

# **River Corridor Baseline Risk Assessment (RCBRA) – Human Health Risk Assessment (Volume 2)**

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# Purpose of this Human Health Risk Assessment

- Reaffirms basis for action for interim action records of decisions (IARODs)
- Evaluates need for further post-IAROD implementation
- Identifies contaminants of concern
- Identifies risk pathways of interest
- Identifies sites to move to Feasibility Study process
- Develop preliminary remediation goals (PRG)

# **Other information remedial investigation/feasibility study (RI/FS) will use to develop cleanup goals**

- Human health remedial action goals
- Ecological remedial action goals
- Groundwater protection
- Applicable or Relevant and Appropriate Requirements (ARARS)

# Process for River Corridor soil cleanup

- Qualitative risk assessments
- IARODs
  - 15 mrem for radionuclides
  - Model Toxic Control Act (MTCA) for chemicals
  - RESRAD model for Groundwater protection
- River Corridor Baseline Risk Assessment
- Remedial Investigation/Feasibility Study
- Proposed Plan
- Record of Decision (ROD)

## Key messages from RCBRA

- IAROD cleanups were mostly successful
  - Cleanups met IAROD objectives
- RCBRA adequate to support River Corridor Records of Decisions
- Some remediated waste sites will require further evaluation in the RI/FS

# Local Area Exposure Scenarios - Occupational

## Industrial/Commercial Worker

Adult working 40 hours/week, 50 weeks/year in an industrial setting located on a remediated waste site.

Key exposure characteristics:

- Residual contaminants in soil (external radiation, inadvertent ingestion, dust inhalation, absorption through skin)



## Resident Monument Worker

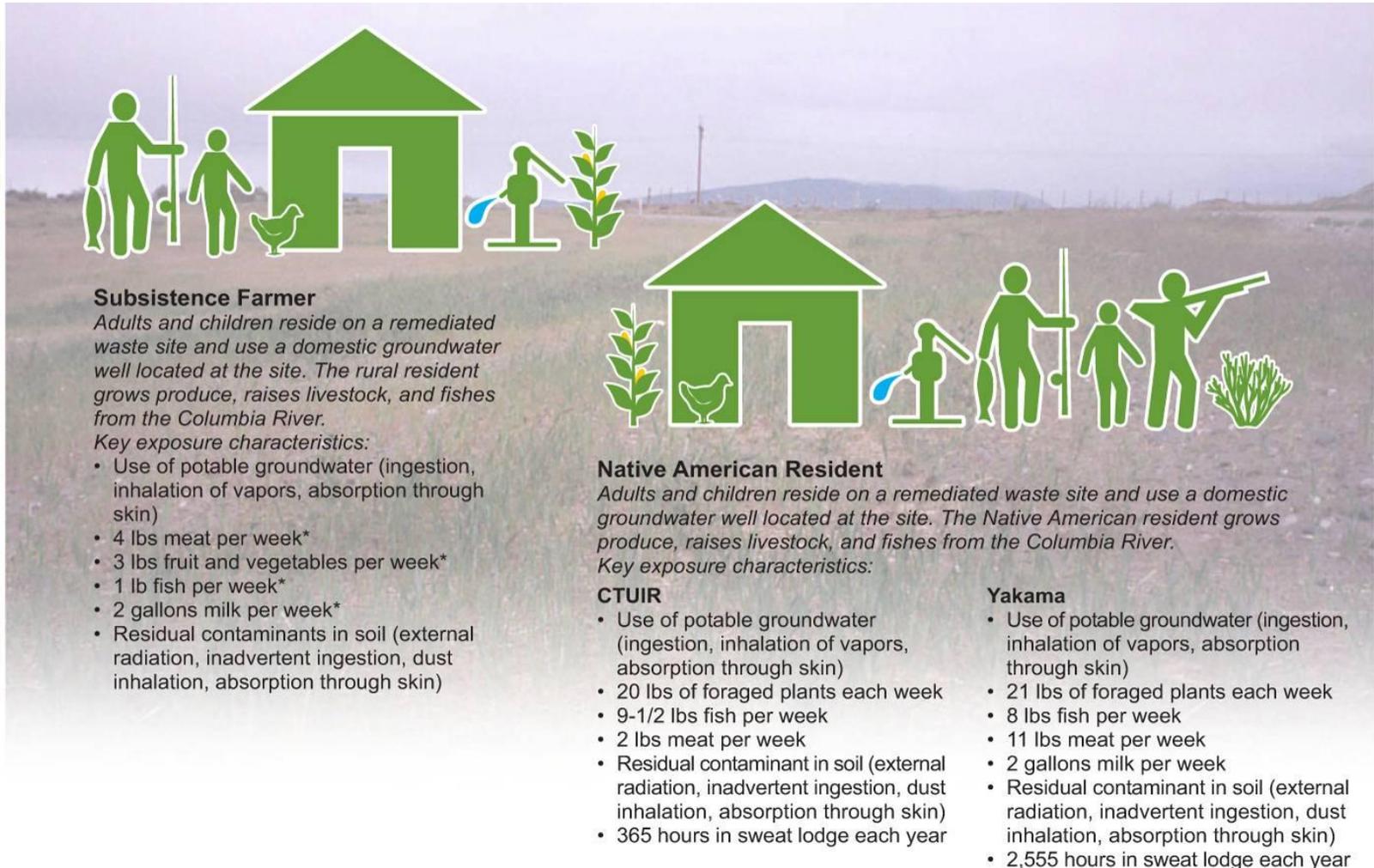
Adult working 40 hours/week, 50 weeks/year leading tours and ecological education in the various River Corridor environments. The monument worker resides on a remediated waste site and uses a domestic well located at the site.

Key exposure characteristics:

- Use of potable groundwater (ingestion, inhalation of vapors, absorption through skin)
- Residual contaminants in soil (external radiation, inadvertent ingestion, dust inhalation, absorption through skin)
- Surface soil in upland environment of the River Corridor (external radiation, inadvertent ingestion, dust inhalation, absorption through skin)

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# Local Area Exposure Scenarios - Residential



## Subsistence Farmer

Adults and children reside on a remediated waste site and use a domestic groundwater well located at the site. The rural resident grows produce, raises livestock, and fishes from the Columbia River.

Key exposure characteristics:

- Use of potable groundwater (ingestion, inhalation of vapors, absorption through skin)
- 4 lbs meat per week\*
- 3 lbs fruit and vegetables per week\*
- 1 lb fish per week\*
- 2 gallons milk per week\*
- Residual contaminants in soil (external radiation, inadvertent ingestion, dust inhalation, absorption through skin)

## Native American Resident

Adults and children reside on a remediated waste site and use a domestic groundwater well located at the site. The Native American resident grows produce, raises livestock, and fishes from the Columbia River.

Key exposure characteristics:

### CTUIR

- Use of potable groundwater (ingestion, inhalation of vapors, absorption through skin)
- 20 lbs of foraged plants each week
- 9-1/2 lbs fish per week
- 2 lbs meat per week
- Residual contaminant in soil (external radiation, inadvertent ingestion, dust inhalation, absorption through skin)
- 365 hours in sweat lodge each year

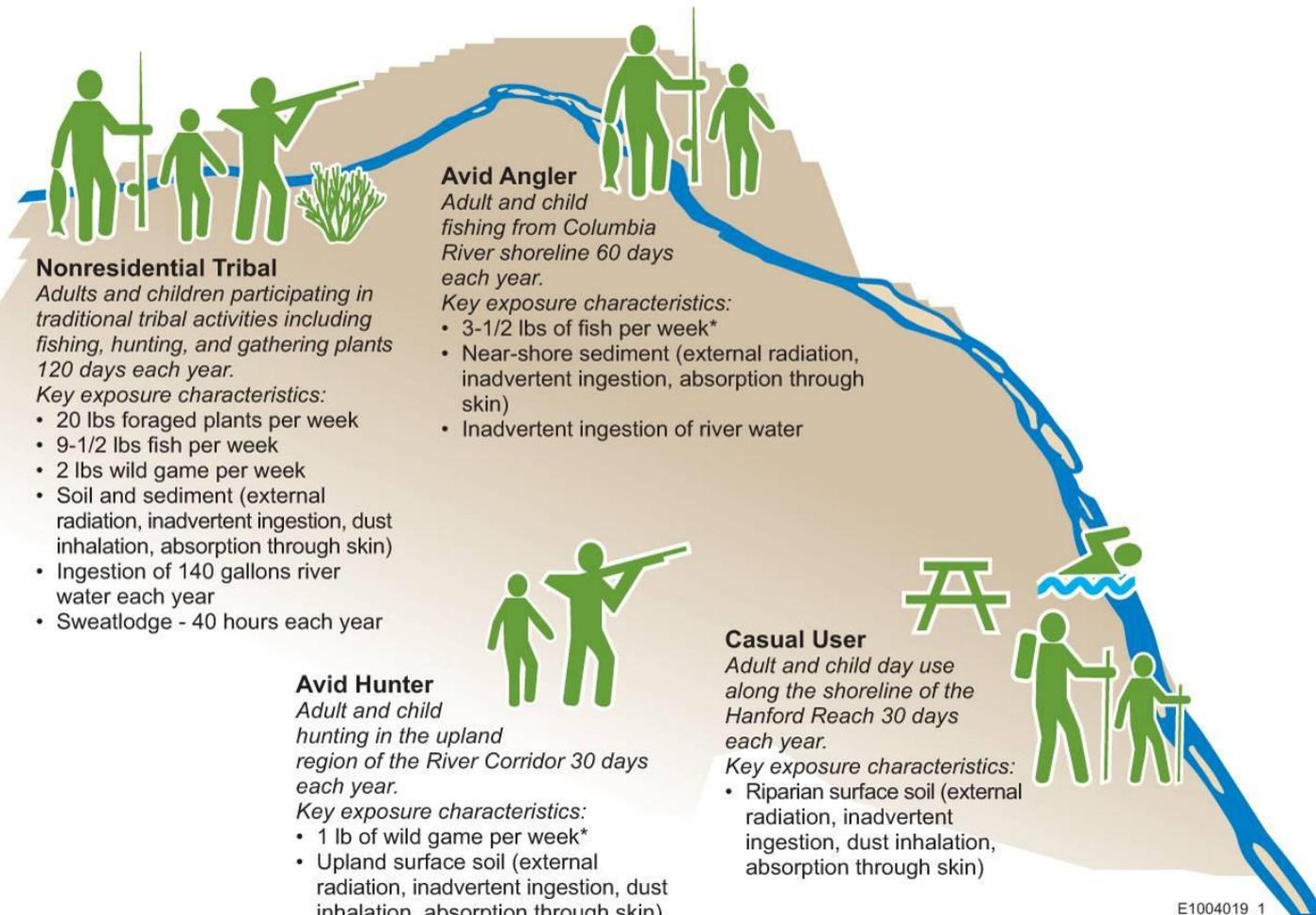
### Yakama

- Use of potable groundwater (ingestion, inhalation of vapors, absorption through skin)
- 21 lbs of foraged plants each week
- 8 lbs fish per week
- 11 lbs meat per week
- 2 gallons milk per week
- Residual contaminant in soil (external radiation, inadvertent ingestion, dust inhalation, absorption through skin)
- 2,555 hours in sweat lodge each year

\*Reasonable Maximum Exposure (adult)

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# Broad Area Exposure Scenarios



\*Reasonable Maximum Exposure (adult)

# Comparison to IAROD resident scenario

- IAROD cleanups were mostly successful
- Evaluated cumulative risk of individual remediated waste sites using IAROD resident scenario
- Most sites meet IAROD target residential risk threshold for radionuclides
  - 11 sites in 100 Area and 3 in 300 Area exceed risk threshold by up to 5 times for short-lived radionuclides
    - Meets threshold after additional 75 years of decay
  - 3 sites in the 300 Area exceed risk thresholds by up to 5 times for uranium
    - Cleanup completed to industrial use assumptions
  - Most sites meet current unrestricted target risk thresholds for nonradionuclides
    - 2 sites in 300 Area exceed thresholds by up to 3 times for arsenic
- Use of cleanup verification data may not represent soil conditions on the surface after the remediated waste sites are backfilled. This uncertainty may overestimate potential risk for surface exposure.

# Results

- Casual User scenario does not indicate elevated risk
  - Total lifetime cancer risks are near or below EPA de minimus threshold ( $1 \times 10^{-6}$ )
  - Noncancer chemical hazard is below threshold level of 1
- Avid Hunter scenario does not indicate elevated risk
  - Total cancer risks are within the EPA target risk range ( $10^{-6}$  to  $10^{-4}$ )
  - Noncancer chemical hazard is at the threshold level of 1
  - Exposure to arsenic through ingestion of game is the principle contributor to risk
- Avid Angler scenario does not indicate elevated risk
  - Lifetime cancer risk of  $4 \times 10^{-5}$
  - Screening-level assessment using surrogate fish (sculpin) to evaluate potential Hanford-related impacts

## **Nonresidential Tribal scenario indicates elevated risk**

- Total cancer risks of approximately  $1 \times 10^{-2}$
- Noncancer chemical hazard exceeds threshold of 1
- Exposure to arsenic through ingestion of plants is the principle contributor to risk
- Some exposure assumptions are highly uncertain, e.g. plant ingestion
  - Risk assessment recommends more field data to reduce this uncertainty
- Risk from eating fish based on small sample size and nontypical food fish (sculpin)
- DOE has notified and will work with tribes to help reduce identified uncertainties

# Occupational Scenarios - Risk Results

- Industrial Worker less than  $10^{-4}$  for radionuclides for most sites
  - 4 sites in 100 Area up to two times the  $10^{-4}$  threshold for short-lived radionuclides
    - Below  $10^{-4}$  after additional 75 years of decay
  - Noncancer chemical hazard is below threshold level of 1
- Resident Monument Worker less than  $10^{-4}$  for radionuclides for most sites
  - 8 sites in 100 Area up to two times 3 times greater than the  $10^{-4}$  threshold for short-lived radionuclides
    - Meets thresholds after additional 75 years of decay
  - 3 sites in the 300 Area up to 3 times  $10^{-4}$  threshold for uranium
    - Cleanup completed to industrial standards
  - Noncancer chemical hazard is below threshold level of 1
- Uncertainties
  - Use of cleanup verification data may not represent soil conditions on the surface after the remediated waste sites are backfilled. This uncertainty may overestimate potential risk for surface exposure.

# Subsistence Farmer

- Total cancer risk at 37% of the sites show elevated risk
- 47 sites in 100 Area exceed EPA target risk threshold ( $10^{-4}$ ) by up to 30 times
  - Risk Drivers - Exposure to short-lived radionuclides through external radiation and ingestion of on-site foodstuffs (produce, meat, milk, eggs)
  - Risk Drivers - Arsenic and strontium-90 exposure through ingestion of on-site foodstuffs (produce, meat, milk, eggs)
- 10 sites in the 300 Area exceed EPA target risk threshold by up to 30 times
  - Risk Drivers - Arsenic and uranium exposure through ingestion of on-site foodstuffs (produce, meat, milk, eggs)

# Subsistence Farmer

- Noncancer chemical hazard for 28% of sites exceeds thresholds
  - 33 sites in 100 Area exceed noncancer thresholds
    - Risk Drivers - Arsenic, mercury, and cadmium exposure through ingestion of on-site foodstuffs (produce, meat, milk, eggs)
  - 10 sites in the 300 Area exceed noncancer thresholds
    - Risk Drivers - Arsenic and uranium exposure through ingestion of on-site foodstuffs (produce, meat, milk, eggs)
- Uncertainties
  - Use of cleanup verification data may not represent soil conditions on the surface after the remediated waste sites are backfilled and may overestimate potential risk.
  - Some exposure highly uncertain, e.g. modeled values in food pathways

# Resident Native American Senarios

- Total cancer risks at 71% of the sites exceed the EPA target threshold
  - 99 sites in 100 Area exceed EPA target risk threshold by up to 90 times
    - Exposure to short-lived radionuclides (Co-60, Cs-137, Eu-152) through external radiation and ingestion of on-site foodstuffs (produce, meat, milk, eggs)
    - Arsenic and strontium-90 exposure through ingestion of on-site foodstuffs (produce, meat, milk, eggs)
  - 12 sites in the 300 Area exceed EPA target risk threshold by up to 40 times
    - Arsenic and uranium exposure through ingestion of on-site foodstuffs (produce, meat, milk, eggs)

# Resident Native American Senarios (cont'd)

- Noncancer chemical hazard for 59% of sites exceeds thresholds
  - 80 sites in 100 Area exceed noncancer thresholds
    - Arsenic, mercury, and cadmium exposure through ingestion of on-site foodstuffs (produce, meat, milk, eggs)
  - 12 sites in the 300 Area exceed noncancer thresholds
    - Arsenic and uranium exposure through ingestion of on-site foodstuffs (produce, meat, milk, eggs)
- Uncertainties
  - Use of cleanup verification data may not represent soil conditions on the surface after the remediated waste sites are backfilled and may overestimate potential risk for surface exposure.
  - Modeled values in food pathways are highly uncertain and may overestimate risk
  - Exposure assumptions are conservative and may overestimate risk

# Groundwater Baseline Risk Assessment

- Screening-level assessment
- Fulfills requirement for baseline assessment of groundwater
  - Provides basis for additional groundwater sampling conducted as a part of the remedial investigation (RI)
- Available unfiltered groundwater data collected from 1998 to 2008 from approximately 330 wells throughout River Corridor
  - Identify contaminants of potential concern (COPCs)
  - Identify spatial distribution of contaminants
- Uncertainties
  - Spatial and temporal variability
  - RI collection activity for broad range of constituents

## Risk Drivers

- Contaminants that represent highest potential for risk are identified for each scenario and ROD Area
  - Soil: Co-60, Sr-90, Cs-137, Eu-152, uranium, arsenic, mercury
  - Groundwater: tritium, hexavalent chromium, Sr-90, uranium, nitrate, C-14

# Support the RI/FS process and risk management decisions (cont'd)

- Preliminary Remediation Goals (PRG)
  - Soil PRGs are provided recreational users, industrial/commercial worker, monument worker
  - Soil PRGs are provided for current IAROD cleanup levels and EPA standard residential scenario

## **Support the RI/FS process and risk management decisions (cont'd)**

- Recommendations for the RI/FS to address significant data gaps and uncertainties
  - Collect soil data to assess lateral distribution of contaminants around remediated waste sites (step out sampling)
  - Collect groundwater samples to assess current spatial disposition, chemical composition, and temporal representativeness of groundwater data
- Consult with tribes on risk derived from Tribal scenarios