Sediment Budget Analysis System (SBAS2001)

CIRP Technology Transfer Workshop

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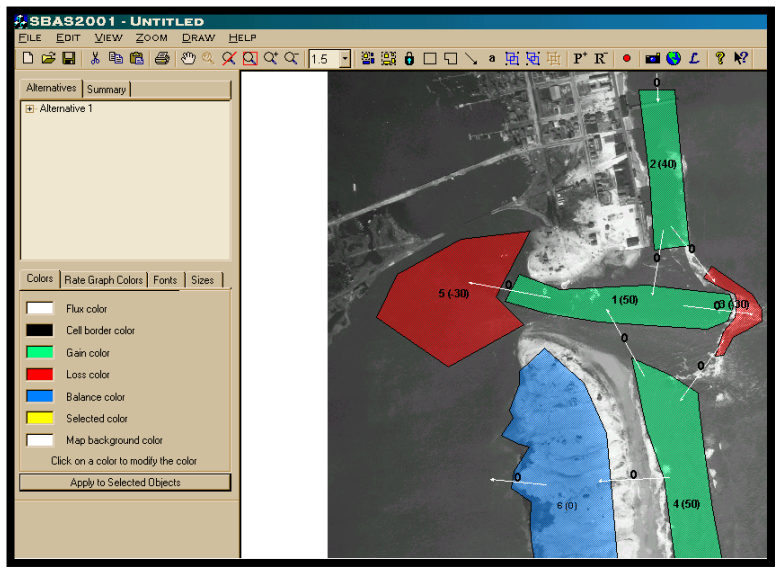
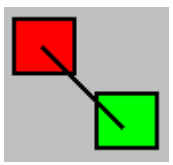
In cooperation with
National Conference on Beach Preservation Technology

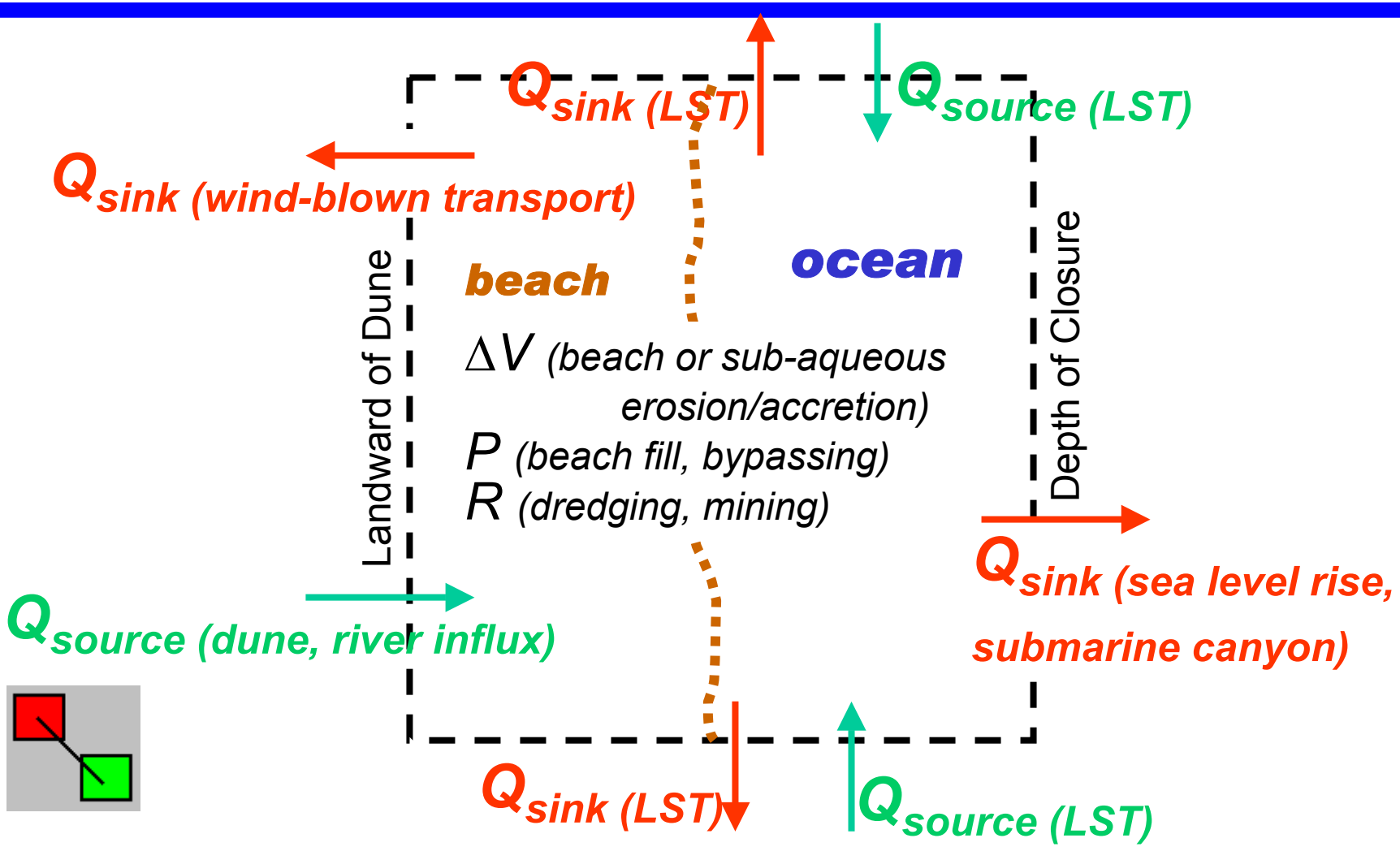
Overview

- Define Terms
- SBAS2001 Capabilities
- Application: Hillsboro Inlet, FL
- Demonstration
- Hands-on

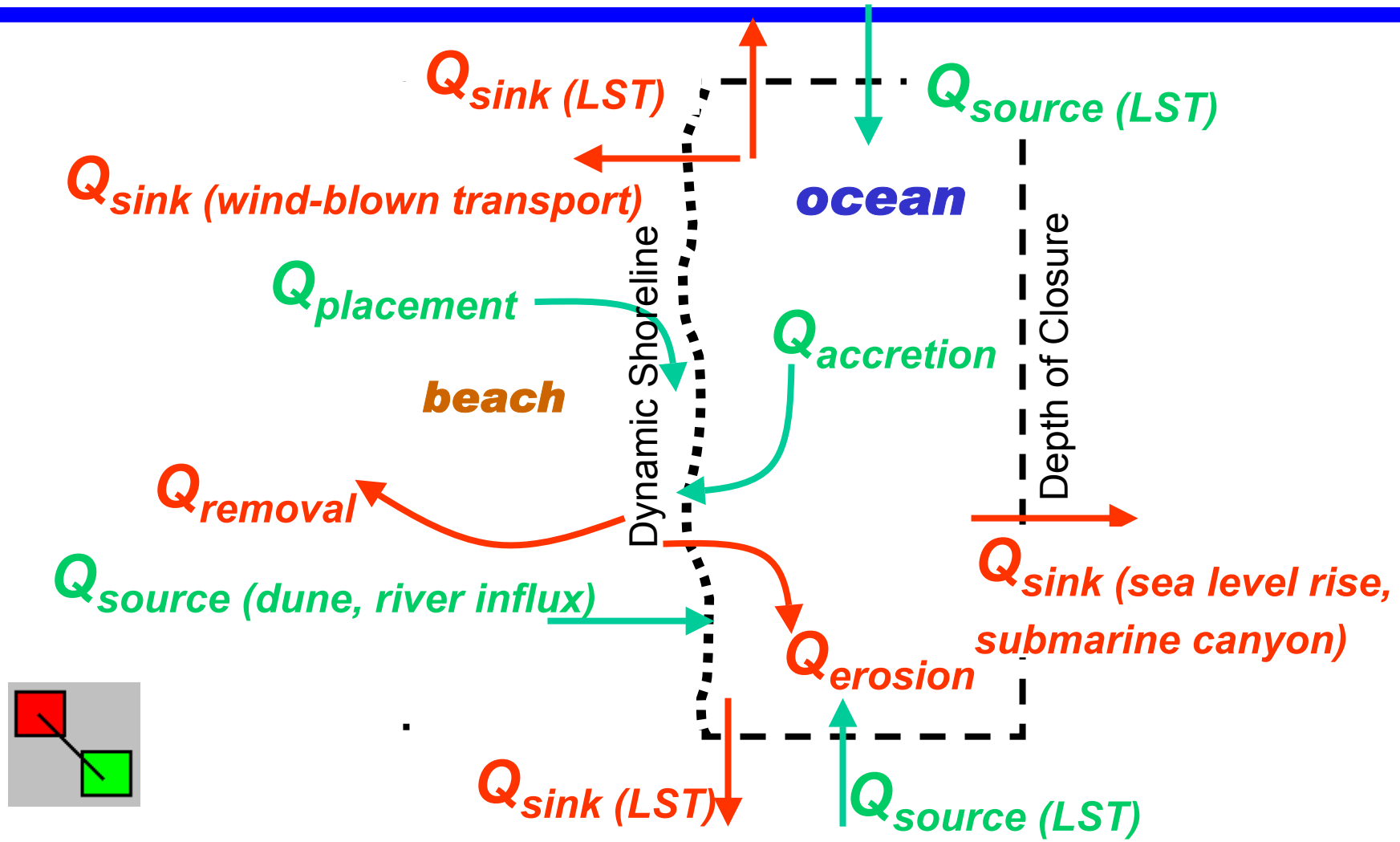




Terminology -- Cell Type 1
Boundary Landward of Dune



Terminology -- Cell Type 2
Boundary at Dynamic Shoreline



Terminology:
Sediment Budget Equation

$$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = Residual$$

Q_{source} , Q_{sink} = input or export to cell

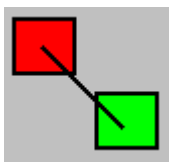
ΔV = Volume change within cell

P = Placement into cell

R = Removal from cell

Residual = cell surplus or deficit

(= 0 for balanced cell)



Hillsboro Inlet, Florida
Sediment Budget

120,000 cy/yr is the net longshore sand transport rate updrift of the inlet

54,000 cy/yr is transported over the north jetty weir section into the sediment basin

60,000 cy/yr is deposited into the entrance channel

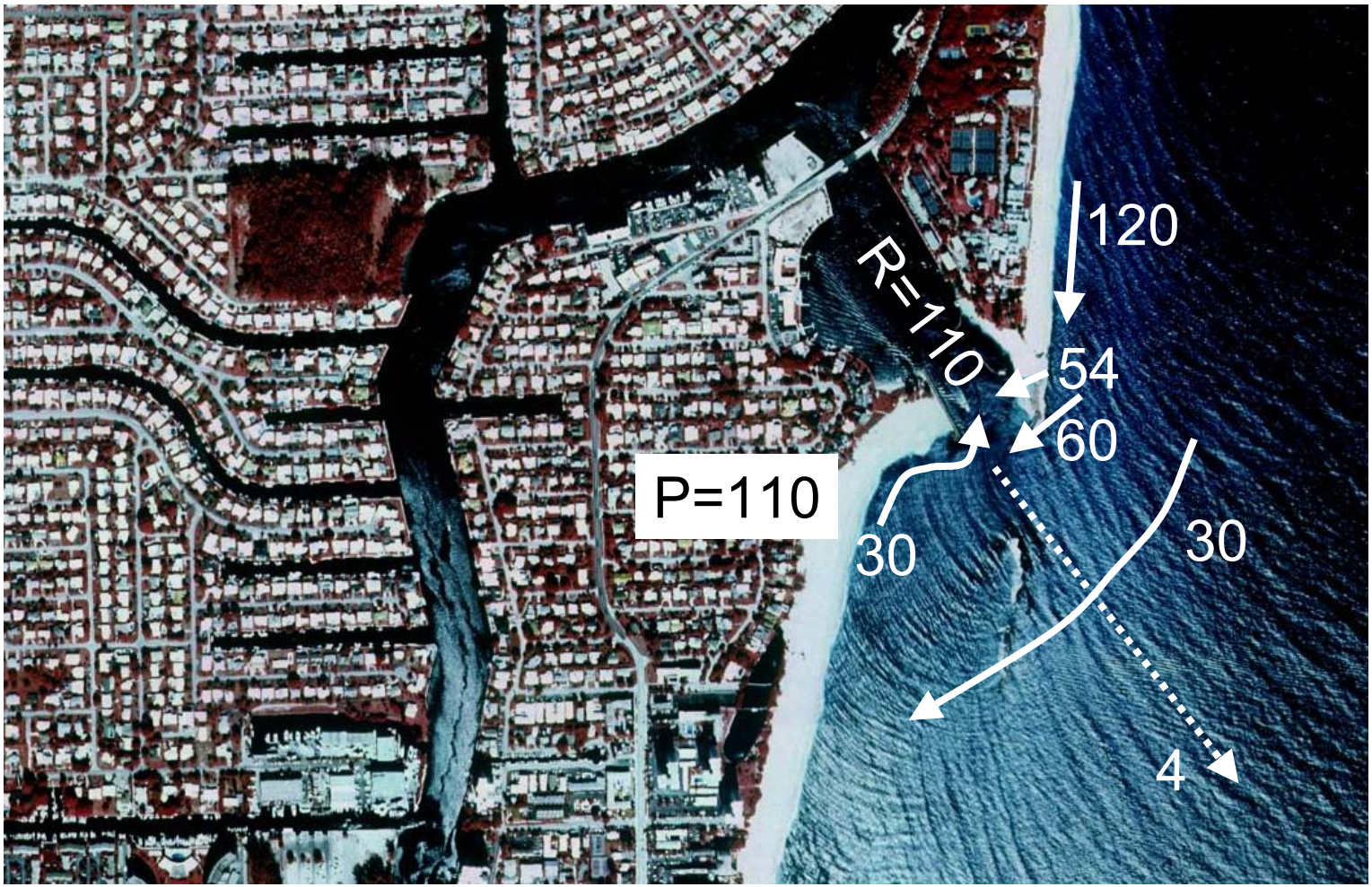
30,000 cy/yr moves into the inlet from the south

30,000 cy/yr bypasses the inlet naturally (north to south)

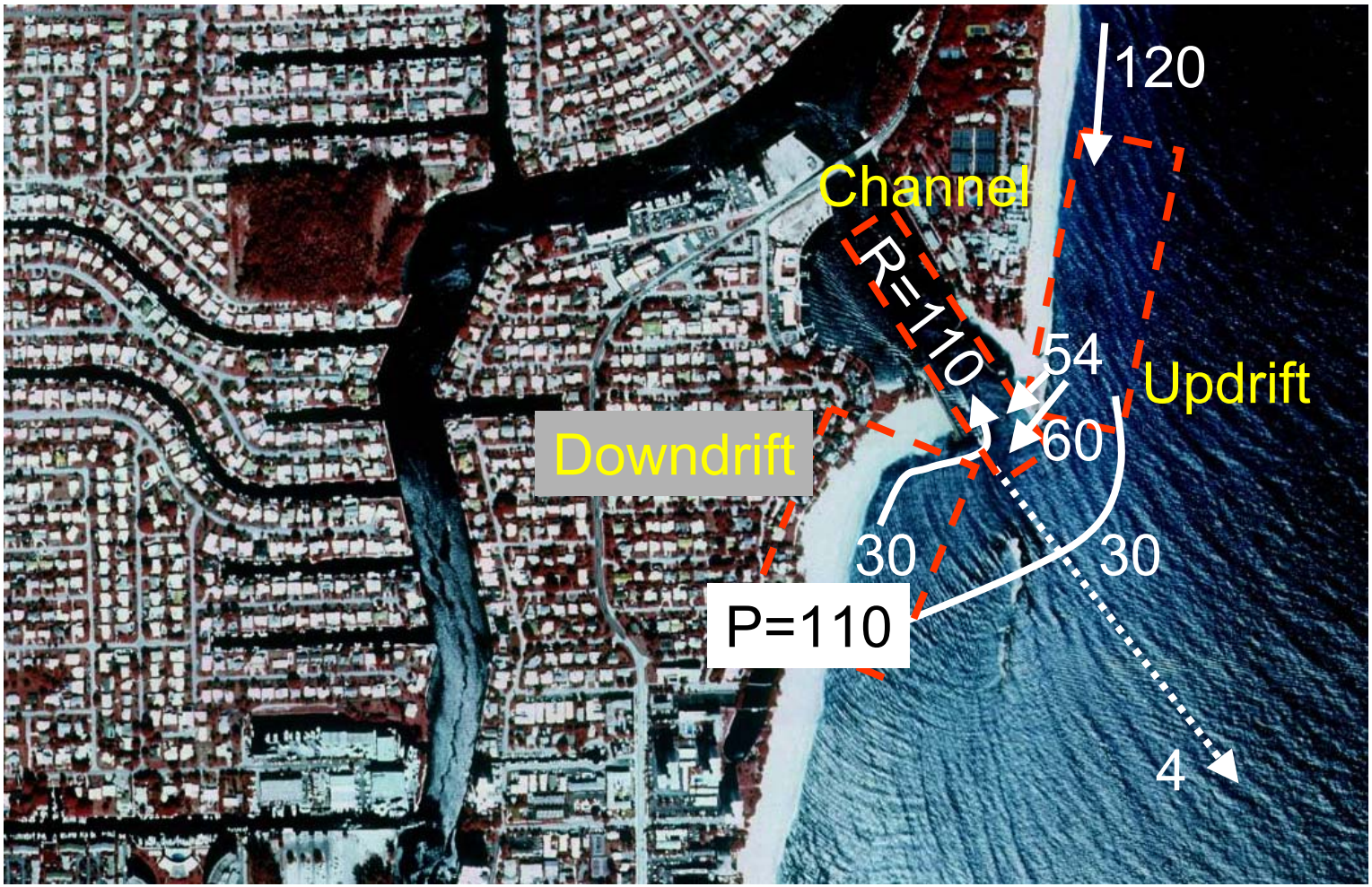
4,000 cy/yr lost to deep water on ebb flow

110,000 cy/yr is dredged from the channel and bypassed to the downdrift beach

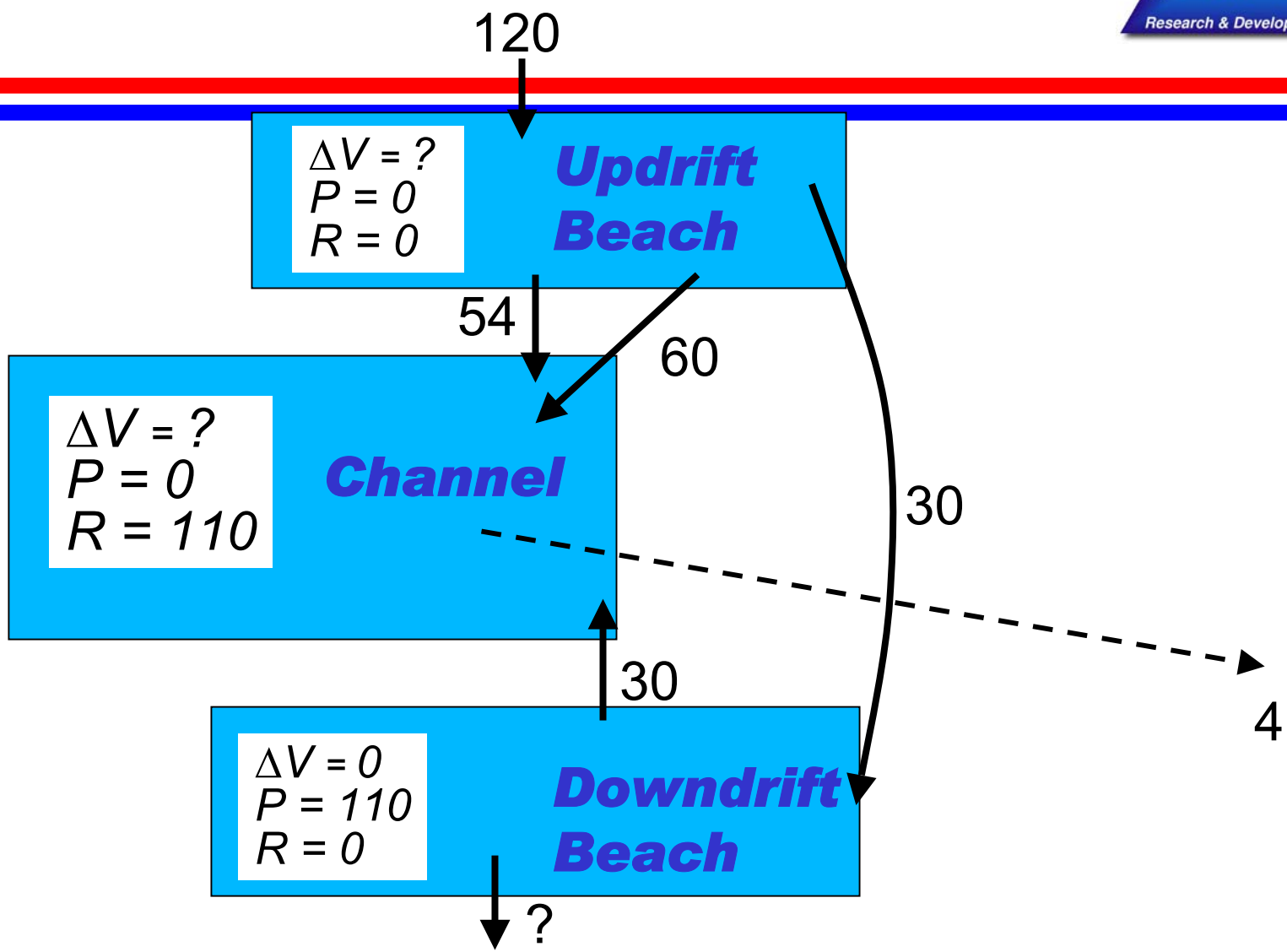
Hillsboro Inlet, Florida
Sediment Budget



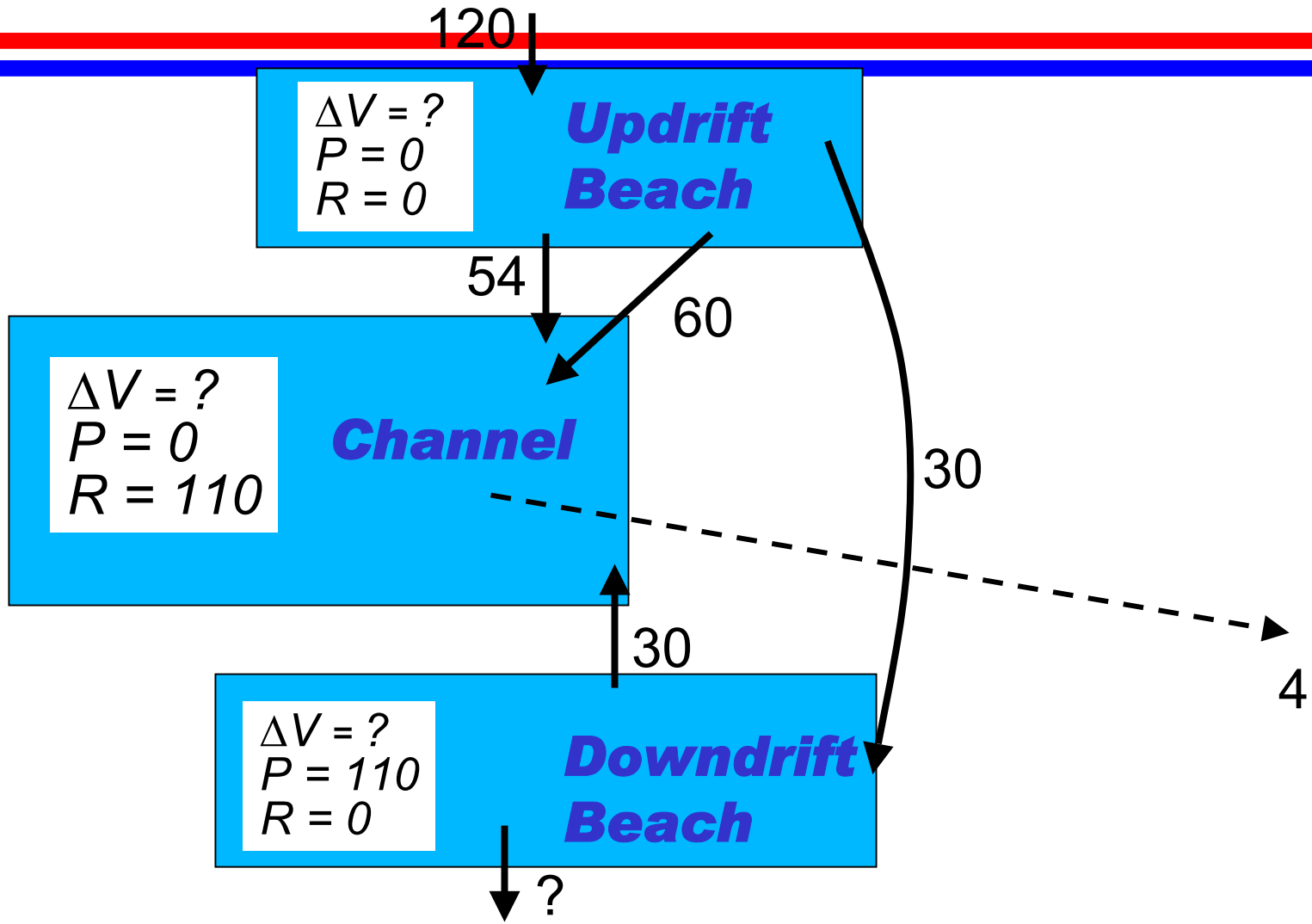
Hillsboro Inlet, Florida
Sediment Budget



Hillsboro Inlet Sediment Budget

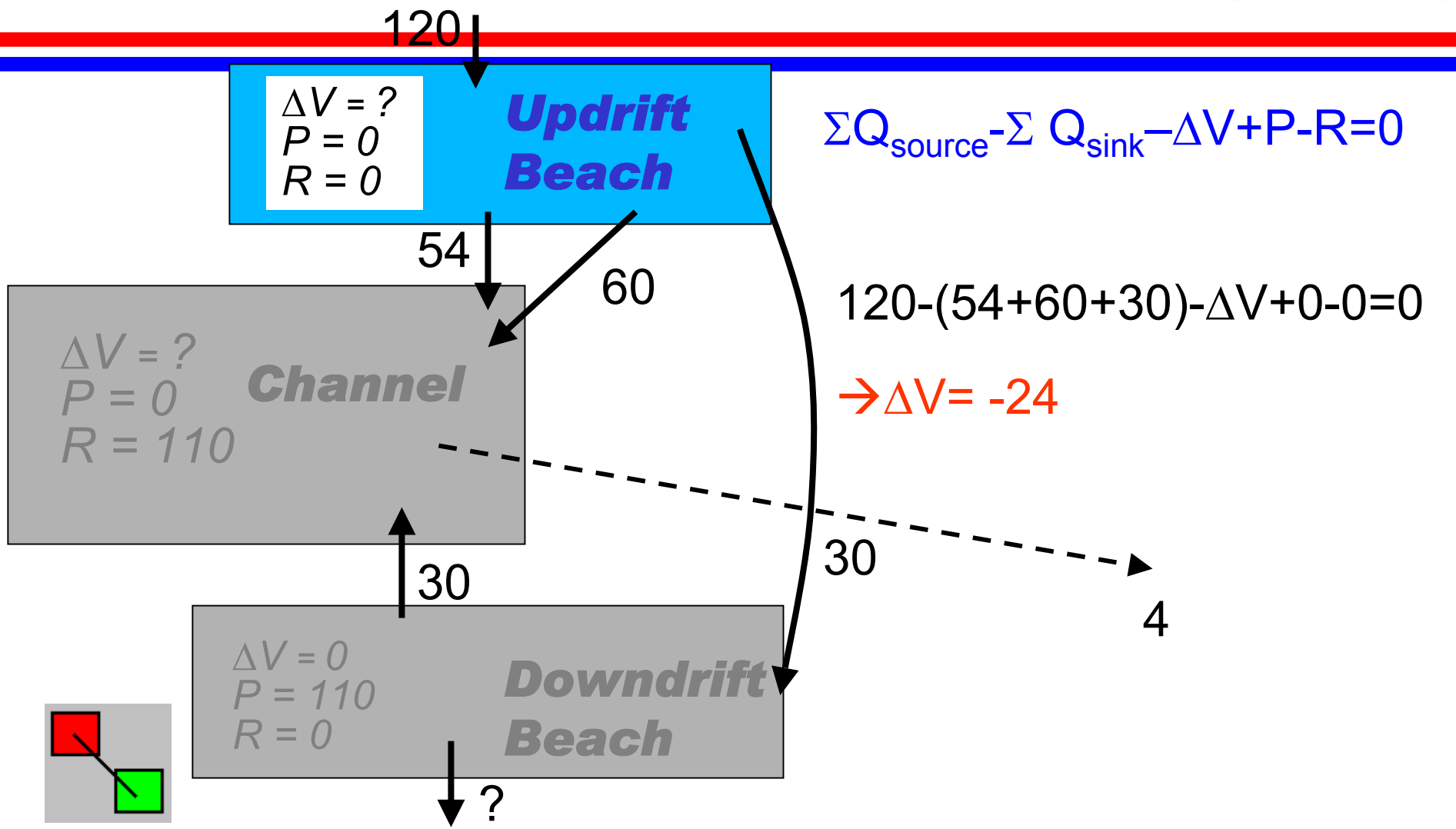


Hillsboro Inlet Sediment Budget



Hillsboro Inlet Sediment Budget:

Updrift Cell

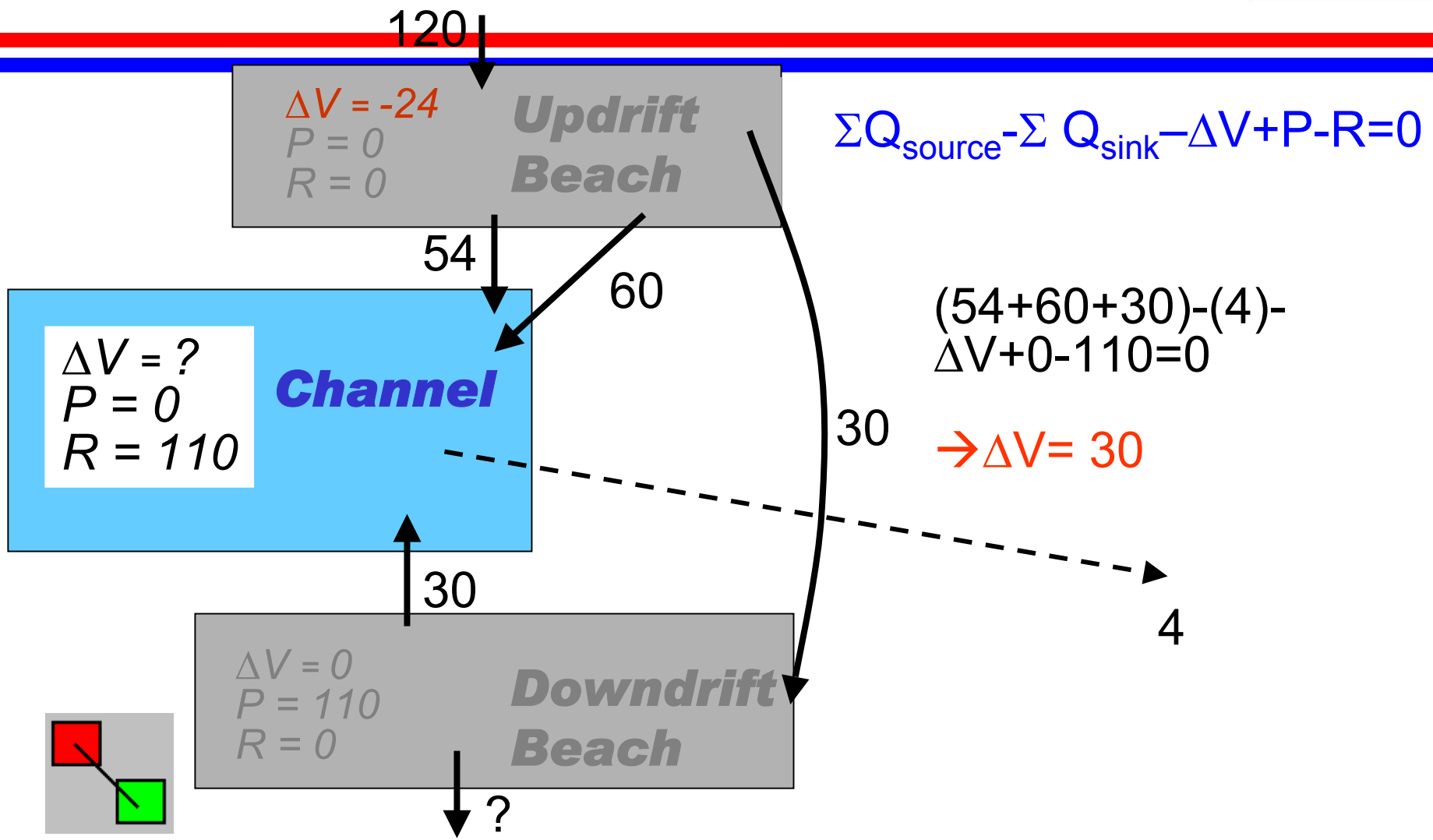


$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = 0$

$120-(54+60+30)-\Delta V+0-0=0$

$\rightarrow \Delta V = -24$

Hillsboro Inlet Sediment Budget:
Channel Cell



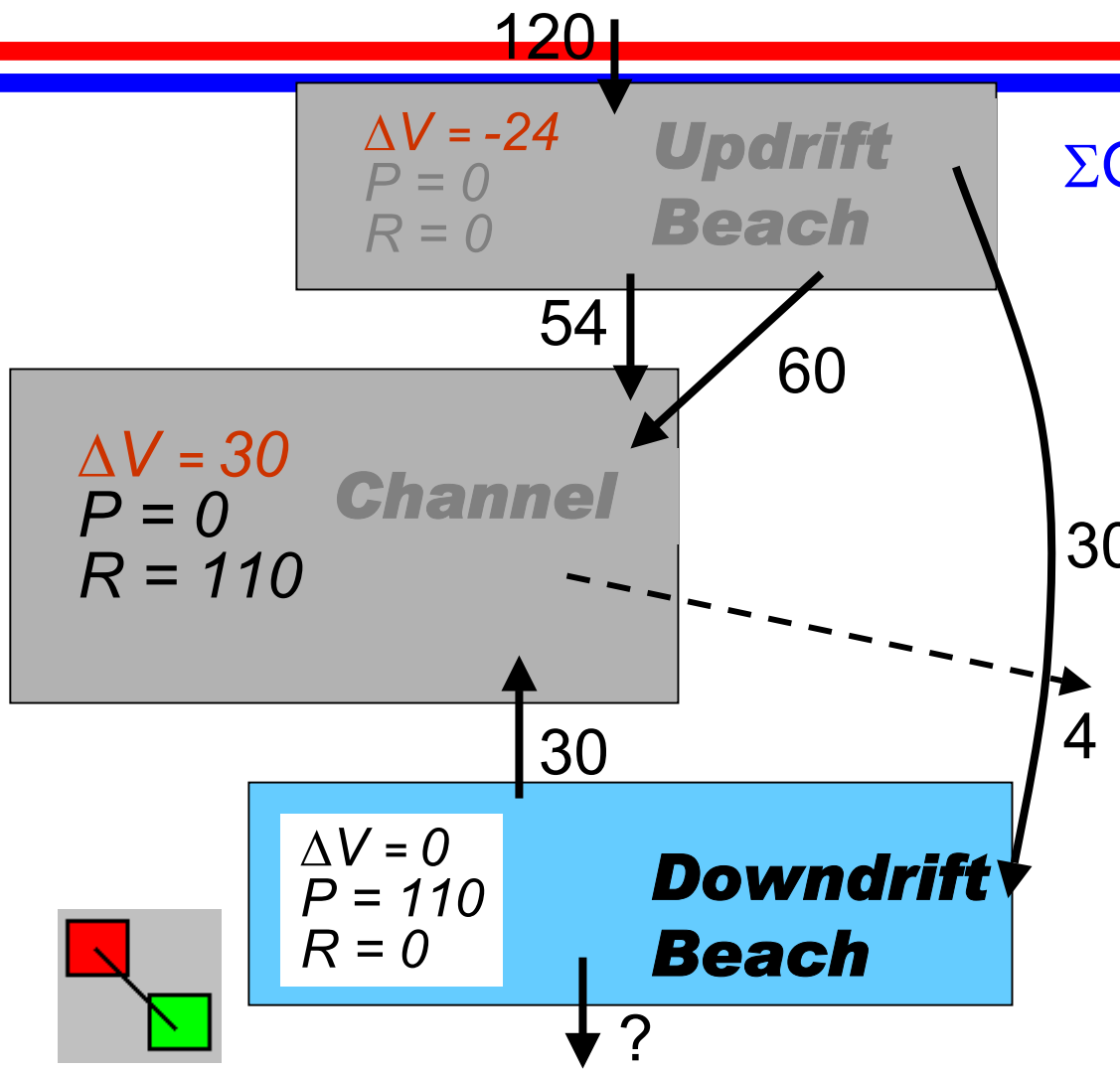
$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = 0$

(54+60+30)-(4)-
ΔV+0-110=0

→ΔV= 30

Hillsboro Inlet Sediment Budget:

Downdrift Cell



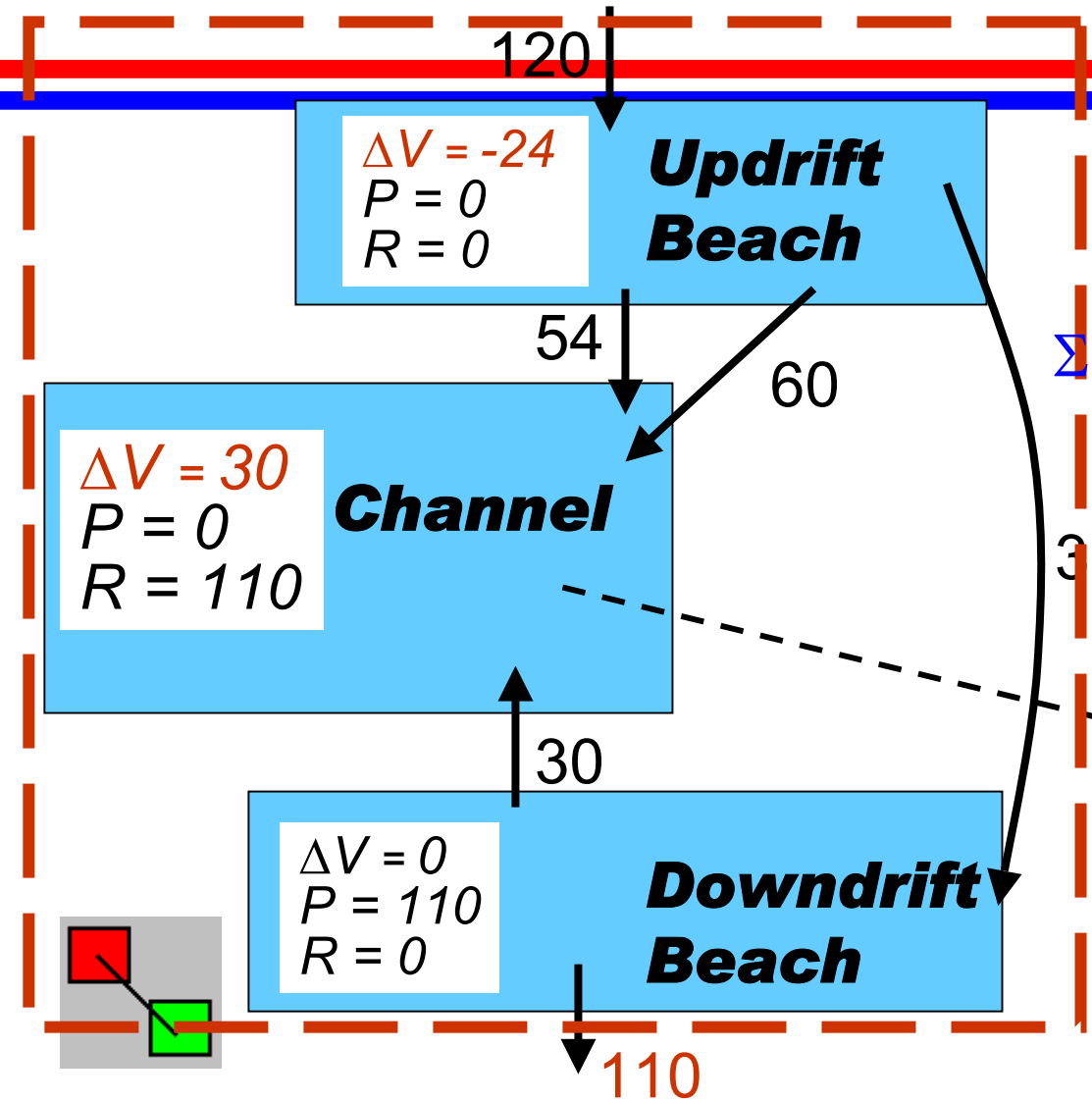
$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = 0$

$(30)-(30+Q_{out})-$
$0+110-0=0$

$\rightarrow Q_{out} = 110$

Hillsboro Inlet Sediment Budget:

Macrobudget



Macrobudget:
Budget of all cells

$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = 0$

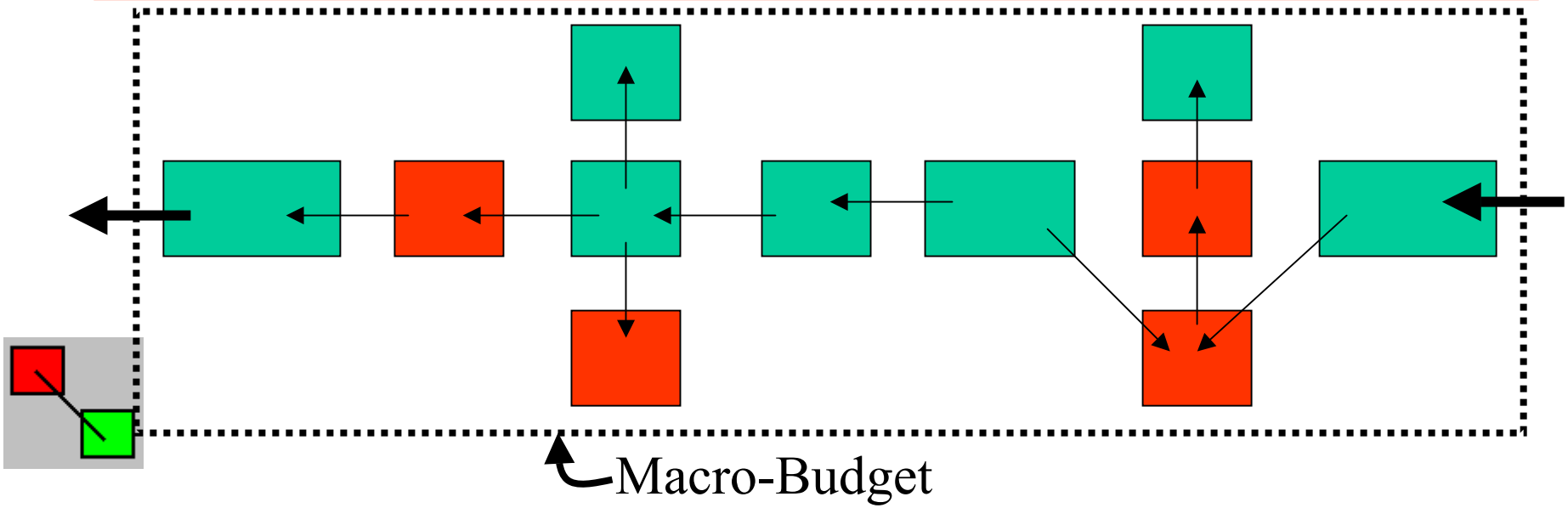
(120)-(110+4)-
(-24+30+0)+(110)-
(110)=0

Checks correctly!

Macro-Budget

Macro-Budget:

- Budget of ALL cells
- Must = zero to balance individual cells
- In SBAS2001, “collapse” & “explode” cells

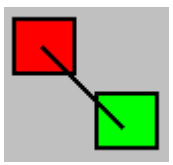


Uncertainty (1 of 3)

Reported Value = Best Estimate ± Uncertainty

error --> typically limitations in measurement procedure

true uncertainty --> error contributed by unknowns that may not be directly related to the measurement process

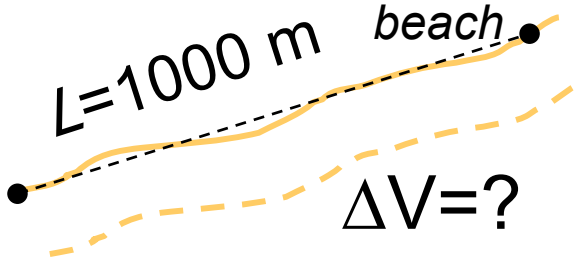


Uncertainty consists of

error and

true uncertainty

Uncertainty (2 of 3)

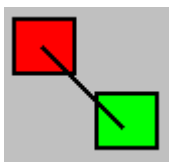


Example: Estimate uncertainty in volume change of beach segment

$$\Delta V = L\, D_A\, \Delta y = 1000\, m \times 9\, m \times -1\, m/yr = -9000\, cu\, m/yr$$

$\delta L/L$ = 0.01/1000 = negligible

$\delta D_A/D_A$ =0.9/9 = 0.10



$(\delta \Delta y)/\Delta y$ = 0.30 (high variability)

Uncertainty (3 of 3)

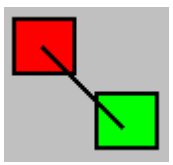
Multiplication or Division:

$$\left(\frac{\delta \Delta V}{\Delta V}\right)_{rms} = \sqrt{\left(\frac{\delta L}{L}\right)^2 + \left(\frac{\delta D_A}{D_A}\right)^2 + \left(\frac{\delta(\Delta y)}{\Delta y}\right)^2} = 0.32$$

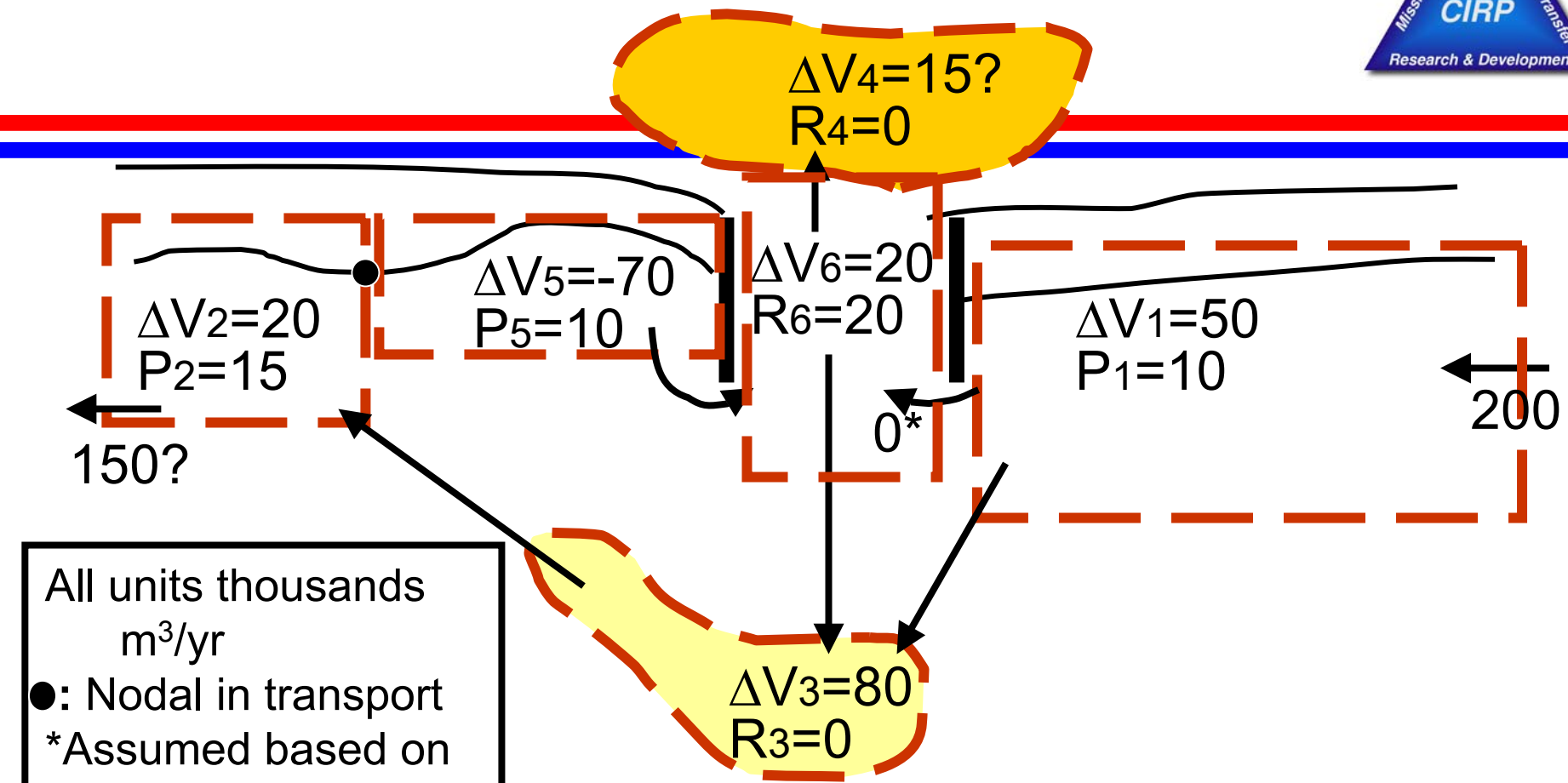
$$\Delta V = -9000 \pm 2900 \quad cu \quad m/ \quad yr$$

Addition or Subtraction:

$$\delta X_{rms} = \sqrt{(\delta x)^2 + (\delta y)^2 + (\delta z)^2 + \ldots}$$



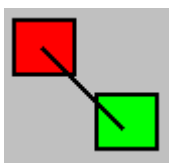
Class Exercise



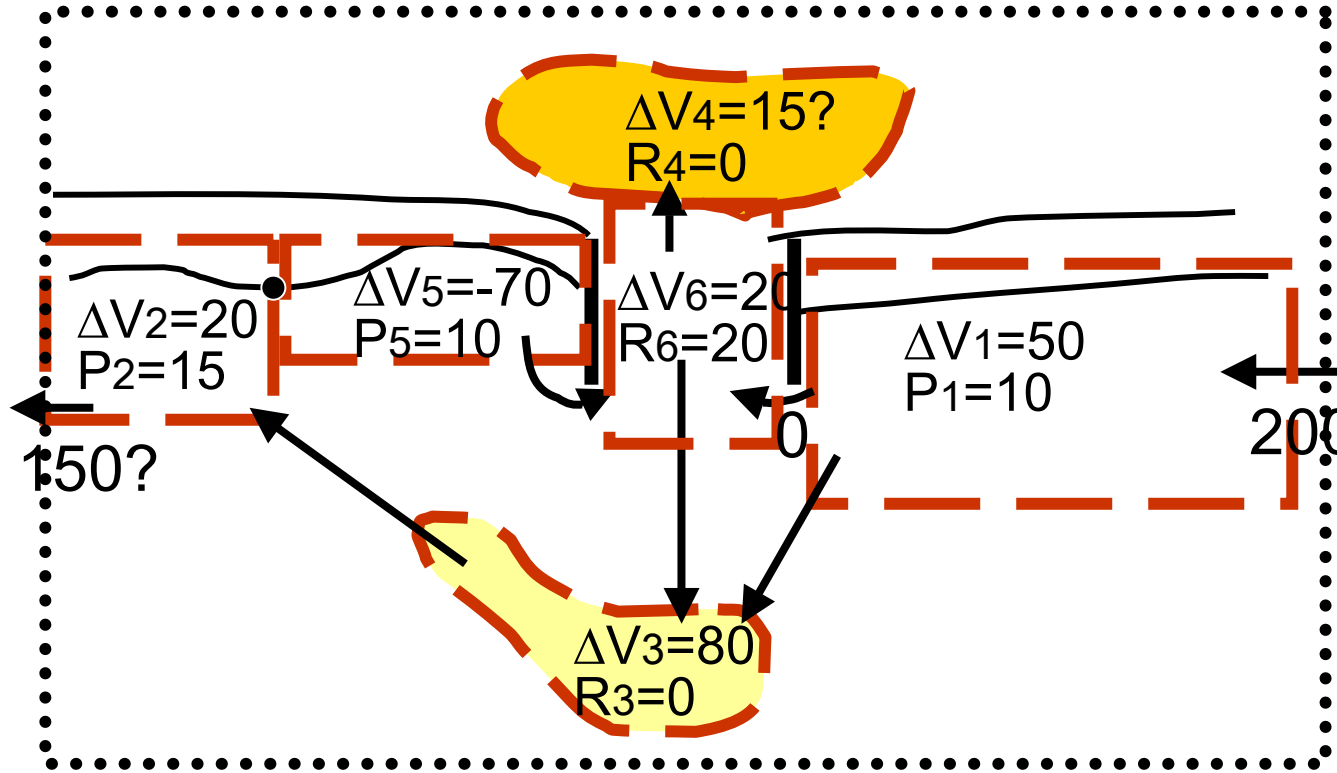
All units thousands m^3/yr

●: Nodal in transport

*Assumed based on morphology



$$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = 0$$



$$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = 0$$

Macrobudget:

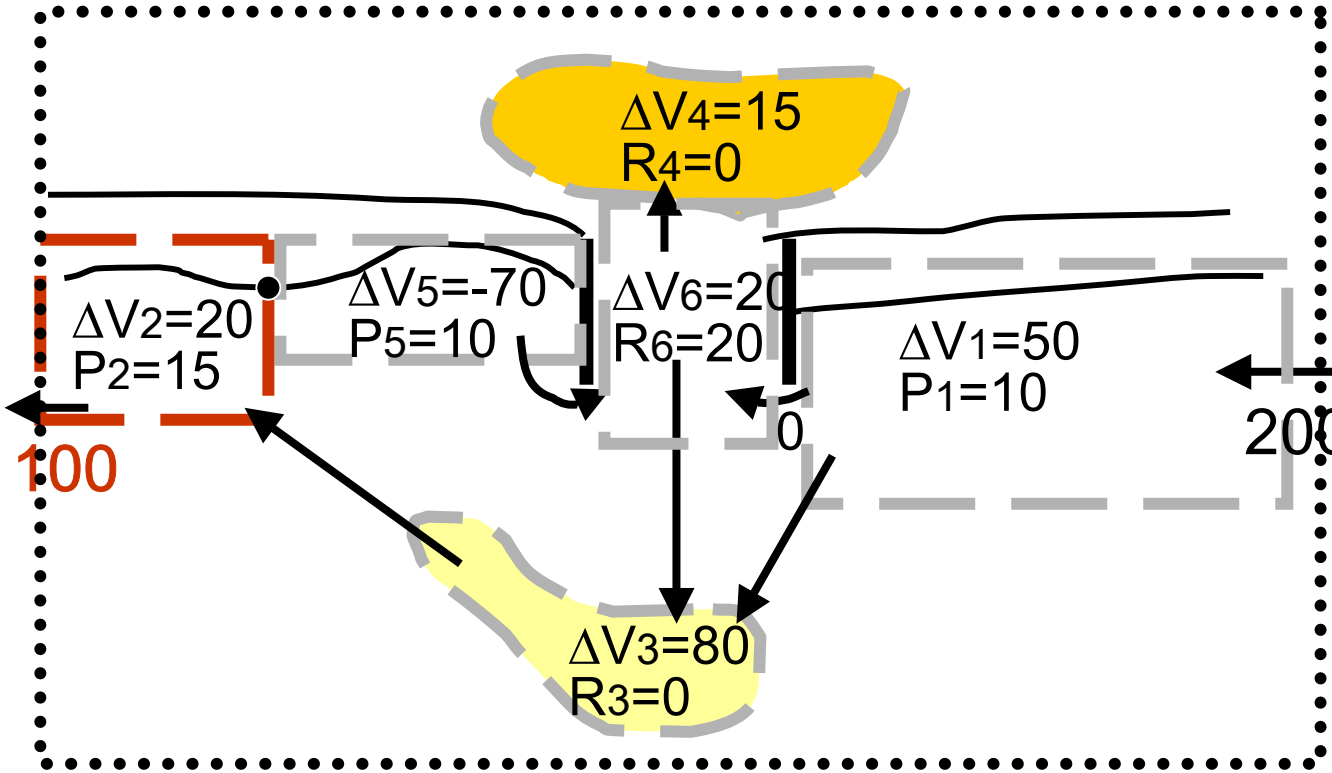
(200)-(150?)-(50+20+80+15?+-70+20)+(10+15+10)-(20)=Residual

-50 = Residual

→ Something wrong with assumptions!

Assume 150? Incorrect; solve for Q_{out}

Q_{out} = 100

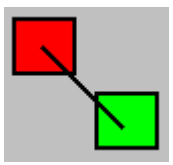


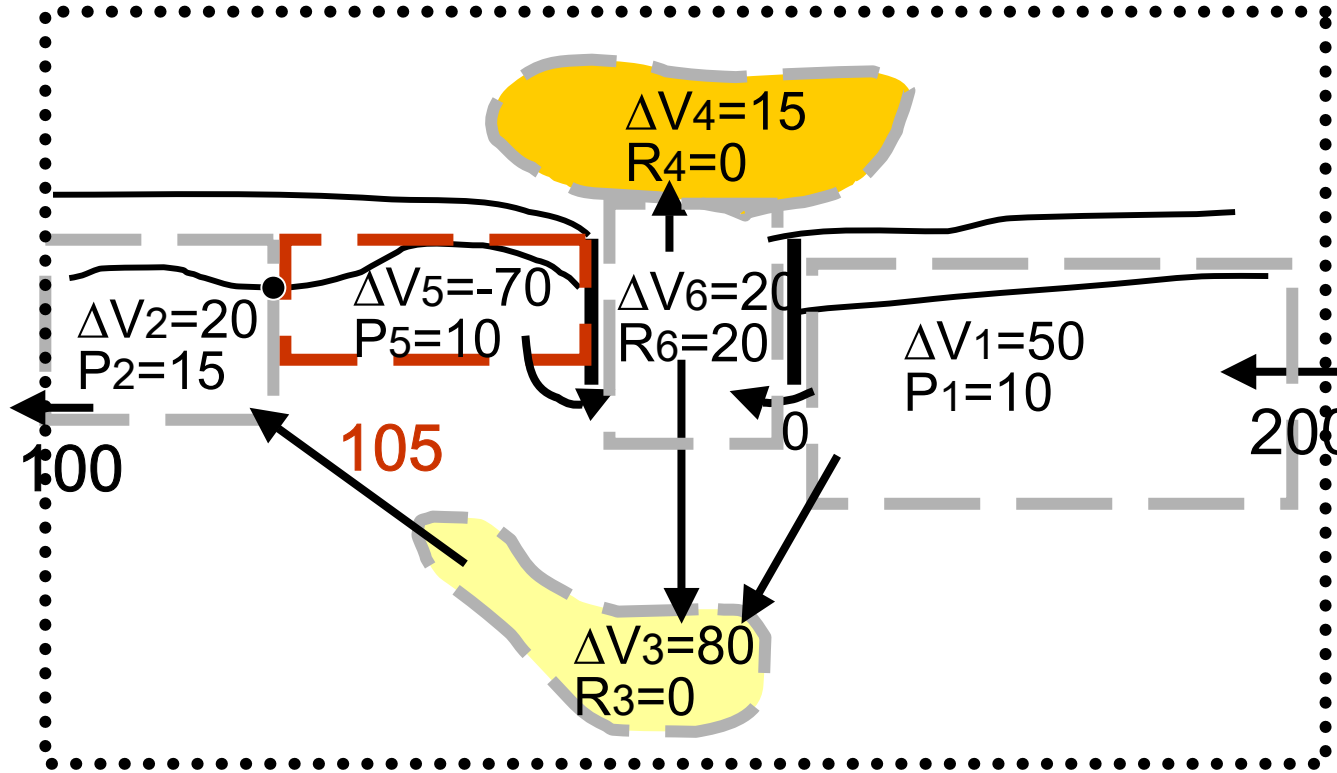
$$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = 0$$

Solve Cell 2:

(Qin)-(100)-(20)+(15)-(0)=0

Qin=105



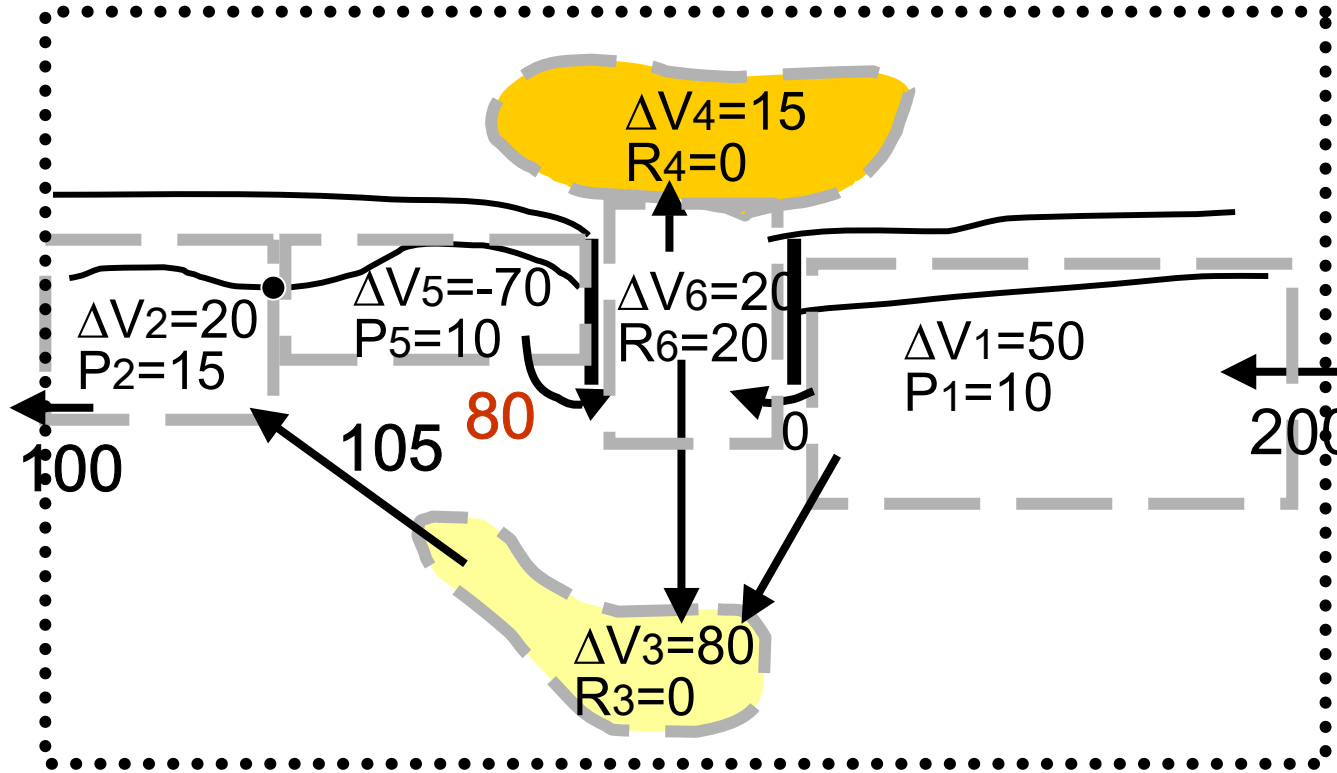


$$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = 0$$

Solve Cell 5:

(0)-(Qout)-(-70)+(10)-(0)=0

Qout=80

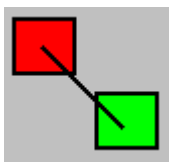


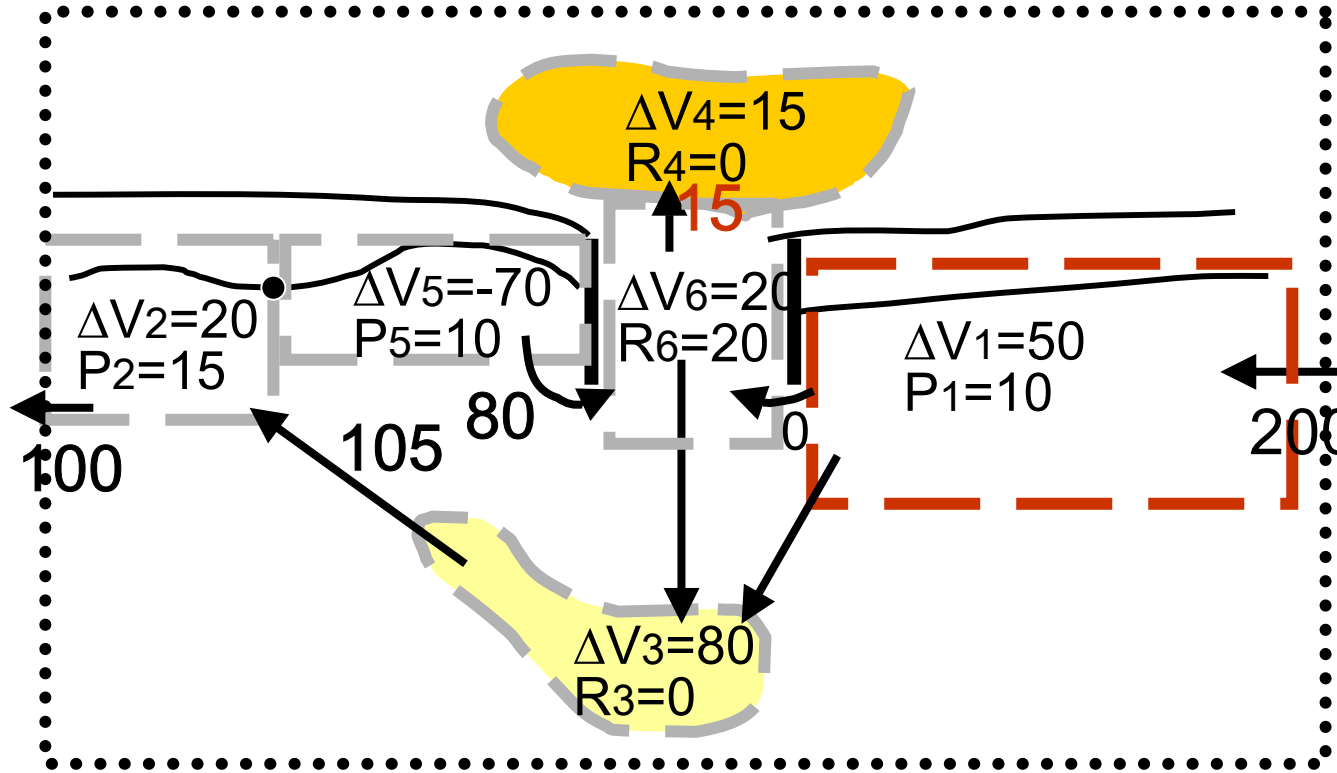
$$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = 0$$

Solve Cell 4:

(Qin)-(0)-(15)+(0)-(0)=0

Qin=15



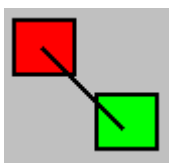


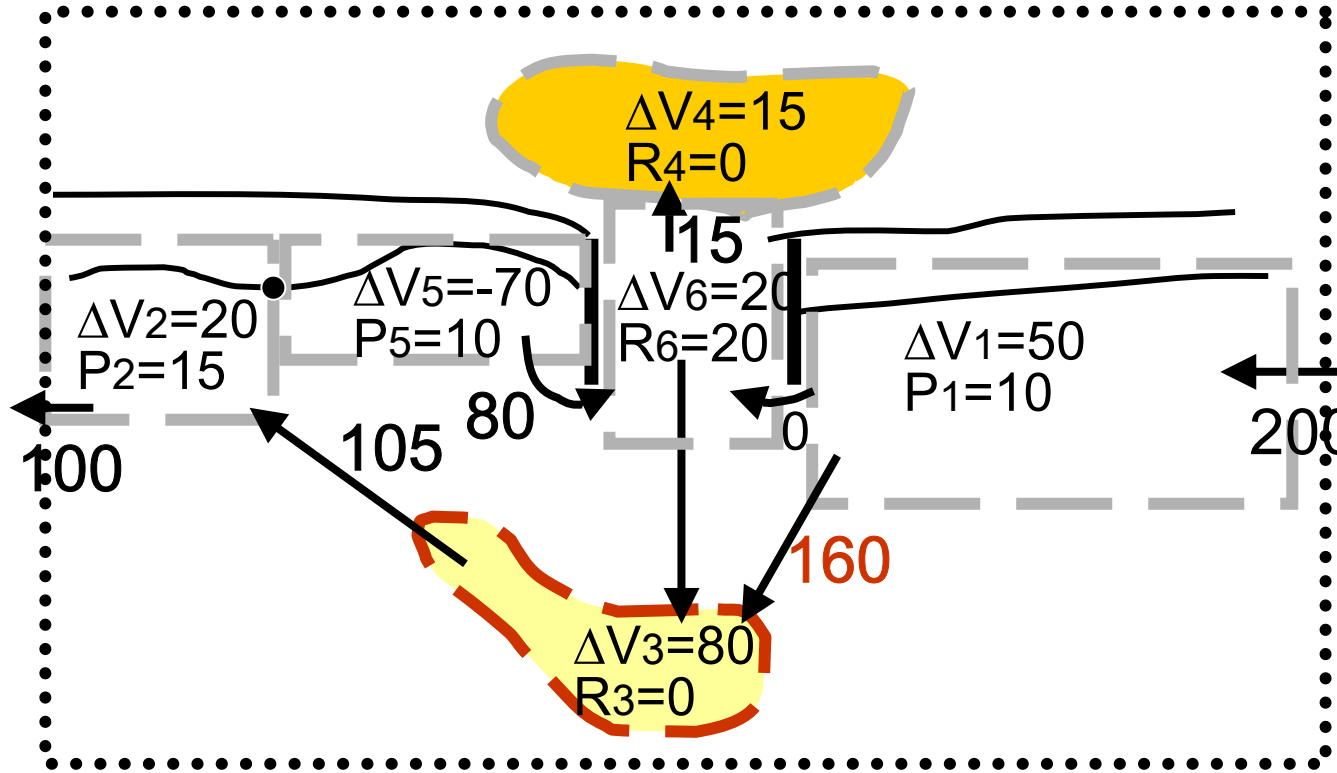
$$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = 0$$

Cell 1:

(200)-(Qout+0)-(50)+(10)-(0)=0

Qout=160



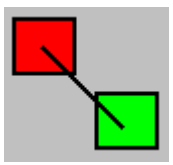


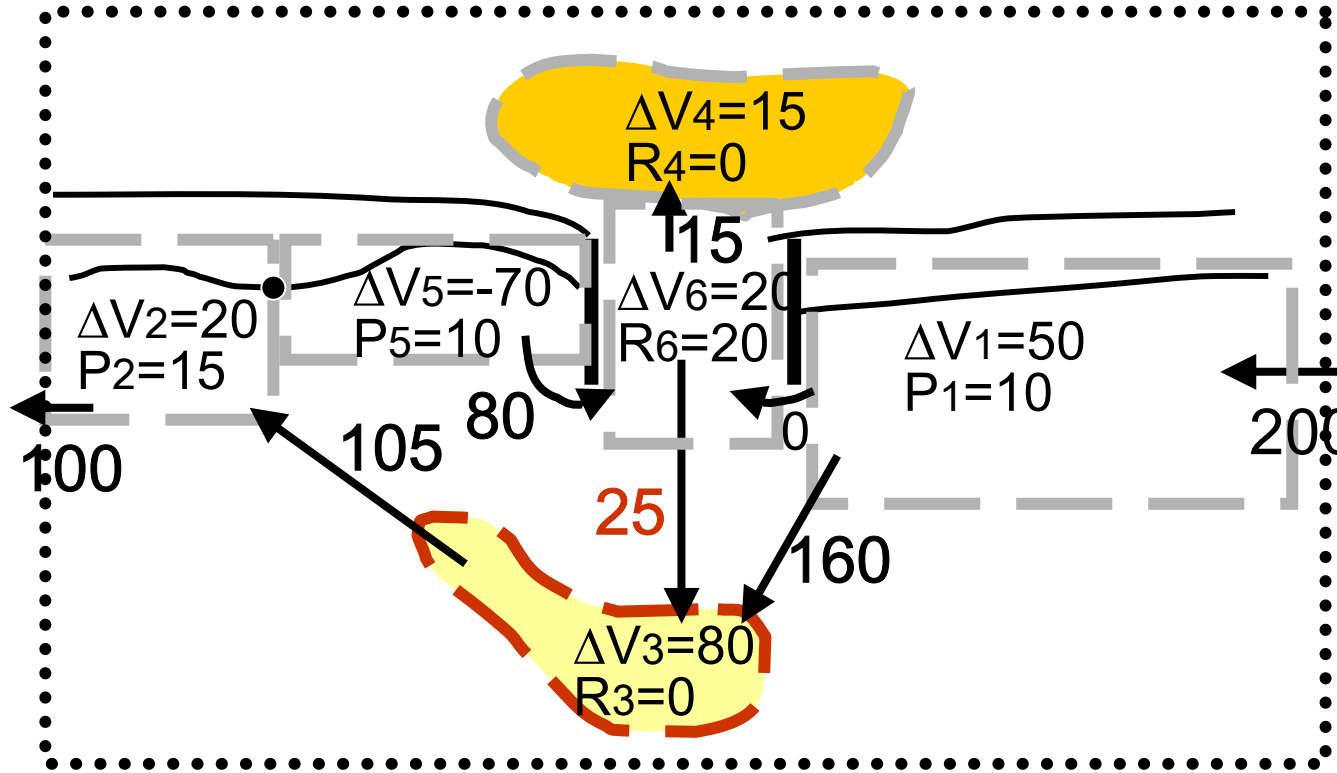
$$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = 0$$

Cell 3:

(Qin +160)-(105)-(80)+(0)-(0)=0

Qin =25



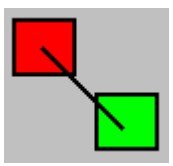


$$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = 0$$

Cell 6 (check):

(0 + 80)-(15+25)-(20)+(0)-(20)=0

~ Balanced budget ~



Contact Information

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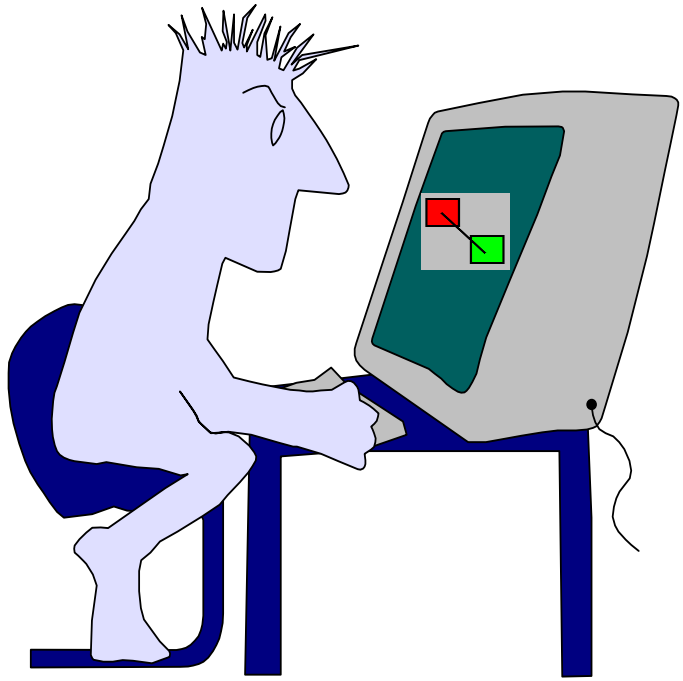

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