OEHHA SYNTHETIC TURF STUDY

Synthetic Turf Scientific Advisory Panel Meeting

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Amy Kyle, Ph.D.

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Robina Suwol

PROCEEDINGS FROM MONDAY, APRIL 28, 2025

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DR. EDWARDS: Good morning, everyone. Welcome to our Synthetic Turf Scientific Advisory Panel meeting to go over our draft synthetic turf study. My name is Dave Edwards. I'm the acting director here at OEHHA. I just wanted to let you know that we'll be starting shortly, probably at about 10:07. So we'll be back on at 10:07. Thank you.

(Recess.)

DR. EDWARDS: Good morning, everyone, again. Once again, my name is Dave Edwards, and I am the acting director at OEHHA. So welcome, everyone, today in the room and online to our Synthetic Turf Scientific Advisory Panel meeting.

Just to let you know that we have two of our members had a little transportation hiccup, so they will be joining shortly. But we will go ahead and start for the sake of time.

Just a little bit of background on OEHHA. We are an office within the California Environmental Protection Agency and the lead state agency for the assessment of health risks posed by environmental contaminants.

First off, I would like to welcome our panel members to this fifth meeting of the Scientific Turf Advisory Panel. Let me start out by calling on panel members to introduce and provide their affiliation, if any, at this point.

We'll start with Dr. Debbie Bennett.

DR. BENNETT: (No audio.)

DR. EDWARDS: Thank you. Mr. Ed Avol.

MR. AVOL: (No audio.)

DR. EDWARDS: And then Dr. Sandy Eckel.

DR. ECKEL: Hi. I'm Dr. Sandy Eckel. I am an associate professor in the Department of Population and Public Health Sciences at USC.

DR. EDWARDS: Online we have Dr. Tom McKone.

DR. MCKONE: Hello. I'm Tom McKone, professor emeritus at the University of California at Berkeley School of Public Health.

DR. EDWARDS: Thank you. And our chair, Dr. Balmes, and Dr. Amy Kyle, another member, they're on their way, so they will introduce themselves when they arrive.

I would now like to introduce you to the OEHHA team. So if you can, just raise your hands in the room so everyone on the panel gets to know who you all are.

We first off have assistant deputy director for scientific programs, Dr. Kannan Krishnan; our acting chief counsel, Ryan Mahoney.

And as far as our staff goes, we have Dr. Jocelyn Claude, Mrs. Allison Lensing, and Ms. Kiana Vaghefi and Chris Sawders. So thanks, everyone, for helping on getting this day ready.

Before we begin, there's a few housekeeping items. So first off, the drinking fountains and the restrooms are located out the back door and left, and to your left down the hall, and then they're located on the right side of that hallway.

In the event of a fire alarm or any other reason to evacuate this room, please leave by those lighted exit doors, here or here. And then take the steps down, and outside we will gather across the street in Cesar Chavez Park.

It is a day-long meeting, so we are planning to take a 75-minute break for lunch around noon, and a 15-minute break at 2:30 in the afternoon, for those of you online just for planning purposes.

If members of the public have digital media that they want to show during their three-minute comment period, please bring the external devices to the OEHHA staff to upload the files before the lunch break.

This meeting is being recorded and transcribed. Remind people to identify themselves and speak clearly into the microphones when you are giving public comment.

The transcript will be posted on OEHHA's website.

A little bit of background on the draft itself. The draft report of this OEHHA study on synthetic turf was released for public comments on March 13th. The goal of the study was to assess the potential health impacts associated with the use of synthetic turf and playground mats made of crumb rubber.

The Scientific Advisory Panel has held four previous meetings to advise OEHHA on study plans, data interpretation, and reporting of study results. Now, here we are after the publication of the draft report and looking forward to your advice and comments on the draft report.

This report has been a long time coming, six years since our last panel meeting, and several folks have retired that have been involved with this. So before we go forward, I'd like to recognize their contributions. First off, starting with Scientific Advisory Panel member Dr. Linda Sheldon; lab members Randy Maddalena, Hugo Destaillats, and Marion Russell; and OEHHA staff retirees and former project staff Patty Wong, Lori Lim, Dave Siegel, David Ting, and Rebecca Belloso.

So with that, I'd now like to do a little bit more logistics regarding public comment. There will be an opportunity to provide oral public comment in the afternoon. The public comment will be limited to three minutes per commenter. For those of you that are in person, you should have received a comment card at check-in. Otherwise, cards are available on the back table. Please fill one out if you would like to speak, and then turn it in to the OEHHA staff.

For those of you watching by CalEPA webcast, you'll be able to watch the meeting but you'll need to join the meeting by Zoom to speak or you may send the comments via e-mail to SyntheticTurf@oehha.ca.gov. Staff will read the comments allowed up to three minutes each as time allows.

For folks who are joining virtually and

wish to comment, are asked to join the Zoom webinar. You will receive a link to join the webinar at the end of the registration process. If you have provided a working e-mail address, you will also receive an e-mail with a link. When requested by the chair, individuals may queue to provide oral comment by using the raise hand function.

When your name is called to speak, you will unmute yourself and comment. If you would like to present slides and have not already sent them, please e-mail them now to SyntheticTurf@oehha.ca.gov.

With that, I'm going to turn it over to Dr. Kannan Krishnan to give a brief introduction and overview presentation.

Kannan.

DR. KRISHNAN: Let me start today's scientific presentation by OEHHA with this brief introduction.

The goal of the OEHHA Synthetic Turf Study (no audio).

This study was designed with the consultations and input from the general public, player support groups, parents, tire industry, and field owners, and we're thankful for that. And a study of this complexity was only possible due to collaborations and partnerships that included Lawrence Berkeley National Laboratory and California Institute of Quantitative Sciences at UCB, UCB Center for Environmental Research and Children's Health, and the University of Arizona.

Since the last SAP meeting in 2019, thanks to the panel input and advice on the design and implementation of the study, now we have completed the data analysis, the exposure assessment, hazard and risk assessment and have released the draft report for public and SAP review, as Dr. Edwards mentioned earlier, on March 13th, with the public comment period ending today.

This particular OEHHA study differs from other studies in terms of its uniqueness of the field characterization, exposure characterization, and the human health risk assessment component.

In terms of the field characterization or to understand what are on the fields, we collected air samples right next to soccer activities, important for characterizing inhalation exposure of athletes, coaches, and referees. We also conducted nontarget analysis to identify chemicals that may be released from crumb rubber and present in the air on the fields.

In terms of exposure characterization to be able to get better estimate of exposure of athletes, we collected both exposure and activity data directly from athletes, as Dr. Claude will be referring to in detail momentarily.

In order to better evaluate the risks from exposure to tire-related chemicals, we compiled and derived toxicity criteria of selected tire-related chemicals, and we conducted exposure assessment and risk characterization for athletes, coaches, referees, and spectators, both on average and at individual field level.

On average, it reflects exposure across all fields indicative of players, referees, and coaches traveling to many fields. But as the individual field assessment reflects, playing at the same local field or a home field primarily or only. These are the scenarios for which we've conducted the exposure and risk characterizations.

These aspects will be covered in detail in the upcoming presentations. First of all, Dr. Jocelyn Claude on field characterization and exposure characterization, and then in the afternoon by myself on toxicity evaluation and risk characterization.

With that brief intro, I was going to turn it over to the chair.

DR. EDWARDS: Thank you, Kannan. Just for interest of time, we're going to just go on to Jocelyn's presentation, and then after Jocelyn's presentation, we'll have a time for clarifying questions and panel discussion.

All right. Jocelyn.

DR. CLAUDE: Good morning. My name is Jocelyn Claude. I'm a staff toxicologist here at OEHHA, and I have been working on the synthetic turf project over the past ten years. Happy to be here to kind of sum up what we've done.

I'm going to be talking about the field characterization and exposure characterizations we did for this study. As evidenced by our report, these two topics encompass quite a bit of information. Since we've talked a lot about several aspects of these in prior meetings, I'm going to be providing mostly an overview, but I will go into detail in some areas that we haven't previously discussed before.

Here is our outline. I'll give just a brief introduction to kind of refresh our memories on a synthetic turf field and the various components. Then I'll talk about the field characterization, exposure characterization, and I'll sum up with a short summary before I'll turn it over to Dave and we'll have discussion then.

First, I just want to give a brief reminder of what a turf field is since it's been a while since our last meeting. These are fields that are typically used for recreation. You can see them in residential and commercial areas, and they're designed to look like natural grass fields. So we focus specifically on synthetic turf athletic fields which are popular due to reduced need for water and maintenance.

And they've also got improved playability, which means they need very little or no rest between use so they can be used all year around.

They're comprised of three basic parts. They've got synthetic grass blades, which look like natural grass blades. They're attached to backing material, which helps to provide support for those blades. And then the fields contain an in-fill, which helps support the blades and provides cushion for the fields.

And there are many types of in-fill out there. You can have crumb rubber, which I'll talk about a little bit. Also, you can have organic materials like husk or coconut. Our study focused on specifically the crumb rubber in-fill, and this is made from recycled automobile and light truck tires. And after these tires are recycled, they're ground up into very small pieces and they're used on this field to provide cushioning.

So these in-fill particles are the focus of our study. We did not specifically look at blades or the backing materials on these fields.

So now for the field characterization. So this was one of the primary tasks of our study, which was to examine and identify the chemicals that could potentially be released from the in-fill used on these fields.

So to do that we sampled 35 fields across California. We had a database of roughly 900 fields to start with, and we used a random stratified sampling method to ensure that we got representative samples across the state. The specific details of this can be found in Chapter 2 of the report. I won't get into too many of those right now.

But we did stratify by both climate zone and region as well as age, since these factors can affect how the crumb rubber itself gets weathered and ages.

So you can see here on the map we had five regions based on climate zones. Regions 4 and 5 were combined mainly due to the fewer number of fields that were located in those areas. And within itself California has quite a diverse climate. You have desert, mountain areas. You've also got locales where they have mild temperatures all year round and some areas where they have very hot summers and very cold winters. So all of these types of things can affect how crumb rubber gets broken down and weathered and aged.

So for age we characterized fields based on whether they were less than nine years old as new, and older than nine years old as old. And we made this cutoff based on discussions with field owners and managers who told us that typically warranties on the fields run out about eight to ten years, and at that point fields may be replaced.

As I mentioned, our goal was to collect the samples to quantify and characterize the chemicals. Our collaborators at the Lawrence Berkeley National Lab were instrumental in helping us achieve this goal. They designed an experimental unit that consists of a regulation soccer goal and the depth of the penalty box, as you can see here in this pictures.

So the goal net was used as a backstop, and we had air-sampling packages on both sides as well as behind the net. We used volunteers to kind of kick the ball around on the field to simulate activity on the field and we also used a soccer ball kicking machine, as you can see on the picture on the right here, to kick a ball into the goal area to kind of simulate activity within that area as samples were being taken.

Now, the top two pictures here show more details about what the sampling packages look like. So in addition to the equipment for air sampling, these sampling packages also contained equipment to measure temperature, humidity, wind speed, direction, as well as particle collection.

So we sampled air on the field and at a nearby off-field location so that way we could characterize differences in chemical exposure. We used targeted chemical lists that we derived from literature research, solvent extractions of crumb rubber, as well as chamber emission and thermal desorption studies.

And our samples were analyzed for volatile organic chemicals, VOCs; semi-volatile organic chemicals, SVOCs; and carbonyls, aldehydes and ketones.

We also did stratified sampling where we collected samples at different heights above the field so that way we could differentiate the source of the chemicals which I'll --

(Lost audio.)

DR. CLAUDE: I'll restate that. That table at the top there shows the total number of samples we collected across the 35 fields. And the bottom table shows how many were detected.

So out of targeted 55 VOCs, we detected 46 chemicals on-field and 45 off-field.

Out of 13 targeted carbonyls, we detected 11 on-field and three off-field.

For semi-volatiles we targeted 70 and detected 62 and 60 chemicals, respectively, on- and off-field.

Now, in our analysis of the crumb rubber samples, we collected several hundred crumb rubber samples across all the fields, and they were analyzed with artificial biofluids to simulate dermal and ingestion exposures. These were analyzed and we identified chemicals and calculated bioaccessible concentrations. So these are concentrations that would be releasable into the human body for absorption from the GI tract or the skin.

So using our gastrointestinal or GI fluids, as indicated on the slide, we detected 30 metals and 76 organic chemicals for dermal biofluids, which was comprised of mainly sweat. We detected 75 organic chemicals.

All together, 81 of the 86 targeted chemicals were detected with 70 chemicals being detected in both biofluids.

Some of our organic classes that we detected include aldehydes, phthalates, and PAHs. We did not detect any PFAS in our analysis, which included nontarget analysis on both the air and the crumb rubber samples.

You may note here in the slide, metals were only analyzed in our GI fluids. There is data that shows that the bioaccessibility of metals in crumb rubber and released into the air is very low, so considering this, inhalation and dermal exposure to metals was very unlikely and was not assessed in this study.

So our chair has joined. Do we want to take a moment to give an introduction?

DR. BALMES: Thank you. I don't know if you heard. I took Capital Corridor Amtrak California train from Berkeley this morning, and we made it on time to Sacramento, except that we were a few yards outside of the station and there was a signal problem and we literally sat there for 40 minutes. So much for taking public transportation.

Anyway, I'm pleased that we're finally having what I think will be the final public workshop or meeting of this advisory committee. It's been ten years. It's a long time. The pandemic didn't help. But I'm actually very pleased that we're here to discuss the report, and I think it's, if I might say, well-written. It's actually understandable, I would think, for many people even without a scientific background.

So I'm sorry I'm late, but I'm pleased to be here, and I look forward to the rest of the day. Thank you.

DR. CLAUDE: Thank you. To continue, as part of our chemical characterization process, we also used the data to help determine each chemical's primary source. So we used this to help differentiate which chemicals might be coming from the field versus which chemicals might be coming from other environmental or human sources.

For chemicals that would be coming from

the field, we designated them as field-related, as indicated here on the slide. And from those which might be coming from another source, we designated them as non-field-related.

So for all metals and SVOCs, our target lists for those chemicals were derived from direct analysis of crumb rubber itself, so we presumed all of those to be field-related.

For VOCs, we used those stratified samples that I mentioned a few minutes ago to help differentiate their source. So as the VOCs get released from the crumb rubber, they're going to enter the air and become less concentrated as they rise from the surface and mix with the ambient air.

So for VOCs that had statistically significant higher concentrations closer to the field and followed a trend of decreasing concentrations with increasing height, we designated those as field-related. For all chemicals that lacked that gradient, we designated them as non-field-related.

And the specifics or analysis for this can be found in Chapter 3 as well Appendix D in the report.

So for aldehydes and ketones, for chemicals where there was stratified data available, we used that to make the designation. For chemicals that didn't have stratified data, we used the South Coast Air Quality Management District's Multiple Air Toxics Exposure Study, MATES, exposure as a point of comparison for our study data from fields in the same district to make our designation, if there was chemical data available.

So if our data was higher than what was reported by MATES to be the ambient concentration, we designated it as field-related.

And then for chemicals where there was no tower data and no MATES data available, we presumed that it was field-related.

So for the last slide for our field characterization, we collected environmental data at each field, and these data were collected for one hour before, three hours during, and one hour following field activity. So we collected temperature data continuously at various heights.

The air temperatures decreased as the height increased. And the average surface temperatures increased as the ambient temperatures increased.

In general, our surface temperatures were about 20 degrees higher than the ambient temperatures, and as you can see on the slide, the maximum reported surface temperature was 131 degrees.

We also measured ozone, which is known to affect the aging of crumb rubber. It's naturally occurring, but it also is formed near the ground surface from photochemical reactions. So all measured concentrations were within the California ambient zone's one-hour exposure standard of 90 parts per billion.

There were three exceedances of the eight-hour standard of 70 parts per billion with a max value of 87 parts per billion.

We collected PM2.5 on and off the field, and levels observed on and off the field were similar and activity did not appear to increase the particle concentrations that were observed.

Moving to the exposure characterization, our goal here was to characterize the exposure of soccer players and other related users of synthetic turf fields. So we focused on soccer due to its popularity in both males and females. Players tended to start from a young age and continued all the way to adulthood.

And we looked at four main groups including athletes, soccer coaches, referees, as well as spectators. So we evaluated exposure on-field for all these groups as well as off-field for spectators who might sit on the sidelines or stand on the sidelines.

These groups have a wide range of ages that could be associated with them. So those ages represent different stages of development, activity patterns, as well as susceptibility to exposure. So to account for this, we broke our receptor age groups into these various groupings, as you can see here on the slide.

Each check mark indicates that we did an assessment for that age group for that receptor. So for athletes, we evaluated ages 2 to 70. Coaches and referees, we evaluated ages 16 to 70. And for spectators, we evaluated the third-trimester fetus all the way to age 70.

This slide here shows our exposure model. So it describes the potential pathways that receptors can be exposed on synthetic turf fields. So, for example, here at the top it illustrates how gases or vapors can be released from the field and available for inhalation by all receptor groups.

Our model also shows which pathways we deemed were either incomplete, negligible, or not dominant, such as dermal exposure of vapor and suspended particles; and thus, we excluded those from our analysis.

So for us to evaluate the exposure of soccer players and the other exposure groups, we needed to characterize their activities and exposure patterns. To do this, we found no information in the literature that was relevant to help us, so we developed three exposure studies in collaboration with both UC Berkeley and the University of Arizona, and we conducted three time-activity studies, as we call them.

We did a survey, a field observational study, as well as an archived recording study, and the study reports and data for each of these can be found in the supplemental materials for the draft report.

But briefly, the survey captured soccer players' activity patterns and behaviors on the fields. We also collected data online and in person. We collected demographic data. We were able to look at what kind of activities they did during practices like diving or sliding, and the types of direct contact they might have with the field.

We also collected information on the frequency of practices and games, as well as what types of uniforms they wore, so shorts and long sleeve versus long-sleeve shirts; personal hygiene practices; as well as soccer history. And overall we received 1,029 responses online and 40 in-person responses.

And for those 40 in-person responses, those players were also videotaped at either a practice or a game. So University of Arizona analyzed the videotape that we collected for micro-level activity data, and so this data tells you the types and behaviors that occur on field with very precise detail, like for how long, how many contacts.

For the archived video recording study, the University of Arizona translated archived footage of children playing on synthetic turf or in playground settings. And these data were helpful in developing mouthing frequency parameters specifically for the infant spectators on the field.

All together, these three exposure studies were used to help us evaluate inhalation, dermal, and ingestion exposure on the fields for all the receptors. You can see in this table for each pathway some of the pathway-specific parameters that we developed.

One of them is the time-weighted breathing rate during activity. So we estimated these using reported exertion levels from the survey data, as well as we looked into the literature to develop some breathing rates that would be relevant for trained athletes.

We developed dermal loading onto the skin, which we used body metric data that was provided to us along with kind of estimates of what body parts and to what extent they might be exposed based on how soccer players report their dress during activities.

We also developed ingestion rates by combining the amount of crumb rubber that might be incidentally or accidentally ingested as well as what might be indirectly ingested from pathways including hand to mouth, hand to object to mouth, and object to mouth.

So the details of how we developed all these parameters can be found in Appendix B in the draft report.

We were also -- we are also able to develop body weight and exposure duration parameters specific to athletes for the soccer scenario.

Though we did not collect survey data specifically for coaches, referees, or spectators, we borrowed parameters from athletes based on some assumptions that are detailed in the report.

For instance, for coaches, since they're the team leaders, we presume that they're going to be on the field when athletes are on the field, so we used similar parameters for coaches as athletes.

And we used mean values for athletes, so for coaches, receptors, and spectators, we used the higher mean estimates, so we took all the means and we used the highest value to make sure that we would get a protective value.

Now, for the remaining slides, I'm going to talk about our exposure estimation. So this is where we estimate exposure concentrations and exposure doses, which are the dose that a receptor would be exposed to on the field.

So we evaluated five specific scenarios that differ based on different types of toxicity. So the first is an acute one-hour inhalation scenario to these 11 chemicals shown here on the screen. So we did not assess acute dermal or oral exposures, which Dr. Krishnan will talk about a little bit later in the afternoon.

So these short-term, high-level exposures can lead to adverse health effects on the respiratory and circulatory system.

So we used acute exposure concentrations that are equal to the maximum air concentration that was detected at any time point across any of the 35 fields in order to get a health-protective estimate.

Now, before I continue, Dr. Krishnan alluded to this a little bit in his introduction. So for the data that we collected for both air samples and in our crumb rubber samples, we have two different options to utilize the data.

One option represents individual field data where we can use values that might represent a single home field or home practice field. And these would be relevant for acute effects as well as developmental and reproductive effects or DART, as indicated here on the slides.

And DART effects are assumed to have the potential to occur after a single exposure. So these individual field data, since they're collected on a single day, they're a good surrogate for that one-time, single-event exposure.

The second option would be to use the average across all the 35 fields, which would reflect players traveling for games or tournaments across the state during the soccer season. And we use this data for all other relevant health end points.

For the one-day exposures I just mentioned, we used individual field data to evaluate these chemical end points. And so we did evaluate all three pathways. We did inhalation, dermal, and ingestion. So these exposures focus on a single day or event.

And so for inhalation we assessed 18 chemicals. The top ten chemicals that contributed to exposure are listed here on the slide. And so for the inhalation exposure concentration, we used the average air concentrations for an individual field, and we used an adjustment factor that adjusted by a receptor's breathing rate and the duration of exposure.

For the dermal pathway, we used exposure doses that are represented by the dermal load times the average individual field concentrations in crumb rubber, divided by the body weight. And so for dermal we assessed 19 chemicals. And the top ten contributors to exposure are listed here on the slide.

For ingestion, the ingestion dose is represented by the one-day ingestion rate, which assumes a single-event exposure per day, times the average of the individual bioaccessible concentration in crumb rubber all over body weight. So we assessed 20 chemicals for this pathway. And again, here the top ten exposure contributors are listed here in the table.

So one other end point we looked at was sensory irritants, and these are chemicals that cause irritation to the eye and respiratory system. So there were three chemicals we assessed by this pathway, and the exposure concentration for these was just the average air concentrations since it's concentration-dependent mediated effect.

So now for chemicals that have all other end points other than acute, sensory irritation or developmental end points, we evaluated chronic exposure. We did inhalation, ingestion, and dermal exposures.

So for inhalation, the exposure concentration is equal to the average air concentration times that adjustment factor, once again, for breathing rate as well as exposure duration. The top ten contributors here are listed on the slide for spectators ages zero to two.

For the dermal pathway, the daily dose is equal to the dermal load times the average crumb rubber bioaccessible concentration times the events per year, all over the body weight. And the top ten contributors are listed here on the slide.

For ingestion, we assessed 69 chemicals, and the exposure dose is equal to the daily ingestion rate times the crumb rubber bioaccessible concentration over the body weight. And for all of these chronic exposures, we did the calculations using both individual field data as well as the average across all fields.

For chemicals that are known carcinogens, we calculated lifetime average daily doses for those. So we assessed each life stage from the third trimester of pregnancy all the way to 70 years old, and these doses measured the potential lifetime exposure to a chemical.

In order to do those calculations, we used average daily doses. So for dermal ingestion, the doses are the same as I just described a couple slides ago. But I do want to highlight here the average inhalation daily dose. So unlike for acute, one-day and chronic where we use an exposure concentration, here we use an inhalation daily dose that's equal to the air concentration times a breathing rate over the body weight.

And those average daily doses are used

to calculate the lifetime average daily dose by multiplying by an age-sensitivity factor, which is a time-weighting factor that accounts for increased susceptibility to chemical exposure earlier in life. So it modifies the chemical's cancer potency for each life stage presuming an increased sensitivity early in life. So it decreases with age from a factor of 10 for infants to 1 for adults.

We also include an exposure duration that represents the length of exposure, and all of this is divided by the averaging time, which represents an average lifetime of 70 years.

Shown here are ten chemicals. These ten chemicals were evaluated across all three pathways. So on this slide you can see how -- and all these are for spectators zero to two. So you can see how the lifetime average daily dose can vary across the pathways and how a pathway with the largest contribution can vary for each chemical.

So this afternoon's presentation will look more into how we assess chemicals that were detected across these multi-routes.

So just to wrap up, so we sampled 35 fields across California. We collected air and crumb rubber samples. We identified chemicals that potentially could be released from them. So we identified 119 chemicals in the air above the turf fields as well as 75 chemicals in the dermal extracts. We identified 76 organic chemicals and 30 metals in the gastric extracts of crumb rubber. And we estimated exposures to these chemicals using California soccer-specific exposure parameters that were developed from three time-activity studies we conducted.

So for all of our calculations where I indicated previously we utilized either individual field data or we utilized the average across all the fields, here I only presented a small fraction of the results. So for any more results or details, I encourage you to look at the report, both the main report as well as the appendices and supplemental materials as they contain a lot more on the sampling methods and the specific sampling results.

Now, with that, I'd like to turn it back over to Dr. Balmes for clarifying questions and panel discussions and also we want to introduce Dr. Amy Kyle who has joined us.

DR. BALMES: Dr. Kyle, do you want to say hi?

DR. KYLE: I'm happy to be here and happy to see you all again, and while I have the floor for just a moment, I want to say I thought you guys did an amazing job explaining this in the report. Truly amazing. Blue ribbon. I do have some questions, but I just wanted to say that first. So thank you.

DR. BALMES: And I will say, because I've worked with Dr. Kyle for a long time, that's a major compliment. And I would like to compliment you on your presentation just now, the part of it I caught. Because it was also very clear. Good slides.

Now, the panel may ask clarifying questions or make comments.

Is your mic on?

DR. BENNETT: Again, I agree, this was a great report. You guys did a great job. And I feel like some of my clarifying questions are super detailed because those were the only questions I had to come up with, but some of them are bigger.

So on the time activity for the one-day exposure, I wasn't quite clear on the decision to only use the mean exposure duration for the athletes, because especially I did not -- I will admit I did not dig into your appendices. But it looked like the mean was on the order of the length of one game, and I was thinking for that one-day exposure, you would want to be reflective of kind of a day where they're playing a tournament on a field. And I wasn't quite sure why -- and maybe I misunderstood why the one-day exposure seemed to be on the order of only I think it said like two and a half hours.

DR. CLAUDE: So for some of the parameters from the time-activity studies, some of them we asked them how many days per week do you practice, how many games per week do you practice or play. So for some of them, when we calculated, we calculated only using individual athlete's data, so we didn't calculate a mean across all of them.

And for some of them, we did exclude data because we don't know if it's just misunderstanding the question. We did have some people report that they used like maybe 16 hours a day they practiced on the field or 20 hours a day they practiced on the field. So some of those higher end values did wind up getting excluded just because we weren't sure about what the data actually looked like, and we didn't want to potentially overestimate too much, telling people six hours a day on the field or something like that.

So we went with the mean to kind of just look at what the average scenario would be.

DR. BENNETT: But I think a lot of them do spend six hours a day on a field on a tournament.

DR. CLAUDE: Some of these were like for little kids, you know like six-year-olds or 12-year-olds. So we're not sure if there was just misinterpretation of the question. Like for some older athletes, we did have some professionals who answered the survey, and for sure, they might spend all day on the field practicing or playing different types of games and stuff.

DR. BENNETT: I saw the thing about the 16 hours a day. That did seem a little excessive, but I feel like there's data that clearly was a misunderstanding of the question. But then to go all the way from those maximum ones that misunderstood down to the average, and basically effectively exclude on your one-day exposure anyone playing a tournament, seemed like an odd choice to me.

DR. CLAUDE: And a lot of those higher end values, they were definitely the high end. There was a clear separation too as well between those kind of values where we were like this might be misunderstanding versus the mean. So we can revisit it to kind of see what -- when we take out what that kind of high-end mean looks like to see if maybe we can use something to better represent if there was a tournament several days.

DR. BENNETT: Yeah, because I mean, because if the DART is a health end point applicable to a one-day exposure, there's a lot of kids that play in tournaments. I don't have kids that played soccer tournaments, but from my friends that did, they would be at Stockton at 8:00 a.m. and they would be there on the field until 5:00 p.m. and back the next day for a repeat encore. I just wasn't sure about that. So that's my first question.

My second comment was, you talked about how you did not sum athletes -- people being different positions, but I think it's -- actually, I'm going to skip that one.

So my next question is on the lifetime exposure. I wasn't quite clear, when you summed up, were you summing up assuming a kid went from being a spectator to a player and then through the years or were you just summing the total over each given stage?

DR. CLAUDE: Each given stage. So we did calculations for the incremental risk, so we didn't sum any of the age groups together. We presented values for each age group separately.

We didn't assume you'd be a spectator

during pregnancy and then zero to two and then you might transition to an athlete and then to a coach or receptor. We didn't do any summations like that. We just strictly calculated for each specific age group for each receptor.

DR. BENNETT: And so if you wanted to get the lifetime risk, somebody would need to sum the --

DR. CLAUDE: Yeah, you would have to sum the relevant categories.

DR. BENNETT: You just might want to make that a little bit clearer in the text because that wasn't super clear.

And then on the field selection, it appeared you only had one field that was fairly new, less than a year old. And it seemed to me that was one with the non-crumb rubber. And I just didn't know if -- it did look like you had three fields that were a year old. And I just didn't know if you had done any analysis to see if when those fields were very new, if there was any increase in the VOCs, just because like intuitively you kind of think, huh, that first year they'd have the highest levels. And I noticed that there was very little measured in that initial time frame. And I just wanted to hear your thoughts on that.

DR. CLAUDE: There is data that shows that once you know those new fields, that first year is when you get the largest off-gas of those volatile chemicals. So if I recall, we didn't see any specific increase compared to the other fields for those fields --

DR. BENNETT: Because you didn't measure any the first year.

DR. CLAUDE: -- either for the air or the crumb rubber because, like I said, we only had a couple out of the whole 35 that we see. We didn't see very much difference. As well as other fields too, sometimes the -- sometimes the crumb rubber, it will get in the shoes so it will get taken off the field. So some other fields do replenish the crumb rubber as the season goes along, so the field might not be new but they might still have new areas of crumb rubber that have been on there too, so that might dilute some of that kind of analysis as well.

DR. BENNETT: Do you think it would make sense to know that as like a potential limitation if there weren't really very many? There wasn't really anything that was less than a year old except for that one, if I remember.

I have other questions but I'll let

somebody else take a turn for a while.

DR. BALMES: I'd like to recognize Dr. McKone, who is remote.

DR. MCKONE: Thank you. Sorry I couldn't be there in person, but I guess the technology I chose was a little bit more reliable than the train today. It would have been three of us that would have been late, but I made it on time.

First of all, I want to add my compliment. This is a just such a remarkable study, and of course, we've been following it for years. But for anyone who has questions about -- I mean, I think for the general audience and the scientific audience, just the detailed efforts to not make assumptions but actually make so many measurements. You worked with some really good scientists. I'm biased because some of them worked with me when I wasn't retired and they weren't. But it was really clever.

And I think it's compelling that this is not just a hand-waving exercise. It's really literally in the dirt or in the crumb rubber and really looking.

So I had kind of a comment or a question, something I wanted to explore a bit that you alluded to, I think early on about, if you look at this list of chemicals, many of these, probably most of them are chemicals people are exposed to from other sources. There are toxic air contaminants or they're in consumer products.

I know you tried to mention -- or you mentioned something about looking at the relative exposure from people associated with soccer events, either on-field or off-field. And I was wondering the extent to which you were really able to put it in context in terms of cumulative exposure to toxic air contaminants from all other sources.

Again, that's highly variable, so that's hard to do. Some of the communities that people live in are quite clean and others are coming from communities where I'm guessing a substantial amount of their exposure to these substances may be in their backyard and not on their soccer field.

But I don't know if you could just comment a little bit about how -- I guess how you would address people's question about, is this big relative to their cumulative exposure to these substances from other sources over the lifetime, and if so, how might we communicate that?

DR. CLAUDE: That's a good question. So yes, we really didn't compare to other sources, like for the chemicals that -- like for example, we detected all the BTEX chemicals. And when we sampled, we sampled in the morning during high periods of traffic and people traveling to work and school and other places.

So we did see fluctuations of those types of chemicals with the time pattern of the day. So it kind of increased in the morning, and then it kind of flattened out in the afternoon. So we did see those kinds of patterns for certain chemicals that we presume you'll have other sources of exposure to them.

So we did do hazard and risk. We did separate out our calculations for what we presumed to be field-related versus what we might presume to be non-field-related. And so we did not compare those kind of non-field-related exposures to anything that might be in ambient air or any types of other cumulative exposures from those types of things.

But we did see predominantly that a lot of the exposures were driven by those non-field-related chemicals. The contribution from the field-related chemicals tended to be much less than the field-related exposures. So it is a likelihood that a lot of those exposures could be coming from other sources, traffic or some fields are located where the area is industrial areas or just high areas of traffic.

DR. MCKONE: If I can follow up, it seems, though this is kind of getting into the next topic, but mostly the concern is acute exposures, right, or maybe chronic over a period when someone is in soccer.

So I guess the question I'm asking is probably only relevant for chemicals that give rise to chronic -- long-term chronic exposures and lifetime burdens of disease, whereas I think the bigger issue was acute for a lot of these. I guess we can take this up this afternoon. But I think in kind of supporting your response, because the goal was to look at short-term typically acute exposures during a day or during a soccer game.

Then the other non-field-related exposures probably wouldn't matter that much unless they just happened to be near a facility that was having an off-normal event and releasing chemicals, which I don't think that's part of your purview to go into a rare event like that. But anyway, thank you.

DR. BALMES: Thanks, Dr. McKone. And if I could just jump in a little bit, Jocelyn. I think that exchange with Dr. McKone, it might be worth considering adding some wording about how -- even though we don't know how the synthetic turf exposures compare to exposures to, for example, BTEX chemicals from other sources, I think it's probably worth saying that it's not likely to be an overwhelming exposure. Don't use that word.

But I think somebody reading this might have that same kind of question that Dr. McKone just dealt with trying to put it in context. I know you're being very careful about on-field and off-field and not exceeding your purview. But I think putting that in context for the public would be helpful.

DR. CLAUDE: Okay.

DR. BALMES: So I'm going to turn to Dr. Eckel next.

DR. ECKEL: I would like to echo the rest of the panel and say that this is a really great study. I really enjoyed reading it, and I've enjoyed seeing the development over time, and so my comments are coming from a statistician point of view. So I really appreciated the rigor that I saw and the sampling of the fields, that stratified random sampling to really characterize the different ages and the different climate areas of California. I thought that was great.

And I also really appreciated the

characterization of the on-field based on the height of the VOCs, for example, using that linear mix model. I thought that was great to see that -- the state of the science on statistical methodology.

I did have one question about the exposure characterization, and I saw looking at like individual fields versus looking at averages across all the fields of exposures to chemicals, and I was wondering, did the approach that you take -- when I was reading through and seeing your presentation, it looked like for shorter exposures, like maybe one-day exposures, you looked at individual fields, but for longer exposures it was more of an average across all the fields.

But I was wondering if maybe that didn't capture individuals who maybe are playing on the same home field over a period of years because an average does attenuate a little bit the extremes.

DR. CLAUDE: And we did. So for those ones like the chronic exposure, we did do calculations with the average across all the fields, assuming people will travel, but we also did those individual fields assuming people might have a home base kind of field for practice and/or games. So we do have both those data.

DR. ECKEL: Oh, great.

DR. CLAUDE: So it's both in the appendix. In the main report we just have the individual data, but we did present the data for both.

And generally, when we look at the distribution of the individual fields as well, the average value tended to fall right around where the average across all the fields looked at. So we thought that was -- we were like that's nice-looking data, right, that were our average. So we did kind of look at both of those situations to kind of see what it would look like, especially for like younger kids. They're probably most likely not going to travel across the state. They'll probably have that one field that they might look at.

So we did look at both of those scenarios for the chronic exposures.

DR. ECKEL: Thank you.

DR. BALMES: I would be careful in saying that they wouldn't travel across the state. I had a kid who was on a traveling team, and he traveled all over the state.

Dr. Avol.

MR. AVOL: I just have a couple of questions and I might ask you a question much larger than this, which is, I know you focused on exposure characterization, and this afternoon we'll hear more about the health assessment, but some of your summary and questions did get -- had some of the health. So I don't know whether to hold this and expect that we'll hear more in the afternoon or ask it now.

DR. CLAUDE: I would say ask now because the topics do very much kind of intertwine with each other. So I would say ask away, and if there will be more on it this afternoon, we can talk about --

MR. AVOL: I only have maybe one or two additional comments over and above my colleagues. And parenthetically, I will say that as a parent of children who did play lots of soccer on lots of fields and did play both local AYSO and traveling squad team, Dr. Balmes is exactly right. We were all over the state.

But more importantly, I think for many hours a day, particularly at tournaments, as Dr. Bennett suggested, the teams will stay at or near the fields and be there for hours of the day. So I think you may have thought about it may be only minimal exposures that you consider in the scheme of what teams actually do in these tournaments. We were there for a weekend.

So I think whether that comes up in the limitations or discussions or commentary, I think it's worth thinking about how you sort of address that. Because I know that's an issue for many parents who are going to look at this and say, well, wait a second. That's not my experience.

I have two questions related to what you presented and then your summary. But you talked about this sort of defining point, older or younger than, I guess, nine years of field life. But when you summarized your data, you didn't say anything about whether there was any appreciable difference you wanted to call attention to, or just say that you really didn't see much difference.

Again, Dr. Bennett alluded to this question of the very new fields, which is certainly an issue. But because there's so many fields in use across California and the country, I was wondering if you did have any insights or whether there will be more said in the final report about this dichotomy -- if there is such a dichotomy.

DR. CLAUDE: We really didn't see much of that kind of separation between like the old versus the new because, like I said, some of those older fields as the years go on, they do replenish the crumb. So when your field gets to be nine years old, your crumb is likely not going to be nine years old. You will have replenished either certain areas or the whole field by that time point.

But we could make a note in the report to address that we didn't see that kind of breakdown, that old versus new kind of difference in either the VOCs, the difference in the release or the crumb rubber, the presence of those chemicals.

MR. AVOL: I think it also would be useful for the public to understand better through OEHHA's sort of guided expertise eyes to say something about the mean versus the max in terms of what you've seen in the range of these fields. Because, again, you talked about a number of fields. You talked about a number of concentration, but then you sort of focused in on this is the average exposure. This is the average thing.

I understand why we do that, but I think there's still some concerns about these outlier conditions which do -- may not be so much outlier for a number of people.

DR. CLAUDE: Yes. Thank you.

DR. BALMES: Dr. Kyle.

DR. KYLE: Thank you. I'm thinking about

not only the details of the study and the methods but also what did we learn from this is kind of the main thing on my mind because of some of the reasons people mentioned of the depth of the analysis that you did, the creativity of it, and the fact that we looked at this in a different way than we often do.

And so this is the spirit in which I'm asking this question. I don't know if it's germane, really, to this part, but it's from the beginning. I'm trying to understand what we thought we'd find and then what we found in terms of the substances in this material. And I'm very interested in how that distributed about between the air, dermal, and the ingestion-related one.

I think that that pattern is really interesting. But my first question for you is, remember the ones that fell out because we couldn't find an analytic standard for them? Did they ever reappear anywhere? And I understand why you took them out, I think. But I also would like to figure out what they -- I'd like to commemorate that there was some number between 10 and 100, I think.

DR. CLAUDE: I forget the exact number, but yeah, so if it disappeared before we could do -- find the standard. So we didn't look for it after that.

Because when we did our analysis, we had those specific targeted lists that we used. So if it fell out before it got to that point, we didn't look for it again in the rest of the analysis.

DR. KYLE: But can we find that again?

DR. CLAUDE: We can pull out those lists of chemicals.

DR. KYLE: Because I would just like to see what was left there and the reasons it was left there. And I'm not saying you made the wrong decision, but in terms of what we learned from this, there's something we learned about that piece of it too, and the issue of standards and why they're not available and what is it we don't have standards for at all. And I'm running into this in other contexts as well. But there are whole areas of inquiry that are limited because, oh, gee, we don't have a standard, which in the 21st century seems like kind of a lame answer, doesn't it?

So I would like to figure out the right way to ask about that. So I guess that's the main thing I'm going to ask right now. I have some others for later, but thank you.

DR. BENNETT: I had some other questions on that, because I got a little confused on some of the non-targeted stuff. So the non-targeted wasn't done by LBNL? It was done somewhere on campus by different people?

DR. CLAUDE: LBNL analyzed the samples, they got the extracts, and the sample extracts were analyzed by UC Berkeley's QCB lab because LBNL did not have a liquid gas -- a liquid chromatography machine. So LBNL did all the GC/MS, and then the QCB lab at Berkeley did all the liquid chromatography.

DR. BENNETT: And that was only on the pilot samples then?

DR. CLAUDE: It was the pilot and then -- we did pilot and then we did a second phase where we -- pilot we did four and we did the manufacturing samples, and then we expanded a little bit for the second phase and we did some of those.

DR. BENNETT: And then in addition to the ones that you couldn't buy the standard for, were there other ones that you just couldn't identify for sure what the compound was? The nontarget world, they come up with so much stuff, and I also felt a little bit like ...

DR. CLAUDE: And I think a couple meetings ago we showed some of the chromatograms, and you could see there's so much stuff in there. So there was some stuff, I think, that we weren't able to identify. I don't know off the top of my head the magnitude of how many that was, but there was some stuff that was just kind of out that we were not able to identify.

DR. BENNETT: It said they didn't find any of the PFAS in that. So did they look -- they ran a library of PFAS versus the nontarget?

DR. CLAUDE: Yeah, so in our nontarget analysis we didn't see any PFAS, but also we looked at the crumb rubber, so we didn't look at any of the blades or the backing which is likely where the PFAS would be present. And in the air samples PFAS are likely not going to volatilize.

DR. BALMES: And that's in the report.

DR. CLAUDE: Yes, and we did put that in the report.

DR. BENNETT: And you didn't really look for any OPEs either, the organophosphate ones?

DR. CLAUDE: No.

DR. BENNETT: I was also confused on the volatile sulfur compounds because it said they did something with the volatile sulfur compounds in the pilot, and then that seemed to go away. I didn't see where there was any reference to like "we just didn't see anything."

DR. CLAUDE: So those volatiles, that was for the benzothiazole that we wanted to make sure if it was there, we captured it; as well as the 2-Mercaptobenzothiazole. So when we were doing the analysis, they came up in the regular VOC analysis, so we wound up not needing to do the additional specialized sampling and analysis for those volatile sulfur compounds.

So that was mainly to make sure that we saw the benzothiazole.

DR. BENNETT: Okay. I missed that, so you might just want to put -- I mean, maybe it was in there but ...

Then I have one more question on the chemical analysis. So I did notice that you guys did find a few fields where the maximum was just really high for a few compounds. I didn't ever find anything to get a sense as to whether or not those really high levels were scattered across different fields or if it was just like a limited number of fields that tended to be the outlier fields for all of the different concentrations.

I didn't know if you did anything to look at that or not, to just get a sense of is it one chemical high here and another somewhere else or is it just some fields that were just high.

DR. CLAUDE: We didn't look to see if -- you know, in the high end, those fields, it was all one field. We did note some fields did tend to have higher concentrations of chemicals. We measured wind speed and all that kind of -- so for some fields we did look to see if that kind of played into seeing those higher levels.

And we did have some fields where we had frequent changes in wind direction that we noted, so that could be why we did see either higher or lower concentrations of chemicals. But we didn't look to see if those higher values all tended to congregate in one field. We didn't look specifically at that kind of individual analysis. But that's something we could look at to see if it was localized into certain areas, all those max values.

DR. BENNETT: I think that's everything I had.

DR. BALMES: I think Dr. Avol has another question.

MR. AVOL: I have one question to sort of help place this into relevance. Given that the sampling on this study, I mean, it was an excellent study, tremendous detail has evolved -- been appreciating. But given that the sampling was done almost ten years ago, and I think it's fair for public to ask a question of relevance in terms of current fields.

So I don't know if there's information that you have access to or if you looked at or even thought about as to whether in today's fields in the last five years, the fields that are being used now, if crumb rubber from passenger and light-duty vehicle trucks is still the primary in-fill or if there has been a move by the industry to go to coconut or something else, that is, is all your hard work still --

DR. CLAUDE: Still relevant? Yeah. And when we did the study ten years ago, there was already that you started seeing kind of people moving towards the alternatives because the senate, they tried to push for that moratorium to stop installing fields and parents became more, "Are we going to put this? Is there an alternative?" That's why we did see those organic, corn husks, coconut husks, you've got sand, and I forget Nike, they had their recycled shoe rubber kind of in-fill.

So there have been quite a few in-fills that have been pushed in the past ten years as well.

And we haven't updated our database, so we don't know of the 900 that were in California how many might still be around or how many might have switched to an alternative or gone back to natural grass. So we don't have that information at this time, but yeah.

DR. BALMES: Anybody else have another question?

So I have one issue, and it may not be the right time. I know we have public comment this afternoon. But the report came out in March. Have there been written comments from the public, from scientists, that you can tell us how you responded to?

DR. CLAUDE: So we received actually a comment yesterday, a written one, to our e-mail -- so we received a comment yesterday from the public that obviously we haven't responded to yet, but it dealt with the issues around the heat stress on the field and the temperatures, so that issue where the surface temperature, it gets hot. So people have complained of getting burns and your shoes are melting.

So after the meeting we'll read into that comment more and see how we address those issues there.

DR. BALMES: Was that the only written comment?

DR. CLAUDE: That's the only written comment.

DR. BALMES: That actually dovetails to a concern. Dave and I, when you posted the surface temperature, I said "Whoa." This is only going to get worse with the climate change -- dare I use that term?

And I have heard about when my son was a soccer player, when it was really hot, how they felt the heat in their shoes and didn't like to fall when it was that hot.

DR. CLAUDE: Yeah. And some managers, you don't need to water the fields, but some managers, they do water the field to kind of help to alleviate some of that temperature. It's only a temporary remedy, but they do tend to water it before the players go on to kind of help with that.

DR. BALMES: Do we think that those high surface temperatures affected exposures to the various toxicants that you have looked at?

DR. CLAUDE: On hot days you might have more volatilization on those days.

DR. BALMES: But we didn't look at that specifically? When I say "we," you.

DR. CLAUDE: No, because we collected -- it was mainly the summertime when we collected. We had a lot of those hot days. So we had very few fields that we sampled in like the wintertime, and we didn't sample fields like during both periods. So if we had sampled fields during both periods, that would have been a great way for us to help see.

DR. BALMES: I think, again, just a little note in the discussion about how that's a potential concern would be good.

Dr. Bennett. Your mic is off.

DR. BENNETT: One other quick thing. I just thought on the ingestion, you guys give the mass that you assume for the ingestion. It might be useful just for readability for a non-science audience to convert that into a volume measurement that would be in something people would be familiar with.

DR. CLAUDE: Okay.

DR. BALMES: That said, I still think given the complexity of the study and the multiple sections of the report, it's in pretty public user-friendly form. Much better than I expected, actually. As scientists.

DR. CLAUDE: We did work hard on trying to make sure --

DR. BALMES: As scientists we often are not good at communicating with the public, but you did a good job.

DR. CLAUDE: Many thanks. It was a group effort. But thanks to all.

DR. BALMES: If there are no more questions from the panel here or Dr. McKone virtually, then I think we can adjourn early for our lunch break. But then we'll come back early. We'll come back at 12:45 instead of 1:00.

(Recess.)

DR. BALMES: Our next speaker is Dr. Krishnan. Kannan Krishnan.

Take it away.

DR. KRISHNAN: Good afternoon. Do you hear me okay?

In this presentation I'll focus on toxicity evaluation, risk characterization, and present the conclusions of the draft report.

This study examined the non-cancer hazards and cancer risks as the health outcome, as you see in the first column, from exposure to chemicals from crumb rubber in-fill via multiple routes, as shown in the second column, inhalation, dermal, ingestion, on the synthetic turf fields for four receptor categories, athletes, coaches, referees, and spectators and appropriate age groups in each one of those categories.

Specifically, the toxicity evaluation or the health outcome focused on acute inhalation exposure to chemicals. That's the first line combining the first two columns. And one-day inhalation, oral, or dermal exposure to DARTs, or the developmental reproductive toxicants, on chronic inhalation exposure to sensory irritants, then chronic inhalation, dermal, or ingestion exposure to general toxicants.

What we refer to as general toxicants, those that cause chronic effects other than DART or sensory irritation, where the key critical effect is other than sensory irritation and developmental reproductive toxicity.

And then cancer outcome where we calculated the lifetime risk from exposure to carcinogens by inhalation, dermal, and ingestion routes.

In applying these on-field or for off-field exposures, the only difference is that the turf materials are only present on-field, obviously. That's the only difference when it comes to the calculations on-field or off-field.

In terms of the toxicity evaluation of

these chemicals or the dose-response assessment of these chemicals requires the knowledge of toxicity criteria. The toxicity criteria are basically the numerical value that quantitatively characterizes the relationship between the exposure and the outcome such that either reference exposure level is developed for non-cancer end points or cancer slope factors are developed for carcinogens.

In terms of developing toxicity criteria, we had five complementary approaches. Initially, toxicity criteria developed by OEHHA or other governmental agencies were used. Then extrapolation using toxic equivalency factors was conducted, particularly using benzo[a]pyrene for the PAHs, and then adopting toxicity criteria from structurally similar chemicals, and then the conduct of route-to-route extrapolation of toxicity criteria. When a value is available for oral route, converting it to an inhalation route and vice versa, particularly for systemically acting chemicals.

Finally, development of de novo toxicity criteria for chemicals based on toxicological studies from the literature.

For chemicals with established toxicity criteria, the most health-protective value based on the most sensitive end point was used. For chemicals without such established -- my picture keeps coming in the middle of the slides so it's hard to read.

For chemicals without established non-cancer toxicity criteria, as alluded to earlier, new toxicity criteria were developed either de novo or based on route-to-route extrapolation or based on structural similarity.

For those without any toxicity criteria or toxicity data, those weren't included in risk characterization.

In terms of the data availability for acute toxicity, there were 11 chemicals with tox criteria from OEHHA or U.S. EPA for inhalation route. So that was for the acute inhalation toxicity.

For those without toxic criteria for the acute exposures, comparisons were made with the subchronic health guidance values. Even though subchronic is a longer duration with lower health guidance values, those were used in this project.

Now, regarding DART, six chemicals had toxic criteria from OEHHA or EPA. Two were developed in this study and 12 were based on structural analogs.

And for sensory irritation there were three chemicals, as we will see momentarily, and all of them were from OEHHA. And in terms of the chronic toxicity, for the inhalation route, 41 values were available from OEHHA, EPA, and the ATSDR. 52 were based on analog values, structural analogs, and 37 were developed based on route-to-route extrapolation.

In terms of the oral and dermal route, the toxicity criteria, 18 of them were available from OEHHA and EPA, and 36 were based on structural analogy.

Four relatively nontoxic chemicals were excluded from these calculations. The limonenes, pinene and carene were those.

And in terms of the cancer slope factor, out of the 23 identified carcinogens in the study, 16 of them had chemical-specific cancer slope factor, five of them had established potency equivalency factor or toxic equivalency factor. Those are the PAHs, polycyclic aromatic hydrocarbons. And for two of them, we had derived specific values in this study.

And of the 23 carcinogens, 13 were identified in a single route with a chemical-specific cancer slope factor, whereas ten of them were assessed for multiple routes of exposures, inhalation, dermal, and ingestion.

So in terms of risk characterization combining the exposure assessment and toxicity criteria, we have evaluated the acute and chronic non-cancer hazards as well as the lifetime excess cancer risks for each category; that is, athletes, coaches, referees, and spectators, for a total of 33 groups, based on individual field data on chemical concentrations as well as the average across fields, as we had indicated.

And acute and chronic exposure scenarios for both on-field and off-field were considered in computing the cancer risks and non-cancer hazards.

For non-cancer hazards, initially a hazard quotient for each chemical was calculated. So hazard quotient is basically the ratio of the exposure metric to the toxicity criterion or the reference value.

So the exposure metric is either an exposure concentration or a dose that's calculated. For inhalation exposures, it's an airborne concentration, whereas for dermal and ingestion exposures, it's an average daily dose.

And the toxicity criterion is a chemical-specific numerical value that reflects the potency of the chemical for the specific non-cancer effect and the route of exposure.

An example would be the REL, or the reference exposure levels developed by OEHHA. So these are concentrations at or below, which no adverse health --

(No audio.)

DR. KRISHNAN: Thanks for bringing that up.

Now, for cancer risk, was calculated using the general equation, lifetime average daily dose times the cancer slope factor, CSF. LADD times the CSF for the route of exposure here.

The cancer slope factor or CSF is a 95th percentile upper confidence limit on the slope of the dose-response curve, which is based on continuous lifetime exposure to a substance.

The risk calculations are conducted for multiple chemicals via multiple routes for all age groups. One in a million or one excess cancer in a population of one million people over a lifetime is considered a negligible risk or de minimus risk level. So that's the benchmark that I will be referring to as we go along.

So now let's start with some of the results of risk characterization. First, for acute toxicity, using the maximum one-hour concentration of a chemical, detected at any time in any of the fields, the acute hazard quotient for the inhalation route was well below the benchmark of 1, both for on-field and off-field exposures.

So there's a single field-related chemical and ten non-field-related chemical, and this table shows that the on-field acute hazard index was well below 1 for the field-related chemicals and also was below 1 for the non-field-related chemicals. And same scenario for the off-field.

The styrene was the only field-related chemical with toxicity criteria here, whereas acetaldehyde, benzene, 2-butanone, 2-butoxyethanol, formaldehyde, phenol, tetrachloroethylene, toluene and xylenes were the non-field-related chemicals that were included in this calculation. You have already seen this during this morning's presentation.

So those were the chemicals that had sources other than crumb rubber in-fill or the synthetic turf field as the source.

For the field-related chemicals, without toxicity criteria for acute exposures, we have made comparisons of maximal air concentrations with available subchronic health guidance values from other sources. So there are three of them available from U.S. EPA's PPRTV database and the ATSDR MRL. And in all those cases, those concentrations were much lower than the subchronic health guidance values as well.

Similarly, for one-day dermal and ingestion exposures there were no one-day toxicity criteria available, but there were no exceedances based on comparisons with the subchronic health guidance values for the dermal or oral route as well.

Now, after developmental and reproductive toxicants, here on average, the hazard index was less than 1 ranging from .01 to .58 for all the receptor groups and age groups. That was based on the 24 field-related chemicals. So it's adding the hazard quotient for all the chemicals via all of the routes yielding a hazard index which was well below 1 on average.

Looking at the individual values, the maximal value we could find were -- there were cases where it exceeded 1. That would be for athletes of 11 to 70 years old, when it ranged from 1.2 to 1.8.

The chemical driver in this case was benzo[a]pyrene. Benzo[a]pyrene was one for which the toxicity criteria was calculated using an uncertainty factor of 3,000. This means the reference guidance value for humans is 3,000 times less than the lowest concentration at which adverse health effects were observed in animals, just to put it in perspective in terms of the data gaps for benzo[a]pyrene.

And it's also relevant to note that the parameters and assumptions used for the exposure assessment -- well, I'll come to that in a moment.

So here, this picture captures the maximal hazard index. You know, the hazard index was calculated for the 24 chemicals for each one of the fields. I'm picking out the maximal numbers. One can see that it ranged from 1.2 to 1.8 in athletes of 16 to 30 years old, whereas in all other cases it was below 1.

All the average values were within 1, the benchmark of 1, whereas the maximum individual value that we had seen were in the range of that 1.2 to 1.8 in those three cases.

So this hazard indices, once again, were calculated based on the 24 chemicals accounting for inhalation exposure during about three hours during each game and practice, ingestion of about 300 milligrams crumb rubber per event and dermal exposure based on skin load of about 180 milligram crumb rubber per event.

And the odds of all of these occurring in these age groups were actually low. They're indicating a low probability of observing a hazard of 1.2 to 1.8, which is well within the uncertainty factor of 3,000 used for benzo[a]pyrene which is the driver in this case.

Now on to chronic exposure to sensory irritants. Here the hazard indices were well below 1, based on either the field-related chemical, which was styrene, and the two non-field-related sensory toxicants which were formaldehyde and acetaldehyde.

So each individual field hazard was assessed using the field's average concentration for this. So each field, the sensory irritation hazard indices were calculated based on values from each field.

So these were below .01 for the on-field exposures for all exposure groups, and the off-field numbers were always below .01, and not shown on this table.

So overall, only the field-related chemical styrene evaluated as a sensory irritant did not present a hazard on-field or off-field. However, you do see the contributions from the non-field-related chemicals in the second column as the maximum numbers did exceed 1 in the case of formaldehyde and acetaldehyde as the non-field-related contributors.

Now on to the non-cancer hazards, chronic effects.

The average across fields was below 1. The hazard index was below 1, ranging from .03 to .5 for all receptors. This was based on 99 field-related chemicals and 21 non-field-related chemicals.

Now, to the second scenario of looking into the individual field values, the maximal hazard index was below 1 for all receptors except in two cases, or in 31 groups except for two cases. One is the athletes of 16 to 30-year-old where the hazard index was equal to 1. And the second was on-field spectators, zero to two years old where the hazard index was 1.2.

So the on-field spectators are children going off of the spectator stands onto the play field, sitting, playing, and eating in the field. Those are the on-field infant spectators that are being referred to here where there's a small exceedance compared to a benchmark of 1.

In this case the driver was lead and ingestion route was the main contributor as well.

Pictorially I'm just capturing those chronic hazard indices for the field-related general chemicals. In this case you see the values for athletes and then coaches, referees, and finally the on-field spectators. Where you see the infant group all the way in the top, that's the blue circle that you see just above the dotted line. That's the one that I'm referring to.

So these are the maximum hazard indices calculated. And this value for the on-field infant spectators, as I mentioned, is driven by ingestion and by lead basically.

And in all other cases it's well-below the reference value of 1. And also very often you see all of them congested together below. That's why you don't see all of the colors in there. So they're all kind of together in there at the bottom, on the bottom and the lower levels.

So this pictorial shows the ingestion contribution is the main driver of the hazard index in the on-field spectators or the infants. Where you see the distribution of hazard index that goes from below .2 to .4 to .6 to .8 to 1, and above 1, that's the last case where I referred to with the circle in the previous picture. In all cases it's the ingestion that's the driver.

Whereas in the athletes of 16 to 30 years, it's mainly inhalation that contributed, which was a driver of the hazard index.

Finally, the cancer risk. Here, the mean cancer risk for combined exposure to field and non-field-related carcinogens was greater than one in a million for all receptors. And it was primarily driven by the non-field-related carcinogens. The non-field-related carcinogens accounted for more than 90 percent of the cancer values. That's the mean.

And the mean cancer risk levels associated with field-related chemicals in all the receptor groups, athletes, coaches, referees, and spectators, were below one in a million except for one group, the on-field infant spectators for which it was slightly above the benchmark which was at 1.1 in a million.

So once again, the on-field spectators are the ones who go from the bleachers onto the field, sitting and playing and consuming.

Based on the individual field cancer risk levels, the maximum, when you look at the individual field cancer risk levels, the maximal value exceeded -- was always greater than one in a million in two groups. One, the on-field infant spectators where the range was .3 to 2.7 in a million. So the one in a million is encompassed in there or the slight exceedance is encompassed in there. The same with the athlete groups as well as I'll show in the next two slides.

So here we see the range of the values, the cancer risk levels in each one of the age groups of the on-field spectators and off-field spectators based on multi-route considerations and multi-chemical considerations.

And I draw your attention to the first bar graph that exceeds the dotted line. So here it goes from .3 to 2.7. So those are the -- that's the range of the values calculated for the on-field spectators.

One of the considerations is the assumptions and parameters of going into the exposure assessment and categorizing the risk for the on-field spectators, the infants that get on the field.

They're exposed to about three hours per event. 161 events per year for the infants. And these are numbers from the supplementary materials. I'm just repeating them. Oral exposure to 153 milligrams of crumb rubber per event, per game, that they'll go to, 153 milligrams during those 161 events.

And dermal exposure or a skin load of about 50 milligrams of crumb rubber per event during the 161 events on the children -- in the infants that get onto the field.

So considering all of these worst-case scenarios and parameters used, we conclude that these do not raise to significant level of concern.

Also, there's the additional application of an age sensitivity factor of 10 to calculate the cancer risk for infants of zero to two-year-old, calculations as Jocelyn had shown this morning.

So considering that we would say, considering that this risk level is of possible concern, particularly because of the hand-to-mouth activity and the ingestion of crumb rubber in-fill in the turf field by the infants.

Similarly, these are the ones for the athletes. And I draw your attention to the two bars where they're slightly above the benchmark of 1. The whole range goes from well below 1 to a little above 1.

So having presented these numbers for

the cancer and non-cancer risks, let me move on to address the considerations of variability, uncertainty and limitations of the study before concluding.

In terms of the variability was addressed to the extent by considering -- to the extent of considering the various subgroups, the 33 subgroups, seven athletes, four for coaches, four referees, nine on-field spectators, and nine off-field spectators.

Additional aspects that deserve mention are the sample heterogeneity. Given that crumb rubber in-fill is produced from a variety of sources, in terms of automobile waste tires, different tire types, models, brands, production years, age in traffic and so forth, but we have considered this heterogeneity in the analysis of crumb rubber variation within the samples and within the fields in their analysis.

Then for time-activity and exposure parameters, as Dr. Claude mentioned this morning, we conducted a California specific time-activity survey to derive athlete-specific physical parameters and also soccer-specific exposure parameters to better characterize exposures and better characterize the variability there.

In terms of the athlete player

position, even though we did not consider the variability among the various athlete positions, given the concern for the high exposure of chemicals for goalies due to frequent diving activity and potentially ingestion of crumb rubber, the study used a goalie-specific scenario to compute the risk values for all the athlete exposure scenarios.

In terms of uncertainty, any risk characterization should recognize the sources and impact of uncertainty. In this regard I would bring about three aspects here. One on the subject of chemical characterization and source designations, a critical concept and aspect of designating the chemicals as being field-related or non-field-related.

You saw the methodologies that were used to characterize them. But in this study, however, we conducted and presented calculations for both, both field-related and non-field-related. That's the way to address that concern for uncertainty.

And then in terms of exposure assessment, the parameters for coaches, referees, and spectators were based on the time-activity survey collected in athletes. And we used the highest mean values from athletes for all the other groups to be health-protective.

This task survey did not provide any information about the amount of crumb rubber ingested during the course of soccer activities, so we either used literature data to estimate the direct ingestion amount and it is likely to be a conservative overestimate in the exposure on risk assessments.

On the topic of dose-response assessment, I think we have already touched upon that for noncarcinogens for chemicals without established values, for which we developed new values applying appropriate factors. And for the DARTs considered as single-exposure event as being sufficient to cause developmental and reproductive health outcomes, so we did not use the overall average or anything but we considered just a single-day or single-event concentrations there.

Also, the use of the toxic equivalency factor or potency equivalency factor of BaP or benzo[a]pyrene and other PAHs is certainly a source of uncertainty to be kept in mind in this context.

That's what was used to derive the toxicity criteria for benzanthracene, benzofluoranthene, chrysene, indeno pyrene, and cyclopenta pyrene.

In terms of the study boundaries and limitations, I just want to emphasize that we evaluated the crumb rubber in-fill, but not the backing materials or the grass blade components. And no analysis for metals and fine particulate matter from the air was conducted due to logistics and logical constraints.

However, we measured the bioaccessible concentrations of metals and crumb rubber for evaluating ingestion exposure, as you saw in this morning's presentation.

Finally, the study conducted assessments for each receptor category and not for various scenarios of combined receptor roles, which can be done given the -- like a person acting multiple roles during a single event or on different roles during a year or more than a year and so forth.

But a time-adjusted hazard index or a combination of cancer risks can be calculated based on what we have presented.

But given the sufficient number of hours, exposure hours used per year in these calculations in any given role, and given essentially that all the risk values were below the -- or above the acceptable benchmark, below the acceptable benchmarks, the likelihood of significant health risks arising from combined those scenarios is considered to be low, and we indicate that in the report.

So to conclude, overall, based on the available data, the methods used and the limits described in this report, overall the study found no significant health risks in terms of acute toxicity, developmental and reproductive toxicity, sensory irritation, general chronic toxicity and cancer risk to players, coaches, referees, and spectators from on-field or off-field exposures to field-related chemicals in crumb rubber in-fill from synthetic fields.

Based on the maximal values from the individual field data, there were a few instances associated with turf-field-related chemicals that are of low odds of actually occurring that one would consider as of low probability and of low concern. And that would be three cases. DART in athletes aged 11 to 70, chronic toxicity in the on-field infant spectators, and the excess cancer risk in on-field infant spectators and athletes of 16 to 30 years.

And much of these calculations for the on-field infant spectators would indicate that the necessity or the emphasis to reduce the hand-to-mouth activity and limiting the time on the turf field for the infant spectators who get off the spectator stand and play on the turf fields.

I would stop at that and address any questions or clarifications either to me or to Jocelyn.

DR. BALMES: Thank you, Dr. Krishnan.

So the floor is open for the panel. The dais is open for the panel to comment.

Sandy?

DR. ECKEL: This is Sandy Eckel. I have a clarification question about the elevated DART for athletes aged 11 to 70. I think it was on Slide 15. I was just trying to understand the heterogeneity on Slide 15, the hazard index estimates for athletes. And I noticed that -- I at least see three dots that are above the 1, and one dot that's very close to 0, and I was trying to understand what was the driver of that heterogeneity in those estimates there?

Was it different breathing rates? Because it seems like it's by age, these differences, and I was trying to understand why there was such a difference there.

DR. KRISHNAN: Do you want to start or do you want me to start?

DR. CLAUDE: I can start. So a lot of those groups that are -- so a lot of those groups that are down there toward right on the X axis, so they look like they're 0, but those are the values that are like the less than .01. And for most of those groups are the younger age groups, so their time on the field is a lot less than those older age groups. And they may not have as many practices. They might have one practice per week, whereas some of the other groups might have two or three practices and games.

So a lot of that is due to differences in exposure frequency. You do get some of those breathing rates in there because the younger kids aren't going to have as high breathing rates and have such high exertion levels as some of the higher, more competitive athletes.

So a lot of what's driving that is those types of differences and physiological differences in breathing rate and then duration and exposure frequencies.

DR. KRISHNAN: Thank you. These are maximal values for any of the age groups. So if you picked the one on the top, the 1.8, that's for the 16 to 30 years. So the average for that across the 35 fields was .6. So from that distribution we just picked only the maximal value to show here in each one of those cases.

But all of the averages for all of the age groups were well-below the reference index of 1.

DR. ECKEL: Thank you very much. I had one other big-picture comment. My expertise is more in epidemiology studies, and I noticed that it seems like these risk assessments are all sort of chemical by chemical. And it's very popular in epidemiological studies these days of multiple exposures to look at interactions between different exposures, and it seems like this might not be possible in this kind of study but it might be worth it to mention the limitations that the elements were considered one by one rather than potential joint effects of multiple chemical exposures, if I understand correctly.

DR. KRISHNAN: We'll certainly take that into account and mention that. One way this study has addressed that is by adding the hazard or the risk associated with each one of the chemicals. So it's the additivity that's used in this particular case. So that's the hazard index.

DR. BALMES: While we're on this Slide 15, I actually like the way that age strata are shown here. But in the conclusions, when you say DART for athletes age 11 to 70, it's the 70 -- I'm 75, so I appreciate you're worried about developmental reproductive toxicity for old people, but it doesn't -- I don't know for public, it just seems like too wide of a range in terms of summarizing things.

Again, I don't have any problem the way it's broken down on Slide 15 because you have each age group, but it just sounds weird to have DART for athletes aged 11 to 70. I know people are still playing soccer at 70, but I don't think there's too much concern about developmental reproductive toxicity at that age. It just doesn't quite meet the test, to me.

DR. BENNETT: And I had a quick question about the slide too because I wasn't clear. I thought you didn't calculate the DART for 6 to 11, but you did calculate the DART for 6 to 11 and it was basically zero? Isn't that one that's on the line, the 6 to 11? What's the value of the 6 to 11 years? Isn't that that dot that's basically athletes at zero? That brown dot at zero?

DR. CLAUDE: The 6 to 11 for field-related DARTs is less than .01. So it was very low. So it's the 11 to 16 through 50 to 70 that encompassed those three dots. And there's a little bit of overlap

between them for those five age groups.
DR. BENNETT: So the 6- to 11-year-olds had basically like a hundred times less exposure?
DR. CLAUDE: Very low, yeah. Also one thing to keep in mind, because these are individual field calculations, so -- there's 35 fields, so not every DART was tested and detected. Well, not tested, it was not detected on each field. So some fields may have less detection than others, so that also will take into account in the average. You might have one field that's only got three versus one that's got all of them.
So some of that difference you're seeing in the levels of the hazard might be due kind of to that too just because some fields having fewer chemicals detected on it as well.
DR. BENNETT: It's just surprising that the exposure is 100 times greater for 11- to 16-year-olds than 6- to 11-year-olds.
DR. BALMES: Did you have --
DR. BENNETT: I did have one other question. Or do you want to go and then I can ask mine?
DR. BALMES: No, you have the floor. Go ahead.
DR. BENNETT: I noticed on the zero- to

two-year-olds, you had lead exposure rates, but I know on -- again, sort of from epidemiology and whatnot, really seeing no level of lead exposure is safe. So I felt like, yeah, you guys probably are taking a published value for the levels of lead exposure that were considered safe, but I feel like it would be important to note that at this point we kind of consider no exposure to lead as being acceptable.

I mean, I do agree that you've got, I think, the 153 grams of field ingested is a lot. Again, it would probably be good to convert that into some sort of measurement we can understand. But even so, I feel like you needed to say a little bit more about any lead exposure being problematic.

It sounds like John might concur with that thought.

DR. BALMES: Well, yes, I definitely agree that no level of lead exposure is currently advised for child development, cognitive development.

You may, Dr. Kyle.

DR. KYLE: I support your comment. If you're adding lead to children's environment, that's a health concern irregardless of these numbers.

But I was wondering what you used for the hazard index for lead because we don't have a hazard index for lead number because there's no safe level of exposure. So it talks here as if a hazard index calculation was used, and I was just wondering how you did that. Because I don't think OEHHA even has one, do they?

And if this is a look-up, you can answer that later. I don't want to draw the meeting to a close. This is a small question.

Do you understand my question?

DR. CLAUDE: Yes.

DR. KYLE: Thank you.

DR. BALMES: While they're working on that, do you have any other comments, Dr. Kyle?

DR. KYLE: Yeah.

DR. BALMES: You may.

DR. KYLE: And this may be more a matter of writing than the science, but the distinction between the so-called field-related chemicals and the so-called non-field-related chemicals is soft under these methods because, as the report says, this is what the report says somewhere else, that we're not really sure whether what is measured on-field and off-field are real differences between what comes from the crumb rubber and what doesn't because of the proximity of the areas, for one reason, the space between what was measured on-field and off-field wasn't necessarily that far away or free of wind interference.

And also there's another reason. I'm blanking on it right now.

So I guess I feel like this makes too much of that distinction. The way that some of this is done, it really makes it look like we know that these are the ones that are, quote, on-field which means from the crumb rubber, and these other ones which are off-field, are therefore not from the crumb rubber. And we really -- we're not as sure about that as this sounds.

I remember the second reason now. The second reason was because the crumb rubber also may have blown around. It's not necessarily strictly limited to the field or any specific proximity. It gets tracked in and out so that could be another reason.

So I'm not saying we shouldn't do this, but I feel like that softness of that distinction doesn't get drawn into the discussion about -- I don't know if that's exactly uncertainty. It's a limitation, I guess, or something like that. I'm not sure what category to put that in, but I feel like that was missing from this discussion.

And it's really quite important whether -- and also probably unknowable without spending a lot more money. Which is kind of part of the, well, what did we learn from this? What kind of studies can we do to figure out actually in the environment to make these small differentiation between what's actually on a field.

In my mind, then, does that mean that when is this kind of research valuable or when should we look at what the ingredients are and make decisions and finding space on that? That's a policy question, not a science question.

But again, I'm thinking about what did we learn from this. And one thing we learned is, it's hard to be clear in the environment about what's ambient and what comes from where in a dispositive way.

And I still commend your efforts. We learned a lot from this. And so I'm not being critical of doing it, but just that maybe the conclusion is too -- the distinction is too strong. As we think about what we can learn and where in this sort of chain of use, et cetera, it's worthwhile to do studies and how we can make decisions. It's on my mind a little bit. When is this helpful?

It's related to the question that someone raised about, well, are these facts still true? When you have something that you know is an unmanaged mix that's uncharacterized, it may change in the form of the waste rubber, in ways that no one will flag for you. So how long are findings like this good for and what are the implications for that and should we spend more time measuring upstream to see whether the upcoming stream is changing.

So those are some thoughts on my mind.

DR. BALMES: Can I butt in for a second?

DR. KYLE: Yes, please, because I need to look up my next point.

DR. BALMES: Because to be fair -- I don't have -- I don't disagree with you that maybe the softness of the field versus non-field exposures could be highlighted, but Section 7.5.1 actually does talk about the issue of field versus non-field being difficult to characterize.

So it may not have been spelled out as clearly as I think you'd like it to be. And I agree with that. But it is in there.

DR. KYLE: And I said it was in there.

DR. BALMES: I'm sorry. I missed that.

DR. KYLE: I said I know you have it in here. And that's where I learned about it. I'm quoting back to them really their own text. That's okay. Maybe it was confusing in my presentation. But I think in the way this data is structured, it doesn't reflect that. It makes it sound more like a real --

DR. BALMES: And I agree with you.

DR. KYLE: Thank you. So I will yield the mic for now.

DR. BALMES: I wanted to see if Dr. McKone, who is online, has any thoughts.

DR. MCKONE: I just have a couple of points. One is a kind of a technical question, I guess. So just to be clear, each of the hazard quotients that were used to aggregate a hazard index, I think you said the toxicity criteria came from either OEHHA or probably a REL or EPA, right? Was the choice based on which was most restrictive, would lead to the highest hazard quotient? Or were they all OEHHA RELs?

I can't hear. I'm not hearing the answer. Sorry. I'm not getting ...

DR. KRISHNAN: Okay.

DR. MCKONE: Now I can hear you.

DR. KRISHNAN: There's a schematic in the Chapter 4 that's presented as to how the values were chosen. It's the most health-protective value with the way it has been the priority.

DR. MCKONE: That's what I thought. So it wouldn't be preferenced to REL. It would be preferenced to the most health-restrictive, right? Which makes sense.

So the question I have, though, is, it might be useful to look at the date that the toxicity criteria was established. For example, I've done this where we look at OEHHA REL, or we look at EPA, reference dose, and sometimes the one that is most restrictive is also the oldest, and may even be 20 years old.

And so one of the things that -- not that it would really change things, but it might be interesting to see if this is the most restrictive value is based on more recent data or older data. And I don't think -- it's not that you should change it, but it's interesting to see, in terms of understanding some of the uncertainties and other issues, it would just be useful to have a date associated with the toxicity criteria that was used in the hazard quotient.

I don't know if that's possible, but it's kind of useful because for an outsider to look at it, "Oh, it was really restrictive," but it was like 1970 study and nobody has updated it.

Another comment, while people were talking, I looked up OEHHA's website. There is no REL for lead that I could find, but there is a Prop 65 MADL, maximum allowed daily --

DR. KRISHNAN: Which one are you referring to?

DR. MCKONE: For lead. There's no safe dose for lead, but Prop 65 actually has MADL.

DR. KRISHNAN: So for DART --

DR. MCKONE: Well, it's reproductive under Prop 65. So that might have been what you were using in the toxicity criteria.

DR. EDWARDS: It's our maximum allowable daily level.

DR. KRISHNAN: That's the MADL. That's what is indicated on page E8 of the index.

DR. MCKONE: You were saying there's no standard. Well, there is no REL. And I'm not sure about EPA, but Prop 65 does have a number, just for information.

This is more of a broader comment and it has to do -- and I think in your summary and discussion I really welcome the fact that it kind of gets into issues of confidence and how safe people are. I get a little nervous when somebody says, "Well, one in a million is de minimus, and we're all safe." But if it goes above that -- I mean, I always get a little uncomfortable when somebody says, "Well, it doesn't meet the standard because it's two in a million."

And I always ask, "Well, if somebody made a bet with me and said you have a one in a million chance of winning a million dollars, how much would you pay?"

And then they say, "What if it goes to 2.7 in a million? Would you double your bet?"

No, not really, right? It's two in a million. In the grand scheme of things, 2.7 in a million, in the reality of likelihood and things is not that -- so I think instead of focusing as much on oh, the hazard index went slightly above 1 or the risk was a little over one in a million, it might be -- I mean, not to focus so much on that as the fact -- what I see in this is a study that says, yes, there's health issues but we have high confidence based on everything we did, looking at exposures, looking at toxicity factors. We're down in numbers that any reasonable person would be comfortable with if you trust the toxicity and the exposure assessment.

And, again, it's just how we discuss our confidence or communicate the fact that the study really points to the fact that the community is quite safe. There's no reason to run out and put a ban on all soccer playing on synthetic turf.

And, again, I mean, that's just a little bit about crafting the language for communities. So I'm not quite sure how to do that, and others may have an idea, but I do get a little nervous when somebody says, "Well, if one in a million is acceptable, two in a million is over the limit so it's not good."

That's the end of my comments.

DR. BALMES: Thank you, Dr. McKone.

DR. CLAUDE: Could I chip in real quick?

DR. BALMES: Go ahead, Jocelyn.

DR. CLAUDE: I just want to address the toxicity criteria. So we did choose values that were the most health-protective, but we also did put more weight on more recent assessments. So in the case where we did have some of those chemicals that had criteria from the '80s, if there was a more recent assessment if the value maybe wasn't as low, we did still look at all the data and quite possibly choose maybe a value that was higher because based on more recent data of higher quality. So we did take that into account.

In the appendix, I believe it's Appendix E, all of the studies and all of the years for all the criteria that are used are presented, so that data should be in the appendix.

DR. MCKONE: That's wonderful.

DR. KRISHNAN: The workflow is captured in Figure 4-1 in the main report. That shows not only the most health-protective but also the most recent value was sought for and used. Thank you.

DR. BALMES: Thank you for that clarification, Jocelyn.

Ed, do you have any comments?

MR. AVOL: I'm still struggling a little bit with, again, it's more in the sense of interpretation and how this is going to be understood by the public. So I'm looking at, I guess, Slide 15, the one-day hazard index and that plot that showed the athletes over a range and then the conclusion, Slide 27, I guess, that sort of said the DART for the athletes age 11 to 70.

One comment just as a side issue for those of us who are color-challenged when looking at a chart, it would have helped me to somehow identify what those four dots are under athletes to know who we're talking about. So could you actually just tell me once again so I can make sure that the comment I'm about to make, makes sense? The top one.

DR. EDWARDS: The top one is 16 to 30 years. The gray one is 50 to 70. And the third one down --

MR. AVOL: Which one is the gray one?

DR. EDWARDS: A little bit below 1.4. And then the third one at 1.2 is 40 to 50.

DR. BALMES: And the one on the bottom is 6 to 11.

DR. KRISHNAN: Actually, there's a table in Chapter 6, page 767. That's the table that has these numbers. And we only tried to pull out just the maximum numbers to show in this.

MR. AVOL: I appreciate that the report is much more detailed. The numbers are there. But if you're going to use a chart like this to sort of summarize it so people can look at it, I think you want to be sure that you get the right message across that you plan to apply.

So then the question -- not to dredge it up again, this 6 to 11 being almost at zero on the sheet here, which was a little surprising given that children sort of ages 7 to 11, are a large, if not substantial, component of the soccer population, the kids soccer population. They get per kilogram mass, they get to pretty high ventilation rates when they're running around, and they're close to the field, so they're potentially in the right exposure range.

And based on what your previous comment was in terms of, I guess, even a cancer risk, you said it was from 10 to 1, you assigned some numbers with the highest number being in the lowest ages. So it seems like they would be in the higher category.

So it seems like -- I guess my expectation is they're all pushing in the direction that they would have been sort of highest in range and it came out sort of just barely being measurable in the chart.

And so I don't dispute the data, the actual data. If that's what it says, that's what it says. It's just a question of the interpretation, how you explain that, because it seems like it's -- I wouldn't say inconsistent, but it seems like it's counterintuitive to what all the built-in considerations were leading up to that calculation.

So it seems like it would be helpful to have some sort of sentence or two that explains why even children, who we are potentially most concerned about being exposed on these fields, in this calculations turn out to be those we need to be concerned least about.

DR. BALMES: Dr. Bennett just pointed out -- I didn't notice this before -- the 11 to 16 is not even showing up.

DR. BENNETT: And what's also curious is when you read the table in the text, they don't list the value for 6 to 10. They start at 11 to 16 in the table. And now I've put my thing back, I don't remember what table it was. So it didn't even show that they calculated a 6 to 10.

DR. BALMES: But on Slide 15 there's no --

DR. BENNETT: It's probably under another value, right?

DR. BALMES: It must be under the athletes -- I mean, it must be under 6 to 11.

DR. CLAUDE: In the tables for the individual exposure routes, if the value was below .1, it wasn't put in the table. So those are the values only that are above .1. And so for the field-related DARTs too, inhalation was the primary driver of the pathway, and those were very low for those age groups. So that's why they're not in the inhalation table but they are in the tables for the oral exposures.

DR. BENNETT: But they're chronic inhalation -- if you look at Table 6-10, the 6- to 11-year-olds have very similar values to all of the other age groups for inhalation.

DR. BALMES: The other thing, as Dr. Avol just said, or Mr. Avol just said, the ventilation rates of young kids relative to their body mass is high.

DR. CLAUDE: Some uncertainty in that aspect. So in the survey we did, we had a very small number of participants aged two to six. So for that age group, I think we had three six-year-olds who filled out information.

So we did ask them information about exertion levels. So their reported exertion levels were lower than the athletes. They do say they're running at high intensity for most of the practice, whereas the borrowed six-year-old data, they didn't report having --

(No audio.)

DR. BENNETT: And then throwing in that the kids, also probably one of referees to really get at kind of modeling a kid that soccer is their youth sport and they do it all, you'd have a risk value if you added those up. It is slightly over 1 times 10 minus 6. It would probably be like 5 or 6.

Just to do that and show, look, even if we're really conservative and you were dragged to the soccer field as an infant to watch your older sibling and you then you played and then you kept playing and then you were a referee, you know, you pointed out that you can add these things up, but you just might want to do a couple scenarios and say here's what it is. It's still going to be relatively low in the grand scheme of things, but then it just feels like you've taken this extra step to being conservative on the exposure side and it's still showing that the risks are above de minimus, but they're still not that high.

DR. BALMES: Ed?

MR. AVOL: So I have a larger question. This morning we were the beneficiaries of an excellent report on the characterization, this afternoon on one of the toxicity and the risk characterization parts. And so now I'm not sure if there's going to be -- I don't think there's going to be a third presentation on sort of the synthesis of what the whole total picture is in the report.

So I guess I'm asking, put it all

together, and then you think about what we have. So we have this dataset from 2015, and in the appendices you did go back and you said, well, there have been a number of studies since then and some additional newer studies are cited and what the implications or the reported results of those studies are, and how that fits with your findings and how that's assimilated.

In some ways it's sort of like the report is sort of a picture in time. And then in the appendices there's sort of additional updates on where we are. But in the discussion and summary conclusion in the main body of the report, it seems like it would be useful for the public, for the reader, for people to be able to say, "Don't just think about this as this is something we did in the past. We've looked at what we did, which was exhaustively detailed. We've looked at what's been done since then to see if there had been any meaningful changes in it, and here is where we sit now," which I think helps to frame the study in a more contextually relevant and important consideration than saying, "Well, all this was done ten years ago. We better go look back and see where we are now."

DR. BALMES: Any other thoughts from the panel?

Dr. Kyle.

DR. KYLE: On the issue of the chemicals that fell out because of lack of tox values like the issue I raised in the first session about let's identify where things fell out and building on your comment, I think it would be good to identify that and where it fell out and what.

I agree with all the comments that everyone else has made here too. I guess the last thing I wanted to say is that I agree our hair doesn't need to be on fire about this issue. It's not an emergency. I wouldn't evacuate playgrounds, et cetera.

But if I were advising my friend on the school board about this, I would say I would try not to use this stuff because it has known toxic chemicals. It's lead. We don't really know everything about it and you don't necessarily have to. The only context for this is not people coming in and banning it. It's also an information thing about, are we sure it's safe? And I would say I agree it's not a huge problem or a crisis, but am I sure it's safe? No.

So I think there's a range of questions people ask. And there might be some way to acknowledge that. And maybe there isn't because it's OEHHA, and you're the government, and you're speaking in kind of a government way. And someone might sue you.

But I do think that the standard you're setting here in a way is too high and that a lot of people, they want to avoid things that might be hazardous. They want to make sure their kids are using and have safe food and products and stuff. And so if you look at this -- and maybe no one wants to answer that -- but would you say you're sure it's safe? I would say I would probably pick something else if I could, speaking solely for myself, but based with having reviewed this. Thank you.

DR. BALMES: Dr. McKone, any other thoughts?

DR. MCKONE: No. I mean, I don't think a government report can really say what Dr. Kyle did, but I think that's kind of the reality of it, is this is not something -- after years of study, we don't see a smoking gun or we don't see anything where it's time to call out or for the state to take regulatory action or ban it.

But it is -- I mean, there's an interesting question of when people say, "Well, what would you do?" I'm kind of with Dr. Kyle. It's like, well, if you could avoid it, who knows. If somebody said, "Are we at risk?" I would say, "No, I don't think you are."

But if you asked me, I would look through the data and think about it. There's a lot of things that are that way but I don't think the state can write that in a report, but we can say that.

DR. BALMES: And I'm glad my kid mostly played on grass.

Dr. Eckel, any other comments?

Well, I guess I would make one comment and maybe let our OEHHA scientists respond. This report took ten years. I think it's really an excellent report, as we've all said. And I realize there was a pandemic in there, and also a change in leadership at the agency and such.

But anyways, a complicated study design with lots of moving parts. But it really did take a long time. And now we're saying, is this still relevant, this 2015 snapshot? I'm not being critical of any individual here, but sort of institutionally, CARB, my agency, is part of CalEPA as well, but it just seems like this took too long.

So in the future when OEHHA has a big task like this -- there's no question it was big --

we'll probably need to have it better resourced. I guess I'll put it that way. Again, not being critical of anyone in the room because I think you worked hard and have a good report to show for it.

So we finished the morning session early, which I think is a testament to how well it was presented. So we came back early. I don't think we really need a break, if I can read the room, at least my colleagues on the dais here. Do we need to have our public comments right at 2:45?

Thank you.

DR. KYLE: I've been authorized to bring up a detail, and that is, I was wondering if we could look up how you did the PFAS testing on this because of the reason that there aren't standards either for very many PFAS chemicals. So I'm -- I'm just curious about.

DR. BALMES: One of the more recent reports did find PFAS.

DR. KYLE: I think from the grass part.

DR. BALMES: Yeah.

DR. KYLE: I'm just interested to know how you did that because you said you didn't find any. I'm wondering what was tested. What did you test for? And I don't want need to know right now. But thank you.

And I guess I would also say I guess we should have looked at the grass too or the -- it's not grass, the plastic stuff.

DR. BALMES: Synthetic fibers.

DR. KYLE: Yes, thank you so much, John.

DR. BALMES: Blades, yes.

We need the court reporter for the public comments, right?

We'll take a five-minute break while waiting to hear from the court reporter.

(Recess.)

MS. SUWOL: I'm Robina Suwol. I'm the executive director of California Safe Schools. I want to thank you very much for the opportunity to comment both in writing and provide a short verbal comment today on the OEHHA Synthetic Turf Study Report.

We greatly respect and appreciate the significant time and effort and extensive details contributed by staff and the OEHHA scientific panel in preparing the report.

The report indicates 35 fields were studied, with a focus of risk from tire crumb rubber. Given the wide variation of materials, age, maintenance, and usage of artificial turf across

California, the limited focus on tire crumb rubber appears to be insufficient to represent the broader landscape and variability of all chemicals in artificial turf installations statewide and their health impacts.

We would like to see comprehensive health and safety assessment with real-time biomonitoring of individuals actively using the synthetic turf fields under normal playing conditions.

The current conclusions of health impacts in the report appear to have been determined by the responses of the 1,069 participants who completed online or in-person surveys, designated staff observing and noting 40 videotaped soccer players during five practices and five games, and 35 field studies, and artificial biofluid studies, which is a wonderful first step but not the same as real-time biomonitoring.

We hope that future research will evaluate all potential pathways including not only tire crumb, but synthetic turf fibers, backing materials, and in-fill materials, all of which may contribute to health risk.

Without full chemical exposure biomonitoring data, the health risk analysis remains limited and speculative. And given the limitations identified and the time frame that these studies were performed in 2015, California Safe Schools respectfully and strongly urges OEHHA to call for a precautionary moratorium on installation of new synthetic turf fields until full comprehensive peer-reviewed health and environmental risk assessments, including biomonitoring of active users, are completed. The health and safety of our children, athletes, community, and public deserve the highest protection.

And, again, thank you to OEHHA for this report. Thank you.

DR. BALMES: Thank you, Ms. Suwol.

Do we have any other public comments?

MS. VAGHEFI: I do not see any hands raised.

DR. BALMES: I guess we should keep the line open until 2:45.

Moving on, our next discussion is the final panel discussion and comments. We've been giving our overall comments along the way.

Any big thoughts, Dr. Bennett?

DR. BENNETT: I've kind of given most of my thoughts.

DR. BALMES: That's fine.

Dr. McKone, any sort of overriding comments?

DR. McKONE: No. Just I guess it's a thought that we probably brought up and discussed, but I think the real challenge in trying to do all of this is there is an expectation that people want quick answers. And it's very difficult. I mean, this is not -- it's just the nature of the issue that you can't throw together a team, you can't throw together protocols and measurements and deploy them within months.

As you brought out early, Dr. Balmes, it took longer for a number of factors, including the pandemic. A broader thought is how do we deploy or how does an agency like OEHHA deploy a rapid response? I'm not sure they can. But it's something I think we all need to think about it, is when communities have a concern.

I mean, a similar issue that I've been involved with but also is the same kind of problem as Aliso Canyon, where communities really need answers and it's just putting together the team and the equipment and the protocols, just takes years. And I don't know if we can get around that.

And I'm sure there are many others that

we have experience with. So that's kind of something that bothers me at some level, is the failure of the environmental health sciences community to engage in a little more rapid response because our problem is we want to get it right, and if you do a rapid response, you usually get it wrong. And that doesn't serve anyone well.

So it's kind of rambling, but I think that's what this and a number of other issues bring up.

DR. BALMES: Thank you, Dr. McKone.

Dr. Eckel, any last comments?

DR. ECKEL: I just wanted to reiterate that I really enjoyed this experience being on this panel. I thought it was a well-conducted study. I did want to think more broadly. This study was narrow and it was focused on the chemical exposures from the crumb rubber. You had some really interesting data on temperature, and I know that that will be of interest to folks in the future.

I didn't look in all the appendices, but if you could include the data, like a plot of the ambient temperature versus the surface temperature, that could be useful to people in the future because I think that will be of growing concern.

Thank you very much.

DR. BALMES: Before I ask Dr. Kyle for her final comments, I just would echo what you just said about the heat. That is in some ways the most striking thing in the report for me.

Dr. Kyle.

DR. KYLE: Thank you.

I also have enjoyed this and appreciate the creativity that OEHHA brought to this in doing some things that we don't usually do. I'm not sure we've drawn the full lessons from those yet. I think we will, and I appreciate that because sometimes we aren't creative and we do the same thing we did the last time.

I think about this from a little broader point of view in that I think we're in somewhat of a crisis with toxics because we're not able to keep up generally with the identification of toxic materials and substances, characterization, testing, listing, all those things that OEHHA does and other entities like EPA do too. We're not keeping up with changes in use or anything. We're still in many ways in 1990.

And so some of the methods and explorations you did here I think would be informative to ways to catch up. And so that's one reason I want to look into some of these things somewhat.

But Dr. McKone kind of raised this, we don't have a rapid response capability. I think it's more than that. We don't have a range of methods that we can use to do something rather than nothing instead of the perfect thing.

And I'm working a lot on PFAS now and we just got last year the mega reviews of two of the legacy PFAS that were supposedly phased out 20 years ago. And now we have a long major review that they can use to set a drinking water standard.

Okay, then what about the 800 other ones? We're nowhere on most of that. We don't have standards for most of those things.

And this is an endemic problem that we're not keeping up. So how do we deal with that?

Like I said, I think you all were creative in trying to do some new things and there are things to learn from that, and that's kind of what my next spot is.

Thank you.

DR. BALMES: Thank you for those comments.

And I guess I would just say that while I just express my sort of frustration about how long it took, on the other hand I agree with Dr. Kyle. This is a state agency report that actually was innovative and looked at multiple -- looked at both exposure and potential toxicity of the exposures in creative ways that she said.

So I'm not in any way trying to devalue what you've done. It's our job to look at it, especially how it translates for future work and to the public, and I think we've done that.

And I'll ask Dr. Bennett for her last comment.

DR. BENNETT: I just had one more thought. It's kind of related to not being able to keep up and the rapid response thing. And I think partly a lot of the problem is a lot of the compounds that we're concerned about, we're exposed to every day, and so it's hard to tease out how much came from this event that happened or the fields, and if we go all the way and look at biomonitoring, you can't differentiate out what was already there versus what's new from the event; and the fact that we're not keeping up to have measurement techniques to look at all the new things to see if maybe there is something new that came from some event that happened or particular exposure. And then, again, understanding how those go into the body and what the changes in concentration are.

So it's just all very challenging, and I do feel like you guys did the absolute best that you could with the techniques and methods that we have available.

DR. BALMES: And I guess I would say that one of the main reasons we can't keep up is that new chemicals and new uses of the chemicals are being put forward on almost a daily basis, certainly a frequent basis. And I think Dr. Kyle would probably agree with me, we need to go upstream and assess exposures in toxicity before there's wide market use of something.

I mean, crumb rubber use was supported by the EPA because it was a good use of -- good way to recycle tires, which when they're in a big dump they catch on fire and they burn for months.

Europe has done a little bit better than we have with their REACH efforts, but we really need to be looking at toxicity before market -- widespread market use, which we're a long way from in this country.

I think Mr. Avol has a comment or two.

MR. AVOL: So I just have one other consideration. I think I look at this -- in some ways I look at the reporting in two parts, one in terms of the science, which is excellent. It was diverse. It was creative. Thought about a lot of these pieces. Many different groups contributed to it, and all should be thanked as an accomplished piece of work.

And I think about how this is going to be used and how it's described and contextualized. So on that second point I would just say clearly -- well, I don't want to put words in your mouth. But from my perspective in 2014, 2013, there's a lot of concern about the use of crumb rubber on these fields and that was the focus.

And so it makes contextual complete sense that we systematically went to understand what it was in that rubber which was not meant to be used for children's fields but rather for car tires and truck tires and so forth, to see if there were any health concerns. So I think that's completely legitimate.

Now that we've looked at that and we understand that, maybe if we could rewind and go back and say, well, there's also the plastic fibers. There's also the cushioning material. There's several components to this, but clearly the crumb rubber was the red flag in our face that we're trying to understand, and the paints and the coverings and so forth on the material.

So I don't think you need to be particularly defensive about focusing on the rubber, but I think, again, in the report, in the summary and description, maybe in the introduction or rationale for why this study was set up the way it was, I think it would be appropriate to say something. Crumb rubber is widely and generally used in all this and was not made for a specific purpose. And so from a public health standpoint, it was an important question to ask because of the potential for exposure.

DR. BALMES: I think if the panel is finished with final comments, I'll turn the mic over to Dr. Edwards.

DR. EDWARDS: Thanks, John.

All right. So just wanted to really thank the committee. Really appreciate all the thoughtful comments from today. I thought the discussion was excellent, and we really do appreciate the feedback around the draft report and sort of broadly where we can go in the future.

Just to kind of summarize some of the main actions that I heard, I think from the afternoon discussion to -- and also from the morning from Dr. Bennett's comments around sort of the time activity relationships, really look at those factors to -- I guess my quotes here or my notes says "the soccer is life youth," where there is a strong soccer component to their everyday activities that we can kind of look at and see where the values come from that compared to what we had done.

The sort of second piece around -- and this is just a broader categorization, but within the limitations and the uncertainties to really be able to highlight and provide context into some of the areas a little bit more that we had not looked at before to kind of see if we could tease out a little bit on the first-year effects a little bit more. And then also to maybe look at heat, if there's any inferences we can make on the evaluation of the temperatures a little bit more throughout the report.

The last item is sort of to kind of go back and have that sort of revisit component to really look at the chemicals that we initially started looking at. This gets to Dr. Kyle's comments. And to be able to maybe talk about why they weren't conducted and sort of so that there is an expansion of the discussion to have a broader awareness of these gaps and that was not evaluated during this study.

As for next steps on this report, we're

going to be taking into consideration the oral comments that we received today, the panel member comments, any written comments that we've also received, updating the current draft and finalizing later this year. So we're excited to get to a sort of closure on this work.

A couple of -- just to go off of Dr. Kyle's comments on sort of we're behind a bit. Just sort of stay tuned. We had a couple of workshops last year. It's what Dr. Krishnan is leading a group at OEHHA that just started a couple years ago concerning computational toxicology and new approach methodologies sort of really looking instead of trying to identify everything with animal studies or an epi study to be able to leverage existing information that does have those types of studies, to looking at chemical analogs and so forth from not only a scientific and technical perspective, but also the ability to use in a regulatory construct.

So I think the behindness part could maybe sort of try to -- through this, can hopefully maybe be able to get on par or catch up to some extent. But I did want to highlight that to this group so that you're aware that we are starting this work and in the next couple years hope to have something out in the near future.

DR. BALMES: I'm glad to hear that, Dave, because in the academic world that's already been going on for a few years, as I'm sure Dr. Krishnan knows. But it's good to see OEHHA getting there, getting up to speed.

DR. KYLE: Dr. Balmes, if I might, just for a second. And it's not just you. Everyone is behind. I didn't want that to sound like it was OEHHA. And I listened in to some of those workshops and there's some great stuff there.

DR. BALMES: I would just say this state is blessed to have OEHHA. Most states don't have anything like this agency.

DR. EDWARDS: So we're just waiting for four more minutes. Okay. This is going to be the last call for anyone that wants to have a public comment go on the record.

I don't see anything in the room and we're not seeing anything online.

So with that, I will go ahead and adjourn the meeting. Once again, thank you for everyone that attended online and in person. And the panel.

Thank you.

(Meeting adjourned at 2:41 p.m..)

STATE OF CALIFORNIA)
)ss:
COUNTY OF LOS ANGELES)

I, RUBEN GARCIA, CSR, do hereby certify that I am a duly qualified Certified Shorthand Reporter, in and for the State of California, holder of Certificate Number 11305, which is in full force and effect.

That the foregoing reporter videoconference proceedings were taken before me at the time herein set forth; that any witness in the foregoing proceedings, prior to testifying, were placed under oath; that every attempt was made to ensure a verbatim record of the remote proceedings which inherently have technical interference and audio interruptions and issues. Such transcript was created by me using machine shorthand which was thereafter transcribed under my direction.

I further certify that I am not a relative or employee or attorney or counsel of any of the parties nor am I financially interested in the outcome of this action.

IN WITNESS WHEREOF, I have subscribed my name this 12th day of May, 2025.

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RUBEN GARCIA, CSR NO. 11305

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