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

APRIL 6, 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 6th 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 A.J.
23 Moore Academy Lecture Hall, 500 North University Parks
24 Drive, Waco, Texas, whereupon the following proceedings
25 were had:

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MR. HEADLEY: I'd like to welcome everybody tonight. This is our final set of public meetings. We will be presenting the results and the findings of the Bosque and Leon Rivers Perchlorate study. My name is Kyle Headley. I'm an environmental planner for the Brazos River Authority and a member of the Perchlorate study team. This is our planned agenda for tonight: I'll go over some introductory materials. Dave Ebersold with MWH will do the exposure concepts, human exposure. Dr. Anderson with the Texas Institute of Environmental Human Health will do the ecological exposure. Wayne Elliott with the Corp of Engineers will summarize the findings of the project.

We'd like for you to hold your questions until the end of the presentation, if possible, and if you have a cell phone, if you would switch it to silent or vibrate, we would appreciate that.

This slide lists the project study team members and their roles in the project. As I go through this slide, if I could get the members of those particular organizations to raise their hands and I'll recognize those guys so you can see who all is here. The U.S. Army Corp of Engineers, their role was project management and technical support. We have Wayne Elliott and Clay Church up in the back from the Corp.

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The Texas Commission on Environmental Quality, we've got Kip Haney over here of the toxicology group. I believe he's the only one here tonight. Their role was an advisory to the study team and liaison with the interagency Perchlorate steering committee. The Brazos River Authority, their role was technical the services and coordination, and I'm the only representative here tonight. The Institute of Environmental and Human Health at Texas Tech University, we have Dr. Todd Anderson with us tonight. Their role is toxicological

11 and ecological studies. From MWH, their role was the
12 watershed and hydrology and ecological studies, fate
13 and transport, conceptual modeling, exposure to
14 sediment. We have David Ebersold, Kartik Gandhi, and
15 Kathy Greenly. From the U.S. EPA, whose role was
16 advisory to the study team and regulatory liaison, we
17 have Bob Sturdiman, Cheryl Overstreet. And last but
18 not least, our stakeholder consortium, who was an
19 advisory to the team and community interface. This is
20 a listing of the stakeholders that were involved. They
21 make up the groups that get their water from Lake Waco
22 and Lake Belton, and they supply the drinking water to
23 approximately 500,000 Central Texans. Before we go
24 much further, we need to recognize the support of our
25 elected officials, that would be Congressman Edwards

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1 and Senator Kay Bailey Hutchinson who were instrumental
2 in securing the funding for this project.

3 Okay. We're going to do a little bit of
4 an overview of what Perchlorate is and why it's become
5 a local issue. Perchlorate is the primary oxidizer in
6 all solid propellents. It's used in our strategic
7 national defense, space shuttles, and satellites.
8 Without the oxygen that's supplied by the Perchlorate,
9 the reactions wouldn't occur that provide the thrust
10 and propulsion for the equipment, and I'll go over this
11 a little more detail later. I need to also point out
12 that Perchlorate is used in making various explosives,
13 pyrotechnics, fireworks. When a propellant sits around
14 too long, it's called a shelf life, they become no
15 longer reliable to perform their function, so they need
16 to be really cleaned out and replaced. And that was
17 the case at the Naval Weapons Industrial Reserve Plant
18 over in McGregor. It was a common practice to use
19 high-pressure water to clean those devices out, and
20 that kind of -- through the various means of disposal
21 that were considered acceptable through the years,
22 Perchlorate was allowed to impact the area soils and
23 water wells.

24 Okay. A little bit more on the
25 background of Perchlorate. Again, it's the primary

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1 ingredient in solid rocket propellents. A large supply
2 of Perchlorate is disposed of at ammunition facilities
3 across the country. This just shows little depiction
4 of the Perchlorate itself. You can see the red circles
5 indicate oxygen that surrounds the chlorine molecule,
6 that's where it supplies the oxygen for the reactions.
7 It dissolves easily in water and it's transported
8 through ground water and surface water.

9 Just a little bit on what it may do. It
10 can interfere with iodide uptake in the thyroid and may
11 disrupt production of thyroid hormones. So why is it a
12 concern for this region? We've got a known source at
13 the Naval Weapons Industrial Reserve Plant, NWIRP,
14 McGregor. We had documented migration beyond the NWIRP
15 boundaries detected in streams and ground water. These
16 streams and ground water flows into Lake Belton and
17 Lake Waco, and as I stated previously, these lakes
18 serve as public drinking water supplies for about half
19 a million people in Central Texas.

20 This map has been around, I guess, for a
21 long time, but it really gives a good orientation or

22 overview of where we're at in location within Central
23 Texas. The little white area in the middle, that's the
24 NWIRP site, the Naval Weapons Industrial Reserve Plant
25 site. It's located just to the south side of McGregor

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1 right in here. This black line is actually the
2 watershed boundary line, where everything from the site
3 that drains to the east goes through the south from
4 Bosque and Harris Creek and flows into Lake Waco.
5 Everything in this lower corner that drains south and
6 west goes through the station Creek, Leon River
7 watershed area down into Lake Belton.

8 This slide states our project goal. We
9 felt it was important to define what our project goal
10 was and what it was not, so I'm just going to read the
11 goal. To evaluate the potential human and
12 environmental exposure to Perchlorate in the Lakes Waco
13 and Belton study area. It was not the intent of the
14 study to project or determine the concentration that
15 would be considered protective of human health or the
16 environment. That was not the charge of this project.
17 Those kinds of regulatory determinations are made by
18 regulatory agencies, state and federal agencies.

19 Now, I'd like to turn it over to Dave
20 Ebersold.

21 MR. EBERSOLD: Good evening. As Kyle
22 said, the main goal of the project was to look at
23 exposure, ecological and human exposure, to
24 Perchlorate, and so I think before we talk about
25 exposure, we need to be clear about what it means when

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1 we say exposure because that could mean different
2 things to different people.

3 In this setting, what we're talking
4 about is traditional concepts of exposure, and there's
5 four components to that. The first is, there needs to
6 be a source; next, there needs to be a receiving or
7 transport medium; third, there needs to be a point of
8 exposure; and fourth, there needs to be an exposure
9 route. That's great. What does it all mean? For this
10 project, the exposure sources are known sources at
11 NWIRP McGregor and then a portion of the project also
12 evaluated whether Fort Hood was a source of Perchlorate
13 to Lake Belton.

14 When we talk about receiving or
15 transport medium, basically the issue there is, okay,
16 Perchlorate, now what does it get into? Does it get
17 into the water or air or soil? Some of these things
18 can, not only be impacted by Perchlorate, but can also
19 cause Perchlorate to migrate, so once Perchlorate gets
20 into a stream, then that stream can carry Perchlorate
21 further than it otherwise might have gone.

22 Exposure point is where something living
23 comes in contact with that water or soil or air, so
24 where out in the watershed does that point of contact
25 happen? And then lastly, how does that living thing

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1 get effected? What route does it -- is it through
2 dermal contact, contact through the skin, or inhalation
3 through the nose or ingestion through the mouth? So
4 those are the four major components of exposure.

5 I mentioned that we looked at Fort Hood
6 as a potential source; it was a pretty limited look,

7 and we looked at the lower end of Cowhouse Creek right
8 before it comes into Lake Belton. We did repeated
9 sampling of that location, didn't find any Perchlorate,
10 so based on that limited data set, it doesn't look like
11 Fort Hood is a potential source for Perchlorate to Lake
12 Belton.

13 This is graphically showing a similar
14 thing. There's a series of streams coming off, and
15 what we did is look at, you know, Perchlorate in the
16 streams and then what, along the streams, can touch it.
17 Are there animals that drink out of the streams,
18 plants, birds, fish, vegetation along the streams? The
19 idea that, well, maybe some people collect some of that
20 vegetation; some of those streams might be used for
21 stock pond watering, and then as the streams come down
22 into the lakes, people swim there. There's drinking
23 water coming off of those lakes that are used to
24 provide water to the residents of the area. So this is
25 just a conceptual idea of that last slide.

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1 well, to get at what the exposure is or
2 isn't in this area, we designed a number of field
3 studies to look specifically at different exposure
4 pathways, so you see the different components of the
5 exposure path, the source medium, the exposure point,
6 the route, and what the different studies did in the
7 process of evaluating those things. The source work,
8 since we knew that NWIRP was the major source in the
9 area, we didn't do a lot of work to look further at
10 that. That's a known thing, and the Navy is dealing
11 with it. We didn't need to duplicate those efforts.
12 We did, as I mentioned, look at Fort Hood, so that's
13 the meaning of that "X" right there.

14 In terms of exposure routes, previous
15 work out there at the scientific body indicates that
16 dermal exposure, touching the skin, and inhalation of
17 Perchlorate aren't big deals with regard to humans and
18 ecological receptors, but ingestion is the main one.
19 The exception to that is with some ecological
20 receptors, and Dr. Anderson will talk about this later,
21 in particular, fish. We found that there are a number
22 of different exposure routes for fish, and that became
23 evident as a result of the study.

24 I want to talk about a couple of
25 different project components. The first one is the

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1 stream sampling and also look at the ground water and
2 surface water roles, so to look at those things, we
3 installed 15 different stream sampling locations -- or,
4 15 different stream stations at different locations,
5 and this is a diagram of a typical stream sampler.
6 It's an automated sampler and it allows us to take
7 water samples out of the stream at predetermined times.
8 It also allowed us to take water samples after rainfall
9 events, so when water flows through the streams,
10 samples were automatically collected so that we could
11 look at how the Perchlorate concentrations might change
12 from different periods of flow. The idea there was to
13 determine if rainfall increased the amount of
14 Perchlorate. So we looked at Perchlorate
15 concentrations. We looked at stream levels.

16 And then most of these stations also had
17 a monitoring well installed nearby so that we could

18 simultaneously look at the ground, what was happening
19 in the shallow ground water, and the interaction of the
20 shallow ground water with the stream systems. That was
21 important to look at whether or not streams were losing
22 water into the ground water system or whether the
23 ground water was contributing water to the streams. We
24 got some really good information on that. There's a
25 poster board over to the side that actually shows some

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1 of that.

2 Another component of the study is what
3 we call the ADCP study. ADCP stands for ACCoustic
4 Doppler Current Profiler. Fancy words, but what does
5 it mean? what we were looking for here is to determine
6 whether water coming into Lake Belton from the Leon
7 River whether it mixed up in the lake as it worked its
8 way through or whether it flowed down the old stream
9 channel that was there prior to damming of Lake Belton
10 or whether it had some other preferential pathway, so
11 to do that, we used this accoustic Doppler technology
12 and we measured the currents at a bunch of different
13 locations all across the lake all the way down, and in
14 addition to looking at current, we also got basic
15 information about the properties, the water
16 temperature, PH conductivities, and other properties,
17 and we also took Perchlorate samples at different
18 depths, so if we found an area that had a high flow of
19 velocity, we sampled that area to determine if there
20 was Perchlorate present. This is a picture of the ADCP
21 equipment. It's got a lot of instruments in it and it
22 gets towed by the boat across the lake and collects
23 data all along the way.

24 Intake sampling was another component of
25 the study. The Navy had been doing sampling of the

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1 different intakes on both Lake Waco and Lake Belton all
2 the way up until about December of 2002. Our study was
3 ongoing past that point, so we added those intakes to
4 our sampling protocols and continued that all the way
5 until the end of our field work. No Perchlorate was
6 ever detected in the intakes. We also did -- since the
7 lakes were such a big area of focus, we spent a lot of
8 effort looking at the delta areas of the lakes, and in
9 particular at sediment and pore water. Sediment and
10 pore water is that water that was trapped in the pore
11 state of the sediment. There's two ways to sample
12 sediment, one is to take a grab sample of it and look
13 at Perchlorate concentrations there and the other way
14 is to look specifically at the water in that sediment.
15 And what was found early on in the study is, in some of
16 the streams, Perchlorate was present in that sediment
17 and pore water and so we wanted to look down in the
18 delta areas to see if it was the case there. The
19 concern is, could that be a potential future source of
20 Perchlorate?

21 These are the delta areas for Lake Waco
22 and Lake Belton, and what we did is have a number of
23 sampling points all along the way here. We looked at
24 Perchlorate concentrations with depth and also the
25 sediment and pore water. As part of this, we also

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1 tried to collect algae samples in the delta areas to
2 see if algae was uptaking Perchlorate, and we tried

3 that several times but couldn't collect adequate
4 samples of algae to be able to analyze it. This has
5 the sampling locations for the delta area study over in
6 Lake Belton. The dotted lines are the boundaries of
7 the water at the time of the study. These are some
8 photos from that effort. This is a peeper that used to
9 collect sediment pore water samples.

10 There's an anoxic study in Lake Belton,
11 and it's pretty well known that under certain
12 conditions, anoxic conditions where there is anoxic
13 present, there could be biological degradation, and so
14 what we wanted to know is, can that happen in Lake
15 Belton. We designed the study specifically to look at
16 that where samples of sediment were taken from the
17 bottom of the lake. There were also water samples
18 taken from the anoxic zone, and the work was done to
19 determine if those samples -- if those samples were
20 spiked with Perchlorate, did reduction of Perchlorate
21 happen, and, in fact, we did document that, under
22 natural circumstances, at the bottom of Lake Belton,
23 you can have reduction of Perchlorate, and that's a
24 good thing. Another major component includes a lot of
25 vegetation sampling and looking at animals throughout

0014 1 the watershed and extensive laboratory studies on them.

2 So, in terms of general exposure pathway
3 findings, what did we find? Well, NWIRP McGregor is
4 considered a source of Perchlorate in the study area.
5 There's no evidence that Fort Hood is a source of
6 Perchlorate to Lake Belton. We used a number of
7 studies to determine if exposure pathways were complete
8 with different receptors, and we focussed on two main
9 groups, human receptors and ecological receptors.
10 Ingestion, taking in Perchlorate through the mouth,
11 appears to be the only viable exposure route for
12 Perchlorate in humans and complete exposure pathways do
13 exist for the humans ecological receptors, and we'll
14 talk more about those.

15 So looking at the human receptors, what
16 we did is determine six different routes or categories
17 of human receptors, and these are based on where people
18 live, land use pattern, and types of activities that
19 people partake in. The first group is the public water
20 supply user. These are people who use publicly
21 provided water, so if you're hooked up to the public
22 water system, you'd fall into this group. The next
23 group is residential users of local surface water or
24 ground water. If you get your drinking water from a
25 source other than the public supply, you would be in

0015 1 this group. Commercial and industrial workers, these
2 are people who work within the study area but outside
3 NWIRP. NWIRP site workers are addressed specifically
4 through very detailed health and safety plans.
5 Agricultural workers are people who do agricultural
6 work within the study area, farmers, ranchers, that
7 type of activity. Recreational users, fishers,
8 hunters, swimmers, people who might gather wild
9 vegetation, those types of activities. NWIRP vicinity
10 residents are people that live near NWIRP, particularly
11 along streams draining in the NWIRP area.

12 So for each of these different receptor
13 groups we looked to see whether or not an exposure

14 pathway was complete, and for public water supply
15 users, there is no complete pathway. There is a source
16 of Perchlorate and it does affect the water, but it's
17 never detected in Lake Belton, so there's no point of
18 exposure. For users of local surface water or shallow
19 low ground water, that exposure pathway would be
20 complete. For commercial and industrial workers, there
21 is no complete pathway. For agricultural workers,
22 there's a technically complete pathway. If there's an
23 area of soil and it has Perchlorate in it and that dust
24 is being churned up, there's a remote possibility that
25 there might be some ingestion. While it's technically

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1 complete, it's really not a significant issue, so
2 that's why it's shaded a different color. For
3 recreational users and NWIRP vicinity residents, we do
4 consider the exposure pathways to be complete.
5 So, in summary, there is no exposure
6 through the public water supply and through the
7 consumption of beef, and Dr. Anderson will talk
8 specifically about beef a little bit later. There is
9 potential exposure through the consumption of garden
10 produce irrigated with stream water, for example, or
11 through the consumption of wild vegetation along
12 streams or through consumption of fish caught in the
13 area, potentially ingestion of stream water while
14 swimming or recreating along the streams. However,
15 there isn't a potential for ingestion for exposure from
16 swimming or water skiing in the lakes. It's just in
17 areas where Perchlorate impacts those surface water
18 bodies, and there's some more detail on the maps.
19 There's a map here that shows those areas and the same
20 map is over there, if, afterwards, you want to look in
21 our report.

22 With that, I'm going to turn it over to
23 Dr. Anderson.

24 DR. ANDERSON: Thank you. I'd like to
25 start by acknowledging the team of people at Texas Tech

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1 who participated in the project. At these meetings,
2 it's always me typically that stands up here and
3 presents the information. I'm not sure why this is,
4 but there's a whole team of people at Texas Tech that
5 are involved in the project, and so I want to begin by
6 at least acknowledging them.

7 We have a couple of terrestrial
8 toxicology type folks, Scott McMurray and Phil Smith.
9 We have two aquatic toxicology type people, Chris
10 Gaterack, who's the fish guy, and Jim Carr, who's a
11 frog person. Ken Dixon is the last person; he's an
12 ecological model, so I'll begin by, it's on record, I
13 guess, too, that I've acknowledged them, and they
14 played a big role obviously in the completion of the
15 work.

16 We evaluated several different aquatic
17 and terrestrial receptor groups, and we did these
18 studies both in the laboratory and in the field, and
19 over the course of the project, even before the project
20 technically began, we had been doing studies on
21 Perchlorate both in the laboratory and in the field, at
22 the Longhorn Army Ammunition Plant, for example. We
23 had been doing several Perchlorate-related studies at
24 that facility, so a lot of the stuff, sort of the

25 preliminary kind of information, we had access to

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1 because we were doing these types of tests. We brought
2 that information to bear on some of the questions we
3 were trying to address in this particular study.

4 The context of the work that we did
5 was -- we are wildlife toxicologists, so the work that
6 we did focussed on evaluating whether the critters were
7 safe. We don't typically do human health kinds of --
8 you know, addressing human health kinds of toxicology
9 questions, but because some of the wildlife serve as
10 food sources for, I guess, higher organisms, we did
11 look at some of those types of human exposure, or
12 potential human exposure, questions. So in the context
13 of the work we did, we focussed mainly on ecological
14 kinds of receptors in a lot of the information we were
15 collecting. In some cases, we collected information
16 that we wouldn't necessarily collect, and the reason
17 for doing that is to evaluate the potential for human
18 health exposure.

19 Okay. I'll start with plants, and I'm
20 just going to briefly describe some of the highlights
21 of the work, and, hopefully, if you have questions and
22 I didn't cover something that you were really
23 interested in, you can catch me afterwards and I'd be
24 happy to talk about that in more detail.

25 Plants near Perchlorate-contaminated

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1 streams take up Perchlorate, that's a fact.
2 Perchlorate is very water soluble. Some of the
3 pathways in which it enters plants are shared with
4 nitrate, and plants like nitrate; they need nitrate,
5 and so if they're taking up water, they're going to
6 take up Perchlorate. If there's Perchlorate in that
7 water, the plants are going to take it up; there's no
8 denying that. In aquatic plants, Perchlorate seemed to
9 exist in like a pseudo equilibrium, in that, you can
10 make a really good relationship between the
11 concentration of Perchlorate in the water and the
12 concentration of Perchlorate in aquatic plants that are
13 also in the water. It's about a -- if I recall, it's
14 about a 50-fold concentration factor, so if there's --
15 you can make a really strong relationship between those
16 two, and we did that in a variety of studies.

17 The interesting thing is that the plant
18 changes in Perchlorate concentrations in water, so if
19 an aquatic plant is in a flowing water system and the
20 concentration of Perchlorate in the flowing water
21 decreases, it takes a little bit longer for the plant to
22 get rid of that Perchlorate, so we used that as a way
23 to make the argument that plants -- looking at plants
24 is maybe a better way to sort of characterize the
25 potential exposure. Because if you go out there and

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1 you don't detect it in water, that doesn't necessarily
2 mean that there isn't Perchlorate in that water system.
3 Because the plant concentrations lack those in the
4 water.

5 As far as terrestrial plants go, they're
6 much more variable in their Perchlorate levels, and
7 part of the reason is the environment in which they're
8 sitting in. The soil or sediment is dramatically
9 different than a relatively homogeneous aquatic

10 environment, but we did make some relationships there
11 with respect to the distance that a plant sits relative
12 to the stream. The further away the plant was from the
13 stream, the less Perchlorate in the leaves, for
14 example. We did some mapping of various trees and
15 plants in a particular area where we had relatively
16 constant perchlorate in the stream. You can make just
17 really good relationships between, you know, how far
18 away the plant is from the stream and what sort of
19 levels of Perchlorate you see, so it does get into
20 terrestrial plants.

21 The interesting thing is that, once the
22 leaves drop in the fall and hit the ground, Perchlorate
23 comes out of those leaves and goes back in the
24 environment, so the idea that some people have proposed
25 is like going in and putting plants or managing plants

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1 that are already there and they suck up contaminants
2 out of the soil or water and then harvesting those
3 plants and disposing of that material. Well, you,
4 essentially, can do the same thing with Perchlorate but
5 if you're not necessarily disposing of the leaves,
6 Perchlorate is going to get re-introduced into the
7 environment as those leaves fall during the fall of the
8 year.

9 With regard to aquatic animals, I'll
10 start with fish, Perchlorate was detected sporadically
11 in fish, and that's the best way I can describe it. We
12 would sample all kinds of fish, and, you know, there
13 was no -- it was just very infrequent that we would
14 find Perchlorate. We initially looked at heads and we
15 looked at fillets and we did some whole body analyses
16 of fish, so we looked at a bunch of different tissue
17 types. I would say that probably 90 -- more than
18 90 percent of the Perchlorate detections that we did
19 find were in fish that would not be of a legal size;
20 they would not be fish where you would legally be able
21 to keep. In the fish where we did detect it in what
22 would be considered, I guess, catchable-size fish,
23 oftentimes it's in the fish that aren't necessarily
24 desirable species. We found it in fillets, for
25 example, but those aren't necessarily fish that you

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1 would be likely to consume.
2 So, overall, I would certainly
3 characterize the potential for exposure by eating
4 contaminated fish to be pretty remote. When we did
5 detect it, the Perchlorate concentrations were higher
6 than what was in the water. We've seen that a lot in
7 the laboratory studies that we've done, especially at
8 really low -- when the water concentrations were a
9 little low, the Perchlorate concentrations tend to be a
10 little bit larger than if you -- in the laboratory
11 exposed fish with really high concentrations.

12 We did look at some thyroid histology on
13 some of the fish that we caught, and there was an
14 effect of Perchlorate on thyroid histology. And the
15 reason that I'm saying that it's due to Perchlorate is
16 because there's sort of a weight of evidence there,
17 that we didn't see as dramatic changes in thyroid
18 histology in the streams that were contaminated and
19 there was sort of a relationship between the levels of
20 contamination and the impact on thyroid histology.

21 There's a scoring system that they use to characterize
22 the impact on thyroid histology, and the larger the
23 impact, typically those fish were in streams that were
24 more contaminated. There's other contaminants that can
25 affect the thyroid, so it's possible, certainly, that

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1 it's something else in the water, maybe it's a lack of
2 iodide, for example, that's affecting the thyroid
3 histology, but the way that these things are done
4 typically is sort of a weight of evidence. If you have
5 something known that affects the thyroid and there's a
6 relationship between the impact that you see and the
7 levels of that particular contaminant, then there's a
8 little bit more evidence to conclude that it's from
9 Perchlorate.

10 The real tricky question is what sort of
11 impact would that have on the population of fish, and
12 that's not really clear. One of the downsides to
13 looking at sort of the end points that are not the
14 population level, but the individual level is, that
15 they're really sensitive, but there's a big jump
16 between an individual and a population. Now, we could
17 have went out and sampled just numbers of fish and come
18 to some conclusion, well, Perchlorate -- the numbers of
19 fish in Perchlorate-contaminated streams is less than
20 in streams that aren't contaminated, but we wouldn't
21 necessarily be able to tie that to Perchlorate. And by
22 the time you see changes at the population levels,
23 oftentimes, it's too late to do something about it, so
24 you tend to look at these bio markers, but the problem
25 with that is the link between that and the populations

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1 of fish isn't always clear. I would say that if
2 somebody went out there and shocked fish in the streams
3 that there were plenty of fish. There wasn't anything
4 that -- I guess, anecdotal evidence would suggest that
5 there wasn't any problem with the numbers of fish.

6 We concluded that native frogs were
7 affected by Perchlorate in the streams. We sampled
8 various streams around and we found increases in
9 thyroid follicle cell height, which suggested that
10 Perchlorate is having an impact, but we didn't find
11 changes in the colloid depletion, the colloid is the
12 area where the thyroid hormones are stored, so as the
13 levels of thyroid hormones decrease, you get changes in
14 the colloid, and we didn't see that in the frogs that
15 we examined, so if there was an impact of Perchlorate
16 on the thyroid, it wasn't big enough to cause changes
17 in the place where the thyroid hormones are stored.

18 In some cases we took surface water from
19 the study area and brought that back to the lab and
20 used that in some frog assays, and when we did that, we
21 didn't see any indication that there was any effect on
22 the thyroid function in the frogs we looked at, levels
23 of thyroid hormones and several other things. Now, the
24 species that we looked at is not a native species. In
25 the laboratory, we sent the larger animals, they're a

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1 little bit easier to deal with in the lab, so we didn't
2 see any kind of effect on thyroid function by taking
3 the surface water from the site and bringing it back to
4 the lab and testing these assays.

5 Perchlorate did not affect the gonadal

6 fenal type in sex organs, frogs, and there's a lot of
7 intersects in the frogs, they don't -- they have,
8 somewhere in between the ovaries or testis, for some
9 reason, that's common in frogs. In the previous
10 studies that we've done, we had seen some -- at higher
11 Perchlorate concentrations, we'd see some shifts in the
12 gonadal fenal type. We didn't see that in the water we
13 brought back in the study area and tested it in the
14 laboratory. We did that both for native frogs and for
15 laboratory frogs.

16 The one area where we did see some
17 effects, or another area where we did see some effects
18 in the laboratory, was taking water from S Creek, which
19 is one of the more contaminated streams in the study
20 area, and we looked at the ratio of female frogs to
21 male frogs. Because Perchlorate affects thyroid
22 hormones in some of the previous work that we had done,
23 we had seen some shifts in the numbers of males and
24 females. There were twice as many females as males in
25 this test. Normally that would raise a red flag, but,

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1 statistically, there's no difference there because the
2 low number of animals that we actually tested, those
3 were native; it doesn't show up there, but both native
4 and laboratory frogs we did those tests.

5 We looked at small mammals and birds,
6 and we focussed a lot of our efforts on areas that we
7 knew were contaminated, so we don't have to necessarily
8 have to have a lot of reference sites for this
9 particular study area, but when we did sample small
10 animals and birds near contaminated streams, we did
11 find Perchlorate in the livers and kidneys. The
12 concentrations that we observed, when you compared
13 those to some of the laboratory studies that we did
14 several years ago, the concentrations should have been
15 high enough to alter thyroid histology. Because when
16 we did laboratory exposure at those concentrations, we
17 found changes in thyroid histology and thyroid
18 hormones, but we didn't see that in any of the
19 field-collected animals. So, even though the
20 concentrations we observed in the livers and kidneys
21 were high enough compared to laboratory studies to
22 alter thyroid function, we didn't see that in the
23 field-collected animals. And having Perchlorate in a
24 liver or kidney of a small mammal or a bird, the
25 ecological relevance of that is not really clear. The

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1 mammal guys complained that it was hard to catch small
2 animals, but I think that's more related to habitat
3 than Perchlorate. We did some doves, some migratory
4 birds, we sampled those, and we didn't find Perchlorate
5 in any of the eatable tissue.

6 One of the concepts in exposure is that
7 the larger the animal, the more surface area the animal
8 has, the surface to volume ratio decrease dramatically
9 the bigger the animal is, and so one of the concepts is
10 that the smaller animals tend to have more exposure
11 than larger animals because their surface to volume
12 ratio is larger. So, we shifted some of our focus to
13 look at bigger animals. We sampled raccoons and
14 possums, possums trapped near some contaminated
15 streams, no Perchlorate in the plasma; there wasn't any
16 change in the thyroid hormones compared to animals we

17 trapped in controlled areas; their thyroids were just
18 fine; all the data that we had suggested that those
19 animals were normal, so we sampled those. The
20 contaminated streams where we caught those animals were
21 some of the most contaminated streams in the study
22 area.

23 And we also focussed some efforts on
24 some large animals. Normally, that's testing that we
25 wouldn't necessarily do as wildlife toxicologists, but

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1 there was certainly some questions about whether it was
2 safe to eat the beef or the cattle living near these
3 streams that were drinking water out of these streams
4 and being exposed, so we did a controlled study. The
5 only water that these animals had access was water that
6 had Perchlorate in it, and the Perchlorate
7 concentrations were relatively constant. We sampled
8 the animals every couple of weeks, pulled blood and
9 looked for Perchlorate in the plasma; they were all
10 nondetects with the exception of one animal on two
11 consecutive sampling periods we found Perchlorate in
12 the plasma. The detection for Perchlorate in plasma in
13 our work is about 11 parts per billion, so not as good
14 as water, but it's certainly sensitive enough to detect
15 whether Perchlorate is present.

16 At the end of the study, we sampled --
17 those animals were processed like a commercial
18 processing operation. We tested various cuts of meat,
19 and no Perchlorate in any of those tissues. The
20 detection in that case was about 23 parts per billion,
21 so, again, not as good as what it is in water, but
22 relatively sensitive, and there were no changes in
23 thyroid hormones compared to the referenced animals
24 which were from an area which was not drinking
25 contaminated water. And these data are comparable to

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1 some other work that we've done in more contaminated
2 streams, like animals that have access to that water
3 and other water, and we had a few more detections, but
4 no changes in thyroid hormones. And then we also
5 tested two animals that had been living on that site
6 for at least five years. These were adult cows and
7 they had been drinking that water and water from the
8 upper part of Harris creek for at least five years, no
9 Perchlorate in any of those tissues either.

10 I think that's it. Hopefully, we'll
11 have time for questions. If you have some, I will
12 attempt to answer them.

13 MR. ELLIOTT: That really doesn't leave
14 a whole lot for me to say. They've covered everything
15 that we've done. I've been involved in the project
16 since the beginning in about 2000. I'm currently the
17 project manager. The Corp's role, as I said earlier,
18 is that we were just basically the coordinator of the
19 study. We got all these team members together and
20 they've all done a great job in putting a report
21 together. That's about all I have to say.

22 There's CD's. The entire report, some
23 1500 pages or so, is available on the web site. If
24 anybody wants it, I can get you the web site, but the
25 entire report is here on the CD's and you're welcome to

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1 one or two if you'd like. And I guess I can just open

2 it up to questions at this point.

3 This is the summary that basically Dave
4 and Todd had gone over. If any of you saw the
5 newspaper report today, it mentioned \$16.5 million
6 study, but it was a \$6.5 million study. I don't know
7 where that extra 150 million came from.

8 UNIDENTIFIED SPEAKER: Did the
9 Perchlorate exposure that you observed in the fish come
10 from ingestion or was it dermal uptake?

11 MR. ELLIOTT: Yeah, it's ingestion.
12 It's not just water, though, we sampled some algae in
13 various streams, not the floating algae, but attached,
14 and there was Perchlorate in -- when we sampled
15 contaminated streams, there would be Perchlorate in the
16 algae, so it's not really clear whether -- the
17 laboratory studies that we've done suggest that the
18 fish probably get most of the Perchlorate from
19 contaminated food, like algae, as opposed to water, but
20 you certainly couldn't rule out the idea that it's more
21 of just a passing process, that they're passing water
22 through the gills and they're getting Perchlorate that
23 way as opposed to actually ingesting Perchlorate.

24 UNIDENTIFIED SPEAKER: when you looked
25 at Fort Hood, did you look at potential sources as well

0031 as for Perchlorate in the stream itself?

2 MR. ELLIOTT: Fort Hood doesn't have
3 any -- doesn't use Perchlorate in their activities and
4 we didn't detect any Perchlorate in any of the streams.
5 Cowhouse Creek that runs off of Fort Hood, we did -- as
6 David said, we set up a -- we didn't set up a sample
7 station there, but we sampled that location on several
8 occasions and never, ever found any.

9 Anything else? As I said, there are
10 CD's available here if you'd like one. Thank you for
11 coming.
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0032 REPORTER'S CERTIFICATION

1
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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