

Drone Deliveries to Reduce Suburban Freight Costs

Talking Freight Webinar: Freight beyond the city: Approaches to improving freight mobility in the suburban context
15th April 2020

Tom Cherrett, Andy Oakey

(Transportation Research Group, University of Southampton)

With contributions from Danail Ivanov, Shadi Hamou, Tara Banahan, Rai Garcia-Figueras, Pablo Lahoz, Nelson Ng

Amy Moore

(National Transportation Research Center, Oak Ridge National Laboratory)

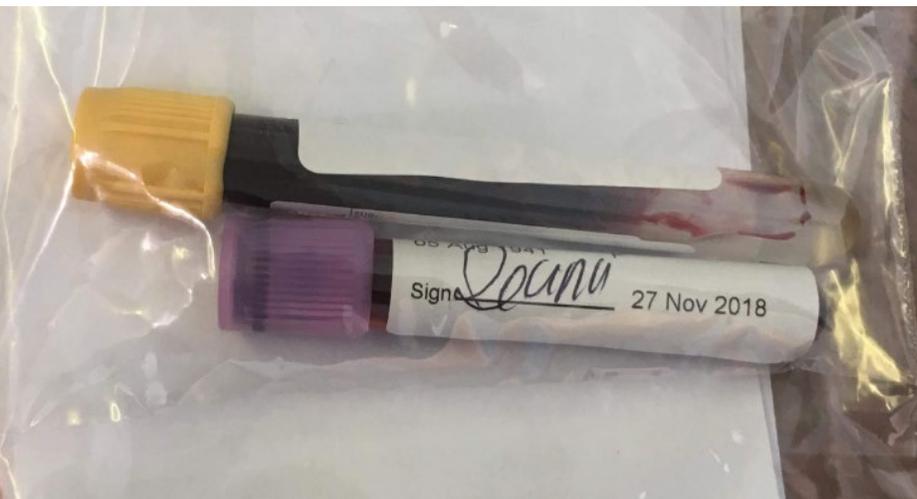
Pathology Logistics

460h*305d*255w)



Pathology Logistics

Blood Related	Body Tissue	Faeces	General Fluid	General Sample	General Swab	Sexual Health	Urine
Blood	Duodenal biopsy	Faeces	Cerebrospinal fluid	Calculus	Ear swab	Cervical swab	Catheter Urine
Plasma	Gastric biopsy		Fluid	Gallbladder	Eye swab	Endocervical swab	Midstream urine
	Isolate		Knee aspirate	Hair	Groin swab	High Vaginal Swab	Urine
	Paraffin embedded		Saliva	Miscellaneous	Mouth swab	Low vaginal swab	
	Skin biopsy NOS		Sputum	Miscellaneous spec	Nose and Throat swab	Penile Swab	
	Tissue		Synovial fluid	Nail clippings	Nose swab	Semen, Infertility	
				Skin scrapings	Perineal swab	Semen, Post Vasectomy	
					Pernasal swab	Urethral swab	
					Pharyngeal swab	Vaginal swab	
					Pus	Vulval swab	
					Pus swab	Vulvo-vaginal swab	
					RECTAL SWAB		
					Sacral swab		
					Skin swab		



Pathology logistics using UAVs

Zipline drone delivering medical supplies in Ghana



Matternet ONE transporting medical equipment in Papua New Guinea



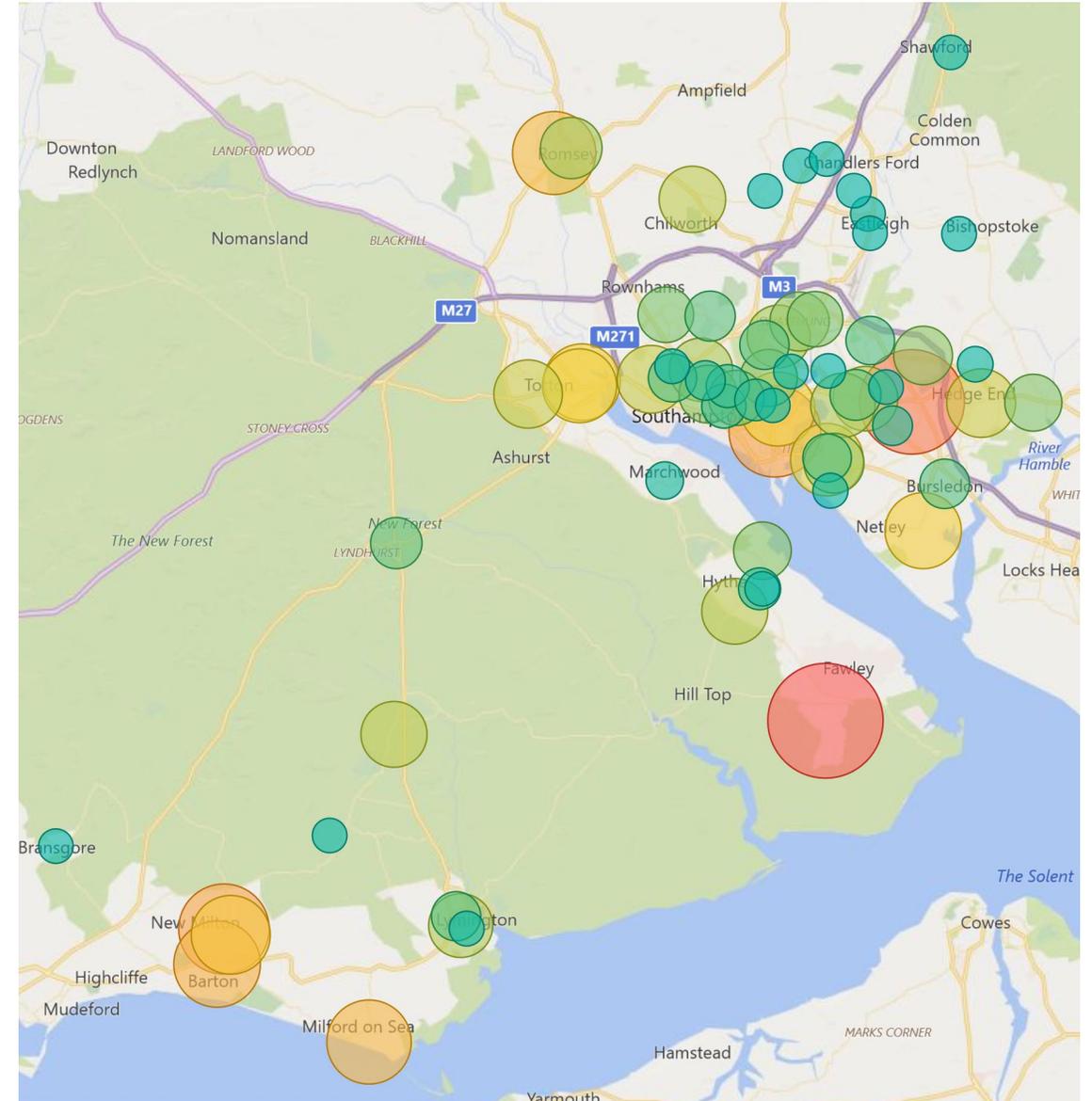
Objectives

- Quantify current business-as-usual pathology logistics serving GP surgeries in Southampton
- Investigate the scope for integrated logistics concepts for pathology (UAV-Van-Cycle)
- Quantify the likely costs and benefits from such an introduction

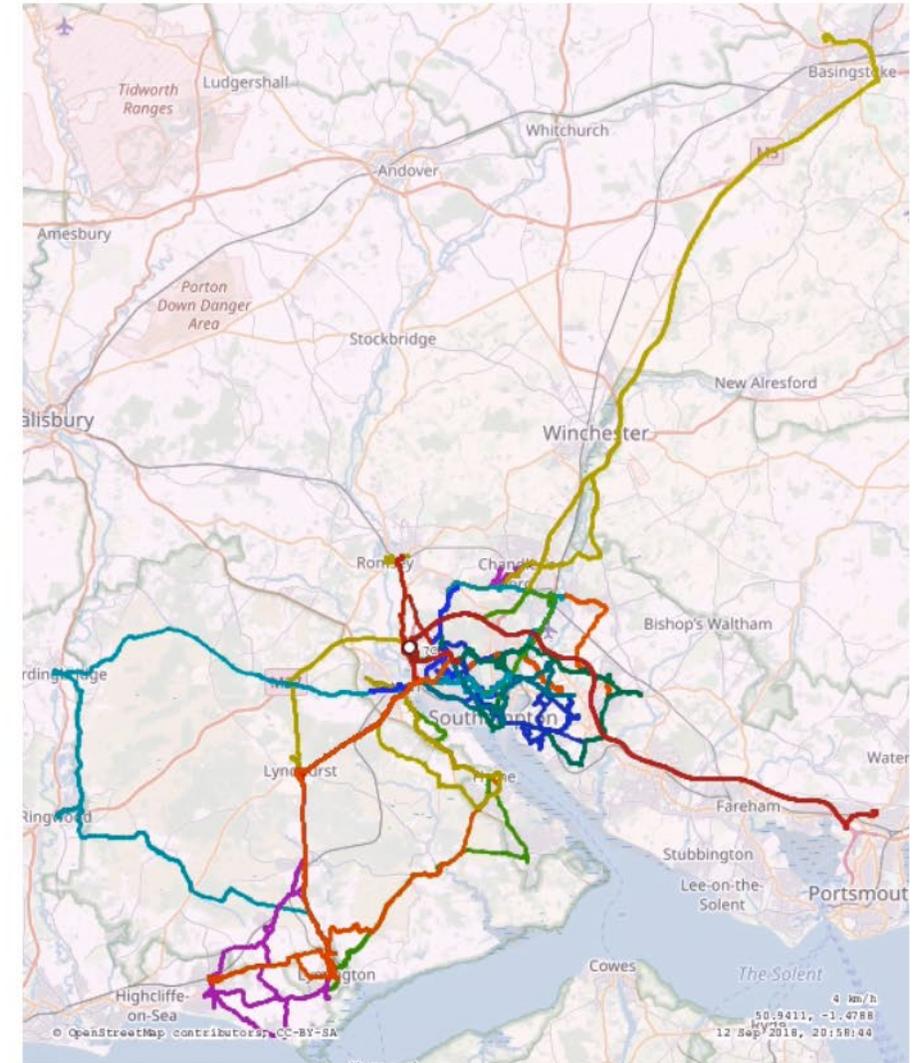
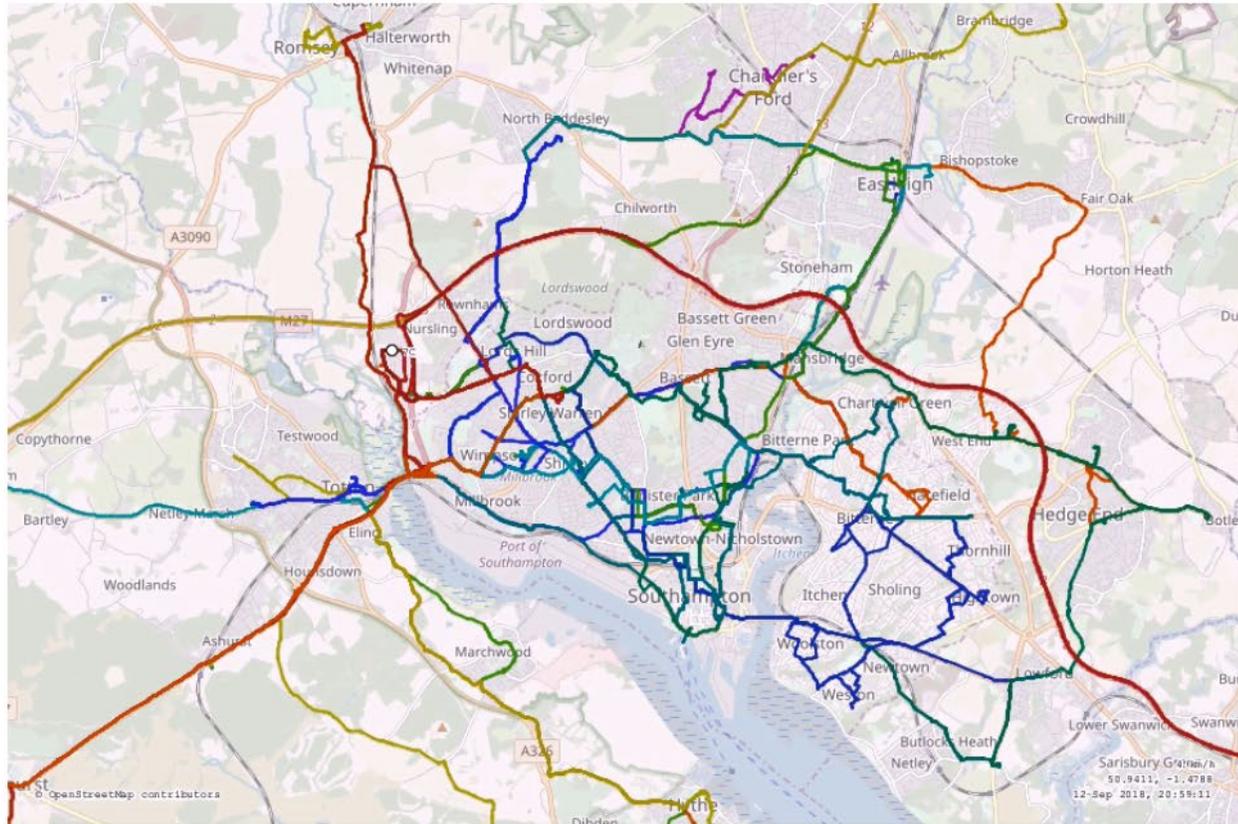


Pathology - BAU

- 75 surgeries supplying Southampton General Hospital
- 70,092 samples generated in Nov 2018
- 934/surgery/22 days
- 42 samples/day
- Blackfield = 177/day!
- 12 daily van rounds
- Surgeries visited twice daily

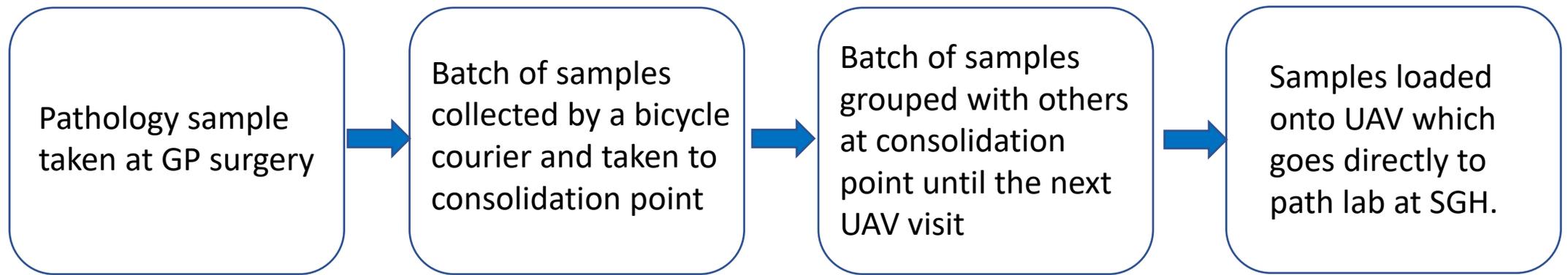
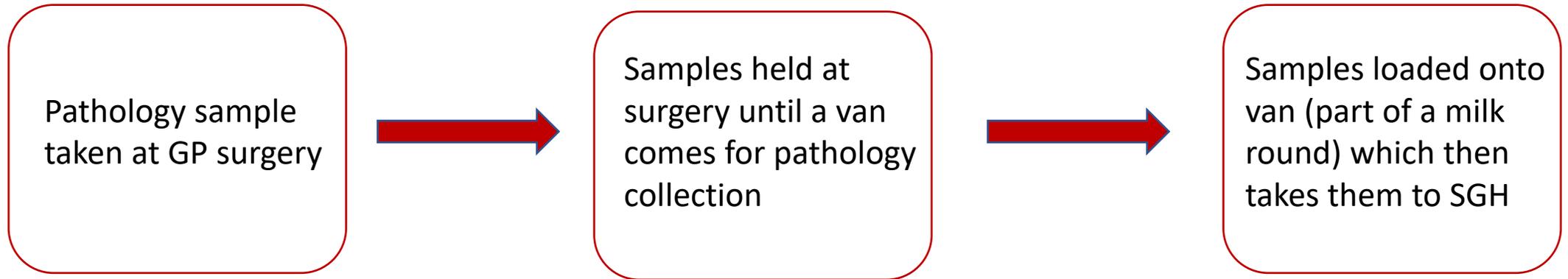


Pathology - BAU

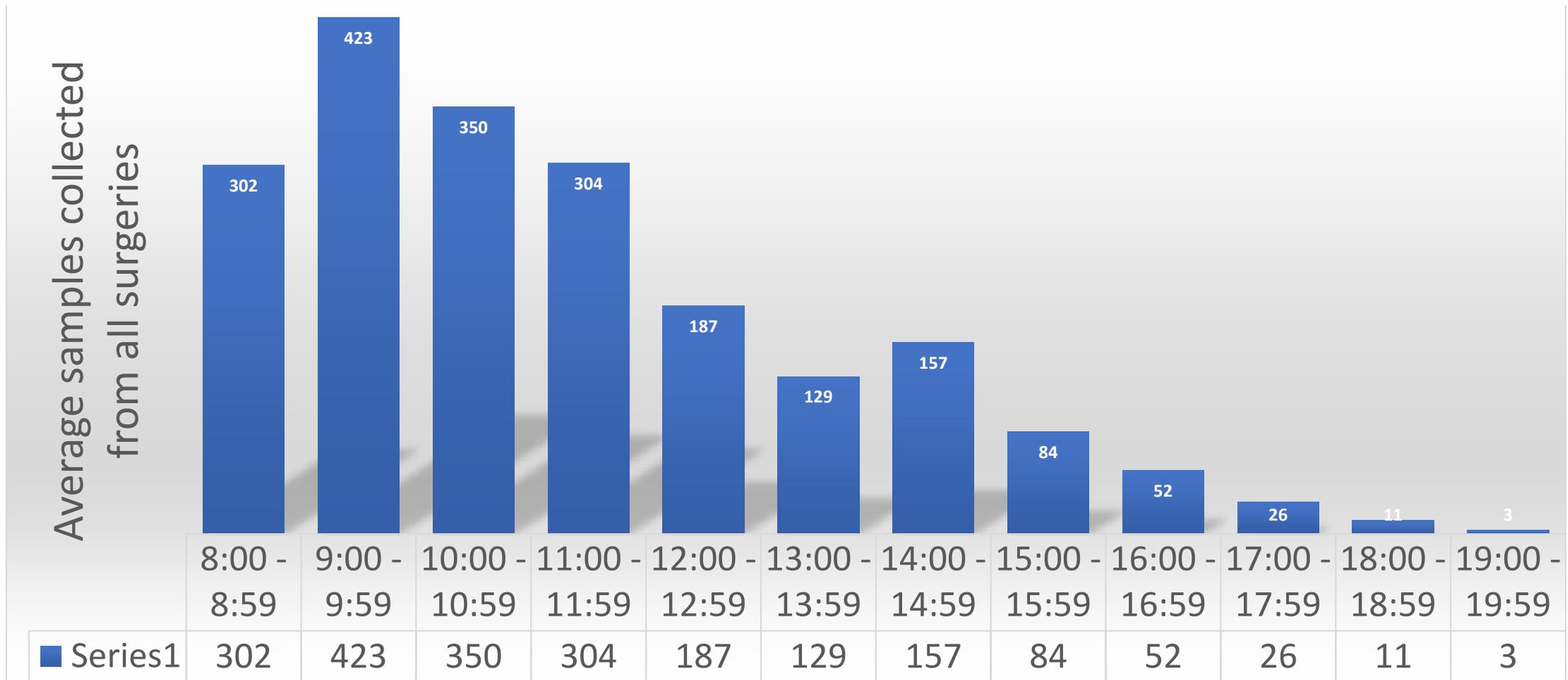


Ref: Andy Oakey PhD project

Possible integrated UAV interventions

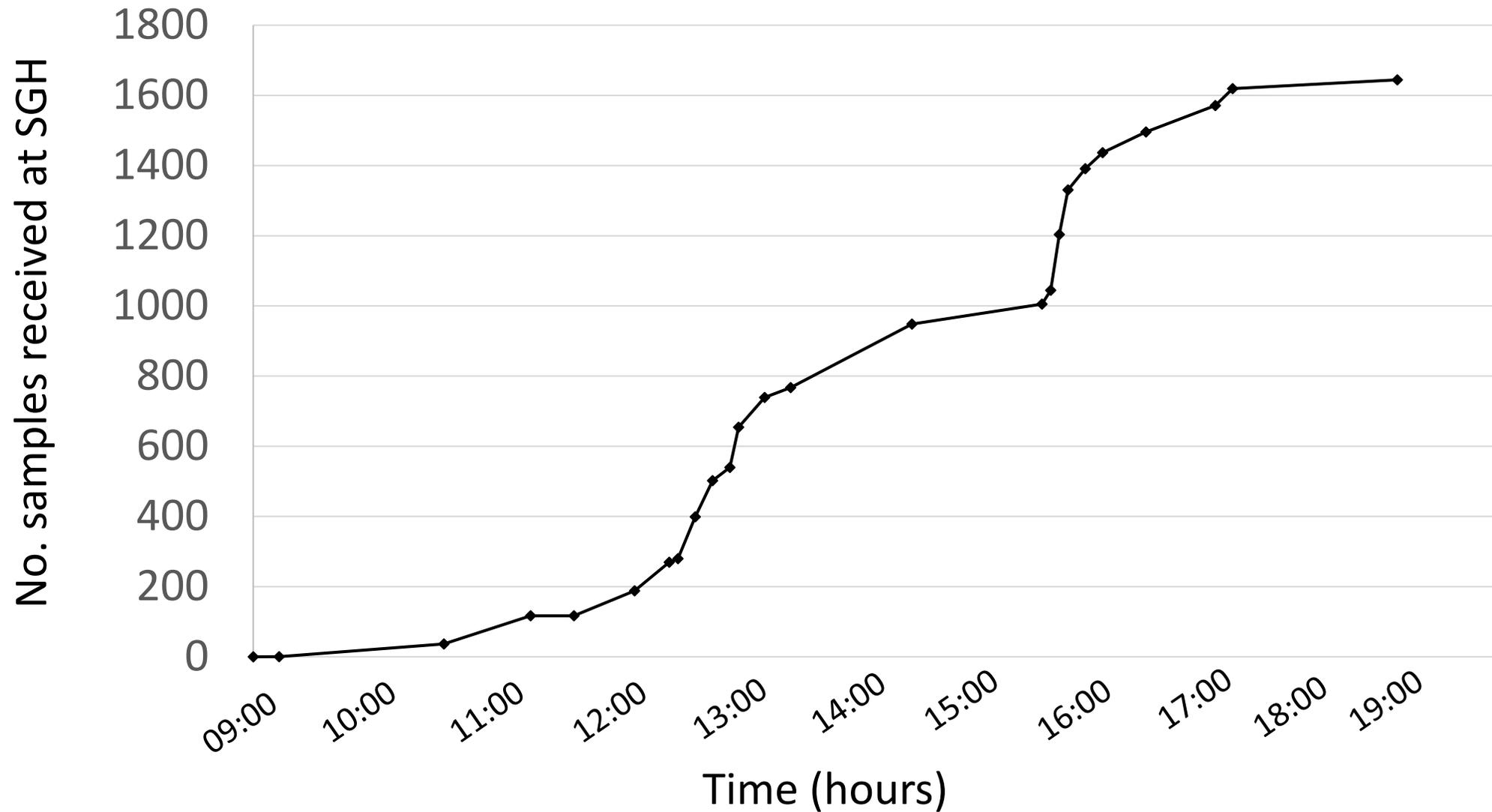


Average specimens collected from patients by time of day



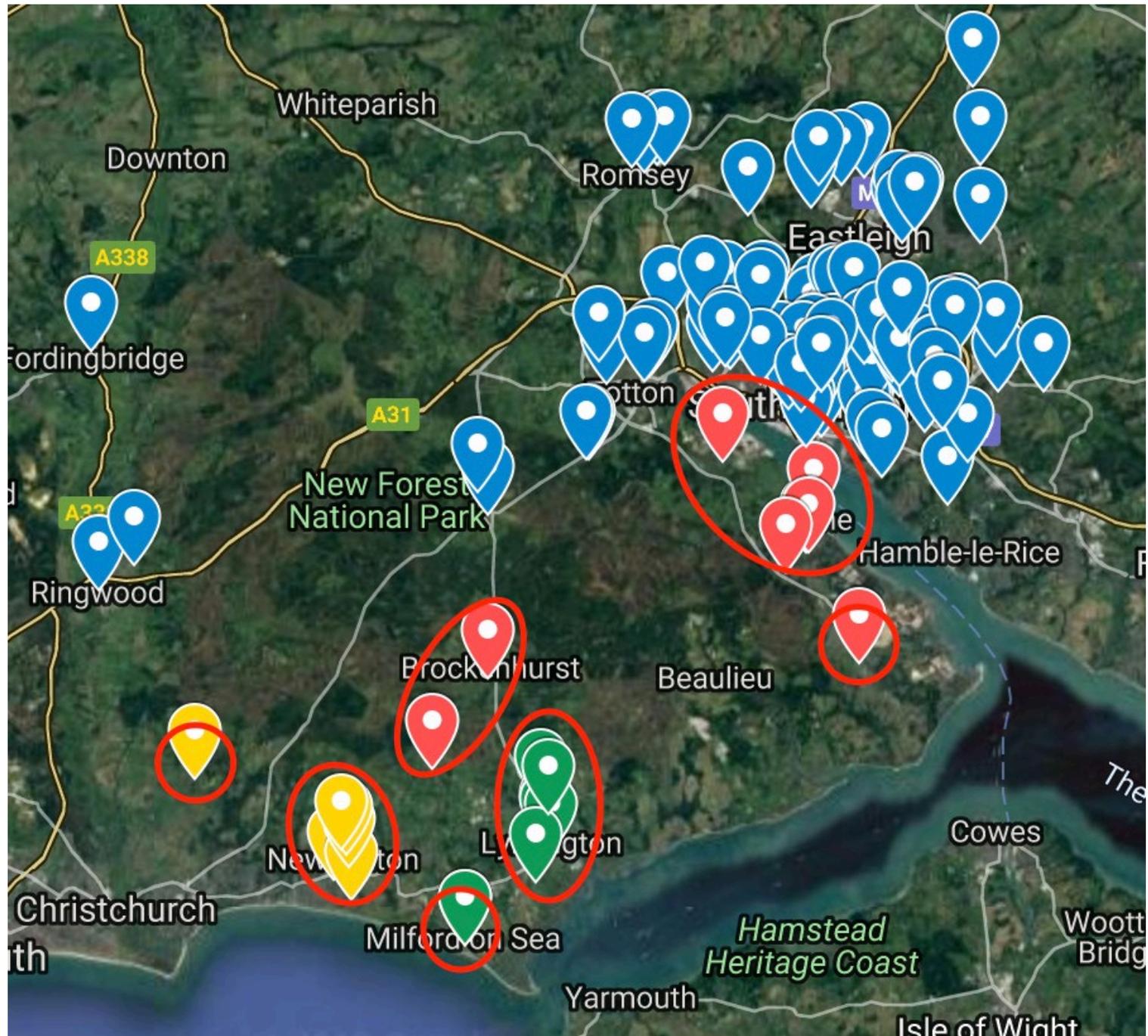
Collection time (hours)

Cumulative average daily arrivals of samples at SGH

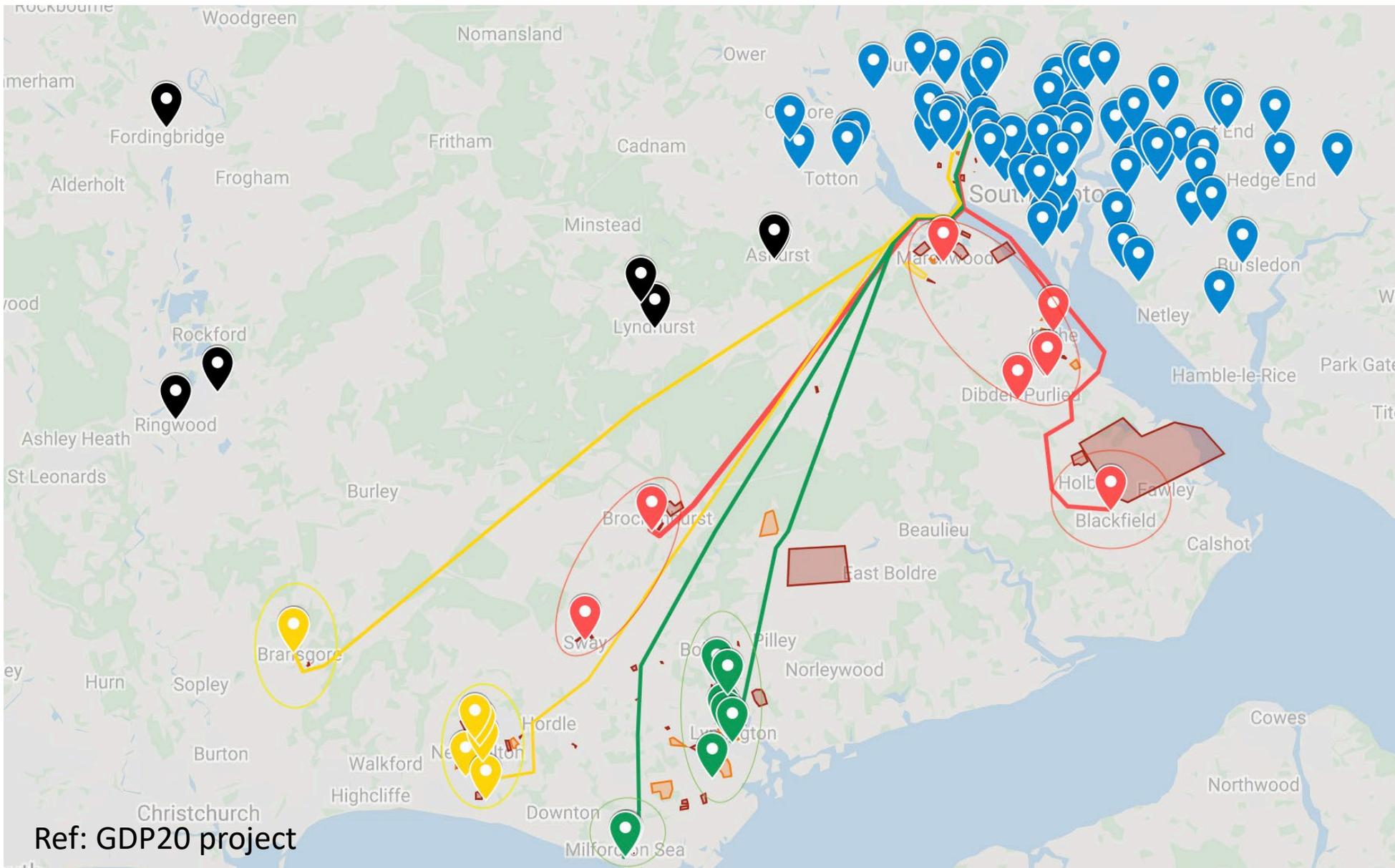


Targeting rural surgeries with UAVs

- Cycle couriers transport specimens between surgeries & consolidation points.
- Surgery groups assigned based on a max cycle time of 20 minutes between furthest surgery
- Consolidation point chosen based on lowest average distance between surgeries in a group



Targeting rural surgeries with UAVs



-  UAV #1 collection
-  UAV #2 collection
-  UAV #3 collection

Top Level Requirements

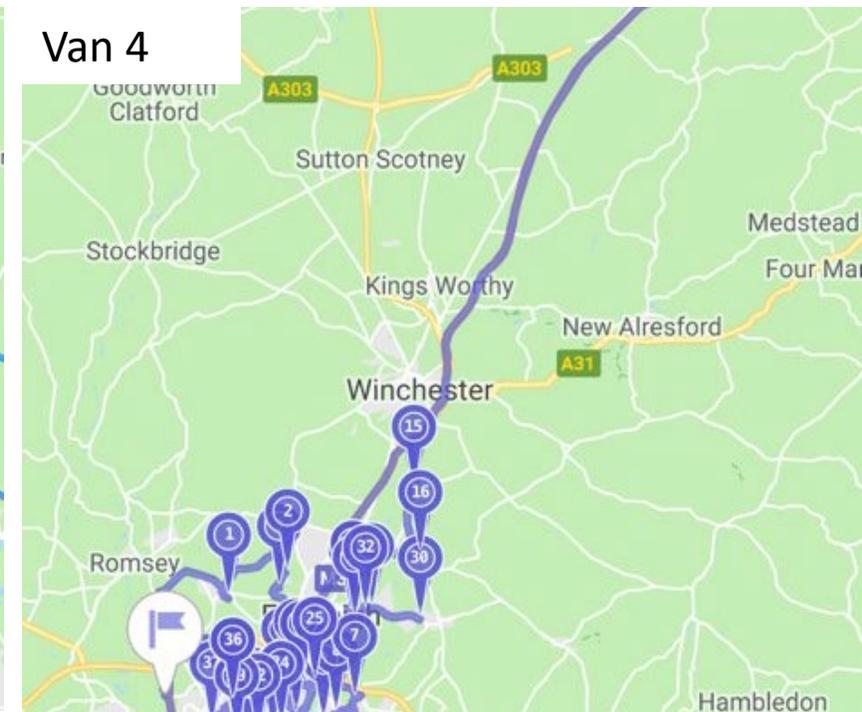
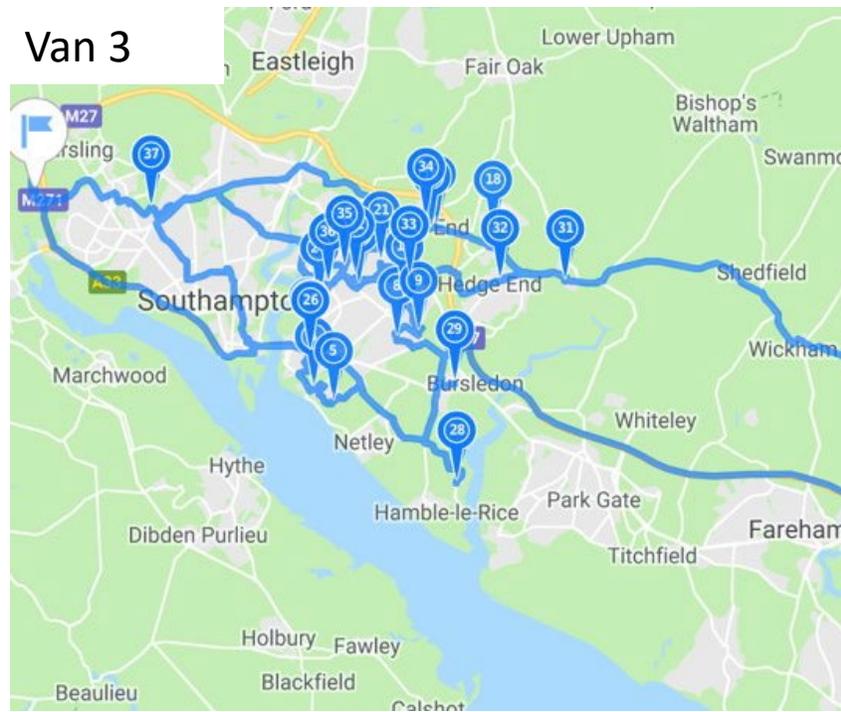
Requirements for UAV

- 1.5 kg payload
- 30 m/s
- Vertical take off and landing
- Least human interaction
- Easy storage
- Easily accessible batteries



Including UAVs into the pathology distribution logistics solution

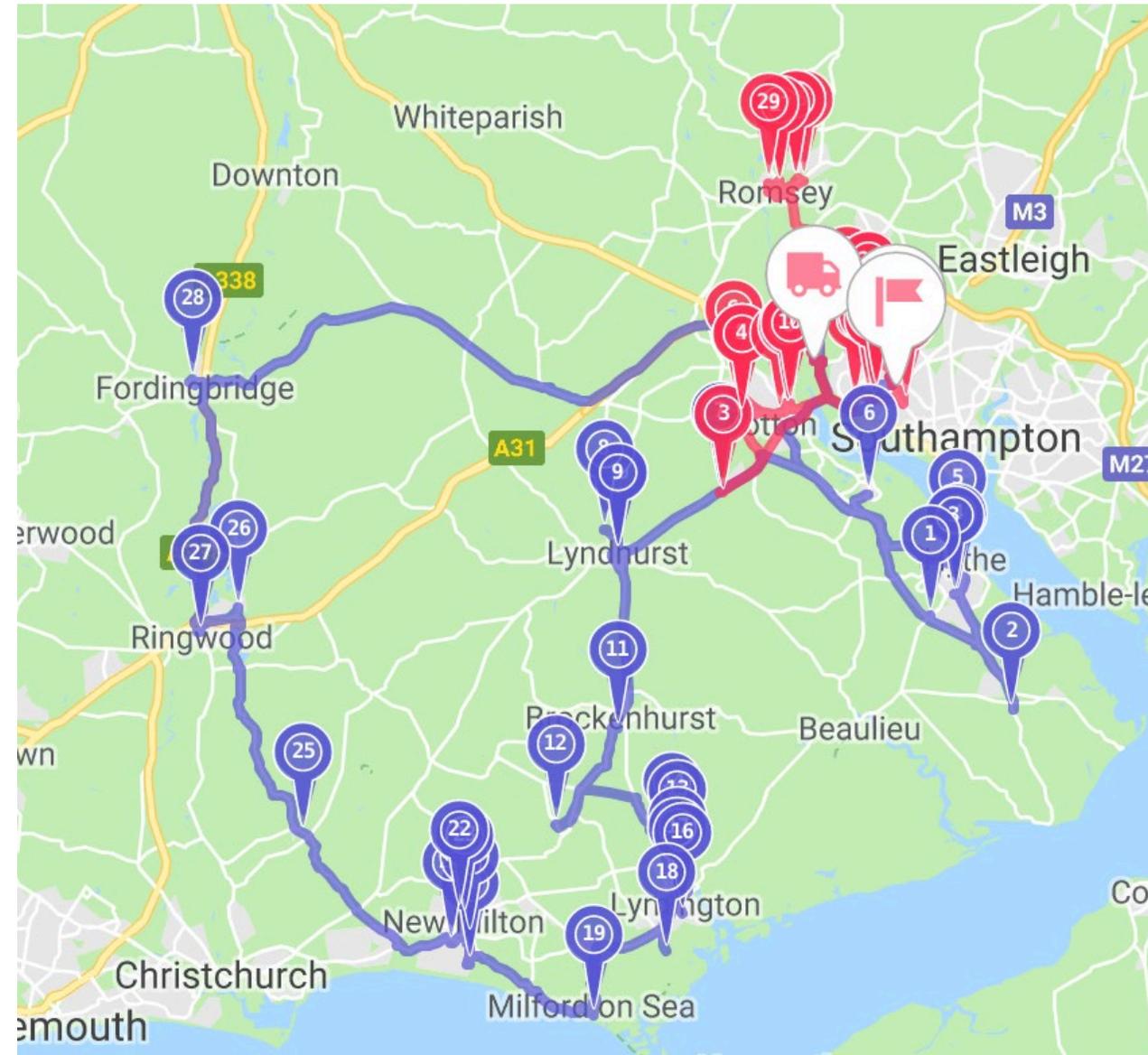
- Target city GPs with vans
- Target remote GPs with UAVs
- Determine safe airspace regions for UAV flights
- Develop UAV routes and consolidations points
- UAVs start and end flights from SGH



Contingency routes

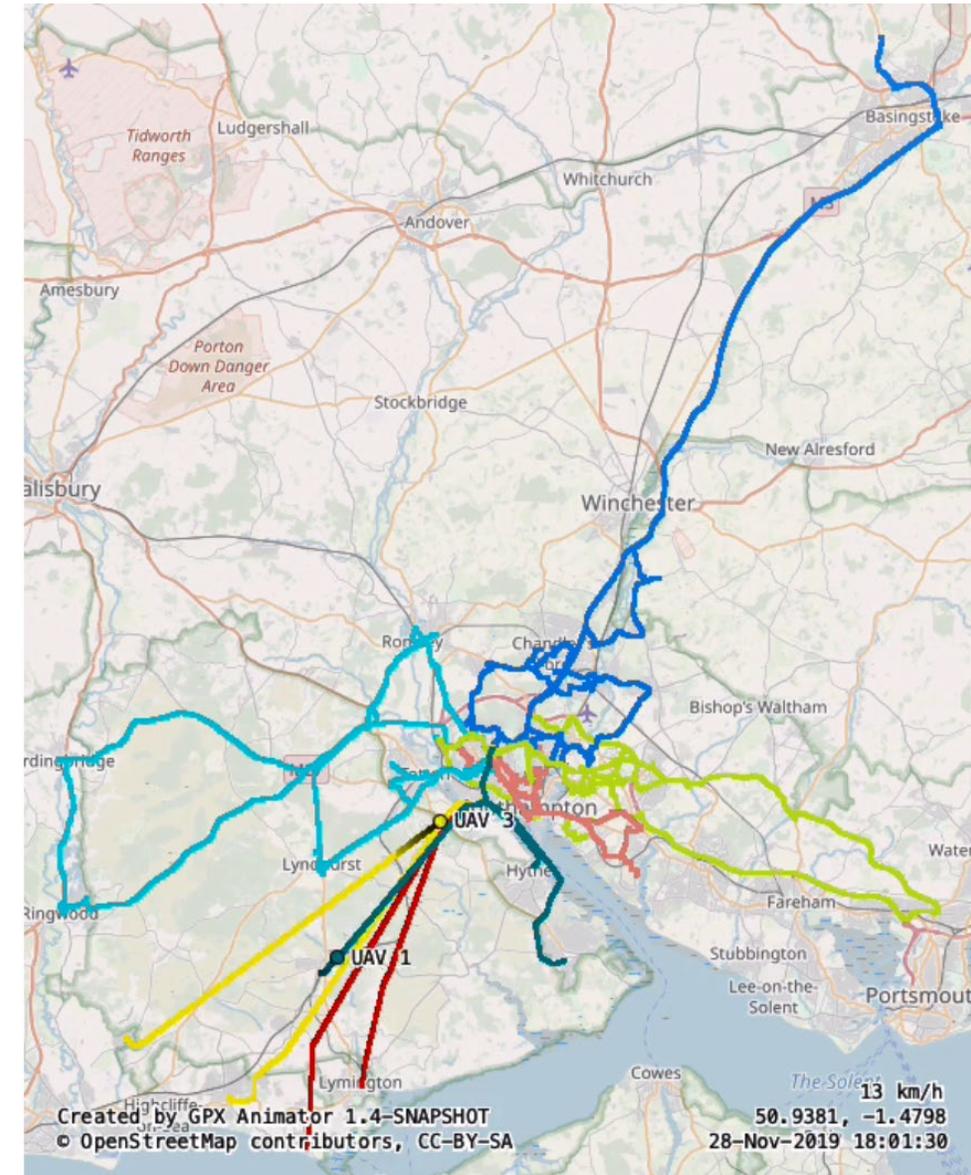
In case of UAVs not cleared for flight (e.g. thunderstorm, mechanical malfunction, fireworks show etc.):

Van route 3 and UAV routes replaced by these two routes.



Targeting rural surgeries with UAVs

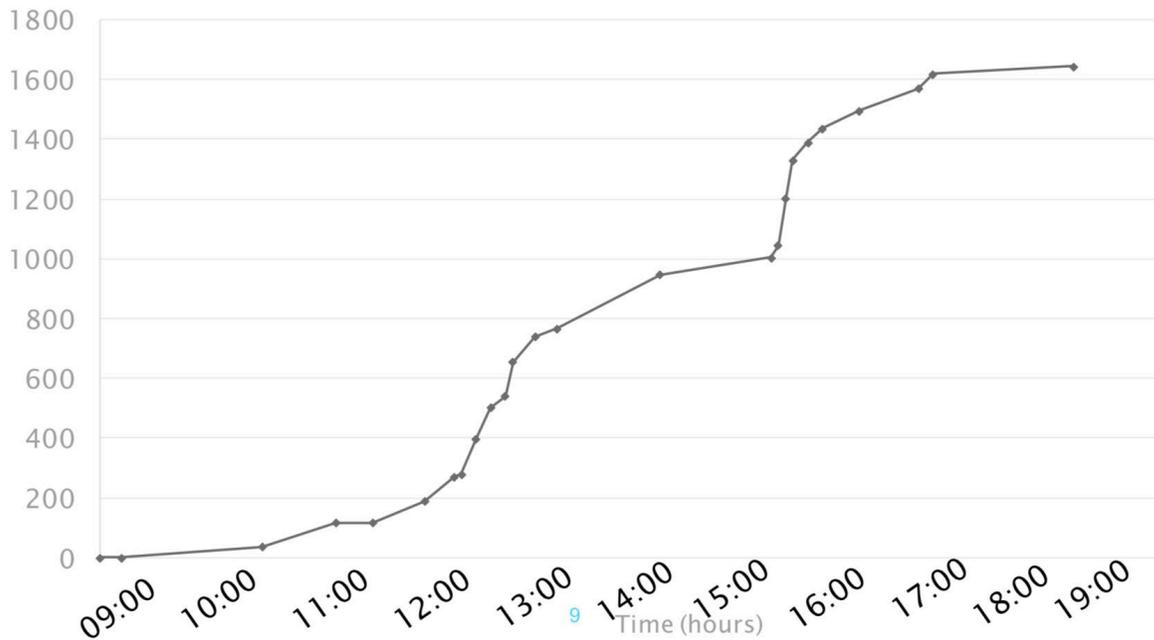
- 4 vans working 8.5 hrs/day, collecting 2190 samples from 103 surgeries and travelling 610.8 km
- 3 drones working 12 hrs/day, carrying 885 samples from 21 surgeries and travelling 1140.44 Km
- First drone flight carrying 40 samples would arrive at SGH around 9:00am
- The drone schedule would see approx. 850 samples arrive every day at SGH
- ~ 580 samples would now be received at SGH by 11:00 as opposed to ~160 previously



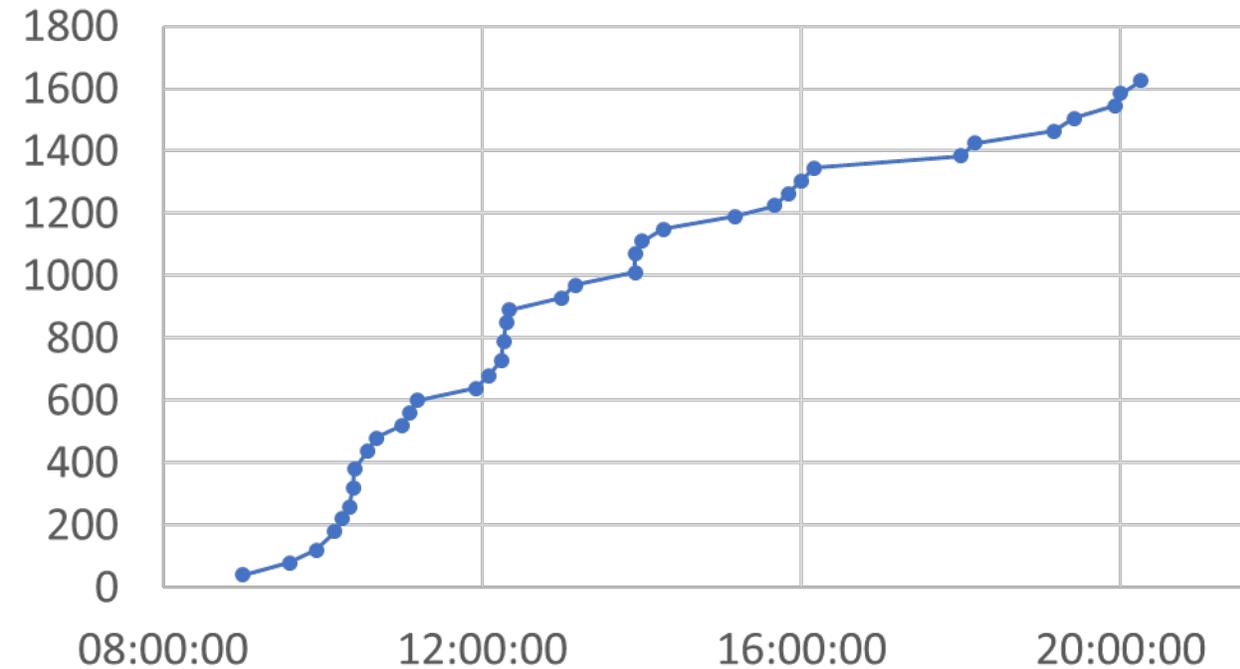
Targeting rural surgeries with UAVs

Temporal receipt of samples at SGH

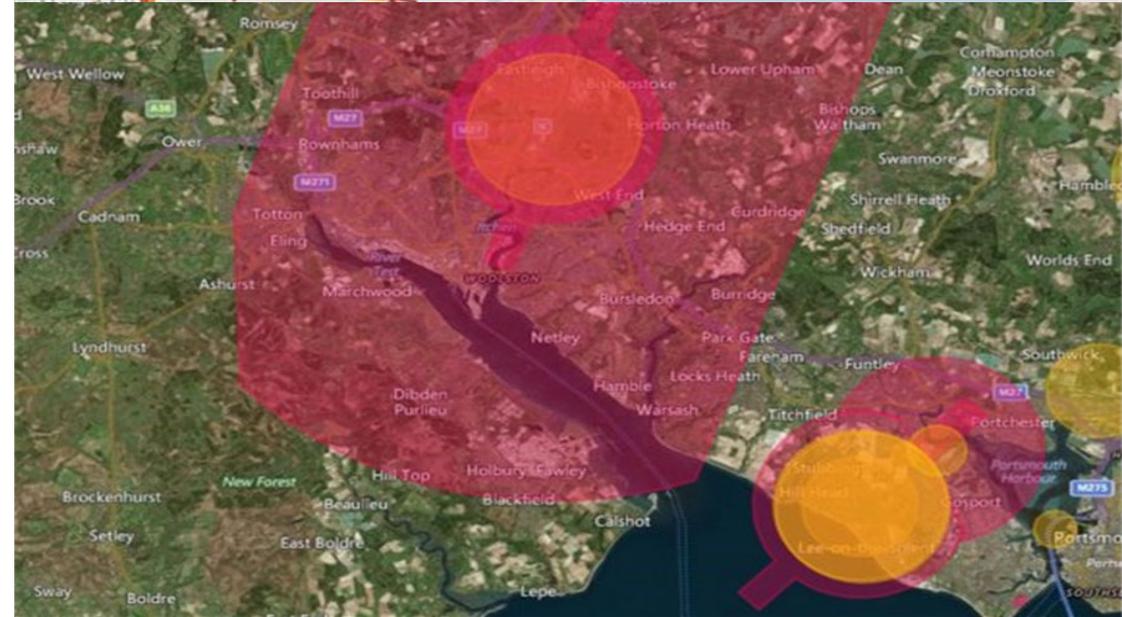
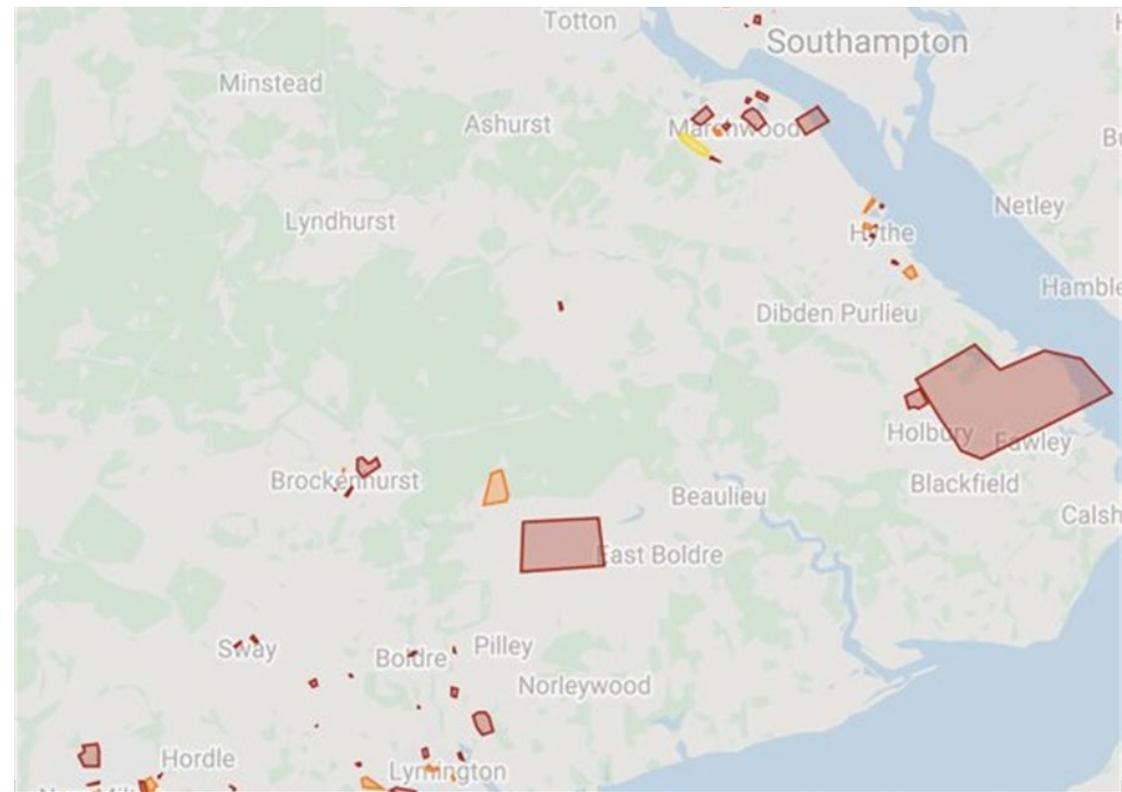
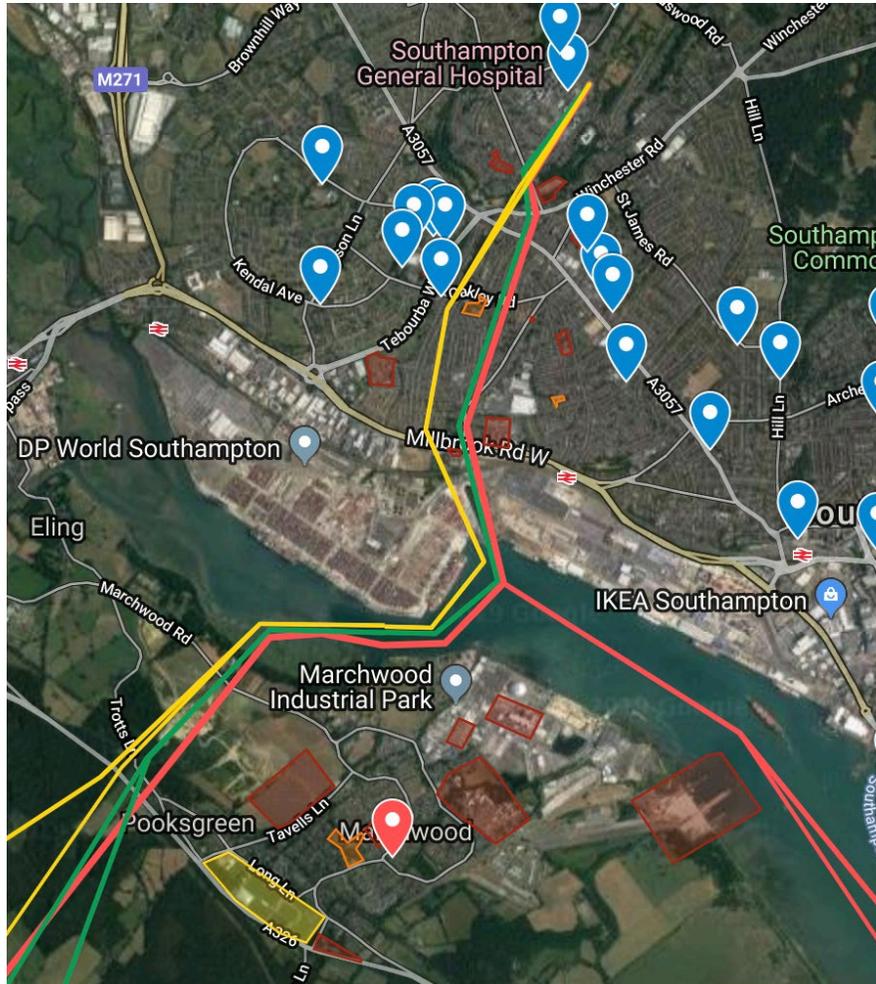
Business-as-usual



Drones + Vans



Impacts of over-flight restrictions



Ref: GDP20 project

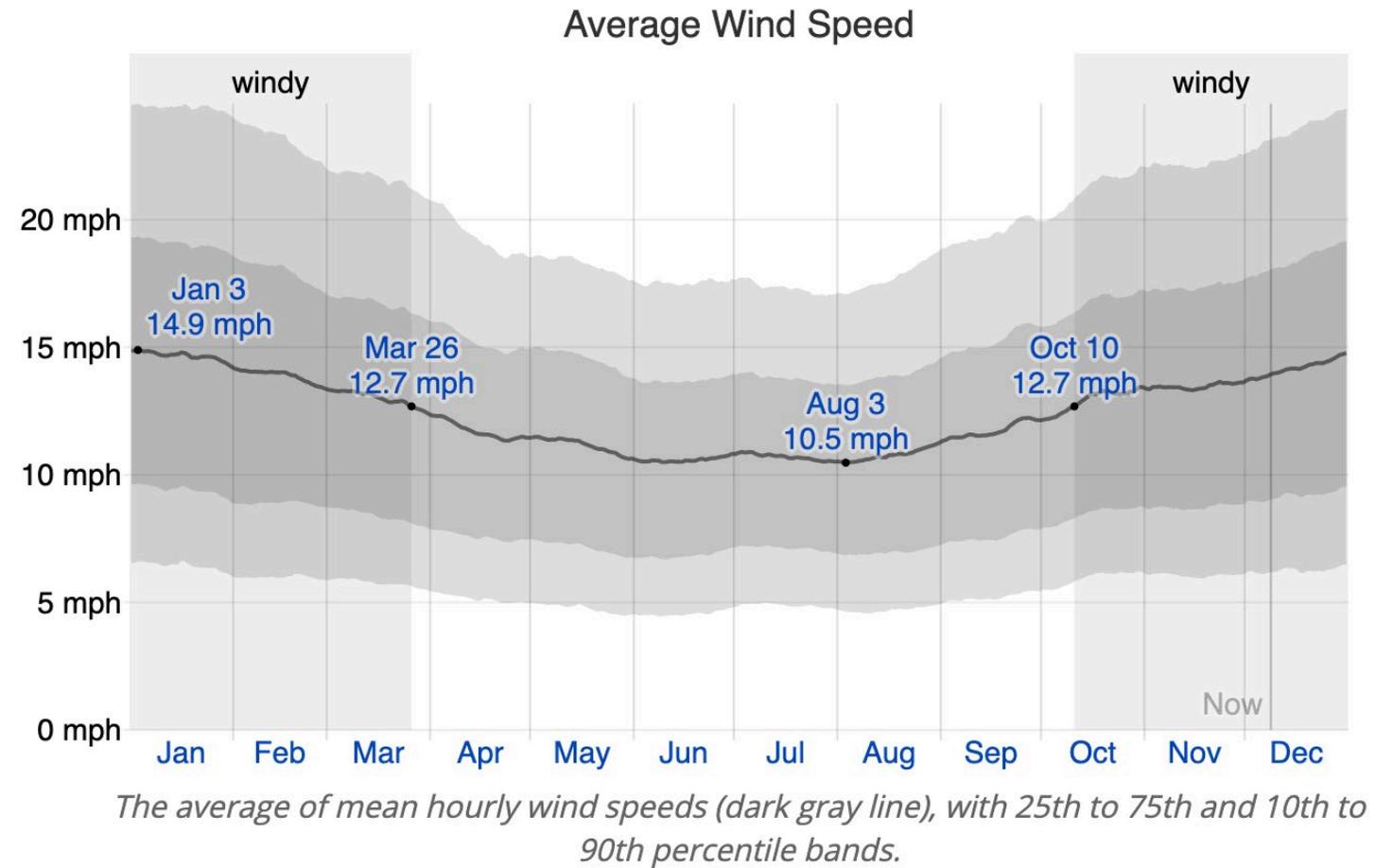
Impacts of over-flight restrictions



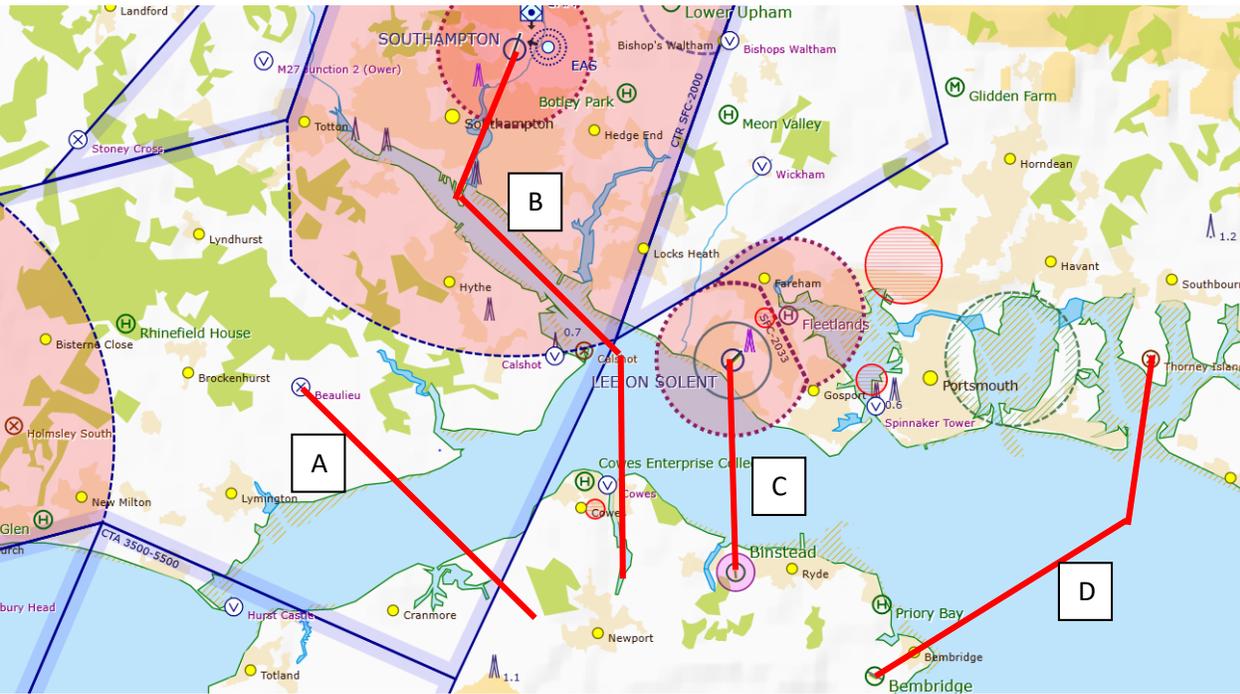
Impacts of weather conditions

- Wind speed (not usually higher than 25 mph)
- Precipitation
- Visibility
- Temperature (not much of an issue)
- Lightning (thunderstorms not uncommon in late July early August)

<http://www.southamptonweather.co.uk/longterm.php>



Covid-19 response



Ref: Professor Jim Scanlan (University of Southampton)



Ref: <https://www.windracers.org/home>

Contact details

Prof Tom Cherrett: t.j.cherrett@soton.ac.uk

Transportation Research Group, Faculty of Engineering and Physical Sciences
University of Southampton, SO16 7QF, United Kingdom

T: +44 (0)23 8059 4657