BOARD COMMUNICATIONS – AUGUST 05, 2022

TO: Members of the Board of Education
FROM: Superintendent, Robert G. Nelson, Ed.D.

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Fresno Unified School District
Board Communication

BC Number S-1

From the Office of the Superintendent
To the Members of the Board of Education
Prepared by: Robert G. Nelson, Superintendent
Cabinet Approval:

Date: August 05, 2022

Phone Number: 457-3884

Regarding: Superintendent Calendar Highlights

The purpose of this communication is to inform the Board of notable calendar items:

- Attended the Tatarian Steering Committee Meeting
- Met with Executive Cabinet
- Participated in call with Fresno County Superintendents
- Attended the Foundation for Fresno Unified Schools Board Meeting
- Held press conference regarding Back to School
- Spoke at the Principals Institute
- Attended the Fresno Unified Family Goal Kickoff Event
- Spoke at the New Teacher Conference

Approved by Superintendent
Robert G. Nelson Ed.D. _____ Date: August 05, 2022

Fresno Unified School District
Board Communication

BC Number BFS-1

From the Office of the Superintendent
To the Members of the Board of Education
Prepared by: Kim Kelstrom, Executive Officer
Cabinet Approval:

Date: August 05, 2022

Phone Number: 457-3907

Regarding: School Services Weekly Update Reports for July 28, 2022

The purpose of this board communication is to provide the Board a copy of School Services of California's (SSC) Weekly Updates. Each week SSC provides an update and commentary on different educational fiscal issues. In addition, they include different articles related to education issues. The SSC Weekly Updates for July 28, 2022 is attached and includes the following articles:

- Inflation Beginning to Affect State Revenues – July 26, 2022
- Deep Divisions, Further Delay for California's Math Guidelines – July 26, 2022
- Study: Pandemic-Era Suspension Rate Drops May be Misleading – July 26, 2022

If you have any questions pertaining to the information in this communication, or require additional information, please contact Kim Kelstrom at 457-3907.

Approved by Superintendent
Robert G. Nelson Ed.D. _____ Date: August 05, 2022

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DATE: July 28, 2022

TO: Robert G. Nelson
Superintendent

AT: Fresno Unified School District

FROM: Your SSC Governmental Relations Team

RE: ***SSC's Sacramento Weekly Update***

Legislature to Return From Summer Recess on Monday

The Legislature will officially return from its month-long summer recess this Monday, August 1, 2022, and thus will begin the sprint to the end of the 2021-22 legislative session where the fate of hundreds of measures will be decided. By August 31, 2022, bills will need to have passed the final two hurdles before being sent to Governor Gavin Newsom for his consideration: the Appropriations Committee and concluding floor votes by the entire Legislature.

Several hundred bills are scheduled to be heard in the Assembly and Senate Appropriations Committees over the next two weeks. Most of these bills will go directly to the respective committee's suspense file. The suspense file is a sort of legislative purgatory, where measures that are deemed to have a fiscal impact of a certain magnitude are placed until all those measures can be dealt with at once. In many cases, bills that go to the committee's suspense file never come off and are effectively killed without legislators having to cast a vote. Bills have until Friday, August 12, 2022, to pass the Appropriations Committees and proceed to the house floors. We suspect that both the Assembly and Senate Appropriations Committees will hold their suspense file hearings on Thursday, August 11, 2022, so that members can be in their districts on Friday.

Some of the more significant bills with implications for local educational agencies (LEAs) that are still active and need to clear the Appropriations Committee, include:

- Assembly Bill (AB) 1655 (Jones-Sawyer, D-South Los Angeles) would establish June 19, known as "Juneteenth," as a state holiday and require public K-12 schools and community colleges to close on June 19

- AB 1797 (Weber, D-San Diego) would, until January 1, 2026, authorize schools, if their LEA has adopted a local policy mandating COVID-19 immunization for school attendance, to access the California Immunization Registry to determine the COVID-19 immunization status of students

- AB 1973 (McCarty, D-Sacramento) would require a school district or charter school that has an unduplicated pupil percentage of at least 50% to offer at least one full-day kindergarten class at each school site beginning with the 2027-28 school year and would extend this requirement to all school districts and charter schools beginning with the 2030-31 school year (this requirement would not apply to transitional kindergarten)

- AB 2375 (Rivas, L., D-Arleta) would require all LEAs to administer a housing questionnaire, which identifies the homeless and unaccompanied youths at their schools, by the end of the 2021-22 school year

- AB 2774 (Weber) would, beginning with the 2023-24 school year, expand the definition of unduplicated pupil for Local Control Funding Formula purposes to include pupils who are classified as a member of the lowest performing subgroups based on the most recently available Smarter Balanced Summative Assessments for English language arts and mathematics

- Senate Bill (SB) 878 (Skinner, D-Berkeley) was originally a bill that would have mandated home-to-school transportation, but the bill now largely mirrors the transportation provisions included in the 2022-23 Enacted Budget, except for establishing new requirements for drivers

- SB 1016 (Portantino, D-La Cañada Flintridge) would require the State Board of Education to include "fetal alcohol spectrum disorder" under the definition of "other health impairment" for the purpose of special education eligibility

- SB 1479 (Pan, D-Sacramento) would require each LEA to create a COVID-19 testing plan that is consistent with guidance from the California Department of Public Health

- SB 1144 (Wiener, D-San Francisco) would require public schools and state agencies to complete a water efficiency and quality assessment report on their facilities, including testing for lead, Legionella, and other contaminants and would require the operating agency to remedy the problem at the earliest practical time should the report identify noncompliant plumbing fixtures and appliances or contaminants

The California Constitution states that no bill can be approved by either house on or after September 1, except for measures that are included in a special session called by the governor, statutes calling for elections, bills that levy taxes or appropriations, urgency measures, and bills vetoed by the governor. Considering that none of the bills above fit this exception, then they will need to clear the Legislature by midnight of August 31, 2022.

Leilani Aguinaldo

Inflation Beginning to Affect State Revenues

By Patti F. Herrera, EdD, and Anjanette Pelletier
School Services of California Inc.'s *Fiscal Report*
July 26, 2022

In its latest state revenue update through the 2021-22 fiscal year, the Department of Finance (DOF) indicates that larger national and state economic challenges are beginning to impact state General Fund revenues. It appears that, along with supply chain issues, efforts to tame skyrocketing headline inflation are slowing economic production and the residential real estate market.

In June 2022, U.S. headline inflation rose to 9.1%—a 40-year high and the fastest pace since November 1981. Increased costs were fueled (pun intended) by rising prices at the pump, as well as increased costs for shelter and food. Excluding increases in food and energy, which are the more volatile goods in the basket that comprises headline inflation, brings the U.S. core inflation measure to 5.9%—down from May 2022 but up on a year-over-year basis. By comparison, California headline inflation was 7.7% year-over-year as of April 2022.

The U.S. and California economies contracted in the first quarter of 2022, as measured by gross domestic product (GDP). National GDP decreased by 1.6% while California's productivity declined by 1.0%, following a 6.9% and 9.5% increase, respectively, in the last quarter of 2021.

Rising consumer costs and increased interest rates are also beginning to affect the housing market. The DOF reports that year-to-date single- and multi-housing building permits are down from April 2022. The median price of single-family homes in California decreased 4.0% (to $863,790) from May 2022 but is still up 5.4% on a year-over-year basis. Sales of single-family homes in June 2022 were down on a monthly and year-over-year basis by8.4% and 20.9%, respectively.

The single steady economic bright spot continues to be employment. According to the DOF, the U.S. has almost completely recovered from job losses experienced at the start of the COVID-19 pandemic, and unemployment remains at 3.6% in June 2022. Additionally, ten of eleven U.S. industry sectors added jobs with only the government sector losing 9,000 jobs. This good news, however, is insufficient to mitigate the downward economic pressures of inflation and slowing GDP on state revenues.

Relative to the 2022 Budget Act projections, revenues for the 2021-22 fiscal year were down $2.18 billion with June 2022 revenues below forecast by $2.40 billion. While the smaller two contributors to the "Big Three" taxes were above the annual forecast, personal income tax receipts were below 2021-22 annual projections by $4.47 billion with June withholding and cash receipts coming in below estimates.

2021-22 State General Fund Revenues
(Dollars in Millions)

	June 2022			2021-22 Year-to-Date		
	Forecast	**Actual**	**Difference**	**Forecast**	**Actual**	**Difference**
Personal Income Tax	$16,939	$13,595	-$3,344	$148,428	$143,959	-$4,469
Sales and Use Tax	$3,563	$3,464	-$99	$33,440	$33,816	$376
Corporation Tax	$10,771	$10,625	-$146	$45,612	$46,058	$446

Note: The State Board of Education has pushed back the adoption of the California Math Framework to sometime in 2023 due to the hundreds of suggested changes and critiques that have been lobbed in response to the current framework draft.

Deep Divisions, Further Delay for California's Math Guidelines

By John Fensterwald
EdSurce
July 26, 2022

The debate that continues to simmer over California's new math guidelines is a reminder that divisions remain deep over approaches to instruction, the pacing of algebra in middle school and the offerings at high school, particularly for students interested in STEM in college.

The State Board of Education has pushed back the adoption of the California Math Framework to sometime in 2023, an indication that it is taking seriously hundreds of suggested changes and critiques and that potentially extensive changes may be coming.

At the heart of the issue is a disagreement over how best to motivate and raise the math success of underperforming students, including Black students, Latino students and English learners.

Similar to frameworks in English language arts and science, the math framework is intended to offer guidance on translating state standards — the Common Core — to the classroom. A framework is not a mandate; districts can pick or reject whatever suggested lessons, tactics or strategies work for them.

But it is important, not only to publishers, who will base textbooks on it, but also for teachers, superintendents and education advocates. California students lag behind the nation in math, scoring in the bottom fourth of states in fourth grade and bottom third in eighth grade in the National Assessment of Educational Progress.

Only 34% of students overall, 18% of African American students and 20% of Latino students met or exceeded standards on the state's 2019 Smarter Balanced standardized test in math, the last time that all students took it until this past spring. Those results aren't out yet.

Teachers haven't had a framework since 2013, and that one was done after the adoption of Common Core; its purpose was to explain and prioritize the standards. Teachers have been eager for guidance on how to make math more engaging, fun and relevant to students and expressed that in focus groups, said Ma Bernadette Andres-Salgarino, assistant director for integrated STEM development at the Santa Clara County Office of Education and president-elect of the California Mathematics Council.

"They wanted a focus on habits of mind, and a huge component of that is to ensure we have equitable participation from people of color," she said.

In the introductory chapter, the framework explicitly says it is designed to respond to structural barriers that impede math success: "Equity influences all aspects of this document."

Despite criticism, the framework continues to resonate with classroom teachers who participated in the framework process and with advocacy groups for low-income children. "We believe that the guidance in this

Framework, if effectively implemented, has the potential to transform mathematics instruction to ensure that all students have equitable access to rigorous and relevant coursework," said a letter from two dozen organizations, including Children Now, the California Mathematics Project and Californians Together, that advocate for English learners.

Critics, unmollified by changes so far, continue to argue that the framework pushes social justice over rigor — a charge the drafters of the document deny — and that its policies, if implemented, will ultimately set back many of the students it's intended to help.

"We fully agree that mathematics education should not be a gatekeeper but a launchpad," said a letter signed by more than 1,700 science, technology, engineering and math educators or professionals from California and elsewhere. "However, we are deeply concerned about the unintended consequences of recent well-intentioned approaches to reform mathematics education, particularly the California Mathematics Framework."

Failure of the status quo

The framework stated that a different approach is needed because traditional math instruction turned off many students by stressing rote memorization of "meaningless formulas" and procedures; along with being boring, it was disconnected from students' lives and experiences.

Instead, math should build positive math mindsets among all students, but especially for students of color who have become convinced they're not capable of doing well. Teachers should stress problem-solving and inquiry, the framework said. "Mathematics learning, understanding, and enjoyment comes when students are actively engaged with mathematical concepts — when they are developing mathematical curiosity, asking their own questions, reasoning with others and encountering mathematical ideas in multi-dimensional ways," according to the framework.

Departing from a traditional approach, the framework discourages lessons based on individual Common Core standards, including the priority standards identified in the first framework. Instead, teachers should create more complex tasks around "big ideas" that involve clusters of standards and make connections across grades between concepts like number sense and probability to give students a bigger picture.

"The value of focusing on big ideas for teachers, and their students, cannot be overstated," the framework said.

Writers of the framework and proponents like Andres-Salgarino acknowledge the framework will require teachers to teach differently. "Creating such classroom experiences is not easy," the framework said. Extensive training will be needed, she said.

Kyndall Brown, executive director of the California Mathematics Project Statewide Office, which is affiliated with the University of California, and a proponent of the framework, agrees. Teaching a conceptual understanding of math will require discussion and take more class time at the beginning of the year, as teachers "are trying to retrain students to problem-solve on their own," he said. "But once they get used to that way of thinking, then you actually get through more of the curriculum. It's like going slow to go fast."

Katherine Stevenson, a math professor at California State University, Northridge, who has worked with teachers in Los Angeles Unified, said, "It's very hard for teachers not to get lost in skills and practices that are very concrete, so I applaud the big ideas." But, she said, preparing lesson plans and classroom tasks will require an intense amount of preparation and continuous training. "If you look at the framework as an aspirational document, I am OK with it, but I have real concerns as an actionable document."

Misstated or misunderstood research

Brian Lindaman, faculty co-director of the Center for Science and Mathematics Instruction at California State University, Chico, chaired the five-person committee that drafted the framework, but the writer most identified with the framework and whose prolific writing is most often referenced in it is Jo Boaler. Boaler is a professor of mathematics education at the Stanford Graduate School of Education.

The most prolific and one of the strongest critics of the framework is a colleague at Stanford, Brian Conrad, a professor of mathematics and director of undergraduate studies in math. Conrad said he agrees that math is often poorly taught and needs to be improved. But he faults the framework's solutions as simplistic, oversold and not grounded in research.

Conrad said he spent spring break reading not only the framework but also many of the sources in footnotes on which the authors justified their recommendations. "To my astonishment, in essentially all cases, the papers were seriously misrepresented" and in some cases "even had conclusions opposite to what was said" in the framework. The misrepresentations of the neuroscience of math comprehension, de-tracking in favor of heterogeneous student grouping, the use of assessments and acceleration call into question the recommendations. Writers, he said, "should not be citing papers they do not understand to justify their public policy recommendations" fitting their perspectives.

The first version had called for districts to discourage students from accelerating to take Algebra I in middle school; a more equitable approach, it indicated, would be to require all students to take the course in ninth grade. That, however, would force students to take extra courses, summer school or compressed courses to get to calculus by senior year. After a big pushback from the STEM community and parents of high-achieving students, Conrad said, the writers have left it to others to recommend how courses could be consolidated to accommodate students forced to squeeze in extra math.

Alternative high school pathways

The chapters on high school math provoked the most comments, anger and division; it is also an area with the potential, with more work and needed clarity, for a resolution, said Stevenson.

A high school diploma in California requires two years of math. Admission to California State University and the University of California requires three, usually Algebra I, Geometry and Algebra II, either in a traditional sequence or an integrated sequence that blends content from the three. And for students interested in science and math majors, UC and CSU recommend at least precalculus, if not calculus.

For too long, the pathway to calculus for a competitive college has been the only option, proponents argued. "It doesn't matter if you're going to be a theater, journalism or arts major, students feel pressure to put it on their transcript," said Brown.

And yet, he said calculus isn't offered in many high-poverty schools, and in schools that do offer it, "they put so many barriers in place that the many students of color who attend those schools never get access to it."

Seeing no relevance to their lives from calculus and no other options besides AP statistics, many students take no math in their senior year, which is a lost opportunity, Brown said.

The framework encourages alternative senior year courses, such as modeling or quantitative reasoning, which CSU campuses designed with state funding. It suggests a third pathway in addition to traditional and integrated math, called Mathematics: Investigating and Connecting, although it is vague on details. And it includes a lengthy chapter on data science in K-12, including design principles for a high school course.

"I like the emphasis on data science. It's important for students to have a really good understanding of data, and it is a viable career field," Brown said.

STEM professors and professionals say that Black and Latino students are already under-represented in quantitative majors; the framework, by proposing alternative pathways and data courses that avoid Algebra II and courses preparing students for calculus, would make that worse.

"Students who take a data science course as an alternative to Algebra II in high school will be substantially underprepared for any STEM major in college, including data science, computer science, statistics, and engineering. Such students will need remedial math classes in college before they can even begin such majors, putting them at a considerable disadvantage," stated a letter signed by more than 400 academic staff at California universities.

Conrad said that the framework conflates data literacy, an essential skill that can be taught in many courses, and data science, which requires advanced math as a career pursuit. And he objects to a "bias" toward data science in the framework with language that implies that it offers a more interesting and equitable career. All fields of math can be taught well or badly," Conrad wrote. "All educators should object to the notion that students of color or girls cannot excel in mathematical fields other than data science."

Stevenson said she wished the framework had not used the term data science, an evolving academic discipline that uses linear algebra, calculus, statistics and computer science to analyze large data sets. "If you start saying to K-12 kids 'You are in the data science track' but when they get to UC they cannot make that jump, you are creating a second-class pathway and have actually created what you are trying to eliminate; you just gave it a different name."

Conrad and others urge the state board to eliminate the proposed Mathematics: Investigating and Connecting high school pathway and to rewrite the data science chapter from scratch by a group of "disinterested content experts" from industry and colleges along with high school teachers.

Stevenson suggested that creatively redesigning some math courses could offer a middle ground that leads to post-graduation options, not dead-ends. Examples could be a three-year integrated pathway that blends statistics or a two-year course in statistics after the first two years of high school math that combines Algebra II.

"There could be consensus around that," she said.

Freed from a looming deadline, the state board and the California Department of Education have the time to look at these and other alternatives that could temper the debate and do right for students.

Note: Many school districts were on track to have substantially higher rates of suspensions showing racial disparities during the 2019-20 school year had the coronavirus pandemic not forced schools to go remote, according to a new study.

Study: Pandemic-Era Suspension Rate Drops May Be Misleading

Suspension rates in California would have been substantially higher in 2019-20 for certain student populations had COVID-19 not disrupted the school year.

By Kara Arundel
K-12DIVE
July 26, 2022

Many California school districts were on track to have substantially higher rates of suspensions showing racial disparities during the 2019-20 school year had the coronavirus pandemic not forced schools to go remote, according to a study released Tuesday by the Center for Civil Rights Remedies at the UCLA Civil Rights Project.

COVID-19's abrupt arrival in early 2020 caused schools across the nation to move to virtual learning, and as a result suspension rates fell for the remainder of that school year.

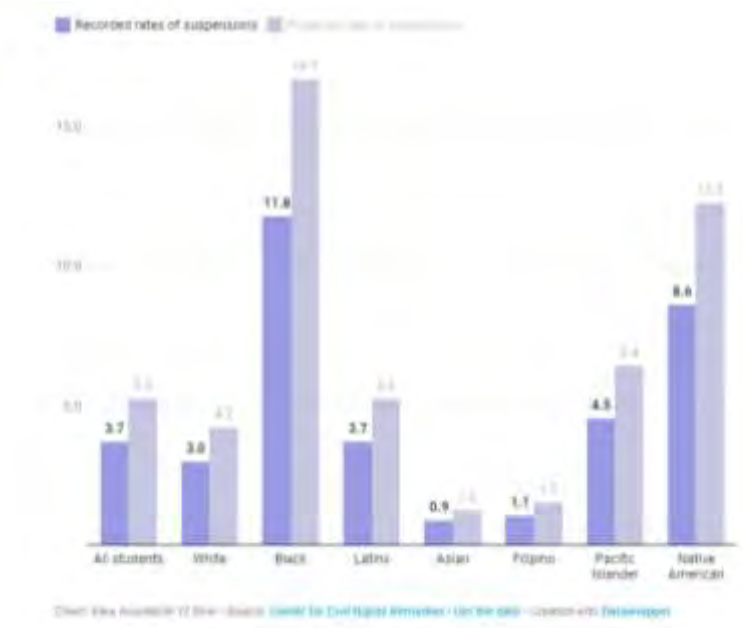
In California, that translated to a 34% drop in K-12 suspension rates, from 354,516 in 2018-19 to 233,753 in 2019-20, the study said. But had the pandemic not intervened, suspensions would have hit an estimated 330,304 in 2019-20, which at a 6.8% drop would still have been lower than the actual recorded suspensions in 2018-19.

This report uses the recorded suspensions that took place in the first 70% of the 2019-2020 school year. To arrive at the projected rate, researchers calculated the rate of suspensions per 100 students had they continued at the same rate in the final 30% of the year. The report includes statewide data, as well as district-level data for systems with more than 500 students, said Daniel Losen, the center's director.

For example, the recorded suspension rate for Black students in 2019-20 was 11.78 per 100 students. The projected suspension rate for Black students, however, hit 16.70 per 100, Losen said. Researchers found larger racial disparities for those suspended had the pandemic not occurred.

California rates of suspension per 100 students in 2019-20

The projected rates of suspension show increased levels of racial disparities for certain student populations.



Schools "still have very serious problems with how they're responding to kids' misconduct," Losen said. But "if you looked at your discipline data, it would be easy to overlook."

Furthermore, continued disruptions to in-person learning during the 2020-21 school year resulted in most districts in the state reporting no in-school or out-of-school suspensions , the study said. California discipline data for the 2021-22 school year will not be available until later this year.

Comparing the raw data to include when school campuses were shut down shows an incomplete picture of discipline trends in California by creating a false impression that disproportionate discipline has decreased, Losen said.

Without the full analysis of discipline trends, districts may miss opportunities to improve school climates and allocate staff resources to respond to student misconduct, he said. Efforts to reduce disproportionality are especially needed now, as anecdotal evidence points to increased challenging behaviors in schools, and as schools struggle with staff shortages, Losen said.

The report notes the state had acted before the pandemic to reduce exclusionary and disproportionate discipline. For example, California was the only state to include high suspension rates as a key indicator in its statewide system of school and district accountability. That accountability system, however, was paused during the pandemic, according to the Center for Civil Rights Remedies report.

Moreover, the state legislature has taken action to reduce suspensions, including amending the school code of conduct to prohibit them as a disciplinary response to minor disruptive or disobedient conduct in K-8.

The report also raises concerns about inaccuracies and under-reporting on using police to address school discipline.

School-generated reports from the 2017-18 school year show students with disabilities were twice as likely to be referred to law enforcement. Law enforcement data collected by police for reporting to the district attorney's office, however, show students without disabilities are more than three times as likely to be stopped by police than students with disabilities.

Nationally, school suspensions for secondary students had been declining in the years leading up to the pandemic. According to a survey by the National Center for Education Statistics, 14.4% of students in grades 6-12 in 2019 reported having been suspended, compared to 19.6% in 2012.

Some school districts are making efforts to decrease or eliminate exclusionary discipline. Dallas Independent School District in Texas, for instance, has eliminated most traditional in-school and out-of-school suspensions by creating a Reset Center classroom at each comprehensive middle and high school.

Fresno Unified School District
Board Communication

BC Number BFS-2

From the Office of the Superintendent
To the Members of the Board of Education
Prepared by: Kim Kelstrom, Executive Officer
Cabinet Approval:

Date: August 05, 2022

Phone Number: 457-3907

Regarding: Medi-Cal Administrative Activity Program

The purpose of this board communication is to provide the Board information regarding the reimbursements from the Medi-Cal Administrative Activity Program (MAA).

The district recently received $680,777 in MAA reimbursements from 2019/20 fourth quarter claims and $570,403 in MAA reimbursements from 2020/21 first quarter claims. As mentioned in previous board communications and budget revisions, the California Department of Health Care Services held back reimbursement funds. After several years of uncertainty, invoices are now being processed.

In December 2016, the State released a new claims method for submission of reimbursements beginning with January 2015. The district is working with the Madera County Superintendent of Schools (MCSOS) to submit claims. The district received $3.5 million in reimbursements in 2020/21 and $2.7 million in reimbursements in 2021/22.

The MCSOS continues to recommend that districts recognize MAA revenues only after they are received since future funding adjustments may occur. Therefore, additional funds will be recognized once received.

If you have any questions pertaining to the information in this communication, or require additional information, please contact Kim Kelstrom at 457-3907.

Approved by Superintendent
Robert G. Nelson Ed.D. _____ Date: August 05, 2022

Fresno Unified School District
Board Communication

BC Number BFS-3

From the Office of the Superintendent
To the Members of the Board of Education
Prepared by: Santino Danisi, Chief Financial Officer
Cabinet Approval:

Date: August 05, 2022

Phone Number: 457-6226

Regarding: District's Bond Rating Affirmed by Moody's Investors Service

The purpose of this board communication is to inform the Board that Fresno Unified School District's Aa3 rating was affirmed by Moody's Investor's Service.

In the Moody's Investors Service update to potential investors dated July 29, 2022, the credit opinion labeled the district's outlook as "stable". "The stable outlook reflects our expectation that the district's economy will continue to grow, and the district's financial profile will remain sound, supported by management's conservative budgeting practices".

In the rationale, the Moody's report noted, "the districts growing central valley economy, relatively stable enrollment trend and healthy finances, with solid reserves and considerable alternate liquidity outside of the general fund that could be used for operations. The district's finances also benefit from prudent management, with conservative budgeting practices and an adopted reserve policy. The rating also incorporates low resident income and wealth levels and elevated leverage, driven by significant voter approved debt, a growing pension burden and large unfunded other post-employment-benefits liability."

The Moody's Investors Services press release is attached.

The Board approved the issuance of and sale of 2021 Refunding General Obligation Bonds in the aggregate principal amount of $125 million at the June 15, 2022 Board of Education meeting with proceeds scheduled to be received August 2022.

If you have any questions pertaining to the information in this communication, or require additional information, please contact Santino Danisi at 457-6226.

Approved by Superintendent
Robert G. Nelson Ed.D. _____ Date: August 05, 2022

MOODY'S
INVESTORS SERVICE

Rating Action: Moody's assigns Aa3 to Fresno USD CA's 2020B GOULT B Outlook stable

29 Jul 2022

New York, July 29, 2022 -- Moody's Investors Service has assigned a Aa3 rating to Fresno Unified S District, CA's General Obligation Bonds, Election of 2020, Series B. The expected par amount is $1 Moody's maintains the district's outstanding A1 issuer rating, Aa3 general obligation unlimited tax (G bond rating and A2 lease revenue bond ratings. The issuer rating reflects the district's ability to repa debt-like obligations without consideration of any pledge, security or structural features. The outlook

RATINGS RATIONALE

The A1 issuer rating reflects the district's growing central valley economy, relatively stable enrollmer and healthy finances, with solid reserves and considerable alternate liquidity outside of the general f could be used for operations. The district's finances also benefit from prudent management, with co budgeting practices and an adopted reserve policy. The rating also incorporates low resident incom wealth levels and elevated leverage, driven by significant voter approved debt, a growing pension b large unfunded other post-employment benefits liability.

The Aa3 rating on the district's GOULT bonds is one notch higher than the issuer rating. The one nc distinction reflects bond security features that include the physical separation through a "lockbox" fo property tax collections and a security interest created by statute.

RATING OUTLOOK

The stable outlook reflects our expectation that the district's economy will continue to grow and the c financial profile will remain sound, supported by management's conservative budgeting practices. Le will likely remain elevated with additional issuances planned under the district's remaining authoriza

FACTORS THAT COULD LEAD TO AN UPGRADE OF THE RATING

- Significant improvement in wealth and income measures

- Sustained strengthening of the district's financial position

- Material reduction of long-term liabilities and related fixed costs

FACTORS THAT COULD LEAD TO A DOWNGRADE OF THE RATING

- Deterioration of the district's reserves and liquidity

- Sharp enrollment losses that would pressure financial performance

- Material growth in long term liabilities and their related fixed costs

LEGAL SECURITY

The district's GOULT bonds are secured by an unlimited property tax pledge of all taxable property v district's boundary. The portion of district's ad valorem property tax levy restricted for debt service is held and transferred directly to the paying agent by Fresno County on behalf of the district.

USE OF PROCEEDS

Bond proceeds will be used for the purpose of financing the renovation, construction, improvement a equipping of school facilities.

PROFILE

Fresno Unified School District serves the City of Fresno (A2 stable issuer rating), a small portion of t
Clovis (Aa2), and unincorporated areas of Fresno County. With 103 schools and approximately 71,0
students projected for fiscal 2022 enrollment, the district is the third largest public school district in C
measured by enrollment.

METHODOLOGY

The principal methodology used in this rating was US K-12 Public School Districts Methodology pub
January 2021 and available at https://ratings.moodys.com/api/rmc-documents/70154. Alternatively, please se
the Rating Methodologies page at https://ratings.moodys.com for a copy of this methodology.

REGULATORY DISCLOSURES

For further specification of Moody's key rating assumptions and sensitivity analysis, see the sections
Methodology Assumptions and Sensitivity to Assumptions in the disclosure form. Moody's Rating Sy
Definitions can be found at https://ratings.moodys.com/rating-definitions

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credit rating.

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Fresno Unified School District
Board Communication

BC Number BFS-4

From the Office of the Superintendent
To the Members of the Board of Education
Prepared by: Santino Danisi, Chief Financial Officer
Cabinet Approval:

Date: August 05, 2022

Phone Number: 457-6226

Regarding: School Site Staffing Comparison

The purpose of this board communication is to provide a summary of information as requested by Trustee Slatic from the Superintendent's Office.

The attached summary provides staffing detail for selected schools.

If you have any questions pertaining to the information in this communication, or require additional information, please contact Santino Danisi at 457-6226.

Approved by Superintendent
Robert G. Nelson Ed.D. _____

Date: August 05, 2022

Fresno Unified School District
STAFFING - FY2022-23

	Bullard High School			Edison High School		
	UPP% - 61.45*			UPP% - 82.62*		
	Enrollment	SDC	Total	Enrollment	SDC	Total
	2,335	85	2,420	2,248	100	2,348
	FTE			FTE		
Job Title	Site Funded	District	School Total	Site Funded	District	School Total
Administration	**-**	**17.00**	**17.00**	**-**	**17.00**	**17.00**
Principal V	-	1.00	1.00	-	1.00	1.00
Vice Principal III	-	6.00	6.00	-	6.00	6.00
School Counselor	-	9.00	9.00	-	9.00	9.00
Head Counselor	-	1.00	1.00	-	1.00	1.00
Certificated	**1.40**	**119.20**	**120.60**	**1.80**	**111.20**	**113.00**
Teachers - Regular/Voc Ed	1.40	96.20	97.60	0.80	96.20	97.00
Teachers - Special Ed	-	17.00	17.00	-	10.00	10.00
TSA/TSA Act. Director	-	3.00	3.00	1.00	2.00	3.00
Library Media Teacher	-	1.00	1.00	-	1.00	1.00
Literacy Coach	-	1.00	1.00	-	1.00	1.00
Nurse	-	1.00	1.00	-	1.00	1.00
Clerical/Classified	**1.44**	**46.76**	**48.20**	**5.75**	**32.20**	**37.95**
School Office Manager IV	-	1.00	1.00	-	1.00	1.00
Attendance Records Assistant	-	2.00	2.00	-	2.00	2.00
School Office Assistant	-	3.00	3.00	-	3.00	3.00
Registrar	-	1.00	1.00	-	1.00	1.00
Assistant Registrar	-	1.00	1.00	-	1.00	1.00
HS Financial Technician	-	1.00	1.00	-	1.00	1.00
Paraprofessional - Special Ed	-	24.6875	24.6875	-	9.125	9.125
Paraprofessional - Bilingual/Spanish	0.44	-	0.44	1.00	-	1.00
Paraprofessional - PE/Athletics	-	1.00	1.00	-	1.00	1.00
Resource Counseling Assistant	-	1.00	1.00	1.00	1.00	2.00
Resource Counseling Assistant - Spanish	-	-	-	2.00	-	2.00
Campus Safety Assistant	-	8.00	8.00	-	8.00	8.00
Choral Accompanist Assistant	-	0.325	0.325	-	0.325	0.325
After School/Ext. Day Lead	-	-	-	0.75	-	0.75
Job Developer II	-	1.00	1.00	-	1.00	1.00
Child Welfare & Attendance Spec. II	-	-	-	1.00	-	1.00
Licensed Vocational Nurse	-	0.75	0.75	-	0.75	0.75
Library Media Technician - HS	-	1.00	1.00	-	1.00	1.00
Home/School Liaison	1.00	-	1.00	-	1.00	1.00
Centralized Support	**-**	**6.40**	**6.40**	**-**	**5.00**	**5.00**
Clinical Social Worker		1.00	1.00		1.00	1.00
Restorative Practice Counselor		1.00	1.00		1.00	1.00
Child Welfare Attendance Specialist II		1.00	1.00			-
School Psychologist		2.00	2.00		2.00	2.00
Speech Language Pathologist		1.40	1.40		1.00	1.00
Grand Total	**2.84**	**189.36**	**192.20**	**7.55**	**165.40**	**172.95**

***UPP% Sourced from CALPADS 1.17 FRPM/English Learner/Foster Youth - Count**

Fresno Unified School District
STAFFING - FY2022-23

	Tenaya Middle School			Gaston B Rutherford Middle School		
	UPP% - 68.3*			UPP% - 98.33*		
	Enrollment	SDC	Total	Enrollment	SDC	Total
	733	47	780	826	50	876
	FTE			FTE		
Job Title	Site Funded	District	School Total	Site Funded	District	School Total
Administration	**0.4**	**7.0**	**7.4**	**-**	**7.0**	**7.0**
Principal III		1.0	1.0		1.0	1.0
Vice Principal II		2.0	2.0		2.0	2.0
Advisor, Guidance and Learning		1.0	1.0		1.0	1.0
Counselor, School	0.4	3.0	3.4		3.0	3.0
Certificated	**0.9**	**42.8**	**43.7**	**1.375**	**49.0**	**50.375**
Teacher, Regular/Voc Ed	0.5	35.0	35.5	1.375	40.0	41.375
Teacher, Special Ed		6.0	6.0		7.0	7.0
Teacher, Library Media		1.0	1.0		1.0	1.0
Teacher, Spec Assgn	0.4	-	0.4			-
Nurse		0.8	0.8		1.0	1.0
Clerical/Classified	**0.8**	**16.375**	**17.125**	**0.75**	**14.8125**	**15.5625**
Manager, School Office Middle		1.0	1.0		1.0	1.0
Assistant, School Office		0.75	0.75		1.0	1.0
Assistant, Attendance Records		1.0	1.0		1.0	1.0
Assistant, Resrce Cnslg	0.8		0.75			-
Paraprof, Special Ed		8.5	8.5		5.0625	5.0625
Assistant,Campus Safety		2.75	2.75		4.0	4.0
Liaison, Home/School Spanish	-	1.0	1.0	0.75	1.0	1.75
Nurse, Vocational License		0.375	0.375		0.75	0.75
Technician, Libr Media-Middle		1.0	1.0		1.0	1.0
Centralized Support	**-**	**4.0**	**4.0**	**-**	**5.0**	**5.0**
Clinical Social Worker		1.0	1.0		1.0	1.0
Restorative Practice Counselor			-		1.0	1.0
Child Welfare Attendance Specialist II		1.0	1.0		1.0	1.0
School Psychologist		1.0	1.0		1.0	1.0
Speech Language Pathologist		1.0	1.0		0.8	0.8
Speech Language Pathologist Asst					0.2	0.2
Grand Total	**2.1**	**70.175**	**72.225**	**2.1**	**75.8125**	**77.9375**

***UPP% Sourced from CALPADS 1.17 FRPM/English Learner/Foster Youth - Count**

Fresno Unified School District
Board Communication

BC Number C1

From the Office of the Superintendent
To the Members of the Board of Education
Prepared by: Maiyer Vang, Interim Executive Director
Cabinet Approval:

Date: August 3, 2022

Phone Number: 250-1322

Regarding: Home School Liaisons Professional Development

The purpose of this communication is to provide the Board with information regarding Parent University's upcoming Professional Development and Meet & Greet for Home School Liaisons on Thursday, August 25, 2022, from 10:00 a.m. to 12:00 p.m. The event will be held at the Clinton Business & Conference Center, 4315 E. Clinton Ave., Fresno, CA 93703.

In leading the district's Family Goal to "increase inclusive opportunities for families to engage in their students' education," Parent University collaboratively worked alongside a steering committee of multiple departments, families, and school sites to establish 10 topics for the new 2022/23 Family Engagement Hour. Family Engagement Hour will be replacing Coffee Hours at the school sites. In this shared work, Parent University and various departments developed curriculum for each topic to provide families with support and resources to support student outcomes.

In establishing this partnership and working collectively, it is essential to develop home school liaisons and school site staff towards this shared family goal, equipping them with tools and expectations for implementing the Family Engagement Hour districtwide. Home school liaisons will receive a monthly family resource tool kit to support the launch of the new Family Engagement Hour.

Below are the 10 topics of the district's Family Engagement Hour to be provided to families.

Family Engagement Hour Topics:

September:	Be Familiar with iReady
October:	Getting to Know Dual Language Immersion Programs
November:	Financial Literacy Tips
December:	Tips to Monitor Social Media
January:	Attend Today, Achieve Tomorrow!
February:	School Safety and Procedures
March:	Strategies for Early Learning and Teens
April:	Wellness and Healthy Choices
May:	Mental Health and Suicide Awareness
June:	Family Engagement Hour Celebration!

If you have any questions pertaining to the information in this communication, or require additional information, please contact Maiyer Vang at (559) 250-1322.

Approved by Superintendent
Robert G. Nelson, Ed.D. _____

Date: August 05, 2022

Fresno Unified School District

Board Communication

BC Number HR-1

From the Office of the Superintendent
To the Members of the Board of Education
Prepared by: David Chavez, Chief of Human Resources
Cabinet Approval:

Date: August 5, 2022

Phone Number: 457-3548

Regarding: Reclassification of Manager II – Special Education/Principal I to Principal II for Rata High School and Addicott K-8 School

The purpose of this board communication is to provide background information for the agenda item on the August 10, 2022 Board meeting for the reclassification of Manager II – Special Education/Principal I to Principal II.

The reclassification allows for expanded recruitment and retention for Rata High School and Addicott K-8 School, each special education schools.

If you have any questions pertaining to the information in this communication, or require additional information, please contact David Chavez at 457- 3548.

Approved by Superintendent
Robert G. Nelson Ed.D._____ Date: August 05, 2022

Fresno Unified School District
Board Communication

BC Number HR-2

From the Office of the Superintendent
To the Members of the Board of Education
Prepared by: David Chavez, Chief of HR/LR
Cabinet Approval:

Date: August 10, 2022

Phone Number: 457-3548

Regarding: Staffing of Schools for 2022/23 School Year

The purpose of this board communication is to provide a high-level update on the certificated staffing for schools, as well as classified and management positions for the upcoming school year. The table below represents filled and unfilled positions to date:

	Filled	**Unfilled**	**Comments**
Classroom Teachers	184	34	34 Hard to fill positions
Classified	222	803	Positions filled at the lateral or permanent level create additional vacancies.
Management	142	52	Unfilled positions reflect 10 site vacancies (3 principals will go to the Board on 08/10/2022 and 3 vice principals will be selected on 08/09/2022).

Human Resources has hosted recruitment campaigns which began on July 27, 2022 and will run through September 01, 2022. This is the first ever summer campaign where Human Resources has focused on classified hiring and to date, we have 392 candidates that have shown an interest in classified openings.

If you have any questions pertaining to the information in this communication, or require additional information, please contact David Chavez at 457-3548.

Approved by Superintendent
Robert G. Nelson Ed.D. _____ Date: August 05, 2022

Fresno Unified School District
Board Communication

BC Number ID-1

From the Office of the Superintendent
To the Members of the Board of Education
Prepared by: Sandra Toscano, Instructional Superintendent
Cabinet Approval:

Date: August 05, 2022

Phone Number: 457-3916

Regarding: 2022/23 District English Learners Advisory Committee Meeting Dates

The purpose of this board communication is to provide the Board with the 2022/23 District English Learners Advisory Committee (DELAC) meeting schedule. Meetings will be held in person at various school sites. The meetings are scheduled from 5:00 p.m. to 7:30 p.m. with dinner and babysitting provided to families.

Meeting dates and locations are:

- Thursday, August 25, 2022 – Roosevelt High School
- Thursday, November 03, 2022 – Roeding Elementary School
- Thursday, February 02, 2023 – Tioga Middle School
- Thursday, June 01, 2023 – Herrera Elementary School

If you have any questions pertaining to the information in this communication, or require additional information, please contact Sandra Toscano at 457-3928.

Approved by Superintendent
Robert G. Nelson Ed.D. _____ Date: August 05, 2022

Fresno Unified School District
Board Communication

BC Number ID-2

From the Office of the Superintendent
To the Members of the Board of Education
Prepared by: Ed Gomes, Instructional Superintendent
Cabinet Approval:

Date: August 05, 2022

Phone Number: 457-3781

Regarding: Back to School Night Dates

The purpose of this board communication is to provide the Board with information on Back-To-School Night. The attached document contains the dates and times for each location.

If you have any questions pertaining to the information in this communication, or require additional information, please contact Ed Gomes at 457-3781.

Approved by Superintendent
Robert G. Nelson Ed.D. _____ Date: August 05, 2022

SITE	BACK TO SCHOOL	TIME
ADDICOTT	To be determined	
ADDAMS	August 25	5:15 PM – 6:30 PM
ANTHONY	August 11	5:00 PM – 6:30 PM
AYER	August 18	5:30 PM – 7:30 PM
AYNESWORTH	August 25	5:00 PM – 6:00 PM
BAKMAN	August 25	5:30 PM – 7:00 PM
BALDERAS	August 30	5:00 PM – 6:30 PM
BIRNEY	August 18	5:30 PM – 7:00PM
BULLARD TALENT	August 11	5:00 PM – 7:30 PM
BURROUGHS	August 18	4:00 PM – 6:00 PM
CALWA	August 25	5:30 PM – 6:30 PM
CENTENNIAL	August 11	5:00 PM – 6:30 PM
COLUMBIA	August 18	4:30 PM – 5:45 PM
DEL MAR	August 25	5:15 PM – 6:30 PM
EASTERBY	August 25	5:30 PM – 7:00 PM
EATON	August 11	6:00 PM – 7:30 PM
ERICSON	August 18	5:30 PM – 6:30 PM
EWING	(TK-K) August 11 (1-6th) August 25	3:30 PM – 5:30 PM 4:30 PM – 6:30 PM
FIGARDEN	(TK/K) August 11 (1-6th) August 16	To be determined
FREMONT	September 8	5:30 PM – 7:00 PM
GIBSON	August 11	5:15 PM – 6:30 PM
GREENBERG	August 18	5:00 PM – 6:30 PM
HAMILTON	August 11	5:30 PM – 7:00 PM
HEATON	August 11	5:30 PM – 7:00 PM
HERRERA	August 11	5:00 PM – 7:00 PM
HIDALGO	August 18	5:45 PM – 7:00 PM
HOLLAND	August 11	5:30 PM – 7:00 PM
HOMAN	August 18	5:00 PM – 7:30 PM
JACKSON	August 25	5:00 PM – 6:30 PM
JEFFERSON	August 18	5:00PM – 6:30 PM
KING	August 15	4:00 PM – 6:00 PM
KIRK	August 12	5:00 PM – 7:00 PM
KRATT	August 11	5:30 PM – 7:00 PM
LANE	August 25	5:00 PM – 6:30 PM
LAWLESS	August 18	5:30 PM - 7:00 PM
LEAVENWORTH	August 18	5:30 PM – 6:55 PM

LINCOLN	August 11	5:00 PM – 6:30 PM
LOWELL	August 13	5:00 PM – 6:30 PM
MALLOCH	August 11	5:30 PM - 7:00 PM
MANCHESTER GATE	August 12	3:00 PM – 4:00 PM
MAYFAIR	August 25	5:30 PM – 7:00 PM
MC CARDLE	August 11	6:00 PM – 7:00 PM
MUIR	August 11	5:00 PM – 6:00 PM
NORSEMAN	August 17	4:00 PM – 5:30 PM
OLMOS	August 18	5:30 PM – 7:00 PM
PHOENIX	August 8 and August 9	By Appointment
POWERS	August 11	6:00 PM - 7:00 PM
PYLE	August 11	5:00 PM – 7:00 PM
ROBINSON	August 15	5:30 PM – 6:30 PM
ROEDING	August 11	4:00 PM – 5:30 PM
ROWELL	August 25	5:00 PM – 6:30 PM
SLATER	August 11	9:00 AM – 6:00 PM Scheduled w/ teacher
STARR	August 11	5:30 PM – 7:00 PM
STOREY	August 11	5:30 PM – 7:00 PM
SUNSET	August 25	5:00 PM – 7:00 PM
TATARIAN	August 11	5:00 PM – 6:30 PM
THOMAS	August 11	5:00 PM – 6:30 PM
TURNER	August 18	5:30 PM – 6:30 PM
VANG PAO	August 25	5:00 PM – 6:30 PM
VIKING	August 18	6:00 PM – 7:10 PM
VINLAND	TK/K August 11 1-6 August 18	5:15 PM – 6:00 PM 5:15 PM – 6:15 PM
WEBSTER	August 25	4:30 PM – 6:00 PM
WILLIAMS	August 12	5:30 PM – 6:30 PM
WILSON	August 25	5:30 PM – 6:30 PM
WINCHELL	August 25	5:00 PM – 6:30 PM
WISHON	August 25	5:30 PM – 7:00 PM
WOLTERS	August 11	5:00 PM – 6:30 PM
YOKOMI	August 16	5:00 PM – 6:30 PM
AHWAHNEE	September 1	5:30 PM – 7:30 PM
BAIRD	(5/6) August 15 (7/8) August 17	5:30 PM – 7:00 PM 5:30 PM – 7:00 PM
COMPUTECH	August 11	4:00 PM – 6:00 PM
COOPER	August 11	5:00 PM – 7:00 PM
FORT MILLER	August 25	4:00 PM – 6:00 PM
GASTON	August 15	5:00 PM – 6:30 PM

KINGS CANYON	(7th Orientation) August 12	8:00 AM – 1:00 PM
SCANDINAVIAN	August 25	5:00 PM – 7:00 PM
SEQUOIA	August 11	5:00 PM – 6:00 PM
TEHIPITE	August 18	5:00 PM – 7:00 PM
TENAYA	August 25	5:30 PM – 7:00 PM
TERRONEZ	August 16	5:00 PM – 7:00 PM
TIOGA	August 11	4:30 PM – 6:30 PM
WAWONA	August 25	5:30 PM – 7:00 PM
YOSEMITE	August 25	5:00 PM – 7:00 Pm
ATP	To be determined	
BULLARD	August 29	5:00 – 8:00 p.m.
CAMBRIDGE	September 26	
DESIGN SCIENCE	August 9	6:00 - 7:00 p.m.
DEWOLF	September 1	5:00 – 6:30 p.m.
DUNCAN	August 18	5:30 – 7:30 p.m.
EDISON	August 29	5:30 – 7:30 p.m.
e-LEARN	August 9	By appointment
FRESNO	August 31	5:00 – 6:30 p.m.
HOOVER	August 29	4:45 – 7:00 p.m.
JE YOUNG	October 11	4:00 – 6:00 p.m.
MCLANE	August 23	6:00 – 7:00 p.m.
PATINO	September 9	5:15 – 6:15 p.m.
PHOENIX SECONDARY	September 2	11:00 am – 1:00 p.m. By appointment
RATA	To be determined	
ROOSEVELT	August 29	6:00 – 8:00 p.m.
SUNNYSIDE	September 12	5:00- 7:00 p.m.
FULTON SECONDARY	To be determined	

Fresno Unified School District
Board Communication

BC Number ID-3

From the Office of the Superintendent
To the Members of the Board of Education
Prepared by: Bryan Wells, Assistant Superintendent
Cabinet Approval:

Date: August 05, 2022

Phone Number: 457-3805

Regarding: Athletic Coach Hiring and Evaluation Update

The purpose of this board communication is to provide the Board an update on how sites are continuing to improve their hiring practices this year to mirror best practices as modeled through the National Federation of High Schools.

- There will be a pre-season meeting held by the site Athletic Director (AD) with each head coach to set goals, ensure roles and responsibilities are known and followed, and hold a post season evaluation (after the season of sport ends) to assess the overall performance of hiring practices. Signatures of the Coach, AD, and Vice Principal (VP) overseeing athletics, will be a required element.
- An end-of-season student athlete survey will be added to the coach's evaluation. This survey will be developed by our Athletic Manager and site AD's, with common wording to share growth opportunities or areas to celebrate with coaches.
- Finally, there will be mandatory professional learning sessions for coaching staff at each site to earn certifications or learn new techniques or strategies pertaining to their specific sport.

Distribution of the updated Fresno Unified School District Athletic Handbook will be completed prior to the start of the 2022/23 school year. Every middle school and high school AD, VP, and Principal will receive a copy for reference and can make copies for distribution for their coaches.

If you have any questions pertaining to the information in this communication, or require additional information, please contact Bryan Wells at 457-3805.

Approved by Superintendent
Robert G. Nelson Ed.D. _____ Date: August 05, 2022

Fresno Unified School District
Board Communication

BC Number OS-1

From the Office of the Superintendent
To the Members of the Board of Education
Prepared by: Alex Belanger, Chief Executive
Cabinet Approval:

Date: August 05, 2022

Phone Number: 457-3134

Regarding: Improvements to Heating, Ventilation, and Air Conditioning and Classroom Ventilation

The purpose of this board communication is to provide the Board an update on improvements completed, underway and planned to upgrade heating, ventilation, and air conditioning (HVAC) systems and classroom ventilation. Spot testing has been performed to confirm we are meeting our goals. At Adams, Anthony, Ayer, Aynesworth, Balderas, Cooper, Easterby, Edison, Fresno, Fort Miller, Fremont, Greenberg, Leavenworth, Storey, Terronez, Thomas, and Yosemite chiller water buffer tanks were installed to increase the water capacity of the HVAC system, allowing the fans to operate at higher speeds to increase air exchange and filtration. The schools were selected based on existing HVAC system design and age of equipment. At Ahwahnee, Bakman, Burroughs, Eaton, Figarden, Fresno, Heaton, Hoover, Lane, McCardle, Olmos, Rowell, and Yokomi; work has been completed to increase the level of air filtration to MERV-13 (minimum efficiency reporting value). Air balancing, CO2 sensor and MERV-13 filters are recommended, however only certain system designs can accommodate MERV-13 filtration due to motor and ducting capabilities. Maintenance is currently conducting tests at additional sites to determine if the system design will accept MERV-13 filtration. Systems are running continuously and at greater fan speeds with maximum outside air to allow for as many air exchanges as possible. In addition, Pure and Clean Air Filtration and PIP Max RestorAir Devices have been placed in each classroom to support air filtration and combat viruses, bacteria, mold spores and odors. Both devices are certified by the California Air Resources Board (CARB) certified.

District-wide, consultants continue to evaluate all HVAC systems developing scopes of work and cost estimates for short- and long-range projects to upgrade all schools to MERV-13 filtration. Air quality assessment were performed per American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) & OSHA standards by two independent environmental firms (results attached). The assessment concluded no indoor air quality concerns were identified by sampling ten school sites with differing infrastructure/design by measuring carbon monoxide, carbon dioxide, humidity, temperature, and particulate matter. The ten schools sampled were Thomas, Columbia, Eaton, Yokomi, Kirk, Figarden, Easterby, Wishon, Gibson, and Storey. Several sites were shown to have varying temperatures and are in review. The CO^2 levels measured at each site were also found to be within American National Standards Institute (ANSI)/ASHRAE Standard. All samples taken measuring for particulate matter fell within the guidelines established by the Environmental Protection Agency (EPA).

If you have questions pertaining to the information in this communication, or require additional information, please contact Alex Belanger at 457- 6126.

Approved by Superintendent
Robert G. Nelson Ed.D. _____ Date: August 05, 2022

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LIMITED INDOOR AIR QUALITY ASSESSMENT FOR AIRBORNE PARTICULATE MATTER & ENVIRONMENTAL CONDITIONS

FRESNO UNIFIED SCHOOL DISTRICT
VARIOUS SCHOOL SITE LOCATIONS
FRESNO, CALIFORNIA

June 9, 2022

PREPARED FOR:
Mr. Drone Jones
Operations Manager
Maintenance & Operations
Fresno Unified School District
2309 Tulare Street
Fresno, California 93721

PREPARED BY:

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June 9, 2022 Project No. 1130-22-001

Mr. Drone Jones
Operations Manager
Maintenance & Operations
Fresno Unified School District
2309 Tulare Street
Fresno, California 93721

Regarding: Limited Indoor Air Quality Assessment for Airborne Particulate Matter & Environmental Conditions
Locations: Various FUSD School Site Locations

Dear Mr. Jones:

At your request, our firm conducted an indoor air quality assessment of airborne Particulate Matter (PM) at four (4) Fresno Unified School District school sites. This serves as our final summary report of findings related to our investigation based on data and readings generated during the assessment.

Scope of Investigation

Extended Duration Air Quality Monitoring

The evaluation included the assessment of airborne PM of the following sizes:

PM 1: Inhalable particles with diameters that are generally 1 microns and smaller
PM 2.5: Inhalable particles with diameters that are generally 2.5 microns and smaller
PM 10: Inhalable particles with diameters that are generally 10 microns and smaller

Particulate matter consists of a mixture of solid particles, aerosols composed of small droplets of liquid, dry solid fragments, and solid cores with liquid coatings found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be observed with the naked eye. Others are so small that they can only be detected using an electron microscope. Particles are defined by their diameter for air quality regulatory purposes. Those particles with a diameter of ten (10) microns or less (PM10) are inhalable into the lungs and can induce adverse health effects. Fine particulate matter is defined as particles that are 2.5 microns or less in diameter, therefore PM2.5 comprises a portion of PM10. To date, no standard has been promulgated for PM1 or less sized particles.

Instrument: *DustTRAK DRX Desktop 8533 Dust/Aerosol Monitors*

As part of the assessment, we used *DustTRAK DRX Desktop 8533 Dust/Aerosol Monitors* to collect the sampling data at each location. Each monitor device used as part of the evaluation

was in current calibration. Each test parameter evaluates inhalable particles with diameters that are generally of the designated size range or smaller.

The school sites and room sampling locations were selected by the Client. An outside location was determined at each site location based on determining a secure area for the equipment.

The interior area of four (4) classrooms were assessed at each school site as well as an outside location. The monitoring at each school location included the monitoring equipment being setup prior to school instruction beginning and then picked up at the conclusion of the school day after instruction ended.

The outside sample provided a means of establishing a baseline level in outside air, so as to provide a comparison between PM levels in outside air and those in inside environments.

Environmental Readings

Instrument: *Fluke 975 Airmeter*

As part of the assessment, we also collected real-time environmental data at each sampling location using a *Fluke 975 Airmeter*. The environmental test parameters included: temperature, relative humidity, carbon dioxide, carbon monoxide, dew point temperature, and wet bulb temperature. Readings were typically collected at the beginning and end of the test period at each location. In some instances, readings were only taken at the beginning or end of the test period. The readings were compared to industry guidelines.

Carbon monoxide readings only were compared to state and federal regulations for carbon monoxide levels. All other readings were compared to published industry information and standards concerning recommended comfort levels within typical indoor environments as there are no state or federal regulations for them.

Reported standards are from the ASHRAE Standard 62.1-2013 “Ventilation for Acceptable Indoor Air Quality”, and the EPA.

- **Temperature:** An indoor temperature of 74 ºF is reported as acceptable by 80% of persons.
- **Relative Humidity (R.H.):** Relative humidity in habitable space preferably should be maintained between 30% and 60%. An indoor Relative Humidity of 45% is reported as acceptable by 80% of persons.
- **Dew Point (D.P.):** The dew point is the temperature at which water vapor in the air at a constant barometric pressure condenses into liquid water at the same rate at which it evaporates. At temperatures below the dew point, water will leave the air. The condensed water is called dew when it forms on a solid surface. Interior temperatures should always be maintained below the dew point to prevent formation of liquid water on interior surfaces which may support microbial growth.
- **Wet Bulb Temperature:** The wet-bulb temperature is the temperature a parcel of air would have if it were cooled to saturation (100% relative humidity) by the evaporation of water into it, with the latent heat being supplied by the parcel.
- **Carbon Monoxide** (**CO**) is a colorless, odorless, and tasteless gas that is slightly less dense than air. It is toxic to humans and animals when encountered in higher concentrations, although it is also produced in normal animal metabolism in low

quantities and is thought to have some normal biological functions. In the atmosphere, it is spatially variable and short lived, having a role in the formation of ground-level ozone. Carbon monoxide is produced from the partial oxidation of carbon-containing compounds; it forms when there is not enough oxygen to produce carbon dioxide (CO_2), such as when operating a stove or an internal combustion engine in an enclosed space.

- **Carbon Dioxide**: (**CO_2**) is a naturally occurring chemical compound composed of 2 oxygen atoms each covalently double bonded to a single carbon atom. Carbon dioxide is produced by all living organisms and is exhaled in the breath of humans and other land animals. Indoor CO^2 levels allow for an evaluation as to the amount of fresh air being introduced into a building and is influenced by the occupant load. Excessive CO^2 levels can result in interior building odors. Interior **CO_2** levels below 1,000 are generally considered to be healthy according to the EPA Reference Guide for Indoor Air Quality in Schools and ASHRAE, with levels of 800 or below recommended.

A summary of the data and readings collected at each sampling location are included in the Appendix of this report, along with current calibration certificates for each monitoring device and Troy Brooks' professional certification.

Regulatory Standards- State & Federal

Federal standards, such as the ASHRAE standard, the U.S. National Ambient Air Quality standard, and the EPA Ambient Air Quality standard, have been established for the following pollutants which were considered as part of our evaluation:

Carbon Monoxide

	1-hour Average	8-Hour Average
Federal Standard:	35 ppm	9 ppm
California Standard	20 ppm	9 ppm

Respirable Particulate Matter <10 microns in diameter (PM10)

	Annual Average*	24-Hour Average**
Federal Standard:	None	150 µg/m³
California Standard	20 µg/m³	50 µg/m³

Fine Particulate Matter <2.5 microns in diameter (PM2.5)

	Annual Average*	24-Hour Average**
Federal Standard:	12 µg/m³	35 µg/m³
California Standard	12 µg/m³	None

* Annual Average = includes both long-term and short-term exposures
** 24-Hour Average = short-term exposures

Visibility Reducing Particles

California standards include the previous list as well. This standard is based on visibility standards at Lake Tahoe basin and statewide per 1989 revision of the standard.

Carbon Monoxide (CO)

1. Regulatory Standards

   CAS number: 630-08-0

   NIOSH REL: 35 ppm (40 mg/m^3) 10-minute/Ceiling 200 ppm (229 mg/m^3)

   CAL/OSHA PEL: 25 ppm/Ceiling: 200 ppm

   ILDH: 1200 ppm

2. Description of Substance: Colorless gas

School Site Assessments

1. Thomas Elementary School: 4444 N. Millbrook Ave., Fresno CA.

Assessment Locations: K-1, Rooms 12 & 24, Office & Outside

Assessment Date: May 10, 2022

The data was collected within classrooms and other interior areas selected by the Client. The sampling duration for each location was approximately 7-8 hours in length and encompassed the daily school instruction period. The data collected at each location is as follows:

Summary of Findings

Particulate Matter – Extended Duration Monitoring

PM 1: There are no established state or federal standards for PM1. The peak level was 0.022 µg/m^3. This is well below state and federal requirements for PM 2.5.

PM 2.5: The peak level was 0.022 µg/m^3. Results are below state and federal requirements

PM10 The peak level was 0.054 µg/m^3. Results are below state and federal requirements

Environmental Readings:

The following is a summary of the data collected by the *Fluke 975 Airmeter* at each location at the specified school site:

- **Temperature:** According to the information collected at the specified interior locations, the average indoor temperature at the end of the sampling period was 73.2 ºF, with a low of 69.8 ºF and a high of 78.8 ºF. This closely meets the indoor temperature comfort level recommended by ASHRAE guidelines with the exception of the highest recorded

temperature at the Office area which was approximately 4 ºF above recommended level. The morning interior temperatures were not utilized as classroom instruction had not started at that time.

- **Relative Humidity:** According to information collected at the specified interior locations, indoor relative humidity levels ranged from 24.0% - 32.8% R.H. with an average of 27.9% R.H. **This is below the recommended comfort range under ASHRAE of 30 – 60% R.H.**

- **Dew Point Temperature:** According to the information collected at the specified interior location, indoor temperatures during the sampling period were found to be well above the dew point temperature in accordance with industry guidelines.

- **Wet Bulb Temperature:** According to the information collected at the specified interior location, the average interior temperature was maintained above the temperature at which the air would have 100% moisture saturation in accordance with industry guidelines.

- **Carbon Monoxide:** According to information collected at each specified interior location, no Carbon Monoxide (CO) gas was detected. This is below the NIOSH "Recommended Exposure Limit" of 35 ppm (40 mg/m³), and the CAL/OSHA "Permissible Exposure Limit" of 25 ppm (29 mg/m³) and 9 ppm (level of interest) from the National Ambient Air Quality Standards (NAAQS).

- **Carbon Dioxide:** According to the information collected at the specified interior locations, CO_2 levels averaged 467 ppm with a range from 401 (lowest) to 536 ppm (highest). This level suggests that the rate of mechanical ventilation falls within EPA and industry recommendations, and ASHRAE guidelines.

2. Easterby Elementary School: 2309 Tulare Avenue, Fresno, CA.

Assessment Locations: K-1, Rooms 16 & PCR41, Office & Outside

Assessment Date: May 11, 2022

The data was collected within classrooms and other interior areas selected by the Client. The sampling duration for each location was approximately 7-8 hours in length and encompassed the daily school instruction period. The data collected at each location is as follows:

Summary of Findings

Particulate Matter – Extended Duration Monitoring

PM 1: There are no established state or federal standards for PM1. The peak rate was 0.014 µg/m³. This is well below state and federal requirements for PM 2.5.

PM 2.5: The peak rate was 0.015 µg/m³. Results are below state and federal requirements

PM10 The peak rate was 0.024 µg/m³. Results are below state and federal requirements

Environmental Readings:

The following is a summary of the data collected at each location at the specified school site:

- **Temperature:** According to the information collected at the specified interior locations, the average indoor temperature at the conclusion of the test period was 72.1 ºF, with a low of 69.8 ºF and a high of 74.3 ºF. The average temperature was calculated as approximately 2°F below the indoor temperature comfort level recommended by ASHRAE guidelines. The morning interior temperatures were not utilized as classroom instruction had not started at that time.

- **Relative Humidity:** According to information collected at the specified interior locations, indoor relative humidity levels ranged from 20.9% - 29.0% R.H. with an average of 24.5% R.H. **This is below the recommended comfort range under ASHRAE of 30 – 60% R.H.** The morning interior R.H. readings were not utilized as classroom instruction had not started at that time.

- **Dew Point Temperature:** According to the information collected at the specified interior location, indoor temperatures during the sampling period were found to be well above the dew point temperature in accordance with industry guidelines.

- **Wet Bulb Temperature:** According to the information collected at the specified interior location, the average interior temperature was maintained above the temperature at which the air would have 100% moisture saturation in accordance with industry guidelines.

- **Carbon Monoxide:** According to information collected at each specified interior location, no Carbon Monoxide (CO) gas was detected. This is below the NIOSH "Recommended Exposure Limit" of 35 ppm (40 mg/m³), and the CAL/OSHA "Permissible Exposure Limit" of 25 ppm (29 mg/m³) and 9 ppm (level of interest) from the National Ambient Air Quality Standards (NAAQS).

- **Carbon Dioxide:** According to the information collected at the specified interior locations, CO_2 levels averaged 424 ppm with a range from 375 (lowest) to 519 ppm (highest). This level suggests that the rate of mechanical ventilation falls within EPA and industry recommendations, and ASHRAE guidelines.

3. Columbia Elementary School: 1025 S. Trinity Street, Fresno, CA.

Assessment Locations: K-1, Room 10. MPR, Office & Outside

Assessment Date: May 12, 2022

The data was collected within classrooms and other interior areas selected by the Client. The sampling duration for each location was approximately 7-8 hours in length and encompassed the daily school instruction period. The data collected at each location is as follows:

Summary of Findings

Particulate Matter – Extended Duration Monitoring

PM 1: There are no established state or federal standards for PM1. The peak rate was 0.021 µg/m³. This is well below state and federal requirements for PM 2.5.

PM 2.5: The peak rate was 0.021 µg/m³. Results are below state and federal requirements

PM10 The peak rate was 0.036 µg/m³. Results are below state and federal requirements

Environmental Readings:

The following is a summary of the data collected at each location at the specified school site:

- **Temperature:** According to the information collected at the specified interior locations, the average indoor temperature at the conclusion of the test period was 79.9 ºF, with a low of 77.9 ºF and a high of 83.3 ºF. The average temperature was approximately 6 degrees above the indoor temperature comfort level recommended by ASHRAE guidelines, although 3 of the 4 locations were below 80 ºF. The morning interior temperatures were not utilized as classroom instruction had not started at that time.

- **Relative Humidity:** According to information collected at the specified interior locations, indoor relative humidity levels ranged from 23.4% - 23.9% R.H. with an average of 23.7% R.H. **This is below the recommended comfort range under ASHRAE of 30 – 60% R.H.** The morning interior R.H. readings were not utilized as classroom instruction had not started at that time.

- **Dew Point Temperature:** According to the information collected at the specified interior location, indoor temperatures during the sampling period were found to be well above the dew point temperature in accordance with industry guidelines.

- **Wet Bulb Temperature:** According to the information collected at the specified interior location, the average interior temperature was maintained above the temperature at which the air would have 100% moisture saturation in accordance with industry guidelines.

- **Carbon Monoxide:** According to information collected at each specified interior location, no Carbon Monoxide (CO) gas was detected. This is below the NIOSH "Recommended Exposure Limit" of 35 ppm (40 mg/m³), and the CAL/OSHA "Permissible Exposure Limit" of 25 ppm (29 mg/m³) and 9 ppm (level of interest) from the National Ambient Air Quality Standards (NAAQS).

- **Carbon Dioxide:** According to the information collected at the specified interior locations, CO_2 levels averaged 476 ppm with a range from 445 (lowest) to 513 ppm (highest). This level suggests that the rate of mechanical ventilation falls within EPA and industry recommendations, and ASHRAE guidelines.

4. Gibson Elementary School: 1266 W. Barstow Ave., Fresno, CA.

Assessment Locations: K-1, Rooms 5, 8, 21, Office & Outside

Assessment Date: May 13, 2022

The data was collected within classrooms and other interior areas selected by the Client. The sampling duration for each location was approximately 7-8 hours in length and encompassed the daily school instruction period. The data collected at each location is as follows:

Summary of Findings

Particulate Matter – Extended Duration Monitoring

PM 1: There are no established state or federal standards for PM1. The peak rate was 0.098 µg/m³. This is well below state and federal requirements for PM 2.5.

PM 2.5: The peak rate was 0.106 µg/m³. Results are below state and federal requirements

PM10 The peak rate was 0.231 µg/m³. Results are below state and federal requirements

Environmental Readings:

The following is a summary of the data collected at each location at the specified school site:

- **Temperature:** According to the information collected at the specified interior locations the average indoor temperature at the conclusion of the test period was 83.1 ºF, with a low of 81.5 ºF and a high of 85.1 ºF. The average temperature was approximately 9 degrees above the indoor temperature comfort level recommended by ASHRAE guidelines. The morning interior temperatures were not utilized as classroom instruction had not started at that time.

- **Relative Humidity:** According to information collected at the specified interior locations, indoor relative humidity levels ranged from 27.0% – 37.2% R.H. with an average of 32.4% R.H. **This is within the recommended comfort range under ASHRAE of 30 – 60% R.H.** The morning interior R.H. readings were not utilized as classroom instruction had not started at that time.

- **Dew Point Temperature:** According to the information collected at the specified interior location, indoor temperatures during the sampling period were found to be well above the dew point temperature in accordance with industry guidelines.

- **Wet Bulb Temperature:** According to the information collected at the specified interior the average interior temperature was maintained above the temperature at which the air would have 100% moisture saturation in accordance with industry guidelines.

- **Carbon Monoxide:** According to information collected at each specified interior location, no Carbon Monoxide (CO) gas was detected with the exception of Room 5 which had a CO level of “1” at the conclusion of the sampling period. This is below the NIOSH “Recommended Exposure Limit” of 35 ppm (40 mg/m³), and the CAL/OSHA “Permissible

Exposure Limit" of 25 ppm (29 mg/m³) and 9 ppm (level of interest) from the National Ambient Air Quality Standards (NAAQS).

- **Carbon Dioxide:** According to the information collected at the specified interior locations, CO_2 levels averaged 611 ppm with a range from 386 (lowest) to 765 ppm (highest). This level suggests that the rate of mechanical ventilation falls within EPA and industry recommendations, and ASHRAE guidelines.

Summary

Based on the review of the data and readings generated as part of the limited indoor air quality assessment for each site and test parameter included in the investigation, it was observed that airborne levels of particulate matter of sizes ranging from PM1 - PM10 were detected and shown to be below state and federal regulations and in each case, were found to be well below those regulatory levels. Levels of carbon monoxide were detected and shown to be below state and federal regulations with each area having no detectable levels of CO at interior test locations with the one exception at Gibson Elementary where a CO level of "1" was recorded at the conclusion of the monitoring period.

Review of environmental readings taken at the beginning and end of the monitoring phase at each site (with the exception of Thomas Elementary which had only PM levels recorded), were observed to be within industry guidelines for carbon dioxide, Dew Point, and Wet Bulb temperatures.

Some deviations from industry guidelines were found regarding indoor temperature and relative humidity levels, however it is difficult to evaluate if these readings are representative of conditions during the majority of the day since the data was collected prior to students arriving and after departure. Classroom environments may have been significantly different during those hours in which the classrooms were occupied due to operation of the HVAC system, repeated opening and closing of doors, and the human presence in the rooms.

Limitations

The conclusions and opinions presented herein are based upon the agreed upon scope of work under the terms and conditions of our agreement with the Client. Brooks & Associates, A Division of Provost & Prichard Consulting Group (TBA/P&P), makes no warranties or guarantees as to the accuracy or completeness of information obtained from information provided or compiled by others. It is possible that additional information exists beyond the scope of our investigation..

The conclusions herein presented were accurate at the time that the sampling was conducted. The enclosed opinions are limited to the specifically referenced sampling areas and are not intended to represent areas not specifically referenced.

Additional information which was not available to TBA/P&P at the time of writing this report may result in a modification of the conclusions presented. This report is not a legal opinion.

TBA/P&P services consist of professional opinions and recommendations made in accordance with generally accepted industry principles and practices and area designed to provide an analytical tool to assist the Client. TBA/P&P or those representing TBA/P&P have no

responsibility for the actual condition of the structure or safety of a site pertaining to Indoor Air Quality (IAQ) contamination regardless of the actions taken by the Client.

Upon acceptance of the enclosed report, the Client agrees that TBA/P&P's investigation shall be limited by the terms and conditions stated in TBA/P&P 's report, and that the actual site conditions at the subject property may change with time; that hidden conditions (not discovered within the scope of this assessment) may exist at the site; and that the scope of this investigation was limited by time, budget and other constraints imposed by the Client.

Regardless of the findings of TBA/P&P 's limited investigation, TBA/P&P makes no warranty that the site is free from existing or threatened mold, bacteria, or other contaminants, and TBA/P&P is not responsible for consequences or conditions arising from facts that were concealed, withheld, or not fully disclosed at the time the inspection and sampling was conducted.

TBA/P&P represents to the Client that it has used the degree of care and skill ordinarily exercised by environmental consultants in the preparation of the limited investigation for the Subject Property and in the assembling of data and information related thereto in accordance with referenced standards. No other warranties are made either expressed or implied.

TBA/P&P representatives are not licensed as medical professionals: therefore, the conclusions and recommendations contained within this report do not constitute medical opinions, human health risk analysis, or public health alerts. A licensed physician should be consulted for such opinions.

Please feel free to contact me should you require further assistance.

Sincerely,

T. Brooks & Associates, A Division of
Provost & Pritchard Consulting Group

Troy F. Brooks, RRC, CAC, CIEC
Certified Indoor Environmental Consultant
Principal Environmental & Roofing Specialist

Dave Norman, Principal

Reviewed By:

Mikolyn Ainsworth, CIH, REHS, CAC

Appendix A

Thomas Elementary School

Summary of Data & Readings

Thomas Elementary
4444 N. Millbrook Ave., Fresno

Sample Location: K-1

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	---	---	---	---	---	---	---
PM	4:07	73.4° F	32.8%	0	536	41.0° F	55.4° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:25 AM	11:33 AM	12:41 PM	1:49 PM	2:57 PM	4:05 PM
PM 1 µg/m³	0	0.005	0.006	0.008	0.003	0.006	0.002	0	0.001
PM 2.5 µg/m³	0	0.006	0.006	0.009	0.003	0.007	0.002	0	0.001
PM 10 µg/m³	0	0.013	0.014	0.021	0.007	0.014	0.004	0.001	0.001

Sample Location: Room 12

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	---	---	---	---	---	---	---
PM	4:22	69.8° F	29.7%	0	407	37.4° F	52.7° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:21 AM	12:29 PM	1:37 PM	2:45 PM	3:53 PM
PM 1 µg/m³	0.004	0.007	0.014	0.022	0.012	0.018	0.020	0.008	0.002
PM 2.5 µg/m³	0.004	0.007	0.014	0.022	0.012	0.018	0.020	0.008	0.002
PM 10 µg/m³	0.004	0.016	0.031	0.051	0.030	0.043	0.054	0.018	0.003

Sample Location: Room 24

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	---	---	---	---	---	---	---
PM	4:18	70.7° F	24.0%	0	401	33.8° F	52.7° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.002	0.004	0.004	0.003	0.012	0.016	0.005	0.002	0.003
PM 2.5 µg/m³	0.002	0.004	0.004	0.003	0.013	0.017	0.005	0.002	0.003
PM 10 µg/m³	0.003	0.007	0.007	0.005	0.026	0.036	0.010	0.002	0.003

Sample Location: Office

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	---	---	---	---	---	---	---
PM	4:01	78.8° F	25.0%	0	523	39.2° F	56.3° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:15 AM	11:21 AM	12:29 PM	1:37 PM	2:45 PM	3:53 PM
PM 1 µg/m³	0.004	0.008	0.008	0.009	0.009	0.015	0.015	0.007	0.011
PM 2.5 µg/m³	0.004	0.008	0.009	0.009	0.009	0.015	0.016	0.007	0.012
PM 10 µg/m³	0.005	0.014	0.014	0.015	0.015	0.031	0.032	0.010	0.019

Sample Location: Outside

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	---	---	---	---	---	---	---
PM	4:12	69.8° F	24.9%	0	423	32.9° F	50.9° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.006	0.003	0.002	0.004	0.003	0.004	0.005	0.004	0.007
PM 2.5 µg/m³	0.007	0.003	0.002	0.004	0.003	0.004	0.005	0.004	0.007
PM 10 µg/m³	0.008	0.005	0.004	0.010	0.004	0.006	0.007	0.005	0.009

Appendix B

Easterby Elementary School

Summary of Data & Readings

Easterby Elementary
2309 Tulare Ave., Fresno

Sample Location: K-1

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:26	59.0° F	42.4%	0	449	35.6° F	47.3° F
PM	4:07	69.8° F	20.9%	0	375	32.0° F	50.9° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0	0.007	0.004	0.004	0	0.003	0.002	0.002	0.001
PM 2.5 µg/m³	0	0.007	0.005	0.005	0	0.004	0.002	0.002	0.001
PM 10 µg/m³	0	0.013	0.009	0.009	0	0.008	0.004	0.003	0.001

Sample Location: Room 16

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:15	61.7° F	42.7%	0	457	38.3° F	49.1° F
PM	3:58	74.3° F	27.1%	0	427	38.3° F	54.5° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	3:47 PM
PM 1 µg/m³	0.001	0.004	0.003	0.004	0.003	0.003	0.006	0.006	0.005
PM 2.5 µg/m³	0.002	0.004	0.003	0.004	0.003	0.003	0.006	0.006	0.005
PM 10 µg/m³	0.002	0.006	0.005	0.007	0.005	0.005	0.010	0.008	0.006

Sample Location: PCR 41

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:21	56.3° F	46.7%	0	448	35.6° F	46.4° F
PM	4:12	69.8° F	20.9%	0	375	32.0° F	50.9° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.003	0.002	0.002	0.003	0.003	0.001	0.002	0.005	0.002
PM 2.5 µg/m³	0.003	0.002	0.002	0.003	0.003	0.001	0.002	0.005	0.002
PM 10 µg/m³	0.003	0.003	0.003	0.006	0.005	0.002	0.003	0.007	0.002

Sample Location: Office

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:10	56.3° F	51.1%	0	440	38.3° F	47.3° F
PM	3:55	74.3° F	29.0%	0	519	40.1° F	55.4° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	3:47 PM
PM 1 µg/m³	0.005	0.011	0.013	0.009	0.007	0.008	0.012	0.014	0.010
PM 2.5 µg/m³	0.005	0.012	0.014	0.009	0.007	0.009	0.013	0.015	0.011
PM 10 µg/m³	0.007	0.019	0.023	0.014	0.011	0.015	0.020	0.024	0.013

Sample Location: Outside

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:06	47.3° F	67.9%	0	449	37.4° F	41.9° F
PM	4:20	69.8° F	18.5%	0	375	32.0° F	50.9° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.006	0.005	0.005	0.005	0.004	0.003	0.007	0.011	0.004
PM 2.5 µg/m³	0.006	0.005	0.006	0.005	0.004	0.004	0.007	0.011	0.004
PM 10 µg/m³	0.008	0.007	0.008	0.008	0.007	0.007	0.010	0.013	0.008

Appendix C

Columbia Elementary School

Summary of Data & Readings

Columbia Elementary
1025 S. Trinity Street, Fresno

Sample Location: K-1

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:11	62.6° F	36.5%	0	493	34.7° F	48.2° F
PM	4:22	79.7° F	23.9%	0	461	40.1° F	57.2° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.001	0.003	0.006	0.018	0.012	0.003	0.002	0.002	0.001
PM 2.5 µg/m³	0.002	0.003	0.006	0.018	0.012	0.003	0.002	0.002	0.001
PM 10 µg/m³	0.002	0.005	0.009	0.023	0.014	0.003	0.003	0.003	0.002

Sample Location: Room 10

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:15	64.4° F	33.2%	0	451	34.7° F	49.1° F
PM	4:21	77.9° F	23.9%	0	445	38.3° F	57.2° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.006	0.010	0.014	0.021	0.020	0.017	0.014	0.004	0.001
PM 2.5 µg/m³	0.006	0.010	0.014	0.021	0.020	0.017	0.014	0.004	0.001
PM 10 µg/m³	0.006	0.020	0.028	0.033	0.036	0.036	0.028	0.008	0.002

Sample Location: MPR

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:21	66.2° F	36.8%	0	444	39.2° F	51.8° F
PM	4:18	83.3° F	23.6%	0	486	44.6° F	60.8° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.001	0.002	0.002	0.004	0.006	0.005	0.001	0.002	0.001
PM 2.5 µg/m³	0.001	0.002	0.002	0.004	0.006	0.005	0.001	0.002	0.001
PM 10 µg/m³	0.001	0.002	0.002	0.005	0.008	0.008	0.002	0.004	0.002

Sample Location: Office

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:31	65.3° F	36.7%	0	445	37.4° F	50.9° F
PM	4:12	78.8° F	23.4%	0	513	38.3° F	57.2° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.004	0.007	0.007	0.014	0.013	0.009	0.006	0.006	0.006
PM 2.5 µg/m³	0.004	0.007	0.007	0.014	0.013	0.009	0.006	0.006	0.006
PM 10 µg/m³	0.005	0.009	0.008	0.015	0.014	0.012	0.007	0.008	0.009

Sample Location: Outside

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:26	56.3° F	50.1%	0	638	37.4° F	46.4° F
PM	4:14	79.7° F	18.9%	0	384	33.8° F	56.3° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.004	0.007	0.007	0.014	0.013	0.009	0.006	0.006	0.006
PM 2.5 µg/m³	0.004	0.007	0.007	0.014	0.013	0.009	0.006	0.006	0.006
PM 10 µg/m³	0.005	0.009	0.008	0.015	0.014	0.012	0.007	0.008	0.009

Appendix D

Gibson Elementary School

Summary of Data & Readings

Gibson Elementary
1266 W. Barstow Ave., Fresno

Sample Location: Room 5

PM							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:22	62.6° F	50.0%	0	482	42.8° F	51.8° F
PM	4:15	84.2° F	37.2%	1	765	53.6° F	65.3° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.005	0.003	0.029	0.028	0.039	0.025	0.025	0.010	0.007
PM 2.5 µg/m³	0.005	0.004	0.032	0.030	0.042	0.027	0.026	0.011	0.008
PM 10 µg/m³	0.006	0.004	0.069	0.060	0.086	0.047	0.047	0.016	0.009

Sample Location: Room 8

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:28	64.4° F	45.1%	0	461	41.9° F	51.8° F
PM	4:18	81.5° F	33.8%	0	617	49.1° F	61.7° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.003	0.010	0.015	0.017	0.020	0.010	0.012	0.006	0.001
PM 2.5 µg/m³	0.003	0.010	0.015	0.017	0.020	0.010	0.012	0.006	0.001
PM 10 µg/m³	0.003	0.013	0.018	0.022	0.032	0.016	0.023	0.009	0.002

Sample Location: Room 21

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:35	63.5° F	42.4%	0	432	41.0° F	51.8° F
PM	4:21	81.5° F	31.5%	0	675	48.2° F	60.8° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.007	0.020	0.060	0.098	0.064	0.025	0.021	0.004	0.004
PM 2.5 µg/m³	0.007	0.020	0.063	0.106	0.067	0.026	0.022	0.004	0.004
PM 10 µg/m³	0.009	0.032	0.124	0.231	0.140	0.039	0.045	0.006	0.006

Sample Location: Office

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:15	61.7° F	50.7%	0	456	42.8° F	50.9° F
PM	4:10	85.1° F	27.0%	0	386	47.3° F	62.6° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.036	0.025	0.030	0.031	0.031	0.023	0.010	0.017	0.019
PM 2.5 µg/m³	0.037	0.026	0.032	0.033	0.032	0.024	0.010	0.017	0.020
PM 10 µg/m³	0.070	0.051	0.053	0.051	0.043	0.036	0.013	0.031	0.044

Sample Location: Outside

Environmental Readings							
	Time	Temp	RH	CO	CO2	Dew Point	Wet Bulb
AM	6:05	54.5° F	66.3%	0	441	43.7° F	49.1° F
PM	4:08	86.0° F	30.8%	1	665	50.9° F	64.4° F

Airborne Particulate Matter Data									
Particulate Matter 2 Min. Reading Average	Time of Reading								
	7:00 AM	8:08 AM	9:16 AM	10:24 AM	11:32 AM	12:40 PM	1:48 PM	2:56 PM	4:04 PM
PM 1 µg/m³	0.012	0.028	0.020	0.021	0.018	0.010	0.006	0.005	0.006
PM 2.5 µg/m³	0.012	0.028	0.020	0.022	0.019	0.010	0.006	0.005	0.006
PM 10 µg/m³	0.013	0.030	0.024	0.024	0.021	0.014	0.008	0.008	0.009

Appendix E

Calibration Certificates for *DustTRAK DRX Desktop 8533 Dust/Aerosol Monitors*

ID# 22063

TSI P/N 2300157

CERTIFICATE OF CALIBRATION AND TESTING

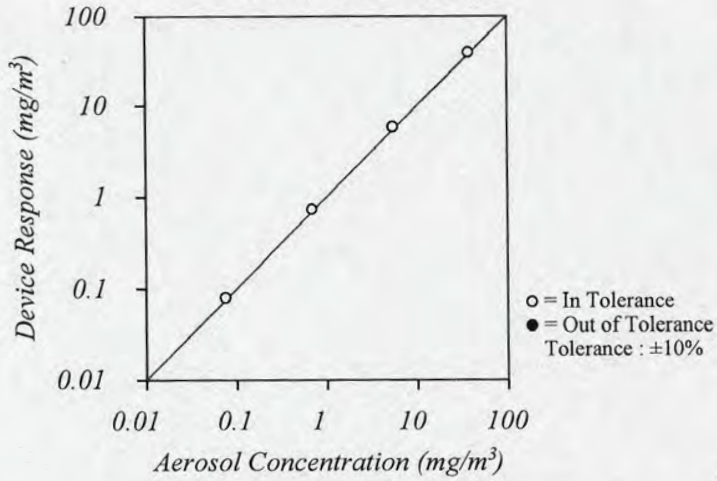
TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

Environment Conditions		
Temperature	74.63 (23.7)	°F (°C)
Relative Humidity	49.7	%RH
Barometric Pressure	29.13 (986.5)	inHg (hPa)

Model	**8533**
Serial Number	**8533133303**

☒ As Left ☒ In Tolerance
☐ As Found ☐ Out of Tolerance

Concentration Linearity Plot



System ID: DTII01-02

FLOW AND PRESSURE VERIFICATION — **SYSTEM DTII01-02**

Parameter	Standard	Measured	Allowable Range	Parameter	Standard	Measured	Allowable Range
Flow lpm	3.00	3.11	2.88 ~ 3.12	Pressure kPa	98.6	98.6	93.66 ~ 103.52
Full Flow lpm	N/A	4.18	>3.80				

TSI Incorporated does hereby certify that all materials, components, and workmanship used in the manufacture of this equipment are in strict accordance with the applicable specifications agreed upon by TSI and the customer and with all published specifications. All performance and acceptance tests required under this contract were successfully conducted according to required specifications. There is no NIST standard for optical mass measurements. Calibration of this instrument performed by TSI has been done using emery oil and has been nominally adjusted to respirable mass per standard ISO 12103-1, A1 test dust (Arizona dust). Our calibration ratio is greater than 1.2:1

Measurement Variable	System ID	Last Cal.	Cal. Due	Measurement Variable	System ID	Last Cal.	Cal. Due
DC Voltage	E003314	01-11-21	01-31-22	Photometer	E003319	02-15-21	08-31-21
Microbalance	M001324	01-29-21	01-31-23	1 um PSL	698880	n/a	n/a
3 um PSL	221853	n/a	n/a	10 um PSL	212455	n/a	n/a
Pressure	E003511	10-26-20	10-31-21	Flowmeter	E005626	03-09-21	03-31-22
DC Voltage	E003315	01-11-21	01-31-22				

Calibrated

June 29, 2021

Date

TSI P/N 2300157

CERTIFICATE OF CALIBRATION AND TESTING

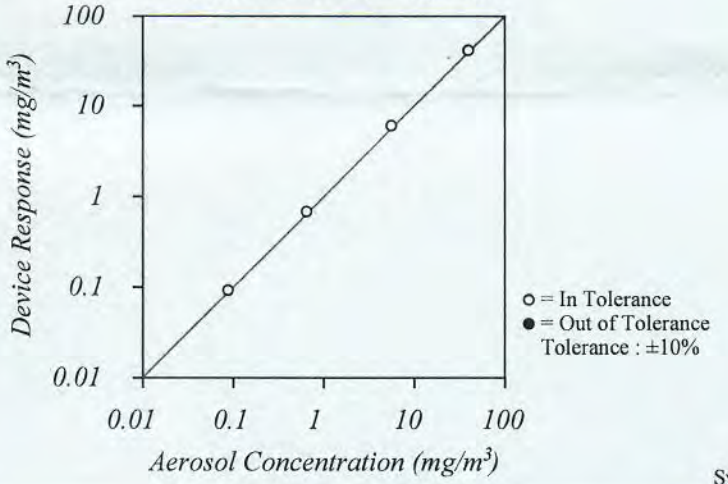
TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

Environment Conditions		
Temperature	74.19 (23.4)	°F (°C)
Relative Humidity	46.6	%RH
Barometric Pressure	29.15 (987.1)	inHg (hPa)

Model	**8533**
Serial Number	**8533172601**

☒ As Left ☒ In Tolerance
☐ As Found ☐ Out of Tolerance

Concentration Linearity Plot



System ID: DTII01-02

FLOW AND PRESSURE VERIFICATION — **SYSTEM DTII01-02**

Parameter	Standard	Measured	Allowable Range	Parameter	Standard	Measured	Allowable Range
Flow lpm	3.00	3.11	2.88 ~ 3.12	Pressure kPa	98.7	98.7	93.72 ~ 103.59
Full Flow lpm	N/A	4.42	>3.80				

TSI Incorporated does hereby certify that all materials, components, and workmanship used in the manufacture of this equipment are in strict accordance with the applicable specifications agreed upon by TSI and the customer and with all published specifications. All performance and acceptance tests required under this contract were successfully conducted according to required specifications. There is no NIST standard for optical mass measurements. Calibration of this instrument performed by TSI has been done using emery oil and has been nominally adjusted to respirable mass per standard ISO 12103-1, A1 test dust (Arizona dust). Our calibration ratio is greater than 1.2:1

Measurement Variable	System ID	Last Cal.	Cal. Due	Measurement Variable	System ID	Last Cal.	Cal. Due
DC Voltage	E003314	01-11-21	01-31-22	Photometer	E003319	02-15-21	08-31-21
Microbalance	M001324	01-29-21	01-31-23	1 um PSL	698880	n/a	n/a
3 um PSL	221853	n/a	n/a	10 um PSL	212455	n/a	n/a
Pressure	E003511	10-26-20	10-31-21	Flowmeter	E005626	03-09-21	03-31-22
DC Voltage	E003315	01-11-21	01-31-22				

Elizah S. Kay

Calibrated

July 30, 2021

Date

TSI P/N 2300157

CERTIFICATE OF CALIBRATION AND TESTING

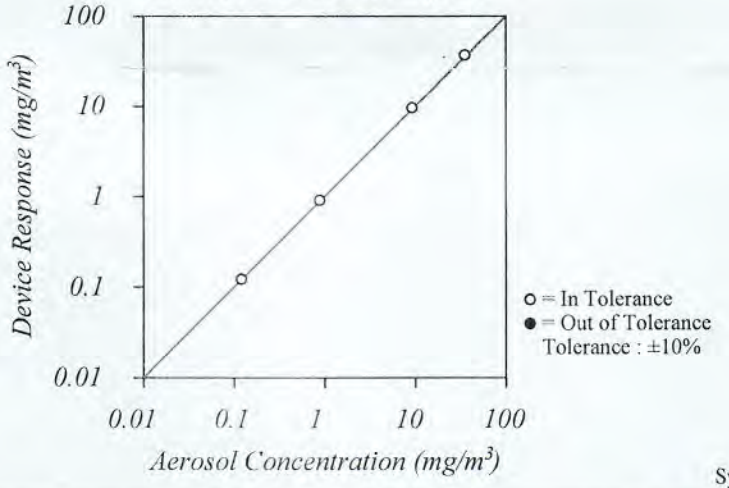
TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

Environment Conditions		
Temperature	76.29 (24.6)	°F (°C)
Relative Humidity	37.3	%RH
Barometric Pressure	29.00 (982.1)	inHg (hPa)

Model	**8533**
Serial Number	**8533172602**

☒ As Left ☒ In Tolerance
☐ As Found ☐ Out of Tolerance

Concentration Linearity Plot



System ID: DTII01-01

FLOW AND PRESSURE VERIFICATION — **SYSTEM DTII01-01**

Parameter	Standard	Measured	Allowable Range	Parameter	Standard	Measured	Allowable Range
Flow lpm	3.00	3.07	2.88 ~ 3.12	Pressure kPa	98.1	98.1	93.18 ~ 102.98
Full Flow lpm	N/A	4.37	>3.80				

TSI Incorporated does hereby certify that all materials, components, and workmanship used in the manufacture of this equipment are in strict accordance with the applicable specifications agreed upon by TSI and the customer and with all published specifications. All performance and acceptance tests required under this contract were successfully conducted according to required specifications. There is no NIST standard for optical mass measurements. Calibration of this instrument performed by TSI has been done using emery oil and has been nominally adjusted to respirable mass per standard ISO 12103-1, A1 test dust (Arizona dust). Our calibration ratio is greater than 1.2:1

Measurement Variable	System ID	Last Cal.	Cal. Due	Measurement Variable	System ID	Last Cal.	Cal. Due
Photometer	E003433	09-22-21	03-31-22	Flowmeter	E003434	08-26-21	08-31-22
DC Voltage(Keithley)	E002859	06-09-21	06-30-22	Microbalance	M001324	01-29-21	01-31-23
Pressure	E005651	07-30-21	07-31-22	1 um PSL	698880	n/a	n/a
3 um PSL	206030	n/a	n/a	10 um PSL	212455	n/a	n/a

David Farrell — Calibrated

October 20, 2021 — Date

CERTIFICATE OF CALIBRATION AND TESTING

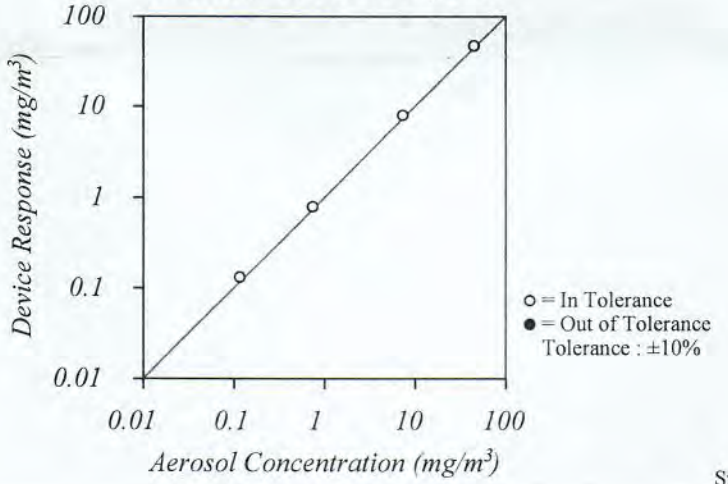
TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

Environment Conditions		
Temperature	73.6 (23.1)	°F (°C)
Relative Humidity	32	%RH
Barometric Pressure	29.13 (986.5)	inHg (hPa)

Model	**8533**
Serial Number	**8533172611**

☒ As Left ☒ In Tolerance
☐ As Found ☐ Out of Tolerance

Concentration Linearity Plot



System ID: DTII01-02

FLOW AND PRESSURE VERIFICATION — **SYSTEM DTII01-02**

Parameter	Standard	Measured	Allowable Range	Parameter	Standard	Measured	Allowable Range
Flow lpm	3.00	3.08	2.88 ~ 3.12	Pressure kPa	98.6	98.6	93.66 ~ 103.52
Full Flow lpm	N/A	4.76	>3.80				

TSI Incorporated does hereby certify that all materials, components, and workmanship used in the manufacture of this equipment are in strict accordance with the applicable specifications agreed upon by TSI and the customer and with all published specifications. All performance and acceptance tests required under this contract were successfully conducted according to required specifications. There is no NIST standard for optical mass measurements. Calibration of this instrument performed by TSI has been done using emery oil and has been nominally adjusted to respirable mass per standard ISO 12103-1, A1 test dust (Arizona dust). Our calibration ratio is greater than 1.2:1

Measurement Variable	System ID	Last Cal.	Cal. Due	Measurement Variable	System ID	Last Cal.	Cal. Due
DC Voltage	E003314	01-11-22	01-31-23	Photometer	E003319	02-22-22	08-31-22
Microbalance	M001324	01-29-21	01-31-23	1 um PSL	698880	n/a	n/a
3 um PSL	221853	n/a	n/a	10 um PSL	234230	n/a	n/a
Pressure	E003511	10-26-21	10-31-22	Flowmeter	E005626	03-04-22	03-31-23
DC Voltage	E003315	01-11-22	01-31-23				

Calibrated

March 14, 2022
Date

TSI P/N 2300157

CERTIFICATE OF CALIBRATION AND TESTING

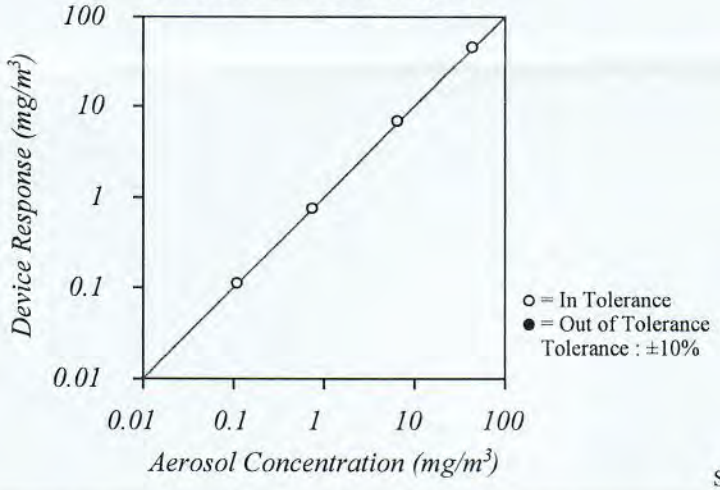
TSI Incorporated, 500 Cardigan Road, Shoreview, MN 55126 USA
Tel: 1-800-874-2811 1-651-490-2811 Fax: 1-651-490-3824 http://www.tsi.com

Environment Conditions		
Temperature	74.21 (23.5)	°F (°C)
Relative Humidity	25.8	%RH
Barometric Pressure	28.73 (972.9)	inHg (hPa)

Model	**8533**
Serial Number	**8533182909**

☒ As Left ☒ In Tolerance
☐ As Found ☐ Out of Tolerance

Concentration Linearity Plot



System ID: DTII01-02

FLOW AND PRESSURE VERIFICATION — **SYSTEM DTII01-02**

Parameter	Standard	Measured	Allowable Range	Parameter	Standard	Measured	Allowable Range
Flow lpm	3.00	3.06	2.88 ~ 3.12	Pressure kPa	97.2	97.2	92.37 ~ 102.10
Full Flow lpm	N/A	4.50	>3.80				

TSI Incorporated does hereby certify that all materials, components, and workmanship used in the manufacture of this equipment are in strict accordance with the applicable specifications agreed upon by TSI and the customer and with all published specifications. All performance and acceptance tests required under this contract were successfully conducted according to required specifications. There is no NIST standard for optical mass measurements. Calibration of this instrument performed by TSI has been done using emery oil and has been nominally adjusted to respirable mass per standard ISO 12103-1, A1 test dust (Arizona dust). Our calibration ratio is greater than 1.2:1

Measurement Variable	System ID	Last Cal.	Cal. Due	Measurement Variable	System ID	Last Cal.	Cal. Due
DC Voltage	E003314	01-11-22	01-31-23	Photometer	E003319	08-30-21	02-28-22
Microbalance	M001324	01-29-21	01-31-23	1 um PSL	698880	n/a	n/a
3 um PSL	221853	n/a	n/a	10 um PSL	234230	n/a	n/a
Pressure	E003511	10-26-21	10-31-22	Flowmeter	E005626	03-09-21	03-31-22
DC Voltage	E003315	01-11-22	01-31-23				

Tom Lang — Calibrated

February 9, 2022 — Date

TSI P/N 2300157

Appendix F

Professional Certification

American Council for Accredited Certification

hereby certifies that

Troy F. Brooks

has met all the specific standards and qualifications of the re-certification process, including continued professional development, and is hereby re-certified as a

CIEC

Council-certified Indoor Environmental Consultant

This certificate expires on March 31, 2023

Charles F. Wiles, Executive Director

0701064

Certificate Number

This certificate remains the property of the American Council for Accredited Certification.

May 26, 2022

Indoor Environmental Quality Assessment: Findings of Initial Assessment

Fresno Unified School District
Eaton Elementary School
1451 East Sierra Avenue
Fresno, CA 93710

Prepared for:

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Prepared By:

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FACS Project #PJ69864

Contents

Executive Summary

Forensic Analytical Consulting Services was retained by Fresno Unified School District to perform a proactive indoor environmental quality assessment of selected areas of Eaton Elementary School in Fresno, CA. Findings of this assessment did not identify hazardous conditions related to indoor air quality in the areas of concern. However, this investigation did find conditions that have the potential to negatively impact indoor environmental quality, and associated actions that can be taken to address them were identified along with other suggestions for generally improving indoor environmental quality. A summary of the primary causes of indoor environmental quality concerns considered, FACS' conclusions and related recommendations are provided in the table below. A more complete discussion of findings, conclusions and recommendations is provided in the body of this report.

FACS IEQ Evaluation Summary		
#	**Primary IEQ Concerns and Recommendations**	**Conclusion & Completion**
1	***Are temperature and humidity conditions resulting in undesirable IEQ in the representative rooms assessed?***	**Potential**
a)	*Occupants and maintenance staff should communicate and work together to understand how the HVAC system functions and to attempt to adjust thermal comfort conditions to match occupant preferences to the extent practicable based upon system design limitations and the above referenced Federal OSHA and ANSI/ASHRAE Standard 55 guidelines.*	❑
b)	*If conditions cannot be controlled to satisfy individual occupant preferences, occupants should self-regulate thermal comfort with clothing choices (e.g., lighter fabrics or short sleeves during hotter conditions, heavier fabrics or long sleeves during cooler conditions, removable layers for varied conditions). Or consider the use of heavier duty blinds or exterior curtains that can block out the direct sun.*	❑
2	***Is inadequate ventilation resulting in undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*None at this time.*	--
3	***Is mold growth contributing to undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*None at this time.*	❑
4	***Are excessive or unusual dust/particulates contributing to undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*None at this time.*	❑

Introduction

Forensic Analytical Consulting Services was retained by Fresno Unified School District (FUSD) to perform indoor environmental quality assessments of various schools at the district. FUSD has selected multiple sites and representative rooms to evaluate proactively to further improve the indoor environment quality for students and staff. On May 10, 2022, FACS conducted an indoor environmental quality assessment of rooms K-1, 8, and 21 at Eaton Elementary School located at 1451 East Sierra Avenue in Fresno, CA. The purpose of the evaluation was to 1) identify and evaluate potential explanations, sources and pathways for possible symptoms related to indoor environment quality issues; 2) provide information for consideration in assessing risk to occupants; and 3) provide recommendations for additional investigation and corrective actions as necessary.

Site Characterization

Eaton Elementary School houses various permanent and portable classroom buildings, an administration office, a staff break room, and multiple restrooms. The exterior of permanent buildings is characterized by stucco with a flat single-ply roof. The buildings are surrounded by light vegetation on all sides. The interior of permanent buildings is generally characterized by carpeted floors over concrete slab, drywall walls covered with tackboard, and cellulose false ceiling tiles suspended on a T-bar grid. The permanent buildings are served by multiple roof mounted air handling units. Supply and return air are ducted above ceiling. The exterior of portable buildings is comprised of stucco with a pitched composition shingle roof, while the interior is characterized by vinyl sheet flooring, wood panel walls, and acoustic ceiling tiles. The portable buildings are served by individual exterior ground mounted cooling units, and interior heating units.

Additional characteristics of the rooms assessed are as follows:

- Room K-1 is located within a single-story permanent building which houses other classrooms (e.g., K-2) and is surrounded by a playground area. The room is served conditioned air through a “forced air” system. The room also has operable windows. The space functions as a kindergarten classroom and is occupied for the majority of school hours.
- Room 8 is located within a single-story permanent building which houses other rooms (e.g., Library, Room 7). The room is served conditioned air through a “forced air” system. The room also has operable windows. The space functions as primary school classroom and is occupied for the majority of the school day.
- Room 21 is a single-story portable/modular unit located on the school campus. The room is served conditioned air through a “forced air” system. The room also has operable windows. The room functions as a secondary recess room and is sporadically occupied throughout the day.

Site History

According to client representatives and occupants/employees, the following history was developed:

- There are currently no reported ill health claims by employees or students.
- A single air purifying unit has been placed in all classrooms. These units run all week and are turned off for the weekend.
- There was no reported history of major water intrusion events in the rooms assessed.
- No recent renovations to the school or rooms assessed.

Scope of Work

In the course of this project, FACS conducted the following scope of work:

1. Development of a site characterization and history (see sections above).
2. Visual assessment of areas of concern (perimeter office spaces).
3. Visual assessment of accessible components of the HVAC systems serving the buildings.
4. Monitoring of various indoor air quality parameters, including carbon dioxide levels, temperature, relative humidity and carbon monoxide, using a data-logging direct reading instrument. Measurements were collected in representative rooms. Monitors were set to collect data for approximately 6 hours.
5. Monitoring of airborne particulates (PM2.5 and PM10) using a data-logging direct reading instrument. Measurements were collected in representative rooms. Monitors were set to collect data for approximately 6 hours.

The data collected in the course of the investigation and supporting information is presented in this report as follows:

- Appendix A: FACS Materials and Methods
- Appendix B: Site Plan
- Appendix C: Photographs
- Appendix D: Data Results Table and Laboratory Reports

Conclusions and Recommendations

This investigation did not find hazardous conditions with regard to indoor air quality; however, it did identify issues that could potentially cause indoor air quality concerns.

In the course of collecting and analyzing the data from this investigation, FACS identified and evaluated typical indoor air quality concerns that could be identified in the school setting. A discussion of these concerns, along with related FACS conclusions and recommendations to improve indoor environmental quality are provided below.

Issue-by-Issue Discussion

1. *Are temperature and humidity conditions resulting in undesirable IEQ in the representative rooms assessed?*

Conclusion: CONFIRMED PROBABLE **POTENTIAL** UNLIKELY

The combination of temperature and humidity in a building is the primary driver of occupant thermal comfort. Occupant thermal discomfort is often associated with increased dissatisfaction with indoor environmental quality and may exacerbate occupant symptoms. Cal/OSHA does not regulate thermal comfort in buildings; however, the California labor code indicates that temperatures in work areas shall provide reasonable comfort consistent with industry-wide standards for the work performed. To this end, Federal OSHA recommends temperature control in the range of 68-76°F and corresponding relative humidity from 60-20%. Similarly, the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) has developed widely accepted guidelines for managing temperature and humidity in buildings to help ensure the thermal comfort of occupants (ANSI/ASHRAE Standard 55). This guideline generally recommends 75-83ºF & 60-10%RH (warm weather) and 68-77ºF & 60-10%RH (cool weather). While these guidelines attempt to define conditions that are acceptable for approximately 80% of occupants, individual preferences may vary.

The following are findings from the assessment:

1. Monitoring for temperature and relative humidity was conducted in rooms K-1, 8, and 21 from approximately 7:30 am to 2:30 pm using data logging indoor air quality monitors. Hours were selected to be representative of a typical school day.

2. Temperature readings are as follows:
    a. K-1: temperatures ranged between 70.2 to 75.9 ºF
    b. Room 8: temperatures ranged between 64.5 to 79.7 ºF
    c. Room 21: temperatures ranged between 67.0 to 76.4 ºF
3. Review of temperatures measured indicate that temperatures were slightly out of both the OSHA and ASHRAE (assuming cooler weather) guidelines for comfort.
4. Relative humidity readings are as follows
    a. K-1: humidity ranged between 20.9 to 29.3%
    b. Room 8: humidity ranged between 22.9 to 38.1%
    c. Room 21: humidity ranged between 23.2 to 43.9%
5. The relative humidity levels measured were within OSHA and ASHRAE guidelines for comfort.
6. Summary of the data is provided in the appendices.

Based on assessment findings, there is the potential that temperature conditions may result in undesirable IEQ in some of the rooms assessed.

Recommendations:

a) Occupants and maintenance staff should communicate and work together to understand how the HVAC system functions and to attempt to adjust thermal comfort conditions to match occupant preferences to the extent practicable based upon system design limitations and the above referenced Federal OSHA and ANSI/ASHRAE Standard 55 guidelines.

b) If conditions cannot be controlled to satisfy individual occupant preferences, occupants should self-regulate thermal comfort with clothing choices (e.g., lighter fabrics or short sleeves during hotter conditions, heavier fabrics or long sleeves during cooler conditions, removable layers for varied conditions). Or consider the use of heavier duty blinds or exterior curtains that can block out the direct sun.

2. Is inadequate ventilation resulting in undesirable IEQ in the representative rooms assessed?

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Mechanical ventilation systems (a.k.a., HVAC systems) generally mix recirculated indoor air with outside "fresh" air. If the ventilation rate (i.e., amount of outside air) is too low, common indoor contaminants such as particles, odors, chemical vapors and exhaled carbon dioxide can accumulate and result in degraded indoor air quality. Occupants in poorly ventilated rooms will frequently describe the air as "stuffy" or "stale" and will more often report symptoms and discomfort related to indoor environmental quality. Cal/OSHA regulations (8CCR§5142) generally require that in mechanically ventilated buildings the HVAC system must be run continuously during working hours. The regulation further requires minimum outdoor airflows based on the building codes in place at the time of construction. The current minimum outdoor airflows called for in the building code are derived from guidelines by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE Standard 62.1--Ventilation for Acceptable Indoor Air Quality) and are calculated based upon the type of building space, number of occupants, size of the occupied area and other variables related to the design of the HVAC system.

In occupied buildings, carbon dioxide (CO_2) concentrations are typically higher then ambient outdoor concentrations due to exhaled air from people. As such, comparison of indoor and outdoor CO_2 levels are often used as a general indicator of indoor ventilation relative to human bioeffluents (i.e., body odor). ANSI/ASHRAE Standard 62.1 indicates that keeping indoor CO_2 levels less than 700 ppm above outdoor (about 1,000 to 1,500 ppm) will provide satisfaction the substantial majority of people in the building relative to human bioeffluents. As a general rule of thumb, ventilating to keep indoor CO_2 levels below 1,000 ppm and closer to outdoor levels results in less occupant complaints regarding indoor air quality and "stuffy" or "stale" air.

The following are findings from the assessment:

1. Per site representatives, HVAC units run continuously, 24 hours a day, seven days a week in the permanent buildings. The HVAC units that serve the portables are turned off by custodial staff at the end of the day.
2. Monitoring for carbon dioxide was conducted in rooms K-1, 8, and 21 from approximately 7:30 am to 2:30 pm using data logging indoor air quality monitors. Hours were selected to be representative of a typical school day.
3. Rooms K-1 and 8 were occupied for the monitoring period, with the exception of lunch and recess. Room 21 was thinly occupied all day as the room is used as a secondary recess room.
4. Carbon dioxide readings are as follows:
    a. K-1: carbon dioxide levels ranged between 460 to 1060 ppm
    b. Room 8: carbon dioxide levels ranged between 387 to 828 ppm
    c. Room 21: carbon dioxide levels ranged between 370 to 618 ppm
5. Review of data measured indicate that carbon dioxide levels were within ASHRAE guidelines for comfort. Note: review of K-1 data indicated that concentrations greater than 1000 ppm were only identified in one instance for 1 minute and therefore not considered significant.
6. Summary of the data is provided in the appendices.

Based on assessment findings, inadequate ventilation resulting in undesirable IEQ is not suspected.

Recommendations:

a) None at this time.

3. *Is mold growth contributing to undesirable IEQ in some parts of the building?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Mold growth can occur when organic building materials or accumulated organic debris is impacted by moisture. This may occur within 24-48 hours from the time such materials become wet, hence it is critical that materials are substantially dried within this time frame in order to minimize the potential for mold growth to develop. Mold growth has the potential to elicit negative health effects in sensitive persons. This most frequently manifests as allergic respiratory symptoms which may range from mild to severe depending on individual sensitivities. Irritant and infectious effects are possible. It is generally accepted that mold growth in buildings should be removed following appropriate precautions to protect workers involved in the clean-up and the surrounding environment. Greater precautions are taken for greater amounts of mold growth. In addition, the underlying cause of mold and moisture intrusion should be identified and corrected in order to minimize the potential for recurrent mold growth. Additional information can be found at the U.S. Environmental Protection Agency website (http://www.epa.gov/mold/).

The following are findings from the assessment:

1. According to site representatives, there have been no known water intrusion events that have occurred in the representative rooms assessed.
2. Many gutters located near HVAC units on the buildings assessed were found to be filled with heavy debris, which may result in clogging and potential water intrusion into buildings.
3. No signs of mold growth was identified in rooms assessed.
4. Minor water staining was identified around a supply register in Room 21.
5. Visual inspection of accessible components of the HVAC units that served the rooms did not indicate any areas of mold growth.
6. Supporting photos are provided in Appendix C.

Based on assessment findings, mold growth is not suspected to be negatively impacting indoor environmental quality in the inspected areas.

Recommendations:

a) None at this time.

4. *Are excessive or unusual dust/particulates contributing to undesirable IEQ?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Various particulates are common in indoor environments. Particles ("dust") from various indoor and outdoor sources (e.g., human skin, paper, dirt, clothing, building material) can accumulate in the indoor environment and result in degraded indoor air quality, i.e. ("dusty" air). In general, we are concerned with particulates that are small enough to be inhaled. While such dust is not considered toxic, health problems that can be caused by breathing non-specific particulates include: eye, nose, and throat irritation and increased risk for respiratory infections and allergic reactions. Acute exposure to particulates, such as can occur if settled dust is disturbed and aerosolized, can potentially cause irritation to building occupants and increase the risk of respiratory problems in sensitive individuals. Inadequate housekeeping and insufficient filtration by the HVAC system can exacerbate dusty environments. Occupants in these conditions may report symptoms such as coughing, sneezing, and discomfort.

The following are findings from the assessment:

1. Light to moderate dust loading was identified in the air handling units assessed.
2. The air handling units that serve the school are equipped with filters that are reportedly changed every six months.
3. Roof mounted HVAC units inspected on permanent buildings were found to have light to heavy dust deposition on filters. FACS could not observed the dedicated unit for the portable classroom assessed (21).
4. Light to moderate dust deposition was observed in the interior of the classrooms assessed. In general, heavier dust accumulation was identified on locations identified as "hard to reach" or surfaces not subject to regular cleaning.
5. Visible ghosting and heavy dust accumulation was identified around the supply registers in room 21.
6. Custodial staff reportedly lightly cleans the rooms on campus daily, which include trash removal, vacuuming of accessible areas, dusting etc.
7. Monitoring for airborne dust levels was conducted in rooms K-1, 8, and 21 from approximately 7:30 am to 2:30 pm using data logging aerosol monitors. Readings included particulate matter with diameter of less than 2.5 microns (PM2.5) and particulate matter with diameter of less than 10 microns (PM10). Results were compared to U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) ranges, which are for outdoor air and 24 hour average concentrations. Currently there are no indoor air quality references to compare indoor particulate levels. Hours were selected to be representative of a typical school day.
8. Airborne particulate readings are as follows:
    - K-1:
        - PM2.5 levels ranged between 0 to 0.025 mg/m^3, with an average of 0.002 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
        - PM10 levels ranged between 0 to 0.061 mg/m^3, with an average of 0.009 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)
    - Room 8:
        - PM2.5 levels ranged between 0.002 to 0.026 mg/m^3, with an average of 0.007 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)

        - PM10 levels ranged between 0.002 to 0.045 mg/m^3, with an average of 0.011 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)
    - Room 21
        - PM2.5 levels ranged between 0.001 to 0.052 mg/m^3, with an average of 0.007 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
        - PM10 levels ranged between 0.001 to 0.090 mg/m^3, with an average of 0.013 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)

9. Summary of the data and supporting photographs is provided in the appendices of the report.

Based on assessment findings, it is unlikely that excessive or unusual dust/particulates is contributing to undesirable IEQ in the rooms assessed.

Recommendations:

a) None at this time.

Limitations

This investigation is limited to the conditions and practices observed and information made available to FACS. The methods, conclusions and recommendations provided are based on FACS' judgment, expertise and the standard of practice for professional service. They are subject to the limitations and variability inherent in the methodology employed. As with all environmental investigations, this investigation is limited to the defined scope and does not purport to set forth all hazards, nor indicate that other hazards do not exist.

Please do not hesitate to contact our offices at 559-436-0277 with any questions or concerns. Thank you for the opportunity to assist Fresno Unified School District in promoting a more healthful environment.

Respectfully,
FORENSIC ANALYTICAL

Joe Blair

Joe Blair
Environmental Health Specialist, Fresno

Reviewed by:
FORENSIC ANALYTICAL

Michelle Rosales

Michelle Rosales, MPH, CIH
Principal Consultant

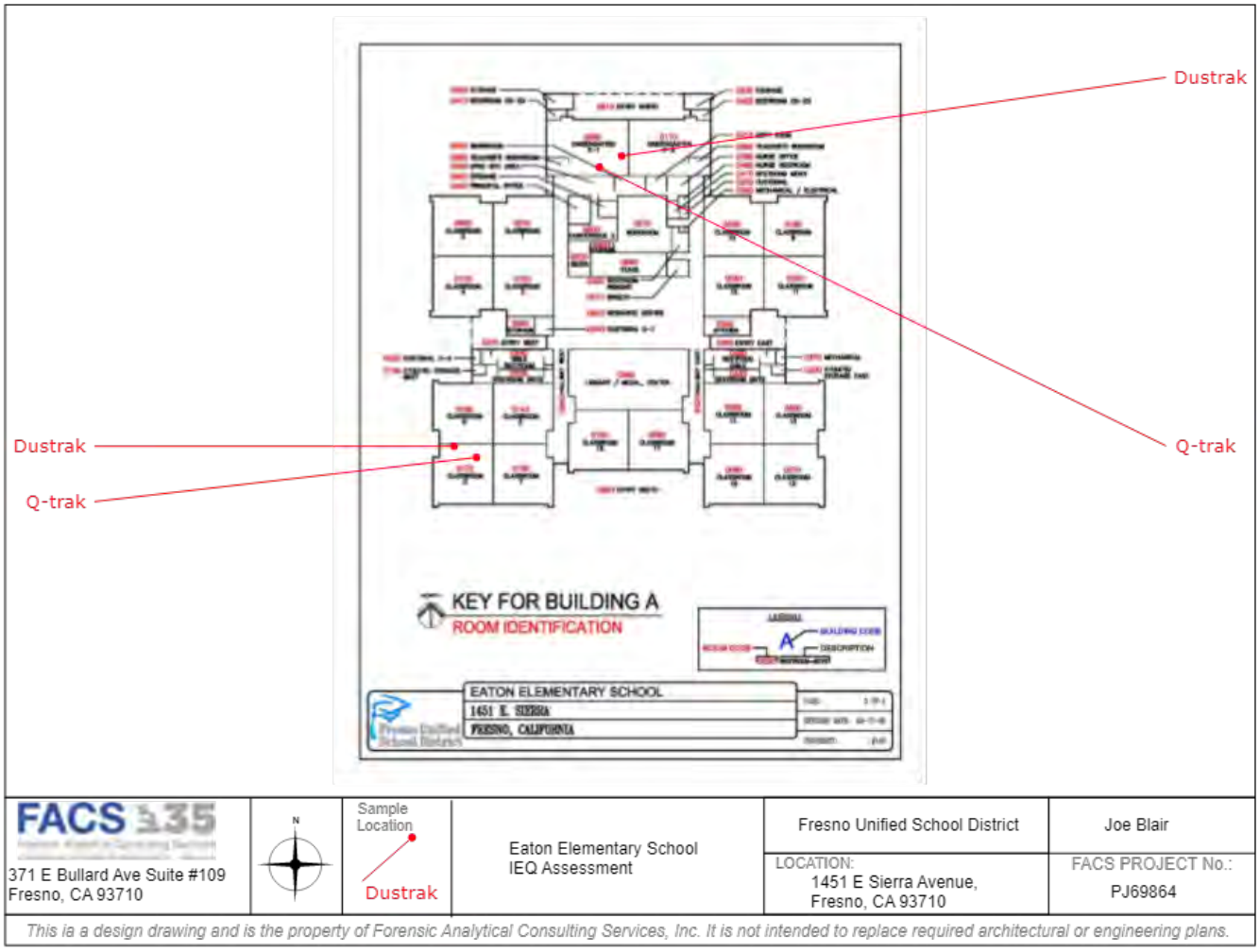
Appendix A
FACS Materials and Methods

Comfort Parameters Air Monitoring. Temperature, relative humidity, carbon dioxide (CO_2), and carbon monoxide (CO) measurements were collected using Q-Trak 7575 Indoor Air Quality Monitors. Measurements for carbon dioxide and carbon monoxide were expressed in concentration values of parts per million (ppm) with a detection limit of 1 ppm. Temperature was collected in degrees Fahrenheit and relative humidity in percentage (%). All data was collected in 60 second intervals within an approximate six hours of sampling time (equivalent to room occupancy).

Airborne Particulates. Airborne particulates were measured using a TSI Dustrak set to collect the fraction of airborne particulates less than 10 microns (<10 µm) in diameter and less than 2.5 µm (PM10 and PM2.5, respectively. The monitor had been factory calibrated within the previous 12 months at the time of sampling and zero calibrated prior to the assessment. Results were expressed in milligrams per cubic meter (mg/m^3).

Appendix B
Sample Map

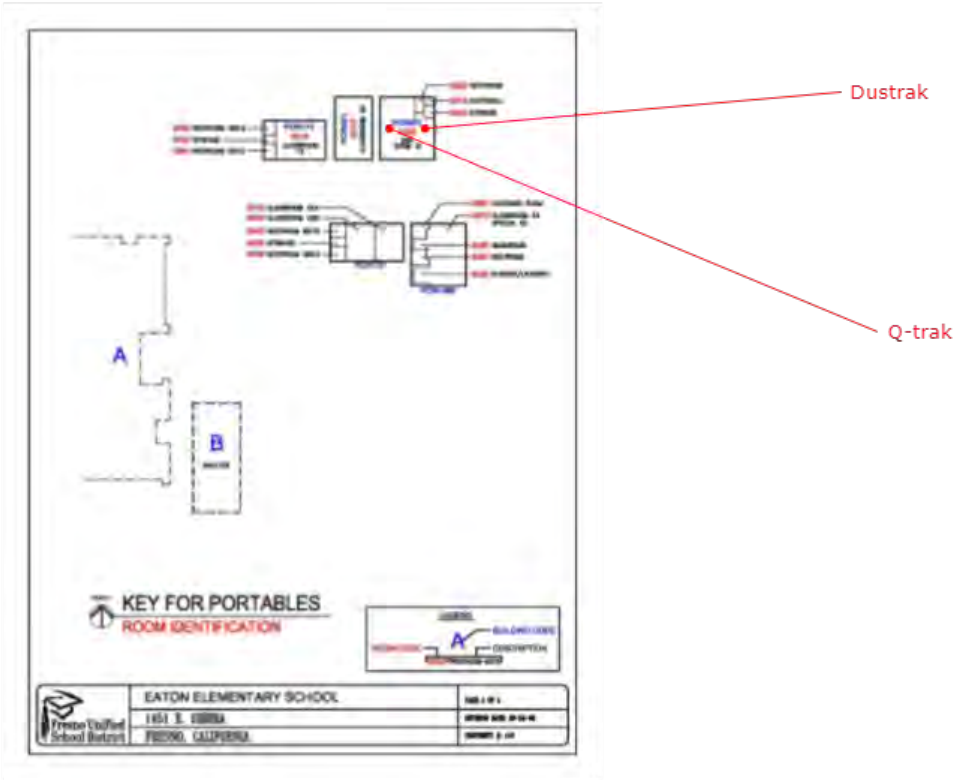
Rooms K-1, 8



FACS 135 371 E Bullard Ave Suite #109 Fresno, CA 93710	N	Sample Location Dustrak	Eaton Elementary School IEQ Assessment	Fresno Unified School District LOCATION: 1451 E Sierra Avenue, Fresno, CA 93710	Joe Blair FACS PROJECT No.: PJ69864

This ia a design drawing and is the property of Forensic Analytical Consulting Services, Inc. It is not intended to replace required architectural or engineering plans.

Room 21



FACS 35 371 E Bullard Ave Suite #109 Fresno, CA 93710	N	Sample Location Dustrak	Eaton Elementary School IEQ Assessment	Fresno Unified School District LOCATION: 1451 E Sierra Avenue, Fresno, CA 93710	Joe Blair FACS PROJECT No.: PJ69864

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Appendix C
Photographs

Photo #1: Room K-1
Site Overview

Photo #2: Room K-1
Light Dust Loading on Surfaces

Photo #3: Room K-1
Light Dust Loading on HVAC Supply

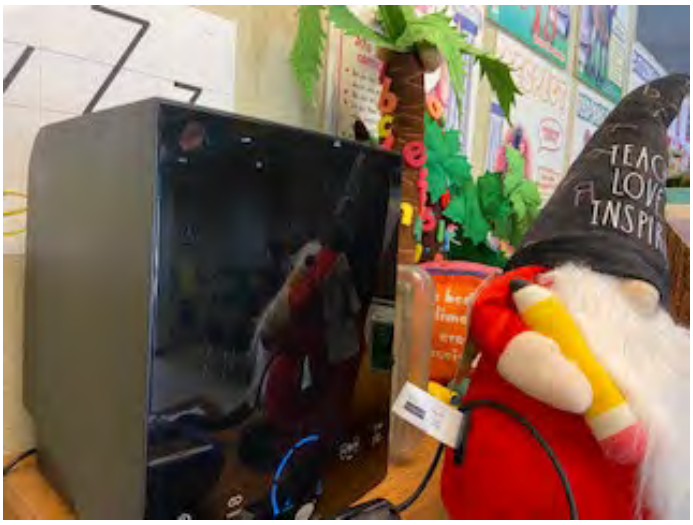

Photo #4: Room K-1
Air Purifier Operating in Room

Photo #5: Room K-1
Hand Sanitizer Used by Staff and Students

Photo #6: HVAC Roof Mounted Unit –
Serves Room K-1

Photo #7: Gutter with Heavy Debris –
Near K-1 Air Handler

Photo #8: K-1 Air Handler –
Heavy Dust Loading on Air Filters

Photo #9: K-1 Air Handler –
Light Dust Loading on Cooling Coils

Photo #10: Room 8 Overview

Photo #11: Room 8 –
Light Dust Loading on HVAC Supply

Photo #12: Room 8 Roof Mounted Air Handler –
Overview

Photo #13: Room 8 Air Handler –
Light to Moderate Dust Loading on Air Filters

Photo #14: Room 8 Air Handler –
Light Dust Loading on Air Filters

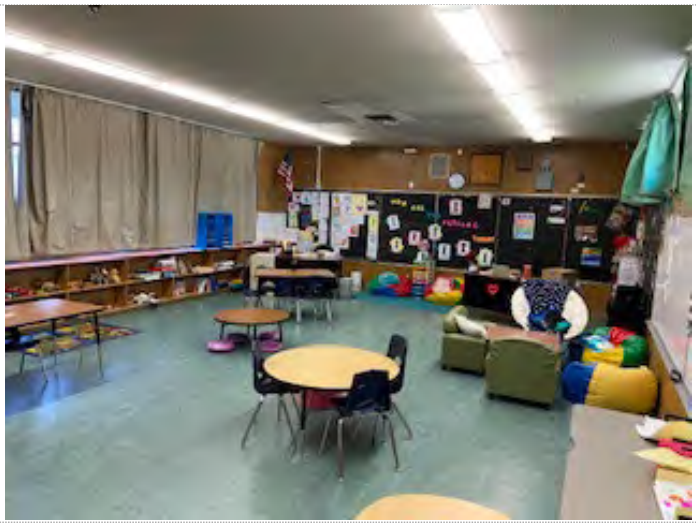

Photo #15: Room 21 –
Overview

Photo #16: Room 21 –
Peeling Paint and Ghosting on ACT's Near Air Supply

Photo #17: Room 21 –
Peeling Paint and Moisture Staining on ACT's Near Air Supply

Photo #18: Room 21 –
Interior Furnace Overview

Photo #19: Room 21 –
Interior Furnace Overview

Photo #20: Room 21 –
Exterior Ground Mounted Condenser Unit

Appendix D
Data Results Tables

Q-Trak Indoor Air Quality Monitors

Instrument Number	Location	$C0_2$	T	H	CO
P12090033	K-1	Avg. 630 ppm Min. 460 ppm Max. 1060 ppm	Avg. 73.0 deg F Min. 70.2 deg F Max. 75.9 deg F	Avg. 24.5% Min. 20.9% Max. 29.2%	Avg. 0.0 ppm Min. 0.0 ppm Max. 0.2 ppm
P14200072	Room 8	Avg. 651 ppm Min. 387 ppm Max. 828 ppm	Avg. 76.8 deg F Min. 64.5 deg F Max 79.7 deg F	Avg. 34.0% Min. 22.9% Max. 38.1%	Avg. 0.0 ppm Min. 0.0 ppm Max. 0.6 ppm
P11380045	Room 21	Avg. 421 ppm Min. 370 ppm Max. 618 ppm	Avg. 70.0 deg F Min. 67.0 deg F Max. 76.4 deg F	Avg. 29.2% Min. 23.2% Max. 43.9%	Avg. 0.0 ppm Min. 0.0 ppm Max. 0.6 ppm

Note:
CO_2 – Carbon dioxide; T – Temperature; H – Humidity (rh – Relative Humidity); CO – Carbon monoxide; PPM – parts per million

DustTrak DRX Aerosol Monitor

Room		PM2.5 (mg/m^3)	PM10 (mg/m^3)
K-1	Ave	0.002	0.009
	Min	-0.003	-0.003
	Max	0.025	0.061
Room 8	Ave	0.007	0.011
	Min	0.002	0.002
	Max	0.026	0.045
Room 21	Ave	0.007	0.013
	Min	0.001	0.001
	Max	0.052	0.090

Note:
The U.S. EPA Air Quality Index (AQI) is an index for reporting daily air quality. The AQI categories for 24-hour average PM2.5 concentrations (in mg/m3) are as follows:

- Good: 0 - 0.0150 mg/m3
- Moderate: 0.0151 -0.0404 mg/m3
- Unsafe for Sensitive Groups: 0.01405 – 0.0654 mg/m3
- Unhealthy: 0.0655 – 0.1504 mg/m3
- Very Unhealthy: 0.1505 -0. 2504 mg/m3
- Hazardous: 250.5 - 500.4 mg/m3

The U.S. EPA Air Quality Index (AQI) is an index for reporting daily air quality. The AQI categories for 24-hour average PM10 concentrations (in mg/m3) are as follows:

- Good: 0 – 0.054 mg/m3
- Moderate: 0.055 – 0.154 mg/m3
- Unsafe for Sensitive Groups: 0.155 – 0.254 mg/m3
- Unhealthy: 0.255 – 0.354 mg/m3
- Very Unhealthy: 0.355 – 0.424 mg/m3
- Hazardous: 0.425 – 0.604 mg/m3

Right People

Right Perspective

Right Now

www.forensicanalytical.com

June 14, 2022

Indoor Environmental Quality Assessment: Findings of Initial Assessment

Figarden Elementary School
6235 North Brawley Avenue
Fresno, CA 93722

Prepared for:

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Executive Summary

Forensic Analytical Consulting Services was retained by Fresno Unified School District to perform a proactive indoor environmental quality assessment of selected areas of Figarden Elementary School in Fresno, California. The assessment did not identify hazardous conditions related to indoor air quality in the areas assessed. However, this investigation did find conditions that have the potential to negatively impact indoor environmental quality, and associated actions that can be taken to address them were identified along with other suggestions for generally improving indoor environmental quality. A summary of the primary causes of indoor environmental quality concerns considered FACS' conclusions and related recommendations are provided in the table below. A more complete discussion of findings, conclusions and recommendations is provided in the body of this report.

FACS IEQ Evaluation Summary		
#	**Primary IEQ Concerns and Recommendations**	**Conclusion & Completion**
1	***Are temperature and humidity conditions resulting in undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*None at time*	--
2	***Is inadequate ventilation resulting in undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*None at this time.*	--
3	***Is mold growth contributing to undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*Remove and replace all stained ceiling tiles in the Library.*	❑
4	***Are excessive or unusual dust/particulates contributing to undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*Communicate custodial practices regarding cleaning regimens (i.e., scope and frequency). Particular attention should be paid to cleaning practices for individual desk and shelving areas. If EVS staff is unable to clean spaces, occupants should be educated on the importance of regularly cleaning of work areas. Avoid brushing off or "dusting" surfaces (dry dusting) and instead employ vacuuming or damp wiping methods. Dry dusting does not physically remove dust and particulates; this technique only temporarily aerosolizes (makes airborne) the dust. Eventually, the particles will re-settle on the surfaces.*	❑
b)	*Ensure air filters are replaced semi-annually or as needed based on dust loading.*	❑

Introduction

Forensic Analytical Consulting Services was retained by Fresno Unified School District to perform indoor environmental quality assessments of various schools at the district. FUSD has selected multiple sites and representative rooms to evaluate proactively to further improve the indoor environment quality for students and staff. On May 12, 2022, FACS conducted an indoor environmental quality assessment of the Library, room 201, and room 36 at Figarden Elementary School located at 6235 North Brawley Avenue in Fresno, California. The purpose of the evaluation was to 1) identify and evaluate potential explanations, sources and pathways for possible symptoms related to indoor environment quality issues; 2) provide information for consideration in assessing risk to occupants; and 3) provide recommendations for additional investigation and corrective actions as necessary.

Site Characterization

Figarden Elementary School houses various permanent and portable buildings, an administration office, a staff break room, and multiple restrooms. The exterior of permanent buildings is characterized by stucco with a flat single-ply roof. The buildings are surrounded by light vegetation on all sides. The interior of permanent buildings is generally characterized by carpeted floors over concrete slab, drywall walls covered with tackboard, and cellulose false ceiling tiles suspended on a T-bar grid. The permanent buildings are served by multiple roof mounted air handling units. Supply and return air are ducted above ceiling. The exterior of portable buildings is comprised of wood panel siding with a flat roof, while the interior is characterized by carpet on wood subfloors, gypsum wallboard walls covered with tackboard, and cellulose false ceiling tiles suspended on a T-bar grid. The portable buildings are served by individual exterior wall mounted cooling and heating units.

Additional characteristics of the rooms assessed are as follows:

- The library is located within a single-story permanent building which houses other rooms (e.g., Wing 200). The space is served conditioned air through a “forced air” system. The space also has operable windows. The space functions as a library and is thinly occupied for the majority of school hours.
- Room 201 is located within a single-story permanent building which houses other classrooms within the “200 wing” and is surrounded by a playground area. The room is served conditioned air through a “forced air” system. The room also has operable windows. The space functions as a kindergarten classroom and is occupied for the majority of the school day.
- Room 36 is a single-story portable/modular unit located on the school campus. The room is served conditioned air through a “forced air” system. The room also has operable windows. The room functions as a standardized testing facility and is sporadically occupied throughout the day.

Site History

According to client representatives and occupants/employees, the following history was developed:

- No employees or students have experienced or claimed ill health effects when occupying the spaces.
- A single air purifying unit has been placed in all classrooms. These units run all week and are turned off for the weekend.
- There was no reported history of major water intrusion events.
- No recent renovations to the school or rooms assessed.

Scope of Work

In the course of this project, FACS conducted the following scope of work:

1. Development of a site characterization and history (see sections above).
2. Visual assessment of the interior of the subject rooms assessed.
3. Visual assessment of accessible components of the HVAC systems serving the subject rooms.
4. Monitoring of various indoor air quality parameters, including carbon dioxide levels, temperature, relative humidity and carbon monoxide, using a data-logging direct reading instrument. Measurements were collected in representative locations throughout the school. Monitors were set to collect data for approximately 7 hours.
5. Monitoring of airborne particulates (PM2.5 and PM10) using a data-logging direct reading instrument. Measurements were collected in representative rooms. Monitors were set to collect data for approximately 7 hours.

The data collected in the course of the investigation and supporting information is presented in this report as follows:

- Appendix A: FACS Materials and Methods
- Appendix B: Site Plan
- Appendix C: Photographs
- Appendix D: Data Results Table and Laboratory Reports

Conclusions and Recommendations

This investigation did not find hazardous conditions with regard to indoor air quality; however, it did identify issues that could potentially cause indoor air quality concerns.

In the course of collecting and analyzing the data from this investigation, FACS identified and evaluated various potential explanations for client and occupant concerns. A discussion of these potential explanations, along with related FACS conclusions and recommendations to improve indoor environmental quality are provided below.

Issue-by-Issue Discussion

1. *Are temperature and humidity conditions resulting in undesirable IEQ in some parts of the building?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

The combination of temperature and humidity in a building is the primary driver of occupant thermal comfort. Occupant thermal discomfort is often associated with increased dissatisfaction with indoor environmental quality and may exacerbate occupant symptoms. Cal/OSHA does not regulate thermal comfort in buildings; however the California labor code indicates that temperatures in work areas shall provide reasonable comfort consistent with industry-wide standards for the work performed. To this end, Federal OSHA recommends temperature control in the range of 68-76°F and corresponding relative humidity from 60-20%. Similarly, the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) has developed widely accepted guidelines for managing temperature and humidity in buildings to help ensure the thermal comfort of occupants (ANSI/ASHRAE Standard 55). This guideline generally recommends 75-83ºF & 60-10%RH (warm weather) and 68-77ºF & 60-10%RH (cool weather). While these guidelines attempt to define conditions that are acceptable for approximately 80% of occupants, individual preferences may vary.

The following are findings from the assessment:

1. Monitoring for temperature and relative humidity was conducted in rooms 36, 201 and the library, from approximately 7:30 am to 2:30 pm using data logging indoor air quality monitors. Hours were selected to be representative of a typical school day.
2. Temperature readings are as follows:
    a. Library: temperatures ranged between 73.3 to 74.9 ºF
    b. Room 36: temperatures ranged between 74.1 to 77.1 ºF
    c. Room 201: temperatures ranged between 74.1 to 75.8 ºF
3. Review of temperatures measured indicate that temperatures were within both the OSHA and ASHRAE (assuming cooler weather) guidelines for comfort.
4. Relative humidity readings are as follows:
    a. Library: humidity ranged between 28.2 to 41.1%
    b. Room 36: humidity ranged between 28.2 to 41.1%
    c. Room 201: humidity ranged between 29.7 to 35.0%
5. The relative humidity levels measured were within OSHA and ASHRAE guidelines for comfort.
6. Summary of the data is provided in the appendices

Based on assessment findings, there is the potential that temperature conditions may result in undesirable IEQ in some parts of the building; particularly the perimeter offices.

Recommendations:

a) None at this time.

2. Is inadequate ventilation resulting in undesirable IEQ in some parts of the building?

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Mechanical ventilation systems (a.k.a., HVAC systems) generally mix recirculated indoor air with outside "fresh" air. If the ventilation rate (i.e., amount of outside air) is too low, common indoor contaminants such as particles, odors, chemical vapors and exhaled carbon dioxide can accumulate and result in degraded indoor air quality. Occupants in poorly ventilated rooms will frequently describe the air as "stuffy" or "stale" and will more often report symptoms and discomfort related to indoor environmental quality. Cal/OSHA regulations (8CCR§5142) generally require that in mechanically ventilated buildings the HVAC system must be run continuously during working hours. The regulation further requires minimum outdoor airflows based on the building codes in place at the time of construction. The current minimum outdoor airflows called for in the building code are derived from guidelines by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE Standard 62.1--Ventilation for Acceptable Indoor Air Quality) and are calculated based upon the type of building space, number of occupants, size of the occupied area and other variables related to the design of the HVAC system.

In occupied buildings, carbon dioxide (CO_2) concentrations are typically higher then ambient outdoor concentrations due to exhaled air from people. As such, comparison of indoor and outdoor CO_2 levels are often used as a general indicator of indoor ventilation relative to human bioeffluents (i.e., body odor). ANSI/ASHRAE Standard 62.1 indicates that keeping indoor CO_2 levels less than 700 ppm above outdoor (about 1,000 to 1,500 ppm) will provide satisfaction the substantial majority of people in the building relative to human bioeffluents. As a general rule of thumb, ventilating to keep indoor CO_2 levels below 1,000 ppm and closer to outdoor levels results in less occupant complaints regarding indoor air quality and "stuffy" or "stale" air.

The following are findings from the assessment:

1. Per site representatives, HVAC units run continuously, 24 hours a day, seven days a week in the permanent buildings.

2. Monitoring for carbon dioxide was conducted in rooms 36, 201, and the library from approximately 7:30 am to 2:30 pm using data logging indoor air quality monitors. Hours were selected to be representative of a typical school day.
3. Room 201 and the library were occupied for the monitoring period, with the exception of lunch and recess. Room 36 was sparsely occupied during the day as the room is used as a standardized testing facility.
4. Carbon dioxide readings are as follows:
    - Room 36: carbon dioxide levels ranged between 439 to 906 ppm
    - Room 201: carbon dioxide levels ranged between 418 to 782 ppm
    - Library: carbon dioxide levels ranged between 371 to 664 ppm
5. Review of data measured indicate that carbon dioxide levels were within ASHRAE guidelines for comfort.
6. Summary of the data is provided in the appendices.

Based on assessment findings, inadequate ventilation resulting in undesirable IEQ is not suspected.

Recommendations:

a) *None at this time*

3. *Is mold growth contributing to undesirable IEQ in some parts of the building?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Mold growth can occur when organic building materials or accumulated organic debris is impacted by moisture. This may occur within 24-48 hours from the time such materials become wet, hence it is critical that materials are substantially dried within this time frame in order to minimize the potential for mold growth to develop. Mold growth has the potential to elicit negative health effects in sensitive persons. This most frequently manifests as allergic respiratory symptoms which may range from mild to severe depending on individual sensitivities. Irritant and infectious effects are possible. It is generally accepted that mold growth in buildings should be removed following appropriate precautions to protect workers involved in the clean-up and the surrounding environment. Greater precautions are taken for greater amounts of mold growth. In addition, the underlying cause of mold and moisture intrusion should be identified and corrected in order to minimize the potential for recurrent mold growth. Additional information can be found at the U.S. Environmental Protection Agency website (http://www.epa.gov/mold/).

The following are findings from the assessment:

1. According to site representatives, there have been no known water intrusion events that have occurred in the representative rooms assessed.
2. No signs of mold growth was identified in rooms assessed.
3. Minor moisture staining was identified on ceiling tile in the library. Based on the severity and quantity of the staining identified, significant mold growth that would result in negative air quality if present, is not suspected.
4. Visual inspection of accessible components of the HVAC units that served the rooms did not indicate any areas of mold growth.
5. Supporting photos are provided in Appendix C.

Based on assessment findings, mold growth is not suspected to be negatively impacting indoor environmental quality in the inspected areas. As best practice the following recommendation was generated.

Recommendations:

a) *Remove and replace all stained ceiling tile.*

4. *Are excessive or unusual dust/particulates contributing to undesirable IEQ?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Various particulates are common in indoor environments. Particles ("dust") from various indoor and outdoor sources (e.g., human skin, paper, dirt, clothing, building material) can accumulate in the indoor environment and result in degraded indoor air quality, i.e. ("dusty" air). In general, we are concerned with particulates that are small enough to be inhaled. While such dust is not considered toxic, health problems that can be caused by breathing non-specific particulates include: eye, nose, and throat irritation and increased risk for respiratory infections and allergic reactions. Acute exposure to particulates, such as can occur if settled dust is disturbed and aerosolized, can potentially cause irritation to building occupants and increase the risk of respiratory problems in sensitive individuals. Inadequate housekeeping and insufficient filtration by the HVAC system can exacerbate dusty environments. Occupants in these conditions may report symptoms such as coughing, sneezing, and discomfort.

The following are findings from the assessment: The following are findings from the assessment:

1. Light to moderate dust loading was identified in the air handling units assessed.
2. The air handling units that serve the school are equipped with filters that are reportedly changed every six months.
3. Roof mounted HVAC units inspected were found to have light to heavy dust deposition on filters.
4. Light to moderate dust deposition was observed in the classrooms assessed. In general, heavier dust accumulation was identified on locations identified as "hard to reach" or surfaces not subject to regular cleaning.
5. Custodial staff reportedly lightly cleans the rooms on campus daily, which include trash removal, vacuuming of accessible areas, dusting etc.
6. Monitoring for airborne dust levels was conducted in rooms 36, 201, and the library from approximately 7:30 am to 2:30 pm using data logging aerosol monitors. Readings included particulate matter with diameter of less than 2.5 microns (PM2.5) and particulate matter with diameter of less than 10 microns (PM10). Hours were selected to be representative of a typical school day.
7. Airborne particulate readings are as follows:
    - Room 36:
        - PM2.5 levels ranged between 0.004 to 0.034 mg/m^3, with an average of 0.015 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
        - PM10 levels ranged between 0.005 to 0.068 mg/m^3, with an average of 0.022 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)
    - Room 201:
        - PM2.5 levels ranged between 0.000 to 0.036 mg/m^3, with an average of -0.002 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
        - PM10 levels ranged between 0.000 to 0.063 mg/m^3, with an average of 0.004 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)
    - Library
        - PM2.5 levels ranged between 0.002 to 0.015 mg/m^3, with an average of 0.006 mg/m^3, which is considered within the U.S. Environmental Protection Agency

(USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)

- PM10 levels ranged between 0.002 to 0.035 mg/m^3, with an average of 0.011 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)

8. Summary of the data is provided in the appendices of the report.

Based on assessment findings, it is unlikely that excessive or unusual dust/particulates are contributing to undesirable IEQ in the inspected areas. The following recommendations is provided as best practice.

Recommendations:

a) *Communicate custodial practices regarding cleaning regimens (i.e., scope and frequency). Particular attention should be paid to cleaning practices for individual desk and shelving areas. If EVS staff is unable to clean spaces, occupants should be educated on the importance of regularly cleaning of work areas. Avoid brushing off or "dusting" surfaces (dry dusting) and instead employ vacuuming or damp wiping methods. Dry dusting does not physically remove dust and particulates; this technique only temporarily aerosolizes (makes airborne) the dust. Eventually, the particles will re-settle on the surfaces.*
b) *Ensure air filters are replaced semi-annually or as needed based on dust loading.*

Limitations

This investigation is limited to the conditions and practices observed and information made available to FACS. The methods, conclusions and recommendations provided are based on FACS' judgment, expertise and the standard of practice for professional service. They are subject to the limitations and variability inherent in the methodology employed. As with all environmental investigations, this investigation is limited to the defined scope and does not purport to set forth all hazards, nor indicate that other hazards do not exist.

Please do not hesitate to contact our offices at 559-436-0277 with any questions or concerns. Thank you for the opportunity to assist Fresno Unified School District in promoting a more healthful environment.

Respectfully,
FORENSIC ANALYTICAL

Joe Blair

Joe Blair
Environmental Health Specialist, Fresno

Reviewed by:
FORENSIC ANALYTICAL

Michelle Rosales

Michelle Rosales, MPH, CIH
Principal Consultant

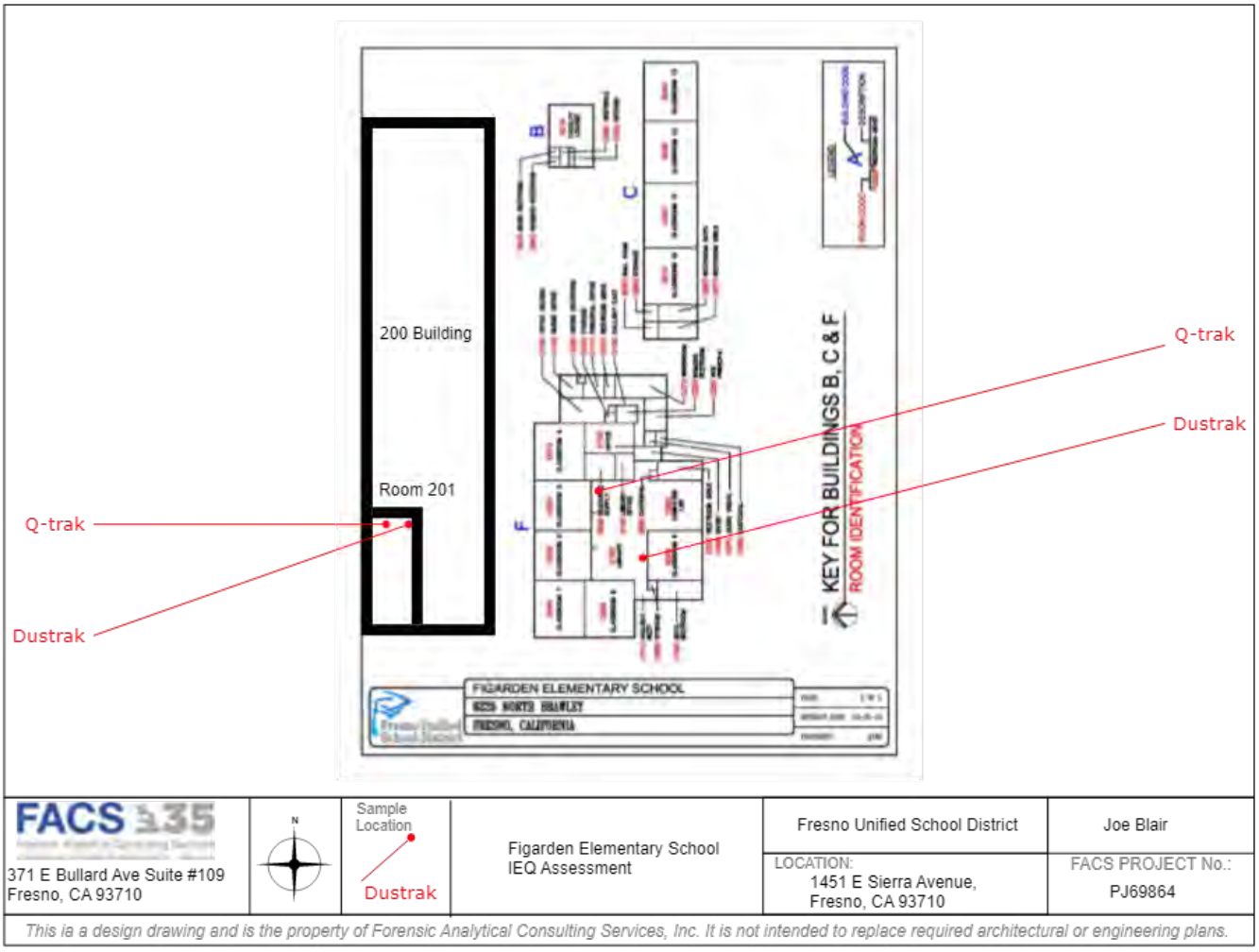
Appendix A
FACS Materials and Methods

Comfort Parameters Air Monitoring. Temperature, relative humidity, carbon dioxide (CO_2), and carbon monoxide (CO) measurements were collected using a Q-Trak 7575 Indoor Air Quality Monitors. Measurements for carbon dioxide and carbon monoxide are expressed in concentration values of parts per million (ppm) with a detection limit of 1 ppm. Temperature was collected in degrees Fahrenheit and relative humidity in percentage (%). All data was collected in 60 second intervals within an approximate six hours of sampling time.

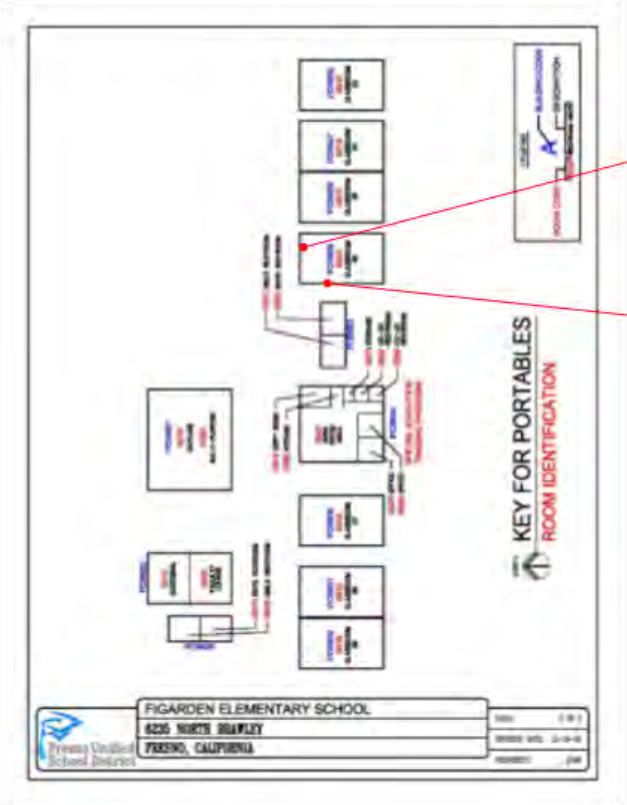
Airborne Particulates. Airborne particulates were measured using a TSI Dustrak set to collect the fraction of airborne particulates less than 10 microns (<10 µm) in diameter and less than 2.5 µm (PM10 and PM2.5, respectively. The monitor had been factory calibrated within the previous 12 months at the time of sampling and zero calibrated prior to the assessment. Results were expressed in milligrams per cubic meter (mg/m^3). All data was collected in 60 second intervals within an approximate six hours of sampling time.

Appendix B
Sample Map

Library, Room 201



Room 36



FACS 35 371 E Bullard Ave Suite #109 Fresno, CA 93710	N	Sample Location Dustrak	Figarden Elementary School IEQ Assessment	Fresno Unified School District LOCATION: 1451 E Sierra Avenue, Fresno, CA 93710	Joe Blair FACS PROJECT No.: PJ69864

This ia a design drawing and is the property of Forensic Analytical Consulting Services, Inc. It is not intended to replace required architectural or engineering plans.

Appendix C
Photographs

Photo #1: Room 36
Site Overview

Photo #2: Room 36
Light Dust Loading on HVAC Supply

Photo #3: Room 36
Storm Downspout Near Exterior Siding

Photo #4: Room 36
Wall Mounted HVAC Unit

Photo #5: Room 36
Evaporation Line

Photo #6: Room 36 –
Heavy Dust Loading on HVAC Return

Photo #7: Room 201 –
Overview

Photo #8: Room 201 –
Light Dust Loading on HVAC Supply

Photo #9: Room 201 –
HVAC Roof Mounted Unit

Photo #10: Room 201
Heavy Dust Loading on HVAC Components

Photo #11: Room 201 –
Heavy Dust Loading on HVAC Filters

Photo #12: Room 201 –
Heavy Dust Loading on HVAC Filters

Photo #13: Library –
Overview

Photo #14: Library –
Light Dust Loading on Contents

Photo #15: Library –
Stain on False Ceiling Panels

Photo #16: Library –
Staining on False Ceiling Panels

Photo #17: Library –
Roof Mounted HVAC Unit

Photo #18: Library –
Roof Mounted HVAC Condensate Pan

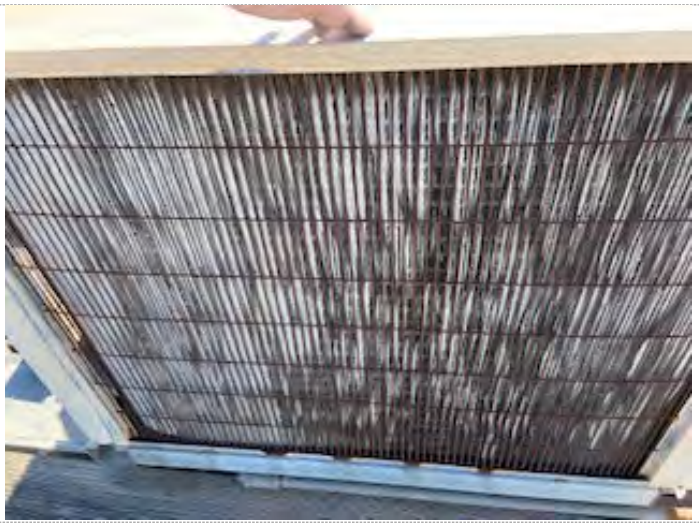


Photo #19: Library –
Heavy Dust Loading on HVAC Condenser Cell

Photo #20: Library –
Overview

Appendix D
Data Results Tables

Q-Trak Indoor Air Quality Monitors

Instrument Number	Location	$C0_2$	T	H	CO
P12090033	36	Avg. 689 ppm Min. 439 ppm Max. 906 ppm	Avg. 74.1 deg F Min. 69.1 deg F Max. 77.1 deg F	Avg. 29.7% rh Min. 27.0% rh Max. 35.0% rh	Avg. 0.0 ppm Min. 0.0 ppm Max. 0.0 ppm
P11380045	201	Avg. 599 ppm Min. 418 ppm Max. 782 ppm	Avg. 74.1 deg F Min. 63.0 deg F Max 75.8 deg F	Avg. 30.8% rh Min. 27.2% rh Max. 48.8% rh	Avg. 0.0 ppm Min. 0.0 ppm Max. 0.3 ppm
P14200072	Library	Avg. 433 ppm Min. 371 ppm Max. 664 ppm	Avg. 73.3 deg F Min. 64.8 deg F Max. 74.9 deg F	Avg. 28.2% rh Min. 24.8% rh Max. 41.1% rh	Avg. 0.0 ppm Min. 0.0 ppm Max. 0.2 ppm

Note:
CO_2 – Carbon dioxide; T – Temperature; H – Humidity (rh – Relative Humidity); CO – Carbon monoxide; PPM – Parts per million

DustTrak DRX Aerosol Monitor

Room		PM2.5 (mg/m^3)	PM10 (mg/m^3)
36	Avg	0.015	0.022
	Min	0.004	0.005
	Max	0.034	0.068
201	Avg	0.000	0.004
	Min	0.000	0.000
	Max	0.036	0.063
Library	Avg	0.006	0.011
	Min	0.002	0.002
	Max	0.015	0.035

Note:
The U.S. EPA Air Quality Index (AQI) is an index for reporting daily air quality. The AQI categories for 24-hour average PM2.5 concentrations (in mg/m3) are as follows:

- Good: 0 - 0.0150 mg/m3
- Moderate: 0.0151 -0.0404 mg/m3
- Unsafe for Sensitive Groups: 0.01405 – 0.0654 mg/m3
- Unhealthy: 0.0655 – 0.1504 mg/m3
- Very Unhealthy: 0.1505 -0. 2504 mg/m3
- Hazardous: 250.5 - 500.4 mg/m3

The U.S. EPA Air Quality Index (AQI) is an index for reporting daily air quality. The AQI categories for 24-hour average PM10 concentrations (in mg/m3) are as follows:

- Good: 0 – 0.054 mg/m3
- Moderate: 0.055 – 0.154 mg/m3
- Unsafe for Sensitive Groups: 0.155 – 0.254 mg/m3
- Unhealthy: 0.255 – 0.354 mg/m3
- Very Unhealthy: 0.355 – 0.424 mg/m3

Hazardous: 0.425 – 0.604 mg/m3

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June 1, 2022

Indoor Environmental Quality Assessment: Findings of Initial Assessment

Fresno Unified School District
Kirk Elementary School
2000 East Belgravia Avenue
Fresno, CA 93706

Prepared for:

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FACS Project #PJ69864

Contents

Executive Summary

Forensic Analytical Consulting Services was retained by Fresno Unified School District to perform a proactive indoor environmental quality assessment of selected areas of Kirk Elementary School in Fresno, CA. Findings of this assessment did not identify hazardous conditions related to indoor air quality in the areas of concern. However, this investigation did find conditions that have the potential to negatively impact indoor environmental quality, and associated actions that can be taken to address them were identified along with other suggestions for generally improving indoor environmental quality. A summary of the primary causes of indoor environmental quality concerns considered, FACS' conclusions and related recommendations are provided in the table below. A more complete discussion of findings, conclusions and recommendations is provided in the body of this report.

FACS IEQ Evaluation Summary		
#	**Primary IEQ Concerns and Recommendations**	**Conclusion & Completion**
1	***Are temperature and humidity conditions resulting in undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*None at this time.*	--
2	***Is inadequate ventilation resulting in undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*None at this time.*	--
3	***Is mold growth contributing to undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*None at this time.*	--
4	***Are excessive or unusual dust/particulates contributing to undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*Ensure that the HVAC units that serve the portable units are also included on the PM schedule and regularly cleaned.*	❑

Introduction

Forensic Analytical Consulting Services was retained by Fresno Unified School District (FUSD) to perform indoor environmental quality assessments of various schools at the district. FUSD has selected multiple sites and representative rooms to evaluate proactively to further improve the indoor environment quality for students and staff. On May 13, 2022, FACS conducted an indoor environmental quality assessment of rooms K-1, 14, and 28 PCR at Kirk Elementary School located at 2000 East Belgravia Avenue in Fresno, CA. The purpose of the evaluation was to 1) identify and evaluate potential explanations, sources and pathways for possible symptoms related to indoor environment quality issues; 2) provide information for consideration in assessing risk to occupants; and 3) provide recommendations for additional investigation and corrective actions as necessary.

Site Characterization

Kirk Elementary School houses various permanent and portable classroom buildings, an administration office, a staff break room, and multiple restrooms. The exterior of permanent buildings is characterized by stucco with a flat single-ply roof. The buildings are surrounded by light vegetation on all sides. The interior of permanent buildings is generally characterized by carpeted floors over concrete slab, drywall walls covered with tackboard, and cellulose false ceiling tiles suspended on a T-bar grid. The permanent buildings are served by multiple roof mounted air handling units. Supply and return air are ducted above ceiling. The exterior of portable buildings is comprised of stucco with a flat roof, while the interior is characterized by carpet on wood subfloors, tackboard covering drywall, and cellulose false ceiling tiles suspended on a T-bar grid. The portable buildings are served by individual exterior ground mounted cooling units, and interior heating units.

Additional characteristics of the rooms assessed are as follows:

- Room K-1 is located within a single-story permanent building which houses other classrooms (e.g., K-2) and is surrounded by a playground area. The room is served conditioned air through a “forced air” system. The room also has operable windows. The space functions as a kindergarten classroom and is occupied for the majority of school hours.
- Room 14 is located within a single-story permanent building which houses other rooms (e.g., Room 13). The room is served conditioned air through a “forced air” system. The room also has operable windows. The space functions as primary school classroom and is occupied for the majority of the school day.
- Room 28 PCR is a single-story portable/modular unit located on the school campus. The room is served conditioned air through a “forced air” system. The room also has operable windows. The room functions as a standardized testing facility room and is sporadically occupied throughout the day.

Site History

According to client representatives and occupants/employees, the following history was developed:

- There are currently no reported ill health claims by employees or students.
- A single air purifying unit has been placed in all classrooms. These units run all week and are turned off for the weekend.
- There was no reported history of major water intrusion events in the rooms assessed.
- No recent renovations to the school or rooms assessed.

Scope of Work

In the course of this project, FACS conducted the following scope of work:

1. Development of a site characterization and history (see sections above).
2. Visual assessment of areas of the interior of the subject rooms.
3. Visual assessment of accessible components of the HVAC systems serving the subject rooms.
4. Monitoring of various indoor air quality parameters, including carbon dioxide levels, temperature, relative humidity and carbon monoxide, using a data-logging direct reading instrument. Measurements were collected in representative rooms. Monitors were set to collect data for approximately 8 hours.
5. Monitoring of airborne particulates (PM2.5 and PM10) using a data-logging direct reading instrument. Measurements were collected in representative rooms. Monitors were set to collect data for approximately 8 hours.

The data collected in the course of the investigation and supporting information is presented in this report as follows:

- Appendix A: FACS Materials and Methods
- Appendix B: Site Plan
- Appendix C: Photographs
- Appendix D: Data Results Table and Laboratory Reports

Conclusions and Recommendations

This investigation did not find hazardous conditions with regard to indoor air quality; however, it did identify issues that could potentially cause indoor air quality concerns.

In the course of collecting and analyzing the data from this investigation, FACS identified and evaluated typical indoor air quality concerns that could be identified in the school setting. A discussion of these concerns, along with related FACS conclusions and recommendations to improve indoor environmental quality are provided below.

Issue-by-Issue Discussion

1. *Are temperature and humidity conditions resulting in undesirable IEQ in the representative rooms assessed?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

The combination of temperature and humidity in a building is the primary driver of occupant thermal comfort. Occupant thermal discomfort is often associated with increased dissatisfaction with indoor environmental quality and may exacerbate occupant symptoms. Cal/OSHA does not regulate thermal comfort in buildings; however, the California labor code indicates that temperatures in work areas shall provide reasonable comfort consistent with industry-wide standards for the work performed. To this end, Federal OSHA recommends temperature control in the range of 68-76°F and corresponding relative humidity from 60-20%. Similarly, the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) has developed widely accepted guidelines for managing temperature and humidity in buildings to help ensure the thermal comfort of occupants (ANSI/ASHRAE Standard 55). This guideline generally recommends 75-83ºF & 60-10%RH (warm weather) and 68-77ºF & 60-10%RH (cool weather). While these guidelines attempt to define conditions that are acceptable for approximately 80% of occupants, individual preferences may vary.

The following are findings from the assessment:

1. Monitoring for temperature and relative humidity was conducted in rooms K-1, 14, and 28 PCR from approximately 7:30 am to 2:30 pm using data logging indoor air quality monitors. Hours were selected to be representative of a typical school day.
2. Temperature readings are as follows:
    a. K-1: temperatures ranged between 68.1 to 74.3 ºF
    b. Room 14: temperatures ranged between 69.3 to 75.4 ºF
    c. Room 28 PCR: temperatures ranged between 67.8 to 74.0 ºF
3. Review of temperatures measured indicate that temperatures were within both the OSHA and ASHRAE (assuming cooler weather) guidelines for comfort.
4. Relative humidity readings are as follows
    a. K-1: humidity ranged between 29.5 to 40.2%
    b. Room 14: humidity ranged between 30.4 to 35.7%
    c. Room 28: humidity ranged between 33.6 to 42.5%
5. The relative humidity levels measured were within OSHA and ASHRAE guidelines for comfort.
6. Summary of the data is provided in the appendices.

Based on assessment findings, there is the potential that temperature conditions may result in undesirable IEQ in some of the rooms assessed.

Recommendations:

a) None at this time.

2. Is inadequate ventilation resulting in undesirable IEQ in the representative rooms assessed?

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Mechanical ventilation systems (a.k.a., HVAC systems) generally mix recirculated indoor air with outside "fresh" air. If the ventilation rate (i.e., amount of outside air) is too low, common indoor contaminants such as particles, odors, chemical vapors and exhaled carbon dioxide can accumulate and result in degraded indoor air quality. Occupants in poorly ventilated rooms will frequently describe the air as "stuffy" or "stale" and will more often report symptoms and discomfort related to indoor environmental quality. Cal/OSHA regulations (8CCR§5142) generally require that in mechanically ventilated buildings the HVAC system must be run continuously during working hours. The regulation further requires minimum outdoor airflows based on the building codes in place at the time of construction. The current minimum outdoor airflows called for in the building code are derived from guidelines by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE Standard 62.1--Ventilation for Acceptable Indoor Air Quality) and are calculated based upon the type of building space, number of occupants, size of the occupied area and other variables related to the design of the HVAC system.

In occupied buildings, carbon dioxide (CO_2) concentrations are typically higher then ambient outdoor concentrations due to exhaled air from people. As such, comparison of indoor and outdoor CO_2 levels are often used as a general indicator of indoor ventilation relative to human bioeffluents (i.e., body odor). ANSI/ASHRAE Standard 62.1 indicates that keeping indoor CO_2 levels less than 700 ppm above outdoor (about 1,000 to 1,500 ppm) will provide satisfaction the substantial majority of people in the building relative to human bioeffluents. As a general rule of thumb, ventilating to keep indoor CO_2 levels below 1,000 ppm and closer to outdoor levels results in less occupant complaints regarding indoor air quality and "stuffy" or "stale" air.

The following are findings from the assessment:

1. Per site representatives, HVAC units run continuously, 24 hours a day, seven days a week in the permanent buildings. The HVAC units that serve the portables are turned off by custodial staff at the end of the day.
2. Monitoring for carbon dioxide was conducted in rooms K-1, 14, and 28 PCR from approximately 7:30 am to 2:30 pm using data logging indoor air quality monitors. Hours were selected to be representative of a typical school day.
3. Room 14 was occupied for the monitoring period, with the exception of lunch and recess. Room K-1 was sparsely occupied due to a class field trip. Room 28 PCR was sparsely occupied all day due to the space functioning as a standardized testing facility.
4. Carbon dioxide readings are as follows:
    a. K-1: carbon dioxide levels ranged between 588 to 756 ppm
    b. Room 14: carbon dioxide levels ranged between 367 to 1005 ppm
    c. Room 28 PCR: carbon dioxide levels ranged between 425 to 756 ppm
5. Review of data measured indicate that carbon dioxide levels were within ASHRAE guidelines for comfort. Note: review of Room 14 data indicated that concentrations increased throughout the school day and results reached levels greater than 1000 ppm for approximately three minutes around 2:00 pm and then began to decrease for the remainder of the monitoring period.
6. Summary of the data is provided in the appendices.

Based on assessment findings, inadequate ventilation resulting in undesirable IEQ is not suspected.

Recommendations:

a) None at this time.

3. *Is mold growth contributing to undesirable IEQ in some parts of the building?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Mold growth can occur when organic building materials or accumulated organic debris is impacted by moisture. This may occur within 24-48 hours from the time such materials become wet, hence it is critical that materials are substantially dried within this time frame in order to minimize the potential for mold growth to develop. Mold growth has the potential to elicit negative health effects in sensitive persons. This most frequently manifests as allergic respiratory symptoms which may range from mild to severe depending on individual sensitivities. Irritant and infectious effects are possible. It is generally accepted that mold growth in buildings should be removed following appropriate precautions to protect workers involved in the clean-up and the surrounding environment. Greater precautions are taken for greater amounts of mold growth. In addition, the underlying cause of mold and moisture intrusion should be identified and corrected in order to minimize the potential for recurrent mold growth. Additional information can be found at the U.S. Environmental Protection Agency website (http://www.epa.gov/mold/).

The following are findings from the assessment:

1. According to site representatives, there have been no known water intrusion events that have occurred in the representative rooms assessed.
2. Many gutters located near HVAC units on the buildings assessed were found to be filled with heavy debris, which may result in clogging and potential water intrusion into buildings.
3. No signs of mold growth was identified in rooms assessed.
4. Visual inspection of accessible components of the HVAC units that served the rooms did not indicate any areas of mold growth.
5. Water pooling observed under exterior HVAC unit at 28 PCR.
6. Algae growth observed on exterior HVAC unit at 28 PCR.
7. Supporting photos are provided in Appendix C.

Based on assessment findings, mold growth is not suspected to be negatively impacting indoor environmental quality in the inspected areas.

Recommendations:

a) *None at this time.*

4. *Are excessive or unusual dust/particulates contributing to undesirable IEQ?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Various particulates are common in indoor environments. Particles ("dust") from various indoor and outdoor sources (e.g., human skin, paper, dirt, clothing, building material) can accumulate in the indoor environment and result in degraded indoor air quality, i.e. ("dusty" air). In general, we are concerned with particulates that are small enough to be inhaled. While such dust is not considered toxic, health problems that can be caused by breathing non-specific particulates include: eye, nose, and throat irritation and increased risk for respiratory infections and allergic reactions. Acute exposure to particulates, such as can occur if settled dust is disturbed and aerosolized, can potentially cause irritation to building occupants and increase the risk of respiratory problems in sensitive individuals. Inadequate housekeeping and insufficient filtration by the HVAC system can exacerbate dusty environments. Occupants in these conditions may report symptoms such as coughing, sneezing, and discomfort.

The following are findings from the assessment:

1. Light to heavy dust loading was identified in the air handling units assessed. Specifically, heaving dust loading on accessible components for the unit that serves room 28.
2. The air handling units that serve the school are equipped with filters that are reportedly changed every six months.
3. Roof mounted HVAC units inspected on permanent buildings were found to have light dust deposition on filters.
4. Light to moderate dust deposition was observed in the interior of the classrooms assessed. In general, heavier dust ("moderate") accumulation was identified on locations identified as "hard to reach" or surfaces not subject to regular cleaning.
5. Light black dust accumulation was identified on and around the supply registers in room 28 PCR.
6. Custodial staff reportedly lightly cleans the rooms on campus daily, which include trash removal, vacuuming of accessible areas, dusting etc.
7. Monitoring for airborne dust levels was conducted in rooms K-1, 14, and 28 PCR from approximately 7:30 am to 2:30 pm using data logging aerosol monitors. Readings included particulate matter with diameter of less than 2.5 microns (PM2.5) and particulate matter with diameter of less than 10 microns (PM10). Results were compared to U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) ranges, which are for outdoor air and 24 hour average concentrations. Currently there are no indoor air quality references to compare indoor particulate levels. Hours were selected to be representative of a typical school day.
8. Airborne particulate readings are as follows:
    - K-1:
        - PM2.5 levels ranged between -0.003 to 0.031 mg/m^3, with an average of -0.001 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
        - PM10 levels ranged between -0.003 to 0.091 mg/m^3, with an average of 0.002 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)
    - Room 14:

        - PM2.5 levels ranged between 0.008 to 0.037 mg/m^3, with an average of 0.021 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
        - PM10 levels ranged between 0.011 to 0.057 mg/m^3, with an average of 0.031 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)
    - Room 28 PCR
        - PM2.5 levels ranged between 0 to 0.011 mg/m^3, with an average of 0.001 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
        - PM10 levels ranged between 0.000 to 0.016 mg/m^3, with an average of 0.002 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)
9. Summary of the data and supporting photographs is provided in the appendices of the report.

Based on assessment findings, it is unlikely that excessive or unusual dust/particulates is contributing to undesirable IEQ in the rooms assessed.

Recommendations:

a) *Ensure that the HVAC units that serve the portable units are also included on the PM schedule and regularly cleaned.*

Limitations

This investigation is limited to the conditions and practices observed and information made available to FACS. The methods, conclusions and recommendations provided are based on FACS' judgment, expertise and the standard of practice for professional service. They are subject to the limitations and variability inherent in the methodology employed. As with all environmental investigations, this investigation is limited to the defined scope and does not purport to set forth all hazards, nor indicate that other hazards do not exist.

Please do not hesitate to contact our offices at 559-436-0277 with any questions or concerns. Thank you for the opportunity to assist Fresno Unified School District in promoting a more healthful environment.

Respectfully,
FORENSIC ANALYTICAL

Joe Blair

Joe Blair
Environmental Health Specialist, Fresno

Reviewed by:
FORENSIC ANALYTICAL

Michelle Rosales

Michelle Rosales, MPH, CIH
Principal Consultant

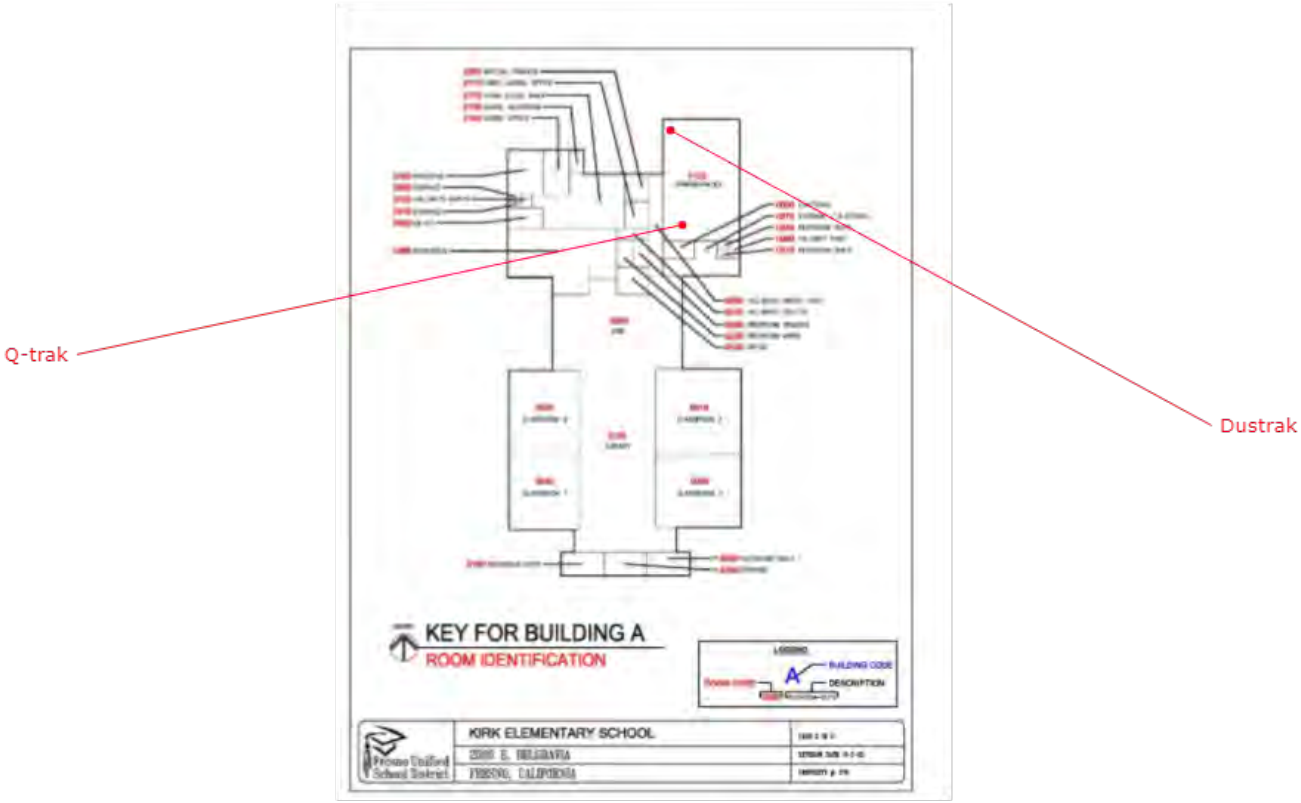
Appendix A
FACS Materials and Methods

Comfort Parameters Air Monitoring. Temperature, relative humidity, carbon dioxide (CO_2), and carbon monoxide (CO) measurements were collected using Q-Trak 7575 Indoor Air Quality Monitors. Measurements for carbon dioxide and carbon monoxide were expressed in concentration values of parts per million (ppm) with a detection limit of 1 ppm. Temperature was collected in degrees Fahrenheit and relative humidity in percentage (%). All data was collected in 60 second intervals within an approximate eight hours of sampling time (equivalent to room occupancy).

Airborne Particulates. Airborne particulates were measured using a TSI Dustrak set to collect the fraction of airborne particulates less than 10 microns (<10 µm) in diameter and less than 2.5 µm (PM10 and PM2.5, respectively. The monitor had been factory calibrated within the previous 12 months at the time of sampling and zero calibrated prior to the assessment. Results were expressed in milligrams per cubic meter (mg/m^3). All data was collected in 60 second intervals within an approximate eight hours of sampling time (equivalent to room occupancy).

Appendix B
Sample Maps

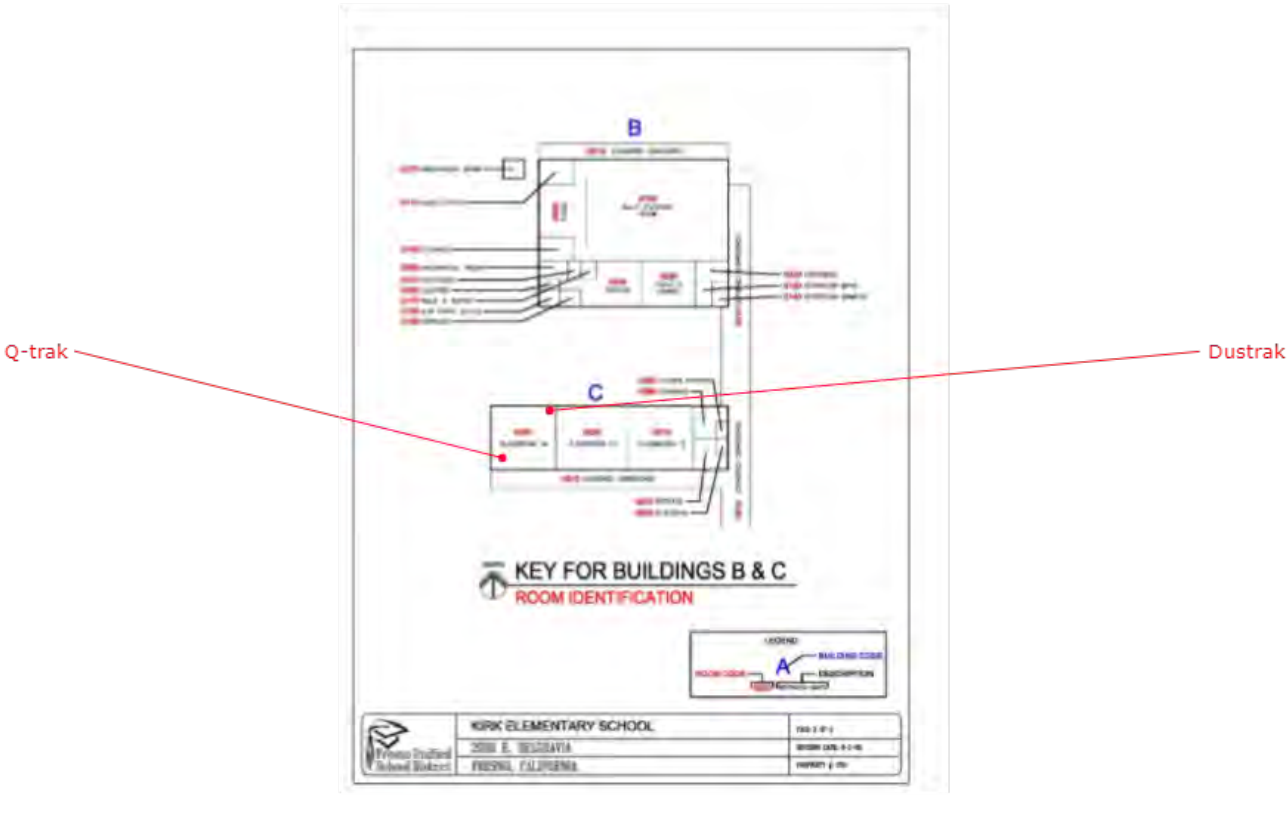
K-1



FACS 135 371 E Bullard Ave Suite #109 Fresno, CA 93710	N	Sample Location Dustrak	Kirk Elementary School IEQ Assessment	Fresno Unified School District LOCATION: 2000 E. Belgravia Ave., Fresno, CA 93706	Joe Blair FACS PROJECT No.: PJ69864

This ia a design drawing and is the property of Forensic Analytical Consulting Services, Inc. It is not intended to replace required architectural or engineering plans.

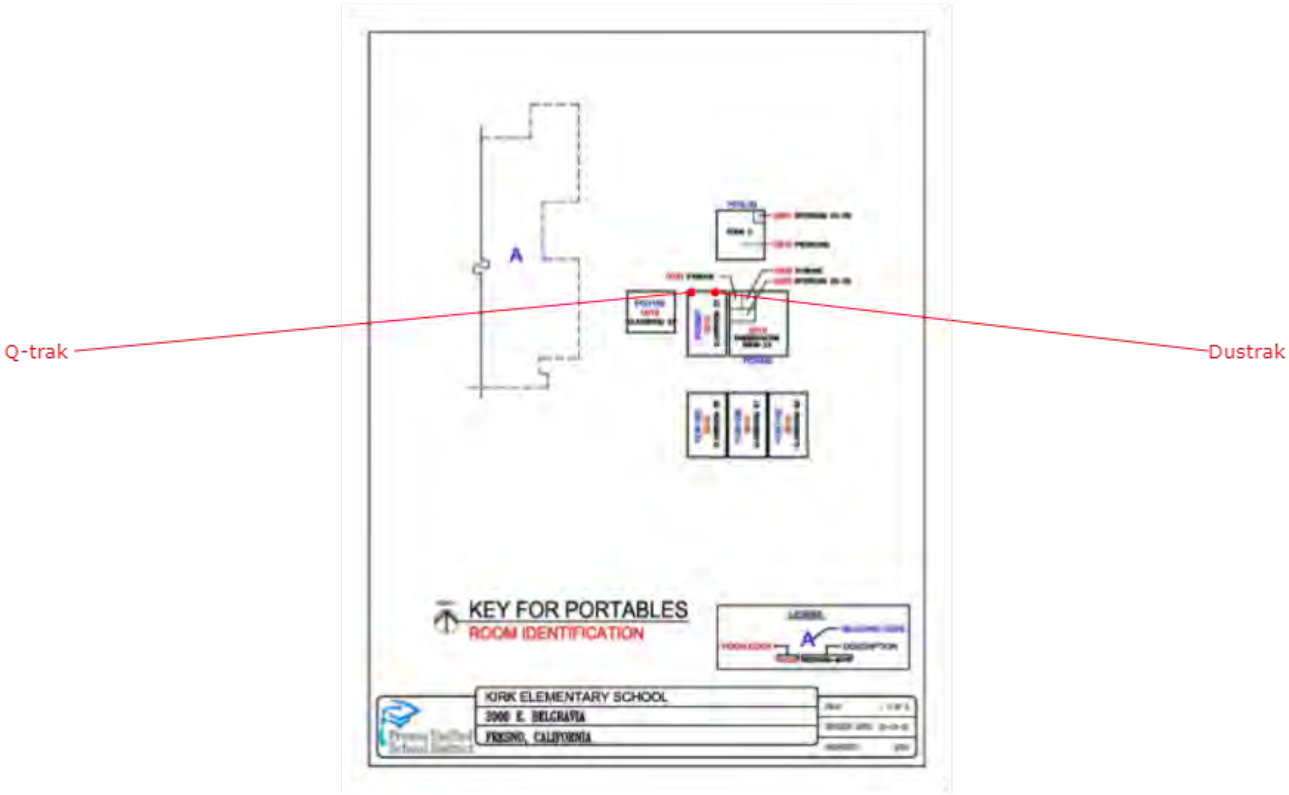
Room 14



FACS 135 371 E Bullard Ave Suite #109 Fresno, CA 93710	N	Sample Location Dustrak	Kirk Elementary School IEQ Assessment	Fresno Unified School District LOCATION: 2000 E. Belgravia Ave., Fresno, CA 93706	Joe Blair FACS PROJECT No.: PJ69864

This ia a design drawing and is the property of Forensic Analytical Consulting Services, Inc. It is not intended to replace required architectural or engineering plans.

Room 28 PCR



FACS 35 371 E Bullard Ave Suite #109 Fresno, CA 93710	N	Sample Location Dustrak	Kirk Elementary School IEQ Assessment	Fresno Unified School District LOCATION: 2000 E. Belgravia Ave., Fresno, CA 93706	Joe Blair FACS PROJECT No.: PJ69864

This ia a design drawing and is the property of Forensic Analytical Consulting Services, Inc. It is not intended to replace required architectural or engineering plans.

Appendix C
Photographs

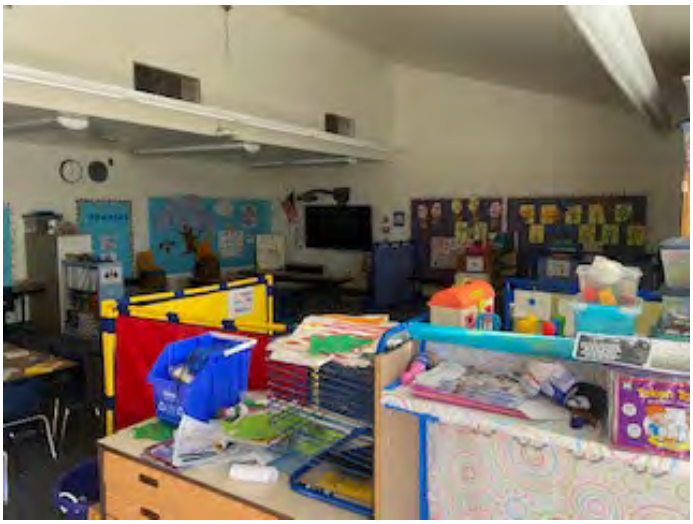


Photo #1: Room K-1
Site Overview

Photo #2: Room K-1
Light Dust Loading on HVAC Supply

Photo #3: Roof Air Handler Unit
Serves Room K-1

Photo #4: Light Dust Loading on Air Filters
Serves Room K-1

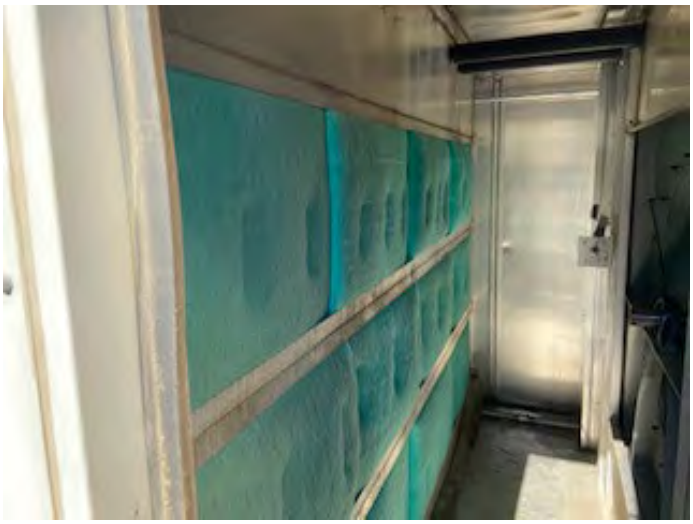


Photo #5: Light Dust Loading on Air Filters
Serves Room K-1

Photo #6: Minimal Dust on HVAC Components
Serves Room K-1

Photo #7: Heavy Dust Loading on Outdoor Intake –
K-1 Air Handler

Photo #8: Room 14 –
Site Overview

Photo #9: Room 14 Air Handler – Overview

Photo #10: Room 14 – Air Purifier on Site

Photo #11: Room 14 – Light Dust Loading on HVAC Supply

Photo #12: Room 14 – Moderate Dust Loading on Windowsills

Photo #13: Room 28 –
Room Overview

Photo #14: Room 28 –
Black dust on and around the HVAC supply register

Photo #15: Room 28 –
HVAC Return Vent

Photo #16: Room 28 –
Light Dust Loading on Air Filters

Photo #17: Room 28 –
Heavy Dust Loading on HVAC Components

Photo #18: Room 28 –
Exterior Cooling Unit Overview

Photo #19: Room 28 –
HVAC Condenser Drains

Photo #20: Room 28 –
Moisture on Ground Under Condenser Drains

Appendix D
Data Results Tables and Laboratory Reports

Q-Trak Indoor Air Quality Monitors

Instrument Number	Location	$C0_2$	T	H	CO
P14200072	K-1	Avg. 473 ppm Min. 423 ppm Max. 587 ppm	Avg. 73.5 deg F Min. 68.1 deg F Max. 74.3 deg F	Avg. 31.1% Min. 29.5% Max. 40.2%	Avg. 0.0 ppm Min. 0.0 ppm Max. 0.2 ppm
P12090033	Room 14	Avg. 681 ppm Min. 367 ppm Max. 1005 ppm	Avg. 73.4 deg F Min. 69.3 deg F Max 75.4 deg F	Avg. 33.1% Min. 30.4% Max. 35.7%	Avg. 0.0 ppm Min. 0.0 ppm Max. 0.0 ppm
P11380045	Room 28 PCR	Avg. 588 ppm Min. 425 ppm Max. 756 ppm	Avg. 71.4 deg F Min. 67.8deg F Max. 74.0 deg F	Avg. 37.2% Min. 33.6% Max. 42.5%	Avg. 0.0 ppm Min. 0.0 ppm Max. 0.4 ppm

Note:
CO_2 – Carbon dioxide; T – Temperature; H – Humidity (rh – Relative Humidity); CO – Carbon monoxide; PPM – parts per million

DustTrak DRX Aerosol Monitor

Room		PM2.5 (mg/m^3)	PM10 (mg/m^3)
K-1	Avg	0.000	0.002
	Min	0.000	0.000
	Max	0.032	0.091
Room 14	Avg	0.021	0.031
	Min	0.008	0.011
	Max	0.037	0.057
0Room 28 PCR	Avg	0.001	0.002
	Min	0.000	0.000
	Max	0.011	0.012

Note:
The U.S. EPA Air Quality Index (AQI) is an index for reporting daily air quality. The AQI categories for 24-hour average PM2.5 concentrations (in mg/m3) are as follows:

- Good: 0 - 0.0150 mg/m3
- Moderate: 0.0151 -0.0404 mg/m3
- Unsafe for Sensitive Groups: 0.01405 – 0.0654 mg/m3
- Unhealthy: 0.0655 – 0.1504 mg/m3
- Very Unhealthy: 0.1505 -0. 2504 mg/m3
- Hazardous: 250.5 - 500.4 mg/m3

The U.S. EPA Air Quality Index (AQI) is an index for reporting daily air quality. The AQI categories for 24-hour average PM10 concentrations (in mg/m3) are as follows:

- Good: 0 – 0.054 mg/m3
- Moderate: 0.055 – 0.154 mg/m3
- Unsafe for Sensitive Groups: 0.155 – 0.254 mg/m3
- Unhealthy: 0.255 – 0.354 mg/m3
- Very Unhealthy: 0.355 – 0.424 mg/m3
- Hazardous: 0.425 – 0.604 mg/m3

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June 7, 2022

Indoor Environmental Quality Assessment: Findings of Initial Assessment

Fresno Unified School District
Storey Elementary School
5250 East Church Avenue,
Fresno, CA 93725

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FACS Project #PJ69864

Contents

Executive Summary

Forensic Analytical Consulting Services was retained by Fresno Unified School District to perform a proactive indoor environmental quality assessment of selected areas of Storey Elementary School in Fresno, CA. Findings of this assessment did not identify hazardous conditions related to indoor air quality in the areas of concern. However, this investigation did find conditions that have the potential to negatively impact indoor environmental quality, and associated actions that can be taken to address them were identified along with other suggestions for generally improving indoor environmental quality. A summary of the primary causes of indoor environmental quality concerns considered, FACS' conclusions and related recommendations are provided in the table below. A more complete discussion of findings, conclusions and recommendations is provided in the body of this report.

FACS IEQ Evaluation Summary		
#	**Primary IEQ Concerns and Recommendations**	**Conclusion & Completion**
1	***Are temperature and humidity conditions resulting in undesirable IEQ in the representative rooms assessed?***	**Potential**
a)	*Occupants and maintenance staff should communicate and work together to understand how the HVAC system functions and to attempt to adjust thermal comfort conditions to match occupant preferences to the extent practicable based upon system design limitations and the above referenced Federal OSHA and ANSI/ASHRAE Standard 55 guidelines.*	❑
b)	*If conditions cannot be controlled to satisfy individual occupant preferences, occupants should self-regulate thermal comfort with clothing choices (e.g., lighter fabrics or short sleeves during hotter conditions, heavier fabrics or long sleeves during cooler conditions, removable layers for varied conditions). Or consider the use of heavier duty blinds or exterior curtains that can block out the direct sun.*	❑
2	***Is inadequate ventilation resulting in undesirable IEQ in the representative rooms assessed?***	**Probable**
a)	*Ensure that outdoor air intake dampers are set to stay open during working hours to a minimum position that ensures airflow rates called for by building codes as referenced in the Cal/OSHA regulations and ANSI/ASHRAE Standard 62.1 guideline identified above. The outdoor air settings should also generally maintain CO2 levels below 1,000 ppm (or <700 ppm above outdoor).*	❑
3	***Is mold growth contributing to undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*None at this time.*	❑
4	***Are excessive or unusual dust/particulates contributing to undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*None at this time.*	❑

Introduction

Forensic Analytical Consulting Services was retained by Fresno Unified School District (FUSD) to perform indoor environmental quality assessments of various schools at the district. FUSD has selected multiple sites and representative rooms to evaluate proactively to further improve the indoor environment quality for students and staff. On May 11, 2022, FACS conducted an indoor environmental quality assessment of rooms 12, 29, and the MTU Lobby at Storey Elementary School located at 5250 East Church Avenue in Fresno, CA. The purpose of the evaluation was to 1) identify and evaluate potential explanations, sources and pathways for possible symptoms related to indoor environment quality issues; 2) provide information for consideration in assessing risk to occupants; and 3) provide recommendations for additional investigation and corrective actions as necessary.

Site Characterization

Storey Elementary School houses various permanent and portable classroom buildings, an administration office, a computer lab, multiple restrooms, and an attached private physical therapy wing. The exterior of permanent buildings is characterized by stucco with a flat single-ply roof, or a pitched composition roof. The buildings are surrounded by light vegetation on all sides. The interior of permanent buildings is generally characterized by carpeted floors over concrete slab, plaster walls covered with tackboard, and cellulose false ceiling tiles suspended on a T-bar grid. The permanent buildings are served by multiple plenum mounted air handling units, or individual wall mounted units. The exterior of portable buildings is comprised of wood with a flat roof, while the interior is characterized by carpet on wood subfloors, tackboard covering drywall, and cellulose false ceiling tiles suspended on a T-bar grid. The portable buildings are served by individual exterior wall mounted cooling units.

Additional characteristics of the rooms assessed are as follows:

- Room 12 is located within a single-story permanent building which houses other rooms (e.g., Room 11). The room is served conditioned air through a “forced air” system. The room also has operable windows. The space functions as primary school classroom and is occupied for the majority of the school day.
- Room 29 is a single-story portable/modular unit located on the school campus. The room is served conditioned air through a “forced air” system. The room also has operable windows. The space functions as primary school classroom and is occupied for the majority of the school day.
- The MTU Lobby is located within a single-story permanent building which houses other classrooms (e.g., K-2). The room is served conditioned air through a “forced air” system. The room also has operable windows. The space functions as an intake lobby for physical therapy patients and is occupied from approximately 8am to 5pm. Though attached to a classroom wing, the facility is not associated with the elementary school.

Site History

According to client representatives and occupants/employees, the following history was developed:

- There are currently no reported ill health claims by employees or students.
- A single air purifying unit has been placed in all classrooms. These units run all week and are turned off for the weekend.
- There was no reported history of major water intrusion events in the rooms assessed.
- No recent renovations to the school or rooms assessed.

Scope of Work

In the course of this project, FACS conducted the following scope of work:

1. Development of a site characterization and history (see sections above).
2. Visual assessment of areas of the interior of the subject rooms.
3. Visual assessment of accessible components of the HVAC systems serving the subject rooms.
4. Monitoring of various indoor air quality parameters, including carbon dioxide levels, temperature, relative humidity and carbon monoxide, using a data-logging direct reading instrument. Measurements were collected in representative rooms. Monitors were set to collect data for approximately 7 hours.
5. Monitoring of airborne particulates (PM2.5 and PM10) using a data-logging direct reading instrument. Measurements were collected in representative rooms. Monitors were set to collect data for approximately 7 hours.

The data collected in the course of the investigation and supporting information is presented in this report as follows:

- Appendix A: FACS Materials and Methods
- Appendix B: Site Plan
- Appendix C: Photographs
- Appendix D: Data Results Table and Laboratory Reports

Conclusions and Recommendations

This investigation did not find hazardous conditions with regard to indoor air quality; however, it did identify issues that could potentially cause indoor air quality concerns.

In the course of collecting and analyzing the data from this investigation, FACS identified and evaluated typical indoor air quality concerns that could be identified in the school setting. A discussion of these concerns, along with related FACS conclusions and recommendations to improve indoor environmental quality are provided below.

Issue-by-Issue Discussion

1. *Are temperature and humidity conditions resulting in undesirable IEQ in the representative rooms assessed?*

Conclusion: CONFIRMED PROBABLE **POTENTIAL** UNLIKELY

The combination of temperature and humidity in a building is the primary driver of occupant thermal comfort. Occupant thermal discomfort is often associated with increased dissatisfaction with indoor environmental quality and may exacerbate occupant symptoms. Cal/OSHA does not regulate thermal comfort in buildings; however, the California labor code indicates that temperatures in work areas shall provide reasonable comfort consistent with industry-wide standards for the work performed. To this end, Federal OSHA recommends temperature control in the range of 68-76°F and corresponding relative humidity from 60-20%. Similarly, the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) has developed widely accepted guidelines for managing temperature and humidity in buildings to help ensure the thermal comfort of occupants (ANSI/ASHRAE Standard 55). This guideline generally recommends 75-83ºF & 60-10%RH (warm weather) and 68-77ºF & 60-10%RH (cool weather). While these guidelines attempt to define conditions that are acceptable for approximately 80% of occupants, individual preferences may vary.

The following are findings from the assessment:

1. Monitoring for temperature and relative humidity was conducted in rooms 12, 29, and the MTU Lobby from approximately 7:30 am to 2:30 pm using data logging indoor air quality monitors. Hours were selected to be representative of a typical school day.
2. Temperature readings are as follows:
    a. Room 12: temperatures ranged between 63.8 to 72.9 ºF
    b. Room 29: temperatures ranged between 63.8 to 79.1 ºF
    c. MTU Lobby: temperatures ranged between 70.5 to 76.2 ºF
3. Review of temperatures measured indicate that temperatures were slightly out of both the OSHA and ASHRAE (assuming cooler weather) guidelines for comfort.
4. Relative humidity readings are as follows
    a. Room 12: humidity ranged between 25.4 to 38.4%
    b. Room 29: humidity ranged between 27.2 to 60.3%
    c. MTU Lobby: humidity ranged between 20.2 to 31.5%
5. The relative humidity levels measured were slightly out of both OSHA and ASHRAE guidelines for comfort.
6. Summary of the data is provided in the appendices.

Based on assessment findings, there is the potential that temperature conditions may result in undesirable IEQ in some of the rooms assessed.

Recommendations:

a) *Occupants and maintenance staff should communicate and work together to understand how the HVAC system functions and to attempt to adjust thermal comfort conditions to match occupant preferences to the extent practicable based upon system design limitations and the above referenced Federal OSHA and ANSI/ASHRAE Standard 55 guidelines.*
b) *If conditions cannot be controlled to satisfy individual occupant preferences, occupants should self-regulate thermal comfort with clothing choices (e.g., lighter fabrics or short sleeves during hotter conditions, heavier fabrics or long sleeves during cooler conditions, removable layers for varied conditions). Or consider the use of heavier duty blinds or exterior curtains that can block out the direct sun.*

2. Is inadequate ventilation resulting in undesirable IEQ in the representative rooms assessed?

Conclusion: CONFIRMED **PROBABLE** POTENTIAL UNLIKELY

Mechanical ventilation systems (a.k.a., HVAC systems) generally mix recirculated indoor air with outside "fresh" air. If the ventilation rate (i.e., amount of outside air) is too low, common indoor contaminants such as particles, odors, chemical vapors and exhaled carbon dioxide can accumulate and result in degraded indoor air quality. Occupants in poorly ventilated rooms will frequently describe the air as "stuffy" or "stale" and will more often report symptoms and discomfort related to indoor environmental quality. Cal/OSHA regulations (8CCR§5142) generally require that in mechanically ventilated buildings the HVAC system must be run continuously during working hours. The regulation further requires minimum outdoor airflows based on the building codes in place at the time of construction. The current minimum outdoor airflows called for in the building code are derived from guidelines by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE Standard 62.1--Ventilation for Acceptable Indoor Air Quality) and are calculated based upon the type of building space, number of occupants, size of the occupied area and other variables related to the design of the HVAC system.

In occupied buildings, carbon dioxide (CO_2) concentrations are typically higher then ambient outdoor concentrations due to exhaled air from people. As such, comparison of indoor and outdoor CO_2 levels are often used as a general indicator of indoor ventilation relative to human bioeffluents (i.e., body odor). ANSI/ASHRAE Standard 62.1 indicates that keeping indoor CO_2 levels less than 700 ppm above outdoor

(about 1,000 to 1,500 ppm) will provide satisfaction the substantial majority of people in the building relative to human bioeffluents. As a general rule of thumb, ventilating to keep indoor CO_2 levels below 1,000 ppm and closer to outdoor levels results in less occupant complaints regarding indoor air quality and "stuffy" or "stale" air.

The following are findings from the assessment:

1. Per site representatives, HVAC units run continuously, 24 hours a day, seven days a week in the permanent buildings. The HVAC units that serve the portables are turned off by custodial staff at the end of the day.
2. Monitoring for carbon dioxide was conducted in rooms 12, 29, and the MTU Lobby from approximately 7:30 am to 2:30 pm using data logging indoor air quality monitors. Hours were selected to be representative of a typical school day.
3. Rooms 12 and 29 were occupied for the monitoring period, with the exception of lunch and recess. The MTU Lobby was thinly occupied all day due to the space functioning as a physical therapy intake area and waiting room.
4. Room 29 is close to a parking lot.
5. Carbon dioxide readings are as follows:
    a. Room 12: carbon dioxide levels ranged between 384 to 587 ppm
    b. Room 29: carbon dioxide levels ranged between 402 to 3160 ppm
    c. MTU Lobby: carbon dioxide levels ranged between 405 to 654 ppm
6. Review of data measured indicate that carbon dioxide levels in Room 29 were not within ASHRAE guidelines for comfort.
7. Summary of the data is provided in the appendices.

Based on assessment findings, inadequate ventilation resulting in undesirable IEQ is suspected in room 29. Concentrations of carbon dioxide increased significantly throughout the school day.

Recommendations:

a) Ensure that outdoor air intake dampers are set to stay open during working hours to a minimum position that ensures airflow rates called for by building codes as referenced in the Cal/OSHA regulations and ANSI/ASHRAE Standard 62.1 guideline identified above. The outdoor air settings should also generally maintain CO_2 levels below 1,000 ppm (or <700 ppm above outdoor).

3. *Is mold growth contributing to undesirable IEQ in some parts of the building?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Mold growth can occur when organic building materials or accumulated organic debris is impacted by moisture. This may occur within 24-48 hours from the time such materials become wet, hence it is critical that materials are substantially dried within this time frame in order to minimize the potential for mold growth to develop. Mold growth has the potential to elicit negative health effects in sensitive persons. This most frequently manifests as allergic respiratory symptoms which may range from mild to severe depending on individual sensitivities. Irritant and infectious effects are possible. It is generally accepted that mold growth in buildings should be removed following appropriate precautions to protect workers involved in the clean-up and the surrounding environment. Greater precautions are taken for greater amounts of mold growth. In addition, the underlying cause of mold and moisture intrusion should be identified and corrected in order to minimize the potential for recurrent mold growth. Additional information can be found at the U.S. Environmental Protection Agency website (http://www.epa.gov/mold/).

The following are findings from the assessment:

1. According to site representatives, there have been no known water intrusion events that have occurred in the representative rooms assessed.

2. Many gutters located near HVAC units on the buildings assessed were found to be filled with heavy debris, which may result in clogging and potential water intrusion into buildings.
3. No signs of mold growth or moisture were identified in rooms assessed.
4. Visual inspection of accessible components of the HVAC units that served the rooms did not indicate any areas of mold growth.
5. Supporting photos are provided in Appendix C.

Based on assessment findings, mold growth is not suspected to be negatively impacting indoor environmental quality in the inspected areas.

Recommendations:

a) None at this time.

4. *Are excessive or unusual dust/particulates contributing to undesirable IEQ?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Various particulates are common in indoor environments. Particles ("dust") from various indoor and outdoor sources (e.g., human skin, paper, dirt, clothing, building material) can accumulate in the indoor environment and result in degraded indoor air quality, i.e. ("dusty" air). In general, we are concerned with particulates that are small enough to be inhaled. While such dust is not considered toxic, health problems that can be caused by breathing non-specific particulates include: eye, nose, and throat irritation and increased risk for respiratory infections and allergic reactions. Acute exposure to particulates, such as can occur if settled dust is disturbed and aerosolized, can potentially cause irritation to building occupants and increase the risk of respiratory problems in sensitive individuals. Inadequate housekeeping and insufficient filtration by the HVAC system can exacerbate dusty environments. Occupants in these conditions may report symptoms such as coughing, sneezing, and discomfort.

The following are findings from the assessment:

1. Light to heavy dust loading was identified in the air handling units assessed.
2. The air handling units that serve the school are equipped with filters that are reportedly changed every six months.
3. Plenum mounted HVAC units inspected on permanent buildings were found to have moderate dust deposition on filters.
4. Light to moderate dust deposition was observed in the interior of the classrooms assessed. In general, heavier dust accumulation was identified on locations identified as "hard to reach" or surfaces not subject to regular cleaning.
5. Moderate dust accumulation was identified around the supply registers in rooms 29 and 12.
6. Custodial staff reportedly lightly cleans the rooms on campus daily, which include trash removal, vacuuming of accessible areas, dusting etc.
7. Monitoring for airborne dust levels was conducted in rooms 12, 28, and the MTU Lobby from approximately 7:30 am to 2:30 pm using data logging aerosol monitors. Readings included particulate matter with diameter of less than 2.5 microns (PM2.5) and particulate matter with diameter of less than 10 microns (PM10). Results were compared to U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) ranges, which are for outdoor air and 24 hour average concentrations. Currently there are no indoor air quality references to compare indoor particulate levels. Hours were selected to be representative of a typical school day.
8. Airborne particulate readings are as follows:
    - Room 12:
        - PM2.5 levels ranged between 0.002 to 0.028 mg/m^3, with an average of 0.006 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)

        - PM10 levels ranged between 0.003 to 0.053 mg/m^3, with an average of 0.011 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)
    - Room 29:
        - PM2.5 levels ranged between 0.001 to 0.042 mg/m^3, with an average of 0.009 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
        - PM10 levels ranged between 0.002 to 0.106 mg/m^3, with an average of 0.019 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)
    - MTU Lobby
        - PM2.5 levels ranged between 0.000 to 0.001 mg/m^3, with an average of -0.005 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
        - PM10 levels ranged between 0.000 to 0.003 mg/m^3, with an average of -0.004 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)
9. Summary of the data and supporting photographs is provided in the appendices of the report.

Based on assessment findings, it is unlikely that excessive or unusual dust/particulates is contributing to undesirable IEQ in the rooms assessed.

Recommendations:

a) None at this time.

Limitations

This investigation is limited to the conditions and practices observed and information made available to FACS. The methods, conclusions and recommendations provided are based on FACS' judgment, expertise and the standard of practice for professional service. They are subject to the limitations and variability inherent in the methodology employed. As with all environmental investigations, this investigation is limited to the defined scope and does not purport to set forth all hazards, nor indicate that other hazards do not exist.

Please do not hesitate to contact our offices at 559-436-0277 with any questions or concerns. Thank you for the opportunity to assist Fresno Unified School District in promoting a more healthful environment.

Respectfully,
FORENSIC ANALYTICAL

Joe Blair

Joe Blair
Environmental Health Specialist, Fresno

Reviewed by:
FORENSIC ANALYTICAL

Michelle Rosales

Michelle Rosales, MPH, CIH
Principal Consultant

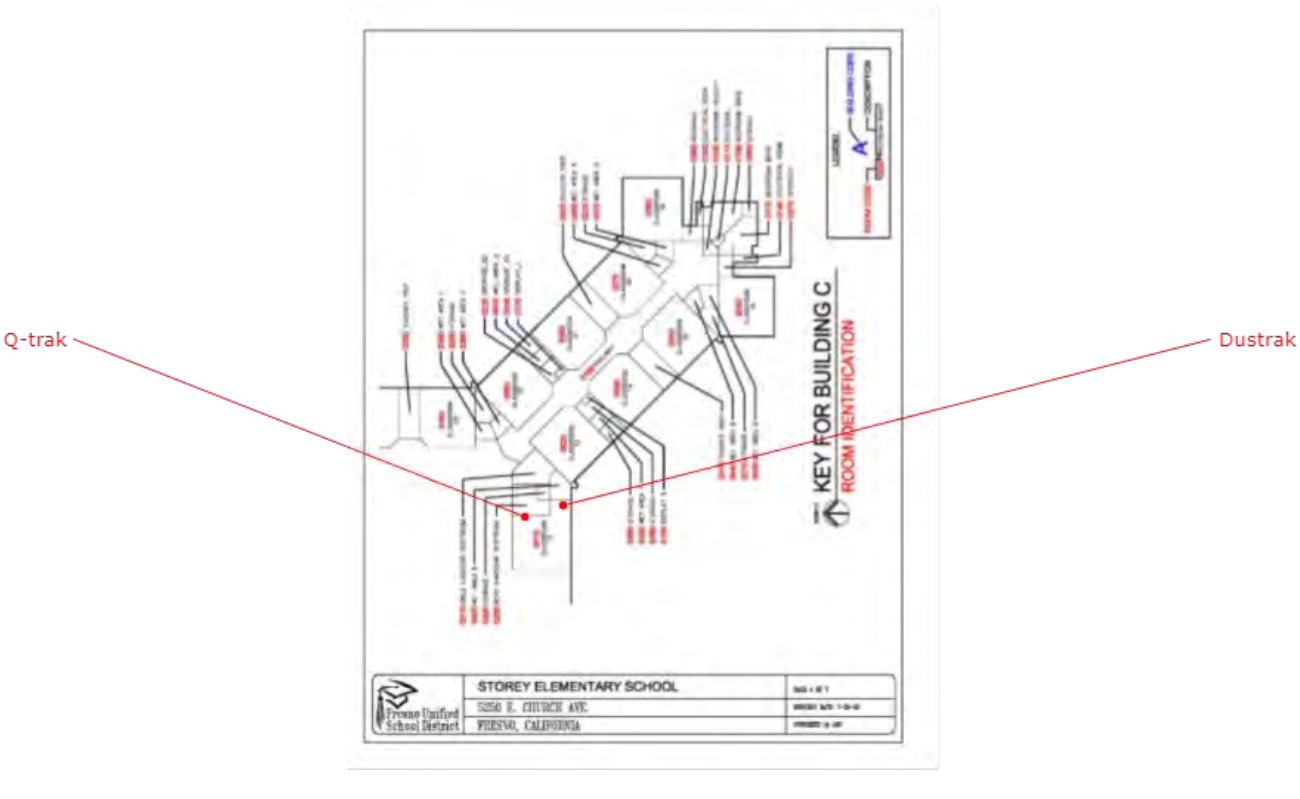
Appendix A
FACS Materials and Methods

Comfort Parameters Air Monitoring. Temperature, relative humidity, carbon dioxide (CO_2), and carbon monoxide (CO) measurements were collected using Q-Trak 7575 Indoor Air Quality Monitors. Measurements for carbon dioxide and carbon monoxide were expressed in concentration values of parts per million (ppm) with a detection limit of 1 ppm. Temperature was collected in degrees Fahrenheit and relative humidity in percentage (%). All data was collected in 60 second intervals within an approximate six hours of sampling time (equivalent to room occupancy).

Airborne Particulates. Airborne particulates were measured using a TSI Dustrak set to collect the fraction of airborne particulates less than 10 microns (<10 µm) in diameter and less than 2.5 µm (PM10 and PM2.5, respectively. The monitor had been factory calibrated within the previous 12 months at the time of sampling and zero calibrated prior to the assessment. Results were expressed in milligrams per cubic meter (mg/m^3).

Appendix B
Sample Maps

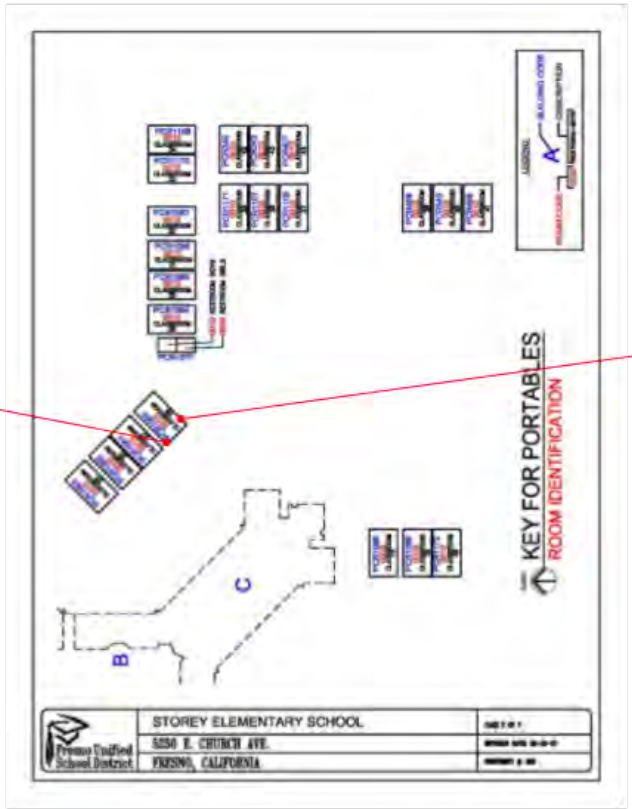
Room 12



FACS 135 371 E Bullard Ave Suite #109 Fresno, CA 93710	N	Sample Location Dustrak	Storey Elementary School IEQ Assessment	Fresno Unified School District LOCATION: 5250 East Church Avenue, Fresno, CA 93725	Joe Blair FACS PROJECT No.: PJ69864

This ia a design drawing and is the property of Forensic Analytical Consulting Services, Inc. It is not intended to replace required architectural or engineering plans.

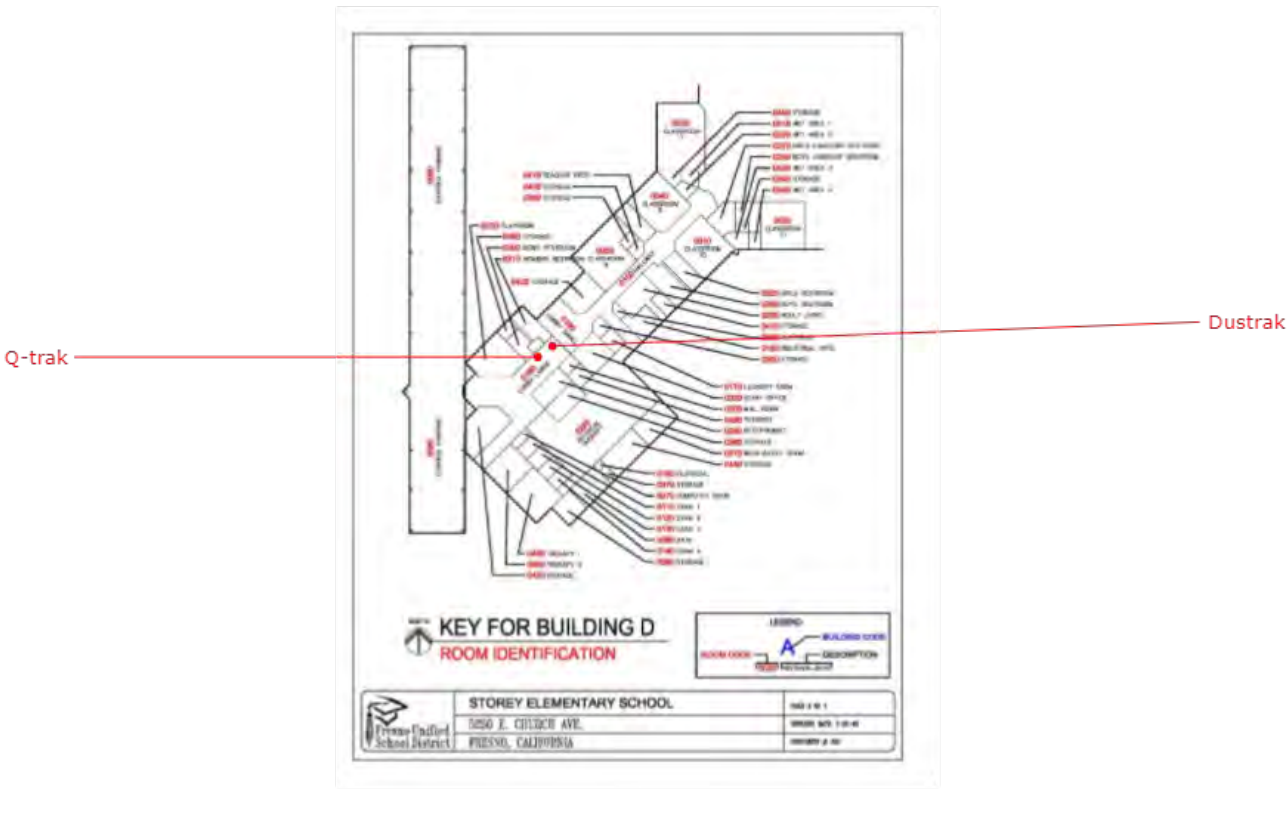
Room 29



FACS 371 E Bullard Ave Suite #109 Fresno, CA 93710	N	Sample Location Dustrak	Storey Elementary School IEQ Assessment	Fresno Unified School District LOCATION: 5250 East Church Avenue, Fresno, CA 93725	Joe Blair FACS PROJECT No.: PJ69864

This ia a design drawing and is the property of Forensic Analytical Consulting Services, Inc. It is not intended to replace required architectural or engineering plans.

MTU Lobby



FACS 371 E Bullard Ave Suite #109 Fresno, CA 93710	N	Sample Location Dustrak	Storey Elementary School IEQ Assessment	Fresno Unified School District	Joe Blair
				LOCATION: 5250 East Church Avenue, Fresno, CA 93725	FACS PROJECT No.: PJ69864

This ia a design drawing and is the property of Forensic Analytical Consulting Services, Inc. It is not intended to replace required architectural or engineering plans.

Appendix C
Photographs

Photo #1: Room 12
Site Overview

Photo #2: Room 12
Wall Mounted HVAC Unit

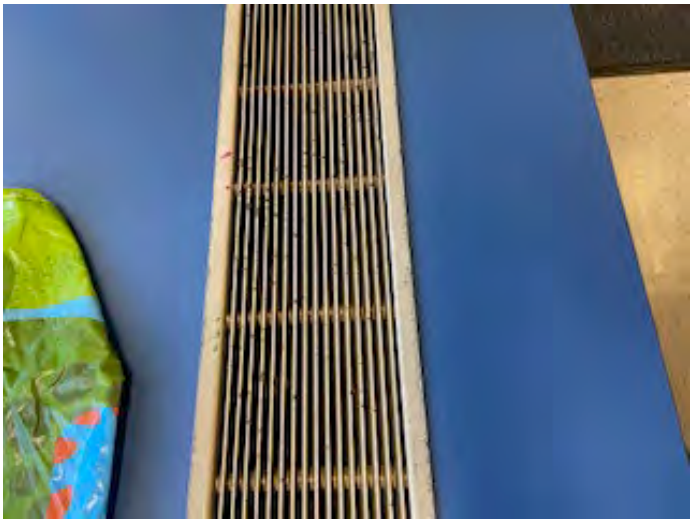


Photo #3: Room 12
Moderate Loading on HVAC Supply

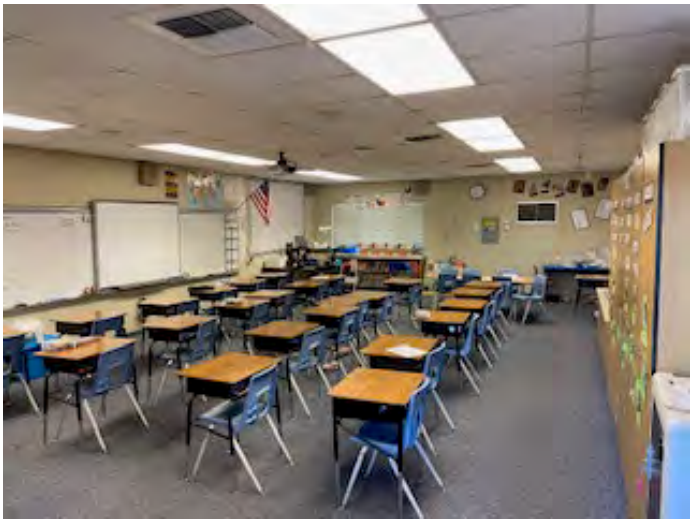


Photo #4: Room 29
Site Overview

Photo #5: Room 29
Moderate Dust Loading on HVAC Supply

Photo #6: Room 29
HVAC Return

Photo #7: Room 29
Exterior Wall Mounted Unit Near Parking Lot

Photo #8: Room 29
Heavy Dust Loading on Exterior HVAC Components

Photo #9: Room 29
Heavy Dust Loading on Exterior HVAC Components

Photo #10: MTU Lobby –
Site Overview

Photo #11: MTU Lobby –
Hand Sanitizer Used on Site

Photo #12: MTU Lobby –
HVAC Unit in Attic

Photo #13: MTU Lobby –
Minimal Dust Loading on Air Filters

Appendix D
Data Results Tables and Laboratory Reports

Q-Trak Indoor Air Quality Monitors

Instrument Number	Location	$C0_2$	T	H	CO
P14200072	Room 12	Avg. 520 ppm Min. 384 ppm Max. 587 ppm	Avg. 69.7 deg F Min. 63.9 deg F Max. 72.9 deg F	Avg. 31.4% Min. 25.4% Max. 38.4%	Avg. 0.0 ppm Min. 0.0 ppm Max. 0.3 ppm
P11380045	Room 29	Avg. 2129 ppm Min. 402 ppm Max. 3160 ppm	Avg. 69.0 deg F Min. 63.8 deg F Max 79.1 deg F	Avg. 46.7% Min. 27.2% Max. 60.3%	Avg. 0.3 ppm Min. 0.0 ppm Max. 1.2 ppm
P12090033	MTU Lobby	Avg. 428 ppm Min. 405 ppm Max. 654 ppm	Avg. 74.2 deg F Min. 70.5deg F Max. 76.2 deg F	Avg. 23.5% Min. 20.2% Max. 31.5%	Avg. 0.0 ppm Min. 0.0 ppm Max. 0.0 ppm

Note:
CO_2 – Carbon dioxide; T – Temperature; H – Humidity (rh – Relative Humidity); CO – Carbon monoxide; PPM – parts per million

DustTrak DRX Aerosol Monitor

Room		PM2.5 (mg/m^3)	PM10 (mg/m^3)
Room 12	Ave	0.006	0.011
	Min	0.002	0.003
	Max	0.028	0.053
Room 29	Ave	0.009	0.019
	Min	0.001	0.002
	Max	0.042	0.106
MTU Lobby	Ave	0.000	0.000
	Min	0.000	0.000
	Max	0.001	0.003

Note:
The U.S. EPA Air Quality Index (AQI) is an index for reporting daily air quality. The AQI categories for 24-hour average PM2.5 concentrations (in mg/m3) are as follows:

- Good: 0 - 0.0150 mg/m3
- Moderate: 0.0151 -0.0404 mg/m3
- Unsafe for Sensitive Groups: 0.01405 – 0.0654 mg/m3
- Unhealthy: 0.0655 – 0.1504 mg/m3
- Very Unhealthy: 0.1505 -0. 2504 mg/m3
- Hazardous: 250.5 - 500.4 mg/m3

The U.S. EPA Air Quality Index (AQI) is an index for reporting daily air quality. The AQI categories for 24-hour average PM10 concentrations (in mg/m3) are as follows:

- Good: 0 – 0.054 mg/m3
- Moderate: 0.055 – 0.154 mg/m3
- Unsafe for Sensitive Groups: 0.155 – 0.254 mg/m3
- Unhealthy: 0.255 – 0.354 mg/m3
- Very Unhealthy: 0.355 – 0.424 mg/m3
- Hazardous: 0.425 – 0.604 mg/m3

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FACS
Forensic Analytical Consulting Services

June 23, 2022

Indoor Environmental Quality Assessment: Findings of Initial Assessment

Fresno Unified School District
Yokomi Elementary School
2323 East McKenzie Avenue
Fresno, CA 93701

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FACS Project #PJ71255

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Contents

Executive Summary

Forensic Analytical Consulting Services was retained by Fresno Unified School District to perform a proactive indoor environmental quality assessment of selected areas of Yokomi Elementary School in Fresno, California. Findings of this assessment did not identify hazardous conditions related to indoor air quality in the areas of concern. However, this investigation did find conditions that have the potential to negatively impact indoor environmental quality, and associated actions that can be taken to address them were identified along with other suggestions for generally improving indoor environmental quality. A summary of the primary causes of indoor environmental quality concerns considered, FACS' conclusions and related recommendations are provided in the table below. A more complete discussion of findings, conclusions and recommendations is provided in the body of this report.

FACS IEQ Evaluation Summary		
#	**Primary IEQ Concerns and Recommendations**	**Conclusion & Completion**
1	***Are temperature and humidity conditions resulting in undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*Occupants and maintenance staff should communicate and work together to understand how the HVAC system functions and to attempt to adjust thermal comfort conditions to match occupant preferences to the extent practicable based upon system design limitations and the above referenced Federal OSHA and ANSI/ASHRAE Standard 55 guidelines.*	--
b)	*If conditions cannot be controlled to satisfy individual occupant preferences, occupants should self-regulate thermal comfort with clothing choices (e.g., lighter fabrics or short sleeves during hotter conditions, heavier fabrics or long sleeves during cooler conditions, removable layers for varied conditions). Or consider the use of heavier duty blinds or exterior curtains that can block out the direct sun.*	--
2	***Is inadequate ventilation resulting in undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*None at this time.*	--
3	***Is mold growth contributing to undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*None at this time.*	--
4	***Are excessive or unusual dust/particulates contributing to undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*Ensure that the HVAC units that serve the portable units are also included on the PM schedule and regularly cleaned.*	❑

Introduction

Forensic Analytical Consulting Services was retained by Fresno Unified School District (FUSD) to perform indoor environmental quality assessments of various schools at the district. FUSD has selected multiple sites and representative rooms to evaluate proactively to further improve the indoor environment quality for students and staff. On June 20, 2022, FACS conducted an indoor environmental quality assessment of rooms Room 7, MPR, and K-6 PCR at Yokomi Elementary School located at 2323 E McKenzie Avenue in Fresno, California. The purpose of the evaluation was to 1) identify and evaluate potential explanations, sources and pathways for possible symptoms related to indoor environment quality issues; 2) provide information for consideration in assessing risk to occupants; and 3) provide recommendations for additional investigation and corrective actions as necessary.

Site Characterization

Yokomi Elementary School houses one large permanent building that contains multiple classrooms, an administration office, a multi-purpose room, and multiple restrooms. Also observed on site are several portable classroom buildings. The exterior of the permanent building is characterized by stucco with a flat single-ply roof. The buildings are surrounded by light vegetation on all sides. The interior of permanent buildings is generally characterized by carpeted floors/ceramic floor tiles over concrete slab, drywall walls covered with tackboard, and cellulose false ceiling panels suspended on a T-bar grid. The permanent building is served by five roof mounted air handling units. Supply and return air are ducted above ceiling. The exterior of portable buildings are comprised of wood siding with a flat roof, while the interior is characterized by carpet on wood subfloors, tackboard covering drywall, and cellulose false ceiling tiles suspended on a T-bar grid. The portable buildings are served by individual exterior wall mounted cooling units, and interior heating units.

Additional characteristics of the rooms assessed are as follows:

- Room 7 is located within a single-story permanent building which houses other classrooms (e.g., room 9). The room is served conditioned air through a "forced air" system. The room also has operable windows. The space functions as a primary school classroom and is occupied for the majority of school hours.
- The Multipurpose Room (MPR) is located within a single-story permanent building which houses other rooms (e.g., Kitchen). The room is served conditioned air through a "forced air" system. The room also has operable windows. The space functions as a student cafeteria, stage, and kitchen and is occupied sporadically throughout the day. Student lunches begin at 1150 and end at 1250.
- Room K-6 PCR is a single-story portable/modular unit located on the school campus. The room is served conditioned air through a "forced air" system. The room also has operable windows. The room functions as a kindergarten school classroom and is occupied for the majority of school hours with the exception of lunch and recess.

Site History

According to client representatives and occupants/employees, the following history was developed:

- There are currently no reported ill health claims by employees or students.
- There was no reported history of major water intrusion events in the rooms assessed.
- No recent renovations to the school or rooms assessed.
- An air purifying machine was placed in room K-6.

Scope of Work

In the course of this project, FACS conducted the following scope of work:

1. Development of a site characterization and history (see sections above).
2. Visual assessment of areas of the interior of the subject rooms.
3. Visual assessment of accessible components of the HVAC systems serving the subject rooms.
4. Monitoring of various indoor air quality parameters, including carbon dioxide levels, temperature, relative humidity and carbon monoxide, using a data-logging direct reading instrument. Measurements were collected in representative rooms. Monitors were set to collect data for approximately 6 hours.
5. Monitoring of airborne particulates (PM2.5 and PM10) using a data-logging direct reading instrument. Measurements were collected in representative rooms. Monitors were set to collect data for approximately 6 hours.

The data collected in the course of the investigation and supporting information is presented in this report as follows:

- Appendix A: FACS Materials and Methods
- Appendix B: Site Plan
- Appendix C: Photographs
- Appendix D: Data Results Table

Conclusions and Recommendations

This investigation did not find hazardous conditions with regard to indoor air quality; however, it did identify issues that could potentially cause indoor air quality concerns.

In the course of collecting and analyzing the data from this investigation, FACS identified and evaluated typical indoor air quality concerns that could be identified in the school setting. A discussion of these concerns, along with related FACS conclusions and recommendations to improve indoor environmental quality are provided below.

Issue-by-Issue Discussion

1. ***Are temperature and humidity conditions resulting in undesirable IEQ in the representative rooms assessed?***

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

The combination of temperature and humidity in a building is the primary driver of occupant thermal comfort. Occupant thermal discomfort is often associated with increased dissatisfaction with indoor environmental quality and may exacerbate occupant symptoms. Cal/OSHA does not regulate thermal comfort in buildings; however, the California labor code indicates that temperatures in work areas shall provide reasonable comfort consistent with industry-wide standards for the work performed. To this end, Federal OSHA recommends temperature control in the range of 68-76°F and corresponding relative humidity from 60-20%. Similarly, the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) has developed widely accepted guidelines for managing temperature and humidity in buildings to help ensure the thermal comfort of occupants (ANSI/ASHRAE Standard 55). This guideline generally recommends 75-83°F & 60-10%RH (warm weather) and 68-77°F & 60-10%RH (cool weather). While these guidelines attempt to define conditions that are acceptable for approximately 80% of occupants, individual preferences may vary.

The following are findings from the assessment:

1. Monitoring for temperature and relative humidity was conducted in rooms 4, MPR, and 22 PCR from approximately 8:00 am to 2:30 pm using data logging indoor air quality monitors. Hours were selected to be representative of a typical school day.
2. Temperature readings are as follows:
   a. Room 7: temperatures ranged between 74.8 to 82.3°F
   b. MPR: temperatures ranged between 74.6 to 76.8 °F
   c. Room K-6 PCR: temperatures ranged between 76.3 to 77.4 °F
3. Review of temperatures measured indicate that temperatures were within ASHRAE (assuming warmer weather) guidelines for comfort, but outside federal OSHA's temperature range.
4. Relative humidity readings are as follows
   a. Room 7: humidity ranged between 26.9 to 33.8%
   b. MPR: humidity ranged between 31.6 to 34.6%
   c. Room K-6 PCR: humidity ranged between 32.5 to 37.6%
5. The relative humidity levels measured were within OSHA and ASHRAE guidelines for comfort.
6. Summary of the data is provided in the appendices.

Based on assessment findings, it is unlikely that temperature and humidity conditions may result in undesirable IEQ in some of the rooms assessed. However, it should be noted that temperature preferences may differ occupant by occupant. The following recommendations are provided to assist FUSD in overcoming temperature preference issues.

Recommendations:

a) *Occupants and maintenance staff should communicate and work together to understand how the HVAC system functions and to attempt to adjust thermal comfort conditions to match occupant preferences to the extent practicable based upon system design limitations and the above referenced Federal OSHA and ANSI/ASHRAE Standard 55 guidelines.*
b) *If conditions cannot be controlled to satisfy individual occupant preferences, occupants should self-regulate thermal comfort with clothing choices (e.g., lighter fabrics or short sleeves during hotter conditions, heavier fabrics or long sleeves during cooler conditions, removable layers for varied conditions). Or consider the use of heavier duty blinds or exterior curtains that can block out the direct sun.*

2. *Is inadequate ventilation resulting in undesirable IEQ in the representative rooms assessed?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Mechanical ventilation systems (a.k.a., HVAC systems) generally mix recirculated indoor air with outside "fresh" air. If the ventilation rate (i.e., amount of outside air) is too low, common indoor contaminants such as particles, odors, chemical vapors and exhaled carbon dioxide can accumulate and result in degraded indoor air quality. Occupants in poorly ventilated rooms will frequently describe the air as "stuffy" or "stale" and will more often report symptoms and discomfort related to indoor environmental quality. Cal/OSHA regulations (8CCR§5142) generally require that in mechanically ventilated buildings the HVAC system must be run continuously during working hours. The regulation further requires minimum outdoor airflows based on the building codes in place at the time of construction. The current minimum outdoor airflows called for in the building code are derived from guidelines by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE Standard 62.1--Ventilation for Acceptable Indoor Air Quality) and are calculated based upon the type of building space, number of occupants, size of the occupied area and other variables related to the design of the HVAC system.

In occupied buildings, carbon dioxide (CO_2) concentrations are typically higher then ambient outdoor concentrations due to exhaled air from people. As such, comparison of indoor and outdoor CO_2 levels are often used as a general indicator of indoor ventilation relative to human bioeffluents (i.e., body odor).

ANSI/ASHRAE Standard 62.1 indicates that keeping indoor CO_2 levels less than 700 ppm above outdoor (about 1,000 to 1,500 ppm) will provide satisfaction the substantial majority of people in the building relative to human bioeffluents. As a general rule of thumb, ventilating to keep indoor CO_2 levels below 1,000 ppm and closer to outdoor levels results in less occupant complaints regarding indoor air quality and "stuffy" or "stale" air.

The following are findings from the assessment:

1. Per site representatives, HVAC units run continuously, 24 hours a day, seven days a week in the permanent buildings. The HVAC units that serve the portables are turned off by custodial staff at the end of the day.
2. Monitoring for carbon dioxide was conducted in rooms 7, MPR, and K-6 PCR from approximately 8:30 am to 2:30 pm using data logging indoor air quality monitors. Hours were selected to be representative of a typical school day.
3. Rooms 7 and K-6 PCR were occupied for the monitoring period, with the exception of lunch and recess. The MPR was sparsely occupied for most of the day, and heavily occupied from 1150-1250.
4. Carbon dioxide readings are as follows:
    a. Room 7: carbon dioxide levels ranged between 524 to 713 ppm
    b. MPR: carbon dioxide levels ranged between 424 to 533 ppm
    c. Room K-6 PCR: carbon dioxide levels ranged between 514 to 752 ppm
5. Review of data measured indicate that carbon dioxide levels were within ASHRAE guidelines for comfort.
6. Summary of the data is provided in the appendices.

Based on assessment findings, it is unlikely that inadequate ventilation is resulting in undesirable IEQ in some of the rooms assessed.

Recommendations:

a) None at this time.

3. *Is mold growth contributing to undesirable IEQ in some parts of the building?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Mold growth can occur when organic building materials or accumulated organic debris is impacted by moisture. This may occur within 24-48 hours from the time such materials become wet, hence it is critical that materials are substantially dried within this time frame in order to minimize the potential for mold growth to develop. Mold growth has the potential to elicit negative health effects in sensitive persons. This most frequently manifests as allergic respiratory symptoms which may range from mild to severe depending on individual sensitivities. Irritant and infectious effects are possible. It is generally accepted that mold growth in buildings should be removed following appropriate precautions to protect workers involved in the clean-up and the surrounding environment. Greater precautions are taken for greater amounts of mold growth. In addition, the underlying cause of mold and moisture intrusion should be identified and corrected in order to minimize the potential for recurrent mold growth. Additional information can be found at the U.S. Environmental Protection Agency website (http://www.epa.gov/mold/).

The following are findings from the assessment:

1. According to site representatives, there have been no known water intrusion events that have occurred in the representative rooms assessed.
2. Many gutters located near HVAC units on the buildings assessed were found to be filled with heavy debris, which may result in clogging and potential water intrusion into buildings.
3. No signs of mold growth were identified in rooms assessed.

4. Visual inspection of accessible components of the HVAC units that served the rooms did not indicate any areas of mold growth.
5. Supporting photos are provided in Appendix C.

Based on assessment findings, mold growth is not suspected to be negatively impacting indoor environmental quality in the inspected areas.

Recommendations:

b) None at this time.

4. *Are excessive or unusual dust/particulates contributing to undesirable IEQ?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Various particulates are common in indoor environments. Particles ("dust") from various indoor and outdoor sources (e.g., human skin, paper, dirt, clothing, building material) can accumulate in the indoor environment and result in degraded indoor air quality, i.e. ("dusty" air). In general, we are concerned with particulates that are small enough to be inhaled. While such dust is not considered toxic, health problems that can be caused by breathing non-specific particulates include: eye, nose, and throat irritation and increased risk for respiratory infections and allergic reactions. Acute exposure to particulates, such as can occur if settled dust is disturbed and aerosolized, can potentially cause irritation to building occupants and increase the risk of respiratory problems in sensitive individuals. Inadequate housekeeping and insufficient filtration by the HVAC system can exacerbate dusty environments. Occupants in these conditions may report symptoms such as coughing, sneezing, and discomfort.

The following are findings from the assessment:

1. Light to heavy dust loading was identified in the air handling units assessed. Specifically, heaving dust loading on accessible components for the unit that serves room K-6 PCR.
2. The air handling units that serve the school are equipped with filters that are reportedly changed every six months.
3. Roof mounted HVAC units inspected on permanent buildings were found to have light dust deposition on filters.
4. Light to moderate dust deposition was observed in the interior of the classrooms assessed. In general, heavier dust ("moderate") accumulation was identified on locations identified as "hard to reach" or surfaces not subject to regular cleaning.
5. Custodial staff reportedly lightly cleans the rooms on campus daily, which include trash removal, vacuuming of accessible areas, dusting etc.
6. Monitoring for airborne dust levels was conducted in rooms 7, MPR, and K-6 PCR from approximately 8:30 am to 2:30 pm using data logging aerosol monitors. Readings included particulate matter with diameter of less than 2.5 microns (PM2.5) and particulate matter with diameter of less than 10 microns (PM10). Results were compared to U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) ranges, which are for outdoor air and 24 hour average concentrations. Currently there are no indoor air quality references to compare indoor particulate levels. Hours were selected to be representative of a typical school day.
7. Airborne particulate readings are as follows:
    - Room 7:
        - PM2.5 levels ranged between 0.000 to 0.016 mg/m^3, with an average of 0.002 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
        - PM10 levels ranged between 0.000 to 0.054 mg/m^3, with an average of 0.008 mg/m^3, which is considered within the U.S. Environmental Protection Agency

(USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)

- MPR:
  - PM2.5 levels ranged between 0.000 to 0.005 mg/m^3, with an average of 0.000 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
  - PM10 levels ranged between 0.000 to 0.015 mg/m^3, with an average of 0.003 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)
- Room K-6 PCR
  - PM2.5 levels ranged between 0.000 to 0.007 mg/m^3, with an average of 0.001 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
  - PM10 levels ranged between 0.000 to 0.015 mg/m^3, with an average of 0.003 mg/m^3, which is considered within the U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) range for good air quality for PM10 (0 – 0.054 mg/m^3)

8. Summary of the data and supporting photographs is provided in the appendices of the report.

Based on assessment findings, it is unlikely that excessive or unusual dust/particulates is contributing to undesirable IEQ in the rooms assessed.

Recommendations:

a) *Ensure that the HVAC units that serve the portable units are also included on the PM schedule and regularly cleaned.*

Limitations

This investigation is limited to the conditions and practices observed and information made available to FACS. The methods, conclusions and recommendations provided are based on FACS' judgment, expertise and the standard of practice for professional service. They are subject to the limitations and variability inherent in the methodology employed. As with all environmental investigations, this investigation is limited to the defined scope and does not purport to set forth all hazards, nor indicate that other hazards do not exist.

Please do not hesitate to contact our offices at 559-436-0277 with any questions or concerns. Thank you for the opportunity to assist Fresno Unified School District in promoting a more healthful environment.

Respectfully,
FORENSIC ANALYTICAL

Joe Blair

Joe Blair
Environmental Health Specialist, Fresno

Reviewed by:
FORENSIC ANALYTICAL

Michelle Rosales

Michelle Rosales, MPH, CIH
Principal Consultant

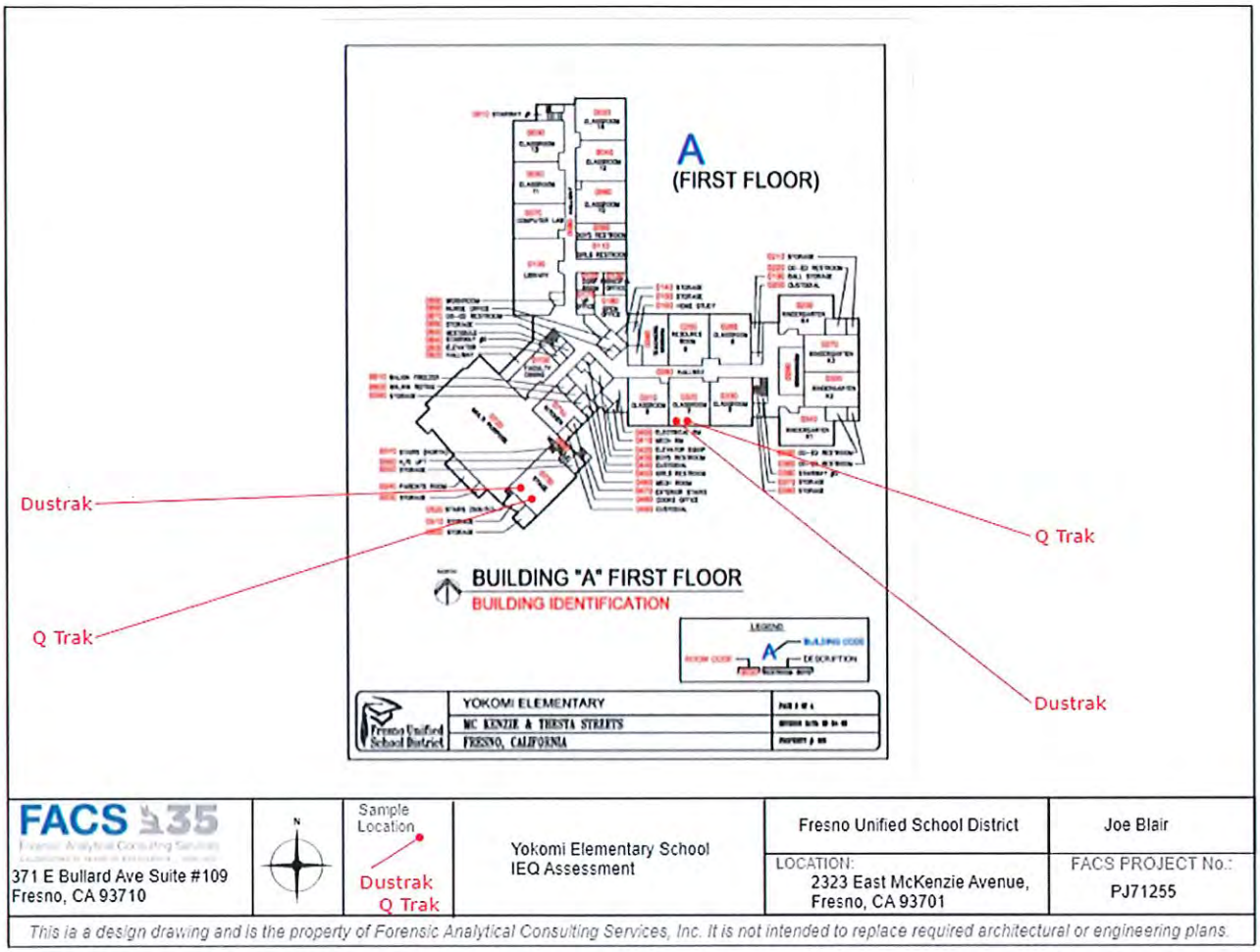
Appendix A
FACS Materials and Methods

Comfort Parameters Air Monitoring. Temperature, relative humidity, carbon dioxide (CO_2), and carbon monoxide (CO) measurements were collected using Q-Trak 7575 Indoor Air Quality Monitors. Measurements for carbon dioxide and carbon monoxide were expressed in concentration values of parts per million (ppm) with a detection limit of 1 ppm. Temperature was collected in degrees Fahrenheit and relative humidity in percentage (%). All data was collected in 60 second intervals within an approximate eight hours of sampling time (equivalent to room occupancy).

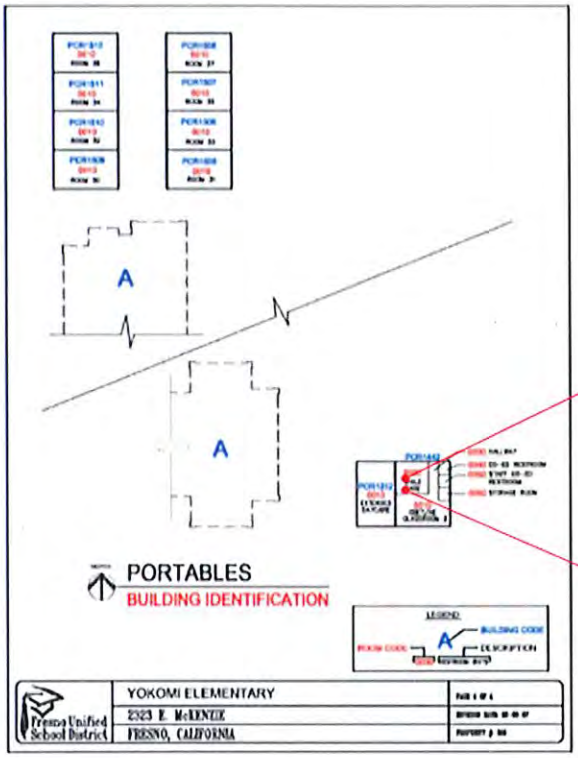
Airborne Particulates. Airborne particulates were measured using a TSI Dustrak set to collect the fraction of airborne particulates less than 10 microns (<10 µm) in diameter and less than 2.5 µm (PM10 and PM2.5, respectively. The monitor had been factory calibrated within the previous 12 months at the time of sampling and zero calibrated prior to the assessment. Results were expressed in milligrams per cubic meter (mg/m^3). All data was collected in 60 second intervals within an approximate eight hours of sampling time (equivalent to room occupancy).

Appendix B
Sample Maps

Room 7 and Multi-Purpose Room



Room K-6 PCR



FACS 35 Forensic Analytical Consulting Services 371 E Bullard Ave Suite #109 Fresno, CA 93710	N	Sample Location Dustrak Q Trak	Yokomi Elementary School IEQ Assessment	Fresno Unified School District LOCATION: 2323 East McKenzie Avenue, Fresno, CA 93701	Joe Blair FACS PROJECT No.: PJ71255

This is a design drawing and is the property of Forensic Analytical Consulting Services, Inc. It is not intended to replace required architectural or engineering plans.

Appendix C
Photographs

Photo #1: MPR
Site Overview

Photo #2: MPR
HVAC Supply Air Register

Photo #3: Air Handler HC-14
Serves MPR/Stage

Photo #4: Light Dust Loading on Air Filters
Serves MPR/Stage

Photo #5: Air Handler HC-13
Serves MPR/Kitchen

Photo #6: Moderate Dust Loading on Air Filters
Serves MPR/Kitchen

Photo #7: Hand Sanitizer Used in MPR
Overview

Photo #8: Room 7
Site Overview

Photo #9: Air Handler
Serves Building A, Including Room 7

Photo #10: Light Dust Loading on Air Filter
Serves Building A, Including Room 7

Photo #11: Heavy Dust Loading on Components
Serves Building A, Including Room 7

Photo #12: K-6 PCR
Site Overview

Photo #13: K-6 PCR
Wall Unit Overview

Photo #14: K-6 PCR
Clean Condenser Coils

Photo #15: Air Purifier
Serves Room K-6

Photo #16: Return Grille
Serves Room K-6

Photo #17: Heavy Dust Loading on Air Filters/Components
Serves Room K-6 PCR

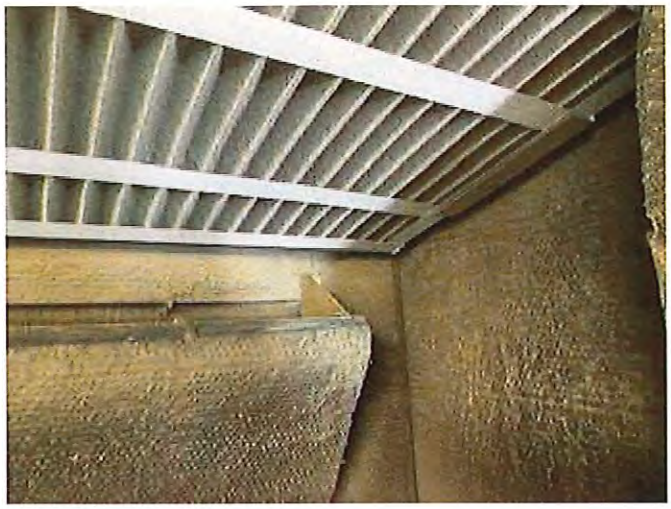


Photo #18: Heavy Dust Loading on Air Filters/Components
Serves Room K-6 PCR

Appendix D
Data Results Tables and Laboratory Reports

Q-Trak Indoor Air Quality Monitors

Instrument Number	Location	$C0_2$	T	H	CO
FA01502	Room 7	Avg. 630 ppm Min. 524 ppm Max. 713 ppm	Avg. 79.5 deg F Min. 74.8 deg F Max. 82.3 deg F	Avg. 29.6% Min. 26.9% Max. 33.8%	Avg. 0.3 ppm Min. 0.0 ppm Max. 0.9 ppm
FA01499	Multi-Purpose Room	Avg. 457 ppm Min. 424 ppm Max. 533 ppm	Avg. 75.8 deg F Min. 74.6 deg F Max 76.8 deg F	Avg. 32.7% Min. 31.6% Max. 34.6%	Avg. 0.0 ppm Min. 0.0 ppm Max. 0.0 ppm
FA01301	Room K-6 PCR	Avg. 647 ppm Min. 514 ppm Max. 752 ppm	Avg. 76.8 deg F Min. 76.3 deg F Max. 77.4 deg F	Avg. 35.9% Min. 32.5% Max. 37.6%	Avg. 0.0 ppm Min. 0.0 ppm Max. 0.0 ppm

Notes: Findings in bold considered elevated or outside of guidelines where applicable

(1) Industry guidelines[5] recommend CO_2 levels be no greater than 700 ppm above ambient outdoor levels.

(2) OSHA recommends temperature control in the range of 68-76°F. Industry guidelines[5] recommend indoor temperatures between 68 and 77°F during cold weather, and 75 to 83°F during warm weather.

(3) OSHA recommends indoor relative humidity in the range of 60-20%. Industry guidelines[5] recommend indoor relative humidity levels be less than 60% during warm weather and 80% during cool weather.

(4) No standards for CO have been agreed upon for indoor air. The EPA National Ambient Air Quality Standard for outdoor air is 9 ppm for an 8-hour average, and 35 ppm for a 1-hour average.

(5) "Industry Guidelines" refers to American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) standards 62.1-2019 "Ventilation for Acceptable Indoor Air Quality" and ASHRAE Standard 55-2020 "Thermal Environmental Conditions for Human Occupancy".

DustTrak DRX Aerosol Monitor

Room		PM2.5 (mg/m^3)	EPA Interpretation[1]	PM10 (mg/m^3)	EPA Interpretation[2]
Room 7	Avg	0.002	Good	0.008	Good
	Min	0.000		0.000	
	Max	0.016		0.054	
Multi-Purpose Room	Avg	0.000	Good	0.003	Good
	Min	0.000		0.000	
	Max	0.005		0.015	
Room K-6 PCR	Avg	0.001	Good	0.003	Good
	Min	0.000		0.000	
	Max	0.007		0.015	

Note:

(1) The U.S. EPA Air Quality Index (AQI) is an index for reporting daily air quality. The AQI categories for 24-hour average PM2.5 concentrations (in mg/m3) are as follows:
- Good: 0 – 0.0150 mg/m3
- Moderate: 0.0151 -0.0404 mg/m3
- Unsafe for Sensitive Groups: 0.01405 – 0.0654 mg/m3
- Unhealthy: 0.0655 – 0.1504 mg/m3
- Very Unhealthy: 0.1505 -0. 2504 mg/m3
- Hazardous: 250.5 – 500.4 mg/m3

(2) The U.S. EPA Air Quality Index (AQI) is an index for reporting daily air quality. The AQI categories for 24-hour average PM10 concentrations (in mg/m3) are as follows:
- Good: 0 – 0.054 mg/m3
- Moderate: 0.055 – 0.154 mg/m3
- Unsafe for Sensitive Groups: 0.155 – 0.254 mg/m3
- Unhealthy: 0.255 – 0.354 mg/m3
- Very Unhealthy: 0.355 – 0.424 mg/m3
- Hazardous: 0.425 – 0.604 mg/m3

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June 21, 2022

Indoor Environmental Quality Assessment: Findings of Initial Assessment

Fresno Unified School District
Wishon Elementary School
3857 East Harvard Avenue
Fresno, CA 93703

Prepared for:

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FACS Project #PJ71255

Contents

Executive Summary

Forensic Analytical Consulting Services was retained by Fresno Unified School District to perform a proactive indoor environmental quality assessment of selected areas of Wishon Elementary School in Fresno, California. Findings of this assessment did not identify hazardous conditions related to indoor air quality in the areas of concern. However, this investigation did find conditions that have the potential to negatively impact indoor environmental quality, and associated actions that can be taken to address them were identified along with other suggestions for generally improving indoor environmental quality. A summary of the primary causes of indoor environmental quality concerns considered, FACS' conclusions and related recommendations are provided in the table below. A more complete discussion of findings, conclusions and recommendations is provided in the body of this report.

FACS IEQ Evaluation Summary		
#	**Primary IEQ Concerns and Recommendations**	**Conclusion & Completion**
1	***Are temperature and humidity conditions resulting in undesirable IEQ in the representative rooms assessed?***	**Potential**
a)	*Occupants and maintenance staff should communicate and work together to understand how the HVAC system functions and to attempt to adjust thermal comfort conditions to match occupant preferences to the extent practicable based upon system design limitations and the above referenced Federal OSHA and ANSI/ASHRAE Standard 55 guidelines.*	❑
b)	*If conditions cannot be controlled to satisfy individual occupant preferences, occupants should self-regulate thermal comfort with clothing choices (e.g., lighter fabrics or short sleeves during hotter conditions, heavier fabrics or long sleeves during cooler conditions, removable layers for varied conditions). Or consider the use of heavier duty blinds or exterior curtains that can block out the direct sun.*	❑
2	***Is inadequate ventilation resulting in undesirable IEQ in the representative rooms assessed?***	**Potential**
a)	*Ensure that outdoor air intake dampers are set to stay open during working hours to a minimum position that ensures airflow rates called for by building codes as referenced in the Cal/OSHA regulations and ANSI/ASHRAE Standard 62.1 guideline identified above. The outdoor air settings should also generally maintain CO2 levels below 1,000 ppm (or <700 ppm above outdoor).*	❑
3	***Is mold growth contributing to undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*None at this time.*	--
4	***Are excessive or unusual dust/particulates contributing to undesirable IEQ in the representative rooms assessed?***	**Unlikely**
a)	*Ensure that the HVAC units that serve the portable units are also included on the PM schedule and regularly cleaned.*	❑

Introduction

Forensic Analytical Consulting Services was retained by Fresno Unified School District (FUSD) to perform indoor environmental quality assessments of various schools at the district. FUSD has selected multiple sites and representative rooms to evaluate proactively to further improve the indoor environment quality for students and staff. On June 17, 2022, FACS conducted an indoor environmental quality assessment of rooms 4, multipurpose room (MPR), and 22 PCR at Wishon Elementary School located at 3857 East Harvard Avenue in Fresno, California. The purpose of the evaluation was to 1) identify and evaluate potential explanations, sources and pathways for possible symptoms related to indoor environment quality issues; 2) provide information for consideration in assessing risk to occupants; and 3) provide recommendations for additional investigation and corrective actions as necessary.

Site Characterization

Wishon Elementary School houses various permanent and portable classroom buildings, an administration office, a multi-purpose room, and multiple restrooms. The exterior of permanent buildings is characterized by stucco with a flat single-ply roof, or a pitched composition shingle roof. The buildings are surrounded by light vegetation on all sides. The interior of permanent buildings is generally characterized by carpeted floors/vinyl floor tiles over concrete slab, drywall walls covered with tackboard, and cellulose acoustic ceiling tiles nailed to the ceiling substrate. The permanent buildings are either served by multiple roof mounted air handling units, or individual wall mounted cooling and heating units. Supply and return air are ducted above ceiling or within the wall cavity. The exterior of portable buildings is comprised of stucco with a flat roof, while the interior is characterized by carpet on wood subfloors, tackboard covering drywall, and cellulose false ceiling tiles suspended on a T-bar grid. The portable buildings are served by individual exterior ground mounted cooling units, and interior heating units.

Additional characteristics of the rooms assessed are as follows:

- Room 4 is located within a single-story permanent building which houses other classrooms (e.g., room 5) and is surrounded by a playground area. The room is served conditioned air through a “forced air” system. The room also has operable windows. The space functions as a primary school classroom and is occupied for the majority of school hours.
- The Multipurpose Room (MPR) is located within a single-story permanent building which houses other rooms (e.g., Kitchen). The room is served conditioned air through a “forced air” system. The room also has operable windows. The space functions as a student cafeteria, stage, and kitchen and is occupied sporadically throughout the day. Student lunches begin at noon and end at 1250.
- Room 22 PCR is a single-story portable/modular unit located on the school campus. The room is served conditioned air through a “forced air” system. The room also has operable windows. The room functions as a primary school classroom and is sporadically occupied throughout the day.

Site History

According to client representatives and occupants/employees, the following history was developed:

- There are currently no reported ill health claims by employees or students.
- There was no reported history of major water intrusion events in the rooms assessed.
- No recent renovations to the school or rooms assessed.

Scope of Work

In the course of this project, FACS conducted the following scope of work:

1. Development of a site characterization and history (see sections above).
2. Visual assessment of areas of the interior of the subject rooms assessed.
3. Visual assessment of accessible components of the HVAC systems serving the subject rooms.
4. Monitoring of various indoor air quality parameters, including carbon dioxide levels, temperature, relative humidity and carbon monoxide, using a data-logging direct reading instrument. Measurements were collected in representative rooms. Monitors were set to collect data for approximately 6 hours.
5. Monitoring of airborne particulates (PM2.5 and PM10) using a data-logging direct reading instrument. Measurements were collected in representative rooms. Monitors were set to collect data for approximately 6 hours.

The data collected in the course of the investigation and supporting information is presented in this report as follows:

- Appendix A: FACS Materials and Methods
- Appendix B: Site Plan
- Appendix C: Photographs
- Appendix D: Data Results Table and Laboratory Reports

Conclusions and Recommendations

This investigation did not find hazardous conditions with regard to indoor air quality; however, it did identify issues that could potentially cause indoor air quality concerns.

In the course of collecting and analyzing the data from this investigation, FACS identified and evaluated typical indoor air quality concerns that could be identified in the school setting. A discussion of these concerns, along with related FACS conclusions and recommendations to improve indoor environmental quality are provided below.

Issue-by-Issue Discussion

1. *Are temperature and humidity conditions resulting in undesirable IEQ in the representative rooms assessed?*

Conclusion: CONFIRMED PROBABLE **POTENTIAL** UNLIKELY

The combination of temperature and humidity in a building is the primary driver of occupant thermal comfort. Occupant thermal discomfort is often associated with increased dissatisfaction with indoor environmental quality and may exacerbate occupant symptoms. Cal/OSHA does not regulate thermal comfort in buildings; however, the California labor code indicates that temperatures in work areas shall provide reasonable comfort consistent with industry-wide standards for the work performed. To this end, Federal OSHA recommends temperature control in the range of 68-76°F and corresponding relative humidity from 60-20%. Similarly, the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) has developed widely accepted guidelines for managing temperature and humidity in buildings to help ensure the thermal comfort of occupants (ANSI/ASHRAE Standard 55). This guideline generally recommends 75-83ºF & 60-10%RH (warm weather) and 68-77ºF & 60-10%RH (cool weather). While these guidelines attempt to define conditions that are acceptable for approximately 80% of occupants, individual preferences may vary.

The following are findings from the assessment:

1. Monitoring for temperature and relative humidity was conducted in rooms 4, MPR, and 22 PCR from approximately 8:00 am to 2:30 pm using data logging indoor air quality monitors. Hours were selected to be representative of a typical school day.
2. Temperature readings are as follows:
    a. Room 4: temperatures ranged between 74.4 to 82.4 ºF
    b. MPR: temperatures ranged between 72.5 to 75.2 ºF
    c. Room 22 PCR: temperatures ranged between 71.6 to 74.4 ºF
3. Review of temperatures measured indicate that temperatures were slightly out of range for both the OSHA and ASHRAE (assuming warmer weather) guidelines for comfort in room 4 and 22.
4. Relative humidity readings are as follows
    a. Room 4: humidity ranged between 26.4 to 34.9%
    b. MPR: humidity ranged between 26.8 to 32.1%
    c. Room 22: humidity ranged between 35.1 to 36.5%
5. The relative humidity levels measured were within OSHA and ASHRAE guidelines for comfort.
6. Summary of the data is provided in the appendices.

Based on assessment findings, there is the potential that temperature conditions may result in undesirable IEQ in some of the rooms assessed.

Recommendations:

a) *Occupants and maintenance staff should communicate and work together to understand how the HVAC system functions and to attempt to adjust thermal comfort conditions to match occupant preferences to the extent practicable based upon system design limitations and the above referenced Federal OSHA and ANSI/ASHRAE Standard 55 guidelines.*
b) *If conditions cannot be controlled to satisfy individual occupant preferences, occupants should self-regulate thermal comfort with clothing choices (e.g., lighter fabrics or short sleeves during hotter conditions, heavier fabrics or long sleeves during cooler conditions, removable layers for varied conditions). Or consider the use of heavier duty blinds or exterior curtains that can block out the direct sun.*

2. Is inadequate ventilation resulting in undesirable IEQ in the representative rooms assessed?

Conclusion: CONFIRMED PROBABLE **POTENTIAL** UNLIKELY

Mechanical ventilation systems (a.k.a., HVAC systems) generally mix recirculated indoor air with outside "fresh" air. If the ventilation rate (i.e., amount of outside air) is too low, common indoor contaminants such as particles, odors, chemical vapors and exhaled carbon dioxide can accumulate and result in degraded indoor air quality. Occupants in poorly ventilated rooms will frequently describe the air as "stuffy" or "stale" and will more often report symptoms and discomfort related to indoor environmental quality. Cal/OSHA regulations (8CCR§5142) generally require that in mechanically ventilated buildings the HVAC system must be run continuously during working hours. The regulation further requires minimum outdoor airflows based on the building codes in place at the time of construction. The current minimum outdoor airflows called for in the building code are derived from guidelines by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE Standard 62.1--Ventilation for Acceptable Indoor Air Quality) and are calculated based upon the type of building space, number of occupants, size of the occupied area and other variables related to the design of the HVAC system.

In occupied buildings, carbon dioxide (CO_2) concentrations are typically higher then ambient outdoor concentrations due to exhaled air from people. As such, comparison of indoor and outdoor CO_2 levels are often used as a general indicator of indoor ventilation relative to human bioeffluents (i.e., body odor). ANSI/ASHRAE Standard 62.1 indicates that keeping indoor CO_2 levels less than 700 ppm above outdoor (about 1,000 to 1,500 ppm) will provide satisfaction the substantial majority of people in the building

relative to human bioeffluents. As a general rule of thumb, ventilating to keep indoor CO_2 levels below 1,000 ppm and closer to outdoor levels results in less occupant complaints regarding indoor air quality and "stuffy" or "stale" air.

The following are findings from the assessment:

1. Per site representatives, HVAC units run continuously, 24 hours a day, seven days a week in the permanent buildings. The HVAC units that serve the portables are turned off by custodial staff at the end of the day.
2. Monitoring for carbon dioxide was conducted in rooms 4, MPR, and 22 PCR from approximately 8:30 am to 2:30 pm using data logging indoor air quality monitors. Hours were selected to be representative of a typical school day.
3. Rooms 4 and 22 PCR were occupied for the monitoring period, with the exception of lunch and recess. The MPR was sparsely occupied for most of the day, and heavily occupied from 1150-1250.
4. Carbon dioxide readings are as follows:
    a. Room 4: carbon dioxide levels ranged between 402 to 523 ppm
    b. MPR: carbon dioxide levels ranged between 407 to 558 ppm
    c. Room 22 PCR: carbon dioxide levels ranged between 615 to 1212 ppm
5. Review of data measured indicate that carbon dioxide levels were within ASHRAE guidelines for comfort.
6. Summary of the data is provided in the appendices.

Based on elevated CO levels in PCR 22 from 10:58 – 11:53, there is a potential that the spaces may not be receiving a sufficient amount of outdoor "fresh" air, particularly if spaces are heavily occupied.

Recommendations:

a) *Ensure that outdoor air intake dampers are set to stay open during working hours to a minimum position that ensures airflow rates called for by building codes as referenced in the Cal/OSHA regulations and ANSI/ASHRAE Standard 62.1 guideline identified above. The outdoor air settings should also generally maintain CO_2 levels below 1,000 ppm (or <700 ppm above outdoor).*

3. *Is mold growth contributing to undesirable IEQ in some parts of the building?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Mold growth can occur when organic building materials or accumulated organic debris is impacted by moisture. This may occur within 24-48 hours from the time such materials become wet, hence it is critical that materials are substantially dried within this time frame in order to minimize the potential for mold growth to develop. Mold growth has the potential to elicit negative health effects in sensitive persons. This most frequently manifests as allergic respiratory symptoms which may range from mild to severe depending on individual sensitivities. Irritant and infectious effects are possible. It is generally accepted that mold growth in buildings should be removed following appropriate precautions to protect workers involved in the clean-up and the surrounding environment. Greater precautions are taken for greater amounts of mold growth. In addition, the underlying cause of mold and moisture intrusion should be identified and corrected in order to minimize the potential for recurrent mold growth. Additional information can be found at the U.S. Environmental Protection Agency website (http://www.epa.gov/mold/).

The following are findings from the assessment:

1. According to site representatives, there have been no known water intrusion events that have occurred in the representative rooms assessed.

2. Many gutters located near HVAC units on the buildings assessed were found to be filled with heavy debris, which may result in clogging and potential water intrusion into buildings.
3. No signs of mold growth was identified in rooms assessed.
4. Visual inspection of accessible components of the HVAC units that served the rooms did not indicate any areas of mold growth.
5. Supporting photos are provided in Appendix C.

Based on assessment findings, mold growth is not suspected to be negatively impacting indoor environmental quality in the inspected areas.

Recommendations:

a) None at this time.

4. *Are excessive or unusual dust/particulates contributing to undesirable IEQ?*

Conclusion: CONFIRMED PROBABLE POTENTIAL **UNLIKELY**

Various particulates are common in indoor environments. Particles ("dust") from various indoor and outdoor sources (e.g., human skin, paper, dirt, clothing, building material) can accumulate in the indoor environment and result in degraded indoor air quality, i.e. ("dusty" air). In general, we are concerned with particulates that are small enough to be inhaled. While such dust is not considered toxic, health problems that can be caused by breathing non-specific particulates include: eye, nose, and throat irritation and increased risk for respiratory infections and allergic reactions. Acute exposure to particulates, such as can occur if settled dust is disturbed and aerosolized, can potentially cause irritation to building occupants and increase the risk of respiratory problems in sensitive individuals. Inadequate housekeeping and insufficient filtration by the HVAC system can exacerbate dusty environments. Occupants in these conditions may report symptoms such as coughing, sneezing, and discomfort.

The following are findings from the assessment:

1. Light to heavy dust loading was identified in the air handling units assessed. Specifically, heaving dust loading on accessible components for the unit that serves room 22 PCR.
2. The air handling units that serve the school are equipped with filters that are reportedly changed every six months.
3. Roof mounted HVAC units inspected on permanent buildings were found to have light dust deposition on filters.
4. Light to moderate dust deposition was observed in the interior of the classrooms assessed. In general, heavier dust ("moderate") accumulation was identified on locations identified as "hard to reach" or surfaces not subject to regular cleaning.
5. Custodial staff reportedly lightly cleans the rooms on campus daily, which include trash removal, vacuuming of accessible areas, dusting etc.
6. Monitoring for airborne dust levels was conducted in rooms 4, MPR, and 22 PCR from approximately 8:30 am to 2:30 pm using data logging aerosol monitors. Readings included particulate matter with diameter of less than 2.5 microns (PM2.5) and particulate matter with diameter of less than 10 microns (PM10). Results were compared to U.S. Environmental Protection Agency (USEPA) Air Quality Index (AQI) ranges, which are for outdoor air and 24-hour average concentrations. Currently there are no indoor air quality references to compare indoor particulate levels. Hours were selected to be representative of a typical school day.
7. Airborne particulate readings are as follows:
    - Room 4:
        - PM2.5 levels ranged between 0.000 to 0.007 mg/m^3, with an average of 0.000 mg/m^3, which is considered within the USEPA AQI range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)

        - PM10 levels ranged between 0.000 to 0.020 mg/m^3, with an average of 0.001 mg/m^3, which is considered within the U. USEPA AQI range for good air quality for PM10 (0 – 0.054 mg/m^3)
    - MPR:
        - PM2.5 levels ranged between 0.001 to 0.007 mg/m^3, with an average of 0.003 mg/m^3, which is considered within the USEPA AQI range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
        - PM10 levels ranged between 0.002 to 0.010 mg/m^3, with an average of 0.005 mg/m^3, which is considered within the USEPA AQI range for good air quality for PM10 (0 – 0.054 mg/m^3)
    - Room 22 PCR
        - PM2.5 levels ranged between 0.000 to 0.038 mg/m^3, with an average of 0.010 mg/m^3, which is considered within the USEPA AQI range for good air quality for PM2.5 (0 – 0.0154 mg/m^3)
        - PM10 levels ranged between 0.006 to 0.112 mg/m^3, with an average of 0.035 mg/m^3, which is considered within the USEPA AQI range for good air quality for PM10 (0 – 0.054 mg/m^3)
8. Summary of the data and supporting photographs is provided in the appendices of the report.

Based on assessment findings, it is unlikely that excessive or unusual dust/particulates is contributing to undesirable IEQ in the rooms assessed.

Recommendations:

a) *Ensure that the HVAC units that serve the portable units are also included on the PM schedule and regularly cleaned.*

Limitations

This investigation is limited to the conditions and practices observed and information made available to FACS. The methods, conclusions and recommendations provided are based on FACS' judgment, expertise and the standard of practice for professional service. They are subject to the limitations and variability inherent in the methodology employed. As with all environmental investigations, this investigation is limited to the defined scope and does not purport to set forth all hazards, nor indicate that other hazards do not exist.

Please do not hesitate to contact our offices at 559-436-0277 with any questions or concerns. Thank you for the opportunity to assist Fresno Unified School District in promoting a more healthful environment.

Respectfully,
FORENSIC ANALYTICAL

Joe Blair

Joe Blair
Environmental Health Specialist, Fresno

Reviewed by:
FORENSIC ANALYTICAL

Michelle Rosales

Michelle Rosales, MPH, CIH
Principal Consultant

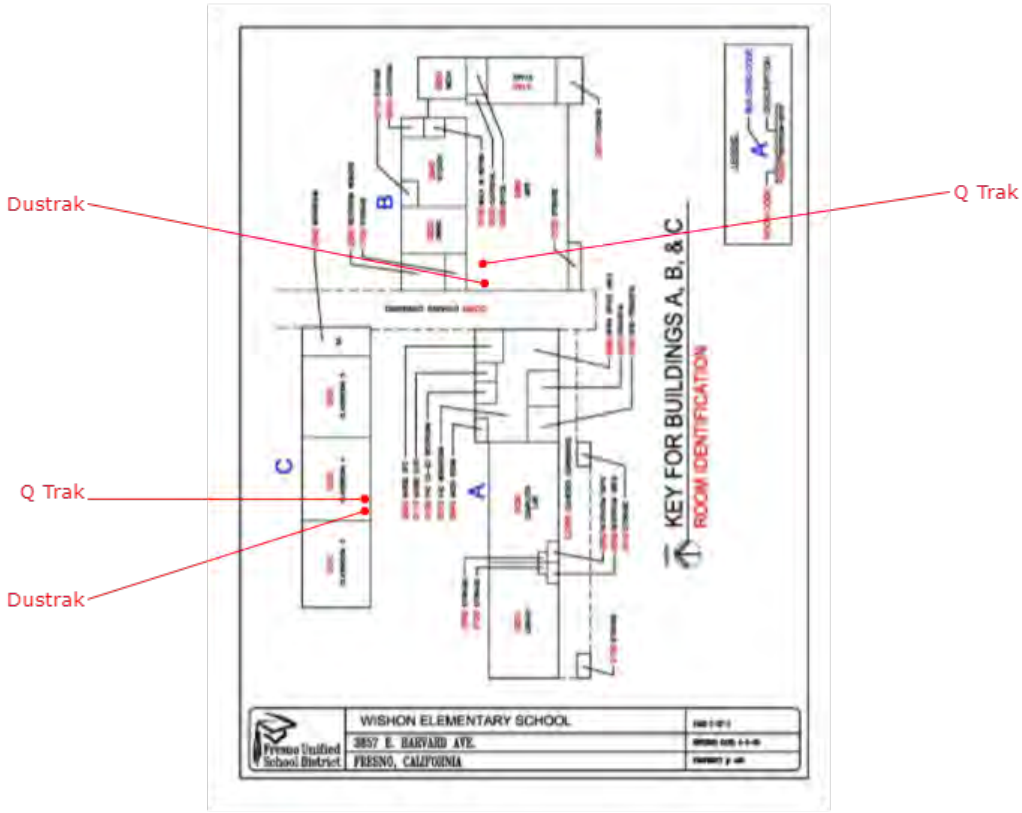
Appendix A
FACS Materials and Methods

Comfort Parameters Air Monitoring. Temperature, relative humidity, carbon dioxide (CO_2), and carbon monoxide (CO) measurements were collected using Q-Trak 7575 Indoor Air Quality Monitors. Measurements for carbon dioxide and carbon monoxide were expressed in concentration values of parts per million (ppm) with a detection limit of 1 ppm. Temperature was collected in degrees Fahrenheit and relative humidity in percentage (%). All data was collected in 60 second intervals within an approximate six hours of sampling time (equivalent to room occupancy).

Airborne Particulates. Airborne particulates were measured using TSI Dustraks set to collect the fraction of airborne particulates less than 10 microns (<10 µm) in diameter and less than 2.5 µm (PM10 and PM2.5, respectively. The monitor had been factory calibrated within the previous 12 months at the time of sampling and zero calibrated prior to the assessment. Results were expressed in milligrams per cubic meter (mg/m^3). All data was collected in 60 second intervals within an approximate six hours of sampling time (equivalent to room occupancy).

Appendix B
Sample Maps

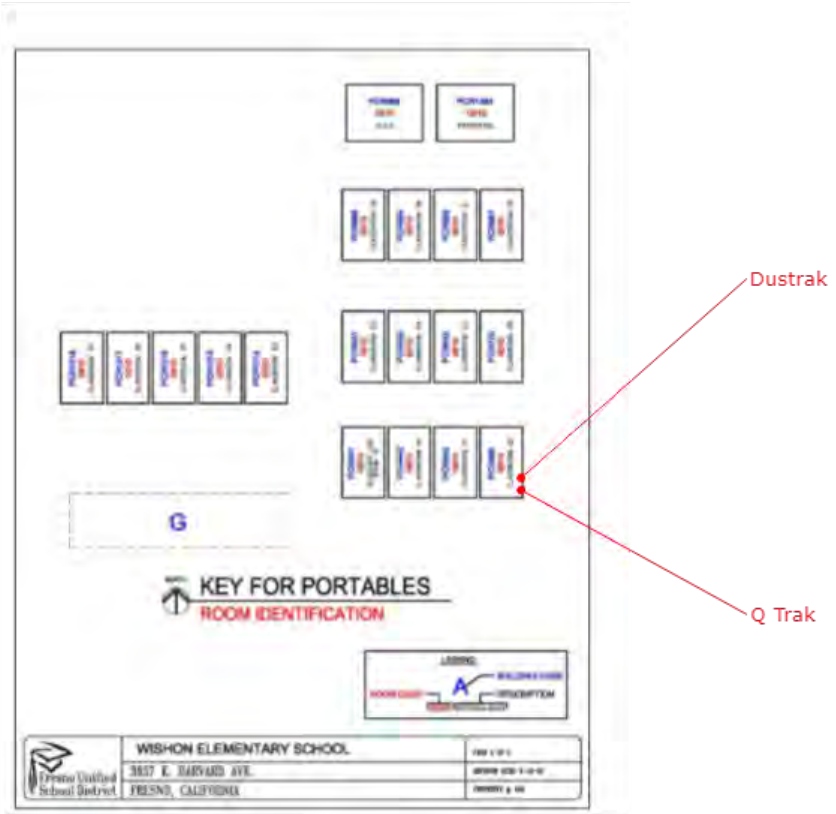
Room 4 and Multi-Purpose Room



FACS 371 E Bullard Ave Suite #109 Fresno, CA 93710	N	Sample Location Dustrak Q Trak	Wishon Elementary School IEQ Assessment	Fresno Unified School District	Joe Blair
				LOCATION: 3857 East Harvard Avenue, Fresno, CA 93703	FACS PROJECT No.: PJ71255

This ia a design drawing and is the property of Forensic Analytical Consulting Services, Inc. It is not intended to replace required architectural or engineering plans.

Room 22 PCR



FACS 35 371 E Bullard Ave Suite #109 Fresno, CA 93710	N	Sample Location Dustrak Q Trak	Wishon Elementary School IEQ Assessment	Fresno Unified School District LOCATION: 3857 East Harvard Avenue, Fresno, CA 93703	Joe Blair FACS PROJECT No.: PJ71255

This ia a design drawing and is the property of Forensic Analytical Consulting Services, Inc. It is not intended to replace required architectural or engineering plans.

Appendix C
Photographs

Photo #1: Room 4
Site Overview

Photo #2: Room 4
HVAC Wall Unit Overview

Photo #3: Room 4
Air Filter with Change Date

Photo #4: Light Dust Loading on Air Filters
Serves Room 4

Photo #5: Heavy Dust Loading and Cobwebs on Components - Serves Room 4

Photo #6: Outdoor Intake
Serves Room 4

Photo #7: Room 22
Site Overview

Photo #8: Room 22 –
Heavy Dust Loading on Components

Photo #9: Heavy Dust Loading on Air Filters
Serves Room 22

Photo #10: Multi-Purpose Room
Site Overview

Photo #11: Multi-Purpose Room
Air Filter with Change Date

Photo #12: Moderate Dust Loading on Air Filters–
MPR Air Handler

Appendix D
Data Results Tables

Q-Trak Indoor Air Quality Monitors

Location	Carbon Dioxide ($C0_2$)	Temperature	Relative Humidity (RH)	Carbon Monoxide (CO)
Room 4	Avg 418 ppm Min 402 ppm Max 523 ppm	**Avg 79.2 deg F** **Min 74.4 deg F** **Max 82.4 deg F**	Avg 28.2% Min 26.4% Max 34.9%	Avg 0.0 ppm Min 0.0 ppm Max 0.0 ppm
Multi-Purpose Room	Avg 427 ppm Min 407 ppm Max 558 ppm	Avg 73.9 deg F **Min 72.5 deg F** Max 75.2 deg F	Avg 28.9% Min 26.8% Max 32.1%	Avg 0.7 ppm Min 0.6 ppm Max 0.8 ppm
Room 22 PCR	Avg 844 ppm Min 615 ppm **Max 1212 ppm**	**Avg 73.7 deg F** **Min 71.6 deg F** **Max 74.4 deg F**	Avg 36.3% Min 35.1% Max 38.0%	Avg 0.0 ppm Min 0.0 ppm Max 0.0 ppm

Notes: Findings in bold considered elevated or outside of guidelines where applicable

(1) Industry guidelines[5] recommend CO_2 levels be no greater than 700 ppm above ambient outdoor levels.

(2) OSHA recommends temperature control in the range of 68-76°F. Industry guidelines[5] recommend indoor temperatures between 68 and 77°F during cold weather, and 75 to 83°F during warm weather.

(3) OSHA recommends indoor relative humidity in the range of 60-20%. Industry guidelines[5] recommend indoor relative humidity levels be less than 60% during warm weather and 80% during cool weather.

(4) No standards for CO have been agreed upon for indoor air. The EPA National Ambient Air Quality Standard for outdoor air is 9 ppm for an 8-hour average, and 35 ppm for a 1-hour average.

(5) "Industry Guidelines" refers to American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) standards 62.1-2019 "Ventilation for Acceptable Indoor Air Quality" and ASHRAE Standard 55-2020 "Thermal Environmental Conditions for Human Occupancy".

DustTrak DRX Aerosol Monitor

Room		PM2.5 (mg/m^3)	EPA Interpretation[1]	PM10 (mg/m^3)	EPA Interpretation[2]
Room 4	Avg	0.000	Good	0.001	Good
	Min	0.000		0.000	
	Max	0.007		0.020	
Multi-Purpose Room	Avg	0.003	Good	0.005	Good
	Min	0.001		0.002	
	Max	0.007		0.010	
Room 22 PCR	Avg	0.010	Good	0.035	Good
	Min	0.000		0.006	
	Max	0.038		0.112	

Note:

(1) The U.S. EPA Air Quality Index (AQI) is an index for reporting daily air quality. The AQI categories for 24-hour average PM2.5 concentrations (in mg/m3) are as follows:
- Good: 0 – 0.0150 mg/m3
- Moderate: 0.0151 -0.0404 mg/m3
- Unsafe for Sensitive Groups: 0.01405 – 0.0654 mg/m3
- Unhealthy: 0.0655 – 0.1504 mg/m3
- Very Unhealthy: 0.1505 -0. 2504 mg/m3
- Hazardous: 250.5 – 500.4 mg/m3

(2) The U.S. EPA Air Quality Index (AQI) is an index for reporting daily air quality. The AQI categories for 24-hour average PM10 concentrations (in mg/m3) are as follows:
- Good: 0 – 0.054 mg/m3
- Moderate: 0.055 – 0.154 mg/m3
- Unsafe for Sensitive Groups: 0.155 – 0.254 mg/m3
- Unhealthy: 0.255 – 0.354 mg/m3
- Very Unhealthy: 0.355 – 0.424 mg/m3
- Hazardous: 0.425 – 0.604 mg/m3

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