Massachusetts Military Reservation Cleanup Team
Building 1805
Camp Edwards, MA
January 11, 2012
6:00 – 8:15 p.m.

Meeting Minutes

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Handouts Distributed at Meeting:

1. Map: Demolition Area 1 leading edge
2. Presentation handout: J-2 Range Remedial Investigation/Feasibility Study Part I
3. Figures to accompany J-2 Range presentation
4. Impact Area Groundwater Study Program DRAFT Program Major Milestones
5. Presentation handout: 2011 Ashumet Pond Update
6. MMR Cleanup Team Meeting Evaluation form

Agenda Item #1. Introductions, Agenda Review, Approval of October 12, 2011 MMRCT Meeting Minutes

Mr. Karson convened the meeting of the Massachusetts Military Reservation Cleanup Team (MMRCT) at 6:03 p.m. and announced that Michael Minior, who was the deputy program manager for the Air Force Center for Environment and Engineering (AFCEE) at MMR, retired on December 31, 2011. He also reported that Shawn Cody is the new program manager for the Impact Area

Groundwater Study Program (IAGWSP), and that Desiree Moyer would be filling in for Lynne Jennings as the U.S. Environmental Protection Agency (EPA) representative at tonight's meeting.

Mr. Karson then reviewed the agenda and asked if there were any changes or additions to the October 12, 2011 MMRCT meeting minutes. No changes were offered and the minutes were approved as written.

Agenda Item #2. Demolition Area 1 Update

Mr. Gregson showed a map of the Demolition Area 1 (Demo 1) plume area and pointed out the Cape Cod Canal, Buzzards Bay, and the MMR boundary. He also showed a detail map and pointed out Route 28, the Otis rotary, and the location where a treatment system was installed at the base boundary a year ago and is cutting off the plume.

Mr. Gregson noted that the IAGWSP is continuing to investigate the downgradient extent of the Demo 1 plume. He pointed out two drive-point locations on private property west of Lily Pond where perchlorate was detected above the state drinking water standard of 2 parts per billion (ppb), at 3.4 ppb and 2.46 ppb. The next step is to see if the plume has traveled farther downgradient, and given the existence of the nearby densely wooded area, it's been determined that additional drive-point locations would be installed at County Road. Mr. Gregson also pointed out where permanent monitoring wells have been installed at three drive-point locations and said that the IAGWSP has developed those wells and is expecting to collect samples from them soon. He further noted that the program is working with the Town of Bourne and the property owner to finalize real estate documents and start drilling.

Mr. LoGiudice asked why the new drive-points are being located on County Road. Mr. Gregson explained that it's really a matter of space, as the private properties go right up to the road. He also mentioned the issues of utilities, power lines, and so forth, but added that County Road is the best location the IAGWSP has found so far.

Ms. Rielinger asked Mr. Gregson to describe groundwater flow in the area, and whether it's expected to jog a little north. Mr. Gregson replied that the direction of groundwater flow is generally from right to left. He also noted that modeling indicated that the plume would curve toward the north to intercept the Pocasset River. It turns out that the geology is a little more complex and the plume is farther south than expected, but some kind of northward curve is still expected as the plume moves downgradient and is influenced by the Pocasset River.

Mr. Dinardo inquired about the depth of the plume in relation to the water body shown on the map. Mr. Gregson noted that the plume is well below the bottom of the pond. The pond is very shallow, about 10 feet deep, while the plume is about 60 to 90 feet below that.

Mr. Saucier asked about the couple with some commercial property who came to an MMRCT meeting last April and expressed concern about the Demo 1 plume. Mr. Gregson replied that the IAGSWP installed a well on the property, which had test results of 7.46 ppb. The IAGWSP also tested the irrigation well on the couple's property, but that well is shallow and has been okay, so it doesn't appear that the plume is influencing it. Mr. Gregson further noted that "irrigation well" is probably not the correct term; rather the water from that well is used for mixing with pesticides and fertilizers used in the couple's business.

Agenda Item #3. J-2 Range Draft Remedial Investigation/Feasibility Study

Mr. Gregson stated that this presentation is the first of a two-part series on the J-2 Range Draft Remedial Investigation and Feasibility Study (RI/FS). Tonight's presentation will include a general overview and information on the soil and source work that's been done. The presentation at the March MMRCT meeting will focus on groundwater alternatives and modeling conducted for the RI/FS.

Mr. Gregson showed a map and noted that the J-2 Range area is located in the northeast part of the base and includes two plumes of contamination: J-2 Northern and J-2 Eastern. He also noted that groundwater flow is from south to north, and he pointed out three downgradient public water supply wells that were installed for the Water Co-op. Because of the supply wells, several years ago the IAGWSP implemented the interim action of installing groundwater treatment systems on both of the J-2 Range plumes.

Mr. Gregson showed a figure depicting the J-2 Range, pointed out the direction of groundwater flow, and noted that there are several other plumes in the area (J-1 Northern, J-1 Southern, and J-3). He also said that the interim systems installed for the J-2 plumes are fairly comprehensive and doing a good job of cleaning up the entire plumes rather than just cutting them off at the downgradient edge. The J-2 Northern system has three extraction wells with infiltration trenches on the sides, and the J-2 Eastern plume also three extraction wells, with reinjection off to the sides.

Mr. Gregson reported that the J-2 Range was used for military training from 1935 to the late 1980s, as a musketry range, a transition range, and then a rifle range. From the 1950s to 1980s it was also used as a defense contractor testing range, which is believed to have caused the primary source of contamination. Most of the information about defense contractor activities at the range was learned through interviews and the investigations that have been conducted at the range. A lot of munitions testing occurred at the range (artillery, fuzes, and rockets), and several disposal areas were found, one of which is the source of the J-2 Northern plume.

Mr. Gregson reported that at the J-2 Northern plume, there are 76 monitoring wells at 36 separate locations. At the J-2 Eastern plume, there are 107 monitoring wells at 44 separate locations. The J-2 Northern treatment system includes an extraction well near the toe of the plume (pumping at 125 gallons per minute [gpm]), a well in the middle (175 gpm), and one near the source (75 gpm). The J-2 Eastern system also includes three extraction wells, pumping at 125 gpm, 210 gpm, and 90 gpm.

Mr. Gregson then stated that the contaminants of concern (COCs) for the J-2 Northern plume are perchlorate and RDX. The dominant COC, perchlorate, covers a fairly large area, more than a mile long and about 650 feet wide. The maximum perchlorate concentration seen was 198 ppb, in 2011. The RDX contamination area is about 3,000 feet long and 200 feet wide. The maximum RDX concentration seen was 15.1 ppb, in 2008; the current maximum is 4 ppb, in the same well. The cleanup number being used for RDX is 0.6 ppb, which is the one-in-a-million cancer risk for RDX in groundwater.

Mr. Gregson noted that the J-2 Northern treatment system began operating in September 2006. The extraction wells pump a total of 375 gpm, and one billion gallons of groundwater have been treated to date. The plume has become segmented as the pumping is breaking it up into smaller pieces. Mr. Gregson also reported that recent monitoring has shown that the contaminant mass at the extraction well closest to the source is greater and slightly deeper than initially predicted.

Mr. Gregson said that perchlorate and RDX are also the COCs at the J-2 Eastern plume. The perchlorate area is about 5,000 feet long and 1,100 feet wide, and the maximum concentration, 87.5 ppb, occurred in 2011 in monitoring well 368 (MW-368), located in the middle of the plume. The RDX portion is about 3,000 feet long and 900 feet wide. The maximum RDX concentration, in 2008, was 16 ppb, also in MW-368, where the current maximum (15.4 ppb) was also detected. The J-2 Eastern treatment system began operating in September 2008. The extraction wells pump a total of 425 gpm, and 700 million gallons of groundwater have been treated to date. The perchlorate core is bifurcated, meaning there is a deep plume and a shallow plume, and as with J-2 North, segmentation of the plume is beginning to develop.

Mr. LoGiudice asked if segmentation is a good sign. Mr. Gregson confirmed that it is, because it means that the plume is collapsing due to treatment.

Mr. Gregson then discussed source characterization activities. He reported that from February 1999 through September 2009 more than 3,000 soil samples (including soil borings, surface soil samples, and post-excavation samples) were collected from 700 locations. In 2000, much of the vegetation across the entire range was flush-cut in order to conduct a geophysics munitions survey and various grid, pit, and data gap investigations to look for burial and disposal areas using a geophysical signal. In addition, a pilot project using explosives detection dogs (EDD) was conducted at the range, as were a number of aerial photo assessments. Mr. Goddard asked if the dogs were able to detect anything. Mr. Gregson replied that the dogs turned out to be too sensitive and detected everything, including expended bullet casings.

Mr. Gregson reported that for the purpose of investigation, the J-2 Range was divided into four areas. Three hundred and seventy-eight soil samples at 83 locations were collected at Area 1. The features in Area 1 included a melt/pour facility, fixed firing points (FFP), a loading/conditioning/CONEX area, a drop tower, a latrine, and what's known as N Range, to the right. During the course of the investigation, the IAGWSP looked at 10 geophysical anomaly areas called Munitions Survey Phase (MSP) III polygons, as well as numerous "pit-like" anomalies.

Mr. Gregson then reviewed Area 1 findings, noting that in Grid K11, a burial pit that contained munitions debris, munitions and explosives of concern (MEC), and small quantities of energetics was found. He also reported that: six more burial pits were found in Priority 1 Grids; a MEC item was found at Grid M17; and munitions debris and other debris was found at 15 locations. Supplemental geophysical investigations found munitions items in three more grids (H13, J16, and K11) and munitions debris and other debris at other locations. An aerial photo assessment identified an additional feature that the IAGWSP investigated, a burial pit containing building demolition debris. It was also noted on the Area 1 Findings slide that 100 cubic yards (cy) of soil from Grid I12, 100 cy of soil from Grid I16, and 5 cy of soil from Grid J16 were disposed of off-site.

Mr. Gregson reported that 1,803 soil samples were collected at 354 locations at Area 2. Features at Area 2 included brick-lined pit #1, berm 2, disposal area 1, a mortar position, berm 3, the Range Road burn area, and FFPs 3, 4 and 5. The program looked at 20 MSP III polygons and numerous "pit-like" anomalies. Mr. Gregson noted that in 2004, as part of a Rapid Response Action (RRA), contaminated soil (primarily RDX, HMX, TNT, and DNTs) was removed from six Area 2 locations and treated in the thermal desorption unit on base at that time. At berm 2, 173 cy of soil was removed and ten 66mm rockets were found. Twenty-one cy of soil was removed from disposal area 1, where two 81mm mortars were found. At the Range Road burn area, 21 cy of soil was removed. At the twin berms, 651 cy of soil was removed, and 123 and 162 cy of soil was removed from FFP 3 and FFP 4 respectively. At this time Mr. Gregson also noted that the portions of the figure shown in green represent areas where munitions were removed to some extent, either through preparing a road for safe passage, from a soil excavation of a disposal area, or removal of a berm.

Mr. Gregson stated that Area 3, the primary source for the J-2 Northern plume, is believed to be an old disposal area where defense contractors disposed of waste munitions and local towns disposed of unused fireworks – the same sort of activities that occurred later at Demo 1. At Area 3, where the program collected 790 soil samples from 172 locations, features included berm 5, disposal area 2, brick-lined pit #2, and several MSP III polygons.

Mr. Gregson reported that a large amount of contaminated soil (RDX, HMX, TNT, and DNTs) was removed from Area 3: seven hundred and thirty-one (731) cy from berm 5; four hundred and thirty-five (435) cy from polygon 1; two hundred and thirty-four (234) cy from the anomaly west of polygon 1; three thousand five hundred and seventy-two (3,572) cy from polygon 2, which is the believed to be the main source area; 343 cy from the anomaly north of polygon 1; and 14 cy from a blow-in-place (BIP) excavation near polygon 1. This effort, which was part of a 2004 RRA, involved treating the soil in the thermal desorption unit and putting the treated soil into the Demo 1 depression. Mr. Gregson also noted that geophysical findings at Area 3 included 32 burn/burial pits, from which 280 cy of contaminated soil was excavated and transported off site for disposal.

Mr. Gregson then stated that most of Area 4, the J-2 extension area, is located within the Impact Area, and includes a couple of berms along the margins. He noted that the IAGWSP mowed down the vegetation and conducted a comprehensive detailed reconnaissance and electromagnetic survey of the entire area. This is also the area where the EDD pilot project was done. Mr. Gregson further noted that there was an intrusive investigation of “pit-like” anomalies and that extensive soil sampling was done using multi-point samples. He also reported that some munitions and contaminated soil (with fairly high levels of HMX) were found at Area 4. A little more than 1,000 cy of soil was removed and treated in the alkaline hydrolysis treatment cell in place at L Range.

Mr. Gregson then reviewed the J-2 Soil/Source Removal summary slide: 6,474 cy of soil was treated on-site thermally during the 2004 RRA; 1,110 cy of soil was treated on-site by alkaline hydrolysis; 1,117 cy of soil was transported off-site for disposal; 49 burial pits were removed from Areas 1 and 3; and it’s believed that all of the known active sources have been addressed through the removal of contaminated soil and burn/burial pits.

Mr. Dinardo said that he’s impressed with the tremendous amount of work the IAGWSP has performed. He also asked if it’s correct that all of the treated soil was placed at Demo 1. Mr. Gregson clarified that the soil treated by thermal desorption was placed in the Demo 1 depression, the soil treated by alkaline hydrolysis was placed on the L Range floor, and the remaining soil was transported off-site for disposal.

Mr. Gregson noted that range activities involving munitions included small arms training, testing, and disposal, which included junk, munitions debris, items containing small quantities of energetics (such as fuzes and primers), and MEC, which was the primary source of the groundwater contamination. He also said that large numbers of munitions were removed as part of the J-2 Range investigations. Areas 2 and 3 contained the majority of munitions items found, Area 3 had the highest number of items, and more than 700 items were blown-in-place during investigations. Residual munitions are likely limited to scattered individual items.

Mr. Gregson said that the next steps are: an MMRCT presentation on the groundwater alternatives described in the RI/FS; resolution of agency comments and finalization of the RI/FS in winter/early spring; and issuance of a draft Remedy Selection Plan/Decision Document (RSP/DD) in the spring.

Mr. Goddard asked if the treatment units being used are mobile treatment units (MTUs). Mr. Gregson replied that three MTUs are being used for the J-2 Eastern plume, while two MTUs and a separate small treatment plant are being used for the J-2 Northern plume. Mr. Goddard also asked if, in regard to the RI/FS, the IAGWSP will be looking just for comments on groundwater. Mr. Gregson clarified that the program will be looking for comments on the entire document. Mr. Goddard then asked if it’s correct that the IAGWSP feels confident that there’s no need to remove more munitions. Mr. Gregson replied that that is correct; it’s believed that the major sources contributing to groundwater have been removed. He further noted that part of the remedy will be future monitoring to maintain the treatment systems and ensure that the source has in fact been removed.

Mr. Goddard then mentioned the new protocol that describes how source areas are “put to bed” with respect to unexploded ordnance (UXO), and asked the regulatory agencies whether the J-2 Range situation follows the protocol, and whether it’s been finalized. Mr. Pinaud replied that decisions have been made on L Range and J-1 Range, and the regulators are currently looking at the Central Impact Area. He also said that each one is a little bit different. Mr. Goddard said that he was referring to the presentation that Mr. Gonser made at a recent MMRCT meeting, when he spoke about estimates of UXO remaining. Mr. Gregson clarified that that presentation was specific to the Central Impact Area. Mr. Goddard then asked if the regulators are comfortable that the IAGWSP has removed the UXO that needed to be removed. Mr. Pinaud replied that that is certainly the case for L Range and J-1 Range, but the regulators are still reviewing the J-2 Range RI/FS.

Ms. Grillo brought up the subject of public involvement relating to the J-2 Range RSP/DD. Mr. Gregson reminded the group that the J-2 Range groundwater alternatives will be reviewed at the March MMRCT meeting, and added that there will also be a public meeting for a wider audience, probably sometime in April or May.

Mr. Dinardo inquired about the fate of the uncaptured portion of the J-2 Eastern plume. Mr. Gregson replied that the extraction wells were situated to capture the main part of contaminant mass, and the small uncaptured portion will attenuate naturally as it moves downgradient.

Mr. LoGiudice commended the IAGWSP for its work at the J-2 Range and said that he hopes that the local newspapers report on it.

Agenda Item #4. IAGWSP Program Schedule/Overview

Mr. Gregson stated that the IAGWSP Program Schedule was developed in November 2011 in response to a request from the regulators, so some of the dates have changed since then. He then reviewed the schedule chart, site by site.

For Demo 1, Mr. Gregson noted that: the program is working on delineation of the off-base portion of the plume; modeling and analysis will be conducted to come up with a proposed remedy in mid-2012; and a Demo 1 Five-Year Review will occur later in 2012. For the Central Impact Area, he noted that: the DD is expected to be finalized by late January/early February 2012; the next step will be treatment system design, with startup scheduled for September 2013; the Source Area Response Work Plan, which is part of the DD, will be developed during the first half of 2012; and Phase I of the source response will be implemented over the next three years.

For Former A Range, Former K Range, and the Gun & Mortar Positions, Mr. Gregson reported that the last investigation report (for Former A Range) should be done by the end of this month, and the draft DD, which might be a topic at the March 2012 MMRCT meeting, should be finalized by the end of that month. For J-1 Range South, the IAGWSP is working on system design and startup tasks (including property acquisition, contracting, and construction), with an enforceable milestone date of December 31, 2012. For J-1 Range North, the enforceable milestone date is September 2013. Currently the IAGWSP is conducting additional investigation to delineate the extent of contamination, which will be followed by some modeling, designing the well field, and getting the funding and contracting in place in order to being construction in May 2013.

For the J-Range, Mr. Gregson reiterated that the IAGWSP is looking to finalize the RI/FS by the end of March 2012, with the draft RSP to be issued at the end of April, and the draft DD to be issued at the end of May and finalized sometime in the late summer. For the J-3 Range, the IAGWSP is currently occupied with a work plan to conduct additional investigation to ensure that the existing treatment system is performing as expected. This effort might push out the timing of the draft RI/FS, but in November 2011 it was envisioned that the RI/FS would go final in early summer 2012, with the RSP issued in July, and a final DD by the end of November 2012.

Mr. Gregson also noted that the IAGWSP is currently working on an investigation of Sierra Range in order to allow the Army National Guard to begin using that range again. He said that the program and the regulators are working through comments on the draft Investigation Report and hope to have the report finalized sometime in January or February 2012. Mr. Gregson further noted that the IAGWSP and regulatory agencies plan to have meetings over the next several months to scope what's needed to complete the rest of the Small Arms Ranges and Training Areas. He also explained that the last line on the chart pertains to the ongoing cycle of reports on long-term system performance and groundwater monitoring at the various sites.

Mr. Goddard asked if the final Central Impact Area DD will pertain to groundwater. Mr. Gregson clarified that it will pertain to both groundwater and source decisions. Mr. Goddard then asked if the document will then include a description of how the IAGWSP will address UXO. Mr. Gregson explained that the DD will include a requirement for the development of a work plan to address UXO, which will be the Source Area Response Work Plan. Mr. Goddard also inquired about the Central Impact Area groundwater remedy. Mr. Gregson replied that the remedy is going to be a three-well extraction system on Burgoyne Road. Mr. Goddard then asked if MTUs will be used. Mr. Gregson replied no, and explained that the extracted groundwater will be piped to the Demo 1 treatment plant, which has excess capacity.

Mr. Pinaud said that he believes that EPA wants a meeting around the time the CIA DD is signed to let everyone know the details about the decision, because it is complicated and a little different. Mr. Goddard asked about any interplay with the Chemical Spill 19 (CS-19) plume. Mr. Pinaud replied that CS-19 has its own remedy. Mr. Davis indicated that there would only be overlap if the IAGWSP plans on treatment in the southern end of the Central Impact Area, and Mr. Gregson confirmed that there’s no plan for treatment there. Mr. Goddard explained that he’s concerned about any remaining concentrations traveling west, as they could affect land in Bourne.

Ms. Moyer stated that EPA is considering a public meeting on the Central Impact Area at the end of February, or at the next MMRCT meeting. Mr. Goddard said that he thought the next MMRCT meeting is scheduled to occur in March. Mr. Karson noted that the regulators and agencies will be discussing the plan at a meeting tomorrow.

Mr. Dinardo asked if there is a plan to conduct more prescribed burns. Mr. Cody replied that every year there is a plan for prescribed fires, although some years there are more than others, depending on weather conditions. Mr. Dinardo then asked if the burns are connected with cleanup areas at all. Mr. Cody said that the cleanup program has actually paid for some of the plans for burn areas, “but one is not slowing down the other one.” He added that burns are conducted in areas for habitat and if there’s a need to investigate areas.

Agenda Item #5. Ashumet Pond Update

Mr. Davis announced that Ed Baker, a long-time advocate for Ashumet Pond, has passed away. He noted that it was Mr. Baker’s advocacy that caused the Congressional delegation to put enough pressure on the Air Force to give the Installation Restoration Program (IRP) the authority to work on cleaning up the pond, given that the contaminant is a nutrient, and not a hazardous substance. Mr. Davis said that Mr. Baker will be missed and that the IRP will continue its commitment to work at Ashumet Pond until the phosphate is finished migrating.

Dr. Blount showed a figure and pointed out Ashumet Pond, the phosphorus plume that emanates from the former wastewater treatment plant, the geochemical barrier that was installed to intercept the higher concentrations of phosphorus entering the pond, and the red line depicting the pond’s deep basin, where alum treatments were applied. He also said that from the 1960s to 2000, the trophic health of Ashumet Pond gradually declined. Over that time, the pond saw reduced water clarity, increased algae blooms, and decreased oxygen levels in the deeper parts of the pond, especially during the summer. The cause of the decline was from excess phosphorus getting into the pond and producing larger algae blooms, which died and sank to the bottom of the pond where their decay consumed oxygen. Sources of the excess phosphorus include the septic systems and yard fertilizers associated with increased housing development around the pond, but probably more so the phosphorus plume emanating from the former on-base wastewater treatment plant and gradually reaching the pond. Dr. Blount noted that remnants of the plume still persist today and are gradually continuing to migrate to the pond.

Dr. Blount reported that the wastewater treatment plant was closed in 1995, which eliminated the introduction of additional phosphorus to the groundwater. However, the phosphorus that was caught up in the sediments, and in the groundwater itself, continue to feed the plume. Dr. Blount stated that long-term monitoring of the phosphorus plume began in 1999, and he showed figures of what the plume looked like in 1999 and in 2007. He pointed out a small zone of the highest phosphorus concentrations (more than 5 milligrams per liter [mg/L]) in 1999, and he noted that although the plume is much larger in 2007, the concentrations are much lower. The highest concentrations of phosphorus have gradually dissipated and continue to do so. Dr. Blount also noted that the U.S. Geological Survey (USGS) collected data and developed the plume maps. He then showed a blowup of the 2007 plume and reported that two additional monitoring wells installed by the USGS in 2009 showed concentrations of 0.42 mg/L and 0.29 mg/L, indicating that the plume continues to dissipate. He further noted that the USGS will be updating the plume map this summer.

Dr. Blount reviewed the remedial actions taken at Ashumet Pond: a September 2001 alum treatment over approximately 27 acres, at the deep part of the pond in order to prevent fish kills and because that's where most of the phosphorus is released during the summer; the installation of a geochemical barrier in August 2004, to reduce phosphorus loading to the pond; and a second alum treatment, which was performed in 2010.

Dr. Blount then explained that prior to the installation of the geochemical barrier, the USGS used data from numerous drive-point locations (at depths from 6 inches to 3 feet) in order to map the footprint of the plume as it discharges to pond and determine the best location for the barrier. Testing was conducted to identify the best reactive material for the barrier, which turned out to be zero valent iron (ZVI). The barrier was designed to be 300 feet long, 40 feet wide, and a maximum of 3 feet thick. Native sand was excavated, mixed with an average of 3% ZVI by weight, and replaced. Based on design testing performed at the School of Marine Science & Technology at UMass Dartmouth, it was estimated that the barrier should have a lifespan of 20 to 25 years, an estimate that was confirmed by additional testing of the barrier in 2009.

Dr. Blount showed cross-sectional schematic drawings of how the barrier works under average water level conditions and under high water level conditions. He explained that the location of the barrier installation was based on average water levels over a 30-year period, and was limited on the offshore side by the depth of the water and on the onshore side by vegetation. He also reported that since 2004, when the barrier was installed, there have been high water levels much of the time, and therefore while most of the plume discharges to the barrier and is captured, a small slice gets through between the edge of the barrier and the shoreline. Dr. Blount then showed photos of the area before, during, and after installation of the barrier, and pointed out the dark shoreline in the first photo, from manganese, and the reddish color in the last photo, from oxidation of the barrier at the surface.

Dr. Blount then stated that objectives of the USGS's permanent monitoring network are to evaluate the barrier's effectiveness and to identify ongoing changes of phosphorus levels entering the barrier over time. He also displayed a figure depicting the monitoring network and pointed out the barrier and the shoreline (in 2009). He then noted that monitoring devices include horizontal multi-port samplers, which are PVC pipes that run the width of the barrier along the bottom of the pond and the bottom of the barrier and collect groundwater at intervals. The deep device shows what's entering the barrier, and the shallow device shows what's exiting the barrier. Vertical diffusion chambers are another monitoring device, used to measure vertical profiles through and outside of the barrier. Vertical multi-level samplers are used to measure the vertical profile at a single point, and seepage meters are used to see how much water is discharging into the pond at different points in the barrier.

Dr. Blount displayed data plots for the deep and shallow horizontal multiport samplers, pointed out on the deep sampler plot the main part of the plume, where phosphorus concentrations are about 1.5 mg/L, and noted that concentrations flat-line in the plot showing the shallow sampler data. He said that the plots show that by the time the water gets to the upper part of the barrier the phosphorus has virtually all been removed. He then showed plots for three vertical diffusion chambers (DC1, DC2, and DC3). He noted that DC1 is outside the barrier, so phosphorus concentrations would be expected to remain high from top to bottom, while the other two are inside the barrier, where a phosphorus decline would be expected as the water moves through the barrier. Dr. Blount pointed out that the plot for DC1 does show relatively high phosphorus concentrations until about four inches below the pond bottom, which is probably due to dilution. The plot for DC2 shows a gradual decrease in concentrations until a spike (which may simply be an anomalous data point or small variation in the plume) and then a continued decrease. Dr. Blount then mentioned that the bottom of the barrier is not perfectly flat, so the depth of the DC3 device is about 2.75 feet. He also pointed out the decreasing trend at DC3, and said that the plots indicate that the barrier is working.

Dr. Blount stated that the temporary drive-points that the USGS installs every few years provide a second line of evidence that the barrier is working. The drive-points are installed at three different depths: about 3 feet below the pond bottom, or below the barrier; about 1.5 feet below the pond bottom, or halfway through the barrier; and about 4 inches below the pond bottom, near the top of the barrier. He pointed out that the figures that illustrate the drive-point investigation results show that the barrier is working, but a small piece of the plume is slipping by between the shore side edge of the barrier and the actual shoreline. Dr. Blount also showed a bar graph entitled "Comparison of Average Phosphorus Entering the Barrier in 2006 and 2009" and noted that the average concentrations entering the barrier in 2006 were between 0.75 mg/L and 1 mg/L, halfway through the barrier concentrations were below 0.5 mg/L, and near the top they were less than 0.25 mg/L. By 2009, concentrations entering the barrier were substantially lower, which is consistent with the plume gradually dissipating.

Dr. Blount then reported that prior to implementation of the 2010 alum treatment a series of studies was conducted in order to get the necessary permitting. These included a 2010 bathymetry update (mapping the depth of the pond in more detail), tidewater mucket and other mussel habitat survey work performed by UMass Dartmouth and OceanServer, and the collection/incubation of sediment cores for phosphorus generation studies performed by UMass Dartmouth. Dr. Blount also made a point of noting that there are two main categories of sources of phosphorus to the pond – external sources such as the plume, and internal sources, which involve the regeneration of phosphorus during the fall turnover in the deep part of the pond where the algae, which accumulate phosphorus in their cells, die. He explained that the purpose of the alum treatment is to trap the phosphorus so it cannot be released.

Dr. Blount stated that for the sediment core study, cores were taken from different depths of the pond, (between 0 to 30 feet, between 30 and 45 feet, and between 45 and 60 feet) and then measured under oxygenated and anoxic conditions. He then referred to a bar graph that illustrated that the highest concentrations of phosphorus come from the deepest part of the pond. However, the area outside of the deep hole is much larger, and therefore a lot of phosphorus comes from the shallower zones as well.

Dr. Blount then showed a photo of the alum treatment being applied. He also explained that the alum was actually a combination of aluminum sulfate and sodium aluminate, which when mixed together, result in a near neutral pH that won't cause fish kills or other problems. He further noted that the dosage for the 2010 alum treatment was 40 grams of alum per square meter of the pond bottom, with a target ratio of 1.8:1 aluminum sulfate to sodium aluminate (the 2001 alum treatment used 43 grams, which is very comparable). Extensive monitoring was conducted before, during, and after the alum treatment, which was implemented September 9 through 16, 2010.

Dr. Blount displayed a figure depicting the bathymetry of the pond and the area where the alum treatment was implemented, a 57-acre area roughly twice the size of the 2001 alum treatment, which is expected to last longer and achieve greater phosphorus removal. He also reported that no fish kills or mollusk kills were observed during the treatment, and the post-treatment mussel survey found no measurable stress or negative impacts on the mollusk community. Approximately 17,500 gallons of aluminum sulfate and nearly 10,000 gallons of sodium aluminate were applied at a rate of 40 grams per square meter.

Dr. Blount stated that early-stage results after the alum treatment showed that the alkalinity and pH of the pond remained within the targeted levels, there was no dissolved aluminum at concentrations that exceeded the acute water quality criteria, and there were immediate indicators of improved water clarity and less total phosphorus in the pond. He also mentioned that the Mashpee Conservation Commission issued a certificate of compliance in October 2010. Dr. Blount said that the improvements in the pond that were seen soon after treatment (water clarity, total phosphorus) will be far more substantial in the long term.

Dr. Blount noted that trophic health monitoring of the pond water itself has been conducted on an annual basis since 1999. The criteria used for evaluation of trophic health include lower phosphorus levels in the epilimnion (the shallow part of the pond, with lots of oxygen) and the hypolimnion (the deep part of the pond, isolated cold water with little oxygen), which exist only in the summer when the temperature difference causes stratification of the pond. Additional criteria that are evaluated are: reduced production of algae, as measured by Chlorophyll *a*; increased water clarity; increased oxygen in the hypolimnion; lower ammonium (an oxygen-consuming chemical) in the hypolimnion; and improvements in the Trophic State Index (whether the pond is eutrophic, mesotrophic, or oligotrophic). Dr. Blount stated that the criteria are used to evaluate how the water quality of the pond has changed since the 2001 alum treatment, the 2004 barrier installation, and the 2010 alum treatment, and determine if further remedial actions are needed.

Dr. Blount then showed a slide illustrating typical seasonal changes in Ashumet Pond, with cross-section figures for three different constituents: oxygen, phosphorus, and dissolved iron. He pointed out that during the spring all the water is oxygenated, but in the summer the hypolimnion sets up and the oxygen there becomes depleted because of a density gradient. Then, during the fall turnover, the cold deep zone and the warm shallow zone become mixed together again. Dr. Blount explained that in the spring, the phosphorus that accumulates at the bottom of the pond gets tied up by the iron. In the summer, when the deep water becomes anoxic, the iron dissolves and releases the phosphorus into the hypolimnion, where it remains trapped. In the fall, however, when the turnover occurs, all of that phosphorus is released back into the pond, and the cycle begins again – the algae feed on it all winter, then they die and gradually accumulate on the pond bottom, in the summer all of that phosphorus is re-released, and so on. Dr. Blount stated that the alum treatment is designed to short-circuit this cycle.

Dr. Blount then displayed a figure entitled "Average Total Phosphorus in Epilimnion," which graphed total phosphorus in the pond from spring 1999 through December 2011. He told the group that the figure pertains to the upper 0 to 26 feet of the pond, or the "algae growing part of the pond." He noted that phosphorus concentrations were quite high before the first alum treatment, dropped after the treatment, continued to decline, and reached a plateau around 2004, when the barrier was installed. He also pointed out that higher phosphorus concentrations and increases in the spikes that happened during the fall turnover, started to occur around 2008, and so a second alum treatment was applied to prevent the pond from regressing. The graph showed that the second treatment has had some effect, and that effect is expected to continue to increase over the next few years.

Dr. Blount stated that the impact of the alum treatment is more obvious in the deeper part of the pond, the zone that becomes anoxic during the summer. He displayed a graph entitled "Average Total Phosphorus in Hypolimnion," pointed out the spikes of phosphorus concentrations that occurred during the summer when the iron dissolves and the phosphorus accumulates, and explained that the dramatic drops after the spikes represent the fall turnover. He also noted that phosphorus concentrations were very high prior to the first alum treatment, then decreased, but started to climb again. The barrier was installed and improvements were observed, until around 2008. After the second alum treatment, in

2010, total phosphorus in the hypolimnion dropped off, and dropped off even more so in 2011. Dr. Blount stated that the graph shows that the phosphorus that was trapped in the sediments is not being released back into the hypolimnion, “so this coming year should be a very good year for the pond.” He also showed a graph that illustrated the results of the sediment core studies, and noted that these studies also provide a line of evidence that the alum treatments worked very well.

Dr. Blount then showed a graph entitled “Summer DO Depletion Trends.” He noted that in spring and fall the dissolved oxygen (DO) in the water extended from the top of the pond all the way to the bottom. So, throughout the year the upper 20 to 23 feet of the pond contained oxygen, but during the summer everything below a certain depth had very low oxygen. Dr. Blount said that it’s hoped that the 2010 alum treatment will result in more oxygen to a greater depth during the summer. He noted that this would benefit the trout, which like cool water but also require oxygen to live.

Dr. Blount also displayed and discussed the Trophic State Index (TSI) graph, which plotted secchi depth data (water clarity), total phosphorus data (the fertilizer for the algae), and Chlorophyll *a* (an indicator of the amount of algae in the pond) from 1999 through December 2011. He noted that prior to the first alum treatment, the TSI indicated that the pond was between mesotrophic (swimmable but able to support a nice fishery) and eutrophic (lots of blue/green algae blooms). Oligotrophic means very clear water, but not likely a very good fishery. Dr. Blount pointed out that conditions in the pond improved until about 2007/2008, and after the second alum treatment are again heading in the right direction.

Dr. Blount reviewed the Summary & Conclusion slides. The 2001 alum treatment and 2004 geochemical barrier installation improved the trophic health of Ashumet Pond between 2001 and 2007, substantially decreasing the phosphorus and Chlorophyll *a* levels and increasing the water clarity of the pond. The pond health started to decline around 2008, with increases in total phosphorus and Chlorophyll *a* concentrations, decreases in water clarity, and relatively large fall algae blooms in 2007 and 2009. The TSIs calculated for the pond, based on these parameters, indicated gradually increasing eutrophication of the pond in 2008 through 2010. The treatment capacity of the 2001 alum treatment was nearly exhausted by 2007, as indicated by the trends toward higher phosphorus and Chlorophyll *a* concentrations and lower water clarity. In order to reverse the trend toward increasing eutrophication, a second alum treatment was implemented in September 2010. Since implementation of the 2010 alum treatment, preliminary data indicate that the increasing eutrophication has been reversed. Steady improvement in the pond’s trophic health is expected over the next five+ years, especially since the second alum treatment covered twice the area of the original one. Total phosphorus concentrations in the groundwater plume discharging to the pond are gradually decreasing. Dr. Blount said that with the combination of less phosphorus coming into the pond and the large alum treatment, he feels good about the continued health of the pond for the foreseeable future.

Dr. Blount then discussed the path forward, noting that: the barrier performance monitoring will continue on a biennial basis; a USGS drive-point investigation is planned for summer of 2012, which will results in a detailed map of the footprint of the plume in the pond; trophic health monitoring of the pond will continue, and optimization of that monitoring program is planned; and the mussel habit monitoring conducted to support the 2010 alum treatment will continue in future years.

Mr. Goddard asked how many more years the plume is expected to discharge to the pond. Dr. Blount replied that while it’s not known for certain, concentrations have been decreasing fairly rapidly and his best guess would be that over the next 15 to 20 years concentrations discharging to the pond will have a much lesser effect on the pond. Mr. Goddard said that he’s wondering when the barrier will be enough to maintain a mesotrophic state, without having to do repeated alum treatments. Dr. Blount replied that if the plume continues dissipating at the current rate, he thinks that, at most, one more alum treatment might be needed before the plume is no longer a driving factor, although other factors may exist.

Mr. Davis confirmed that the plume is not the only problem at Ashumet Pond. He noted that there are many empty lots along the pond, but no sewers in the area, so future development could affect the pond. Therefore, the towns will have to take the steps necessary to keep the pond healthy. Mr. Goddard suggested that at some point the IRP will have to say that it's taken care of the wastewater treatment plant plume, and it's up to the town to take care of the health of the pond going forward. Mr. Davis agreed.

Ms. Donovan inquired about the cost of the alum treatments. Mr. Davis replied that they cost a couple hundred thousand dollars each.

Mr. Jacobs asked about factors affecting the oxygen demand in the deep part of the pond. Dr. Blount replied that there are many different factors, with ammonium, which comes from the breakdown of algae and other organics that accumulate, being a big one. How hot the summer weather is, and how long the heat lasts, is another factor. He further noted that even if all the algae were eliminated one year, there would still be significant oxygen demand based on the organic material that built up in the bottom of the pond over hundreds of years.

Mr. Jacobs referred to a slide entitled "Geochemical Barrier Performance" and said that it appears that higher phosphorus concentrations were discharging into the barrier in 2011 than in 2010. Dr. Blount explained that the plume is not perfectly homogeneous; also, as the pond level rises and lowers, the plume shifts laterally. He also noted that it's important to look at multi-year trends.

Mr. Dinardo noted that the diffusion chamber slide shows phosphorus levels entering a diffusion chamber at higher concentrations in later years. Mr. Davis agreed that concentrations entering the bottom of the barrier were higher in 2011, but only at that one specific location, which is why data from a couple hundred locations are averaged. He also noted that the new plume footprint that comes out this summer will indicate whether indeed the average concentration entering the barrier has increased. Dr. Blount added that he'd be unpleasantly surprised if that occurred given that upgradient monitoring well data has shown concentrations steadily declining over several years. He also said that there can be significant fluctuations at any specific sampling point because the plume is not fixed and coming into the same exact spot.

Mr. Davis then addressed the question of how long the plume is expected to last by explaining that unlike regular plumes, phosphate doesn't migrate with the groundwater; instead, it sticks to the sediments. He said that the USGS developed a very complex geochemical model (that takes into account redox and pH in the sediment) in order to estimate what the phosphate will do.

Mr. Dinardo then asked how Ashumet Pond compares with other ponds in the area. Mr. Davis referred to the Cape Cod Commission's "Ponds in Peril" studies and said that it's not really possible to pick an average because some Cape Cod ponds have no development around them. He also mentioned that lower mestrophic is the comfort zone. Dr. Blount added that he thinks Ashumet Pond is in better condition than nearby Johns Pond, and in much better condition than Santuit Pond. He also mentioned that Peters Pond is probably oligotrophic, a very clear pond.

Agenda Item #6. Next Meeting Schedule and Adjourn

Mr. Karson announced that the MMRCT is scheduled to meet next on March 14, 2012, and then adjourned the meeting at 8:15 p.m.