ASSESSMENT OF PYROTECHNIC DISPLAYS AND IMPACTS WITHIN THE MONTEREY BAY NATIONAL MARINE SANCTUARY 1993 – 2001

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INTRODUCTION

This report includes many terms unique to the pyrotechnic industry. A glossary has thus been added to define industry terms, and figures and graphics have been attached to provide the reader with a better understanding of the form and function of pyrotechnic devices employed in professional (commercial) fireworks displays.

BACKGROUND

The Monterey Bay National Marine Sanctuary (MBNMS) was designated as the ninth national marine sanctuary in the United States on September 18, 1992. Managed by the Office of National Marine Sanctuaries (ONMS) within the National Oceanic and Atmospheric Administration (NOAA), the MBNMS encompasses 5300 square miles of ocean waters from mean high tide to an average of 30 miles offshore between Rocky Point in Marin County and Cambria in San Luis Obispo County (see Map A). The site adjoins 296 miles of California's outer coastline, overlaying 25% of state coastal waters.

Federal regulations governing activities within the MBNMS became effective on January 1, 1993. In April 1993, a Monterey firm inquired whether Sanctuary authorization was necessary to conduct a professional fireworks display over the waters of the Sanctuary. The MBNMS replied that the debris fallout from the display would constitute a discharge into the Sanctuary and thus a violation of Sanctuary regulations, unless written authorization were secured from the MBNMS. Since that time, the MBNMS has received a total of 46 requests for professional fireworks displays and has issued 42 permits. A list of fireworks requests received since 1993 is included as Appendix A. The majority of displays have been associated with large community events such as Independence Day and city festivals.

The MBNMS was the first national marine sanctuary to be designated adjacent to urban shorelines and, when designated, became the largest marine sanctuary in the United States, equal in area to 77% of all other Federal marine sanctuaries in existence at the time. As a result of its large size and near proximity to urban areas, the MBNMS has faced many regulatory issues not previously encountered by the national program. Authorization of commercial fireworks is one such issue that has required a steady refinement of MBNMS policies and procedures, as the Sanctuary has learned more about the potential impacts of professional fireworks displays on the marine environment. The Sanctuary has monitored individual displays over the years to improve its understanding of their characteristics and potential impacts to Sanctuary resources, but no comprehensive scientific studies have been completed on fireworks in the Sanctuary. This report presents empirical information and the cumulative findings of the MBNMS to date concerning fireworks impacts upon marine resources within the Sanctuary.

As stated above, the MBNMS has issued 42 permits for professional fireworks displays since 1993, with a current average of 7 approvals per year. The number of public fireworks displays within the Sanctuary has remained relatively constant, while private fireworks requests have increased considerably in recent months. Private fireworks displays averaged one per year between 1993 and 2000. Within a six month period from October 2000 to March 2001, the MBNMS received four requests for private fireworks displays in the Sanctuary, and information suggests that such requests will continue and increase in the future. The table below presents a relative comparison of the types of fireworks events authorized by the MBNMS over the past eight years:

Table 1

Fireworks Event Category	Percentage of Total Fireworks Permits Issued
Independence Day festivals	36%
City festivals	33%
Private events	17%
Public school fundraisers	14%

Pyrotechnic displays within the Sanctuary are conducted from a variety of coastal launch sites – beaches, bluff tops, piers, offshore barges, and golf course sand traps and tee boxes. The authorized displays have been confined to eight general locations in the Sanctuary, listed below and shown on Map B.

Table 2

Fireworks Display Locations	
Half Moon Bay	Monterey
Santa Cruz[1]	Pacific Grove
Capitola	Pebble Beach[2]
Aptos	Cambria

These sites were approved for each display based on their proximity to urban areas and pre-existent high human use patterns; seasonal considerations, such as the abundance and distribution of marine wildlife; and the acclimation of wildlife to human activities and elevated ambient noise levels in the area. The Pebble Beach site is no longer authorized for displays within the Sanctuary due to its proximity to sensitive marine resources in the area. The City of Santa Cruz continues to sponsor an annual fireworks display each October; however, the MBNMS ceased issuing permits to the city after 1995, when a boundary confirmation revealed that the fireworks display and fallout area are outside Sanctuary boundaries.

In considering requests for fireworks displays, the MBNMS has consulted with biologists from State and Federal agencies and universities, local property managers and residents, environmental sensitivity index (ESI) maps prepared for the California Department of Fish and

Game (CDFG) and the National Oceanic and Atmospheric Administration (NOAA)[3], other environmental maps, and both published and unpublished sources.

The Sanctuary has issued no written denials of fireworks requests to date, but has redirected at least three displays away from the Sanctuary through preliminary discussions with prospective applicants.[4] These prospective shows were private events planned for non-traditional display locations that would have posed an undue threat to marine resources.[5] The MBNMS suspended review of new applications in February 2001, pending completion of consultation with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) regarding potential adverse effects to marine mammals, seabirds, and other protected species. Community fireworks displays and recurring annual events permitted in past years will still be authorized, with conditions, pending conclusion of consultation.

PYROTECHNIC DEVICES AND EFFECTS

Professional pyrotechnic devices can be grouped into three general categories: aerial shells (paper and cardboard spheres ranging from 2 inches to 12 inches in diameter[6] and filled with incendiary materials); low-level comet and multi-shot devices similar to over-the-counter fireworks, such as roman candles; and set piece displays that are static in nature and are mounted on the ground.

AERIAL SHELLS

Aerial shells are launched from tubes (called mortars), using black powder charges, to altitudes of 200 to 1000 feet where they explode and ignite internal burst charges and incendiary chemicals. Most of the incendiary elements and part of the shell casings burn up in the atmosphere; however, portions of the casings and some internal structural components and chemical residue fall back to the ground or water, depending on prevailing winds.

An aerial shell casing is constructed of paper/cardboard or plastic and may include some plastic or paper internal components used to compartmentalize chemicals within the shell. Aerial shells may be constructed in the shape of spheres or cylinders. The most cost-effective and commonly used shells are cardboard spheres manufactured primarily in Asia.[7] The anatomy of a typical shell is shown in Figures A and B. Within the shell casing are a burst charge (usually black powder) and a "secret recipe" of various chemical pellets (stars) that emit prescribed colors when ignited. These stars are composed of a group of common chemical elements shown in Figure C and Appendix B. Manufacturers consider the amount and composition of chemicals within a given shell to be proprietary information and only release aggregate descriptions of internal shell components. The arrangement and packing of stars and burst charges within the shell determine the type of effect produced upon detonation (see Figure D for examples).

Attached to the bottom of an aerial shell is a lift charge of black powder. The lift charge and shell are placed at the bottom of a mortar that has been buried in earth/sand or affixed to a wooden rack (see Figures E-G). A fuse attached to the lift charge is ignited with an electric charge or heat source, the lift charge explodes, and propels the shell through the mortar tube and into the air to a height determined by the amount of powder in the lift charge and the weight of the shell. As the shell travels skyward, a time-delay secondary fuse is burning that eventually ignites the burst charge within the shell at peak altitude. The burst charge detonates, igniting and scattering the stars, which may, in turn, possess small secondary explosions (see Figure H). Shells can be launched one at a time or in a barrage of simultaneous or quick succession launches. They are designed to detonate between 200 and 1000 feet above ground level (AGL).

In addition to color shells (also known as designer or star burst shells), a typical fireworks show will usually include a number of aerial "salute" shells. The primary purpose of salute shells is to announce the beginning and end of the show and produce a loud percussive audible effect. The shells are typically two to three inches in diameter and packed with black powder to produce a punctuated explosive burst at high altitude. From a distance, these shells sound similar to cannonfire when detonated.

LOW-LEVEL DEVICES

Low-level devices are similar to over-the-counter fireworks, such as roman candles, bottle rockets, and firecrackers. They often consist of stars packed linearly within a tube. When ignited, the stars exit the tube in succession, producing a fountain effect of single or multi-colored light as the stars incinerate through the course of their flight. Typically, the stars burn rather than explode, thus producing a ball or trail of sparkling light to a prescribed altitude where they simply extinguish. Sometimes, they may terminate with a small explosion similar to a firecracker. Other low-level devices emit a projected hail of colored sparks or perform erratic low-level flight while emitting a high pitched whistle. Some emit a pulsing light pattern or crackling or popping sound effects. Common low-level devices are multi-shot devices, mines, comets, meteors, candles, strobe pots and gerbs (see the glossary for detailed descriptions). They are designed to produce effects between 0 and 200 feet AGL.

SET PIECE OR GROUND-LEVEL DEVICES

A set piece device is primarily static in nature and remains close to the ground. It is usually attached to a framework that may be crafted in the design of a logo or other familiar shape, illuminated by pyrotechnic devices such as flares, sparklers and strobes. It may have some moving parts, but typically does not launch devices into the air. Set piece displays are designed to produce effects between 0 and 50 feet AGL. Examples are shown in Figure I.

DISCHARGES AND EFFECTS

Commercial pyrotechnic devices produce noise, light, sparks, smoke, and paper, cardboard, plastic, and cotton string debris. These effects can be grouped into three categories: light, sound, and debris. In general, devices that operate at higher altitudes impact a larger area. Conversely, ground and low-level devices have more confined effects.

The largest commercial aerial shells used within the Sanctuary are 10-12 inches in diameter and reach a maximum altitude of 1000 feet AGL. The bursting radius of the largest shells is approximately 850 feet. The acute impact area can extend from 1 to 2 statute miles from the center of the detonation point depending on the size of the shell, height of the explosions, type of explosions, wind direction, atmospheric conditions, and local topography. *Acute impact area* is defined as the area where sound, light, and debris effects have direct impacts on marine organisms and habitats. Direct impacts include, but are not limited to, immediate physical and physiological impacts such as abrupt changes in behavior, flight response, diving, evading, flushing, cessation of feeding, and physical impairment or mortality.

Aerial Shells produce flashes of light that can be brilliant (exceeding 30,000 candela[8]) and can occur in rapid succession. Loud explosive and crackling sound effects stem primarily from salutes and bursting charges at altitude. The sound waves and the accompanying rapid shift of ambient atmospheric pressure can be felt by people and wildlife on the ground and on the surface of the water. This pressure wave has been known to activate car alarms that detect vibration.

Sounds attenuate farther from high altitude shells than low altitude shells since they are not as easily masked by buildings and landforms, allowing the sound envelope to ensonify more surface area on the ground and water. The sound from the lifting charge detonation is vectored upward through the mortar tube opening and reports as a dull thump to bystanders on the ground, far less conspicuous than the high-level aerial bursts.

Each aerial display is unique according to the type and number of shells, the pace of the show, the length of the show, the acoustic qualities of the display site, and even the weather and time of day. The intensity of an aerial show can be amplified by increasing the number of shells used, the pace of the barrage, and the length of the display. Some fireworks displays are synchronized with musical broadcasts over loudspeakers and may incorporate other non-pyrotechnic sound and visual effects.

When a shell detonates, its chemical components burn at high temperatures, which usually promotes efficient incineration. However, by design, the chemical components within a shell are scattered by the burst charge, separating them from the casing and internal shell compartments. The explosion separates the cardboard and paper casing and compartments, scattering some of the shell's structural pieces clear of the blast and burning others. Some pieces are immediately incinerated, while others burn up or partially burn on their way to the ground. Many shell casings simply part into two halves or into quarters when the burst charge detonates and are projected clear of the explosion. MBNMS staff have recovered many substantial uncharred casing remnants on ocean waters immediately after marine displays. Other items found in the acute impact area are cardboard cylinders, disks, and shell case fragments; paper strips and wading; plastic wading, disks, and tubes; aluminum foil; cotton string; and even whole unexploded shells (duds or misfires).

The fallout area for the aerial debris is determined by local wind conditions. In coastal regions with prevailing winds, the fallout area can often be projected in advance. This information is, in fact, calculated by pyrotechnicians and fire department personnel in selection of the launch site to abate fire and public safety hazards. Mortar tubes are often angled to direct shells over a prescribed fallout area, away from spectators and property. Generally, the bulk of the debris will fall to the surface within a 1/2 statute mile radius of the launch site. In addition, the tops of the mortars and other devices are usually covered with household aluminum foil to prevent premature ignition from sparks during the display and to protect them from moisture. The shells and stars easily punch through the thin aluminum foil when ignited, thus scattering pieces of aluminum in the vicinity of the launch site. The aluminum debris, and garbage generated during preparation of the display, may be swept into ocean waters by winds or discarded into the water by the set-up crew.

Chemical residue is produced in the form of smoke, airborne particulates, and fine solids. The fallout area for chemical residue is unknown, but is probably similar to that for solid debris. Pyrotechnic vendors have stated that the chemical components are incinerated upon successful detonation of the shell. However, a 1992 Florida study indicates that chemical residues (fireworks decomposition products) do result from fireworks displays and can be measured under certain circumstances.[9]

Low-Level Devices reach a maximum altitude of 200 feet AGL. The acute impact area can extend to 1 statute mile from the center of the ignition point depending on the size and flight patterns of projectiles, maximum altitude of projectiles, the type of special effects, wind direction, atmospheric conditions, and local structures and topography. Low level devices also produce brilliant flashes and fountains of light and sparks accompanied by small explosions, popping, and crackling sounds. Since they are lower in altitude than aerial shells, sound and light effects impact a smaller area. Low-level devices do not typically employ large black powder charges, such as aerial shells, but are often used in large numbers, in concert with one another, and in rapid succession, producing very intense localized effects.

Some low-level devices may project small casings into the air (such as small cardboard tubes used to house flaming whistle and firecracker type devices). These casings will generally fall to earth within a two hundred yard radius of the launch site, since they do not attain altitudes sufficient for significant lateral transport by winds. In general, low-level launch devices and encasements remain on the ground or attached to a fixed structure, and can be removed upon completion of the display. As described above, low-level pyrotechnics and mortars are often covered with aluminum foil to protect them from weather and errant sparks. Portions of the foil are shredded during the course of the show, and initially deposited near the launch site.

Residue includes smoke, airborne particulates, fine solids, and slag (spent chemical waste material that drips from the deployment canister/launcher and cools to a solid form). Similar to aerial shells, the chemical components of low-level devices produce chemical residue that can migrate to ocean waters as a result of fallout. The point of entry would likely be within a small radius of the launch site.

Set Piece Devices typically employ bright flares and sparkling effects that may also emit limited sound effects such as cracking, popping, or whistling. Set pieces may also include moving parts such as wheels, propelled into a spinning motion by small solid-fuel rockets attached to their outer edges (see Figure I). Set pieces are usually used in concert with low-level effects or an aerial show and sometimes act as a centerpiece for the display.

The acute impact area can extend to 1/2 statute mile from the center of the ignition point depending on the size and height of the fixed structure, the number and type of special effects, wind direction, atmospheric conditions, and local structures and topography. Fallout is generally confined within a one hundred yard radius of the launch site. Residue may include smoke, airborne particulates, fine solids, and slag (commonly produced by burning flares).

FIREWORKS DISPLAYS – PROFILE

The vast majority (95%) of fireworks displays authorized in the Sanctuary between 1993 and 2001 have been aerial displays that usually include simultaneous low-level displays. An average large aerial display will last 20 minutes and include 700 shells and 750 low-level effects. An average small aerial display lasts approximately 7 minutes and includes 300 aerial shells and 550 low-level effects. There seems to be a declining trend in the total number of shells used in aerial

displays. This could be due to increasing shell costs and fixed entertainment budgets. Low-level displays compensate for the absence of an aerial show by squeezing a larger number of effects into a shorter timeframe. This results in a dramatic and rapid burst of light and sound effects at low level. A large low-level display may expend 4900 effects within a 7 minute period, and a small display will use an average of 1800 effects within the same timeframe. The table below provides a comparison of fireworks displays performed in the Sanctuary in the past:

Table 3

Average Display Types	Duration of Display	No. of Aerial Shells	No. of Low-Level Effects	No. of Set-Piece Devices
Aerial - Small	5 Minutes	300	550	0
Aerial - Large	20 Minutes	700	750	1
Aerial Display – Largest to Date[10]	25 Minutes	1700	1800	
Low-Lvl - Small	7 minutes	0	1800	0
Low-Lvl - Large	7 Minutes	0	4900	1

ENVIRONMENTAL IMPACTS

The MBNMS has monitored commercial fireworks displays for potential impacts to marine life and habitats since 1993. However, monitoring has been sporadic, has not employed a consistent methodology, and has focused primarily on displays in Monterey. In addition, visual monitoring is complicated by the fact that fireworks are held at night, making timed and detailed species counts and behavioral studies difficult. In July 1993, the MBNMS performed its initial field observations of professional fireworks at the annual Independence Day fireworks display conducted by the City of Monterey. Subsequent "documented" field observations were conducted in Monterey by MBNMS staff in July 1994, July 1995, July 1998, March 1998 (private display), and October 2000 (private display). Documented field observations were also made at Aptos in October 2000. MBNMS staff have observed additional displays at Monterey, Pacific Grove, Capitola, and Santa Cruz, but observations were primarily for permit compliance purposes, and written assessments of environmental impacts were not generated. All available written assessments have been included as Appendices C-I to this report.

Empirical observations have focused on impacts to water quality and selected marine mammals and birds in the vicinity of the displays. No observations were made in upland areas (beyond the jurisdiction of the Sanctuary) due to limited staff resources. No negative impacts to water quality have been detected. The primary impact to wildlife noted in past observation reports by Sanctuary staff is the disturbance of marine mammals and seabirds from the light and sound effects of the exploding aerial shells. The loud sound bursts and pressure waves created by the exploding shells appear to cause more wildlife disturbance than the illumination effects. As the fireworks presentation progresses, most marine mammals and birds generally evacuate the impact area. In particular, the percussive aerial "salute" shells have been observed to elicit a strong flight response in California sea lions and marine birds in the vicinity of the impact area (within 800 yards of the launch site).

During the course of a display, some devices will fail to detonate after launch (duds) and fall back to earth/sea as an intact sphere or cylinder. Aside from post display surveys and recovery, there is no way to account for these misfires. The freefalling projectile could pose a physical risk to any wildlife within the fallout area, but the general avoidance of the area by wildlife during the display and the low odds for such a strike probably present a negligible potential for harm. Whether such duds pose a threat to wildlife (such as curious sea otters) once adrift is unknown. After soaking in the sea for a period of time, the likelihood of detonation quickly declines. Presumably, even curious otters would not attempt to consume such a device. At times, some shells explode in the mortar tube (referred to as a flower pot) or far below their designed detonation altitude. It is highly unlikely that mobile organisms would remain close enough to the launch site during a fireworks display to be within the effective danger zone for such an explosion.

The MBNMS has conducted surveys of solid debris on surface waters, beaches, and subtidal habitat and has discovered no visual evidence of acute or chronic impacts to the environment or wildlife (see Appendices D and E). Aerial displays generally produce a larger volume of solid debris than low-level displays. MBNMS fireworks permits require the permittee to clean area beaches of fireworks debris for up to two days following the display. In some cases, debris has been found in considerable quantity on beaches the morning following the display. In other cases, virtually no fireworks debris was detected. This variance is likely due to several factors, such as type of display, tide state, sea state, and currents.

The MBNMS has found only one scientific study directed specifically at the potential impacts of fireworks chemical residue upon the environment[11] (see Appendix J). The report, prepared for the Walt Disney Corporation in 1992, presented the results of a 10-year study of the impacts of fireworks decomposition products (chemical residue) upon an aquatic environment. Researchers studied a small lake in Florida subjected to 2000 fireworks shows over a ten-year period to measure key chemical levels in the lake. The report concluded that detectable amounts of barium, strontium, and antimony had increased in the lake but not to levels considered harmful to aquatic biota. The report further suggested that "environmental impacts from fireworks decomposition products typically will be negligible in locations that conduct fireworks displays infrequently" and that "the infrequence of fireworks displays at most locations, coupled with a wide dispersion of constituents, make detection of fireworks decomposition products difficult." According to one of the authors of the report, had the same study been conducted in California, the elevated metal concentrations in the lake would not have even been detectable against natural background concentrations of those same metals, due to naturally higher metal concentrations in the western United States.[12] Based on the findings of this report and the lack of any evidence that fireworks displays within the Sanctuary have degraded water quality, the MBNMS believes that chemical residue from fireworks does not pose a significant risk to the marine environment.

In some display locations, mobile species may temporarily depart the area prior to the beginning of the fireworks display due to the increased human activities (noise, boating, kayaking, fishing, diving, swimming, surfing, picnicking, beach combing, tidepooling, etc.) associated with the larger coastside celebrations. In particular, a flotilla of recreational and commercial boats usually gathers in a semi circle within the impact area to view the fireworks display from the

water. From sunset until the start of the display, security vessels of the U.S. Coast Guard and/or other government agencies often patrol throughout the waters of the impact area to keep vessels a safe distance from the launch site.

POTENTIAL AFFECTED SPECIES

Tables 4 and 5 below present a list of species protected under the Endangered Species Act (ESA),16 U.S.C. 1531 *et seq*.; the Marine Mammal Protection Act (MMPA), 16 U.S.C. 1361 *et seq*.); and/or the Migratory Bird Treaty Act (MBTA), 16 U.S.C. 703 *et seq*. that "may" be impacted by fireworks displays within the Sanctuary:

Table 4

Marine Species*	
Birds**	**Marine Mammals**
Brown Pelican, *Pelicanus occidentalis*	Southern Sea Otter, *Enhydra lutris neries*
Snowy Plover †, *Charadrius alexandrinus nivosus*	CA Gray Whale †, *Eschrichtius robustus*
Brandt's Cormorant, *Phalacrocorax penicillatus*	CA Sea Lion, *Zalophuus californianus*
Double Cr. Cormorant, *Phalacrocorax auritus*	Harbor Seal, *Phoca vitulina*
Pelagic Cormorant, *Phalacrocorax pelagicus*	Bottlenose Dolphin, *Tursiops truncatus*
Western Gull, *Larus occidentalis*	Harbor Porpoise, *Phocoena phocoena*
Heerman's Gull, *Larus heermanni*	
Gulls sp., *Larus sp*.	
Shearwater sp., *Puffinus sp*.	
Western Grebe, *Aechmophorus occidentalis*	
Black Turnstone, *Arenaria melanocephala*	
Marbled Godwit, *Limosa fedoa*	
Willet, *Catoptrophorus semipalmatus*	
Black Bellied Plover, *Pluvialis squatarola*	
Tern sp., *Sterna sp*.	

* All species are not necessarily found at each fireworks display site within the MBNMS.

** This is not an exhaustive list of bird species that may be impacted by fireworks displays. It represents bird species positively sighted by MBNMS staff within fireworks impact areas of the Sanctuary at the time of displays.

† Species has not been detected within impact areas for any fireworks display, but impact areas contain potential species habitat.

The USFWS has identified several listed species (ESA) in Monterey dune habitat that could be impacted by fireworks spectators. A similar assessment has not been made for terrestrial habitats at other fireworks sites.

Table 5

Listed Terrestrial Species - Monterey	
Sand Gilia, *Gilia tenuiflora* ssp. *arenaria*	Tidestroms Lupine, *Lupinus tidestromii*
Robust Spine Flower, *Chorizanthe robusta* var. *robusta*	Coastal Dunes Milk Vetch, *Astragalus tener* var. *titi*
Menzies Wallflower, *Erysimum menziesii* ssp. *menziesii*	Monterey Spine Flower, *Chorizanthe pungens* var. *pungens*
Yadon's Wallflower, *Erysimum menziesii* ssp. *yadonii*	
Beach Layia, *Layia carnosa*	Smith's Blue Butterfly, *Euphilotes enoptes smithi*

California Sea Lion

The following is an excerpt from a 1998 MBNMS staff report (Appendix F) of the reaction of sea lions to a large aerial fireworks display in Monterey. Of all the display sites in the Sanctuary, California sea lions are only present in significant concentration at Monterey.

> In the first seconds of the display, the sea lion colony becomes very quiet, vocalizations cease, and younger sea lions and all marine birds evacuate the breakwater. The departing sea lions swim quickly toward the open sea. Most of the colony remains intact until the older bulls evacuate, usually after a salvo of overhead bursts in short succession. Once the bulls depart, the entire colony follows suit, swimming rapidly in large groups toward the open sea. A select few of the largest bulls may sometimes remain on the breakwater. Sea lions have been observed attempting to haul out onto the breakwater during the fireworks display, but most are frightened away by the continuing aerial bursts.
>
> Sea lions begin returning to the breakwater within 30 minutes following the conclusion of the display but have been observed to remain quiet for some time. The colony usually reestablishes itself on the breakwater within 2-3 hours following the conclusion of the display, during which vocalization activity returns. Typically, the older bulls are the first to renew vocalization behavior (within the first hour), followed by the younger animals. By the next morning, the entire colony seems to be intact and functioning with no visible sign of abnormal behavior.

No signs of physical impairment or mortality have been detected for this species as a result of fireworks displays. The species does not breed in the Sanctuary.

Harbor Seal

The only survey of harbor seal reactions to fireworks displays in the Sanctuary was conducted during monitoring of a display at Aptos in October 2000 (Appendix H). The staff report made the following finding:

> Harbor seals could not be seen during and immediately after the event. Its likely, based on the reaction of the birds and the noise of the display, that the seals evacuated the area on and around the cement ship. Harbor seals were sighted hauled out on the ship and in the water the following morning.

In general, harbor seals are more timid and easily disturbed than California sea lions. Thus, based on past observations of sea lion disturbance thresholds, it is very likely that harbor seals evacuate the acute impact area during fireworks displays. The species does breed in the Sanctuary.

SOUTHERN SEA OTTER

The MBNMS has not observed otter responses to fireworks events; however, sea otters do frequent all general display areas (see Map B). As noted under Environmental Impacts above, otters and other species may temporarily depart the area prior to the beginning of the fireworks display due to increased human activities such as noise, boating, kayaking, fishing, diving, swimming, surfing, picnicking, beach combing, tidepooling, etc. Some otters in Monterey harbor have become quite acclimated to very intense human activity, often continuing to feed undisturbed, as boats pass simultaneously on either side and within 20 feet of the otters. It is therefore possible that select individual otters may have a higher tolerance level than others to fireworks displays. The species does breed in the Sanctuary.

CALIFORNIA GRAY WHALE

No California gray whales have ever been sighted in fireworks impact areas during displays. Display locations within Monterey Bay are not immediately adjacent to the prime coastal migration route, since most gray whales bypass the inner shorelines of the bay, instead transiting between Point Piños and Point Santa Cruz. Likewise, the Half Moon Bay display occurs east of the natural reef barrier between the migration route and the shoreline. The only remaining display site that might impact gray whales is at Cambria, but the current display authorized for the area occurs in July, outside of the prime migration seasons. The species does not breed in the Sanctuary.

BOTTLENOSE DOLPHIN AND HARBOR PORPOISE

Though these species are known to frequent nearshore areas within the Sanctuary, they have never been reported in the vicinity of a fireworks display, nor have there been any reports to the MBNMS of strandings or injured/dead animals discovered after any display. Since sound does not transmit well between air and water, these animals would likely not encounter the effects of fireworks except when surfacing for air. As noted under Environmental Impacts above, cetaceans and other marine wildlife may avoid or depart the impact area prior to the beginning of the fireworks display due to increased human activities associated with the overall celebration event.

MARINE BIRDS

Marine birds (especially pelicans, cormorants, and gulls) are among the first wildlife to evacuate the area at the start of the display. The staff reports included as Appendices C-I consistently indicate that virtually all birds within the acute impact area depart in a burst of flight within 1 minute of the start of a fireworks display, including low-level displays. Their return rates have not been noted, except that their numbers appear to be back to normal by the following morning. During a 1998 display in Monterey, MBNMS staff observed a marine bird swim within 70 yards of the launch site during the fireworks display. The bird remained on the water as the pyrotechnic effects were ignited aboard the barge. It is possible that the bird was injured or ill

and not capable of flight. However, the bird also made no effort to swim away from the launch site.

Undocumented observations made in July 2000 by MBNMS staff in Monterey indicated that Brandt's cormorants nesting at the Monterey Breakwater remained on their nests (approximately 7 nests) throughout the large aerial display that was launched from a barge approximately 900 yards away. Some of the other marine birds on the breakwater evacuated the area.

BROWN PELICAN

Brown pelicans are seasonally present at all general display locations and generally react in the same manner as other marine birds. Pelicans do not nest or breed in the Sanctuary.

SNOWY PLOVER

The MBNMS has consulted with biologists from the California Department of State Parks as well as biologists from other agencies concerning the potential impact of displays on the snowy plover at most general display locations. Research and inquiries have not revealed an impact on this species or on currently active nesting habitat. The greatest likelihood of plover interactions would be in Monterey. The southernmost documented nest site (no longer active) near East Monterey was located along the periphery of the acute impact area. The public beaches where spectators gather for City fireworks displays are routinely groomed by municipal public works department staff and frequented daily by beachgoers and their domestic pets. These beaches are high human use areas, and therefore, do not present optimal nesting habitat. The likelihood of successful nesting and nest survival in these high-use beach areas is not great. Besides Monterey, plovers may be present near the Half Moon Bay and Cambria fireworks display areas. The species does breed in the Sanctuary.

TERRESTRIAL SPECIES

The USFWS identified the Smith's blue butterfly and several listed plant species (see Table 5 above) that could be indirectly impacted by spectators intruding into sand dune habitat areas, noting that the Service has "observed destruction of habitat, and crushing of individuals and abandonment of nest sites of listed species as a result of people and vehicles gathering to view fireworks displays." The Sanctuary's regulatory authority is generally limited to ocean waters seaward of the mean high water line; therefore, protection of upland dune habitat would fall within the primary jurisdiction of other governmental agencies. The Sanctuary can assist the Service in notifying and coordinating with appropriate agencies to ensure that sensitive coastal habitats are not inadvertently damaged by spectator traffic.

SITE REVIEWS (North to South)

HALF MOON BAY

Site Description – The site has been used annually for Independence Day fireworks displays on July 4. The launch site is on a sandy beach, inside and adjacent to the east outer breakwater (see Map C). The medium-size aerial display lasts approximately 20 minutes. The aerial shells are aimed to the southwest. The site is often fogged in during summer months. The marine venue adjacent to Pillar Point Harbor is preferred for optimal public access and to avoid the fire hazard associated with terrestrial display sites. The fireworks display occurs at the height of the dry season in central California, when area vegetation is particularly prone to ignition from sparks or embers.

Human Use Patterns – The harbor immediately adjacent to the impact area is home to a major commercial fishing fleet that operates at all times of the day and night throughout the year. The harbor also supports a considerable volume of recreational boat traffic. Half Moon Bay Airport (HAF) is located adjacent to the harbor, and approach and departure routes pass directly over the acute impact area. The airport is commonly used by general aviation pilots for training with an annual average attendance of approximately 15 flights per day. On clear sunny weekends, the airport may accommodate as many as 50 flights in a single day. The beaches to the south of the launch site are used by beachgoers and water sport enthusiasts. The impact area is also used by recreational fishermen, surfers, swimmers, boaters, and personal watercraft operators. To the north, around Pillar Point is an area known as "Mavericks", considered a world-class surfing destination. Periodically, surfing contests are held at Mavericks. The impact area is also subjected to daily traffic noise from California Highway 1, which runs along the coast and is the primary travel route through the area.

Marine Wildlife – Resource information and discussions with area biologists indicate that snowy plover are present within 2 statute miles to the south of the launch site. A considerable concentration of harbor seals are present to the north around Pillar Point, and harbor seals are also found on the coast to the south of the launch site. Brown pelicans, gulls, cormorants, and other marine birds are present in the harbor where they roost on piers and other structures or rest on the calm waters within the breakwater. Sea otters are not concentrated in the impact area, though some individuals may be present. It is possible that individual elephant seals may enter the area from breeding sites at Año Nuevo Island and the Farallon Islands, but breeding occurs in the winter. As stated above, gray whales typically migrate west of the reefs extending south from Pillar Point.

SANTA CRUZ

Site Description – The site has been used annually for City anniversary fireworks displays in early October. The launch site is on a sandy beach, adjacent to the Santa Cruz Boardwalk and the San Lorenzo River, along the west bank (see Map D). The aerial shells are aimed to the south. The site is sometimes fogged in during summer months.

Human Use Patterns – The harbor immediately adjacent to the impact area is home to a commercial fishing fleet that operates at all times of the day throughout the year. The harbor primarily supports a large volume of recreational boater traffic. The launch site is in the center of the shoreline of a major urban coastal city. The beaches to the west of the launch site are adjacent to a large coastal amusement park complex and are used extensively by beachgoers and water sport enthusiasts from the local area as well as San Jose and San Francisco. The impact area is used by boaters, recreational fishermen, swimmers, surfers, and other recreational users. Immediately southwest of the launch site is a mooring field and the Santa Cruz Municipal Pier which is lined with retail shops, restaurants, and offices. To the west of the pier is a popular local surfing destination known as "Steamer Lane." Surfing contests are routinely held at the site. During the period from sunset through the duration of the fireworks display, 40-70 vessels anchor within the acute impact area to view the fireworks. Vessels criss-cross through the waters south of the launch site to take up position. In addition, U. S. Coast Guard and harbor patrol vessels motor through the impact area to maintain a safety zone around the launch site.

Marine Wildlife – California sea lions and brown pelicans routinely use the Municipal Pier as a haulout and roosting site. The Pier is also host to a large number of gulls and other marine birds. Sea otters are moderately concentrated in the impact area, primarily around the nearshore kelp forests. As stated above, gray whales typically migrate along a southerly course, west of Point Santa Cruz.

CAPITOLA

Site Description – The site has been used only once since 1993 for a 50-year City anniversary fireworks display on May 23, 1999. This display was the largest volume fireworks display conducted in the MBNMS to date, incorporating 1700 aerial shells and 1800 low-level effects and lasting 25 minutes. The launch site was on the Capitola Municipal Pier, adjacent to the City of Capitola (see Map E). The aerial shells were aimed above the pier. The site is sometimes fogged in during summer months.

Human Use Patterns – The impact area is immediately adjacent to a small urban community. The beaches to the east and west of the launch site are used daily by beachgoers and water sport enthusiasts from the regional area. The impact area is used by boaters, recreational fishermen, swimmers, surfers, and other recreational users. To the east of the Pier is a mooring field and popular public beach.

Marine Wildlife – Brown pelicans, cormorants, gulls, and other marine birds routinely use the Municipal Pier as a roosting site. Seabirds also often gather on the sand beach at the mouth of Soquel Creek where a lagoon forms in the summer. The creek empties into the ocean immediately east of the Municipal Pier. Sea otters are moderately concentrated in the impact area, primarily around the nearshore kelp forests.

APTOS

Site Description – The site has been used annually for a large fundraiser for Aptos area schools in October. The launch site is on the Aptos Pier and part of a grounded cement barge at Seacliff State Beach (see Map F). The aerial shells are aimed above and to the south of the pier. The site is sometimes fogged in during summer months. The large aerial show lasts for approximately 20 minutes.

Human Use Patterns – The impact area is immediately adjacent to a recreational beach. The beaches to the east and west of the launch site are used daily by beachgoers and water sport enthusiasts from the regional area. The impact area is used by boaters, recreational fishermen, swimmers, surfers, and other recreational users, but typically at moderate to light levels of activity. To the east and west of the Pier are public use beach areas and private homes at the top of steep coastal bluffs. During the period from sunset through the duration of the fireworks display, 30-40 vessels anchor within the acute impact area to view the fireworks. Vessels criss-cross through the waters seaward of the cement barge to take up position. In addition, U. S. Coast Guard and State Park Lifeguard vessels motor through the impact area to maintain a safety zone around the launch site.

Marine Wildlife – At the seaward end of the Aptos Pier is a 400-foot grounded cement barge. The barge was set in position as an extension of the pier, but has since been secured against public access. Brown pelicans, cormorants, gulls, and other marine birds routinely use the cement barge as a roosting site. The barge has broken into two parts isolating the bow section from the rest of the vessel. The exposed interior decks of the barge have created convenient haulout surfaces for harbor seals. In a 2000 survey, the MBNMS recorded as many as 45 harbor seals hauled out on the barge in the month of October. The isolated bow section is particularly favored by pelicans and cormorants, and contains the bulk of roosting seabirds. Black turnstones seem to favor the interior spaces of the vessel along the aft section, and gulls attend the upper portions of the aft superstructure. See Appendix H for survey information. Approximately 1/2 statute miles to the east of the pier is the mouth of Aptos Creek where shorebirds congregate. Sea otters are moderately concentrated in the impact area, primarily around the nearshore kelp forests. The following are excerpts from the staff survey included as Appendix H:

> All the birds flushed the cement ship after the start of the fireworks display.
>
> During the fireworks show some pelicans and cormorants could be seen circling the area. Within 10 minutes of the show being over, pelicans and cormorants began to return. I would estimate that approximately 25% of the birds returned by the end of the survey which was at 2155. Debris was visible floating on the surface of the water.
>
> It was obvious that all the birds flushed the cement ship after the start of the fireworks display, but even with the aid of a night vision monocular it was difficult to quantify exactly how many birds were returning. Harbor seals could not be seen during and immediately after the event. Its likely, based on the

reaction of the birds and the noise of the display, that the seals evacuated the area on and around the cement ship. Harbor seals were sighted hauled out on the ship and in the water the following morning. Previous surveys were generally conducted mid-day and there may be some variability in the data, based on behavioral patterns of birds and mammals during afternoon hours as opposed to early morning and evening.

MONTEREY

Site Description – Each Independence Day, the City of Monterey launches approximately 750 shells and an equal number of low-level effects from a barge anchored approximately 1000 feet east of Municipal Wharf II and 1000 feet north of Del Monte Beach (see Map G). The aerial shells are aimed above and to the northeast. The site is often fogged in during summer months. The City's display lasts approximately 20 minutes and is accompanied by music broadcasted from speakers on Wharf II. The marine venue adjacent to Monterey Harbor is preferred for optimal public access and to avoid the fire hazard associated with terrestrial display sites. The fireworks display occurs at the height of the dry season in central California, when area vegetation is particularly prone to ignition from sparks or embers.

Since 1999, a Monterey New Year's festival has used the City's launch barge for an annual fireworks display. The medium-size aerial display lasts approximately 8 minutes.

Three private displays (1993, 1998, and 2000) have been authorized from a launch site on Del Monte Beach, depicted on Map G. The 1993 display was an aerial display. Subsequent displays have been low-level displays, lasting approximately 7 minutes.

Human Use Patterns – The fireworks impact area lies directly under the approach/departure flight path for Monterey Peninsula Airport (MRY) and is commonly exposed to noise and exhaust from general aviation, commercial, and military aircraft at approximately 500 feet altitude. The airport supports approximately 280 landings/takeoffs per day in addition to touch-and-goes (landing and takeoff training). Commercial and recreational vessels operate in the area during day and night hours from the adjacent harbor. A 30-station mooring field lies within the acute impact area between the launch barge and Municipal Wharf II. The moorings are completely occupied during the annual fireworks event. Auto traffic and emergency vehicles are audible from Lighthouse and Del Monte Avenues, main transportation arteries along the adjacent shoreline. The impact area is utilized by thousands of people each week for boating, kayaking, scuba diving, fishing, swimming, and harbor operations. During the period from sunset through the duration of the fireworks display, 20-30 vessels anchor within the acute impact area to view the fireworks. Vessels criss-cross through the waters south of the launch site to take up position. In addition, U. S. Coast Guard and harbor patrol vessels motor through the impact area to maintain a safety zone around the launch site.

Marine Wildlife – In general, marine wildlife depart or avoid surface waters and haul-out sites within a 1000-yard radius of the center of the impact area during fireworks displays. Even short, low-level displays cause a flight response in wildlife within the acute impact area (see the recent

staff report at Appendix I). The largest concentration of wildlife near the impact area are California sea lions and marine birds resting at the Monterey breakwater approximately 700 yards northwest of the center of the impact area. Typical impacts within the harbor area are reflected in the following excerpts from a 1998 MBNMS staff report (Appendix F):

> In the first seconds of the display, the sea lion colony becomes very quiet, vocalizations cease, and younger sea lions and all marine birds evacuate the breakwater. The departing sea lions swim quickly toward the open sea. Most of the colony remains intact until the older bulls evacuate, usually after a salvo of overhead bursts in short succession. Once the bulls depart, the entire colony follows suit, swimming rapidly in large groups toward the open sea. A select few of the largest bulls may sometimes remain on the breakwater. Sea lions have been observed attempting to haul out onto the breakwater during the fireworks display, but most are frightened away by the continuing aerial bursts.
>
> Sea lions begin returning to the breakwater within 30 minutes following the conclusion of the display but have been observed to remain quiet for some time. The colony usually reestablishes itself on the breakwater within 2-3 hours following the conclusion of the display, during which vocalization activity returns. Typically, the older bulls are the first to renew vocalization behavior (within the first hour), followed by the younger animals. By the next morning, the entire colony seems to be intact and functioning with no visible sign of abnormal behavior.
>
> MBNMS staff have not observed the behavior of resident harbor seals in response to the annual fireworks display. Up to 15 harbor seals may be typically present on rocks in the outer harbor in early July. The seal haulout area is approximately 700 yards (horizontal distance) from the primary impact zone for the aerial pyrotechnic display. Likewise, staff have made no observation of sea otter activity relative to the display. Up to 5 sea otters may typically frequent the immediate harbor area in early July. All the above abundance estimates are empirical values only. Marine birds (cormorants, pelicans, and gulls) are among the first wildlife to evacuate the area at the start of the display. Their return rates have not been noted, except that their numbers appear to be back to normal by the next morning.

As noted above, several sea otters are present within Monterey Harbor and the acute impact area during the time of the fireworks display. Otters in residence within the harbor display a greater tolerance for intensive human activity than their counterparts in more remote locations. Otters outside the harbor are most concentrated to the northwest of the Monterey breakwater, however, otters routinely forage and loiter within the acute impact area and along the shoreline to the north.

Past Sanctuary observations have not detected any disturbance to snowy plovers or California sea otters as a result of the fireworks displays; however, past observations have not included

specific surveys for these species. The southernmost documented plover nest site (no longer active) near East Monterey was located approximately 1000 yards north of the launch site. The public beaches where spectators gather for City fireworks displays are routinely groomed by municipal public works department staff and frequented daily by beachgoers and their domestic pets. These beaches are high human use areas, and therefore, do not present optimal nesting habitat. The likelihood of successful nesting and nest survival in these high-use beach areas is not great. The greatest nesting density for snowy plover in the local region is centered 6-10 statute miles to the north.

Non-breeding California brown pelicans appear in greatest number in central California during the late summer and fall. Within the Monterey harbor area, pelicans roost on the Monterey breakwater; on wharfs, piers, and structures; on exposed rocks in the harbor; and on the barge used to launch pyrotechnics during the fireworks display. Any pelicans present on the launch barge are flushed at the time the barge is towed to the pier for cleaning and loading. Pelicans depart the impact area during the fireworks display and may retreat to other nearby roosting sites on the Monterey Peninsula or at Elkhorn Slough. No specific observations have been made by Sanctuary staff to determine the rate of return to harbor roost sites following the fireworks display, though normal roosting attendance within the harbor has been observed at daybreak the following morning.

The USFWS has expressed concerns that the Smith's blue butterfly and several listed plant species identified in Table 5 above could be indirectly impacted by spectators intruding into sand dune habitat areas in Monterey, noting that the Service has generally "observed destruction of habitat, and crushing of individuals and abandonment of nest sites of listed species as a result of people and vehicles gathering to view fireworks displays." The majority of spectators gather on Municipal Wharf II and on the recreational beach (Del Monte Beach) immediately adjacent to the wharf. The nearest extensive dune habitat is on U.S. Navy property approximately 1/2 statute miles northeast of the wharf and is not used by spectators. Spectators also concentrate at a recreational beach approximately 1 statute mile northeast of the wharf and at other shoreline parks and viewpoints around the City. The Sanctuary's regulatory authority is generally limited to ocean waters seaward of the mean high water line; therefore, protection of upland dune habitat would fall within the primary jurisdiction of other governmental agencies. The Sanctuary can assist the Service in notifying and coordinating with appropriate agencies to ensure that sensitive coastal habitats are not inadvertently damaged by spectator traffic.

PACIFIC GROVE

Site Description – The site has been used annually for a "Feast of Lanterns" fireworks display in late July. The Feast of Lanterns is a community event that has been celebrated in the City of Pacific Grove for over 95 years. The fireworks launch site is at the top of a rocky coastal bluff adjacent to an urban recreation trail and public road (see Map H). The aerial shells are aimed to the northeast. The site is often fogged in during summer months. The small aerial display lasts approximately twenty minutes and is accompanied by music broadcasted from speakers at Lover's Cove. The fireworks are part of a traditional outdoor play that concludes the festival. The marine venue is preferred for optimal public access and to avoid the fire hazard associated

with terrestrial display sites. The fireworks display occurs at the height of the dry season in central California, when area vegetation is particularly prone to ignition from sparks or embers.

Human Use Patterns – The launch site is in the center of an urban shoreline, adjacent to a primary public beach in Pacific Grove. The shoreline to the east and west of the launch site is lined with residences and a public road and pedestrian trail. The impact area is used by boaters, recreational fishermen, swimmers, surfers, divers, beachgoers, tidepoolers, and others. The center of the impact area is in a cove with 30-40 foot coastal bluffs. Immediately north of the launch site is a popular day use beach area. On a clear summer day, the beach may support up to 500 visitors at any given time. Surfing activity is common immediately north of the site. During the period from sunset through the duration of the fireworks display, 10-20 vessels anchor within the acute impact area to view the fireworks. A U. S. Coast Guard vessel motors through the impact area to maintain a safety zone seaward of the launch site.

Marine Wildlife – Sea otters and pups routinely forage and loiter within the acute impact area in moderate numbers. Individual cormorants and gulls often roost on offshore rocks adjacent to the launch site, but there are no large concentrations of marine birds due to the high volume of human activity and lack of significant roosting habitat. A small roost site exists at Point Cabrillo, approximately 3/4 miles southeast of the launch site, and hosts aggregations of gulls, cormorants, pelicans, and other marine birds. Harbor seals routinely use offshore rocks and wash rocks for haulout and also forage in the area. Extensive kelp beds cover much of the impact area. The Hopkins Marine Reserve boundary is approximately 1/2 statute mile southeast of the launch site.

PEBBLE BEACH

Site Description – The location was used in 1993 and 1994 for three private fireworks displays staged from three different launch site locations (see Map I). The fireworks displays were conducted for private parties at the Pebble Beach Resort. The fireworks launch sites were at the top of rocky coastal bluffs and on a private pier adjacent to a golf course. The aerial shells were aimed to the south or southwest over Stillwater Cove. The small aerial displays lasted 10-15 minutes. Subsequent review of these sites revealed that they are not appropriate for marine fireworks displays, therefore, no further permits have been issued for this general location.

Human Use Patterns – The launch sites were located on the Pebble Beach Golf Course with a generally low level of human activity along the shoreline and within the marine impact area. The general environment of the resort area is quiet and pastoral. The shoreline to the east and west of the launch sites is either part of the golf course or undeveloped residential grounds. The impact area is used by some boaters (primarily in the summer), kayakers, and occasional divers. A small seasonal mooring field of approximately 15 stations is deployed in the summer, south of the private pier in Stillwater Cove. Carmel City Beach is approximately 1/2 mile southeast of the easternmost launch site.

Marine Wildlife – Stillwater Cove is the most protected natural coastal cove within the Sanctuary. Sea otters and pups routinely forage and loiter within the acute impact area in moderate numbers. Aggregations of gulls, cormorants, pelicans, pigeon guillemots, black oystercatchers, and other marine birds gather on a group of offshore rocks in the center of Stillwater Cove that has served as a long-term marine research site for Moss Landing Marine Laboratories for many years. Harbor seals routinely use offshore rocks and wash rocks for haulout and also forage in the area. Extensive kelp beds cover much of the impact area. The impact area is within the Carmel Bay Ecological Reserve. The Point Lobos Ecological Reserve is approximately 3 statute miles south of the launch sites.

CAMBRIA

Site Description – The site has been used annually for Independence Day fireworks displays on July 4. The launch site is on a sandy beach at Shamel County Park (see Map J). The small aerial display lasts approximately 20 minutes. The aerial shells are aimed to the west. The marine venue is preferred for optimal public access and to avoid the fire hazard associated with terrestrial display sites. The fireworks display occurs at the height of the dry season in central California, when area vegetation is particularly prone to ignition from sparks or embers.

Human Use Patterns – The impact area is immediately adjacent to a county park and recreational beach. The impact area is used by boaters, recreational fishermen, swimmers, surfers, and beachgoers. The shoreline south of the launch site is lined with hotels, abuts a residential neighborhood, and is part of San Simeon State Beach.

Marine Wildlife – The impact area includes low concentrations of harbor seals. Sea otters are present in the impact area in moderate numbers. It is possible that individual elephant seals may enter the area from breeding sites to the north at Point Piedras Blancas, but breeding occurs in the winter. Gray whales migrate along the coast in this area and may pass through the acute impact area, but July is not peak gray whale migration period. Immediately north of the launch site is the mouth of Santa Rosa Creek and Lagoon. Gulls, shorebirds, and waterfowl are commonly found in the lagoon. Snowy plover habitat is located 1 1/2 miles to the north of the launch site.

GLOSSARY

Of Pyrotechnic Terms

GLOSSARY OF PYROTECHNIC TERMS

(Definitions reprinted from Title 19, California Code of Regulations, Chapter 6, Article 2 (Section 980), except for those containing an asterisk * adjacent to the term.)

Aerial Shell A cylindrical or spherical cartridge containing a burst charge and pyrotechnic or non-pyrotechnic effects compositions, a fuse, a black powder lift charge and is fired from a mortar.

Barrage A rapidly fired sequence of effects.

Break An individual burst from an aerial shell, producing either a visible or audible effect or both, and may consist of a single burst or multiple effects.

Burst Charge* A device containing explosive pyrotechnic composition in a fused container whose primary function is to scatter incendiary components into a pre-designed spatial pattern and may also produce an audible effect and flash of light.

Comet A pyrotechnic device launched from a mortar that produces an ascending burning effect, is self-consuming, and may or may not contain a burst charge or stars.

Dud A pyrotechnic item which leaves the mortar and returns to earth without producing the intended burst or effect. See also Misfire.

Electric Firing A technique used to discharge fireworks in which an electric match or squib and a source of electric current are used to ignite fuses or lift charges.

Firecracker A device containing explosive pyrotechnic composition in an amount not to exceed 50 milligrams (.772 grains) in total pyrotechnic weight, in a fused container whose primary function is to produce an audible effect.

Flash Powder Pyrotechnic composition intended for use in firecrackers and salutes, and often used for "flash"-type effects on stage and in productions involving special effects. Flash powder produces an audible report and a flash of light when ignited. Typical flash powder compositions contain potassium chlorate or potassium perchlorate, sulfur or antimony sulfide, and powdered aluminum.

Flower Pot A shell (not the lifting charge) that explodes at or near the bottom of a mortar blowing a shower of stars and burning material into the air.

Fountain See Gerb.

Gerb A device that, when ignited, emits a shower of sparks into the air at various altitudes. (Also known as a Fountain).

Ground Device* Any pyrotechnic device designed to operate in a fixed position at or near ground level.

Ground-Level Display* A pyrotechnic display involving set pieces, wheels, strobes, and other stationary pyrotechnics.

High-Level Display* A pyrotechnic display involving aerial shells and effects that travel a vertical distance of between 200 feet and 1000 feet.

Ignitor An electric, chemical or mechanical device used to initiate burning of pyrotechnic or propellant materials.

Lance A thin cardboard tube packed with a color-producing pyrotechnic composition.

Lift Charge* An explosive composition, usually black powder, used to launch a projectile (e.g. aerial shell) into the air.

Low Burst or Low Break The result of a shell exploding below its prescribed height.

Low-Level Display* A pyrotechnic display involving aerial shells and effects that travel a vertical distance of no more than 200 feet.

Meteoric Shower A self-contained cardboard tube mounted on a plastic base emitting a shower of stars into the air.

Mines or Mine Bags A device contained within a reusable or disposable tube, where upon ignition stars, firecrackers, salutes, whistles or other devices are propelled into the air, with the tube remaining on the ground.

Misfire A pyrotechnic item which fails to function as designed after initiation. Also see Dud.

Mortar A cylinder that is used to hold and fire public display or special effects pyrotechnic items or compositions.

Mortar Box Also known as a Trough. A portable wooden structure used for the placement of mortars.

Mortar Rack A wooden rack holding closely spaced HDPE or paper mortars. Mortar racks are limited to 10 tubes per individual rack.

Multiple Break Shell Aerial shell which has two or more breaks.

Multi-Shot or Cake Devices* Individual devices much like a roman candle that project colored incindiary elements into the air that may also produce a crackling sound. They are usually

packaged and deployed as a single unit of 50-200 individual small launch tubes that fire in rapid succession, creating a barrage or bombardment effect.

Paper Mortar A mortar constructed of spiral or convolute wound paper or chipboard.

Public Display of Fireworks "Public display of fireworks" means an entertainment feature where the public or a private group is admitted or permitted to view the display or discharge of dangerous fireworks, as defined in Section 12505 of the California Health and Safety Code.

Pyrotechnic Device* Any device containing a combustible substance that is designed to ignite or explode, creating a visual and/or audible effect (includes aerial shells and ground devices)

Roman Candle A heavy paper or cardboard tube containing pellets of pyrotechnic composition which, when ignited, are expelled into the air at several-second intervals.

Salute An aerial shell as well as other pyrotechnic items whose primary effects are detonation and flash of light.

Set Piece Also known as ground display piece, mechanical piece. A pyrotechnic device or series of devices that while on the ground or elevated produces a visual and/or audible effect. These devices may employ fountains, roman candles, wheels, and lances.

Shell See Aerial Shell.

Single Break Shell Aerial shell having one or more effects within a cylindrical or spherical casing.

Sparkler A stick or wire coated with a pyrotechnic composition that produces a shower of sparks upon ignition.

Squib See Electric Match, or Detonator or Soft Detonator.

Stars* Spherical pellets of varying chemical composition that emit colored light effects when ignited.

Strobe or Strobe Pot* A stationary pyrotechnic device that emits pulses of light as it burns.

Travel To move from point of ignition either vertically or horizontally.

Trough Also known as a Mortar Box. A portable wooden structure used for the placement of mortars.

Wheel* A wooden wheel mounted on a central axle at the top of a pole, designed to spin when propelled by pyrotechnic devices attached to the surface/and or edges of the wheel.

Wheel Driver A heavy paper or cardboard tube emitting a shower of sparks from a very small orifice, similar to a propellant motor.

END NOTES

END NOTES

1. The City of Santa Cruz continues to sponsor an annual fireworks display each October; however, the MBNMS ceased issuing permits to the city after 1995, when a boundary confirmation revealed that the fireworks display and fallout area are outside Sanctuary boundaries.

2. The Pebble Beach site is no longer authorized for displays within the Sanctuary due to its proximity to sensitive marine resources in the area.

3. "Sensitivity of Coastal Environments and Wildlife to Spilled Oil: Central California," Research Planning Incorporated. Columbia, South Carolina. September 1994.

4. Unless the MBNMS receives a written inquiry or permit request, it typically does not keep records of informal discussions and proposed permit actions. It is therefore possible that additional fireworks displays have been relocated to alternative onshore locations due to recommendations by Sanctuary staff.

5. One proposed site was offshore of Cannery Row in Monterey. The sponsor wanted to stage the show adjacent to a restaurant for a wedding anniversary. The site was not appropriate for display and the sponsor abandoned the plan. The second proposed site was near the Pebble Beach Lodge where the sponsor wished to present a New Year's Eve display for a private party. The display was moved inland from the water's edge and confined to a low-level fireworks show. The third proposed site was near Point Joe at the Monterey Peninsula Country Club community center, where the sponsor planned to present a display for a wedding reception. The display was moved inland from the water's edge and confined to a low-level fireworks show. In each case, the sponsors were very cooperative, and found acceptable alternatives that did not require display within the Sanctuary.

6. Some aerial shells can be as large as 24 inches in diameter, but these are reserved for only the largest world-class fireworks displays and are not used in the MBNMS.

7. Plastic shells are usually of European origin, are more costly, and produce more elaborate effects.

8. The candela is a standard unit for measuring intensity of light, defined by the National Institute of Standards and Technology as the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540 x 1012 hertz and that has a radiant intensity in that direction of 1/683 watt per steradian.

9. "Environmental Effects of Fireworks on Bodies of Water". Debusk, Thomas et. al., First International Symposium on Fireworks Proceedings, Montreal, Canada. May 1992. pp. 92-102.

10. The largest aerial display performed in the Sanctuary to date was the City of Capitola 50 Year Anniversary Display staged from the Capitola Pier held in May 1999.

11. See notes 8 and 12. Benedict Schwegler, Jr., one of the report authors, stated that directed research on the environmental impacts of fireworks decomposition products is simply not pressing for the vast majority of fireworks sponsors who only purchase one display per year. They simply would not see the necessity for funding a multi-year study to determine impacts for one or two annual displays. He explained that the Disney Corporation funded the 1992 impact study due to the unusual volume of fireworks displays conducted within Disney theme parks and the company's desire to determine whether the weekly displays posed a risk to environmental quality within the parks. He said that he is very familiar with past and current research on fireworks impacts and is unaware of any study similar to the 1992 Florida research on impacts of chemical residue.

12. Personal Communication. Telephone conversation between Scott Kathey (MBNMS) and Benedict R. Schwegler, Jr. (Walt Disney Corporation). March 22, 2001.

MAPS

APPENDIX