Willamette Basin Mercury TMDL Advisory Committee Meeting

Modeling Update

March 21, 2018

Linn County Extension Offices

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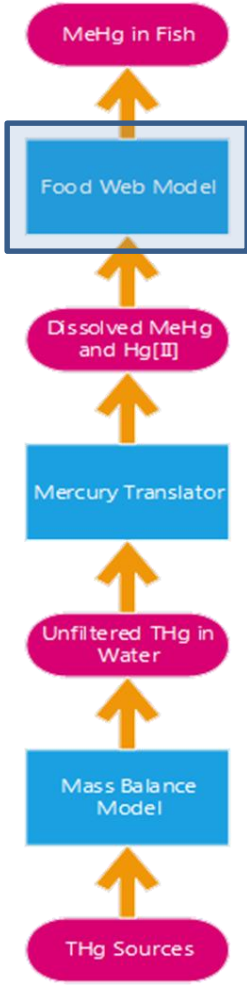
DEQ
State of Oregon
Department of
Environmental
Quality

Overview

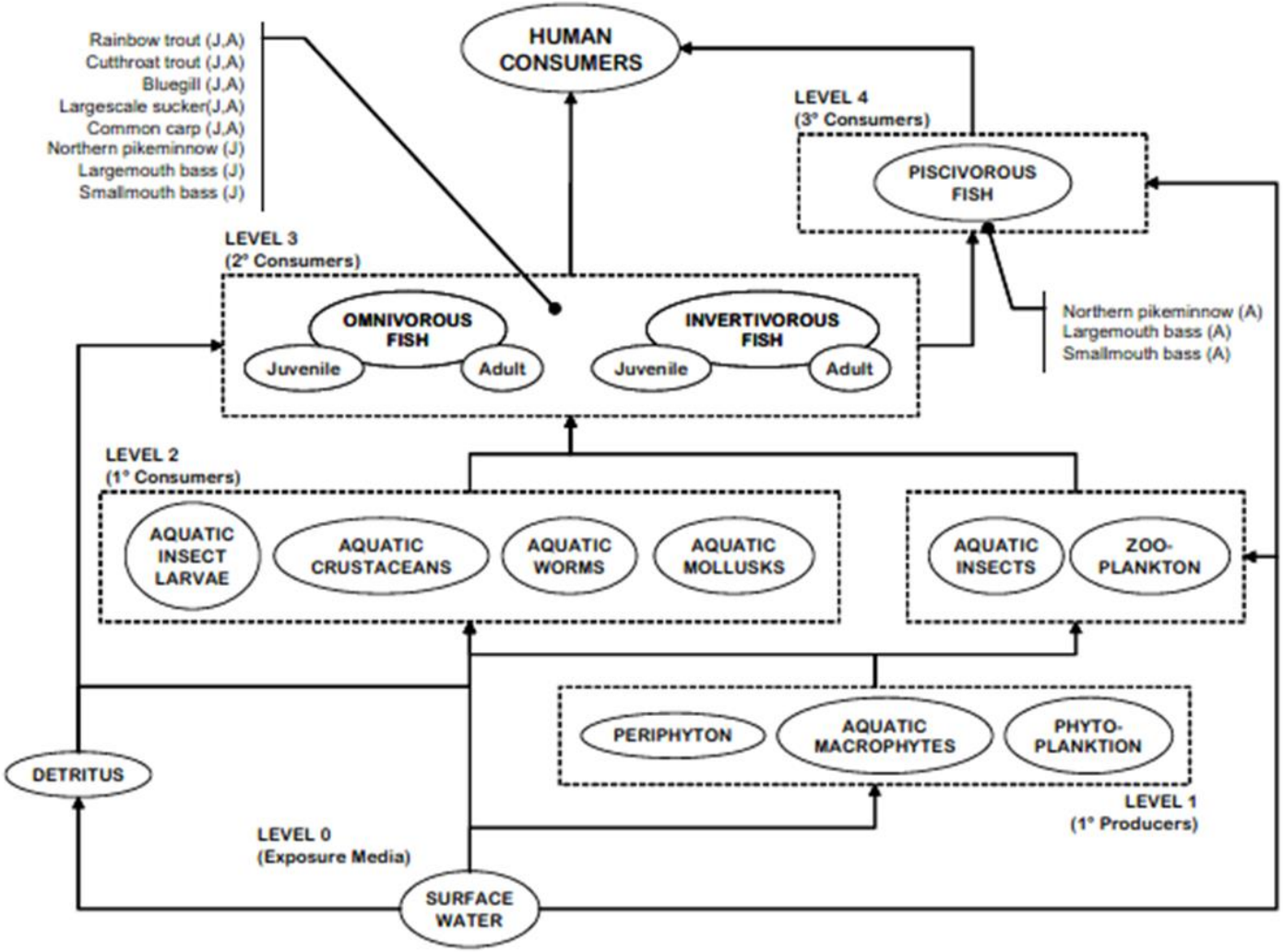
- Food Web Model
- MeHg/THg Translator
- Mass-Balance Model

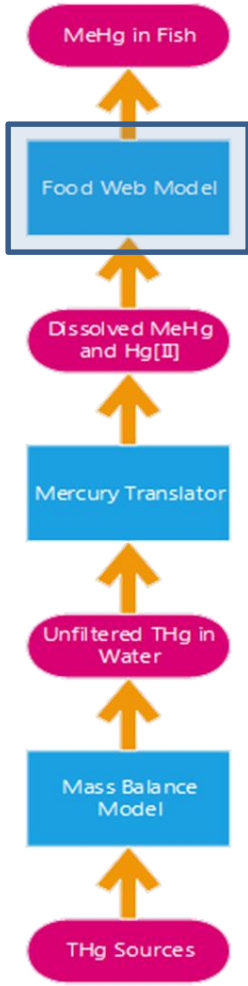
Food Web Model

- Determine exposure concentrations (MeHg, Hg[II]) consistent with achieving fish tissue targets in species of interest
- Describes accumulation of mercury through complex food web relationships **“Who eats what?”**
- Probabilistic uses thousands of model runs



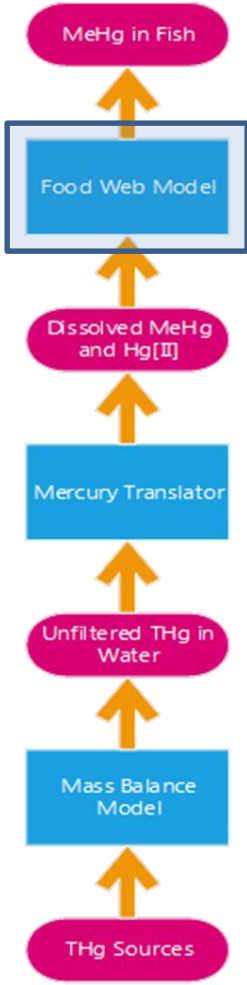
Food Web Model





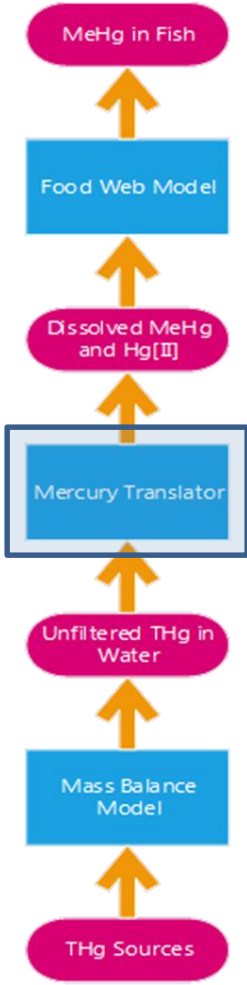
Food Web Model

- Updated and recalibrated
- Some changes due to the large amount of new data collected
- New biomagnification factors calculated to relate fish tissue concentration to dissolved MeHg exposure concentrations (dMeHg)

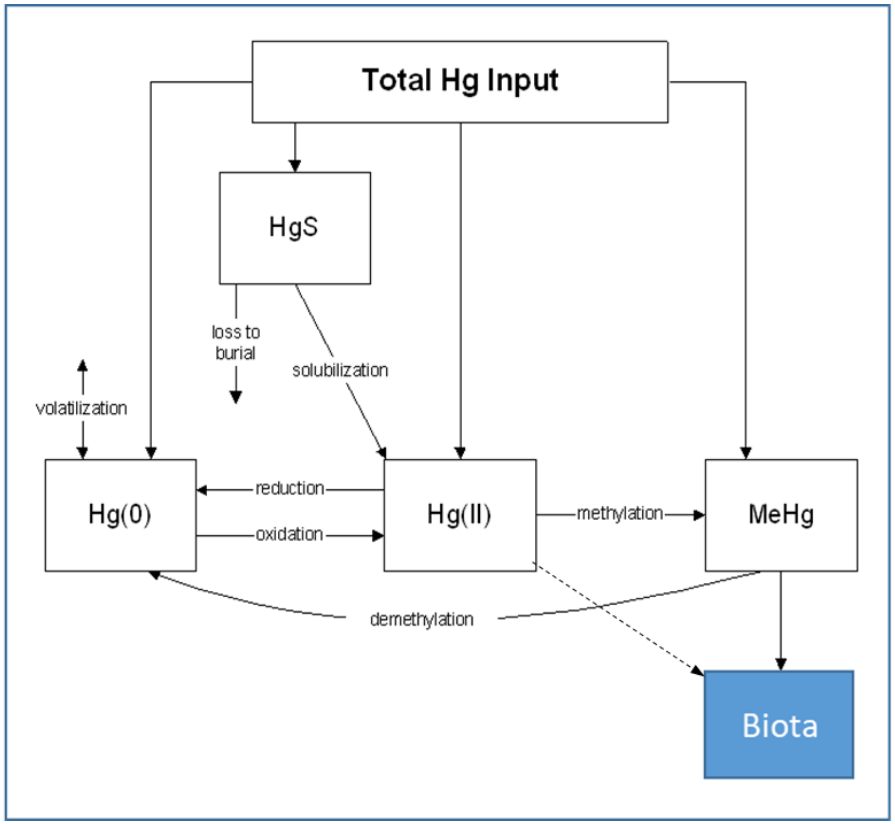


MeHg/THg Translator

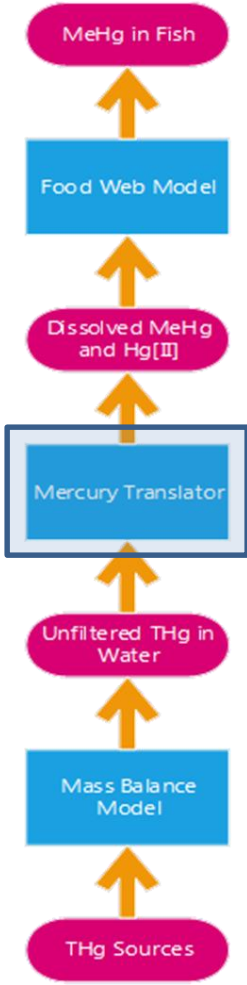
- Convert dMeHg target exposure concentrations to THg concentration targets in water
- Use empirical equation to approximate complex relationships that determine Hg solubility and methylation
- Expressed as dMeHg/THg over spatial and temporal scale



MeHg/THg Translator

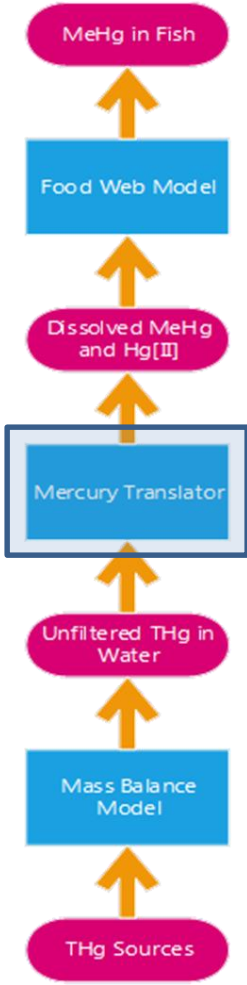


- Methylation by bacterial
- De-methylated by bacteria and light
- Created from Hg[II]
- Created (mostly) in environment, not directly loaded



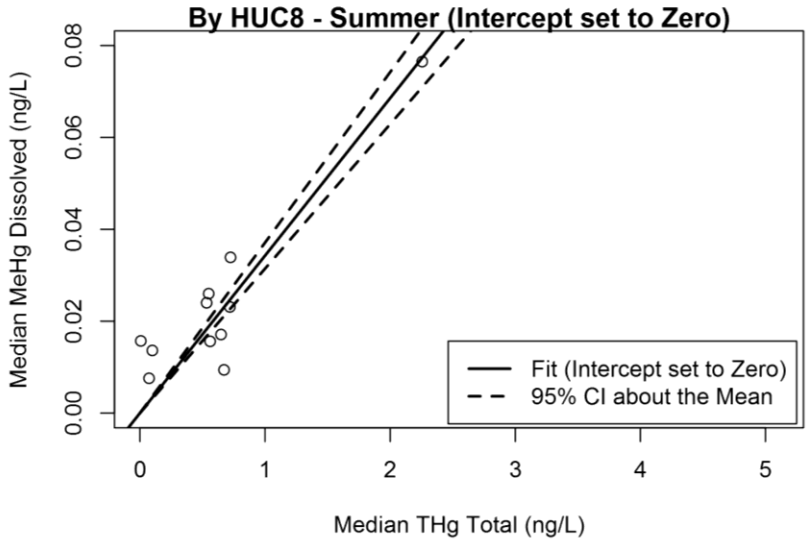
MeHg/THg Translator

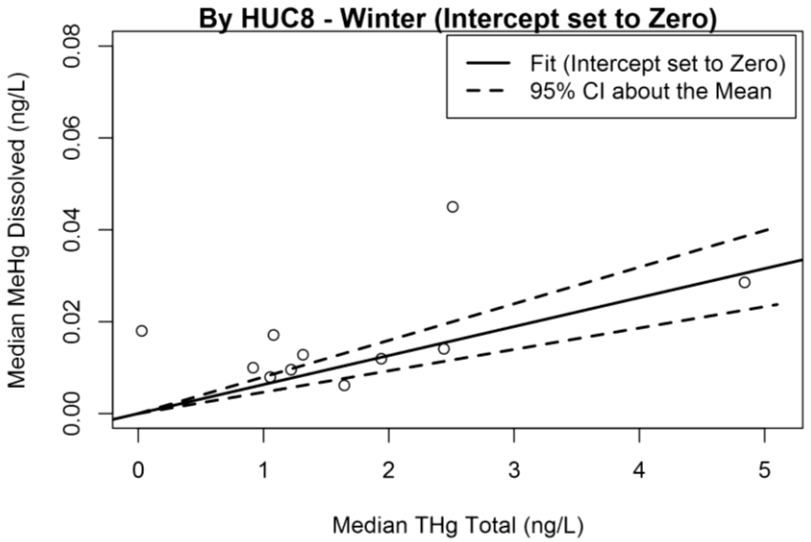
- Selected aggregated approach that uses average dMeHg and THg at a site rather than relying on paired samples
- Reflects the fact that methylation usually takes place in or near the sediment
  - Occurs over longer-term Hg loading
  - Not represented well using instantaneous pairing of water column concentrations
- Provides much better goodness-of-fit statistics
- Used statistical techniques that account for presence of non-detects in data

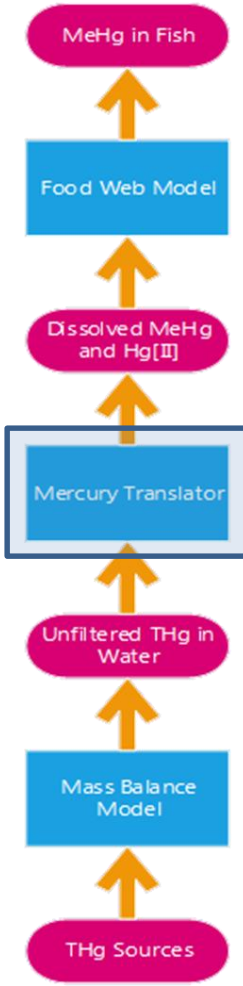


MeHg/THg Translator

Example

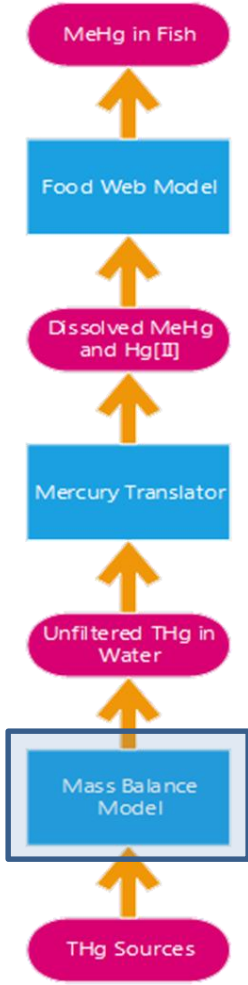






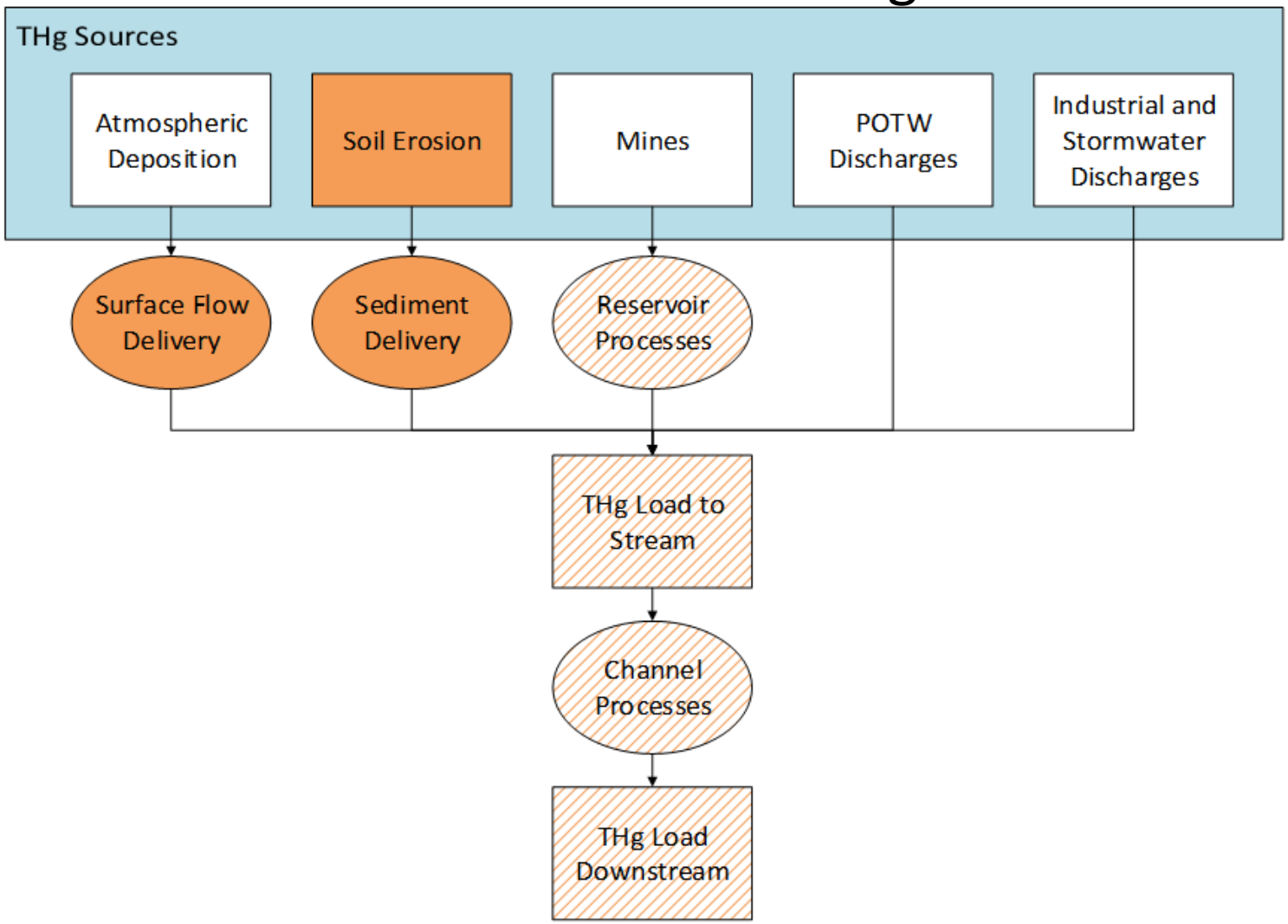
Mass Balance Model

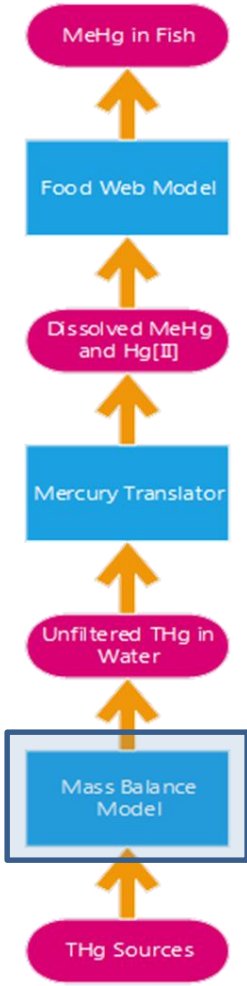
- Connect sources of THg load throughout the watershed to THg concentrations in river network
- Use watershed model (HSPF) to predict flow and sediment loading/transport to river network



Mass Balance Model

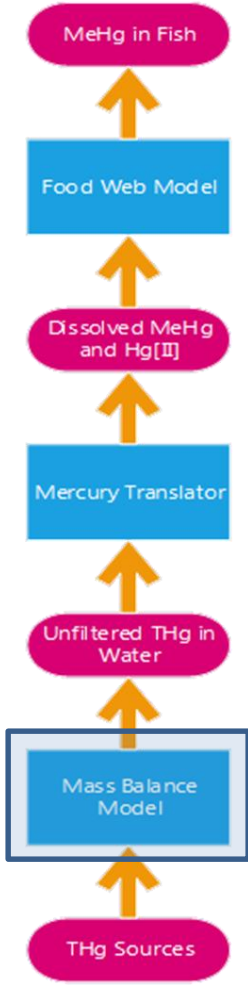
What's modeled using HSPF





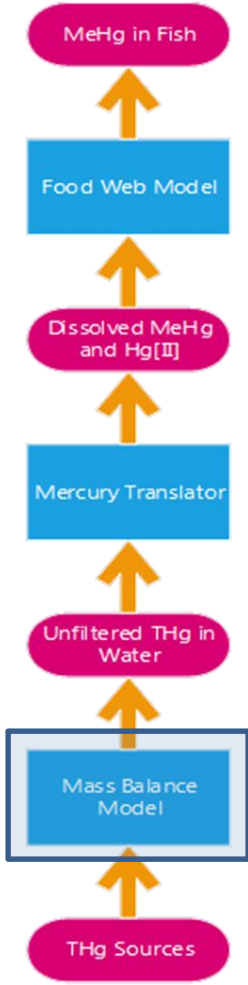
Mass Balance Model

- Represents major source and transport components system
- Provides unit-area runoff and loading rates by land use type.
- Combined unit-area rates with more recent land use (NLCD 2011) to estimate near-current loads



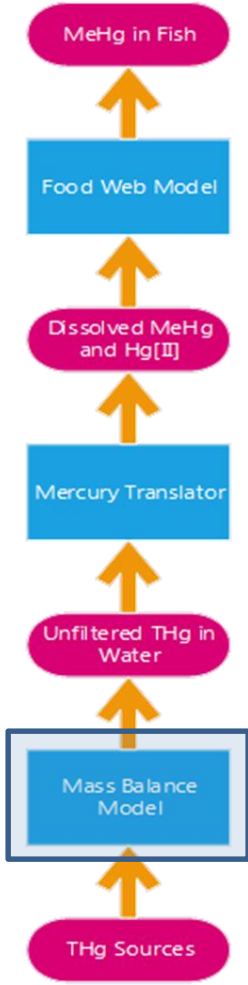
Mass Balance Model

- Represent Atmospheric Deposition – **Done**
  - NAMS studies to estimate wet and dry deposition
  - HSPF to evaluate transport via surface runoff
- Soil Matrix Sources – **Done**
  - Updated information on how surface soil concentrations vary with land cover
  - Estimated sediment detachment and delivery using HSPF



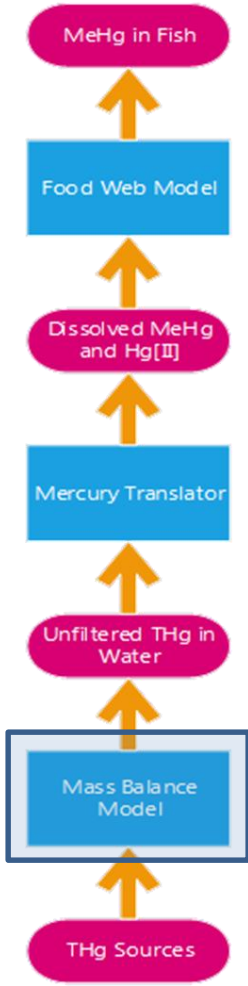
Mass Balance Model

- Mining Sources – **Done**
  - Major loads are in the Coast Fork watershed, upstream of Cottage Grove and Dorena reservoirs
  - Representing net loads from Black Butte and Bohemia Mining Districts based using in Reservoir outflow concentrations.
  - Loads generated from other defunct mines considered small relative to the total mass balance and not possible to quantify directly



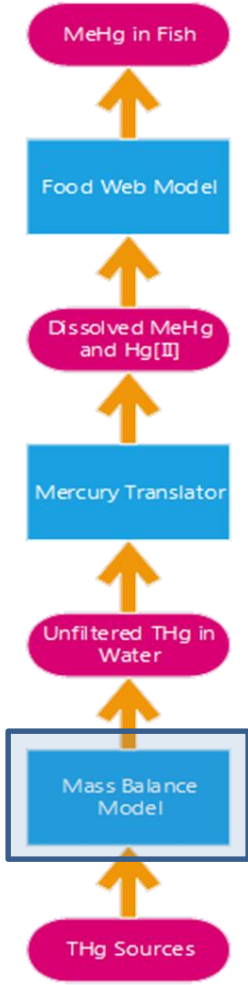
Mass Balance Model

- Groundwater Loading – **Done**
  - Ignored in the 2006 TMDL
  - Expect low concentrations
  - Loads important because majority of flow volume from groundwater
  - Use literature concentration ≈ 1 ng/L
- Losses during transit – **Done**
  - Represent demethylation, Hg gas loss, and precipitation of cinnabar as exponential decay
  - Calibrated using USGS LOADEST of Hg load at gaged sites and estimates land-based loads



Mass Balance Model

- POTW sources – *Mostly Completed*
  - Received data
  - Currently conducting data QC
- Industrial permits – *Incomplete*
  - Waiting for complete information from DEQ
  - HSPF setup to include inflows once data received
- Stormwater and MS4 sources – *Incomplete*
  - Waiting for information for areas of impervious surface flow that go direct to stream



Questions


MeHg in Fish
Food Web Model
Dissolved MeHg and Hg[II]
Mercury Translator
Unfiltered THg in Water
Mass Balance Model
THg Sources