Coupling Ecological Risk Assessment with the Ecosystem Services Concept to Better Balance Trade-offs in Environmental Management and Resource Usage

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Task

Examine some of the challenges of moving toward a form of ecological risk assessment (ERA) that more directly assesses the effects of stressors, including but not limited to toxic chemicals, on ecosystem properties that are necessary for generating valued ecological services.

Product

3 priorities for refining ERA to better align with protecting/restoring ecosystem services

Challenge #1 – Using Ecological Understanding to Guide Decisions

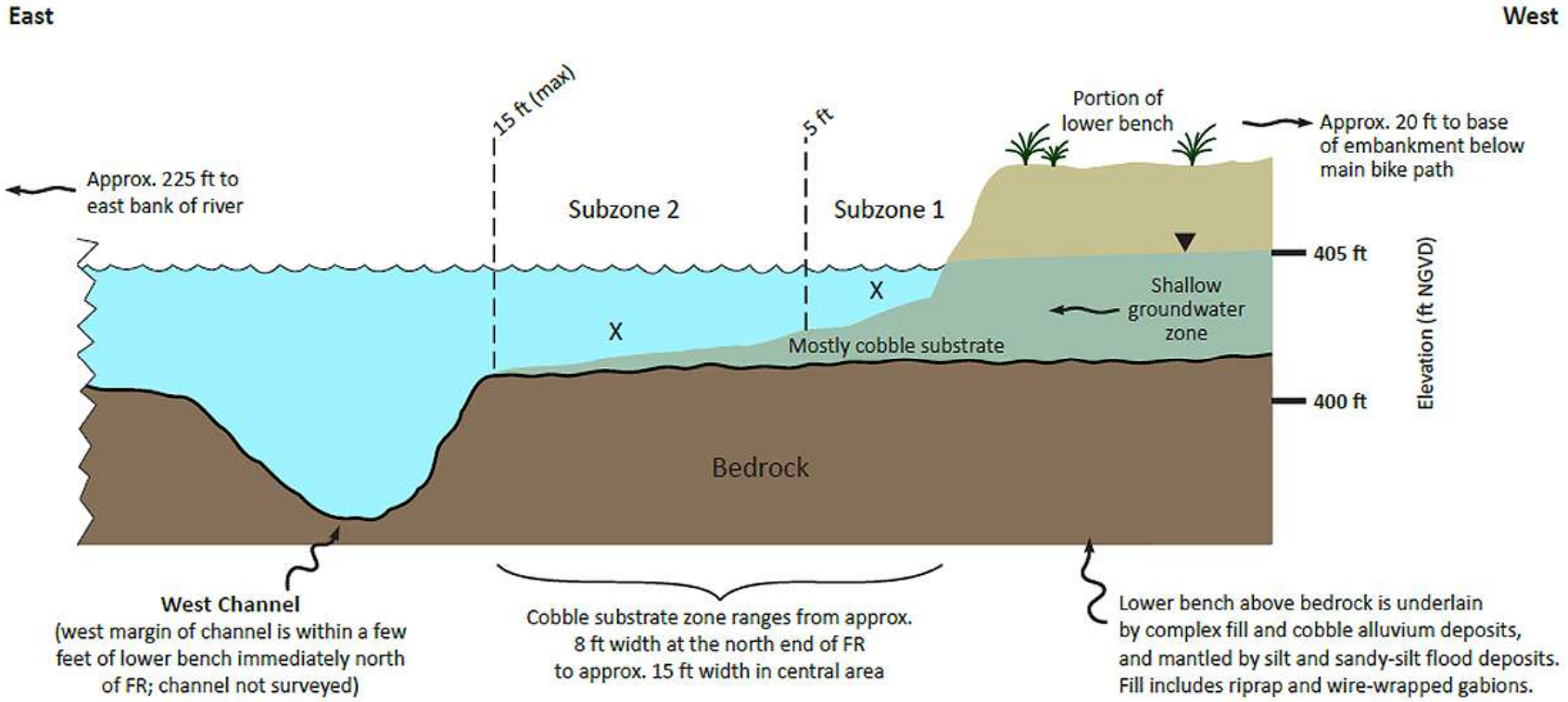


Figure 3-1. Schematic Illustration of Shoreline Conceptual Model
Former MGP Site; view looking upstream (south) along Focus Reach (FR)

Ecological Survey

- Unique habitat units documented for each distinct change in river flow velocity, substrate type, or bank cover type
- Riverbed substrates examined for benthic invertebrates
- Fish habitat evaluated by bank and snorkeling surveys
- Riparian habitat evaluated for influence on instream habitat quality

Outcome

- **PAH and BTEX sediment and interstitial water HQs in the 10s to 100s, surface water HQs < 1**
- **Diverse, abundant, and mature benthic invertebrate community**
    - Primarily epibenthic fauna on cobble substrate
    - Fine sediment very limited, mostly ephemeral
- **Good quality instream and supporting riparian habitat for rearing fish, including juvenile Chinook salmon**
- **Disruption of instream and riparian habitat would result in lost ecosystem services; exposure to GW contaminants does not**
- **No remedial action**
- **Bank stabilization to preserve habitat**

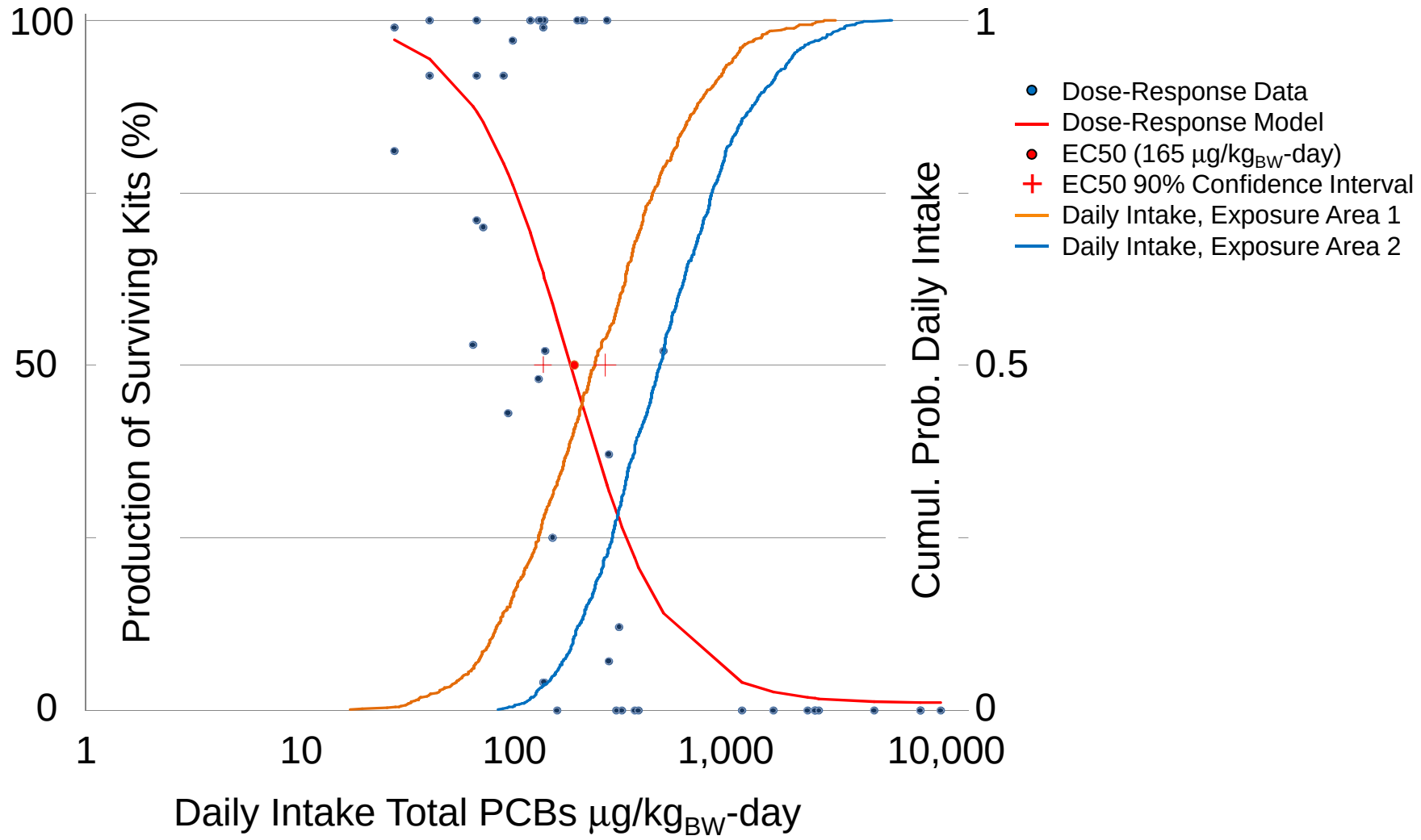
Challenge #2 – Considering the Landscape

- Exposure to toxic chemicals poses risk to individual organisms
- Landscape determines potential ecosystem service

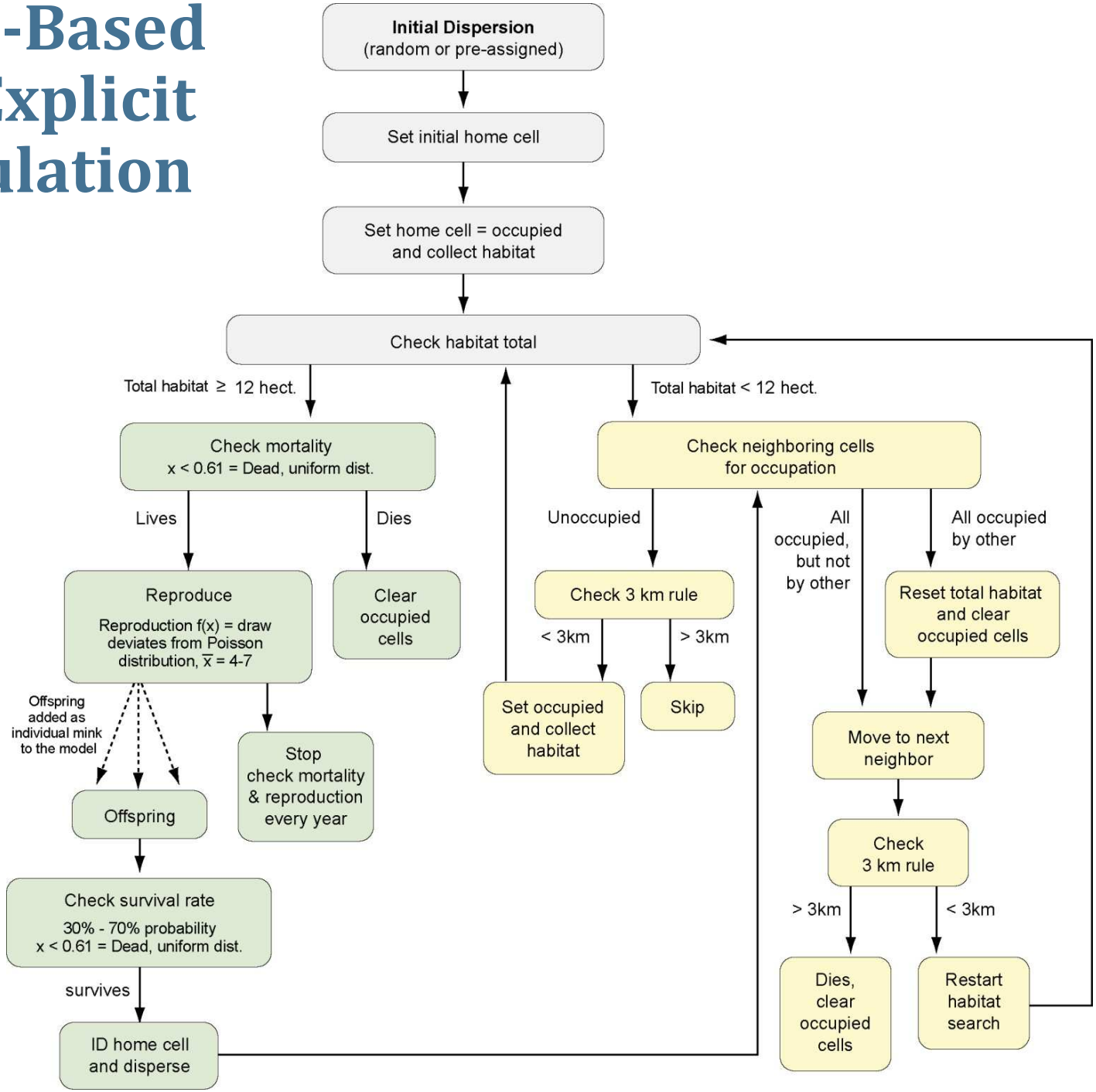
Mustela vison

- Fecundity, survival, and dispersal rates determine population's ability to take advantage of the potential ecosystem service
- Individual risks influence fecundity and survival

Mink Fecundity Affected at Environmentally Relevant PCB Concentrations



Individual-Based Spatially Explicit Mink Population Model



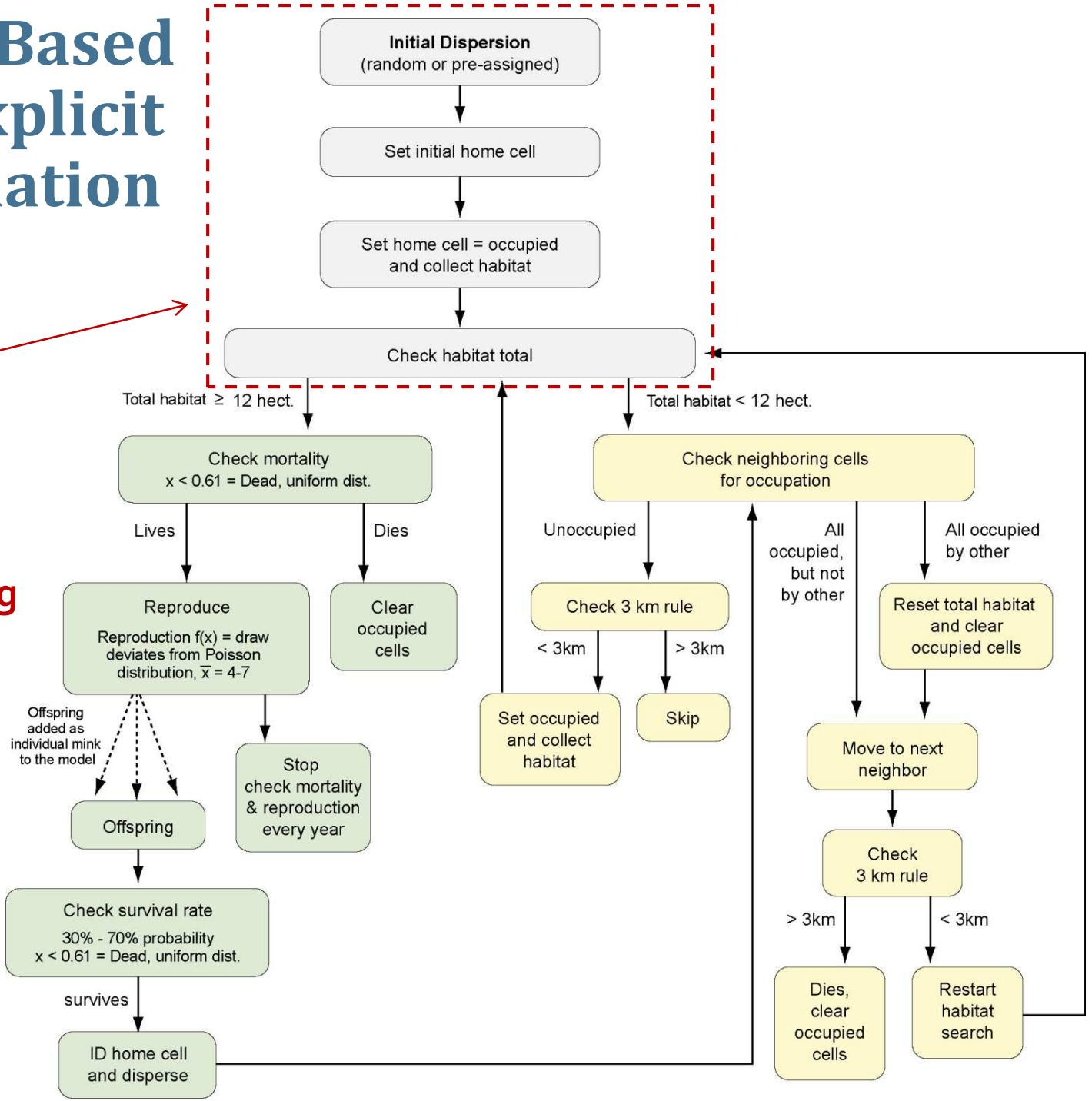
Individual-Based Spatially Explicit Mink Population Model

MacDonald DW, Rushton S. 2003. Modelling space use and dispersal of mammals in real landscapes: a tool for conservation. J Biogeog 30:607-620.

Bonesi L, Rushton SP, Macdonald DW. 2007. Trapping for mink control and water vole control: Identifying key criteria using a spatially explicit individual based model. Biol Conserv 136:636-650.

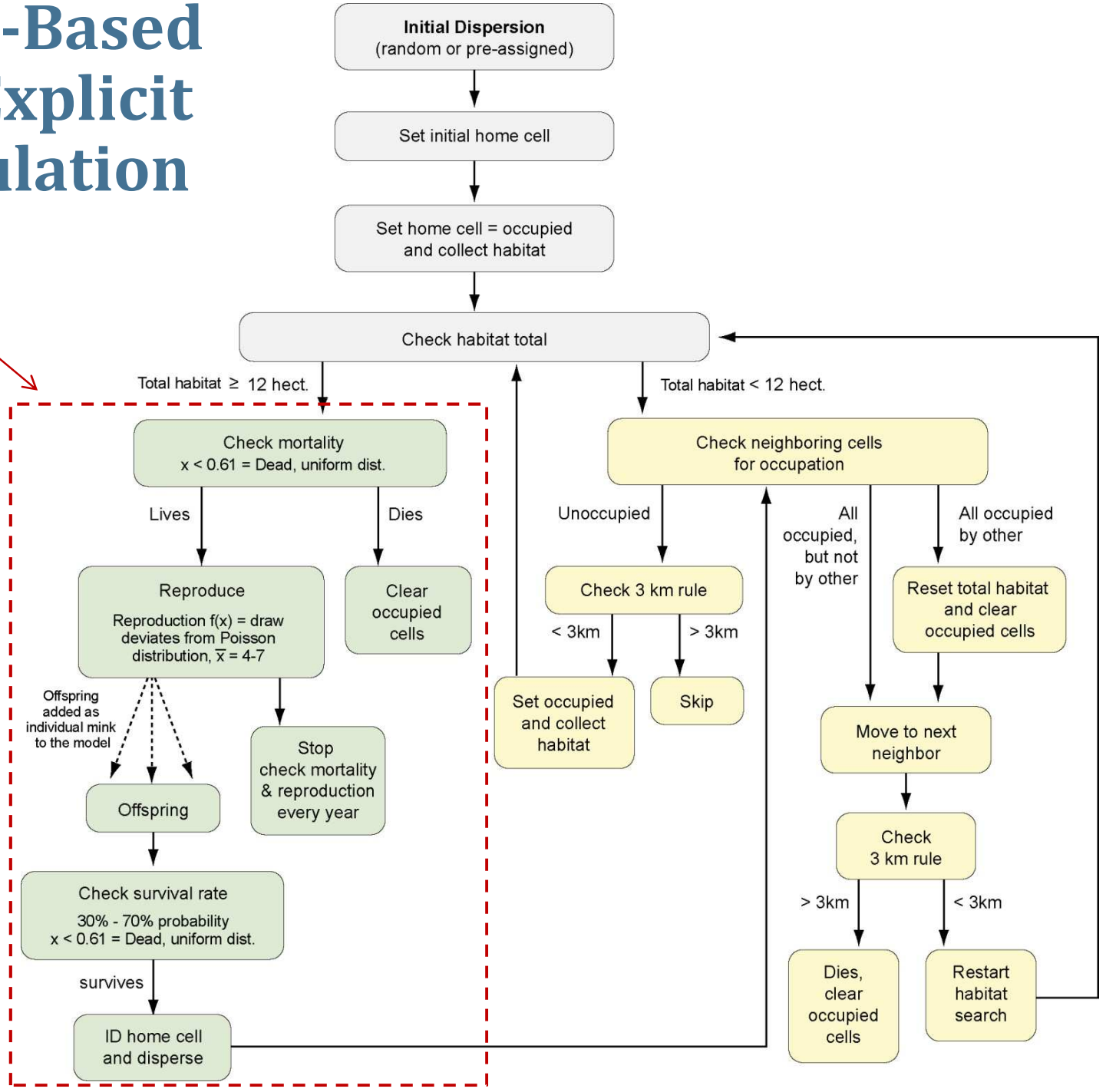
Individual-Based Spatially Explicit Mink Population Model

Initial dispersion module distributes mink across the landscape and establishes carrying capacity

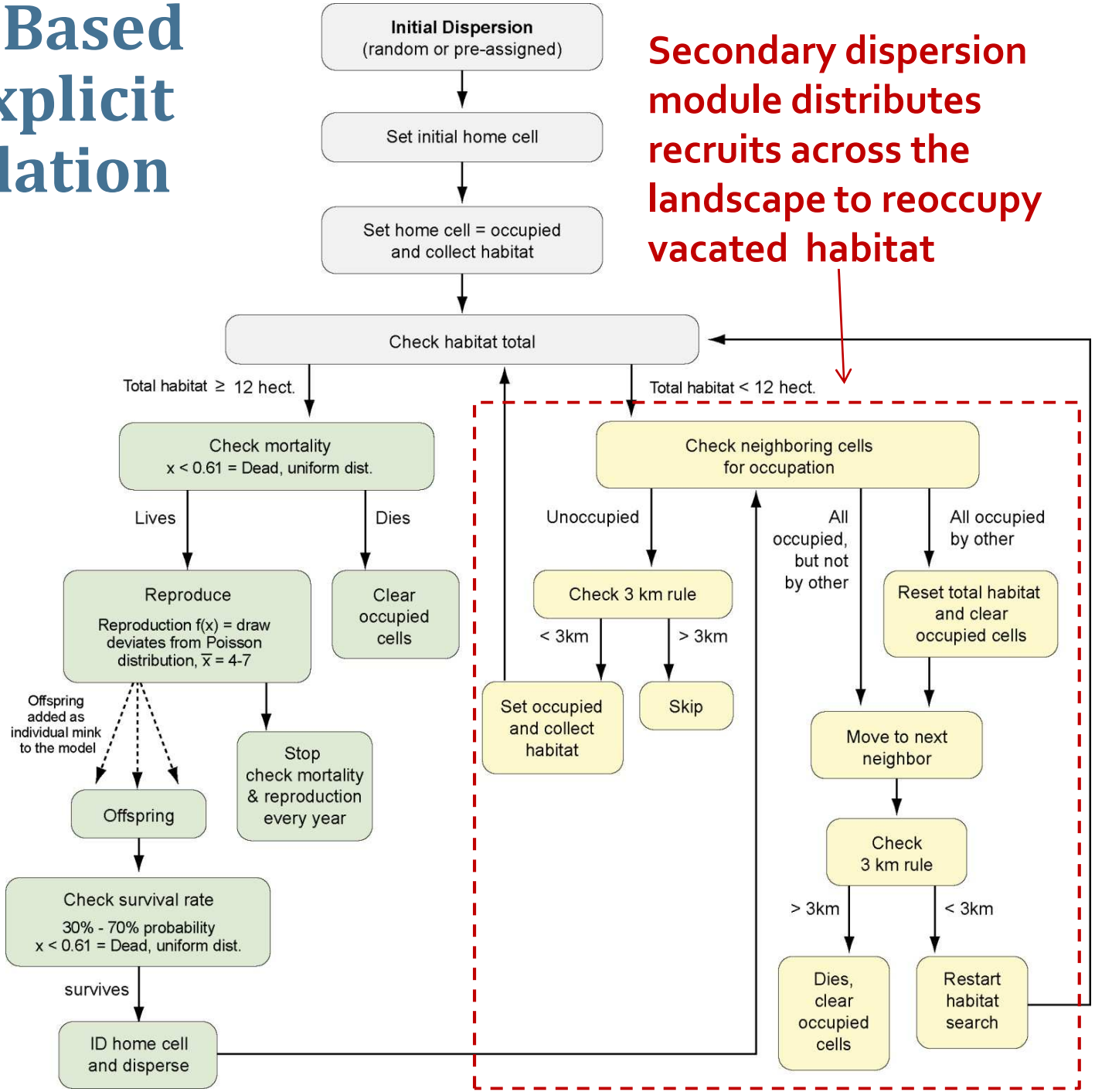


Individual-Based Spatially Explicit Mink Population Model

Stochastic survival and reproduction module determines the pool of individuals available to occupy habitat



Individual-Based Spatially Explicit Mink Population Model



Secondary dispersion module distributes recruits across the landscape to reoccupy vacated habitat

Outcome

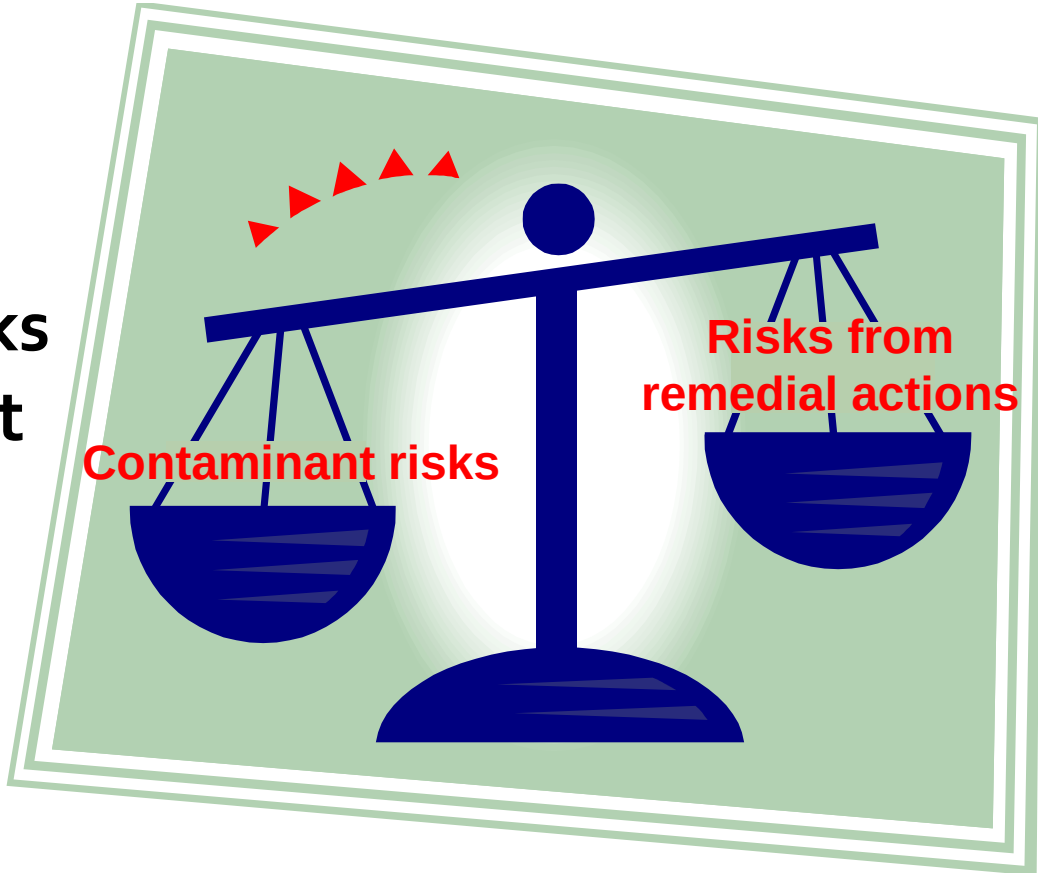
- Ecosystem service = sufficient habitat to support a (sub)population of *n* mink
- Ecological risk potentially reduces the ability of mink to utilize the ecosystem service
- Coupling ecological risk models to landscape models answers whether
  PCB exposure
  limits the ability of mink
  to fully utilize
  the ecosystem service

Challenge #3 – Maximizing Net Environmental Benefit

Texas Commission on Environmental Quality (TCEQ) Texas Risk Reduction Program (TRRP) (30 TAC 350)

Ecological Services Analysis Under TRRP

Formally considers ecological service flows in remedy selection by balancing ecological risks of contaminants and net environmental benefits of remedial actions

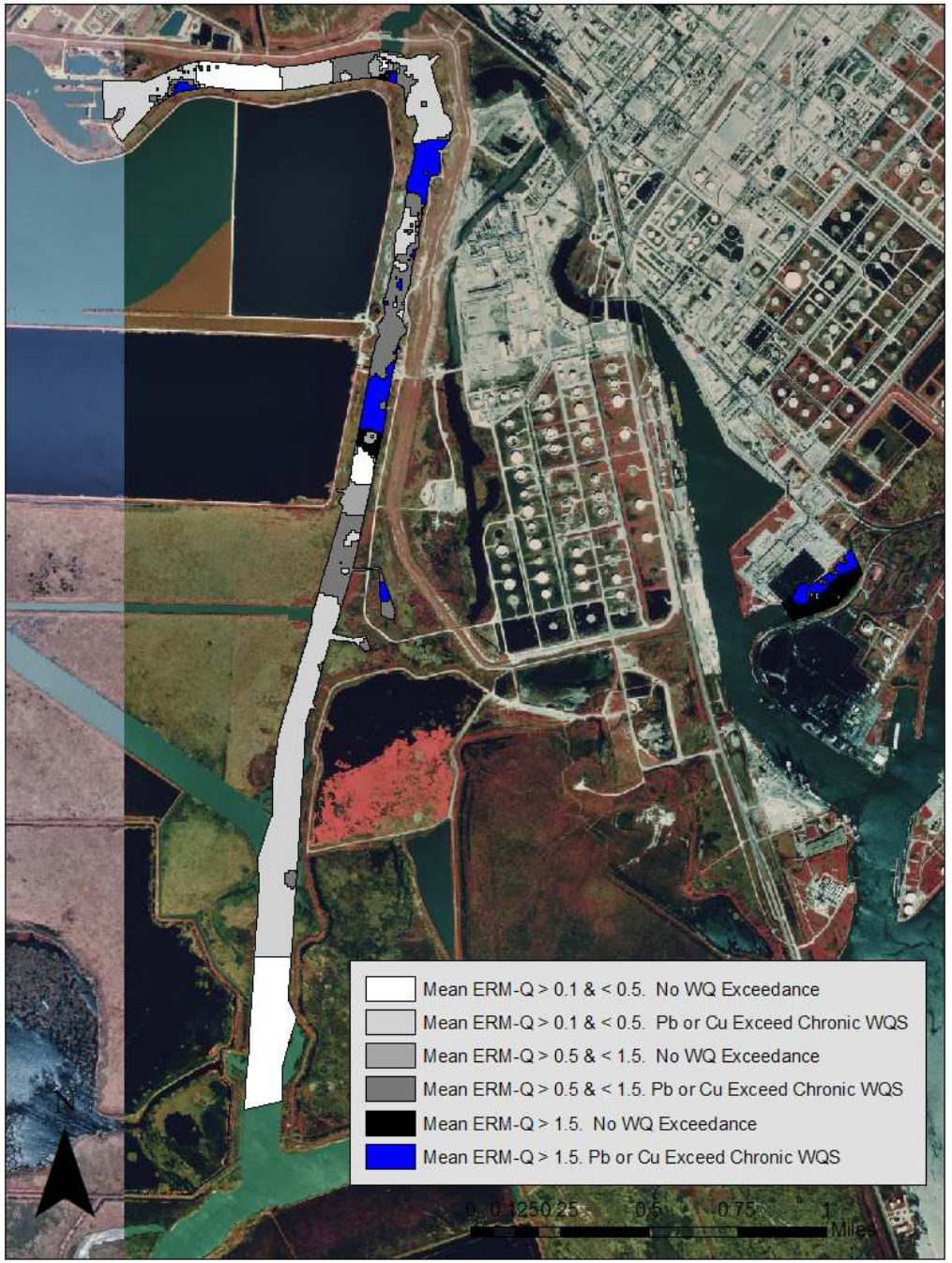


Ecological Services Analysis Under TRRP

An affected property is part of the ecosystem that extends beyond its perimeter. Habitat services reductions may be offset by providing compensatory services through restoration elsewhere in the surrounding landscape

ESA at the Old Gulf Refinery

- ERA found potential ecological risk
- Remedial alternatives included dredging and monitored natural recovery (MNR)
- ESA conducted to select remedy that provided best ecological service flows



Outcome

MNR w/ offsite compensatory restoration selected based on ESA (greatest net environmental benefit)

Priorities for Refining ERA to Better Align with Ecosystem Services Protection/Restoration

1. Get better at writing ecological (rather than ecotoxicological) problem formulations.
2. Get serious about using our ecotoxicological data in landscape models and population-level assessments.
3. Embrace compensatory remediation.

Treat problems as ecotoxicological we'll only find ecotoxicological solutions. Treat them as ecological and a whole new range of possibilities will emerge. More is better!

Questions?

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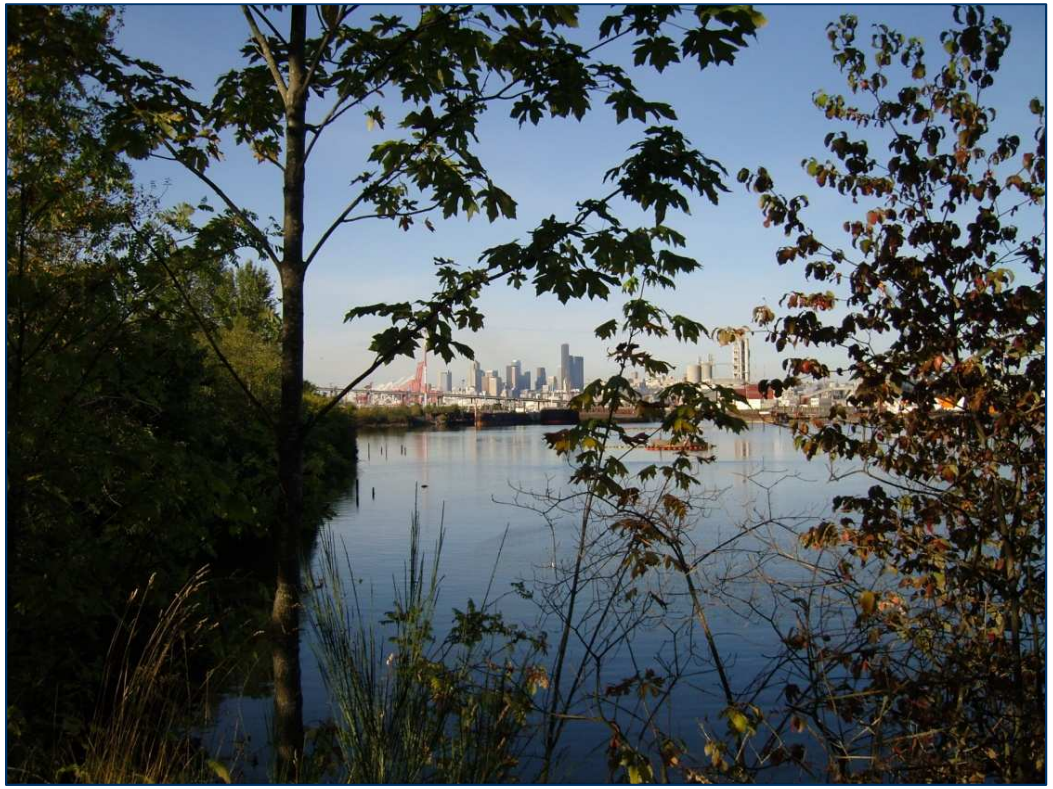

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