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June 30, 2015
RGC Project No: 212006

Nyrstar Myra Falls
British Columbia, Canada

Attention: Nicole Pesonen

RE: Update on Water Balance Modeling for Nyrstar Myra Falls

Nicole,

This memo provides an update on the development of an operational water balance model for Nyrstar Myra Falls (NMF). This work is being undertaken in support of Old TDF closure planning, yet the water balance model includes all components of NMF's surface water management system. The project lead for this work is Pat Bryan, an independent hydraulic engineer and RGC Associate.

1 Project Deliverables and Timelines

The key deliverable is a model that can be used to track the operational water balance of the mine, including the day-to-day variations in the water balance for the Old TDF and the Lynx TDF. The platform adopted for programming the model was GoldSim, a graphical software package that has gained wide acceptance throughout the mining industry for preparing water balances.

Completion of the coding and calibration of the model will be completed in early July. The documentation of the model, including preparation of the finalized flowsheet, is anticipated by the end of August 2015. Modeling results will then be used to update the site-wide contaminant load balance and evaluate closure scenarios for the Old TDF.

2 Progress to Date

2.1 Completed Tasks

The following is a list of completed tasks:

- Review reports prepared by mine personnel and the mine's consultants to extract information on the mine's water management system, including details on hydraulic structures such as decants, spillways and pipelines.
- Prepare a draft flowsheet for the mine's water balance to provide a framework for developing the GoldSim Model.
- Visit the mine to clarify details on the mine's water management system and to request data inputs for water balance components related to the concentrator, paste plant and backfill plant.
- Process the mine's daily precipitation and temperature records, which span a period of 35 years. This entailed distributing accumulation periods in the precipitation record and making estimates for missing data in both records.
- Develop a hydrological model in GoldSim to simulate un-gauged runoff components and inflows to the underground mine workings. Figure 1 shows the layout of the model. It includes a snow model that simulates ripening of the snowpack and estimates snowmelt rates using a temperature index. A soil moisture routine is incorporated in the model to simulate the effect of antecedent moisture conditions on runoff response. Linear reservoirs are used to simulate delay and dispersion of runoff as it passes through a catchment *en route* to the catchment's outlet. The hydrological model is used to simulate runoff hydrographs for 25 minesite subcatchments. The coding shown in Figure 1 does all this computational work in parallel by taking advantage of the vector structure in the GoldSim software.
- Delineation of catchment boundaries, determination of catchment average elevations, and the preparation of elevation-area-volume relationships for key storage reservoirs at site.
- Development of rating curves for hydraulic structures, such as decants, pipeline inlets and culverts. This required mine personnel to survey elevations and measure dimensions of some of these structures.

2.2 Substantially Completed Tasks

The following is list of tasks that are substantially completed:

- Assemble model input data required to characterize dewatering of the aquifer underlying the Old TDF and water balance components related to the concentrator, paste plant and backfill plant.
- Program model representation of the mine's water management system. Figure 2 shows a high level representation of the water balance programmed in GoldSim. Each container represents a mine element (e.g., Lynx TDF, Old TDF, and Super Pond) that has a significant influence on the movement and storage of water at the mine. Figure 3 presents the contents of the "Old TDF" container, and graphically illustrates the coding used to simulate the water balance of the Old TDF. The coding for the individual mine elements is essentially complete. Work is now focusing on completing the linkages between the mine elements, such as the pumping of water from the Lynx TDF to the Super Pond's inflow channel.

2.3 Remaining Tasks

Tasks remaining are:

- Calibrate the model. The main calibration target will be the measured outflows from the Polishing Ponds. The calibration will largely involve adjusting parameters associated with the hydrological model. In addition to simulating runoff components of the mine's water balance, the hydrological model will also be used to simulate intermittent springs that discharge to the tailings facilities, and to simulate groundwater inflows to the underground mine workings.
- Finalize the formal flowsheet to represent the structure of the GoldSim model and provide a means of summarizing the operational water balance.
- Prepare a report describing the structure of the GoldSim model and results of the model calibration. It is anticipated that the model will be calibrated for the three-year period from January 1st, 2012, to December 31st, 2014. This period includes both below-average and above-average climatic conditions. Text describing the hydrological model and the algorithm for the Old TDF is complete.

3 Closure

We trust that the information provided here meets your requirements.

Please contact the undersigned if you have any questions regarding the content of this memo or require any further information.

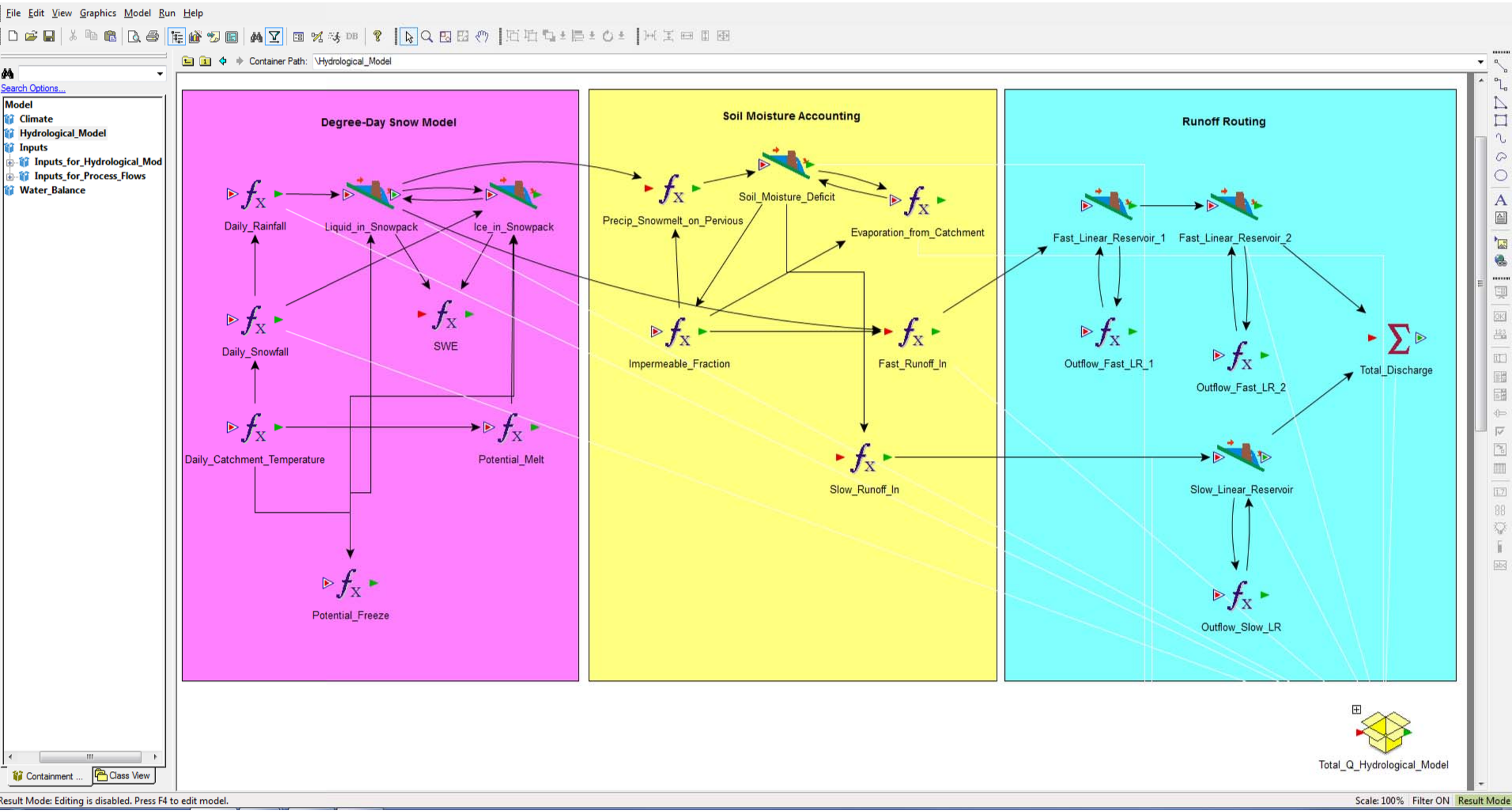
Best Regards,

ROBERTSON GEOCONSULTANTS INC.

Dr. Paul Ferguson
Senior Geochemist

FIGURES

Figure 1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Degree-Day Snow Model
Daily_Rainfall
Liquid_in_Snowpack
Ice_in_Snowpack
SWE
Daily_Snowfall
Daily_Catchment_Temperature
Potential_Melt
Potential_Freeze
Soil Moisture Accounting
Precip_Snowmelt_on_Pervious
Soil_Moisture_Deficit
Evaporation_from_Catchment
Impermeable_Fraction
Fast_Runoff_In
Slow_Runoff_In
Runoff Routing
Fast_Linear_Reservoir_1
Fast_Linear_Reservoir_2
Outflow_Fast_LR_1
Outflow_Fast_LR_2
Total_Discharge
Slow_Linear_Reservoir
Outflow_Slow_LR
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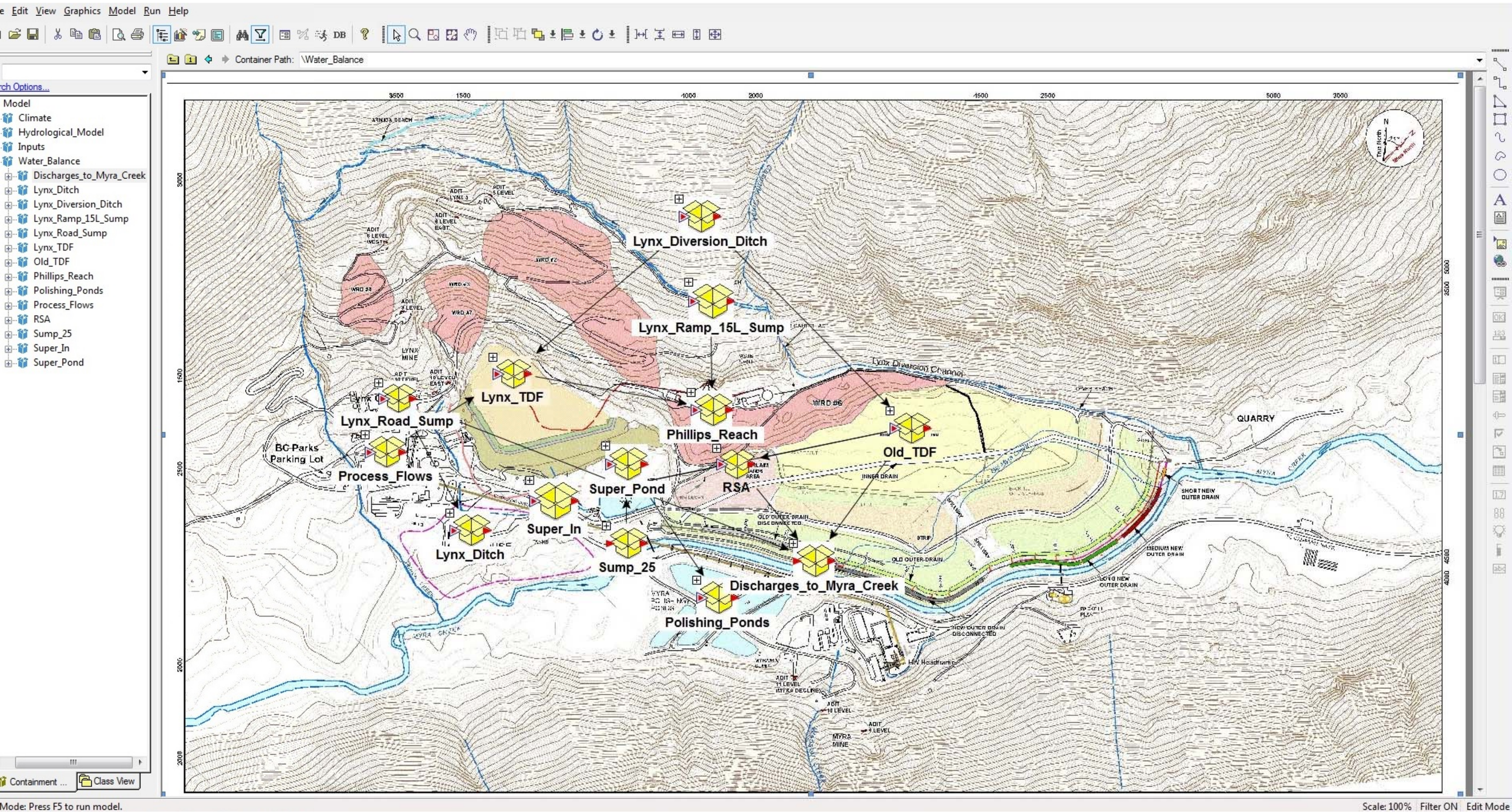
Figure 2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Lynx_Diversion_Ditch
Lynx_Ramp_15L_Sump
Lynx_Road_Sump
Lynx_TDF
Old_TDF
Phillips_Reach
Polishing_Ponds
Process_Flows
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Super_In
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Sump_25
Containment ...
Class View
Lynx_Diversion_Ditch
Lynx_Ramp_15L_Sump
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Lynx_Road_Sump
Phillips_Reach
Old_TDF
Process_Flows
Super_Pond
RSA
Super_In
Lynx_Ditch
Sump_25
Discharges_to_Myra_Creek
Polishing_Ponds
BC Parks Parking Lot
QUARRY
Lynx Diversion Channel
INNER DRAIN
OLD OUTER DRAIN
SHORT NEW OUTER DRAIN
MEDIUM NEW OUTER DRAIN
LONG NEW OUTER DRAIN
NEW OUTER DRAIN DISCONNECTED
OLD OUTER DRAIN DISCONNECTED
LYNX MINE
MYRA MINE
MYRA CREEK
WRD #2
WRD #3
WRD #4
WRD #5
WRD #6
WRD #7
ADIT 5 LEVEL
ADIT 6 LEVEL WEST
ADIT 6 LEVEL EAST
ADIT 7 LEVEL
ADIT 10 LEVEL EAST
ADIT 11 LEVEL MYRA DECLINE
ADIT 10 LEVEL
ADIT 9 LEVEL
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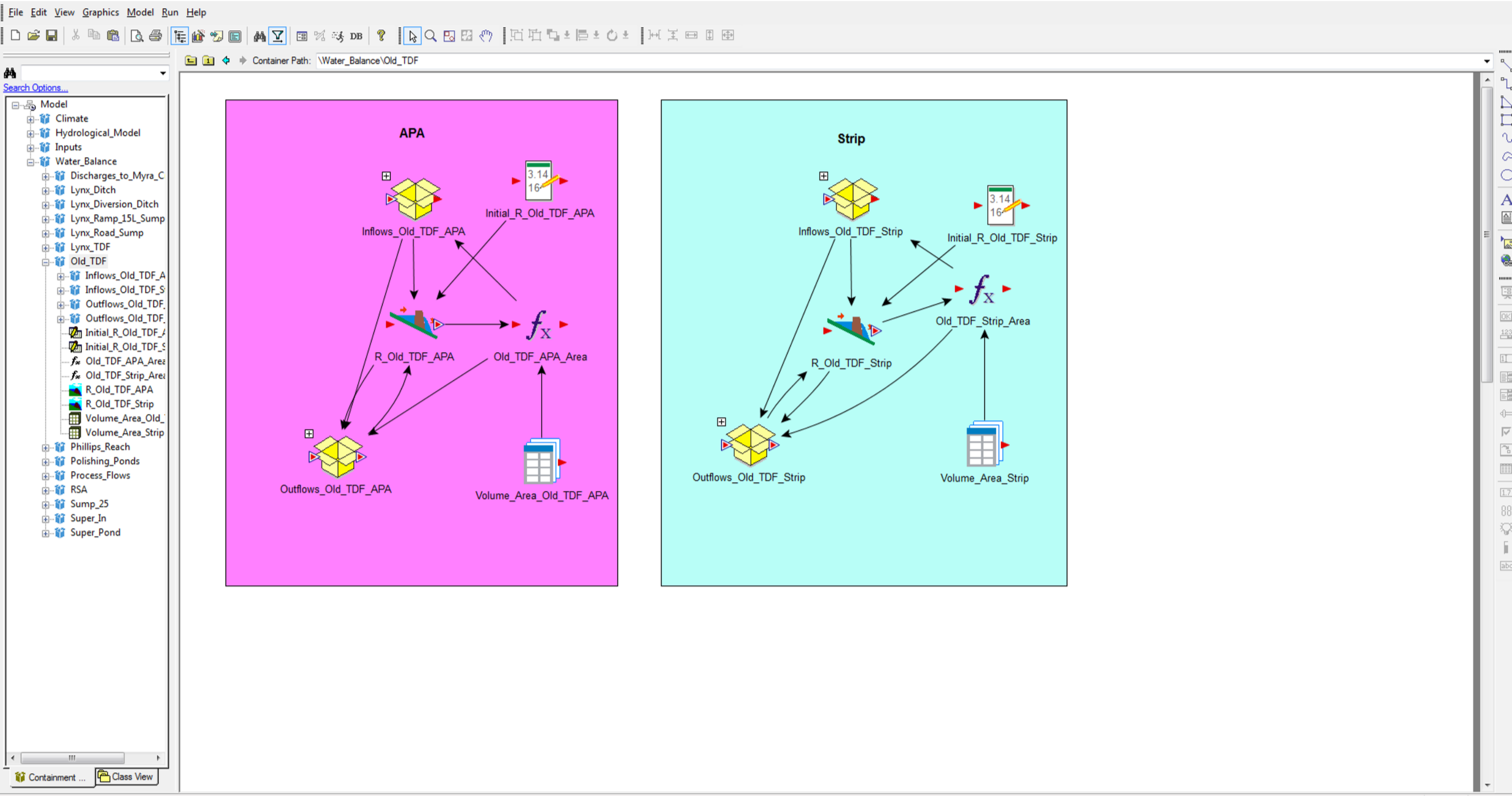
Figure 3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Lynx_Diversion_Ditch
Lynx_Ramp_15L_Sump
Lynx_Road_Sump
Lynx_TDF
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Outflows_Old_TDF_
Outflows_Old_TDF_
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Initial_R_Old_TDF_S
Old_TDF_APA_Area
Old_TDF_Strip_Area
R_Old_TDF_APA
R_Old_TDF_Strip
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Volume_Area_Strip
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Sump_25
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Super_Pond
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Initial_R_Old_TDF_APA
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Old_TDF_APA_Area
Outflows_Old_TDF_APA
Volume_Area_Old_TDF_APA
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