

## CONTEXT

### WHAT IS ENVIRONMENTAL JUSTICE?

Environmental Justice (EJ) is the fair treatment and meaningful involvement of all people with respect to the development, implementation and enforcement of environmental laws, regulations, and policies.

EJ research has focused on demonstrating the extent to which air pollution is equally—or unequally—distributed across particular defined social groups.

### WHY FOCUS ON SCHOOL CHILDREN?

Children are especially susceptible to air pollution (Pope & Dockery, 2006). More than just exhibiting negative health consequences, exposure to air pollution has also been associated with poor academic performance among school-aged children (Mohai et al., 2011). In the UK, Children spend a significant amount of time at school: ~190 days per year, and ~30 hours per week.

### WHY MEASURE INSIDE AND OUTSIDE?

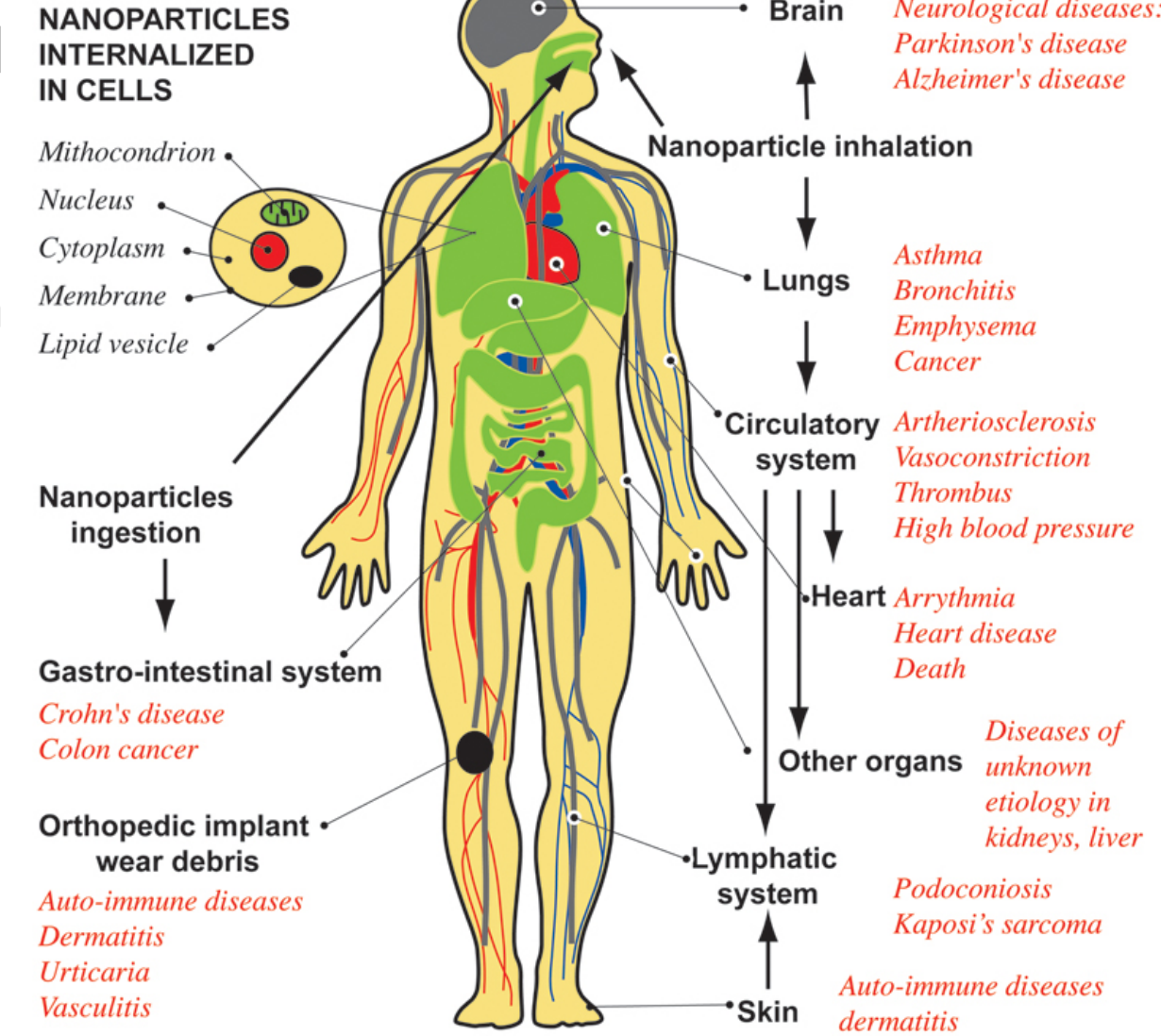
Research has focused on outdoor air pollution, yet, on average, people spend more than 90% of their time indoors (Klepeis et al. 2001). However, to understand indoor air quality (IAQ), one must rely on the principle that the indoor atmosphere is an extension of the outdoor atmosphere. The most recent large-scale research into indoor-outdoor air pollution in schools came under the framework of the BREATHE study located in Barcelona (Reche et al. 2014; Rivas et al. 2014). To understand environmental justice, one must have a holistic understanding of air pollution, indoors and outdoors

### WHY FOCUS ON ULTRAFINE PARTICLES (UFPs)?

- Ubiquitous indoors and outdoors.
- High temporal/spatial variability.
- No ambient UFP legislation
- Need more research (DEFRA, 2018).

DISEASES ASSOCIATED TO NANOPARTICLE EXPOSURE

*C. Rossi, F. Pacheco, & E. Baldo. Nanomaterials and nanoparticles: Sources and toxicity. Biomedicine 2 (2007) 187-187*

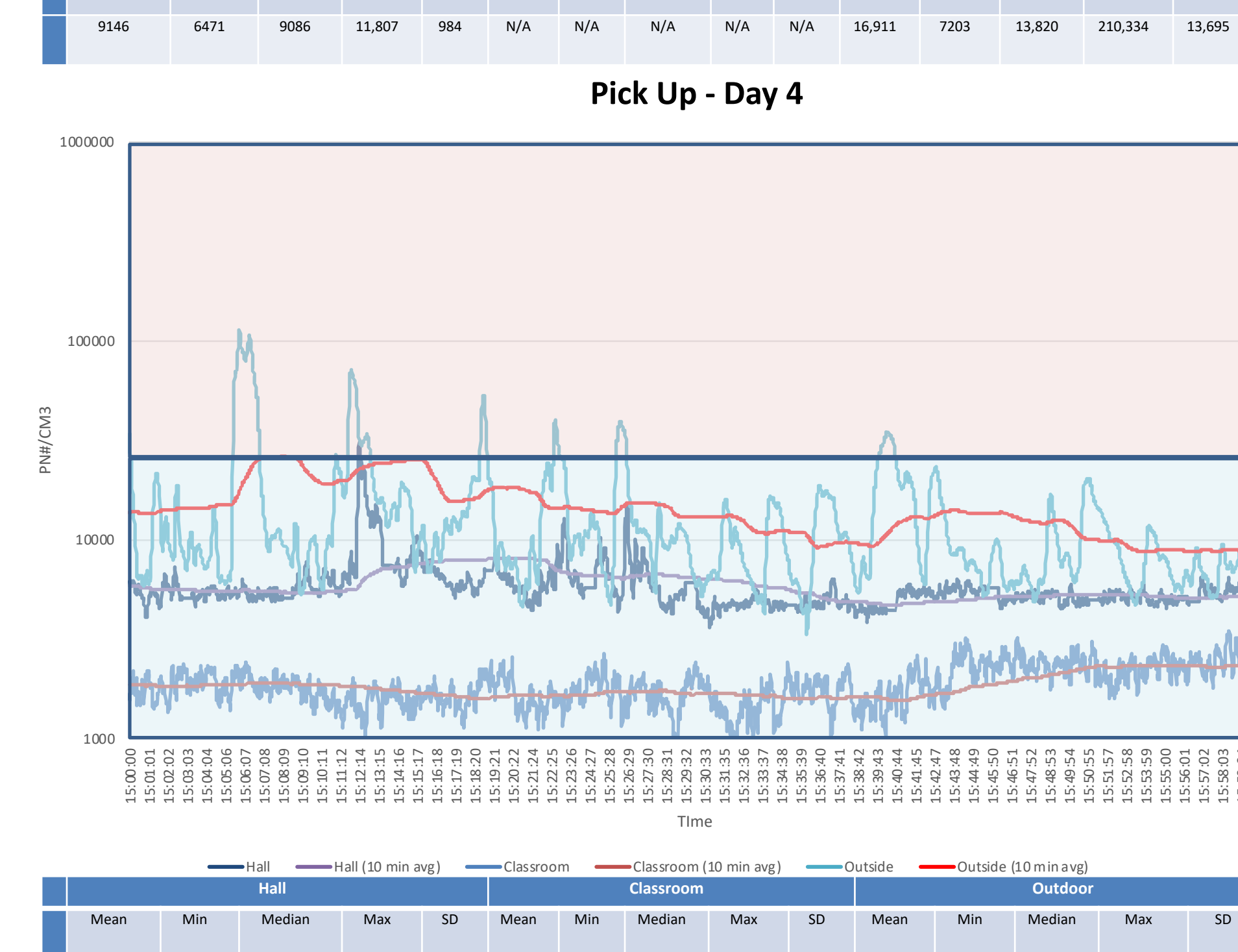
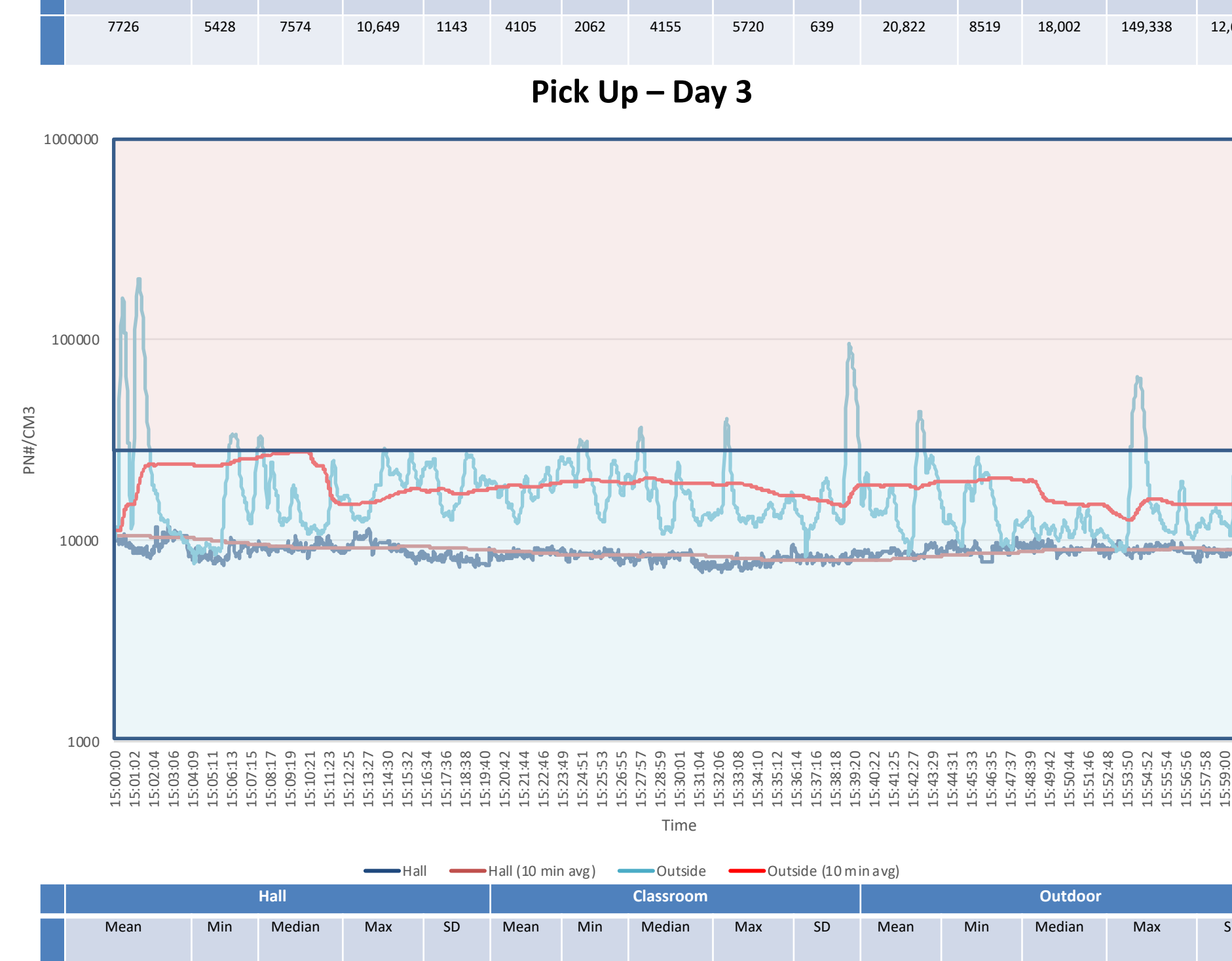
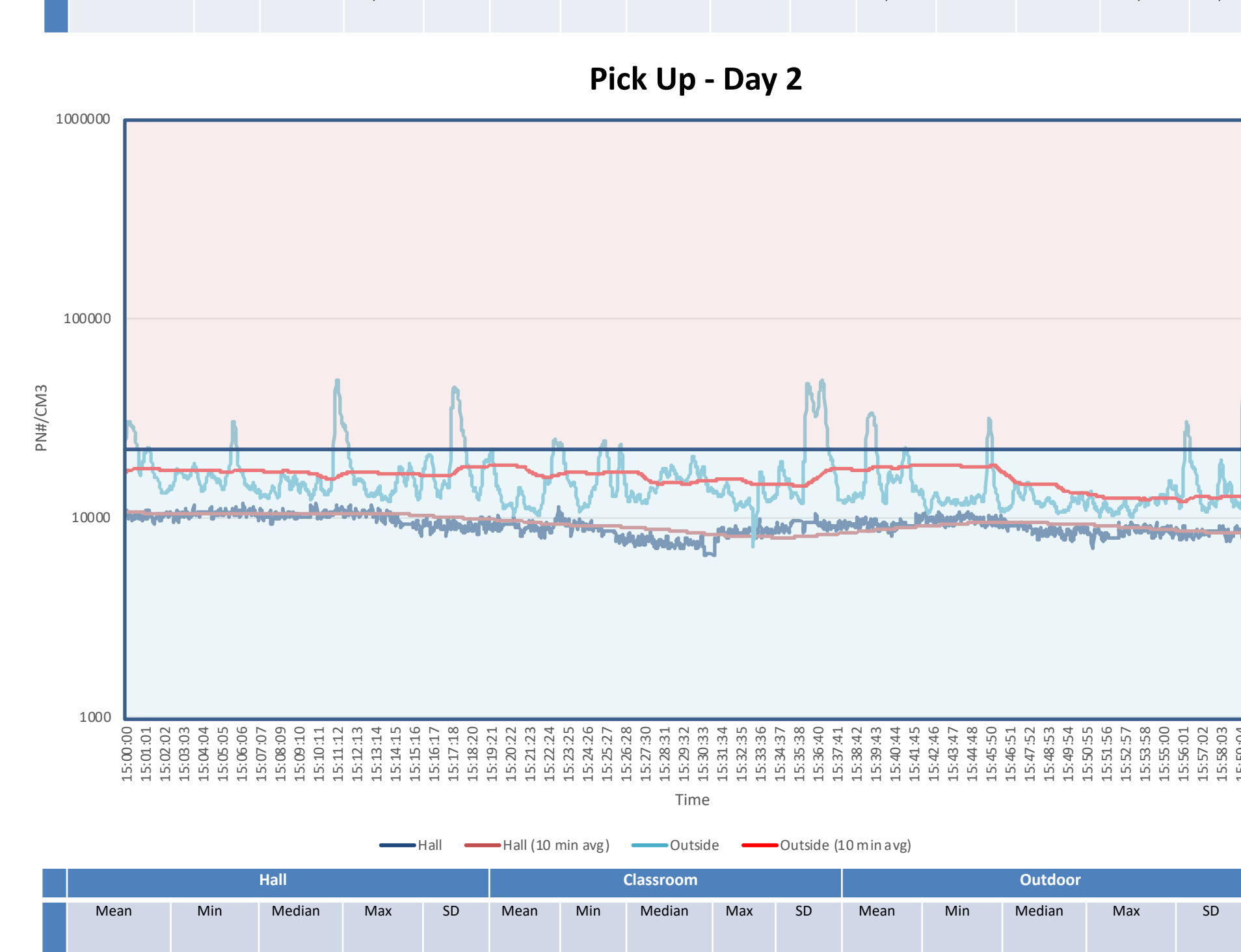
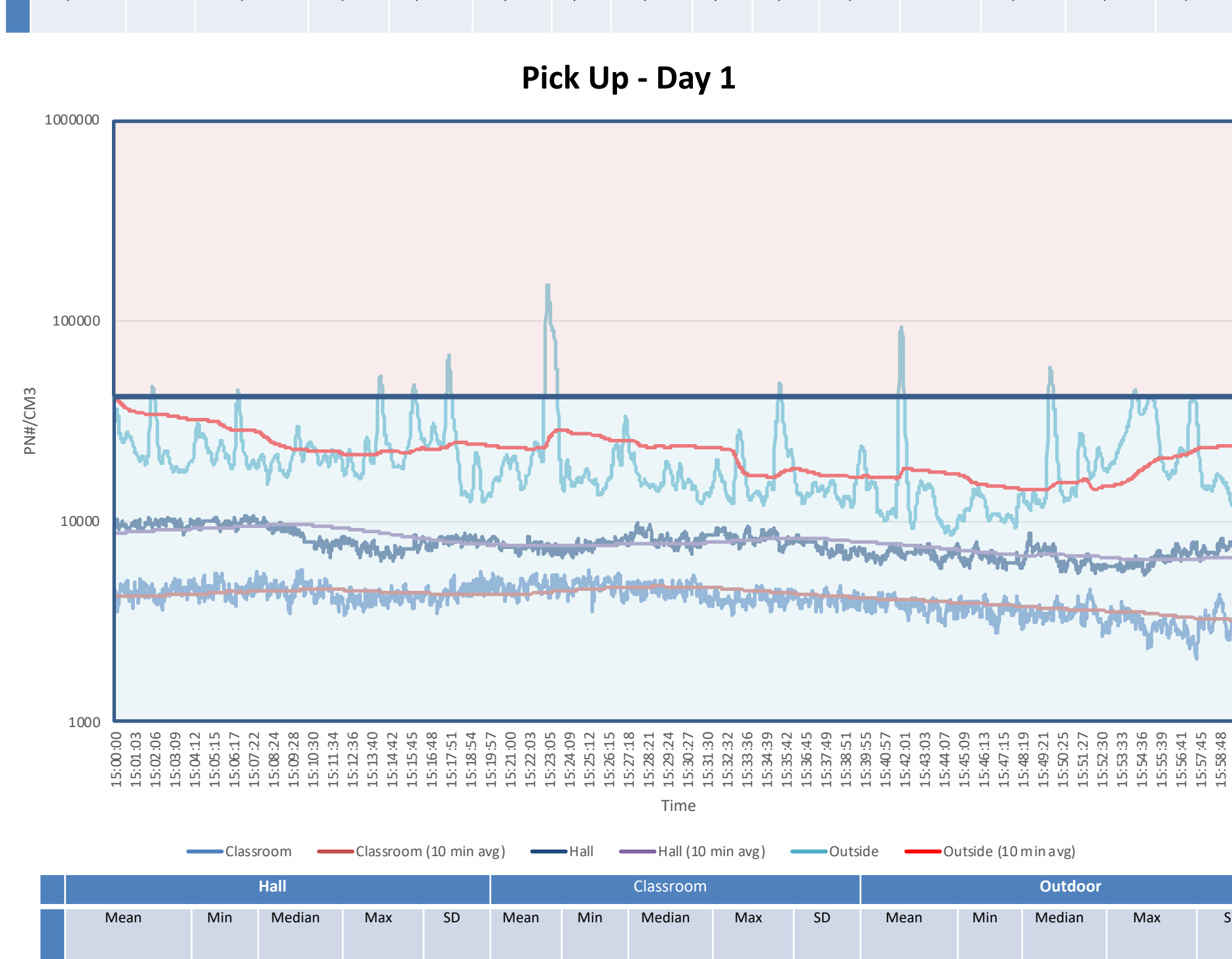
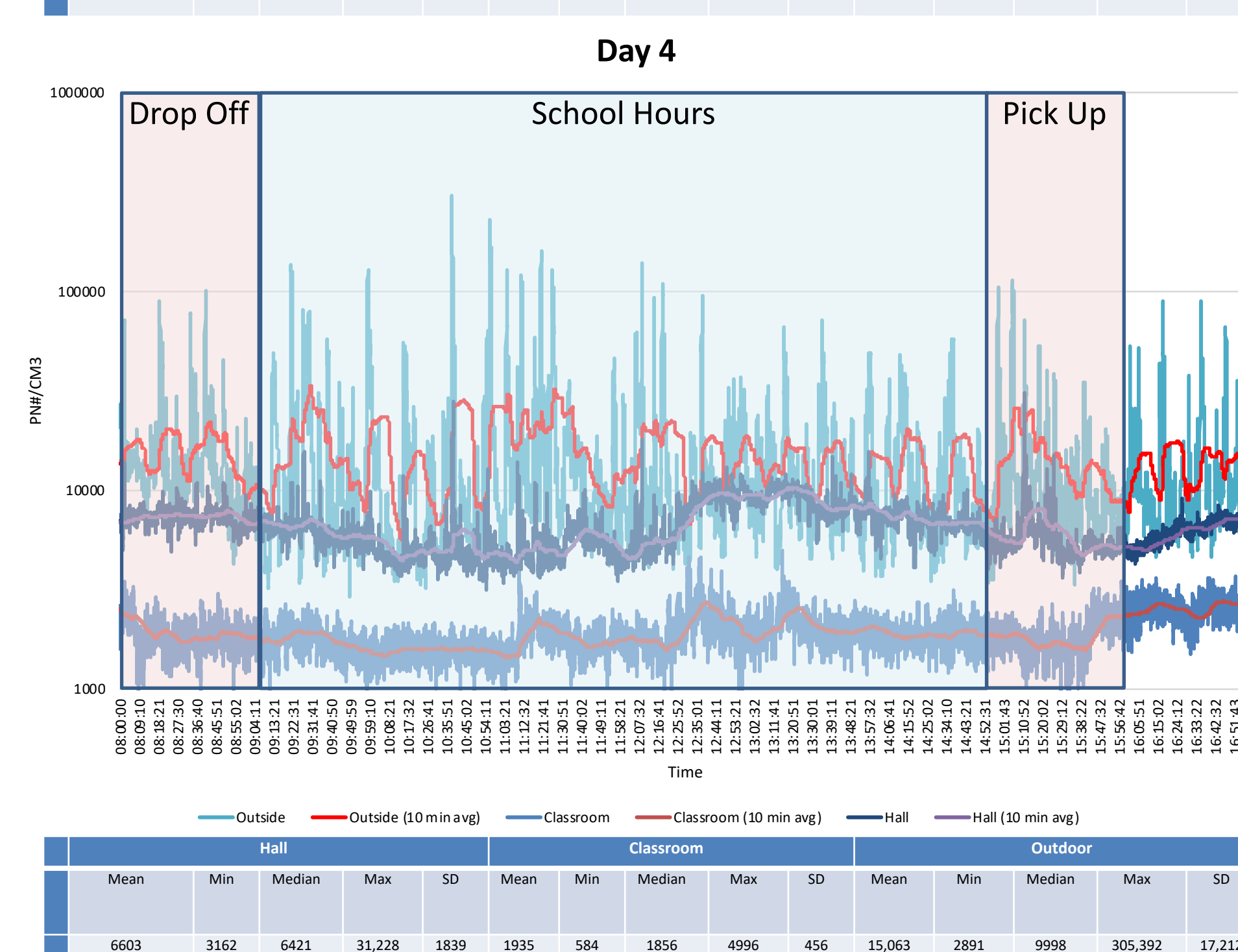
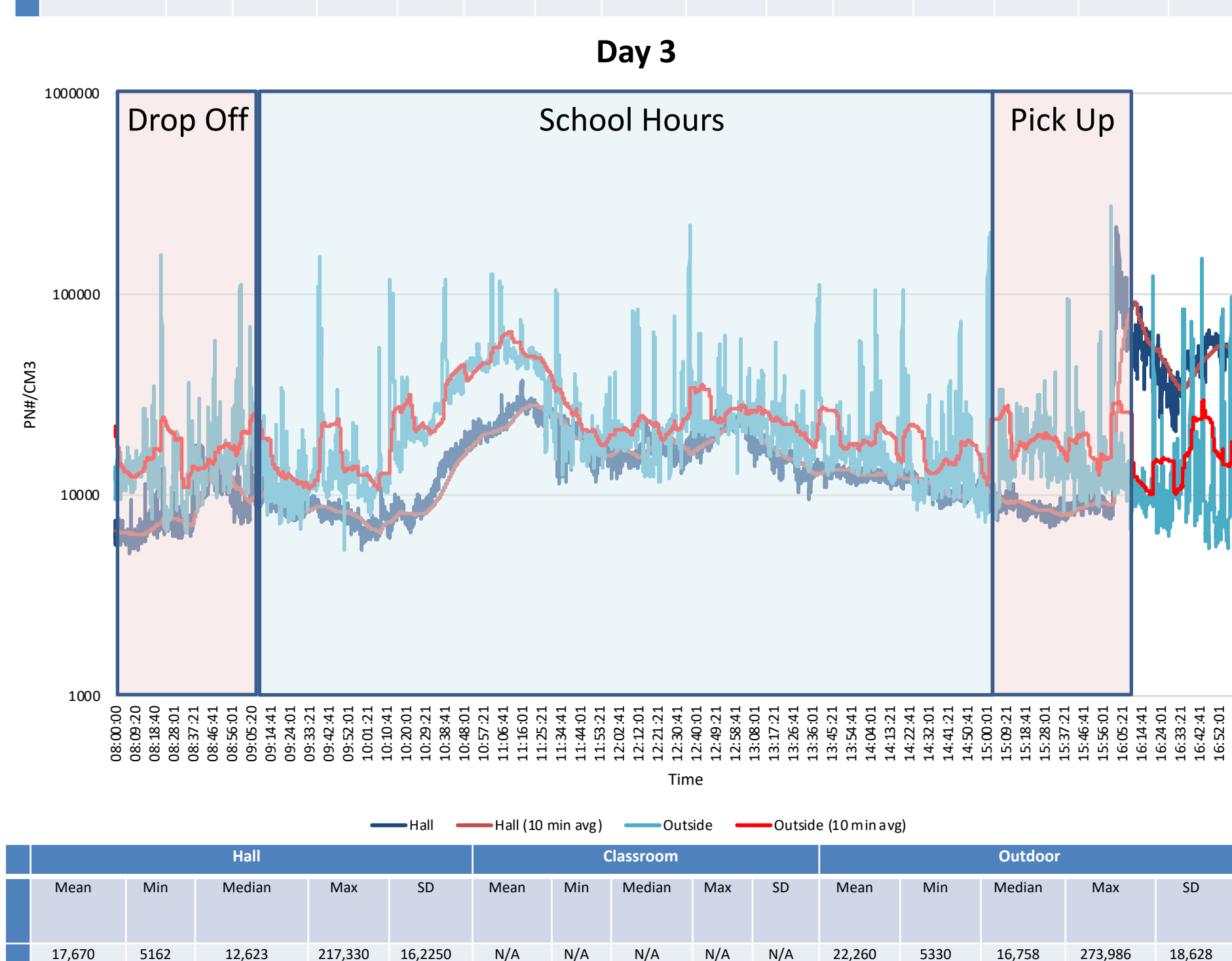
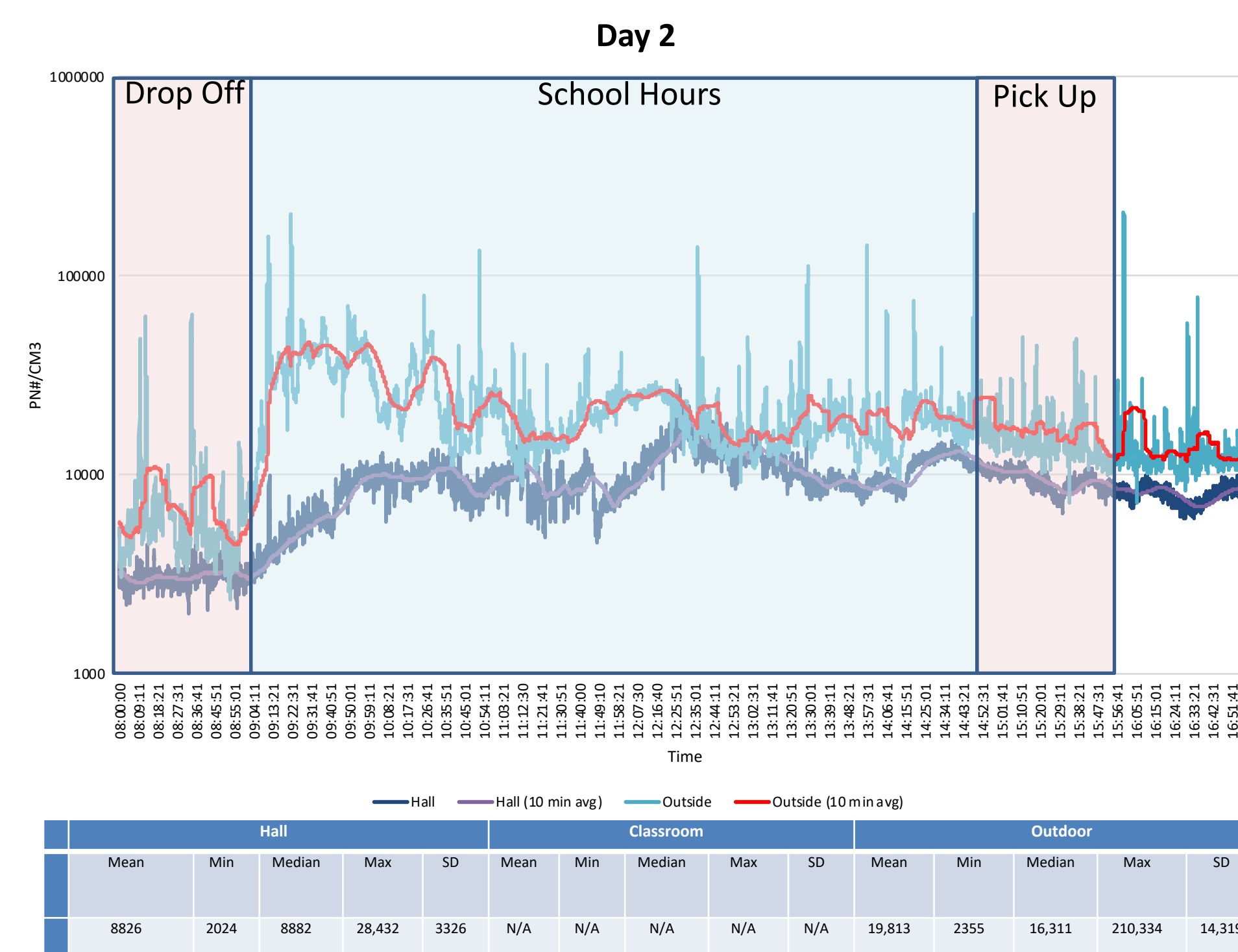
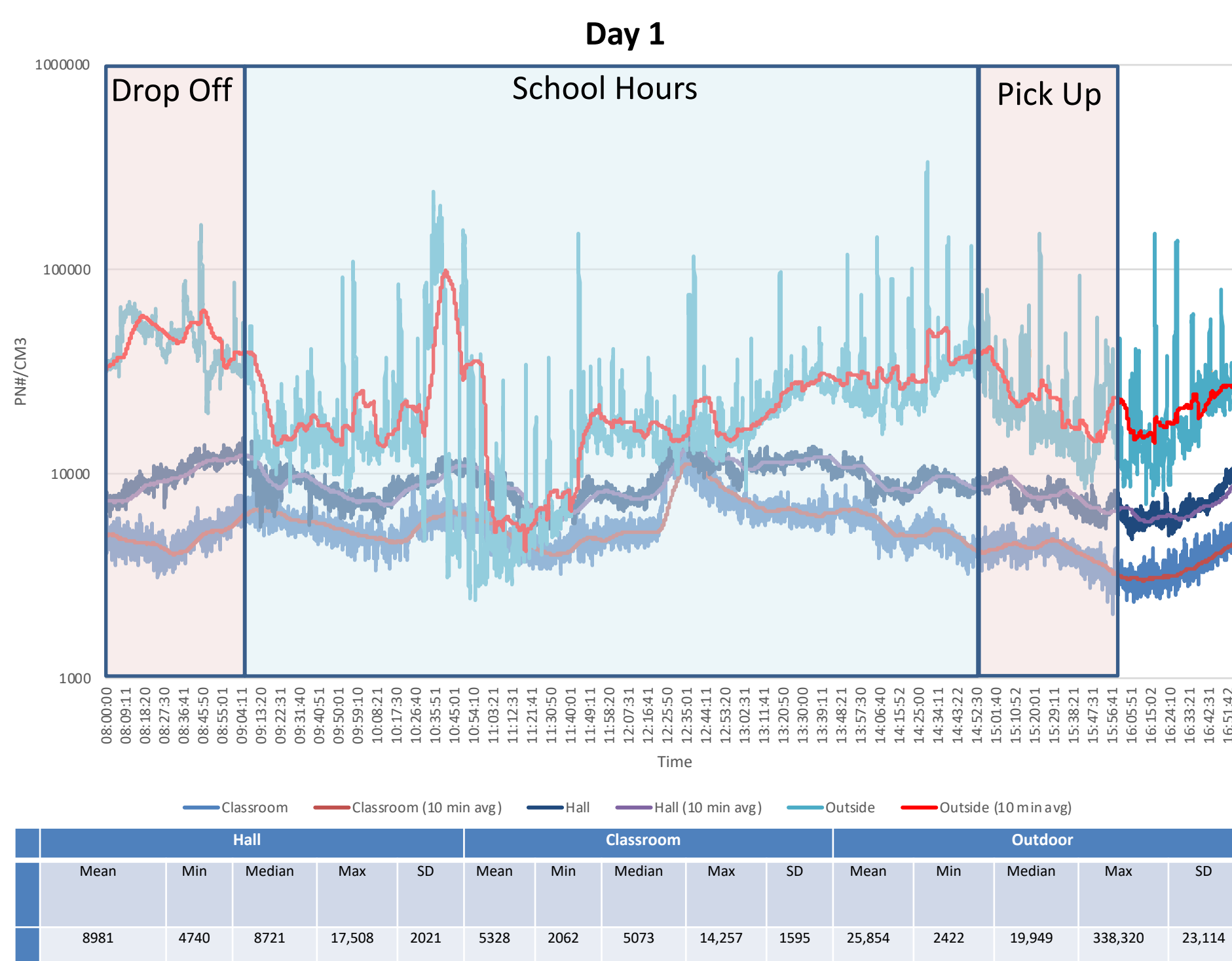


### WHY MEASURE WITH HIGH TIME RESOLUTION?

- BREATHE study and others have traditionally used 5-10 minute sampling time for UFPs.
- Health effects community unsure if UFPs can be a “trigger” for acute air pollution symptom (HEI, 2013; WHO, 2013).
- First ever UK death legally “triggered” by air pollution!



## RESULTS



## METHODOLOGY & OBJECTIVES

The sampling campaign was carried out in one school in Lancaster (North West of the UK) for one week in July 2018. The sampling was performed simultaneously indoors (in a classroom, and in the main hall) and outdoors (at the school gates). Air quality in the schools was monitored for four days (from Monday morning to Friday morning) during typical –extended- school hours (8am – 5pm) to capture the normal school hours and drop off and pick up. Air quality data was collected at a 1s sampling rate using the NAQTS V2000. Weather data was collected using a Kestrel 4500 for wind speed and direction. This was a preliminary study.

### Research Questions:

- Where are the air pollution exposure pathways greatest for school children? Indoors or outdoors?
- Are certain periods of the school day susceptible to high pollution episodes inside and outside? (e.g. drop off / pick up)
- Do we gain a different understanding of children’s potential health consequences from exposure to air pollution from higher resolution data collection?

## TECHNOLOGY – NAQTS V2000

- PN: CPC (d<sub>50</sub> 15nm)
- CO, NO<sub>2</sub>, NO, VOCs: Metal Oxide & Electrochemical
- VOCs - 4 event-driven thermal desorption tubes
- CO<sub>2</sub>: NDIR
- T, P, RH: BME280
- Noise: dBA



## CONCLUSIONS & FUTURE RESEARCH

- Highest concentrations are generally seen outdoors. However, there are moments when concentrations are higher inside reaching up to 217,330 particles/cm<sup>3</sup> (Day 3). This appears to be from ingress of outdoor UFPs.
- 10 min averaging of UFP data missed a number of potential “trigger” events across all time periods, these acute events are associated with high traffic density and are likely to be caused by “dirty” vehicles.
- We need high time resolution data to show these acute exposure periods as they may have significant health effects.

Next steps, more data needed to investigate:

- How does this change with different indoor environments? (e.g. in vehicles)
- How does this change seasonally? (i.e. owing to different ventilation habits, windows open more in the summer etc.)
- How does this change between different schools owing to their location and design?

## REFERENCES

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