FINAL

HISTORICAL SITE ASSESSMENT

FOR THE FOREST GLEN ANNEX OF WALTER REED ARMY MEDICAL CENTER, SILVER SPRING, MD AND THE LEASED GILLETTE BUILDING AND TAFT BUILDING, ROCKVILLE, MD

Contract No. W912-DQ-08-D-0003, Delivery Order DA01

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Radiolological HSA
Draft Report Comments
WRAMC Forest Glen Annex

Comment Number	Page Number	Section/Figure/ Table/Appendix	Commentor-ORG	Comment	Response By	Response
1	4-3(34)	4.2.3	D. Burton-WRAMC	Rooms 7544 and 7545 are not waste storage rooms in the hospital but patient treatment rooms. Room 7A14 is a Nuclear Medicine waste room.	Cabrera	Concur. The affected text has been revised accordingly.
2	4-3 (34)	4.2.3	D. Burton-WRAMC	"Hot sinks" or "Wash sinks" are for equipment decon. Not waste disposal. All liquid waste "disposal" was performed by the HPO.	Cabrera	Concur. The affected text has been clarified.
3	5-13 (44)	5.3.2.1	D. Burton-WRAMC	The vial crusher has a HEPA filter only (no charcoal)	Cabrera	Concur. The reference to a charcoal filter has been removed.
4	5-13 (44)		D. Burton-WRAMC	The underground storage tanks were hold-up tanks to allow sampling of any water from floor drains or the pool prior to release.	Cabrera	Concur. The clarification has been made that the tanks were used for hold-up.
5	5-13 (44)	5.3.3	D. Burton-WRAMC	Building 101 contained only sealed sources which were leak tested. No leakage was ever found, why isn't this room and building Non-Impacked?	Cabrera	Concur. Building 101 has been re-classified as "Non-Impacted," and all affected text has been revised accordingly.
6	(98)	Appendix B	D. Burton-WRAMC	See comment 5, Non-Impacked, No further action.	Cabrera	See above response.
7	(107)	Appendix B	D. Burton-WRAMC	Building 188 has been demolished and the current building at the site is entirerly new. Building 188 was one floor.	Cabrera	Building 188 as discussed in the report is the building on the National Park Seminary land, shown in Figure 5-1. When the site walk-down occurred, this building was still standing, albeit in the process of renovation. Cabrera was unaware if there is any new Building 188, but historical documentation describes the former RAM usage in the old Building 188, which should be correctly depicted in the report. Building 188 is Non-Impacted.
8	(110)	Appendix B	D. Burton-WRAMC	Building 501 had only P-32 and S-35 used in it. With half-lives of less than 90 days and an elapsed time of 18 years shouldn't this building be Non-Impacked and No further action?	Cabrera	Concur. Building 501 has been re-classified as "Non-Impacted," and all affected text has been revised accordingly.

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Comment Number	**Page Number**	**Section/Figure/ Table/Appendix**	**Commentor-ORG**	**Comment**	**Response By**	**Response**
9	(300)	Pictures Building 516	D. Burton-WRAMC	The pictures of the vial crusher ventilation, generator, and Main Floor Source room are all mislabeled and are in the "equipment room"	Cabrera	Concur. The captions underneath the photographs have been revised.
10	(310)	As built drawing 516	D. Burton-WRAMC	In the main floor drawing of 516 the location #11 is in the "source room" and #10, #12 and #13 are in the equipment room. (see comment 9)	Cabrera	Concur. See above response.
1	ix	Executive Summary	W. Macon ARO	U-NAT used instead of U-238?	Cabrera	The nomenclature of U-NAT was used since it was used in inventories and historical documentation, but for clarity's sake, U-NAT has been revised to U-238 where appropriate.
2	1-1	1.2	W. Macon ARO	MARSSIM (NRC, 2000) is referenced, but not Revision 1 dated June 29, 2001 (66 FR 34727)?	Cabrera	According to NRC, Revision 1 of MARSSIM still is the version released in August, 2000. The updates published in 66 FR 34727 from June 29, 2001, were very minor and mostly editorial in nature, and thus did not result in a full re-release of the guide under a new revision. Previous editorial updates to MARSSIM were published in 65 FR 62531 from October 18, 2000, but these also did not result in a full re-release of the document under new revision number. Similarly, the most recent updates to MARSSIM were actually made in August 2002, but again, no formal document re-release occurred. NRC, 2000 remains how MARSSIM is referenced in-text, but a note has been made in the MARSSIM listing in the Reference Section (Section 8.0) that updates occurred in October 2000, June 2001, and August 2002.
3	5-11	5.3.2.1	W. Macon ARO	Typo, ARL Staff requested that the ARO *issue* a permit...	Cabrera	Concur. The affected text has been revised accordingly.

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Comment Number	**Page Number**	**Section/Figure/ Table/Appendix**	**Commentor-ORG**	**Comment**	**Response By**	**Response**
4	5-12	5.3.2.1	W. Macon ARO	DORF was (not fully) decommissioned in 1978? Discussion addresses the NRC decommission regulation in 1980. Also, some discussion of the earlier 100 mrem/yr criterion and how the DORF DP satisfied that criterion (did it?) could be included in the discussion. Except for continued use for radioactive waste operations under NRC License No. 08-01738-02, did the DP satisfy all other regulatory requirements for decommissioning at the time? More historical perspective here would be helpful.	Cabrera	The decommissioning effort was started in 1978, but the facility was not deemed in compliance until 1980 (being subject to regulations of that time); thus, the reason for discussion of 1980 regulations. The limits used for this effort were from RG 1.86, and were not dose based, as they are currently. The limits discussed in Table 5-3 of the HSA (modified from Table 2 of the Rockwell report) were developed by Rockwell based on the principles of ALARA, but were not based on any particular regulatory criteria. The criterion of 100 mrem/yr was apparently not used during this effort. The Rockwell report says that "limits were also met in all areas except for the exposure room where, due to room geometry and the accumulative properties of activation products, the activity ranged from 0.08 – 0.24 mrad/hr. The overall average was slightly higher than 0.1 mrad/hr. Individual pieces of concrete from the higher activity areas, when removed from the exposure room, indicated levels below 0.1 mrad/hr." These activity levels were deemed acceptable by the contracting officer's representative and by the USAEHA radiation surve satisfy all other regulatory requirements at the time, but even then it was agreed that levels in the exposure room were still high. If the overall average was 0.1 mrad/hr in the exposure room, at the time of decommissioning, that would equate to well above 100 mrem/yr, and also explaining why current dose rates are observed to be upwards of 70 mrem/yr (given the number of decay periods since then).
5	7-7	7.3	W. Macon ARO	Again, more historical perspective of the previous decommissioning effort would be helpful. Current dose is 57-70 mrem/yr, after 30 years? That's roughly 3 decay periods taking average of Co-60 (5.2 yr), Eu-152 (13.5 yr) and Eu-154 (8.6 yr). Was 1978 dose about 171-210 mrem/yr or more? This would have greatly exceeded the 100 mrem/yr criterion at the time. If true, then the decay-in-place option may require another 2-3 decay periods, about 20-30 more years, to get below 25 mrem/yr and could be mentioned. Ditto for Bldg 516 Factsheet with same discussion.	Cabrera	See above response.

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Comment Number	**Page Number**	**Section/Figure/ Table/Appendix**	**Commentor-ORG**	**Comment**	**Response By**	**Response**
				It occurred to me that my math was probably off regarding decay periods, that factors of 4 and 8 should have been used instead of 2 and 3. Regardless, my point was to highlight what the previous higher dose rates were in 1978 and what the expected timeframe would be for the current dose rates to decay below the 25 mrem/yr threshold for unrestricted use. USACE/Cabrera should provide some more discussion about this to put things into proper perspective. When Mike Borisky told me that DORF was decommissioned in 1978, I took that to mean it was actually decommissioned and satisfied the 100 mrem/yr criterion at the time. I now question this. I mean, if dose rates were below 100 in 1978 then they should be well below 25 now, but they aren't. So I'm confused, and any historical discussion about decommissioning efforts in 1978 should clarify what exactly happened. I understand dose rates and measuring techniques have changed. The 1978 criterion should be compared to the current criterion, and then the previous results compared with current data. If I'm confused,	Cabrera	See above response.
1	General		Barbour-USACE HP	Include reference to and evaluation with respect to AMC Decomm Guidance (05Apr2004).	Cabrera	Concur. Reference to the AMC, 2004 guidance has been added and discussion has been added where appropriate (i.e. Building 101).

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Comment Number	**Page Number**	**Section/Figure/ Table/Appendix**	**Commentor-ORG**	**Comment**	**Response By**	**Response**
2	General		Barbour-USACE HP	Need to be consistent as to whether cutoff for halflives is 6 months or 1 year. Also, if 1 year, then need to be make description that most recent decay period was 7-10 years and that currently used radionuclides of all halflives are still included.	Cabrera	Concur. Text has been revised to state, "Of all radionuclides discovered to have been used at the WRAMC Forest Glen Annex and leased facilities in Rockville, MD, generally only radionuclides with half-lives greater than 1 year were retained as Radiological Contaminants of Potential Concern (RCOPCs). Using 1 year as a half-life cut-off for which radionuclides would be considered RCOPCs, it was assumed that if at least 7 10 years had passed since RAM usage, the radionuclide would be decayed to negligible levels, and thus not pose a concern. Short-lived radionuclides were only retained if documentation showed usage in an active laboratory or storage area (i.e. currently used/stored radionuclides are noted and included)."
3	General		Barbour-USACE HP	Be sure to include any missing sources for information, including: -ARL -Army Reactor Committee Files -Army Chief of Engineers Office -AMC HQ (was HQ for Harry Diamond Labs) -JMC (for any new info via Joe Heart) -USATHEMA (as per Mke Borisky's note at the meeting)	Cabrera	Concur. All information sources have been included and are listed in Section 3.2.
4	General		Barbour-USACE HP	Be sure to list the following documents in the HSA as having been reviewed. If you haven't recvd any of these let me know. Note that some of these may already be listed in the HSA: -WRAIR HSA -WRAMC HSA -DORF DP -All docs listed as furnished by govt in Sec 10 of the SOW	Cabrera	Concur. Section 3.3 includes a list of key documents reviewed during this effort (all documents listed in the SOW are on this list).

Radiolological HSA Draft Report Comments WRAMC Forest Glen Annex						
Comment Number	**Page Number**	**Section/Figure/ Table/Appendix**	**Commentor-ORG**	**Comment**	**Response By**	**Response**
5	3-4	3.2.5	Barbour-USACE HP	Include specific searches	Cabrera	Concur. Section 3.2.6 includes a list of all websites consulted during this effort.
6	3-6	Figure 3-1	Barbour-USACE HP	What about "Don't Know" answers. In other words, responses are not always yes or no. This may simply be a footnote that states that yes was assumed when no info was available.	Cabrera	Concur. A footnote has been added to the table explaining that "Yes" is assumed in cases where the answer is not known.
7	4-2	4.2.1	Barbour-USACE HP	2nd sentence. Revise "issues" to "issued"	Cabrera	Concur. The affected text has been revised accordingly.
8	5-5	5.1	Barbour-USACE HP	2nd para is confusing. An FSS is needed if the area is considered to be impacted.	Cabrera	Concur. The paragraph has been revised to state, "The radionuclide list also contains sealed sources used for instrument calibrations, brachytherapy, and radiology procedures. Radionuclides present in sealed sources (on their own) will not contribute to a building/area's status as impacted, and thus will not necessitate Final Status Survey (FSS) when the source is removed, provided that leak tests are conducted and results are satisfactory. Since all sealed source leak tests at WRAMC have shown satisfactory results, no buildings/areas were considered impacted due to sealed sources, and no radionuclides present as sealed sources only were retained as RCOPCs."
9	Table 5-2		Barbour-USACE HP	In Table 5-2, include 1)impacted or non-impacted, 2) radionuclides of concern, 3)impacted/non-impacted rooms list (as possible in the available table space), 4)notes for bldgs that will have contined rad use	Cabrera	Concur. This table has been expanded as appropriate.
10	General		Barbour-USACE HP	Include discussion regarding the two buildings that are scheduled for continued rad use. Specifically, that future surveys may stilll need to be performed based on whether the new license holder (Navy?) deems that to be necessary.	Cabrera	Concur. Text has been added to the end of Sections 5.3.2.1 and 5.3.2.2 stating, "After the licenses/permits are transferred post-BRAC, the new holder may deem surveys necessary, although they will not be recommended within this current investigation."

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Comment Number	**Page Number**	**Section/Figure/ Table/Appendix**	**Commentor-ORG**	**Comment**	**Response By**	**Response**
11	5-8	5.3	Barbour-USACE HP	Revise "moot". Moot may also mean it is up for discussion, so just find a different word.	Cabrera	Concur. Text has been revised to state, "However, being that Buildings 504 and 509 have been demolished and the new WRAIR Building (Building 503) sits atop their footprints, as well as the fact that Building 149A consists of only one room that has already been appropriately closed out, it is unnecessary to narrow down potentially impacted rooms."
12	General		Barbour-USACE HP	Discuss DORF upfront in the ES and Sect 1 so that folks only looking for DORF info know where to find it.	Cabrera	Concur. A summary of the DORF discussion has been added to the ES and Section 1. A reference to Sections 5.3.2.3 And 7.3 for further information has been added in this summary as well.
13	5-13	5.3.2	Barbour-USACE HP	Revise "3 5000-gal" to "three 5000-gal"	Cabrera	Concur. The affected text has been revised accordingly.
14	5-14	5.4+	Barbour-USACE HP	Need to address whether there is a need to survey outside areas, specifically: 1)Potential Onsite burials 2)Potential landfill burials 3) Potential pathway from broken or removed sewer pipes 4) Potential pathway via demolition of a contaminated bldg. I think that the solution to this one is simply stating that the demolished have new bldgs on top of them and that the expectation was low to begin with.	Cabrera	Concur. Section 3.7.1 has been revised to clarify that no on-site disposal ever occurred, and that being that the new Building 503 has been built in the footprints of 504 and 509, the potential pathway via demolition of a contaminated building has been removed. Discussion of the potential pathway from broken or removed sewer pipes has been added (and discredited due to the close-out/removal of the hold-up tanks)
15	App B		Barbour-USACE HP	Title the CSM table in App B for when people use it independently. Also my xls version of that is corrupted. Could you guys email me a QA'd copy of that. It's probably an issue with my crappy laptop. By the way, that App B table is amazing, good work.	Cabrera	Concur. The App B table has been formatted for independent usage.

Radiolological HSA Draft Report Comments WRAMC Forest Glen Annex						
Comment Number	**Page Number**	**Section/Figure/ Table/Appendix**	**Commentor-ORG**	**Comment**	**Response By**	**Response**
16	5-20	Fig 5-5	Barbour-USACE HP	Where does sewer discharge and outdoor areas fit into this CSM figure?	Cabrera	No outdoor areas other than the water retention tank area near Building 516 (DORF) would pose a potential cause for concern. The figure has been revised to incorporate this tank area and sewer discharge into the box for Disposal and Storage Activities.
17	7-5	Table 7-1	Barbour-USACE HP	Please revisit all of the N/Ls on Table 7-1 and find some alternative approaches. This just looks terrible and leaves one thinking, OK, then what do I use?!	Cabrera	Concur. The table has been re-done to only provide values for the isotope in its primary decay mode (thus, eliminating the N/L values for alpha, being that most of these isotopes are beta emitters). Also, values from NUREG/CR-5512 have been used to supplement the table where necessary. For the few isotopes remaining where no values is listed, a note has been made to the effect of these isotopes are all very short-lived, and would likely be decayed away to negligible levels between the time they are removed and the time any scoping survey would occur.
18	General		Barbour-USACE HP	Find any references to Bldg 516 on their own and add "(DORF)". I see one ref in Table 7-2 that needs it, not sure if there are others.	Cabrera	Concur. The affected text has been revised accordingly.
19	General		Barbour-USACE HP	Make a note that the fenceline of the DORF will be used as the demarcation	Cabrera	Concur. Text has been added to Section 7.3 stating that the fence will be used as the demarcation for what constitutes the area of investigation for the DORF complex.
20	General		Barbour-USACE HP	Verify with Dave Burton how we will approach the land down below the DORF, as per our discussions when we visited he DORF after the WRAMC site meeting. Let me know what comes out of that.	Cabrera	The land down below the DORF is not an area to be concerned with, as it was never used for anything (especially anything DORF-related). The fence was used to establish any radiologically controlled area, and this land is beyond the fenceline.
21	2-3	2.2.2	Barbour-USACE HP	Revise "northlsouth" at top of page	Cabrera	Concur. The affected text has been revised accordingly.
22	3-6	Figure 3-1	Barbour-USACE HP	May want to footnote flowchart for how to move through logic when the answer is not known (neither yes or no).	Cabrera	Concur. See response to previous comment (Barbour - Comment 6).
23	4-2	4.2.1	Barbour-USACE HP	Revise "issues to" in first section para	Cabrera	Concur. The affected text has been revised accordingly.

Radiolological HSA Draft Report Comments WRAMC Forest Glen Annex						
Comment Number	**Page Number**	**Section/Figure/ Table/Appendix**	**Commentor-ORG**	**Comment**	**Response By**	**Response**
24	5-11	5.3.2.1	Barbour-USACE HP	Revise "Staff requested that the ARO [issue?] a permit"; near bottom of page	Cabrera	Concur. The affected text has been revised accordingly.
25	App B	Table	Barbour-USACE HP	For the pdf version of the table, resort so that 149A falls into chronological order.	Cabrera	Concur. The table has been re-sorted and the pdf version now shows chronological order.
26	App B	Fact Sheet B512	Barbour-USACE HP	Attempt should be made to make the recommendations presented in the Fact sheet for Bldg 512 more definitive. That is, we should know whether more info will be available by the time the HSA goes final.	Cabrera	Based on the available information, the recommendations presented are as definitive as possible. No new information has been discovered regarding Building 512, and thus it will be investigated as part of the next phase. Due to the fact that we know this is all the documentation we are going to see, the phrase, "If appropriate prior closure record cannot be found..." has been deleted in the App. B fact sheet and in-text. As this comment applies to Building 511 and the Gillette Building as well, the same edits have been made in-text and in their respective fact sheets.
27	General		Barbour-USACE HP	Bldg 501 has all short lived radionuclides and so may not need to be considered impacted.	Cabrera	Concur. Building 501 has been re-classified as "Non-Impacted," and all affected text has been revised accordingly. See response to Burton - Comment 8.
28	General		Barbour-USACE HP	For each bldg that had close-out documentation available and is being deemed non-impacted on the basis of that documentation, it would be good to have a description included in the text and/or fact sheets that indicates that the documentation was evaluated with respect to MARSSIM release and/or AMC commodity decom guidance (whichever is appropriate) release. The statement should provide evidence that the survey methods and data were reviewed and are sufficient to meet current day established methods; this would include criteria such as ensuring direct and transferrable activity measurements were performed and were of adequate quantity and quality.	Cabrera	Per Dave Burton, the WRAMC HPO room/building close-out surveys are performed with a rigor more strict than both MARSSIM and AMC guidance. Discussion has been added in Sections 5.3.1 and 3.2.1 to explain how the WRAMC HPO close-outs compare to MARSSIM and AMC guidance, and why the HPO close-outs can be used to prove acceptability for release.

Radiolological HSA Draft Report Comments WRAMC Forest Glen Annex						
Comment Number	**Page Number**	**Section/Figure/ Table/Appendix**	**Commentor-ORG**	**Comment**	**Response By**	**Response**
29	General		USACE	It was requested during the project review meeting on 5 November that Cabrera summarize any significant edits made to the report not directly arising from comments listed in this matrix.	Cabrera	Concur. No major text edits have been made to the body of the report that were not prompted by comments as listed above. A marked up MS Word file has been distributed to the group with the track changes feature enabled. Cabrera received a package of documentation from Mr. Burton during the 5 November meeting. This package contained further building construction data that Mr. Burton had requested from DPW as well as several as-built/renovation drawings for various buildings - this information has been incorporated into the building fact sheets, as well as added to the reference library. None of this new information is significant enough to change any findings or recommendations; however, it has allowed for several unknowns to be filled in on the building fact sheets. The only changes that have been made based on this new information is that building areas have been edited to be consistent with what DPW has on record, which takes into account buildings with more than one floor (building area values as presented in the draft report were based on aerial photographic analysis). A summary of the changes: *Building 101* : Value in Draft HSA = 68032 sq. ft. - New Value based on DPW records = 224983 sq. ft. (this new value incorporates all additions - but since building is non-impacted, it is irrelevant) *Building 149A* : Value in Draft HSA = 2990 sq. ft. - New Value based on DPW records = 800 sq. ft. (even though this is a significant change, it is irrelevant due to building being non-impacted) *Building 188* : Value in Draft HSA = 9874 sq. ft. - New Value based on DPW records = 2685 sq. ft. (even though this is a significant change, it is irrelevant due to building being non-impacted) Building 500: Value in Draft HSA = 21962 sq. ft. - New Value based on DPW records = 20806 sq. ft. (not a significant change, not an impacted building) Building 501: Value in Draft HSA = 17945 sq. ft. - New Value based on DPW records = 15305 sq. ft. (not a significant change, not an impacted building) Building 506: Value in Draft HSA = 3654 sq. ft. - New Value based on DPW records = 3403 sq. ft. (not a significant change, not an impacted building) Building 508: Value in Draft HSA = 10045 sq. ft. - New Value based on DPW records = 8593 sq. ft. (not a significant change, not an impacted building) Building 511: Value in Draft HSA = 36343 sq. ft. - New Value based on DPW records = 58488 sq. ft. (even though this is a significant change and the building is impacted, the area is unlimited for a Class 3 building, so changing the area does not change any findings or recommendations Building 512: Value in Draft HSA = 9555 sq. ft. - New Value based on DPW records = 9885 sq. ft. (although this is an impacted building, this is not a significant change)

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APPENDICES

Appendix A HSA Work Plan

Appendix B CSM Chart, Building Fact Sheets, Photographs, and Floor Plans

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ACRONYMS AND ABBREVIATIONS

ADAMS	Agency-wide Documents Access and Management System
AEC	U.S. Atomic Energy Commission
AFIP	Armed Forces Institute of Pathology
ALARA	as low as reasonably achievable
AMC	Army Materiel Command
AR	Army Regulation
ARA	Army Radiation Authorization
ARL	U.S. Army Research Laboratory
ARC	U.S. Army Reactor Council
ARCHS	U.S. Army Reactor Committee for Health and Safety
ARO	U.S. Army Reactor Office
BRAC	Base Realignment and Closure
CABRERA	Cabrera Services, Inc.
CENAB	U.S. Army Corps of Engineers, Baltimore District
CFR	Code of Federal Regulations
cm^2	square centimeter
CSM	Conceptual Site Model
DC	Washington, D.C.
DCGL	Derived Concentration Guideline Level
DLA	Defense Logistics Agency
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DORF	Diamond Ordnance Radiation Facility
dpm	disintegrations per minute
DPW	Directorate of Public Works and Transportation
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
ERDA	U.S. Energy Research and Development Administration
F	degrees Fahrenheit
FOIA	Freedom of Information Act
FSS	Final Status Survey
g	gram
HECSA	Humphries Engineering Center Support Activity
HDL	Harry Diamond Laboratories
hr	hour
HPO	Health Physics Office
HSA	Historical Site Assessment
JMC	U.S. Army Joint Munitions Command
kW	kilowatt
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
mCi	milliCurie
µCi	microCurie
MD	Maryland
mph	miles per hour
mR	milliRoentgen
µR	microRoentgen
mrad	millirad
mrem	millirem
mSv	milliSievert
NOAA	National Oceanic and Atmospheric Administration

NRC	U.S. Nuclear Regulatory Commission
NUREG	U.S. Nuclear Regulatory Commission Regulation
NW	northwest
pCi	picoCurie
PDR	Public Document Room
PI	principal investigator
RAM	radioactive material
RCC	Radiation Control Committee
RCOPC	radiological contaminant of potential concern
RG	regulatory guide
RSC	Radiation Safety Committee
RSO	Radiation Safety Officer
S	south
SCRAM	super-critical reactor axe man
SE	southeast
SNM	special nuclear material
SOP	Standard Operating Procedure
SU	survey unit
TEDE	Total Effective Dose Equivalent
TRIGA	Training, Research, Isotopes, General Atomics
TLTS	Terminated License Tracking System
U.S.	United States
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Center
USAEHA	U.S. Army Environmental Hygiene Agency
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USAIDR	U.S. Army Institute of Dental Research
USANCA	U.S. Army Nuclear and Chemical Agency
USATHEMA	U.S. Army Toxic and Hazardous Materials Agency
USGS	U.S. Geological Survey
WRAIR	Walter Reed Army Institute of Research
WRAMC	Walter Reed Army Medical Center

EXECUTIVE SUMMARY

The following is a radiological historical site assessment (HSA) prepared by CABRERA Services, Inc. for the Forest Glen Annex and leased facilities in Rockville, MD of the Walter Reed Army Medical Center (WRAMC). The WRAMC Forest Glen Annex is located near the suburban community of Forest Glen in Montgomery County, Maryland, approximately 3.5 miles northwest of the WRAMC Main Post. The Forest Glen Annex is bounded by the Capital Beltway to the north, Brookeville Road to the east and Rock Creek Park to the west. The Gillette Building is located in the 270 Research Center at 1413 Research Blvd, Rockville, MD 20850 (across from Interstate-270) approximately 14 miles northwest of the WRAMC Main Post. The Taft Building is located at 13 Taft Court, Rockville, MD 20850, approximately 12 miles northwest of the WRAMC Main Post. The former Diamond Ordnance Radiation Facility (DORF) is located at Building 516 of the Forest Glen Annex.

WRAMC has been identified as one of the military installations identified as part of Base Realignment and Closure (BRAC) 2005 (Public Law 101-510 as amended). BRAC is the process by which the nation reshapes its military installations to become more efficient and effective in supporting its forces. In 2006, CABRERA prepared an HSA for the Main Post of WRAMC. This HSA is being conducted to specifically address facilities and areas within the Forest Glen Annex and leased facilities in Rockville, MD that had operations involving radioactive materials that were U.S. Nuclear Regulatory Commission (NRC) licensed, or that fall under a Department of the Army Radiation Authorization (ARA). This HSA is being conducted as part of an overall effort to ensure that WRAMC can be turned over for redevelopment or reuse as part of the BRAC process.

This HSA is being conducted to specifically address facilities and areas that had operations involving radioactive materials that were NRC-licensed, or that fall under an ARA. As such, the purpose of the HSA is to: (1) identify potential, likely, or known sources of potential radioactive contamination resulting from radioactive material use or storage; (2) identify areas as Impacted or Non-Impacted in accordance with assessment protocol as outlined in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NRC, 2000); (3) identify specific data gaps for Impacted areas; and (4) provide information useful for designing subsequent radiological characterization surveys of Impacted areas that will support unrestricted release.

Documents gathered from various sources were reviewed and evaluated to extract information on the possession and use of radioactive materials (RAM). These documents included licenses, permits, authorizations, inventory records, surveys, historical drawings, and floor plans. In addition, the HSA included a visual inspection of all buildings and areas where RAM was used or stored, as well as interviews/conversations with personnel knowledgeable of RAM handling, storage, and disposal. Based on the information review, determinations were made as to whether a building/area could be classified as “Impacted” or “Non-Impacted” by RAM.

Specific uses of RAM at the WRAMC Forest Glen Annex and leased facilities in Rockville, MD can be summarized as follows:

- Medical treatment using sealed sources in milliCurie (mCi) quantities (e.g., brachytherapy and oncology seeds),

- Health physics support using sealed sources in microCurie (μCi) quantities (e.g., calibration sources), and

- Clinical and biomedical research using unsealed μCi and mCi quantities. Of the various unsealed isotopes used in research, only long-lived radioisotopes, i.e. half-lives greater than 1 year to present any potential for residual contamination.

Harry Diamond Laboratories (HDL) formerly operated the Diamond Ordnance Radiation Facility (DORF) at Building 516 of the WRAMC Forest Glen Annex, which utilized a research reactor with associated experimental equipment. The facility was originally developed in late 1959 and began operations in September 1961. Decommissioning was performed by Rockwell International in 1977, and was completed by 1980. Upon completion of decommissioning, the building was given to Walter Reed Army Medical Center (WRAMC) for their use. Since 1988, the various rooms on the basement level have been used by the WRAMC HPO to decay short-lived hospital and research nuclides until they may be shipped offsite as purely bio-medical wastes. ARO Permit DORF-97-1, issued on 3 June, 1997 (USANCA, 1997) was opened due to residual exposure rates in the Exposure Room of the DORF. Radionuclides currently being stored include Iodine-125,-131 (I-125, I-131), Chromium-51 (Cr-51), Phosphorus-32 (P-32), Sulfur-35 (S-35), Technicium-99m (Tc-99m), among others. These wastes are stored in drums, laboratory overpack containers, i.e. 'labpacks', plastic trash bags, and boxes. Typical waste products can also contain longer-lived nuclides like Carbon-14 (C-14, T1/2 = 5700 yrs) and Tritium (H-3, T1/2 = 12.3 yrs). Further information on DORF is presented in Sections 5.3.2.3 and 7.3 of this HSA report.

Seventeen buildings/areas throughout the WRAMC Forest Glen Annex and leased facilities in Rockville, MD were investigated, and six buildings were found to be Impacted from historical use of RAM (four buildings on Forest Glen Annex and both leased buildings in Rockville, MD). Within the six buildings identified, 68 rooms or laboratories have been classified as "Impacted." No radiologically Impacted outdoor areas or release points were identified. Based on the methodologies presented, four buildings on the WRAMC Forest Glen Annex and both leased buildings in Rockville, MD have been classified as "Impacted" from historical use of RAM: Building 503, 511, 512, 516 (DORF), Gillette, and Taft.

Of all radionuclides discovered to have been used at the WRAMC Forest Glen Annex and leased facilities in Rockville, MD, generally only radionuclides with half-lives greater than 1 year were retained as Radiological Contaminants of Potential Concern (RCOPCs). Using 1 year as a half-life cut-off for which radionuclides would be considered RCOPCs, it was assumed that if at least 7-10 years had passed since RAM usage, the radionuclide would be decayed to negligible levels, and thus not pose a concern. Short-lived radionuclides were only retained if documentation showed usage in an active laboratory or storage area (i.e. currently used/stored radionuclides are noted and included).

Radionuclides considered of potential concern for future surveys include: Am-241 (americium-241), Ba-133 (barium-133), C-14 (carbon-14), Ca-45 (calcium-45), Cl-36 (chlorine-36), Co-60 (cobalt-60), Cr-51 (chromium-51), Cs-137 (cesium-137), Eu-152 (europium-152), Eu-154 (europium-154), H-3 (tritium), I-125 (iodine-125), I-129 (iodine-129), I-131 (iodine-131), Ni-63 (nickel-63), P-32 (phosphorus-32), P-33 (phosphorus-33), Pu-239 (plutonium-239), S-35 (sulfur-35), technetium-99m (Tc-99m), and U-238 (uranium-238), based on reported use and evaluation of radioactive half-life (decay). Of these radionuclides, only Ca-45, C-14, Co-60, Cs-137, H-3, I-125, I-129, I-131, P-32, P-33, Ni-63, S-35, and Tc-99m apply to non-DORF buildings and structures.

The information presented is intended to form the framework for future MARSSIM investigations at the WRAMC Forest Glen Annex and leased facilities in Rockville, MD. The findings outlined in the HSA have been applied to develop scoping survey strategies for each Impacted building with the intent of filling data gaps for future characterization or verifying that an area is Non-Impacted and may be released. Data quality objectives and recommendations for specific radiological scoping activities to support unrestricted release of Impacted areas are provided.

1.0 INTRODUCTION AND OBJECTIVES

CABRERA Services, Inc. (CABRERA) has prepared the following Historical Site Assessment (HSA) for the Forest Glen Annex of the Walter Reed Army Medical Center (WRAMC) located in Silver Spring, Maryland. The HSA also includes the two leased buildings in Rockville, Maryland, known as the Gillette Building (located in the 270 Research Center at 1413 Research Boulevard, Rockville, MD 20850) and the Taft Building (located at 13 Taft Court, Rockville, MD 20850). This work was accomplished in accordance with the U.S. Army Corps of Engineers (USACE) Statement of Work entitled *Historical Site Assessment - Environmental Audit for Forest Glen Annex of Walter Reed Army Medical Center, Washington D.C., 20 May 2008,* under the terms and conditions of Contract No. W912DQ-08-D-0003, Delivery Order DA01, dated July 2, 2008 between the USACE Baltimore District (CENAB) and CABRERA. A Final HSA Work Plan, dated August 2008, was prepared by CABRERA and is included as Appendix A to this report. The *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM; NUREG-1575 Rev. 1/EPA 402-R-97-016 Rev. 1/DOE/EH-0624, Rev. 1) was the primary guidance document for conducting this HSA.

1.1 Program Objectives

WRAMC has been identified as one of the military installations identified as part of Base Realignment and Closure (BRAC) 2005 (Public Law 101-510 as amended). BRAC is the process by which the nation reshapes its military installations to become more efficient and effective in supporting its forces. In 2006, CABRERA prepared an HSA for the Main Post of WRAMC. This HSA is being conducted to specifically address facilities and areas within the Forest Glen Annex and leased facilities in Rockville, MD that had operations involving radioactive materials that were U.S. Nuclear Regulatory Commission (NRC) licensed, or that fall under a Department of the Army Radiation Authorization (ARA).

1.2 Specific Objectives of this HSA

This HSA is being conducted as part of an overall effort to ensure that WRAMC can be turned over for redevelopment or reuse as part of the BRAC process. Specifically, this HSA is the first step in the process of releasing all buildings and areas at the WRAMC Forest Glen Annex and leased facilities in Rockville, MD for unrestricted use. Such release will be sought from NRC as appropriate for all radioactive materials (RAM) license(s). In accordance with the MARSSIM (NRC, 2000), this HSA should accomplish the following:

- Identify current known and potential sources of radiological contamination
- Determine which parts of the annex are Impacted (and Non-Impacted) by previous radiological operations
- Classify areas as Impacted or Non-Impacted as defined in MARSSIM
- Identify any data gaps in Impacted Areas

- Provide recommendations for decisions regarding potential radiological scoping and characterization surveys

1.3 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements that clarify the study objective, define the most appropriate type of data to collect, determine the most appropriate conditions for collecting data, and specify limits on decision errors. DQOs define the performance criteria that limit the probabilities of making decision errors by considering the purpose of collecting the data, defining the appropriate type of data needed, and specifying tolerable probabilities of making decision errors. Project-specific DQOs are developed using the seven-step DQO Process. The DQOs for this HSA are:

Step 1 - State the Problem

Does sufficient information exist to define the nature and extent of radioactive materials at the WRAMC Forest Glen Annex and leased facilities in Rockville, MD, and does the information support the decision that areas have or have not been impacted by radiological activities? The decision makers for this HSA are Department of the Army, specifically Joint Munitions Command (JMC), U.S. Army Nuclear and Chemical Agency (USANCA), CENAB, and WRAMC. Other stakeholders include the NRC and local communities in Washington, DC and Maryland.

Step 2 - Identify the Decision

The principal study question is: Have any buildings/areas on the WRAMC Forest Glen Annex and leased facilities in Rockville, MD been impacted by radiological activities? Potential actions include: additional investigation of radiologically impacted areas (i.e., additional review of existing data, collection of additional environmental data, or additional remediation) or release of non-impacted areas from radiological controls. Impacted areas have a possibility of containing residual radioactivity in excess of natural background (MARSSIM 2000, GL-11). Non-impacted areas have no reasonable possibility of residual radioactivity. All areas are either Impacted or Non-Impacted.

Step 3 - Identify Inputs to the Decision

Inputs to the decision are archival documents provided by the WRAMC Health Physics Office (HPO), documents provided by NRC, documents provided by the U.S. Army Center for Health Promotion and Preventative Maintenance (USACHPPM), documents provided by the Army Reactor Office (ARO) at the USANCA, and interviews with site workers. Pertinent information includes radioactive material use authorizations and inventories for various WRAMC facilities permitted to receive, store, and use radiological materials. Documentation of particular importance includes routine radiological surveys conducted by the HPO in each room where RAM is present, as well as room/building final/close-out surveys, where applicable. The WRAMC Directorate of Public Works (DPW) has also served as an additional source of pertinent documentation and information.

Step 4 - Define the Boundaries of the Study

Temporal boundaries for the study are defined by the period of use of radiological materials at the WRAMC Forest Glen Annex and leased facilities in Rockville, MD. Spatial boundaries are defined by the locations of historical radiological materials storage and use.

Step 5 - Develop a Decision Rule

If there is reasonable probability or conclusive evidence that an area was impacted (i.e., contaminated) by site activities (i.e., storage, use, disposal) at the WRAMC Forest Glen Annex and leased facilities in Rockville, MD, then the area will be considered radiologically impacted and additional investigations will be performed in that area. All other areas will be considered Non-Impacted (i.e., non-disturbed); however, additional investigations may be performed in these areas.

Step 6 - Specify Tolerable Limits on Decision Errors

Decision errors occur when an incorrect action based on the decision rules is recommended. Decision errors occur primarily as a result of uncertainty in the data. Most HSA data collected are qualitative or require professional judgment to be interpreted meaningfully, which makes it difficult to assign a quantitative value for decision error rates. All available information, including historical decision errors used to define Impacted and Non-Impacted areas, have been considered to limit decision errors in the HSA.

Step 7 - Optimize the Design for Collecting Data

The WRAMC HPO provided access to their archival records, maintained in accordance with their NRC licenses and facility requirements. These records, as well as additional documents provided by various applicable sources have been reviewed and evaluated to decide if radiological activities have or have not impacted any areas. Information on impacted areas was also evaluated for completeness to identify data gaps and support development of additional investigations.

1.4 Report Organization

The WRAMC Forest Glen Annex and leased facilities in Rockville, MD HSA is organized as follows:

- Section 2.0 of the HSA provides a description of location and environmental setting, including geology, hydrogeology, surface water, meteorology, seismicity, and cultural resources.

- Section 3.0 summarizes the HSA methodology, including document review, personnel interviews, historical and current photo documentation, and site walk-downs.

- Section 4.0 summarizes the WRAMC Forest Glen Annex and leased facilities in Rockville, MD history from its initial construction/development to the present day

condition, and includes a description of activities in specific buildings/areas that could have affected their respective radiological status.

- Section 5.0 discusses the findings of this HSA, including those related to DORF in Section 5.3.2.3, discussing impacted or potentially impacted areas, non-impacted areas, and regulatory issues. Appendix B contains a "Fact Sheet" summary of findings, including photographic documentation of conditions at the time of investigation, building plans, if available, and other information pertinent to each of the buildings investigated.

- Section 6.0 provides a summary of conclusions reached during the HSA.

- Section 7.0 provides a summary of recommendations for future phases of work, based on the findings of the HSA. DORF recommendations are presented in this section as well.

- Section 8.0 presents the list of references cited in the text of the HSA.

2.0 PROPERTY IDENTIFICATION

The following is a brief physical description of the subject property location and setting.

2.1 Location

The WRAMC Forest Glen Annex is located near the suburban community of Forest Glen in Montgomery County, Maryland, approximately 3.5 miles northwest of the WRAMC Main Post. The Forest Glen Annex is bounded by the Capital Beltway to the north, Brookeville Road to the east and Rock Creek Park to the west. The Gillette Building is located in the 270 Research Center at 1413 Research Blvd, Rockville, MD 20850 (across from Interstate-270) approximately 14 miles northwest of the WRAMC Main Post. The Taft Building is located at 13 Taft Court, Rockville, MD 20850, approximately 12 miles northwest of the WRAMC Main Post. Aerial photographs showing the extents of the WRAMC Forest Glen Annex and leased buildings in Rockville, MD (in relation to the WRAMC Main Post) are provided in Figure 2-1 and Figure 2-2.

2.2 Environmental Setting

The following information was primarily derived from a document entitled: Environmental Baseline Survey, Enhanced Use Lease Project, Buildings 40 & 18, July 2004 (WRAMC, 2004).

2.2.1 Climate and Meteorology

WRAMC, as well as the Forest Glen Annex and leased facilities in Rockville, MD, is geographically located on the transition zone between northern and southern climates of the U.S. Atmospheric conditions are influenced by the Appalachian Mountains and Blue Ridge Mountains to the west and the Chesapeake Bay and Atlantic Ocean to the east. The prevailing wind is from the northwest during the winter months and from the southeast in the summer. The maximum wind speed was recorded to be 80 miles per hour (mph) from the southeast. Average wind speed is 9.1 mph. The normal daily mean temperature is 55°F for this area, with recorded extremes of -7°F in the winter and 105°F in the summer. Normal annual precipitation is 40.8 inches and average annual snowfall is 20.4 inches for this area. Summers are characterized by maritime-tropical winds from the south and southwest, which bring warm, humid air to the region. Winter is characterized by cold, dry, continental-polar winds from the west and northwest.

The humid continental climate for the area allows for a large variance in weather conditions and temperatures. There is a difference of 42.8 °F from the coldest month of the year, January, to the warmest month of the year, July. The area receives an average of 39.54 inches of rain per year, with an average of 12 inches of snow per year. No wet and dry seasons exist since rainfall is well distributed throughout the year. The greatest rainfall for a 24-hour period was 7.31 inches, on August 11-12, 1928. The greatest snowfall ever recorded in the area was 28 inches, which occurred in January of 1922. The average annual relative humidity for the area is 63%.

For reference, average meteorological data for the Washington, D.C. area is also provided in Table 2-1.

TABLE 2-1: AVERAGE METEOROLOGICAL DATA - WASHINGTON, D.C. AREA

	January	February	March	April	May	June	July	August	September	October	November	December
High Temp (°F)	42	46	56	67	76	85	89	87	80	69	58	47
Low Temp (°F)	27	29	38	46	57	67	71	70	62	50	41	32
Precipitation (Inches)	3	3	3	3	4	3	4	4	3	3	3	3
Snow (Inches)	4	4	Trace	-	-	-	-	-	-	-	Trace	1
Wind Speed (mph)	10	11	11	11	10	9	9	9	9	9	10	10
Wind Direction	NW	NW	NW	S	S	S	S	S	S	S	S	NW

2.2.2 Geology

The entire WRAMC complex (Main Post, Forest Glen Annex, and leased facilities in Rockville, MD) is located at the junction of the Atlantic Coastal Plain and the Piedmont Plateau physiographic provinces. The Piedmont Plateau is comprised of granites and other crystalline rocks and is defined by greater surface relief. The Coastal Plain province consists of sands, gravels, and clays of recent deposition, which overlap the older Piedmont surface to the west.

The lithology of the region consists of a thin mantle of soils overlying a layer of saprolite, which overlies a metamorphic rock unit. Soils in the Building 500 area of the WRAMC Forest Glen Annex are members in the Manor-Channery silt loam complex, which are shallow, micaceous soils that occur in upland areas. Saprolite is a general geologic term for a soft, earthy, clay-rich thoroughly decomposed rock, formed in place by chemical weathering of igneous, sedimentary, or metamorphic rocks. Saprolite is characterized by preservation of structures that were present in the un-weathered rock. In the area of investigation, saprolite exhibits foliation characteristic of the metamorphic gneiss and schist that underlie this layer. Gneiss is a rock in which bands of granular minerals alternate with bands of micaceous minerals having a subparallel to parallel orientation. Schist is a strongly foliated metamorphic rock with well developed parallelism of more than 50 percent of the minerals present (USACHPPM, 1998).

The Forest Glen Annex is underlain by the Kensington quartz diorite. The Kensington quartz diorite was intruded into the Wissahickon schist and was subsequently metamorphosed. Little of the original igneous structure remains. The gneiss is mostly plagioclase (33.1%) and quartz (39.0%) and is strongly schistose. The uppermost portion of the unit is saprolite (weathered rock) of varying thickness. An approximately 15-mile long wedge of the Kensington quartz diorite

runs north-south, roughly parallel to Rock Creek with the Forest Glen Annex near the middle. This wedge is bounded by Wissahickon schist east and west of the installation (USACHPPM, 2000).

Figure 2-3 shows the northwest-southeast geologic cross-section of the northern Washington, DC area.

2.2.3 Topography

Montgomery County is on the eastern edge of the Piedmont physiographic province and is characterized by varied topography that ranges from lowlands to peaks and ridges of moderate altitude and relief. Rolling hills are predominant in the Forest Glen area. The land forms slope in a westerly direction toward the Rock Creek drainage system (USACHPPM, 1998).

Rivers such as the Potomac and large estuaries have drowned the submerged landscapes of the northern Coastal Plain region. Glaciofluvial outwash channels have dissected the Coastal Plain surface, creating numerous terraced regions. One such terrace, the Columbia Formation, which covers most of the area presently occupied by WRAMC, was formed as a thin veneer of stream-laid material and presently occupies the higher elevations in the area. Directly underlying the Columbia Formation are the unconsolidated deposits of the Potomac Group, which occupy the lower elevations and the exposed shoreline at WRAMC. This group of sandstone, clay and conglomerate has a thickness of 450 to 500 feet and has a slight southeasterly dip. Below the Potomac Group lies bedrock of granites and schists.

Figure 2-4 shows the topography of the Forest Glen area.

2.2.4 Soils

There are eight types of soil on the WRAMC Main Post according to the Soil Surveys for the District of Columbia. These eight soil classifications are: Chillum-Urban Complex; Glenelg Variant; Manor Loam; Manor-Urban Land Complex; Urban Land- Chillum Complex; Urban Land-Manor Complex; Udorthents; and Urban Land. The predominant soil classifications at WRAMC are Manor-Urban Land Complex, Urban Land-Chillum Complex, and Urban Land-Manor Complex. The land surface is gently sloping, with the soils being well-drained, silty, micaceous, and containing a small amount of silty alluvium. The soil ranges from 10 to 50 deep over metamorphic bedrock. The soils have been widely disturbed from construction, site grading and landscaping activities. The soil permeability is from 0.6 to 2.0 inches per hour. There are no hydric or inclusive hydric soils in this area. (USAEHA, 1976)

The three predominant soil series at Forest Glen are the Brandywine loam, Glenelg silt loam, and the Manor-Channery silt loam, each covering about 28 percent of the Forest Glen Section. The approximate remaining 16 percent is covered by Glenville silt loam and the Wehadkee silt loam (USAEHA, 1989).

Figure 2-5 shows soil types present in the Forest Glen area.

2.2.5 Hydrology

Surface water generally flows west to Rock Creek, then south. The northeast section of the installation drains to the north before flowing west to Rock Creek. Most of the streams on post are intermittent with only one at the north side of the installation had flowing water. It was about 3 to 5 feet wide and up to a foot deep (USACHPPM, 2000).

There are no water areas on-post except for open ditches and natural drainage basins which carry surface run-off to Rock Creek near the western boundary. The District of Columbia groups waters of the District into Beneficial Use Classes. Rock Creek is classified as a Class B and C stream by the District of Columbia. Class B waters are protected for secondary contact recreation and aesthetic enjoyment. Class C waters are protected for aquatic life, waterfowl, shore birds, and water-oriented wildlife.

Rock Creek is also designated as an anti-degradation segment. Under this designation, the following requirements apply: (1) new point source discharges are prohibited; (2) non-point discharges shall be controlled to the extent feasible, with best management practices and regulatory programs; (3) construction projects shall be considered on a case-by-case basis to ensure that there will be no long-term adverse water quality effects; and (4) short-term water quality effects on anti-degradation segments, resulting from construction projects, shall be subject to intergovernmental coordination and public participation requirements. The entire installation is outside the 100-year flood plain of Rock Creek.

2.2.6 Hydrogeology

The bedrock does not act as an aquifer at the WRAMC Forest Glen Annex. Groundwater may be present in fractures in the rock, but yields would not be sufficient for more than one household, Groundwater is present in the soils and saprolite at the site. Groundwater flow generally follows the surface contours and discharges to Rock Creek. The ground water is encountered in the saprolite in higher elevations and in the soils closer to surface drainage.

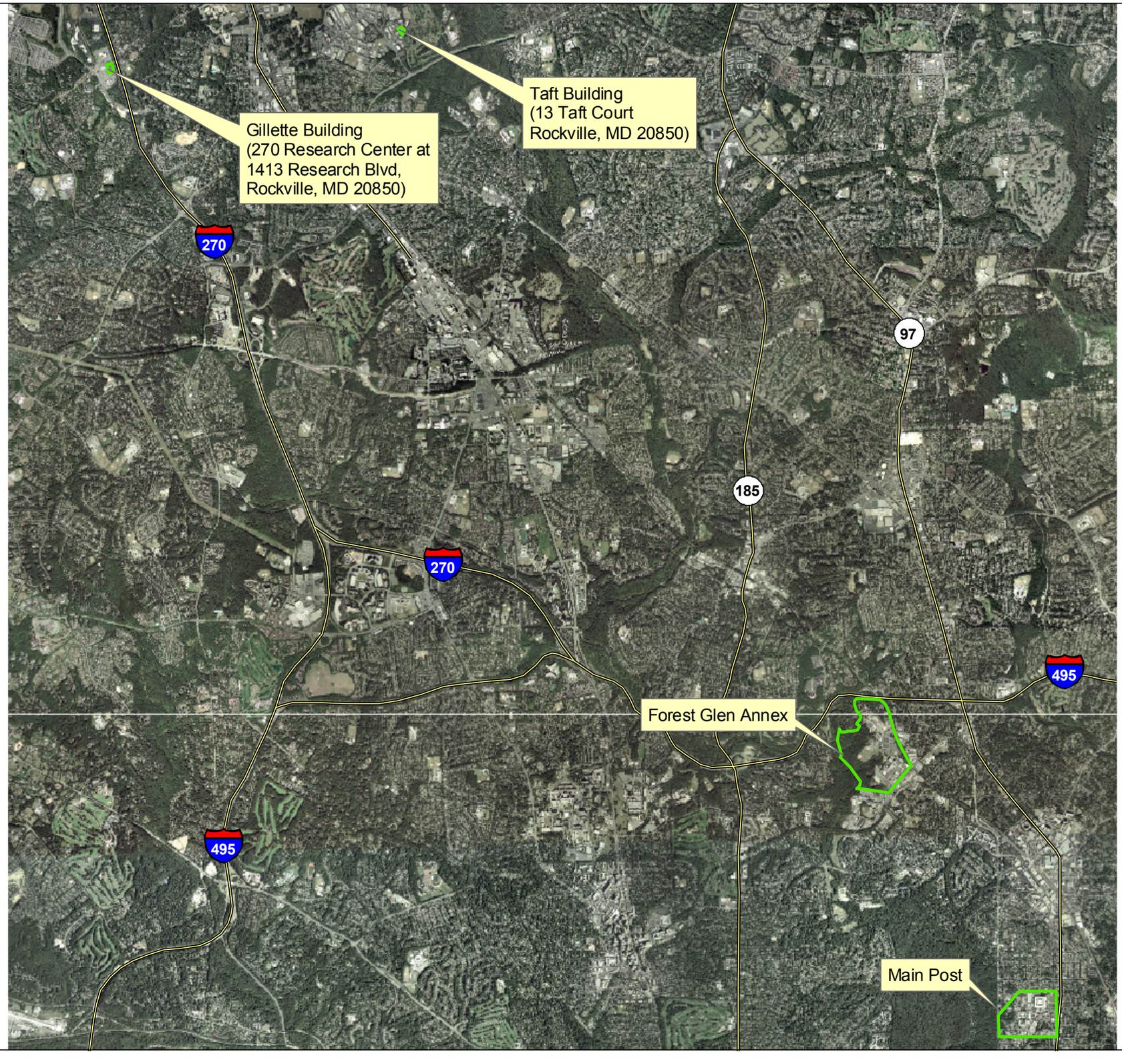
Although metamorphic bedrock in the area of investigation does not serve as an aquifer, a thick wedge of coastal sediments lies approximately 10 to 20 miles to the south and east, forming the Potomac aquifer. This aquifer underlies the North Atlantic Coastal Plain and consists of the Patuxent, Patapsco, and Magothy Aquifers in the Delaware and Maryland vicinity. A confining unit of clay and sandy clay overlies the aquifer in most of this region.

The main target for ground water is Rock Creek where most ground water in the uppermost aquifer is expected to discharge. Only four unused water wells were reported within 2 miles of the site. All overland flow eventually flows to the west into Rock Creek. Most overland flow on the Forest Glen Annex is in intermittent stream channels. A stream at the north end of the installation is perennial, Steep slopes around the stream channels prevent most flooding (USACHPPM, 2000).

Figure 2-6 shows the aquifer recharge areas of the Baltimore, MD – Washington, DC area.

2.2.7 Seismicity

The history of this area shows a low probability of an earthquake of sufficient magnitude to cause damage to structures. Only one earthquake of moderate intensity has ever been reported in the area. This incident occurred on August 31, 1861, with the epicenter located at 38.8 degrees north latitude and 77 degrees west longitude, which is approximately 12 miles south of the WRAMC Main Post. The intensity of this shock was listed as a 5 on the Rossi-Forel scale ("shock of moderate intensity…felt generally by everyone; disturbance of furniture, beds, etc., ringing of some bells"). The U.S. Geological Survey (USGS) reports that no seismic shocks have originated in the area since the above-mentioned earthquake.



REV	DATE	DESCRIPTION	BY

CABRERA SERVICES
103 E. MT ROYAL AVE.
BALTIMORE, MD 21202

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARLYAND

PREPARED BY: KJ

REVIEWED BY: MB

WALTER REED ARMY MEDICAL CENTER

FOREST GLEN ANNEX
MARYLAND

HISTORICAL SITE ASSESSMENT
WRAMC AREA OVERVIEW MAP

CONTRACT # W912DQ-08-D-0003

PROJECT # 08-3800.03

Figure 2 - 1

SCALE: 0 0.15 0.3 0.6 0.9 Miles

DATE: 8/12/2008

REV	DATE	DESCRIPTION	BY

CABRERA SERVICES
103 E. MT ROYAL AVE.
BALTIMORE, MD 21202

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARLYAND

PREPARED BY: KJ

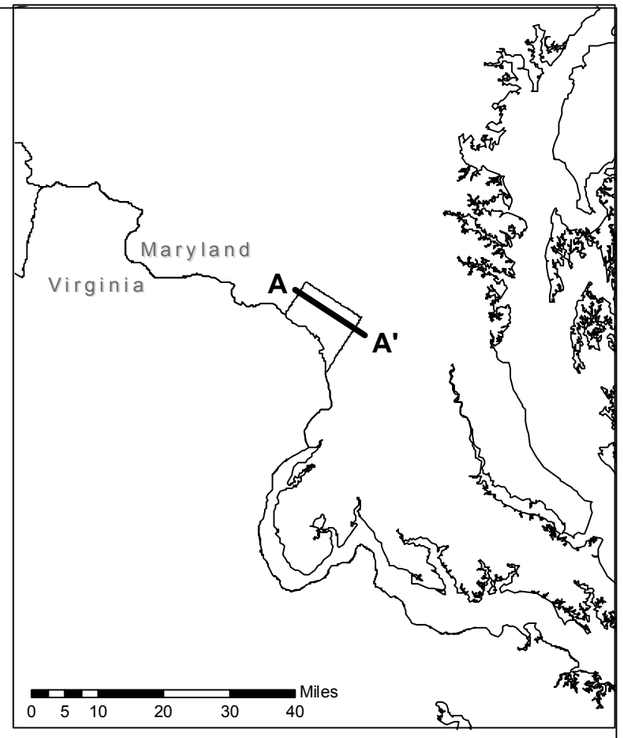
REVIEWED BY: MB

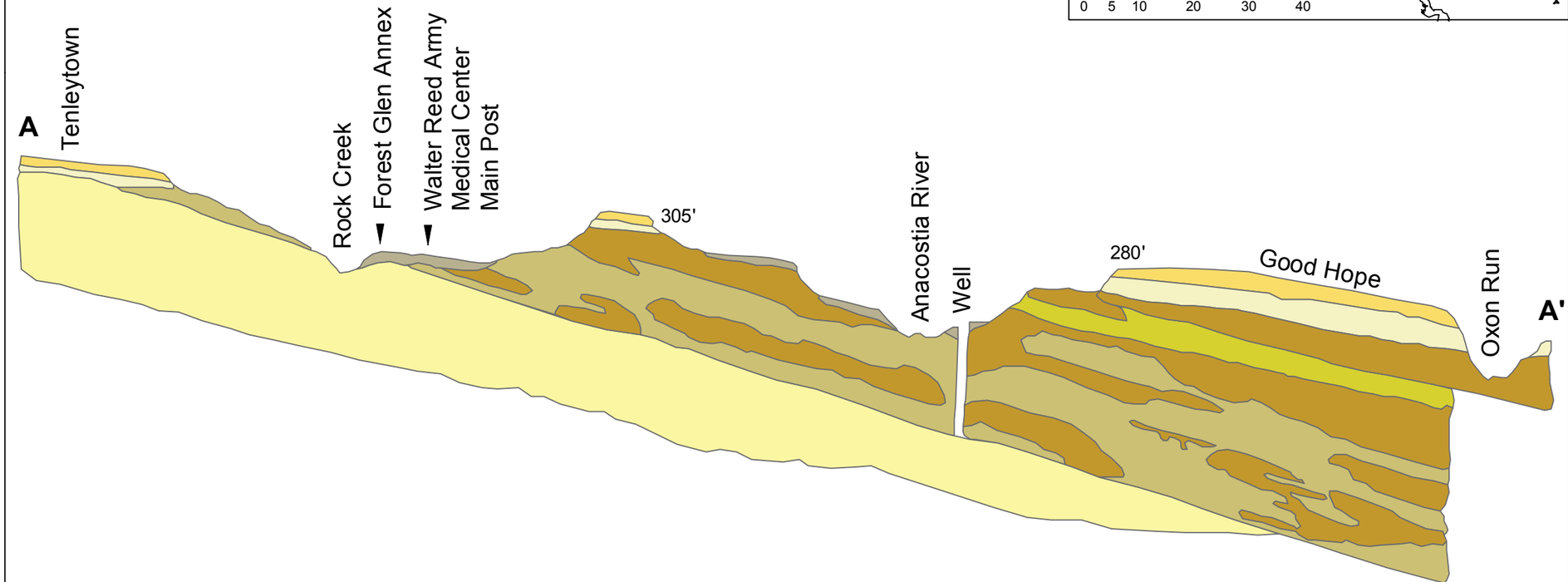
WALTER REED ARMY MEDICAL CENTER — FOREST GLEN ANNEX MARYLAND

HISTORICAL SITE ASSESSMENT MAIN POST IN RELATION TO FOREST GLEN ANNEX

CONTRACT # W912DQ-08-D-0003 | PROJECT # 08-3800.03 | **Figure 2 - 2**

SCALE: 0 0.05 0.1 0.2 0.3 Miles | DATE: 8/12/2008





Geologic Layers

- Potomac Group (Lower Cretaceous)
- Raritan Formation (Upper Cretaceous)
- Magothy Formation (Upper Cretaceous)
- Calvert Formation of Chesapeake Group (Miocene)
- Upland Gravels (Pleistocene and Pliocene)
- Terrace Deposits (Pleistocene)
- Granite and Gneiss

Source: Ground-Water Quality Study
No. 38-26-0354-90, 19 - 30 Jun 89

REV	DATE	DESCRIPTION	BY

CABRERA SERVICES
103 E. MT ROYAL AVE.
BALTIMORE, MD 21202

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARLYAND

PREPARED BY: KJ

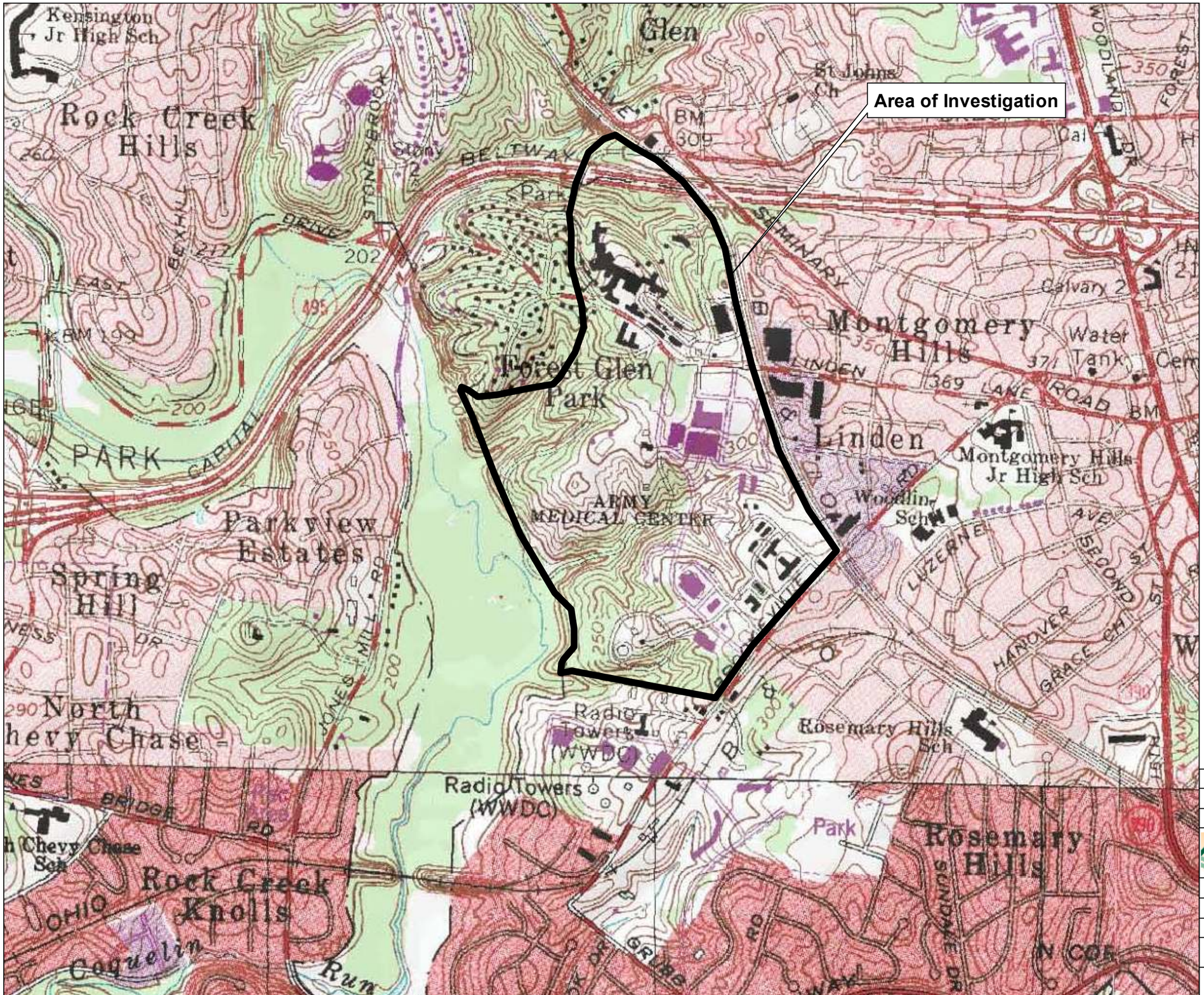
REVIEWED BY: MB

WALTER REED ARMY MEDICAL CENTER — FOREST GLEN ANNEX MARYLAND

HISTORICAL SITE ASSESSMENT
NORTHEAST TO SOUTHWEST GEOLOGIC CROSS SECTION OF WASHINGTON D.C.

CONTRACT # W912DQ-08-D-0003 | PROJECT # 08-3800.03 | **Figure 2 - 3**

SCALE: 0 55 110 220 330 Feet | DATE: 8/12/2008



REV	DATE	DESCRIPTION	BY

CABRERA SERVICES
103 E. MT ROYAL AVE.
BALTIMORE, MD 21202

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARLYAND

PREPARED BY: KJ

REVIEWED BY: MB

WALTER REED ARMY MEDICAL CENTER

FOREST GLEN ANNEX
MARYLAND

HISTORICAL SITE ASSESSMENT
FOREST GLEN
TOPOGRAPHIC MAP

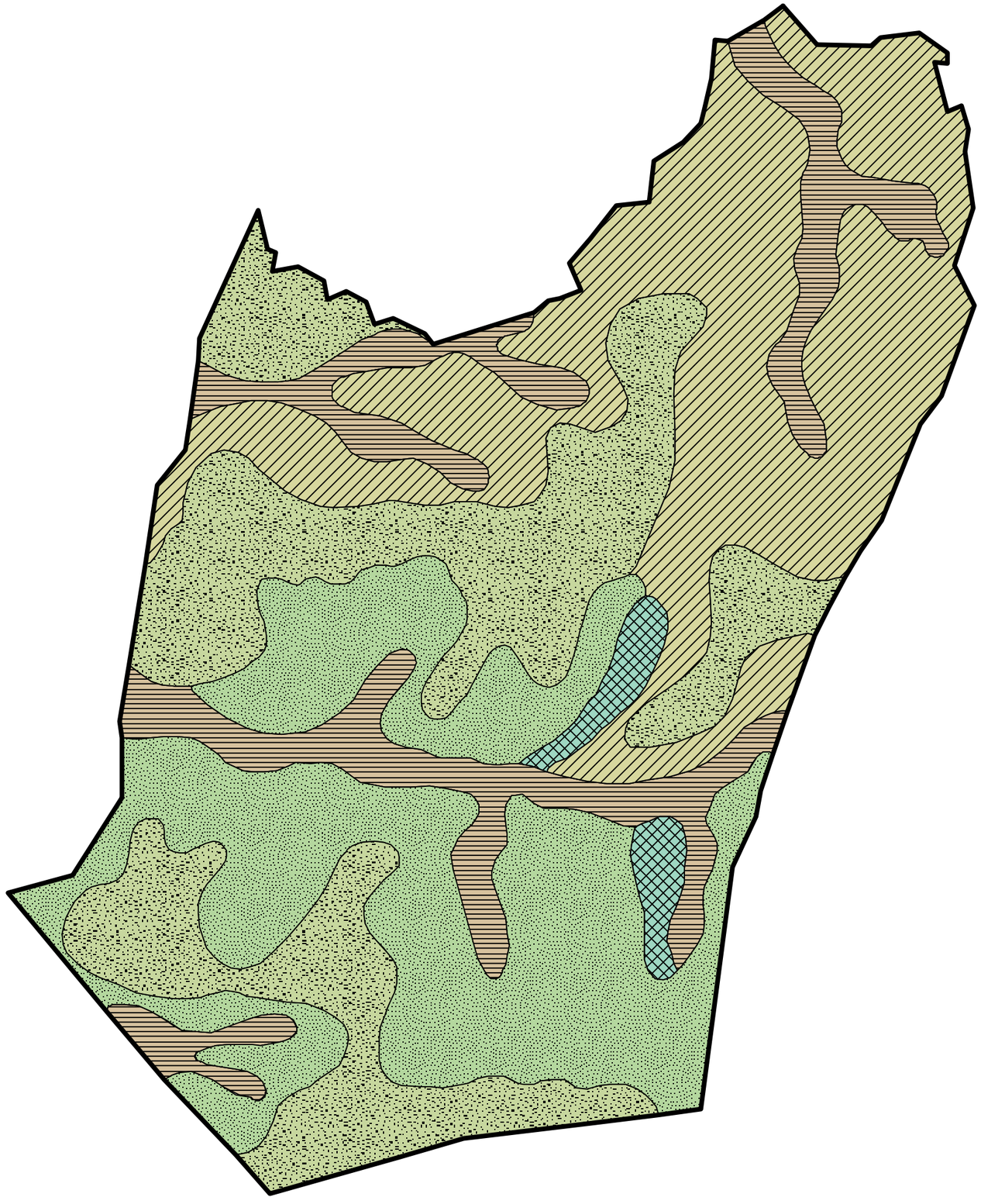
CONTRACT # W912DQ-08-D-0003

PROJECT # 08-3800.03

Figure 2 - 4

SCALE: 0 20 40 80 120 Feet

DATE: 8/12/2008



N

Soil Types

- Brandywine Loam
- Glenelg Silt Loam
- Glenville Silt Loam
- Manor-Channery Silt Loam
- Wehadkee Silt Loam

Source: Ground-Water Quality Study
No. 38-26-0354-90, 19 - 30 Jun 89

REV	DATE	DESCRIPTION	BY

CABRERA SERVICES
103 E. MT ROYAL AVE.
BALTIMORE, MD 21202

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARLYAND

PREPARED BY: KJ

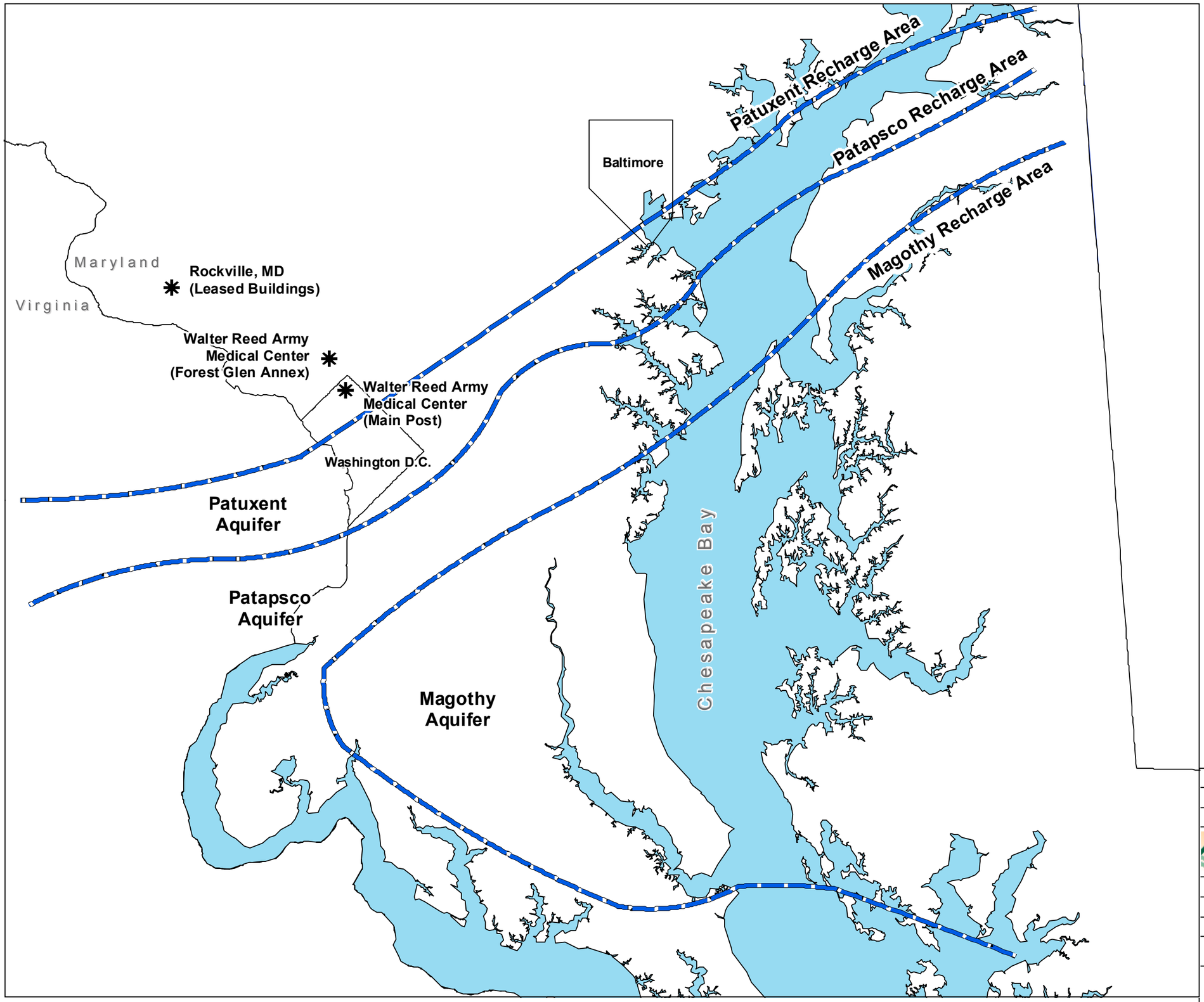
REVIEWED BY: MB

WALTER REED ARMY MEDICAL CENTER — FOREST GLEN ANNEX MARYLAND

HISTORICAL SITE ASSESSMENT
FOREST GLEN SOILS MAP

CONTRACT # W912DQ-08-D-0003 | PROJECT # 08-3800.03 | **Figure 2 - 5**

SCALE: 0 55 110 220 330 Feet | DATE: 8/12/2008



Source: Ground-Water Quality Study
No. 38-26-0354-90, 19 - 30 Jun 89

REV	DATE	DESCRIPTION	BY

CABRERA SERVICES
103 E. MT ROYAL AVE.
BALTIMORE, MD 21202

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARLYAND

PREPARED BY: KJ

REVIEWED BY: MB

WALTER REED ARMY MEDICAL CENTER — FOREST GLEN ANNEX MARYLAND

HISTORICAL SITE ASSESSMENT
AQUIFER RECHARGE AREAS
BALTIMORE - WASHINGTON AREA

CONTRACT # W912DQ-08-D-0003 | PROJECT # 08-3800.03 | **Figure 2 - 6**

SCALE: 0 1.5 3 6 9 Miles | DATE: 8/11/2008

3.0 HISTORICAL SITE ASSESSMENT METHODOLOGY

This section summarizes the methodology and decision criteria for the WRAMC HSA as detailed in the HSA Work Plan (Appendix A; CABRERA, 2008b).

3.1 Approach and Rationale

This HSA is being conducted as part of an overall effort to terminate the WRAMC NRC radioactive material licenses and safely release the facility and grounds for future use. The purpose of this radiological HSA is to collect and organize information describing radiological activities at the WRAMC Forest Glen Annex and leased facilities in Rockville, MD from the onset of the first radioactive material licensed use until cessation of operations. This HSA reviews historical information to determine if there is sufficient data to declare buildings as "Impacted" or "Non-Impacted" in accordance with MARSSIM methodology (Table 3-1; NRC, 2000). The HSA also evaluates migration of contamination in the environment and makes recommendations for future surveys. To achieve this goal, a systematic approach was developed for screening the WRAMC Forest Glen Annex and leased facilities in Rockville, MD facilities. Each building/area was screened using the questions found in the decision trees in Figure 3-1.

TABLE 3-1: HSA RADIOLOGICAL RISK CATEGORIES

Category	Description
Impacted (Additional Surveys Needed)	There is a reasonable probability that the building or area was impacted by radiological activities
Non-Impacted	There is a very low probability that building/area was impacted radiologically during operations. This was determined either through: a) No documented use of RAM; or b) Records indicate that area was used for radiological operations or storage, but survey records exist documenting decontamination, decommissioning, final/close-out survey, and/or free release.

In order to answer the questions in the referenced decision trees, the following information sources were investigated or used:

- WRAMC operating history records, including radioactive materials licenses, permits, and use authorizations and protocols;
- Minutes of the WRAMC Radiation Control Committee (RCC) for references to any spills, releases of radioactive material to the environment surrounding the WRAMC during facility operations, or onsite disposals of radioactive or hazardous materials;
- Routine radiological surveys performed by the WRAMC HPO at the WRAMC Forest Glen Annex and leased facilities in Rockville, MD where RAM is currently being used/has previously been used;

- Final status survey reports and records of disposal of radioactive waste to offsite licensed facilities for previously decommissioned facility areas (Buildings 40 and T-2);
- Final room/building close-out surveys for buildings/rooms with no further RAM usage;
- Physical tours of the WRAMC Forest Glen Annex and leased facilities in Rockville, MD expected to be potentially impacted due to current and/or former RAM usage;
- Off-installation document sources including NRC, USACHPPM, ARL, and USANCA/ARO.
- Interviews/conversations with:
  - Staff responsible for ongoing WRAMC site control and surveys
  - Previous WRAMC personnel, including operators and training personnel, and personnel who performed previous radiological surveys, if available
  - Staff currently occupying buildings suspected of having an historical RAM presence

3.2 Document Sources

3.2.1 WRAMC Health Physics Office Supplied Information

The majority of the records available were stored at the Health Physics Office (HPO) in Building 41 at the WRAMC Main Post, administered by Colonel Mark Melanson, WRAMC Radiation Safety Officer (RSO), and assisted by Mr. David Burton, WRAMC Licensing Branch Chief and Assistant RSO. The HPO is responsible for administration and maintenance of WRAMC's NRC Broad Scope RAM license as well as issuing base-level RAM use authorizations for biomedical treatment and research activities performed at WRAMC. The HPO contains more than 60 file drawers with records documenting radiological matters dating back to the 1970s.

The types of documents supplied by the HPO include:

NRC License(s) – A copy of the current NRC Broad Scope RAM License was provided, detailing which radioactive isotopes may be possessed at the WRAMC Main Post, the Forest Glen Annex, and the leased facilities in Rockville, MD and in what quantities. The NRC License also contains a chronological account of all license amendments made by WRAMC since its inception.

Authorizations – A RAM authorization is essentially a permit granted to a principal investigator (PI) from the WRAMC RCC. The authorization contains all relevant information regarding use of RAM in the PI's laboratories. The authorization details what isotopes may be used and in what quantities, buildings and rooms authorized, as well as secondary investigators who may use RAM. Authorizations are active for a three year period and may be transferred, combined, or terminated.

Protocols – Protocols are accompanying documents to Authorizations. Protocols detail the specific experiments for which a PI requires RAM. Protocols are useful as they detail how much of which isotopes were used in each room.

Inventory Records – Each Authorization also has accompanying inventory records, which details all RAM inventories on a given Authorization. The inventory records include all RAM purchases, results of the quarterly audits performed by the HPO, and any waste turn-in records. Inventories of all sealed sources administered by the HPO and their leak-test records were also reviewed to capture any reports of leaks. Mr. Dave Burton, a twenty-one-year veteran of the WRAMC HPO, also does not recall any reports of sealed source leakage. Going back as far as 1963, WRAMC standard procedures for quarterly leak tests of sealed sources required source removal if leakage was in excess of 0.005 μCi. Sealed alpha sources less than 10 μCi and sealed beta-gamma sources less than 100 μCi do not require leak testing.

RCC Meeting Minutes – Quarterly Radiation Safety Committee (RSC) (previously known as the Radiation Control Committee) meeting minutes for the last 15 years were reviewed. RAM spills, changes to specific authorizations, and other general information would be found in these minutes, if an incident were to have occurred.

Routine Survey Results and Templates – In 1974, the WRAMC standard operating procedure (SOP) for weekly and monthly contamination surveys (issued as WRAMC Regulation 40-10), conducted by the Health Physics Office, specified requirements for decontamination for any area found to exceed 100 disintegrations per minute per 100 square centimeters (dpm/100 cm^2). By 1996, the SOP had been modified such that unrestricted areas required decontamination below 200 dpm/100 cm^2 and restricted areas required decontamination below 1000 dpm/100 cm^2.

The room-based routine survey packages used by the HPO are a quick reference to which radionuclides are used in that room under which Authorization. They also provide a snapshot of the radiological status of a building/room given a specific time period. When RAM is no longer to be used in a room/building, the source is removed, and a "Room Final" or "Building-Close-out" survey is performed and documented in the routine survey package for the particular authorization under which the room/building falls. These Room-Final/Building-Close-out surveys, although not designed according to MARSSIM, are performed with a rigor more strict than both MARSSIM and AMC, 2004 guidance, and thus serve as acceptable documentation that an area is suitable for release.

DORF Documentation – Documentation regarding the Diamond Ordnance Radiation Facility (DORF), formerly at Building 516 at Forest Glen Annex is maintained at the WRAMC HPO and at the U.S. Army Research Laboratory (ARL).

3.2.2 U.S. Army Center for Health Promotion and Preventative Medicine

During the completion of the WRAMC Main Post HSA, USACHPPM (via Mr. Dave Alberth) provided CABRERA with 5 CD's worth of survey documentation applicable to WRAMC (Main Post, Forest Glen Annex, and leased facilities in Rockville, MD). The CD's contained approximately 300 documents applicable to WRAMC, all of which were re-reviewed as part of this investigation for applicability to the radiological investigation of the Forest Glen Annex and leased facilities in Rockville, MD.

3.2.3 NRC Document Repositories

No records pertaining to WRAMC licenses or inspection reports were directly obtained from the NRC during the preparation of this HSA. In 2006, the NRC required submission of a Freedom of Information Act (FOIA) request to the agency in order to request any documents specific to licenses currently or formerly held by WRAMC (including the Forest Glen Annex and leased facilities in Rockville, MD). During the completion of the HSA for the WRAMC Main Post, CABRERA filed a FOIA request and received all available documentation on all current and former WRAMC licenses. In completion of this HSA for the WRAMC Forest Glen Annex and leased facilities in Rockville, MD, this documentation was re-reviewed for any information pertinent to Forest Glen and/or Rockville facilities, and inquiries were also made to the NRC Public Document Room (PDR) to see if any additional documentation had been made available since the fulfillment of the FOIA request. It was discovered that any new documentation would have been archived on their web-based public document retrieval system known as ADAMS (Agency-wide Documents Access and Management System). ADAMS was searched for applicable license numbers and appropriate documentation was downloaded and reviewed. Roughly 2900 pages of documentation received via FOIA, and 700 pages of new documentation, were reviewed as part of this effort.

3.2.4 U.S. Army Reactor Office Files

ARO (via Lieutenant Colonel Stephanie Vaughn and Mr. Bill Macon) provided two binders worth of records pertaining to the DORF, formerly housed in Building 516 at WRAMC Forest Glen Annex. These were provided for review via USANCA. Select minutes of Army Reactor Council (ARC) meetings were also made available via USANCA.

3.2.5 U.S. Army Research Laboratory /U.S. Army Joint Munitions Command Files

ARL, as the former DORF operator and current permit holder, provided access to its historical archives (via Mr. Mike Borisky), which included roughly four archive boxes and four filing cabinet shelves. Documentation held at ARL included: all historical decommissioning documents (mostly original copies of what was held at the WRAMC HPO in duplicate form), annual reports, copies of ARC meeting minutes from 1998, minutes of the ARL Ionizing Radiation Control Committee meeting minutes (an ARL-specific group) dating back to 1956, shipping documents showing post-decommissioning transfer of usable materials from DORF to the ARL headquarters in Adelphi, MD and waste materials to disposal facility in Nevada circa 1980, inventories pertaining to former licenses ARL has held through NRC/AEC (not all DORF-related), faulty source incidents (none at DORF), and personnel film badge exposure incidents (none at DORF).

It was determined (via Mr. Joe Hart and Mr. Borisky) that all files pertaining to the DORF (and WRAMC in general) contained at JMC were all duplicates of files maintained at ARL. Mr. Borisky was the individual who originally copied and sent the files to JMC. Mr. Borisky requested the file copies be sent back to ARL, and then provided to CABRERA for use and review.

3.2.6 Internet Review

Internet searches were conducted to determine if there was any pertinent information not available through other sources. Websites reviewed include, but are not limited to:

- U.S. Nuclear Regulatory Commission (NRC): http://www.nrc.gov
- NRC Agency-wide Documents Access and Management (ADAMS): http://www.nrc.gov/reading-rm/adams/web-based.html
- NRC Terminated License Tracking System (TLTS): https://nrctracking.ornl.gov/tlts/
- U.S. Environmental Protection Agency (EPA): http://www.epa.gov
- U.S. Department of Defense (DOD): http://www.defenselink.mil
- U.S. Military Search Engine: http://www.searchmil.com
- U.S. Department of Energy (DOE): http://www.doe.gov
- U.S. Geological Survey (USGS): http://www.usgs.gov
- National Oceanic and Atmospheric Administration (NOAA): http://www.noaa.gov/
- Global Security: http://www.globalsecurity.org

General information was available describing the WRAMC history and facilities, but no additional information pertinent to RAM usage at the Forest Glen Annex or leased facilities in Rockville, MD was discovered.

3.2.7 Other Document Sources

During the completion of the WRAMC Main Post HSA in 2006, inquiries were made at the following facilities concerning availability of radiological material use and storage records at WRAMC:

- Humphreys Engineering Center Support Activity (HECSA), Ft. Belvoir, VA.
- Defense Logistics Agency (DLA), New Cumberland Depot, PA.

No records pertaining to RAM use or storage at the WRAMC Main Post, Forest Glen Annex, or leased facilities in Rockville, MD were identified from any of these sources in 2006; therefore, they were deemed unnecessary to search during this effort.

During completion of this HSA for the WRAMC Forest Glen Annex and leased facilities in Rockville, MD, inquiries were also made at the following facilities:

- U.S. Army Environmental Center (USAEC), formerly the U.S. Army Toxic and Hazardous Materials Agency (USATHEMA), Edgewood, MD.
- U.S. Army Chief of Engineers Office, Washington, DC.
- U.S. Army Materiel Command (AMC), Ft. Belvoir, VA.

However, it was discovered that neither of these organizations keep any records pertaining to RAM storage/usage/disposal at specific installations, and thus nothing applicable to this investigation was available.

3.3 Key Documents Reviewed

Appendix D includes a complete listing of references reviewed during completion of this HSA. A summary of key documents reviewed in preparation of this HSA include:

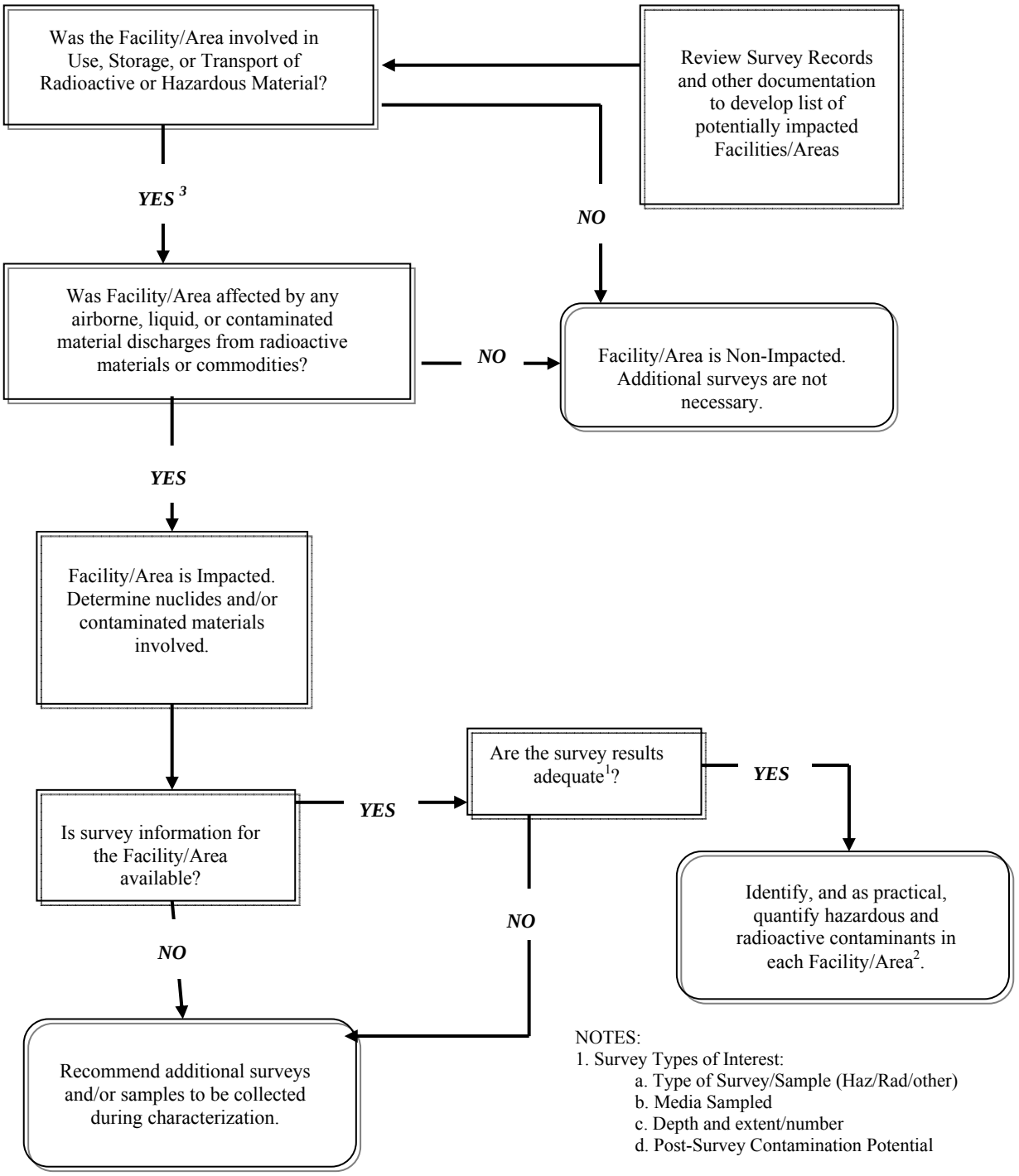
- NRC License Numbers 08-01738-02, 08-01738-03, 08-01738-04, and 08-01738-05; with additional information pertinent to license application and termination;
- ARO Permit DORF-1-97
- ARA 08-01-15 (and previous iterations of this authorization)
- WRAMC HPO Authorizations
- WRAMC HPO Source Inventories
- WRAMC HPO Operating Procedures and Radiation Safety Precautions
- WRAMC Engineering Drawings and Aerial Photographs
- ARC Meeting Minutes (from 1998 and 2008)
- WRAMC HPO Routine Surveys and Room Final Surveys
- WRAMC HPO Building Decommissioning/Close-out Surveys
- Final Historical Site Assessment for the WRAMC Main Post from 2007
- Historical Site Assessment for WRAIR from 1997
- Final Phase II Environmental Condition of Property (ECP) Recommendations for the WRAMC Main Post from 2007
- DORF Decommissioning Documentation (Plan, Report, and Surveys)
- WRAMC Master Building Data Sheet
- Army Letter Statement of Intent to NRC
- USACE Statement of Work (SOW) for the WRAMC Forest Glen HSA, with attached ECP Workshop Summary

3.4 Property Inspections

Review of the RAM authorizations and protocols provided by the HPO resulted in a list of WRAMC buildings that have used or are currently using radioactive materials. Each of these buildings was toured, if accessible, to gain building-specific information relevant to assigning risk categories and planning of future MARSSIM related activities. Photographs were taken in areas approved by personnel and are included in Appendix B as part of the appropriate Building Fact Sheet.

3.5 Personnel Interviews

CABRERA personnel worked closely with Mr. David Burton, the WRAMC Licensing Branch Chief, during the two site visits conducted on May 9, and July 31 through August 1, 2008. Appendix C contains the completed interview form from Mr. Burton from June of 2006, as well as a supplemental interview form completed based on 2008 conversations. Specific building contacts are noted on the Building Fact Sheets in Appendix B as appropriate, but due to the fact that many of the buildings being investigated ceased using radiological materials many years ago, and no primary users of radioactive materials within the buildings remain, full interviews were not conducted. Mr. Burton is the primary authority on radiological materials throughout all of WRAMC, and based on experience, his was the only interview necessary to gain the information required to complete this HSA.



NOTES:
1. Survey Types of Interest:
   a. Type of Survey/Sample (Haz/Rad/other)
   b. Media Sampled
   c. Depth and extent/number
   d. Post-Survey Contamination Potential

2. If a Facility/Area has been demolished or removed, consider a survey of the site of the former building, as appropriate.

3. "YES" is also assumed in cases where no information is available

FIGURE 3-1: FLOWCHART OF HSA RADIOLOGICAL DECISION METHODOLOGY

4.0 WRAMC (FOREST GLEN) HISTORY AND CURRENT USAGE

4.1 Installation History

The WRAMC has been operational for 97 years. In ten decades, the WRAMC has grown to a vast medical complex, teaching medical professionals, medical research programs, and treating hundreds of thousands of patients.

The Main Post was established by Congressional Legislation in 1905 as Walter Reed General Hospital. Construction was completed in 1909 and the first patients were admitted. The Hospital started as a small 80 bed facility and from this modest beginning has emerged the present day Walter Reed General Hospital which is world acclaimed as one of the finest military medical facilities. The tenant activities associated with WRAMC include but are not limited to the following: Armed Forces Institute of Pathology (AFIP), Armed Forces Pest Management Board, Tri-Service Medical Information Systems, U.S. Army Area Dental Laboratory, U.S. Army Information Systems Command, U.S. Army Institute of Dental Research (USAIDR), and Walter Reed Army Institute of Research (WRAIR). (USACHPPM, 1997)

The Forest Glen Annex of WRAMC was purchased for use as a convalescent center near the beginning of the United States' involvement in World War II, and it was officially established as a military reservation in 1942. It was activated for use as a convalescent center for the Main Post and received its first patients in January 1943. In addition to clinics and wards, it had separate messing and billeting facilities for duty personnel and patients. The real estate on which the Forest Glen Section is situated was formerly the National Park Seminary, a private women's junior college. The buildings and grounds were acquired in 1942 at a cost of $1,000,000. The peak patient-load during World War II reached approximately 500. After 1946, the need for convalescent beds abated and space was made available for other activities. In addition to the Convalescent Hospital activities, the WRAMC has maintained its Audiology and Speech Center, as well as psychiatry and some orthopedic patients at Forest Glen. Minimal housing and recreation facilities have also been provided.

From 1961 through 1977, Harry Diamond Laboratories operated the Diamond Ordnance Radiation Facility (DORF) out of Building 516 at the Forest Glen Annex. A logistics warehouse, community center complex, automotive maintenance shop motor pool, facilities engineering shop, and post laundry were built during the 1970s. During the 1980s, the AFIP Repository and Research Services Facility, a child development center, and a temporary residence facility, the Fisher House, were completed.

Since the closure of Building 40 on the Main Post in 1997, the main WRAIR administrative buildings and research laboratories have been located on the Forest Glen Annex. The area currently serves as an auxiliary service, support, and research area for the WRAMC Main Post, and current activities conducted at Forest Glen include motor vehicle maintenance, research laboratories, and a post exchange. The post is no longer used for convalescent care (USACHPPM, 2000).

4.2 Overview of Radiological Operations

The use of RAM in affected buildings can be summarized as follows:

- Medical treatment using sealed sources in milliCurie (mCi) quantities (e.g., brachytherapy and oncology seeds).

- Health physics support using sealed sources in μCi quantities (e.g., calibration sources).

- Clinical and biomedical research using unsealed μCi and mCi quantities. Of the various unsealed isotopes used in research, only long-lived radioisotopes, i.e. half-lives greater than 1 year to present any potential for residual contamination. This is the main historical usage of RAM in the laboratories at the WRAMC Forest Glen Annex and leased facilities in Rockville, MD.

4.2.1 Permits and Licenses

Radioactive materials use at the WRAMC Main Post is conducted under NRC Licenses, and Department of the Army Radioactive Authorizations (ARA) issued to the WRAMC. The following is a list of active and terminated licenses and permits issued to WRAMC:

- NRC License No. 08-01738-02, Expiration Date 30 April 2015 (original Atomic Energy Commission License dates to 1957) – Operations are conducted at the Main Post in the District of Columbia, the Forest Glen Annex in Maryland, and at the leased facilities in Rockville, Maryland. License 08-01738-02 allows possession and use of any byproduct radionuclide with mass number between 1 and 83 up to 400 mCi each, plus many nuclide-specific possession and use limits pertaining to nuclear medicine and bio-medical research activities. A copy of NRC License Number 08-01738-02 as well as all associated documentation is provided in Appendix D.

- Terminated NRC License No. 08-01738-03, terminated on 17 August 2004 – NRC License 08-01738-03 allowed for possession and use of gamma cell irradiators. Upon termination of the license, gamma cell irradiator possession was transferred to NRC License No. 08-01738-02.

- Terminated NRC License No. 08-01738-04 and NRC License No. 08-01738-05 – These licenses allowed for the possession and use of a Co-60 Irradiation Unit at Fort Detrick, MD.

- ARA No. 08-01-15, Expiration Date 30 November 2015. This ARA allows for the use of radium in medical treatment and research; previous iterations of this authorization predate the original 1957 U.S. Atomic Energy Commission (AEC) License and other multiple ARAs through the years. This ARA represents a renewal of the former ARA 08-01-97.

- Historically, prior to obtaining its own NRC License during the 1990s, the U.S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD, was also listed as a facility user on the WRAMC NRC License.

- U.S. Army Reactor Office Reactor Permit No. DORF-1-97, issued to Director, U.S. Army Research Laboratory (ARL), for the Diamond Ordnance Radiation Facility (DORF), Building 516, Forest Glen Annex, WRAMC. The permit retains control of the building to ensure that the building's residual radioactivity remains fixed in place and does not become loose or airborne. The reactor facility was decommissioned in 1978 according to standards at that time, but this permit was issued in 1997 when surveys showed that residual radioactivity levels were higher than current standards (which are more stringent than those in 1978 at the time of decommissioning). After decommissioning in 1978, WRAMC continued to use this building under its NRC License No. 08-01738-02 for its radioactive waste operations from medical procedures and research. There are unknown materials under the 20 feet of concrete in the reactor pool area, as well as neutron activation of the concrete walls of the exposure cells and other areas in the former reactor building.

Correspondence from the NRC was provided to document that certain buildings formerly used for radioactive materials use under NRC License No. 08-01738-02, are now "released for unrestricted use." These include:

- Decommissioned Building 40, Main Post (NRC Letter dated 26 May 2004)

- Decommissioned Building T-2, Main Post (NRC Letter dated 10 March 2005)

- Decommissioned U.S. Army Medical Laboratory Building, Fort Meade, MD (NRC Letter dated 24 April 2005)

- The research reactor that was located in the basement of Building 40 at the WRAMC Main Post was operated under U.S. Atomic Energy Commission (AEC) License Number AEC SUB 603 and AEC SNM 472. The Building 40 Research Reactor was de-fueled in 1971 and partially decontaminated in 1972. The AEC license was terminated at this time. Complete decommissioning of the sub-basement and basement levels of Building 40 was completed in 2001.

4.2.2 Authorizations and Protocols

The WRAMC HPO has issued over 700 RAM use and possession Authorizations, as described in Section 3.2.1, since this method of tracking was instituted. From this extensive list, 24 Authorizations had direct ties to Forest Glen/Rockville buildings. Of the 24, only 2 are currently active. Authorizations researched as part of this HSA include: H05, 78, 221, 416, 454, 569, 623, 624, 625, 639, 644, 650, 658, 659, 662, 664, 668, 669, 672, 678, 679, 696, 699, and 700.

4.2.3 Waste Handling Procedures

Dry active radioactive wastes are held by the waste generating laboratory or facility and delivered periodically to several specific locations controlled by the WRAMC Health Physics Office (HPO). Building 2, Room 7A14 and Building 41, Room 42 at the WRAMC Main Post are used for this purpose. The WRAMC HPO collects and moves waste to the waste decay and storage facility located at Building 516 (former DORF facility) at the Forest Glen Annex. Prior to the institution of using Building 516 for waste, the waste was handled at Buildings 509 and 149A at Forest Glen. All radioactive wastes are transported between these facilities using a dedicated vehicle, stationed at Building 516 at the Forest Glen Annex. Control measures are in place to assure that contamination is not spread during movement of waste (USACHPPM, 1997).

Liquid radioactive wastes are either delivered to the HPO designated location or disposed of via sanitary sewer. Documentation indicates extensive use of radioactive hot sinks/wash sinks within the WRAMC Forest Glen Annex laboratory facilities. Hot sinks were only used for equipment decontamination fluids, not waste disposal. Many laboratories utilized sinks identified as hot sinks and then removed the hot sinks from service. The identification and termination of hot sinks was a frequent occurrence, with the HPO office completing random surface area surveys upon termination (USACHPPM, 1997).

5.0 FINDINGS

A review of the documentation described in Section 3.0 suggests that there are buildings on the WRAMC Forest Glen Annex and leased facilities in Rockville, MD potentially impacted by the use of RAM. The following sections describe the findings of this HSA, including radiological contaminants of potential concern, potentially impacted buildings (as well as rooms within each building, where known), and potential regulatory issues.

5.1 Summary of Potential Radiological Contaminants

A list of radionuclides used throughout the WRAMC Forest Glen Annex and leased facilities in Rockville, MD is shown in Table 5-1. These nuclides were listed in Authorizations, as well as HPO Inventories, pertaining to biomedical research, nuclear medicine, and radiation diagnostics and treatment. This list is in no way a comprehensive list of all radionuclides used. However, it does represent the most commonly encountered isotopes listed in the Authorizations and Inventories. Generally, nuclides with half-lives greater than 1 year were retained as RCOPCs, as they have the greatest potential to be remaining post-closure of the facility. Exceptions to this philosophy are calcium-45 (Ca-45), chromium-51 (Cr-51), iodine-125 (I-125), iodine-131 (I-131), phosphorus-32 (P-32), phosphrous-33 (P-33), sulfur-35 (S-35), and technetium-99 (Tc-99m), which have been retained despite having shorter half-lives since they were documented to either have been used in active research labs or being held as waste in Building 516 (DORF). Using 1 year as a half-life cut-off for which radionuclides would be considered RCOPCs, it was assumed that if at least 7-10 years had passed since RAM usage, the radionuclide would be decayed to negligible levels, and thus not pose a concern. Short-lived radionuclides were only retained if documentation showed usage in an active laboratory or storage area (i.e. currently used/stored radionuclides are noted and included).

The radionuclide list also contains sealed sources used for instrument calibrations, brachytherapy, and radiology procedures. Radionuclides present in sealed sources (on their own) will not contribute to a building/area's status as impacted, and thus will not necessitate Final Status Survey (FSS) when the source is removed, provided that leak tests are conducted and results are satisfactory. Since all sealed source leak tests at WRAMC have shown satisfactory results, no buildings/areas were considered impacted due to sealed sources, and no radionuclides present as sealed sources only were retained as RCOPCs.

Radionuclides expected to be considered Radiological Contaminants of Potential Concern (RCOPCs) for future surveys are shown in bold in Table 5-1.

TABLE 5-1: PRIMARY RADIOACTIVE NUCLIDES USED AT WRAMC FOREST GLEN ANNEX AND FACILITIES IN ROCKVILLE, MD

RADIONUCLIDE	USE/SOURCE	NAME	HALF-LIFE	DECAY TYPE	RCOPC?
Am-241	**NRC-2704**	**americium-241**	**432.2 yr**	**alpha**	**Y**
Am-241	sealed source	americium-241	432.2 yr	alpha	-
Ba-133	**any**	**barium-133**	**10.53 yr**	**electron capture**	**Y**
Ba-133	sealed source	barium-133	10.53 yr	electron capture	-

RADIONUCLIDE	USE/SOURCE	NAME	HALF-LIFE	DECAY TYPE	RCOPC?
C-14	**any**	**carbon-14**	**5730 yr**	**beta emission**	**Y**
C-14	**organic compound**	**carbon-14**	**5730 yr**	**beta emission**	**Y**
C-14	**unsealed**	**carbon-14**	**5730 yr**	**beta emission**	**Y**
Ca-45	**any**	**calcium-45**	**163.8 day**	**beta emission**	**Y**
Ca-45	**unsealed**	**calcium-45**	**163.8 day**	**beta emission**	**Y**
Cd-109	any	cadmium-109	462.3 day	electron capture	-
Cd-109	gas chromatography	cadmium-109	462.3 day	electron capture	-
Ce-141	any	cerium-141	32.5 day	beta emission	-
Cl-36	**any**	**chlorine-36**	**3x10^5 yr**	**beta emission**	**Y**
Co-57	any	cobalt-57	271 day	electron capture	-
Co-57	sealed source	cobalt-57	271 day	electron capture	-
Co-60	sealed source	cobalt-60	5.272 yr	beta emission	-
Co-60	**activation product**	**cobalt-60**	**5.272 yr**	**beta emission**	**Y**
Cr-51	**any**	**chromium-51**	**27.7 day**	**electron capture**	**Y**
Cr-51	**liquid**	**chromium-51**	**27.7 day**	**electron capture**	**Y**
Cr-51	**sodium chromate**	**chromium-51**	**27.7 day**	**electron capture**	**Y**
Cs-137	3M 6D6C-CA	cesium-137	30.2 yr	beta emission	-
Cs-137	amer nuc corp	cesium-137	30.2 yr	beta emission	-
Cs-137	**any**	**cesium-137**	**30.2 yr**	**beta emission**	**Y**
Cs-137	sealed source	cesium-137	30.2 yr	beta emission	-
Cs-141	any	cesium-141	24.9 sec	beta emission	-
Eu-152	**activation product**	**europium-152**	**13.4 yr**	**beta emission, electron capture**	**Y**
Eu-154	**activation product**	**europium-154**	**8.5 yr**	**beta emission, electron capture**	**Y**
Fe-59	any	iron-59	44.51 day	beta emission	-
Ga-67	any	gallium-67	78.25 hr	electron capture	-
Gd-153	sealed source	gadolinium-153	241.6 day	electron capture	-
H-3	**any**	**tritium**	**12.26 yr**	**beta emission**	**Y**
H-3	**gas chromatography**	**tritium**	**12.26 yr**	**beta emission**	**Y**
H-3	**organic compound**	**tritium**	**12.26 yr**	**beta emission**	**Y**
H-3	**thymidine**	**tritium**	**12.26 yr**	**beta emission**	**Y**
H-3	**unsealed**	**tritium**	**12.26 yr**	**beta emission**	**Y**
Hg-203	-	mercury-203	46.6 day	beta emission	-
I-123	AECL	iodine-123	13.1 hr	electron capture	-
I-123	any	iodine-123	13.1 hr	electron capture	-
I-125	AECL	iodine-125	59.9 day	electron capture	-
I-125	**any**	**iodine-125**	**59.9 day**	**electron capture**	**Y**
I-125	**samples**	**iodine-125**	**59.9 day**	**electron capture**	**Y**
I-125	**unsealed**	**iodine-125**	**59.9 day**	**electron capture**	**Y**
I-129	**any**	**iodine-129**	**1.6x10^7 yr**	**beta emission, electron capture**	**Y**
I-129	sealed source	iodine-129	1.6x10^7 yr	beta emission, electron capture	-
I-131	**any**	**iodine-131**	**8.04 day**	**beta emission**	**Y**
In-111	any	indium-111	2.8 day	electron capture	-
Ir-192	any	iridium-192	73.83 day	beta emission	-
K-42	-	potassium-42	12.36 hr	beta emission	-
Mn-54	any	manganese-54	312 day	electron capture	-
Mo-99	any	molybdenum-99	65.94 hr	beta emission	-

RADIONUCLIDE	USE/SOURCE	NAME	HALF-LIFE	DECAY TYPE	RCOPC?
Na-22	any	sodium-22	2.605 yr	positron emission, electron capture	-
Nb-95	any	niobium-95	34.98 day	beta emission	-
Ni-63	**foils**	**nickel-63**	**100 yr**	**beta emission**	**Y**
Ni-63	sealed source	nickel-63	100 yr	beta emission	-
P-32	**any**	**phosphorus-32**	**14.28 day**	**beta emission**	**Y**
P-32	**organic compound**	**phosphorus-32**	**14.28 day**	**beta emission**	**Y**
P-32	**unsealed**	**phosphorus-32**	**14.28 day**	**beta emission**	**Y**
P-33	**any**	**phosphorus-33**	**25.3 day**	**beta emission**	**Y**
P-33	**unsealed**	**phosphorus-33**	**25.3 day**	**beta emission**	**Y**
Pu-239	**calibration source**	**plutonium-239**	**2.4x10^4 yr**	**alpha**	**Y**
Ra-226	sealed source	radium-226	1600 yr	beta emission	-
Rb-86	any	rubidium-86	18.63 day	beta emission	-
Ru-103	any	ruthenium-103	39.24 day	beta emission	-
S-35	**any**	**sulfur-35**	**87.2 day**	**beta emission**	**Y**
S-35	**unsealed**	**sulfur-35**	**87.2 day**	**beta emission**	**Y**
Sb-125	any	antimony-125	2.76 yr	beta emission	-
Sc-46	any	scandium-46	83.8 day	beta emission	-
Se-75	any	selenium-75	118.5 day	electron capture	-
Sr-85	any	strontium-85	64.8 day	electron capture	-
Sr-89	any	strontium-89	50.52 day	beta emission	-
Sr-90	sealed source	strontium-90	29 yr	beta emission	-
Ta-182	any	tantalum-182	114.5 day	beta emission	-
Tc-99m	**any**	**technetium-99m**	**6.01 hr**	**isomeric transition**	**Y**
Tc-99m	**liquid**	**technetium-99m**	**6.01 hr**	**isomeric transition**	**Y**
Tl-201	any	thallium-201	3 day	electron capture	-
Tl-204	any	thallium-204	3.78 yr	beta emission, electron capture	-
U-238	**any**	**Uranium-238**	**4.46x10^9 yr**	**alpha**	**Y**
Xe-127	any	xenon-127	36.3 day	electron capture	-
Xe-133	any	xenon-133	5.25 day	beta emission	-
Yb-169	any	ytterbium-169	32 day	electron capture	-
Zn-65	any	zinc-65	243.8 day	positron emission, electron capture	-

5.2 Summary of Potentially Contaminated Areas

Based on reviews of all available documentation, seventeen buildings/areas were identified throughout the WRAMC Forest Glen Annex and leased facilities in Rockville, MD as being places where RAM was used or stored (possibly impacted). A summary of these buildings is provided in Table 5-2. Based on further review, six of the seventeen buildings/areas investigated (shown in bold in Table 5-2) have been classified as Impacted, and additional surveys and/or samples will be required to show closure. Specific findings for each building are described in the following sections and provided in the HSA Building Fact Sheets included in Appendix B. The locations of investigated buildings are shown in Figure 5-1 and Figure 5-2.

TABLE 5-2: LIST OF BUILDINGS/AREAS WITH RAM USE AT WRAMC FOREST GLEN ANNEX AND FACILITIES IN ROCKVILLE, MD

Building	Building Area (sq.ft.)	Original Structure Name	Department(s) / RAM Use(s)	Current Tenant and Conditions	Impacted or Non-Impacted	Radionuclides Used	Radionuclides Retained as RCOPCs[3]	Rooms With Historical RAM Presence	Non-Impacted Rooms	Impacted Rooms
101	224983	Former Dormitory for National Seminary Park	Portable Lead Paint Analyzer	Abandoned, building/land turned over to Montgomery County	Non-Impacted	Cd-109, H-3	None	1082	All	None
149A	800	Bunker	Health Physics Office Storage	Abandoned, building/land turned over to Montgomery County	Non-Impacted	All	None	All (Only one room)	All	None
188	2685	WRAMC, Health Physics Office	Former use by Health Physics Office	Abandoned, building/land turned over to Montgomery County	Non-Impacted	All	None	8, 9, Conference, Exits, Floors, Restrooms	All	None
500	20806	WRAIR	WRAIR Research Labs	WRAIR Administration	Non-Impacted	Am-241, Ba-133, C-14, Ca-45, Cr-51, Cs-137, H-3, I-125, I-131, K-42, Na-22, Ni-63, P-32, P-33, Ra-226, Rb-86, S-35, Sb-125, Se-75, Sr-90	None	11, 29, 30, 31, 34, 35, 36, 37, 38, 39, 40, 41, 42, 63, 66, 67, 68, 69, 70, 71, 72, 74, 75, 78, 1B-1, 41A, 63B, 71A, B-1, Basement, Hall 1, Hall 2	All	None
501	15305	WRAIR	WRAIR Research Labs	WRAIR Pilot Bioproduction Facility	Non-Impacted	P-32, P-33, S-35	None	23	All	None
503[1]	**137761**	**WRAIR**	**WRAIR Research Labs**	**WRAIR Research Labs**	**Impacted**	**C-14, Ca-45, Cr-51, Cs-137, H-3, I-125, P-32, P-33, S-35**	**C-14, Ca-45, Cr-51, Cs-137, H-3, I-125, P-32, P-33, S-35**	**2E12, 3E12, 3E14, 3E18, 1E22, 1E24, 3E24, 1E26, 1N40, 2N22, 2N24, 2N34, 2N42, 2N47, 2N48, 2N58, 2N69, 2N80, 2S18, 2W02, 2W106, 2W18, 2W23, 3N38, 3N54, 3N66, 3W08, 3W10, 3W110, 3W16, 3W22, 3W26, 3W40, 3W50, 3W71, elevators, exits, floor 1, floor 2, floor 3, floor G, GW04, GW05B, GW72**	**2N22, 2S18, 3N54, 3W08, 3W10, 3W22, and 3W40**	**2E12, 3E12, 3E14, 3E18, 1E22, 1E24, 3E24, 1E26, 1N40, 2N24, 2N34, 2N42, 2N47, 2N48, 2N58, 2N69, 2N80, 2W02, 2W106, 2W18, 2W23, 3N38, 3N66, 3W110, 3W16, 3W26, 3W50, 3W71, elevators, exits, floor 1, floor 2, floor 3, floor G, GW04, GW05B, GW72**

Building	Building Area (sq.ft.)	Original Structure Name	Department(s) / RAM Use(s)	Current Tenant and Conditions	Impacted or Non-Impacted	Radionuclides Used	Radionuclides Retained as RCOPCs[3]	Rooms With Historical RAM Presence	Non-Impacted Rooms	Impacted Rooms
504[2]	Unknown	Unknown	Unknown	None, Demolished	Non-Impacted	All	None	Unknown	All	None
506	3403	WRAIR	WRAIR Research Labs	Abandoned	Non-Impacted	Ra-226	None	back cubicle, chemical room, counting room, main lab sink	All	None
508	8593	WRAIR	WRAIR Research Labs	Viral Con Projects	Non-Impacted	C-14, Ca-45, Cr-51, H-3, I-125, I-131, P-32, P-33, Rb-86, S-35, Zn-65	None	1, 2, 4, 7, 10, 14, 17, 18, 19, 20, 21, 106, 114, 115, 116, 117, 124, 136, 137, 108A, hallways	All	None
509[2]	36442 (formerly)	WRAMC, Health Physics Office	Health Physics Office Waste Storage	None, Demolished	Non-Impacted	All	None	Unknown	All	None
511	**58488**	**WRAIR**	**Animal Medical Research Facility**	**Animal Research**	**Impacted**	**C-14, Co-57, H-3, Hg-203, I-125, I-131, P-32, S-35**	**C-14, H-3**	**114**	**All, except for 114**	**114**
512	**9885**	**WRAIR**	**Veterinary Quarantine, Medical Research Facility**	**Hospital, Allergen Extract Lab, Pharmacy**	**Impacted**	**C-14, H-3**	**C-14, H-3**	**4, 6, 30**	**All except for 4, 6, 30**	**Any original rooms/hallways in vicinity of former Rooms 4, 6, and 30**
513	775	WRAMC, Health Physics Office	Source range for calibration of instruments at DORF	General non-radiological storage, used by WRAMC HPO	Non-Impacted	All	None	All (Only one room)	All	None

Building	Building Area (sq.ft.)	Original Structure Name	Department(s) / RAM Use(s)	Current Tenant and Conditions	Impacted or Non-Impacted	Radionuclides Used	Radionuclides Retained as RCOPCs[3]	Rooms With Historical RAM Presence	Non-Impacted Rooms	Impacted Rooms
516	**3051**	**DORF**	**Radiation Experiments**	**Used by WRAMC HPO as a temporary radioactive waste decay and storage facility**	**Impacted**	**Am-241, Ba-133, C-14, Ca-45, Cd-109, Ce-141, Cl-36, Co-57, Co-60, Cr-51, Cs-137, Eu-152, Eu-154, Fe-59, Ga-67, Gd-153, H-3, I-123, I-125, I-129, I-131, In-111, Ir-192, Mn-54, Mo-99, Na-22, Nb-95, Ni-63, P-32, P-33, Pu-239, Ra-226, Rb-86, Ru-103, S-35, Sb-125, Sc-46, Se-75, Sr-85, Sr-89, Sr-90, Ta-182, Tc-99m, Tl-201, Tl-204, U-238, Xe-127, Xe-133, Yb-169, Zn-65**	Am-241, Ba-133, C-14, Ca-45, Cl-36, Co-60, Cr-51, Cs-137, Eu-152, Eu-154, H-3, I-125, I-129, I-131, Ni-63, P-32, P-33, Pu-239, S-35, Tc-99m, U-238	**Lower Floor, Main Floor, Mezzanine Level, Truck, Exposure Room**	**None**	**All**
516 (outside)	2335	Water Retention Tanks	Holdup Tanks for Water from DORF Pool and Wash Sink	WRAMC HPO Decay and Storage Facility	Non-Impacted	C-14, H-3	C-14, H-3	All	All	None
Taft[1]	**19223**	**Taft Court (Rickman Building)**	**WRAIR Medical Research Labs**	**WRAIR Medical Research Labs**	**Impacted**	**C-14, Ca-45, Cr-51, Cs-137, H-3, I-125, P-32, S-35**	**C-14, Ca-45, Cr-51, Cs-137, H-3, I-125, P-32, S-35**	**4, 5, 6, 7, 9, 10, 11, 14, 15, 16, 18, 20, 21, 24, 129, break, exits, floors (Only Rooms 15 and 20 currently contain RAM)**		**4, 5, 6, 7, 9, 10, 11, 14, 15, 16, 18, 20, 21, 24, 129, break, exits, floors**
Gillette	**101552**	**Gillette Building**	**WRAIR Medical Research Labs**	**WRAIR Medical Research Labs**	**Impacted**	**Co-57, Co-60, Cr-51, Cs-137, H-3, I-125, I-129, Ni-63, Tc-99m**	**H-3, Co-60, Cs-137, I-129, Ni-63**	**14, 1066, 1082, 1097, 1110, 1205, 1206, 1207, 2143, 1086A, exits, floors**	**14, 1066, 1082, 1097, 1110, 1086A, exits, floors**	**1205, 1206, 1207, and 2143**

Notes

1 - Building 503 and the Taft Building, although Impacted, are slated to continue using RAM under new license/licensee.

2 - Buildings 504 and 509 would be considered Impacted, but since they were demolished, and Building 503 (an Impacted building) has been built within their footprints, they essentially have now become part of the footprint for Building 503, and any futures investigations should treat them as such.

3 - Generally only radionuclides with half-lives greater than 1 year were retained as RCOPCs, unless documentation showed presence in an active laboratory or storage area.

5.3 Known and Potential Impacted Buildings/Areas

The permit and authorization process that implements WRAMC's broad scope RAM license allows a breakdown of individual rooms or areas within buildings that may be impacted due to RAM usage. If this level of information is available, follow-up investigations can be focused on areas where they are required (i.e. room-level) rather than requiring entire buildings be investigated. For the seventeen buildings/areas identified as potentially impacted in Table 5-2, only Buildings 149A, 504, and 509 lacked sufficient information to narrow down the potentially impacted rooms located within. However, being that Buildings 504 and 509 have been demolished and the new WRAIR Building (Building 503) sits atop their footprints, as well as the fact that Building 149A consists of only one room that has already been appropriately closed out, it is unnecessary to narrow down potentially impacted rooms.

The rooms or areas originally identified as potentially impacted were screened against available close-out survey information or known radionuclide use characteristics to see if any of the identified rooms could be screened out as previously released. Where documented, credit was taken for close-out surveys performed by WRAMC HPO when a lab or room was abandoned. Close-out surveys of this kind are the *status quo* at hospital and biomedical research facilities operating under a broad-scope materials license. One limitation to this approach is that document retention protocols at WRAMC only require routine survey packages to be retained for 3 to 5 years. Close-out surveys are generated when an Authorization is terminated, or when RAM is no longer to be used in a room or building, and are primarily stored with the routine surveys. For this reason, several surveys performed in buildings prior to renovation may not have been available for review during this investigation. These buildings/rooms have thus been screened as impacted since no permanent record of closure can be produced.

5.3.1 Non-Impacted Buildings

Discovery of HPO close-out surveys for Buildings 149A, 188, 500, 506, 508, 513, the former UST area outside 516 (DORF), and the north wing of the Gillette Building led to the conclusion that they could be classified as Non-Impacted with no further surveys required (Morton, 1997a, 1997b, 1997c, 1998, 1999a, 1999b, 1999c, and Collins, 2000). These surveys, although not designed according to MARSSIM, were completed to a rigor more strict than MARSSIM and AMC, 2004 guidance, and thus serve as acceptable documentation as to the buildings' release.

No close-out documentation exists for Building 101, but during the site visit, it was discovered that the building has already been released to Montgomery County (along with many buildings on the land to the north of the Forest Glen Annex, formerly the National Seminary Park property). No radioactive controls or restrictions exist in this building or on any of the property that has been turned over to Montgomery County. Physical documentation of the turnover to Montgomery County was not available. The only commodity briefly used in this building was a portable lead paint analyzer, which is not applicable under Army Materiel Command (AMC) Guidance (AMC, 2004), thus the building can be classified as Non-Impacted with no further surveys required.

Historical documentation shows that one room in Building 501 had RAM usage (Room 23). No close-out documentation could be found, but this building has been extensively renovated, and a "clean" medical room now exists where the room containing RAM previously existed. No radioactive controls or restrictions exist. The only isotopes used in this building all have half-lives of less than 1 year (P-32, P-33, and S-35), and no RAM has been used in this building in over 18 years. Thus, there is a virtually non-existent chance of finding any contamination, and the building can be classified as Non-Impacted with no further surveys required.

5.3.2 Known Impacted Buildings

5.3.2.1 Building 503

Building 503, although impacted, is slated for continued use for laboratory research after BRAC. Appropriate radiological permits/licenses are set to be turned over to the Navy. Findings presented in this HSA, with regards to specific radionuclides and rooms where used, are meant to serve as a snapshot of the RAM usage as of the publication date of this HSA (WRAMC, 2008a). At some point during the license transfer as part of BRAC, the new holder may deem surveys necessary, although they will not be recommended within this current investigation.

5.3.2.2 Taft Building

Similar to Building 503, the Taft Building in Rockville, MD, although impacted, is slated for continued use for laboratory research after BRAC. Appropriate radiological permits/licenses are set to be turned over to the Navy. Findings presented in this HSA, with regards to specific radionuclides and rooms where used, are meant to serve as a snapshot of the RAM usage as of the publication date of this HSA. Currently, only Rooms 15 and 20 are known to be impacted (WRAMC, 2008b). At some point during the license transfer as part of BRAC, the new holder may deem surveys necessary, although they will not be recommended within this current investigation.

5.3.2.3 Building 516 (DORF)

Harry Diamond Laboratories (HDL) formerly operated the Diamond Ordnance Radiation Facility (DORF) at Building 516 of the WRAMC Forest Glen Annex, which utilized a research reactor with associated experimental equipment. The facility occupied a single remote building on 4.2 acres of the Forest Glen Annex. An intra-service agreement between the Commanding Officer, WRAMC and Commanding Officer, HDL established the WRAMC support services for DORF. The reactor model was the familiar General Atomic Company Training, Research, Isotopes, General Atomics (TRIGA) Mark F, moderated by light water and mounted on a track support carriage assembly which could be moved through a 15,000 gallon capacity pool. The reactor core consisted of 85 (maximum 87) fuel elements, four control rods, neutron source, and miscellaneous neutron detectors. The fuel elements were composed of zirconium hydride moderator homogeneously combined with 20% enriched uranium fuel. The control system consisted of borated graphite safety, shim, regulating and pulse control rods, having either solid aluminum or fuel followers. Experiments were conducted in a 20 x 20 x 8 foot high fast neutron exposure room adjacent to pool, the pool itself, and within the core.

The facility was originally developed in late 1959 and began operations in September 1961. Modifications applied included: (1) replacement of the aluminum clad fuel elements with stainless steel clad elements (1964), (2) automatic super-critical reactor axe man, SCRAM, timing (1969), (3) replacement of the poison-followed transient rod with an aluminum follower (1964), (4) replacement of aluminum follower control rods with fuel-followed control rods (1971), and (5) replacement of reactor instrumentation with up-to-date instrumentation (1973).

The reactor was capable of the following modes of operation:

1. Steady-state operation up to 250 kilowatts (kW).

2. Square-wave operation up to 250 kW.

3. Pulse operation resulting in up to a maximum peak power of 2000 MW with a pulse width of 9.5 ms at half maximum.

The decision to decommission the DORF reactor was the culmination of an Army reactor utilization study begun in mid-1975 to examine the requirement for the three Army research reactors.

The primary objectives of the decommissioning of the DORF were:

(1) Remove the Special Nuclear Material (SNM), i.e., reactor fuel elements, and to return it to U.S. Energy Research and Development Administration (ERDA) for disposal;

(2) Remove all radioactive material from the facility and ship to an NRC-licensed burial site; and

(3) Decontaminate and prepare the facility building for alternate use.

Decommissioning was performed by Rockwell International, and was completed by 1980. Upon completion of decommissioning, the building was given to Walter Reed Army Medical Center (WRAMC) for their use (Giesler, 1977).

The Rockwell decommissioning effort (Rockwell, 1980) was performed using criteria published in Table 1 of AEC Regulatory Guide (RG) 1.86 (AEC, 1974), "Termination of Operating Licenses for Nuclear Reactors." However, the activation products present in the concrete in the exposure room far exceeded the contamination-based criteria for beta and gamma emitters published in RG 1.86 [5,000 (average) /15,000 (max) dpm/100 cm^2]. Therefore, the limits used during the DORF decommissioning were amended to be exposure rate based for beta-gamma emitters as shown in Table 5-3 (modified from Table 2 in the Rockwell Report).

TABLE 5-3: CONTAMINATION LIMITS USED DURING ROCKWELL DECOMMISSIONING OF THE DORF FACILITY

Contaminant	Total	Removable
Beta-Gamma Emitters	0.1 mrad/hr average* and 0.3 mrad/hr maximum† at 1 cm with 7 mg/cm^2 absorber	100 dpm / 100 cm^2
Alpha Emitters	100 dpm / 100 cm^2	20 dpm / 100 cm^2
** Measurements of average contaminant should not be averaged over more than 1 m^2. For objects of less surface area, the average should be derived for each such object.*		
† The maximum contamination level applies to an area of not more than 100 cm^2		

The Rockwell Report documented general area exposure rates up to 0.2 milliRoentgens per hour mR/hr, or 200 microRoentgens per hour (μR/hr) in the Exposure Room due to activation of the concrete walls, floor, and ceiling as described below:

"Radioactive materials and components that exceeded (*Rockwell Report*) Table 1 limits (*from AEC RG 1.86*) were removed from the facility. The limits in Table 2 (*shown as Table 5-3 above*) were also met in all areas except for the exposure room where, due to room geometry and the accumulative properties of activation products, the activity ranged from 0.08 – 0.24 millirad per hour (mrad/hr) as measured with a Technical Associates Mark III Cutie Pie – CP7M. The overall average was slightly higher than 0.1 mrad/hr. Individual pieces of concrete from the higher activity areas, when removed from the exposure room, indicated levels below 0.1 mrad/hr. These activity levels were deemed acceptable by the contracting officer's representative and by the United States Army Environmental Health Agency (USAEHA) radiation survey team," (Rockwell, 1980).

Core samples of the concrete structural materials confirmed that cobalt-60 (Co-60), Europium-152 (Eu-152), and Eu-154 were the principal activation products contributing to the elevated exposure rates. According to the Rockwell Report, the highest concentrations of these isotopes totaled 162 picocuries per gram (pCi/g) on the non-excavated north wall. After scabbling of the surface concrete up to depths of approximately 6 – 12 inches on the east wall, the highest concentrations of these isotopes totaled 39 pCi/g.

ARO Permit DORF-97-1, issued on 3 June, 1997 (USANCA, 1997) was opened due to residual exposure rates in the Exposure Room of the DORF. Follow-up surveys by the U.S. Army Research Laboratory (ARL) staff in 1997 (Borisky, 1997) confirmed that exposure rates in Exposure Room exceeded ambient background levels (~ 27 μR/hr general area). At the time of these surveys, no additional radiological controls were in place at the DORF to prevent individuals from gaining access to this area and receiving an unintended personnel exposure. ARL Staff requested that the ARO issue a permit to the DORF so that additional controls and monitoring procedures could be implemented to prevent removal or disturbance of the activated concrete. As a result, ARO Permit DORF-97-1 was issued on 3 June, 1997 (USANCA, 1997).

The permit required posting of two signs on the basement level of the DORF (outside and within the exposure room) alerting personnel that the structural materials are slightly radioactive and providing the ARO Permit number and ARL contact information. In addition, ARL is required to perform annual inspections of the Exposure Room and file reports to the ARO. The signs and the reporting requirements shall remain in place until the ARO permit is terminated.

The current NRC regulation governing release of decommissioned facilities for unrestricted use is found in 10 CFR 20.1402 – Radiological Criteria for Unrestricted Use (NRC, 1997):

"A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a total effective dose equivalent (TEDE) to an average member of the critical group that does not exceed 25 millirem (mrem), or 0.25 mSv (milliSieverts), per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal."

There are two primary differences between the current NRC decommissioning regulation and what was implemented for the DORF in 1980. The first of which being that license (or permit, in the case of ARO) termination is based on comparison with a dose-based criterion of 25 mrem/yr from all applicable pathways to an average member of the critical group. This means those persons who are likely to receive the highest dose from occupying the facility post-decommissioning. The second difference being the 'ALARA' clause, requiring the licensee (permit holder) to remove as much contamination or radioactive material as is reasonable during the decommissioning (Cabrera, 2008a).

Since 1988, the various rooms on the basement level have been used by the WRAMC HPO to decay short-lived hospital and research nuclides until they may be shipped offsite as purely bio-medical wastes.

Building 516 (the former DORF building) was chosen as short-term decay/storage facility for processing of radioactive waste because it offered the most utility without a great amount of money needing to be spent in building a new facility or upgrading an old facility to meet the regulatory requirements of the NRC. Because of the DORF, the building had already been found to be in compliance by the NRC for both safety and security. Building 516 also possessed water retention tanks (up until 1999), an air filtration system, crane, and a truck height loading dock. In addition, it offered floor space for the storage of a large number of barrels containing radioactive waste (Connock, 1988).

Radionuclides currently being stored include Iodine-125,-131 (I-125, I-131), Chromium-51 (Cr-51), Phosphorus-32 (P-32), Sulfur-35 (S-35), Technicium-99m (Tc-99m), among others. These wastes are stored in drums, laboratory overpack containers, i.e. 'labpacks', plastic trash bags, and boxes. Typical waste products also contain longer-lived nuclides like Carbon-14 (C-14, T1/2 = 5700 yrs) and Tritium (H-3, T1/2 = 12.3 yrs), but at the time of our visit neither of these nuclides were present in the inventory.

In addition to the containerized wastes, the DORF also has the following waste processing equipment that is known (or suspected) to be contaminated:

(2) Drum Compactors, an active unit on the Main Floor (blue) and a retired unit on the basement level. The retired unit is suspected to only have contamination on the impact head.

(1) Vial Crusher, which is used to separate the scintillation fluids from the glass and plastic vials. This unit is assumed to be contaminated and will require disposal. The exhaust of the crusher is vented through a series of filters (HEPA) prior to its release outdoors.

(1) Inactive Radioactive Hood on the Main Floor. The exhaust from the hood was also vented through dual HEPA filters located on top of the hood assembly.

Water from the DORF reactor pool and hot sinks was stored in three 5000-gal underground storage tanks, which served as hold-up tanks to allow sampling of any water from floor drains or the pool prior to release to the sanitary sewer. These tanks were sampled, found to be free of contamination, and removed by October 1999; however, the piping remains. When the tanks were removed the original pipes were left in place and reconnected to the sanitary sewer system.

In addition to the waste processing equipment, there is an assortment of hazardous waste issues present within Building 516 primarily from the presence of lead. These include:

• Stacks of lead bricks that were previously used for shielding purposes within the facility.

• Several storage 'pigs', either in the form of enclosed solid lead or containing lead shot. The versions containing lead shot previously were filled with oil to fill the void space, but have since been drained. One of these units has damage resulting in loss of lead shot from the shield.

• Lead-lined drums used (or unused) by hospital staff for gamma-emitting treatment or diagnostic radionuclides.

• Lead-lined penetrations in the ceiling of the Exposure Room. These lines were used to run cabling for electronics and other reactor support components. Any additional remedial activities on the ceiling of the exposure room must include consideration for this lead.

5.3.3 Data Gaps / Potentially Impacted Buildings

A December 1997 letter to the NRC indicates that RAM would no longer be used in Buildings 511 and 512, but no close-out documentation was discovered. No radioactive controls or restrictions exist (Shanbaky, 2000).

Close-out documentation exists for the entire north wing of the Gillette Building, but historical records show RAM usage in several other rooms, not within the north wing. RAM is not used in any of these rooms currently, but close-out documentation was not discovered. No radioactive controls or restrictions exist.

Based on information discovered during the site visit, the only rooms currently using RAM in the Taft Building are Rooms 15 and 20. Historical records show RAM usage in several other rooms,

not within Rooms 15 and 20. No radioactive controls or restrictions exist outside of Rooms 15 and 20. Routine surveys were available for Rooms 15 and 20, but no close-out documentation was discovered for any room/lab (WRAMC, 2008b). At some point during the license transfer as part of BRAC, the new holder may deem surveys necessary, although they will not be recommended within this current investigation as the Taft Building is slated for continued RAM usage.

Buildings 504 and 509 would be considered impacted, but they were demolished when the new WRAIR Building (503) was built; however, no documentation of close-out prior to demolition was discovered. Since Building 503 (also considered impacted) was built over the footprints of these Buildings 504 and 509, they can be disregarded at this time. Based on their proximity to Building 503, the footprints of these buildings may be re-visited at a later date during the eventual decommissioning of Building 503 (post-BRAC).

The locations of buildings classified as Impacted are shown on Figure 5-3 and Figure 5-4. Rooms are shown on the floor plans in Appendix B (where known and available).

5.4 Summary of Potential Contaminated Media

The only potentially contaminated media are the internal surfaces of buildings. No exterior areas were found to be impacted at the WRAMC Forest Glen Annex or leased facilities in Rockville, MD.

5.5 Radiological Conceptual Site Model

A conceptual site model (CSM) is a basic description of how radiological contaminants enter a system, how they are transported within the system, and where routes of exposure to organisms and humans occur. As such, it is used to assess the nature and extent of contamination, to identify potential contaminant sources, release mechanisms, exposure pathways, human and/or environmental receptors, and to develop exposure scenarios. The CSM is depicted graphically in Figure 5-5. A table summarizing location-specific findings (Building/Room/Radionuclide) with regards to the CSM is provided in Appendix B.

5.5.1 Known and Potential Release Mechanisms

The following mechanisms are proposed for possible contaminant release at WRAMC:

- Leaks and/or spills - This possibility could result laboratory accidents or the transfer of contamination from unsealed radiological sources and research compounds.
- Storage/disposal activities - Materials that have been disposed down laboratory sinks could then contaminate areas apart from where they were in active use. Radioactive wastes are temporarily stored in designated areas, but no on-site disposal was ever undertaken. No burials in any on-site landfills ever occurred. Demolition of contaminated buildings could also serve as a pathway, but in the case Buildings 504 and 509 being demolished to make space for Building 503 (which is also impacted), this pathway is eliminated.

Primary transport mechanisms include surface contamination of building materials (work surfaces, shelves, floors, walls, ceilings, etc.) and internal contamination of building piping and drains resulting from licensed disposal of RAM into sanitary sewer.

5.5.2 Known and Potential Migration Pathways

The following potential exposure pathways are proposed:

- Inhalation, ingestion, and/or dermal contact with contaminants found on building materials and/or transfer of contamination following dermal contact to other materials;
- Ingestion and/or inhalation of leachate in surface water and sediment present in contaminated building drains and piping; and
- Inhalation, ingestion, and/or dermal contact with leachate from water retention tanks and/or sanitary sewer discharge to soil and/or groundwater. Because sampling results showed water in the retention tanks to be clean before discharge, this pathway is very unlikely.

5.5.3 Known and Potential Human and Environmental Receptors

Human receptors potentially include occupational and/or laboratory workers who are in daily contact with radiological materials or work in and around potentially contaminated buildings. In addition, any construction workers at the site who are involved in building remediation or demolition activities would be potential receptors. Base and off-site local residents are potentially impacted via transfer of contamination obtained through contact with building materials or debris during remediation or demolition activities. Aquatic and terrestrial biota could be affected via contaminated soil/groundwater; however, due to the unlikelihood of this exposure pathway, no ecological receptors of consequence have been identified for the WRAMC Forest Glen Annex or leased facilities in Rockville, MD.

Former Buildings

Existing Buildings

Site Outline

REV	DATE	DESCRIPTION	BY

CABRERA SERVICES
103 E. MT ROYAL AVE.
BALTIMORE, MD 21202

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARLYAND

PREPARED BY: KJ

REVIEWED BY: MB

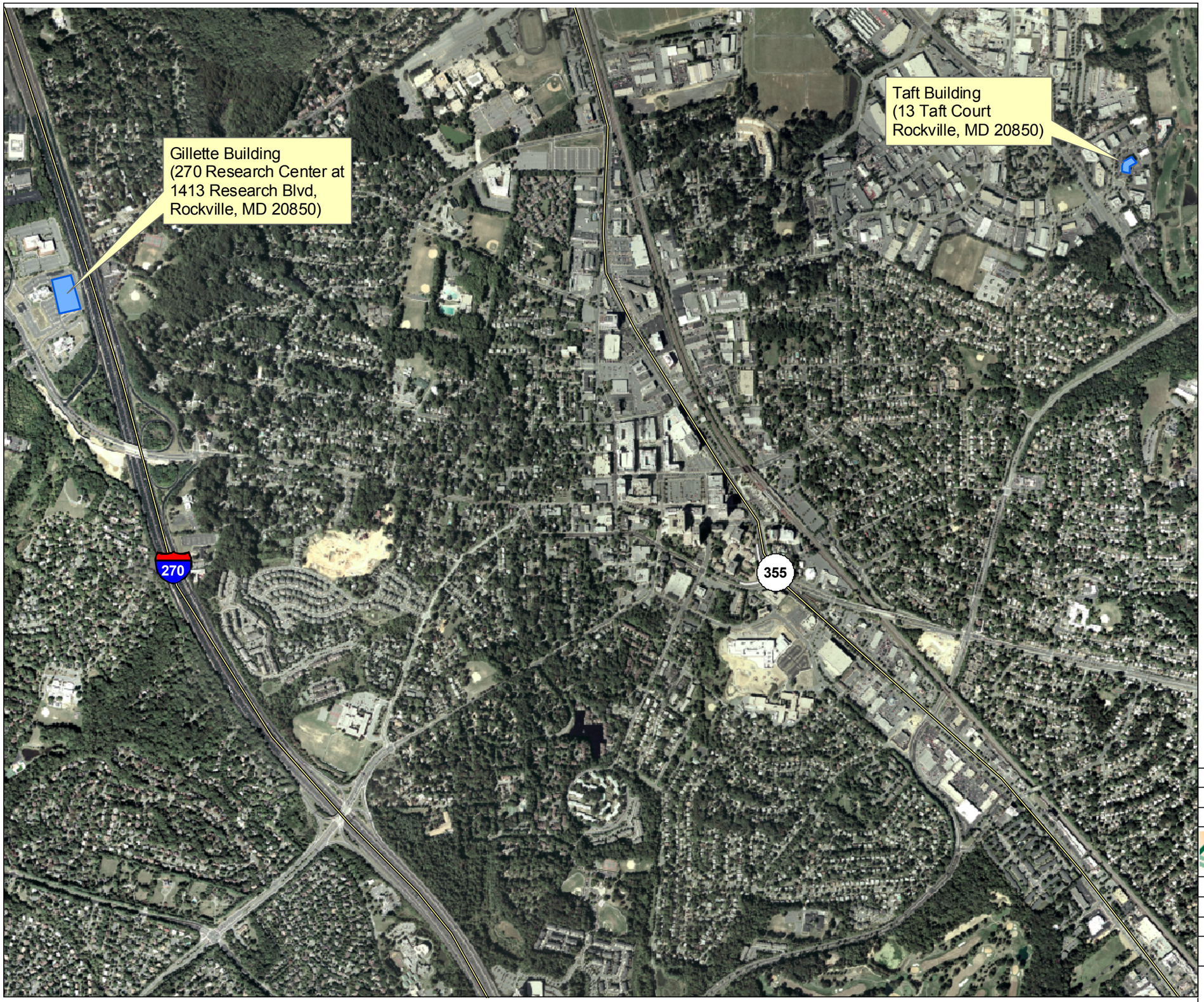
WALTER REED ARMY MEDICAL CENTER — FOREST GLEN ANNEX MARYLAND

HISTORICAL SITE ASSESSMENT
BUILDINGS INVESTIGATED

CONTRACT # W912DQ-08-D-0003 | PROJECT # 08-3800.03 | **Figure 5 - 1**

SCALE: 0 0.015 0.03 0.06 0.09 Miles

DATE: 8/12/2008



N

Existing Buildings

REV	DATE	DESCRIPTION	BY

CABRERA SERVICES
103 E. MT ROYAL AVE.
BALTIMORE, MD 21202

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARLYAND

PREPARED BY: KJ

REVIEWED BY: MB

WALTER REED ARMY MEDICAL CENTER — FOREST GLEN ANNEX MARYLAND

HISTORICAL SITE ASSESSMENT
BUILDINGS INVESTIGATED

CONTRACT # W912DQ-08-D-0003 | PROJECT # 08-3800.03 | **Figure 5 - 2**

SCALE: 0 0.045 0.09 0.18 0.27 Miles | DATE: 8/12/2008

N

Impacted Buildings

Site Outline

REV	DATE	DESCRIPTION	BY

CABRERA SERVICES
103 E. MT ROYAL AVE.
BALTIMORE, MD 21202

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARLYAND

PREPARED BY: KJ

REVIEWED BY: MB

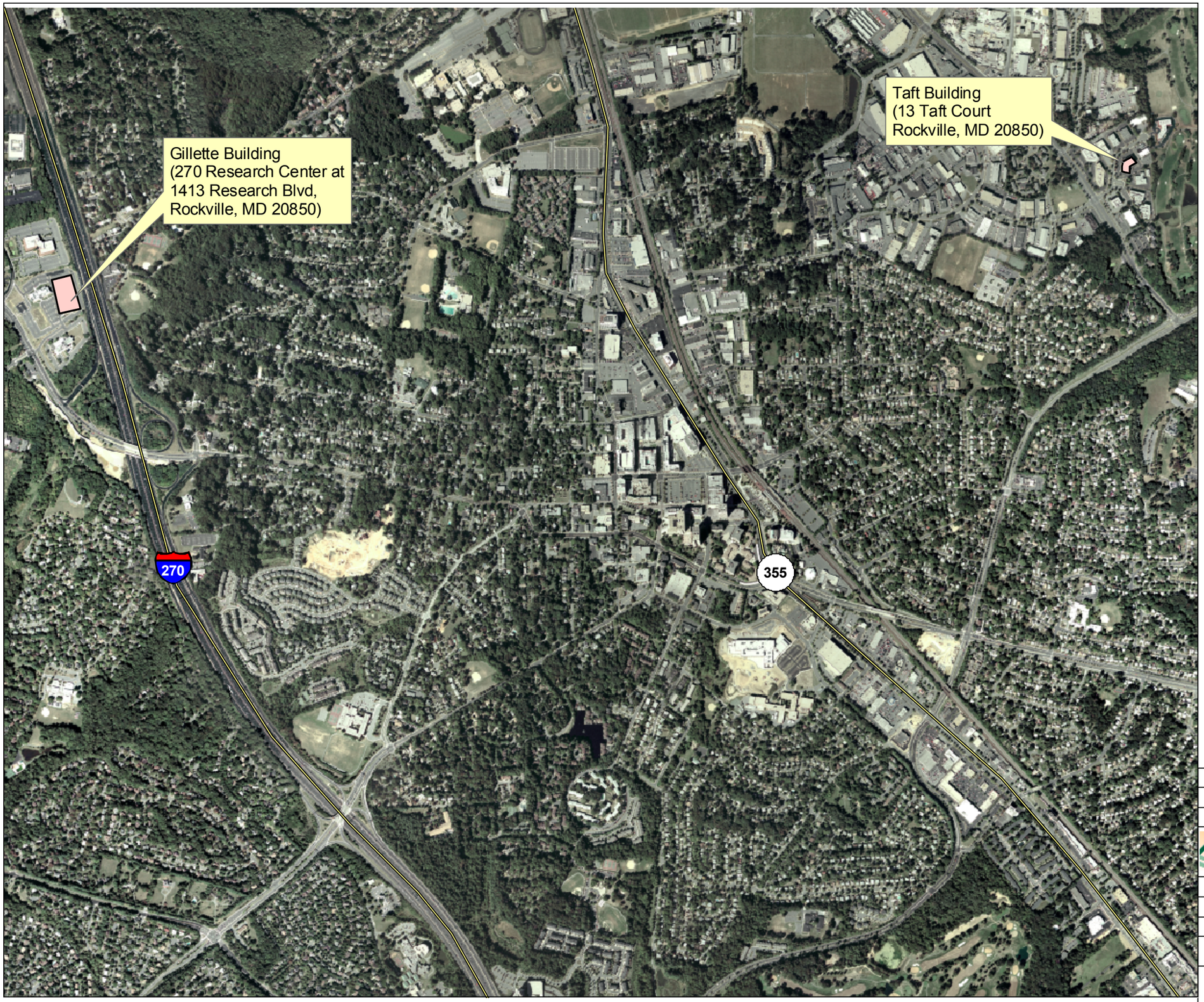
WALTER REED ARMY MEDICAL CENTER — FOREST GLEN ANNEX MARYLAND

HISTORICAL SITE ASSESSMENT IMPACTED BUILDINGS AT THE WRAMC FOREST GLEN ANNEX

CONTRACT # W912DQ-08-D-0003 | PROJECT # 08-3800.03 | Figure 5 - 3

SCALE: 0 0.015 0.03 0.06 0.09 Miles

DATE: 8/12/2008



Impacted Buildings

REV	DATE	DESCRIPTION	BY

CABRERA SERVICES
103 E. MT ROYAL AVE.
BALTIMORE, MD 21202

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARLYAND

PREPARED BY: KJ

REVIEWED BY: MB

WALTER REED ARMY MEDICAL CENTER — FOREST GLEN ANNEX MARYLAND

HISTORICAL SITE ASSESSMENT IMPACTED BUILDINGS AT THE WRMAC - LEASED FACILITIES IN ROCKVILLE, MARYLAND

CONTRACT # W912DQ-08-D-0003 | PROJECT # 08-3800.03 | **Figure 5-4**

SCALE: 0 0.045 0.09 0.18 0.27 Miles | DATE: 10/15/2008

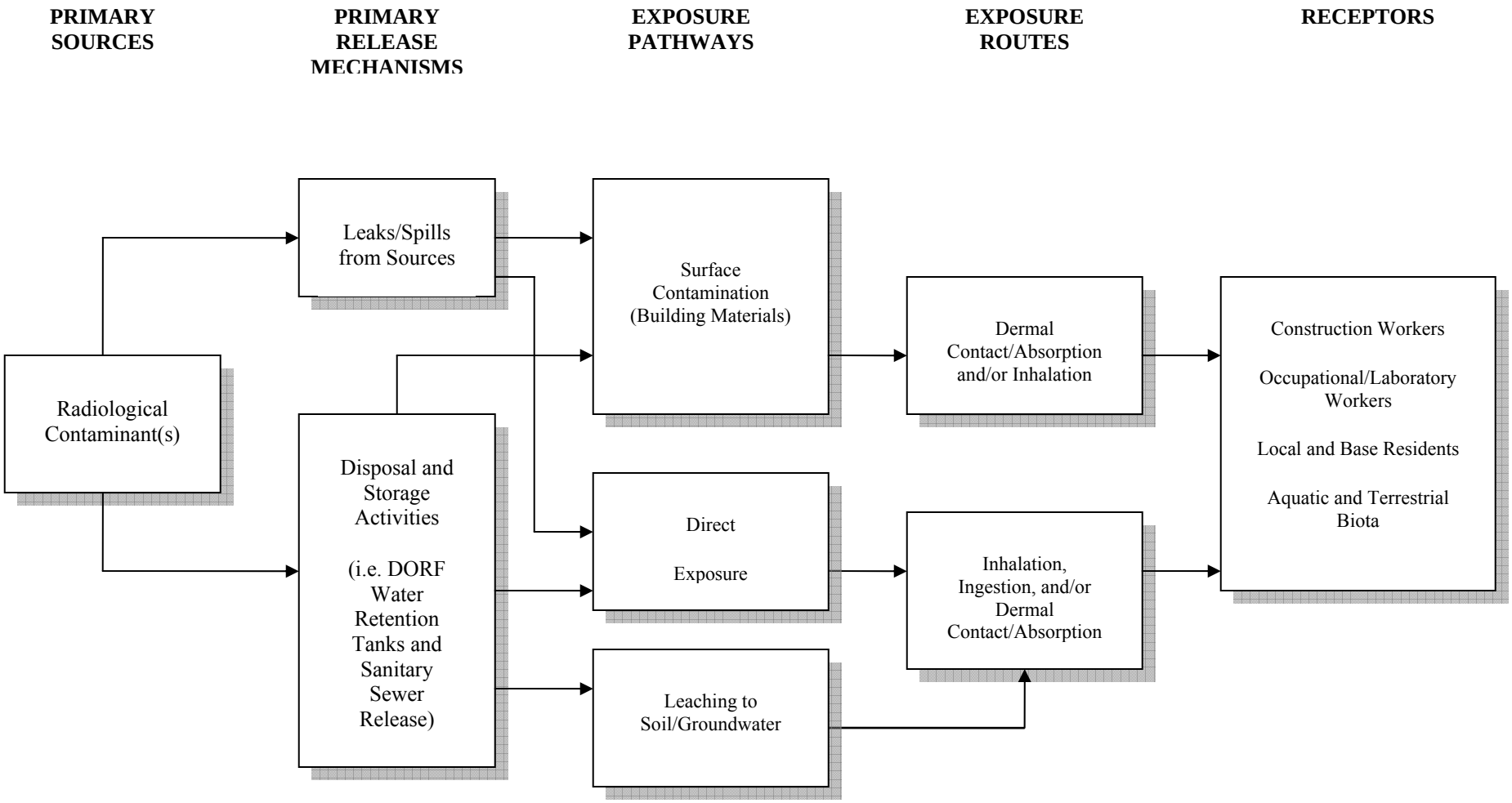


FIGURE 5-5: CONCEPTUAL SITE MODEL (CSM) FOR WRAMC

6.0 CONCLUSIONS

Using the survey methods outlined in Section 3.0, four buildings on the WRAMC Forest Glen Annex and both leased buildings in Rockville, MD can be classified as "Impacted" from historical use of RAM: Building 503, 511, 512, 516 (DORF), Gillette, and Taft.

Within the six buildings identified, 68 rooms, cells, or laboratories have been classified as "Impacted." Specific rooms are identified on the Building Fact Sheets (along with detailed drawings where available) included in Appendix B for each of the impacted buildings. No radiologically impacted outdoor areas or release points were identified for the Forest Glen Annex or leased Rockville, MD facilities during this HSA.

Many of the buildings/rooms identified during records searches have had extensive renovations performed, and/or been demolished and had a new facility built in place, since the use or possession of RAM was terminated. The WRAMC HPO is required to perform close-out surveys of all authorized rooms that are terminated; however, document retention procedures at WRAMC only require storage of survey documentation for 3-5 years. As a result, several buildings/rooms may be determined to be impacted due to the lack of appropriate closure documentation.

The WRAMC Forest Glen Annex and leased facilities in Rockville, MD contain active laboratories, with three of the buildings identified as impacted in this HSA having active RAM use authorizations in place (Building 503, 516, and Taft). Therefore, it must be noted that the information provided in this HSA should be viewed as a "snapshot" of current conditions and that these conditions may change in the time between publication of this HSA and final decommissioning of these facilities.

Of all radionuclides discovered to have been used at the WRAMC Forest Glen Annex and leased facilities in Rockville, MD, generally only radionuclides with half-lives greater than 1 year were retained as Radiological Contaminants of Potential Concern (RCOPCs). Using 1 year as a half-life cut-off for which radionuclides would be considered RCOPCs, it was assumed that if at least 7-10 years had passed since RAM usage, the radionuclide would be decayed to negligible levels, and thus not pose a concern. Short-lived radionuclides were only retained if documentation showed usage in an active laboratory or storage area (i.e. currently used/stored radionuclides are noted and included).

Radionuclides considered of potential concern for future surveys include: Am-241 (americium-241), Ba-133 (barium-133), C-14 (carbon-14), Ca-45 (calcium-45), Cl-36 (chlorine-36), Co-60 (cobalt-60), Cr-51 (chromium-51), Cs-137 (cesium-137), Eu-152 (europium-152), Eu-154 (europium-154), H-3 (tritium), I-125 (iodine-125), I-129 (iodine-129), I-131 (iodine-131), Ni-63 (nickel-63), P-32 (phosphorus-32), P-33 (phosphorus-33), Pu-239 (plutonium-239), S-35 (sulfur-35), technetium-99m (Tc-99m), and U-238 (uranium-238), based on reported use and evaluation of radioactive half-life (decay). Of these radionuclides, only Ca-45, C-14, Co-60, Cs-137, H-3, I-125, I-129, I-131, P-32, P-33, Ni-63, S-35, and Tc-99m apply to non-DORF buildings and structures.

Based on currently available information, as summarized herein, additional radiological survey activities, including direct measurements and/or discrete sampling will be required in order to support request for license termination and unrestricted release from applicable regulatory agencies.

7.0 RECOMMENDATIONS

The information contained herein is intended to form the framework for future MARSSIM investigations at the WRAMC Forest Glen Annex and leased facilities in Rockville, MD. The findings outlined in the HSA can be applied to develop scoping survey strategies for each impacted building with the intent of filling data gaps for future characterization or verifying that the area is non-impacted and may be released. With the latter point in mind, it is advantageous to design the scoping surveys with the rigor of a MARSSIM Final Status Survey (FSS) so that areas confirmed to be free of residual contamination may be released after this next step. Conversely, rooms or areas found to have residual radioactive contamination will be evaluated against the initial MARSSIM survey unit (SU) classifications assigned in this HSA to assess whether any impacted areas may require upgrade.

Data Quality Objectives (DQOs) for specific radiological scoping activities in Impacted areas are provided in Section 7.1. Specific recommendations for each building and future scoping survey efforts are provided in Section 7.4.

7.1 Data Quality Objectives

The following outlines the DQOs for the next phase of radiological investigation.

7.1.1 Step 1: State the Problem

7.1.1.1 Problem Description

RAM has been used in existing and former hospital facilities and research laboratories at WRAMC over the course of its operating history. A scoping survey must be conducted in impacted areas as defined in the HSA to provide a more comprehensive picture of what areas have been truly impacted by this RAM usage.

7.1.2 Step 2: Identify the Decision

7.1.2.1 Principal Study Question

Do RCOPC concentrations within impacted WRAMC areas exceed background levels by more than the chosen applicable levels for unrestricted release; and if so, what is the nature and extent of the contamination?

7.1.2.2 Decision Statements

The following statements assume that RCOPC concentrations inside buildings exceed release levels. If RCOPC concentrations inside impacted areas do not exceed the Derived Concentration Guideline Levels (DCGLs), the condition of the area will satisfy the release criterion.

- Determine whether RCOPC concentrations on interior building surfaces exceed background concentrations by more than the applicable DCGLs.
- If survey unit RCOPC concentrations inside buildings exceed background by more than the applicable release criteria, then affected areas must undergo further investigation and

or remediation to levels satisfying the release criteria.

- Surveys of mechanical systems with impacted areas found to be in excess of chosen DCGLs will be flagged for further characterization and possible remediation. Examples of mechanical systems that should be investigated include sinks and drains in known RAM labs; floor drains suspected for use of disposal of RAM into the sanitary sewer; and ventilation systems in RAM use areas.

7.1.3 Step 3: Identify Inputs to the Decision

7.1.3.1 Information Inputs

Data collection and evaluation should be performed using guidance found in the MARSSIM, and include:

- Interior scan surveys for alpha, beta, and gamma RCOPCs;
- Fixed-point measurements at designated systematic, random, and judgmental locations;
- Smear surveys for removable contamination at designated systematic, random , and judgmental locations;
- Dose rate surveys within the confines of each survey area; and
- Analysis of debris and material samples from within mechanical system components.

7.1.4 Step 4: Define the Study Boundaries

7.1.4.1 Data Population

The population of interest should be the concentrations of RCOPCs on interior building surfaces and in building systems in the impacted buildings. This population will be further subdivided by floors into survey areas during future scoping surveys.

7.1.4.2 Spatial and Temporal Boundaries

Spatial boundaries for this investigation are horizontally and vertically limited to interior building surfaces of impacted rooms and mechanical system components suspected to be impacted.

Data collection and analyses should be performed in a time frame to support the future decommissioning and BRAC milestones at WRAMC.

7.1.4.3 Constraints on Data Collection

Constraints on data collection include the continued occupancy and use of various hospital and laboratory spaces during execution of future scoping surveys. In those cases where existing operations restrict collection of additional radiological information, disposition will likely have to be delayed until these areas are abandoned.

Constraints on data collection may also exist in inaccessible areas, such as pipe runs between drains and cleanout traps. In these instances, decisions may be made based on data collected

from the areas where radioactive material may have entered the system, such as drains and hood exhaust vents.

7.1.5 Step 5: State the Decision Rules

7.1.5.1 Surface Scan Surveys

If areas of elevated radioactivity are identified during alpha and beta surface scan surveys above chosen DCGL levels or assigned Action Levels, identified areas should be marked for additional follow-up characterization activities or decontamination, as appropriate. Additional surveys should include static and smear samples for removable activity. The source and radionuclide mix at that location should also be determined, if feasible.

Scan surveys for gamma RCOPCs with a sodium iodide (NaI) detector, or equivalent, should also be considered for supplemental characterization information.

7.1.5.2 Exposure Rate Measurements

Exposure rate surveys will be evaluated directly against nominal background levels in non-impacted areas of WRAMC.

7.1.5.3 Systems Surveys

Surveys of building systems should also be evaluated to determine if they have been impacted by historical use of RAM. Evaluation of volumetric samples should initially be compared directly to instrument background levels to determine if any residual contamination requires characterization. Positively identified system samples may be evaluated against soil screening levels in NUREG-1757 Appendix B (NRC, 2003) as a means for determining whether a more rigorous dose assessment may be required.

7.1.6 Step 6: Define Acceptable Decision Errors

Constraints on decision error are not needed, because a statistical sampling plan is not required at the scoping survey phase of the project. The numbers of samples selected would likely be acceptable for a final status survey; however, no statistical evaluation is performed at this phase. Areas surveyed will be deemed impacted or non-impacted based on historical information, scoping survey results, and professional judgment.

7.1.7 Step 7: Optimize the Design

The variability of data will have an effect on the sampling design. If necessary, the sample frequency and the analytical procedures will undergo changes to optimize the design. Changes will occur concurrently for several steps with the DQO process. The design options, such as sample collection design, sample size, and analytical procedures will be evaluated based on cost and the ability to meet the DQOs.

7.2 Scoping Survey Criteria

7.2.1 Criteria for License Termination

Unrestricted use criteria and methodology considerations will be developed as part of the Data Quality Objective (DQO) process during subsequent phases of this investigation. The following technical documents are used by both private contractors and government agencies as bases for decommissioning and license termination in order to release buildings that have radiological contamination:

- "Radiological Criteria for License Termination", 10 CFR 20, Subpart E (NRC, 1997)
- NUREG-1757, "Consolidated NMSS Decommissioning Guidance – Decommissioning Process for Materials Licensees." (NRC, 2006a and 2006b)
- NUREG-5512, "Residual Radioactive Contamination from Decommissioning." Volumes 1-3. (NRC, 1999).
- U.S. Army Regulation, AR-11-9, "The Army Radiation Safety Program" (USDOA, 1999)
- MARSSIM (NRC, 2000)
- U.S. Atomic Energy Commission (AEC), Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors" (AEC, 1974) – Pertains to original standards used for DORF decommissioning
- U.S. Army Materiel Command (AMC) Guidance, "Radiological Surveys for Areas Where NRC-Licensed Commodities or Radium Containing Commodities Were Present," February, 2004 (AMC, 2004)
- U.S. Army Regulation, AR-50-7, "Army Reactor Program" (USDOA, 1996) – The Army Reactor Committee for Health and Safety was established by AR-385-80 in 1991; AR-50-7 supersedes AR-385-80, creating the Army Reactor Council (ARC).
- U.S. Army Regulation, AR-385-10, "Army Safety Program" (USDOA, 2000)
- U.S. Army Regulation, AR-10-16, "United States Army Nuclear and Chemical Agency" (USDOA, 2005)

7.2.2 Residual Radioactivity Limits

NUREG-1757 provides predetermined 'screening levels' for interior building surfaces [in units of disintegrations per minute (dpm) per 100 cm^2] and surface soils [in units of picoCuries per gram (pCi/g)] as a means for evaluating site contamination levels relative to the NRC's 25 millirem per year (mrem/yr) criterion without development of a site-specific dose assessment. Each screening value provided in NUREG/1757 corresponds to the concentration for each

RCOPC that would result in 25 mrem/yr. If residual activity does not exceed these values, then the NRC considers that the area does not need further radiological remediation. Building Surface Screening Levels for the specific RCOPCs are also provided in Table 7-1. However, if multiple nuclides are present, the 'unity rule' must be used to account for the fractions of the dose resulting from each RCOPC.

If residual radioactivity is found in an isolated area of elevated activity, in addition to residual radioactivity distributed relatively uniformly across the survey unit, the unity rule, also called the Sum of the Ratios (SOR), will be used to ensure that the total dose is within the release criterion decommissioning guidance (NRC, 2000). When multiple contaminants are present on a site, site radiological conditions are evaluated using the SOR and a $DCGL_w$ of SOR=1.0. The SOR is calculated as follows:

$$SOR = \frac{(C_1)}{(DCGL_1)} + \frac{(C_2)}{(DCGL_2)} + \frac{(C_3)}{(DCGL_3)} + \ldots$$

Where: $C_{1,2,3..}$ = Concentration of Radionuclides

$DCGL_{1,2,3..}$ = DCGL for that Radionuclide

The pCi/g soil criteria will only be applied to volumetric samples collected from building systems during the scoping survey. Examples of these types of samples may be debris from ventilation filters or ductwork or sediment/sludge from floor drains or piping.

A list of potential starting DCGL values for WRAMC building and systems investigations are provided in Table 7-1.

TABLE 7-1: DECOMMISSIONING REGULATORY CRITERIA

Release for Unrestricted Use	
USNRC: 10 CFR 20.1402	Total dose to the public after decommissioning of not more than 25 millirem per year

Acceptable License Termination Screening Values for Building Surface Contamination

	Nuclide	**Primary Decay Mode[1]**	**Total ($dpm/100cm^2$)**	**Removable[2] ($dpm/100cm^2$)**
USNRC NUREG 1757, Vol. 1, Table B-1 Building Surface Screening Values, and USNRC NUREG/CR-5512, Table 5.19 Concentration (dpm/cm^2) equivalent to 25 mrem/y for the specified value of P_{crit} (where $P_{crit} = 0.90$)	Am-241	alpha	2.7E+01	2.7E+00
	Ba-133	electron capture	**	**
	C-14	beta	3.7 E+06	3.7 E+05
	Ca-45	beta	2.8E+06	2.8E+05
	Cl-36	beta	5.0E+06	5.0E+05
	Co-60	beta	7.1E+03	7.1E+02
	Cr-51	electron capture	*	*
	Cs-137	beta	2.8E+04	2.8E+03
	Eu-152	beta	1.27E+04	1.27E+03
	Eu-154	beta	1.15E+04	1.15E+03
	H-3	beta	1.2 E+08	1.2 E+07
	I-125	electron capture	*	*
	I-129	beta	3.5E+04	3.5E+03
	I-131	beta	*	*
	Ni-63	beta	1.8E+06	1.8E+05
	P-32	beta	*	*
	P-33	beta	*	*
	Pu-239	alpha	2.8E+01	2.8E+00
	S-35	beta	1.3E+07	1.3E+06
	Tc-99m	isomeric transition	1.3E+06	1.3E+05
	U-238	alpha	1.0E+01	1.0E+00

Interim Screening Values for Soil Surface (USNRC NUREG 1757, Vol. 1, Table B-2)[3]

Nuclide	**Concentration (pCi/g)**
Am-241	2.1E+00
Ba-133	**
C-14	1.2E+01
Ca-45	5.7E+01
Cr-51	*
Cl-36	3.6E-01
Co-60	3.8E+00
Cs-137	1.1E+01
Eu-152	8.7E+00
Eu-154	8.0E+00
H-3	1.1E+02
I-125	*
I-129	5.0E-01
I-131	*
Ni-63	2.1E+03
P-32	*
P-33	*
Pu-239	2.3E+00
S-35	2.7E+02
Tc-99m	1.9E+01
U-238	1.4E+01

NOTES:
1. Building surface screening values were assigned to the primary decay mode, e.g., alpha,/beta, that will be used for detection during scoping surveys.
2. Removable limits have been set to 10% of the total surface screening level.
3. Interim soil screening values are listed here since they will be used to evaluate bulk system samples, vis a vis, drain sediment, other debris.

** these isotopes do not have listed soil or building screening values; they are very short lived and would be expected to have decayed to negligible levels between the time they are removed from use and the time the scoping survey occurs.*

*** Ba-133 has no listed soil or building screening value, so the lowest screening value among the other RCOPCs can be used as a suitable surrogate*

7.3 Survey Area Breakdown

Buildings screened as impacted, along with their preliminary MARSSIM Survey Unit (SU) classifications, are listed in Table 7-2.

TABLE 7-2: PRELIMINARY CLASSIFICATION OF IMPACTED BUILDINGS AT WRAMC FOREST GLEN ANNEX AND LEASED FACILITIES IN ROCKVILLE, MD

Building Number	Impacted Rooms	Preliminary MARSSIM Classification
503	2E12, 3E12, 3E14, 3E18, 1E22, 1E24, 3E24, 1E26, 1N40, 2N24, 2N34, 2N42, 2N47, 2N48, 2N58, 2N69, 2N80, 2W02, 2W106, 2W18, 2W23, 3N38, 3N66, 3W110, 3W16, 3W26, 3W50, 3W71, elevators, exits, floor 1, floor 2, floor 3, floor G, GW04, GW05B, GW72	None – Routine
511	114	Class 3
512	4, 6, 30	Class 3
516 (DORF)	Main, Lower, Mezzanine, Truck, Exposure Room	Class 1
Gillette	1205, 1206, 1207, 2143	Class 3
Taft	4, 5, 6, 7, 9, 10, 11, 14, 15, 16, 18, 20, 21, 24, 129, break, exits, floors	None – Routine

Building 503 This building is slated to continue RAM usage after BRAC; therefore, the only recommendation is to continue performing routine surveys in rooms with continued RAM usage and continue performing room final close-out surveys when RAM is no longer to be used in particular area.

It should be noted that all rooms are listed to provide a snapshot of the building's current radiological status as of the publication date of this HSA. Due to the building's plan for continued RAM usage under new permit/license (and the possibility that any of these rooms (or others), even those formerly reported as being closed out, may be used for operations with RAM in the future), a characterization/close-out survey is not recommended at this time. If RAM usage is ever to cease, to ensure proper close-out of these rooms/labs, after the source(s) removal, all present and retired labs/rooms listed in Table 7-2 should be surveyed according to MARSSIM with a focus on original surfaces, if possible. It is also recommended that any remaining mechanical systems at that time (sinks, drains, hoods) in all research laboratory areas be investigated for residual contamination.

Building 511 The building (with bias toward Room 114) should be surveyed as MARSSIM Class 3 with a focus on original surfaces, if possible. A 10% scan survey on

floors, bench tops, and lower wall surfaces should be performed, along with 30 random smears and a general area dose rate measurement.

Building 512 The building (with bias toward the area expected to be in the location of the former Rooms 4, 6, and 30) should be surveyed as MARSSIM Class 3 with a focus on original surfaces, if possible. A 10% scan survey on floors, bench tops, and lower wall surfaces should be performed, along with 30 random smears and a general area dose rate measurement. It is also recommended that any remaining original mechanical systems (sinks, drains, hoods) be investigated for residual contamination. Representative samples from systems should be collected based on professional judgment. Given the extensive renovation of this building, the chance of finding any original surfaces is low.

Building 516 (Former DORF Building) The fence surrounding the DORF complex will serve as the demarcation of what is considered the investigation area. Remove and package all legacy radioactive wastes and processing equipment for disposal at a licensed or permitted radioactive waste disposal facility. This includes the compactors, crusher, hoods, and legacy containerized wastes that remain at the former DORF building.

Given the current state of the Exposure Room, additional remediation will be required in this area to support termination of the ARO permit in the near future, i.e. within the next 5-10 years.

A decay-in-place option should only be considered if the ARL/ARO determines that permit termination is not a time-critical priority. The three principal activation products remaining have half-lives measured in years (Co-60, T1/2 = 5.2 yrs; Eu-152, T1/2 = 13.5 yr, and Eu-154, T1/2 = 8.6 yr), so this decision would require upkeep of the current ARO permit conditions until that time when conditions fall below 25 mrem/yr (current dose estimate is 57 – 70 mrem/yr from direct exposure alone)

Remediation of the activated surfaces in the Exposure Room will be far more cost-effective than demolition of the entire Building 516 as radioactive waste. Concrete removal in the Exposure Room may be accomplished using penetrating hammers, scabblers, or diamond-tipped cutting devices.

Removal should continue until the ambient exposure rates fall below a nominal 12 µrem/yr above background, which would allow a 2000 hr/year occupation by a critical group receptor and still fall below 25 mrem/yr. Provided that an average depth of 1-ft of additional concrete must be removed from all surfaces of the Exposure Room, this would lead to a waste volume of less than 50 cubic yards (assuming room dimensions of 20’ x 15’ x 8’). It must be noted that the actual volume will likely be far less than this value, given the previous remediation that has occurred and the uneven activation profile present.

Independent of the Exposure Room, a full characterization/FSS should be performed in all other areas on the Main Level and Basement Level (after waste removal has occurred) using the guidance provided in MARSSIM. All surveys should be designed as a FSS to take advantage of the possibility that many areas will pass in their current condition. These surveys should include the following:

- All areas should be classified as MARSSIM Class 1;

- 100% coverage scans of all accessible floors and lower walls (up to 2 meters) with gas-flow proportional detectors as well as focused scans using sodium iodide (NaI) detectors. Scans of upper walls and ceilings should be performed using engineering judgment based on potential for contamination;

- Static measurements at predetermined locations (assume 15 per survey unit) using gas-flow proportional detectors;

- Swipes for removable alpha/beta contamination at predetermined and select biased locations based on scan survey results;

- Dose rate surveys.

- Swipes or swabs from all sinks, sink traps, hoods, and ventilation system components (including filter housings and ductwork) within Building 516, and remaining piping leading from the building to the sanitary sewer system, that had direct or potential contact with RAM. Positive identification of radioactive material in these areas will lead to further characterization and potential remediation. It is recommended that the NRC Indoor Building Surface and Surface Soil Screening Values found in NUREG-5512 Tables 5-19 and 6-91, respectively, be used as the derived concentration guideline levels (DCGLs) for this project. This would preclude the need for derivation of site-specific DCGLs for the DORF.

Perform a MARSSIM Class 1 FSS in the Exposure Room, post remediation. This FSS should include all of the components outlined above.

All FSS activities should be presented in a summary report that may be submitted to the WRAMC HPO, ARL, ARO, and NRC for review and approval.

Gillette The building, with bias toward all present and retired labs/rooms listed in Table 7-2 (1205, 1206, 1207, 2143) should be surveyed as MARSSIM Class 3 with a focus on original surfaces, if possible. A 10% scan survey on floors, bench tops, and lower wall surfaces should be performed, along with 30 random smears and a general area dose rate measurement. It is also recommended that any remaining mechanical systems (sinks, drains, hoods) in all research laboratory areas be investigated for residual contamination.

Taft This building is slated to continue RAM usage after BRAC; therefore, the only recommendation is to continue performing routine surveys in rooms with continued RAM usage (Rooms 15 and 20) and continue performing room final close-out surveys when RAM is no longer to be used in particular area.

It should be noted that all rooms (other than Rooms 15 and 20) are listed to provide a snapshot of the building's current radiological status as of the publication date of this HSA. Due to the building's plan for continued RAM usage under new permit/license (and the possibility that any of these rooms, even those no longer using RAM, or new rooms, may be used for operations with RAM in the future), a characterization/close-out survey is not recommended at this time. If RAM usage is ever to cease, to ensure proper close-out of these rooms/labs, if appropriate prior closure record cannot be located, all present and retired labs/rooms listed in Table 7-2 should be surveyed according to MARSSIM with a focus on original surfaces, if possible. It is also recommended that any remaining mechanical systems at that time (sinks, drains, hoods) in all research laboratory areas be investigated for residual contamination.

7.4 Rationale for Scoping Surveys

The recommendations provided herein center around the fact that the buildings may be occupied during survey execution. As such, surveys should concentrate on areas, facilities, equipment, and systems that represent the highest probability of displaying residual contamination. Examples of these 'biased' areas would include any remaining lab sinks and accompanying piping, lab countertops, hood surfaces and ventilation equipment, and RAM storage / waste areas. The remainder of scoping survey efforts should focus on randomly sampling the surfaces on each floor of each presumed impacted building to test assumptions outlined in the DQOs.

Several buildings were screened as impacted due to the lack of close-out survey information, and many of these buildings have undergone substantial renovation and internal remodeling after the WRAMC HPO performed their surveys. It is understood that the probability of finding residual contamination in these areas is small. However, scoping surveys of the original building surfaces and systems should still be performed at some level to provide assurance that these buildings are suitable for unrestricted release. These operations may include the following:

- Removal of surficial flooring materials, e.g, vinyl tiles, carpeting, etc.
- Removal of cosmetic wall materials such as drywall so surveys can be performed on surfaces that were consistent when area had RAM use.
- Tracing building mechanical lines to get an understanding of where former floor drains or sinks may have been so that appropriate piping can be sampled for RAM.

Preliminary design recommendations for all scoping surveys in impacted WRAMC areas are summarized in Table 7-3.

TABLE 7-3: SUMMARY OF SCOPING SURVEY RECOMMENDATIONS FOR IMPACTED BUILDINGS

WRAMC Forest Glen Survey Design Summary					Direct Measurements and Sample Collection Minimum Number and Type (see Table Notes for descriptions and assumptions)				Measurement Type and Analysis (see Table Notes for descriptions and assumptions)		
Building	**Total Building Area (sq. ft.)**	**Impacted Rooms (Original)**	**RCOPCs**	**Preliminary MARSSIM SU Classification***	**Surface Scan Survey (Note A)**	**Smears for Removable Contamination (Note B)**	**Dose Rates**	**System Sample Survey (Note D)**	**Surface Scan Analysis**	**Removable Contamination Analysis**	**System Sample Analysis**
511	58488	114	C-14, H-3	3	10% (over no more than 3,634 sq. ft.)	30 per area, randomly chosen	C	At least 1 (but no more than 5) per area	Gross alpha-beta	E	F
512	9885	4, 6, 30	C-14, H-3	3	10% (over no more than 956 sq. ft.)	30 per area, randomly chosen	C	At least 1 (but no more than 5) per area	Gross alpha-beta	E	F
Gillette	101,552	1205, 1206, 1207, 2143	Cs-137, Co-60, H-3, I-129, Ni-63	3	10% (over no more than 10,155 sq. ft.)	30 per area, randomly chosen	C	At least 1 (but no more than 5) per area	Gross alpha-beta	E	F
516	3051	Lower Floor, Main Floor, Exposure Room, Mezzanine	Am-241, Ba-133, C-14, Ca-45, Cl-36, Co-60, Cr-51, Cs-137, Eu-152, Eu-154, H-3, I-125, I-129, I-131, Ni-63, P-32, P-33, Pu-239, S-35, Tc-99m, U-238	1	100%	One smear per 10 m^2, or a minimum of 10 per area on a systematic grid, whichever is greater	C	All accessible systems	Gross alpha-beta	E	F
503	No recommendations at the present time										
Taft	No recommendations at the present time										

** MARSSIM defined survey unit designations are not necessary at the scoping survey stage. Preliminary classifications may change based on the scoping survey results.*

TABLE NOTES

General Note: The extent of the survey will be determined by accessibility and current operations in the individual laboratories.

A - Low Priority Areas: Perform 10% scan survey on floors, bench tops, and lower wall surfaces (up to 6').

B - Smears should be taken per the number of locations listed in the table. The locations will be determined during generation of Scoping Survey Work Plan and on the judgment of the survey supervisor, and will generally be taken at the locations of the fixed static-count measurements. An additional biased smear will be performed at the location of the highest scan survey result.

C - Perform general area dose rate measurement within all rooms or areas. General guideline: walkthrough all areas with high sensitivity gamma detector, use professional judgment to check in the most likely locations for contamination, and record at least one reading per survey area, and record any readings significantly above background.

D - Collect representative samples from all systems that are suspect based on professional judgment (e.g. accessible ventilation ducting, hoods, and drains). One composite scraping of each type of material may be taken of representative materials or debris.

E - Smear samples, scrapings, and systems samples should be counted for gross beta and H-3/C-14 contamination via liquid scintillation counting. In addition, any samples with gross alpha-beta results above release limits should also be screened for gamma contamination.

F - Bulk system matrix samples should be analyzed using liquid scintillation and gamma spectroscopy counting. Any questionable results should be evaluated on a per-sample basis to gauge whether additional analyses are warranted.

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