Air Dispersion Conditions & Outlook Form **EXPLANATION**

"This AM Sfc. Inv." = Morning (7 a.m. EST) surface temperature inversion conditions. Included is whether or not a substantial upper-level inversion exists, starting at below about 1000 meters (330 ft).

"Forecast Period" = beginning date as noted by preparer at bottom of page.

"TODAY" and "TMRW" = Anticipated dispersion conditions for today and tomorrow (TMRW) during the daytime.

"Dispersion Potential" = Qualitative assessment of dispersion conditions for today and tomorrow ranging from "Good" to "Fair" to "Poor."

"Mixing Height (ft)" = Afternoon height above ground through which pollutants can mix.

"Transport Wind (dir, mph)" = Afternoon wind direction (direction *from which* the wind is coming) and speed through mixing layer.

"Ventilation Rate (mph-ft)" = Product of Mixing Height and Transport Wind.

"Wind (dir, mph)" = Daytime wind direction and speed across Allegheny County.

"Nite Wind (dir, mph)" = Evening and overnight wind direction and speed across county.

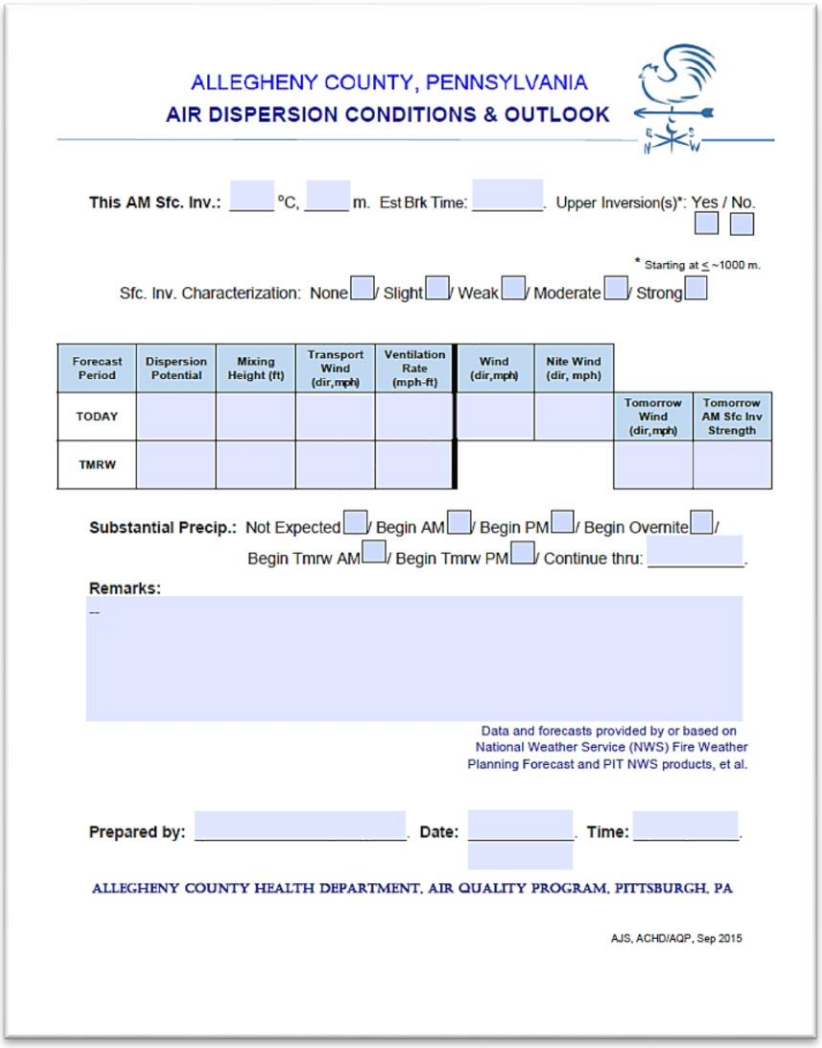
"Tomorrow Wind (dir, mph)" = Tomorrow's wind direction and speed across County.

"Tomorrow AM Sfc Inv Strength" = Qualitative assessment of tomorrow morning's surface inversion strength, ranging from "None" to "Weak" (~0.4^{o}C ~ 2.9^{o}C) to "Moderate" (~3^{o}C ~ 4.9^{o}C) to "Strong" ($\geq$ ~5^{o}C).

"Substantial Precip." = Outlook for whether a significant amount of precipitation will be occurring within the next two days or will continue through the stated time period. For this form, "substantial precip." is considered to be precipitation greater than about 0.01 inch per hour and rather steady throughout most of the county.

Note that most of the data in the report are extracted or derived from National Weather Service (NWS) products, including those from the Pittsburgh (PIT) forecasting office in Moon Township.

For further details, contact Tony Sadar at ACHD/AQP, 412-578-8125.



ALLEGHENY COUNTY, PENNSYLVANIA

AIR DISPERSION CONDITIONS & OUTLOOK

This AM Sfc. Inv.: ____ °C, ____ m. Est Brk Time: _____. Upper Inversion(s)*: Yes / No

* Starting at ≤ ~1000 m.

Sfc. Inv. Characterization: None / Slight / Weak / Moderate / Strong

Forecast Period	Dispersion Potential	Mixing Height (ft)	Transport Wind (dir,mph)	Ventilation Rate (mph-ft)	Wind (dir,mph)	Nite Wind (dir, mph)	Tomorrow Wind (dir,mph)	Tomorrow AM Sfc Inv Strength
TODAY								
TMRW								

Substantial Precip.: Not Expected / Begin AM / Begin PM / Begin Overnite / Begin Tmrw AM / Begin Tmrw PM / Continue thru: _____.

Remarks:

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Data and forecasts provided by or based on National Weather Service (NWS) Fire Weather Planning Forecast and PIT NWS products, et al.

Prepared by: _____. **Date:** _____. **Time:** _____.

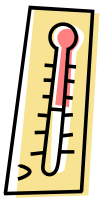
ALLEGHENY COUNTY HEALTH DEPARTMENT, AIR QUALITY PROGRAM, PITTSBURGH, PA

AJS, ACHD/AQP, Sep 2015

AJS, ACHD/AQP, Feb. 2019

See next two pages for general discussion of a “temperature inversion,” which is important to air dispersion conditions.

The Upside-Down World of Temperature Inversions, A.J. Sadar, ACHD/AQP



Air quality in southwestern Pennsylvania, as in most other areas of the U.S., is very much influenced by surface based temperature inversions. A temperature inversion is a condition in the atmosphere that yields little or no mixing of the air.

An atmospheric temperature inversion occurs when air temperature increases with increasing height. This situation is the inverse of the "normal" condition where a warm ground keeps low lying air warmer than air higher up. The warm air can then rise, causing the atmosphere to mix.

A surface based (or ground level) temperature inversion forms when air next to the ground cools faster than air at higher altitude or when warmer air is advected over cooler surface air. So, warmer, lighter air is found above cooler, heavier air. In such a situation, air is stable and mixing within the surface air layer will be suppressed.

Detection of atmospheric inversions is very important, since the dispersion of atmospheric contaminants is affected by the mixing potential of the atmosphere. Typically, some of the worst-case conditions for the buildup of pollution concentrations occur under stable situations when surface-based temperature inversions are present.

To detect temperature and various other conditions starting at the surface, the National Weather Service (NWS) launches a balloon with a measurement transmitter (see radiosonde photos on next page) into the atmosphere twice a day—once in the morning and once in the evening in the eastern U.S.—at about 70 locations across the contiguous U.S. (There are similar scheduled launches at about 1000 locations outside the U.S.)

When radiosonde data indicates that temperature from the surface to some level above the surface is increasing with ascent, then a surface-based temperature inversion exists.

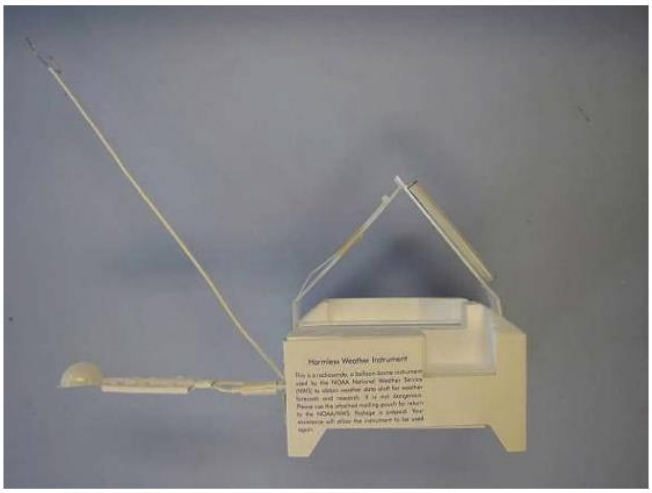
The table shows the strength and frequency of surface-based temperature inversions estimated from Pittsburgh-area NWS morning balloon launches from 2009 through 2018. During the 10-year period, the strength of the inversions (measured by degree of temperature increase with height) averaged 3.8 ^{o}C (a moderate strength), topping out at about 240 meters (790 feet) above the ground. About 43 percent of mornings experienced a significant (at least 1 ^{o}C) inversion. The inversions typically dissipated by about 9:30 a.m. EST each morning.

In valleys or low lying areas, inversions can form first and/or be more intense and longer lasting than at elevated locations. So, in the many river valleys throughout Allegheny County, inversions are expected to be much more frequent than those recorded at the Pittsburgh NWS, which is located significantly above the river valleys. This can certainly be a problem for local air quality, since many large industrial operations are located in the valleys.

Once air pollutants are released, they are transported and spread into surrounding neighborhoods. This contaminant dispersion is facilitated by the wind and stability conditions of the atmosphere. If an inversion exists, it acts like a cap that restricts airflow within the valley, preventing pollution from quick dispersal.

Regardless of whether an inversion forms in or out of a valley, with sufficient sunshine, wind speed, and/or precipitation, inversions will eventually dissipate to allow air to once again flow freely and air quality to improve.

RADIOSONDE WITH BALLOON AND PARACHUTE



(Photo from U.S. National Weather Service www.weather.gov/upperair/factsheet.)

(Photo from Radiosonde Museum of North America radiosondemuseum.org/what-is-a-radiosonde/.)

ALLEGHENY COUNTY'S MORNING INVERSIONS* FOR **2009-2018**

Year	Mean Inversion Strength (°C)	Mean Inversion Depth Abv. Sfc. (m)	Inversion Break Time (EST)	Total Annual Days of Inversions (%)
2009	3.8	244	9:30	154 (44)
2010	4.1	226	9:30	171 (47)
2011	3.7	246	9:30	134 (37)
2012	3.9	229	9:30	158 (43)
2013	3.4	244	9:30	127 (35)
2014	3.4	233	9:30	141 (39)
2015	3.9	250	10:00	166 (45)
2016	4.1	262	10:00	167 (46)
2017	3.8	214	9:30	203 (56)
2018	3.3	260	10:00	146 (40)
Mean 2009-2018	**3.8**	**240**	**9:30**	**157 (43)**

*Surface inversion statistics are based on morning (12:00 UTC, 7:00 AM EST) inversion data observed by the National Weather Service (NWS) office serving Pittsburgh, located near the International Airport. A minimum surface inversion strength of 1.0°C was chosen to ensure that an inversion observed at the NWS office at a relatively high elevation was indicative of conditions throughout most of the rest of the county. The estimated time until break-up of the morning inversion was calculated using a method developed by A.J. Sadar.

Compilations and evaluations by A.J. Sadar, A. Holt, and Q. Lin, ACHD/AQP.