



**Pacific
Northwest**
NATIONAL LABORATORY

RemPlex Seminar

March 31, 2026

Research Priorities for Environmental Remediation



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U.S. DEPARTMENT
of ENERGY

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Looking Forward with RemPlex

June

“Enhanced Attenuation and Sustainability” seminar
co-hosted with SURF, the Sustainable Remediation
Forum

Seminar Topics Under Consideration for 2026

- AI Needs in Environmental Remediation
- Groundwater/Surface Water Interactions
- PFAS Migration in the Vadose Zone
- Data Management Practices

Give us your thoughts on topics of interest

*For more information and to register for the seminars,
go to <https://www.pnnl.gov/projects/remplex/seminars>*



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Today's Seminar and Speakers

Research Priorities for Environmental Remediation



Mark Toner

Science Team Manager
Scottish Environmental Protection Agency



Frank Wigley

Remediation Strategy
UK Nuclear Decommissioning Authority



Rod Rimando

Director of Technology Operations Office
DOE Office of Environmental Management

Dalgety Bay

Radioactive Contaminated Land Investigation and Remediation

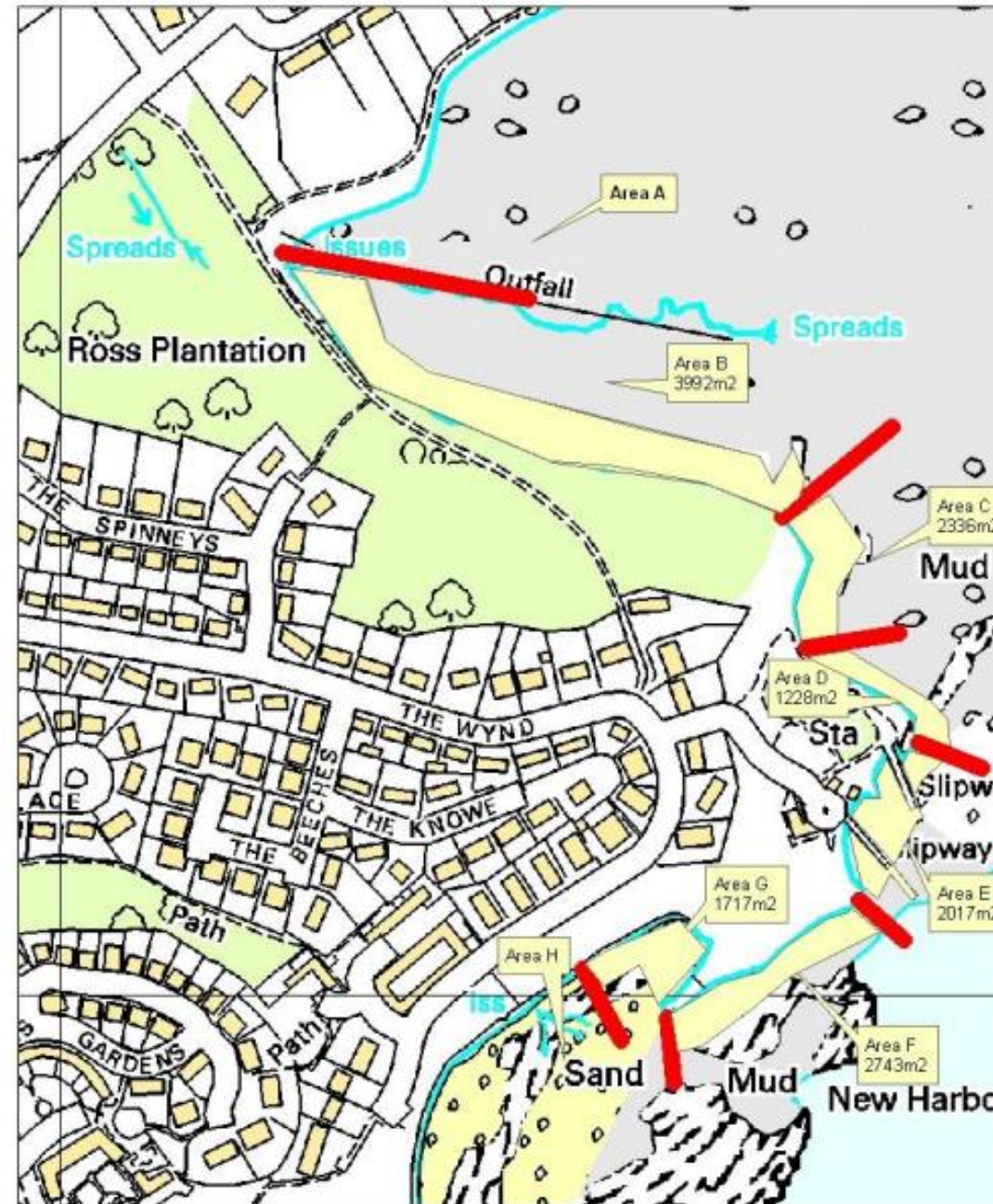
Mark Toner

Radioactive Substances (Science)

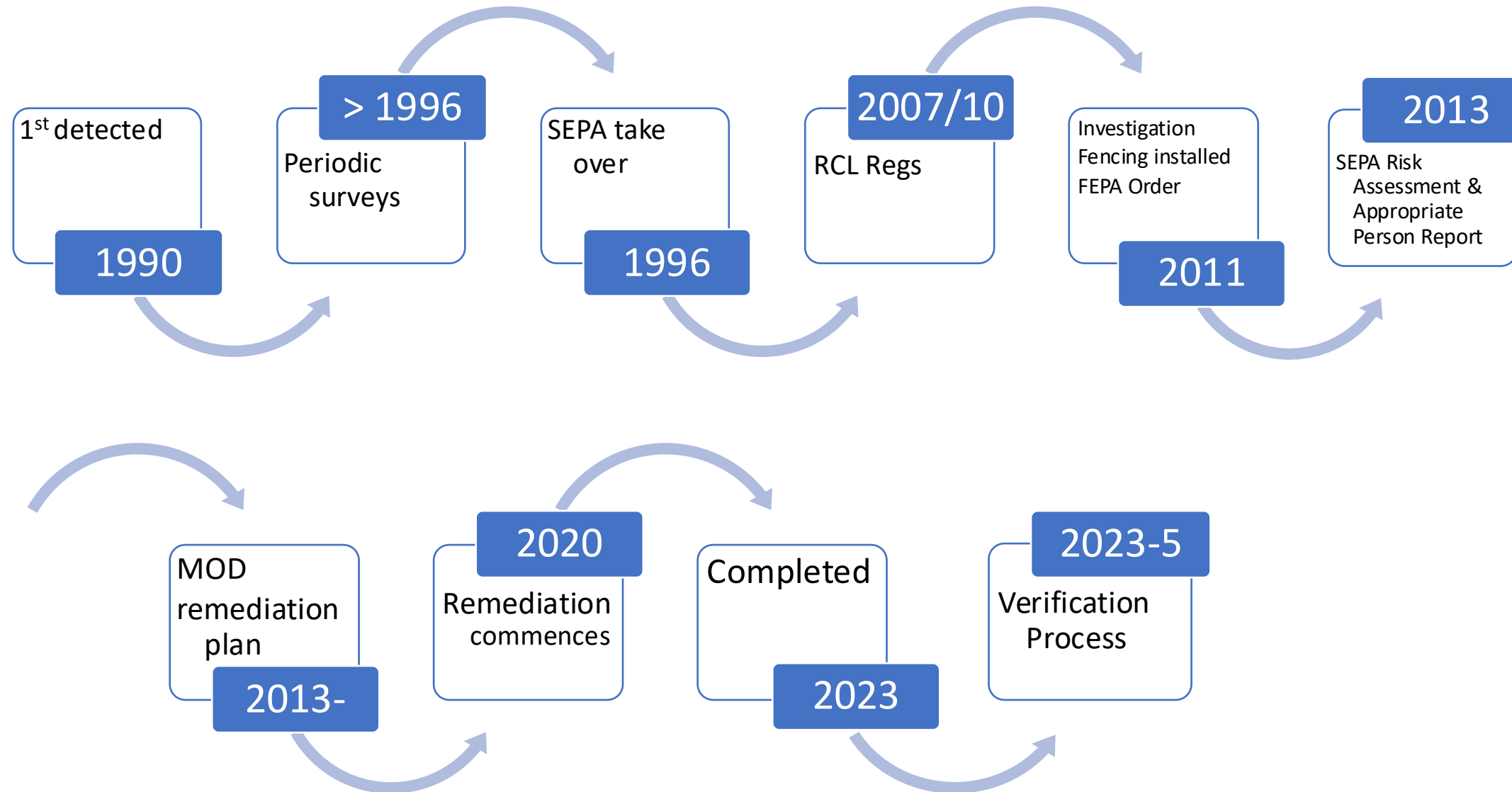
REMPLEX March 2026



Site Overview



Dalgety Bay Timeline

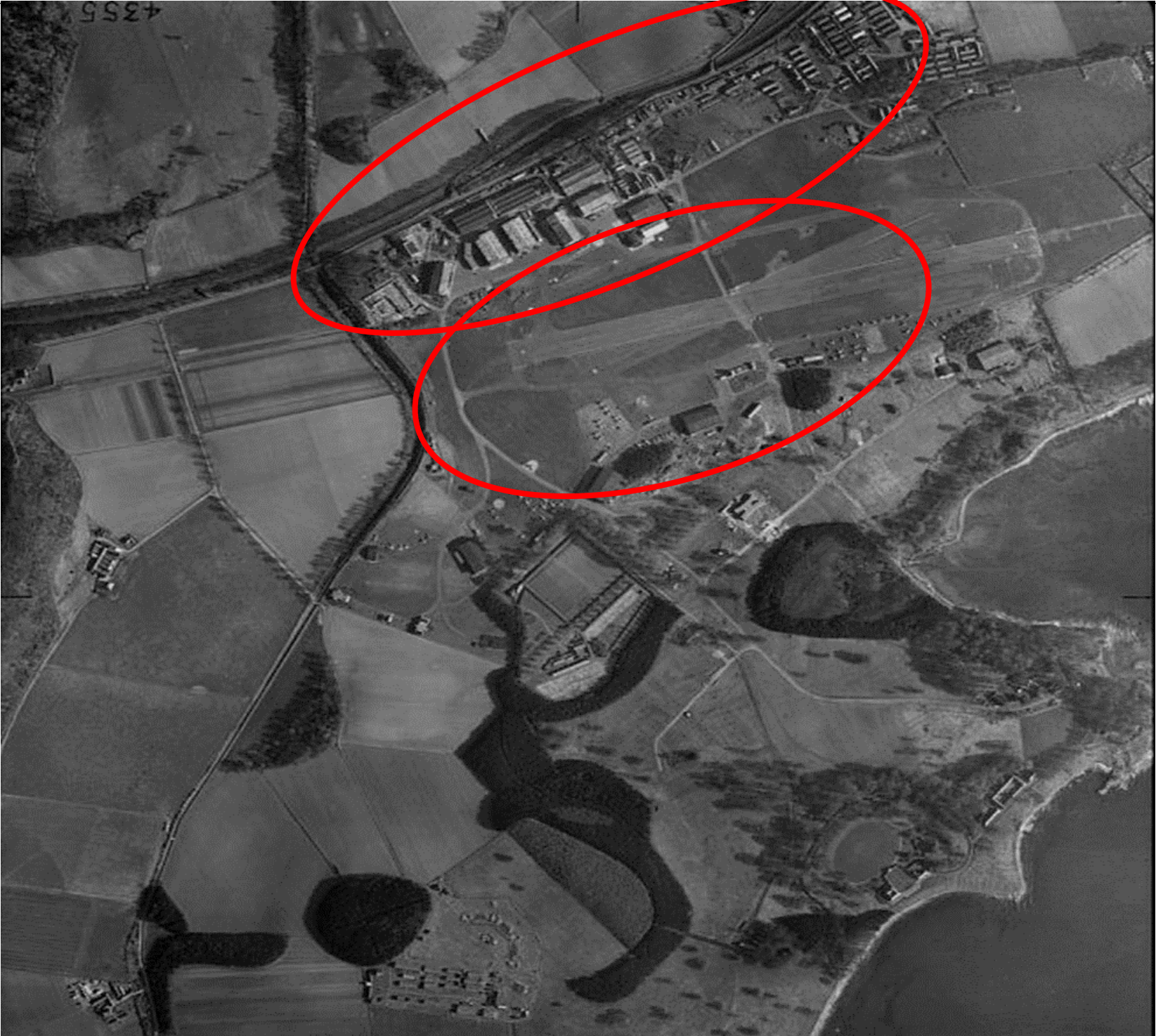


Dalgety Bay: Past

OFFICIAL

Dalgety Bay: Past Present & Future

RNAS Donibristle & HMS Merlin



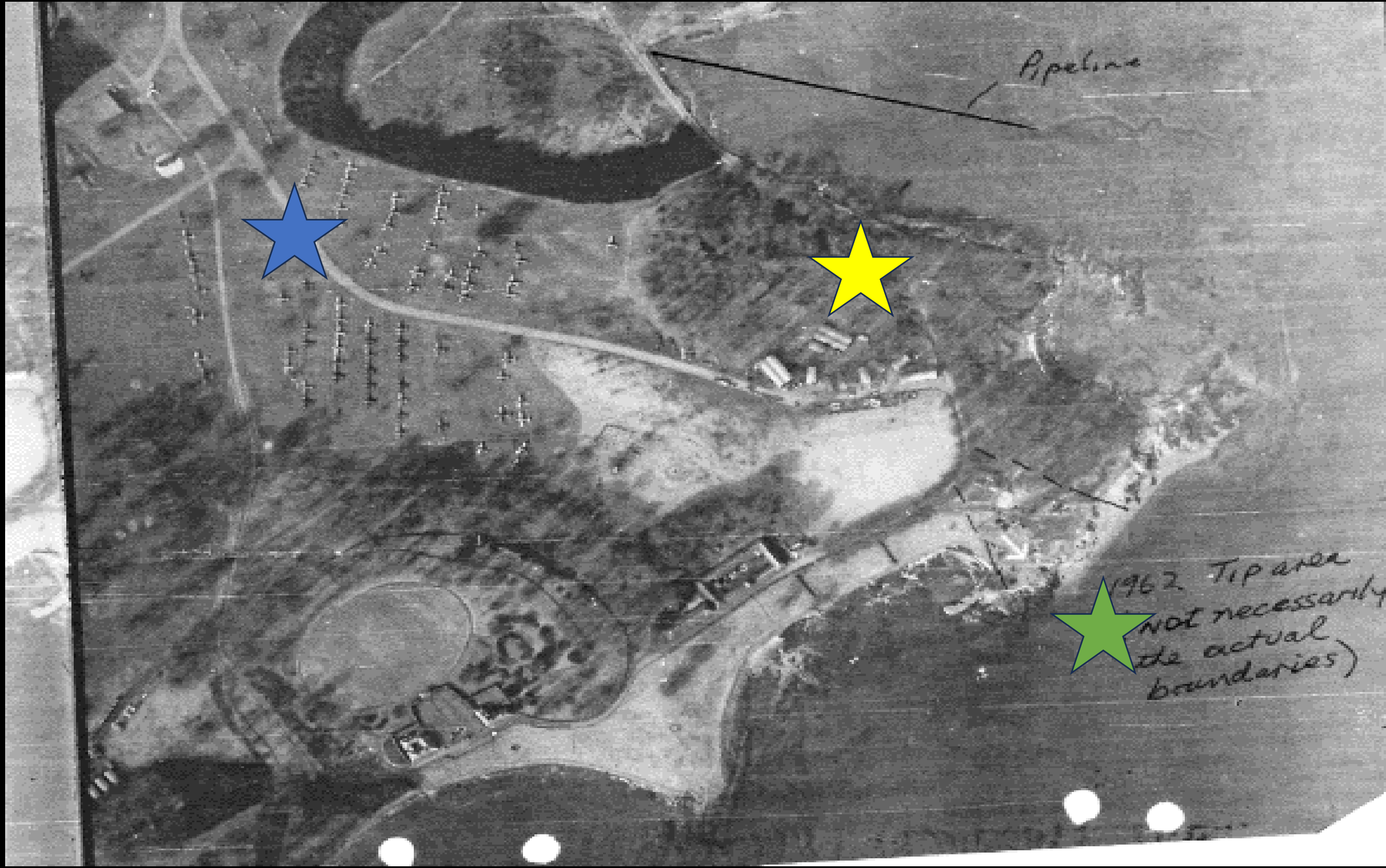
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Dalgety Bay: Past

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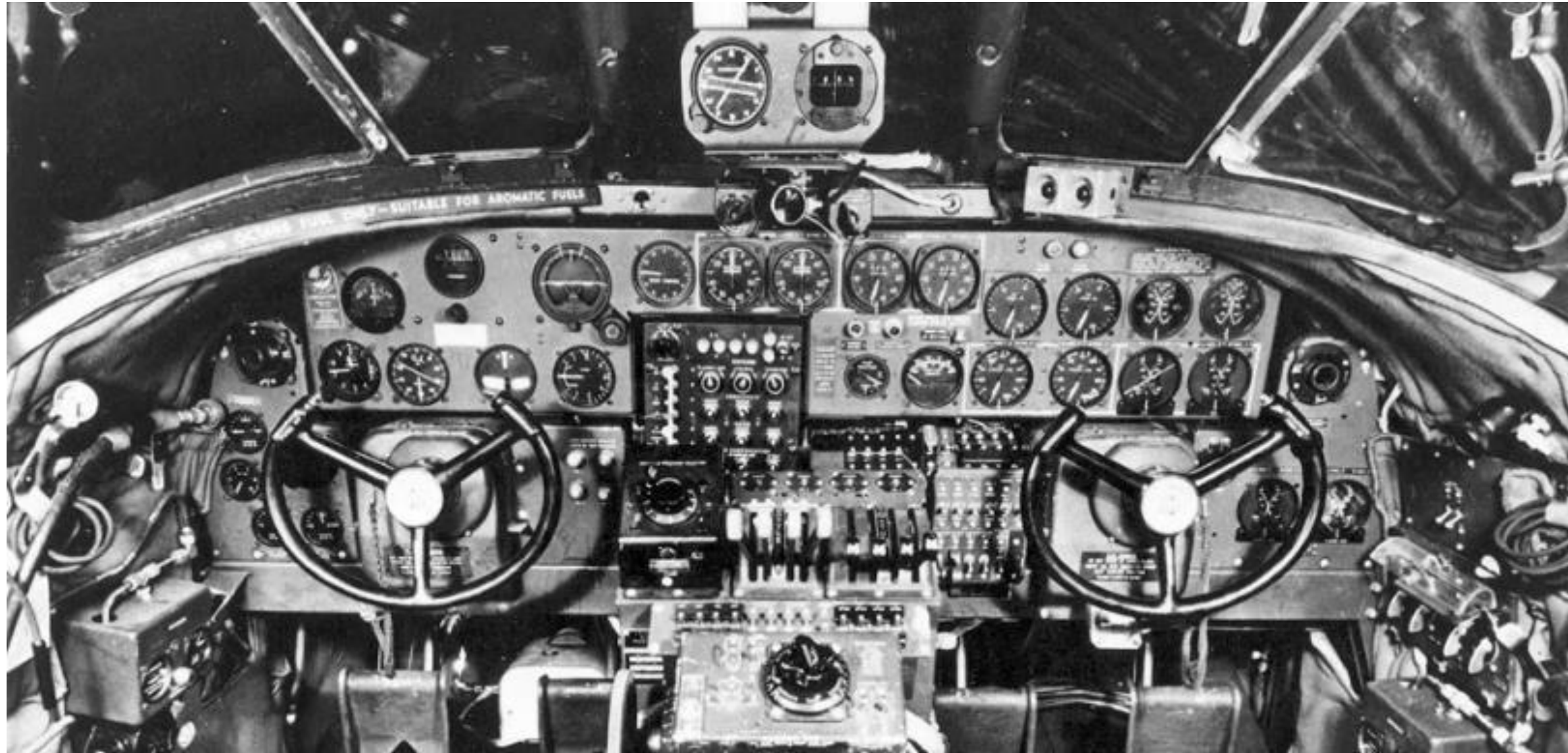
Dalgety Bay: Past Present & Future

RNAS Donibristle & HMS Merlin



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Dalgety Bay Monitoring and Public Protection Measures



Dalgety Bay Monitoring and Public Protection Measures







Image © 2025 CNES / Airbus

Size and Physical Form of Particles

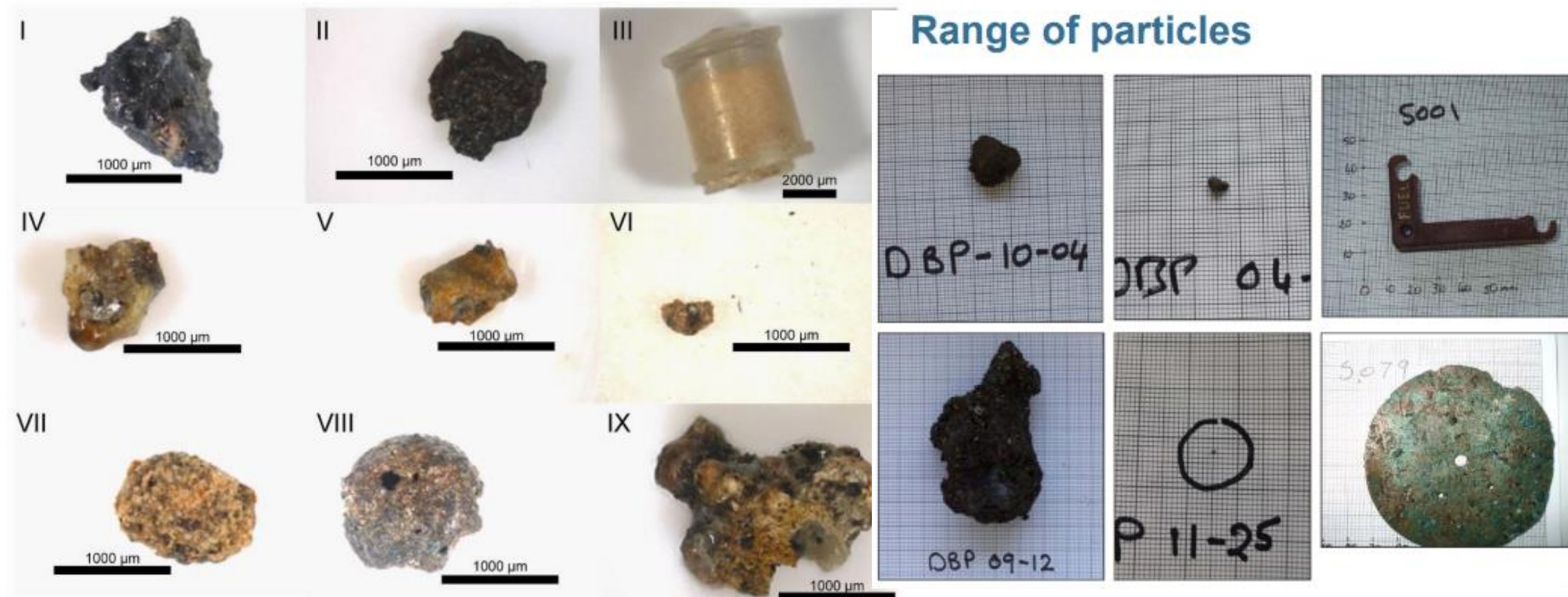


Figure 21: Images of some of the sources and sizes.

Activities and Occurrence of Particles

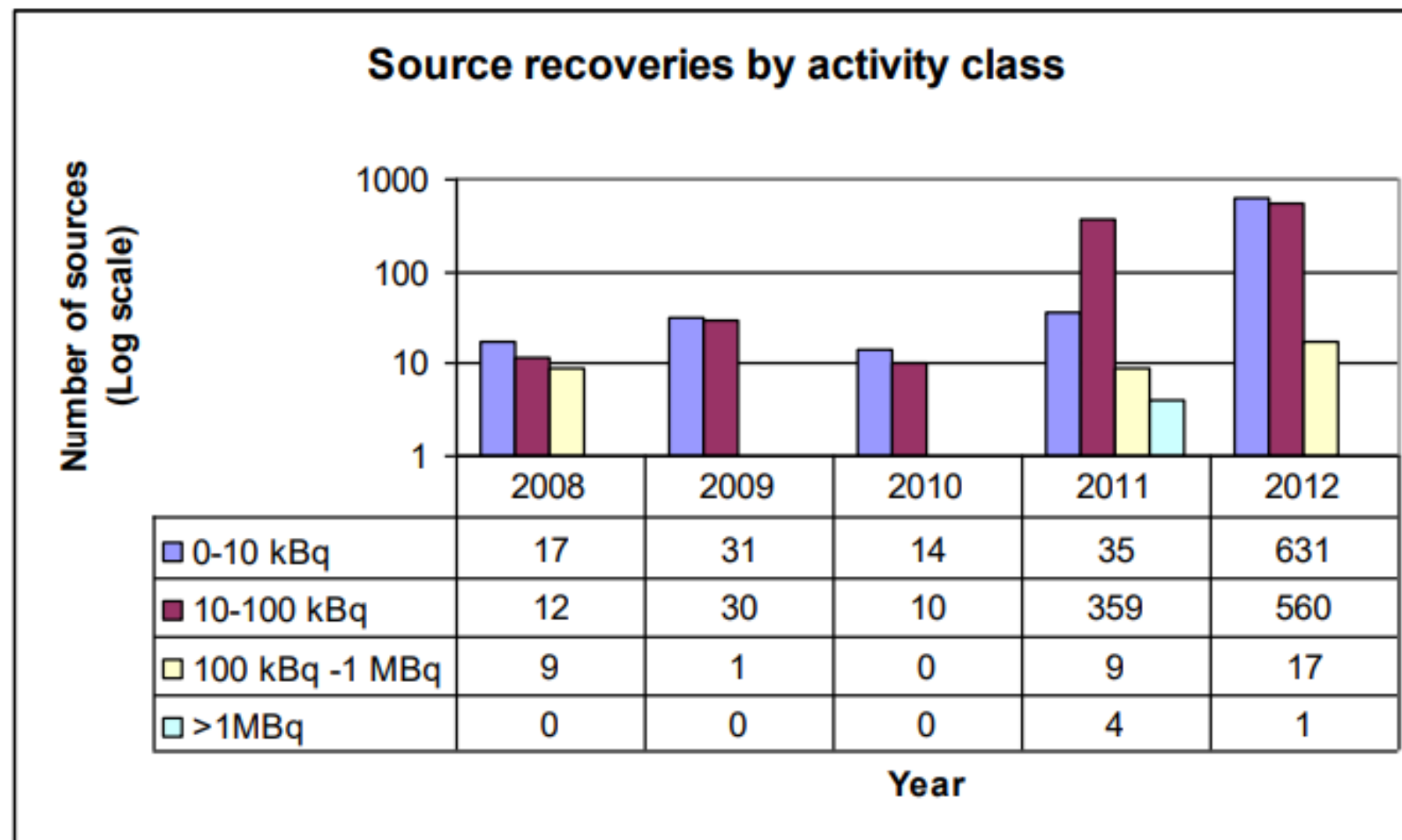


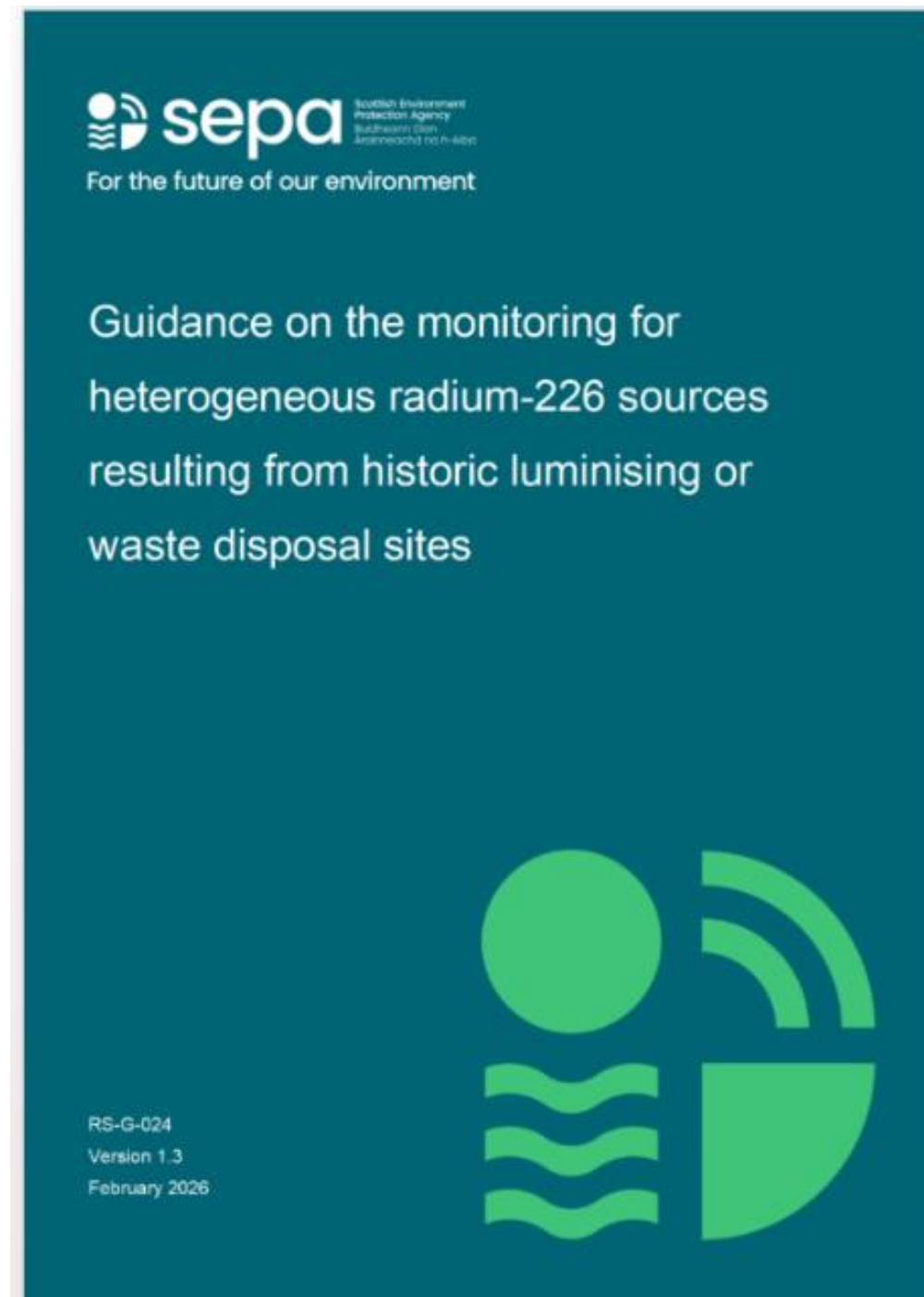
Figure 6: Sources recovered classified by activity bands 2008 to 2012



Monitoring Guidance

Improving standards

- Detector type/Set up
- Confidence in performance
- Regulatory acceptance
- Tied to known data on hazards

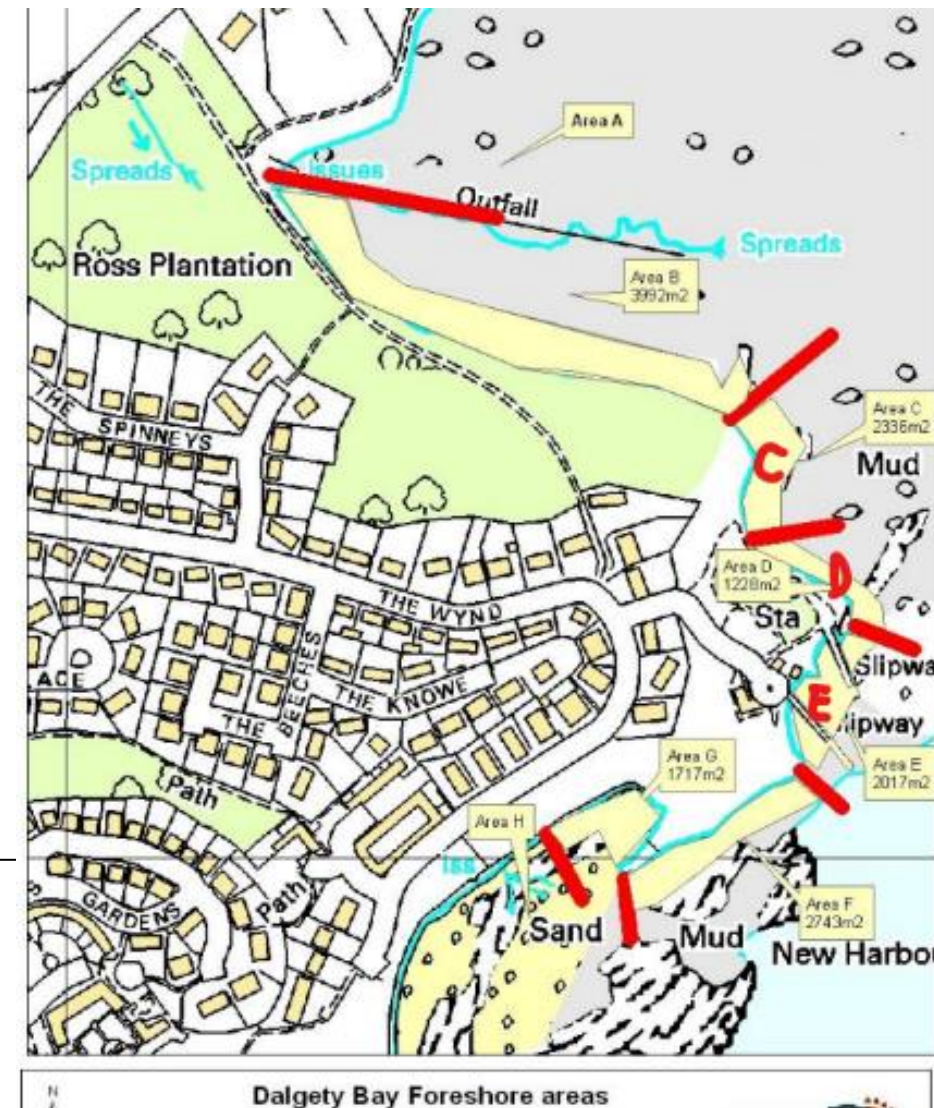


SEPA Risk Assessment 2013

- Considers Source – Pathway – Receptor
- Utilises Gathered Habits Data from Site
- Ingestion, Inhalation, Skin Contact, Direct Radiation all considered in line with RCL Statutory Guidance
- Probability of encounter
- Average data used – not extreme

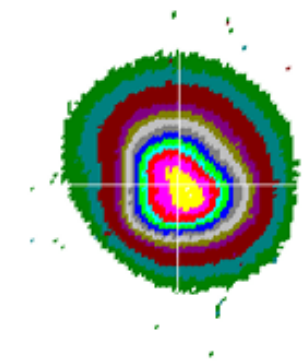
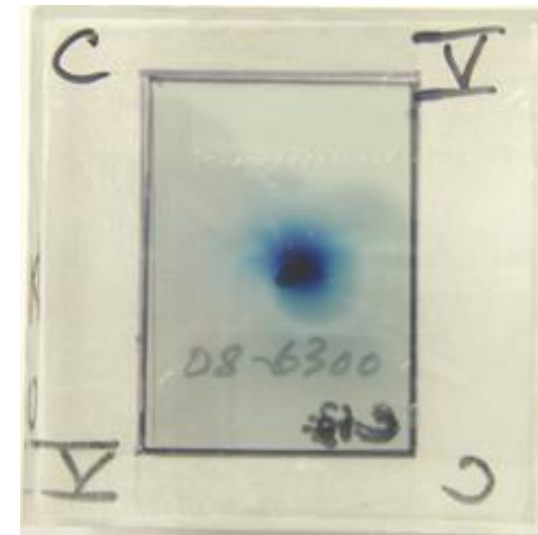
SEPA considers that significant possibility of significant harm from the identified Significant Pollutant Linkage is occurring on Area C, D and E at Dalgety Bay in line with the criteria set out in paragraph A.32 of the Statutory Guidance.

For Areas C, D and E current management arrangements including signage demarcation and monitoring and removal is reducing the risks to the public. However, the practicability, effectiveness and durability of these current measures are still to be assessed.

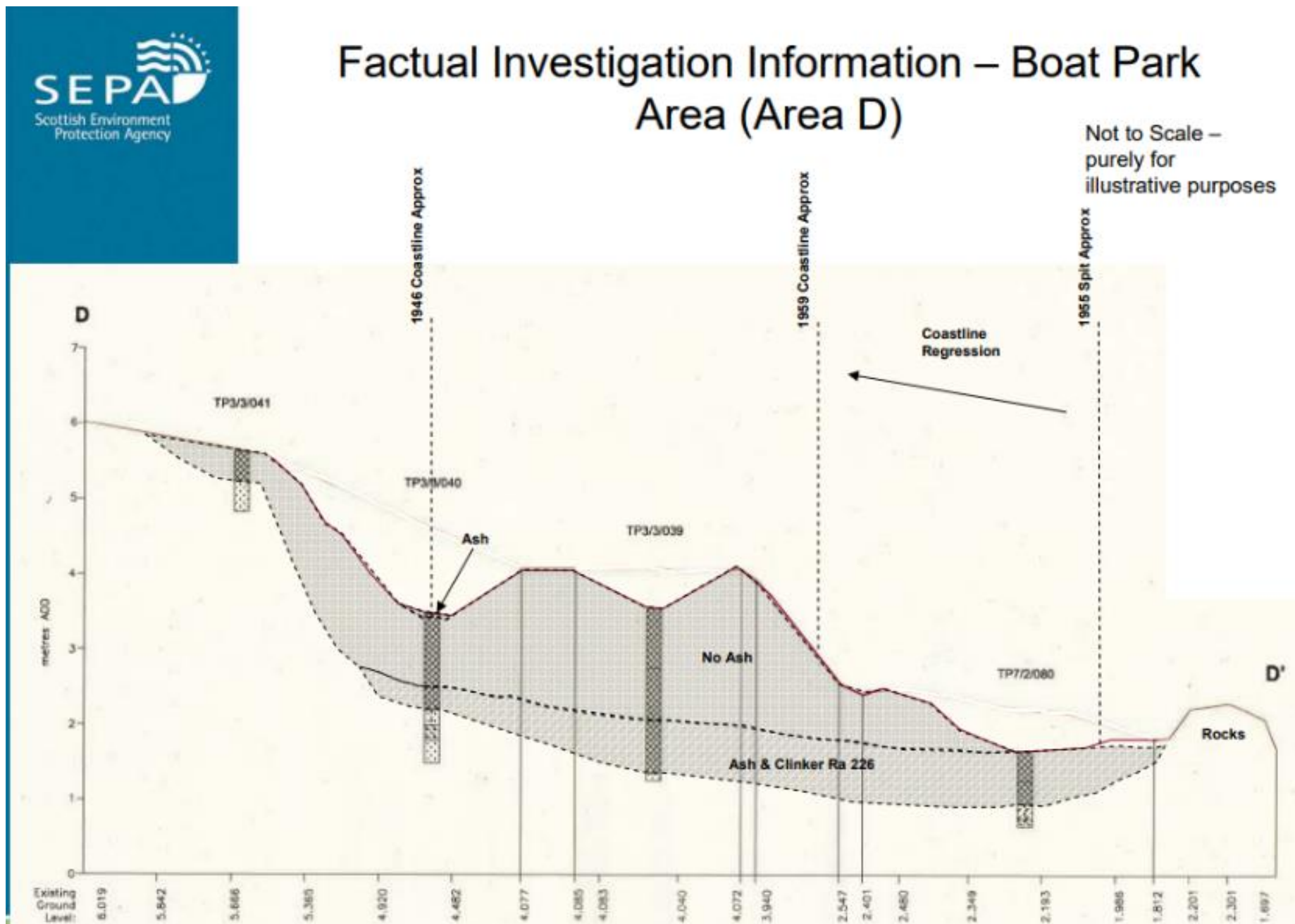


SEPA Risk Assessment Research Requirements

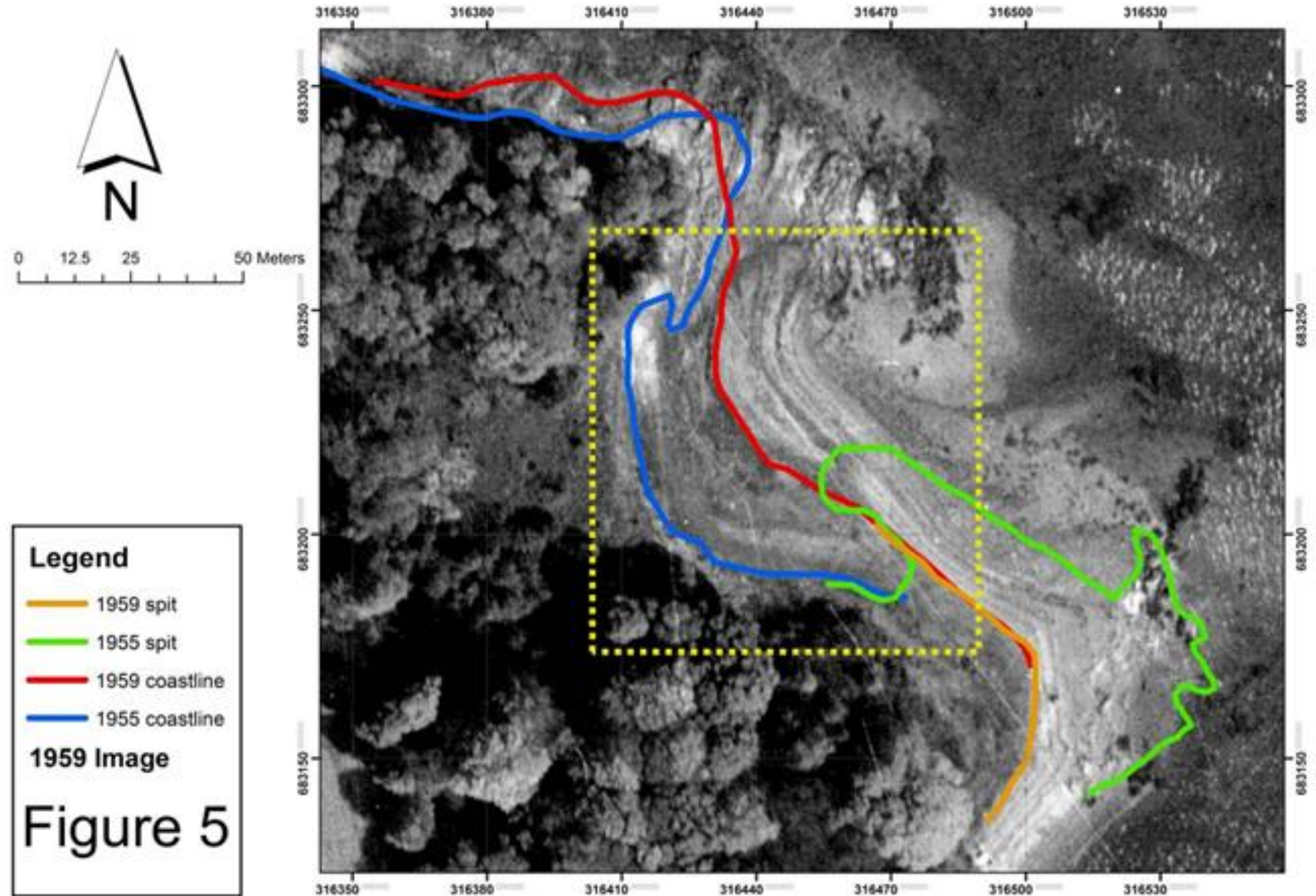
- Skin contact studies
- Ingestion studies
- Radiological Habits Survey
- Average data used – not extreme



Appropriate Persons Report



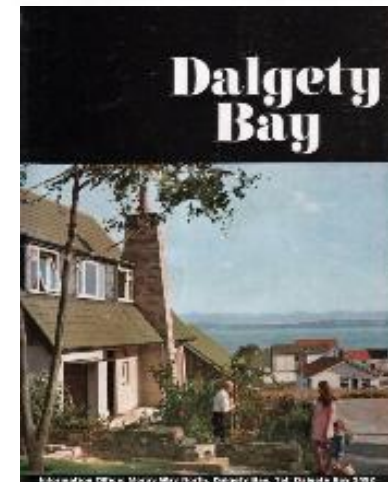
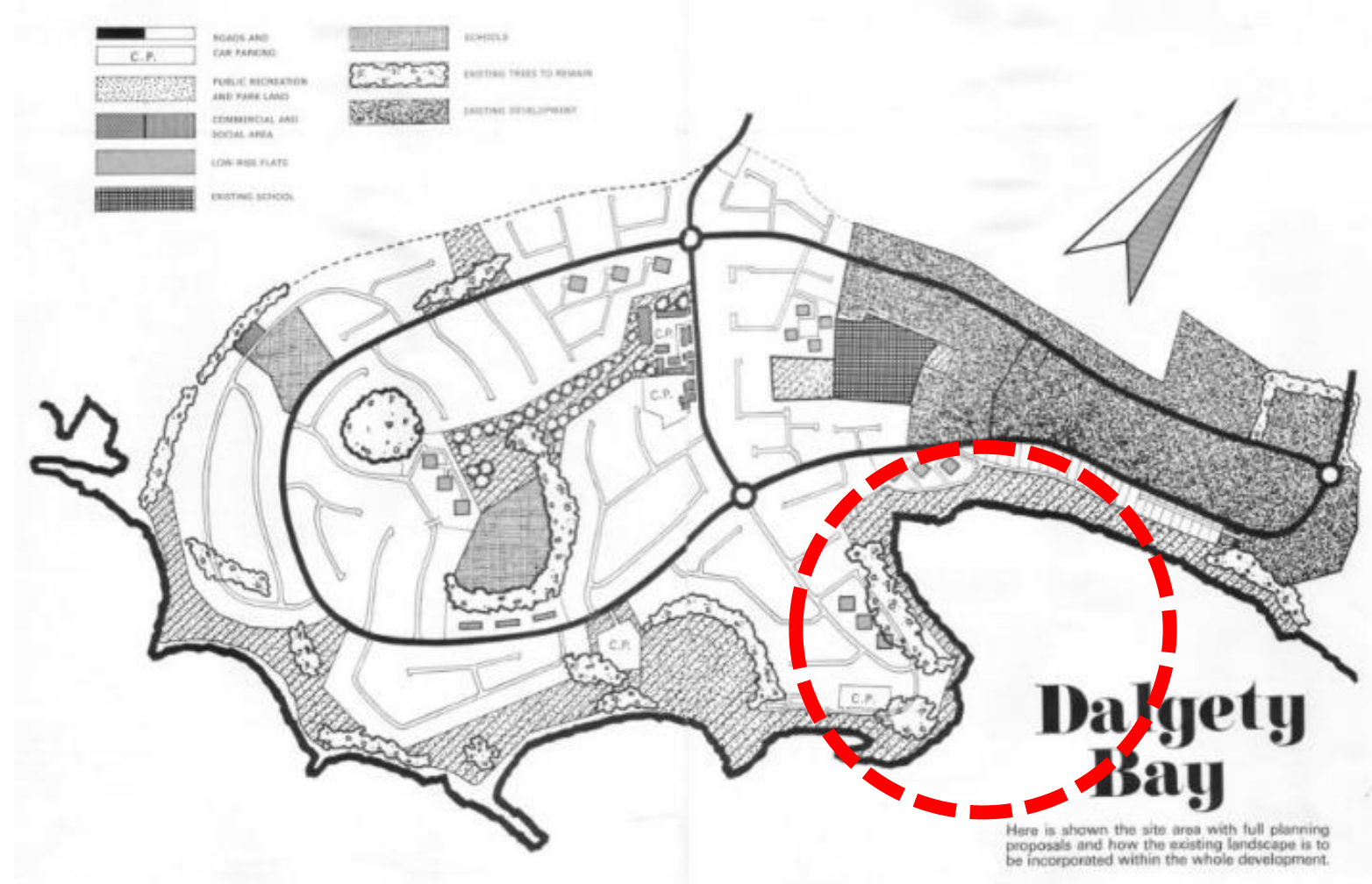
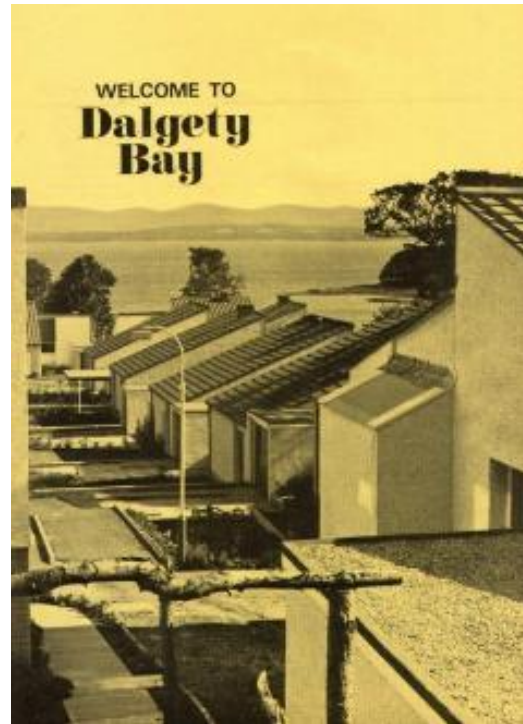
Aerial Photo – Coastline Reconstruction



Dalgety Bay: Past Present & Future

Dalgety Bay: Past

Development of New Town



Remediation Scheme

Designation or voluntary approach

- Ministry of Defence rejected SEPA's assessment
- Potential for Judicial Review and Legal Designation
- Stakeholders worked together to avoid protracted issues
- MoD contractors prepared remediation scheme
- Monthly monitoring continues



Monitoring

Particles detection, recovery and consignment

- Transit routes
- Surfaces
- Criteria



Photo : SEPA 2021

Conveyor and Detection

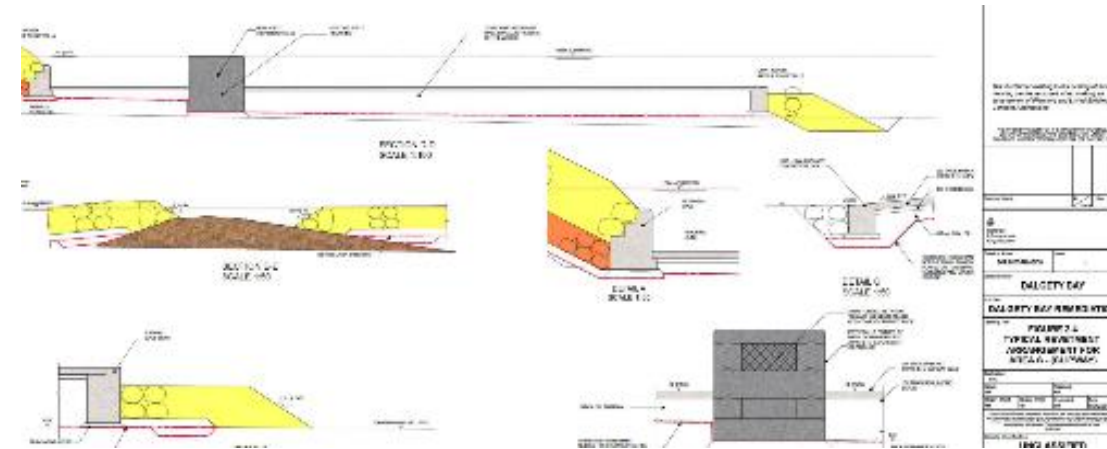
Particles detection, recovery and consignment for disposal

- Criteria set against SEPA's guidance



Barrier and Rock Armour

- Concrete block barrier with membrane to seal undisturbed soils
- Treated soils are re-used



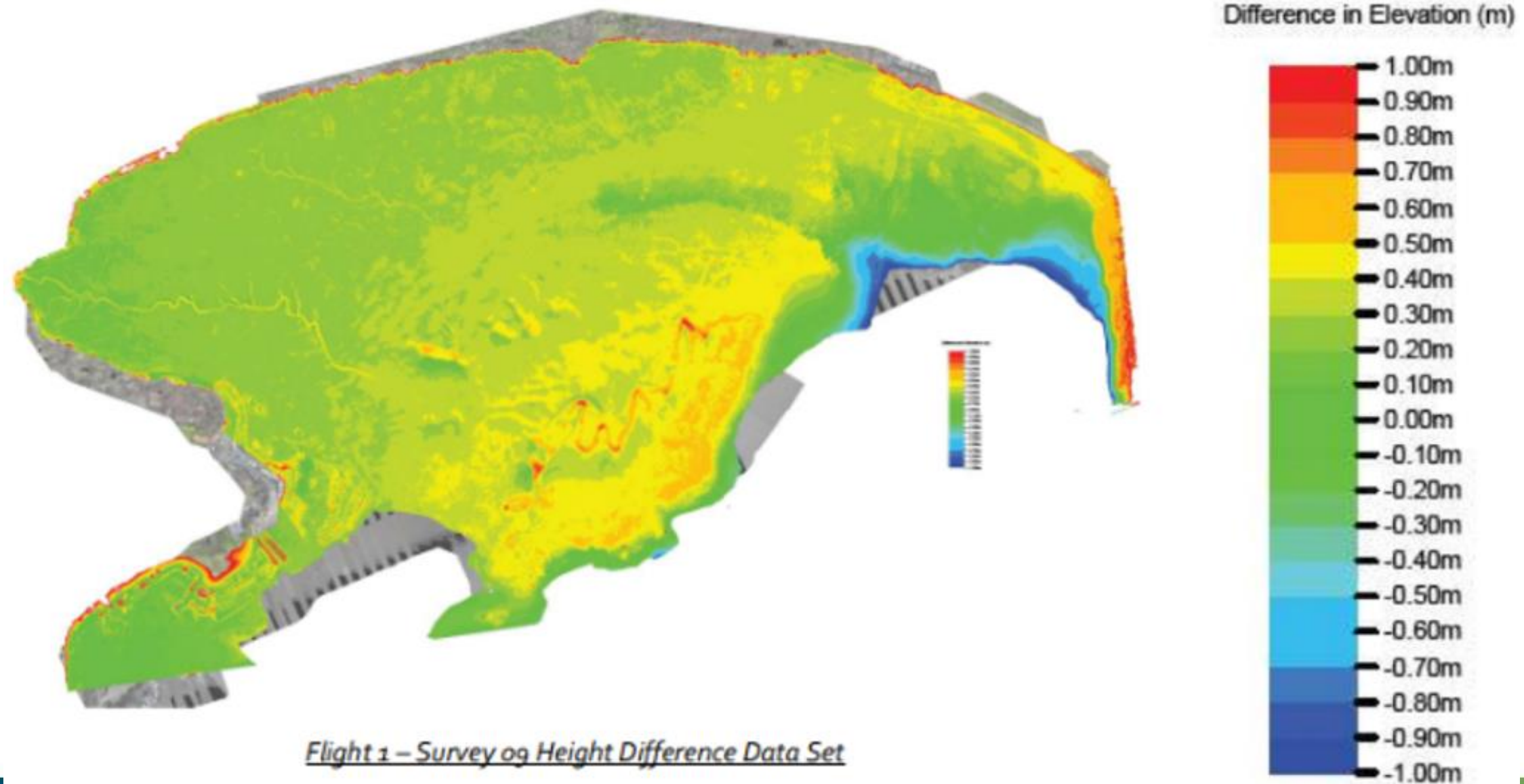
Ref: EIA documents on Fife Council's Planning website



Photos: SEPA 2021

Verification

Topographical Surveys with Drone



Verification

Recent finds



Year	Find
2023	29
2024	55
2025	14
2026 (January)	4

DALGETY BAY Summary





UK NDA Areas of Research Interest: Land Quality, Characterisation & End States – REMPLEX

Exploring land quality and environmental end states research

Dr. Frank Wigley
31st March 2026

Dr. Kate Canning
Head of R&D





Purpose of the Research Areas of Interest Document

A strategic, forward-looking statement of the NDA group's evidence and innovation needs

- **Identifies priority research challenges** where focused RD&I will reduce uncertainty, address technical barriers, and strengthen confidence in decisions across the waste, decommissioning, and remediation lifecycle.
- **Fosters collaboration** across government, industry, academia, and national laboratories, building dialogue, avoiding duplication, and accelerating translation of technology into deployable solutions.
- **Aligns external research** with NDA mission needs, guiding proposal development, shaping funding programmes, and informing cross-government coordination.
- **Provides a consistent research framework** for characterisation, monitoring, remediation, and environmental modelling — core pillars relevant to UK science partners such as RemPlex.

Published March 27 2026

Technical Priorities

Innovative Monitoring Techniques

Utilizing in situ and remote methods enables effective characterization in high-dose or constrained environments.

Continuous Environmental Monitoring

Tracking changes in soil and groundwater conditions in real time to inform ongoing site management.

Data Integration and Transparency

Real-time soil and groundwater monitoring surpasses periodic sampling for better risk management and remediation.

Advanced Characterisation Techniques

Integrating monitoring data with predictive models supports risk-informed decisions and builds community trust.

Monitoring Contaminated Land

Foundation for high-quality evidence and proportional decision-making under uncertainty in contaminated sites.

Soil and Groundwater Remediation

Safe and proportionate intervention strategies, especially when excavation is not feasible for site cleanup.

Future End States and Decision Support

Using predictive models and monitoring feedback to guide long-term environmental site conditions and decisions.





Advances in Monitoring and Characterisation

Challenge:

How can advances in characterisation improve our understanding of our wastes and our facilities to ensure fit-for-purpose decommissioning plans?

Solutions that can be deployed in situ and/or remotely, with results available quickly to support timely decision making.

Faster off-site analytical techniques to increase characterisation capacity.

Improvements in data acquisition speeds, lower detection limits and wider performance envelopes.

Approaches that support the design of remediation strategies for legacy contamination, including poorly defined or inaccessible contamination, and improve understanding of the influence of changing environmental and climatic conditions.

Techniques to support characterisation of a range of radiological and non-radiological contaminants, including persistent organic pollutants (POPs), asbestos, oils, and heavy metals.

Sampling tools and techniques that can be deployed effectively in a range of environments (including confined spaces, high radiation areas, and by remote operation) to ensure consistent, representative sampling.

Approaches that help quantify and reduce uncertainty, complementing the more detailed focus on uncertainty management set out in Section 3.1.2.

Improved accessibility of characterisation data, supporting improved data insight.



Monitoring Techniques for Contaminated Land and Groundwater

Challenge:

Which monitoring approaches can provide reliable, long-term, and in situ insight into the behaviour of land and groundwater contamination, reducing reliance on intrusive sampling while supporting proportionate decision making?

- Move beyond periodic, intrusive sampling and towards approaches that provide continuous or near real-time evidence of:
 - contaminant presence
 - migration and change over time
 - across diverse environments.
- In situ, remote, and non-invasive monitoring will strengthen confidence in site models and support earlier detection, with benefits of:
 - reducing uncertainty in long-term stewardship
 - more proportionate remediation and end state decisions
 - maintaining environmental protection



Improvements in Uncertainty Management

Challenge:

How can improvements in uncertainty management enable more proportionate, risk informed decision making?

- Reduce unnecessary conservatism in characterisation, waste sentencing, and long-term performance assessment, enabling waste to be managed higher up the waste hierarchy, where appropriate.
- Identifying appropriate opportunities to reduce conservatism in waste packaging advice for final disposal.
- Improve the traceability and transparency of the data, assumptions, and judgements that underpin decisions.
- Support proportionate, evidence-based planning that balances safety, environmental protection, and value for money while sustaining regulatory confidence.
- Use of AI tools to support risk management.



Moving Up the Waste Hierarchy

Challenge:

Which approaches could enable us to safely reuse or recycle wastes that pose very little hazard or risk or present an inherent value and could therefore provide opportunities to manage higher up the waste hierarchy?

- Recycling and repurposing approaches for wastes including scrap metals, soil, concrete, rubble, aggregates, and other bulk materials, that transform existing waste streams into compliant materials that can be used for other purposes.
- The recovery of radionuclides or radioactive metals from specific waste streams, where strategically aligned, technically feasible, and regulatory frameworks permit, e.g. carbon-14 from graphite.
- Energy and water recovery technologies that improve resource efficiency and reduce environmental impact.
- Better ways to assess lifecycle benefits in comparison to additional secondary and tertiary waste generation, increasing complexity and diversity of waste streams.
- Investigating reuse options for the NDA uranium inventory, for example as a feed inventory for a future plutonium immobilisation product (Disposal MOX).



Alternatives to Existing Disposal Routes

Challenge:

Under what conditions do on-site, in situ, or near-surface disposal routes deliver a demonstrable lifecycle benefit, and how should facility design, operation, and closure be adapted to realise that benefit?

- In situ or on-site disposal and
- Forms of near-surface disposal, and the
- Associated technologies and techniques that would improve the design, construction, operation, and closure of disposal facilities.
- Stronger evidence of long-term environmental resilience will support assessments of alternative disposal approaches, including
- Technically underpinned models that predict how alternative disposal approaches will evolve over prolonged periods.

Soil and Groundwater Remediation



Challenge:

How can contaminated soil and groundwater be remediated safely, and in a manner proportionate to the associated risks?

Safety and Sustainability

- Remediation must be safe, risk-proportionate, and sustainable over long timescales in nuclear contexts.

Innovative Remediation Approaches

- Chemical, physical, and biotechnological methods immobilize contaminants and limit plume migration.

Demonstration and Testing

- Demonstration-led pathways mature technologies under realistic conditions, addressing uncertainties and failures.

Climate Impact Considerations

- Environmental changes like droughts or floods affect remedy durability and performance over time.



Underpinning the Future End States of Our Sites

Challenge:

The understanding of how contaminants behave in the environment is essential to defining, protecting, and enabling the future end states for our sites.

Long-term Contaminant Prediction: Robust models predict contaminant transport and fate over centuries, accounting for environmental and radiological factors.

Model Validation and Transparency: Validated and transparent predictive models support long-term decisions amid uncertainties like climate change and erosion.

Integration of Monitoring Data: Combining high-resolution monitoring with advanced simulations enhances accuracy and reduces uncertainty in predictions.

Supporting Remediation Decisions: Modelling advances aid in setting remediation levels, designing stewardship plans, and protecting environments long-term.

Opportunities for Further Discussion at RemPlex



Demonstration Projects

At UK legacy sites for subsurface monitoring using invasive and non-invasive methods.

Uncertainty Quantification

Methods to quantify and communicate uncertainty to regulators and communities, with traceable data and validation protocols.

Data Standards Alignment

Data and metadata standards for interoperability with digital twins, enabling reuse and cross-site comparisons.

Field-Ready Remediation

Advanced remediation approaches with nuclear-grade evidence focusing on performance, durability, and waste integration.





Realizing Joint Opportunities

Collaborative Sensor Development

Co-developing autonomous and robust sensor systems for long-term subsurface and groundwater monitoring ensures enhanced environmental data accuracy.

Remediation Technology Advancement

Maturing remediation technologies to nuclear standards supports safe and effective site clean-up and environmental protection.

Decision-Support and Data Standards

Validating uncertainty frameworks and establishing interoperable data standards enable reliable decision-support and integrated modelling environments.

International Best Practice Alignment

Aligning UK approaches with IAEA and NEA standards strengthens consistency in site remediation and end state planning globally.



Thank you

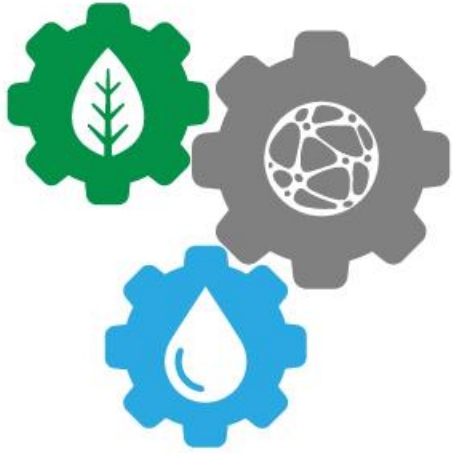
https://assets.publishing.service.gov.uk/media/69c55cb778ca1aa5a6360948/NDA_group_Areas_of_Research_Interest_2026.pdf

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REMPLEX 2026 Seminar Series: Research Priorities for Environmental Remediation



Tuesday, March 31, 2026

8:00 to 9:30 a.m. PDT (11:00 to 12:30 p.m. EDT)



Cusp of Industry 5.0



Ushering the 5th Industrial Revolution



Basic Materials



Energy Sources



Machines



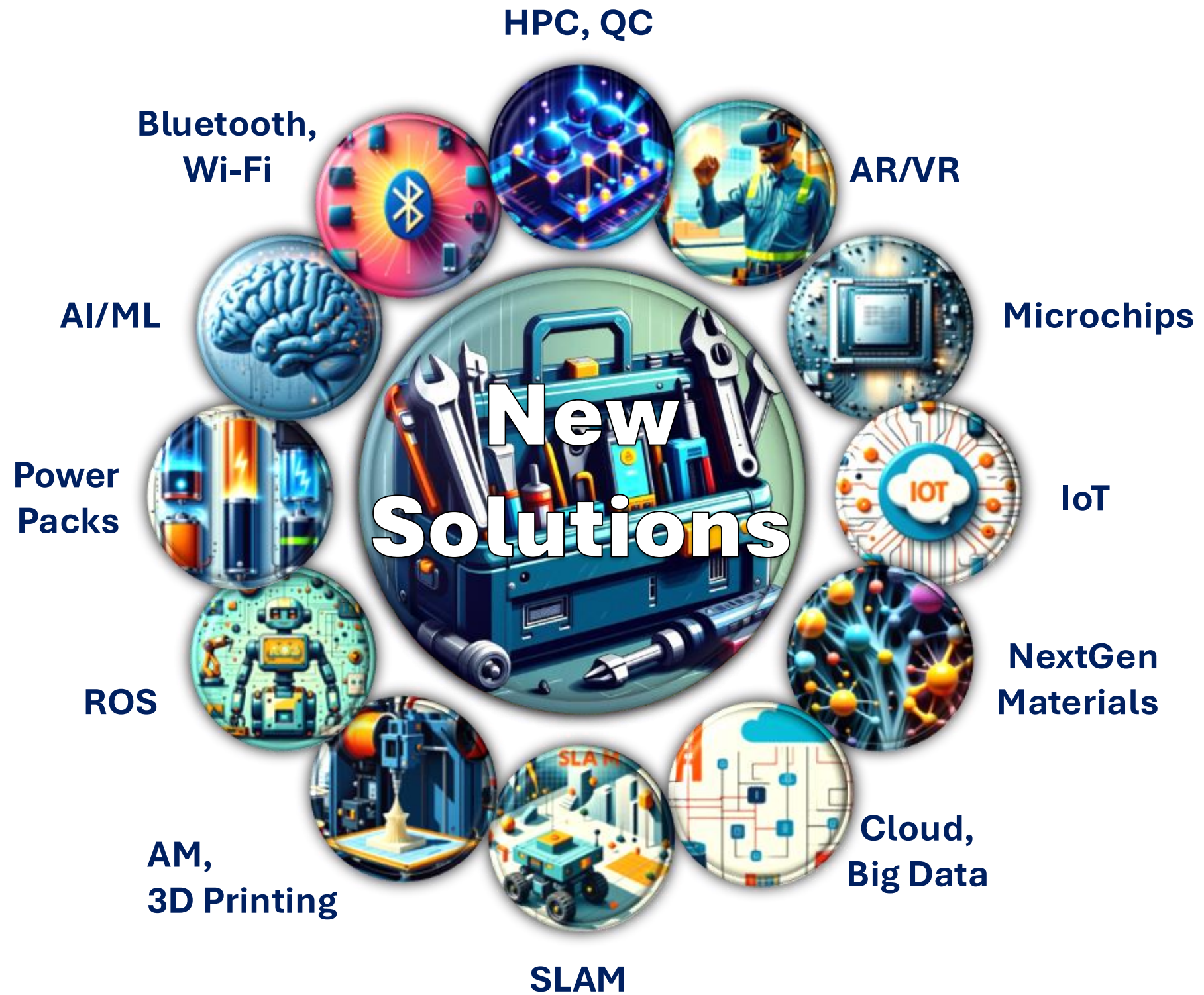
Workflows



Transportation & Communications



Applied Science



Priorities



Genesis Mission Launch

- On November 24, 2025, President Trump signed EO 14363 launching the "Genesis Mission," a national initiative aiming to double U.S. scientific productivity within a decade using AI.
 - Modeled as a "Manhattan Project" for AI, DOE will lead 17 national laboratories in creating an integrated AI platform to accelerate discoveries in energy, medicine, and material sciences.



Genesis Mission Implementation

- On February 9, 2026, DOE launched the Genesis Mission Consortium, a public-private partnership advancing DOE’s Genesis Mission to harness the power of AI to accelerate scientific discovery, strengthen national security, and ensure America leads in energy and emerging technologies. Refer to <https://genesis.energy.gov/>.
- On January 13, 2026, EM issued “Charter for Developing the Research and Development Roadmap for Leveraging AI to Enable Acceleration of the EM Cleanup Mission”
 - Commissioned the Network of National Laboratories for Environmental Management and Stewardship
 - Draft R&D Roadmap, April 30, 2026
 - Final R&D Roadmap, June 30, 2026



EM Soil and Water R&D Roadmap

- **Research and development priorities that have the potential of impacting the environmental liability**
 - 1) **Shift from active remedies to passive remediation**
 - 2) **Improve plume monitoring**
 - 3) **Refine conceptual site models**
 - 4) **Use of testbeds**

Restoration & Revitalization



Delivering Nuclear Remediation and Revitalization for American Energy, Security, and Innovation



Delivering Nuclear Remediation and Revitalization for American Energy, Security and Innovation

2025 Accomplishments

- **Advancing DOE's three-pillared vision for American Security, Science, and Energy**
 - **Safely addressing aging facilities to contribute to the modernization of America's strategic deterrent**
 - **Advancing infrastructure critical to winning the AI race**
 - **Grow America's burgeoning nuclear renaissance**
- **Starting a new chapter of remediation, revitalization, and redevelopment**
- **Enabling a transition from nuclear remediation to nuclear renaissance in 2026 and beyond**

Environmental, Ecological, Cultural Resiliency



Economic, Industrial, Workforce Resiliency



Final Thoughts



Perspectives

- **Turn liabilities into opportunities**
- **Catalyze ingenuity and innovation**
 - Reduce environmental liability
- **Continuously improve**
 - Operational efficiency
 - Cleanup effectiveness
 - Environmental protectiveness
 - Public safety



Looking Forward

- **Springboard to unleash American energy dominance**
 - Nuclear renaissance → backend of the nuclear fuel cycle
 - AI and innovation → global leader and technological excellence
 - National security → securing nuclear and radiological materials
- **Forward-looking vision on revitalizing EM sites**
- **Clean up the past and build a prosperous future**



Collaboration



Thank You

Rodrigo Rimando

**Director, Office of Technology Operations
Office of Environmental Management
rodrigo.rimando@em.doe.gov**



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