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U.S ARMY CORP OF ENGINEERS  
PUBLIC MEETING  
ON THE BOSQUE AND LEON RIVERS

APRIL 7, 2004

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18 BE IT REMEMBERED that the U.S. ARMY CORP OF  
19 ENGINEERS held a Public Meeting on the Bosque and Leon  
20 Rivers on the 7th day of April, 2004 at 7:00 p.m.,  
21 before Kimberlye A. Furr, RPR, CSR in and for the State  
22 of Texas, reported by machine shorthand, at the Temple  
23 Public Library (McLane Room), 100 West Adams Avenue,  
24 Temple, Texas, whereupon the following proceedings were  
25 had:

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MR. HEADLEY: Good evening. Did everybody sign in the sign-in sheet, before we get started? If not, on your way out, we'd appreciate if you'd that.  
I'd like to welcome our guests tonight. This is our final public meeting where we'll be presenting the findings from our Bosque and Leon River Perchlorate Study. My name is Kyle Headley, the regional environmental planner for the Travis River Authority, and we're a member of the project study team. This is our agenda that we have planned for tonight's presentation: I'll be doing a little introduction, going over some introductory material. Dave Ebersold with MWH will be doing some exposure concepts and human exposure. Dr. Todd Anderson with Environmental and Human Health at Texas Tech will be doing the ecological exposure part. Wayne Elliott with the Corp of Engineers will summarize the findings of the project. If you have questions, please hold them until the end. And if you a cell phone, if you can turn them on vibrate or silent, I'd appreciate that.  
This slide lists the project team members and the role of that group within the study, and as I go through here, I'm going to mention the folks that are here that are associated with those

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groups and have them raise hair hand so you can put a name with a face. With the Corp of Engineers, we have Wayne Elliot and Clay Church back there; their role was as project management and technical support. TCEQ, formerly TNRCC, tonight we have Kip Haney back there, Vicki Reed, and Mark Arthur; their role was as advisory to the study team and acted as liaison with the inner agency steering committee. The BRA, our role was as technical services and stakeholder coordination, and I'm their representative here tonight. The Institute

11 of Environmental and Human Health at Texas Tech,  
12 Dr. Todd Anderson is here tonight; their roll is  
13 toxicological and ecological studies related to  
14 Perchlorate. MWH, we have Ron Hartline, Kartik  
15 Gandhi, Dave Ebersold, Kathy Freeman back there. MWH's  
16 role in this study was to do watershed hydrological  
17 studies, conceptual modeling, and exposure assessment.  
18 From the U.S. EPA, we've got Bob Sturdiman and Cheryl  
19 Overstreet here tonight; their role was as advisory to  
20 the study team and regulatory liaison. And the  
21 stakeholder consortium was also an advisory and a link  
22 to the community, and that's basically covered on this  
23 next slide.

24 These entities made up the stakeholder  
25 group for the most part. These are the entities that

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1 take their water either out of either Lake Waco or Lake  
2 Belton and then supply finished drinking water to their  
3 customers, which is about 500,000 central Texans that  
4 get their water from one of these groups. I want to  
5 make sure that we mention that -- that we recognize our  
6 elected officials that helped secure the funding for  
7 this project, they include Congressman Chad Edwards and  
8 Senator Kay Bailey Hutchison.

9 A little overview of Perchlorate and why  
10 it has become an issue in Central Texas. Amonium  
11 Perchlorate is the primary oxidizer in all solid  
12 propellants used in our strategic national defense --  
13 the space shuttle, satellites, those kind of things --  
14 and without that oxygen that's supplied by that  
15 Perchlorate, the chemical reactions wouldn't be able to  
16 happen that provide the thrust and the propulsion for  
17 that equipment, and I'll go over this a little bit more  
18 in a minute. And there's three other areas that  
19 Perchlorate is used, and it's in the manufacturing of  
20 explosives, psychotechnics, and fireworks as well.

21 When these propellants sit around very  
22 long, they go beyond their reliability time, their  
23 shelf life; they're no longer reliable, and so they  
24 have to be replaced, and as was the case in McGregor,  
25 the Naval Weapons Industrial Reserve Plant near

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1 McGregor, they still use a high-pressure washout  
2 procedure to get those propellants out of there. And  
3 through the various means of disposal that was accepted  
4 and considered acceptable at the time, the Perchlorate  
5 was allowed to impact the soils and waterways that were  
6 near these cleanout facilities.

7 A little more on the kind of general  
8 nature of Perchlorate: As I said earlier, it's the  
9 primary ingredient in solid rocket propellant. Large  
10 supplies of Perchlorate have been disposed of at  
11 ammunition facilities across the country. Here's a  
12 little depiction of a Perchlorate molecule. The little  
13 red circles indicate the amount of the four oxygens  
14 that are around this chlorine atom. It dissolves  
15 easily in water, which is one of the issues why it  
16 actually ends up in the ground water and the surface  
17 water, and it's transported through those mediums.

18 Just a bit on the health issue: It's  
19 known to interfere with iodide uptake in the thyroid  
20 and it could disrupt the production of the thyroid  
21 hormones. Why is Perchlorate a concern in this region?

22 well, we have a known source of Perchlorate at the  
23 NWIRP site near McGregor with documented migration of  
24 Perchlorate beyond the NWIRP boundaries where it was  
25 detected in the streams and the ground water, and these

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1 streams and ground water flow ultimately to Lake Belton  
2 on the west side and Lake Waco on the east side, and as  
3 I said earlier, Lake Belton and Lake Waco serve as  
4 public water supplies for about half a million people.

5 This is a map that we've shown a number  
6 of times throughout this study, but it really gives a  
7 good overview or orientation of where the site is  
8 located relative to Lake Waco and Waco and Lake Belton  
9 and the Temple, Killeen, Fort Hood area down here. The  
10 white little rectangle-looking box, that represents the  
11 Naval Weapons Industrial Reserve Plant. It was  
12 originally about 9700 acres. There's McGregor just to  
13 the northeast of that. Why we have the effect of Lake  
14 Belton and Lake Waco is they actually have a watershed  
15 divide that transects that property. Everything on  
16 this side of the property drains toward South Bosque,  
17 Harris Creek, and then to Lake Waco, and everything on  
18 this side over here drains through Station Creek, the  
19 Leon River, and then on into Lake Belton.

20 We thought it was really important that  
21 we state what our project goal was, so it's clear what  
22 other goal was and what it was not. The goal was to  
23 evaluate the potential human and environmental exposure  
24 to Perchlorate in the Lakes Waco and Belton study area.  
25 It was not the goal or the intent of the project to

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1 determine the concentration of Perchlorate that would  
2 be considered protective of human health or the  
3 environment. That's going to be a role of the federal  
4 and state regulatory folks.

5 Our presentation tonight is just a real  
6 brief summary of the amount of work that actually went  
7 into this project. We've got a web site that's  
8 developed that has all the details and everything that  
9 has been done since the start. That's our last slide.  
10 I'll show you that web site and encourage you to go  
11 there if you have further questions that we don't  
12 answer for you or if you come up with something that  
13 you're curious about later on down the road.

14 Now I'll turn it over to Dave Ebersold,  
15 vice president of MWH. Thanks.

16 MR. EBERSOLD: Thank you, Kyle.

17 Good Evening. Kyle said the point of  
18 the study was to look at human and environmental  
19 exposure from Perchlorate, and I wanted to talk a  
20 little bit about what exposure is. There's four --  
21 when we talk about a study like this, there's four  
22 components to exposure. The first is, there needs to  
23 be a source; the second is, there needs to be a  
24 receiving or transport medium, such as water or air;  
25 the third is, there needs to be a point of contact with

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1 a receptor, a plant needs to be where the Perchlorate  
2 is or a person needs to be where it is; and the last  
3 is, there needs to be a route of exposure, some way for  
4 that receptor to take in that Perchlorate, with people,  
5 that's either through skin contact or inhalation or  
6 ingestion, so, specifically, we started off the study

7 knowing that NWIRP McGregor was a source of Perchlorate  
8 and the other potential source that we evaluated was  
9 Fort Hood, and so there was some limited sampling done  
10 on Cowhouse Creek right before it enters Lake Belton,  
11 and no Perchlorate was detected in that sampling.

12 The receiving -- the receiving --  
13 there's different receiving media or transport media --  
14 water, soil, air, sediment, food -- and those things  
15 can be affected directly by Perchlorate or, as in the  
16 case of water, for example, they can also help in the  
17 migration of Perchlorate and take it further than it  
18 would otherwise go.

19 Then looking at exposure points, places  
20 where people come in contact with Perchlorate, and then  
21 how do they get it in. This is looking at the same  
22 thing in a cartoon style with streams coming down off  
23 of NWIRP McGregor. Here's a -- you know, there's  
24 houses located in proximity to those streams. People  
25 might use that water in the streams for gardening or

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1 stock ponds for cattle. There's also wildlife that may  
2 be supposed along the streams, including fish and birds  
3 and frogs. There's also the potential for uptake by  
4 plants, and then eventually this water flows into  
5 either Lake Belton or Lake Waco where there's a number  
6 of drinking water intakes and then it gets served out  
7 to the population as a drinking water source.

8 So, we looked at -- we started off the  
9 study by collecting all the data that were available  
10 from a whole multitude of sources and asking the  
11 questions, what additional things are there that we  
12 need to evaluate to be able to address the issue of  
13 whether or not there is exposure to these different  
14 groups of receptors, so we designed a number of field  
15 studies that looked at different exposure root  
16 elements, and this is a summary of those studies.

17 I want to talk about a few of them  
18 individually, the first being stream sampling and  
19 ground water and surface water interactions. To look  
20 at that, we installed 15 surface water monitoring  
21 stations throughout the watersheds, collected over 2800  
22 samples for analysis for Perchlorate, including samples  
23 during times when there was high runoff to determine if  
24 there was an increase in Perchlorate concentrations  
25 with higher runoff. We also looked at stream levels

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1 and how those levels changed over time and the  
2 interaction of the stream levels with the shallow  
3 ground water system. We looked at that by installing  
4 ground water monitoring wells at most of these sites.

5 We did a lot of work in the lakes, in  
6 particular Lake Belton, and one of the main issues  
7 associated with that -- with Lake Belton was whether or  
8 not there was preferential flow in the lake, and by  
9 that, we were looking at the issue of whether or not  
10 water flowing in from the Leon River gets mixed up and,  
11 thus, Perchlorate gets deluded when it enters the lake  
12 or whether that water sort of stays intact and flows  
13 preferentially through the lake, so to look at that, we  
14 used some technology called Acoustic Doppler Current  
15 Profiling and had a number of transects across the lake  
16 where we looked at the currents. We found that there  
17 isn't preferential flow through the lake and that the

18 water is pretty well mixed. We also did a lot of  
19 Perchlorate sampling along these transects and we  
20 didn't detect any in the Lake Belton samples.

21 MS. UNDERWOOD: None?

22 MR. EBERSOLD: None.

23 And these are some photos of the  
24 Accoustic Doppler Equipment. Basically, it's towed  
25 across the lake in a straight line and then we record

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1 the coordinates of those transects so we can go back to  
2 the same place each time.

3 we also did -- the Navy had been  
4 sampling the raw water, or drinking water, intakes that  
5 are present on the lakes all the way up until December  
6 of 2002. At that time, since they were discontinuing  
7 that sampling and our field work was still ongoing, we  
8 picked up that sampling and continued it until the end  
9 of our field work, and we did not detect any  
10 Perchlorate in any of the drinking water intakes off of  
11 the lakes.

12 These are some photos of the different  
13 intakes.

14 we did additional work in the lakes  
15 looking at what are called the delta areas, and these  
16 are the areas where the main rivers flow in; this is  
17 the first place where the streams meet the lakes, and  
18 we looked at a number of different things there. In  
19 Lake Waco, this shows the different monitoring points  
20 that we had, and we looked at water quality, looking  
21 specifically for Perchlorate, and we also took samples  
22 of the pore water down in the sediment. The reason we  
23 did that is previous work in the streams had shown that  
24 Perchlorate can accumulate down in that pore space in  
25 the sediment and we wanted to see if that was happening

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1 in the delta areas and if that could act as a future  
2 source of Perchlorate, and we did not find any  
3 Perchlorate in the water samples taken here nor did we  
4 find any in the soil pore water.

5 we attempted a number of times to  
6 collect algae samples from the delta areas so that we  
7 could see if algae was uptaking Perchlorate out of  
8 these areas, and there wasn't enough algae present in  
9 any of the times we tried to be able to do those  
10 analyses. This figure shows the same thing for Lake  
11 Belton, and the dotted line here are what the actual  
12 area of the water body was at the time of the sampling.  
13 It wasn't quite as big as is shown in this photo.

14 MS. UNDERWOOD: The results were also  
15 negative?

16 MR. EBERSOLD: Also negative.

17 And these are some photos showing the  
18 soil pore water sampling, insulation, and some of the  
19 equipment used. One of the things that's known about  
20 Perchlorate, in fact, it's a technique that's used to  
21 clean up or remediate Perchlorate, is that in  
22 conditions without oxygen, Perchlorate can be broken  
23 down into innocuous components, and so knowing that  
24 there's an anoxic zone at the bottom of Lake Belton, a  
25 zone without any oxygen, one of the important things

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1 was to determine if Perchlorate naturally would be  
2 degraded in this anoxic zone within Lake Belton, so we

3 did a study where we took samples of the sediment from  
4 the bottom of the lake in the anoxic zone and we also  
5 took water samples from the anoxic zone and we added  
6 Perchlorate to those samples in the laboratory and then  
7 studied those samples to determine if Perchlorate  
8 degraded over time, and, in fact, we were able to  
9 document that Perchlorate does naturally degrade in the  
10 anoxic zone of Lake Belton. We also did, as part of  
11 the study, an extensive amount of vegetation sampling,  
12 animal sampling, laboratory studies, modeling, and also  
13 looked at some food supplies. This is a photo of some  
14 fishnetting in one of the streams.

15 The general findings, NWIRP McGregor is  
16 considered a source of Perchlorate in the study area,  
17 and there was no evidence that Fort Hood is a source of  
18 Perchlorate to Lake Belton based on the limited  
19 sampling at that single point. We did a number of  
20 studies to determine if exposure pathways were  
21 complete, and we looked at both human and ecological  
22 receptors. Ingestion, taking in Perchlorate through  
23 the mouth, appears to be the only viable exposure route  
24 for Perchlorate with humans, and complete exposure  
25 pathways do exist for both human and ecological

0014 1 receptors.

2 Looking specifically at human receptors,  
3 looking at land use patterns and different types of  
4 activities that people are involved in the study area,  
5 we divided that whole group of humans into six  
6 different categories. The first is people who use the  
7 public water supply; the second is residential users of  
8 local surface water or ground water, people who might  
9 not be connected to the public water supply; third is  
10 commercial and industrial worker in the study area, but  
11 excluding people who worked on NWIRP because they are  
12 addressed through very specific health and safety plans  
13 developed by the Navy and their contractors; fourth,  
14 workers; fifth, recreational users, like fishers,  
15 hunters, swimmers, people who might collect wild greens  
16 along some of streams; and lastly, NWIRP vicinity  
17 residents, people who live near the facility,  
18 particularly along the streams that drain from NWIRP.

19 For these six different groups, we  
20 looked to see if each of the four elements of exposure  
21 were present -- the source, the medium, the exposure  
22 point, and then an exposure route -- and for humans,  
23 again, the only viable exposure route is ingestion.  
24 For each of the six groups, we found that public water  
25 supply users do not have a complete exposure pathway

0015 1 for Perchlorate, so they're not exposed. Local users  
2 of surface water or ground water may be exposed.  
3 Commercial and industrial workers do not appear to be  
4 exposed. Agricultural workers technically have the  
5 ability to be exposed through Perchlorate that might be  
6 in dust where there's soil contamination, and while  
7 that's technically a complete pathway, we consider the  
8 probability of that to be pretty remote, so that's why  
9 it gets a different color. And the pathways are  
10 considered complete for both recreational users and  
11 NWIRP vicinity residents.

12 So, in summary, there's no exposure to  
13 Perchlorate through the public water supply and also

14 through the consumption of beef. Dr. Anderson will  
15 talk more about that in a little bit. There is  
16 potential exposure through the consumption of garden  
17 produce irrigated with stream water that would have  
18 Perchlorate in it, through the consumption of wild  
19 vegetation along the streams that are impacted by  
20 Perchlorate, through consumption of fish caught in the  
21 area, and through the ingestion of stream water while  
22 swimming. The maps that we have to each site show the  
23 locations of streams where there are Perchlorate  
24 deductions, and these maps are also on the web site and  
25 also in our report.

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1 With that, I'll turn it over to  
2 Dr. Anderson.  
3 DR. ANDERSON: Thank you.  
4 Tonight I'm representing a team of  
5 people at Texas Tech that contributed to the project.  
6 Andrew Jackson, who is a civil engineer, did a lot of  
7 the plant and sediment work; Phil Smith and Scott  
8 McMurray are terrestrial toxicologists who did the  
9 small mammal, medium mammal, large mammal, and bird  
10 work; and Jim Carr, who's a frog person; and Chris  
11 Gaterack [phonetic] is a fish person; those were the  
12 individuals that worked on the aquatic portion of the  
13 study. And Ken Dixon, who is an ecological modeler,  
14 integrated a lot of the data that we collected related  
15 to ecological exposure.  
16 We examined both aquatic and terrestrial  
17 receptor groups, and we did those studies both in the  
18 field and in the laboratory. We had been working on  
19 Perchlorate for about two years prior to the beginning  
20 of this study, so there was a lot of data that could be  
21 brought to bear on addressing some of the gaps in  
22 looking at ecological exposure to Perchlorate. The  
23 context of the work that we did was to evaluate whether  
24 or not the animals were healthy or were they being  
25 exposed to Perchlorate within the watershed, and that

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1 was our primary interest and our main focus, but those  
2 animals, or those ecological receptors, are sometimes  
3 used as food sources for, I guess, higher organism, and  
4 so a part of the context of our assessment was to look  
5 at the potential for human exposure through these  
6 ecological receptors.  
7 Beginning with plants, plants near  
8 Perchlorate-contaminated streams take up Perchlorate.  
9 Perchlorate is very water soluble, and if a plant is  
10 using water, Perchlorate is going to be taken up into  
11 the plant. We looked at both aquatic vegetation and  
12 terrestrial vegetation. Some of the key finding  
13 related to aquatic vegetation were that you could make  
14 a pretty good relationship between the concentrations  
15 of Perchlorate in the water and the concentrations of  
16 Perchlorate in the vegetation growing in the water;  
17 they seem to exist in pseudo equilibrium. So, it turns  
18 out that that's probably a better way to characterize  
19 exposure to Perchlorate because the concentrations of  
20 Perchlorate in the vegetation tend to lag the  
21 concentrations of Perchlorate in the water, so if the  
22 flowing water -- the Perchlorate in the flowing water  
23 decreases, it takes a little bit longer for Perchlorate  
24 to get out of the plant and into the water, so you

25 can -- there were times where you could go to a stream  
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1 and not find Perchlorate, but there would still be  
2 Perchlorate in that particular environment because the  
3 vegetation that was there would have perchlorate in it.  
4 Terrestrial plants, we also looked at  
5 relationships between levels of Perchlorate in the  
6 water in various locations and levels of Perchlorate in  
7 terrestrial plants. It's much more difficult to make  
8 relationships between those two, but one of  
9 relationships that we did establish was that the  
10 distance that a plant is away from the stream was a  
11 good predictor in determining whether there would be  
12 Perchlorate in the vegetation, so plants that were  
13 further away from a stream tended to be less  
14 contaminated than plants that were closer to a stream.

15 Another interesting finding related to  
16 terrestrial plants is that, while Perchlorate can be  
17 readily taken up into the plant and into the leaves,  
18 once those leaves fall to the ground in the fall of the  
19 year, that Perchlorate is then released back into the  
20 environment, so even though there's some removal of  
21 Perchlorate from the water, the sediment, or the soil  
22 by these plants, very few plant species are able to  
23 metabolize Perchlorate to chloride, so when the leaves  
24 fall, there's Perchlorate that gets re-released back  
25 into the environment.

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1 Our findings related to fish were that  
2 Perchlorate was detected very sporadically in fish. We  
3 did find it in some fish. It tended to be found more  
4 in small insectivorous fish as opposed to larger fish.  
5 I'd say 90 percent -- or, more than 90 percent of the  
6 detections that we observed in fish were in fish that  
7 would not be of legal size, less than about  
8 eight inches or 12 inches, so most of the fish -- most  
9 of the detections were in small insectivorous fish.  
10 When we did detect it, the concentrations were higher  
11 than the surrounding water, so that would suggest,  
12 based on some of our laboratory data, that the fish get  
13 Perchlorate, not just from ingestion of water, but  
14 through some food source, probably algae or maybe some  
15 aquatic insects.

16 We did find it in different tissues. We  
17 found it in the head of various fish species when we  
18 did have detections. Fish don't have a thyroid gland;  
19 they have a dispersed thyroid. They have thyroid  
20 follicles throughout the head, so it's logical that you  
21 would find Perchlorate at least in some cases in the  
22 head of these fish, and that's also supported by a lot  
23 of the laboratory data that we collected. We also did  
24 find it in fillets, and we found it in fillets -- in  
25 some cases, we found it in fillets of legal-sized fish.

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1 Most of those fish were not necessarily desirable game  
2 fish, in a lot of cases, fish that aren't necessarily  
3 fish that would be desirable as far as consumption  
4 goes.

5 We collected fish from contaminated  
6 streams and looked at their thyroid histology, looked  
7 at the thyroid follicles, and there was an impact from  
8 Perchlorate, and the reason that we're concluding that  
9 it's from Perchlorate is because of sort of a

10 weight-of-evidence approach. There are other  
11 contaminants that could affect the thyroid, but because  
12 there was -- there were changes in thyroid histology  
13 and those changes were related to the amount of  
14 Perchlorate that was in the contaminated water, we  
15 concluded that those changes were produced by  
16 Perchlorate and not from some other environmental  
17 contaminant. But the relationship between, you know,  
18 an impact on the thyroid histology and a population  
19 level end point, like the numbers of fish, that  
20 relationship is not very clear. We didn't have  
21 problems shocking fish. There were plenty of fish  
22 available in most of the streams to look at, so it  
23 didn't appear that the population was affected by that  
24 impact on thyroid histology.

25 we looked at both native and  
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1 laboratory-reared frogs and we looked at -- we looked  
2 at those end points in laboratory studies and in the  
3 field. We did conclude that native frogs were affected  
4 by Perchlorate; although, you need to put that effect  
5 in context. There were an increase in the thyroid  
6 follicle cell height, which suggested an impact from  
7 Perchlorate, but the colloid, the place where the -- in  
8 the thyroid follicle where the thyroid hormones are  
9 stored, that was not impacted, and so there's sort of a  
10 series of effects that occur with Perchlorate exposure,  
11 and certainly, one of those is a change in the thyroid  
12 histology and an increase in the size of the thyroid  
13 follicles, the thyroid follicle cells, and then a  
14 subsequent affect is a decrease in the colloid, but we  
15 didn't observe that in the frogs, the native frogs from  
16 the study streams that we tested.

17 In some cases we brought surface water  
18 back to the laboratory and tested it in these endocrine  
19 disruptor screening and testing assays, and in those  
20 cases with -- those were with nonnative frogs; they're  
21 with the standard laboratory frogs as used on these  
22 assays. There were no effects on thyroid function in  
23 those frogs. If you test the water from the site in  
24 these assays, the frogs go through metamorphosis just  
25 fine and all of those metamorphic steps are triggered

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1 by -- well, a significant portion of them are triggered  
2 by thyroid hormones, and the stages that we looked at  
3 were triggered by thyroid hormones. So the frogs are  
4 able to produce enough thyroid hormone to go through a  
5 metamorphosis.

6 In some of the more earlier studies, we  
7 noticed that high Perchlorate concentrations affected  
8 the gonads, the gonadal fenal type of frogs, the sex  
9 organs, the ovaries and intestines. We did not notice  
10 that in the studies that we did within the watershed.  
11 We looked at -- both in the laboratory and in the  
12 field, we looked at water from the site and then in the  
13 field assessments, we went out and collected native  
14 frogs, looked for changes in gonadal fenal type, there  
15 was no effect, so the concentrations -- while some of  
16 the streams are contaminated, the concentrations that  
17 are there are not high enough to elicit that type of  
18 information. There was one exception, somewhat of an  
19 exception to that, in that, water from S Creek affected  
20 the ratio of males to females. There were twice as

21 many female frogs in the S Creek sampling locations as  
22 male frogs, and normally that would -- might raise a  
23 red flag, but, statistically, that was not a  
24 significant effect, mainly because of the overall  
25 number of frogs that we examined was relatively low in

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1 that particular location, so no significant impact on  
2 frogs, at least with the population.  
3 Small mammals and birds, we collected a  
4 variety of small mammals and birds mainly from  
5 contaminated areas, streams that were contaminated, and  
6 we did find Perchlorate in some of the birds and some  
7 of the small mammals; it was usually in the kidneys and  
8 livers. Based on the concentrations that we observed,  
9 if you compare those levels to some studies that we did  
10 in the laboratory, the concentrations should have been  
11 high enough to alter thyroid function or thyroid  
12 histology, but we didn't observe that in any of the  
13 frenal collected animals, so there's some differences in  
14 sensitivity between some of these lab animals and some  
15 of the field animals. And the ecological relevance of  
16 having Perchlorate in your liver or kidney if you're a  
17 small mammal or a bird is also not very clear. In  
18 general, the small mammal and bird people complain  
19 about not being able to find that many animals, but  
20 that's probably a just function of the habitat more  
21 than any sort of Perchlorate effect. We did test some  
22 migratory birds that we sampled, no Perchlorate in any  
23 of the tissues that we examined, and those would be  
24 edible tissues.

25 One of the concepts in exposure is that

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1 the smaller an animal is, the larger it's surface to  
2 volume ratio. As an animal gets larger, its surface  
3 area increases, but its surfaces to volume ratio  
4 decreases, so small animals tend to have a much higher  
5 relative exposure than larger animals. The way that I  
6 learned this was, my advisor in graduate school told me  
7 that there's a reason we don't do toxicity tests with  
8 elephants. And I said, well, that would be really  
9 expensive and you couldn't house all of them. And she  
10 said, no, their surface to volume ratio is very small  
11 so they don't receive a significant exposure, so I  
12 didn't get ten bonus points on the test.

13 So one of the things we wanted to look  
14 at, if the smaller animals were exposed, we wanted to  
15 check bigger animals to see if we can see that same  
16 type of exposure. We looked at raccoons and possums  
17 that we tracked on contaminated streams and some  
18 reference areas, no Perchlorate in the plasma of these  
19 animals and no alterations in thyroid histology or no  
20 effect on thyroid hormones. If you compare the thyroid  
21 hormone levels in these animals that were caught on  
22 contaminated streams, they're essentially the same as  
23 the animals from reference areas.

24 We also looked at large mammals. We  
25 did a -- it's the equivalent of an enclosure study.

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1 Basically, we had an environment where we had -- didn't  
2 have control, but we knew what the exposure levels were  
3 in the water, so we put two animals, two cows, on this  
4 area and two cows on reference areas and we looked at  
5 their Perchlorate exposure over a 14-week period. We

6 sampled these animals every two weeks. We collected  
7 blood for residue analysis and for thyroid hormone  
8 analysis. In the exposed animals, there were two  
9 Perchlorate detections in the same animal on  
10 consecutive weeks about midway through the 14-week  
11 experiment, so we detected Perchlorate two times. The  
12 detection limit in blood plasma is about 11 parts per  
13 billion, so not as good as water but sensitive enough  
14 to detect Perchlorate if it was there.

15 The thyroid hormones in these animals  
16 were normal compared to -- if you compared their  
17 thyroid hormones to reference animals, no changes in  
18 thyroid hormones. And then at the conclusion of the  
19 study, these animals were processed like a  
20 commercial -- using a commercial beef operation, and we  
21 tested various cuts of meat and also livers and the  
22 thyroid in these animals, and there was no Perchlorate  
23 in any of those tissues. So, although small animals  
24 tend to be exposed, as the animals get bigger, there's  
25 no indication that there's a significant exposure, and

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1 certainly, the pathway, then, to humans doesn't exist  
2 or is incomplete with regard to consumption of beef.

3 Thank you.

4 MR. ELLIOTT: Good evening. I'M Wayne  
5 Elliott, project manager with the Corp of Engineers.  
6 The Corp's role in this whole thing was primarily as a  
7 coordinator for the efforts of everybody else. We got  
8 the money from Congress; we paid the money to those  
9 guys and mostly watched them work. I want to give you  
10 just a -- you've heard all the details that they've  
11 given you about their studies, I just wanted to go over  
12 briefly the overview of the whole study process and  
13 what we did.

14 The first thing, we began this project  
15 in about February of 2000. The team got together  
16 several different times, laid out a plan of how we were  
17 going to go about this, and then we got down to work.  
18 The first thing we did was develop a community  
19 relations plan trying to figure out how we were going  
20 to communicate or progress and our information to the  
21 public. We scheduled public meetings on various  
22 occasions through the past four years and they also  
23 began compiling all the existing data that was  
24 available, much of it was from the Navy, but also some  
25 from local water districts and local cities and

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1 governments and so forth.

2 Looking at that information, they  
3 discovered -- they found where they had data gaps,  
4 where they needed more information, and then put  
5 together a plan to obtain that information through  
6 field sampling and testing. Once all the data was  
7 gathered together and they began to evaluate it, the --  
8 again, the study purpose was to evaluate the potential  
9 for exposure to both human and environment exposure to  
10 see if these exposure pathways were complete, as David  
11 mentioned earlier.

12 Again, you've heard all the details of  
13 what everyone has said, so in conclusion, we find that  
14 there is no exposure to Perchlorate through the public  
15 water supply. Although, there is some potential for  
16 exposure through fish and vegetation along the streams

17 or swimming in the streams, that exposure is very  
18 unlikely; it's remote. As David said, these two maps  
19 upfront show the areas that have had detections of  
20 Perchlorate in the streams. They're color-coded and  
21 you can look at them later. We've also found that  
22 plants in these areas do uptake Perchlorate, and  
23 although small animals and fish are exposed, medium and  
24 larger animals show no evidence of exposure  
25 Just in general, the project was

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1 completed on time, and although it had an initial  
2 budget of \$8 million, we accomplished all we set out to  
3 accomplish for about \$5.5 million. Hopefully these  
4 results will be used by other agencies, regulatory  
5 agencies, state EPA to help develop regulatory levels,  
6 action levels for Perchlorate. The web site that we  
7 mentioned earlier is there. Actually, you can go to  
8 just the part ending in Army.mil, and that's the Fort  
9 Worth home page and then just go from link to link to  
10 get into the report, and you can look at the rest of  
11 our web site if you'd like.

12 But everything -- as we said, all our  
13 study plans and meeting minute notes and public meeting  
14 notes, everything we've developed over the course of  
15 the study is there, and I believe someone has given you  
16 a copy of the final report on a CD, and that's also  
17 there but it takes forever to download.

18 Anyway, that's it. I open up to  
19 questions at this point. If you have any questions,  
20 hopefully we can have somebody answer them.

21 UNIDENTIFIED SPEAKER: Where did you  
22 find the person to test the water from their gardens?

23 MR. HEADLEY: There was at least one  
24 individual on Harris creek that was pulling water out  
25 of Harris Creek.

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1 UNIDENTIFIED SPEAKER: Do you recall  
2 where on Harris Creek?

3 MR. HEADLEY: Yes. Right where the  
4 sampling station was on Val Verde, just to the McGregor  
5 side of Val Verde. There is also -- at South Bosque  
6 and Indian Trail a guy that lived there, his garden was  
7 well water, river water. I know those because when we  
8 did the market basket, quote, market basket survey, we  
9 attempted to locate people along the streams using the  
10 water.

11 UNIDENTIFIED SPEAKER: So you identified  
12 those, too. Did you go in -- did they allow you to  
13 sample their garden?

14 MR. HEADLEY: Yeah, we took actual  
15 vegetables, I think okra, potatoes. It was at the fall  
16 of the year so the quality of the sampling was not  
17 great, but we collected actual samples from the  
18 gardens. We also collected water.

19 UNIDENTIFIED SPEAKER: Did you detect  
20 Perchlorate in some or all of those?

21 MR. HEADLEY: Not all of them, but I  
22 don't remember all the details. There's a table in the  
23 report that has that data plus some other data from  
24 west Texas and some other areas where we have access to  
25 irrigation water and then crops that were irrigated

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1 with that water.

2 MS. UNDERWOOD: I think you talked about  
3 documenting Perchlorate going through a natural  
4 degradation in Lake Belton. What does it become when  
5 it degrades and is that a toxic problem?

6 MR. HEADLEY: It turns into nothing  
7 that's toxic. It just breaks down into oxygen.

8 MS. UNDERWOOD: Does that change the  
9 level where there's no oxygen in the lake?

10 MR. EBERSOLD: I don't know that anyone  
11 has looked at that.

12 MS. UNDERWOOD: I just asked.

13 MR. EBERSOLD: And that's -- we  
14 documented that that process is possible. We didn't --  
15 in other words, since we didn't find any Perchlorate in  
16 the lakes, we couldn't document whether it was or  
17 wasn't actually happening in the lake so we took  
18 samples from the zone where it would be expected to  
19 happen and then added Perchlorate to those samples and  
20 then observed it that way.

21 The report also has some graphs from  
22 some of the streams that show the same type of thing.  
23 They have the depth and the levels of Perchlorate and  
24 you can see that it's there, it's there, and it's  
25 there, and then when you get further down to the

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1 sediment, then it goes away, so it degrades, but you  
2 have to get rid of some of the nitrate system because  
3 the organisms that are there, we'd much rather utilize  
4 the nitrate than take on the Perchlorate. If you  
5 follow how nitrate disappears with depth in the  
6 sediment, it parallels with Perchlorate. The nitrate  
7 goes away and then the Perchlorate starts to flow.

8 MS. UNDERWOOD: So, in summary, one  
9 sentence or message to the public.

10 MR. ELLIOTT: There's no Perchlorate in  
11 the drinking water.

12 MS. UNDERWOOD: And you came in under  
13 budget, that's good, too.

14 MR. ELLIOTT: Anymore questions?  
15 Okay.

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1 REPORTER'S CERTIFICATION

2  
3 STATE OF TEXAS )  
4 COUNTY OF TRAVIS )

5  
6 I, KIMBERLYE A. FURR, Certified Shorthand  
7 Reporter for the State of Texas, do hereby certify that  
8 the above-captioned matter came on for hearing before  
9 the U.S. ARMY CORPS OF ENGINEERS as hereinafter set  
10 out, that I did, in shorthand, report said proceedings,  
11 and that the above and foregoing typewritten pages  
12 contain a full, true, and correct computer-aided

13 transcription of my shorthand notes taken on said  
14 occasion.

15  
16 witness my hand on this the 26th day of  
17 April, 2004.

18  
19  
20

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