies, directly below calculated concentrations	(Tables to present, B312)
10	Recommended data for different design parameters added for wetlands	Input data box "Wet ponds and wetlands"(Flowchart)
11	Revised notations on land uses	Identical with the notations in the file "standard conc.xls", translations to Swedish through link (Flowchart).
12	Added checks of sufficient emptying time in wet ponds or wetlands, maximal water velocity regarding risk for erosion and sediment settling velocity	(Wet ponds, Z107, AF107 and AO107)

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Earlier model updates (see the following pages)

StormTac – previous model updates

The table presents model changes (revisions and complements) and when these changes were performed.

No.	Change (“+” = complement, “-“ = revision)	Date (model version)
1	<ul style="list-style-type: none"> + The layout of the flowchart was improved with more comments and hints. + A manual was written. - “Stormwater management model” was divided into “Stormwater treatment model” and “Detention model”. 	2002-04
2	<ul style="list-style-type: none"> + More checks for the design of swales, new design ideas + Data %dissolved from road runoff added in the data base + Concentration data of SS and Zn from road runoff added + New input cells (area names) in the sheet “Multiple areas” + Automatic calculation of flow based on input rain depth. - Changed verification procedures and clarification regarding specific (contributing) areas and runoff coefficients for calculation of detention volumes and flows. - Revised functions of SS and Zn concentrations to traffic intensity. 	2002-05
3	<ul style="list-style-type: none"> + New table of pollutant concentrations as a mix of stormwater and base flow in the sheet “Multiple areas”. + Automatic calculation of water depth in recipients. + Added possibility of input of desired design flow for the design of ditches for stormwater transport in the Detention model, including the addition of a verification procedure. - Updated reduction functions of lakes in the “Recipient model” with links to the sheet “Reduction efficiency”. 	2002-06
4	<ul style="list-style-type: none"> + More results accessible from Recipient model in Flowchart. + Complementary input data of measured and critical concentrations, and extra point flow and point load data, in the input data box of the Recipient model in Flowchart. + Bottoms for automatically deleting default area values in the Runoff model and in the Recipient model. - Revised equations for automatic calculations of recipient reduction efficiencies and allowable loads in the Recipient model. - Revised equation for outflow load from recipients. Outflow load is calculated from measured concentrations if accessible, else from calculated concentrations. 	2002-09
5	<ul style="list-style-type: none"> + Complemented recipient model; new alternative methods for calculating accessible loads, sediment loads and recipient concentrations. New default values based on a new case study. New report of input and output data in the sheet “More results”. Developed concept of paper presenting the equations and 6 case studies. - Revised recipient model concerning accessible load for the case of no measured concentration data. - Updated standard concentrations for forests, farmland and atmospheric deposition (see web page). 	2002-10
6	<ul style="list-style-type: none"> - Recipient model: corrected acceptable load (L_{acc}) calculation in the alternative method of the OECD management model for phosphorus (P), resulting in 10 times higher L_{acc}. - Recipient model: corrected calculation of sediment load (L_{sed}) according to the alternative method by Reckhow (1988). - Flowchart: corrected calculation of reduced load (kg/year) after treatment and reduction efficiency (%) in the Stormwater treatment model when m^2 instead of ha is selected in the Runoff model. 	2002-11
7	<ul style="list-style-type: none"> + Added flow results in the unit $l/s/km^2$ (accessed from the flowchart by clicking on the “More results”-symbol in the Runoff model) and added model of calculating the flow in $l/s/km^2$ from mm/year and a runoff coefficient (accessed by clicking on the symbol “Unit transformation” in the down-right corner of the flowchart). + Added information on the definition/calculation of the precipitation value and the land use areas in the Runoff model (see notes in the flowchart). - Changed value/calculation method of the detention volume in the facility picture (accessed from “The stormwater treatment model” in the flowchart by clicking on the picture symbol). Now these values and the total detention values are consistent with the results (accessed by clicking on the symbol “More results” in “The stormwater treatment model” in the flowchart). 	2003-01
8	<ul style="list-style-type: none"> + Added boxes in Pollutant transport model and in the Recipient model, making it possible to consider existing and planned treatment in the watershed, e.g. in stormwater tunnels, wetlands and open ditches. + Added estimated recipient concentrations, presented in the flowchart of the Recipient model, as a 	2003-03

	<p>result of chosen design and estimated treatment efficiency.</p> <ul style="list-style-type: none"> + Added result tables in the Stormwater treatment model regarding reduction efficiency, loads and concentrations after treatment. + Added alternative design sub model for transport in ditches/channels (soil/concrete). + Estimation of oil index (new analysis method 2003) from unpolar aliphates and comments of differences. + Scientific Paper describing the Recipient model is completed and included in the model CD. The recipient model is verified and "complete" (however to be continuously updated with new data) - Changed standard concentrations from a study 2003-02. - Changed sedimentation coefficients in the Recipient model as a result of more case studies. - New default case study (lake Flaten in Salem, sub watershed Herrängsparken to Lake Flaten). Reason: both recipient and sub watershed data exists for the same case study. - New initially marked design method (No. 3) and changed default factor=150 (instead of 200) for this method. Method 1 is still of highest priority, but is somewhat more complicated. 	
9	<ul style="list-style-type: none"> + Added model for designing ditches and channels for stormwater transport, using Manning's equation. Accessible from the symbol "Go to Excel sheet" next to the box "Ditch" in the flowchart. - Revision in Manning's equation. - Revised link to dissolved fractions for studied pollutant, presented by clicking on the symbol "More results" next to the box "Runoff" in the "Pollutant transport model" in the flowchart. Some earlier model versions gave only zero values due to a link to wrong Excel cells. 	2003-04
10	<ul style="list-style-type: none"> + Swedish flowchart (click on a box next to the flowchart to get a Swedish version of the flowchart, i.e. the main model interface). + English-Swedish vocabulary (click on a box next to the flowchart to come to a vocabulary containing some of the more difficult words and including some comments). The vocabulary is continuously to be updated in later versions (not commented below). 	2003-05
11	<ul style="list-style-type: none"> + Choice of a specific sub watershed area to study of all 150 possible areas, directly from the flowchart. + Added sediment data from stormwater culverts to the data base in the Excel sheet "Ref tables". + Added and smaller minimum rain return time (5 minutes instead of 10 minutes) for calculation of detention volumes, see sheet "Detention". - Revised calculated transport time for estimation of design flow by setting the transport time to be minimum 10 minutes, else same calculation method. See sheet "Detention". 	2003-06
12	<ul style="list-style-type: none"> + Added concentration data concerning phosphorus (P), nitrogen (N) and suspended solids (SS) for different land uses in the data base - Revised and completed cost sub model for estimating costs for monitoring programs. - Revised English words for different land uses. 	2003-07
13	<ul style="list-style-type: none"> - Revised and strongly completed detailed cost sub model for estimating costs for stormwater facilities and sewers. 	2003-08
14	<ul style="list-style-type: none"> + Complementary calculated and measured recipient pollutant water concentration values presented in the flowchart, with a verification check. + New facility in the Stormwater treatment model; design of detention basins for pollutant reduction according to a methodology used by the Swedish Road Agency ("Vägverket"), designing the basin after a specific rain depth, e.g. 15 mm. + New verification check for minimum and not negative bottom width of treatment facility. + New verification check of areas in the studied subwatershed in relation to total recipient watershed area, the former to be smaller than the latter. - Changed equation for calculation of recipient water calculation after treatment, using recipient volume directly instead of depth multiplied with area and thereby decreasing the risk for getting wrong results (since the water depth can be wrongly calculated if formulas are overwritten by mistake, using input data forms). - Revised metal, PAH and BaP base flow concentrations presented in flowchart (before 1000 times to large). However the corresponding loads have not be changed (they were correct). 	2003-09
15	<ul style="list-style-type: none"> + New land uses for adding input concentration values to e.g. "Other land uses" in the sheet "Data base standard conc.". Added land uses: golf courses, airports, petrol stations and green areas as a mixture of forests and meadows. + Adding a possibility to change all land uses (also to overwrite the standard land uses), to be done in the sheet "Data base standard conc.", except for roads 2-10 to be changed in the sheet "model". + New result table of areas per land use for up to 150 subwatersheds, accessed from the result table symbol at the box "(sub)watershed area". + New result table of runoff+baseflow load per land use, accessed from the bottom of the sheet "Tables to present". - revised box "Sewer" in the flowchart, e.g. to use new inner diameters for plastic sewers. 	2003-10
16	<ul style="list-style-type: none"> + Addition of the tool menu "StormTac" from which the user e.g. can open and save input data that occupy much less space on the hard drive. The files are in the Excel format and have the extensions 	2003-11

	<p>“.tac”, to be easily searched for from e.g. Explorer. From this model version and forward it is recommended always to start by opening the original file stormtac.xls and then open and save data from the new menu. The input data files can be opened from updated model versions, not having to rewrite input data from a project when the model is updated. From the menu you can also select “Flowchart” to quickly come back to the flowchart, you can erase all area values and you can read about general information about StormTac.</p> <p>+ Addition of region-specific z-values for calculation of region- specific rain intensity values (l/s/ha) according to Dahlström’s formula, including a map of Sweden for the choice of z-value.</p>	
17	<p>+ Added estimation of time of concentration regarding Design flow (ref: Svenskt Vatten (2003). Dimensionering av allmänna avloppsledning. Publikation P90. Förhandskopia, November 2003).</p> <p>+ Other added features from P90 (se above): notes runoff coefficients for sewer design, changed notes of the choice of design rain return times, an added model for calculation of detention volumes and an added model for calculation of design flow for watersheds with large share of natural areas (click on the symbol “More results” next to the box “Design flow”).</p> <p>+ Added result data (recipient concentrations, limit loads and sediment loads) from alternative calculation methods. These data are accessible by clicking on symbols “More results” next to the corresponding boxes in the sub model “Recipient model” in the flowchart.</p> <p>+ Possibility to only use only one detention volume (deleting the first detention volume) in a wet pond and a limit maximum flow ($Q_{out, 2}$) is added. Notes about this are added in the sheet “Wet ponds”, cells F72, F73 and C23.</p> <p>- changed standard concentration values for apartments and golf courses (the latter available from the data base of runoff concentrations, clicking on the box “Input data”).</p> <p>- Deleted water depth and residence time in input box “Recipient data” in the flowchart, since these are calculated and else the formulas will be deleted. It is still possible to use own values by writing these data in the corresponding cells in the sheet “Recipient model”.</p>	2003-12
18	<p>+ Added sub model for calculating design sink velocity considering inflow and outflow particle (SS) concentrations, viscosity, water temperature, particle size and density. The model is based on Stoke´s law. The sink velocity is linked to the design method for wet ponds (No. 5, surface load).</p> <p>+ Added features in the specific StomTac menu (developed in version 2003-11): recent saved files are presented and can be opened directly, the split windows may be deleted and all sheets may be zoomed by a desired value.</p> <p>+ Added saving features: when you save StormTac a window appears reminding you if you want to save a data file before you close the main StormTac model file (which generally is not to be saved since it occupies much memory).</p>	2004-01
19	<p>+ Added note/calculation box in the flowchart in which the user may write notes or calculation to be saved in the specific project tac-file.</p> <p>+ Improved features when saving a tac-file. When the file is re-opened not only the data but also the selected parameters and design methods are the same as when the file was saved.</p> <p>- Changed default model for design of ditches in the Detention model, adding bottom width in the input data box. The other alternative and iterative model may be studied in the sheet “Detention” for comparison of results. In that sheet several verification checks have been included.</p> <p>- Revised sub model for calculating recipient water concentrations before and after treatment.</p> <p>Improved features in the flowchart considering changes between calculated and measured recipient concentrations.</p>	2004-02
20	<p>+ Added zoom boxes in the central of the flowchart, making it possible to zoom in to a specific sub model or back to view the whole flowchart (by clicking on the central square).</p> <p>+ Added sub model for calculating sediment growth rate (mm/year) in stormwater treatment facilities. Accessed from the flowchart next to the box “Facility area”, by clicking on the symbol for “More results”.</p> <p>+ Calculated facility cost per reduced amount phosphorus (cost-benefit, including comparative values from built facilities).</p> <p>- Corrected 2-year intensity values for detention volumes.</p> <p>- New (higher) standard concentration values for phosphorus in atmospheric deposition after complemented literature studies.</p>	2004-03
21	<p>+ Complemented Design method 1 in the Stormwater treatment model by adding a possibility to input a maximum flow value to the pond (the rest bypasses the pond). Click on the symbol “Goto Excel sheet” next to the Design method 1 “Red. Eff.” in the Flowchart.</p> <p>+ Complemented information (not included in the manual) on how to use the Recipient model, available as a notification in cell K43 in the Flowchart.</p>	2004-04

	<ul style="list-style-type: none"> + Adding a possibility to replace default substances by the substances COD, Fe, BOD, TOC, Cl and Arsenic. Click on the box Runoff in the flowchart and in the sheet Standard concentration that you then come to click on the box "Other substances" around cell S2. - Corrected that the factor slope 0-10 is in function again after being lost since version 2003-02. Also corrected that 0-10 and not 1-10 shall be used as factors for slope and the choice of land use specific stormwater concentration values. 	
22	<ul style="list-style-type: none"> + Complemented possibility to add input data of outflow concentrations from lakes (or surface water values). This data may be used to calculate outflow loads instead of using an average concentration for the whole water body. + Added data of %dissolved fractions in stormwater from roads. 	2004-08
23	<ul style="list-style-type: none"> + Added data of sediment metal concentrations in Swedish wet ponds (Vägverket, 2003). + Added data of aquatic plants and their capacity of removing different metals in stormwater wet ponds or wetlands. The data is accessed from the sheet StormTac, beginning from cell A259. + Added data of pollutant reduction efficiencies (%) from 2 Swedish underground detention basins. + New model for estimation of the pollutant reduction efficiencies (%) for underground detention basins as a function of calculated or measured pollutant concentrations (mg/l) in the inflow water. 	2004-09
24	<ul style="list-style-type: none"> + Added data of pollutant reduction efficiencies (%) for open ditches from 4 references. + Added notes of pollutants of priority according to a Danish study (2004). See lists of pollutants in the right corner of the flowchart where the pollutants of priority now are in written in bold and all the substances of priority are noted in the cell marked "Other". - Corrected equation for calculation of Sediment growth rate in wet ponds, in the sheet "More results" (accessed by clicking on the symbol "More results" next to the box "Facility area" in the flowchart). 	2004-10
25	<ul style="list-style-type: none"> + Addition of the new submodel "Source model", accessed from a new box in the flowchart in the "Pollutant transport model". Pollutant loads from different sources, such as wet and dry deposition, road wear, brake wear, car tyre wear and copper and zinc surfaces, are calculated and compared to the pollutant loads calculated in the "Pollutant transport model". 	2004-11
26	<ul style="list-style-type: none"> + Addition of 2 new sheets for analyses of uncertainty and sensitivity. These are however still under development (are not ready). For instance, the sensitivity analysis for the Recipient model is not yet added, diagrams and links from the flowchart are yet to be included and the Stormwater treatment model and the Detention model are not yet included in these analyses. 	2004-12
27	<ul style="list-style-type: none"> + Added information in the sheet "Multiple areas" regarding how to add several (column) areas to a new (column) summed area, which may be selected from the flowchart for calculations. + Added data of standard concentrations to the database in StormTac from the large database NSQD v.1.1, U.S.A., Feb. 2004. Includes other substances such as BOD, COD, As, Fecal coliform, Total E. Coli, Total coliform and Fecal Strept, making it possible to calculate concentrations and loads of these substances by replacing some of the ordinary substances. + Added calculation form in the sheet Wet ponds, for "calculated required inflow (l/s) for different residence times (h)" in a wet pond as a function of the pond volume. - Revised standard concentrations from studying the NSQD database, see www.stormtac.com. - Revised functions for expressing the "slope" (z) and "density" (x), see the corresponding boxes in the flowchart. - Revised function for calculating costs and material areas for filling material, rubber coating and fleece in ponds (considering pond depth etc.). 	2005-02
28	<ul style="list-style-type: none"> + Added equations for the calculation of sediment pollutant concentrations (mg/kg DS) in the facility. Accessed from Tables to present (P255:AC262). + Complementary standard values of facility costs. + Added alternative method for calculation of sediment growth rates in the facility. More results E41:M48. + Added design outflow criteria. More results (from Detention facility). + Added standard concentration data for COD, BOD, TOC and NH4-N. + Complementary results for receiving waters are presented and accessed from More results in the Recipient model. - Changed standard methods for calculation of pollutant concentrations and acceptable loads in the receiving waters, based on the OECD-model but with regional data from Stockholm as default. 	2005-03
29	<ul style="list-style-type: none"> + Added data of dissolved pollutant fractions. + 13 added land uses (harbour area, grave yard, school, athletic field, less and more dense commercial areas, less and more dense industry, airports, railway area, petrol stations, golf courses, mixed green areas, office and commercial). Almost completed. + Added data of base flow pollutant concentrations. 	2005-04
30	<ul style="list-style-type: none"> + 13 added land uses completed in the sheets and the input data forms. + Complementary and revised analyse costs, e.g. including a recommended storm water package. 	2005-05

31	<ul style="list-style-type: none"> + Added input data cells F86:F87 in the sheet "Wet ponds" for changing u-parameter for designing holes in weirs, and adding a comment that hr is in this case the distance between the centre of the hole and the top of the weir. + New x_j and y_j data from 23 Swedish lakes instead of 7 lakes, employed for calculating lake pollutant concentrations from the OECD-model. Also new sedimentation coefficients (k_j) from these lakes, used in a alternative method for calculating lake pollutant concentrations. - Changed default return time "N" from 5 to 2 years. - Deleted plastic sewer dimension "225" in the box "Sewer", Flowchart. - Revised standard equation for calculation of acceptable load. The equation is derived from the OECD-model, however as default employing added data from 23 Swedish lakes. 	2005-10
32	<ul style="list-style-type: none"> + Added calculation of yearly reduction efficiencies from summer values or winter reduction efficiencies from summer values, accessible from the sheet Reduction efficiency, cells A165:W174. + Added calculation of yearly pollutant concentrations from summer values or winter concentrations from summer values, accessible from the sheet Data base standard concentrations, cells B636:T646. + Added data of reduction efficiencies and of pollutant concentrations from roads. 	2005-11
33	<ul style="list-style-type: none"> + Added standard concentration data for base flow, giving changed pollutant concentrations for the base flow part. - Revised equations when using z-values according to Dahlströms equation for calculating rain intensities; correcting an error that occurred for 5 and 10 minutes rain durations for "2. Detention volume and heght" (i.e. not for longer rain durations), and also correcting for the rain intensities for "1. Design flow". 	2005-12
34	<ul style="list-style-type: none"> + Added cost posts for different kinds of facilities, such as sewers, digging costs, oil separators and working costs. + Added data of reduction efficiencies for wet ponds. + Added data of pollutant concentrations as a function of traffic intensity. - Changed equations for calculating reduction efficiencies and dimensions of wet ponds as a function of V_p/V_r, A_p/A_{red} and RE. - Changed equations for calculating pollutant concentrations as a function of traffic intensity. - Corrected that base flow is calculated also from the added land uses in version 2005-05. - Changed that Arsenic concentration is calculated in $\mu\text{g/l}$, not mg/l. 	2006-01
35	<ul style="list-style-type: none"> + Added design method of infiltration basins, accessed from the box Detention facility, flowchart. + Added picture pond outlet design, sheet Wet ponds. - Updated manual. - Updated method for calculation of the reduction efficiency of detention basins. - Updated design of the volume of wet ponds from updates empirical equation and new data of reduction efficiencies of suspended solids and phosphorus. - Changed standard concentrations from the land use Petrol stations. 	2006-05
36	<ul style="list-style-type: none"> + Added land use "Cutting area" (Swedish: hygge), with runoff coefficients and standard concentrations. - Revised and complemented design method of infiltration basins, accessed from the box Detention facility, flowchart. In the sheet More results methods in P90 and P46 are included (revised and now completed equations). 	2006-09
37	<ul style="list-style-type: none"> + Added measured data of stormwater pollutant concentrations in the data base for 3 case studies during every month during at least one year, making it possible to study monthly and seasonal differences. + Added data of wet pond reduction efficiencies during different seasons. + Added reduction efficiencies and (reduced) runoff coefficients of local infiltration measures (LOD) for residential areas with detached houses, terraced houses and apartments respectively. These are available from the data base with reduction efficiencies, at the bottom rows of this data base. This makes it possible to calculate reduced pollutant concentrations and loads from areas with these local facilities. As an alternative, new land uses with reduced standard concentrations may be used; available by clicking on the box runoff concentrations in the flow chart, then clicking on the box "Input data (more land uses and LOD)" and follow the instructions there. + Added data of standard concentrations for different substances, for the land uses commercial, industry, detached houses, terraced houses and apartments (however the standard concentrations affecting the calculations have not been changed as a result by these data, but the data can be used for future changes). + Added result table of the sum of stormwater and base flow (m^3/year and l/s), available from the box or sheet "Multiple areas", the last table in the sheet. + Added table in the note next to the box sewer, presenting minimum dimensions for sewers below different road types (Swedish: trummor). + Added data in the data base for wet pond reduction efficiencies, affecting the following listed update. - Updated equations of reduction efficiencies (%) for wet ponds and the design volumes for certain 	2007-02

	<p>required reduction efficiencies.</p> <ul style="list-style-type: none"> - Updated (reduced) standard Pb-concentrations for terraced houses, apartments, commercial and industry. 	
38	<ul style="list-style-type: none"> + Added area number 150 in Multiple areas as a sum of the previous areas. + Added result tables of water quality criteria, in the sheet Result tables (not ready) + Added separate StormTac file with security settings for those who have the security setting as the highest and thereby disabling macros. The file makes it possible to choose to trust the StormTac certificate and thereby enabling macros. This file is included only if asked for and is not including a total secured solution. The Office program Selcert.exe was used which is mainly for test purposes but seems to function correctly. - Revised box "Wet ponds" in the flowchart in which A_s and φ_s were deleted since these parameters only affect some part results that are not presented as main results from the flowchart. Values of the parameters can however be used directly from the sheet Wet ponds and the results are presented in that sheet in the rows 107:125. - Revised recipient sheet, correcting an error that occurred in versions from 2006-10 to 2007-02. The error occurred when data was filled in the box "Recipient data" from the flowchart and when clicking on the box again an error message occurred. As a result even some of the cells in the recipient sheet presented error signs, however all cells with output data presented correct results. - Revised standard concentration of P from areas with leisure houses, increased from 0.2 to 0.46 mg/l as a result of calculated values from the Swedish EPA (1983). 	2007-03
39	<ul style="list-style-type: none"> + Added water quality criteria for StormTac, Stockholm city, lakes, sea and shore, rivers and sediments. Data can easily be copied to reports with <u>automatically generated</u> colors (white-light grey-grey-dark grey) in measured/calculated concentrations reflecting which class they belong to. Accessed from the sub model Recipient model & water quality criteria, in the flowchart. The box Limit concentrations may be clicked on for input data and the symbol for result table may also be clicked on. + Added land uses: heat plant with deposition area for bio fuels and offices and traffic, waste deposit areas. + Two added calculation methods (Dahlström, 2006, and Hedebring, 2006) for detention facilities and design flows from updated precipitation data, reflecting climate changes. Accessed from the results shown from the flowchart (next to the boxes Detention facility and Design flow, and in the sheet Detention). + Added notes next to the box precipitation with time trends in precipitation, flow and pollutant loads from the reference studies Dahlström (2006), Hernebring (2006) and Persson (2007). - Increased standard concentrations for farmland (agriculture) and decreased minimum concentrations from airports. - Decreased prices for analyses of pollutants in storm water. - Decreased average rain duration as default value, from 12 h to 6.7 h, reflecting updated precipitation data from the period 1984-2004 (Hernebring, 2006). - Increased average rain dept as default value, from 6 to 7.3 mm (Hernebring, 2006). This and the changed average rain duration results in a relatively large increased calculated average rain flow (l/s). 	2007-05
40	<ul style="list-style-type: none"> + updated trend notes of precipitation (next to the box precipitation in the flow chart) + new design guidelines of wetlands in the sheet wetlands and notes of reduction processes. - revised standard concentrations of P and N from golf courses as a result of complemented measurements data from 4 American golf courses. 	2007-07
41	<ul style="list-style-type: none"> - revised standard concentrations for SS from forests and for DOC from forests. - Moved box "Click" next to the box Detention facility, to the sheet More results. 	2007-09
42	<ul style="list-style-type: none"> + Added "land use area" as input in limit concentrations , the "area" is instead of the 10th area (A10) now an "area" A1 after treatment. This makes it possible to compare reduced concentrations after the designed treatment facility for area A1 with stormwater quality criteria, to study if the facility is efficient enough. See the box Limit concentration. 	2007-10
42	<ul style="list-style-type: none"> + Updated, complemented and revised data for the design of wet ponds (resulting in revised reduction efficiencies and also pond dimensions for Design method 1). + Updated and revised flow model for calculating part flow and pumping flow, presenting a studied flow's share of total runoff using equations based on long term precipitation data with short time steps. + Updated and revised standard concentrations for airports. + Updated database from complementary literature studied with reduction efficiencies for different types of stormwater treatment facilities. + Complementary data of metals in atmospheric deposition (the standard concentrations were not changed). - Revised to zero concentration of oil in baseflow from rural land uses. 	2008-03

	<ul style="list-style-type: none"> - Revised runoff coefficients for LOD-facilities (local facilities). - The box for automatic Swedish translation of the flowchart was deleted. - Revised detention volumes for watersheds <65 ha by automatically multiplying with a factor (from Swedish experiences of detention facilities, an equation for estimating the factor was developed). 	
43	- Revised equations for calculating pollutant concentrations for different traffic intensities for road 2-10, changed to be the same (before updated) values as for Road 1.	2008-04
44	+ Separation of design runoff coefficients and volume runoff coefficients; updated model for design flow using specific runoff coefficients and specific design areas, not necessarily total areas (as opposed to use volume runoff coefficients and always total area as in the pollutant transport model).	2008-05
45	+ New stormwater quality criteria for required stormwater treatment (preliminary values, to be updated autumn/winter 2008) and improved layout in flowchart for both concentration and load criteria, e.g. coloured cells to be compared and added notes in cells.	2008-07
46	- Revised area links for baseflow from the three land uses Industry less dense, industry more dense and office areas.	2008-08
47	+ Updated stormwater quality criteria (preliminary values, to be updated autumn/winter 2008).	2008-09
48	<ul style="list-style-type: none"> + Compiled irreducible concentrations, sheet Reduction efficiency, rows 252:263. + Added concentrations data from Irish and British highways (ADT=25 000-30 000 vehicles/day), however not yet changed equations for calculations of concentrations due to traffic intensity (ADT). + Added data of dissolved metals from highways (%). - Revised (increased) standard concentrations of P from forests and farmland, revised standard concentrations of Cl and TOC from general highways. 	2008-10
49	<ul style="list-style-type: none"> +New standard concentrations for Hg and BaP, see homepage table or Excel file to be downloaded. +Updated data base of sediment concentrations in wet ponds. +Updated data base of dissolved metals from highways (%). + Updated data base of reduction efficiencies (%) from permeable asphalt, swales and infiltration trenches. + New land uses: green roofs (including runoff coefficients for mean precipitation, for different seasons and more intense rain events), local streets and detached houses excluding road ditches. 	2008-11
50	+ New model for designing wet ponds and wetlands considering the new parameters inflow concentration, irreducible concentration, cold climate, detention volume (detention time/emptying time at average runoff flows), %vegetated (wetland zones) and form (hydraulic efficiency or length:width ratio). Reduction efficiencies and the design dimensions may therefore be calculated as before or by including one, more or all of these parameters (i.e. site specific conditions are considered in a way they were not before). This is a major improvement of the model, even if there are uncertainties and the parameters will be updated in future model versions and with more data. Papers are planned to be written and reviewed, one reviewed paper is already available for download from www.stormtac.com . It is recommended to first use the default model and than to test and compare by adding new parameters, and to present results with interval values as results of these compared calculations or to write notes of this uncertainty in the report.	2008-12
51	<ul style="list-style-type: none"> - Revised recipient model regarding K_x, the share of infiltrated water that reaches the base flow. As default the value =1.0 for recipients (all infiltrated water reaches the recipient) and 0.7 for stormwater transport systems, 1.0 is more normal for receiving waters than the previous default value $K_x=0.7$. Furthermore, in previous versions there was only one K_x value used for both stormwater systems and recipients, now they are separated so that different values may be used in the same file. The K_x input data cell for recipients is located in the sheet Recipient model, cell C69. The K_x for stormwater systems is as before accessed from the input data box Base flow in the Runoff model of the flowchart. + Added box above the flowchart, clicking on the box results in a Swedish flowchart. 	2009-01
52	- Revised stormwater criteria for different level of emissions to different types of receiving waters. This is a major improvement of the model. (Reference: RTK, Stockholm county, Feb 2009).	2009-02
53	<ul style="list-style-type: none"> + Added presentation of 3 levels of uncertainty regarding the standard concentrations, using different background colours for different uncertainties (click on the box concentration from the flowchart or see the table presented in www.stormtac.com) + Added calculated detention times of wet ponds during yearly average flow, mean runoff flow and design flow (in sheet Wet ponds, cells E75:O77) + new standard concentrations for NH4-N, SO4, conductivity and alkalinity. -Updated standard concentrations for harbours. 	2009-03

	<ul style="list-style-type: none"> - Updated standard concentrations for bacteria (Fecal coliform and E-coli). - Changed standard concentrations from low intense roads (<500 vehicles/day) and changed minimum road runoff concentrations. - Changed presented number of decimals for the standard concentrations. 	
54	<ul style="list-style-type: none"> + Added and updated cost data for around 30 different facilities or facility parts, such as floating sea bridges and stormwater sewers. Also updated general standard cost data for wet ponds (SEK/m³). + Added stormwater criteria from USA (2005-2006) and Canada (2002-2003), for comparison of the used standard stormwater criteria from Sweden. + Added criteria for receiving waters from EU (2008), updated criteria added from the Swedish EPA and added criteria from the US EPA (2006). + Added and updated data from Swedish wet ponds; 2 new ponds, updated data of reduction efficiencies for 3 of the Swedish ponds and corrected dimensions for 2 of the Swedish ponds. Resulted new empirical equations for calculation of reduction efficiencies for the designed pond. + Added data of reduction efficiencies for floating wall basins. - Changed standard concentration for oil from 7 of the land uses. - Changed calculated detention volumes for wet ponds, based upon average values from Dahlström and Hernebring, better reflecting the detention volumes calculated from the sub model Detention model. The total detention volume considers the effect of Detention volume 1 for treatment. Changes have been performed in the sheet Wet ponds, cells C70:C75 and in the sheet Diagrams to present, cell F7. - Revised equation for calculation of acceptable load on recipients, regarding the method that is based on measured recipient water concentration. 	2009-10
55	<ul style="list-style-type: none"> + More results added in the drawing of the wet pond facility. - Changed standard concentrations for roofs (Cu), loading street (Cu), meadows (N and SS) and green area (N and SS). - Average runoff flow, presented in the flowchart, has been moved to a cell above the runoff flow box. - Changed method numbers in the box Wet ponds. - The parameter rain depth (r_{da}) in the box Precipitation and the box Wet ponds has been changed to have the same default value, and the parameters from the both boxes have been linked (if one is changed, the other is changed automatically). 	2009-12
56	<ul style="list-style-type: none"> + Added cost data for filters in gully pots (wells) and for floating vegetation beds. - Changed standard concentrations for atmospheric deposition (N) and farmland (P and SS). - Changed (increased) baseflow concentration for farmland (N). - Changed (increased) runoff concentration for farmland. 	2010-01
57	<ul style="list-style-type: none"> - Changed design data (changed input data such as area, volume and reduction efficiencies) for wet ponds, resulting in changed reduction efficiencies. - Changed parameter values and optional design criteria for wet ponds, e.g. added data resulting in new functions for %vegetated, inflow concentration and irreducible concentration. Much more data, i.e. more reliable than before. - Changed standard concentrations for mercury (Hg) for most of the standard- and minimum concentrations, resulting in much lower calculated concentrations of Hg than before. This is a result of calibration to case study Tibbledammen, and new added base flow concentrations. 	2010-03
58	<ul style="list-style-type: none"> + Added post of input specific oil reduction efficiency for oil separation in wet ponds/wetlands, box Reduction efficiency, flowchart. - Changed default base (main) method for calculating reduction efficiency, now A_p/A_{red} instead of V_p/V_r is default, due to a general better fit to data for the A_p/A_{red} function. -The results of standard calculation of reduction efficiency without considering optional parameters, such as inlet concentrations, is now in hidden cells. In order to only see the results of either V_p/V_r- or A_p/A_{red}-functions, the user needs to input 0 for each default optional parameter to be included, box Reduction efficiency, flowchart. This has been performed since it is believed better to consider site specific parameters than not and to not present too much alternative results (more user friendly). 	2010-04
59	<ul style="list-style-type: none"> - Increased Hg-concentration from roads, increased standard concentrations of P and Cr from garden plots. - Updated data and functions of concentrations from road runoff as function of traffic intensity. 	2010-07
60	<ul style="list-style-type: none"> + New tables of dissolved fractions from all land uses and from Swedish highways + CV-data (Coefficient of variation) of standard concentrations added. - Updated concentrations (standard, min and max) for atmospheric deposition and for E. Coli (almost all urban land uses). 	2010-09
61	<ul style="list-style-type: none"> - Updated concentrations (standard and min) for N, PAH₁₆ and BaP from atmospheric deposition, and decreased max values for SS from commercial areas. - Updated function for N from roads. 	2010-10

62	<p>+ Possible to get some results in the flowchart presented in US-units, and in unit transformation section more conversion functions from SI to US units have been added.</p> <p>-Changed layout of flowchart, e.g. colours and clickable boxes around the flowcharts with links to useable web sites for watershed maps, traffic intensities and information search.</p>	2010-12
63	<p>- Corrected that if Vd1 is set to 0 then reduction efficiency can still be calculated as a function of detention volume (and detention time).</p> <p>-Minor changed layout of flowchart, e.g. colours.</p>	2011-01
64	<p>+ Added parameter for estimating reduction efficiencies in wet ponds and wetlands depending on input temperature in water or air.</p> <p>+ Adding a possibility to calculate the effects of existing treatment facilities upstream in a (sub)watershed area, for multiple areas. This results in decreased loads and concentrations of pollutants in the outlets of these areas.</p> <p>+ New flowchart layout (photos to click to delete), complementary US-units.</p>	2011-02
65	<p>+ Updated rainfall intensity frequency duration (IFD) data from Dahlström (2010), replacing old data from Dahlström (2006), Hernebring (2006) and old z-values, no longer recommended.</p> <p>+ Adding a data base of IFD data from other countries, and adding a possibility to input optional data of rain durations and intensities so that the model can calculate required detention volumes and design flows.</p> <p>+ New IFD curves with presented input and output (design flow) data for reports, including historical data, climate factors and curves for different countries.</p> <p>+ New detention curves based on rainfall data from Dahlström (2010), including historical data and climate factors. The presentation includes input and output data for reports.</p> <p>+ Optional input of climate factors for calculated design flow and required detention volumes, with recommended values for Sweden, for different return times (based on SMHI data from 2010 and Danish data presented on ICUD'08).</p> <p>+ Optional input of added design flow (Qdim+) from e.g. upstream detention facilities, making it possible to calculate detention facilities in series.</p> <p>+Added N=50 years (rain return time), for design flow and detention volume calculations. Also, adding a possibility to change N to other values, e.g. to calculate for N=0,5, 3, 20, .. years instead of the standard values of N (1,2,5,10,50 and 100).</p>	2011-04
66	<p>+ Updated and improved flow and detention model from version 2011-04. The model is used for calculating design flow (l/s) and required flow detention (m3), based on the in Sweden newly recommended equation by Dahlström (2010). It is possible to change to return times (years), durations (min) and rain intensities (l/s/ha), for all sites of the World (by e.g. adapting the equation coefficients to input data).</p> <p>+ Added land use with standard concentrations: recycling centrals (Swedish: återvinningscentraler).</p> <p>+ Updated base flow concentrations for all land uses, based on 14 case studies (9 Swedish and 4 American).</p> <p>+ Updated data for estimating the Kx-coefficient for calculating base flow (l/s). However the default standard value was not changed since the added case studies showed that the best fit-to-data-value was the same as before. The value is 0.7, normally varying between 0.3-0.8, extremes between 0-1, the later used for e.g. lakes for which all infiltrated flow is transported to the lake.</p>	2011-05
67	<p>+ Added design of smaller underground concrete retention basins (EcoVault, EcoSense, FL, USA)</p> <p>+ Added calculations of the reduction efficiencies of retention basins.</p> <p>+ Added rain intensity data for Florida rain zone 7, USA.</p> <p>+ Added a possibility to save changed design rain intensities from other countries than Sweden.</p>	2011-06

68	+ Simplified flowchart, deleting not required data (still left unchanged in the data sheets).	2011-07
69	+ Updated base flow concentrations with general rural, minimum and maximum data. + Input all other (other than the default ones) land uses for base flow concentrations in StormTac (the same that since 2011-07 have been accessed from "standard conc.xls" and the home page), making it more easy to change default base flow concentrations.	2011-08
70	+ Many added substances with standard concentration, min- and max concentrations for storm water and base flow, e.g. priority substances of EU Water directive. Possible to calculate pollutant loads and concentrations (but not yet recipient concentrations and reduction efficiencies).	2012-01