Hearing Officer's Report and Recommendations

Carolina Sunrock, LLC – Burlington North
Digital Public Hearing via Webex
September 20, 2021

Public Comment Period: August 9, 2021 through September 22, 2021

Pertaining to Permit Application No. 1700016.21A and
Draft Air Quality Permit No. 10693R00 for:

Carolina Sunrock LLC
12971 S NC Highway 62
Burlington, NC, Caswell County
Facility ID No. 1700016
Fee Class: Synthetic Minor

Hearing Officer
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Regional Supervisor, Asheville Regional Office

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I. Background

On September 17, 2019, the NC Division of Air Quality (DAQ) Winston-Salem Regional Office (WSRO) received an application package from Carolina Sunrock LLC, requesting an Air Permit for a new asphalt plant and concrete batch plant located at 12971 S NC Highway 62, Burlington, NC. After reviewing the applications and public comments submitted to date, DAQ conducted ambient air quality modeling of criteria pollutant emissions from each facility to assess compliance with the National Ambient Air Quality Standards (NAAQS). DAQ found that the facility, operated as described in the permit application, and under modeled conditions, would cause violations of the nitrogen dioxide and sulfur dioxide NAAQS beyond the property boundary. The letter denying the air quality permit application was issued August 24, 2020.

On April 22, 2021, the North Carolina Department of Environmental Quality (DEQ), Division of Air Quality-WSRO, received a new air quality permit application (App. No. 1700016.21A) from Carolina Sunrock LLC to construct and operate a new truck mix concrete plant and asphalt plant at 12971 S NC Highway 62 in Burlington, Caswell County, NC. This new application addressed the permitting concerns in the mentioned August 24, 2020 denial letter. Pending issuance of the air quality permit, Carolina Sunrock LLC plans to construct and operate:

- a drum-mix asphalt plant with a production capacity of 250 tons of asphalt per hour
- a truck mix concrete batch plant (120 cubic yards per hour maximum capacity)

The proposed asphalt plant will be will be subject to several North Carolina Air Quality Regulations emission standards as well as the federal New Source Performance Standard (NSPS) Subpart I emission standards.

II. Air Quality Permit Application and Review

DAQ's mission is to work with the state's citizens to protect and improve outdoor, or ambient, air quality in North Carolina for the health, benefit and economic well-being of all. To accomplish this mission, DAQ requires industrial facilities to apply for and receive air quality permits prior to construction and operation of the air pollution sources and air pollution control equipment to ensure compliance with all applicable federal and state regulations. As a new facility, Carolina Sunrock LLC is required to apply for and receive an air quality permit prior to installing a new asphalt and concrete batch plant at 12971 S NC Highway 62 in Burlington, NC, Caswell County. Additionally, as a new facility, the proposed facility is required to demonstrate compliance with state laws governing the release of toxic air pollutants. On April 22, 2021, Carolina Sunrock LLC submitted an application to the DAQ-WSRO requesting an air permit for the 12971 S NC Highway 62 site. It is noted that this proposed site is located in an area without zoning; therefore, the applicant is required to publish a legal notice in accordance with 15A NCAC 2Q .0113. The application also contained a letter that stated that a public notice was published on April 7, 2021 in *The Caswell Messenger* and a sign was posted on April 1, 2021. A notarized Affidavit of Publication was also included with a scanned copy of the newspaper clipping. Date-stamped photographs provided indicate that the sign was posted as required on April 1, 2021. A Zoning Consistency Determination, signed by Bryan S. Miller, County Manager, Caswell County Local Government, dated March 30, 2021, attesting that "the "proposed operation is consistent with applicable zoning and subdivision ordinances," was received with the permit application.

Leo Governale, permit engineer in the DAQ WSRO, reviewed the application submitted by Carolina Sunrock LLC and determined that the facility could comply with all applicable federal and state air quality requirements provided that the specific conditions included in the draft air quality permit are met. Matthew Porter and Nancy Jones, meteorologists in DAQ Raleigh Central Office (RCO), provided technical support in the application review process by conducting a site-wide dispersion modeling analysis to evaluate the combined toxic and criteria air pollutant ambient impacts from all affected operations located at the site. The site-wide total emissions of arsenic, benzene, formaldehyde, mercury, and nickel were estimated to exceed the modeling thresholds, also known as the toxic air pollutant (TAP) emission rates (TPERs) outlined in 15A NCAC 02Q .0711. Site-wide criteria pollutants including particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2) were modeled for comparison with the National Ambient Air Quality Standards (NAAQS). PM concentrations were modeled for comparison with the State Ambient Air Quality Standards (SAAQS).

Ultimately, the site-wide dispersion modeling analysis of TAPs and criteria air pollutant emissions demonstrated compliance with the Acceptable Ambient Levels (AALs) outlined in 15A NCAC 02D.1104 and the NAAQS/SAAQS.

Unless the public comments received during the public hearing reveal that DAQ was in error or incomplete in its evaluation of the proposed asphalt and concrete batch plants from an air quality standpoint, and if the applicant will meet all federal and state laws and rules for the protection of air quality, DAQ is obligated to issue an air permit to Carolina Sunrock LLC. The below hearing officer responses to written and oral public comments will address issues raised in light of these requirements (Section IV).

III. Notice of Public Hearing

The Division of Air Quality regulations do not require a hearing or comment period for the issuance of this permit. At the discretion of the Director of the DAQ, a notice of the opening of a public comment period and a notice of public hearing on the draft air quality permit for Carolina Sunrock LLC was posted on the DAQ website and a press release was issued on August 9, 2021.

The notice of public hearing on the draft air quality permit for Carolina Sunrock LLC was published in the *Burlington-Times News* on August 9, 2021 and *The Caswell Messenger* on August 11, 2021, and on the Division of Air Quality's website on August 9, 2021.

Copies of the air quality permit application, draft permit application review, draft air permit, and dispersion modeling review memorandum were also posted on the DAQ website for public review. Copies of the air quality permit application and related documents were available for public review in DAQ's Winston-Salem Regional Office (WSRO) and Raleigh Central Office (RCO) throughout the public comment period. On September 20, 2021, the public hearing was conducted virtually via Webex to allow for public participation while protecting public health under current guidance to prevent the spread of COVID-19. The DAQ accepted comments via mail, voicemail, and electronic mail in addition to the virtual public hearing.

IV. Public Comments Received and Hearing Officer Responses

From the comments received during the public comment period, it is apparent that many residents and business owners around the proposed Carolina Sunrock facility are very concerned about potential impacts on their health, the environment, and their local economy. At the WebEx public hearing on September 20, 2021, approximately 37 people were registered in attendance. Thirteen attendees spoke (two of which were unregistered) predominantly in opposition to the proposed Carolina Sunrock LLC facility (twelve of the thirteen). The Reverend Bryon Shoffner presented orally for 27 additional attendees via recordings or orally by himself. During the public hearing it was agreed Reverend Shoffner's associates would submit written comments in lieu of him continuing to present orally in their stead. Additionally, 139 written e-mail comments (some with attachments) were received during the public comment period, of which one was in support of the proposed asphalt plant. Numerous email comments were submitted by the Reverend Shoffner on behalf of other citizens. Two voicemail comments were received. All comments were given equal consideration, whether they were electronic mail, written, voicemail, or made orally at the virtual public hearing.

The comments received, both written and oral, addressed many of the same issues. In order to make this report concise, address all issues and minimize redundancy, I have grouped the comments by topic similarity and summarized and addressed the issues of concern below. Comments in italics are direct quotes from submitted written comments, whereas non-italics are paraphrased from verbal or written comments. Hearing Officer's comments are designated by "HOC:" below. Unless otherwise specified in the Hearing Officer's comments, the Hearing Officer recommendation is that no changes to the draft permit are deemed necessary to address the specific comment. Any recommended changes are also summarized in Section V.

Comment Category #1: General Concerns about Air Pollution

A. Numerous commenters expressed general concerns regarding the expected air pollutants and the possible health effects;
B. Several commenters presented pollutant specific information and health studies (from a variety of sources/institutions/countries) regarding pollutants such as SO_2, metals, formaldehyde; as well as anecdotal evidence;
C. One commenter requested a rigorous on-site ambient monitoring program in light of personal air sensor data for the neighborhood. (This data was not provided.)

HOC: The Division of Air Quality works to protect and improve outdoor, or ambient, air quality in North Carolina for the health, benefit and economic well-being of all. In doing this work, the Division implements a stationary source permitting program as well as enforces numerous Federal and State regulations designed to protect the ambient air quality.

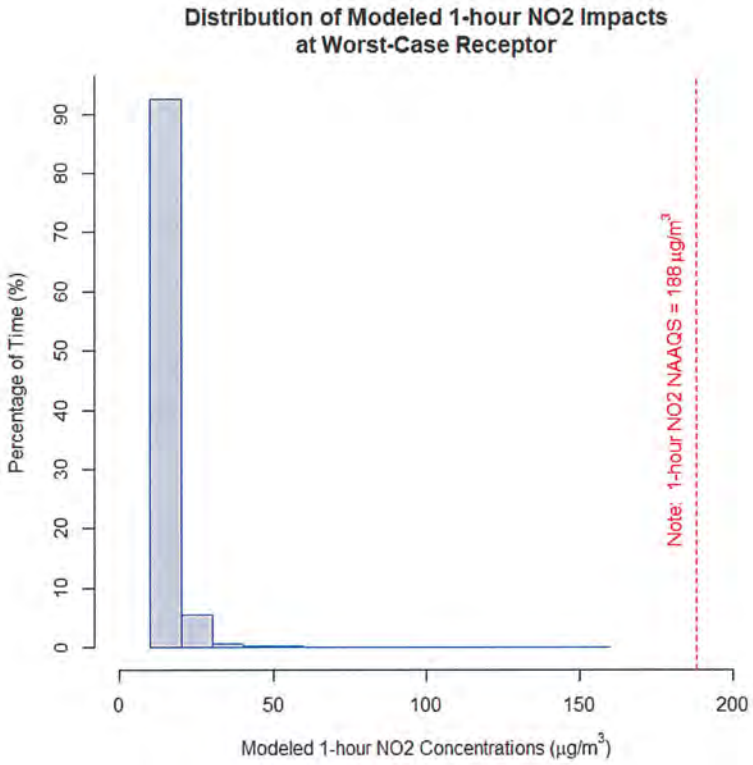
The Division acknowledges and understands the air pollutant and community health concerns presented above. Health concerns are considered in great detail for all air pollutants during the regulatory standard development process. For each regulated air pollutant, there is a defined process to develop the appropriate standard(s) that serve to protect the ambient air and the public health. Compromised and sensitive populations, such as the young, elderly, asthmatics, and health compromised are considered in State and Federal standard

development. In addition, margins of safety, at times factors of 10 to 400, are imbedded in these developed standards.

More information on NC Air Toxics standard development (such as benzene or formaldehyde) can be found here:
https://files.nc.gov/ncdeq/Air%20Quality/toxics/risk/sab/aaldisc.pdf
The NC acceptable ambient air levels (AALs) are set at a conservative value following recommendations provided by an independent scientific advisory board to protect the public health with a protective margin. Current AALs are periodically reviewed to determine if new and relevant information has been published in peer-reviewed journals which may influence the AAL determination. Several commenters implied the necessity of more stringent toxic air pollutant limitations than currently required by NC Air Toxics Regulations. Changes to the AALs can be formally requested to the Division Director or the Scientific Advisory Board Liaison, but cannot be done through this permitting action.

More information on Federal National Ambient Air Quality Standard (NAAQS) development (including Science and Risk Assessment) can be found here:
https://www.epa.gov/criteria-air-pollutants/process-reviewing-national-ambient-air-quality-standards. Commenters implied the necessity of more stringent criteria pollutant limitations. Changes to the NAAQS standards would be made through the above process outlined by the Environmental Protection Agency, but cannot be done through this permitting action.

In regard to the air dispersion modeling results discussed in Section II, the results predict "worst case impacts" based on worst case air emissions, worst case meteorological conditions, and worst case-receptor location. The typical hourly or daily impact from the proposed facility will be significantly less than this worst case analysis. As an example to illustrate this point, the following NO_2 impact histogram from the approved modeling shows (at the worst case receptor) the impact to be well less than 30% of the NAAQS approximately 99% of the time.



As indicated, one commenter requested a rigorous on-site ambient monitoring program in light of personal air sensor data for the neighborhood. More information on air sensors can be found at: https://deq.nc.gov/about/divisions/air-quality/air-quality-monitoring/air-sensors-faq

Additionally, a good resource and summary of air quality concerns from asphalt plants in North Carolina can be found at https://deq.nc.gov/about/divisions/air-quality/air-quality-permits/asphalt-plants

Comment Category #2: Permit Application Concerns

A. *Changes, correspondence, and attachments to the air permit applications and DAQ review were not made available to the public before the hearing or comment period. Action Requested: Post the information to the DAQ website, reschedule the hearing, and extend the comment periods to allow the public sufficient time to review and comment.*

HOC: All permit application materials were available for public review in their entirety at the DAQ/Winston-Salem Regional Office and the DAQ/Raleigh Central Office. Substantive application materials, draft permit review (including emission summaries and regulatory review summaries), draft permit, modeling summaries, an informational flyer, and the Draft Environmental Justice Report were available electronically. The draft permit review summarized any additional information received and the application chronology, as well as the final facility-wide potential emissions. Any application or permit review information was also available upon request.

B. *The applicant claims the only difference between the 2019 and 2021 air permit applications is the use of ultra-low sulfur diesel (ULSD).*

Action Requested: Explain why particulate matter (PM) pollution estimates have increased between the two applications. Was this the result of using ULSD?
Action Requested: Explain why cadmium was calculated to be emitted higher than TPER limit in the 2019 application estimates but not in the 2021 estimates. What caused the decrease of cadmium between the two applications?

HOC: The potential facility-wide cadmium emissions in the 2019 submittal were based on a total asphalt production of 1,488,581 tons/yr (8,760 hr/yr operation) and were calculated to be 0.675 lb/yr, which exceeded the TPER limit of 0.37 lb/yr. The potential facility-wide cadmium emissions in the 2021 submittal were based on the operating restriction of 500,000 tons/yr of asphalt production and calculated to be 0.27 lb/yr, below the TPER limit. For the PM increase, the company added in previously unquantified fugitive emissions.

C. *The air permit application requires revision and resubmittal due to substantial changes to the original application. E-mails, phone conversations, and memos since the submittal on 4/22/2021 have affected the core basis for review and approval. When projected emissions change substantially during the course of DAQ review, as in this case, the application must be revised and resubmitted. As an example, the particulate matter projected emissions jumped from 28.88 tons per year in the application to 38.05 tons per year by the time the DAQ review was concluded.*
Action Requested: Require applicant to revise, update, and resubmit the air permit application. Post the information to the DAQ website, reschedule the hearing, and extend the comment periods to allow the public sufficient time to review and comment.

HOC: Additional information received is considered part of the permit application and was referenced and incorporated in the air permit review. It is acceptable and not uncommon for a permit application to be amended after the initial submittal typically as a result of questions and clarification requests by DAQ staff upon their engineering review. The format of these amendments is not restricted to the application forms. They can be in a supplemental form, but must satisfy the minimum data needs of the review engineer. All permit application materials were available for public review in their entirety at the DAQ/Winston-Salem Regional Office and the DAQ/Raleigh Central Office. The draft permit review summarized any additional information received and the application chronology, as well as the final facility-wide potential emissions.

D. *The materials presented in their current form are haphazard and, intentionally or unintentionally prevent a non-technical person from following and comprehending the materials. They are a barrier to citizens who want to understand the impacts to their community, the environment, and their health. They discriminate against those without an advanced technical degree. When providing for public comment and review, the materials need to be organized, clearly written, errors corrected, and revisions incorporated so an average person can read and understand the content.*
Action Requested: Require applicant to correct, revise, update, and resubmit the air permit application. Post the information to the DAQ website, reschedule the hearing, and extend the comment periods to allow the public sufficient time to review and comment.

HOC: The Division strives to balance the very technical nature of air permit applications and air quality control with the need for the layperson to understand our permitting actions. There are certain engineering and technical items required in the permit application forms that cannot be simplified further. The Division's air permit review, modeling memos, and information on the DAQ website are opportunities for the Division to summarize the air emissions, regulatory review, and the permitting activity. However, the very technical nature of the work at times does not allow the information to be distilled any further without losing important content.

E. *The materials for public review do not adequately describe the facility. Forms have missing information and pollution control methods and systems are not fully identified. The type and configuration of all the equipment is not known.*
Action Requested: Require applicant to provide all information on the systems and fill out all the forms completely.

HOC: Sufficient and substantial information was submitted for the Division to identify the proposed equipment, conduct a comprehensive regulatory permit application/engineering review, and prepare a draft permit properly identifying the permitted equipment and regulatory requirements. Any additional information required by the air permit engineer to conduct these activities was requested and received from the company.

F. *Asphalt and concrete plant have been operating for years across the country with little change to the various technologies and methods used. Some technology being used is known to be better than others (counterflow vs batch). Enclosures, wet suppression, odor control, counterflow double drum, blue smoke control, are some that should be required and incorporated.*
Action Requested: Evaluate the facility configuration and equipment and require the best technology and methods that would benefit the environment and public health.

HOC: The Division cannot require controls more stringent than regulatory requirements.

G. *The facility has the capability to store and use No. 2 fuel oil. No. 2 recycled, No. 4, and No. 4 recycled fuel oils pollute more than No. 2 fuel oil.*
Action Requested: Do not allow more polluting fuel oils (No. 2 recycled, No. 4, and No. 4 recycled fuel oils) to be used.

HOC: DAQ has no legal basis to deny the use of fuels that comply with air quality regulations.

H. *In the DAQ review, DAQ assumes No. 4 Fuel Oil has the same emission factor as Recycled No. 4 Fuel Oil and that emissions factors for Propane are similar to those of Natural Gas. Action Requested: Confirm these assumptions and cite the appropriate sources. If not true and they are different, then re-evaluate the SO2 emission rate for the drum dryer/mixer.*

HOC: For the purpose of reviewing compliance with 15A NCAC 02D .0516, propane and natural gas are both known to have very little sulfur content effecting a large margin

of compliance for the 02D .0516 regulation. This regulation is of greater importance for fuels that have known higher sulfur contents such as coal and heavier oils. For the recycled No. 4 oil, the Permittee will be required to demonstrate through sampling and analysis (typically supplier certifications) that the recycled oil is equivalent to virgin oil per established protocols (per draft permit Condition A.19.) The sulfur content, as well as metals and several other parameters are included in this sampling and analysis to ensure this fuel is equivalent. More information on the DEQ Recycled Oil Management Program can be found at https://deq.nc.gov/about/divisions/air-quality/air-quality-compliance/recycled-oil-management-program.

I. [Fugitive Emissions] *Except in the case of crushers, haul roads, and front-end loader work area, DAQ states that fugitive dust and process generated emissions shall be controlled but do not require how or by what means. DAQ leaves it up to the applicant to determine how the emissions will be controlled and then, after construction, confirms it against an opacity standard.*
Action Requested: Require the applicant to identify the systems, processes, and procedures to specifically control emissions in the application. Review them for adequacy. Require emission controls be put in place that have been proven effective in the industry such as enclosures and wet suppression systems.
DAQ was not provided information on how the applicant will control fugitive dust.
Action Requested: Require the facility to develop, implement, and comply with a fugitive dust control plan. Review and approve the plan before the air permit is approved. The plan should include controlling fugitive dust emissions at unloading and loading areas, process area stockpiles, stockpile working areas, plant parking lots, plant roads (access and haul roads), conveyors, screens, transfer points, crushers, silos, truck loadout points, aggregate weigh batcher, etc.

HOC: As the first commenter mentions, emissions control techniques are specified in the permit for fugitive emissions from the crushers, haul roads, and front-end loader work area. The air permit requires a water truck on site at all times and that "*The roads and front-end loader work area shall be adequately maintained by wet suppression to minimize fugitive emissions*." Further, the fugitive emissions from the concrete plant truck loadout are required to be controlled by an enclosure and bagfilter. In addition, the bagfilter installed on the drum dryer is the primary particulate control device on site and has required stack testing, particulate emissions standards, stack opacity limitations, and maintenance requirements. If these enclosures and bagfilters are not properly operated or maintained, the Division has enforcement authority under permit condition B.6. to ensure the equipment is properly operated. Opacity (visible emissions) determinations are an excellent tool to determining if the filtration devices are operating properly. The Reclaimed/Recycled Asphalt Pavement (RAP) system components have stringent opacity requirements as well. During compliance inspections, DAQ inspectors evaluate all sources on site for proper operation, and for compliance with all permit requirements including the visible emissions standards. Fugitive dust concerns, if substantiated, can be addressed by DAQ compliance staff through 15A NCAC 02D .0540 "Particulates from Fugitive Dust Emission Sources." This regulation has a clear mechanism for requiring a fugitive dust plan if deemed necessary.

J. *Covering equipment and sources reduces fugitive emissions.*
Action Requested: Require components of the HMA and concrete plants be covered or enclosed to limit fugitive emissions. This includes conveyors, tops of silos, loading stations, and gobb hopper.

HOC: The Division cannot require controls more stringent than regulatory requirements. Fugitive dust concerns, if substantiated, can be addressed by DAQ compliance staff through 15A NCAC 02D .0540 "Particulates from Fugitive Dust Emission Sources." The concrete plant truck loadout will be enclosed and vented to the bagfilter.

K. *Recycled/reclaimed asphalt pavement (RAP) composition may be unknown. The addition of unknown composition RAP into the HMA drum is a concern as all RAP is not the same and that subsequent loads and batches may have different composition. Some batches may contain chemicals, waste materials, heavy metals, oils, paints, adhesives, solvents, etc. that have been applied or accumulated prior to being removed from pavements and roofs. When added to the HMA drum, they may emit odors and pollutants at different levels and include pollutants not in the review and analysis.*
Action Requested: Have strict requirements and record keeping regarding the composition of RAP to ensure the composition is consistent and the emissions are known. Include the emissions caused by adding RAP to the HMA drum into the facility emissions calculations. Require the facility to use only RAP meeting an industry standard and not contain any materials or compounds (such as rubber or plastics) that would cause additional pollution or odors when added to the HMA drum. Require applicant to maintain records from the suppliers certifying each batch or load of RAP. If the RAP is found to be contaminated, not clean, or substandard, then require the permit for the use of RAP to be withdrawn and the stockpiles and RAP equipment removed from the property.

HOC: RAP addition is commonly used by most asphalt plants as a way of recycling road material and reducing needed liquid asphalt cement. The emission factor determinations in EPA Document AP-42 Chapter 11.1 Hot Mix Asphalt Plants used stack testing from numerous plants when running RAP. Therefore, drum dryer emissions from processing RAP are already included in the emissions estimates. In addition, page 11.1-3 of the AP-42 document indicates "*A counterflow drum mix plant can normally process RAP at ratios up to 50 percent with little or no observed effect upon emissions*."

L. *Diesel trucks are expected to line up and idle awaiting loadout throughout the day. Loaders are expected to operate continuously. The emissions from all the vehicles will add to the emissions of the facility and should be considered. After all, these vehicles are concentrated at this site because of the facility.*
Action Requested: Evaluate and include emission from vehicles – dump trucks, delivery vehicles, loaders, and worker vehicles – into the facility wide estimates.

HOC: Modeling was performed on the stationary source equipment. Other air quality rules and emission standards apply to mobile source (vehicle) emissions.

M. *Form D1 is not correct and has not been updated. Form D1 is the key/primary form in the entire application that summarizes the facility wide pollutants. The form lists 28.88*

tons of particulate matter (PM) per year and the DAQ review lists 38.05 tons of PM. The quantity in the form and in the review should match.
Action Requested: Require the applicant to revise Form D1 with the correct information. Explain why the applicant wasn't required to correct or update key forms in the application.

HOC: Additional information received is considered part of the permit application and was referenced and incorporated in the air permit review. It is acceptable and not uncommon for a permit application to be amended after the initial submittal typically as a result of questions and clarification requests by DAQ staff upon their engineering review. The format of these amendments is not restricted to the application forms, can be in a supplemental form, but must satisfy the minimum data needs of the review engineer. In this case an Excel spreadsheet was submitted and accepted by the review engineer as fulfilling the D1 form equivalency.

N. *There is no mention of power generators in the application. The application states there is no changes from the previous air permit submitted last year other than the use of ultra-low sulfur fuel, however the previous application had multiple generators listed. My first question is why were the generators not listed this time?*

HOC: There were no generators identified in the previous or current application.

Comment Category #3: Dispersion Modeling Concerns

A. *NC DAQ needs to explain why the Burlington Airport dataset was used. If this is because of proximity to the proposed facility, then that should be stated.*

HOC: Yes, this was the closest and most representative data set.

B. *NC DAQ needs to explain why the ADJ_U* option was used in the current air modeling when it was not used in the previous air modeling.*

HOC: The NC DAQ modeling was an initial conservative, screening level assessment. As such, the meteorological data did not include the adjust u* option (ADJ_U*). The modeling submitted using the ADJ_U* option was a refinement of the earlier screening level modeling. ADJ_U* is appropriately used in this application.

C. *NC DAQ needs to explain why a permit was denied based of NO2 Tier 1 modeling in 2020, but NO2 Tier 2 modeling was used in the current modeling.*

HOC: The NC DAQ modeling was an initial conservative, screening level assessment. As such, the simpler NO_2 Tier 1 option was used. The modeling submitted using the Tier 2 option was a refinement of the earlier screening level modeling. Tier 2 is less conservative than Tier 1, but has been shown to be more accurate based on EPA AERMOD model performance evaluations.

D. *We also point out that NC DAQ used 2017-2019 data for the NAAQS background concentrations for SO2 and PM but did not for NO2. In addition, the monitors located nearest to the proposed Burlington North facility were used for SO2 and PM, but not for*

NO2. NC DAQ cannot just randomly decide to use whichever monitor has the lowest concentration. NC DAQ needs to provide an explanation for this change in background concentration ... NC DAQ needs to show rationale and use the proper background concentration of 67.68 ug/m3 for NO2. The agency cannot go all willy-nilly when making these important modeling decisions.

HOC: In accordance with Section 8.3.b of Appendix W to 40 CFR Part 51, a "regional site" may be selected and used to determine background concentrations where quality assured data collected at a monitoring site located nearest to the project is unavailable or unrepresentative of local conditions. As such, regional sites with available quality assured NO_2 data were reviewed based on distance and representativeness of non-modeled source inventories. The Blackburn Site (Lee County) was selected as the most representative "regional site" based on its rural setting and exposure to area sources such as lower-volume road traffic and other non-point biogenic and anthropogenic regional scale NOx emissions inventories. Measurement data collected 2015-2017 at the Blackburn Site was considered sufficiently contemporaneous and representative of rural NO_2 concentrations expected at the Carolina Sunrock project location. The alternative "regional site" reviewed by NC DAQ (Hattie Avenue Site) is located one mile northeast of downtown Winston-Salem and was determined to be unrepresentative of the Carolina Sunrock project location due to its exposure to nearby high-volume road traffic and mobile source NOx emissions as well as the urban non-point source NOx emission inventories reflected in the NO_2 hourly monitoring data. While the NO_2 data collected at the Hattie Avenue Site was determined as unrepresentative for the Carolina Sunrock project locations, the SO_2 and PM10/2.5 data collected 2017-2019 there was determined to be sufficiently conservative to demonstrate that the modeled impacts added to the Hattie Avenue background concentrations would not cause or contribute to a violation of the SO_2 and PM10/2.5 NAAQS.

E. *Using the proper NO2 background concentration will increase the total impact concentration to 197.41 ug/m3 which is above the NO2 1-Hour NAAQS of 188 ug/m3.*

HOC: See response to previous comment on selection of the Blackburn Site NO_2 monitoring data.

F. *Carolina Sunrock in its resubmitted application indicated that no changes were made since the original submittal "other than the acceptance of utilizing ultra-low sulfur diesel...". In that resubmitted application the previous air modeling for TAPs was resubmitted without remodeling. However, there were stack height changes which impacts the modeling. The Hot Mix Asphalt stack height (emissions source CD_1) has been increased from 9.20 m to 14.02 m in the new application. This is an increase of 15.81 feet. In the new application the concrete plant stack height (emissions source CD_2) has been increased 5 feet from 10.668 m to 12.19 m. The stack height changes the air modeling for both the AERMOD and the BPIPPRM building parameters files. This affects the modeled concentration results.*

HOC: The air toxics modeling was updated and re-submitted by Carolina Sunrock July 1, 2021, and subsequently reviewed by AQAB July 27, 2021. The updated air toxics modeling is consistent with the NAAQS modeling and shows stack heights modeled for

the Hot Mix Asphalt Plant Baghouse stack (14.02 m) and the Concrete Plant Baghouse stack (12.19 m).

G. *We do point out a discrepancy with the BPIPPRM building parameter files. There is a change in these files in the Carolina Sunrock air modeling compared to the NC DAQ air modeling. It appears that NC DAQ has not changed its BPIPPRM file to indicate the changes in the current application. We have included the building parameters for the Hot Mix Asphalt Plant CD_1/CD1 as an example of this discrepancy [See Attachment 3]. NC DAQ needs to double-check the building parameters for all emission sources, make the necessary changes, then re-run the air modeling.*

HOC: There was a change in the building parameters in the modeling because the original DAQ modeling was a screening level assessment using information available at the time. The updated modeling provided for the TAPs assessment includes more refined information about actual planned locations of buildings.

H. *DAQ denied the 2019 air permit application because NO_2 exceeded NAAQS limits. Action Requested: Explain why the same level of nitrogen oxide (NOx) pollution is now acceptable when it wasn't previously.*

HOC: The initial permit denial was based on simplified and conservative screening type dispersion modeling. The current modeling was based on more extensive and refined modeling using acceptable guidance for background monitors and Tier I/II concerns.

I. Commenters indicated air dispersion modeling does not take into account setbacks that would be required by the Caswell County High Impact Ordinance.

HOC: Carolina Sunrock is required to comply with the submitted and approved air dispersion modeling. This includes constructing and locating the air emission sources as submitted in the modeling analysis. If the sources are not located as per the modeling (as a result of any local ordinance requirements or for any other reason), Carolina Sunrock would be in violation of the air quality permit and subject to enforcement action.

Comment Category #4: Air Permit Concerns

A. (Sunrock) - *The second paragraph of this condition contains the following - "Placement of the emission sources, configuration of the emission points, and operation of the sources shall be in accordance with the submitted sitewide NAAQS dispersion modeling analysis and should reflect any changes From the original analysis submittal as outlined in the AQAB review memo." Carolina Sunrock requests that the phrase "and should reflect any changes to the SUNROCK®CAROLINA SUNROCK LLC original analysis submittal as outlined in the AQAB review memo. "be removed from the permit, as the revisions themselves rather than DAQ's comments on the revisions should be used. Accordingly, the condition should be revised to: "Placement of the emission sources, configuration of the emission points, and operation of the sources shall be in accordance with the submitted sitewide NAAQS dispersion modeling analysis, including Permittee's revisions to the original analysis submittal."*

HOC: The primary concern for this permit condition is that the facility will be constructed and operated as modeled (source location, stack height, etc.). I understand the commenter's concern and the permit condition will be revised to keep the intent and improve clarity as follows:

> *Placement of the emission sources, configuration of the emission points, and operation of the sources shall be in accordance with the submitted sitewide NAAQS dispersion modeling analysis and should reflect the modeling analysis that was reviewed and approved by the DAQ Air Quality Analysis Branch (AQAB) on March 23, 2021.*

B. *Carolina Sunrock requests that the words "filterable" and "(Method 5)" be added to Permit Condition No. A.11.b.i. as follows: "contain filterable particulate matter (Method 5) in excess of 90 mg/dscm (0.04 gr/dscf); or". 40 CFR 60, Subpart I only regulates filterable particulate matter.*

HOC: The Division agrees 40 CFR 60, Subpart I only regulates filterable particulate matter as stack tested by EPA Reference Method 5. We have implemented this regulation in this manner consistently for all affected asphalt plants in North Carolina. However, the permit condition directly reflects the wording of the Federal rule which also simply indicates "particulate matter." The permit will not be changed at this time.

C. *Carolina Sunrock does not have any "wet material processing operations" as defined within 40 CFR 60, Subpart OOO. As such and to simplify issues and to remove confusing permit language, we suggest that all references to "wet material processing operations" be removed from the permit.*

HOC: The Division acknowledges the suggestion, but will leave the standard format "boiler-plate" condition in the air permit.

D. *The table in this permit condition implies that testing for NSPS (Subpart I) must include Test Methods 5 and 202. As stated in Comment No. 2 above, Subpart I only has emission limits for filterable particulate matter which is only Method 5. We request that DAQ modify the table to correct this implied error.*

HOC: The testing condition also refers to total particulate matter limits of 15A NCAC 02D .0506 which does require the inclusion of condensable particulate matter. The Division agrees that only the filterable portion of the total PM test will be compared to the NSPS Subpart I limitation. Method 202 will still be required as part of the 02D .0506 compliance determination. No changes will be made to this permit condition.

E. *Condition No. 14.d. requires a 30 day written notice of the test date as required by NSPS, Subpart A. The NC DAQ Rule 15A NCAC 02D .2602 requires a 15 day notice. As the NSPS has been accepted into the NC SIP and regulations, we request that DAQ amend this requirement to 15 days to be consistent with the DAQ testing rules. We see no need for a 30 day written notice where, in all other testing situations, DAQ allows a 15 day notice.*

HOC: The Division cannot waive the federal NSPS requirement. The 30-day notification will remain in the air permit.

F. *Carolina Sunrock requests that the arsenic limits for the Truck Mix Concrete Batch Plant Bagfilter (RMC-CD2) be corrected to lb/yr instead of lb/hr.*

HOC: This error will be corrected.

G. *Carolina Sunrock requests that this permit condition be removed from the permit. The requirements in 15A NCAC 2Q .0304, including those related to zoning, merely specify the material to be included in the permit application and have already been satisfied by Carolina Sunrock. There is no basis to include an application condition that has already been met as an ongoing condition of the permit. Further, this condition is atypical for synthetic minor asphalt plants such as Sunrock, as is evident by reference to the following permits issued within the past three months for similar facilities, none of which include an equivalent provision: (i) Permit No. 05428R16 issued September 3, 2021 to Maymead Materials; (ii) Permit No. 02676R21 issued August 19, 2021 to Barnhill contracting Company; (iii) Permit No. 01406R15 issued August 27, 2021 to APAC-Atlantic. The inclusion of this provision in the final permit would both exceed the agency's authority and be arbitrary and capricious.*

HOC: As discussed in the zoning comments 9.A-C below, I recommend this permit condition be removed.

H. *Condition A.17 .c. requires quarterly reporting. Carolina Sunrock requests that this be changed to semiannual reporting. As currently written, this permit requires more stringent reporting than a Title V permit. DAQ has deemed semiannual reporting appropriate for major facilities, and there is no legitimate reason to impose a more stringent reporting standard against Carolina Sunrock as a synthetic minor facility.*

HOC: This condition requires annual reporting in the current draft permit.

I. *Carolina Sunrock requests that permit condition numbering be corrected from Page 12 through Page 15 since the condition numbers are duplicated and mis-numbered.*

HOC: These errors will be corrected.

J. *The toxic air pollutant TPER table under this condition is missing ammonia.*

HOC: This error will be corrected.

K. *Carolina Sunrock would like to utilize recycled asphalt shingles at Burlington North and therefore requests that the same permit condition be added to Burlington North as appears in the draft permit for the Prospect Hill Quarry and Distribution Center (Draft Permit No. 10694R00, Condition 25).*

HOC: Carolina Sunrock did not request this flexibility in the submitted air permit application. It would be inappropriate to make this change at this time post public notice and public hearing. Carolina Sunrock can submit a permit application at a later date for this air permit modification.

L. *In Section A – Specific Conditions and Limitations, Item no. 3 Compliance with Emission Control Standards, under a. Production Limitations, there is a reference to Condition A.20 (Section A, Item 20). There is no A.20 listed in the draft permit. There appears to be some misnumbering of Section A. Item numbers 15, 16 and 19 are repeated {15. Fabric Filter Requirements…(Page 11), 15. Control and Prohibition of Odorous Emissions (Page 12); 16. Toxic Air Pollutant Emissions…(Page 11), 16. Zoning Specific Condition (Page 12); 19. Vendor Supplied Recycled…(Page 14), 19. Toxic Air Pollutant Emissions…(Page 15)}. Therefore, we are not sure which condition the A.3.a reference applies to. This duplication of numbers has made the draft permit impossible to understand. Clarification is needed.*
Condition A.10B.i and ii (page 5) limitations are unclear with regards to the referenced statute 15A NCAC 2D .0524/ 40 CFR Part 60 . Clarification is needed as to how the specific limits were derived from statutes.
Unsure why Condition A.11.b.i is listed in the permit when this affected facility will have commenced after April 22, 2008. Including A.11.b.i. limit only serves to add confusion in the permit for the applicable limits. Only A.11.b.ii should be included in the permit.
Per Draft Permit condition A.16 (the second A.16 listed on pages 12-13), the applicant cannot begin construction or operation until all local permissions have been granted. There are several local permits that are in question. Several residents appealed the Caswell County Watershed Review Board's decisions in January to approve the Watershed Protection and Special Non-residential Intensity Allocation (SNIA) permits. However, the county has not set a hearing date on these appeals. In addition, the applicant has sued these residents in Superior Court. There is no court date set for that hearing. In addition, there may be future zoning requirements which may affect this facility. NC DAQ must stay informed on these issues and not allow the applicant to violate this condition of the permit. The applicant cannot begin construction or operation until these hearings have been held. The upcoming decisions from those hearings significantly affect this facility.

HOC: The typographical errors mentioned will be corrected. Condition A.10.B.i and ii limitations are taken directly from federal regulation 40 CFR 60.92 (40 CFR Part 60 / NSPS Subpart I) which is incorporated by reference by state regulation 15A NCAC 02D 0524. Condition A.11.b.i is part of a standard format "boiler-plate" permit condition and will remain in the air permit. See the discussion in 9.A-C. below for a discussion of the zoning permit condition and zoning concerns.

M. *Fabric filters in baghouses are the primary pollution control devices. DAQ is requiring an annual internal inspection, but a monthly visual inspection is required to ensure the filters are attached, intact, and in good condition. With only an annual inspection, the facility could pollute above permitted thresholds for months before a problem is discovered. Action Requested: Require monthly visual inspections of the baghouse and fabric filters.*

HOC: NCDAQ will retain the standard permit condition requirement of annual inspections. This is standard and applicable to all permitted asphalt and concrete batch plants in North Carolina. DAQ inspectors will conduct routine compliance inspections to verify proper operation and maintenance. In addition, the company must follow manufacturer's recommended maintenance procedures.

N. *In the draft permit for NSPS monitoring requirements, DAQ is requiring the permittee to perform monthly periodic inspections to check that water is flowing to discharge spray nozzles in wet suppression systems. Monthly is too long a period between inspections. Faulty nozzles could allow emissions for weeks without being detected. Action Requested: At a minimum, require weekly inspections.*

HOC: The permit condition directly reflects the federal requirements of NSPS Subpart OOO. The Division does not see a need to require monitoring more stringent this federal requirement.

O. *Limit the amount of asphalt produced to a daily amount based on the 500,000 tons per consecutive 12-month period, the expected operating schedule of 6 day/wk, and 50 wk/yr, and the percentage annual throughput. Production should not exceed 1,667 tons per day at any time during the year. Action Requested: Require a daily maximum to ensure the facility did not exceed the 12-month asphalt production limit and therefore not exceed SO2 and CO emission limits. Require the permittee to record daily as well as monthly and total annual amount [tons] of asphalt produced.*

HOC: It would be inappropriate to designate a daily limit for an annual requirement in this case. The regulatory basis for the identified limitation is an annual (12-month rolling) basis and it is not necessary or appropriate in this case to limit daily production.

P. *Employ audit methods to confirm asphalt and concrete production and emissions other than just reviewing permittee's logs.*
Action Requested: Audit sales receipts, contracts, invoices, and fuel and cement purchases to confirm asphalt and concrete production and emissions.

HOC: The permittee's logs are verified by the DAQ inspector during compliance inspections. It is up to the discretion of DAQ to consider further validation of the logs through auditing receipts, etc.

Q. *For the fabric filter requirements in the draft air permit, the permittee shall perform periodic inspections and maintenance as recommended by the equipment manufacturer. No manufacturer's recommendations were provided in the materials for public review. The baghouses are extremely important because they are the primary filter for particulate matter. Action Requested: Obtain, review, and mandate manufacturer inspections and maintenance recommendations. Add additional requirements if the manufacturer recommendations are inadequate.*

HOC: The bagfilter inspection and maintenance, as well as adherence to the manufacturer's recommendations, will be verified by the DAQ compliance inspector. DAQ will retain this standard permit condition requirement.

R. *The draft permit states if the facility does not use wet suppression to control emissions, the Permittee shall repeat the NSPS performance tests within five (5) years of the previous test. If the facility uses an upstream wet suppression to control fugitive emissions, then the facility is exempt from the 5-year repeat testing requirement. The applicant doesn't state the facility will use wet suppression or use upstream wet suppression, so it is unclear whether the performance tests will be required to be repeated every 5 years. Action Requested: Require the applicant to identify the systems, equipment, processes, and procedures to control emissions and then determine whether subsequent performance tests will be required.*

HOC: These requirements are reviewed for compliance by DAQ inspectors during routine compliance inspections.

S. *DAQ intends to permit Carolina Sunrock LLC to produce 5 toxic air pollutants (TAPs) - formaldehyde, mercury, nickel, arsenic, and benzene - at rates significantly higher than their permitting emission rates (TPERs) by scaling up TAPs to their acceptable ambient levels (AALs). As an example, Carolina Sunrock estimated they will pollute a total of 198 pounds per year of benzene from the entire facility, however, DAQ is drafting a permit to allow them to pollute 854 pounds per year from just the asphalt drum. Allowing the facility to pollute over four times more than they estimated does not improve the outdoor air quality of North Carolina or protect its citizens. DAQ should not permit toxic chemicals at these high rates and should restrict them as much as possible to protect the environment and our citizens. Workers, visitors, inspectors, animals, and the environment inside the property boundary will be exposed to high levels of these 5 TAPs above what is known to be healthy especially during climatic conditions such as inversions.*
Action Requested: Only allow emission rates of TAPs, HAPs, and PM to what was calculated and not scaled up.

T. *DAQ intends to permit Carolina Sunrock LLC to produce benzene at a rate significantly higher than its permitted emission rate (TPER) by scaling up the emission to its acceptable ambient level (AAL). That basically means that the level of benzene will be greater than what has been determined healthy within the property boundary. The modeling of benzene dispersion does not consider all benzene emitting sources at the facility such as from dump trucks, delivery vehicles, loaders, and worker vehicles. Diesel trucks are expected to line up and idle awaiting loadout throughout the day. Loaders are expected to operate continuously. The emissions from all the vehicles will add to the emissions of the facility and may cause the AAL of benzene to be exceeded at the property boundary.*
Action Requested: Evaluate all emitting sources of benzene and include in modeling to determine if the level is truly acceptable.
Action Requested: Deny the air permit because the facility will be releasing benzene at higher concentrations than are considered healthy.
Action Requested: Deny the air permit because the facility will be releasing arsenic at higher concentrations than are considered healthy.
Action Requested: Deny the air permit because the facility will be releasing formaldehyde at higher concentrations than are considered healthy.
Action Requested: Deny the air permit because the facility will be releasing mercury at higher concentrations than are considered healthy.

Action Requested: Deny the air permit because the facility will be releasing nickel at higher concentrations than are considered healthy.

HOC: Carolina Sunrock requested scaled-up benzene and other air emissions in the air permit application and adequately demonstrated compliance through a dispersion modeling analysis. Scaling up is an option conducted by some permitted facilities to provide a compliance margin. This analysis was reviewed and approved by DAQ engineers and meteorologists. DAQ has no legal basis to deny these requested emission limitations that comply with the applicable air quality regulations. In addition, the NC Toxics Air Pollutant Regulations do not apply to the identified mobile sources. More information on acceptable ambient levels and mobile sources can be found here: https://files.nc.gov/ncdeq/Air%20Quality/toxics/risk/sab/aaldisc.pdf

Comment Category #5: Community Pre-Existing Health Concerns

A. Citizen diagnosis of MGUS … *A rare blood disease that predispositions me to a rare form of cancer known as Multiple Myeloma … I am requesting that NCDAQ re-calculate the human risk of toxic chemicals of Burlington North; in light of the scientific evidence from studies linking human health risk from these chemicals to my illness.*
B. General Community-Wide Health Concerns
C. *UNC Chapel Hill School of Global Public Health … RESIDENTS REPORT HIGHER THAN AVERAGE RATES OF MULTIPLE CHRONIC ILLNESSES*
D. *A health assessment conducted by UNC and the NCIPH found that over 75% of residents report having at least one diagnosed chronic illness.*
E. *Caswell County residents have higher rates of asthma compared to state averages, per CDC data.*
F. *University of North Carolina at Chapel Hill Gillings School of Global Public Health health survey/ Report on Anderson Community Environmental Quality and Health.* Higher rates of death due to heart disease, cancer, and diabetes
G. Covid-19 co-effects.

HOC: The Division acknowledges and understands the community health concerns highlighted above. Many of these same health concerns can be found in varying degrees in communities throughout North Carolina. However, health concerns are considered in great detail during the regulatory standard development process. Compromised and sensitive populations, such as the young, elderly, asthmatics, and health compromised are considered in State and Federal standard development. In addition, margins of safety, at times factors of 10 to 400, are imbedded in these developed standards. More information on NC Toxics standard development can be found here:
https://files.nc.gov/ncdeq/Air%20Quality/toxics/risk/sab/aaldisc.pdf
These NC acceptable ambient air levels are set at a conservative value following recommendations provided by an independent scientific advisory board to protect the public health with a protective margin. More information on Federal National Ambient Air Quality Standard development (including Science and Risk Assessment) can be found here:
https://www.epa.gov/criteria-air-pollutants/process-reviewing-national-ambient-air-quality-standards

Comment Category #6: Title VI & Environmental Justice Concerns

A. General Environmental Justice Concerns

DEQ Response: DEQ prepared an Environmental Justice (EJ) Report for the proposed Sunrock LLC facility that analyzed sociodemographic data (race, ethnicity, and poverty, county health data, and state designated Tribal statistical areas) in conjunction with the draft air quality permit. The data from this EJ Report does indicate slightly higher percentages for some non-white populations as well as elevated poverty levels overall, which is consistent with the points made by multiple commenters. The EJ Report states that no other permitted industrial sources of pollution or incident reports were identified within a one mile radius of the facility. Given the data assessed in the EJ Report, DEQ conducted additional outreach and public engagement in the area surrounding the proposed facility. Many commenters expressed concerns over individual health issues. While the Division of Air Quality lacks authority to base permitting decisions on individual health concerns, the Division has ensured that the permit contain conditions necessary to demonstrate compliance with air quality standards designed to protect human health and the environment.

B. NC DEQ must ensure compliance with Title VI

DEQ Response: DEQ is committed to maintaining compliance with Title VI of the Civil Rights Act of 1964 and has made significant strides in support of this commitment over the past several years. The Division of Air Quality has no jurisdiction or say in where an applicant selects to locate operations. Additionally, DEQ adheres to federal guidance set out in E.O. 12898—an executive order addressing activities that have disproportionate adverse environmental and human health impacts on non-white and Hispanic or Latino populations and/or low-income populations—by preparing (EJ) Reports, providing communities access to public information, offering opportunity for meaningful public participation, and ensuring that all comments are carefully considered during the permitting process. More information on DEQ's Title VI compliance can be found here: https://deq.nc.gov/permits-regulations/title-vi-compliance.

In this case, DAQ conducted significant outreach in to ensure that local communities could meaningfully participate in the permitting process. See Responses to Comment Category #10. Further, DAQ carefully considered all comments submitted during the permitting process and imposed permit conditions to ensure that the facility will operate in compliance with regulatory requirements designed to protect public health.

C. Report on Anderson Community Environmental Quality and Health
From Report*: At minimum, the NC Department of Environmental Quality must ensure that it is upholding its own rules, including Subchapter 01c of the North Carolina Environmental Policy Act and ensure compliance with federal non-discriminatory laws, such as Title VI of the Civil Rights Act. Finally, NC DEQ should consider establishing a permanent role for their Equity and EJ Board in environmental decision making and permitting and establishing a process for by which input from the impacted community plays an integral role in in permitting. Similar efforts to center impacted communities in*

local city council and planning board decisions will also move our most marginalized NC communities towards more protective and more just outcomes.

DEQ Response: The North Carolina Environmental Policy Act is discussed in Comment Category #7 below.

As set out in the Charter, the purpose of the Secretary's Environmental Justice and Equity Advisory Board is to:

> Assist the Department in achieving the fair and equal treatment and meaningful involvement of North Carolinians regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations, and policies. Advise the Department on the interests of Native American Indian Tribes as well as vulnerable, at-risk North Carolinians who face language barriers and disabilities. Advise the Secretary on the consistent implementation of fair treatment and meaningful involvement of North Carolina citizens across the Department regarding new and ongoing complex permits, ongoing and proposed innovation, ongoing and future mitigation of contaminant exposures to human health and the environment, and other items deemed important by the Department. Advise the Secretary on the integration of environmental justice and equity considerations into Departmental programs, policies and activities to mitigate the environmental or public health impacts in communities disproportionately burdened by environmental harms.

The request to modify the role of the Environmental Justice and Equity Board is beyond the scope of DAQ's permitting action. For information on the role and internal operating procedure of the EJE Board visit: https://deq.nc.gov/outreach-education/environmental-justice/secretarys-environmental-justice-and-equity-board.

D. *I am requesting that North Carolina Secretary of the Department of Environmental Quality, Elizabeth S. Biser; postpone the NCDAQ Public Hearing for Air Permit No. 10693R00. I am deeply concerned that possible misconduct may have occurred by state agency's involving possible Title 6 violations in the process of the initial NCDAQ draft permit 10628ROO -Burlington North in 2020; I have deeply concerned of possible gas lighting of a marginalized community by the very agency's that were meant to protect them. Such as (but not limited to)NCDAQ's possible negligence of calculating EJ communities in the permit process, possible misconduct by NCDEQ for the amount of pressure, risks and stress placed on this EJ community during a COVID-19 worldwide epidemic (forcing citizens to obtain "life threatening" door-to-door surveys to prove they were indeed a EJ community) and NCDAQ's unwillingness to postpone Public Hearings and Public Comments during Covid-19 world wide epidemic multiples times until the very last minute. And again, forcing the citizens of this disadvantaged, low income EJ community to risk their lives collecting another door-to-door Health Survey's to enter into public comments in the NCDAQ Public Hearing; due to NCDAQ refused to cancel Public Hearing due to Covid-19 until the very last minute. All this took place before NCDAQ implemented ANY of the EJ guidelines for a EJ community, to educate the citizens to prepare for NCDEQ permit processes. The citizens of Anderson Community*

was forced to contact the EPA in Washington, DC; to help NCDAQ enforce NCDAQ Title 6 rights. My concerns is, if the facts are substantiated; these acts may have resulted in "the wearing down" and possibly unfair practices of Title 6 laws and regulations to an EJ community. Which resulted in this overburdened "at risk" EJ community to give up, due to what they felt as possible unfair practices and injustice. I am requesting an investigation of these possible concerns. I am requesting a full investigation, including an in depth FOIA requests of all state and federal agencies (persons) involved in NCDAQ Permit 1063900 Burlington North in 2020.

DEQ Response: Throughout the COVID-19 pandemic, DEQ has followed the state guidelines for reducing the spread of the virus. To protect public health, the Division of Air Quality conducted appropriate outreach that limited in-person interactions and maintained social distancing measures, such as emailing and calling citizens to keep them informed of the permitting process. The 2020 permitting process included significant outreach including onsite visits and virtual meetings with community members. In the current permitting process, that outreach continued. A flyer was distributed by mail to addresses near the site in both Burlington North and Prospect Hill communities with information describing changes made to the respective permits since 2020. On May 12, 2021, members of the Anderson Community also met with former Acting Secretary Dionne Delli-Gatti to voice their concerns and ask questions regarding the permitting process. DEQ is committed to maintaining compliance with Title VI of the Civil Rights Act of 1964. More information on DEQ's Title VI compliance can be found here: https://deq.nc.gov/permits-regulations/title-vi-compliance.

E. *Environmental Justice is well served when the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies cannot be usurped by an entity that has the financial means to do so by causing fear of reprisal and enormous financial hardships on an already impoverished community with the possible effect of rendering it mute. This can have profound effects well beyond the 1-mile radius and the Census Tracts upon which this Report centers. I ask you to consider these facts and deny the air permit application from Carolina Sunrock.*

DEQ Response: DAQ assesses air permit applications based on the federal and state statutes and regulations, and then determines if facilities meet those requirements before issuing or denying a permit.

Comment Category #7: North Carolina Environmental Protection Act: Subchapter 01C

A. *I am requesting that the Burlington North Permit be denied due to conformity with Subchapter 01C, NCEAP regulations in conformity with Cumulative Health Impacts risk. Anderson Community is an EJ community.*
B. *For eighteen months Anderson Community has been asking NCDEQ/NCDENR if conformity with Subchapter 01C - North Carolina Environmental Policy Act (NCEPA) applies to Anderson Community's documented "high risk" Cumulative Health Impact concerns? We believe NCEPA provides a regulation that NCDENR should enforce once they were notified that this pollutant permit "may result in a potential risk to human health?"*

HOC: The North Carolina Environmental Policy Act (NCEPA) and implementing regulations set forth at 1 NCAC Chapter 25 and 15A NCAC Subchapter 01C do not apply to the issuance of this permit. NCEPA only applies where there has been (1) An expenditure of $10 million in funds provided by the state of North Carolina for a single project or action or related group of projects or action; or (2) land-disturbing activity of equal to or greater than 10 acres of public lands resulting in substantial, permanent changes in the natural cover or topography of those lands (or waters). NCGS § 113A-4; § 113A-9 (defining "public land" and "significant expenditure of public moneys"). DAQ's decision to issue an air quality permit for this facility does not meet these criteria.

Comment Category #8: Odor Concerns

A. *I am worried that the asphalt plant will produce smelly and toxic hydrogen sulfides, which will impact our ability to enjoy the outdoors.*
B. *A report by the Blue Ridge Environmental Defense League reported almost 30 years of complaints made by community members about the smells and noises produced by asphalt plants in NC.*
C. *A UNC study showed that polluting asphalt plants produce hydrogen sulfides, which cause foul smells.*
D. *The facility is required to utilize management practices or odor control equipment sufficient to prevent objectionable odorous emissions.*
Action Requested: Require the applicant to identify the equipment, processes, and practices to prevent odors. Determine if the equipment and practices significantly reduce or eliminate odors.
E. *Additives are a way to control odor emissions when using recycled/reclaimed asphalt pavement (RAP). Action Requested: Evaluate and require the applicant to use additives (if environmentally friendly) to control odors when using RAP.*

HOC: DAQ acknowledges that some amount of odors can be expected from the proposed facility as well as many other industries within the state. Odors from industrial processes are regulated under 15A NCAC 02D .1806 "Control and Prohibition of Odorous Emissions" (Specific Condition 14 of the proposed Draft Air Permit). 15A NCAC 02D .1806(f) requires an Odor Management Plan when a determination of Objectionable Odors is made by the Director based on a recommendation by staff at the local regional office according to the following:

15A NCAC 02D .1806(i):

i. Determination of the existence of an objectionable odor. A source or facility is causing or contributing to an objectionable odor when:
a. a member of the Division staff determines by field investigation that an objectionable odor is present by taking into account the nature, intensity, pervasiveness, duration, and source of the odor and other pertinent such as wind direction, meteorology, and operating parameters of the facility;
b. the source or facility emits known odor-causing compounds such as ammonia, total volatile organics, hydrogen sulfide, or other sulfur compounds at levels that cause objectionable odors beyond the property line of that source or facility; or

c. the Division receives from the State Health Director epidemiological studies associating health problems with odors from the source or facility.

These determinations are typically driven by citizen complaints but can also be made based solely on a DAQ inspector's observations. Odors are regulated consistently throughout NC by DAQ. In all cases, the same odor condition referencing 15A NCAC 02D .1806 is placed in applicable air permits and in all cases, the requirement for an Odor Management Plan is based on field observations by staff in accordance with the procedures above.

Comment Category #9: Zoning/External Litigation

(Zoning Permit Condition)

A. *Carolina Sunrock requests that this permit condition be removed from the permit. The requirements in 15A NCAC 2Q .0304, including those related to zoning, merely specify the material to be included in the permit application and have already been satisfied by Carolina Sunrock. There is no basis to include an application condition that has already been met as an ongoing condition of the permit. Further, this condition is atypical for synthetic minor asphalt plants such as Sunrock, as is evident by reference to the following permits issued within the past three months for similar facilities, none of which include an equivalent provision: (i) Permit No. 05428R16 issued September 3, 2021 to Maymead Materials; (ii) Permit No. 02676R21 issued August 19, 2021 to Barnhill contracting Company; (iii) Permit No. 01406R15 issued August 27, 2021 to APAC-Atlantic. The inclusion of this provision in the final permit would both exceed the agency's authority and be arbitrary and capricious.*

B. *In the section of the permit review labeled: 2Q .0304 – Zoning Specific Condition: It states that It is DAQ policy to include a permit condition in permits for facilities located in areas without zoning requiring compliance with all lawfully adopted local ordinances that apply to the facility at the time of construction or operation of the facility. Caswell County adopted a High Impact Ordinance last year which came out of the County wide Moratorium on polluting Industries. This Ordinance placed set backs on Rock Quarry, Asphalt and Cement Plants. Sunrock applied for this air permit after the High Impact Ordinance was adopted. This being said the submission of the application does not take the setbacks into consideration. All the data complied does not take the setbacks into consideration. The air modeling does not take this into consideration. The setbacks will change the location of the asphalt and cement plants. If it is DAQ policy to have the condition that lawfully adopted ordinances to the facility at the time of construction or operation then the setbacks in the High Impact Ordinance should be applied.*

C. *Per Draft Permit condition A.16 (the second A.16 listed on pages 12-13), the applicant cannot begin construction or operation until all local permissions have been granted. There are several local permits that are in question. Several residents appealed the Caswell County Watershed Review Board's decisions in January to approve the Watershed Protection and Special Non-residential Intensity Allocation (SNIA) permits. However, the county has not set a hearing date on these appeals. In addition, the applicant has sued these residents in Superior Court. There is no court date set for that hearing. In addition, there may be future zoning requirements which may affect this facility. NC DAQ must stay informed on these issues and not allow the applicant to*

violate this condition of the permit. The applicant cannot begin construction or operation until these hearings have been held. The upcoming decisions from those hearings significantly affect this facility.

HOC: Carolina Sunrock requested the Zoning Permit Condition A.16. be removed from the air permit, while other parties requested the company be restricted from construction or operation until zoning and ordinance concerns are resolved in Caswell County.

DAQ's authority regarding local zoning laws in the context of the air quality permitting process is described in G.S. 143-215.108(f):

> *An applicant for a permit under this section for a new facility or for the expansion of a facility permitted under this section shall request each local government having jurisdiction over any part of the land on which the facility and its appurtenances are to be located to issue a determination as to whether the local government has in effect a zoning or subdivision ordinance applicable to the facility and whether the proposed facility or expansion would be consistent with the ordinance ... The determination shall be verified or supported by affidavit signed by the official designated by the local government to make the determination and, if the local government states that the facility is inconsistent with a zoning or subdivision ordinance, shall include a copy of the ordinance and the specific reasons for the determination of inconsistency. A copy of any such determination shall be provided to the applicant when it is submitted to the Commission. The Commission shall not act upon an application for a permit under this section until it has received a determination from each local government requested to make a determination by the applicant. If a local government determines that the new facility or the expansion of an existing facility is inconsistent with a zoning or subdivision ordinance, and unless the local government makes a subsequent determination of consistency with all ordinances cited in the determination or the proposed facility is determined by a court of competent jurisdiction to be consistent with the cited ordinances, the Commission shall attach as a condition of the permit a requirement that the applicant, prior to construction or operation of the facility under the permit, comply with all lawfully adopted local ordinances, including those cited in the determination, that apply to the facility at the time of construction or operation of the facility. If a local government fails to submit a determination to the Commission as provided by this subsection within 15 days after receipt of the request, the Commission may proceed to consider the permit application without regard to local zoning and subdivision ordinances ...*

This statute authorizes DAQ to include a zoning permit condition only where the local government has made the determination that a facility is inconsistent with a zoning or subdivision ordinance. In this case, Caswell County through its County Manager issued a zoning consistency determination on March 31, 2021, attesting that "the proposed operation is consistent with applicable zoning and subdivision ordinances." In light of this consistency determination, the statute does not confer authority on DAQ to include permit condition A.16. This determination is consistent with DAQ's July 31, 2000 Zoning Consistency Determination Guidance Memorandum, which stated that DAQ's

zoning consistency determination language would be included in permits as a specific condition "only if the local government states that the facility is inconsistent with a zoning or subdivision ordinance."[1]

Therefore, I recommend the zoning permit condition be removed from the draft air permit.

(*External litigation (include portions of comments A-C as well)*)

D. *We want to make part of the public record the applicant's attempt to curtail public participation prior to the official public commenting period. Several subpoenas have been served to dozens of residents along with community groups. In addition, these citizens have had to answer intrusive legal interrogatories and some are having to deliver depositions. To date, neither BREDL nor our chapter Protect Caswell has appealed local Caswell County decisions through the local governmental process or court system. Yet, BREDL has been served with 3 separate subpoenas related to individuals' or other organizations' actions regarding the proposed Burlington North and Prospect Hill Quarry facilities. The applicant has sued at least 55 residents who chose to appeal a local watershed review board's decision on Watershed Protection and Special Non-residential Intensity Allocation (SNIA) permits. The resident's appeal was an administrative appeal within the county government. However, the applicant chose to take these community members to Superior Court instead of letting the local appeal process conclude. To date, Caswell County has not scheduled a date to hear these residents' appeals.*
E. *The applicant is suing 55 neighbors when they exercised their right to object to a local permit that was issued by our county Planning Director. The lawsuit is seen as intimidation and has had a chilling effect on people wanting to come forward and speak out against the projects.*
Action Requested: Delay DAQ decision on the air permit until after a court ruling in the lawsuit. If the applicant loses, our county's High Impact Development Ordinance (HIDO) will apply and will affect the location and configuration of the projects. New air permit applications will be required if they can meet the HIDO requirements.
F. *No permit should be issued to Carolina Sunrock prior to the outcome of the lawsuit that Sunrock has initiated.*

HOC: Several comments addressed the impact of a lawsuit that was filed by Sunrock against Caswell County residents, which one commenter alleged constitutes intimidation and has had a chilling effect on public participation. DAQ believes that the public's meaningful participation in the permitting process is an essential component of DAQ's air quality program. DAQ's efforts to ensure that the public has had the opportunity to meaningfully engage in the permitting process are described in Comment Categories #6 and #10. With regard to the request that DAQ delay issuance of the permit in light of these concerns, DAQ's time for processing an air permit application is prescribed by statute and regulation and DAQ is without authority to delay finalization of its permitting action based on the lawsuit referenced by the comments.

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[1] Available at https://files.nc.gov/ncdeq/Air%20Quality/permits/memos/newzoning.pdf.

Comment Category #10: Hearing/Public Notice Concerns

A. *Additionally, due to technical difficulties and the virtual nature of Monday's hearing, I think it is necessary to extend the comment period so that residents have adequate time and means to provide input.*
B. *BREDL requests an extension of the Public Comment Period as stated in 15A NCAC 02Q .0307(d). Due to high interest in the Caswell County community for both Carolina Sunrock draft permits (Facility IDs: 1700016 and 1700017), there needs to be more time to allow impacted residents to review documents for both proposed sites.*
C. *I had been told that we would have three minutes to speak, but the moderator changed that to two minutes at the beginning of the meeting. The meeting finished much earlier than 9:00 pm. Tonight, I am attending the virtual public comment meeting for Carolina Sunrock-Prospect Hill. Individuals are being allowed the full three minutes. This seems very unfair to those who participated in the the meeting for Carolina Sunrock-Burlington North. I question why this was done.*
D. *The materials for public review do not adequately describe the facility. Information was received after the deadline making it very hard for me to review and understand the permit request. Additionally, there was only one notice in the newspapers, that is not enough. Given the amount of interest, It should have been in the newspaper calendar for the remaining time. This has kept many in the dark. No radio announcements.*

HOC: In general commenters indicate there was not enough public notice/outreach or time to comment. To start, there was a strong foundation of community awareness based on the initial (first) permit application in 2019-2020. Regarding this current (second) submittal, a public notice was published on April 7, 2021 in the Caswell Messenger by the applicant and a sign was posted at the property on April 1, 2021. The opening of a public comment period and a notice of public hearing on the draft air quality permit for Carolina Sunrock LLC was posted on the DAQ website and a press release was issued on August 9, 2021. The notice of public hearing on the draft air quality permit for Carolina Sunrock LLC was published in the Burlington-Times News on August 9, 2021 and The Caswell Messenger on August 11, 2021, and on the Division of Air Quality's website on August 9, 2021. Known community leaders were consulted, the Occaneechi Band of the Saponi Nation was kept informed of the permitting process, and flyers and letters were mailed to a 1-mile radius around the proposed facility on August 16.

The commenter is correct the comment period was changed to two minutes from three minutes for the Burlington North public hearing. This was a result of an unusually large amount registered speakers (121 people). The time was adjusted to give everybody registered a chance to be heard.

Comment Category #11: Other Matters Not Related to Air Quality

A. Groundwater, noise, unsightly, property values, light pollution, fire prevention
B. In a recent health assessment conducted by UNC and the NCIPH, 49% of respondents reported fear of encounter with wildlife and excessive buzzards, rodents, or insects.
C. The Caswell County Community Health Assessment reported in 2019 that 52% of water samples in Caswell County did not meet state guidelines for chemical contaminants.
D. One study in Sweden found that 50% of households located near an oil furnace and two asphalt plants complained of noise, even as low as 55dB.
E. Neighborhood Safety - *I am worried that the truck traffic associated with the operating hours of the asphalt plant will put my children at risk as they walk to the bus stop on busy roads with no sidewalks.*
F. Site Safety: Mandate the use of personal protective equipment (PPE) and proper respiratory equipment to negate this exposure for use by anyone on the property.

While most of the comments received were thoughtful and worth considering in the proper forum, some of the comments were not directly related to the proposed Carolina Sunrock air quality permit application or the air quality permitting process. As such, these comments fall outside the purview of this public hearing and are therefore not directly addressed in this report.

V. Conclusions and Recommendations

North Carolina General Statute 143.215.108(c)(5a)b requires that an applicant satisfies to the Department that it "has substantially complied with the air quality and emission control standards applicable to any activity in which the applicant has previously engaged, and has been in substantial compliance with federal and state laws, regulations, and rules for the protection of the environment." A review of the 5-year compliance history for all Carolina Sunrock facilities in North Carolina was conducted:

Facility ID	Facility Name	Address	City
9100102	Carolina Sunrock	214 Sunrock Road	Kittrell
7300078	Carolina Sunrock - Woodsdale	5280 Woodsdale Road	Roxboro
9200623	Carolina Sunrock Corporation ** INACTIVE **	8620 Barefoot Industrial Road	Raleigh
3900117	Carolina Sunrock LLC - Butner Asphalt	300 Sunrock Drive	Butner
3900074	Carolina Sunrock LLC - Butner Quarry	100 Sunrock Drive	Butner
9200779	Carolina Sunrock LLC - Eastern Wake Facility	1524 Old US Highway 264	Zebulon
3200270	Carolina Sunrock LLC - Muirhead Dist. Center	1503 Camden Avenue	Durham
1700015	Carolina Sunrock LLC - Prospect Hill Facility	4266 Wrenn Road	Prospect Hill
9200602	Carolina Sunrock Wake Forest Plant	5043 Unicon Drive	Wake Forest
3900093	Carolina Sunrock, LLC - Butner Concrete	100 Sunrock Drive	Butner
9200457	Carolina Sunrock, LLC - RDU Dist. Center	8620 Barefoot Industrial Rd	Raleigh

Only one compliance concern was noted for the above set of facilities for the past five years: a Notice of Violation was issued to the Butner Concrete facility in November 2018 for excessive visible emissions from a dust collector.

After considering all the public comments addressing whether or not DAQ should issue an air quality permit for the proposed Carolina Sunrock LLC –Burlington North to allow the construction and operation of an asphalt plant and concrete batch plant at 12971 S NC Highway 62 in Burlington, NC, it is the recommendation of the hearing officer that the Director issue the Air Quality permit with the following changes:

A. **Correct typographical and minor errors as mentioned in Comment Category 4 items F, I, J, and L.**
B. **Revise the dispersion modeling permit condition text as suggested in Category 4 item A. to ensure clarity of intent. The general requirement is not changing with this recommendation.**
C. **Remove the zoning permit condition A.16. as discussed in Comment Category 9.A-C.**

Additionally, I recommend DAQ staff remain sensitive to the health of the nearby communities and to the concerns that will remain should the asphalt plant begin operation. This can be accomplished through thorough frequent inspections and prompt responses to the citizen's air quality concerns and complaints. I also recommend DAQ staff ensure through compliance inspections and document review that the facility is constructed and operated as provided in the dispersion modeling analysis.

Brendan G. Davey, P.E., Hearing Officer

October 19, 2021
Date

Hearing Officer's Report and Recommendations

Carolina Sunrock LLC
Digital Public Hearing via Webex
September 20, 2021

SUPPORTING DOCUMENTATION

Permit Application Review
Draft Permit
Notice of Public Hearing
Public Hearing Attendance List
2 transcribed voicemail comments
139 E-mailed Public Comments
Audio of Public Hearing Comments
EJ Report

NORTH CAROLINA
DIVISION OF AIR QUALITY

Air Permit Review

Issue Date: XX/XX/XXXX

Region: Winston-Salem Regional Office
County: Caswell
NC Facility ID: 1700016
Inspector's Name: To be assigned
Date of Last Inspection: N/A
Compliance Code: N/A

Facility Data	Permit Applicability (this application only)
Applicant (Facility's Name): Carolina Sunrock LLC - Burlington North **Facility Address:** 12971 S NC Highway 62 Burlington, NC 27127 **SIC:** 2951 / Paving Mixtures and Blocks **NAICS:** 324121 / Asphalt Paving Mixture and Block Manufacturing **Facility Classification: Before:** Permit Pending **After:** Synthetic Minor **Fee Classification: Before:** N/A **After:** Synthetic Minor	**SIP:** Yes **NSPS:** Yes (40 CFR 60, Subparts I and OOO) **NESHAP:** No **PSD:** No **PSD Avoidance:** Yes (SO_2) **NC Toxics:** Yes (2D .1100 and 2Q .0711) **112(r):** No **Other:** Recycled Fuel Oil

Contact Data

Facility Contact	Authorized Contact	Technical Contact
Scott Martino Compliance Manager (984) 202-4761 200 Horizon Drive Suite 100 Raleigh, NC 27615	Gregg Bowler CFO (919) 747-6400 200 Horizon Drive Suite 100 Raleigh, NC 27615	Scott Martino Compliance Manager (984) 202-4761 200 Horizon Drive Suite 100 Raleigh, NC 27615

Application Data
Application Number: 1700016.19A
Date Received: April 22, 2021
Application Type: Greenfield Facility
Application Schedule: State

Existing Permit Data
Existing Permit Number: N/A
Existing Permit Issue Date: N/A
Existing Permit Expiration Date: N/A

Review Engineer: Leo L. Governale, P.E.
Review Engineer's Signature:

Date:

Comments / Recommendations:
Issue Permit Number: 10693R00
Permit Issue Date: XX/XX/XXXX
Permit Expiration Date: XX/XX/XXXX

I. PURPOSE OF APPLICATION

On April 22, 2021, WSRO-DAQ received an application package from Carolina Sunrock LLC, requesting an Air Permit for a new facility located at 12971 S NC Highway 62, Burlington, Caswell County, NC. Included in the submittal were the appropriate A, B, C and D forms along with supporting documentation and a check in the amount $400, the application fee required for a Greenfield Synthetic Minor facility. It is noted that this proposed site is located in an area without zoning; therefore, the applicant is required to publish a legal notice in accordance with 2Q .0113. The application also contained a letter that stated that a public notice was published on April 7, 2021 in the Caswell Messenger and a sign was posted on April 1, 2021. A notarized Affidavit of Publication was also included with a scanned copy of the newspaper clipping. Date-stamped photographs provided indicate that the sign was posted as required on April 1, 2021.

The contact information provided in the application was entered in the IBEAM database. Carolina Sunrock LLC is duly registered under this name with the North Carolina Secretary of State (NCSOS) – Division of Corporations and holds a current-active status, as verified by this reviewer via online search of the NCSOS database.

Application Chronology

Date	Event	Comment
April 22, 2021	Application received	Application deemed complete; clock started
June 14, 2021	Request for additional information; need completed C1 forms for Bagfilters and revised modeling analysis	Clock stopped
July 8, 2021	Additional information received	Clock restarted
August XX, 2021	Facility notified that draft permit will be noticed to the public and posted for public comment period.	Clock stopped
XX/XX/XXXX	Permit issued	-----

II. DESCRIPTION OF BUSINESS

Information contained in the application states that this facility will include a Drum Mix Asphalt Plant (250 tons per hour maximum capacity), RAP Crushing System and a Truck Mix Concrete Batch Plant (120 cubic yards per hour). The Permitted Emission Sources and Insignificant/Exempt Activities are listed in the following tables:

Permitted Emission Sources

Emission Source ID	Emission Source Description	Control System ID	Control System Description
One Drum Mix Asphalt Plant (250 tons per hour maximum capacity), consisting of:			
HMA-1 **(NSPS-I)**	Propane/Natural Gas/No. 2 Fuel Oil/Recycled No. 2 Fuel Oil/Recycled No. 4 Fuel Oil-fired Drum-type Hot Asphalt Plant (80 million Btu per hour maximum heat input capacity)	HMA-CD1	Cyclone in series with Bagfilter (9,299 square feet of filter area)
HMA-Silo1	Hot Mix Asphalt Storage Silo (150 tons maximum capacity)	N/A	N/A
HMA-Silo2	Hot Mix Asphalt Storage Silo (150 tons maximum capacity)	N/A	N/A
HMA-Silo3	Hot Mix Asphalt Storage Silo (200 tons maximum capacity)	N/A	N/A
HMA-Silo4	Hot Mix Asphalt Storage Silo (200 tons maximum capacity)	N/A	N/A
HMA-Silo5	Hot Mix Asphalt Storage Silo (200 tons maximum capacity)	N/A	N/A
HMA-LO1	Asphalt Loadout Operation Silo 1	N/A	N/A
HMA-LO2	Asphalt Loadout Operation Silo 2	N/A	N/A
HMA-LO3	Asphalt Loadout Operation Silo 3	N/A	N/A
HMA-LO4	Asphalt Loadout Operation Silo 4	N/A	N/A
HMA-LO5	Asphalt Loadout Operation Silo 5	N/A	N/A
HMA-H1	Natural Gas/No. 2 Fuel ULSD Oil-fired Liquid Asphalt Cement Heater (1.2 million Btu per hour maximum heat input)	N/A	N/A
HMA-H2	Natural Gas/No. 2 Fuel ULSD Oil-fired Liquid Asphalt Cement Heater (1.1 million Btu per hour maximum heat input)	N/A	N/A
RAP Crushing System consisting of:			
RAP-CRSH **[NSPS-OOO]**	RAP Impact Crusher (65 tons per hour maximum rated capacity)	N/A	N/A
RAP-CNV **[NSPS-OOO]**	Four (4) Conveyors	N/A	N/A
RAP-SCN **[NSPS-OOO]**	8' x 20' Double Deck Screen	N/A	N/A
Truck Mix Concrete Batch Plant (120 cubic yards per hour maximum capacity), consisting of:			
RM-1	Cement Storage Silo (200-ton capacity)	RMC-CD2	Bagfilter (1,433 square feet of filter area)
RM-2	Flyash Storage Silo (200-ton capacity)	N/A	N/A
RM-3	Truck Loadout Point		
RM-4	Cement/Flyash Weigh Batcher (25-ton maximum capacity)		
RM-5	Aggregate Weigh Batcher (50-ton maximum capacity)		

Insignificant/Exempt Sources

Source	Exemption Regulation	Source of TAPs?	Source of Title V Pollutants?
IES-1, IES-2 - Two (2) Used Oil Storage Tanks associated with Asphalt Plant (20,000-gallon capacity, each)	2Q .0102 (g)(4)... *"storage tanks with no applicable requirements other than Stage I controls pursuant to 15A NCAC 02D .0928, Gasoline Service Stations Stage I"*	Yes	Yes
IES-3, IES-4 - Two (2) Liquid Asphalt Storage Tanks (30,000-gallon capacity, each)			
IES-5, IES-6 - Two (2) Diesel Fuel Storage Tanks associated with Asphalt Plant (20,000-gallon capacity, each)			

III. REVIEW OF REGULATIONS

The following North Carolina Administrative Code Title 15A regulations were evaluated under this review:

2D .0202 - Registration of Air Pollution Sources
2D .0501(c) - Compliance with National Ambient Air Quality Standards
2D .0503 - Particulates from Fuel Burning Indirect Heat Exchangers
2D .0506 - Particulates from Hot Mix Asphalt (HMA) Plants
2D .0510 - Particulates from Sand, Gravel, or Crushed Stone Operations
2D .0515 - Particulates from Miscellaneous Industrial Processes
2D .0516 - Sulfur Dioxide (SO_2) Emissions from Combustion Sources
2D .0521 - Control of Visible Emissions (VE)
2D .0524 - New Source Performance Standards (NSPS)
2D .0535 - Excess Emissions Reporting and Malfunctions
2D .0540 - Particulates from Fugitive Dust Emission Sources
2D .0605 - General Recordkeeping and Reporting Requirements
2D .0611 - Monitoring Emissions from Other Sources
2D .1100 - Control of Toxic Air Pollutants (TAPs)
2D .1806 - Control and Prohibition of Odorous Emissions
2Q .0304 - Zoning Specific Condition
2Q .0315 - Synthetic Minor Facilities
2Q .0317 - Avoidance Condition (PSD and Toxics)
2Q .0711 - Emission Rates Requiring a Permit

CONTROL DEVICE EVALUATION
Bagfilter HMA-CD1

The proposed Bagfilter (HMA-CD1), associated with the Hot Mix Asphalt Plant (HMA-1), was evaluated using the NCDENR Bagfilter Evaluation Spreadsheet - Version 3.3, September 23, 1999 (see Attachment A1). The following table lists the characteristics based on the data provided on revised Form C1 dated July 7, 2021.

Material Controlled	Abrasive Dust
No. of Compartments	12
No. of Bags per Compartment	64
Bag Length / Bag Diameter	120 in. / 4 5/8 in.
Filter Surface Area	9,299 ft^2
Inlet Air Flow Rate:	51,111 ACFM
Air to Cloth Ratio	5.5:1
Filter Material	Aramid (Nomex)

Max. Operation Temperature	325 ^{0}F
Cleaning Procedure	Air Pulse
Claimed Capture Efficiency	99% for PM/PM_{10}

According to the spreadsheet, the filtering velocity of 5.5 fpm does not exceed the typical filtering velocity of 10.0 fpm and the filter fabric is appropriate for both the maximum operating temperature and chemical resistance to acids, alkalis and organics. Also, the control efficiency as stated in the application seems reasonable, so the Bagfilter was assessed as an adequate control device. Pursuant to 15A NCAC 02Q .0112, the technical portions of the permit application related equipment controlling emissions of particulate matter with air flow rates of greater than 10,000 actual cubic feet per minute are required to be sealed by a licensed Professional Engineer (P.E.). This certification was provided on Application Form D5, bearing the seal and signature of Aimee L. Andrews, P.E., NC Professional Engineer No. 029987.

Bagfilter RMC-CD2

The proposed Bagfilter (RMC-CD2), associated with the Concrete Batch Plant, was evaluated using the NCDENR Bagfilter Evaluation Spreadsheet - Version 3.3, September 23, 1999 (see Attachment A2). The following table lists the characteristics based on the data provided on revised Form C1 dated July 7, 2021.

Material Controlled	Cement/Fly Ash
No. of Compartments	1
No. of Bags per Compartment	72
Bag Length / Bag Diameter	114 in. / 8 in.
Filter Surface Area	1,433 ft^2
Inlet Air Flow Rate:	6,500 ACFM
Air to Cloth Ratio	4.54:1
Filter Material	Felt Polyester (Dacron)
Max. Operation Temperature	70 ^{0}F
Cleaning Procedure	Air Pulse
Claimed Capture Efficiency	99% for PM/PM_{10}

According to the spreadsheet, the filtering velocity of 4.5 fpm does not exceed the typical filtering velocity of 8.0 fpm and the filter fabric is appropriate for both the maximum operating temperature and chemical resistance to acids, alkalis and organics. Also, the control efficiency as stated in the application seems reasonable, so the Bagfilter was assessed as an adequate control device. It is noted that, because the air flow rate does not exceed 10,000 ACFM, a P.E. seal is not required.

2D .0202 – Registration of Air Pollution Sources

This regulation allows the Director to require a facility to report, as in this case, total weights and kinds of air pollution released as well as any other information considered essential in evaluating the potential of the source to cause air pollution. In accordance with this regulation, the facility will be required to submit a CY **20XX** Emissions Inventory at least ninety (90) days prior to **[DATE to be determined]**, which is the expiration date of this Air Permit.

It is reasonable to anticipate compliance.

2D .0501(c) - Compliance with National Ambient Air Quality Standards

In addition to any control or manner of operation necessary to meet emission standards in 2D .0500, any source of air pollution shall be operated with such control or in such manner that the source shall not cause the ambient air quality standards pursuant to 2D .0400 to be exceeded at any point beyond the premises on which the source is located. When controls more stringent than those named in the applicable emission standards in this Section are required to prevent violation of the ambient air quality standards or are required to create an offset, the permit shall contain a condition requiring these controls.

A sitewide National Ambient Air Quality Standards (NAAQS) dispersion modeling analysis was reviewed by Matthew Porter, Meteorologist, Air Quality Analysis Branch (AQAB) based on information by the Permittee on March 2, 2021, and revised March 10, 2021. The dispersion modeling analysis was conducted to evaluate the combined criteria air pollutant ambient impacts from all operations located

at the site, which included emissions from the proposed construction and operation of a hot mix asphalt plant and concrete batch plant. Sitewide criteria pollutants including particulate matter (PM, $PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2) were modeled for comparison with the NAAQS. Subsequently, Mr. Porter issued a memorandum, dated March 23, 2021 stating that the sitewide dispersion modeling analysis of criteria air pollutant emissions adequately demonstrated compliance with the NAAQS, on a source-by-source basis. The maximum modeled impacts are provided in following table.

Pollutant	Averaging Period	NAAQS (µg/m3)	Background Concentration (µg/m3)	Modeled Impact (µg/m3)	Total Impact (µg/m3)	% of NAAQS
PM	24-hour	150	--	145.32	145.32	97%
	Annual	75	--	27.36	27.36	36%
PM_{10}	24-hour	150	17	54.48	71.48	48%
$PM_{2.5}$	24-hour	35	15	8.80	23.80	68%
	Annual	12	7.3	1.35	8.65	72%
SO_2	1-hour	196	83.8	39.87	123.67	63%
NO_2	1-hour	188	15.3	129.73	145.03	77%

The following requirements will be placed in the permit under this condition:

Placement of the emission sources, configuration of the emission points, and operation of the sources shall be in accordance with the submitted sitewide NAAQS dispersion modeling analysis and should reflect any changes from the original analysis submittal as outlined in the AQAB review memo.

a. Production Limitations - To ensure compliance with 2D.0501(c), the Permittee shall operate the modeled sources in accordance with the operating restrictions presented in 2Q .0315 Synthetic Minor condition, below.
b. Water Truck – An operable water truck shall be available on site at all times while the plant is operating. The roads and front-end loader work area shall be adequately maintained by wet suppression to minimize fugitive emissions.

2D .0503 – Particulates from Fuel Burning Indirect Heat Exchangers

This regulation applies to the two (2) Natural Gas/No. 2 Fuel ULSD Oil-fired Asphalt Cement Heaters (HMA-H1 and HMA-H2), and it limits particulate emissions according to the following equation:

$$\mathbf{E = 1.09 \times Q^{-0.2594}}$$

where: **E** = allowable emission limit for particulate matter in lb./MMBtu
Q = maximum total heat input of all fuel burning indirect heat exchangers in MMBtu/hr.,
except where the maximum total heat input is ≤ 10 MMBtu/hr., as in this case, then **E** = 0.60 lb./MMBtu

Using the AP-42 emission factor for Fuel Oil – Tables 1.3-1 and 1.3-2, rev 5/10, and Natural Gas – Table 1.4-2, rev 7/98, the actual emissions rates are calculated as follows:

$$E_{actual\ -\ Natural\ Gas} = 7.6 \text{ lb. } PM_{total}/10^6 \text{ scf} / 1{,}020 \text{ MMBtu}/10^6 \text{ scf} = 0.007 \text{ lb. PM/MMBtu}$$

$$E_{actual\ -\ No.\ 2\ Fuel\ Oil} = (2 \text{ lb. } PM_{filterable} + 1.3 \text{ lb. } PM_{condensable})/10^3 \text{ gallons} / 140 \text{ MMBtu}/10^3 \text{ gallons} = 0.024 \text{ lb. PM/MMBtu}$$

$$0.007;\ 0.024 \text{ lb. PM/MMBtu} \leq 0.60 \text{ lb. PM/MMBtu} \rightarrow \text{O.K.}$$

Based on the foregoing, actual emissions for combustion of No. 2 Fuel ULSD Oil and Natural Gas are less than the allowable emissions limit; therefore, compliance is demonstrated.

2D .0506 – "Particulates from Hot Mix Asphalt Plants"

This regulation is applicable to both filterable and condensable particulate emissions from the plant. It limits the allowable particulate matter emissions from Hot Mix Asphalt Plants as calculated by the following equations:

$$\mathbf{E = 4.9445(P)^{0.4376}} \quad \text{if } \mathbf{P} < 300 \text{ tons/hr.}$$
$$\mathbf{E = 60.00} \quad \text{if } \mathbf{P} \geq 300 \text{ tons/hr.}$$

where: **P** = the process rate in tons/hr.
E = the maximum allowable emission rate for PM in lb./hr.

Since the permitted process rate is 250 tons per hour, this plant's allowable PM emission rate is calculated as follows:

$$\mathbf{E = 4.9445(250)^{0.4376}} = \underline{55.4 \text{ lb. PM/hr.}}$$

Using AP-42 emission factor for Drum Mix Asphalt Plants (Table 11.1-3, 3/04), the emission factor total PM for a Drum Mix HMA plant controlled by a fabric filter is 0.033 lb. PM/ton of asphalt; therefore, the actual expected PM emission rate is calculated as follows:

PM = 0.033 lb. PM/ton x 250 ton/hr. = <u>8.25 lb. PM/hr.</u>

<u>8.25 lb. PM/hr. < 55.4 lb. PM/hr.</u> → O.K.

Also, this regulation requires that visible emissions from stacks or vents at a HMA plant shall be less than 20% opacity when averaged over a six-minute period and that fugitive dust shall be controlled as required by 2D .0540 (discussed below). A source test on the Drum-type Hot Asphalt Plant (HMA-1) controlled by a Bagfilter (HMA-CD1) will be required within 60 days after achieving the maximum production rate at which the affected source(s) will be operated, but not later than 180 days after the initial start-up of the affected source(s), the Permittee shall conduct the required performance test(s) to verify compliance with this rule and Subpart I. See 2D .0605 of this review for more details regarding testing. Per the Memorandum "Hot Mix Asphalt Plant Performance Testing/Emission Testing Frequency" issued August 13, 2013, by Sheila Holman, former DAQ Director, the facility must test for compliance at least once every ten (10) years. If the emission sources operate according to manufacturer specifications and with the permitted bagfilter, the sources should be in compliance with this regulation.

<u>2D .0510 – Particulates from Sand, Gravel, or Crushed Stone Operations</u>

This facility, engaging in sand, gravel, recycled asphalt pavement (RAP), or crushed stone operations, must not cause, allow, or permit any material to be produced, handled, transported, or stockpiled without taking measures to reduce to a minimum any particulate matter from becoming airborne. This is in order to prevent exceeding the ambient air quality standards beyond the property line for particulate matter. Fugitive dust shall be controlled as required by 2D .0540 as discussed below. Process generated emissions from crushers, conveyors, screens, and transfer points shall be controlled so that opacity standards required by 2D .0521 and 2D. 0524, as applicable, are not exceeded. It seems reasonable to anticipate compliance.

<u>2D .0515 – Particulates from Miscellaneous Industrial Processes</u>

This rule is applicable to particulate matter (PM) emissions from all Concrete Batch Plant sources at this facility and it limits the allowable PM emissions as derived by the following equations:

$$\mathbf{E = 4.10\ (P)^{0.67}} \quad \textbf{if P} \leq \textbf{30 tons per hour}$$

or

$$\mathbf{E = 55.0\ (P)^{0.11} - 40} \quad \textbf{if P} > \textbf{30 tons per hour}$$

where: **P** = the process rate in tons per hour, and
E = maximum allowable emission rate of PM in pounds per hour

Expected actual controlled emission rates were calculated using the NCDENR Concrete Batch Plant Emissions Calculator Spreadsheet, Revision D - October 15, 2015. The process weight rates for the Cement Silo and Flyash Silo were taken from information provided with the application. Process weight rates for the Truck Loadout Point, Cement/Flyash Weigh Batcher and Aggregate Weigh Batcher were calculated by this reviewer as indicated in the table footnotes. The following table indicates that the facility can comply with this rule when the Bagfilter (RMC-CD2) is installed and properly operated and maintained on the respective emission sources.

Emission Source (ID No.)	Process Weight Rate (P) [tons/hr.]	Allowable Emissions Rate (E) 2D .0515 Limit [lb. PM/hr.]	Expected Controlled Actual Emissions Rate[5] [lb. PM/hr.]	Expected Uncontrolled Actual Emissions Rate [lb. PM/hr.]
Cement Silo (RM-1)	40.00[1]	42.53	0.027	27.00[7]
Flyash Silo (RM-2)	50.00[1]	44.58	0.079	79.0[7]
Truck Loadout Point (RM-3)	240.96[2]	60.55	1.001	52.21[7]
Cement/Flyash Weigh Batcher (RM-4)	35.76[3]	41.51	1.001[6]	52.21[7]
Aggregate Weigh Batcher (RM-5)	205.20[4]	58.78	N/A	0.985[8]

[1] Taken from information provided with the application and as shown on the NCDENR Spreadsheet.

[2] 120 yd^3/hr. × (448 lb. Cement/yd^3 + 148 lb. Flyash/yd^3 + 1,980 lb. Coarse Aggregate/yd^3 + 1,440 lb. Sand/yd^3) ÷ 2,000 lb./ton = 240.96 ton/hr.

[3] 120 yd^3/hr. × (448 lb. Cement/yd^3 + 148 lb. Flyash/yd^3) ÷ 2,000 lb./ton = 35.76 ton/hr.

[4] 120 yd^3/hr. × (1,980 lb. Coarse Aggregate/yd^3 + 1,440 lb. Sand/yd^3) ÷ 2,000 lb./ton = 205.20 ton/hr.

[5] From the NCDENR Spreadsheet. Aggregate Weigh Batcher emissions are uncontrolled.

[6] As noted in the spreadsheet *"Truck/Central Mix emission factors include emissions from cement and supplement weigh hoppers,"* and so, to be conservative, the Cement/Flyash Weigh Batcher emission rate is shown the same as the Truck Loadout emission rate.

[7] From NCDENR Concrete Batch Emissions Calculator Spreadsheet – Revision D, October 15, 2015.

[8] 205.20 tons/hr. x 0.0048 lb. PM/ton (uncontrolled PM emission factor from AP-42 Table 11.12-2) = 0.985 lb. PM/hr.

2D .0516 – Sulfur Dioxide Emissions from Combustion Sources

This regulation applies to the Propane/Natural Gas/No. 2 Fuel Oil/Recycled No. 2 Fuel Oil/Recycled No. 4 Fuel Oil-fired Drum-type Asphalt Plant (HMA-1) and the two (2) Natural Gas/No. 2 ULSD Fuel Oil-fired Asphalt Heaters (HMA-H1 and HMA-H2), and it limits the emissions of sulfur dioxide (SO_2) from any source of combustion that is discharged from any vent, stack, or chimney to 2.3 lb. SO_2 /MMBtu input.

For the drum dryer/mixer associated with the Asphalt Plant (HMA-1), the SO_2 emission rate is equal to 0.0003 lb./MMBtu when combusting Natural Gas, 0.253 lb./MMBtu when combusting No. 2 Fuel Oil, and 0.262 lb./MMBtu when combusting No. 4 Fuel Oil, as demonstrated below. It is assumed that No. 4 Fuel Oil has the same emission factor as Waste Oil and the emission factor for Propane is similar to that for Natural Gas.

Natural Gas (AP-42, Table 11.1-7)
SO_2 = 0.0001 lb./ton of asphalt produced × 250 ton/hr. ÷ 80 MMBtu/hr. = 0.0003 lb./MMBtu < 2.3 lb./MMBtu → O.K.

No. 2 Fuel Oil - 0.50% sulfur (NCDENR Asphalt Emissions Calculator Spreadsheet Revision G, 08/30/2019)
SO_2 = 0.0811 lb./ton of asphalt produced × 250 ton/hr. ÷ 80 MMBtu/hr. = 0.253 lb./MMBtu < 2.3 lb./MMBtu → O.K.

No. 4 Fuel Oil - 0.50% sulfur (NCDENR Asphalt Emissions Calculator Spreadsheet Revision G, 08/30/2019)
SO_2 = 0.0837 lb./ton of asphalt produced × 250 ton/hr. ÷ 80 MMBtu/hr. = 0.262 lb./MMBtu < 2.3 lb./MMBtu → O.K.

For the two (2) Natural Gas/No. 2 Fuel Oil-fired Asphalt Heaters (HMA-H1 and HMA-H2), the SO_2 emission rate is equal to 0.00059 lb./MMBtu when combusting Natural Gas and 0.00152 lb./MMBtu when combusting No. 2 ULSD Fuel Oil as demonstrated below. The first equation assumes the sulfur content of Natural Gas is 2,000 grains/10^6 scf, and the average heating value of Natural Gas is 1,020 Btu/scf. The second equation assumes a No. 2 ULSD Fuel Oil sulfur content (S) of 0.0015% by weight, and the average heating value of No. 2 Fuel Oil is 140,000 Btu/gal. Compliance is demonstrated.

Natural Gas (AP-42, Table 1.4-2)
SO_2 = 0.6 lb./10^6 scf × (10^6 scf/1,020 MMBtu) = 0.00059 lb./MMBtu < 2.3 lb./MMBtu → O.K.

No. 2 Fuel Oil (AP-42, Table 1.3-1)

$SO_2 = 142 \times S$ (S = 0.0015) lb./10^3 gal × (10^3 gal/140 MMBtu) = 0.00152 lb./MMBtu < 2.3 lb./MMBtu → O.K.

2D .0521 - Control of Visible Emissions

This rule applies to all fuel burning operations and industrial processes where visible emissions can reasonably be expected to occur and limits visible emissions to 40% opacity for sources manufactured as of July 1, 1971 and to 20% opacity for sources manufactured after July 1, 1971, when averaged over a six-minute period. The visible emissions from the Drum-mix Hot Asphalt Plant (HMA-1) is subject to both 2D .0506 and 2D .0524, and the RAP Operations are subject to 2D .0524. Therefore, this rule regulates visible emissions from the rest of the emission sources. Because all sources are new, it is reasonable to assume that they were manufactured after July 1, 1971, and so the 20% opacity limit applies. Compliance is expected with proper operation and maintenance of the subject equipment and associated control devices, where applicable.

2D .0524 – New Source Performance Standards (NSPS)

This facility is subject to **40 CFR Part 60, Subpart I – "Standards of Performance for Hot Mix Asphalt Plants,"** and it applies to particulate emissions from hot mix asphalt facilities that commence construction or modification after June 11, 1973, as in this case. Within 15 days after start-up of the HMA plant, the Permittee is required to notify the DAQ of the start-up date in writing. The facility shall not discharge into the atmosphere from the affected source any gases which contain particulate matter in excess of 90 mg/dscm (0.04 gr/dscf) or exhibit 20% opacity or greater. A source test on the HMA plant (HMA-1), controlled by a Bagfilter (HMA-CD1) will need to be conducted to determine the HMA plant's particulate matter and visible emissions. See 2D .0605 below for additional details regarding testing. It is reasonable to anticipate compliance.

The facility is also subject to **40 CFR 60, Subpart OOO for "Nonmetallic Mineral Processing Plants."** This rule applies to each crusher, grinding mill, screening operation, bucket elevator, belt conveyor, bagging operation, storage bin, enclosed truck, or railcar loading station (sources) at fixed or portable nonmetallic mineral processing plants that commenced construction, reconstruction, or modification after August 31, 1983, except, in part, to fixed plants with capacities of 25 tons per hour or less or portable plants with capacities of 150 tons per hour or less. Also, crushers and grinding mills at hot mix asphalt facilities that reduce the size of nonmetallic minerals embedded in recycled asphalt pavement and subsequent affected facilities up to, but not including, the first storage silo or bin are subject to the provisions of this Subpart. Therefore, the RAP Crushing System, comprising of the Crusher, four (4) Conveyors and Screen (RAP-CRSH, RAP-CNV, and ES-SCN, respectively), is subject to this rule. Within 15 days after start-up of each source, the facility is required to notify the DAQ of the start-up date in writing. For affected sources that commenced construction, modification, or reconstruction after August 31, 1983, but before April 22, 2008, visible emissions are limited to 15% opacity for crushers and 10% opacity for fugitive emissions from conveyor belts, screening operations, and other affected sources.

For sources constructed, modified, or reconstructed on or after April 22, 2008, visible emissions are limited to 12% opacity for crushers and 7% opacity for fugitive emissions from conveyor belts, screening operations, and other affected sources. Monthly inspection requirements apply for affected sources that were constructed on or after April 22, 2008, and that use wet suppression to control emissions. A source test using EPA Method 9 on the crusher, screen, and conveyor will need to be conducted to determine their compliance with the respective opacity limits. It is reasonable to anticipate compliance.

2D. 0535 – Excess Emissions Reporting and Malfunctions

This facility is subject to this regulation. In accordance with section (f) of this rule, the Permittee must notify DAQ in the event of a source of excess emissions that last for more than four (4) hours and that result from a malfunction, a breakdown of process or control equipment, or any other abnormal conditions. It is reasonable to anticipate compliance.

2D .0540 – Particulates from Fugitive Dust Emission Sources

This facility is subject to this regulation. It applies to particulate emissions that do not pass through a process stack or vent and are generated within plant property boundaries. If fugitive dust emissions cause excessive visible emissions beyond property boundaries, or cause substantive complaints, the Director may require the facility to develop, implement, and comply with a fugitive dust control plan. It is reasonable to anticipate compliance.

2D .0605 – General Recordkeeping and Reporting Requirements

This rule allows the DAQ to require any monitoring, recordkeeping, reporting, or testing it deems necessary for the facility to demonstrate compliance with an emission standard or permit condition. As mentioned previously, a memorandum titled "Hot Mix Asphalt Plant Performance Testing/Emission Testing Frequency" was issued August 13, 2013, by Sheila Holman, former DAQ Director. This requires all hot mix asphalt plants to test for compliance with 2D .0506 at least once every 10 years. The results also happen to reinforce compliance

with 2D .0524 (NSPS Subpart I). The stack testing is for filterable and condensable particulate matter using EPA Methods 5 and 202, respectively. Additionally, EPA Method 9 is required for visible emissions from the HMA plant, as this is the initial test. The tests must be conducted within 60 days after achieving the maximum production rate at which the affected source(s) will be operated, but not later than 180 days after the initial start-up of the affected source(s), the Permittee shall conduct the required performance test(s) and submit two copies of a written report of the test(s) to the Regional Supervisor, DAQ. The facility must test while combusting the fuel that will be utilized for the majority of the operating time. In accordance with 2D .2602, a testing protocol must be provided to DAQ prior to testing. Protocols are not required to be approved before the test date, but those that are received at least 45 days prior to the test date will be reviewed. The facility must provide at least 30 day notice in written form of any required performance testing, to provide DAQ the opportunity to have an observer present. It is reasonable to anticipate compliance.

2D .0611 – Monitoring Emissions from Other Sources

This rule applies to the Cyclone in series with Bagfilter (HMA-CD1) associated with the Drum Mix Asphalt Plant and Bagfilter (RMC-CD2) associated with the Truck Mix Concrete Batch Plant. It allows the Director to require the facility to conduct monitoring in order to demonstrate compliance with rules in Subchapters 2D and 2Q and is the basis for requiring control device inspections in the Air Permit. This facility will be required to perform periodic inspections and maintenance (I&M) as recommended by the manufacturer. At a minimum, this facility will be required to perform an annual internal inspection of each bagfilter. Records of all inspections and maintenance with dates and descriptions should be kept in a log book (written or electronic format) located on-site. This log book should be made available to DAQ personnel upon request. It is reasonable to anticipate compliance.

2D .1100 – Control of Toxic Air Pollutants (TAPs)

A toxics review has been triggered because the HMA plant and associated sources will emit toxic air pollutants (TAPs). The facility modeled for Arsenic, Benzene, Formaldehyde, Mercury and Nickel due to expected actual emissions of these TAPs being above their respective toxic permit emission rates (TPERs) listed at 2Q .0711. The sources of these TAP emissions are the HMA Plant (HMA1), the five (5) HMA Storage Silos (HMA-Silo1 through HMA-Silo5), the Asphalt Loadout Operations (HMA-LO1 through HMA-LO5), the two (2) Asphalt Cement Heaters (HMA-H1 and HMA-H2), and the Concrete Batch Plant. Note that the heaters cannot be exempt from toxics per 2Q .0702 (a)(18), because they are combustion sources permitted after July 10, 2010. TAPs are also expected to be emitted from the exempt storage tanks containing No. 4/Used Oil/Diesel Fuel[1] (IES-1, IES-2 and IES-3) and Liquid Asphalt[2] (IES-4 and IES-5), but these sources currently qualify for exemption from toxics rules per 2Q .0702 (a)(19)(B) for *"storage tanks used only to store: fuel oils [...] or petroleum products with a true vapor pressure (TVP) less than 1.5 pounds per square inch absolute."*

On July 27, 2021, Nancy Jones, Meteorologist, Air Quality Analysis Branch (AQAB) issued a Memorandum regarding the analysis stating that *"The purpose for modeling was to demonstrate compliance with guidelines specified in 15A NCAC 2D .1104 for Toxic Air Pollutants (TAPs) emitted in excess of the Toxic Permitting Emission Rates (TPERs) listed in 15A NCAC 2Q .0711. The modeling adequately demonstrates compliance, on a source-by-source basis, for all toxics modeled."*

The following table illustrates the maximum impacts from the modeling:

Maximum Modeled TAP Impacts

TAP	Averaging Period	AAL [µg/m³]	AAL [%]
Arsenic	Annual	0.0021	5
Benzene		0.12	10
Formaldehyde	1-hr	150	4
Mercury	24-hr	0.60	<1
Nickel		6	1

[1] Distillate Fuel Oil has a TVP of 0.062 kPa (0.0090 psi) at 700 F (AP-42 7.1, Organic Liquid Storage Tanks, rev. 11/06, Table 7.1-2).

[2] Liquid Asphalt has a TVP less than 0.12 kPa (0.017 psi) at 325° F (AP-42 11.1 HMA plants, background document, 2/2004, p. 4-82).

TAP Emission Limits

Emission(s) Source	TAP (CAS #)	Emission Limit
Propane/Natural Gas/No. 2 Fuel Oil/Recycled No. 2 Fuel Oil/Recycled No. 4 Fuel Oil-fired Drum-type Hot Asphalt Plant Baghouse (HMA-CD1)	Arsenic unlisted compounds (ASC-other)	1.23 lb./yr.
	Benzene (71-43-2)	854.0 lb./yr.
	Formaldehyde (50-00-0)	0.775 lb./hr.
	Mercury vapor (7439-97-6)	0.0156 lb./24-hr
	Nickel metal (7440-02-0)	0.379 lb./24-hr
Truck Mix Concrete Batch Plant Bagfilter (RMC-CD2)	Arsenic unlisted compounds (ASC-other)	0.577 lb./yr.
	Nickel metal (7440-02-0)	0.00462 lb./24-hr
Natural Gas/No. 2 Fuel Oil-fired Asphalt Cement Heater (HMA-H1)	Arsenic unlisted compounds (ASC-other)	0.042 lb./yr.
	Benzene (71-43-2)	0.206 lb./yr.
	Formaldehyde (50-00-0)	0.000411 lb./hr.
	Mercury vapor (7439-97-6)	0.0000864 lb./24-hr
	Nickel metal (7440-02-0)	0.0000864 lb./24-hr
Natural Gas/No. 2 Fuel Oil-fired Asphalt Cement Heater (HMA-H2)	Arsenic unlisted compounds (ASC-other)	0.0385 lb./yr.
	Benzene (71-43-2)	0.189 lb./yr.
	Formaldehyde (50-00-0)	0.000377 lb./hr.
	Mercury vapor (7439-97-6)	0.0000792 lb./24-hr
	Nickel metal (7440-02-0)	0.0000792 lb./24-hr
Five (5) Hot Mix Asphalt Storage Silos (HMA-Silo 1 through HMA-Silo 5)[2]	Benzene (71-43-2)	8.54 lb./yr.
	Formaldehyde (50-00-0)	0.021 lb./hr.
Five (5) Asphalt Loadout Operation Silos (HMA-LO1 through HMA-LO5)	Benzene (71-43-2)	4.73 lb./yr.
	Formaldehyde (50-00-0)	0.000915 lb./hr.

Compliance with the above is demonstrated by complying with the Synthetic Minor limits noted under 2Q .0315 below. The heights and geodetic positions of the stacks and release points, as specified in the modeling and contained in this permit condition, shall remain unchanged. It is reasonable to anticipate compliance.

2D .1806 – Control and Prohibition of Odorous Emissions

This rule requires the facility to utilize management practices or odor control equipment sufficient to prevent odorous emissions from causing or contributing to objectionable emissions beyond the facility's boundaries. It is reasonable to anticipate compliance.

2Q .0304 – Zoning Specific Condition

This rule is the basis for requesting that, prior to construction or operation of the facility under this permit, as prescribed by NCGS 143-215.108(f), *"An applicant for a permit under this section for a new facility or for the expansion of a facility permitted under this section shall request each local government having jurisdiction over any part of the land on which the facility and its appurtenances are to be*

located to issue a determination as to whether the local government has in effect a zoning or subdivision ordinance applicable to the facility and whether the proposed facility or expansion would be consistent with the ordinance." As mentioned under Section I. of this review, this site is located in an area without zoning and the Applicant was required to publish a legal notice pursuant to 15A NCAC 02Q .0113. On April 7, 2021, the required legal notice was published in The Caswell Messenger, a local publication that services the area of the proposed facility. In addition, a sign was posted on the property on April 1, 2021. It is DAQ policy to include a permit condition in permits for facilities located in areas without zoning requiring compliance with all lawfully adopted local ordinances that apply to the facility at the time of construction or operation of the facility.

2Q .0315 - Synthetic Minor Facilities

The facility is subject to this rule. It allows the facility to choose to have terms and conditions placed in their permit to restrict operation to limit the potential for the facility to emit in order to avoid Title V applicability and thus be classified as a Synthetic Minor facility. The facility has the potential without controls and limits to emit more than 100 tons of CO and SO_2 each per year. To ensure that the facility emits less than 100 tons of CO and SO_2 per year, the Permittee has requested via the application that production be limited to 500,000 tons of asphalt per consecutive 12-month period (see Attachment B for an excerpted copy of the application narrative requesting this production limit). According to the DAQ Asphalt Emissions Calculator Spreadsheet, Revision G – 08/30/2019 (Attachment E1), and based on a maximum annual asphalt production of 500,000 tons per year and a fuel sulfur content of 0.5% for Recycled No. 4 Fuel Oil (worst case), this facility would remain under the Synthetic Minor limits for SO_2 and CO of 100 tons per year, each. Therefore, the requested annual production limit is acceptable. This production limit will be placed in the permit under the Synthetic Minor condition.

The Permittee will be required to record monthly and total annually the amount of asphalt produced and keep fuel supplier certifications on-site and made available to DAQ personnel upon request. Within 30 days after each calendar year, regardless of actual emissions, the following data, including monthly and 12-month totals for the previous 12-month totals, should be reported to the Regional Supervisor: CO and SO_2 emissions, monthly asphalt production, and a summary of the sulfur content of the fuel oils from the fuel certification records for the previous 12 months. It is noted that the above production limit is required only to keep CO emissions below 100 tons per year. Compliance with SO_2 emission limitations is achieved by burning No. 2 Fuel Oil with a maximum sulfur content of 0.5%. It is reasonable to anticipate compliance.

2Q .0317 – Avoidance Conditions (2D .0530 PSD – Sulfur Dioxide)

This facility has the potential to emit more than 250 tons per year of sulfur dioxide (SO_2) emissions before controls and limits (see SECTION V. FACILITY-WIDE EMISSIONS). Compliance with the SO_2 emissions limit set forth under 2Q .0315 above ensures compliance with this regulation and will make the facility minor for PSD. Nonetheless, a PSD avoidance condition will be placed in this permit.

2Q .0317 – Avoidance Conditions (2Q .0700 – Recycled Fuel Oil)

This facility is subject to this rule for the avoidance of 2D .0530 "Prevention of Significant Deterioration" as previously mentioned above. It is also subject to this rule for the avoidance of 2Q .0700 "Toxic Air Pollutant Procedures" due to the use of recycled No. 2 and No. 4 fuel oils. The recycled fuel oil must be equivalent to its virgin counterpart. This can be met by following the allowable levels for arsenic, cadmium, chromium, lead, total halogens, flash point, sulfur, and ash as listed in the permit condition. The facility must record and maintain for a minimum of three (3) years the actual amount of recycled fuel oil delivered to and combusted on an annual basis. Each load received shall include a delivery manifest, a batch specific analytical report, batch signature information, and a certification indicating there were no detectable PCBs (<2ppm). It is reasonable to anticipate compliance.

2Q .0711 – Emission Rates Requiring a Permit (Toxics)

As previously discussed under 2D .1100, a toxics review has been triggered for this facility for certain TAP (i.e., Arsenic, Benzene, Formaldehyde, Mercury and Nickel) because they are expected to be emitted above their respective toxic permit emission rates (TPER). In addition, this facility will emit additional TAP as shown in the table below that are not expected to be emitted above their respective TPER.

This facility must be operated and maintained so that any toxic air pollutant (TAP) emitted does not exceed its respective toxic permit emission rate (TPER). Prior to exceeding any TPER, the facility must modify their air quality permit. The Permittee shall maintain records of operational information demonstrating that the TAP emissions do not exceed the TPERs. A toxics review has been triggered for this initial review for the emissions of TAPs listed in the table below due to the new HMA and Concrete Batch plants. The Hot Mix Asphalt Plant (HMA-1), the five HMA Storage Silos (HMA-Silo 1 through HMA-Silo 5) and five (5) Asphalt Loadout Operation Silos (HMA LO1 through HMA-LO5-5), the two (2) Asphalt Cement Heaters (HMA-H1 and HMA-H2), and the Concrete Batch Plant will be sources of these TAPs. The expected potential controlled emission rates of these TAPs were calculated using the NCDEQ Concrete Batch Plant, Asphalt, and Fuel Oil Combustion spreadsheets (Attachments C, D, E2 and E3) and the submitted spreadsheets. Expected potential controlled emission rates for the HMA plant are based on either Natural Gas or No. 4/No. 6 Fuel Oil combustion, to obtain the worst-case

TAP emissions, and 500,000 tons of asphalt production per year. These emission rates will not exceed the TPERs as demonstrated below. It is reasonable to anticipate compliance.

Toxic Air Pollutant (CAS #)	TPER	Expected Potential Controlled Emission Rate
Acetaldehyde (75-07-0)	6.8 lb./hr.	0.325 lb./hr.
Acrolein (107-02-8)	0.02 lb./hr.	0.0065 lb./hr.
Benzo(a)pyrene (Component of 83329/POMTV & 56553/7PAH) (50-32-8)	2.2 lb./yr.	0.0088 lb./yr.
Beryllium Metal (7440-41-7)	0.28 lb./yr.	0.10 lb./yr.
Cadmium metal (7440-43-9)	0.37 lb./yr.	0.27 lb./yr.
Carbon disulfide (75-15-0)	3.9 lb./day	0.015 lb./day
Chromium (VI) Soluble Chromate Compounds (Component of CRC) (SolCR6)	0.013 lb./day	0.0067 lb./day
Fluorides (16984-48-8)	0.34 lb./day 0.064 lb./hr.	0.0147 lb./day 0.00061 lb./hr.
Hexachlorodibenzo-p-dioxin 1,2,3,6,7,8 (57653- 85-7)	0.0051 lb./yr.	6.50×10^{-7} lb./yr.
Hexane, n- (110-54-3)	23 lb./day	5.74 lb./day
Hydrogen sulfide (7783-06-4)	1.7 lb./day	0.328 lb./day
MEK (methyl ethyl ketone, 2-butanone) (78-93-3)	78 lb./day 22.4 lb./hr.	0.161 lb./day 0.0067 lb./hr.
Manganese unlisted compounds (MNC)	0.63 lb./day	0.0645 lb./day
Methyl chloroform (71-55-6)	250 lb./day 64 lb./hr.	0.288 lb./day 0.012 lb./hr.
Methylene chloride (75-09-2)	1,600 lb./yr. 0.39 lb./hr.	0.0165 lb./yr. 8.23×10^{-6} lb./hr.
Perchloroethylene (tetrachloroethylene) (127-18-4)	13,000 lb./yr.	0.160 lb./yr.
Phenol (108-95-2)	0.24 lb./hr.	0.0010 lb./hr.
Styrene (100-42-5)	2.7 lb./hr.	0.00024 lb./hr.
Tetrachlorodibenzo-p-dioxin 2,3,7,8 (1746-01-6)	0.00020 lb./yr.	1.05×10^{-7} lb./yr.
Toluene (108-88-3)	98 lb./day 14.4 lb./hr.	17.53 lb./day 0.73 lb./hr.
Xylene (mixed isomers) (1330-20-7)	57 lb./day 16.4 lb./hr.	1.45 lb./day 0.0604 lb./hr.

IV. NEW SOURCE PERFORMANCE STANDARDS (NSPS) / NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP) / PREVENTION OF SIGNIFICANT DETERIORATION (PSD) / EPA SECTION 112r / ATTAINMENT/NON-ATTAINMENT STATUS

- **NSPS APPLICABILITY** - As discussed in Section III. under 2D .0524, the facility **is** subject to 40 CFR 60 Subpart I – "Standards of Performance for Hot Mix Asphalt Facilities" and Subpart OOO for "Nonmetallic Mineral Processing Plants."

  The two Asphalt Cement Heaters (HMA-H1 and HMA-H2) **are not** subject to 40 CFR Part 60, Subpart Dc because the maximum heat input of each is less than 10 million Btu per hour.

  The insignificant aboveground storage tanks containing fuel oil and liquid asphalt (IES-1, IES-2, IES-4 and IES-5) are not subject to 40 CFR Part 60, Subpart Kb, because fuel oil has a true vapor pressure (TVP) less than 0.062 kilopascals (kPa), or 0.0090 psi, at 70^0 F. (AP-42 7.1, Organic Liquid Storage Tanks, rev. 11/06, Table 7.1-2), and liquid asphalt has a TVP of 0.12 kPa (0.017 psi) at 325 °F (AP-42 11.1 HMA plants, background document, 2/2004, p. 4-82).

- **NESHAP APPLICABILITY** - This facility **is not** subject to any current NESHAP regulation.

  The two Asphalt Cement Heaters (HMA-H1 and HMA-H2) **are not** subject to 40 CFR 63 Subpart JJJJJJ for Industrial, Commercial, and Institutional Boilers at Area Sources. This rule defines boilers as "an enclosed device using controlled flame combustion in which water is heated to recover thermal energy in the form of steam or hot water." These heaters are not considered boilers as defined by this rule, i.e., it is not used to create steam, and so this rule **does not** apply.

  The facility **is not** subject to 40 CFR 63 Subpart LLLLL - National Emission Standards for Hazardous Air Pollutants: Asphalt Processing and Asphalt Roofing Manufacturing. This facility is not defined as an asphalt processing plant or asphalt roofing manufacturer in this Subpart, and is classified as minor for HAP emissions, and so this rule **does not** apply.

- **PSD APPLICABILITY** - As discussed in Section III. under 2Q .0317, this facility has the potential to emit greater than 250 tons per year (after controls) of a criteria pollutant (SO_2) but has a permit condition under rule 2Q .0317 so that it can be considered minor for PSD purposes. This facility is not one of the twenty-eight named PSD source categories limited to 100 tons per year (after controls) of any criteria pollutant. Caswell County has not yet triggered a PSD baseline date. Therefore, increment tracking is not required.

- **TOXICS APPLICABILITY** - The facility will emit toxics and **is** subject to 2D .1100 and 2Q .0711. See Section III. for further discussion.

- **EPA SECTION 112(r)** - This facility **is** subject to the "General Duty Clause" of EPA Section 112(r) regulations; however, it **is not** subject to the Risk Management Plan (RMP) requirement.

- **ATTAINMENT/NON-ATTAINMENT STATUS** - Caswell County is considered in attainment or unclassifiable for all regulated pollutants.

V. FACILITY – WIDE EMISSIONS

The following table summarizes the facility-wide emissions. Potential emissions (before and after controls/limits) were calculated by adding emissions from the NCDEQ Asphalt, Fuel Oil Combustion, and Concrete Batch spreadsheets (Attachments C, D, E3, E4 and E5) as applicable. Potential emissions before controls/limits are based on the maximum rate of 250 tons per hour, for 8,760 hours per year with a worst-case sulfur content of 2.1%. Potential emissions after controls/limits are based on the Synthetic Minor limits of 500,000 tons of asphalt per year and 0.5% sulfur content. As the asphalt spreadsheets do not include HAPs from the heaters, the NCDEQ Fuel Oil Combustion Emissions Calculator spreadsheet (Attachment D) was used to add potential HAPs from the heaters to the total potential HAPs from the plant. PM and PM_{10} emissions include fugitive emissions, as provided in the application, from paved/unpaved roads within the facility and stockpiles due to unloading and wind erosion. See Attachment E9 for a breakdown of facility-wide emissions.

Pollutant	Potential Emissions [tons/year]	
	Before controls/limits	After controls/limits
PM	544.85	38.05
PM_{10}	212.22	19.00
PM_{10} for Title V[1,2]	39.00 + 0.23[1] + 0.99[2] = 40.22	7.34 + 0.23[1] + 0.99[2] = 8.56
SO_2	665.81	26.06
NO_x	63.10	16.63
CO	145.84	33.85
VOC	52.70	12.06
HAP_{Total}	11.32	2.59
$HAP_{Highest}$ (Formaldehyde)	3.49	0.80

[1] For Title V applicability, only emissions from the cement and fly ash storage silos after controls are considered from the Concrete Batch Plant, because the EPA considers emissions from cement/fly ash scales (weigh batchers) and truck loading operations to be fugitive and uncontrolled. In addition, the EPA considers the bagfilter for the cement and fly ash silos to be integral. Therefore, the facility does not trigger Synthetic Minor for PM_{10}.

[2] Combined fugitive emissions from paved/unpaved roads and stockpiles, also not considered with regard to Title V applicability.

VI. COMPLIANCE

There is no compliance history as this is a Greenfield facility. This facility will be targeted for a compliance inspection upon issuance of this permit.

VII. APPLICATION FEE

An application fee of $400, the required fee for a new permit for a Greenfield facility, was submitted along with the application.

VIII. ZONING CONSISTENCY DETERMINATION (ZCD)

A ZCD, signed by Bryan S. Miller, County Manager, Caswell County Local Government, dated March 30, 2021, attesting that *"the "proposed operation is consistent with applicable zoning and subdivision ordinances,"* was received with the application. Also, as mentioned previously, a sign was posted on the property on April 1, 2021 and a public notice was published in The Caswell Messenger on April 7, 2021. Photo images of the sign placement and Affidavit of Publication were also received with the application.

IX. RECOMMENDATION

It is recommended that Air Quality Permit No. 10693R00 be issued to Carolina Sunrock LLC – Burlington North.

X. SUMMARY OF ATTACHMENTS

The following attachments accompany this review:

Attachment	Description
A1	Bagfilter Evaluation for HMA-CD1
A2	Bagfilter Evaluation for RMC-CD2
B	Application narrative requesting asphalt production to be limited to 50,000 tons per year
C	NCDENR Concrete Batch Emissions Calculator spreadsheet
D	NCDENR Fuel Oil Emissions Calculator spreadsheet
E1	NCDENR Asphalt Emissions Calculator spreadsheet for Actual SO_2 and CO Emissions w/ Synthetic Minor Limits
E2	NCDENR Asphalt Emissions Calculator spreadsheet for Expected Actual Emissions using Natural Gas
E3	NCDENR Asphalt Emissions Calculator spreadsheet for Expected Actual Emissions using Waste/No. Fuel Oil
E4	NCDENR Asphalt Emissions Calculator spreadsheet for Potential Emissions before controls/limits
E5	NCDENR Asphalt Emissions Calculator spreadsheet for Potential Emissions after controls/limits
E6	NCDENR Asphalt Emissions Calculator spreadsheet for Potential TAP Emissions using Natural Gas
E7	NCDENR Asphalt Emissions Calculator spreadsheet for Potential TAP Emissions using No.4/No 6 Fuel Oil
E8	NCDENR Concrete Batch Emissions Calculator spreadsheet for Potential TAP Emissions
E9	Facility-Wide Emissions Summary Spreadsheet

ROY COOPER
Governor

ELIZABETH S. BISER
Secretary

MICHAEL A. ABRACZINSKAS
Director

NORTH CAROLINA
Environmental Quality

XXXX XX, 2021

Gregg Bowler
President
Carolina Sunrock LLC- Burlington North
200 Horizon Drive, Suite 100
Raleigh, NC 27615

Subject: Air Permit No. 10693R00
Carolina Sunrock LLC - Burlington North
Burlington, Caswell County, North Carolina
Permit Class: Synthetic Minor
Facility ID# 1700016

Dear Mr. Bowler:

In accordance with your completed application received July 8, 2021, we are forwarding herewith Permit No. 10693R00 to Carolina Sunrock LLC- Burlington North, Burlington, Caswell County, North Carolina for the construction and operation of air emissions sources or air cleaning devices and appurtenances. Additionally, any emissions activities determined from your air permit application as meeting the exemption requirements contained in 15A NCAC 2Q .0102 have been listed for information purposes as an "ATTACHMENT" to the enclosed air permit. Please note the records retention requirements are contained in General Condition 2 of the General Conditions and Limitations.

If any parts, requirements, or limitations contained in this permit are unacceptable to you, you have the right to request a formal adjudicatory hearing within 30 days following receipt of this permit, identifying the specific issues to be contested. Such a request will stay the effectiveness of the entire permit. This hearing request must be in the form of a written petition, conforming to G.S. 150B-23 of the North Carolina General Statutes, and filed with the Office of Administrative Hearings, 6714 Mail Service Center, Raleigh, NC 27699-6714. The form for requesting a formal adjudicatory hearing may be obtained upon request from the Office of Administrative Hearings. Unless a request for a hearing is made pursuant to G.S. 150B-23, this air permit shall be final and binding.

You may request modification of your air permit through informal means pursuant to G.S. 150B-22. This request must be submitted in writing to the Director and must identify the specific provisions or issues for which the modification is sought. Please note that the permit will become final and binding regardless of a request for informal modification unless a request for a hearing is also made under G.S. 150B-23.

Unless exempted by a condition of this permit or the regulations, construction of new air pollution sources or air cleaning devices, or modifications to the sources or air cleaning devices described in this permit must be covered under a permit issued by the Division of Air Quality prior to construction. Failure to do so is a violation of G.S. 143-215.108 and may subject the Permittee to civil or criminal penalties as described in G.S. 143-215.114A and 143-215.114B.

This permit shall be effective from XXXX XX, 2021 until XXXX XX, 2029, is nontransferable to future owners and operators, and shall be subject to the conditions and limitations as specified therein.

The Permittee is responsible for carefully reading the entire permit and evaluating the requirements of each permit stipulation. The Permittee shall comply with all terms, conditions, requirements, limitations and restrictions set forth in this permit. Noncompliance with any permit condition is grounds for enforcement action, for permit termination, revocation and reissuance, or modification, or for denial of a permit renewal application.

Should you have any questions concerning this matter, please contact Leo L. Governale, P.E. at 336-776-9638.

Sincerely,

T. Ray Stewart, Jr., P.E., CPM, Regional Supervisor
Division of Air Quality, NC DEQ

LLG
Enclosures

c: Winston-Salem Regional Office

NORTH CAROLINA ENVIRONMENTAL MANAGEMENT COMMISSION

DEPARTMENT OF ENVIRONMENTAL QUALITY

DIVISION OF AIR QUALITY

AIR PERMIT NO. 10693R00

Issue Date: XXXX XX, 2021 | Effective Date: July XX, 2021
Expiration Date: XXXX XX, 2029 | Replaces Permit: (new)

To construct and operate air emission source(s) and/or air cleaning device(s), and for the discharge of the associated air contaminants into the atmosphere in accordance with the provisions of Article 21B of Chapter 143, General Statutes of North Carolina (NCGS) as amended, and other applicable Laws, Rules and Regulations,

Carolina Sunrock LLC- Burlington North
12971 S NC Highway 62
Burlington, Caswell County, North Carolina
Permit Class: Synthetic Minor
Facility ID# 1700016

(the Permittee) is hereby authorized to construct and operate the air emissions sources and/or air cleaning devices and appurtenances described below:

Emission Source ID	Emission Source Description	Control System ID	Control System Description
One Drum Mix Asphalt Plant (250 tons per hour maximum capacity), consisting of:			
HMA-1 (**NSPS-I**)	Propane/Natural Gas/No. 2 Fuel Oil/Recycled No. 2 Fuel Oil/Recycled No. 4 Fuel Oil-fired Drum-type Hot Asphalt Plant (80 million Btu per hour maximum heat input capacity)	HMA-CD1	Cyclone in series with Bagfilter (8,968 square feet of filter area)
HMA-H1	Natural Gas/No. 2 Fuel ULSD Oil-fired Asphalt Cement Heater (1.2 million Btu per hour maximum heat input)	N/A	N/A
HMA-H2	Natural Gas/No. 2 Fuel ULSD Oil-fired Asphalt Cement Heater (1.1 million Btu per hour maximum heat input)	N/A	N/A
HMA-LO1	Asphalt Loadout Operation Silo 1	N/A	N/A
HMA-LO2	Asphalt Loadout Operation Silo 2	N/A	N/A
HMA-LO3	Asphalt Loadout Operation Silo 3	N/A	N/A
HMA-LO4	Asphalt Loadout Operation Silo 4	N/A	N/A
HMA-LO5	Asphalt Loadout Operation Silo 5	N/A	N/A
HMA-Silo 1	Hot Mix Asphalt Storage Silo (150-ton capacity)	N/A	N/A
HMA-Silo 2	Hot Mix Asphalt Storage Silo (150-ton capacity)	N/A	N/A
HMA-Silo 3	Hot Mix Asphalt Storage Silo (200-ton capacity)	N/A	N/A
HMA-Silo 4	Hot Mix Asphalt Storage Silo (200-ton capacity)	N/A	N/A
HMA-Silo 5	Hot Mix Asphalt Storage Silo (200-ton capacity)	N/A	N/A

Emission Source ID	Emission Source Description	Control System ID	Control System Description
RAP Crushing System consisting of:			
RAP-CRUSH (**NSPS-OOO**)	RAP Impact Crusher (65 tons per hour maximum rated capacity)	N/A	N/A
RAP-CNV (**NSPS-OOO**)	Four (4) Conveyors	N/A	N/A
RAP-SCN (**NSPS-OOO**)	8' x 20' Double Deck Screen	N/A	N/A
Truck Mix Concrete Batch Plant (120 cubic yards per hour maximum capacity), consisting of:			
RM-1	Cement Storage Silo (200-ton capacity)	RMC-CD2	Bagfilter (1,433 square feet of filter area)
RM-2	Fly Ash Silo (150-ton capacity)		
RM-3	Truck Loadout Point		
RM-4	Cement/Fly Ash Weigh Batcher (25-ton maximum capacity)		
RM-5	Aggregate Weigh Batcher (50-ton maximum capacity)	N/A	N/A

in accordance with the completed application 1700016.21A received July 8, 2021 including any plans, specifications, previous applications, and other supporting data, all of which are filed with the Department of Environmental Quality, Division of Air Quality (DAQ) and are incorporated as part of this permit.

This permit is subject to the following specified conditions and limitations including any TESTING, REPORTING, OR MONITORING REQUIREMENTS:

A. SPECIFIC CONDITIONS AND LIMITATIONS

1. Any air emission sources or control devices authorized to construct and operate above must be operated and maintained in accordance with the provisions contained herein. The Permittee shall comply with applicable Environmental Management Commission Regulations, including Title 15A North Carolina Administrative Code (NCAC), Subchapter 2D .0202, 2D .0501, 2D .0503, 2D .0506, 2D .0510, 2D .0515, 2D .0516, 2D .0521, 2D .0524 (40 CFR 60, Subpart I, Subpart OOO), 2D .0535, 2D .0540, 2D .0605, 2D .0611, 2D .1100, 2D .1806, 2Q .0304, 2Q .0315, 2Q .0317 (Avoidance) and 2Q .0711.

2. PERMIT RENEWAL AND EMISSION INVENTORY REQUIREMENT - The Permittee, at least 90 days prior to the expiration date of this permit, shall request permit renewal by letter in accordance with 15A NCAC 2Q .0304(d) and (f). Pursuant to 15A NCAC 2Q .0203(i), no permit application fee is required for renewal of an existing air permit (without a modification request). The renewal request (with application Form A) should be submitted to the Regional Supervisor, DAQ. Also, at least 90 days prior to the expiration date of this permit, the Permittee shall submit the air pollution emission inventory report (with Certification Sheet) in accordance with 15A NCAC 2D .0202, pursuant to N.C. General Statute 143 215.65. The report shall be submitted to the Regional Supervisor, DAQ and shall document air pollutants emitted for the XXXX calendar year.

3. COMPLIANCE WITH EMISSION CONTROL STANDARDS - As required by 15A NCAC 2D .0501 (c) any source of air pollution shall be operated with such control or in such manner that the source shall not cause the ambient air quality standards pursuant to 15A NCAC 02D .0400 to be exceeded at any point beyond the premises on which the source is located. When controls more stringent than those named in the applicable emission standards in this Section are required to prevent violation of the ambient air quality standards or are required to create an offset, the permit shall contain a condition requiring these controls.

   The Permittee submitted a sitewide NAAQS dispersion modeling analysis that was received March 2, 2021, and revised March 10 and 17, 2021. The modeling analysis was reviewed and approved by the DAQ Air Quality Analysis Branch (AQAB) on March 23, 2021. Placement of the emission sources, configuration of the emission points, and operation of the sources shall be in accordance with the submitted sitewide NAAQS dispersion modeling analysis and should reflect any changes from the original analysis submittal as outlined in the AQAB review memo.

   a. Production Limitations - To ensure compliance with 2D.0501(c), the Permittee shall operate the modeled sources in accordance with the operating restrictions presented in Condition A.20, below.

   b. Water Truck – An operable water truck shall be available on site at all times while the plant is operating. The roads and front-end loader work area shall be adequately maintained by wet suppression to minimize fugitive emissions.

4. PARTICULATE CONTROL REQUIREMENT - As required by 15A NCAC 2D .0503 "Particulates from Fuel Burning Indirect Heat Exchangers," particulate matter emissions from the fuel burning indirect heat exchangers shall not exceed the allowable emission rates listed below:

Source	Emission Limit (lbs./million Btu)
Natural Gas/No. 2 Fuel ULSD Oil-fired Liquid Asphalt Cement Heater (1.2 million Btu per hour maximum heat input) (HMA-H1)	0.60
Natural Gas/No. 2 Fuel ULSD Oil-fired Liquid Asphalt Cement Heater (1.1 million Btu per hour maximum heat input) (HMA-H2)	0.60

5. PARTICULATE CONTROL REQUIREMENT - As required by 15A NCAC 2D .0506 "Particulates from Hot Mix Asphalt Plants,"

   a. Particulate matter emissions resulting from the operation of a hot mix asphalt plant shall not exceed allowable emission rates. The allowable emission rates are, as defined in 15A NCAC 2D .0506, a function of the process weight rate and shall be determined by the following equation (calculated to three significant figures), where P is the process throughput rate in tons per hour (tons/hr.) and E is the allowable emission rate in pounds per hour (lbs./hr.).

$E = 4.9445 * (P)^{0.4376}$ for P < 300 tons/hr., or

E = 60 lbs./hr. for P >=300 tons/hr.

b. Visible emissions from stacks or vents at a hot mix asphalt plant shall be less than 20 percent opacity when averaged over a six-minute period.

c. Fugitive dust emissions shall be controlled as required by 15A NCAC 2D .0540 "Particulates From Fugitive Dust Emission Sources."

d. Fugitive emissions for sources at a hot mix asphalt plant not covered elsewhere under this Rule shall not exceed 20 percent opacity averaged over six minutes.

6. PARTICULATE CONTROL REQUIREMENT - As required by 15A NCAC 2D .0510 "Particulates from Sand, Gravel, or Crushed Stone Operations," the following requirements apply:

   a. The Permittee of a sand, gravel, recycled asphalt pavement (RAP), or crushed stone operation shall not cause, allow, or permit any material to be produced, handled, transported, or stockpiled without taking measures to reduce to a minimum any particulate matter from becoming airborne to prevent exceeding the ambient air quality standards beyond the property line for particulate matter, both PM_{10} and total suspended particulates.

   b. Fugitive dust emissions from sand, gravel, RAP, or crushed stone operations shall be controlled by 15A NCAC 2D .0540 "Particulates from Fugitive Dust Emission Sources."

   c. The Permittee of any sand, gravel, RAP, or crushed stone operation shall control process-generated emissions:

      i. From crushers with wet suppression (excluding RAP crushers); and

      ii. From conveyors, screens, and transfer points

   such that the applicable opacity standards in 15A NCAC 2D .0521 Control of Visible Emissions," or 15A NCAC 2D .0524 "New Source Performance standards" are not exceeded.

7. PARTICULATE CONTROL REQUIREMENT - As required by 15A NCAC 2D .0515 "Particulates from Miscellaneous Industrial Processes," particulate matter emissions from the Cement Storage Silo (200-ton capacity) (ID No. RM-1), Flyash Storage Silo (150-ton capacity) (ID No. RM-2), Truck Loadout Point (ID No. RM-3), Cement/Flyash Weigh Batcher (25-ton maximum capacity) (ID No. RM-4) and Aggregate Weigh Batcher (50-ton maximum capacity) (ID No. RM-5) shall not exceed allowable emission rates. The allowable emission rates are, as defined in 15A NCAC 2D .0515, a function of the process weight rate and shall be determined by the following equation(s), where P is the process

throughput rate in tons per hour (tons/hr.) and E is the allowable emission rate in pounds per hour (lbs./hr.).

$E = 4.10 * (P)^{0.67}$ for P <= 30 tons/hr., or
$E = 55 * (P)^{0.11} - 40$ for P >30 tons/hr.

8. SULFUR DIOXIDE CONTROL REQUIREMENT - As required by 15A NCAC 2D .0516 "Sulfur Dioxide Emissions from Combustion Sources," sulfur dioxide emissions from the combustion sources shall not exceed 2.3 pounds per million Btu heat input.

9. VISIBLE EMISSIONS CONTROL REQUIREMENT - As required by 15A NCAC 2D .0521 "Control of Visible Emissions," visible emissions from the emission sources, manufactured after July 1, 1971, shall not be more than 20 percent opacity when averaged over a six-minute period, except that six-minute periods averaging not more than 87 percent opacity may occur not more than once in any hour nor more than four times in any 24-hour period. However, sources which must comply with a visible emissions standard in 15A NCAC 2D .0524 "New Source Performance Standards" or .1110 "National Emission Standards for Hazardous Air Pollutants" shall meet that standard instead of the 2D .0521 visible emissions standard.

10. 15A NCAC 2D .0524 "NEW SOURCE PERFORMANCE STANDARDS" - For Propane/Natural Gas/No. 2 Fuel Oil/Recycled No. 2 Fuel Oil/Recycled No. 4 Fuel Oil-fired Drum-type Hot Asphalt Plant (80 million Btu per hour maximum heat input capacity) (ID No. HMA-1), the Permittee shall comply with all applicable provisions, including the notification, testing, reporting, recordkeeping, and monitoring requirements contained in Environmental Management Commission Standard 15A NCAC 2D .0524 "New Source Performance Standards" (NSPS) as promulgated in 40 CFR 60, Subpart I, including Subpart A "General Provisions."

    a. NSPS Reporting Requirements - In addition to any other notification requirements to the Environmental Protection Agency (EPA), the Permittee is required to NOTIFY the Regional Supervisor, DAQ, in WRITING, of the following:

        i. The date construction (40 CFR 60.7) or reconstruction (40 CFR 60.15) of an affected source is commenced, postmarked no later than 30 days after such date. This requirement shall not apply in the case of mass-produced sources which are purchased in completed form;

        ii. The actual date of initial start-up of an affected source, postmarked within 15 days after such date.

    b. NSPS Emissions Limitations - As required by 15A NCAC 2D .0524, the Permittee shall not discharge or cause the discharge into the atmosphere from any affected source any gases which:

        i. Contain particulate matter in excess of 90 mg/dscm (0.04 gr/dscf); or

        ii. Exhibit 20 percent opacity, or greater.

c. NSPS Performance Testing - As required by 15A NCAC 2D .0524, the following performance tests shall be conducted:

i. The Permittee shall conduct the testing as required at Permit Condition A.14.

11. 15A NCAC 2D .0524 "NEW SOURCE PERFORMANCE STANDARDS" - For the nonmetallic mineral processing equipment (wet material processing operations, as defined in 60.671, are not subject to this Subpart) including Four (4) Conveyors (ID No. RAP-CNV), RAP Impact Crusher (65 tons per hour maximum rated capacity) (ID No. RAP-CRSH) and 8' x 20' Double Deck Screen (ID No. RAP-SCN), the Permittee shall comply with all applicable provisions, including the notification, testing, reporting, recordkeeping, and monitoring requirements contained in Environmental Management Commission Standard 15A NCAC 2D .0524 "New Source Performance Standards" (NSPS) as promulgated in 40 CFR 60, Subpart OOO, including Subpart A "General Provisions."

a. NSPS Reporting Requirements - In addition to any other notification requirements to the Environmental Protection Agency (EPA), the Permittee is required to NOTIFY the Regional Supervisor, DAQ, in WRITING, of the following:

i. The actual date of initial start-up of an affected facility, postmarked within 15 days after such date;

b. NSPS Emissions Limitations - As required by 15A NCAC 2D .0524 [40 CFR 60.672], the following permit limits shall not be exceeded:

i. For affected facilities that commenced construction, modification, or reconstruction after August 31, 1983 but before April 22, 2008 (wet material processing operations, as defined in 60.671, and Like-For-Like-Replacement, as allowed in 60.670(d), are not subject to this Subpart):

Affected Facility	Pollutant	Emission Limit
Crushers	Visible Emissions	15% opacity
Fugitive emissions from conveyor belts, screening operations, and other affected facilities	Visible Emissions	10% opacity

ii. For affected facilities that commenced construction, modification, or reconstruction on or after April 22, 2008 (wet material processing operations, as defined in 60.671, and Like-For-Like-Replacement, as allowed in 60.670(d), are not subject to this Subpart):

Affected Facility	Pollutant	Emission Limit
Crushers	Visible Emissions	12% opacity
Fugitive emissions from conveyor belts, screening operations, and other affected facilities	Visible Emissions	7% opacity

c. NSPS Monitoring Requirements - As required by 15A NCAC 2D .0524 [40 CFR 60.674], the following monitoring shall be conducted:

i. For any affected facility that commenced construction, modification, or reconstruction on or after April 22, 2008 that uses wet suppression to control emissions (Like-For-Like-Replacement, as allowed in 60.670(d), is not subject to this Subpart), the Permittee shall:

A. Perform monthly periodic inspections to check that water is flowing to discharge spray nozzles in the wet suppression systems.

B. Initiate corrective action within 24 hours and complete corrective action as expediently as practical if the Permittee finds that water is not flowing properly during an inspection of the water spray nozzles.

d. NSPS Recordkeeping Requirements - As required by 15A NCAC 2D .0524 [40 CFR 60.676], the following recordkeeping requirements shall be conducted:

i. Each inspection of the water spray nozzles, including the date of each inspection and any corrective actions taken, shall be recorded in a logbook (in written or electronic form).

ii. The logbooks (in written or electronic form) shall be maintained on-site and made available to DAQ personnel upon request.

e. NSPS Performance Testing - As required by 15A NCAC 2D .0524, the following performance tests shall be conducted:

Affected Facility	Pollutant	Test Method
Crushers	Visible Emissions	Method 9
Fugitive emissions from conveyor belts, screening operations, and other affected facilities	Visible Emissions	Method 9

i. All performance tests shall be conducted in accordance with EPA Reference Methods, contained in 40 CFR 60, Appendix A;

ii. The EPA Administrator retains the exclusive right to approve equivalent and alternative test methods, continuous monitoring procedures, and reporting requirements;

iii. Within 60 days after achieving the maximum production rate at which the affected facility(s) will be operated, but not later than 180 days after the initial start-up of the affected facility(s), the Permittee shall conduct the required performance test(s) and submit two copies of a written report of the test(s) to the Regional Supervisor, DAQ;

iv. The Permittee shall be responsible for ensuring, within the limits of practicality, that the equipment or process being tested is operated at or near its maximum normal production rate or at a lesser rate if specified by the Director or his delegate;

v. All associated testing costs are the responsibility of the Permittee;

vi. The Permittee shall arrange for air emission testing protocols to be provided to the DAQ prior to testing. Testing protocols are not required to be pre-approved by the DAQ prior to testing. The DAQ shall review testing protocols for pre-approval prior to testing if requested by the Permittee at least 45 days before conducting the test; and

vii. To afford the Regional Supervisor, DAQ, the opportunity to have an observer present, the Permittee shall PROVIDE the Regional Office, in WRITING, at least 7 days notice of any required performance test(s) that involve only Method 9. All other tests require a 30 day notice.

viii. When determining compliance with the visible emissions limit from fugitive emissions from crushers, conveyor belts, screening operations, and other affected facilities (as described in 60.672(b) or 60.672(e)(1)), the duration of the Method 9 test must be 30 minutes (five 6-minute averages). Compliance with the fugitive visible emissions limits must be based on the average of the five 6-minute averages.

ix. For any affected facility that commenced construction, modification, or reconstruction on or after April 22, 2008 that does not use wet suppression to control emissions, the Permittee shall repeat the performance tests within five (5) years of the previous test.

A. If an affected facility relies on water carryover from upstream wet suppression to control fugitive emissions, then that affected facility is exempt from the 5-year repeat testing requirement provided that the Permittee conducts periodic inspections of the upstream wet suppression that is responsible for controlling fugitive emissions from the affected facility and designates which upstream wet suppression systems will be periodically inspected at the time of the initial performance test.

f. Like-For-Like-Replacement - As provided in 40 CFR 60.670(d), when an existing facility is replaced by a piece of equipment of equal or smaller size, as defined in 40 CFR 60.671, having the same function as the existing facility, and there is no increase in the amount of emissions, the new facility is exempt from the provisions of 40 CFR 60.672, 60.674, and 60.675 except as provided for in 60.670(d)(3). The Permittee shall comply with the reporting requirements of 40 CFR 60.676(a). Equipment covered under 40 CFR 60.670 shall comply the requirements of 15A NCAC 2D .0521.

12. NOTIFICATION REQUIREMENT - As required by 15A NCAC 2D .0535, the Permittee of a source of excess emissions that last for more than four hours and that results from a malfunction, a breakdown of process or control equipment or any other abnormal conditions, shall:

    a. Notify the Director or his designee of any such occurrence by 9:00 a.m. Eastern time of the Division's next business day of becoming aware of the occurrence and describe:

        i. the name and location of the facility,

        ii. the nature and cause of the malfunction or breakdown,

        iii. the time when the malfunction or breakdown is first observed,

        iv. the expected duration, and

        v. an estimated rate of emissions.

    b. Notify the Director or his designee immediately when the corrective measures have been accomplished.

    This reporting requirement does not allow the operation of the facility in excess of Environmental Management Commission Regulations.

13. FUGITIVE DUST CONTROL REQUIREMENT - As required by 15A NCAC 2D .0540 "Particulates from Fugitive Dust Emission Sources," the Permittee shall not cause or allow fugitive dust emissions to cause or contribute to substantive complaints or excess visible emissions beyond the property boundary. If substantive complaints are received or excessive fugitive dust emissions from the facility are observed beyond the property boundaries for six minutes in any one hour (using Reference Method 22 in 40 CFR, Appendix A), the owner or operator may be required to submit a fugitive dust plan as described in 2D .0540(f).

    "Fugitive dust emissions" means particulate matter that does not pass through a process stack or vent and that is generated within plant property boundaries from activities such as: unloading and loading areas, process areas stockpiles, stock pile working, plant parking lots, and plant roads (including access roads and haul roads).

14. TESTING REQUIREMENT - Under the provisions of North Carolina General Statute 143-215.108 and in accordance with 15A NCAC 2D .0605, the Permittee shall demonstrate compliance with the emission limit(s) by testing the emission source(s) for the specified pollutant(s) as follows:

Affected Source(s)	Pollutant	Target Parameter	Test Method
Hot Asphalt Plant (HMA-1)	Filterable Particulate Matter	As per 15A NCAC 2D .0506 and 2D .0524	Method 5
	Condensable Particulate Matter		Method 202
	Visible Emissions	20% opacity	Method 9

a. All performance tests shall be conducted in accordance with EPA Reference Methods, contained in 40 CFR 60, Appendix A;

b. The EPA Administrator retains the exclusive right to approve equivalent and alternative test methods, continuous monitoring procedures, and reporting requirements;

c. The Permittee shall arrange for air emission testing protocols to be provided to the DAQ prior to testing. Testing protocols are not required to be pre-approved by the DAQ prior to testing. The DAQ shall review testing protocols for pre-approval prior to testing if requested by the Permittee at least 45 days before conducting the test.

d. To afford the Regional Supervisor, DAQ, the opportunity to have an observer present, the Permittee shall PROVIDE the Regional Office, in WRITING, at least 30 days notice of any required performance test(s).

e. Within 60 days after achieving the maximum production rate at which the affected source(s) will be operated, but not later than 180 days after the initial start-up of the affected source(s), the Permittee shall conduct the required performance test(s) and submit two copies of a written report of the test(s) to the Regional Supervisor, DAQ.

f. The facility must test while combusting the fuel that will be utilized for the majority of the operating time.

g. The Permittee shall be responsible for ensuring, within the limits of practicality, that the equipment or process being tested is operated at or near its maximum normal production rate, or at a lesser rate if specified by the Director or his delegate.

h. This permit may be revoked, with proper notice to the Permittee, or enforcement procedures initiated, if the results of the test(s) indicate that the facility does not meet applicable limitations.

i. All associated testing costs are the responsibility of the Permittee.

15. FABRIC FILTER REQUIREMENTS including cartridge filters, baghouses, and other dry filter particulate collection devices - As required by 15A NCAC 2D .0611, particulate matter emissions shall be controlled as described in the permitted equipment list.

    a. Inspection and Maintenance Requirements - To comply with the provisions of this permit and ensure that emissions do not exceed the regulatory limits, the Permittee shall perform, at a minimum, an annual (for each 12-month period following the initial inspection) internal inspection of each particulate collection device system. In addition, the Permittee shall perform periodic inspections and maintenance as recommended by the equipment manufacturer.

    b. Recordkeeping Requirements - The results of all inspections and any variance from manufacturer's recommendations or from those given in this permit (when applicable) shall be investigated with corrections made and dates of actions recorded in a logbook. Records of all maintenance activities shall be recorded in the logbook. The logbook (in written or electronic format) shall be kept on-site and made available to DAQ personnel upon request.

16. TOXIC AIR POLLUTANT EMISSIONS LIMITATION AND REPORTING REQUIREMENT - Pursuant to 15A NCAC 2D .1100 "Control of Toxic Air Pollutants," and in accordance with the approved application for an air toxic compliance demonstration, the permit limits in the table below shall not be exceeded. The Permittee has submitted a toxic air pollutant dispersion modeling analysis dated April 22, 2021 for the facility's toxic air pollutant emissions as listed in the below table. The modeling analysis was reviewed and approved by the DAQ Air Quality Analysis Branch (AQAB) on July 27, 2021. Placement of the emission sources, configuration of the emission points, and operation of the sources shall be in accordance with the submitted dispersion modeling analysis and should reflect any changes from the original analysis submittal as outlined in the AQAB review memo. Compliance is demonstrated by complying with the Synthetic Minor limits noted under 2Q .0315 (Condition A.17) below

Affected Source(s)	Toxic Air Pollutant	Emission Limit
Propane/Natural Gas/No. 2 Fuel Oil/Recycled No. 2 Fuel Oil/Recycled No. 4 Fuel Oil-fired Drum-type Hot Asphalt Plant Baghouse (HMA-CD1)	Arsenic & Compounds (total mass of elemental AS, arsine and all inorganic compounds) (ASC (7778394))	1.23 lb./yr.
	Benzene (71-43-2)	854.0 lb./yr.
	Formaldehyde (50-00-0)	0.775 lb./hr.
	Mercury, vapor (Component of HGC) (7439-97-6)	0.0156 lb./24-hr
	Nickel metal (Component of NIC) (7440-02-0)	0.379 lb./24-hr
Truck Mix Concrete Batch Plant Bagfilter (RMC-CD2)	Arsenic & Compounds (total mass of elemental AS, arsine and all inorganic compounds) (ASC (7778394))	0.577 lb./hr.
	Nickel metal (Component of NIC) (7440-02-0)	0.00462 lb./24-hr

Affected Source(s)	Toxic Air Pollutant	Emission Limit
Natural Gas/No. 2 Fuel ULSD Oil-fired Liquid Asphalt Cement Heater (1.2 million Btu per hour maximum heat input) (HMA-H1)	Arsenic & Compounds (total mass of elemental AS, arsine and all inorganic compounds) (ASC (7778394))	0.042 lb./yr.
	Benzene (71-43-2)	0.206 lb./yr.
	Formaldehyde (50-00-0)	0.000411 lb./hr.
	Mercury, vapor (Component of HGC) (7439-97-6)	0.0000864 lb./24-hr
	Nickel metal (Component of NIC) (7440-02-0)	0.0000864 lb./24-hr
Natural Gas/No. 2 Fuel ULSD Oil-fired Liquid Asphalt Cement Heater (1.1 million Btu per hour maximum heat input) (HMA-H2)	Arsenic & Compounds (total mass of elemental AS, arsine and all inorganic compounds) (ASC (7778394))	0.0385 lb./yr.
	Benzene (71-43-2)	0.189 lb./yr.
	Formaldehyde (50-00-0)	0.000377 lb./hr.
	Mercury, vapor (Component of HGC) (7439-97-6)	0.0000792 lb./24-hr
	Nickel metal (Component of NIC) (7440-02-0)	0.0000792 lb./24-hr
Five (5) Hot Mix Asphalt Storage Silos (HMA-Silo1 through HMA-Silo5)	Benzene (71-43-2)	8.54 lb./year
	Formaldehyde (50-00-0)	0.021 lb./hr.
Five (5) Asphalt Loadout Operation Silos (HMA-LO1 through HMA-LO5)	Benzene (71-43-2)	4.73 lb./year
	Formaldehyde (50-00-0)	0.000915 lb./hr.

a. To ensure compliance with the above limits, the Permitted shall comply with the operations restrictions, recordkeeping and reporting requirements of Condition A.17. If these requirements are not met, the Permittee shall be deemed in noncompliance with 15A NCAC 2D. 1100.

15. CONTROL AND PROHIBITION OF ODOROUS EMISSIONS - As required by 15A NCAC 2D .1806 "Control and Prohibition of Odorous Emissions" the Permittee shall not operate the facility without implementing management practices or installing and operating odor control equipment sufficient to prevent odorous emissions from the facility from causing or contributing to objectionable odors beyond the facility's boundary.

16. ZONING SPECIFIC CONDITION - In accordance with 15A NCAC 2Q .0304, prior to construction or operation of the facility under this permit, the Permittee shall comply with all

lawfully adopted local ordinances that apply to the facility at the time of construction or operation of the facility. The local zoning authority shall have the responsibility of enforcing all lawfully adopted local zoning or subdivision ordinances.

17. LIMITATION TO AVOID 15A NCAC 2Q .0501 - Pursuant to 15A NCAC 2Q .0315 "Synthetic Minor Facilities," to avoid the applicability of 15A NCAC 2Q .0501 "Purpose of Section and Requirement for a Permit," as requested by the Permittee, facility-wide emissions shall be less than the following:

Pollutant	Emission Limit (Tons per consecutive 12-month period)
SO_2	100
CO	100

a. Operations Restrictions - To ensure emissions do not exceed the limitations above, the following restrictions shall apply:

i. The amount of asphalt produced shall be less than 500,000 tons per consecutive 12-month period.

ii. The sulfur content of the Recycled No. 4 Fuel Oil shall be limited to 0.5% sulfur by weight.

iii. The sulfur content of the No. 2 Fuel Oil combusted in the Asphalt Cement Heaters (HMA-1 and HMA-2) shall be limited to 0.0015% sulfur by weight..

b. Recordkeeping Requirements

i. The Permittee shall record monthly and total annually the following:

A. The amount [tons] of asphalt produced.

ii. Fuel supplier certification shall be kept on-site and made available to DAQ personnel upon request.

c. Reporting Requirements - Within 30 days after each calendar year, regardless of the actual emissions, the Permittee shall submit the following:

i. Emissions and/or operational data listed below. The data should include monthly and 12-month totals for the previous 12-month period.

A. The amount [tons] of asphalt produced.

B. The facility-wide SO_2 and CO emissions [tons].

ii. A summary of the fuel certification records for the previous 12 months.

18. LIMITATION TO AVOID 15A NCAC 2D .0530 "PREVENTION OF SIGNIFICANT DETERIORATION" - In accordance with 15A NCAC 2Q .0317, to comply with this permit and avoid the applicability of 15A NCAC 2D .0530 "Prevention of Significant Deterioration," as requested by the Permittee, emissions shall be limited as follows:

Affected Source(s)	Pollutant	Emission Limit (Tons Per Consecutive 12-month Period)
Facility Wide	SO_2	250

19. VENDOR SUPPLIED RECYCLED No(s). 2 and 4 FUEL OIL REQUIREMENTS - In accordance with Rule 2Q .0317, the Permittee is avoiding the applicability of Rule 2Q .0700 by using recycled fuels which are equivalent to their virgin counterparts. The Permittee is allowed to use the recycled fuel oil(s) as follows:

a. Specifications - The recycled fuel oil(s) shall be equivalent to unadulterated fossil fuel by meeting the following criteria:

Constituent/Property	Allowable Level
Arsenic	1.0 ppm maximum
Cadmium	2.0 ppm maximum
Chromium	5.0 ppm maximum
Lead	100 ppm maximum
Total Halogens	1000 ppm maximum
Flash Point No. 2 No. 4	 100°F minimum 130°F minimum
Sulfur No. 2 No. 4	 0.5% maximum (by weight) 2.0% maximum (by weight)
Ash	1.0% maximum

b. The Permittee is responsible for ensuring that the recycled fuel oil(s), as received at the site, meet(s) the approved criteria for unadulterated fuel. The Permittee is held responsible for any discrepancies discovered by DAQ as a result of any sampling and analysis of the fuel oil(s).

c. Recordkeeping Requirements - The Permittee shall maintain at the facility for a minimum of three years, and shall make available to representatives of the DAQ upon request, accurate records of the following:

i. The actual amount of recycled fuel oil(s) delivered to and combusted at the facility on an annual basis.

ii. Each load of recycled fuel oil received shall include the following:

A. A delivery manifest document clearly showing the shipment content and amount, its place and date of loading, and place and date of destination.

B. A batch specific analytical report that contains an analysis for all constituents / properties listed above. Analytical results of the samples representative of the recycled oil shipment from the vendor shall be no more than one year old when received.

C. Batch signature information consisting of the following: a batch number, tank identification with batch volume of recycled oil, date and time the batch completed treatment, and volume(s) delivered.

D. A certification indicating that the recycled fuel oil does not contain detectable PCBs (<2ppm).

d. The DAQ reserves the right to require additional testing and/or monitoring of the recycled fuel oil(s) on an annual basis or without notice.

19. TOXIC AIR POLLUTANT EMISSIONS LIMITATION REQUIREMENT - Pursuant to 15A NCAC 2Q .0711 "Emission Rates Requiring a Permit," for each of the below listed toxic air pollutants (TAPs), the Permittee has made a demonstration that facility-wide actual emissions, where one or more emission release points are obstructed or non-vertically oriented, do not exceed the Toxic Permit Emission Rates (TPERs) listed in 15A NCAC 2Q .0711(a). The facility shall be operated and maintained in such a manner that emissions of any listed TAPs from the facility, including fugitive emissions, will not exceed TPERs listed in 15A NCAC 2Q .0711(a).

a. A permit to emit any of the below listed TAPs shall be required for this facility if actual emissions from all sources will become greater than the corresponding TPERs.

b. PRIOR to exceeding any of these listed TPERs, the Permittee shall be responsible for obtaining a permit to emit TAPs and for demonstrating compliance with the requirements of 15A NCAC 2D .1100 "Control of Toxic Air Pollutants."

c. In accordance with the approved application, the Permittee shall maintain records of operational information demonstrating that the TAP emissions do not exceed the TPERs as listed below:

Pollutant	Carcinogens (lb./yr.)	Chronic Toxicants (lb./day)	Acute Systemic Toxicants (lb./hr.)	Acute Irritants (lb./hr.)
Acetaldehyde (75-07-0)				6.8
Acrolein (107-02-8)				0.02

Pollutant	Carcinogens (lb./yr.)	Chronic Toxicants (lb./day)	Acute Systemic Toxicants (lb./hr.)	Acute Irritants (lb./hr.)
Benzo(a)pyrene (Component of 83329/POMTV & 56553/7PAH) (50-32-8)	2.2			
Beryllium Metal (unreacted) (Component of BEC) (7440-41-7)	0.28			
Cadmium Metal, elemental, unreacted (Component of CDC) (7440-43-9)	0.37			
Carbon disulfide (75-15-0)		3.9		
Chromium (VI) Soluble Chromate Compounds (Component of CRC) (SolCR6)		0.013		
Fluorides (sum of all fluoride compounds as mass of F ion) (16984-48-8)		0.34	0.064	
Hexachlorodibenzo-p-dioxin 1,2,3,6,7,8 (57653-85-7)	0.0051			
Hexane, n- (110-54-3)		23		
Hydrogen chloride (hydrochloric acid) (7647-01-0)				0.18
Hydrogen sulfide (7783-06-4)		1.7		
MEK (methyl ethyl ketone, 2-butanone) (78-93-3)		78		22.4
Manganese & compounds (MNC)		0.63		
Methyl chloroform (71-55-6)		250		64
Methylene chloride (75-09-2)	1600		0.39	
Perchloroethylene (tetrachloroethylene) (127-18-4)	13000			
Phenol (108-95-2)			0.24	
Styrene (100-42-5)			2.7	
Tetrachlorodibenzo-p-dioxin, 2,3,7,8- (Component of CLDC & 83329/POMTV) (1746-01-6)	0.0002			
Toluene (108-88-3)		98		14.4
Xylene (mixed isomers) (1330-20-7)		57		16.4

B. GENERAL CONDITIONS AND LIMITATIONS

1. In accordance with G.S. 143-215.108(c)(1), TWO COPIES OF ALL DOCUMENTS, REPORTS, TEST DATA, MONITORING DATA, NOTIFICATIONS, REQUESTS FOR RENEWAL, AND ANY OTHER INFORMATION REQUIRED BY THIS PERMIT shall be submitted to the:

   Regional Supervisor
   North Carolina Division of Air Quality
   Winston-Salem Regional Office
   450 West Hanes Mill Road
   Suite 300
   Winston-Salem, NC 27105
   336-776-9800

   For identification purposes, each submittal should include the facility name as listed on the permit, the facility identification number, and the permit number.

2. RECORDS RETENTION REQUIREMENT - In accordance with 15A NCAC 2D .0605, any records required by the conditions of this permit shall be kept on site and made available to DAQ personnel for inspection upon request. These records shall be maintained in a form suitable and readily available for expeditious inspection and review. These records must be kept on site for a minimum of 2 years, unless another time period is otherwise specified.

3. ANNUAL FEE PAYMENT - Pursuant to 15A NCAC 2Q .0203(a), the Permittee shall pay the annual permit fee within 30 days of being billed by the DAQ. Failure to pay the fee in a timely manner will cause the DAQ to initiate action to revoke the permit.

4. EQUIPMENT RELOCATION - In accordance with 15A NCAC 2Q .0301, a new air permit shall be obtained by the Permittee prior to establishing, building, erecting, using, or operating the emission sources or air cleaning equipment at a site or location not specified in this permit.

5. REPORTING REQUIREMENT - In accordance with 15A NCAC 2Q .0309, any of the following that would result in previously unpermitted, new, or increased emissions must be reported to the Regional Supervisor, DAQ:

   a. changes in the information submitted in the application regarding facility emissions;

   b. changes that modify equipment or processes of existing permitted facilities; or

   c. changes in the quantity or quality of materials processed.

   If appropriate, modifications to the permit may then be made by the DAQ to reflect any necessary changes in the permit conditions. In no case are any new or increased emissions allowed that will cause a violation of the emission limitations specified herein.

6. In accordance with 15A NCAC 2Q .0309, this permit is subject to revocation or modification by the DAQ upon a determination that information contained in the application or presented in the support thereof is incorrect, conditions under which this permit was granted have changed, or violations of conditions contained in this permit have occurred. In accordance with G.S. 143-

215.108(c)(1), the facility shall be properly operated and maintained at all times in a manner that will effectuate an overall reduction in air pollution. Unless otherwise specified by this permit, no emission source may be operated without the concurrent operation of its associated air cleaning device(s) and appurtenances.

7. In accordance with G.S. 143-215.108(c)(1), this permit is nontransferable by the Permittee. Future owners and operators must obtain a new air permit from the DAQ.

8. In accordance with G.S. 143-215.108(c)(1), this issuance of this permit in no way absolves the Permittee of liability for any potential civil penalties which may be assessed for violations of State law which have occurred prior to the effective date of this permit.

9. In accordance with G.S. 143-215.108(c)(1), this permit does not relieve the Permittee of the responsibility of complying with all applicable requirements of any Federal, State, or Local water quality or land quality control authority.

10. In accordance with 15A NCAC 2D .0605, reports on the operation and maintenance of the facility shall be submitted by the Permittee to the Regional Supervisor, DAQ at such intervals and in such form and detail as may be required by the DAQ. Information required in such reports may include, but is not limited to, process weight rates, firing rates, hours of operation, and preventive maintenance schedules.

11. A violation of any term or condition of this permit shall subject the Permittee to enforcement pursuant to G.S. 143-215.114A, 143-215.114B, and 143-215.114C, including assessment of civil and/or criminal penalties.

12. Pursuant to North Carolina General Statute 143-215.3(a)(2), no person shall refuse entry or access to any authorized representative of the DAQ who requests entry or access for purposes of inspection, and who presents appropriate credentials, nor shall any person obstruct, hamper, or interfere with any such representative while in the process of carrying out his official duties. Refusal of entry or access may constitute grounds for permit revocation and assessment of civil penalties.

13. In accordance with G.S. 143-215.108(c)(1), this permit does not relieve the Permittee of the responsibility of complying with any applicable Federal, State, or Local requirements governing the handling, disposal, or incineration of hazardous, solid, or medical wastes, including the Resource Conservation and Recovery Act (RCRA) administered by the Division of Waste Management.

14. PERMIT RETENTION REQUIREMENT - In accordance with 15A NCAC 2Q .0110, the Permittee shall retain a current copy of the air permit at the site. The Permittee must make available to personnel of the DAQ, upon request, the current copy of the air permit for the site.

15. CLEAN AIR ACT SECTION 112(r) REQUIREMENTS - Pursuant to 15A NCAC 2D .2100 "Risk Management Program," if the Permittee is required to develop and register a risk management plan pursuant to Section 112(r) of the Federal Clean Air Act, then the Permittee is required to register this plan with the USEPA in accordance with 40 CFR Part 68.

16. PREVENTION OF ACCIDENTAL RELEASES - GENERAL DUTY - Pursuant to Title I Part A Section 112(r)(1) of the Clean Air Act "Hazardous Air Pollutants - Prevention of Accidental Releases - Purpose and General Duty," although a risk management plan may not be required, if the Permittee produces, processes, handles, or stores any amount of a listed hazardous substance, the Permittee has a general duty to take such steps as are necessary to prevent the accidental release of such substance and to minimize the consequences of any release. **This condition is federally-enforceable only.**

17. GENERAL EMISSIONS TESTING AND REPORTING REQUIREMENTS - If emissions testing is required by this permit, or the DAQ, or if the Permittee submits emissions testing to the DAQ in support of a permit application or to demonstrate compliance, the Permittee shall perform such testing in accordance with 15A NCAC 2D .2600 and follow all DAQ procedures including protocol approval, regional notification, report submittal, and test results approval. Additionally, in accordance with 15A NCAC 2D .0605, the Permittee shall follow the procedures for obtaining any required audit sample and reporting those results.

Permit issued this the XX of XXXX, 2021.

NORTH CAROLINA ENVIRONMENTAL MANAGEMENT COMMISSION

_____

T. Ray Stewart, Jr., P.E., CPM
Regional Supervisor
By Authority of the Environmental Management Commission

Air Permit No. 10693R00

Insignificant / Exempt Activities

Source	Exemption Regulation	Source of TAPs?	Source of Title V Pollutants?
IES-1 - Used Oil Storage Tank associated with Asphalt Plant (20,000-gallon capacity)	2Q .0102 (g)(4)	Yes	Yes
IES-2 - Used Oil Storage Tank associated with Asphalt Plant (20,000-gallon capacity)			
IES-3 - Liquid Asphalt Storage Tank (30,000-gallon Capacity)			
IES-4 - Liquid Asphalt Storage Tank (30,000-gallon Capacity)			
IES-5 - Diesel Fuel Storage Tank associated with Asphalt Plant (20,000-gallon capacity)			
IES-6 - Diesel Fuel Storage Tank associated with Asphalt Plant (20,000-gallon capacity)			

1. Because an activity is exempted from being required to have a permit or permit modification does not mean that the activity is exempted from an applicable requirement or that the owner or operator of the source is exempted from demonstrating compliance with any applicable requirement.

2. When applicable, emissions from stationary source activities identified above shall be included in determining compliance with the permit requirements for toxic air pollutants under 15A NCAC 2D .1100 "Control of Toxic Air Pollutants" or 2Q .0711 "Emission Rates Requiring a Permit."

3. Sample permit conditions showing the regulatory requirements for exempt sources subject to NESHAP, NSPS, and NCAC rules may be found here: https://deq.nc.gov/aqpermitconditions

NOTICE FOR REMOTE PUBLIC HEARING

AIR PERMIT APPLICATION FOR:

CAROLINA SUNROCK LLC – BURLINGTON NORTH PLANT

The North Carolina Department of Environmental Quality, Division of Air Quality (DAQ), is providing notice of a scheduled public hearing by teleconference to accept comments on a draft air permit. Internet access is not required to participate in the public hearing.

DAQ hereby gives notice that the following company, Carolina Sunrock LLC, has submitted a permit application to construct and operate an asphalt and concrete batch plant at its Burlington North location. The proposed project would be classified as a synthetic minor facility.

Carolina Sunrock LLC– Burlington North Plant
12971 S NC Highway 62
Burlington, NC 27127
Caswell County
Application ID: 1700016.21A

If you wish to speak at the public hearing, you must register by 4:00 p.m. on September 20. To register, please visit: https://bit.ly/2TYC1HC or call (919) 618-0968.

Event title: Public Hearing for Carolina Sunrock LLC – Burlington North Plant
Date and Time: September 20, 2021 at 6 p.m.
Phone: US TOLL +1-415-655-0003, **Access Code** 161 633 4904
WebEx Link: https://bit.ly/3xlihM1
Event Password: NCDAQ

Member of the public may participate by phone or online. To comment by phone, when your name is called, press *3 so the moderator can identify and open your line. Once you have made your comment, please press *3 to end your comment.

Copies of all data and the applications submitted by Carolina Sunrock LLC are available for public inspection on our website at https://deq.nc.gov/carolina-sunrock or in person by appointment only at:

Winston-Salem Regional Office
450 West Hanes Mill Road, Suite 300
Winston-Salem, NC 27105

For those who are unable to attend or who experience technical difficulties, comments can also be submitted by email to DAQ.publiccomments@ncdenr.gov with the subject line "Carolina

Sunrock – Burlington North." Comments may also be submitted via voicemail message at (919) 707-8726. Comments will be accepted until September 22, 2021 at 5 p.m.

The Division is also providing public notice of an Alternate Hearing Date of Monday, September 27, 2021. In the event of a postponement due to extraordinary circumstances such as severe weather interfering with the Division's ability to conduct the hearing, the public hearing will be held on the Alternate Hearing Date using the same procedures described above for the hearing on September 27. Any notice of postponement shall be posted on the Division's website at https://deq.nc.gov/carolina-sunrock. If the Alternate Hearing Date is required, the comment period will remain open until September 29, 2021 at 5 p.m.

More information can be found at https://deq.nc.gov/carolina-sunrock.

Carolina Sunrock Public Comments

Burlington North

9/20

Yes, this is Art and Joyce Miller at 12011 NC Highway 66 S Burlington. We are about a mile from the proposed Burlington North site and are very concerned of air quality, which you are to be sure North Carolina has good air quality and with groundwater contamination and also with the noise pollution from trucks and just the plant itself, and it's also going to be really an unsightly building process and if it makes it an asphalt and cement mix making process, and you enter a county that is totally rural and beautiful, and we are adamantly against having Carolina Sunrock build a plant in the Burlington North plant. I want to continue to enjoy our peaceful existence and we'd appreciate your help in denying Sunrock the permit.

9/19

Yes, concerning the Sunrock Burlington North air permit, please don't let them get this air permit. I live very close to the proposed site, my wife has a blood disorder, and she will not be able to live here if they are allowed to come in. We're trying to sell our house just to see if we can sell it, we're having no luck, we had 3 people interested, when they found out about the asphalt plant which we had to disclose, they backed off. That's 35 years of saving money and paying for a house we could lose our behinds on this. We might not even nowhere close to what it's worth. Secondly, there are a lot of people around here that have health problems. I don't see where an asphalt plant would help them, they would probably only potentially worsen their conditions. And I don't think it's a good location for them to come into, for lots of great reasons. So I'm asking you to reconsider allowing them to get this air permit and let them go somewhere else and locate, somewhere where it's not so many houses and sick people with health problems and hurting people's home values that we worked for all our lives, and now we can't even get our money back for these houses when people find out about that no one wants to live beside of an asphalt plant, and I'm the closest one to them. I'm in my 60s, close to retirement, and it's pretty depressing because we'd definitely have to move because of my wife's blood disorder. Thank you very much.

From: Nasif, Zaynab R
To: SVC_DENR.DAQ.publiccomments
Subject: FW: [External] 9.20.21 Public Comments for Burlington North Facility
Date: Thursday, September 23, 2021 9:05:43 AM

From: Anita Foust99 <anitafoust99@gmail.com>
Sent: Wednesday, September 22, 2021 2:59 PM
To: Nasif, Zaynab R <zaynab.nasif@ncdenr.gov>; DAQ.publiccomments@nc.gov
Cc: tant98 <tant98@gmail.com>; Day-Holt NAACP Branch <dayholtnaacp@gmail.com>; Bryon Shoffner <shoffnerb@ymail.com>; Anita Foust <anitafoust99@gmail.com>; Jones, Kristi - Governor Office <Kristi.Jones@nc.gov>; Pigues, Stephanie <stephanie.pigues@nc.gov>; elizabeth.biser@nc.gov; Abraczinskas, Michael <michael.abraczinskas@ncdenr.gov>
Subject: [External] 9.20.21 Public Comments for Burlington North Facility

Dear Governor Cooper, Secretary Bisen, and Director Abraczinskas:

I am Anita Foust, a member of the Anderson Community.

According to subchapter 01c, once thie following information is brought to your attention, you can require an environmental document. The University of North Carolina at Chapel Hill's School of Global Public Health completed a scientific health survey, flyer attached, on the area where the Burlington North Facility is proposed to be sited in Caswell County.

I, and the others, are expressing to you, the DENR/DEQ agency, that

1. the proposed activity, an asphalt plant, is of such an unusual nature being placed so closely to homes and has such widespread implications that a concern for its environmental effects that we mus expressed to the DENR/DEQ agency to deny the permit due to its negative impacts to human health.

The Anderson Community is comprised mostly of low-income, elderly, Black farmers where food for humans and animals are still grown.

RESIDENTS REPORT HIGHER THAN AVERAGE RATES OF MULTIPLE CHRONIC ILLNESSES*

Asthma is three times more prevalent than state average[1].
High blood pressure and Type 2 Diabetes are twice as prevalent[2]. Lung disease and a mental health diagnosis were both more prevalent[3].

Caswell County Human Health Issues

1. CASWELL COUNTY, COMPARED TO THE STATE AVERAGE, HAS: Higher rates of death due to heart disease, cancer, and diabetes
2. CASWELL COUNTY, COMPARED TO THE STATE AVERAGE, HAS: Higher than

average rate of preterm births, child mortality, and infant death

3. And CASWELL COUNTY, COMPARED TO THE STATE AVERAGE, HAS nearly half the average number of primary care physicians.

Governor Cooper, Secretary Bisen, and Director Abraczinskas please don't permit them to kill us. Require the environmental documentation and stop the asphalt plant.

Thank you.

Anita Foust

From: Patricia Warren
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock - Burlington North
Date: Wednesday, September 22, 2021 5:15:22 PM

I read the following public comment at the DAQ Public Hearing Proposed Burlington North Facility 9/20/21

According to the Draft Environmental Justice Report, *Carolina Sunrock, LLC. Burlington North Facility* written by the NC Department of Environmental Quality and dated August 9, 2021, "*Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies* (US EPA)."

The Report examines Caswell County in a multitude of specific conditions in which the great majority indicate concerning disparities when compared to the State.

The report goes on to recognize that "Caswell County is designated as a Tier 1 county by the NC Department of Commerce. Tier 1 counties encompass the 40 most distressed counties based on average unemployment rate, median household income, percentage growth in population, and adjusted property tax per capita." (pg.6)

Environmental Justice is well served when the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies cannot be usurped by an entity that has the financial means to do so by causing fear of reprisal and enormous financial hardships on an already impoverished community with the possible effect of rendering it mute. This can have profound effects well beyond the 1-mile radius and the Census Tracts upon which this Report centers. I ask you to consider these facts and deny the air permit application from Carolina Sunrock.

--

Pronouns: she/her/hers

From: Lindsay Savelli
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock – Burlington North
Date: Wednesday, September 22, 2021 4:24:07 PM

Hello,

My name is Lindsay Savelli and I am representing myself. I am a concerned resident of North Carolina and I am alarmed by the environmental injustice at stake in our state. I ask that the NC DAQ deny the permit to the Carolina Sunrock facility on the grounds that this proposed asphalt plant will exacerbate the health inequities already experienced by the Anderson community, which is a predominantly Black community. The NC DEQ must ensure compliance with Title 6. A health assessment conducted by UNC and the NCIPH found that over 75% of residents report having at least one diagnosed chronic illness. Per the Blue Ridge Environmental Defense League, asphalt plants produce toxic chemicals including benzenes, nitrogen oxides, and particulate matter that risk further exacerbating the health of Caswell residents. Additionally, the asphalt plant will require increased truck traffic to move material in/out of the plant. The associated truck traffic will disrupt the peace of Caswell county and residents of the Anderson community, while placing community members and children at risk of toxic particulate matter as a result of diesel fuel pollution. A study in Europe found that exposure to pollutants from diesel truck traffic worsened asthma symptoms - of which Caswell County residents have higher rates of asthma compared to state averages, per CDC data. Allowing this plant to operate will reduce health outcomes for this population and may lead to premature morbidity and mortality. The NC DAQ has an obligation to protect the health and safety of Caswell residents and should deny the permit request. Additionally, due to technical difficulties and the virtual nature of Monday's hearing, I think it is necessary to extend the comment period so that residents have adequate time and means to provide input.

Sincerely,
Lindsay Savelli

From:	Scott Martino
To:	SVC_DENR.DAQ.publiccomments
Cc:	Scott Martino
Subject:	[External] Carolina Sunrock – Burlington North
Date:	Wednesday, September 22, 2021 12:02:09 PM
Attachments:	Carolina Sunrock Burlington North Draft permit Comments 09-22-2021.pdf

Please Find the attached comments on behalf of Carolina Sunrcok in regards to the draft permit for our proposed facility.

Thankyou

Scott Martino

Scott Martino

Environmental Compliance Manager/Mine Engineer
Carolina Sunrock
200 Horizon Drive Suite 100
Raleigh, NC 27615
Office Phone:(919) 7476336 Cell (984) 202-4761

SUNROCK®
CAROLINA SUNROCK LLC

Galen Boerema
Executive Vice President and General Counsel
200 Horizon Drive, Suite 100
Raleigh, NC 27615

September 21, 2021

Submitted via email at: DAQ.publiccomments@ncdenr.gov

Mr. Brendan Davey
North Carolina Department of Environmental Quality
Division of Air Quality
1641 Mail Service Center
Raleigh, NC 27669-1641

Re: Carolina Sunrock LLC Comments to Draft Permit, Air Permit No. 10693R00, Facility ID #1700016 located in Burlington, Caswell County, North Carolina

Dear Mr. Davey:

Carolina Sunrock LLC (Sunrock) appreciates the opportunity to submit comments on the North Carolina Department of Environmental Quality (DEQ), Division of Air Quality (DAQ)'s proposed Air Permit No. 10693R00 for Burlington North, Facility ID #1700016 (Proposed Air Permit) located in Prospect Hill, North Carolina.

EXECUTIVE SUMMARY

Carolina Sunrock appreciates the collaboration, time, and expertise provided by the North Carolina Division of Air Quality (DAQ) in developing the Proposed Air Permit. Moreover, Carolina Sunrock appreciates the DAQ's recommended approval of Permit 10693R00. Carolina Sunrock's comments include permit term wording clarifications, testing clarifications, toxic air pollutant limit corrections, zoning condition deletion, condition renumbering, and reporting frequency revisions.

In accordance with the public notice for the Prospect Hill Quarry and Distribution Center, the following comments are submitted for the referenced Draft Permit. Please consider that any comments that have been submitted for the Draft Permit also apply to the DAQ Air Permit Review document, as applicable.

Comment No. 1 - Permit Condition No. A.3.

The second paragraph of this condition contains the following – ***"Placement of the emission sources, configuration of the emission points, and operation of the sources shall be in accordance with the submitted sitewide NAAQS dispersion modeling analysis and should reflect any changes from the original analysis submittal as outlined in the AQAB review memo."*** Carolina Sunrock requests that the phrase ***"and should reflect any changes to the***

original analysis submittal as outlined in the AQAB review memo." be removed from the permit, as the revisions themselves rather than DAQ's comments on the revisions should be used. Accordingly, the condition should be revised to: **"Placement of the emission sources, configuration of the emission points, and operation of the sources shall be in accordance with the submitted sitewide NAAQS dispersion modeling analysis, including Permittee's revisions to the original analysis submittal."**

Comment No. 2 - Permit Condition No. A.10.

Carolina Sunrock requests that the words "filterable" and "(Method 5)" be added to Permit Condition No. A.11.b.i. as follows: "contain filterable particulate matter (Method 5) in excess of 90 mg/dscm (0.04 gr/dscf); or". 40 CFR 60, Subpart I only regulates filterable particulate matter.

Comment No. 3 – Permit Condition No. A.11.

Carolina Sunrock does not have any "wet material processing operations" as defined within 40 CFR 60, Subpart OOO. As such and to simplify issues and to remove confusing permit language, we suggest that all references to "wet material processing operations" be removed from the permit.

Comment No. 4 – Permit Condition No. A.14.

The table in this permit condition implies that testing for NSPS (Subpart I) must include Test Methods 5 and 202. As stated in Comment No. 2 above, Subpart I only has emission limits for filterable particulate matter which is only Method 5. We request that DAQ modify the table to correct this implied error.

Comment No. 5 – Permit Condition No. A.14.

Condition No. 14.d. requires a 30 day written notice of the test date as required by NSPS, Subpart A. The NC DAQ Rule 15A NCAC 02D .2602 requires a 15 day notice. As the NSPS has been accepted into the NC SIP and regulations, we request that DAQ amend this requirement to 15 days to be consistent with the DAQ testing rules. We see no need for a 30 day written notice where, in all other testing situations, DAQ allows a 15 day notice.

Comment No. 6 – Permit Condition No. A.16. (Page 11)

Carolina Sunrock requests that the arsenic limits for the Truck Mix Concrete Batch Plant Bagfilter (RMC-CD2) be corrected to lb/yr instead of lb/hr.

Comment No. 7 – Permit Condition No. A.16. (Page 12)

Carolina Sunrock requests that this permit condition be removed from the permit. The requirements in 15A NCAC 2Q .0304, including those related to zoning, merely specify the material to be included in the permit application and have already been satisfied by Carolina Sunrock. There is no basis to include an application condition that has already been met as an ongoing condition of the permit. Further, this condition is atypical for synthetic minor asphalt plants such as Sunrock, as is evident by reference to the following permits issued within the past three months for similar facilities, none of which include an equivalent provision: (i) Permit No. 05428R16 issued September 3, 2021 to Maymead Materials; (ii) Permit No. 02676R21 issued August 19, 2021 to Barnhill Contracting Company; (iii) Permit No. 01406R15 issued August 27, 2021 to APAC-Atlantic. The inclusion of this provision in the final permit would both exceed the agency's authority and be arbitrary and capricious.

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CAROLINA SUNROCK LLC

Comment No. 8– Permit Condition No. A.17.

Condition A.17.c. requires quarterly reporting. Carolina Sunrock requests that this be changed to semiannual reporting. As currently written, this permit requires more stringent reporting than a Title V permit. DAQ has deemed semiannual reporting appropriate for major facilities, and there is no legitimate reason to impose a more stringent reporting standard against Carolina Sunrock as a synthetic minor facility.

Comment No. 9 – Permit Conditions No. A.15 – A.19. (Page 12-15)

Carolina Sunrock requests that permit condition numbering be corrected from Page 12 through Page 15 since the condition numbers are duplicated and mis-numbered.

Comment No. 10 – Permit Condition No. A.19. (Page 15)

The toxic air pollutant TPER table under this condition is missing ammonia.

Comment No. 11 – Other Comments

Carolina Sunrock would like to utilize recycled asphalt shingles at Burlington North and therefore requests that the same permit condition be added to Burlington North as appears in the draft permit for the Prospect Hill Quarry and Distribution Center (Draft Permit No. 10694R00, Condition 25).

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Carolina Sunrock looks forward to continuing its on-going dialogue with North Carolina DAQ on the issuance of air permits in the State of North Carolina. It is Carolina Sunrock's desire that DAQ issue the air permit to Carolina Sunrock to construct and operate the Burlington North facility in a manner that protects North Carolina's residents.

Respectfully submitted,

Galen Boerema
Executive Vice President and General Counsel
~~~~~~~~~~~~~~~~~~~~~~

From: Mark E. Barker
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock - Burlington North
Date: Wednesday, September 22, 2021 10:33:58 AM
Attachments: 20210922_BREDL_CarolinaSunrock_Burlington_North.pdf

To Whom It May Concern:

Please find attached comments from the Blue Ridge Environmental Defense League regarding the proposed Carolina Sunrock Burlington North facility in Caswell County.

Mark

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September 22, 2021

N.C. Division of Air Quality
450 West Hanes Mill Road, Suite 300
Winston-Salem, NC 27105
336-776-9800
Email: DAQ.publiccomments@ncdenr.gov
Subject: Carolina Sunrock – Burlington North

Delivered via email

COMMENTS REGARDING CAROLINA SUNROCK LLC – BURLINGTON NORTH APPLICATION 1700016.21A DRAFT AIR PERMIT

To Whom It May Concern:

I am submitting comments on behalf of the Blue Ridge Environmental Defense League (BREDL), our Protect Caswell chapter and North Carolina members. Our chapter will submit additional comments.

Draft Permit must be denied

The draft permit made available for public comment on the NC DAQ website[1] contained numerous errors. These errors include duplicate numbering of conditions and an exclusion of a referenced condition. In addition, there are several issues with the air modeling which was completed to demonstrate compliance with criteria and hazardous air pollutant standards. Please see additional details under our Arbitrary and Capricious use of Air Modeling heading within this document. Revised air modeling analysis and a revised draft permit must be posted. These errors made it impossible to properly review the draft permit. Please see additional details under our Draft Permit heading within this document.

Request for extension of Public Comment Period

BREDL requests an extension of the Public Comment Period as stated in 15A NCAC 02Q .0307(d). Due to high interest in the Caswell County community for both Carolina Sunrock draft permits (Facility IDs: 1700016 and 1700017), there needs to be more time to allow impacted residents to review documents for both proposed sites. Scheduling the public hearings and comment periods on adjacent days may restrict some public participation. BREDL requests a corrected, revised version of the draft permit be posted with an allowable extension for public

[1] https://deq.nc.gov/about/divisions/air-quality/air-quality-permitting/asphalt-plants/carolina-sunrock-draft-permits#carolina-sunrock---burlington-north

comments.

Arbitrary and Capricious use of Air Modeling

Per 15A NCAC 02D.1106, "Modeling shall be used to determine process operational and air pollution control parameters and emission rates for toxic air pollutants to place in the air quality permit..."

As NC DAQ has stated, "These sources will be required to be operated under the parameters that they are modeled; therefore, it is very important that the parameters in the toxics and NAAQS modeling match exactly.[2]"

Thus, the air modeling needs to be as accurate as possible as it affects the air permit.

We have notable concerns about the North Carolina Division of Air Quality (NC DAQ) arbitrary and capricious use of air modeling for the proposed Burlington North facility. BREDL received the air modeling files from NC DAQ on August 10, 2021.

Both the air modeling that was completed for the previous application received by NC DAQ on September 17, 2019 (previous air modeling) and the current resubmitted application received by NC DAQ on April 22, 2021 (current air modeling) used the five-year dataset for the years 2014-2018.

The NC DAQ website[3] lists using the Danville prepared dataset for Caswell County. Previous Toxic Air Pollution (TAPS) modeling completed by Carolina Sunrock in 2019 did initially use the Danville dataset. Then, when NC DAQ completed NAAQS air modeling for the previous application, the agency used the Burlington dataset. The current air modeling for the current resubmitted application used the Burlington dataset for both TAPs and NAAQS.

- NC DAQ needs to explain why the Burlington Airport dataset was used. If this is because of proximity to the proposed facility, then that should be stated.

The current air modeling utilizes the adjusted friction velocity (ADJ_U*) option for low wind speed stable conditions. Since the previous air modeling did not use this ADJ_U* option, NC DAQ needs to provide an explanation for this change in modeling – especially since the same five-years of data were used.

- NC DAQ needs to explain why the ADJ_U* option was used in the current air modeling when it was not used in the previous air modeling.

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[2] NC DAQ Email to Carolina Sunrock, Additional information need for permit applications for the proposeds [sic] Caswell County Carolina Sunrock facilities, Stewart to Martino, 10:06 AM, June 16, 2021.

[3] https://deq.nc.gov/about/divisions/air-quality/air-quality-permits/modeling-meteorology/meteorological-data

It's interesting to note that in the previous air modeling, NC DAQ denied the permit – in part based on NO_2 Tier 1 modeling. For the current air modeling, Tier 2 was used. NC DAQ needs to provide an explanation as to why this change in modeling.

- NC DAQ needs to explain why a permit was denied based of NO_2 Tier 1 modeling in 2020, but NO_2 Tier 2 modeling was used in the current modeling.

The August 24, 2020 NC DAQ Air Modeling Review memo regarding the previous air modeling indicated that the background concentration for NO_2 is "about 60 ug/m^3"[4]. Now, a few months later, NC DAQ is stating that the background concentration for NO_2 is 15.3 ug/m^3 using the 2015-2017 data. The NC DAQ 2015-2017 data indicates four NO^2 monitors[5] were in use (Forsyth, Lee, Mecklenburg and Wake) [See Attachment 1]. The Forsyth, Lee and Wake monitors are all identified as Urban location types on the NC Urban Toxics Network.[6]

The Lee County monitor concentration is roughly converted to 15.04 ug/m^3. While the Forsyth and Wake monitors' concentrations are converted to 67.68 ug/m^3. The Forsyth County monitor is over 23 miles closer to the Burlington North proposed facility [See Attachment 2] than the Lee County monitor which was used for the background concentration.

We also point out that NC DAQ used 2017-2019 data for the NAAQS background concentrations for SO^2 and PM but did not for NO^2. In addition, the monitors located nearest to the proposed Burlington North facility were used for SO^2 and PM, but not for NO^2.

NC DAQ cannot just randomly decide to use whichever monitor has the lowest concentration. NC DAQ needs to provide an explanation for this change in background concentration.

- NC DAQ needs to show rationale and use the proper background concentration of 67.68 ug/m^3 for NO^2. The agency cannot go all willy-nilly when making these important modeling decisions.
- Using the proper NO^2 background concentration will increase the total impact concentration to 197.41 ug/m^3 which is above the NO^2 1-Hour NAAQS of 188 ug/m^3.

We do commend NC DAQ for completing updated air modeling for toxins. Carolina Sunrock in its resubmitted application indicated that no changes were made since the original submittal "other than the acceptance of utilizing ultra-low sulfur diesel...". In that resubmitted application the previous air modeling for TAPs was resubmitted without remodeling. However, there were stack height changes which impacts the modeling. The Hot Mix Asphalt stack height (emissions source CD_1) has been increased from 9.20 m to 14.02 m in the new application. This is an increase of 15.81 feet. In the new application the concrete plant stack

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[4] North Carolina Division of Air Quality Memorandum, Criteria Pollutant Air Dispersion Modeling Analysis for Carolina Sunrock, LLC, Jones, August 24, 2020, p.2

[5] https://deq.nc.gov/about/divisions/air-quality/air-quality-monitoring/historical-data-summaries/design-value-2#2015---2017

[6] https://deq.nc.gov/about/divisions/air-quality/air-quality-data/urban-air-toxics-network

height (emissions source CD_2) has been increased 5 feet from 10.668 m to 12.19 m. The stack height changes the air modeling for both the AERMOD and the BPIPPRM building parameters files. This affects the modeled concentration results.

We do point out a discrepancy with the BPIPPRM building parameter files. There is a change in these files in the Carolina Sunrock air modeling compared to the NC DAQ air modeling. It appears that NC DAQ has not changed its BPIPPRM file to indicate the changes in the current application. We have included the building parameters for the Hot Mix Asphalt Plant CD_1/CD1 as an example of this discrepancy [See Attachment 3].

- NC DAQ needs to double-check the building parameters for all emission sources, make the necessary changes, then re-run the air modeling.

Health Impacts

This proposed facility will emit several dozen harmful pollutants with varying health impacts. The following list details a few of these. In addition, the University of North Carolina at Chapel Hill Gillings School of Global Public Health conducted a health survey [See Attachment 4] of the Anderson Township. Anderson is one of the communities that will be impacted by the Burlington North facility.

Formaldehyde

Formaldehyde is a colorless, flammable gas at room temperature. It has a pungent, distinct odor and may cause a burning sensation to the eyes, nose, and lungs at high concentrations. The breakdown products of formaldehyde in air include formic acid and carbon monoxide. The most common health symptoms include irritation of the eyes, nose, and throat, along with increased tearing, which occurs at air concentrations of about 0.4–3 parts per million (ppm). National Institute for Occupational Safety and Health (NIOSH) states that formaldehyde is immediately dangerous to life and health at 20 ppm. One large study of people with asthma found that they may be more sensitive to the effects of inhaled formaldehyde than other people.[7]

A recent media report[8] details an Environmental Protection Agency (EPA) draft assessment from 2017 of formaldehyde that was suppressed by the previous Administration. The assessment found that the pollutant causes myeloid leukemia. The draft assessment concluded that 1 microgram of formaldehyde in a cubic meter of air increases the number of myeloid leukemia cases by roughly 3.5 in 100,000 people. That's more than three times the cancer risk in the assessment now in use.

Cadmium

Cadmium (as oxide, chloride, and sulfate) will exist in air as particles or vapors (from high

[7] https://www.atsdr.cdc.gov/ToxProfiles/tp111-c1-b.pdf

[8] https://theintercept.com/2021/08/19/formaldehyde-leukemia-epa-trump-suppressed/

temperature processes). It can be transported long distances in the atmosphere, where it will deposit (wet or dry) onto soils and water surfaces. Breathing air with lower levels of cadmium over long periods of time (for years) results in a build-up of cadmium in the kidney, and if sufficiently high, may result in kidney disease. The U.S. Department of Health and Human Services (DHHS) has determined that cadmium and cadmium compounds are known human carcinogens. The International Agency for Research on Cancer (IARC) has determined that cadmium is carcinogenic to humans. The EPA has determined that cadmium is a probable human carcinogen.[9]

Arsenic

Arsenic released from combustion processes is usually attached to very small particles. Arsenic contained in wind-borne soil is generally found in larger particles. These particles settle to the ground or are washed out of the air by rain. Arsenic that is attached to very small particles may stay in the air for many days and travel long distances. If you breathe high levels of inorganic arsenic, then you are likely to experience a sore throat and irritated lungs. You may also develop some of the skin effects mentioned above. The exposure level that produces these effects is uncertain, but it is probably above 100 micrograms of arsenic per cubic meter (µg/m3) for a brief exposure. Longer exposure at lower concentrations can lead to skin effects, and also to circulatory and peripheral nervous disorders.[10]

Benzene

Benzene reacts with other chemicals in the air and breaks down within a few days. Benzene in the air can attach to rain or snow and be carried back down to the ground. It breaks down more slowly in water and soil, and can pass through the soil into underground water. Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death. The major effect of benzene from long-term exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection. Long-term exposure to high levels of benzene in the air can cause leukemia, particularly acute myelogenous leukemia, often referred to as AML. This is a cancer of the bloodforming organs. The Department of Health and Human Services (DHHS) has determined that benzene is a known carcinogen. The International Agency for Research on Cancer (IARC) and the EPA have determined that benzene is carcinogenic to humans.[11]

Mercury

Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or "salts," which are usually white powders or crystals. Mercury also

[9] https://www.atsdr.cdc.gov/PHS/PHS.asp?id=46&tid=15

[10] https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=22&tid=3

[11] https://www.atsdr.cdc.gov/toxfaqs/TF.asp?id=38&tid=14

combines with carbon to make organic mercury compounds. The nervous system is very sensitive to all forms of mercury. Methylmercury and metallic mercury vapors are more harmful than other forms, because more mercury in these forms reaches the brain. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems. Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation. The EPA has determined that mercuric chloride and methylmercury are possible human carcinogens.[12]

Nickel

Nickel can combine with other elements such as chlorine, sulfur, and oxygen to form nickel compounds. Many nickel compounds dissolve fairly easy in water and have a green color. Nickel and its compounds have no characteristic odor or taste. In the air, it attaches to small particles of dust that settle to the ground or are taken out of the air in rain or snow; this usually takes many days. The most common harmful health effect of nickel in humans is an allergic reaction. Approximately 10-20% of the population is sensitive to nickel. People can become sensitive to nickel when jewelry or other things containing it are in direct contact with the skin for a long time. Once a person is sensitized to nickel, further contact with the metal may produce a reaction. Some people who are sensitive to nickel have asthma attacks following exposure to nickel. Some sensitized people react when they consume food or water containing nickel or breathe dust containing it.

NO_X

Health Impacts from NO_X include inflammation of the airways and an increase in heart attack risk. Long term exposure increases the risk of respiratory conditions, can decrease lung function, and increases the response to allergens. Long-term exposure to traffic-related nitrogen dioxide (NO2) and nitrogen oxides (NOx) may contribute to the development of COPD with possibly enhanced susceptibility in people with diabetes and asthma.

VOCs

There are various health impacts from volatile organic compounds. Short-term exposure to VOCs may cause irritation of the eyes and respiratory tract, headaches, dizziness, visual disorders and memory problems. Long-term exposure to VOCs may cause irritation of the eyes, nose, and throat, nausea, fatigue, cancer, loss of coordination, damage to the liver and kidneys and damage to the central nervous system.

PM 2.5

Health impacts from Particulate Matter include increased hospital admissions, aggravated asthma, increases in respiratory symptoms (coughing, difficult/painful breathing), chronic bronchitis, decreased lung function, premature death, increases dementia risk, increases risks for heart attacks, heart disease, strokes, and increases premature births. Lung cancer rose by

[12] https://www.atsdr.cdc.gov/toxfaqs/TF.asp?id=113&tid=24

18% for every increase of 5 ug/m3 in PM 2.5. PM 2.5 causes about 200,000 early deaths each year. Reducing particulates has added 5 months to urban life expectancy.

SO_2

Sulfur dioxide irritates the skin and mucous membranes of the eyes, nose, throat, and lungs. Short-term exposures to SO_2 can harm the human respiratory system and make breathing difficult. Symptoms can include pain when taking a deep breath, coughing, throat irritation, and breathing difficulties. People with asthma, especially children, can suffer effects.

Applicant's attempt to curtail public participation

We want to make part of the public record the applicant's attempt to curtail public participation prior to the official public commenting period. Several subpoenas have been served to dozens of residents along with community groups. In addition, these citizens have had to answer intrusive legal interrogatories and some are having to deliver depositions. To date, neither BREDL nor our chapter Protect Caswell has appealed local Caswell County decisions through the local governmental process or court system. Yet, BREDL has been served with 3 separate subpoenas related to individuals' or other organizations' actions regarding the proposed Burlington North and Prospect Hill Quarry facilities. The applicant has sued at least 55 residents who chose to appeal a local watershed review board's decision on Watershed Protection and Special Non-residential Intensity Allocation (SNIA) permits. The resident's appeal was an administrative appeal within the county government. However, the applicant chose to take these community members to Superior Court instead of letting the local appeal process conclude. To date, Caswell County has not scheduled a date to hear these residents' appeals.

Public comments, meetings and hearings are an integral part of our free society and a huge part of our Constitutional rights . There are still many countries in the world where these activities are not granted. Federal, state and local statutes govern these public participation opportunities ensuring that we as citizens have our chance to speak out in favor or opposition to various proposals and projects, or simply to share our thoughts on an issue. It's just one of many things that make this country great. Any attempt to curtail these rights should not be taken lightly. Residents should not feel intimidated about participating in the permitting process.

Carolina Sunrock actions have included

- September 11, 2020: Files Administrative Appeal on NC DAQ permits denial decisions - Carolina Sunrock v. NC DEQ, DAQ Administrative Hearings case. Heard in January 2021, working on negotiations end of February 2021. Instead of appealing further, in March, Carolina Sunrock asked for the case to be dismissed and decided to resubmit their applications.

- November 2020: Began subpoenaing citizens regarding Carolina Sunrock v. NC DEQ, DAQ Administrative Hearings case. They requested correspondence that could have been easily obtained via FOIA to NC DEQ – correspondence between the individuals and NC DEQ. BREDL also received a subpoena in this case that BREDL is not involved in. BREDL responded mid-November.

- April 22, 2021: Sues 55 citizens in Superior Court for using their U.S. First Amendment and NC administrative rights in appealing county permitting decisions to the County Watershed Review Board.

- April 2021: Carolina Sunrock sends letter to Caswell County requesting the County send them any correspondence between the County and Protect Caswell and any of the 55 defendants.

- May 5, 2021: Requests info from BREDL – seeking correspondence between BREDL and DEQ and Caswell County. A case that BREDL is not involved in. BREDL responded on May 27, 2021.

- July 30, 2021: Subpoena for info regarding Foust/Shoffner/NAACP administrative hearing case against NC DEQ, DWR. A case that BREDL is not involved in. Commanded to produce, permit inspection and copying of communications between said individuals.

In addition, residents who have corresponded with Caswell County officials receive a note such as this:

> ** Please note, as part of a standing public records request, Bill Brian of Morningstar Law Group (currently representing Carolina Sunrock) is copied on this email.

The above is another example of how local citizens, even those not involved with the company's lawsuit, can feel intimidated thus reducing public participation.

Draft Permit

In Section A – Specific Conditions and Limitations, Item no. 3 Compliance with Emission Control Standards, under a. Production Limitations, there is a reference to Condition A.20 (Section A, Item 20). There is no A.20 listed in the draft permit. There appears to be some misnumbering of Section A. Item numbers 15, 16 and 19 are repeated {15. Fabric Filter Requirements...(Page 11), 15. Control and Prohibition of Odorous Emissions (Page 12); 16. Toxic Air Pollutant Emissions...(Page 11), 16. Zoning Specific Condition (Page 12); 19. Vendor Supplied Recycled...(Page 14), 19. Toxic Air Pollutant Emissions...(Page 15)}. Therefore, we are not sure which condition the A.3.a reference applies to. This duplication of numbers has made the draft permit impossible to understand. Clarification is needed.

Condition A.10B.i and ii (page 5) limitations are unclear with regards to the referenced statute 15A NCAC 2D .0524/ 40 CFR Part 60 . Clarification is needed as to how the specific limits were derived from statutes.

Unsure why Condition A.11.b.i is listed in the permit when this affected facility will have

commenced after April 22, 2008. Including A.11.b.i. limit only serves to add confusion in the permit for the applicable limits. Only A.11.b.ii should be included in the permit.

Per Draft Permit condition A.16 (the second A.16 listed on pages 12-13), the applicant cannot begin construction or operation until all local permissions have been granted. There are several local permits that are in question. Several residents appealed the Caswell County Watershed Review Board's decisions in January to approve the Watershed Protection and Special Non-residential Intensity Allocation (SNIA) permits. However, the county has not set a hearing date on these appeals. In addition, the applicant has sued these residents in Superior Court. There is no court date set for that hearing. In addition, there may be future zoning requirements which may affect this facility. NC DAQ must stay informed on these issues and not allow the applicant to violate this condition of the permit. The applicant cannot begin construction or operation until these hearings have been held. The upcoming decisions from those hearings significantly affect this facility.

EPA Review of Synthetic Minor Permit

On July 8, EPA Office of Inspector General (OIG) released a report[13] outlining details of their "audit to determine whether EPA and state and local agencies provide sufficient oversight to assure that synthetic-minor sources of air emissions comply with the limits in their air permits."

As mentioned in the OIG report accompanying "At a Glance" document, synthetic-minor facilities agree to permit restrictions in order to reduce their emissions below major-source thresholds thus avoiding more stringent permitting and compliance requirements.

The OIG reviewed 16 permits and found that nearly 1 in 5 permit limits did not have sufficient information within the permit to determine whether the limits were technically accurate. Of those limits, over 1 in 10 did not have sufficient monitoring requirements to determine whether the facility's assumed pollution reduction was being achieved. As the OIG document pointed out, "This could result in a synthetic-minor facility emitting pollutants at or above major-source levels without being detected."

In lieu of this EPA OIG report, we will request that EPA review this permit to ensure that it is technically accurate with regards to limits and monitoring requirements.

Thank you for this opportunity to comment.

Respectfully submitted,

[13] EPA Should Conduct More Oversight of Synthetic-Minor-Source Permitting to Assure Permits Adhere to EPA Guidance, Report # 21-P-0175, July 8, 2021, EPA, https://www.epa.gov/office-inspector-general/report-epa-should-conduct-more-oversight-synthetic-minor-source-permitting

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Attachment 1

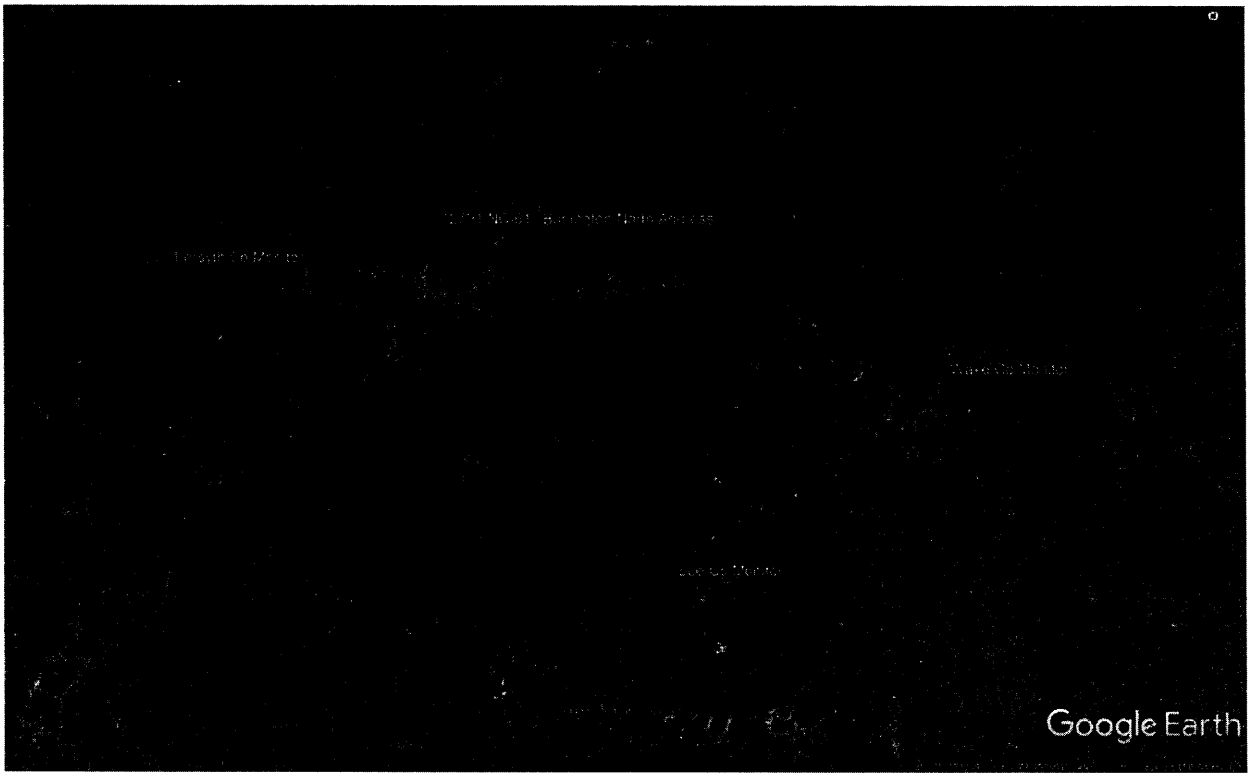
North Carolina NO^2 Monitors in use during 2015-2017

County	Average 98th Percentile	Site Name	Arithmetic Mean	Site Name
Forsyth	36 ppb [a]	Hattie Avenue [1]	7 ppb	Hattie Avenue [1]
Lee	8 ppb [a]	Blackstone [2]	1 ppb	Blackstone [2]
Mecklenburg	39 ppb	Remount Road [1]	11 ppb	Remount Road [1][*]
Wake	36 ppb	Millbrook [1]	9 ppb	Triple Oak [1]

Source: https://deq.nc.gov/about/divisions/air-quality/air-quality-monitoring/historical-data-summaries/design-value-2#2015---2017

Attachment 2

NO^2 Monitors proximity to proposed Burlington North facility



Attachment 3

1	SO	BUILDHGT	CD1	10.67	10.67	10.67	6.86	6.86	6.86
2	SO	BUILDHGT	CD1	6.86	6.86	6.86	10.67	10.67	10.67
3	SO	BUILDHGT	CD1	10.67	10.67	10.67	10.67	10.67	10.67
4	SO	BUILDHGT	CD1	10.67	10.67	10.67	6.86	6.86	6.86
5	SO	BUILDHGT	CD1	6.86	18.29	18.29	18.29	10.67	10.67
6	SO	BUILDHGT	CD1	10.67	10.67	10.67	10.67	10.67	10.67
7	SO	BUILDWID	CD1	14.00	12.48	10.58	8.11	5.79	5.80
8	SO	BUILDWID	CD1	8.11	10.18	11.94	14.00	15.10	15.74
9	SO	BUILDWID	CD1	15.90	15.58	15.58	15.90	15.74	15.10
10	SO	BUILDWID	CD1	14.00	12.48	10.58	8.11	5.79	5.80
11	SO	BUILDWID	CD1	8.11	7.14	8.25	8.84	15.10	15.74
12	SO	BUILDWID	CD1	15.90	15.58	15.58	15.90	15.74	15.10
13	SO	BUILDLEN	CD1	14.00	15.10	15.74	14.98	14.63	14.64
14	SO	BUILDLEN	CD1	14.99	14.89	14.33	14.00	12.48	10.58
15	SO	BUILDLEN	CD1	8.35	5.88	5.88	8.36	10.58	12.48
16	SO	BUILDLEN	CD1	14.00	15.10	15.74	14.98	14.63	14.64
17	SO	BUILDLEN	CD1	14.99	10.00	9.25	8.30	12.48	10.58
18	SO	BUILDLEN	CD1	8.35	5.88	5.88	8.36	10.58	12.48
19	SO	XBADJ	CD1	5.32	3.69	1.94	-0.49	-0.07	-0.05
20	SO	XBADJ	CD1	-0.42	-0.78	-1.12	-12.19	-13.49	-14.38
21	SO	XBADJ	CD1	-14.83	-14.84	-15.72	-17.45	-18.65	-19.28
22	SO	XBADJ	CD1	-19.33	-18.79	-17.68	-14.49	-14.56	-14.59
23	SO	XBADJ	CD1	-14.57	-43.74	-43.92	-42.80	1.01	3.80
24	SO	XBADJ	CD1	6.48	8.96	9.84	9.09	8.07	6.80
25	SO	YBADJ	CD1	5.19	7.25	9.09	-2.01	-0.77	0.50
26	SO	YBADJ	CD1	1.76	2.96	4.07	12.33	11.24	9.81
27	SO	YBADJ	CD1	8.08	6.11	3.95	1.67	-0.66	-2.97
28	SO	YBADJ	CD1	-5.19	-7.25	-9.09	2.01	0.77	-0.50
29	SO	YBADJ	CD1	-1.76	6.76	-0.10	-6.94	-11.24	-9.81
30	SO	YBADJ	CD1	-8.08	-6.11	-3.95	-1.67	0.66	2.97

1	SO	BUILDHGT	CD_1	9.14	24.38	24.38	24.38	24.38	24.38
2	SO	BUILDHGT	CD_1	9.14	9.14	9.14	9.14	9.14	9.14
3	SO	BUILDHGT	CD_1	2.13	2.13	4.57	7.62	7.62	7.62
4	SO	BUILDHGT	CD_1	9.14	9.14	9.14	9.14	9.14	9.14
5	SO	BUILDHGT	CD_1	9.14	9.14	9.14	9.14	9.14	9.14
6	SO	BUILDHGT	CD_1	2.13	2.13	2.13	7.62	7.62	7.62
7	SO	BUILDWID	CD_1	9.76	8.86	9.71	10.37	10.73	10.76
8	SO	BUILDWID	CD_1	13.19	13.39	13.18	12.57	11.58	10.24
9	SO	BUILDWID	CD_1	20.11	16.15	9.62	12.38	12.80	16.70
10	SO	BUILDWID	CD_1	9.76	11.20	12.31	13.03	13.37	13.29
11	SO	BUILDWID	CD_1	13.19	13.39	13.18	12.57	11.58	10.24
12	SO	BUILDWID	CD_1	20.11	16.15	11.71	9.98	12.80	15.23
13	SO	BUILDLEN	CD_1	12.57	8.64	7.58	6.37	5.08	3.43
14	SO	BUILDLEN	CD_1	3.87	6.04	8.02	9.76	11.20	12.31
15	SO	BUILDLEN	CD_1	24.07	26.04	17.82	41.22	42.14	41.78
16	SO	BUILDLEN	CD_1	12.57	11.58	10.24	8.59	6.68	4.56
17	SO	BUILDLEN	CD_1	3.87	6.04	8.02	9.76	11.20	12.31
18	SO	BUILDLEN	CD_1	24.07	26.04	27.22	18.65	19.53	19.81
19	SO	XBADJ	CD_1	-12.96	-37.62	-37.92	-37.11	-35.22	-31.70
20	SO	XBADJ	CD_1	-12.82	-13.49	-13.75	-13.59	-13.02	-12.06
21	SO	XBADJ	CD_1	-0.05	0.29	-29.03	12.75	13.12	13.08
22	SO	XBADJ	CD_1	0.39	2.29	4.13	5.84	7.37	8.68
23	SO	XBADJ	CD_1	8.95	7.45	5.73	3.83	1.82	-0.25
24	SO	XBADJ	CD_1	-24.02	-26.34	-27.86	-53.98	-55.26	-54.86
25	SO	YBADJ	CD_1	8.71	7.58	1.69	-4.25	-10.06	-7.71
26	SO	YBADJ	CD_1	-1.42	-3.29	-5.06	-6.67	-8.09	-9.25
27	SO	YBADJ	CD_1	-8.90	-6.68	5.22	-7.57	-0.88	6.30
28	SO	YBADJ	CD_1	-8.71	-7.42	-5.91	-4.21	-2.38	-0.49
29	SO	YBADJ	CD_1	1.42	3.29	5.06	6.67	8.09	9.25
30	SO	YBADJ	CD_1	8.90	6.68	4.26	8.77	0.88	-7.04
31									

1	SO	BUILDHGT	CD_1	10.67	19.81	19.81	19.81	19.81	19.81
2	SO	BUILDHGT	CD_1	10.67	10.67	10.67	10.67	10.67	10.67
3	SO	BUILDHGT	CD_1	10.67	9.14	7.62	7.62	10.67	10.67
4	SO	BUILDHGT	CD_1	10.67	10.67	10.67	10.67	10.67	10.67
5	SO	BUILDHGT	CD_1	10.67	10.67	10.67	10.67	10.67	10.67
6	SO	BUILDHGT	CD_1	10.67	9.14	7.62	7.62	10.67	10.67
7	SO	BUILDWID	CD_1	11.91	8.86	9.76	10.38	10.73	10.76
8	SO	BUILDWID	CD_1	16.32	16.48	16.14	15.31	14.01	12.29
9	SO	BUILDWID	CD_1	10.20	15.45	22.88	12.38	7.30	9.75
10	SO	BUILDWID	CD_1	11.91	13.70	15.08	16.01	16.44	16.38
11	SO	BUILDWID	CD_1	16.32	16.48	16.14	15.31	14.01	12.29
12	SO	BUILDWID	CD_1	10.20	15.45	22.88	9.98	7.30	9.75
13	SO	BUILDLEN	CD_1	15.31	8.64	7.29	6.08	5.08	3.43
14	SO	BUILDLEN	CD_1	4.62	7.30	9.75	11.91	13.70	15.08
15	SO	BUILDLEN	CD_1	16.01	25.80	51.11	41.22	16.48	16.14
16	SO	BUILDLEN	CD_1	15.31	14.01	12.29	10.20	7.79	5.15
17	SO	BUILDLEN	CD_1	4.62	7.30	9.75	11.91	13.70	15.08
18	SO	BUILDLEN	CD_1	16.01	25.80	51.11	18.65	16.48	16.14
19	SO	XBADJ	CD_1	-15.04	-37.62	-35.51	-35.29	-35.22	-31.70
20	SO	XBADJ	CD_1	-1.75	-1.56	-1.32	-1.04	-0.73	-0.40
21	SO	XBADJ	CD_1	-0.05	-9.07	0.63	12.75	0.38	0.06
22	SO	XBADJ	CD_1	-0.27	-0.58	-0.88	-1.16	-1.39	-1.59
23	SO	XBADJ	CD_1	-2.87	-5.74	-8.43	-10.87	-12.97	-14.69
24	SO	XBADJ	CD_1	-15.95	-16.73	-51.74	-53.98	-16.86	-16.20
25	SO	YBADJ	CD_1	-4.91	7.58	5.09	-0.53	-10.06	-7.71
26	SO	YBADJ	CD_1	-8.86	-8.62	-8.13	-7.39	-6.42	-5.26
27	SO	YBADJ	CD_1	-3.94	-6.33	-9.85	-7.57	2.09	3.56
28	SO	YBADJ	CD_1	4.91	6.12	7.14	7.95	8.51	8.82
29	SO	YBADJ	CD_1	8.86	8.62	8.13	7.39	6.42	5.26
30	SO	YBADJ	CD_1	3.94	6.33	9.85	8.77	-2.09	-3.56

1	SO	BUILDHGT	CD1	9.14	24.38	24.38	24.38	24.38	24.38
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3	SO	BUILDHGT	CD1	2.13	2.13	4.57	7.62	7.62	7.62
4	SO	BUILDHGT	CD1	9.14	9.14	9.14	9.14	9.14	9.14
5	SO	BUILDHGT	CD1	9.14	9.14	9.14	9.14	9.14	9.14
6	SO	BUILDHGT	CD1	2.13	2.13	2.13	7.62	7.62	7.62
7	SO	BUILDWID	CD1	9.76	8.86	9.71	10.37	10.73	10.76
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9	SO	BUILDWID	CD1	20.11	16.15	9.62	12.38	12.80	16.70
10	SO	BUILDWID	CD1	9.76	11.20	12.31	13.03	13.37	13.29
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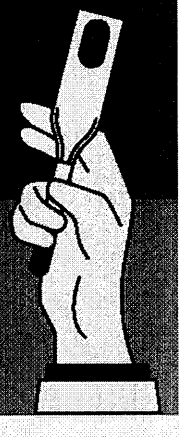
20	SO	XBADJ	CD1	-12.82	-13.49	-13.75	-13.59	-13.02	-12.06
21	SO	XBADJ	CD1	-0.05	0.29	-29.03	12.75	13.12	13.08
22	SO	XBADJ	CD1	0.39	2.29	4.13	5.84	7.37	8.68
23	SO	XBADJ	CD1	8.95	7.45	5.73	3.83	1.82	-0.25
24	SO	XBADJ	CD1	-24.02	-26.34	-27.86	-53.98	-55.26	-54.86
25	SO	YBADJ	CD1	8.71	7.58	1.69	-4.25	-10.06	-7.71
26	SO	YBADJ	CD1	-1.42	-3.29	-5.06	-6.67	-8.09	-9.25
27	SO	YBADJ	CD1	-8.90	-6.68	5.22	-7.57	-0.88	6.30
28	SO	YBADJ	CD1	-8.71	-7.42	-5.91	-4.21	-2.38	-0.49
29	SO	YBADJ	CD1	1.42	3.29	5.06	6.67	8.09	9.25
30	SO	YBADJ	CD1	8.90	6.68	4.26	8.77	0.88	-7.04
31									

Attachment 4

CHECKING UP ON THE HEALTH OF ANDERSON TOWNSHIP



ANDERSON TOWNSHIP IS LOCATED IN CASWELL COUNTY, NORTH CAROLINA

Data, unless otherwise cited, are from a recent phone survey of a sample of Anderson Township residents (n=48). The survey was conducted by the University of North Carolina at Chapel Hill Gillings School of Global Public Health.

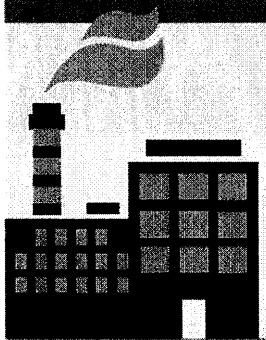
77% OF RESIDENTS REPORT A FORMALLY DIAGNOSED CHRONIC ILLNESS
48% REPORT HAVING THREE OR MORE

RESIDENTS REPORT HIGHER THAN AVERAGE RATES OF MULTIPLE CHRONIC ILLNESSES*

- Asthma is three times more prevalent than state average[1].
- High blood pressure and Type 2 Diabetes are twice as prevalent[2].
- Lung disease and a mental health diagnosis were both more prevalent[3,4].

CASWELL COUNTY, COMPARED TO THE STATE AVERAGE, HAS:

- Higher rates of death due to heart disease, cancer, and diabetes
- Higher than average rate of preterm births, child mortality, and infant death
- Nearly half the average number of primary care physicians[5]



ENVIRONMENTAL HEALTH ISSUES

- 60% of residents report plumes of smoke in their community
- 62% report strange smells
- The local animal park is a major source of odor and noise complaints

*When compared to NC state average
[1]Centers for Disease Control and Prevention [2]Community Clinical Connections [3]North Carolina Medical Journal [4]North Carolina Health News [5]North Carolina Department of Health and Human Services

For questions about the survey, contact Dr. Courtney Woods (courtney.woods@unc.edu)

From:	Bryon Shoffner
To:	SVC_DENR.DAQ.publiccomments; Abraczinskas, Michael; Jones, Kristi - Governor Office; Piques, Stephanie; elizabeth.biser@nc.go; Pjetraj, Michael; tant98; Anita Foust99
Subject:	[External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date:	Tuesday, September 21, 2021 7:39:02 PM
Attachments:	Report on Anderson Community Environmental Quality and Health (2).pdf

Please add the Anderson Community Health Survey into the public Comments as well as denies the permit

Report on Anderson Community Environmental Quality and Health

Prepared by Lindsay Savelli, Amy Kryston, Courtney Woods
University of North Carolina at Chapel Hill
August 2021

Table of Contents

Background

In September and November 2019, Carolina Sunrock, LLC submitted two air permit requests to build an asphalt plant and quarry in Caswell County.[1] Residents of the Anderson community, which is located less than ¼ mile away from the proposed site (Figure 1) developed the Anderson Community Group to communicate information about the facility to fellow community members and generally organize for health and well-being of their community.

One primary concern is that the community is already plagued with many chronic health issues, including increased health risks that COVID-19 pose.[2] The Anderson community members requested that the Caswell County Health Department (CCHD) conduct an "imminent health risks" assessment of the proposed asphalt plant. However, the CCHD did not have the necessary resources to sustain this request and contacted the NC Department for Health and Human Services (NC DHHS) for assistance[3]. In response, the NCDHHS conducted a literature review on the effects of asphalt plants on community health.[1] To examine the health-related conditions in the community, UNC Gillings School of Global Health and the NC Institute for Public health (NCIPH) was contacted by a state legislative representative to conduct a health survey. Also Dr. Courtney Woods, at UNC Gillings, who conducts community-engaged research with environmental justice (EJ) communities to lead the health survey, given the EJ implications of the proposed site.

The NC Department of Environmental Quality (DEQ) produced an Environmental Justice Report, which assessed the environmental, socioeconomic, and demographic conditions within a 2-mile radius of the proposed asphalt plant. The report cited 34% African American residents (based on 2010 census data)[4], whereas the Anderson Community Group (led by Rev. Bryon Shoffner) learned through door-to-door surveying within a mile-radius of the proposed plant that the composition of the community is closer to 75% African American[5]. The group also conducted an informal health survey to collect additional demographic and health information from residents.[5] The findings were compiled in a report referred to as the Shoffner Report. Following the preparation of the report, community leaders were concerned about whether the Sunrock permit request was a potential Title VI matter.[5,6] The Shoffner report, in addition to highlighting that African American residents would likely "bear a disproportionate share of the pollution," the report also noted issues with the NCDEQ EJ snapshot including: discrepancies in Expected Actual Emissions (tons/year) for SO, NOx, and HAP; underrepresenting the distance between the two Sunrock facilities by over 50%; lack of consideration for additional types of recycled fuel oil that could be used by burners at the plant (No. 2 and No. 4 fuel specifically); and lack of recognition of oil-fired asphalt heaters that would be present at the facilities.[6] Sunrock was initially denied the two permits on August 24, 2020, due to a lack of compliance with National Ambient Air Quality Standards (NAAQS) levels for sulfur dioxide and nitrogen dioxide, as modeling showed that levels of sulfur dioxide would exceed NAAQS levels by up to 403%.[7] They have since reapplied for air permits and also filed a lawsuit against several residents who have been opposed to them operating facilities in the area.[8]

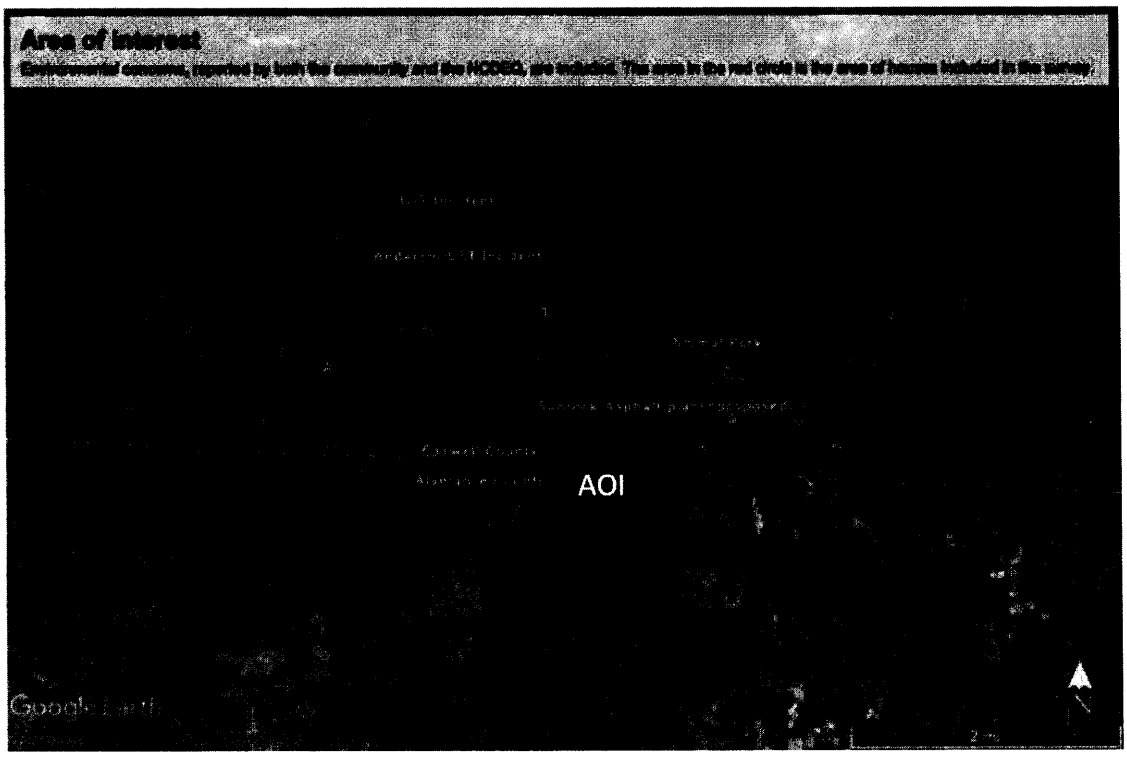


Figure 1: Map of environmental issues near Anderson Township

Methods

To conduct the community health assessment, the UNC Gilings research team utilized a community-based participatory research (CBPR) approach. The benefits of a CBPR approach are well-documented in peer-reviewed literature.[9,10] CBPR has been found to enhance the *rigor* of the research, from the design of the study to interpretation of results, the improves *relevance* of research, including what research questions are considered, and the *reach* of findings via improved dissemination strategies and application of results into practice, tools, and policies.[9]

The research team utilized a survey template developed by the NCIPH. With input from Anderson Community leaders, the survey template was modified for length, accessibility, culturally sensitive language, and privacy concerns for community members. The template was also modified to not only include questions regarding health quality, but also environmental factors relevant to the community. Once finalized, the survey was input into Qualtrics, and pilot testing was conducted among research team members. The NCDEQ website and Anderson Community maps were used to locate households within a 1-mile radius of the proposed asphalt plant. The area was further refined to focus on a region of the 1-mile radius that was east and south of the facility (hereafter referred to as the Area of Interest, or AOI) based on reports of the predominant wind direction. We identified a total of 105 eligible households for the survey. The CBPR approach was instrumental to the completion of the health survey, as the initial presence of community leaders allowed outside researchers to gain the trust of the community members to complete the survey. The full survey (Appendix 1) was completed by household members 18 year or older, and an abbreviated survey (Appendix 2) was available for additional adults in the household. Respondents to the full survey were allowed to include responses for their

dependents for question 11 pertaining to health conditions. Through a combination of in-person and phone-based approaches, the team was able to conduct a total of 48 surveys. Figure 1 shows that some of AOI extends into Alamance County, but the vast majority of households are in Caswell County, and thus Caswell County will be used for additional information later in this report.

Table 1: Number of addresses used in survey for Anderson Township

Address type in Anderson Township	Number of addresses
Total amount	105
Non-viable for survey	15
Total surveyed & included in subsequent data	48

Survey Results & Discussion

Demographics

Figure 2 shows demographics of the Anderson community within the AOI, including race and ethnicity, sex, age and highest level of education, along with health insurance type and nicotine use (including cigarettes, vaping, and chewing tobacco). While the survey did not include questions pertaining to income, data for Caswell County collected by the County's 2019 Community Health Assessment indicate that 21.3% of Caswell County residents are under the federal poverty line (FPL), compared to the North Carolina average of 16.1% of residents.[11] Also, education attainment, which strongly correlates with income,[12] shows 6% of residents with Bachelor's education or higher, compared to 22.9% or higher in Caswell County and 31.3% in North Carolina.[13]

Health outcomes

Residents were first asked about their overall well-being and the health of their neighborhood. As shown in Figure 3, approximately one-third of residents rated both their well-being (mental and physical health) and their neighborhood as poor or fair.

Regarding well-being, residents were also asked about specific mental and emotional states (e.g., trouble sleeping, feelings of anxiousness, etc). As shown in Figure 4, reported are the three states (i.e., trouble relaxing, low energy, trouble sleeping) for which the number of residents experiencing them "more than half of the days" or "nearly every day" was close to or over 20%.

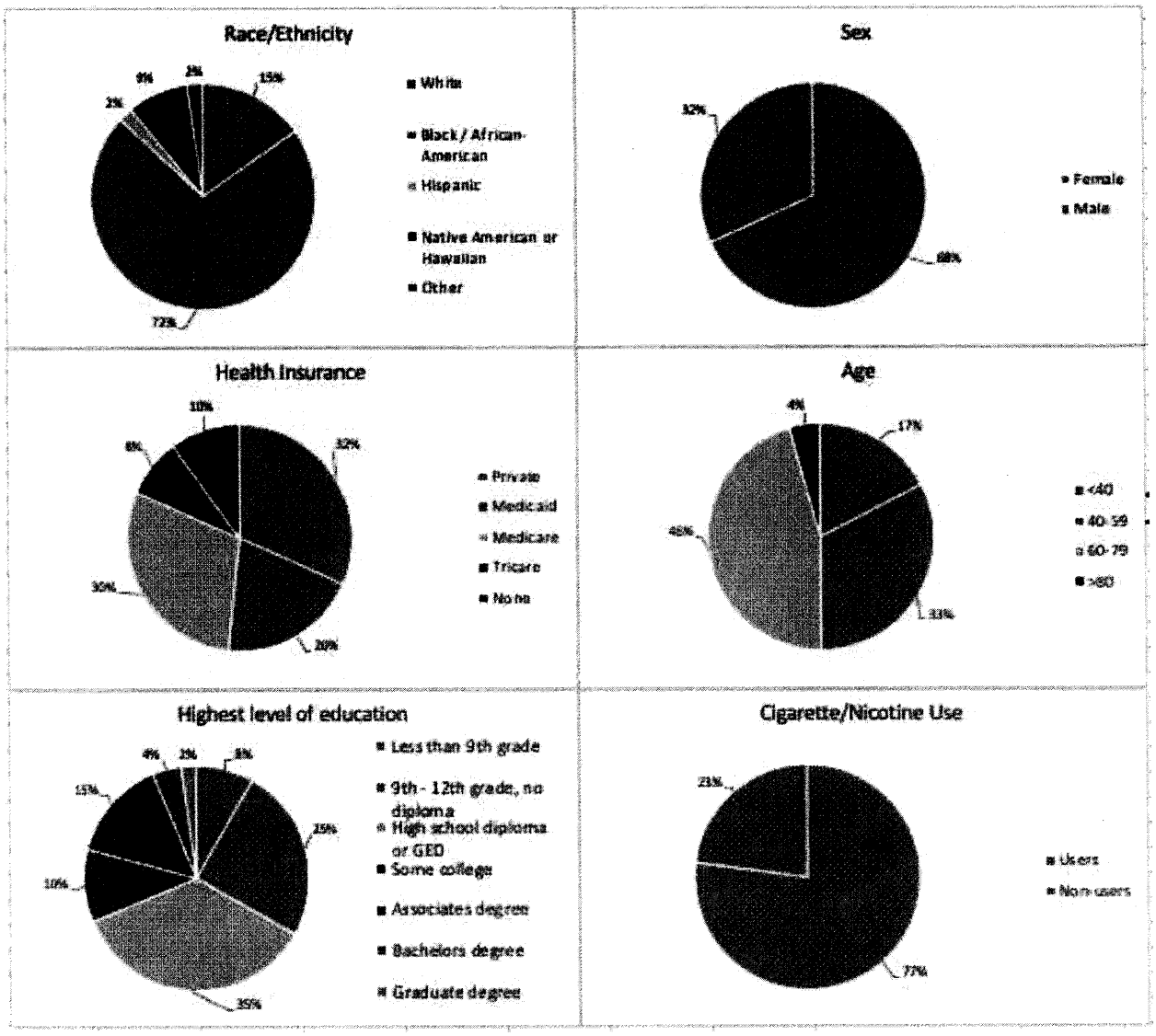


Figure 2: Demographic Information

Figure 3: Residents' rating of neighborhood quality or overall health.

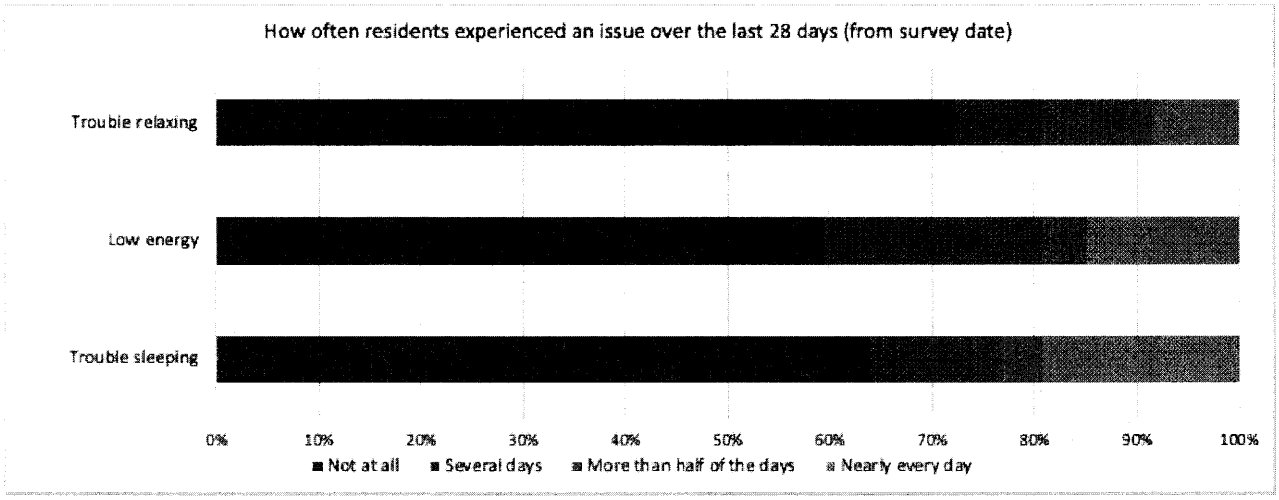


Figure 4: Emotional or general quality of life issues

Approximately 77% of residents reported a chronic illness, and 48% of residents report having three or more formally diagnosed chronic illnesses. Prevalence of specific chronic conditions are summarized in Table 2, with corresponding prevalence of Caswell County and North Carolina provided for comparison. The data are representative of individuals with formally diagnosed conditions. Parenthetical in column "Prevalence in Caswell County" and row "Overweight/ Obesity" is the percentage of residents that believed they were overweight or obese, though some may not have had a formal diagnosis. While lung disease was generally defined in the survey for ease of comprehension, the prevalence data provided for the County and state refer to COPD (and Emphysema). Six of eleven residents in the AOI who reported lung disease also reported asthma. Table 2 includes the data from all eleven residents, but in the interest of caution, we provide here the number of residents who reported lung disease and not asthma. Five residents (of n= 45) reported lung disease, a prevalence of 11%, which is still notable higher than both the County and state percentages. The term "immunocompromised" was not further defined in the survey, and thus data at the County and state level were not provided.

Of particular note is the high level of asthma reported in by Anderson residents. The prevalence is twice that of Caswell County, and the county rate is already much higher than the state average. High blood pressure is also reported at a higher rate in the AOI. Aforementioned lung disease rates are much higher than in the County or state.

To further illuminate the health outcomes reported, relevant information on leading causes of death from chronic conditions for Caswell County compared to the North Carolina average[11] are provided in Table 3.

Table 2: Health outcomes of Anderson, Caswell County, and North Carolina

1

Health condition	Prevalence in AOI (n)[a]	Prevalence in dependents in AOI (n=50)	Prevalence in Caswell County	Prevalence in North Carolina
Asthma	25.9% (54)	5%	13%	8.3%[14]
High blood pressure	60.4% (56)	1.2%	47.33%	35%[15]
High cholesterol	34.8% (54)	0.6%	33.5%	33.5%[16]
Type 2 Diabetes	19.6% (54)	0%	17%	10%[15]
Overweight/ Obesity	29.8% (55)	0.6%	33.01% (57.4%)	68%[15]
Lung disease	24.4% (53)	0%	6.07% (COPD/ Emphysema)	5.6% (COPD)[17]
Dementia	6.8% (52)	0%	NA	8.7% (rural)[18]
Liver disease	0% (52)	0%	NA	1.8% (US)[19]
Cancer	8.7% (54)	0%	11.65%	NA
COVID	8.8% (53)	1.2%	9.8%[18]	10%[20]
Kidney disease	2.3% (53)	0.6%	2.67%	10%[21]
Heart disease	8.9% (53)	0%	11.89%	9.7%[22]
Mental health issue	24.4% (53)	1.8%	29.37%	20%[23]
Immunocompromised	11.9% (50)	0%	NA	NA

Of particular note is the high level of asthma reported in by Anderson residents. The prevalence is twice that of Caswell County, and the county rate is already much higher than the state average. High blood pressure is also reported at a higher rate in the AOI. Aforementioned lung disease rates are much higher than in the County or state.

To further illuminate the health outcomes reported, relevant information on leading causes of death from chronic conditions for Caswell County compared to the North Carolina average[11] are provided in Table 3.

Table 3: Leading causes of death from chronic conditions
(2013 – 2017) per 100,000 residents

Cause of death	Caswell County[11]	North Carolina
Diabetes	48.2	27
Lung disease (COPD and Emphysema)	65.7	51.9
Dementia (reported only as Alzheimer's)	46.4	36.5
Cancer	292.6	191.4
Kidney disease	27.2	18.8
Heart disease	227.7	180.9

[a] Number of residents responding to each question

Asthma may be triggered and other lung disease may be exacerbated by regular exposure to air pollution.[24] Per the *EPA Hot Mix Asphalt Emissions Assessment Report*, asphalt plants produce known carcinogens and toxic pollutants, such as particulate matter less than 10 micrometers (PM_{10}), volatile organic compounds (VOC), carbon monoxide, sulfur oxides, nitrogen oxides, polycyclic aromatic hydrocarbons (PAH), phenol, and volatile and metal hazardous air pollutants.[25,26] A study conducted by Blue Ridge Environmental Defense League (BREDL) found that air pollution caused by asphalt plants led to higher cancer rates among residents living within a one mile-radius of the plant, including lung and primary brain cancers.[25,27] Another study found that asphalt plant workers exposed to PM_{10} had shorter telomere lengths, which is associated with increased risk of cancer and age-related diseases, and reduced life-expectancy.[28,29]

In addition to industrial activity, diesel and other increased traffic associated with industrial activity pose an additional health concern. Studies have documented the negative health impacts of living near traffic and include lower life expectancy and low birthweight, and increased risks of cardiovascular disease and asthma.[30] A study conducted by Gauderman et al. found that children exposed to outdoor nitrogen dioxides, due to traffic-related pollution, were more likely to develop asthma and wheezing, and reported more frequent use of asthma medications.[31] Similarly, an air toxics evaluation conducted in Tacoma and Seattle, Washington found that ambient air pollution related to motor vehicle traffic was an important driver for increased risk of cancer among residents.[32]

Figure 5 reports the typical wind direction (the direction the wind is coming from) throughout the year, and the bar on top of the figure notes the predominant direction from which the wind is coming for that time period. Given that the winds from the north and from the west are the most frequent, any air emissions northwest of the Anderson Community may contribute significant airborne exposures among residents.

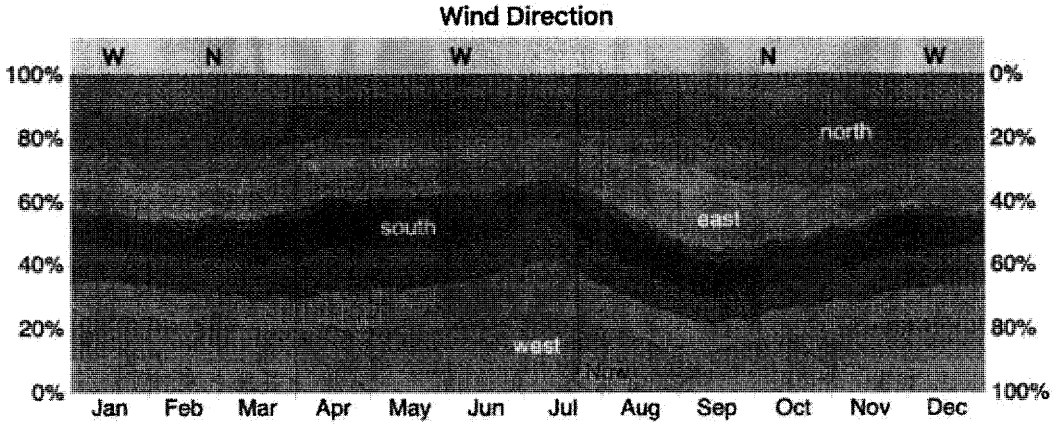


Figure 5: Wind patterns in Caswell County

(Note: this image borrowed from weatherspark.com[33] with data from NASA MERRA-2)

Physical environment

As noted in Figure 3, approximately one-third of residents rated both neighborhood quality as poor or fair. Approximately 60% of residents report plumes of smoke in their community, and 62% or residents report strange smells in their community. The nearby animal

conservator center (see Figure 1) is a major source of odor and noise complaints, with the smell of "dead animals" and "rotting meat" reported by multiple study participants. Also, 49% of respondents report "fear of encounter with wildlife" and "excessive buzzards, rodents or insects." Annoyance with odors, air pollution and noise have also been shown to adversely impact physical and mental health.[34,35]

All residents in the AOI use private wells for drinking water. Residents did not report concerns with water pressure or water quality. However, the Caswell County Community Health Assessment[11] noted that 52% (n = 65) of water samples in the county did not meet state guidelines for chemical contaminants, 24% (n=137) tested for coliform contamination.

Access to community support and healthcare

Availability of community support and healthcare is moderate to low, according to the survey and Caswell County Community Health Assessment[11] according to Figure 6. Approximately 47% of residents were not confident that public officials would address and/or work to improve upon environmental and health issues brought to their attention. In most cases, residents reported turning to family members, not public officials or public safety if they had an issue with any of the environmental conditions described in the survey questions 2-7.

In terms of healthcare, 57% of residents reported seeing a primary care physician when they felt sick, though they did not report where the physician was located. Approximately 28% report going to either a community clinic, urgent care or an emergency room instead. Compared to other counties in NC, Caswell has a dearth of physicians per capital. There are only 3.8 physicians per 10,000 residents, compared to the state average of 23.5. [11]

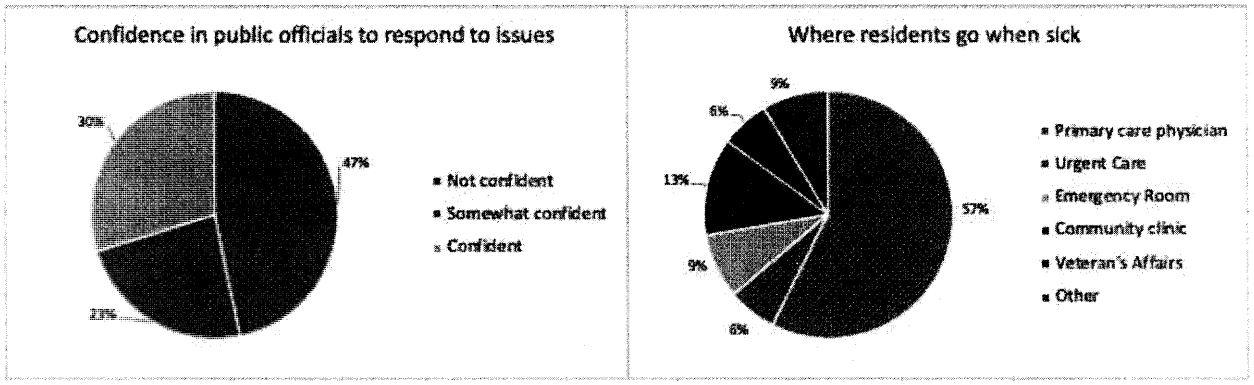


Figure 6: Reliance on public and medical service

Strengths and Limitations

There are several limitations of the study. While our research team aimed to achieve a census, with input from every unit, we instead reached a sample of residents, which we believe to be representative of the residents in the AOI. Also, as with all surveys, there is self-selection bias in who agrees to complete the survey. Recall bias may have affected participant responses to questions about physical environment and housing, depending on how recently they experienced any of the nuisances described in questions 2-7. Finally, we aimed to

create a survey that would not greatly exceed 20 min and that used plain language. Therefore, simpler descriptions of some chronic diseases were listed, which may not always correspond directly to conditions for which we have extensive county and state data for comparison. The survey was administered either face-to-face, by phone or via printed copy, though less than 10% of surveys were completed via the latter method. While we did not perceive a difference in how participants responded, there is always the potential for greater social desirability bias—the tendency to underreport socially undesirable attributes and behaviors—during the face-to-face surveys, as has been previously reported.[36]

The major strength of the study was our collaboration with local leaders, to ensure that the survey was culturally appropriate and a suitable length. The collaboration undoubtedly enhanced our ability to gain access to residents get such a fairly high survey completion rate (53%) within a short period of time. Our research team included members of the predominant racial group of the community, which likely improved response rates for the in-person surveys.

Conclusions and Implications

This report serves as a brief summary of some health and quality of life-related conditions in the Anderson community of Caswell County. Based on health conditions that residents report, we believe there is sufficient evidence that this community would be particularly vulnerable to any exposures from a polluting industry, and where possible, the Anderson community should be protected. The prevalence of several chronic conditions, including asthma, high blood pressure, diabetes and lung disease exceed state and county rates, and there is a wealth of research to demonstrate that these conditions may be exacerbated by exposure to ambient air pollution. Furthermore, access to physician care is significantly lower in Caswell County, in comparison to the state average. With the potential for cumulative impacts, limited access to medical care, presumably limited financial resources and skepticism in support from public officials, this community would likely be hampered in their ability to avoid exposure and may be reluctant to pursue action via local and state officials to mitigate exposure. Furthermore, as a community with a substantial proportion of residents identifying as people of color, public officials must increase efforts to understand community concerns and meaningfully incorporate their involvement and input in decision making.

Several states have recently implemented policies that encourage greater public participation of impacted communities and EJ-related inquiry as a part of the permitting process. Some examples include Connecticut's Public Act 20-6, which that "residents of an environmental justice community have an appropriate opportunity to participate in decisions about a proposed facility or the expansion of an existing facility that may adversely affect such residents' environment or health."[37] New Jersey has made permitting of new and existing facilities contingent on the absence of impacts on marginalized communities. In their Senate Bill 232, the Department of Environmental Protection is required "to evaluate environmental and public health stressors of certain facilities on overburdened communities when reviewing certain permit application" and can deny permits if sufficiently adverse impacts are expected on an overburdened community[38]. They define an overburdened community as census blocks with either 35% or more percent of the households qualifying as low-income households, 40% or more of residents identify as minority or members of a State recognized tribal community or where 40% or more of the households have limited English proficiency.

At minimum, the NC Department of Environmental Quality must ensure that it is upholding its own rules, including Subchapter 01c of the North Carolina Environmental Policy Act and ensure compliance with federal non-discriminatory laws, such as Title VI of the Civil Rights Act. Finally, NC DEQ should consider establishing a permanent role for their Equity and EJ Board in environmental decision making and permitting and establishing a process for by which input from the impacted community plays an integral role in in permitting. Similar efforts to center impacted communities in local city council and planning board decisions will also move our most marginalized NC communities towards more protective and more just outcomes.

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Appendix 1. Anderson Community Environmental Quality and Health Survey-Full Version

Part 1: Housing, Physical Environment and Family

This set of questions are about housing and your physical environment. Remember, the answers you give for this survey will not be linked to you in any way and you can indicate "I prefer not to answer" for questions that you don't wish to answer.

1. **In general, how would you rank the quality of life in your neighborhood? Would you say...**
   - ○ Excellent
   - ○ Very good
   - ○ Good
   - ○ Fair
   - ○ Poor
   - ○ Don't know/not sure
   - ○ *I prefer not to answer*

Now we are going to ask about some specific issues that could interrupt quality of life in your neighborhood.

2. **How frequently do you see plumes of smoke in your community?**
   - ○ Daily
   - ○ Once or twice a week
   - ○ Once or twice a month
   - ○ A few times a year
   - ○ I don't ever recall ever seeing plumes of smoke
   - ○ *I prefer not to answer*

3. **How frequently do you smell strange odors in your community?**
   - ○ Daily
   - ○ Once or twice a week
   - ○ Once or twice a month
   - ○ Once or twice a year
   - ○ I don't ever recall smelling strange odors ***(skip question to Question 5)***
   - ○ Other_____
   - ○ *I prefer not to answer*

4. **How would you characterize the odors?**
   - ☐ Gas smell
   - ☐ Rotten egg smell
   - ☐ Decomposing trash smell
   - ☐ Animal odors
   - ☐ Other_____
   - ☐ I Don't know
   - ☐ *I prefer not to answer*

5. **Do you know what is the source of the plume or foul odor?** ***(Skip this question if you don't recall plumes or odor)***
   - ☐ _____
   - ☐ I don't know
   - ☐ *I prefer not to answer*

6. **Do you experience any of the following issues or nuisances within your community? (at least once a week) Check all that apply.**
   - ☐ Low or no water pressure
   - ☐ Discolored or foul-smelling tap water
   - ☐ Excessive or disruptive noises
   - ☐ Danger or fear of encounter with animals or wildlife
   - ☐ Excessive traffic
   - ☐ Excessive light
   - ☐ Excessive animals (like buzzards, rodents or insects)
   - ☐ Nuisance flooding (e.g., areas where water drains very slowly)
   - ☐ Other_____
   - ☐ None of the above
   - ☐ *I prefer not to answer*

7. **If you responded selected any of the options in the previous questions, which of the following do you do to avoid the nuisance/issue? Check all that apply.**
   - ☐ Buy bottled water
   - ☐ Go indoors
   - ☐ Leave the neighborhood
   - ☐ Go to sleep
   - ☐ Engage in comforting or joyful activities
   - ☐ Keep the kids indoors
   - ☐ Change schedule/plans to avoid the nuisance
   - ☐ Other_____
   - ☐ None of the above
   - ☐ *I prefer not to answer*

8. **Who do you turn to most frequently to discuss any of the issues you just mentioned? Check all that apply.**
   - ☐ Neighborhood community leader(s)/community group
   - ☐ Police
   - ☐ Public official (for example, councilperson, mayor, planning board, state official)
   - ☐ Local agency (health department, social services)
   - ☐ Faith leader
   - ☐ Co-worker(s)
   - ☐ Family member(s)
   - ☐ Other: _____
   - ☐ None of the above
   - ☐ *I prefer not to answer*

9. **How confident are you that local or public officials will respond to the issue if you bring it to their attention? Would you say….**

- O Confident
- O Somewhat confident
- O Not confident
- O *I prefer not to answer*

Part 2: Personal Health Status and Access to Care

This next set of questions is about your own personal health and your access to health care.

10. Considering both your mental and physical health, would you say that, in general, your health is ...

- O Excellent
- O Very good
- O Good
- O Fair
- O Poor
- O Don't know/not sure
- O *I prefer not to answer*

11. Now I have a list of health conditions that I would like to ask you about. I will first ask if you have been diagnosed with the condition and then ask how many of your dependents or minors in the household have also been diagnosed with the condition. So, in the past year, has a doctor, nurse, or other health professional diagnosed you with any of the following illnesses or conditions? You can tell me yes or no or that you would prefer not to answer.

	Diagnosis (You)		**How many of your dependents/minor**	
a. Asthma	O Yes	O No	O I prefer not to answer	Enter # (0, 1, 2 etc.)
b. High blood pressure	O Yes	O No	O I prefer not to answer	
c. High cholesterol				
d. Type 2 Diabetes (not during pregnancy or Type 1)	O Yes	O No	O I prefer not to answer	
e. Overweight/Obesity	O Yes	O No	O I prefer not to answer	
f. Lung disease including COPD	O Yes	O No	O I prefer not to answer	
g. Dementia/Short-term memory loss	O Yes	O No	O I prefer not to answer	
h. Liver disease (hepatitis)	O Yes	O No	O I prefer not to answer	
i. Cancer				
If yes, what kind of cancer have you been diagnosed with:_____	O Yes	O No	O I prefer not to answer	
j. COVID-19	O Yes	O No	O I prefer not to answer	
k. Kidney disease				
l. Heart disease				
m. Mental health diagnosis (depression, anxiety, etc.)Are you immunocompromised?	O Yes	O No	O I prefer not to answer	
n. Other health conditions or symptoms for which you don't have a formal diagnosis_____	O Yes	O No	O I prefer not to answer	

12. **Next I have a list of disabilities I would like to ask you about. Please answer yes or no to the following statements. You may also choose to skip any of these questions if you would like.**

a. Are you deaf, or do you have serious difficulty hearing?	O Yes	O No	O I prefer not to answer
b. Are you blind, or do you have serious difficulty seeing, even when wearing glasses?	O Yes	O No	O I prefer not to answer
c. Because of a physical, mental, or emotional condition, do you have serious difficulty concentrating, remembering, or making decisions?	O Yes	O No	O prefer not to answer
d. Do you have serious difficulty walking or climbing stairs?	O Yes	O No	O I prefer not to answer
e. Do you have difficulty dressing or bathing?	O Yes	O No	O I prefer not to answer
f. Because of a physical, mental, or emotional condition, do you have difficulty doing errands alone such as visiting a doctor's office or shopping?	O Yes	O No	O I prefer not to answer

13. **Do you currently smoke cigarettes or use any kind of tobacco or nicotine product on a daily basis? This could include smokeless tobacco like dip or chewing tobacco, e-cigarettes, vape pens or juuls.** (E-cigarettes, vape pens and juuls (pronounced "jewels") are electronic devices that heat a liquid form of nicotine to generate a vapor that the user inhales.)

O Yes
O No
O Don't know/Not Sure
O *I prefer not to answer*

14. **Where do you go <u>most often</u> when you are sick?** *(DO NOT read the options. Mark only the one they say. If they cannot think of one, read:* **Here are some possibilities.** *Read responses.* **Choose only one please.)**

O Doctor's office (primary care)
O Health department
O Hospital Emergency Room
O Urgent Care Center
O Community Clinic
O Other:_____
O None of the above
O *I prefer not to answer*

15. **In the past 12 months, have you had trouble getting any needed healthcare for either yourself or your dependents from any kind of health care provider including, prescriptions, mental treatment or other healthcare services?**

O Yes
O No *(skip <u>to</u> Q18)*
O *I prefer not to answer* ***(skip <u>to</u> Q18)***

16. **Since you said "yes," what type of provider or facility, did you or your family member have trouble getting health care from? I will read out a few answers...If I don't mention one, please let me know and I will write it down.**

- ☐ Dentist
- ☐ Eye care/ optometrist/ ophthalmologist
- ☐ General practitioner/primary care
- ☐ Health department
- ☐ Hospital
- ☐ Medical Clinic
- ☐ Mental health care provider
- ☐ OB/GYN
- ☐ Pediatrician
- ☐ Pharmacy
- ☐ Substance abuse treatment center
- ☐ Urgent Care Center
- ☐ Specialist *(What type?)* _____
- ☐ Other _____
- ☐ *I prefer not to answer*

17. **What were the reasons that prevented you or your family member from getting the health care you needed?**

- ☐ No health insurance.
- ☐ Insurance didn't cover what I/we needed.
- ☐ Share of the cost (deductible /co-pay) was too high.
- ☐ Doctor would not take my/our insurance or Medicaid.
- ☐ Hospital would not take my/our insurance.
- ☐ Dentist would not take my/our insurance or Medicaid.
- ☐ Pharmacy hours didn't work with my schedule.
- ☐ Pharmacy was too far away.
- ☐ No way to get there.
- ☐ Service was not available near me
- ☐ Not enough providers offer the service
- ☐ Didn't know where to go.
- ☐ Couldn't get an appointment.
- ☐ The wait was too long.
- ☐ I didn't have childcare.
- ☐ Other: _____
- ☐ *I prefer not to answer*

18. **Now thinking about your state of mind, have you felt any of the following in the past 30 days, and if so, how frequently did you experience the feeling? You can say not at all, several days, more than half the days, nearly every day, or that you prefer not to answer.**

Sadness	○ Not at all	○ Several days	○ More than half the days	○ Nearly every day	○ I prefer not to answer
Nervousness	○ Not at all	○ Several days	○ More than half the days	○ Nearly every day	○ I prefer not to answer
Trouble sleeping	○ Not at all	○ Several days	○ More than half the days	○ Nearly every day	○ I prefer not to answer
Trouble concentrating	○ Not at all	○ Several days	○ More than half the days	○ Nearly every day	○ I prefer not to answer
Trouble relaxing (anxious)	○ Not at all	○ Several days	○ More than half the days	○ Nearly every day	○ I prefer not to answer
Low energy/ tired	○ Not at all	○ Several days	○ More than half the days	○ Nearly every day	○ I prefer not to answer
Annoyed / irritated	○ Not at all	○ Several days	○ More than half the days	○ Nearly every day	○ I prefer not to answer
Afraid	○ Not at all	○ Several days	○ More than half the days	○ Nearly every day	○ I prefer not to answer
Worried	○ Not at all	○ Several days	○ More than half the days	○ Nearly every day	○ I prefer not to answer
		○ Several days	○ More than half the days	○ Nearly every day	○ I prefer not to answer

19. What type of health insurance do you currently have?

- ☐ Private or employer provided insurance
- ☐ Medicaid
- ☐ Medicare
- ☐ NC Health Choice
- ☐ TriCare (Military or veteran's insurance
- ☐ Community Care Plan
- ☐ ACA Marketplace / Obamacare
- ☐ I do not have health insurance
- ☐ Other (specify):_____
- ☐ *I prefer not to answer*

20. Since the start of the COVID-19 pandemic, have you had trouble getting either of the following:

- ☐ Getting a COVID test
- ☐ Getting COVID vaccine
- ☐ No troubles
- ☐ Other COVID-related resources (specify):_____
- ☐ *I prefer not to answer*

Part 3: Demographics

Alright! Thank you for your feedback. We have just a few more questions to ask. Remember everything you share with us will remain confidential and anonymous.

21. What is your age in years? _____ *(enter age)*

- ○ *I prefer not to answer*

22. How do you describe your gender?_____

- ○ *I prefer not to answer*

23. Are you an essential worker who is not currently working from home?

- ○ Yes
- ○ No
- ○ *I prefer not to answer*

24. *Which category or categories best describes your racial/ethnic identity? Check all that apply.*

- ☐ American Indian or Native American
- ☐ Asian (Chinese, Japanese, Korean, Vietnamese, Asian Indian)
- ☐ Black or African American
- ☐ Hispanic, Latino or Spanish origin (Mexican, Mexican American, Puerto Rican, Cuban Salvadorian, Columbian)
- ☐ Native Hawaiian and other Pacific Islander
- ☐ White/Caucasian
- ☐ Middle Eastern
- ☐ Other race or ethnicity, please specify _____
- ☐ *I prefer not to answer*

25. What is the highest grade or year of school you completed? *(Read if necessary, choose one)*

- ○ Less than 9th grade
- ○ 9-12th grade, no diploma
- ○ High school graduate (or GED/ equivalent)
- ○ Some college (no degree)
- ○ Associate's Degree or Vocational Training
- ○ Bachelor's degree
- ○ Graduate or professional degree
- ○ *I prefer not to answer*

26. **Including yourself, how many people live in your home?** (*Enter #*)_____

27. **How many dependents live your home?**

    (*Enter #*)_____

28. **What are the ages of the dependents?** _____

29. **If you would like to receive additional information about the survey results, please provide an email address so we can contact you. Note that by giving your email address here, your confidentiality in your previous responses will still be maintained.**

    _____

Thank you so much for your time! We will share the summary results (not individual results) with The Anderson Community Group, who will be following up on some of the issues and concerns raised by the community. Thank you again for your time.

Appendix 2. Anderson Community Environmental Quality and Health Survey-Abbreviated Version

Part 1: Personal Health Status and Access to Care

This next set of questions is about your own personal health and your access to health care.

30. Considering both your mental and physical health, would you say that, in general, your health is ...

- ○ Excellent
- ○ Very good
- ○ Good
- ○ Fair
- ○ Poor
- ○ Don't know/not sure
- ○ *I prefer not to answer*

31. Now I have a list of health conditions that I would like to ask you about. I will first ask if you have been diagnosed with the condition and then ask how many of your dependents or minors in the household have also been diagnosed with the condition. If someone else in your household has already answered for these dependents, do not respond here.

So, in the past year, has a doctor, nurse, or other health professional diagnosed you with any of the following illnesses or conditions? You can tell me yes or no or that you would prefer not to answer.

	Diagnosis (You)	**How many of your dependents/minor**

o. Asthma	○ Yes	○ No	○ I prefer not to answer	Enter # (0, 1, 2 etc.)
p. High blood pressure	○ Yes	○ No	○ I prefer not to answer	
q. High cholesterol				
r. Type 2 Diabetes (not during pregnancy or Type 1)	○ Yes	○ No	○ I prefer not to answer	
s. Overweight/Obesity	○ Yes	○ No	○ I prefer not to answer	
t. Lung disease including COPD	○ Yes	○ No	○ I prefer not to answer	
u. Dementia/Short-term memory loss	○ Yes	○ No	○ I prefer not to answer	
v. Liver disease (hepatitis)	○ Yes	○ No	○ I prefer not to answer	
w. Cancer				
If yes, what kind of cancer have you been diagnosed with:_____	○ Yes	○ No	○ I prefer not to answer	
x. COVID-19	○ Yes	○ No	○ I prefer not to answer	
y. Kidney disease				
z. Heart disease				
aa. Mental health diagnosis (depression, anxiety, etc.)Are you immunocompromised?	○ Yes	○ No	○ I prefer not to answer	
bb. Other health conditions or symptoms for which you don't have a formal diagnosis_____	○ Yes	○ No	○ I prefer not to answer	

32. Next I have a list of disabilities I would like to ask you about. Please answer yes or no to the following statements. You may also choose to skip any of these questions if you would like.

g. Are you deaf, or do you have serious difficulty hearing?	O Yes	O No	O I prefer n to answe
h. Are you blind, or do you have serious difficulty seeing, even when wearing glasses?	O Yes	O No	O I prefer n to answe
i. Because of a physical, mental, or emotional condition, do you have serious difficulty concentrating, remembering, or making decisions?	O Yes	O No	O prefer no to answe
j. Do you have serious difficulty walking or climbing stairs?	O Yes	O No	O I prefer n to answe
k. Do you have difficulty dressing or bathing?	O Yes	O No	O I prefer n to answe
l. Because of a physical, mental, or emotional condition, do you have difficulty doing errands alone such as visiting a doctor's office or shopping?	O Yes	O No	O I prefer n to answe

33. Now thinking about your state of mind, have you felt any of the following in the past 30 days, and if so, how frequently did you experience the feeling? You can say not at all, several days, more than half the days, nearly every day, or that you prefer not to answer.

Sadness	O Not at all	O Several days	O More than half the days	O Nearly every day	O I prefer not to answer
Nervousness	O Not at all	O Several days	O More than half the days	O Nearly every day	O I prefer not to answer
Trouble sleeping	O Not at all	O Several days	O More than half the days	O Nearly every day	O I prefer not to answer
Trouble concentrating	O Not at all	O Several days	O More than half the days	O Nearly every day	O I prefer not to answer
Trouble relaxing (anxious)	O Not at all	O Several days	O More than half the days	O Nearly every day	O I prefer not to answer
Low energy/ tired					
Annoyed / irritated	O Not at all	O Several days	O More than half the days	O Nearly every day	O I prefer not to answer
Afraid	O Not at all	O Several days	O More than half the days	O Nearly every day	O I prefer not to answer
Worried	O Not at all	O Several days	O More than half the days	O Nearly every day	O I prefer not to answer
	O Not at all	O Several days	O More than half the days	O Nearly every day	O I prefer not to answer
		O Several days	O More than half the days	O Nearly every day	O I prefer not to answer

Part 2: Demographics

Alright! Thank you for your feedback. We have just a few more questions to ask. Remember everything you share with us will remain confidential and anonymous.

34. What is your age in years? _____ *(enter age)*

○ *I prefer not to answer*

35. How do you describe your gender?_____

○ *I prefer not to answer*

36. Are you an essential worker who is <u>not</u> currently working from home?

○ Yes ○ No ○ *I prefer not to answer*

37. *Which category or categories best describes your racial/ethnic identity? Check all that apply.*

☐ American Indian or Native American
☐ Asian (Chinese, Japanese, Korean, Vietnamese, Asian Indian)
☐ Black or African American
☐ Hispanic, Latino or Spanish origin (Mexican, Mexican American, Puerto Rican, Cuban Salvadorian, Columbian)
☐ Native Hawaiian and other Pacific Islander
☐ White/Caucasian
☐ Middle Eastern
☐ Other race or ethnicity, please specify _____
☐ *I prefer not to answer*

38. What is the highest grade or year of school you completed? *(Read if necessary, choose one)*

○ Less than 9th grade
○ 9-12th grade, no diploma
○ High school graduate (or GED/ equivalent)
○ Some college (no degree)
○ Associate's Degree or Vocational Training
○ Bachelor's degree
○ Graduate or professional degree
○ *I prefer not to answer*

39. Including yourself, how many people live in your home? (*Enter #*)_____

40. How many dependents live your home?

*(Enter #)*_____

41. What are the ages of the dependents? _____

42. If you would like to receive additional information about the survey results, please provide an email address so we can contact you. Note that by giving your email address here, your confidentiality in your previous responses will still be maintained.

_____

Thank you so much for your time! We will share the summary results (not individual results) with The Anderson Community Group, who will be following up on some of the issues and concerns raised by the community. Thank you again for your time.

From: K L TATE
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock--Burlington North
Date: Tuesday, September 21, 2021 7:06:12 PM

My name is Karen Tate Gray, and I attended the virtual public comment meeting held on Monday, September 20, 2021. The meeting was to be from 6:00 pm to 9:00 pm. I had been told that we would have three minutes to speak, but the moderator changed that to two minutes at the beginning of the meeting. The meeting finished much earlier than 9:00 pm. Tonight, I am attending the virtual public comment meeting for Carolina Sunrock-Prospect Hill. Individuals are being allowed the full three minutes. This seems very unfair to those who participated in the the meeting for Carolina Sunrock-Burlington North. I question why this was done.

I have submitted my comments in writing in a previous email and ask that you read them completely since I was allowed only two rather than the full three minutes. I am requesting that you deny the air quality permit taking in consideration the points that I made in the writing that I submitted. I want to re-emphasize that no permit should be considered until the lawsuit, which was initiated by Sunrock, is settled.

Thank you,
Karen Tate Gray

From: Leslie Zimmerman
To: SVC_DENR.DAQ.publiccomments
Subject: [External] burlington/anderson sunrock
Date: Tuesday, September 21, 2021 4:51:57 PM

The materials for public review do not adequately describe the facility. Information was received after the deadline making it very hard for me to review and understand the permit request.
Additionally, there was only one notice in the newspapers, that is not enough.
Given the amount of interest, It should have been in the newspaper calendar for the remaining time
This has kept many in the dark. No radio announcements.

Please inform the people of Caswell and neighbors of the intent of this company.

Leslie Zimmerman
Caswell Local Foods Council, Inc

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing
Date: Tuesday, September 21, 2021 4:00:40 PM

Hello, my name is **Dolleen Garrison**, and I am a concerned resident of the Anderson Community. A recent health assessment conducted by UNC and the NCIPH reported that 72% of respondents identified as Black or African American. A large body of research illustrates that communities of color are disproportionately affected by environmental and climate hazards. We are already burdened by other hazards and cannot allow any more in our community.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:59:31 PM

Hello, my name is **Kennis Wiley,** and I live in the Anderson Community. I am worried about how this polluting asphalt plant will affect COVID-19 cases in my community. Asphalt plants produce harmful air pollutants, including PM2.5 and PM2.5. A 2021 study in London found that air pollution, including PM2.5, resulted in higher COVID-19 cases and related deaths. [50] Please protect our community from these harmful pollutants and COVID-19.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:58:35 PM

Hello, my name is Kenneth Love, and I am a concerned resident of the Anderson Community. A 2020 study in Italy found that exposure to ambient air pollution, including PM2.5 and PM10, was a primary cause of COVID-19 cases and deaths. Polluting asphalt plants produce PM2.5 and PM10, which may increase our community's risk of COVID-19 and death.[48] We cannot afford to have this additional threat to our health.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:57:57 PM

Hello, my name is Dianne Love, and I live in the Anderson Community. The polluting asphalt plant will produce harmful chemicals including sulfur dioxides, particulate matter, and nitrogen dioxides which were found to increase COVID-19 related cases and deaths in California.[48] Please protect the health of our community and stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:57:17 PM

Hello, my name is **Curtis Holmes**, I am concerned that the polluting asphalt plant will cause even higher COPD and lung disease rates in my community. People with COPD and lung disease are at a higher risk of developing more severe and deadly COVID-19 infections according to a 2020 study in Canada.[42] We cannot afford to have this harmful, polluting plant in our community.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:56:37 PM

Hello, my name is **Gladys Knight**, and I am a concerned resident of the Anderson Community. Polluting asphalt plants are known to produce toxic chemicals that increase the risk of developing diabetes according to a 2015 study in Saudi Arabia.[28] Our community is already impacted by disproportionate rates of diabetes, which has been associated with more severe and more deadly COVID-19 outcomes.[40] Our community cannot afford this additional threat to our health.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:55:58 PM

Hello, my name is **Wilma Dewer** and I am a concerned resident of the Anderson Community. Our community and the state of North Carolina has been impacted by COVID-19, and researchers in 2020 have illustrated that those living in areas with higher air pollution were at a 9% higher risk of COVID mortality than those in areas of less air pollution[22]. We do not need any more environmental hazards.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:55:12 PM

Hello, my name is **Brandon Foust**, and I am a concerned resident of the Anderson Community. Asphalt plants produce harmful chemicals, like PM2.5. A 2020 Harvard study found that exposure to PM2.5 has been associated with higher death rates from COVID-19.[23] Our community is already impacted by health disparities, and we cannot afford these additional threats to our health.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:54:15 PM

Hello, my name is **Myrna Rodriguez,** and I am a concerned resident of the Anderson Community. The Pollutant Facility was found to exceed National Ambient Air Quality Standards levels for Sulfur Dioxides by over 400%. Exposure to sulfur dioxides causes oxidative stress, which was linked to developmental delays and reduced neural development in a 2021 study in Taiwan.[45] Please protect the health of our young community members and stop the plant from operating.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:53:11 PM

Hello, my name is **Kimberly Jones** and I live in the Anderson Community. I am concerned that the polluting asphalt plant will expose our children to harmful levels of sulfur dioxides, which were linked to increased developmental delays and Tourette's in a 2021 study.[45] Please protect our young and unborn children from these harmful chemicals and stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:52:08 PM

Hello, my name is Zackary Robert's Jr., and I am concerned for the resident of the Anderson Community. The polluting facility is modeled to produce high levels of sulfur dioxides – over 400% higher than national standards. A 2020 study in Korea found that exposure to sulfur dioxides was associated with dry eye disease among adults[51]. Our community already experiences health disparities, with higher rates of chronic illnesses, and less access to doctors. Please protect our health and stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:51:11 PM

Hello, my name is William Graves, and I live in the Anderson Community. I wear glasses and I am worried that a polluting asphalt plant will make my vision worse. Asphalt plants produce toxic chemicals, including PM2.5, which is a harmful air pollutant. Exposure to PM2.5 has been associated with allergic conjunctivitis in a study in Japan[52]. I do not want to experience additional problems with my eyesight. Please stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:50:14 PM

Hello, my name is Rebecca Long, and I am a concerned resident of the Anderson Community. Asphalt plants produce harmful air pollutants including PM10, nitrogen oxides, and sulfur dioxides. A 2020 study in Korea found that exposure to these harmful air pollutants resulted in increased vision issues, including cataracts, especially among people over the age of 50[51]. We cannot afford this additional threat to our health. Please stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:48:52 PM

Hello, my name is Nenssa Long, and I am a resident of the Anderson Community. I am worried that the toxic chemicals produced by the polluting asphalt plant will make my vision worse. Studies by the CDC and NIOSH have found that asphalt plant pollution can cause eye irritation and cataracts[43]. Please protect my health and vision and prevent the plant from operating in our community.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:48:17 PM

Hello, my name is Elizabeth Love, and I live in the Anderson Community. Asphalt plants produce harmful chemicals that were found in a 2014 study in Japan to increase vision issues including cataracts[52]. Please protect the health of our community and deny the polluting asphalt plant a permit.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:46:21 PM

Hello, my name is Beatrice Bigelow, and I am a concerned resident of the Anderson Community. Many of us in the community have vision problems. Air pollution was strongly linked to ocular diseases such as conjunctivitis in a 2019 study in Japan[37]. Please stop the plant to protect our vision.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:45:39 PM

Hello, my name is Jermiah Jones, and I live in the Anderson Community. A study by the CDC and NIOSH found that exposure to harmful chemicals produced by polluting asphalt plants could increase the risk of skin cancers according to a 2000 study.[43] Please protect the health of my community and stop the plant by not polluting the air.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:44:49 PM

Hello, my name is Lilian Norman, and I am a concerned resident of the Anderson Community. Asphalt plants are known to produce PAHs, which are toxic chemicals. Exposure to PAHs were associated with extrinsic skin aging and skin cancers in a 2017 dermatology study.[32] We cannot afford these additional health risks to our community. Please stop the plant!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:43:56 PM

Hello, my name is Tacan Goodwin, and I am a concerned resident of the Anderson Community. In a recent health assessment conducted by UNC and the NCIPH, 49% of respondents reported fear of encounter with wildlife and excessive buzzards, rodents, or insects. We do not need any more environmental concerns in the community!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:43:05 PM

Hello, my name is Tina Robert's, and I am a concerned resident of the Anderson Community. Most of our community reside downwind of the proposed plant during prevailing wind conditions, according to data from the federal government[38]. A plant and the increased pollution would directly impact many of our neighbors.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock LLC - Burlington North Public Hearing Comment
Date: Tuesday, September 21, 2021 3:42:12 PM

Hello, my name is Zack Roberts, and I am a concerned resident of the Anderson Community. In a recent health assessment conducted by UNC and the NCIPH, many residents reported smelling rotting animals from the local Animal Park. Please do not allow for another polluting entity in our community.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:40:58 PM

Hello, my name is Cyteese Yancey, and I live in the Anderson Community. I am worried that the asphalt plant will produce smelly and toxic hydrogen sulfides, which will impact our ability to enjoy the outdoors.[1] The Blue Ridge Environmental Defense League states that hydrogen sulfides are released by asphalt plants. Please protect our community environment and prevent the asphalt plant from operating.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:40:11 PM

Hello, my name is Ericia Mebane, and I am a concerned resident of the Anderson Community. The Caswell County Community Health Assessment[6] reported in 2019 that 52% of water samples in Caswell County did not meet state guidelines for chemical contaminants. We do not need more environmental hazards!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:39:22 PM

Hello, my name **is Rufus Wiley,** and I am a concerned resident of the Anderson Community. In a recent health assessment conducted by UNC and the NCIPH, 60% of respondents in Anderson reported seeing plumes of smoke in their community, and 62% report strange smells. Please do not allow this asphalt plant to further deteriorate the environment of this area.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:38:31 PM

Hello, my name is Harmony Jones, and I am a concerned resident of the Anderson Community. In a recent health assessment conducted by UNC and the NCIPH, nearly 12% of respondents reported that they were immunocompromised. Air pollution is linked to reducing immune function, especially in children, according to a 2010 Stanford study[27]. We cannot allow this asphalt plant to endanger the vulnerable members of our community. Do not allow the plant to add to the pollution!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant
Date: Tuesday, September 21, 2021 3:37:16 PM

Hello, my name is Chelsee Vega, and I live in the Anderson Community. Polluting asphalt plants produce harmful chemicals called Sulfur Dioxides. The polluting facility was initially denied their permit request because sulfur dioxide levels exceeded national ambient air quality standards by over 400%. Studies, including one from 2021 in Taiwan, have found that pregnant women who are exposed to sulfur dioxides are more likely to have children with neurological and cognitive deficits.[45] We cannot afford this threat to the health of our children.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comments
Date: Tuesday, September 21, 2021 3:35:54 PM

Hello, my name is Stella Harris and I am a concerned for the Anderson Community. I am worried about the harmful chemicals produced by asphalt plants and the impact this will have on infant deaths in our community. A Harvard study published in 2010 found that reducing toxic chemicals in air pollution saved $25 billion worth of human lives, by preventing infant deaths.[34] Please prevent this industry from killing our children.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:35:04 PM

Hello, my name is Timmy Harrelson, and I live in the Anderson Community. Polluting asphalt plants are known to produce harmful, ambient toxic chemicals. One study, published in 2010 by Harvard, found that reducing toxic chemicals in air pollution saved almost 14,000 infant lives across the US over 13 years.[34] Please save our children and stop the plant!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:34:24 PM

Hello, my name is Aniyah Allen, and I am a concerned parent of the Anderson Community. The polluting asphalt plant will produce toxic chemicals that have been found in a Harvard study to increase infant and fetal mortality rates in the United States.[34] Please protect future generations and stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:33:28 PM

Hello, my name is Shy Degreffeidt, and I am a concerned resident of the Anderson Community. Like almost 20% of Anderson residents, Exposure to toxic chemicals produced by the asphalt plant, such as PM2.5 among women with diabetes and who are pregnant, was found to severely increase the risk of preterm birth in a 2019 study on prenatal exposure.[29] Please protect the health of my community and future generations by denying a permit to the asphalt plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:32:25 PM

Hello, my name is Debra Rogers, and I am a resident of the Anderson Community. Asphalt plants produce benzene, which is a known carcinogen. This toxic chemical is also associated with birth defects and low birth weights for pregnant women exposed to this toxic chemical, as reported in a 2014 toxicology study.[20] Please protect our children and future generations by preventing this plant from moving into our community.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:31:35 PM

Hello, my name is **Katrina Shoffner,** and I am a concerned resident of the Anderson Community. I am worried that exposure to harmful chemicals produced by the asphalt plant, like benzenes, which have been shown to increase the risk of leukemia in young children and even in unborn babies according to a 2010 study.[19] We have a responsibility to protect future generations and we cannot afford to have this polluting industry in our community.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:30:19 PM

Hello, my name is **Felica Sellars,** and I am concerned resident of Anderson Community. I am worried about exposure to volatile organic compounds that cause cancer and can negatively affect pregnant women and unborn children by causing birth defects, low birth weights, and learning disabilities, per a fact sheet by BREDL. Please protect future generations of Anderson residents and stop the plant. [1]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:29:13 PM

Hello, my name is **Myra Blackwell** and as a resident of the Anderson Community, I am worried about exposure to formaldehyde, which is a by-product of asphalt production. A fact sheet by the Blue Ridge Environmental Defense league states that exposure to even low levels of formaldehyde can increase lung inflammation and fluid build-up in the lungs, even in small children. Please help us protect future generations of Anderson residents and stop the plant. [1]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:27:57 PM

Hello, my name is **KahBria Gonzales,** and I am a concerned resident of the Anderson Community. Asphalt plants produce benzenes, which have been shown in studies, and reported in a Blue Ridge Environmental Defense League fact sheet, to be harmful to pregnant women and their unborn babies, resulting in low birth weights, bone deformations, and damaged bone marrow. We must protect future generations of Anderson residents and stop the plant. [1]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:27:02 PM

Hello, my name is **Barbra Day**, and I am a concerned resident of the Anderson Community. A study by UNC in Salisbury, NC found that a polluting asphalt plant produced carbon disulfides. The study reported that this chemical is associated with increased risk of mood disorders, personality changes, and suicides.[12] As a community already impacted by environmental hazards and health disparities, we cannot afford these additional risks to our health.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:26:12 PM

Hello, my name is **William Brown**, and I am a concerned resident of the Anderson Community. A study by UNC found that asphalt plants produce hydrogen sulfides, which are associated with increased risks of suicide. Please protect our community from these harmful chemicals and stop the plant! [11]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:11:04 PM

Hello, my name is **Lynette Winstead**, and I am a concerned resident of the Anderson Community. A study by UNC found that a community in Salisbury, NC experienced suicide rates 10 times higher than the state average after a polluting asphalt plant moved into their community. Please protect our community and stop the plant. [11]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:09:51 PM

Hello, my name is **Jake Degreffeneidt**. I have live in the Anderson Community for. A report by the Blue Ridge Environmental Defense league cited many instances where asphalt plants in NC did not follow required visible emissions protocols from 1983-2003. Please keep our community safe from this polluting industry.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:08:58 PM

Hello, my name is **Larry Shoffner**. I am a resident of the Anderson Community. I am worried about my ability to enjoy my neighborhood if the polluting asphalt plant is allowed to move in. A report by the Blue Ridge Environmental Defense League reported almost 30 years of complaints made by community members about the smells and noises produced by asphalt plants in NC.[1] Please protect the peace and calm in my neighborhood and stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:08:13 PM

Hello, my name is **Helen Johnson**, and I am a concerned resident of the Anderson Community. One study in Sweden found that 50% of households located near an oil furnace and two asphalt plants complained of noise, even as low as 55dB. [44] Please protect the peace and quiet of our neighborhoods and prevent the plant from operating in our community.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:06:57 PM

Hello, my name is **Aden McCain,** and I am a resident of the Anderson community. In a recent health assessment conducted by UNC and the NCIPH, about a quarter of residents reported at least one formally diagnosed mental health condition. Research done by the EPA and the University of Wisconsin found that air and noise pollution can be very harmful for mental health[10]. Please protect our well-being and health.

From:	Bryon Shoffner
To:	SVC_DENR.DAQ.publiccomments
Subject:	[External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date:	Tuesday, September 21, 2021 3:06:01 PM

Hello, my name is **Myon Shoffner,** and I am a resident of the Anderson community. In a recent health assessment conducted by UNC and the NCIPH, approximately 20% of Anderson community members stated that they have trouble sleeping, trouble relaxing, and they have low energy the majority of or all the time. We do not need any more disturbances in our community. Please protect our well-being and health.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:05:19 PM

Hello, my name is **Alvin Johnson**. I am a resident of the Anderson Community. Our community already experiences foul smells and noise due to the Animal Conservator Center which is located nearby. A UNC study showed that polluting asphalt plants produce hydrogen sulfides, which cause foul smells.[11] We cannot afford to have these additional odors in our community and ruin our time spent outdoors. Please stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 3:04:13 PM

Hello, my name is **Kendell Ruffin**, and I am a resident of the Anderson community. I am worried about the plant for several reasons. As someone who already experiences emotional stress, the pollution and noise from the plant are very likely to worsen those conditions. Research done by the EPA and the University of Wisconsin found that noise pollution increases one's sensitivity to stress, and can increase more irritability, frustration, and anger. [10] Please stop the plant.

From: Michael Russell
To: SVC_DENR.DAQ.publiccomments
Subject: [External] My health
Date: Tuesday, September 21, 2021 1:39:46 PM

I am a citizen that stays in the Anderson community my address is 298 Ross Acres roads#2 Burlington N.C. 27217 my comments is I suffer with COPD and sleep apnea I have to use nebulizer machine and sleep apnea machine every night in order to breathe, I also suffer with diabetes, high blood pressure, by bringing this asphalt plant in this community will only worsen my breathing condition, I also have a grandson named Isaiah Johnson who suffer with asthma, I'm only asking to deny the asphalt plant these last permit to build this company in my community (COPD is a disease that cost the lungs to be inflammatory without anyone)

Thank Michael L Russell

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:22:09 PM

Hello, my name is **Jimmy Daye**, and I am a resident of the Anderson community . Asphalt plants can be heard up to 1 mile away, as reported by residents of Buncombe County. [9] The plants also operate around the clock during some parts of the year. As someone who already suffers from chronic sleep issues, this plant will only make that worse.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:19:35 PM

Hello, my name is **Antonio Ruffin**, and I am a resident of the Anderson Community and I have enjoyed the peaceful and calm quality of life that country living offers. I am very worried that the noise produced by the asphalt plant and associated truck traffic will severely disrupt the peace and quiet that we enjoy.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:17:43 PM

Hello, my name is **James Phinnix**, and I am a concerned parent in the Anderson Community. An asphalt plant in New Jersey operates from 7am to 3pm daily.[56] I am worried that the truck traffic associated with the operating hours of the asphalt plant will put my children at risk as they walk to the bus stop on busy roads with no sidewalks. Please keep our kids safe from this traffic and stop the plant

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comments
Date: Tuesday, September 21, 2021 12:16:42 PM

Hello, my name is **Ullyess Dewer** and I live in the Anderson Community. Residents of Weaverville said that noise from a nearby asphalt plant has awakened them as early as 2am. I am worried that this asphalt plant will disrupt the calm in our community and prevent us from getting good sleep, which is needed for good health. Please stop the plant. 55

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:15:56 PM

Hello, my name is **Myon Shoffner**, and I am a concerned resident of the Anderson Community. I am worried about the noise that this proposed, polluting asphalt plant will cause. A report by Los Angeles on asphalt plant operations found that trucks began delivering materials at 5am.[54] Noise from these trucks and the plant will ruin our ability to sleep. Please stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:15:01 PM

Hello, my name is **Mylon Shoffner**, and I am a concerned parent and resident of the Anderson community. I am worried about my son's asthma, a 2013 study in Spain showed that young boys who live in neighborhoods with high truck traffic, have three times the odds of having severe or exercise- induced asthma, compared to neighborhoods with little to no truck traffic. Please protect our kids and stop the plant. [4]

From: Nasif, Zaynab R
To: Bryon Shoffner
Cc: SVC_DENR.DAQ.publiccomments; anitafoust99@gmail.com; valerie.batement@forrestfirm.com
Subject: RE: [External] Public Comment Burlington North not working
Date: Tuesday, September 21, 2021 12:14:16 PM

Hi Rev. Shoffner,

Just to clarify: it is not a link that will take you to a webpage, it's an email address that can be copied and pasted into the field on emails.

I've cc'd the email address to this email, so any response you send to me will automatically go to the email address as extra assurance.

Best,
Zaynab

From: Bryon Shoffner <shoffnerb@ymail.com>
Sent: Tuesday, September 21, 2021 10:26 AM
To: Nasif, Zaynab R <zaynab.nasif@ncdenr.gov>
Cc: anitafoust99@gmail.com; Valerie Bateman <valerie.bateman@forrestfirm.com>
Subject: Re: [External] Public Comment Burlington North not working

Please correct the link so the public can continue to add comments.

On Tuesday, September 21, 2021, 10:20:00 AM EDT, Nasif, Zaynab R <zaynab.nasif@ncdenr.gov> wrote:

Good morning Rev. Shoffner,

I just checked and the link is working on my end, and we have also received other public comments to that address. If you manually enter it in, it should work. Try it now by clicking this: DAQ.publiccomments@ncdenr.gov

If that does not work, you can send the comments to me through this email (zaynab.nasif@ncdenr.gov).

Best,

Zaynab

From: Bryon Shoffner <shoffnerb@ymail.com>
Sent: Tuesday, September 21, 2021 10:15 AM
To: Nasif, Zaynab R <zaynab.nasif@ncdenr.gov>; Abraczinskas, Michael <michael.abraczinskas@ncdenr.gov>; Pigues, Stephanie <stephanie.pigues@nc.gov>; Jones, Kristi - Governor Office <Kristi.Jones@nc.gov>; Pjetraj, Michael <michael.pjetraj@ncdenr.gov>; Valerie Bateman <valerie.bateman@forrestfirm.com>; Murphy, Davis <davis.murphy@ncdenr.gov>; Stewart, Ray <ray.stewart@ncdenr.gov>; Anita Foust99 <anitafoust99@gmail.com>
Subject: [External] Public Comment Burlington North not working

This link for some reason is not opening for me to enter the public comments as requested from last nights hearing, Please fix this so I can enter the public comments for the community as requested.

Rev. Shoffner

DAQ.publiccomments@ncdenr.gov

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant
Date: Tuesday, September 21, 2021 12:14:05 PM

Hello, my name is **Isiah Johnson**, and I am a resident of the Anderson community. I am worried that truck traffic related to the asphalt plant will make my child's asthma much worse. A 2014 study in Europe showed that diesel truck traffic increases the severity of asthma symptoms. We do not need this polluting industry, and related truck traffic, in our neighborhood! [3]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:13:20 PM

Hello, my name is **Michael Russell**, and I am a concerned citizen and parent in the Anderson Community. I am worried about my child's asthma, as an international study conducted in 2009 showed that increased truck traffic in residential areas increases the risk of asthma, rhinitis, and eczema among children. Please protect our children and stop the plant.[2]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:12:34 PM

Hello, my name is **Paula Sellars**, and I am a concerned citizen of the Anderson Community. I am worried that increased truck traffic due to the plant will expose my children to harmful levels of toxic chemicals including particulate matter, which can increase their risk of preventable asthma, as shared by a UCSF Medical Center Pediatric Environmental Health Specialist. Please protect the Anderson children and community and stop the plant. [1]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:11:43 PM

Hello, my name is **Chris Shoffner,** and I am a concerned citizen of the Anderson Community. Polluting asphalt plants require trucks to move the asphalt. An asphalt plant in Greensboro called Colfax reported producing enough asphalt to fill hundreds of trucks per day[1]. The pollution and noise caused by these trucks will ruin our health and disrupt the peace in our neighborhood. Please stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:10:50 PM

Hello, my name is **Jose Gonzales** and I live in the Anderson Community. I am worried about a huge increase in truck traffic in our community if the asphalt plant is allowed to operate. An asphalt plant in Los Angeles was expected to have over 660 truck trips per day when producing 700,000 tons of Hot Mix Asphalt per year. Please protect our community from this noise and pollution and stop the plant.[54]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:09:59 PM

Hello, my name is **Nathan Love**, and I am a resident of the Anderson community with kidney disease. A 2019 Community Health Assessment found that from 2013-2017, 27.2 deaths per 100,000 residents were caused by kidney disease in Caswell County[6], compared to 18.8 per 100,000 residents for the state of North Carolina. This county and this community are much more impacted by this disease, and do not need another environmental hazard.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:09:01 PM

Hello, my name is **Laverne Corbett**, and I am a concerned resident of the Anderson Community. I have lived in the Anderson Community for 27 years and I own my home. A report by the Blue Ridge Environmental Defense League found that properties located within 3,200 feet of an asphalt plant in Pineola, NC lost property value. I won't be able to afford to move if this plant is allowed to operate.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:08:08 PM

Hello, my name is **Crishauna Yancey,** and I have lived in the Anderson Community for 28 years. If the asphalt plant opens, I will be forced to move because of the health risks associated with this polluting industry. A 2015 study found that housing prices drop significantly when located near polluting industries.[33] Our community cannot afford the health and economic risks associated with this plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:07:00 PM

Hello, my name is **Mamie McCandies**, and I am a concerned resident of the Anderson Community. I am worried about the property value of my home if the asphalt plant is allowed to operate. A study supported by Princeton University, University of California-Berkeley, and the University of Chicago found that houses within a 0.5-mile radius of a polluting industry experienced a loss worth $4.25 million due to bad air quality produced by industrial facilities.[33] We can't afford this type of economic loss in our community.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:06:15 PM

Hello, my name is **Tyrone Knight**, and as a concerned resident of the Anderson community, I am worried that my property value will decrease significantly if an asphalt plant, or any other polluting industry, moves near my home. A report by the Blue Ridge Environmental Defense League found that housing prices dropped by up to 56% in Pineola, NC since an asphalt plant moved into their community in 1999, and we don't need a similar effect in the Anderson community.[52] Please stop the plant from destroying our community

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:05:15 PM

Hello, my name is **Mahogani Graves**, and I am a concerned resident of the Anderson Community. A study in England found that children who live within 2-3 kilometers of a polluting industry, including asphalt plants, have an increased risk of leukemia. Please protect the health of our children and families and stop the plant from operating. [1]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comments
Date: Tuesday, September 21, 2021 12:04:18 PM

Hello, my name is **Frank Simmons**, and I am a resident of the Anderson community with cancer. A 2019 Community Health Assessment found that from 2013-2017, 292.6 deaths per 100,000 residents were caused by cancer in Caswell County[6], compared to 191.4 per 100,000 residents for the state of North Carolina. Our county and community already have higher rates of disease, please protect our health, and stop the pant no cumulative impacts are needed in our community.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:02:27 PM

Hello, my name is **Orlando Harris**, and I live in the Anderson community. A study in 2020 found that exposure to PM10 produced by polluting asphalt plants was associated with genetic damage related to reduced life expectancy and increased risk of cancer. [13,14] We cannot afford to have this polluting industry in our community that is already impacted by health disparities.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:01:32 PM

Hello, my name is **Samuel Harris**, and I am a concerned resident of the Anderson Community. I am worried about the toxic fumes that may be produced by the polluting asphalt plant, including benzene. A UNC study found that a community in Salisbury, NC experienced 6 times the rate of brain cancers after a polluting asphalt plant moved in.[11] Please protect our community from these toxic fumes and stop the plant from polluting the air.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:00:43 PM

Hello, my name is **Hazel Robertson**, and I have been a resident of the Anderson community for 20 years. I am worried that the asphalt plant will produce arsenic, which is a known carcinogen in humans. A fact sheet by the Blue Ridge Environmental Defense League on harmful toxins produced by asphalt plants states that living near a polluting industry increases exposure to arsenic, which increases the risk for lung cancer. Please protect the Anderson Community and stop the plant. [1]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 12:00:00 PM

Hello, my name is **Barbra Simmons**, and I am a concerned resident of the Anderson Community. I ask that you stop the plant from moving into our community. Per a fact sheet from the Blue Ride Environmental Defense League, asphalt plants may produce chemicals called polycyclic aromatic hydrocarbons or PAHs which have been shown to increase the risk of lung, stomach, and skin cancers for people who breathe them in, have them land on their skin via dust particles, or drink them. Please protect our community from these harmful chemicals and stop the plant. We enjoy our clean air. [1]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:59:08 AM

Hello, my name is **Zada Jones**, and I am a resident of the Anderson community. I am worried about the toxic fumes that the asphalt plant will produce, including benzene, which is a known carcinogen and causes leukemia, per a fact sheet created by the Blue Ridge Environmental Defense League. The Anderson Community cannot afford this risk to our health. [1]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:58:18 AM

Hello, my name is **Poonom Patel**, and I am worried about the health of this community if this polluting plant is allowed to operate. Asphalt plants produce harmful chemicals called Particulate Matter (PM). A study by the University of Michigan found that being exposed to these harmful chemicals is associated with different cardiovascular diseases.[35] My community is already impacted by health disparities, and we cannot afford this additional threat to our health.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:57:24 AM

Hello, my name is **Elizabeth Love** and I am a concerned resident of the Anderson community. Asphalt plants are known to produce toxic chemicals, including particulate matter (PM). A study from the University of Michigan found that exposure to PM increases the risk of heart attacks for those exposed to these harmful particles.[35] Our community cannot afford this threat to our health.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:56:28 AM

Hello, my name is **Mabel Ruth**, and I am a resident of the Anderson community with heart disease. A 2019 Community Health Assessment found that from 2013-2017, 227.7 deaths per 100,000 residents were caused by heart disease in Caswell County[6], compared to 180.9 per 100,000 residents for the state of North Carolina. Our county has higher rates of many diseases so please do not make them worse – stop the plant!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:55:39 AM

Hello, my name is **Vance Riley**, and I am a resident of the Anderson community. In a recent health assessment done by UNC and the NCIPH, nearly 9% of residents, including myself, reported diagnosed heart disease. We will be negatively impacted if this plant is allowed to be constructed and pollute this area. Please stop the plant!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:54:46 AM

Hello, my name is **Selena Shoffner**, and I am a resident of the Anderson Community. A review of existing studies by the University of Michigan, Johns Hopkins, and universities and hospitals in Cleveland Ohio, show that high concentrations of PM 2.5, which may be produced by the asphalt plant, are linked to increases in cardiovascular events and all-causes of death[7]. As a community already impacted by other environmental hazards and health disparities, we cannot allow this plant to further pollute the air.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:53:57 AM

Hello, my name is **Rachel Jones**, and I am a resident of the Anderson Community. I am concerned about how the increased air pollution will affect my existing heart disease. The EPA states that there is a proven association between air pollution and increased plaque buildup in blood vessels[5]. My health will very likely be impacted by this plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:53:09 AM

Hello, my name is **Kaylia Jones**. I am a resident of the Anderson Community. I am worried that the asphalt plant will ruin our quality of life. A study by the Blue Ridge Environmental Defense League found that when an asphalt plant moved a community in Bethel, NC, 15% of people reported headaches from being exposed to the plant. Please stop the polluting asphalt plant from moving into our community.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:52:05 AM

Hello, my name is **Bobby Harris.** I am a resident of the Anderson Community and I have lived here for 6 years. A study by the Blue Ridge Environmental Defense League found that almost 1 in 5 people in Bethel, NC had sinus problems after an asphalt plant was allowed to operate in their community. Please protect our community and do not let this polluting asphalt plant move in!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:51:02 AM

Hello, my name is **Sandy Corbett,** and I am a resident of the Anderson community with lung disease. A 2019 Community Health Assessment found that from 2013-2017, 65.7 deaths per 100,000 residents were caused by COPD and emphysema in Caswell County[6], compared to 51.9 per 100,000 residents for the state of North Carolina. Our community already experiences health disparities. Please do not make them worse. It is time to stop this polluting asphalt plant from moving into our community!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:49:59 AM

Hello, my name is **Vanise Foust**, and I am a concerned resident. I am concerned about how the increased air pollution will affect my existing lung disease. In a recent health assessment conducted by UNC and the NCIPH, over 24% of respondents reported lung disease. We must protect the members of this community from more air pollution!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant comment
Date: Tuesday, September 21, 2021 11:47:33 AM

Hello, my name is **Ronnie Foust**, and I am a concerned resident. The asphalt plant will increase diesel truck traffic in our community. A 2021 study found that exposure to diesel exhaust increased the risk of developing COPD.[24] Our community already has higher rates of lung disease compared to the state and county averages. Please stop the plant!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Community
Date: Tuesday, September 21, 2021 11:45:07 AM

Hello, my name is **Janette Wiley**, and I am concerned resident of the Anderson Community. Polluting asphalt plants, and diesel fuel from truck traffic, produce harmful particles. A 2021 study found that exposure to these harmful particles increases the risk of developing COPD.[24] My health will likely be negatively affected by this plant. Please protect the health of my community and stop the plant from damaging our air.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Community
Date: Tuesday, September 21, 2021 11:42:50 AM

Hello, my name is **Cornelius Jones**, and I am resident of the Anderson Community. I am worried about the toxic chemicals the asphalt plant will produce, including PM2.5. A 2015 study in Norway found that being exposed to PM2.5 can increase a person's risk of COPD.[18] Our community is already impacted by higher rates of lung diseases compared to the state and county averages, and we cannot afford to have this polluting industry in our community. Let me breath freely.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comments
Date: Tuesday, September 21, 2021 11:37:53 AM

Hello, my name is **D Andrea Corbett**, and I am a resident of the Anderson community with diabetes. A 2019 community health assessment found that from 2013-2017, 48.2 deaths per 100,000 residents were caused by diabetes in Caswell County[6], compared to 27 per 100,000 residents for the state of North Carolina. My community already has health disparities. Please don't make them worse. Stop the plant!

From:	Bryon Shoffner
To:	SVC_DENR.DAQ.publiccomments
Subject:	[External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comments
Date:	Tuesday, September 21, 2021 11:36:11 AM

Hello, my name is **Tony Harris**, and I am a concerned resident of the Anderson community. Asphalt plants are known to produce harmful chemicals, like PM2.5. A 2015 study found that even at very low levels of exposure, PM2.5 are associated with increased risk of various health conditions including diabetes.[30] My community already experiences health inequities, and this plant would only make those inequities worse. Please stop the plant.

From:	Bryon Shoffner
To:	SVC_DENR.DAQ.publiccomments
Subject:	[External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date:	Tuesday, September 21, 2021 11:34:58 AM

Hello, my name is **Joseph Lawson**, and I live in the Anderson Community. Asphalt plants produce harmful chemicals, including PM10. A 2020 study associated exposure to ambient PM10 with a much higher risk of diabetes.[31] Our community already suffers from much higher rates of diabetes compared to county and state averages, and we cannot afford this additional threat to our health. Please stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:33:23 AM

Hello, my name is **Mona Ruffin**, and I am a concerned resident of the Anderson Community. The asphalt plant will not only produce harmful chemicals, but increase truck traffic, which will expose our community to additional air pollution. A 2015 study found that particulate matter and traffic pollutants were a leading cause of Type 2 diabetes.[28] Please protect the health of my community and stop the plant.

From:	Bryon Shoffner
To:	SVC_DENR.DAQ.publiccomments
Subject:	[External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date:	Tuesday, September 21, 2021 11:31:52 AM

Hello, my name is **Danny Shoffner**, and I am a resident of the Anderson Community. In a recent health assessment completed by UNC and the NCIPH, 19.6% of Anderson residents reported diagnosed having Type 2 diabetes, compared with the state average of 10%. More air pollution and specifically the production of PAHs could increase this disparity. Please protect our neighbors!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:30:47 AM

Hello, my name is **Brenda Jones,** and I am a concerned resident of the Anderson Community. A 2014 study in China found that polycyclic aromatic hydrocarbons (PAHs), which may be produced by asphalt plants, are associated with an increased risk of diabetes.[17] Our community is already negatively impacted by health disparities, and we cannot afford to have this polluting plant in our community especially by this EJ community.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:29:32 AM

Hello, my name is **Rufus Knight,** and I am a concerned resident of the Anderson Community. Our community is already impacted by health disparities, including much higher rates of high blood pressure. Asphalt plants produce toxic chemicals, like PM2.5. A University of Michigan study associated exposure to PM2.5 with an increased risk of high blood pressure.[35] Please protect our community from experiencing additional health disparities!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:28:51 AM

Hello, my name is **Lynn Shoffner**, and I am a resident of the Anderson Community. We know that air pollution will exacerbate the health condition of those with high blood pressure. In a recent health assessment conducted by UNC and the NCIPH, over 60% of respondents reported diagnosed high blood pressure, compared with the state average of 38%. More air pollution in our community could lead to more chronic diseases and even death. Please protect our neighbors!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:27:12 AM

Hello, my name is **Maurice Shoffner**, and I am a concerned resident of the Anderson Community. I am worried about the health of my community, as we are impacted by health disparities, including higher rates of blood pressure. Asphalt plants are known to produce harmful chemicals, like benzenes, which in a 2014 study, was shown to increase the risk of hypertension.[20] Please protect our community and stop the plant!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:26:06 AM

Hello, my name is **Alma Knight**, and I live in the Anderson Community in Caswell County. Our neighborhood has a rate of high blood pressure that is higher than the county, and much higher than the state average. A 2016 study found that air pollution and high blood pressure are associated with a higher risk for cardiovascular disease[8]. We cannot allow the most vulnerable in our community to be exposed to this type of pollution.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant comment
Date: Tuesday, September 21, 2021 11:25:06 AM

Hello, my name is **Felicia Love**, and I am a resident of the Anderson Community. I am concerned about how breathing in toxic air produced by the plant may affect my high blood pressure. The Blue Ridge Environmental Defense League reported that in Pineola, NC, almost 1 in 5 residents complained of high blood pressure after an asphalt plant moved into their community. Please protect our health and stop the plant.[1]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:24:00 AM

Hello, my name is **Donna Turner**, and I am a concerned resident of the Anderson Community. Polluting asphalt plants produce harmful chemicals, including Sulfur Dioxides. A Stanford study found that being exposed to sulfur dioxides causes respiratory problems in both people who are healthy, and those who have lung issues.[46] Our community already has much higher rates of asthma, which will be made worse by this plant. Please protect our lungs and stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:14:09 AM

Hello, my name is **Brenda Harris**, I am a concerned parent living in the Anderson Community. I am worried that my children will develop asthma or other respiratory issues if the polluting asphalt plant is permitted to operate. One health study funded by Johns Hopkins found that living near polluting industries resulted in a higher risk of respiratory issues in children.[15] Please protect the health of our kids and stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:13:21 AM

Hello, my name is **George Sellars**. A study funded by Johns Hopkins found that living close to a polluting asphalt plant increases the risk of asthma attacks.[15] The study reported that living close to a source of air pollution resulted in having more than 12 asthma attacks in a year.[15] My community already has much higher rates of asthma compared to the state and county levels, and we cannot afford this additional threat to our health.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:12:34 AM

Hello, my name is Joseph Wiley, and I am a concerned resident of the Anderson community. Our community has much higher rates of asthma compared to county and state averages. Asphalt plants are known to produce harmful chemicals – In a 2021 study in Nigeria, researchers found that exposure to these chemicals can trigger asthma attacks and reduce lung function.[16,1] Please protect the health of my community and stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:11:31 AM

Hello, my name is **Meshia Jones** and I am a concerned resident of the Anderson Community. I have asthma and I am concerned that the asphalt plant will make my asthma worse. Asphalt plants are known to produce toxic chemicals including PAHs and hydrogen sulfides. A study by the Blue Ridge Environmental Defense League found that exposure to these toxic chemicals caused a reduction in lung function.[16,26] I cannot afford this additional threat to my health. Please stop the plant from operating in my community so I can breathe clean air freely.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:10:33 AM

Hello, my name is **Ann Paylor**, and I live in the Anderson community. Asphalt plants are known to produce hydrogen sulfides, which produce a bad smell. A study by the Blue Ridge Environmental Defense League found that exposure to low levels of hydrogen sulfides reduced lung function in people with asthma.[26] As someone with asthma, my health will be negatively impacted if the plant is allowed to operate in my community. Please stop the plant to protect my health and the health of my community.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:09:50 AM

Hello, my name is **Edward Shoffner**, and I live in the Anderson Community. I am worried about how the polluting asphalt plant will impact my asthma. A 2021 study in Nigeria found that asphalt plants produce polycyclic aromatic hydrocarbons (PAH) and that exposure to this toxic chemical reduces lung function.[16] I cannot afford to have this polluting industry threaten my ability to breath.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:08:59 AM

Hello, my name is **Charles Love**, and I live in the Anderson Community. I am worried about my children's health, as a study funded by Johns Hopkins found that living near a polluting asphalt plant was associated with an increased risk of asthma attacks among children.[15] Please protect our young residents from this pollution.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:08:27 AM

Hello, my name is **Cedrick Chavis Jr** and I have lived in the Anderson Community. I have asthma, as do many other residents. In a recent health assessment conducted by UNC and the NCIPH, nearly 26% of respondents reported asthma, compared to a statewide prevalence of 8.3%. Allowing this plant to operate in our community will just make asthma worse and will increase the health inequities we already experience.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:07:22 AM

Hello, my name is **Antonio McCain**, and I am a resident of the Anderson Community. I am worried about the toxic chemicals that the asphalt plant may produce. The Blue Ridge Environmental Defense League states that asphalt plants can produce hydrogen sulfides which are known to trigger asthma. I do not want to make my asthma worse. [1]

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:06:27 AM

Hello, my name is **Rodney Lawson** and I have lived in the Anderson Community for 27 years. I have asthma and the pollution from the new plant is likely to trigger my asthma. The Blue Ridge Environmental Defense League found that living close to an asphalt plant increases the risk of asthma attacks.[1] We do not need this polluting industry in our neighborhood.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:05:33 AM

Hello, my name is **Regina Albino,** and I live in the Anderson Community. The Pollutant Facility will produce high amounts of sulfur dioxides, as shown in modeling done by the NC Division of Air Quality. A 2020 study found that exposure to higher levels of sulfur dioxides is associated with increased death from COPD, cardiovascular diseases, and respiratory disease. [47] Our community is already impacted by health disparities, please do not make them worse by granting a permit to this polluting industry.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comments
Date: Tuesday, September 21, 2021 11:04:36 AM

Hello, my name is **Ella Love** and I live in the Anderson Community. I am worried about the health of my community. We already experience health disparities, and the polluting asphalt plant will only make them worse. The Blue Ridge Environmental Defense League states that asphalt plants may produce Particulate Matter (PM). A 2018 study in Italy found that exposure to particulate matter negatively affected different organs, including the brain, heart, liver, and lungs.[40] Please prevent this plant from moving into our community to protect our health.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:03:46 AM

Hello, my name is **Dekova Rogers,** and I am a concerned resident of the Anderson Community. I am worried about the toxic chemicals the asphalt plant may produce in our community, including particulate matter (PM). Theses harmful particles, when breathed in, can cause oxidative stress in the body. A study supported by the University of Alberta found that exposure to particulate matter is associated with many health problems including diabetes, cardiovascular diseases, and cancers.[39] We cannot afford to have this polluting plant ruin our health.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:02:59 AM

Hello, my name is **Devita Jones**, and I live in the Anderson Community. My community is already impacted by health disparities, which will be made worse if the polluting asphalt plant is allowed to operate. Asphalt plants may produce harmful chemicals called Particulate Matter (PM). A study supported by the University of Alberta found that when people breath in these harmful particles, their bodies produce an inflammatory response, which has been shown to cause chronic illnesses over the long-term.[39] Please protect my community's health and stop the plant industry from moving in

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:02:05 AM

Hello, my name is **Craig Shoffner** and I have lived in the Anderson community for 30 years. A recent health assessment conducted by UNC and the NCIPH found that 77% of Anderson residents have a formally diagnosed chronic illness, and 48% of residents three or more chronic illnesses. Please do not allow more health risks in our community; the many impacts of this plant on top of the many health disparities already faced by other residents and myself would be devasting.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:01:30 AM

Hello, my name is **Tracy Shoffner** and I have lived in the Anderson community for 25 years. Polluting asphalt plants produce harmful chemicals, like benzenes. I am worried that exposure to benzenes produced by the polluting plant will cause health issues in my community. A 2014 study found that exposure to benzene caused neurological issues.[20] Please protect the health of our community and stop the plant.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 11:00:25 AM

Hello, my name is **Bryon Shoffner II**, and I have lived in the Anderson Community for 28 years. I am worried that the polluting asphalt plant will increase our community's exposure to benzene, a known carcinogen. A 2014 study linked exposure to benzene with reproductive, cardiovascular, endocrine, immune, neurological, and respiratory health issues.[20] Our community is already impacted by health disparities, and we cannot afford to have this polluting industry threaten our health even more.

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comment
Date: Tuesday, September 21, 2021 10:59:26 AM

Hello, my name is **Christy Enoch**, and as a concerned resident of the Anderson Community, I would like to state that we are already at greater health risk than most people in the state because of the low number of doctors in Caswell County. The 2019 Caswell County Community Health Assessment reported that there are only 3.8 doctors per 10,000 residents, compared to the state average of 23.5[6]. That's 6X higher chance that other North Carolinians will have their health conditions attended to and many of them don't have to worry about the added burden of neighborhood pollution. Stop the plant!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant Comments
Date: Tuesday, September 21, 2021 10:58:17 AM

Hello, my name is **Rebecca Long**, and as a concerned resident of the Anderson Community, I am worried that this polluting asphalt plant will negatively affect my overall health. In Bethel, NC we learned from the Blue Ridge Environmental Defense League that almost half the residents reported increased negative health outcomes since a polluting asphalt plant moved into their community.[1] The Anderson Community cannot afford additional threats to our health. Stop the plant!

From: Bryon Shoffner
To: SVC_DENR.DAQ.publiccomments; Valerie Bateman
Subject: [External] Public Hearing for Carolina Sunrock LLC Air Permit – Burlington North Plant/ Rev. Bryon Shoffner
Date: Tuesday, September 21, 2021 10:56:13 AM

Hello my name is Rev. Bryon Shoffner of the Anderson Community. I am speaking reference to the Burlington North Air permit.
I am asking for this air permit to be denied, for several reasons. Reason number one is because the UNC school of Gilling's Global Public Health conducted a health survey in the Anderson Community and found that this EJ Community is very sick. 77% sick to be exact. Also, the community is already full of other cumulative impacts. God created clean air to be free and we should not be forced to choice or trade clean air for daily pollution. Just in case we missed the definition of air pollution it is: the presence in or introduction into the air a substance which has harmful or poisonous effects. These Poisonous effects will affect people whom already have: asthma, Copd, skin disease, heart disease, cancer, vascular disease, I could go on and on with this list. But just in case you missed the point of why our health is more important than a pollutant industry. Please read: Coronavirus and Air Pollution on the Harvard Edu website, for it finds that breathing more polluted air over many years may itself worsen the effects of Covid 19. We know Covid 19 has hit the black/brown communities very hard so why add another stress to the list. Let the people breathe freely and denies the air permit. Do not give them a permit to kill, do not give them a license to kill, denies the polluting industry and allow us to live. God Bless and please choose life over pollution. Let the people breathe, let the people breathe freely, let the people breathe clean air and most importantly let the people breathe clean air unconditionally.

God Bless
Rev. Shoffner

From:	Phil
To:	SVC_DENR.DAQ.publiccomments
Subject:	[External] Carolina Sunrock – Burlington North
Date:	Tuesday, September 21, 2021 6:58:07 AM
Attachments:	Carolina Sunrock LLC – Burlington North Comments - Sept 21 2021.pdf

DAQ,

Attached are my comments to the Burlington North air permit application.

Please acknowledge receipt.

Thank you,
Phil Barfield

1. The applicant is suing 55 neighbors when they exercised their right to object to a local permit that was issued by our county Planning Director. The lawsuit is seen as intimidation and has had a chilling effect on people wanting to come forward and speak out against the projects.

   Action Requested: Delay DAQ decision on the air permit until after a court ruling in the lawsuit. If the applicant loses, our county's High Impact Development Ordinance (HIDO) will apply and will affect the location and configuration of the projects. New air permit applications will be required if they can meet the HIDO requirements.

2. Changes, correspondence, and attachments to the air permit applications and DAQ review were not made available to the public before the hearing or comment period.

   Action Requested: Post the information to the DAQ website, reschedule the hearing, and extend the comment periods to allow the public sufficient time to review and comment.

3. The applicant claims the only difference between the 2019 and 2021 air permit applications is the use of ultra-low sulfur diesel (ULSD).

   Action Requested: Explain why particulate matter (PM) pollution estimates have increased between the two applications. Was this the result of using ULSD?

   Action Requested: Explain why cadmium was calculated to be emitted higher than TPER limit in the 2019 application estimates but not in the 2021 estimates. What caused the decrease of cadmium between the two applications?

4. DAQ denied the 2019 air permit application because NO2 exceeded NAAQS limits.

   Action Requested: Explain why the same level of nitrogen oxide (NOx) pollution is now acceptable when it wasn't previously.

5. The air permit application requires revision and resubmittal due to substantial changes to the original application. E-mails, phone conversations, and memos since the submittal on 4/22/2021 have affected the core basis for review and approval. When projected emissions change substantially during the course of DAQ review, as in this case, the application must be revised and resubmitted. As an example, the particulate matter projected emissions jumped from 28.88 tons per year in the application to 38.05 tons per year by the time the DAQ review was concluded.

   Action Requested: Require applicant to revise, update, and resubmit the air permit application. Post the information to the DAQ website, reschedule the hearing, and extend the comment periods to allow the public sufficient time to review and comment.

6. The materials presented in their current form are haphazard and, intentionally or unintentionally prevent a non-technical person from following and comprehending the materials. They are a barrier to citizens who want to understand the impacts to their

community, the environment, and their health. They discriminate against those without an advanced technical degree. When providing for public comment and review, the materials need to be organized, clearly written, errors corrected, and revisions incorporated so an average person can read and understand the content.

Action Requested: Require applicant to correct, revise, update, and resubmit the air permit application. Post the information to the DAQ website, reschedule the hearing, and extend the comment periods to allow the public sufficient time to review and comment.

7. The materials for public review do not adequately describe the facility. Forms have missing information and pollution control methods and systems are not fully identified. The type and configuration of all the equipment is not known.

   Action Requested: Require applicant to provide all information on the systems and fill out all the forms completely.

8. Asphalt and concrete plant have been operating for years across the country with little change to the various technologies and methods used. Some technology being used is known to be better than others (counterflow vs batch). Enclosures, wet suppression, odor control, counterflow double drum, blue smoke control, are some that should be required and incorporated.

   Action Requested: Evaluate the facility configuration and equipment and require the best technology and methods that would benefit the environment and public health.

9. Fabric filters in baghouses are the primary pollution control devices. DAQ is requiring an annual internal inspection, but a monthly visual inspection is required to ensure the filters are attached, intact, and in good condition. With only an annual inspection, the facility could pollute above permitted thresholds for months before a problem is discovered.

   Action Requested: Require monthly visual inspections of the baghouse and fabric filters.

10. The facility has the capability to store and use No. 2 fuel oil. No. 2 recycled, No. 4, and No. 4 recycled fuel oils pollute more than No. 2 fuel oil.

    Action Requested: Do not allow more polluting fuel oils (No. 2 recycled, No. 4, and No. 4 recycled fuel oils) to be used.

11. In the DAQ review, DAQ assumes No. 4 Fuel Oil has the same emission factor as Recycled No. 4 Fuel Oil and that emissions factors for Propane are similar to those of Natural Gas.

    Action Requested: Confirm these assumptions and cite the appropriate sources. If not true and they are different, then re-evaluate the SO2 emission rate for the drum dryer/mixer.

12. Except in the case of crushers, haul roads, and front-end loader work area, DAQ states that fugitive dust and process generated emissions shall be controlled but do not require how

or by what means. DAQ leaves it up to the applicant to determine how the emissions will be controlled and then, after construction, confirms it against an opacity standard.

Action Requested: Require the applicant to identify the systems, processes, and procedures to specifically control emissions in the application. Review them for adequacy. Require emission controls be put in place that have been proven effective in the industry such as enclosures and wet suppression systems.

13. DAQ was not provided information on how the applicant will control fugitive dust.

    Action Requested: Require the facility to develop, implement, and comply with a fugitive dust control plan. Review and approve the plan before the air permit is approved. The plan should include controlling fugitive dust emissions at unloading and loading areas, process area stockpiles, stockpile working areas, plant parking lots, plant roads (access and haul roads), conveyors, screens, transfer points, crushers, silos, truck loadout points, aggregate weigh batcher, etc.

14. Covering equipment and sources reduces fugitive emissions.

    Action Requested: Require components of the HMA and concrete plants be covered or enclosed to limit fugitive emissions. This includes conveyors, tops of silos, loading stations, and gobb hopper.

15. The facility is required to utilize management practices or odor control equipment sufficient to prevent objectionable odorous emissions.

    Action Requested: Require the applicant to identify the equipment, processes, and practices to prevent odors. Determine if the equipment and practices significantly reduce or eliminate odors.

16. Additives are a way to control odor emissions when using recycled/reclaimed asphalt pavement (RAP).

    Action Requested: Evaluate and require the applicant to use additives (if environmentally friendly) to control odors when using RAP.

17. Recycled/reclaimed asphalt pavement (RAP) composition may be unknown. The addition of unknown composition RAP into the HMA drum is a concern as all RAP is not the same and that subsequent loads and batches may have different composition. Some batches may contain chemicals, waste materials, heavy metals, oils, paints, adhesives, solvents, etc. that have been applied or accumulated prior to being removed from pavements and roofs. When added to the HMA drum, they may emit odors and pollutants at different levels and include pollutants not in the review and analysis.

    Action Requested: Have strict requirements and record keeping regarding the composition of RAP to ensure the composition is consistent and the emissions are known.

Include the emissions caused by adding RAP to the HMA drum into the facility emissions calculations. Require the facility to use only RAP meeting an industry standard and not contain any materials or compounds (such as rubber or plastics) that would cause additional pollution or odors when added to the HMA drum. Require applicant to maintain records from the suppliers certifying each batch or load of RAP. If the RAP is found to be contaminated, not clean, or substandard, then require the permit for the use of RAP to be withdrawn and the stockpiles and RAP equipment removed from the property.

18. Property lighting will cause light pollution at night.

    Action Requested: Require all outside lighting to be covered and directed downward with shields.

19. In the draft permit for NSPS monitoring requirements, DAQ is requiring the permittee to perform monthly periodic inspections to check that water is flowing to discharge spray nozzles in wet suppression systems. Monthly is too long a period between inspections. Faulty nozzles could allow emissions for weeks without being detected.

    Action Requested: At a minimum, require weekly inspections.

20. Limit the amount of asphalt produced to a daily amount based on the 500,000 tons per consecutive 12-month period, the expected operating schedule of 6 day/wk, and 50 wk/yr, and the percentage annual throughput. Production should not exceed 1,667 tons per day at any time during the year.

    Action Requested: Require a daily maximum to ensure the facility did not exceed the 12-month asphalt production limit and therefore not exceed SO2 and CO emission limits. Require the permittee to record daily as well as monthly and total annual amount [tons] of asphalt produced.

21. Limit noise, traffic, odor, and fugitive dust in the surrounding community.

    Action Requested: Restrict the hours per day, days per week, and weeks per year to the expected operating schedule. Do not allow nighttime or early morning operations (i.e., no operations from 8PM to 8AM).

22. Diesel trucks are expected to line up and idle awaiting loadout throughout the day. Loaders are expected to operate continuously. The emissions from all the vehicles will add to the emissions of the facility and should be considered. After all, these vehicles are concentrated at this site because of the facility.

    Action Requested: Evaluate and include emission from vehicles – dump trucks, delivery vehicles, loaders, and worker vehicles – into the facility wide estimates.

23. Employ audit methods to confirm asphalt and concrete production and emissions other than just reviewing permittee's logs.

Action Requested: Audit sales receipts, contracts, invoices, and fuel and cement purchases to confirm asphalt and concrete production and emissions.

24. For the fabric filter requirements in the draft air permit, the permittee shall perform periodic inspections and maintenance as recommended by the equipment manufacturer. No manufacturer's recommendations were provided in the materials for public review. The baghouses are extremely important because they are the primary filter for particulate matter.

    Action Requested: Obtain, review, and mandate manufacturer inspections and maintenance recommendations. Add additional requirements if the manufacturer recommendations are inadequate.

25. The draft permit states if the facility does not use wet suppression to control emissions, the Permittee shall repeat the NSPS performance tests within five (5) years of the previous test. If the facility uses an upstream wet suppression to control fugitive emissions, then the facility is exempt from the 5-year repeat testing requirement. The applicant doesn't state the facility will use wet suppression or use upstream wet suppression, so it is unclear whether the performance tests will be required to be repeated every 5 years.

    Action Requested: Require the applicant to identify the systems, equipment, processes, and procedures to control emissions and then determine whether subsequent performance tests will be required.

26. DAQ intends to permit Carolina Sunrock LLC to produce 5 toxic air pollutants (TAPs) - formaldehyde, mercury, nickel, arsenic, and benzene - at rates significantly higher than their permitting emission rates (TPERs) by scaling up TAPs to their acceptable ambient levels (AALs). As an example, Carolina Sunrock estimated they will pollute a total of 198 pounds per year of benzene from the entire facility, however, DAQ is drafting a permit to allow them to pollute 854 pounds per year from just the asphalt drum. Allowing the facility to pollute over four times more than they estimated does not improve the outdoor air quality of North Carolina or protect its citizens. DAQ should not permit toxic chemicals at these high rates and should restrict them as much as possible to protect the environment and our citizens. Workers, visitors, inspectors, animals, and the environment inside the property boundary will be exposed to high levels of these 5 TAPs above what is known to be healthy especially during climatic conditions such as inversions.

    Action Requested: Only allow emission rates of TAPs, HAPs, and PM to what was calculated and not scaled up. Mandate the use of personal protective equipment (PPE) and proper respiratory equipment to negate this exposure for use by anyone on the property.

27. DAQ intends to permit Carolina Sunrock LLC to produce benzene at a rate significantly higher than its permitted emission rate (TPER) by scaling up the emission to its acceptable ambient level (AAL). That basically means that the level of benzene will be greater than what has been determined healthy within the property boundary. The modeling of benzene

dispersion does not consider all benzene emitting sources at the facility such as from dump trucks, delivery vehicles, loaders, and worker vehicles. Diesel trucks are expected to line up and idle awaiting loadout throughout the day. Loaders are expected to operate continuously. The emissions from all the vehicles will add to the emissions of the facility and may cause the AAL of benzene to be exceeded at the property boundary.

Action Requested: Evaluate all emitting sources of benzene and include in modeling to determine if the level is truly acceptable.

28. The air permit application should be denied because the facility will be releasing benzene at higher concentrations than are considered healthy (above TPER). Benzene causes cancer and is unacceptable at any level. According to the Center for Disease Control (CDC) – "Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death.

    The major effect of benzene from long-term exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection.

    Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries, but we do not know for certain that benzene caused the effects. It is not known whether benzene will affect fertility in men.

    Long-term exposure to high levels of benzene in the air can cause leukemia, particularly acute myelogenous leukemia, often referred to as AML. This is a cancer of the blood forming organs. The Department of Health and Human Services (DHHS) has determined that benzene is a known carcinogen. The International Agency for Research on Cancer (IARC) and the EPA have determined that benzene is carcinogenic to humans.

    Children can be affected by benzene exposure in the same ways as adults. It is not known if children are more susceptible to benzene poisoning than adults.

    Benzene can pass from the mother's blood to a fetus. Animal studies have shown low birth weights, delayed bone formation, and bone marrow damage when pregnant animals breathed benzene."

    Action Requested: Deny the air permit because the facility will be releasing benzene at higher concentrations than are considered healthy.

29. The air permit application should be denied because the facility will be releasing arsenic at higher concentrations than are considered healthy (above TPER). Industrial emission of

arsenic is unacceptable at any level. According to CDC – "Inhalation of inorganic arsenic may cause respiratory irritation, nausea, skin effects, and increased risk of lung cancer.

Acute high dose oral exposure to inorganic arsenic may cause nausea, vomiting, diarrhea, cardiovascular effects and encephalopathy.

Long term oral exposure to low levels of inorganic arsenic may cause dermal effects (such as hyperpigmentation and hyperkeratosis, corns and warts) and peripheral neuropathy characterized by a numbness in the hands and feet that may progress to a painful "pins and needles" sensation. There may also be an increased risk of skin cancer, bladder cancer, and lung cancer.

Oral exposure to MMA may result in gastrointestinal damage. Kidney effects may be observed following chronic exposure.

Chronic oral exposure to DMA may result in urinary bladder and kidney effects.

Children who are exposed to high levels of arsenic exhibit symptoms similar to those seen in adults, including cardiovascular, dermal, and neurological effects, and vomiting following ingestion.

There is some evidence that metabolism of inorganic arsenic in children is less efficient than in adults."

Action Requested: Deny the air permit because the facility will be releasing arsenic at higher concentrations than are considered healthy.

30. The air permit application should be denied because the facility will be releasing formaldehyde at higher concentrations than are considered healthy (above TPER). Formaldehyde causes cancer and industrial emission is unacceptable at any level. According to CDC – "Nasal and eye irritation, neurological effects, and increased risk of asthma and/or allergy have been observed in humans breathing 0.1 to 0.5 ppm. Eczema and changes in lung function have been observed at 0.6 to 1.9 ppm.

    Decreased body weight, gastrointestinal ulcers, liver and kidney damage were observed in animals orally exposed to 50–100 milligrams/kilogram/day (mg/kg/day) formaldehyde.

    The Department of Health and Human Services (HHS) determined in 2011 that formaldehyde is a known human carcinogen based on sufficient human and animal inhalation studies.

    A small number of studies have looked at the health effects of formaldehyde in children. It is very likely that breathing formaldehyde will result in nose and eye irritation. We do not know if the irritation would occur at lower concentrations in children than in adults.

There is some evidence of asthma or asthma-like symptoms for children exposed to formaldehyde in homes."

Action Requested: Deny the air permit because the facility will be releasing formaldehyde at higher concentrations than are considered healthy.

31. The air permit application should be denied because the facility will be releasing mercury at higher concentrations than are considered healthy (above TPER). Mercury emission is unacceptable at any level. According to CDC – "Inorganic mercury (metallic mercury and inorganic mercury compounds) enters the air from mining ore deposits, burning coal and waste, and from manufacturing plants.

    It enters the water or soil from natural deposits, disposal of wastes, and volcanic activity.

    Methylmercury may be formed in water and soil by small organisms called bacteria.

    Methylmercury builds up in the tissues of fish. Larger and older fish tend to have the highest levels of mercury.

    The nervous system is very sensitive to all forms of mercury. Methylmercury and metallic mercury vapors are more harmful than other forms, because more mercury in these forms reaches the brain. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems.

    Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation.

    There are inadequate human cancer data available for all forms of mercury. Mercuric chloride has caused increases in several types of tumors in rats and mice, and methylmercury has caused kidney tumors in male mice. The EPA has determined that mercuric chloride and methylmercury are possible human carcinogens.

    Very young children are more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and may accumulate there. It can also can pass to a nursing infant through breast milk. However, the benefits of breast feeding may be greater than the possible adverse effects of mercury in breast milk.

    Mercury's harmful effects that may be passed from the mother to the fetus include brain damage, mental retardation, incoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage."

Action Requested: Deny the air permit because the facility will be releasing mercury at higher concentrations than are considered healthy.

32. The air permit application should be denied because the facility will be releasing nickel at higher concentrations than are considered healthy (above TPER). Nickel emission is unacceptable at any level. According to CDC – "The most commonly reported adverse health effect associated with nickel exposure is contact dermatitis.

    After an individual is sensitized to nickel, dermal contact with small amount of nickel or oral exposure to fairly low doses can result in dermatitis. Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

    Approximately 10–20% of the general population is sensitized to nickel.

    Lung inflammation is the predominant noncancerous respiratory effect.

    The toxicity of nickel in the respiratory tract appears to be related to solubility of the individual nickel compounds with soluble nickel compounds being the most toxic.

    Atrophy of the nasal epithelium has been observed following exposure to soluble nickel compounds.

    Nickel compounds are considered human carcinogens and metallic nickel is possibly a human carcinogen.

    Decreased survival has been observed in the offspring of rats exposed to nickel in drinking water.

    It is not known if children are more susceptible to nickel poisoning than adults"

    Action Requested: Deny the air permit because the facility will be releasing nickel at higher concentrations than are considered healthy.

33. Fires at asphalt plants do happen and are not uncommon. They are real possibilities due to the high temperatures required for the asphalt mix and asphalt cement. These temperatures can approach or exceed the flash points of the products where a source of ignition will cause the vapors produced to catch on fire. Case in point is the fire at an asphalt plant in Statesville, NC on Aug 5, 2019. More than 15 different agencies responded. Flames leaped 50 feet into the air and smoke could be seen billowing for miles. The smoke is presumed to contain many toxic and hazardous air pollutants well above TPER thresholds that would be an immediate danger to human and animal health.

    Action Requested: Require a fire prevention plan, a fire safety plan, a firefighting plan, an emergency response plan, and an evacuation plan that includes neighboring properties. Have local fire and sheriff departments review and approve the plans since they would be

the ones to respond. Require the applicant to provide the surrounding community with the evacuation plan in the event of a fire.

34. Form D1 is not correct and has not been updated. Form D1 is the key/primary form in the entire application that summarizes the facility wide pollutants. The form lists 28.88 tons of particulate matter (PM) per year and the DAQ review lists 38.05 tons of PM. The quantity in the form and in the review should match.

    Action Requested: Require the applicant to revise Form D1 with the correct information. Explain why the applicant wasn't required to correct or update key forms in the application.

Thank you for this opportunity to comment.

Respectfully submitted,
Phil Barfield

From: Phil
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock – Burlington North
Date: Tuesday, September 21, 2021 6:02:31 AM

DAQ,

I am submitting my comments below that I prepared for the Sept 20 public hearing. They are a full rather than the condensed version of what was given at the hearing due to the shortened time we were allowed to speak.

Thank you,
Phil Barfield

==========

Comments for the 6PM, September 20, 2021 Public Hearing for Carolina Sunrock LLC Proposed Air Quality Permit – Burlington North:

The Division of Air Quality mission statement is "***to protect and improve the outdoor air quality of North Carolina. DAQ works with the state's citizens to protect and improve outdoor, or ambient, air quality in North Carolina for the health, benefit and economic well-being of all.***"

I request DAQ to do just that and deny this air permit application from Carolina Sunrock.

I come here tonight very concerned. The applicant is suing 55 neighbors when they exercised their right to object to a local permit that was issued by our county Planner. The lawsuit is seen as intimidation and has had a chilling effect on people wanting to come forward and speak out against the projects.

As I and others have pointed out in previous submitted comments, the application is incomplete, contains errors, has contradicting information, and omits critical information for review. Also, it has substantially changed since original submission through revision after revision. DAQ should demand an accurate, complete application from Carolina Sunrock.

Carolina Sunrock is planning to come into our county with 3 asphalt plants, 3 truck mix concrete batch plants, and a 630-acre rock quarry site. The planned activities will pollute our air, our land, and our water with particulate matter and toxic chemicals. Some chemicals will be released from smokestacks at toxic levels higher than considered healthy for humans and will require DAQ permits to do so. Carolina Sunrock is requesting permission to pollute these toxic chemicals at maximum rates that are much higher than they will produce to, and I quote, "***afford the facility operational flexibility***." As an example, Carolina Sunrock estimated they will pollute a total of 198 pounds per year of benzene from the entire facility, however, you are drafting a permit to allow them to pollute 854 pounds per year from just the asphalt drum. Allowing the facility to pollute over four times more than they estimated does not improve the outdoor air quality of North Carolina or protect its citizens. DAQ should not permit toxic

chemicals at these high rates and should restrict them as much as possible to protect the environment and our citizens.

If not denied, DAQ should not take any further action on this application until after a court ruling in the lawsuit. If the applicant loses, our county's new development ordinance will apply and will affect the location and configuration of the projects. If they can meet the new ordinance requirements for this project, then they will need to submit a new air permit application.

Thank you for the opportunity to voice my concerns.

Phil Barfield

From:	william Compton
To:	SVC_DENR.DAQ.publiccomments
Cc:	Rev Bryon Shoffner; Anita Foust99; Dawn
Subject:	[External] Re: Carolina Sunrock- Burlington North- Public Comments
Date:	Monday, September 20, 2021 4:27:27 PM

CAUTION: External email. Do not click links or open attachments unless you verify. Send all suspicious email as an attachment to Report Spam.<mailto:report.spam@nc.gov>

> On Sep 20, 2021, at 4:13 PM, william Compton <comptoncountry@me.com> wrote:
>
> Hello,
> My name is William Compton and my wife and I live at 12068 S. NC Hwy 62, near the proposed site called "Burlington South" Asphalt/Concrete.
> I live in the Anderson Community and me and my family would be directly affected by the emissions from this proposed operation.
> I am currently under medical care at Duke for IPF, advanced Pulmonary Fibrosis, Atrial Fibrillation, Irregular Heart Beats, and High Blood pressure.
> A recent Health Assessment by UNC and the NCIPH found that 77% of our Anderson residents have formally diagnosed chronic illnesses, and 48% of residents have three or more chronic illnesses, like me.
> Studies have shown that Asphalt plants produce harmful chemicals, like Benzenes, and airborne particles called Particulate Mater (PM, PM2.5), which cause many negative effects on Pulmonary and Cardiovacular systems, which could kill many of us in the Anderson community.
> Please see studies by the University of Alberta, and by the Blue Ridge Environmental Defense League to verify these negative effects.
>
> We can not afford to have this polluting industry threaten our health even more.
> Please protect the health of our community and STOP the plant, and DO NOT PERMIT them to KILL us.
> Thank you.
>

From:	william Compton
To:	SVC_DENR.DAQ.publiccomments
Cc:	Bill Compton; Rev Bryon Shoffner; Anita Foust99; Dawn
Subject:	[External] Sunrock- Burlington North- Public Comments
Date:	Monday, September 20, 2021 4:15:17 PM

Hello,
My name is William Compton and my wife and I live at 12068 S. NC Hwy 62, near the proposed site called "Burlington South" Asphalt/Concrete.
I live in the Anderson Community and me and my family would be directly affected by the emissions from this proposed operation.
I am currently under medical care at Duke for IPF, advanced Pulmonary Fibrosis, Atrial Fibrillation, Irregular Heart Beats, and High Blood pressure.
A recent Health Assessment by UNC and the NCIPH found that 77% of our Anderson residents have formally diagnosed chronic illnesses, and 48% of residents have three or more chronic illnesses, like me.
Studies have shown that Asphalt plants produce harmful chemicals, like Benzenes, and airborne particles called Particulate Mater (PM, PM2.5), which cause many negative effects on Pulmonary and Cardiovacular systems, which could kill many of us in the Anderson community.
Please see studies by the University of Alberta, and by the Blue Ridge Environmental Defense League to verify these negative effects.

We can not afford to have this polluting industry threaten our health even more.
Please protect the health of our community and STOP the plant, and DO NOT PERMIT them to KILL us.
Thank you.

From: K L TATE
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Sunrock Burlington-North
Date: Monday, September 20, 2021 1:33:34 PM

My name is Karen Tate Gray. I am requesting that the Division of Air Quality deny the most recent air permit that Carolina Sunrock has submitted for the Burlington North Asphalt Plant site.

To begin, this company has sued residents of the area who voiced their objection to a local permit that was issued to the company. This can be seen as an effort to intimidate residents from expressing their concerns about the negative impact that the asphalt plant will have on the quality of life in this community. No permit should be issued to Carolina Sunrock prior to the outcome of the lawsuit that Sunrock has initiated. Only after that suit has been settled should the DAQ consider any permits and only, if at that time, the company meets criteria put forth by the county.

The location of this site is adjacent to the homes of many who have health issues and no means to relocate. The health of these individuals can be negatively impacted by the toxicity of the chemical levels expelled by the the plant. The present application has the same level of nitrogen oxide that caused the permit to be denied previously. It appears that the level of benzene and arsenic emitted will be greater than what has been determined healthy. These are just a few of the examples of chemicals that can have a negative impact on those that live in proximity to the site.

Not only will this plant negatively impact those adjacent to the site, but also the community. This will negatively affect the air quality. It will add to, not only air pollution, but also noise pollution and impact the traffic in the area as the truck traffic will increase significantly. There is the issue of fugitive dust from the trucks as well as exhaust that is emitted while traveling and also while waiting for loads. There will also be light pollution in the area of the facility. These issues will disrupt not only the lives of the residents in the community but also the wildlife in the area. I see no positives from having this plant in our community.

My concern is that not only is Sunrock planning this plant, but they are planning for at least one more plant and a rock quarry in the same general vicinity. This heightens the negative impact on air and water quality of the area.

Again, I am requesting that you again deny the air quality permit to Carolina Sunrock for the Burlington North Asphalt Plant due to an ongoing lawsuit initiated by Sunrock against residents of the community and due to the fact that they have not sufficiently made changes to their original application that will protect surrounding areas and the community from high levels of toxic chemicals being emitted into our air.

Thank you for considering my request.

From: Caroline Long
To: SVC_DENR.DAQ.publiccomments
Cc: Mary.Lee@ncleg.gov; mary.lee@ncleg.gov; Veronica.Green@ncleg.gov; veronica.green@ncleg.gov; Robert.Reives@ncleg.gov; robert.reives@ncleg.gov; Ann.Raeford@ncleg.gov; ann.raeford@ncleg.gov; Kelly.Alexander@ncleg.gov; kelly.alexander@ncleg.gov; Emily.Hagstrom@ncleg.gov; emily.hagstrom@ncleg.gov; Vernetta.Alston@ncleg.gov; vernetta.alston@ncleg.gov; Tina.Riley-Humphrey@ncleg.gov; tina.riley-humphrey@ncleg.gov; John.Autry@ncleg.gov; john.autry@ncleg.gov; Edward.Sheehy@ncleg.gov; edward.sheehy@ncleg.gov; Kandie.Smith@ncleg.gov; kandie.smith@ncleg.gov; Charles.Graham@ncleg.gov; charles.graham@ncleg.gov; Brandon.Combs@ncleg.gov; brandon.combs@ncleg.gov; Caroline.Enloe@ncleg.gov; caroline.enloe@ncleg.gov; Linda.Cooper-Suggs@ncleg.gov; linda.cooper-suggs@ncleg.gov; Allison.Dahle@ncleg.gov; allison.dahle@ncleg.gov; Anne.Evangelista@ncleg.gov; anne.evangelista@ncleg.gov; Susan.Fisher@ncleg.gov; susan.fisher@ncleg.gov; Samantha.Saunders@ncleg.gov; samantha.saunders@ncleg.gov; Rosa.Gill@ncleg.gov; rosa.gill@ncleg.gov; Lisa.Ray@ncleg.gov; lisa.ray@ncleg.gov; Wilson.Brown@ncleg.gov; wilson.brown@ncleg.gov; Wesley.Harris@ncleg.gov; wesley.harris@ncleg.gov; Anita.Wilder@ncleg.gov; anita.wilder@ncleg.gov; Zack.Hawkins@ncleg.gov; zack.hawkins@ncleg.gov; Arianna.Alvarez@ncleg.gov; arianna.alvarez@ncleg.gov; Ricky.Hurtado@ncleg.gov; ricky.hurtado@ncleg.gov; Young.Bae@ncleg.gov; young.bae@ncleg.gov; Verla.Insko@ncleg.gov; verla.insko@ncleg.gov; Virginia.Reed@ncleg.gov; virginia.reed@ncleg.gov; Joe.John@ncleg.gov; joe.john@ncleg.gov; Carolyn.Logan@ncleg.gov; carolyn.logan@ncleg.gov; Robert.LockardIII@ncleg.gov; robert.lockardiii@ncleg.gov; Marvin.Lucas@ncleg.gov; marvin.lucas@ncleg.gov; Thelma.Utley@ncleg.gov; thelma.utley@ncleg.gov; Graig.Meyer@ncleg.gov; graig.meyer@ncleg.gov; Grier.Martin@ncleg.gov; grier.martin@ncleg.gov; Daphne.Quinn@ncleg.gov; daphne.quinn@ncleg.gov; Christopher.Hailey@ncleg.gov; christopher.hailey@ncleg.gov; Pamela.Best@ncleg.gov; pamela.best@ncleg.gov; Marcia.Morey@ncleg.gov; marcia.morey@ncleg.gov; Janice.Fenner@ncleg.gov; janice.fenner@ncleg.gov; Garland.Pierce@ncleg.gov; garland.pierce@ncleg.gov; Susan.Thompson@ncleg.gov; susan.thompson@ncleg.gov; Raymond.Smith@ncleg.gov; raymond.smith@ncleg.gov; Hudson.McCormick@ncleg.gov; hudson.mccormick@ncleg.gov; Julie.vonHaefen@ncleg.gov; julie.vonhaefen@ncleg.gov; Martin, Sharon L.; Masemore, Sushma; Nicholson, John A.; customerservice@newsobserver.com; Caroline Long; Carol Johnson
Subject: [External] Cumulative Health Impact Laws to Stop Permit No. 10693ROO in EJ Community?
Date: Monday, September 20, 2021 9:46:16 AM
Attachments: Duke Letter Peggy.pdf
MyChart - Inbox Duke Dr. Yubin Kang.pdf
IHR MGUS peggy.pdf
IHR MGUS Peggy Hemotology.pdf
IHR - Air pollution, oxidative stress, and exacerbation of autoimmune diseases.html
IHR Epidemiology of the plasma-cell disorders - ScienceDirect.pdf
IHR Brian Durie.pdf
IHR benzene and AML.pdf
IHR ASTDR.pdf
IHR Journal of Epidemiology Benzene and Leukemia.pdf
6.21.20 PDF Confidential- Anderson Potential IHR 6.19.2020.pdf

Subject: Air Permit No. 10693R00

Burlington North Burlington (Known as Anderson Community), Caswell County, North Carolina
Permit Class: Synthetic Minor
Facility ID# 1700016

Caroline Laur:

I am requesting that the Burlington North Permit be denied due to conformity with Subchapter 01C, NCEAP regulations in conformity with Cumulative Health Impacts risk. Anderson Community is an EJ community.

Attached please find the health records for Caroline Laur. Caroline Laur owns 12671 NC HWY Burlington North Carolina; adjacent to Burlington North - Air Permit No. 10693R00. The proposed facility is 190 feet from the home to the property line of the proposed Pollutant

facility.

Duke Stem Cell Cancer Center diagnosed me with a rare blood disease know as MGUS (monoclonal gammopathy of undermine significance), a premalignant condition that carries a high risk of transformation to Multiple Myeloma or other lymphoproliferater disorders. There are many scientific studies that demonstrating the association between several of the chemicals listed on NCDAQ draft permit No. 10693ROO - Burlington North and my illness. Multiple Myeloma is a rare and painful cancer that there is no known cure for, terminal. (See the attached letters: Duke Cancer Center, Duke Scholar, and Scientific Research.) The International Foundation of Multiple Myeloma also published news articles and scientific evidence to substantiate my concerns. This email is not meant to be an inclusive scientific research study of my health risk, but a small sample go substantiate my cumulative health concerns. I am not a lawyer, scientist, or large governmental health agency that is qualified to gather this type of data.

And there are 101 others citizens in our EJ community like me; having overburden illnesses within a 1 mile radius. (See attached community health survey)

Isn't this known as Cumulative Health Impact risk?

North Caroline Environmental Protection Act: Subchapter 01C

SUBCHAPTER 01C - CONFORMITY WITH NORTH CAROLINA ENVIRONMENTAL POLICY ACT SECTION .0101 – GENERAL PROVISIONS

15A NCAC 01C .0101 STATEMENT OF PURPOSE, POLICY, AND SCOPE

(a) The purpose of the rules in this Subchapter is to establish procedures within the Department of Environment and Natural Resources (DENR) for conforming with the North Carolina Environmental Policy Act (NCEPA).
(b) Rules for implementation of the NCEPA (01 NCAC 25) are hereby incorporated by including subsequent amendments and editions. Copies of these Rules can be obtained from the Department of Administration, State Clearinghouse, 1302 Mail Service Center, Raleigh, NC 27699-1302.

(c) Environmental documents shall be available to public officials and citizens before decisions are made and before actions are taken. The information shall be reliable and sufficient to allow selection among alternatives.
(d) The Secretary is the "responsible state official" for DENR. The Secretary may delegate responsibility for the implementation of the NCEPA to staff.

(e) The provisions of the rules in this Subchapter, the state rules (01 NCAC 25), and the NCEPA shall be read together as a whole in order to comply with the spirit and letter of the law.

(f) These Rules establish the procedures for determining whether an environmental document is required when DENR is the State Project Agency.

History Note: Authority G.S. 113A-2; 113A-6; 113A-9; 143B-10; Eff. August 1, 1989;

Transferred from T15.01D .0201 Eff. November 1, 1989;

Amended Eff. April 1, 2003; August 1, 1996; March 1, 1990.

15A NCAC 01C .0102 AGENCY COMPLIANCE

History Note: Authority G.S. 113A-2; 113A-5; 113A-6; 113A-10; 143B-10; Eff. August 1, 1989;

Transferred from T15.01D .0202 Eff. November 1, 1989; Amended Eff. March 1, 1990;
Repealed Eff. April 1, 2003.

15A NCAC 01C .0103 DEFINITIONS

The definition of any word or phrase used in rules of this Subchapter is the same as given in G.S. 113A-9 and in 1 NCAC 25, including subsequent amendments and editions. The following words and phrases have the following meaning.

(1) "Agency" means the Divisions and Offices of DENR, as well as the boards, commissions, committees, and councils of DENR having decision-making authority and adopting these rules by reference; except where the context clearly indicates otherwise.

(2) "Channel Disturbance" means activities that permanently remove or degrade the natural functions of the stream such as culverting, relocation, channelization or streambank stabilization methods including gabions, rip rap or similar hard structures.

(3) "Cumulative Impacts" mean environmental impacts resulting from incremental effects of an activity when added to other past, present, and reasonably foreseeable future activities regardless of what entities undertake such other actions. Cumulative impacts are the reasonably foreseeable impacts from individually minor but collectively significant activities.

(4) "Direct Impacts" mean environmental impacts which are caused by an activity and occurring at the same time and place.

(5) "Disposal" means the discharge, deposit, injection, dumping, spilling, leaking or placing of any waste into or on any land or water so that the waste or any constituent part of the waste may enter the environment or be emitted into the air or discharged into any waters, including groundwaters, or beneath or on the surface of the land.

(6) "Ecosystem" means all the interrelated organisms and their environment within a defined area.

(7) "Forestry Management Plan" means a document that guides the practical and sustainable application of biological, physical, quantitative, managerial, economic, social and policy principles to the regeneration, management, utilization and conservation of forests to meet specified goals and objectives while maintaining the productivity of the forest. Forest management includes management

for aesthetics, fish, recreation, urban values, water, wilderness, wildlife, wood products and other

forest resource values.

(8) "Hazardous Waste" means a waste, or combination of wastes, in any state or form including gas, liquid

or solid, that because of its quantity, concentration or physical, chemical or infectious characteristics may cause or contribute to an increase in mortality or an increase in irreversible or incapacitating reversible illness, or pose a present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of or otherwise managed.

(9) "High Quality Waters (HQW)" means a subset of waters with quality higher than the existing classification standards. These include those rated as excellent based on biological and physical/chemical characteristics through Division of Water Quality monitoring or special studies; native and special native trout waters (and their tributaries) designated by the Wildlife Resources Commission; primary nursery areas (PNA) designated by the Marine Fisheries Commission and other functional nursery areas designated by the

Marine Fisheries Commission; all water supply watersheds which are either classified as WS-I or WS-II or those for which a formal petition for reclassification as WS-I or WS-II has been received from the appropriate local government and accepted by the Division of Water Quality; and all Class SA waters.

(10) "Inlet" means a waterway between islands connecting a lagoon, estuary, sound or similar water body with the ocean.

(11) "Instream Flow" means the amount of water needed in a stream to adequately provide for downstream uses occurring within the stream channel, including some or all of the following: aquatic habitat, recreation, wetlands maintenance, navigation, hydropower, riparian vegetation, and water quality.

(12) "Land-Disturbing Activity" means any use of the land by any person in residential, industrial, educational, institutional or commercial development, highway and road construction and maintenance that results in a change in the natural cover or topography and that may cause or contribute to sedimentation.

(13) "Lead Agency" means the agency or agencies preparing or having taken primary responsibility for preparing an environmental document. The lead agency is a sub-agency of the state project agency.

(14) "Non-State Entity" means local governments, special purpose units of government, contractors, and

individuals or corporations to whom NCEPA may apply.

(15) "Perennial Stream" means a channel that contains water year round during a year of normal rainfall

with the aquatic bed located below the water table for most of the year. Groundwater is the primary source of water for a perennial stream, but it also carries stormwater runoff. A perennial stream exhibits the typical biological, hydrological, and physical characteristics commonly associated with the continuous conveyance of water.

(16) "Prime agricultural and forest land" means lands which possess the best combination of physical and chemical characteristics for producing food, feed, fiber (including forest products), forage, oilseed, and other agricultural products (including livestock), without intolerable soil erosion. This does not apply to lands which are already in or committed to development projects such as water impoundment, transportation, and urban development.

(17) "Reclaimed Water Utilization" means the use of reclaimed water that meets the criteria provided in 15A NCAC 02H .0219(k) for beneficial uses in lieu of water from other sources.

(18) "Resource" means any natural product or value, not necessarily economic, but including trees, minerals, wildlife, clean air and water, fisheries, ecosystems, landscapes and open space.

(19) "River Basin" means the watershed of a major river system.

(20) "Secondary Impacts" mean indirect impacts caused by and resulting from a specific activity that occur

later in time or further removed in distance than direct impacts, but are reasonably foreseeable. Indirect impacts may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

(21) "Secretary" means the Secretary of DENR.

(22) "State Project Agency" means the state department or council of state agency which has been

designated pursuant to 1 NCAC 25 .0210(a) for ensuring compliance with NCEPA.

(23) "Stream Enhancement" means the process of implementing stream rehabilitation practices in order to

improve water quality or ecological function. These practices are typically conducted on the stream

(24)

(25) (26)

History Note:

bank or in the flood prone area. Enhancement activities may also include the placement of in-stream habitat structures.
"Stream Restoration" means the process of converting an unstable, altered or degraded stream corridor, including adjacent riparian zone and flood prone areas to its natural or referenced, stable conditions considering recent and future watershed conditions. This process also includes restoring the geomorphic dimension, pattern and profile as well as biological and chemical integrity, including transport of water and sediment produced by the stream's watershed in order to achieve dynamic equilibrium.

"Total Design Withdrawal" means the pumping rate at which water can be removed from the contributing stream. It is the sum of any pre-existing withdrawal capacity plus any withdrawal increase.
"Wetlands" mean "wetlands" as defined in 15A NCAC 02B .0202.

Authority G.S. 113A-2; 113A-6; 113A-9; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0104 AGENCY COMPLIANCE

(a) Each DENR agency shall interpret the provisions of the NC EPA as a supplement to its existing authority and as a mandate to view its policies and programs in the light of the NC EPA's comprehensive environmental objectives, except where existing law applicable to the DENR agency's operations expressly prohibits compliance or makes compliance impossible.

(b) As part of making a decision on a project for which an environmental document has been prepared, the DENR agency decision-maker shall review the document and incorporate it as part of continuing deliberations. The resulting decision shall be made after weighing all of the impacts and mitigation measures presented in the environmental document, which shall become part of the decision-making record.

History Note: Authority G.S. 113A-2; 113A-5; 113A-6; 113A-10; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0105 LEAD AND COOPERATING AGENCY RESPONSIBILITY

Where DENR is the State Project Agency and more than one DENR agency must issue a permit or other authorization for the project requiring review under NCEPA, the Secretary shall appoint a lead DENR agency to be responsible for issuance of the environmental document. The lead and cooperating DENR agencies' responsibilities shall be established by the Secretary.

History Note: Authority G.S. 113A-2; 113A-4; 113A-6; 113A-7; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0106 SCOPING AND HEARINGS

DENR agencies shall utilize scoping and hearing processes in their NCEPA activities to the extent appropriate to the complexity, potential for environmental effects, and level of expressed interest associated with the proposed activity. Scoping and hearing processes are public processes designed to determine the types of environmental issues to be addressed in environmental documents. They are open processes intended to obtain the view of other agencies and the public in order for state agencies to make informed decisions.

History Note: Authority G.S. 113A-2; 113A-4; 113A-6; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0107 LIMITATION ON ACTIONS DURING NCEPA PROCESS

(a) While work on an environmental document is in progress, no DENR agency shall undertake in the interim any action which might limit the choice among alternatives or otherwise prejudice the ultimate decision on the issue. A permit approval or other action to approve land disturbing activity or construction of part of the project or action, other than those actions necessary for gathering information needed to prepare the environmental document, limits the choice among alternatives and shall not be approved until the final environmental document for the action is published in the Environmental Bulletin pursuant to 01 NCAC 25 .0212 and adopted by the DENR agency through the procedures

established by the Department of Administration's Rules for administering NC EPA and this Subchapter of the Department's rules.
(b) If a DENR agency is considering a proposed action for which an environmental document is to be or is being prepared, the DENR agency shall promptly notify the initiating party that the DENR agency cannot take final action until the environmental documentation is completed and available for use as a decision-making tool. The notification shall be consistent with the statutory and regulatory requirements of the DENR agency and may be in the form of a notification that the application is incomplete.

(c) When a DENR agency decides that a proposed activity, for which state actions are pending or have been taken, requires environmental documentation then the DENR agency shall promptly notify all DENR action agencies of the decision. When statutory and regulatory requirements prevent a DENR agency from suspending action, the DENR agency shall deny any action for which it determines an environmental document is necessary but not yet available as a decision-making tool.

History Note: Authority G.S. 113A-2; 113A-4; 113A-6; 113A-7; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0108 EMERGENCIES

(a) Where emergency circumstances make it necessary to take an otherwise lawful action with potential environmental effects without observing the public review provisions of the NC EPA, the DENR agency taking the action shall notify the Secretary and limit actions to those necessary to control and mitigate for the immediate threat to the public health, safety, and welfare.

(b) DENR agencies may prepare and maintain environmental documents for repetitive emergency programs affecting the public, to review the scope of involved activities, identify specific effects to be expected, and mitigation measures that can be employed in various circumstances to assure protection of the public and long-term environmental productivity. (c) The minimum criteria established pursuant to Section .0400 of this Subchapter or the review processes for environmental assessments or environmental impact statements set out in Rules 01 NCAC 25 .0506 and .0605, may be altered where an emergency makes it necessary to take action or control or mitigate any threat to the public health, safety and welfare caused by the emergency. Rule 01 NCAC 25 .1002 establishes the procedures to supplement the provisions of this Chapter in an emergency consistent with the policies of NC EPA.

History Note: Authority G.S. 113A-4; 113A-6; 113A-7; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0109 NON-STATE INVOLVEMENT AND CONSULTANTS

(a) If a lead DENR agency requires a non-state entity to submit environmental information for use by the DENR agency in preparing an environmental document for the non-state entity's activity, then the DENR agency shall assist by outlining the types of information requested. The DENR agency shall independently evaluate the information provided and shall be responsible for its accuracy.

(b) If a lead DENR agency permits a non-state entity to prepare an environmental document, the lead DENR agency shall furnish guidance and participate in the preparation, and take responsibility for its scope, objectivity, content, and accuracy.
(c) An environmental document may be prepared by a consultant.

(d) The Environmental Assessment Guidance Document available through the State Clearinghouse and Rules 01 NCAC 25 .0400 through .1000 offer guidance in preparing environmental documents.

History Note: Authority G.S. 113A-4; 113A-5; 113A-6; 113A-9; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0201 15A NCAC 01C .0202 15A NCAC 01C .0203 15A NCAC 01C .0204

SECTION .0200 - INTEGRATION WITH AGENCY ACTIVITY

EARLY APPLICATION OF THE NCEPA
WHEN TO PREPARE ENVIRONMENTAL DOCUMENTS LEAD AND COOPERATING AGENCY RESPONSIBILITY SCOPING AND HEARINGS

History Note: Authority G.S. 113A-2; 113A-4; 113A-6; 113A-7; 113A-8; 113A-9; 143B-10; Eff. August 1, 1989;

Transferred from T15.01D .0301; .0302; .0303; .0304 Eff. November 1, 1989; Amended Eff. March 1, 1990; Repealed Eff. April 1, 2003.

15A NCAC 01C .0205 IMPLEMENTATION

DENR agencies shall prepare environmental documents in accordance with the NC EPA, its related rules at 01 NCAC 25, and the rules in this Subchapter. As set out in Rule .0109 of this Subchapter, consultants may prepare environmental documents.

History Note: Authority G.S. 113A-2; 113A-4; 113A-5; 113A-6; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0206 WHEN TO PREPARE ENVIRONMENTAL DOCUMENTS

(a) DENR agencies shall prepare an environmental assessment in accordance with the NC EPA and the related state rules at 01 NCAC 25 for those activities described in Section .0300 of this Subchapter, and for those activities above the thresholds set in DENR's minimum criteria described in Section .0400 of this Subchapter.
(b) An environmental assessment is not necessary if a DENR agency has decided to prepare an environmental impact statement, because the scope or complexity of the activity has a clear potential for environmental effects.

(c) DENR agencies shall insure that the activity that is the subject of the environmental document is properly defined. Closely connected activities should be reviewed together. Closely connected activities include:

(1) (2)

(3)

History Note:

activities that automatically trigger other activities that may require environmental impact statements; activities that cannot or will not proceed unless other activities occur either previously or simultaneously; and
activities that are interdependent parts of a larger plan of development and depend on the larger plan of development for justification.

Authority G.S. 113A-2; 113A-4; 113A-6; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0207 INCORPORATION BY REFERENCE

(a) DENR agencies shall incorporate material into environmental documents by reference to cut down on bulk without impeding DENR agency and public reviews of the action. The incorporated material shall be cited in the document and its contents briefly described.
(b) Incorporated-by-reference material must be made available by the applicant for inspection by reviewers and potentially interested persons within the time allowed for comment.

History Note: Authority G.S. 113A-4; 113A-6; 113A-10; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0208 INCOMPLETE OR UNAVAILABLE INFORMATION

(a) Where a DENR agency is evaluating significant effects upon the environment in an environmental document and there are gaps in relevant information or scientific uncertainty, the DENR agency should always make clear that such information is lacking or that uncertainty exists.
(b) If the information relevant to the effects is essential to a reasonable choice among alternatives and the overall costs of and time for obtaining it are not out of proportion to the potential environmental effects of the activity, the DENR agency should include the information in the environmental document.

(c) If the information relevant to the effects is essential to a reasoned choice among alternatives and the overall cost of and time for obtaining it are out of proportion to the potential environmental effects of the activity, or the means of obtaining it are not known (beyond the state of the art), then the DENR agency shall weigh the need for the action against the risk and severity of possible adverse impacts were the action to proceed in the face of uncertainty. If the DENR agency proceeds, it shall include within the environmental document:

(1) a statement that such information is incomplete or unavailable;

(2) a statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment;

(3) a summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment; and

(4) the DENR agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community.

(d) For the purposes of this Section, "reasonably foreseeable" includes impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason.

History Note: Authority G.S. 113A-4; 113A-6; 143B-10; Eff. April 1, 2003.

SECTION .0300 - PREPARATION OF ENVIRONMENTAL DOCUMENTS

15A NCAC 01C .0301 15A NCAC 01C .0302 15A NCAC 01C .0303

IMPLEMENTATION
INCORPORATION BY REFERENCE
INCOMPLETE OR UNAVAILABLE INFORMATION

History Note: Authority G.S. 113A-2; 113A-4; 113A-5; 113A-6; 113A-10; 143B-10; Eff. August 1, 1989;

Transferred from T15.01D .0401; .0402; .0403 Eff. November 1, 1989; Amended Eff. March 1, 1990;
Repealed Eff. April 1, 2003.

15A NCAC 01C .0304 ACTIVITIES ABOVE THE MINIMUM CRITERIA

Any activity which is outside the parameters of the minimum criteria set out in Section .0400 of this Subchapter is required to have environmental documentation under the NCEPA.

History Note: Authority G.S. 113A-2; 113A-4; 113A-6; 113A-11; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0305 TYPES OF ACTIVITIES REQUIRING ENVIRONMENTAL DOCUMENTATION

The following DENR agency activities will be deemed to have a potential effect upon the environment of the state and require preparation of an environmental document unless they fall under the minimum criteria set out in Section .0400 of this Subchapter.

(1) (2) (3)

(4)

History Note:

Proposed construction of facilities or infrastructures on lands and waters owned or managed by any DENR agency. Specific programs conducted by DENR agencies on lands and waters or in the atmosphere owned or managed by the state.

Demolition of or additions, rehabilitation and/or renovations to a structure listed in the National Register of Historic Places or more than 50 years of age except where agreement exists with the Department of Cultural Resources that the structure lacks architectural or historical significance. Ground disturbances involving National Register listed archaeological sites or areas around buildings 50 years old or older, except where agreement exists with the Department of Cultural Resources.

Authority G.S. 113A-4; 113A-6; 113A-8; 113A-9; 113A-10; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0306 ACTIVITIES OF A SPECIAL NATURE

Any activity falling within the parameters of the minimum criteria set out in Section .0400 of this Subchapter shall not routinely be required to have environmental documentation under the NCEPA. However, an environmental document is required when the Secretary determines that:

(1) the proposed activity may have a potential for significant adverse effects on wetlands; surface waters such as rivers, streams and estuaries; parklands; game lands; prime agricultural or forest lands; or areas

(2)

(3) (4)

History Note:

of local, state or federally recognized scenic, recreational, archaeological, ecological, scientific research or historical value, including secondary impacts; or would threaten a species identified on the Department of Interior's or the state's threatened and endangered species lists; or
the proposed activity could cause changes in industrial, commercial, residential, agricultural, or silvicultural land use concentrations or distributions which would be expected to create adverse water quality, instream flow, air quality, or ground water impacts; or affect long-term recreational benefits, fish, wildlife, or their natural habitats; or

the proposed activity has secondary impacts, or is part of cumulative impacts, not generally covered in the approval process for the state action, and that may result in a potential risk to human health or the environment; or
the proposed activity is of such an unusual nature or has such widespread implications that a concern for its environmental effects has been identified by the DENR agency or expressed to the DENR agency.

Authority G.S. 113A-4; 113A-6; 113A-9; 113A-10; 113A-11; 113A-12; 143B-10; Eff. April 1, 2003.

SECTION .0400 – OTHER REQUIREMENTS

AGENCY DECISION-MAKING PROCEDURES LIMITATION ON ACTIONS DURING NCEPA PROCESS EMERGENCIES
NON-STATE INVOLVEMENT AND CONTRACTORS

15A NCAC 01C .0401 15A NCAC 01C .0402 15A NCAC 01C .0403 15A NCAC 01C .0404

History Note:

Authority G.S. 113A-2; 113A-4; 113A-5; 113A-6; 113A-7; 113A-9; 143B-10; Eff. August 1, 1989;
Transferred from T15.01D .0501; .0502; .0503; .0504 Eff. November 1, 1989; Amended Eff. March 1, 1990;

Temporary Amendment Eff. August 1, 2000; Amended Eff. April 1, 2001;
Repealed Eff. April 1, 2003.

15A NCAC 01C .0405 PURPOSE OF THE MINIMUM CRITERIA THRESHOLDS

(a) This Section establishes minimum criteria to be used in determining when environmental documents are not required. The minimum criteria, as defined in state rules at 01 NCAC 25, shall be used by the Secretary and DENR agencies to provide sound decision-making processes by allowing separation of activities with a high potential for environmental effects from those with only a minimum potential.

(b) The minimum criteria set out in this Section are established to determine when environmental documentation under the NCEPA is not required. An activity must be at or below each applicable minimum criteria threshold to maintain this status. As set out in Rule .0306 of Section .0300, the Secretary may require environmental documentation for activities that would otherwise qualify under these minimum criteria thresholds.

History Note: Authority G.S. 113A-2; 113A-4; 113A-6; 113A-11; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0406 SAMPLING, SURVEY, MONITORING, AND RELATED RESEARCH ACTIVITIES

Sampling, survey, monitoring and research activities do not require the filing of environmental documentation. These activities include, but are not limited to the following:

(1) Aerial photography projects involving the photographing or mapping of the lands of the state;

(2) Biology sampling and monitoring of:

(a) Fisheries resources through the use of traditional commercial fishing gear, electricity, and rotenone; and

(b) Wildlife resources through the use of traditional techniques, including but not limited to traps, drugs, and firearms;

(3) (4) (5) (6)

(7) (8)

(9)

History Note:

Soil survey projects involving the sampling or mapping of the soils of the state;
Establishing stream gaging stations for the purpose of measuring water flow at a particular site; Placement of monitoring wells for the purpose of measuring groundwater levels, quantity, or quality; Gathering surface or subsurface information on the geology, minerals, or energy resources, of the state.
Placement and use of geodetic survey control points;
Other routine survey and resource monitoring activities, or other temporary activities required for research into the environment which do not have adverse effects; and
Investigation and assessment of sites contaminated with regulated substances.

Authority G.S. 113A-4; 113A-6; 113A-9; 113A-10; 113A-11; 113A-12; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0407 STANDARD MAINTENANCE OR REPAIR ACTIVITIES

Standard maintenance or repair activities, if needed to maintain the originally defined function of an existing project or facility (but without expansion, increase in quantity, decrease in quality, use, or release of hazardous waste), do not require the filing of environmental documents. These activities include but are not limited to maintenance and repair of the following:

(1)

(2) (3) (4) (5) (6) (7)

(8) (9)

History Note:

Housekeeping projects which maintain a facility's original condition and physical features, including re-roofing and minor alterations where in-kind materials and techniques are used. This also encompasses structures 50 years of age and older and for which no separate law, rule, or regulation dictates a formal review and approval process;

Roads, bridges, parking lots, and their related facilities;
Utilities on their existing rights-of-way;
Surface drainage systems;
Boat ramps, docks, piers, bulkheads, rip rap, breakwaters and associated facilities; Diked, high ground dredge-material disposal areas;

Activities necessary to fulfill the existing requirements of in-effect permits for the protection of the environment and human health;
Other maintenance and repair activities on projects which are consistent with previously approved environmental documents; and

Routine grounds maintenance and landscaping of sidewalks, trails, walls, gates, and related facilities, including outdoor exhibits.

Authority G.S. 113A-4; 113A-6; 113A-9; 113A-10; 113A-11; 113A-12; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0408 MINOR CONSTRUCTION ACTIVITIES

This Rule sets out the general and specific minimum criteria for construction activities. Construction and land disturbing activities must fall under both the general minimum criteria and any specific minimum criteria applicable to the project. (1) General criteria. The following categories of land disturbing activity do not require preparation of an

environmental document.

(a) In the 20 coastal counties, land disturbing activity that:

(i) is located more than 575 feet away from waters classified as High Quality Waters (HQW) or impacts less than five acres located all or in part within 575 feet of waters classified as High Quality Waters (HQW);

(ii) is located outside of any Outstanding Resource Waters (ORW) watershed or area that requires specific management actions to protect ORW waters as defined in 15A NCAC 02B .0225; and

(iii) impacts less than five acres located in any Outstanding Resource Waters (ORW) watershed or in any area that requires specific management actions to protect ORW waters as defined in 15A NCAC 02B .0225.

(b) Land disturbing activity outside the twenty coastal counties that:

(i) is located more than one mile from waters classified as HQW or impacts less than

five acres located within one mile of and draining to waters classified as HQW;

(ii) is located outside of any Outstanding Resource Waters (ORW) watershed or area that requires specific management actions to protect ORW waters as defined in 15A NCAC 02B .0225;

(iii) impacts less than five acres located in any Outstanding Resource Waters (ORW) watershed or in any area that requires specific management actions to protect ORW waters as defined in 15A NCAC 02B .0225; and

(iv) is located more than 25 feet from any waters classified as Trout (Tr) waters or impacts less than five acres located all or in part within 25 feet of any waters classified as Trout (Tr) waters.

(c) Channel disturbance and land disturbing activities associated with non-compensatory stream restoration or stream enhancement.

(d) Land disturbing activities impacting wetlands if the activity will result in the loss of one acre or less of Class WL wetlands.

(e) Land disturbing activities impacting streams if the activity will result in channel disturbance of less than 500 linear feet of perennial streams. Land disturbing activities that impact 500 linear feet or more of perennial streams do not require preparation of an environmental document if stream restoration or stream enhancement is performed.

(2) Specific Criteria. Construction or expansion activities listed below require an environmental document if they exceed either the minimum criteria set out in Item (1) of this Rule or the thresholds established below.

(a) The following activities related to wastewater treatment systems.

(i) Relocation of discharge points within the same river basin;

(ii) New discharge facilities with a proposed permitted expansion of less than 500,000 gallons per day and producing an instream waste concentration of less than 33

percent during the 7-day 10-year low flow conditions;

(iii) Expansion of an existing discharge facility of less than 500,000 gallons per day

additional flow;

(iv) New surface irrigation, high rate infiltration, or subsurface waste water systems

with a proposed permitted capacity not exceeding 100,000 gallons per day;

(v) Reclaimed water utilization systems with reclaimed water utilization being the sole disposal option with a proposed permitted capacity not exceeding 200,000 gallons

per day;

(vi) New reclaimed water utilization sites with a proposed permitted capacity not to

exceed 500,000 gallons per day when the reclaimed water utilization system is

required for compliance with any other wastewater disposal permit;

(vii) New reclaimed water utilization sites with a proposed permitted capacity not to exceed

1,000,000 gallons per day when the reclaimed water utilization system is not

required for compliance with any other wastewater disposal permit;

(viii) New reclaimed water utilization distribution lines;

(ix) New permits or modification to existing permits for land application of residuals

utilization, where less than 10 acres not previously permitted is prior converted within three years or will be converted from a non-plantation forested area to application area;

(x) New or expanding surface disposal sites disposing less than 3000 dry tons of residuals per year;

(xi) Gravity sewer extensions with less than three miles of new lines or lines of less than 18 inches in diameter; and

(xii) New or expanding individual pump stations and associated force mains with a proposed permitted capacity of less than 1750 gallons per minute.

(b) The following activities related to potable water systems.

(i) Improvements to water treatment plants that involve less than 1,000,000 gallons per

day added capacity and total design withdrawal less than one-fifth of the 7-day, 10-

year low flow of the contributing stream;

(ii) Improvements not intended to add capacity to the facility;

(iii) Installation of appurtenances in existing rights-of-way for streets or utilities, or water lines and appurtenances less than five miles in length and having only directional bore stream crossings or no stream crossings; and

(iv) Construction of water tanks, or booster pumping or secondary or remote disinfection stations.

(c) Groundwater withdrawals of less than 1,000,000 gallons per day where such withdrawals are not expected to cause alterations in established land use patterns, or degradation of groundwater or surface water quality.

(d) The following activities related to solid waste disposal:

(i) Construction of solid waste management facilities, other than landfills exempt

pursuant to G.S. 130A-294 (a)(4), which store, treat, process incinerate, or dispose

of less than 350 tons per day (averaged over one year) of solid waste; and

(ii) Disposal of solid waste by land application on 100 total acres or less, where less than 10 percent of the total land application area is converted from a non-plantation

forested area.

(e) Development requiring a Coastal Area Management Act (CAMA) permit or State Dredge

and Fill Law permit that does not involve:

(i) Construction of a new marina, or a 25% or greater expansion in the number of slips

at existing and operating marinas;

(ii) Excavation of a new navigation channel. Maintenance activities associated with

maintaining the traditional and established use of a channel and new excavation activities located entirely within 100 feet of the shoreline, or within 50 feet from the waterward edge of any existing or authorized docking facility and involving the excavation of less than 5,000 square feet of public trust bottom do not constitute excavation of a new navigation channel for purposes of these rules.

(iii) Excavation of materials from aquatic environments for use for beach nourishment or other purposes not directly related to approved navigation projects;

(iv) A large scale beach nourishment or spoil deposition project. A project shall be considered large scale when it places more than a total volume of 200,000 cubic yards of sand at an average ratio of more than 50 cubic yards of sand per linear foot of shoreline;

(v) The salvaging of cut logs from public trust waters for commercial use, unless the salvage operation complies with any departmentally-approved best management practices developed for such activities;

(vi) The construction over state owned submerged lands of private bridges to privately owned islands, unless the length of the bridge is less than 50 feet; and

(vii) The excavation, dredging or other hydrodynamic manipulation of an inlet, inlet channel(s) or inlet shoal(s) for non-navigational purposes.

(f) Construction of a minor source or modification of a minor source of air emissions as defined in 15A NCAC 02D .0530, that are less than 100 tons per year or 250 tons per year as defined therein.

(g) Construction relating to the reclamation of underground storage tanks and restoration of groundwater quality.

(h) The construction, repair or removal of dams less than 25 feet in height and having less than 50 acre-feet of effective storage capacity.

(i) Any new construction for a building which involves all of the following;

(i) A footprint of less than 10,000 square feet;

(ii) A location that is not a National Register Archaeological site; and

(iii) The building's purpose is not for storage of hazardous waste.

(j) Demolition of or additions, rehabilitation or renovations to a structure not listed in the National Register of Historic places or less than 50 years of age.

(k) Routine grounds construction and landscaping of sidewalks, trails, walls, gates and related facilities, including outdoor exhibits.

History Note:

(l) Installation of on-farm Best Management Practices that meet the standards of the North Carolina Soil and Water Conservation Commission and the federal Natural Resources Conservation Service.

(m) Construction or remodeling of swimming pools.

(n) Construction of a new two-lane road in accordance with DOT accepted design practices and

DOT standards and specifications involving less than a total of 25 cumulative acres of ground surface limited to a single project, and not contiguous to any other project making use of this provision.

(o) Expansion of a two-lane road in accordance with DOT accepted design practices and DOT standards and specifications involving less than a total of 10 cumulative acres of ground surface limited to a single project, and not contiguous to any other project making use of this provision.

Authority G.S. 113A-4; 113A-6; 113A-9; 113A-10; 113A-11; 113A-12; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0409 MANAGEMENT ACTIVITIES

Management activities do not require the filing of environmental documents. These activities include but are not limited to the following:

(1) Replenishment of shellfish beds through the placement of seed oysters, seed clams or shellfish cultch on marine or estuarine habitats.

(2) Creation and enhancement of marine fisheries habitat through the establishment of artificial reefs in accordance with the Division of Marine Fisheries' Artificial Reef Master Plan.

(3) Placement of fish attractors and shelter in public waters managed by the N.C. Wildlife Resources Commission.

(4) Translocation and stocking of native or naturalized fish and wildlife in accordance with appropriate DENR agency species management plans, watershed management plans, or other state agency approved resource management plans.

(5) Reintroduction of native endangered or threatened species in accordance with state or federal guidelines or recovery plans.

(6) Production of native and agricultural plant species to create or enhance fish or wildlife habitat and forest resources, including fertilization, planting, mowing, and burning in accordance with fisheries, wildlife, or forestry management plans.

(7) Forest products harvest in accordance with the forestry Best Management Practices (BMPs) and the performance standards in the Forest Practice Guidelines (FPGs) Related to Water Quality (15A NCAC 01I .0201 - .0209) and the United States Forest Service or the N.C. Division of Forest Resources forest management plans.

(8) Reforestation of woodlands in accordance with the United States Forest Service or the N.C. Division of Forest Resources forest management plans.

(9) Use of forestry best management practices to meet the performance standards in Forest Practice Guidelines Related to Water Quality codified as 15A NCAC 01I.

(10) The control of forest or agricultural insects and disease outbreaks by biological treatments, mechanical treatments, or the lawful application of labeled pesticides by licensed applicators, or any combination of those practices, on areas of no more than 100 acres.

(11) Control of species composition on managed forestlands as prescribed by approved forest management plans by the lawful application of labeled herbicides by licensed applicators, on areas no more than 100 acres.

(12) Control of aquatic weeds in stream channels, canals and other water bodies, by the lawful application of labeled herbicides by licensed applicators, on areas of no more than two acres or 25 percent of surface area, whichever is less, except in Primary Nursery Areas designated by the Marine Fisheries Commission,

Inland Primary Nursery Areas designated by the Wildlife Resources Commission, and Anadromous Fish Spawning Areas designated by the Marine Fisheries Commission or the Wildlife Resources Commission.

(13) Removal of logs, stumps, trees, and other debris from stream channels where there is no channel excavation, and activities are carried out in accordance with "Best Management Practices (BMPs) for

History Note:

(14) (15) (16) (17) (18) (19)

(20) (21) (22) (23)

(24) (25) (26)

Selective Clearing and Snagging," Appendix B in Incremental Effects of Large Woody Debris Removal on Physical Aquatic Habitat, US Army Corps of Engineers Technical Report EL-92-35, Smith et al, 1992, or other guidelines approved through the Intergovernmental Review process as set out at 01 NCAC 25 .0211.

Dredging of existing navigation channels and basins to originally approved specifications, provided that the spoil is placed in existing and approved high ground disposal areas.
Controlled or prescribed burning for wildlife, timber enhancement, and hazard reduction in accordance with applicable management plans.

Plowing fire lines with tractor plow units, or other mechanized equipment, for the purpose of suppressing wildland (brush, grass, or woodland) fires and prescribed burning.
Scooping or dipping water from streams, lakes, or sounds with aircraft or helicopters for the purpose of suppressing wild land (brush, grass, or woodland) fires.

Drainage projects where the mean seasonal water table elevation will be lowered less than one foot over an area of one square mile or less, and riparian and wetland areas will not be affected. Manipulation of water levels in reservoirs or impoundments in accordance with approved management plans, for the purpose of providing for water supply storage, flood control, recreation, hydroelectric power, fish and wildlife, downstream water quality and aquatic weed control.

Installation of on-farm Best Management Practices that meet the standards of the North Carolina Soil and Water Conservation Commission and the federal Natural Resources Conservation Service. Continuation of previously permitted activities where no increase in quantity or decrease in quality are proposed.

Acquisition or acceptance of real property to be retained in a totally natural condition for its environmental benefits.
Acquisition or acceptance of real property to be managed in accordance with plans for which environmental documents have been approved.

Care of all trees, plants, and groundcovers on public lands.
Care, including medical treatment, of all animals maintained for public display. Activities authorized for control of mosquitoes such as the following:

(a) Mosquito control water management work in freshwater streams performed in accordance

with "Best Management Practices (BMPs) for Selective Clearing and Snagging" Appendix B in Incremental Effects of Large Woody Debris Removal on Physical Aquatic Habitat, US Army Corps of Engineers Technical Report EL-92-35, Smith et al, 1992, or other guidelines reviewed through the Intergovernmental Review process as set out at 01 NCAC 25 .0211;

(b) Mosquito control water management work in salt marsh environments performed under Open Marsh Water Management guidelines reviewed through the Intergovernmental Review process as set out at 01 NCAC 25 .0211;

(c) Lawful application of chemicals approved for mosquito control by the United States Environmental Protection Agency and the State when performed under the supervision of licensed operators; and

(d) Lawful use of established species to control mosquitoes.

Authority G.S. 113A-4; 113A-6; 113A-9; 113A-10; 113A-11; 113A-12; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0410 PRIVATE USE OF PUBLIC LANDS

Activities related to the private use of public lands, when conducted in accordance with permit requirements, do not require the filing of environmental documents. These activities include but are not limited to the following:

(1) Use of pound nets.

(2) Shellfish relaying and transplanting.

(3) Harvest of shellfish during closed season.

(4) Special fisheries management activities under 15A NCAC 03I .0012.

(5) Aquaculture operations within coastal waters.

(6) Scientific collecting within coastal waters.

(7) Introduction and transfer of marine and estuarine organisms.

(9)

History Note:

(8) Development requiring a Coastal Area Management Act (CAMA) or a State Dredge and Fill Law permit that does not involve:

(a) Construction of a new marina, or a 25% or greater expansion in the number of slips at existing and operating marinas;

(b) Excavation of a new navigation channel. Maintenance activities associated with maintaining the traditional and established use of a channel and new excavation activities located entirely within 100 feet of the shoreline, or within 50 feet from the waterward edge of any existing or authorized docking facility and involving the excavation of less than 5,000 square feet of public trust bottom do not constitute excavation of a new navigation channel for purposes of these rules.

(c) Excavation of materials from aquatic environments for use for beach nourishment or other purposes not directly related to approved navigation projects;

(d) A large scale beach nourishment or spoil deposition project. A project shall be considered large scale when it places more than a total volume of 200,000 cubic yards of sand at an average ratio of more than 50 cubic yards of sand per linear foot of shoreline;

(e) The salvaging of cut logs from public trust waters for commercial use, unless the salvage operation complies with any Departmentally approved best management practices developed for such activities;

(f) The construction over state owned submerged lands or private bridges to privately owned islands, unless the length of the bridge is less than 50 feet; and

(g) The excavation, dredging or other hydrodynamic manipulation of an inlet, inlet channel(s) or inlet shoal(s) for non-navigational purposes.

Construction of piers and boat docks on all State Lakes when conducted in accordance with 15A NCAC 12C .0300.

Authority G.S. 113A-4; 113A-6; 113A-9; 113A-10; 113A-11; 113A-12; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0411 REMEDIATION ACTIVITIES

Activities that seek to clean up, remove, remediate, abate, contain or otherwise protect public health or the environment from the effect of contamination released to the environment do not require the filing of environmental documentation.

History Note: Authority G.S. 113A-4; 113A-6; 113A-9; 113A-10; 113A-11; 113A-12; 143B-10; Eff. April 1, 2003.

15A NCAC 01C .0412 HURRICANE RELIEF ACTIVITY WITH MINIMUM POTENTIAL FOR ENVIRONMENTAL EFFECTS

History Note:

Authority G.S. 113A-4; 113A-6; 113A-11; 143B-10; Emergency Adoption Eff. April 25, 2005; Temporary Adoption Eff. July 29, 2005;
Temporary Adoption Expired on May 12, 2006.

SECTION .0500 - MINIMUM CRITERIA

PURPOSE
MAJOR ACTIVITIES
EXCEPTIONS TO MINIMUM CRITERIA

15A NCAC 01C .0501 15A NCAC 01C .0502 15A NCAC 01C .0503

History Note: Authority G.S. 113A-2; 113A-4; 113A-6; 113A-9; 113A-10; 113A-11; 113A-12; 143B-10; Eff. August 1, 1989;

Transferred from T15.01D .0601; .0602; .0603 Eff. November 1, 1989; Amended Eff. August 1, 1996; March 1, 1990;
Repealed Eff. April 1, 2003.

15A NCAC 01C .0504 NON-MAJOR ACTIVITY

History Note:

Authority G.S. 113A-4; 113A-6; 113A-9; 113A-10; 113A-11; 113A-12; 143B-10;
Eff. August 1, 1989;
Transferred from T15.01D .0604 Eff. November 1, 1989;
Temporary Amendment Eff. December 7, 1992 for a Period of 180 Days or Until the Permanent Rule Becomes Effective, Whichever is Sooner;

Amended Eff. August 1, 1996; March 1, 1993; Repealed Eff. April 1, 2003.

15A NCAC 01C .0505 NON-MAJOR HURRICANE RELIEF ACTIVITY

History Note: Authority G.S. 113A-4; 113A-6; 113A-11; 143B-10; S.L. Ex. Session 1999-463, Part IV, c.463, s. 4; Temporary Adoption Eff. February 4, 2000 to expire on January 1, 2003;

Temporary Adoption expired January 1, 2003.

Duke University Medical Center

STEM CELL TRANSPLANT PROGRAM

March 10, 2020

To Whom It May Concern:

It has come to my attention there is a proposal for building a concrete batch plant and asphalt hot mix plant close to a residential area. One of my patients, Carolyn Laur, lives very close to the proposed plant. Ms. Laur has a pre-malignant condition which might progress to myeloma. Exposure to known carcinogens could cause hematologic malignancies even without this predisposition. This condition causes Ms. Laur to be at significant risk for development of cancer. A number of carcinogens will be used in the production of concrete and asphalt. Some of these include arsenic, beryllium, formaldehyde, methylene chloride, and styrene which are linked to the development of hematologic malignancies.

It would not be in Ms. Laur's best interest to be exposed to any of these carcinogens, even in small amounts. Location of concrete and asphalt production close to her residence would place her at undo risk of developing cancer, specifically multiple myeloma. Multiple myeloma is incurable. Allowing the placement of the concrete and asphalt plant near her home would be unsafe and ill advised.

Please feel free to contact me with any questions. Thank you.

Sincerely,

Margaret Eren FNP-BC, MSN, RN, AOCNP

Margaret (Peggy) Eren
Nurse Practitioner
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RE: Visit Follow-Up Question

To:
Caroline A Laur

From:
Yubin Kang, MD

Received:
3/2/2020 9:55 PM EST

Note:

Cannot reply to an expired message

You can do a google search and type in "benzene exposure and multiple myeloma" or "benzene and leukemia. There should be several papers/studies demonstrating the association between benzene exposure and myeloma or leukemia". Below is one of the papers

Ann N Y Acad Sci. 2006 Sep;1076:90-109.
Benzene exposure and multiple myeloma: a detailed meta-analysis of benzene cohort studies.

Abstract
Case reports and epidemiological studies of workers exposed to benzene have demonstrated associations with a number of lymphohematopoietic diseases, but the association with multiple myeloma (MM) has been less apparent. Data from all of the "benzene cohort studies" conducted to date have been selected and evaluated for inclusion in a meta-analysis. The analysis demonstrates a significant excess in the relative risk (RR) of MM in relation to benzene exposure. Pooling the data from seven cohort studies, a meta-analysis yields a statistically significant weighted RR estimate of 2.13 (95% CI = 1.31-3.46). In the analysis of cohort data, an understanding of the cohort follow-up

period in relation to benzene exposure and RR of MM is important. Exposure-related RRs of disease decline after the median latency periods are exceeded, particularly when exposure has terminated decades earlier. The positive epidemiological evidence for benzene as a cause of MM is supported by biological
plausibility for such an effect from benzene exposure. Studies of refinery workers are difficult to interpret in relation to benzene exposure and risk of MM, but are limited in the study design and analysis. Nonetheless, they provide some support for an association between refinery work and MM.

Yubin

----- Message -----
From: Caroline A Laur
Sent: 3/2/2020 6:58 AM EST
To: Yubin Kang, MD
Subject: RE: Visit Follow-Up Question

Dr. Kang,
I have been trying to get an appointment to let you look over the toxins list and determine if the toxins on the list qualify would qualify for increasing my risk. The list I provided Ms Eren list the daily amount of exposure of each chemical. The toxins and chemicals include benzene, arsenic, lead, exhaust fumes, and fugitive fumes. I would be breathing them in 24 hrs a day, 7 days a week, 365 days a year. We (Several of us with health concerns) have a hearing coming up with North Carolina Department of Air Quality. We have an opportunity to block them.

But I need your professional opinion documented that states that you believe that being this close to this level of toxins has shown to increase the risk of development of myeloma and leukemia. The hearing is in 3 weeks. Without this, I will be forced to leave my home and move elsewhere. Anything you can provide me with will helpful. And if you know where else I can get studies or documentation to substantiate this would be very important.
Thank you very much. Caroline
----- Message -----
From: Yubin Kang, MD
Sent: 3/1/2020 11:57 AM EST
To: Caroline A Laur
Subject: RE: Visit Follow-Up Question

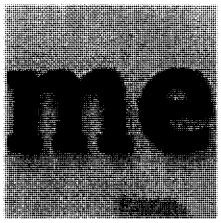
Yes. High level of chemical and toxin exposures have been shown to increase the risk of development of myeloma and leukemia.

Yubin

----- Message -----
From: Caroline A Laur
Sent: 2/28/2020 1:42 PM EST
To: Yubin Kang, MD
Subject: RE: Visit Follow-Up Question

I am concerned that a proposed Pollutant Industry is proposing to build a Asphalt/Cement Batch Plant 190 ft from my back door. It will releasing hundred's of toxins (i.e. - benzene, arsenic, lead, etc) that I have read in a few studies could create health risk for me. My neighbor with Lymphoma and the other with a double lung transplant have received letters from their doctor telling them it is a health risk for their specific health issue as well. I have forwarded the two separate list of toxins to Peggy in your office. I am wanting to know if you think breathing this 24/7/365 days a year (this is what they are permitted to be able to do) and multiple burners to heat up the asphalt and 150 to 250 large dump trucks with exhaust fumes and fugitive toxins will be released daily. Could such a high level of exposure increase my chances of multiple meyloma or lukemia; In your professional opinion?

Thank you, Caroline Laur



Margaret Eren <margaret.eren@duke.edu>
To:
Caroline Long

Thu, Mar 5 at 5:59 PM

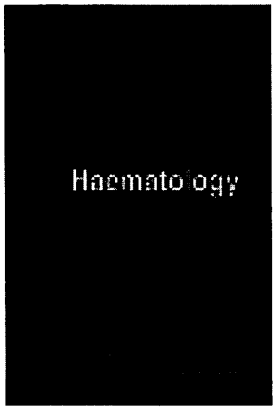
More good info:

S. Vincent Rajkumar, in Goldman's Cecil Medicine (Twenty Fourth Edition), 2012

Definition

Monoclonal gammopathy of undetermined significance (MGUS; formerly called *benign monoclonal gammopathy*) is a premalignant clonal plasma cell disorder characterized by the presence of a serum M protein in persons who lack evidence of multiple myeloma, macroglobulinemia, amyloidosis, or other related diseases. MGUS is defined by a serum M protein concentration lower than 3 g/dL, less than 10% clonal plasma cells in the bone marrow, and absence of lytic bone lesions, anemia, hypercalcemia, and renal insufficiency that can be attributed to a plasma cell disorder. The main clinical significance of MGUS is its lifelong risk of transformation to myeloma or related malignancy at a fixed but unrelenting rate of 1% per year.

Volume 20, Issue 4, December 2007, Pages 637-664



5

Epidemiology of the plasma-cell disorders

Author links open overlay panel
Robert A.KyleMD(Professor of Medicine)S. VincentRajkumarMD(Professor of Medicine)
Show more
https://doi.org/10.1016/j.beha.2007.08.001

This review of the plasma-cell disorders begins with the definition of monoclonal gammopathy of undetermined significance (MGUS). The prevalence of MGUS in white and black populations is described. MGUS is a common finding in the medical practice of all physicians, and thus it is important to both the patient and the physician to determine whether the monoclonal protein remains stable or progresses to multiple myeloma (MM), Waldenström's macroglobulinemia (WM), primary systemic amyloidosis (AL), or a related disorder. The long-term (almost 40

years) follow-up data of 241 patients in the Mayo Clinic population is provided. In a large study of 1384 patients with MGUS from southeastern Minnesota, the risk of progression to MM, WM, AL, or other disorders was approximately 1% per year. Risk factors for progression are provided. The incidence of MM in Olmsted County, Minnesota, remained stable for the 56-year span 1945–2001. The apparent increase in incidence and mortality rates among patients with MM in many studies is due to improved case ascertainment, especially among the elderly. The incidence and mortality rates of MM in the United States and other countries are presented. The major emphasis is on the cause of MM, which is unclear. Exposure to radiation from atomic bombs, therapeutic and diagnostic radiation, and in workers in the nuclear industry field are addressed. Many studies involving agricultural occupations, exposure to benzene, petroleum products, and engine exhaust and other industrial exposures are discussed.

Central-European Journal of Immunology
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Air pollution, oxidative stress, and exacerbation of autoimmune diseases

Anna Gawda, Grzegorz Majka, [...], and Janusz Marcinkiewicz

Additional article information

Abstract

A number of epidemiological studies have shown a strong association between exposure to ambient airborne particulate matter (PM 2.5, PM < 1.0) and lung or cardiovascular diseases characterised by high mortality and morbidity. However, much less is known about the role of air pollution in the pathogenesis of autoimmune diseases, which constitutes a significant problem in modern society.

This paper summarises the state of current research regarding the influence of PM on the development and/or progression of autoimmune diseases. A brief review of the great body of research concerning pathogenesis of autoimmune disorders is presented. Then, the scope of our review is narrowed to the research related to the impact of particulate matter on oxidative and nitrosative stress, as well as exacerbation of chronic inflammation, because they can contribute to the development of autoimmune diseases. Moreover, we discuss the impact of various components of PM (metal, organic compounds) on PM toxicity and the ability to generate oxidants.

Keywords: inflammation, oxidative stress, air pollution, particulate matter, autoimmune disease, nitrosative stress

Introduction

The detrimental health effect of the exposure to particulate matter (PM) present in air pollution has been documented in numerous studies [1, 2]. Epidemiological evidence indicates that poor air quality contributes to increased morbidity and mortality due to several reasons. Primarily, chronic exposure to PM increases the risk and is associated with progression of lung and cardiovascular diseases [3]. Production of oxidants, either directly by components of PM or by the host response to air pollution, seems to be the major biological effect responsible for tissue injury, and a local as well as systemic inflammatory response [4]. The question arises whether oxidative stress induced by exposure to PM contributes to an increased risk and/or pathogenesis of autoimmune diseases. It is not clear yet whether composition (metal vs. organic components) and/or size of air pollution particles (PM 2.5 vs. PM < 1.0) affects their toxicity and capacity to induce inflammation and immune response to autoantigens.

The immune system – consisting of the fine-tuned network of humoral and cellular components – provides protection against microbial pathogens. The unique ability to discriminate between 'self' and 'non-self' allows this defensive network to eliminate the invading microorganisms while maintaining tolerance towards autoantigens [5]. However, there are cases in which the system fails, and its malfunctioning contributes to pathological processes such as autoimmune diseases (ADs). Prolonged activation of the immune system resulting in chronic inflammation and tissue damage with following involvement of the adaptive immune system is typically observed in most ADs [6].

Autoimmune diseases have a strong genetic background involved [7, 8], but the impact of environmental factors must not be underestimated. Infectious agents, drugs as well as physical agents such as cold exposure or air pollution, have been considered as risk factors for either development or exacerbation of these conditions [6].

In this short review, we focus on the pathogenesis of ADs associated with oxidative stress in the correlation with particulate matter (present in air pollution), which can provide an environmental trigger for autoimmune processes.

Autoimmune diseases

Autoimmune diseases are chronic pathogenic conditions embodying a heterogeneous group of disorders associated with the loss of immunological tolerance to self-antigens [8]. Affecting ca. 5% of the world population, they are the fourth leading cause of disability for women [9], who are more predisposed to suffer from them (80% of AD patients being female [10]).

The common feature that defines autoimmune diseases is the breakdown of immune tolerance, leading to the development of the adaptive immune response to self-antigens. The hallmarks of the ADs are: the presence of defined autoantigens, production of autoantibodies, and activation of autoreactive CD4+ T helper cells and self-reactive CD8+ cytotoxic T cells along with the engagement of the innate immune systems components, such as phagocytic cells (macrophages and neutrophils) [11]. Macrophages take part in tissue damage by releasing reactive oxygen (hydrogen peroxide, superoxide anion) and nitrogen species (nitric oxide). Pro-inflammatory cytokines secreted by macrophages recruit neutrophils and T cells to the site of inflammation [8]. Moreover, macrophages can drive the autoimmune process by phagocytosis of apoptotic/necrotic cells serving as a potential source of self-antigens that can be subsequently presented to the auto-reactive T cells.

Autoimmune diseases are usually classified into two groups, depending on whether the effect is organ-specific or systemic [8]. Systemic autoimmune disorders, such as rheumatoid arthritis (RA) or systemic lupus erythematosus (SLE), are characterised by multi-organ involvement, which probably arises from the systemic distribution of the auto-antigens.

Organ-specific autoimmune disorders develop when the immune response is directed against auto-antigens located in a specific organ. Diabetes mellitus type 1, multiple sclerosis (MS), primary biliary cirrhosis (PBC), Hashimoto's thyroiditis or Graves' disease deserve to be mentioned among numerous organ-specific autoimmune diseases. What is important, the autoimmune processes which take part in the development of the chronic inflammatory diseases mentioned above demonstrate organ-specific characteristics.

The involvement of the immune system has implied theories that specific proteins, which play a crucial role in the immunological response, may take part in the pathogenesis of ADs. Some HLA haplotypes are considered to be particularly important for presentation of autoantigens in the autoimmune process. Thus, concurrent expression of both HLA-DR2 and HLA-DR3 predisposes an individual to development of systemic lupus erythematosus (SLE). Type 1 diabetes mellitus (DM) has a particularly strong correlation with HLA-DR3, -DR4, -DQ2, and -DQ8 [12, 13]. People with certain alleles of HLA-DR4 are notably predisposed to rheumatoid arthritis (RA) [14]. Although genetic predilection plays a major role in autoimmunity (over 200 loci have been implicated in autoimmune disorders), genetics cannot fully explain the patterns of these diseases.

Infections [15, 16] and immune adjuvants [17, 18] are thought to play a crucial role in AD development or exacerbation in genetically susceptible individuals [19, 20]. Our current studies focus on elucidating the impact of the inorganic chemical substances (such as transition metal oxides) present in air pollution on the autoimmune processes.

Oxidative/nitrosative stress

Prolonged activation of the innate immune system and chronic inflammatory response are both features of ADs that are commonly associated with increased concentration of reactive species of oxygen and nitrogen that can significantly contribute to the development of these pathogenic conditions.

A relatively new term of oxidative stress refers to the imbalance between oxidant and antioxidant molecules that can potentially lead to a tissue damage due to the excess of the former [21]. Such a situation occurs when production of reactive oxygen species exceeds their elimination rate regulated by the antioxidant system. Similarly, nitrosative stress has been described as a phenomenon in which the reactive nitrogen species in excess contribute to the pathogenic processes [22].

The terms reactive oxygen and nitrogen species encompass molecules that are natural by-products of the normal cell metabolism. Physiologically, these molecules are involved in numerous processes – they are important for respiratory burst of phagocytic cells, cellular signalling, and thyroid hormone synthesis [23].

Most of the reactive oxygen species (ROS) are generated by electron leak during ATP production in mitochondria [24], but they can also be generated by NAPDH oxidase and other oxidases. Superoxide anion, hydrogen peroxide and hydroxyl radical are the three most important ROS in biological systems. Other reactive molecules such as HOCl (important for microbicidal activity of phagocytes) can be generated by reaction of hydrogen peroxide with chloride anion catalysed by myeloperoxidase present in azurophilic granules of neutrophils [25, 26].

Nitric oxide (NO) is the primary source of all reactive nitrogen species (RNS) present in the biological system [27, 28]. NO is a small signalling molecule generated by nitric oxide synthase, which plays a major role in vasodilation and neurotransmission but is also involved in the antimicrobial response of the phagocytes. The nitric oxide potential in the pathogenesis of diseases stems from its reaction with superoxide, and results in formation of peroxynitrite, which is a potent nitrating and oxidising agent [29, 30].

Under physiological conditions, the concentration of reactive oxygen and reactive nitrogen species (RONS) is controlled by the scavenging system involving molecular and enzymatic antioxidants, which serve to maintain cellular redox balance [31]. A decrease of RONS level negatively affects cellular signalling [32], whereas high levels of RONS have been implicated in the pathogenesis of ADs [33, 34]. The mechanism behind this observation might be related not only to the initiation of pro-inflammatory response, but also to the structural modification of autoantigen resulting in a generation of novel, potentially auto-reactive epitopes [35]. These alterations usually occur upon RONS-dependent peroxidation of lipids within the cells, which leads to formation of highly reactive aldehydes, such as malondialdehyde and 4-hydroxynonenal. These molecules can form covalent bonds with proteins and alter both their structure and biological functions. Products of oxidative modification present in blood are considered potential biomarkers of the systemic oxidative stress, inflammation, and ADs [36].

Particulate matter present in air pollution

Air pollution is a mixture of gases (carbon monoxide, nitrates, sulphur dioxide, and ozone), aerosols, and particulate matter (solid and liquid particles) [37, 38]. There are two main subtypes of atmospheric particulate matter: fine particles and ultrafine particles. Fine particles have a diameter smaller than 2.5 μm (PM 2.5), while the ultrafine particles have a diameter smaller than 0.1 μm [3].

Roughly-speaking, particulate matter (PM) is a complex mixture of solid and liquid particles that is released into the air during combustion of coal, wood, gasoline, diesel, or fossil fuels, as well as from natural sources (road dust, fires, volcanic emissions, etc.) [39]. Most of the ultrafine particles are composed of sulphates and nitrates, but hydrocarbons, benzene, toluene, metals, and other substances can also be present in the adsorbed molecules, which can be inhaled by humans [2].

Human lungs make up the largest surface area exposed to the environmental factors present in the air. The human respiratory system possesses its own defensive mechanisms involving components of both innate

(mechanical mucus barrier, mucociliary clearance, and antimicrobial factors) and acquired immunity (reaction to specific antigens with T-cell involvement) [40]. However, some oxidant substances constituting air pollution are likely to influence the physiology of the cells and either trigger or exacerbate the inflammatory reaction. Progressing industrialisation and the growing number of motor vehicles put people at risk to exposure of high concentrations of such substances that have the capability to percolate to the upper respiratory tract.

Air pollution vs. autoimmune diseases

Several epidemiological studies have provided substantial evidence for the relationship between air pollution and development of autoimmune diseases [41, 42]. Herein, we present certain ADs and analyse the correlation between disease incidence and the presence of particulate matter in inhaled air.

SLE is a chronic autoimmune disease characterised by the presence of autoantibodies, formation of immune complexes, and activation of autoreactive B and T lymphocytes [43, 44]. Occupational exposure to silica, pesticides, solvents, and other inhaled substances has been linked to its development [45–49]. The incidence of SLE has not been found to correlate with particulate matter present in the air. However, it seems likely that PM 2.5 may exacerbate the onset of the disease because they were attributed to a significant increase of the level of anti-dsDNA antibodies, and the presence of the renal casts in SLE patients [50].

Diabetes mellitus type 1 can be characterised by total deficiency of insulin release by the β-cells of pancreas, which are destroyed in the autoimmune process [51]. The root cause of DM type 1 remains unknown, but some studies suggest that a combination of genetic and environmental factors is involved. Exposure to ozone, sulphates, and other pollutants present in the air has been associated with type 1 diabetes in children [52, 53]. Air pollution was found to increase the risk of acute complications of diabetes demanding hospitalisation [54]. Nevertheless, there are only a few reports suggesting that air pollution increases mortality among diabetics [55–57].

Rheumatoid arthritis is a systemic autoimmune disease characterised by multi-system inflammation [58–60]. Both genetic and environmental factors have been implicated in its development; however, the mechanism through which the environmental triggers might affect the disease has not been elucidated [61]. Both tobacco smoking and exposure to silica have been associated with higher risk of developing RA [62–66]. High concentration of PM 2.5 has been shown to increase the risk of juvenile idiopathic arthritis among young children by 60% [67]. Similarly, exposure to PM 2.5 has been associated with the prevalence of systemic RA [61, 68]. Furthermore, the analyses performed by the Nurses' Health Study in 2009 [69] suggest that pollution emissions from road traffic may be an environmental factor responsible for exacerbation of RA.

Association between air pollution and autoimmunity has also been found for multiple sclerosis (MS) – increased concentration of pollutants in the air (PM10 as well as SO_2 + NO_2 + NO) was correlated with relapses of the disease [42]. The potential association between MS occurrence and air pollution was implied following the study in the state of Georgia, US [70]. These findings were later confirmed by similar studies performed in Iran, Serbia, France, and Italy – demonstrating that MS occurrence and hospitalisation was associated with exposure to air pollutants such as PM10, SO_2, NO_2, and NOx [71–74].

From air pollution to autoimmune process

The mechanisms behind the relationship between poor air quality and AD prevalence and exacerbation are still unclear. While the local impact of inhaled air pollution particles on lung injury might seem obvious, it is not evident how they can affect other remote tissues to initiate autoimmune processes (how they can prime autoimmune processes in other remote tissues). Several hypotheses suggest activation of the systemic inflammatory response via oxidative/nitrosative stress, as well as the enhanced presentation of oxidative-modified autoantigens [75, 76].

When PMs are inhaled, some oxidants are generated locally in lung alveoli, where they may cause local chronic inflammation. However, the correlation between air pollution, the lung, and chronic inflammation has not been well examined [36]. The key to explain the role of lung in systemic inflammation lies in understanding the mechanism of modification of the biomolecules produced by inhaled oxidants (PM components), or generated by inflammatory cells in the upper and lower airways (alveolar macrophages) [77, 78]. Oxidised biomolecules are more susceptible to degradation, but they can also inhibit the removal of oxidatively modified proteins via the proteasome system [79].

The effect of inhaled nanoparticles (PM) on human health depends on both individual predisposition (such as genetic factors) and PM properties [80]. The opinion that a particle's toxicity depends on its size, shape, and composition is broadly accepted [81]. Importantly, the oxidative stress can result from Fenton-type reactions catalysed by the transition metal present in particles, such as Fe, V, Cr, Co, Ni, Cu, Zn, and Ti [82], but other metals and non-metals can also exert negative effects on the cells. For example, silica particles are toxic to macrophages [83–85] and induce cell death causing exposure of intracellular self-antigens to immune cells [86, 87]. In murine models of silica exposure an increase in the production of autoantibodies and formation of autoantibody immune complexes was observed [88, 89], as well as an increase in numbers of B-lymphocytes and CD4 T cells [90]. All these factors might contribute to chronic lung inflammation and have been reported as possible risk factors for development of autoimmune diseases, such as RA and SLE [91].

It has been shown that environmental exposure to asbestos particularly increases the risk of autoimmune diseases [92, 93]. In turn, exposure to iron and other transition metals can result in generation of reactive oxygen species on the lung cells surface, which may cause injury and lead to formation of scar tissue [94].

Numerous studies have revealed a negative impact of inhalation of air pollutants on human health. In general, particulate matter (PM) affects the upper bronchi, and this may lead to pulmonary inflammation [95]. Nanoparticles are considered even more dangerous than large size particles because they are more difficult to remove from the human body by the organism itself. Due to their small size, nanoparticles penetrate easily via the respiratory tract into the biological structures and disrupt their functions by driving oxidative stress and contributing to tissue inflammation [80].

Inhalation of nanoparticles has been shown to stimulate alveolar macrophages, creating conditions for development of an acute systemic inflammatory response [37, 96, 97]. Airway inflammation, a major short-term effect of inhalation of the particles present in the polluted air [98], is characterised by an increased secretion of pro-inflammatory mediators like interleukin-8 [99] and granulocyte macrophage-colony stimulating factor (GM-CSF), as well as by neutrophil influx [100, 101]. Inflammatory cells, neutrophils, and macrophages, generate a variety of reactive oxygen and nitrogen species and release various proteases that damage lung tissue [22]. Then, following the fine and ultrafine particles' passage into the blood, exposure to PM can potentially trigger a systemic inflammatory process [95] via induction of ROS production and pro-inflammatory cytokine release [102, 103].

It seems plausible that generation of soluble inflammatory mediators in the lungs upon PM inhalation might have a systemic impact. Systemic oxidative stress [104, 105], stimulation of the bone marrow [97, 106, 107], and increased levels of cytokines and leukocytes in blood have all been associated with exposure to air pollutants [108, 109]. Furthermore, air pollution has been shown to induce maturation of antigen presenting cells by inducing expression of costimulatory molecules [110–116]. Particulate matter present in the air can also act as an adjuvant and induce immune response against otherwise non-immunogenic antigens in several animal models [101, 117–119]. Animal studies have also provided evidence that exposure to particulate matter can have glycaemic consequences in a gestational diabetes mellitus rat model [120].

Therefore, air pollution could affect the autoimmune processes in multiple ways. Induction of oxidative/nitrosative stress can lead to production of autoantigens (via oxidative modification) and additionally to the stimulation of the release of soluble inflammatory mediators (cytokines) that can trigger maturation of antigen-presenting cells [75]. APCs migrating to the lymph nodes could thus present the self-antigens to the lymphocytes that had evaded the mechanisms of central tolerance. Upon establishment of the autoimmune

reaction, pro-inflammatory cytokines that are released following continuous inhalation of the pollutants could additionally exacerbate the process.

Conclusions

Autoimmune diseases are among the most crucial challenges of current medicine. They still cause chronic disability and mortality of patients with pulmonary and cardiovascular diseases. Currently, it has been accepted that particulate matter can contribute to autoimmunity by complex interactions between genetic, environmental, and epigenetic factors. However, the exact molecular mechanisms by which chemicals contained in air pollution affect autoimmunity are still unknown. Particulate matter present in air pollution can induce oxidative stress and cell death, both by apoptosis and necrosis of human cells leading to aggravation of chronic inflammation, i.e. the tissue damaging reaction observed in autoimmune diseases. Therefore, identification of strong inducers of oxidative stress among components of PM seems to be crucial for their neutralisation and elimination from the ambient environment.

Footnotes

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The authors declare no conflict of interest.

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5

Epidemiology of the plasma-cell disorders

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This review of the plasma-cell disorders begins with the definition of monoclonal gammopathy of undetermined significance (MGUS). The prevalence of MGUS in v and black populations is described. MGUS is a common finding in the medical pr of all physicians, and thus it is important to both the patient and the physician to determine whether the monoclonal protein remains stable or progresses to multip myeloma (MM), Waldenström's macroglobulinemia (WM), primary systemic amylc (AL), or a related disorder. The long-term (almost 40 years) follow-up data of 241 p in the Mayo Clinic population is provided. In a large study of 1384 patients with M from southeastern Minnesota, the risk of progression to MM, WM, AL, or other disorders was approximately 1% per year. Risk factors for progression are provided

countries are presented. The major emphasis is on the cause of MM, which is diff
Exposure to radiation from atomic bombs, therapeutic and diagnostic radiation, a
workers in the nuclear industry field are addressed. Many studies involving agricu
occupations, exposure to benzene, petroleum products, and engine exhaust and ot
industrial exposures are discussed. Tobacco use, obesity, diet, and alcohol ingestio
all possible causes of MM. Clusters of MM have been noted. Multiple cases of MM
been found in first-degree relatives.

Previous Next

Key words

agricultural workers; atomic bombs; benzene and solvent exposure; famili
aspects; incidence; monoclonal gammopathy of undetermined significanc
multiple myeloma; therapeutic and diagnostic radiation

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Toxic Exposures Unleashed

Author
Dr. Brian GM Durie
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Causes of Myeloma

I have previously discussed ways to prevent myeloma. A key step is to avoid toxic exposures. Although the Agency for Toxic Substances and Disease Registry (ATSDR), part of the U.S. Dept. of Health and Human Services, clearly identifies chemicals known to cause cancer, the Environmental Protection Agency (EPA) is currently rolling back many programs and rules to protect Americans. This is especially disturbing since the same chemicals that cause cancer, also cause brain damage in children.

As with other aspects of myeloma care, knowledge is power. That is why it is so important to have a broad understanding of the toxic factors that can seriously impact health.

Know what causes myeloma

Several toxic chemicals are known to cause myeloma. Multiple studies provide the "proof of principle" that chemicals are involved:

- The dioxins in Agent Orange, a powerful herbicide used by the U.S. military to destroy foliage and crops during the war in Vietnam, are well studied. A 2015 study linked the levels of the toxic chemical in the blood of exposed Vietnam veterans to the likelihood of developing myeloma.

- Another example is benzene, one of the 20 most widely used chemicals in this country. Studies linking benzene to myeloma go back to 1897. Two recent meta-analyses, in 2015 and in 2011, have confirmed the association of benzene exposure with the development of myeloma. The 1965 Bradford Hill criteria, established by British scientist Sir Bradford Hill, are used to make the connection between benzene and myeloma. This approach has been endorsed by the Occupational Safety and Health Administration (OSHA), the National Toxicology Program (NTP), and the National Cancer Institute (NCI) President's Panel in the U.S, and by the International Agency for Research on Cancer (IARC) in France. Other countries have researched and published data on the topic as well. The Occupational Diseases Medical Advisory Board in Germany published a study showing a connection between benzene exposure and myeloma in 2009. South Korean studies appeared in 2014 and 2015.

Other causal factors

In addition to workplace exposures, other factors have been shown to be important. There are more than 100,000 chemicals in widespread use, with more than 1,000 new ones added annually. Unfortunately, regulations for these chemicals are weak to nonexistent. Exposures can occur in a variety of ways. For example, widespread pollution and toxic exposures have occurred in the aftermath of hurricane Harvey in Houston, with particular concern about possible exposures to benzene. The New York Times reports that more than 2,500 sites in the U.S. handle toxic chemicals and are located in flood-prone areas. In addition, toxic exposures to benzene and POPs (persistent organic pollutants), which occurred during and after the events of 9/11, have been linked to the subsequent development of myeloma.

Contaminated drinking water

As part of its responsibility to evaluate health hazards at specific superfund (toxic) sites, the Agency for Toxic Substances and Disease Registry (ATSDR) has assessed drinking water contamination at Camp Lejeune in North Carolina. The agency concluded that the evidence

linking benzene exposure to the development of myeloma was sufficient to allow the Department of Veterans Affairs to consider a presumptive service connection based upon causal evidence.

You are your own advocate

We can take personal responsibility for our health by avoiding chemicals that have been linked to cancer whenever possible. These include Likewise, the types of chemicals that cause myeloma are bone marrow toxins, which means they cause blood cancers like leukemia and lymphomas, in addition to myeloma. (Some of the myeloma mutations, such as t(4;14) and 17p-, are linked to specific toxin exposures and, as such, represent the signatures of that exposure.) Since the number of patients with leukemia and lymphomas are larger, the statistical correlations between toxins and those two diseases are often much stronger than in myeloma.

Bottom Line

Toxic exposures cause myeloma. Regulations are not in place to protect U.S. citizens. Personal awareness and protection measures are essential to reduce or eliminate known risks. The enhancement of personal knowledge and advocacy on these fronts are among the IMF's key goals moving forward. Stay tuned!

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Reviews and Commentary

BENZENE AND LEUKEMIA

A REVIEW OF THE LITERATURE AND A RISK ASSESSMENT[1]

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The major purpose of this paper is to review the evidence, primarily epidemiologic, pertaining to the relation between benzene and leukemia. Benzene is widely considered to be a leukemogen for human beings, but its potency is uncertain. Since low-level exposures to benzene characterize many occupational settings, it is important to determine to what extent, if at all, low exposures increase leukemia risk. Moreover, as we write, the US Occupational Safety and Health Administration is attempting to reduce workplace exposures from an eight-hour time-weighted average level of 10 parts per million (ppm) to 1 ppm. This paper also includes an evaluation and critique of various risk assessments of benzene and leukemia. These risk assessments were done for policymaking and were developed to predict the leukemogenic effect of benzene exposures in the vicinity of the present occupational standard of 10 ppm.

BACKGROUND

In 1981, a Working Group of the International Agency for Research on Cancer concluded that there was sufficient evidence that benzene is carcinogenic to humans (1). Specifically, they concluded that exposure to benzene may damage the hematopoietic system and that evidence from epidemiologic studies establishes a causal relation between benzene and acute myelocytic leukemia. In the same report, it was noted that the evidence linking benzene with cancer other than acute myelocytic leukemia was inadequate. Benzene is included on the list of carcinogens published by the Secretary of the US Department of Health and Human Services (2) and is designated as a suspect carcinogen by the American Conference of Governmental Industrial Hygienists (3).

The present Occupational Safety and Health Administration regulation for exposure to benzene was established in 1971 and revised in 1974 (4). The regulation limits exposure to an eight-hour time-weighted average of 10 ppm with a ceiling concentration of 25 ppm over a 10-minute period and a peak concentration not to exceed 50 ppm for more than 10 minutes.

Abbreviations: CI, confidence interval; ppm, parts per million; RR, relative risk.

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This regulation was established because benzene was known to be a bone marrow depressant and because of its acute toxicity; benzene was not generally recognized as a carcinogen at that time. Indeed, in 1974, the National Institute for Occupational Safety and Health noted that, although case reports, chromosomal studies, and several epidemiologic studies suggested a link between benzene and leukemia, the evidence was not sufficient to conclude that it was a carcinogen (5). However, in 1976, the National Institute for Occupational Safety and Health recommended that benzene be regulated as a carcinogen because of new epidemiologic evidence (6). In that year, the Occupational Safety and Health Administration issued an emergency temporary standard for occupational exposure to benzene which stipulated an eight-hour time-weighted average of 1 ppm with a ceiling level of 5 ppm for any 15-minute period. This became the Occupational Safety and Health Administration standard in 1978 (7). However, a number of organizations representing industrial concerns obtained an injunction against the new standard. In 1980, the Supreme Court struck the 1 ppm standard, stating in essence that the Occupational Safety and Health Administration had not demonstrated that the 10 ppm standard was unsafe (8). Thus, a controversy remains about the reasonable exposure limit in occupational settings and especially about the leukemogenic effect of low-level exposures.

Scientific evidence

The potential adverse health effects of benzene have been evaluated in experimental studies of animals, in investigations of chromosomes, and in epidemiologic studies of workers exposed to benzene. Here, we emphasize the epidemiologic studies because they have provided both the qualitative and the quantitative estimates of the leukemogenic effect of benzene on which risk assessments and regulations largely have been based. Nevertheless, a brief summary of the results of animal studies and of chromosomal studies is pertinent, since these have also contributed to the evaluation of the leukemogenicity of benzene.

Animal studies

The carcinogenicity of benzene has been assessed experimentally in rats and mice using several exposure methods, such as skin application, inhalation, intragastric, and subcutaneous administration (1). The International Agency for Research on Cancer reviewed these and other studies of animals in 1982 and concluded that "there is limited evidence that benzene is carcinogenic in experimental animals" (1). Additional studies now have been reported, and they strengthen the hypothesis that benzene is an animal carcinogen which acts on several organ systems (9–12). However, this work has limitations which affect its relevance to the evaluation of the relation between benzene and leukemia in human beings. None of the experimental work provides an adequate animal model for benzene-induced myelocytic leukemia. Although the studies have demonstrated the induction of nonmalignant hematologic disorders by benzene, the carcinogenic effects are confined largely to nonhematologic tissues. In rats and mice, for example, benzene appears to be strongly related to the occurrence of carcinoma of the zymbal gland, a structure with no human analog. An additional limitation of the animal studies is the lack of data on the potential carcinogenicity of benzene exposures below 100 ppm.

Chromosome studies

Despite several studies, benzene has not been found to be a genotoxic (DNA-reactive) agent (13). However, it causes chromosome breaks and other chromosomal changes in animals, and it has been suggested that an excess of chromosomal aberrations occurs among human beings exposed to benzene (1, 11). Studies of workers with benzene-induced blood disorders have consistently shown an increased prevalence of chromosomal aberrations in so-

matic cells. However, studies of workers who had low (<25 ppm) benzene exposures or who had no overt signs of chronic benzene poisoning have been inconsistent with respect to cytogenetic findings. In addition, many of these studies are quite small, and most have methodological deficiencies, including inadequate assessment of average or cumulative benzene exposure, failure to adjust for age differences between groups, and no dose-response evaluations. Moreover, there are no data that establish a relation between chromosomal aberrations and the subsequent development of leukemia or other disease.

Epidemiologic studies

Eleven epidemiologic studies have evaluated the association between benzene and leukemia (14–28). These studies were preceded by many case reports of leukemia patients with industrial benzene exposure and by descriptions of series of leukemia cases associated with benzene exposure, two of which have been updated by Aksoy (29) in Turkey and by Vigliani (30) in Italy.

Aksoy (29) studied 51 leukemia cases, identified in 1967–1983, among men occupationally exposed to benzene in Istanbul, Turkey, and he estimated that from 1967 to 1975 the crude incidence rate of leukemia was 13 per 100,000 person-years among shoe workers, compared with six per 100,000 person-years among men in the general population. However, the validity of these estimates and the meaningfulness of the comparison of the leukemia rates of shoe workers with those of the general population are doubtful because ascertainment of leukemia cases was incomplete and was not conducted in the same manner for the two groups.

Vigliani (30) in Italy reported 11 leukemia cases that occurred between 1942 and 1974 in Milan and 13 cases that occurred between 1959 and 1974 in Pavia among workers in shoe and rotogravure factories. Benzene exposures were thought to have ranged from 26 to 600 ppm for workers handling glues in shoe factories and from 200 to 400 ppm for workers in the rotogravure plants. Vigliani estimated that the incidence rate of acute leukemia among workers heavily exposed to benzene was 20 times higher than that of the general population, but this estimate is not adequately documented.

The epidemiologic studies of benzene and leukemia are summarized in table 1. They are reviewed briefly below.

In a hospital-based case-control study in France, Girard and Revol (14) evaluated the association between benzene and leukemia and other hematologic diseases. The cases were hematology service patients, of whom 140 had acute leucosis (also referred to as acute leukemia in the study report), 61 had chronic lymphocytic leukemia, and 56 had myeloid leukemia. There were also 124 controls hospitalized for nonhematologic conditions. Exposure to benzene and toluene was determined by questioning subjects about chemicals which they had used during the 10-year period preceding the hospitalization. Relative risks for benzene or toluene were 3.3 (95 per cent confidence interval (CI) = 1.2–8.9) for acute leucosis/leukemia, 4.1 (1.4–12) for chronic lymphocytic leukemia, and 1.8 (0.5–6.6) for myeloid leukemia. This study suggests a strong positive relation between most forms of leukemia and benzene or toluene. However, it does not distinguish between benzene and toluene, and it provides no estimate of dose-response.

Ishimaru et al. (15) conducted a study of 303 leukemia cases and 303 controls in Nagasaki and Hiroshima, Japan. The study evaluated occupational exposures to benzene and to medical x-rays; potential exposure was determined on the basis of subjects' occupations. The relative risk of leukemia was 2.5 (95 per cent CI = 1.3–5.0) for persons with occupations involving potential benzene or medical x-ray exposure compared with those with no such exposures.

The main limitation of this study is its use of occupation as a surrogate for benzene exposure. Each occupation classified as in-

TABLE 1

Summary of epidemiologic studies of benzene exposure and leukemia

Study location and year of publication (ref no(s).)	Study design and observation period	No. and type of subjects	Exposure measure	SMR* or RR† for leukemia (95% confidence interval)
France, 1970 (14)	Case-control, 1966–1969	257 leukemia cases; 124 hospital controls	Occupational or household exposure to solutions containing benzene or toluene	RR = 3.3 (1.2–8.9) (acute leukemia) RR = 4.1 (1.4–12) (chronic lymphocytic leukemia) RR = 1.8 (0.5–6.6) (myelocytic leukemia)
Japan, 1971 (15)	Case-control, 1945–1967	303 adult leukemia cases; 303 controls	Employment in an occupation involving potential exposure to benzene or x-rays	RR = 2.5 (1.3–5.0)
Europe, 1974 (16)	Retrospective follow-up, 1962–1971	38,000‡ employees of oil company affiliates. Referent: general population	Employment involving potential exposure to >1% benzene for >5 years	SMR = 121 (37–205)
United States, 1977 and 1981 (17, 18)	Retrospective follow-up, 1950–1975	1,006 rubber hydrochloride (Pliofilm) workers. Referent: 1) general population; 2) 1,447 fibrous glass workers; 3) 398 nonbenzene-exposed rubber hydrochloride workers	Employment involving exposure to benzene for at least 1 day during 1940–1959; duration of employment	SMR = 560 (225–1,154) (first exposed in 1940–1949; general population referent) SMR = 2,100 (706–5,073) (exposed for >5 years; general population referent)
United States, 1986 (19)	Retrospective follow-up, 1950–1981	1,165 rubber hydrochloride (Pliofilm) workers. Referent: general population	Employment involving benzene exposure for at least 1 day during 1940–1965; cumulative benzene exposure (ppm-years)	SMR = 337 (154–641) (overall cohort) SMR = 109 (12–394) (0.001–39.99 ppm-years) SMR = 322 (36–1,165) (40.0–199.99 ppm-years) SMR = 1,186 (133–4,285) (200.0–399.99 ppm-years) SMR = 6,637 (1,334–19,393) (≥400.0 ppm-years)

United States, 1978 (20)	Retrospective follow-up, 1940–1973	594 benzene workers. Referent: general population	Cumulative benzene exposure (ppm-months)	SMR = 200 (24–722) (leukemia mortality) RR = 3.8 (myelocytic leukemia incidence)
United States, 1986 (21)	Retrospective follow-up, 1940–1982	956 benzene workers. Referent: general population	Cumulative benzene exposure (ppm-months)	SMR = 194 (52–488) (leukemia mortality) RR = 4.4 (1.2–11) (myelocytic leukemia incidence)
Olmsted Co., MN, 1980 (22)	Case-control, 1955–1974	138 adult leukemia cases; 276 controls	Medical record indication of benzene exposure	RR = 3.3 (0.6–28)
United Kingdom, 1981 (23)	Case-control, 1950–1975	Oil refinery workers: 36 cases; 216 controls	Employment involving low, medium, or high benzene exposure	RR = 2.0 (1.0–4.0) (High or medium vs. low exposure)
United States, 1983 (24)	Retrospective follow-up, 1960–1977	259 chemical workers. Referent: general population	Employment during 1947–1970 at a plant that has used large amounts of benzene	SMR = 682 (141–1,992)
United States, 1983 (25)	Retrospective follow-up, 1946–1977	4,602 chemical workers. Referent: 1) general population; 2) 3,074 chemical workers with no occupational benzene exposure	Exposed to benzene for >6 months; continuous vs. intermittent exposure; cumulative exposure (ppm-months); duration of exposure and time since first exposure	SMR = 117 (47–242) (general population referent) SMR = 135 (50–295) (continuously exposed) SMR = 276 (>720 ppm-months exposure)
United States, 1983 (26)	Retrospective follow-up, 1952–1978	454 oil refinery workers. Referent: 1) general population; 2) 10% sample of nonbenzene-exposed refinery workers	Employment in benzene-related production units; duration of benzene-related work	Observed, 0; expected, 0.42 (general population referent)
United States, 1983 (27)	Case-control, 1964–1973	Rubber manufacturing workers: 15 lymphocytic leukemia cases; 30 controls	Primary benzene exposure: employment in jobs involving direct use of benzene	RR = 4.5 (0.4–50)
			Secondary benzene exposure: employment in work areas where benzene was used but no direct use in job	RR = 1.5 (0.2–14)
United States, 1984 (28)	Case-control, 1964–1973	11 lymphocytic leukemia cases; 1,350 controls	Employment in work areas where benzene was used	RR = 2.5 (0.6–10)

* SMR, standardized mortality ratio.
† RR, relative risk.
‡ Total, exposed and unexposed. Number of workers exposed and unexposed not stated.

volving potential benzene exposure may have included workers with no exposure to benzene, as well as workers with exposure to chemicals other than benzene. In addition, the relative risks were not reported separately for benzene and medical x-ray exposures, and no attempt was made to quantify leukemia risk according to intensity or duration of benzene exposure.

Thorpe (16) investigated leukemia incidence and mortality among 38,000 active workers and annuitants at eight European affiliates of a large oil company. The observation period was from 1962 to 1971. Employees were classified either as having been exposed to benzene (potential exposure for at least five years to refinery streams or petroleum products containing at least 1 per cent benzene) or not (no or only occasional benzene exposure). The ascertainment both of benzene exposure and of leukemia occurrence was conducted separately by each of the affiliates. The expected number of leukemia deaths was derived from the general population mortality rates of the countries in which the affiliates were located. For workers potentially exposed to benzene, the standardized mortality ratio was 121 (95 per cent CI = 37–205), whereas the standardized mortality ratio was 60 for the unexposed.

This study has a number of limitations. Ascertainment of leukemia cases and documentation of exposure were inadequate. In addition, the report indicates that there was considerable uncertainty about the age structure of the overall cohort. For these reasons, the validity of the reported standardized mortality ratios is questionable. The standardized mortality ratio of 121 for leukemia among potentially exposed workers is unremarkable. However, the study is neither persuasively positive nor negative because of the lack of an analysis of leukemia mortality by induction period, the unexplained deficit of deaths from leukemia among the unexposed and the lack of documentation of the methods used to identify leukemia deaths and to determine benzene exposure.

In 1977, Infante et al. (17) reported the preliminary findings of a retrospective follow-up study of 1,006 workers employed in the manufacture of rubber hydrochloride (trade name, Pliofilm) at three plants in two Ohio locations. Rinsky et al. (18) presented additional results from this study in 1981. All workers with at least one day of exposure to benzene during 1940 through 1959 were included, although most of the results pertained to the 748 men who were first exposed between 1940 and 1949. These men were followed through mid-1975. The investigators used historical benzene exposure monitoring data to describe exposure conditions at the two locations. Although these data were sparse, especially for location 2, the investigators believed that exposure tended to be below the recommended limits.

The mortality experience of the benzene-exposed workers was compared with that of US white men, unexposed rubber hydrochloride workers at the study plants (n = 398), and white male fibrous glass workers in Ohio (n = 1,447). The standardized mortality ratio for leukemia among the 748 men who were first exposed between 1940 and 1949, compared with that of the general population, was 560 (95 per cent CI = 225–1,154), based on seven observed deaths. Using the fibrous glass workers as the referent, the standardized mortality ratio was 473. There were no deaths from leukemia among the unexposed rubber hydrochloride workers; the expected number was not reported but was probably small.

Five of the seven leukemia deaths occurred among men with five or more years of benzene exposure (standardized mortality ratio = 2,100). All of the leukemias were of the myelocytic (acute, 4; chronic, 1) or monocytic (acute, 1; unspecified, 1) cell type. Among men who had first been exposed to benzene between 1950 and 1959, there was one death from myelogenous leukemia compared with 0.5 expected.

Rinsky et al. (19) have recently updated this investigation. The updated study includes 1,165 men who had been exposed to benzene for at least one day during 1940–1965 and extends follow-up through 1981.

The update also uses a job-exposure linkage procedure to estimate the cumulative benzene exposure of the men in the study. The leukemia standardized mortality ratio for the overall cohort compared with the general population was 337, based on nine observed and 2.7 expected leukemia deaths. The findings of the updated study are discussed further in the next section.

The study of rubber hydrochloride workers is the strongest evidence available that benzene is associated with myelocytic leukemia. Even so, the estimate of the standardized mortality ratio for benzene-exposed workers is imprecise. Moreover, the study contains little relevant data on the exposure levels associated with excess leukemia mortality. Five of the seven leukemia deaths occurred at location 2, for which measurements on benzene levels were particularly sparse. Furthermore, location 2 was the site of several manufacturing operations, including tire manufacturing, in addition to rubber hydrochloride production. It is likely that four of the five men with leukemia at location 2 had started working there before 1940, and one had started in 1944. Benzene has been used as a solvent in tire manufacturing; therefore, many of the study members from location 2 may have been exposed to benzene in departments other than rubber hydrochloride, and their actual exposure levels may have been underestimated.

Ott et al. (20) conducted a retrospective follow-up study of 594 Dow Chemical Company employees occupationally exposed to benzene in the production of alkyl benzene, chlorobenzene, and ethyl cellulose. Men employed in these operations from 1938 to 1970 were identified and followed-up through 1973. The study was updated to include an additional 362 exposed employees, and follow-up was extended through the end of 1982 (21). Cumulative exposure to benzene was estimated for each cohort member. The expected numbers of leukemia deaths were derived from leukemia mortality rates of all US white men.

Four leukemia deaths occurred among benzene-exposed workers, whereas 2.1 were expected. Another deceased worker had myelomonocytic leukemia, but this was not certified as the underlying cause of death and was not included in the mortality analysis. The four leukemias were of the myelocytic cell type. Ott et al. estimated an incidence rate ratio of 4.4 (95 per cent CI = 1.2–11) for myelocytic leukemia for benzene-exposed workers relative to the general population.

The average cumulative exposure of cohort members can be estimated from data presented in the updated report. Among a total of 242 expected deaths from all causes, the cumulative exposure category was 0–499 (midpoint, 250) ppm-months for 151 of the expected deaths, 500–999 (midpoint, 750) ppm-months for 35, and 1,000+ (say 1,250) ppm-months for 56. Thus, the average cumulative exposure of cohort members is estimated as 554 ppm-months, or about 46 ppm-years. The cumulative benzene exposures were lower than this for three of five of the leukemia cases.

The major limitations of this study are its small size and thus its imprecise estimate of the effect of benzene on the occurrence of leukemia. The observation that the cumulative benzene exposure of three of the five leukemia cases probably was below the average cumulative exposure of the entire cohort has several possible implications: there may be a threshold effect of benzene among susceptibles; the leukemias may not have been caused by benzene; or the benzene exposure estimates may have been incorrect.

Linos et al. (22) evaluated the relation between leukemia and benzene in a case-control study of 138 leukemia cases and 276 controls. Any mention of a history of exposure to benzene listed in the medical records was the sole criterion of benzene exposure. The relative risk was 3.3 (95 per cent CI = 0.6–28), based on four exposed cases and three exposed controls. Three of the exposed cases had chronic lymphocytic leukemia. This study is largely uninformative because of the limited information on benzene exposures and because of its small size.

Rushton and Alderson (23) conducted a case-control study of leukemia within a large cohort of workers at eight oil refineries in the United Kingdom. An earlier retrospective follow-up study of these workers (31) had reported a standardized mortality ratio for leukemia of 94. The case-control study included 36 leukemia deaths which occurred among men employed between 1950 and 1975 and 216 controls who had worked at the refineries during the same period. Measurements of workplace benzene levels were not available. However, study subjects were classified as having been exposed to low, medium, or high levels of benzene based upon their work histories. The relative risk for medium or high exposure compared with low exposure was 2.0 (95 per cent CI = 1.0–4.0). The relative risk was not higher among men with high exposure compared with medium exposure, and, furthermore, relative risk did not appear to be related to length of service at the refineries. The relative risks for the various types of leukemia were not presented.

The results of this study are supportive of a leukemogenic effect of benzene or other solvents used in conjunction with benzene. However, the informativeness of the study is limited by the lack of data on exposure levels and by the absence of any analyses by duration of exposure or by induction period.

Decouflé et al. (24) evaluated the mortality experience of 259 men employed between 1947 and 1960 at a chemical manufacturing plant. Large amounts of benzene had been used at the plant, but no measurements of benzene levels were available. Employees had also worked with other chemicals. These men were followed from 1960 through 1977. There were three deaths from leukemia compared with 0.44 expected (standardized mortality ratio = 682; 95 per cent CI = 141–1,992). The cell types of the three leukemias were chronic lymphocytic, acute monocytic, and acute myelomonocytic.

Wong (25) conducted a retrospective follow-up study of 4,602 male chemical workers at seven plants. The study group included men who had been exposed to benzene for at least six months between 1946 and 1977. Jobs were classified as involving intermittent or continuous benzene exposure. For workers with continuous exposure, cumulative exposure to benzene (ppm-months) was calculated by using length of employment and the estimated eight-hour time-weighted average for each job. Using the distribution of workers according to a cumulative ppm-months benzene measure presented by Wong, the average exposure of continuously exposed workers is estimated to be about 366 ppm-months (about 30 ppm-years). This corresponds to a time-weighted average of about 3 ppm, since the average duration of exposure was 10 years. The mortality rates of exposed workers were compared with those of US men and with those of an internal comparison group comprised of 3,074 men who had worked at the same or at nearby chemical plants but who were not exposed to benzene.

For the overall group of exposed workers, there was a slight excess of leukemia deaths compared with US men (seven deaths, standardized mortality ratio = 117; 95 per cent CI = 47–242). Four of these leukemias were of the lymphocytic cell type, two were myelocytic (both chronic), and one was unspecified. Among unexposed workers, there were no leukemias, whereas 3.4 were expected (two-tailed p value = 0.07). The standardized mortality ratio for all causes was similar for the exposed workers (standardized mortality ratio = 87) and unexposed workers (standardized mortality ratio = 75).

Six of the leukemia deaths among exposed workers occurred among men with continuous exposure (standardized mortality ratio = 135; 95 per cent CI = 50–295). However, for these workers, there was no consistent trend in the standardized mortality ratio for leukemia over categories of either duration of exposure or cumulative exposure, although the latter test for trend, using the nonexposed internal comparison

group, yielded a one-tailed p value of 0.01. The standardized mortality ratio increased with years since first exposure from a value of 0 for under 10 years to 182 (four leukemia deaths) for at least 20 years. For men with cumulative benzene exposure of at least 60 ppm-years, the leukemia standardized mortality ratio was 276 based on three deaths.

This study contains some evidence of a positive relation between benzene and leukemia. However, the overall standardized mortality ratio of 117 for leukemia is not statistically significant and the slight excess could be due to confounding by exposure to other chemicals. Moreover, the study is too small to provide an adequate assessment of dose-response. Because unexposed workers had a deficit of leukemia deaths, no confidence can be placed in statistical tests of trend which include the unexposed group. The fact that none of the leukemia deaths among the benzene-exposed workers was acute myelocytic leukemia further detracts from a causal interpretation of the study results.

Tsai et al. (26) reported the mortality experience of 454 men who had been employed at an oil refinery between 1952 and 1978 and who had worked in benzene-related production units. Review of industrial hygiene data for 1973–1982 indicated that the median exposure level in these units was about 0.5 ppm. Comparison groups consisted of the general US male population and a 10 per cent sample of nonbenzene-exposed workers at the same refinery (n = 823). There were no leukemia deaths among the workers exposed to benzene. The expected numbers, based on general population rates, were 0.42 for all exposed workers and 0.29 for workers employed for at least one year in a benzene-related unit. There were five deaths from leukemia and lymphatic cancer among unexposed workers, but no data were presented on the expected numbers of deaths. Although this study found no excess of leukemia, its small size and the relatively small proportion (36 per cent) of the cohort with an adequate follow-up period preclude any firm conclusion about the risk of leukemia associated with the low levels of benzene described.

Several case-control studies of leukemia and solvent exposures have been conducted within the rubber industry (27, 28, 32, 33). Three of these studies were based on the same series of cases from one rubber company (27, 28, 32). A fourth study included this series plus additional cases from three other companies (33). Each study reported a positive association between lymphocytic leukemia and solvents. This association was present in only one of the four rubber companies, and it was not found for other leukemia cell types.

Two of the studies evaluated the relation between lymphocytic leukemia and exposure to specific solvents, including benzene (27, 28). In the study by Arp et al. (27), exposure to benzene and to other solvents was determined by linking subjects' work histories with historical information on specific solvents used in various work areas and processes. Subjects were classified as having "primary" benzene exposure if they had worked in areas where benzene was used and if their jobs entailed direct handling of benzene or benzene-containing solutions. Subjects were considered to have "secondary" exposure if they had worked in areas where benzene was used but did not have jobs involving direct contact. Quantitative levels of benzene exposure were not estimated. The relative risk of lymphocytic leukemia was 4.5 for workers with primary benzene exposure and 1.5 for workers with secondary exposure. Estimated relative risks for exposure to solvents other than benzene were nearly identical to those for benzene, 4.5 for primary exposure and 1.6 for secondary exposure.

Checkoway et al. (28) studied 11 of the lymphocytic leukemia cases included in the study by Arp et al. and 1,350 controls. Benzene exposure was determined on the basis of employment in work areas where benzene was used; no distinction was made between primary and secondary benzene exposures. The relative risk of lymphocytic leukemia was 2.5 for workers with benzene

exposure. Elevated relative risks were found for workers exposed to a number of other solvents, including acetone, carbon disulfide, carbon tetrachloride, ethylacetate, and hexane.

These studies do not provide persuasive evidence of a causal relation between benzene and lymphocytic leukemia among rubber workers. The confidence intervals of the relative risk estimates are wide, reflecting the imprecision of these estimates, and they include the null value of 1.0. Moreover, it is evident that these rubber workers were exposed to solvents other than benzene and some of these are associated with a relative risk of leukemia that is at least as large as that for benzene. Because exposure classification was not mutually exclusive with regard to solvents, it is possible that the observed association between benzene and lymphocytic leukemia is due, not to benzene, but to other solvents whose use is correlated with the use of benzene.

In addition to the studies described above, investigations of large groups of rubber workers (32, 34–42), newspaper web pressmen (43), and refinery workers (16, 31, 44–55) evaluated leukemia mortality or incidence, and some have found excesses (32, 34–37, 41, 43, 46, 48–51, 53, 54). Workers in these industries are exposed to solvents other than benzene and to other chemicals as well. Several authors have noted that because of this, leukemia excesses among rubber and refinery workers should not be attributed solely to benzene.

In the aggregate, the epidemiologic evidence suggests a link between benzene and leukemia. However, this evidence is not conclusive because it comes primarily from the single relatively small study by Rinsky et al. (19). The other epidemiologic data provide, at best, weak evidence of a causal association between benzene and leukemia. No study rules out the possibility that observed associations between benzene and leukemia are attributable, at least in part, to confounding by solvents other than benzene. As others have pointed out (28), this possibility has not been explored adequately in the rubber industry, an observation which also applies to the petrochemical industry and to other industries in which there is widespread exposure to many solvents. Also, because the major pertinent studies have been small, little confidence can be placed in available quantitative estimates of the magnitude of any association. Measures of benzene exposure levels for relevant time periods are extremely sparse in all of the studies. Therefore, considerable doubt remains about the leukemogenic effect of benzene at specific exposure levels and especially at low levels.

Risk assessments

The expression "risk assessment" describes the final step in a long process. The process usually begins with an effort, often based solely on experimental findings in animals, to describe a dose-response relation between a carcinogen and a cancer. This phase of the process usually involves extrapolation from observed, usually high, dose levels to hypothetical, usually low, dose levels. The process then continues by the making of a generalization to man on the basis of the results in animals. This generalization involves a number of assumptions to equate both the manner of dosing and the manner of responding of animals and man. These assumptions are usually not subject to evaluation.

In other instances, the process of risk assessment does not employ findings from animals but rather uses epidemiologic findings on human beings. In such instances, the difficulties of the animal-to-man generalization are irrelevant. Nonetheless, the process may still lead to results of dubious validity. There are two common reasons for this: 1) the available data are sparse and 2) the people studied experienced quite high exposures so that some extrapolation is necessary to predict effects at lower doses.

Efforts to describe a risk assessment for benzene and leukemia are in the second category. There are little meaningful animal data. Data for human beings are few and relate to uncertain, but probably rather

high, exposure levels. Thus, efforts to describe the extent of small increases in leukemia risk as a consequence of low-level exposure to benzene must lead to imprecise results.

The benzene-leukemia risk assessments have used "linear" and "exponential" models to relate benzene exposures to leukemia. However, the use of such mathematical models obscures the fact that the data are too sparse to provide an adequate description of the shape of the dose-response curve. Essentially, the results of most of the benzene-leukemia risk assessments can be well approximated by assuming that the leukemia "effect" is directly proportional to the dose, usually measured as lifetime cumulative exposure. For example, if 15 years of exposure to 10 ppm (150 ppm-years) of benzene is associated with a twofold excess of leukemia deaths, then it is assumed that 30 years of exposure to 10 ppm (300 ppm-years) of benzene would cause a fourfold excess. This linear model is generally considered "conservative" in that it probably overestimates the leukemogenic effects at low doses. It must be borne in mind, however, that the validity of a linear model in the benzene-leukemia risk assessments is not established.

The concept of a "threshold" is meaningful for the benzene-leukemia risk assessments and relates directly to the issue of what constitutes a meaningful measure of benzene exposure. Most of the benzene-leukemia risk assessments are based on cumulative benzene exposures; these are obtained by multiplying years of exposure by the average ambient benzene levels. Thus, exposure to 1 ppm benzene for 10 years is considered as the equivalent to exposure to 10 ppm benzene for one year. This method of obtaining a summary exposure measure is used frequently in carcinogen risk assessments, the motivation being its simplicity. Nonetheless, it may not be particularly meaningful. The human body metabolizes and excretes with no apparent harm low levels of toxic substances that are harmful at higher levels. This may be true of benzene. That is, there may be a level of benzene exposure below which no leukemogenic effect occurs. Thus, a lifetime of exposure to benzene at 1 ppm may entail no increased leukemia risk, although a nonthreshold linear model using a cumulative exposure measure might entail an appreciable excess risk. A related problem is that of peak exposures. No adequate provision is made in the risk assessments for the possibly high, perhaps very high, benzene levels that may be uniquely harmful. These intermittently high exposures are of special concern with respect to the Pliofilm cohort, a group upon which most risk assessments are largely based. There is evidence that these workers were occasionally exposed to benzene levels high enough to require hospitalization for aplastic anemia (56). Thus, it is plausible that the excess leukemia mortality observed among the Pliofilm cohort was due to transient high exposures.

We do not suggest that carcinogen risk assessments are never useful. However, in the present situation of a risk assessment for benzene and leukemia, there are special problems. There are few human studies relevant to an evaluation of the relation between benzene and leukemia, and those that exist are small. Thus, estimates of the leukemogenic effect of benzene are imprecise. An even more serious limitation is that the levels of benzene to which the workers in these cohorts were exposed are essentially unknown. These particular limitations must be considered in the context of the more general limitations of carcinogen risk assessments. A reasonable argument could be made that the data pertaining to benzene and leukemia are inadequate for the purposes of a meaningful risk assessment. Nonetheless, such risk assessments have been and probably will continue to be done.

Five benzene-leukemia risk assessments are reviewed below. An attempt is made to refine and to extend the findings of some of them. We also present our own risk assessment. However, we emphasize that by doing so we do not endorse the validity of a benzene-leukemia risk assessment re-

sult. We wish only to consider the various assumptions of these risk assessments and to evaluate the extent to which their results agree or differ.

The White et al. risk assessment

One risk assessment has been made by White et al. (57) of the Office of Carcinogen Identification and Classification, US Occupational Safety and Health Administration. These investigators used the so-called one-hit, non-threshold model. Although this is an exponential mathematical model, it is essentially linear in the range of benzene exposures considered. For clarity, the results are approximated below by us with a simple linear model. The original model and our approximation produce almost identical results.

This risk assessment is based upon the results of two retrospective follow-up studies: the study of rubber hydrochloride workers originally reported by Infante et al. (17) and later updated by Rinsky et al. (18) (hereafter termed the Pliofilm study) and the first report of the study of Dow chemical workers by Ott et al. (20). White et al. considered other epidemiologic studies of benzene and leukemia inadequate for the purpose of a risk assessment.

Using the assumptions of White et al. regarding the findings of the Pliofilm study, the excess risk of death from leukemia (P_d) resulting from a specified benzene exposure is approximated by the following equation:

$$P_d = P_o\left(\frac{\text{SMR} - 100}{100}\right)\left(\frac{d_p}{d}\right),$$

where P_o = risk of death from leukemia for a white man from age 20 through 84 years with no occupational exposure to benzene (P_o = 7/1,000 according to White et al.); SMR = the standardized mortality ratio—the mortality rate of leukemia among workers exposed to benzene divided by the rate among men in the general population and multiplied by 100 (a standardized mortality ratio of 2,100 was used by White et al.); d = the average cumulative benzene exposure sustained by members of the Pliofilm cohort expressed in ppm-years (415–1,500 ppm-years according to White et al.); and d_p = the cumulative benzene exposure (expressed in ppm-years) for which an estimate of the excess leukemia mortality is desired.

Thus, for example, if 1,000 men were exposed in the workplace for 30 years to 10 ppm of benzene (300 ppm-years per man), this modified version of the White et al. risk assessment predicts that between 28 and 101 of the exposed men will die from benzene-induced leukemia. This is as compared with a baseline of seven deaths among unexposed men. Throughout the remainder of this paper we will use an exposure level of 300 ppm-years to compare the results of the various risk assessments.

The standardized mortality ratio of 2,100 was obtained from the observation of five leukemia deaths compared with 0.23 expected among men who had been employed for five or more years. White et al. excluded workers with fewer than five years of employment because the elevated leukemia risk was observed largely among the long-term employees. This is a prejudicial justification for excluding the short-term employees. A more defensible basis for their exclusion is that over half of these men had been employed for less than one year, and therefore had little benzene exposure. Nonetheless, White et al. do apply their risk assessment method to exposure durations as short as one year. It is inappropriate to derive a model excluding the experience of those with short exposure durations and, yet, to apply it to this very same situation.

The ambient benzene levels experienced by the Pliofilm workers were considered to be equal to the then current recommended standards. This assumption is controversial. Infante et al. (58) maintain that this assumption overestimates the actual benzene exposures (and, hence, that their risk assessment underestimates excess leukemia mortality). Others (59, 60) believe that the actual benzene exposures were consid-

erably higher than the recommended standards. A point of agreement is that the actual benzene exposures sustained by members of the Pliofilm cohort are unknown, as Infante et al. (58) recognize. This uncertainty about the benzene levels is the major limitation of a risk assessment based on the Pliofilm cohort. White et al. obtained a lower bound for the average benzene exposure (415 ppm-years) by multiplying the average recommended standards for 1937 through 1954 (83 ppm) by five years, the minimum employment duration. The upper bound for the average benzene exposure (1,500 ppm-year) was obtained by multiplying the average recommended standard for 1937 through 1975 (50 ppm) by the maximum length of employment, 30 years. These bounds cover a broad range of benzene exposures and neither is likely to accurately describe the benzene exposure of a typical worker. It is unclear why White et al. did not estimate individual cumulative benzene exposures by multiplying each year of employment of each subject by the standard prevailing in that year and then summing these exposure years. This failure is a major shortcoming of their risk assessment. However, this problem was corrected in a more recent risk assessment based on these data (see below).

White et al. also did a risk assessment based upon the results of the first report of the Dow study. This risk assessment yielded results similar to those obtained from the Pliofilm data. As mentioned earlier, the men in the Dow cohort probably were exposed to considerably lower levels of benzene (cumulative exposure of about 45 ppm-years) than were the men in the Pliofilm cohort. Although there were two leukemia deaths observed, compared with one expected in the Dow study, White et al. did not use the resulting standardized mortality ratio of 200; rather, a relative incidence rate of 3.75 is used. This relative incidence rate is based upon the occurrence of three myelocytic leukemia cases among the cohort compared with 0.8 expected. It is emphasized that this risk assessment is based on only three leukemia cases and so is very imprecise.

The International Agency for Research on Cancer risk assessment

The International Agency for Research on Cancer (1) also has estimated that benzene levels similar to those experienced by men in the Pliofilm cohort are likely to cause an excess of 140–170 leukemia deaths per 1,000 men exposed for a working lifetime. The estimate of 140 excess leukemia deaths was obtained by considering that those men who had been employed for at least five years had experienced a 20-fold excess in leukemia mortality and that the risk that a man will die from leukemia in the absence of benzene exposure is about seven per 1,000. The same assumptions were made by White et al. (57). The International Agency for Research on Cancer considered this estimate a lower bound for the risk associated with a working lifetime (45 years) at similar levels. However, it can be inferred from table 11 of Rinsky et al. (18) that the average duration of employment among men who had worked for at least five years was about 11 years. Presumably, 45, as opposed to 11, years of exposure at such benzene levels would cause about a fourfold higher excess. The figure of 170 was obtained by considering that the overall excess in the Pliofilm cohort was 460 per cent (i.e., the rate of leukemia among the cohort was 5.6 times that of the general population rate) and that the average duration of employment of *leukemia cases* was 8.5 years. The authors then assumed that this overall excess would increase "smoothly" (presumably, linearly) from zero just after initial exposure to about 2,400 per cent after 45 years (i.e., 460 × 45/8.5). The resulting age-specific excesses were then applied to the age-specific leukemia rates, and the figure of 170 excess cases of leukemia per 1,000 men was obtained.

In our opinion, their second risk assessment is wrong. The problem is evident in their statement that "the overall relative

risk of 5.6 in the Rinsky study derives from leukaemia cases who had an average of 8.5 years of exposure." A relative risk does not derive from leukemia cases; it is obtained from the comparative mortality experience of exposed and unexposed persons. The authors should have used the average employment duration of the entire cohort (3.2 years, our estimate based upon information in Rinsky et al. (18)) rather than that of the leukemia cases. Thus, the estimate of the excess after 45 years of exposure would be about 6,500 per cent (i.e., 460 × 45/3.2) rather than 2,400 per cent. If this correction is made, the result would be about three times as high.

The authors judged that the Pliofilm cohort members had been exposed to between 10 and 100 ppm of benzene. They state that "assuming exposure was at the upper end of the range, then it is reasonable to postulate that a working lifetime exposure to 100 ppm of benzene would be likely to result in 140–170 cases of leukemia per 1,000 exposed workers." However, it is unlikely that these men were exposed constantly to as much as 100 ppm benzene, and it is certainly true that they were not exposed for as long as 45 years. Thus, this statement is not justified by the results of the Pliofilm study. According to the White et al. risk assessment (57), 45 years of exposure to 100 ppm benzene would produce between about 420 and 1,500 excess leukemia deaths per 1,000 men. Because of the problems discussed above, little confidence can be placed in the risk assessment done by the International Agency for Research on Cancer, and their methodology is not applied to an exposure situation of 300 ppm-years.

The Carcinogen Assessment Group risk assessment

The Carcinogen Assessment Group of the US Environmental Protection Agency (61) has also done a benzene-leukemia risk assessment. The Group attempted to estimate the number of excess leukemia deaths in the general population attributable to exposure to benzene as an air pollutant. However, their methodology can be applied to an occupational setting.

The Group's risk assessment was based upon the results of the Pliofilm study (17, 18), the Dow study (20), and Aksoy's study (29). For the Pliofilm study, they used an overall standardized mortality ratio of 720, based upon nine observed leukemia cases compared with 1.25 expected. The nine observed cases include two that were "known to exist" but were not mentioned on the death certificate. Since the expected number of deaths is based only upon information on death certificates, the inclusion of these two extra cases yields a spuriously high standardized mortality ratio. This group assumed that the Pliofilm cohort members had been exposed to between about 24 and 40 ppm of benzene. However, they erroneously assumed that these men had been employed for 25 to 35 years, whereas their actual period of employment was considerably shorter. If their risk assessment is applied to a workplace exposure of 300 ppm-years, an estimate of about 15 excess leukemia deaths per 1,000 men is obtained. However, because of the errors discussed above, no confidence can be placed in this estimate.

The Carcinogen Assessment Group also based a risk assessment on the results of the Dow study. In doing so, they this time correctly estimated the duration of employment of the cohort. Applying their risk assessment to 300 ppm-years of benzene yields an excess of 47 myelocytic leukemia deaths per 1,000 men so exposed. This result is similar to that obtained by White et al. (57). The Group also attempted to use the results of the study by Aksoy (29) in a risk assessment. However, it is difficult to interpret the result because of the many limitations of Aksoy's study and we therefore do not consider this risk assessment meaningful.

The Rinsky et al. risk assessment

This risk assessment is based upon the update of the Pliofilm cohort (19) and is an improvement over that done by White et

al. (57) insofar as a cumulative measure of benzene exposure was obtained for each cohort member.

Rinsky et al. (19) report standardized mortality ratios according to four levels of cumulative benzene exposure (less than 40 ppm-years, 40–200 ppm-years, 200–400 ppm-years, and greater than 400 ppm-years). The corresponding number of leukemia deaths and the standardized mortality ratios (which have been divided by 100 so that they can be compared with the odds ratios presented below) are 2 and 1.1; 2 and 3.2; 2 and 11.9; and 3 and 66, respectively. Thus, there is a strong positive relation between cumulative benzene exposure and leukemia mortality in this study.

These investigators, however, did not use the results of the cohort study to do the risk assessment, but, instead, did a nested case-control study (10 matched controls per case) and used conditional logistic regression to derive an exposure-response relation between cumulative benzene exposure and leukemia mortality. Based upon their risk assessment, they would predict that 300 ppm-years of benzene exposure would result in an odds ratio (a relative mortality rate) of about 44, which we calculate would yield about 250 excess lifetime leukemia deaths among 1,000 men exposed to 10 ppm for 30 years beginning at age 20 years.

In our opinion, their risk assessment should have derived from the results of the cohort study rather than from those of the case-control study. Presumably, an estimate of cumulative benzene exposure was available for all cohort members. Thus, the need to restrict the analysis to a subset of the subjects is unclear. More importantly, if their model is applied to the data obtained in the cohort study, the estimated odds ratios for the four categories of cumulative benzene exposure presented above (using midpoints of exposure categories and 480 ppm-years for the highest, open-ended category) are 1.3, 4.5, 43.8 and 423, respectively. Although the interpretation of an odds ratio is not strictly comparable to that of a standardized mortality ratio, they are both a measure of the relative rate of disease among the exposed compared with the unexposed and therefore should be similar. It is apparent that the Rinsky et al. model overestimates the observed standardized mortality ratios in the upper two exposure categories, especially in the highest. As an alternative risk assessment based on these data, we fitted a Poisson regression model using the four reported standardized mortality ratios and the midpoint of their four cumulative exposure categories (62). Our predicted standardized mortality ratios are 1.2, 2.8, 13.6, and 65, respectively. Our model provides a considerably better fit to the observed standardized mortality ratios than does the model of Rinsky et al. Our predicted number of excess leukemia deaths for 1,000 men exposed to 10 ppm benzene for 30 years beginning at age 20 years based upon the Poisson regression model is 82.

The Crump and Allen risk assessment

Crump and Allen (63) also have done a benzene-leukemia risk assessment. Their risk assessment is based upon the results of the Pliofilm cohort, the Dow cohort, and Wong's study of chemical workers.

These investigators used two types of linear models for their risk assessment. The first, the absolute risk model, assumes that the number of excess leukemia deaths attributable to a specific amount of benzene exposure is constant at every age (an additive excess). The second, a relative risk model, assumes that the increase in leukemia mortality at any age for a given level of benzene exposure is directly proportional to the baseline age-specific leukemia mortality rate (a multiplicative excess). They also considered three measures of benzene dose: 1) lifetime cumulative exposure, 2) a weighted cumulative exposure which considers recent benzene exposures as most relevant (exposures sustained between 2.5 and seven years before follow-up) and provides progressively less weight to exposures sustained in the more distant past, and 3) a window exposure method which essen-

tially ignores all benzene exposures sustained more than 15 years in the past. Their relative risk model used in conjunction with lifetime cumulative exposure yielded the highest risks. Since the other risk assessments discussed above used a relative risk model with lifetime cumulative exposure as a measure of benzene dose, we report here only these results from Crump and Allen's report. However, it is emphasized that their risk assessment result based upon the absolute risk model used in conjunction with the window exposure method yielded results about one-eighth as high as those reported here. This observation demonstrates that risk assessment results will vary widely depending upon the choice of the model and the measurement of benzene dose.

Crump and Allen estimated that 40 years of exposure beginning at age 20 years to 10 ppm benzene would cause 88 excess leukemia deaths per 1,000 men so exposed. By simple linear interpolation, we estimate that their risk assessment method applied for 30 years to 10 ppm (beginning at age 20 years) would yield about 68 excess leukemia deaths.

These investigators also did a risk assessment based solely on the Pliofilm cohort using a relative risk model with a lifetime cumulative dose. They did their own analysis of the Pliofilm cohort and were able to include additional years of follow-up. They report eight observed leukemia deaths versus about 3.0 expected, yielding a standardized mortality ratio of 268. Their risk assessment result based upon the Pliofilm cohort is 63 excess leukemia deaths per 1,000 men exposed to 400 ppm-years of benzene, or about 48 for 300 ppm-years. They also did a risk assessment based solely on Wong's study. From these data, they calculate that exposure to 10 ppm benzene beginning at age 20 years and continuing for 40 years would cause 121 excess leukemia deaths per 1,000 exposed men (or about 94 for 300 ppm-years). However, they point out that this excess is due largely to a deficit of leukemia mortality among the unexposed and therefore place little confidence in it.

Some of the discrepancy between the risk assessment results on the Pliofilm cohort reported by Rinsky et al. and Crump and Allen apparently results from disagreement between them as to the levels of benzene to which these men were exposed. Crump and Allen's estimates of the benzene exposures are generally higher (and therefore their risk assessment results are lower) than those of Rinsky et al., especially for exposures sustained between 1940 and 1948. However, Crump and Allen calculated that if their exposure estimates are decreased to levels more comparable with those of Rinsky, their risk assessment results would increase by about only 25 per cent.

Our risk assessment

We have used the method suggested by Enterline (64) for our risk assessment. An estimate of lifetime excess leukemia deaths attributable to benzene is obtained by dividing the difference between the observed and expected number of leukemia deaths by the total number of expected deaths (all causes) in the cohort. The underlying assumption of this method is that the proportional excess leukemia mortality observed during the follow-up period will continue until all cohort members have died. If a cohort is followed until most of its members are deceased, the method will be accurate. On the other hand, if a cohort has been followed for only a small fraction of its life expectancy, this risk assessment method must extrapolate the proportional excess to future deaths and hence the result is likely to be less valid and less precise.

In the latest report of the Pliofilm study (19), 6.34 excess leukemia deaths were observed among the cohort (observed = 9, expected = 2.66). The total number of expected deaths was 331.6. Therefore, the number of excess leukemia deaths per 1,000 exposed men is estimated as

$$1{,}000 \times (6.34/331.6) \text{ or } 19.$$

To apply the method to an exposure situa-

tion of 300 ppm-years, the benzene exposures experienced by the Pliofilm workers must be considered and, furthermore, it is assumed that excess leukemia mortality is directly proportional to cumulative benzene dose. It can be inferred from table 2 of their report that the average cumulative benzene exposure among members of the Pliofilm cohort was about 69 ppm-years. The excess number of leukemia deaths resulting from 300 ppm-years is then estimated as:

$$(6.34/331.6) \times (300 \text{ ppm-years}/69 \text{ ppm-years}) = 83 \text{ per } 1{,}000.$$

We also applied Enterline's method to the Pliofilm cohort for follow-up through 1975 (18) so that the result could be compared with that of White et al. (57). The observed number of leukemia deaths as of that time was seven versus an expectation of 1.25. The total number of expected deaths was 161.3. We assumed, as did White et al., that these men had been exposed to between 50 and 83 ppm benzene (say, 66 ppm). The average duration of employment for the entire Pliofilm cohort was about 3.2 years. The result is an excess of about 51 leukemia deaths per 1,000 men exposed to 300 ppm-years benzene. This result agrees reasonably well with that obtained by White et al. for long-term workers only. It should be mentioned that the cumulative benzene exposure level assumed by White et al. in their risk assessment and the level considered by us in this risk assessment are appreciably higher than the level of 69 ppm-years presented in the latest report of the Pliofilm cohort (19).

Enterline's risk assessment method also can be applied to the latest report of the Dow cohort in which there were four leukemia deaths observed versus 2.1 expected (21). These men had an average cumulative benzene exposure of about 46 ppm-years and the total number of expected deaths was 268.6. Thus, it is estimated that 300 ppm-years of benzene exposure would result in

$$(1.9/268.6) \times (300 \text{ ppm-years}/46 \text{ ppm-years}) = 46 \text{ per } 1{,}000 \text{ excess leukemia deaths.}$$

The retrospective follow-up study of refinery workers by Tsai et al. (26) included estimates of benzene exposures. These workers were typically exposed to less than 1 ppm of benzene (median, 0.5 ppm). The average duration of employment was about seven years, resulting in an average cumulative benzene exposure of about 3.5 ppm-years. If these refinery workers were subjected to the same benzene-induced leukemia mortality as were the Pliofilm workers, their overall standardized mortality ratio would be about 112. Therefore, the observation that there was no leukemia death observed compared with 0.42 expected does not contradict the results of the above risk assessments. Tsai's study is simply too small and the benzene exposures too low for it to contribute to the benzene-leukemia risk assessment.

The study by Wong (25) of chemical workers also contains estimates of benzene exposures. There were 3,536 men "continuously" exposed to benzene in this study. Their average cumulative benzene exposure was about 30 ppm-years. There were six observed leukemia deaths compared with 4.4 expected (standardized mortality ratio = 135) and the total number of expected deaths was 613. Therefore, the number of excess leukemia deaths resulting from exposure to 300 ppm-years is estimated as:

$$(1.57/613) \times (300 \text{ ppm-years}/30 \text{ ppm-years}) = 26 \text{ per } 1{,}000.$$

The result does not agree well with that of Crump and Allen (63). The discrepancy is in part related to the observation that there is no consistent dose-response relation between leukemia mortality and the cumulative benzene dose in Wong's study and in part to the deficit of leukemia among the

unexposed in this study. For these reasons, we believe that Wong's study is not as informative to a risk assessment as are the Pliofilm and Dow studies.

Summary of risk assessments

Five risk assessments for benzene-induced leukemia have been reviewed. Table 2 presents a summary of the results of four of the risk assessments based on the Pliofilm and Dow cohorts, along with our own estimates. Some of these investigators did not directly calculate the estimates displayed in table 2, but we extended their methodology to this particular exposure situation.

Our own risk assessment results, those of Crump and Allen (63), and those of White et al. (57) agree fairly well. The Carcinogen Assessment Group estimate is too low for the Pliofilm study because of an error regarding the duration of employment of this cohort, as discussed. Their risk assessment result based upon the Dow study, however, agrees well with the other results. Given the different methodologies and assumptions applied by the various risk assessment authors, the results, with the exception of that of Rinsky et al. (19), are reasonably consistent.

The result reached by Rinsky et al. is considerably higher than the others. It is difficult to understand why and, unfortunately, we cannot directly attempt to replicate their case-control results. However, we did do two risk assessments based on the results of the cohort study from which their case-control study derives. Our result using Poisson regression is 82 excess leukemia deaths per 1,000 men exposed to 300 ppm-years, while our result based upon Enterline's method is 83. Since the Rinsky et al. result does not agree with the others, including two independent risk assessments (ours and that of Crump and Allen) based upon the same cohort, we believe their result is too high.

An interpretation of these risk assessment results is that the Pliofilm study indicates an appreciable excess leukemia risk attributable to benzene and that the other studies provide some support, or at least do not contradict this. However, it must be borne in mind that the other studies were either very small or suffered serious methodological problems, so that, despite the observation that they seem to support the results of a risk assessment based upon the Pliofilm study, little confidence can be placed in them.

TABLE 2

Numbers of lifetime excess leukemia deaths per 1,000 workers exposed to 10 ppm benzene for 30 years, as estimated by various risk assessments

Risk assessment authors (ref. no.)	Study from which risk assessments derive			
	Pliofilm cohort		Dow cohort	
	(Follow-up through)		(Follow-up through)	
	1975	1981	1973	1982
White et al. (57)	30–104* (Midpoint, 67)	(Not done)	32–93† (Midpoint, 62)	(Not done)
Carcinogen Assessment Group (61)	15	(Not done)	47‡	(Not done)
Rinsky et al. (19)	(Not done)	250	(Not done)	(Not done)
Crump and Allen (63)	(Not done)	48	68§	(Not done)
Present study	51	83	47	46

* Based on cohort members with five or more years of employment.

† Leukemia cell types other than lymphocytic or monocytic.

‡ Myelocytic leukemia only.

§ Based on the Pliofilm cohort, the Dow cohort, and Wong's study.

TABLE 3

Summary of epidemiologic studies from which the risk assessment results presented here are derived

Study (ref. no.)	Leukemia deaths		Total expected deaths	Cumulative benzene exposure (in ppm-years)
	Observed	Expected		
Pliofilm study (19)	9	2.7	332	69
Dow study (21)	4	2.1	269	46
Tsai et al. (26)	0	0.42	59	4
Wong et al. (25)	6	4.4	613	30
Total	19	9.6	1,273	42*

* A weighted average according to the expected number of deaths in each study.

The results of the epidemiologic studies which we considered in our benzene-leukemia risk assessment are displayed in table 3. The overall standardized mortality ratio from these four studies is 198. A weighted average (weighted according to the expected number of total deaths) of the cumulative benzene exposures sustained by the men in these cohorts is about 42 ppm-years. Thus, an overall estimate of the number of excess leukemia deaths associated with 300 ppm-years of occupational exposure to benzene is obtained as:

$$(19 - 9.6)/1{,}273$$

$$\times \text{ (300 ppm-years/42 ppm-years)}$$

$$= 53 \text{ per } 1{,}000.$$

Using the lower and upper 95 per cent confidence limits of the overall standardized mortality ratio, a lower and upper bound for the number of excess leukemia deaths for 300 ppm-years of benzene exposure are 10 and 113 per 1,000, respectively. The estimates for 30 years of exposure beginning at age 20 years to the proposed new standard of 1 ppm benzene are one-tenth of these results.

SUMMARY

Benzene is widely recognized as a leukemogen, and the Occupational Safety and Health Administration is currently attempting to limit exposure to it more strictly. The proposed new regulation is a limit of an eight-hour time-weighted average of 1 ppm in place of the current limit of 10 ppm. The fundamental rationale for the change is a perception that the current standard is associated with an inordinate excess of leukemia.

The epidemiologic literature on benzene and leukemia supports the inference that benzene causes acute myelocytic leukemia. However, the available data are too sparse, or suffer other limitations, to substantiate the idea that this causal association applies at low levels (i.e., 1–10 ppm) of benzene. Nonetheless, under the assumption that causation does apply at such low levels, a number of authors, including ourselves, have performed risk assessments using similar data but different methodologies. The assessments that we consider acceptable suggest that, among 1,000 men exposed to benzene at 10 ppm for a working lifetime of 30 years, there would occur about 50 excess deaths due to leukemia in addition to the baseline expectation of seven deaths. However, this estimate is speculative and whether or not enough confidence can be placed in it to justify a lower occupational benzene standard remains a decision for policy makers.

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PUBLIC HEALTH STATEMENT
Benzene
CAS#: 71-43-2

Division of Toxicology and Environmental Medicine **August 2007**

This Public Health Statement is the summary chapter from the Toxicological Profile for Benzene. It is one in a series of Public Health Statements about hazardous substances and their health effects. A shorter version, the ToxFAQs™, is also available. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present. For more information, call the ATSDR Information Center at 1-800-232-4636.

This public health statement tells you about benzene and the effects of exposure to it.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites are then placed on the National Priorities List (NPL) and are targeted for long-term federal clean-up activities. Benzene has been found in at least 1,000 of the 1,684 current or former NPL sites. Although the total number of NPL sites evaluated for this substance is not known, the possibility exists that the number of sites at which benzene is found may increase in the future as more sites are evaluated. This information is important because these sites may be sources of exposure and exposure to this substance may harm you.

When a substance is released either from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. Such a release does not always lead to exposure. You can be exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance, or by skin contact.

If you are exposed to benzene, many factors will determine whether you will be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider any other chemicals you are exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

1.1 WHAT IS BENZENE?

Benzene, also known as benzol, is a colorless liquid with a sweet odor. Benzene evaporates into air very quickly and dissolves slightly in water. Benzene is highly flammable. Most people can begin to smell benzene in air at approximately 60 parts of benzene per million parts of air (ppm) and recognize it as benzene at 100 ppm. Most people can begin to taste benzene in water at 0.5–4.5 ppm. One part per million is approximately equal to one drop in 40 gallons. Benzene is found in air, water, and soil. Benzene comes from both industrial and natural sources.

Industrial Sources and Uses. Benzene was first discovered and isolated from coal tar in the 1800s. Today, benzene is made mostly from petroleum. Because of its wide use, benzene ranks in the top 20 in production volume for chemicals produced in the United States. Various industries use benzene to make other chemicals, such as styrene (for Styrofoam® and other plastics), cumene (for various resins), and cyclohexane (for nylon and synthetic fibers). Benzene is also used in the

manufacturing of some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides.

Natural Sources. Natural sources of benzene, which include gas emissions from volcanoes and forest fires, also contribute to the presence of benzene in the environment. Benzene is also present in crude oil and gasoline and cigarette smoke.

1.2 WHAT HAPPENS TO BENZENE WHEN IT ENTERS THE ENVIRONMENT?

Benzene is commonly found in the environment. Industrial processes are the main sources of benzene in the environment. Benzene levels in the air can be elevated by emissions from burning coal and oil, benzene waste and storage operations, motor vehicle exhaust, and evaporation from gasoline service stations. Tobacco smoke is another source of benzene in air, particularly indoors. Industrial discharge, disposal of products containing benzene, and gasoline leaks from underground storage tanks release benzene into water and soil.

Benzene can pass into air from water and soil surfaces. Once in the air, benzene reacts with other chemicals and breaks down within a few days. Benzene in the air can also be deposited on the ground by rain or snow.

Benzene in water and soil breaks down more slowly. Benzene is slightly soluble in water and can pass through the soil into underground water. Benzene in the environment does not build up in plants or animals.

1.3 HOW MIGHT I BE EXPOSED TO BENZENE?

Everyone is exposed to a small amount of benzene every day. You are exposed to benzene in the outdoor environment, in the workplace, and in the home. Exposure of the general population to benzene mainly occurs through breathing air that contains benzene. The major sources of benzene exposure are tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions. Vapors (or gases) from products that contain benzene, such as glues, paints, furniture wax, and detergents, can also be a source of exposure. Auto exhaust and industrial emissions account for about 20% of the total national exposure to benzene. About half of the exposure to benzene in the United States results from smoking tobacco or from exposure to tobacco smoke. The average smoker (32 cigarettes per day) takes in about 1.8 milligrams (mg) of benzene per day. This amount is about 10 times the average daily intake of benzene by nonsmokers.

Measured levels of benzene in outdoor air have ranged from 0.02 to 34 parts of benzene per billion parts of air (ppb) (1 ppb is 1,000 times less than 1 ppm). People living in cities or industrial areas are generally exposed to higher levels of benzene in air than those living in rural areas. Benzene levels in the home are usually higher than outdoor levels. People may be exposed to higher levels of benzene in air by living near hazardous waste sites, petroleum refining operations, petrochemical manufacturing sites, or gas stations.

For most people, the level of exposure to benzene through food, beverages, or drinking water is not as

high as through air. Drinking water typically contains less than 0.1 ppb benzene. Benzene has been detected in some bottled water, liquor, and food. Leakage from underground gasoline storage tanks or from landfills and hazardous waste sites that contain benzene can result in benzene contamination of well water. People with benzene-contaminated tap water can be exposed from drinking the water or eating foods prepared with the water. In addition, exposure can result from breathing in benzene while showering, bathing, or cooking with contaminated water.

Individuals employed in industries that make or use benzene may be exposed to the highest levels of benzene. As many as 238,000 people may be occupationally exposed to benzene in the United States. These industries include benzene production (petrochemicals, petroleum refining, and coke and coal chemical manufacturing), rubber tire manufacturing, and storage or transport of benzene and petroleum products containing benzene. Other workers who may be exposed to benzene include coke oven workers in the steel industry, printers, rubber workers, shoe makers, laboratory technicians, firefighters, and gas station employees.

1.4 HOW CAN BENZENE ENTER AND LEAVE MY BODY?

Benzene can enter your body through your lungs, gastrointestinal tract, and across your skin. When you are exposed to high levels of benzene in air, about half of the benzene you breathe in passes through the lining of your lungs and enters your bloodstream. When you are exposed to benzene in food or drink, most of the benzene you take in by mouth passes through the lining of your gastrointestinal tract and enters your bloodstream. A small amount will enter your body by passing through your skin and into your bloodstream during skin contact with benzene or benzene-containing products. Once in the bloodstream, benzene travels throughout your body and can be temporarily stored in the bone marrow and fat. Benzene is converted to products, called metabolites, in the liver and bone marrow. Some of the harmful effects of benzene exposure are caused by these metabolites. Most of the metabolites of benzene leave the body in the urine within 48 hours after exposure.

1.5 HOW CAN BENZENE AFFECT MY HEALTH?

Scientists use many tests to protect the public from harmful effects of toxic chemicals and to find ways for treating persons who have been harmed.

One way to learn whether a chemical will harm people is to determine how the body absorbs, uses, and releases the chemical. For some chemicals, animal testing may be necessary. Animal testing may also help identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method for getting information needed to make wise decisions that protect public health. Scientists have the responsibility to treat research animals with care and compassion. Scientists must comply with strict animal care guidelines because laws today protect the welfare of research animals.

After exposure to benzene, several factors determine whether harmful health effects will

occur, as well as the type and severity of such health effects. These factors include the amount of benzene to which you are exposed and the length of time of the exposure. Most information on effects of long-term exposure to benzene are from studies of workers employed in industries that make or use benzene. These workers were exposed to levels of benzene in air far greater than the levels normally encountered by the general population. Current levels of benzene in workplace air are much lower than in the past. Because of this reduction and the availability of protective equipment such as respirators, fewer workers have symptoms of benzene poisoning.

Brief exposure (5–10 minutes) to very high levels of benzene in air (10,000–20,000 ppm) can result in death. Lower levels (700–3,000 ppm) can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. In most cases, people will stop feeling these effects when they are no longer exposed and begin to breathe fresh air.

Eating foods or drinking liquids containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, coma, and death. The health effects that may result from eating foods or drinking liquids containing lower levels of benzene are not known. If you spill benzene on your skin, it may cause redness and sores. Benzene in your eyes may cause general irritation and damage to your cornea.

Benzene causes problems in the blood. People who breathe benzene for long periods may experience harmful effects in the tissues that form blood cells, especially the bone marrow. These effects can disrupt normal blood production and cause a decrease in important blood components. A decrease in red blood cells can lead to anemia. Reduction in other components in the blood can cause excessive bleeding. Blood production may return to normal after exposure to benzene stops. Excessive exposure to benzene can be harmful to the immune system, increasing the chance for infection and perhaps lowering the body's defense against cancer.

Long-term exposure to benzene can cause cancer of the blood-forming organs. This condition is called leukemia. Exposure to benzene has been associated with development of a particular type of leukemia called acute myeloid leukemia (AML). The Department of Health and Human Services has determined that benzene is a known carcinogen (can cause cancer). Both the International Agency for Cancer Research and the EPA have determined that benzene is carcinogenic to humans.

Exposure to benzene may be harmful to the reproductive organs. Some women workers who breathed high levels of benzene for many months had irregular menstrual periods. When examined, these women showed a decrease in the size of their ovaries. However, exact exposure levels were unknown, and the studies of these women did not prove that benzene caused these effects. It is not known what effects exposure to benzene might have on the developing fetus in pregnant women or on fertility in men. Studies with pregnant animals show that breathing benzene has harmful effects on the developing fetus. These effects include low birth weight, delayed bone formation, and bone marrow damage.

We do not know what human health effects might occur after long-term exposure to food and water

contaminated with benzene. In animals, exposure to food or water contaminated with benzene can damage the blood and the immune system and can cause cancer.

1.6 HOW CAN BENZENE AFFECT CHILDREN?

This section discusses potential health effects in humans from exposures during the period from conception to maturity at 18 years of age.

Children can be affected by benzene exposure in the same ways as adults. Benzene can pass from the mother's blood to a fetus. It is not known if children are more susceptible to benzene poisoning than adults.

1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO BENZENE?

If your doctor finds that you have been exposed to substantial amounts of benzene, ask whether your children might also have been exposed. Your doctor might need to ask your state health department to investigate.

Gasoline and cigarette smoke are two main sources of human exposure to benzene. Benzene exposure can be reduced by limiting contact with these sources. People are exposed to benzene from both active and passive second-hand smoke. Average smokers take in about 10 times more benzene than nonsmokers each day. Families are encouraged not to smoke in their house, in enclosed environments, or near their children.

Benzene is a major component of gasoline and used in many manufacturing processes. Increased levels of benzene can be found at fueling stations, and in air emissions from manufacturing plants and hazardous waste sites. Living near gasoline fueling stations or hazardous waste sites may increase exposure to benzene. People are advised not to have their families play near fueling stations, manufacturing plants, or hazardous waste sites.

1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO BENZENE?

Several tests can show whether you have been exposed to benzene. Some of these tests may be available at your doctor's office. All of these tests are limited in what they can tell you. The test for measuring benzene in your breath must be done shortly after exposure. This test is not very helpful for detecting very low levels of benzene in your body. Benzene can be measured in your blood. However, because benzene rapidly disappears in the blood, measurements may be useful only for recent exposures.

In the body, benzene is converted to products called metabolites. Certain metabolites of benzene, such as phenol, muconic acid, and *S*-phenylmercapturic acid can be measured in the urine. The amount of phenol in urine has been used to check for benzene exposure in workers. The test is useful only when you are exposed to benzene in air at levels of 10 ppm or greater. However, this test must also be done shortly after exposure, and it is not a reliable indicator of how much benzene you have been

exposed to, because phenol is present in the urine from other sources (diet, environment). Measurements of muconic acid or *S*-phenylmercapturic acid in the urine are more sensitive and reliable indicators of benzene exposure. The measurement of benzene in blood or of metabolites in urine cannot be used for making predictions about whether you will experience any harmful health effects. Blood counts of all components of the blood and examination of bone marrow are used to determine benzene exposure and its health effects.

For people exposed to relatively high levels of benzene, complete blood analyses can be used to monitor possible changes related to exposure. However, blood analyses are not useful when exposure levels are low.

1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations *can* be enforced by law. The EPA, the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA) are some federal agencies that develop regulations for toxic substances. Recommendations provide valuable guidelines to protect public health, but *cannot* be enforced by law. The Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH) are two federal organizations that develop recommendations for toxic substances.

Regulations and recommendations can be expressed as "not-to-exceed" levels, that is, levels of a toxic substance in air, water, soil, or food that do not exceed a critical value that is usually based on levels that affect animals; they are then adjusted to levels that will help protect humans. Sometimes these not-to-exceed levels differ among federal organizations because they used different exposure times (an 8-hour workday or a 24-hour day), different animal studies, or other factors.

Recommendations and regulations are also updated periodically as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for benzene include the following:

EPA has set 5 ppb as the maximum permissible level of benzene in drinking water. EPA has set a goal of 0 ppb for benzene in drinking water and in water such as rivers and lakes because benzene can cause leukemia. EPA estimates that 10 ppb benzene in drinking water that is consumed regularly or exposure to 0.4 ppb in air over a lifetime could cause a risk of one additional cancer case for every 100,000 exposed persons. EPA recommends 200 ppb as the maximum permissible level of benzene in water for short-term exposures (10 days) for children.

EPA requires that the National Response Center be notified following a discharge or spill into the environment of 10 pounds or more of benzene.

OSHA regulates levels of benzene in the workplace. The maximum allowable amount of benzene in workroom air during an 8-hour workday, 40-hour workweek is 1 ppm. Because benzene can cause

cancer, NIOSH recommends that all workers wear special breathing equipment when they are likely to be exposed to benzene at levels exceeding the recommended (8-hour) exposure limit of 0.1 ppm.

1.10 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department, or contact ATSDR at the address and phone number below.

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses that result from exposure to hazardous substances.

Toxicological profiles are also available on-line at www.atsdr.cdc.gov and on CD-ROM. You may request a copy of the ATSDR ToxProfiles™ CD-ROM by calling the toll-free information and technical assistance number at 1-800-CDCINFO (1-800-232-4636), by e-mail at cdcinfo@cdc.gov, or by writing to:

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Environmental Medicine
1600 Clifton Road NE
Mailstop F-32
Atlanta, GA 30333
Fax: 1-770-488-4178

Organizations for-profit may request copies of final Toxicological Profiles from the following:

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
Phone: 1-800-553-6847 or 1-703-605-6000
Web site: http://www.ntis.gov/

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Reviews and Commentary

BENZENE AND LEUKEMIA

A REVIEW OF THE LITERATURE AND A RISK ASSESSMENT[1]

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The major purpose of this paper is to review the evidence, primarily epidemiologic, pertaining to the relation between benzene and leukemia. Benzene is widely considered to be a leukemogen for human beings, but its potency is uncertain. Since low-level exposures to benzene characterize many occupational settings, it is important to determine to what extent, if at all, low exposures increase leukemia risk. Moreover, as we write, the US Occupational Safety and Health Administration is attempting to reduce workplace exposures from an eight-hour time-weighted average level of 10 parts per million (ppm) to 1 ppm. This paper also includes an evaluation and critique of various risk assessments of benzene and leukemia. These risk assessments were done for policymaking and were developed to predict the leukemogenic effect of benzene exposures in the vicinity of the present occupational standard of 10 ppm.

BACKGROUND

In 1981, a Working Group of the International Agency for Research on Cancer concluded that there was sufficient evidence that benzene is carcinogenic to humans (1). Specifically, they concluded that exposure to benzene may damage the hematopoietic system and that evidence from epidemiologic studies establishes a causal relation between benzene and acute myelocytic leukemia. In the same report, it was noted that the evidence linking benzene with cancer other than acute myelocytic leukemia was inadequate. Benzene is included on the list of carcinogens published by the Secretary of the US Department of Health and Human Services (2) and is designated as a suspect carcinogen by the American Conference of Governmental Industrial Hygienists (3).

The present Occupational Safety and Health Administration regulation for exposure to benzene was established in 1971 and revised in 1974 (4). The regulation limits exposure to an eight-hour time-weighted average of 10 ppm with a ceiling concentration of 25 ppm over a 10-minute period and a peak concentration not to exceed 50 ppm for more than 10 minutes.

Abbreviations: CI, confidence interval; ppm, parts per million; RR, relative risk.

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This regulation was established because benzene was known to be a bone marrow depressant and because of its acute toxicity; benzene was not generally recognized as a carcinogen at that time. Indeed, in 1974, the National Institute for Occupational Safety and Health noted that, although case reports, chromosomal studies, and several epidemiologic studies suggested a link between benzene and leukemia, the evidence was not sufficient to conclude that it was a carcinogen (5). However, in 1976, the National Institute for Occupational Safety and Health recommended that benzene be regulated as a carcinogen because of new epidemiologic evidence (6). In that year, the Occupational Safety and Health Administration issued an emergency temporary standard for occupational exposure to benzene which stipulated an eight-hour time-weighted average of 1 ppm with a ceiling level of 5 ppm for any 15-minute period. This became the Occupational Safety and Health Administration standard in 1978 (7). However, a number of organizations representing industrial concerns obtained an injunction against the new standard. In 1980, the Supreme Court struck the 1 ppm standard, stating in essence that the Occupational Safety and Health Administration had not demonstrated that the 10 ppm standard was unsafe (8). Thus, a controversy remains about the reasonable exposure limit in occupational settings and especially about the leukemogenic effect of low-level exposures.

Scientific evidence

The potential adverse health effects of benzene have been evaluated in experimental studies of animals, in investigations of chromosomes, and in epidemiologic studies of workers exposed to benzene. Here, we emphasize the epidemiologic studies because they have provided both the qualitative and the quantitative estimates of the leukemogenic effect of benzene on which risk assessments and regulations largely have been based. Nevertheless, a brief summary of the results of animal studies and of chromosomal studies is pertinent, since these have also contributed to the evaluation of the leukemogenicity of benzene.

Animal studies

The carcinogenicity of benzene has been assessed experimentally in rats and mice using several exposure methods, such as skin application, inhalation, intragastric, and subcutaneous administration (1). The International Agency for Research on Cancer reviewed these and other studies of animals in 1982 and concluded that "there is limited evidence that benzene is carcinogenic in experimental animals" (1). Additional studies now have been reported, and they strengthen the hypothesis that benzene is an animal carcinogen which acts on several organ systems (9–12). However, this work has limitations which affect its relevance to the evaluation of the relation between benzene and leukemia in human beings. None of the experimental work provides an adequate animal model for benzene-induced myelocytic leukemia. Although the studies have demonstrated the induction of nonmalignant hematologic disorders by benzene, the carcinogenic effects are confined largely to nonhematologic tissues. In rats and mice, for example, benzene appears to be strongly related to the occurrence of carcinoma of the zymbal gland, a structure with no human analog. An additional limitation of the animal studies is the lack of data on the potential carcinogenicity of benzene exposures below 100 ppm.

Chromosome studies

Despite several studies, benzene has not been found to be a genotoxic (DNA-reactive) agent (13). However, it causes chromosome breaks and other chromosomal changes in animals, and it has been suggested that an excess of chromosomal aberrations occurs among human beings exposed to benzene (1, 11). Studies of workers with benzene-induced blood disorders have consistently shown an increased prevalence of chromosomal aberrations in so-

matic cells. However, studies of workers who had low (<25 ppm) benzene exposures or who had no overt signs of chronic benzene poisoning have been inconsistent with respect to cytogenetic findings. In addition, many of these studies are quite small, and most have methodological deficiencies, including inadequate assessment of average or cumulative benzene exposure, failure to adjust for age differences between groups, and no dose-response evaluations. Moreover, there are no data that establish a relation between chromosomal aberrations and the subsequent development of leukemia or other disease.

Epidemiologic studies

Eleven epidemiologic studies have evaluated the association between benzene and leukemia (14–28). These studies were preceded by many case reports of leukemia patients with industrial benzene exposure and by descriptions of series of leukemia cases associated with benzene exposure, two of which have been updated by Aksoy (29) in Turkey and by Vigliani (30) in Italy.

Aksoy (29) studied 51 leukemia cases, identified in 1967–1983, among men occupationally exposed to benzene in Istanbul, Turkey, and he estimated that from 1967 to 1975 the crude incidence rate of leukemia was 13 per 100,000 person-years among shoe workers, compared with six per 100,000 person-years among men in the general population. However, the validity of these estimates and the meaningfulness of the comparison of the leukemia rates of shoe workers with those of the general population are doubtful because ascertainment of leukemia cases was incomplete and was not conducted in the same manner for the two groups.

Vigliani (30) in Italy reported 11 leukemia cases that occurred between 1942 and 1974 in Milan and 13 cases that occurred between 1959 and 1974 in Pavia among workers in shoe and rotogravure factories. Benzene exposures were thought to have ranged from 26 to 600 ppm for workers handling glues in shoe factories and from 200 to 400 ppm for workers in the rotogravure plants. Vigliani estimated that the incidence rate of acute leukemia among workers heavily exposed to benzene was 20 times higher than that of the general population, but this estimate is not adequately documented.

The epidemiologic studies of benzene and leukemia are summarized in table 1. They are reviewed briefly below.

In a hospital-based case-control study in France, Girard and Revol (14) evaluated the association between benzene and leukemia and other hematologic diseases. The cases were hematology service patients, of whom 140 had acute leucosis (also referred to as acute leukemia in the study report), 61 had chronic lymphocytic leukemia, and 56 had myeloid leukemia. There were also 124 controls hospitalized for nonhematologic conditions. Exposure to benzene and toluene was determined by questioning subjects about chemicals which they had used during the 10-year period preceding the hospitalization. Relative risks for benzene or toluene were 3.3 (95 per cent confidence interval (CI) = 1.2–8.9) for acute leucosis/leukemia, 4.1 (1.4–12) for chronic lymphocytic leukemia, and 1.8 (0.5–6.6) for myeloid leukemia. This study suggests a strong positive relation between most forms of leukemia and benzene or toluene. However, it does not distinguish between benzene and toluene, and it provides no estimate of dose-response.

Ishimaru et al. (15) conducted a study of 303 leukemia cases and 303 controls in Nagasaki and Hiroshima, Japan. The study evaluated occupational exposures to benzene and to medical x-rays; potential exposure was determined on the basis of subjects' occupations. The relative risk of leukemia was 2.5 (95 per cent CI = 1.3–5.0) for persons with occupations involving potential benzene or medical x-ray exposure compared with those with no such exposures.

The main limitation of this study is its use of occupation as a surrogate for benzene exposure. Each occupation classified as in-

TABLE 1

Summary of epidemiologic studies of benzene exposure and leukemia

Study location and year of publication (ref no(s).)	Study design and observation period	No. and type of subjects	Exposure measure	SMR* or RR† for leukemia (95% confidence interval)
France, 1970 (14)	Case-control, 1966–1969	257 leukemia cases; 124 hospital controls	Occupational or household exposure to solutions containing benzene or toluene	RR = 3.3 (1.2–8.9) (acute leukemia) RR = 4.1 (1.4–12) (chronic lymphocytic leukemia) RR = 1.8 (0.5–6.6) (myelocytic leukemia)
Japan, 1971 (15)	Case-control, 1945–1967	303 adult leukemia cases; 303 controls	Employment in an occupation involving potential exposure to benzene or x-rays	RR = 2.5 (1.3–5.0)
Europe, 1974 (16)	Retrospective follow-up, 1962–1971	38,000‡ employees of oil company affiliates. Referent: general population	Employment involving potential exposure to >1% benzene for >5 years	SMR = 121 (37–205)
United States, 1977 and 1981 (17, 18)	Retrospective follow-up, 1950–1975	1,006 rubber hydrochloride (Pliofilm) workers. Referent: 1) general population; 2) 1,447 fibrous glass workers; 3) 398 nonbenzene-exposed rubber hydrochloride workers	Employment involving exposure to benzene for at least 1 day during 1940–1959; duration of employment	SMR = 560 (225–1,154) (first exposed in 1940–1949; general population referent) SMR = 2,100 (706–5,073) (exposed for >5 years; general population referent)
United States, 1986 (19)	Retrospective follow-up, 1950–1981	1,165 rubber hydrochloride (Pliofilm) workers. Referent: general population	Employment involving benzene exposure for at least 1 day during 1940–1965; cumulative benzene exposure (ppm-years)	SMR = 337 (154–641) (overall cohort) SMR = 109 (12–394) (0.001–39.99 ppm-years) SMR = 322 (36–1,165) (40.0–199.99 ppm-years) SMR = 1,186 (133–4,285) (200.0–399.99 ppm-years) SMR = 6,637 (1,334–19,393) (≥400.0 ppm-years)

United States, 1978 (20)	Retrospective follow-up, 1940–1973	594 benzene workers. Referent: general population	Cumulative benzene exposure (ppm-months)	SMR = 200 (24–722) (leukemia mortality) RR = 3.8 (myelocytic leukemia incidence)
United States, 1986 (21)	Retrospective follow-up, 1940–1982	956 benzene workers. Referent: general population	Cumulative benzene exposure (ppm-months)	SMR = 194 (52–488) (leukemia mortality) RR = 4.4 (1.2–11) (myelocytic leukemia incidence)
Olmsted Co., MN, 1980 (22)	Case-control, 1955–1974	138 adult leukemia cases; 276 controls	Medical record indication of benzene exposure	RR = 3.3 (0.6–28)
United Kingdom, 1981 (23)	Case-control, 1950–1975	Oil refinery workers: 36 cases; 216 controls	Employment involving low, medium, or high benzene exposure	RR = 2.0 (1.0–4.0) (High or medium vs. low exposure)
United States, 1983 (24)	Retrospective follow-up, 1960–1977	259 chemical workers. Referent: general population	Employment during 1947–1970 at a plant that has used large amounts of benzene	SMR = 682 (141–1,992)
United States, 1983 (25)	Retrospective follow-up, 1946–1977	4,602 chemical workers. Referent: 1) general population; 2) 3,074 chemical workers with no occupational benzene exposure	Exposed to benzene for >6 months; continuous vs. intermittent exposure; cumulative exposure (ppm-months); duration of exposure and time since first exposure	SMR = 117 (47–242) (general population referent) SMR = 135 (50–295) (continuously exposed) SMR = 276 (>720 ppm-months exposure)
United States, 1983 (26)	Retrospective follow-up, 1952–1978	454 oil refinery workers. Referent: 1) general population; 2) 10% sample of nonbenzene-exposed refinery workers	Employment in benzene-related production units; duration of benzene-related work	Observed, 0; expected, 0.42 (general population referent)
United States, 1983 (27)	Case-control, 1964–1973	Rubber manufacturing workers: 15 lymphocytic leukemia cases; 30 controls	Primary benzene exposure: employment in jobs involving direct use of benzene	RR = 4.5 (0.4–50)
			Secondary benzene exposure: employment in work areas where benzene was used but no direct use in job	RR = 1.5 (0.2–14)
United States, 1984 (28)	Case-control, 1964–1973	11 lymphocytic leukemia cases; 1,350 controls	Employment in work areas where benzene was used	RR = 2.5 (0.6–10)

* SMR, standardized mortality ratio.
† RR, relative risk.
‡ Total, exposed and unexposed. Number of workers exposed and unexposed not stated.

volving potential benzene exposure may have included workers with no exposure to benzene, as well as workers with exposure to chemicals other than benzene. In addition, the relative risks were not reported separately for benzene and medical x-ray exposures, and no attempt was made to quantify leukemia risk according to intensity or duration of benzene exposure.

Thorpe (16) investigated leukemia incidence and mortality among 38,000 active workers and annuitants at eight European affiliates of a large oil company. The observation period was from 1962 to 1971. Employees were classified either as having been exposed to benzene (potential exposure for at least five years to refinery streams or petroleum products containing at least 1 per cent benzene) or not (no or only occasional benzene exposure). The ascertainment both of benzene exposure and of leukemia occurrence was conducted separately by each of the affiliates. The expected number of leukemia deaths was derived from the general population mortality rates of the countries in which the affiliates were located. For workers potentially exposed to benzene, the standardized mortality ratio was 121 (95 per cent CI = 37–205), whereas the standardized mortality ratio was 60 for the unexposed.

This study has a number of limitations. Ascertainment of leukemia cases and documentation of exposure were inadequate. In addition, the report indicates that there was considerable uncertainty about the age structure of the overall cohort. For these reasons, the validity of the reported standardized mortality ratios is questionable. The standardized mortality ratio of 121 for leukemia among potentially exposed workers is unremarkable. However, the study is neither persuasively positive nor negative because of the lack of an analysis of leukemia mortality by induction period, the unexplained deficit of deaths from leukemia among the unexposed and the lack of documentation of the methods used to identify leukemia deaths and to determine benzene exposure.

In 1977, Infante et al. (17) reported the preliminary findings of a retrospective follow-up study of 1,006 workers employed in the manufacture of rubber hydrochloride (trade name, Pliofilm) at three plants in two Ohio locations. Rinsky et al. (18) presented additional results from this study in 1981. All workers with at least one day of exposure to benzene during 1940 through 1959 were included, although most of the results pertained to the 748 men who were first exposed between 1940 and 1949. These men were followed through mid-1975. The investigators used historical benzene exposure monitoring data to describe exposure conditions at the two locations. Although these data were sparse, especially for location 2, the investigators believed that exposure tended to be below the recommended limits.

The mortality experience of the benzene-exposed workers was compared with that of US white men, unexposed rubber hydrochloride workers at the study plants (n = 398), and white male fibrous glass workers in Ohio (n = 1,447). The standardized mortality ratio for leukemia among the 748 men who were first exposed between 1940 and 1949, compared with that of the general population, was 560 (95 per cent CI = 225–1,154), based on seven observed deaths. Using the fibrous glass workers as the referent, the standardized mortality ratio was 473. There were no deaths from leukemia among the unexposed rubber hydrochloride workers; the expected number was not reported but was probably small.

Five of the seven leukemia deaths occurred among men with five or more years of benzene exposure (standardized mortality ratio = 2,100). All of the leukemias were of the myelocytic (acute, 4; chronic, 1) or monocytic (acute, 1; unspecified, 1) cell type. Among men who had first been exposed to benzene between 1950 and 1959, there was one death from myelogenous leukemia compared with 0.5 expected.

Rinsky et al. (19) have recently updated this investigation. The updated study includes 1,165 men who had been exposed to benzene for at least one day during 1940–1965 and extends follow-up through 1981.

The update also uses a job-exposure linkage procedure to estimate the cumulative benzene exposure of the men in the study. The leukemia standardized mortality ratio for the overall cohort compared with the general population was 337, based on nine observed and 2.7 expected leukemia deaths. The findings of the updated study are discussed further in the next section.

The study of rubber hydrochloride workers is the strongest evidence available that benzene is associated with myelocytic leukemia. Even so, the estimate of the standardized mortality ratio for benzene-exposed workers is imprecise. Moreover, the study contains little relevant data on the exposure levels associated with excess leukemia mortality. Five of the seven leukemia deaths occurred at location 2, for which measurements on benzene levels were particularly sparse. Furthermore, location 2 was the site of several manufacturing operations, including tire manufacturing, in addition to rubber hydrochloride production. It is likely that four of the five men with leukemia at location 2 had started working there before 1940, and one had started in 1944. Benzene has been used as a solvent in tire manufacturing; therefore, many of the study members from location 2 may have been exposed to benzene in departments other than rubber hydrochloride, and their actual exposure levels may have been underestimated.

Ott et al. (20) conducted a retrospective follow-up study of 594 Dow Chemical Company employees occupationally exposed to benzene in the production of alkyl benzene, chlorobenzene, and ethyl cellulose. Men employed in these operations from 1938 to 1970 were identified and followed-up through 1973. The study was updated to include an additional 362 exposed employees, and follow-up was extended through the end of 1982 (21). Cumulative exposure to benzene was estimated for each cohort member. The expected numbers of leukemia deaths were derived from leukemia mortality rates of all US white men.

Four leukemia deaths occurred among benzene-exposed workers, whereas 2.1 were expected. Another deceased worker had myelomonocytic leukemia, but this was not certified as the underlying cause of death and was not included in the mortality analysis. The four leukemias were of the myelocytic cell type. Ott et al. estimated an incidence rate ratio of 4.4 (95 per cent CI = 1.2–11) for myelocytic leukemia for benzene-exposed workers relative to the general population.

The average cumulative exposure of cohort members can be estimated from data presented in the updated report. Among a total of 242 expected deaths from all causes, the cumulative exposure category was 0–499 (midpoint, 250) ppm-months for 151 of the expected deaths, 500–999 (midpoint, 750) ppm-months for 35, and 1,000+ (say 1,250) ppm-months for 56. Thus, the average cumulative exposure of cohort members is estimated as 554 ppm-months, or about 46 ppm-years. The cumulative benzene exposures were lower than this for three of five of the leukemia cases.

The major limitations of this study are its small size and thus its imprecise estimate of the effect of benzene on the occurrence of leukemia. The observation that the cumulative benzene exposure of three of the five leukemia cases probably was below the average cumulative exposure of the entire cohort has several possible implications: there may be a threshold effect of benzene among susceptibles; the leukemias may not have been caused by benzene; or the benzene exposure estimates may have been incorrect.

Linos et al. (22) evaluated the relation between leukemia and benzene in a case-control study of 138 leukemia cases and 276 controls. Any mention of a history of exposure to benzene listed in the medical records was the sole criterion of benzene exposure. The relative risk was 3.3 (95 per cent CI = 0.6–28), based on four exposed cases and three exposed controls. Three of the exposed cases had chronic lymphocytic leukemia. This study is largely uninformative because of the limited information on benzene exposures and because of its small size.

Rushton and Alderson (23) conducted a case-control study of leukemia within a large cohort of workers at eight oil refineries in the United Kingdom. An earlier retrospective follow-up study of these workers (31) had reported a standardized mortality ratio for leukemia of 94. The case-control study included 36 leukemia deaths which occurred among men employed between 1950 and 1975 and 216 controls who had worked at the refineries during the same period. Measurements of workplace benzene levels were not available. However, study subjects were classified as having been exposed to low, medium, or high levels of benzene based upon their work histories. The relative risk for medium or high exposure compared with low exposure was 2.0 (95 per cent CI = 1.0–4.0). The relative risk was not higher among men with high exposure compared with medium exposure, and, furthermore, relative risk did not appear to be related to length of service at the refineries. The relative risks for the various types of leukemia were not presented.

The results of this study are supportive of a leukemogenic effect of benzene or other solvents used in conjunction with benzene. However, the informativeness of the study is limited by the lack of data on exposure levels and by the absence of any analyses by duration of exposure or by induction period.

Decouflé et al. (24) evaluated the mortality experience of 259 men employed between 1947 and 1960 at a chemical manufacturing plant. Large amounts of benzene had been used at the plant, but no measurements of benzene levels were available. Employees had also worked with other chemicals. These men were followed from 1960 through 1977. There were three deaths from leukemia compared with 0.44 expected (standardized mortality ratio = 682; 95 per cent CI = 141–1,992). The cell types of the three leukemias were chronic lymphocytic, acute monocytic, and acute myelomonocytic.

Wong (25) conducted a retrospective follow-up study of 4,602 male chemical workers at seven plants. The study group included men who had been exposed to benzene for at least six months between 1946 and 1977. Jobs were classified as involving intermittent or continuous benzene exposure. For workers with continuous exposure, cumulative exposure to benzene (ppm-months) was calculated by using length of employment and the estimated eight-hour time-weighted average for each job. Using the distribution of workers according to a cumulative ppm-months benzene measure presented by Wong, the average exposure of continuously exposed workers is estimated to be about 366 ppm-months (about 30 ppm-years). This corresponds to a time-weighted average of about 3 ppm, since the average duration of exposure was 10 years. The mortality rates of exposed workers were compared with those of US men and with those of an internal comparison group comprised of 3,074 men who had worked at the same or at nearby chemical plants but who were not exposed to benzene.

For the overall group of exposed workers, there was a slight excess of leukemia deaths compared with US men (seven deaths, standardized mortality ratio = 117; 95 per cent CI = 47–242). Four of these leukemias were of the lymphocytic cell type, two were myelocytic (both chronic), and one was unspecified. Among unexposed workers, there were no leukemias, whereas 3.4 were expected (two-tailed p value = 0.07). The standardized mortality ratio for all causes was similar for the exposed workers (standardized mortality ratio = 87) and unexposed workers (standardized mortality ratio = 75).

Six of the leukemia deaths among exposed workers occurred among men with continuous exposure (standardized mortality ratio = 135; 95 per cent CI = 50–295). However, for these workers, there was no consistent trend in the standardized mortality ratio for leukemia over categories of either duration of exposure or cumulative exposure, although the latter test for trend, using the nonexposed internal comparison

group, yielded a one-tailed p value of 0.01. The standardized mortality ratio increased with years since first exposure from a value of 0 for under 10 years to 182 (four leukemia deaths) for at least 20 years. For men with cumulative benzene exposure of at least 60 ppm-years, the leukemia standardized mortality ratio was 276 based on three deaths.

This study contains some evidence of a positive relation between benzene and leukemia. However, the overall standardized mortality ratio of 117 for leukemia is not statistically significant and the slight excess could be due to confounding by exposure to other chemicals. Moreover, the study is too small to provide an adequate assessment of dose-response. Because unexposed workers had a deficit of leukemia deaths, no confidence can be placed in statistical tests of trend which include the unexposed group. The fact that none of the leukemia deaths among the benzene-exposed workers was acute myelocytic leukemia further detracts from a causal interpretation of the study results.

Tsai et al. (26) reported the mortality experience of 454 men who had been employed at an oil refinery between 1952 and 1978 and who had worked in benzene-related production units. Review of industrial hygiene data for 1973–1982 indicated that the median exposure level in these units was about 0.5 ppm. Comparison groups consisted of the general US male population and a 10 per cent sample of nonbenzene-exposed workers at the same refinery (n = 823). There were no leukemia deaths among the workers exposed to benzene. The expected numbers, based on general population rates, were 0.42 for all exposed workers and 0.29 for workers employed for at least one year in a benzene-related unit. There were five deaths from leukemia and lymphatic cancer among unexposed workers, but no data were presented on the expected numbers of deaths. Although this study found no excess of leukemia, its small size and the relatively small proportion (36 per cent) of the cohort with an adequate follow-up period preclude any firm conclusion about the risk of leukemia associated with the low levels of benzene described.

Several case-control studies of leukemia and solvent exposures have been conducted within the rubber industry (27, 28, 32, 33). Three of these studies were based on the same series of cases from one rubber company (27, 28, 32). A fourth study included this series plus additional cases from three other companies (33). Each study reported a positive association between lymphocytic leukemia and solvents. This association was present in only one of the four rubber companies, and it was not found for other leukemia cell types.

Two of the studies evaluated the relation between lymphocytic leukemia and exposure to specific solvents, including benzene (27, 28). In the study by Arp et al. (27), exposure to benzene and to other solvents was determined by linking subjects' work histories with historical information on specific solvents used in various work areas and processes. Subjects were classified as having "primary" benzene exposure if they had worked in areas where benzene was used and if their jobs entailed direct handling of benzene or benzene-containing solutions. Subjects were considered to have "secondary" exposure if they had worked in areas where benzene was used but did not have jobs involving direct contact. Quantitative levels of benzene exposure were not estimated. The relative risk of lymphocytic leukemia was 4.5 for workers with primary benzene exposure and 1.5 for workers with secondary exposure. Estimated relative risks for exposure to solvents other than benzene were nearly identical to those for benzene, 4.5 for primary exposure and 1.6 for secondary exposure.

Checkoway et al. (28) studied 11 of the lymphocytic leukemia cases included in the study by Arp et al. and 1,350 controls. Benzene exposure was determined on the basis of employment in work areas where benzene was used; no distinction was made between primary and secondary benzene exposures. The relative risk of lymphocytic leukemia was 2.5 for workers with benzene

exposure. Elevated relative risks were found for workers exposed to a number of other solvents, including acetone, carbon disulfide, carbon tetrachloride, ethylacetate, and hexane.

These studies do not provide persuasive evidence of a causal relation between benzene and lymphocytic leukemia among rubber workers. The confidence intervals of the relative risk estimates are wide, reflecting the imprecision of these estimates, and they include the null value of 1.0. Moreover, it is evident that these rubber workers were exposed to solvents other than benzene and some of these are associated with a relative risk of leukemia that is at least as large as that for benzene. Because exposure classification was not mutually exclusive with regard to solvents, it is possible that the observed association between benzene and lymphocytic leukemia is due, not to benzene, but to other solvents whose use is correlated with the use of benzene.

In addition to the studies described above, investigations of large groups of rubber workers (32, 34–42), newspaper web pressmen (43), and refinery workers (16, 31, 44–55) evaluated leukemia mortality or incidence, and some have found excesses (32, 34–37, 41, 43, 46, 48–51, 53, 54). Workers in these industries are exposed to solvents other than benzene and to other chemicals as well. Several authors have noted that because of this, leukemia excesses among rubber and refinery workers should not be attributed solely to benzene.

In the aggregate, the epidemiologic evidence suggests a link between benzene and leukemia. However, this evidence is not conclusive because it comes primarily from the single relatively small study by Rinsky et al. (19). The other epidemiologic data provide, at best, weak evidence of a causal association between benzene and leukemia. No study rules out the possibility that observed associations between benzene and leukemia are attributable, at least in part, to confounding by solvents other than benzene. As others have pointed out (28), this possibility has not been explored adequately in the rubber industry, an observation which also applies to the petrochemical industry and to other industries in which there is widespread exposure to many solvents. Also, because the major pertinent studies have been small, little confidence can be placed in available quantitative estimates of the magnitude of any association. Measures of benzene exposure levels for relevant time periods are extremely sparse in all of the studies. Therefore, considerable doubt remains about the leukemogenic effect of benzene at specific exposure levels and especially at low levels.

Risk assessments

The expression "risk assessment" describes the final step in a long process. The process usually begins with an effort, often based solely on experimental findings in animals, to describe a dose-response relation between a carcinogen and a cancer. This phase of the process usually involves extrapolation from observed, usually high, dose levels to hypothetical, usually low, dose levels. The process then continues by the making of a generalization to man on the basis of the results in animals. This generalization involves a number of assumptions to equate both the manner of dosing and the manner of responding of animals and man. These assumptions are usually not subject to evaluation.

In other instances, the process of risk assessment does not employ findings from animals but rather uses epidemiologic findings on human beings. In such instances, the difficulties of the animal-to-man generalization are irrelevant. Nonetheless, the process may still lead to results of dubious validity. There are two common reasons for this: 1) the available data are sparse and 2) the people studied experienced quite high exposures so that some extrapolation is necessary to predict effects at lower doses.

Efforts to describe a risk assessment for benzene and leukemia are in the second category. There are little meaningful animal data. Data for human beings are few and relate to uncertain, but probably rather

high, exposure levels. Thus, efforts to describe the extent of small increases in leukemia risk as a consequence of low-level exposure to benzene must lead to imprecise results.

The benzene-leukemia risk assessments have used "linear" and "exponential" models to relate benzene exposures to leukemia. However, the use of such mathematical models obscures the fact that the data are too sparse to provide an adequate description of the shape of the dose-response curve. Essentially, the results of most of the benzene-leukemia risk assessments can be well approximated by assuming that the leukemia "effect" is directly proportional to the dose, usually measured as lifetime cumulative exposure. For example, if 15 years of exposure to 10 ppm (150 ppm-years) of benzene is associated with a twofold excess of leukemia deaths, then it is assumed that 30 years of exposure to 10 ppm (300 ppm-years) of benzene would cause a fourfold excess. This linear model is generally considered "conservative" in that it probably overestimates the leukemogenic effects at low doses. It must be borne in mind, however, that the validity of a linear model in the benzene-leukemia risk assessments is not established.

The concept of a "threshold" is meaningful for the benzene-leukemia risk assessments and relates directly to the issue of what constitutes a meaningful measure of benzene exposure. Most of the benzene-leukemia risk assessments are based on cumulative benzene exposures; these are obtained by multiplying years of exposure by the average ambient benzene levels. Thus, exposure to 1 ppm benzene for 10 years is considered as the equivalent to exposure to 10 ppm benzene for one year. This method of obtaining a summary exposure measure is used frequently in carcinogen risk assessments, the motivation being its simplicity. Nonetheless, it may not be particularly meaningful. The human body metabolizes and excretes with no apparent harm low levels of toxic substances that are harmful at higher levels. This may be true of benzene. That is, there may be a level of benzene exposure below which no leukemogenic effect occurs. Thus, a lifetime of exposure to benzene at 1 ppm may entail no increased leukemia risk, although a nonthreshold linear model using a cumulative exposure measure might entail an appreciable excess risk. A related problem is that of peak exposures. No adequate provision is made in the risk assessments for the possibly high, perhaps very high, benzene levels that may be uniquely harmful. These intermittently high exposures are of special concern with respect to the Pliofilm cohort, a group upon which most risk assessments are largely based. There is evidence that these workers were occasionally exposed to benzene levels high enough to require hospitalization for aplastic anemia (56). Thus, it is plausible that the excess leukemia mortality observed among the Pliofilm cohort was due to transient high exposures.

We do not suggest that carcinogen risk assessments are never useful. However, in the present situation of a risk assessment for benzene and leukemia, there are special problems. There are few human studies relevant to an evaluation of the relation between benzene and leukemia, and those that exist are small. Thus, estimates of the leukemogenic effect of benzene are imprecise. An even more serious limitation is that the levels of benzene to which the workers in these cohorts were exposed are essentially unknown. These particular limitations must be considered in the context of the more general limitations of carcinogen risk assessments. A reasonable argument could be made that the data pertaining to benzene and leukemia are inadequate for the purposes of a meaningful risk assessment. Nonetheless, such risk assessments have been and probably will continue to be done.

Five benzene-leukemia risk assessments are reviewed below. An attempt is made to refine and to extend the findings of some of them. We also present our own risk assessment. However, we emphasize that by doing so we do not endorse the validity of a benzene-leukemia risk assessment re-

sult. We wish only to consider the various assumptions of these risk assessments and to evaluate the extent to which their results agree or differ.

The White et al. risk assessment

One risk assessment has been made by White et al. (57) of the Office of Carcinogen Identification and Classification, US Occupational Safety and Health Administration. These investigators used the so-called one-hit, non-threshold model. Although this is an exponential mathematical model, it is essentially linear in the range of benzene exposures considered. For clarity, the results are approximated below by us with a simple linear model. The original model and our approximation produce almost identical results.

This risk assessment is based upon the results of two retrospective follow-up studies: the study of rubber hydrochloride workers originally reported by Infante et al. (17) and later updated by Rinsky et al. (18) (hereafter termed the Pliofilm study) and the first report of the study of Dow chemical workers by Ott et al. (20). White et al. considered other epidemiologic studies of benzene and leukemia inadequate for the purpose of a risk assessment.

Using the assumptions of White et al. regarding the findings of the Pliofilm study, the excess risk of death from leukemia (P_d) resulting from a specified benzene exposure is approximated by the following equation:

$$P_d = P_o\left(\frac{\text{SMR} - 100}{100}\right)\left(\frac{d_p}{d}\right),$$

where P_o = risk of death from leukemia for a white man from age 20 through 84 years with no occupational exposure to benzene (P_o = 7/1,000 according to White et al.); SMR = the standardized mortality ratio—the mortality rate of leukemia among workers exposed to benzene divided by the rate among men in the general population and multiplied by 100 (a standardized mortality ratio of 2,100 was used by White et al.); d = the average cumulative benzene exposure sustained by members of the Pliofilm cohort expressed in ppm-years (415–1,500 ppm-years according to White et al.); and d_p = the cumulative benzene exposure (expressed in ppm-years) for which an estimate of the excess leukemia mortality is desired.

Thus, for example, if 1,000 men were exposed in the workplace for 30 years to 10 ppm of benzene (300 ppm-years per man), this modified version of the White et al. risk assessment predicts that between 28 and 101 of the exposed men will die from benzene-induced leukemia. This is as compared with a baseline of seven deaths among unexposed men. Throughout the remainder of this paper we will use an exposure level of 300 ppm-years to compare the results of the various risk assessments.

The standardized mortality ratio of 2,100 was obtained from the observation of five leukemia deaths compared with 0.23 expected among men who had been employed for five or more years. White et al. excluded workers with fewer than five years of employment because the elevated leukemia risk was observed largely among the long-term employees. This is a prejudicial justification for excluding the short-term employees. A more defensible basis for their exclusion is that over half of these men had been employed for less than one year, and therefore had little benzene exposure. Nonetheless, White et al. do apply their risk assessment method to exposure durations as short as one year. It is inappropriate to derive a model excluding the experience of those with short exposure durations and, yet, to apply it to this very same situation.

The ambient benzene levels experienced by the Pliofilm workers were considered to be equal to the then current recommended standards. This assumption is controversial. Infante et al. (58) maintain that this assumption overestimates the actual benzene exposures (and, hence, that their risk assessment underestimates excess leukemia mortality). Others (59, 60) believe that the actual benzene exposures were consid-

erably higher than the recommended standards. A point of agreement is that the actual benzene exposures sustained by members of the Pliofilm cohort are unknown, as Infante et al. (58) recognize. This uncertainty about the benzene levels is the major limitation of a risk assessment based on the Pliofilm cohort. White et al. obtained a lower bound for the average benzene exposure (415 ppm-years) by multiplying the average recommended standards for 1937 through 1954 (83 ppm) by five years, the minimum employment duration. The upper bound for the average benzene exposure (1,500 ppm-year) was obtained by multiplying the average recommended standard for 1937 through 1975 (50 ppm) by the maximum length of employment, 30 years. These bounds cover a broad range of benzene exposures and neither is likely to accurately describe the benzene exposure of a typical worker. It is unclear why White et al. did not estimate individual cumulative benzene exposures by multiplying each year of employment of each subject by the standard prevailing in that year and then summing these exposure years. This failure is a major shortcoming of their risk assessment. However, this problem was corrected in a more recent risk assessment based on these data (see below).

White et al. also did a risk assessment based upon the results of the first report of the Dow study. This risk assessment yielded results similar to those obtained from the Pliofilm data. As mentioned earlier, the men in the Dow cohort probably were exposed to considerably lower levels of benzene (cumulative exposure of about 45 ppm-years) than were the men in the Pliofilm cohort. Although there were two leukemia deaths observed, compared with one expected in the Dow study, White et al. did not use the resulting standardized mortality ratio of 200; rather, a relative incidence rate of 3.75 is used. This relative incidence rate is based upon the occurrence of three myelocytic leukemia cases among the cohort compared with 0.8 expected. It is emphasized that this risk assessment is based on only three leukemia cases and so is very imprecise.

The International Agency for Research on Cancer risk assessment

The International Agency for Research on Cancer (1) also has estimated that benzene levels similar to those experienced by men in the Pliofilm cohort are likely to cause an excess of 140–170 leukemia deaths per 1,000 men exposed for a working lifetime. The estimate of 140 excess leukemia deaths was obtained by considering that those men who had been employed for at least five years had experienced a 20-fold excess in leukemia mortality and that the risk that a man will die from leukemia in the absence of benzene exposure is about seven per 1,000. The same assumptions were made by White et al. (57). The International Agency for Research on Cancer considered this estimate a lower bound for the risk associated with a working lifetime (45 years) at similar levels. However, it can be inferred from table 11 of Rinsky et al. (18) that the average duration of employment among men who had worked for at least five years was about 11 years. Presumably, 45, as opposed to 11, years of exposure at such benzene levels would cause about a fourfold higher excess. The figure of 170 was obtained by considering that the overall excess in the Pliofilm cohort was 460 per cent (i.e., the rate of leukemia among the cohort was 5.6 times that of the general population rate) and that the average duration of employment of *leukemia cases* was 8.5 years. The authors then assumed that this overall excess would increase "smoothly" (presumably, linearly) from zero just after initial exposure to about 2,400 per cent after 45 years (i.e., $460 \times 45/8.5$). The resulting age-specific excesses were then applied to the age-specific leukemia rates, and the figure of 170 excess cases of leukemia per 1,000 men was obtained.

In our opinion, their second risk assessment is wrong. The problem is evident in their statement that "the overall relative

risk of 5.6 in the Rinsky study derives from leukaemia cases who had an average of 8.5 years of exposure." A relative risk does not derive from leukemia cases; it is obtained from the comparative mortality experience of exposed and unexposed persons. The authors should have used the average employment duration of the entire cohort (3.2 years, our estimate based upon information in Rinsky et al. (18)) rather than that of the leukemia cases. Thus, the estimate of the excess after 45 years of exposure would be about 6,500 per cent (i.e., 460 × 45/3.2) rather than 2,400 per cent. If this correction is made, the result would be about three times as high.

The authors judged that the Pliofilm cohort members had been exposed to between 10 and 100 ppm of benzene. They state that "assuming exposure was at the upper end of the range, then it is reasonable to postulate that a working lifetime exposure to 100 ppm of benzene would be likely to result in 140–170 cases of leukemia per 1,000 exposed workers." However, it is unlikely that these men were exposed constantly to as much as 100 ppm benzene, and it is certainly true that they were not exposed for as long as 45 years. Thus, this statement is not justified by the results of the Pliofilm study. According to the White et al. risk assessment (57), 45 years of exposure to 100 ppm benzene would produce between about 420 and 1,500 excess leukemia deaths per 1,000 men. Because of the problems discussed above, little confidence can be placed in the risk assessment done by the International Agency for Research on Cancer, and their methodology is not applied to an exposure situation of 300 ppm-years.

The Carcinogen Assessment Group risk assessment

The Carcinogen Assessment Group of the US Environmental Protection Agency (61) has also done a benzene-leukemia risk assessment. The Group attempted to estimate the number of excess leukemia deaths in the general population attributable to exposure to benzene as an air pollutant. However, their methodology can be applied to an occupational setting.

The Group's risk assessment was based upon the results of the Pliofilm study (17, 18), the Dow study (20), and Aksoy's study (29). For the Pliofilm study, they used an overall standardized mortality ratio of 720, based upon nine observed leukemia cases compared with 1.25 expected. The nine observed cases include two that were "known to exist" but were not mentioned on the death certificate. Since the expected number of deaths is based only upon information on death certificates, the inclusion of these two extra cases yields a spuriously high standardized mortality ratio. This group assumed that the Pliofilm cohort members had been exposed to between about 24 and 40 ppm of benzene. However, they erroneously assumed that these men had been employed for 25 to 35 years, whereas their actual period of employment was considerably shorter. If their risk assessment is applied to a workplace exposure of 300 ppm-years, an estimate of about 15 excess leukemia deaths per 1,000 men is obtained. However, because of the errors discussed above, no confidence can be placed in this estimate.

The Carcinogen Assessment Group also based a risk assessment on the results of the Dow study. In doing so, they this time correctly estimated the duration of employment of the cohort. Applying their risk assessment to 300 ppm-years of benzene yields an excess of 47 myelocytic leukemia deaths per 1,000 men so exposed. This result is similar to that obtained by White et al. (57). The Group also attempted to use the results of the study by Aksoy (29) in a risk assessment. However, it is difficult to interpret the result because of the many limitations of Aksoy's study and we therefore do not consider this risk assessment meaningful.

The Rinsky et al. risk assessment

This risk assessment is based upon the update of the Pliofilm cohort (19) and is an improvement over that done by White et

al. (57) insofar as a cumulative measure of benzene exposure was obtained for each cohort member.

Rinsky et al. (19) report standardized mortality ratios according to four levels of cumulative benzene exposure (less than 40 ppm-years, 40–200 ppm-years, 200–400 ppm-years, and greater than 400 ppm-years). The corresponding number of leukemia deaths and the standardized mortality ratios (which have been divided by 100 so that they can be compared with the odds ratios presented below) are 2 and 1.1; 2 and 3.2; 2 and 11.9; and 3 and 66, respectively. Thus, there is a strong positive relation between cumulative benzene exposure and leukemia mortality in this study.

These investigators, however, did not use the results of the cohort study to do the risk assessment, but, instead, did a nested case-control study (10 matched controls per case) and used conditional logistic regression to derive an exposure-response relation between cumulative benzene exposure and leukemia mortality. Based upon their risk assessment, they would predict that 300 ppm-years of benzene exposure would result in an odds ratio (a relative mortality rate) of about 44, which we calculate would yield about 250 excess lifetime leukemia deaths among 1,000 men exposed to 10 ppm for 30 years beginning at age 20 years.

In our opinion, their risk assessment should have derived from the results of the cohort study rather than from those of the case-control study. Presumably, an estimate of cumulative benzene exposure was available for all cohort members. Thus, the need to restrict the analysis to a subset of the subjects is unclear. More importantly, if their model is applied to the data obtained in the cohort study, the estimated odds ratios for the four categories of cumulative benzene exposure presented above (using midpoints of exposure categories and 480 ppm-years for the highest, open-ended category) are 1.3, 4.5, 43.8 and 423, respectively. Although the interpretation of an odds ratio is not strictly comparable to that of a standardized mortality ratio, they are both a measure of the relative rate of disease among the exposed compared with the unexposed and therefore should be similar. It is apparent that the Rinsky et al. model overestimates the observed standardized mortality ratios in the upper two exposure categories, especially in the highest. As an alternative risk assessment based on these data, we fitted a Poisson regression model using the four reported standardized mortality ratios and the midpoint of their four cumulative exposure categories (62). Our predicted standardized mortality ratios are 1.2, 2.8, 13.6, and 65, respectively. Our model provides a considerably better fit to the observed standardized mortality ratios than does the model of Rinsky et al. Our predicted number of excess leukemia deaths for 1,000 men exposed to 10 ppm benzene for 30 years beginning at age 20 years based upon the Poisson regression model is 82.

The Crump and Allen risk assessment

Crump and Allen (63) also have done a benzene-leukemia risk assessment. Their risk assessment is based upon the results of the Pliofilm cohort, the Dow cohort, and Wong's study of chemical workers.

These investigators used two types of linear models for their risk assessment. The first, the absolute risk model, assumes that the number of excess leukemia deaths attributable to a specific amount of benzene exposure is constant at every age (an additive excess). The second, a relative risk model, assumes that the increase in leukemia mortality at any age for a given level of benzene exposure is directly proportional to the baseline age-specific leukemia mortality rate (a multiplicative excess). They also considered three measures of benzene dose: 1) lifetime cumulative exposure, 2) a weighted cumulative exposure which considers recent benzene exposures as most relevant (exposures sustained between 2.5 and seven years before follow-up) and provides progressively less weight to exposures sustained in the more distant past, and 3) a window exposure method which essen-

tially ignores all benzene exposures sustained more than 15 years in the past. Their relative risk model used in conjunction with lifetime cumulative exposure yielded the highest risks. Since the other risk assessments discussed above used a relative risk model with lifetime cumulative exposure as a measure of benzene dose, we report here only these results from Crump and Allen's report. However, it is emphasized that their risk assessment result based upon the absolute risk model used in conjunction with the window exposure method yielded results about one-eighth as high as those reported here. This observation demonstrates that risk assessment results will vary widely depending upon the choice of the model and the measurement of benzene dose.

Crump and Allen estimated that 40 years of exposure beginning at age 20 years to 10 ppm benzene would cause 88 excess leukemia deaths per 1,000 men so exposed. By simple linear interpolation, we estimate that their risk assessment method applied for 30 years to 10 ppm (beginning at age 20 years) would yield about 68 excess leukemia deaths.

These investigators also did a risk assessment based solely on the Pliofilm cohort using a relative risk model with a lifetime cumulative dose. They did their own analysis of the Pliofilm cohort and were able to include additional years of follow-up. They report eight observed leukemia deaths versus about 3.0 expected, yielding a standardized mortality ratio of 268. Their risk assessment result based upon the Pliofilm cohort is 63 excess leukemia deaths per 1,000 men exposed to 400 ppm-years of benzene, or about 48 for 300 ppm-years. They also did a risk assessment based solely on Wong's study. From these data, they calculate that exposure to 10 ppm benzene beginning at age 20 years and continuing for 40 years would cause 121 excess leukemia deaths per 1,000 exposed men (or about 94 for 300 ppm-years). However, they point out that this excess is due largely to a deficit of leukemia mortality among the unexposed and therefore place little confidence in it.

Some of the discrepancy between the risk assessment results on the Pliofilm cohort reported by Rinsky et al. and Crump and Allen apparently results from disagreement between them as to the levels of benzene to which these men were exposed. Crump and Allen's estimates of the benzene exposures are generally higher (and therefore their risk assessment results are lower) than those of Rinsky et al., especially for exposures sustained between 1940 and 1948. However, Crump and Allen calculated that if their exposure estimates are decreased to levels more comparable with those of Rinsky, their risk assessment results would increase by about only 25 per cent.

Our risk assessment

We have used the method suggested by Enterline (64) for our risk assessment. An estimate of lifetime excess leukemia deaths attributable to benzene is obtained by dividing the difference between the observed and expected number of leukemia deaths by the total number of expected deaths (all causes) in the cohort. The underlying assumption of this method is that the proportional excess leukemia mortality observed during the follow-up period will continue until all cohort members have died. If a cohort is followed until most of its members are deceased, the method will be accurate. On the other hand, if a cohort has been followed for only a small fraction of its life expectancy, this risk assessment method must extrapolate the proportional excess to future deaths and hence the result is likely to be less valid and less precise.

In the latest report of the Pliofilm study (19), 6.34 excess leukemia deaths were observed among the cohort (observed = 9, expected = 2.66). The total number of expected deaths was 331.6. Therefore, the number of excess leukemia deaths per 1,000 exposed men is estimated as

$$1{,}000 \times (6.34/331.6) \text{ or } 19.$$

To apply the method to an exposure situa-

tion of 300 ppm-years, the benzene exposures experienced by the Pliofilm workers must be considered and, furthermore, it is assumed that excess leukemia mortality is directly proportional to cumulative benzene dose. It can be inferred from table 2 of their report that the average cumulative benzene exposure among members of the Pliofilm cohort was about 69 ppm-years. The excess number of leukemia deaths resulting from 300 ppm-years is then estimated as:

$$(6.34/331.6) \times (300 \text{ ppm-years}/69 \text{ ppm-years}) = 83 \text{ per } 1{,}000.$$

We also applied Enterline's method to the Pliofilm cohort for follow-up through 1975 (18) so that the result could be compared with that of White et al. (57). The observed number of leukemia deaths as of that time was seven versus an expectation of 1.25. The total number of expected deaths was 161.3. We assumed, as did White et al., that these men had been exposed to between 50 and 83 ppm benzene (say, 66 ppm). The average duration of employment for the entire Pliofilm cohort was about 3.2 years. The result is an excess of about 51 leukemia deaths per 1,000 men exposed to 300 ppm-years benzene. This result agrees reasonably well with that obtained by White et al. for long-term workers only. It should be mentioned that the cumulative benzene exposure level assumed by White et al. in their risk assessment and the level considered by us in this risk assessment are appreciably higher than the level of 69 ppm-years presented in the latest report of the Pliofilm cohort (19).

Enterline's risk assessment method also can be applied to the latest report of the Dow cohort in which there were four leukemia deaths observed versus 2.1 expected (21). These men had an average cumulative benzene exposure of about 46 ppm-years and the total number of expected deaths was 268.6. Thus, it is estimated that 300 ppm-years of benzene exposure would result in

$$(1.9/268.6) \times (300 \text{ ppm-years}/46 \text{ ppm-years}) = 46 \text{ per } 1{,}000 \text{ excess leukemia deaths.}$$

The retrospective follow-up study of refinery workers by Tsai et al. (26) included estimates of benzene exposures. These workers were typically exposed to less than 1 ppm of benzene (median, 0.5 ppm). The average duration of employment was about seven years, resulting in an average cumulative benzene exposure of about 3.5 ppm-years. If these refinery workers were subjected to the same benzene-induced leukemia mortality as were the Pliofilm workers, their overall standardized mortality ratio would be about 112. Therefore, the observation that there was no leukemia death observed compared with 0.42 expected does not contradict the results of the above risk assessments. Tsai's study is simply too small and the benzene exposures too low for it to contribute to the benzene-leukemia risk assessment.

The study by Wong (25) of chemical workers also contains estimates of benzene exposures. There were 3,536 men "continuously" exposed to benzene in this study. Their average cumulative benzene exposure was about 30 ppm-years. There were six observed leukemia deaths compared with 4.4 expected (standardized mortality ratio = 135) and the total number of expected deaths was 613. Therefore, the number of excess leukemia deaths resulting from exposure to 300 ppm-years is estimated as:

$$(1.57/613) \times (300 \text{ ppm-years}/30 \text{ ppm-years}) = 26 \text{ per } 1{,}000.$$

The result does not agree well with that of Crump and Allen (63). The discrepancy is in part related to the observation that there is no consistent dose-response relation between leukemia mortality and the cumulative benzene dose in Wong's study and in part to the deficit of leukemia among the

unexposed in this study. For these reasons, we believe that Wong's study is not as informative to a risk assessment as are the Pliofilm and Dow studies.

Summary of risk assessments

Five risk assessments for benzene-induced leukemia have been reviewed. Table 2 presents a summary of the results of four of the risk assessments based on the Pliofilm and Dow cohorts, along with our own estimates. Some of these investigators did not directly calculate the estimates displayed in table 2, but we extended their methodology to this particular exposure situation.

Our own risk assessment results, those of Crump and Allen (63), and those of White et al. (57) agree fairly well. The Carcinogen Assessment Group estimate is too low for the Pliofilm study because of an error regarding the duration of employment of this cohort, as discussed. Their risk assessment result based upon the Dow study, however, agrees well with the other results. Given the different methodologies and assumptions applied by the various risk assessment authors, the results, with the exception of that of Rinsky et al. (19), are reasonably consistent.

The result reached by Rinsky et al. is considerably higher than the others. It is difficult to understand why and, unfortunately, we cannot directly attempt to replicate their case-control results. However, we did do two risk assessments based on the results of the cohort study from which their case-control study derives. Our result using Poisson regression is 82 excess leukemia deaths per 1,000 men exposed to 300 ppm-years, while our result based upon Enterline's method is 83. Since the Rinsky et al. result does not agree with the others, including two independent risk assessments (ours and that of Crump and Allen) based upon the same cohort, we believe their result is too high.

An interpretation of these risk assessment results is that the Pliofilm study indicates an appreciable excess leukemia risk attributable to benzene and that the other studies provide some support, or at least do not contradict this. However, it must be borne in mind that the other studies were either very small or suffered serious methodological problems, so that, despite the observation that they seem to support the results of a risk assessment based upon the Pliofilm study, little confidence can be placed in them.

TABLE 2

Numbers of lifetime excess leukemia deaths per 1,000 workers exposed to 10 ppm benzene for 30 years, as estimated by various risk assessments

Risk assessment authors (ref. no.)	Study from which risk assessments derive			
	Pliofilm cohort		Dow cohort	
	(Follow-up through) 1975	1981	(Follow-up through) 1973	1982
White et al. (57)	30–104* (Midpoint, 67)	(Not done)	32–93† (Midpoint, 62)	(Not done)
Carcinogen Assessment Group (61)	15	(Not done)	47‡	(Not done)
Rinsky et al. (19)	(Not done)	250	(Not done)	(Not done)
Crump and Allen (63)	(Not done)	48	68§	(Not done)
Present study	51	83	47	46

* Based on cohort members with five or more years of employment.

† Leukemia cell types other than lymphocytic or monocytic.

‡ Myelocytic leukemia only.

§ Based on the Pliofilm cohort, the Dow cohort, and Wong's study.

TABLE 3

Summary of epidemiologic studies from which the risk assessment results presented here are derived

Study (ref. no.)	Leukemia deaths		Total expected deaths	Cumulative benzene exposure (in ppm-years)
	Observed	Expected		
Pliofilm study (19)	9	2.7	332	69
Dow study (21)	4	2.1	269	46
Tsai et al. (26)	0	0.42	59	4
Wong et al. (25)	6	4.4	613	30
Total	19	9.6	1,273	42*

* A weighted average according to the expected number of deaths in each study.

The results of the epidemiologic studies which we considered in our benzene-leukemia risk assessment are displayed in table 3. The overall standardized mortality ratio from these four studies is 198. A weighted average (weighted according to the expected number of total deaths) of the cumulative benzene exposures sustained by the men in these cohorts is about 42 ppm-years. Thus, an overall estimate of the number of excess leukemia deaths associated with 300 ppm-years of occupational exposure to benzene is obtained as:

$$(19 - 9.6)/1{,}273$$

$$\times (300 \text{ ppm-years}/42 \text{ ppm-years})$$

$$= 53 \text{ per } 1{,}000.$$

Using the lower and upper 95 per cent confidence limits of the overall standardized mortality ratio, a lower and upper bound for the number of excess leukemia deaths for 300 ppm-years of benzene exposure are 10 and 113 per 1,000, respectively. The estimates for 30 years of exposure beginning at age 20 years to the proposed new standard of 1 ppm benzene are one-tenth of these results.

SUMMARY

Benzene is widely recognized as a leukemogen, and the Occupational Safety and Health Administration is currently attempting to limit exposure to it more strictly. The proposed new regulation is a limit of an eight-hour time-weighted average of 1 ppm in place of the current limit of 10 ppm. The fundamental rationale for the change is a perception that the current standard is associated with an inordinate excess of leukemia.

The epidemiologic literature on benzene and leukemia supports the inference that benzene causes acute myelocytic leukemia. However, the available data are too sparse, or suffer other limitations, to substantiate the idea that this causal association applies at low levels (i.e., 1–10 ppm) of benzene. Nonetheless, under the assumption that causation does apply at such low levels, a number of authors, including ourselves, have performed risk assessments using similar data but different methodologies. The assessments that we consider acceptable suggest that, among 1,000 men exposed to benzene at 10 ppm for a working lifetime of 30 years, there would occur about 50 excess deaths due to leukemia in addition to the baseline expectation of seven deaths. However, this estimate is speculative and whether or not enough confidence can be placed in it to justify a lower occupational benzene standard remains a decision for policy makers.

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ID: N is north of facility; white community		
ID #	**Underlying Illness**	**Form**
ICB 1	Born with 1 bad kidney. Kidney Transplant at 8 yrs old. Only have 1 kidney On Anti rejection medication for life. Take 15 pills a day. Nervousness and Depression also	Yes
ICB 2	Insulin dependent Diabetic. Type 1 & Type 2. Asthma	Yes
ICB 3	Severe Rett's. Unable to walk. Causes behavioral, cognitive and physical handicaps. Need a Calming Support area with a hyperactivity relief. Respiratory issues including episodes of no breathing, rapid breath and shallow breath. Extremely sensitive to Loud Noises, fire trucks, fire crackers, Loud noises. Seizures, tremors, etc. Unable to speak or understand. Over 11 pills a day. More info. reported	Yes
ICB 4	COPD and High Blood Pressure	Yes
ICB 5	Cancer (kidney). Kidney removed. Tumor behind Left eye Unable to have tested for Cancer because of COVID 19) High Blood Pressure and Thyroid	Yes
ICB 6	High Blood Pressure, Kidney Failure, Diabetes	Yes
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ICB 9	Diabetic, Cancer, High Blood Pressure	Yes
ICB 10	Breast Cancer, Heart Murmor, COPD, Wear a stomach bag, High Blood Pressure	Yes
ICB 11	High Blood Pressure and Heart Disease	Yes
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ICB 12	Asthma & Allergies (18 yrs)	Yes
ICB 13	High Blood Pressure	Verbal
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ICB 15	Asthma and ADHD	Phone Survey/ Rev. Shoffner
ICB 16	Heart Disease, High Blood Pressure (Congestive Heart Failure told me verbally)	Yes

ICB 24	Asthma and High Blood Pressure	Yes
ICB 25	Heart Disease and Breathing Issues	Yes
ICB 26	Diabetes, High Blood Pressure	Yes
ICB 27	COPD, High Blood Pressure, Diabetic, Sleep Apnea, Chronic Neck and Back Pain	Yes
ICB 28	Stroke	Yes
ICB 29	Cardiovascular Disease and High Blood Pressure	Yes
ICB 30	Thyroid Disease and High Blood Pressure	Yes
ICB 31	Arthritis Right Leg	Yes, on back of sheet for ICB 29
ICB 32	COPD, Asthma, Bronchitas	Yes
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ICB 35	High Blood Pressure, Mental Illness Depression, Low Platens (forgot name of disease)	Yes
ICB 36	Thyroid Disease & High Blood Pressure	Yes
ICB 37	High Blood Pressure	Yes
ICB 38	Asthma (MINOR)	Yes
ICB 39	Anxiety Disorder & Depression, High Blood Pressure, High Cholesterol	Yes
ICB 40	High Blood Pressure Sister lives with her w/ eczema	Yes
ICB 41	COPD, High Blood Pressure, Heart Disease	Yes
ICB 42	I stay with sister Rachel Jones. She take care of me. I can't see good, I don't smell, or hear good. 75% of my body got burned as a child. I get very scared of things. I suffer from Depression, and development delay. The plant will be bad on my health and noise making.	Yes
ICB 43	Asthma (MINOR)	Yes
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ICB 57	Diabetes, High Blood Pressure, COPD	Yes
ICB 58	High Blood Pressure & High Cholesterol	Yes
ICB 59	High Blood Pressure, Borderline Diabetic, High Cholesterol , Bronchitis	Yes
ICB 60	High Blood Pressure/COPD	Yes
ICB 61	High Blood Pressure (35 yrs old)	Yes
ICB 62	Asthma (MINOR)	Yes
ICB 63	High Blood Pressure & Asthma	Yes
ICB 64	Severe Allergies, Diabetes, Arthritis, High Blood Pressure	Yes
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From: Caroline Long
To: Mary.Lee@ncleg.gov; Veronica.Green@ncleg.gov; Robert.Reives@ncleg.gov; Ann.Raeford@ncleg.gov; Kelly.Alexander@ncleg.gov; Emily.Hagstrom@ncleg.gov; Vernetta.Alston@ncleg.gov; Tina.Riley-Humphrey@ncleg.gov; John.Autry@ncleg.gov; Edward.Sheehy@ncleg.gov; Kandie.Smith@ncleg.gov; Charles.Graham@ncleg.gov; Brandon.Combs@ncleg.gov; Caroline.Enloe@ncleg.gov; Linda.Cooper-Suggs@ncleg.gov; Allison.Dahle@ncleg.gov; Anne.Evangelista@ncleg.gov; Susan.Fisher@ncleg.gov; Samantha.Saunders@ncleg.gov; Rosa.Gill@ncleg.gov; Lisa.Ray@ncleg.gov; Wilson.Brown@ncleg.gov; Wesley.Harris@ncleg.gov; Anita.Wilder@ncleg.gov; Zack.Hawkins@ncleg.gov; Arianna.Alvarez@ncleg.gov; Ricky.Hurtado@ncleg.gov; Young.Bae@ncleg.gov; Verla.Insko@ncleg.gov; Virginia.Reed@ncleg.gov; Joe.John@ncleg.gov; Carolyn.Logan@ncleg.gov; Robert.LockardIII@ncleg.gov; Marvin.Lucas@ncleg.gov; Thelma.Utley@ncleg.gov; Graig.Meyer@ncleg.gov; Grier.Martin@ncleg.gov; Daphne.Quinn@ncleg.gov; Christopher.Hailey@ncleg.gov; Pamela.Best@ncleg.gov; Marcia.Morey@ncleg.gov; Janice.Fenner@ncleg.gov; Garland.Pierce@ncleg.gov; Susan.Thompson@ncleg.gov; Raymond.Smith@ncleg.gov; Hudson.McCormick@ncleg.gov; Julie.vonHaefen@ncleg.gov
Cc: Caroline Long; SVC_DENR.DAQ.publiccomments; Governor"s Press Office
Subject: [External] EJ Community Public Comments for NCDAQ Public Hearing - Cumulative Health Impact Risk
Date: Sunday, September 19, 2021 9:18:35 PM
Attachments: Anderson Health Survey Dr. Courtney Woods.pdf
6.21.20 PDF Confidential- Anderson Potential IHR 6.19.2020.pdf

Requesting NCDAQ Air Permit No. 10693R00 - Burlington North Public Hearing be postponed to determine if Cumulative Health Impact risk may result from proposed permit.

Caroline Laur
Re: Burlinton North Public Comments for NCDAQ Proposed Permit No. 10693R00.

The Pollutant Air Permit for proposed NCDAQ **Air Permit No. 10693R00 - Burlington North** is a documented EJ community. The residents that reside within a 1 mile radius of proposed Asphalt/Cement NCDAQ Air Permit NO. 10693ROO - Burlington North are a low income, overburdened, a "at risk" predominately black community.

The Anderson Community (within a one mile radius) is classified "at risk" because the "preliminary" health survey's conducted by the community indicated that approximately ninety-three percent of the black households within a one mile radius were overburdened with series health issues that were predominately either cancer, diabetes, cardiovascular disease, high blood pressure and Asthma/COPD. There is a fear that this Pollutant Industry will add an additional layer of toxic chemicals that could result in human health risks.

The Anderson Community documented higher levels of series illnesses than state averages, and higher level of multiple illnesses in individuals. And then add the racial disparities in NC when it comes to Covid-19 deaths, only increases Anderson Community's concerns for Cumulative Health Impact risk resulting from passing proposed **Air Permit No. 10693R00 - Burlington North.** (Attached Preliminary Health Survey conducted by citizens of Community & Validated Health Study Conducted by UNC at Chapel Hill Gillings School of Public Health)

For eighteen months Anderson Community has been asking NCDEQ/NCDENR if conformity with Subchapter 01C - North Carolina Environmental Policy Act (NCEPA) applies to

Anderson Community's documented "high risk" Cumulative Health Inpact concerns? We believe NCEPA provides a regulation that NCDENR should enforce once they were notified that this pollutant permit ***"may result in a potential risk to human health?"***

We are trying to find out if the rules outlined in NCEPA; such as (but not limited to) 15A NCAC 01C .0106 SCOPING AND HEARINGS and 15A NCAC 01C .0208 INCOMPLETE OR UNAVAILABLE INFORMATION; especially **" (3) a summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment";** apply to the Anderson Cumulative Health risk concerns? And if yes, WHY AFTER 18 MONTHS hasn't anyone enforced them? We had notified NCDAQ, NCDEQ, NCDHHS, local and state health departments about Anderson EJ Community's cumulative health impact concerns by certified mail, emails and public comments.

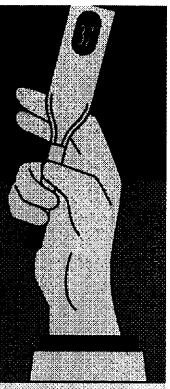
Anderson Community is requesting that the state provide this low income Environmental Justice (EJ) community with "voluntary" genetic testing (Presymptomatic diagnostic and predictive genetic genome sequencing testing) to analyze DNA of the now validated "at risk" citizens. This testing would provide Anderson citizens and NCDENR with the "required credible scientific evidence which is relevant to evaluating the reasonably foreseeable" for Cumulative Health impacts risk (NCEPA subchapter 01C). This level of testing would help identify genetic variants that contribute to the overall health; and factors contributing to the cumulative health risk of every household within the community.

I am requesting that North Carolina Secretary of the Department of Environmental Quality, Elizabeth S. Biser; postpone the NCDAQ Public Hearing for Air Permit No. 10693R00. I am deeply concerned that possible misconduct may have occurred by state agency's involving possible Title 6 violations in the process of the initial NCDAQ draft permit 10628ROO - Burlington North in 2020; I have deeply concerned of possible gaslighting of a marginalized community by the very agency's that were meant to protect them. Such as (but not limited to) NCDAQ's possible negligence of calculating EJ communities in the permit process, possible misconduct by NCDEQ for the amount of pressure, risks and stress placed on this EJ community during a COVID-19 worldwide epidemic (forcing citizens to obtain "life threatening" door-to-door surveys to prove they were indeed a EJ community) and NCDAQ's unwillingness to postpone Public Hearings and Public Comments during Covid-19 worldwide epidemic multiples times until the very last minute. And again, forcing the citizens of this disadvantaged, low income EJ community to risk their lives collecting another door-to-door Health Survey's to enter into public comments in the NCDAQ Public Hearing; due to NCDAQ refused to cancel Public Hearing due to Covid-19 until the very last minute. All this took place before NCDAQ implemented ANY of the EJ guidelines for a EJ community, to educate the citizens to prepare for NCDEQ permit processes. The citizens of Anderson Community was forced to contact the EPA in Washington, DC; to help NCDAQ enforce NCDAQ Title 6 rights. My concerns is, if the facts are substantiated; these acts may have resulted in "the wearing down" and possibly unfair practices of Title 6 laws and regulations to an EJ community. Which resulted in this overburdened "at risk" EJ community to give up, due to what they felt as possible unfair practices and injustice. I am requesting an investigation of these possible concerns. I am requesting a full investigation, including an in depth FOIA requests of all state and federal agencies (persons) involved in NCDAQ Permit 1063900 Burlington North in 2020.

It would truly be an Environmental Injustice if the citizens in this EJ community were not

given the right to determine if any acts of Environmental Injustice did occur. And to determine if the state is responsible for providing the means to determine if this EJ community is at risk for Cumulative Health Impacts if NCDAQ Permit 1063900 is approved.

CHECKING UP ON THE HEALTH OF ANDERSON TOWNSHIP



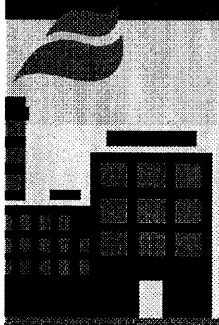
77% OF RESIDENTS REPORT A FORMALLY DIAGNOSED CHRONIC ILLNESS
48% REPORT HAVING THREE OR MORE

RESIDENTS REPORT HIGHER THAN AVERAGE RATES OF MULTIPLE CHRONIC ILLNESSES*

- Asthma is three times more prevalent than state average[1].
- High blood pressure and Type 2 Diabetes are twice as prevalent[2].
- Lung disease and a mental health diagnosis were both more prevalent[3,4].

CASWELL COUNTY, COMPARED TO THE STATE AVERAGE, HAS:

- Higher rates of death due to heart disease, cancer, and diabetes
- Higher than average rate of preterm births, child mortality, and infant death
- Nearly half the average number of primary care physicians[5]



ENVIRONMENTAL HEALTH ISSUES

- 60% of residents report plumes of smoke in their community
- 62% report strange smells
- The local animal park is a major source of odor and noise complaints

[1] Centers for Disease Control and Prevention | [2] Community Clinical Connections | [3] North Carolina Medical Journal | [4] North Carolina Health News | [5] North Carolina Department of Health and Human Services

For questions about the survey, contact Dr. Courtney Woods (courtney.woods@unc.edu)

ANDERSON COMMUNITY GROUP - PRE-EXISTING HEALTH RISK ASPHALT CEMENT CHEMICALS		
Estimated 250 ft to 1 Mile Radius		
ID: ICB & X is in Black Community		
ID: N is north of facility; white community		
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From: Caroline Long
To: SVC_DENR.DAQ.publiccomments
Cc: SVC_DENR.DAQ.publiccomments; Caroline Long
Subject: [External] Public Comments - NCDAQ Permit No. Burlington North
Date: Sunday, September 19, 2021 9:18:35 PM
Attachments: 6.21.20 PDF Confidential- Anderson Potential IHR 6.19.2020.pdf
Anderson Health Survey Dr. Courtney Woods.pdf

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Download all attachments as a zip file

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  95.9kB

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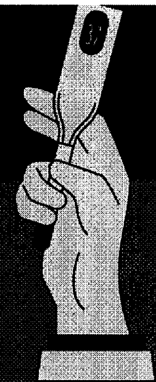
ICB 40	High Blood Pressure Sister lives with her w/ eczema	Yes
ICB 41	COPD, High Blood Pressure, Heart Disease	Yes
ICB 42	I stay with sister Rachel Jones. She take care of me. I can't see good, I don't smell, or hear good. 75% of my body got burned as a child. I get very scared of things. I suffer from Depression, and development delay. The plant will be bad on my health and noise making.	Yes
ICB 43	Asthma (MINOR)	Yes
ICB 44	Asthma (MINOR)	Yes

ICB 52	1 premature baby (3 months old) MINOR	Yes
ICB 53	Chronic Asthma (MINOR)	Yes
ICB 54	Asthma (MINOR)	Yes
ICB 55	Diabetes and High Blood Pressure	Yes
ICB 56	High Blood Pressure	Yes
ICB 57	Diabetes, High Blood Pressure, COPD	Yes
ICB 58	High Blood Pressure & High Cholesterol	Yes
ICB 59	High Blood Pressure, Borderline Diabetic, High Cholesterol , Bronchitis	Yes
ICB 60	High Blood Pressure/COPD	Yes
ICB 61	High Blood Pressure (35 yrs old)	Yes
ICB 62	Asthma (MINOR)	Yes
ICB 63	High Blood Pressure & Asthma	Yes
ICB 64	Severe Allergies, Diabetes, Arthritis, High Blood Pressure	Yes
ICB 65	Asthma	Yes
ICB 66	Thyroid Disease	Yes
ICB 67	Asthma	Yes
ICB 68	Bronchitis, High Blood Pressure, COPD, Allergies, and Very noticeable Tremors that have not been diagnosed yet. Parkinson???	Yes
ICB 69	High Blood Pressure (very bad), Allergies, and other severe health issues.	Yes
ICB 70	Allergies	On sheet ICB 69
ICB 71	Allergies	On sheet ICB 70
ICB 72	High Blood Pressure	Yes
ICB 73	sleep APNEA, arthritis, cardiovascular	
ICB 74	Asthma	

ICB 85	Asthma	Yes
X 86	Series health issues but does not want to disclose name DPS/Xty	Yes
X 87 (x1)	Cardiovascular Disease and High Blood Pressure	Verbal
X 88	Cancer	Verbal
ICB 89	Asthma (MINOR)	Yes
ICB 90	High Blood Pressure	
N 91	MGUS , PTSD, ADHD, Anxiety Disorder. MGUS - pre-malignacy that can turn into Multiple Myeloma. Sensitive to toxins and chemicals.	Yes
N 92	Double Lung Transplant, Anti Rejection blockers for life	Petition
N 93	High Blood Pressure, High Cholesterol, Anxiety, Extreme Exczema,and skin allergies.	Yes
N 94	Lymphoma	Petition
N 95	Diabetes, Emphysema, Upper Respiratory Infections/Allergies, BIId Clits Hypertension, Gout, Cardiac Arrhythmias, Compromised Immune System.	
N 96	Cancer	Verbal
N 97	Parkinsons	Petition
N 98	RA	
N 99	Lupus	Petition
N 100	Lung Problems, Cardiovascular Disease, High Blood Pressure, Arthritis	Petition
N 101	Upper Respiratory Infections/Allergies, Sleep Apnea, Recent Brain bleed requiring surgery, Compromised Immune System	
ICB 102	Asthma (MINOR)	Phone Survey/ Rev
ICB 103	Asthma (MINOR)	Phone Survey/ Rev
ICB 104	High Blood Pressure Sister lives with her w/ eczema	Go back p/u form.
	And Counting	

CHECKING UP ON THE HEALTH OF
ANDERSON TOWNSHIP



ERSON TOWNSHIP IS LOCATED IN
ASWELL COUNTY, NORTH CAROLINA

[illegible]

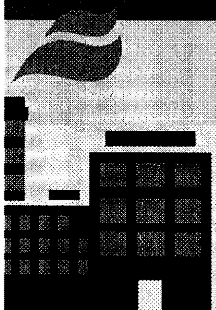
77% OF RESIDENTS REPORT A FORMALLY DIAGNOSED CHRONIC ILLNESS
48% REPORT HAVING THREE OR MORE

RESIDENTS REPORT HIGHER THAN AVERAGE RATES OF MULTIPLE CHRONIC ILLNESSES*

- Asthma is three times more prevalent than state average[1].
- High blood pressure and Type 2 Diabetes are twice as prevalent[2].
- Lung disease and a mental health diagnosis were both more prevalent[3,4].

CASWELL COUNTY, COMPARED TO THE STATE AVERAGE, HAS:

- Higher rates of death due to heart disease, cancer, and diabetes
- Higher than average rate of preterm births, child mortality, and infant death
- Nearly half the average number of primary care physicians[5]



ENVIRONMENTAL HEALTH ISSUES

- 60% of residents report plumes of smoke in their community
- 62% report strange smells
- The local animal park is a major source of odor and noise complaints

*...n compared to NC state average
...ters for Disease Control and Prevention, [2] Community Clinical Connections, [3] North Carolina Medical Journal, [4] North Carolina Health News
...th Carolina Department of Health and Human Services

For questions about the survey, contact Dr. Courtney Woods (courtney.woods@unc.edu)

From: K L TATE
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Sunrock Burlington-Anderson
Date: Sunday, September 19, 2021 7:46:37 PM

My name is Karen Tate Gray. I am requesting that the Division of Air Quality deny the most recent air permit that Carolina Sunrock has submitted for the Burlington North Asphalt Plant site.

To begin, this company has sued residents of the area who voiced their objection to a local permit that was issued to the company. This can be seen as an effort to intimidate residents from expressing their concerns about the negative impact that the asphalt plant will have on the quality of life in this community. No permit should be issued to Carolina Sunrock prior to the outcome of the lawsuit that Sunrock has initiated. Only after that suit has been settled should the DAQ consider any permits and only, if at that time, the company meets criteria put forth by the county.

The location of this site is adjacent to the homes of many who have health issues and no means to relocate. The health of these individuals can be negatively impacted by the toxicity of the chemical levels expelled by the the plant. The present application has the same level of nitrogen oxide that caused the permit to be denied previously. It appears that the level of benzene and arsenic emitted will be greater than what has been determined healthy. These are just a few of the examples of chemicals that can have a negative impact on those that live in proximity to the site.

Not only will this plant negatively impact those adjacent to the site, but also the community. This will negatively affect the air quality. It will add to, not only air pollution, but also noise pollution and impact the traffic in the area as the truck traffic will increase significantly. There is the issue of fugitive dust from the trucks as well as exhaust that is emitted while traveling and also while waiting for loads. There will also be light pollution in the area of the facility. These issues will disrupt not only the lives of the residents in the community but also the wildlife in the area. I see no positives from having this plant in our community.

My concern is that not only is Sunrock planning this plant, but they are planning for at least one more plant and a rock quarry in the same general vicinity. This heightens the negative impact on air and water quality of the area.

Again, I am requesting that you again deny the air quality permit to Carolina Sunrock for the Burlington North Asphalt Plant due to an ongoing lawsuit initiated by Sunrock against residents of the community and due to the fact that they have not sufficiently made changes to their original application.

Thank you for considering my request.

From: Evangeline Vinson
To: SVC_DENR.DAQ.publiccomments
Subject: [External] Carolina Sunrock - Burlington North
Date: Sunday, September 19, 2021 2:25:09 PM

My name is Evangeline Vinson Gaudette. I live at 441 Baynes Rd, Burlington NC. I am one of the citizens of this county that is being sued by this company because I exercised my right to object to a local permit.

I am requesting today that you delay a decision on the air permit until after a court ruling in this lawsuit. If the applicant loses, our county's High Impact Development Ordinance (HIDO) will apply, which will affect the location and configuration of the projects. At that time new air permit applications will be required. No permits should be considered until this matter is decided in a court of law.

Thank You.

From: Phil
To: Nasif, Zaynab R
Cc: Murphy, Davis; SVC_DENR.DAQ.publiccomments
Subject: Re: [External] Re: Carolina Sunrock Hearings
Date: Friday, September 17, 2021 9:10:10 AM
Attachments: image002.png
image003.png

Hi Zaynab,

Can you provide the missing attachments mentioned in the DAQ reviews of the air permit applications?

Prospect Hill review:

- NCDENR Bagfilter Evaluation Spreadsheet - Version 3.3, September 23, 1999 (Attachment B2)
- Miratech document

Burlington North review:

- A1 Bagfilter Evaluation for HMA-CD1
- A2 Bagfilter Evaluation for RMC-CD2
- B Application narrative requesting asphalt production to be limited to 50,000 tons per year
- C NCDENR Concrete Batch Emissions Calculator spreadsheet
- D NCDENR Fuel Oil Emissions Calculator spreadsheet
- E1 NCDENR Asphalt Emissions Calculator spreadsheet for Actual SO2 and CO Emissions w/ Synthetic Minor Limits
- E2 NCDENR Asphalt Emissions Calculator spreadsheet for Expected Actual Emissions using Natural Gas
- E3 NCDENR Asphalt Emissions Calculator spreadsheet for Expected Actual Emissions using Waste/No. Fuel Oil
- E4 NCDENR Asphalt Emissions Calculator spreadsheet for Potential Emissions before controls/limits
- E5 NCDENR Asphalt Emissions Calculator spreadsheet for Potential Emissions after controls/limits
- E6 NCDENR Asphalt Emissions Calculator spreadsheet for Potential TAP Emissions using Natural Gas
- E7 NCDENR Asphalt Emissions Calculator spreadsheet for Potential TAP Emissions using No.4/No 6 Fuel Oil
- E8 NCDENR Concrete Batch Emissions Calculator spreadsheet for Potential TAP Emissions
- E9 Facility-Wide Emissions Summary Spreadsheet

Again, I request DAQ postpone the hearing and extend the comment deadline until all the information is provided and the public is given the opportunity and time to review the materials. Without the information, the applications and reviews are incomplete and does not allow a basis for public review and comment.

Thank you,
Phil Barfield

On Tue, Sep 14, 2021 at 9:13 PM Phil <cambarus.davidi@gmail.com> wrote:

> Hi Zaynab,
>
> As I'm reviewing the materials, I'm noticing missing information and updates. The latest Form D1 (6-6-2021) you sent doesn't appear to reflect the most recent facility emission summary (7-16-2021). Also, the attachment "**Carolina Sunrock Prospect Hill 2 Revised Table 4-6.pdf**" is missing from the Trinity Consultants email on 7-22-2021. Can you provide these two documents?
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Apologies for the delay as we were compiling the documents you requested. This link contains the documents below that you requested: https://northcarolinadeptofenvandnat.sharefile.com/d-s1734230506b84da696ac2737753a6547

Note that the link will expire in 7 days, so it is recommended you download the documents to your device as soon as possible.

I am still working on gathering the correspondence portion (your last bullet) of the request, so I will get that to you soon when they are available.

Let me know if you have any additional questions.

Best,

Zaynab

Zaynab Nasif

Public Information Officer – Division of Air Quality

North Carolina Department of Environmental Quality

(o) 919.707.8446

(c) 919.618.0968

Zaynab.Nasif@ncdenr.gov

From: Phil <cambarus.davidi@gmail.com>
Sent: Thursday, August 26, 2021 9:15 AM
To: Nasif, Zaynab R <zaynab.nasif@ncdenr.gov>
Cc: Murphy, Davis <davis.murphy@ncdenr.gov>; SVC_DENR.DAQ.publiccomments <DAQ.publiccomments@ncdenr.gov>
Subject: Re: [External] Re: Carolina Sunrock Hearings

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Please provide the correspondence as soon as possible. If you cannot provide by 9/1/2021, please postpone the hearing until the information is released and the public is given enough time to review (30 days).

Thank you,

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Just to clarify, do you mean what changed since submittal of the original 2021 applications or the ones in 2020?

From: Phil [mailto:cambarus.davidi@gmail.com]
Sent: Tuesday, August 10, 2021 4:45 PM
To: Nasif, Zaynab R <zaynab.nasif@ncdenr.gov>
Cc: Murphy, Davis <davis.murphy@ncdenr.gov>
Subject: [External] Re: Carolina Sunrock Hearings

Hi Zaynab,

Thank you for posting the permitting documents.

Has any information in the applications changed since they were submitted by the applicant? I ask because in each of the DAQ reviews, it was noted in section I, Application Chronology, that there were requests for additional information and additional information received from the applicant. Also, in the previous applications in 2019, correspondence between the applicant and their contractors was included with the application. This time, I do not see any correspondence between DAQ and the applicant and their contractors.

Since we are being asked to comment on the draft air permit, it would be beneficial to know if the permit takes into consideration any changes from the original application. Can you send me or post correspondence related to the applications on the website?

Thank you,

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Zaynab.Nasif@ncdenr.gov

From: Nasif, Zaynab R
Sent: Friday, August 6, 2021 4:13 PM
To: Nasif, Zaynab R <zaynab.nasif@ncdenr.gov>
Subject: Carolina Sunrock Hearings

Good afternoon,

I hope this email finds you well. You are receiving this email because you are a member of the local Caswell County community and expressed interest in being kept aware of updates regarding Carolina Sunrock.

The Division of Air Quality will host two digital public hearings on the two separate permit applications that were re-submitted by Carolina Sunrock for their Burlington North and Prospect Hill locations. You can participate in the hearing by phone or by computer. I am also attaching the public notices that further explain additional methods for providing public comments.

Below are the meeting times and information needed to attend. Please note that these hearings are happening on separate nights and will therefore have separate links and phone numbers. Registration is not required to attend the hearing, but it is required if you would like to speak:

If you wish to speak at the Burlington North public hearing, you must register by 4:00 p.m. on September 20. To register, please visit: https://bit.ly/2TYC1HC or call (919) 618-0968.

Event title: Public Hearing for Carolina Sunrock LLC – Burlington North Plant

Date and Time: September 20, 2021 at 6 p.m.

Phone: US TOLL +1-415-655-0003, Access Code 161 633 4904

WebEx Link: https://bit.ly/3xlihM1

Event Password: NCDAQ

If you wish to speak at the Prospect Hill public hearing, you must register by 4:00 p.m. on September 21. To register, please visit: https://bit.ly/3ithnla or call (919) 618-0968.

Event title: Public Hearing for Carolina Sunrock LLC – Prospect Hill Quarry and Distribution Center

Date and Time: September 21, 2021 at 6 p.m.

Phone: US TOLL +1-415-655-0003, Access Code 161 805 4856

WebEx Link: https://bit.ly/3rW9FdA

Event Password: NCDAQ

This information will be posted on our website within the next few days at https://deq.nc.gov/carolina-sunrock. Please do not hesitate to reach out to me with any questions regarding the permitting process or public hearings.

Best,

Zaynab

Zaynab Nasif
Public Information Officer – Division of Air Quality
North Carolina Department of Environmental Quality
(o) 919.707.8446
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Zaynab.Nasif@ncdenr.gov

From: Phil
To: Nasif, Zaynab R
Cc: Murphy, Davis; SVC_DENR.DAQ.publiccomments
Subject: Re: [External] Re: Carolina Sunrock Hearings
Date: Tuesday, September 14, 2021 9:13:58 PM
Attachments: image002.png
image003.png

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WebEx Link: https://bit.ly/3xlihM1

Event Password: NCDAQ

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Event title: Public Hearing for Carolina Sunrock LLC – Prospect Hill Quarry and Distribution Center

Date and Time: September 21, 2021 at 6 p.m.

Phone: US TOLL +1-415-655-0003, Access Code 161 805 4856

WebEx Link: https://bit.ly/3rW9FdA

Event Password: NCDAQ

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From: Phil
To: Nasif, Zaynab R
Cc: Murphy, Davis; SVC_DENR.DAQ.publiccomments
Subject: Re: [External] Re: Carolina Sunrock Hearings
Date: Thursday, August 26, 2021 9:15:04 AM
Attachments: image001.png
image002.png

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> > Hi Zaynab,
> >
> > I am assuming DAQ is considering these as new applications and not modifications or amendments to the previous ones submitted in 2019, so I would only want to see any changes to the ones submitted on April 22, 2021.
> >
> > Thank you,
> > Phil
> >
> > On Wed, Aug 11, 2021 at 9:22 AM Nasif, Zaynab R <zaynab.nasif@ncdenr.gov> wrote:
> >
> > > Hi Phil,
> > >
> > > Just to clarify, do you mean what changed since submittal of the original 2021 applications or the ones in 2020?
> > >
> > > ---
> > >
> > > **From:** Phil [mailto:cambarus.davidi@gmail.com]
> > > **Sent:** Tuesday, August 10, 2021 4:45 PM
> > > **To:** Nasif, Zaynab R <zaynab.nasif@ncdenr.gov>
> > > **Cc:** Murphy, Davis <davis.murphy@ncdenr.gov>

Subject: [External] Re: Carolina Sunrock Hearings

Hi Zaynab,

Thank you for posting the permitting documents.

Has any information in the applications changed since they were submitted by the applicant? I ask because in each of the DAQ reviews, it was noted in section I, Application Chronology, that there were requests for additional information and additional information received from the applicant. Also, in the previous applications in 2019, correspondence between the applicant and their contractors was included with the application. This time, I do not see any correspondence between DAQ and the applicant and their contractors.

Since we are being asked to comment on the draft air permit, it would be beneficial to know if the permit takes into consideration any changes from the original application. Can you send me or post correspondence related to the applications on the website?

Thank you,

Phil Barfield

On Mon, Aug 9, 2021 at 3:01 PM Nasif, Zaynab R <zaynab.nasif@ncdenr.gov> wrote:

> Good afternoon,
>
> This is a courtesy email to let you know that permitting documents for both Burlington North and Prospect Hill are now available on the DEQ website at https://deq.nc.gov/carolina-sunrock
>
> Note that the draft Environmental Justice Reports will be ready within the next few days. Please don't hesitate to contact me for any additional questions.
>
> Best,
>
> Zaynab

Zaynab Nasif
Public Information Officer – Division of Air Quality
North Carolina Department of Environmental Quality
(o) 919.707.8446
(c) 919.618.0968
Zaynab.Nasif@ncdenr.gov

From: Nasif, Zaynab R
Sent: Friday, August 6, 2021 4:13 PM
To: Nasif, Zaynab R <zaynab.nasif@ncdenr.gov>
Subject: Carolina Sunrock Hearings

Good afternoon,

I hope this email finds you well. You are receiving this email because you are a member of the local Caswell County community and expressed interest in being kept aware of updates regarding Carolina Sunrock.

The Division of Air Quality will host two digital public hearings on the two separate permit applications that were re-submitted by Carolina Sunrock for their Burlington North and Prospect Hill locations. You can participate in the hearing by phone or by computer. I am also attaching the public notices that further explain additional methods for providing public comments.

Below are the meeting times and information needed to attend. Please note that these hearings are happening on separate nights and will therefore have separate links and phone numbers. Registration is not required to attend the hearing, but it is required if you would like to speak:

If you wish to speak at the Burlington North public hearing, you must register by 4:00 p.m. on September 20. To register, please visit: https://bit.ly/2TYC1HC or call (919) 618-0968.

Event title: Public Hearing for Carolina Sunrock LLC – Burlington North Plant

Date and Time: September 20, 2021 at 6 p.m.

Phone: US TOLL +1-415-655-0003, Access Code 161 633 4904

WebEx Link: https://bit.ly/3xlihM1

Event Password: NCDAQ

If you wish to speak at the Prospect Hill public hearing, you must register by 4:00 p.m.

on September 21. To register, please visit: https://bit.ly/3jthnIa or call (919) 618-0968.

Event title: Public Hearing for Carolina Sunrock LLC – Prospect Hill Quarry and Distribution Center

Date and Time: September 21, 2021 at 6 p.m.

Phone: US TOLL +1-415-655-0003, Access Code 161 805 4856

WebEx Link: https://bit.ly/3rW9FdA

Event Password: NCDAQ

This information will be posted on our website within the next few days at https://deq.nc.gov/carolina-sunrock. Please do not hesitate to reach out to me with any questions regarding the permitting process or public hearings.

Best,

Zaynab

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From: Wrenn, Mark A.
To: SVC_DENR.DAQ.publiccomments
Cc: Earl Wrenn
Subject: [External] Public Hearing for Carolina Sunrock LLC – Burlington North Plant
Date: Wednesday, August 11, 2021 6:53:58 PM

To whom it may concern:

In reviewing the Air permit application for the Carolina Sunrock Burlington North Plant I noticed that there is no mention of electrical generators. There is no mention of power generators in the application. The application states there is no changes from the previous air permit submitted last year other than the use of ultra-low sulfur fuel, however the previous application had multiple generators listed. My first question is why were the generators not listed this time? Currently there is no three phase power at this location. I think it should be confirmed weather or not Sunrock plans to use generators or not. This would greatly change the air modeling analysis.

In the section of the permit review labeled : 2Q .0304 – Zoning Specific Condition: It states that It is DAQ policy to include a permit condition in permits for facilities located in areas without zoning requiring compliance with all lawfully adopted local ordinances that apply to the facility at the time of construction or operation of the facility.

Caswell County adopted a High Impact Ordinance last year which came out of the County wide Moratorium on polluting Industries. This Ordinance placed set backs on Rock Quarry, Asphalt and Cement Plants. Sunrock applied for this air permit after the High Impact Ordinance was adopted. This being said the submission of the application does not take the setbacks into consideration. All the data complied does not take the setbacks into consideration. The air modeling does not take this into consideration. The setbacks will change the location of the asphalt and cement plants.

If it is DAQ policy to have the condition that lawfully adopted ordinances to the facility at the time of construction or operation then the setbacks in the High Impact Ordinance should be applied.

While County Manager Brian Miller signed a zoning consistency letter would only mean that it is permissible, however the operation will have to meet set back requirements. I will also add that there is currently a litigation over vested rights for Sunrocks projects in Caswell County.

I would ask that these issues be addressed before the DAQ moves forward with the Air Permit process.

Regards,

Mark Wrenn
2372 Ridgeville Rd
Prospect Hill, NC

From: Caroline Long
To: SVC_DENR.DAQ.publiccomments
Cc: Caroline Long
Subject: [External] Permit # 10693R00 - Burlington North Public Comment
Date: Tuesday, September 21, 2021 9:00:22 PM

Air Permit No. 10693R00

My name is Caroline Laur. My home is 200 feet from the proposed Asphalt/Cement Plant. Duke Cancer Center diagnosed me with MGUS. A rare blood disease that predispositions me to a rare form of cancer known as Multiple Myeloma. Multiple Myeloma does not have a cure; and is a terminal form of cancer. Scientific research has linked seven of the toxic chemicals from Air Permit No. 10693R00 to multiple myeloma.

I am requesting that NCDAQ re-calculate the human risk of toxic chemicals of Burlington North; in light of the scientific evidence from studies linking human health risk from these chemicals to my illness. And in light of the scientific evidence; can NCDAQ scientifically estimate the calculated dose that is unlikely to cause an adverse (terminal) effect if I am exposed 24 hours a day, 7 days a week, 365 days a year, 200 feet from my home?

Know what causes myeloma

Several toxic chemicals are known to cause myeloma. Multiple studies provide the "proof of principle" that chemicals are involved: Benzene is one just one of these chemicals.

> Another example is benzene, one of the 20 most widely used chemicals in this country. Two recent meta-analyses, in 2015 and in 2011, have confirmed the association of benzene exposure with the development of myeloma. The 1965 Bradford Hill criteria, established by British scientist Sir Bradford Hill, are used to make the connection between benzene and myeloma. This approach has been endorsed by the Occupational Safety and Health Administration (OSHA), the National Toxicology Program (NTP), and the National Cancer Institute (NCI) President's Panel in the U.S. and by the International Agency for Research on Cancer (IARC) in France. Other countries have researched and published data on the topic as well. The Occupational Diseases Medical Advisory Board in Germany published a study showing a connection between benzene exposure and myeloma in 2009. South Korean studies appeared in 2014 and 2015.

Study 1:

BERICHT

Published: 01 April 2009

Paradigmenwechsel in der Beurteilung myeloischer und lymphatischer Neoplasien bei beruflicher Benzolexposition (BK-Ziffer 1303)

Paradigm Change in the Assessment of Myeloid and Lymphoid Neoplasms Associated with Occupational Benzene Exposure

Stefanie Beete, Rainer Haas, Ulrich Germing & Paul-Josef Jansing

Medizinische Klinik volume 104, pages 197–203 (2009) | Cite this article

Zusammenfassung

Benzolbedingte hämatologische Neoplasien können im Sinne der Berufskrankheitenverordnung als Berufskrankheit (BK) anerkannt werden. Gegenwärtig umfasst die Ziffer 1303 heterogene Krankheitsbilder und verschiedenartige auslösende Gefahrstoffe. Der Ärztliche Sachverständigenbeirat „Berufskrankheiten" beim Bundesministerium für Arbeit und Soziales empfahl aktuell, „Erkrankungen des Blutes, des blutbildenden und des lymphatischen Systems durch Benzol" aus dieser Ziffer auszugliedern und als eigenständige BK zu führen. Benzol als Ursache akuter myeloischer Leukämien ist allgemein anerkannt und durch zahlreiche epidemiologische Studien belegt. Ein epidemiologischer Zusammenhang mit anderen hämatologischen Neoplasien, insbesondere Non-Hodgkin-Lymphomen (NHL), ist hingegen weniger evident. Die Sachverständigen nahmen dies zum Anlass einer Überprüfung und Klarstellung und schlussfolgerten, dass eine berufliche Benzolexposition grundsätzlich zu allen Malignomen des myeloischen und lymphatischen Systems sowie deren Vorstufen führen kann. Behandelnde Ärzte sollten daher Patienten zu einer möglichen beruflichen Benzolexposition befragen und alle Formen diagnostizierter hämatologischer Neoplasien, einschließlich deren Vorstufen, zur BK-Anzeige bringen. Aus Sicht des Beirats ist ab einem Bereich von 10 ppm-Jahren (kumulative Benzolexposition) von einer Verursachungswahrscheinlichkeit > 50% für folgende Krankheitsbilder auszugehen: Leukämien nach der WHO-Definition – einschließlich chronischer lymphatischer Leukämie, jedoch ausgenommen chronische myeloische Leukämie (CML) – sowie die potentiellen Präleukämien aplastische Anämie und myelodysplastisches Syndrom. Für NHL und myeloproliferative Erkrankungen (einschließlich CML) ist die epidemiologische Evidenz derzeit nicht ausreichend, eine präzise Beschreibung der Dosis-Wirkungs-Beziehung vorzunehmen.

Abstract

Benzene-caused hematologic neoplasms may be recognized as an occupational disease (OD) according to the German ordinance on ODs. At present, the OD No. 1303 covers heterogeneous diseases and various chemical agents triggering these diseases. The members of the medical advisory board specia lizing in ODs within the Ministry of Employment and Social Affairs recently proposed excluding "diseases of the blood, the hematopoietic and lymphatic system caused by benzene" from OD No. 1303 and classifying them as a separate OD. Benzene is generally acknowledged as a cause of acute myeloid leukemia, proven by numerous epidemiologic studies. However, there is less epidemiologic evidence of its association with other hematologic neoplasms, notably non-Hodgkin's lymphoma (NHL). To clarify this issue, the experts evaluated international literature and concluded that all kinds of myeloid and lymphoid malignancies including their prestages can be caused by occupational benzene exposure. Hence, physicians should ask patients about occupational benzene exposure and report any kind of diagnosed hematologic neoplasms, including their prestages, as suspected OD. The advisory board considered that a dose range starting from 10 ppm-years (cumulative benzene exposure) is sufficient for a > 50% probability of causing leukemias according to the WHO classification, including chronic lymphatic leukemia, and the potential preleukemias aplastic anemia and myelodysplastic syndrome, but excluding chronic myeloid leukemia (CML). For NHL and myeloproliferative diseases (including CML) the present epidemiologic evidence is considered not to be sufficient to describe a precise dose-effect relationship.

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Paul-Josef Jansing

Corresponding author

Correspondence to Paul-Josef Jansing.

Study 2:

Compensation for Occupational Cancer

Inah Kim,1 Eun-A Kim,[redacted]2 and Jae Young Kim3

Go to:

Abstract

The legal scope and criteria for occupational cancer in Korea was out of date. The aim of this study was to review the current criteria for occupational cancer and amend the existent criteria on the basis of recent scientific evidence. The scientific evidence and the legal list of occupational cancer were analyzed to identify the causes of occupational cancer on a global scale. The relationship between compensated occupational cancer cases and carcinogen exposure in Korea was examined. The factors associated with specific causes and target cancers were determined to produce additional criteria. Five-hundred and nineteen cases of 2,468 were awarded compensation for occupational cancer including lung, malignant mesothelioma, lymphohematopoietic, and liver cancers from January 2000 to October 2012. Between 1996 and 2005, benzene accounted for 84.4% of cases, and between 1999 and 2005, asbestos was associated with 62.3% of cases. Fourteen novel causative agents and 12 additional target cancers were identified and the final guidelines were amended to include 23 causative agents and 21 target cancers. This amendment of the criteria for occupational cancer represents the widest change in Korean history and is expected to improve the understanding of occupational cancer by providing an up-to-date and accurate reference guide.

Graphical Abstract

[redacted]

Keywords: Occupational Cancer, Compensation, Korea

Go to:

INTRODUCTION

The Korean public is highly concerned about the risk of occupation cancer as a result of exposure to carcinogens in the workplace. An increase in the incidence of occupational cancer among workers based in industries manufacturing goods such as asbestos textiles, semiconductors, and tires, as well as those working in the refinery/petrochemical sector has raised public concern (1,2,3,4). Cancer is the most common cause of death in the Korean population and because of the costs incurred and the impact it has on the loss of workforce, it is of major concern for employers or policymakers (5). This situation makes the compensation criteria for occupational cancer an important agenda for policymakers.

Occupational cancer is defined as cancer resulting from occupational exposure to carcinogens or an increased risk of cancer incidence during the performance of a specific task (6). Usually, the evidence indicating if a worker was occupationally exposed to a carcinogen or not is insufficient and the measurement of the past carcinogen exposure level or the cumulative exposure level is very difficult. The general ambiguity regarding past exposure makes the decision for the work-relatedness a controversial subject (7).

Article 34 on the Enforcement Decree of the Industrial Accident Compensation Insurance (IACI) Act defines the criteria for the recognition of work-related disease. The first criterion is to identify the history of hazard exposure. The second is to determine the cumulative exposure level and latent period, which is the period between the first exposure to causative agent and the diagnosis of cancer. The third is a consideration of medically recognized causal relationships (8). Occupational lung cancer is covered by 2 acts under Korean law. According to the Ordinance of the Ministry of Employment and Labor, workers dealing with soil, rocks, or minerals who are exposed to dust that might cause pneumoconiosis and who have confirmed pneumoconiosis by chest radiography (profusion of 1/0 or greater according to the International Labor Organization [ILO] classification) can be compensated according to the Act on The Prevention of Pneumoconiosis and Protection, Etc., of Pneumoconiosis Workers (PPPW) (9). Other lung cancers are compensated for according to the IACI Act.

The Occupational Safety and Health Research Institute of the Korean Occupational Safety and Health Agency and the Occupational Lung Disease Institute of the Workers' Compensation and Welfare Service (COMWEL) investigate individual cancer cases to make a scientific decision on the work-relatedness. This process involves thorough occupational history taking, a work environment survey, and a review of epidemiologic literature and medical records. The COMWEL usually request this epidemiologic investigation for the majority of claims.

The criteria determining whether or not an employee is entitled to compensation as a result of occupational cancer are a major issue because the criteria is the only legal standard adapted all processes of compensation for occupational disease from COMWEL to the Administrative Court. Workers' compensation and approval rates of individual countries are very closely related to social contexts such as social recognition for the occupational disease, the health insurance system, or the social security system (10).

Owing to the increase in public concern in Korea, the opinion that the criteria for occupational cancer should be reviewed and amended on the basis of up-to-date scientific evidence was presented. The aim of this study was to review the history of compensated occupational cancer in Korea and to clarify and update the criteria for awarding occupational cancer compensation in Korea. This paper will assist clinicians in understanding the issue of occupational cancer for a more informed decision regarding whether compensation should be awarded or not.

Go to:

MATERIALS AND METHODS

A review of the published literature was undertaken to determine the strength of the causal association between cancer risks and the workplace environment. Literature included data published by the International Agency for Research on Cancer (IARC) (11,12,13,14,15,16,17,18) and related peer-reviewed articles. The occupational cancer lists of international organizations such as the ILO (19) and the European Union (EU) and their member countries were also investigated (20). An analysis of each individual occupational cancer case awarded compensation in Korea between 1992 and 2012 was conducted to decide the validity of including specific causative agents and types of cancer to the criteria list. Based on these results, we suggested the list of the carcinogens and its target cancers to include recent amendments of the scope and criteria.

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RESULTS

A review of the recognition of occupational cancer in Korea between 2000 and 2012

The first officially reported case of occupational cancer in Korea was a case of mesothelioma at an asbestos thread factory in 1993. A 56-yr-old non-smoking woman employed at the factory for 18 yr was officially approved by the COMWEL and was compensated by the IACI (21). After the first reported compensation case, between 1992 and 1999, out of 379 claims for occupational cancer, only 22 cases were confirmed as occupational disease by the Occupational Safety and Health Research Institute (Table 1) (22). The 31 lung cancer cases associated with pneumoconiosis reported until 1999 that were compensated according to the PPPW Act are not included in Table 1, which only included cases to be conduct professional and specific examination for the work-relatedness by occupational physician and occupational hygienist of OSHRI. However, Table 2 included all cases to be decided based on PPPW Act, the result of special examination for the work-relatedness, or the self process of COMWEL.

Table 1

Occupational cancers identified by OSHRI from 1992 to 2000 in Korea

***Except for lung cancer with pneumoconiosis; †Reprinted from Kang et al. (2000). OSHRI, Occupational Safety and Health Research Institute.**

Table 2

Occupational cancers compensated by COMWEL from January 2000 to October 2012 in Korea

***Updated from Lee et al. (2011) and analyses COMWEL data. COMWEL, Workers' Compensation and Welfare Service.**

From 2000 to 2009, out of 1933 claims, the COMWEL approved 253 cases as occupational cancer (23). Sixty-one of these were compensated according to the PPPW Act. From January 2010 to October 2012, out of 544 claims, the COMWEL approved 266 cases as occupational cancer (Table 2). After 2000, the number of claims increased rapidly. Especially after 2010, the number of compensated cancers also increased because the social awareness for occupational cancers or carcinogens such as asbestos or benzene improved and the claims from various high risk jobs such as miners, masons, construction workers, painters, welders, and so on, which would be influenced by social issue for the occupational cancer in semiconductor industry or communal claims by metal union. Respiratory cancers, especially lung cancer, were the most common cancers compensated for by the IACI. Between 2000 and 2009, occupational cancer types included respiratory (n=107), lymphohematopoietic (LHP) (n=35), malignant mesothelioma (n=28), and digestive tract cancer (n=74) (24). Between January 2010 and October 2012, occupational cancer types included respiratory (n=226), LHP (n=5), malignant mesothelioma (n=19), and digestive tract cancer (n=2). Cancers originating from digestive tract cancer abruptly decreased after the late 2000s, because hepatocellular carcinoma related to workload or stress in healthy hepatitis B virus carriers were rejected in court, and the specific criteria for recognition of liver disease was amended in 2003 (24).

Between 1999 and 2005, lung cancer related to asbestos exposure (62.3%, 33 out of 53 cases) and LHP cancer related to benzene (84.4%, 43 out of 50 cases) was the most common cause of occupational cancers (5, 25, 26). Between 2000 and 2009, construction (n=15) was most common industry among compensated cancers, followed by shipbuilding (n=11), and other metal product manufacturing (n=10). The most common occupation among compensated cancers was metal molders, welders, and related trades workers (n=16), followed by miners, shot firers, stone cutters, and carvers (n=14) (Table 3) (23).

Table 3

Frequency of occupational cancer in Korea from 2000 to 2009 according to industry and occupation

***Reprinted from Lee et al. (2011).**

After the early 1990s, the number of claims and compensations has increased, but the origin of cancers awarded compensation is still limited to 2 organs, namely the lung and LHP system. The major carcinogens are asbestos and benzene. Among compensated lung cancer cases, the most probable carcinogens were asbestos (45%), hexavalent chromium (30%), and crystalline silica (19%) (27). In case of LHP malignancies, the most probable carcinogens were pure benzene (27.5%), impurity of benzene in a mixture (56.9%), and ionizing radiation (8.0%) (26). With these data in mind, the existing criteria and scope for occupational cancer required amendment with respect to the causative carcinogens and the target cancer type.

The main focus of recognition criteria amendments

The prior Korean criteria included only 10 agents and were very outdated compared with the ILO occupational disease list or the IARC list of Group 1 carcinogens. Skin cancer was the first cancer included in ILO Convention No. 42 in 1934. Mesothelioma due to asbestos was included in the occupational disease list in Convention 121 in 1980. On Recommendation No. 194 in 2002, the ILO added 15 carcinogens to the list including asbestos; benzidine and its salts; bis-chloromethyl ether; chromium VI; coal tars and coal tar pitches; beta-naphthylamine; vinyl chloride; benzene; toxic nitro and amino derivatives of benzene or its homolog; ionizing radiation; tar, pitch, bitumen, mineral oil, anthracene, or related compounds; coke oven emissions; nickel; wood dust; and other carcinogens. At this time, an association between specific occupational cancers caused by specific carcinogens was not included. In 2010, arsenic, beryllium, cadmium, erionite, ethylene oxide, and hepatitis B and C viruses were included on the ILO occupational cancer list (8).

The IARC reviewed the entire Group I carcinogenic agents list between 2006 and 2010, and 113 agents were included as Group I carcinogens. Since these agents cover both occupational and environmental exposure, Siemiatycki et al. (28) proposed 28 agents and 12 occupations or industries as definite occupational risk factors and we listed other additional occupational carcinogens updated after the review of IARC.

In the European occupational cancer lists including those of Austria, Belgium, Denmark, Germany, Finland, France, Italy, Luxemburg, Portugal, Spain, Swiss, and the EU. Finland included the fewest agents (n=17) and Germany, Denmark, and Luxemburg included >40 agents. Lung cancer due to chromate, asbestos, or nickel and malignant mesothelioma due to asbestos were included in the list of occupational cancers in all countries. The prior criteria for recognition of occupational cancer according to the Enforcement Decree of the IACI Act included only 11 agents, for example soot, tar, pitch, asphalt, mineral oil, paraffin, vinyl chloride, chrome or its compounds, benzene, asbestos, and hepatitis virus. Except for hepatocellular carcinoma due to occupational exposure to hepatitis B or C virus, which was included in the criteria in 2003, other carcinogens and their target cancers have not ever been amended after since the 1980s'. Table 4 shows the presented agents on the occupational cancer lists of the ILO, and European countries, those suggested by Siemiatycki et al. or us based on the IARC list, and the Korean criteria of occupational carcinogens before 2013.

Table 4

The carcinogenic agents presented in the occupational disease list of the ILO or European countries and the IARC

Occupational carcinogens included in only the IARC list: Solar radiation, crystalline silica, talc containing asbestiform fibers, 4-aminobiphenyl, 2,3,7,8-tetrachlorodibenzo-para-dioxin, passive smoking, mustard gas, strong inorganic-acid mists, aflatoxin, diesel engine exhaust, formaldehyde, leather dust, polyaromatic hydrocarbons, shale oil, trichloroethylene, ortho-tohuidine, anti-cancer drugs or immunosuppressants. *List of occupational diseases (revised 2010) from the International Labor Organization; †International Agency for Cancer Research: Occupational carcinogen list from Siemiatychi et al. (2004) or authors based on the Group 1 carcinogens classified by the IARC.

Table 5 shows the prior criteria and considerations of carcinogen exposure in Korea. Originally, cancer caused by soot, tar, pitch, asphalt, mineral oil, or paraffin was incorrectly identified as epithelial cancer, but needed to be amended as skin cancer. In addition, myelodysplastic syndrome is not cancer, but is a hematologic malignancy, and the epidemiologic evidence for larynx cancer caused by chrome exposure was insufficient. Vinyl chloride exposure as a cause of human hepatocellular carcinoma had sufficient evidence. In case of ionizing radiation, as a definite cause of cancer was not included in prior criteria, which only included acute radiation injury-related diseases. Therefore, the previous list had 3 main problems. First, the number of covered agents was smaller than those of the international lists. Second, the target cancer or the name of the agent was not clear. Third, a reconsideration of exposure duration or cumulative exposure level was needed; however, this was not included in the current amendment because this would require a national consensus across professional review boards considering various situations of exposure in Korea.

Table 5

The prior specific criteria for the recognition of occupational diseases according to the Enforcement Decree of the Industrial Accident Compensation Insurance Act (before July 2013)

The main points of this amendment were as follows: First, the type and number of carcinogens should match those of international levels, considering the lists of the ILO, EU, and IARC, with the occupational cancer list of the ILO taking first priority. Second, the priority order of the list should be decided by the carcinogen exposure possibility in Korea. Third, the criteria should include matches between specific carcinogens and target cancers, as evidenced by clinical data from the IARC.

An overview of the recent amendments to the scope and criteria of compensation for occupational cancer

We, who suggested the list of carcinogens and its target cancers for recent amendment and directly participated in the policy making process of amendments to the scope and criteria, selected 28 agents and 11 industries to extend the criteria of occupational cancer according to the results the previously described review of the occupational cancer list of the ILO, the EU, and the IARC classification, and the exposure possibility in Korea to identified risk factors. Aflatoxins, 4-aminobiphenyl, arsenics, ultraviolet-emitting tanning devices, benzidine, beryllium, beta-naphthylamine, 1,3-butadiene, cadmium, crystalline silica, diesel engine exhaust, erionite, ethylene oxide, formaldehyde, leather dust, nickel compounds, passive smoking, polyaromatic hydrocarbons (PAHs), radon, shale oil, solar radiation, strong inorganic acid, 2,3,7,8-tetrachlorodibenzo-para-dioxin, trichloroethylene, ortho-toluidine, wood dust, anti-cancer drugs or immunosuppressants, and sulfur mustard were included in reviewed list of agents. Occupations or industries included the rubber industry, painting magenta production, coal gasification, aluminum production, auramine production, isopropyl alcohol manufacture using strong acids, underground hematite mining, iron and steel founding, coke production, and coal-tar distillation.

Coal gasification, coke production, and coal-tar distillation were reviewed with respect to PAHs. These industries could be matched to causative agents in a Korean-based exposure situation. Occupational cancer risk of the rubber industry could be explained by exposure to aromatic amines or solvents. The magenta, aluminum, auramine, isopropyl alcohol, or hematite production industries are rare in Korea. PAHs, crystalline silica, and strong inorganic acid could explain the occupational cancer risks of the iron and steel founding industry. As a result, painter was the only occupation/industry added to the amended criteria.

It was not possible to determine the exposure to passive smoking, solar radiation, ultraviolet-emitting tanning device, and solar radiation between environmental exposure and occupational exposure. In Korea, exposure to aflatoxins, sulfur mustard, erionite, shale oil, and 2,3,7,8-tetrachlorodibenzo-para-dioxin is unlikely and was classified as low risk. Measuring the exposure level of leather dust, strong inorganic acid mist, PAHs, 4-aminobiphenyl, and ortho-toluidine was very difficult. Diesel engine exhaust and trichloroethylene were recently upgraded by the IARC and information concerning exposure measurements, epidemiological evidence, or cases in Korea was limited. Anti-cancer drugs and immunosuppressant exposure are usually important to patients. In total, 13 agents and 1 occupation among 39 considerable agents and industries were assigned as priority add-ons to the amended scope and criteria specific for Korea.

We also suggest classifying the system of occupational cancer into an agent- and organ-oriented systems according to the specific criteria for the recognition of occupational diseases according to the Enforcement Decree of Labor Standard Act (LSA) and the Enforcement Decree of IACI Act. Therefore, on the basis of the scope of occupational cancers of the LSA, on which all the agents were listed without target cancer, agents were listed with target cancers based on organ oriented system named cancer on the specific criteria of the IACI Act. Especially, regarding some agents such as benzene, asbestos, or chrome, the considerations related with exposure duration or level persisted unless there were definite evidences.

As a result, 14 agents and occupation matched with 12 target cancers were added to the list including X-rays or γ-rays; arsenic and its inorganic compounds; nickel compounds; cadmium and its compounds; beryllium and its compounds; wood dust; benzidine; beta-naphthylamine; crystalline silica; formaldehyde; 1,3-butadiene; radon-222 and its decay; spray painting; ethylene oxide. Asphalt and paraffin were removed because of the ambiguity of chemical characteristics that could be masked by other agents. The descriptions for some agents were revised to enhance the clarity of the characteristics of the agent; tar was revised to coal tar, pitch was revised to coal tar pitch, chrome was revised to hexavalent chrome, mineral oil was revised to untreated mineral oil, and hepatitis virus was revised to hepatitis B and C virus.

Target cancers, especially those related with ionizing radiation, such as cancers of the salivary glands, esophagus, stomach, colon, bone, breast, kidney, thyroid, ovary, nasopharynx, and bladder were incorporated. Table 6 presents the scope of occupational cancers according to the Enforcement Decree of the LSA, July 2013 and the specific criteria for the recognition of occupational diseases according to the Enforcement Decree of the IACI Act, July 2013.

Table 6

The scope of occupational cancers according to the Enforcement Decree of Labor Standard Act and the specific criteria for the recognition of occupational diseases according to the Enforcement Decree of Industrial Accident Compensation Insurance Act (enforcement date: July 1, 2013)

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DISCUSSION

Occupational cancer underwent the widest changes in a recent amendment for tables of the Enforcement of Decree of the LSA and the IACI Act. As a result of a review of the published literature including international occupational cancer lists, alongside an analysis of the carcinogen exposure situation in Korea, and a review of cases compensated in Korea, the carcinogen agents included in legal tables increased from 11 to 23 and the target cancers increased from 9 to 21. Various stakeholders such as representative organizations of employers, workers, insurers, and policymakers participated in this amendment process.

As previously stated, it was not possible to further define the work-relatedness between agents and target cancers as a function of exposure level and duration or cumulative exposure. Further investigation and discussion between researchers to form a social consensus among various stakeholders will be necessary to resolve criteria for rapid compensation for occupational cancer based on estimates of past exposure level and individual susceptibility. A difference in social security systems between countries is one of the main issues to consider, especially an understanding of the compensation criteria or scope of occupational cancer, because cancer usually develops post-exposure (8). The determination of past exposure history or the level of carcinogens in the work environment is very difficult, because of environmental changes over time and the closure of workplaces deemed unfit in the past (7).

Cancer is a chronic disease with a significant financial and health burden at both an individual and national level (29). The financial difference between compensation coverage and wage compensation benefit for absenteeism from the workplace between the National Health Insurance and the IACI system can aggravate the burden of disease for the individual worker, and the outcome of whether a worker is compensated by IACI or not is a major issue for them and their families. The policy makers, professionals, and various stakeholders should carefully consider the fundamental issue in the Korean welfare system by introducing sickness absence benefit for workers during the treatment and rehabilitation of occupational cancer.

The continuous modification of compensation coverage by the IACI according to new evidence presented in the scientific literature and according to general consensus is essential until sickness absence benefit for workers is introduced by the National Health Insurance system. A continuous review system of the evidence of causal association is necessary to modify and update the criteria of occupational cancer to formulate guidelines to decide work-relatedness. Many countries, such as the UK, Germany, France, Canada, or Japan, operate this kind of regular review system with medical professionals based on legal background, which is not the case in Korea.

Expanding the criteria and scope of occupational cancers is unlikely to lead to an increase in claims for the compensation for occupational cancers, because cancer is a rare disease and the added carcinogens and target

cancers in this time have been compensated by decision of professional through out of list system. However, this amendment of the scope and criteria of occupational cancer could increase the public concerns for the compensation for occupational cancer. This situation could improve the very low frequency of claims due to lack of understanding on occupational cancers.

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Footnotes

The authors have no conflicts of interest to disclose.

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Study 3:

Estimating Benzene Exposure Level over Time and by Industry Type through a Review of Literature on Korea

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Associated Data

Supplementary Materials

1. Introduction

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According to the database compiled through the Survey for National Work Environment Status of 2009, which has been conducted every 5 years in Korea since 1993, the respective numbers of factories and workers directly handling products containing benzene were estimated to be 450 and 2,255 [1]. No study has reported comprehensive benzene exposure levels classified based on time, type of industry, job, and other determinants for estimation of retrospective exposure in Korea. There may currently be an excessive risk of hematopoietic disorders due to relatively high past exposures among workers who were exposed to benzene in specific industries, jobs, or eras. Basic information on the likelihood, duration, and intensity of benzene exposure should be estimated in order to associate with health effects, including hematopoietic diseases. Among the 236 cases of hematopoietic diseases reported to the Korea Workers Compensation and Welfare Service during 2000–2009, 35 were accepted as cases of hematopoietic disease caused by exposure to benzene [2].

One of the most challenging tasks in examining the association of work environment with disease is the lack of past exposure information, such as industry, job, and work characteristics. The methodologies and the results of using the expert system and historical measurement data for estimating retrospective exposures have been reported elsewhere [3], [4]. In Korea, no study has yet been conducted to estimate retrospective exposure to benzene, although substantial airborne benzene measurements have been reported regarding specific periods or purposes. The major purpose of this study is to estimate retrospective exposure to benzene through a comprehensive review of literature reported in Korea.

2. Materials and methods

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2.1. Scope of literature search

Airborne benzene measurements reported in scientific journals and government documents for occupational settings in Korea were summarized through an extensive literature review. The keywords used for the literature search were 'benzene', 'thinner', and 'solvent' and they were used singly and in combination. Of the 38 published documents reviewed, a total of 34 were found to feature benzene measurement data and were used to estimate retrospective exposures to benzene (Table 1). Four documents were excluded for the following reasons: lack of a range or geometric mean (GM) and geometric standard deviation (GSD) for airborne benzene measurement (n = 1) [5]; comparison of sampling and analytical methods (n = 1) [6]; and measurements from indoor environments for either community or general population use (n = 2) [7], [8] (Table 1).

Table 1

Inclusion and exclusion criteria for database on airborne benzene measurements through a review of literature reported in Korea

Characteristics	No. of publications
No. of publications on airborne benzene monitoring	38
Lack of a range or a GM and GSD	1
Validation study of analytical method	1
Measurement from indoor environments	2
No. of publications reviewed for airborne	34

Benzene measurement analysis	
No. of summary measurements	429
No. of total measurements	15,729

GM, geometric mean; GSD, geometric standard deviation.

2.2. Selection and analysis of measurements

All personal or area airborne measurements taken were included in the summary statistics regardless of the type of charcoal sorbent or sampling device (pump, passive sampler, or detecting tube) or duration of sampling. Thus, due to the lack of a sufficient number of measurements, all measurements taken for either > 1 hour or for short term exposures (i.e., < 15 minutes) were included for estimating exposure. Standard sampling and internationally approved analytic methods were found to be used to collect airborne benzene. Two approaches were used to summarize airborne benzene measurements.

First, all articles reporting airborne benzene measurements were summarized and categorized according to the type of benzene sample, such as long term samples taken for > 1 hour and short term samples taken for < 15 minutes. Benzene measurements taken by a colorimetric detector tube were assigned to the short term period sampling category (≤ 15 minutes).

Second, all benzene measurements were combined to calculate the summary of benzene statistics. The best summary measure of exposure information for epidemiologic studies is considered to be the arithmetic mean (AM) [9], [10]. Most of the papers reviewed presented benzene measurement data as the AM; however, some publications provided only a GM and a GSD. Rather than exclude summary measures that were not AMs, we used these summary measures to estimate an AM. When both the GM and GSD were provided, a lognormal distribution was assumed and the equation was used to provide an estimate of AM as follows in Eq. (1) [11]:

$$AM = GM \times \exp\{1/2 \times [\ln(GSD)]2\} \quad (1)$$

If only the range was provided, the AM was estimated by assuming a lognormal distribution according to the following method. First, the midpoint of the log transformed minimum and maximum levels provided an estimate of the mean of the log transformed levels (μL). Second, the range of the log transformed levels divided by four provided an estimate of the standard deviation of the log transformed levels (σL). Finally, an estimate of the AM was provided as follows in Eq. (2) [11]:

$$AM = \exp(\mu L + 1/2 \times \sigma 2L) \quad (2)$$

2.3. Korea Standard Industrial Classification

Most of the industry information in the literature we reviewed was either provided only at the two-digit level or was unavailable. Benzene measurements were categorized according to the Korea Standard Industrial Classification (KSIC) Revision 09 [12]. For the manufacturing industry, we tried to classify by a four-digit industry code based on the information available in the article or report. For some nonmanufacturing sectors, the one- or two-digit level was used as the assessment level when available. To increase the reliability of industry classification, the results were classified first by an industrial hygienist with a master's degree and then confirmed by a research team consisting of three industrial hygiene professors experienced with the classification of Korean industries.

2.4. Statistical analysis

Weighted AM [AM(w)] were calculated based on the number of measurements reported for each mean and classified according to period and industry. The AMs were multiplied by the number of measurements, summed, and then divided by the total number of measurements in order to derive the AM(w):

$$AM(w) = \sum_{ni=1} AMi \times Ni \Big/ \sum_{ni=1} Ni$$

AM(w) = arithmetic mean (ppm), AM = arithmetic mean, ppm, N = number of sample

The standard deviation for the AMs across studies was also calculated. The distribution of the measurements was found to be positively skewed and approximately lognormal. Benzene measurements for the long term (≥ 1 hour) and short term period sampling category (≤ 15 minutes) were included together in the calculation of AM(w). All area airborne measurements taken to estimate exposure to benzene were included in the summary statistics. AM(w) levels were categorized by 5 year intervals and type of industry and compared using a multiple comparison test. Consequently, the natural logarithms of the calculated AM(w) were used for those analyses. All statistical analysis was performed using STATA version 9.0 (STATA Corp, College Station, TX, USA).

3. Results

3.1. Airborne benzene measurements reported in the literature

A total of 34 papers and reports containing 429 summary statistics and 15,729 individual measurements were summarized and reviewed. Short Term Exposure Limit (STEL) measurements (n = 2,457, AM(w) = 15.41 ppm) showed a significantly higher level compared to those of Time-Weighted Average (TWA) (n = 10,279, AM(w) = 0.89 ppm). Nineteen percent (n = 2,993) of measurements were found to have no information for estimating sampling duration (Table 2). Airborne benzene measurements reported in the literature from 1977 through 2013 were summarized by for > 1 hour (Table 3) and short term samples taken for < 15 minutes (Table 4). The first benzene measurements were reported from several industries (printing, rubber, electronic, and auto industry) using detector tubes in 1977 and ranged from 5 ppm to 40 ppm.

Table 2

Summary statistics for airborne benzene level according to sampling characteristics

Sampling characteristics	No. of measurements	AM(w), ppm	SD, ppm
Sampling duration			
≤ 15 min	2,457	15.4	25.2
≥ 1 h	10,279	0.9	4.1
No information	2,993	49.5	27.9
Sampling type			
Personal	12,819	3.5	12.6
Area*	2,362	49.0	27.3
No information	548	0.2	0.5
Total	15,729	10.2	22.6

AM(w), weighted arithmetic mean; SD, standard deviation.

*Include measurements done with a colorimetric detector tube.

Table 3

Summary of benzene exposure level categorized as long period sampling (≥ 1 hour) in Korea

Refs	Korean Standard Industrial Classification (sub-major code)	Korean Standard Industrial Classification (minor code)	*n*	Range of AM (ppm)	Range of SD (ppm)	Range of GM (ppm)	Range of GSD
Lee et al 1990 [13]	Tanning and Dressing of Leather, Manufacture of Luggage and Footwear (15)	Manufacture of Footwear and Parts of Footwear (152)	61	0.12–0.97	0.07–2.21	NI	NI
Pae et al 1991 [14]	Tanning and Dressing of Leather, Manufacture of Luggage and Footwear (15)	Manufacture of Footwear and Parts of Footwear (152)	34	1.01	0.41	NI	NI
Lee et al 1994 [15]	Manufacture of Coke, Hard-Coal and Lignite Fuel Briquettes and Refined Petroleum Products (19)	NI	20	0.19–0.61	0.14–0.93	NI	NI
Lee et al 1994 [15]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	NI	3	0.33	0.54	NI	NI
Lee et al 1994 [15]	Manufacture of Other Non-metallic Mineral Products (23)	NI	5	0.08–0.10	0.01–0.03	NI	NI
Lee et al 1994 [15]	Manufacture of Basic Metal Products (24)	NI	2	0.394	0.37	NI	NI
Lee et al 1994 [15]	NI	NI	5	0.07	0.03	NI	NI
Cha et al 1994 [16]	Manufacture of Rubber and Plastic Products (22)	Manufacture of Plastic Products (222)	20	NI	NI	2.50–12.20	1.60–2.00
Cha et al 1994 [16]	Printing and Reproduction of Recorded Media (18)	Printing and Service Activities Related to Printing (181)	21	NI	NI	0.70	3.90
Cha et al 1994 [16]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Other Chemical Products (204)	19	NI	NI	1.60	4.50
Bang et al 1996 [17]	NI	NI	53	NI	NI	0.25–0.31	0.62–0.69
Jeong 1996 [18]	NI	NI	3	NI	NI	0.03	NI
Moon 1997 [19]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	85	ND–1.45	NI	NI	NI
Moon 1997 [19]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Synthetic Rubber and of Plastics in Primary Forms (203)	1	ND	NI	NI	NI
Moon 1997 [19]	NI	NI	159	ND–0.04	NI	NI	NI
Song et al 2000 [20]	Retail Trade, Except Motor Vehicles and Motorcycles (47)	Retail Sale of Fuel (477)	30	NI	NI	0.08–0.18	NI
Ahn et al 2001 [21]	Manufacture of Other Transport Equipment (31)	Building of Ships and Boats (311)	398	0.08	0.49	NI	NI
Roh et al 2001 [22]	Other Personal Services Activities (96)	Other Personal Service Activities n.e.c. (969)	17	NI	NI	1.43	2.63
Jo and Kim 2001 [23]	Other Personal Services Activities (96)	Other Personal Service Activities n.e.c. (969)	116	8.70–10.30	4.10–7.40	NI	NI
Choi 2003 [24]	Manufacture of Coke, Hard-Coal, and Lignite Fuel Briquettes and Refined Petroleum Products (19)	Manufacture of Refined Petroleum Products (192)	276	ND–0.33	NI	NI	NI
Choi 2003 [24]	Architectural, Engineering, and Other Scientific Technical Services (72)	Other Scientific and Technical Services (729)	25	NI	NI	0.01	NI
Choi 2003 [24]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	270	ND–7.20	NI	< 0.01–0.02	NI
Joo et al 2004 [25]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	2,644	NI	NI	0.01–0.22	3.39–4.13
Choi et al 2005 [26]	Manufacture of Coke, Hard-Coal, and Lignite Fuel Briquettes and Refined Petroleum Products (19)	Manufacture of Refined Petroleum Products (192)	473	0.51	3.00	0.08	3.30
Kang et al 2005 [27]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	61	0.01–1.08	< 0.01–1.42	0.01–0.64	NI
Joo et al 2006 [28]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	157	NI	NI	0.01–0.02	3.39–4.13
Park et al 2006 [29]	Printing and Reproduction of Recorded Media (18)	Printing and Service Activities Related to Printing (181)	2	NI	NI	0.02	NI
Choi et al 2007 [8]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	570	0.01–99.73	NI	0.01–33.72	NI
Kim 2007 [30]	Printing and Reproduction of Recorded Media (18)	Printing and Service Activities Related to Printing (181)	41	NI	NI	0.09–0.20	NI
Kim et al 2008 [31]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	19	0.42	NI	NI	NI
Kim and Kim 2009 [32]	Printing and Reproduction of Recorded Media (18)	Printing and Service Activities Related to Printing (181)	66	NI	NI	0.09–0.10	2.22–4.60
Koh et al 2009 [33]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	3,190	ND–1.28	0.01–9.16	< 0.01–0.46	0.02–7.69
Chung et al 2010 [34]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	976	0.02–1.17	0.02–6.07	0.01–0.06	2.46–9.10
Chung et al 2010 [35]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	880	0.21–2.59	0.32–14.38	0.07–0.17	3.9–9.16
Byun et al 2011 [36]	Research and Development (70)	Research and Experimental Development on Natural Sciences and Engineering (701)	27	0.05	NI	NI	NI

AM, arithmetic mean; GM, geometric mean; GSD, geometric standard deviation; ND, not detected; < LOD, limit of detection; NI: no information; SD, standard deviation.

Table 4

Summary of benzene exposure level categorized as short term period sampling (≤ 15 minutes) in Korea

Refs	Korean Standard Industrial Classification (sub-major code)	Korean Standard Industrial Classification (minor code)	*n*	Range of AM (ppm)	Range of SD (ppm)	Range of GM (ppm)	Range of GSD
Lee and Kim 1997 [37]	Manufacture of Furniture (32)	Manufacture of Furniture (320)	2	20.00–40.00	14.14	NI	NI
Lee and Kim 1997 [37]	Manufacture of Rubber and Plastic Products (22)	Manufacture of Rubber Products (221)	3	8.00–30.00	12.17	NI	NI
Lee and Kim 1997 [37]	Manufacture of Other Transport Equipment (31)	Building of Ships and Boats (311)	2	5.00–15.00	7.07	NI	NI

Lee and Kim 1997 [37]	Printing and Reproduction of Recorded Media (18)	Printing and Service Activities Related to Printing (181)	1	25.00	NA	NI	NI
Lee and Kim 1997 [37]	Manufacture of Motor Vehicles, Trailers, and Semitrailers (30)	Manufacture of Motor Vehicles and Engines for Motor Vehicles (301)	1	30.00	NA	NI	NI
Lee and Kim 1997 [37]	Manufacture of Electronic Components, Computer, Radio, Television, and Communication Equipment and Apparatuses (26)	Manufacture of Electronic Components (262)	3	5.00–23.00	10.39	NI	NI
Chun et al 1980 [36]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	NI	94	11.70–43.50	NI	NI	NI
Chun et al 1980 [36]	Manufacture of Rubber and Plastic Products (22)	Manufacture of Rubber Products (221)	374	61.00–87.30	NI	NI	NI
Kim et al 1981 [39]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Synthetic Rubber and of Plastics in Primary Forms (203)	140	23.90–51.80	NI	NI	NI
Kim et al 1981 [39]	Manufacture of Rubber and Plastic Products (22)	Manufacture of Rubber Products (221)	2,128	6.70–111.80	NI	NI	NI
Lee et al 1990 [40]	Tanning and Dressing of Leather, Manufacture of Luggage and Footwear (15)	Manufacture of Footwear and Parts of Footwear (152)	61	5.63–7.86	2.65-3.63	NI	NI
Choi 2003 [24]	Manufacture of Coke, Hard-Coal and Lignite Fuel Briquettes and Refined Petroleum Products (19)	Manufacture of Refined Petroleum Products (192)	82	ND–2.49	NI	NI	NI
Choi 2003 [24]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	203	ND	NI	< 0.01–0.04	NI
Choi et al 2005 [26]	Manufacture of Coke, Hard-Coal and Lignite Fuel Briquettes and Refined Petroleum Products (19)	Manufacture of Refined Petroleum Products (192)	290	10.90	57.60	1.15	5.30
Kim 2007 [30]	Printing and Reproduction of Recorded Media (18)	Printing and Service Activities Related to Printing (181)	108	NI	NI	0.16–1.59	NI
Koh et al 2009 [33]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	1,086	ND–84.57	0.13–301.30	0.01–2.26	5.26–37.01
Chung et al 2010 [34]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	217	ND–1.55	0.28–6.78	ND–0.11	7.39–19.86
Chung et al 2010 [35]	Manufacture of Chemicals and Chemical Products Except Pharmaceuticals, Medicinal Chemicals (20)	Manufacture of Basic Chemicals (201)	430	0.15–118.30	0.86–322.00	0.03–8.14	4.72–41.14
Byun et al 2011 [36]	Research and Development (70)	Research and Experimental Development On Natural Sciences and Engineering (701)	41	0.01–0.69	NI	NI	NI

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AM, arithmetic mean; GM, geometric mean; GSD, geometric standard deviation; NA, not applicable; ND, not detected; < LOD, limit of detection; NI: no information; SD, standard deviation.

3.2. Airborne benzene measurement classified by period and industry

Most of the reviewed benzene measurements (82%) were collected after the 2000s, with an additional 15% (n = 2,289) collected between 1980 and 1984 (Table 5). Based on the AM(w) for benzene exposure, levels can be seen to have declined dramatically from 1980 to 1984 [number of measurements = 2,289, AM(w) = 50.4 ppm] to prior to the 2000s ($p < 0.05$). This reduction in exposure levels over the period was found regardless of the type of industry. AM(w) estimated after 2005 increased to around 4 ppm. For the petrochemical manufacturing industry, 70.3% of the measurements taken (n = 11,065) showed an AM(w) of 2.6 ppm. Samples from the rubber manufacturing industry (n = 2,140) were estimated to be the highest [AM(w) = 51.5 ppm]. The highest benzene levels [AM(w) = 20.9–73.7 ppm] reported during the period of 1980 through 1984 were assessed in the manufacture of rubber products and the manufacture of synthetic rubber and plastics in primary forms. Since 2000, the level of benzene has increased sharply from 0.7 ppm of AM(w) in 2000–2004, to 4.3 ppm in 2005–2009, and to 4.5 ppm in 2010–2013. Using both summaries and AM(w), it was found that airborne benzene levels dramatically decreased from 1975 until the mid-1980s (Fig. 1). Little actual measurement of relevant exposures had taken place before the 1980s. We found that substantial benzene measurement data were available for several industries manufacturing certain products: chemicals and chemical products [KSIC = 20, number of measurements = 10,583, AM(w) = 4.1 ppm], rubber and plastic products [KSIC = 22, number of measurements = 2,188, AM(w) = 50.4 ppm], and coke and briquettes including petrochemicals [KSIC = 19, number of measurements = 1,208, AM(w) = 3.0 ppm] (Table S1). Unfortunately, we were unable to estimate benzene measurements by task or occupation title due to the lack of information in this regard in the literature. Our estimates are incapable of addressing specific features of exposure patterns that may differ among the diverse types of operations, jobs, and tasks within an industry.

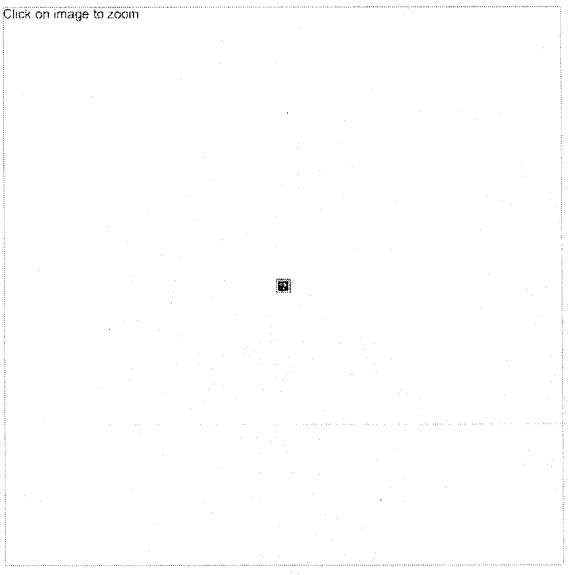

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Fig. 1

Estimated airborne benzene levels over time in Korea.

Table 5

Weighted arithmetic means [AM(w)] for airborne benzene level by decade

Decade	No. of measurements	AM(w), ppm	SD, ppm	p*
1977–1979	12	18.00	11.79	A
1980–1984	2,289	50.35	26.83	B
1990–1994	305	2.78	3.57	C
1995–1999	294	0.09	0.23	D
2000–2004	3,260	0.69	1.91	D
2005–2009	6,211	4.32	12.55	D
2010–2013	3,358	4.47	17.22	D
Total	15,729	10.20	22.55	<0.0001

AM(w), weighted arithmetic mean; SD, standard deviation.

*Multiple mean comparison *t* test; different letters indicate significant differences.

4. Discussion

This paper summarized airborne benzene measurements and classified them according to industry and period based on a comprehensive review of literature reported in Korea. We found a reduction in airborne benzene levels over time, regardless of industry type, until the 2000s. No further reduction has been seen since the 2000s, at which point average benzene measurements are still far higher than Korea's permissible exposure limit of 1 ppm. The proportions of measurements exceeding 1 ppm were analyzed to be 10% (n = 79) in 2003, 13% (n = 8) in 2005, 38% (n = 29) in 2007, 10% (n = 52) in 2009, 24% (n = 37) in 2010, and 32% (n = 119) in 2011.

Certain factors may be related to the decrement of airborne benzene measurement or exposure levels of benzene over time. First, a substantial reduction of the benzene content (%) in products has contributed significant decrements in airborne benzene exposure over the last several decades. This was confirmed by Fedoruk and Bronstein [10] who reported that benzene concentrations in a simulated breathing zone were approximately proportional to the benzene content of a solvent according to Raoult's law. For example, doubling the concentration of benzene in a given liquid will double the concentration of benzene found in the vapor phase at the liquid-vapor interface. Since 1990, when the Industrial Safety and Health Act (ISHA) was thoroughly revised in Korea, rubber adhesive products containing > 5% benzene were not legally allowed to be manufactured, used, and handled in the workplace, with the exception of laboratories [41]. The Clean Air Conservation Act enforced by the Ministry of Environment lowered the maximum limit of benzene content in gasoline fuel from 6% in 1992 to 0.7% in 2009 [42]. The AM(w) of airborne benzene level was found to have markedly dropped in 1990, when legal enforcement of amounts of benzene in industrial products began, but there was little change after that (Fig. 1). Even if the amount of benzene as an impurity in paint, thinners, or solvents has decreased since the 1980s, benzene was commonly found as an impurity (< 1%) until the early 1990s [27]. Paik et al [43] analyzed 108 different thinners in 1998 and reported that eight (7.4%) still contained benzene with contents ranging from 0.1% to 56.7%. Lee et al [44] found seven thinners containing benzene (10%) in 70 different bulk thinners sampled from automobile manufacturing factories in 2002, but the amounts of benzene were < 0.1%.

Second, legally mandated reductions in the occupational exposure limit (OEL) have contributed to dramatically decreasing airborne benzene levels. The Korea TWA-OEL of 10 ppm for benzene first stipulated in 1986 was reduced to 1 ppm in 2003, and the STEL-OEL of 5 ppm was additionally established in 2007 [41], whereas those in other developed countries are commonly 0.5 ppm [45]. In 1990, the ISHA legally required employers to assess occupational exposure to hazardous agents, including benzene, twice/year. Our airborne benzene estimates declined sharply from 2.8 ppm (n = 305) of AM(w) in 1990–1994 to 0.1 ppm in 1995–1999 (n = 294) and to 0.7 ppm in 2000–2004. It is not clear whether this trend shows an actual decrement because of the relatively small number of samples from several industries. The ambient benzene levels in most workplaces have decreased to below the 10 ppm OEL, but there are many industries still showing levels > 1 ppm benzene (Supplementary Table).

The AM(w) of benzene measurements reported since 2005 were found to be rather higher than those from 2000 to 2004 and in the 1990s. A large proportion of the benzene measurement results in those periods (78% in 2005–2009 and 25% in 2010–2013) were derived from extensive studies on petrochemical industry workplaces conducted between 2000 and 2003. These exposure assessment results included maintenance work and peak exposure [34], resulting in a high level of benzene since 2005. Currently, even if occupational exposure in regular operations or work can be tightly controlled, benzene exposure for maintenance work performed regularly or irregularly could still be high, regardless of industry type. However, when retrospective exposure to benzene for specific industries is estimated, several exposure characteristics such as time and job should be considered together.

Finally, engineering measures can also be generally considered as a major factor in lowering airborne benzene levels, even if there is a lack of literature providing specific evidence for Korea. Examples of such engineering measures in a number of operating practices include shifting from the use of open to closed bottle process sampling in reformer and isomerization units, the addition of fixed tank roofs over internal floating roofs, automation of blending in refinery streams, and the introduction of automatic tank level gauging [46]. It is well known that benzene is generally handled in enclosed systems wherever possible [47] because of its nature as a confirmed carcinogen with high toxicity. Changes in refining practices related to hydro-treating and solvent extraction in petrochemical plants substantially reduced the residual benzene content of many petroleum-derived products during the 1960s and 1970s (pers. commun.) [48].

The widespread use of benzene as an industrial or consumer solvent declined in the United States and most other developed countries during the mid to late 1970s, after which point such uses were considered to range from minimal to negligible [49], [50]. Specific characteristics of these changes, such as the specific start date and duration of legal enforcement, patterns, and benzene levels may vary among countries, including Korea.

The ubiquitous use of benzene as a solvent has led to a number of working populations being exposed, often with uncontrolled conditions during its early applications resulting in high exposures. Although benzene has been replaced by other organic solvents in nearly all commercial products, it may still be present as a trace impurity or residual component in mixed petroleum products (e.g., mineral spirits, paint thinners, cleaning agents, degreasers) [51], [52]. This is because benzene is a naturally occurring compound in crude oil and natural gas, and very low concentrations of benzene often remain in certain products refined from these sources due to the nature of the fractional distillation process [51], [53]. Solvents or thinners containing benzene as an impurity have been used in many occupational circumstances. As an integral component of the petrochemical process, benzene cannot simply be banned, since products such as solvents, fuels, and oils that are refined from crude oil and natural gas with benzene content generally between 0.1% and 3.0% by volume will still show a degree of benzene contamination [47], [54].

In Korea, claims for compensation of hematopoietic diseases related to benzene have been rising. Ahn and Kang [55] reported a link between occupational diseases, such as cancer, and benzene exposure at petrochemical work sites. Although the benzene exposure level has been relatively reduced, the occurrence of myelodysplastic syndrome, a preleukemia condition, has increased [55] Even though overall current estimated exposure to benzene at work or as part of a job conducted during the normal operations in most industries is low, the occurrence of health effects, including hematopoietic diseases, is still regarded as a possibility, since some jobs or workers have been exposed to higher levels.

In general, it is likely that average benzene measurements from all types of industries followed the overall pattern of decline over time, especially prior to 2000, although there may be inconsistencies by specific operation or job. In particular, maintenance tasks or employment still feature a potential for high benzene exposure. In general, the highest risk for hazardous exposure occurs while performing maintenance tasks. Maintenance work cleaning, replacing, and repairing chemical equipment, reactors, and components that may be contaminated with benzene are performed either regularly or irregularly in almost every industry, with a potential for benzene exposure, including in petrochemical plants. The level of benzene exposure in the petrochemical industry during regular operations has been well established, but not with regard to maintenance, where high exposures may occur. There have been a few efforts assessing exposure to benzene among maintenance workers in Korea. We found that the highest risk of benzene exposure occurs while performing maintenance tasks during turnaround at petrochemical plants (shut down = 1.1–31.8 ppm, maintenance = 1.0–61.9 ppm, startup = 2.4–42.1 ppm). The proportion of turnaround maintenance samples exceeding TWA-OEL of 1 ppm and the STEL-OEL of 5 ppm were 4.1% (20/488 samples) and 6.0% (13/217 samples), indicating that the proportion of the measurements over the exposure limits in not high. Refinery maintenance workers in petrochemical plants tend to experience intermittent benzene exposures due to a variety of tasks performed over short periods, which may include draining, opening, cleaning, and working on enclosed equipment [34]. The available benzene exposure data reviewed suggests that, although mean full-shift exposures are typically low, higher exposures may occasionally be experienced during shutdown and cleaning procedures, and during irregularly performed maintenance work.

One major limitation of this review is that it is not possible to know how representative our benzene estimates may be with regard to various industries over the preceding decades. The data are too limited to be considered representative for the 1990s (number of measurements = 305 for 1990–1994 and 294 for 1995–1999) and for specific industries. In particular, there may be limitations in using our benzene estimates as inhalation TWA exposure level, because benzene levels taken during consecutive and short periods as well as from working areas were all combined as AM(w). As many as 2,993 measurements (19%) were from publications with no information on sampling duration. Despite these limitations, our estimations could be used to estimate past exposure to benzene qualitatively (low, moderate, or high, etc.) by the decade. Further study is needed to examine the effect of time, industry, type of sampling duration, and other sampling characteristics on benzene measurement.

Another limitation was the lack of descriptions of the working conditions under which airborne benzene measurements were taken. All measurements failed to specify operations or job titles within each specific industry, since most of the studies reviewed here did not include such specific exposure information. It is not common in the occupational safety and health field to classify measurements based on the type of occupation or job. There have been no published materials, including official government reports, because of the lack of use of standard classification of occupation in occupational safety and health areas in Korea. As is the case with all historical analyses, the sample duration or exact task descriptions were not consistently provided. Thus, the measurements taken may include periods of higher or lower exposure, and personal exposures during certain tasks are likely to be higher than area samples. We were unable to cover all industries where benzene exposure occurs. Nevertheless, we found that substantial benzene measurement data, which can be used to associate work-related disease, were available for several manufacturing industries during specific periods: petrochemical, rubber and plastic, basic organic chemicals, and auto part manufacturing (Supplementary Table).

5. Conclusions

Our estimated benzene measurements indicate a clear reduction in exposure levels over time until prior to the 2000s. The AM(w) of benzene measurements reported since 2005 were found to be rather higher than those from 2000 to 2004 and from the 1990s, even though most data were collected from petrochemical industries among workers conducting maintenance tasks.

Our results can be used not only to determine the probability of retrospective exposure to benzene in a specific industry, but also to estimate the level of quantitative or semiquantitative retrospective exposure to benzene, especially when supplemented by further assessment from expert users, and can be applied to retrospective exposure assessment and association with the development of health effects.

Conflicts of interest

Go to

None.

Footnotes

Go to

Appendix ASupplementary data related to this article can be found online at http://dx.doi.org/10.1016/j.shaw.2015.07.007.

Appendix A. Supplementary data

Go to

The following is the supplementary data related to this article:

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Carolina Sunrock, LLC.- Burlington North Facility

Draft Environmental Justice Report

North Carolina Department of Environmental Quality
August 9, 2021

Contents

1 Introduction

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (US EPA). This evaluation examines the demographic and environmental conditions in Caswell and Alamance Counties, census tracts 9306 and 213, and the one-mile radius around the property boundary of the proposed Carolina Sunrock, LLC. – Burlington North Facility. Finally, the demographics of the entire state of North Carolina are also considered as they compare to both the county and local census tract and radius setting.

An Environmental Justice (EJ) Snapshot was prepared in August 2020, at the beginning of the previous application process. The EJ Snapshot was distributed to interested community members (if known) and published on the DEQ website with the relevant permit application. The purpose of the EJ Snapshot was to encourage comments and suggestions from the surrounding community, industry, and environmental groups throughout the comment period at that time. The public hearing and accompanying comment period was extended three times in 2020 due to COVID-19, community concerns, and inclement weather. Carolina Sunrock LLC did not receive a permit from the Division of Air Quality in 2020, so has reapplied for a similar permit. Public comments will be considered throughout the remainder of the comment period to inform the final version of this EJ Report.

2 Environmental Justice Evaluation

The Department has assessed the permit applications and the potential impact on communities surrounding the sites associated with the requested permit applications. Carolina Sunrock LLC. submitted two separate permit applications for two locations. This Draft EJ Report only includes information regarding the Burlington North Facility. Please review the accompanying Draft EJ Report for information on the Prospect Hill Distribution Center. Accordingly, the Draft EJ Report will include:

- The permit application submitted by Carolina Sunrock, LLC – Burlington North
- Emissions overview for the facility location
- Study of area demographics for the proposed location (determined by utilizing the US EPA Environmental Justice tool (EJSCREEN) https://ejscreen.epa.gov/mapper/ and current, available census data. https://data.census.gov/cedsci/)
- Comparison of local area demographics for the facility to both county and statewide census data
- County health assessment for all counties
- Sensitive receptors surrounding the facility
- Local industrial sites for the facility (using the NCDEQ Community Mapping System https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=1eb0fbe2bcfb4cccb3cc212af8a0b8c8).

Demographics for Caswell and Alamance counties, as well as the state, will be compared to the local level data (census tracts and project radius) to identify any disparities surrounding the project area. Using standard environmental justice guidelines from the EPA and National Environmental Policy Act (NEPA) documentation, the following conditions will be flagged as potentially underserved communities:

- 10% or more in comparison to the county or state average
- 50% or more minority
- 5% or more in comparison to the county or state average for poverty

3 Proposed Project

Carolina Sunrock, LLC. has submitted permit applications for two proposed sites in Caswell County, North Carolina. One is a hot mix asphalt and concrete batch plant, while the other is a quarry, hot mix asphalt plant, concrete batch plant, and distribution center. They are located approximately nine miles apart from each other. This report only details the Burlington North facility. Please review the accompanying Draft EJ Report for information on the Prospect Hill Distribution Center.

The first proposed site, Carolina Sunrock LLC-Burlington North, will include a hot mix asphalt plant and concrete batch plant. The proposed asphalt plant will include a 250 tons per hour maximum capacity drum-type dryer/mixer with an 80 million BTU per hour maximum heat input capacity burner capable of combusting propane, natural gas, No. 2/4 fuel oils, and recycled No. 2 fuel oil. Particulate matter emissions from the mixer will be controlled by a bag filter.

The plant will include 5 hot mix asphalt storage silos, each with loadouts, and Recycled Asphalt Pavement (RAP) crushing, screening and conveying system. The concrete batch plant is a truck mix plant rated at 120 cubic yards per hour maximum production capacity. Particulate emissions from the plant will be controlled by a bag filter.

Potential emissions of criteria and hazardous air pollutants (after emissions controls and permit limits are taken into account) are shown in Table 1.[1]

Table 1. Burlington North Asphalt Facility Emissions Overview

Pollutant	Potential Emissions (with controls and permit limits, tons/year)
PM	34.08
PM_{10}	19.00
SO_2	26.06
NO_x	16.63
CO	33.85
VOC	12.06
HAP_{Total}	2.59
$HAP_{Highest}$ (Formaldehyde)	0.80

[1] Accurate as of August 6, 2021. Values may change due to modifications to the permit throughout the permitting process.

4 Geographic Area

The proposed facility, Carolina Sunrock LLC- Burlington North, is located at 12971 S NC Highway 62, Burlington, NC 27127 (Figure 1). The highest off-site ambient air impacts will occur at the plant fence line. A one-mile radius was used to evaluate the local demographics and socioeconomics of the surrounding community and help inform public outreach efforts.

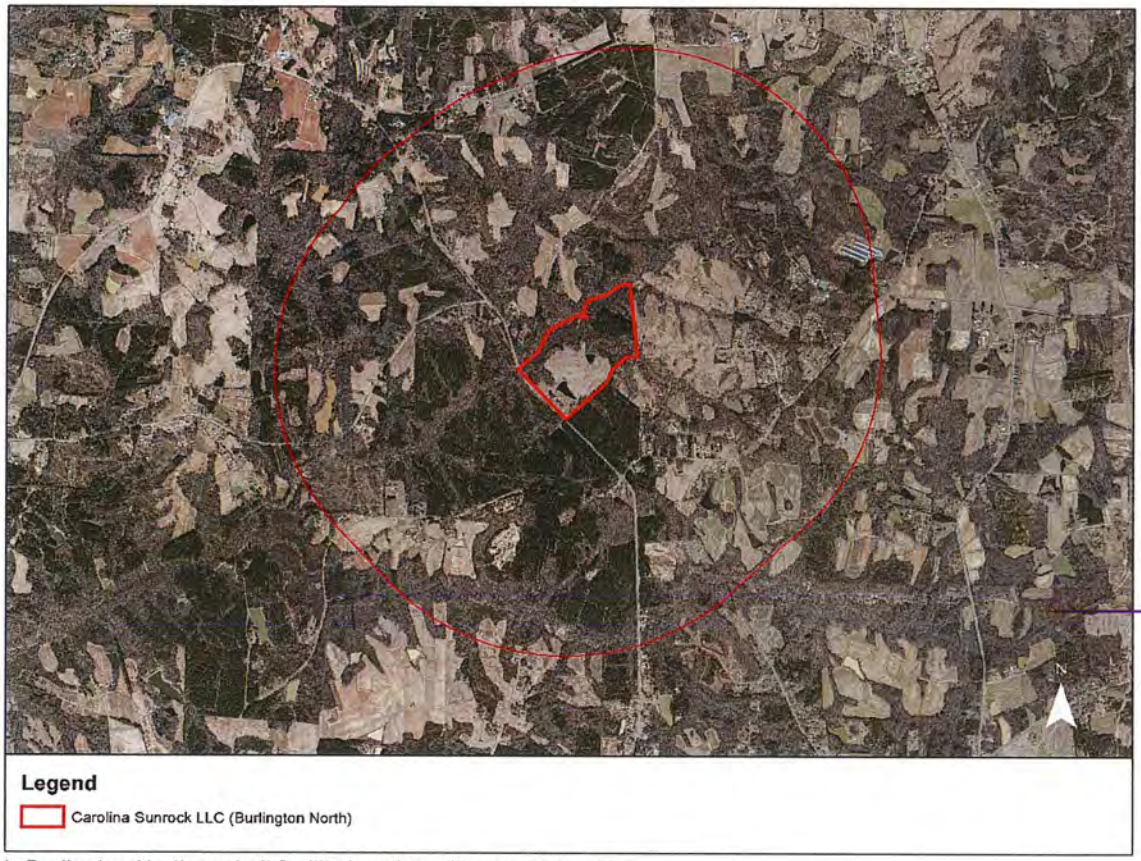

Figure 1. Burlington North asphalt facility location with one-mile radius.

The proposed facility would be located in Caswell County. Caswell County is designated as a Tier 1 county by the NC Department of Commerce. The one-mile buffer surrounding the Burlington North facility includes land in Alamance County, which is designated as a Tier 2 county. According to the Department of Commerce, Tier 1 counties encompass the 40 most distressed counties based on average unemployment rate, median household income, percentage growth in population, and adjusted property tax per capita. Tier 2 counties encompass the next 40 counties based on this ranking system.

The one-mile radius used in this analysis is encompassed by two census tracts. The proposed facility site is located in Census Tract 9306 in Caswell County, and the one-mile buffer enters Census Tract 213 in Alamance County (Figure 3). Census tracts are small, relatively permanent statistical subdivisions of a county with a unique numeric code (US Census Bureau). Census Tract 213 in Alamance County encompasses land within the state designated tribal statistical area for the Occaneechi Band of the Saponi Nation.

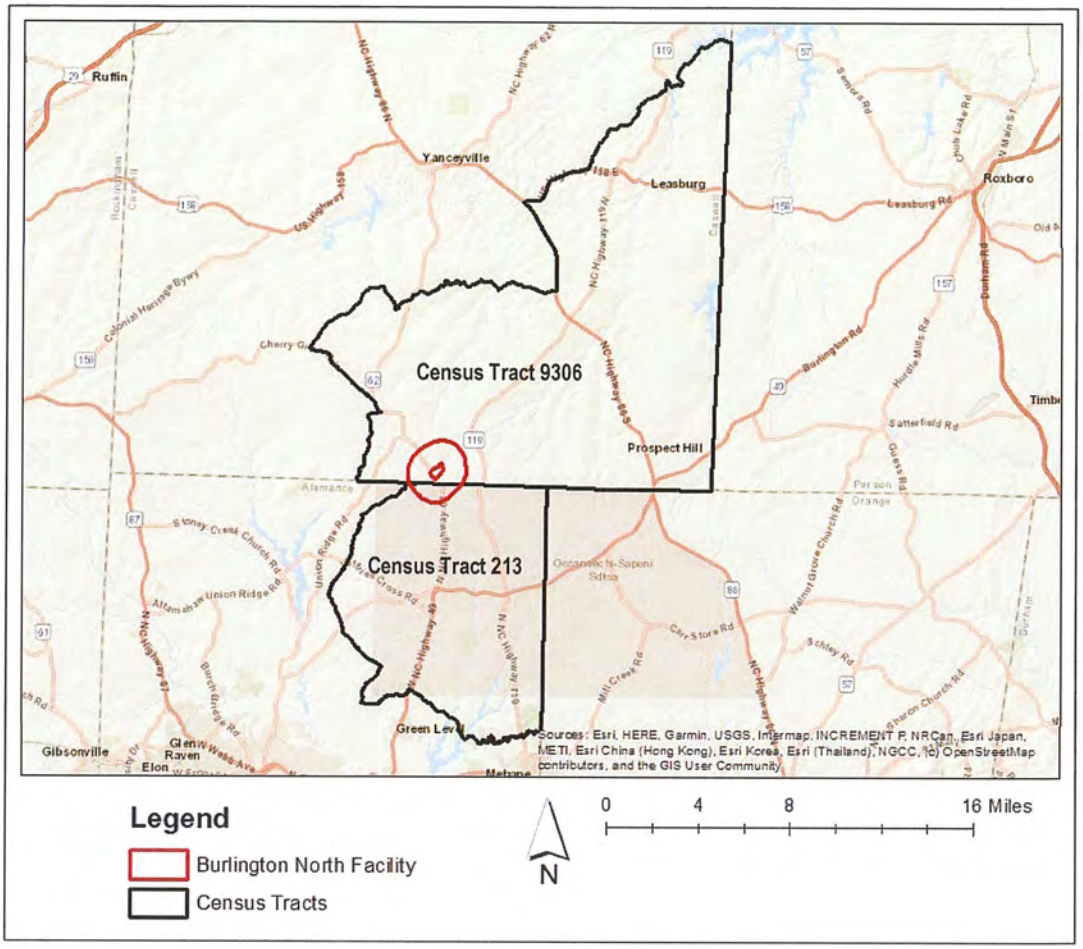

Figure 2. Census tracts surrounding the proposed facility location.

5 Regional and Local Settings

The following sections on race and ethnicity, age and sex, disability, poverty, household income, and Limited English Proficiency (LEP) populations are based on US Census Bureau data, first at a state and county level (regional setting), and then at a census tract and project radius level (local setting). The surrounding census tracts included are those that overlap into the one-mile radius. Demographics of the counties will be compared to the local level data to identify any disparities surrounding the project area. Using standard environmental justice guidelines from the EPA and NEPA documentation, the following conditions will be flagged as potential communities of concern:

1. 10% or more in comparison to the county or state average
2. 50% or more minority
3. 5% or more in comparison to the county or state average for poverty

For example, if a census tract has 35% of the population classified as low income but the county consists of 30% low income, the census tract would exceed the county average by 16.7% and thus be flagged as a potential area of concern. For this report, census data from 2010 and census data estimates from 2011-2015 and 2013-2017 were used. 2010 Census Bureau data is real data gathered every ten years, whereas the estimates from the more recent years are modeled based on the real data. For the data gathered from the 2013-2017 and 2011-2015 estimates, the margin of error (MOE) has been included. This value is a measure of the possible variation of the estimate around the population value (US Census Bureau). The Census Bureau standard for the MOE is at the 90% confidence level and may be any number between 0 and the MOE value in either direction (indicated by +/-).

5.1 Race and Ethnicity

Regional Setting

According to the 2010 US Census Data Table 9: Hispanic or Latino, and Not Hispanic or Latino By Race, North Carolina's population totaled 9,535,483 individuals (Table 3). The three most common racial groups across the state were White (68.5%), Black or African American (21.5%) and Hispanic or Latino (of any race) at 8.4%.

Caswell County had a total population of 23,719 individuals (Table 3). Alamance County had a total population of 151,131 individuals. The three most common racial or ethnic groups within both counties were White (62.5%, and 71.1%), Black or African American (33.8%, and 18.8%), and Hispanic or Latino (3.1%, and 11.0%). In Caswell County, the Black or African American Population (33.8%) was greater than 10% different when compared to the state (21.5%). In Alamance County, the populations of Some other Race (6.1%) and the Hispanic or Latino population (11.0%) were greater than 10% different when compared to the state (4.3% and 8.4%).

Table 2. Regional Setting - Race and Ethnicity

Race and Ethnicity	North Carolina		Caswell County		Alamance County	
	Number	Percent	Number	Percent	Number	Percent
Total Population	9,535,483	100	23,719	100.0	151,131	100.0
White	6,528,950	68.5	14,819	62.5	107,420	71.1
Black or African American	2,048,628	21.5	8,020	**33.8**	28,369	18.8
American Indian or Alaska Native	122,110	1.3	85	0.4	1,020	0.7
Asian	208,962	2.2	60	0.3	1,837	1.2
Native Hawaiian and Other Pacific Islander	6,604	0.1	4	0.0	58	0.0
Some other Race	414,030	4.3	350	1.5	9,291	**6.1**
Two or More Races	206,199	2.2	381	1.6	3,136	2.1
HISPANIC OR LATINO (of any race)	800,120	8.4	744	3.1	16,639	**11.0**
Mexican	486,960	5.1	607	2.6	11,664	**7.7**
Puerto Rican	71,800	0.8	42	0.2	861	0.6
Cuban	18,079	2.3	17	0.1	186	0.1
Other Hispanic or Latino	223,281	2.3	78	0.3	3,928	2.6

Source: US Census Bureau, 2010 Census
All **bolded and orange** cells indicate a difference that is greater than 10% when compared to the State

Local Setting

According to the 2010 US Census Data Table 9: Hispanic or Latino, and Not Hispanic or Latino By race or ethnicity, the largest population within Census Tract 9306 in Caswell County was White at 70.3%, followed by Black or African American at 25.8%, and Hispanic or Latino at 3.2%. The Black or African American population (25.8%) was greater than 10% different compared to the state (21.5%). The largest population within Census Tract 213 in Alamance County was White at 61.8% followed by Black or African American (31.8%) and Hispanic or Latino (5.8%). The Black or African American population is greater than 10% different when compared to the county (18.8%) and the state (21.5%).

The one-mile radius surrounding the Burlington North facility is majority White (67.0%), followed by Black or African American (29.0%), and Hispanic or Latino (4.0%). The Black or African American population is greater than 10% different when compared to the state (21.5%) but not the County (Table 4).

Table 3. Local Setting: Burlington North – Race and Ethnicity

Subject	Project Area 1-Mile		Census Tract 9306 Caswell County		Census Tract 213 Alamance County	
Race and Ethnicity	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Total Population	310	100.0	4,790	100.0	6,057	100.0
White	206	67.0	3,367	70.3	3,743	61.8
Black or African American	89	**29.0**	1,238	**25.8**	1,925	**31.8**
American Indian or Alaska Native	3	1.0	20	0.2	65	1.1
Asian	0	0.0	8	0.2	15	0.2
Native Hawaiian and Other Pacific Islander	0	0.0	0	0.0	0	0.0
Some other Race	5	2.0	84	1.8	188	3.1
Two or More Races	6	2.0	73	1.5	121	2.0
HISPANIC OR LATINO (of any race)	11	4.0	151	3.2	353	5.8
Mexican			113	2.4	236	3.9
Puerto Rican			17	0.4	22	0.4
Cuban			0	0.0	7	0.1
Other Hispanic or Latino			21	0.4	88	1.5

Source: US Census Bureau, 2010 Census
All **bolded and orange** cells indicate a difference that is greater than 10% when compared to the State
All **bolded and blue** cells indicate a difference that is greater than 10% when compared to the county and the State

5.2 Age and Sex

Regional Setting

According to the 2010 US Census Data Table P 12: Sex by Age, North Carolina had a total population of 9,535,483 individuals (Table 5). The largest percentage of the total state population (63.1%) was between the ages of 18 and 64, followed by under 18 years (23.9%), and 65 years and older (12.9%).

Caswell County had a total population of 23,719 individuals. The largest percentage of the total population (63.56%) was between the ages of 18 and 64, followed by under 18 years (20.6%) and 65 years and older (15.8%).

Alamance County had a total population of 151,131 individuals. The largest percentage of the total population (61.9%) was between the ages of 18 and 64, followed by under 18 years (23.5%) and 65 years and older (14.6%).

In both counties, for both male and female subgroups, as well as the population overall, the populations of 65 years and older is greater than 10% different when compared to the state.

Table 4. Regional Setting- Age Groups and Sex

Subject	North Carolina		Caswell County		Alamance County	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Total Population:	9,535,483	100	23,719	100	151,131	100
Under 5 years:	632,040	6.6	1,181	5.0	9,524	6.3
Under 18 years:	2,281,635	23.9	4,889	20.6	35,443	23.5
18 to 64 years:	6,019,769	63.1	15,075	63.6	93,607	61.9
65 years and older:	1,234,079	12.9	3,755	**15.8**	22,081	**14.6**
Male:	4,645,492	100	12,074	100	71,890	100
Under 5 years:	322,871	7.0	602	5.0	4,846	6.7
Under 18 years:	1,167,303	25.1	2,537	21.0	18,109	25.2
18 to 64 years:	2,954,233	63.6	7,935	65.7	44,687	62.2
65 years and older:	523,956	11.28	1,602	**13.3**	9,094	**12.7**
Female:	4,889,991	100	11,645	100	79,241	100
Under 5 years:	309,169	6.32	579	5.0	4,678	5.9
Under 18 years:	1,114,332	22.79	2,352	20.2	17,334	21.9
18 to 64 years:	3,065,536	62.69	7,140	61.3	48,920	61.7
65 years and older:	710,123	14.52	2,153	**18.5**	12,987	**16.4**

Source: US Census Bureau, 2010 Census
All **bolded and orange** cells indicate a difference that is greater than 10% when compared to the State

Local Setting

According to the 2010 US Census Data Table P 12: Sex by Age, Census Tract 9306 had a total population of 4,790 individuals (Table 6). The largest percentage of the total population (62.8%) was between the ages of 18 and 64, followed by under 18 years (20.6%), and 65 years and older (16.6%). The total population, as well as the female subgroup have a population of 65 years and older that is greater than 10% different than the state. The male subgroup has a population of 65 years and older that is greater 10% different than the county and the state.

Census Tract 213 had a total population of 6,057 individuals. The largest percentage of the total population (61.9%) was between the ages of 18 and 64, followed by under 18 years (23.4%), and 65 years and older (14.7%). The total population, as well as the male and female subgroups have a population of 65 years and older that is greater than 10% different than the state.

Table 5. Local Setting- Age Groups and Sex

Subject	Census Tract 9306, Caswell County		Census Tract 213, Alamance County	
	Number	**Percent**	**Number**	**Percent**
Total Population:	4,790	100	6,057	100
Under 5 years:	246	5.1	306	5.1
Under 18 years:	988	20.6	1,417	23.4
18 to 64 years:	3,007	62.8	3,752	61.9
65 years and older:	795	**16.6**	888	**14.7**
Male:	2,407	100	2,950	100
Under 5 years:	132	5.5	145	4.9
Under 18 years:	535	22.2	707	24.0
18 to 64 years:	1,511	62.8	1,854	62.9
65 years and older:	361	**15.0**	389	**13.2**
Female:	2,383	100	3,107	100
Under 5 years:	114	4.8	161	5.2
Under 18 years:	453	19.0	710	22.9
18 to 64 years:	1,496	62.8	1,898	61.1
65 years and older:	434	**18.2**	499	**16.1**

Source: US Census Bureau, 2010 Census
All **bolded and orange** cells indicate a difference that is greater than 10% when compared to the State
All **bolded and blue** cells indicate a difference that is greater than 10% when compared to the county and the State

EJSCREEN identified an approximate population of 372 in the 1-mile radius surrounding the Burlington North facility. The largest population was 18+ years, at 78%, followed by 0-17 years at 22% (Table 7).

Table 6. Project Radius- Age Groups and Sex

Subject	1-mile radius	
	Number	Percent
Total Population	372	100
0-4 years	18	6
0-17 years	64	22
18+ years	243	78
65+ years	47	15
Source: US Census Bureau, 2010 Census		

5.3 Disability

Regional Setting

According to the 2013-2017 American Community Survey 5-Year Estimates, Table S1810 Disability Characteristics from the US Census Bureau, the state of North Carolina had an estimated total population of 9,845,238 noninstitutionalized citizens. Of those individuals, an estimated 13.7% (MOE +/- 0.1%) had a disability. The largest population of disabled civilians were 75 years and over (51.0%, MOE +/- 0.5%). The second largest population was the 65 years to 74 years at 27.2% (MOE +/- 0.3%). By race, American Indian and Alaskan Native had the highest estimated disability rate of 18.3% (MOE +/- 0.7%). Black or African American, White, and Native Hawaiian and Other Pacific Islander were the next three highest population estimates with disabilities in North Carolina, at 15.1% (MOE +/-0.2%, 14.0% (MOE +/- 0.1%), and 11.6% (MOE +/- 0.6%), respectively (Table 8).

Caswell County had an estimated total population of 21,970 noninstitutionalized citizens. Of those, an estimated 19.7% (MOE +/- 2%) had a disability. The largest population of disabled civilians were 75 years and over (60.9%, MOE +/- 7.2%) followed by 65 years to 74 years (32.4%, MOE +/-6%). By race, residents of Two or more races had the highest estimated disability rate (50.9%, MOE +/-31%). All populations, excluding American Indian and Alaska Native, Native Hawaiian and Other Pacific Islander, some other race, Hispanic or Latino, and 5 to 17 years displayed estimates that were greater than 10% different when compared to the state.

Alamance County had an estimated total population of 156,660 noninstitutionalized citizens. Of those, an estimated 14.6% (MOE +/- .6%) had a disability (Table 9). The largest population of disabled civilians were 75 years and over (50.1%, MOE +/- 2.8%) followed by 65 years to 74 years (28.4, MOE +/-2.3%). By race, Native Hawaiian and Other Pacific Islander residents had the highest estimated disability rate (28.4%, MOE +/-17.1%). The following population groups displayed estimates that were greater than 10% different when compared to the state: Black or African American, Native Hawaiian and other Pacific Islander, Two or more races, under 5 years, and 5-17 years.

Table 7. Regional Setting- Disability

Subject	North Carolina						Caswell County					
	Total		With a Disability		Percent with a Disability		Total		With a Disability		Percent with a Disability	
	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)
Total civilian noninstitutionalized population	9,845,238	1,883	1,344,677	9,296	13.7%	0.1	21,970	136	4,339	445	**19.7%**	2.0
SEX												
Male	4,734,744	2,356	644,157	5,756	13.6%	0.1	10,738	191	2,216	264	**20.6%**	2.5
Female	5,110,494	1,611	700,520	5,791	13.7%	0.1	11,232	96	2,123	275	**18.9%**	2.4
RACE AND HISPANIC OR LATINO ORIGIN												
White alone	6,805,260	7,679	950,044	7,928	14.0%	0.1	13,885	214	2,594	350	**18.7%**	2.5
Black or African American alone	2,101,735	5,025	316,325	4,035	15.1%	0.2	7,202	228	1,573	257	**21.8%**	3.7
American Indian and Alaska Native alone	114,961	1,802	20,994	862	18.3%	0.7	23	26	0	22	0.0%	61.8
Asian alone	266,672	1,954	13,149	763	4.9%	0.3	130	22	35	32	**26.9%**	24.5
Native Hawaiian and Other Pacific Islander alone	5,842	533	678	170	11.6%	3	32	38	0	22	0.0%	52.4
Some other race alone	306,809	7,341	15,461	1,136	5.0%	0.3	429	184	0	22	0.0%	7.3
Two or more races	243,959	5,401	28,026	1,407	11.5%	0.5	269	163	137	106	**50.9%**	31
Hispanic or Latino (of any race)	895,338	953	53,910	1,944	6.0%	0.2	806	27	10	15	1.2%	1.9
AGE												
Under 5 years	603,917	730	5,099	590	0.8%	0.1	1,080	35	22	33	**2.0%**	3.1
5 to 17 years	1,682,039	807	95,840	2,124	5.7%	0.1	3,253	38	169	71	5.2%	2.2
18 to 34 years	2,190,572	2,241	144,807	3,125	6.6%	0.1	4,018	103	300	110	**7.5%**	2.8
35 to 64 years	3,894,704	2,076	560,147	6,001	14.4%	0.2	9,350	140	2,003	321	**21.4%**	3.4
65 to 74 years	895,249	1,047	243,488	2,801	27.2%	0.3	2,651	47	859	155	**32.4%**	6
75 years and over	578,757	1,013	295,296	2,759	51.0%	0.5	1,618	56	986	122	**60.9%**	7.2

Table 8. Regional Setting- Disability cont'd

Subject	Alamance County					
	Total		With a Disability		Percent with a Disability	
	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)
Total civilian noninstitutionalized population	156,660	231	22,895	988	14.6%	0.6
SEX						
Male	74,611	185	10,661	650	14.3%	0.9
Female	82,049	200	12,234	601	14.9%	0.7
RACE AND HISPANIC OR LATINO ORIGIN						
White alone	110,346	1,242	16,922	862	15.3%	0.8
Black or African American alone	29,705	417	4,837	466	**16.3%**	1.6
American Indian and Alaska Native alone	529	196	96	49	18.1%	7.5
Asian alone	2,378	216	103	63	4.3%	2.7
Native Hawaiian and Other Pacific Islander alone	67	23	19	15	**28.4%**	17.1
Some other race alone	9,594	1,250	285	161	3.0%	1.6
Two or more races	4,041	621	633	219	**15.7%**	4.8
Hispanic or Latino (of any race)	19,423	35	772	249	4.0%	1.3
AGE						
Under 5 years	9,226	50	104	70	**1.1%**	0.8
5 to 17 years	26,696	60	1,801	367	**6.7%**	1.4
18 to 34 years	34,324	73	2,178	358	6.3%	1
35 to 64 years	61,661	101	9,487	603	15.4%	1
65 to 74 years	14,165	159	4,021	327	28.4%	2.3
75 years and over	10,588	167	5,304	291	50.1%	2.8

Source: US Census Bureau, ACS 5-year Estimates (2013-2017)
All **bolded** and orange highlighted cells indicate a difference that is greater than 10% when compared to the State

Local Setting

According to the 2013-2017 American Community Survey 5-Year Estimates, Table S1810 Disability Characteristics from the US Census Bureau, Census Tract 9306 in Caswell County had an estimated total population of 5,005 noninstitutionalized citizens (Table 10). Of those individuals, an estimated 15.4% (MOE +/- 4.2%) had a disability. The largest population of disabled civilians were 75 years and over (69.2%, MOE +/- 20.8%). The second largest population was the 65 years to 74 years at 35.5% (MOE +/- 14%). By race, Black or African American residents had the highest estimated disability rate of 19.6% (MOE +/- 12%). The following population groups had estimates that were greater than 10% when compared to the state: total civilian noninstitutionalized population, male, Black or African American alone, 35-64 years, and 65-74 years. The population group 75 years and older had an estimate that was greater than 10% when compared to the county and to the state.

Census Tract 213 in Alamance County had an estimated total population of 6,073 noninstitutionalized citizens. Of those individuals, an estimated 15% (MOE +/- 1.7%) had a disability. The largest population of disabled civilians were 75 years and over (52.1%, MOE +/- 7.1%). The second largest population was the American Indian and Alaska Native population at 33.3% (MOE +/- 16.9%). The female subgroup had an estimate that was greater than 10% different when compared to the state. The following population groups had estimates that were greater than 10% when compared to the state and the county: Black or African American alone, American Indian and Alaska native, Asian, and 18-34 years.

Table 9. Local Setting- Disability

Subject	Census Tract 9306, Caswell County						Census Tract 213, Alamance County					
	Total		With a Disability		Percent with a Disability		Total		With a Disability		Percent with a Disability	
	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)
Total civilian noninstitutionalized population	5,005	493	769	227	**15.4%**	4.2	6,073	266	912	113	15.0%	1.7
SEX												
Male	2,556	270	436	142	**17.1%**	5.5	2,972	153	430	72	14.5%	2.1
Female	2,449	286	333	123	13.6%	4.5	3,101	176	482	68	**15.5%**	2.1
RACE AND HISPANIC OR LATINO ORIGIN												
White alone	3,697	377	517	199	14.0%	5.3	3,867	203	550	86	14.2%	2
Black or African American alone	1,289	312	252	165	**19.6%**	12	1,741	175	323	62	**18.6%**	2.7
American Indian and Alaska Native alone	0	17	0	17	-	**	42	23	14	8	**33.3%**	16.9
Asian alone	8	16	0	17	0.0%	100	60	49	4	5	**6.7%**	8.7
Native Hawaiian and Other Pacific Islander alone	0	17	0	17	-	**	6	10	0	17	0.0%	100
Some other race alone	0	17	0	17	-	**	188	85	7	8	3.7%	4.5
Two or more races	11	22	0	17	0.0%	89.4	169	58	14	16	8.3%	8.8
Hispanic or Latino (of any race)	33	39	0	17	0.0%	51.6	324	103	10	9	3.1%	2.7
AGE												
Under 5 years	324	93	0	17	0.0%	9.5	266	58	0	17	0.0%	11.5
5 to 17 years	854	199	25	28	2.9%	3.4	1,100	117	50	20	4.5%	1.7
18 to 34 years	1,094	209	30	47	2.7%	4.3	881	102	65	25	**7.4%**	2.7
35 to 64 years	1,959	270	378	150	**19.3%**	7.2	2,772	141	426	81	15.4%	2.7
65 to 74 years	592	135	210	104	**35.5%**	14	653	72	162	44	24.8%	5.9
75 years and over	182	69	126	65	**69.2%**	20.8	401	64	209	41	52.1%	7.1

Source: US Census Bureau, American Community Survey (5-year estimates)
All **bolded** and orange highlighted cells indicate a difference that is greater than 10% when compared to the State
All **bolded** and blue highlighted cells indicate a difference that is greater than 10% when compared to the County and State

5.4 Poverty

Regional Setting

According to the Census Table S1701, Poverty Status in the Past 12 Months, 2013-2017 American Community Survey 5-Year Estimates, from the US Census Bureau, North Carolina had an estimated population of 9,783,738, with 16.1% (MOE +/- 0.2%) below the poverty level (Table 11). Across all subjects, Some other race had the highest percent living below the poverty level at 32.0% (MOE +/- 1.4%). The next three subjects with the highest poverty level were Hispanic or Latino at 30.1% (MOE +/- .8%), American Indian and Alaska Native at 26.2% (MOE +/- 1.5%), and Black or African American at 24.9% (MOE +/- .4%). The age group with the highest population below poverty was under 18 (22.9%, MOE +/- 0.4%), followed by 18 to 64 (15.3%, MOE +/- 0.2%).

Caswell County had an estimated population of 21,870 with 21.3% (MOE +/-2.9%) living below the poverty level. Across all subjects, two or more races had the highest percent living below the poverty level at 65.4% (MOE +/- 7.4%). The next subjects with the highest poverty level were Some other race at 59.2% (MOE +/- 32.2%) and Hispanic or Latino at 56.1% (MOE +/- 19.9%). All subject groups had a greater than 5% difference when compared to the state, excluding Native Hawaiian and Other Pacific Islander and American Indian and Alaska Native.

Alamance County had an estimated population of 153,649 with 17.6% (MOE +/-1%) living below the poverty level. Across all subjects, some other race had the highest percent living below the poverty level at 37% (MOE +/- 7.4%). The next subjects with the highest poverty level were American Indian and Alaska Native at 35% (MOE +/- 20.5%) and Hispanic or Latino at 32.2% (MOE +/- 5.2%). The following subject groups had a greater than 5% difference when compared to the state: overall population, under 18, female, Black or African American, American Indian and Alaska Native, Some other race, and Two or more races (Table 12).

Table 10. Regional Setting- Poverty

Subject	North Carolina						Caswell County					
	Total		Below poverty level		Percent below poverty level		Total		Below poverty level		Percent below poverty level	
	Estimate	Margin of Error +/-	Estimate	Margin of Error +/-	Estimate	Margin of Error +/-	Estimate	Margin of Error +/-	Estimate	Margin of Error +/-	Estimate	Margin of Error +/-
Population for whom poverty status is determined	9,783,738	1,751	1,579,871	17,833	16.1%	0.2	21,870	156	4,666	650	**21.3%**	2.9
AGE												
Under 18	2,256,186	1,865	516,821	9,185	22.9%	0.6	4,233	76	1,449	312	**34.2%**	7.2
18 to 64	6,053,546	1,090	923,859	9,663	15.3%	0.4	13,368	144	2,471	395	**18.5%**	2.9
65 years and over	1,474,006	881	139,191	2,754	9.4%	0.2	4,269	56	746	199	**17.5%**	4.6
SEX												
Male	4,733,269	2,259	694,126	9,539	14.7%	0.2	10,709	189	2,255	378	**21.1%**	3.5
Female	5,050,469	2,443	885,745	10,217	17.5%	0.2	11,161	115	2,411	368	**21.6%**	3.3
RACE AND HISPANIC OR LATINO ORIGIN												
White	6,776,691	7,591	845,573	13,639	12.5%	0.2	13,814	220	2,263	503	**16.4%**	3.7
Black or African American	2,077,559	4,736	517,071	8,162	24.9%	0.4	7,188	227	1,950	365	**27.1%**	5.1
American Indian and Alaska Native	114,751	1,804	30,017	1,757	26.2%	1.5	23	26	4	7	17.4%	36.9
Asian	262,596	1,970	33,282	2,248	12.7%	0.9	130	22	29	41	**22.3%**	31.8
Native Hawaiian and Other Pacific Islander	5,886	537	1,097	297	18.6%	4.9	32	38	0	22	0.0%	52.4
Some other race	305,431	7,334	97,609	5,276	32.0%	1.4	429	184	254	204	**59.2%**	32.2
Two or more races	240,824	5,455	55,222	2,570	22.9%	1	254	162	166	165	**65.4%**	43.5
Hispanic or Latino	894,810	1,312	268,985	7,035	30.1%	0.8	806	27	452	160	**56.1%**	19.9
All individuals below:												
50 percent of poverty level	688,118	10,757					1,965	538				
125 percent of poverty level	2,094,292	20,441					5,709	679				
150 percent of poverty level	2,596,452	22,139					6,652	697				
185 percent of poverty level	3,291,075	23,334					8,328	753				
200 percent of poverty level	3,571,557	25,056					9,398	764				

Table 11. Regional Setting- Poverty cont'd

Subject	Alamance County					
	Total		Below poverty level		Percent below poverty level	
	Estimate	Margin of Error +/-	Estimate	Margin of Error +/-	Estimate	Margin of Error +/-
Population for whom poverty status is determined	153,649	450	26,996	1,473	17.6	1.0
AGE						
Under 18	35,598	152	9,296	798	**26.1**	2.3
18 to 64	93,298	383	15,152	932	16.2	1.0
65 years and over	24,753	194	2,548	338	10.3	1.4
SEX						
Male	73,579	326	11,355	838	15.4	1.1
Female	80,070	333	15,641	895	**19.5**	1.1
RACE AND HISPANIC OR LATINO ORIGIN						
White	107,948	1,261	14,381	1,398	13.3	1.3
Black or African American	29,487	432	7,707	794	26.1	2.6
American Indian and Alaska Native	525	195	184	158	**35.0**	20.5
Asian	2,202	227	95	80	4.3	3.7
Native Hawaiian and Other Pacific Islander	61	23	1	2	1.6	3.2
Some other race	9,498	1,226	3,518	794	**37.0**	7.4
Two or more races	3,928	617	1,110	412	**28.3**	8.6
Hispanic or Latino	19,127	109	6,157	1,007	32.2	5.2
All individuals below:						
50 percent of poverty level	10,201	1,191				
125 percent of poverty level	36,793	1,785				
150 percent of poverty level	44,823	1,900				
185 percent of poverty level	57,083	1,664				
200 percent of poverty level	61,966	1,721				

Source: American Community Survey 5-year Estimates, 2013-2017
All **bolded and orange** cells indicate a difference that is greater than 5% when compared to the State

Local Setting

According to the Census Table S1701, Poverty Status in the Past 12 Months, 2013-2017 American Community Survey 5-Year Estimates, from the US Census Bureau, Census Tract 9306 in Caswell County had an estimated population of 4,956 with 22.3% (MOE +/-7.5%) living below the poverty level (Table 13). Across all subjects, Asian (100%, MOE +/- 100%) and two or more races (100% MOE +/- 89.4%) had the highest percent living under the poverty level. The next subjects with the highest poverty level were Hispanic or Latino at 69.7% (MOE +/- 50.5%), and under 18 at 39.8% (MOE +/- 17.2%). The following subject groups had a greater than 5% difference when compared to the county and the state: under 18, male, white, Black or African American, American Indian and Alaska Native, Asian, Two or more races, and Hispanic or Latino. The following groups had a greater than 5% difference when compared to the state: total population, 18 to 64 years, and female.

Census Tract 213 in Alamance County had an estimated population of 6,076 with 14.1% (MOE +/-2.4%) living below the poverty level (Table 13). Across all subjects, some other race had the highest percent living below the poverty level at 37.2% (MOE +/- 25.7%). The next subjects with the highest poverty level were Hispanic or Latino at 25.3% (MOE +/- 16.9%), and under 18 at 21.4% (MOE +/- 6%). The following subject groups had a greater than 5% difference when compared to the state: Asian and Native Hawaiian and Other Pacific Islander.

Table 12. Local Setting- Poverty

Subject	Census Tract 9306, Caswell County						Census Tract 213, Alamance County					
	Total		Below poverty level		Percent below poverty level		Total		Below poverty level		Percent below poverty level	
	Estimate	Margin of Error +/-	Estimate	Margin of Error +/-	Estimate	Margin of Error +/-	Estimate	Margin of Error +/-	Estimate	Margin of Error +/-	Estimate	Margin of Error +/-
Population for whom poverty status is determined	4,956	496	1,106	401	22.3	7.5	6,076	268	857	156	14.1	2.4
AGE												
Under 18	1,129	210	449	239	39.8	17.2	1,365	126	292	90	21.4	6
18 to 64	3,053	354	587	224	19.2	6.9	3,657	179	433	80	11.8	2.1
65 years and over	774	124	70	59	9.0	7.6	1,054	77	132	41	12.5	4
SEX												
Male	2,556	270	616	289	24.1	10.6	2,975	154	412	90	13.8	2.9
Female	2,400	293	490	191	20.4	7.4	3,101	176	445	86	14.4	2.5
RACE AND HISPANIC OR LATINO ORIGIN												
White	3,648	380	705	303	19.3	8	3,871	204	439	97	11.3	2.5
Black or African American	1,289	312	382	261	29.6	17.5	1,740	175	319	92	18.3	4.5
American Indian and Alaska Native	0	17	0	17	-	**	42	23	0	17	0.0	45.8
Asian	8	16	8	16	100.0	100	60	49	9	8	15.0	15.8
Native Hawaiian and Other Pacific Islander	0	17	0	17	-	**	6	10	1	2	16.7	43.4
Some other race	0	17	0	17	-	**	188	85	70	65	37.2	25.7
Two or more races	11	22	11	22	100.0	89.4	169	58	19	16	11.2	8.5
Hispanic or Latino	33	39	23	32	69.7	50.5	324	103	82	66	25.3	16.9
All individuals below:												
50 percent of poverty level	414	250					329	78				
125 percent of poverty level	1,148	402					1,212	172				
150 percent of poverty level	1,238	413					1,502	193				
185 percent of poverty level	1,418	430					1,851	208				
200 percent of poverty level	1,862	515					2,053	213				

5.5 Household Income

Regional Setting

The following table was compiled using data from the Census Table S1901, Income in the Past 12 Months (in 2017 Inflation-Adjusted Dollars) 2013-2017 American Community Survey 5-Year Estimates for North Carolina. The North Carolina household income range with the highest percent was $50,000 to $74,999, at 18.1%. The median household income was $50,320 and the mean income was $70,523 (Table 14).

The household income range for Caswell County with the highest percent was $50,000 to $74,999 at 16.7% (MOE +/- 2.6%). The median income was $39,428 and the mean income was $52,548. All income ranges less than $50,000 had percentages that were more than 10% higher than the state ranges. The household income range for Alamance County with the highest percent was $50,000 to $74,999 at 16.6% (MOE +/- 1%). The median income was $44,281 and the mean income was $61,661. The income ranges $15,000 to $34,999 had percentages that were more than 10% higher than the state ranges

Table 13. Regional Setting- Household Income

Subject	North Carolina		Caswell County		Alamance County	
	Households		Households		Households	
	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)
Total	3,874,346	8,789	9,160	276	63,035	641
Less than $10,000	7.3%	0.1	**9.1%**	2	7.4%	0.7
$10,000 to $14,999	5.8%	0.1	**10.2%**	2.5	5.8%	0.7
$15,000 to $24,999	11.1%	0.1	**13.5%**	2.3	**14.2%**	0.9
$25,000 to $34,999	11.0%	0.1	**12.1%**	2.2	**12.2%**	0.8
$35,000 to $49,999	14.5%	0.1	**16.6%**	2.7	15.8%	1.1
$50,000 to $74,999	18.1%	0.1	16.7%	2.6	16.6%	1
$75,000 to $99,999	11.8%	0.1	10.4%	2.1	11.3%	0.8
$100,000 to $149,999	11.7%	0.1	7.1%	1.7	11.3%	0.7
$150,000 to $199,999	4.4%	0.1	2.4%	1.2	3.2%	0.4
$200,000 or more	4.3%	0.1	1.9%	1.1	2.2%	0.4
Median income (dollars)	50,320	204	39,428	2,039	44,281	1,192
Mean income (dollars)	70,523	287	52,548	3,820	61,661	1,701

Source: US Census, ACS 5-year Estimates 2013-2017. All **orange and bolded** cells indicate a difference of greater than 10% increase when compared to the state.

Local Setting

The household income range for Census Tract 9306 in Caswell County with the highest percent was $50,000 to $74,999 at 19.1% (MOE +/- 7.2%). The median income was $55,975 and the mean income was $62,498 (Table 15). The income range $10,000 to $14,999 had percentages that were more than 10% higher than the state ranges. The household income range for Census Tract 213 in Alamance County with the highest percent was $50,000 to $74,999 at 19.8% (MOE +/- 2.7%). The median income was $51,098 and the mean income was $67,798. The income

range $25,000 to $34,999 had an estimate that was more than 10% greater than the state estimate. The income ranges $50,000 to $74,999 and $100,000 to $149,999 had estimates that were greater than 10% different from the state and the county.

Table 14. Local Setting- Household Income

Subject	Census Tract 9306, Caswell County		Census Tract 213, Alamance County	
	Households		Households	
	Estimate	Margin of Error (+/-)	Estimate	Margin of Error (+/-)
Total	1,821	190	2,344	98
Less than $10,000	6.0%	6.2	7.0%	1.5
$10,000 to $14,999	**9.6%**	5.4	5.8%	1.4
$15,000 to $24,999	12.0%	4.8	9.8%	1.7
$25,000 to $34,999	9.3%	4.6	**12.3%**	2.6
$35,000 to $49,999	11.4%	5.1	14.4%	2.3
$50,000 to $74,999	19.1%	7.2	**19.8%**	2.7
$75,000 to $99,999	15.5%	7.1	9.6%	1.9
$100,000 to $149,999	10.8%	5.4	**13.9%**	2.4
$150,000 to $199,999	3.5%	3.8	4.5%	1.6
$200,000 or more	2.7%	3.4	3.1%	1.3
Median income (dollars)	55,795	15,776	51,098	4,760
Mean income (dollars)	62,498	10,639	67,798	3,746

Source: US Census, 2013-2017 ACS 5-Year Estimates.
All **orange and bolded** highlighted cells indicate a difference that is greater than 5% when compared to the state.
All **bolded** and blue highlighted cells indicate a difference that is greater than 5% when compared to the county and the state.

In the one-mile radius from the Burlington North facility, the household income range with the highest percent was less than $75,000+ at 33%, followed by $25,000-$50,000 at 25% (Table 16).

Table 15. Project Radius- Household Income

Subject	1-mile (Burlington North)	
	Households	
	Estimate	Percent
Total	93	100.0%
Less than $15,000	13	14.0%
$15,000 to $25,000	13	14.0%
$25,000 to $50,000	24	25.0%
$50,000 to $75,000	12	13.0%
$75,000+	31	33.0%
Source: EJSCREEN. US Census, 2013-2017 ACS 5-year Estimates		

Per Capita Income

Per Capita Income data was obtained through the Census Table B19301, Per Capita Income in the Past 12 Months (In 2017 Inflation-Adjusted Dollars), 2013-2017 American Community

Survey 5-Year Estimates. The North Carolina per capita income estimate was $28,123. The estimates for the counties are: $21,692 in Caswell County and $25,157 in Alamance County. The estimates for the census tracts are: $22,753 (9306) and $26,427 (213). Both the county and the census tracts had a lower Per Capita Income compared to the state (Table 17).

The EJSCREEN analysis also provided per capita income estimates for the one-mile buffer surrounding facility sites. The Burlington North facility has an estimated per capita income of $21,076.

Table 16. Per Capita Income

Location	Subject		Per Capita Income in Last 12 Months (Dollars)
North Carolina	Per Capita Income	Estimate	$28,123
		Margin of Error +/-	130
Caswell County	Per Capita Income	Estimate	$21,692
		Margin of Error +/-	1,521
Alamance County	Per Capita Income	Estimate	$25,157
		Margin of Error +/-	738
Census Tract 9306 Caswell County	Per Capita Income	Estimate	$22,753
		Margin of Error +/-	3,182
Census Tract 213 Alamance County	Per Capita Income	Estimate	$26,427
		Margin of Error +/-	1,538
Project Area 1-mile Burlington North	Per Capita Income	Estimate	$21,076
		Margin of Error +/-	***
Source: American Community Survey 5-year Estimates, 2013-2017			

6 Limited English Proficiency (LEP)

Per the Safe Harbor Guidelines, should an LEP Group be identified during the permit application process, written translations of vital documents for each eligible LEP language group that constitutes five percent or includes 1,000 members (whichever is less) of the population of persons eligible to be served or likely to be affected or encountered. If there are fewer than 50 persons in a language group that reaches the five percent trigger, then DEQ will not translate vital written materials, but instead will provide written notice in the primary language of the LEP language group of the right to receive competent oral interpretation of those written materials, free of cost. The safe harbor provisions apply to the translation of written documents only. Safe harbor guidelines are per the EPA guidance for LEP persons and implemented by DEQ when deemed appropriate.

Seven potential LEP language groups were identified during this initial screening of demographic data (Table 18). However, none of the language groups identified in this screening reached the

5% threshold. If larger LEP groups are identified during the site visit or specific translation requests are received, then DEQ will revisit the Safe Harbor Guidelines.

Table 17. Limited English Proficiency

Language Spoken at Home	Census Tract 9306, Caswell County		Census Tract 213, Alamance County	
	Estimate	**Margin of Error**	**Estimate**	**Margin of Error**
Total:	4,576	+/-420	5,720	+/-287
Speak only English	4,536	+/-407	5,301	+/-251
Spanish or Spanish Creole:	40	+/-59	330	+/-99
Speak English "very well"	14	+/-22	237	+/-75
Speak English less than "very well"	26	+/-56	93	+/-44
German:	0	+/-12	47	+/-51
Speak English "very well"	0	+/-12	17	+/-18
Speak English less than "very well"	0	+/-12	30	+/-34
Vietnamese:	0	+/-12	7	+/-8
Speak English "very well"	0	+/-12	3	+/-4
Speak English less than "very well"	0	+/-12	4	+/-5
Tagalog:	0	+/-12	11	+/-11
Speak English "very well"	0	+/-12	8	+/-10
Speak English less than "very well"	0	+/-12	3	+/-6
Source: American Community Survey 5-year Estimates, 2011-2015				

7 County Health

The University of Wisconsin Population Health Institute, in collaboration with the Robert Wood Johnson Foundation, calculated a County Health Rankings system for all the States in the United States (www.countyhealthrankings.org).This ranking is based on health outcomes (such as lifespan and self-reported health status) and health factors (such as environmental, social and economic conditions). According to this 2021 report, out of all 100 counties in North Carolina (with 1 indicating the healthiest), Caswell County ranks 73rd in health factors and 78th in health outcomes. Alamance County ranks 46th in health factors and 38th in health outcomes (Figure 3).

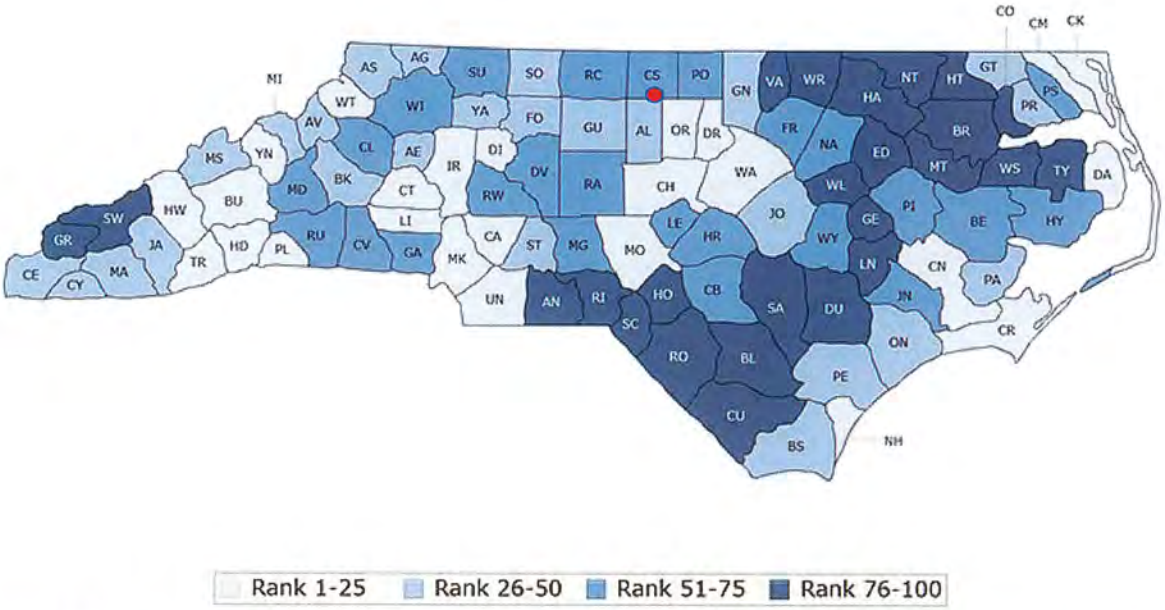

Figure 3. County Health Rankings for Health Factors in North Carolina provided by University of Wisconsin Public Health Institute.

According to the NC DEQ Community Mapping System Environmental Justice Tool, Table 19 demonstrates the rates of death due to various causes in the counties surrounding the proposed facility, as compared to the state.

Table 18. Health Outcomes

Cause of Death	Caswell	Alamance	North Carolina
Cancer	198.7	175.1	169.1
Heart Disease	169.6	164.2	163.7
Stroke	37.6	41.8	43.1
Cardiovascular Disease	218.8	223.7	221.9
Diabetes	27.9	22.9	22.8
Source: NCDEQ 2020 EJ Tool			

8 Local Sensitive Receptors

The Environmental Protection Agency suggests that sensitive receptors include, but are not limited to, hospitals, schools, daycare facilities, elderly housing, and convalescent facilities. These are areas where the occupants are more susceptible to the adverse effects of exposure to toxic chemicals, pesticides, and other pollutants. Extra care must be taken when dealing with contaminants and pollutants in close proximity to areas recognized as sensitive receptors. For instance, children and the elderly may have a higher risk of developing asthma from elevated levels of certain air pollutants than a healthy individual aged between 18 and 64.

Within the one-mile project radius from the Burlington North facility, the following potential sensitive receptors were identified (Figure 4):

- Bethel United Church of Christ
- Living Home Church

Additional sensitive receptors may be identified during the permit application process, such as during the field reconnaissance visit or through public comment.

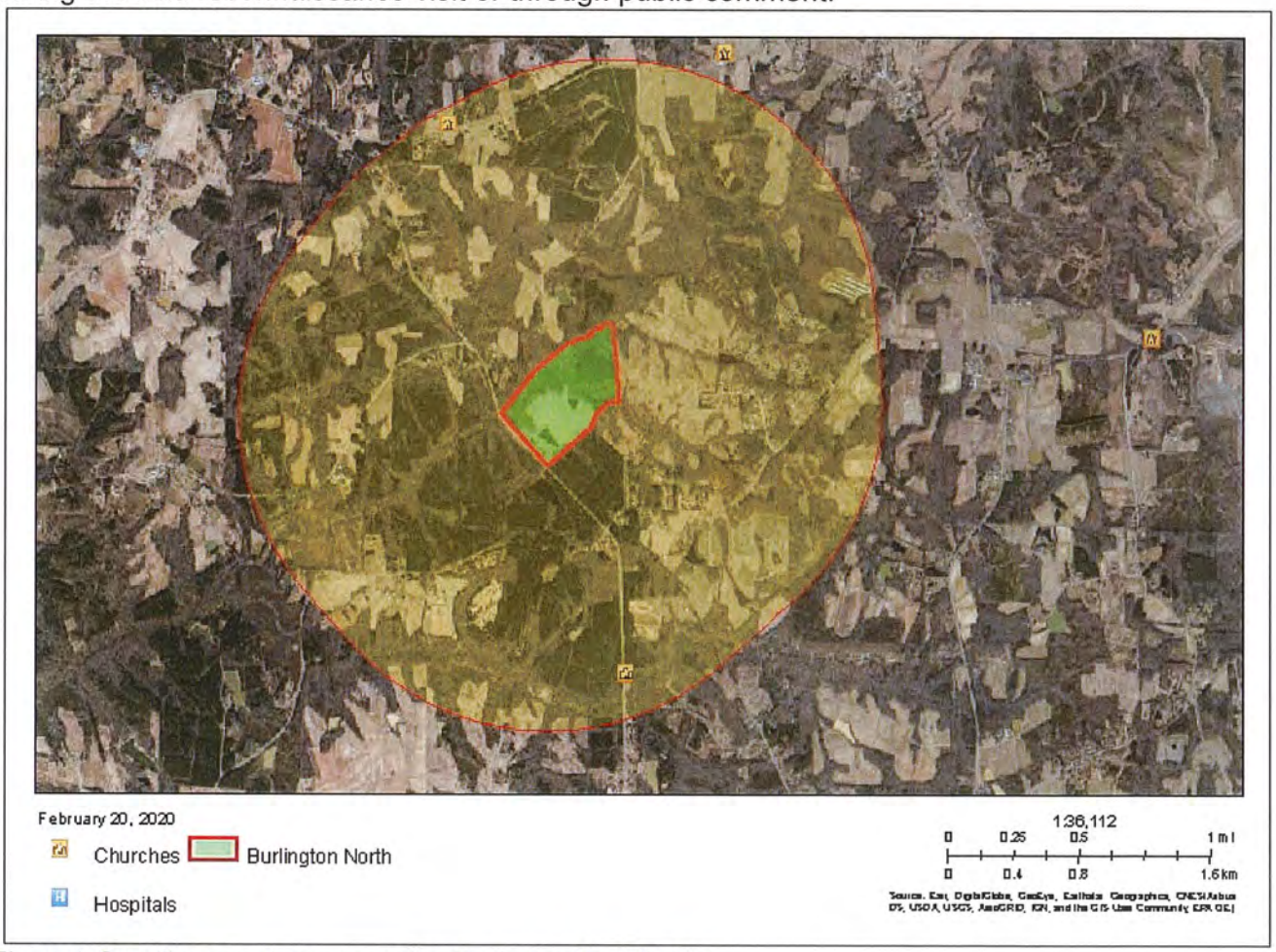

Figure 4. Sensitive receptors surrounding Burlington North facility

9 Local Industrial Sites

Within the one-mile radius, there are no other[2] facility permits or incident reports (as of August 4, 2021) (Figure 5).

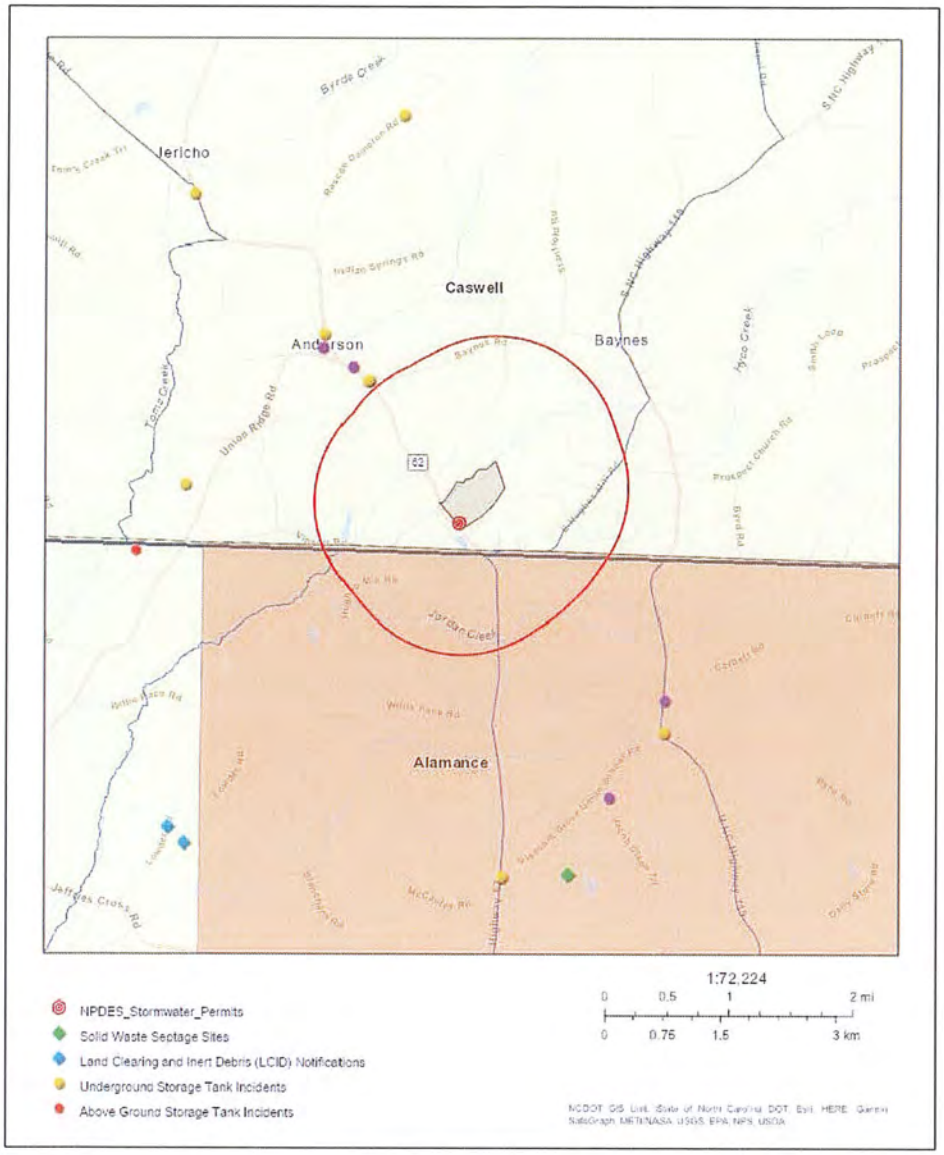

Figure 5. Permitted facilities and incidents with the one-mile radius surrounding the Burlington North facility.

[2] There is one NPDES Permit belonging to the facility itself. Just outside the one-mile radius of the Burlington North facility, are several Underground Storage Tank Facilities and reported past incidents.

10 Conclusion

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (US EPA). This report examined the demographic and environmental conditions in the state of North Carolina, Caswell, and Alamance counties, census tracts 213 and 9306, and the one-mile radius around the Carolina Sunrock LLC, Burlington North Facility. Potential emissions rates outlined in the permit application and county level health data were also included, as well as data from the NCDEQ Community Mapping System.

It is important to keep in mind that based on the available data, the following limitations of this report: census data is from 2010 and may be outdated; the more recent census data through 2017 are estimates; EJSCREEN does not provide all of the data categories that were used in this analysis so the census tracts data and county data cannot be compared to the radius used surrounding the facility boundary for all criteria; census tracts can still be large areas and do not allow for exact locations of each population; some of the census tracts slightly overlap with the one-mile radius; and the Department cannot determine which populations may be located in that small amount of overlap around the facility.

The census tracts and the one-mile radius surrounding the Burlington North facility display slightly higher percentages of Black or African American populations. However, the census tract data for the census tracts surrounding the Burlington North facility differ significantly from state and county estimates, as well as from the census tract and radius data for African American populations. The surrounding census tracts display a population of individuals over 65 years old that is higher than the state average.

Census Tract 9306 that encompasses the facility displays overall poverty estimates that are greater than 10% different than the state and the county. Both census tracts have the largest population within the $50,000 to $74,900 range for household income. The project radius estimates have the largest population falling in the $75,000+ income bracket. Both census tracts display a per capita income lower than the state, and slightly lower than the counties. The Burlington North facility displays a Per Capita Income level moderately lower than the state.

Caswell County ranks 71th in health factors and 64th in health outcomes, and Alamance County ranks 53rd in health factors and 33rd in health outcomes. There were no permitted facilities or incidents within one mile from the proposed facility.

Based on this Draft EJ Report, the following outreach will be conducted:

- The Occaneechi Band of the Saponi Nation will be kept informed throughout the permitting process.
- Extra attention will be given to ensure language data is accurate and that translation or interpretation will be considered if more LEP populations are identified at any point throughout the process.
- The list of sensitive receptors will be consulted while considering additional outreach options that may best fit this community's needs.
- Known community leaders will be consulted.

Attendance	Event ID	Event Name	User Type	FirstName	LastName	Email	Invited	Regi	Atten	Join Time	Leave Time	Attendance	Client Agent
1	201630432	Carolina Sunrock LLC - Burlingt	Panelist	Zaynab	Nasif	zaynab.nasif@ncdenr.gov	Yes	No	Yes	5:33 pm Ne	7:18 pm Ne	105.0 mins	WINDOWS,IE
2	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Andrew	Kormos	andrew.kormos@ncdenr.gov	No	No	Yes	5:54 pm Ne	7:18 pm Ne	84.0 mins	MAC,Chrome
3	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Scott	Martino	smartino@thesunrockgroup.com	No	No	Yes	5:57 pm Ne	7:18 pm Ne	81.0 mins	WINDOWS,IE
4	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Daisha	Williams	daisha@cleanairenc.org	No	No	Yes	6:01 pm Ne	7:18 pm Ne	76.0 mins	MAC,Chrome
5	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Aimee	Andrews	aandrews@trinityconsultants.com	No	No	Yes	5:52 pm Ne	7:18 pm Ne	86.0 mins	WINDOWS,IE
6	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Phil	Barfield	cambarus.davidi@gmail.com	No	No	Yes	5:53 pm Ne	7:18 pm Ne	85.0 mins	WINDOWS,IE
7	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Senator	Mike Wooc	mike@mikewoodard.com	No	No	Yes	5:55 pm Ne	6:44 pm Ne	48.0 mins	MAC,Chrome
8	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Mark	Barker	mebarker@cox.net	No	No	Yes	5:55 pm Ne	7:18 pm Ne	82.0 mins	WINDOWS,IE
9	201630432	Carolina Sunrock LLC - Burlingt	Attendee	michael	Pjetraj	michael.pjetraj@ncdenr.gov	No	No	Yes	5:40 pm Ne	7:18 pm Ne	98.0 mins	WINDOWS,Chrome
10	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Galen	Boerema	gboerema@thesunrockgroup.com	No	No	Yes	5:54 pm Ne	7:18 pm Ne	84.0 mins	WINDOWS,PT
11	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Sharon	Vinson	marchhare313@bellsouth.net	No	No	Yes	5:59 pm Ne	7:18 pm Ne	79.0 mins	MAC,IE
12	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Brian	Holtzclaw	holtzclaw.brian@epa.gov	No	No	Yes	7:00 pm Ne	7:18 pm Ne	18.0 mins	WINDOWS,Chrome
13	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Lisa	Sorg	lisa@ncpolicywatch.com	No	No	Yes	6:00 pm Ne	7:18 pm Ne	78.0 mins	MAC,Safari
14	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Tracy	Davis	tracy.davis@atsenvirosolutions.com	No	No	Yes	6:07 pm Ne	7:18 pm Ne	70.0 mins	WINDOWS,IE
15	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Dylan	Wright	dylan.wright@ncdenr.gov	No	No	Yes	5:32 pm Ne	7:19 pm Ne	107.0 mins	WINDOWS,Chrome
16	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Estelle	Bae	bae.estelle@epa.gov	No	No	Yes	5:59 pm Ne	7:18 pm Ne	79.0 mins	WINDOWS,Chrome
17	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Pat	WARREN	patwarren9@gmail.com	No	No	Yes	5:49 pm Ne	7:18 pm Ne	89.0 mins	WINDOWS,Chrome
18	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Jon	Hill	jhill@trinityconsultants.com	No	No	Yes	5:50 pm Ne	7:18 pm Ne	87.0 mins	WINDOWS,Chrome
19	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Terry	Johnson	johnson.terry@epa.gov	No	No	Yes	6:05 pm Ne	7:18 pm Ne	73.0 mins	MAC,IE
20	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Davis	Murphy	davis.murphy@ncdenr.gov	No	No	Yes	5:57 pm Ne	7:18 pm Ne	81.0 mins	WINDOWS,IE
21	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Daphne	Quinn	dapbro@gmail.com	No	No	Yes	6:28 pm Ne	7:18 pm Ne	50.0 mins	MAC,Firefox
22	201630432	Carolina Sunrock LLC - Burlingt	Attendee	sharon	guy	guycookn@gmail.com	No	No	Yes	6:33 pm Ne	7:18 pm Ne	44.0 mins	WINDOWS,IE
23	201630432	Carolina Sunrock LLC - Burlingt	Attendee		karen	tategrk@bellsouth.net	No	No	Yes	5:51 pm Ne	7:18 pm Ne	87.0 mins	IPHONE,Standalone Ap
24	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Evangeline	Gaudette	evangeline_vinson@yahoo.com	No	No	Yes	5:54 pm Ne	6:59 pm Ne	65.0 mins	MAC,Safari
25	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Evangeline	Gaudette	evangeline_vinson@yahoo.com	No	No	Yes	7:03 pm Ne	7:18 pm Ne	15.0 mins	MAC,Safari
26	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Leo	Governale	leo.governale@ncdenr.gov	No	No	Yes	5:28 pm Ne	7:19 pm Ne	111.0 mins	WINDOWS,Chrome
27	201630432	Carolina Sunrock LLC - Burlingt	Attendee	leslie	zimmermai	lesliezimmerman1@gmail.com	No	No	Yes	5:58 pm Ne	6:47 pm Ne	49.0 mins	MAC,Chrome
28	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Donna	Nicholais	dnicholais@gmail.com	No	No	Yes	5:48 pm Ne	7:18 pm Ne	90.0 mins	MAC,Safari
29	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Cornelius	Jones	cnjones57@yahoo.com	No	No	Yes	5:59 pm Ne	7:18 pm Ne	79.0 mins	WEB BASED THIN CLIEI
30	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Graig	Meyer	graig.meyer@ncleg.net	No	No	Yes	6:00 pm Ne	7:17 pm Ne	77.0 mins	IPHONE,Standalone Ap
31	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Ed	Dougherty	ed@treeiflifedesugns.com	No	No	Yes	7:04 pm Ne	7:18 pm Ne	14.0 mins	IPHONE,Standalone Ap
32	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Michael	Koerschner	michael.koerschner@ncdenr.gov	No	No	Yes	5:33 pm Ne	7:19 pm Ne	106.0 mins	WINDOWS,Chrome
33	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Brendan	Davey	brendan.davey@ncdenr.gov	No	No	Yes	5:34 pm Ne	7:19 pm Ne	105.0 mins	WINDOWS,Chrome
34	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Dale	Overcash	dovercash@trinityconsultants.com	No	No	Yes	5:57 pm Ne	7:18 pm Ne	81.0 mins	WINDOWS,IE
35	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Renee	Kramer	renee.kramer@ncdenr.gov	No	No	Yes	6:01 pm Ne	7:16 pm Ne	75.0 mins	IPHONE,Standalone Ap
36	201630432	Carolina Sunrock LLC - Burlingt	Attendee	Ray	Stewart	ray.stewart@ncdenr.gov	No	No	Yes	5:32 pm Ne	7:19 pm Ne	106.0 mins	WINDOWS,IE
37	201630432	Carolina Sunrock LLC - Burlingt	Attendee	jim	Hafner	jim.hafner@ncdenr.gov	No	No	Yes	6:02 pm Ne	7:18 pm Ne	76.0 mins	WINDOWS,IE
38	201630432	Carolina Sunrock LLC - Burlingt	Attendee		Oakley	scottoakley@att.net	No	No	Yes	6:08 pm Ne	7:17 pm Ne	68.0 mins	Android,Standalone Ap