



TRC ENVIRONMENTAL CORP.

Roche-Nutley Remediation Project

AAEES Environmental Sustainability Grand Prize

April 25, 2019

Introduction



- **Roche-Nutley:** Roche's US HQ, and a manufacturing and R&D facility for >80 years
- **Site Closure:** Roche closed the 120-acre Site in 2013 and retained TRC to spearhead Site Remediation
- **Roche Strategic Goal:** accelerate remediation while exceeding/meeting stringent NJ's standards and Roche guiding & sustainability principles to enable rapid and socially responsible site redevelopment



- **Remediation Road Map**
 - 15 Investigative Areas (IAs)
 - 200 Areas of Concern (AOCs)
 - 10 Interim Remedial Measures (IRMs)
 - 7 Licensed Site Remediation Professionals (LSRPs)
- **Adaptive investigations & cleanup**
 - Dynamic, systematic & accelerated plans
 - Pioneering & sustainable approaches
 - Dedicated IA design teams

Sustainable Management Practices



- **Roche Guiding & Sustainability Principles**
- **Deliberative governance:** oversight and progress tracking by teams of experts & stakeholders and IA design teams
- **Programmatic Management Plans**
- **Green Remediation Practices:** Environmental Footprint Life-Cycle Analyses (LCA) & Best Management Practices

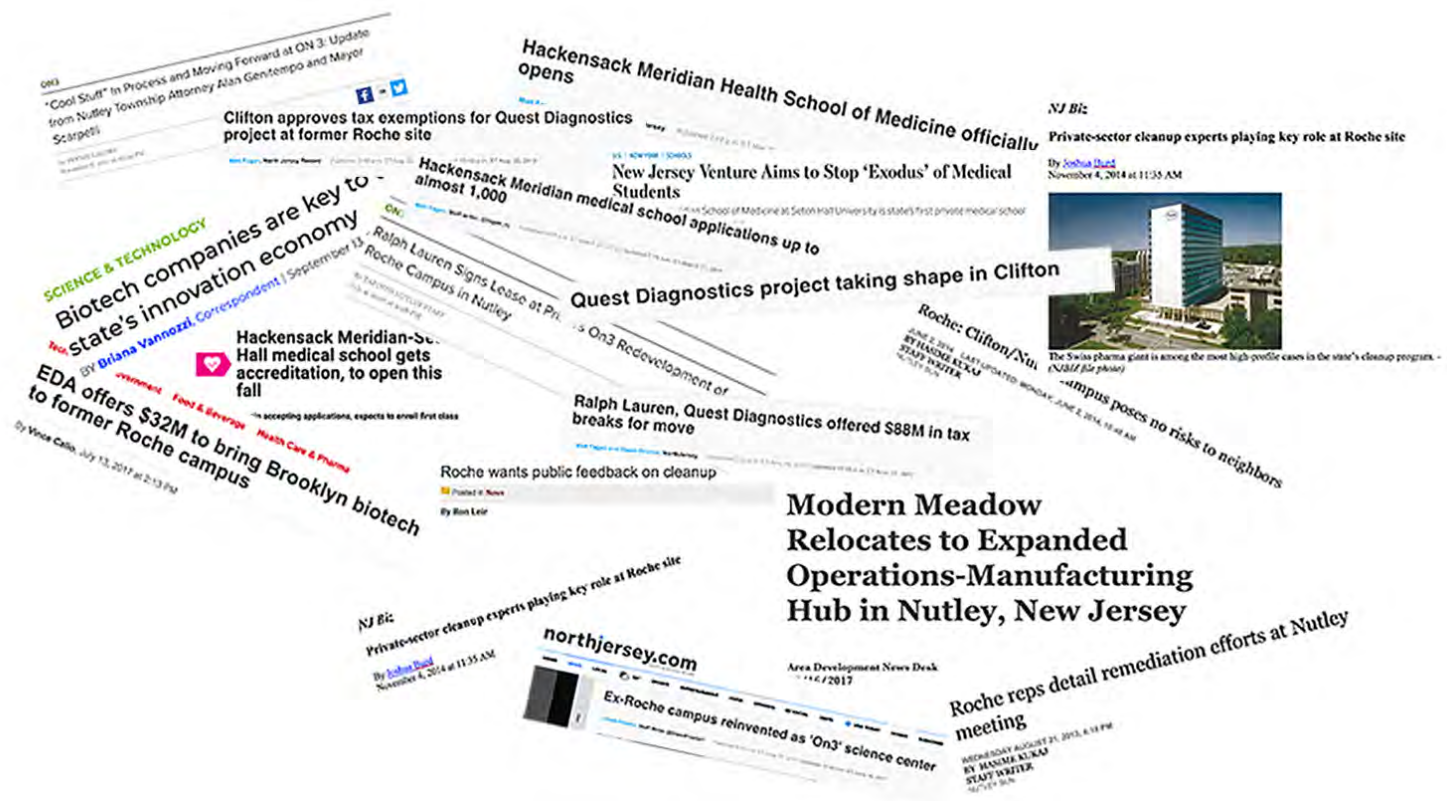


Summary of Environmental Footprint Metrics		
Core Element	Metric	Unit of Measure
Materials & Waste (M&W)	M&W-1. Refined materials used on site	Tons
	M&W-2. % of refined materials from recycled or waste material	%
	M&W-3. Unrefined materials used on site	Tons
	M&W-4. % of unrefined materials from recycled or waste material	%
	M&W-5. Onsite hazardous waste disposed of off site	Tons
	M&W-6. Onsite non-hazardous waste disposed of off site	Tons
	M&W-7. % of total potential waste recycled or reused	%
Water (W)	Onsite water used (by source)	
	▪ W-1. Source, use, fate combination #1	Millions of gallons
	▪ W-2. Source, use, fate combination #2	Millions of gallons
	▪ W-3. Source, use, fate combination #3	Millions of gallons
	▪ W-4. Source, use, fate combination #4	Millions of gallons
Energy (E)	E-1. Total energy used	MMBtu
	E-2. Total energy voluntarily derived from renewable resources	
	▪ E-2A. Onsite generation or use and biodiesel use	MMBtu
	▪ E-2B. Renewable electricity purchase	MWh
	▪ E-2C. Purchase of renewable energy certificates (RECs)	MWh
Air (A)	A-1. Onsite NO _x , SO _x , and PM emissions	Pounds
	A-2. Onsite HAP emissions	Pounds
	A-3. Total NO _x , SO _x , and PM emissions	Pounds
	A-4. Total HAP emissions	Pounds
	A-5. Total GHG emissions	Tons CO ₂ e
Land & Ecosystems	Qualitative description	

Communication Outreach and Media Engagement



- **Proactive Communication Program**
 - Weekly regulatory & LSRP updates/calls
 - Ongoing transparent public outreach (meetings & multi-lingual communications/notifications)
 - Exceeds both State and Federal outreach and notification requirements
 - Periodic IA design teams coordination calls/meetings



Comprehensive Remedial Investigations

- Multi-media: Soil, Rock, Groundwater, NAPL, Surface Water, Sediment, Vapor
- 30 drilling rigs at times
- >1,100 monitoring wells (up-to 700' deep)
- >9000 soil borings & 20,000 soil samples
- ~ 500 surface water & sediment samples



Soil Remedial Actions (RAs)



- Remediated all accessible soil to NJDEP's most stringent, unrestricted use standards
- Applied spatially-weighted compliance averaging to limit volume and achieve unrestricted use
- Completed remediation and obtained NJDEP approvals of RA Reports within an unprecedented 3-year time

Soils RAs – Sustainable Approach

- Off-site rail transport/disposal
 - Constructed on-site rail terminal
 - Activated nearby inactive rail line
- Efficiencies (v. truck transport)
 - 180,000 fewer gallons of fuel
 - >4 million fewer pounds of greenhouse gases
- 30% of impacted soil was beneficially reused as daily landfill cover



St. Paul's Brook Riparian Area Restoration



Before removal of 1,600 tons of debris, fill material and invasive plants



Winter 2013

After installation of clean soils, erosion controls and native species



Winter 2018

Pre-Design Investigations (PDIs)

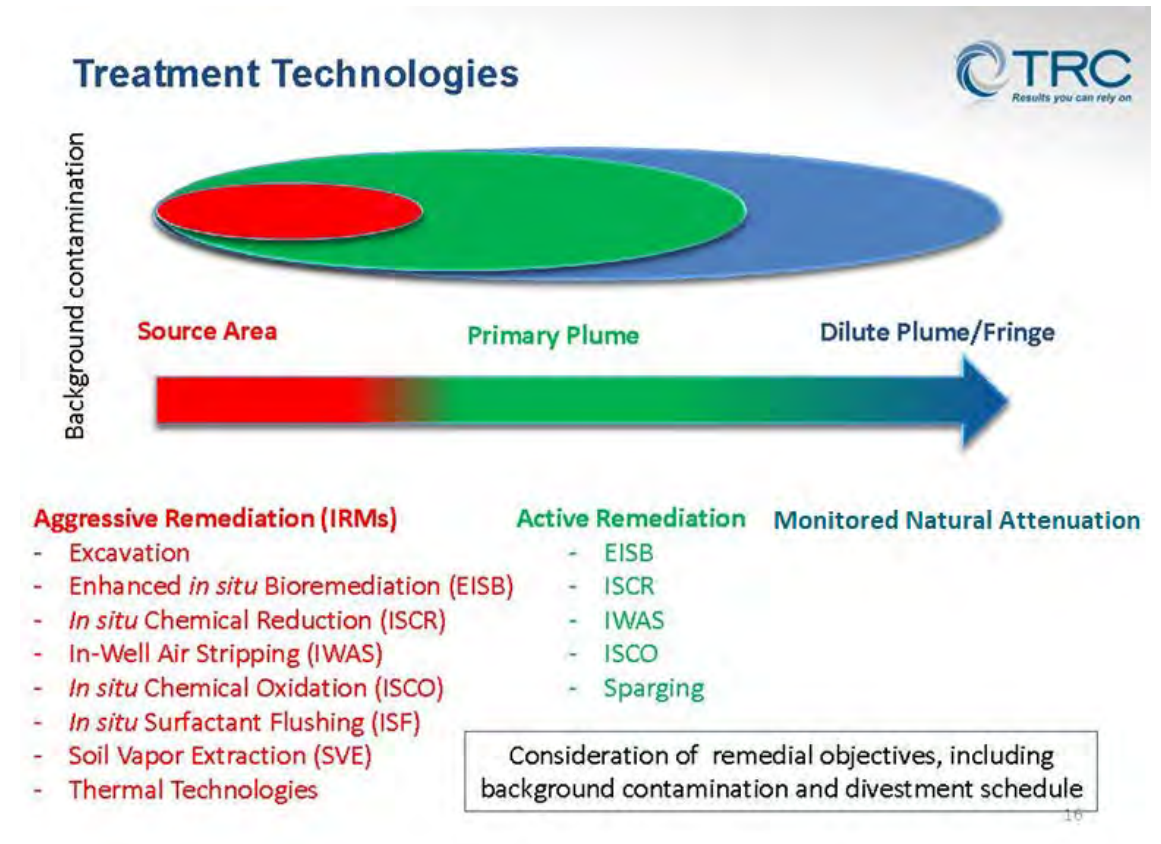


- Proactive & adaptive PDIs to define volumes, conditions, and remedial options
- Advanced & high resolution characterization techniques to optimize IRM efficiency
- Roche and TRC partnered with cutting-edge technology and labs advancing the science and engineering of the remediation field.

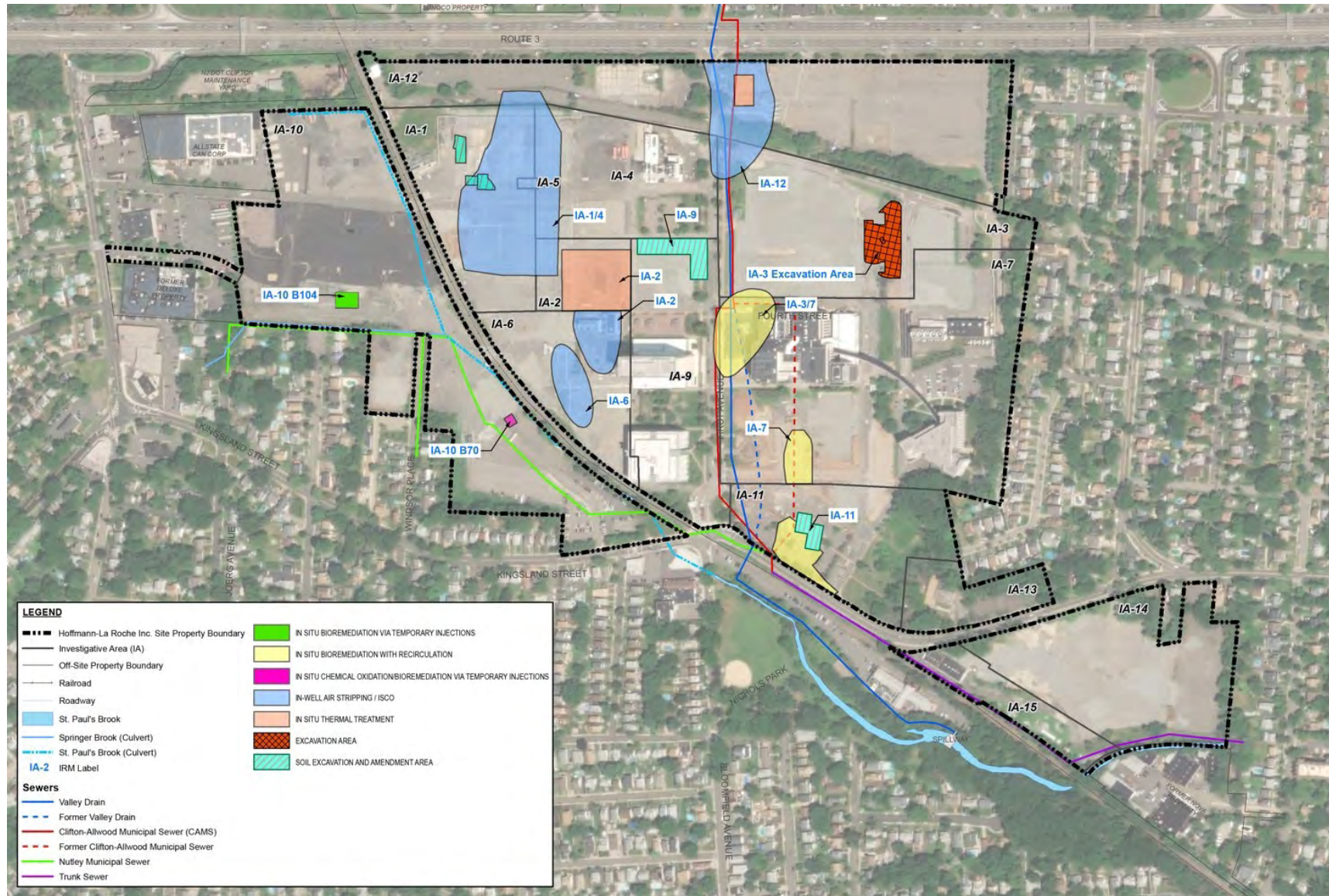
Groundwater Interim Remedial Measures (IRMs)



- Innovative technologies
- Multi-technology combinations including contingent soil vapor extraction (SVE)
- Remedial Action Selection Process (CERCLA protocols & Roche Guiding Principles)
- Environmental Footprint/LCA Analyses (EPA SEFA tool)
- Met aggressive timelines and achieved IRM goals on most IAs within 1 to 3 years



Groundwater IRMs



IA-12 In-Situ Thermal Treatment (ISTT) IRM

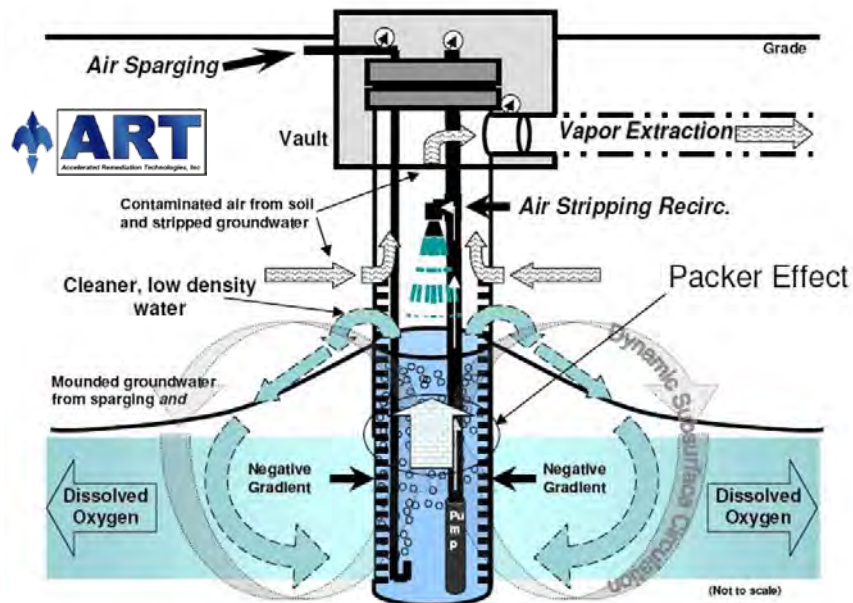


- Electrical resistance heating (ERH) for source zone chlorinated volatile organic compound (CVOCs) in groundwater and bedrock
 - 92% removal (~1,143 lbs. VOCs)
 - RASP & LCA → ISTT more energy-efficient and cost effective than alternative remedies
 - Innovative design combined ART In-Well Air Stripping (IWAS) and In-Situ Chemical Oxidation (ISCO) around ISTT area

IA-1/4 ART-IWAS/ISCO IRM



- Unique approach to treat emerging contaminant, 1,4-Dioxane and VOCs, in fractured bedrock
- Innovative design combined IWAS Recirculation with ISCO using ozone
- 70 to >99% 1,4-D concentration reduction
- ~100% VOC concentration reduction
- Supplemental ISCO using activated persulfate in rate-limited areas
- One of the first applications of this technology combination in New Jersey



IA-3/7 Enhanced In-Situ Bioremediation (EISB) with ART- IWAS Recirculation IRM



- Extensive treatability and pilot study for remedy selection & optimization
- EISB with Anaerobic ART-IWAS recirculation for CVOCs
 - Innovative multi-technology strategy
 - Reduced CVOC concentrations: 76% to 100%
- Methane inhibition additive
 - First application at this scale
 - Minimized EISB amendment loadings
 - Minimized methane by-product production



IA-11 DNAPL Excavation and EISB IRM

- DNAPL in soil and bedrock due to breach in non-Roche municipal sewer
- DNAPL source zone excavation of overburden and shallow bedrock
 - Limited area, large depths (~27 ft bgs)
 - Difficult weathered bedrock matrix
 - Continuous dewatering required
- Creative structural design
- 3-D visual-model design
- Engineered backfill for permeable bio-reactive zone for EISB polishing
- EISB with recirculation for outer plume
- ~100% CVOC concentration reduction



Sustainability Highlights



- Soil and groundwater remedies saved:
 - >1.3 Billion BTUs of energy
 - >7,000 tons of CO₂ emissions
- Water preservation and waste minimization
 - On-site treatment of >8MM gallons of contaminated water eliminated 2,500 truck trips for off-site disposal.
 - Recirculation
- Holistic, innovative, programmatic, and collaborative remediation approach resulted in:
 - Accelerated remediation
 - Enabled rapid redevelopment
 - Provided education, research, and career opportunities
 - Rekindled tax revenues to benefit the surrounding communities



Path Forward

- Pioneering remediation program facilitated rapid property divestment & repurposing, which is vital to the region's economic development
- Redevelopment of ON3 campus: a medical school and state-of-the-art lab facilities





Thank You

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