STATE OF CONNECTICUT
DEPARTMENT OF PUBLIC HEALTH

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Environmental Health Section

To: Erik Bedan, CT DEEP
Amanda Killeen, CT DEEP

From: Meg Harvey, Site Assessment and Chemical Risk Unit

Through: Brian Toal, EOHA Program Supervisor

Subject: Human Health Risk Evaluation, Former Lordship Gun Club, Stratford, CT

Date: March 16, 2018

As requested by the CT Department of Energy and Environmental Protection (CT DEEP), the CT Department of Public Health (CT DPH) reviewed the Human Health Risk Evaluation (HHRE) for the Former Lordship Gun Club in Stratford, CT dated October 31, 2017 and prepared by AECOM on behalf of Sporting Goods Properties [SGP], a subsidiary of E.I. du Pont.

CT DPH's review focused on:

- Whether the approaches and assumptions in the exposure assessment are health protective, given how the site is used.
- Whether the input parameters and approach used to assess risks from lead exposure to adult and children recreational receptors are health protective.

Background

In February 2016, CT DPH reviewed a previous evaluation of human health risks for this site (Gradient, 2009). That review is documented in a February 2, 2016 memorandum to CT DEEP. Since that review, additional data have been collected by AECOM for the purpose of addressing data gaps at the site. The additional data consist of surface water, shellfish and sediment data, all collected in July 2016. The 2016 sediment samples were collected from a total of 20 locations at the site as well as 3 upstream and 3 downstream locations. As with the 2008 analyses, lead was analyzed in fine grained and course grained sediments at each location.

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Shellfish were collected from 11 site locations plus 2 upstream and 2 downstream locations. Surface water was collected from 7 site locations plus 2 upstream and 2 downstream locations.

Also since the 2016 review, SGP/du Pont greatly expanded the pilot living shoreline (artificial reef) they constructed in 2014 to address erosion which was uncovering and concentrating lead shot.

A full site history is contained in the 2009 and 2017 risk evaluations and thus is not repeated here. In short, trap and skeet range operations from the mid-1920s until 1986 resulted in the deposition of lead shot into the intertidal and subtidal areas surrounding the site (a point of land called Stratford Point, situated at the mouth of the Housatonic River in Stratford). Remediation efforts within a 23-acre contaminated area were performed in 2000 and 2001. These efforts included sediment and upland soil excavation and processing to remove lead shot. Following the remediation, erosion and other natural processes resulted in sporadic areas of concentrated lead shot and so several follow-up lead shot removals were conducted between 2003 and 2011. Additionally, a pilot living shoreline was constructed in May 2014 to address continued erosional impacts. The living shoreline was expanded in November 2016.

Overarching Comments on the HHRE:

1. 95% UCLs in fine grained sediments from 2016 indicate that lead levels in both the subtidal and intertidal areas are well below 400 mg/kg (the current residential direct contact exposure criterion for lead in the CT Remediation Standard Regulations [RSRs]). The combined 2008 and 2016 dataset is also below 400 mg/kg. However, comparing 2008 with 2016 data shows that lead concentrations are higher in 2016 than in 2008 in both areas (see Table 1 in Attachment A). DuPont/AECOM should comment on possible reasons for this lead concentration increase in fine grained sediments.

2. Regarding course grained sediments, the 2016 data show that lead concentrations are much lower than in 2008 (see Table 1). Average lead levels in course grained sediments in both the subtidal and intertidal areas are well below 400 mg/kg. However, sample number in 2016 is much lower than in 2008 (20 samples versus 95 samples) so it is difficult to determine to what degree sample size is a factor in the lower lead levels found in 2016.

3. Even though 2016 lead concentrations in course grained sediments do not exceed 400 mg/kg, lead concentrations in course grained sediments using the combined 2008 and 2016 datasets show that lead significantly exceeds 400 mg/kg (6,104 in subtidal area and 2,654 in intertidal area). These concentrations are high enough to result in an estimated probability greater than 5% exceeding the CDC blood lead reference level of 5 ug/dL (see calculation results in Attachment A). EPA guidance on evaluating risks from shooting ranges states that lead in coarse sediments has implications for future exposures as the lead undergoes weathering (and

then becomes finer in size and more of a risk for inadvertent ingestion) (EPA 2003). Therefore, DPH's recommendations from its February 2, 2016 memo are still valid and they are repeated below.

- The property owner should confirm that there are no visible lead fragments in sediments that are uncovered by water during low tide. Visible lead fragments should be removed.
- It would be prudent to post signs advising the public of the presence of lead at the site and to provide common sense suggestions about how to minimize exposure to sediments. These suggestions could include sashing hands before eating and removing sand from feet and shoes before leaving the beach area.

4. The 2016 sampling effort included analysis of mussel and oyster tissue for lead. As stated in the HHRE, the 95% UCL for mussels and oysters was 1.1 mg/kg and 0.423 mg/kg, respectively. The HHRE used the EPA Adult Lead Model (ALM) to evaluate exposures and risks from shellfish consumption by deriving a shellfish tissue concentration "preliminary remediation goal" (PRG) that would not result in a greater than 5% probability of exceeding a fetal blood lead level of 5 ug/dL. The 95% UCL shellfish tissue concentrations at the site were below the PRG derived with the ALM so the HHRE concludes that exposure of adults to lead via the shellfish ingestion pathway would not result in unacceptable risks. Based on this evaluation, the HHRE also concludes that children are protected by the PRG because they consume fish/shellfish at rates lower than adults. This rationale is not necessarily correct. Children may have a lower gram/day shellfish consumption rate than adults but because of their lower body weight, they may have a higher ug/kg/day dose than adults. The appropriate and health protective approach to evaluate lead exposure to children is using the EPA IEUBK model.

Running the IEUBK model indicates that lead exposure from shellfish ingestion (using the HHRE's consumption rate of 22 g/d and the 95% UCL of 1.1 mg/kg for mussels) has the potential to increase the geometric mean blood lead level in children approximately 1 ug/dL. This exposure level is within the same order of magnitude as the lead dose associated with consumption of drinking water at the current federal guideline of 15 ug/L. Complete details for these calculations are provided in Attachment A.

While shellfish consumption is not necessarily a trivial lead exposure to children and should not be dismissed, as a practical matter it is very unlikely that consumption of shellfish at this site would occur. According to information provided by the Stratford Health Department, shellfish harvesting is prohibited in the entire historic shot fall zone at the site (see CT Department of Agriculture Classification map in Attachment B).

It is also worth mentioning that the Federal Department of Agriculture's (FDA's) National Shellfish Sanitation Program guidance historically included an action level for lead in shellfish of 1.7 mg/kg. Action levels for lead and other heavy metals were eliminated from this guidance a number of years ago but the value remains an informative benchmark for general comparison purposes. 95% UCLs for shellfish at the Lordship site are below the historic FDA guidance level.

Specific Risk Assessment Comments:

1. There appear to be a number of inaccuracies in Table 8. Data for HRE and LIS are reversed in a number of cases. For example, the first row indicates 2008 data for the LIS exposure area. However, the data presented in this row are actually HRE exposure area data. Similarly, the next row is labeled HRE exposure area but the data are from the LIS exposure area. This reversal also appears in the combined sampling event portion of the table.

2. Sample numbers for the 2016 data in Table 8 include duplicates as separate sample locations. When there is a duplicate sample, common practice is to use the average of the two results because the data do not represent separate locations. Thus, sample number for HRE-intertidal should be 5 (not 6). Similarly, sample number for LIS-intertidal should be 5 (not 6). This has a small impact on the mean and UCLs calculated in Tables 8 and 15. I have recalculated averages for all exposure areas using the average of the two duplicates and also the correct data for each exposure area (see Table 1 in Appendix A).

3. Many of the course grained sample results from 2016 are "J" values. Please explain why so many results are tagged with a "J" value.

4. In Table 6, the result for HR-1 is missing and two results for HR-5 are listed.

5. The risk assessment does not clearly describe the purpose of the "bulk" sediment samples. Presumably they are co-located with the biota samples. Summary statistics for the bulk samples are included in Table 15 (Sediment Course Fraction). Are the bulk samples course grained?

6. Table 15 treats the duplicate for HR-6 as a separate sample location. The number of samples in Table 15 should be 10 (not 11).

7. The risk assessment should comment on why there is such poor agreement between the parent and duplicate for HR-6 (80.2 ppm and 1,740 ppm). This sample has the highest lead concentration detected in the 2016 sampling event.

8. Table 15 provides summary statistics for the coarse grained sediments but only for 2016 data. Omitting 2008 data presents an incomplete analysis. 2008 data should be included in

Table 15 just like Table 8 includes fine grained sediment data from both the 2008 and 2016 sampling events.

9. The approach used in the HHRE to evaluate exposure to lead in fine-grained sediments by recreational users is not consistent with EPA guidance for evaluating intermittent or variable exposures at lead sites (EPA 2003). According to EPA Guidance, the IEUBK model should be used for exposures that exceed a minimum frequency of one day per week and a duration of 3 consecutive months because this is the minimum exposure to produce a quasi-steady-state blood lead concentration. Exposures at this site exceed the minimum frequency described in EPA Guidance but the IEUBK model was not used to evaluate child exposures.

Further, EPA guidance generally recommends that time-weighted exposure inputs for the models not be annualized and instead, be calculated only for the duration of the shorter-term exposure. The time-weighted soil lead concentration used in the HHRE was annualized over the total number of months that the ground is not frozen (108 days/270 days = 0.4). Instead, the time-weighted soil lead concentration should have been based on the site exposure frequency only during the summer when frequency is greatest (5 days/7 days or 70 days/98 days = 0.7).

That being said, the 95% UCL concentrations in fine grained sediments at the site are below 400 mg/kg. Therefore it is not necessary for DuPont to recalculate risks for the fine-grained sediments.

10. The reference for the presumed lead level in backyards of 20 mg/kg is listed as the 1996 CT RSRs. Please provide more detail as to where in the 1996 RSRs this concentration appears.

Please contact me at 860-509-7748 or Margaret.harvey@ct.gov if you have any questions.

References:

EPA 1994. Technical Support Document: Parameters and Equations Used in the IEUBK Model for Lead in Children. EPA 540/R-94/040 PB94-963505 OSWER #9285.7-22 December 1994.

EPA 2011. EPA Exposure Factors Handbook, EPA/600/R-09/052F. September 2011.

EPA 2003. Assessing intermittent or variable exposures at lead sites. EPA-540-R-03-008, November 2003.

EPA 2003. TRW Recommendations for Performing Human Health Risk Analysis on Small Arms Shooting Ranges. EPA OSWER #9285.7-37 March 2003

Attachment A

Table 1. Recalculated Exposure Point Concentrations for each exposure area, former Lordship Gun Club Site, 2008 and 2016 data (all concentrations in mg/kg).

Fine Grained Sediments								
Exposure Area	2008 Data			2016 Data			2008 & 2016	
HRE Subtidal	144.8	N=3	mean	181.98	N=5	mean	168	mean
LIS Subtidal	97.6	N=8	mean	31.48	N=5	mean	149.4	UCL
All Subtidal	177.4	N=11	UCL	357.9	N=10	UCL	251.2	UCL
HRE Intertidal	194.6	N=10	UCL	358.02	N=5	mean	343	UCL
LIS Intertidal	343.2	N=6	mean	99.88	N=5	mean	351	UCL
All Intertidal	331.1	N=16	UCL	561.3	N=10	UCL	306	UCL
Course Grained Sediments								
HRE Subtidal	106.1	N=10	UCL	126	N=5	mean	128.5	UCL
LIS Subtidal	9989	N=31	UCL	60.6	N=5	mean	8611	UCL
All Subtidal	7570	N=41	UCL	167.3	N=10	UCL	6104	UCL
HRE Intertidal	4331	N=36	UCL	176	N=5	mean	3824	UCL
LIS Intertidal	2056	N=18	UCL	135.4	N=5	mean	1658	UCL
All Intertidal	3161	N=54	UCL	217	N=10	UCL	2654	UCL

IEUBK Lead Model Inputs and Predicted Blood Lead Levels in Children, Lordship Gun Club, Stratford, CT

Sediment Size	**Exposure Area**	**95% UCL[1] Lead (mg/kg)**	**Weighted EPC[2]**	**GM Child Blood Lead (ug/dL)[3]**	**Probability Child Blood Lead > 5 ug/dL[4]**	**With shellfish ingestion pathway[5]**	
						GM Child Blood Lead (ug/dL)	**Probability Child Blood Lead >5 ug/dL**
<2 mm	Subtidal	6,104	1,758	8.7	88%	9.7	92%
<2 mm	Intertidal	2,654	773	4.6	42%	5.8	63%

[1]95% Upper Confidence Level of the mean.

[2]Weighted Exposure Point Concentration in sediment based on 2 days per week site exposure and non-site soil lead concentration = 20 mg/kg (as used in 2017 Lordship Risk Assessment). Per EPA, dust concentration is calculated using default mass transfer rate of 0.7 with non-site soil lead concentration of 20 mg/kg (

[3]Geometric Mean (GM) blood lead level in micrograms per deciliter (ug/dL) based on average of 6 runs (12-24 months, 24-26 months, 36-48 months, 48-60 months, 60-72 months, 72-84 months). In accordance with EPA Guidance (Assessing Intermittent or Variable Exposures at Lead Sites, EPA-540-R03-008, November 2003).

[4]Probability is average of 6 runs. 5 ug/dL is CDC blood lead level at which public health actions are recommended (http://www.cdc.gov/nceh/lead/).

[5]Shellfish concentration used in the model is 95% UCL of 1.1 mg/kg for mussels at the site. The model assumes the substitution of site fish/shellfish for other meat dishes so an estimate of fish meals as a proportion of total meat meals is required for the exposure calculation. Value used for this parameter is 20%. The model assumes daily meat consumption of 104.5 g/d for 3-5 year olds. 20% of this consumption (20.9 g/d) is roughly equivalent to the shellfish consumption rate assumed in the HHRE (22 g/d).

Lead Dose from water consumption as compared with shellfish consumption

Calculations focus on the 3-5 year old age span because they have the highest shellfish consumption for children <7 years.

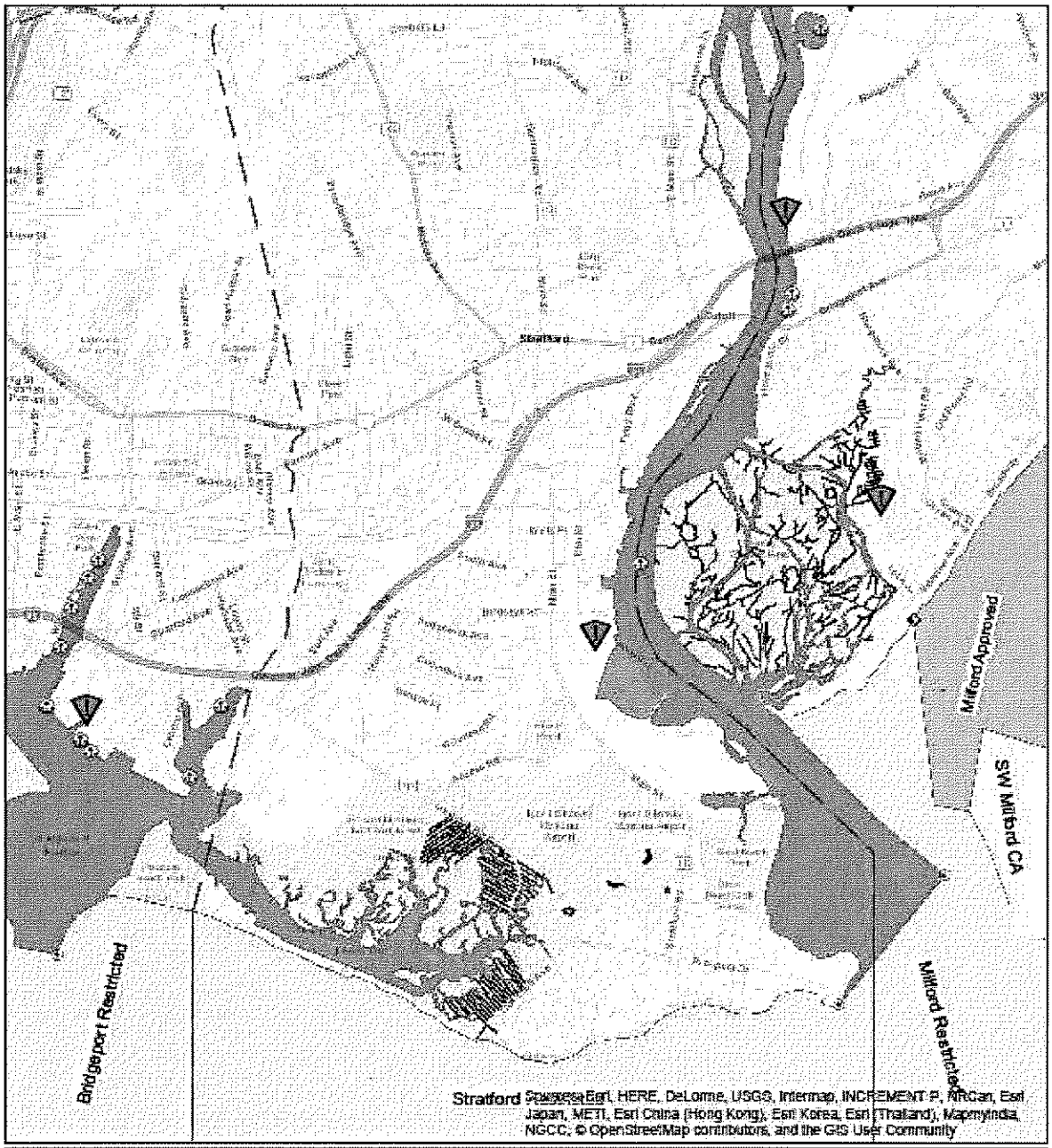
Lead Drinking Water Action Level = 15 ug/L
Drinking Water Ingestion Rate = 1 L/d
Body Weight age 3-5 years = 18.6 kg (EPA Exposure Factors Handbook, 2011)
95% UCL Pb conc. in Oyster = 0.423 mg/kg
95% UCL Pb conc. in mussels = 1.1 mg/kg (ug/g)
Shellfish ingestion rate = 22 g/d

Drinking Water:
(15 ug/L * 1 L/d)/18.6 kg = 0.8 ug/kg-d

Mussels:
(1.1 ug/g * 22 g/d)/18.6 kg = 1.3 ug/kg/d

Oysters:
(0.423 ug/g * 22 g/d)/18.6 kg = 0.5 ug/kg/d

Attachment B - Shellfish Classification Map



Stratford 1

Classification Effective Date: 04/01/16

Map Date: 2/9/2018

0 0.3 0.6 Miles

Map not intended for navigation

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Shellfish Area Classifications

Line
- Approved
- Conditionally Approved
- or Conditionally Approved Seasonal
- or Restricted
- or Conditionally Restricted
- or Prohibited

NPDES Major CT

State
Town
Town Shell

Demarcation buoy or sign
Pilings/Tower/Piling/Pier
Navigational buoy/Lighthouse
Status signal disk
Marinas CT

wet basin of seasonal marina/mooring field is closed while marina is in use

wet basin of year-round marina is prohibited