Application of the DQO Methodology and Visual Sample Plan software for Regulatory Delicensing

Presentation given by Dr Stephanie Bloomer

Slides by Steven Wilcox

The site

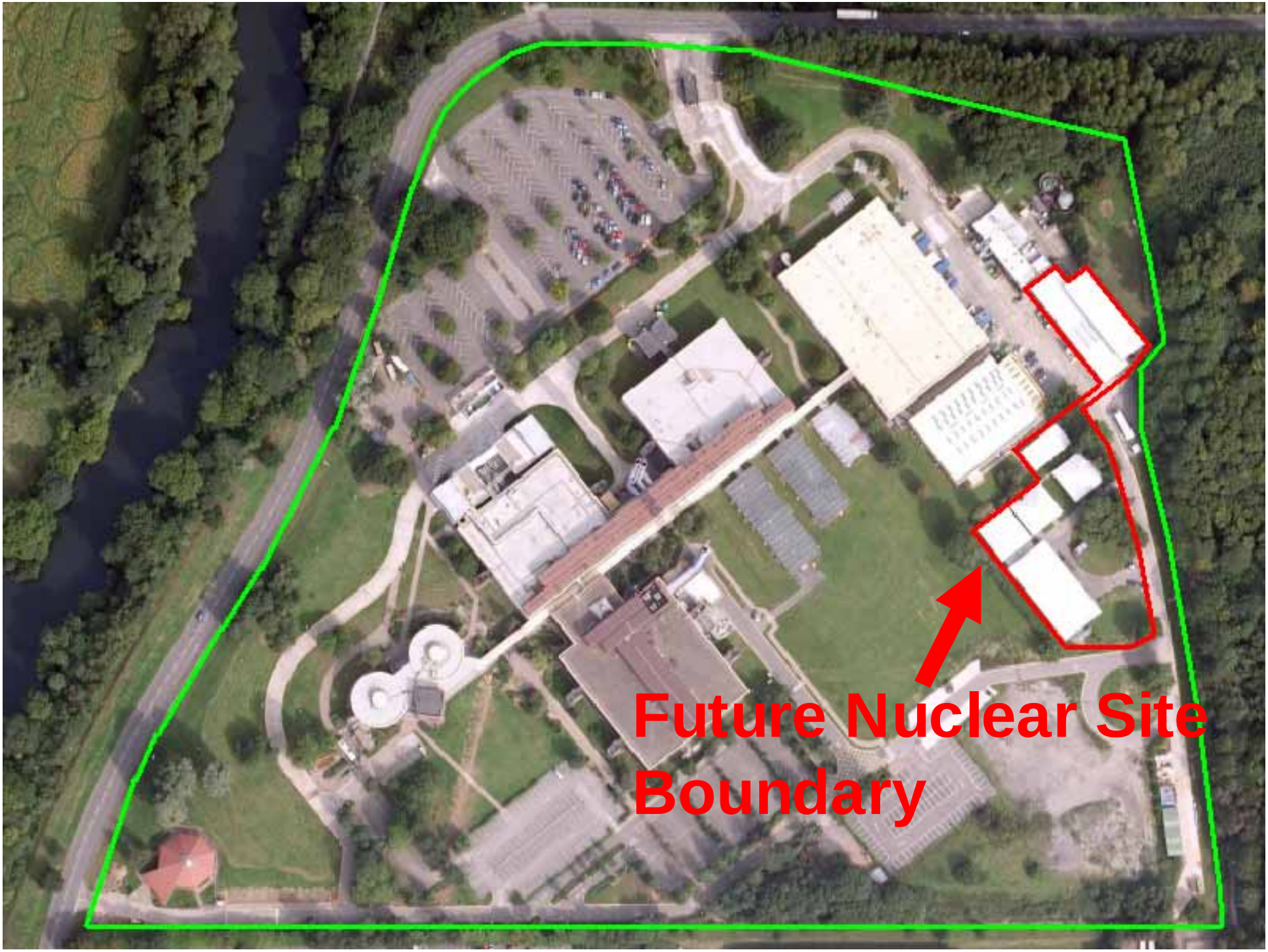
- The facility was built on a 30 acre green field site, which was manufacturing C14/H3
  - Stopped using (H3) late 2009
  - and (C14) April 2010

End of an era

- Business decision taken in Dec 2008 to:
  - Exit the Radiochemical/Custom Synthesis
  - Delicense over 90% of site with Regulatory Approval
  - Redefine the nuclear site boundary
  - Use de-licensed areas for growth opportunities

Following business closure a Decom Project Team was formed in Jan 2009

- Satisfy all regulatory requirements

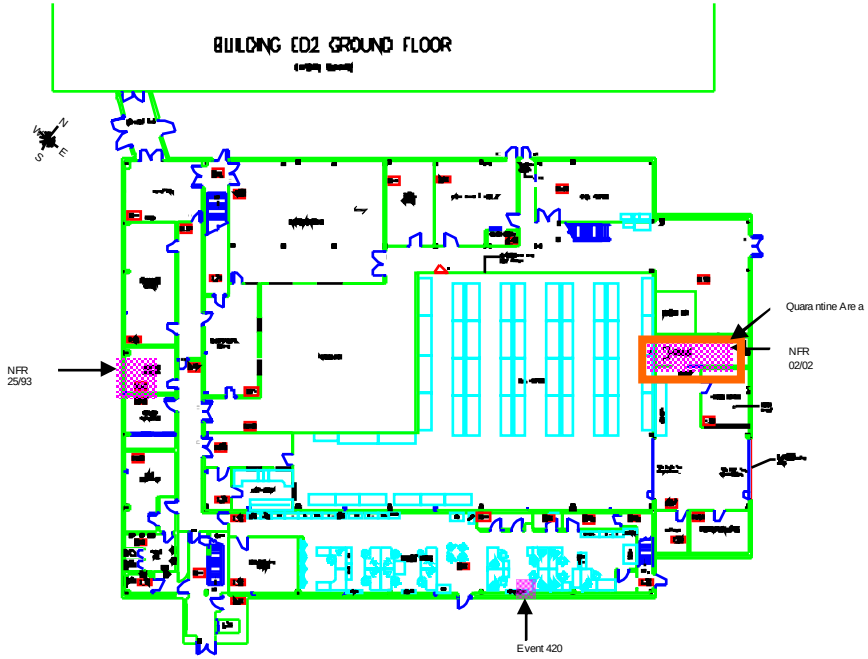

Future Nuclear Site
Boundary

DQO Application at TMC

- The site has chosen to use the **D**ata **Q**uality **O**bjectives methodology and Visual Sample Plan
- Support clearance decisions and underpin site licence variation submission
- DQO workshops completed for the many buildings
- Clearance in Principle for the first building (ED2) agreed with the NII in Jan 2010
- This is the first time VSP has been used in the UK for a major Delicensing project

Understand the History

- Staff knowledge
- Site Drawings
- Accident reports
- Project Files



- Identify Areas of heightened interest based upon operating history and unusual events
- Identify areas of common potential exposure

Regulatory position

- The Maynard Centre is subject to two principal regulations as a result of its work with radioactivity:
  - The Nuclear Installations Act – administered by the NII – which regulates the operation of the site.
  - The Radioactive Substances Act – administered by the EA – which regulates radioactive wastes.
- A site (or part of site) may be de-licensed if the operator demonstrates that '*no danger*' from radioactivity remains on the site.
  - Site target: **H-3 activity(Bq/g)/10 + C-14 activity (Bq/g) < 1**
- An RSA authorisation is required for the disposal of waste where the activity is above 0.4Bq/g (H-3 and C-14).

Defining the decisions

- **Decision Statements:**
  - 1. The material will be analysed and if no contamination is found it will be declared as ‘free from regulatory concern’ with no additional control imposed on its disposal.
  - 2. If radioactivity is found below 0.4 Bq/g added artificial radioactivity then the material will be exempt from the SOLA Exemption Orders ("The Radioactive Substances (Substances of Low Activity) Exemption Order 1986" and "The Radioactive Substances (Substances of Low Activity) Exemption (Amendment) Order 1992"). Restrictions may still be imposed on its subsequent disposal.
  - 3. If remaining structures are found to be above the delicensing criteria (10 Bq/g 3H, 1 Bq/g 14C) then remedial actions will be required to remove identified areas of contamination.

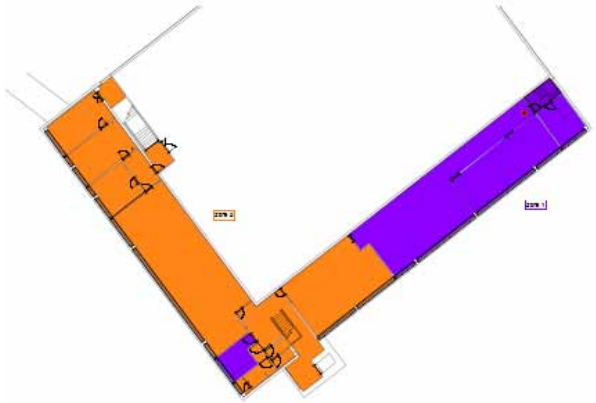
Defining the sampling zones

- Conceptual Site Model developed and building zoned upon basis of previous history, similarity of operations and areas of particular interest which were:

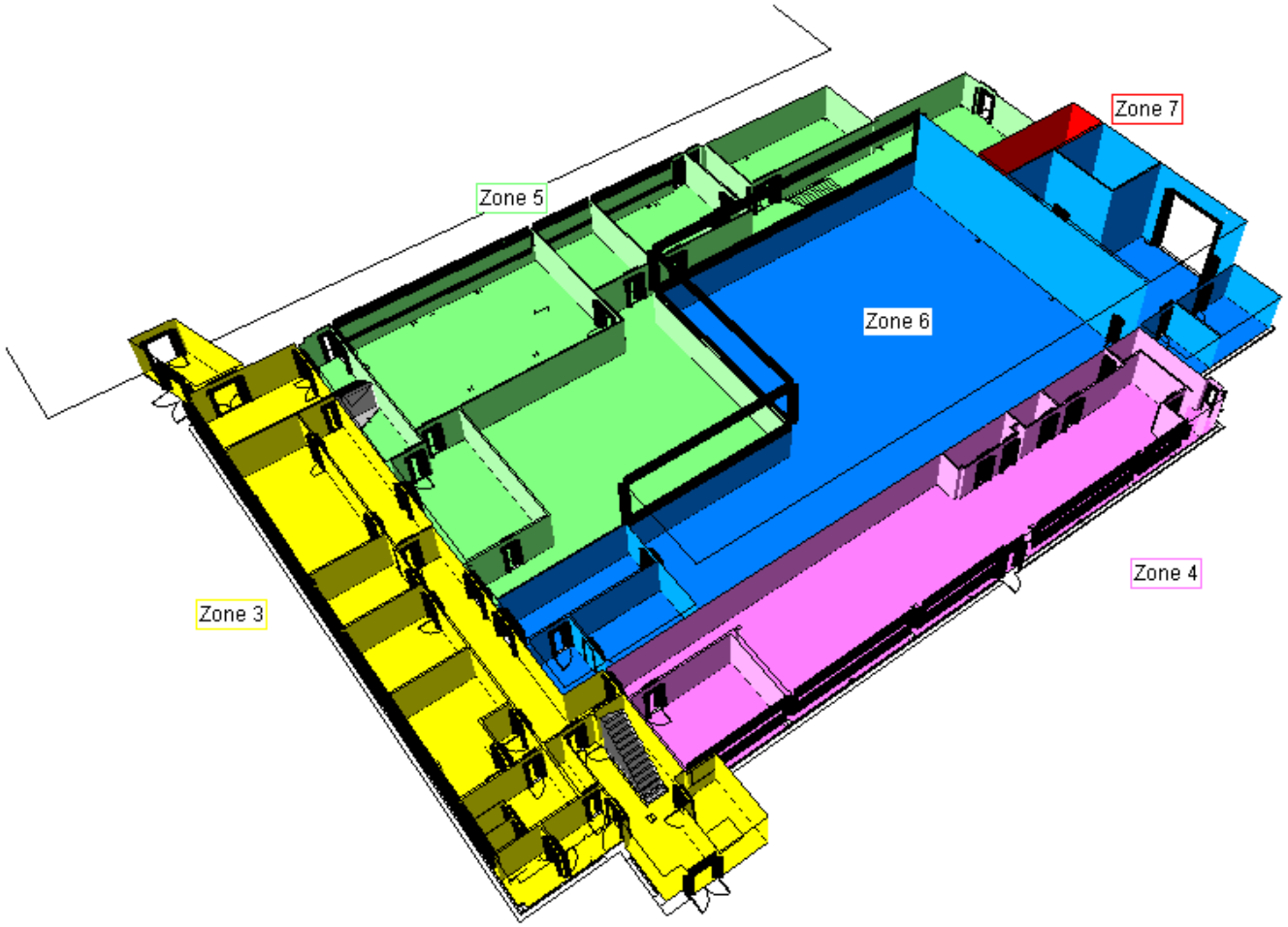
- The Central Laboratory located on the first floor

- The personal decontamination room located on the first floor

- The Quarantine area located within the Stores area on the ground floor.



Area Zoning

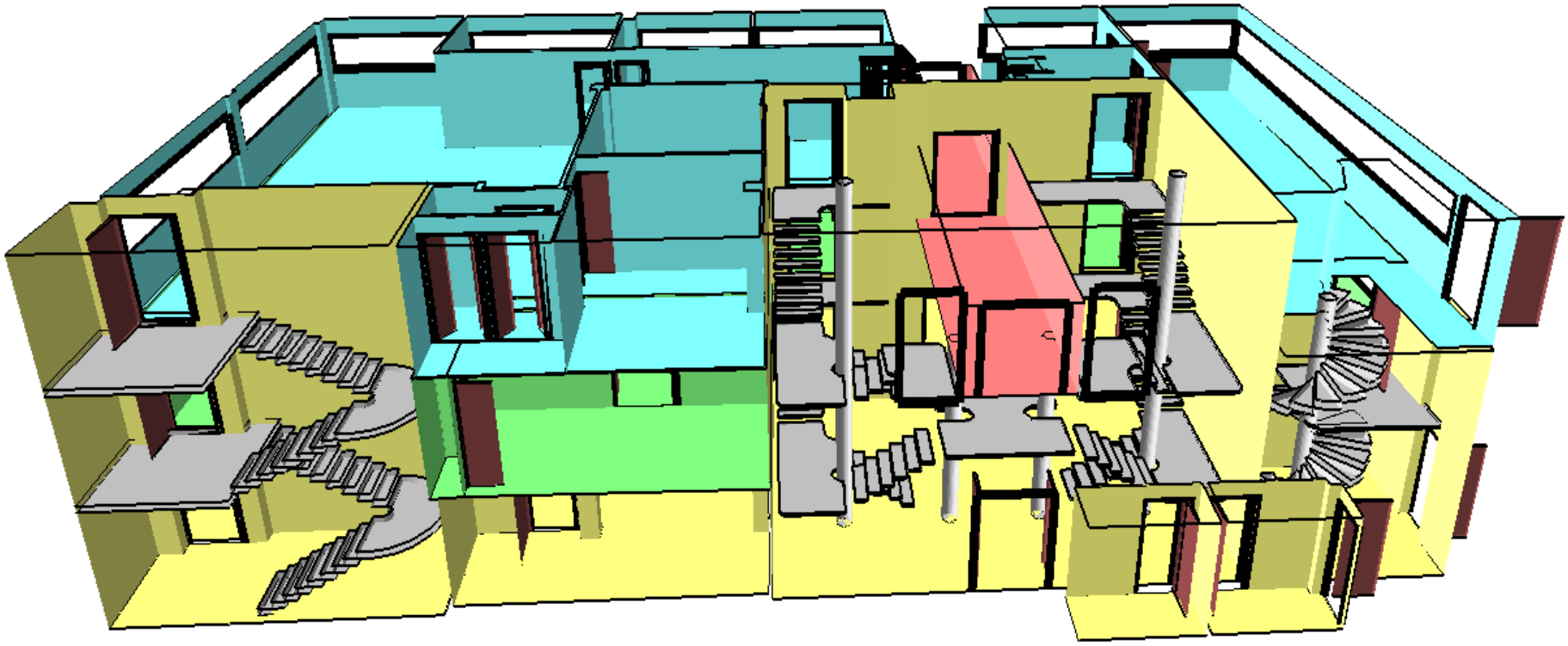


Preparing sampling plans

- Each zone has been sub-divided into material matrices (e.g. carpet, plasterboard etc) and number of samples required identified.
- The equation used to calculate the number of samples is based on a MARSSIM Sign test.
  - The number of samples was increased by at least 20% to account for missing or unusable data.
- A nonparametric systematic grid sampling approach was selected to determine the number of samples. A nonparametric formula was chosen because the conceptual model and historical information (e.g., historical data from this site or a very similar site) indicate that typical parametric assumptions may not be true.

- Locating the sample points over a systematic grid with a random start ensures spatial coverage of the site

Designing the sampling plans



Locating the sampling points

- Sample Analysis Plans for each zone identify location and reference number for each sample. Shown diagrammatically using VSP tool.

Area: 0.01								Analysis Requirements	
X Coord	Y Coord	Z Coord	Label	Type	Surface	LX	LY	Tritium	Carbon-14
313401.72	181227.422	0.7953	ED2/3/0.01/2E/1	Systematic	Wall	5.311	0.795	x	x
313397.593	181224.205	0.7953	ED2/3/0.01/2E/2	Systematic	Wall	0.079	0.795	x	x

Area: 0.05								Analysis Requirements	
X Coord	Y Coord	Z Coord	Label	Type	Surface	LX	LY	Tritium	Carbon-14
313405.137	181220.245	0.0645	ED2/3/0.05/2E/3	Systematic	Wall	3.266	0.065	x	x
313408.269	181216.053	0.0645	ED2/3/0.05/2E/4	Systematic	Wall	8.498	0.065	x	x
313405.078	181213.557	0.0645	ED2/3/0.05/2E/5	Systematic	Wall	0.581	0.065	x	x
313402.427	181217.597	0.0645	ED2/3/0.05/2E/6	Systematic	Wall	0.121	0.065	x	x

Area: 0.08								Analysis Requirements	
X Coord	Y Coord	Z Coord	Label	Type	Surface	LX	LY	Tritium	Carbon-14
313414.305	181207.978	1.7189	ED2/3/0.08/2E/7	Systematic	Wall	1.706	1.719	x	x
313412.715	181203.846	1.7189	ED2/3/0.08/2E/8	Systematic	Wall	0.315	1.719	x	x

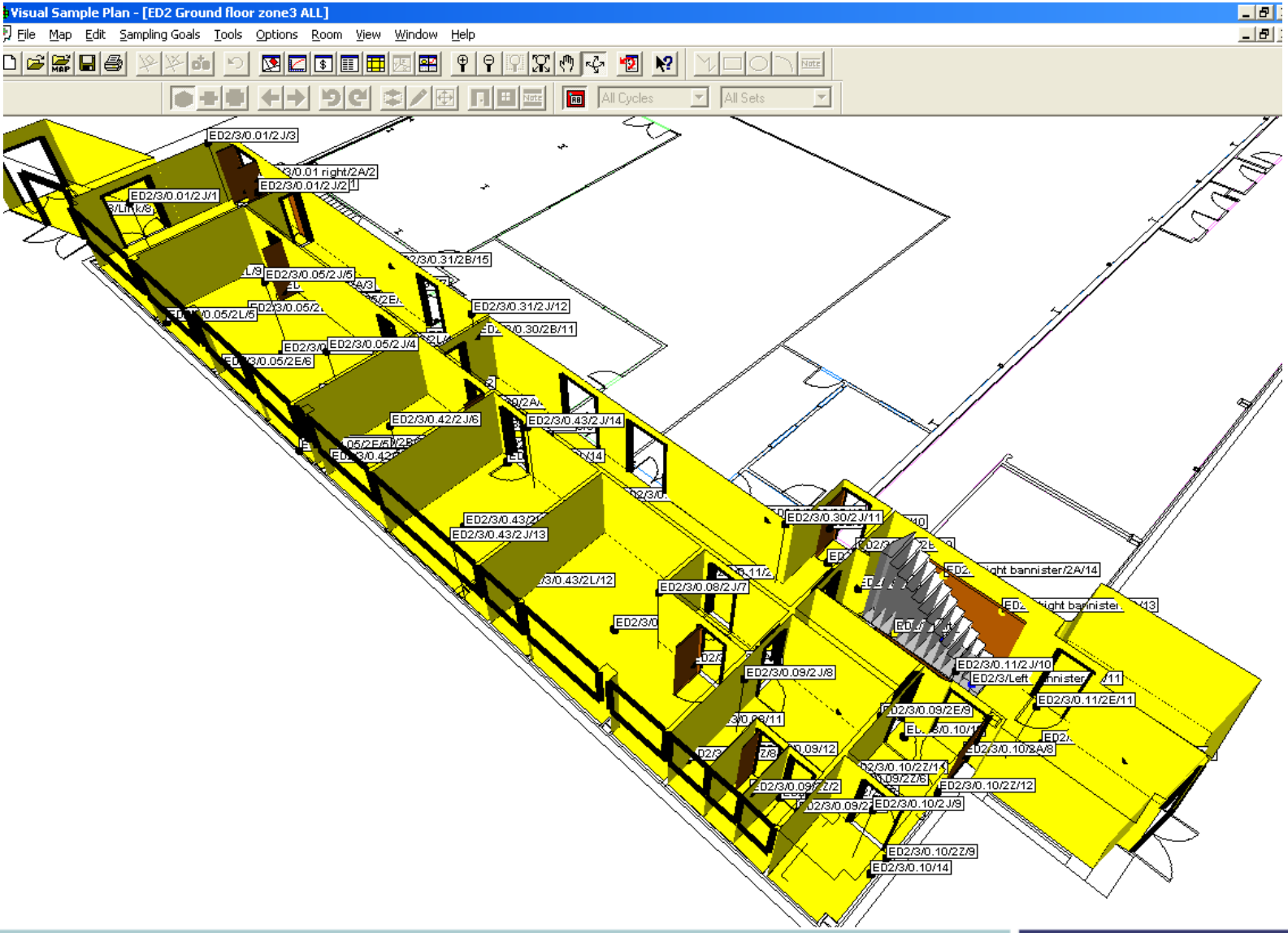
Area: 0.09								Analysis Requirements	
X Coord	Y Coord	Z Coord	Label	Type	Surface	LX	LY	Tritium	Carbon-14
313418.264	181202.082	1.7315	ED2/3/0.09/2E/9	Systematic	Wall	0.358	1.732	x	x

Area: 0.10								Analysis Requirements	
X Coord	Y Coord	Z Coord	Label	Type	Surface	LX	LY	Tritium	Carbon-14
313418.369	181202.777	0.2114	ED2/3/0.10/2E/10	Systematic	Wall	0.484	0.211	x	x

Area: 0.11								Analysis Requirements	
X Coord	Y Coord	Z Coord	Label	Type	Surface	LX	LY	Tritium	Carbon-14
313421.269	181201.522	2.3	ED2/3/0.11/2E/11	Systematic	Wall	3.64	2.65	x	x
313422.418	181199.11	2.1197	ED2/3/0.11/2E/12	Systematic	Wall	0.448	2.12	x	x
313417.979	181204.688	2.1197	ED2/3/0.11/2E/13	Systematic	Wall	2.965	2.12	x	x
313420.834	181200.585	2.1197	ED2/3/0.11/2E/14	Systematic	Wall	2.137	2.12	x	x

Area: 0.43								Analysis Requirements	
X Coord	Y Coord	Z Coord	Label	Type	Surface	LX	LY	Tritium	Carbon-14
313411.94	181211.141	1.4426	ED2/3/0.43/2E/15	Systematic	Wall	0.764	1.443	x	x

Sample Plan (Including sample points)



Collect the Samples and Analyse

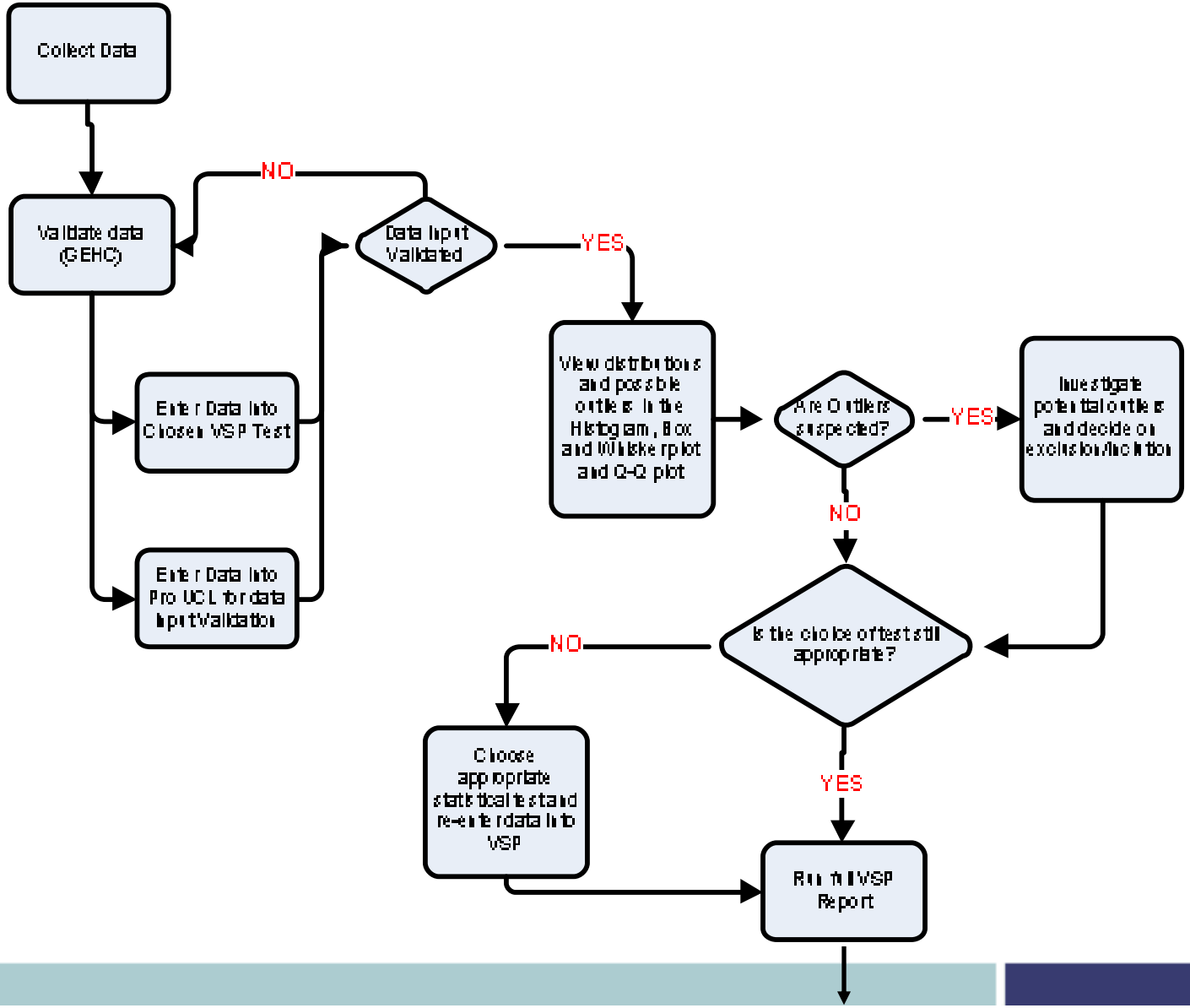
- Dedicated teams collect samples.
- Chain of custody to laboratory.
- Sample storage and preservation important

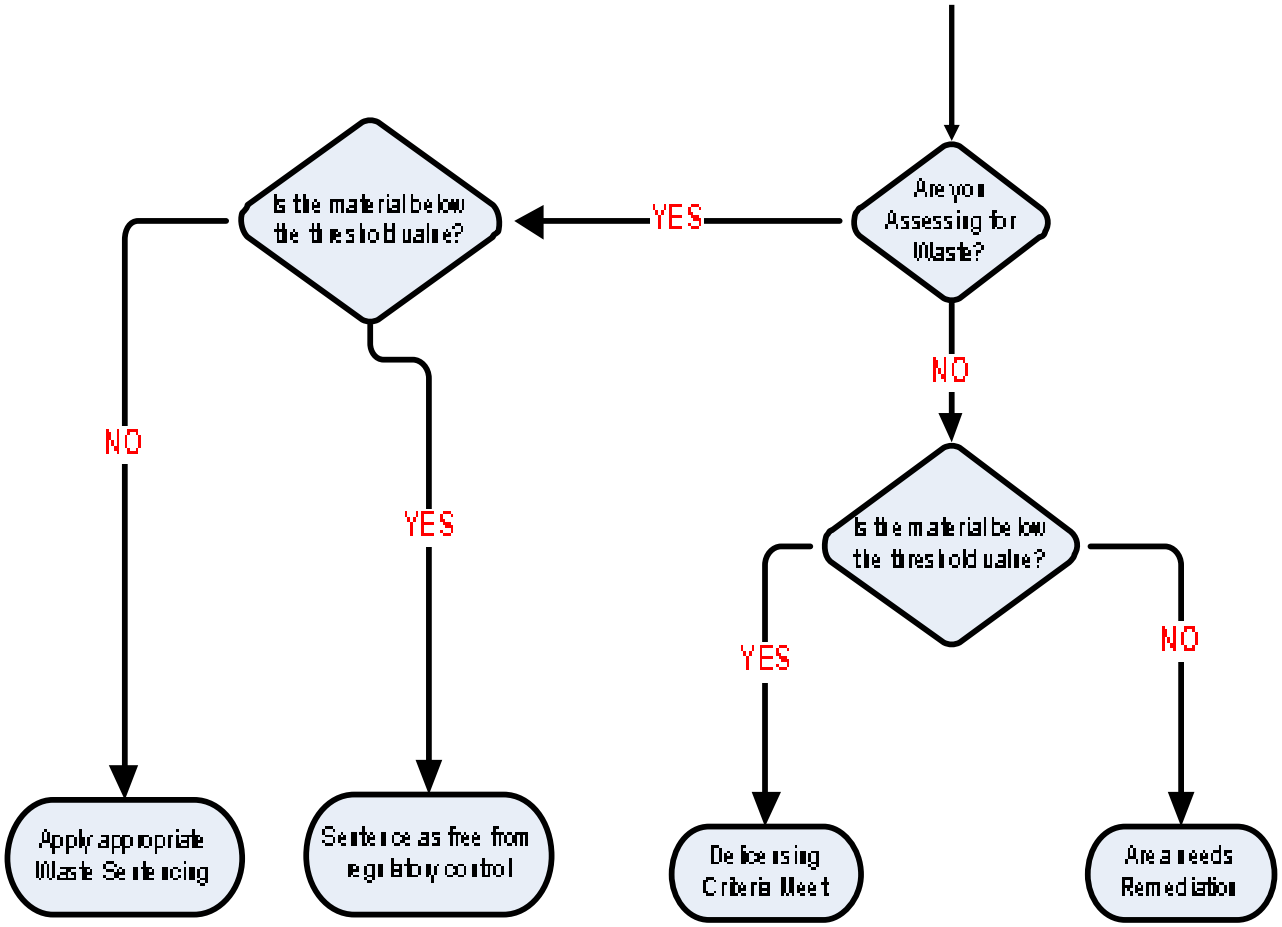
- Laboratory uses best techniques to determine ^{3}H and ^{14}C levels in samples.
- Majority of analysis done in-house

DATA ANALYSIS

DQA

Decision Flow Diagram




Are you Assessing for Waste?
YES
Is the material below the threshold value?
NO
YES
Apply appropriate Waste Sentencing
Sentence as free from regulatory control
NO
Is the material below the threshold value?
YES
NO
De-licensing Criteria Meet
Area needs Remediation

The End Results

- The resulted number of samples generated through the DQO process was much lower.
  - Expected Number 100k
  - DQO Process 10k
  - Less analysis (cost savings)
  - Planned analysis (with external Labs)

- Able to strip the building in a logical order (Avoid cross contamination)
- Waste material was managed more efficiently (segragation)
- More material was reused on site

- The project is on time and budget

Why This Worked?

- All participants involved had a vested interest
  - ensured the process was streamlined with minimal hold points
  - This emphasizes the importance of carefully selecting the participants of the DQO team and the Decision Makers / Technical Authorities
- The Importance of a good quality history file was recognised at the outset
  - It clarified clearly the goal of the project at each step and minimising data collection or repeat work.
- The DQO process provided a set of documents which transparently set out all assumptions and associated justifications
  - allowing for thorough independent auditing prior to approval by external regulators
- Regulatory buy-in from the start

Why VSP

- Supported and helped underpin the DQO methodology
- Excellent Visualisation
- User friendly
- Removes the guess work from deciding on samples
- Enabled the use of complex statistical equations
  - through a guided interface (expert mentor)
  - produced a visual output of the number and locations of samples required.
  - led to a statistically defensible sampling strategy
- Help always at hand
- Electronic records for the future
- Supports defensible decisions
- Saved time (example: report generator)
- Saved money (less sample numbers)
- Identified that its not a “black-box”

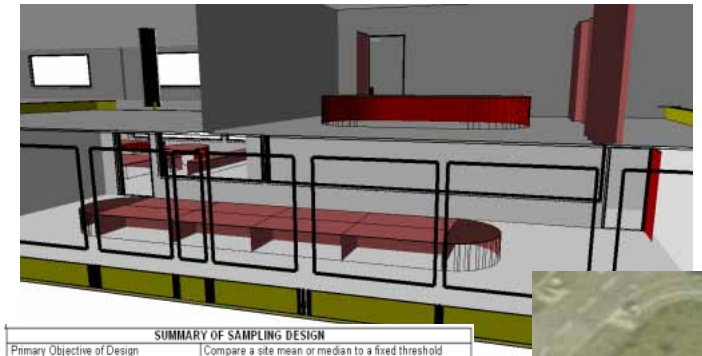
Conclusion

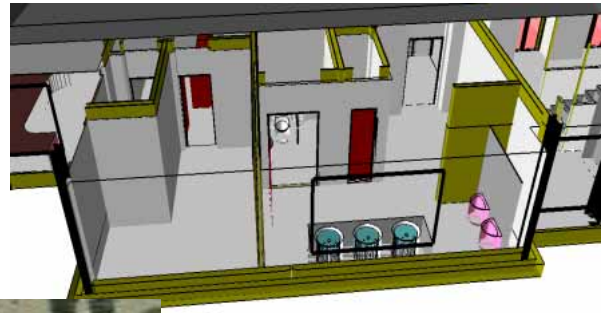
- Implementing systematic planning using the DQO methodology provided a logical framework for environmental characterisation.
  - invested up-front time and money in the planning stages
  - ensured that the end-product satisfied all the goals of the project.
  - provided cradle-to-grave justification for data collection, analysis and interpretation.
- Placed emphasis on maximising the use of existing analytical and historical information
- Agreements and assumptions made through the DQO process become the basis for preparing project sampling plans for subsequent sampling and measurements.
- The VSP software package assists us in determining the number and location of samples that meet the objective in a transparent and defensible way.
  - Provided various sample designs
  - sample-size equations needed for specific statistical tests
  - easy to use,
  - highly visual
  - Provided excellent graphical representation.

- This process implements a consistent, co-operative, defensible and streamlined graded approach to ensure that appropriate risks associated with each task is identified.

- Robust and rigorous process supported by fully validated statistical calculations

THANK YOU VERY MUCH, DO YOU HAVE ANY QUESTION?





SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Compare a site mean or median to a fixed threshold
Type of Sampling Design	Nonparametric
Sample Placement (Location) in the Field	Simple random sampling
Working (Null) Hypothesis	The median(mean) value at the site exceeds the threshold
Formula for calculating number of sampling locations	Sign Test - MARSSIM version
Calculated total number of samples	8
Number of samples on map [a]	8
Number of selected sample areas [b]	1
Specified sampling area [c]	3430.39 ft²
Total cost of sampling [d]	$5,000.00