NORTH PRB MASS BALANCE FOR SULFATE BASED ON AVERAGE VALUES DURING YEAR 10 (Operations)

In

$Q_1 := 2065.9 \cdot gpm$	$C_1 := 322.1 \cdot \frac{mg}{L}$	North Toe to PRB	$M_1 := Q_1 \cdot C_1$	$M_1 = 1324.8 \cdot \frac{tonne}{yr}$
$Q_2 := 30.8 \cdot gpm$	$C_2 := 241.6 \cdot \frac{mg}{L}$	North Buttress to PRB	$M_2 := Q_2 \cdot C_2$	$M_2 = 14.8 \cdot \frac{tonne}{yr}$

Unclear why C_1 and C_2 are so far below concentration cap for sulfate

Out

$Q_3 := 10.1 \cdot gpm$	$C_3 := 319.4 \cdot \frac{mg}{L}$	PRB to North GW surficial aquifer flow path	$M_3 := Q_3 \cdot C_3$	$M_3 = 6.4 \cdot \frac{tonne}{yr}$
$Q_4 := 2086.5 \cdot gpm$	$C_4 := 319.4 \cdot \frac{mg}{L}$	Pumped out of PRB and sent to other parts of site	$M_4 := Q_4 \cdot C_4$	$M_4 = 1326.8 \cdot \frac{tonne}{yr}$
$Q_5 := 0 \cdot gpm$	$C_5 := 319.4 \cdot \frac{mg}{L}$	PRB to surface water (MLC3 and TC1)	$M_5 := Q_5 \cdot C_5$	$M_5 = 0 \cdot \frac{tonne}{yr}$

Flow

$Q_{in} := Q_1 + Q_2$	Flow in	$Q_{in} = 2096.7 \cdot gpm$
$Q_{out} := Q_3 + Q_4 + Q_5$	Flow out	$Q_{out} = 2096.6 \cdot gpm$
	This ratio should be close to unity because there is not storage in PRB	$\frac{Q_{out}}{Q_{in}} = 1$

Mass Flux

$M_{in} := M_1 + M_2$	Mass flux in	$M_{in} = 1339.6 \cdot \frac{tonne}{yr}$
$M_{out} := M_3 + M_4 + M_5$	Mass flux out	$M_{out} = 1333.2 \cdot \frac{tonne}{yr}$
$RE := 1 - \frac{M_{out}}{M_{in}}$	Removal efficiency. This should be zero for year 10 because the PRB is not in operation. Computed value is reasonably close to zero.	$RE = 0.5 \cdot \%$

NORTH PRB MASS BALANCE FOR SULFATE BASED ON AVERAGE VALUES DURING YEAR 99 (Closure)

In

$Q_1 := 457.6 \cdot gpm$	$C_1 := 107.0 \cdot \frac{mg}{L}$	North Toe to PRB	$M_1 := Q_1 \cdot C_1$	$M_1 = 97.5 \cdot \frac{tonne}{yr}$
$Q_2 := 30.8 \cdot gpm$	$C_2 := 241.5 \cdot \frac{mg}{L}$	North Buttress to PRB	$M_2 := Q_2 \cdot C_2$	$M_2 = 14.8 \cdot \frac{tonne}{yr}$

Unclear why C_1 and C_2 are far lower than concentration cap for sulfate

Out

$Q_3 := 10.1 \cdot gpm$	$C_3 := 33.3 \cdot \frac{mg}{L}$	PRB to GW surficial aquifer flow path	$M_3 := Q_3 \cdot C_3$	$M_3 = 0.7 \cdot \frac{tonne}{yr}$
$Q_4 := 0 \cdot gpm$	$C_4 := 33.3 \cdot \frac{mg}{L}$	No pumpage out of PRB during closure	$M_4 := Q_4 \cdot C_4$	$M_4 = 0 \cdot \frac{tonne}{yr}$
$Q_5 := 478.6 \cdot gpm$	$C_5 := 33.3 \cdot \frac{mg}{L}$	From PRB to surface water (MLC3 and TC1)	$M_5 := Q_5 \cdot C_5$	$M_5 = 31.7 \cdot \frac{tonne}{yr}$

Flow

$Q_{in} := Q_1 + Q_2$	Flow in	$Q_{in} = 488.4 \cdot gpm$
$Q_{out} := Q_3 + Q_4 + Q_5$	Flow out	$Q_{out} = 488.7 \cdot gpm$
	This ratio should be close to unity because there is not storage in PRB	$\frac{Q_{out}}{Q_{in}} = 1.001$

Mass Flux

$M_{in} := M_1 + M_2$	Mass flux in	$M_{in} = 112.3 \cdot \frac{tonne}{yr}$
$M_{out} := M_3 + M_4 + M_5$	Mass flux out	$M_{out} = 32.4 \cdot \frac{tonne}{yr}$
$RE := 1 - \frac{M_{out}}{M_{in}}$	Removal efficiency. According to model input, the PRB removal efficiency should be 50% for sulfate. The GoldSim model is apparently overestimating the sulfate removal.	$RE = 71.1 \cdot \%$