Overview of the Rocky Flats Site Annual Report of Site Surveillance and Maintenance Activities

Calendar Year 2011

Rocky Flats Stewardship Council
June 4, 2012

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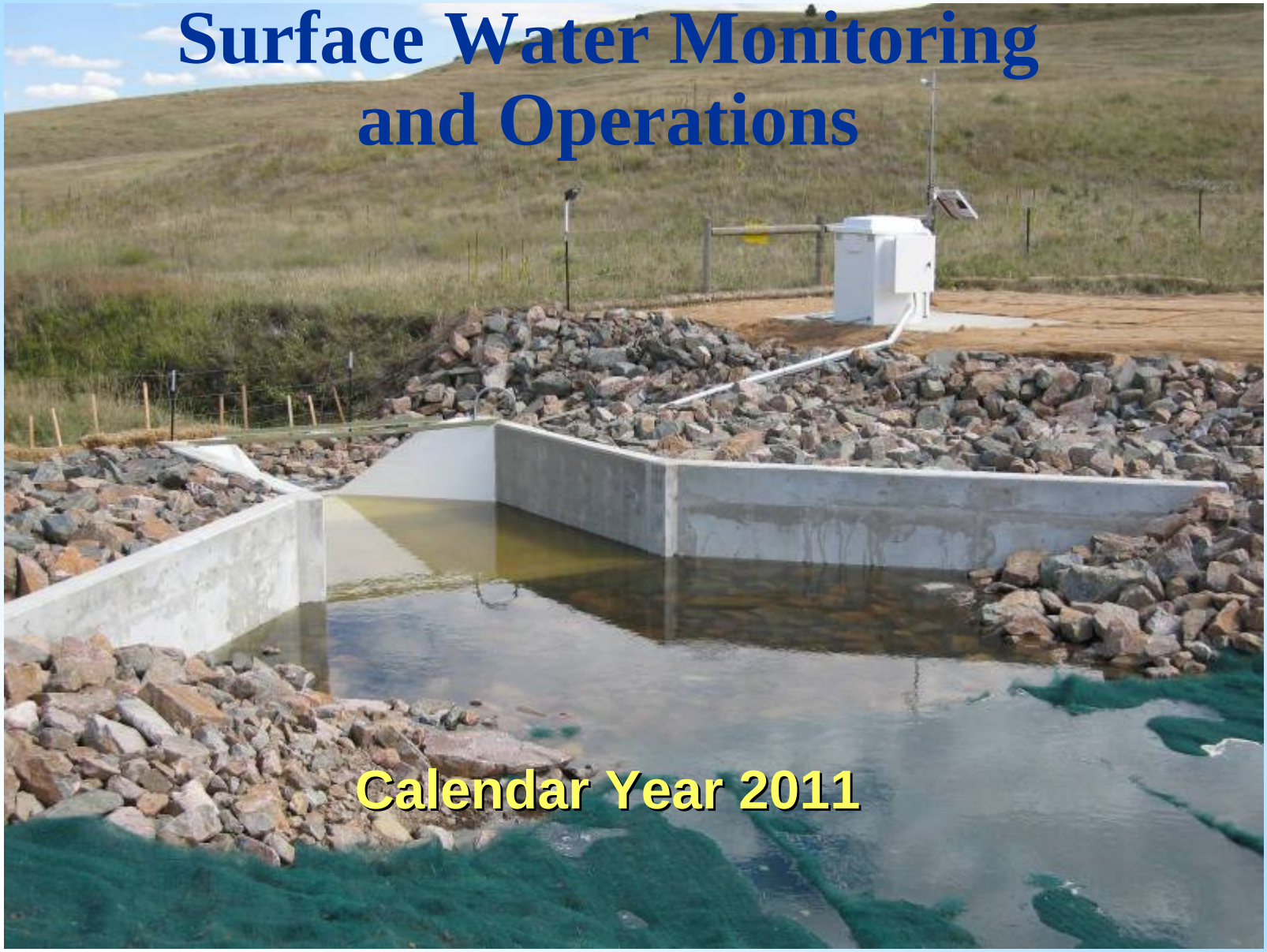
Surface Water Monitoring and Operations



Calendar Year 2011

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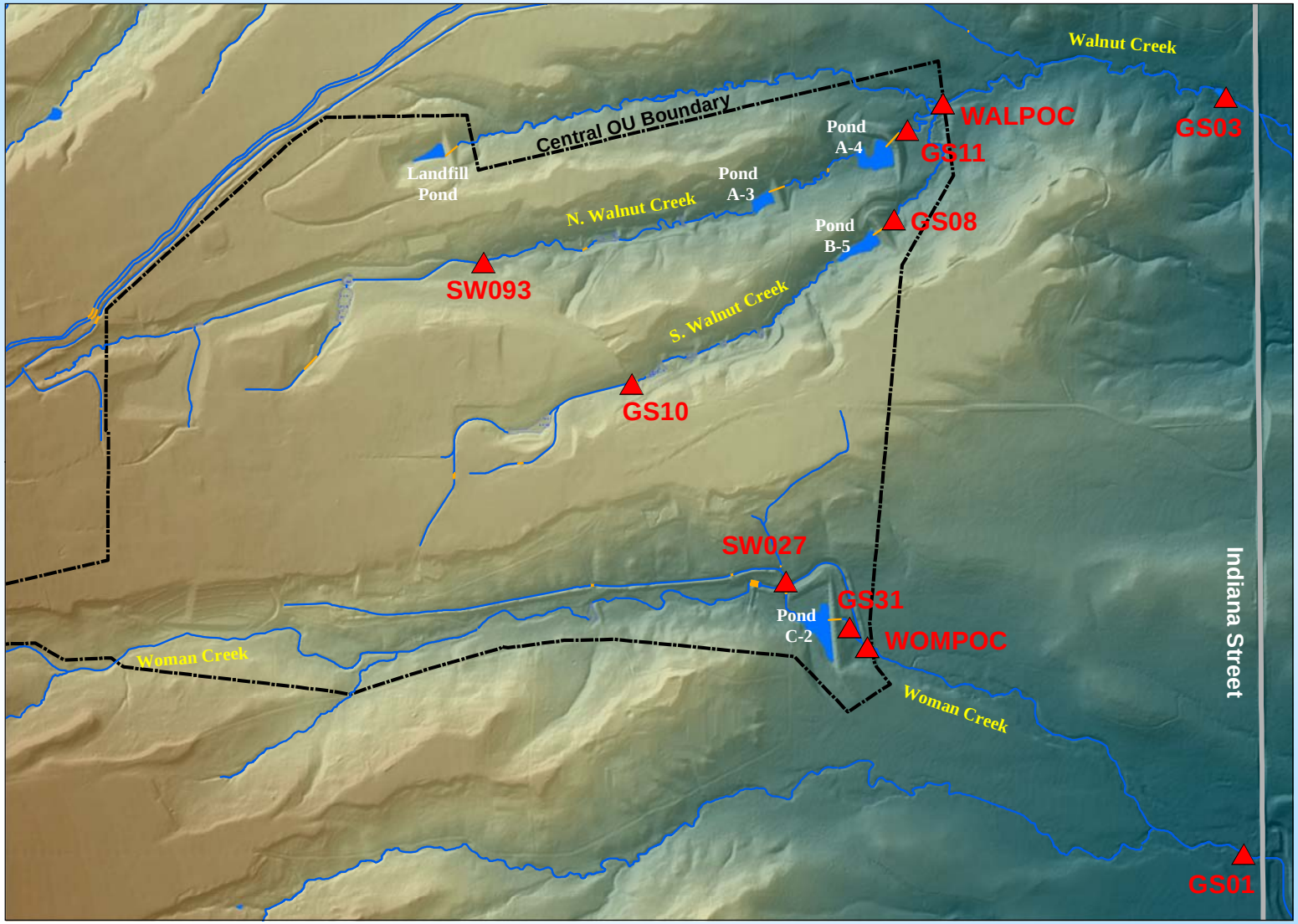
Selected Surface Water Monitoring Locations



Pond Operations – Calendar Year 2011

- Terminal Pond Discharges:
  - Ponds A-4 and B-5
    - March 24 through March 30, 2011 (3.5 MG)
    - Started flow-through operations September 12, 2011
  - Pond C-2
    - Started flow-through operations November 7, 2011
- Transfers:
  - Pond A-3 to A-4
    - Flow-through operations January 1 through October 12, 2011
    - Pond A-3 'offline' for dam breach for the reminder of CY 2011
- Pond Levels:
  - As of January 1, 2012, Ponds A-3, A-4, B-5, and C-2 and the Landfill Pond were holding approximately 6.7 MG (6.8 percent of capacity).

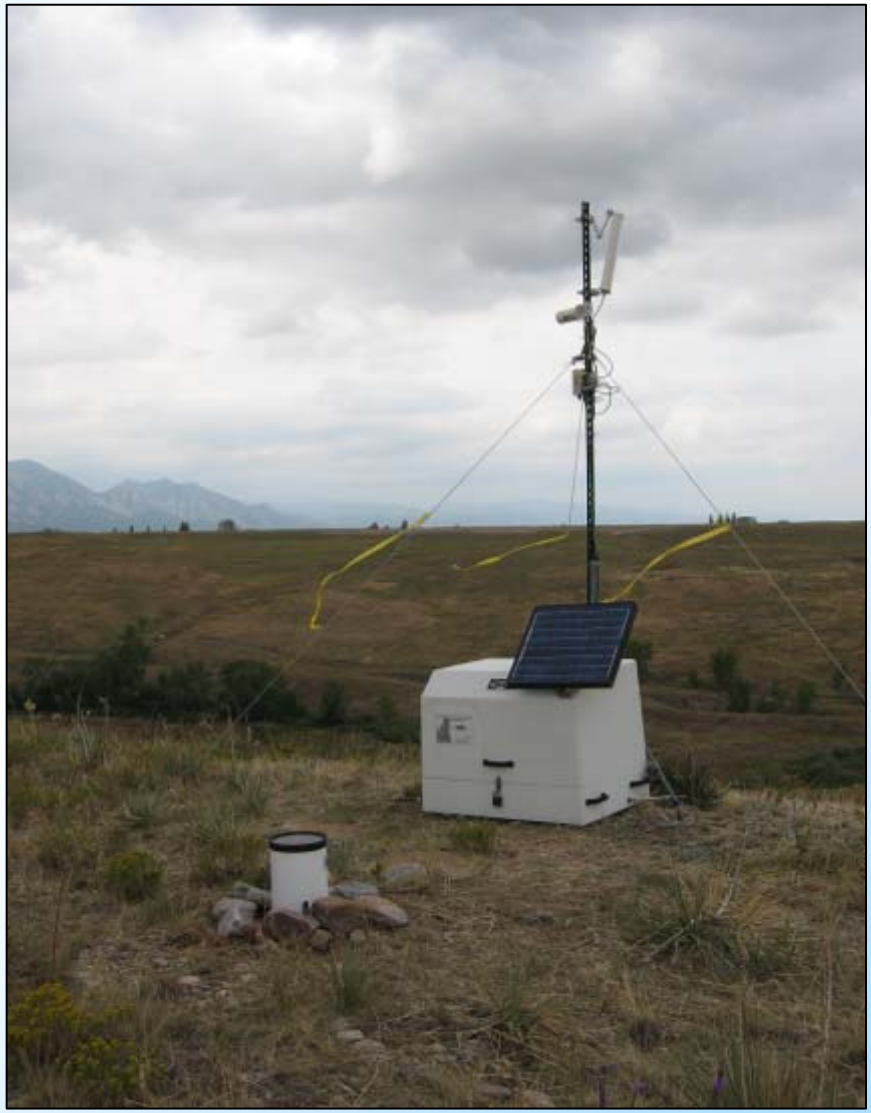
Recent Pond Levels (May 16, 2012):

- Landfill (100 percent)*
- A-3 (100 percent)*
- A-4 (9.7 percent)
- B-5 (11.1 percent)
- C-2 (2.4 percent)

* Post-breach

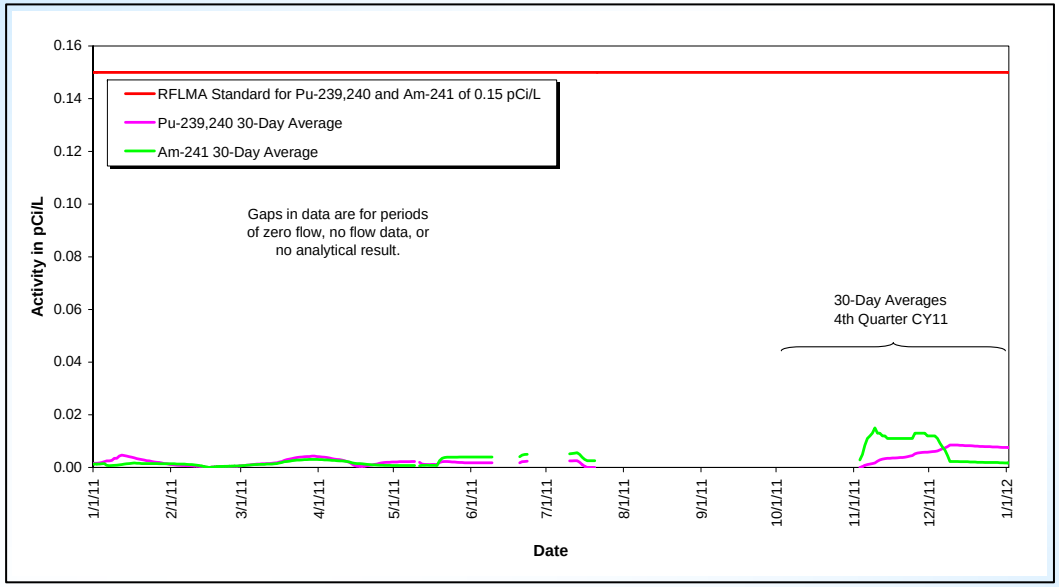
Hydrologic Data – Calendar Year 2011

- Precipitation:
  - 13.1 inches total precipitation
  - 107 percent of average CY 1993–2010
- Flow rates (percentage of CY 1997–2010 average):
  - GS01 (37 percent)
  - GS03 (26 percent)
  - GS10 (39 percent)
  - SW027 (<0.1 percent)
  - SW093 (55 percent)

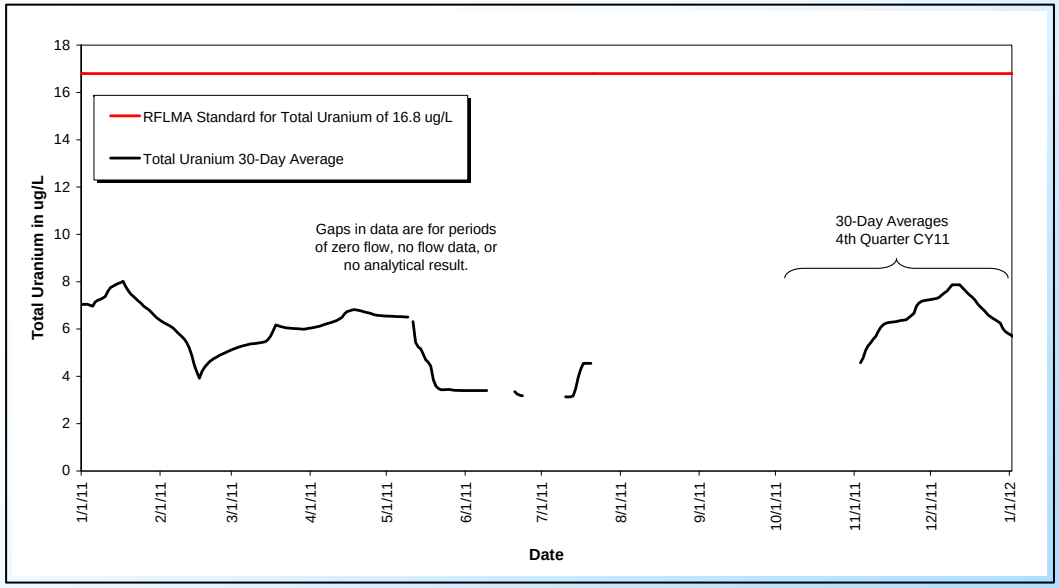


POC GS01

- Plutonium and Americium

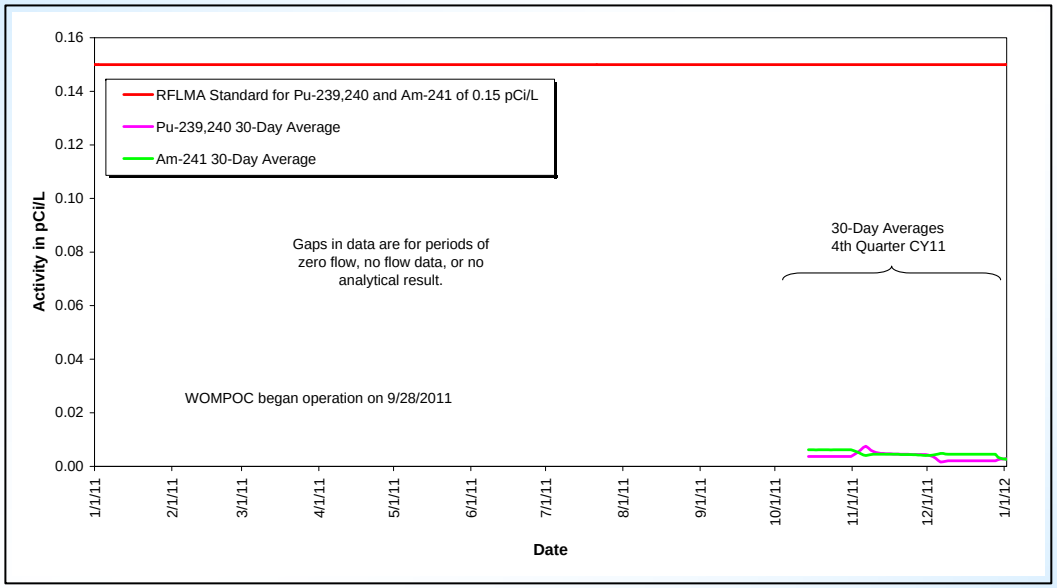


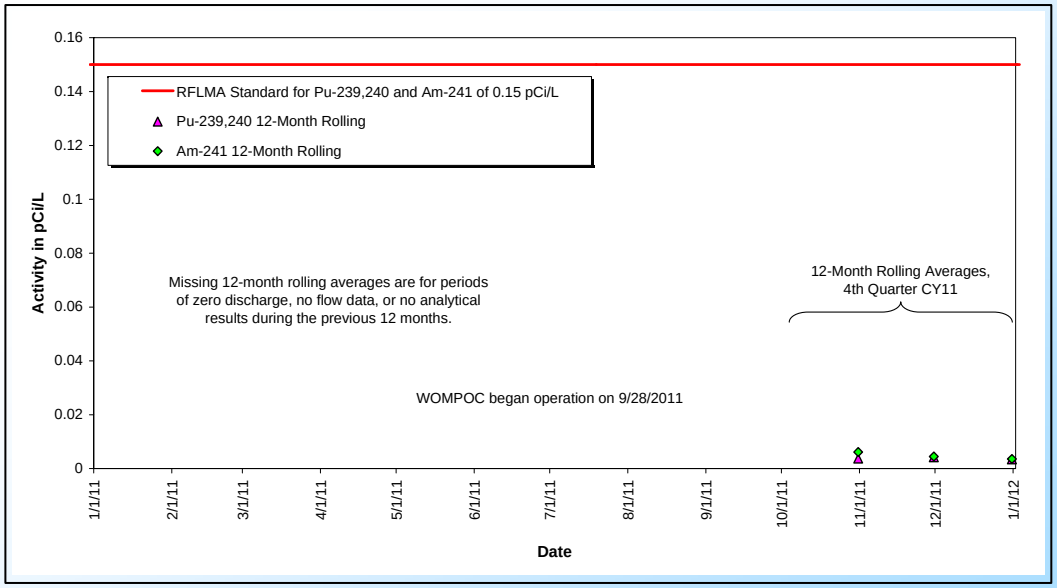
- Total Uranium



POC WOMPOC

- Plutonium and Americium





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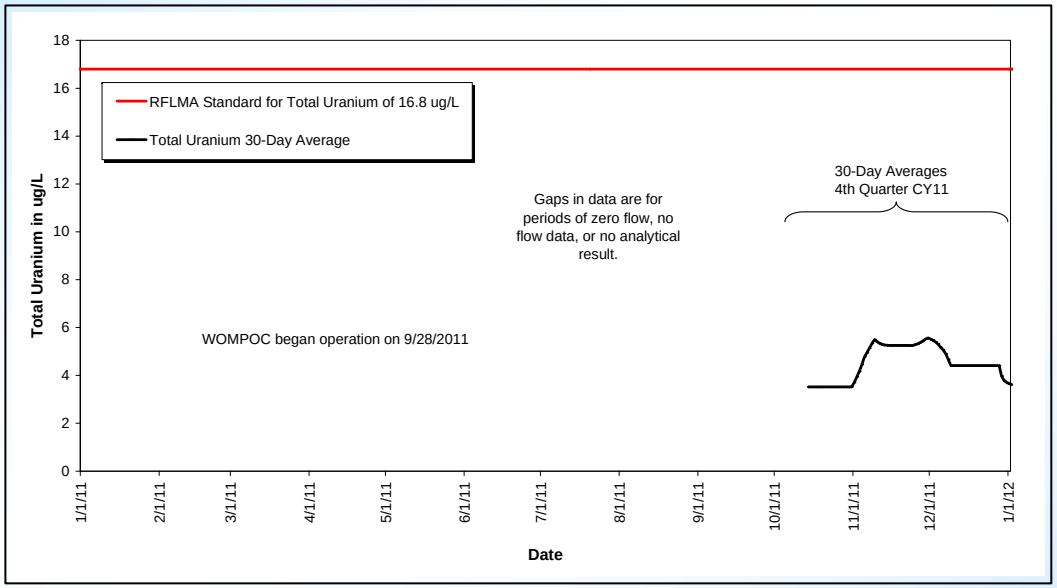
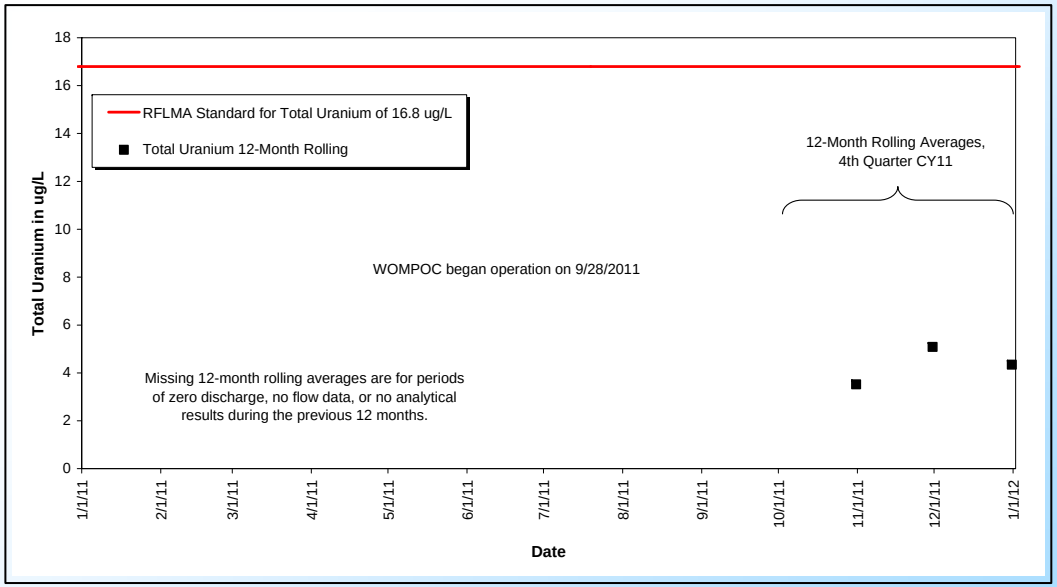
POC WOMPOC

- Total Uranium





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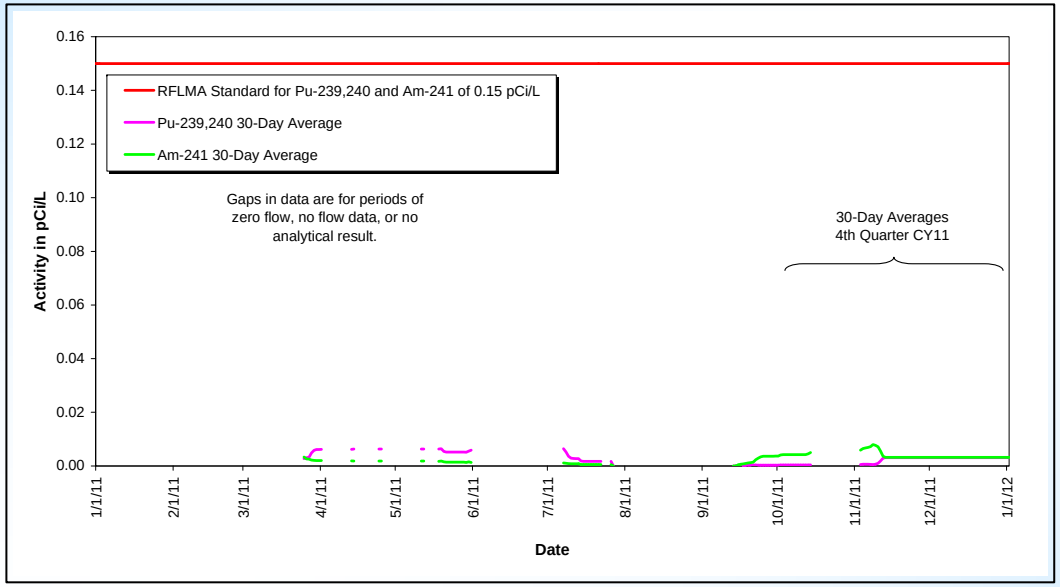
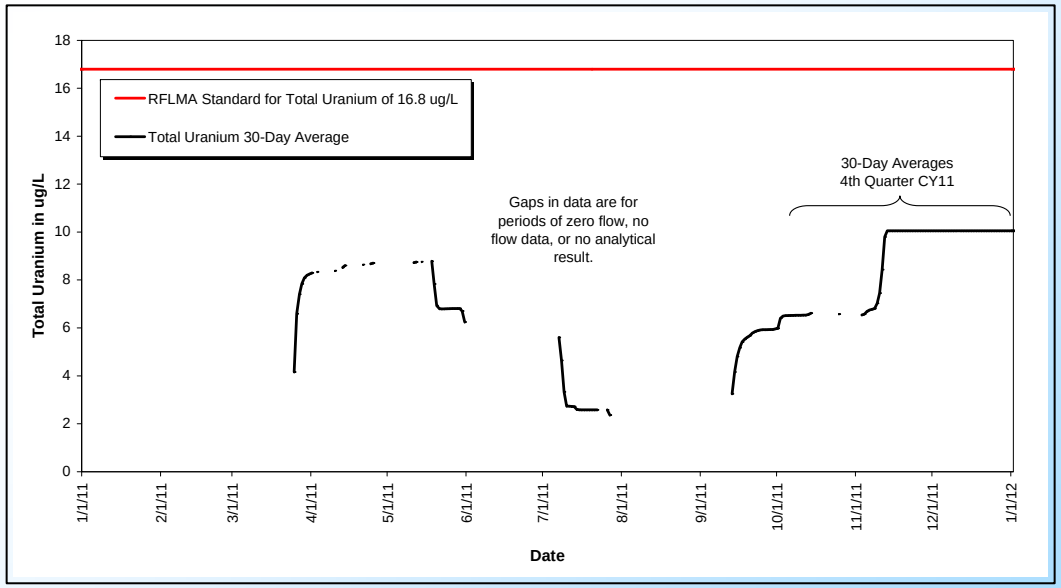
POC GS03

- Plutonium and Americium



- Total Uranium



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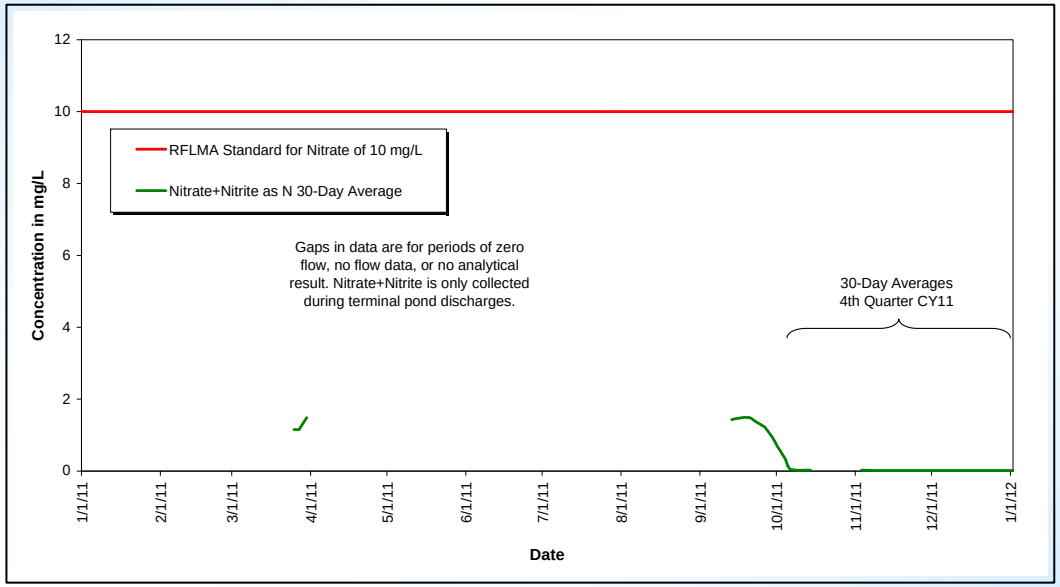
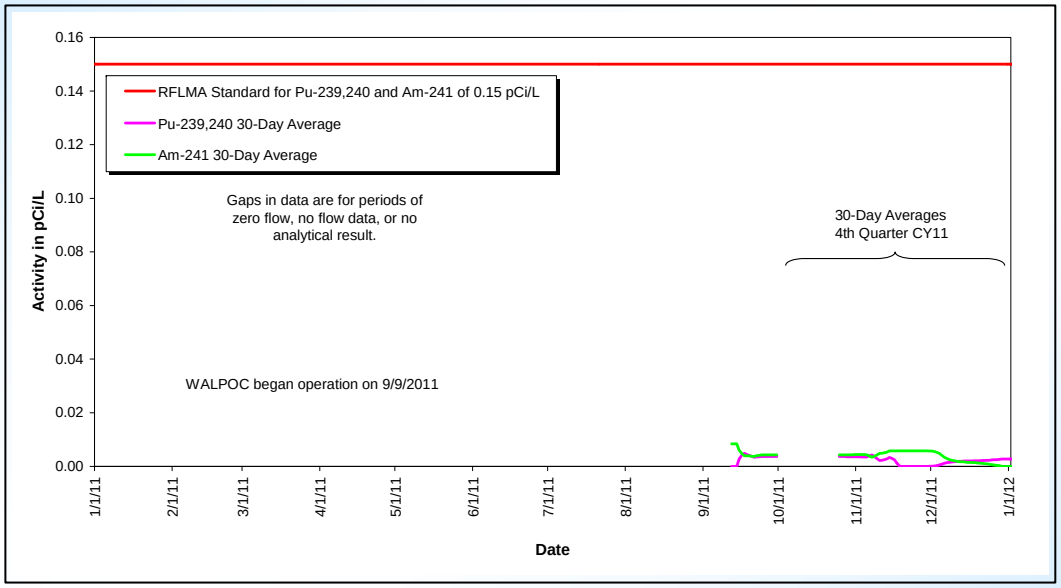
POC GS03

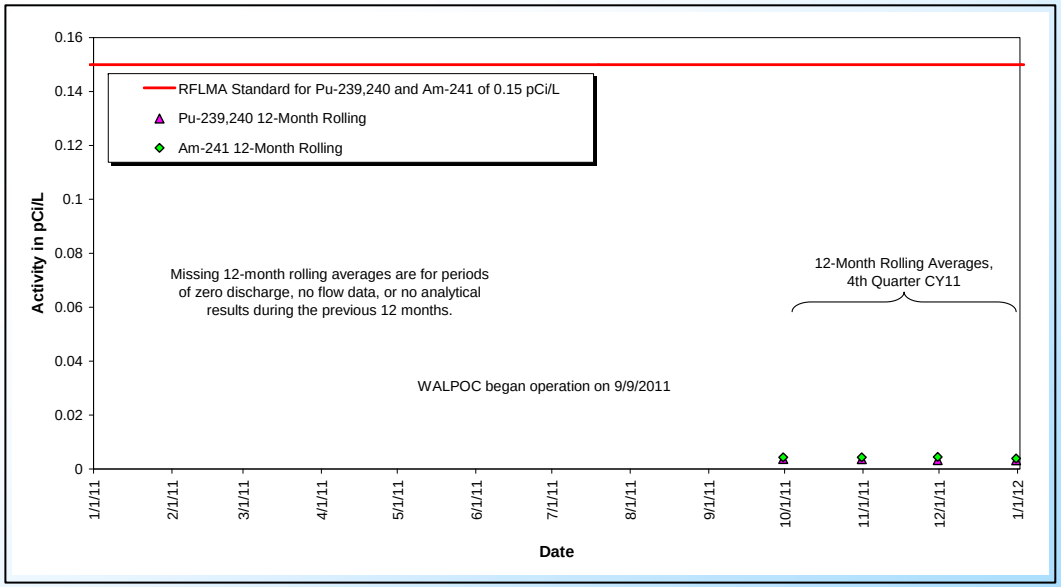
- Nitrate + Nitrite as Nitrogen



POC WALPOC

- Plutonium and Americium





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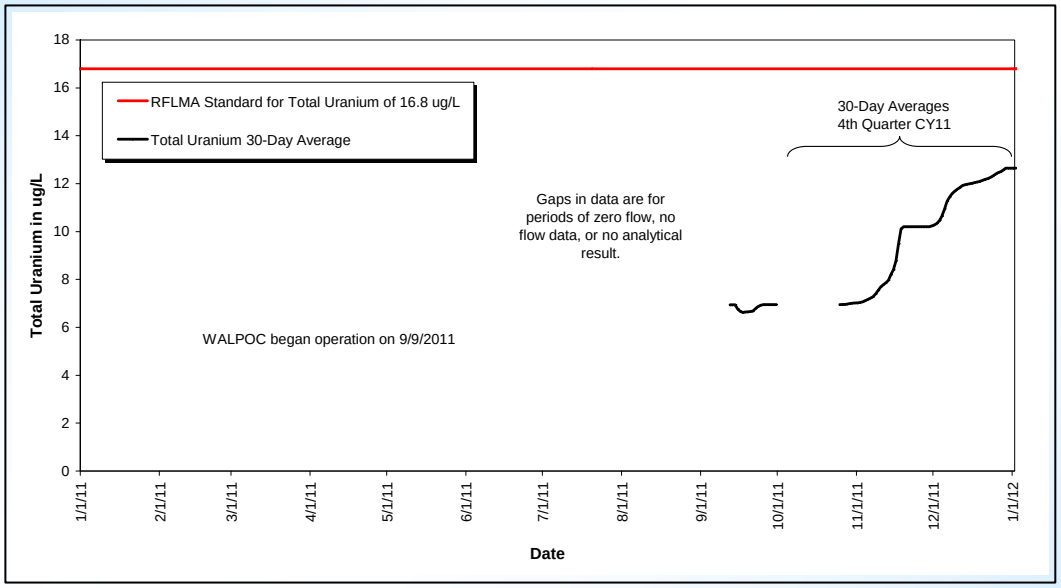
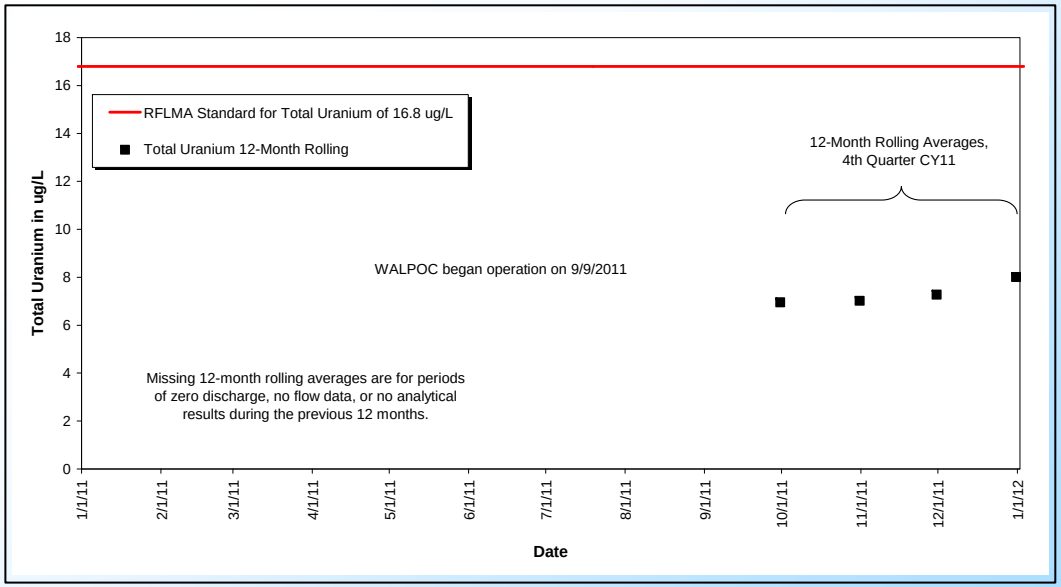
POC WALPOC

- Total Uranium





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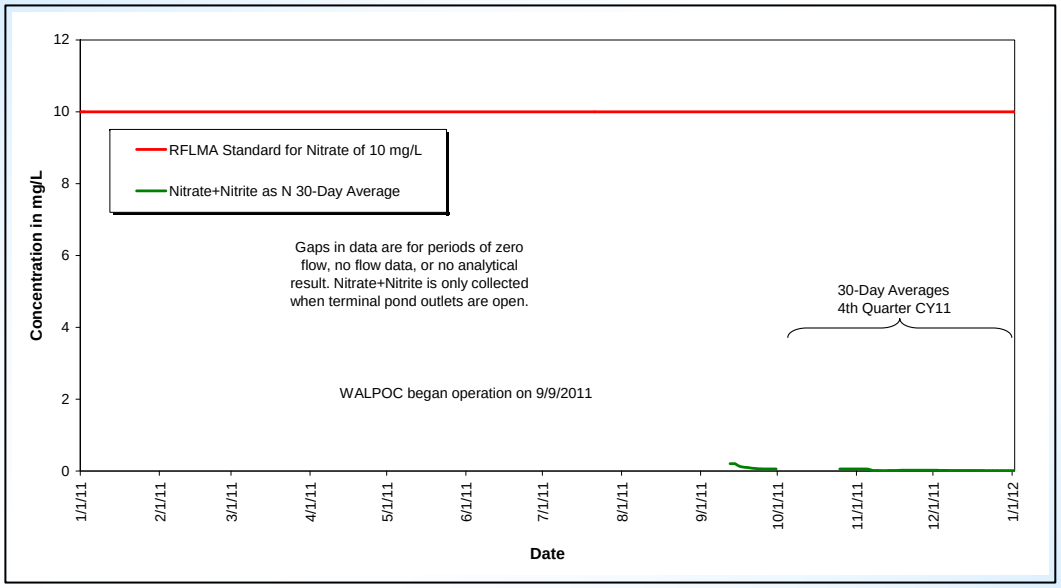
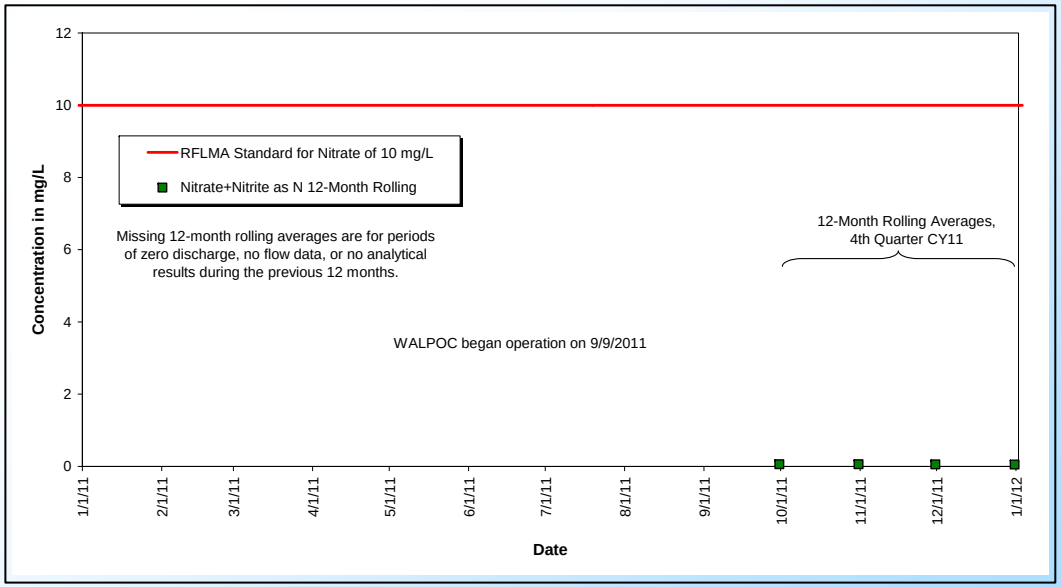
POC WALPOC

- Nitrate + Nitrite as Nitrogen





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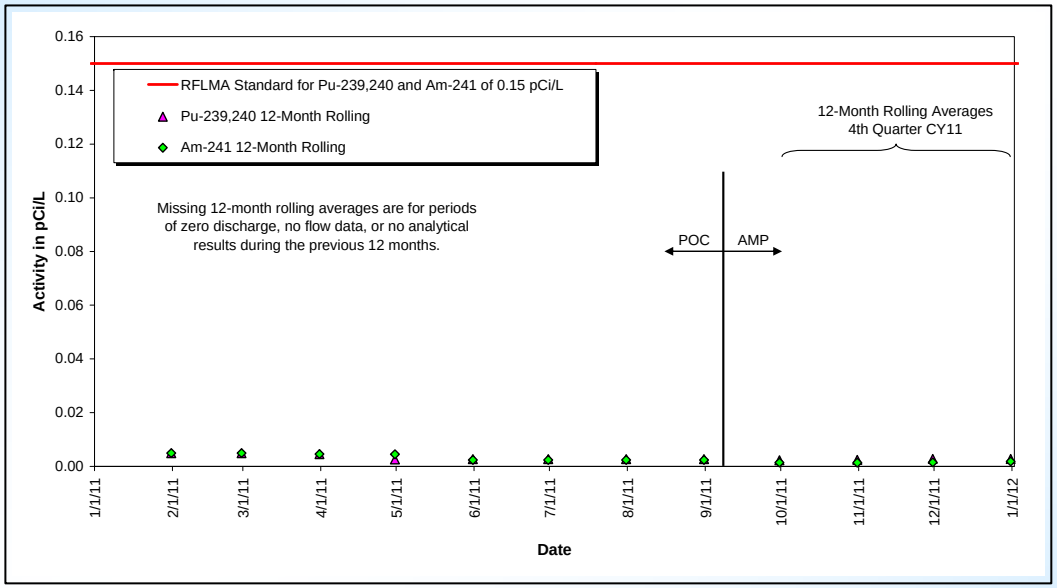
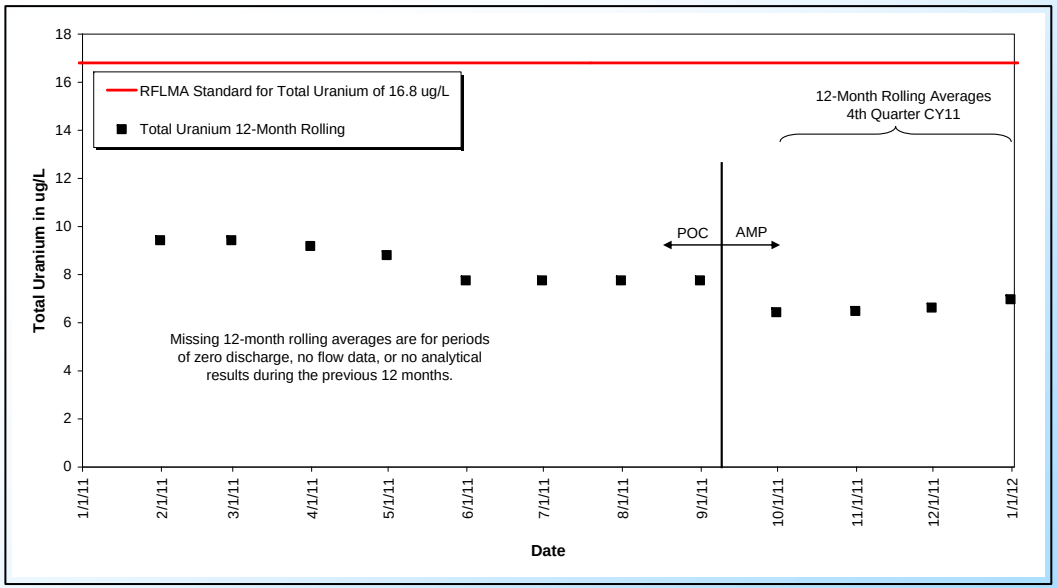
POC GS08

- Plutonium and Americium



- Total Uranium



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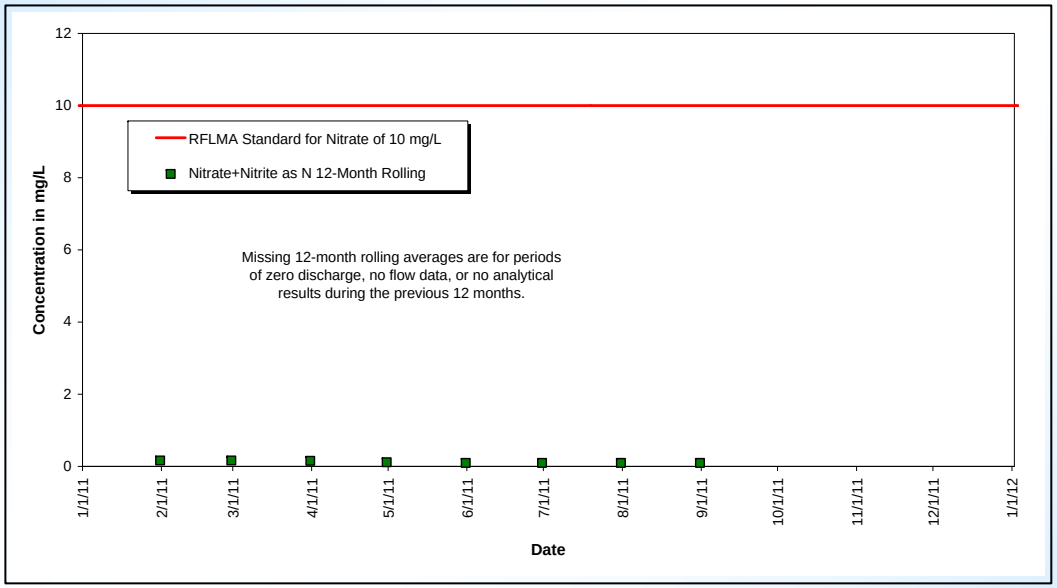
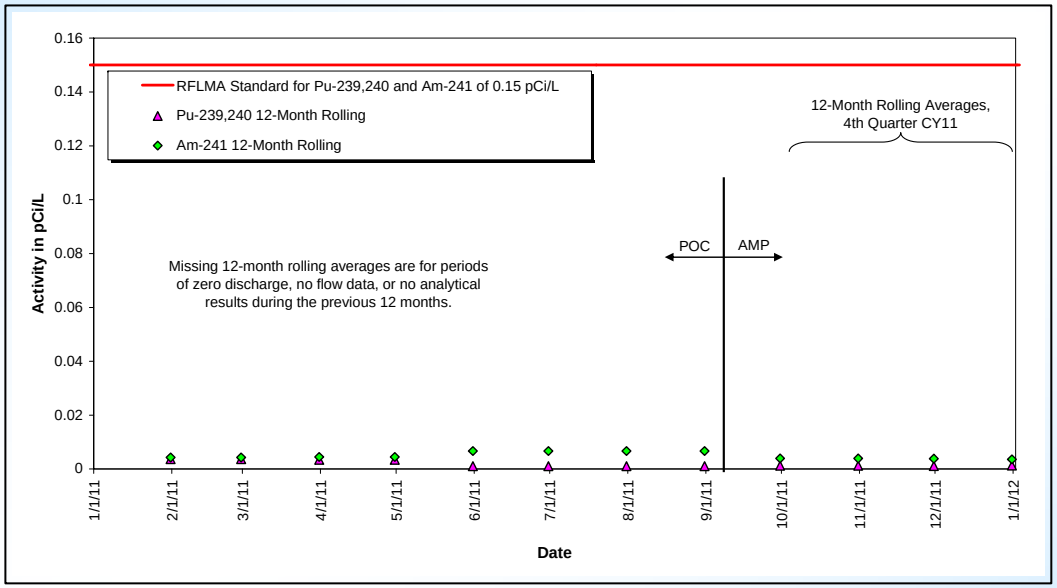
POC GS08

- Nitrate + Nitrite as Nitrogen

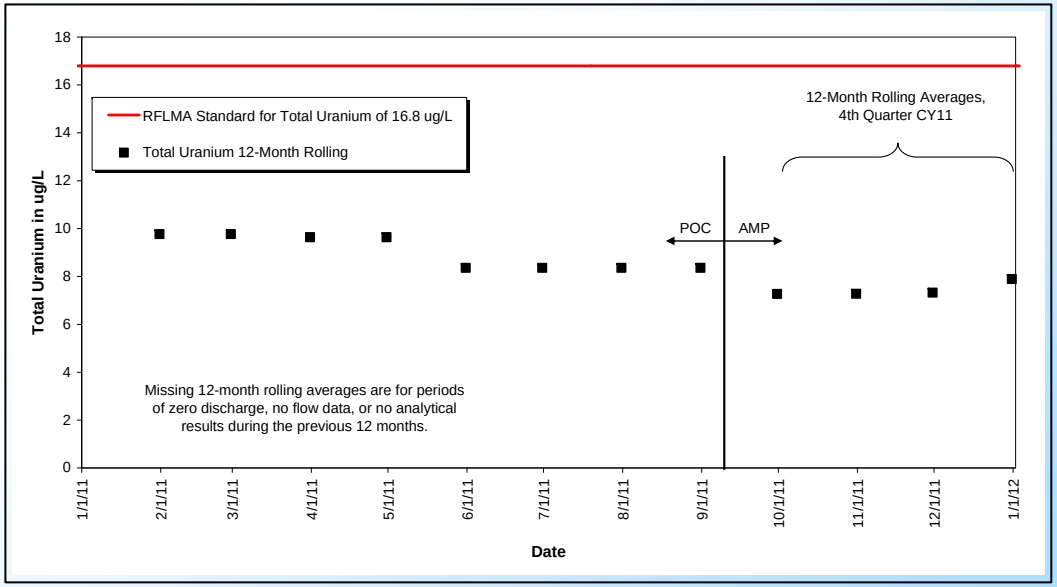


POC GS11

- Plutonium and Americium



- Total Uranium



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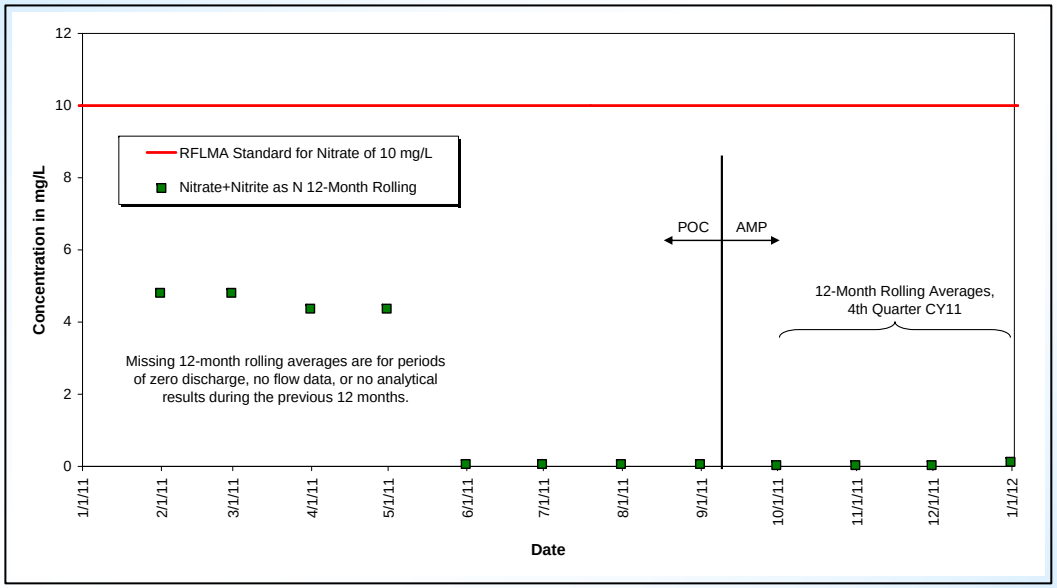
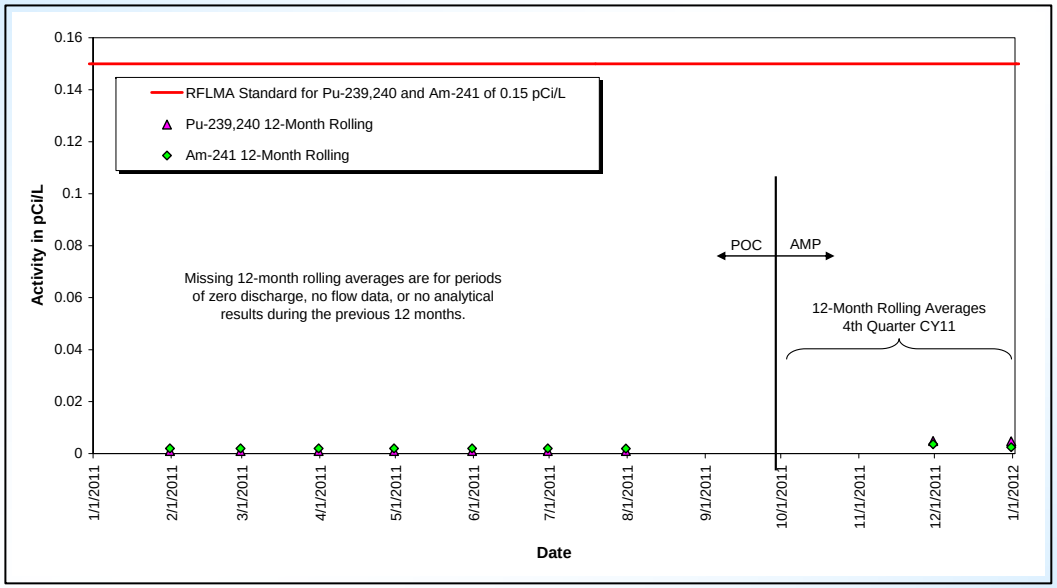
POC GS11

- Nitrate + Nitrite as Nitrogen

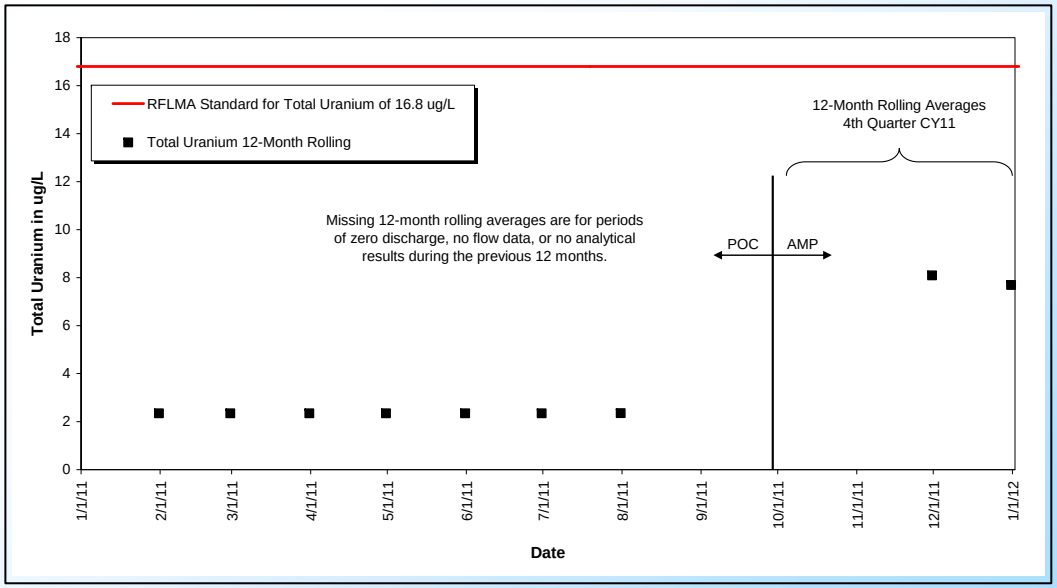


POC GS31

- Plutonium and Americium



- Total Uranium



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Point of Evaluation Monitoring – Calendar Year 2011

- Reportable 12-month rolling average values for uranium at GS10 were observed starting April 30, 2011.
- Additional sampling is being conducted both upstream of and downstream of GS10.
- Contact Records 2011-04 and 2011-05 can be found on the Rocky Flats website.

Point of Evaluation Monitoring – Calendar Year 2011

- Reportable 12-month rolling average values for americium at GS10 were observed starting August 31, 2011.
- Additional sampling is being conducted both upstream of and downstream of GS10.
- Contact Record 2011-08 can be found on the Rocky Flats website.

Point of Evaluation Monitoring – Calendar Year 2011

- Reportable 12-month rolling average values for plutonium at SW027 were initially observed starting April 30, 2010.
- Plutonium was no longer reportable at SW027 starting on April 30, 2011.
- Contact Record 2010-06 can be found on the Rocky Flats website.

Performance Monitoring – Calendar Year 2011
Original Landfill (OLF)

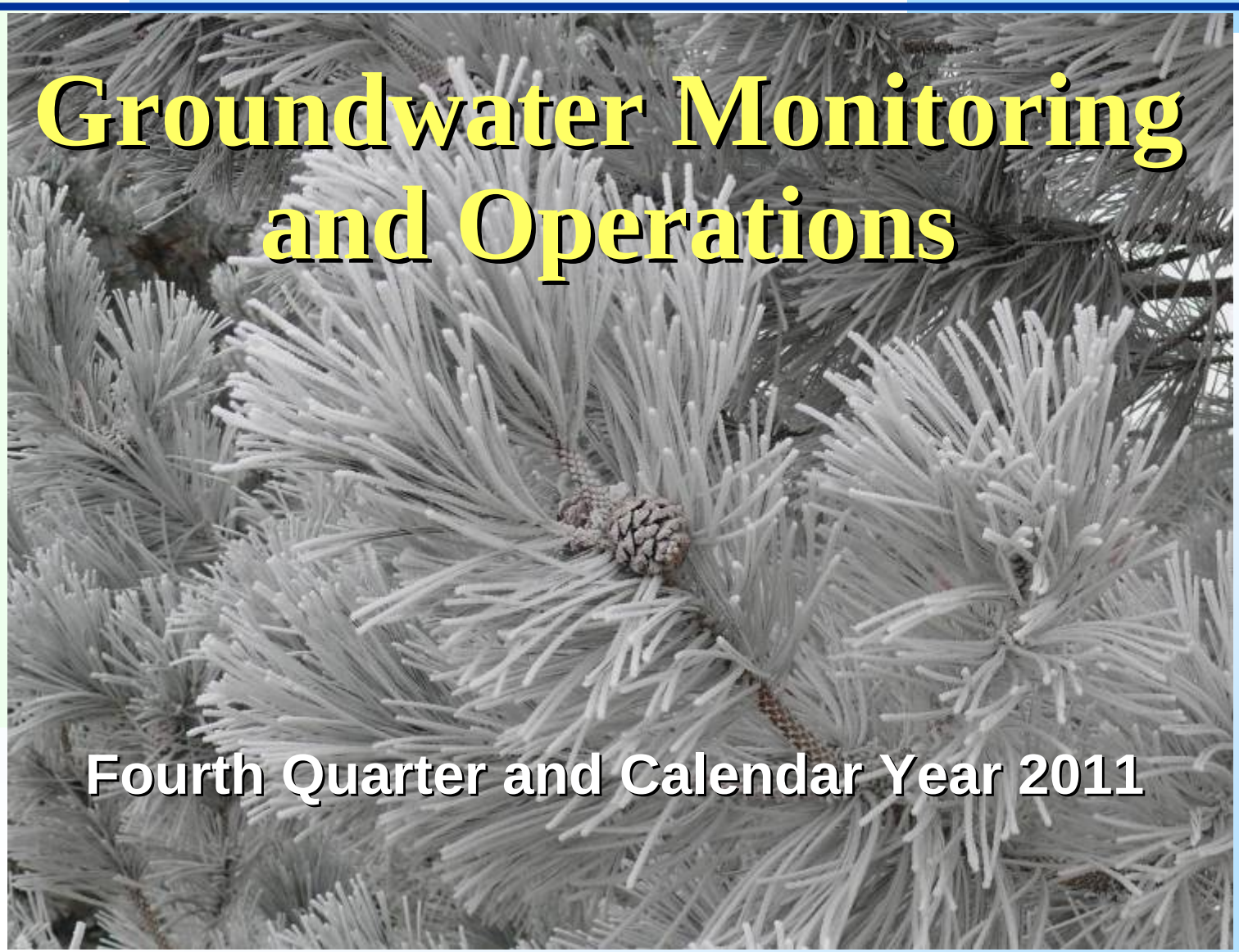
- During routine quarterly sampling, total selenium and dissolved silver concentrations were measured to be above the standard at location GS59 (Woman Creek downstream of the OLF).
- These concentrations triggered sampling at an increased frequency (monthly).
- Total selenium and dissolved silver were not detected in the subsequent monthly sample, and the sampling frequency reverted back to quarterly.

Performance Monitoring – Calendar Year 2011
Present Landfill (PLF)

- During routine quarterly sampling, selenium and arsenic concentrations were measured to be above the standard at location PLF treatment system effluent (PLFSYSEFF).
- These concentrations triggered sampling at an increased frequency (monthly).
- Selenium and arsenic were not detected in the subsequent monthly samples, and the sampling frequency reverted back to quarterly.

Questions?

Groundwater Monitoring and Operations



Fourth Quarter and Calendar Year 2011

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Groundwater Monitoring, Fourth Quarter 2011

- RFLMA monitoring
  - All AOC, Sentinel, and RCRA wells
    - AOC wells monitored for impact of groundwater on surface water
    - Sentinel wells provide indication of plume movement
    - RCRA wells support PLF, OLF
  - Treatment system locations
- Non-RFLMA monitoring
  - Additional sampling at the SPPTS
  - Continued evaluation of air stripper at MSPTS
  - Confirmatory sampling at several locations
  - Extra sampling to support GS10 evaluation

Summary Highlights from 2011

- All RFLMA-required monitoring was performed
  - One location was dry
  - Analytical data evaluated per RFLMA Attachment 2
- Groundwater treatment systems continue to remove contaminants from the groundwater
  - MSPTS media replaced
  - MSPTS prototype polishing component (solar-powered air stripper) installed

Summary Highlights from 2011

- Seepage velocities (groundwater flow rates) estimated from water levels measured across the COU
  - Used 22 well pairs
  - Median velocity (127 ft/yr) and range (8 to 428 ft/yr) very similar to 2010
  - Locations where velocity is at least 200 ft/yr
    - Part of 881 hillside
    - B771 hillside
    - OLF
    - Part of 903 Pad/Lip
    - Oil Burn Pit #1
  - Locations where velocity is less than 50 ft/yr
    - South IA
    - North side of solar ponds

Statistics Performed for 2011 Annual

- Statistical analyses of groundwater quality data performed per RFLMA
  - Analysis of variance (ANOVA): RCRA wells
    - Downgradient groundwater vs. upgradient groundwater
  - Statistical trending: Sentinel and RCRA wells, plus several Evaluation wells sampled for non-RFLMA purposes
- Additional, non-RFLMA statistical analyses performed
  - Selected data from AOC wells
- See Annual Report text, tables, figures, and Appendix B for well- and chemical-specific details
- References to concentration trends in this presentation are for those calculated to have 95 percent statistical confidence

Statistical Analysis: OLF Groundwater

- Summary: ANOVA results for 2011 same as for 2007–2010
  - Concentrations of two metals are higher in downgradient than upgradient groundwater
    - Boron in all three wells, uranium in well 80205
  - All below applicable RFLMA levels
  - May be attributable to natural sources
  - Uranium characterized as 100 percent natural (2007)
- Statistical trending calculations also same as 2010
  - No increasing trends at downgradient wells
  - Boron decreasing at well 80005
  - Uranium decreasing at well 80205
- RFLMA: higher downgradient concentration ***or*** increasing trend trigger consultation – **boron and uranium conditions meet this requirement**
- See Annual Report

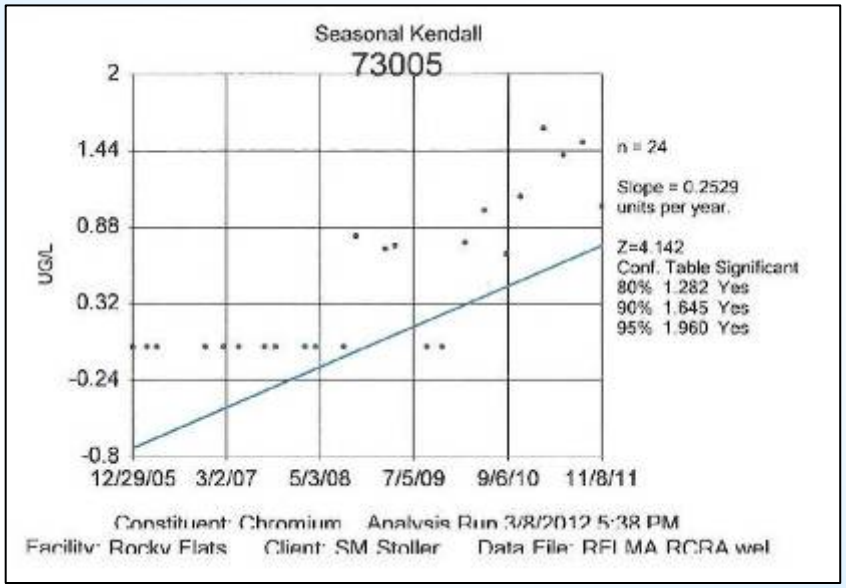
Statistical Analysis: PLF Groundwater

- ANOVA results for 2011 very similar to preceding years
  - Concentrations of several metals are higher in downgradient than upgradient groundwater
  - Most represented by datasets including numerous nondetects, estimated results
- Statistical trending calculations also similar to preceding years
  - Boron concentrations at well 73105 are on an increasing trend
  - Chromium and selenium at well 73005 are on increasing trends
    - Numerous nondetects in dataset suggest trends may not be real
- Data replacement affects statistical output
- RFLMA: higher downgradient concentration ***and*** increasing trend trigger consultation – **boron at 73105, chromium and selenium at 73005 meet this requirement**
  - As in 2008–2010, only selenium exceeded applicable RFLMA level
  - May be attributable to natural sources (ore mineralization, organic-rich sediments)
- See Annual Report

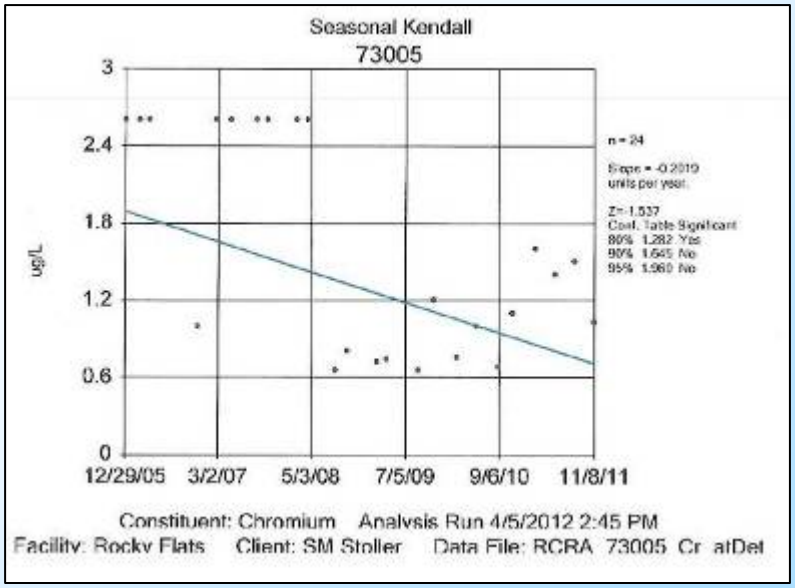
Statistical Analysis: PLF Groundwater

- Data replacement: effect on statistical trends
  - Consistent with preclosure, nondetects replaced with 0.001
  - If retained at detection limit, strong variations in detection limits can suggest nonexistent trend
  - If replaced, same outcome is possible. Example: chromium at well 73005

Left: nondetects replaced with 0.001



Right: nondetects retained at detection limit

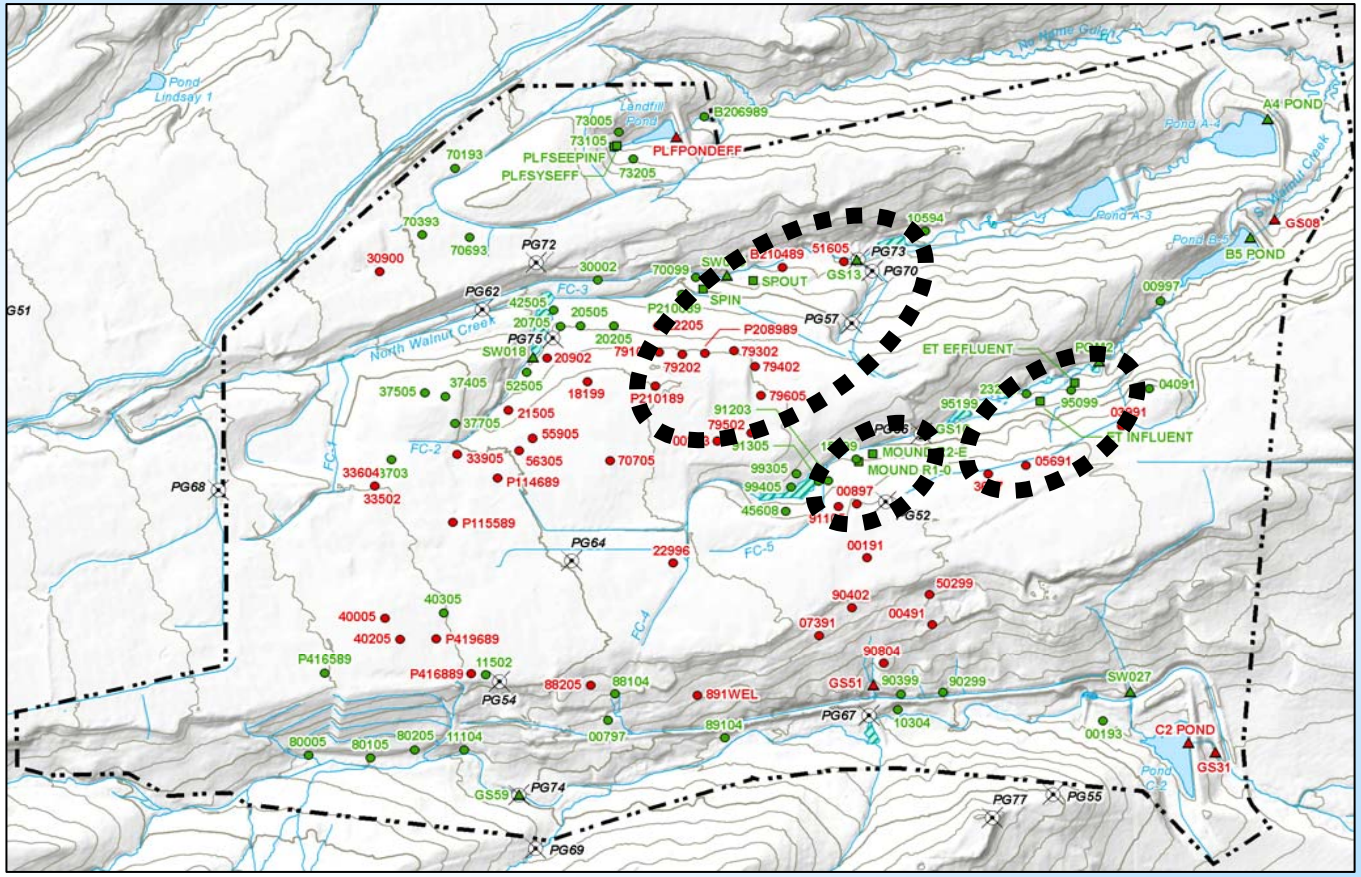


Other PLF, OLF Results

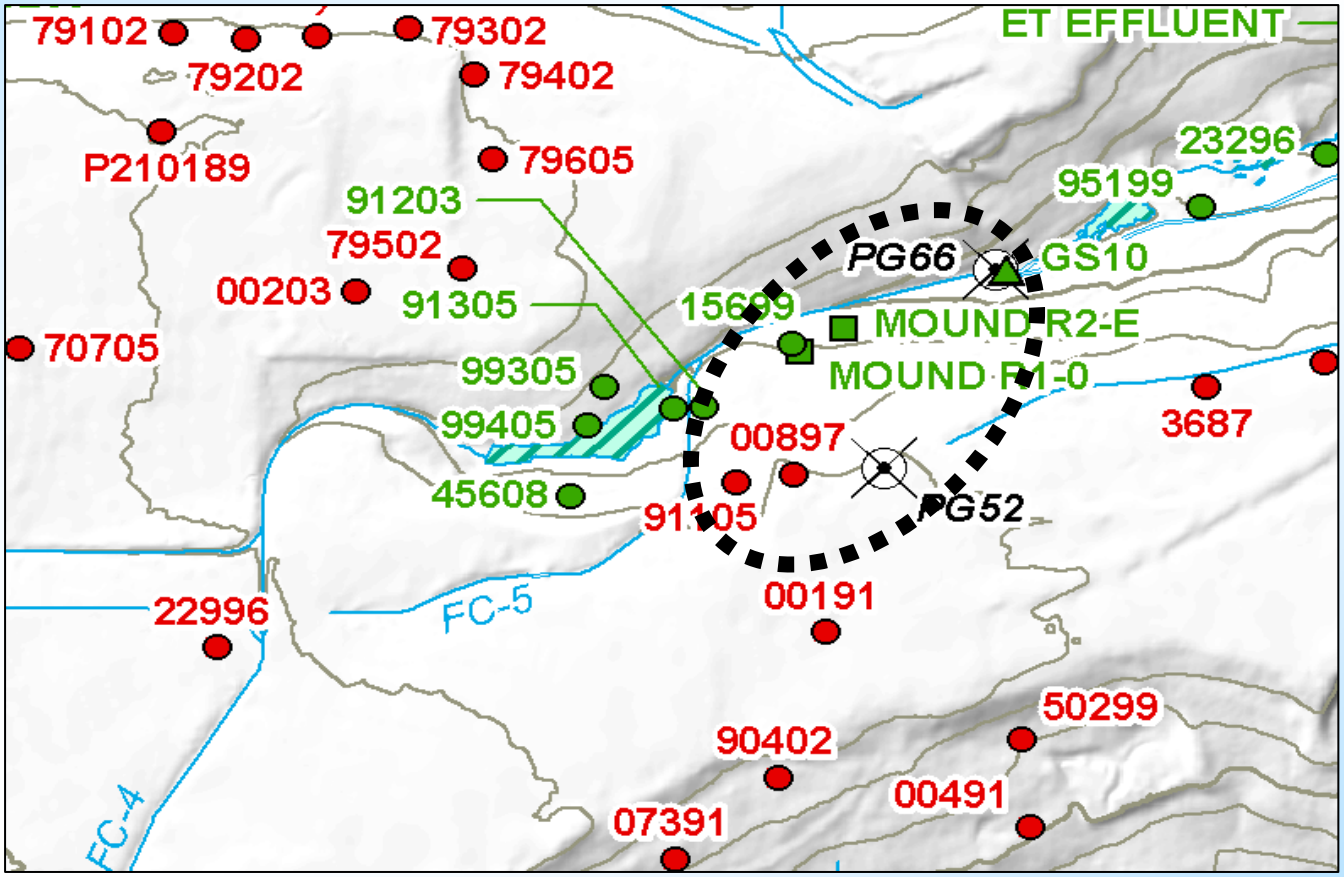
- No SVOCs, one VOC detected in downgradient OLF groundwater
  - 1,1-DCE, second quarter, well 80105
    - Applicable RFLMA standard is 7 µg/L
    - Concentration estimated at 0.48 µg/L
- No VOCs detected in downgradient PLF groundwater

Selected Highlights from 2011: Plumes with Treatment Systems

- General areas of discussion



Selected Highlights from 2011: Mound Site Plume

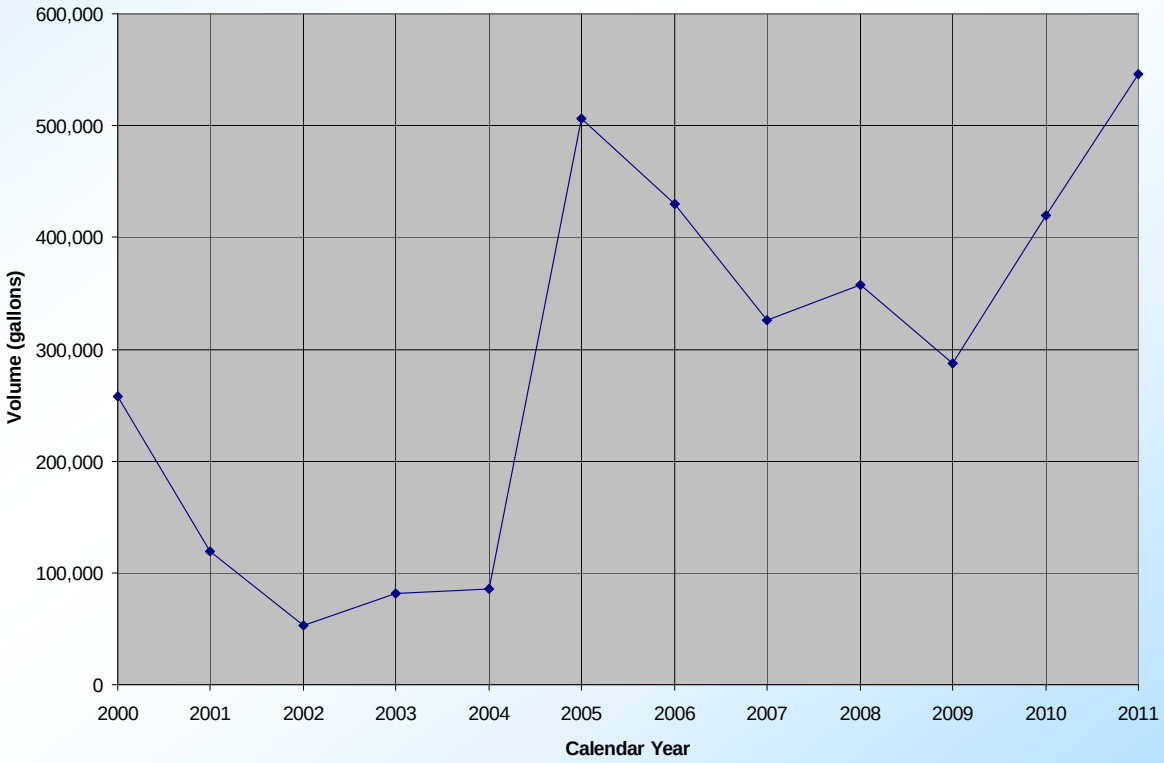


Selected Highlights from 2011: Mound Site Plume (continued)

- Mound and Oil Burn Pit #2 (OBP #2) Plume
  - Source area Evaluation wells not scheduled for RFLMA sampling in 2011
    - OBP #2 well sampled to support other evaluations
    - Results generally consistent with previous data
  - Sentinel well 15699
    - Downgradient of Mound source area and MSPTS collection trench
    - Fourth-quarter increases in PCE, TCE
      - May reflect water storage in trench during MSPTS maintenance in 2011
      - Concentrations decreased in follow-up sample
  - Sentinel well 91299
    - Downgradient to side-gradient of OBP #2 source area
    - Concentrations of several VOCs decreased in 2011
    - Several trends identified (see Annual Report)

Selected Highlights from 2011: MSPTS

- MSPTS treated approximately 546,000 gallons
  - Highest volume ever
  - Continues trend of higher volumes observed since closure
  - Due to addition of OBP #2 water, continuing effects of wet 2010



Time Period	Average Volume Treated Per Year
Preclosure, 2000–2004	119,600
Postclosure, 2005–2011	394,500

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Selected Highlights from 2011: MSPTS (continued)

- MSPTS characteristics
  - Influent concentrations of PCE, TCE remained higher in 2011
  - Influent continues to reflect presence of OBP #2–impacted groundwater

	111TCA	111DCE	CT	CF	c12DCE	MCl	PCE	TCE	VC
Through 2005	5.3	6.1	110.0	24.1	31.9	4.4	65.1	88.7	3.9
2005 through 2011	222.7	54.6	46.9	59.2	3415.0	7.1	187.8	375.9	130.6

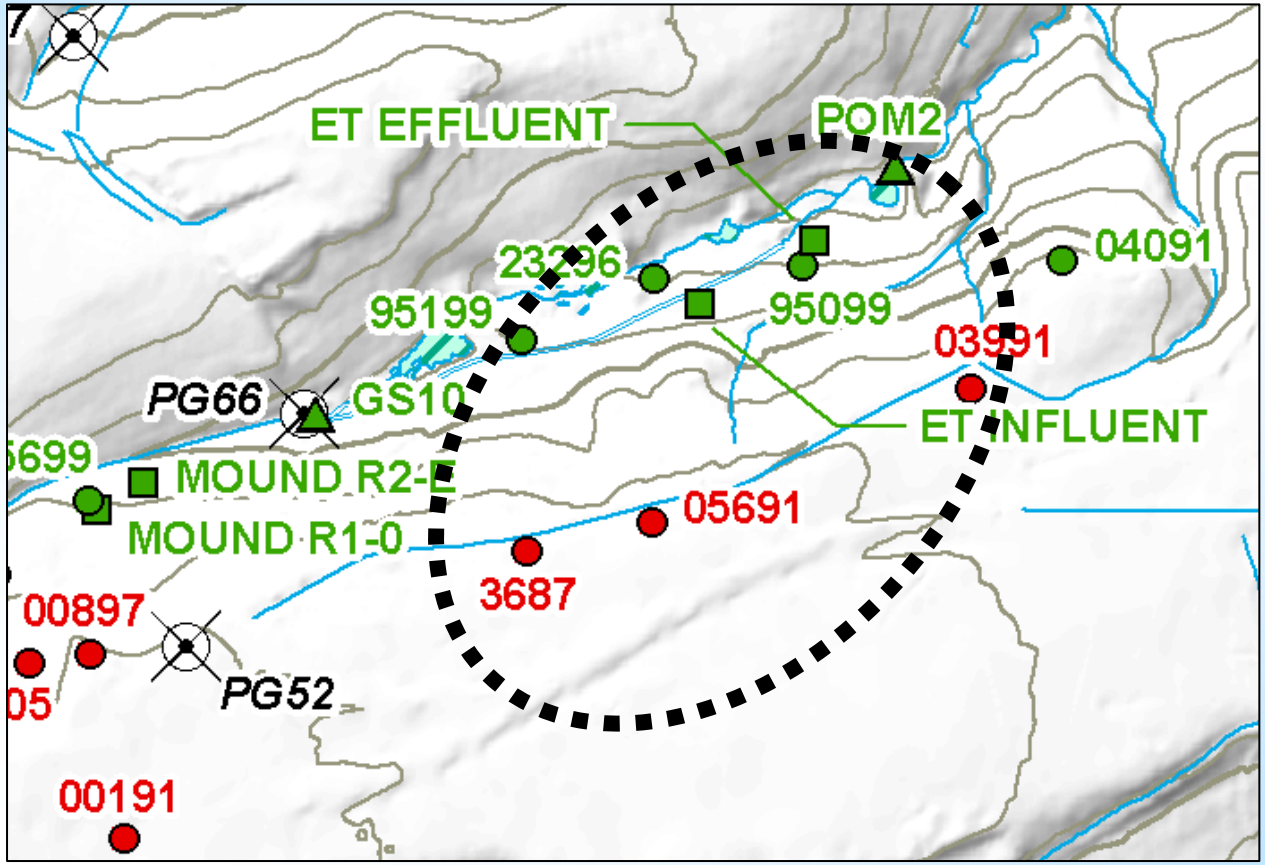
NOTE: Averages incorporate all data at face value, including nondetects

  - See Annual Report for discussion

Selected Highlights from 2011: MSPTS (continued)

- System maintenance in February and March 2011
  - ZVI media replaced
  - Subsurface discharge gallery repaired
  - Installed small solar-powered air stripper in effluent manhole
    - Optimization and testing continues
- Effluent water quality improved
- Results from surface water performance location GS10 also improved over 2010
  - Four detections of VOCs reported
  - None exceeded applicable RFLMA standards

Selected Highlights from 2011: East Trenches Plume

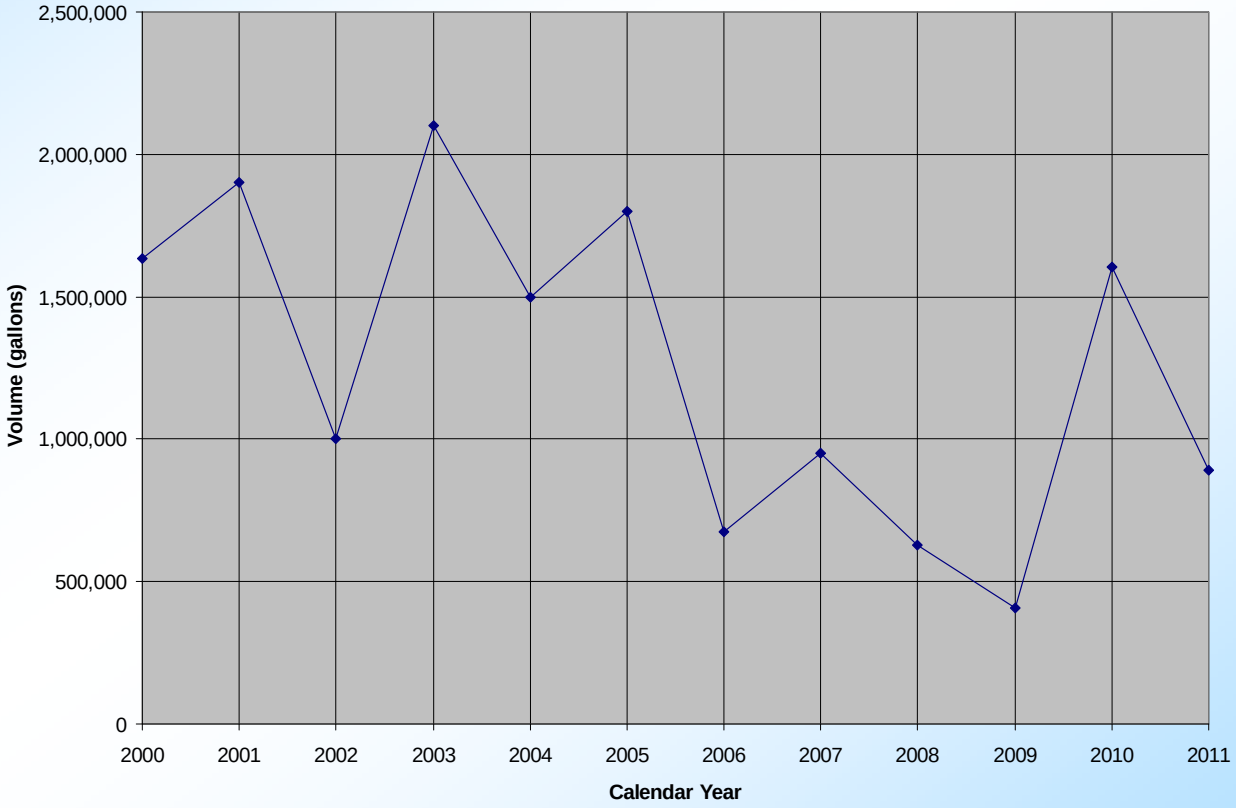


Selected Highlights from 2011: East Trenches Plume (continued)

- Source area Evaluation wells not scheduled for sampling
- Water quality at downgradient Sentinel, AOC wells consistent with previous
- Downgradient Sentinel well 23296 (next to South Walnut Creek)
  - Increasing trends in main degradation byproducts
  - Decreasing trends in main parent compounds
  - Higher water levels since dam breach
- Several other trends identified – see Annual Report

Selected Highlights from 2011: ETPTS

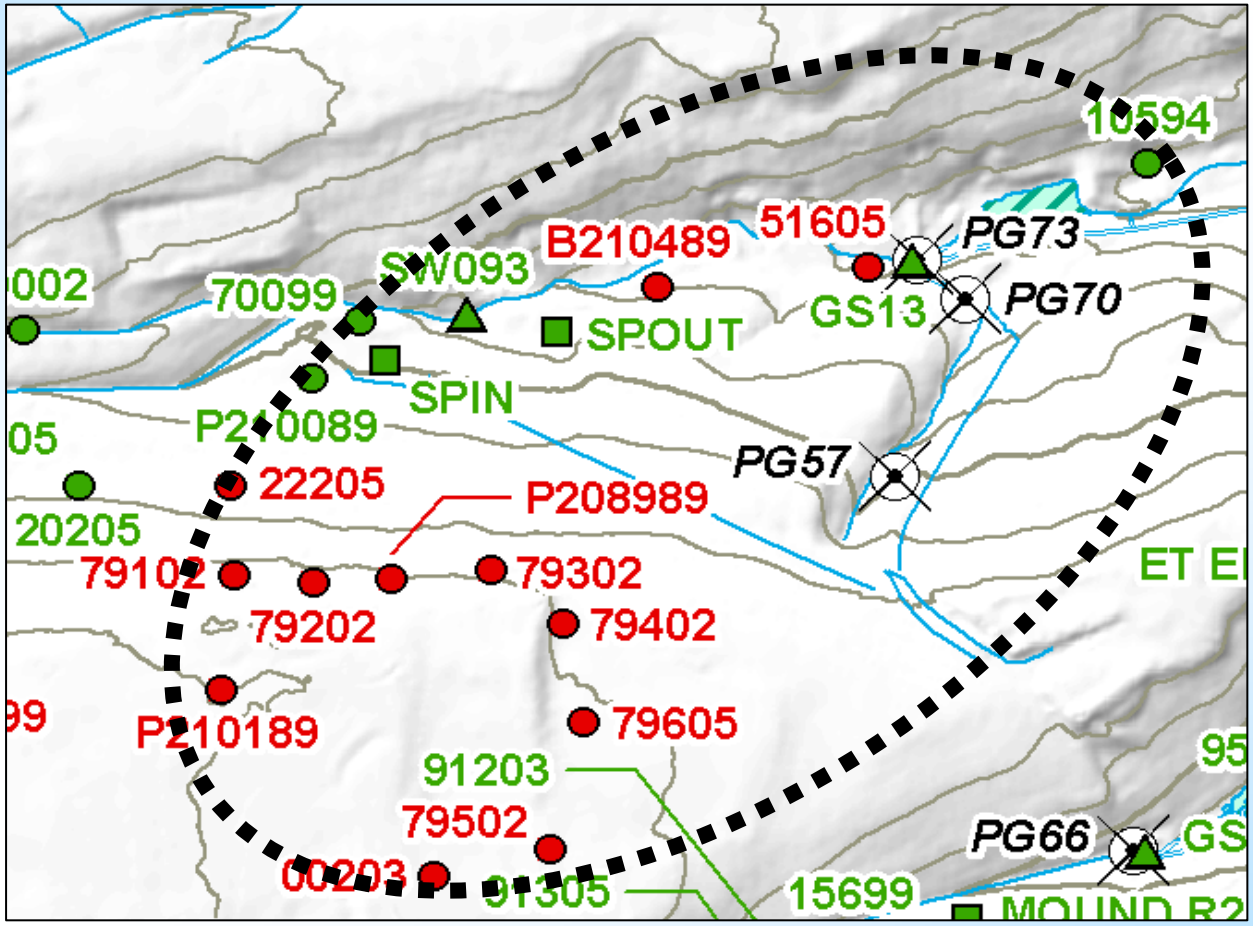
- ETPTS treated approximately 890,000 gallons
  - Much lower than 2010 and more similar to previous postclosure years
  - Still see effects from wet 2010



Selected Highlights from 2011: ETPTS (continued)

- ETPTS characteristics
  - Concentrations of some VOCs in system influent are higher
    - Especially TCE: typically in 2500 µg/L range, has been greater than 3000 µg/L since fourth quarter 2010
  - Effluent showed much higher TCE concentrations in fourth quarter sample
    - Collected follow-up sample: results similar
    - Reconfigured flow from parallel upflow in both treatment cells to series, upflow in first cell and downflow in second cell
    - Collected sample in January 2012 to evaluate flow reconfiguration
    - Treatment effectiveness restored – will be included in 2012 reports
- Results from surface water performance location POM2 included no VOC detections

Selected Highlights from 2011: Solar Ponds Plume

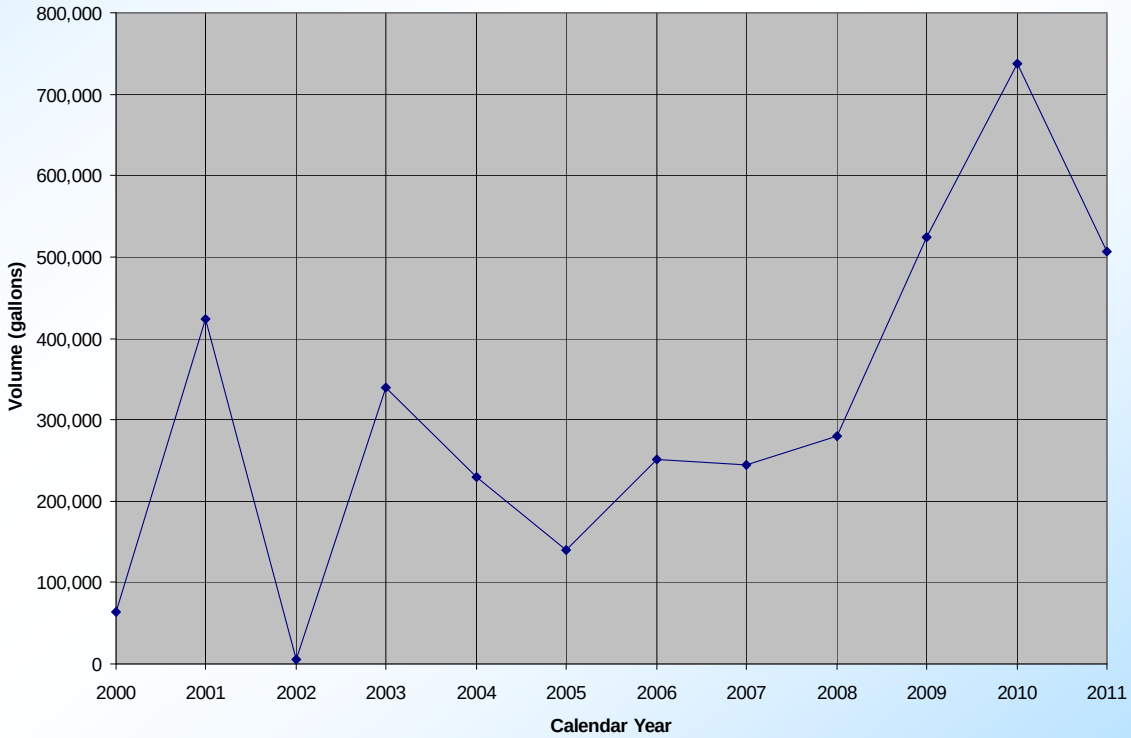


Selected Highlights from 2011: Solar Ponds Plume (continued)

- Source-area Evaluation wells not scheduled for sampling
  - Three on south/southeast portion of source area sampled to support GS10 evaluation
  - Results consistent with previous, including continued decreasing uranium in one well
- Overall patterns at downgradient Sentinel wells
  - Higher uranium often not accompanied by higher nitrate
    - Wells nearer source area (Sentinel well P210089) may be lower in uranium than wells farther away (Sentinel well 70099, AOC well 10594)
    - Illustrates importance of natural uranium
- AOC well 10594 reports decreasing uranium trend
- See Annual Report for more trends, discussion

Selected Highlights from 2011: SPPTS

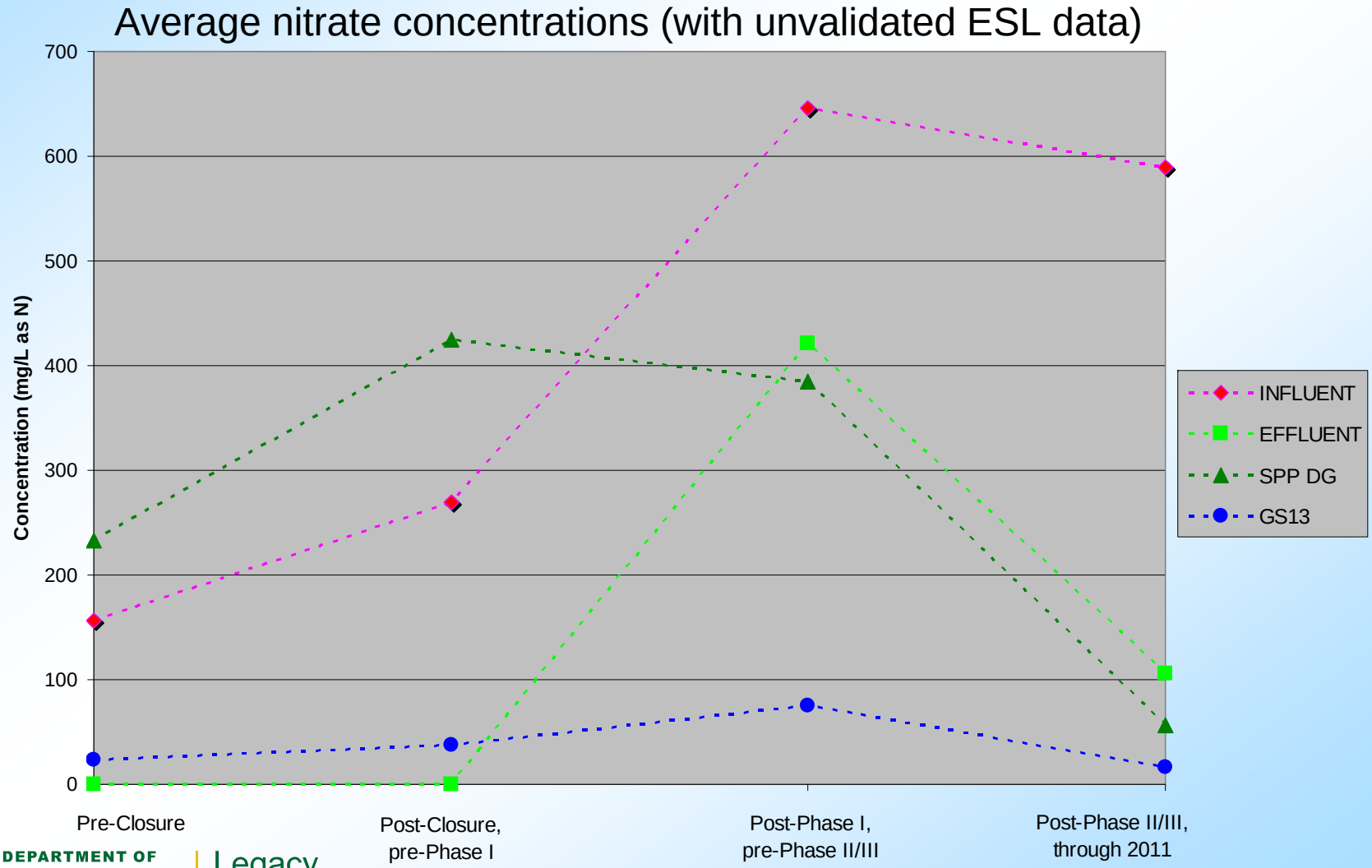
- SPPTS treated approximately 507,000 gallons
  - Annual average volume treated has increased since Phase I upgrades in 2008
  - Average for 2006–2011 is more than twice average 2000–2005
  - Average for 2009–2011 is almost three times average 2000–2008



Selected Highlights from 2011: SPPTS (continued)

- SPPTS characteristics
  - Higher flow rates reduce residence time, treatment effectiveness
  - Average concentrations of nitrate and uranium remain much lower at SPP Discharge Gallery than prior to site closure
  - Results from surface water performance location GS13 indicate overall effectiveness of SPPTS is improving

Selected Highlights from 2011: SPPTS (continued)



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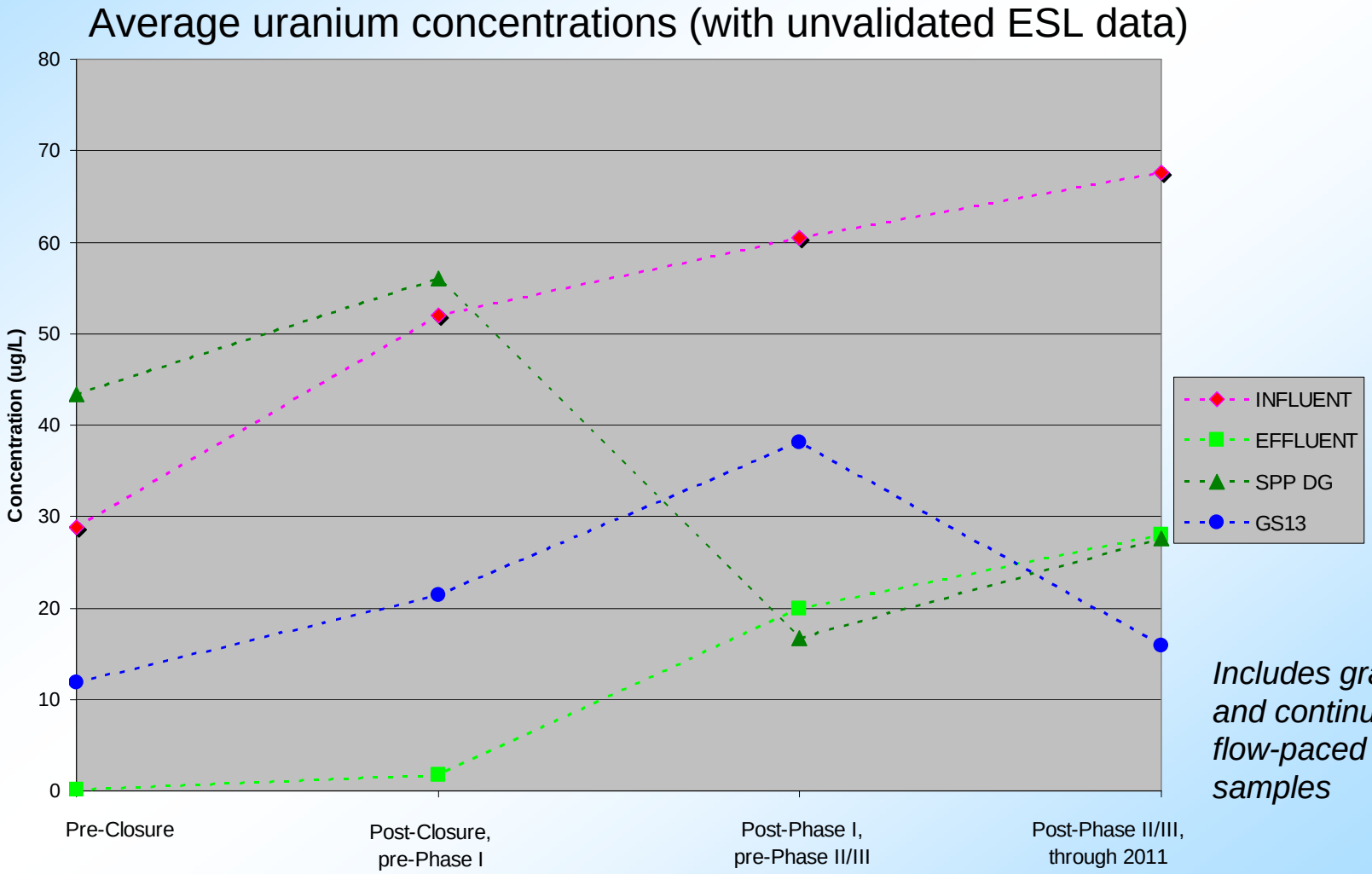
Selected Highlights from 2011: SPPTS (continued)



Includes grabs and continuous flow-paced samples

Selected Highlights from 2011: SPPTS (continued)

- SPPTS upgrade summary
  - Phase I (October 2008) collects more contaminated groundwater and routes to treatment cells, routes effluent via new, nonperforated line
  - Phase II (May 2009) moves uranium treatment to first step in easily accessible cell
  - Phase III (May 2009) evaluates pilot-scale nitrate treatment
- Main activities
  - Continued operation of Phase III components
  - Cleaned media (biomass removal) in Phase III Cell A
  - Conceptualization of revised approach to uranium treatment ("microcell") to address reduced effectiveness of Phase II Cell
    - Shorten residence time and attempt to replicate successful lab results
    - Testing underway in 2012

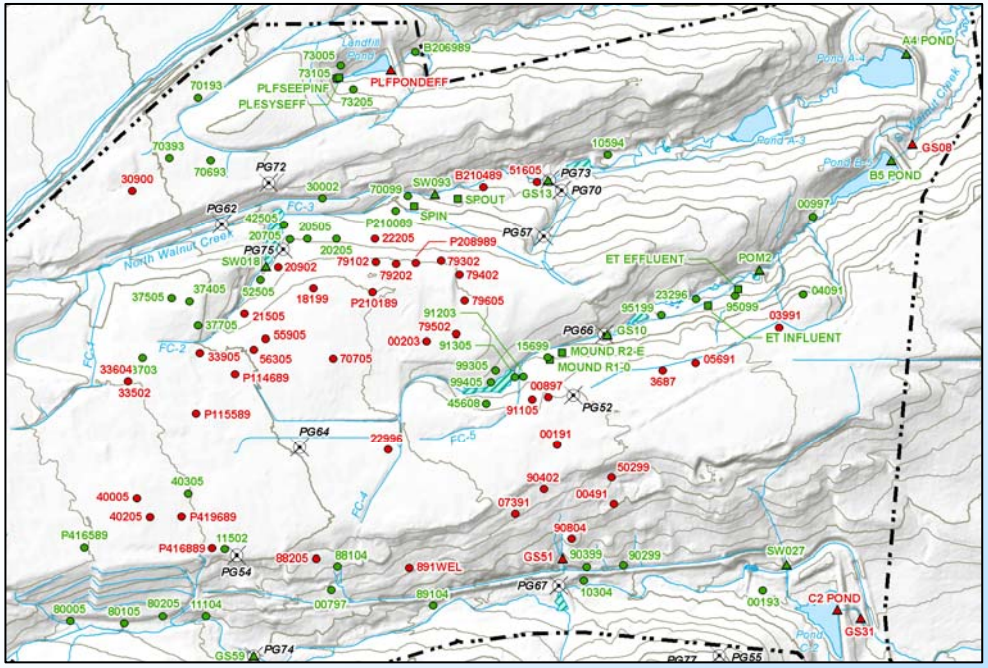
Selected Highlights from 2011: SPPTS (continued)

- Phase III optimization concluded
  - Results: organic media alternative requires much larger treatment cell, active alternative requires much more maintenance and power
  - Continue to operate
- Additional detail in Annual Report

Selected Highlights from 2011: Other Plumes

Only a few source-area Evaluation wells were sampled in 2011

- 903 Pad/Ryan's Pit plume
- IA plume
- Vinyl chloride plume
- IHSS 118.1 plume
- Other areas
  - Former B991
  - AOC well B206989 (No Name Gulch)
- See Annual Report for more information



Selected Highlights from 2011: 903 Pad/Ryan's Pit Plume

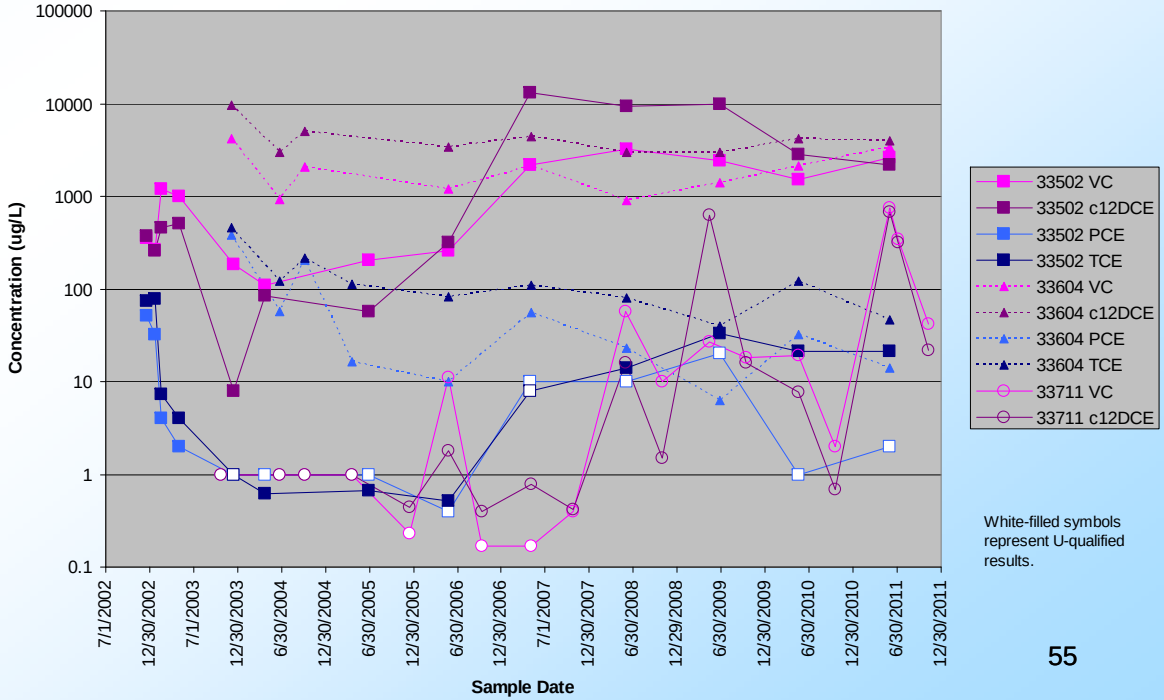
- Results from source-area Evaluation wells generally consistent with previous data
  - 903 Pad groundwater: primarily carbon tetrachloride and PCE
  - Ryan's Pit groundwater: primarily TCE
  - 07391 (Ryan's Pit) produces samples with highest VOC concentrations
- AOC wells 10304 and 00193 do not suggest impacts to surface water
- Several trends identified, see Annual Report for details

Selected Highlights from 2011: IA Plume

- Southern portion
  - No Evaluation wells sampled
  - Sentinel well results consistent with previous
  - Results for AOC well 11104 (at Woman Creek) do not suggest impact to surface water
  - Uranium concentrations also consistent with previous, remain below threshold
- Central portion not sampled
- Northern portion
  - Biodegradation of VOCs is suggested at Evaluation well 21505
    - Located between two other areas that support biodegradation
    - Parent compounds (PCE, TCE) decreasing, daughter products on uncertain trend
  - VOCs in Sentinel well 52505 and Surface Water Support location SW018 consistent with previous (well below RFLMA standards)
  - No VOCs detected in AOC well 42505
- Several trends calculated, see Annual Report for details

Selected Highlights from 2011: Vinyl Chloride Plume

- Replaced downgradient, kinked Sentinel well 33711 (original: 33703)
  - Second-quarter results from replacement well higher than typical in original well
  - Confirmatory sample and fourth quarter sample results were lower
- Source-area results consistent with previous years
  - Concentrations of daughter products are higher, parent compounds lower
- Biodegradation appears to be continuing



White-filled symbols represent U-qualified results.

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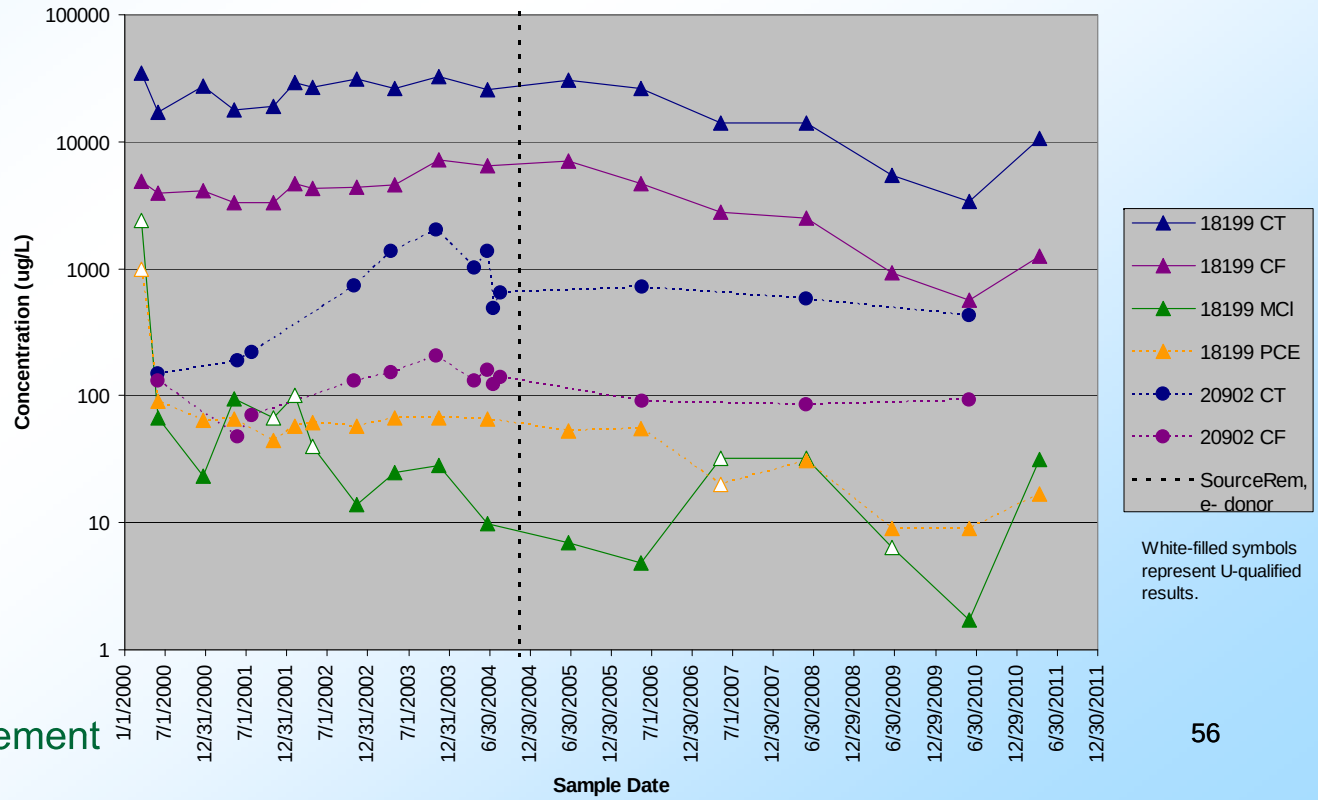
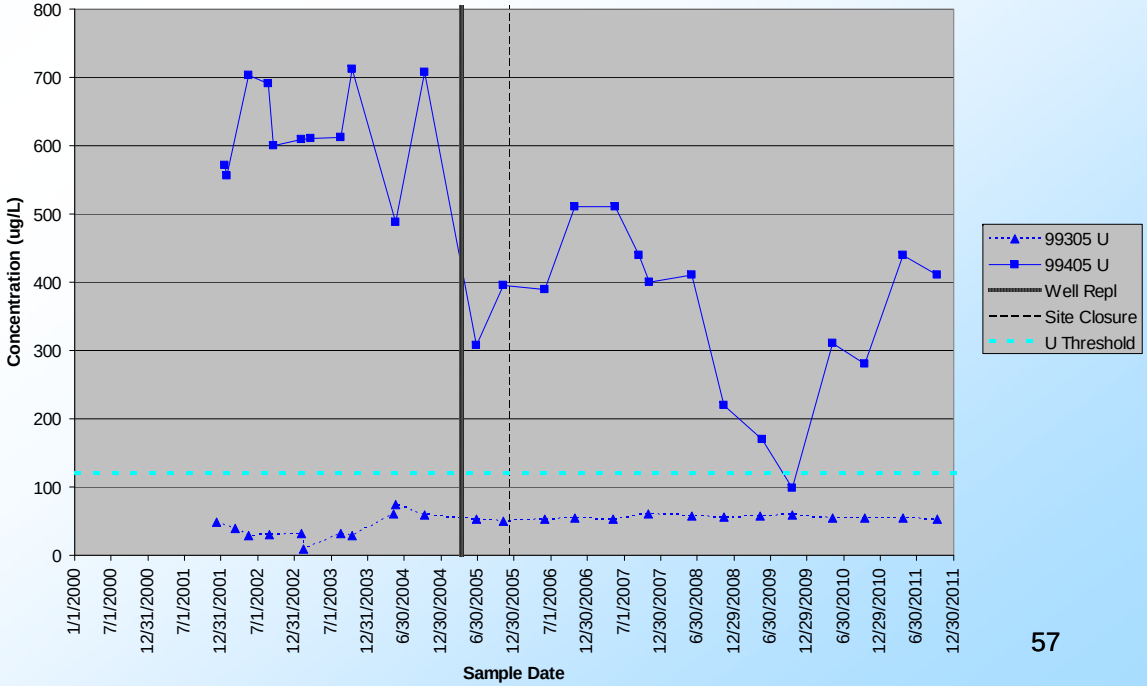
Selected Highlights from 2011: IHSS 118.1 Plume

- Sampled source-area Evaluation well 18199
  - Results suggest some rebound of carbon tetrachloride and chloroform (main contaminants)
- Downgradient Evaluation well 20902 not sampled in 2011
- Downgradient Sentinel wells (N of B771) do not suggest impacts from this plume



Selected Highlights from 2011: Other Areas of Interest

- B991 uranium
  - Uranium concentrations at well 99405 continued rebound after 2009 low
    - Still calculated to be on a decreasing trend
  - Uranium at 99305 calculated to be increasing
  - Both wells characterized as natural uranium



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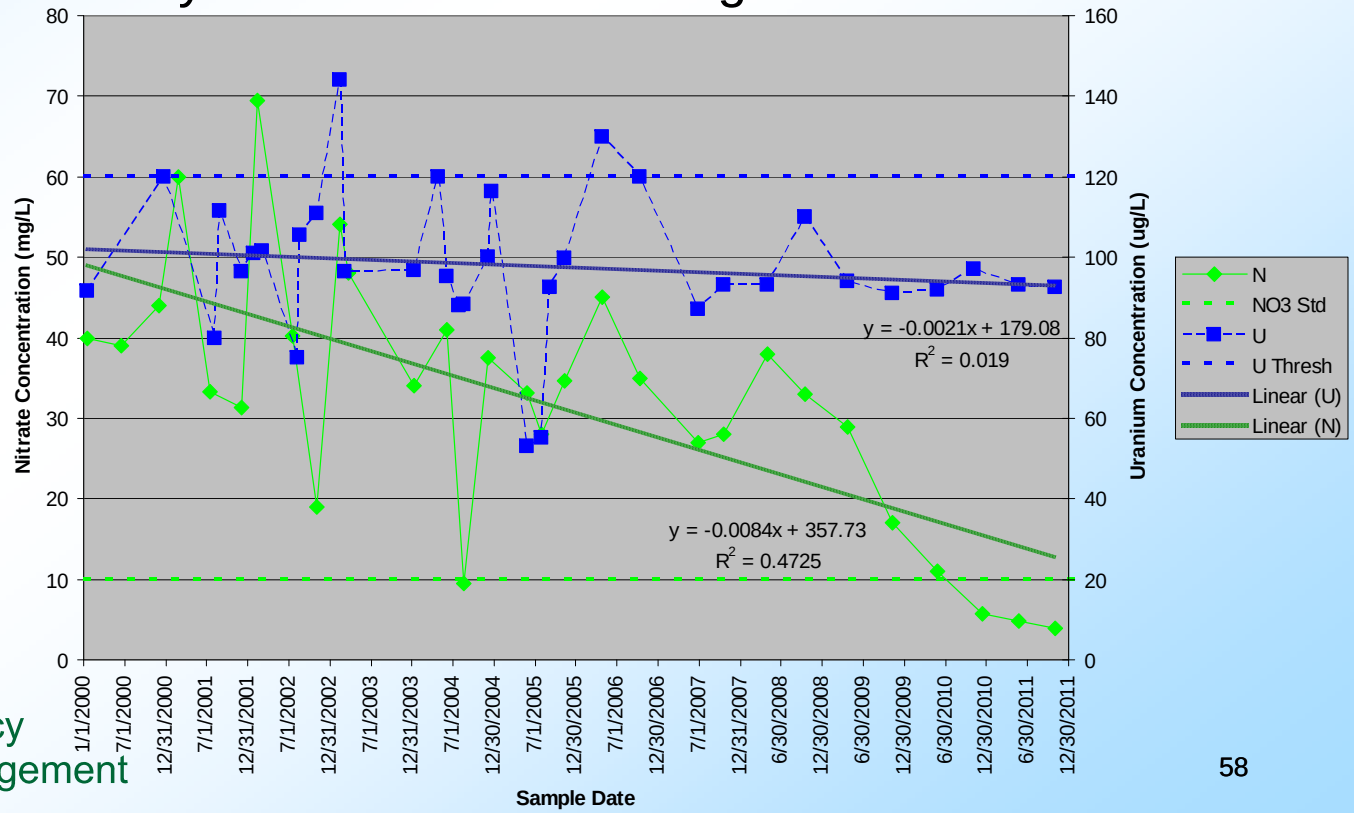
Selected Highlights from 2011: Other Areas of Interest (continued)

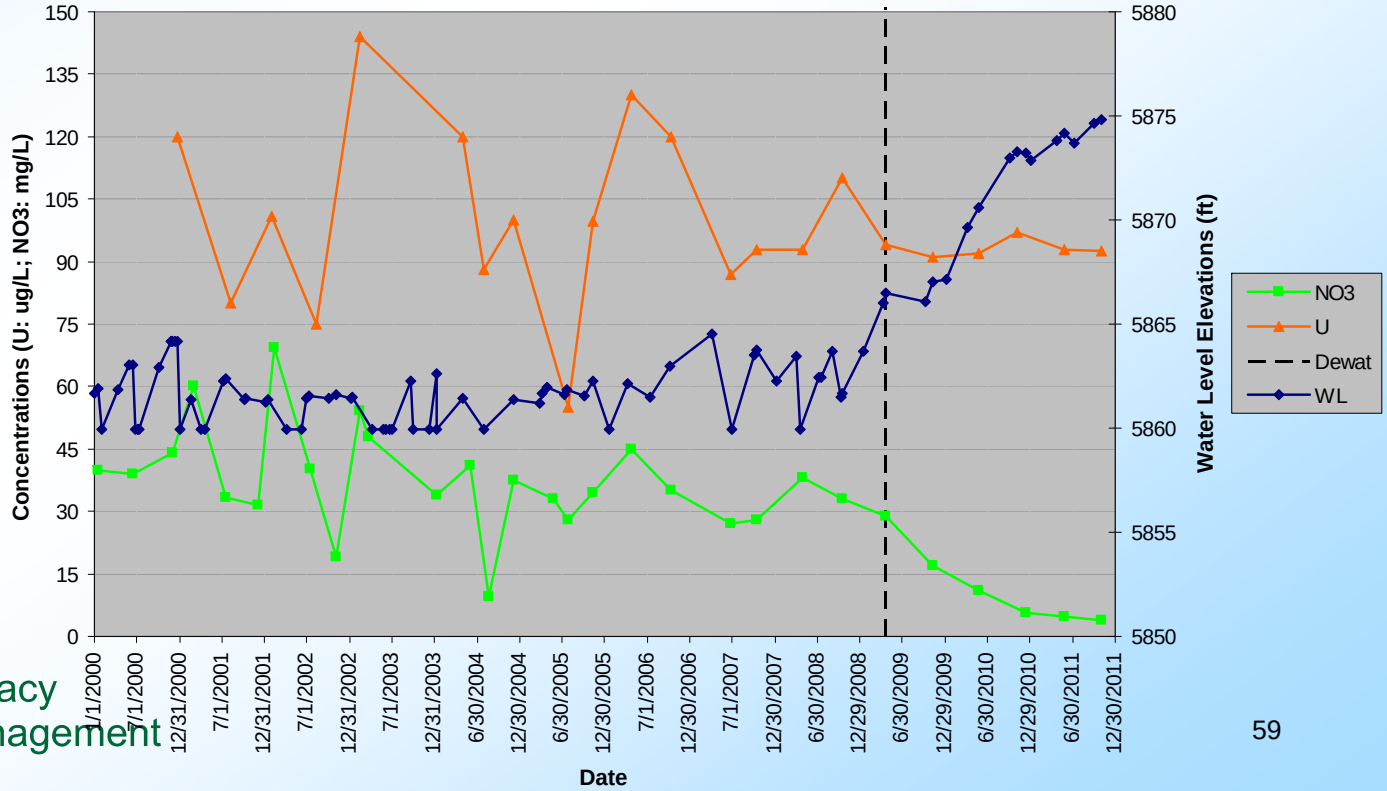
- AOC well B206989 (east of Landfill Pond dam)
  - Entered reportable condition for nitrate in 2007
  - Decreasing trend is calculated
  - Results since early 2010 are below 10 mg/L standard



Simple regression lines are shown at right; see Annual Report for required trending output

Selected Highlights from 2011: Other Areas of Interest (continued)

- Reported concentrations of nitrate and uranium at B206989 are affected by sampling method
  - Previous: purge stagnant water, collect sample from recharge
  - Current: purge to acclimate equipment and collect sample



Questions?

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Site Operations – Calendar Year 2011

Site Operations – OLF

- 12 monthly inspections were performed in 2011
- Fourth quarter inspections were completed on October 30, November 30, and December 23, 2011
- Settlement monuments surveyed in March, June, September, and December – results are within the expected range per Monitoring and Maintenance Plan and do not trigger any maintenance
- Biannual topographic survey performed in March 2011
  - Berm height maintenance to meet minimum height criteria completed based on survey and field measurement

OLF Features

OLF Inclinometers Evaluation

- Inclinometers were measured on October 20, November 22, and December 21, 2011
- Very little deflection was noted in the fourth quarter (and all of 2011)
- Review of 2011 data by geotechnical engineer – consistent with 2008 Geotechnical Report
  - Localized slumping occurs as groundwater levels saturate organic layer near bedrock
  - 2011data support conclusion that monitoring and implementing maintenance to fill and grade surface cracking is effective
  - Filling and grading to reduce depth and slope of west perimeter channel and to promote drainage of seeps in 2008 and 2009 may contribute to gradual stabilization

Site Operations – PLF

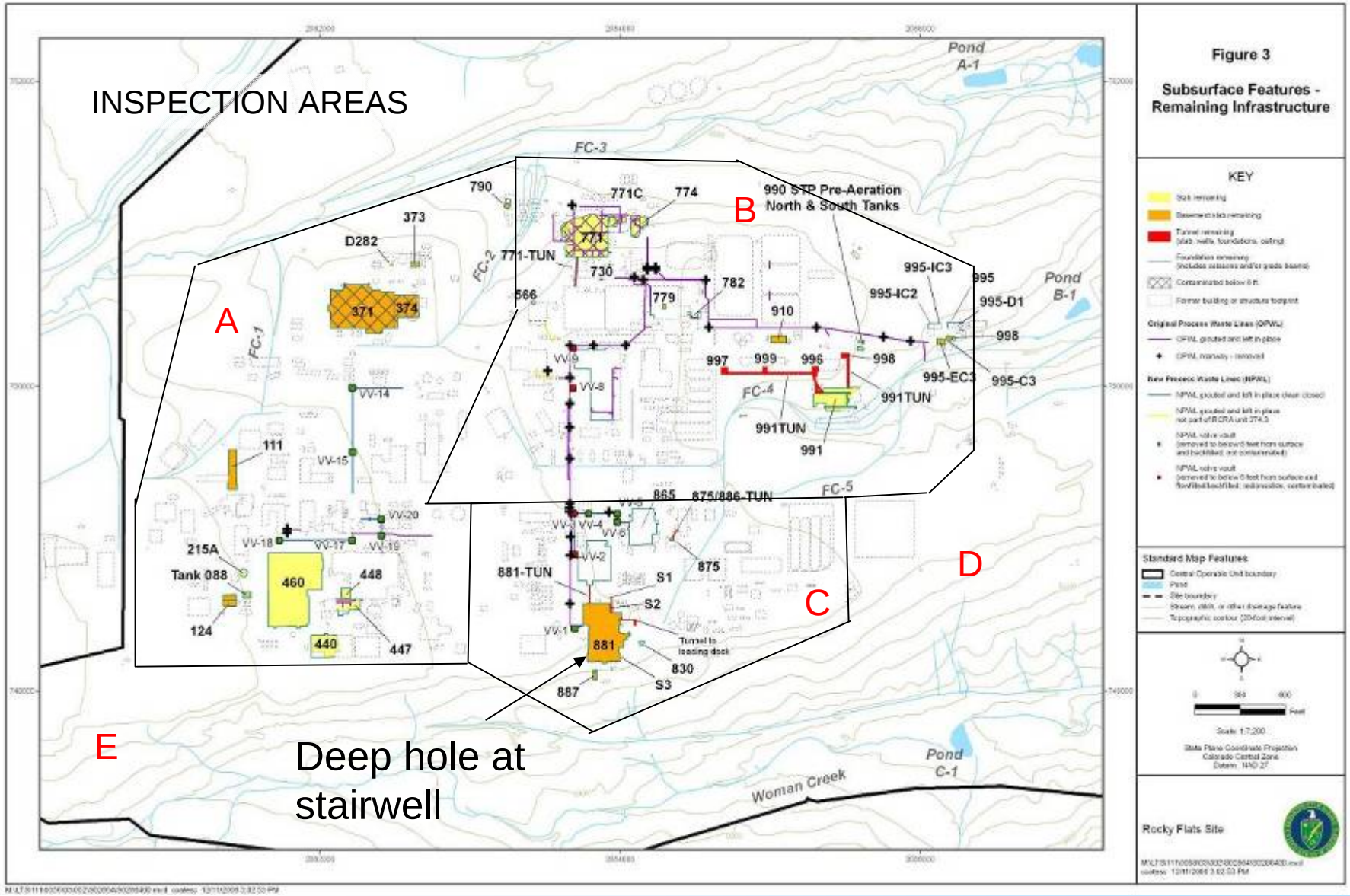
- Four quarterly inspections were completed in 2011
- The fourth quarter inspection was completed on November 30, 2011
- Nine settlement monuments and six side slope monitors were surveyed in December 2011 – results are within the expected range per Monitoring and Maintenance Plan and do not trigger any maintenance

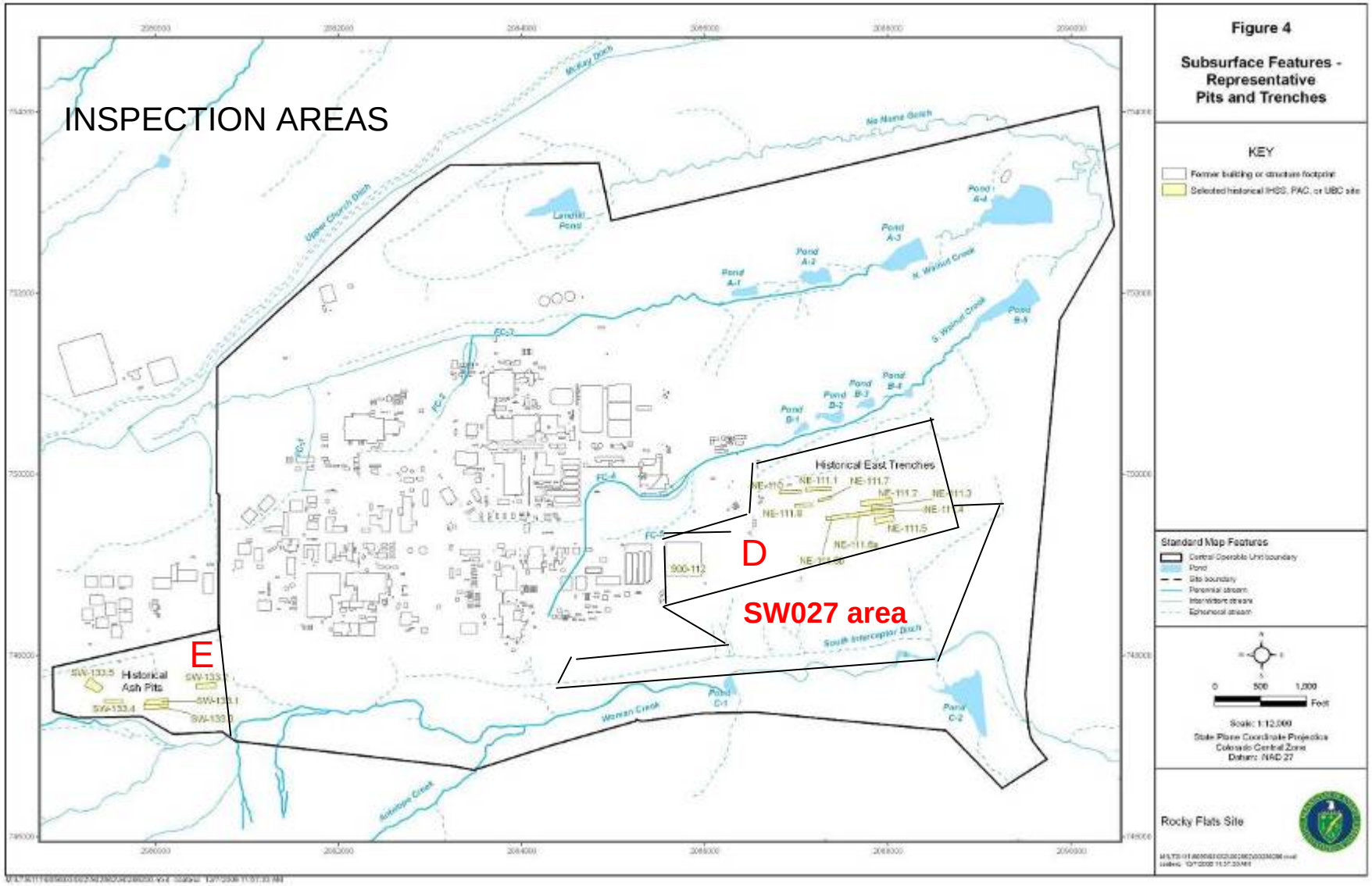
Annual Site (Central Operable Unit) Inspection – March 15, 2011

- Inspection and monitoring for evidence of significant erosion
  - Conduct visual observation for precursors of significant erosion
  - Evaluate proximity of any significant erosion to subsurface features
- Inspect effectiveness of institutional controls (ICs)
  - Determine effectiveness by evaluating any evidence of violation of ICs and determine whether required signs are in place
  - Verify that Environmental Covenant is in Administrative Record and on file with Jefferson County (verified March 19, 2011)
- Evidence of any adverse biological conditions observed during inspection

Annual Inspection (continued)

- COU divided into five areas:
  - A – Former 300 and 400 Areas
  - B – Former 700 and 991 Areas
  - C – Former 800 Area
  - D – Former 903 Pad and East Trenches Area
  - E – Former Ash Pits Area
- SW027 drainage area also inspected – erosion controls added in 2010 as follow-up to elevated plutonium levels in 2010
- Landfills, treatment systems, and water monitoring stations inspected during the year on a routine basis
- Team walked down surface of each area (A–E) and SW027 drainage area to observe conditions


INSPECTION AREAS
A
B
C
D
E
Deep hole at stairwell
Figure 3
Subsurface Features - Remaining Infrastructure
KEY
Standard Map Features
Rocky Flats Site
Pond A-1
Pond B-1
Pond C-1
Woman Creek
FC-1
FC-2
FC-3
FC-4
FC-5
790
373
D282
371
374
771C
774
771
771-TUN
730
566
779
782
910
990 STP Pre-Aeration North & South Tanks
995-IC3
995-IC2
995
995-D1
998
995-EC3
995-C3
997
999
996
991TUN
991
865
875/886-TUN
875
881-TUN
S1
S2
S3
881
Tunnel to loading dock
830
887
111
VV-14
VV-15
VV-20
VV-18
VV-17
VV-19
215A
Tank 088
124
460
448
440
447


INSPECTION AREAS
Figure 4
Subsurface Features - Representative Pits and Trenches
KEY
Former building or structure footprint
Selected historical IHSS, PAC, or UBC site
Standard Map Features
Central Operable Unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream
Scale: 1:12,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
Rocky Flats Site
Historical East Trenches
D
SW027 area
E
Historical Ash Pits
Upper Church Ditch
Mckay Ditch
No Name Gulch
Landfill Pond
Pond A-1
Pond A-2
Pond A-3
Pond A-4
N. Walnut Creek
S. Walnut Creek
Pond B-1
Pond B-2
Pond B-3
Pond B-4
Pond B-5
South Interceptor Ditch
Woman Creek
Antelope Creek
Pond C-1
Pond C-2
900-112

Annual Inspection (continued)

- No significant erosion noted – some holes and surface debris
  - Former B881 deep hole – other holes minor
  - Very limited aerial extent – holes filled in
  - Debris and trash collected or flagged for pick up
- No adverse biological conditions noted
- No evidence of IC violations
- Signs in place

Hole at stairwell on SW corner former B881

Small hole former B991 tunnel area – fill added in 2010

Annual Inspection (continued)

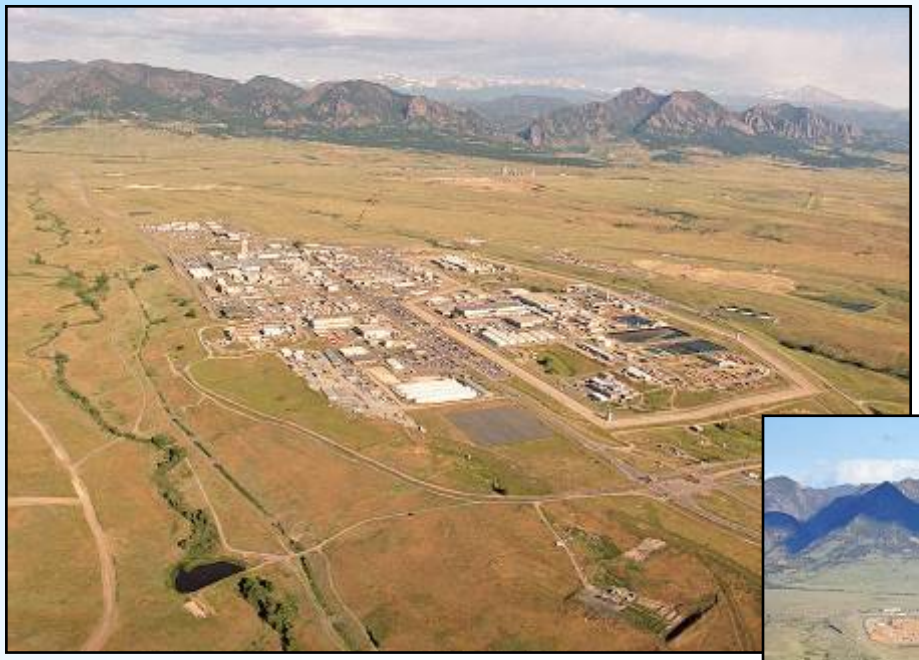
Filling hole at former B881

Former Building Areas

- Inspecting areas with buried building remnants quarterly
  - B371
  - B771
  - B881
  - B991
- In fourth quarter, noted depression and cracking in gravel road south of B771
- In vicinity of B771 stairwell
- Road moved to south, area roped off
- Area to be filled during road construction

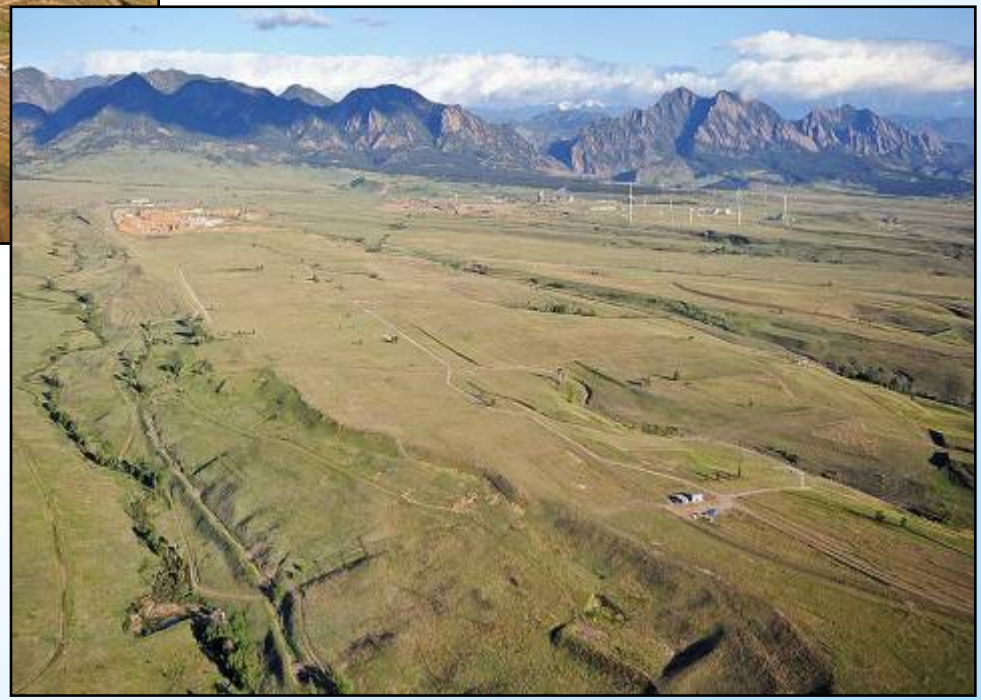
Questions?

2011 Ecological Monitoring Summary



1995

2011



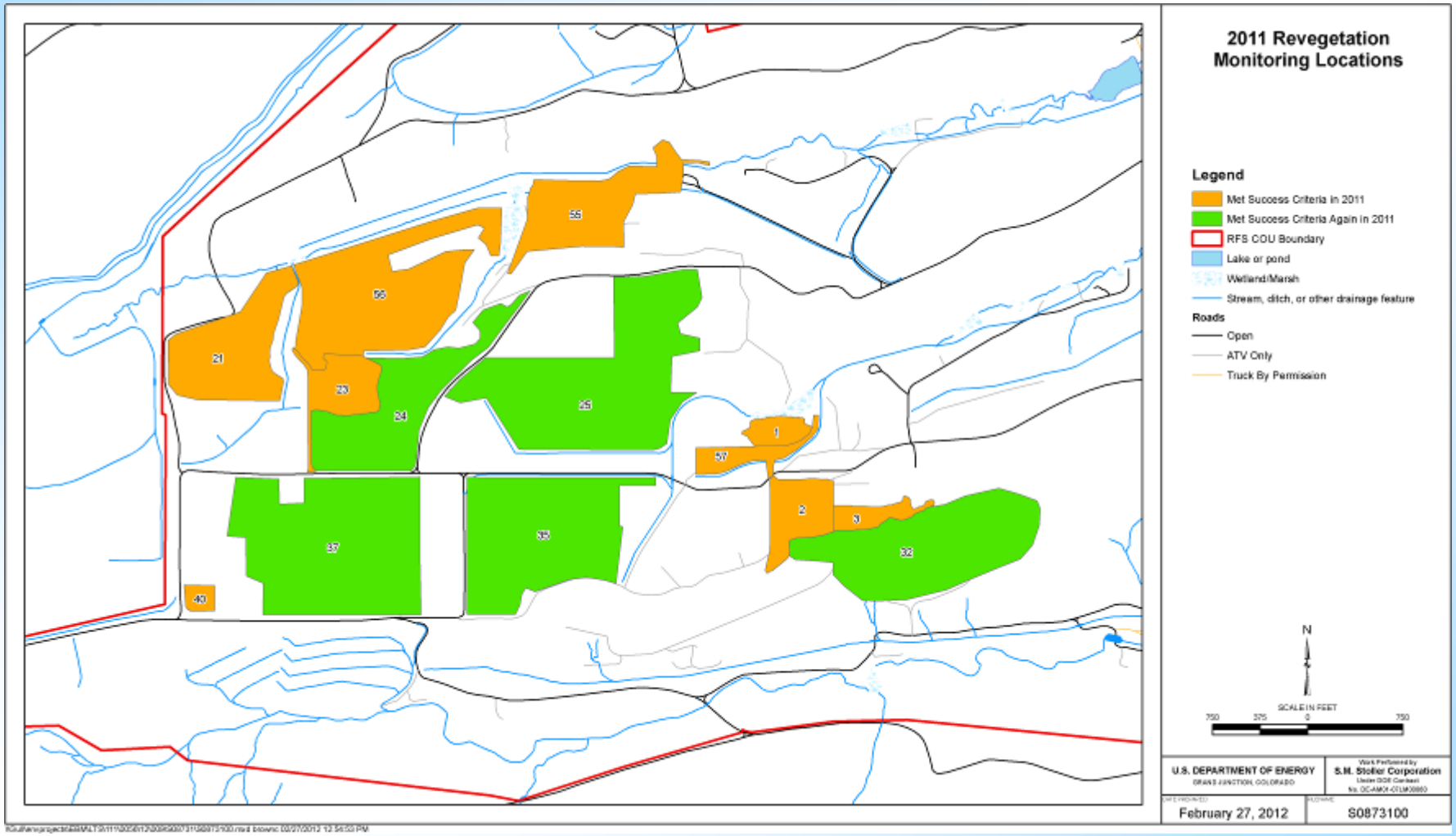
Project Assistance

- Project support for ecological issues was provided for the:
  - A-3/PLF dam breach project
  - POC flumes project
  - Annual roads project
  - Annual dam mowing and riprap spraying project
  - OLF maintenance
  - Pond bottom revegetation project (A-4, B-5, and C-2)
  - Stoplog removal project
  - Solar Ponds Plume Treatment System projects
  - Annual weed control efforts

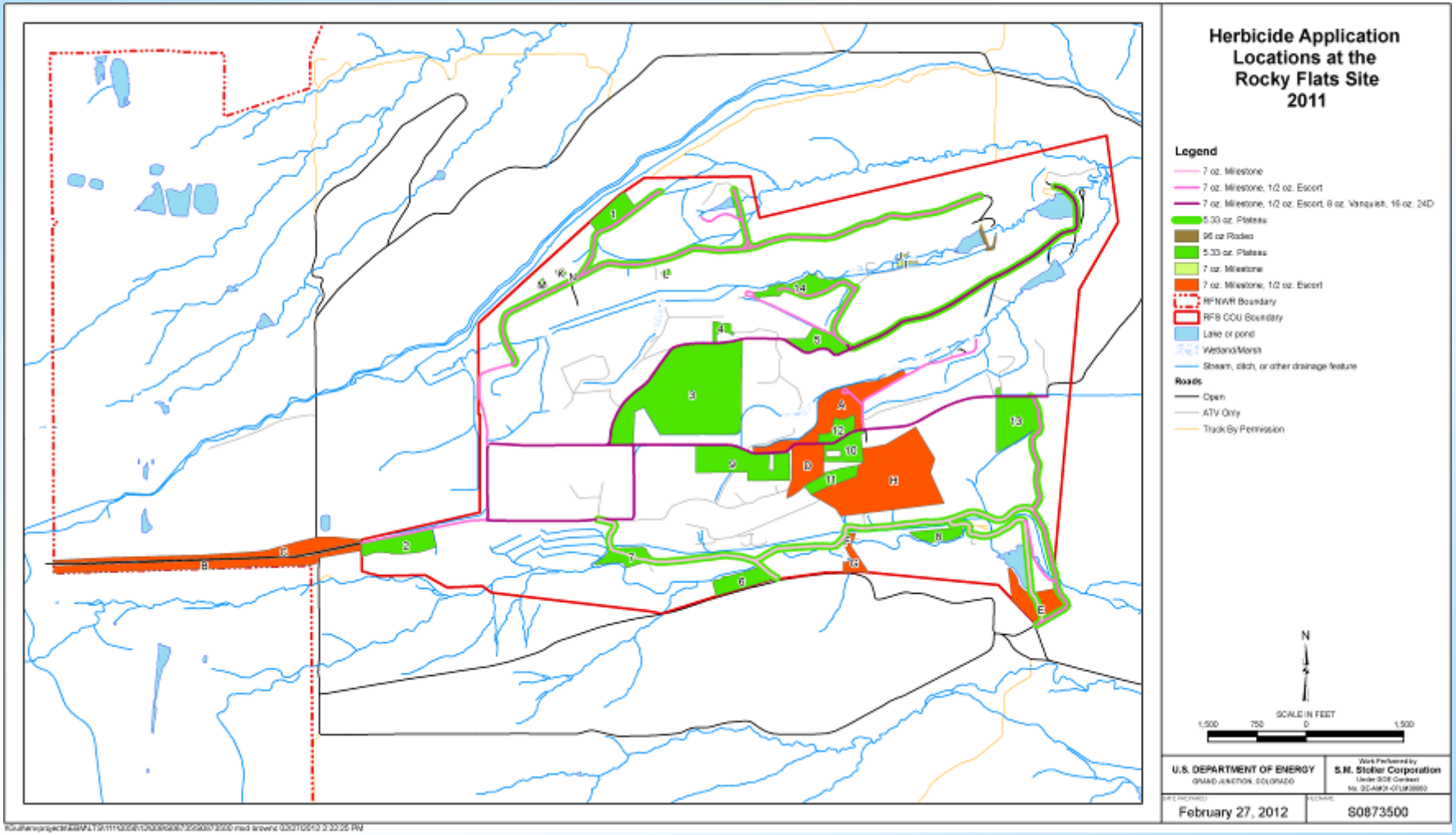
Ecological Monitoring

- OLF and PLF vegetation surveys
- Weed and water level surveys in the mitigation wetlands
- Revegetation monitoring
- Weed monitoring and mapping
- Preble's mouse mitigation monitoring
- Wetland mitigation monitoring
- Bluebird box monitoring

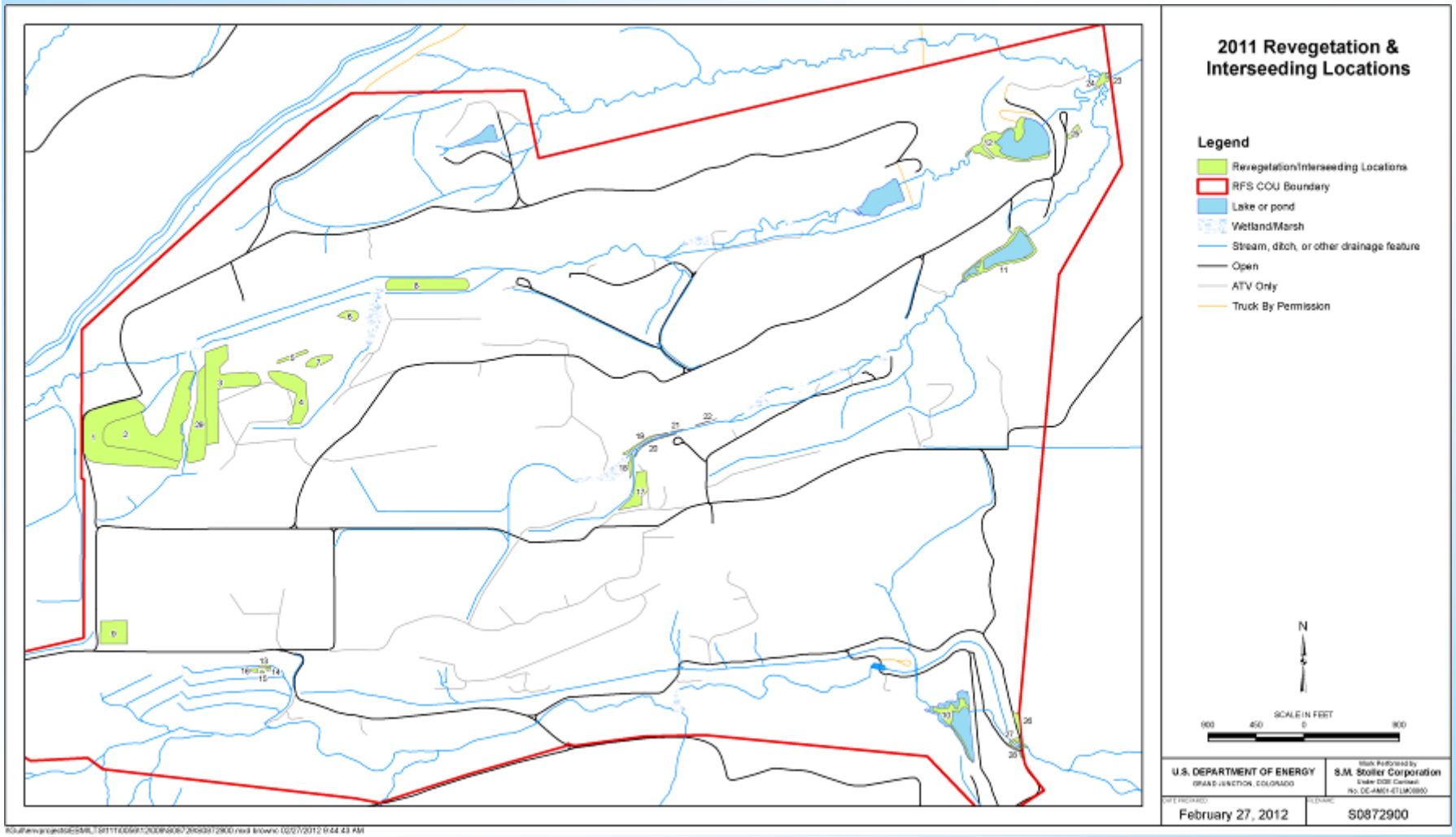
Revegetation Monitoring



Weed Control



Revegetation Activities



2004

2011

2003

2011

2004

2011

2004

2011

2005

2011

2003

2011

2011 Wildlife Monitoring

- Prairie dogs – no active towns within COU
- Raptor nests
  - 1 Great Horned Owl nest – 3 young fledged
- Bluebird nest boxes
  - No bluebirds using nest boxes yet
  - 3 boxes used by tree swallows

Questions?

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