2 PROPOSED ACTION AND ALTERNATIVES

The CEQ *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* establish a number of policies for federal agencies, including using the NEPA process "…to identify and assess the reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these actions upon the quality of the human environment" (40 CFR § 1500.2(e)). This chapter describes the Proposed Action, alternatives to meet the purpose of and need for the project, and the No Action Alternative, which provides a basis upon which a comparison of the potential impacts associated with the Proposed Action can be made. The chapter concludes with the Navy's determination of the Preferred Alternative.

2.1 The Proposed Action

The Proposed Action is to expand NSWCDD's RDT&E activities within the PRTR and EEA complexes, the Mission Area, and in the special-use airspace (SUA). These capabilities include outdoor activities that require the use of:

- Ordnance
- Electromagnetic (EM) energy
- Lasers
- Chemical and biological (chem/bio) simulants

In the future, because of the growing need to test EM equipment, lasers, and chem/bio sensors in foggy, rainy, or nighttime conditions, some testing would take place at dawn, at dusk, at night and on weekends. This would enable tests to be conducted when conditions match realistic operational requirements.

Under the Proposed Action, the number of firings, detonations, events, and hours of range use that would take place annually would increase above recent levels for all activities except large-caliber gun firing, as described in the following sections. Increases in activities would occur gradually; however, because of the nature of RDT&E, the rate of increase cannot be predicted. The alternatives being evaluated in this EIS – the No Action Alternative, Alternative 1, and Alternative 2 – reflect different numbers of annual firings, detonations, and events for each activity. The No Action Alternative includes the number of firings, detonations, and events typical of the years from 1993 (1995 for ordnance) through 2009. Alternative 1 includes annual increases of 325 percent in small arms firing, 5 percent in detonations, 20 percent in EM energy events, 108 percent in laser events, 400 percent in chem/bio events, and 16 percent in PRTR hours of use above recent levels. Alternative 2 includes annual increases of 400 percent in small arms firing, 21 percent in detonations, 39 percent in EM energy events, 142 percent in laser

events, 483 percent in chem/bio events, and 33 percent in PRTR hours of use above recent levels.

2.2 Alternatives Development Process

The process of developing alternatives began by establishing NSWCDD's RDT&E activities baseline. NSWCDD's programs are diverse and numerous. Over several years, the EIS team interviewed each of the managers of 75 NSWCDD programs at least once. The managers of programs that are expanding and that are likely to generate environmental impacts were interviewed several times. The kinds of information collected included:

- Program objectives, schedule and support requirements.
- Customer base.
- Typical test scenarios.
- Annual operations tempo and whether there were any night/weekend operations.
- Expected increase in operations tempo and changes in operations.
- Whether program was expanding or evolving.
- RDT&E facilities used.
- Expected increase in RDT&E facilities use or need for new or modified facilities.
- Whether installation infrastructure was sufficient to support program requirements.
- Whether operations take place indoors or outdoors.
- The kinds of materials released by and environmental impacts generated by operations.

With extensive knowledge of their field and of DoD requirements, customer needs, and future trends, the program managers helped to clarify which programs were growing, describe the ways in which the technology was evolving, and define future RDT&E needs and requirements. From these interviews and from reviewing range operations logs, the firing, detonation, and event baseline for each RDT&E activity was established. In most cases, because of the cyclical nature of RDT&E – which can vary considerably from year to year depending upon such factors as whether or not a new system is being tested – the baseline was generated by averaging data collected in the years from 1993 to 2009 (the years of data vary by activity) and then weighting the data for the highest-activity years in the RDT&E cycle to arrive at an average annual number of large-caliber guns and small arms firings; detonations; and EM energy, laser, and chem/bio sensor events. Table 2-1 documents the historical and current baseline, and future RDT&E mission requirements defined through this process.

From the interviews, it became clear that activities conducted in indoor laboratories with ample safeguards in place do not generate environmental impacts on the human environment. Therefore, activities that take place outdoors became the focus of the EIS. Those activities that had the potential to affect the environment – such as firing guns because of the noise produced, using lasers because of potential safety concerns, or using chem/bio simulants because of human and animal health concerns – were singled out. Further reviews established that lower-power EM energy operations, such as the use of Class 1 and 2 lasers, do not affect human health or the

environment. In this way, the types of activities to be included in the Proposed Action and evaluated in the EIS impact analysis became more clearly defined.

Table 2-1
RDT&E Mission Requirements

RDT&E Activity	Historical and Current Activity Magnitude	Historical and Current Baseline Average Annual Activity Levels	Known Future Average Annual Activity Levels	Future Average Annual Activity Levels with a Margin of Growth
Large-caliber Guns/ Projectiles	>20 mm to 8" caliber gun/ projectile	**4,700 projectiles**	**4,700 projectiles**	**4,700 projectiles**
Small Arms	≤20 mm caliber gun/bullet	**6,000 bullets**	**25,500 bullets**	**30,000 bullets**
Detonations	<0.01 lbs to 1,000 lbs NEW	**190 detonations**	**200 detonations**	**230 detonations**
EM Energy	300 kHz to 300 GHz frequency 10 W to 500 MW average power	**490 events**	**590 events**	**680 events**
Lasers	500 nm to 11 μm wavelength 1 mW to 100 kW maximum power	**60 events** 100 kW maximum power	**125 events** 500 kW maximum power	**145 events** 500 kW maximum power
Chemical & Biological Defense	≤20 gals of simulant/event	**12 events** Chemical simulants only	**60 events** Chemical and biological simulants used separately	**70 events** Chemical and biological simulants used separately and together
PRTR Use	750 hours annually	**750 hours**	**870 hours**	**1,000 hours**

For each of the components of the Proposed Action, potential alternatives were developed and evaluated based on the following criteria:

Criterion 1 – Accommodate historical and current, baseline RDT&E mission requirements for activities that have the potential to affect human health and/or the environment – namely, those involving ordnance, the use of EM energy, the use of high-energy (HE) lasers, the use of chemical simulants, and the use of the PRTR.

Criterion 2 – Accommodate known future requirements, which include the use of biological simulants alone.

Criterion 3 – Accommodate a margin of growth for those programs for which it is difficult to accurately forecast future needs. Mixtures of biological and chemical simulants would be included.

Criterion 4 – Minimize impacts to commercial and recreational use of the Potomac River.

The No Action Alternative constitutes the baseline for the portion of NSWCDD's outdoor activities that have the potential to affect human health and/or the environment and meets Criteria 1 and 4. Alternative 1 reflects the growth necessary to meet the minimum RDT&E mission requirements in the foreseeable future, without significantly increasing environmental impacts. Alternative 1 includes outdoor use of biological simulants. Alternative 1 meets Criteria 1, 2, and 4. Alternative 2 satisfies current requirements; includes the growth necessary to meet minimum requirements for the foreseeable future; includes the use of biological and chemical simulants together; and includes a margin of growth for the most actively evolving programs – those for which the number of future annual test events, firings, and hours of use is harder to predict because of the uncertainties inherent in carrying out RDT&E. Alternative 2 optimizes NSWCDD's outdoor RDT&E activities and meets all four criteria.

2.3 Alternatives Considered but Eliminated from Further Analysis

Alternatives that do not accommodate historical and current, baseline RDT&E mission requirements and known future requirements – and therefore do not meet Criteria 1 and 2 – do not satisfy the purpose and need for the Proposed Action and are considered unreasonable. Such alternatives were eliminated from further analysis, as were alternatives that substantially increase impact to commercial and recreational use of the Potomac River and therefore do not meet Criterion 4. The following potential alternatives other than no action, and Alternatives 1 and 2 were identified, but were eliminated from further analysis, as detailed in the following paragraphs.

2.3.1 Full Range Use Alternative

NSWCDD considered an alternative that would utilize the range complexes, SUA, and the Mission Area to the maximum extent possible in order to accommodate the maximum amount of growth in mission operations. Currently, activities are scheduled for about 750 hours a year. As NSWCDD normally conducts outdoor RDT&E activities Monday through Friday between 8 am and 5 pm, excluding weekends and holidays, the maximum potential availability of the PRTR and EEA complexes, the Mission Area, and the SUA is approximately 2,260 hours per year. Occasional use in early mornings, evenings and on weekends adds to the potential maximum annual hours of use. Also, some activities can be scheduled concurrently – for example, those using lasers or directed energy across Upper Machodoc Creek and those using chemical simulants farther out into the MDZ. However, weather conditions, such as storms, fog, and freezing weather that forms ice on the river, and the time required for pre- and post-test operations further reduce the maximum potential hours to approximately 1,800 hours annually.

While this maximum potential 1,800 hours would use the range complexes, SUA, and the Mission Area to the fullest feasible level, the alternative would require substantial increases in public access restrictions to the PRTR – more than doubling the number of hours when public access could be restricted, negatively affecting public commercial and recreational use of the

river well beyond the levels resulting from implementing either Alternative 1 (increase from 750 to 870 hours annually) or Alternative 2 (increase from 750 to 1,000 hours annually). For almost three-quarters of a century, the Navy and its community neighbors in Virginia's Northern Neck and Southern Maryland have prospered in a much-treasured partnership that was established and is secured by the common bonds of friendship, patriotism, national defense, and economics. NSWCDD actively engages with the local community to maintain this partnership.

Although this maximum range use alternative would meet Criteria 1 and 2 and would accommodate a margin of growth for programs for which it is difficult to accurately forecast future needs as specified by Criterion 3, increased range use would significantly restrict public access to the Potomac River for commercial and recreational uses; and the alternative, therefore, would not meet Criterion 4. For this reason, this alternative was dismissed from further consideration.

2.3.2 Locations other than NSF Dahlgren

As the Navy's leading surface warfare RDT&E center, with more than 3,000 highly-skilled scientists and engineers, operating ranges, and extensive infrastructure developed over 90 years specifically to support this kind of RDT&E, NSWCDD is unique. NSWCDD also is the Navy's primary center for proof-testing Navy guns, for safety and environmental testing for explosives, and for naval gun RDT&E. The laser program, which began in the 1970s, has been recognized by the Navy and the Office of Naval Research as a center of excellence for laser RDT&E. NSWCDD is the Navy's primary center for chem/bio research as part of DoD's Chemical and Biological Defense Program (CBDP). The 2005 Defense Base Closure and Realignment (BRAC) Commission, which reviewed the work of all DoD installations, identified NSWCDD as a center of excellence for weapon systems integration, which involves RDT&E for communications and sensors that use EM energy. NSWCDD is also the Navy's lead laboratory for the RDT&E of issues surrounding EM environmental effects (E3).

The activities that comprise the Proposed Action are not new technology, nor are they programs new to NSWCDD, but rather expansions of current programs based at NSWCDD. The development and implementation of specific safety procedures for these activities have resulted in an excellent health and safety record with no illnesses or injuries attributable to outdoor activities over the last 10 years. Safety programs and procedures are constantly reviewed and updated to ensure their continuing validity and appropriateness, as discussed in Section 3.8. For example, specific safety procedures will be developed and implemented for biological and chem/bio simulant testing. Relocation of these programs is neither desirable nor feasible. It would involve moving existing, active programs from NSWCDD to a new location, which would needlessly disrupt program operations, cause unnecessary delays, and generate substantial additional costs, all without any additional benefits. The 2005 BRAC Commission concurred with this thinking and recommended that NSWCDD's programs remain in place. Therefore, the Navy concluded that no other location for expanding these programs was a reasonable alternative.

2.4 Description of the No Action Alternative

Chapter 1 describes NSWCDD's current activities, which constitute existing baseline conditions and are the basis for the No Action Alternative. Implementing the No Action Alternative would not increase the average annual number of outdoor RDT&E firings, detonations, and events, or hours of PRTR use above recent levels – the numbers would remain at recent levels. Even though the Navy proposes to increase outdoor RDT&E activities, including the No Action Alternative in the evaluation of impacts provides a baseline against which to measure the impacts of the other two alternatives.

Table 2-2, which describes all three EIS alternatives, shows existing outdoor RDT&E activity levels on ranges and the Mission Area in the No Action Alternative column. The numbers of annual firings, detonations, events, and hours of PRTR use represent averages recorded for each RDT&E activity during the years from 1993 (1995 for ordnance) through 2009 weighted to take into account years with the highest activity levels. The No Action Alternative Activity Magnitude column of Table 2-2 indicates the magnitude of baseline activities, averaged from data collected for the years 1993 (1995 for ordnance) to 2009 inclusive. Magnitude indicates caliber, weight, frequency, power, wavelength, volume, or time duration.

Table 2-2
EIS Alternatives

RDT&E Activity	No Action Alternative Activity Magnitude	No Action Alternative Average Annual Activity Levels	Alternative 1 Average Annual Activity Levels	Alternative 2 Average Annual Activity Levels
Large-caliber Guns/ Projectiles	>20 mm to 8" caliber gun/ projectile	**4,700 projectiles**	**4,700 projectiles**	**4,700 projectiles**
Small Arms	≤20 mm caliber gun/bullet	**6,000 bullets**	**25,500 bullets**	**30,000 bullets**
Detonations	<0.01 lbs to 1,000 lbs NEW	**190 detonations**	**200 detonations**	**230 detonations**
EM Energy	300 kHz to 300 GHz frequency 10 W to 500 MW average power	**490 events**	**590 events**	**680 events**
Lasers	500 nm to 11 μm wavelength 1 mW to 100 kW maximum power	**60 events** 100 kW maximum power	**125 events** 500 kW maximum power	**145 events** 500 kW maximum power
Chemical & Biological Defense	≤20 gals of simulant/event	**12 events** Chemical simulants only	**60 events** Chemical and biological simulants used separately	**70 events** Chemical and biological simulants used separately and together
PRTR Use	750 hours annually	**750 hours**	**870 hours**	**1,000 hours**

2.4.1 Ordnance Activities

2.4.1.1 Large-caliber Guns/Projectiles

The guns included in the No Action Alternative are large-caliber weapons that can fire either live (explosive) or inert (non-explosive) projectiles. The guns range in size from more than 20 millimeters (mm) up to 8"-caliber, although the largest gun normally fired is the 155 mm howitzer (the 8" gun is only fired occasionally to launch non-explosive canisters of electronic components of new projectiles to test how well they can withstand high gravitational forces). In the years from 1995 to 2009, 74 percent of the projectiles fired from the PRTR land ranges into the Potomac River were inert, and 26 percent were live explosive projectiles. The gun fired most frequently is the 5" gun. ***Each projectile*** fired from a gun counts as one of the 4,700 projectiles fired annually on average in particularly active years. In most years, the average number of projectiles fired is considerably less than 4,700 projectiles; in some years, the number fired annually exceeds 4,700. Not all projectiles go into the river range. Some projectiles fired on the Missile Test Range and Terminal Range are aimed at gun butts on land rather than targets in the river. In this case, the river is used as a backstop.

2.4.1.2 Small Arms Activities

NSWCDD's small arms tests usually employ machine guns firing mostly inert bullets with small propellant charges, and producing lower noise levels that affect a smaller area than the noise resulting from firing the large-caliber guns. Approximately ten percent of the bullets are fired into the river range. ***Each bullet*** fired counts as one of the 6,000 bullets fired annually, on average.

2.4.1.3 Detonations

Most ordnance detonations take place on the EEA's Churchill and Harris Ranges but a few take place on the Explosive Ordnance Disposal training area of the Missile Test Range. Non-fragmenting ordnance detonated on the Explosive Ordnance Disposal training area includes detonators but no other explosives. The amount of explosives used in the ordnance that is detonated on the EEA can vary from less than 0.01 pounds (lbs) up to 1,000 lbs net explosive weight (NEW). ***Each detonation*** that takes place on the EEA is counted as one of the 190 total annual detonations.

2.4.2 Electromagnetic (EM) Energy Activities

The EM energy devices included under the No Action Alternative operate in the frequency range of 300 kilohertz (kHz) (or 300,000 cycles per second) to 300 gigahertz (GHz) (or 300 billion cycles per second) and at average powers ranging from 10 watts (W) up to 500 megawatts (MW), but with most events well below the maximum. Devices such as radios and range radars with power, frequency and exposure levels below established thresholds for hazards of EM radiation to personnel (HERP), ordnance (HERO), fuel (HERF), and the potential for EM interference (EMI) are not included in the Proposed Action. NSWCDD coordinates with the

Navy and Marine Corps Spectrum Center, which is responsible for ensuring access to and effective use of the EM spectrum in national security and military operations. As part of the SOP process for EM tests, NSWCDD uses power levels approved by and frequencies authorized by the Spectrum Center and HERO programs in order to mitigate interference with civilian devices.

An ***EM event*** consists of the tests that take place under one standard operating procedure (SOP) on one day. If similar tests under the same SOP occur the following day (or on multiple following days), this group of tests is considered a separate event (or multiple separate events). If two different tests are conducted on the same day under separate SOPs, then they would be counted as two separate events of the total 490 annual events. Power levels, frequencies, and safety parameters are all delineated, and must be approved in an SOP well before the event commences.

Events

For purposes of this EIS, an **event** consists of the operations that take place under one SOP on one day. If the same operation occurs the following day, it is considered a separate event. If two different operations are conducted on the same day under separate SOPs, then they are counted as two separate events.

2.4.3 Laser Activities

The HE lasers that are operated at NSWCDD included under the No Action Alternative emit focused (lased) light ranging in power from 1 milliwatt (mW) (Class 3) to 100 kilowatt (kW) (Class 4) in a wavelength range from 500 nanometers (nm) to 11 micrometers (μm). NSWCDD currently conducts approximately 60 outdoor HE laser events a year. Class 1 and Class 2 lasers, which are usually eye-safe (see Table 1-1), are not included in the Proposed Action because they have negligible environmental impacts.

For lasers and EM energy devices, effects are possible only as the device is emitting. The time of emission is usually brief – varying from less than a second to several minutes – and there are no residual effects. However, one event could entail several hundred instantaneous pulses while another event with a different device could be one single pulse of five minutes. To capture this range of options in a meaningful way that lends itself to analysis, a ***laser event*** is also defined as consisting of the tests that take place under one SOP on one day. If similar tests under the same SOP occur on the following day (or on multiple following days), this group of tests is considered a separate event (or multiple separate events). If two different tests are conducted on the same day under separate SOPs, then they would be counted as two separate events of the total 60 annual events. Power levels, frequencies, and safety parameters are all delineated, and must be approved in an SOP well before the event commences.

2.4.4 Chemical Defense Activities

A ***chemical defense event*** is defined the same way that EM and laser events are defined: as the tests that take place on one day under one SOP. The development and rigorous implementation of SOPs is a vital component of NSWCDD's health and safety approach as detailed in Section 3.8.1. If similar tests take place the following day under the same SOP, the group of tests is

regarded as a separate event. If two different tests are conducted on the same day but are based on separate SOPs, then they would be counted as two separate events. NSWCDD currently conducts approximately 12 outdoor chemical defense events a year.

The quantities of simulant used for an event may vary depending on the tests being conducted. Tests may include small quantities of a number of simulants or larger quantities of one or two simulants, consisting of no more than 20 gallons (gals) of simulant per test. There may be more than one test during one event.

Outdoor biological defense activities using simulants are not included in the No Action Alternative because such operations have not yet been conducted outdoors at NSWCDD and so are not existing conditions. Operations using chemical simulants are included because they have been conducted outdoors on NSF Dahlgren since the 1980s. The chemical and biological simulants that would be tested would be influenced by parameters such as global threats, homeland security, and technological developments. Therefore, it is not possible to provide exact specifications of future quantities, simulants, and potential mixtures.

2.4.5 PRTR Use

When NSWCDD is using the PRTR for mission activities, public access to the part of the range in use is restricted, as described in Section 1.6.2. Currently, only access to the part of the MDZ or upper LDZ in use is restricted. The types of activities conducted on the UDZ and mid-to-lower LDZ do not require that public access to these danger zones be restricted. Access to the MDZ or part of the MDZ or LDZ currently is restricted an average of 750 hours a year, based on the hours that range control boats are deployed.

2.5 Description of Alternative 1

Table 2-2 lists the proposed annual outdoor RDT&E activity levels under Alternative 1. The numbers shown in the Alternative 1 column represent average annual activity levels under Alternative 1 and were determined by combining:

1. An average of the annual number of bullets, events, or hours, as appropriate, for each RDT&E activity from 1993 (1995 for ordnance) to 2009, weighted to take into account years with the highest activity levels (No Action Alternative levels);
2. ***Plus*** growth above No Action Alternative levels necessary to meet known requirements in the near future.

The following sections describe in more depth the changes proposed for each type of activity – ordnance, EM energy, HE lasers, and chem/bio defense – under Alternative 1 and the reasons for the changes. A summary comparing the changes proposed under Alternative 1 with the No Action Alternative concludes each of these sections.

2.5.1 Alternative 1 Proposed Ordnance Activities

As noted in Chapter 1, the Navy established NSWCDD to test ordnance in 1918, and testing ordnance will remain a primary part of NSWCDD's mission into the future. Testing and improving ordnance reliability, safety, lethality, accuracy, fuzing, and distance for small-, medium-, and large-caliber guns up to 8", and assessing explosive compounds remains a basic Navy requirement. This is because these weapons remain core components of Navy ships or are used by the Marine Corps.

Ordnance technology has reached the point where fundamental changes in ordnance are now possible. The Navy's goals are to develop guns and projectiles that are more effective or lethal when they reach their target, can reach targets farther away, are integrated into warfare systems, and are safer to handle so that they don't explode inadvertently. NSWCDD has been and will continue to be a primary Navy RDT&E facility for existing and new types of ordnance. The use of reactive materials in projectiles is an example of such changes – projectiles carrying reactive materials will only be capable of exploding when hitting a target. When sufficiently developed, projectiles with reactive materials will begin to augment current explosive projectiles.

The Navy's goal to develop an all-electric ship within the next decade also is spurring development of weapons that use electricity rather than explosives. EM launchers, which when fully developed will use EM energy rather than explosives to fire an inert projectile at velocities more than seven times the speed of sound, are an example of a new type of motive force being developed at NSWCDD. Ultimately, when ready to be mounted on ships, EM launchers are expected to meet two of the Navy's other goals: they will be able to hit targets more than 200 nautical miles (NM) away and they will be very effective in destroying their targets.

2.5.1.1 Large-caliber Gun Activities

In the coming years, RDT&E to improve existing types of ordnance will decline, while RDT&E for newer types of ordnance will increase. As a result, the tempo of large-caliber gun testing is expected to remain relatively constant for the foreseeable future.

The use of computer modeling to predict certain aspects of ordnance testing has allowed much of the live firing to be replaced with virtual testing. Thus, modeling has played a substantial role in reducing the number of rounds fired into the PRTR. In the 1970s, approximately 15,000 to 18,000 large-caliber projectiles were fired in a year, compared to an average of 2,900 projectiles fired annually since 1995. However, as each new conflict demonstrates, no amount of modeling can completely replicate real-world environments; consequently, firing guns and projectiles will continue to be needed as a real-world test of what modeling has indicated will happen.

NSWCDD expects the number of large-caliber projectiles fired in the foreseeable future to remain at recent (last 15 years – 1995-2009) levels – an average of 2,900 projectiles fired annually ranging up to an average of 4,700 projectiles fired in particularly active years. Because of the cyclical nature of ordnance RDT&E, the actual number fired annually and the proportions fired from each type of gun will vary from year to year. In the last 15 years, annual firing has ranged from a low of 910 projectiles fired in 2005 to a high of 6,170 (all inert) fired in 2004. As is the case now, large guns would be fired typically from 8 am to 5 pm, Monday through Friday into the MDZ and rarely into the upper LDZ. The Range Operations Center (ROC) would issue a

notice to mariners in advance if firing were scheduled to take place in the evenings or on weekends.

The relative proportion of explosive and inert projectiles fired annually varies from year to year, depending on what is being tested, but the ratio prevailing from 1995 to 2009 of 74 percent inert and 26 percent live projectiles fired annually – approximately three inert projectiles for every live projectile – is expected to remain the average ratio in the future. By far, 5" projectiles would remain the most commonly fired large-gun projectile. The typical weight of explosives contained in most 5" projectiles would continue to be in the 6- to 10-lb range. The 155 mm howitzer would continue to be fired infrequently, and only rarely with live projectiles. For example, 11 inert projectiles were fired from the 155 mm gun in 2008, but none were fired in 2009. Live 155 mm projectiles typically contain 11 to 15 lbs of explosives. The use of NEWs above these ranges would be rare.

EM launchers, a type of large-caliber gun, would fire inert projectiles at conventional targets on the land and river ranges, rather than only into catchment facilities, as under the No Action Alternative. The EM launcher projectiles that would be fired are simple, shaped iron or aluminum "slugs" with fins for guidance. Projectiles would be fired at speeds no faster than the speeds of conventional large-gun projectiles.

To address the Navy's goal of developing longer-range guns and projectiles, in the future large-caliber guns would fire into a target area from 32,000 to 35,000 yards in the upper LDZ up to 10 days a year, which represents an increase over recent firing levels in this target area. While NSWCDD currently can fire up to 40,000 yards (see Figure 1-5), it has only fired beyond 30,000 yards (approximately the downstream boundary of the MDZ – see Figure 1-5) occasionally in the last 15 years, such as during live-fire tests conducted in 2009.

2.5.1.2 Small Arms Activities

As is the case today, much of the future small arms firing would take place indoors, but some must be done outdoors. The number of bullets fired from small arms (defined as those having a projectile diameter of less than or equal to 20 mm) is expected to increase under Alternative 1 from the current 6,000 up to 25,500 per year to support projected Marine Corps requirements for small arms and related systems evaluation and development. The Marine Corps small-arms program bullets will be no larger than .50-caliber. All ammunition would be inert. NSWCDD has not used lead in bullets for more than 10 years, and there would be no lead contained in bullets fired from small arms. Estimates of the numbers of each type of bullet cannot be made at this time because of the nature of RDT&E where the program evolves as each set of test results is evaluated. Bullets will be fired at targets on land that will trap them and over the river at targets up to 4,000 yards from shore where the bullets will enter the river and not be recovered. When firing at targets in the river, the PRTR will be cleared to 6,000 yards, which is standard. Future firing would take place on and from the Machine Gun Range into the river range on weekdays.

2.5.1.3 Detonations

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 detonations to 200 detonations under Alternative 1. Normally, detonations are and would continue to be scheduled for weekdays.

2.5.1.4 Summary Comparison of Alternative 1 with No Action Alternative

- There would be no change in large-caliber gun use, which would vary from year to year but would remain at the current level of approximately 4,700 projectiles on average fired in a particularly active year.
- EM launchers, a type of large-caliber gun, would fire inert, shaped metal projectiles at conventional targets on land and river ranges. Projectile speeds would be no higher than conventional large-caliber gun projectile speeds.
- Long-range guns would fire into a target area from 32,000 to 35,000 yards in the upper LDZ up to 10 days a year, which is more frequently than over the last 15 years.
- Outdoors small arms use would increase fourfold from 6,000 to 25,500 bullets fired annually.
- Detonations would increase by 10 detonations, or five percent annually.

2.5.2 Alternative 1 Proposed Activities Using Electromagnetic Energy

As described in Chapter 1, many types of EM energy emitters are present at NSWCDD, most of which operate at low powers and have negligible human health risks. Therefore, low-powered devices such as radios and range radars with power, frequency, and exposure levels well below established HERP, HERO, HERF, and EMI thresholds are not included in the Proposed Action because they pose little known hazard to humans or the environment. No special precautions are necessary in the vicinity of lower-power EM energy emitters such as radios, cell phones, remote controls, and radars because their operation generates negligible human health risks and environmental impacts. By contrast, the EM energy devices evaluated in this EIS operate in the frequency range of 300 kHz to 300 GHz and at average powers ranging from 10 W up to 500 MW, but with most events well below the maximum. Currently, an annual average of 490 events takes place at NSWCDD using EM energy fields in these ranges. More than three quarters of these events are ground plane operations, described in Section 1.5.2.3. Future activities using high-power EM energy are described in the following sections.

Because of the rapidly growing role of unmanned systems (UMSs) in modern warfare, NSWCDD anticipates that unmanned aerial vehicles (UAVs), unmanned ground vehicles (UGVs), and unmanned surface vehicles (USVs) would be used more frequently for outdoor RDT&E for weapons systems integration and as platforms for sensors and directed-energy sources, as sensor, laser, or directed-energy targets, and as communication relays. As the use of range patrol boats and other watercraft would increase with the increase in the number of operations and the use of the PRTR, so too would the use of USVs on the PRTR. Annual flight hours for UAVs are expected to increase in future years from 200 hours in calendar year 2009. However, the actual number of hours UAVs are in the SUA over the ranges would not rise as much as total flight hours because more than one UAV could be flying at the same time. They also could be flying concurrently with other range activities. If no other range activities are taking place, the PRTR surface would not need to be restricted while UAVs are flying. However,

the SUA would be reserved for military use while UAVs are flying. UAVs would be flown in all types of weather conditions and at night.

2.5.2.1 Electromagnetic Sensors

In the future, NSWCDD would continue to employ radio frequency (RF) radars, a form of directed energy, to ensure range safety and to test new or upgraded RF radar sensing systems. RDT&E for new and upgraded radar systems would focus on ensuring that they work well with – are integrated with – new and existing shipboard hardware and software. RF emissions would have the appropriate HERP, HERO, HERF, and EMI safety zones and restrictions when emitters are being operated.

2.5.2.2 Hazards of Electromagnetic Radiation to Ordnance (HERO) and Electromagnetic Environmental Effects (E3)

The number of HERO and E3 events that take place annually at the NOTES facility on the EEA and the MOATS and ground-plane facilities on Mainside would increase. Their operational power levels and frequency ranges would remain the same. Whenever these facilities are in operation, HERP, HERO, HERF, and EMI safety zones and restrictions are in effect.

2.5.2.3 Directed Energy

The number of outdoor events using directed energy, excluding EM sensors, would increase above current levels, as would the power of the emissions. Future directed-energy emissions being tested outdoors would include high-power microwave and radio frequency (RF) emissions. Future high-power directed-energy emitters might include the Navy Directed Energy Center (NDEC); a directed-energy mobile emitter on one of the land ranges; or a mobile emitter on a barge on the MDZ. Beams of directed energy might be directed at the Counter Explosive Test Facility (CETFAC), at targets on the land ranges, or at targets on the MDZ.

Increasingly, UMSs would be used as part of directed-energy RDT&E. UAVs, UGVs, and USVs may be used as mobile targets for beams of directed energy. The aim of targeting might be to electronically track, disable, or destroy a UMS, but UAVs would only be tracked – not disabled or destroyed.

An example of a target on the MDZ might be a USV such as an unmanned “go-fast” boat, to test whether directed energy could disable the vessel by overloading the circuits in the engine or other electrical equipment on board, such as radar or computers, or destroy it. High-power microwave energy might also be focused on explosive devices on land ranges or on vessels on the MDZ to test whether directed energy could disable fuzes or timing devices in order to render them harmless.

UAVs could also be used as platforms for directed-energy emitters. The constraint for this application for UAVs would be the current size and weight of the energy source required to power the directed-energy emitter versus the capacity of the UAVs used by NSWCDD, but the technology is changing quickly, and this may be less of an issue in the future. UAVs could be used as relay platforms to communicate from a land range or vessel on the PRTR to USVs or transmission targets on various platforms in the UDZ, MDZ, LDZ, or to targets on the land ranges.

USVs and UAVs could be used to "bounce" or reflect a beam emitted from a land range or a vessel on the PRTR to a UAV or similar airborne platform to a target located over the horizon on the land ranges or on a platform in the UDZ, MDZ, or LDZ. This would allow testing in over-the-horizon conditions, which would overcome a limitation in the use of directed energy (including lasers) as naval weapons: they fire straight beams that cannot arc over the horizon. Lower-power directed energy would be used for initial operations, with gradual increases in power levels as RDT&E progresses and as safety is assured through preparation of risk hazard assessments (RHAs).

For each type of operation proposed in the future, NSWCDD's Safety and Environmental Office in consultation with NSF Dahlgren personnel 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.

2.5.2.4 Summary Comparison of Alternative 1 with No Action Alternative

- Under Alternative 1, the number of annual events using EM energy would increase from No Action Alternative levels of 490 to 590. This represents a 20 percent increase in the number of tests annually using EM energy in the frequency range of 300 kHz to 300 GHz and at average powers ranging from 10 W up to 500 MW.
- Directed EM energy sensors and emitters may be mobile.
- EM energy may be directed at UAVs and USVs on the MDZ; USVs may be disabled or destroyed; UAVs would only be tracked.
- 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 EM energy 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 at night.

2.5.3 Alternative 1 Proposed Activities Using Lasers

As described in Section 1.5.3.2, the Navy's use of lasers is expanding virtually as rapidly as technology allows. Therefore, NSWCDD's laser RDT&E program is growing. Laser RDT&E work in the foreseeable future would continue along the path of the work already being conducted. Research involving lasers would focus on uses ranging from communications and targeting to weapons and sensors – including detecting simulated weapons of mass destruction, such as chemical and biological simulants.

As described in 1.5.3, the EIS focuses on HE lasers because of their potential to be hazardous to the human environment. Under Alternative 1, NSWCDD's HE laser operating power levels,

currently a maximum of 100 kW, would increase up to 500 kW for some tests. The sizes of targets and types and thickness of backstop material would increase proportionally to absorb the increased energy.

Under Alternative 1, HE lasers would be directed from sources on land ranges (such as NDEC) over the waters of the PRTR to targets/backstops that would be located on the waters of the MDZ (likely on a barge) at varying distances from the source. Because the beam would become more diffuse and its diameter would expand as it gets farther from the laser emitter, the sizes of the targets/backstops that intercept the laser beam and absorb its energy would increase to contain the beam's width. Locations and scenarios for tests would be approved by the Navy's Laser Safety Review Board (LSRB) and NSWCDD's Laser System Safety Officer (LSSO) prior to testing.

Some HE laser operations under Alternative 1 would involve directing HE lasers at moving airborne targets, such as mortar shells and UAVs in flight, over the waters of the PRTR's MDZ. This would help to determine the value of employing the HE laser system for point defense against moving aerial targets and high-speed missiles. UAVs would be electronically tracked as targets but would not be destroyed; mortar shells would be destroyed. Currently, HE lasers used by NSWCDD are fixed and only emit on a slightly downward angle to fixed targets/backstops. In order to direct HE lasers above the horizon, NSWCDD would coordinate with the FAA and affected DoD components, such as the North American Defense Command, and, in this case, NAS Patuxent River, which coordinates the use of NSWCDD's SUA, in accordance with the joint Chief of Naval Operations Instruction/Marine Corps Order, OPNAVINST 5100.27/MCO 5104.1A

Some HE laser operations might involve directing lasers at an airborne platform, such as a UAV, but rather than trying to destroy the platform, the laser beam would be aimed at a mirror-like surface on the airborne platform to reflect the laser beam to a target over the horizon. Lasers may be emitted from a land range or a vessel on the PRTR to targets on various platforms in the UDZ, MDZ, or LDZ or the land ranges. The coordination and range controls described above for UAVs as targets would apply to this kind of test as well. Initially, laser emissions would be at eye-safe, lower-power levels. As RDT&E progresses, power levels would gradually increase.

As described for directed-energy activities, for each laser operation proposed in the future, NSWCDD's Safety and Environmental Office 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.

More events would take place at dawn and dusk, when the atmosphere is thermally stable. Also, because lasers must be operated at all times of the day in order to fully evaluate their capabilities, some laser operations would occur at night, after dark. To help in evaluation of their performance in inclement weather, lasers may also occasionally be operated when it is rainy or foggy.

2.5.3.1 Summary Comparison of Alternative 1 with No Action Alternative

- Under Alternative 1, the number of HE laser events would increase from current/No Action levels of 60 annually to 125 annually, which is a 108 percent increase.
- The maximum HE laser power levels would increase from the current/No Action Alternative level of 100 kW to 500 kW.
- HE lasers would be directed from land ranges to floating targets on the MDZ.
- HE lasers would target UAVs by tracking them and would disable/destroy 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.
- If lighter-weight power sources are developed, lasers may be fired from manned and unmanned aerial vehicles 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 at night.

2.5.4 Alternative 1 Proposed Activities Using Chemical and Biological Simulants

As new chem/bio detectors, decontaminants, and collective protection (COLPRO) systems are developed and existing ones upgraded under the DoD's CBDP, they will need to be operated in maritime conditions and aboard vessels over water. NSWCDD, as the primary Navy laboratory for the CBDP, is the most cost-effective site for such activities. Activities would also take place on land ranges and the Mission Area.

Testing detectors in an outdoor marine/estuarine environment is essential. Stand-off detectors such as the Joint Service Lightweight Stand-off Chemical Agent Detector (JSLSCAD) remotely detect chemical-agent vapors some distance from the source using a scanner, a detector, and an electronics module to process and communicate information. These sensors detect infrared (IR) radiation, recognized as temperature differences – such as the temperature difference between a vapor cloud and the surrounding air. When the background air being sensed includes the area where water and sky meet (the water-sky interface), the IR sensor may lose sensitivity, making it more difficult to distinguish a harmful vapor. Water vapor and fog from the marine/estuarine environment present a challenge for chemical sensors, which must be overcome. Passive IR sensors such as JSLSCAD do not emit IR radiation.

As compared to stand-off detectors that are designed to detect remotely, point detector sensors typically are tested by first attaching the sensor – a badge, a patch or a small unit – to a surface or to the inside or outside of a protective suit; then challenging the sensors with a cloud of simulant at various concentrations; and, finally, observing whether the sensors detect the simulant. Interferents could be added to further test the accuracy of the sensor or detector.

2.5.4.1 Increase in Activities

Future activities using chemical and biological simulants outdoors on the land and water range complexes and the Mission Area would increase from the current baseline of 12 events annually using chemical simulants and none using 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 may take place would expand from the areas used in the past shown in Figure 1-11 to include all the land ranges, the Mission Area, and the MDZ.

2.5.4.2 Likely Progression of Chem/Bio RDT&E

Based on the current state of the technology, the likely progression of chem/bio defense RDT&E for the foreseeable future would be:

1. More operational tests on the PRTR's MDZ and on land similar to those conducted in 2003, 2005 and 2009, using comparable chemical simulants, but representing a wider range of chemical agents, to test updated or new point and stand-off detector systems.
2. Biological point and/or stand-off sensor tests on the PRTR's MDZ and on land using biological simulants to challenge detectors.
3. Chemical and biological simulants used separately for stand-off or point sensor tests on the PRTR's MDZ to challenge detectors.
4. Tests of the effectiveness of point and stand-off sensor/detector systems to sense chemical and/or biological simulants in an environment with various interferents, smokes, and obscurants on the PRTR's MDZ and on land.
5. Decontamination operations on equipment and facilities, on land and on the PRTR's MDZ, using chemical or biological simulants representing known or expected chem/bio threats.
6. Outdoor COLPRO operations on land and on the PRTR's MDZ using chemical and/or biological simulants representing known or expected chem/bio threats. This would include clearing spaces exposed to simulants, as well as preventing exposure of spaces to simulants.

2.5.4.3 Outdoor Chemical Detector Operations

A typical future operational scenario for outdoor testing of a chemical-detector system using chemical simulants would be similar to the JSLSCAD testing that NSWCDD conducted in 2003, 2005, and 2009. Operations likely would be conducted several times a year, each lasting for approximately two weeks. Stand-off detectors like the JSLSCAD would be used, but point detectors could be tested as well. Testing could take place on any of the land ranges or the Mission Area, but most testing would be conducted on the PRTR's MDZ.

Chemical simulants are chosen for their low toxicity, low environmental impacts, and ability to closely simulate, or mimic, the actual agent the sensor is designed to detect. The toxicity of a chemical is defined by the extent of its adverse effects on a biological organism, as described further in Section 3.8.5.1. The chemical simulants that have been used in NSWCDD's past indoor or outdoor RDT&E operations include the following compounds:

- Polyethylene glycol (PEG 200)
- Methyl salicylate (MeS)
- Sulfur hexafluoride (SF_6)
- Triethyl phosphate (TEP)
- Glacial acetic acid (GAA)
- Dipropylene glycol methyl ether (DPGME)
- Dimethyl methylphosphonate (DMMP)
- Diethyl malonate (DEM)
- Diethyl phthalate (DEP)
- Dimethyl adipate (DMA)
- Diethyl ethyl phosphonate (DEEP)

PEG 200 and MeS were used in outdoor chemical simulant tests at NSWCDD in the 1980s. SF_6 was used as a simulant in the 1996 outdoor tests and to calibrate the JSLSCAD equipment for the 2003 and 2005 tests. TEP and GAA were used as chemical simulants for the tests on the PRTR in 2003 and 2005. The 2009 test activities involved release of the liquids MeS, TEP, GAA, and the gases R-134 and R-152a .To date, DPGME, DMMP, DEM, DEP, DMA, and DEEP have not been used as simulants outdoors at NSWCDD.

Future operations could use any of these 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. All operations would be conducted in accordance with local, state, and federal regulations.

Other materials and chemicals that have been used during chemical-detector operations include thickeners, flavorings, and ultraviolet (UV) dye indicators, as listed below:

- Polymethyl methacrylate (PMMA), Acryloid K-125 (a thickener; trademark Rohm and Haas)
- Isoamyl acetate (banana oil)
- Tinopal CBS-X (trademark Ciba-Geigy), which is a UV dye (used as a shirt whitener in laundry detergents)

These compounds are used to aid in dispersal and identification. Future testing could use similar auxiliary chemicals.

Operational tests over water would be conducted on the MDZ. Details of operational conditions and restrictions would be documented in SOPs approved by NSWCDD authorities. Prior to the operation, the Navy team would determine where, based on wind conditions, the operation should begin to release the vapor to attain the desired vapor concentration for a particular test. Vapor releases would take place well within the boundaries of the ranges and the Mission Area, so that vapor clouds would disperse before reaching their boundaries, as determined by modeling and by monitoring weather conditions just prior to the test. Over-water operations would involve

release of a vapor of chemical simulant in a variety of weather conditions from a vessel, helicopter, or UAV. Prior to releasing simulants, the MDZ would be cleared of non-participating boats and personnel by range control boats – both as a safety measure and to preclude non-background sources of IR radiation (i.e., other vessels) that could interfere with the test. Range boats would continue to patrol the MDZ during the tests and during cleanup, if required, afterwards.

Sensors mounted on and operated from vessels and/or on shore would be aimed upriver or downriver, to detect the simulant vapor against a sky/water background. The release for each operational test would take about two minutes, and the resulting vapor would dissipate in less than ten minutes. The PRTR's cameras, a global positioning system (GPS), meteorological stations, real-time surface radars, and a locational system would be used to detect and record in detail the release, dispersion, and ultimate dissipation of the simulant vapor.

Operational tests on land could be conducted on any of the land ranges or the Mission Area. Test methods would be similar to tests on the PRTR. Wind and storm conditions would be monitored prior to releasing the vapor to attain the desired vapor concentration and location for a particular test. Operations could occur in a variety of weather conditions. Releases of vapor could take several minutes, and the resulting vapor would dissipate quickly. Operations on land would be monitored using much the same equipment used on the river.

Operations on the PRTR or on land would be designed to determine not only whether stand-off detectors are working as designed, but also whether point detectors and protective gear are working as designed.

2.5.4.4 Quantity of Simulants

For both land and river range operations, repetitive tests would be conducted with each simulant or group of simulants. A typical test would involve the release of approximately 10 gallons (gals) of simulant, but the amount could vary from a few ounces up to 20 gals of simulant. The amount of simulant used would be the minimum amount needed to test the lowest level of simulant the sensor can detect (its threshold capacity). Thus, the concentrations produced within each vapor cloud would be extremely low.

Typically, for tests over water, a simulant would be released by boat at a height of approximately 40 ft. Simulants also would be released over land or water by a helicopter-mounted or UAV-mounted sprayer system at a height of about 300 ft. Some simulant coming from the helicopter or UAV spraying over water might enter the river, and cleanup of the test platform would result in some effluent with low concentrations of simulants entering the river.

SF_6 has been used in past tests to calibrate detectors but is unlikely to be used in the future because it has been identified as a greenhouse gas and is on the US Environmental Protection Agency's (USEPA's) Greenhouse Gas Watch List. Instead, R-134a and R-152a (common commercial refrigerant gases) or similar substances would be used in the future to calibrate detectors. Based on past experience, future tests could each use approximately 30 lbs to 150 lbs of these chemicals (averaging 125 lbs per test) to calibrate test equipment.

2.5.4.5 Dispersal of Simulants

In a typical scenario, the simulant would be pressurized with nitrogen gas and blown out as an aerosol or mist into the air using a high-velocity blower, or dispersed as a liquid or aerosol from the helicopter-mounted sprayer. The simulant could be dispersed from a boat, helicopter, or UAV at altitudes that would ensure test objectives are met while at the same time achieving the desired movement and dispersion of the simulant. Similar results could be obtained from similar exposure concentrations in a JSLSCAD-type test using either 10 gals of simulant released at a height of 40 ft or 1.5 gals of simulant released at 6 ft. The test objective in this example – to test the reliability of a JSLSCAD-type sensor some distance "x" downwind of the "attack" – would dictate the simulant scenario employed.

2.5.4.6 Outdoor Biological Sensor Tests

In many ways, outdoor testing of biological-agent sensors would be similar to chemical sensor tests using chemical simulants. These tests could be conducted on land ranges or within the Mission Area, but 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.

Biosafety Level (BSL)-1 Organisms

BSL-1 organisms are defined by the Centers for Disease Control and Prevention (CDC) (September 3, 2008) as "well-characterized strains of viable microorganisms not known to consistently cause disease in healthy adult humans and of minimal potential hazard to laboratory personnel and the environment."

Biological simulants are microorganisms that exhibit a quality similar to an actual biological threat agent. NSWCDD would only use Biosafety Level (BSL)-1 organisms as simulants. BSL-1 organisms are commonly used in high school and introductory college teaching laboratories. Examples of BSL-1 organisms are *Lactobacillus acidophilus,* which is used to turn milk into yogurt, and *Neurospora crassa*, a bread mold, which is used for genetic studies because its simple genome has been completely sequenced. Future test activities would use the simulants listed below or similar BSL-1 organisms. All simulants would be approved through the NSWCDD Safety and Environmental Office in consultation with NSF Dahlgren and would only be approved after considering biosafety-level data relative to the intended use of the simulant and the purpose of the test. All tests would be conducted in accordance with local, state and federal regulations.

Tests of biological detectors would use the following BSL-1 bio-simulants or BSL-1 organisms similar to them:

- Spore-forming bacteria: *Bacillus atrophaeus* (formerly known as *Bacillus globigii*), *Bacillus subtilis*, and *Bacillus thuringiensis*
- Non-spore-forming bacteria: *Pantoea agglomerans* (formerly known as *Erwinia herbicola*) and *Deinococcus radiodurans*
- The fungus *Aspergillus niger*
- The protein ovalbumin
- MS2 bacteriophages

These biological simulants are described in Section 3.8.5.2.

The amount of simulant used would be the minimum amount necessary to obtain the desired results. Operations would likely be conducted over a two-week period, with up to two tests per day, for a maximum of up to 20 tests in a two-week period.

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. Aside from this, operational tests of both stand-off and point detectors would be similar to those described for tests of chemical simulants.

2.5.4.7 Outdoor Chemical and/or Biological Sensor Tests with Interferents, Smokes, and Obscurants

All of the sensor-testing described in the preceding sections could be repeated with the introduction of interferents, smokes, or obscurants to study how these substances interact with simulants to affect the capability of detectors. Examples of these include fog oil, PEG 200, poly alpha olephin, paints, fuels, and cleaners. All interferents, smokes, or obscurants must be approved through the NSWCDD Safety and Environmental Office in consultation with NSF Dahlgren and would only be approved after considering the intended quantity and concentration of the interferent, smoke, or obscurant to be used. All tests would be conducted in accordance with local, state and federal regulations.

2.5.4.8 Outdoor Collective Protection (COLPRO) Tests

Operational testing of COLPRO systems in an outdoor setting would be another RDT&E scenario that would use chemical and biological simulants. These tests could be performed on land or on the PRTR to measure the impacts of outdoor conditions on COLPRO systems.

2.5.4.9 Summary Comparison of Alternative 1 with No Action Alternative

- The annual number of outdoor chem/bio defense events would increase fivefold from 12 to 60.
- A wider range of chemical simulants would be used for outdoor chemical defense operations.
- Biological simulants would be used as well as chemical simulants outdoors, but they would not be tested together.
- Chemical and biological simulants may be tested on ranges previously used – the PRTR, EEA, and Main Range – as well as other land ranges, the Mission Area, and the MDZ, where they have not been tested in the past.
- Some chem/bio sensor activities 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 at night.

2.5.5 Alternative 1 PRTR Use

The increase in activities and the requirement to test beyond normal range operations hours under Alternative 1 would result in:

- An overall increase in the number of hours that public access to some part of the PRTR would be restricted from 750 hours under the No Action Alternative to 870 hours annually under Alternative 1.
- Restricting public access to the PRTR UDZ and the LDZ approximately two times a year each to allow, for example, for weapon systems integration operations using vessels and aircraft, compared to no restrictions under the No Action Alternative.
- Restricting public access to the upper LDZ approximately 10 days a year for long-range, large-caliber gun firing, compared to only infrequent restrictions under the No Action Alternative.

2.6 Description of Alternative 2

In most respects, Alternative 2 would include the same types of activities described for Alternative 1, but the number of large-caliber gun and small arms firings, events, and hours would increase. Table 2-2 shows the proposed annual outdoor RDT&E activity levels under Alternative 2. The number of average annual activities under Alternative 2 represents:

1. An average of the annual number of large-caliber gun and small arms firings, detonations, and events for each RDT&E activity from 1993 (1995 for ordnance) to 2009, weighted to take into account years with the highest activity levels (No Action Alternative levels);
2. ***Plus*** the increase in average annual RDT&E activities under Alternative 1 above No Action Alternative levels;
3. ***Plus*** roughly 15 percent growth in the number of average annual RDT&E activities above Alternative 1 levels.

This alternative satisfies current requirements, known outdoor RDT&E scheduled for the coming years, and projected increases in tests in the foreseeable future based on current trends. It provides the flexibility required in RDT&E to accommodate future developments that may influence global threats, homeland security, and future missions. Alternative 2 includes the following increases above Alternative 1 levels:

- Small arms firing would activities would grow by about 4,500 bullets fired annually (18 percent) above Alternative 1 levels. The number of large-caliber projectiles fired would not increase (0 percent).
- Detonations on the EEA would increase by about 30 annually (15 percent) above Alternative 1 levels.

- RDT&E for operations using EM energy events would increase above Alternative 1 levels by 90 (15 percent) annually, HE laser events would increase by 20 (16 percent); and chem/bio simulant events would increase by 10 (17 percent).
- Biological simulants may be tested simultaneously with chemical simulants. Detectors capable of immediately recognizing a mixture of chemical and biological threats would be tested.
- NSWCDD's use of the PRTR would increase by 130 hours annually (15 percent above Alternative 1 levels). The number of days that the UDZ and LDZ would be restricted would be similar to Alternative 1, approximately two times a year, and the upper LDZ would be restricted approximately 10 days a year.

The one respect in which Alternative 2 would differ from Alternative 1 – other than annual numbers of firings, detonations, and events – is that outdoor tests would include mixtures of chemical and biological simulants. Alternative 1 would use both types of simulants, but separately. DoD's and Navy's goal is to develop detectors capable of immediately recognizing either a chemical or biological threat, or a mixture of both, which would only be addressed under Alternative 2. A mixture of chemical and biological simulants would be used for this type of operation. 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. Detector tests would be similar to those described for chemical simulants. 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.

2.7 Preferred Alternative

Alternative 2 is the Navy's Preferred Alternative because it would support an increased level of outdoor RDT&E activities in the foreseeable future, thus optimizing NSWCDD's activities on ranges and the Mission Area, without significantly increasing environmental impacts, such as noise. This alternative would improve NSWCDD's operational capability and flexibility to provide mission support to the Navy and to the other services and organizations now benefiting from NSWCDD's RDT&E programs.

2.8 Comparison of Environmental Impacts

Each alternative was evaluated for its potential to produce environmental impacts. 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, as well as the size of the area affected by the action.
- **Intensity** – Intensity refers to the severity of the impacts. Intensity is rated as negligible, minor, moderate, or major, in accordance with the framework presented below.
- **Short-term or Long-term** – 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** – 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** – A positive impact is one having beneficial outcomes on an environmental resource. A negative impact is one having adverse, unfavorable, or undesirable outcomes.

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.

Table 2-3 compares in summary form the environmental impacts of the No Action Alternative with Alternatives 1 and 2. Chapter 3 describes the existing conditions that set the stage for the analysis of impacts in Chapter 4. In Chapter 4, the impacts of each alternative on resources are evaluated in detail.

Table 2-3
Summary of Environmental Impacts

Resource	No Action Alternative	Alternative 1	Alternative 2
Land Use, Plans, & Coastal Zone Management			
NSF Dahlgren	No military construction proposed. Activities would continue to use existing facilities and corridors within operational ranges and the Mission Area. No direct or indirect impacts on NSF Dahlgren land use pattern. Negligible, short-term, direct, negative impacts and no indirect impacts on non-operational uses of ranges and the Mission Area on NSF Dahlgren. Consistent with Navy plans to guide development at NSF Dahlgren, except that alternative would not support regional plans to further promote district as an RDT&E center.	No military construction proposed. Activities would use existing facilities and existing plus some new areas within operational ranges and the Mission Area. Activities would take place more frequently than under No Action Alternative (Alt). No direct or indirect impacts on NSF Dahlgren land use pattern. Negligible, short-term, direct, negative impacts and no indirect impacts on non-operational uses of ranges and the Mission Area on NSF Dahlgren. Consistent with Navy plans for NSF Dahlgren. Would support regional plans to promote district as an RDT&E center and maximize existing facilities for highest and best use.	No military construction proposed. Activities would use existing facilities and existing plus some new areas within operational ranges and the Mission Area. Activities would take place more frequently than under other alternatives. No direct or indirect impacts on NSF Dahlgren land use pattern. Negligible, short-term, direct, negative impacts on non-operational uses of ranges and the Mission Area on NSF Dahlgren. Consistent with Navy plans for NSF Dahlgren. Would support, to a greater extent than Alt 1, regional plans to promote district as an RDT&E center and maximize existing facilities for highest and best use.
Dahlgren Area and Potomac River Shoreline	Master plans, market forces, and the presence of NSF Dahlgren have determined current land use pattern and development projects. Therefore, continuing RDT&E activities would have no direct or indirect impacts on land use near NSF Dahlgren or along the shoreline of the PRTR. Consistent with master plans and policies of counties and towns near the PRTR. No direct or indirect impacts on existing access to the Potomac River for commercial or recreational purposes.	PRTR use increase of 16% plus 20% increase in EM energy and 108% increase in HE laser events would have negligible, short-term, direct, negative impacts and no indirect impacts on river use. No direct impacts and negligible, long-term, indirect, negative impacts on the desirability of waterfront property based on the slight increase in noise levels in the upper LDZ. NSWCDD gives notice of restrictions in advance, boat traffic is allowed to pass during lulls in tests, and recreational boating mainly takes place on weekends when operations rarely are conducted. No direct impacts and negligible, long-term, indirect, negative impacts on land use, land use planning, and ongoing development projects.	PRTR use increase of 33% plus 39% increase in EM energy and 142% increase in HE laser events would have negligible, short-term, direct, negative impacts and no indirect impacts on river use. No direct impacts and negligible, long-term, indirect, negative impacts on the desirability of waterfront property for the reasons described under Alt 1. No direct impacts and negligible, long-term, indirect, negative impacts on land use, land use planning, and ongoing development projects
Special-Use Airspace	No change from existing conditions; no direct or indirect impacts on civilian air traffic.	Negligible, short-term, direct, negative impacts and no indirect impacts on civilian air traffic. No change in the hours that airspace is restricted annually. Although fewer hours	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
		would be turned back to FAA for civilian use, commercial and general aviation operators normally stay out of the special-use airspace at all times; many operators consider the special-use airspace to be off-limits at all times. It is expected that few aircraft would actually use the airspace during hours normally restricted.	
Coastal Zone	The Proposed Action is consistent to the maximum extent practicable with the enforceable policies of Virginia's and Maryland's coastal zone management (CZM) programs. The Virginia Department of Environmental Quality (VDEQ) concurred that the Proposed Action will be consistent with the Virginia Coastal Zone Management Program. The Maryland Department of the Environment (MDE) received a copy of the DEIS and the Federal Coastal Consistency Determination (Appendix I) but did not respond within 60 days to the Navy's consistency determination nor ask for an extension, so under the provisions of the Coastal Zone Management Act, the state has waived its consistency rights, stating neither that it concurs with nor objects to the Navy's consistency determination.	Same as No Action Alt.	Same as No Action Alt.
Socioeconomics			
Demographics	No significant increase in NSWCDD's outdoor RDT&E personnel anticipated; unlikely to affect population projections and would have no direct or indirect impacts on demographics.	No significant increase in NSWCDD's outdoor RDT&E personnel anticipated; unlikely to affect population projections and would have no direct impacts and negligible, long-term, indirect, negative impacts on demographics.	Same as Alt 1.
Economics	Current PRTR activities have not suppressed real estate development driven by proximity to Washington, DC and attractiveness of the Potomac River. Marine navigation (freight movement, commercial fishing, and recreational boating) coexists with range use; inconvenience of delays of up to 30 minutes (10 minutes typical) for small vessels and up	Based on No Action Alt experience, the 16% increase in PRTR use and no significant increase in noise, coupled with Range Operations Center measures to facilitate river traffic movement (as described under No Action Alt), are expected to have no direct and negligible, long-term, indirect, negative impacts on real estate development; and	Based on No Action Alt experience, the 33% increase in PRTR use and no significant increase in noise, coupled with Range Operations Center measures to facilitate river traffic movement (as described under No Action Alt.), are expected to have no direct and negligible, long-term, indirect, negative impacts on real estate development; and minor, short-

Resource	No Action Alternative	Alternative 1	Alternative 2
	to one hour (half-hour typical) for large vessels is mitigated by Range Operations Center's early notices of upcoming operations and working with vessel operators to allow them to pass during lulls in testing. 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.	minor, short-term, direct and minor, long-term, indirect, negative impacts on marine commerce.	term, direct and minor, long-term, indirect, negative impacts on marine commerce.
Environmental Justice and Protection of Children	No disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. No disproportionate environmental health or safety risks to children.	Same as No Action Alt.	Same as No Action Alt.
Utilities			
Utilities	NSWCDD's current power requirements are being adequately supplied by the power grid and NSF Dahlgren's auxiliary generators. RDT&E activities would have no direct or indirect impacts on utilities. The Dominion Virginia Power (DVP) application to build a new 230 kilovolt transmission source and substation at NSF Dahlgren has been approved and construction is scheduled to be completed in 2014. This would meet NSF Dahlgren's needs and King George County's growth and development.	Despite 20% increase in EM energy and 108% increase in HE laser events, RDT&E activities would have no direct and negligible, long-term, indirect impacts on the Virginia power grid. RDT&E activities would have no direct or indirect impacts on other utility systems, which are sufficient to support proposed activities.	Despite 39% increase in EM energy and 142% increase in HE laser events, RDT&E activities would have no direct and negligible, long-term, indirect impacts on the Virginia power grid. RDT&E activities would have no direct or indirect impacts on other utility systems, which are sufficient to support proposed activities.
Air Quality			
Stationary & Mobile Sources	No construction of any new major stationary sources is proposed. The land-based portion of NSF Dahlgren is in an attainment area and has a state operating permit for stationary air emissions. Annual emission levels do not exceed Title V major source thresholds. The emissions from the portion of the PRTR's MDZ located within an ozone nonattainment area would be unchanged. RDT&E activities would result in negligible, long-term, direct and	Same as No Action Alt.	Same as No Action Alt.

Resource	No Action Alternative	Alternative 1	Alternative 2
	indirect, negative impacts on air quality.		
Other Sources	Chemical simulants released have low toxicity and are rapidly dispersed to low concentrations. NSWCDD personnel exposed to simulants use personal protective equipment. Chemical defense activities would result in negligible, long-term, direct and indirect, negative impacts on air quality.	The 400% increase in chem/bio defense events and the addition of biological simulants would result in negligible, long-term, direct and indirect, negative air quality impacts comparable to impacts under the No Action Alt.	The 483% increase in chem/bio defense events and the addition of biological simulants, which may be mixed with chemical simulants, would result in negligible, long-term, direct and indirect, negative air quality impacts comparable to impacts under the No Action Alt.
Greenhouse Gases	NSWCDD RDT&E activities make an incremental contribution to greenhouse gas emissions, representing a very small percentage of total United States emissions. Based on an estimate of CO_2 equivalents generated, NSF Dahlgren's facility-wide total greenhouse gas emissions in 2008 represented approximately 0.0001% of the total emissions for the country as a whole. NSWCDD RDT&E activities when combined with other past, present, and reasonably foreseeable future actions would have the potential for negligible, long-term, indirect, negative impacts on climate.	Same as No Action Alt because increases in greenhouse gas emissions would be negligible.	Same as No Action Alt because increases in greenhouse gas emissions would be negligible.
Noise			
Noise	Noise levels resulting from firing large guns and small arms and from detonations would remain the same as at present. Ordnance activities would have minor, long-term, direct, negative weapons-testing noise impacts; negligible, long-term, direct, negative vibration impacts; and no indirect noise or vibration impacts. EM energy, HE laser, chemical defense activities, and PRTR use would have no direct or indirect noise or vibration impacts.	Although small-arms firing would increase by 325% and detonations by 5%, there would be no significant overall increase in noise levels. Ordnance activities would have minor, long-term, direct, negative weapons-testing noise impacts; negligible, long-term, direct, negative vibration impacts; and no indirect noise or vibration impacts. EM energy, HE laser, chemical and biological defense activities, and PRTR use would have no direct or indirect noise or vibration impacts.	Although small-arms firing would increase by 400% and detonations by 21%, there would be no significant overall increase in noise levels. Ordnance activities would have minor, long-term, direct, negative weapons-testing noise impacts; negligible, long-term, direct, negative vibration impacts; and no indirect noise or vibration impacts. EM energy, HE laser, chemical and biological defense activities, and PRTR use would have no direct or indirect noise or vibration impacts.
Cultural Resources			
Archaeolog-ical Resources	RDT&E activities would have no direct or indirect impacts on previously identified archaeological resources and are not expected to affect unknown resources within the Archaeological Area of Potential Effect	RDT&E activities would have no direct or indirect impacts on previously identified archaeological resources and are not expected to affect unknown resources within the Archaeological APE. In accordance with	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
	(APE) because no groundbreaking activities and no expansion of outdoor RDT&E activities are proposed. In accordance with Section 106 of the National Historic Preservation Act, the Virginia Department of Historic Resources (VDHR) and Maryland Historic Trust (MHT) concurred that this alternative would not have an adverse effect on archaeological resources within the archaeological APE.	Section 106 of the National Historic Preservation Act, the VDHR and MHT concurred that this alternative would not have an adverse effect on archaeological resources within the archaeological APE. No archaeological resources are known to occur in the heavily-disturbed range areas used for detonations so an increase in detonations would have no effect. There would be no increase in large-caliber gun firing.	
Historic Architectural Resources	In accordance with Section 106, ordnance noise and vibration modeling indicates no adverse effect to either the National Register-eligible Dahlgren Residential Historic District or the three proposed districts on NSF Dahlgren.The VDHR and MHT concurred that the Proposed Action would have no direct or indirect adverse effect on National Register of Historic Places-eligible or -listed properties within the Historic Architectural APE. In accordance with NEPA, the No Action Alternative would have minor direct impacts and no indirect negative impacts on historic architectural resources within the APE.	Same as the No Action Alt. Although there would be a 325% increase in small-arms use, the area affected is limited and would not include National Register-listed or -eligible resources. There would be no increase in large-caliber gun firing.	Same as the No Action Alt. Although there would be a 400% increase in small-arms use, the area affected is limited and would not include National Register-listed or -eligible resources. There would be no increase in large-caliber gun firing.
Hazardous Materials and Waste			
Hazardous Materials and Hazardous Waste	The numerous policies and programs in place to remediate and to safely use, store, transport, and dispose of hazardous materials and hazardous waste ensure that they are safely handled and do not enter the environment. The environmental restoration program is addressing past range use when environmental programs were less stringent. Ordnance activities would have minor, long-term, direct and indirect, negative impacts and EM energy, HE laser, and chemical defense activities would have negligible, long-term, direct and indirect, negative impacts.	The numerous policies and programs in place to remediate and to safely use, store, transport, and dispose of hazardous materials and hazardous waste would ensure that they are safely handled and do not enter the environment. The environmental restoration program is addressing past range use when environmental programs were less stringent. Comparable to the No Action Alt, ordnance activities would have minor, long-term, direct and indirect, negative impacts and EM energy, HE laser, and chem/bio defense activities would have negligible, long-term, direct and indirect, negative impacts.	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
Health & Safety			
Health and Safety	Activities are conducted in accordance with Navy policies, carefully-conceived management controls, and operation-specific risk hazard assessments and standard operating procedures, which are implemented to ensure safety during the RDT&E activities. Input of munitions constituents (MCs) into the Potomac River from current and past ordnance use are well below concentrations that could cause adverse effects on human health. Ordnance, EM energy, HE laser, and chemical defense activities would have negligible, long-term, direct and indirect, negative impacts. PRTR use would have negligible, long-term, direct, negative impacts and no indirect impacts.	The 325% increase in small-arms firing and 5% increase in detonations would not increase releases of MCs on or off range or pose unacceptable risks to human health. Most bullets are fired into butts and those entering the PRTR are likely to be buried in sediments and be isolated from exposure pathways. The MC contribution of the additional number of bullets settling near the surface of the sediments is negligible (0.1% of duds and inert bullets or about 26 bullets). Treatment of explosive waste from the additional detonations would take place at NSWCDD, consistent with current operations. Biological simulants would be tested, but simulants proposed for use are common and found naturally in the environment. Ordnance, EM energy, HE laser, and chem/bio defense activities would have negligible, long-term, direct and indirect, negative impacts. PRTR use would have negligible, long-term, direct, negative impacts and no indirect impacts.	The 400% increase in small-arms firing and 21% increase in detonations would not increase releases of MCs on or off range or pose unacceptable risks to human health. Most bullets are fired into butts and those entering the PRTR are likely to be buried in sediments and be isolated from exposure pathways. The MC contribution of the additional number of bullets settling near the surface of the sediments is negligible (0.1% of duds and inert bullets or about 30 bullets). Treatment of explosive waste from the additional detonations would take place at NSWCDD, consistent with current operations. Biological simulants would be tested, but simulants proposed for use are common and found naturally in the environment. Biological simulants tests could be performed in combination with chemical simulants; there are no known synergistic interactions between the proposed types of biological organisms and low-toxicity chemical simulants. Ordnance, EM energy, HE laser, and chem/bio defense activities would have negligible, long-term, direct and indirect, negative impacts. PRTR use would have negligible, long-term, direct, negative impacts and no indirect impacts.
Geology, Topography, Soils & Sediments			
Geology, Topography, Soils and Sediments	Ordnance activities would have minor, long-term, direct, negative impacts on soils and sediments, based on localized disturbances to soil and sediments, and no direct or indirect impacts on geology or topography. EM energy, HE laser, and chemical defense activities would have negligible, short-term, direct impacts and no indirect impacts on geology, topography, soils, or sediments, as there would be minimal contact with these features. Use of boats during activities on the	Same as No Action Alt.	Same as No Action Alt.

Resource	No Action Alternative	Alternative 1	Alternative 2
	PRTR would have no direct impacts and negligible, long-term, indirect, negative impacts on geology, topography, soils, and sediments.		
Water Resources			
Surface Water	RDT&E activities would have little contact with surface water resources and minimal potential to affect them. Low concentrations of MCs and simulants enter surface water with predicted concentrations below standard detection levels. Ordnance activities and PRTR use would have negligible, long-term, direct and indirect, negative impacts on surface waters. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts. Any incidental EM/laser energy would be quickly diminished by reflection, absorption, or scattering by water. Chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts. PRTR use would have negligible, long-term, direct and indirect, negative impacts on surface waters.	Same as No Action Alt. Naturally-occurring biosafety level (BSL)-1 organisms used in bio defense tests would not affect surface water.	Same as Alt 1.
Wetlands and Floodplains	Ordnance and PRTR use would have no direct impacts and negligible, long-term, indirect, negative impacts on wetlands and floodplains. EM energy, HE laser, and chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect wetlands and floodplains.	Same as Alt 1.
Groundwater	Ordnance activities would have no direct impacts and negligible, long-term, indirect, negative impacts on groundwater. EM energy, HE laser, chemical defense activities, and PRTR use do not contact groundwater and therefore would not directly or indirectly impact groundwater.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not enter the groundwater.	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
Potomac River Biological Resources			
Submerged Aquatic Vegetation (SAV)	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on SAV communities. Exposure concentrations of MCs and simulants are below levels that could cause adverse effects in aquatic organisms. EM energy, HE laser, and PRTR use would have negligible, short-term, direct, negative impacts and no indirect impacts on SAV. Chemical defense activities would have no direct impacts and negligible, short-term, indirect, negative impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect SAV.	Same as Alt 1.
Plankton	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on plankton communities. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts. Chemical defense and PRTR activities would have no direct impacts and negligible, short-term, indirect, negative impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect plankton communities.	Same as Alt 1.
Aquatic Invertebrates	Ordnance, activities would have negligible, long-term, direct and indirect, negative impacts on aquatic invertebrate communities. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts. Chemical defense and PRTR activities would have no direct impacts and negligible, short-term, indirect, negative impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect aquatic invertebrate communities.	Same as Alt 1.
Fish	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on fish communities. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts. Chemical defense activities would have no direct impacts and negligible, short-term, indirect, negative impacts. PRTR use would have negligible, short-term, direct	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect fish communities.	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
	and indirect, negative impacts.		
Essential Fish Habitat (EFH)	The RDT&E activities conducted by NSWCDD on the PRTR 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 National Marine Fisheries Service (NMFS) concurred that the proposed action would not substantially adversely affect EFH or habitat areas of particular concern. In accordance with NEPA, ordnance activities would have negligible, long-term, direct and indirect, negative impacts on EFH. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on EFH. Chemical defense activities would have no direct impacts and negligible, short-term, indirect, negative impacts. PRTR use would have negligible, short-term, direct and indirect, negative impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect EFH.	Same as Alt 1.
Potomac River Birds			
Potomac River Birds	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on Potomac River birds. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts. Chemical defense activities would have no direct impacts and negligible, short-term, indirect, negative impacts. PRTR use would have negligible, short-term, direct and indirect, negative impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect birds.	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
NSF Dahlgren's Biological Resources			
Ponds, Streams, and Creeks	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on biological resources associated with NSF Dahlgren's ponds, streams, and creeks. Large-caliber guns are mostly fired into the river rather than at land targets; 90% of small arms are fired at targets on land that trap the bullets, but 10% are fired at targets in the water up to 4,000 yds out and end up in the river. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts, as most activities occur well away from ponds, streams, and creeks. Chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect ponds, streams, and creeks.	Same as Alt 1.
Vegetation	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on NSF Dahlgren's vegetation. HE laser, EM energy, and chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect vegetation.	Same as Alt 1.
Wildlife	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on NSF Dahlgren's wildlife. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts. EM and laser corridors are checked for presence of wildlife before and during tests. Chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect wildlife.	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
Special Interest Areas (SIAs)	Ordnance, EM energy, HE laser, and chemical defense activities would have no direct or indirect impacts on biological resources associated with SIAs.	Same as No Action Alt. Biological defense activities would have no direct or indirect impacts on biological resources associated with SIAs.	Same as Alt 1.
Hunting and Fishing	Ordnance activities would have no direct impacts and negligible, long-term, indirect, negative impacts on hunting and fishing. EM energy, HE laser, and chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts. These activities have little or no spatial overlap with hunting and fishing areas.	Same as No Action Alt. Biological defense activities would have little or no spatial overlap with hunting and fishing areas.	Same as Alt 1.
Protected Species			
Fish	NMFS has provided concurrence in accordance with Section 7 of the Endangered Species Act (ESA) that existing RDT&E activities may affect, but are not likely to adversely affect the endangered shortnose sturgeon and Atlantic sturgeon. In accordance with NEPA, ordnance activities and PRTR use would have negligible, long-term, direct and indirect, negative impacts on the shortnose sturgeon and Atlantic sturgeon. EM energy, HE laser, and chemical defense activities would have no direct or indirect impacts.	Same as No Action Alt. Biological defense activities would have no direct or indirect impacts.	Same as Alt 1.
Sea Turtles	Ordnance use is more than 6.5 nautical miles above the lowest reach of the Potomac River where sea turtles (ESA-listed loggerhead, Kemp's ridley and green) are found seasonally. There is minimal spatial overlap between RDT&E activities conducted by NSWCDD on the PRTR and sea turtles using the lower Potomac River. NMFS has provided concurrence in accordance with Section 7 of the ESA that the baseline RDT&E activities impacts are considered to be insignificant or discountable and may affect, but are not likely to adversely affect sea turtles.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not change the conclusions.	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
	In accordance with NEPA, ordnance activities would have no direct and negligible, short-term, indirect negative impacts on sea turtles. EM energy, HE laser, chemical defense activities, and PRTR use would have no direct or indirect impacts.		
Birds	Ordnance, EM energy, HE laser, chemical defense activities, and PRTR use would not affect the birds protected by the Bald and Golden Eagle Protection Action (BGEPA), Migratory Bird Treaty Act (MBTA), Lacey Act, or the ESA. In accordance with NEPA, ordnance, EM energy, HE laser, chemical defense activities, and PRTR use would have no direct or indirect impacts on the bald eagle or other protected bird species.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not change the conclusions.	Same as Alt 1.
Marine Mammals	There are no reasonably foreseeable takes of marine mammals associated with ordnance, EM energy, HE laser, chemical defense activities, and PRTR use in accordance with the MMPA. In accordance with NEPA, ordnance, EM energy, HE laser, chemical defense activities, and PRTR use would have no direct or indirect impacts on marine mammals.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not change the conclusions.	Same as Alt 1.
Insects	The ESA-listed threatened northeastern beach tiger beetle is found on sandy beaches in the lowest reach of the Potomac River, but no RDT&E activities, inclusive of ordnance, EM energy, HE laser, and chemical defense activities, would take place near the shoreline of the LDZ. In accordance with Section 7 of the ESA, RDT&E activities would have no effect on listed insect species. In accordance with NEPA, ordnance, EM energy, HE laser, chemical defense activities, and PRTR use would have no direct or indirect impacts on tiger beetles.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect the tiger beetle, and in any event, would not be released near the beaches on which they live.	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
Plants	A USFWS Virginia Field Office online project review of the Proposed Action determined that because suitable habitat exists for the ESA-listed sensitive joint-vetch in tidal wetlands within NSF Dahlgren, the Proposed Action may adversely affect the sensitive joint-vetch. However, based on site- and project-specific information, the No Action Alternative would have no effect on this species. Even if the species occurs in tidal wetlands on the installation, it is unlikely to be present in the parts of the range used for ground-disturbing activities, because there is no suitable habitat in these areas. Further, the No Action Alternative would not cause ground disturbance outside of existing target areas and other areas subject to recent and continuing disturbance. In accordance with NEPA, ordnance, EM energy, HE laser, chemical defense activities, and PRTR use would have no direct or indirect impacts on rare, threatened, or endangered plants.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not change the conclusions.	Same as Alt 1.
Cumulative Impacts			
Cumulative Impacts	The baseline RDT&E activities when combined with other past, present, and reasonably foreseeable future actions would have the potential for negligible or minor, but recoverable, negative impacts to the resources evaluated in this EIS.	Same as No Action Alt. The addition of biological defense activities would not change the conclusion.	Same as No Action Alt. The addition of biological defense activities alone or in combination with chemical defense activities would not change the conclusion.

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