Runway Contaminant Depth Sensors

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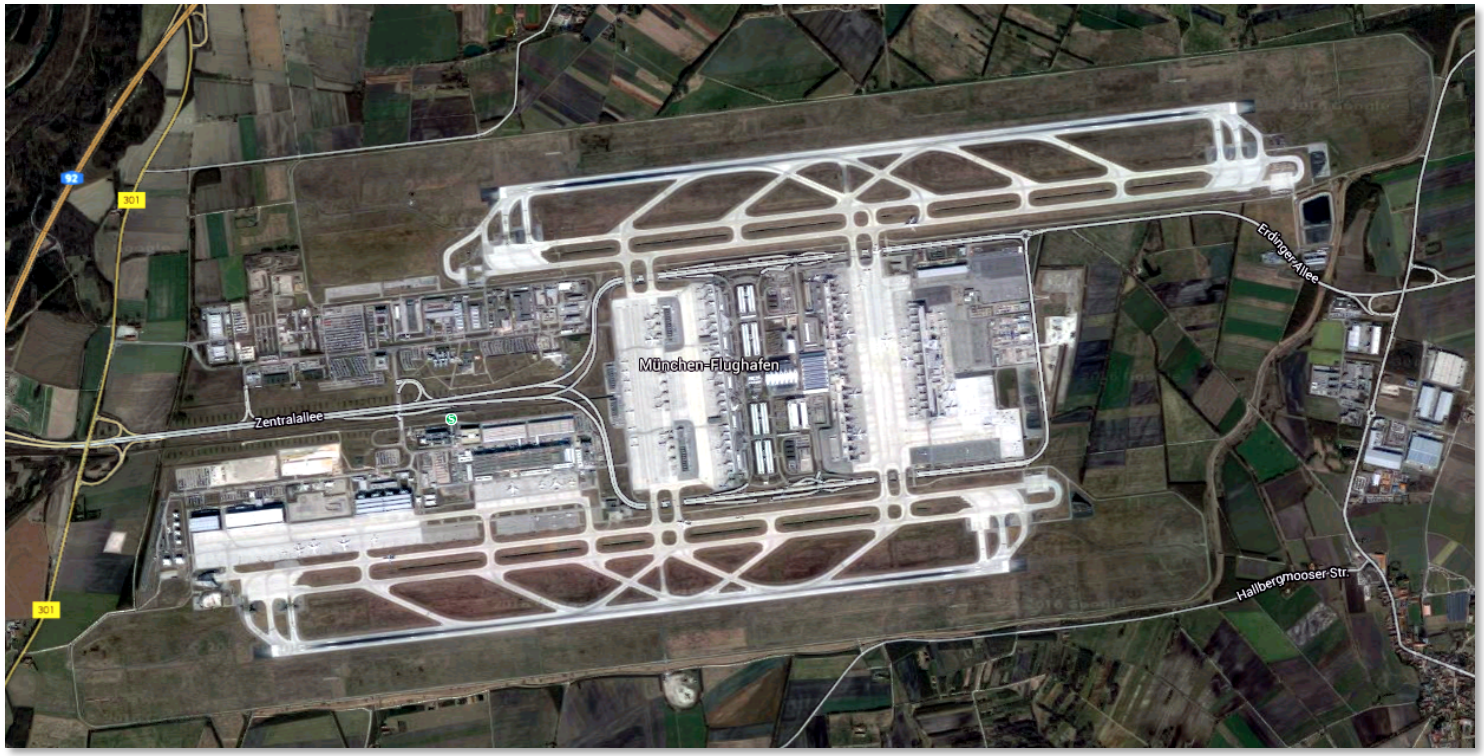
Facts and Figures

Munich Airport

- Runways: 2, 08/26, Concrete, Grooved, 4000 x 60 m, independantely operated
- Runway capacity: 90 movements/ hour (mixed mode ops)
- Daily movements: ~ 1100



Winter Service Concept

Equipment and Strategy for the Runways

- 1 team for both runways (30 jet sweeper, 4 deicing trucks)
- Alternate clearing of runways - target: at least one runway open
- Average runway closure time for snow removal: 20 minutes

Runway condition assessment based on

- RCAM

guess-timating' , contaminant depth

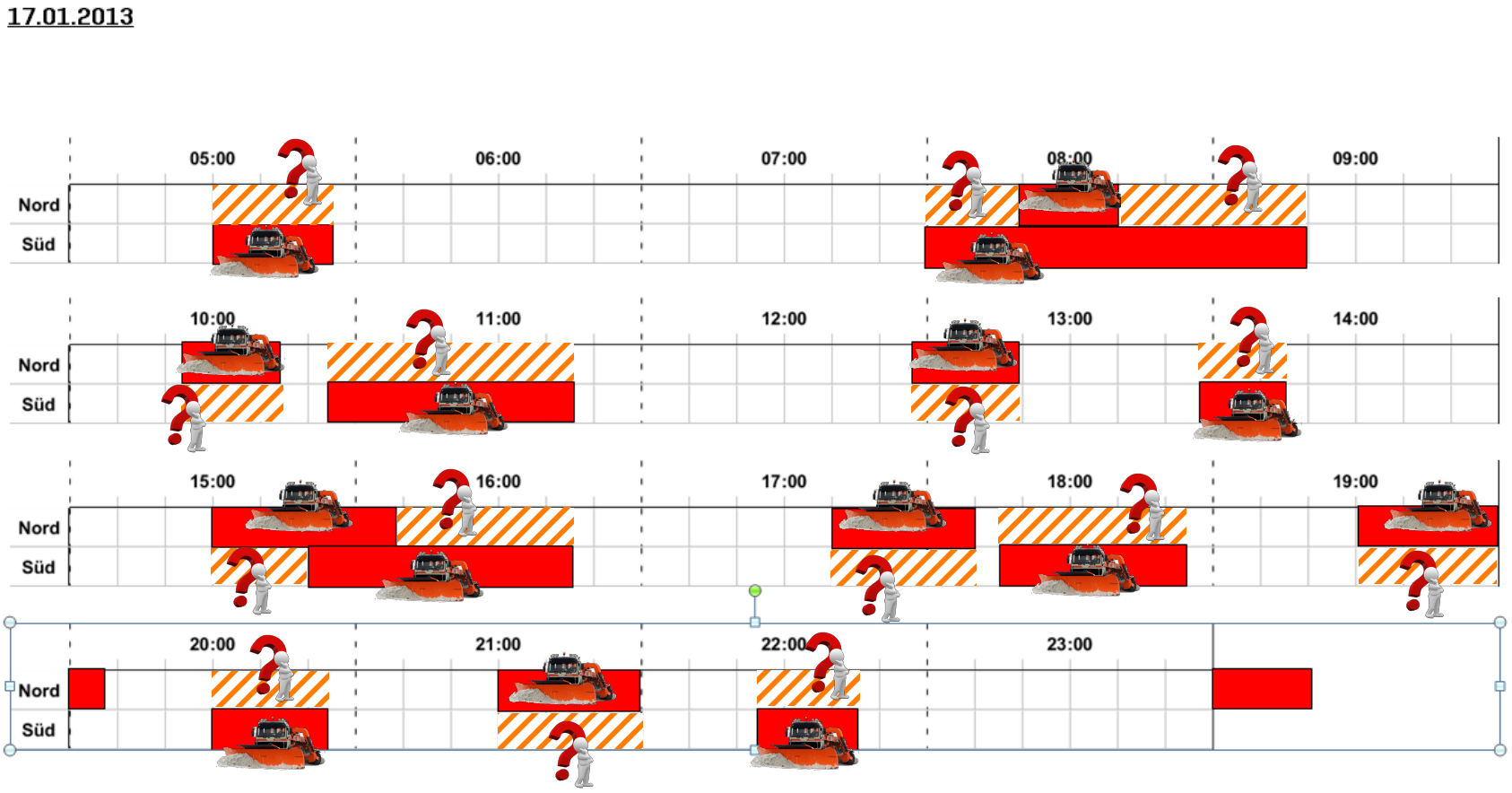
- Friction Measurements (μ - values are not published)

Runway Condition Assessment Matrix (RCAM)

RWY Condition Description	ESF	ACFT Deceleration and Directional Control
DRY	-	-
FROST WET (includes DAMP and less than 3 mm depth of water) SLUSH (less than 3 mm depth) DRY SNOW (less than 3 mm depth) WET SNOW (less than 3 mm depth)	GOOD	Braking deceleration is normal for the wheel braking applied. Directional control is normal.
COMPACTED SNOW (-15°C and lower outside air temperature)	GOOD - MEDIUM	Braking deceleration and controllability is between Good and Medium.
WET („Slippery when wet") DRY SNOW (3 mm - 50 mm) WET SNOW (3 mm - 30 mm) DRY SNOW ON TOP OF COMPACTED SNOW WET SNOW ON TOP OF COMPACTED SNOW COMPACTED SNOW (Higher than -15°C outside air temperature)	MEDIUM	Braking deceleration is noticeably reduced for the wheel braking applied. Directional control may be reduced
STANDING WATER (3 mm - 12 mm) SLUSH (3 mm - 12 mm)	MEDIUM - POOR	Braking deceleration and controllability is between Medium and Poor. Potential for Hydroplaning exists
ICE (Cold & Dry)	POOR	Braking deceleration is significantly reduced for the wheel braking effort applied. Directional control may be significantly reduced.
WET ICE WATER ON TOP OF COMPACTED SNOW DRY SNOW ON ICE WET SNOW ON ICE	NIL	Braking deceleration is minimal to non-existent for the wheel braking effort applied. Directional control may be uncertain.

- Eine ESF von GOOD, GOOD - MEDIUM, MEDIUM, MEDIUM-POOR darf **nicht herauf gestuft** werden
- Eine ESF von POOR oder NIL kann herauf gestuft werden, wenn alle Beobachtungen, das Bremsverhalten des Fahrzeugs und die gemessenen Bremskoeffizienten dies unterstützen.

Snow removal actions on a snowy day



Why sensors?

2.9 Condition of the movement area and related facilities

2.9.1 Information on the condition of the movement area and the operational status of related facilities shall be provided to the appropriate aeronautical information services units, and similar information of operational significance to the air traffic services units, to enable those units to provide the necessary information to arriving and departing aircraft. The information shall be kept up to date and changes in conditions reported without delay.

Runway surface condition(s) for use in the global reporting format

Introductory Note.— The philosophy of the global reporting format is that the aerodrome operator assesses the runway surface conditions whenever water, snow, slush, ice or frost are present on an operational runway. From this assessment, a runway condition code (RWYCC) and a description of the runway surface are reported which can be used by the flight crew for aeroplane performance calculations. This report, based on the type, depth and coverage of contaminants, is the best assessment of the runway surface condition by the aerodrome operator; however, all other pertinent information may be taken into consideration. See Attachment A, Section 6, for further details. The PANS-Aerodromes (Doc 9981) contains procedures on the use of the global reporting format and assignment of the RWYCC in accordance with the runway condition assessment matrix (RCAM).

The information shall be kept up to date…

... all other pertinent information may be taken into consideration.

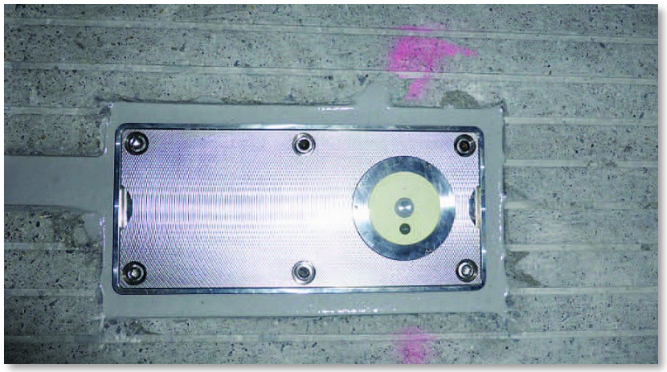
Closing the information gap

Installed sensors at Munich Airport

System in use

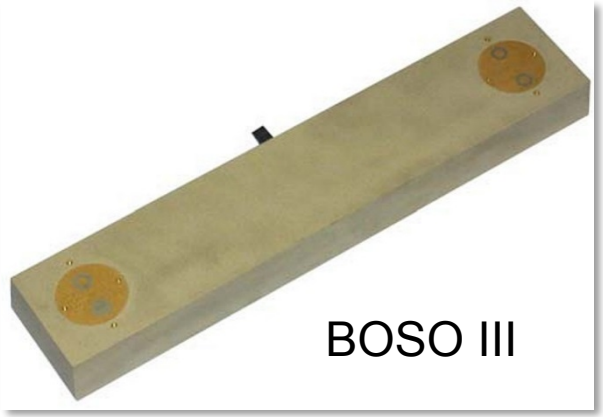
- Ice Early Warning System: Boschung GFS 3000 (18 Sensors ARCTIS, BOSO III)
  - In use since 1992 (overhauled in 2012)
  - Used for decision making (e.g. activation of winter service team)
- Runway Contaminant Depth System: Boschung RCD (36 sensors IT-sense RCD)
  - In use since 2012
  - Used as info tool, not yet for decision making (additional improvements necessary)

Sensors



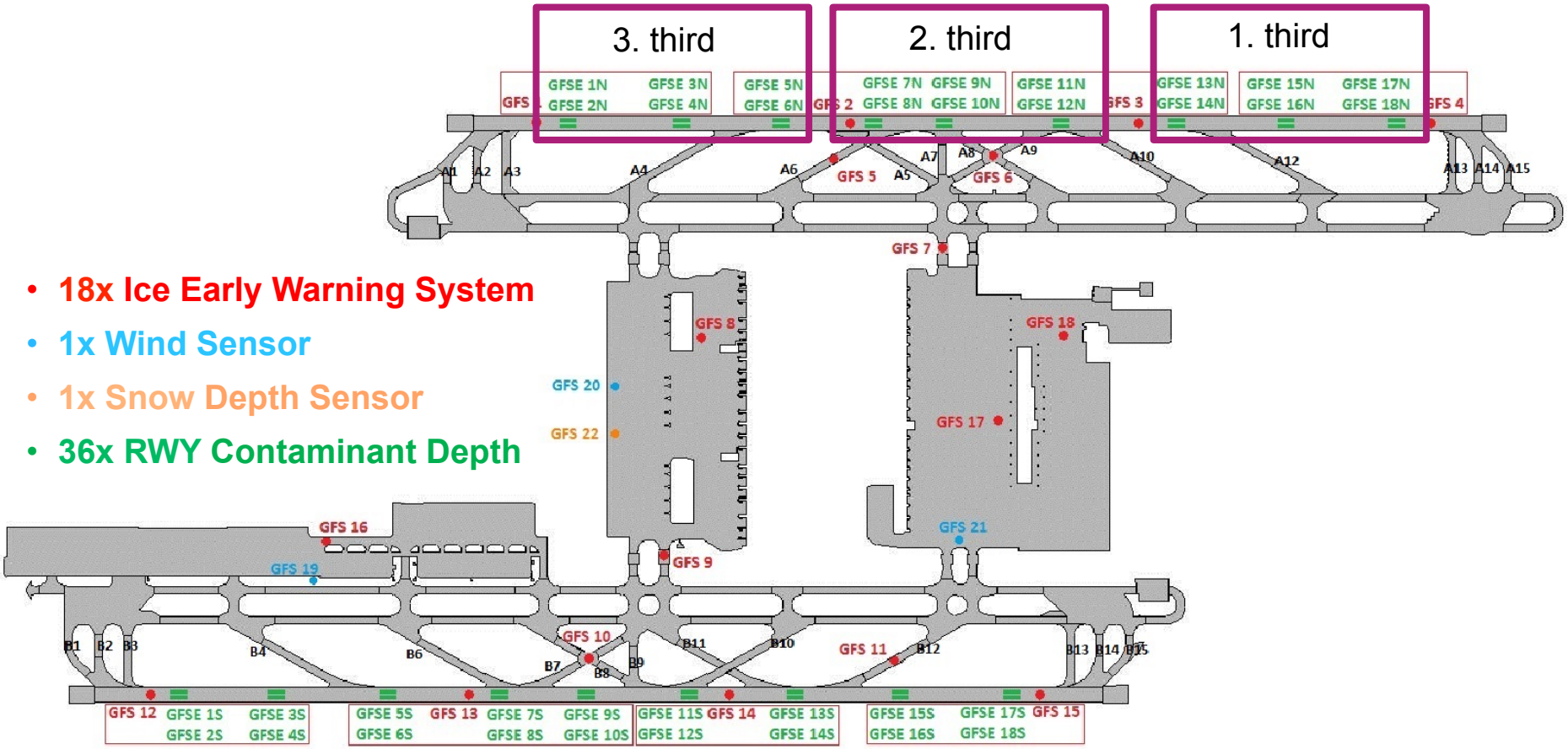
RCD

ARCTIS



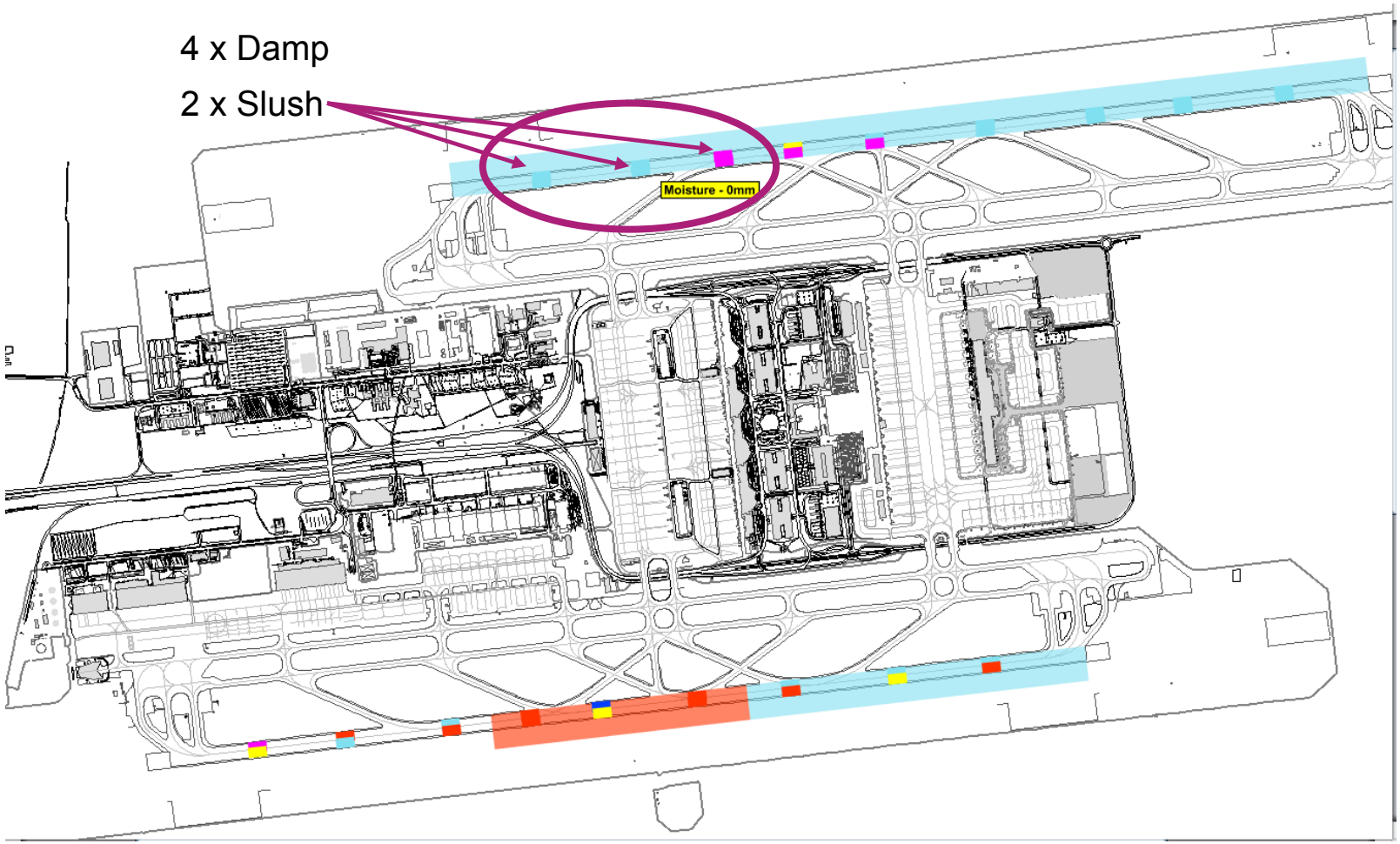
Placement of sensors

- **18x Ice Early Warning System**
- **1x Wind Sensor**
- **1x Snow Depth Sensor**
- **36x RWY Contaminant Depth**



Logic of indication

More than 50% of the same contaminant triggers the indication of the third



The main challenge…

Surface area: 240.000 m² per Runway

Is this representative?

20 cm² of sensors

Practical Experience

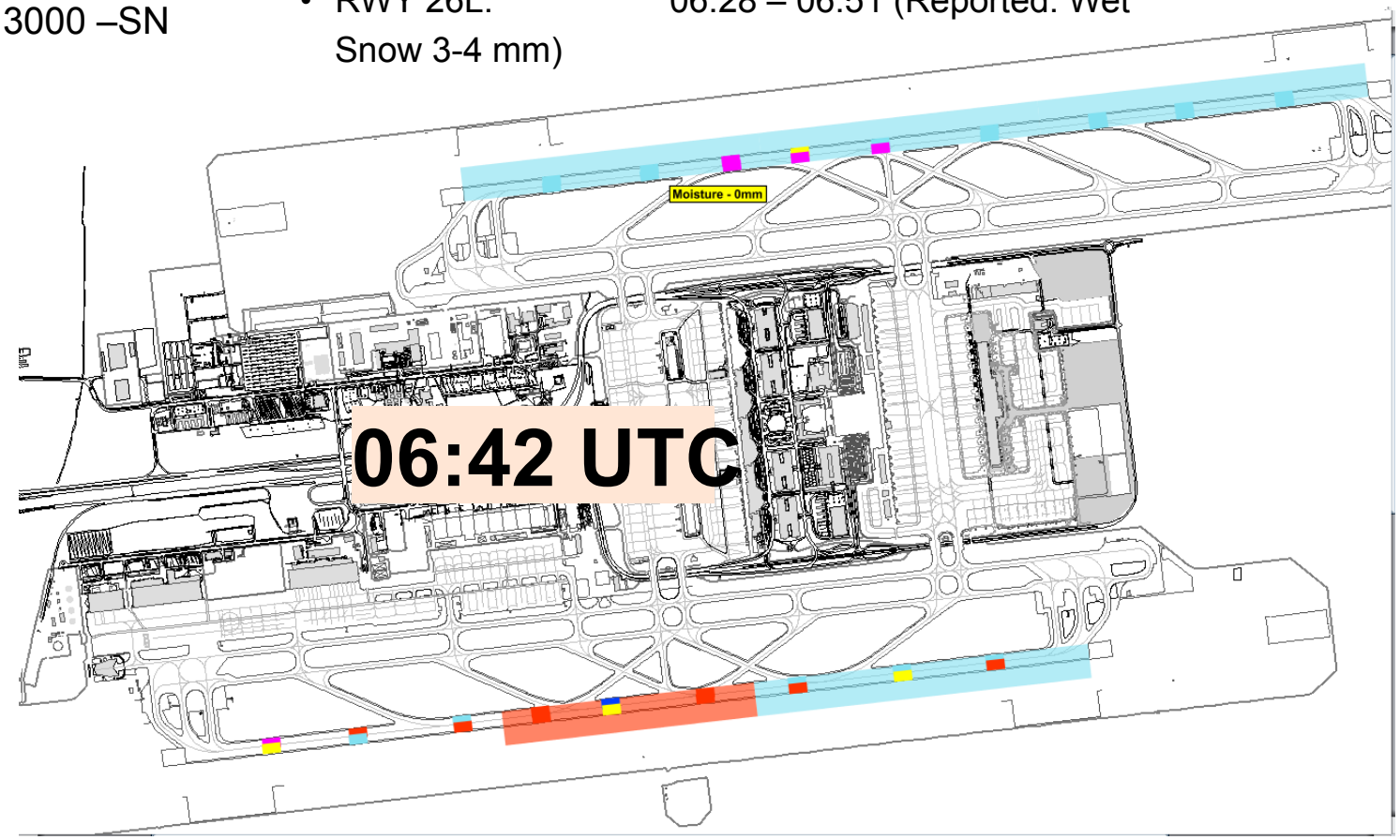
Example January 17th, 2016

WX

- 0550: 27011KT 9999 –SN
- 0620: 27010KT 0700 SN
- 0650: 24012KT 3000 –SN

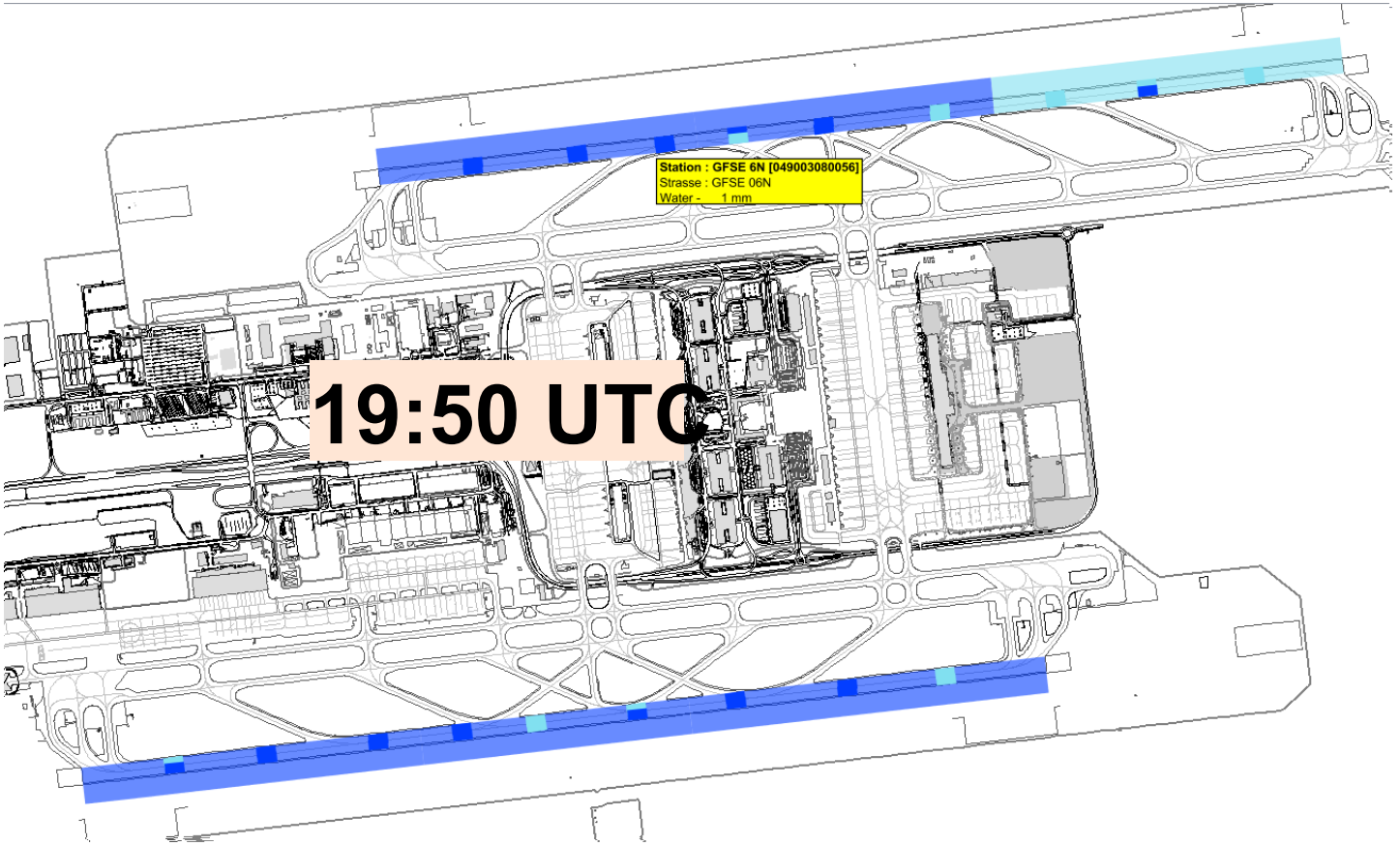
Snow Removal

- RWY 26R: 05:42 – 06:05 (Reported: Wet Snow 4-5 mm)
- RWY 26L: 06:28 – 06:51 (Reported: Wet Snow 3-4 mm)



Example January 31st, 2016

WX: light rain, TEMPO moderate rain



Thank you