Stream restoration effects on exchange, storage and baseflow generation

Ninemile Creek, Montana

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How much water is being stored or drained?
Net Change in Discharge

Net $\Delta Q = Q_{\text{downstream}} - Q_{\text{Upstream}}$

$Q_{\text{Upstream}}$
100 liters/sec

$Q_{\text{downstream}}$
120 liters/sec

Net Gain
+20 liters/sec
Net change in Discharge

Valley normalized Net change in Q

(m$^3$ day$^{-1}$ m$^{-1}$ valley)

Jul  Aug  Sep  Oct  Nov

Restored
Degraded
How much *groundwater* is entering the stream? 
Radon-222 modeling

\[
Q \frac{dc}{dx} = I(c_i - \bar{c}) + wE\bar{c} - kw\bar{c} - dw\lambda\bar{c} + \frac{\gamma hw\theta}{1 + \lambda t_h} - \frac{\lambda hw\theta}{1 + \lambda t_h} \bar{c}
\]

Cook et al. 2006
Summary

- Increased underflow/storage
- Longer duration of storage period
- More gradual decline in GW discharge to stream
- Higher volumetric gains/groundwater discharge at baseflow