4 ENVIRONMENTAL IMPACTS

This chapter provides an assessment of the potential environmental impacts that would result from implementing the alternatives considered in this EIS. Each alternative was evaluated for its potential to produce environmental impacts. Chapter 4 is organized like Chapter 3, by resource area.

For the purposes of this EIS, the terms "impacts" and "effects" are used interchangeably; they are synonymous. Impacts can be described as having several distinct attributes. The following defines the impact attributes that were used to assess potential impacts:

- **Context** – Context refers to the geographic, social, and environmental circumstances within which a proposed action may have effects on an environmental resource. An action in a disturbed urban area may have little effect compared to one in an old growth forest. Context also refers to the scale of the impact; i.e., the size of the area affected by the action.
- **Intensity** – Intensity refers to the severity of the impacts – the degree to which a proposed action would affect an environmental resource. Intensity is rated as negligible, minor, moderate, or major, in accordance with the framework presented below.
- **Short-term or Long-term** – Impacts can be short-term (noise and dust during the construction of a building) or long-term (destroying a historic structure to make way for a new building). These characteristics are determined on a case-by-case basis and do not refer to any rigid time period. In general, short-term impacts are those that would occur only with respect to a particular discontinuous activity or for a finite period, or only during the time required for installation activities. Long-term impacts are those that are more likely to be persistent and chronic.
- **Direct or Indirect** – Impacts can also be direct (filling wetlands to build a new road) or indirect (population growth induced by the new road). A direct impact is caused by a proposed action and occurs contemporaneously at or near the location of the action. An indirect impact is caused by a proposed action but might occur later in time or be farther removed in distance but still be a reasonably foreseeable outcome of the action.
- **Positive or Negative** – Impacts of a proposed action can be positive (more jobs from a new factory) or negative (cutting down trees to build a factory). A positive impact is one having beneficial outcomes on an environmental resource. A negative impact is one having adverse, unfavorable, or undesirable outcomes. A single action might result in positive impacts on one environmental resource and negative impacts on another resource.

The following scale is the qualitative framework used in this EIS to evaluate the intensity of impacts:

- **No Impacts** – No change to the environmental resource.
- **Negligible Impacts** – Impacts either are non-detectable or, if detected, are well within natural or normal variability and do not appreciably affect the extent or value of the environmental resource. Adverse impacts are easily absorbed by the natural or human environment without mitigation or long-term consequences.
- **Minor Impacts** – Impacts are clearly detectable but they approximate natural or normal variability and do not appreciably affect the extent or value of the resource. If needed to offset adverse impacts, mitigation is simple and mitigation success is likely.
- **Moderate Impacts** – Impacts exceed natural or normal variability; impacts appreciably affect the value or extent of the resource, but do not affect its viability. Although mitigation typically would be needed for the environment to absorb adverse impacts without long-term deterioration, mitigation success is likely.
- **Major Impacts** – Impacts exceed natural or normal variability and likely affect the viability of the resource or, as the impacts are highly uncertain or involve unique or unknown risks, the future viability of the resource is in question. Full mitigation of adverse impacts may not be possible or mitigation success is not likely, and some long-term deterioration of the environment may be unavoidable.

4.1 Land Use, Plans, and Coastal Zone Management

4.1.1 No Action Alternative

Under the No Action Alternative, outdoor RDT&E activities at NSF Dahlgren would continue at the existing level into the foreseeable future. There would be no increase in the average annual number of such activities, as described in Table 2-1.

4.1.1.1 NSF Dahlgren

Existing land uses at NSF Dahlgren, described in Section 3.1.1, reflect and support current operations, including outdoor RDT&E activities. Implementation of the No Action Alternative, under which outdoor RDT&E activities would continue to be conducted as at present, would neither cause nor require any changes in land use. The EEA and PRTR range complexes and their associated infrastructure, which currently support NSWCDD's outdoor RDT&E activities, would continue to be used and maintained as they are now. Outdoor RDT&E activities would continue to be conducted on the ranges and Mission Area (Figure 1-4), but not in the Sailor and Family Support Area (see Figure 3.1-1). Impacts on land use at NSF Dahlgren result from the need to divert non-RDT&E-related uses, such as recreation and installation travel, during some outdoor RDT&E activities to ensure the safety of personnel. Consequently, travel times on the installation may be longer during certain operations, or personnel may need to reschedule their outdoor recreational activities, such as jogging. These negative impacts on other NSF Dahlgren land uses would be negligible, short-term, and direct. There would be no indirect impacts.

Generally, continuation of outdoor RDT&E activities at the current level would be consistent with the plans that have been developed to guide the development of NSF Dahlgren and Naval District Washington (NDW), which include the *Naval Surface Warfare Center Dahlgren Site Area Development Plans: Warfare Systems Complex, Weapons Development Complex, and Advanced Concepts Complex* and the *NDW Regional Shore Infrastructure Plan* (RSIP) (see Sections 3.1.1.2 and 3.1.1.3, respectively). However, by not allowing for future increases in NSWCDD's outdoor RDT&E activities, and thus restricting its potential to accommodate new and emerging RDT&E needs and requirements, the No Action Alternative would not fully support the recommendation from the RSIP to "recognize NDW as an RTD&E center" that stands out among other regions (see Section 3.1.1.3), as the extent of RTD&E would be limited.

4.1.1.2 Dahlgren Area and Potomac River Shoreline

Existing land uses near NSF Dahlgren and along the Potomac River shoreline on either side of the PRTR, described in Section 3.1.2.1, are the cumulative result over time of a wide range of factors, including geography, demographic conditions, economic conditions, and local and state land use and development policies, along with the corresponding regulatory requirements. The presence of the Navy at Dahlgren since 1918 also has been a factor, as have other features, such as the presence of the Potomac River, the proximity of Washington, DC, and the state and federal transportation infrastructure.

Historically, the two aspects of NSF Dahlgren most likely to have had a significant influence in shaping existing land use patterns are (1) the installation's role as a major employment center, creating a demand for nearby housing and supporting commercial uses, and (2) the installation's

role as a center for outdoor RDT&E activities, with associated noise impacts (see Section 4.5) and occasional restrictions on river use. While the former can be expected to have made the area around NSF Dahlgren more attractive to residential development, the latter, to the contrary, may be expected to have made it less so, though it is not possible to ascertain to what degree, especially since so many other factors have also been, and continue to be, at play.

However, the No Action Alternative would cause no change to any of the multifarious factors that have created existing land use patterns. In particular, it would not affect those aspects of NSF Dahlgren most likely to influence surrounding land uses: NSF Dahlgren would remain a major employment center, though no significant increase in personnel is expected; and the environmental impacts of the outdoor RDT&E activities conducted at the installation would remain the same as well.

One possible foreseeable consequence of increased population encroachment with no economic affiliation to NSF Dahlgren is the potential for a growing negative reaction to the Navy's activities, and particularly to the noise associated with them. Increases in noise complaints can be expected, not from an increase in Navy activity, but rather from a changing population with little relationship to NSF Dahlgren. Conceivably, dissatisfaction with NSF Dahlgren as a neighbor could nominally dampen the rate of future residential development and affect land use patterns.

However, to monitor and control noise from its outdoor RDT&E activities and, thereby, reduce noise complaints from surrounding communities, NSWCDD has developed and implemented a noise management process, which is summarized in Section 3.5.3.5 and reproduced in full in Appendix C. Implementation of the noise management process is expected to minimize noise impacts and noise complaints resulting from NSWCDD's outdoor RDT&E activities, and substantially preclude noise-related effects on future residential development and land use.

The land use plans and policies of the five counties included in the study area for this EIS as well as those of the Town of Colonial Beach would continue to guide future development, in combination with demographic and economic conditions. These plans and policies are briefly characterized in Section 3.1.2.2 and are described in more detail in Appendix B. Continuation of the current level of outdoor RDT&E activities at NSF Dahlgren, as would occur under the No Action Alternative, would be consistent with the plans, which all have been developed relatively recently and, therefore, can be expected to have taken the installation and its on-going activities into account.

Therefore, under the No Action Alternative, current development patterns can be expected to evolve as envisioned by the different comprehensive plans developed by the jurisdictions making up the study area. No significant new factors that could unexpectedly and substantially alter the character or density of development near the installation or along the Potomac River would be introduced as a result of this alternative. (Although unforeseen demographic or economic changes may intervene and significantly alter land use patterns, such potential changes are independent from the Navy's decision with respect to the Proposed Action evaluated in this EIS.) Thus, the No Action Alternative would have no direct or indirect impact on land use near NSF Dahlgren and along the Potomac River shoreline because it would not change factors such as noise and river use, which are already incorporated into existing land use patterns.

The No Action Alternative would have no direct or indirect impact on existing access to the Potomac River for either commercial or recreational purposes (commercial navigation is addressed in Section 4.2.1.2). As is currently the case, portions of the river, mostly within the

MDZ but also occasionally including the upper LDZ, would continue to be restricted on average a total of 750 hours per year to allow for the safe performance of RDT&E activities in the PRTR. This impact would continue to be minimized, as is done at present, through the procedures described in Section 3.8.1.1, including advance notice of any restrictions and reasonable efforts to minimize inconvenience by taking advantage of any lulls in operations (e.g., for equipment adjustments and the like) to allow watercraft to move through the affected area. Shallow-draft boats (which most recreational vessels are) can always pass by hugging the Maryland shore of the river.

The No Action Alternative would not result in any direct or indirect impacts on the ongoing projects described in Section 3.1.2.5. The projects' owners can be expected to have taken the presence of and activities at NSF Dahlgren into account in their planning. Under the No Action Alternative, no new factors or impacts would be introduced that could affect the economic or operational viability of any of those projects.

4.1.1.3 Special-Use Airspace

Under the No Action Alternative, NSWCDD's designated special-use airspace (SUA) at NSF Dahlgren would continue to operate as it does today and as is described in Section 3.1.3. Commercial operators would continue to fly along long-established routes that avoid the SUA, and general aviation operators would continue to avoid the SUA at all times as a matter of course. They would also continue to have the option of checking Notices to Airmen (NOTAMs) and communicating with air traffic control at NAS Patuxent River in case they want or need to fly through the SUA. However, as noted in Section 3.1.3, such an occurrence is, and is expected to remain, very rare. There would be no change to existing conditions and no direct or indirect impact on non-military airspace users.

4.1.1.4 Coastal Zone Management

Pursuant to Coastal Zone Management Act (CZMA) § 307(c)(1) and 15 CFR Part 930, Sub-part C, Federal Coastal Consistency Determinations (CCDs) for the Proposed Action evaluated in this EIS (including the No Action Alternative and Alternatives 1 and 2) were prepared to evaluate the consistency of the Proposed Action with the coastal zone management programs of Virginia and Maryland, respectively. These documents, contained in Appendix I of this EIS, were submitted for review to the Virginia Department of Environmental Quality (VDEQ) and the Maryland Department of the Environment (MDE) along with the DEIS when it was published.

Based on the impact analyses contained in the EIS, the Navy concludes in the CCDs that the Proposed Action, under any of the alternatives considered, including the No Action Alternative, is consistent to the maximum extent practicable with the enforceable policies of the coastal zone management programs of Virginia and Maryland. VDEQ responded to the Navy's conclusion in a letter dated October 18, 2012 (reproduced on page A-69 in Appendix A; consistency determination conclusion on page A-82) that "Based on our review of the Navy's consistency determination, and the comments and recommendations submitted by agencies administering the enforceable policies of the VCP [Virginia Coastal Program], DEQ concurs that the proposed actions are consistent, to the maximum extent practicable, with the VCP."

MDE did not respond within 60 days to the Navy's consistency determination nor ask for an extension, so under the provisions of the CZMA, the state has waived its consistency rights,

stating neither that it concurs with nor objects to the Navy's consistency determination. The Maryland Department of Natural Resources' (MDNR's) comments on the DEIS (documented on pages A-64 and A-65) included a section entitled "Consistency with the Coastal Zone Management Act," with three comments:

- Navigational comments focus on the noise policy.
- Charles County notes a potential use conflict with a marina and development project.
- Proposed increased training and testing activities may conflict with other activities in the Potomac River, such as recreational and commercial fishing, recreational boating and War of 1812-related 200th Anniversary commemoration events in the Potomac River.

MDNR also asked that "General Comments" be considered when assessing the consistency of the proposed activities with Maryland's enforceable coastal zone management policies. These comments concern:

- Bald eagles
- Waterfowl concentration and staging areas
- Noise impacts on residents
- Terrapin and horseshoe crab spawning habitat
- Largemouth bass habitat and shoreline erosion control projects
- Submerged aquatic vegetation
- Increased exclusion of commercial and recreational boaters
- Natural oyster bars
- Sea-level rise
- Striped bass, Atlantic sturgeon, and anadromous fish spawning sites
- Need to consult US Coast Guard for mainstem boating modifications
- Fish and shellfish tissue analysis
- Point and non-point pollution
- Potential effects on wildlife due to magnetic and electric field exposure

Responses to comments S004.3 through S004.19 in the DEIS comment matrix in Appendix A address MDNR's issues and describe their resolution.

4.1.2 Alternative 1

Under Alternative 1, NSWCDD's RDT&E activities would increase relative to baseline (existing and no action) conditions as shown in Table 2-2.

4.1.2.1 NSF Dahlgren

Under Alternative 1, while there would be an increase in the annual average number of outdoor RDT&E activities performed at NSF Dahlgren, there would be no change in the type of activities

(with the exception of the use of biological simulants for chem/bio testing, as only chemical simulants are used under existing conditions and would be used under the No Action Alternative). This quantitative increase would not require new or different facilities than those that currently exist or are being built. No new military construction (MILCON) is included in the Proposed Action. The facilities now supporting NSWCDD's RDT&E work, including the two range complexes, would continue to be used and maintained as they are now. RDT&E activities would continue to be conducted within the ranges and the mission area, where they are already performed. Likewise, outdoor RDT&E activities would continue to be conducted typically during normal operating hours (8 am to 5 pm on weekdays), with infrequent activities outside normal hours, as would be the case under the No Action Alternative. However, under Alternative 1, EM energy, laser, and chem/bio sensor activities outside the normal operating hours would occur at greater frequency than is the case now. None of these differences would affect land use patterns at the installation. However, an increased number of outdoor operations requiring restrictions on land range access would increase the inconvenience to other land uses, such as travel around the installation and recreation, resulting in negligible, short-term, direct, negative impacts and no indirect impacts during some outdoor RDT&E activities.

Alternative 1 would be consistent with the plans that have been developed to guide the development of NSF Dahlgren and NDW, including the *Naval Surface Warfare Center Dahlgren Site Area Development Plans: Warfare Systems Complex, Weapons Development Complex, and Advanced Concepts Complex* and the NDW RSIP (see Sections 3.1.1.2 and 3.1.1.3). Unlike the No Action Alternative, Alternative 1 would support the recommendation from the RSIP to promote NDW as an RTD&E center that stands out among other regions, since it would allow NSWCDD to better accommodate new and emerging RDT&E needs and requirements. Because it would result in NSWCDD's making better use of its facilities at NSF Dahlgren, Alternative 1 would also support the RSIP's recommendation to maximize existing facilities for highest and best use.

4.1.2.2 Dahlgren Area and Potomac River Shoreline

As explained in Section 4.1.1.2, existing land uses near NSF Dahlgren and along the shores of the Potomac River on either side of the PRTR are the cumulative result of a number of factors, including, though to an unknown degree, the influence of NSF Dahlgren as both a major employment center and the location of various outdoor RDT&E activities, with impacts on noise levels and river use. Continuation of the current levels of outdoor RDT&E activities (the No Action Alternative) would have no direct or indirect impact because it would not change factors such as noise and river use, which are already incorporated into existing land use patterns, current plans, and on-going projects.

Conversely, an increase in the number of RDT&E activities, as would occur under Alternative 1, could potentially have an impact on land use patterns, existing land use plans and policies, and ongoing projects if it affects those NSF Dahlgren-related factors most likely to have an influence on land use, namely noise and river use. For instance, a significant increase in noise levels could create incompatibilities with land uses or projects requiring a reasonably quiet environment, such as residential developments, parks, or historic properties. Similarly, a significant increase in the number and/or duration of river range restrictions might create incompatibilities with water-based recreational or commercial uses. Potential impacts would not necessarily be adverse. For instance, an increase in noise levels, which might discourage future waterside residential

development, could indirectly further land use policies aiming to preserve as much as possible of the shoreline in an undeveloped state for environmental conservation and recreational purposes.

As shown by the noise analysis for Alternative 1 (Section 4.5.2), the alternative is expected to result in minor, long-term, direct, negative noise impacts. The noisiest activities (large gun activities and detonations) would either not increase (large guns), increase negligibly (detonations), or be contained within the installation (small arms). The greater use of UAVs for EM or laser testing also may result in some additional noise, but given the small size of many of the UAVs used and their associated modest noise levels, as well as the altitude at which they fly (2,000 to 3,000 ft; sometimes more), noise from flights is expected to be negligible. Increased use of the upper LDZ as a target area for large-gun firing would extend the area affected by large-gun noise downriver more frequently than the occasional use made of this area in recent years. With the exception that noise levels would be higher downriver in the vicinity of the upper LDZ up to ten days a year, noise levels in the study area under Alternative 1 would not substantially vary from noise levels under existing and no action conditions. Because greater use of the upper LDZ would take place at most ten days a year and the rounds fired may be inert, which would not increase noise levels in the target area, current or future land use patterns, including ongoing residential projects such as the Villages at Swan Point Project (see Section 3.1.2.5), are not likely to be affected.

With respect to river access, under Alternative 1, some part of the PRTR would be in use on average for 870 hours a year, as opposed to 750 hours a year under existing and no action conditions – an increase of 120 hours during which a portion of the Potomac River and its tributary Upper Machodoc Creek may not be accessible to commercial or recreational boaters or may require that vessels go around the edge of the range when it is restricted. In addition to the relatively modest size of the increase (16 percent), the impact on recreational boating (the most relevant factor when dealing with land use, as it may more directly affect the desirability of waterside property; potential impacts on commercial boating are addressed in Section 4.2.1.2 and would be minimal) would be small because for the most part, access restrictions would still be limited to approximately 8 am to 5 pm on weekdays (set-up for testing may begin before 8 am and activities may continue after 5 pm on some days), whereas pleasure boating is predominantly a weekend or evening activity.

Restriction of the MDZ often covers only part of the MDZ – not all of it – allowing vessels to move freely in the unrestricted part. When firing is taking place, a larger part or even the whole of the MDZ or upper LDZ, depending on the location of the target area, may be restricted. While under Alternative 1 activities requiring water access restrictions may take place on weekends – EM energy, HE laser, or chem/bio defense, but no gun firing – such occasions would typically be those when the specific weather conditions needed for a test are present, but such weather conditions – often involving fog or wet weather – are also those most likely to keep pleasure boaters home. Activities could also take place during the week outside normal working hours, at dawn, dusk, or during the night. Again, in addition to the relatively low frequency of such cases, these are hours when recreational use of the water is at a minimum, with the possible exception of recreational fishing from boats, but anglers are often not limited to one spot and, if needed, may relocate with little trouble.

These impacts would not be distributed evenly throughout the river range. Under existing and no action conditions, all or part of the MDZ and the upper LDZ (to 40,000 yds from firing) are restricted for range activities, but not the UDZ or lower LDZ. This would change under

Alternative 1. Access to all or part of the UDZ and/or the LDZ would be restricted approximately two days a year for operations involving vessels and aircraft. Access to the upper LDZ to 40,000 yards from the firing line would be restricted approximately ten days a year. Restricting public access to these areas has been infrequent in recent years, so the inconvenience to other river users would be more noticeable to them than to users accustomed to the regular restrictions imposed on the MDZ.

Another area that would sustain more impact is the mouth of Upper Machodoc Creek. The increased impact would be in large part a direct result of the more frequent HE laser and other directed energy tests that would be conducted across the creek to and from the Navy Directed Energy Center (NDEC) and the Counter Explosives Test Facility (CETFAC), located on the northern and southern shores of the creek, respectively (see Figure 1-8). HE laser and directed energy testing would require restricting public access to the mouth of the creek while the test is in progress more often than is currently the case or would be the case under the no action conditions. A substantial number of such tests would take place at either dawn or dusk, which are times when boats docked on the creek's shores may be on their way to or back from Potomac waters. (Tests would also take place occasionally at night, but few, if any, recreational boaters are likely to be affected by this.)

However, several factors contribute to minimizing this localized adverse impact. First, as is the case with all river range restrictions, information on the time and duration of each test would be made available in advance on the web and via a toll-free number (see Sections 1.6 and 3.8.1.1). Second, by their nature, activities involving lasers and directed energy are intermittent and include long periods during which boats would be allowed to pass under controlled conditions, through the restricted test area, consistent with NSWCDD's policy to make all reasonable efforts to minimize public inconvenience. Finally, inevitable delays are expected to be 10 minutes on average, and, in the worst case, are not expected to exceed 30 minutes. For these reasons, the impact on boat traffic across the mouth of Upper Machodoc Creek is expected to be minor.

More generally, any impact on river use would continue to be minimized, as is done at present, through the procedures described in Section 3.8.1.1, including issuance of advance notice of any restrictions and reasonable efforts to limit inconvenience by taking advantage of any lulls in testing to allow watercraft to move through the affected area. Shallow-draft vessels, which most recreational craft are, would continue to be able to pass by the range by hugging the Maryland shore of the river. Thus, impacts on water access would be negligible and not sufficient to noticeably affect present or future land use patterns.

The increased outdoor laser, EM energy, and chem/bio defense RDT&E activities that would take place under Alternative 1 would have no impacts likely to affect land use patterns in the study area, as they would remain within the confines of the ranges or the mission area (potential effects relating to noise and water access are addressed in the preceding paragraphs).

Under Alternative 1, as under the No Action Alternative, current development patterns can be expected to evolve as envisioned by the different comprehensive plans developed by the jurisdictions in the study area. No significant new factors that could unexpectedly and substantially alter the character or density of development near the installation or along the Potomac River would be introduced as a result of this alternative. (Although unforeseen demographic or economic changes may intervene and significantly alter land use patterns, such potential changes are independent from the Navy's decision with respect to the Proposed Action

evaluated in this EIS.) However, the increase in the number of RDT&E activities under Alternative 1 and the resulting adverse noise and river use effects potentially would nominally affect land use patterns, existing land use plans and policies, and ongoing projects. Thus, Alternative 1 would have no direct impacts and negligible, long-term, indirect, negative impacts on land use, land use planning, and ongoing development projects.

4.1.2.3 Special-Use Airspace

The increased use of the SUA for NSWCDD's RDT&E activities that would occur under Alternative 1, compared to existing and no action conditions, would have negligible, short-term, direct, negative impacts and no indirect impacts on non-military airspace users for the following reasons:

The lower tier (surface to 7,000 or 40,000 ft) of the SUA above NSF Dahlgren and the PRTR is normally in effect every non-holiday weekday from 8 am to 5 pm and the higher tier (40,000 to 60,000 ft) is used as needed, in which case a NOTAM is issued. A NOTAM is also issued when the lower tier of airspace is needed outside the normal weekday hours. When, conversely, it is not needed during the normal weekday hours, it is released to FAA control for potential use by civilian aviation. This would continue to be the case under Alternative 1. Since, under Alternative 1, the SUA would be used more than under existing conditions (the No Action Alternative), the hours during which it is potentially open to civilian aircraft would be reduced. However, as explained in Section 3.1.3, both commercial and general aviation operators in fact normally stay out of the SUA at all times. Commercial airliners fly along long-established routes that do not cross the SUA, and general aviation pilots, although they do have the option of checking whether the SUA is in effect when planning their flights, very rarely do so; as a matter of course, they consider the SUA to be off-limits at all times.

In the event of an emergency, any commercial or general aviation aircraft may contact ground control and request and be granted permission to fly through the controlled air space. This would not change under Alternative 1. In addition to being very rare, such emergency situations would not be affected by an increase in NSWCDD activities within the SUA.

4.1.2.4 Coastal Zone Management

Pursuant to CZMA § 307(c)(1) and 15 CFR Part 930, Sub-part C, Federal CCDs for the Proposed Action evaluated in this EIS (including the No Action Alternative and Alternatives 1 and 2) were prepared to evaluate the consistency of the Proposed Action with the coastal zone management programs of Virginia and Maryland. These documents, contained in Appendix I of this EIS, were submitted for review to the VDEQ and the MDE along with the DEIS when it was published.

Based on the impact analyses contained in the EIS, the Navy concludes in the CCDs that the Proposed Action, under any of the alternatives considered, including Alternative 1, is consistent to the maximum extent practicable with the enforceable policies of the coastal zone management programs of Virginia and Maryland. VDEQ responded to the Navy's conclusion in a letter dated October 18, 2012 (reproduced on page A-69 in Appendix A; consistency determination conclusion on page A-82) that "Based on our review of the Navy's consistency determination, and the comments and recommendations submitted by agencies administering the enforceable

policies of the VCP [Virginia Coastal Program], DEQ concurs that the proposed actions are consistent, to the maximum extent practicable, with the VCP."

MDE did not respond within 60 days to the Navy's consistency determination nor ask for an extension, so under the provisions of the CZMA, the state has waived its rights to concur with or object to the Navy's consistency determination. MDNR comments on the DEIS (documented on pages A-64 and A-65) included a section entitled "Consistency with the Coastal Zone Management Act," described in Section 4.1.1.4. Responses to comments S004.3 through S004.19 in the DEIS comment matrix in Appendix A address MDNR's issues and describe their resolution.

4.1.3 Alternative 2

4.1.3.1 NSF Dahlgren

The difference between Alternative 2 and Alternative 1 is almost entirely quantitative: under Alternative 2, the same RDT&E activities are proposed but the average annual number of events would be roughly 16 percent higher than under Alternative 1. Therefore, Alternative 2 would have no direct or indirect impact on present or future land use patterns at NSF Dahlgren for the same reasons that Alternative 1 would have no impact (see Section 4.1.2.1). Because of the increase in events on land ranges above no action and Alternative 1 levels, however, Alternative 2 would have no indirect impacts and negligible, short-term, direct, negative impacts on other land uses, such as recreation and travel on the installation, as a result of increased use of land ranges and an increase in access restrictions during some operations. Another difference between the alternatives is that by making greater use of NSF Dahlgren's facilities, Alternative 2 would better support the recommendations of the RSIP to promote NDW as an RTD&E center that stands out among other regions and maximize existing facilities for the highest and best use than would Alternative 1.

4.1.3.2 Dahlgren Area and Potomac River Shoreline

Like Alternative 1 (see Section 4.1.2.2), Alternative 2 could have effects on existing and future land use patterns as well as ongoing development projects and current land use plans and policies if it resulted in a change in noise levels or river use great enough to affect the desirability of land in the study area for different types of use.

With regard to noise, as explained in Section 4.5.3, implementation of Alternative 2 is expected to result in minor, long-term, direct, negative noise impacts. The noisiest activities would either not increase in number (large gun activities), increase slightly (detonations), be largely contained within the installation (small arms), or generate negligible noise levels (UAV flights). For the most part, noise levels outside NSF Dahlgren under Alternative 2, as under Alternative 1, would not substantially vary from noise levels under existing and no action conditions. The one exception to this is that firing into the upper LDZ would increase and, if live rounds are used, higher noise levels would extend downriver. Because this would take place no more than ten days a year, and inert projectiles may be used, this change is unlikely to affect land use.

With regard to river access, impacts under Alternative 2 would be greater than under Alternative 1: on average, part of the PRTR would be restricted for 1,000 hours a year, as opposed to 870

hours under Alternative 1 and 750 hours under existing and no action conditions. The adverse impacts from the resulting river closures (in the PRTR's MDZ and Upper Machodoc Creek; restrictions in the UDZ and LDZ would be the same as under Alternative 1: an average of two days a year for the whole of the UDZ and LDZ plus 10 days a year for firing into the upper LDZ to 40,000 yards from the installation) would be more noticeable than under Alternative 1. However, the same mitigating factors noted in Section 4.1.2.2 would contribute to minimizing them. As explained in Section 4.2.3.2, impacts on commercial river traffic would be minor. Impacts on recreational river traffic would be limited, especially since, compared to commercial vessel operators, pleasure boaters can often more readily change their route or destination and, using mostly shallow-draft vessels, would remain able to pass by the range by remaining close to the Maryland shore of the river. Restriction of the MDZ may cover only part of the MDZ—not all of it—allowing vessels to move freely in the unrestricted part. Overall, impacts on river use are expected to be minor and not sufficient to noticeably affect existing or future land use patterns.

Like under Alternative 1, the increased outdoor laser, EM energy, and chem/bio defense RDT&E activities that would take place under Alternative 2 would have no impacts likely to affect land use patterns in the study area, as they would remain within the confines of the ranges or the mission area (potential effects relating to noise and water access are addressed in the preceding paragraphs).

Under Alternative 2, as under the No Action Alternative and Alternative 1, current development patterns can be expected to evolve as envisioned by the different comprehensive plans developed by the jurisdictions in the study area. No significant new factors that could unexpectedly and substantially alter the character or density of development near the installation or along the Potomac River would be introduced as a result of this alternative. (Although unforeseen demographic or economic changes may intervene and significantly alter land use patterns, such potential changes are independent from the Navy's decision with respect to the Proposed Action evaluated in this EIS.) However, the increase in the number of RDT&E activities under Alternative 1 and the resulting adverse noise and river use effects potentially would nominally affect land use patterns, existing land use plans and policies, and ongoing projects. Thus, Alternative 2 would have no direct impacts and negligible, long-term, indirect, negative impacts on land use, land use planning, and ongoing development projects.

4.1.3.3 Special-Use Airspace

Under Alternative 2, as under Alternative 1 and the No Action Alternative, the lower tier (surface to 7,000 or 40,000 ft) of the SUA would remain in effect every non-holiday weekday from 8 am to 5 pm and the higher tier (40,000 to 60,000 ft) would be used as needed, in which case a NOTAM would be issued. A NOTAM would also be issued when the lower tier of airspace is needed outside the normal weekday hours. When, conversely, it is not needed during the normal weekday hours, it would be released to FAA control for potential use by civilian aviation. Since, under Alternative 2, the SUA would be used more than under the other alternatives, the hours during which it is potentially open to civilian aircraft would be reduced. However, as explained in Section 3.1.3, both commercial and general aviation operators in fact already normally remain out of the SUA at all times. Commercial airliners fly along long-established routes that do not cross the SUA and general aviation pilots, although they do have

the option of checking whether the SUA is in effect when planning their flights, very rarely do so; as a matter of course, they consider the SUA to be off-limits at all times.

In the event of an emergency, any commercial or general aviation aircraft may contact ground control and request and be granted permission to fly through the controlled air space. This would not change under Alternative 2. In addition to being very rare, such emergency situations would not be affected by an increase in NSWCDD activities within the SUA.

For these reasons, the increased RDT&E activities that would occur under Alternative 2, compared to existing and no action conditions, would have negligible, short-term, direct, negative impacts and no indirect impacts on non-military airspace users.

4.1.3.4 Coastal Zone Management

Pursuant to CZMA § 307(c)(1) and 15 CFR Part 930, Sub-part C, Federal CCDs for the Proposed Action evaluated in this EIS (including the No Action Alternative and Alternatives 1 and 2) were prepared to evaluate the consistency of the Proposed Action with the coastal zone management programs of Virginia and Maryland, respectively. These documents, contained in Appendix I of this EIS, were submitted for review to the VDEQ and the MDE along with the DEIS when it was published.

Based on the impact analyses contained in the EIS, the Navy concludes in the CCDs that the Proposed Action, under any of the alternatives considered, including Alternative 2, is consistent to the maximum extent practicable with the enforceable policies of the coastal zone management programs of Virginia and Maryland. VDEQ responded to the Navy's conclusion in a letter dated October 18, 2012 (reproduced on page A-69 in Appendix A; consistency determination conclusion on page A-82) that "Based on our review of the Navy's consistency determination, and the comments and recommendations submitted by agencies administering the enforceable policies of the VCP [Virginia Coastal Program], DEQ concurs that the proposed actions are consistent, to the maximum extent practicable, with the VCP."

MDE did not respond within 60 days to the Navy's consistency determination nor ask for an extension, so under the provisions of the CZMA, the state has waived its rights to concur with or object to the Navy's consistency determination. MDNR comments on the DEIS (documented on pages A-64 and A-65) included a section entitled "Consistency with the Coastal Zone Management Act," described in Section 4.1.1.4. Responses to comments S004.3 through S004.19 in the DEIS comment matrix in Appendix A address MDNR's issues and describe their resolution.

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4.2 Socioeconomics

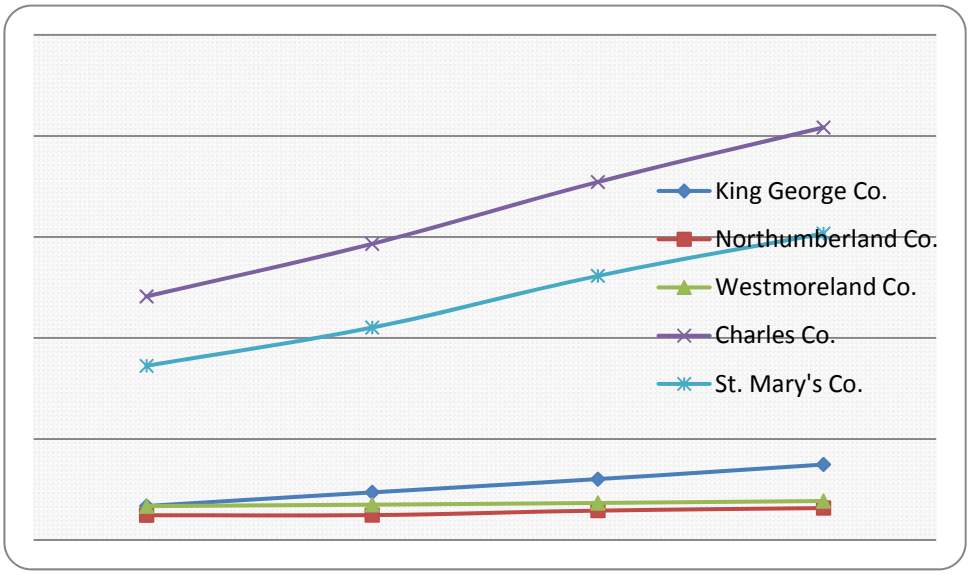
4.2.1 No Action Alternative

The No Action Alternative assumes that the existing baseline conditions describing NSWCDD's activities in Chapter 1 would continue for the foreseeable future. No significant increase in NSWCDD RDT&E personnel is anticipated, and, consequently, NSWCDD's proposed activities would not be a factor driving any changes to the surrounding region's future socioeconomic characteristics.

4.2.1.1 Demographics

Baseline demographic conditions are described for the five-county study area and the two states in Section 3.2.1. Table 3.2-1 notes population trends through 2010, and Table 3.2-2 presents population projections for the study area through 2020. Additional county and state population projection data through 2030 are shown in Table 4.2-1. Figure 4.2-1, Population Projections 2000-2030, presents the data graphically for the five counties of the study area.

Figure 4.2-1
Population Projections 2000-2030



These data reveal that, in numerical terms, the two Maryland counties account for the highest projected population growth, with Charles County accounting for 47.6 percent of the growth in the study area and St. Mary's for 37.2 percent. The three Virginia counties together account for only 15.2 percent of the study area's projected growth, of which King George County accounts for 11.7 percent. Although numerically King George County has a relatively small share of the study area's growth, its percentage increase from 2000 to 2030 is high, at 122.4 percent, larger than Charles County, at 69.4 percent, and St. Mary's, at 76.0 percent (Table 4.2-1).

Table 4.2-1
Population Projections 2000-2030

Jurisdiction	Population				Change 2000-2030			Percentage of 2030 Study Area Population	Percentage of 2000 Study Area Population
	2000	2010	2020	2030	Growth	Percentage Growth	Percentage of Study Area's Growth		
King George Co.	16,803	23,584	30,126	37,365	20,562	122.4	11.7	8.7	6.7
Northumberland Co.	12,259	12,330	14,587	15,821	3,562	29.1	2.0	3.7	4.9
Westmoreland Co.	16,718	17,454	18,336	19,261	2,543	15.2	1.4	4.5	6.6
Charles Co.	120,546	146,551	177,200	204,200	83,654	69.4	47.6	47.7	47.7
St. Mary's Co.	86,211	105,151	130,750	151,700	65,489	76.0	37.2	35.4	34.1
Study Area	252,537	305,070	370,999	428,347	175,810	69.6	100	100	100
Maryland	5,296,486	5,773,552	6,339,290	6,737,750	1,441,264	27.2	-	-	-
Virginia	7,078,515	8,001,024	8,917,396	9,825,019	2,746,504	38.8	-	-	-

Source: US Census Bureau, 2011, Census 2000, DP-1 Profile of General Demographic Characteristics 2000; Census 2010, DP-1 Profile of General Population and Housing Characteristics 2010; Virginia Employment Commission, 2011; Maryland Department of Planning, 2008.

Westmoreland County has the smallest projected growth in both absolute and relative terms. Northumberland County's and Westmoreland County's growth rates are below that of the state; all other counties of the study area exceed the projected growth rate of their respective state.

The No Action Alternative is unlikely to affect these population projections and would have no direct or indirect impact on demographics. The future patterns generally reflect recent demographic trends, mostly attributable to regional migration and population dispersal from the center of the Washington, DC metropolitan area to its periphery. The two Maryland counties in the study area are closer to and better served by highways to the metropolitan core than the three counties in Virginia's Northern Neck. Thus, the Maryland counties are more accessible from the employment centers of the region. In addition, the Maryland counties already have larger population bases and a wider choice of amenities, and so are more appealing to households used to these choices than the quieter, more rustic Virginia counties.

4.2.1.2 Economic Impacts

As previously noted, under the No Action Alternative, existing employment conditions at NSWCDD would continue into the foreseeable future. While the Navy at NSF Dahlgren is presently one of the largest employers in the region, no significant increase in outdoor RDT&E employment related to the Proposed Action is anticipated. Consequently, NSWCDD outdoor RDT&E activities would not be a factor causing any changes to the surrounding region's future economic character.

The projected growth in population in the study area (discussed in the previous section) will, however, likely increase employment and earnings there. As a consequence, more vacant land will be developed for housing, business, and institutional use. To some extent, these growth activities will also increase population in proximity to NSF Dahlgren and the range complexes. It is apparent that current activities at NSF Dahlgren have not deterred new development along the Potomac River – e.g., several major residential development projects initiated over the last few years in Colonial Beach on the Virginia shore not far from the installation. The No Action Alternative would have no direct or indirect impacts on economic conditions in the study area because it would not change factors such as noise and river use, which are already incorporated into existing economic activities.

Marine-Related Economic Activity

The Navy shares the use of the Potomac River with others, including commercial and industrial vessels (e.g., fuel and sand and gravel barges), commercial fishing, and recreational users.

Marine Freight

As discussed in Section 3.2.2.3, navigation of the Potomac River south of Washington, DC is limited by its relatively shallow depth at a number of locations, but the river still is active in waterborne commerce with a total of 6,332 vessel trips up or down the Potomac River below Washington, DC in 2008 (USACE, 2008). Deeper draft vessels, such as those carrying freight or passengers, must use the main navigation channel, which the US Army Corps of Engineers dredges in places to maintain sufficient depth. The main navigation channel passes through the UDZ, MDZ, and LDZ closer to the Maryland shoreline than the Virginia shoreline. There are currently approximately 122 vessels per week transiting the Potomac River below Washington, DC. However, because the data indicate only port of departure, it is not clear that all of these

vessels pass through the PRTR – some may be going from one port to another above the PRTR or going from a port far downriver out into the bay, barely passing through the PRTR (USACE, 2008).

NSWCDD's Range Operations Center (ROC) maintains two marine radio channels. While smaller vessels can skirt around the Maryland side of the range when the whole MDZ is restricted, larger vessels needing to pass through the main channel, which is within the MDZ, must call ROC to let it know of their approach. ROC in turn notifies them when they are allowed to pass. Vessels either slow down or stop until allowed through. A typical wait is less than 30 minutes, with a maximum delay of about an hour. Smaller fishing boats also radio ROC for permission to cross the range.

The Mirant Morgantown coal-fired power plant has constructed facilities that allow it to supplement the importation of coal by rail to include an estimated four to five 20,000-ton barges per week, with each taking about 16 hours to unload, day and night. Actual coal deliveries vary and are very limited at this time – the majority of coal deliveries are by rail and, based on current market conditions, likely will remain so for the foreseeable future (Allen, pers. comm., June 3, 2010). The barges – typically 485 ft long with a beam of 80 ft and sitting approximately 20 ft above water – will have to traverse the MDZ and LDZ in the main channel to reach the unloading facility. The coal barges for the Mirant plant would add at most four or five barges a week to this total, so that the new average for vessels passing through the PRTR would be 126 or 127 vessels per week – an increase of about four percent or less.

The Navy reached an operating agreement with Mirant and its barge-unloading facility (McGettigan and Smith, pers. comm., April 24, 2007). Mirant has agreed where feasible to schedule barge traffic through the PRTR outside the range's normal operating hours of Monday to Friday, 8 am to 5 pm and to coordinate alternate schedules with the Navy when PRTR activities would pose undue hardship to barge shipments.

Commercial Fishing

Commercial fishing in the Potomac River involves fishing, crabbing, and, less frequently, oystering. Section 3.2.2.3 discusses employment, citing available data from the 2000 Census and noting that the occupational category of *Farming, Fishing and Forestry* in the five-county study area accounted for 817 jobs, thereby setting an upper limit on the scale of commercial fishing employment in the region. Data from the Potomac River Fisheries Commission (PRFC) indicate that, during the ten-year period from 2001 through 2010, 86 percent of finfish as well as 50 percent of crabs were obtained in the lower reaches of the river – from the mouth to Coltons Point, corresponding to the LDZ (Cosby, PRFC, pers. comm., March 1, 2011). Over the ten-year period, 16,189 bushels of oysters or 79 percent of the catch were obtained within the MDZ (see Table 3.2-12). The PRFC issues about 1,300 commercial finfish licenses annually, but many fishermen hold multiple licenses, so that an estimated 800 commercial fishermen fish the Potomac from its mouth to Moss Point, Maryland (Cosby, PRFC, pers. comm., October 7, 2008).

Efforts to survey fishermen for the EIS met with few responses. Those fishermen that did respond indicated no issues with NSWCDD's activities, presumably because most fishing activity is in the LDZ, which has relatively few RDT&E events compared to the MDZ, and because the fishermen are able to work around activities in the MDZ when needed.

Recreational Activities

Recreational marine activity is very popular on the Potomac River, as evidenced by the number of charter boat companies and marinas along the river. These are described at the end of Section 3.2.2.3, with various sources citing approximately 30 public and private marinas on each side of the river between Nanjemoy Creek (north of the Harry Nice Bridge) and the Chesapeake Bay (see also Section 3.1.2.3). Because recreational use of the river is heaviest on weekends and holidays, when events rarely take place, conflicts between RDT&E use of the range and recreational boating are minimized. Most of the vessels used in recreational boating in the vicinity of the MDZ have shallow drafts, so that, when access is restricted during testing, they are able to navigate around the MDZ by staying close to the Maryland shore if they are going up or down the river. As the range is contiguous with the Virginia shore around NSF Dahlgren, recreational vessels affected by RDT&E activities would be directed to the Maryland shore or out of the range. Recreational boaters wishing to cross the range when it is active or to proceed along the Virginia shoreline or in or out of Upper Machodoc Creek can contact the NSWCDD ROC, which will allow passage during gaps in the operations. Normally, the wait is no more than 30 minutes for recreational vessels and more typically 10 minutes. The popularity of recreational boating on the Potomac does not appear to be inhibited by NSWCDD's present activity level.

Real Estate Activity

Another segment of the local economy potentially affected by NSWCDD's activities at NSF Dahlgren and on the PRTR is the residential real estate market. Under the No Action Alternative, NSWCDD's testing activities on the PRTR would continue at existing levels. Future real estate development is likely to continue, some within proximity to NSF Dahlgren.

As noted in the discussion of demographics above, the five-county study area is forecast to increase its population by 175,810, or 69.6 percent, between 2000 and 2030 (Table 4.2-1). The great bulk – 84.8 percent – of this anticipated growth is projected for the two Maryland counties, with Charles County accounting for 47.6 percent and St. Mary's County 37.2 percent, and the three Virginia counties sharing the remaining 15.2 percent. If the study area's average number of persons per household of 2.73 (Table 3.2-4) is applied to this projected population (less the estimated 2010 population), there would be 45,164 new households in the study area by 2030. Most of the growth can be expected to occur at the periphery of the Washington, DC suburbs in Charles County, but some will be attracted to the waterfront of both the Maryland and Virginia shores of the Potomac.

Land use policies of the various counties and the municipality (Colonial Beach) adjacent to the PRTR will steer this anticipated residential growth to areas each community considers appropriate. In Maryland, communities' master plans must conform to the state's Eight Visions of Smart Growth (see Section 3.1.2.2). Among these visions are the following goals: concentrating development in suitable areas; protecting sensitive areas; directing growth to existing population centers; conserving resources; encouraging economic growth; and assuring appropriate public infrastructure is in place where growth is to occur. In Virginia, county and local comprehensive plans conform to the Code of Virginia, which states the purpose of such plans as "guiding and accomplishing a coordinated, adjusted and harmonious development of the territory which will, in accordance with present and future needs and resources, best promote the

public health, safety, morals, order, convenience, prosperity and general welfare of the inhabitants."

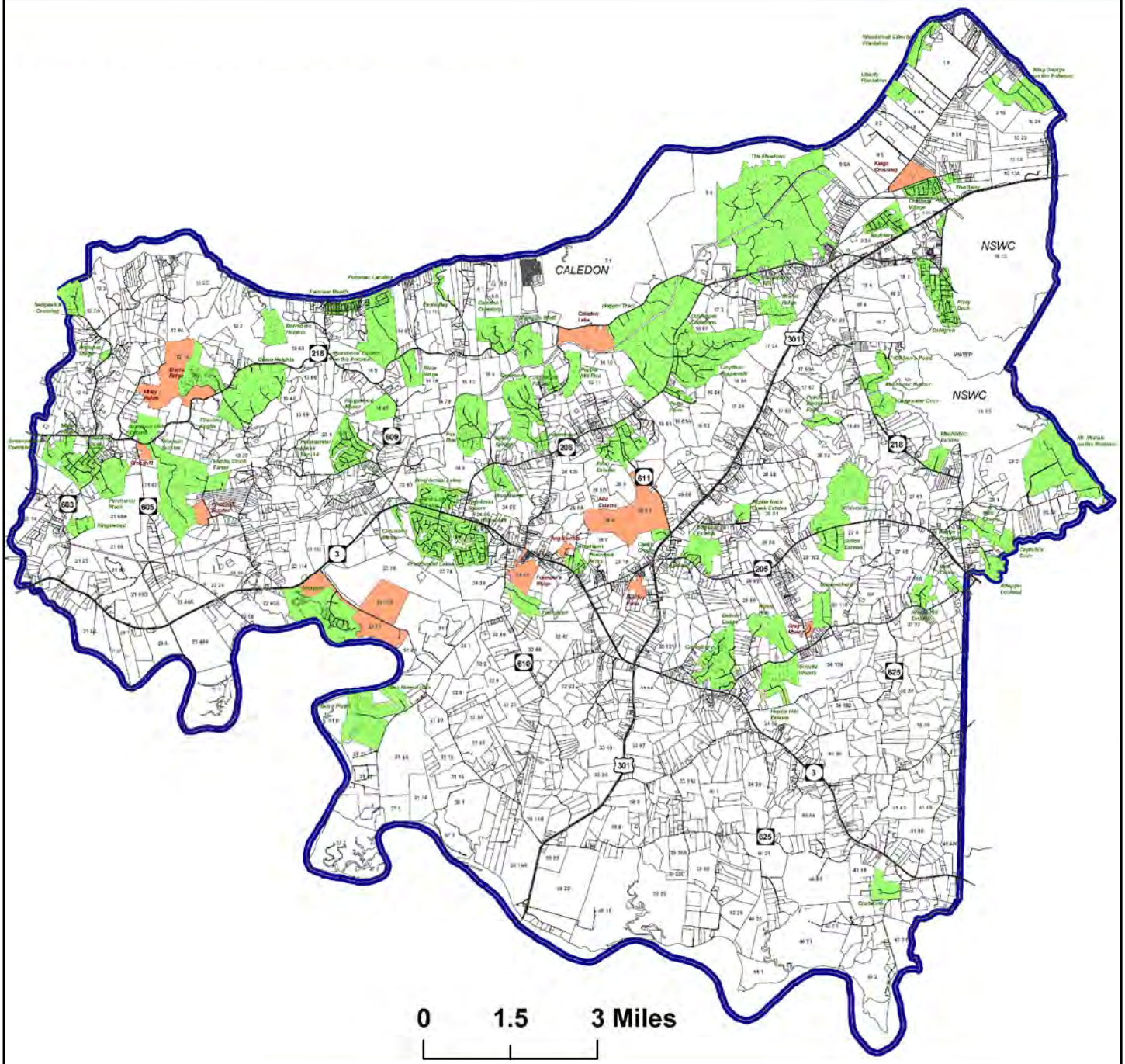
The comprehensive plans of all five study-area counties aim to direct most anticipated growth to specific areas (growth areas) already served by county services and to discourage sprawl. In order to assess the potential role that NSF Dahlgren has played in housing development and prices, it is most relevant to examine the counties in closest proximity to NSF Dahlgren and the active MDZ.

The 2000 Census revealed that of the workers of King George County, 32 percent lived and worked in the county, 40 percent were in-commuters, and 27 percent were out-commuters (with only 6 percent of these out-commuters working in Washington, DC) (Virginia Employment Commission, 2012). The Navy at NSF Dahlgren is the largest employer in the county and accounts for much of the in-commuting. Growth rates in the county have been substantial over recent decades, with a 29 percent increase in housing units (1,540 units) from 1990 to 2000, and a further 39 percent (2,657 units) from 2000 to 2010 (US Census Bureau, 2011, Census 1990, DP-1 General Population and Housing Characteristics 1990; Census 2000, QT-H4 Physical Housing Characteristics 2000; Census 2010, QT-H1 General Housing Characteristics 2010).

In King George County, the designated growth areas are referred to as "primary settlement areas" (King George County Planning Commission, 2006). The area near NSF Dahlgren is designated as one of these. The 2006 comprehensive plan anticipates the development of 3,800 new housing units by 2020 and considers their allocation under a "trend scenario" and a "compact scenario." The former assigns 50 percent of growth to the primary settlement areas and 50 percent to rural areas, while the compact scenario assigns 90 percent to the primary settlement areas. The compact scenario assumes 1,710 ac for higher-density development (at 0.5 units per ac) and 1,900 rural ac (at 5 ac per unit). The trend scenario would allocate 9,500 rural ac and 950 ac of higher-density areas to accommodate the anticipated growth. Adjusting to allow for efficient markets (a factor of three) and for non-residential land needs (10 percent, or 100 ac), the 2006 comprehensive plan foresees requiring 2,950 ac in the primary settlement areas under the trend scenario and 5,230 ac under the compact scenario – or, roughly 4.6 sq mi and 8.2 sq mi, respectively. Using an estimate for new housing units in 2030 and the same method for analyzing potential future land demand as used in the 2006 plan, the 2012 draft comprehensive plan (King George County, 2012) anticipates a need for 4.9 sq mi in the primary settlement areas under the trend scenario and 10.5 sq mi under the compact scenario. Both the 2006 current (adopted) and 2012 draft plans note that 10 sq mi are available for future development in the primary settlement planning areas, providing sufficient land for these demand estimates (King George County Planning Commission, 2006; King George County, 2012). These data indicate that anticipated housing growth in King George County can be accommodated in an efficient and smart-growth manner.

Recent residential development in the county has not been deterred by NSWCDD's activities, as evidenced by the high growth rates noted above. Moreover, the fact that the county has designated the area near NSF Dahlgren as a growth area implies that the local policymakers, who are familiar with the area, are not deterred by the Navy's testing activities. Figure 4.2-2 (King George County Subdivisions) shows existing subdivisions and those under review. Several subdivisions are on the water near NSF Dahlgren, notably Mt. Morieh on the Potomac and King George on the Potomac. The figure also shows that no major subdivisions are proposed on the waterfront of King George County. In part this may be because of a tightening of Virginia's

King George County Subdivisions



EXISTING LARGE SUBDIVISIONS

SUBDIVISIONS UNDER REVIEW

N

NSWCDD EIS

NAVSEA WARFARE CENTERS DAHLGREN

Source: Department of Community Developement, King George County, Virginia. 09/10. www.king-george.va.us

Figure 4.2-2

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regulations under the Chesapeake Bay Preservation Act, with its goals of promoting clean waters in the state. Under these regulations, King George County has designated a 100-ft buffer from tidal wetlands as a *resource protection area*, where development is restricted to water-dependent uses or the redevelopment of already-developed areas. The entire remainder of the county is designated a *resource management area*.

The town of Colonial Beach, adjacent to King George County and in Westmoreland County, also has experienced substantial residential growth in recent years, including about 330 units at Monroe Point, 751 units on Virginia Route 205, and the proposed development of Potomac Crossing with 913 units, a golf course, and commercial space. However, in October, 2007, Potomac Crossing was put on hold (see Section 3.1.2.5) and has remained on hold (Colonial Beach Virginia Attractions, 2011). It appears, therefore, that although NSWCDD's activities have not deterred development in the past, the current economic downturn is deferring some planned growth.

In Charles County, the 2006 comprehensive plan provides for a "development district" located in the northern part of the county (Charles County, 2006). The part of the county along the Potomac River is largely designated as an "agricultural conservation" district. Exceptions are the area immediately around the Harry Nice Bridge (with Mirant's Morgantown Power Plant to the south and a business district to the north) and the "mixed use" district associated with the Swan Point development. The Villages at Swan Point project, sponsored by US Steel Corporation and Brookfield Homes Corporation, began as a high-end waterfront and golf resort community in 1986. An expansion is presently planned, providing for an additional 1,500 homes along with a hotel on the Weir Peninsula, a private beach, retail shops and restaurants along the Potomac shoreline, and a 150-slip marina on the Potomac River at Weir Creek (Degregorio, 2006; McConaty, 2007a, b). Although the project has been approved – after a lengthy review because it is in a critical waterfront area – initiation of construction of all components of the development has been delayed because of the state of the economy and the housing market. Construction is expected to start in 2012 (Lannin, pers. comm., July 27, 2010).

One possible foreseeable consequence of increased population encroachment with no economic affiliation to NSF Dahlgren is the potential for a growing negative reaction to the Navy's activities, and particularly to the noise associated with them. Increases in noise complaints can be expected, not from an increase in Navy activity, but rather from a changing population with little relationship to NSF Dahlgren. Although it would be a "self-created" hardship for new residents who choose to locate near NSWCDD's testing facilities, it is likely to create additional issues for the Navy's public relations in the future. Conceivably, dissatisfaction with NSF Dahlgren as a neighbor could nominally depress property values in the area and dampen the rate of future residential development.

However, to monitor and control noise from its outdoor RDT&E activities and, thereby, reduce noise complaints from surrounding communities, NSWCDD has developed and implemented a noise management process. The process is described in Section 3.5.3.5 and included in full in Appendix C. Implementation of the noise management process is expected to minimize noise impacts and noise complaints resulting from NSWCDD outdoor RDT&E activities and effectively preclude noise-related effects on property values and future residential development.

4.2.1.3 Environmental Justice and the Protection of Children

Assessments of environmental justice and protection of children are intertwined with other environmental topics. In particular, air emissions, noise emissions, health and safety issues, and water discharges from the Proposed Action may affect the quality of air, health and safety, and water resources in communities surrounding NSF Dahlgren and the PRTR. The effects of air emissions from RDT&E activities are addressed in Section 4.4, and the effects of noise are addressed in Section 4.5. The effects to public health and safety are addressed in Section 4.8 and the effects on water quality are addressed in Section 4.10.

Geographic Distribution

Baseline conditions for an environmental justice (EJ) review are presented in Section 3.2.4. Populations or communities of concern (COCs) are identified at the census tract level, with 22 of the 49 census tracts in the two Maryland counties identified as minority COCs. Of the 13 census tracts in the three Virginia counties, 3 are defined as minority COCs. Figure 3.2-2 shows the locations of the minority-defined COCs.

Three of the 22 minority COCs in the two Maryland counties are on the Potomac River, but distant from NSF Dahlgren and 25 river miles upriver from the upstream limit of the UDZ. The 3 minority COCs in the three Virginia counties – census tract 401, which is occupied by NSF Dahlgren, and census tracts 202 and 101 – are adjacent to the river and the PRTR.

Fifteen of the census tracts in Maryland and 5 of those in Virginia are defined as low-income COCs. Figure 3.2-3 shows the locations of the low-income COCs. Three of the 15 low-income COCs in Maryland are on the Potomac River, in Charles County. One of these COCs is distant from NSF Dahlgren and more than 25 river miles upriver from the UDZ. However, census tract 8504, in Charles County, is only approximately 4.9 miles from NSF Dahlgren and just 3.5 river miles upriver from the UDZ; and tract 8512, also in Charles County, is across the river from NSF Dahlgren, adjacent to the MDZ. Of the 5 low-income COCs in Virginia, one is about 5.9 miles from NSF Dahlgren and 9.2 river miles upriver from the UDZ, sufficiently distant to not be adversely affected by NSWCDD's RDT&E activities – see, for example, the peak noise level contours shown in Figures 3.5-5, 3.5-6, and 3.5-7. On the other hand, census tract 402 in King George County is immediately landward of the tract occupied by NSF Dahlgren; census tracts 104 and 103 in Westmoreland County are on the Potomac River and adjacent to the MDZ; and tract 202 in Northumberland County is on the river, adjacent to the lower LDZ.

As a result of the geographic distribution of COCs outlined above, the following minority and low-income census tracts on the Virginia and Maryland shores of the Potomac are of particular interest for the purposes of this evaluation, as they comprise the minority and low-income COCs at greatest risk of being adversely affected by the activities that comprise the Proposed Action:

Minority COCs

- 401 in King George County, Virginia
- 101 in Westmoreland County, Virginia
- 202 in Northumberland County, Virginia

Low-income COCs

- 8504 and 8512 in Charles County, Maryland
- 402 in King George County, Virginia
- 104 and 103 in Westmoreland County, Virginia
- 202 in Northumberland County, Virginia (also a minority COC)

With respect to Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, Section 3.2.5 describes the executive order and its requirements, and the use of 2010 Census data on children under 18 to identify any concentrations of minors. On average, such persons represented 25.7 percent of their respective tract populations. A meaningfully higher percentage of 10 points higher than this average – i.e., 35.7 percent – was set to identify any unusual concentrations of children.

Eleven of the census tracts in Maryland within the study area and two in Virginia were identified as having higher-than-average concentrations of children, as shown in Figure 3.2-4. None of these tracts in Maryland are adjacent to the Potomac River. Both tracts in Virginia are adjacent to the Potomac River and the PRTR—one adjacent to the MDZ and the other adjacent to the lower LDZ. As a result of this geographic distribution, the following census tracts on the Virginia shore of the Potomac are of particular interest for the purposes of this evaluation, as they have concentrations of children at greatest risk of being adversely affected by Proposed Action activities:

- 103 in Westmoreland County, Virginia
- 201 in Northumberland County, Virginia

Environmental Justice and Protection of Children Effects

Based on the analysis presented in this EIS on air quality, noise, public health and safety, and water resources associated with the No Action Alternative, the following conclusions are presented in regard to human health and environmental effects to minority populations, low-income communities, and concentrations of children:

- Air Quality – NSF Dahlgren's annual air emissions levels would not exceed the Title V major source threshold, and the facility would continue to operate under a state operating permit for stationary air emissions. With respect to simulant vapors emitted during chemical defense activities, based on the low toxicity of the simulants selected for testing, short exposure duration of simulants, restrictions on access to test areas, likely overestimate of simulant concentrations in modeling predictions, and the requirement that anyone potentially exposed to elevated concentrations would be equipped with personal protective equipment, adverse impacts from exposure to chemical simulants would be none to negligible. No Action Alternative RDT&E air emissions would not result in disproportionately high and adverse human health or environmental effects on minority or low-income populations, or pose disproportionate environmental health or safety risks to children.
- Noise – Based on the distribution and magnitude of noise impacts, noise from ordnance activities would affect some communities immediately adjacent to the PRTR MDZ, such as Potomac Beach, Colonial Beach, Swan Point, Cobb Island, and Coltons Point.

However, No Action Alternative RDT&E noise would not result in disproportionately high and adverse human health or environmental effects on minority or low-income populations, or pose disproportionate environmental health or safety risks to children – everyone living in these communities would be exposed equally.

- Health and Safety – RDT&E activities are conducted in accordance with Navy policies, carefully-conceived management controls, and operation-specific risk hazard assessments and standard operating procedures (SOPs) implemented to ensure safety to both participants and non-participants, including children. The No Action Alternative RDT&E activities would not result in disproportionately high and adverse human health or environmental effects on minority or low-income populations, or pose disproportionate environmental health or safety risks to children.
- Water Resources – No Action Alternative RDT&E activities would have little contact with surface water resources and minimal potential to affect them, and do not pose health or environmental risks.

Therefore, no disproportionately high and adverse human health or environmental effects on minority populations and low-income populations would occur. The RDT&E activities conducted by NSWCDD would not pose disproportionate environmental health or safety risks to children. As noted in the preceding discussion, the No Action Alternative would not alter existing conditions in the study area.

4.2.2 Alternative 1

Alternative 1 is described in Section 2.5. The use of large-caliber guns would remain at current levels, but small-arms firing would increase from 6,000 bullets to 25,500 bullets annually, and detonations would increase slightly, from 190 to 200 events. The number of EM energy events would increase by about 20 percent – from the current 490 to 590 annually. There would be substantial increases in tests using lasers (from 60 to 125 events) and chem/bio simulants (from 12 to 60 events). PRTR use would increase to 870 hours a year, or 16 percent more than the 750 hours under the No Action Alternative. Most range usage would be in the MDZ, as at present. Access to all or part of the UDZ and/or the LDZ would be restricted approximately two days a year for operations involving vessels and aircraft. Access to the upper LDZ to 40,000 yards from the firing line would be restricted up to ten days a year. In addition, some activities would take place outside the normal hours – Monday to Friday, 8 am to 5 pm – and would occur at dawn, dusk, and night, in order to test the performance of systems under all kinds of weather and light conditions.

4.2.2.1 Demographics

The projected future population in the study area, discussed in Section 4.2.1.1, would be unchanged as a result of the Navy's actions under Alternative 1. As no significant increase in NSWCDD outdoor RDT&E personnel is anticipated, there would be no infusion of additional households as a consequence of implementing the alternative. The Navy's activities on the PRTR have been shown not to have deterred past population growth in the study area, and the increases

in RDT&E activity levels under this alternative are unlikely to alter this pattern more than nominally. Alternative 1 would have no direct or indirect impact on demographics.

4.2.2.2 Economic Impacts

Economic factors, including marine-related economic activity and real estate, were examined for no action conditions in Section 4.2.1.2. The additional hours during which access to the PRTR would be restricted under Alternative 1 are not expected to materially alter the conditions for marine commercial freight movements, commercial fishing, or recreational boating on the Potomac River. Recreational boating and fishing would likely be minimally affected by any dawn, dusk, or night-time activities because they would be advertised well in advance (see also the discussion in Section 4.1.2.2). The commercial vessels using the main channel would continue to be subject to the minimal delays – typically 30 minutes, but possibly up to about an hour – they currently endure when the range is in use.

The increase in use of the upper LDZ for firing (up to ten days a year) and some or all of UDZ and LDZ for approximately two days a year, would, however, extend restrictions to areas that have been restricted for NSWCDD's activities infrequently in recent years. The restrictions would inconvenience river users not used to restrictions in these areas, causing them delays. These slight impacts would be minimized as described above by advertising restrictions well in advance and by the ROC's working with vessels to minimize delays.

Although the use of coal barges for the Mirant plant at Morgantown is expected to grow, the plant would require only four or five barges per week, which, as indicated in Section 4.2.1.2, would constitute an increase in vessel traffic of less than four percent. Actual coal deliveries vary and are very limited at this time – the majority of coal deliveries are by rail and, based on current market conditions, likely will remain so for the foreseeable future (Allen, pers. comm., June 3, 2010).

Real estate development in the area has been undaunted by the Navy's activities on the PRTR, as evidenced by the residential waterfront development that has already occurred close to NSF Dahlgren in King George County and in Colonial Beach, as well as by the proposed expansion of the luxury waterfront resort community of the Villages at Swan Point in Charles County. Ongoing efforts by the states and counties to steer future growth away from the sensitive waterfront areas to designated growth areas more appropriate for development and better served by infrastructure and amenities should ameliorate potential problems from residential "encroachment" close to the PRTR. However, the expansion of RDT&E activities outside the normal scheduling days and times of Monday to Friday, 8 am to 5 pm, along with the slight increase in detonations, may generate some quality-of-life concerns from residents. Residents are often concerned with noise from guns; however, Alternative 1 proposes no increase in large-caliber gun activities. Despite the more-than-threefold increase in the number of bullets fired in small arms events, such firings have a small noise impact area, almost entirely confined to the installation itself, and so are unlikely to contribute to quality-of-life concerns. The other activities with large annual increases – involving EM energy, lasers, and the use of chem/bio simulants – would generate little to no increase in noise impacts. Nearby residents would be unlikely to notice most of these tests.

Alternative 1 would have no direct and negligible, long-term, indirect, negative impacts on real estate development; and minor, short-term, direct and minor, long-term, indirect, negative impacts on marine commerce.

4.2.2.3 Environmental Justice and Protection of Children

Based on the analysis presented in this EIS on air quality, noise, public health and safety, and water resources associated with Alternative 1, the following conclusions are presented in regard to human health and environmental effects to minority populations, low-income communities, and concentrations of children:

- Air Quality – NSF Dahlgren's annual emissions levels would not exceed the Title V major source threshold, and the facility would continue to operate under a state operating permit for stationary air emissions. With respect to simulant vapors emitted during chem/bio testing, based on the low toxicity of the simulants selected for testing, short exposure duration of simulants, restrictions on access to test areas, likely overestimate of simulant concentrations in modeling predictions, and the requirement that anyone potentially exposed to elevated concentrations would be equipped with personal protective equipment, adverse impacts from exposure to chemical simulants would be none to negligible. Alternative 1 RDT&E air emissions would not result in disproportionately high and adverse human health or environmental effects on minority or low-income populations, or pose disproportionate environmental health or safety risks to children.
- Noise – Based on the distribution and magnitude of noise impacts, noise from ordnance activities would affect some communities immediately adjacent to the PRTR MDZ, such as Potomac Beach, Colonial Beach, Swan Point, Cobb Island, and Coltons Point. However, Alternative 1 RDT&E noise would not result in disproportionately high and adverse human health or environmental effects on minority or low-income populations, or pose disproportionate environmental health or safety risks to children – everyone living in these communities would be exposed equally.
- Health and Safety – RDT&E activities are conducted in accordance with Navy policies, carefully-conceived management controls, and operation-specific risk hazard assessments and SOPs implemented to ensure safety to both participants and non-participants, including children. Alternative 1 RDT&E activities would not result in disproportionately high and adverse human health or environmental effects on minority or low-income populations, or pose disproportionate environmental health or safety risks to children.
- Water Resources – Alternative 1 RDT&E activities would have little contact with surface water resources and minimal potential to affect them, and do not pose health or environmental risks.

Therefore, no disproportionately high and adverse human health or environmental effects on minority populations and low-income populations would occur. The RDT&E activities conducted by NSWCDD would not pose disproportionate environmental health or safety risks to children.

4.2.3 Alternative 2

Alternative 2 is described in Section 2.6. The use of large-caliber guns would remain at current levels; the number of detonation events would increase from the current 190 to 230 annually, or by about 21 percent; small-arms firing would increase from the current 6,000 to 30,000 bullets annually. The number of annual events involving EM energy would increase by about 40 percent, lasers by about 140 percent, and chem/bio simulants by more than 480 percent from current levels. PRTR usage would increase noticeably, to 1,000 hours a year, or 33 percent from the 750 hours under the No Action Alternative. Most range usage would be in the MDZ, as at present, but restrictions would be in place on the LDZ approximately two days every year for tests of integrated systems, involving multiple vessels and aircraft. Access to the upper LDZ to 40,000 yards from the firing line would be restricted for firing up to a maximum of ten days a year. In addition, some activities would take place outside the normal hours—Monday to Friday, 8 am to 5 pm—and would occur at night in order to test the performance of systems under all kinds of weather and light conditions.

4.2.3.1 Demographics

The projected future population in the study area, discussed in Section 4.2.1.1 would be unchanged as a result of the Navy's actions under Alternative 2. As no significant increase in NSWCDD's outdoor RDT&E personnel is anticipated under this alternative, there would be no infusion of additional households as a consequence of its implementation. The Navy's activities on the PRTR have been shown not to have deterred past population growth in the study area, and the increases in RDT&E activity levels under this alternative are unlikely to alter this pattern more than nominally. Alternative 2 would have no direct or indirect impact on demographics.

4.2.3.2 Economic Impacts

Economic factors, including marine-related economic activity and real estate, are described in Section 4.2.1.2. The difference in annual hours of river range usage can be expected to have some effect on marine commercial freight movements, commercial fishing, and recreational boating on the Potomac River. Average annual restriction of the range under existing and no action conditions would be 750 hours, or about 8.6 percent of the hours in a year. Under Alternative 2, this would increase to 1,000 hours, or about 11.4 percent. Except for approximately ten days a year when restrictions would apply to the upper LDZ, and two days a year when the restrictions would apply to the UDZ and the LDZ, the MDZ would be the part of the PRTR restricted. For many of these hours, however, the full MDZ is not restricted. For example, when directed energy or lasers are being emitted across Upper Machodoc Creek, much of the MDZ would not be restricted, and large vessels could use the shipping channel and commercial fishermen could cross the river. Nevertheless, this is a discernible increase and would add some inconvenience to commercial and recreational river users. The small amount of commercial freight shipping on the Potomac would experience on an annual basis an increase in the number of occasions that vessels are delayed from moving through the PRTR. However, given that typical delays are only about 30 minutes, these negative impacts would be minor and are not considered significant economic impacts to these users.

Recreational boating and fishing are also unlikely to be significantly affected by the increased hours of operation and would be relatively unaffected by testing at night or in adverse weather conditions that would drive small boats off the river. Testing of lasers at dusk and dawn would be announced in advance, minimizing impacts (see also Section 4.1.3.2 for potential impacts to recreational boating). Potential impacts to fishing and recreational boaters are unlikely to generate significant economic impacts to these users.

As noted in the case of the other alternatives, real estate development in the area has been undeterred by the Navy's activities on the PRTR, as evidenced by recent residential waterfront development that has already occurred close to NSF Dahlgren in King George County and in Colonial Beach as well as by the proposed expansion of the luxury waterfront resort community of the Villages at Swan Point in Charles County. Ongoing efforts by the states and counties to steer future growth away from the sensitive waterfront areas and into designated growth areas that are more appropriate for development and better served by infrastructure and amenities should ameliorate potential problems from residential "encroachment" close to the PRTR.

The additional hours of annual use of the PRTR are unlikely to alter recent trends. Quality-of-life comments from residents have noted noise from guns as being the principal concern, but Alternative 2 proposes an increase only in small-arms tests, which have limited noise impact areas. A 21-percent increase in detonations annually (40 more detonations) would add sporadic booms, but many of the detonations would be small and go unnoticed. The proposed increases in activities involving EM energy, lasers, and the use of bio/chem simulants would generate little to no noise, and nearby residents would be unlikely to notice most of these tests. Consequently, minimal effect on real estate markets is anticipated from implementing Alternative 2.

Alternative 2 would have no direct and negligible, long-term, indirect, negative impacts on real estate development; and minor, short-term, direct and minor, long-term, indirect, negative impacts on marine commerce.

4.2.3.3 Environmental Justice and Protection of Children

Based on the analysis presented in this EIS on air quality, noise, public health and safety, and water resources associated with Alternative 2, the following conclusions are presented in regard to human health and environmental effects to minority populations, low-income communities, and concentrations of children:

- Air Quality – NSF Dahlgren's annual emissions levels would not exceed the Title V major source threshold and the facility would continue to operate under a state operating permit for stationary air emissions. With respect to simulant vapors emitted during chem/bio testing, based on the low toxicity of the simulants selected for testing, short exposure duration of simulants, restrictions on access to test areas, likely overestimate of simulant concentrations in modeling predictions, and the requirement that anyone potentially exposed to elevated concentrations would be equipped with personal protective equipment, adverse impacts from exposure to chemical simulants would be none to negligible. Alternative 2 RDT&E air emissions would not result in disproportionately high and adverse human health or environmental effects on minority or low-income populations, or pose disproportionate environmental health or safety risks to children.

- Noise – Based on the distribution and magnitude of noise impacts, noise from ordnance activities would affect some communities immediately adjacent to the PRTR MDZ, such as Potomac Beach, Colonial Beach, Swan Point, Cobb Island, and Coltons Point. However, Alternative 2 RDT&E noise would not result in disproportionately high and adverse human health or environmental effects on minority or low-income populations, or pose disproportionate environmental health or safety risks to children – everyone living in these communities would be exposed equally.
- Health and Safety – RDT&E activities are conducted in accordance with Navy policies, carefully-conceived management controls, and operation-specific risk hazard assessments and SOPs implemented to ensure safety to both participants and non-participants, including children. Alternative 2 RDT&E activities would result in disproportionately high and adverse human health or environmental effects on minority or low-income populations, or pose disproportionate environmental health or safety risks to children.
- Water Resources – Alternative 2 RDT&E activities would have little contact with surface water resources and minimal potential to affect them, and do not pose health or environmental risks.

Therefore, no disproportionately high and adverse human health or environmental effects on minority populations and low-income populations would occur. The RDT&E activities conducted by NSWCDD would not pose disproportionate environmental health or safety risks to children.

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4.3 Utilities

4.3.1 No Action Alternative

Under the No Action Alternative, carrying out ordnance, EM energy, laser, and chemical defense activities would not increase demand for utilities above existing levels. Therefore, there would be no additional impact to the utility systems that support the installation and its tenants, including NSWCDD. NSWCDD's current power requirements are being adequately supplied by the power grid and NSF Dahlgren's auxiliary generators. Therefore, the No Action Alternative would not directly or indirectly impact utility systems.

4.3.2 Alternative 1

4.3.2.1 Electricity

Under Alternative 1, increased ordnance and chem/bio defense activities would not result in increased demand for electricity and would have no impact on the installation's electrical system.

The EM energy and HE laser events included under the alternative and the gradually-increasing power levels used during these events would generate more demand for electrical power. The planned new Dominion Virginia Power (DVP) 230 kV transmission line and substation, scheduled to begin construction in 2013 and to be completed in 2014 (DVP, 2011), would meet these power needs.

Given the planned completion and energizing of the new DVP 230 kV transmission line and substation in 2014, Alternative 1 would have no direct and negligible, long-term, indirect impacts on the Virginia power grid or the NSF Dahlgren electrical system.

4.3.2.2 Water and Wastewater

Under Alternative 1, there would be no significant increase in personnel and, therefore, no increase in the demand for potable water. Likewise, while there would be an increase in outdoor RDT&E activities, none of these activities would require additional water. Therefore, the installation's three deep-water wells would not be affected and would continue to provide the base with ample drinking and domestic water.

Because there would be no personnel or operational needs for additional water, there would be no increase in the production of wastewater. The Navy-owned municipal sewage treatment plant located at the southern end of Mainside would not be affected and would continue to meet current and future wastewater requirements.

4.3.2.3 Other Utilities

None of the other utilities listed in Section 3.3.3 would be affected by the implementation of Alternative 1.

4.3.3 Alternative 2

4.3.3.1 Electricity

Under Alternative 2, increased ordnance and chem/bio defense activities would not generate increased demand for electricity and, therefore, would have no impact on the installation's electrical system.

As under Alternative 1, the EM energy and HE laser events under Alternative 2 and the gradually-increasing power levels used would require more electricity. The amount of power required for the proposed activities would become clearer as RDT&E progresses. Because only the number of events, not the type, would change, Alternative 2 would not generate a greater maximum demand per event than Alternative 1. Although the total amount of electricity consumed in the future will depend on the RDT&E testing undertaken and therefore cannot be predicted accurately, it is expected that the amount consumed every year would be slightly greater. The planned new DVP 230 kV transmission line and substation, scheduled to begin construction in 2013 and to be completed in 2014 (DVP, 2011), would meet these power needs.

Given the planned completion and energizing of the new DVP 230 kV transmission line and substation in 2014, Alternative 2 would have no direct and negligible, long-term, indirect impacts on the Virginia power grid or the NSF Dahlgren electrical system.

4.3.3.2 Water and Wastewater

As described for Alternative 1 (Section 4.3.2.2), there would be no impacts on the installation's water or wastewater systems.

4.3.3.3 Other Utilities

None of the other utilities listed in Section 3.3.3 would be affected by the implementation of Alternative 2.

4.4 Air Quality

This section provides an assessment of the potential environmental impacts that would result from implementing the alternatives on stationary and mobile and other sources (chem/bio simulants). As described in Section 3.4.3, the potential effects of proposed greenhouse gas emissions change is discussed in the context of cumulative impacts in Chapter 5, as individual sources of greenhouse gas emissions are not large enough to have any noticeable effect on climate change.

4.4.1 No Action Alternative

4.4.1.1 Stationary and Mobile Sources

Under the No Action Alternative, air quality at NSF Dahlgren would remain the same as it is at present for stationary, mobile, and other sources. NSF Dahlgren's annual emissions levels do not currently exceed the Title V major source threshold of 100 tons per year for any individual criteria pollutant. NSF Dahlgren would continue to operate under a state operating permit that covers stationary emission sources on the installation. The No Action Alternative would have negligible long-term, direct and indirect, negative impacts on air quality.

4.4.1.2 Other Sources (Chemical Simulants)

NSWCDD is performing RDT&E activities on chem/bio detectors, decontaminants, and collective protection (COLPRO) systems under the DoD Chemical and Biological Defense Program (CBDP), as described in Section 2.1.4. These simulants, many of which are everyday compounds (see Section 3.8), are not hazardous air pollutants. Under the No Action Alternative chemical simulants of low toxicity would continue to be released as a vapor or mist over the MDZ. As noted in Section 3.4, these chemical simulants are not considered to be criteria pollutants under the Clean Air Act (CAA).

The detection systems used during activities using simulants are passive infrared spectrometers that detect vapors only. Clouds of simulant vapor need to be generated to test detection systems and thus achieve the desired test objectives. The ability to generate simulant clouds of vapor and very fine airborne liquid aerosol particles that will readily evaporate has already been demonstrated by previous tests (NSWCDD, 2003) using the same or similar simulant- delivery systems that would be continued to be used for simulant releases on the MDZ.

Assessments completed for chemical simulant testing performed by NSWCDD using some of the same chemical simulants showed no significant impacts and there were no observable environmental effects during or after testing (NSWCDL, 2004; Bossart, letter, February 9, 2006; NSWCDL, 31 July 2009). In addition, to monitoring performed during testing, chemical simulant modeling is performed prior to testing, as described below.

Chemical Simulant Dispersion Modeling

Air quality analyses for potential impacts from other sources (chemical simulants) are based on dispersion modeling of the chemical simulants that have been or are proposed to be released during RDT&E events.

Atmospheric dispersion of chemical simulants was modeled based on established testing methods and protocols used at NSWCDD. The analysis used the DoD-approved Vapor, Liquid, and Solid Tracking Model (VLSTRACK: Version 3.2.3) to calculate the air concentration and deposition levels resulting from the proposed testing. VLSTRACK is based on a Gaussian plume dispersion algorithm. Using this model, the simulant concentration at various points in time and distance from the release point can be predicted, along with the amount of each simulant that will be deposited on the water's surface within the MDZ. The modeling used a range of inputs for each parameter (see text box), including testing four release quantities, two release heights, three different atmospheric conditions (wind speeds), two temperatures, and two droplet sizes.

Release Quantities

A typical simulant test involves the release of approximately 10 gals of simulant, but the amount varies from a few ounces up to a maximum of 20 gals of simulant, with the larger quantities of 20 gals used primarily for whole-vessel tests that would occur infrequently. The amount of simulant used is the minimum amount needed to test the lowest level of simulant the sensor can detect. Quantities of 1.5, 5, 10, and 20 gals were used as modeling inputs.

Release Height and Method

One method of testing on the MDZ uses a pressurized spray tank or multiple tanks mounted on the release boat for dissemination of liquid simulants. The pressurized sprayer is mounted to the top of a ducting tube, at heights of about 6 ft or 40 ft. The blower and simulant spray tank are located on the deck of the simulant release boat. The simulant transfer line from the spray tank connects to an atomizing aerosol spray nozzle at the top of the duct and the nozzle releases the liquid simulants into the air as very fine aerosols or vapor. The blower discharge and spray nozzle also can be directed upward so that the fine aerosols are carried more than 40 ft above the water. Gases used for calibration, such as R-134 and R-152a, are disseminated directly from compressed gas cylinders. Chemical simulants are released over a maximum duration of a few minutes. Testing of 1.5 gals can be sprayed from a lower height of 6 ft.

Simulant Modeling Assumptions

Quantity: 1.5, 5, 10, and 20 gals.

Release height: 6 ft or 40 ft.

Atmospheric conditions: 1 mile per hour (mph) (0.5 meters per second [m/s]), 5 mph (2.25 m/s), and 10 mph (4.5 m/s)

Temperature: 65 and 85°F

Droplet size: 7 and 72 micron mass median diameter (MMD)

Simulant releases are conducted in such a manner as to ensure that no personnel or other individuals are exposed to concentrated simulant vapor or aerosol during or after release. During simulant releases, the simulant release boat generally heads into the wind. Upon completion of the simulant release, the release boat stays clear of the simulant release area until sufficient time has elapsed for the simulant to disperse. The existing standard operating procedure (SOP) calls for simulant releases to be spaced so that no area is exposed multiple times to the same simulant (NSWCDL, 15 July 2009).

Typically, for tests over water, less than 20 gals of a simulant would be released by boat at a height of approximately 40 ft. Simulant could also be released over land or water by a helicopter-mounted or UAV-mounted sprayer system at a height of about 300 ft to test chemical simulant decontamination and contamination avoidance equipment, similar to tests that have been performed at Naval Weapons Station Charleston, South Carolina (US Navy and US Army, 2001). In this scenario, a specially-designed sprayer tank mounted on a helicopter would spray

chemical simulants onto a vessel. Some simulant coming from the helicopter or UAV spraying over water might enter the river, and cleanup of the test platform (the vessel) would result in some simulant-containing effluent entering the environment. For tests done on the MDZ, the Maryland Department of the Environment (MDE) and the Virginia Department of Environmental Quality (VDEQ) are consulted by the NSWCDD Safety and Environmental Office prior to testing.

Droplet Size

Two types of nozzle configurations were simulated in the modeling conducted to provide estimates of simulant concentrations and deposition:

- A nozzle that generates a droplet mass median diameter (MMD) of 72 microns (to simulate misty conditions).
- For comparison purposes, a smaller nozzle that results in a droplet MMD of seven microns (to simulate maximum vapor concentrations).

Meteorological Conditions

The simulation included modeling at three wind speeds – 1 mph, 5 mph, and 10 mph – to represent neutral, stable, and unstable atmospheric stability categories. Two temperatures – 65° and 85°F – were also modeled to determine the effects of temperature on dispersion and deposition.

Receptor Locations

The model predicts short-term ground-level air concentration and surface deposition levels for every one-minute interval after the chemical simulants would be released and dispersed. Both air concentration and surface deposition levels were tracked down to specific thresholds in order to determine the size of the potential hazard area. The hazard area as defined for the VLSTRACK-modeled scenarios included the area with predicted levels that would exceed:

- 0.1 milligrams per cubic meter (mg/m^3) for ground-level air concentration
- 0.01 milligrams per square meter (mg/m^2) for surface deposition

Ambient Air Quality Impacts

The predicted maximum chemical simulant concentration levels at ground level and the distances to which these concentrations would spread are summarized in Table 4.4-1 for both small and large droplets. Forty-eight modeling scenarios were run for diethyl malonate (DEM) and methyl salicylate (MeS), and 36 modeling scenarios were run for the remainder of the chemical simulants (DMA, DMMP, GAA, and TEP). Each scenario modeled maximum concentrations and dispersal distances using a combination of possible release heights, quantity of simulant, droplet mass median diameter, wind speed, and air temperature. Table 4.4-1 presents the maximum modeled air concentrations from all modeling scenarios. A full listing of concentrations for all runs modeled is provided in Appendix J.

Based on the modeling, the highest concentrations occur close to the release point and well before any simulants reach landfall. No one is allowed close to the release vessel. The forward velocity of the release boat and the fact that the simulant is discharged into the air greatly limits the potential for exposure of the release vessel crew to the simulants. The crews operating the

vessels equipped with the infrared sensors to detect simulants remain well away from the vapor, and both the dispersing vessel and sensor crews are equipped with respirators and protective clothing as an extra safety measure, ensuring that there is no direct exposure of humans to the maximum concentrations of simulants.

Table 4.4-2 provides the maximum concentration for each simulant modeled after 10 minutes from the time of release from all 48 test runs for DEM and MeS and 36 test runs for DMA, DMMP, GAA, and TEP. Simulant concentrations decrease rapidly after release, with concentrations returning to undetectable levels within minutes.

An example of the quick return to background levels is shown in Figure 4.4-1, Decrease in Air Concentration over Time - DEM Test Run Example (Run 029, see Appendix J for summary).

Table 4.4-1
Modeled Maximum Air Concentrations

Chemical	Maximum Concentration (mg/m^3)	Distance from Release Point (ft)	Time from Release (minutes)	Conditions Resulting in Maximum Concentrations
Diethyl malonate (DEM)	20,200	≤33	0.5	1.5 gal, 7 MMD, 1 mph, 85°F (run 028)
Dimethyl adipate (DMA)	12,000	≤33	1.80	20 gal, 7 MMD, 1 mph, 85°F (run 028)
Dimethyl methylphosphonate (DMMP)	2,780	131	2.2	20 gal, 72 MMD, 1 mph, 65°F (run 103)
Glacial acetic acid (GAA)	4,940	197	11	20 gal, 72 MMD, 1 mph, 85°F (run 106)
Methyl salicylate (MeS)	19,300	≤33	0.47	20 gal, 7 MMD, 1 mph, 85°F (run 028)
Triethyl phosphate (TEP)	5,060	164	1.93	20 gal, 72 MMD, 1 mph, 65°F (run 103)

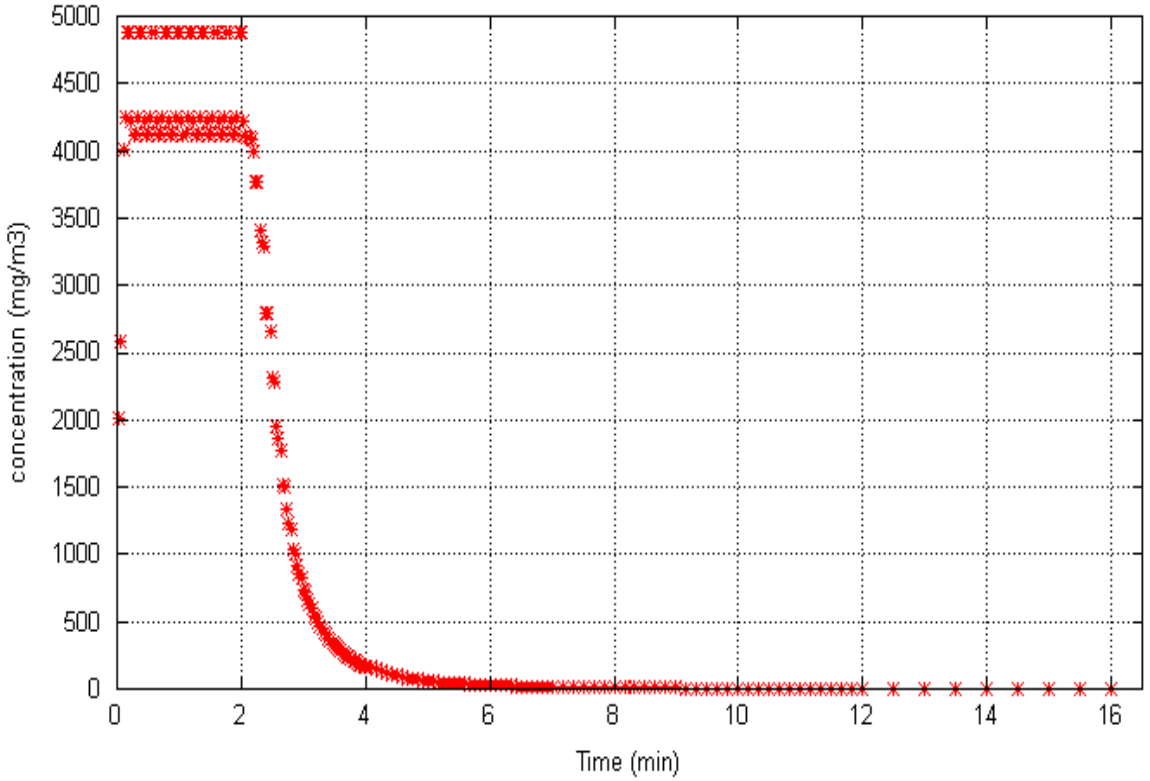
Notes: The maximum concentrations are based on the full range of parameters modeled.
mg/m^3 = milligrams per cubic meter; gal = gallons; MMD = mass median diameter; mph = miles per hour.
≤ 33 indicates that the simulant cloud is predicted to disperse within 33 feet (10 meters).
A full summary of all modeling runs is provided in Appendix J.

Table 4.4-2
Modeled Maximum Air Concentrations after 10 Minutes

Chemical	Maximum Concentration after 10 minutes (mg/m^3)	Distance from Release Point (ft)	Conditions Resulting in Maximum Concentrations
Diethyl malonate (DEM)	1,340	≤33	1.5 gal, 7 MMD, 10 mph, 85°F (run 030)
Dimethyl adipate (DMA)	851	919	20 gal, 7 MMD, 1 mph, 85°F (run 100)
Dimethyl methylphosphonate (DMMP)	801	919	20 gal, 7 MMD, 1 mph, 85°F (run 100)
Glacial acetic acid (GAA)	719	919	20 gal, 7 MMD, 1 mph, 85°F (run 100)
Methyl salicylate (MeS)	1,210	≤33	20 gal, 7 MMD, 10 mph, 85°F (run 030)
Triethyl phosphate (TEP)	726	919	20 gal, 7 MMD, 10 mph, 85°F (run 100)

Notes: The maximum concentrations are based on the full range of parameters modeled (i.e., quantity, droplet diameter, wind speed, and temperature).
mg/m^3 = milligrams per cubic meter; gal = gallons; MMD = mass median diameter; mph = miles per hour.
≤ 33 indicates that the simulant cloud is predicted to disperse within 33 ft (10 meters).
A full summary of all modeling runs is provided in Appendix J.

Figure 4.4-1
Decrease in Air Concentration over Time - DEM Test Run Example (Run 029)



Predicted maximum surface deposition levels are summarized in Table 4.4-3. The surface area with concentrations above 0.01 mg/m^2 using maximum deposition rates range from a fraction of an acre to 63.5 acres. Potential water-quality impacts on aquatic life from these chemical simulants deposited in the PRTR are further discussed in Sections 4.10 through 4.14. The chemicals that would be likely be used to calibrate the detectors – R-134a and R-152a – at normal temperatures are gases. Therefore, no deposition would occur for these chemicals.

Table 4.4-3
Predicted Maximum Surface Deposition Levels

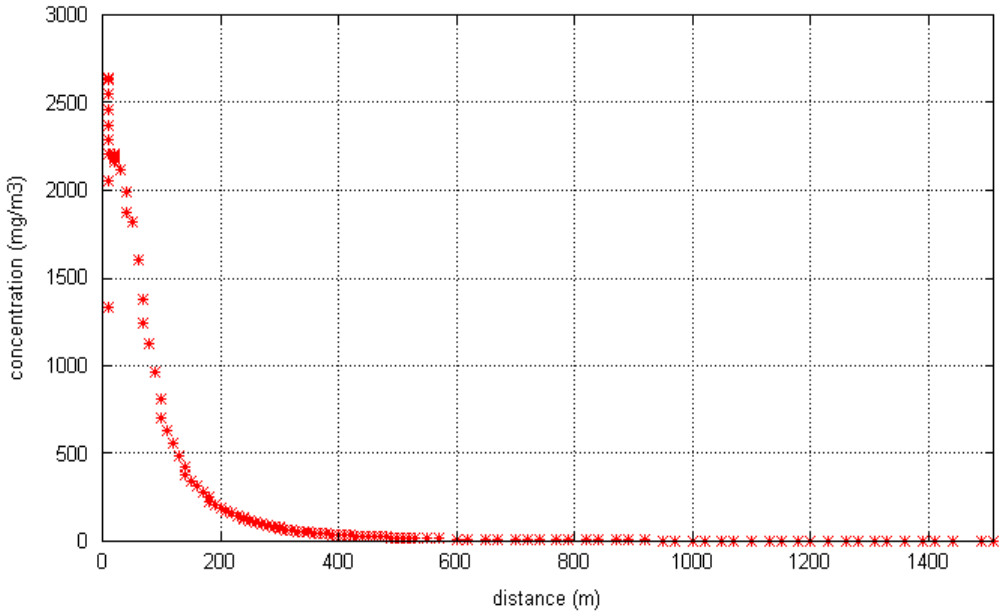
Chemical	Maximum Deposition Level (mg/m^2)	Total Mass Deposition (kilograms)	Surface Area with Concentrations above 0.01 mg/m^2 per km^2 (acres)
Diethyl malonate (DEM)	35,700	2.59	0.0043 (1.06)
Dimethyl adipate (DMA)	119,000	75.9	0.234 (57.8)
Dimethyl methylphosphonate (DMMP)	28.2	0.003	0.00068 (0.17)
Glacial acetic acid (GAA)	99,400	76.7	0.257 (63.5)
Methyl salicylate (MeS)	83,200	59.9	0.0371 (9.16)
Triethyl phosphate (TEP)	0.281	0.0004	0.00145 (0.36)

There is limited toxicity information available on most of the simulants, as these compounds are considered to have low toxicity and have not been the focus of extensive toxicological research. Most laboratory testing of chemical simulants is by exposure routes other than inhalation, such as ingestion – as these compounds are in a liquid state at room temperature – with the exception of the calibration gases. In addition, toxicity values are generally based on long-term exposure to compounds of low toxicity and concentrations of simulants would rapidly disperse so that exposure levels on shore would be at or near background levels within a short time period.

The individuals potentially exposed to higher concentrations of simulants would be limited to personnel associated with the dispersing vessel or structure and the sensor crews, all of whom would be equipped with respirators and protective clothing (NSWCDL, 15 July 2009). Full-face respirators are also worn by personnel while operating pressurized simulant lines or valves, in case of an incidental release (e.g., ruptured line). As shown in Figure 4.4-2, Decrease in Air Concentration over Distance – DEM Test Run Example (Run 027), concentrations of simulants decrease rapidly from the release point. Moreover, maximum concentrations are only present in one direction from the release point. Therefore, people without protective equipment would not be exposed to elevated simulant concentrations.

In addition, actual exposure concentrations of simulants are likely to be lower than predicted based on previous dispersion modeling and field tests conducted by NSWCDD on the PRTR (NSWCDD, 2003; Bossart, letter, February 9, 2006). The modeling results predicted both the airborne and water column concentrations that would result from simulant releases. Field tests indicated that the modeling results exceeded the concentrations that were measured during testing by more than an order of magnitude.

Figure 4.4-2
Decrease in Air Concentration over Distance – DEM Test Run Example (Run 027)



Based on the low toxicity of the simulants selected for testing, short exposure duration to simulants and limited exposure pathways (i.e., access to test area is restricted), likely overestimate of simulant concentrations in modeling predictions, spacing of tests, and the requirement that anyone potentially exposed to elevated concentrations would be equipped with personal protective equipment, adverse impacts from exposure to chemical simulants are considered to be none to negligible.

Summary

Based on the simulant modeling, previous testing, and low toxicity of chemical simulants, continued RDT&E activity involving chemical simulants under the No Action Alternative would result in negligible, long-term, direct and indirect, negative air quality impacts.

4.4.2 Alternative 1

4.4.2.1 Stationary and Mobile Sources

Alternative 1 does not include the construction of any new major stationary sources at NSF Dahlgren. However, the increase in activities from current No Action Alternative levels of 60 to 125 HE laser events per year, and of 490 to 590 EM energy events per year, coupled with an associated increase in power levels needed for testing, may increase the possibility in the future that an additional stationary source of power would be required. As described in Section 3.3, Dominion Virginia Power (DVP) has submitted an application to build a new 230 kV transmission source and substation at NSF Dahlgren. If this new source is built and operated the air permit would be updated. Expanded RDT&E activities under Alternative 1 would have negligible, long-term, direct and indirect, negative stationary source impacts on air quality.

With respect to the weapon operational activities, NSWCDD would:

- Continue to conduct the same number of large-gun firings annually on their operating ranges as under the No Action Alternative.
- Increase explosive detonations from 190 annual events under the No Action Alternative to 200 annual events in EEA Range Complex.
- Increase small-arms firing from 6,000 bullets fired annually under the No Action Alternative to 25,500 bullets fired annually.
- Continue to test rail gun with greater muzzle energy.

The increase of these weapon operational activities would likely increase air emissions over NSF Dahlgren. However, given the small magnitude of increase in firing rounds, slightly expanded weapon testing activities under Alternative 1 would have negligible impacts on air quality.

Clean Air Act General Conformity

As discussed in Section 3.4, NSF Dahlgren is located in an area currently designated as in attainment for all criteria pollutants, within which the general conformity rule does not apply to the Proposed Action. However, the activities in the MDZ within the boundary of Charles County, Maryland, an ozone nonattainment area, are subject to the general conformity rule.

The conformity analysis for the federal action should examine the impacts of the direct and indirect net emissions within the applicable nonattainment area as compared to the baseline condition. Both direct and indirect net emissions should be included in the determination if both of the following apply:

- The Navy can practicably control the emissions and has continuing program responsibility to maintain control.
- The emissions caused by the Proposed Action are reasonably foreseeable.

However, as summarized previously in this chapter, the net emissions resulting from operational activities under Alternative 1, such as increases in small arms firing and explosive detonation in EEA, would not affect those within the PRTR's MDZ nonattainment area as compared to the existing condition. Therefore, no net emissions would occur within the PRTR's MDZ nonattainment area and consequently the general conformity rule does not apply to Alternative 1.

4.4.2.2 Other Sources (Chemical/Biological Simulants)

Under Alternative 1 there would be up to 60 events annually of either chemical or biological simulants released for each event, but chemical and biological simulants would not be mixed. The areas in which the activities would take place would expand from part of the MDZ (depicted in Figure 1-11) to include all of the MDZ, the PRTR land ranges, the EEA, and the Mission Area. None of the chemical simulants used would be criteria pollutants.

Chemical Simulants

The existing SOP calls for simulant releases to be spaced so that no area is exposed multiple times to the same simulant (NSWCDL, 15 July 2009). Testing on the water would continue, as

described under the No Action Alternative. For land tests, a specially designed sprayer tank mounted on a helicopter or UAV would spray chemical simulants onto a land-based platform. Some simulant coming from the helicopter or UAV spraying over water might enter the river or land, and cleanup of the test platform (the vessel) would result in some simulant-containing effluent entering the environment.

For tests done on the MDZ, MDE and VDEQ would be consulted by the NSWCDD Environment and Safety Office prior to testing. If a helicopter-mounted sprayer or UAV were used over land, VDEQ and the Virginia Department of Game and Inland Fisheries (VDGIF) would be consulted prior to testing.

As described for the No Action Alternative, assessments completed for chemical simulant testing performed by NSWCDD showed no significant impacts and there were no observable environmental effects during or after testing (NSWCDL, 2004; Bossart, letter, February 9, 2006; NSWCDL, 31 July 2009). Modeling of chemical simulants that have been used in past indoor or outdoor RDT&E operations indicate that simulants would disperse rapidly and that high concentrations would only be found near the testing area for a short time period.

Future operations might use any of the previously tested simulants or other ones with similar or lesser toxicities. Prior to use, all simulants would be reviewed and approved by the NSWCDD Safety and Environmental Office in consultation with NSF Dahlgren personnel, as applicable, and would only be approved after considering toxicity data relative to the intended quantity and concentration of the simulant to be used.

Under Alternative 1, testing could also be conducted with the introduction of interferents, smokes, or obscurants (e.g., fog oil, PEG 200, poly alpha olephin, paints, fuels, and cleaners). The intended quantity, concentration, and toxicity of the interferent, smoke, or obscurant to be used along with the predicted dispersal would be carefully evaluated prior to use.

Based on the low toxicity of the simulants selected, short exposure duration to simulants and limited exposure pathways (i.e., access to test area is restricted), likely overestimate of simulant concentrations, spacing of tests, and the requirement that anyone potentially exposed to elevated concentrations be equipped with personal protective equipment, adverse impacts from exposure to chemical simulants are considered to be none to negligible.

Chemical simulants are not considered criteria pollutants under the CAA and no quantifiable nonattainment pollutant emissions would occur within the PRTR's Charles County ozone nonattainment area. Therefore, an emissions analysis in accordance with the general conformity rule is not required. As noted previously, the chemical simulants discussed in this report are not hazardous air pollutants.

Biological Simulants

Biological simulants that may be used for testing include bacteria, proteins, fungi, and bacteriophages. Only biosafety level (BSL)-1 simulants (see Section 3.8.4.2) would be used and NSWCDD will model biological simulant dispersion (similar to the chemical simulant dispersion modeling contained in Appendix J) before outdoor testing takes place. Modeling biological simulant dispersion requires information on the quantity, type, and dispersion method to be used for each simulant, which will not be known until outdoor tests are actually being planned. No tests using biological simulants currently take place outdoors.

Many of the BSL-1 organisms, such as the bacteria, are ubiquitous and often found in high concentrations in nature, including in water (CRI, 2004; USEPA, 1997). For example, *Bacillus subtilis* is a widely adapted bacterial species capable of growing within many environments including soil, plant roots and the gastrointestinal tracts of animals (Earl et al., 2008). Population levels of 10^6 to 10^7 per gram of soil have been estimated for this species (USEPA, 1997).

One of the organisms that could be used as a biological simulant, the bacterium *Pantoea agglomerans,* may be harmful to certain plants (for example, causing fire blight of pear and apple trees). There are no published reports of disease associated with these organisms in aquatic plants or animals, and the small concentrations of these bacteria deposited in the water are not expected to cause any significant increase in the resident bacteria populations nor would adverse effects be anticipated from a temporary increase in levels of these bacteria. Any testing of *Pantoea agglomerans* over land would be modeled prior to release to ensure that it is not dispersed in the direction of any pear or apple trees in the area. As described in Section 2.5.4.6, the PRTR's MDZ would be the most likely focus of the work because of DoD's – and particularly the Navy's – need to test biological sensors over water to observe how riverine/marine conditions affect them.

The amount of biological simulant used would be the minimum amount necessary to obtain the desired results. In contrast to chemical simulants, biosimulants are typically dry and powdery rather than liquid. Therefore, the simulants could be released by a blower to form a small dry cloud rather than a vapor cloud.

Respirators and personal protective equipment would be used by personnel on the release boat for biological, as well as chemical simulant testing. Individuals with compromised immune systems or respiratory conditions would not be able to serve as personnel on the release boat, as they would not qualify for respirator use. Therefore, no high risk individuals would be potentially exposed to biological simulants. As noted, only BSL-1 organisms would be used, so even in the event of exposure, the risk of adverse effects would be negligible.

Summary

Based on the simulant modeling, previous testing, and low toxicity of chemical and biological simulants, expanded RDT&E activity involving chemical and biological simulants under Alternative 1 would result in negligible, long-term, direct and indirect, negative air quality impacts.

4.4.3 Alternative 2

4.4.3.1 Stationary and Mobile Sources

Like Alternative 1, Alternative 2 does not include the construction of any new major stationary sources at NSF Dahlgren. Annual HE laser activities would increase from the Alternative 1 average of 125 annual events to 145 events, EM energy activities would increase from 590 to 680 annual events, and EEA Range Complex explosive detonations would increase from the Alternative 1 of 200 annual events to 230 events. This increase in testing may increase the possibility that other sources of power would be required. The 2010 installation power study conducted by NSF Dahlgren addressed future power needs and recommended needed

improvements. If new sources are implemented, the air permit would be updated. Expanded RDT&E activities under Alternative 2 would have negligible, long-term, direct and indirect, negative impacts on air quality.

Clean Air Act General Conformity

As compared to Alternative 1, Alternative 2 would only increase explosive detonation events from 200 to 230 at the EEA Complex. Therefore no net change in air emissions would occur under Alternative 2 within the PRTR's MDZ nonattainment area. Consequently the general conformity rule does not apply to Alternative 2.

4.4.3.2 Other Sources (Chemical/Biological Simulants)

The impacts from Alternative 2 would be similar to those for Alternative 1. None of the chemical simulants used would be criteria pollutants and are not hazardous air pollutants. The difference between chem/bio defense activities under the two alternatives would be an increase in the number of chemical and biological simulant events – from 60 per year under Alternative 1 to 70 per year under Alternative 2. In addition, whereas chemical simulants and biological simulants would be used separately under Alternative 1, they would be used separately or together under Alternative 2. The chemical and biological simulants used would be the same ones approved for use in the individual chemical and biological operational tests under Alternative 1. The same protective and safety measures taken for chemical-simulant testing and biological-simulant testing would be used for the combined chemical and biological sensor testing. There are no known synergistic effects between the chemical simulants and BSL-1 biological simulants that would be tested together. In addition, preliminary research indoors in laboratories is conducted at NSWCDD before tests are performed outdoors. Potential issues would be identified and addressed during indoor tests.

The concentrations of simulants used in any event would not change, and locations on the MDZ and on land would vary within the areas shown on Figure 1-11, so that no single area would be used for repeated testing until concentrations of chemical and biological simulants return to background levels. Concentrations of chemical and biological simulants that people would be exposed to without protective equipment would be at background levels and would not cause adverse effects to human health. Based on the previous testing, low toxicity of chemical and biological simulants, short exposure duration to simulants, limited exposure pathways (i.e., access to test area is restricted), likely overestimate of simulant concentrations, and spacing of tests, expanded RDT&E activities involving chemical and biological simulants under Alternative 2 would result in negligible, long-term, direct and indirect, negative air quality impacts.

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4.5 Noise

4.5.1 No Action Alternative

Under the No Action Alternative, NSWCDD would continue to conduct the same number of annual weapons-testing activities on its operating ranges as are conducted under existing conditions. Therefore, noise and vibration levels around Dahlgren would remain the same as under existing conditions, described in Section 3.5.

Existing noise conditions include continuous noise from aircraft/helicopter/UAV activities and impulse noise from ordnance activities. Continuous noise (as opposed to sporadic gun firing noise) from all flights is considered negligible due to the low number of flights. While UAVSs are flown more than helicopters or fixed-wing aircraft, the altitude at which they fly (normally 2,000 to 3,000 ft, but they can go up to 5,000 ft) and their associated noise levels (around 80 dBA at takeoff and landing for the smaller UAVs and about 100 dBA for the largest UAV flown by NSWCDD) make them fairly quiet and unobtrusive.

For large-gun firing and explosive detonations, modeling was used to develop installation-wide noise contours (Section 3.5.4). Peak blast noise levels in dBP from large-gun firing were predicted using the DoD's large-caliber weapon-noise model BNOISE2.

Additionally, noise measurements were taken in November 2009 at six historic structures located along the PRTR, as detailed in Appendix D. The measurements took place when NSWCDD was firing the largest gun routinely fired on the PRTR – the 5"/62 caliber gun – with live projectiles filled with relatively large amounts of explosives (approximately 9 lbs net explosive weight) compared to standard 5" live projectiles. This set of tests, therefore, produced the greatest possible noise and vibration levels using the 5" gun. NSWCDD's use of projectiles containing larger amounts of explosives than the projectiles tested is, and will continue to be, rare.

The noise measurements at historic structures confirmed that the model-predicted peak noise contours reasonably represent worst-case gun firing peak noise conditions around the PRTR. The monitored peak noise levels at each site along the PRTR were comparable to, though slightly lower than, the peak noise levels modeled for large-gun firing noise without the 8"/55 gun as shown in Figure 3.5-7, which shows targets areas in the MDZ. The contours shown in Figure 3.5-7 include 5"/54 caliber and 155 mm gun firing plus detonations and small gun firing.

Although NSWCDD is very unlikely to fire live projectiles from the 8"/55 caliber gun in the future, this caliber of gun was included in the development of the peak noise contours shown in Figure 3.5-5 as a surrogate for the 5"/62 gun, which is not included in the model, as well as for future versions of 5"guns/projectiles that may include more explosives than currently used. Because the 8"/55 gun has a much larger firing charge and carries projectiles with explosives weighing more than twice as much as the 5"/62 gun, this represents a worst case scenario because it overestimates expected noise levels.

Since the model predictions for peak sound levels without the 8"/55 gun were validated by field measurements during the historic structure noise measurement program, the modeled peak noise contours that include the 8"/55 gun and that were developed using the same methodology can be assumed to accurately reflect worst-case noise and vibration impacts. Furthermore, since the

measured noise levels were slightly lower than the predicted peak noise levels, the predicted peak noise levels can be considered conservative, particularly at on-land receiving sites.

The 2009 noise measurement program at six historic structures also included airborne and ground borne vibration monitoring. Based on the low vibration levels measured over the two-day firing and monitoring period, it is unlikely that the largest gun firing at NSWCDD would result in vibration impacts to structures near the PRTR significant enough to cause any structural damage (see Appendix D for detailed results).

In addition, as part of its outdoor noise management process (Appendix C), NSWCDD uses the Sound Intensity Prediction System (SIPS) to identify areas with potential to be exposed to peak-noise levels above 140 dBP based on weather conditions. Tests expected to generate such levels would be postponed until the weather changes to ensure that no peak-noise level would exceed 140 dBP when large-gun firing occurs. Implementation of SIPS and the other components of the noise management process (see Section 3.5.3.5 and Appendix C) are expected to minimize noise impacts resulting from NSWCDD outdoor RDT&E activities.

Therefore, minor, long-term, direct, negative weapons-testing noise impacts and negligible, long-term, direct, negative vibration impacts would occur under the No Action Alternative. No indirect noise or vibration impacts would occur.

4.5.2 Alternative 1

Under Alternative 1, NSWCDD would:

- Continue to conduct the same number of large-gun firings annually on its operational ranges as under the No Action Alternative.
- Increase the frequency of large-gun firing into a target area in the upper part of the LDZ within 40,000 yards of the firing line, from current occasional use up to ten days a year.
- Fire inert, shaped-metal projectiles from EM launchers over the PRTR land and water ranges. Because the projectiles are inert, noise would originate from the launch site but not from the target area.
- Increase explosive detonations from 190 events annually under the No Action Alternative to 200 events.
- Increase annual small-arms firings from 6,000 bullets under the No Action Alternative to 25,500 bullets.

Continuous noise from aircraft would increase because of an increase in the number of hours UAVs would be flown over the PRTR. However, the increase in hours would have negligible impact on overall noise levels because, as described under the No Action Alternative, the altitude at which UAVs fly (usually at 2,000 to 3,000 ft but they can go up to 5,000 ft) and their associated noise levels (around 80 dBA at takeoff and landing for the smaller UAVs and about 100 dBA for the largest UAV flown by NSWCDD) make them fairly quiet and unobtrusive.

Alternative 1 would only increase the frequency of small-arms firing and detonations on the installation. There would be no change in the number of large-gun firings. Therefore, event peak noise levels would not increase under Alternative 1. They would remain as described in Section

3.5 and shown in Figures 3.5-5. 3.5-6, and 3.5-7. Similarly, potential impacts from vibrations would remain unlikely, as described in Section 3.5.5 and Appendix D. The increase in the frequency of use of the long-range target area in the upper LDZ would lead to more days annually with firing noise experienced downrange, if live projectiles are used. However, the proposed increases would result in higher DNL noise. With respect to large-caliber guns, Figure 4.5-1 (Alternative 1 C-Weighted Day-Night Average Noise Contours with 8"/55 Gun Firing in the Middle Danger Zone) shows the predicted CDNL contours under Alternative 1. The contours would be marginally larger and the areas within Noise Zones II and III (CDNLs between 62 dBC and 70 dBC and equal or greater than 70 dBC, respectively) would be slightly greater than under existing and no action conditions as shown on Figure 3.5-3. However, the difference would be so small as to be negligible and contained within the EEA where the 10 additional detonations would take place.

Similarly, with respect to small-arms activities, comparison between Figure 3.5-8 and Figure 4.5-2 (Alternative 1/Alternative 2 Small Arms A-Weighted Day-Night Average Noise Contours) shows the increase in the amount of land within Noise Zones II and III (ADNLs between 65 dBA and 75 dBA and equal or greater 75 dBA, respectively) resulting from the higher number of bullets that would be fired under Alternatives 1 and 2. This slight increase would occur on the installation at the EEA and Mainside, and would be negligible. Under Alternative 1, the increase would be even less than shown because Figure 4.5-2 was developed using the higher number of bullets – 30,000 – that would be fired under Alternative 2.

For the reasons explained above, Alternative 1 would result in minor, long-term, direct, negative noise impacts. The impacts would be comparable to those predicted for the No Action Alternative, mostly because the noisiest activities would not increase (large-gun firings) or increase only negligibly (detonations). Further, Alternative 1 would result in negligible, long-term, direct, negative vibration impacts. No indirect noise or vibration impacts would occur.

4.5.3 Alternative 2

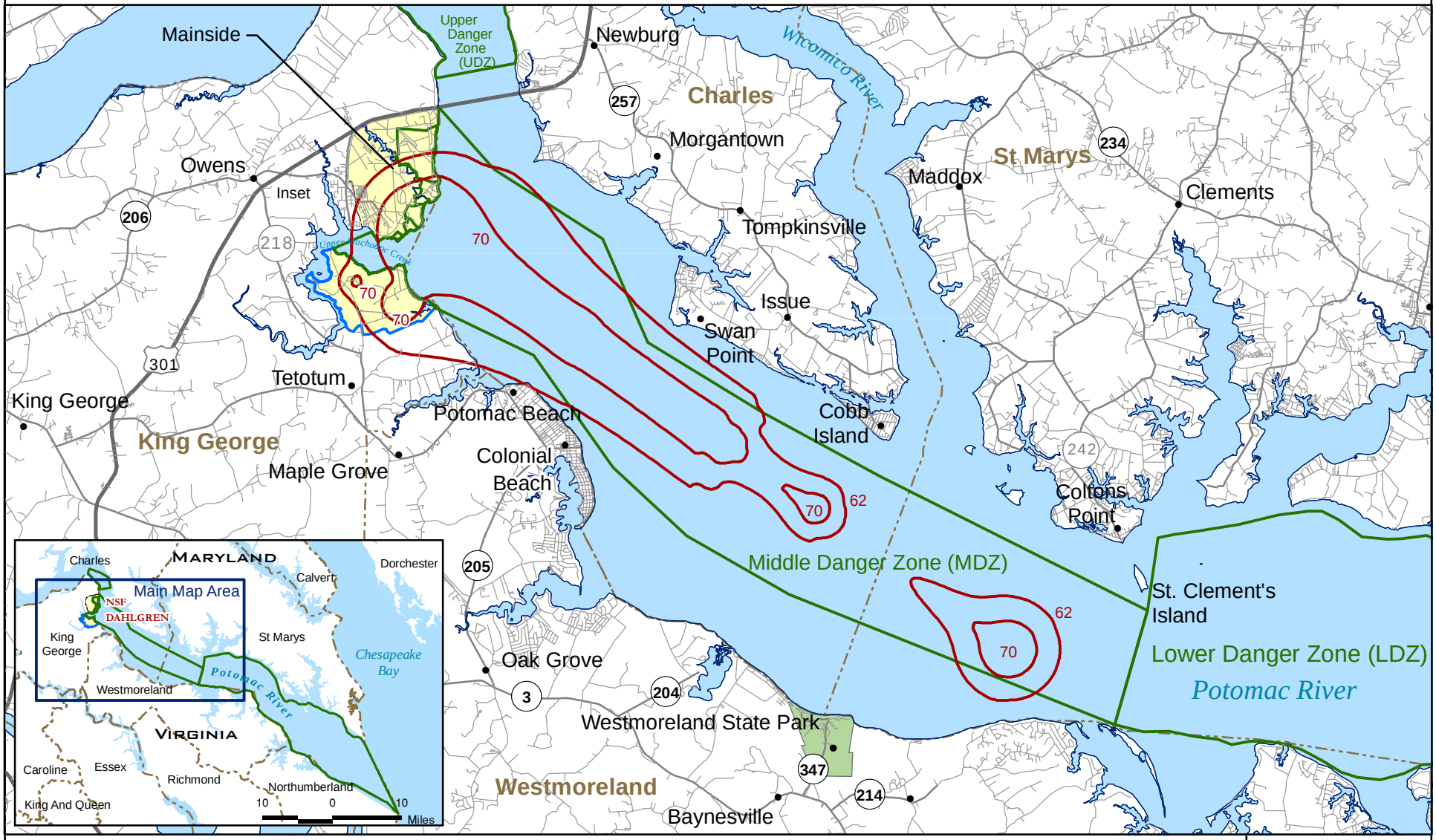
Under Alternative 2, NSWCDD would:

- Continue to conduct the same number of large-caliber gun firings annually on its operating ranges as under the No Action Alternative and Alternative 1.
- Increase the frequency of large-gun firing into a target area in the upper part of the LDZ within 40,000 yards of the firing line, from current occasional use up to ten days a year.
- Fire inert, shaped-metal projectiles from EM launchers over the PRTR land and water ranges. Because the projectiles are inert, noise would originate from the launch site but not from the target area.
- Increase the annual number of explosive detonations from 190 events under the No Action Alternative to 230 events (30 more events than under Alternative 1).
- Increase annual small-arms firings from 6,000 bullets under the No Action Alternative to 30,000 bullets (4,500 more bullets than under Alternative 1).
- Continuous noise from aircraft would increase above Alternative 1 levels because of an increase in the number of EM energy events on the PRTR, which would increase the

number of hours UAVs fly. However, as described under Alternative 1, the impact on noise levels would be negligible because of the altitude at which UAVs fly and the relatively small size of the craft used by NSWCDD.

- Event peak noise levels would remain the same as under existing conditions and as shown in Figures 3.5-5, 3.5-6, and 3.5-7. Similarly, potential impacts from vibrations would remain unlikely, as explained in Sections 3.5.5 and 4.5.1 and Appendix D.
- The proposed increases, however, would affect DNL contours. With respect to large-caliber guns, the predicted CDNL contours under Alternative 2 are shown in Figure 4.5-3 (Alternative 2 C-Weighted Day-Night Noise Average Contours with 8"/55 Gun Firing in the Middle Danger Zone). A comparison between Figure 3.5-3 and Figure 4.5-3 shows that, as under Alternative 1, the increase in the size of the contours under Alternative 2 would be so small as to be negligible and would be contained within the EEA, where the additional detonations would take place.
- The annual number of small-arms firings would rise to 30,000 under Alternative 2. However, as already noted in Section 4.5.2 and as can be seen by comparing Figures 3.5-8 and 4.5-2, the increase in the ADNL contours would be very small and fully contained within the vicinity of the firing ranges.
- Like Alternative 1, Alternative 2 would result in minor, long-term, direct, negative noise impacts; comparable to the impacts predicted for the No Action Alternative, because the noisiest activities would either not increase (large-gun firings) or increase only slightly (detonations). Alternative 2 also would result in negligible, long-term, direct, negative vibration impacts. No indirect noise or vibration impacts would occur.

Alternative 1 C-Weighted Day-Night Average Noise Contours with 8"/55 Gun Firing in the Middle Danger Zone



C-Weighted Day-Night Average Noise Contours

Potomac River Test Range (PRTR) Complex

Explosives Experimental Area (EEA) Range Complex

County Boundary

Naval Support Facility (NSF) Dahlgren

3 0 3 Miles

5 0 5 Kilometers

N

NSWCDD EIS

NAVSEA WARFARE CENTERS DAHLGREN

Sources: BNOISE2 Model & NSWCDD SIPS Model

Figure 4.5-1

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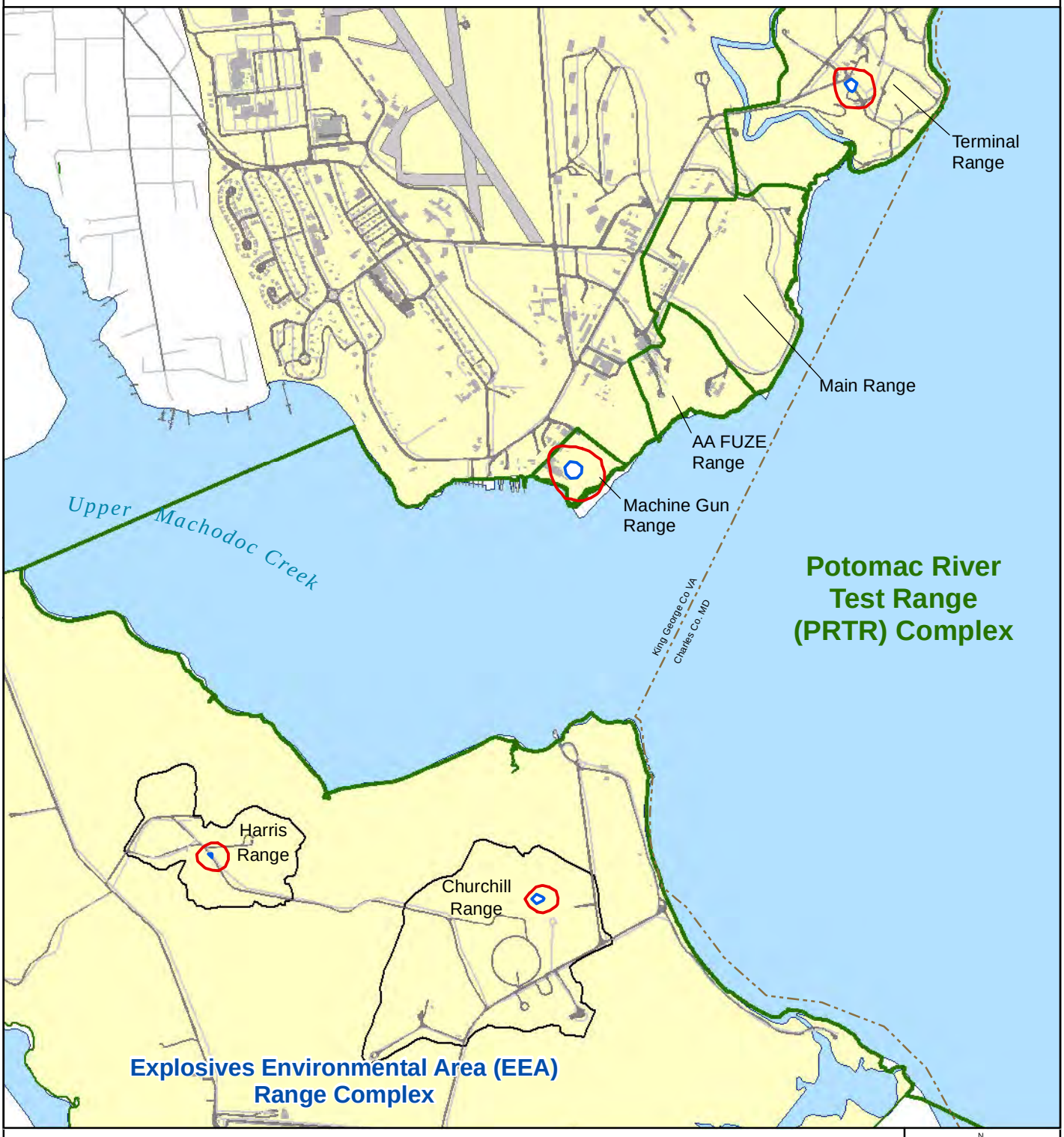
Alternative 1/Alternative 2 Small Arms A-Weighted Day-Night Average Noise Contours



Sources: NSWCDD 2008-2011 and BNOISE2 Model

Figure 4.5-2

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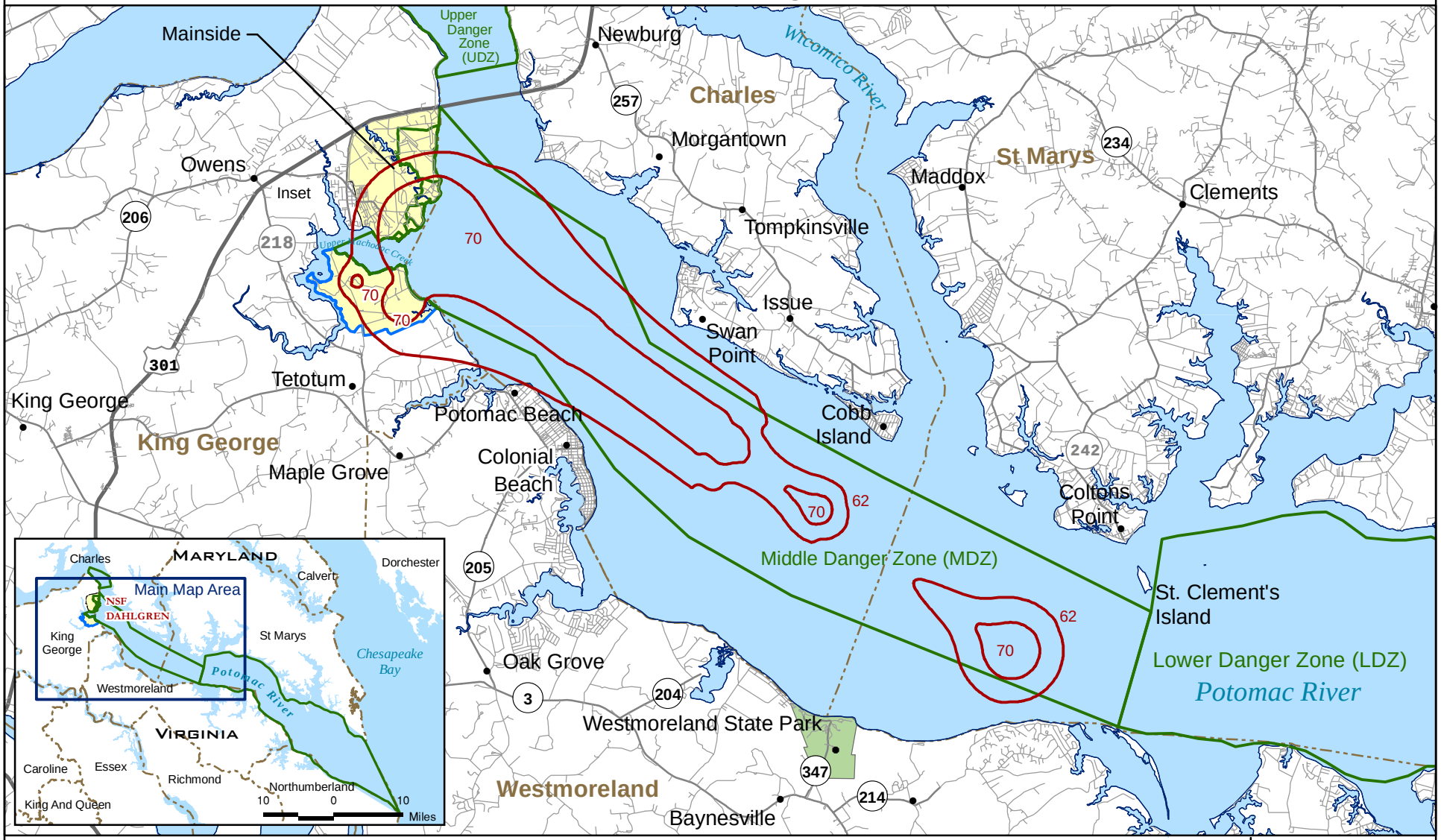
Alternative 2 C-Weighted Day-Night Noise Average Contours with 8”/55 Gun Firing in the Middle Danger Zone



C-Weighted Day-Night Average Noise Contours

Potomac River Test Range (PRTR) Complex

Explosives Experimental Area (EEA) Range Complex

County Boundary

Naval Support Facility (NSF) Dahlgren

3 0 3 Miles

5 0 5 Kilometers

N

NSWCDD EIS

NAVSEA WARFARE CENTERS DAHLGREN

Source: BNOISE2 Model & NSWCDD SIPS Model

Figure 4.5-3

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4.6 Cultural Resources

Section 106 of the National Historic Preservation Act (NHPA) provides that federally-funded agencies, such as NSWCDD, take into account the effects of their actions on any district, site, building, structure, or object included in, or eligible for inclusion in, the National Register. Implementing regulations for Section 106 established by the Advisory Council on Historic Preservation (ACHP) are contained in 36 CFR Part 800 – Protection of Historic Properties, as amended. These regulations provide specific criteria for identifying effects on historic properties. Effects on cultural resources listed in, or eligible for listing in, the National Register are evaluated with regard to the Criteria of Adverse Effect set forth in 36 CFR § 800.5(a)(1) (Table 4.6-1).

Table 4.6-1
Section 106 of NHPA – Criteria of Adverse Effect

Criteria of an Adverse Effect
"An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of an historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative" (36 CFR § 800.5(a)(1)).
Examples of Adverse Effects
Adverse effects on historic properties include, but are not limited to: 1. Physical destruction of or damage to all or part of the property; 2. Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access, that is not consistent with the *Secretary of the Interior's Standards for the Treatment of Historic Properties* (36 CFR Part 68) and applicable guidelines; 3. Removal of the property from its historic location; 4. Change of the character of the property's use or physical features within the property's setting that contribute to its historic significance; 5. Introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features; 6. Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization; 7. Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance" (36 CFR § 800.5(a)(2)).

The Proposed Action is the expansion of NSWCDD's outdoor RDT&E activities at NSF Dahlgren within the PRTR and EEA Range complexes, the Mission Area at Mainside, and the SUA over the ranges. These activities require the use of ordnance, EM energy, HE lasers, and chemical and biological simulants as described in Chapter 2.

4.6.1 Archaeological Resources

The Archaeological Area of Potential Effect (APE) is typically concerned with *direct effects* and is defined by considering the areas of ground disturbance that would occur as a result of carrying out a proposed project action, such as building a new facility. In terms of the Proposed Action described in Chapter 2, the proposed activities associated with all three alternatives – the No Action Alternative, Alternative 1, and Alternative 2 – would have no direct impact on archaeological resources within or near NSF Dahlgren, because no groundbreaking activities are proposed.

However, *indirect effects* upon archaeological resources resulting from testing-related noise are of potential concern. The Archaeological APE encompasses the PRTR MDZ in the Potomac River; the EEA Complex at NSF Dahlgren; and a 300-ft-wide zone along the southern boundary of the EEA between Upper Machodoc Creek and the Potomac River shoreline where indirect impacts resulting from testing-related noise may occur.

Based on the files of the Virginia Department of Historic Resources (VDHR), the Maryland Historic Trust (MHT), and NSF Dahlgren, eight archaeological sites have been identified within the Archaeological APE. A review of the files of the Naval Historical Center (NHC) indicates that an additional three resources that may also be located within the Archaeological APE, for a total of 11 archaeological resources within or possibly within the Archaeological APE. Of these 11 resources, six are terrestrial sites identified on the EEA and include two prehistoric and four possible historic-period sites. The remaining five are maritime sites/resources identified within the Potomac River. The two maritime sites clearly identified within the Archaeological APE include an 18th-century anchor and a possible buried shipwreck; the three maritime resources whose exact locations are unknown but which may be located within the Archaeological APE consist of five US Navy shipwrecks from the Civil War Period.

VDHR and the MHT have not yet evaluated nine of the resources, and, therefore, their National Register eligibility status remains undetermined. VDHR evaluated the Black Marsh 1 and 2 sites, and concurred that they are eligible for listing in the National Register. Table 4.6-2 provides a list of the 11 archaeological resources identified within or potentially within the Archaeological APE, the condition of the resource, if known, and whether indirect impacts are anticipated.

The majority of the proposed project actions associated with the three alternatives, due either to the nature of their activities or the fact that no change in activities is proposed, would have no effect on previously identified or potential archaeological resources within the Archaeological APE. Because no increase in large-gun firing is proposed, only two of the proposed actions has the potential to indirectly impact previously identified or unknown resources: an increase in detonations on the Churchill and Harris Ranges within the EEA Complex (see Figure 3.6-4), and an increase in small arms firing.

Table 4.6-2
Archaeological Resources within or Potentially within the Archaeological APE

Resource Name	Resource Type	Indirect Impact to Resource			Condition of Resource	On File
		No Action	Alternative 1	Alternative 2		
44KG217 (Black Marsh 1)	Terrestrial	None	None	None	Recommended NRE[2]	VDHR and NSF Dahlgren
44KG218 (Black Marsh 2)	Terrestrial	None	None	None	Not recommended NRE[2]	VDHR and NSF Dahlgren
MWC17	Terrestrial	None	None	None	Unknown[3]	NSF Dahlgren
MWC18	Terrestrial	None	None	None	Unknown[3]	NSF Dahlgren
MWC19	Terrestrial	None	None	None	Unknown[3]	NSF Dahlgren
MWC34	Terrestrial	None	None	None	Unknown[3]	NSF Dahlgren
Colonial Beach South QF04 (Dahlgren Anchor Site)	Maritime	None	None	None	Anchor recovered from site by US Coast Guard in 1990[4]	MHT
STRATF QF05 [side-scan sonar anomaly]	Maritime	None	None	None	Unknown[4]	MHT
Christiana Keen[1]	Maritime	None	None	None	Burned and sunk[5]	NHC
Frances Elmor[1]	Maritime	None	None	None	Burned and sunk[5]	NHC
Three Boats[1]	Maritime	None	None	None	"Destroyed" and sunk[5]	NHC

[1] Resource located within or potentially within the Archaeological APE (MHT, 1997).
[2] Recommendations for National Register Eligibility (NRE) based on National Register criteria as determined in NSF Dahlgren and Engineering Field Activity Chesapeake (2006).
[3] GIS data from NSF Dahlgren, 2008.
[4] Site file forms at MHT.
[5] MHT, 1997.

4.6.1.1 No Action Alternative

Under this alternative, the annual level of outdoor RDT&E activities taking place in the PRTR and EEA Range complexes and the Mission Area would continue as currently executed. As this alternative does not propose an expansion of outdoor RDT&E activities, indirect impacts to previously identified or potential archaeological resources in the Archaeological APE are not anticipated. Therefore, in accordance with Section 106 of the NHPA, VDHR and MHT concurred that the No Action Alternative would have no adverse effect on archaeological resources within the APE (Appendix E, pages E-156 and E-148). In accordance with NEPA, the No Action Alternative would have no direct or indirect impact on archaeological resources.

4.6.1.2 Alternative 1

Alternative 1 proposes an increase in existing outdoor RDT&E activities in the PRTR and EEA Range complexes and the Mission Area, as described in Chapter 2. Impacts associated with proposed increased activities are discussed below.

The proposed increased HE laser, EM energy, and chem/bio defense activities and hours of PRTR use to support these activities under Alternative 1 are not expected to affect previously

identified or potential archaeological resources within the Archaeological APE based on the character of their actions, which would not affect resources underground.

An increase in the number of annual detonations from 190 events to 200 events is proposed at the Churchill and Harris ranges within the EEA Range Complex. The proposed detonations have the potential to directly or indirectly impact the ranges and the area immediately surrounding the ranges. A study conducted for military safety testing within the EEA noted that ground impacts from a buried detonation of up to 1,000 lbs net explosive weight (the largest detonation that takes place on the EEA) could cause ground motion that could impact structures less than 300 ft away (see Figure 3.5-4) (US Navy, Not Dated). As there are no previously identified sites within these locations on file with the VDHR or NSF Dahlgren, there would be no impacts to known resources from the proposed actions. The archaeological potential for unknown resources to be present within these two ranges is none-to-low, as a result of past subsurface disturbances. The Churchill and Harris ranges have been subjected to extensive subsurface disturbance as the result of aircraft bombing from 1944 to 1957 and detonations since World War II.

Under Alternative 1, the use of small arms would increase from 6,000 to 25,500 bullets fired outdoors annually. Some bullets will be fired indoors into backstops. Bullets fired outdoors will be fired from the Machine Gun Range either at a target on land that traps the projectiles or at a target in the water up to 4,000 yards out (typically ten percent of bullets). As the bullets on land would be fired into set targets, this action would not impact known or unknown archaeological resources. Similarly, the firing of rounds into the river would not impact known or unknown archaeological resources due to the small size of the rounds and the rapid deceleration of the rounds as they enter the water.

Finally, an increase in the number of annual hours of use of the PRTR is proposed – from 750 hours to 870 hours. For more than 90 years, activities within the PRTR Complex have included the firing of inert and live projectiles from the PRTR land ranges into the Potomac River. Inert projectiles consist of a steel case filled with material such as concrete, replicating the weight of live projectiles. Live ordnance utilized have included naval gun projectiles, small explosives (i.e., grenades), aircraft bombs, and small rockets, which are set to explode in the air above the water or upon impact with the water. However, it should be noted that due to the nature of testing, some projectiles remain unexploded. Remnants of the inert and live projectiles are propelled into the river bottom, where they remain, covered in silt.

Five unevaluated maritime resources have been identified within or possibly within the PRTR portion of the Archaeological APE. One of these resources – the anchor of the Colonial Beach South QF04-Dahlgren Anchor Site – has been removed to another location, while three others were either wholly or partially destroyed before they came to rest on the river bottom (shipwrecks of the Christiana Keen, Frances Elmor, and Three Boats). The remaining resource, known via a side-scan sonar anomaly identified in 2006, is situated along the river bottom at the northeastern end of the Archaeological APE. In addition, there is the potential for unknown resources to be located within the Archaeological APE. However, the prior nine decades of gun-testing in this area have likely heavily disturbed the river bottom. Therefore, while the previously described activities may cause indirect impacts to previously identified and unknown resources within the Archaeological APE, in accordance with Section 106, they are not expected to have an adverse effect on archaeological resources within it.

Therefore, the proposed activities are not expected to cause indirect impacts to previously identified and unknown resources within the Archaeological APE; in accordance with Section 106 of the NHPA, they are not expected to have an adverse effect on archaeological resources within it. VDHR and MHT have both concurred with the no adverse effect determination (Appendix E, pages E-156 and E-148). In accordance with NEPA, Alternative 1 would have no direct or indirect negative impact on archaeological resources within the APE.

4.6.1.3 Alternative 2

Alternative 2 would lead to increases in existing outdoor RDT&E activities at NSF Dahlgren, as described in Chapter 2. Table 4.6-2 summarizes the possibility for the Proposed Action to indirectly affect previously identified archaeological resources in or potentially within the Archaeological APE. Despite increases in small gun, detonation, chem/bio, laser, and EM energy activities, as described in the No Action Alternative and Alternative 1 discussions, there is little-to-no possibility for Alternative 2 to directly affect archaeological resources.

The possibility for Alternative 2 to indirectly affect previously identified and unknown archaeological sites within the Archaeological APE is the same as discussed for Alternative 1. Therefore, the proposed activities are not expected to cause indirect impacts to previously identified and unknown resources within the Archaeological APE; in accordance with Section 106 of the NHPA, they are not expected to have an adverse effect on archaeological resources within it. The VDHR and MHT have both concurred with the no adverse effect determination (Appendix E, pages E-156 and E-148). In accordance with NEPA, Alternative 2 would have no direct or indirect negative impacts on archaeological resources within the APE.

4.6.2 Historic Architectural Resources

Impacts on historic architectural resources outside and within NSF Dahlgren were examined with regard to the Criteria of Adverse Effect set forth in Table 4.6-1. Table 4.6-3 provides a list of 36 resources (20 National Register-listed resources and 16 National Register-eligible resources) within or immediately adjacent to the 120-dBP noise contour based on firing an 8” gun, which also functions as the Historic Architectural APE. These resources are featured in Figure 3.6-2. As the number of events associated with the 120-dBP noise contour (i.e., large-gun firing) is the same under the No Action Alternative, Alternative 1, and Alternative 2, the impacts of these alternatives are discussed together.

Table 4.6-4 provides a list of the four historic architectural resources both within and partially within the 134-dBP noise contour at NSF Dahlgren’s Mainside. These resources are featured in Figure 4.6-1, Detailed View of Historic Districts.

In accordance with Section 106 of the NHPA, VDHR and MHT concurred that the Proposed Action, under the No Action Alternative, Alternative 1, or Alternative 2, would have no adverse effect on historic architectural resources within the APE. In accordance with NEPA, the Proposed Action, under the No Action Alternative, Alternative 1, or Alternative 2, would have minor direct impacts and no indirect negative impacts on historic architectural resources within the APE. The following sections substantiate this finding.

4.6.2.1 Activities with No Impacts on Resources within the Historic Architectural APE

Five of the seven classes of RDT&E activities associated with the No Action Alternative, Alternative 1, and Alternative 2, are not anticipated to affect resources within the Historic Architectural APE. These activities and the reasons for no effect are:

- HE Laser Activities. Laser activities would take place on the range complexes and have no overlap with historic architectural resources.
- EM Energy Activities. EM energy activities would take place on the range complexes and have no overlap with historic architectural resources. Existing data for the EM launcher are not sufficient to develop a noise-prediction model, but the measurements to date do not show a close correlation between increasing power and noise (see Section 3.5.3.7).
- Chemical and Biological Defense Activities. Chemical and biological sensor tests employ low toxicity simulants rather than actual agents, in accordance with federal laws. Testing of simulants would not affect buildings.
- Small-Arms Activities. Firing of small arms (those of calibers 20 mm or less) occurs under controlled conditions on the PRTR and EEA ranges. Most bullets would be fired into gun butts on ranges. Approximately ten percent would be fired into the river. The frequency of outdoors small-arms testing would increase from 6,000 bullets annually under the No Action Alternative to 25,500 bullets annually under Alternative 1 and 30,000 bullets annually under Alternative 2. This action would generate additional noise in the vicinity of the installation, including the Proposed Main Battery Historic District at NSF Dahlgren Mainside, the site of the Main Range. However, the Historic Architectural APE is based upon peak-noise contours associated with large gun/projectile tests and detonations that may cause vibrations to buildings. Small-arms testing would not cause vibrations to buildings and, therefore, such testing would not impact buildings in the vicinity of the installation.
- PRTR Use. Increased use of the river would have no effect on buildings. The increased use would be to support non-ordnance activities, including HE lasers, EM energy, and chem/bio sensor tests.

Therefore, these five classes of activities would not directly or indirectly impact resources within the Historic Architectural APE and, as a result, will not be analyzed in this section.

Table 4.6-3
Historic Architectural Resources outside NSF Dahlgren

Map Number	Resource Name	Location	Status	Within APE	Adjacent to APE
1	Waverley	13535 Waverly Point Road, Newburg, Charles County, MD	National Register-listed, 1987	X	
2	Sarum	Budds Creek Road (Maryland State Route 234) Newport, Charles County, MD	National Register-listed, 1974		X
3	Christ Episcopal Church	Church: 25390 Maddox Road Chaptico, St. Mary's County, MD Parish Hall: 37497 Zach Fowler Road Chaptico, St. Mary's County, MD	National Register-listed, 1994		X
4	Deep Falls	Deep Falls Road Chaptico, St. Mary's County, MD	National Register-listed, 1975		X
5	Bachelor's Hope	Manor School Road Chaptico, St. Mary's County, MD	National Register-listed, 2007	X	
6	Ocean Hall	Bushwood Road Bushwood, St. Mary's County, MD	National Register-listed, 1973	X	
7	St. Clement's Island Historic District	St. Clement's Island St. Mary's County, MD	National Register-listed, 1972	X	
8	The River View	Burch Road St. Mary's County, MD	National Register-listed, 1976	X	
9	St. Francis Xavier Church and Newtown Manor Historic District	Newtown Neck Road (Maryland State Route 243) Leonardtown, St. Mary's County, MD	National Register-listed, 1972	X	
10	Bushfield	367 Club House Loop, Virginia State Route 708 Mount Holly, Westmoreland County, VA	National Register-listed, 2004	X	
11	Spring Grove	Virginia State Route 202, Mount Holly Westmoreland County, VA	National Register-listed, 1985	X	
12	Armstead T. Johnson High School	Virginia State Route 202, Montross Westmoreland County, VA	National Register-listed, 1998	X	
13	Stratford Hall	Great House Road, Stratford Westmoreland County, VA	National Historic Landmark; National Register-listed, 1966	X	
14	Westmoreland State Park Historic District	Westmoreland State Park Westmoreland County, VA	National Register-listed, 2005	X	
15	Ingleside	Virginia State Route 638 Oak Grove, Westmoreland County, VA	National Register-listed, 1977	X	

Table 4.6-3 (Cont'd)
Historic Architectural Resources outside NSF Dahlgren

Map Number	Resource Name	Location	Status	Within APE	Adjacent to APE
16	Blenheim	Virginia State Route 3 Oak Grove, Westmoreland County, VA	National Register-listed, 1976	X	
17	Roxbury	Virginia State Route 638 Oak Grove, Westmoreland County, VA	National Register-listed, 1977	X	
18	Wirtland	Virginia State Route 638 Oak Grove, Westmoreland County, VA	National Register-listed, 1977	X	
19	St. Peter's Episcopal Church	Virginia State Route 3 Oak Grove, Westmoreland County, VA	National Register-listed, 2004	X	
20	Bell House	821 Irving Avenue Colonial Beach, Westmoreland County, VA	National Register-listed, 1987	X	
21	Governor Harry W. Nice Memorial Bridge (Bridge 8039)	US Route 301 over the Potomac River Newburg, Charles County, MD	National Register-eligible, 2001	X	
22	Marshall's Rest (Clifton Potomac Property)	11985 Edgehill Road Newburg, Charles County, MD	National Register-eligible, 1997	X	
23	John H. Reeder Property (Jones Property)	11450 Edgehill Road Newburg Charles County, MD	National Register-eligible, 1997		X
24	Bridge 1808	Maddox Road (Maryland State Route 238) over Burroughs Run, vicinity of Maddox, St. Mary's County, MD	National Register-eligible, 2001	X	
25	Bridge CH-0016	Rock Point Road over Ditchley Prong, vicinity of the Village of Wayside, Charles County, MD	National Register-eligible, 2001	X	
26	Small Structure No. 18049XO	Maryland State Route 520 over Branch of Whites Neck Creek, Bushwood, St. Mary's County, MD	National Register-eligible, 1997	X	
27	Chaptico Historic District	Chaptico, St. Mary's County, MD	National Register-eligible, 2004	X	
28	Locust Grove	25434 Hurry Road, Chaptico, St. Mary's County, MD	National Register-eligible, 2004		X
29	Hague House	Virginia State Route 202 Hague, Westmoreland County, VA	National Register-eligible, 1996	X	
30	Washington & Lee Agricultural High School	16380 Kings Highway (Virginia State Route 3) Montross, Westmoreland County, VA	National Register Eligible, 2000	X	
31	Montross Town Hall (Bank of Montross) ***DEMOLISHED IN 2001***[1]	100 Hawthorne Street Montross, Westmoreland County, VA	National Register-eligible, 2000	X	

Table 4.6-3 (Cont'd)
Historic Architectural Resources outside NSF Dahlgren

Map Number	Resource Name	Location	Status	Within APE	Adjacent to APE
32	Panorama (Hummel Vineyards)	1005 Panorama Road Montross, Westmoreland County, VA	National Register-eligible, 2004; nominated to the NR in 2008; NR listing pending	X	
33	Endurance (Himes House)	29 Irving Avenue South Colonial Beach, Westmoreland County, VA	National Register-eligible, 2001; also located within potentially NR-eligible Colonial Beach Historic District.	X	
34	Bank of Westmoreland (Colonial Beach Town Hall)	18 Irving Avenue North Colonial Beach, Westmoreland County, VA	National Register-eligible, 2001; also located within potentially NR-eligible Colonial Beach Historic District.	X	
35	Colonial Beach Historic District	Colonial Beach, Westmoreland County, VA	National Register-eligible, 2001	X	
36	Greg House	1763 McKinney Boulevard, Potomac Beach, Westmoreland County, VA	National Register-eligible, 2008	X	

[1] Reamy, Brenda, Town of Montross, Virginia. October 14, 2009. Phone call with AECOM.

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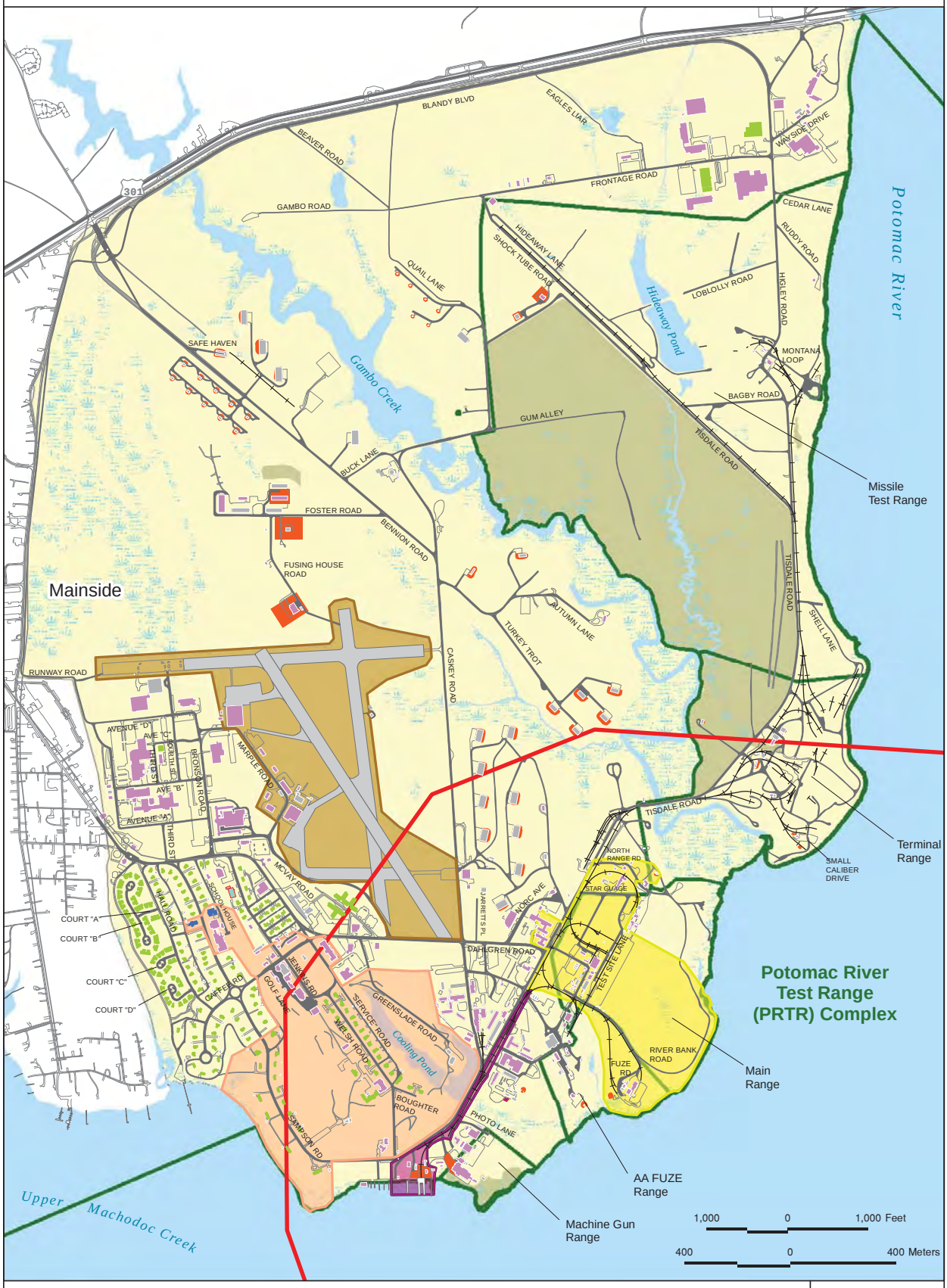
Detailed View of Historic Districts



Proposed Airfield Historic District (1994)
Proposed Main Battery Historic District (1994)
Proposed Residential Historic District (1994)
Proposed Wharf Area Historic District (1994)
Naval Support Facility (NSF) Dahlgren

Residential
Church
School
Office / Warehouse
Other Building

Ammunition Storage Area
Hazardous Materials Storage Area
Ordnance Explosive Waste Area
Potomac River Test Range (PRTR) Complex
Historic Architecture APE/134 dBP Peak Noise Contour

NSWCDD EIS

Source: NSWCDD, 2008-2011

Figure 4.6-1

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Table 4.6-4
Historic Architectural Resources within NSF Dahlgren-Mainside

Resource Name	Description	Status
Dahlgren Residential Historic District	Early 20th-century residential community at NSF Dahlgren; possesses historic significance as planned military community and architectural significance as good example of American domestic architecture from 1918 to 1945.	Determined National Register eligible, 2004.
Proposed Main Battery Historic District	Industrial buildings and structures which form the main battery at NSF Dahlgren. Resources date from the 1920s to the 1950s.	Recommended National Register eligible; determination pending.
Proposed Wharf Area Historic District	Industrial buildings and structures which form the wharf at NSF Dahlgren. Resources date from the 1920s to the 1970s.	Recommended National Register eligible; determination pending.
Proposed Airfield Historic District	Aviation-related buildings and structures at NSF Dahlgren airfield. Resources date from the 1920s to the 1970s.	Recommended National Register eligible; determination pending.

4.6.2.2 Activities with Potential to Impact Historic Architectural Resources

Impacts from two of the seven classes of RDT&E activities associated with the No Action Alternative, Alternative 1, and Alternative 2 may affect resources in the Historic Architectural APE. These two classes are:

- Large Gun/Projectile Activities
- Detonation Activities

As indicated in Section 3.6.2.2, the Historic Architectural APE is based upon peak-noise contours associated with multiple gun/projectile firings and detonations that would not occur simultaneously, but combined together form the worst-case scenario under the No Action Alternative, Alternative 1, and Alternative 2. The worst-case large gun/projectile firings are based on firing live projectiles from an 8”gun on the PRTR’s Main Range at a target 27,500 yds away on the surface of the PRTR’s MDZ. The worst case also includes ordnance detonations taking place on Churchill Range on the EEA Range Complex.

Four peak-noise contours are indicated in Figure 3.6-2: the 120-dBP noise contour, which circumscribes a wide area, and three 134-dBP noise contours around smaller, more-focused areas. The easternmost 134-dBP contour partially occurs on land and in target areas in the Potomac River, and is associated with gun/projectile activities. The central contour occurs in target areas in the Potomac River, and is associated with gun/projectile activities. The westernmost contour partially occurs on land and in target areas in the Potomac River, and is associated with both gun/projectile activities at Mainside and detonations on the EEA.

Impulse noises associated with large-gun firing and detonations, such as those that occur at NSF Dahlgren, have the potential to cause minor damage to structures when they reach levels of 134 dBP. Within the land-based portions of the easternmost and westernmost 134-dBP contours, such noises may result in vibrations which have the potential to cause window panes and plaster to crack in structurally-compromised buildings. Therefore, impacts to historic architectural resources within the land-based portions of the easternmost and westernmost 134-dBP contours

caused by worst-case scenario gun/projectile firings and detonations will be analyzed separately, according to activity type.

Impacts of the impulse noises associated with large-gun firing and detonations are unlikely to result in damage at levels of 120 dBP. However, such noises may result in vibrations which have the potential to rattle loose window panes and cause concern on the part of property owners. As described in Section 3.6.4 and Appendix D, NSWCDD selected six historic architectural resources within the 120-dBP contour of the Historic Architectural APE to conduct noise and vibration monitoring during the firing of live projectiles from the 5"/62 gun on the PRTR Complex's AA Fuze Range in November 2009. The resources were selected in response to concerns raised by the National Register-listed Christ Episcopal Church in Chaptico, Maryland about the proposed expansion of NSWCDD's outdoor RDT&E activities and the validity of noise models employed to develop the Historic Architectural APE.

The results of the noise and vibration monitoring at the six resources assisted in the analysis of impacts of worst-case scenario gun/projectile firings and detonations on historic architectural resources within the 120-dBP contour of the Historic Architectural APE. The analysis of impacts of gun/projectile activities and detonations on these resources will be combined because both actions would likely result in similar impacts.

4.6.2.3 Impacts to Historic Architectural Resources within the 134-dBP Peak-Noise Contours outside NSF Dahlgren

Gun/Projectile Activities

There are no previously identified and evaluated National Register-listed or National Register-eligible resources located within the land-based portions of the easternmost and westernmost 134-dBP noise contours associated with worst-case scenario gun/projectile firings outside NSF Dahlgren.

Detonation Activities

There are no previously identified and evaluated National Register-listed or National Register-eligible resources within the land-based portion of the westernmost 134-dBP noise contour associated with worst-case scenario detonations outside NSF Dahlgren.

4.6.2.4 Impacts to Historic Architectural Resources within the 134-dBP Peak-Noise Contour at NSF Dahlgren

Gun/Projectile Activities

Four historic districts within the 134-dBP peak-noise contour may be impacted by worst-case scenario gun/projectile firings conducted within the PRTR Complex ranges at Mainside, including firing an 8" gun with live projectiles from the Main Range. The districts are:

- National Register-eligible Dahlgren Residential Historic District
- Proposed National Register-eligible Main Battery Historic District
- Proposed National Register-eligible Wharf Area Historic District
- Proposed National Register-eligible Airfield Historic District

The districts are featured in Figure 4.6-1. The boundaries in the figure are based upon the 1994 survey described in Section 3.6. In 2004, VDHR determined one district National Register eligible, the Residential Historic District, and recommended a slightly different boundary. As noted previously, the 1994 boundary has been used for the purposes of this report as it was an installation evaluation. As indicated in Section 3.6, to date VDHR has not reviewed and concurred with the boundaries of the other three proposed districts.

As shown in Figure 4.6-1, the majority of the southern and central portion of the Dahlgren Residential Historic District is located within the 134-dBP contour, and the remainder of the district is located in proximity to the 134-dBP contour. Furthermore, the proposed Main Battery Historic District and proposed Wharf Area Historic District are fully located within the 134-dBP contour. Impulse noises associated with gun/projectile activities may result in vibrations that have the potential to cause window panes and plaster walls in weak buildings to crack.

The southern portion of the proposed Airfield Historic District is also located within the 134-dBP contour. This portion of the Airfield district is characterized by intersecting runways and taxiways which are rarely used, except by helicopters. However, buildings within the district are located roughly 1,000 ft north of the 134-dBP contour.

The worst-case scenario gun/projectile firings conducted within the PRTR Complex ranges, including the firing of an 8” gun with live projectiles from the Main Range, would indirectly affect the southern and central portions of the National Register-eligible Dahlgren Residential Historic District within the 134-dBP contour, and may also impact the remainder of the district because of its proximity to testing activity. The entire proposed Main Battery Historic District and the entire proposed Wharf Area Historic District would also be indirectly impacted. Buildings in the proposed Airfield Historic District located approximately 1,000 ft north of the 134-dBP contour and beyond may also be indirectly impacted because of their proximity to testing activity. According to Section 106 Criteria of Adverse Effect (Table 4.6-1), indirect effects to historic architectural resources may include noise and vibration. Noise and vibration may be caused by the ordnance activities conducted within the ranges of the PRTR Complex.

Although the four historic districts would be indirectly affected by the large-gun firing proposed under Alternative 2, the key event which drives the shape of the 134-dBP contour – the firing of an 8” gun with live projectiles from the Main Range – has not actually taken place in almost a decade. It was used only for worst case noise modeling purposes. If a gun requiring a firing charge similar to the 8” gun were to be fired in the future, weak buildings within the 134-dBP contour in the one National Register-eligible district and the three proposed districts may be subject to vibrations which could crack plaster and windows. Such actions would not diminish the integrity of the one eligible and three proposed districts provided that NSF Dahlgren personnel undertake repairs as required.

Furthermore, as indicated in Table 4.6-2, the level of gun/projectile activities under the No Action Alternative, Alternative 1, and Alternative 2 would remain constant for the foreseeable future. For this reason, it is unlikely that weak buildings within the one eligible district and three proposed districts would suffer further vibration damage beyond what they have in the past.

Therefore, in accordance with Section 106 and NEPA, worst-case scenario gun/projectile firings would have no adverse effect, with conditions, on either the National Register-eligible Dahlgren Residential Historic District or the three proposed historic districts at NSF Dahlgren, part or all of the areas of which fall within the 134-dBP contour. Such conditions would require NSF

Dahlgren personnel to undertake repairs to plaster walls and glass windows that may be cracked by vibrations associated with worst-case scenario gun/projectile firings. The VDHR and MHT have both concurred with the no adverse effect determination (Appendix E). The report *Noise and Vibration Measurements at Six Historic Structures* and cultural resources coordination and documentation are provided in Appendices D and E, respectively.

Detonation Activities

There are no previously identified and evaluated National Register-listed or National Register-eligible resources located within the land-based portion of the westernmost 134-dBP noise contour at NSF Dahlgren associated with the worst-case scenario of detonations at the Churchill Range in the EEA Complex.

4.6.2.5 Impacts to Historic Architectural Resources within the 120-dBP Peak-Noise Contour outside NSF Dahlgren

Thirty-six previously identified and evaluated historic architectural resources are located within or adjacent to the 120-dBP peak-noise contour outside NSF Dahlgren along the PRTR. Specifically, 18 National Register-listed resources are located within the 120-dBP contour outside NSF Dahlgren, and 2 National Register-listed resources are located immediately adjacent to the northern border of the 120-dBP contour. Furthermore, 14 National Register-eligible resources are located within the 120-dBP contour outside NSF Dahlgren, and two National Register-eligible resources are located immediately adjacent to the northern border of the 120-dBP contour. The 36 resources are depicted in Figure 3.6-2 and listed in Table 4.6-4.

As indicated in Section 4.6.2.2 and Appendix D, six historic architectural resources within the 120-dBP contour were selected for noise and vibration monitoring during the firing of the 5”/62 gun with live projectiles from the PRTR Complex AA Fuze Range in November 2009. Measured peak noise levels ranged from 89 to 129 dBP.

Vibration levels ranged from non-detectable to slightly above 0.5 in/sec. Vibration levels of 2.0 in/sec are regarded as the threshold at which minor structural damage may begin to occur. However, 0.5 in/sec has been conservatively identified as a potential level at which glass and plaster may crack in poorly maintained buildings and structures. Stratford Hall, Christ Episcopal Church, and St. Francis Xavier Church & Newtown Manor were not subject to clearly detectable vibration levels during gun/projectile firings. The Greg House and Waverley were subject to vibration levels well below 0.5 in/sec during gun/projectile firings. The Bell House was subject to vibration levels which were slightly above 0.5 in/sec. As indicated in Appendix D, the six resources did not suffer structural damage caused by vibration during gun/projectile firings.

According to Section 106 Criteria of Adverse Effect shown in Table 4.6-1, indirect effects may include noise and vibration. Although the six resources were not damaged during gun/projectile firings, live projectiles from the 5”/62-caliber gun resulted in indirect noise and vibration effects. Therefore, it is anticipated that the 36 resources would be indirectly affected by worst-case scenario gun/projectile firings and detonations in a similar manner to impacts caused by firing live projectiles from the 5”/62 gun.

Large gun/projectile activities would remain at current levels for the foreseeable future. Annual numbers of detonations would increase by about 5 percent under Alternative 1, and by about 21 percent under Alternative 2, as indicated in Table 4.6-2. It is unlikely that vibrations which may

result from the large-gun firing or the detonations would diminish the integrity of the 36 resources within and adjacent to the 120-dBP contour. Because of their age and their having remained intact through the period when 12", 14", and 16" guns were being fired (the 16" gun, for example, required a very large quantity of explosives to fire – the firing charge – and fired projectiles that contained 150 lbs of explosives vs. 9 lbs in the 5"/62 projectiles fired during noise measurements at historic structures), these resources have been subjected to such vibrations over time and would not likely suffer damage. Furthermore, the current NSWCDD Noise Management Process would ensure that noise and vibrations anticipated as a result of gun/projectile firing and detonations are kept to reasonable levels.

Therefore, in accordance with Section 106 of the NHPA and NEPA, worst-case scenario gun/projectile firings and detonations would have no adverse effect on the 36 resources within and adjacent to the 120-dBP contour. The VDHR and MHT have both concurred with the no adverse effect determination (Appendix E). The report *Noise and Vibration Measurements at Six Historic Structures* and cultural resources coordination and documentation are provided in Appendices D and E, respectively.

4.6.2.6 Impacts to Historic Architectural Resources within the 120-dBP Peak-Noise Contour at NSF Dahlgren

Four historic districts within the 120-dBP peak-noise contour may be impacted by worst-case scenario gun/projectile firings conducted at the PRTR Complex ranges and detonations conducted at the EEA Complex. The districts are as follows:

- National Register-eligible Dahlgren Residential Historic District
- Proposed National Register-eligible Main Battery Historic District
- Proposed National Register-eligible Wharf Area Historic District
- Proposed National Register-eligible Airfield Historic District

These districts are also located within the 134-dBP contour, and impacts were assessed in Section 4.6.2.4. The results of the impacts analysis indicate that the Proposed Action would result in no adverse effect to either the National Register-eligible Dahlgren Residential Historic District or the three proposed districts within the 134-dBP contour. Similarly, in accordance with Section 106 Criteria of Adverse Effect, worst-case scenario gun/projectile firings and detonations would result in no adverse effect to the National Register-eligible district or to the three proposed districts at NSF Dahlgren, all of which lie entirely within the 120-dBP contour. The VDHR and MHT have both concurred with the no adverse effect determination (Appendix E). The report *Noise and Vibration Measurements at Six Historic Structures* and cultural resources coordination and documentation are provided in Appendices D and E, respectively.

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4.7 Hazardous Materials and Hazardous Waste Management

4.7.1 No Action Alternative

Under the No Action Alternative, outdoor RDT&E activities at NSF Dahlgren would continue at the existing level into the foreseeable future. There would be no increase in the average annual number of such activities, as described in Table 2-1.

4.7.1.1 Ordnance

Under the No Action Alternative, the current firing of large-caliber guns and small arms, and detonations would continue. Large-caliber gun testing – averaging 4,700 projectiles per year in the most active years – is primarily conducted on NSWCDD's gun line on the Main Range and the Missile Test Range within the PRTR Complex (see Figures 1-4 and 1-5), but also on the AA Fuze Range and the Terminal Range. Outdoor small-arms activities usually employ machine guns firing inert bullets with small propellant charges, although some rounds are live. Approximately 10 percent of the small-arms rounds are fired into the river from the Main, Machine Gun, and Missile Test Ranges, but the vast majority of them are fired on land, principally on the Machine Gun, Terminal, Harris, and Churchill Ranges. Detonations take place at the EEA Range Complex's Harris and Churchill Ranges and range in size from less than 0.01 lbs up to 1,000 lbs net explosive weight (NEW).

As discussed in Section 3.7, NSF Dahlgren and NSWCDD have in place a number of programs, plans, and processes to safely use, transport, handle, store, and dispose of hazardous materials (HM) and hazardous waste (HW), inclusive of explosive hazardous waste (EHW). HW accumulation areas must have contingency plans designed to minimize hazards to human health and the environment. These planning documents include: a Hazardous Waste Contingency Plan, a Hazardous Waste Management Plan, a Military Munitions Implementation Plan, Accumulation Area Requirements, and Satellite Accumulation Point Requirements.

The USEPA Munitions Rule (MR) defines when used or unused munitions (ordnance) are considered EHW. Under the MR, military munitions are not considered EHW when used in training, used in RDT&E activities, during range clearance operations, repaired, or otherwise subjected to materials recovery. Under the MR definition of wastes, ordnance remaining on the land and water ranges at NSF Dahlgren is considered used for its intended purpose and is not subject to HW regulations. The operational ranges at NSF Dahlgren are managed under several military directives and programs that require range maintenance and clearance activities, as discussed in detail in Section 3.7. The NSWCDD Range Management Plan (RMP) and specific post-operation cleanup procedures documented in standard operating procedures (SOPs) prepared for each operation ensure that all range wastes, such as ordnance casings and residues, are managed as required by all applicable regulations and directives.

NSWCDD thermally treats (burns or detonates) EHW from on-site and off-site sources and non-transportable ordnance from on site. The amount of EHW generated, stored, and treated from on-site or off-site activities varies considerably from year to year. The NEW of EHW thermally treated (by open burning/open detonation [OB/OD]) at NSWCDD in 2007 was 8,597 lbs by OB and 10,277 lbs by OD.

To address the requirements of the Navy's Range Sustainability Environmental Program Assessment (RSEPA), a Range Condition Assessment (RCA) for land-based NSWCDD operational ranges at NSF Dahlgren was completed in September of 2010. The RCA found RDT&E activities at NSWCDD land-based ranges to generally be in compliance with all applicable environmental regulations and program requirements (NAVSEA, 2010).

In addition, as there is potential at the PRTR for interaction between the munitions fired into the Potomac River and human and ecological receptors, to support the environmental impact analysis in this EIS, range-specific screening-level risk assessments (RSSRAs) were performed. The results of the ecological and human health RSSRAs indicate that the effects of the cumulative and yearly input of munitions constituents (MCs) during RDT&E in the PRTR are orders of magnitude below concentrations that could cause adverse effects to human health or the environment. This analysis is further described in Sections 4.8, 4.11, 4.12, and 4.13, and Appendix F.

NSF Dahlgren and NSWCDD programs, plans, and processes ensure the safe use, transportation, handling, storage, and disposal of HM, HW, and EHW and the RCA findings indicate that NSWCDD's operational ranges are in compliance with all applicable HM and HW (inclusive of EHW) regulations. These regulations ensure that there are no adverse effects to human health or the environment from ordnance activities. However, even when all programs comply with all regulations, there is still the potential for small amounts of HM and HW to enter the environment. Therefore, there would be minor, long-term, direct and indirect, negative impacts on HM and HW management associated with the continuation of ordnance activities under the No Action Alternative.

4.7.1.2 EM Energy Activities

The EM energy devices included in the No Action Alternative include outdoor facilities for EM testing for the RDT&E of issues surrounding EM environmental effects: the Naval Ordnance Transient Electromagnetic Simulator (NOTES); the Maginot Open Air Test Site (MOATS); and two ground planes. Search and track sensor test site (STSTS) radars, the Navy Directed Energy Center (NDEC), and Counter Explosive Test Facility (CETFAC) for RDT&E of directed energy and HE lasers are also included in the No Action Alternative. NSWCDD conducts approximately 490 EM energy events a year; with more than three quarters of these events currently taking place at the ground planes.

As with ordnance activities, SOPs developed for each operation using EM energy identify and incorporate safe operating parameters with respect to personnel, ordnance, fuels, the environment, and electronic equipment near the test site. As described in Section 3.7, NSWCDD has a fully-developed HM management program in place, in accordance with Virginia Department of Environmental Quality (VDEQ) Resource Conservation and Recovery Act (RCRA) regulations and OPNAVINST 5100.23G procedures. Use of HM other than small amounts of lubricants and oils for high-voltage insulation would not be routine for EM energy RDT&E. However, should HM or HW be generated during outdoor EM energy activities, the material would be approved and tracked according to NSWCDD's HM management program. Any HW would be disposed of in accordance with applicable federal and state laws and regulations.

NSWCDD's programs, plans, and processes ensure the safe use, transportation, handling, storage, and disposal of HM, HW, and EHW, and the RCA findings indicate that NSWCDD's operational ranges are in compliance with all applicable HM and HW (inclusive of EHW) regulation. As the use and generation of HM and HW for EM energy operations would be minimal, there would be negligible, long-term, direct and indirect, negative impacts on HM, and HW management associated with outdoor EM energy activities under the No Action Alternative.

4.7.1.3 HE Laser Activities

The HE lasers primarily used at NSF Dahlgren include (NSWCDL, 2009):

- **Solid State** – Generally, the active medium of a solid-state laser consists of a glass or crystalline host material. Solid-state lasers are rugged, simple to maintain, and capable of generating high powers.
- **Carbon Dioxide (CO_2)** – Carbon dioxide lasers are the highest-powered continuous-wave lasers available. The most common gas composition in CO_2 lasers is a mixture of helium, nitrogen, and CO_2. Additional gases other than CO_2 are used to increase the efficiency of the laser.

Solid-state laser systems commonly use water as a coolant for the neodymium doped crystal yttrium aluminum garnet and thus produce no HW during the lasing process. Other solid-state laser systems may use deuterium as a coolant for the ytterbium-doped crystal yttrium aluminum garnet. Deuterium, also called heavy hydrogen, is an isotope of hydrogen with one proton and one neutron in the nucleus; natural hydrogen has one proton in the nucleus and no neutrons. In this case, deuterium may be considered as water, as it has many of the same properties as water, is a stable isotope, and does not have a regulated maximum contaminant level established by the USEPA.

CO_2 lasers do not require a coolant, but they do use several inert gases, such as helium and nitrogen, for increased operating efficiency, and CO_2 as the prominent lasing medium. None of these inert gases are hazardous, but nitrogen – although it comprises about 78 percent of our atmosphere – in its pure form is an asphyxiant and rapid release of nitrogen into an enclosed space can displace oxygen.

Laser coolants operate within a closed-loop system and are only replaced for routine system maintenance. During tests, the minimum amount of chemicals required would be used, in order to minimize the potential for an incidental release to the environment.

As part of NSWCDD's HW management program, all compressed gases would comply with Occupational Safety and Health Administration (OSHA) regulations contained in 29 CFR § 1910.101, *Compressed Gases (General Requirements)*. In the event that liquid oxygen or nitrogen facilities are required, they would also comply with those regulations. All operations are conducted in accordance with applicable federal and state regulations and policies, and under an NSWCDD-approved SOP.

The use of HM during HE laser activities is not routine. However, any HM utilized would be labeled, stored, contained, inspected, and disposed of according to the HM and HW management program. As with ordnance activities, SOPs developed for each operation using HE lasers identify and incorporate safe operating parameters with respect to personnel, ordnance, fuels, the environment, and electronic equipment near the test site. Therefore, there would be negligible,

long-term, direct and indirect, negative HM and HW management impacts associated with HE laser activities under the No Action Alternative.

4.7.1.4 Chemical Defense Activities

The quantities of simulants used in outdoor chem/bio defense activities represent a very small portion of the amount of materials requiring storage and handling at NSWCDD. The simulants utilized are non-hazardous, even in concentrated form, and are not subject to HM requirements. A maximum of 20 gals of chemical simulant is released over land or water per release. Prior to use, all simulants would be approved by the NSWCDD Safety and Environmental Office in consultation with the NSF Dahlgren Environmental Office and with the Maryland Department of the Environment (MDE) and the VDEQ. Simulants in a compressed-gas state would comply with OSHA regulations contained in 29 CFR § 1910.101.

All tests are conducted in accordance with applicable federal and state regulations and policies, and under an approved SOP. Under the No Action Alternative, only chemical simulants would be used. Chemical simulants are released and dispersed in small quantities as a vapor into the atmosphere, generating little to no HW. Based on the limited quantity and low toxicity of the simulants released into the environment, there would be negligible, long-term, direct and indirect, negative HM and HW management impacts from outdoor chemical defense activities under the No Action Alternative.

4.7.2 Alternative 1

4.7.2.1 Ordnance Activities

Under Alternative 1, the number of large-caliber projectiles at the PRTR would remain at the current levels, although the frequency of firing into the upper LDZ would increase to up to 10 days per year. Outdoor small-arms activities would increase from firing 6,000 bullets to 25,500 bullets. A nominal increase of detonations – from 190 to 200 annually – is anticipated.

NSWCDD has in place a number of programs and processes to ensure the safe use, transportation, handling, storage, and disposal of HM and HW, inclusive of EHW, generated at operational ranges. The RMP and specific post-operation cleanup procedures documented in SOPs ensure that all range wastes, such as ordnance casings and residues, are managed as required according to all applicable regulations and directives. The additional 19,500 bullets under Alternative 1 would be required to be tracked and spent bullets disposed of through the ordnance-handling and -disposal SOPs according to DoD directives. The RCA findings indicate that NSWCDD's operational ranges are in compliance with all applicable HM and HW (inclusive of EHW) regulations.

Under Alternative 1 there would be minor, long-term, direct and indirect, negative impacts on HM and HW management resulting from ordnance activities.

4.7.2.2 EM Energy Activities

Under Alternative 1, some outdoor EM activities would increase in power, and the number of annual events would increase from 490 to 590. Most EM energy events would continue to be conducted at the main outdoor facilities for EM testing – NOTES, MOATS, and the ground planes – the STSTS for radars as well as the NDEC and CETFAC facilities for RDT&E of directed energy and lasers, although some events could take place from mobile emitters anywhere on the ranges or the Mission Area. The majority of events would continue to take place at the two ground planes.

As with ordnance activities, SOPs developed for each operation using EM energy identify and incorporate safe operating parameters with respect to personnel, ordnance, fuels, the environment, and electronic equipment near the test site. Should HM or HW be generated during EM events, the material would be approved and tracked according to the NSF Dahlgren HM management program. Any HW would be disposed of in accordance with applicable federal and state laws and regulations.

As discussed under the No Action Alternative, the use of HM other than proposed lubricants and oils for high-voltage insulation would not be routine; NSWCDD programs, plans, and processes ensure the safe use, transportation, handling, storage, and disposal of HM, HW, and EHW; and the RCA findings indicate that NSWCDD's operational ranges are in compliance with all applicable HM and HW regulations. Therefore, there would be negligible, long-term, direct and indirect, negative impacts to HM and HW management associated with outdoor EM energy activities under Alternative 1.

4.7.2.3 HE Laser Activities

Under Alternative 1, the number of outdoor HE laser test events would increase from 60 to 125 per year and the maximum power from 100 kW to 500 kW. As discussed under the No Action Alternative, the HE lasers currently in use include solid state and CO_2 lasers (NSWCDL, 2009). As discussed in Section 4.7.1.3, coolants for the steady state lasers may include water or deuterium (heavy hydrogen). CO_2 lasers do not require a coolant, but they do use several inert gases, such as helium and nitrogen, for increased operating efficiency, and CO_2 as the prominent lasing medium, none of which are considered HM.

As part of NSWCDD's safety management program, all compressed gases would comply with storage and handling specifications under 29 CFR § 1910.101, and in the event that liquid oxygen or nitrogen facilities are required, they would comply with applicable standards. All laser activities would be conducted in accordance with applicable federal and state regulations and policies, and under an NSWCDD-approved SOP.

During laser activities, inclusive of HE lasers, the use of HM is not routine, and any HW utilized would be labeled, stored, contained, inspected, and disposed of. SOPs developed for use of HE lasers identify and incorporate safe operating parameters with respect to personnel, ordnance, fuels, the environment, and electronic equipment near the test site. Therefore, there would be negligible, long-term, direct and indirect, negative HM and HW management impacts associated with laser activities under Alternative 1.

4.7.2.4 Chemical and Biological Defense Activities

Under Alternative 1, outdoor testing using chemical and biological simulants would expand from the baseline 12 events annually to 60 events annually over land and water. The amount of simulants used in typical events would not increase from a maximum of 20 gals per test currently used. However, under Alternative 1, biological simulants could be used as well as chemical simulants.

The simulants that would be utilized for chem/bio tests are non-hazardous, even in concentrated form, and are not subject to HM requirements. Prior to use, all simulants would be approved by the NSWCDD Safety and Environmental Office, in consultation with the NSF Dahlgren Environmental Office and the MDE and VDEQ. All simulants in a compressed-gas state would comply with storage and handling specifications under 29 CFR §1910.101.

All activities would be conducted in accordance with applicable federal and state regulations and policies under an approved SOP. Chemical and biological simulants would be released and dispersed in small quantities into the atmosphere, generating no HW requiring disposal. Therefore, there would be negligible, long-term, direct and indirect, negative impacts from chem/bio sensor RDT&E on HM and HW management under Alternative 1.

4.7.3 Alternative 2

4.7.3.1 Ordnance Activities

Under Alternative 2, the number of large-caliber projectiles would remain at current levels and use would be the same as under Alternative 1. Outdoor small-arms activities would increase from firing 6,000 bullets to 30,000 bullets. An increase of detonations – from 190 to 230 annually – is anticipated.

NSWCDD has in place a number of programs and processes to ensure the safe use, transportation, handling, storage, and disposal of HM and HW generated at operational ranges. The RMP and specific post-operation cleanup procedures documented in SOPs ensure that all range wastes, such as ordnance casings and residues, are managed as required according to all applicable regulations and directives. The additional 24,000 bullets under Alternative 2 would be required to be tracked, and spent bullets disposed of, through the ordnance-handling and disposal SOPs according to DoD directives. The RCA findings indicate that NSWCDD's operational ranges are in compliance with all applicable HM and HW (inclusive of EHW) regulations.

There would be minor, long-term, direct and indirect, negative impacts on HM and HW management resulting from ordnance activities under Alternative 2.

4.7.3.2 EM Energy Activities

Under Alternative 2, the number of EM energy test events would increase from 490 per year under the No Action Alternative to 680 per year. It is anticipated that these events would be conducted at existing EM outdoor testing facilities on the Mission Area and operational ranges, with the majority of events continuing to take place at the ground plane test facilities. An increasing number of events would take place over the MDZ. Higher power levels would be used for some tests.

As discussed under previous alternatives, SOPs developed for each operation using EM energy identify and incorporate safe operating parameters with respect to personnel, ordnance, fuels, the environment, and electronic equipment near the test site. NSWCDD has an HM management program in place, in accordance with VDEQ RCRA regulations and OPNAVINST 5100.23G procedures. Should HM or HW be generated during EM energy RDT&E, the material or waste would be required to be approved and tracked according to the HM management program. Any HW generated as a result of activities would be managed in accordance with applicable regulations.

Based on a review of EM energy RDT&E testing materials, which indicate that the use of HM other than proposed lubricants and oils for high-voltage insulation would not be routine; NSWCDD programs, plans, and processes to ensure the safe use, transportation, handling, storage, and disposal of HM, HW, and EHW; and the RCA findings of NSWCDD's operational range compliance with all applicable HM and HW regulations, there would be negligible, long-term, direct and indirect, negative impacts to HM and HW management associated with outdoor EM energy activities under Alternative 2.

4.7.3.3 Laser Activities

Under Alternative 2, the number of HE laser events would increase from No Action Alternative levels of 60 to 145 annually. As discussed under the previous alternatives, the coolants used in the outdoor HE lasers are considered non-hazardous and are only replaced during routine system maintenance, and all compressed gases would comply with storage and handling specifications under 29 CFR § 1910.101. All laser activities would be conducted in accordance with applicable federal and state regulations and policies, and under an NSWCDD-approved SOP.

During laser activities, inclusive of HE lasers, the use of HM is not routine, and any HW utilized would be labeled, stored, contained, inspected, and disposed of. SOPs developed for use of HE lasers identify and incorporate safe operating parameters with respect to personnel, ordnance, fuels, the environment, and electronic equipment near the test site. Therefore, there would be negligible, long-term, direct and indirect, negative HM and HW management impacts associated with laser activities under Alternative 2.

4.7.3.4 Chemical and Biological Defense Activities

Under Alternative 2, outdoor activities using chemical and biological simulants would expand from the baseline 12 events annually to 70 events over land and water. The amount of simulants used for typical events would not be greater than the 20 gals per test currently used. Biological simulants could be used as well as chemical simulants and events could use both chemical and biological simulants simultaneously.

As discussed under previous alternatives, all simulants used in outdoor chem/bio sensor activities would be approved by the NSWCDD Safety and Environmental Office, in consultation with the NSF Dahlgren Environmental Office and appropriate Maryland and Virginia regulatory authorities, prior to use, and would only be approved after considering toxicity data relative to the intended quantity and concentration of the simulant to be used. The simulants approved for use are non-hazardous. All activities would be conducted in accordance with all applicable federal and state regulations and policies, under an approved SOP. Therefore, it is anticipated that there would be negligible, long-term, direct and indirect, negative HM and HW management impacts from chem/bio defense RDT&E activities under Alternative 2.

4.8 Health and Safety

4.8.1 No Action Alternative

Under the No Action Alternative, health and safety activities would remain the same as they are at present, continue to be an integral part of NSWCDD's mission, and continue to follow the Occupational Safety and Health Policy (NSWCDD, 2011). All outdoor activities associated with RDT&E activities would continue to comply with all applicable federal and state, Department of Defense- (DoD-), Navy-, and installation-level occupational and environmental safety requirements. The development and rigorous implementation of risk hazard assessments (RHAs), standard operating procedures (SOPs), or general operating procedures (GOPs) with associated operation procedures supplements (OPSs) described in Section 3.8 would continue for all activities described below, as would the safety measures specific to each type of operation, as detailed in Section 3.8.

Policies and SOPs/GOPs/OPSs include, but are not limited to, very specific operating parameters for range clearance and scheduling, safety controls, environmental preservation, materials-handling safety procedures, and control hazard briefings. Additionally, the dedicated technical facilities and equipment at NSF Dahlgren have features specifically designed to support safety requirements for the activities covered in this EIS.

4.8.1.1 Ordnance Activities

NSWCDD would continue to conduct weapon/explosives testing at various operating range locations, as at present, in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls, RHAs, and SOPs/GOPs/OPSs. Gun-firing control measures would be strictly adhered to (Section 3.8.2.1).

An average of 4,700 projectiles (greater than 20 mm to 8" caliber), 6,000 bullets (less than or equal to 20 mm caliber), and 190 detonations (less than 0.1 lbs to 1,000 lbs net explosive weight [NEW]) would be fired annually. The SOPs and GOPs/OPSs, range- and airspace-control measures, gun-firing control measures, unexploded ordnance (UXO) control measures, and procedures for UXO (Section 3.8.2.2) would remain in effect.

The safety zones (Section 3.8.1.1) associated with the PRTR, airfield and SUA, and explosive safety quantity distance (ESQD) arcs would remain in effect to minimize risks and ensure safety during activities.

Range Sustainability Program Assessment

The Navy's Munitions Response Program provides for compliance with the National Defense Authorization Act of 2000 requiring DoD to establish a program addressing military munitions as part of the Defense Environmental Restoration Program (US Navy, 2007). The purpose of the Munitions Response Program is to address munitions and explosives of concern and munitions constituents (MCs) used or released on sites from past activities.

The DoD Range Sustainability Environmental Program Assessment (RSEPA) process described in Section 3.7.6 specifically addresses the sustainability of land ranges, including a determination of whether the release or substantial threat of a release of MCs of potential concern (MCOPCs) from an operational range to an off-range area poses an unacceptable risk to human health or the

environment. DoD Directive 4715.11 (DoD, 2007), DoD Instruction 4715.14 (DoD, 2005), and the *US Navy Range Sustainability Environmental Program Assessment Policy Implementation Manual* (US Navy, 2006) define and provide guidance on this process. The RSEPA process provides a consistent and defensible approach for assessing and addressing the environmental condition of land-based operational ranges where munitions are or were used, excluding small-arms ranges, which are mainly assessed as part of an existing environmental compliance program (e.g., the Navy's best management practices [BMPs] for small-arms ranges).

The conditions on the seven land-based munitions ranges – Missile Test Range, Terminal Range, Main Range, AA Fuze Range, Machine Gun Range, Harris Range, and Churchill Range – at NSWCDD were assessed in the Range Condition Assessment (RCA) Report (NAVSEA, 2010). Areas where there is a potential for an off-range release of MCs are already under investigation and areas where releases have occurred have already been addressed in most cases through the Environmental Restoration Program (ERP) and Subpart X permitting requirements. Groundwater monitoring has detected explosives and perchlorate in wells located in a shallow aquifer. However, this aquifer is not used or suited for drinking water and consequently does not present a health risk. The RCA report concluded that there is no need to investigate any areas for potential off-range releases of MCs beyond investigations already planned and other programs and the procedures described in Section 3.7.6 to ensure the health and safety of NSF Dahlgren personnel and the general public.

PRTR Evaluation

An evaluation of whether MCs and military expended material constituents (MEMCs) entering the PRTR during RDT&E activities could result in an unacceptable risk to human health or the environment was conducted as part of this EIS. As there is potential for interaction of constituents released from munitions fired into the Potomac River to affect both human and ecological receptors, two separate range-specific screening-level risk assessments (RSSRAs) were performed, one for human health and one for ecological receptors.

The human health and ecological RSSRAs employed conservative (i.e., stringent/protective) assumptions to evaluate existing data on munitions in the PRTR and to determine whether additional analysis is necessary; protective measures are warranted; or whether the range poses acceptable risks, in which case no further analysis is needed. In order to perform the RSSRAs, the quantity of munitions entering the PRTR was estimated based on records extending back to the establishment of Dahlgren in 1918. Appendix F, Derivation of Concentrations of Munitions Constituents in Potomac River Test Range Sediment and Water, contains a summary of the quantification of munitions, focusing on large-caliber projectiles.

Once a list of the types and quantities of MCs used at Dahlgren was compiled, a subset of MCOPCs was selected for geochemical modeling to provide an estimate of their concentrations in sediments and water. MCOPCs were selected based on total mass (cumulative over the last 90 years), toxicity, and US Navy guidance (US Navy, 1999, 2001), as described in Appendix F.

The concentrations of the MCOPCs were estimated in the areas with the densest concentrations of large-caliber projectiles. The area between the Main Range Gun Firing Line (0 yds) and 25,000 yds in the MDZ accounts for a total of 341,706 rounds fired, or 99.4 percent of all large-caliber munitions recorded in log books as tested on the PRTR in the last 90 years (refer to Figure 3.7-1). This area was termed the "diffuse zone," as munitions are distributed over a relatively large area.

Within this area, the zone from 11,000 to 13,000 yds was termed the "dense zone," as it has the highest density of rounds in the PRTR. The dense zone has a surface area of approximately 2.29 sq NM and contains approximately 159,580 rounds, yielding a density of 69,686 rounds per sq NM. These two areas were used to derive upper bound estimates of MCOPCs in PRTR water and sediments using conservative modeling assumptions, as detailed in Appendix F. Dilution of MCOPCs in the water column and burial of sediments (the PRTR is a high deposition area; see Section 3.9) were not considered when modeling water or sediment concentrations. Estimates of concentrations of MCOPCs in fish based on uptake from the water column were calculated (see Section 4.11.1.1). The human health RSSRA is summarized below, while the ecological RSSRA is described in Sections 4.11.1.1, 4.12.1.1, and 4.13.1.

The human health RSSRA evaluated the following three exposure pathways in the absence of any institutional controls or other restrictions:

- Ingestion of fish from the PRTR.
- Incidental ingestion of and dermal contact with surface water during recreational uses (e.g., wading, boating, or swimming) in the PRTR.
- Incidental ingestion of and dermal contact with surface sediments during recreational uses (e.g., wading, boating, or swimming) in the PRTR.

To determine the potential for adverse effects, modeled concentrations of MCOPCs were compared to risk-based regional screening levels developed by the US Environmental Protection Agency (USEPA, 2012). These screening levels are based on default exposure parameters and factors that represent reasonable maximum exposure conditions for long-term/chronic exposures and methods outlined in USEPA's Risk Assessment Guidance for Superfund, Part B Manual (USEPA, 1991) and Soil Screening Guidance documents (USEPA, 1996; 2002).

The screening-level concentrations correspond to either a 1×10^{-6} (one in a million) excess cancer risk for carcinogens or a hazard quotient (HQ) of 1 for non-carcinogens (USEPA, 2012). The HQ is the ratio of the exposure concentration over the non-cancer reference dose. A value of 1.0 or higher indicates the potential for non-cancer effects from exposure to a compound. If the HQ is below 1 – i.e., all concentrations were below levels associated with adverse effects – concentrations are considered to be at acceptable levels and no further evaluation is required.

Modeled concentrations of constituents in fish in the dense and diffuse zones were compared to USEPA fish-ingestion regional screening levels. As shown in Table 4.8-1, there were no exceedances of USEPA fish-tissue screening-level concentrations. HQs of modeled concentrations are orders of magnitude below the target ratio of 1, indicating that concentrations of MCOPCs in fish from ordnance activities are hundreds of times to billions of times lower than concentrations that may result in adverse effects to people.

Table 4.8-1
Risk Characterization of Modeled Constituents in Fish Tissue

MCOPC	Concentration in Fish Tissue (mg/kg ww)		Fish-Tissue Screening Level (mg/kg)[1]	Hazard Quotient	
	Dense Zone	Diffuse Zone		Dense Zone	Diffuse Zone
Metals					
Cadmium	0.0000046	0.00000063	1.35	0.0000034	0.00000047
Chromium	0.00000016	0.000000037	2,030	7.9×10^{-11}	1.8×10^{-11}
Copper	0.0000042	0.0000011	54.1	7.8×10^{-8}	2.0×10^{-8}
Lead	5.2×10^{-13}	1.1×10^{-13}	NA	NA	NA
Manganese	0.00066	0.00022	189	0.0000035	0.0000012
Nickel	0.0000017	0.0000017	27	6.3×10^{-8}	6.3×10^{-8}
Zinc	0.000094	0.000015	406	0.00000023	3.7×10^{-8}
Explosives					
Ammonium Picrate	0.0000083	0.00000043	NA	NA	NA
HMX	4.9×10^{-9}	2.9×10^{-9}	67.6	7.3×10^{-11}	4.3×10^{-11}
RDX	0.0001	0.0000018	0.029	0.0035	0.000063
Tetryl	0.000013	0.00000036	5.41	0.0000024	6.7×10^{-8}
TNT	0.00025	0.000048	0.105	0.0024	0.00046

Notes: NA = not available, no criteria available.mg/kg ww = milligrams per kilogram (parts per million) wet weight; mg/kg = milligrams per kilogram; Scientific notation is used for very small numbers; for example 1.0×10^{-9} is one billionth (0.000000001).
Hazard quotients are the modeled concentration divided by the screening level concentration.
Hazard quotients above 1 indicate the potential for adverse effects.

Modeled concentrations of constituents in surface water were compared to USEPA tap water screening levels to screen whether ingestion of surface water posed a potential risk. In the event that ingestion of tap water posed a potential risk, site-specific parameters would have been modeled for incidental surface water ingestion as the next step. As shown in Table 4.8-2, there were no exceedances of residential tap water-ingestion screening-level concentrations for MCOPCs based on the modeled concentrations in the PRTR. HQs of modeled concentrations were far below the target ratio of 1, indicating that surface water concentrations are below tap water concentrations that could result in adverse effects. It should be noted that ingestion rates used for screening levels are based on water used as a drinking water source (2 liters per day), rather than incidental ingestion of water during recreational activities (0.05 liters per day).

Table 4.8-2
Risk Characterization of Modeled Constituents in Surface Water

MCOPC	Modeled River Water Concentration from Munitions (Daily) (µg/l)		USEPA Tap Water Screening Levels	Hazard Quotient	
	Dense Zone	Diffuse Zone		Dense Zone	Diffuse Zone
Metals					
Cadmium	0.000005	0.00000069	6.91	7.2×10^{-7}	1.0×10^{-7}
Chromium	0.0000085	0.0000019	1001	8.5×10^{-9}	1.9×10^{-9}
Copper	0.0000059	0.0000015	622	9.5×10^{-9}	2.4×10^{-9}
Lead	5.8×10^{-9}	1.2×10^{-9}	151	3.8×10^{-11}	7.9×10^{-12}
Manganese	0.00001	0.000034	322	3.1×10^{-8}	1.1×10^{-7}
Nickel	0.000022	0.000022	303	7.3×10^{-8}	7.3×10^{-8}
Zinc	0.000046	0.0000073	4,670	9.9×10^{-9}	1.6×10^{-9}
Explosives					
Ammonium Picrate	0.000052	0.0000027	No Criteria	NA	NA
HMX	4.5×10^{-9}	2.6×10^{-9}	781	5.8×10^{-12}	3.3×10^{-12}
RDX	0.000034	0.00000057	0.61	0.000056	9.4×10^{-7}
Tetryl	0.00000057	0.000000016	62.9	9.1×10^{-9}	2.5×10^{-10}
TNT	0.0000033	0.00000064	2.19	0.0000015	2.9×10^{-7}

Notes: NA = not available
µg/l = micrograms per liter (parts per billion);
Scientific notation is used for very small numbers; for example 1.0×10^{-9} is one billionth (0.000000001).
Hazard quotients are the modeled concentration divided by the screening level concentration.
Hazard quotients s above 1 indicate the potential for adverse effects.

Modeled concentrations of constituents in sediments were compared to USEPA residential soil screening levels, as site-specific parameters would have to be modeled for incidental sediment ingestion. As for surface water ingestion, this step would have been completed in the event that incidental ingestion of soil posed a potential risk. As seen in Table 4.8-3, there were no exceedances of residential soil screening concentrations. The ratios of modeled concentrations to screening levels are orders of magnitude below the target HQ of 1.

Based on the human health RSSRA, none of the MCOPCs exceed screening targets, even using extremely conservative exposure assumptions for water and sediment exposure that considerably overestimate potential exposure. Although one explosive (ammonium picrate) lacks health-based screening concentrations, it should not pose a significant risk to human health due to the lack of known significant toxicological effects associated with it. The analysis of fish consumption and recreational exposure scenarios indicates that there is no potential for increased risk from the ingestion of fish or incidental ingestion or contact with surface water or sediment, and that all potential risks posed by the range-related MCOPCs are within USEPA acceptable limits.

Based on health and safety procedures in place, the RCA report, and the risk screening, ordnance activities associated with the No Action Alternative would have negligible, long-term, direct and indirect, negative impacts on health and safety.

Table 4.8-3
Risk Characterization of Modeled Constituents in Sediments

MCOPC	Monthly Sediment Concentration from Munitions (mg/kg)		USEPA Residential Soil Screening Levels (mg/kg)	Hazard Quotient	
	Dense Zone	Diffuse Zone		Dense Zone	Diffuse Zone
Metals					
Cadmium	0.015	0.0021	70.22	0.00021	0.00003
Chromium	0.0056	0.0013	0.29	0.019	0.0045
Copper	6.5	1.7	3,130	0.002	0.00054
Lead	0.12	0.026	400	0.00030	0.00007
Manganese	2.3	0.80	1,830	0.00126	0.00044
Nickel	0.079	0.082	15,502	0.000005	0.000005
Zinc	1.1	0.19	23,000	0.000048	0.000008
Explosives					
Ammonium Picrate	0.00000054	0.000000041	No Criteria	NA	NA
HMX	6.1×10^{-9}	5.1×10^{-9}	3,800	1.6×10^{-12}	1.3×10^{-12}
RDX	0.000014	0.00000034	5.562	0.0000025	0.000000061
Tetryl	0.0006	0.000025	244	0.0000025	0.0000001
TNT	0.003	0.00081	19.42	0.00015	0.000042

Notes:
mg/kg = milligrams per kilogram; NA = not available, no criteria available.
Hazard quotients are the modeled sediment concentration divided by the screening level concentration.
Hazard quotients above 1 indicate the potential for adverse effects.
Scientific notation is used for very small numbers; for example 1.0×10^{-9} is one billionth (0.000000001).

4.8.1.2 EM Energy Activities

Under the No Action Alternative, NSWCDD would conduct up to 490 EM test events (three-quarters of which would be ground plane activities) at power levels ranging up to 500 MW at its present testing locations. Activities would continue to be conducted in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls and RHAs and SOPs. RHAs and SOPs developed for each operation using EM energy would continue to identify and incorporate safe operating parameters with respect to personnel (HERP), ordnance (HERO), fuels (HERF), electronic equipment (EMI), and the environment near each test site, as described in Section 3.8.3.

Current EM activities at NSF Dahlgren have been addressed in the following four environmental assessments (EAs):

- The construction and operation of the Naval Ordnance Transient Electromagnetic Simulator (NOTES) facility (NSWCDD, 1992)
- The Electromagnetic Research and Engineering Facility [now called Navy Directed Energy Center (NDEC)] and Counter Explosive Test Facility (CETFAC) (NSF Dahlgren, 2006)
- The EM Launcher (Railgun) RDT&E Facility (MILCON P-306) (NSWCDL, 2009a).
- Maritime Laser RDT&E (NSWCDL, 2009c).

All four EAs resulted in findings of no significant impact (FONSIs). EM activities under the No Action Alternative would follow the specific SOPs previously developed for each type of operation. The magnetic and electrical fields generated during EM activities are discussed below.

Magnetic Fields

Magnetic fields generated during the operation of high-energy systems can present a potential EM hazard. A typical example of a strong magnetic field generated by RDT&E activities at NSF Dahlgren occurs when railguns, a type of EM launcher, are fired at the Electromagnetic Launch Facility (EMLF) (see Sections 1.5.1.2 and 1.5.2.5). The Railgun EA (NSWCDL, 2009a) evaluated magnetic fields projected to occur from the operation of a 64-megajoule (-MJ) railgun at the EMLF. The analysis in the EA determined that the magnetic field strength generated by the railgun would be intense close to the railgun launcher during firing. However, all site personnel would leave the EMLF during launcher firings and would conduct the testing from a control building located 80 ft behind the EMLF and with a thick wall facing the EMLF, thereby eliminating exposure to magnetic fields close to the EM launcher during RDT&E activities.

Magnetic fields predicted to result from the operation of a 64-MJ EM railgun are presented in Figure 4.8-1 (Magnetic Field Predictions) (Balchin, 2007). The magnetic field strengths predicted for on-site personnel and individuals at distances outside the testing area during the operation of the 64-MJ EM railgun were compared to exposure standards to determine whether operation of the railgun would pose a risk to people. The exposure standard selected for comparison was the lowest time-varying exposure guideline (i.e., most protective) listed by Institute of Electrical and Electronics Engineers (IEEE), International Commission on Non-Ionizing Radiation Protection (ICNIRP), or the American Conference of Governmental Industrial Hygienists (ACGIH). This guideline is the ICNIRP guideline for time-varying magnetic field exposure to pacemakers of 0.833 Gauss (G) (ICNIRP, 1998). For comparison, this magnetic field strength level is slightly more than five times the magnetic field strength experienced by an individual one foot away from an operating electric can opener.

As shown in Figure 4.8-1, the magnetic field strength measured in G would be intense close to the launcher during firing, decreasing by about four orders of magnitude within 30 ft. The exposure standard of 0.833 G selected for comparison is reached approximately 80 ft away from a 32-MJ EM railgun during firing (Figure 4.8-1). Distance is measured outwards from the mid-point of the EM railgun between the rear of the barrel, or breech, and the muzzle at the front end of the EM railgun. Since the EMLF would be vacated during launcher firings, and site personnel would be located in a control building – 80 ft behind the EMLF and with a thick wall facing the EMLF – the magnetic field strengths experienced by these site personnel would be well below the applicable exposure standards. In addition, any personnel having an active implantable medical device, such as pacemakers and implantable cardioverter defibrillators, must inform the Process Supervisor prior to the firing of the railgun.

Table 4.8-4 provides a comparison of the railgun magnetic field strength at a distance of 80 ft away from the firing launcher (0.833 G) to the established IEEE uncontrolled and controlled exposure limits at the mid-point frequencies of the frequency ranges covered.

Table 4.8-4
Comparison of Magnetic Field Strength 80 ft from EM Launcher (Railgun) to IEEE Exposure Limits

Frequency (Hz) [1]	IEEE Uncontrolled Environment Exposure Limit[2] (G)	Exposure Level at 80 ft[3] (G)	Magnitude Below IEEE Uncontrolled Exposure Limit	IEEE Controlled Environment Exposure Limit[2] (G)	Exposure Level at 80 ft[3] (G)	Magnitude Below IEEE Controlled Exposure Limit
0.076	1,180	0.833	1,416 times	3,530	0.833	4,237 times
10	18.1	0.833	21.7 times	54.3	0.833	65.1 times
370	9.04	0.833	10.8 times	27.1	0.833	32.5 times
1,120	0.613	0.833	-[4]	18.3	0.833	21.9 times

Notes: [1] The mid-point frequency of each IEEE C95.6 frequency range was selected for illustrative purposes. The four ranges are: <0.153; 0.153-20; 20-759; and 759-3000 Hertz (Hz).
[2] Exposure limits as cited in IEEE C95.6 *Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0-3 kHz*. Exposure limits are magnetic maximum permissible exposure (MPE) for head and torso.
[3] The exposure level at 80 ft from the EM launcher is also the ICNIRP guideline for time-varying magnetic field exposure to pacemakers.
[4] Exceeds the uncontrolled (general public) exposure limit at 80 feet by 1.3 times; however, the general public and site personnel will not have access to the launcher during firing activities. Therefore, no overexposures would occur.
Hz = Hertz.

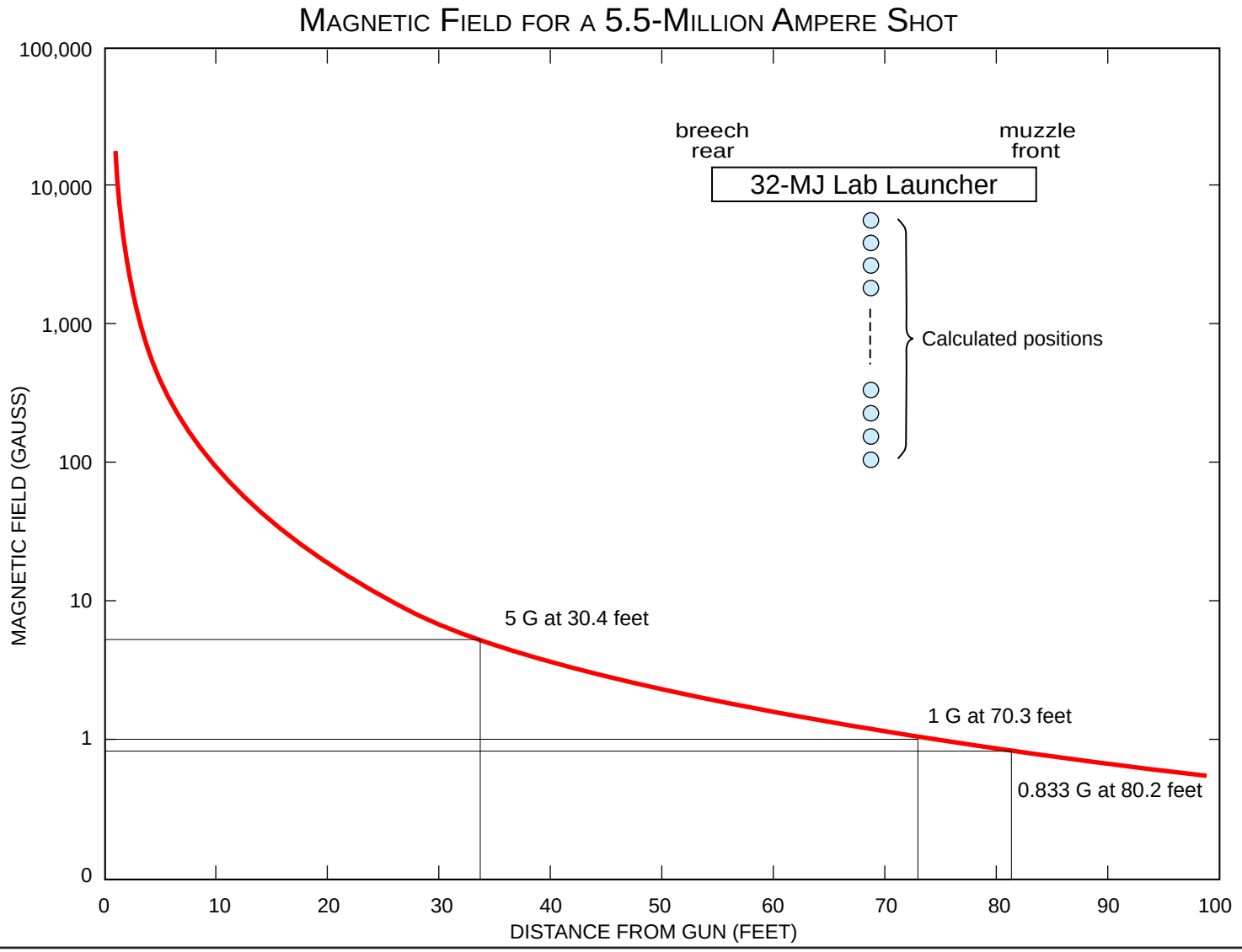
The predicted magnetic field levels represent the worst-case exposure potential. The 64-MJ railgun is being constructed with a series of steel plates along its length on both sides, which provide additional shielding from the radiated electric and magnetic fields. Protection would also be provided by the metal walls of the existing EMLF, which houses the 32-MJ railgun and the proposed launcher building addition, because metal substantially shields from and attenuates magnetic fields.

Electrical Fields

Using the railguns again as an example of a typical higher-power EM operation, RDT&E on EM energy applications would involve the generation and discharge of electrical energy at levels that could exceed 3 mega amps, the current associated with EM railgun muzzle energy levels of 64 MJ. The electrical fields that were observed during previous 32-MJ EM railgun firings (but below 32 MJ muzzle energy) were below the established IEEE exposure limits in IEEE C95.1 *Standard for Safety Levels with Respect to Radiofrequency Electromagnetic Fields, 3 kHz to 300 GHz*. Measurements showed that the highest electric field reading inside the EMLF was 17 kilovolt per meter (kV/m) as compared to the IEEE exposure limit of 100 kV/m (IEEE, 1999). Thus, the highest measurement within the EMLF during launcher testing was approximately 5.8 times lower than the exposure limit. The highest electrical field measured outside the EMLF during a test was 0.3 kV/m, which is less than one-fifteenth of the household guideline limit value of 5 kV/m (World Health Organization [WHO], 2008) and approximately 333 times lower than the 100 kV/m exposure limits applicable to electric fields associated with the EM launcher/railgun system testing.

Electric and magnetic field levels were also predicted for the closest locations where ordnance and persons may be present for activities involving EM energy, using the EMLF location as an example (Bean, 2006). The on-site facility in which ordnance is stored and handled that is closest to the EMLF facility is Building 1180. The electric and magnetic field levels reaching this building (located at a distance of 1,250 ft from the EM launcher facility) were modeled, even though no ordnance would be present at this building during EM launcher activities (Naval Ordnance Safety and Security Activity

Magnetic Field Predictions



G = Gauss
= B55MA vs Pos

NSWCDD EIS

Figure 4.8-1

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[NOSSA], letter, August 13, 2008). Also modeled were the nearest occupied building – Building 1426, at a distance of 435 ft – and the portion of US 301 closest to the EM launcher building, 1,600 ft away.

The results, presented in Table 4.8-5, show that both electric and magnetic field strengths are more than an order of magnitude below exposure limits for a muzzle energy of 64 MJ at all locations, thus providing room for an increase in muzzle energy in future testing. Additionally, the duration of the firing pulse is approximately 8 milliseconds (8/1000 of a second), which results in a very short exposure time.

Table 4.8-5
Electric and Magnetic Field Exposure Limits

Location	Concern	Electric Fields (volts/meter)		Magnetic Field Strength (G)	
		Limit	Predicted	Limit	Predicted
Control Van	HERP	614	0.60	2.3	0.32
	EMI	> 3.0		4.5	
Building 1426	HERP	614	2.77	2.3	0.068
Building 1180	HERO	50	0.97	74.5	0.008
US Route 301	EMI	> 3.0	0.40	4.5	0.005

Source: Bean, 2006.

Magnetic field and electric field exposures for personnel on-site and on-installation, as well as for the public off-installation, during firing of the 64-MJ railgun do not exceed established exposure limits. For powers greater than 64 MJ, electric and magnetic field strengths would be calculated and compared to safety limits. Testing would only occur after RHAs/SOPs/GOPs/OPs are established that would not put personnel or the general public at increased risks from EM exposure.

Using EMLF EM launcher/railgun activities at the EMLF as an example of high-energy EM activities under the No Action Alternative, indicates that activities at this facility and at other EM energy facilities on the installation would have negligible, long-term, direct and indirect, negative health and safety impacts.

4.8.1.3 Laser Activities

Under the No Action Alternative, NSWCDD would continue to conduct up to 60 test events (Class 3 and 4 lasers) at strengths of up to 100 kW at various present locations and continue its long history of safe testing. Activities would continue to be conducted in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls and SOPs. A recent EA for Maritime Laser RDT&E at NSF Dahlgren (NSWCDL, 2009c) determined that no significant impacts are associated with current activities or expanded testing over the PRTR and those findings are considered to also be inclusive of the activities covered in this EIS.

Laser activities under the No Action Alternative would have negligible, long-term, direct and indirect, negative impacts on health and safety.

4.8.1.4 Chemical Defense Activities

Under the No Action Alternative, NSWCDD would continue to conduct chemical simulant sensor tests based on approval received for each series of events over land and water, and continue its long history of safe testing. No testing of biological simulants would be performed. Activities would continue to be conducted in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls and SOPs.

A *Chemical and Biological Defense Program Programmatic Environmental Impact Statement* (US Army, 2004) covering nationwide chemical and biological military defense programs found impacts at NSWCDD to be negligible. All observed effects at the eight sites covered in the Programmatic EIS, including NSWCDD, were insignificant. The EIS concluded that potential risks to chemical and biological defense program laboratory workers, public health, and the environment are and will continue to be mitigated by adherence to the benchmark guidelines and regulations and by developing and following appropriate SOPs.

Chemical defense activities under the No Action Alternative would have negligible, long-term, direct and indirect, negative impacts on health and safety.

4.8.1.5 PRTR Use

Under the No Action Alternative, NSWCDD would continue to use the PRTR for up to 750 hours each year. Activities would continue to be conducted in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls and SOPs.

PRTR activities under the No Action Alternative would have no indirect impacts and negligible, long-term, direct, negative impacts on health and safety.

4.8.2 Alternative 1

4.8.2.1 Ordnance Activities

Under Alternative 1, the number of large-caliber projectiles would remain at current levels, although the frequency of firing into the upper LDZ would increase to up to 10 days per year. Small-caliber gun use would increase from 6,000 bullets fired annually on average to 25,500 bullets. Detonations would increase from 190 to 200 detonations a year on average.

Bullets fired outdoors will be fired from the Machine Gun Range either at a target on land that traps the projectiles or about ten percent of them would be fired at a target in the water. Most bullets would be propelled or sink into the river bottom, where they would be covered in silt.

NSWCDD would continue to conduct weapon/explosive testing in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls and SOPs, and gun-firing control measures would be strictly adhered to (Section 3.8.2.1).

NSWCDD would continue to comply with land and water range sustainability processes, and land ranges would be reassessed at a minimum of five-year intervals dating from the completion of the previous RCA as required by Navy policy (US Navy, 2006), regardless of the alternative implemented. The additional small-arms bullets fired and ten detonations per year under

Alternative 1 would result in a negligible increase in releases of MCs on-range or off-range and would not pose an unacceptable risk to human health or the environment.

The increased ordnance activities under Alternative 1 would result in negligible, long-term, direct and indirect, negative impacts.

4.8.2.2 EM Energy Activities

Under Alternative 1, there would be an increase in the number of EM activities from 490 to 590 events per year, power levels of EM energy activities would be increased, and RDT&E would be expanded. As under the No Action Alternative, the majority of these events would be ground plane activities, with the remaining activities occurring at MOATS, NOTES, NDEC, CEFTAC, STSTS, and on the PRTR. Directed-energy power levels would increase to allow for high-power microwave (HPM) and higher-power radio frequency (RF) emissions. EM energy may be directed at UAVs and USVs on the MDZ. EM energy emitted from a land range or a vessel on the PRTR may be reflected off a UAV or similar airborne platform over the horizon to a target on the land ranges or a platform located in the UDZ, MDZ, or LDZ. Some activities might take place in rain and fog, when activities are normally not conducted now, and at night. Activities would continue to be conducted in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls and SOPs/GOPs/OPSs, with new operational procedures developed for any significant changes in activities.

Exposure to low-frequency EM fields normally results in negligible energy absorption and no measurable body temperature increase (ICNIRP, 1998). However, exposure to EM fields at frequencies above about 100 kilohertz (kHz) can lead to significant absorption of energy, resulting in an increase in body temperature. Prolonged exposure can result in increased body temperature, ultimately leading to failure of thermoregulatory mechanisms (ICNIRP, 1998). As discussed in Section 3.8.3, standards are available to determine maximum permissible exposure levels to frequencies up to 300 GHz (IEEE, 1999, 2002; ICNIRP, 1998), as well as Navy permissible exposure limits (PELs) (see Section 2216 of US Navy, 2011).

High-power microwave and higher-power (operating with high power levels) RF emissions (e.g., radar associated with navigation and surveillance systems) may be generated under Alternative 1. These are lower-frequency EM emissions with longer wavelengths (see Figure 1-2) than laser emissions.

Pulsed or modulated microwave frequencies can induce a microwave auditory effect in people, which consists of audible clicks in people with normal hearing (Frey, 1962). The phenomenon manifests itself as a clicking, buzzing, or hissing sound depending on the modulatory characteristics of the microwaves. Although the energy absorbed (less than 10 microjoules per gram) and the resulting increments of temperature (less than 10^{-6} °C) per pulse at the threshold of perception are small, most investigators of the phenomenon believe that it is caused by thermoelastic expansion. It is thought that this phenomenon takes place because we hear sound as the result of a miniscule wave of pressure that is set up within the head and then detected at the cochlea when the absorbed microwave pulse is converted to thermal energy (Chou et al., 1982). This phenomenon does not result in adverse effects, as described by Elder and Chou (2003):

> Human perception of pulses of RF radiation is a well-established phenomenon that is not an adverse effect. RF-induced sounds are similar to other common sounds such as a click, buzz, hiss, knock or chirp. Furthermore, the phenomenon

can be characterized as the perception of subtle sounds because, in general, a quiet environment is required for the sounds to be heard.

Increases in power and/or frequency of EM energy associated with RDT&E activities would be conducted in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls and RHA/SOPs/GOPs/OPSs. Procedures would be developed so that NSF Dahlgren personnel and the general public would not be exposed to levels of EM energy that could result in adverse impacts. The Navy has specific guidance that requires adequate protection measures or operational restrictions for RDT&E activities (see Section 2220 of US Navy, 2011) and also in instances where multiple RF emitters exist close to one another (see Section 2217 of US Navy, 2011).

For each type of operation proposed in the future, NSWCDD's Safety and Environmental Office in consultation with the NSF Dahlgren Safety and Environmental Offices would consider the risks on a case-by-case basis. An RHA would be prepared to define the risks and the safety measures required to minimize risks. Using the RHA, the Range Safety Director would then make the final decision, and if he/she believes the operation can be done safely, the operation would proceed. If the Range Safety Director determines that the operation would be unsafe, it would not be conducted. For operations over the water, public access to the danger zones to be used and to the SUA would be controlled to ensure the safety of the public.

Based on the regulations, policies, and protocols that would be followed for all tests, increased EM energy activities under Alternative 1 would result in negligible, long-term, direct and indirect, negative health and safety impacts.

4.8.2.3 Laser Activities

Under Alternative 1 there would be an increase in the number of HE laser events from 60 to 125 per year, and the power, locations, and type of testing associated with these events would expand, as described in Section 2.5.3. HE lasers RDT&E activities could include: firing lasers from land ranges to floating targets on the MDZ; targeting UAVs by tracking and disabling/destroying mobile targets such as USVs on the water and mortar shells in the air; HE laser beams emitted from a land range or a vessel on the PRTR may be reflected off a UAV or similar airborne platform located over the horizon to a target on land ranges or on various types of platforms in the UDZ, MDZ, or LDZ; and if lighter-weight power sources are developed, lasers may be fired from UAVs at targets on the MDZ water surface. Some laser operations would take place beyond the normal 8 am to 5 pm, Monday-to-Friday PRTR range schedule because of the increasing need to test systems in all kinds of weather conditions and at dawn, dusk, and night.

Personnel Safety

As under the No Action Alternative, activities would be conducted in accordance with federal and state regulations, stringent DoD policies specifically developed for laser activities (see Sections 2204-2212 of US Navy, 2011), and carefully-conceived management controls and RHAs/SOPs/GOPs/OPSs. These procedures would minimize exposure to laser radiation that may present risks to the eyes and skin. Injuries can be associated with three mechanisms (WHO, 1982; University of California Berkeley, 2001):

- **Thermal** – Thermal injury mechanisms all require that sufficient radiant energy is absorbed in a tissue at a fast-enough rate to create a substantial increase above normal tissue temperature within a short period of time – typically less than a minute (WHO, 1982).
- **Photochemical** – A photochemical injury results from the impact of light particles (photons) on skin molecules; the molecule's chemical composition gets altered, resulting in minor or severe sunburn, and prolonged exposure may promote the formation of skin cancer.
- **Acoustical Transient (eye only)** – Acoustical transient effects are related to pulse duration and may occur in short-duration pulses (up to 1 millisecond or a thousandth of a second), depending on the specific wavelength of the laser. The acoustical transient effect is poorly understood, but it can cause retinal damage that cannot be accounted for by thermal injury alone (University of California at Berkeley, 2001).

Class 3 lasers – the less powerful of the two laser classes that are considered HE lasers – may cause injury to the eye through intrabeam viewing or through viewing a specular reflection for less than 250 milliseconds (see Section 1.5.3 for information on diffuse and specular reflections). Viewing a diffuse reflection from a Class 3 laser would not cause injury to the eye. Class 4 lasers pose the same hazards as Class 3 lasers, but due to their higher beam power – greater than 500 mW – they may also cause injury to the eye when viewing a diffuse reflection and may present a hazard to the skin.

Some of the proposed laser systems to be tested at NSWCDD are pulsed. The average power of a pulsed laser will usually be less than that of a continuous-wave laser, but the peak power in the pulse may be very large if the pulse duration is very short. Pulses lasting less than 1 microsecond focused on the retina can cause an acoustical transient effect, resulting in substantial damage and bleeding, in addition to thermal injury (University of California Berkeley, 2001). Laser safety standards applied by NSWCDD include ANSI Z136.1 (2007), which defines the maximum permissible exposure for direct, reflected, or scattered laser emissions that the eye can receive without expecting an eye injury (under specific exposure conditions).

For non-eye-safe activities, safety hazard zones are established around the laser corridor and the target/backstop based on calculations of the power being emitted by the laser. Safety hazard zones are demarcated to keep personnel a safe distance away during the brief time a laser operates. During these activities, much of the laser beam is absorbed by a specially-designed target within a backstop, but some energy would reflect off the backstop as diffuse reflections. The backstops are designed to have rough, irregular surfaces that cause most reflections to be diffuse rather than specular, as specular reflections bounce off a mirror-like surface and retain more of the beam's coherence and energy (see Figure 1-8b). Due to the surface roughness, diffuse reflectors scatter the reflected radiation in a wide distribution (see Figure 1-8a). Diffuse and specular reflections are also known as "backscatter." Even though the energy of diffuse reflections is scattered and weaker than that of specular reflections, an eye-safety hazard zone is calculated around the target/backstop, and personnel shelters are located beyond the area where diffuse or specular reflections pose a risk to personnel.

The eye-hazard area and associated backstop required is based on the beam diameter at the output of the laser, the divergence of the beam, and the distance traveled. For example, for a 100 kW HE laser operation examined in the Maritime Laser EA (NSWCDL, 2009c), the eye-hazard

area around the laser beam would be about 6 ft in diameter and the eye-hazard area would be at least 6 ft above mean water level, as shown in Figure 1-10. The hazard area would increase with the use of higher-powered lasers. The practicality of the required backstop size would be considered during test planning to ensure that the implementation of appropriate health and safety measures is feasible. In addition to the backstop, a laser safety buffer zone (or laser hazard cone) is established for each test, as discussed in Section 3.8.4 and shown in Figure 3.8-4.

Personnel near the target would be completely enclosed in a personnel shelter during eye-hazardous laser activities. Observers on land or on range control boats would be kept well away from the eye hazardous zone around the laser beams. By implementing strict health and safety procedures, NSWCDD scientists and engineers conducting HE laser testing would be located well beyond distances that could result in injury from either continuous-wave or pulsed lasers, and distance to the general public would be even farther away from testing (i.e., beyond areas of potential injury). In addition, the laser control measures that would be in place during testing as part of NSWCDD's Health and Safety Program (see Section 3.8), minimize the potential for exposure to lasers that could result in injury, and provide automatic and manual mechanisms to cease testing if required.

When a laser is directed on a distant target on the water, the beam would become more diffuse with distance and, therefore, larger targets would be used. Targets are likely to be a tunnel-like shape on a platform with extra layers of materials to absorb the energy. Backscatter out to the barge or the water can be reduced by increasing the length of the tunnel and/or the depth of absorbent material. Any laser energy that breaches the water surface would be absorbed, scattered, or reflected off of molecules in the water (Bai et al., 2007; De Giacomo et al., 2007; Li et al., 2007; Bai et al. 2008). As laser energy interacts with more molecules the energy dissipates and spreads out causing the amount and the intensity of the energy to decrease.

In addition to direct hazards to the eyes and skin associated with exposure to the laser beam, there are potential non-beam hazards – electrocution, fire, laser-generated air contaminants (LGACs), and collateral radiation – as a result of lasing activities.

As described in Section 3.8.4, LGACs may be generated when certain Class 4 laser beams interact with matter such as plastics, composites, metals, and tissues (ANSI, 2007). Areas will be cleared of debris prior to testing, and NSWCDD will ensure that appropriate industrial hygiene characterizations of exposure to LGACs take place in accordance with 29 CFR 1910.1000, Air Contaminants and OPNAVINST 5100.23G, the Navy Safety and Occupational Health Program Manual, so that no occupational over-exposures occur.

Potential collateral radiation or broad-band black-body radiation (i.e., ultraviolet or blue light) produced as a result of air breakdown at the laser/target interface does not present an immediate hazard to personnel, because no personnel will be within close proximity to the target impact area. Once lasing activities stop, all collateral radiation (if any) ceases, and no residual collateral radiation remains.

The non-beam control measures in place, along with strict adherence to the health and safety program, minimize the health and safety risks associated with non-beam effects of lasing activities at NSWCDD.

Increased laser activities would have negligible, long-term, direct and indirect, negative impacts on health and safety.

4.8.2.4 Chemical and Biological Defense Activities

Under Alternative 1, the number of simulant events would increase to up to 60 events per year, the use of outdoor biological simulants would be introduced (for use alone), and the area where testing could take place would be expanded, as described in Section 2.5.4. The simulants used and their degeneration products would be relatively harmless (low-toxicity) compounds, as discussed in Section 3.8.5. Activities would continue to be conducted in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls and RHAs/SOPs/GOPs/OPSs. A nationwide Chemical and Biological Defense Program Programmatic Environmental Impact Statement that included NSWCDD's activities concluded that that the scale of military biological and chemical simulant activities could be increased without causing significant, unmitigable environmental and health impacts (US Army, 2004).

Prior to each release, surface meteorological conditions would be used to select the release point and confirm the anticipated cloud track. The procedure used would be similar to previous testing (NSWCDL, 2005), where the simulant release point was selected so that simulant clouds must travel 5,250 yds downwind before landfall (with concentrations essentially returning to background levels), except in situations when the air is calm or no wind direction is clearly established and a 3,830-yd standoff could be used. Additionally, during previous testing, simulant releases were spaced so that no land or water area was exposed multiple times to the same simulant (NSWCDL, 2009b). When quantities of more than 5 gals are to be used, crosswind releases could be specified by the Test Director in order to limit the dosage of simulant as the cloud passes over any area of land or water.

The modeling approaches used to determine potential impacts of concentrations of chemical simulants in the air and the deposition of chemical simulants on human health and the environment are discussed in Sections 4.4 and 4.11-4.13, respectively, and the results of modeling runs are provided in Appendix J. The results indicate that concentrations rapidly return to background levels within the test area, and potential impacts to human health and the environment would be negligible.

No modeling was performed for biological simulants, as NSWCDD would only use BSL-1 simulants. These organisms rarely cause reactions or diseases, and many are ubiquitous in the environment. Some of the *Bacillus* species proposed for testing may cause infections in people whose immune systems are already comprised if an individual is exposed to high numbers of bacteria. However, the SOP for simulant testing includes the provision that anyone with the potential for exposure to elevated concentrations within restricted test areas would be equipped with personal protective equipment, including respirators, in the event of an unexpected incident, such as a spill, or wind shift. Individuals with compromised immune systems or respiratory conditions would not be able to serve as personnel at the release site, as they would not qualify for respirator use. Therefore, no high risk individuals would be potentially exposed to biological simulants.

Under Alternative 1, biological defense activities and increased chemical defense activities would have negligible, long-term, direct and indirect, negative impacts on health and safety.

4.8.2.5 PRTR Use

Under Alternative 1, NSWCDD would use the PRTR for up to 870 hours each year, with the additional hours used to support increased testing of lasers, EM energy devices, and chem/bio simulants. Activities would continue to be conducted in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls and SOPs.

Expanded activities under Alternative 1 could involve directing lasers at moving airborne targets, such as mortar shells and UAVs in flight over the waters of the MDZ. (UAVs would only be electronically tracked, not destroyed.) If an HE laser is proposed to be fired above the horizon, NSWCDD would coordinate with the FAA and affected DoD components, such as the North American Defense Command, and NAS Patuxent River, which coordinates the use of NSWCDD's SUA, to ensure that non-participating aircraft are not put at risk while RDT&E activities take place. Coordination would include giving details of the test, such as laser parameters, altitude of the targets, and time and location windows. Permission would only be given when it is certified that the testing would not interfere with aircraft or satellites that may be in the area at that time.

Access to public waters, such as Upper Machodoc Creek and the Potomac River, during testing would be restricted by NSWCDD's ROC and its range control boats, which clear the PRTR prior to testing and prevent unauthorized entry (e.g., by transiting boaters and recreational fishermen) during testing. Warning measures, continuous radar coverage, restricted access to the affected airspace, and visual clearances by range operation and test personnel would be implemented during all planned laser-system tests. Whenever possible, advance notice of scheduled activities and danger zone closures would be provided to the public.

PRTR activities under Alternative 1, would have negligible, long-term, direct, negative impacts and no indirect impacts on health and safety.

4.8.3 Alternative 2

4.8.3.1 Ordnance Activities

Under Alternative 2, the number of large-caliber projectiles would remain at current levels and use would be the same as under Alternative 1. Small-caliber gun use would increase from 6,000 bullets fired annually under the No Action Alternative to approximately 30,000 bullets, an increase over the 25,500 bullets of Alternative 1. Detonations would increase from the current 190 to 230 a year. Consistent with the No Action Alternative and Alternative 1,

Bullets fired outdoors will be fired from the Machine Gun Range either at a target on land that traps the projectiles or about ten percent of them would be fired at a target in the water. Most bullets entering the water would be propelled or sink into the river bottom, where they would be covered in silt.

NSWCDD would continue to conduct weapon/explosive testing in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls, RHAs, and SOPs, and gun-firing control measures would be strictly adhered to (Section 3.8.2.1). NSWCDD would continue to comply with land and water range sustainability processes. The

additional small-arms bullets fired and 40 additional detonations per year would not contribute significantly to releases of MCs in either on-range or off-range areas, based on the discussion provided in Section 4.8.2.1 for Alternative 1.

Large-gun firing and increased small-arms firing and detonations would have negligible, long-term, direct and indirect, negative impacts on health and safety under Alternative 2.

4.8.3.2 EM Energy Activities

Under Alternative 2, there would be an increase in the number of EM activities from 490 to 680 events per year, power levels used in EM energy activities would be increased, and RDT&E would be expanded, as described for Alternative 1. Some activities might take place in rain and fog, when activities are normally not conducted now, and at dawn, dusk, and night. Activities would continue to be conducted in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls and RHAs/SOPs/GOPs/OPSs, with new operational procedures developed for any significant changes in activities, so that neither personnel nor the general public would be placed at increased risks from EM exposure, as described for Alternative 1.

Increased EM energy activities under Alternative 2 would result in negligible, long-term, direct and indirect, negative health and safety impacts.

4.8.3.3 Laser Activities

Under Alternative 2, there would be an increase in the number of HE laser activities from the current 60 events to 145 events per year, an increase in power levels and distances, and RDT&E would be expanded, as described for Alternative 1. Activities would be conducted in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls and SOPs.

Increased laser activities under Alternative 2 would result in negligible, long-term, direct and indirect, negative impacts to health and safety and negligible, long-term, direct, negative impacts on aviation and maritime safety.

4.8.3.4 Chemical and Biological Defense Activities

Under Alternative 2, the number of simulant events would increase to up to 70 per year, and the area where testing could occur would be expanded, as under Alternative 1. Chemical and biological simulants would be tested together. The simulants used and their degeneration products would be relatively harmless (low-toxicity) compounds, as discussed in Section 3.8.5, and there are no known synergistic interactions between the low-toxicity chemical simulants and BSL-1 biological simulants. As for all simulant testing, there would be indoor trials in laboratories prior to simulants being tested outdoors. Activities would continue to be conducted in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls and SOPs/GOPs/OPSs. A nationwide Chemical and Biological Defense Program Programmatic Environmental Impact Statement that included the NSWCDD program concluded that that the scale of military biological and chemical simulant activities could be increased without causing significant, unmitigable environmental and health impacts (US Army, 2004).

Based on these protocols, additional measures described under Alternative 1, and the air-concentration and deposition (Section 4.4) modeling performed, increased chem/bio defense activities under Alternative 2 would have negligible, long-term, direct and indirect, negative health and safety impacts.

4.8.3.5 PRTR Use

Under Alternative 2, NSWCDD would use the PRTR for up to 1,000 hours each year, with the additional hours used to support increased testing of lasers, EM energy devices, and chem/bio simulants. Expanded activities under Alternative 2 would be similar to those described under Alternative 1. Activities would continue to be conducted in accordance with federal and state regulations, stringent DoD policies, and carefully-conceived management controls and SOPs.

PRTR activities under Alternative 2, would have negligible, long-term, direct, negative impacts and no indirect impacts on health and safety.

4.9 Geology, Topography, Soils, and Sediment

This section discusses the physical impacts to the geology, topography, soils, and sediment of NSF Dahlgren, the PRTR, and areas near NSF Dahlgren that would result from outdoor RDT&E activities proposed under the No Action Alternative, Alternative 1, and Alternative 2. No new building or facility construction that would disturb surface topography and soils and subsurface geology is included in the Proposed Action. If such construction were necessary in the future, NEPA documentation would be prepared for each project, as required.

4.9.1 No Action Alternative

4.9.1.1 Ordnance Activities

Under the No Action Alternative, the current firing of large-caliber guns and small arms, and detonations would continue. Ordnance activities take place on water and land ranges, as described in Section 1.4.

The bullets used on land-based operational ranges are fired from the Machine Gun Range either at a target on land that traps the projectiles or at a target in the water up to 4,000 yards out, in which case they would clear the range up to 6,000 yards. The bullet fragments and residue at land-based operational-range butts or backstops are managed under NSWCDD Range Management Plan (RMP) and RDT&E test-specific SOPs that minimize impact to the surrounding topography. The NSWCDD RMP and RDT&E test-specific SOPs are described in Section 3.7.

Most detonations take place on the Harris and Churchill Ranges of the EEA Range Complex. In an average year, 95 percent of the items detonated for RDT&E activities contain less than 100 lbs net explosive weight (NEW). For example, the NEW of the detonations in 2007 ranged from less than 1 lb up to 623 lbs, with an average of 28 lbs per detonation. Large NEW detonations usually take place on the EEA for treatment of explosive wastes. In 2007, NSF Dahlgren treated 66 pieces of ordnance with a total NEW of 19,000 lbs. Detonations over 200 lbs NEW are buried under 8 ft or more of dirt to reduce noise and flying fragments.

Munitions detonations may displace or alter the soil structure immediately surrounding the detonations. Dust is likely, especially from larger detonations. The EEA ranges have been subjected to detonations since Pumpkin Neck was purchased as a range for aircraft bombing in 1944. Given the long testing period, areas used for testing have all been previously disturbed. Any localized soil displaced by detonations or fill placed over detonations of 200 lbs NEW or greater is regraded and the range is maintained according to the RMP.

As described in Section 3.5, ground-borne vibration data have been collected for a buried 1,000-lb detonation (the largest detonation that could take place) to determine the worst-case vibration condition around the Churchill Range. Based on the measurements of both lateral and vertical ground displacement, it was found that the worst-case ground-borne vibration resulting from a 1,000-lb buried detonation at the Churchill Range would be confined within the range (see Figure 3.5-10).

Although most of the bullets used are fired on land, approximately 10 percent are fired at a target in the water up to 4,000 yds out, in which case they would clear the range up to 6,000 yds. Most bullets fired in the river decelerate rapidly and are immediately buried intact in the soft bottom sediments. Burial isolates these munitions from movement and potential exposure pathways, thereby limiting contaminant release into surface water and surficial sediments.

The majority (74 percent) of projectiles fired on the PRTR are inert. Live projectiles fired on the PRTR are intended to detonate above the surface of the water. Thick deposits of soft or semi-liquid silts and clays are found beneath the primary target area in the PRTR. Inert projectiles and duds can be assumed to be buried in Potomac River sediment due to the force at which they are propelled into the river and hit the bottom (A. Swope, NSWCDL, pers. com., October 22, 2008). Past projectile-recovery efforts within the PRTR confirm that projectiles are propelled into the accumulated liquefied silt and clay substrate. Any ordnance not propelled into the sediment would be rapidly covered by sediment, with sediment-accumulation rates ranging up to 0.75 inches per year (in/yr). Metals and explosives in buried ordnance would leach slowly into the surrounding subsurface sediments, with no direct contact to surface water or sediments. Based on the current usage and sediment characteristics, the continued use of large-caliber guns and projectiles is expected to have minor physical impacts on the sediments of the Potomac River.

Airborne vibrations resulting from the pressure waves emanating from large-gun firing (described in Section 3.5.5) are unlikely to contribute to shoreline soil instability and erosion, discussed in Section 3.9.3.2. Naval District Washington's study of shoreline erosion at NSF Dahlgren (Naval District Washington, 2007) identified the following factors as responsible for shoreline erosion:

- Effects of hurricanes and nor'easters
- Long fetch (length of water surface across which winds are blowing) which allows wave energy to build when strong winds are present
- Regional soil stratigraphy which allows groundwater seepage into subsurface soils along shoreline cliffs and embankments, thus tending to undermine the layers above
- Boat traffic
- Multi-directional currents; and overland storm flow.

A 1985 United States Geological Survey (USGS) study of the Nomini Cliffs, adjacent to the MDZ, concluded that multiple seepage zones, discontinuous ironstone ledges, sheet joints, and tectonic joints were causing rapid erosion in this area.

Under the No Action Alternative, ordnance activities would have no indirect impacts and minor, long-term, direct, negative impacts to soils and sediments, and no direct or indirect impacts on geology or topography.

4.9.1.2 EM Energy Activities

Outdoor directed-energy RDT&E activities take place above the surface of the water or land and have minimal contact with geology, topography, soils, or sediment. Similarly, EM energy emitted by the E3 facilities – MOATS, NOTES, and the ground planes – is directed at equipment being tested within or on the facilities, not at the ground or water. Only incidental EM energy

would be likely to interact with the soil or sediment, and such energy would be quickly diminished by reflection, absorption, or scattering of the EM energy by surface soil or water.

Before an outdoor EM energy operation takes place, an RHA and SOP are approved and validated, as described in Section 3.8.1. Power levels, frequencies, and safety parameters must be approved in SOPs well before each event commences. These measures ensure that tests are conducted safely, with a minimum of environmental impact.

Under the No Action Alternative, EM energy activities would have negligible, short-term, direct impacts and no indirect impacts on geology, topography, soils, or sediments.

4.9.1.3 Laser Activities

Under the No Action Alternative, both the HE laser emitter and the target/backstop would be fixed. The laser would be pre-aimed at a fixed target slightly downgrade from the laser and would not be able to move in either elevation or azimuth, except for minute corrections to the aim point. For activities over water, the HE laser beam would begin and end well above mean water level. For activities over land, the HE laser beam is sufficiently high to clear the mowed vegetation on the ranges. Most backscatter from an HE laser beam's striking a target/backstop would be contained within the target/backstop, lined with dark, absorbent materials to minimize reflections, and the small amount of energy that could escape would not affect soils or sediments.

As for other operations, before a HE laser operation takes place, an RHA and SOP are developed, reviewed, and validated, as described in Section 3.8.1. Power levels, frequencies, and safety parameters must be approved in SOPs well before each event commences. These measures ensure that tests are conducted safely and with a minimum of environmental impact.

Outdoor HE laser activities under the No Action Alternative would have negligible, short-term, direct impacts and no indirect impacts on geology, topography, soils, or sediments.

4.9.1.4 Chemical Defense Activities

Under the No Action Alternative, NSWCDD would conduct up to 12 operations a year using chemical simulants to test chemical-detection sensors. All simulants used in outdoor sensor RDT&E activities would be approved prior to use by the NSWCDD Safety and Environmental Office, in consultation with the appropriate Maryland and Virginia regulatory authority, and would only be approved after considering toxicity data relative to the intended quantity and concentration of the simulant to be used. All activities would be conducted in accordance with all applicable federal and state regulations and policies, under an approved SOP.

Under the No Action Alternative, chemical defense activities would have negligible, short-term, direct impacts and no indirect impacts on geology, topography, soils, or sediments.

4.9.1.5 PRTR Use

NSWCDD uses several small range control boats to control traffic on the PRTR during outdoor RDT&E activities. The range control boats (and any boats used as part of the operations) create small wakes in the water that could contribute to wave propagation and ultimately to shoreline erosion. However, based on the current relatively limited number of PRTR usage hours requiring range control boats, the small number of boats deployed (typically three), and their relatively small size and speed, the impact from boat wakes has negligible impacts on shoreline erosion.

Range control boat and other boat usage by NSWCDD represents a very small percentage of the daily recreational and commercial boat usage of the waters of the PRTR. The commercial vessels that ply the PRTR include large ships and barges that carry petroleum, coal, sand and gravel to commercial and industrial sites in the region, which can create larger wakes and are more likely to contribute to shoreline erosion than the small craft used by NSWCDD.

PRTR use by NSWCDD under the No Action Alternative would have no direct impacts and negligible, long-term, indirect, negative impacts on geology, topography, soils, and sediments.

4.9.2 Alternative 1

4.9.2.1 Ordnance Activities

Under Alternative 1, the number of large-caliber projectiles would remain at the same level as under the No Action Alternative, although the frequency of firing into the upper LDZ would increase to up to 10 days per year. The impacts on NSF Dahlgren and the PRTR's geology, topography, soils, and sediments would be the same as for the No Action Alternative. Large-gun firing would have minor physical impacts on the sediments of the MDZ, and large-gun firing airborne vibrations would have no effect on shoreline erosion.

Under Alternative 1, small-arms use would increase considerably, with bullets fired increasing from 6,000 to 25,500 a year. Approximately ten percent of the bullets would be fired into the river, with the rest being fired indoors into a backstop or outdoors into a target on land that traps the projectiles. As noted under the No Action Alternative, bullets decelerate rapidly when they enter the river and are buried in the soft sediment, so the approximately 2,550 bullets fired into the river would have little or no impact on bottom sediments, with little displacement taking place as they enter the sediment. The bullets fired on land-based operational ranges are fired into targets and do not contact the ground.

Under Alternative 1, there would be a minor increase in detonations on the EEA, from 190 to 200 a year. Overall impacts on range soils would still be minor because the ranges have been so extensively disturbed for over 60 years.

Ordnance activities under Alternative 1 would have no indirect impacts and minor, long-term, direct, negative impacts on soils and sediments and no direct or indirect impacts on geology and topography.

4.9.2.2 EM Energy Activities

Under Alternative 1, the number of EM energy events would increase from 490 to 590 annually, the power of some of the events would increase, and activities using EM energy would increase. Only incidental EM energy would be likely to interact with the soil or sediment, and such energy would be quickly diminished by reflection, absorption, or scattering of the EM energy by surface soil or water.

EM energy activities under Alternative 1 would have negligible, short-term, direct impacts and no indirect impacts on geology, topography, soils, and sediments.

4.9.2.3 Laser Activities

Under Alternative 1, annual laser events would increase from 60 to 125, power levels for some events would increase, and activities using HE lasers would increase. HE lasers would continue to emit above the surface of the land and water with little interaction with the surface except for backscatter when a beam strikes a target. As described for the No Action Alternative, backscatter would have little effect on the ground or water surface. In the future, UAVs may carry HE lasers that may aim at targets on the MDZ, or laser beams may be bounced off a UAV from the LDZ to a target on the MDZ or one of the land ranges. However, it is anticipated that backscatter would be reflected, scattered, and/or absorbed by ground or water.

Under Alternative 1, HE laser activities would have negligible, short-term, direct impacts and no indirect impacts on geology, topography, soils, and sediments.

4.9.2.4 Chemical and Biological Defense Activities

Under Alternative 1, the number of annual events would increase from 12 to 60, and biological simulants would be tested as well as chemical simulants.

As described for the No Action Alternative, all simulants, inclusive of biological simulants, used in outdoor sensor RDT&E activities would be approved prior to use by the NSWCDD Safety and Environmental Office, in consultation with the appropriate Maryland and Virginia regulatory authority, and would only be approved after considering toxicity data relative to the intended quantity and concentration of the simulant to be used. All activities would be conducted in accordance with all applicable federal and state regulations and policies, under an approved SOP, and would not result in risks to the environment.

Under Alternative 1, biological defense activities and increased chemical defense activities would have negligible, short-term, direct impacts and no indirect impacts on the geology, topography, soils, or sediment.

4.9.2.5 PRTR Use

Under Alternative 1, NSWCDD would restrict public access to the PRTR danger zones for approximately 870 hours per year. Based on the relatively limited number of PRTR usage hours requiring range control boats and the small number of boats deployed (typically three), the impact from boat wakes is anticipated to have negligible impacts on shoreline sediment erosion. Range control boat and other boat usage by NSWCDD represents a very small percentage of the daily recreational and commercial boat usage of the waters of the PRTR.

PRTR use by NSWCDD under Alternative 1 would have no direct impacts and negligible, long-term, indirect, negative impacts on geology, topography, soils, and sediments.

4.9.3 Alternative 2

4.9.3.1 Ordnance Activities

Under Alternative 2, the number of large-caliber projectiles would remain the same and use would be the same as under Alternative 1. Bullets fired annually from small arms would increase from 6,000 under the No Action Alternative and 25,500 under Alternative 1 to 30,000 under Alternative 2. Approximately ten percent of the bullets would be fired into the river and the remainder into targets on land that trap the projectiles. Even with the increase in the number of bullets fired, the impacts on river sediments and range land surfaces would be negligible.

Detonations would increase from 190 to 230 events annually. The munitions safety tests would be conducted within existing ranges with very disturbed soils, and activities would take place in accordance with the NSWCDD RMP and SOPs, which stipulate how the surface would be regraded after detonations.

Under Alternative 2, ordnance activities would have no indirect impacts and minor, long-term, direct, negative impacts on sediments and soils and no direct or indirect impacts on geology or topography.

4.9.3.2 EM Energy Activities

Under Alternative 2, the number of EM events would increase from 490 to 680 per year and activities would be expanded. As described under the No Action Alternative and Alternative 1, activities using EM energy would either take place at the existing indoor facilities where energy is directed at equipment being tested, or take place above the surface of the land or water on operational ranges. Only incidental EM energy would be likely to interact with the soil or sediment, and such energy would be quickly diminished by reflection, absorption, or scattering of the EM energy by surface soil or water.

EM energy activities under Alternative 2 would have negligible, short-term, direct impacts and no indirect impacts on geology, topography, soils, or sediments.

4.9.3.3 Laser Activities

Under Alternative 2, the number of HE laser events would increase from 60 to 145 events per year, and activities would be expanded, as described in Section 2.6. HE laser activities would take place in existing facilities or above the surface of the water or soil on operational ranges; they would not affect soil or sediment.

As described for the No Action Alternative and Alternative 1, laser target backscatter would have little effect on the ground or water surface. In the future, UAVs may carry HE lasers that may aim at targets on the MDZ, or laser beams may be bounced off a UAV from one part of the PRTR or land range to another. However, it is anticipated that brief energy bursts that bypass a target would be reflected, scattered, and/or absorbed by ground or water.

Under Alternative 2, HE laser activities would have negligible, short-term, direct impacts and no indirect impacts on geology, topography, soils, or sediments.

4.9.3.4 Chemical and Biological Defense Activities

Under Alternative 2, the number of events using chem/bio simulants would increase from the current baseline of 12 events annually using chemical simulants to 70 events annually using both chemical and biological simulants. As discussed under the No Action Alternative and Alternative 1, all simulants used in outdoor sensor RDT&E activities would be approved prior to use by the NSWCDD Safety and Environmental Office, in consultation with the appropriate Maryland and Virginia regulatory authority, and would only be approved after considering toxicity data relative to the intended quantity and concentration of the simulant to be used. All activities would be conducted in accordance with all applicable federal and state regulations and policies, under an approved SOP. Activities using chem/bio simulants would not be harmful to land or water.

Under Alternative 2, biological defense activities and increased chemical defense activities would have negligible, short-term, direct impacts and no indirect impacts on the geology, topography, soils, or sediment.

4.9.3.5 PRTR Use

Under Alternative 2, NSWCDD would restrict public access to the PRTR danger zones, usually the MDZ, for approximately 1,000 hours per year. Based on the relatively limited number of PRTR usage hours requiring range control boats and the small number of boats deployed (typically three), the impact from boat wakes is anticipated to have negligible impacts on shoreline sediment erosion. Range control boat and other boat usage by NSWCDD represent a very small percentage of the daily recreational and commercial boat usage of the waters of the PRTR.

PRTR use by NSWCDD under Alternative 2 would have no direct impacts and negligible, long-term, indirect, negative impacts on geology, topography, soils, and sediments.

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4.10 Water Resources

4.10.1 Surface Water

4.10.1.1 No Action Alternative

Implementing the No Action Alternative would not increase the average annual number of outdoor RDT&E activities above existing levels. The activities associated with the No Action Alternative are described in Section 2.4.

Ordnance Activities

Existing NSWCDD ordnance procedures comply with the Navy's *Operational Range Clearance Policy for Navy Ranges* (DoD Instruction 3200.16), which includes requirements for activities such as the removal, treatment, disposal, and recycling of unexploded ordnance (UXO), range scrap, and debris (see Section 3.7.5). Pursuant to the Navy policy, NSWCDD removes fired military munitions and range scrap and debris that are exposed on the ground surface or partially buried.

Residues from the land-based firing of munitions and detonation of explosives that remain on land after operational range surface clearance could enter surface waters indirectly via surface water or soil runoff and shallow groundwater discharge. Drainage from land ranges at NSF Dahlgren – Main, AA Fuze, Missile Test, Machine Gun, Terminal, Churchill, and Harris Ranges – flows into Hideaway Pond, Gambo Creek, Black Marsh Creek, Upper Machodoc Creek, and the Potomac River, as well as to small, unnamed tributaries to Gambo Creek, Upper Machodoc Creek, and the river via surface runoff and groundwater discharge. Although some residues likely would migrate into surface waters, they are expected to occur at concentrations below standard detection levels.

As discussed in Section 3.7.6, a Range Condition Assessment (RCA) was completed for NSWCDD land-based operational ranges in September of 2010 as part of the Range Sustainability Environmental Program Assessment (RSEPA) process. The RCA concluded that the Navy is already investigating, and in most cases has already addressed, areas where there is a potential for an off-range release of MCs from land-based operational areas through the ERP and Subpart X permitting requirements. Further, the RCA concluded that there is no need to investigate any areas for potential off-range releases beyond planned investigations (NAVSEA, 2010). Munitions constituents (MCs) detected in groundwater and soil at the open burn/open detonation (OB/OD) units are monitored and managed in accordance with VDEQ guidance and the RCRA Subpart X Permit and no additional actions are recommended.

On the PRTR, most targets are virtual and generate no debris. Environmental impacts of fragmenting targets – such as floating radar reflectors, fixed platforms in the river, UAVs, aerostats, vessels, towed sleds, and causeway sections – are minimized by removing hazardous materials such as batteries, oil, gasoline, and antifreeze to the extent possible prior to destroying or damaging them. After the target is impacted and the test completed, all remaining debris and any waste is cleaned up.

NSWCDD works to ensure range sustainability while protecting human health and the environment. As there is potential at the PRTR for interaction between the munitions fired into the Potomac River and human and ecological receptors, range-specific screening-level risk assessments (RSSRAs) were performed for this EIS, as described in Sections 4.8, 4.11, 4.12, and 4.13, based on sediment and water concentrations predicted for the areas of heaviest use (see Appendix F). A subset of MCs was selected as munitions constituents of potential concern (MCOPCs) based on their total mass (cumulative over the last 90 years), toxicity of constituents, and Navy guidance, as described in Appendix F.

The ecological and human health RSSRAs employed conservative (i.e., stringent/protective) assumptions to evaluate existing data and determine whether additional analysis is necessary, protective measures are warranted, or the range poses acceptable risks so no further analysis is needed.

The RSSRAs evaluated MCOPCs by comparing modeled concentrations in water, sediment, and fish tissues to risk-based screening concentrations. The results of the ecological and human health RSSRAs indicate that input of MCOPCs from munitions testing in the PRTR are orders of magnitude – hundreds to billions of times – below concentrations that could cause adverse effects to human health or the environment. Therefore, no further analyses are required at this time and continued use of the PRTR for ordnance activities is expected to have negligible impacts on surface water.

Under the No Action Alternative, ordnance activities would have negligible, long-term, direct and indirect, negative impacts on surface waters.

EM Energy Activities

NSWCDD conducts approximately 490 EM energy events a year at three main outdoor facilities for EM testing: NOTES, MOATS, and two ground planes, all of which are located in the Mission Area or land ranges away from the PRTR and other surface waters. Three-quarters of current EM events take place on the ground planes. Testing in the future at these facilities as well as the EMLF would have no potential impacts on surface water.

NSWCDD currently and would continue to transmit directed energy – microwave and RF, as well as laser – across the waters of the PRTR, between the NDEC on the Machine Gun Range and the CETFAC on the EEA, and from radars in the STSTS on Main Range into the MDZ. Beams of directed energy are transmitted above the water between the NDEC and the CETFAC, and do not strike or penetrate the water surface; however, portions of the directed energy beams from radars could strike the water surface. In the event that directed energy does strike the water surface, waves of EM energy do not move easily through water because the energy is reflected at the air-water boundary or is quickly absorbed by the water molecules, with negligible effects on surface water.

Further, some backscatter – diffuse and specular reflections – from a directed energy beam's striking a target could hit the water surface near the target. Backscatter that hits the water has much less energy than the EM beam itself, and would be rapidly diminished further through reflection, absorption, and scattering. When EM energy interacts with water molecules or molecules within a body of water (organic or inorganic), energy is transferred to those molecules. As the transfer of energy is inefficient, there is a loss of some energy as heat to the

water. The amount of heat transferred when backscatter hits the water is negligible and would not impact the surface water.

NSWCDD occasionally conducts RDT&E in the PRTR using modified passive sonobuoys, which constitute the only EM sensor testing conducted below water. Passive sonobuoys do not generate underwater sounds or noise of their own; they only detect sound. The sounds detected by the sonobuoys are amplified, and are converted into and transmitted by EM waves in the air to a receiver, where the sounds can be analyzed. The sonobuoys used in the Potomac are recovered for reuse at the conclusion of the RDT&E events. The use of sonobuoys in the PRTR does not affect surface water.

Overall, EM energy activities under the No Action Alternative would have negligible, short-term, direct, negative impacts and no indirect impacts on surface waters.

Laser Activities

Under the No Action Alternative, NSWCDD would continue to conduct approximately 60 outdoor HE laser events a year. All testing using HE lasers over water would occur in the established laser operating corridors from Terminal Range to CETFAC across the PRTR, from NDEC to CETFAC across the PRTR, or from NDEC to the EEA Dock Area, across the entrance to Upper Machodoc Creek. All testing would occur over land or above the surface of the water.

For activities over water, the HE laser beam would begin about 12 ft above mean water level and terminate at 9 ft above mean water level. Some backscatter – diffuse and specular reflections – from an HE laser beam's striking a target/backstop could hit the water surface near the target. The target/backstops are located within a tunnel-like container or structure, such as CETFAC, and are lined with dark, absorbent materials to minimize reflections, but some energy would escape. Backscatter that hits the water has much less energy than the laser beam itself, and would be rapidly diminished further through reflection, absorption, and scattering, with essentially no effects on surface waters near the target.

There would be negligible, short-term, direct, negative impacts and no indirect impacts to surface waters from laser activities under the No Action Alternative.

Chemical Defense Activities

NSWCDD currently conducts up to 12 outdoor chemical simulant events a year. Outdoor chemical-detector testing may take place on any of the land ranges or the Mission Area, but most testing is conducted on the MDZ. Tests consist of up to a maximum of 20 gals of simulant per release.

Testing of chemical simulants results in the release of small quantities of simulants into the air with even smaller quantities of simulants being deposited on the surface of the water. Once simulants settle upon and sink into the water, they are rapidly diluted in the water column. Water-quality analysis conducted following simulant testing performed by NSWCDD in 2003, 2005, and 2009 showed no significant impacts.

Atmospheric dispersion of chemical simulants was modeled to calculate the concentration and deposition levels resulting from testing. The modeling methodology used is described in Section 4.4 and Table 4.4-3 summarizes the resulting predicted maximum deposition levels. At normal temperatures, 1,1,1,2-tetrafluoroethane (R-134), 1,1-difluoroethane (R-152a), and SF_6 (a

greenhouse gas which is being phased out) used for calibration of sensors are gases and, therefore, no deposition would occur for these chemicals. The surface area with concentrations predicted to be above 0.01 milligrams per square meter (mg/m^2) using maximum deposition rates range from a fraction of an acre to 63.5 acres. There is limited toxicity information available on most of the simulants, as these compounds are considered to be of low toxicity; potential effects on aquatic life are discussed in Section 4.11.1.4. The small amounts of chemical simulants deposited coupled with their low toxicity would not affect surface waters.

Under the No Action Alternative, chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts on surface waters.

PRTR Use

Under the No Action Alternative, NSWCDD currently restricts public access to the PRTR danger zones, usually the MDZ, for testing approximately 750 hours a year.

Existing levels of military small boat traffic have temporary effects to water quality through the direct release into the water of small quantities of oil and gas, contact of antifouling paint (containing chemicals and metals) used on vessels with water, and by vessel wakes that may contribute to shoreline erosion and indirectly to resulting water turbidity. Military boat activities as well as commercial and recreational boat activities on the waters of the PRTR, Upper Machodoc Creek, and other waterways in the vicinity of NSF Dahlgren routinely occur without long-term adverse impacts to these surface water resources. The overall vessel traffic on the PRTR decreases during testing because the movement of commercial and recreational vessels is restricted. Vessels present in the PRTR are limited to range control boats (approximately three) stationed along the perimeter of the range and barges or vessels associated with testing.

The military boats create small wakes that could contribute to shoreline erosion and, ultimately, increased nearshore turbidity. However, based on the relatively limited number of hours NSWCDD restricts public access to the PRTR, requiring range control boats, and the small number of boats deployed, wakes from NSWCDD boats would have negligible effects on shoreline erosion and turbidity. NSWCDD boat use represents a very small percentage of the daily recreational and commercial boat traffic on the waters of the PRTR. The commercial vessels that traverse the PRTR include large ships and barges that can create larger wakes and are more likely to contribute to shoreline erosion than the small craft used by NSWCDD.

Under the No Action Alternative, PRTR use by NSWCDD would have negligible, long-term, direct and indirect, negative impacts on surface waters.

4.10.1.2 Alternative 1

Ordnance Activities

Under Alternative 1, the number of large-caliber projectiles would remain at current levels, although the frequency of firing into the upper LDZ would increase above current use levels to a maximum of 10 days per year. Small-caliber gun use would increase from 6,000 bullets fired annually under the No Action Alternative to 25,500 bullets annually. Approximately 10 percent of the bullets would be fired into the river. Future firing of small arms would take place mainly on the Machine Gun Range, but also on the Terminal Range, Churchill Range, and Harris Range. Fragmentation arena tests on the Churchill Range are expected to increase in the future, leading

to an increase in annual detonations from the current 190 to 200 detonations under Alternative 1, as described in Section 2.5.1.

Pursuant to the Navy's *Operational Range Clearance Policy for Navy Ranges*, NSWCDD removes fired military munitions and range scrap and debris that are lying exposed on the ground surface or partially buried. Residues from the land-based firing of munitions and detonation of explosives that remain on land after operational range surface clearance could enter surface waters indirectly via surface water or soil runoff and shallow groundwater discharge. Although some residues likely would eventually migrate into surface waters, they are expected to occur at concentrations that are virtually undetectable.

For the land ranges on Mainside and the EEA Complex, the RCA found the operational ranges to be in compliance with relevant regulatory requirements, and no additional protective measures related to potential off-range release of MCs were recommended. Continued removal of fired military munitions and range scrap and debris from land ranges is expected to ensure that the substantial increase in small-arms firing and the small increase in detonations under Alternative 1 would not substantially increase potential indirect impacts to surface waters.

As described in Section 4.10.1.1 and detailed in Sections 4.8.1.1, 4.11.1.1, 4.12.1.1, and 4.13.1.1, the results of the human health and ecological RSSRAs indicate that input of MCOPCs from munitions testing in the PRTR are orders of magnitude below concentrations that could cause adverse effects to human health or the environment. Therefore, continued use of the PRTR for ordnance activities is expected to have negligible impact on surface water quality. As the use of large-caliber guns and projectiles would remain at current levels, impacts to surface waters would not increase.

Under Alternative 1, ordnance activities would have negligible, long-term, direct and indirect, negative impacts on surface waters.

EM Energy Activities

Under Alternative 1, the number of EM test events would increase from 490 to 590 per year, power would increase, and RDT&E activities would increase, as described in Section 2.5.2. The number of events at the STSTS, NDEC, CETFAC, and on the PRTR would increase and directed-energy power levels would increase. Directed-energy technology could be used anywhere on the ranges or the Mission Area. Boats and even UAVs could be used as platforms for directed-energy emitters. Beams of directed energy might be directed at targets on the land ranges, the PRTR, or at UAVs, or reflected off of UAVs or other types of aircraft to targets on the land ranges or the PRTR.

NSWCDD would transmit directed energy across the land ranges or across the waters of the PRTR. Beams of directed energy would be transmitted above the water between the NDEC and the CETFAC, and would not strike or penetrate the water surface; however, portions of the directed energy beams from radars could strike the water surface. Were directed energy beams to strike the water surface, the rough surface of the water would cause EM energy to scatter in all directions at the air/water boundary (see Figure 1.8a) and energy entering the water would quickly be absorbed by the water molecules, with negligible effects on surface water. Any backscatter from a directed energy beam's striking a target would be also reflected, absorbed, and scattered, with negligible effects on surface water near the target. The use of sonobuoys in the PRTR, likewise, is expected to have no effects on surface water.

EM energy activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on surface waters.

Laser Activities

Under Alternative 1, the number of HE laser test events would increase from 60 to 125 per year, power levels would increase, and RDT&E activities would increase as described in Section 2.5.3.

Some future laser use might include firing lasers from UAVs at targets on the water. Laser use also might involve directing lasers at a mirror-like surface on an airborne platform to reflect the laser beam to a target over the horizon on a land range or a platform on the UDZ, MDZ, or LDZ. Testing of lasers would occur above the surface of the water, and the laser would not be focused on the water surface. Initially, laser emissions would be at eye-safe power levels, with a gradual increase in power as RDT&E progresses Because of the accuracy of lasers, interaction with the water surface would only be incidental or result from backscatter from an HE laser beam's striking a target/backstop. The rough surface of the water would cause the laser beam to scatter in all directions at the air/water boundary (see Figure 1.8a) and energy entering the water would quickly be absorbed by the water molecules, with negligible effects on surface water.

For each laser operation proposed in the future, NSWCDD's Safety and Environmental Office would consider the risks on a case-by-case basis through preparation of a risk hazards assessment (RHA) to ensure that the operation is safe. If the RHA process indicated that the operation could not be performed safely, the activities would not be conducted. For activities over the water, public access to the PRTR and to NSWCDD's SUA would be restricted during activities, to ensure the safety of the public.

There would be negligible, short-term, direct, negative impacts and no indirect impacts on surface waters from laser activities under Alternative 1.

Chemical and Biological Defense Activities

Under Alternative 1, chemical and biological defense activities would expand from the baseline 12 events annually using only chemical simulants to 60 events annually using both chemical and biological simulants, as described in Section 2.5.4.

For tests of chemical simulants, the impacts from Alternative 1 would be similar to those for the No Action Alternative, although there would be a substantially higher number of events. During releases, some simulant coming from the sprayer system may enter the river, and cleanup of the test platform (the vessel) would result in some simulant-containing effluents' entering the river. The increased testing of chemical simulants would result in a larger number of events involving the dispersal of small quantities of simulants. For each event, the point concentrations of simulants that potentially could settle on the water surface – or settle on land and be carried by runoff into adjacent water – and be dispersed into surface waters would not increase. Simulants entering the PRTR and other surface waters would be rapidly diluted to well-below-detection levels.

No modeling was performed for biological simulants, as NSWCDD would only use BSL-1 simulants (see Section 3.8.4.2 for a description of BSL-1 substances). BSL-1 bacteria, fungi, viruses, and proteins rarely cause reactions or diseases, and many are ubiquitous in the

environment. Therefore, no adverse effects are anticipated from a temporary increase in these organisms.

Under Alternative 1, chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts on surface waters.

PRTR Use

Under Alternative 1, NSWCDD would restrict public access to the PRTR danger zones, usually the MDZ, for testing approximately 870 hours a year, compared to 750 hours under the No Action Alternative, as described in Section 2.5.5.

Although military small boat traffic would have temporary effects to water quality – nominally contributing directly to water pollution and indirectly to turbidity – military, commercial, and recreational boat activities on the waters of the PRTR, Upper Machodoc Creek, and other waterways in the vicinity of NSF Dahlgren routinely occur without long-term adverse impacts to these surface water resources. The overall vessel traffic on the PRTR would decrease during testing because of closure of part of the PRTR to commercial and recreational vessels. Vessels present would be limited to range control boats (approximately three) and barges or vessels associated with testing. Although the military boats create small wakes that could contribute to shoreline erosion and, ultimately, increased near shore turbidity, NSWCDD boat use represents a very small percentage of the daily recreational and commercial boat traffic on the waters of the PRTR.

PRTR use by NSWCDD under Alternative 1 would have negligible, long-term, direct and indirect, negative impacts on surface waters.

4.10.1.3 Alternative 2

Ordnance Activities

Under Alternative 2, the number of large-caliber projectiles would remain at current levels and use would be the same as under Alternative 1. Small-caliber gun use would increase from 6,000 bullets fired annually under the No Action Alternative to 30,000 bullets fired annually and detonations would increase from 190 to 230 detonations, as summarized in Section 2.6.

As noted for the No Action Alternative, the RCA found the operational ranges to be in compliance with relevant regulatory requirements, and no additional protective measures related to potential off-range release of MCs were recommended. Continued removal of fired military munitions and range scrap and debris from land ranges is expected to ensure that the increases in small-arms firing and detonations under Alternative 2 would not substantially increase potential indirect impacts to surface waters. The results of the ecological and human health RSSRAs indicate that continued use of the PRTR for ordnance activities is expected to have negligible impact on surface water quality. As the use of large-caliber guns and projectiles would remain at current levels, impacts to surface waters would not increase.

Under Alternative 2, ordnance activities would have negligible, long-term, direct and indirect, negative impacts on surface waters.

EM Energy Activities

Under Alternative 2, the number of EM energy events would increase from 490 to 680 per year, power levels would increase, and EM energy RDT&E activities would increase, as summarized in Section 2.6.

As under the No Action Alternative and Alternative 1, were beams to strike the water surface, EM energy would be reflected at the air/water boundary or quickly absorbed by the water molecules, with negligible effects on surface water. Any backscatter would be reflected, absorbed, and scattered, with no effects on surface water near the target.

EM energy activities under Alternative 2 would have negligible, short-term, direct, negative impacts and no indirect impacts on surface waters.

Laser Activities

Under Alternative 2, the number of HE laser events would increase from the current 60 to 145 annually, and power levels and HE laser RDT&E activities would increase, as summarized in Section 2.6.

As described for the No Action Alternative and Alternative 1, were beams to strike the water surface, energy would be reflected at the air/water boundary or quickly absorbed by the water molecules, with negligible effects on surface water. Any backscatter would be reflected, absorbed, and scattered, with no effects on surface water near the target.

For each laser operation proposed in the future, NSWCDD's Safety and Environmental Office would consider the risks on a case-by-case basis through preparation of an RHA to ensure that the operation is safe. If the RHA process indicated that the operation could not be performed safely, the activities would not be conducted. For activities over the water, public access to the PRTR and to NSWCDD's SUA would be restricted during activities to ensure the safety of the public.

There would be negligible, short-term, direct, negative impacts and no indirect impacts on surface waters from laser activities under Alternative 2.

Chemical and Biological Defense Activities

Under Alternative 2, chemical and biological defense activities would expand from the baseline 12 events annually using only chemical simulants to 70 events using both chemical and biological simulants, as summarized in Section 2.6.

The impacts from Alternative 2 would be similar to those for Alternative 1; the only difference would be a slightly higher number (10) of simulant tests and chemical and biological simulants may be tested together. For each chemical simulant event, the point concentrations of simulants that potentially could settle on the water surface or on land and be dispersed into surface waters would not increase. Simulants entering the PRTR and other surface waters would be rapidly diluted to well-below-detection levels.

For tests employing biological simulants, NSWCDD would only use BSL-1 simulants, which rarely cause reactions or diseases, and many of which are ubiquitous in the environment. Therefore, no adverse effects are anticipated from a negligible temporary increase in bacteria, fungi, viruses, or proteins levels.

The impacts of testing biological and chemical simulants together are expected to be similar to using either type of simulant alone because simulants entering the PRTR and other surface waters would be rapidly diluted to well-below-detection levels and biological simulants are already ubiquitous in the environment.

Under Alternative 2, chemical and biological defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts on surface waters.

PRTR Use

Under Alternative 2, NSWCDD would restrict public use of the PRTR danger zones, usually the MDZ, for testing approximately 1,000 hours a year, compared to 750 hours under the No Action Alternative, as summarized in Section 2.6.

As under the No Action Alternative and Alternative 1, future levels of military small boat traffic would have temporary effects on water quality – nominally contributing directly to water pollution and indirectly to turbidity. However, NSWCDD boat use represents a very small percentage of the daily recreational and commercial boat traffic on the waters of the PRTR.

PRTR use by NSWCDD under Alternative 2 is would have negligible, long-term, direct and indirect, negative impacts on surface waters.

4.10.2 Wetlands and Floodplains

4.10.2.1 No Action Alternative

Ordnance Activities

Residues from the land-based firing of munitions and detonation of explosives that remain on land after operational range surface clearance could enter wetlands and floodplains via surface water or soil runoff and shallow groundwater discharge. Although some residues may migrate into these resource areas, they are expected to occur at concentrations below most standard detection levels. As described for surface waters, the RCA found the operational ranges to be in compliance with relevant regulatory requirements, and no additional protective measures related to potential off-range release of MCs were recommended. Continued removal of fired military munitions and range scrap and debris from land ranges is expected to ensure that the impacts to wetlands and floodplains of small-arms firing and detonations under the No Action Alternative would be negligible.

Residues from large-caliber gun testing in the PRTR also could enter wetlands and floodplains associated with the Potomac River, Upper Machodoc Creek, Gambo Creek, and Black Marsh Creek, as well as other tidal water bodies along the lower river. As described in Section 4.10.1.1 and detailed in Sections 4.8.1.1 and 4.11.1.1, the results of the ecological and human health RSSRAs indicate that input of MCOPCs from munitions testing in the PRTR are orders of magnitude below concentrations that could cause adverse effects to human health or the environment. Therefore, continued use of the PRTR for ordnance activities is expected to have negligible impact on surface water. By extension, as the use of large-caliber guns and projectiles would remain at current levels, impacts to wetlands and floodplains would be negligible.

Ordnance activities under the No Action Alternative would have no direct impacts and negligible, long-term, indirect, negative impacts on wetlands and floodplains.

EM Energy Activities

NSWCDD currently uses the STSTS, NOTES, MOATS, and two ground planes for the RDT&E of issues surrounding EM energy environmental effects. These outdoor facilities for EM energy testing are located on land in the Mission Area or land ranges away from wetlands and not in the floodplain. EM energy testing at these facilities has no potential impacts on wetlands and floodplains.

NSWCDD would transmit EM energy – microwave, RF, and laser – between the NDEC and the CETFAC, across the waters of the PRTR, and across the associated floodplains and estuarine intertidal emergent wetlands. Beams of EM energy would be transmitted above the wetlands and floodplains, and would not strike or penetrate the ground or water surface. However, some backscatter from a directed energy beam's striking a target could hit wetlands and floodplains near the target, and portions of the directed energy beams from radars could strike wetlands and floodplains.

Under the No Action Alternative, EM energy activities would have negligible, short-term, direct, negative impacts and no indirect impacts on wetlands and floodplains.

Laser Activities

Testing using HE lasers would occur in the established laser corridors from Terminal Range to CETFAC across the PRTR, from NDEC to CETFAC across the PRTR, or from NDEC to the EEA Dock Area, across the entrance to Upper Machodoc Creek (Figure 1-9). All testing would occur over land or above the surface of the water. Some backscatter from an HE laser beam's striking a target/backstop could hit wetlands and floodplains near the target.

There would be negligible, short-term, direct, negative impacts and no indirect impacts to wetlands and floodplains from laser activities under the No Action Alternative.

Chemical Defense Activities

Simulant releases would be spaced so that no land or water area would be exposed multiple times to the same simulant. When quantities of more than 5 gals are to be used, crosswind releases could be specified by the Test Director to limit the dosage of simulant as the cloud passes over any land or water biological system.

Testing of chemical simulants results in the release of small quantities of simulants into the air with even smaller quantities deposited on the land and on the surface of the water. Concentrations of chemical simulants that would reach land would be very low – well below concentrations that have been shown to cause adverse effects – as would the concentrations that could be deposited on terrestrial vegetation or to which wetland communities would be exposed. Assessments completed for similar past simulant activities performed by NSWCDD using some of the same simulants showed no significant impacts and there were no observable environmental effects during or after events (NSWCDD, 2003; NSWCDL, 2004; Bossart, letter, February 9, 2006).

Chemical defense activities under the No Action Alternative would have negligible, short-term, direct, negative impacts and no indirect impacts on wetlands and floodplains along the river and at NSF Dahlgren.

PRTR Use

The banks along the Potomac River and Upper Machodoc Creek shorelines of NSF Dahlgren have experienced undercutting and sloughing (NSWCDL, 1999). As described in Section 4.9, most causes of erosion are natural (NSWCDL, 1999; Naval District Washington [NDW], 2007).

Field measurements made at monitoring sites at Swan Point, Maryland, and Mason Neck, Virginia, during a USGS five-year inter-disciplinary study of the tidal Potomac River and estuary indicated that short-term (10- to 18-month) recession and volume-erosion rates along a shoreline less than 3,280 ft long may vary greatly (USGS, 1985). Local factors, such as the capacity of the beach to buffer wave impact, presence or absence of obstructions that modify patterns of sediment transport, and trees at the top of the bank, may be primarily responsible for these variations. The maximum average volume-erosion rates for an individual reach in this study were measured along the Nomini Cliffs in Westmoreland County (adjacent to the MDZ) and resulted from multiple seepage zones, discontinuous ironstone ledges, sheet joints, and tectonic joints (USGS, 1985).

Military as well as commercial and recreational boat activities on the waters of the Potomac River and Upper Machodoc Creek potentially contribute to the shoreline erosion. NSWCDD range control boats, as well as other range vessels, create small wakes in the water that could contribute to wave propagation and ultimately shoreline erosion. In general, wetland and floodplain areas help control erosion (MDE, 2006). The shallow bottoms near the shore reduce wave action. Range control boat and other boat usage by NSWCDD represent a very small percentage of the daily recreational and commercial boat usage of the waters of the PRTR. Based on the relatively limited number of PRTR usage hours requiring range control boats and the small number of boats deployed (typically three), boat wakes are anticipated to have negligible impacts on wetlands and floodplains.

Existing levels of military small boat traffic may have temporary effects to water quality, if fuel, oil, and/or other related contaminants leak from vessels and enter wetlands and floodplains associated with the Potomac River, Upper Machodoc Creek, Gambo Creek, and Black Marsh Creek, as well as other tidal water bodies along the lower river. However, boats are regularly maintained by NSWCDD to minimize inadvertent releases and activities on the waters of the PRTR, Upper Machodoc Creek, and other waterways in the vicinity of NSF Dahlgren routinely occur without long-term adverse impacts to the wetland and floodplain resources.

Under the No Action Alternative, PRTR use would have no direct impacts and negligible, long-term, indirect, negative impacts on wetlands and floodplains.

4.10.2.2 Alternative 1

Ordnance Activities

Although some residues from the land-based firing of munitions and detonation of explosives could enter wetlands and floodplains, they are expected to occur at concentrations that are virtually undetectable. For both the land ranges on Mainside and for the EEA Range, the RCA

found the operational ranges to be in compliance with relevant regulatory requirements, and no additional protective measures related to potential off-range release of MCs were recommended. Continued removal of fired military munitions and range scrap and debris from land ranges is expected to ensure that the substantial increase in small-arms firing and the small increase in detonations under Alternative 1 would not substantially increase potential indirect impacts to wetlands and floodplains.

Residues from large-caliber gun testing in the PRTR also could enter wetlands and floodplains associated with the Potomac River, Upper Machodoc Creek, Gambo Creek, and Black Marsh Creek, as well as other tidal water bodies along the lower river. As described in Section 4.10.1.1 and detailed in Sections 4.8.1.1 and 4.11.1.1, the results of the human health and ecological RSSRAs indicate that input of MCOPCs from munitions testing in the PRTR are orders of magnitude below concentrations that could cause adverse effects to human health or the environment. Therefore, continued use of the PRTR for ordnance activities is expected to have negligible impact on surface water. By extension, as the use of large-caliber guns and projectiles would remain at current levels, impacts to wetlands and floodplains would be negligible.

Ordnance activities under Alternative 1 would have no direct impacts and negligible, long-term, indirect, negative impacts on wetlands and floodplains.

EM Energy Activities

The outdoor facilities for EM energy testing – STSTS, NOTES, MOATS, and two ground planes – are located on land in the Mission Area or land ranges away from wetlands and not in the floodplain. EM energy testing at these facilities under Alternative 1 would have no potential impacts on wetlands and floodplains.

NSWCDD would transmit directed energy across the land ranges or across the waters of the PRTR, and across the associated floodplains and estuarine intertidal emergent wetlands. Beams of directed energy would be transmitted above the wetlands and floodplains, and would not strike or penetrate the ground or water surface. However, some backscatter from a directed energy beam's striking a target could hit wetlands and floodplains near the target, and portions of the directed energy beams from radars could strike wetlands and floodplains.

Under Alternative 1, EM energy activities would have negligible, short-term, direct, negative impacts and no indirect impacts on wetlands and floodplains.

Laser Activities

Under Alternative 1, HE laser RDT&E activities on the PRTR would expand, as described in Section 2.5.3. However, controls implemented under the detailed RHA/SOP process for the use of HE lasers outdoors would ensure that interaction with wetland or floodplain resources is minimal, as a clear line of sight is required for testing and therefore lasers would have minimal contact with vegetation. Some backscatter from an HE laser beam's striking a target/backstop could hit wetlands and floodplains near the target.

There would be negligible, short-term, direct, negative impacts and no indirect impacts to wetlands and floodplains from laser activities under Alternative 1.

Chemical and Biological Defense Activities

Under Alternative 1, the same quantities of chemical simulants would be used as under the No Action Alternative, as described in Section 2.5.4.Concentrations of chemical simulants that would reach land would be very low – well below concentrations that have been shown to cause adverse effects – as would the concentrations that could be deposited on terrestrial vegetation or to which wetland communities would be exposed. No modeling was performed for biological simulants, as NSWCDD would only use BSL-1 simulants. These bacteria, fungi, viruses, and proteins rarely cause reactions or diseases, and many are ubiquitous in the environment. Therefore, no adverse effects are anticipated from a temporary increase in these organisms.

Chem/bio defense activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on wetlands and floodplains.

PRTR Use

Based on the relatively limited number of PRTR usage hours requiring range control boats and the small number of boats deployed (typically three), boat wakes would have negligible impacts on wetlands. Boat activities on the waters of the PRTR, Upper Machodoc Creek, and other waterways in the vicinity of NSF Dahlgren routinely occur without long-term adverse impacts to the wetland and floodplain resources.

PRTR use under Alternative 1 would have no direct impacts and negligible, long-term, indirect, negative impacts on wetlands and floodplains.

4.10.2.3 Alternative 2

Ordnance Activities

For both the land ranges on Mainside and for the EEA Complex, the RCA found the operational ranges to be in compliance with relevant regulatory requirements, and no additional protective measures related to potential off-range release of MCs were recommended. Continued removal of fired military munitions and range scrap and debris from land ranges is expected to ensure that the substantial increases in small-arms firing and detonations under Alternative 2 would not substantially increase potential indirect impacts to wetlands and floodplains.

As described in Sections 4.8.1.1 and 4.10.1.1 and detailed in Section 4.11.1.1, the results of the human health and ecological RSSRAs indicate that input of MCOPCs from munitions testing in the PRTR are orders of magnitude below concentrations that could cause adverse effects to human health or the environment. Therefore, continued use of the PRTR for ordnance activities is expected to have negligible impact on surface water. By extension, as the use of large-caliber guns and projectiles would remain at current levels, impacts to wetlands and floodplains would be negligible.

Ordnance activities under Alternative 2 would have no direct impacts and negligible, long-term, indirect, negative impacts on wetlands and floodplains.

EM Energy Activities

As described previously, the outdoor facilities for EM energy testing are located on land in the Mission Area or land ranges away from wetlands and not in the floodplain. EM energy testing at these facilities under Alternative 2 would have no potential effects on wetlands and floodplains.

NSWCDD would transmit directed energy across the land ranges or across the waters of the PRTR, and across the associated floodplains and estuarine intertidal emergent wetlands. Beams of directed energy would be transmitted above the wetlands and floodplains, and would not strike or penetrate the ground or water surface. However, some backscatter from a directed energy beam's striking a target could hit wetlands and floodplains near the target, and portions of the directed energy beams from radars could strike wetlands and floodplains.

Under Alternative 2, EM energy activities would have negligible, short-term, direct, negative impacts and no indirect impacts on wetlands and floodplains.

Laser Activities

Under Alternative 2, the increase in HE laser RDT&E activities would be similar to those described for Alternative 1, with a slightly higher frequency, as summarized in Section 2.6. Controls implemented under the detailed RHA/SOP process for the use of HE lasers outdoors would ensure that interaction with wetland or floodplain resources is minimal, as a clear line of sight is required for testing. Some backscatter from an HE laser beam's striking a target/backstop could hit wetlands and floodplains near the target.

There would be negligible, short-term, direct, negative impacts and no indirect impacts to wetlands or floodplains from laser activities under Alternative 2.

Chemical and Biological Defense Activities

Concentrations of chemical simulants that would reach land would be very low – well below concentrations that have been shown to cause adverse effects – as would the concentrations that could be deposited on terrestrial vegetation or to which wetland communities would be exposed. No adverse effects are anticipated from a temporary increase in BSL-1 organisms. There would be no interaction between chemical and biological simulants that would adversely affect water resources.

Chem/bio defense activities under Alternative 2 would have negligible, short-term, direct, negative impacts and no indirect impacts on wetlands and floodplains along the PRTR or on NSF Dahlgren.

PRTR Use

Based on the relatively limited number of PRTR usage hours requiring range control boats and the small number of boats deployed (typically three), boat wakes would have negligible impacts on wetlands. Boat activities on the waters of the PRTR, Upper Machodoc Creek, and other waterways in the vicinity of NSF Dahlgren routinely occur without long-term adverse impacts to the wetland and floodplain resources.

PRTR use under Alternative 2 would have no direct impacts and negligible, long-term, indirect, negative impacts on wetlands and floodplains.

4.10.3 Groundwater

4.10.3.1 No Action Alternative

Ordnance Activities

The recharge zones for the aquifer systems supplying NSF Dahlgren and surrounding areas – the Aquia aquifer and the Potomac aquifer – are approximately 25 miles west of the installation (Brown and Root Environmental, 1996, as cited in Agency for Toxic Substances and Disease Registry [ATSDR], 2006; NSWCDD, 2003). Therefore, there would be little opportunity for residues from land-based firing of munitions and detonation of explosives to contaminate these groundwater resources that supply industrial, municipal, or domestic users.

Some individual households and businesses may withdraw water from the unconfined Columbia aquifer, which is recharged directly by precipitation across most of NSF Dahlgren and elsewhere within King George County. However, the amounts of range residues deposited on the land would be negligible, and exposure concentrations would be below toxicity thresholds. Continued removal of fired military munitions and range scrap and debris from land ranges is expected to further ensure that range residues would have minimal potential impacts on groundwater.

Under the No Action Alternative, ordnance activities would have no direct impacts and negligible, long-term, indirect, negative impacts on groundwater.

EM Energy Activities, Laser Activities, and PRTR Use

Under the No Action Alternative, EM energy activities, HE laser activities, and PRTR use have no contact with groundwater and therefore they would have no direct or indirect impacts on groundwater.

Chemical Defense Activities

Testing of chemical simulants results in the release of small quantities of simulants into the air with even smaller quantities being deposited on the land and on the surface of the water. Chemicals deposited on land or on the surface water would degrade or be diluted to non-detectable levels well before reaching the groundwater.

Chemical defense activities under the No Action Alternative would have no direct or indirect impacts on groundwater.

4.10.3.2 Alternative 1

Ordnance Activities

Some individual households and businesses may withdraw water from the unconfined Columbia aquifer. However, the amounts of range residues that would be deposited on the land would be negligible and exposure concentrations would be well below toxicity thresholds. Continued removal of fired military munitions and range scrap and debris from land ranges is expected to further ensure that range residues would have minimal potential impacts on groundwater under Alternative 1.

Under Alternative 1, ordnance activities would have no direct impacts and negligible, long-term, indirect, negative impacts on groundwater.

EM Energy Activities, Laser Activities, and PRTR Use

Under Alternative 1, EM energy activities, HE laser activities, and PRTR use have no contact with groundwater and therefore they would have no direct or indirect impacts on groundwater.

Chemical and Biological Defense Activities

Testing of chemical and biological simulants results in the release of small quantities of simulants into the air with even smaller quantities of simulants being deposited on the land and on the surface of the water. Chemicals deposited on land or on the surface water would degrade or be diluted to non-detectable levels well before reaching the groundwater and biological organisms would be diluted to non-detectable levels or die before reaching the groundwater.

Under Alternative 1, chem/bio defense activities would have no direct or indirect impacts on groundwater.

4.10.3.3 Alternative 2

Ordnance Activities

Some individual households and businesses may withdraw water from the unconfined Columbia aquifer. However, the amounts of range residues that would be deposited on the land would be negligible, and exposure concentrations would be well below toxicity thresholds. Continued removal of fired military munitions and range scrap and debris from land ranges is expected to further ensure that range residues would have minimal potential impacts on groundwater under Alternative 2.

Under Alternative 2, ordnance activities would have no direct impacts and negligible, long-term, indirect, negative impacts on groundwater.

EM Energy Activities, Laser Activities, and PRTR Use

Under Alternative 2, EM energy activities, HE laser activities, and PRTR use have no contact with groundwater and therefore they would have no direct or indirect impacts on groundwater.

Chemical and Biological Defense Activities

Testing of chemical and biological simulants results in small quantities of simulants being released into the air with even smaller quantities of simulants being deposited on the land and on the surface of the water. Chemicals deposited on land or on the surface water would degrade or be diluted to non-detectable levels well before reaching the groundwater and biological organisms would be diluted to non-detectable levels or die before reaching the groundwater.

Under Alternative 2, chem/bio defense activities would have no direct or indirect impacts on groundwater.

4.11 Potomac River Aquatic Biological Resources

4.11.1 No Action Alternative

4.11.1.1 Ordnance Activities

As described in Section 3.7.7, almost all recorded large-caliber projectiles fired at NSF Dahlgren since 1918 have been fired into the MDZ, with a limited number of projectiles entering the upper end of the LDZ (up to 40,000 yds from the firing line). Nearly half (46.4 percent) of large-gun projectiles tested at NSF Dahlgren have been targeted to a 2.3-sq NM area – referred to as the dense zone – approximately 11,000 to 13,000 yds from the Main Range gun line (see Figure 3.7-1). Under the No Action Alternative, as well as under Alternatives 1 and 2, the majority of the 4,700 large-gun projectiles fired in particularly active years would continue to be fired into the same heavily-used area.

In recent years – i.e., for the period from 1995 through 2009 – approximately 74 percent of the large-gun projectiles fired into the Potomac River have been inert. Inert projectiles enter the water and are propelled by their forward momentum into the sediment. Duds, which comprise about 3 percent of live projectiles, have the same impacts as inert projectiles, as they also enter the sediments and are buried without exploding. Under this alternative, as well as under Alternatives 1 and 2, inert projectiles would continue to be the dominant type of ordnance.

Approximately 26 percent of large-caliber projectiles fired in recent years have been live projectiles, which detonate primarily above the water surface. Most of the live ordnance tested currently is and will continue to be fuzed to explode well above the water surface. More than 98 percent of the live projectiles that detonate are estimated to do so on or above the water, resulting in less than 2 percent – i.e., approximately 24 of the projectiles fired annually during particularly active firing years – detonating under water, at depths of 6 ft or less. After detonation of live projectiles above the water, small fragments or particles would be deposited on the surface of the water, which would then disperse over a wide area upon entering the water column. Limited amounts of material would be deposited in any single area, and constant water movement in the river would redistribute smaller particles after they settle on the bottom.

Approximately 6,000 bullets would be fired each year. Much of the outdoors small-arms firing is directed into gun butts, reducing the number of bullets entering the river. Approximately 90 percent of small-arms firings are and would continue to be over land and those bullets would not enter the river. The remaining 10 percent (600) of the firings would be from land into the river, with the bullets entering the river mainly within 1,000 yds of the shoreline. Under current small-arms activities, as described in Section 1.5.1.3, most bullets fired are inert, but some are explosive.

Approximately 190 detonations would take place each year. Most detonations would take place inland on the EEA's Harris and Churchill Ranges, and much less frequently on the EOD training range on the Missile Test Range, all at considerable distances from the waters of the Potomac River. Occasionally, devices would be detonated on vessels in the river. A portion of the debris and residues from detonations on vessels could enter the river, but the quantities of these materials would be small, as such detonations would be infrequent.

As discussed in Section 3.7.5, NSWCDD removes fired military munitions, as well as range scrap and debris that are exposed on the ground surface or partially buried. Residues from the land-based firing of munitions and detonation of explosives that remain on land after operational range surface clearance could enter surface waters indirectly via surface water or soil runoff, and shallow groundwater discharge. Although some residues would eventually migrate into surface waters, they are expected to occur at extremely low concentrations. The RCA recommends that no actions are required related to potential off-range release of MCs, as discussed in Section 3.7.6.

Impacts related to large-caliber projectiles and bullets may be direct or indirect. Direct impacts could result from inert projectiles or bullets striking organisms directly, or from the detonation of explosive projectiles or bullets above, at, or below the water surface. There would be a small possibility that some individual organisms – notably fish and birds – may be directly impacted if they are in the target area and, in particular, at the point of physical impact at the time of ordnance delivery. However, the size of the projectiles, coupled with the often patchy distribution of fish and birds and the low probability that a fish or bird would occur at the immediate location of impact, minimizes the potential for a direct strike.

As noted above, more than 98 percent of the live projectiles that detonate are estimated to do so on or above the water. The potential effects from above-water detonations would not be of any consequence to aquatic organisms, as the air-water interface would reflect most of the energy from the shockwave outward and upward. Underwater detonations would have more expansive zones of influence and greater potential for injuring fish than would on- or above-water detonations.

Munitions exploding underwater, comprising less than 2 percent of live projectiles that detonate (about 24 in a particularly active firing year), create a shock wave that has the potential to impact aquatic organisms, particularly those with gaseous pockets or cavities. The shock wave creates an expansion of gas and the irregular movement of tissues. The shock wave created by an underwater explosion can rupture swim bladders and blood vessels, tear tissues, and rupture and hemorrhage the spleen, kidney, liver, gonads, and sinus venosus (Wright, 1982; Wright and Hopky, 1998; Lewis, 1996; Govoni et al., 2003). Generally, the closer the detonation is to the water surface, the smaller the horizontal range or extent of the impact zone and the lower the potential impact. This is because the resultant bubble of expanding gases would break the water surface, allowing a significant portion of the energy to escape into the less dense air, in turn reducing the peak pressure. Conversely, the shallower the detonation, the greater the depth at which the maximum horizontal range of the impact zone is attained (Naval Surface Weapons Center [NSWC], 1984).

In addition to direct physical impacts, large-gun projectiles could have indirect impacts on aquatic organisms and communities. Indirect impacts may include increasing turbidity and sedimentation close to the area of impact, or the release of MCs that can alter water and/or sediment quality.

When projectiles impact the river bottom, they disturb bottom sediments, re-suspending sediment into the water column. A disturbance to bottom sediments in aquatic ecosystems can degrade water quality by stirring up sediments that introduce excess organic matter and nutrients into the water column and change the reduction or redox potential (short for reduction-oxidation reaction, which describes all chemical reactions in which atoms have their oxidation number

[oxidation state] changed) (Heinsohn et al., 1977; Burton and Scott, 1992; Kelaher et al., 2003; Bilotta and Brazier, 2008). A change to the redox potential can transform and release toxins, making the habitat unfit for many species to survive (Heinsohn et al., 1977).

Increases in the level of suspended solids in the water column would be concentrated near areas where projectiles enter the sediment. A shell impacting the river sediment is anticipated to create a small crater at the entry point, releasing sediment into the water column. No estimates of the increase in suspended material could be made, but it is anticipated that the sediments disturbed at the impact site would quickly settle out of the water column. Increases in levels of suspended sediments would be localized, short-term events that would not affect current levels of suspended solids found in the water column.

Water and Sediment Quality Modeling

The munitions fired into the PRTR over the last 90 years have introduced organic compounds (explosives) and inorganic compounds (metals) into the river. A fate and transport model was used to provide a quantitative estimate of the potential loading of explosive and metal munitions constituents of potential concern (MCOPCs) to river water and sediment. The potential effects of munitions firing into the PRTR on biological resources based on water and sediment modeling are summarized below and further information on the modeling procedures and assumptions is contained in Appendix F of this EIS.

Concentrations of metal and explosive MCOPCs in water and sediments in the two areas of the PRTR with the highest concentrations of munitions were modeled to focus on the areas with the greatest potential to impact aquatic life. The area between the Main Range gun line and 25,000 yds in the MDZ accounts for 99.4 percent of all munitions tested on the PRTR and is referred to as the diffuse zone (see Figure 3.7-1). Within this area, the dense zone – the zone from 11,000 to 13,000 yds – has the highest density of projectiles. A subset of constituents contained in munitions that were most likely to contribute to an ecological or human health risk was selected for modeling. The annual concentrations of organic explosives and metals constituents were estimated assuming 90 years of environmental exposure for corrosion. The predicted concentrations of metals in the dense and diffuse zones of the MDZ are shown in Table 4.11-1.

Table 4.11-1
Summary of Modeled Concentrations of Metals in Water and Sediment in the PRTR

Metal	Adsorbed in Sediment Due to Munitions (Monthly)		In River Water Column Due to Munitions (Daily)	
	Dense Zone	Diffuse Zone	Dense Zone	Diffuse Zone
	(µg /kg)	*(µg /kg)*	*(µg /l)*	*(µg /l)*
Cadmium	14.5	2.09	0.00000504	0.000000694
Chromium	5.61	1.29	0.00000845	0.00000194
Copper	6,500	1,710	0.00000591	0.00000150
Lead	11.9	26,2	0.00000000577	0.00000000119
Manganese	2,320	797	0.00104	0.000342
Nickel	78.7	81.5	0.0000221	0.0000220
Zinc	1,140	192	0.0000458	0.00000729

Notes: *µg* /kg = micrograms per kilogram (parts per billion); *µg* /l = milligrams per liter (parts per billion).
A concentration of 0.001 mg/kg is equal to 1 part per 1,000,000,000 (part per billion).

Water and sediment criteria and guidelines for protection of aquatic life were selected for comparison with modeled concentrations of metals using the following guidance:

- **USEPA Current National Recommended Water Quality Criteria** (USEPA, 2009) – USEPA's national recommended water quality criteria for the protection of aquatic life and human health in surface water include about 150 pollutants. These criteria are published pursuant to Section 304(a) of the Clean Water Act (CWA) and provide guidance for states and tribes to use in adopting water quality criteria. These aquatic life criteria are intended to be protective of the vast majority of the aquatic communities in the United States. The criteria maximum concentration (acute) is an estimate of the highest concentration of a material in surface water to which an aquatic community (two or more populations of different species occupying the same area) can be exposed briefly without resulting in an unacceptable effect, while the criteria continuous concentration (chronic) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.
- **NOAA Screening Quick Reference Tables (SQuiRTs)** (NOAA, 2008) – These tables compiled by NOAA provide a range of screening concentrations for constituents found in sediments. For freshwater sediments the following values are provided:
  - **Threshold effects level**– Calculated as the geometric mean of the 15th percentile concentration of the toxics effects dataset and the 50th percentile (median) of the no-effect dataset. Threshold effects level represents the concentration at which toxic effects are expected to occur only rarely.
  - **Probable effects level** – Calculated as the geometric mean of the median concentration of impacted samples and the 85th percentile of the non-impacted samples. Probable effects level represents the concentration at which toxic effects are frequently expected.
  - **Upper effects threshold**– The concentration at which biological indicators of adverse effects (e.g., sediment bioassay or reduced benthic infauna) are seen. At concentrations above the upper effects threshold, adverse biological effects are expected.

Marine sediment values also were used for comparison, as most of the PRTR is mesohaline with salinities typically ranging from 5 to 18 ppt. For marine sediments the following values were used:

- **Effects range-low (ER-L)** – The concentration that represents the lowest 10th percentile of the concentrations at which toxic effects were observed. At concentrations below the ER-L, toxic effects are rarely expected (Long and Morgan, 1990).
- **Effects range-median (ER-M)** – The concentration that represents the 50th percentile (median) at which toxic effects were observed. At concentrations above the ER-M, toxic effects are likely to occur (Long and Morgan, 1990).
- **Apparent effects threshold (AET)** – The concentration at which biological indicators of adverse effects (e.g., sediment bioassay or reduced benthic infauna) is seen, essentially equivalent to the concentration in the highest non-toxic sample. At concentrations above the AET, adverse biological effects are always expected.

Tables 4.11-2 and 4.11-3 present the water and sediment criteria and guidelines selected for comparison of MC concentrations.

Table 4.11-2
USEPA Water Quality Criteria for Metals

Metal	Freshwater		Saltwater	
	Acute Ambient Water Quality Criteria (µg/l)	Chronic Ambient Water Quality Criteria (µg/l)	Acute Ambient Water Quality Criteria (µg/l)	Chronic Ambient Water Quality Criteria (µg/l)
Cadmium	2.0	0.25	40	8.8
Chromium III	570	74	NA	NA
Chromium VI	16	11	1,100	50
Copper	13	9.0	4.8	3.1
Lead	65	2.5	210	8.1
Manganese*	NA	NA	NA	NA
Nickel	470	52	74	8.2
Zinc	120	120	90	81

Note: µg/l = micrograms per liter (parts per billion).
* Manganese is a non-priority pollutant.
Source: USEPA, 2009.

Table 4.11-3
NOAA Sediment Quality Guidelines for Metals

Metal	Freshwater Sediment			Marine Sediment				
	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	Threshold Effects Level	Effects Range-Low	Probable Effects Level	Effects Range-Median	Apparent Effects Threshold
	µg/kg dw							
Cadmium	596	3,530	3,000	676	1,200	4,210	9600	3000
Chromium	37,300	90,000	95,000	52,300	81,000	160,400	370,000	62,000
Copper	35,700	197,000	86,000	18,700	34,000	108,200	270,000	390,000
Lead	35,000	91,300	127,000	30,240	46,700	112,180	218,000	400,000
Manganese	630,000	NA	NA	1,100,000	NA	NA	NA	260,000
Nickel	18,000	35,900	43,000	15,900	20,900	42,800	51,600	110,000
Zinc	123,100	315,000	520,000	124,000	150,000	271,000	41,000	41,000

Notes: µg/kg dw = micrograms per kilogram dry weight (parts per billion).
NA = not available.
Source: NOAA, 2008.

MCs from explosives are not listed on USEPA's Contract Laboratory Program Toxic Compound List (USEPA, 2011) and are generally not included in government criteria or guidelines. Talmage et al. (1999, as cited in US Navy, 2002) calculated freshwater and sediment screening levels based on available data using the standard USEPA methodology for generation of water quality. These freshwater and sediment concentrations are presented in Table 4.11-4. No sediment data were available for ammonium picrate or Tetryl.

Table 4.11-4
Freshwater and Sediment Criteria for Explosives

Constituent	Acute Water Quality Criteria-Freshwater [1] (*μ* g/l)	Chronic Water Quality Criteria-Freshwater [1] (*μg* /l)	Sediment [1] (mg/kg)
Ammonium picrate	220,000 FW [2] 66,000 SW [2]	No Data	No Data
HMX	3,800	330	470
RDX	1,440	190	1,300
Tetryl	1,200 [3]	No Data	No Data
TNT	570	90	9,200

Notes: *μ*g/l = micrograms per liter (parts per billion); *μ* g/kg = micrograms per kilogram (parts per billion).
FW = freshwater; SW = saltwater.
Sources:
[1] Talmage et al., 1999; as cited in US Navy, 2002.
[2] NOAA, 2008; FW based on lethal concentration 50 (LC50) (lethal dose resulting in 50 percent mortality) for 96-hr exposure of bluegill sunfish; SW based on LC50 for 96-hr exposure of the inland silverside *Menidia beryllina*.
[3] NAVFAC, 2000; Saltwater toxicity to red fish larvae based on no observed effect.

These modeled concentrations of munitions-related metals and explosives were then compared to water and sediment quality criteria and guidelines to determine if they were above guidelines for the protection of aquatic life. Tables 4.11-5 and 4.11-6 summarize the ratios of modeled concentrations of metals to water and sediment criteria, respectively. Ratios of less than one indicate that concentrations are below levels that could cause adverse effects to aquatic organisms. The ratios of all comparisons of predicted water concentrations and sediment concentrations were well below one, indicating that there are no exceedances associated with metals from munitions usage in water or sediment. Most concentrations are many orders of magnitude below criteria (more than a million times below effects levels).

Concentrations of explosives in water and sediment were also modeled, as summarized in Tables 4.11-7 and 4.11-8, respectively. Ratios of modeled concentrations to water and sediment criteria were also orders of magnitude below one, as shown in these tables, indicating that there would be no adverse effects to aquatic organisms associated with metals or explosives released from munitions.

Vegetation

The primary aquatic vegetation potentially impacted by the Proposed Action is submerged aquatic vegetation (SAV), which is discussed in this section. Emergent intertidal wetlands are discussed separately, in Section 4.10.

SAV is generally found in shallower waters along the edges of the Potomac River (see Figures 3.11-1 and 3.11-2, and Figure 4.11-1, SAV in Relation to the PRTR), as it is restricted to the photic zone where light is available for growth. SAV in the Potomac River in the region of the MDZ and upper LDZ (mesohaline region) requires at least 3.3 ft of light penetration (Buchanan, 2008). The MDZ and LDZ do not include extensive nearshore areas where sufficient light is available for SAV growth.

Table 4.11-5
Summary of Modeled Metal Concentrations in Water Compared to USEPA Water Quality Criteria in the PRTR

Metal	Freshwater		Saltwater	
	Acute Ambient Water Quality Criteria	Chronic Ambient Water Quality Criteria	Acute Ambient Water Quality Criteria	Chronic Ambient Water Quality Criteria
Dense Zone				
Cadmium	0.00000252	0.0000202	0.000000126	0.000000573
Chromium III	0.0000000148	0.000000114	NA	NA
Chromium VI	0.000000528	0.000000768	0.00000000768	0.000000169
Copper	0.000000455	0.000000657	0.00000123	0.00000191
Lead	0.0000000000888	0.00000000231	0.0000000000275	0.000000000712
Manganese	NA	NA	NA	NA
Nickel	0.0000000470	0.000000425	0.000000299	0.00000270
Zinc	0.000000382	0.000000382	0.000000509	0.000000565
Diffuse Zone				
Cadmium	0.000000347	0.00000278	0.0000000174	0.0000000789
Chromium III	0.00000000340	0.0000000262	NA	NA
Chromium VI	0.000000121	0.000000176	0.00000000176	0.0000000388
Copper	0.000000115	0.000000167	0.000000313	0.000000484
Lead	0.0000000000183	0.000000000476	0.00000000000567	0.000000000147
Manganese	NA	NA	NA	NA
Nickel	0.0000000468	0.000000423	0.000000297	0.00000268
Zinc	0.0000000608	0.0000000608	0.0000000810	0.0000000900

Notes: NA = criteria not available.
Values below 1 indicate that concentrations are below water quality criteria. All values shown here are orders of magnitude below 1 (each order of magnitude is equal to ten times).

Table 4.11-6
Summary of Modeled Metal Concentrations in Sediment
Compared to NOAA Sediment Quality Criteria in the PRTR

Metal	Freshwater				Saltwater				
	Lowest ARCS	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	Threshold Effects Level	Effects Range-Low	Probable Effects Level	Effects Range-Median	Apparent Effects Threshold
Dense Zone									
Cadmium	0.025	0.024	0.0041	0.0048	0.021	0.012	0.0034	0.0015	0.0048
Chromium	0.00015	0.00015	0.000062	0.000059	0.00011	0.000069	0.000035	0.000015	0.000090
Copper	0.23	0.18	0.033	0.076	0.35	0.19	0.06	0.024	0.017
Lead	0.0032	0.0034	0.0013	0.00094	0.0039	0.0025	0.0011	0.00055	0.0003
Manganese	0.0058	0.0037	NA	NA	0.0021	NA	NA	NA	0.0089
Nickel	0.004	0.0044	0.0022	0.0018	0.0049	0.0038	0.0018	0.0015	0.00072
Zinc	0.012	0.0093	0.0036	0.0022	0.0092	0.0076	0.0042	0.028	0.028
Diffuse Zone									
Cadmium	0.0036	0.0035	0.00059	0.0007	0.0031	0.0017	0.0005	0.00022	0.0007
Chromium	0.000036	0.000035	0.000014	0.000014	0.000025	0.000016	0.0000080	0.0000035	0.000021
Copper	0.061	0.048	0.0087	0.02	0.091	0.05	0.016	0.0063	0.0044
Lead	0.00071	0.00075	0.00029	0.0021	0.00087	0.00056	0.00023	0.00012	0.000066
Manganese	0.002	0.0013	NA	NA	0.00072	NA	NA	NA	0.0031
Nickel	0.0042	0.0045	0.0023	0.0019	0.0051	0.0039	0.0019	0.0016	0.00074
Zinc	0.002	0.0016	0.00061	0.00037	0.0015	0.0013	0.00071	0.0047	0.0047

Notes: ARCS = Assessment and Remediation of Contaminated Sediments Program.

NA = criteria not available.

Values below 1 indicate that concentrations are below sediment guidelines. All values shown here are orders of magnitude below 1 (each order of magnitude is equal to ten times).

Source: NOAA, 2008.

Table 4.11-7
Summary of Modeled Explosive Concentrations in Water
Compared to Water Quality Values in the PRTR

Explosive	Modeled Water Concentration (mg/l)		Ratios of Water Concentration: Acute Water Values		Ratios of Water Concentration: Chronic Water Values	
	Dense Zone	***Diffuse Zone***	***Dense Zone***	***Diffuse Zone***	***Dense Zone***	***Diffuse Zone***
Ammonium Picrate	0.0000517	0.00000269	0.00000024 FW 0.00000078 SW	0.000000012 FW 0.000000041 SW	No Data	No Data
HMX	4.46×10^{-9}	2.60×10^{-9}	1.2×10^{-9}	6.8×10^{-10}	0.000000014	7.9×10^{-9}
RDX	0.0000337	0.0000000573	0.000023	0.00000040	0.00018	0.0000030
Tetryl	0.000000574	0.0000000164	0.00000048	0.000000014	No Data	No Data
TNT	0.00000334	0.000000635	0.0000059	0.0000011	0.000037	0.0000071

Notes: mg/l = milligrams per liter.

FW = freshwater; SW = saltwater.

Scientific notation is used for very small numbers; for example 1.0×10^{-9} is one billionth (0.000000001).

Values below 1 indicate that concentrations are below water quality values. All values shown here are orders of magnitude below 1 (each order of magnitude is equal to ten times).

Table 4.11-8
Summary of Modeled Explosive Concentrations in Sediment
Compared to Sediment Quality Criteria in the PRTR

Explosive	Modeled Dry Sediment Concentration (mg/kg)		Ratios of Sediment Concentration: Sediment Values	
	Dense Zone	***Diffuse Zone***	***Dense Zone***	***Diffuse Zone***
Ammonium Picrate	0.000000541	0.0000000406	No Data	No Data
HMX	0.00000000611	0.00000000510	0.000000013	0.000000011
RDX	0.0000138	0.000000337	0.000011	0.00000026
Tetryl	0.000603	0.0000250	No Data	No Data
TNT	0.00298	0.000814	0.00032	0.000089

Notes: mg/kg = milligrams per kilogram.

Values below 1 indicate that concentrations are below sediment quality values. All values shown here are orders of magnitude below 1 (each order of magnitude is equal to ten times).

There is little SAV present in the MDZ and upper LDZ, as shown in Figure 4.11-1, and few plants are found in deeper waters of the PRTR where most large-caliber gun projectiles currently are and would continue to be fired. Therefore, there would be limited potential for direct hits of vegetation, disturbance of vegetation adjacent to direct hits, or settlement of shell fragments onto plants in the PRTR.

A limited number of inert or dud projectiles that enter the river where SAV is present may damage plants at and in the immediate vicinity of the point of entry. After detonation of live projectiles, small fragments or particles may be deposited on SAV. Fragments and particles are anticipated to be dispersed over a wide area, with limited amounts of material deposited in any single area. Constant water movement on the surface of submerged plant leaves would remove smaller particles.

The limited number of plants damaged by projectiles would not affect the SAV community. Areas where projectiles enter the sediment are likely to be recolonized by neighboring plants. Relatively low numbers of small-arms bullets would enter the MDZ and there is little SAV in the area where bullets would enter the water (see Figure 4.11-1).

Detonations on the land ranges, all at considerable distances from the waters of the Potomac River, and the occasional detonation of devices on vessels in the river would have no direct impact on SAV communities.

As discussed above, comparison of the modeled concentrations of munitions-related metals and explosives to water and sediment quality criteria and guidelines indicated that concentrations are below levels that could cause adverse effects to aquatic organisms. Most concentrations of metals and all concentrations of explosives were many orders of magnitude below criteria, indicating that there would be no adverse effects to SAV associated with metals or explosives released from munitions. Based on the comparison of metals and explosive concentrations associated with ordnance use in the PRTR to aquatic toxicity values and the minimal increase in suspended solids in the water column, the indirect impacts of ordnance activities on SAV would be negligible.

As discussed previously, NSWCDD removes fired military munitions, and range scrap and debris that are exposed on the ground surface or partially buried. Residues from the land-based firing of munitions and detonation of explosives that remain on land after operational range surface clearance could enter surface waters indirectly via surface water or soil runoff, and shallow groundwater discharge. Although some residues would migrate into surface waters, they are expected to occur at extremely low concentrations. Some debris from occasional detonations on vessels in the river also may enter the river, but only at low concentrations.

Under the No Action Alternative, ordnance activities would have negligible, long-term, direct and indirect, negative impacts on SAV communities.

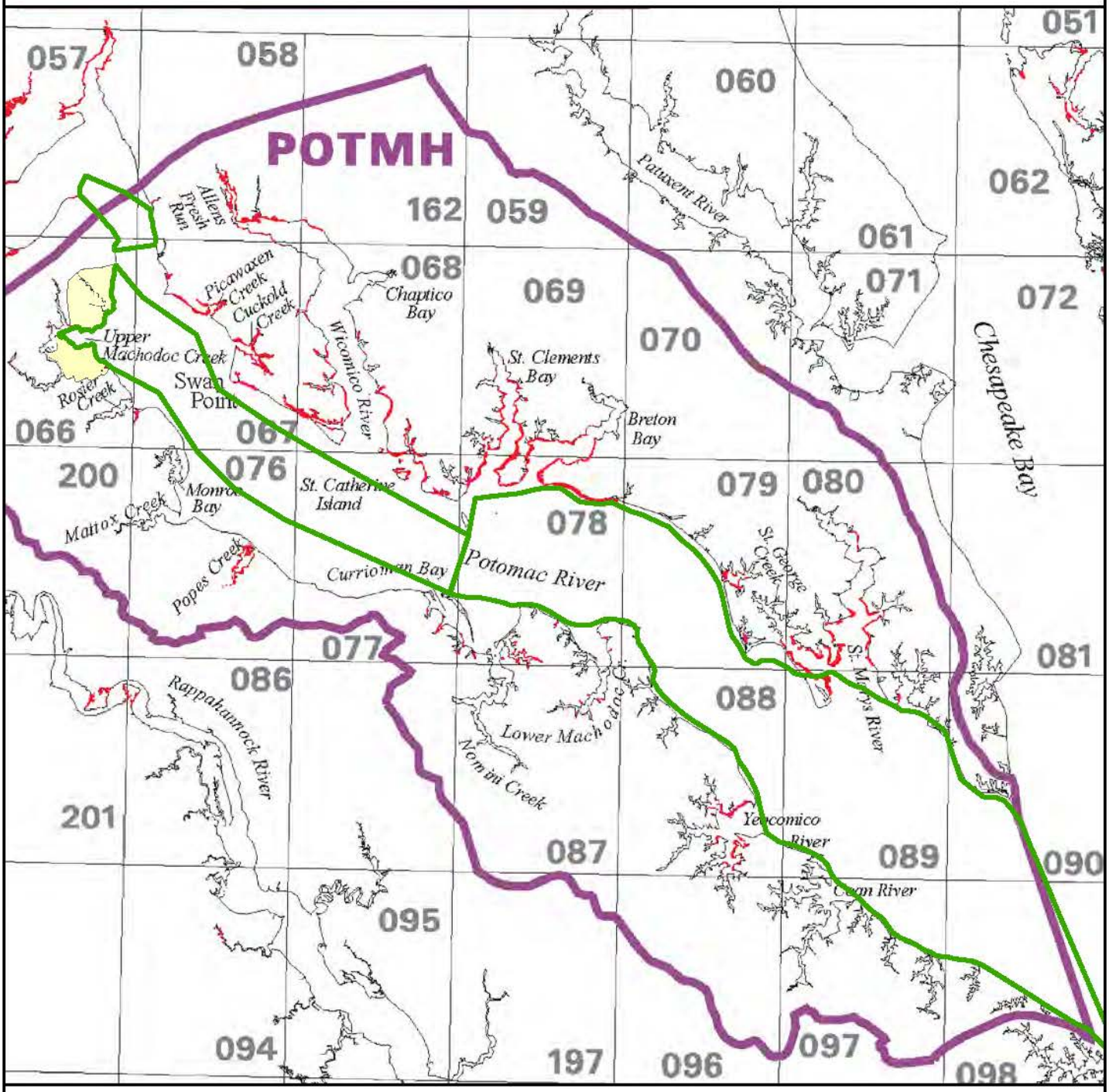
Plankton

Shock waves created by the small number of munitions that explode at or under the surface of the water have the potential to rupture gaseous pockets in plankton. Both phytoplankton and zooplankton possess pockets of gas and tissues that may be impacted from a shock wave induced from an explosion. However, most projectiles fired are inert and less than 2 percent (24 in a particularly active year) of the live projectiles fired are estimated to detonate below water. For these reasons, direct impacts to plankton communities would be negligible.

Large-caliber projectiles may indirectly impact plankton and plankton communities. Potential short-term impacts to plankton would primarily result from increased turbidity and could include the scouring of external respiratory and photosynthetic structures, and decreased biomass (Bilotta and Brazier, 2008; Testa et al., 2008). Increased turbidity can also clog the gut of an organism, causing the organism to stop feeding and starve (Alabaster and Lloyd, 1982). However, due to the ubiquity and abundance of plankton, any indirect impacts to plankton from ordnance activities would be limited to individuals and would not impact the planktonic community of the PRTR.

Impacts of small-arms activities on plankton would be limited to areas within the MDZ, close to shore. As most bullets fired are inert, there would be little interaction with plankton. Detonations

Submerged Aquatic Vegetation in Relation to the PRTR



2005 SAV

Naval Support Facility (NSF) Dahlgren

Potomac River Test Range (PRTR)

0 2 4 6
Miles

0 2 4 6 8 10
Kilometers

N

NSWCDD EIS

NAVSEA WARFARE CENTERS DAHLGREN

Source: Orth et al. (2006) Scale is approximate.

Figure 4.11-1

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that take place inland on the EEA and occasionally on the Missile Test Range as well as on vessels in the river would not impact plankton communities.

Negligible, long-term, direct and indirect, negative impacts to phytoplankton and zooplankton communities from ordnance activities would occur under the No Action Alternative.

Aquatic Invertebrates

Few aquatic invertebrates would be directly impacted from explosions, as only a small number would occur annually over a large area and any impacts related to turbidity would be negligible. Most explosions would occur above the surface of the water and most organisms are considered to be adapted to living in a turbid environment due to the high annual sediment-accumulation rates in the Potomac River, which range up to 0.75 in per year.

Concentrations of MCOPCs from leaching of ordnance are predicted to be well below freshwater, saltwater, and sediment criteria and guidelines – generally by many orders of magnitude – based on the modeling results presented above. The concentrations used for comparisons were in the densest areas of target firing and represent the highest concentrations of MCOPCs in the PRTR. Based on these comparisons, negligible impacts to aquatic invertebrates are anticipated.

Most small-arms bullets fired during testing are inert and only a portion may enter the river; therefore, there would be little interaction with invertebrates. Most detonations take place inland a considerable distance from the waters of the Potomac River and would not impact aquatic invertebrate communities.

NSWCDD removes fired military munitions and range scrap and debris that are exposed on the ground surface or partially buried. Residues from the land-based firing of munitions and detonation of explosives that remain on land after operational range surface clearance could enter surface waters indirectly via surface water or soil runoff, and shallow groundwater discharge. Residues would be reduced to virtually undetectable concentrations prior to reaching surface waters.

Ordnance activities under the No Action Alternative would have negligible, long-term, direct and indirect, negative impacts on aquatic invertebrate communities.

Fish

Fish Species and Stocks

There are approximately 90 species of fish known to occur in the PRTR portion of the Potomac River, as listed in Table 3.11-4. These species are found in a range of habitats and salinities. Some species are year-round residents, while others migrate between the Chesapeake Bay and its tributaries seasonally. Because NSWCDD requires their RDT&E activities to be flexible for optimal weather and other environmental conditions, there is no seasonal component to specific activities. Thus, it is not possible to assess the impacts with respect to the seasonal occurrence of some species of fish. However, the potential effects are differentiated by location within the PRTR, with varying effects between the UDZ, MDZ, and LDZ indicated, as applicable. As the salinity increases downriver (see Subchapters 3.10 and 3.11), the species composition also changes.

Based on PRFC commercial fishing harvest data from 2001 to 2010 (see Table 3.11-11), the majority (89 percent) of landings were in Area 1 (Figure 3.11-6), the lower portion of the river that includes the LDZ. As mentioned in Chapter 3, this highly productive area supports sought-after commercial fish species. The large harvests in Area 1 suggest that these species are more abundant in the LDZ, where NSWCDD activities are limited; however, catch per unit effort data would be necessary to confirm this.

As discussed in Chapter 3, some fish stocks or populations in the Potomac River are more abundant than others, and a few species have been overfished historically and/or are being overfished currently. This section examines the impacts of the RDT&E activities on all species of fish occurring in the PRTR, although it should be noted that species with locally declining population trends and species with a depleted population status may be affected differently than species with a healthy or rebuilding population status (see Table 3.11-12). Individual fish that are part of abundant populations in the Potomac River are more likely to be affected simply because there are more of these fish. However, because these species have healthy, abundant populations, there would be minimal to no long-term population-level effects; thus, these species are discussed in the general analysis. This is in contrast to species with declining population trends (e.g., winter flounder). Individuals of these species are less likely to be affected, but long-term population-level effects would be more pronounced. Nevertheless, fish mortality as the result of recreational and commercial fishing currently being carried out on the river is many orders of magnitude greater than the numbers of fish that would be injured or killed as a result of the proposed RDT&E activities.

Impacts to the shortnose sturgeon, a federal- and state-listed endangered species, and Atlantic sturgeon, a federal proposed species, are discussed in Section 4.14.

Impacts to Fish

Under the No Action Alternative, large-gun projectiles and bullets fired from small arms would continue to enter the PRTR, potentially impacting fish. Direct hits of fish may occur when projectiles are fired in the MDZ. Direct hits would affect fish throughout the water column, but would have more of an impact on shallow-water and pelagic species than on demersal species (see Section 3.11.4.1 for species). In addition, juveniles would be less at risk of being hit than adults, because projectiles are primarily fired into the middle of the Potomac River, and juveniles generally are found in shallow, nearshore areas outside target areas.

As approximately 24 large-caliber projectiles are estimated to detonate underwater annually during particularly active years and because of the large size of the dense zone – approximately 2.3 sq NM – the probability of an underwater explosion's affecting an individual fish would be minimal. Because the shock wave generated by a detonation below the surface of the water spreads spherically outward (NSWC, 1978), the energy of the shock wave attenuates exponentially away from the point of detonation. However, individual fish close to the detonation may be adversely affected.

The potential damage to the fish would depend on the size of the fish, physiology of the species, depth at impact, weight of the explosive charge, depth of the explosion, river bathymetry, and distance between the fish and the explosion. Young fish are more sensitive than adults to direct impacts, as are fish with swim bladders. Direct effects from underwater explosions could include death, damage to swimbladders and blood vessels, tearing of tissues, and rupturing and

hemorrhaging of the spleen, kidney, liver, gonads, and sinus venous (Wright, 1982; Wright and Hopky, 1998; Lewis, 1996; Govoni et al., 2003).

The potential impact of an underwater explosion on a group or school of fish would be proportional to the density of the group. For species with very low populations in the PRTR, the probability of an underwater explosion's affecting the group would be negligible. Conversely, for species with high populations in the PRTR, the probability of an underwater explosion's affecting the group would be higher.

Naval Surface Warfare Center (NSWC, 1991) provides an equation that allows estimation of the potential effect of an underwater explosion on fish with swimbladders using a damage prediction method. The equation predicts the range of vulnerability within which there would be a 90 percent probability of survival for swimbladder fish of given weights, exposed to explosions of given net explosive weights and given detonation depths. The equation parameters are independent of environmental conditions, such as depth of the fish relative to the detonation and the depth to the bottom. Table 4.11-9 provides estimated 90 percent survivability ranges derived from NSWC (1991) for 1-lb, 10-lb, and 100-lb net explosive weight (NEW) charges at a detonation depth of 1 ft and 6 ft, for 1-ounce, 1-lb, and 30-lb fish.

The 90 percent survivability range, or 10 percent mortality range, is the distance beyond which 90 percent of the fish present would be expected to survive and defines the extent of the kill zone, although many fish will survive at positions closer to the charge (NSWC, 1984, 1991). The 90 percent survivability range for a 1-ounce fish would extend for a radius of approximately 385 ft around the location of a 10-lb NEW detonation at a depth of 6 ft, encompassing an area of approximately 465,660 sq ft or about 0.01 sq NM.

Table 4.11-9
Estimated 90 Percent Survivability Ranges (in ft)
for Fish with Swim Bladders

Detonation Depth and NEW	Weight of Fish		
	1 ounce	1 lb	30 lb
1-ft detonation depth			
1-lb NEW	136.2	95.0	61.1
10-lb NEW	259.6	181.0	116.3
25-lb NEW	335.5	234.0	150.4
6-ft detonation depth			
1-lb NEW	202.0	140.9	90.6
10-lb NEW	385.0	268.5	172.5
25-lb NEW	497.6	347.0	223.0
Source: Based on NSWC, 1991, Table 2.			

As discussed in Section 3.10.1.2, based on data provided by the Maryland Department of the Environment (Luckett, pers. comm., February 9, 2010), 65 fish kills involving 12 or more fish occurred from 1984 through 2009 in the tidal Potomac River in Charles and Saint Mary's Counties, Maryland – i.e., from upstream of the UDZ to the mouth of the river. Most of the fish kills probably were caused by low dissolved oxygen (DO) levels or by low DO in combination with other stresses, water quality conditions other than low DO levels, or commercial and

recreational discards. Although the causes of the remaining 16 fish kills are not known, underwater explosions have not been implicated as the probable causes.

Exposure to metal and explosive constituents may occur directly via contact with water and/or sediment, or indirectly via consumption of contaminated prey or food. As discussed above, the potential effects of exposure to metals and explosive MCOPCs that enter the water column and sediments were analyzed. The modeled metal and explosive concentrations in water and sediment were well below levels that could cause adverse effects to fish and, in fact, most concentrations were many orders of magnitude below freshwater and saltwater quality criteria and the sediment quality guidelines. Therefore, based on these comparisons, there would be no adverse effects to fish from metals or explosives released from munitions under the No Action Alternative.

The potential impacts on fish also were evaluated by comparing predicted fish-tissue concentrations (body burdens) to the lowest tissue-residue concentration levels with adverse effects, shown in Table 4.11-10. If a ratio is greater than 1, the concentration of the constituent that a fish is exposed to is above the level at which no adverse effects are expected. Conversely, if a ratio is less than 1, the concentration of the constituent that a fish is exposed to is below the adverse effect level and no adverse effects are expected from exposure. As shown in Table 4.11-11, ratios are all well below 1 – indicating that there are no risks to fish from metal constituents associated with munitions.

Table 4.11-10
Fish Tissue Residue-Based Toxicity Screening Values for Metals

Metal	Screening Concentration (mg/kg)	Level of Confidence	Source
Cadmium	0.9	Very low	Stickleback adult lowest observed effect concentration for mortality (Pascoe and Mattey, 1977).
Chromium	NA	NA	Insufficient fish ecotoxicity data.
Copper	0.4	Very low to moderate	Reduced oxygen consumption in carp (Jezierska and Sarnowski, 2002).
Lead	0.6	Very low	Mortality NOEC in immature brook trout (Holcombe et al., 1976 as cited in Jarvinen and Ankley, 1999).
Manganese	NA	NA	Insufficient fish ecotoxicity data.
Nickel	0.8	Very Low	Rainbow trout survival NOEC, muscle tissue (Calamari et al., 1982).
Zinc	12	Very low to moderate	Atlantic salmon juvenile growth NOEC – whole tissue.

Notes: mg/kg = milligrams per kilogram (parts per million).
NA = criteria not available; NOEC = no observed effect concentration.

A comparison of explosive concentrations in fish tissue was not performed because there are insufficient studies available associating toxicological effects with fish tissue concentrations. However, predicted concentrations of explosives in fish tissue are extremely low (below parts per trillion) and much lower than the modeled concentrations of explosives in water and sediment (see Appendix F). Therefore, inferred results indicate that explosives in the PRTR do not pose a risk to fish.

Table 4.11-11
Modeled Fish Tissue Concentrations Compared to Metal Toxicity Screening Values in the PRTR

Metal	Concentration of Metals in Fish Tissues (mg/kg ww)		Ratio to Toxicity Screening Tissue Concentrations	
	Dense Zone	Diffuse Zone	Dense Zone	Diffuse Zone
Cadmium	0.0000046	0.00000063	0.0000051	0.00000070
Chromium	0.00000016	0.000000037	NA	NA
Copper	0.0000042	0.0000011	0.000010	0.0000027
Lead	0.00000000000052	0.00000000000011	0.00000000000087	0.00000000000018
Manganese	0.00066	0.00022	NA	NA
Nickel	0.0000017	0.0000017	0.0000022	0.0000021
Zinc	0.000094	0.000015	0.0000079	0.0000013

Notes: mg/kg ww = milligrams per kilogram (parts per million) wet weight.

NA= not available (no toxicity data).

Ratios below 1 indicate that concentrations are below fish tissue screening concentrations values. All values shown here are orders of magnitude below 1 (each order of magnitude is equal to ten times).

As noted previously, low numbers of small-arms bullets would enter the PRTR, most of which would be inert. Bullets entering the PRTR would do so mainly within 1,000 yds of the shoreline. Negligible impacts would result from small-arms firing.

Detonations on the land ranges, all at considerable distances from the waters of the Potomac River, and as noted for invertebrates, residues would be reduced to virtually undetectable concentrations prior to reaching surface waters. The occasional detonation of devices on vessels in the river would have no direct impacts and negligible indirect impacts on fish communities.

Ordnance activities under the No Action Alternative would have negligible, long-term, direct and indirect, negative impacts on fish communities.

Essential Fish Habitat Assessment

As stated in Section 3.11.4.4, essential fish habitat (EFH) has been identified in the Potomac River for one or more life stages of cobia, king mackerel, Spanish mackerel, red drum, windowpane flounder, summer flounder, and bluefish. The composition of EFH in the PRTR is as follows:

- UDZ – juvenile and adult summer flounder and bluefish
- MDZ – juvenile and adult summer flounder and bluefish
- LDZ – juvenile and adult cobia, king and Spanish mackerel, red drum, windowpane and summer flounder, and bluefish

For each of the alternatives evaluated below, impacts refer to effects on EFH in general for the life stages of species identified in each danger zone (see Section 3.11.4.4). EFH is defined as "…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Depending on the operation, there is the potential for NSWCDD RDT&E activities to affect only water, only substrate, or both. This is specified in the analysis below.

In addition to EFH designations, habitat areas of particular concern (HAPCs) are designated to provide additional focus for conservation efforts; they represent a subset of designated EFH that are especially important ecologically to a species/life stage or are vulnerable to degradation (50

CFR §§ 600.805-600.815). For detailed effects on SAV, which is identified as HAPC for summer flounder and red drum, refer to the SAV discussions elsewhere throughout Section 4.11. As impacts on SAV would be absent or negligible, impacts on HAPC likewise would be absent or negligible.

Impacts to Essential Fish Habitat

Under the No Action Alternative, bullets would be fired into the MDZ, and large-caliber projectiles would be fired into the MDZ and infrequently into the upper end of the LDZ. NSWCDD does not fire projectiles into the UDZ or the lower LDZ. Therefore, there would be no impacts to EFH in the UDZ or lower LDZ from large-caliber gunfire. Due to the low numbers of small-arms bullets that would enter the PRTR and because most bullets would be inert, negligible impacts would result from small-arms firing.

The only two species with EFH in the MDZ and upper LDZ are juvenile and adult bluefish and summer flounder. Both are seasonal inhabitants, and EFH may be affected during the seasonal occurrence of the species in the Potomac River. Adult bluefish start to enter the Potomac River shortly after they enter the Chesapeake Bay, in March or April. Juveniles enter the Chesapeake Bay in late summer. All stages of bluefish have left the estuary by mid-November. Summer flounder undertake definitive seasonal inshore-offshore movements; they usually enter the Potomac River in April and leave by November, but may arrive in March and leave in December.

EFH for juvenile and adult summer flounder consists of demersal waters, muddy substrate, and sand. EFH for bluefish includes pelagic waters. As discussed in previous sections, impacts from live and inert ordnance would be limited to the initial explosion or transit through the water column. There would be minimal potential for contact with adults and less potential for contact with juveniles, as projectiles are fired into the middle of the river, whereas juveniles generally occur in shallow, nearshore waters. The majority of targets are virtual rather than physical objects, and virtual targets generate no debris. Hazardous materials are removed from physical targets, to the extent possible, prior to destroying or damaging them, with the remaining debris and any waste cleaned up following each event. Therefore, the only impacts from ordnance would be the potential for direct and indirect impacts on prey species and on substrate utilized by prey species.

The potential impacts of metal and explosive constituents on aquatic receptors, including plants, invertebrates, and fish, were analyzed. The predicted concentrations of MCOPCs in the water column and sediments were compared to federal and state criteria and guidelines for the abovementioned organisms and all modeled metals and explosives concentrations were well below the applicable freshwater and saltwater and sediment criteria and guidelines, generally by many orders of magnitude. Therefore, MCOPCs would not adversely affect EFH under the No Action Alternative.

Ordnance also may affect the prey species of bluefish and summer flounder through direct hits and underwater explosions. Wyanski (1990) found that in the lower Chesapeake Bay mysids were the dominant prey of smaller juvenile summer flounder. Lascara (1981 as cited in National Marine Fisheries Service, 1999a) reported that larger juveniles and adults in the same area fed on juvenile spot (*Leiostomus xanthurus*), pipefish (*Syngnathus fuscus*), the mysid *Neomysis americana*, and shrimps (*Palaemonetes vulgaris, Crangon septemspinosa*). In the Chesapeake Bay, oyster bar and reef habitats provide an important source of benthic prey for bluefish,

particularly during time periods when preferred small pelagic fish prey are less abundant (Harding and Mann, 2001). Oyster bars in the Potomac River (see Figure 3.11-5) likely also are a source of benthic prey for bluefish. Bluefish and summer flounder feed on anadromous fish, including shad, alewife, blueback herring, and white/yellow perch in the Potomac River (Nichols, pers. comm., March 9, 2009). Given the low probability for direct hits, the low percentage of live projectiles detonating underwater (2 percent), and the variety of prey species targeted by summer flounder and bluefish, any impacts to prey species would be negligible and would not noticeably affect the ability of summer flounder and bluefish to feed.

Ordnance activities under the No Action Alternative may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. Consistent with Navy policy (US Navy, 2011), the Navy consulted with NMFS in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSA). In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, under the No Action Alternative, ordnance activities would have negligible, long-term, direct and indirect, negative impacts on EFH.

4.11.1.2 EM Energy Activities

As described previously, the three main outdoor facilities for E3 and HERO RDT&E are located on land in the Mission Area or land ranges, away from the PRTR, and their use would not affect aquatic organisms or aquatic habitats. Radars are tested at the STSTS on Main Range and would continue to operate over the PRTR. The EM energy from these radars does strike the water surface.

In 2009, NSWCDD constructed and began operating the NDEC and the CETFAC to transmit directed energy (microwaves, RF, and lasers) outdoors across the waters of the Potomac River within the PRTR, near the mouth of Upper Machodoc Creek (see Figure 1-7). For directed energy activities over the water, beams of directed energy are transmitted above the water and are not targeted at the water surface. Activities are tightly controlled and the likelihood of directed energy beams straying from the target and hitting the surface of the water is small.

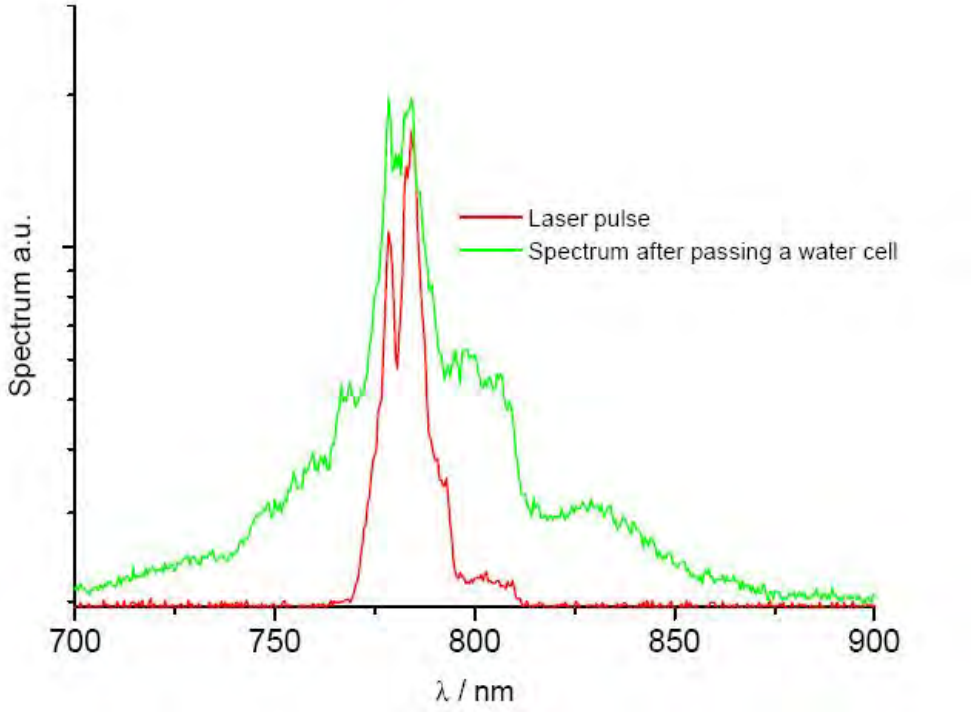
EM energy strikes on the water surface would be incidental. When EM energy interacts with water molecules or molecules within a body of water (organic or inorganic), energy is transferred to those molecules. As the transfer of energy is inefficient, there is a loss of some energy as heat to the water.

The potential harmful effects of EM energy on aquatic organisms would be highly localized and would be limited to the upper-most water layers. EM energy that breaches the water surface would be absorbed, scattered, or reflected off of organic and inorganic molecules (Boulnois, 1986; Dolgaev et al., 2003; Lubatschowski and Heisterkamp, 2004; Bai et al., 2007; De Giacomo et al., 2007; Li et al., 2007; Bai et al. 2008). As the EM energy interacts with more molecules the energy dissipates and spreads out causing the amount and the intensity of the energy to decrease. Water is a strong absorbing medium, and as EM energy travels through a body of water it is subjected to propagation (spreading or broadening) and attenuation (lessening of power), as shown in Figure 4.11-2, Spectrum of a Laser Propagating after Passing through 15 mm of Water.

Propagation and attenuation of EM energy in water are caused primarily by its interaction with the hydrogen bonds of water molecules and are also perpetuated by interactions with suspended particles, which include suspended sediments, dissolved inorganic materials, dissolved organic materials, and plankton (Wetzel, 2001; Babin and Stramski, 2002; Dolgaev et al. 2003).

The only EM sensor activity that would be conducted below water is the occasional deployment of modified passive sonobuoys in the PRTR. Passive sonobuoys detect EM signals but do not emit them. The use of passive sonobuoys would not generate additional sounds or other EM energy on the PRTR. The sonobuoys used in the Potomac River would be recovered for reuse at the conclusion of the events.

Figure 4.11-2
Spectrum of a Laser Propagating after Passing through 15 mm of Water



Note: Spectrum is in atomic units and wavelength (λ) is in nanometers (nm).
Source: Lubatschowski and Heisterkamp, 2004; simplified from Figure 2.

Vegetation, Plankton, and Aquatic Invertebrates

Under the No Action Alternative, the continued use of NOTES, MOATS, and two ground planes on land would not impact aquatic plants or animals. There would be negligible impacts to SAV, plankton, and aquatic invertebrates from radar or directed EM energy striking the surface of the water, due to limited direct and indirect thermal effects.

Although the initial deployment of the modified passive sonobuoys could temporarily scare fish away from the immediate area, the fish would return shortly after deployment. As passive sonobuoys would not generate additional sounds or other EM energy on the PRTR, their use

would not affect SAV, plankton, or aquatic invertebrates in the long term. As noted, the sonobuoys would be recovered for reuse at the conclusion of the events.

Under the No Action Alternative, EM energy activities would have negligible, short-term, direct, negative impacts and no indirect impacts on SAV, plankton, aquatic invertebrates, and their respective communities.

Fish

Fish swimming at or near the surface and at or near the location of impact could be exposed to EM energy. Deeper in the water column and more distant from the impact location, it is unlikely that the remaining low level of EM energy would have any impacts on fish. However, even if fish were swimming at or near the surface, the probability of being in the direct path of incidental EM energy is extremely low.

Nevertheless, some fish species are sensitive to electromagnetic fields (EMFs) in seawater (Kalmijn, 1982), and a disruption to the natural EMF utilized by a navigating fish has the potential to create a non-thermal effect (Adey, 1993; ICNIRP, 1998). Several marine fish, such as elasmobranchs (sharks, rays, and skates) and anadromous (migrating from salt water to spawn in fresh water) fish are well known to utilize natural EMFs for navigation, migratory behavior, finding prey, and sensing potential mates (Gill et al., 2005). A few such species exist in the Potomac River, including, but not limited to, the cow nose ray, sea lamprey, and American eel.

However, only in rare instances would there be the potential for incidental energy to hit the surface of the water and remain powerful enough to affect fish below. Further, there is a lack of conclusive, consistent evidence suggesting that exposure to EMFs has a positive or negative effect on elasmobrachs or other marine species (Gill et al., 2005; Gill et al., 2009). Therefore, any non-thermal effects on fish, and effects on navigation and orientation of EMF-sensitive species would be negligible and limited to fish at or near the surface water.

Under the No Action Alternative, EM energy activities would have negligible, short-term, direct, negative impacts and no indirect impacts on fish communities.

Essential Fish Habitat Assessment

EM energy would have the potential to affect EFH waters only, because the energy likely would not reach substrate on the river bottom, due to propagation and attenuation. In the event that incidental EM energy were to hit the surface of the water, the only effect would be a brief and minor increase in temperature of the immediately surrounding waters as energy is transferred, which would have no impact on waters designated as EFH.

There is a low probability that incidental EM energy could breach the water surface and reach prey species. However, the probability that prey for EFH species would be in the direct path of incidental EM energy is minimal, and the prey would have to be swimming near the surface to be exposed to a high level of EM energy. Further, only certain species are sensitive to EMFs. Therefore, activities under the No Action Alternative would have negligible effects on prey species of fish with EFH in the Potomac River.

The only impact from deployment of modified passive sonobuoys in the PRTR would be the occasional introduction of manmade objects into the water column, which would not adversely affect EFH.

EM energy activities under the No Action Alternative may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, under the No Action Alternative, EM energy activities would have negligible, short-term, direct, negative impacts and no indirect impacts on EFH.

4.11.1.3 Laser Activities

Three of NSWCDD's five current laser corridors cross the waters of Upper Machodoc Creek and the Potomac River through the PRTR. Research in aquatic areas currently is and will continue to be conducted above the surface of the water.

For No Action Alternative activities, both the HE laser emitter and the target/backstop would be fixed and the laser would emit almost horizontally. The laser would be pre-aimed and would not be able to move, except for minute corrections to the aim point. Under the current maximum power (100 kW), for over-water activities, the laser beam would begin at least 12 ft above mean water level and terminate at least 9 ft above mean water level. The eye-hazard area around the laser beam would be about 6 ft in diameter and at least 6 ft above mean water level (see Figure 1-10). Neither the laser beam nor the eye-hazard zone would come in contact with the water.

As with EM energy, laser activities are tightly controlled and the likelihood of a laser beam's hitting the surface of the water is extremely small. Should EM energy from laser tests strike the water surface it would be incidental and the potential adverse effects on aquatic organisms would be highly localized and limited to the uppermost water layers. Waves of EM energy that strike the surface of the water may be reflected at the air-water boundary. Energy that breaches the water surface would be propagated and attenuated, rapidly decreasing in amount and intensity as it travels through the water.

Vegetation, Plankton, and Aquatic Invertebrates

Laser interaction with the water surface, and possibly with SAV, plankton, or aquatic invertebrates, would only be incidental. Were a laser to strike the surface of the water, the energy could be reflected at the air-water boundary or would be propagated and attenuated if it breached the water surface, rapidly decreasing in magnitude and intensity.

Laser activities under the No Action Alternative would have negligible, short-term, direct, negative impacts and no indirect impacts on SAV, plankton, aquatic invertebrates, and the respective biological communities.

Fish

In the rare event that a laser beam does hit the water surface, the beam would be moving at the speed of light and, to be impacted, a fish would have to be at the water surface, at the point of impact, exactly when the laser beam strikes. The surface area of the MDZ is vast (approximately 38.5 sq NM) in comparison to the size of a fish and the small cross-section of a laser beam and the likelihood of a laser beam's striking a fish would be extremely low.

Effects of laser radiation on fish are largely unstudied and must be inferred from available evidence of biological interactions with other sources of EM energy. Should a laser beam strike a fish close to the surface of the water, the fish potentially could suffer from thermal or heating effects on body tissues. In the future, as more powerful lasers are used, the severity of the potential thermal effects would be greater.

The severity of the thermal effects depends on multiple variables, including, but not limited to, the ability of the tissues to conduct heat, EM energy frequency, duration of exposure, and distance from source. The severity of potential effects would be greater were a laser to strike a fish at the surface of the water. However, if a fish were struck by a laser beam below the water surface, the severity of the potential effects would decrease rapidly due to the attenuation and propagation of the laser beam as it travels through water. Although adverse effects may occur if a laser beam comes into contact with a fish located at or near the surface, the probability of this occurring is extremely low.

Under the No Action Alternative, laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on fish communities.

Essential Fish Habitat Assessment

Laser interaction with the water surface, and possibly with EFH waters or substrate, or prey for EFH species, would only be incidental. Were a laser to strike the surface of the water, the energy could be reflected at the air-water boundary or would be propagated and attenuated if it breached the water surface, rapidly decreasing in magnitude and intensity. In the extremely rare event that a laser beam does interact with the water surface, there is the potential for prey species swimming at or near the surface to be adversely affected. However, the loss of the few prey fish that may be affected would not impact the ability of EFH species to find sufficient prey to meet their energy requirements.

Laser activities under the No Action Alternative may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on EFH.

4.11.1.4 Chemical Defense Activities

Outdoor chemical defense activities using simulants would occur under the No Action Alternative, as described in Section 1.5.4. Chemical simulant tests result in small quantities of simulants being released in the air and even smaller quantities of simulants being deposited on the surface of the water. Simulants deposited on the water surface would undergo immediate dilution. Assessments completed for similar past simulant activities performed by NSWCDD using some of the same simulants showed no significant impacts and there were no observable environmental effects during or after events (NSWCDL, 2004; Bossart, letter, February 9, 2006; NSWCDL, 31 July 2009).

Chemical Simulant Modeling

NSWCDD modeled the atmospheric dispersion of chemical simulants released during chemical defense activities, based on established test methods and protocols. The methodology used for modeling is described in Section 4.4, and the model inputs and results are provided in Appendix J.

The predicted maximum surface-deposition levels for a range of simulants that could potentially be used are summarized in Table 4.4-3, based on the maximum amount of simulant tested and conditions that would result in the highest deposition rate. Simulant vapor tests are designed to minimize deposition on land and water areas. The maximum deposition that would occur in any one area, total mass of simulant deposited, and the surface area that would receive a concentration of more than 0.01 milligrams per square meter (mg/m^2) are presented.

Aquatic Toxicity of Chemical Simulants

A comparison of aquatic toxicity values of chemical simulants to estimated concentrations of simulants on surface water was performed to determine potential impacts of simulants on aquatic organisms. Table 4.11-12 lists aquatic toxicity values for chemical simulants modeled.

Table 4.11-12
Simulant Aquatic Toxicity Endpoints

	Toxicity Endpoint (mg/l)[1]	Reference, Notes
Diethyl malonate	*Pimephales promelas* (fathead minnow) LC50 96-hr = **163** mg/l	Netzeva et al., 2005
Dimethyl adipate	*Daphnia magna* EC50 (immobilization), 48-hr, **72** mg/l Green alga *Selenastrum capricornutum,* EC50 (Growth rate inhibition), 72-hr > 100 mg/l	Dow Chemical Company, 2008
Dimethyl methylphosphonate	Fish LC50 96-hr = 21,503 mg/l *Daphnia* EC50 16-d = **330** mg/l Green algae EC50 96-hr = 10,4967 mg/l	Nyden et al., 2000
Glacial acetic acid	Shrimp LC50 48-hr = 100 - 300 mg/l *Pimephales promelas* (fathead minnow) LC50 96-hr = 88 mg/l/ Bluegill/Sunfish: LC50 96-hr = 75 mg/l Goldfish: LC50 24-hr = 423 mg/l *Daphnia*: EC50 96-hr = **32**-47 mg/l	Fisher Scientific Company, 2008
Methyl salicylate	*Brachydanio reri* (zebrafish) LC0 96-hr = **42** mg/l *Daphnia* EC50 24-hr = 50 mg/l	The Good Scents Company, 2011
Triethyl phosphate	*Leuciscus idus* (ide [fish]) LC50 48-hr = 2,140 mg/l *Daphnia magna* EC50 48-hr = 350 mg/l *Scenedesmus subspicatus* (alga) EC50 72-hr = 900 mg/l *Daphnia magna* EC50 21-d = 729 mg/l NOEC 21-d = **31.6** mg/l	United Nations Environmental Program, 1998

Notes: mg/l = milligrams per liter.
LC50= lethal concentration 50; LC0 = lethal concentration 0; EC50 = effect concentration 50; NOEC = no observed effect concentration.
[1] Exposure time varied from 24 hours to 21 days.
Bolded numbers indicate the lowest effect concentration selected for toxicity comparisons.

The lowest aquatic toxicity available, inclusive of algae (considered to be representative of SAV), invertebrates, and fish, was selected for comparison with surface water concentrations for each simulant. Effect levels presented are generally the lowest lethal concentration 50 (LC50) threshold (i.e., the dose that kills 50 percent of the test organisms within a designated period) or

the lowest effect concentration (EC50) threshold (i.e., the dose that has an adverse effect on 50 percent of the test organisms within a designated period) identified for representative organisms.

To estimate the chemical simulant exposure concentrations for aquatic organisms, the total amount of simulant deposited (in kilograms [kg]) for each test was divided by the area where it would be deposited at a concentration of greater than 0.01 mg/m^2. For example, as shown in Table 4.4-3, the total deposition of diethyl malonate (DEM) would be 2.59 kg (2.59×10^6 mg) over an area of 0.0043 square kilometers (km^2) (4,300 square meters). A 1-m mixing depth in the surface water was assumed so that the deposition rate (square meters converted to cubic meters) was divided by 1,000 (1 cubic meters = 1,000 liters) to determine the exposure concentration. Assuming a one-meter (3.3-ft) mixing depth, the exposure concentration of DEM would be:

$$2.59 \times 10^6 \text{ mg} \div (4.3 \times 10^3 \div 1{,}000) = 0.60 \text{ milligrams per liter (mg/l)}$$

Maximum predicted exposure concentrations for all modeled simulants are provided in Table 4.11-13, along with a comparison to the lowest toxicity values found. As shown in this table, all exposure concentrations are below the lowest aquatic toxicity value found, indicating that chemical simulant activities would have no adverse effects on aquatic life. In addition, the shortest exposure time used to derive the aquatic toxicity values is 24 hours. This is far longer than the time period during which the maximum concentration of simulants would be present, as simulants would be rapidly diluted upon entering the Potomac River, resulting in much lower exposure concentrations than presented here.

Table 4.11-13
Maximum Predicted Simulant Exposure Concentrations

Chemical	Total Mass Deposition (kg)	Surface Area with conc. > 0.01 mg/m^2 (km^2)	Exposure Concentration (mg/l)	Lowest Aquatic Toxicity Value (mg/l)
Diethyl malonate	2.59	0.00430	0.602	163
Dimethyl adipate	75.9	0.234	0.325	72
Dimethyl methylphosphonate	0.00300	0.000679	0.00442	330
Glacial acetic acid	76.7	0.257	0.298	32
Methyl salicylate	59.9	0.0371	1.61	42
Triethyl phosphate	0.000400	0.00145	0.0002765	31.6

NSWCDD conducted dispersion modeling and field tests of chemical simulants released on the PRTR to determine the potential human and ecological health risks associated with the release of chemical simulants as a vapor on the MDZ (NSWCDD, 2003). The modeling results predicted both the airborne and water-column concentrations that would result from the vapor releases. Comparison of the modeling results to known human health and ecological toxicity values indicates that the modeled concentrations of chemical simulants released into the air were at least one or two orders of magnitude (10 to 100 times) lower than those values. Monitoring performed during the tests in 2005 (Bossart, letter, February 9, 2006) also supports the conclusions that risks to aquatic organisms from simulant activities are negligible. The Maryland Department of the Environment determined that the modeling results supported the conclusion that the potential for aquatic toxicity was negligible during simulant tests in 2003 (Carlson, Ken, Maryland Department of the Environment, July 7, 2003).

Vegetation, Plankton, Aquatic Invertebrates, and Fish

As discussed above, the quantities of chemical simulants released into the environment and the resulting concentrations of simulants in the river would be well below levels that could cause adverse effects to aquatic organisms. Chemical simulants entering the Potomac River were found to dilute rapidly to well below detection levels, and the use of chemical simulants has not resulted in any observable environmental effects. Considering the low toxicity of the chemical simulants selected for use, the low concentrations of simulants deposited on the water surface, and the large volumes of water available to dilute the simulants, SAV, plankton, aquatic invertebrates, and fish would be exposed to very low concentrations of chemical simulants.

Under the No Action Alternative, chemical defense activities would have negligible, short-term, indirect, negative impacts and no direct impacts on SAV, plankton, aquatic invertebrates, fish, and the respective biological communities.

Essential Fish Habitat Assessment

The quantities of chemical simulants released into the environment and the resulting concentrations of simulants in the river would be well below levels that could cause adverse effects to aquatic organisms, including the prey of EFH species. Chemical simulants entering the Potomac River were found to dilute rapidly to well below detection levels, and the use of chemical simulants has not resulted in any observable environmental effects.

Chemical defense activities under the No Action Alternative may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, under the No Action Alternative, chemical defense activities would have negligible, short-term, indirect, negative impacts and no direct impacts on EFH.

4.11.1.5 PRTR Use

Under the No Action Alternative, PRTR use for RDT&E activities would remain at present levels. Most NSWCDD vessel activities take place on the MDZ. NSWCDD would restrict public access to part or all of the MDZ and occasionally to the upper LDZ approximately 750 hours per year.

The overall vessel traffic on the PRTR would decrease during activities requiring that public access be restricted, because the portion of the PRTR being used would be restricted to range control boats (approximately three) stationed along the perimeter of the range and barges or vessels associated with RDT&E activities. Even when the range is restricted, small watercraft can move up and down the river along the Maryland shoreline, just outside the PRTR boundary. Deep-draft vessels that need to stay in the main channel, which runs through the range, may be advised to slow before reaching the range or could be delayed up to an hour near the range, though in practice the delays are usually less than 30 minutes. During breaks in the activities, range operations center (ROC) personnel work with smaller watercraft to allow them to cross the

range from one side of the river to the other or through the entrance to Upper Machodoc Creek, and with deep-draft vessels so that they can proceed up and down the river channel.

Existing levels of military small-boat traffic have temporary effects to water quality. Range boat activities, as well as commercial and recreational boat activities, on the waters of the PRTR, Upper Machodoc Creek, and other waterways in the vicinity of NSF Dahlgren routinely occur without long-term adverse impacts to these surface water resources.

Vegetation

Vessel traffic, including range boats, as well as recreational and commercial vessels, potentially could incidentally strike SAV at or just below the surface, depending on the draft of the vessel. Vessel wakes and propeller wash also could scour bottom sediments in or near SAV beds, potentially resulting in the uprooting of individual SAV plants or the settlement of sediments on SAV.

SAV is generally found in shallower waters along the edges of the Potomac River and there is little SAV present in the MDZ (as shown in Figure 4.11-1), the most actively used portion of the PRTR. Most NSWCDD vessel activities currently are and will continue to occur in the vicinity of the mouth of Upper Machodoc Creek and in the deeper portions of the PRTR, especially the MDZ. Therefore, there would be limited potential for direct impacts to vegetation, or disturbance of sediments in or adjacent to SAV beds.

Under the No Action Alternative, PRTR use would have negligible, short-term, direct, negative impacts and no indirect impacts on SAV communities.

Plankton

NSWCDD boat activities, as well as commercial and recreational boat activities, on the waters of the PRTR and Upper Machodoc Creek routinely occur without long-term adverse impacts to plankton communities. PRTR use would have no direct impacts and negligible, short-term, indirect, negative impacts on plankton communities of the Potomac River due to temporary effects on water quality.

Aquatic Invertebrates

NSWCDD boat activities, as well as commercial and recreational boat activities, on the waters of the PRTR and Upper Machodoc Creek routinely occur without long-term adverse impacts to aquatic invertebrate communities. PRTR use would have no direct impacts and negligible, short-term, indirect, negative impacts on aquatic invertebrate communities of the Potomac River due to temporary effects on water quality.

Fish

Research is limited on the effects of vessel strikes on fish that occur in the PRTR. Vessel traffic, including range boats, as well as recreational and commercial vessels, potentially could incidentally strike fish swimming at or just below the surface, depending on the draft and speed of the vessel. However, the overall vessel traffic on the PRTR would decrease during activities requiring that public access be restricted. The majority of fish generally would swim out of the way of an approaching vessel; thus, impacts to fish would be negligible under the No Action

Alternative. NSWCDD boat activities, as well as commercial and recreational boat activities, on the waters of the PRTR and Upper Machodoc Creek routinely occur without long-term adverse impacts to fish communities.

PRTR use would have negligible, short-term, direct and indirect, negative impacts on fish communities.

Essential Fish Habitat Assessment

Military small boat traffic would have temporary effects on water quality – nominally contributing directly to water pollution and indirectly to turbidity – and, therefore, would adversely affect EFH and the prey of EFH species. Military as well as commercial and recreational boat activities on the waters of the PRTR, Upper Machodoc Creek, and other waterways in the vicinity of NSF Dahlgren routinely occur without long-term adverse impacts to these surface water resources. The overall vessel traffic on the PRTR would decrease during testing because of closure of the PRTR to commercial and recreational vessels; vessels present would be limited to range control boats (approximately three) and barges or vessels associated with testing. Although the military boats create small wakes that could contribute to shoreline erosion and, ultimately, increased nearshore turbidity, the wakes of NSWCDD boats would have negligible effects on shoreline erosion and turbidity. NSWCDD boat use represents a very small percentage of the daily recreational and commercial boat traffic on the waters of the PRTR.

PRTR use under the No Action Alternative may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, under the No Action Alternative, continued PRTR use by NSWCDD would have negligible, short-term, direct and indirect, negative impacts on EFH.

4.11.2 Alternative 1

4.11.2.1 Ordnance Activities

The number of large-caliber projectiles would remain at current levels, although the frequency of firing into the upper LDZ would increase to up to 10 days per year. Small-caliber gun use would increase from an average of 6,000 bullets fired a year under the No Action Alternative to 25,500 bullets fired a year. Approximately 2,550 bullets would be fired from land into the river. Detonations would increase from 190 events to 200 events under Alternative 1, as described in Section 2.5.1.

Vegetation

Approximately 2,550 bullets a year would enter the river within about 1,000 ft of shore, where there is no SAV present (Figure 4.11-1). Even if ordnance lands in or near SAV, the impacts would be negligible for the reasons described in Section 4.11.1.1 for the No Action Alternative.

Most detonations would take place on the land ranges of the EEA Complex and only occasionally would devices be detonated on vessels in the river. NSWCDD removes fired military munitions, as well as any remaining scrap and debris exposed on the ground or partially buried. Residues from the land-based firing of munitions and detonation of explosives that remain on land after operational range surface clearance could enter surface waters indirectly via surface water or soil runoff and shallow groundwater discharge. Although small concentrations of residues could migrate into surface waters, they would be expected to occur at concentrations that are virtually undetectable. Therefore, detonations would have negligible impacts on SAV communities.

Ordnance activities under Alternative 1 would have negligible, long-term, direct and indirect, negative impacts on SAV communities.

Plankton

The firing of large-gun projectiles would have negligible impacts on plankton communities. The area proposed to be utilized by small-arms activities is small, and most small-arms bullets fired during testing are inert. Therefore, an increase in small-arms activities would not negatively impact plankton communities in the Potomac River. Most detonations would take place on the land ranges of the EEA Complex and would negligibly impact plankton communities.

Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on plankton communities.

Aquatic Invertebrates

Continued large-caliber gun firing at existing levels would have negligible impacts on aquatic invertebrate communities. Small-arms firing would take place near shore with most of the empty cartridges entering the Potomac River in the MDZ. Most small-arms bullets would be inert and only approximately 2,550 bullets potentially would enter the river; therefore, impacts from small-arms bullets on the Potomac River aquatic invertebrate community would be negligible.

As discussed for SAV, aquatic invertebrates would not be directly exposed to detonations. Any residues that migrate into surface waters are expected to occur at concentrations that are virtually undetectable. Under this alternative, impacts from detonations to aquatic invertebrate communities would be negligible.

Ordnance activities under Alternative 1 would have negligible, long-term, direct and indirect, negative impacts on aquatic invertebrate communities.

Fish

Under Alternative 1, impacts to fish from the firing of large-gun projectiles would be the same as the impacts resulting from the No Action Alternative, described above. Although a greater number of small-caliber bullets would enter the PRTR, the probability of a direct hit would be low and impacts to fish would be negligible. Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on fish communities.

Essential Fish Habitat Assessment

Due to the low numbers of small-arms bullets that would enter the PRTR and because most bullets would be inert, negligible impacts would result from small-arms firing. Under Alternative 1, impacts to EFH and the prey of EFH species from the firing of large-gun projectiles would be identical to the impacts resulting from the No Action Alternative, described above. As most detonations would occur on land, impacts to EFH and the prey of EFH species would be negligible.

Ordnance activities under Alternative 1 may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, ordnance activities would have negligible, long-term, direct and indirect, negative impacts on EFH.

4.11.2.2 EM Energy Activities

Under Alternative 1, the number of EM energy events would increase from 490 to 590 per year, the power of the EM energy events would increase, and activities would increase as described in Section 2.5.2.

Vegetation, Plankton, Aquatic Invertebrates, and Fish

Despite expanded activities and an increase in annual events under Alternative 1, there would be negligible impacts to SAV, plankton, aquatic invertebrates, and fish from radar's or directed EM energy's striking the surface of the water. The increase in EM energy activities might slightly increase the probability of EM energy incidentally interacting with surface waters. However, EM energy that hits the surface of the water may be reflected off the surface of the water. Any incidental EM energy that breaches the water surface would likely be absorbed immediately and would rapidly dissipate.

EM energy activities would have negligible, short-term, direct, negative impacts and no indirect impacts on SAV, plankton, and aquatic invertebrate communities.

In the rare event that EM energy does interact with the water surface, the likelihood of its striking a fish would be extremely low. Laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on fish communities.

Essential Fish Habitat Assessment

The potential for EM energy to incidentally interact with surface waters is negligible, and there would be no impacts on EFH waters or substrate under Alternative 1. In the extremely rare event that EM energy does interact with the water surface, there is the potential for prey species swimming at or near the surface to be adversely affected. However, the loss of the few prey fish that may be affected would not impact the ability of EFH species to find sufficient prey to meet their energy requirements.

EM energy activities under Alternative 1 may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, EM energy activities would have negligible, short-term, direct, negative impacts and no indirect impacts on EFH.

4.11.2.3 Laser Activities

Under Alternative 1, the number of HE laser events would increase from the current 60 annually to 125 annually, power would increase, and activities would be expanded as described in Section 2.5.3.

Vegetation, Plankton, and Aquatic Invertebrates

Laser activities would be tightly controlled and the likelihood of lasers straying from the target and hitting the water surface would be very small. Interaction with the water surface, and possibly vegetation, plankton, aquatic invertebrates, or fish, would be incidental. Were a laser to strike the surface of the water, the EM energy might be reflected at the air-water boundary or, if it breaches the water surface, the energy would be propagated and attenuated, rapidly decreasing in amount and intensity as it travels through the water.

Laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on SAV, plankton, and aquatic invertebrate communities.

Fish

In the rare event that a laser beam does interact with the water surface, the likelihood of a laser beam's striking a fish would be extremely low. The severity of potential effects would be greater were a laser to strike a fish at the surface of the water. However, if a fish were struck by a laser beam below the water surface, the severity of the potential effects would decrease. Although adverse effects may occur if a laser beam comes into contact with a fish located at or near the surface, the probability of this occurring is extremely low.

Laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on fish communities.

Essential Fish Habitat Assessment

Under Alternative 1, if laser activities were conducted in the LDZ (where there is EFH for seven species), lasers would not be directed at targets on the LDZ but rather to the other ranges. Laser activities would be conducted predominantly in the MDZ, where EFH is limited to two species. The potential for a laser to incidentally interact with surface waters is negligible, and there would be no impacts on EFH waters or substrate under Alternative 1. In the extremely rare event that a laser beam does interact with the water surface, there is the potential for prey species swimming at or near the surface to be adversely affected. However, the loss of the few prey fish that may be affected would not impact the ability of EFH species to find sufficient prey to meet their energy requirements.

Laser activities under Alternative 1 may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on EFH.

4.11.2.4 Chemical and Biological Defense Activities

Under Alternative 1, activities using chem/bio simulants outdoors would increase from the current baseline of 12 events annually using chemical simulants to 60 events annually using chemical and biological simulants separately, as described in Section 2.5.4. The areas in which the activities would take place would expand to include all the land ranges, the Mission Area, and the MDZ.

As discussed for the No Action Alternative, all modeled chemical simulant exposure concentrations are below the lowest aquatic toxicity value found, indicating that chemical simulant activities would have no adverse effects on aquatic life. In addition, chemical simulants entering the Potomac River would dilute rapidly to well below detection levels, and past use of chemical simulants has not resulted in any observable environmental effects.

No modeling was performed for biological simulants, as NSWCDD would use only BSL-1 simulants. Many of these simulants are ubiquitous and are often found in high concentrations in nature, including in water (CRI, 2004; USEPA, 1997). The increase in these organisms from simulant testing is miniscule in relation to levels naturally present in the environment. There are no published reports of disease associated with the proposed biological simulants in aquatic plants or animals, nor are they considered to be disease-causing agents. The small concentrations of these simulants deposited on the water would not cause any significant increases in their localized populations, and no adverse effects are anticipated.

Vegetation, Plankton, Aquatic Invertebrates, and Fish

The increase in the number of events under Alternative 1 would not affect chemical-simulant exposure concentrations. Based on the aquatic toxicity evaluation, the quantities of chemical simulants released into the environment and the resulting concentrations of simulants in the river would be well below levels that could cause adverse effects. All modeled exposure concentrations are below the lowest aquatic toxicity value found. Considering the low toxicity of the chemical simulants selected for use and the large volumes of water available to dilute the simulants, SAV, plankton, aquatic invertebrates, and fish would be exposed to very low concentrations of chemical simulants.

No adverse effects are anticipated from a temporary increase in levels of BSL-1 biological simulants.

Chem/bio defense activities under Alternative 1 would have no direct impacts and negligible, short-term, indirect, negative impacts on SAV, plankton, aquatic invertebrates, fish, and the respective biological communities.

Essential Fish Habitat Assessment

The increase in the number of events under Alternative 1 would not affect chemical-simulant exposure concentrations. Based on the aquatic toxicity evaluation, the quantities of chemical simulants released into the environment and the resulting concentrations of simulants in the river would be well below levels that could cause adverse effects to aquatic organisms, including the prey of EFH species. All modeled exposure concentrations are below the lowest aquatic toxicity value found.

No adverse effects are anticipated from a temporary increase in levels of BSL-1 biological simulants.

Chem/bio defense activities under Alternative 1 may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, chem/bio defense activities would have no direct impacts and negligible, short-term, indirect, negative impacts on EFH.

4.11.2.5 PRTR Use

Under Alternative 1, NSWCDD would restrict public access to some part of the PRTR danger zones – usually some or all of the MDZ – for approximately 870 hours per year, as described in Section 2.5.5.

Vegetation

SAV is generally found in shallower waters along the edges of the Potomac River, and there is little SAV present in the MDZ. However, most NSWCDD vessel activities take place in deeper waters, mainly in the MDZ. Under Alternative 1, there would be limited potential for direct impacts to vegetation, or disturbance of sediments in or adjacent to SAV beds. PRTR use would have negligible, short-term, direct, negative impacts no indirect impacts on SAV communities.

Plankton and Aquatic Invertebrates

Although future levels of NSWCDD small-boat traffic would have temporary effects on plankton and aquatic invertebrates, military, commercial, and recreational boat activities on the waters of the PRTR and Upper Machodoc Creek routinely occur without long-term adverse impacts. PRTR use would have no direct impacts and negligible, short-term, indirect, negative impacts on plankton and aquatic invertebrate communities.

Fish

Vessel traffic, including range boats, as well as recreational and commercial vessels, potentially could incidentally strike fish swimming at or just below the surface, depending on the draft and speed of the vessel. The majority of fish generally would swim out of the way of an approaching vessel; thus, impacts to fish would be negligible under Alternative 1, despite increased levels of range-vessel activities. NSWCDD boat activities, as well as commercial and recreational boat

activities, on the waters of the PRTR and Upper Machodoc Creek routinely occur without long-term adverse impacts to fish communities.

PRTR use would have negligible, short-term, direct and indirect, negative impacts on fish communities.

Essential Fish Habitat Assessment

Military small boat traffic would have temporary effects on water quality – nominally contributing directly to water pollution and indirectly to turbidity – and, therefore, would adversely affect EFH and the prey of EFH species. However, military as well as commercial and recreational boat activities on the waters of the PRTR, Upper Machodoc Creek, and other waterways in the vicinity of NSF Dahlgren routinely occur without long-term adverse impacts to these surface water resources. Although the military boats create small wakes that could contribute to shoreline erosion and, ultimately, increased nearshore turbidity, the wakes of NSWCDD boats would have negligible effects on shoreline erosion and turbidity. NSWCDD boat use represents a very small percentage of the daily recreational and commercial boat traffic on the waters of the PRTR.

PRTR use under Alternative 1 may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, under Alternative 1, PRTR use would have negligible, short-term, direct and indirect, negative impacts on EFH.

4.11.3 Alternative 2

4.11.3.1 Ordnance Activities

The number of large-caliber projectiles would remain at current levels, and use would be the same as under Alternative 1. The use of small arms would increase. The number of bullets expended annually would increase from 6,000 to 30,000, of which approximately 3,000 bullets would be fired from land into the river. Detonations would increase from 190 events to 230 events, as described in Section 2.6.

Vegetation

Small-arms firings at increased levels would have negligible impacts on SAV communities, as discussed for Alternative 1. As most detonations would take place on the land ranges of the EEA Complex, detonations would not affect SAV communities. Under Alternative 2, ordnance activities would have negligible, long-term, direct and indirect, negative impacts on SAV communities.

Plankton

The firing of large-gun projectiles would have negligible impacts on plankton communities in the Potomac River. The in-river area that would be used for small-arms activities is small in comparison to the Potomac River, and most small-arms bullets fired during testing are inert. Therefore, an increase in small-arms activities would produce negligible impacts to plankton in the Potomac River. Most detonations would take place on the EEA Complex's land ranges and would have negligible impact on plankton.

Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on plankton communities.

Aquatic Invertebrates

Impacts to aquatic invertebrate communities from large-caliber guns and projectiles would have negligible impacts. The increase in small-arms firing would take place in the MDZ, within 1,000 yds of the shoreline. Only 10 percent of small-arms bullets would potentially enter the river, most small-arms bullets fired during testing would be inert, and the area occupied by small-arms bullets entering the river would be small in comparison to the entire Potomac. Therefore, negligible impacts to aquatic invertebrate communities would result from an increase in small-arms activities. Most detonations would take place on the EEA Complex's land ranges and would have negligible impact on aquatic invertebrates.

Ordnance activities under Alternative 2 would have negligible, long-term, direct and indirect, negative impacts on aquatic invertebrate communities.

Fish

Under Alternative 2, impacts to fish from the firing of large-gun projectiles would be the same as the impacts resulting from the No Action Alternative, described in Section 4.11.1.1. Although a greater number of small-caliber bullets would be fired into the PRTR, the probability of a direct hit is low, and impacts to fish would be negligible. Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on fish communities.

Essential Fish Habitat Assessment

Under Alternative 2, impacts to EFH and the prey of EFH species from the firing of large-gun projectiles would be similar to the impacts resulting from the No Action Alternative, described in Section 4.11.1.1. Due to the low numbers of small-arms bullets that would enter the PRTR and because most bullets would be inert, negligible impacts would result from small-arms firing. As most detonations would occur on land, impacts to EFH and the prey of EFH species would be negligible.

Ordnance activities under Alternative 2 may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. Consistent with Navy policy (US Navy, 2011), the Navy initiated consultation

with NMFS in accordance with the MSA. In accordance with NEPA, ordnance activities would have negligible, long-term, direct and indirect, negative impacts on EFH.

4.11.3.2 EM Energy Activities

Under Alternative 2, the number of EM events would increase from 490 to 680 per year and activities would expand, as described in Section 2.6.

Vegetation, Plankton, Aquatic Invertebrates, and Fish

Despite expanded activities and an increase in annual events under Alternative 2, there would be negligible impacts to SAV, plankton, aquatic invertebrates, and fish from radar's or directed EM energy's striking the surface of the water. The increase in EM energy activities might slightly increase the probability of EM energy's incidentally interacting with surface waters. However, EM energy that hits the surface of the water might be reflected off the surface of the water. Any incidental EM energy that breaches the water surface would be absorbed immediately and would rapidly dissipate.

EM energy activities under Alternative 2 would have no indirect impacts and negligible, short-term, direct, negative impacts on SAV, plankton, aquatic invertebrate, and fish communities.

Essential Fish Habitat Assessment

Despite expanded activities and an increase in annual events under Alternative 2, the potential for EM energy to incidentally interact with surface waters is negligible, and there would be no impacts on EFH waters or substrate. In the extremely rare event that EM energy does interact with the water surface, there is the potential for prey species swimming at or near the surface to be adversely affected. However, the loss of the few prey fish that may be affected would not impact the ability of EFH species to find sufficient prey to meet their energy requirements.

EM energy activities under Alternative 2 may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, EM energy activities would have no indirect impacts and negligible, short-term, direct, negative impacts on EFH.

4.11.3.3 Laser Activities

Under Alternative 2, the number of HE laser events would increase from 60 to 145 events per year, and activities would expand, as described in Section 2.6.

Vegetation, Plankton, Aquatic Invertebrates, and Fish

The likelihood of lasers straying from the target and hitting the water surface would be very small. Interaction with the water surface, and possibly vegetation, plankton, aquatic invertebrates, or fish, would be incidental. Were a laser to strike the surface of the water, the EM energy might be reflected at the air-water boundary or, if it breaches the water surface, the

energy would be propagated and attenuated, rapidly decreasing in amount and intensity as it travels through the water. Therefore, any impacts to SAV, plankton, aquatic invertebrates, or fish would be incidental and negligible, and HE laser activities would not result in any long-term impact to the respective aquatic communities of the Potomac River.

Laser activities under Alternative 2 would have no indirect impacts and negligible, short-term, direct, negative impacts on SAV, plankton, aquatic invertebrate, and fish communities.

Essential Fish Habitat Assessment

Under Alternative 2, if laser activities were conducted in the LDZ (where there is EFH for seven species), lasers would not be directed at targets on the LDZ but rather to the other ranges. Laser activities would be conducted predominantly in the MDZ, where EFH is limited to two species. The potential for a laser to incidentally interact with surface waters is negligible, and there would be no impacts on EFH waters or substrate under Alternative 1. In the extremely rare event that a laser beam does interact with the water surface, there is the potential for prey species swimming at or near the surface to be adversely affected. However, the loss of the few prey fish that may be affected would not impact the ability of EFH species to find sufficient prey to meet their energy requirements.

Laser activities under Alternative 2 may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, laser activities would have no indirect impacts and negligible, short-term, direct, negative impacts on EFH.

4.11.3.4 Chemical and Biological Defense Activities

Under Alternative 2, the number of events using chem/bio simulants would increase from the current baseline of 12 events annually using chemical simulants to 70 events annually potentially using chemical and biological simulants together, as described in Section 2.6. The chemical and biological simulants used would be the same ones approved for use in the individual chemical and biological operational tests under Alternative 1.

Vegetation, Plankton, Aquatic Invertebrates, and Fish

The increase in the number of events under Alternative 2 would not affect chemical simulant exposure concentrations. As described in Section 4.11.1.4, the quantities of chemical simulants released into the environment and the resulting concentrations of simulants in the river would be well below levels that could cause adverse effects. Considering the low toxicity of the chemical simulants selected for use and the large volumes of water available to dilute the simulants, SAV, plankton, aquatic invertebrates, and fish would be exposed to very low concentrations of chemical simulants. No adverse effects would be anticipated from a temporary increase in levels of BSL-1 biological simulants.

Chem/bio defense activities under Alternative 2 would have no direct impacts and negligible, short-term, indirect, negative impacts on SAV, plankton, aquatic invertebrates, fish, and their respective biological communities.

Essential Fish Habitat Assessment

The increase in the number of events under Alternative 2 would not affect chemical simulant exposure concentrations. The quantities of chemical simulants released into the environment and the resulting concentrations of simulants in the river would be well below levels that could cause adverse effects to aquatic organisms, including the prey of EFH species. All modeled exposure concentrations are below the lowest aquatic toxicity value found.

No adverse effects are anticipated from a temporary increase in levels of BSL-1 biological simulants.

Chem/bio defense activities under Alternative 2 may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, chem/bio defense activities would have no direct impacts and negligible, short-term, indirect, negative impacts on EFH.

4.11.3.5 PRTR Use

Under Alternative 2, NSWCDD would restrict public access to the PRTR danger zones, usually the MDZ, for approximately 1,000 hours per year, as described in Section 2.6.

Vegetation

SAV is generally found in shallower waters along the edges of the Potomac River, and there is little SAV present in the MDZ. However, most NSWCDD vessel activities take place in deeper waters, mainly in the MDZ. There would be limited potential for direct impacts to vegetation, or disturbance of sediments in or adjacent to SAV beds. Under Alternative 2, PRTR use would have negligible, short-term, direct, negative impacts and no indirect impacts on SAV communities.

Plankton and Aquatic Invertebrates

Although future levels of NSWCDD small-boat traffic would have temporary effects on plankton and aquatic invertebrates, military, as well as commercial and recreational, boat activities on the waters of the PRTR and Upper Machodoc Creek routinely occur without long-term adverse impacts. PRTR use under Alternative 2 would have no direct impacts and negligible, short-term, indirect, negative impacts on plankton and aquatic invertebrate communities.

Fish

Vessel traffic, including range boats, as well as recreational and commercial vessels, potentially could incidentally strike fish swimming at or just below the surface, depending on the draft and speed of the vessel. The majority of fish generally would swim out of the way of an approaching vessel; thus, impacts to fish would be negligible under Alternative 2, despite increased levels of range-vessel activities. NSWCDD boat activities, as well as commercial and recreational boat activities, on the waters of the PRTR and Upper Machodoc Creek routinely occur without long-term adverse impacts to fish communities.

PRTR use would have negligible, short-term, direct and indirect, negative impacts on fish communities.

Essential Fish Habitat Assessment

Military small boat traffic would have temporary effects on water quality – nominally contributing directly to water pollution and indirectly to turbidity – and, therefore, would adversely affect EFH and the prey of EFH species. However, military as well as commercial and recreational boat activities on the waters of the PRTR, Upper Machodoc Creek, and other waterways in the vicinity of NSF Dahlgren routinely occur without long-term adverse impacts to these surface water resources. Although the military boats create small wakes that could contribute to shoreline erosion and, ultimately, increased nearshore turbidity, the wakes of NSWCDD boats would have negligible effects on shoreline erosion and turbidity. NSWCDD boat use represents a very small percentage of the daily recreational and commercial boat traffic on the waters of the PRTR.

PRTR use under Alternative 2 may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The Navy consulted with NMFS in accordance with the MSA. In a letter dated June 7, 2013 (Appendix G, page G-105), NMFS concurred with the Navy's determination that the proposed expansion of RDT&E activities at NSF Dahlgren would not substantially adversely affect EFH or HAPC and had no EFH conservation recommendations. In accordance with NEPA, under Alternative 2, PRTR use would have negligible, short-term, direct and indirect, negative impacts on EFH.

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4.12 Potomac River Birds

4.12.1 No Action Alternative

4.12.1.1 Ordnance Activities

As described previously, almost all recorded large-caliber projectiles fired at NSF Dahlgren since 1918 have been fired into the MDZ, with a limited number of projectiles entering the upper end of the LDZ (up to 40,000 yds from the firing line). Within the MDZ, the primary target area is the dense zone (see Figure 3.7-1). The majority of large-caliber projectiles fired is inert. Most of the live ordnance tested currently is and will continue to be equipped with fuzes that would explode well above the water surface.

Of the approximately 6,000 bullets that would be fired each year, about 10 percent would be from land into the river, with the bullets entering the river mainly within 1,000 yds of the shoreline. Approximately 190 detonations would take place each year. Most detonations would take place inland; occasionally, devices would be detonated on vessels in the river.

Small-caliber bullets are not considered here, as they have a limited range on the Potomac River. Birds are not targeted during ordnance activities and the number of birds in the vicinity of the gunnery range during firing is low due to the noise associated with firing. Most detonations take place on the land ranges of the EEA Complex, with rare detonations on the Missile Test Range and on vessels in the river, which would not result in negative impacts to birds on the river.

Ordnance activities have the potential to affect birds, particularly waterfowl that rest on the water's surface and spend much of their time on or near the river. Many waterfowl make extensive use of the bays and creeks off the main stem of the Potomac River. As described in Section 3.12, the Potomac River is an important resource for birds: it forms parts of a corridor that is used by migratory birds traveling between summer breeding grounds and winter feeding grounds, waterfowl concentration areas are found along the river, it is used as a nesting and migration area for the bald eagle, and it hosts large great blue heron breeding colonies (see Figures 3.12-1 and 3.12-2). Bald eagle and heron nests are located on land in the vicinity of the Potomac River shoreline or tributaries, with no physical presence in the PRTR, as shown in Figure 4.12-1 (Bald Eagle and Great Blue Heron Areas in Relation to the PRTR).

Fired bullets and projectiles have the potential to directly affect birds by injuring them or killing them. However, the often patchy distribution of birds and the low probability that birds would occur at the exact target location at the time a projectile would detonate diminishes the likelihood of direct impacts. Even during late autumn to spring, when ducks, geese, swans, and other waterfowl flock on the river, they are more likely to be found in the bays and creeks than the main stem of the river, with the exception of diving ducks. Although individuals could be hit by projectiles, the total number of birds affected would be too small to cause population-level impacts.

NSWCDD's range operations center (ROC) restricts the range before events begin and deploys range control boats to clear the range of watercraft and waterfowl on the water surface. If waterfowl are resting on the water surface in the target or operations area, they are scared away. However, there is no way to ensure that birds do not enter the airspace during tests or to keep the river surface clear of birds during tests.

While the Migratory Bird Treaty Act prohibits the taking, killing, or possessing of migratory birds unless permitted by regulation, an exemption to the rule that allows for incidental "takes" (wounding or killing) of migratory birds by DoD during military readiness activities was finalized in February 2007 (72 FR 8931). As directed by Section 315 of the 2003 National Defense Authorization Act, this rule authorizes such takes that result from military readiness activities, with limitations. Ordnance activities discussed in this report are considered military readiness activities. There are no reasonably foreseeable takes of migratory birds under the No Action Alternative. Therefore, consultation under the MBTA is not required.

Indirect impacts from ordnance fired into the PRTR, in particular water and sediment quality impacts, are detailed in Appendix F, Derivation of Concentrations of Munitions Constituents in PRTR Sediment and Water. A screening-level ecological risk assessment was performed to determine if concentrations of metals and explosives in water and sediments from ordnance fired into the PRTR are present at concentrations that could cause adverse effects on avian and mammalian wildlife. One representative receptor modeled was the great blue heron. The great blue heron would have higher exposure to MCOPCs in the PRTR than birds feeding on plants, invertebrates, or seeds because it feeds on fish which are exposed to MCOPCs in sediments and water.

To assess potential risks to wildlife, the modeled exposure rate of each constituent was divided by the no-observed-adverse-effect-level (NOAEL[1]) toxicity value to derive a value known as the hazard quotient (HQ). If an HQ is greater than 1 (i.e., the exposure dose is greater than the NOAEL), the concentration of the constituent that a receptor is exposed to is above the level at which no adverse effects are expected. Conversely, if an HQ is less than 1, the concentration of the constituent that a receptor is exposed to is below the level at which no adverse effects are expected and therefore no adverse effects are expected from exposure.

HQs were calculated for the dense zone and the diffuse zone. If HQs for both zones are all well below the target of 1 – indicating that there are no risks to ecological receptors from MCOPCs – then it can be concluded that the areas outside these zones, with lower munitions-related constituent concentrations, are also below levels of concern. As shown in Table 4.12-1, the HQs of all modeled constituents for the great blue heron are orders of magnitude below 1 – hundreds of thousands of times below 1 – indicating that none of the constituents entering into the Potomac River by munitions activities are released at concentrations high enough to cause adverse effects in the great blue heron, which was selected to represent Potomac River birds.

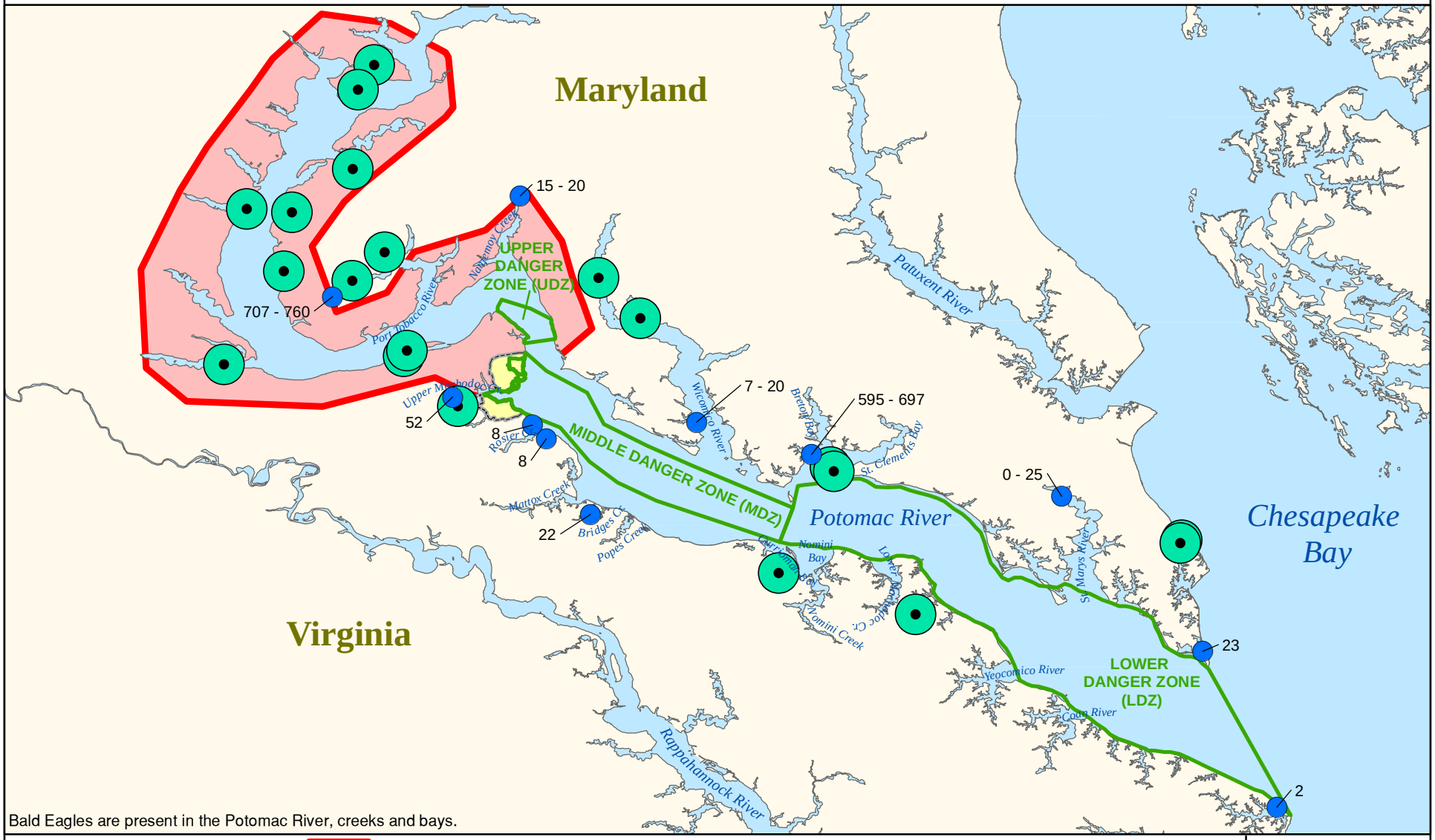
Based on these analyses, ordnance activities would have negligible, long-term, direct and indirect, negative impacts on Potomac River birds.

4.12.1.2 EM Energy Activities

Under the No Action Alternative, the three main outdoor facilities used for E3 and HERO activities – NOTES, MOATS, and two ground planes – are located on land, away from the PRTR. Radars are tested at the STSTS on Main Range and would continue to operate over the PRTR.

[1] The NOAEL is the highest exposure level at which there are no biologically significant increases in the frequency or severity of adverse effect between the exposed population and its appropriate control. Some effects may be produced at this level, but they are not considered adverse or precursors of adverse effects.

Bald Eagle and Great Blue Heron Areas in Relation to the PRTR



22 Number of Heron Nests / Pairs

Heron Nests / Pairs

Bald Eagle Communal Roosts

Bald Eagle Concentration Areas

Naval Support Facility (NSF) Dahlgren

Potomac River Test Range (PRTR) Complex

7 0 7 Miles

11 0 11 Kilometers

N

NSWCDD EIS

NAVSEA WARFARE CENTERS DAHLGREN

Source for Heron Data: National Ocean Service Environmental Sensitivity Index Maps VA-(116,115,111 & 95) , 2005; MD-(54, 52, 44, 43, 29 & 21), 2007.
Source for Bald Eagle Data: Center for Conservatin Biology, 2008.

Figure 4.12-1

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Table 4.12-1
Screening Hazard Quotients for the Great Blue Heron

Constituent	Fish Concentration [1] (mg/kg dw)	Sediment Concentration (mg/kg dw)	Water Concentration (mg/l)	Estimated Environmental Dose (mg/kg-day)	NOAEL (mg/kg-day)	Hazard Quotient
Dense Zone						
Metals						
Cadmium	0.0000011	0.015	5.0×10^{-9}	0.0000064	1.45	0.0000044
Chromium	0.000000040	0.0056	8.5×10^{-9}	0.0000025	1.0	0.0000025
Copper	0.0000010	6.5	5.9×10^{-9}	0.0000029	47	0.000061
Lead	1.3×10^{-13}	0.12	5.8×10^{-12}	0.00005.2	1.13	0.000046
Manganese	0.00016	2.3	0.0000010	0.0010	977	0.0000011
Nickel	0.00000043	0.079	0.000000022	0.000035	77.4	0.00000045
Zinc	0.000024	1.1	0.000000046	0.00050	14.5	0.000035
Explosives						
Ammonium picrate	0.0000021	0.00000054	0.000052	0.0000030	NA	NA
HMX	1.2×10^{-9}	6.1×10^{-9}	4.5×10^{-9}	3.1×10^{-10}	50	6.1×10^{-12}
RDX	0.000026	0.000014	0.000034	0.0000031	8.0	0.00000038
Tetryl	0.0000032	0.00060	0.00000057	0.00000045	13	0.000000034
TNT	0.000063	0.0030	0.0000033	0.0000043	0.5	0.0000085
Diffuse Zone						
Metals						
Cadmium	0.00000016	0.0021	6.9×10^{-10}	0.00000095	1.45	0.00000065
Chromium	9.2×10^{-9}	0.0013	1.9×10^{-9}	0.00000058	1	0.00000058
Copper	0.00000027	1.7	1.5×10^{-9}	0.00077	47	0.000016
Lead	2.7×10^{-14}	0.026	1.2×10^{-12}	0.000012	1.13	0.000010
Manganese	0.000054	0.80	0.00000034	0.00036	977	0.00000037
Nickel	0.00000043	0.082	0.000000022	0.000037	77.4	0.00000047
Zinc	0.0000038	0.19	7.3×10^{-9}	0.000087	14.5	0.0000060
Explosives						
Ammonium picrate	0.00000011	0.000000041	0.0000027	0.00000016	NA	NA
HMX	7.2×10^{-10}	5.1×10^{-9}	2.6×10^{-9}	1.8×10^{-10}	50	3.6×10^{-12}
RDX	0.00000044	0.00000034	0.00000057	0.000000052	8.0	6.5×10^{-9}
Tetryl	0.000000091	0.000025	0.000000016	0.000000016	13	1.3×10^{-9}
TNT	0.000012	0.00081	0.00000064	0.00000094	0.5	0.0000019

Notes: mg/kg = milligrams per kilogram (parts per million); dw = dry weight; mg/l = milligrams per liter (parts per million).

NA = No criteria available.

[1] Fish were assumed to be 75 percent water for conversion from wet to dry weight.

Scientific notation is used for very small numbers; for example 1.0×10^{-9} is one billionth (0.000000001).

Hazard quotients above 1 indicate the potential for adverse effects.

All hazard quotients shown here are orders of magnitude below 1 (each order of magnitude is equal to ten times).

NSWCDD operates NDEC and CETFAC to transmit directed energy (microwaves, RF, and lasers) outdoors across the waters of the Potomac River within the PRTR, near the mouth of Upper Machodoc Creek (see Figure 1-7). For directed-energy activities over the water, beams of directed energy are transmitted above the water and are not directed at the water surface. Activities are tightly controlled and the likelihood of directed energy's straying from the target and unintentionally hitting the surface of the water is small.

Most current EM energy activities occur away from the PRTR, reducing the likelihood of Potomac River birds' coming in contact with EM energy. However, during operation of the EM energy sources, birds entering safety zones around EM energy emitters could be exposed to high electric or magnetic field levels. However, impacts to birds during operation of EM energy emitters would be negligible for two reasons. First, range areas used for EM energy activities are checked for the presence of birds before testing begins; and if they are present, they are either scared away or tests are paused until they leave. Second, even if birds are present in the area, the high electric or magnetic field levels experienced within test areas quickly dissipate and return to background levels outside the test areas. For example, background levels are reached within 80 ft of firing EM launchers at the EMLF (NSWCDL, 2009a). The magnetic field levels outside of the EM launcher's 80-ft buffer zone would be below the most stringent guidelines for humans (i.e., people with pacemakers), which are also considered protective of birds and other wildlife.

Birds flying above EM energy test facilities are unlikely to be exposed to high electric or magnetic fields, as exposure levels rapidly dissipate with distance. For example, for current EM launcher activities, magnetic field exposure levels dissipate to 5 Gauss (G) – well below exposure limits for the general population – within 30 ft from the launcher (NSWCDL, 2009a). In addition, the duration of the EM energy emission is usually brief – varying from less than a second to several minutes. The short duration of each test also means that the likelihood of affecting any animal using magnetic fields for orientation is extremely small.

The EM energy facilities are located outside the buffer zones of bald eagle nests (Figure 3.12-3) and do not offer any specialized habitats for bald eagles, either for nesting or foraging. Therefore, the likelihood of a bald eagle's entering the buffer areas around existing EM energy facilities during operation is extremely small.

EM energy activities would have negligible, short-term, direct, negative impacts and no indirect impacts on Potomac River birds.

4.12.1.3 Laser Activities

Three of NSWCDD's five HE laser corridors cross the waters of Upper Machodoc Creek and the Potomac River through the PRTR (Figure 1-9). Under the No Action Alternative activities, both the laser emitter and the target/backstop would be fixed, and the laser would emit almost horizontally. The laser would be pre-aimed and would not be able to move, except for minute corrections to the aim point. Under the current maximum power (100 kW), for over-water activities, the laser beam would begin at least 12 ft above mean water level and terminate at least 9 ft above mean water level. The eye-hazard area around the laser beam would be about 6 ft in diameter and at least 6 ft above mean water level (see Figure 1-10).

HE laser activities require a high level of preparation and safety precautions prior to firing. NSWCDD has written safety programs and procedures for the protection of scientists and the

public and to minimize potential impacts to wildlife. The impact to birds from HE laser activities would be negligible to minor because of the safety procedures implemented prior to and during events. Lasers would emit beams well above the water and ground surface, and the outdoor activities would be of short duration and intermittent. Before an event begins, NSWCDD personnel would clear the test areas of people and visible wildlife, and the event would be stopped if people or wildlife approach the laser corridor during the event.

Under the No Action Alternative, for over-water activities the laser beam would begin at least 12 ft above mean water level and terminate at least 9 ft above mean water level. Therefore, the lasers would not impact birds on the ground, in shallow water, or flying at very low levels.

The probability of adversely affecting a bird that may fly into or along the laser beam during an event would be very low due to the short duration of the laser emissions and the small area that would be used for testing. Comparison of the volume of a laser eye-hazard area to the size of a square mile of the MDZ illustrates the low probability of a bird's flying into the laser beam during an event and being adversely impacted. The eye-hazard area of a 100-kW laser transmission – the most powerful transmission under the No Action Alternative – would have a calculated diameter of 6 ft and, transmitted over a distance of one mile, a volume of approximately 149,300 cubic feet. By comparison, a one-mile-square area on the MDZ extending from the water surface to a height of 100 ft would have a volume of 2.788 billion cubic feet. A 100-ft height was used in the calculation based on the finding that 60 percent of bird strikes to civil aircraft between 1990 and 2007 occurred at 100 ft above ground level or lower (Federal Aviation Administration and Animal and Plant Health Inspection Service, 2008). This statistic suggests both an abundance of birds at this height and a potential inability of the birds to avoid hazards within this stratum. Based on the preceding assumptions, the volume of the laser eye-hazard area would be approximately 0.005 percent of the volume of the test area. The odds of a bird's flying into the beam during emission would be very low, particularly as most birds spend the majority of their time in activities other than flying – e.g., resting or feeding.

During each laser test, a visual observer trained by the NSF Dahlgren's natural resources manager would watch for eagles, ospreys, waterfowl, other birds, and wildlife that may wander into the laser corridor. The observer would radio the Computer Control Center (C3) van to immediately halt the test if any wildlife is observed. In addition, there would be cameras trained on the laser corridor, with video feed monitored by test personnel in the C3 van. In the event that wildlife moves into the laser corridor, the person doing video surveillance could press a button to immediately stop the test. Small animals close to the ground that may not be seen (e.g., mice, shrews, or rabbits) would be 2 to 3 ft below the 6-ft-diameter eye-hazard zone for the maximum power 100 kW laser and would not have contact with the laser beam (NSWCDL, 2009b). The laser corridor is defined to be wide enough to allow sufficient response time to shut down the laser system. The range would also be visually surveyed for dead animals prior to the commencement of any tests and any dead animals would be removed to limit the chances of scavenger wildlife's entering the test corridor.

Similar procedures would be carried out for the over-water laser corridors. Range control boats would traverse the laser path over the water, and shore personnel would survey the path over land, to look for and remove any dead animals prior to performing any tests to avoid scavengers' entering the test area. Other controls include a video surveillance system and visual observers to watch the corridor to detect wildlife or unauthorized personal watercraft that may enter the area.

Water or shore birds nearby would not be exposed to hazardous backscatter from the target or target shelter because the target shelter would be placed 100 ft from the Potomac River shoreline. Range clearance activities would be brief and similar to normal vessel and range activities. Risks to birds would be no greater than that posed by routine gun activities on the PRTR and would occur at a lower frequency. The use of lasers does not provide a long-term, consistent source of light. Therefore, it is unlikely to attract or disorient birds, as may occur with a fixed light source. In addition, pulsed light does not attract large numbers of insects, which could attract feeding bats and birds.

In the event of a strike, injury to animal tissue from laser exposure is likely to be thermal. Because of the eye's capacity to focus incident light, it is the organ that is most sensitive to laser exposure. Risk of ocular injury is greatest when laser light is focused on the sensory retina (Bennett, 1983). The eye of a bird differs from the human eye, as it is more capable of filtering damaging radiation. It contains a structure called the pecten, which is a pigmented, highly vascularized body near the attachment of the optic nerve that supplies the inner layers of the retina with oxygen (Brach, 1977). Birds' eyes are also coated with a film or oils, depending on species, to protect them from the UV rays of the sun, which some species use to orient themselves (Lustick, 1972).

The highest bird densities are likely to be seen during periods of migration in the spring and fall. However, the probability of striking migratory birds would be very low. Most fly at high altitudes when migrating, and many birds migrate at night to minimize predation, avoid overheating, and allow feeding during the day (Lincoln, 1979). While some laser activities would take place at night, most would take place from dawn to dusk. Nocturnal migrants include the majority of land birds and some waterfowl and shorebirds. Some migrating birds might stop to feed or rest on the waters of Upper Machodoc Creek or the Potomac River near the laser corridors, but the test procedures described above would minimize the likelihood of their being struck by a laser. These safety measures would minimize the risk of a bird's or bat's randomly flying across the laser beam, thereby minimizing potential impacts. Because of the efforts that would be made to clear the area where tests are occurring, and to keep it free of large wildlife, as well as the very brief periods the laser would actually be operating, the likelihood of the beam's hitting an animal would be negligible.

It is possible, although unlikely, that a migratory bird could be struck by the laser and injured. As described previously, the USFWS finalized regulations on February 28, 2007 broadly authorizing incidental takings of migratory birds during military readiness activities (72 FR 8931). The laser activities are considered military readiness activities.

Clearing the corridor prior to the onset of tests may temporarily disturb waterfowl and other water birds, possibly during feeding, resting, and mating periods. The disruption is brief, similar to the disruptions caused by normal vessel and range activities. Test sequences are brief and represent a small fraction of ongoing range and non-range activities. The ongoing presence of waterfowl and other wildlife using the range and near-shore areas indicates that laser and other RDT&E activities under the No Action Alternative have had negligible impact on Potomac River waterfowl.

Laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on Potomac River birds.

4.12.1.4 Chemical Defense Activities

Outdoor chemical defense activities using simulants would occur under the No Action Alternative; activities using biological simulants would not occur. Chemical simulants would be released as a vapor or mist – from a boat or from shore – over the test area in the MDZ (see Figure 1-11) in a variety of weather conditions. Simulant tests are designed to minimize deposition on water and land areas.

NSWCDD conducted dispersion modeling and field tests of chemical simulants released on the PRTR to determine the potential human and ecological health risks associated with the release of chemical simulants as a vapor on the MDZ, as described in Sections 4.4.1.2 and 4.11.1.4. The modeling results predicted both the airborne and water-column concentrations that would result from the vapor releases.

As discussed previously, concentrations of chemical simulants released into the air are well below levels that could cause adverse effects in people (see Section 4.4.1.2) and below concentrations that would result in adverse effects on aquatic life (see Section 4.11.1.4). As the threshold values concentrations for people are based on animal studies, these values are also considered to be protective of birds and other wildlife. Chemical simulants are selected based on their low toxicity and similarity of physicochemical properties to chemical weapons. There is no evidence that, or reason to believe that, birds are more sensitive to these chemicals. Some of the simulants used (e.g., MeS) occur naturally in plants where birds and other wildlife may be exposed to them. Previous modeling and field tests using chemical simulants used at NWSCDL have shown exposure concentrations to be well below levels that could cause adverse impacts.

Chemical defense activities would have negligible, short-term, indirect, negative impacts and no direct impacts on Potomac River birds.

4.12.1.5 PRTR Use

Under the No Action Alternative, PRTR use for RDT&E activities would remain at present levels. Most NSWCDD vessel activities would occur in the deeper portions of the PRTR, especially the MDZ. NSWCDD would restrict public access to part of the PRTR – usually some or all of the MDZ – approximately 750 hours per year.

Existing levels of military small-boat traffic may temporarily disturb birds in the immediate vicinity of boat activities. Range boat activities, as well as commercial and recreational boat activities, on the waters of the PRTR, Upper Machodoc Creek, and other waterways in the vicinity of NSF Dahlgren routinely occur without long-term adverse impacts.

PRTR use by NSWCDD would have negligible, short-term, direct and indirect, negative impacts on Potomac River birds.

4.12.2 Alternative 1

4.12.2.1 Ordnance Activities

Under Alternative 1, the number of large-caliber projectiles would remain at current levels, although the frequency of firing into the upper LDZ would increase to up to 10 days per year. Small-caliber gun use would increase from an average of 6,000 bullets fired a year under the No Action Alternative to 25,500 bullets fired a year. Approximately 2,550 bullets (10 percent) would be fired from land into the river. Detonations would increase from 190 events to 200 events under this alternative, as described in Section 2.5.1.

Although individual birds may be directly impacted by live ordnance, the often patchy distribution of birds and the low probability that birds would occur at the location of ordnance delivery provide little potential for direct impacts. The total number of birds affected would be too small to cause population-level impacts. There are no reasonably foreseeable takes of migratory birds under Alternative 1. Therefore, consultation under the MBTA is not required.

The increase in small-arms testing is unlikely to impact Potomac River birds as it commonly takes place on the Machine Gun, Main, and AA Fuze Ranges, all of which are developed areas that are regularly maintained and do not provide suitable habitat for birds. With respect to potential indirect effects, the results of the screening-level ecological risk assessment indicated that none of the constituents released into the Potomac River by munitions activities are found at concentrations high enough to cause adverse effects in birds. Most detonations would occur over land and would not result in negative impacts to birds on the river.

Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on Potomac River birds.

4.12.2.2 EM Energy Activities

Under Alternative 1, the number of EM energy events would increase from 490 to 590 per year, the power of the EM energy events would increase, and activities would increase, as described in Section 2.5.2.

As detailed in Section 4.8, EM energy activities would follow strict safety protocols so that they pose minimal risk to humans and wildlife. Safety measures in place for birds and other wildlife would follow those described under the No Action Alternative.

Based on these protocols, EM energy activities would have negligible, short-term, direct, negative impacts and no indirect impacts on Potomac River birds.

4.12.2.3 Laser Activities

Under Alternative 1, the number of HE laser events would increase from the current 60 annually to 125 annually. Power levels and activities would also increase, and lasers would be used in more areas, as described in Section 2.5.3.

The safety measures described under the No Action Alternative would also be implemented under Alternative 1. These measures would minimize the risk of a bird's randomly flying across the laser beam at the precise time that the laser is being fired, minimizing potential impacts.

Safety procedures would be modified as needed to address risks associated with increased activities. For example, current target/backstops that intercept the laser beam and absorb its energy would be enlarged to capture the laser beam, which becomes more diffuse and increases its diameter as it gets farther from the laser emitter.

Given that safety procedures would be adapted to specific event requirements, laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on Potomac River birds.

4.12.2.4 Chemical and Biological Defense Activities

Under Alternative 1, activities using chem/bio simulants outdoors would increase from the current baseline of 12 events annually using chemical simulants to 60 events annually using both chemical and biological simulants, as described in Section 2.5.4. The maximum quantity of simulant (20 gals) per release would not increase and the amount of simulant used would be the minimum amount needed to test the lowest level of simulant the sensor can detect. Other chemical simulants with low toxicity, as well as BSL-1 biological simulants, would be added to the tests. The areas in which the activities would take place would expand to include all the land ranges, the Mission Area, and the MDZ.

As described for the No Action Alternative, the use of chemical simulants would have negligible impacts on Potomac River birds. Based upon previous activities and the modeling presented in Sections 4.4.1.2 and 4.11.1.4, simulant concentrations that Potomac River birds would be exposed to are predicted to be well below levels that would cause toxicity.

The biological simulants that may be used include spore-forming bacteria such as *Bacillus atrophaeus, B. subtilis, and B. thuringiensis;* non-spore forming bacteria such as *Pantoea agglomerans* and *Deinococcus radiodurans;* ovalbumin; bacteriophage MS2; and the fungus *Aspergillus niger*. No modeling was performed for biological simulants, as NSWCDD would use only BSL-1 simulants, defined by the Centers for Disease Control and Prevention as well-characterized strains of viable microorganisms with minimal potential hazard to the environment. Many of these biological simulants, such as the bacteria, are ubiquitous and often found in high concentrations in nature, including in water (CRI, 2004). There are no published reports of disease associated with these biological simulants in aquatic plants or animals, nor are they considered to be disease-causing agents. The small concentrations of these simulants deposited on the water would not cause any significant population increase in the environment, and no adverse effects are anticipated from temporary increases of them.

Chem/bio defense activities would have negligible, short-term, indirect, negative impacts and no direct impacts on Potomac River birds.

4.12.2.5 PRTR Use

NSWCDD would restrict public access to some part of the PRTR danger zones, usually some or all of the MDZ, for approximately 870 hours per year, as described in Section 2.5.5.

PRTR use at increased levels would have negligible impacts on Potomac River birds, as there would be only minor increases in range boat traffic (16 percent) or other activities that could disturb them. Range boat activities, as well as commercial and recreational boat activities, on the waters of the

PRTR, Upper Machodoc Creek, and other waterways in the vicinity of NSF Dahlgren routinely occur without long-term adverse impacts.

PRTR use would have negligible, short-term, direct and indirect, negative impacts on Potomac River birds.

4.12.3 Alternative 2

4.12.3.1 Ordnance Activities

The number of large-caliber projectiles would remain at current levels and use would be the same as under Alternative 1. The use of small arms would increase, with the number of bullets expended annually increasing from 6,000 to 30,000; approximately 3,000 bullets would be fired from land into the river. Detonations would increase from 190 events to 230, as described in Section 2.6.

Although individual birds may be directly impacted by gun firing, the often patchy distribution of birds, the low probability that birds would occur at the target area provide little potential for direct impacts. The increase in small-arms testing is unlikely to impact Potomac River birds as it commonly takes place on the Machine Gun, Main, and AA Fuze Ranges, all of which are developed areas that are regularly maintained and do not provide suitable habitat for birds. The total number of birds affected would be too small to cause population-level impacts. There are no reasonably foreseeable takes of migratory birds under Alternative 2. Therefore, consultation under the MBTA is not required.

With respect to potential indirect effects, the results of the screening-level ecological risk assessment indicated that none of the constituents released into the Potomac River by munitions activities are found at concentrations high enough to cause adverse effects in birds. Most detonations would occur on land and, therefore, the increase in detonations would not affect birds on the river.

Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on Potomac River birds.

4.12.3.2 EM Energy Activities

Under Alternative 2, the number of EM events would increase from 490 to 680 per year and activities would expand, as described in Section 2.6. Safety measures in place for birds and other wildlife would follow those described under the No Action Alternative.

EM energy activities would have negligible, short-term, direct, negative impacts and no indirect impacts on Potomac River birds.

4.12.3.3 Laser Activities

Under Alternative 2, the number of laser events would increase from 60 to 145 events per year, and activities would expand, as described in Section 2.6.

The safety measures described under the No Action Alternative would minimize the risk of a bird's randomly flying across the laser beam at the precise time that the laser is being fired, minimizing

potential impacts. Safety procedures would be modified to address risks associated with increased activities, as described under Alternative 1.

Laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on Potomac River birds.

4.12.3.4 Chemical and Biological Defense Activities

The number of events using chem/bio simulants would increase from the current baseline of 12 events annually using chemical simulants to 70 events annually using both chemical and biological simulants, as described in Section 2.6. The chemical and biological simulants used would be the same ones approved for use in the individual chemical and biological operational tests under Alternative 1.

The use of chem/bio simulants would have negligible impacts on Potomac River birds. Based upon previous events and the modeling presented in Sections 4.4.1.2 and 4.11.1.4, simulant concentrations that Potomac River birds would be exposed to are predicted to be are well below levels that would cause toxicity to them. The use of BSL-1 biological simulants would have no effects on birds, as these organisms pose minimal potential hazard to the environment, and some of these organisms are already naturally present in the area. There is no research on synergistic effects between low toxicity chemical and BSL-1 biological simulants most likely because given the low level of risk from both elements, no synergistic effects are expected.

Chem/bio defense activities would have negligible, short-term, indirect, negative impacts but no direct impacts on Potomac River birds.

4.12.3.5 PRTR Use

NSWCDD would restrict public access to some part of the PRTR danger zones, usually some or all of the MDZ, for approximately 1,000 hours per year, as described in Section 2.6.

PRTR use at increased levels would have negligible impact on Potomac River birds, as there would be only minor increases in range boat traffic, operational craft, or other activities that could disturb them. Range-boat activities, as well as commercial and recreational boat activities, on the waters of the PRTR, Upper Machodoc Creek, and other waterways in the vicinity of NSF Dahlgren routinely occur without long-term adverse impacts.

PRTR use would have negligible, short-term, direct and indirect, negative impacts on Potomac River birds.

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4.13 NSF Dahlgren's Biological Resources

4.13.1 No Action Alternative

4.13.1.1 Ordnance Activities

Almost all recorded large-caliber projectiles fired at NSF Dahlgren since 1918 have been fired into the MDZ, with a limited number of projectiles entering the upper end of the LDZ (up to 40,000 yds from the firing line). Under this alternative, and under Alternatives 1 and 2, inert projectiles would continue to be the dominant type of ordnance.

Approximately 6,000 bullets would be fired each year. Much of the outdoors small-arms firing is directed into gun butts and approximately 90 percent of small-arms firings are and would continue to be over land, with the remaining 10 percent from land into the river.

Approximately 190 detonations would take place each year. Most detonations would take place inland on the EEA's Harris and Churchill Ranges, and infrequently on the EOD training range on the Missile Test Range or on vessels on the PRTR. NSWCDD removes fired military munitions, as well as range scrap and debris from the land-based firing of munitions and detonation of explosives that are exposed on the ground surface or partially buried.

NSF Dahlgren's Ponds, Streams, and Creeks

As discussed in Section 3.10, aquatic resources other than the Potomac River associated with NSF Dahlgren include Upper Machodoc Creek, Gambo Creek, Black Marsh Creek, Beaver Pond, Lespedeza Pond, Hideaway Pond, and Cooling Pond. Fish living in aquatic environments outside of the Potomac River generally would have minimal contact – lower than would fish living in the river – with ordnance (the exception is Hideaway Pond, which has elevated levels of contaminants from long-past uses). As described in Section 4.11, RDT&E activities under the No Action alternative would have negligible, long-term, direct and indirect, negative impacts on fish in the Potomac River. The impacts of RDT&E activities would be even lower in aquatic environments outside the river, as there would be fewer interactions with fish. Therefore, potential impacts to fish are not discussed further in this section.

Wildlife living near aquatic resources are not near the Churchill and Harris ranges in the EEA where ordnance activities occur and, therefore, would not be directly exposed to ordnance. Concentrations of MCs entering inland waters from surface water or groundwater transport would be minimal, as operational range clearance (ORC) and best management practices (BMPs) are followed to reduce potential risks to human health and/or the environment if munitions are exposed via erosion from past range activities (NSWCDL, 2003; NAVSEA, 2010).

None of the inland waters are part of the PRTR with the exception of the entrance to Upper Machodoc Creek. Ordnance activities do not occur in this area with the possible exception of some small-arms firing from the Machine Gun Range entering the area at the confluence of Upper Machodoc Creek and the Potomac River.

Ordnance activities under the No Action Alternative would have negligible, long-term, direct and indirect, negative impacts on biological resources associated with NSF Dahlgren's ponds, streams, and creeks.

NSF Dahlgren's Vegetation

To minimize fire hazards, areas where guns are fired and where explosives are detonated are maintained with short or no surrounding vegetation. Larger guns are typically mounted well above the ground, which is covered with concrete, or in the case of the 155 mm howitzer and the 8" gun, guns are placed on concrete slabs.

Projectiles fired from the large guns to targets on land are typically caught in projectile catch facilities. The projectiles have no contact with vegetation, but fragments of the projectile may land on plants nearby. Similarly, small arms fired on land are typically fired into gun butts. Fragments or particles of bullets or projectiles may land on plants. Smaller fragments and particles are unlikely to damage plants, but larger fragments may damage individual plants.

Open detonations (over 200 lbs net explosive weight [NEW]) on the EEA ranges are buried under 8 ft or more of dirt to reduce noise and flying fragments and have no contact with vegetation. Detonations of less than 200 lbs NEW detonate on the EEA ranges above ground and could affect nearby vegetation, although the vegetation on the Harris and Churchill Ranges detonation areas is sparse and short. Various types of tests on the EEA result in detonations that create fragments, such as arena tests where fragmentation patterns are studied.

Overall, the potential impacts on terrestrial vegetation from use of ordnance include direct hits of vegetation, fires, disturbance of vegetation adjacent to direct hits, settlement of shell fragments onto plants, and changes in soil quality from the release of constituents in shell components and explosives. Direct hits of vegetation or adjacent to vegetation may cause damage to individual plants, but as vegetation on the parts of the ranges used for ordnance detonations is mowed intermittently, the species that survive are mowed grasses, short shrubs resistant to repeated mowing, or fast growing colonizing species, which are adapted to their environment.

Ordnance activities under the No Action Alternative would have negligible, long-term, direct and indirect, negative impacts on NSF Dahlgren's vegetation.

NSF Dahlgren's Wildlife

Wildlife may potentially be exposed to large-caliber gun firing, small-arms tests, and detonations. Ranges are cleared before events begin but there is no way to ensure that birds and mammals do not enter the areas during tests. Noise and human activity associated with activities may startle wildlife and cause them to temporarily leave the area, and likely would act as a deterrent to their return before an event's end. Birds or mammals could be injured or killed if they pass in front of guns or near detonations. However, direct hits of wildlife are unlikely, as wildlife would normally vacate test areas temporarily when firing begins because of the noise associated with firing and then return after events conclude.

The availability of vegetation for grazing wildlife, including grasses, shrubs, and other plants would not be affected by ordnance RDT&E activities. It is also likely that the wildlife species that flourish on and near the ranges are adapted to range operations, and may actually benefit from them, such as hawks, owls, and foxes, which may find the mowed vegetation on the ranges (much of which is not mowed to lawn heights, but rather is mowed intermittently to retard tree growth) to be good hunting grounds for mice and rabbits. Ospreys have been known to build their nests near the Main Range gun line, an open landscape which may offer protection from nest predators as well as good visibility. Also, in general, the need to maintain buffer zones

around the most-heavily used parts of the ranges has resulted in the protection of large forested areas and wetlands, which offer excellent wildlife habitat.

Semi-aquatic mammals, such as the river otter, muskrat, and mink, may spend much of their time on or near the Potomac River in search of prey. It is unlikely that individual mink, river otter, or muskrat would be in the PRTR target area, as they forage near the shoreline (USEPA, 1993) and generally would not be out far enough in the river to be within the target range. In addition, mink are nocturnal and would not usually be active during firing times.

Indirect impacts from ordnance fired into the PRTR, in particular water and sediment quality impacts, are detailed in Appendix F, Derivation of Concentrations of Munitions Constituents in PRTR Sediment and Water. As described in Section 4.12.1.1, a screening-level ecological risk assessment was performed to determine if concentrations of MCOPCs (metals and explosives) in water and sediments from ordnance fired into the PRTR are present at concentrations that could cause adverse effects on wildlife. The river otter was selected as a representative receptor for semi-aquatic mammals. The river otter is considered to be at the upper end of the exposure range, as it feeds almost exclusively on fish and aquatic invertebrates that would be exposed to MCOPCs in the PRTR. The results of the screening assessment for the river otter are presented in Table 4.13-1.

HQs were calculated for both the dense zone and the diffuse zone. If HQs for these zones are all well below the target of 1 – indicating that there are no risks to ecological receptors from MCOPCs – then it can be concluded that the areas outside these zones, with lower munitions-related constituent concentrations, are also below levels of concern. As shown in Table 4.13-1, the HQs for all constituents are orders of magnitude below 1 – more than thousands of times lower – indicating that the MCOPCs released into the Potomac River by munitions testing are well below levels that may cause adverse effects in mammals.

Ordnance activities under the No Action Alternative would have negligible, long-term, direct and indirect, negative impacts on NSF Dahlgren's wildlife.

Special Interest Areas (SIAs)

Five SIAs (Figure 3.13-1) have been established at NSF Dahlgren. Of the five, two are wetland areas on Mainside that possess unique ecological characteristics and high-quality rare species habitat; the remaining three are areas on the EEA that provide nesting habitat for bald eagles.

All of the SIAs are located away from firing ranges and detonation areas. There is no spatial overlap between ordnance activities and SIAs. Ordnance activities under the No Action Alternative would have no direct or indirect impacts on biological resources associated with SIAs.

Table 4.13-1
Screening Hazard Quotients for the River Otter

Constituent	Fish Concentration[1] (mg/kg dw)	Sediment Concentration (mg/kg dw)	Water Concentration (mg/l)	Estimated Environmental Dose (mg/kg -day)	NOAEL (mg/kg-day)	Hazard Quotient
Dense Zone						
Metals						
Cadmium	0.0000011	0.015	5.0×10^{-9}	0.0000075	1.0	0.0000075
Chromium	0.000000040	0.0056	8.5×10^{-9}	0.0000029	3.28	0.00000087
Copper	0.0000010	6.5	5.9×10^{-9}	0.0033	11.7	0.00027
Lead	1.3×10^{-13}	0.12	5.8×10^{-12}	0.000061	8.0	0.0000076
Manganese	0.00016	2.3	0.0000010	0.0012	88	0.000014
Nickel	0.00000043	0.079	0.000000022	0.000040	40	0.0000010
Zinc	0.000024	1.1	0.000000046	0.00058	160	0.00000036
Explosives						
Ammonium picrate	0.0000021	0.00000054	0.000052	0.0000055	NA	NA
HMX	1.2×10^{-9}	6.1×10^{-9}	4.5×10^{-9}	5.3×10^{-10}	50	1.1×10^{-11}
RDX	0.000026	0.000014	0.000034	0.0000049	8.0	0.00000061
Tetryl	0.0000032	0.00060	0.00000057	0.00000053	13	0.000000041
TNT	0.000063	0.0030	0.0000033	0.0000051	0.5	0.000010
Diffuse Zone						
Metals						
Cadmium	0.00000016	0.0021	6.9×10^{-10}	0.0000011	1	0.0000011
Chromium	9.2×10^{-9}	0.0013	1.9×10^{-9}	0.00000066	3.28	0.00000020
Copper	0.00000027	1.7	1.5×10^{-9}	0.00087	11.7	0.000075
Lead	2.7×10^{-14}	0.026	1.2×10^{-12}	0.000013	8	0.0000017
Manganese	0.000054	0.80	0.00000034	0.00041	88	0.0000047
Nickel	0.00000043	0.082	0.000000022	0.000042	40	0.0000010
Zinc	0.0000038	0.19	7.3×10^{-9}	0.000098	160	0.00000061
Explosives						
Ammonium picrate	0.00000011	0.000000041	0.0000027	0.00000029	NA	NA
HMX	7.2×10^{-10}	5.1×10^{-9}	2.6×10^{-9}	3.1×10^{-10}	50	6.2×10^{-12}
RDX	0.00000044	0.00000034	0.00000057	0.000000083	8.0	0.000000010
Tetryl	0.000000091	0.000025	0.000000016	0.000000019	13	1.5×10^{-9}
TNT	0.000012	0.00081	0.00000064	0.0000011	0.5	0.0000022

Notes: mg/kg = milligrams per kilogram (parts per million); dw = dry weight; mg/l = milligrams per liter (parts per million).
NA = No criteria available.
[1] Fish were assumed to be 75 percent water for conversion from wet to dry weight.
Scientific notation is used for very small numbers; for example 1.0×10^{-9} is one billionth (0.000000001).
Hazard quotients above 1 indicate the potential for adverse effects.
All hazard quotients shown here are orders of magnitude below 1 (each order of magnitude is equal to ten times), with a minimum of thousands of times below the target value.

Hunting and Fishing

Hunting and fishing at NSF Dahlgren are limited based on time of day, day of week, and time of year, with the limitations based on activities related to the military mission. Hunting takes place in designated areas on NSF Dahlgren's Mainside and EEA (see Figure 3.13-3). Weekday hunting using firearms is prohibited with the exception of: 1) during muzzleloader season at Pumpkin Neck after work hours; 2) federal holidays; 3) site-observed shutdown between Christmas and New Years; and 4) waterfowl hunting from blinds 11 through 15 along the Pumpkin Neck shoreline (NSA South Potomac, 2009a, 2009b). Weekday bow hunting of deer is permitted all day in hunting compartments west of Gambo Creek and after 1500 hours in hunting

compartments east of Gambo Creek (see Figure 3.13-3). Hunting of turkey, small game, and migratory birds is only permitted on Saturday and federal holidays (NSA South Potomac, 2009a, 2009b).

All designated hunting areas are and would continue to be restricted and monitored during RDT&E activities to eliminate any potential impacts. Fishing activities on Mainside and within the Potomac River and Upper Machodoc Creek are restricted based on military mission activities. NSWCDD may restrict fishing on part or all of the MDZ, or infrequently the upper LDZ, when actively using that part of the range.

Current ordnance activities do not physically overlap with hunting and fishing activities; however, restrictions imposed during ordnance activities indirectly affect hunting and fishing. Therefore, ordnance activities under the No Action Alternative would have no direct impacts and negligible, long-term, indirect, negative impacts on hunting and fishing.

4.13.1.2 EM Energy Activities

Under the No Action Alternative, NSWCDD currently uses and would continue to use three main outdoor facilities for E3 and HERO activities: NOTES, MOATS, and two ground planes. MOATS and the two ground planes are in highly-developed areas with little or no natural habitat surrounding them, whereas NOTES is surrounded by forest in an area with little human activity. Radars are tested at the STSTS on Main Range in a developed area. NSWCDD operates NDEC and CETFAC to transmit directed energy (microwaves, RF, and lasers) outdoors, across the waters of the Potomac River. The EM Launcher Facility, beyond a cleared buffer area, is surrounded by forest.

As discussed in the Chapter 2, EM energy devices evaluated in this EIS operate in the frequency range of 300 kHz to more than 300 GHz and at powers up to 500 MW (average power). Exposure to the upper end of these frequencies can result in thermal or heating effects on body tissues. However, the higher frequencies are only present close to EM energy generators when they are operating. The distance from EM energy generators for exposure to reach levels where thermal effects could occur is carefully controlled during events.

NSF Dahlgren's Ponds, Streams, and Creeks

EM energy generators are not located near the ponds, streams, and creeks on NSF Dahlgren. Therefore, there would be minimal potential for wildlife on or near these surface waters to be exposed to dangerous levels of EM energy. EM energy that breaches the water surface would be propagated and attenuated, rapidly decreasing in amount and intensity as it travels through the water.

Under the No Action Alternative, EM energy activities would have negligible, short-term, direct, negative impacts and no indirect impacts on biological resources associated with NSF Dahlgren's ponds, streams, or creeks.

NSF Dahlgren's Vegetation

MOATS and the two ground planes are in highly-developed areas with little or no natural habitat, and minimal vegetation, surrounding them, whereas NOTES is surrounded by forest.

Vegetation growing at the edges of these facilities would not receive high enough doses of EM energy to be impacted because the energy is directed inwards.

Corridors where EM energy activities take place are areas that are already maintained or over open water. No high quality habitat would be cleared for corridors and therefore the effect on vegetation would be negligible. Under the No Action Alternative, EM energy activities would have negligible, short-term, direct, negative impacts and no indirect impacts on vegetation.

NSF Dahlgren's Wildlife

MOATS and the two ground planes are in highly-developed areas and do not provide high-quality habitat that would attract wildlife, whereas NOTES is surrounded by forest in an area with little human activity. Outdoor EM energy activities at NSF Dahlgren require the use of HERP safety zones to protect personnel and these zones would also exclude wildlife, thereby protecting them from high levels of EM energy

As EM energy dissipates exponentially with distance from the energy source, wildlife outside the test area would encounter very low doses of EM energy. Although there are no controls to exclude wildlife from the safety zones during activities, the probability of wildlife's entering test areas at the time of firing would be very low, due to the poor quality habitat (i.e., maintained or concrete areas), the occurrence of tests primarily during times of low wildlife activity, and the presence of test personnel. As discussed above, impacts on vegetation such as grasses, shrubs and other plants used by grazing wildlife would be negligible and therefore there would be no indirect impacts on wildlife from EM energy. EM energy activities under the No Action Alternative would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's wildlife.

Special Interest Areas (SIAs)

MOATS and the two ground planes are located far enough away from SIAs that the power of EM energy would be reduced to background levels by the time the energy reaches the SIAs. Therefore, EM energy activities under the No Action Alternative would have no direct or indirect impacts on biological resources associated with SIAs or the SIAs themselves.

Hunting and Fishing

Minimal wildlife is expected near the EM energy facilities, as vegetation is cleared providing little to no habitat for wildlife species. There is an 8-ft fence surrounding the EM Launcher Facility that prevents large wildlife, such as deer, from coming within 80 ft of the launcher (NSWCDL, 2009). Test areas are cleared prior to the onset of EM energy tests and interruptions are brief. Any interruptions to hunting and fishing are considered to be negligible.

EM energy activities under the No Action Alternative would have negligible, short-term, direct, negative impacts and no indirect impacts on hunting and fishing at NSF Dahlgren.

4.13.1.3 Laser Activities

Two of NSWCDD's five current laser corridors are on the PRTR's developed land ranges. For No Action Alternative activities, both the HE laser emitter and the target/backstop would be fixed and the laser would emit almost horizontally. The laser would be pre-aimed and would not

be able to move, except for minute corrections to the aim point. Under the current maximum power the laser beam would be a minimum of 6 ft above ground level. As with EM energy, laser activities are tightly controlled and the likelihood of a laser beam's straying from the target/backstop and hitting the ground is extremely small.

NSF Dahlgren's Ponds, Streams, and Creeks

As discussed in Section 4.11.2, there is a very low probability that Potomac River birds would be near HE laser beams during RDT&E activities. Birds living in or near inland waters on NSF Dahlgren are also unlikely to be exposed to lasers. Current activities have negligible impact on wildlife living in or near inland waters due to the low number of birds and mammals present during activities; the use of spotters to report whether wildlife is present when lasers are being used; health and safety protocols; and the small volumes occupied by laser beams over short emission times.

Under the No Action Alternative, laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on biological resources associated with NSF Dahlgren's ponds, streams, and creeks.

NSF Dahlgren's Vegetation

Current activities using lasers provide little opportunity for lasers to contact croplands, forest resources, or other vegetation between the laser site and the target area during operations, as laser activities require a clear line of sight. Tree foliage is removed and ground vegetation is cut where necessary to achieve a clear line of sight. The effect of increased vegetation maintenance, if required, in laser corridors is considered negligible.

Exposure of plant material to HE lasers may result in direct damage to the plant, as evidenced by wilting. Selective application of lasers can also inactivate the synthesis of essential amino acids within plants. This finding has led to the filing and granting of a patent for use of lasers in control of water weeds and other invasive plants (US Patent Office, 1972). However, field tests showed that although laser irradiation initially caused a substantial decrease in growth rates with an increase in irradiation level, this effect decreased over time until there was no substantial difference between treated and control plots (Long and Smith, 1975). Rates of photosynthesis were not significantly affected by laser irradiation (Long and Smith, 1975), although more information is needed on threshold responses (both beneficial and deleterious) of plant tissues to laser light (Bennett, 1983).

Under the No Action Alternative, laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on biological resources associated with NSF Dahlgren's vegetation.

NSF Dahlgren's Wildlife

Laser activities require a high level of preparation and safety precautions prior to firing. As described previously, NSWCDD has written safety programs and procedures for the protection of scientists and the public and to minimize potential impacts to wildlife. Personnel used as spotters make sure the test area is clear of large wildlife – predominantly white-tailed deer and visible birds – before initiating each test sequence, and the video surveillance system provides an observer the opportunity to stop the test in the event of wildlife entering the test area. In addition,

trained visual observers with radios or cameras watch for eagles, other birds, and wildlife that may wander into the laser corridor. The corridor is defined to be wide enough to allow sufficient response time to shut down the laser system. The range is also visually surveyed for dead animals prior to performing any tests and any dead animals are removed to limit the chances of scavenger wildlife entering the test range. These safety measures minimize the risk of wildlife entering the area during tests.

Clearing the range prior to the onset of tests may temporarily disturb wildlife. Test sequences are brief and represent a small fraction of ongoing range and non-range activities. The ongoing presence of birds and wildlife using the range suggests that laser activities have little effect on terrestrial wildlife under current usage. As discussed above, impacts on vegetation such as grasses, shrubs and other plants used by grazing wildlife would be negligible and therefore there would be no indirect impacts on wildlife from laser RDT&E activities.

Under the No Action Alternative, laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's wildlife.

Special Interest Areas (SIAs)

All outdoor laser activities are located well away from SIAs. Therefore, under the No Action Alternative there would be no direct or indirect impacts to SIAs from laser activities.

Hunting and Fishing

Minimal wildlife is expected near areas of HE laser operations, as laser corridors are characterized by low vegetation – mowed for range operations – and paved areas (NSWCDL, 2009). HE laser activities require a high level of preparation and safety precautions prior to firing. NSWCDD has written safety programs and procedures for the protection of personnel, the public, and to minimize potential impacts to wildlife. Personnel used as spotters make sure that the test area is clear of large wildlife – predominantly white-tailed deer and visible birds – before initiating each test sequence. Any interruptions to hunting and fishing would be brief and are considered to be negligible.

Laser activities under the No Action Alternative would have negligible, short-term, direct, negative impacts and no indirect impacts on hunting and fishing at NSF Dahlgren.

4.13.1.4 Chemical Defense Activities

Outdoor chemical defense activities using simulants would occur under the No Action Alternative; activities using biological simulants would not occur. Chemical simulants would be released over the test area in the MDZ in a variety of weather conditions. When quantities of more than 5 gals are to be used, crosswind releases could be specified by the Test Director to limit the dosage of simulant as the cloud passes over any land or water biological system.

NSF Dahlgren's Ponds, Streams, and Creeks

Chemical simulant tests result in small quantities of simulants being released in the air and even smaller quantities of simulants being deposited on the surface of the land. Assessments completed for similar past simulant activities performed by NSWCDD using some of the same

simulants showed no significant impacts and there were no observable environmental effects during or after events (NSWCDD, 2003; NSWCDL, 2004; Bossart, letter, February 9, 2006).

NSWCDD conducted dispersion modeling and field tests of chemical simulants released on the PRTR to determine the potential human and ecological health risks associated with the release of chemical simulants as a vapor on the MDZ, as described in Sections 4.4.1.2 and 4.11.1.4. The modeling results predicted both the airborne and water-column concentrations that would result from the vapor releases and the results are provided in Appendix J.

As discussed previously, concentrations of chemical simulants released into the air are well below levels that could cause adverse effects in people (see Section 4.4.1.2) and below concentrations that would result in adverse effects on aquatic life (see Section 4.11.1.4). The concentrations of chemical simulants reaching NSF Dahlgren's ponds, streams, and creeks likely would be much lower and below detection levels.

Under the No Action Alternative, chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts on biological resources associated with NSF Dahlgren's ponds, streams, or creeks.

NSF Dahlgren's Vegetation

Simulant vapor tests are designed to minimize deposition on land and water areas. Simulants released into the air would rapidly disperse in the environment. Concentrations of chemical simulants that may be deposited on terrestrial vegetation would be very low – at or near background levels and well below concentrations that have been shown to cause adverse effects. Under the No Action Alternative, chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's vegetation.

NSF Dahlgren's Wildlife

Concentrations of chemical simulants to which terrestrial wildlife would be exposed would be very low – at or near background levels and well below concentrations that have been shown to cause adverse effects. Vegetation such as grasses, shrubs and other plants used by grazing wildlife would not be affected by chemical or biological simulants. Under the No Action Alternative, chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's wildlife.

Special Interest Areas (SIAs)

Chemical simulants are not tested in the SIAs and any simulants that reach SIAs would be at concentrations equivalent to background levels. Chemical defense activities under the No Action Alternative would have no direct or indirect impacts on biological resources associated with SIAs.

Hunting and Fishing

Chemical defense activities would take place during specific times throughout the year, rather than every day of the year, and would likely occur at times where hunting and fishing is not taking place. As NSWCDD normally conducts outdoor RDT&E activities Monday through Friday between 8 am and 5 pm during daylight hours, chemical defense activities would not

conflict with prime hunting and fishing, which tend to occur early in the morning or late in the evening. Therefore, any interruptions to hunting and fishing activities would be negligible.

Under the No Action Alternative, chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts on hunting and fishing.

4.13.2 Alternative 1

4.13.2.1 Ordnance Activities

The number of large-caliber projectiles would remain at current levels, although the frequency of firing into the upper LDZ would increase to up to 10 days per year. Small-caliber gun use would increase from an average of 6,000 bullets fired a year under the No Action Alternative to 25,500 bullets fired a year. Detonations would increase from 190 events to 200 events under this alternative, as described in Section 2.5.1.

NSF Dahlgren's Ponds, Streams, and Creeks

Ordnance activities would not occur in the ponds, streams, or creeks on NSF Dahlgren, with the possible exception of some small-arms firing from the Machine Gun Range entering the area at the confluence of Upper Machodoc Creek and the Potomac River. As discussed previously, small arms fired on land are typically fired into gun butts with approximately 10 percent of rounds entering the Potomac River within approximately 1,000 yds of shore. The majority of bullets entering the river would be immediately buried, isolating bullets from movement and exposure pathways, resulting in negligible impacts to water bodies. Ordnance activities under Alternative 1 would have negligible, long-term, direct and indirect, negative impacts on NSF Dahlgren's ponds, streams, and creeks.

NSF Dahlgren's Vegetation

Ordnance activities at NSF Dahlgren would minimally affect terrestrial plants under Alternative 1. Although individual plants may be damaged by bullets, plants found in maintained areas are generally rapidly growing species that would be replaced in a short time. Ordnance activities under Alternative 1 would have negligible, long-term, direct and indirect, negative impacts on NSF Dahlgren's vegetation.

NSF Dahlgren's Wildlife

As described for the No Action Alternative, ranges would be cleared before events begin, but there is no way to ensure that birds and mammals do not enter the areas during tests. Noise and human activity associated with activities may startle wildlife and cause them to temporarily leave the area, and likely would act as a deterrent to their return before an event's end. Direct hits of wildlife are unlikely, as wildlife would normally vacate test areas temporarily when firing begins because of the noise associated with firing, and then return after events conclude. Modeling of MCOPCs in munitions indicates that there are no risks to ecological receptors.

Ordnance activities are unlikely to affect terrestrial wildlife, as wildlife would likely avoid the ranges during activities. Ordnance activities under Alternative 1 would have negligible, long-term, direct and indirect, negative impacts on NSF Dahlgren's wildlife.

Special Interest Areas (SIAs)

Increased small-arms firing and detonations would not affect SIAs or associated biological resources, as all of the SIAs are located away from firing ranges and detonation areas. Therefore, ordnance activities under the Alternative 1 would have no direct or indirect impacts on biological resources associated with SIAs or the SIAs themselves.

Hunting and Fishing

Under current conditions, large-caliber guns cause negligible interruptions to hunting and fishing activities. The large increase in small-arms activities would take place mainly on the Machine Gun Range, but also on the Terminal Range, Churchill Range, and Harris Range. Hunting and fishing are not allowed on or near the ranges while events are taking place and there is very limited designated hunting with restricted hours near areas where small-arms activities would occur (see Figure 3.13-3). Detonation activities occur on the EEA, but hunting and fishing do not take place where detonation activities occur.

Ordnance activities under Alternative 1 would have negligible, long-term, indirect, negative impacts and no direct impacts on hunting and fishing.

4.13.2.2 EM Energy Activities

Under Alternative 1, the number of EM energy events would increase from 490 to 590 per year, the power of the EM energy events would increase, and NSWCDD would expand its outdoor RDT&E activities, as detailed in Section 2.5.2.

NSF Dahlgren's Ponds, Streams, and Creeks

EM generators, likely including any additional areas used for EM energy activities in the future, would not be located close to the ponds, streams, and creeks on NSF Dahlgren. EM energy activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's ponds, streams, and creeks.

NSF Dahlgren's Vegetation

Most facilities used for EM energy activities are surrounded by pavement and low, maintained vegetation. The vegetation growing at the edges of the EM energy facilities would not receive high doses of EM energy, as the high electric or magnetic field levels experienced within test areas quickly dissipate and return to background levels outside the test areas. Corridors where EM energy activities would take place are areas that are already maintained or over open water. No high quality habitat would be cleared for corridors and therefore the effect on vegetation would be negligible.

EM energy activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's vegetation.

NSF Dahlgren's Wildlife

Areas where outdoor EM energy activities occur at NSF Dahlgren generally do not provide high-quality habitat that would attract wildlife, and the HERP safety zones around the facilities are cleared of any large wildlife prior to events. Wildlife outside the test area would encounter very low doses of EM energy as the high electric or magnetic field levels experienced within test areas quickly dissipate and return to background levels. The probability of wildlife's entering test areas at the time of firing would be very low. Although clearing the ranges could disturb wildlife, disturbance would be temporary, and likely would not affect foraging or nesting activities. As discussed above, impacts on vegetation such as grasses, shrubs and other plants used by grazing wildlife would be negligible and therefore there would be no indirect impacts on wildlife from EM energy.

EM energy activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's wildlife.

Special Interest Areas (SIAs)

Before reaching the SIAs, the power of EM energy would be reduced to background levels. Therefore, EM energy activities under Alternative 1 would have no direct or indirect impacts on biological resources associated with SIAs or the SIAs themselves.

Hunting and Fishing

During EM activities, HERP, HERO, HERF, and EMI safety zones and restrictions would be in effect. More EM energy activities may temporarily interrupt hunting and fishing activities. However, most hunting and fishing are not focused in the areas where EM activities would take place and would occur outside of prime hunting and fishing hours. EM energy activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on hunting and fishing.

4.13.2.3 Laser Activities

Under Alternative 1, the number of HE laser events would increase from the current 60 annually to 125 annually. Laser power levels would increase, and activities would be expanded as described in Section 2.5.3.

NSF Dahlgren's Ponds, Streams, and Creeks

The increase in laser activities is unlikely to affect NSF Dahlgren's inland waters due to the low number of laser events performed near them and the implementation of health and safety protocols during events. Laser activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on biological resources associated with NSF Dahlgren's ponds, streams, and creeks.

NSF Dahlgren's Vegetation

Under Alternative 1, HE laser activities would be continue to be conducted on corridors where the vegetation is mowed, as activities require a clear line of sight. Therefore, laser beams would

have little, if any contact with vegetation and increased maintenance is considered to have negligible impacts on vegetation.

Laser activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's vegetation.

NSF Dahlgren's Wildlife

Because the corridors used for laser activities are mowed to ensure a clear line of sight, the corridors are not prime wildlife habitat but may adjoin natural areas. NSWCDD personnel would ensure that the test area is clear of wildlife before initiating each test sequence. These safety measures, described under the No Action Alternative, would minimize the risk of wildlife's entering the test area, minimizing potential impacts. As discussed previously, impacts on vegetation such as grasses, shrubs and other plants used by grazing wildlife would be negligible and therefore there would be no indirect impacts on wildlife from laser RDT&E activities.

Laser activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's wildlife.

Special Interest Areas (SIAs)

Under Alternative 1, all outdoor laser activities would continue to be located well away from SIAs. Therefore, laser activities under Alternative 1 would have no direct or indirect impacts on biological resources associated with SIAs or the SIAs themselves.

Hunting and Fishing

During laser activities, eye safety zones and restrictions would be in effect, and laser corridors would be monitored closely before and during all events. The increase in laser activities may cause slight interruptions to hunting and fishing activities but, considering that tests are unlikely to occur at the times during which hunting and fishing is permitted these potential interruptions are considered negligible.

Laser activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on hunting and fishing.

4.13.2.4 Chemical and Biological Defense Activities

Under Alternative 1, activities using chem/bio simulants outdoors would increase from the current baseline of 12 events annually using chemical simulants to 60 events annually using both chemical and biological simulants, but not mixed, as described in Section 2.5.4. Maximum concentrations of chemical simulants that biological receptors could be exposed to are presented in Appendix J. The areas in which the activities would take place would expand to include the PRTR land ranges, the Mission Area, and the MDZ.

NSF Dahlgren's Ponds, Streams, and Creeks

As described for the No Action Alternative, NSWCDD modeled the atmospheric dispersion of chemical simulants released during chemical defense activities, based on established test methods and protocols. Based upon the proposed activities and the modeling presented in Sections 4.4 and 4.8.1, simulant concentrations that aquatic life would be exposed to are

predicted to be well below levels that would cause toxicity, even if simulants are released close to inland waters. The increase in the number of events under Alternative 1 would not affect chemical simulant exposure concentrations.

The biological simulants that may be used under Alternative 1 include spore-forming bacteria such as *Bacillus atrophaeus, B. subtilis, and B. thuringiensis;* non-spore forming bacteria such as *Pantoea agglomerans* and *Deinococcus radiodurans;* ovalbumin; bacteriophage MS2; and the fungus *Aspergillus niger.* No modeling was performed for biological simulants, as NSWCDD would use only BSL-1 simulants. Many of these simulants, such as the bacteria, are ubiquitous and often found in high concentrations in nature, including in water (CRI, 2004; USEPA, 1997). There are no published reports of disease associated with these biological simulants in aquatic plants or animals, nor are they considered to be disease-causing agents. The small concentrations of these simulants deposited on the water would not cause any significant increase in the environment.

Chem/bio defense activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's ponds, streams, and creeks.

NSF Dahlgren's Vegetation

Simulant vapor tests are designed to minimize deposition on land and water areas. Simulants released into the air as vapors would rapidly disperse in the environment. Concentrations of chemical simulants deposited on land and on terrestrial vegetation would be very low – at or near background levels and well below concentrations that have been shown to cause adverse effects. Although there are no terrestrial plant toxicity benchmarks for the simulants that would be used, concentrations that plants would be exposed to would be below levels that would cause adverse effects based on available toxicity tests. In addition, processes such as volatilization and precipitation would reduce concentrations of simulants further. No adverse effects on vegetation would be anticipated from testing of BSL-1 biological simulants.

Chem/bio defense activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's vegetation.

NSF Dahlgren's Wildlife

As noted for vegetation, concentrations of chemical simulants deposited on land and on terrestrial vegetation, and to which terrestrial wildlife would be exposed, also would be very low – well below concentrations that have been shown to cause adverse effects. Air concentrations would also be below levels causing adverse effects. No adverse effects on wildlife are anticipated from testing of BSL-1 biological simulants.

Chem/bio defense activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's wildlife.

Special Interest Areas (SIAs)

Chem/bio simulants would not be tested in the SIAs and any simulants that reach SIAs would be at concentrations equivalent to background levels. Chem/bio defense activities under Alternative 1 would have no direct or indirect impacts on biological resources associated with SIAs.

Hunting and Fishing

Under Alternative 1, the increase in annual events may cause slight interruptions to hunting and fishing activities on Mainside and the EEA and to fishing activities on the PRTR. Although chem/bio defense activities may interrupt hunting and fishing activities; however most testing will take place at times when hunting and fishing is not permitted, limiting the potential overlap. Any interruptions would be brief and concentrations of chem/bio simulants would return to background levels prior to the resumption of hunting and fishing.

Chem/bio defense activities under Alternative 1 would have negligible, short-term, direct, negative impacts and no indirect impacts on hunting and fishing.

4.13.3 Alternative 2

4.13.3.1 Ordnance Activities

The number of large-caliber projectiles would remain at current levels and use would be the same as under Alternative 1. The use of small arms would increase, with the number of bullets expended annually increasing from 6,000 to 30,000. Detonations would increase from 190 events to 230 events, as described in Section 2.6.

NSF Dahlgren's Ponds, Streams, and Creeks

Under Alternative 2, ordnance activities would not occur in the ponds, streams, or creeks on NSF Dahlgren, with the possible exception of some small-arms firing from the Machine Gun Range entering the area at the confluence of Upper Machodoc Creek and the Potomac River. As described for Alternative 1, only a small percentage of the bullets fired would enter the river and most of those would be immediately buried, isolating bullets from movement and exposure pathways, resulting in negligible impacts to water bodies. Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on NSF Dahlgren's ponds, streams, and creeks.

NSF Dahlgren's Vegetation

Ordnance activities at NSF Dahlgren would minimally impact terrestrial plants. Although individual plants may be damaged by bullets, plants found in maintained areas are generally rapidly growing species that would be replaced in a short time. Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on NSF Dahlgren's vegetation.

NSF Dahlgren's Wildlife

As described for the No Action Alternative and Alternative 1, ranges would be cleared before events begin, but there is no way to ensure that birds and mammals do not enter the areas during tests. Noise and human activity associated with activities may startle wildlife and cause them to temporarily leave the area, and likely would act as a deterrent to their return before an event's end. Direct hits of wildlife are unlikely, as wildlife would normally vacate test areas temporarily when firing begins and then return after events conclude. Modeling of MCOPCs in munitions indicates that there are no risks to ecological receptors.

Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on NSF Dahlgren's wildlife.

Special Interest Areas (SIAs)

Increased small-arms firing and detonations under Alternative 2 would have no impacts on SIAs, as all of the SIAs are located away from firing ranges and detonation areas. Therefore, ordnance activities would have no direct or indirect impacts on biological resources associated with SIAs or the SIAs themselves.

Hunting and Fishing

Under this alternative the use of large-caliber guns would remain at current levels, which have negligible impacts to hunting and fishing. The interruption to hunting and fishing from an increase in small-arms firing would result in negligible impact. Detonations would increase, but as hunting and fishing do not take place on the EEA in the areas where detonations occur, no impacts to hunting and fishing would result. Ordnance activities under Alternative 2 would have negligible, long-term, indirect, negative impacts and no direct impacts on hunting and fishing.

4.13.3.2 EM Energy Activities

Under Alternative 2, the number of EM events would increase from 490 to 680 per year, the power of the EM energy devices would increase, and NSWCDD would expand its outdoor RDT&E activities, as detailed in Section 2.5.2.

NSF Dahlgren's Ponds, Streams, and Creeks

EM generators, likely including any additional areas used for EM energy activities in the future, would be located distant from the ponds, streams, and creeks on NSF Dahlgren. EM energy activities under Alternative 2 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's ponds, streams, and creeks.

NSF Dahlgren's Vegetation

The vegetation growing at the edges of the EM energy facilities would not receive high enough doses of EM energy to be impacted. The vegetation growing at the edges of the EM energy facilities would not receive high doses of EM energy, as the high electric or magnetic field levels experienced within test areas quickly dissipate and return to background levels outside the test areas. Corridors where EM energy activities would take place are areas that are already maintained or over open water. No high quality habitat would be cleared for corridors and therefore the effect on vegetation would be negligible.

EM energy activities under Alternative 2 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's vegetation.

NSF Dahlgren's Wildlife

Areas where outdoor EM energy activities occur at NSF Dahlgren do not provide high-quality habitat that would attract wildlife, and the HERP safety zones around the facilities are cleared of large wildlife prior to events. Wildlife outside the test area would encounter very low doses of

EM energy, and the probability of wildlife's entering test areas at the time of firing would be very low. Although clearing the ranges could disturb wildlife, disturbance would be temporary, and likely would not affect foraging or nesting activities. As discussed above, impacts on vegetation such as grasses, shrubs and other plants used by grazing wildlife would be negligible and therefore there would be no indirect impacts on wildlife from EM energy.

EM energy activities under Alternative 2 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's wildlife.

Special Interest Areas (SIAs)

Before reaching the SIAs, the power of EM energy would be reduced to background levels. Therefore, EM energy activities under Alternative 2 would have no direct or indirect impacts on biological resources associated with SIAs.

Hunting and Fishing

During EM activities, HERP, HERO, HERF, and EMI safety zones and restrictions would be in effect. However, most hunting and fishing are not focused in the areas where increased EM activities would take place and would occur outside of prime hunting and fishing hours. EM energy activities under Alternative 2 would have negligible, short-term, direct, negative impacts and no indirect impacts on hunting and fishing.

4.13.3.3 Laser Activities

Under Alternative 2, the number of HE laser events would increase from 60 to 145 events per year, and power levels would increase, and activities would be expanded as described in Section 2.6.

NSF Dahlgren's Ponds, Streams, and Creeks

The increase in laser activities is unlikely to affect NSF Dahlgren's inland waters due to the low number of laser events performed near them and the implementation of health and safety protocols during events. Laser activities under Alternative 2 would have would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's ponds, streams, and creeks.

NSF Dahlgren's Vegetation

Under Alternative 1, HE laser activities would be continue to be conducted on corridors where the vegetation is mowed, as activities require a clear line of sight. Therefore, laser beams would have little, if any contact with vegetation and increased maintenance is considered to have negligible impacts on vegetation.

Laser activities under Alternative 2 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's vegetation.

NSF Dahlgren's Wildlife

Because the corridors used for laser activities are mowed to ensure a clear line of sight, the corridors are not prime wildlife habitat but may adjoin natural areas. NSWCDD personnel used

as spotters would ensure that the test area is clear of wildlife – predominantly white-tailed deer and visible birds – before initiating each test sequence. These safety measures, described under the No Action Alternative, would minimize the risk of wildlife's entering the test area, minimizing potential impacts. As discussed previously, impacts on vegetation such as grasses, shrubs and other plants used by grazing wildlife would be negligible and therefore there would be no indirect impacts on wildlife from laser RDT&E activities.

Laser activities under Alternative 2 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's wildlife.

Special Interest Areas (SIAs)

Under Alternative 2, all outdoor laser activities would continue to be located well away from SIAs. Therefore, laser activities under Alternative 2 would have no direct or indirect impacts on biological resources associated with SIAs or the SIAs themselves.

Hunting and Fishing

During HE laser activities, eye safety zones and restrictions would be in effect, and laser corridors would be monitored closely before and during all events. The increase in laser activities may cause slight interruptions to hunting and fishing activities but, considering that tests are unlikely to occur at the times during which hunting and fishing is permitted these potential interruptions are considered negligible.

Laser activities under Alternative 2 would have negligible, short-term, direct, negative impacts and no indirect impacts on hunting and fishing.

4.13.3.4 Chemical and Biological Defense Activities

Under Alternative 2, the number of events using chem/bio simulants would increase from the current baseline of 12 events annually using chemical simulants to 70 events annually using both chemical and biological simulants, which may be mixed together, as described in Section 2.6. Maximum concentrations of chemical simulants that biological receptors could be exposed to are presented in Appendix J. The areas in which the activities would take place would expand to include the PRTR land ranges and the Mission Area.

NSF Dahlgren's Ponds, Streams, and Creeks

As described for the No Action Alternative and Alternative 1, NSWCDD modeled the atmospheric dispersion of chemical simulants released during chemical defense activities, based on established test methods and protocols. Based upon the proposed activities, simulant concentrations that aquatic life would be exposed to are predicted to be well below levels that would cause toxicity, even if simulants are released close to inland waters. The increase in the number of events under Alternative 2 would not affect chemical simulant exposure concentrations.

There are no published reports of disease associated with these biological simulants in aquatic plants or animals, nor are they considered to be disease-causing agents. The small concentrations of these simulants deposited on the water would not cause any significant increase in the

environment. There are no records of synergistic reactions between the low-toxicity chemical simulants and BSL-1 simulants that would be used.

Chem/bio defense activities under Alternative 2 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's ponds, streams, and creeks.

NSF Dahlgren's Vegetation

Simulant vapor tests are designed to minimize deposition on land and water areas. Simulants released into the air as vapors would rapidly disperse in the environment. Concentrations of chemical simulants deposited on land and on terrestrial vegetation would be very low – at or near background levels and well below concentrations that have been shown to cause adverse effects. Although there are no terrestrial plant toxicity benchmarks for the simulants that would be used, concentrations that plants would be exposed to would be below levels that would cause adverse effects based on available toxicity tests. In addition, processes such as volatilization and precipitation would reduce concentrations of simulants further. No adverse effects would be anticipated from testing of BSL-1 biological simulants. There are no records of synergistic reactions between the low-toxicity chemical simulants and BSL-1 simulants that would be used; and given the low level of risk from both elements, no synergistic effects are expected.

Chem/bio defense activities under Alternative 2 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's vegetation.

NSF Dahlgren's Wildlife

As noted for vegetation, concentrations of chemical simulants deposited on land and on terrestrial vegetation, and to which terrestrial wildlife would be exposed, also would be very low – well below concentrations that have been shown to cause adverse effects. Air concentrations would also be below levels causing adverse effects. No adverse effects on wildlife are anticipated from the testing of BSL-1 biological simulants.

Chem/bio defense activities under Alternative 2 would have negligible, short-term, direct, negative impacts and no indirect impacts on NSF Dahlgren's wildlife.

Special Interest Areas (SIAs)

Chem/bio simulants would not be tested in the SIAs and any simulants that reach SIAs would be at concentrations equivalent to background levels. Chem/bio defense activities under Alternative 2 would have no direct or indirect impacts on biological resources associated with SIAs or the SIAs themselves.

Hunting and Fishing

Under Alternative 2, the increase in annual events may cause more interruptions to hunting and fishing activities on Mainside and the EEA and to fishing activities on the PRTR. However most testing will take place at times when hunting and fishing is not permitted, limiting the potential overlap. Any interruptions would be brief and concentrations of chem/bio simulants would return to background levels prior to the resumption of hunting and fishing.

Chem/bio defense activities under Alternative 2 would have negligible, short-term, direct, negative impacts and no indirect impacts on hunting and fishing.

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4.14 Protected Species

NSWCDD coordinated with appropriate federal and state natural resource agencies, including the United States Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Virginia Department of Conservation and Recreation (VDCR), Virginia Department of Game and Inland Fisheries (VDGIF), and Maryland Department of Natural Resources (MDNR), regarding regulatory compliance with federal and state laws. Coordination with these agencies is documented, as relevant, in this section for protected species and in other applicable sections of Chapters 3 and 4; in Appendix A, which contains the comments received on the NSWCDD DEIS for Outdoor RDT&E Activities; and in Appendix G, which presents the correspondence with these agencies.

4.14.1 No Action Alternative

4.14.1.1 Ordnance Activities

Almost all recorded large-caliber projectiles fired at NSF Dahlgren since 1918 have been fired into the MDZ, with a limited number of projectiles entering the LDZ, particularly the area up to 40,000 yds from the firing line. Under this alternative, as well as under Alternatives 1 and 2, most of the 4,700 large-gun projectiles fired in particularly active years would continue to be fired into the same heavily-used area in the MDZ.

Approximately 6,000 bullets would be fired each year. Much of the outdoors small-arms firing is directed into gun butts, reducing the number of bullets entering the river. Approximately 90 percent of small-arms firings are and would continue to be over land, and the bullets would not enter the river. The remaining 10 percent (600 rounds) of the firings would be from land into the river, with the bullets entering the river.

Approximately 190 detonations would take place each year. Most detonations would take place inland on the EEA's Harris and Churchill Ranges, and infrequently on the EOD training range on the Missile Test Range, all well-removed from the waters of the Potomac River. Occasionally, devices would be detonated on vessels in the river. A portion of the debris and residues from detonations on vessels could enter the river, but the quantities of these materials would be small, as such detonations would be infrequent.

Fish

As described in Section 3.14.2, two federally-listed endangered fish species, the shortnose sturgeon and the Atlantic sturgeon, are found in the PRTR portion of the Potomac River. In compliance with Section 7 of the Endangered Species Act (ESA), a Biological Assessment (BA) was prepared to evaluate the potential effect of the Proposed Action on the shortnose, Atlantic sturgeon, and sea turtles and sent to NMFS (NSWCDD, 2011). NMFS concurred with the determination in the BA on January 11, 2012 (Morris, January 11, 2012). The BA is included as Appendix H of this EIS. The potential impacts on both sturgeon species are discussed below because they share many characteristics.

There is the potential for direct and indirect impacts on sturgeon from RDT&E ordnance activities. Direct effects are considered to be any adverse effects arising from Proposed Action

activities that could result in immediate impacts on individuals or changes to their habitat. These effects include physical injury or death, disruption of migration or reproduction, disruption of egg development, and direct alteration of existing habitat. Indirect effects are defined as any effects that are caused by or could result from the Proposed Action later in time, but which are still reasonably certain to occur. These effects include water/sediment quality impairment and indirect alteration of habitat.

Both shortnose and Atlantic sturgeon are anadromous (migrate to fresher water to spawn but live in more saline water) and demersal (spend most of their time on or near the bottom of the river). Therefore, they usually are found in the river below the water depth where detonations occur, as described below. As discussed in Section 1.5.1, projectiles fired into the MDZ and upper LDZ by NSWCDD can be live or inert. The fuzes tested in both inert and live projectiles are programmed to detonate above the water surface, where detonations can be observed and recorded by researchers. The potential effects from above-water detonations are not expected to affect the shortnose or Atlantic sturgeon, as the air-water interface would reflect most of the energy from the shock wave outward and upward (see Section 4.11.1.1).

A small percentage of projectile fuzes NSWCDD tests fail to detonate in the air and instead detonate when the projectile hits the water surface or below the surface. NSWCDD estimates that less than two percent of live rounds detonate underwater, and those that do generally detonate near the surface of the water (NSWCDL, 2008). A shock wave can be created when fluid (air or water) is rapidly displaced by a projectile. Impacts from live projectiles that detonate underwater may include direct strike of an animal or the effects of pressure pulses generated by the detonation (e.g., organ damage) if an animal is nearby.

In addition to the potential for direct effects from the detonation of live projectiles, there is a remote possibility of directly hitting a breaching sturgeon as it breaks the water surface by the entry of a projectile (either live or inert) into the water, or shooting a foraging/migrating sturgeon as an inert or live dud projectile embeds in the river bottom.

Detonations close to the water surface would have low potential to impact sturgeon that, as bottom feeders, spend most of their time on or near the river bottom (NMFS, 1998; ASSRT, 2007). Because the shock wave generated by a detonation below the surface of the water spreads spherically outward (NSWC, 1978), the energy of the shock wave attenuates exponentially away from the point of detonation and would be substantially reduced near the bottom, the preferred habitat of sturgeon.

Currently, in particularly active years approximately 4,700 large-caliber projectiles are fired into the PRTR. Under the Proposed Action, this number would not change. As described in Section 1.5.1, only 26 percent of projectiles fired are live and of those less than 2 percent detonate under water, resulting in the detonation of about 24 projectiles under water each year (4,700 x 0.26 x 0.02 = 24.4). As described previously, the area between the Main Range gun line and 25,000 yds in the MDZ accounts for 99.4 percent of all munitions tested on the PRTR; this area is referred to as the diffuse zone, and covers an area of 31 sq NM.

The projectiles are fired at gunnery targets – mainly virtual targets (effectively, the river itself), as well as floating targets – on the Potomac River, mostly in the MDZ but infrequently in the upper LDZ. By design, gunfire may destroy or damage some physical targets, such as floating radar reflectors, fixed platforms in the river, UAVs, vessels, towed sleds, and causeway sections. The environmental impacts of fragmenting these targets are minimized by removing hazardous

materials such as batteries, oil, gasoline, and antifreeze to the extent possible prior to destroying or damaging them. After the target is impacted and the test completed, all remaining debris and any waste is cleaned up. Therefore, any impacts from target debris are considered insignificant.

Between 1996 and 2010, 15 shortnose sturgeon and 226 Atlantic sturgeon were documented in the Potomac River as a result of the Atlantic Sturgeon and Shortnose Sturgeon Reward Program (refer to Figures 3.14-2 and 3.14-3). A maximum of two shortnose sturgeon have been captured in any single year, while a maximum of 36 Atlantic sturgeon (including five recaptures) have been caught in any one year. Forty-four of these captures have been within the diffuse zone (43 Atlantic sturgeon and 1 shortnose sturgeon) and nine of these captures (8 Atlantic sturgeon, 1 shortnose sturgeon) have been within the zone receiving the highest density of projectiles, the dense zone.

Given the small number of live projectiles detonating underwater annually (24), the small area that would be affected by a projectile's detonating close to the surface of the water, the large area over which almost all munitions are fired (31 sq NM), the intermittent nature of the testing, and the small number of sturgeon in the Potomac River, the probability of a sturgeon's being hit by a projectile or by an associated shockwave is extremely low.

Indirect effects of ordnance on sturgeons could include increases in the suspended sediments near the area where projectiles enter the sediment, impairment of water and/or sediment quality, disruption of migration or spawning, and habitat disturbance, as discussed below.

Under all alternatives, the number of large-caliber projectiles fired annually in the PRTR would be similar to the levels of the last 15 years. Indirect effects on the shortnose and Atlantic sturgeon from testing are potential increases in suspended sediments in the water column, water and/or sediment quality impairment from munitions constituents, habitat disturbance (i.e., burial of prey by sediment resuspension), and disruption of sturgeon.

When an inert or dud projectile penetrates river sediment, a small crater is created at the entry point, releasing sediment into the water column. Sediment in the main channel of the PRTR is predominantly gray to black clay or silty clay based on samples taken there (Knebel et al., 1981; also see Figure 3.9-9). Increases in the level of suspended solids would be concentrated near the area where projectiles enter the sediment. No documented estimates of the increase in suspended material could be found, but it is anticipated that the sediments disturbed at the impact site would quickly settle out of the water column and not affect populations of invertebrates that sturgeon feed upon. Increases in levels of suspended sediments caused by projectiles entering the sediment would be localized, and these short-term individual events would not affect the current levels of suspended sediments found in the water column.

As described previously, munitions fired into the PRTR over the last 90 years have introduced explosives and metals into the river. A fate and transport model was used (Appendix F) to estimate the potential loading of explosives and metals into the river water and sediment using conservative assumptions. The predicted concentrations of metals in the dense and diffuse areas of the MDZ (Table 4.11-1) were compared to water quality (Tables 4.11-2 and 4.11-4) and sediment quality (Tables 4.11-3 and 4.11-4) criteria. Modeled concentrations of metals and explosives contributed by munitions activities in the PRTR range from about 5 to more than a billion times below target water and sediment quality criteria values (Tables 4.11-5 to 4.11-8) for both metals and explosives, indicating that compounds from munitions activities have no adverse impacts on aquatic life, including shortnose and Atlantic sturgeon.

Sediment criteria and guidelines are generally based on benthic community metrics and toxicity studies performed on invertebrates and fish. As an additional comparison, metal body burdens (tissue concentration) in fish were estimated based on bioconcentration factors (BCFs) from the water column. BCFs were calculated for fish (see Section 4.11.1.4), so they are also applicable to the shortnose and Atlantic sturgeon. All modeled munitions concentrations in fish in the PRTR were thousands to more than a trillion times below concentrations potentially resulting in adverse effects, as shown in Table 4.11-11.

Disturbance of shortnose and Atlantic sturgeon habitat by projectiles entering the river bottom is not anticipated to impact benthic (river bottom) invertebrate communities (see Section 3.11.3), which serve as a food source for sturgeon. Recolonization of impacted areas by benthic invertebrates is expected to be rapid, as most benthic invertebrate communities have been shown to recover rapidly from disturbance, generally within one year (e.g., Gore, 1979; Niemi et al., 1990). Localized areas where projectiles enter the river bottom would be quickly recolonized from adjacent areas. Therefore, habitat disturbance would be temporary, and shortnose and Atlantic sturgeon would not experience any decrease in prey due to localized ordnance activities. Most detonations would occur on land ranges (infrequently, detonations take place on barges in the PRTR), which would have no impact on shortnose or Atlantic sturgeon.

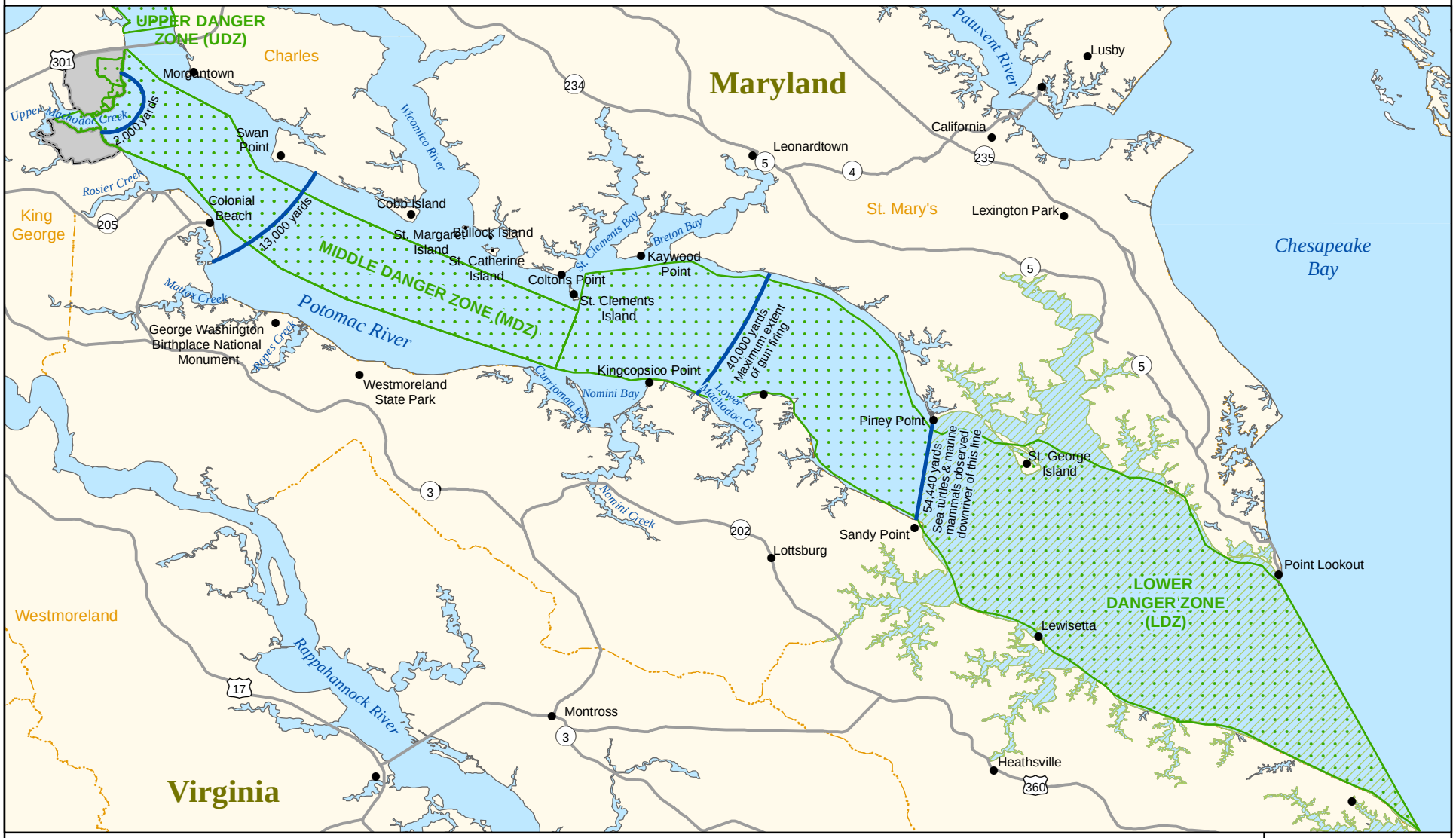
There is no evidence that sturgeon are spawning in the Potomac River. However, if they were, ordnance activities on the PRTR would not disrupt potential spawning of the shortnose or Atlantic sturgeon. There is no physical overlap between the PRTR and potential spawning grounds located at the head of tide in the vicinity of Little Falls above Washington, DC, many miles upriver of the PRTR.

Therefore, under Section 7 of the ESA, the effect of ordnance activities on the shortnose sturgeon and Atlantic sturgeon under the No Action Alternative is expected to be insignificant or discountable. In a letter dated January 11, 2012, NMFS concurred that RDT&E activities covered by this EIS may affect, but are not likely to adversely affect any listed species under NMFS jurisdiction (Morris, January 11, 2012). In accordance with NEPA, ordnance activities under the No Action Alternative would have negligible, long-term, direct and indirect, negative impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

As discussed in Section 3.14.3.2, three species of sea turtles are known to occur in the lower Potomac River based on reported stranding incidents: loggerhead, Kemp's ridley, and, to a lesser extent, the green turtle. No ordnance is fired into the lower LDZ, where sea turtles occur (Figure 4.14-1, Distance to Areas of Sea Turtle and Marine Mammal Occurrence). The maximum extent of projectile testing (40,000 yds from the Main Range gun line) takes place and would continue to occur in the future more than 6.5 NM (13,165 yds) upriver of where sea turtles may be present. Therefore, there would be no possibility of a sea turtle's being in the vicinity of a detonation and no potential for direct effects.

Distance to Areas of Sea Turtle and Marine Mammal Occurrence



Potomac River Test Range (PRTR) Complex

Sea Turtle and Marine Mammal Distribution Area

Naval Support Facility (NSF) Dahlgren

6 0 6 Miles

10 0 10 Kilometers

N

NSWCDD EIS

NAVSEA WARFARE CENTERS DAHLGREN

Source: NSWCDD GIS (2008 - 2011); Danger Zones defined in 33 CFR § 334.230.

Figure 4.14-1

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Under all alternatives of the Proposed Action, the number of large-caliber projectiles fired annually in the PRTR would be similar to the levels of the last 15 years. Indirect effects on sea turtles from testing are potential increases in suspended sediments in the water column and water and/or sediment quality impairment from munitions constituents. The levels of suspended sediments in the water column and concentrations of munitions constituents in water and sediments would be lower than those described above for the shortnose and Atlantic sturgeon. Concentrations would be diluted to undetectable levels by the time they reach Sandy Point, Virginia/Piney Point, Maryland in the lower LDZ, the upper limit of where sea turtles have been observed in the Potomac River (discussed in Section 4.14.1).

Sea turtle auditory sensitivity is not well studied, although research completed to date suggests that it is limited to low-frequency bandwidths. Studies using green, loggerhead, and Kemp's ridley turtles found that sensitivity varies slightly by species and age class (Ketten and Bartol 2006). Sea turtles possess an overall hearing range of approximately 100 to 1,000 Hz, with an upper limit of 2,000 Hz (Ridgway et al., 1969; Ketten and Bartol, 2006).

Sound travels about 4.5 times faster in water than in air, at a speed of about 1,500 m per second, depending on the depth, temperature, and salinity of the water (OceanLink, 2011). Sea turtles are likely to hear low frequency explosions underwater, but given the current ambient sound levels in the Potomac River, the amount of sound contributed by ordnance RDT&E activities is considered to be low. Preliminary data examining computerized tomography scan images of a 100 lbs per square inch shock wave exposure on a small (12-in long) Kemp's ridley carcass showed no ear or lung damage was evident on the scans (NOAA Fisheries Service, 2011). A dolphin would have shown obvious damage at this level, indicating that turtles are less sensitive to explosions than marine mammals (NOAA Fisheries Service, 2011). It is not anticipated that sea turtles would suffer any long-term consequences from ordnance sound, particularly because projectiles would be fired a minimum of 6.5 NM upriver of the area of the river where sea turtles may be found.

As described in Section 4.11.1.1, modeled concentrations of metals and explosives contributed by munitions activities in the PRTR are 5 to billions of times below target water and sediment quality criteria values for both metals and explosives in the dense and diffuse zones of the MDZ. Concentrations would be even lower in the LDZ due to dilution, resulting in background level concentrations of metals and no detection of explosives from NSWCDD activities and would have negligible, if any, effects on sea turtles.

Based on the location of ordnance activities relative to the occurrence of sea turtles, in accordance with Section 7 of the ESA, potential effects of ordnance activities under the No Action Alternative are considered to be insignificant or discountable. In a letter dated January 11, 2012, NMFS concurred that RDT&E activities covered by this EIS may affect, but are not likely to adversely affect any listed species under NMFS jurisdiction (Morris, January 11, 2012). In accordance with NEPA, ordnance activities under the No Action Alternative would have no direct and negligible, short-term, indirect negative impacts on sea turtles.

Birds

Migratory birds are commonly found at NSF Dahlgren, particularly around the Potomac River and other waters. Federal species of concern that may occur within a four-mile radius of the installation include the loggerhead shrike (*Lanius ludovicianus*), black rail (*Laterallus*

jamaicensis), and cerulean warbler (*Dendroica cerulean*) (Table 3.14-1). Nine bird species listed as state threatened or state species of special concern have been observed at NSF Dahlgren (NSF Dahlgren, 2007). Potential impacts on migratory birds and other protected bird species are discussed in Section 4.12. However, as there is a specific management plan for the bald eagle at NSF Dahlgren (NSF Dahlgren and NAVFAC Washington, 2007), this discussion focuses on impacts on the bald eagle, which while no longer an ESA-listed species, is protected at the federal level by the Bald and Golden Eagle Protection Act (BGEPA), the Lacey Act, and the Migratory Bird Treaty Act (MBTA).

Three of the SIAs at NSF Dahlgren, which are located away from firing ranges and detonation areas, provide nesting habitat for bald eagles. Nesting has also been observed outside of the SIAs (Figure 3.12-3), indicating that suitable habitat is not restricted to this area, and that activities conducted in other areas of NSF Dahlgren have not discouraged bald eagle nesting, despite noise associated with firing. Protection zones are established around of all bald eagle nests, with the first protection zone (PZ1) extending from the nest tree to a radius of 750 ft and the second zone (PZ2) extending from 750 ft to 1,320 ft or a quarter-mile in radius (NSF Dahlgren and NAVFAC Washington, 2007).

As discussed in Section 3.12.3.1, the number of bald eagles along the Potomac River has been steadily rising since surveys began in 1977. The number of nests documented at NSF Dahlgren increased from 1 to 11 between 1983 and 2008. The bald eagle population at NSF Dahlgren, in and outside of the SIAs, shows no evidence of being affected by current ordnance activities. Individual bald eagles could be hit by projectiles – although the probability of this would be very low – or the behavior of individuals could be affected by the noise of gun firings; however, no behavioral changes have been observed.

Ordnance activities under the No Action Alternative would not affect the bald eagle, which is protected by the BGEPA and the Lacey Act. Nor would ordnance activities affect ESA-listed bird species, or bird species protected by the MBTA or the Lacey Act. In accordance with NEPA, ordnance activities under the No Action Alternative would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

As discussed in Section 3.14.5, four species of marine mammals have been sighted or stranded in the Potomac River: bottlenose dolphin, harbor porpoise, Risso's dolphin, and minke whale. These species are not ESA-listed, nor are they considered depleted under the Marine Mammal Protection Act (MMPA).

Four marine mammal species that occur rarely or regularly in the Chesapeake Bay are listed as endangered under the ESA. These include three baleen whale species – North Atlantic right whale (*Eubalaena glacialis*), humpback whale (*Megaptera novaeangliae*), and fin whale (*Balaenoptera physalus*) – and the West Indian manatee (*Trichechus manatus*). These three species of whales are known to migrate past the mouth of Chesapeake Bay, and, on rare occasions, they enter the bay and have been sighted or recorded as stranded (DoN, 2009). The three large whale species are transient within the Bay, but there are no records of their occurring in the Potomac River (DoN, 2009). Historical marine mammal sighting records include two sightings of the West Indian manatee in the Potomac River, with the last sighting in August 1980 (DoN, 2009). However, the Chesapeake Bay area is outside of the

normal range of the manatee, which prefers warmer waters, and these two sightings are considered atypical. As there is no spatial overlap between the PRTR and ESA-listed marine mammals under normal conditions, they are not discussed further here.

According to NOAA Ocean Service maps (NOS, 2005), marine mammals are found in the lower Potomac River from the mouth to Sandy Point, Virginia and Piney Point, Maryland (Figure 4.14-1), which coincides with the lower part of the LDZ. NSWCDD range control boat operators, who are on the river in the MDZ five days a week, confirm that marine mammals are not sighted in this most active part of the PRTR (Patteson, pers. comm., August 4, 2008).

Bottlenose dolphins are the only marine mammal regularly sighted in the lower Potomac River. Nearshore bottlenose dolphins occur in the Chesapeake Bay and its tributaries from April to November (VDEQ, 1997).

Since 1995, there have been only two reported strandings of harbor porpoises, one of a Risso's dolphin, and one of a minke whale in the Potomac River (Collins-Payne, pers. comm., March 23, 2006, May 23, 2007, and October 13, 2009). All stranded individuals were found dead and therefore they may have drifted to the locations at which they were found (see Table 3.14-4).

The normal ranges of Risso's dolphin and the minke whale do not include the Chesapeake Bay, so these species are considered "extralimital" in this area (occurring outside their normal range) (DoN, 2009). Based on the feeding and habitat preferences of harbor porpoises and the low incidence of sightings and strandings in the lower Potomac River, harbor porpoises occur very rarely on the PRTR (see Section 3.14.5). Because the ranges of these species normally do not include the lower Potomac River, under all alternatives, no impacts to harbor porpoises, Risso's dolphins, and minke whales are anticipated – only potential impacts to bottlenose dolphins are evaluated further.

As discussed in Section 3.14.1, the National Defense Authorization Act of fiscal year 2004 (Public Law 108-136) amended the definition of harassment under the MMPA as applied to military readiness activities or scientific research activities conducted by or on behalf of the federal government, consistent with Section 104(c)(3) [16 U.S.C. §1374 (c)(3)]. The fiscal year 2004 National Defense Authorization Act adopted the definition of "military readiness activity" as set forth in the fiscal year 2003 National Defense Authorization Act (Public Law 107-314). The Proposed Action constitutes a military readiness activity as that term is defined in Public Law 107-314, as the Proposed Action constitutes "training and operations of the Armed Forces that relate to combat" and constitutes "adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use."

For military readiness activities, MMPA Level A harassment includes any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild. As defined in prior rulings (NOAA, 2001, 2002), injury is the destruction or loss of biological tissue. Consistent with prior actions and rulings (NOAA, 2001), this analysis assumes that all injuries (slight to severe) are considered Level A harassment under the MMPA. MMPA Level B harassment includes all actions that disturb or are likely to disturb a marine mammal or marine mammal stock in the wild through the disruption of natural behavioral patterns. This includes, but is not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behavioral patterns are abandoned or significantly altered. The noise from underwater detonations may have potential adverse effects on marine mammals, resulting in Level A or Level B harassment.

Areas in which Level A and Level B harassment are predicted to occur are described as harassment zones. The Level A harassment zone extends from the source out to the distance and exposure at which the slightest amount of injury is predicted to occur. The acoustic exposure that produces the slightest degree of injury is, therefore, the threshold value defining the outermost limit of the Level A harassment zone. Use of the threshold associated with the onset of slight injury as the most distant point and least injurious exposure takes account of all more serious injuries by inclusion within the Level A harassment zone.

The Level B harassment zone begins just beyond the point of slightest injury and extends outward from that point to include all animals with the potential to experience Level B harassment. The animals predicted to be in the portion of the zone where temporary impairment of sensory function (altered physiological function) is expected are all assumed to experience Level B harassment because of the potential impediment of behaviors that rely on acoustic cues. Beyond that distance, the Level B harassment zone continues to the point at which no biologically-significant behavioral disruption is expected to occur.

Table 4.14-1 provides estimated impact areas associated with harassment thresholds for dolphins for the detonation of a single 155 mm explosive round (22.47 lbs net explosive weight [NEW] – about twice the weight of explosives typically contained in the type of 155 mm round NSWCDD generally fires). If a 155 mm explosive round detonated at the maximum downriver extent of firing on the PRTR – 40,000 yds from the Main Range gun line – the most extensive impact radius indicated in Table 4.14-1 of 692 ft would end approximately 6.5 NM upstream of the area where marine mammals are known to occur (Figure 4.14-1). There would be no overlap between ordnance testing and the occurrence of bottlenose dolphins. Therefore, continued testing under the No Action Alternative would not result in Level A or B harassment.

Table 4.14-1
Estimated Impact Radii for Dolphins for a 155 mm Detonation

Impact Criterion and Threshold	Estimated Impact Radius (ft)	
	Summer	Winter
Injurious Physiological Effects		
Mortality – Onset extensive lung injury (30.5 psi-ms)	66	66
Onset slight lung injury (indexed to 13 psi-ms)	102	102
50% tympanic-membrane rupture (205 dB re 1 μPa^2-s)	125	112
Non-injurious Physiological Effects		
Temporary Threshold Shift – Energy (182 dB re 1 μPa^2-s)	413	351
Temporary Threshold Shift – Peak pressure (23 psi)	692	686

Source: Based on MCB Camp Lejeune, 2009, Table 5-2.

Modeled concentrations of metals and explosives contributed by munitions activities in the PRTR are range from about 5 to more than a billion times below target water and sediment quality criteria values (Tables 4.11-5 to 4.11-8) for both metals and explosives in the dense and diffuse zones of the MDZ. Concentrations would be even lower in the LDZ due to dilution,

resulting in background level concentrations of metals and no detectable explosives from NSWCDD activities.

Based on these analyses, there are no reasonably foreseeable takes of marine mammals associated with ordnance activities in accordance with the MMPA. In accordance with NEPA, ordnance activities would have no direct or indirect impacts on marine mammals.

Insects

The USFWS Virginia Ecological Services Field Office identified the Northeastern beach tiger beetle in a species list that enumerates threatened, endangered, and proposed species, designated critical habitat, and candidate species that may be present in the project area or may be affected by the Proposed Action (USFWS, January 21, 2013; see Appendix G page G-65). USWFS species lists are not entirely based upon the current range of a species and may also take into consideration actions that affect a species downstream.

Northeastern beach tiger beetle populations have been observed on beaches near the mouth of the Potomac River, along the Virginia side of the LDZ (Figure 3.14-4), more than 9 NM below the farthest downriver extent of gun-firing (Figure 4.14-1). The LDZ is a water range and does not include any land areas. Suitable habitat for the tiger beetle, consisting of open, undisturbed beaches, sand flats, dunes, water edges, woodland paths, and sparse grassy areas, is absent within the range areas where RDT&E activities would occur.

Ordnance activities would not directly or indirectly affect Northeastern beach tiger beetle suitable habitat along the PRTR LDZ, as NSWCDD's ordnance activities would take place in deep water well away from the LDZ shoreline.

Modeled concentrations of metals and explosives contributed by munitions activities in the PRTR are orders of magnitude below target water and sediment quality criteria values (Tables 4.11-5 to 4.11-8) for both metals and explosives in the dense and diffuse zones of the MDZ. Based on the low concentrations of munitions constituents, there would be no indirect effects on tiger beetles potentially occurring downstream along the LDZ shoreline.

A USFWS Virginia Ecological Services Field Office online project review of the Proposed Action conducted by NSWCDD determined that because no suitable habitat is present within the project area, the Proposed Action would have no effect on the Northeastern beach tiger beetle (Wray, January 23, 2013; see Appendix G page G-83). The USFWS Virginia Ecological Services Field Office concurred with the determination on February 19, 2013 (Drummond, February 19, 2013; see Appendix G page G-101).

In accordance with Section 7 of the ESA, ordnance activities under the No Action Alternative would have no effect on listed insect species. In accordance with NEPA, ordnance activities would have no direct or indirect impacts on tiger beetles.

Plants

The USFWS Virginia Ecological Services Field Office identified sensitive joint-vetch, an annual plant found in tidal wetlands along the shoreline of the Potomac River, in a species list that enumerates threatened, endangered, and proposed species, designated critical habitat, and

candidate species that may be present in the project area or may be affected by the Proposed Action (USFWS, January 21, 2013; see Appendix G page G-65). This determination was based on screening information and not actual species occurrences. A USFWS Virginia Ecological Services Field Office online project review of the Proposed Action conducted by NSWCDD determined that the Proposed Action may adversely affect the sensitive joint-vetch (Wray, January 23, 2013; see Appendix G page G-83). This determination was the only outcome possible in the online review process, because suitable habitat exists for the sensitive joint-vetch within NSF Dahlgren and no recent surveys have been conducted that demonstrate that the species is not present on the installation. The USFWS Virginia Ecological Services Field Office concurred with the determination on February 19, 2013 (Drummond, February 19, 2013; see Appendix G page G-101). However, based on site- and project-specific information, the Proposed Action would have no effect on this species for the reasons discussed in the following paragraphs.

Although potential habitat exists for rare plants on NSF Dahlgren, no rare plants were found on the installation during a survey performed in 2004 (DoN, 2004b). To confirm that this species is not present, the sensitive joint-vetch, which is an annual (a plant that lives for only one growing season), requires a field survey performed within the last year. Therefore, consistent with USFWS Virginia Ecological Services Field Office guidelines (USFWS, 2004), the 2004 rare, threatened, and endangered plant species survey is not sufficiently recent to confirm that sensitive joint-vetch is not present. However, even if this species occurs in tidal wetlands on the installation, it is unlikely to be present in the range areas used for ground-disturbing activities, as discussed in Section 3.14.7, as there is no suitable habitat in these areas. If a rare plant were to be discovered at NSF Dahlgren, it is likely that an exclusion zone would be placed around it.

No new construction or ranges are associated with any of the proposed activities covered in this EIS, minimizing potential impacts on habitat. Ordnance activities on the PRTR would not affect plants along the shoreline and in wetlands, including any protected species that may be present, because the target and detonation areas are distant from the shoreline and wetlands, as well as distant from suitable habitat for protected plants. There would be no direct impacts from projectiles or bullets on rare plants. There also would be no indirect impacts from munitions constituents on plants, as any potential munitions constituents reaching them in the surface water or sediments would be at or below background concentrations.

In accordance with Section 7 of the ESA, ordnance activities under the No Action Alternative would have no effect on sensitive joint-vetch. In accordance with NEPA, ordnance activities under the No Action Alternative would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.1.2 EM Energy Activities

Under the No Action Alternative NSWCDD would continue to use three main outdoor facilities for electromagnetic environmental effects (E3) and hazards of electromagnetic radiation to ordnance (HERO) activities: NOTES, MOATS, and two ground planes. MOATS and the two ground planes are in highly-developed areas with little or no natural habitat surrounding them, whereas NOTES is surrounded by forest in an area with little human activity. All three facilities are located on land in the Mission Area or land ranges, away from the PRTR, and their use would not affect aquatic organisms or aquatic habitats. Radars are tested at the STSTS on Main Range and would continue to operate over the PRTR. The EM energy from these radars may

strike the water surface. EM launchers RDT&E takes place at the EMLF, which beyond a safety zone, is surrounded by forest.

The NDEC and the CETFAC transmit directed energy (microwaves, RF, and lasers) outdoors across the waters of the Potomac River within the PRTR, near the mouth of Upper Machodoc Creek (see Figure 1-7). For directed energy activities over the water, beams of directed energy are transmitted above the water and predominantly would not strike or penetrate the water surface. Activities are tightly controlled and the likelihood of directed energy beams' straying from the target and target platform and hitting the surface of the water is extremely small.

Should EM energy from radars or from directed energy tests strike the water surface, it would be incidental. For the reasons discussed in Section 4.11.1.2, the potential harmful effects of EM energy on aquatic organisms would be highly localized and would be limited to the uppermost water layer. Waves of EM energy that strike the surface of the water may be reflected at the air-water boundary, but would be scattered upon hitting the rough surface of the water, as shown in Figure 1-8a. EM energy that breaches the water surface would be propagated and attenuated, rapidly decreasing in amount and intensity as it travels through the water.

The only EM sensor activity that would be conducted below water is the occasional deployment of modified passive sonobuoys in the PRTR. The sonobuoys are about a foot high and float. The use of passive sonobuoys, which only receive sound, would not generate additional sounds or other EM energy on the PRTR. The sonobuoys used in the Potomac River would be recovered for reuse at the conclusion of the events.

Fish

EM energy activities would have no direct contact with the shortnose or Atlantic sturgeon or their habitat. EM energy that enters the water would dissipate well before it reaches the river bottom where sturgeon are usually found. Sonobuoys float on the surface, so that sturgeon would have limited physical contact with them. Because they spend most of their time on and near the river bottom, shortnose and Atlantic sturgeon also would be out of the range of any non-thermal EM effects and any potential effects on navigation and orientation.

Under the No Action Alternative, in accordance with Section 7 of the ESA, EM energy activities would have no effect on the shortnose sturgeon and Atlantic sturgeon. In accordance with NEPA, EM energy activities under the No Action Alternative would have no direct or indirect impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

NSWCDD would continue to use active EM energy sensors (e.g., radar) above the water, occasionally on boats, ships, and aircraft in the LDZ, and passive sonobuoys occasionally may be deployed on the LDZ. Although sea turtles are known to occur in the LDZ, the passive EM energy would not affect sea turtles.

In accordance with Section 7 of the ESA, under the No Action Alternative, EM energy activities would have no effect on sea turtles. In accordance with NEPA, EM energy activities would have no direct or indirect impacts on sea turtles.

Birds

While most of the EM energy facilities are in developed areas, NOTES, CETFAC, and EMLF are close to forested areas with less human activity. As discussed in Section 4.12.1.2, birds flying above EM energy test facilities are unlikely to be exposed to high electric or magnetic fields, as exposure levels rapidly dissipate with distance and the duration of the EM energy emission is brief. In the unlikely event that a bald eagle nest were to be established near an EM energy test facility, NSWCDD would consult with the USFWS and the VDGIF; however, as discussed in Section 3.12 EM energy facilities are outside of bald eagle nest buffer zones.

EM energy activities under the No Action Alternative would not affect the bald eagle, which is protected by the BGEPA. Nor would EM energy activities affect ESA-listed bird species protected under Section 7 of the ESA, or bird species protected by the MBTA or the Lacey Act. In accordance with NEPA, EM energy activities under the No Action Alternative would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

As noted above, targets on vessels or passive sonobuoys may occasionally be deployed on the LDZ; however marine mammals would have no contact with the targets as their range does not overlap with target areas, as shown on Figure 4.14-1. Active EM sensors would operate above the water surface where dolphins would not be exposed, and sonobuoys deployed are passive (i.e., do not emit EM energy). Any bottlenose dolphins in the LDZ would not interact with them.

There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with EM energy activities. In accordance with NEPA, EM energy activities would have no direct or indirect impacts on marine mammals.

Insects

EM energy activities in the LDZ take place in deeper waters; no landings on shore take place. Therefore, there would be no potential for interaction with northeastern beach tiger beetles on the beaches of the lower LDZ as there would be no spatial overlap.

In accordance with Section 7 of the ESA, under the No Action Alternative, EM energy activities would have no effect on listed insect species. In accordance with NEPA, EM energy activities would have no direct or indirect impacts on northeastern beach tiger beetles.

Plants

Two of the three main outdoor facilities for E3 and HERO activities, MOATS and the two ground plane areas, are in highly-developed areas with little or no natural habitat surrounding them. In contrast, NOTES is surrounded by forest. Operations at NOTES take place once or twice a year and most of the field energy is contained within the facility structure (see Section 1.5.2.3). Sensitive joint-vetch is not found in forested areas and would not be present here. However, even if protected plants are found nearby, the EM energy would not affect them as it decreases exponentially from the source and would be at a very low level by the time it reached individual plants.

In accordance with Section 7 of the ESA, EM energy activities under the No Action Alternative would have no effect on sensitive joint-vetch. In accordance with NEPA, EM energy activities

under the No Action Alternative would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.1.3 Laser Activities

Two of NSWCDD's five current laser corridors are on the PRTR's developed land ranges, and three cross the waters of Upper Machodoc Creek and the Potomac River through the PRTR. Research in aquatic areas currently is and will continue to be conducted above the surface of the water.

For No Action Alternative activities, both the laser emitter and the target/backstop is fixed and the laser emits almost horizontally. The laser is pre-aimed and is able to move, except for minute corrections to the aim point. Under the current maximum power (100 kW), for over-water activities, the laser beam begins at least 12 ft above mean water level and terminates at least 9 ft above mean water level. The eye-hazard area around the laser beam is about 6 ft in diameter and at least 6 ft above mean water level (see Figure 1-10). Neither the laser beam nor the eye-hazard zone would come in contact with the water. For overland activities, the laser beam is a minimum of 6 ft above ground level.

As with EM energy, laser activities are tightly controlled and the likelihood of a laser beam's straying from the target/backstop and hitting the surface of the water is extremely small. Should EM energy from laser tests strike the water surface it would be incidental and most of it would be reflected at the air-water boundary where it would be scattered upon hitting the rough surface of the water, (see Figure 1-8a). EM energy that breaches the water surface would be propagated and attenuated, rapidly decreasing in amount and intensity as it travels through the water.

Fish

Under the No Action Alternative, laser activities have no direct contact with the shortnose or Atlantic sturgeon. Laser energy that enters the water would be dissipated well before it reached the lower depths of the river, where sturgeon are usually found.

Under the No Action Alternative, in accordance with Section 7 of the ESA, laser activities would have no effect on shortnose and Atlantic sturgeon. In accordance with NEPA, laser activities under the No Action Alternative would not have direct or indirect impacts on shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

Under the No Action Alternative, laser activities would not occur in the LDZ, where sea turtles are known to occur. Therefore, in accordance with Section 7 of the ESA, laser activities would have no effect on sea turtles. In accordance with NEPA, laser activities under the No Action Alternative would not have direct or indirect impacts on sea turtles.

Birds

All over-land laser activities occur in developed or maintained areas with a clear line of sight. The possibility of a laser hitting a flying eagle is considered remote, as during each laser test, a visual observer trained by the NSF Dahlgren's natural resources manager would watch for eagles, ospreys, other birds, and wildlife that may wander into the laser corridor, as discussed in

Section 4.12.1.3. In the unlikely event that a bald eagle nest were to be established near a laser corridor NSWCDD would consult with the USFWS and the VDGIF; however, as seen in Figure 3.12-3 existing nests are well away from laser corridors.

Laser activities under the No Action Alternative would not affect the bald eagle, which is protected by the BGEPA. Nor would laser activities affect ESA-listed bird species under Section 7 of the ESA, or bird species protected by the MBTA or the Lacey Act. In accordance with NEPA, laser activities under the No Action Alternative would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

Under the No Action Alternative, laser activities would not occur in the LDZ, where bottlenose dolphins are known to occur. There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with laser activities. In accordance with NEPA, under the No Action Alternative, laser activities would have no direct or indirect impacts on marine mammals.

Insects

All documented northeastern beach tiger beetle occurrences are along the Virginia shore of the southern reaches of the LDZ. In accordance with Section 7 of the ESA, laser activities under the No Action Alternative would have no effect on listed insect species. In accordance with NEPA, under No Action Alternative laser activities would have no direct or indirect impacts on northeastern beach tiger beetles as there would be no spatial overlap.

Plants

NSWCDD's laser corridors are located on the PRTR's developed land ranges, with three corridors crossing the waters of Upper Machodoc Creek and the Potomac River. The sensitive joint-vetch is not found in developed areas and would not be present in open water. Lasers would be fired above vegetation on the shoreline and would not impact sensitive joint-vetch in the event it were found in the area.

In accordance with Section 7 of the ESA, laser activities under the No Action Alternative would have no effect on sensitive joint-vetch. In accordance with NEPA, laser activities under the No Action Alternative would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.1.4 Chemical Defense Activities

Outdoor chemical defense activities using simulants would occur under the No Action Alternative.

Fish

The quantities of chemical simulants released from a boat on the PRTR were modeled to determine potential chemical concentrations deposited in the river. Modeled concentrations and field measurements of chemical simulants were well below levels that could result in adverse effects to aquatic life, inclusive of fish, as described in Section 4.11.1.4. Current use of chemical

simulants has not resulted in any observable environmental effects during or after events (NSWCDL, 2004; NSWCDL, 2005; NSWCDL, 2009).

Under the No Action Alternative in accordance with Section 7 of the ESA, chemical defense activities would have no effect on shortnose and Atlantic sturgeon. In accordance with NEPA, under the No Action Alternative, chemical defense activities would have no direct or indirect impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

NSWCDD does not currently and would not in the future conduct chemical defense activities on the LDZ. Concentrations of simulants emitted over the MDZ would be diluted to background levels by the time they reach the lower portion of the LDZ, where sea turtles are known to occur, located more than 23 NM downriver from the chemical defense testing area.

Therefore, in accordance with Section 7 of the ESA, chemical defense activities would have no effect on sea turtles under the No Action Alternative. In accordance with NEPA, under the No Action Alternative chemical defense activities would have no direct or indirect impacts on sea turtles.

Birds

Chemical simulants are not tested in the bald eagle protection zones. Any chemical simulants that bald eagles come into contact with would be at concentrations equivalent to background levels, below concentrations that would cause adverse effects.

Chemical defense activities under the No Action Alternative would not affect the bald eagle, which is protected by the BGEPA. Nor would chemical defense activities affect ESA-listed bird species under Section 7 of the ESA, or bird species protected by the MBTA or the Lacey Act. In accordance with NEPA, chemical defense activities would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

NSWCDD does not currently and would not in the future conduct chemical defense activities on the LDZ, where bottlenose dolphins are known to occur. Concentrations of simulants would be diluted to background levels by the time they reach the lower portion of the LDZ, where marine mammals are known to occur, located more than 23 NM below the chemical defense testing area.

There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with chemical defense activities. In accordance with NEPA, chemical defense activities under the No Action Alternative would have no direct or indirect impacts on marine mammals.

Insects

Northeastern beach tiger beetles have only been observed on beaches in the lowest portion of the LDZ, near the mouth of the river. Simulants released over the MDZ would be rapidly dispersed and diluted to concentrations that are less than what would cause toxicity, and any incidental

simulants reaching the beetle habitat would be orders of magnitude below what is considered toxic.

Therefore, in accordance with Section 7 of the ESA, chemical defense activities under the No Action Alternative would have no effect on listed insect species. In accordance with NEPA, chemical defense activities under the No Action Alternative would have no direct or indirect impacts on tiger beetles.

Plants

Chemical simulants released during testing would be rapidly dispersed and diluted to concentrations below those associated with toxic effects. Concentrations of chemical simulants would be at background levels by the time they reach wetlands where sensitive joint-vetch may potentially be found.

In accordance with Section 7 of the ESA, chemical defense activities under the No Action Alternative would have no effect on sensitive joint-vetch. In accordance with NEPA, chemical defense activities under the No Action Alternative would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.1.5 PRTR Use

Under the No Action Alternative, PRTR use for RDT&E activities would remain at present levels. NSWCDD would restrict public access to some or all of the MDZ approximately 750 hours per year.

Fish

Incidental vessel strikes, which have the potential to occur during adult sturgeon breaching behavior (i.e., not during spawning or migration), are not expected to occur during RDT&E activities because of the low number of shortnose and Atlantic sturgeon found in the Potomac River, the limited breaching associated with these individuals, and the overall reduction in vessel traffic when NSWCDD is conducting operations because the range is restricted. As sturgeon are generally found in the deeper areas of the river channel, it is extremely unlikely that an interaction between an individual shortnose sturgeon and a vessel will occur as vessels will not be operating close to the river bottom where sturgeon are likely to occur.

Therefore, in accordance with Section 7 of the ESA, PRTR use under the No Action Alternative may affect, but is not likely to adversely affect the shortnose sturgeon and Atlantic sturgeon. In accordance with NEPA, PRTR use under the No Action Alternative would have negligible, long-term, direct and indirect, negative impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

The only NSWCDD activities that potentially would affect sea turtles are the use of range boats and operational vessels, such as barges, on the LDZ that may incidentally strike a sea turtle swimming or feeding at or near the water surface. The probability of any one of these vessels coming into contact with a sea turtle is the same as any other vessel near the mouth of the Potomac River and is anticipated to be extremely low. Also, when the range boats are active, public vessel traffic is restricted, so overall vessel use would be lower than normal.

Boat engine noise associated with military vessel activities on the waters of the LDZ may have temporary behavioral effects on sea turtles, but as the overall vessel traffic on the PRTR would otherwise decrease during activities, the overall noise level that sea turtles would be exposed to would be lower than usual.

Because this area is beyond the range of NSWCDD's guns and distant from the installation, activities in this portion of the PRTR are infrequent. Also, sea turtles only occur in the Potomac River during summer and fall, further reducing the probability that a sea turtle would be in the immediate area during the infrequent use of the LDZ for NSWCDD activities. Therefore, while adverse effects may occur in the event of a vessel strike, there would be a very low probability of such strikes.

In accordance with Section 7 of the ESA, PRTR use under the No Action Alternative would have no effect on sea turtles. In accordance with NEPA, under the No Action Alternative, PRTR use would have no direct or indirect impacts on sea turtles.

Birds

Bald eagles may use the PRTR for foraging. Vessels using the PRTR would not interfere with foraging. The probability of an eagle's overlapping in space with a UAV is low, particularly as UAVs do not fly low over surface waters, and eagles are likely to avoid them.

PRTR use under the No Action Alternative would not affect the bald eagle, which is protected by the BGEPA. Nor would PRTR use affect bird species listed under the ESA, or bird species protected by the MBTA or the Lacey Act. In accordance with NEPA, PRTR use would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

The only NSWCDD activities that potentially would affect marine mammals on the LDZ are the use of boats that may incidentally strike a marine mammal swimming, breaching, or feeding at or near the water surface. In general, dolphins are able to avoid boats and, if they are struck, usually escape with no more than a propeller scar. The 2008 stock assessment report for western North Atlantic coastal stocks of bottlenose dolphins records no serious injuries or mortality resulting from vessel interactions throughout the range of this coastal type (Waring et al., 2009). While certain behaviors (e.g., diving, feeding) may be affected in heavily-trafficked waters, the few NSWCDD range control boats and other boats that would be active during activities would not incrementally increase vessel traffic to levels that would result in behavioral impacts. Also, when the range boats are active, public vessel traffic is restricted, so overall vessel use would be lower than normal.

As stated above, marine mammals – predominantly bottlenose dolphins – are found in the lower reaches of the LDZ, where activities would continue to occur infrequently. In addition, bottlenose dolphins occur in the Potomac River only from April to November, further reducing the probability that a dolphin would be in the immediate area during the infrequent use of the LDZ for NSWCDD activities. Therefore, under the No Action Alternative, while adverse effects may occur in the event of a vessel strike, there would be a very low probability of such strikes.

Boat engine noise associated with small-boat activities (commercial, recreational, and military) on the waters of the LDZ may have temporary behavioral effects on bottlenose dolphins and

other marine mammals, but likely routinely occurs without long-term adverse impacts. Marine mammals react to vessel-generated sounds in a variety of ways. Some respond negatively by retreating or engaging in antagonistic responses, while other animals ignore the stimulus altogether (Watkins, 1986; Terhune, 1999). Some studies have ascertained the short-term response to vessel sound and vessel traffic (Watkins et al., 1981; Magalhães et al., 2002), but the long-term implications of ship sound on marine mammals are largely unknown.

Human-generated sound has increased in the marine environment over the past 50 years (Richardson et al., 1995; NRC, 2003). Given the current ambient sound levels in the marine environment, the increment of sound contributed by the use of NSWCDD range control boats and other vessels that would be active during activities would be very low. It is anticipated that any marine mammals exposed may exhibit only short-term reactions and would not suffer any long-term consequences from boat sound.

Further, UAVs flying over the LDZ do not fly low over surface waters, and are only audible when the receiver (e.g., a person or a marine mammal) is close to the UAV. Therefore, the noise emitted from UAVs would not affect bottlenose dolphins.

There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with PRTR use. In accordance with NEPA, PRTR use would have no direct or indirect impacts on marine mammals.

Insects

Northeastern beach tiger beetles have only been observed on beaches in the lowest portion of the LDZ, near the mouth of the river. As such there is no spatial overlap with PRTR use, which would occur in the deeper waters of the LDZ, not near beaches.

In accordance with Section 7 of the ESA, PRTR use under the No Action Alternative would have no effect on listed insect species. In accordance with NEPA, PRTR use under the No Action Alternative would have no direct or indirect impacts on tiger beetles.

Plants

Sensitive joint-vetch, if present along the Potomac River, would be found in the intertidal zone and not in the part of the PRTR frequented by vessels. Based on habitat preferences, there is no spatial overlap with PRTR use and the potential occurrence of rare, threatened, or endangered plants.

In accordance with Section 7 of the ESA, PRTR use under the No Action Alternative would have no effect on sensitive joint-vetch. In accordance with NEPA, PRTR use under the No Action Alternative would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.2 Alternative 1

4.14.2.1 Ordnance Activities

The use of large-caliber guns and projectiles would remain at current levels. Small-caliber gun use would increase from an average of 6,000 bullets fired a year under the No Action Alternative

to 25,500 bullets fired a year. Approximately 2,550 bullets (10 percent) would be fired from land into the river. Under Alternative 1, detonations would increase from 190 events to 200 events, as described in Section 2.5.1.

Fish

Under Alternative 1, impacts to shortnose and Atlantic sturgeon from the firing of large-gun projectiles would be the same as the impacts resulting from the No Action Alternative, described above in Section 4.14.1.1. The likelihood of an underwater explosion's affecting sturgeon or of directly hitting a sturgeon would be very low. Indirect impacts to the shortnose and Atlantic sturgeon associated with large-gun projectiles, including potential increases in suspended sediments, effects on water and sediment quality, disruption of spawning and/or migration, and habitat disturbance, also would be negligible. Although a greater number of small-caliber bullets would enter the PRTR, the probability of directly hitting a sturgeon would be minimal. Most detonations would occur on land ranges and would have no impact on shortnose and Atlantic sturgeon.

Therefore, under Section 7 of the ESA, the effect of ordnance activities on the shortnose sturgeon and Atlantic sturgeon under Alternative 1 is expected to be insignificant or discountable. In a letter dated January 11, 2012, NMFS concurred that RDT&E activities covered by this EIS may affect, but are not likely to adversely affect any listed species under NMFS jurisdiction (Morris, January 11, 2012). In accordance with NEPA, ordnance activities would have negligible, long-term, direct and indirect, negative impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

Under Alternative 1, projectile testing would continue to occur a minimum of 6.5 NM upriver of the area where sea turtles have been sighted, providing an ample margin of safety.

Based on the location of ordnance activities relative to the occurrence of sea turtles, in accordance with Section 7 of the ESA, the effect of ordnance activities under Alternative 1 would be insignificant or discountable. In a letter dated January 11, 2012, NMFS concurred that RDT&E activities covered by this EIS may affect, but are not likely to adversely affect any listed species under NMFS jurisdiction (Morris, January 11, 2012). In accordance with NEPA, ordnance activities under Alternative 1 would have no direct and negligible, short-term, indirect negative impacts on sea turtles.

Birds

Ordnance testing of large-caliber projectiles under Alternative 1 would be the same as under the No Action Alternative. The bald eagle population at NSF Dahlgren, in and outside of the SIAs, which has been growing for years, shows no evidence of being affected by current ordnance activities. The increase in small-arms firing is unlikely to impact birds as there is limited vegetative cover in front of Machine Gun Range. The standard operating procedure (SOP) ensures there is a lookout during firing to make sure that birds and wildlife are not in the area.

Ordnance activities under Alternative 1 would not affect the bald eagle, which is protected by the BGEPA. Nor would ordnance activities affect ESA-listed bird species, or bird species protected

by the MBTA or the Lacey Act. In accordance with NEPA, ordnance activities would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

Under Alternative 1, projectile testing would continue to take place a minimum of 6.5 NM upriver of the area where bottlenose dolphins are known to occur. Therefore, there would be no overlap between ordnance activities and marine mammals.

There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with ordnance activities under Alternative 1. In accordance with NEPA, ordnance activities under Alternative 1 would have no direct or indirect impacts on marine mammals.

Insects

All documented northeastern beach tiger beetle occurrences in the vicinity of the PRTR are along beaches in the southern reaches of the LDZ, where there is no overlap with ordnance activities that would occur in the LDZ water range.

In accordance with Section 7 of the ESA, ordnance activities under Alternative 1 would have no effect on listed insect species. In accordance with NEPA, ordnance activities under Alternative 1 would have no direct or indirect impacts on tiger beetles.

Plants

Ordnance testing of large-caliber projectiles under Alternative 1 would be the same as under the No Action Alternative. Small-caliber testing would increase, but would occur on heavily-used land areas of ranges, such as the Machine Gun Range, not near the tidal wetlands habitat necessary to support sensitive joint-vetch. Detonations would increase, but they, too, would take place on the previously-disturbed EEA land ranges, which are not near the tidal wetlands habitat necessary for sensitive joint-vetch.

In accordance with Section 7 of the ESA, ordnance activities under the Alternative 1 would have no effect on sensitive joint-vetch. In accordance with NEPA, ordnance activities under Alternative 1 would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.2.2 EM Energy Activities

Under Alternative 1, the number of EM energy events would increase from 490 to 590 per year, the power of the EM energy events would increase, and activities would increase as described in Section 2.5.2.

Fish

EM energy activities would have no direct contact with the shortnose or Atlantic sturgeon. EM energy that enters the water would dissipate quickly – well before it reached the river bottom where sturgeon typically are found. The possibility that a sturgeon would breach the surface at the precise moment and location that an EM energy beam misses its intended target is considered negligible.

In accordance with Section 7 of the ESA, under Alternative 1 EM energy activities would have no effect on shortnose sturgeon and Atlantic sturgeon. In accordance with NEPA, EM energy activities under Alternative 1 would have no direct or indirect impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

Sonobuoys located in the lower LDZ, where sea turtles are present, are passive and only receive, but do not emit EM energy. EM energy could be directed at targets on platforms in the LDZ, but there would be no targets directly on the surface water. Any residual energy around the target would quickly dissipate or be absorbed by the water. Lower-power directed energy would be used for initial operations, with gradual increases in power levels as RDT&E progresses.

In accordance with Section 7 of the ESA, EM energy activities under Alternative 1would have no effect on sea turtles. In accordance with NEPA, EM energy activities under Alternative 1 would have no direct or indirect impacts on sea turtles.

Birds

As discussed previously, EM testing is not expected to have any impacts on birds in flight. If a bald eagle nest were to be established near an EM energy test facility NSWCDD would consult with the USFWS and the VDGIF; however, as discussed in Section 3.12 EM energy facilities are outside of bald eagle nest buffer zones.

Under Alternative 1, EM energy activities would not affect the bald eagle, which is protected by the BGEPA. Nor would EM energy activities affect ESA-listed bird species, or bird species protected by the MBTA or the Lacey Act. In accordance with NEPA, EM energy activities under Alternative 1 would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

Sonobuoys located in the lower LDZ, where bottlenose dolphins are present, do not emit EM energy. All active EM energy use would be above the surface of the water and have no overlap with marine mammals. EM energy could be directed at targets on platforms in the LDZ, but there would be no targets directly on the surface water. Any residual energy around the target would quickly dissipate or be absorbed by the water.

There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with EM energy activities under Alternative 1. In accordance with NEPA, EM energy activities under Alternative 1 would have no direct or indirect impacts on marine mammals.

Insects

Because all documented northeastern beach tiger beetle occurrences are along beaches in the southern reaches of the LDZ, in accordance with Section 7 of the ESA, under Alternative 1 EM energy activities would have no effect on listed insect species. In accordance with NEPA, EM energy activities under Alternative 1 would have no direct or indirect impacts on northeastern beach tiger beetles.

Plants

Increasing EM energy activities would not result in any spatial overlap between potential habitat for the sensitive joint-vetch and EM energy activities. In accordance with Section 7 of the ESA, under Alternative 1 EM energy activities would have no effect on sensitive joint-vetch. In accordance with NEPA, EM energy activities under Alternative 1 would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.2.3 Laser Activities

Under Alternative 1, the number of HE laser events would increase from the current 60 annually to 125 annually, power levels would increase, and activities would expand as described in Section 2.5.3.

Fish

Although laser activities under Alternative 1 would include directing laser beams at targets on platforms on the water, the beams would be highly unlikely to strike the water surface because of many safeguards, although reflected backscatter energy may strike the water. In the event that a laser bounced off a UAV breaches the water surface, the energy would be rapidly absorbed, scattered, or reflected. Laser activities would have no direct contact with the shortnose or Atlantic sturgeon, which generally stay near the bottom of the river. The possibility that a sturgeon would breach the surface at the precise moment and location that laser beam misses its intended target is considered negligible.

In accordance with Section 7 of the ESA, laser activities under Alternative 1 would have no effect on shortnose sturgeon and Atlantic sturgeon. In accordance with NEPA, laser activities under Alternative 1 would have no direct or indirect impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

As noted for sturgeon, the probability of a laser's hitting the water is very low due to safeguards, and in the event that a laser strikes the water the energy would be rapidly absorbed, scattered, or reflected. In addition, the probability of a sea turtle's being in the vicinity of a test platform in the LDZ during testing is extremely low due to the low density of sea turtles and the limited time those individuals spend at the surface, the large area covered by the PRTR, and small amount of time that testing occurs.

In accordance with Section 7 of the ESA, laser activities under Alternative 1 would have no effect on sea turtles. In accordance with NEPA, laser activities under Alternative 1 would have no direct or indirect impacts on sea turtles.

Birds

All over-land laser activities would continue to occur in developed or maintained areas with a clear line of sight. The possibility of a laser hitting a flying eagle is considered remote, as during each laser test, a visual observer trained by the NSF Dahlgren's natural resources manager would watch for eagles, ospreys, other birds, and wildlife that may wander into the laser corridor, as discussed in Section 4.12.1.3. In the unlikely event that a bald eagle nest were to be established

near a laser corridor NSWCDD would consult with the USFWS and the VDGIF; however, as seen in Figure 3.12-3 existing nests are well away from laser corridors.

Laser activities under Alternative 1 would not affect the bald eagle, which is protected by the BGEPA. Nor would laser activities affect ESA-listed bird species, or bird species protected by the MBTA or the Lacey Act. In accordance with NEPA, laser activities under Alternative 1 would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

As noted for sturgeon and sea turtles, the probability of a laser's hitting the water is very low due to safeguards, and in the event that a laser strikes the water, the energy would be rapidly absorbed, scattered, or reflected. In addition, the probability of a bottlenose dolphin's being in the vicinity of a test platform in the LDZ during testing is considered negligible due to the low density of dolphins, the limited time those individuals spend at the surface, the large area covered by the PRTR, and small amount of time that testing occurs.

There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with laser activities under Alternative 1. In accordance with NEPA, laser activities under Alternative 1 would have no direct or indirect impacts on marine mammals.

Insects

All documented northeastern beach tiger beetle occurrences are along beaches in the southern reaches of the LDZ, while all laser activities would occur in the LDZ, which is a water range.

In accordance with Section 7 of the ESA, laser activities under Alternative 1 would have no effect on listed insect species. In accordance with NEPA, laser activities under Alternative 1 would have no direct or indirect impacts on northeastern beach tiger beetles.

Plants

Under Alternative 1, there would be no spatial overlap between expanded laser activities and the potential habitat of sensitive joint-vetch.

In accordance with Section 7 of the ESA, laser activities under Alternative 1 would have no effect on sensitive joint-vetch. In accordance with NEPA, laser activities under Alternative 1 would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.2.4 Chemical and Biological Defense Activities

Under Alternative 1, activities using chem/bio simulants outdoors would increase from the current baseline of 12 events annually using chemical simulants to 60 events annually using chemical and biological simulants separately, as described in Section 2.5.4. The areas in which the activities would take place would expand and could take place anywhere in the MDZ.

Fish

As described under the No Action Alternative, modeled concentrations and field measurements of chemical simulants were well below levels that could result in adverse effects to aquatic life, inclusive of fish (see Section 4.11.1.4). Current use of chemical simulants has not resulted in any

observable environmental effects during or after events (NSWCDL, 2004; NSWCDL, 2005; NSWCDL, 2009). In addition, concentrations of chemical and biological simulants would be diluted to even lower concentrations well before they reach the river bottom, where sturgeon are found.

No modeling was performed for biological simulants, as NSWCDD would use only BSL-1 simulants. Many of these simulants, such as the bacteria, are ubiquitous and often found in high concentrations in nature, including in water (CRI, 2004; USEPA, 1997). There are no published reports of disease associated with these biological simulants in aquatic plants or animals, nor are they considered to be disease-causing agents. The small concentrations of these simulants deposited on the water would not cause any significant increase in the environment and no adverse effects are anticipated from temporary increases.

In accordance with Section 7 of the ESA, under Alternative 1 chem/bio defense activities would have no effect on the shortnose sturgeon and Atlantic sturgeon. In accordance with NEPA, chem/bio defense activities under Alternative 1 would have no direct or indirect impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

NSWCDD would not conduct chem/bio defense activities on the LDZ, where sea turtles are known to occur. Concentrations of chem/bio simulants would be diluted to background concentrations well before they reach the lower portion of the LDZ, where sea turtles are known to occur, located about 11 NM downriver from the chem/bio defense testing area.

In accordance with Section 7 of the ESA, under Alternative 1, chem/bio defense activities would have no effect on sea turtles. In accordance with NEPA, chemical defense activities under Alternative 1 would have no direct or indirect impacts on sea turtles.

Birds

Under Alternative 1, the number of events and types of chem/bio simulants tested would increase, but no tests would be conducted near bald eagle nests and based on the release height, there would be no overlap between flying bald eagles and the simulant release. Any chemical or biological simulants that reach bald eagle nests would be at concentrations equivalent to background levels.

Chem/bio defense activities under Alternative 1 would not affect the bald eagle, which is protected by the BGEPA. Nor would chem/bio defense activities affect ESA-listed bird species, or bird species protected by the MBTA or the Lacey Act. In accordance with NEPA, chem/bio defense activities would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

NSWCDD does not currently and would not in the future conduct chem/bio defense activities on the LDZ, where bottlenose dolphins are known to occur. Concentrations of chem/bio simulants would be diluted to background concentrations well before they reach the lower LDZ, where marine mammals are known to occur, located about 11 NM below the chem/bio defense testing area.

There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with chem/bio defense activities under Alternative 1. In accordance with NEPA, chem/bio defense activities under Alternative 1 would have no direct or indirect impacts on marine mammals.

Insects

Because all documented northeastern beach tiger beetle occurrences are along beaches in the southern reaches of the LDZ, in accordance with Section 7 of the ESA, chem/bio defense activities under Alternative 1 would have no effect on listed insect species. In accordance with NEPA, chem/bio defense activities would have no direct or indirect impacts on northeastern beach tiger beetles.

Plants

Chemical and biological simulants released during testing would be rapidly dispersed and diluted to concentrations below levels associated with toxic effects. Concentrations of chemical simulants reaching tidal wetlands where sensitive joint-vetch could potentially be found would be at background levels. All biological simulants used would be BSL-1, which rarely cause reactions or diseases and may be commonly found in the environment.

In accordance with Section 7 of the ESA, chem/bio defense activities under Alternative 1 would have no effect on sensitive joint-vetch. In accordance with NEPA, chem/bio defense activities under Alternative 1 would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.2.5 PRTR Use

Under Alternative 1, NSWCDD would restrict public access to the PRTR danger zones for approximately 870 hours per year, usually some part or all of the MDZ.

Fish

Incidental vessel strikes, which have the potential to occur during adult sturgeon breaching behavior (i.e., not during spawning or migration), are not expected to occur during RDT&E activities because of the low number of shortnose and Atlantic sturgeon found in the Potomac River, the limited breaching associated with these individuals, and the overall reduction in vessel traffic when NSWCDD is conducting operations.

In accordance with Section 7 of the ESA, PRTR use under Alternative 1 may affect, but is not likely to adversely affect the shortnose sturgeon and Atlantic sturgeon. In accordance with NEPA, PRTR use under Alternative 1 would have negligible, long-term, direct and indirect, negative impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

While adverse effects may occur in the event of a vessel strike, there would be a very low probability of such strikes, due to the limited number of tests in the lower LDZ and the infrequent, seasonal occurrence of sea turtles. Boat engine noise associated with military vessel

activities on the waters of the LDZ may have temporary behavioral effects on sea turtles, but the overall vessel traffic on the PRTR would otherwise decrease during activities.

In accordance with Section 7 of the ESA, PRTR use under Alternative 1 would have no effect on sea turtles. In accordance with NEPA, PRTR use under Alternative 1 would have no direct or indirect impacts on sea turtles.

Birds

Bald eagles may use the PRTR for foraging. Vessels using the PRTR would not interfere with foraging. The probability of an eagle's overlapping spatially with a UAV is low, particularly as UAVs do not fly low over surface waters and eagles are likely to avoid them.

PRTR use under Alternative 1 would not affect the bald eagle, which is protected by the BGEPA. Nor would PRTR use affect ESA-listed bird species, or bird species protected by the MBTA or the Lacey Act. In accordance with NEPA, PRTR use would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

While adverse effects may occur in the event of a vessel strike, there would be a very low probability of such strikes, due to the limited number of tests in the lower LDZ and the infrequent, seasonal occurrence of bottlenose dolphins. Engine noise associated with military vessel use on the waters of the LDZ may have temporary behavioral effects on dolphins. However, the overall vessel traffic on the lower PRTR would otherwise decrease during activities.

There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with PRTR use. In accordance with NEPA, PRTR use under Alternative 1 would have no direct or indirect impacts on marine mammals.

Insects

Northeastern beach tiger beetles have only been observed on beaches in the lowest portion of the LDZ, near the mouth of the river. As there is no spatial overlap with PRTR use, in accordance with Section 7 of the ESA, there would be no effect on listed insect species. In accordance with NEPA, PRTR use under Alternative 1 would have no direct or indirect impacts on northeastern beach tiger beetles.

Plants

Sensitive joint-vetch, if present along the Potomac River, would be found in the intertidal zone and not in the deeper waters of the PRTR. Therefore, this species would not have any spatial overlap with NSWCDD's PRTR use.

In accordance with Section 7 of the ESA, PRTR use under Alternative 1 would have no effect on sensitive joint-vetch. In accordance with NEPA, PRTR use under Alternative 1 would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.3 Alternative 2

4.14.3.1 Ordnance Activities

The use of large-caliber guns and projectiles would remain at current levels. The use of small arms would increase, with the number of bullets expended annually increasing to 30,000; approximately 3,000 bullets would be fired from land into the river. Detonations would increase from 190 events to 230 events under Alternative 2, as described in Section 2.6.

Fish

Continuation of large-gun firings at current levels and small-arms activities at increased levels would have negligible impacts on shortnose and Atlantic sturgeon and their habitat. Because most detonations would occur over land ranges (infrequently, detonations would take place on a barge in the PRTR), there would be no impacts on shortnose or Atlantic sturgeon.

Therefore, under Section 7 of the ESA, the effect of ordnance activities on the shortnose sturgeon and Atlantic sturgeon under Alternative 2 is expected to be insignificant or discountable. In a letter dated January 11, 2012, NMFS concurred that RDT&E activities covered by this EIS may affect, but are not likely to adversely affect any listed species under NMFS jurisdiction (Morris, January 11, 2012). In accordance with NEPA, ordnance activities under Alternative 2 would have negligible, long-term, direct and indirect, negative impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

Under Alternative 2, projectile testing would take continue to place at least 6.5 NM upriver of the area where sea turtles are known to occur.

Based on the location of ordnance activities relative to the occurrence of sea turtles, in accordance with Section 7 of the ESA, the effect of ordnance activities under Alternative 2 is expected to be insignificant or discountable. In a letter dated January 11, 2012, NMFS concurred that RDT&E activities covered by this EIS may affect, but are not likely to adversely affect any listed species under NMFS jurisdiction (Morris, January 11, 2012). In accordance with NEPA, ordnance activities under Alternative 2 would have no direct and negligible, short-term, indirect negative impacts on sea turtles.

Birds

The bald eagle population at NSF Dahlgren has been growing since 1983 as well as along the PRTR and shows no evidence of being affected by current ordnance activities. Individual bald eagles could be hit by projectiles – although the probability of this would be very low – or the behavior of individuals could be affected by the noise of gun firings, but the total number of birds affected would be too small to cause population-level impacts. Similar to Alternative 1, the increase in small-arms firing is unlikely to impact birds as there is limited vegetative cover in front of Machine Gun Range. The SOP ensures there is a lookout during firing to make sure that birds and wildlife are not in the area.

Ordnance RDT&E activities under Alternative 2 would not affect the bald eagle, which is protected by the BGEPA. Nor would ordnance activities affect ESA-listed bird species, or bird

species protected by the MBTA or the Lacey Act. In accordance with NEPA, ordnance activities would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

Under Alternative 2 projectile testing would continue to take place a minimum of 6.5 NM upriver of the area where bottlenose dolphins are known to occur.

There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with ordnance activities under Alternative 2. In accordance with NEPA, ordnance activities under Alternative 2 would have no direct or indirect impacts on marine mammals.

Insects

All documented northeastern beach tiger beetle occurrences in the vicinity of the PRTR are along beaches in the southern reaches of the LDZ, where there is no overlap with ordnance activities that would occur in the LDZ water range.

In accordance with Section 7 of the ESA, ordnance activities under Alternative 2 would have no effect on listed insect species. In accordance with NEPA, ordnance activities under Alternative 2 would have no direct or indirect impacts on tiger beetles.

Plants

Ordnance testing of large-caliber projectiles under Alternative 2 would be the same as under the No Action Alternative. Small-caliber testing would increase, but would occur on heavily-used areas of ranges, such as the Machine Gun Range, where no tidal wetlands that may support sensitive joint-vetch occur. Detonations would increase, but they would take place on the EEA land ranges, not in the vicinity of tidal wetlands where sensitive joint-vetch may occur.

In accordance with Section 7 of the ESA, ordnance activities under Alternative 2 would have no effect on sensitive joint-vetch. In accordance with NEPA, ordnance activities under Alternative 2 would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.3.2 EM Energy Activities

Under Alternative 2, the number of EM energy events would increase from 490 to 680 per year, the power of the EM energy devices would increase, and activities would increase as summarized in Section 2.6.

Fish

EM energy activities would have no direct contact with shortnose or Atlantic sturgeon or their habitat. EM energy that enters the water would be dissipated well before it reached the river bottom where shortnose and Atlantic sturgeon are usually found. The possibility that a sturgeon would breach the surface at the precise moment and place that an EM energy beam misses its intended target is considered negligible.

In accordance with Section 7 of the ESA, under the Alternative 2 EM energy activities would have no effect on shortnose sturgeon and Atlantic sturgeon. In accordance with NEPA, EM

energy activities under Alternative 2 would have no direct or indirect impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

Sonobuoys occasionally used in the lower LDZ, where sea turtles are present, are passive and only receive, but do not emit EM energy. EM energy could be directed at targets on platforms in the LDZ, but there would be no targets directly on the surface water. Any residual energy around the target would quickly dissipate or be absorbed by water.

In accordance with Section 7 of the ESA, under Alternative 2, EM energy activities would have no effect on sea turtles. In accordance with NEPA, EM energy activities would have no direct or indirect impacts on sea turtles.

Birds

As discussed previously, there would be little or no contact between flying eagles and EM testing areas. If a bald eagle nest were to be established near an EM energy test facility NSWCDD would consult with the USFWS and the VDGIF; however, as discussed in Section 3.12 EM energy facilities are outside of bald eagle nest buffer zones.

Under Alternative 2, EM energy activities would not affect the bald eagle, which is protected by the BGEPA. Nor would EM energy activities affect ESA-listed bird species, or bird species protected by the MBTA or the Lacey Act. In accordance with NEPA, EM energy activities would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

Sonobuoys located in the lower LDZ, where bottlenose dolphins are present, are passive and only receive, but do not emit EM energy. EM energy could be directed at targets on platforms in the LDZ, but there would be no targets directly on the surface water. Any residual energy around the target would quickly dissipate or be absorbed by the water.

There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with EM energy activities under Alternative 2. In accordance with NEPA, EM energy activities would have no direct or indirect impacts on marine mammals.

Insects

Because all documented northeastern beach tiger beetle occurrences are along beaches in the southern reaches of the LDZ, and EM energy would be used for RDT&E in deeper waters – not near beaches – in accordance with Section 7 of the ESA, under Alternative 2 EM energy activities would have no effect on listed insect species. In accordance with NEPA, EM energy activities would have no direct or indirect impacts on tiger beetles.

Plants

Increasing EM energy activities under Alternative 2 would not result in any spatial overlap with the potential habitat of the sensitive joint-vetch. In accordance with Section 7 of the ESA, under Alternative 2 EM energy activities would have no effect on the sensitive joint-vetch. In

accordance with NEPA, EM energy activities under Alternative 2 would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.3.3 Laser Activities

Under Alternative 2, the number of HE laser events would increase from 60 to 145 events per year, power levels would increase, and activities would be expanded, as summarized in Section 2.6.

Fish

Alternative 2 includes directing laser beams at targets on platforms on the water. These beams would be highly unlikely to strike the water surface because of many safeguards built into the RDT&E program, although reflected backscatter energy may strike the water. In the event that a laser bounced off a UAV breaches the water surface, the energy would be rapidly absorbed, scattered, or reflected. The possibility that a sturgeon would breach the surface at the precise moment and location that a laser beam misses its intended target is considered negligible. Laser activities would have no direct contact with the shortnose or Atlantic sturgeon, which generally stay near the bottom of the river.

In accordance with Section 7 of the ESA, laser activities under Alternative 2 would have no effect on shortnose sturgeon and Atlantic sturgeon. In accordance with NEPA, laser activities under Alternative 2 would have no direct or indirect impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

As noted for fish, the probability of a laser's hitting the water is very low due to safeguards, but any laser energy's striking the water would be rapidly absorbed, scattered, or reflected.

In accordance with Section 7 of the ESA, laser activities under Alternative 2 would have no effect on sea turtles. In accordance with NEPA, laser activities under Alternative 2 would have no direct or indirect impacts on sea turtles.

Birds

All over-land laser activities would continue to occur in developed or maintained areas with a clear line of sight. The possibility of a laser hitting a flying eagle is considered remote, as during each laser test, a visual observer trained by the NSF Dahlgren's natural resources manager would watch for eagles, ospreys, other birds, and wildlife that may wander into the laser corridor, as discussed in Section 4.12.1.3. In the unlikely event that a bald eagle nest were to be established near a laser corridor NSWCDD would consult with the USFWS and the VDGIF; however, as seen in Figure 3.12-3 existing nests are well away from laser corridors.

Laser activities under Alternative 2 would not affect the bald eagle, which is protected by the BGEPA. Nor would laser activities affect ESA-listed bird species, or bird species protected by the MBTA or the Lacey Act. In accordance with NEPA, laser activities under Alternative 2 would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

As noted for sturgeon and sea turtles, the probability of a laser beam's striking the water is very low due to safeguards, and any laser energy's striking the water would be rapidly absorbed, scattered, or reflected.

There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with laser activities under Alternative 2. In accordance with NEPA, laser activities under Alternative 2 would have no direct or indirect impacts on marine mammals.

Insects

Because all documented northeastern beach tiger beetle occurrences are along beaches in the southern reaches of the LDZ, while RDT&E would take place in deeper waters, in accordance with Section 7 of the ESA, laser activities under Alternative 2 would have no effect on listed insect species. In accordance with NEPA, laser activities under Alternative 2 would have no direct or indirect impacts on northeastern beach tiger beetles.

Plants

Under Alternative 2, there would continue to be no spatial overlap between increased laser activities and the potential habitat of sensitive joint-vetch. In accordance with Section 7 of the ESA, laser activities under Alternative 2 would have no effect on sensitive joint-vetch. In accordance with NEPA, laser activities under Alternative 2 would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.3.4 Chemical and Biological Defense Activities

Under Alternative 2, the number of events using chem/bio simulants would increase from the current baseline of 12 events annually using chemical simulants to 70 events annually using both chemical and biological simulants together, as summarized in Section 2.6.

Fish

As described under the No Action Alternative and Alternative 1, modeled concentrations and field measurements of chemical simulants were well below levels that could result in adverse effects to aquatic life, inclusive of fish. Many BSL-1 organisms are ubiquitous and often found in high concentrations in nature, including in water (CRI, 2004; USEPA, 1997). There are no published reports of disease associated with these biological simulants in aquatic life, nor are any synergistic interactions between chemical simulants and BSL-1 organisms known. The small concentrations of these simulants deposited on the water would not cause any significant increase in the environment and no adverse effects are anticipated from temporary increases of them.

In accordance with Section 7 of the ESA, under Alternative 2 chem/bio defense activities would have no effect on the shortnose sturgeon and Atlantic sturgeon. In accordance with NEPA, chem/bio defense activities under Alternative 2 would have no direct or indirect impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

NSWCDD would not conduct chem/bio defense activities on the LDZ, where sea turtles are known to occur. Concentrations of chem/bio simulants would be diluted to background concentrations well before they reach the lower LDZ, where sea turtles are known to occur, located about 11 NM downriver from the chem/bio defense testing area.

In accordance with Section 7 of the ESA, under Alternative 2 chem/bio defense activities would have no effect on sea turtles. In accordance with NEPA, chem/bio defense activities under Alternative 2 would have no direct or indirect impacts on sea turtles.

Birds

Under Alternative 2, the number of events and types of chem/bio simulants tested would increase, but no tests would be conducted near bald eagle nests. Any chemical or biological simulants that reach bald eagle nests would be at concentrations equivalent to background levels.

Chem/bio defense activities under Alternative 2 would not affect the bald eagle, which is protected by the BGEPA. Nor would chem/bio defense activities affect ESA-listed bird species, or bird species protected by the MBTA or the Lacey Act. In accordance with NEPA, chem/bio defense activities would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

NSWCDD does not currently and would not in the future conduct chem/bio defense activities on the LDZ, where bottlenose dolphins are known to occur. Concentrations of chem/bio simulants released in the MDZ would be diluted to background concentrations well before they reach the lower LDZ, where marine mammals are known to occur, located about 11 NM below the chem/bio defense testing area.

There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with chem/bio defense activities under Alternative 2. In accordance with NEPA, chem/bio defense activities under Alternative 2 would have no direct or indirect impacts on marine mammals.

Insects

As all documented northeastern beach tiger beetle occurrences are along beaches in the southern reaches of the LDZ, and chem/bio defense activities would not be conducted in the LDZ.

In accordance with Section 7 of the ESA, chem/bio defense activities under Alternative 2 would have no effect on listed insect species. In accordance with NEPA, chem/bio defense activities under Alternative 2 would have no direct or indirect impacts on northeastern beach tiger beetles.

Plants

Chemical and biological simulants released during testing would be rapidly dispersed and diluted to concentrations below levels associated with toxic effects. Concentrations of chemical simulants reaching tidal wetlands where sensitive joint-vetch could potentially be found would be at background levels. All biological simulants used would be BSL-1 and some of them are

commonly found in the environment. The use of chemical and biological simulants together is not associated with any adverse effects.

In accordance with Section 7 of the ESA, chem/bio defense activities under Alternative 2 would have no effect on sensitive joint-vetch. In accordance with NEPA, chem/bio defense activities under Alternative 2 would have no direct or indirect impacts on rare, threatened, or endangered plants.

4.14.3.5 PRTR Use

Under Alternative 2, NSWCDD would restrict public access to the PRTR danger zones, usually some or all of the MDZ, for approximately 1,000 hours per year, as summarized in Section 2.6.

Fish

Incidental vessel strikes, which have the potential to occur during adult sturgeon breaching behavior (i.e., not during spawning or migration), are not expected to occur during RDT&E activities because of the low number of shortnose and Atlantic sturgeon found in the Potomac River, the limited breaching associated with these individuals, and the overall reduction in vessel traffic when NSWCDD is conducting operations.

In accordance with Section 7 of the ESA, PRTR use associated with Alternative 2 may affect, but is not likely to adversely affect the shortnose sturgeon and Atlantic sturgeon. In accordance with NEPA, PRTR use under Alternative 2 would have negligible, long-term, direct and indirect, negative impacts on the shortnose sturgeon and Atlantic sturgeon.

Sea Turtles

While adverse effects may occur in the event of a vessel strike of a sea turtle, there would be a very low probability of such strikes, due to the limited number of tests in the LDZ and the infrequent, seasonal occurrence of sea turtles. Vessel engine noise associated with military vessel activities on the waters of the LDZ may have temporary behavioral effects on sea turtles, but the overall vessel traffic on the PRTR would decrease during activities.

In accordance with Section 7 of the ESA, PRTR use under Alternative 2 would have no effect on sea turtles. In accordance with NEPA, PRTR use under Alternative 2 would have no direct or indirect impacts on sea turtles.

Birds

Bald eagles may use the PRTR for foraging. PRTR use under Alternative 2 would not affect the bald eagle, which is protected by the BGEPA. Nor would PRTR use affect ESA-listed bird species, or bird species protected by the MBTA or the Lacey Act. In accordance with NEPA, PRTR use under Alternative 2 would have no direct or indirect impacts on the bald eagle or other protected species.

Marine Mammals

While adverse effects may occur in the event of a vessel strike, there would be a very low probability of such strikes, due to the limited number of tests in the LDZ and the infrequent, seasonal occurrence of bottlenose dolphins. Vessel engine noise associated with military vessel

activities on the waters of the LDZ may have temporary behavioral effects on dolphins, but the overall vessel traffic on the PRTR would decrease during activities.

There are no reasonably foreseeable takes of marine mammals in accordance with the MMPA associated with PRTR use under Alternative 2. In accordance with NEPA, PRTR use would have no direct or indirect impacts on marine mammals.

Insects

Northeastern beach tiger beetles have only been observed on beaches in the lowest portion of the LDZ, near the mouth of the river. The LDZ is a water range and has no spatial overlap with these beaches.

In accordance with Section 7 of the ESA, there would be no effect on listed insect species. In accordance with NEPA, PRTR use under Alternative 2 would have no direct or indirect impacts on northeastern beach tiger beetles.

Plants

Sensitive joint-vetch, if present along the Potomac River, would be found in the intertidal zone and not in the deeper waters of the PRTR. Therefore, this species would not have any spatial overlap with PRTR activities.

In accordance with Section 7 of the ESA, PRTR use under the Alternative 2 would have no effect on sensitive joint-vetch. In accordance with NEPA, PRTR use under Alternative 2 would have no direct or indirect impacts on rare, threatened, or endangered plants.