Summary of NASA-JPL Groundwater Cleanup Community Meeting on Health

Location/Date/Time:
Altadena Community Center
730 E. Altadena Drive, Altadena
April 21, 2004, 7:00-9:00 p.m.

Attendance:
Based on estimated head count:
- 90 total guests

Civic Leaders:
- Pasadena City Councilwoman Joyce Streator
- Pasadena Cultural Affairs Commissioner Roberta Martinez
- Pasadena Public Affairs Officer Ann Erdman
- Pasadena Water & Power, General Manager Phyllis Currie
- Member of Altadena Town Council, Michele Zack
- Lincoln Avenue Water Company ("LAWC"), General Manager Robert Hayward
- Several members of LAWC Board of Directors

Summary of Meeting

The following summary is compiled from the handwritten notes of NASA consultants that attended the meeting.

Merrilee Fellows, Manager for Outreach for NASA's Groundwater Cleanup explained that the purpose of the meeting was to follow up on a commitment NASA made at the January 2004 public meetings to connect local residents with the health experts who could answer their questions on health. She pointed out that, since the January meetings, NASA talked with interested citizens and sought to better understand their health concerns. NASA also sought advice on the health experts and venues recommended by the community. NASA relied on that advice in planning the meeting.

Ms. Fellows introduced Drs. Mary McDaniel, Chuck Lambert, and Susan Santos and explained their roles as meeting facilitators.

Ms. Fellows introduced Dr. Richard Williams, NASA's Chief Medical and Health Officer. She explained that NASA takes community concerns seriously and thus wanted to have a senior NASA manager present. She noted that the local groundwater cleanup effort continues to receive high-level support from NASA management for this project.

Ms. Fellows explained that, as NASA is not a health agency, the NASA-JPL (Jet Propulsion Laboratory) Water Cleanup team assembled the group of medical and public health experts present to respond to residents' questions on health. While there would be short presentations, including a technical update by NASA and a summary of health aspects by two of the experts, the focus of the meeting is for the public to ask questions and hear responses.

Ms. Fellows introduced NASA's Remedial Project Manager, Steve Slaten.

Mr. Slaten noted that the community would be more fully updated on NASA's progress on the groundwater cleanup project later this summer.

He then presented a short site history, explaining where the plume of chemicals in the groundwater is located (in approximate terms). Mr. Slaten indicated that there is no direct pathway to residents from the chemicals in the groundwater. **[See Slaten's slide 2.]** He emphasized NASA's commitment to cleaning up the groundwater by noting that they are talking action and moving quickly. Mr. Slaten also recognized that NASA is not alone in its efforts. NASA is supported and overseen by both state and federal regulators and works in close cooperation with the area water purveyors.

Mr. Slaten then introduced Pasadena Water & Power General Manager Phyllis Currie, Lincoln Avenue Water Company General Manager Bob Hayward, Mark Ripperda of the EPA Region 9 (the lead regulator on the project), Mohammad Zaidi of the Regional Water Quality Control Board, Michel Iskarous of the State Department of Toxic Substances Control, and Vera Melnyk-Vecchio of the California Department of Health Services.

Mr. Slaten then described the drill rig used to create extraction and injection wells on the JPL site. **[See Slaten's slide 3.]** He pointed out the location of a treatment plant unit that is under construction to remove chemicals from groundwater beneath JPL **[see Slaten's slide 4]** and the location and treatment train for a future treatment plant. He explained that the future treatment plant would treat off-site groundwater after it is piped from nearby City of Pasadena drinking wells onto the JPL property. **[see Slaten's slide 4.]** Mr. Slaten said the treatment plant currently under construction would be up and running this summer and would control chemicals at the source and help prevent further spreading of the chemicals in groundwater.

Ms. Fellows then introduced one of the meeting's co-hosts, Dr. Takashi M. Wada of the City of Pasadena Department of Public Health.

Dr. Wada [see biography at end of this summary] noted that his office knows of the great concern people have for the issue of safe water. He said the mission of the Department of Public Health is to ensure the health of all citizens of Pasadena and Altadena and explained that that was one reason why they co-hosted the meeting.

Mark Ripperda of the US Environmental Protection Agency (EPA), Region 9, then spoke. Mr. Ripperda acknowledged that there are concerns about health effects from chemicals in the groundwater that may have occurred before the wells were closed off. He noted that a number of community members attending NASA's public meetings in January expressed concerns and asked questions relating to health and their historical exposure to chemicals in groundwater associated with JPL. He reminded everyone that the water they are being served today is safe. Responding to a hypothetical question about the water that people were consuming before volatile organic compounds (VOCs) were detected in 1985 and perchlorate in 1997, he explained that those respective years were when wells were either turned off or treatment for those chemicals began.

The health experts then were introduced. *(A brief biography of each of the experts was distributed at the meeting. For a copy of these biographies please see the end of this document.)*

Two of the health experts, Dr. Stralka and Dr. Mack, made presentations.

Dr. Stralka

Dr. Stralka explained how regulators set allowable levels of chemicals in drinking water. He noted that, in the case of groundwater near JPL, the cleanup focuses on three chemicals. These include perchlorate (which he noted was a component of rocket fuel), trichloroethylene (TCE) and carbon tetrachloride (CCI_4). The latter two come from degreasing agents, cleaning fluids, refrigerants, and spot removers.

Dr. Stralka first discussed how risk from the above chemicals is assessed. He listed as goals for such a risk assessment: 1) to determine if the chemical in the environment is a danger to health, 2) to determine whether a safe level for long-term exposure to these chemicals can be set, and 3) to determine whether a cleanup plan for these chemicals can be developed and implemented.

He stressed that EPA tries to set regulatory levels based on the most sensitive individual in the segment of the population addressed.

Dr. Stralka noted that four steps are involved in risk assessment:

- Data gathering,
- Exposure assessments,
- Toxicity assessments, and
- Risk characterization.

Using these four steps, he said, levels can be set and safety factors can be considered.

He then outlined the health effects of exposure to each of the chemicals associated with the JPL groundwater.

Perchlorate at high doses affects the thyroid gland. In the U.S., doctors used therapeutic doses of perchlorate until the 1960s to control overactive thyroid glands.

Dr. Stralka noted that California in March set a public health goal (PHG) for perchlorate at 6 parts per billion (ppb) parts of water and that, before March, the level sought by the state was between 4 and 18 ppb. He also pointed out that the National Academy of Sciences is currently reviewing data on perchlorate to make recommendations to the EPA as to a desirable maximum contaminant level (MCL) of perchlorate in drinking water.

Dr. Stralka noted that the MCL (maximum contaminant level) for TCE (trichloroethylene) is currently set at 5 ppb (parts per billion). He also noted that the EPA regulates TCE because of its potential as a human carcinogen.

Carbon Tetrachloride, he said, is also a carcinogen, affecting both the liver and kidney. The MCL (maximum contaminant level) is set at 5 ppb (parts per billion).

Dr. Stralka explained that MCLs (maximum contaminant levels) are safe levels for the most sensitive parts of the population, such as children or the elderly. MCLs are laws,

while MCL Goals (MCLGs) and PHGs (Public Health Goals) are not laws, merely recommended levels or goals set by state or federal agencies.

Finally, Dr. Stralka referenced two studies of chemicals in groundwater at and near JPL. One is a risk assessment done in 1999 as part of the CERCLA-required "Remedial Investigation." That assessment, performed by NASA contractor Foster-Wheeler, was intended to determine whether exposure to the untreated water would pose any problem given the chemicals in that groundwater. The second study, also published in 1999, was undertaken by the Agency for Toxic Substances and Disease Registry (ATSDR), based in Atlanta, GA. [The ATSDR is one of eight agencies that constitute the Public Health Service, a part of the U.S. Department of Health and Human Services.] That study looked at risks to Altadena and Pasadena residents from drinking the water in the past, or in what is called "historical exposure."

Stralka noted that the ATSDR (Agency for Toxic Substances and Disease Registry) determined that VOCs (volatile organic compounds) in the groundwater beneath and near JPL were not at concentrations that could be expected to produce "adverse health outcomes." For perchlorate, the ATSDR reported that the levels of this chemical delivered in drinking water were below 18 ppb (parts per billion), which was being used at the time in screening levels.

Both studies, Dr. Stralka noted, were available for viewing online at the NASA groundwater cleanup website. *[Ed. note: The ATSDR study is available at: http://jplwater.nasa.gov/NMOWeb/AdminRecord/docs/NAS70569.PDF. The Risk Assessment, part of the Remedial Investigation, is available at: http://cercla.jpl.nasa.gov/NMOWeb/AdminRecord/docs/NAS71001.htm.]*

Dr. Mack

Dr. Mack introduced himself as head of the nation's largest group that studies causes of cancer (USC Norris Cancer Center), a group that produces more than 100 professional papers a year.

Dr. Mack noted that a common approach used in the study of cancer causation and risk is to look for evidence of increased cancer in a given geographic area as compared with what could be expected normally in the general population.

He said that TCE (trichloroethylene) is probably a carcinogen for humans, and there is limited evidence of involvement of TCE in cancers of the liver and biliary tract. He also noted that TCE might be involved in non-Hodgkin's lymphoma. In animals, TCE has been implicated in cancers of the liver, in non-Hodgkin's lymphoma, and other cancers.

PCE [tetrachloroethylene] is a similar carcinogen and has been identified with cancers in humans of the esophagus, with non-Hodgkin's lymphoma, and cervical cancer. Mack noted that he had been told PCE was not a chemical of concern at the JPL site.

Evidence is "inadequate" that Carbon Tetrachloride (CCl_4) causes cancer in humans, he said.

Dr. Mack noted that he is the author of a new book (*Cancers in the Urban Environment*) [publication expected in June 2004]. The book looks at 84 cancers and how they are

distributed in 1600 census tracts in Los Angeles County. The book compares the expected rate of cancers vs. the observed rate. In that book, a census tract is considered "high risk" if there is at least a 50 percent increase in the rate of cases in a given population as opposed to what is expected to be the rate, and if the difference is "statistically significant."

[*Ms. Fellows made a commitment to contact the local libraries (information repositories and JPL library) to ensure that Dr. Mack's book will be available at the libraries. Dr. Mack's presentation draws from his book, which includes the charts and text that explain the concepts discussed during the meeting.*]

Dr. Mack repeated what had been stated earlier – that perchlorate is not associated with increased risks of cancers of any kind.

He then showed examples of the entire county, highlighting the census tracts geographically situated south and east of the JPL site, the area where the chemicals in groundwater have migrated. He plotted levels of increased numbers of different cancers (as compared with expected rates) for the entire county as well as for the specific census tracts near JPL. For background, he discussed a number of cancers that occur in Los Angeles County. Among these are liver and breast cancers, non-Hodgkin's lymphoma, brain cancer, and cancers of the colon and the blood, bone marrow (multiple myeloma and leukemia), pancreas, cervix, esophagus, and prostate. As he discussed each cancer, he noted the population characteristics or demographics generally associated with increased risks for those cancers. These characteristics ranged from number of siblings in the family to "social class" (socio-economic status), to exposure to chemicals such as asbestos and exposure to sunlight or other factors.

None of the cancers he discussed was shown to be at a higher incidence level in the census tracts near JPL, with the single exception of prostate cancer. But, Dr. Mack said, the higher rates of prostate cancers were probably due to the prevalence of African-American residents in the particular census tract and the higher rate of prostate cancer that can generally be expected among African-American men.

Following Dr. Mack's presentation, the floor was opened for questions.

<u>We have provided the question and answer format in order to reflect a sense of the evening's discussion. Note that the questions and responses have been paraphrased.</u>

Q: A community member living locally since 1955 wanted to know how much exposure since that time her family had received from chemicals in the groundwater.

A: *Dr. Stralka* – VOC's (volatile organic compounds) were never delivered in drinking water in concentrations above the MCL (maximum contaminant level). This was also true for perchlorate after perchlorate was discovered in the water in 1997.

A: *Mr. Ripperda* – We can't know what was in your water from 1955 to 1985. In the 80s purveyors started testing for VOCs. Since '85, you haven't been drinking water beyond the MCLs (maximum contaminant levels).

Q: The same resident followed up that she had asked a similar question at NASA's January 2004 public meetings. She noted that she knew someone who had cancer and since then had died, adding that she is now drinking bottled water. She asked whether drinking from bottled water, or letting the tap water run would help.

A: *Dr. Stralka* – It's a good idea to let the water run and have that first flush wash away any rust particles and similar items from the pipes that may be in the water.

Q: A community member living locally since 1985 asked the panel to confirm that she had heard there was no chance that anyone could get cancer.

A: *Dr. Mack* – There are about 120 people in this room. Of those 120, there will be 50 cases of cancer [about 40 percent in any random group of 120 people]. It goes up to 80 percent if skin cancer is included. Nobody can say for sure. All we can say is that we can't find any evidence that you'll get cancer. It's as if a cop goes to your house and doesn't find anything. You may ask him, "Are we safe?" And, his response would be "I don't see any evidence to the contrary."

Q: A resident who did not attend the January 2004 meetings asked for clarification on the areas of Altadena and Pasadena that may be affected and also asked whether the chemicals stay in the body or pass through the body.

A: *Mr. Slaten* – The chemicals are in groundwater hundreds of feet below the surface and unless you were to dig down 500 feet, you wouldn't be in contact with them. When the chemicals reached water wells, the wells were shut down. The chemicals reached drinking water wells in very low levels for the first time in 1980, and in 1985 the wells were shut down. In 1992, a treatment plant to remove volatile organic compounds began operation. In 1997, perchlorate was discovered in those wells, and they have been shut down since then.

A: *Dr. Underwood:* They [volatile organic compounds] leave the body fairly rapidly. Perchlorate also leaves the body rapidly, although it takes a little longer. Thus, you can't go to your doctor and be tested for exposures that ceased a while ago.

A: *Dr. Hershman:* Perchlorate can be concentrated in the thyroid, but it doesn't stay there longer than a day or two.

Q: A person working at JPL asked whether any of the remediation activity would release harmful substances, and also asked for a clarification of the perchlorate levels in relation to an earlier reference to 18 ppb (parts per billion) and 6 ppb (parts per billion) levels for perchlorate.

A: *Mr. Slaten:* The treatment plant will be a closed treatment system. There will be no release of dangerous chemicals. The chemicals will be destroyed at the plant, and the plant is to be on the JPL site.

A: *Dr. Hershman* elaborated on prior recommended levels for perchlorate of 18 ppb (parts per billion) and the new 6 ppb (parts per billion) California PHG (Public Health Goal) for perchlorate. That level provides a tremendous safety factor to vulnerable populations – six parts per billion is a gigantic safety factor for perchlorate in drinking water. He stated that adverse effects on health from perchlorate in drinking water have never been found in humans. He noted that he was one of the reviewers for the California perchlorate PHG. Even at the prior level of 18 ppb, one would have to drink many, many liters of water – far more than is humanly possible – in order for the perchlorate to have a meaningful effect.

A: *Dr. Stralka* explained that prior to the establishment of the PHG (public health goal) of 6 ppb (parts per billion), the recommended safety level for perchlorate in groundwater ranged from 4 to 18 ppb (parts per billion).

Q: A follow-up question by the same employee asked whether there were any special health concerns for JPL employees. He addressed Dr. Mack, asking for his comments on the cancer rate of JPL employees. He also asked whether the risk assessments considered radioactive agents.

A: *Dr. McDaniel*: We went back after the January 2004 JPL employees meeting, because we heard questions related to health at that time, and we talked with JPL's Director of Occupational Health, Dr. Estrada. He has not heard any concerns from employees with regard to groundwater or that relate to these issues.

A: *Dr. Mack*: At the time of exposure – when the chemicals were disposed of – my guess is that the number of people involved at JPL was much too small for a study to show anything, and it is very unlikely that direct exposure caused any measurable excess of cancer cases.

Q: A resident living locally since the early 1960s noted that she was alerted at the first meeting [January 2004] by people who mentioned thyroid conditions. She stated that she had developed a thyroid condition and cancer since moving into the area, adding that she has no genetic or history of cancer in the family. Noting that she is part of a study at UCLA Medical Center she indicated that she was pleased to hear the comments during this meeting. She noted that because of her concern she will now be more informed and would like the issue to be pursued further.

Q: With respect to Metropolitan Water District water imported by a local water company, a resident asked whether breast cancer might be associated with the effect of perchlorate on the thyroid.

A: *Dr. Hershman* – Thyroid conditions are very common – even more so than diabetes, especially in older people.

A: *Dr. Mack* – Cancers are often very dependent on genetic issues.

A: *Dr. Underwood* – Drinking water levels are set not so that you get sick if you drink water exceeding those levels, but instead they are set with a

margin of safety, so that even if you drink the water for many years at levels that high, you still won't get sick.

Q*:* A resident thanked NASA for holding the meeting. Noting that she lives in an area east of the Hahamongna Park with many black residents, she stated that she had an overactive thyroid. She added that she had been drinking perchlorate in her eight glasses of water a day, and asked if she were to buy Dr. Mack's forthcoming book, could she tell anything about cancers in her particular block.

A: *Dr. Mack* – The only increase of cancer in this area is in prostate cancer, but not because of these chemicals in the groundwater.

A: *Dr. Hershman* – Perchlorate cannot cause an overactive thyroid; while we know that to be the case, we do not know the cause of the most common type of overactive thyroid.

Q: A resident who formerly worked at JPL noted that she had thyroid cancer and multiple myeloma and was never sick prior to moving to this area. She believed there was a connection between working at JPL and her sickness.

A: *Dr. Mack* – We can't find any scientific evidence to say that. I can understand your belief. Forty percent of us will get cancer, more as people age. And there are many different kinds of cancer. As for myeloma, we don't know why people get that, although it's more common among African-Americans. Yet it may not be genetic. In any case, it does not look like it's environmentally caused.

Q. A resident noted that the levels of chemicals in the water offer a low risk of health effects, but further noted that there are problems with bottled water. The resident asked whether use of water filters on the tap water would help and whether there were problems associated with these chemicals other than cancer.

A: *Mr. Slaten:* The water from the tap is really good water, though filters can improve the taste of tap water somewhat. They can't remove perchlorate from the water, but the water itself is cleaned before coming to you.

A: *Dr. Hershman* – Perchlorate has never been shown to lower iodine in the human thyroid. The PHG (public health goal) is set for safety for pregnant women and fetuses. The levels in drinking water could never cause thyroid conditions in adults.

A: *Dr. Mack* – There is no evidence that the water can cause any other diseases other than those mentioned earlier.

Q: A community member asked the number of wells currently shut down, the ownership of the wells and whether La Cañada Flintridge were affected.

A: *Phyllis Currie of PWP* – A total of seven wells were turned off. Last month when the state set the PHG (public health goal), we were able to open two of those wells.

A: *Dr. Mack* – The incidence of non-Hodgkin's lymphoma in La Cañada Flintridge is more likely related to the higher socio-economic class of its population, rather than to the water.

A: *Mr. Slaten* – La Cañada Flintridge is in the opposite direction from the flow of the [ground]water.

Q: A resident asked why new wells were not built higher in elevation, instead of pumping contaminated water at their current locations. The resident also asked whether any studies had been done on blood levels.

A: *Mr. Slaten* – In the mountains, you'll find bedrock, which isn't good for drilling wells. It's expensive. The basins are better ground in which to dig wells and the water is more readily available.

A: *Dr. Underwood* – (on blood sampling) The CDHS [California Dept. of Health Services] does study blood sampling when it makes sense. Because these exposures occurred in the past, it would not make sense to do that. You can go to your doctor and ask for a blood sample, but the results might be from exposure in the workplace and other activities.

Q: A resident stated that for fifty years Pasadena residents had been exposed to the chemicals and he did not want that minimized; however, he recognized that none of those present created the problem. He remarked that watering lawns and showering may result in potentially higher levels of contamination. He also commented that there had been no discussion of birth defects or autism caused by the effect of chemicals in vitro, and thus would like to see studies on whether autism and birth defects were related to the water.

A: *Dr. Rangan* – Studies have been done on animals with regard to birth defects, and you'd have to have levels of 100,000 ppb (parts per billion) before seeing birth defects on a mouse drinking these chemicals in their water. The jury, however, is still out on low birth weights. As for autism, there's been a lot of media and internet coverage, but not one single toxicological source has ever related it to chemicals in the water. There's no evidence to suggest that TCE (trichloroethylene), carbon tetrachloride or perchlorate has ever been associated with autism.

Q: A follow-up comment by the same resident noted that the experts are looking at it "backwards." He suggested studies on humans in Pasadena, not rats.

A: *Dr. Rangan* – It's very difficult to do human disease studies – there are lots of barriers, and it's difficult to establish a cause-and-effect. We don't even have a theory to begin to study.

A: *Dr. Mack* – It's very, very difficult to do a study; you need enough numbers to rule out chance, and you need a control group. Also, people are very private about autism. In California right now, there's a study being undertaken on the frequency of autism, and they are having a lot of trouble establishing a control group given concerns about confidentiality.

As for birth defects, there are from 30 to 40 different kinds of birth defects and causes. Diet, for instance, is a very big issue. These things are not simple.

Q: A community resident who has been following the groundwater situation for some time asked what other chemicals are being observed. She suggested that specifically hexavalent chromium is one about which she would have concerns.

A: *Mr. Ripperda* – [EPA and] NASA look for all chemicals. The only ones they found that could cause health effects are the ones we're talking about today. They found chromium in very low levels.

A: *Dr. Underwood* – Chromium and hexavalent chromium are of concern only when they are in the air and go to your lungs. There is not as much concern when they are in the drinking water. In water, stomach acids turn hexavalent chromium into tri-valent chromium, a form that's not taken in by the body very well. No state or nation recognizes chromium in water as cancer-causing.

Q: A resident working at JPL asked the level of perchlorate at the time it was first discovered in the groundwater.

A: *Mr. Slaten* – In the late 1990s, the level of perchlorate in the groundwater measured about 15 ppb (parts per billion).

Dr. Santos asked Dr. Hershman to clarify the context

A: *Dr. Hershman* -- Six parts per billion incorporates a safety factor. To get a real health effect you would have to take in 300 times that amount. Also, perchlorate is not retained in the body; it goes right out and isn't accumulated.

Q: A follow-up question by the same resident asked how often water samples in groundwater were taken.

A: *Ms. Currie* – At least weekly, and that was the case in the 1980s as well.

Q: A resident asked where one could obtain a study cited by Dr. Hershman that showed that perchlorate does not remain in the body.

A: *Dr. Hershman* -- The study was by Greer *et al.*

Ms. Fellows offered to forward the citation for the study to the woman.

[*Ed. note*: The article to which Dr. Hershman referred is http://ehpnet1.niehs.nih.gov/members/2002/110p927-937greer/EHP110p927PDF.PDF, by Greer, Monte A., Gay Goodman*, et al.*, "Health Effects Assessment for Environmental Perchlorate Contamination: The Dose Response for Inhibition for Thyroidal Radioiodine Uptake in Humans."]

Q: A resident asked the method used for the ATSDR (Agency for Toxic Substances and Disease Registry) report, with specific reference to how the individual health information was gathered for studies mentioned earlier by the speakers.

A: *Dr. Stralka* – Individual health forms were sent to residents and filled out and sent in to CDC (Centers for Disease Control and Prevention). That study did not ask anyone about animals. They had doctors here for anyone that was concerned.

*NOTE: During the meeting, Dr. Stralka indicated that ATSDR (*Agency for Toxic Substances and Disease Registry) *does not typically gather health information in a questionnaire format. This conclusion was corroborated by the ATSDR following the meeting. Dr. Stralka contacted the ATSDR Region IX representative, who replied that there was no questionnaire conducted by ATSDR at the NASA JPL site as part of the Public Health Assessment.*

Q: The same resident asked about a study by the CDC (Centers for Disease Control and Prevention) she believed was undertaken in '94 or '95. She also asked about the effect of the chemicals on animals, such as horses in the riding stable near JPL. She believed those horses have a high incidence of thyroid disease, and thus urged studies on the horses. She expressed disappointment that Pasadena had re-opened some wells after the perchlorate public health goal (PHG) was set at 6 ppb (parts per billion), believing that level is too high.

A: *Dr. Stralka* – I am unsure about "earlier studies" but I think they may have been pieces of the ATSDR (Agency for Toxic Substances and Disease Registry) study already cited.

Ms. Fellows also expressed uncertainty on the subject; when she proposed that one of the plaintiffs in a lawsuit may have undertaken a study, the questioner replied that the studies were earlier than a lawsuit.

Dr. McDaniel said she called the CDC (Centers for Disease Control and Prevention) and she theorized that field work on the ATSDR (Agency for Toxic Substances and Disease Registry) study may have begun as early as '96 or '97, as it takes several years to gather such information.

Q. A community member noted she was a six-year lung cancer survivor who had lived near the 210 freeway since in the 1960s. She urged the participants to clear up the matter so that the grandchildren did not have a similar experience.

Q: A community member asked the time lag between exposure to VOCs (volatile organic compounds) and perchlorate and the manifestation of illness.

A: *Dr. Mack* – It is decades, not years. With respect to cancers, my guess is anywhere between 5 to 25 years, but we really don't know. That's only a ballpark.

Q: The same resident made a comment that a level of 18 ppb (parts per billion) was the highest level reported, but that the City had said Arroyo Well had detected 160 ppb (parts per billion). The resident noted, though, that the water from the

wells is blended. However, the resident asked whether it were possible that the Lincoln Avenue wells also had these higher levels.

A: *Mark Ripperda* – Some wells do have higher levels. Water from the four Pasadena wells is pumped into the Windsor Reservoir, where the measurements are from 5 to 20 ppb (parts per billion). Nobody directly receives the water from the wells with the very high levels. In Altadena, there are still consistently lower levels of perchlorate.

Q: A community member asked about the "earthy" taste of the water.

A: *Brad Boman* (works for Pasadena Water & Power) – That's probably due to the MWD (Metropolitan Water District) water from Lake Mathews, the reservoir at the end of the Colorado River [aqueduct]. The aqueduct that takes it into Southern California has some bacterial growth on it affecting taste.

Q. A local resident asked what prompted the health meeting.

A: *Ms. Fellows* – There were health concerns voiced at the January public meetings NASA held on the groundwater cleanup, and NASA wanted to respond to the community's concerns. We organized this meeting so that health experts could respond to those questions.

Q: A local resident asked the location of the wells being discussed.

She was invited to come to the front to see the maps.

The meeting adjourned at 9:42 PM. *Ms. Fellows* stated that there would be a summary of the meeting posted on the NASA Groundwater Cleanup Web site. She also invited people to come up and talk individually with the health experts if they would care to do so.

Biographies of the Medical and Health Experts

Jerome M. Hershman, MD, MS
Dr. Hershman is a Distinguished Professor of Medicine at the UCLA School of Medicine. He is also Associate Chief of the Endocrinology and Diabetes Division and Director of the Endocrine Clinic at the West Los Angeles VA Medical Center. Dr. Hershman has written extensively about thyroid function and disease. He served as one of three peer reviewers for the recently revised California perchlorate public health goal (PHG). Dr. Hershman has a Master's degree in chemistry from the California Institute of Technology and a degree in medicine from the University of Illinois School of Medicine, Chicago.

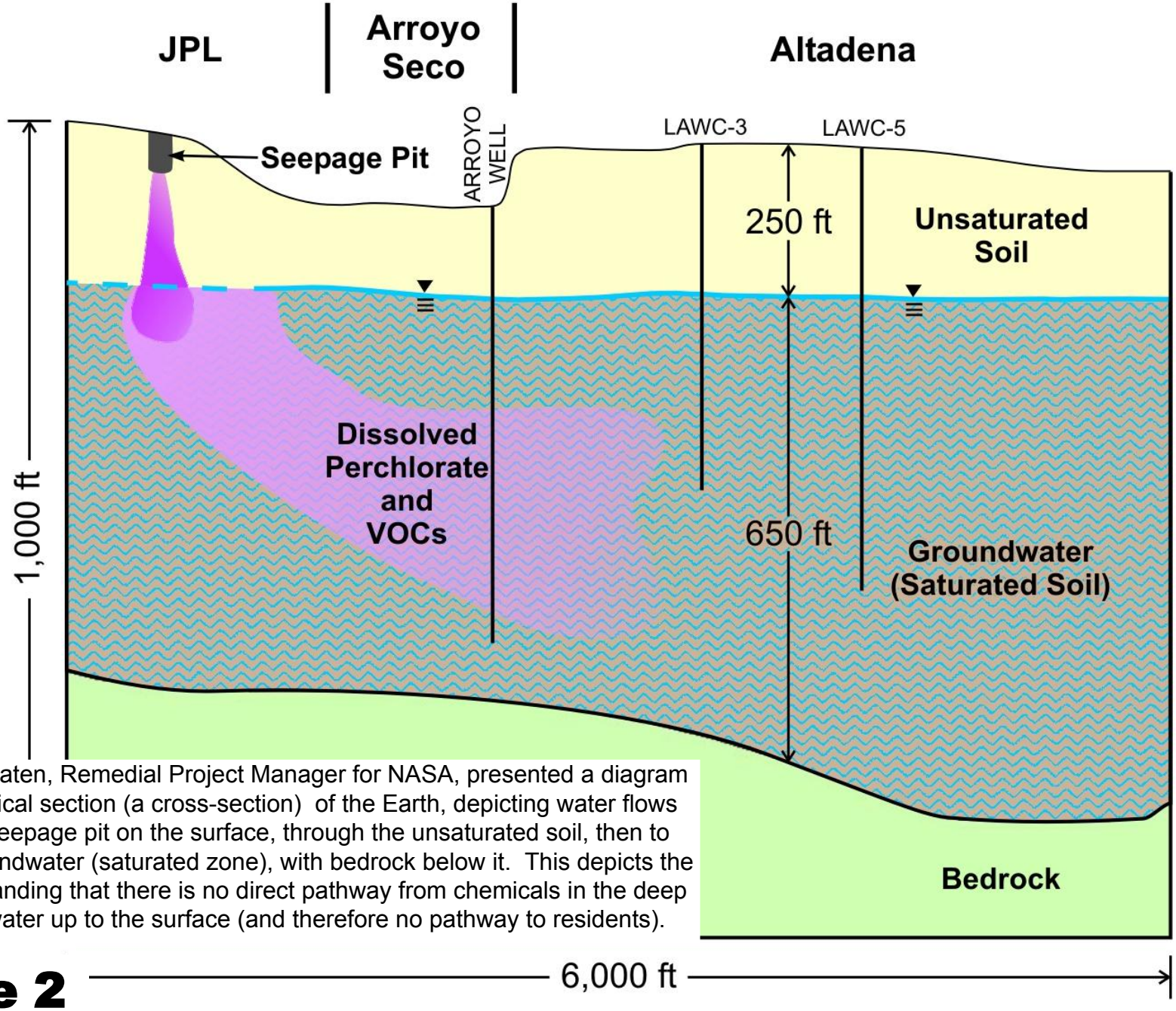
Thomas M. Mack, MD, MPH
Dr. Mack leads the Division of Epidemiology at the USC Norris Cancer Center and the Department of Preventive Medicine in the USC Keck School of Medicine in Los Angeles. He served 10 years as director of the Los Angeles County Cancer Surveillance Program, where he studied patterns in the occurrence and the causes of various types of cancer. He chairs the California EPA "Proposition 65" Carcinogen Identification Committee. Dr. Mack holds an MD degree from Columbia University and a Master of Public Health degree from Harvard University, where he taught before coming to USC. His book, *Cancers in the Urban Environment,* is scheduled for release in June 2004.

Cyrus Rangan, MD
Dr. Rangan is the Director of the Toxics & Epidemiology Program at the Los Angeles County Department of Health Services and is the Director of Los Angeles Medical Toxicology Education for the California Poison Control System. Dr. Rangan is Board-certified in both Pediatrics and Medical Toxicology and is a member of the American Board of Pediatrics and the American College of Medical Toxicology. Dr. Rangan earned his medical degree from the Medical College of Pennsylvania.

Daniel Stralka, Ph.D.
Since 1991, Dr. Stralka has served as a Superfund Program toxicologist for the U.S. Environmental Protection Agency (EPA), Region 9. He has worked with several Superfund project teams to evaluate levels of concern and human health risks associated with releases of contaminants. Dr. Stralka earned his Ph.D. in 1985 from the University of Texas.

Marilyn Underwood, Ph.D.
Dr. Underwood is a toxicologist at the Environmental Health Investigations Branch of the California Department of Health Services. She heads a multidisciplinary section, the Site Assessment Section, that investigates health effects from facilities that handle hazardous chemicals and hazardous waste sites. This group is funded by the U.S. Agency for Toxic Substances and Disease Registry. She holds a Ph.D. from the University of California in San Francisco Department of Medicine, Comparative Pharmacology and Toxicology Program and an undergraduate degree in chemistry.

Takashi M. Wada, MD, MPH
Dr. Wada was recently named Health Officer for the City of Pasadena Public Health Department. He is responsible for enforcing local and state public health orders and coordinating emergency response planning and operations for the City. Dr. Wada is an associate physician and clinical instructor at the UCLA School of Medicine. He holds a Master's degree in public health and a medical degree from UCLA.



Steve Slaten, Remedial Project Manager for NASA, presented a diagram of a vertical section (a cross-section) of the Earth, depicting water flows from a seepage pit on the surface, through the unsaturated soil, then to the groundwater (saturated zone), with bedrock below it. This depicts the understanding that there is no direct pathway from chemicals in the deep groundwater up to the surface (and therefore no pathway to residents).

Slide 2

Mr. Slaten showed photos of the drill rig used to create extraction and injection wells on the JPL site. The photos include a large drill rig at the construction site

Slide 3

Mr. Slaten explained that present plans call for treatment at the JPL plant of off-site groundwater after it is piped from a nearby City of Pasadena drinking well onto the JPL property. This aerial map of the JPL site and surrounding areas indicates the locations of the injection wells on the JPL property, the location of the onsite water treatment plant at JPL, and an offsite nearby City of Pasadena well.

Slide 4