BEST PRACTICES AND TOOLS TO PROVIDE NOISE INFORMATION TO COMMUNITIES

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3 June 2015

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1. Executive Summary

Our research found a very broad range of noise impact information sharing globally. It should be no surprise that best noise management practices recognized in the industry maximize information available to and collaboration with the public. The US aircraft noise management culture remains in a reactive state of measuring, reporting, defending and contesting while other countries have advanced to proactive and collaborative states. Gatwick Airport in England is recognized as a leader in collaborative noise management.

Noise Management System technology advancements have increased airports' ability to engage and empower communities that surround them. Airports that have evolved to a collaborative state of noise management, such as Gatwick, are tailoring noise reporting systems to meet community needs and even varying the reporting by community as required to address unique needs and community interests.

Aircraft noise reporting evolution can be voluntary or forced by community pressure. Either way, the outcome is the same. Aircraft noise is what it is and it can only be dealt with effectively when communities and airports assess the actual noise environment together and work together to identify rational solutions.

Two software systems stood out in our research – Casper's Noise Lab and Bruel and Kjaer's WebTrak. Noise Lab was unique in both quantity and quality of information and WebTrak appears to be dominant in the market with approximately 63 major airports globally utilizing the system to share noise information including the Port Authority of New York and New Jersey, Los Angeles International Airport, and Denver International Airport. Both systems have similar capabilities. They combine noise data collected through traditional noise monitoring systems with flight track data. The technology enables near real time display of noise monitor levels associated with each flight track. This data can be further compiled and analyzed to produce noise reporting tailored to specific needs and metrics.

Airports differ in their use of the systems with some showing flight tracks, some showing flight tracks and noise monitor measurements and some going as far as to display flight tracks, noise monitor measurements and current noise contours (Schiphol in the Netherlands). Quality and quantity of noise information is key to productive dialogue with communities to address and manage noise impacts.

Since our initial recommendation to SOC to explore WebTrak on April 1st of this year, Chicago O'Hare has implemented WebTrak and is now displaying flight tracks in near real time for public viewing.

SOC, other impacted O'Hare communities and neighborhoods, and the City of Chicago can benefit by expanding the use of ANOMS with either Noise Lab or WebTrak to collaborate on best management of ORD's current and future noise environment. Noise

impacts from current plans for infrastructure changes can be predicted, optimized to minimize noise impacts and monitored for accountability. The system can be utilized to improve transparency. Data that we believe can and should be provided include but are not limited to:

- Historic and current flight track data identifying aircraft type, airline, flight number XY coordinates, altitude and speed
- Map changing values of noise monitor measurements as aircraft fly over changing color with noise level
- Map gate locations relative to flight tracks to monitor aircraft to determine if aircraft followed various noise abatement procedures such as the Fly Quiet program
- Map INM annual DNL contours as compared to predicted contours for 55, 60, 65 and 70 DNL
- Map daily DNL contours for the purpose of understanding peak and off peak impacts
- Alternate metrics such as CNEL, N70, N60 and Time Above as determined necessary to tailor noise information to community concerns
- Map noise complaint locations relative to flight track data and current noise contours

Having taken the first step to empower community collaboration the City of Chicago is now positioned to become a world leader in collaborative noise management.

It is recommended that the noise impacted communities around O'Hare approach the City of Chicago, the O'Hare Noise Compatibility Commission, local, state and federal officials to request that ORD expand the use of ANOMs with either the Noise Lab or the WebTrak systems to incorporate the best features of both systems. Both the community and O'Hare stand to benefit by raising the noise management bar to world class standards in operations and sustainability.

2. Airport Noise and Community Impact Best Practices

Airports belong to the communities they serve. Maintaining a healthy balance between air transportation benefits and burdens is critical. The appropriate balance is community specific and noise is becoming a leading variable in determining that balance.

ACRP Report 15 Aircraft Noise: A Toolkit for Managing Community Expectations provides some insight to public sentiment regarding airport noise.

> **What Does the Public Really Want?**
> Based on dozens of interviews for this project, what the public wants from airports about noise conditions can be summarized in three basic concepts:
>
> - Promote communication: this includes working in an interactive way with one or more organized groups, involving them as partners in pursuit of mutual goals.
>
> - Present the facts clearly and honestly: this includes designing websites that can actually be used by the community to both learn and to do their own analysis.
>
> - Reduce the noise impacts: this may refer to an overall reduction of noise levels or the abatement of particularly offensive single events.

Airports' effectiveness at promoting communication, presenting facts clearly and honestly and reducing noise impacts determines their community dynamic. Websites can be a powerful tool to educate and involve the community.

ACRP Report 15 lists Gatwick Airport Interactive Aircraft Noise Website as an example of best practices for large airport noise websites.

> *"Gatwick Airport: Interactive Aircraft Noise Website. The purpose of the BAA's Gatwick Airport website is to provide the public useful and clear information about the aircraft noise they are hearing and why it occurs. This website's purpose is to explain some of the issues about airplane noise, answer the most common questions, and describe what the airport is doing about it.*
>
> *By using the website links, users can find information about areas where they live or work and understand how departing and arriving aircraft can affect them. The interactive website is extensive, informative, and user-friendly with many pages dedicated to communicating the effects of aircraft noise, education, and the airport's role in the community. Additionally, documents, leaflets and reports are available for download."*

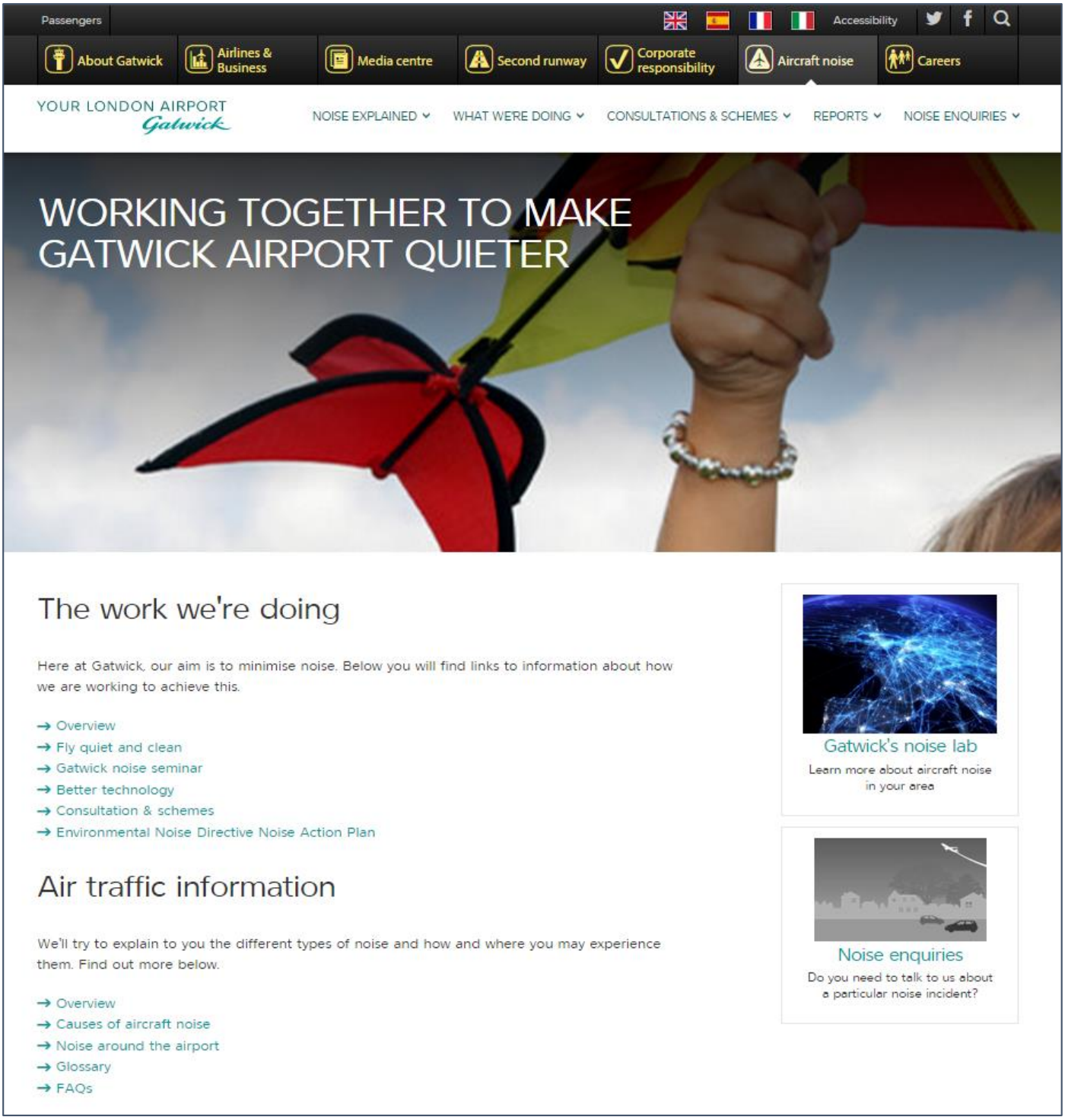

Figure 1 - Gatwick Noise Home Page

Gatwick utilizes their website as an effective tool to give the public what it wants regarding noise.

A. Promoting Communication and Presenting the Facts Clearly and Honestly

The noise homepage acts as a guide to the work that Gatwick is doing to minimize noise and explains:

- noise causes
- where noise occurs
- Gatwick's consultation schemes to engage the public and related reporting

Figure 2- Gatwick Noise Lab Link

Additionally, noise inquiries (complaints), performance reporting and noise committee meeting minutes are linked from homepage tabs.

The Gatwick Noise Lab is linked on the noise homepage. Noise Lab provides the public interface to noise data relative to location to increase public understanding of actual airport noise impacts.

Noise Lab provides interactive pages allowing the public to:

- Analyze noise specific to their location
- Understand causes of noise
- Understand the flight paths of aircraft of interest relative to their location
- See the flight paths of all aircraft that day
- Review historic data specific to a particular noise monitor
    - Departure and arrival distributions per runway
    - dB(A) value distribution
    - Altitude distribution
    - Number of noise events per day and hour
    - Number of flights per day and hour
    - Distribution of flights per region of origin/destination
    - Distribution of departures per corridor
- View actual 2011 57,60,63,66,69 & 72 db(A) noise contours
- Map user location an view relative to actual noise contours from 2011 with noise preferential routes, flight tracks and holding positions
- See a Video of airspace sector traffic to illustrate interaction of traffic passing over the UK
- Access a library of aircraft types

Figure 3 - Gatwick Noise Lab Causes of Noise

See Appendix 1 for examples from the Gatwick Noise Lab website.

Actual noise contours are routinely withheld from the public resulting in an impasse of constructive dialogue to address noise concerns. Predicted noise contours can also be withheld to further obstruct the public from understanding where noise boundaries are or where their property is relative to any specific DNL value.

Gatwick Airport utilizes the flight path and noise data collected to report the latest full year contour maps produced from actual noise readings to allow the public to see the actual noise impact versus previously predicted noise impacts. Additionally, the Noise Lab website plots 2011 contours on the interactive map to demonstrate homeowner location relative to the contours.

Schiphol Airport utilizes Noise Lab to map current contours relative to location. This was the only airport mapping current contours discovered in the research phase of this whitepaper.

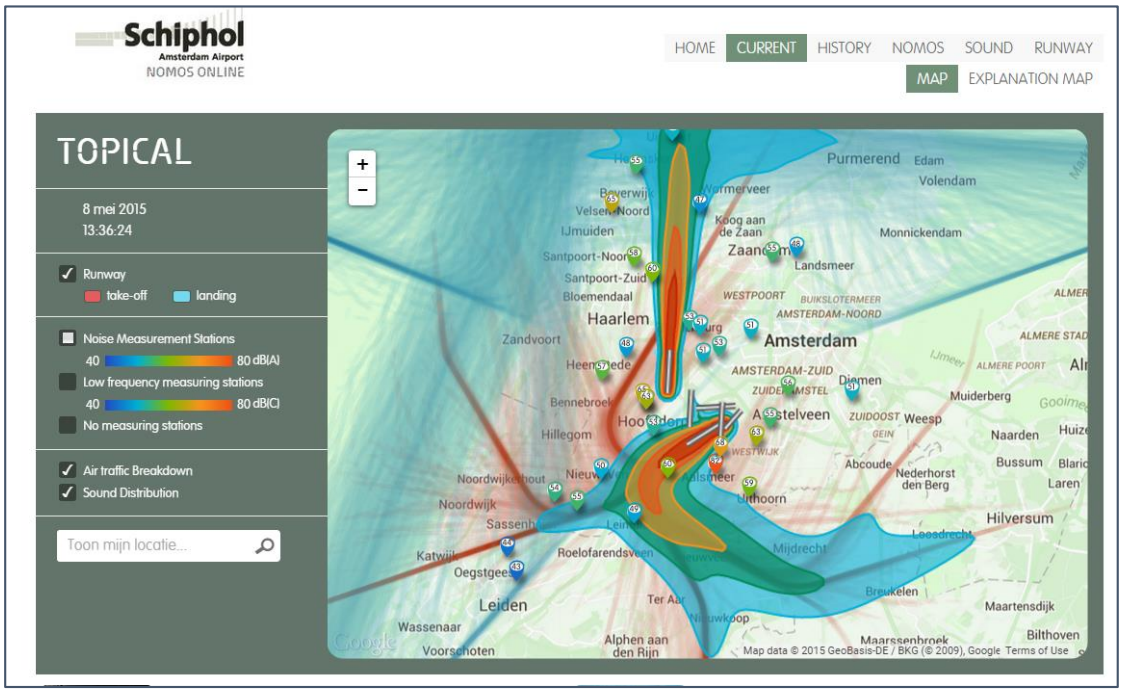

Figure 4- Schiphol Amsterdam Airport Current Flight Track and Noise Contour

B. Reduce Noise Impacts

Gatwick has utilized the website and internet to engage the public in consultation on the Noise Insulation Scheme and the Airspace Modernization.

As a result of consultation with the public the current noise scheme was revised to:

- Extend the current noise insulation boundaries East and West to include an additional 985 homes
- Consider both the increased sensitivity people have towards noise levels as well as the frequency of overflights

- Apply boundary lines flexibly to ensure entire villages are included

Figure 5- Gatwick Noise Scheme Boundary

Gatwick Airspace Modernization employed two separate phases of public consultation to assist in designing the appropriate Performance Based Navigation approach and departure routes for Gatwick airspace. The consultations gathered feedback on the following design options:

- Departure routes and associated Noise Preferential Routes (NPRs) with options for realignment and respite
- Night-time respite options for arrivals
- Updating existing NPRs and associated corridors to account for flight path concentration as a result of PBN routes

As a result of the consultation, NATS (the national air navigation services provider) deferred any changes to the airspace so as to allow further planning and engagement of residents in this area.

Gatwick also utilizes the website and reporting to demonstrate their results in reducing noise through their fly quiet program as managed by their flight performance team.

Detailed reporting is provided on each fly quiet initiative relative to previous performance and performance goals. Figure 7 illustrates the Continuous Descent Approach (CDA) noise procedure performance and Figure 8 illustrates performance of several parameters to key monitoring indices.

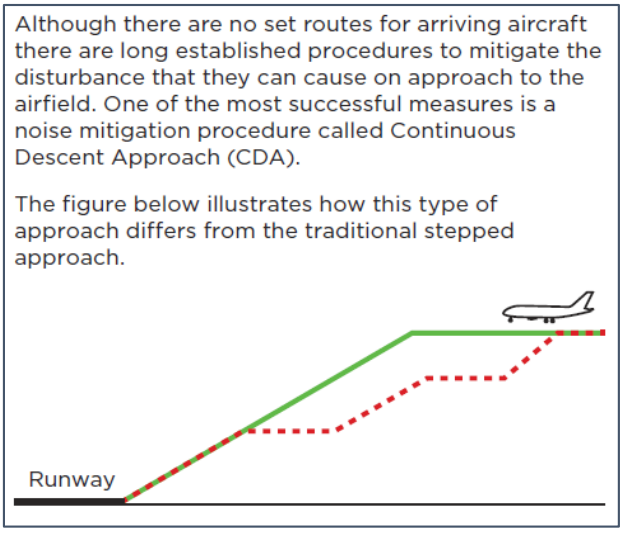

Figure 6- Continuous Decent Approach

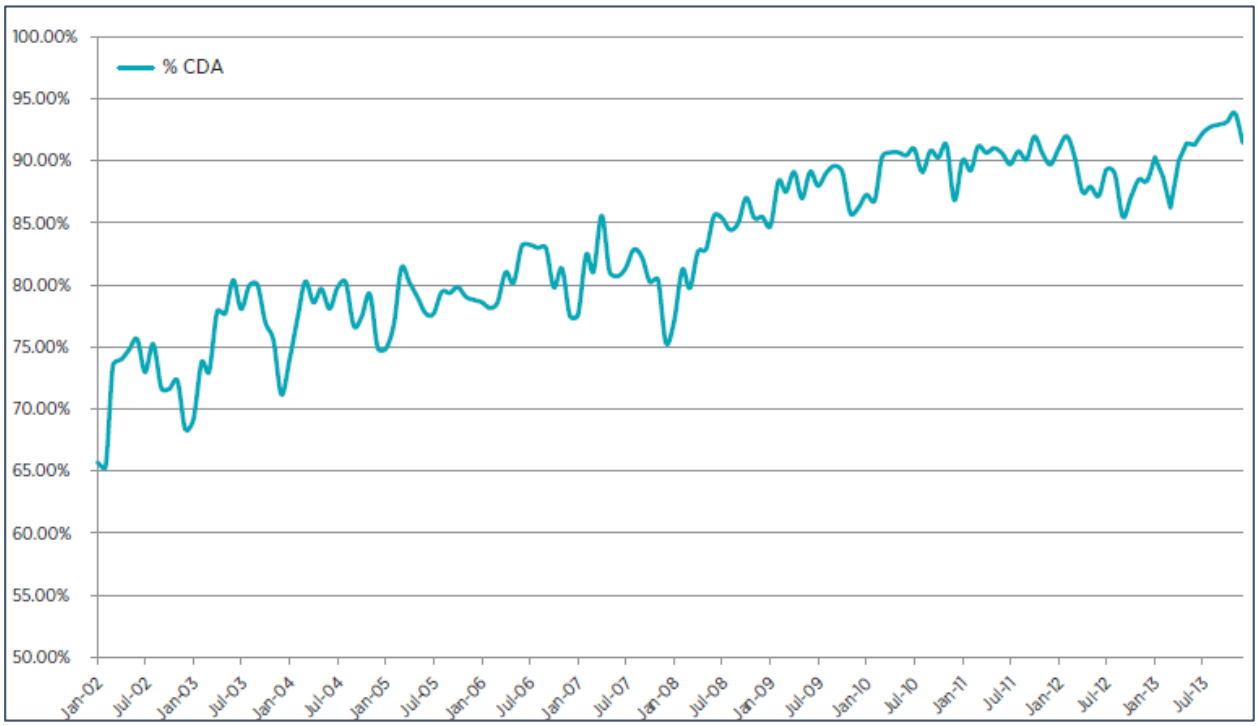

Figure 7- Gatwick 24 Hour CDA Performance 2002-2013

Parameter		12 month averages* Year to date	Previous year	2011	2006
Track keeping performance (% on track)	▲	99.29%	98.04%	97.47	98.17
24hr CDA (% achievement)	▲	91.06%	91.36%	90.49	80.79
Day/Shoulder CDA (% achievement)	▲	90.73%	88.72%	90.19	79.9
Core night CDA (% achievement)	▲	94.29%	94.04%	93.96	89.6
1000ft Infringements (No.)	▼	0	0	3	11
1000ft Infringements (No. below 900ft)	▼	0	0	1	6
Departure Noise Infringements (Day)	-	0	0	0	10
Departure Noise Infringements (Night/Shoulder)	-	0	0	4	2
Callers	▲	3459	533	343	587
Noise complaints	▲	21981	2296	2673	4791
Enquiry response performance target is 95% within 8 days (quarterly)	▼	74.01%	99.24%	KPI 95%	
West/East Runway Split (%)	-	67/33	63/37	67/33	68/32

Figure 8- Gatwick Key Monitoring Indicators 4th Quarter 2014

BEST PRACTICE AT GATWICK

PRECISION NAVIGATION

This year Gatwick Airport became the UK's first to introduce Precision Area Navigation (P-RNAV) into its airspace. We've been working with National Air Traffic Services (NATS) and airlines to develop technology which helps aircraft to fly more accurate routes from the airport.

WHY IS THIS SIGNIFICANT?

P-RNAV technology is a more precise navigation method that allows aircraft to navigate using GPS co-ordinates rather than traditional ground-based navigational aids. This will result in aircraft having a track keeping accuracy of ±1 nautical miles for 95% of its flight time.

- This will result in several important advantages:
- Greater certainty of what areas will be overflown, thereby reducing noise in certain areas
- Environmental benefits include reduced fuel burn and associated reduction in emissions
- Air traffic controllers and flight crew can plan their routes more easily and with greater precision
- Introduces the possibility of creating rotating respite for noise affected communities.

The advent of this technology makes it possible to design P-RNAV routes which more easily avoid areas where large numbers of people live.

Figure 9- Gatwick Precision Navigation

C. Precision Based Navigation (PBN) and Noise

Progress of PBN reduce noise impacts and concentrate flight operations over noise preferential routes is also demonstrated in much tighter adherence to a flight corridor in fourth quarter of 2014 versus 2013 as shown below in Figures 10 and 11. PBN is also used to provide respite periods to impacted areas alternating preferred noise routes weekly to provide relief for communities under PBN routes.

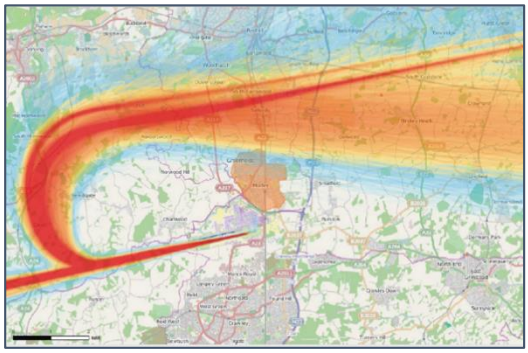

Figure 10 - PBN Flight Paths 2013

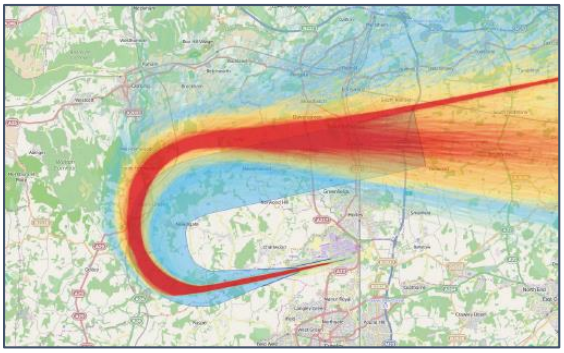

Figure 11 - PBN Flight Paths 2014

Gatwick also maximizes the value of technology to improve transparency regarding complaints. Mapping the location of complaints relative to flight paths as shown in Figure 12 demonstrates actual noise impact. This information then can be used to fine tune PBN or alter other mitigation strategies to improve performance.

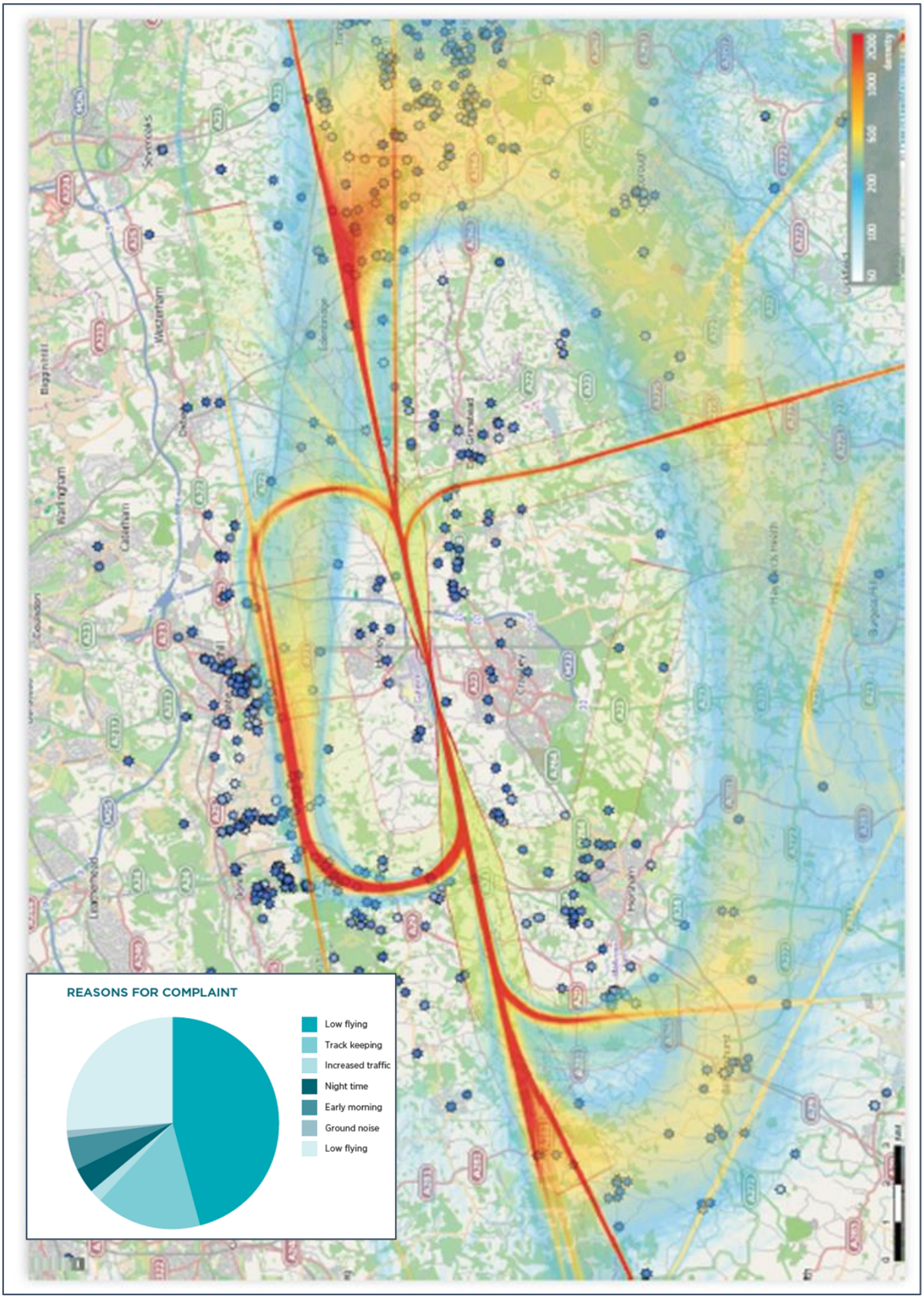

Figure 12 - Gatwick Noise Complaint Locations 4th Quarter 2014

Noise Communications Solutions Ltd (NCA) performed an independent assessment of Gatwick Airport's current and planned noise management practices and performance NCS observed additional best practice examples including:

- Noise Seminar, inviting 'no holds barred' face to face stakeholder questioning
- London Airspace Consultation ensuring stakeholders are involved in shaping the airspace around Gatwick Airport
- Fly Quiet and Clean program to promote the airport's noise initiatives and communications
- PRNAV implementation to provide respite options for the local community
- Regular and well communicated community noise monitoring and reporting
- Minutes of noise meetings and reports for consistent quality checking
- League tables of performance against peer airports/noise functions
- Track keeping trials to test best practice and implement coordinated and proven routings
- GATCOM Consultative Committee held in public session
- New Noise Insulation Scheme
- The Annual Monitoring Report ensuring longer term performance trending

3. Tools to Provide Noise Impact Information to Communities

Noise management culture is evolving with technology to enable public participation to a greater degree. Many examples around the world illustrate successful community and public influence altering major airport development and/or procedures to improve noise impacts including Sydney International Airport, Vancouver International Airport and Toronto Pearson International Airport. Several of these efforts have resulted in the acquisition of WebTrak a near-real time noise reporting system to give the public access to noise information that affects them. Like Noise Lab the WebTrak system is interactive, can be tailored to each airports reporting preference and is accessible to the public.

Our research found two commercially available systems that provide noise impact data in near real time to communities Noise Lab and WebTrak. Both Noise Lab and WebTrak integrate with traditional noise monitoring systems to combine noise data with flight track data to produce real time display of noise associated with each flight track.

Noise Lab, as demonstrated in Section 1 of this report, excels in quality and quantity of data accessible to the public. Noise Lab is a software module developed by Casper. Noise Lab and the Casper Noise Monitoring System are currently live at Gatwick http://noiselab.casper.aero/lgw/#page=home and Schiphol Amsterdam Airport http://noiselab.casper.aero/ams/ .

The WebTrak near real time reporting tool is used globally at more than sixty airports. WebTrak is a subscription product of Bruel and Kjaer. WebTrak and the Airport Noise and Operations Monitoring System (ANOMS) are live at 23 US airports and 41 international airports linked here http://webtrak5.bksv.com/. Additionally, the FAA recently implemented WebTrak to monitor and manage helicopter noise in http://heli-noise-la.com/webtrak/.

Because Chicago O'Hare current noise monitoring system is Bruel and Kjaer's ANOMS system, the balance of this report will focus on ANOMS and WebTrak's capability to support near real time noise reporting for the purpose of illustration.

A. WebTrak

ANOMS/WebTrak can similarly support all of the graphic reporting as demonstrated in Appendix 1 by Noise Lab. The service can be tailored to the airports specific noise management and reporting goals.

WebTrak functions supported include but are not limited to:

- Aircraft position, angle, range and height relative to specific GIS location
- Runway usage by aircraft

- Flight number, aircraft type, beacon code, origin and destination
- Near real time display of noise monitor Leq measurement data
- Collect and display weather data
- Noise event SEL, LMax Duration
- Historic replay capability through query by time period
- Fight tracking through predefined gates and corridors with compliance reporting
- Integration with INM for noise contour modeling DNL & CNEL
- Online complaint entry
- Reports library
- My Neighborhood

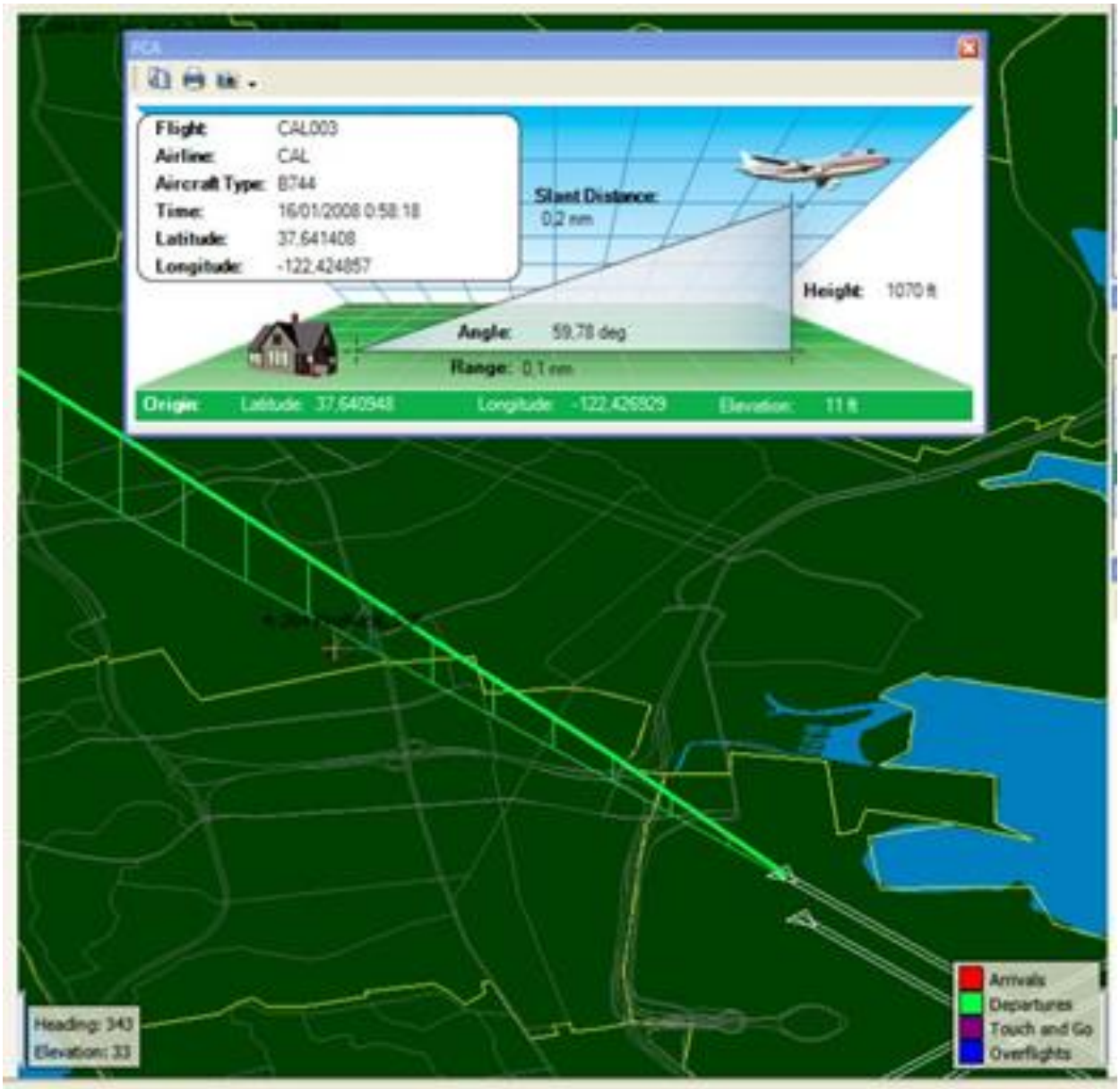

Figure 13 - San Francisco International Airport ANOMS

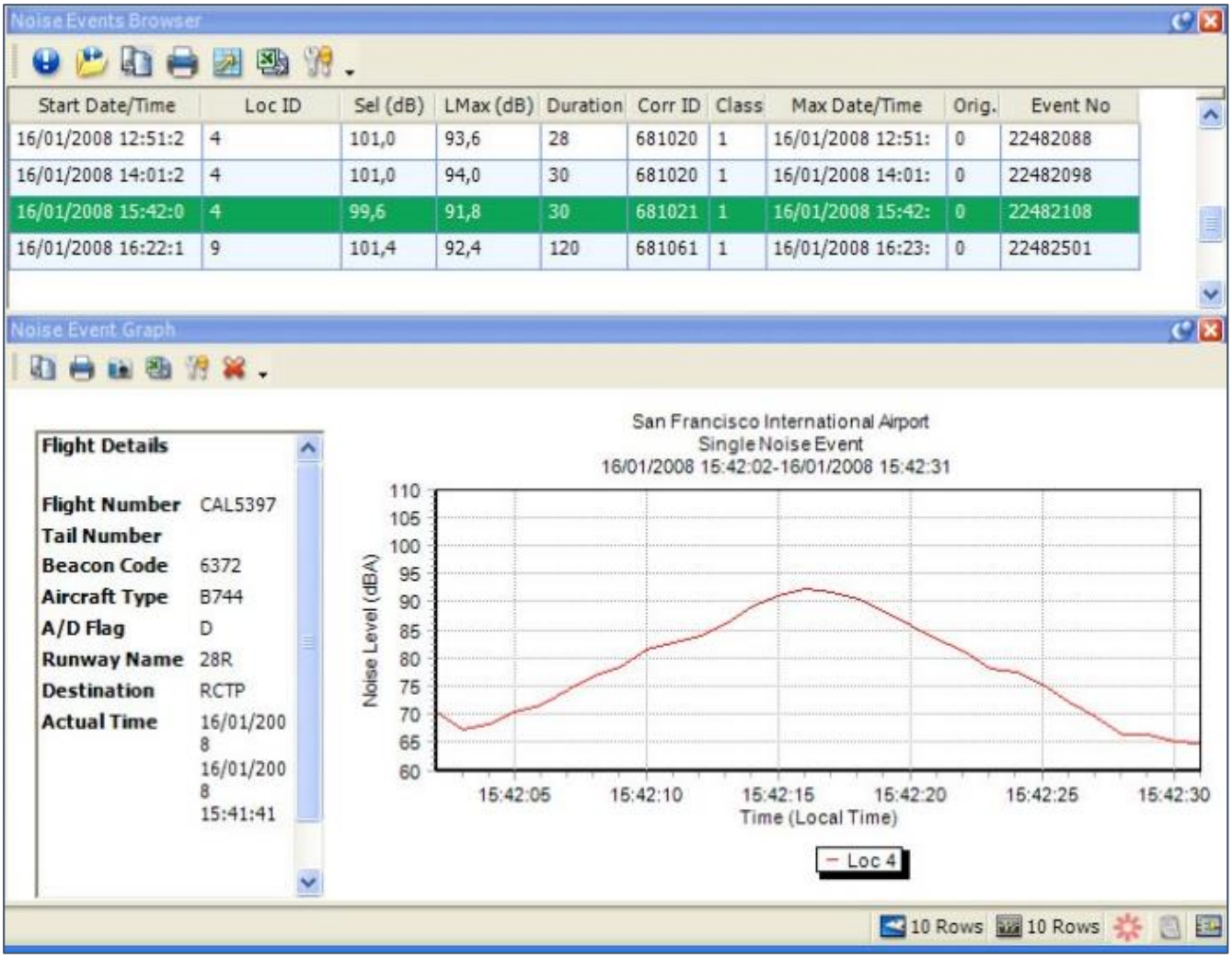

Figure 14 - San Francisco International Airport ANOMS Noise Event Browser

B. WebTrak FlyQuiet

- Identifies flights that don't comply with noise abatement procedures
- Promptly communicates to the aircraft operator
- Provides on online dashboard for airlines and pilots to investigate and explain deviations
- Delivers rapid feedback loop that drives improved compliance, resulting in a quieter airport

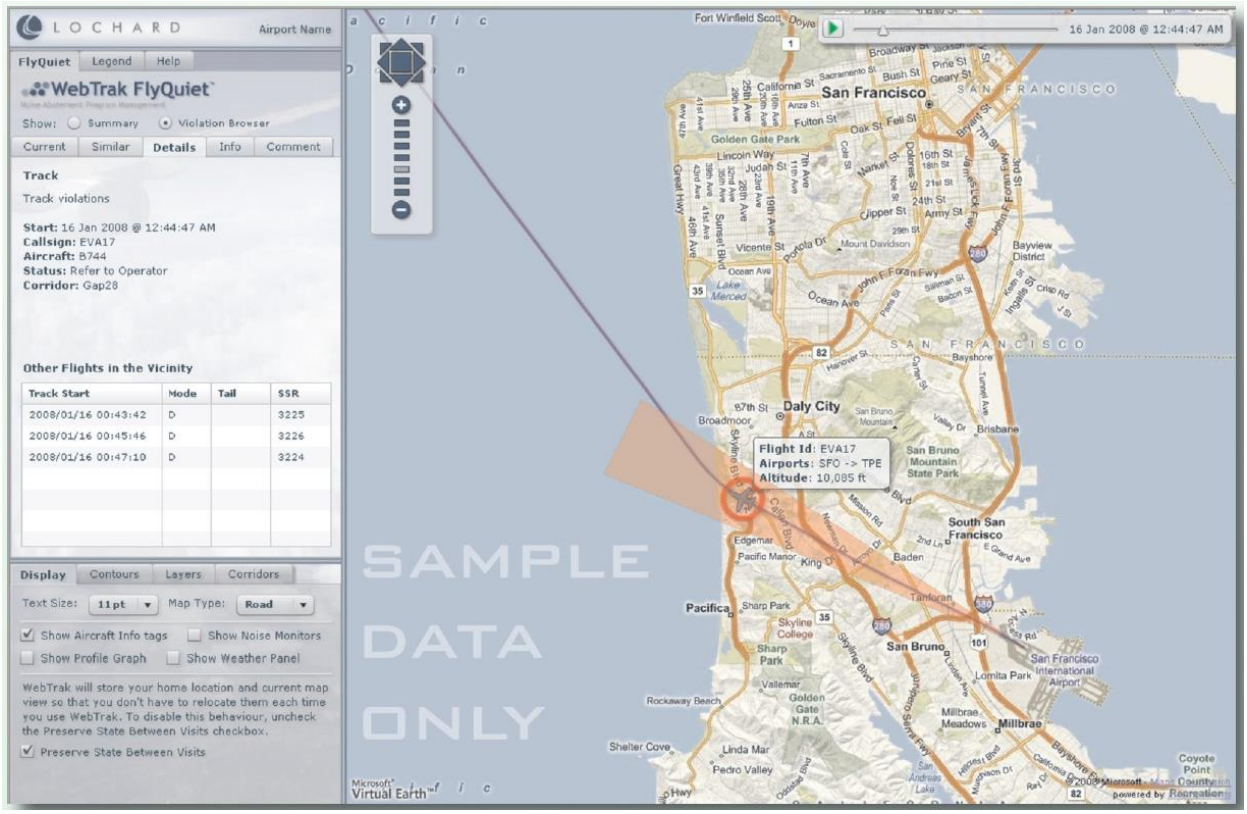

Figure 15 - WebTrak FlyQuiet SFO

The Dashboard information:

- Flight information
- Noise measurements
- Weather conditions
- ATC instructions
- Nearby flights

ANOMS and WebTrak are excellent tools to balance airspace design and management against noise impacts on the ground. Denver International Airport recently redesigned airspace precision navigation procedures. The airport engaged the surrounding communities in analyzing noise impacts and collaborative design to minimize and balance noise impacts of revised flight paths. These efforts included:

- Mapping of proposed route/corridor options
- Assessment of the noise impact of each proposed option with the communities
- Optimizing flight paths and narrowing corridors to minimize noise impacts
- Identify peak and off peak airspace strategies to balance noise impacts in partnership with the communities

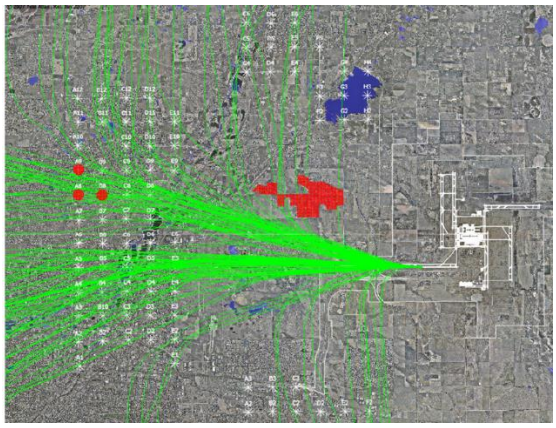

Figure 16 - DEN Pre-RNAV Departure

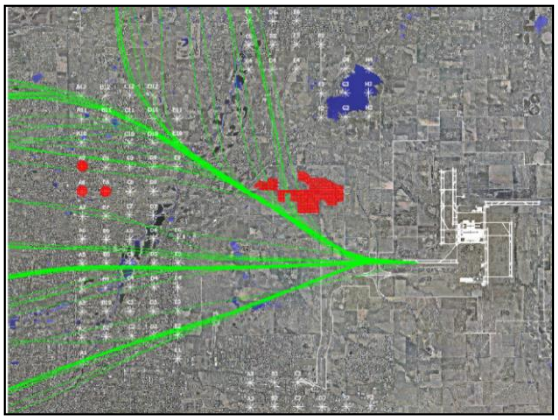

Figure 17 - DEN Post-RNAV Departure

The FAA utilized ANOMS/WebTrak Fly Quiet capability as flight tracking and compliance tool to demonstrate Next Gen precision aircraft navigation capability through predefined gates and corridors defined within the system in this video https://www.facebook.com/video.php?v=10151067714960757. The video provides a visual representation of the gate and corridor technology that can be used as a compliance management tool for fly quiet preferred noise routes.

Technology has evolved to enable transparency of sound information in near real time to partner with communities to balance airport economic benefit against noise impacts. Community collaboration empowered by adequate sharing of predicted noise impacts is becoming the standard for successful implementation of major airport changes. Implementation of PBN nationwide has illustrated both successful community engagement and implementation and struggling implementations that failed to involve the community.

HMMH presented an entire paper titled Implementing Performance Based Navigation Procedures at US Airports: Improving Community Noise Exposure in 2013 at Inter Noise. The paper concluded that:

"Successful Implementation of PBN procedures requires a collaborative team to develop procedures that take into consideration perspectives from multiple stakeholders, including air traffic controllers, operators and airport and community representatives. Detailed sophisticated noise modeling utilizing state of the art models provides transparency that allows for a robust discussion of the tradeoffs and challenges of implementation that ultimately results in a better outcome."

C. Aircraft Noise Management Evolution

Industry is recognizing that noise represents a significant threat to aviation growth and community tolerance can improve with transparent stakeholder engagement. Airport Council International Asia Pacific Airports published a recent article titled Brüel & Kjær's Mike Rikard-Bell discusses an emerging threat to airport growth in Asia – aircraft noise. Mike characterized the evolution of aircraft noise management as follows:

The four generations of noise management

Today's fourth generation noise management strategies go one step further, recognising that there is so much more to community annoyance than noise exposure alone.

It has become clear that annoyance is influenced by a much broader set of concerns including trust, fairness, health effects, property prices and quality of life to name but a few.

Best practice today is focused on building community tolerance through open and transparent stakeholder engagement to address these concerns.

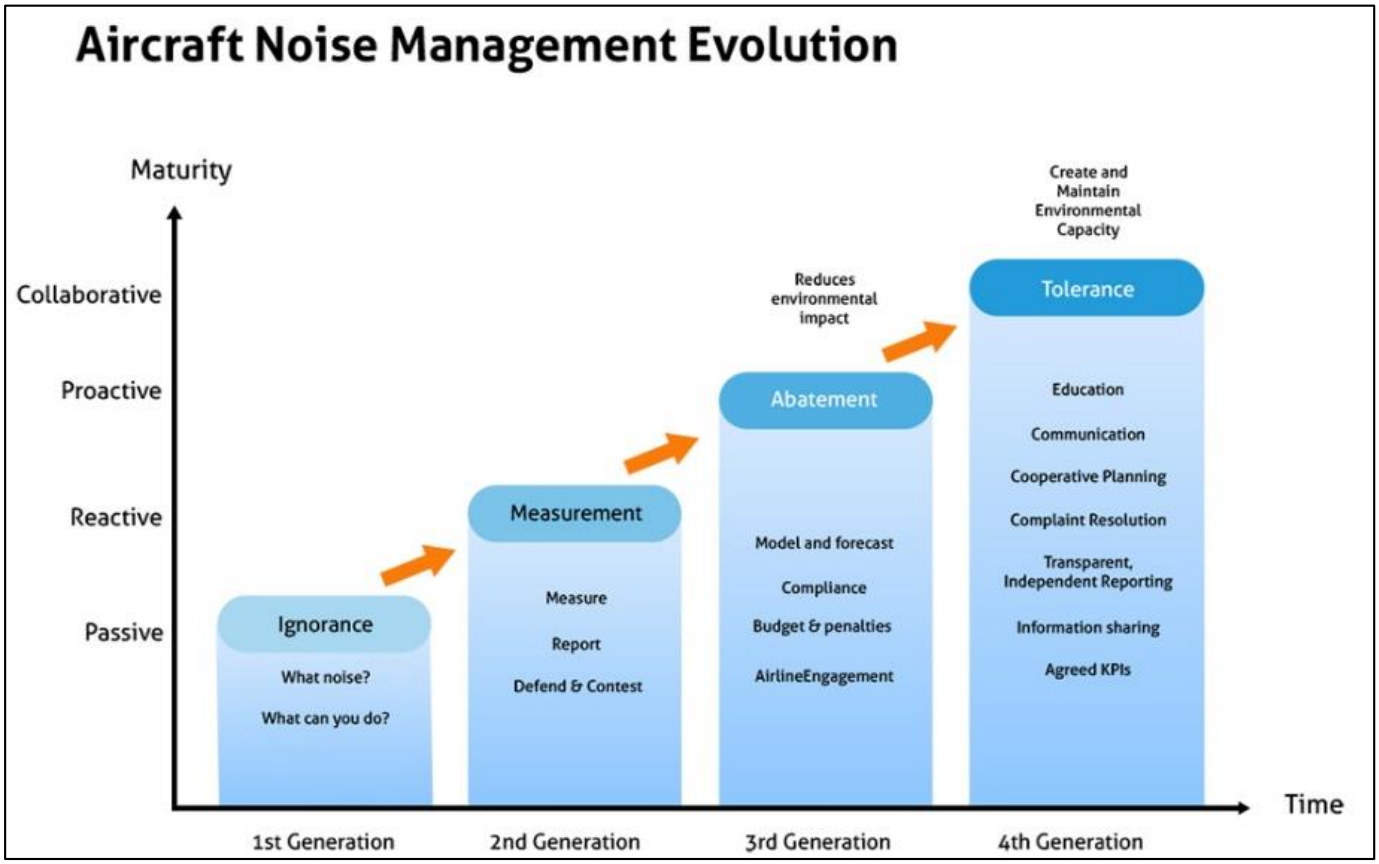

Figure 18 - Aircraft Noise Management Evolution

Leading airports are working hard to replace the silence and distrust of the past with an open and frank conversation where comprehensive information and facts are shared freely, and the wide range of stakeholder opinions and preferences can be debated on their merits.

Rich educational web portals build understanding and trust

Communications technology is playing a huge role with information rich community web portals being used to facilitate open and transparent information sharing.

4. Appendix 1: Gatwick Noise Lab Examples

Figure A 1. Gatwick Noise Lab Home Page

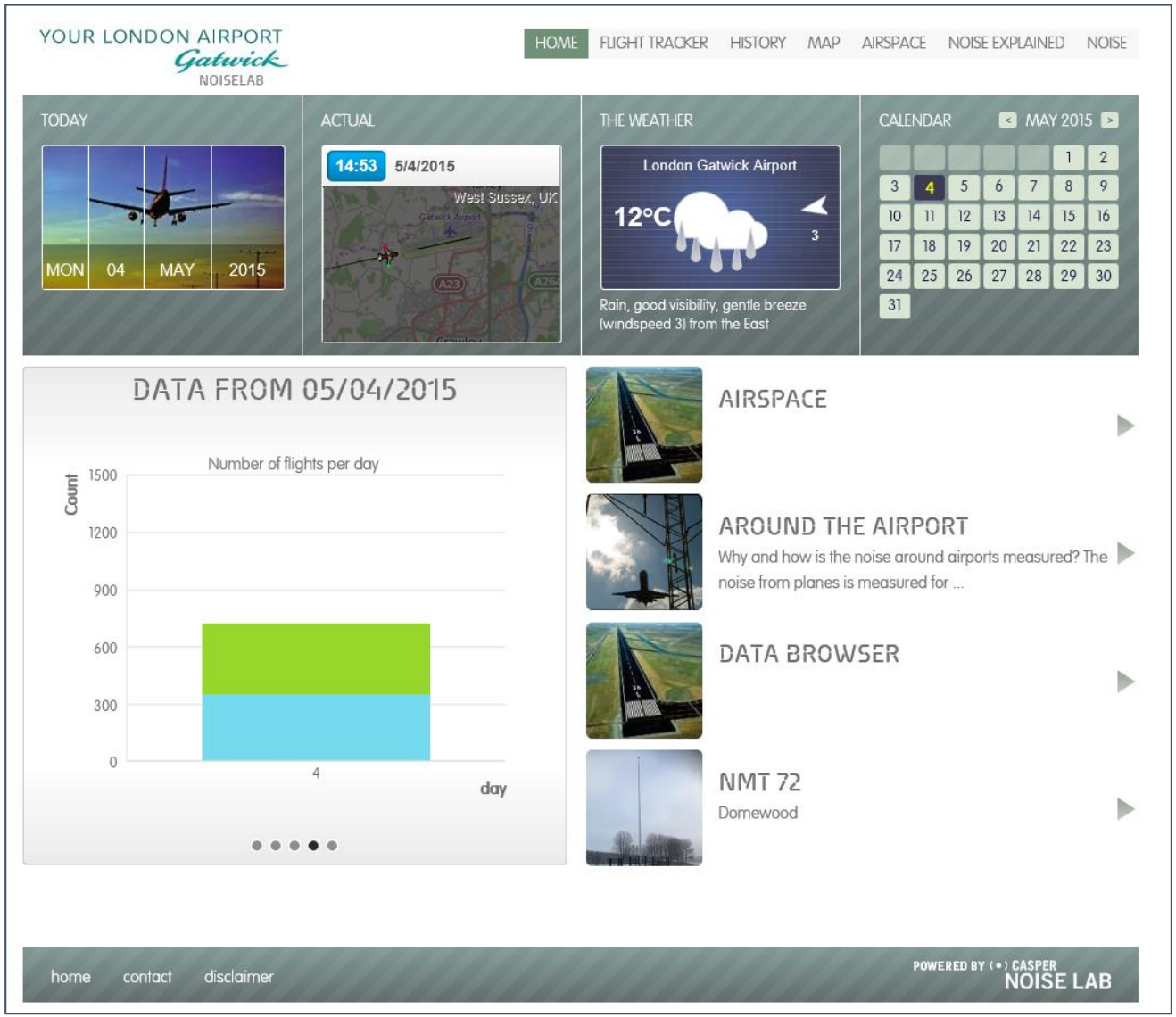

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Figure A 2. Gatwick Noise Lab – Under the Flight Path

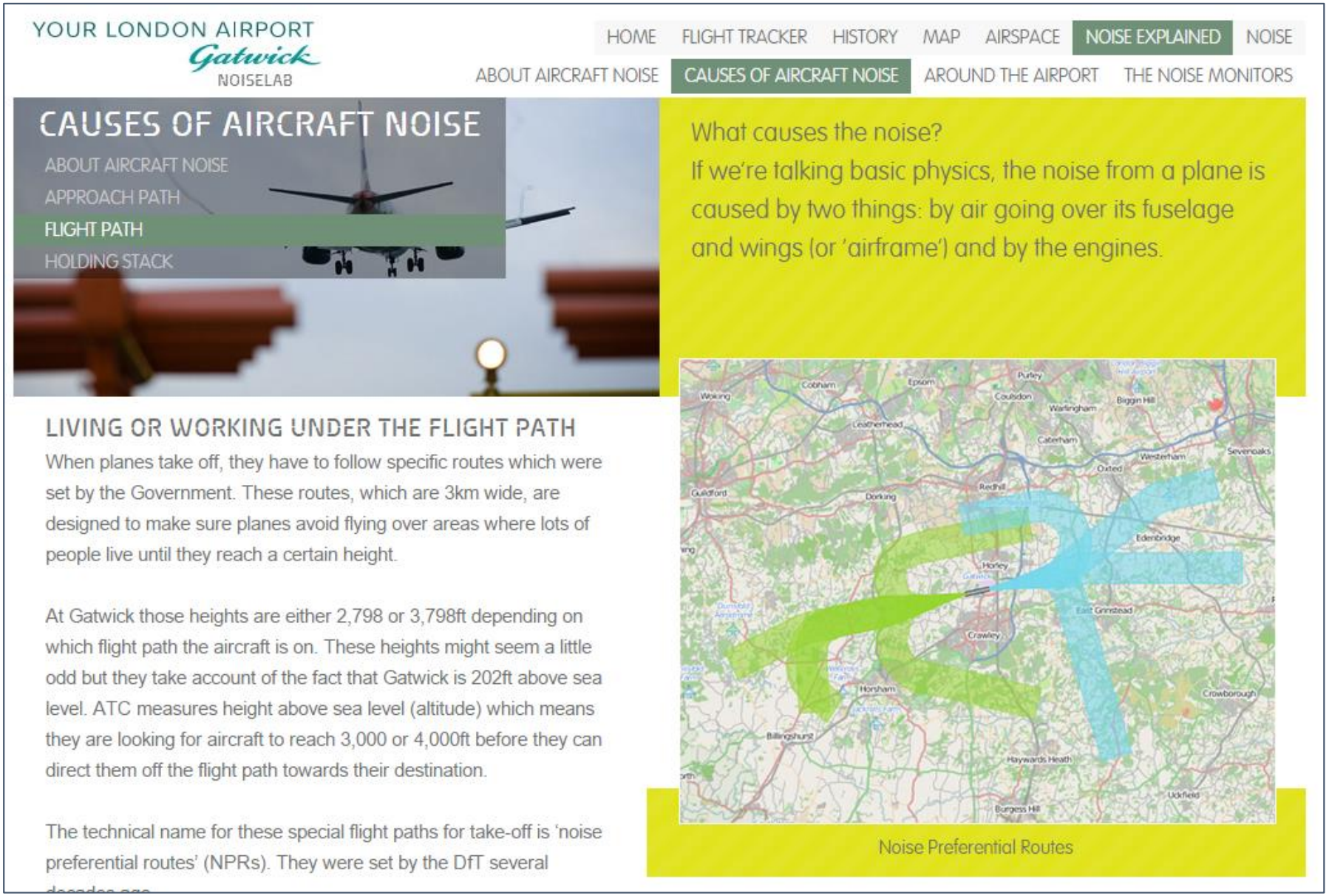

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Figure A 3. Gatwick Noise Lab - Map

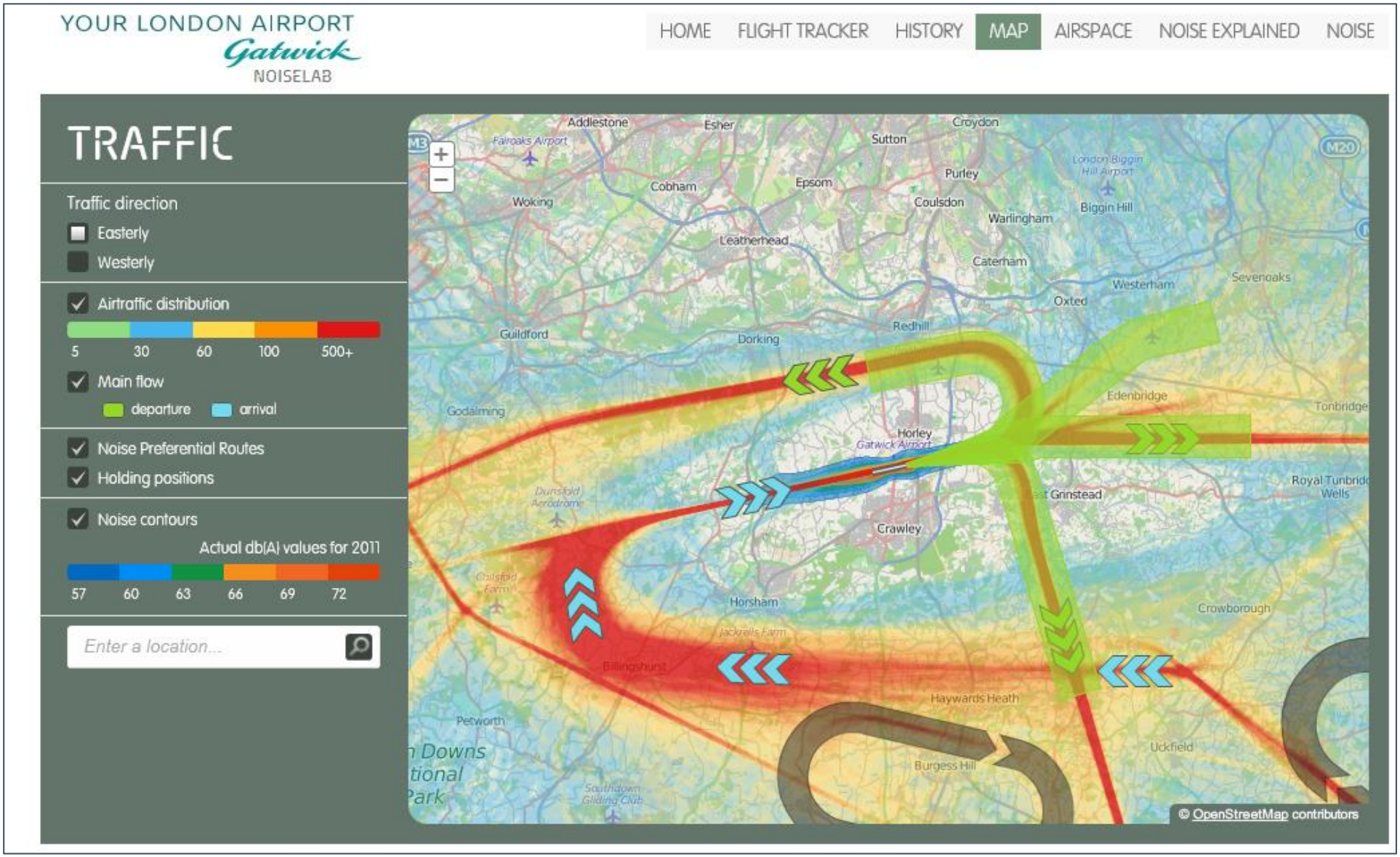

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Figure A 4. Gatwick Noise Lab – Noise Around the Airport

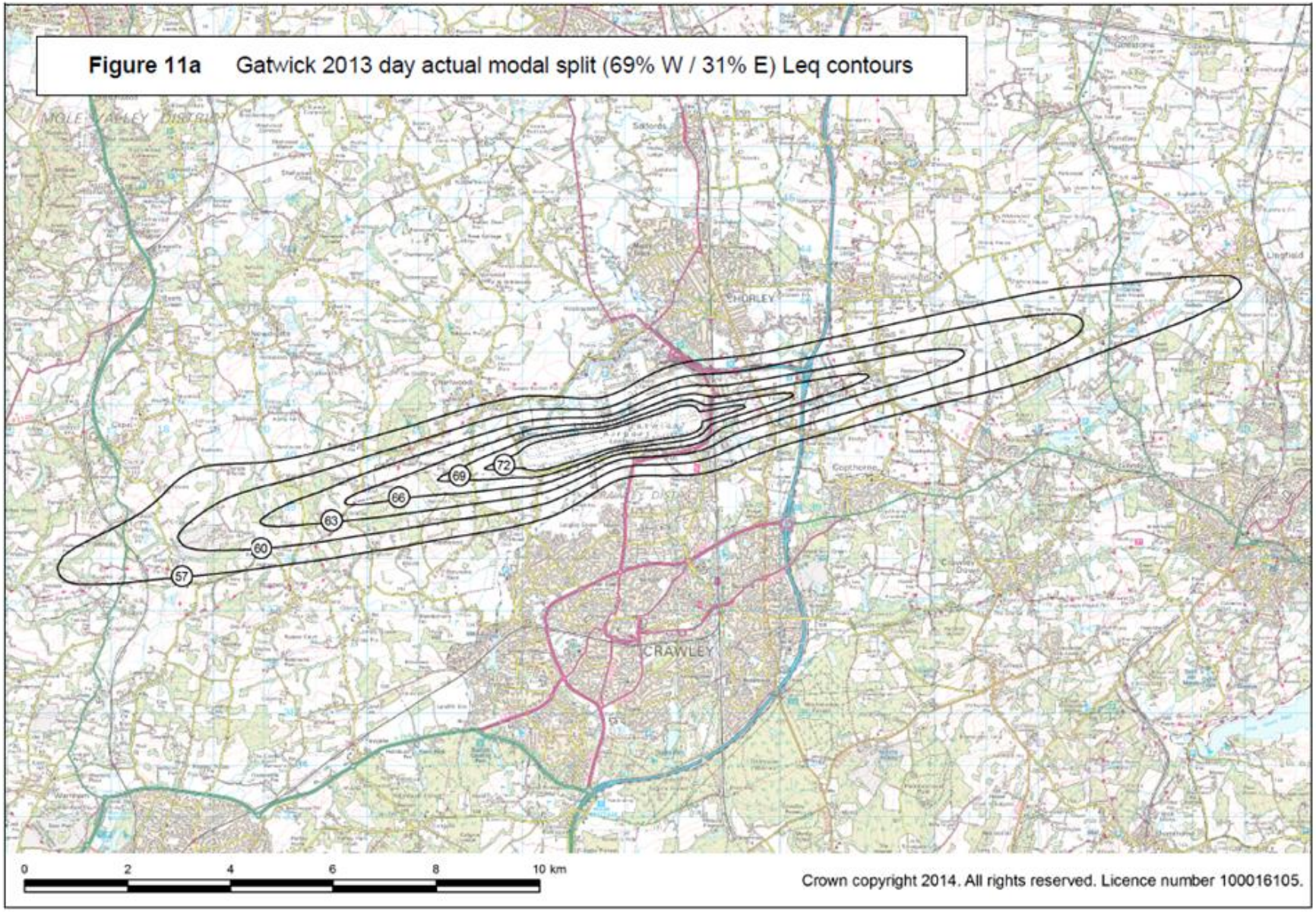

Figure A 5. Gatwick Noise Lab – Aircraft Noise Levels Through Time

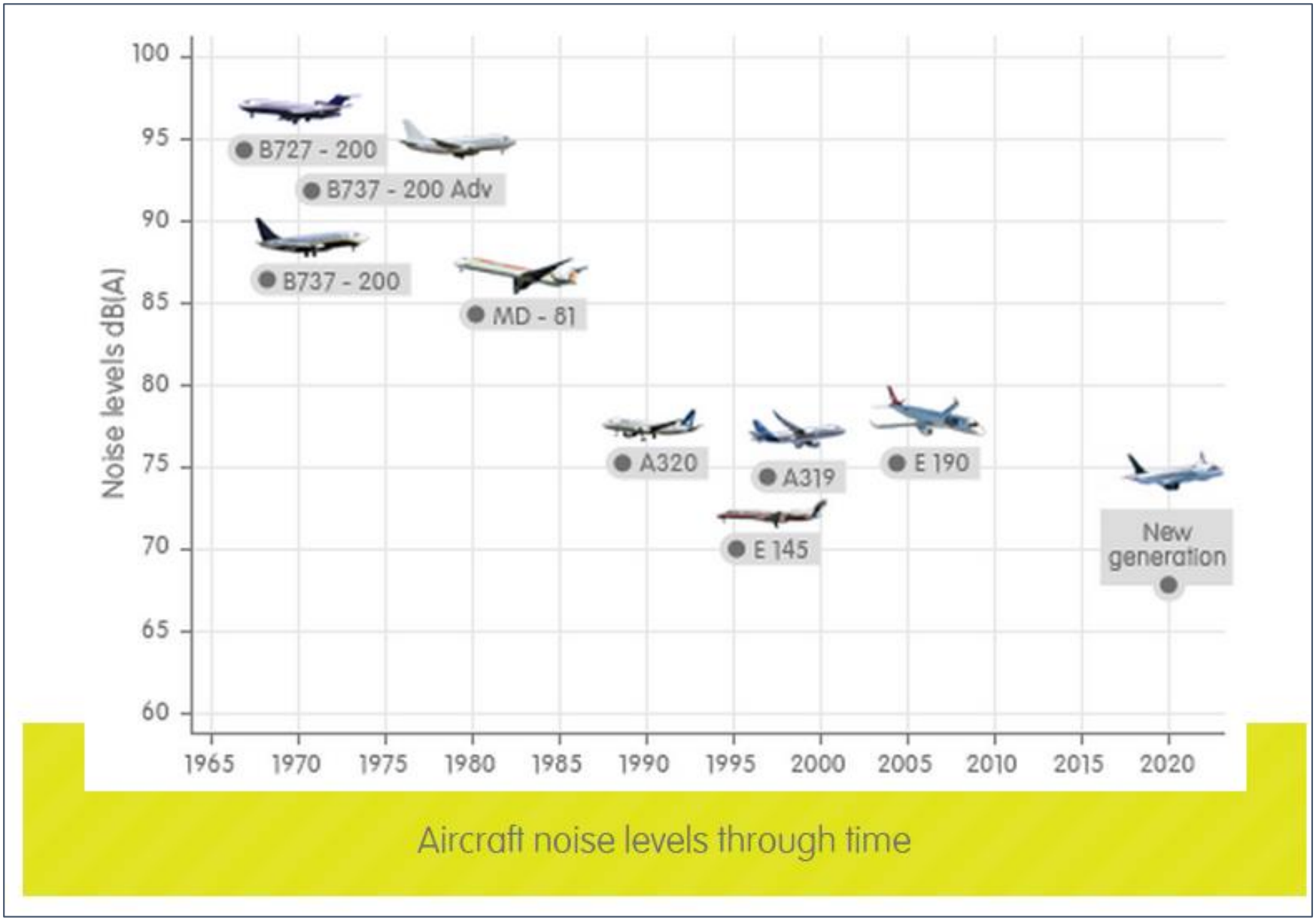

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Figure A 6. Gatwick Noise Lab – Find Location

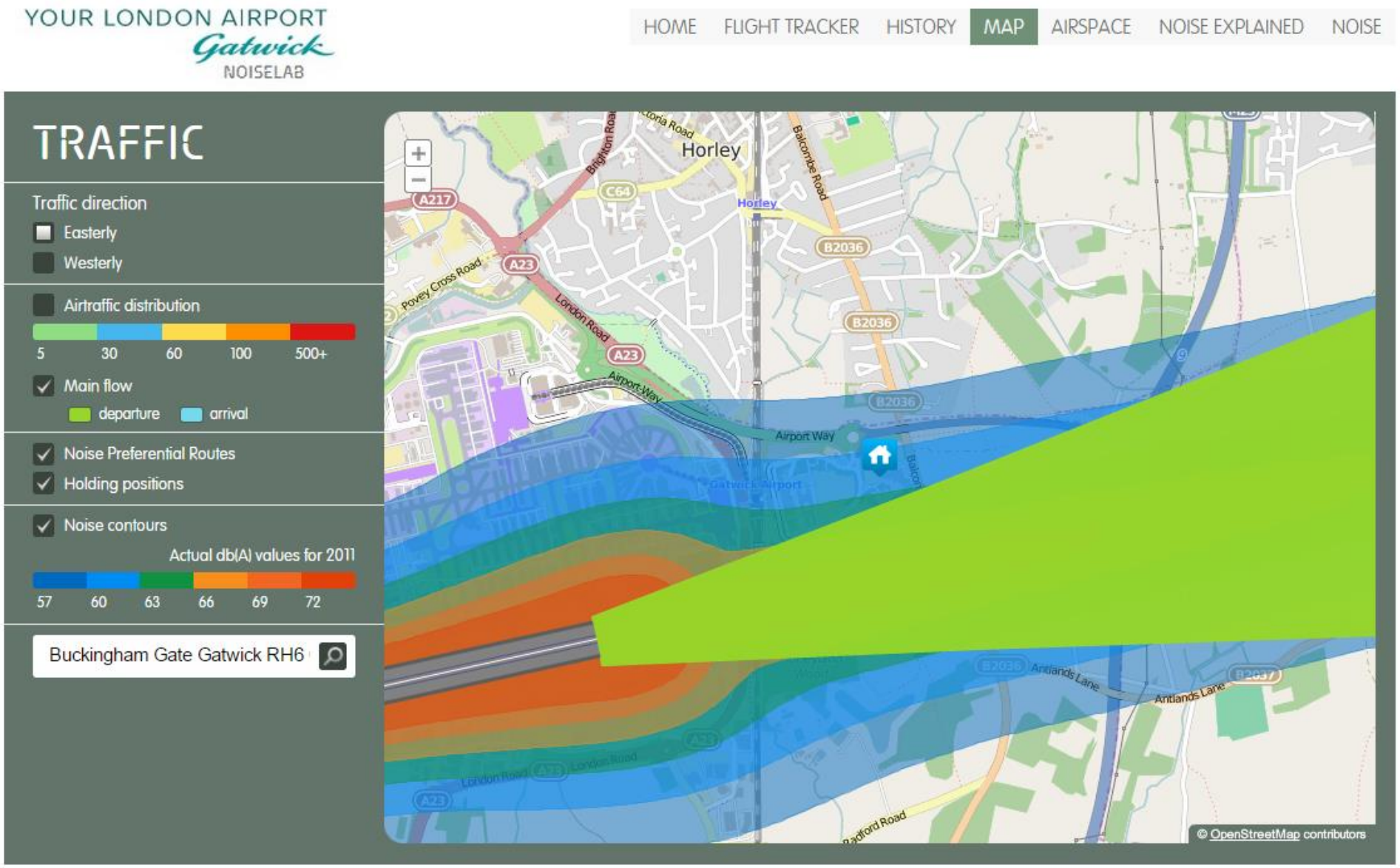

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Figure A 7. Gatwick Noise Lab - Flight Tracker NMT Display

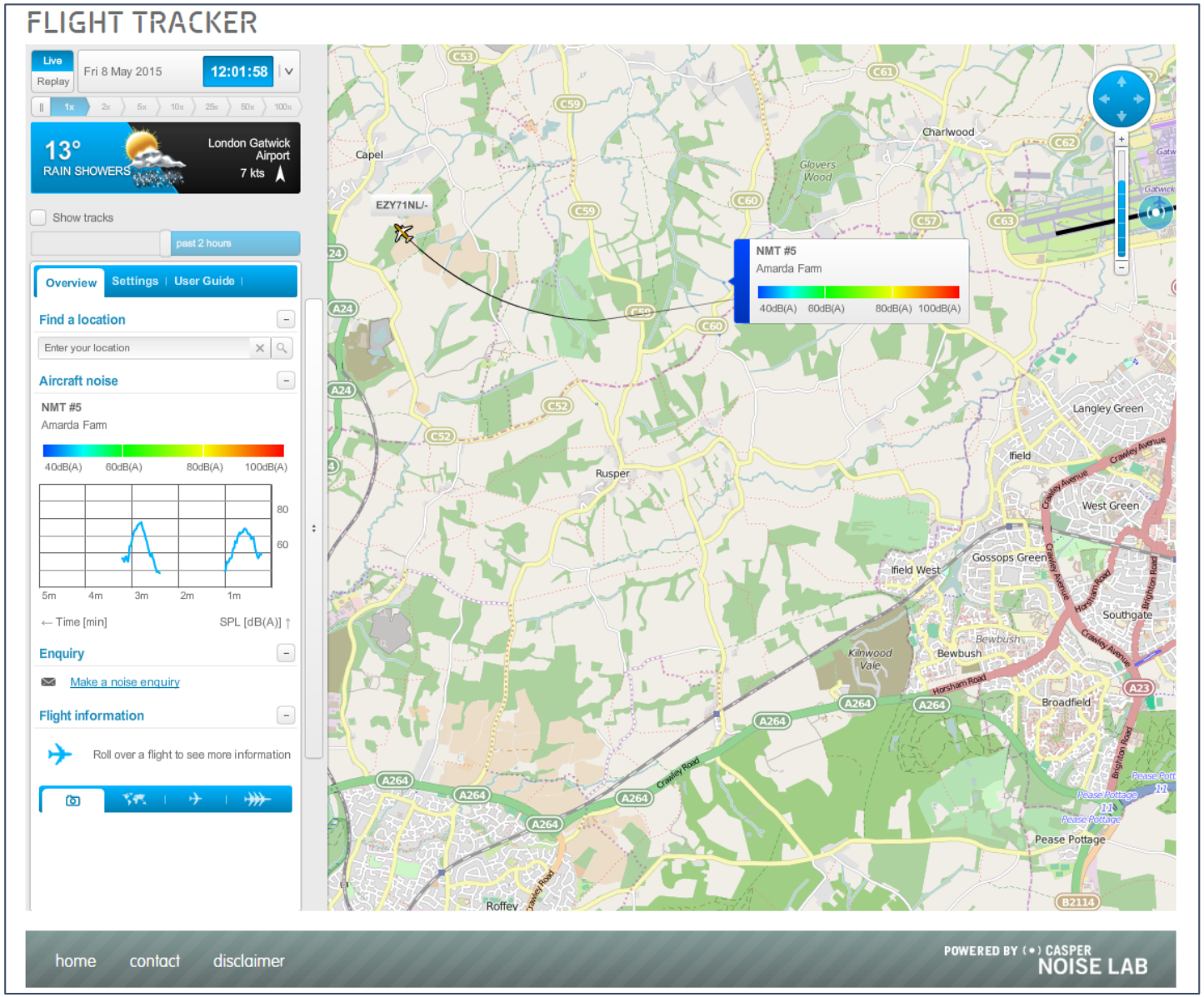

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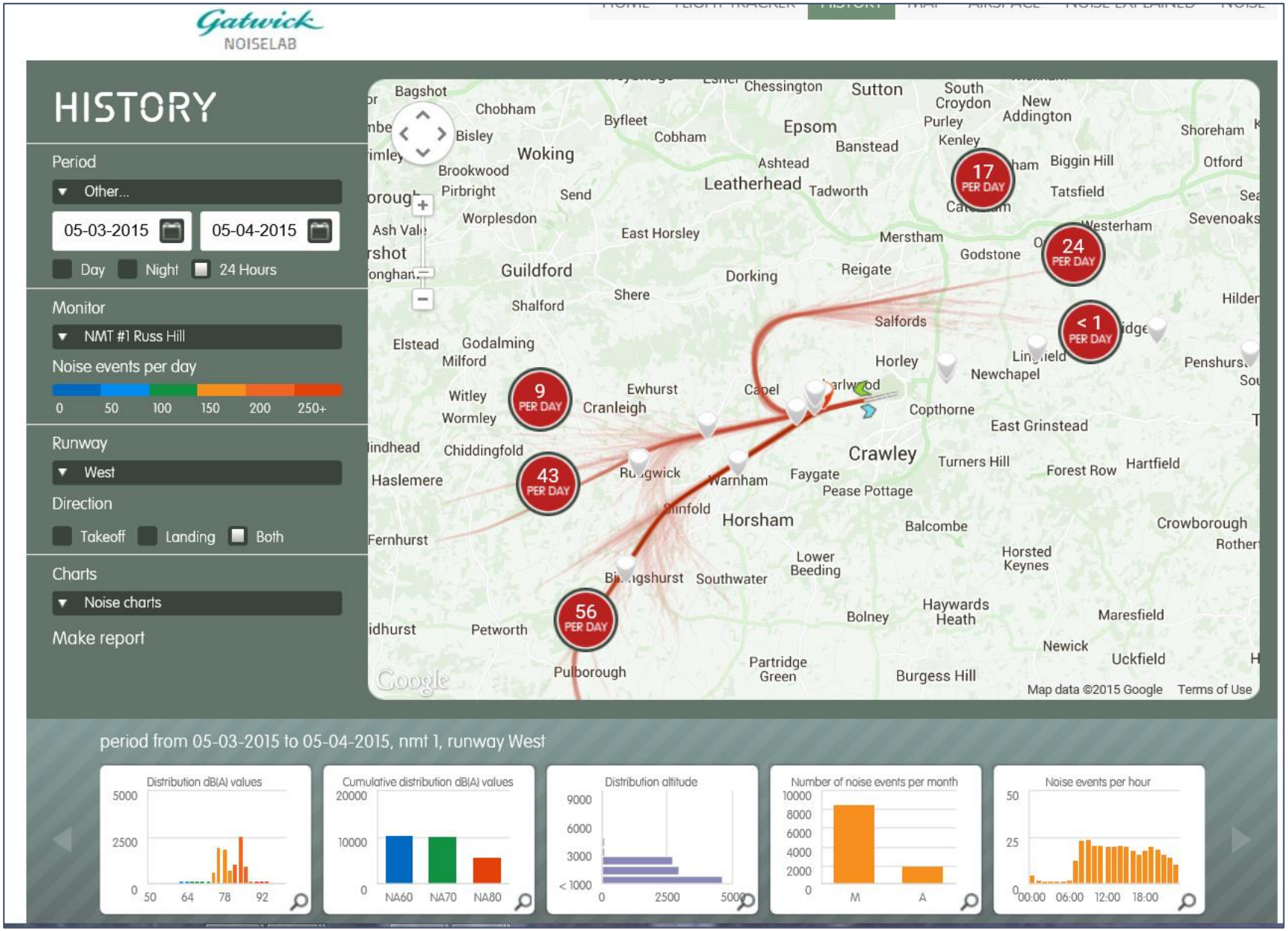
Figure A 8. Gatwick Noise Lab - Noise Monitor

Figure A 9. Gatwick Noise Lab - History



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5. Appendix 2: JDA Team

Author:

Cynthia Schultz PE, AAE is JDA's Vice President of Airports where she manages the airport line of business including, airport Safety Management System services, sustainability, strategic planning, security, facilitating new technology/products for airports, training for airports and airlines, airline negotiation and development of support services. Before joining JDA Cynthia was the Airport Director of Great Falls International Airport where she directed and led all airport operations, maintenance, administration, finances, security and support services including project management of engineering, architectural and construction, negotiation and administration of leases and concessions, safety, certification, design, construction and funding issues.

Contributing:

Dr. Antonio A. Trani, is a JDA associated consultant and Professor with the Department of Civil and Environmental Engineering at Virginia Tech University and is Co-Director of the National Center of Excellence for Aviation Operations Research (NEXTOR). He has been the Principal or Co-Principal Investigator on 68 research projects sponsored by the National Science Foundation, Federal Aviation Administration, National Aeronautics and Space Administration, National Consortium for Aviation Mobility, Federal Highway Administration, and the Center for Naval Analyses. Dr. Trani has provided noise, capacity and safety consulting services to the Norman Manley International Airport, Punta Cana International, National Institute for Aerospace (NIA), Xcelar, Quanta Technologies, Los Angeles World Airport, Charles Rivers Associates, Boeing Phantom Works, Civil Aviation Administration of China (CAAC), British Airports Authority (BAA), SEATAC Airport Authority, Louisville International Airport, Delta Airport Consultants, Celanese, and the MITRE Corporation.

Dr. Sanford Fidell, is a JDA associated consultant and owner and President of Fidell Associates which provides consulting and research services and litigation assistance in environmental acoustics, transportation noise, and effects of noise on individuals and communities. He is the U.S. Representative to International Standards Organization (ISO) Technical Advisory Group on Community Response Questionnaire Standardization and to ISO Working Group 45 on Community Response to Noise. Dr. Fidell is member of the Acoustical Society of America and the Technical Committee on Noise. He was on the Design Review Group for the FAA's Integrated Noise Model software. Dr. Fidell has provided consulting services to community, airport and government agencies involved in aircraft noise controversies and assessments and disclosures of aircraft noise impacts and has consulted on land use planning related to aircraft noise regulation. He is active in international standardization efforts for prediction of aircraft, rail and road noise impacts.

Dr. David Dubbink, is a JDA associated consultant and an Environmental Planning and Noise Management Specialist. He holds a PHD from UCLA in Urban Planning and Environmental Management. He is the designer and developer of ISIS (the Interactive Sound Information System). Dr. Dubbink is a member of the Acoustical Society of America, Institute of Noise Control Engineering, International Association for Impact Assessment and the Transportation Research Board, Committee A1F04, Transportation Related Noise and Vibration. He has provided training and consulting services on noise management to over 80 organizations worldwide.

Craig Burzych is an Air Traffic Operations Specialist, a JDA associated consultant and former career FAA Air Traffic Control Specialist. He spent 24 years working at the O'Hare Control Tower and 4 years working in the Chicago Midway Tower. He was detailed annually to lead the FAA Air Traffic Control support for the annual EAA Oshkosh "fly In" the single largest aviation show and exhibit held in the U.S. Chuck served as President of the National Air Traffic Control Association (NATCA) (Chicago ORD) 9 years and also was a NATCA Aviation Safety Inspector and a member of the FAA Runway Safety Action team for the Great lakes Region.

Rob Voss Senior Air Traffic Operations Subject Matter Expert (SME), is a JDA associated consultant and former career FAA Air Traffic Control Specialist, Operations Supervisor, Quality Assurance and Training Specialist, Plans and Procedures Specialist, Air Traffic Manager, Integration and Efficiency Specialist and finished his FAA career as a System Operations Senior Advisor. Rob spent more than 26 years with the FAA including assignments at Chicago Midway (MDW), San Francisco (SFO), Santa Rosa (STS), Scottsdale (SDL), San Carlos (SQL) and the Midwest Tactical Operations office. While working for several years outside of the FAA, Rob was an Air Traffic Consultant to the Deputy Airport Director (Noise Abatement) at SFO, where he provided analysis, advice and education involving aircraft noise and air traffic procedures and was the Project Manager for a FAR Part 150 noise exposure map update. He has also served as a contractor and Air Traffic Analyst at NASA-Ames Future Flight Central research and simulation facility.

Joe Del Balzo, JDA Founder and President, served as the highest-ranking career professional (Acting Administrator) in the Federal Aviation Administration (FAA). Both in his long career with FAA (where he also served as FAA's Executive Director of System Operations, Executive Director for System Development, Director of the Eastern Region and Director of the FAA Technical Center) and in his subsequent private role as an aviation consultant, he has earned wide respect for his expertise in a wide range of aviation issues.