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The Design and Challenges of Developing a Community Based Environmental Radiation Study in Madagascar

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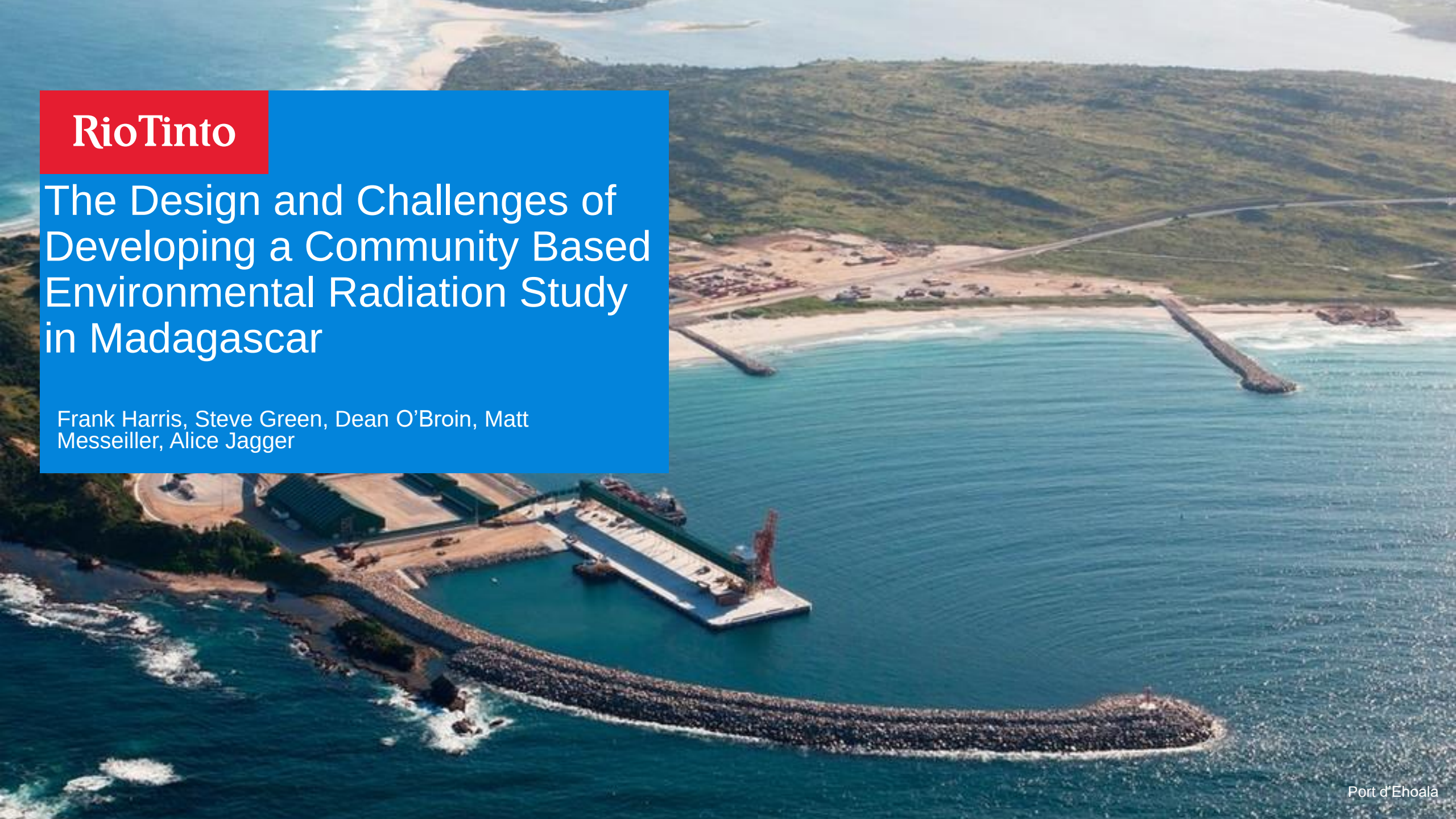

Port d'Ehoala

QIT Madagascar Mineral and the Fort Dauphin Site

- A large mineral sands operation employing approximately 2000 people
- A joint venture between Rio Tinto (80%) and the Government of Madagascar (20%) producing
- Located on the south eastern end of Madagascar
- The site is in a rural area with a number of small villages, isolated farms and river and lake systems with the major regional centre being Fort Dauphin to the south
- The topography is a relatively flat costal plain rising in the west to mountains and a near costal mountain located near Fort Dauphin
- Winds totally dominated by ENE winds with October to January having the highest wind speeds
- The entire costal region is characterised by mineralised sands of varying activity
- Mining has two separate phases: a floating wet processing place separating based on density and a land based dry processing plant separating on the basis of magnetic and electrostatic properties

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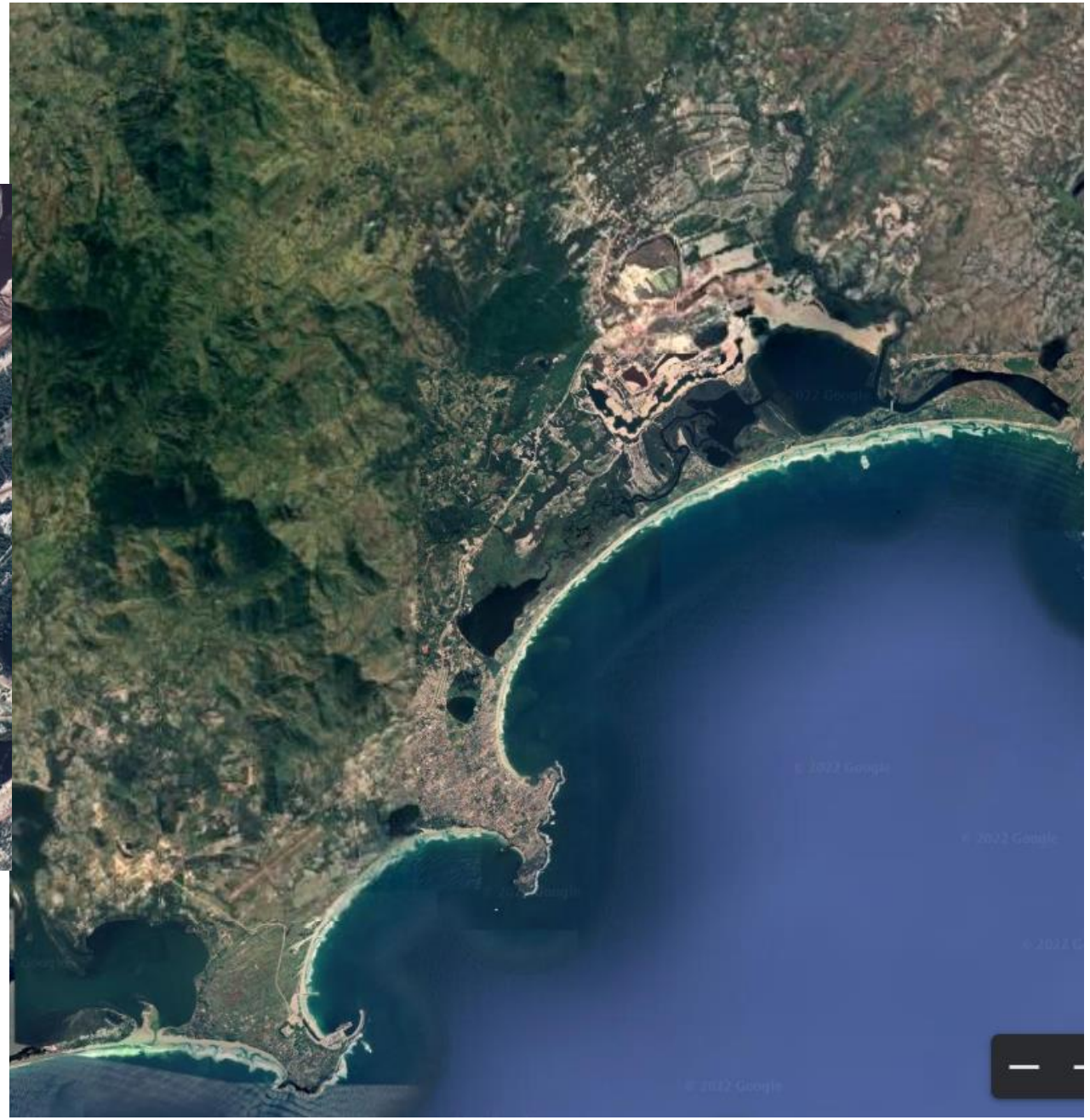
The Region



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NGO’s, The Community and Radiation

- QMM is one of the biggest employers in Madagascar and is the biggest industry in the south eastern region
- QMM is heavily involved in support for the region including operation of the port, local infrastructure, water and electricity supply, etc.
- However, the mine does cause issues in the local community driven by economic inequality and land access
- Internationally the mining operation is of concern to a number of NGO’s
- A 2019 NGO radiological review highlighted a number of deficiencies in the QMM environmental monitoring particularly associated with the aquatic pathway and food stuffs
- QMM contracted JBS&G to undertake a fresh environmental radioactivity study at QMM with a particular focus on potential impacts on surrounding communities
- Strong emphasis on quality assurance and control and chain of custody

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The Design of the Study – Scope

- The scope of the study was focused on covering all the radiological impacts and auxiliary sampling (eg water physical parameters such as pH, conductivity and chemical analysis for potential chemical indicators eg Ba for Ra) was restricted to aspects which would assist with the radiological study
- The sampling program was designed to assess potential risk to identified community receptors (current and future) by three primary pathways direct gamma, inhalation and ingestion.
- Water and food basket sampling and analysis was undertaken representative of current community behaviours (eg water collection to mimic village collection, whole fish and shrimp analysis where local consumption indicates)
- Iterative approach to sampling with results informing expansion of both sample types, sample quantities, locations (including background) and laboratory analysis methods (reduced LODs etc)
- Consideration of atypical exposure practices such as wood collection and product transport
- Pre existing information would only be utilised for guidance on study design or where previous data can be independently verified within the current study

Parameters Studied

The following pathways formed the basis of the sampling

- Gamma monitoring: concentrating on where public exposure could potentially occur such as wood gathering, transport corridors and the port facilities
- Soil and sediments: Concentrate on areas of community concern such as crop fields
- Dust fallout: Dust fallout gauges install upwind and downwind of the mine site and in selected local communities
- Waters (surface, ground and drinking): Examined both upstream and downstream of the local communities.
- Food Stuffs: Focus on community consumptions and local sources taking into account season aspects and variations between communities

Surface Water Monitoring

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Groundwater and Passive Dust

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Fish and Sample Drying

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Analysis

- Cannot assume any aspect of equilibrium or ratios between radionuclides
- Physical parameters measured on site (eg pH, Conductivity, wet weight)
- Sample preparation (eg drying, bagging) performed on site
- Strong chain of custody for all samples from sampling to site to analysis
- Radiochemical and chemical analysis performed at recognised international laboratories

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Key Issues/Challenges

- Logistics: Getting samples out of a country can be EXTREMELY difficult: need for strong logistical support including interrelationships between the company, transport couriers, and all levels of government. Even getting sampling equipment to site is difficult and time consuming
- COVID 19: sampling was supposed to be conducted by or under the direct supervision of JBS&G: This occurred for the first round but site access was impossible after early 2020. Significant delays initially whilst remote methods for confirmation of sampling integrity and chain of custody. COVID delays also heavily impacted logistic and analysis timeframes
- Analysis timeframes: Getting results takes a considerable timeframe (including logistics, customs, irradiation and analysis) which means that getting results prior to the next round is problematic
- Need for changes to analysis techniques for key samples and radionuclides. For example multiple Po210 analysis to get a lower limit of detection for Pb210
- Community consultation and meetings around the sampling and monitoring program and radiation concerns in general
- How much is ever enough

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Explaining Radiation (or trying to)

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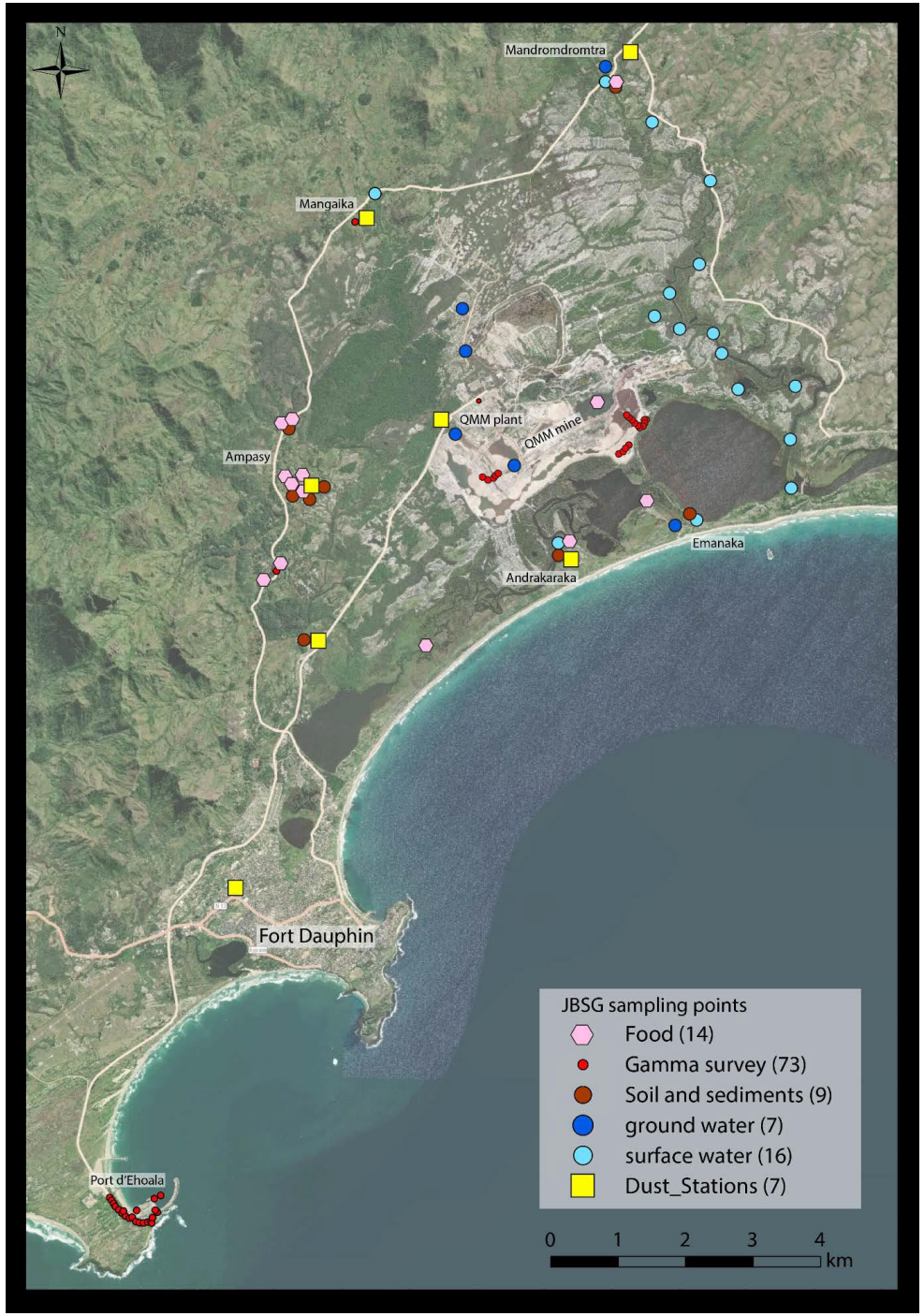
Initial Sampling

- First round sampling structured around local knowledge of communities and local environmental pathways
- Constrained by local issues such as high wind speeds preventing fishing activities
- Some surprise or opportunistic samples such as fish in internal ponds and gamma at the port due to a full load of rare earth concentrate
- Sample preparation and delivery became a real challenge leading to a lot of last minute stress



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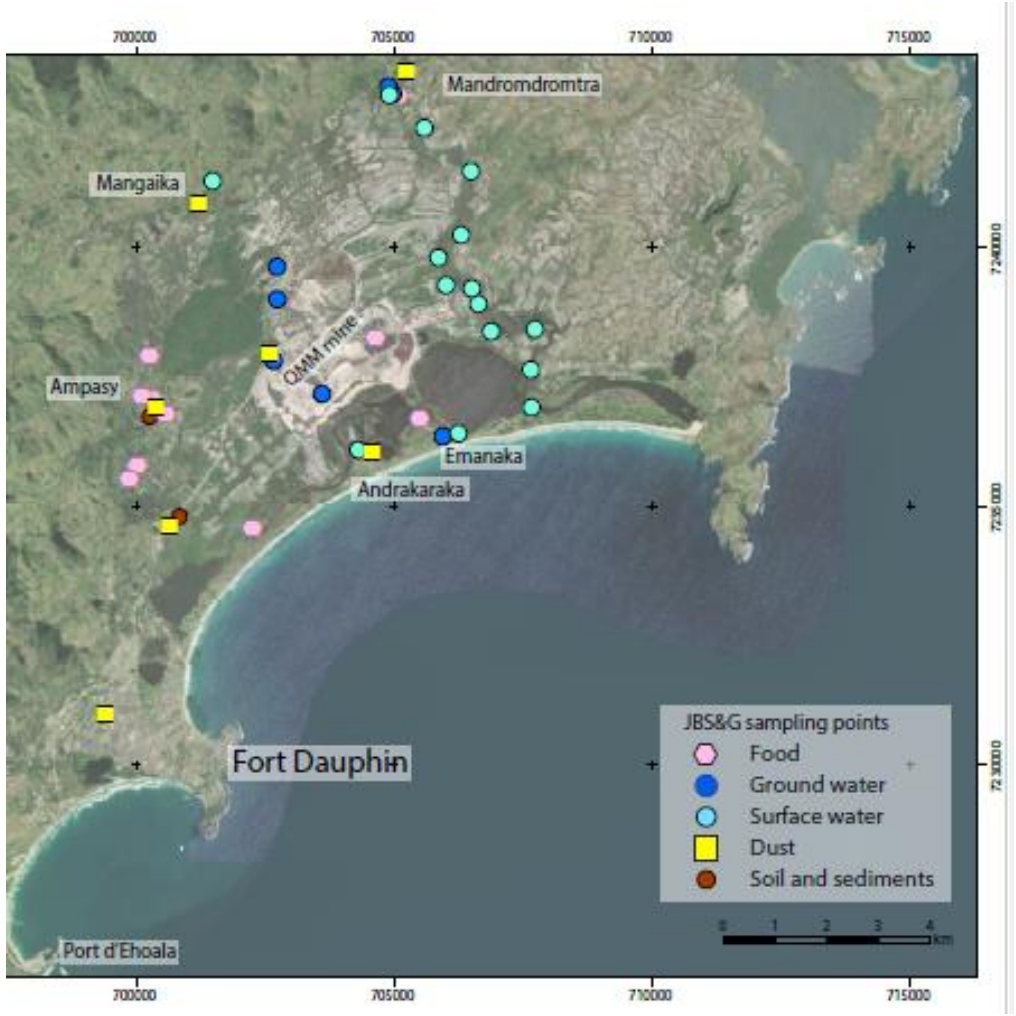
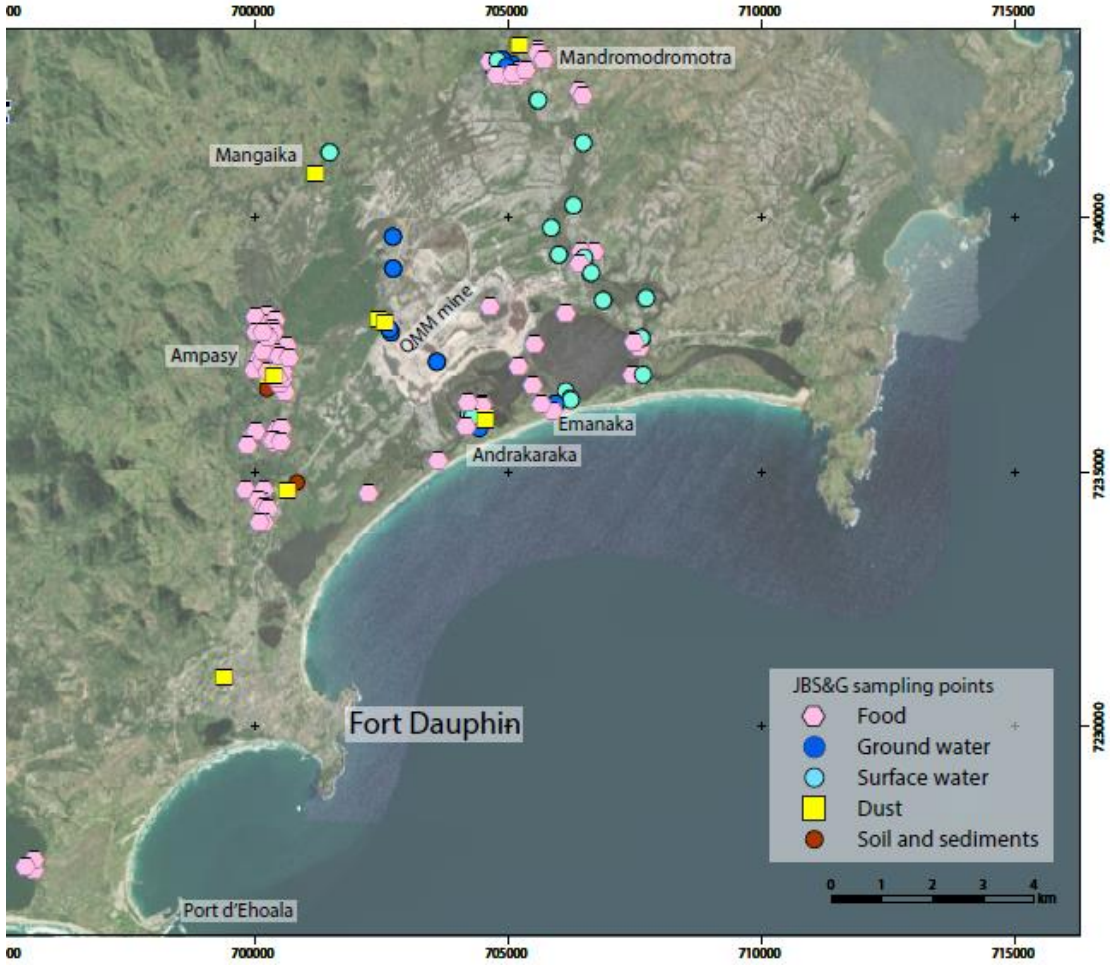
Be Prepared to Evolve the Monitoring





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The Results

- Next presentation????

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The Future

- Communication and community consultation is going to be the major future challenge: difficulties include multiple languages, a diverse education base and multiple communities with different concern
- Need new methods of communicating radiation
- Where to after the study: how to establish an ongoing program given site difficulties and analysis constraints
- Maintain and expand the radiological expertise in the area

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Conclusions and Learnings

- Always be flexible in the design and implementation of a environmental radiation program
- Never underestimate the local issues and constraints
- Be prepared to be amazed by the capabilities of the locals
- It is the surprises and the unexpected which make these studies exciting and challenging

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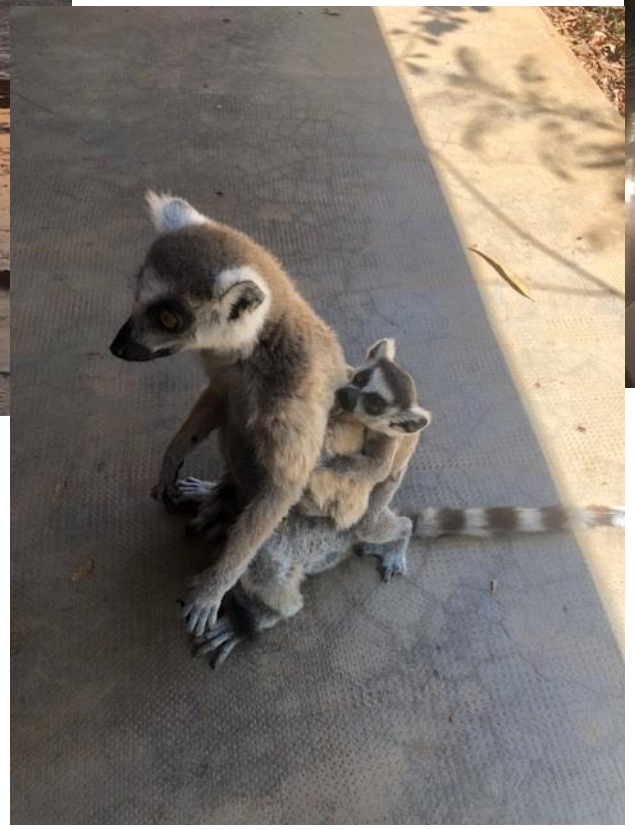

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Any Questions?

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