100-N TPA Decisions; Milestones/Target Dates & Progress

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Future 100-N TPA Milestones & Target Dates

- **M-015-00D DOE shall complete the RI/FS process through the submittal of a proposed plan for all 100 and 300 area operable units Dec 2012**
  - **M-015-62-T01 Submit a feasibility study report and proposed plan for the 100-NR1 and 100-NR-2 Operable Units including groundwater and soil. The FS report &PP will evaluate the permeable reactive barrier technology and other alternatives and will identify a preferred alternative in accordance with CERCLA requirements Dec 2011**
- **M-015-60 If an amendment to the 100-NR-1/2 record of decision for interim action is issued, DOE shall submit an RD/RA work plan within 6 months after the ROD amendment**
- **M-016-00 Complete remedial actions for all non-tank farm operable units Sept 2024**
  - **M-016-110-T03 DOE shall take actions necessary to contain the Sr-90 plume at the 100-NR-2 Operable Unit such that the default ambient water quality standard (8 pCi/L) for Dr-90 is achieved in the hyporheic zone and river water column Dec 2016**
- **M-016-00A Complete all interim response actions for the 100 Areas Dec 2012**

TPA Milestones for CERCLA RI/FS Work Plans Leading to the 1999 Record of Decision for Interim Action

TPA Milestone	Document	Completed
M-012-12	SUBMIT 100-NR-1 OPERABLE UNIT WORK PLAN (SOURCE AND GROUNDWATER OPERABLE UNIT).	Oct 1990
M-012-14	SUBMIT 100-NR-3 OPERABLE UNIT WORK PLAN (SOURCE AND GROUNDWATER OPERABLE UNIT).	Oct 1990
M-012-12A	SUBMIT RESCOPED RFI/CMS WORK PLAN 100-NR-1 OPERABLE UNIT, IN ACCORDANCE WITH FINAL "HANFORD PAST-PRACTICE STRATEGY DOCUMENT".	Dec 1991
M-012-14A	SUBMIT RESCOPED RFI/CMS WORK PLAN FOR 100-NR-2 OPERABLE UNIT, IN ACCORDANCE WITH THE FINAL "HANFORD PAST PRACTICE STRATEGY DOCUMENT".	Dec 1991
M-013-87	SUBMIT 100-NR-01 AND 100-NR-02 RFI/CMS OPERABLE UNIT WORK PLANS.	Oct 1994

TPA Milestones for Investigations Supporting 1999 Record of Decision for Interim Action

TPA Milestone	Document	Date Completed
M-015-12A-T01	SUBMIT TO ECOLOGY AND EPA FOR REVIEW THE 100-NR-1 AND 100-NR-2 LIMITED FIELD INVESTIGATION REPORTS FOR PREVIOUSLY APPROVED FIELD INVESTIGATIONS.	Aug 1994
M-015-12A	SUBMIT LIMITED FIELD INVESTIGATION REPORT FOR NEW WORK COMPLETED UNDER 100-NR-1 AND 100-NR-2 RFI/CMS WORK PLANS.	July 1996
M-015-12B	Submit Closure Plan/Corrective Measures Study (CMS) For 1301-N/1325-N, And 1324-N/1324-NA To Ecology For Approval. ……..	March 1997
M-015-12C	Submit 100-NR-1 And 100-NR-2 CMS To Ecology For Approval. The 100-NR-1 And 100-NR-2 CMS Will Address All 100-N Area Groundwater, And High And Low Priority Past Practice Sites…….	Nov 1996

TPA Milestones for D&D

TPA Milestone	Document	Completed
M-016-01A	Submit Draft 100-N Area Ancillary Facility Decommissioning Engineering Evaluation And Cost Analysis (EE/CA) To Ecology. ……	April 1997
M-016-01E	Complete N Reactor/100-N Area Deactivation Pursuant To The Work Scope Identified In The "N Reactor Deactivation Program Plan", Revision 4, WHC-SP-0615, December 1993.	July 1998
M-093-25	Submit EE/CA For N Reactor ISS	Oct 2004

Engineering Evaluation of Containment Alternatives for N-Springs Releases
May 1991

- Prepared for WHC by Ebasco Environmental (WHC-SD-EN-EE-003)
- Analysis was not required by the TriParty Agreement
- Evaluation of alternatives to restrict N-Springs releases to below DCG in DOE Order 5400.5 (1,000 pCi/L)
- Considered
  - Pump-and-Treat – Evaluated in detail
  - Freeze Wall– Evaluated in detail
  - Slurry Wall– Evaluated in detail
  - In Situ Chemical Precipitation– Evaluated in detail
  - Surface Sealing and Capping – Screened out in initial evaluation
  - Hydraulic Barrier using a carbonate solution – Screened out in initial evaluation
- Slurry Wall and Freeze Wall received similar score and outranked pump-and-treat
- No action was implemented

TPA Milestone M-14 SEC Dispute Decision January 1993

- **DOE commits to a response action at N-Springs**
  - **Reduce the Sr-90 contamination flux to the groundwater that feeds N-Springs**
  - **Evaluate commercially available treatment options for Sr-90**
  - **Provide data necessary to set demonstratable Sr-90 groundwater cleanup standards**
  - **Approval mechanism will be a non-time-critical ERA as defined in the HPPS**
  - **Enforceable milestones**

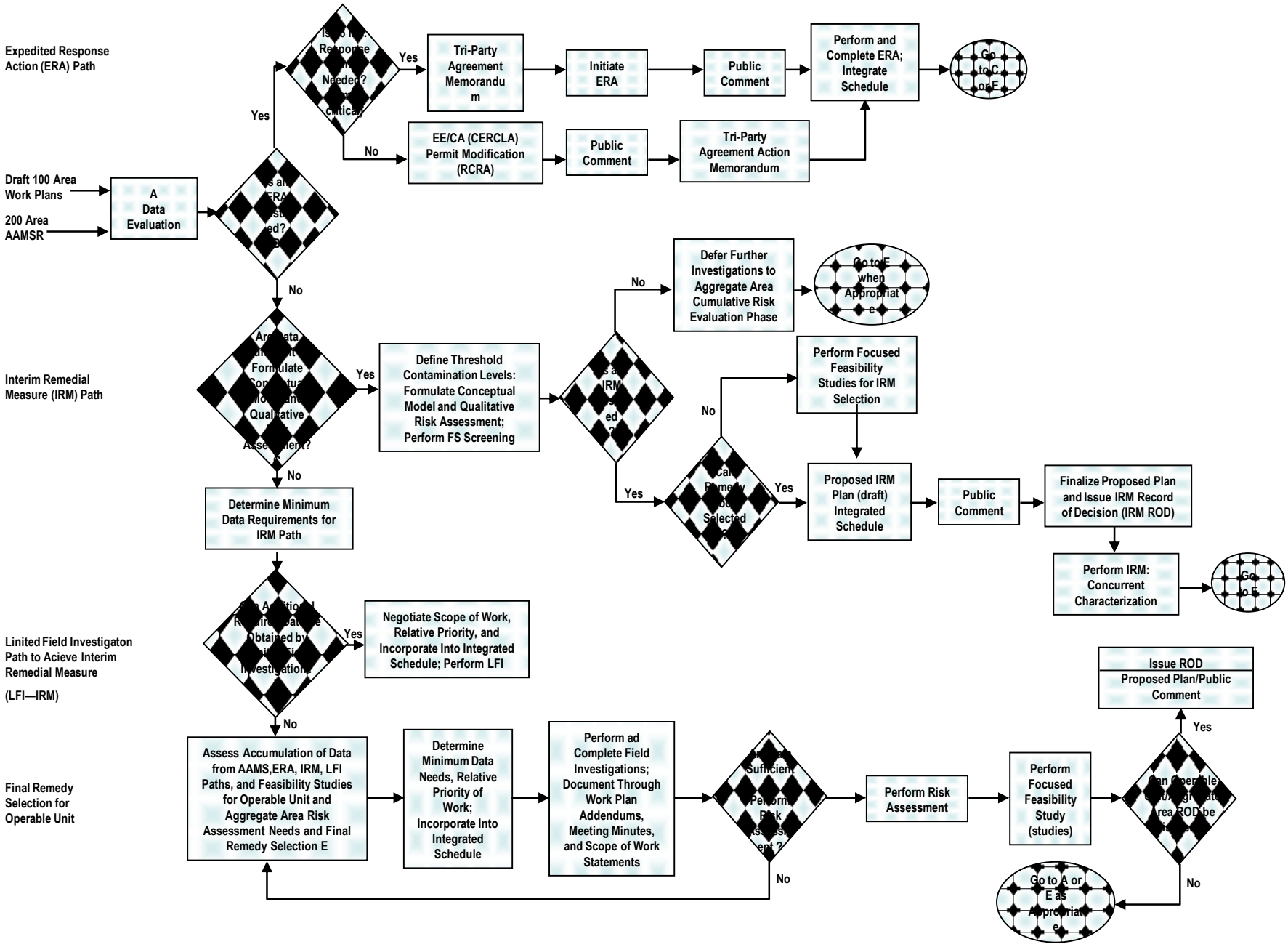
Engineering Evaluation/Cost Analysis
January 1994

- **Four Alternatives Determined to be appropriate for consideration**
  - **No Action (Required for baseline comparisons)**
  - **Pump-and-Treat**
  - **Slurry-Wall Barrier**
  - **Hydraulic Control**

- **DOE concluded that no single alternative could be recommended above the others to meet the 90% reduction of Sr-90 concentrations in the groundwater flowing from N-Springs into the Columbia River**
- **DOE convened an independent expert panel to review the findings.**
- **Ecology and EPA did not concur with the findings of the report (or the findings of the expert panel) – Ecology directed DOE, through an Action Memorandum in September 1994, to install a pump-and-treat system enhanced with a temporary sheet pile barrier.**

Independent Technical Review of N-Springs Expedited Response Action Proposal Hanford Site February 1994

- **Prepared by Advanced Sciences Inc for WHC**
- **Review of "N-Springs Expedited Response Action Proposal, DOE/RL-93-23, Rev 0, January 1993" and supporting documents.**
- **Review Board of nationally recognized experts**
- **Board consensus and recommendations included the following:**
  - **The goal of significant reduction of Sr-90 flux to the Columbia River by separation of Sr-90 from pumped groundwater during the [proposed] 10 year ERA duration would result in insignificant total mass removal due to the natural immobility of Sr-90.**
  - **The most cost-effective alternative appears to be a vertical barrier with monitoring at the ends of the barrier. The Panel stated that a vertical barrier using a slurry wall could have been selected and this option has the least technological and cost uncertainty (The WHC report did not recommend a preferred alternative).**


Expedited Response Action (ERA) Path
Draft 100 Area Work Plans
200 Area AAMSR
A Data Evaluation
Yes
No
Tri-Party Agreement Memorandum
Initiate ERA
Public Comment
Perform and Complete ERA; Integrate Schedule
EE/CA (CERCLA) Permit Modification (RCRA)
Public Comment
Tri-Party Agreement Action Memorandum
Interim Remedial Measure (IRM) Path
Define Threshold Contamination Levels: Formulate Conceptual Model and Qualitative Risk Assessment; Perform FS Screening
Defer Further Investigations to Aggregate Area Cumulative Risk Evaluation Phase
Perform Focused Feasibility Studies for IRM Selection
Proposed IRM Plan (draft) Integrated Schedule
Public Comment
Finalize Proposed Plan and Issue IRM Record of Decision (IRM ROD)
Perform IRM: Concurrent Characterization
Determine Minimum Data Requirements for IRM Path
Linited Field Investigaton Path to Acieve Interim Remedial Measure
(LFI—IRM)
Negotiate Scope of Work, Relative Priority, and Incorporate Into Integrated Schedule; Perform LFI
Final Remedy Selection for Operable Unit
Assess Accumulation of Data from AAMS,ERA, IRM, LFI Paths, and Feasibility Studies for Operable Unit and Aggregate Area Risk Assessment Needs and Final Remedy Selection E
Determine Minimum Data Needs, Relative Priority of Work; Incorporate Into Integrated Schedule
Perform ad Complete Field Investigations; Document Through Work Plan Addendums, Meeting Minutes, and Scope of Work Statements
Perform Risk Assessment
Perform Focused Feasibility Study (studies)
Issue ROD
Proposed Plan/Public Comment
Go to A or E as Appropriate

ACTION MEMORANDUM; N-SPRINGS EXPEDITED RESPONSE ACTION (ERA) CLEANUP PLAN

September 24, 1994

- **Ecology and EPA direction to DOE to perform an ERA**
- **50 gpm pump-and-treat system**
  - **Operational by September 1995**
  - **Continuous operation**
  - **Design Requirements**
    - **Meet Sr-90 draft DWS**
    - **90% reduction of Sr-90 minimum in treatment effluent**
    - **Design to evaluate commercially-availableSr-90 treatment technologies**
    - **Ease of expansion**
    - **Discharge treated water upgradient to aid Sr-90 recovery**

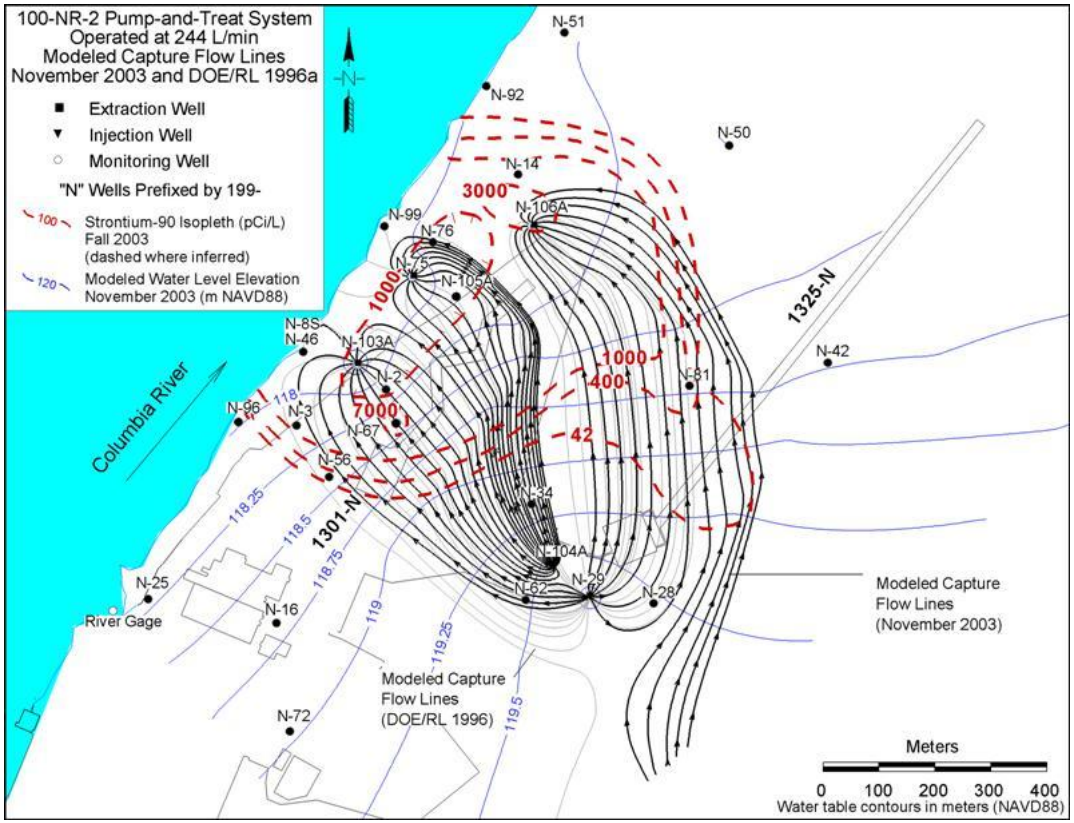
- **P&T System enhanced by a 3,000 ft. grouted hinge sheet pile wall**
  - **Initiate construction February 1995, Complete June 1995**
  - **Terminated after constructability test**
  - **The intent of the wall was to reduce the inflow of river water and increase the capture zone inland.**

Record of Decision for Interim Action September 1999

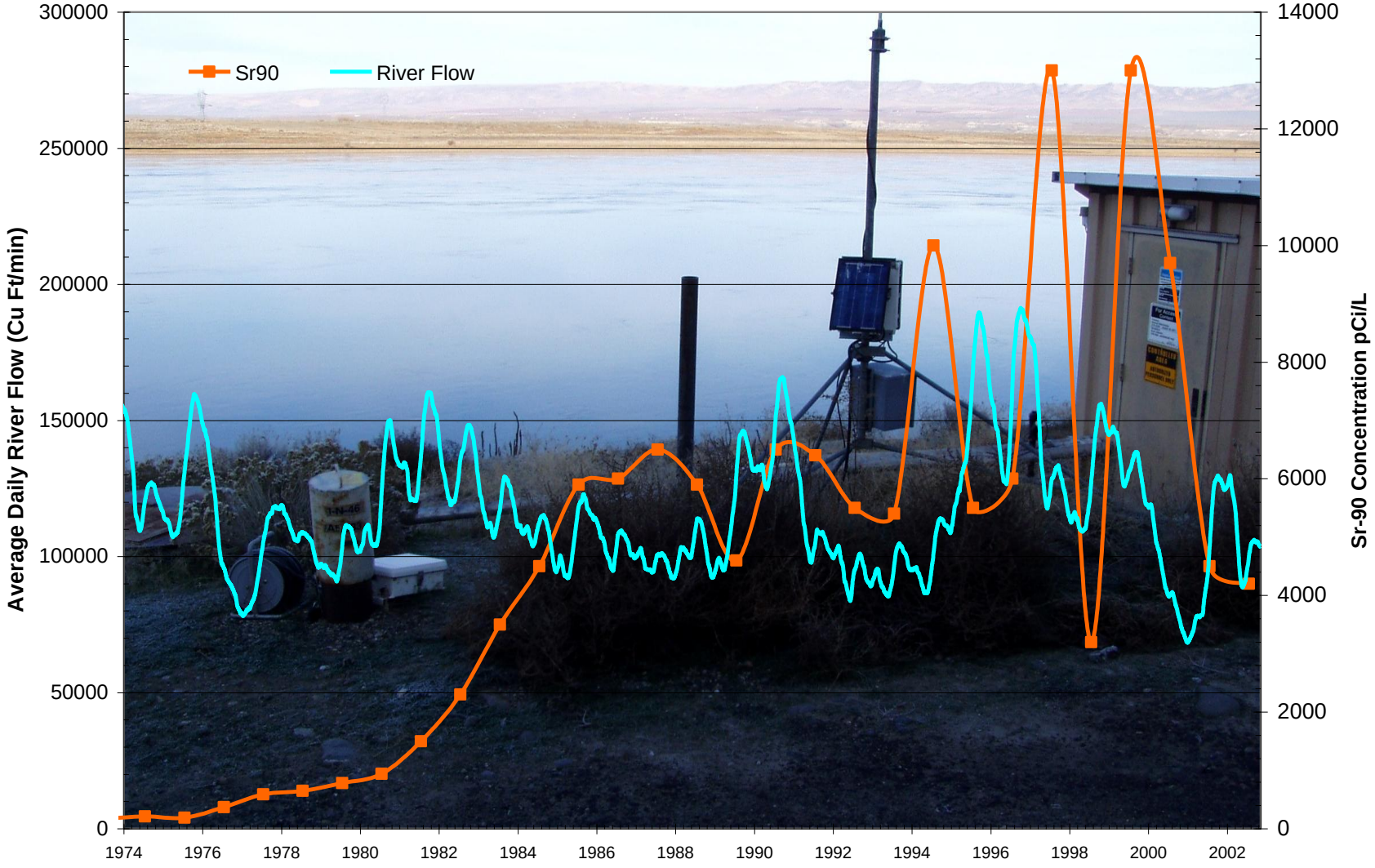
- **100-NR-01 Source & 100-NR-02 Groundwater combined ROD**
- **Groundwater provisions include**
  - **Remove and treat Sr-90 contaminated groundwater through extraction and treatment with ion exchange and discharge treated groundwater upgradient into the aquifer**
  - **Maintain approved groundwater monitoring networks**
  - **Evaluate technologies for Sr-90 removal and submit information to Ecology**
  - **Remove free-floating petroleum hydrocarbons from monitoring wells**
  - **Remove petroleum-contaminated solid waste, if needed, and dispose to ERDF**
  - **Conduct an evaluation of aquatic and riparian receptor impacts at the groundwater/river interface within 5-years. Evaluation will include a literature search and evaluation of existing data. Lab tests and studies may be required.**
  - **5-Year review and maintain institutional controls**

IROD Requirement: Remove and treat Sr-90 contaminated groundwater through extraction and treatment with ion exchange and discharge treated groundwater upgradient into the aquifer

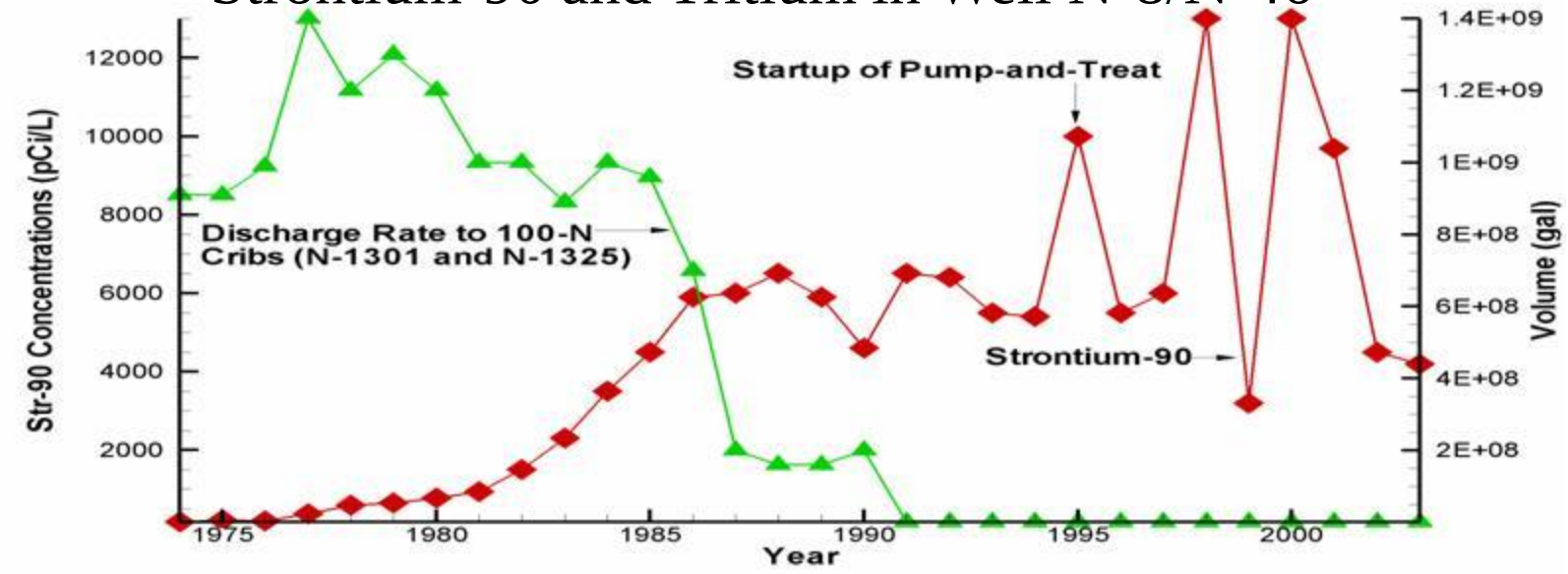
- The P&T system did:
  - Create a hydraulic sink to reduce flux to the river
  - Provide sufficient data to support Proposed Plan
  - Remove ~1.8 Ci Sr-90 at a cost exceeding $20M; Whereas, ~320 curies were “removed” by radioactive decay during same period (15 curies in the groundwater)
- The P&T system did not:
  - Significantly impact the Sr-90 source, groundwater plume and Sr-90 concentrations between the pumping zone and the river

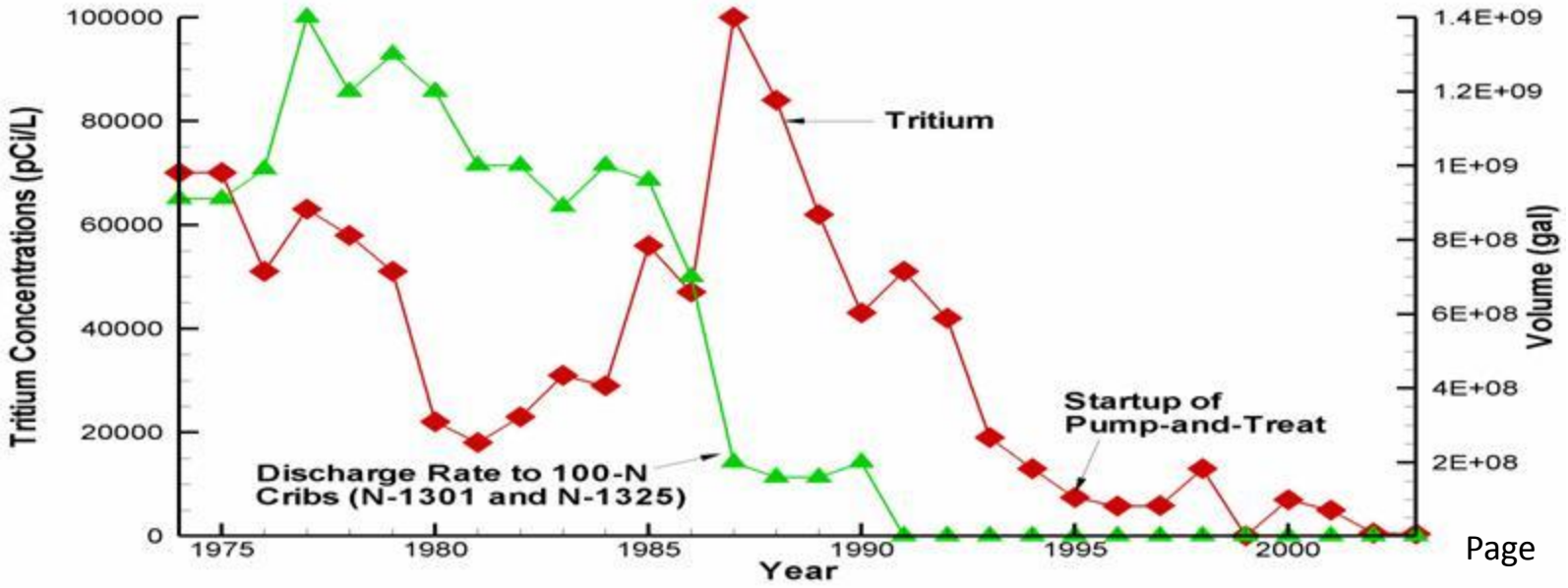


Strontium-90 and river flow at N-8/N-46

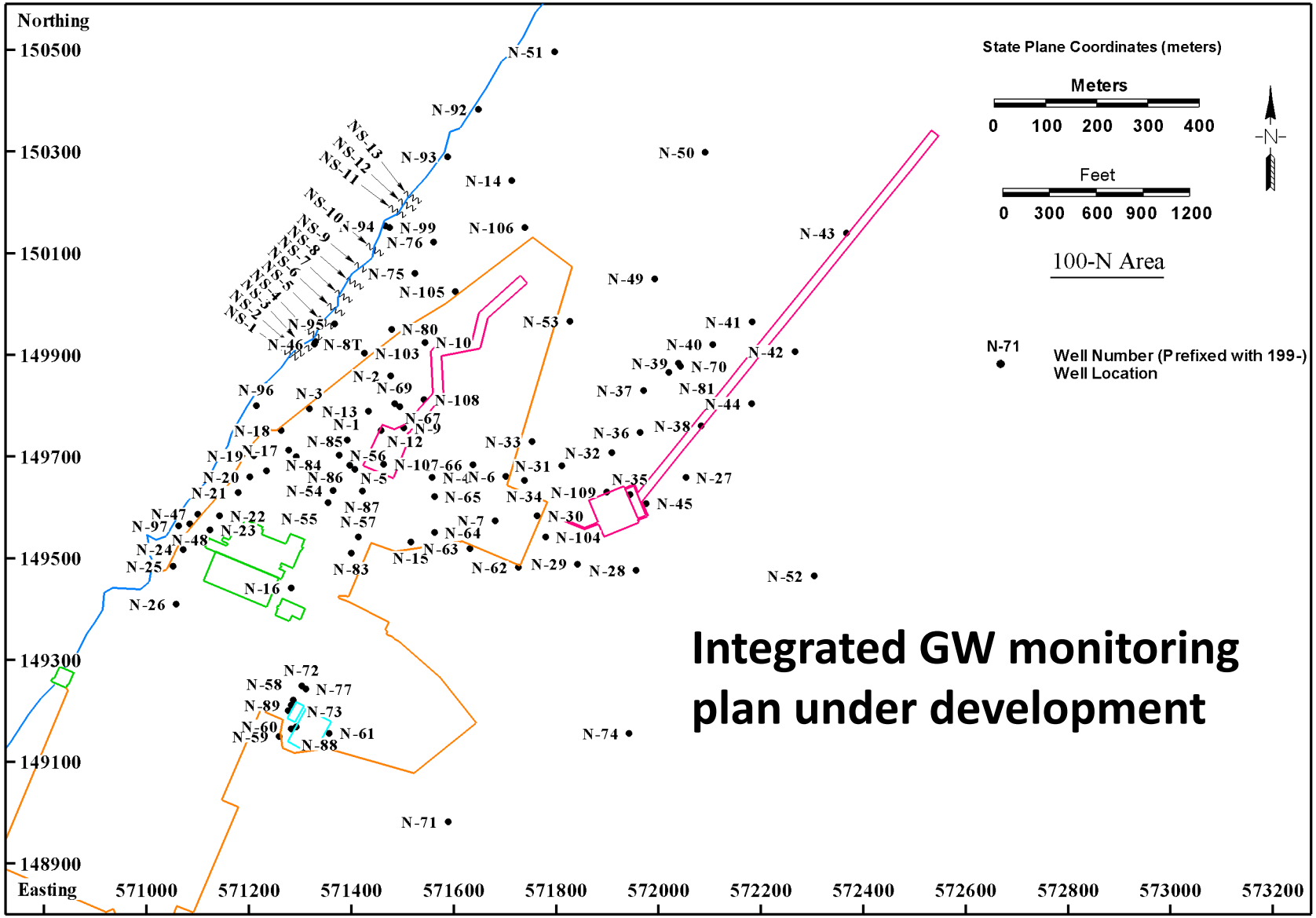


Strontium-90 and Tritium in Well N-8/N-46





IROD Requirement: Maintain approved groundwater monitoring networks



IROD Requirement: Evaluate technologies for Sr-90 removal and submit information to Ecology

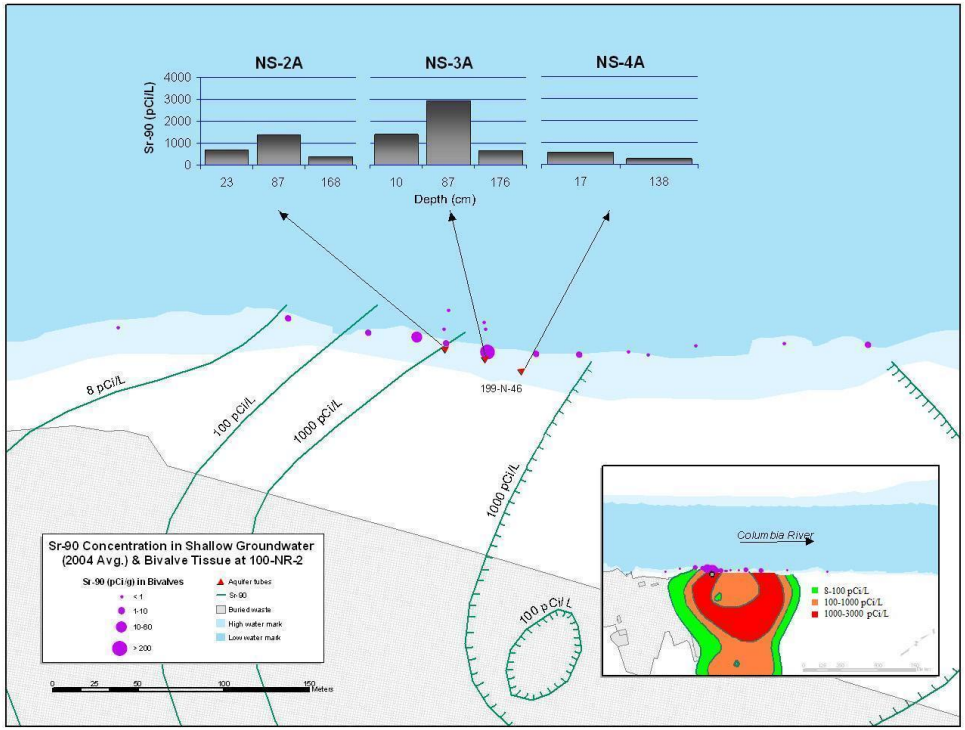
- Pre-IROD Technology Evaluations
  - Engineering Evaluation of Containment Alternatives for N-Springs Releases
    May 1991
  - Engineering Evaluation/Cost Analysis January 1994
  - Independent Technical Review of N-Springs Expedited Response Action Proposal Hanford Site February 1994
  - In Situ Treatability Test Planning Workshop April – May 1996
  - Corrective Measures Study for the 100-NR-01 and 100-NR-02 Operable Units July 1997
- Post-IROD Technology Evaluations:
  - Innovative Treatment and Remediation Demonstration (ITRD) for Hanford's 100-N Area 1998-2001
  - Apatite Permeable Reactive Barrier & Phytoextraction tests

IROD Requirement: Remove free-floating petroleum hydrocarbons from monitoring wells & Remove petroleum-contaminated solid waste, if needed, and dispose to ERDF

- **2 Smart Sponges® (absorbent sponges that preferentially remove floating diesel product from the surface of water) installed in the well 199-N-18 (Only well with persistent hydrocarbon occurrence)**
- **The date of the last change-out was 1-18-2010.**

IROD Requirement: Conduct an evaluation of aquatic and riparian receptor impacts at the groundwater/river interface within 5-years. Evaluation will include a literature search and evaluation of existing data. Lab tests and studies may be required.

- Delivered to Ecology October 31, 2005; Final document submitted December 2009
- Identified abnormalities the soft tissues of clams
- Diesel fuel spill causing reduced oxygen in a localized shoreline area
- High lead levels in some mice captured at the shoreline



Key 100-N Documents Supporting RI/FS Work Plan

- 100-N Literature & Data Review; PNNL-SA-39495 September 2003
  - ~220 reports & technical documents reviewed
  - Describes: biological resources, contaminant data & trend plots, dose assessments, modeling efforts and environmental studies
- 100-N Area Technical Baseline Report; WHC-SD-EN-TI-251
  - Describes waste sites & releases; 1994
- 3 Limited Field Investigation (LFI) Reports
  - DOE/RL-93-80 (100-NR-01)
  - DOE/RL-93-81 (100-NR-02)
  - DOE/RL-96-11 (LWDF's)

100-N Area RI/FS Work Plan

- The work plan is 5th and last addendum to the Integrated 100 Area RI/FS Work Plan that contains the planning elements common to the 100 Area source and groundwater operable units.
- Draft Work Plan was transmitted to Ecology December 22, 2009, meeting TPA Milestone M-015-61; 60 day comment period per Section 9.2 of TPA; Comments provided January 29, 2010
- Today's workshop is intended to facilitate work plan completion.

100-N Area RI/FS Work Plan

The work plan identifies scope of work required to support a remedial decision recommendation via a CERCLA proposed plan due December 2011 (TPA Target Date M-015-16-T01)

- Describes an updated conceptual model based on significant characterization, research & interim remedial action activities since the previous RODs were written.
- Identifies data needs and scope to close them
- SAP for 4 new characterization/monitoring wells
- Continued characterization of 93 waste sites scheduled for evaluation/characterization or remediation
- Preliminary information to determine COPCs, RAO's, remediation goals, and assessment of ARARs
- Describes remediation approach
- Addresses NEPA values
- Includes community relations

The Work Plan reflects considerable characterization and environmental remediation activities

- Implementation of the bias-for-action concepts described in the Hanford Past Practice Strategy (DOE/RL-91-40, 1991)
- 1999, Interim Remedial Action Record of Decision for the 100-NR-1 and -NR-220 Operable Units of the Hanford 100-N Area, as amended
  - characterizing groundwater plumes and their potential sources,
  - evaluation of ecological impacts,
  - evaluation of potential remedial technologies,
  - implementing remedial actions for groundwater and soil,
  - testing new and alternative treatment methods.

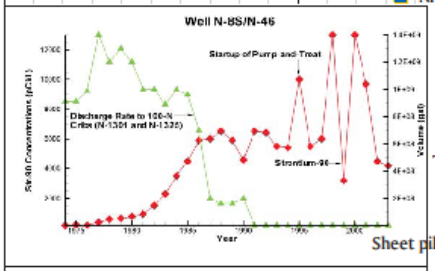
PROGRESS!!!

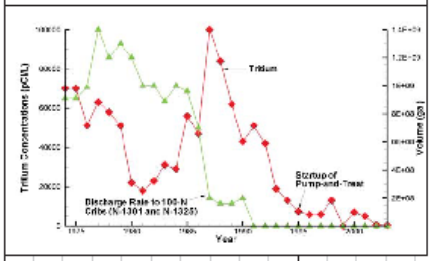
- **76% of the facilities in the decision unit have been demolished or removed.**
- **Reactor ISS completion is scheduled for September 2011.**
- **Cleanup of 18 waste sites -including the large liquid waste disposal facilities (source of groundwater contamination)**
- **~108 K tons of contaminated soil and debris have been removed & more than 650 soil samples have been collected to verify cleanup and document cleanup status.**
- **Orphan site evaluation completed**
- **Pump-and-treat has been implemented and evaluated; and, a hinged sheet-pile barrier, designed to supplement the pump-and-treat system was tested in 1994**
- **Testing a more promising groundwater remediation technology (permeable reactive barrier); 171 wells (ARRA Funding) will be constructed for 2700 ft apatite barrier**
- **A supplemental groundwater remediation technology (phytoextraction) is also being tested**
- **The Innovative Treatment and Remediation Demonstration Program evaluated 40 remediation technologies in 1998 that will serve as the basis of the 100-N feasibility study**
- **Characterization and remediation of petroleum contamination has been initiated**
- **Characterization of groundwater upwelling into the river and sediments is underway**
- **An initial assessment of the current impacts of contaminated groundwater plumes on aquatic and riparian zones within the 10-NR-2 Operable Unit was conducted in 2005 and completed in 2009**
- **River Corridor Baseline Risk Assessment is ongoing**

History of Effluent Control and Groundwater Remedial Actions at 100-N

1960 1970 1980 1990 2000

60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009





Contaminated wastewater discharged to soil column (1301-N crib)

NPDES permit obtained for effluent and seepage discharges to river

New crib (1325-N) built farther away from the river

Decision made that RCRA applies to Hanford

Liquid Effluent Study evaluates sources and driving force

Termination of liquid effluent discharges to the ground at 100-N

Modeling studies of strontium-90 transport to river

Sheet pile barrier proposed to intercept plume near shoreline & pilot test conducted

Pump and Treat system installed to reduce flux of groundwater to river

Corrective Measures Study for NR-1/NR-2 (alternative treatments identified)

Initial design & TTP for permeable reactive barrier(clino trench)
- work cancled due to adverse public opinion

Interim ROD (continue P&T, evaluate new technologies & conduct ecorisk assessment)

ITRD letter report on alternative treatment technologies & recommendations completed (Action #100-2)

Removal of most contaminated soils beneath 1301-N & 1325-N cribs

Public workshop reviewed short list of alternative technologies

Apatite lab studies of chemical solution injection approach & phyto greenhouse uptake study

Updated technology evaluation letter report and schedule

Public workshop to discuss proposed plans & obtain input for treatability testing to address near-shore strontium-90

Initial design & treatability test plan preparation

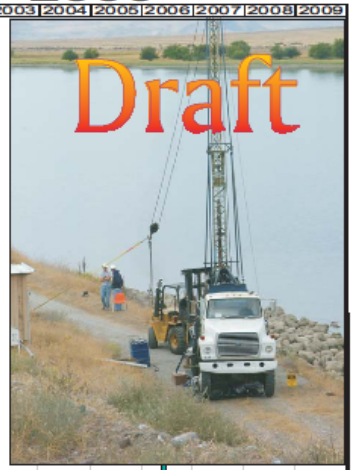
Completion of NR-2 ecorisk assessment

Public workshop to explain approach and FY06 plans

Pilot scale test and installation of 300 foot barrier planned

CERCLA 5 yr Review Report

CERCLA 5 yr Review Report



September 2005, Installation of first of 8 new performance monitoring wells for apatite barrier treatability test

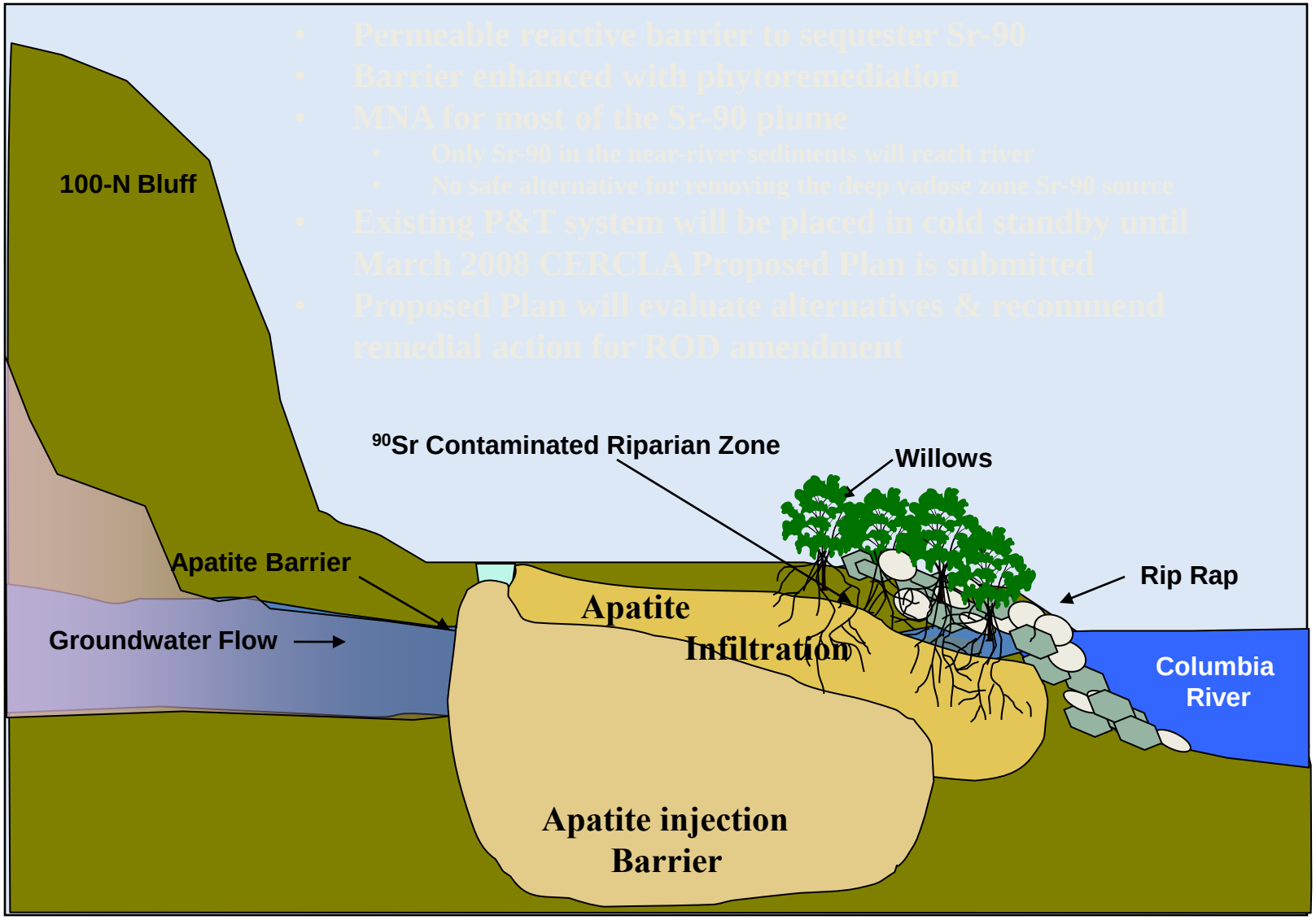
Key Event

Activity

GROUNDWATER REMEDIATION PROJECT

Systems Approach to Address 100-N ^{90}Sr

- Permeable reactive barrier to sequester Sr-90
- Barrier enhanced with phytoremediation
- MNA for most of the Sr-90 plume
  - Only Sr-90 in the near-river sediments will reach river
  - No safe alternative for removing the deep vadose zone Sr-90 source
- Existing P&T system will be placed in cold standby until March 2008 CERCLA Proposed Plan is submitted
- Proposed Plan will evaluate alternatives & recommend remedial action for ROD amendment



Recent Technology Applications and Demonstrations

- Jet Injection technology being tested for emplacement of phosphate and pre-formed apatite
  - Pilot-scale test includes three ~10 x 15-foot test plots
    - One plot injected with pre-formed fish bone apatite
    - One plot injected with phosphate solution
    - One plot injected with both pre-formed fish bone apatite and phosphate
  - Injection depth from just below ground surface to 25 feet
  - Soil sampling in test plots included as part of 171-well installation drilling
- Infiltration gallery – for passive infiltration of apatite or apatite-forming chemicals
  - 8 wells in place for test

Barrier Well Installation

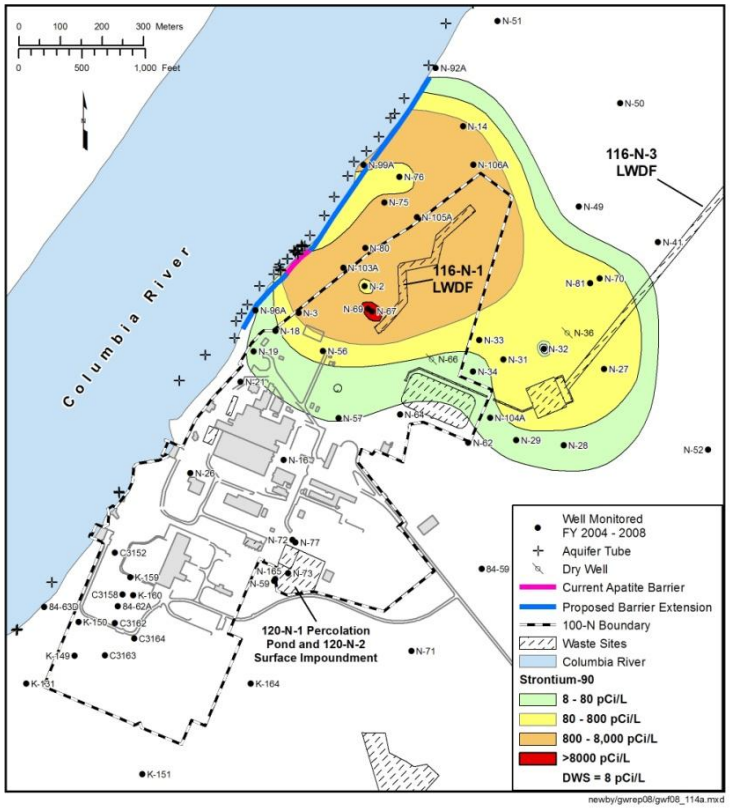
- **CHPRC is drilling 171 wells along Columbia River shoreline**
  - **Wells could be used to expand existing Apatite PRB along 100N shoreline where Sr-90 plume intersects river**
  - **Sonic drilling technology allows wells to be installed faster and more efficiently than previous drilling operations**

Existing Apatite Barrier

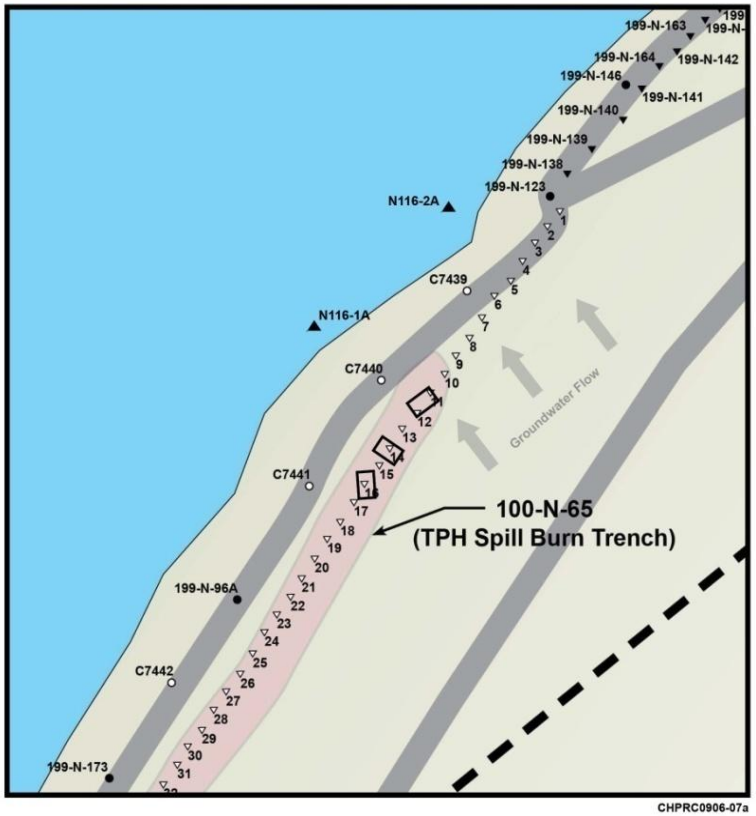
Above and below: Sonic drill rig and support equipment

Technology Applications and Demonstrations

Proposed Apatite PRB

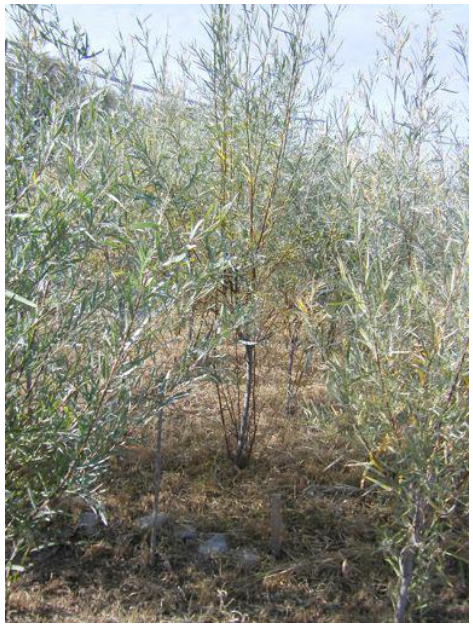


Locations for extensions Jet Injection tests



Phytoremediation Study

- **Work completed at 100K test plot of coyote willows**
  - **Data to date show promise for technology as "polishing" step for Sr-90 remediation on 100N shoreline**
  - **PNNL report completed**



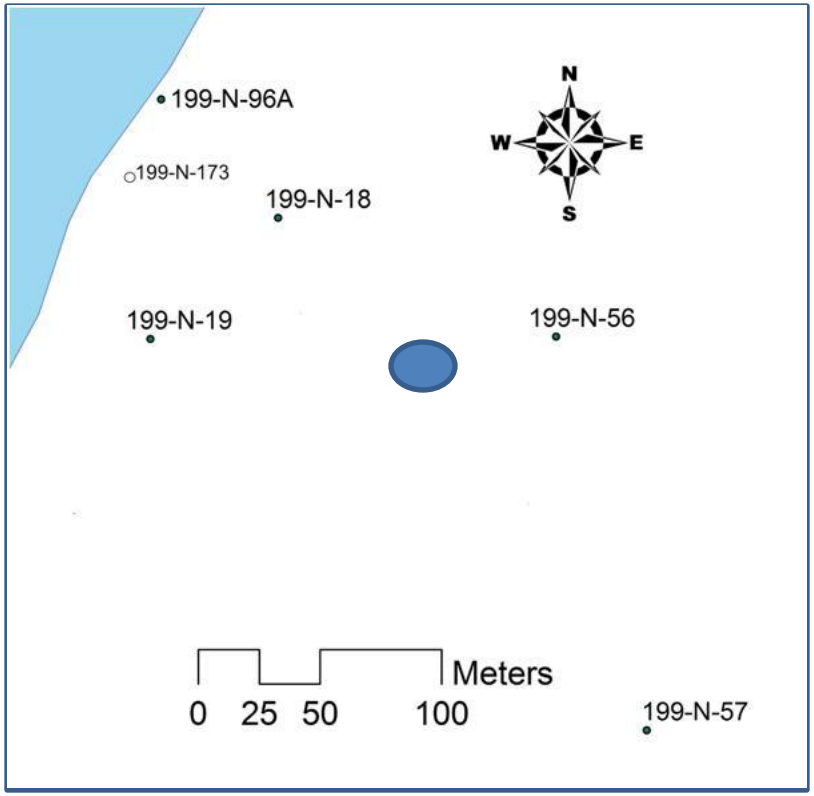
Coyote willows before harvesting biomass

Coyote willows after harvesting biomass

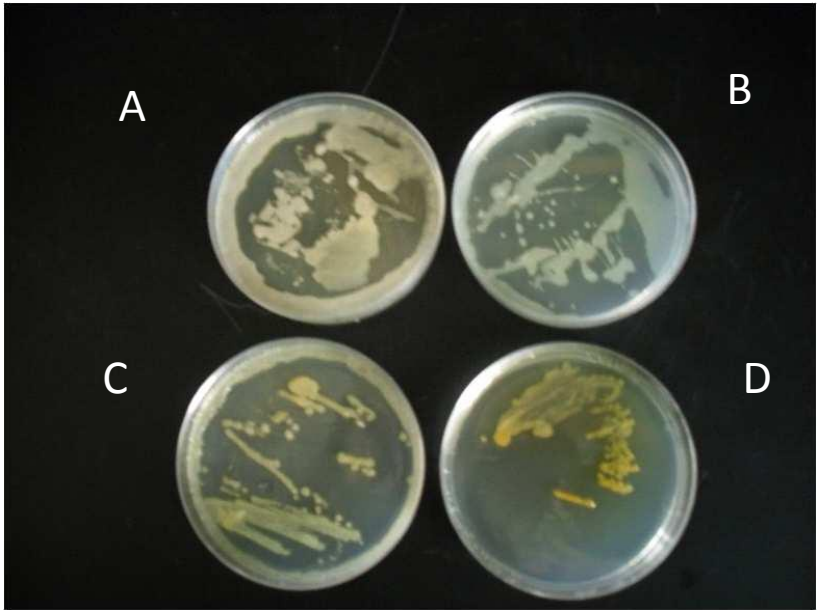
Total Petroleum Hydrocarbons (TPH) Plume Characterization

- **5 wells (199-N-173, 199-N-96A, 199-N-167, 199-N-172, and 199-N-18) sampled in August and September**
- **Future samples planned for late 2009/early 2010 to provide more data for determining possible remediation technologies**
- **PNNL also performing study and taking additional samples and will issue report on study in early 2010**
- **Results promising for diesel-degrading microbes being present in 100N Area soils**

TPH Plume Characterization (continued)



Spill location related to wells



Diesel-degrading microbes, shown above in samples from well 199-N-173, are present in 100N Area soils

Sample A is 35 feet below ground surface (bgs), Sample B is 17 feet bgs, Sample C is 15 feet bgs, Sample D is 17.5 to 20 feet bgs

Draft 100-N Proposed Plan to amend the 1999 ROD for Interim Action

- Draft PP submitted December 18, 2009 in accordance with TPA Milestone M-016-14B.
- Rational for IROD Amendment
  - P&T system has provided sufficient information for P&T to be evaluated in the PP
  - Expanded PRB test is needed to meet remediation goals defined in TPA Target M-016-110-T03
  - A “plug-in” approach is proposed for any newly discovered waste site that is similar to the sites included in IROD.
- Ecology & EPA provided initial comments January 28, 2010