4.0 REMEDIAL ACTIONS

This Second Five-Year Review covers remedial actions at both OU-1 and OU-2 sites. OU-1 includes the soils at eight PSCs, and Basewide air, surface water and groundwater. OU-2 includes those sites where only petroleum-related wastes were disposed. Remedial (cleanup) alternatives were developed for any site not deemed suitable for unrestricted land use, based on the results of the RI. Remedial alternatives also were developed for any site that could potentially impact the underlying groundwater resources in the future. The remedy selection and implementation at each OU are detailed in the following subsections.

4.1 REMEDY SELECTION

The remedy selections are summarized by OU.

4.1.1 Operable Unit 1

Twenty-five PSCs were investigated during the RI/FS phase. As part of the OU-1 RI, a Basewide risk assessment was conducted to evaluate the potential risks to human health and the environment that could result from exposure to the air, soil, surface water, and groundwater at Luke AFB. The results of the OU-1 RI and Basewide risk assessment indicated that the air, surface water, and groundwater resources of Luke AFB did not represent conditions that would pose an imminent and substantial endangerment to public health, welfare, or the environment. However, the soils at eight of the OU-1 PSCs were found to have conditions that could either cause unacceptable human health risks under certain types of land use scenarios or could impact the underlying groundwater. Remedial alternatives were developed for the soils at those eight sites. A remedy selection process was not required for the soils at the remaining 17 PSCs or for the air, surface water, and groundwater resources of the Base.

Based on the results of the RI, remedial action objectives (RAOs) were developed to aid in the development and screening of alternatives for the eight PSCs found to warrant remediation. All remedial alternatives considered for implementation (except no action) were required to satisfy the RAOs. The RAOs for OU-1 were divided into the following groups:

- Exposure Prevention. Prevent incidental ingestion, dermal contact, and inhalation by an at-risk receptor of soil that contains unacceptable concentrations of contaminants, as determined by the Basewide risk assessment.
- Protection of Groundwater. Prevent the migration of contaminants of concern (COCs) from unsaturated soils into groundwater or surface water to ensure that groundwater or surface water is protective of human health and the environment.

These RAOs are considered to be protective of human health and the environment by preventing human contact with impacted material and by eliminating, reducing, or controlling the possible migration of COCs to other environmental media.

General response actions (GRAs) for soils also were established. GRAs are general measures that could be implemented to achieve the RAOs. GRAs are developed to aid in the identification of remedial technologies that can minimize releases, threats of releases, or pathways of exposure to the soils. Although GRAs are not detailed, they categorize technologies that may be pertinent for remediation of soils. GRAs were developed for two soil units: soils to a depth of 16 feet bgs, and soils with the potential to leach COCs to groundwater. The depth limit was established because exposure to soils deeper than 16 feet bgs is unlikely, even during construction activities. This depth is greater than the maximum standard depth of excavation for a residential development and exceeds most depths of trenching for utility lines. The following GRAs were identified:

- No action. The site would remain as it currently exists. Monitoring may be conducted.
- ICs. Institutional action would be implemented to limit site access and land uses. Personal protective equipment (PPE) may also be required during certain site activities.
- Containment. The relevant area would be physically contained.
- Excavation and Disposal. Selected soil volumes would be excavated for subsequent disposal off-site without treatment.
- Excavation, Treatment, and Disposal. Selected soil volumes would be removed for subsequent treatment and disposal either on or off-site.
- In-situ Extraction. Constituents would be removed from the subsurface soils and discharged at the surface for treatment.
- In-situ Treatment. Selected soil volumes would be treated using appropriate technologies applied in-situ.

It should be noted that GRAs were not developed for groundwater because the groundwater resources beneath the OU-1 PSCs were not impacted with COCs at concentrations above Applicable or Relevant and Appropriate Requirements (ARARs). GRAs developed for the soils also ensure that future impacts to groundwater would not occur at sites that showed the potential for COCs to leach to the groundwater.

Remedial alternatives were developed for the soils at the eight sites as part of the OU-1 FS. The OU-1 FS report prepared by ARCADIS Geraghty & Miller, Inc. in 1998 provided recommendations for the most appropriate remedial alternative for each site based on the nine selection criteria. As required under Superfund, the recommendations were presented to the public and regulatory agencies for review and comment in the OU-1 Proposed Plan.

The selected remedies for the eight OU-1 sites that required action are summarized in Table 4.1

4.1.2 Operable Unit 2

Eight sites where only petroleum-related wastes were disposed were evaluated during the RI/FS of OU-2. The results of the OU-2 RI and Basewide risk assessment indicated that the petroleum-impacted soils at six of the eight PSCs evaluated did not represent conditions that would pose an imminent and substantial endangerment to public health, welfare, or the

environment. Remedial alternatives were developed for the remaining two OU-2 sites: ST-18 and DP-23.

The RAOs for OU-2 were the same as for OU-1. Twelve potential remedial alternatives were screened; of these 12 alternatives, the 5 alternatives listed below were retained for a more detailed analysis:

- No Action
- Capping, surface controls, and monitoring
- Excavation, ex situ biological treatment, and on-site disposal
- In situ extraction and monitoring
- In situ biological treatment and monitoring

All these alternatives were considered to be viable and meet the requirements of the RAOs. The selected remedy for ST-18: Former Liquid Waste Storage Facility (Facility 993) was capping, surface controls, and monitoring. The selected remedy for DP-23: Old Surface Impoundment West of Facility 993 was excavation, ex situ biological treatment, and on-site disposal.

4.2 REMEDY IMPLEMENTATION

The manner in which the selected remedies for each of the OU-1 and OU-2 sites under consideration in this Second Five-Year Review were implemented are summarized in the following subsections.

4.2.1 DP-13: Drainage Ditch Disposal Area

The selected remedy for DP-13 was ICs, based on the determination made in the risk assessment that wastes were buried and posed no exposure threat based on current land use scenarios. The remedy was implemented by revising the Base General Plan (BGP) in January 2000 to reflect that land use restrictions had been placed on the site. The BGP serves as the primary mechanism that ensures the institutional and engineering controls are established and maintained. The BGP's constraints against residential development and construction are enforced through procedures already in place at Luke AFB, including the use of AF Form 332, which controls development and construction projects on Base. An AF Form 332 must be submitted before beginning any building project at the Base. The final approval of any building project resides with the Base Chief of Operations, who is required to review the BGP and sign all AF Form 332s. In compliance with the restrictions of the BGP, the Chief of Operations for Luke AFB will not approve any AF Form 332 that plans for the residential development of the site. The BGP is reviewed and updated annually as needed. The process for obtaining a permit for construction is also detailed in the institutional control plan (ICP).

Another IC in place as part of the remedy is the use of personal protective equipment (PPE) during all future excavation activities at the site. All dig permits issued for the site must include a provision for the use of PPE. The Base Chief of Environmental Engineering must ensure that PPE is used during any future excavation work at the site.

DP-13 was added to the Luke AFB ICP to facilitate enforcement of ICs and incorporated into the BGP. Luke AFB filed a Voluntary Environmental Mitigation Use Restriction (VEMUR) with ADEQ on June 15, 2000 stating that Luke AFB agrees to restrict the site to nonresidential usage.

Site inspections are required at 5-year intervals after signing of the ROD to determine the adequacy of ICs and current land use.

4.2.2 FT-07E: Eastern Portion of North Fire Training Area

The selected remedy for FT-07E was ICs, based on the determination made in the risk assessment that impacted soils remain in place and pose no exposure threat based on current land use scenarios. The remedy was implemented by revising the BGP in January 2000 to reflect that land use restrictions had been placed on the site. The BGP serves as the primary mechanism that ensures the institutional and engineering controls are established and maintained. The BGP's constraints against residential development are enforced through procedures already in place at Luke AFB. An AF Form 332 must be submitted before beginning any building project at the Base. The final approval of any building project resides with the Base Chief of Operations, who is required to review the BGP and sign all AF Form 332s. In compliance with the restrictions of the BGP, the Chief of Operations for Luke AFB will not approve any AF Form 332 that plans for the residential development of the site. The BGP is reviewed and updated annually as needed. The process for obtaining a permit for construction is also detailed in the ICP.

FT-07E was added to the Luke AFB ICP to facilitate enforcement of ICs and incorporated into the BGP. Luke AFB filed a VEMUR with ADEQ on June 15, 2000 stating that Luke AFB agrees to restrict the site to nonresidential usage.

Site inspections are required at 5-year intervals after signing of the ROD to determine the adequacy of ICs and current land use.

4.2.3 LF-03: Outboard Runway Landfill

The selected remedy for LF-03 was ICs, based on the determination made in the risk assessment that wastes were buried and posed no exposure threat based on current land use scenarios. The remedy was implemented by revising the BGP in January 2000 to reflect that land use restrictions had been placed on the site. The BGP serves as the primary mechanism that ensures the institutional and engineering controls are established and maintained. The BGP's constraints against residential development are enforced through procedures already in place at Luke AFB. An AF Form 332 must be submitted before beginning any building project at the Base. The final approval of any building project resides with the Base Chief of Operations, who is required to review the BGP and sign all AF Form 332s. In compliance with the restrictions of the BGP, the Chief of Operations for Luke AFB will not approve any AF Form 332 that plans for the residential development of the site. The BGP is reviewed and

updated annually as needed. The process for obtaining a permit for construction is also detailed in the ICP.

LF-03 was added to the Luke AFB ICP to facilitate enforcement of ICs and incorporated into the BGP. Luke AFB filed a VEMUR with ADEQ on June 15, 2000 stating that Luke AFB agrees to restrict the site to nonresidential usage.

Site inspections are required at 5-year intervals after signing of the ROD to determine the adequacy of ICs and current land use.

4.2.4 LF-14: Old Salvage Yard Burial Site

The selected remedy for LF-14 was ICs, based on the determination made in the risk assessment determination that wastes were buried and posed no exposure threat based on current land use scenarios. The remedy was implemented by revising the BGP in January 2000 to reflect that land use restrictions had been placed on the site. The BGP serves as the primary mechanism that ensures the institutional and engineering controls are established and maintained. The BGP's constraints against residential development are enforced through procedures already in place at Luke AFB. An AF Form 332 must be submitted before beginning any building project at the Base. The final approval of any building project resides with the Base Chief of Operations, who is required to review the BGP and sign all AF Form 332s. In compliance with the restrictions of the BGP, the Chief of Operations for Luke AFB will not approve any AF Form 332 that plans for the residential development of the site. The BGP is reviewed and updated annually as needed. The process for obtaining a permit for construction is also detailed in the ICP.

LF-14 was added to the Luke AFB ICP to facilitate enforcement of ICs and incorporated into the BGP. Luke AFB filed a VEMUR with ADEQ on June 15, 2000, stating that Luke AFB agrees to restrict the site to nonresidential usage.

Site inspections are required at 5-year intervals after signing of the ROD to determine the adequacy of surface controls and current land use.

4.2.5 LF-25: Northwest Landfill

The selected remedy for LF-25 was excavation of contaminated soils, ex situ mechanical treatment of contaminated soils, on-site disposal of treated soils, and ICs. Surficial soils were removed from an area 375 feet square that is adjacent to the skeet range. Excavated soil was fed into a metals recovery unit, where about 2,800 pound of lead shot was removed. Confirmation sampling was conducted of remaining soil and lead and antimony levels were below the Arizona Soil Remediation Levels (SRLs). Treated soils were returned to the excavated area, and the site was restored to grade.

ICs were established to restrict future development of the site. ICs were implemented by revising the BGP in January 2000 to reflect that land use restrictions had been placed on the site. The BGP serves as the primary mechanism that ensures the institutional and engineering controls are established and maintained. The BGP's constraints against residential development are enforced through procedures already in place at Luke AFB. An AF Form 332 must be submitted before beginning any building project at the Base. The final approval of any building project resides with the Base Chief of Operations, who is required to review the BGP and sign all AF Form 332s. In compliance with the restrictions of the BGP, the Chief of Operations for Luke AFB will not approve any AF Form that plans for the residential development of the site. The BGP is reviewed and updated annually as needed. The process for obtaining a permit for construction is also detailed in the ICP.

Another IC in place as part of the remedy at LF-25 is the use of PPE during all future excavation activities at the site. All dig permits issued for the site must include a provision for the use of PPE. The Chief of Environmental Engineering must ensure that PPE is used during any future excavation work at the site.

LF-25 was added to the Luke AFB ICP to facilitate enforcement of ICs and incorporated into the BGP. Luke AFB filed a VEMUR with ADEQ on June 15, 2000 stating that Luke AFB agrees to restrict the site to nonresidential usage.

4.2.6 RW-02: Wastewater Treatment Annex Landfill

The selected remedy for RW-02 was ICs to prevent exposure to low-level radioactive wastes buried at the site, and monitoring to assure that the integrity of the concrete burial vault has not been compromised and that groundwater has not been impacted. In November 2000, the Long Term Radiological Monitoring Plan was developed, detailing the procedures and schedule for conducting downhole radiological monitoring. The monitoring program consists of using portable field instrumentation to monitor gamma ray concentrations at four monitoring points and one background location that were installed at the site. The action level was established at twice background. Downhole radiological monitoring is conducted annually and monitoring must be conducted for 30 years.

4.2.6.1 Institutional Controls

Several ICs were implemented and are maintained at RW-02. The site is within the confines of the former Defense Reutilization Marketing Office maintenance yard and is fenced. A second fence was emplaced immediately around the site area and this fence carries a placard that identifies it as a radiological waste site. The fencing and placard are inspected during the annual monitoring events. The photo below illustrates the fence and placarding documented during the 2006 annual monitoring event.

Fence surrounding the permanent concrete monument, placarding, and protective tires at RW-02.

RW-02 was added to the Luke AFB ICP to facilitate enforcement of ICs and incorporated into BGP. Luke AFB filed a VEMUR with ADEQ on June 15, 2000 stating that Luke AFB agrees to restrict the site to nonresidential usage. The BGP serves as the primary mechanism that ensures the institutional and engineering controls are established and maintained. The BGP's constraints against residential development are enforced through procedures already in place at Luke AFB. An AF Form 332 must be submitted before beginning any building project at the Base. The final approval of any building project resides with the Chief of Operations, who is required to review the BGP and sign all AF Form 332s. In compliance with the restrictions of the BGP, the Chief of Operations for Luke AFB will not approve any AF Form 332 that plans for the residential development of the site. The BGP is reviewed and updated annually as needed. The process for obtaining a permit for construction is also detailed in the ICP.

4.2.6.2 Monitoring Program

From 2000 through 2005, a Ludlum Measurements Inc. Model 2221 analyzer was used in combination with a Model 44-10 scintillator probe to record radiation levels. In 2006, a Model 44-20 scintillator probe was used instead of the 44-10 scintillator probe. The 44-20 scintillator probe produces counts per minute (cpm) readings that are three times higher than the Model 44-10 scintillator probe because the surface area is three times greater than the surface area of the 44-10 probe.

The readings obtained from the monitoring locations have never exceeded an action level and were comparable to background levels. The list below provides additional details pertaining to each sampling event.

- 2000 – Readings ranged from 10,546 cpm to 20,695 cpm
- 2001 – Readings ranged from 10,310 cpm to 20,434 cpm
- 2002 – Readings ranged from 8,480 cpm to 16,886 cpm
- 2003 – Readings ranged from 9,124 cpm to 17,570 cpm
- 2004 – Readings ranged from 9,742 cpm to 20,221 cpm
- 2005 – Readings ranged from 9,537 cpm to 19,357 cpm
- 2006 – Readings ranged from 25,869 cpm to 53,302 cpm

The readings collected from 2000 to 2006 are summarized in Tables 4.2 through 4.6. Figures 4.1 through 4.5 graphically display these readings. The readings were normalized by multiplying the 2000 through 2005 readings by three.

Groundwater samples are scheduled to be collected every five years at this site.

4.2.7 SD-38: Oil/Water Separator at Auto Body Shop

The selected remedy for SD-38 was ICs, based on the determination made in the risk assessment that impacted soils remain in place and posed no exposure threat based on current land use scenarios. The remedy was implemented by revising the BGP in January 2000 to reflect that land use restrictions had been placed on the site. The BGP serves as the primary mechanism that ensures the institutional and engineering controls are established and maintained. The BGP's constraints against residential development are enforced through procedures already in place at Luke AFB. An AF Form 332 must be submitted before beginning any building project at the Base. The final approval of any building project resides with the Base Chief of Operations, who is required to review the BGP and sign all AF Form 332s. In compliance with the restrictions of the BGP, the Chief of Operations for Luke AFB will not approve any AF Form that plans for the residential development of the site. The BGP is reviewed and updated annually as needed. The process for obtaining a permit for construction is also detailed in the ICP.

SD-38 was added to the Luke AFB ICP to facilitate enforcement of ICs and incorporated into the BGP. Luke AFB filed a VEMUR with ADEQ on June 15, 2000 stating that Luke AFB agrees to restrict the site to nonresidential usage.

Site inspections are required at 5-year intervals after signing of the ROD to determine the adequacy of ICs and current land use.

4.2.8 SS-42: Bulk Fuels Storage Area

The selected remedy for SS-42 was the installation and operation of an SVE system to remediate the contaminated soil source, then monitoring the groundwater to confirm the effectiveness of the SVE system and groundwater quality. In May 1995, Luke AFB initiated an interim removal action to reduce the contaminant mass and concentrations of contaminants in subsurface soils. A pilot-scale study was conducted to determine the effectiveness of SVE in remediating the contaminated soil source. Based on the results of the pilot study, operation of the full scale SVE system commenced in August of 1996. The extracted vapors were treated by using them to fuel a modified internal combustion engine that vented the wells. The SVE system operated until November 2, 1998, when it was shut down. Soil borings were advanced to determine the effectiveness of the SVE system in reducing the contaminant mass in subsurface soils. Based on analytical results, the SVE system removed nearly 400,000 pounds

of volatile hydrocarbons from the soil. Though TPH and BTEX were still present in at-depth soil samples, levels were substantially reduced. Results of modeling indicated that residual TPH and BTEX would not impact groundwater at concentrations above Arizona WQSs. Because the SVE component of the remedy had already been conducted under a removal action before the ROD was signed in September 1999, this component of the remedy was not implemented under the ROD.

Groundwater samples are collected at 5-year intervals at SS-42 under the Luke AFB LTM program.

4.2.9 SD-20 Oil/Water Separator Canal and Earth Fissure

No remedial alternatives were developed for the SD-20 site during the FS because it was concluded from data collected during the RI that COCs at SD-20 were not present at levels high enough to cause adverse health effects under current land use scenarios. Further, the result of vadose zone transport modeling indicated that any contaminants present in site soils would not migrate to underlying groundwater. However, after the First Five-Year Review was conducted, ADEQ requested that Luke AFB sample monitoring wells MW-112S, MW-112D, and MW-113 because low levels (near the laboratory detection limit) of TCE, tetrachloroethene (PCE), and toluene had been reported during past sampling events. Based on ADEQ's request, Luke AFB samples these three SD-20 wells at every five-year review.

4.2.10 ST-18: Former Liquid Waste Storage Facility (Facility 993)

The selected remedy for ST-18 in the OU-2 ROD was specified as capping, surface controls (ICs), and groundwater monitoring. The USTs once present at the site had been removed in the early 1980s under RCRA closure activities conducted to allow construction of a new taxiway and USAF reserve maintenance building. The site was capped with a concrete runway in 1987 to satisfy part of the RCRA post-closure requirements for the site. This component of the ROD was already in place before the ROD was signed. Post-ROD actions consisted of LTM to monitoring groundwater quality. Internal land use restrictions are in place to restrict future land use.

4.2.11 DP-23: Old Surface Impoundment West of Facility 993

DP-23 was divided into the southern portion and the northern portion. The remedy for the southern portion was excavation, ex situ soil treatment via composting, on-site disposal of treated soils, then subsequent monitoring. Based on the findings of the risk assessment, the remedy for the northern portion of DP-23 was ICs.

At the southern portion of DP-23, an on-site treatment cell was constructed by emplacing berms and lining the bermed area with 40-mL HDPE liner, topped with 6 inches of native fill. In all, 625 cubic yards of soil contaminated with benzo(a)pyrene at levels above the PRG were excavated and placed in the treatment cell for composting. Baseline samples were collected for later comparison to post-treatment samples. Soils were tilled and watered daily and monitored

for temperature, oxygen, and moisture levels. After 120 days, interim samples were collected at baseline locations to determine the effectiveness of the composting: 25% remained above the PRG for benzo(a)pyrene. An optimized soil amendment mix was added to the compost and soil composting continued for an additional 60 days. Final sampling was conducted, and all samples were stated to be below the PRG for benzo(a)pyrene. The treated soils were used as fill to restore the site to its original grade and the site was hydro-seeded. The HDPE liner was disposed at a local landfill.

Internal land use restrictions are in place to restrict future land use. It is unclear what 'monitoring' is required by the ROD. No groundwater samples are required and the contaminated soils were treated and disposed on site.

4.3 SYSTEM OPERATION/OPERATION AND MAINTENANCE

There are no active remedial systems in place at any of the subject sites. Therefore, there are no associated operating costs other than routine inspections. The frequency of inspections depends on the selected remedy for the site. The inspection schedules for the OU-1 and OU-2 sites under consideration in this Five-Year Review are summarized in Table 4.7. The results of the site inspections are discussed in Section 6.

4.4 LONG-TERM GROUNDWATER MONITORING PROGRAM

The selected remedies for sites ST-18 and SS-42 require annual groundwater sampling to monitor groundwater quality in the site vicinity. Based on the recommendation of ADEQ in the First Five-Year Review, PSCs FT-07E, SD-20, and RW-02 were added to the LTM program. The results of the routine groundwater sampling conducted under the Luke AFB LTM program are discussed in Section 6.

Table 4.1
Summary of Selected Remedies
Luke AFB, Arizona

Operable Unit 1	
Site	**Summary of Selected Remedy**
DP-13: Drainage Ditch Disposal Area	ICs to prevent exposure to subsurface soil contamination and restrict land use.
FT-07E: Eastern Portion of North Fire Training Area	ICs to prevent exposure to subsurface soil contamination and restrict land use.
LF-03: Outboard Runway Landfill	ICs to prevent exposure to subsurface soil contamination and restrict land use.
LF-14: Old Salvage Yard Burial Site	ICs to prevent exposure to subsurface soil contamination and restrict land use.
LF-25: Northwest Landfill	• Excavation of contaminated surface soils • Ex situ mechanical treatment (removal of lead shot) • On-site disposal of treated soils • ICs
RW-02: Wastewater Treatment Annex Landfill	• ICs • Annual downhole radiological monitoring for a period of 30 years • Security fencing with radiation waste placarding
SD-38: Oil/Water Separator at Auto Body Shop	ICs to prevent exposure to subsurface soil contamination and restrict land use.
SS-42: Bulk Fuels Storage Area	• Soil vapor extraction to mitigate contaminated soil source • LTM to monitor groundwater quality
Operable Unit 2	
DP-23: Old Surface Impoundment West of Facility 993	DP-23 was divided into the southern portion and the northern portion. The remedy for the southern portion was: • Excavation • Ex situ soil treatment via composting • On-site disposal of treated soils • Monitoring The remedy for the northern portion of DP-23 was ICs to restrict land use.
ST-18: Former Liquid Waste Storage Facility (Facility 993)	• Capping • ICs • LTM to monitor groundwater quality

Table 4.2
Summary of BG-1 Gamma Radiation Monitoring
Luke AFB, Arizona

Depth (ft bgs)	Gamma Ray Readings (cpm)						
	5/23/2000	8/8/2001	9/10/2002	8/26/2003	7/12/2004	7/21/2005	8/21/2006
1	16,354	16,304	13,920	14,470	16,215	15,148	43,327
2	19,959	19,618	16,292	17,129	19,149	18,520	48,808
3	14,453	14,795	12,780	14,082	14,849	14,486	36,339
4	14,057	13,749	12,105	12,565	13,968	13,375	36,257
5	14,844	14,056	12,488	13,001	14,268	13,625	34,703
6	13,444	13,030	11,771	12,664	13,377	13,105	33,713
7	13,393	13,219	11,458	12,273	13,223	12,793	33,672
8	12,859	12,492	10,759	11,552	12,473	12,186	33,321
9	12,980	13,085	11,334	11,924	13,035	12,436	32,921
10	12,549	12,070	10,656	11,141	12,208	11,864	31,727
11	12,762	12,177	10,714	11,398	12,319	12,049	31,558
12	11,647	11,558	10,298	10,825	11,474	11,131	30,982
13	12,920	12,115	11,340	11,493	12,759	12,170	32,889
14	13,915	13,049	11,871	12,605	13,242	12,610	32,674
15	13,807	12,920	11,628	12,408	13,765	12,823	34,014
16	14,343	13,536	12,425	12,895	14,141	13,585	34,777
17	15,300	14,823	13,297	13,825	15,328	14,533	37,543
18	15,495	14,459	13,350	14,359	14,873	14,366	38,130
19	16,041	15,613	13,953	14,833	15,557	14,654	39,299

Notes:
- Sample results before 2006 were obtained using a Ludlum 44-10 probe instead of a 44-20 probe, which accounts for the sudden increase.

cpm counts per minute
ft bgs feet below ground surface

Table 4.3
Summary of MP-1 Gamma Radiation Monitoring
Luke AFB, Arizona

Depth (ft bgs)	Gamma Ray Readings (cpm)						
	5/23/2000	8/8/2001	9/10/2002	8/26/2003	7/12/2004	7/21/2005	8/21/2006
1	16,279	16,673	14,021	14,989	16,541	15,476	41,379
2	18,972	18,994	12,724	16,484	18,346	17,951	48,560
3	14,705	14,287	9,367	13,792	14,632	13,242	36,887
4	11,559	11,612	10,765	10,240	11,104	11,539	28,247
5	12,978	13,231	9,588	11,100	12,622	10,624	32,449
6	11,558	11,377	8,589	10,905	10,867	12,470	27,813
7	10,546	10,310	8,480	9,197	9,742	9,537	25,971
8	10,764	10,565	10,463	9,124	10,044	9,913	25,869
9	13,208	13,113	10,086	10,631	12,654	11,998	32,252
10	12,532	11,917	9,482	11,213	11,325	11,051	31,152
11	11,819	11,623	8,977	10,364	10,872	10,467	27,146
12	11,322	11,334	9,763	10,107	10,552	10,024	27,384
13	11,867	11,863	9,545	10,430	11,081	10,989	29,399
14	13,687	14,054	10,936	12,066	12,694	12,270	33,478
15	13,042	13,370	11,408	12,204	12,104	11,771	32,228
16	12,659	12,775	10,265	11,188	12,221	11,334	31,420
17	15,471	15,589	13,110	13,843	14,911	14,041	37,532
18	14,230	14,038	11,567	12,508	12,993	12,529	34,690
19	14,024	14,954	11,208	12,199	12,987	12,560	35,020

Notes:
- Sample results before 2006 were obtained using a Ludlum 44-10 probe instead of a 44-20 probe, which accounts for the sudden increase.

cpm counts per minute
ft bgs feet below ground surface

Table 4.4
Summary of MP-2 Gamma Radiation Monitoring
Luke AFB, Arizona

Depth (ft bgs)	Gamma Ray Readings (cpm)						
	5/23/2000	8/8/2001	9/10/2002	8/26/2003	7/12/2004	7/21/2005	8/21/2006
1	16,160	16,366	13,609	15,214	16,171	15,360	41,729
2	19,238	19,923	15,708	16,706	19,080	18,362	50,390
3	16,069	16,008	12,620	15,059	16,485	15,227	40,845
4	12,227	12,368	10,090	11,880	12,443	11,477	30,450
5	11,747	11,637	9,355	9,923	11,363	10,655	28,500
6	11,027	11,158	8,904	9,530	10,514	10,096	26,557
7	11,132	10,982	9,127	9,356	10,251	9,761	26,271
8	11,703	11,526	9,485	9,194	10,908	10,680	28,018
9	11,245	11,077	9,269	9,955	10,259	9,981	27,418
10	12,434	12,613	10,801	11,537	11,771	11,528	31,433
11	13,720	13,404	11,485	11,629	12,851	12,246	33,314
12	13,368	13,100	11,246	11,706	12,764	12,460	32,411
13	13,539	13,401	11,327	11,552	13,119	12,246	34,305
14	14,152	14,095	12,024	12,237	13,153	12,768	35,236
15	12,956	13,222	10,854	11,368	12,261	11,535	31,889
16	12,100	12,404	10,205	10,509	11,634	11,082	30,376
17	12,896	12,487	11,045	10,381	12,043	11,309	31,581
18	15,835	16,242	13,982	13,915	14,963	14,731	39,680
19	16,023	16,125	13,845	13,951	15,107	14,361	38,878
20	16,541	16,566	13,450	14,307	15,680	14,297	38,391

Notes:
- Sample results before 2006 were obtained using a Ludlum 44-10 probe instead of a 44-20 probe, which accounts for the sudden increase.

cpm counts per minute
ft bgs feet below ground surface

Table 4.5
Summary of MP-3 Gamma Radiation Monitoring
Luke AFB, Arizona

Depth (ft bgs)	Gamma Ray Readings (cpm)						
	5/23/2000	8/8/2001	9/10/2002	8/26/2003	7/12/2004	7/21/2005	8/21/2006
1	18,801	18,390	15,181	16,312	17,929	17,163	49,751
2	20,695	20,434	16,886	17,270	20,221	19,357	53,302
3	19,100	19,016	15,428	16,598	18,436	17,643	48,204
4	13,134	14,530	11,832	12,969	14,029	13,388	35,240
5	13,174	13,270	11,129	11,710	13,175	12,376	31,740
6	13,155	13,181	11,249	11,838	12,862	12,318	32,340
7	13,140	13,168	10,982	11,422	12,662	12,348	32,284
8	12,892	12,413	10,659	10,816	11,837	11,475	30,635
9	12,841	12,962	11,046	11,198	12,682	12,193	33,060
10	14,010	14,086	12,006	12,110	13,490	13,318	34,871
11	13,808	13,516	11,643	11,706	13,597	12,402	33,845
12	14,060	13,961	11,829	11,927	12,954	13,258	33,487
13	14,798	14,554	12,616	12,175	13,294	15,209	37,363
14	16,657	16,851	14,375	14,466	14,214	14,598	40,607
15	15,494	15,811	13,549	13,711	15,780	14,120	37,770
16	14,897	15,048	12,793	12,948	14,343	14,517	36,241
17	15,248	15,396	13,136	13,231	14,660	15,704	39,495
18	16,864	16,637	14,377	14,595	15,875	15,693	41,200
19	16,470	16,518	14,507	14,552	15,768	15,371	37,705
20	15,599	15,453	13,015	13,507	14,510	13,707	37,828

Notes:
- Sample results before 2006 were obtained using a Ludlum 44-10 probe instead of a 44-20 probe, which accounts for the sudden increase.

cpm counts per minute
ft bgs feet below ground surface

Table 4.6
Summary of MP-4 Gamma Radiation Monitoring
Luke AFB, Arizona

Depth (ft bgs)	Gamma Ray Readings (cpm)						
	5/23/2000	8/8/2001	9/10/2002	8/26/2003	7/12/2004	7/21/2005	8/21/2006
1	19,932	19,656	16,734	17,570	19,783	18,209	47,277
2	19,891	20,021	16,464	13,169	18,958	18,395	51,568
3	14,725	14,602	12,621	12,628	14,327	13,193	38,352
4	14,303	14,289	11,757	12,106	13,706	13,182	34,161
5	13,985	13,957	11,310	11,967	13,263	12,822	32,409
6	13,836	14,016	11,519	12,007	13,139	12,594	33,563
7	15,839	13,776	11,534	11,718	13,253	12,310	33,235
8	13,662	13,682	11,813	12,271	13,207	12,166	32,430
9	13,856	14,095	11,926	11,687	13,376	12,662	33,299
10	13,697	13,558	11,351	11,334	12,973	12,169	32,036
11	13,144	13,252	11,314	11,767	12,431	11,623	31,878
12	13,878	13,729	11,870	12,781	13,051	12,405	31,448
13	14,967	14,960	12,830	13,088	14,080	13,367	35,142
14	15,077	15,399	12,814	13,125	14,535	13,554	36,867
15	15,606	15,389	13,016	13,072	14,506	13,711	37,779
16	15,803	15,313	13,076	13,314	14,485	13,683	37,143
17	15,183	15,450	13,128	13,207	14,741	14,062	38,015
18	16,035	16,258	14,279	14,328	15,443	14,725	38,767
19	15,031	14,947	12,632	13,363	14,231	13,511	36,375

Notes:
- Sample results before 2006 were obtained using a Ludlum 44-10 probe instead of a 44-20 probe, which accounts for the sudden increase.

cpm counts per minute
ft bgs feet below ground surface

Table 4.7
Summary of OU-1 and OU-2 Site Inspection Requirements
Luke AFB, Arizona

Operable Unit 1	
Site	**Inspection Schedule**
DP-13: Drainage Ditch Disposal Area	At every 5-year review cycle and as needed in the event that construction/excavation is proposed in the site vicinity
FT-07E: Eastern Portion of North Fire Training Area	At every 5-year review cycle and as needed in the event that construction/excavation is proposed in the site vicinity
LF-03: Outboard Runway Landfill	At every 5-year review cycle and as needed in the event that construction/excavation is proposed in the site vicinity
LF-14: Old Salvage Yard Burial Site	At every 5-year review cycle and as needed in the event that construction/excavation is proposed in the site vicinity
LF-25: Northwest Landfill	At every 5-year review cycle and as needed in the event that construction/excavation is proposed in the site vicinity
RW-02: Wastewater Treatment Annex Landfill	At every 5-year review cycle
SD-38: Oil/Water Separator at Auto Body Shop	At every 5-year review cycle and as needed in the event that construction/excavation is proposed in the site vicinity
SS-42: Bulk Fuels Storage Area	Annually and as needed in the event that construction/excavation is proposed in the site vicinity
SD-20: Oil/Water Separator Canal and Earth Fissure	At every 5-year review cycle and as needed in the event that construction/excavation is proposed in the site vicinity
Operable Unit 2	
DP-23: Old Surface Impoundment West of Facility 993	In the event that construction/excavation is proposed in the site vicinity and at every 5-year review cycle
ST-18: Former Liquid Waste Storage Facility (Facility 993)	Annually and as needed in the event that construction/excavation is proposed in the site vicinity

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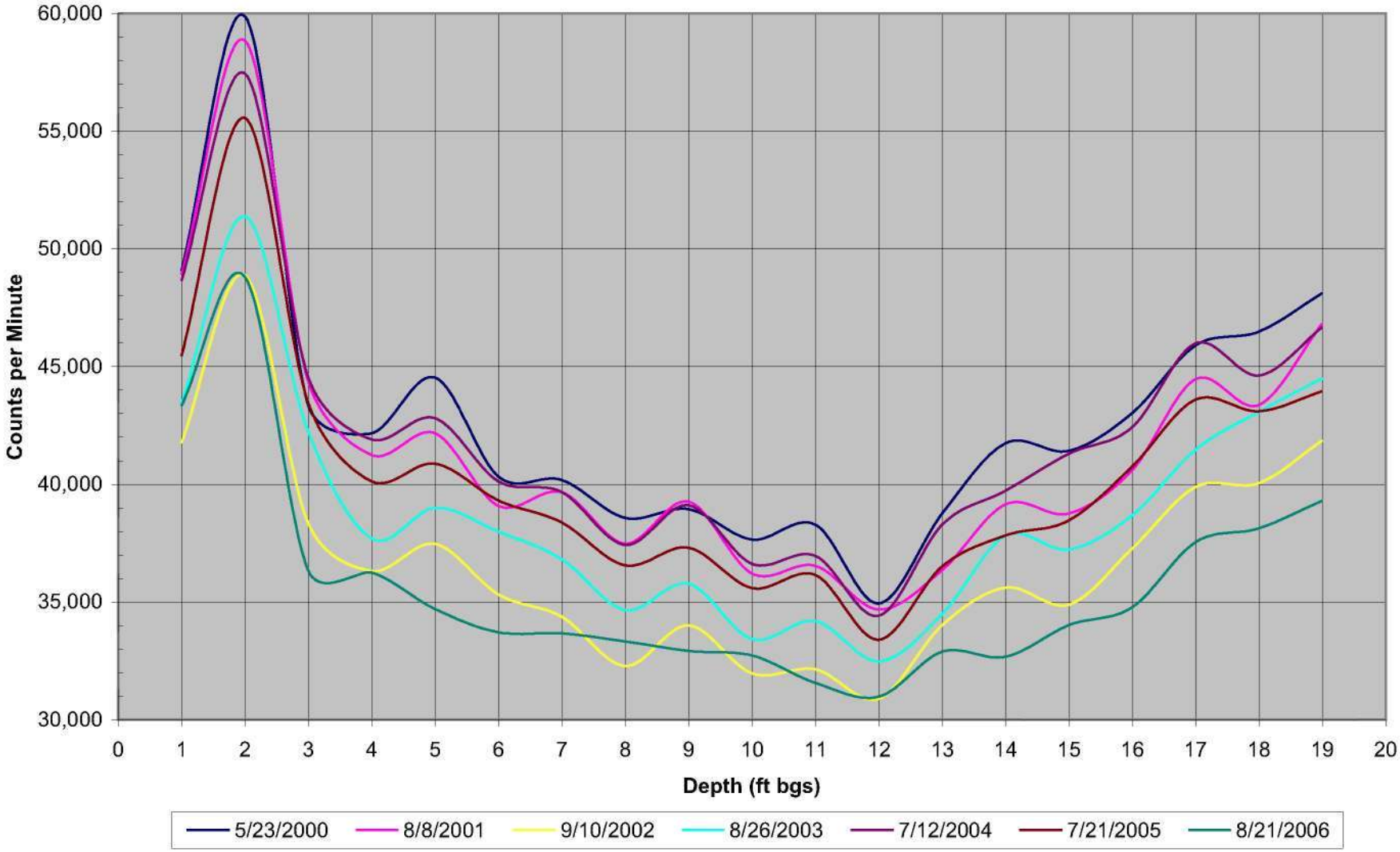
FIGURES



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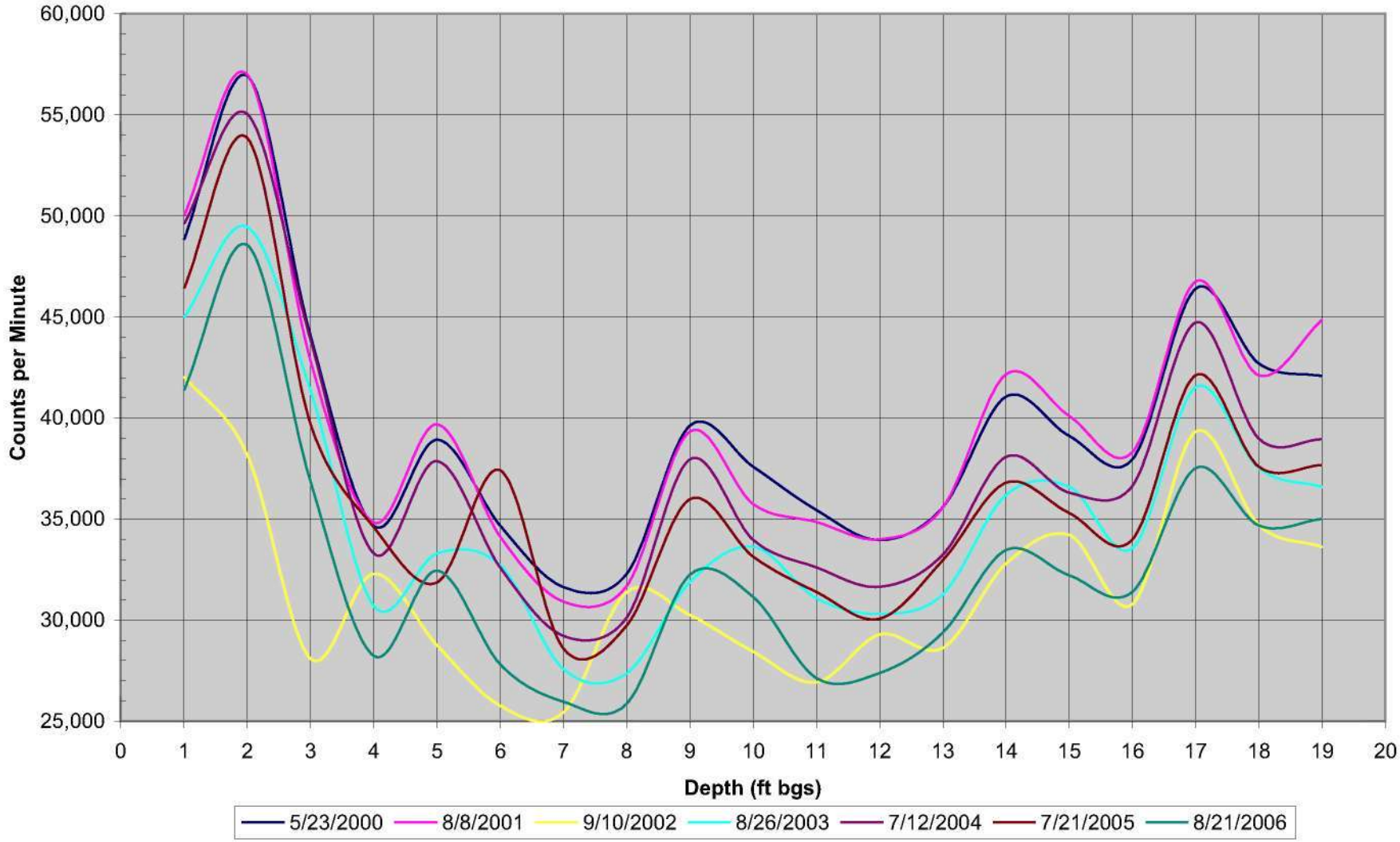
Project: AFC002-057-05-08
Revised:05/31/07 CV
Source: HGL GIS Database, 2001

HGL
HydroGeoLogic, Inc

Note: The readings collected before 2006 were normalized by multiplying them by three. The readings collected from 2000 to 2005 were collected utilizing a 44-10 scintillator probe. The 2006 readings were obtained with a 44-20 scintillator probe. The statement of work stipulated that HGL use the 44-20 scintillator probe. The Model 44-20 scintillator probe produces counts per minute (cpm) readings that are three times higher than the Model 44-10 scintillator probe. The 44-20 scintillator probe has three times the surface area that the 44-10 probe has; thus, the readings, when measuring using cpm, are three times higher.

Figure 4.1
BG-1 Gamma Radiation Trend Analysis
Second Five-Year Review



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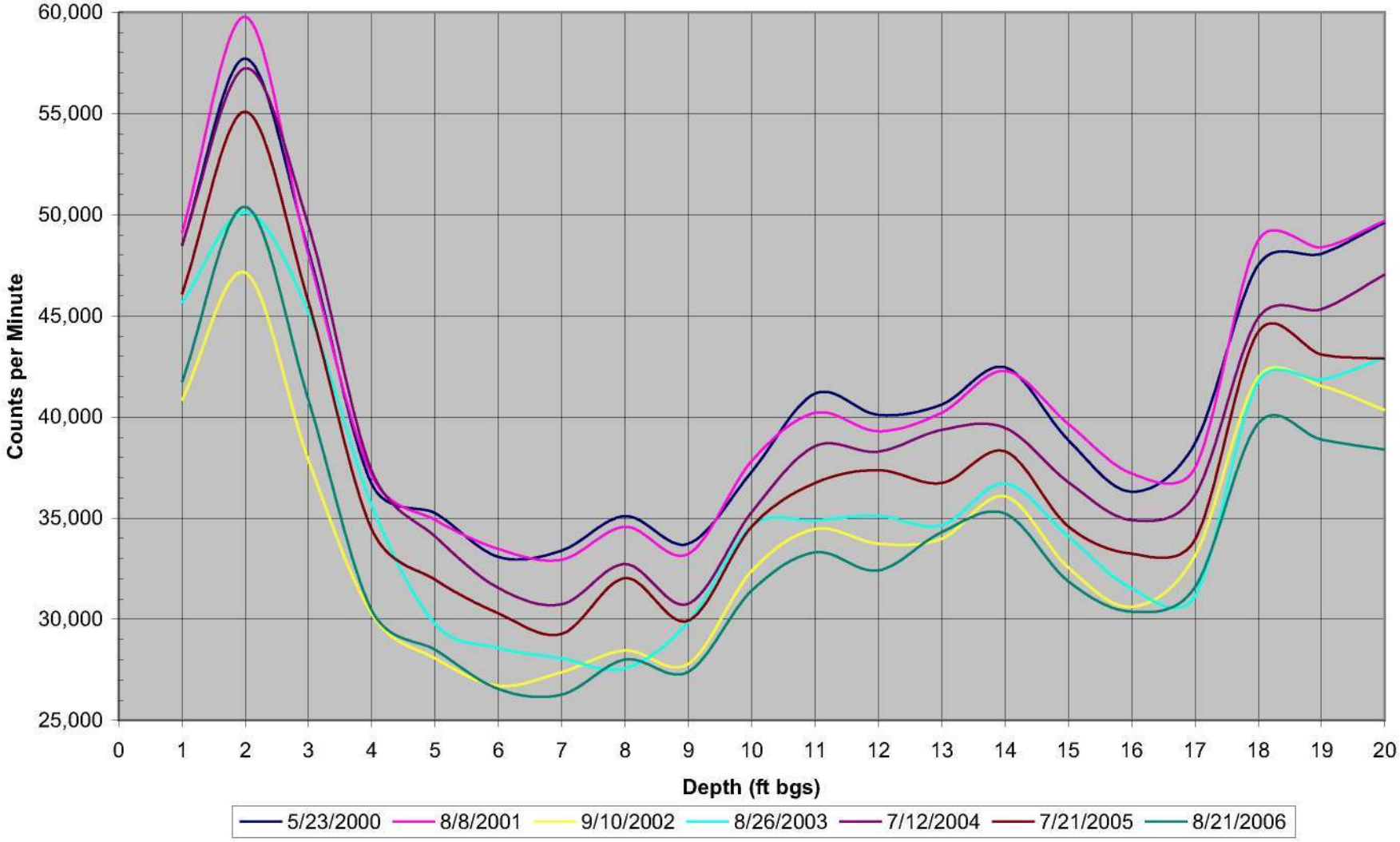
Revised:05/31/07 CV
Source: HGL GIS Database, 2001

HGL
HydroGeoLogic, Inc

Note: The readings collected before 2006 were normalized by multiplying them by three. The readings collected from 2000 to 2005 were collected utilizing a 44-10 scintillator probe. The 2006 readings were obtained with a 44-20 scintillator probe. The statement of work stipulated that HGL use the 44-20 scintillator probe. The Model 44-20 scintillator probe produces counts per minute (cpm) readings that are three times higher than the Model 44-10 scintillator probe. The 44-20 scintillator probe has three times the surface area that the 44-10 probe has; thus, the readings, when measuring using cpm, are three times higher.

Figure 4.2
MP-1 Gamma Radiation Trend Analysis
Second Five-Year Review



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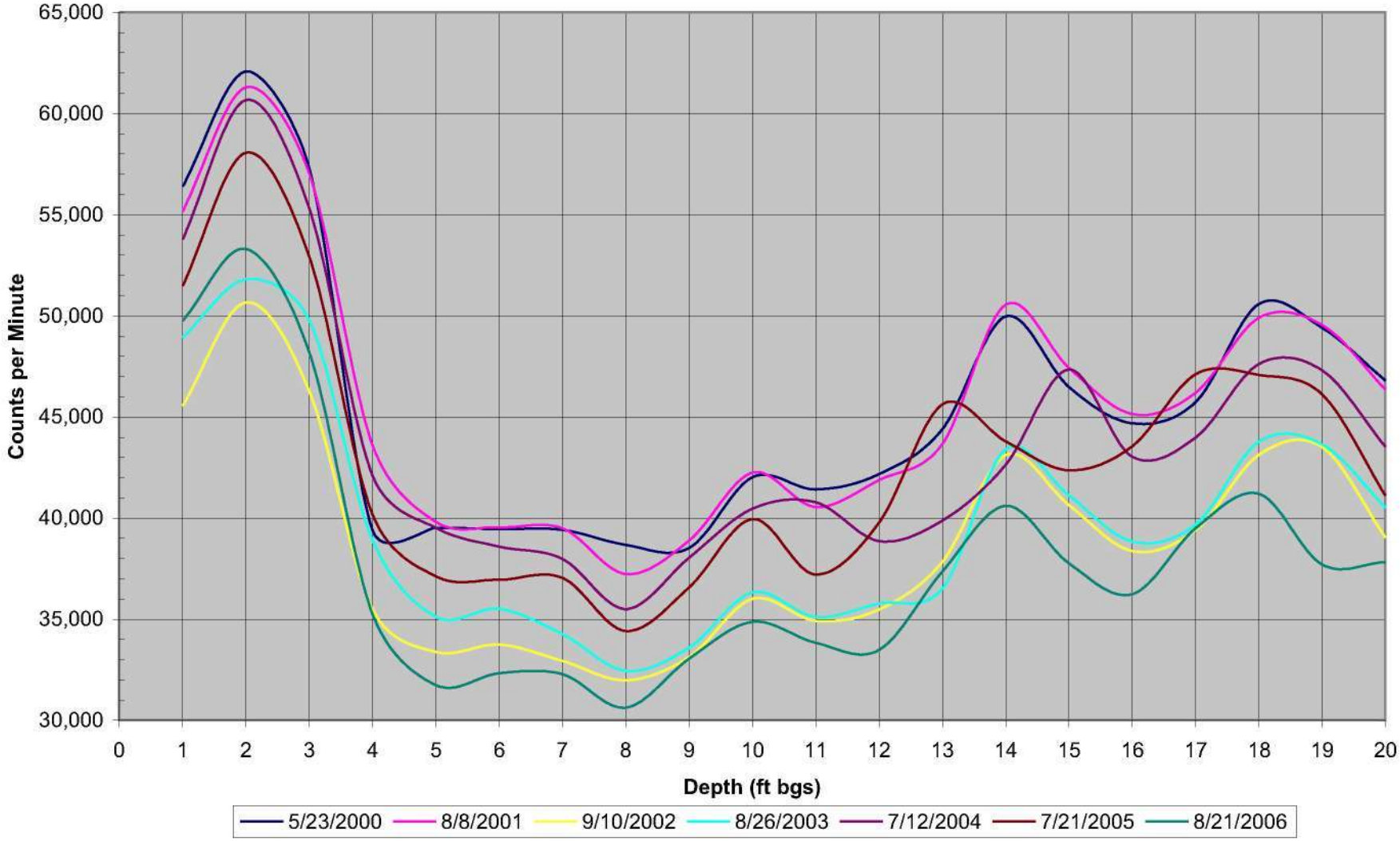
Revised:05/31/07 CV
Source: HGL GIS Database, 2001

HGL
HydroGeoLogic, Inc

Note: The readings collected before 2006 were normalized by multiplying them by three. The readings collected from 2000 to 2005 were collected utilizing a 44-10 scintillator probe. The 2006 readings were obtained with a 44-20 scintillator probe. The statement of work stipulated that HGL use the 44-20 scintillator probe. The Model 44-20 scintillator probe produces counts per minute (cpm) readings that are three times higher than the Model 44-10 scintillator probe. The 44-20 scintillator probe has three times the surface area that the 44-10 probe has; thus, the readings, when measuring using cpm, are three times higher.

Figure 4.3
MP-2 Gamma Radiation Trend Analysis
Second Five-Year Review



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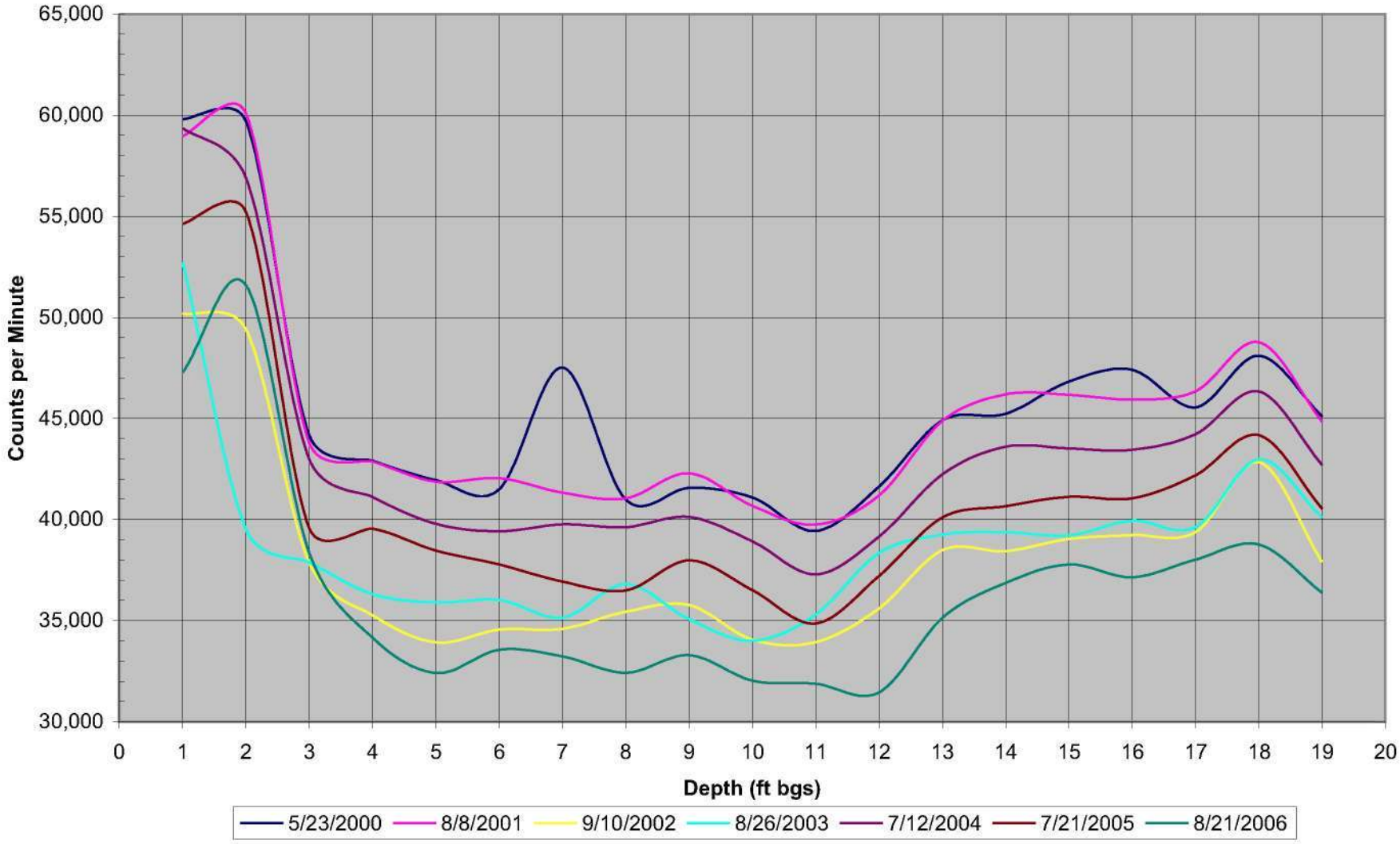
Source: HGL GIS Database, 2001

HGL HydroGeoLogic, Inc

Note: The readings collected before 2006 were normalized by multiplying them by three. The readings collected from 2000 to 2005 were collected utilizing a 44-10 scintillator probe. The 2006 readings were obtained with a 44-20 scintillator probe. The statement of work stipulated that HGL use the 44-20 scintillator probe. The Model 44-20 scintillator probe produces counts per minute (cpm) readings that are three times higher than the Model 44-10 scintillator probe. The 44-20 scintillator probe has three times the surface area that the 44-10 probe has; thus, the readings, when measuring using cpm, are three times higher.

Figure 4.4
MP-3 Gamma Radiation Trend Analysis
Second Five-Year Review



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Revised:05/31/07 CV
Source: HGL GIS Database, 2001

HGL
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Note: The readings collected before 2006 were normalized by multiplying them by three. The readings collected from 2000 to 2005 were collected utilizing a 44-10 scintillator probe. The 2006 readings were obtained with a 44-20 scintillator probe. The statement of work stipulated that HGL use the 44-20 scintillator probe. The Model 44-20 scintillator probe produces counts per minute (cpm) readings that are three times higher than the Model 44-10 scintillator probe. The 44-20 scintillator probe has three times the surface area that the 44-10 probe has; thus, the readings, when measuring using cpm, are three times higher.

Figure 4.5
MP-4 Gamma Radiation Trend Analysis
Second Five-Year Review