From: abrophy@nlh.nl.ca
Sent: Thursday, August 30, 2012 9:02 AM
To: g.shortall@[redacted]
Subject: 3 presentations for this mornings meeting
Attachments: 2012 08 23 Board DG3 Cap Cost Update.pdf

1st one

2012 08 23 Board DG3 Cap Cost Update.pdf

CONFIDENTIAL

DG3 Capital Cost Update

August 23, 2012

Boundless Energy

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LOWER CHURCHILL PROJECT

Safety Moment

Purpose / Objectives

- To present the Decision Gate 3 capital cost estimate.
- To review key drivers of Decision Gate 3 capital cost estimate.

Presentation Outline

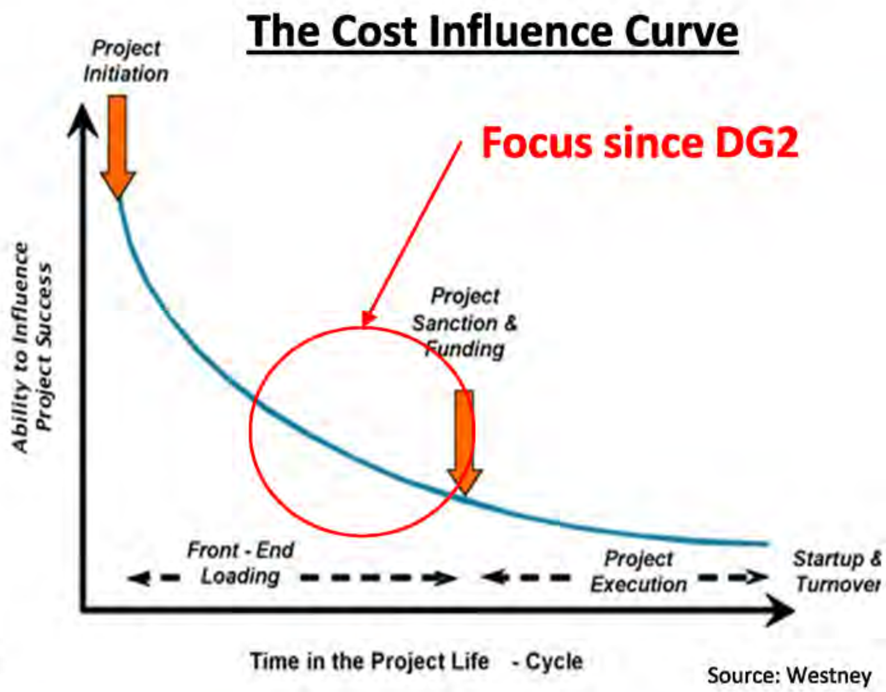
- The Project Today
  - Project Execution Roadmap
  - Project Definition since Decision Gate 2
- Decision Gate 3 Cost Estimate
  - Process and Outcome
  - Review Key Changes since Decision Gate 2

Project Execution Roadmap

Application of Industry Best Practice

- Front-end loading to confirm project scope and align with business objectives
  - Advanced Project Definition through completion of substantial engineering
    - Target engineering completion prior to start of construction
  - Extensive execution and construction planning
  - Adopt contracting strategies that minimizes and optimally allocates risk
  - Firming key prices through bidding before Sanction
- Early and continued focus on de-risking the projects
  - Shaped engineering, execution planning, contracting strategies, and decision to commence Early Infrastructure Works

The Cost Influence Curve



Source: Westney

"... the LCP Gate 3 estimate in its current state is one of the best mega-project "base" estimates that this reviewer has seen in some time."

- John K. Hollmann, PE CCE CEP, Owner – Validation Estimating LLC April 2012

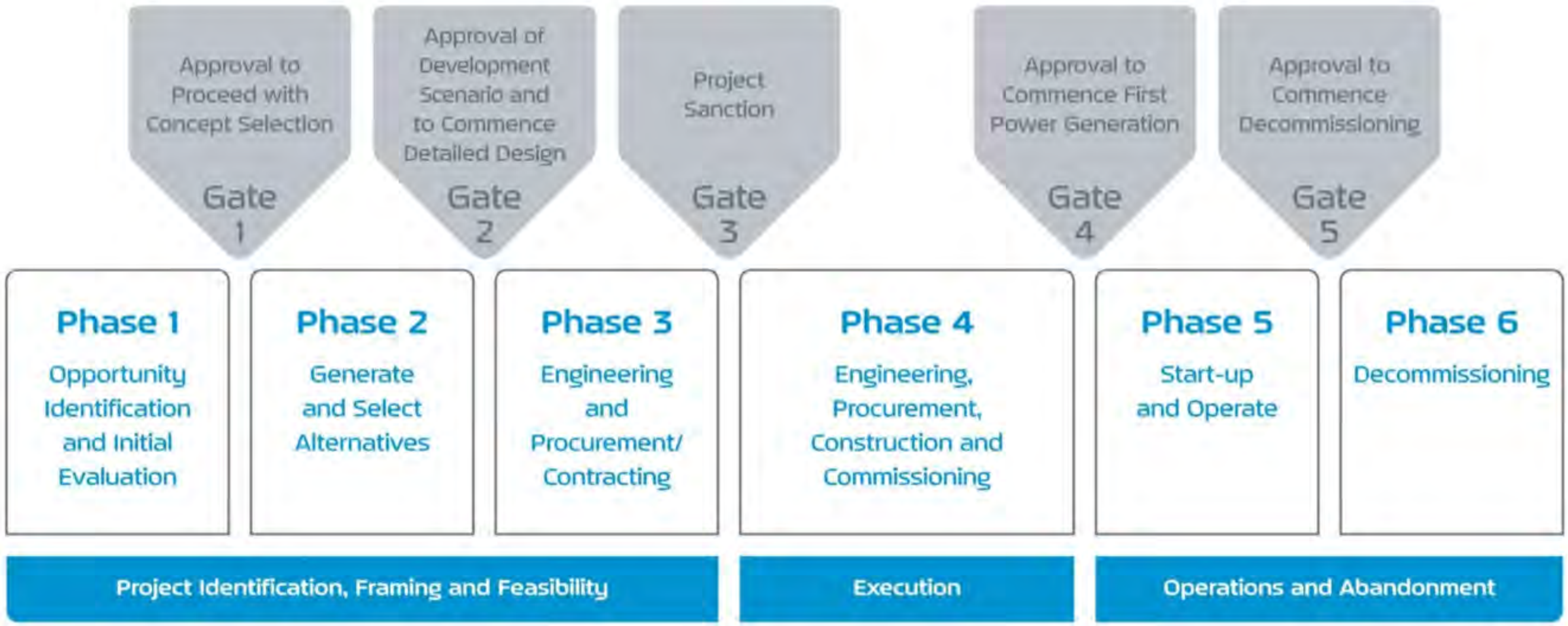
Front-End Loading: *#1 Predictor of Performance*

Site Factors + Engineering Definition + Project Execution Planning → FEL

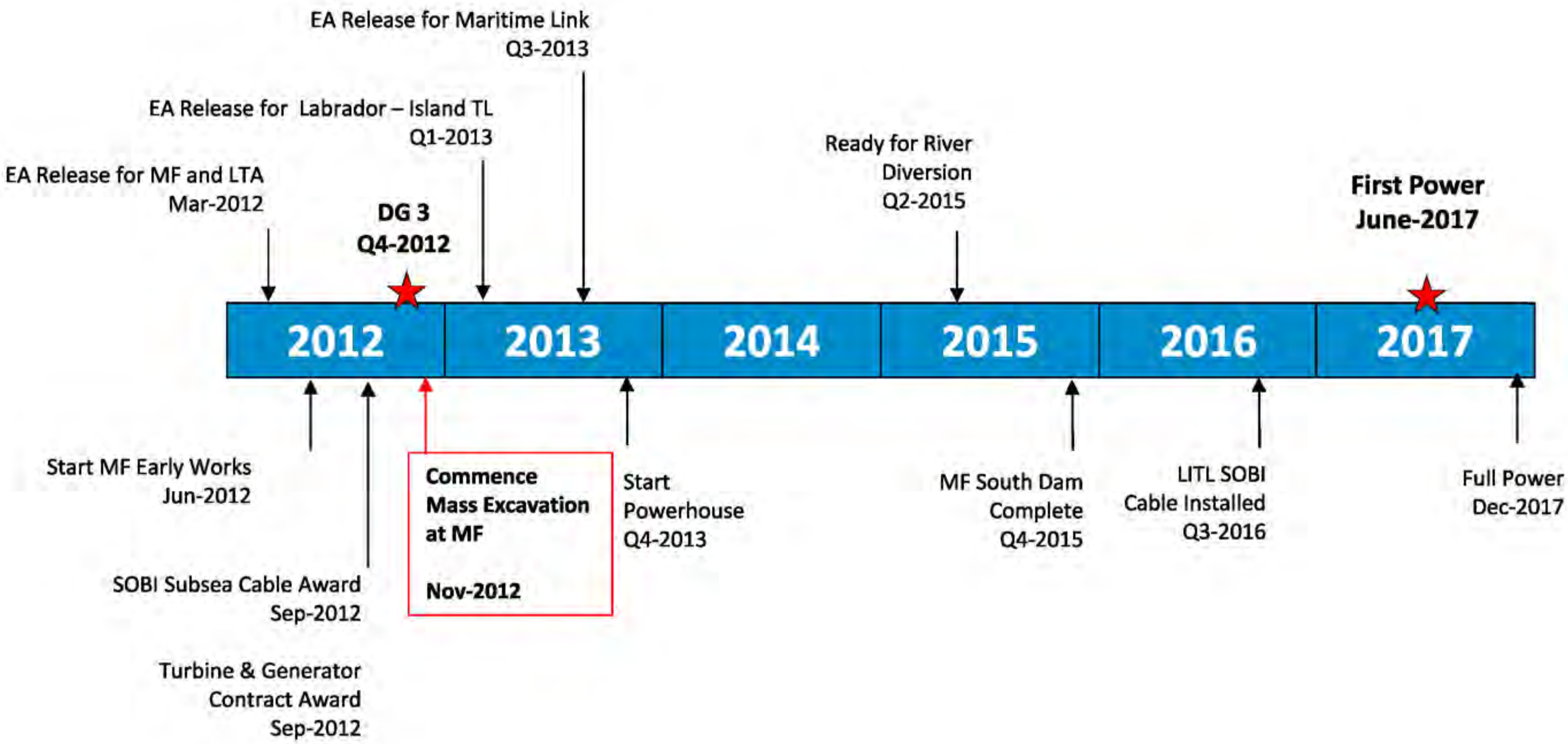
- Gateway Phase 3 focus directed towards completing the level of Front-End Loading to confirm the project definition and a "Sanction-quality" Class 3 cost estimate.
- We are tracking industry best practice which suggest expending 4 – 6% of Total Invested Capital in FEL activities pre-DG3
  - ~$250 million expended to-date
  - Engineering and detailed design well advanced > 45% complete

Nalcor's Stage-Gate Process

Structured, front-end loading process that enables risk-informed decision making at Decision Gates by completing critical analysis in the Phase leading to the Decision Gate, while ensuring a balance of analysis with capital pre-investment .



Project Milestones



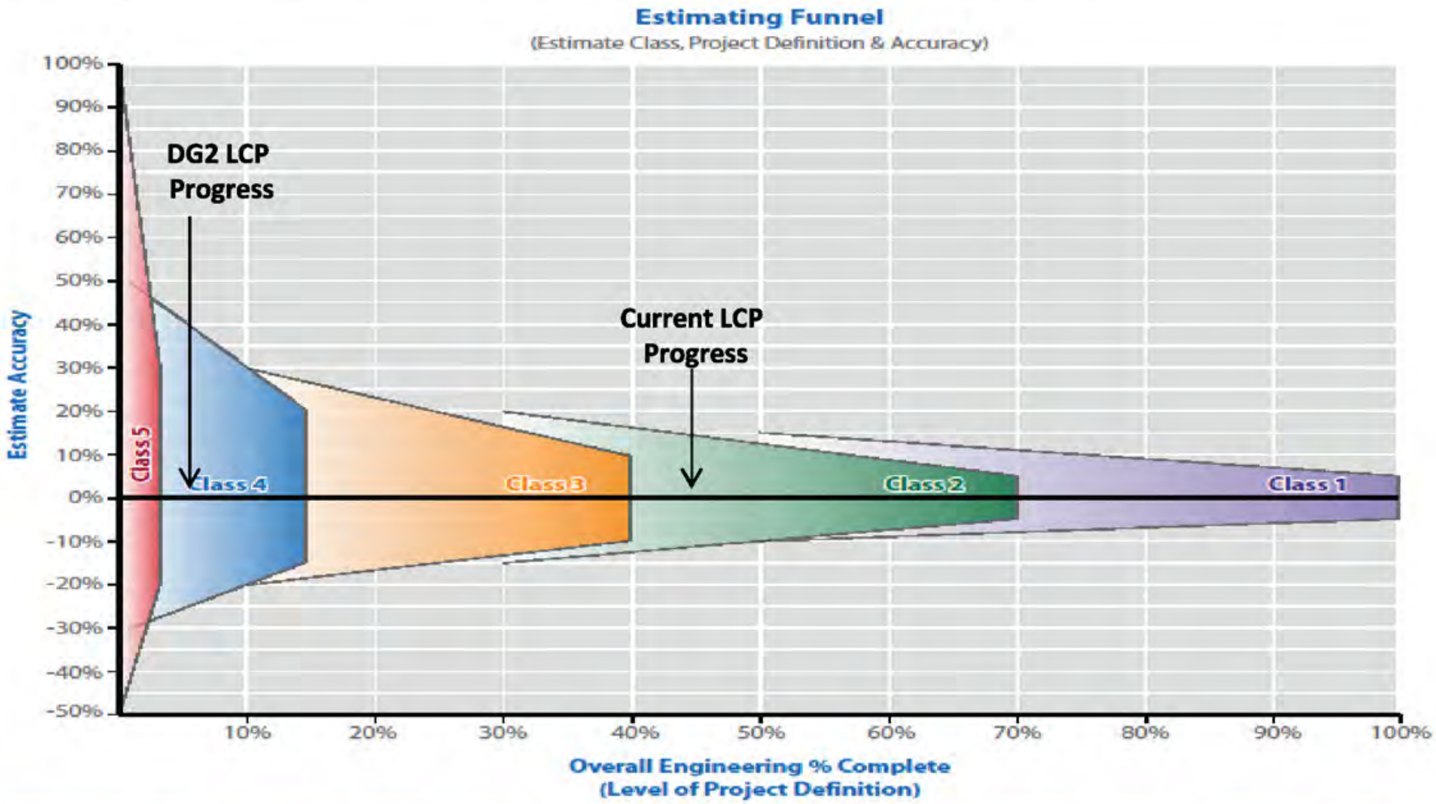
Establishing a High Quality DG3 Cost Estimate

- Estimate accuracy is the degree of confidence that the estimated cost will be close to the final project cost.
- As a project becomes better defined and less likely to change the more confidence there is that the estimate will accurately predict the final project cost.
- The accuracy of a project's cost estimate is a function of the:
  - level of Front-End Loading (i.e. project definition) completed
  - understanding and mitigating project's risk exposure

Estimate Accuracy
Shaping Characteristics for Lower Churchill

- Primary Driver:
  - High degree of project definition (i.e. represented by amount of engineering completed)
- Secondary Drivers:
  - Non-technically complex Project
  - Significant amount of effort expended to prepare estimate
  - High quality reference cost data available

Estimate Accuracy Evolution



Required for	Decision Gate 1	Decision Gate 2	Decision Gate 3	Financial Close	Mid-Point Check
Class	AACEI Class 5	AACEI Class 4	AACEI Class 3	AACEI Class 2	AACEI Class 1
Estimate Purpose	Opportunity Screening	Alternative Selection	Sanction / Control	Financing	Check Estimate
Project Definition	0% to 2%	1% to 15%	10% to 40%	30% to 70%	50% to 70%

Project Definition Since DG2

Significant Engineering has been completed since Decision Gate 2

- Followed work plan established at DG2 with early engineering directed towards areas of uncertainty
  - ~400 FTEs employed
  - Currently >45% engineering and detailed design complete – 1000+ document & drawings issued
- Project scope and execution plan have been confirmed, thereby allowing:
  - well-informed decision at DG3
  - more accurate cost estimate
  - matured risk awareness
  - enhanced capital predictability

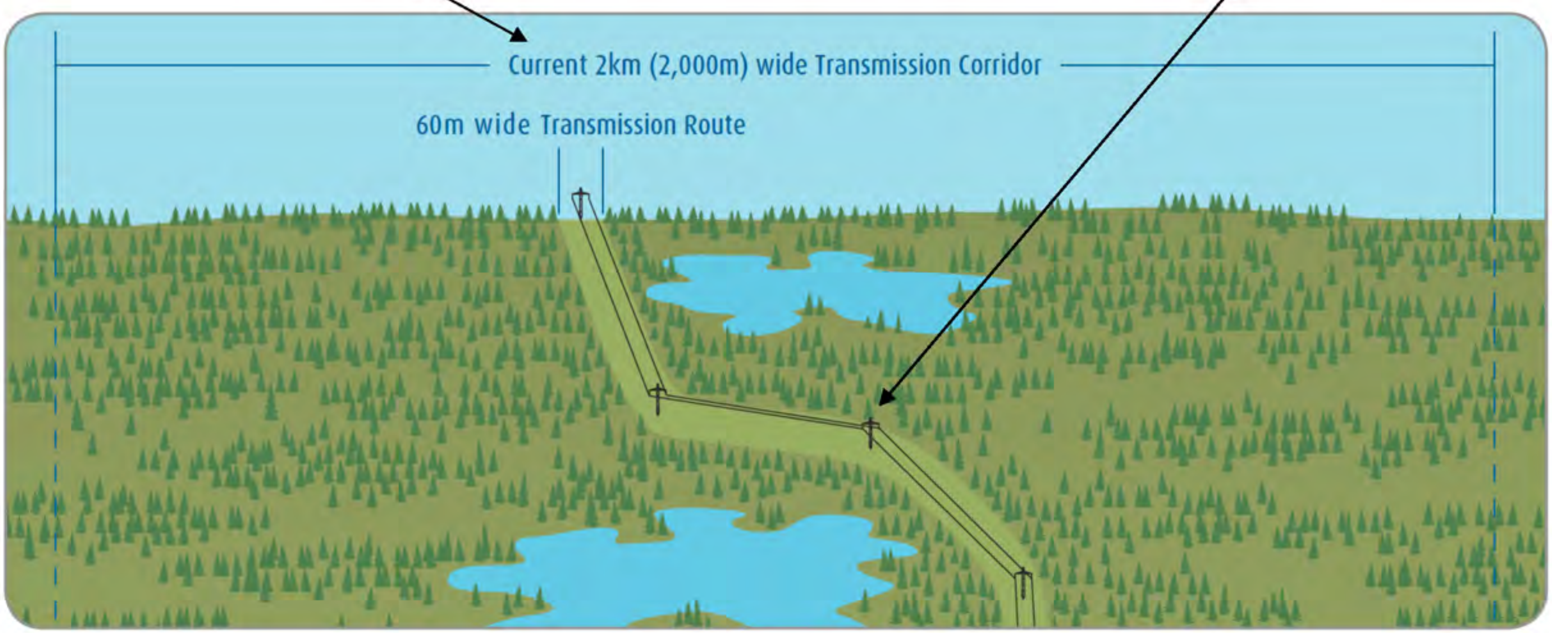
Project Definition – HVdc Transmission

A Closer Look: HVdc Transmission

Significant Engineering Design Development Complete

DG2: Working with general knowledge of Corridor Only

Now: Individual Tower Locations Selected



HVdc Engineering & Design Progress

Decision Gate 2

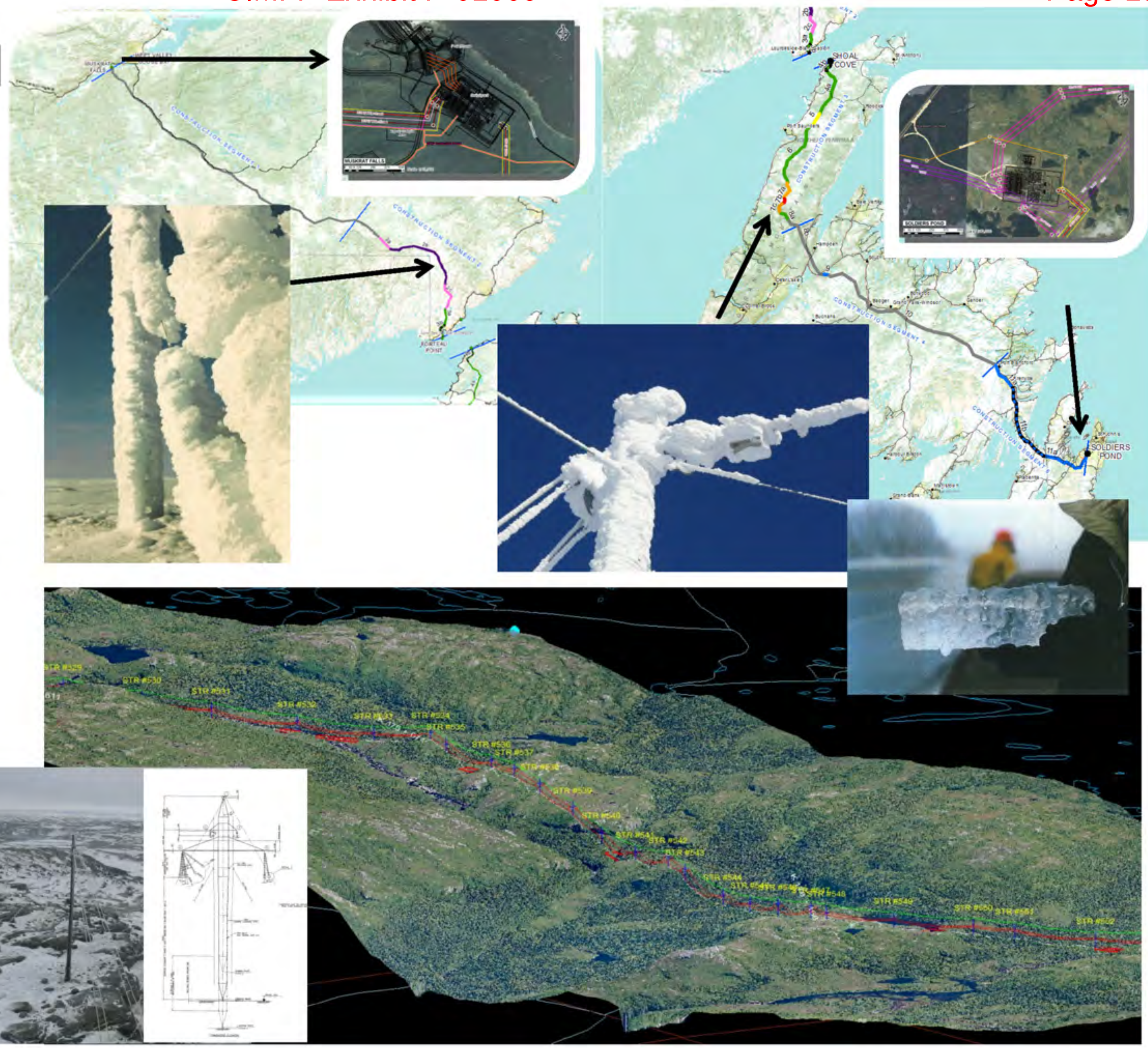
- 320kV operating voltage
- Preliminary 2km wide Transmission Corridor selected and basic geotechnical data obtained from 2007-08 program
- Generic tower configurations using historic meteorological conditions
- Desktop tower loading work underway
- Preliminary construction execution plan
- Preliminary conductor selection
- Budgetary quotes for tower steel and conductor

Decision Gate 3

- System operating voltage optimized to 350kV
- Lidar topography survey complete of Corridor
- Line Routing within Corridor complete
- Individual tower locations selected
- Harsh climatic conditions of southern Labrador and Long Range Mountains confirmed with meteorological data
- 13 Tower meteorological loading cases
- Foundation designs in-progress
- Conductor Optimization and System Stability studies complete
- ROW vegetation and clearing plans in-place
- Insulator and tower hardware designs progressing
- Budgetary quotes for all material
- Detailed construction plan in-place
- Acquisition of property for Marshalling Yards underway
- All line crossings and property easements identified
- Tie-in points being designed

Meteorological Conditions

- 3650 towers
- 350,000 Insulators
- 3,000,000 m of Conductor
- 13 distinct wind and ice combination zones developed from multiple desktop report and existing network of test towers/ test spans
- 170 km of High Alpine (Rime) Ice and Wind Loading, 180 km Heavy Glaze Ice
- 250 km of remote inaccessible line in central Labrador



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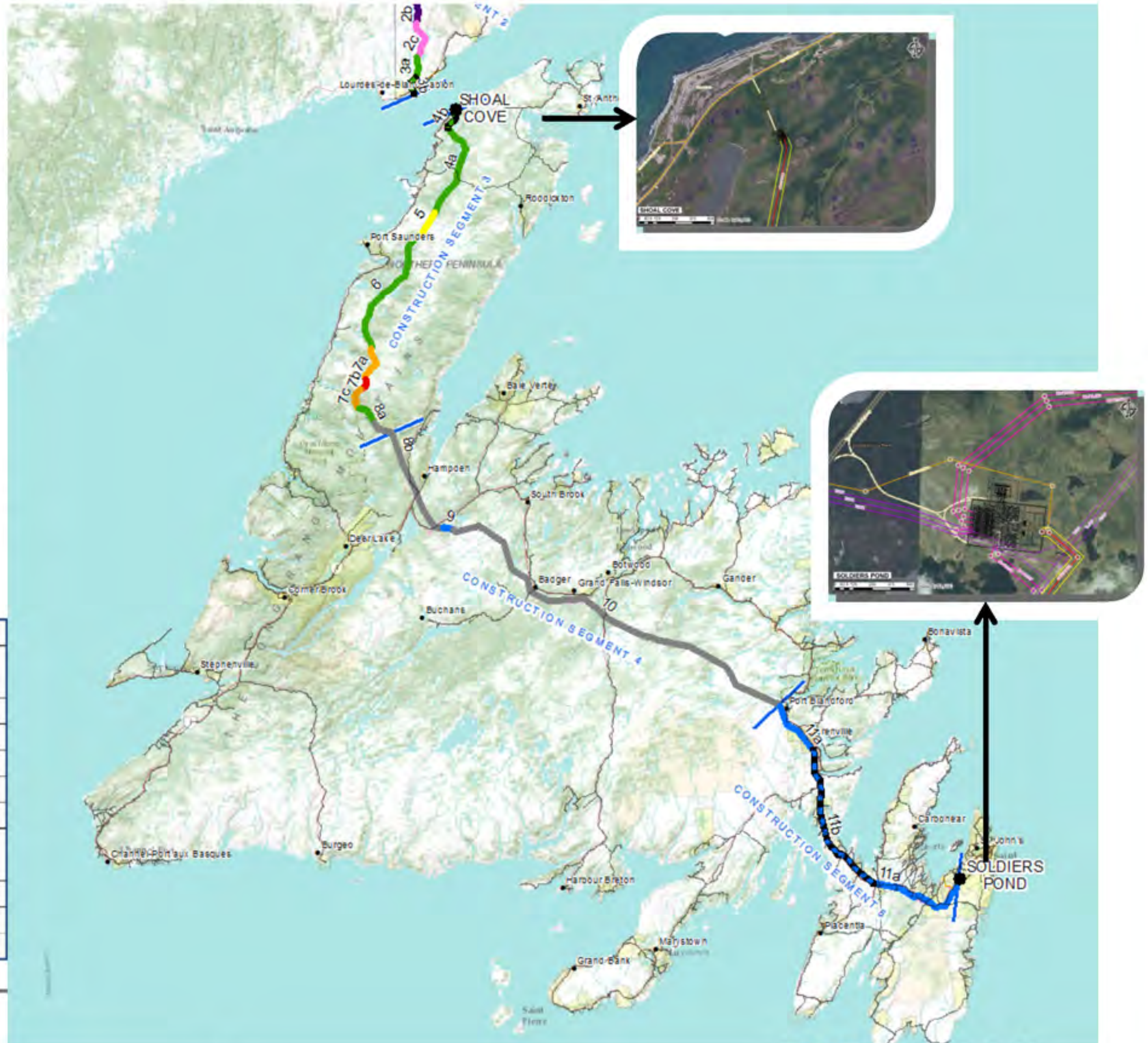
Island Meteorological Loading Cases

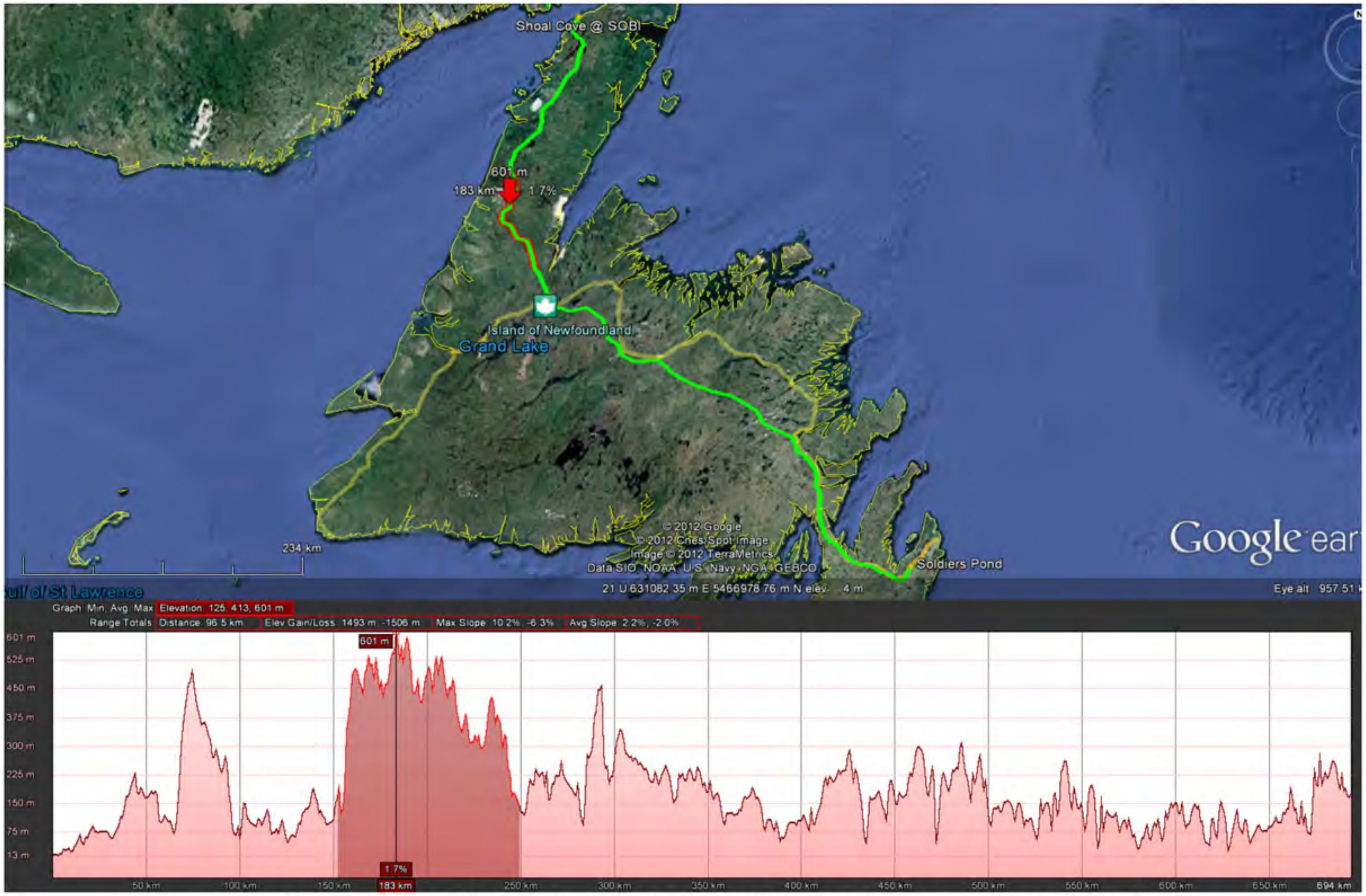
- 696 km from Shoal Cove to Soldiers Pond
- Long Range Mountains
- Avalon higher population density, more existing infrastructure
- 13 Meteorological loading cases (135mm Rime Ice and 180 km/h winds)

Newfoundland	③	4b	Average Zone 2	12.5	50	Glaze	120	N	Coastal	40	F10
		4a	Average Zone 2	56.4	50	Glaze	120	N	Inland	300	F5
		5	HOSJ High Alpine	18.9	115	Rime	150	N	Inland	500	F12
		6	Average Zone 2	72.6	50	Glaze	120	N	Inland	480	F5
		7a	LRM High Alpine	21.1	115	Rime	180	N	Inland	590	F9
		7b	LRM Extreme Alpine	7.1	135	Rime	180	N	Inland	630	F6
		7c	LRM High Alpine	12.8	115	Rime	180	N	Inland	600	F9
		8a	Average Zone 2	12.9	50	Glaze	120	N	Inland	550	F5
	④	8b	Average Zone 1	74.9	50	Glaze	105	N	Inland	400	F4
		9	Alpine	7.8	75	Glaze	130	N	Inland	430	F7
		10	Average Zone 1	221.0	50	Glaze	105	N	Inland	360	F4
	⑤	11a	Eastern Zone	89.4	75	Glaze	130	N	Inland	280	F7
		11b	Eastern Zone	86.8	75	Glaze	130	N	Coastal	210	F8



Detailed Topography Mapped

Significant Elevation Change in Long Range Mtns

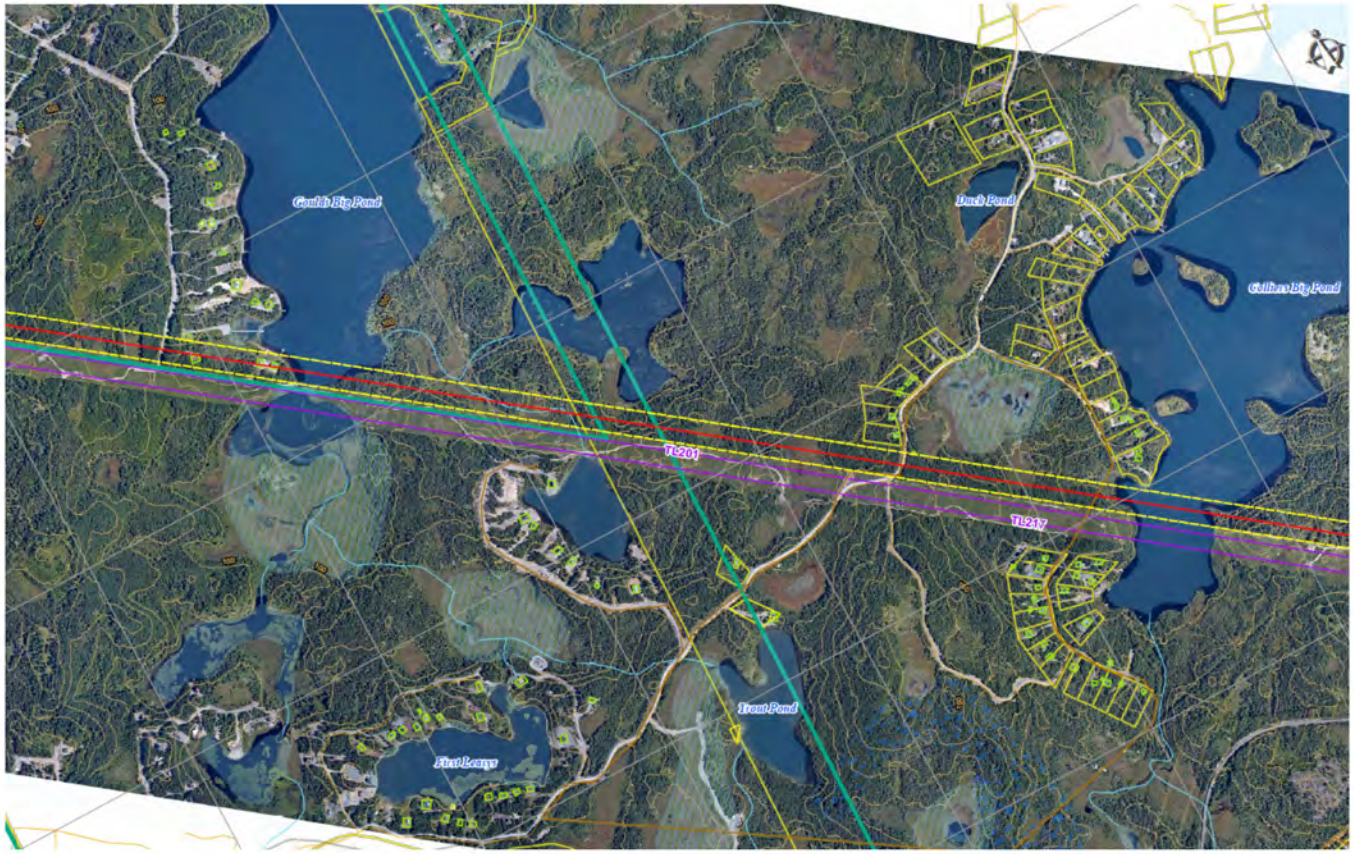


Elevation ranges from 0m to 630m above Mean Sea Level (MSL)

Lidar Terrain Mapping

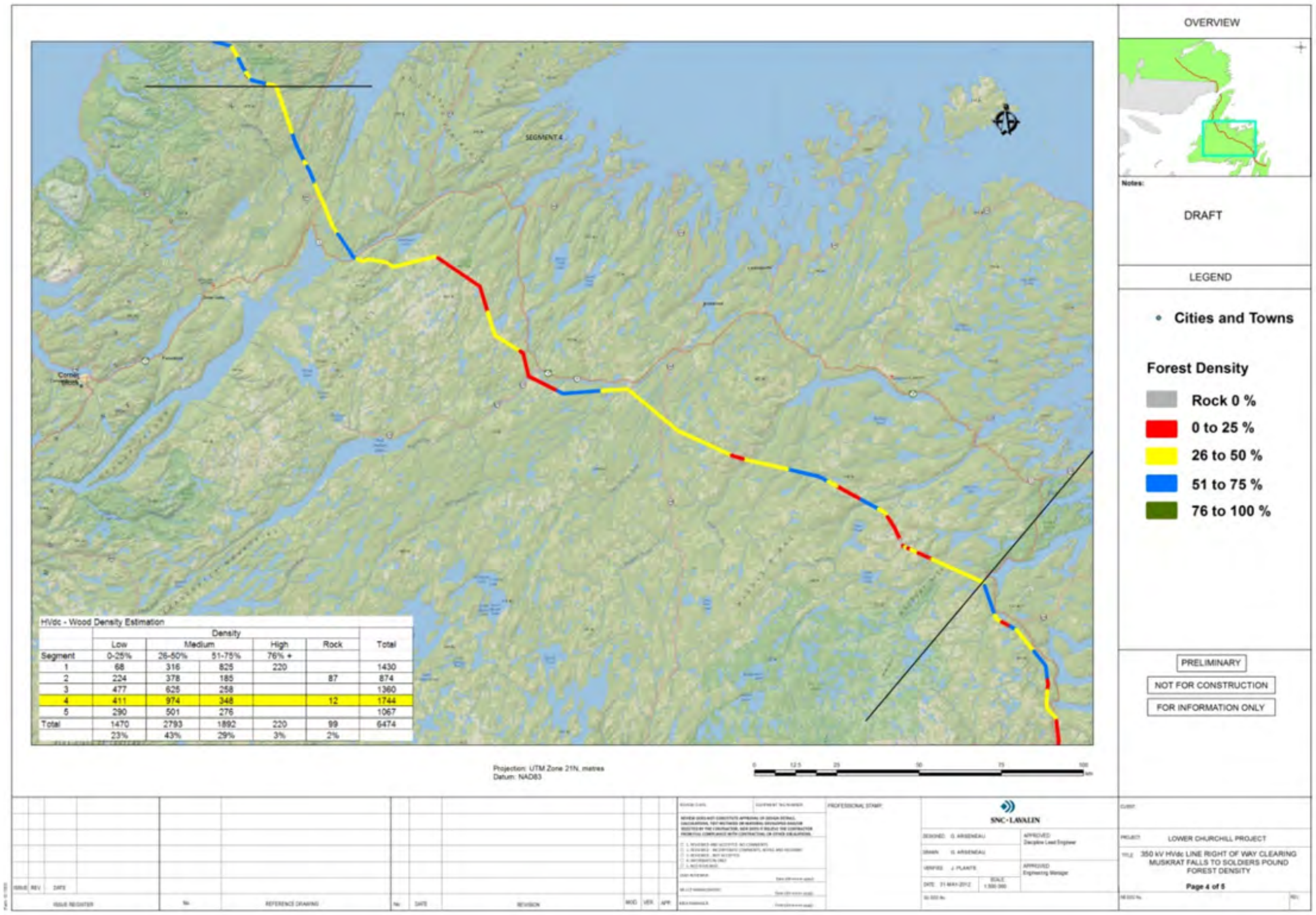
(Lidar = Aircraft based remote sensing technology to detect terrain conditions)

Used to select Right of Way, particularly relevant on Avalon with higher population density, more infrastructure and land use constraints.



Field Assessment of Terrain to Verify Line Routing

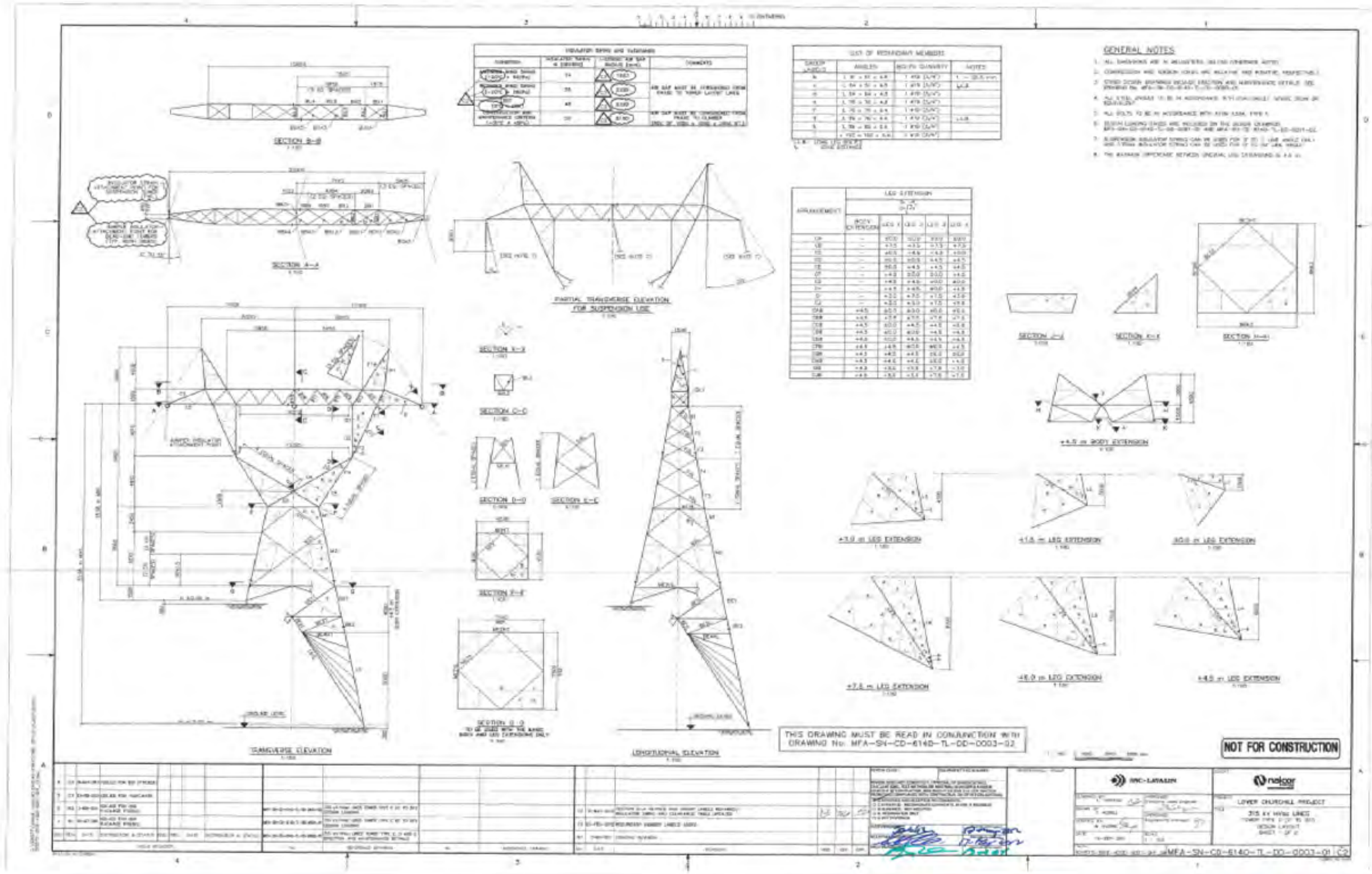
Lidar Leveraged for ROW Clearing Studies



HVdc - Wood Density Estimation

Segment	Density: Low 0-25%	Medium 26-50%	Medium 51-75%	High 76% +	Rock	Total
1	68	316	825	220		1430
2	224	378	185		87	874
3	477	625	258			1360
4	411	974	348		12	1744
5	290	501	276			1067
Total	1470	2793	1892	220	99	6474
	23%	43%	29%	3%	2%	

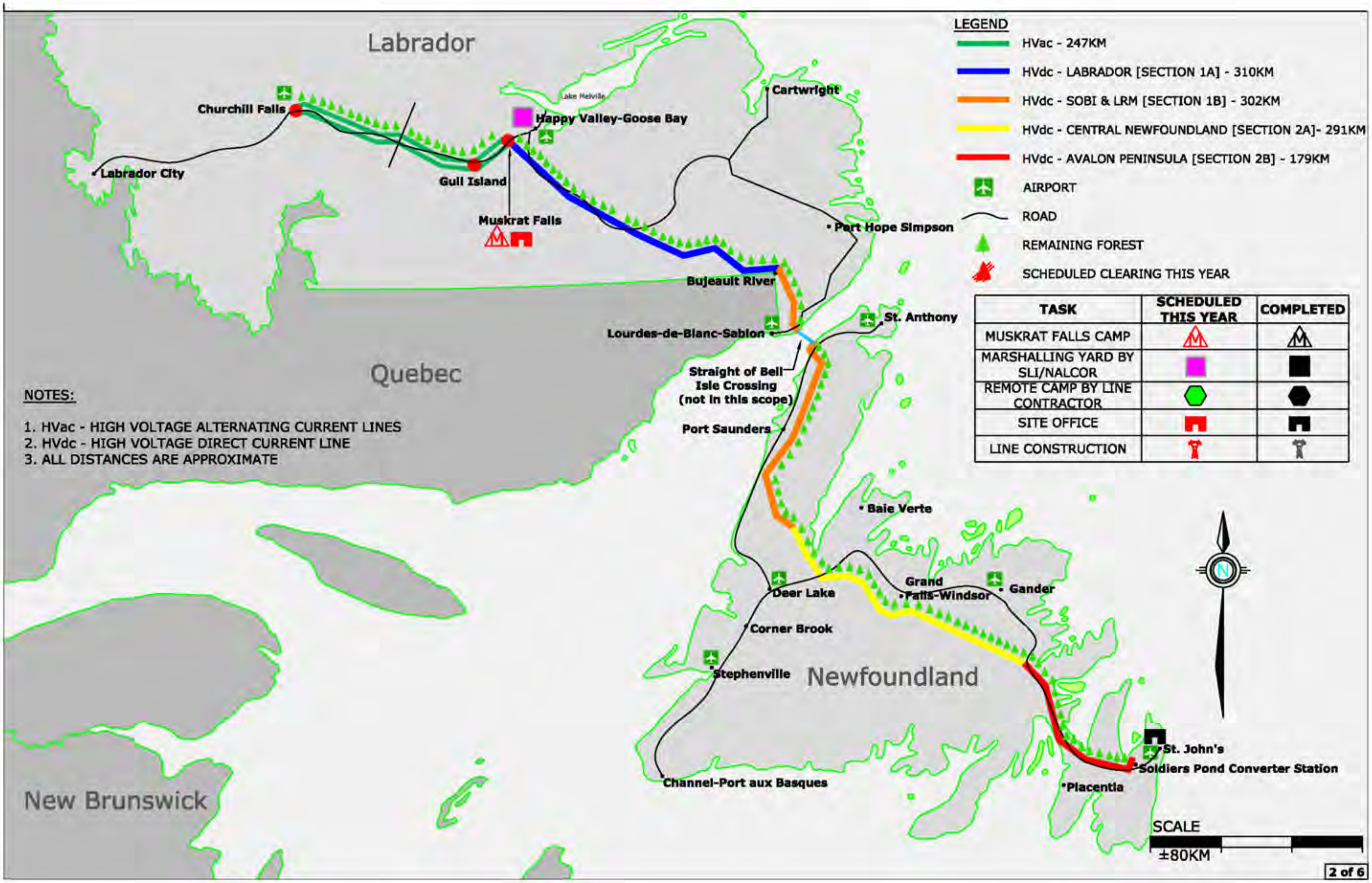
Resultant Information used to Tower Design (315 kV Hvac Tower Type C Design Layout)



HVdc and HVac Transmission Construction Sequence

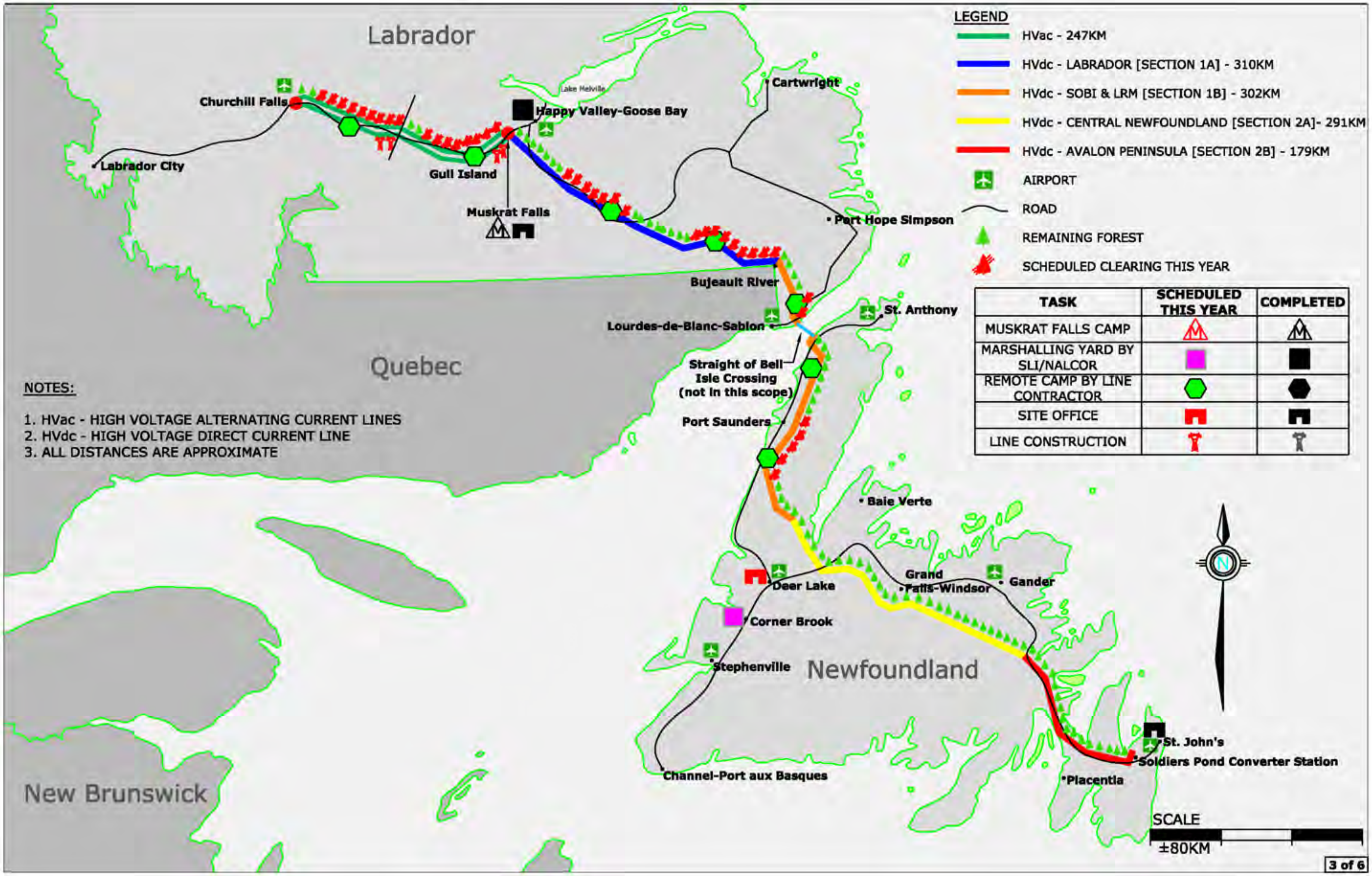
Construction Build Sequence – 2012

Establish Infrastructure in Labrador



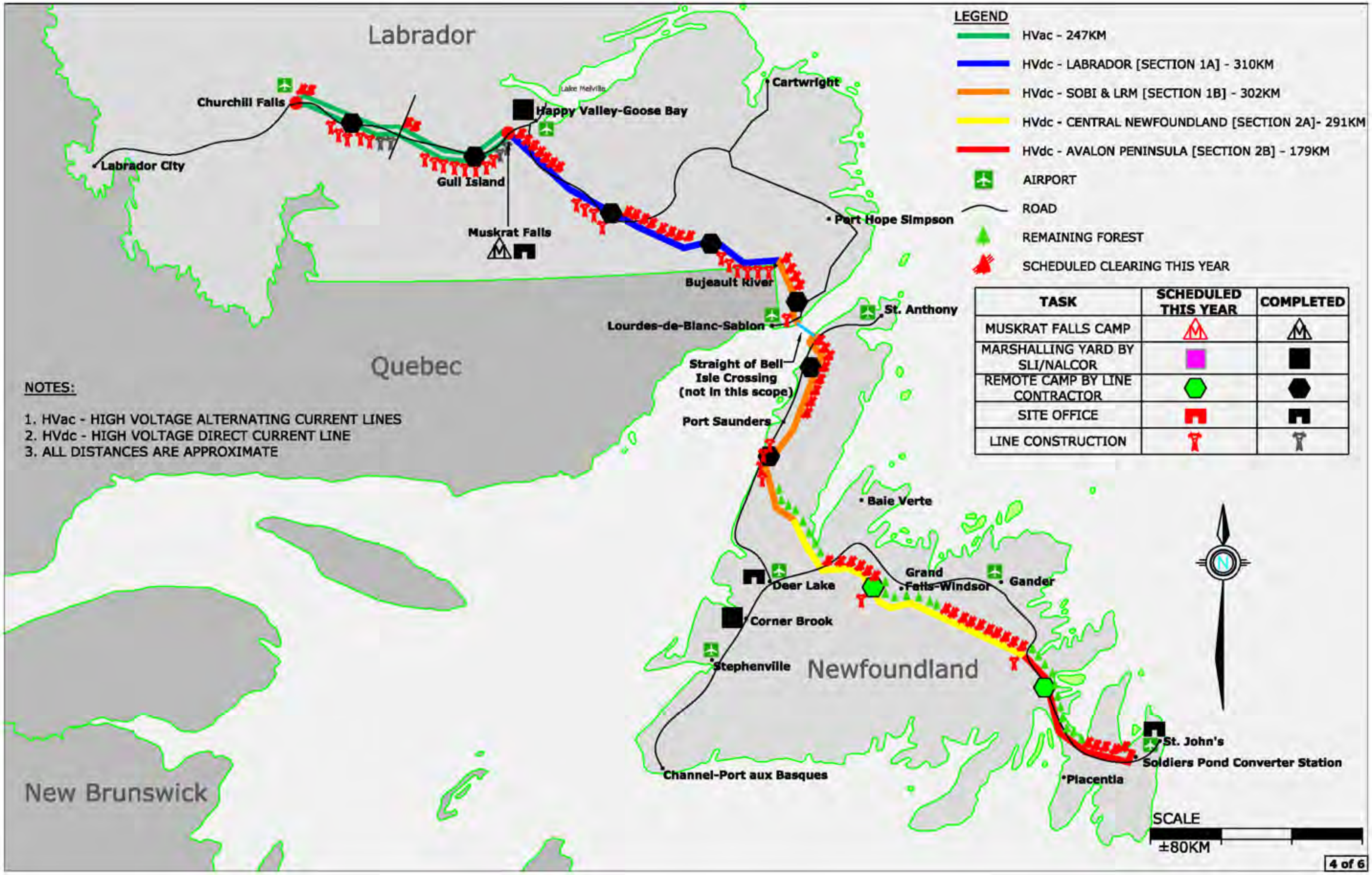
Construction Build Sequence – 2013

HVac ROW Clearing Well Advanced



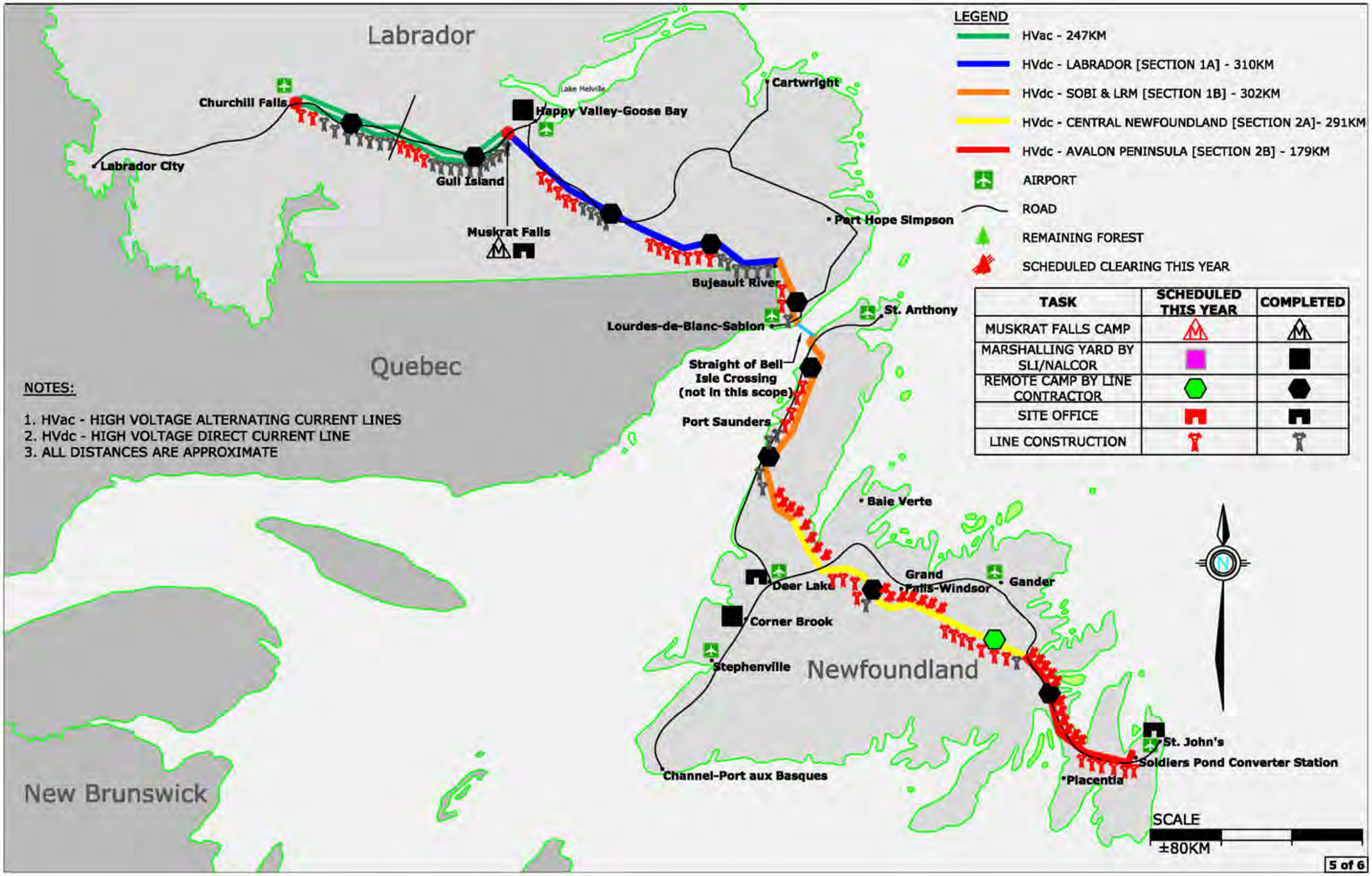
Construction Build Sequence – 2014

Remote Access Get First Priority



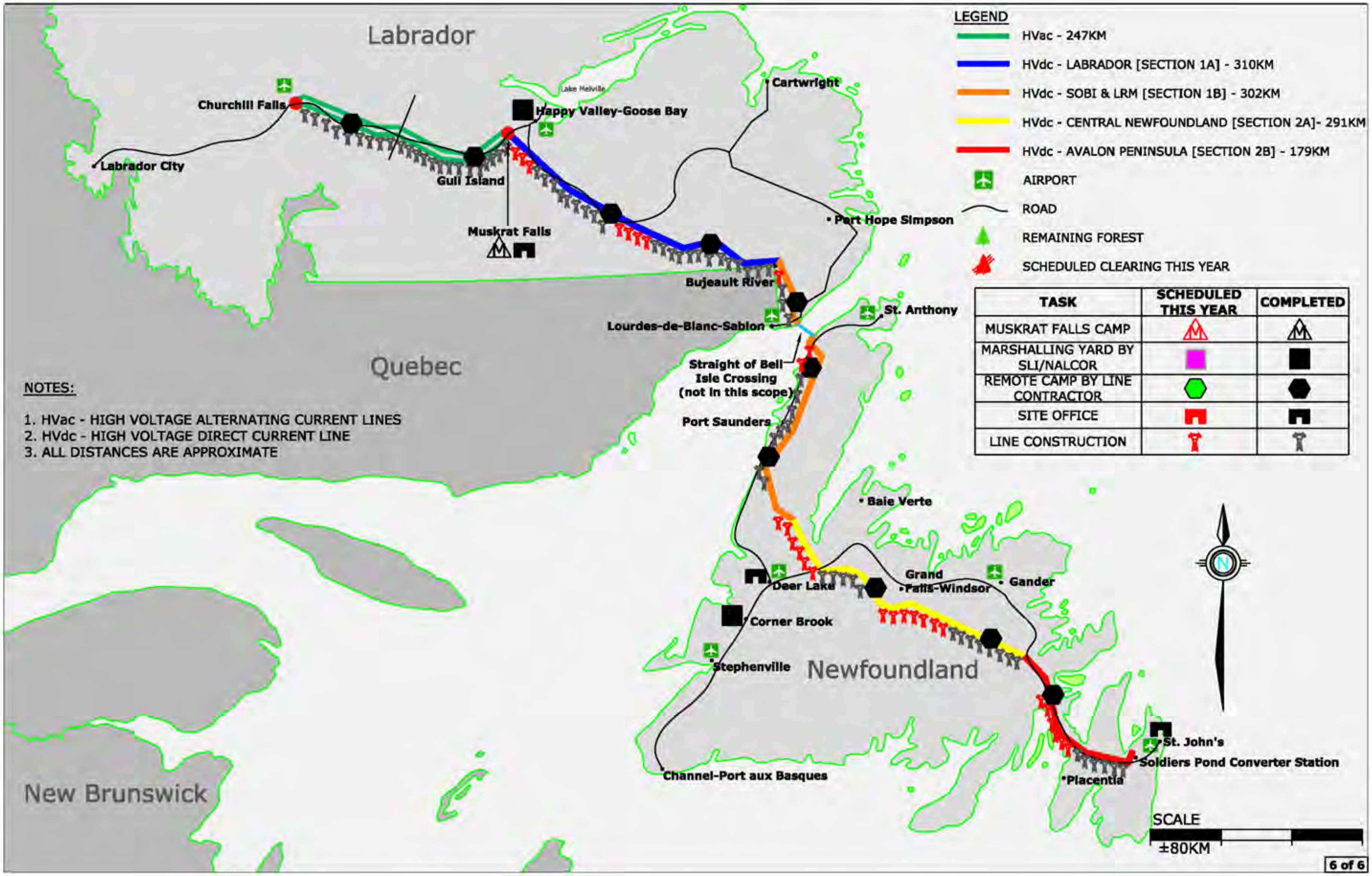
Construction Build Sequence – 2015

HVac Construction is completed



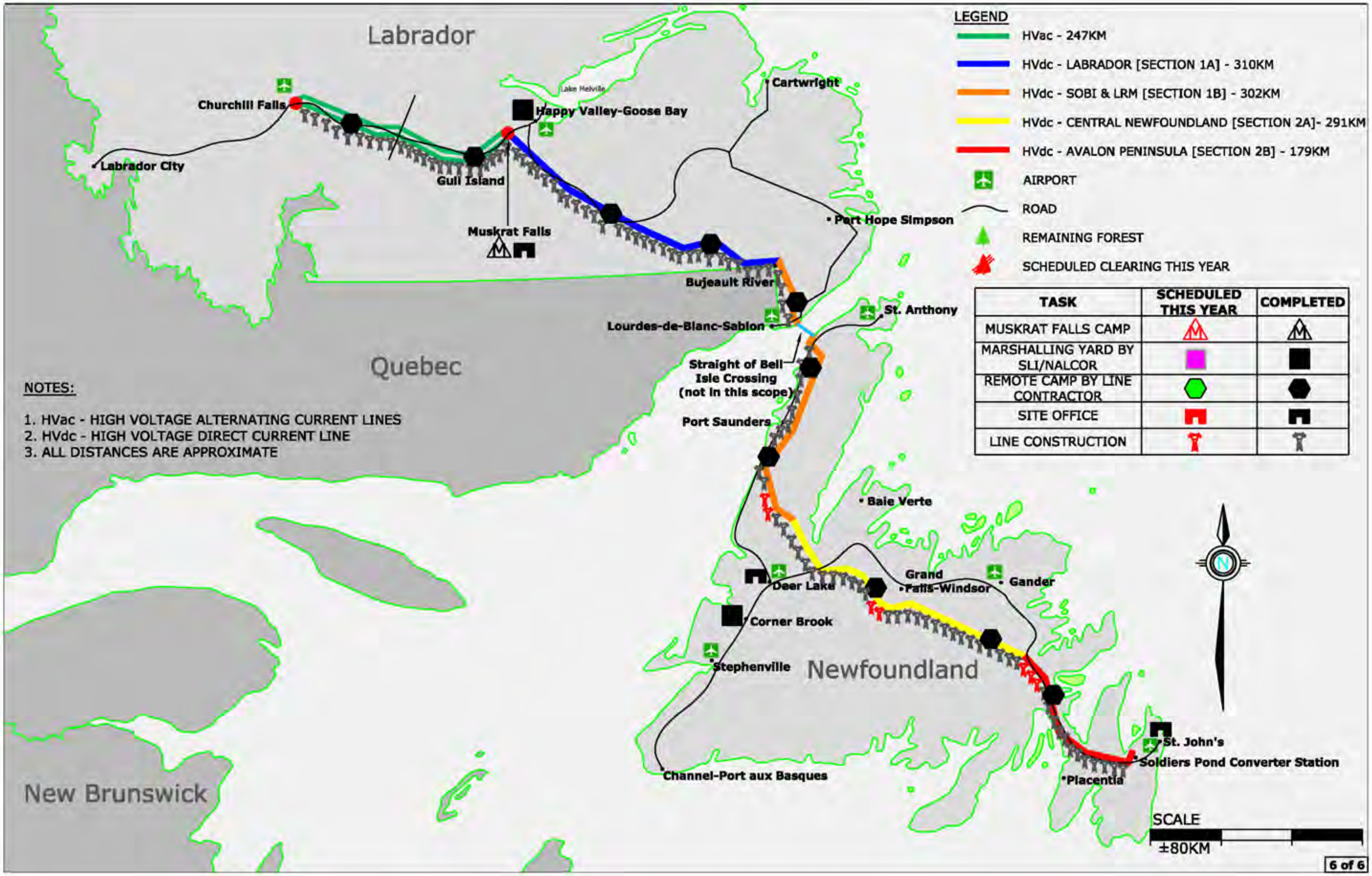
Construction Build Sequence – 2016

HVdc Construction is substantially complete



Construction Build Sequence – 2017

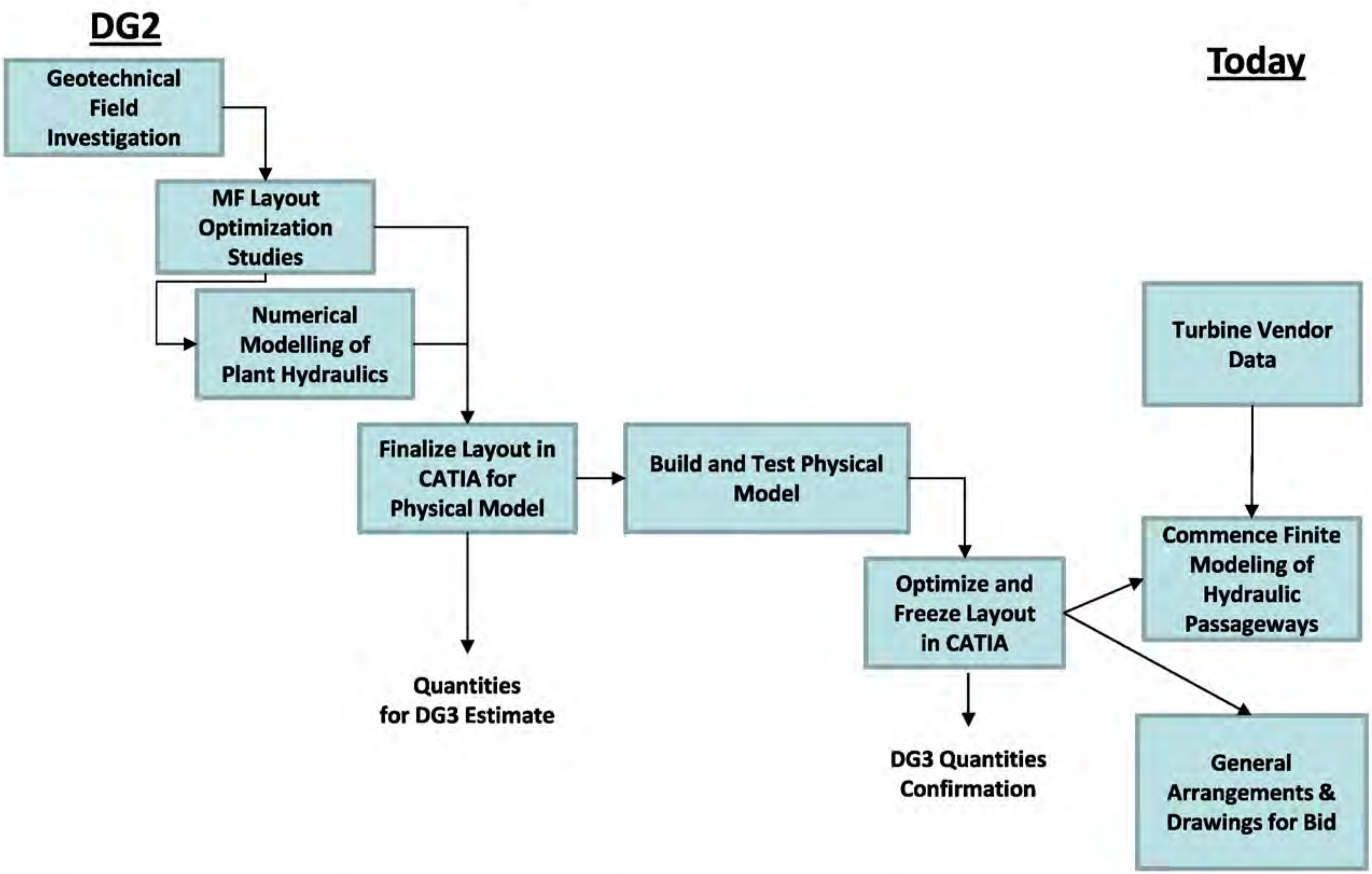
Winter reserved for final completion



Project Definition – Muskrat Falls

Muskrat Falls Today

MF Engineering Work Plan from DG2



MF Engineering & Planning Progress

Decision Gate 2

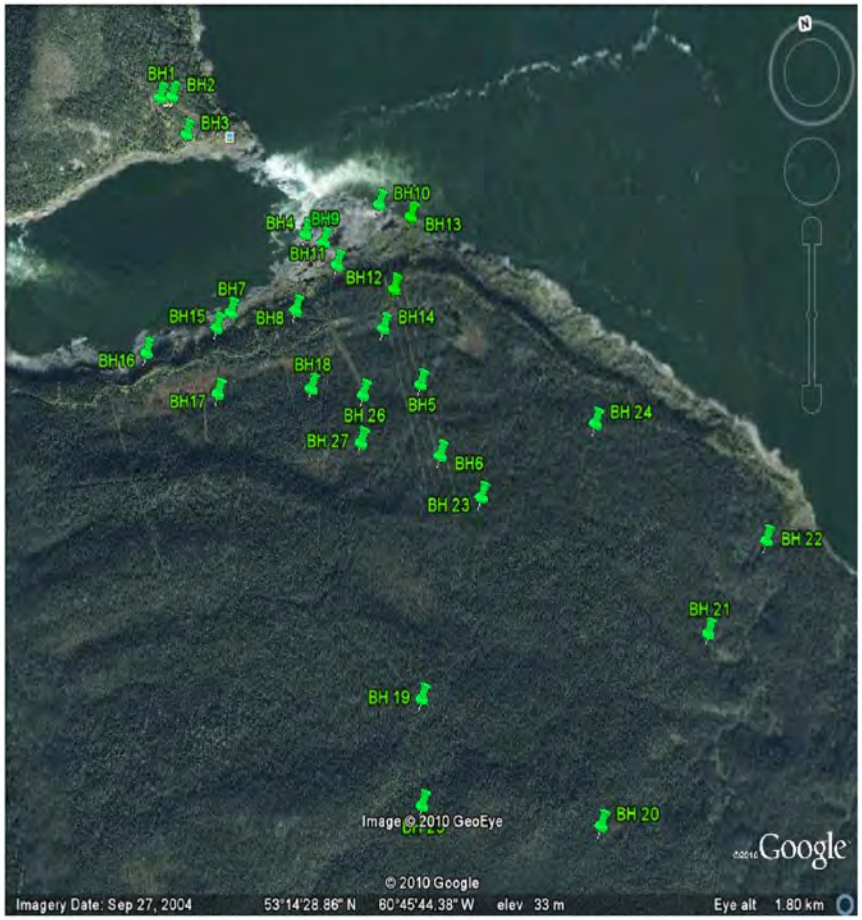
- Desktop studies complete based upon early field work to confirm development Variant
- Quantities calculated using 1998 Feasibility Studies
- River and ice management studies underway
- 1998 geotechnical investigations
- Leverage Gull Island studies for infrastructure works

Decision Gate 3

- Numerical modeling of hydraulic passages complete
- Geotechnical investigations for powerhouse complete
- Site layout optimized to ensure operational reliability and long-term asset integrity
- All structures modeled in CATIA 3D to produce quantities of rock excavation and concrete
- Scaled physical model testing completed to verify layout and various river management operations (e.g. temporary diversion)
- Turbine efficiency model testing complete and incorporated into contractual commitments
- Detailed constructability optimizations complete / underway
- Turbine & Generator contract ready to award
- Engineering complete for infrastructure works
- 300+ drawings ready for Concrete contract RFP
- Mass Excavation bids received and under evaluation

Geotechnical Investigations Confirm Sub-Surface Conditions

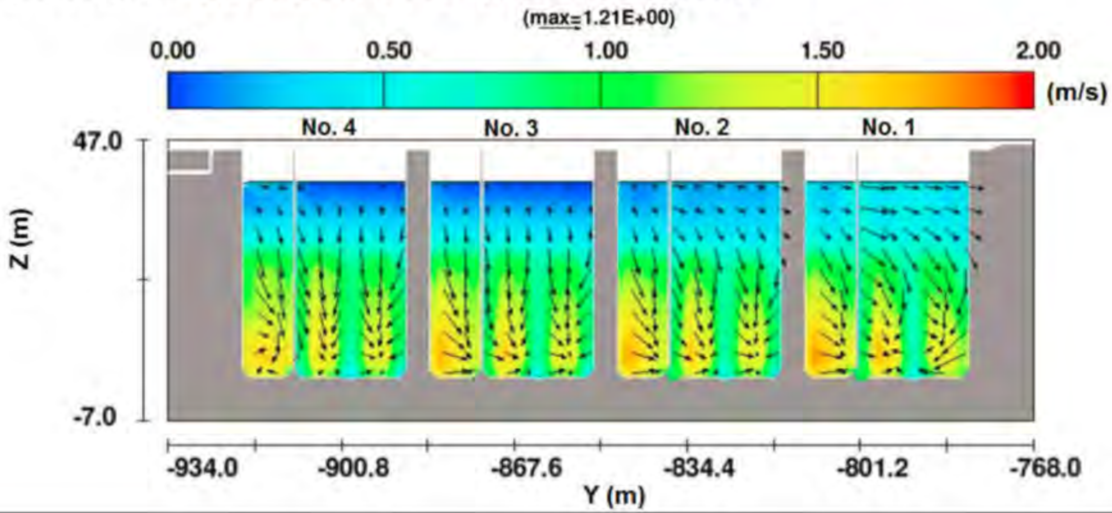
Borehole Locations at Muskrat Falls



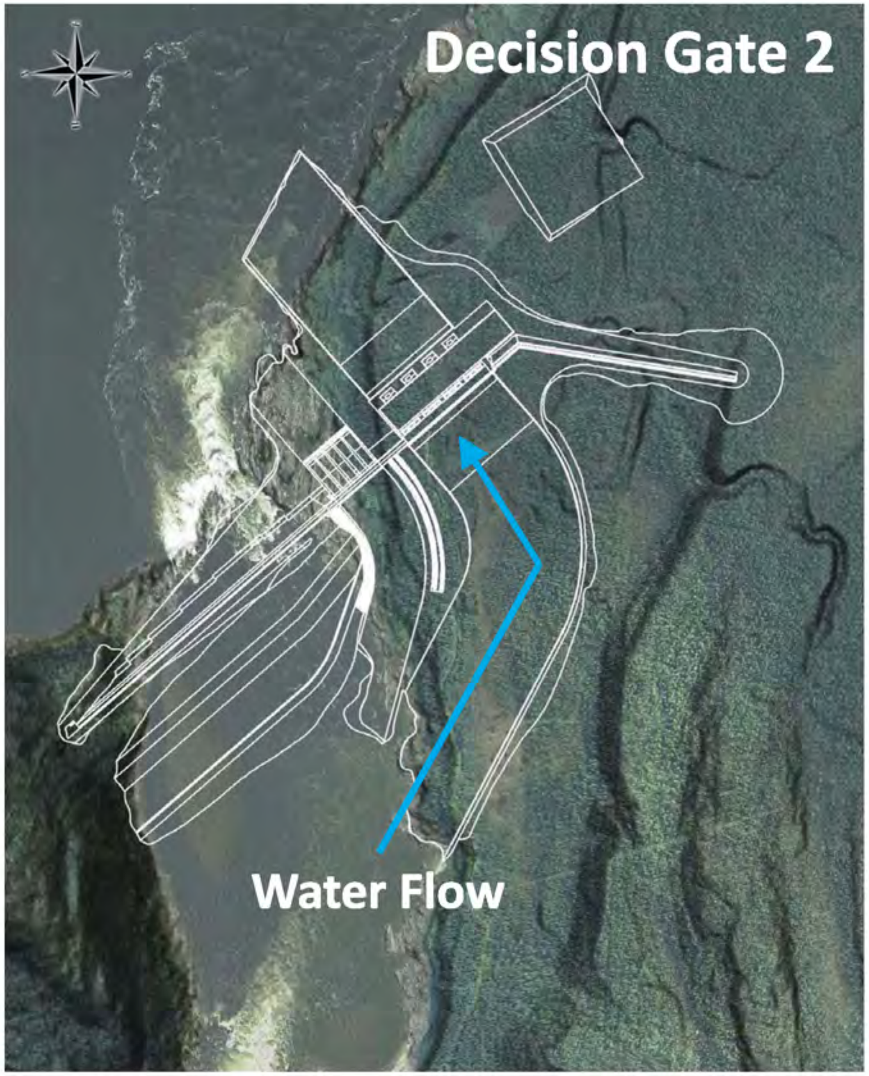
Borehole Operations at Muskrat Falls (Fall 2010)

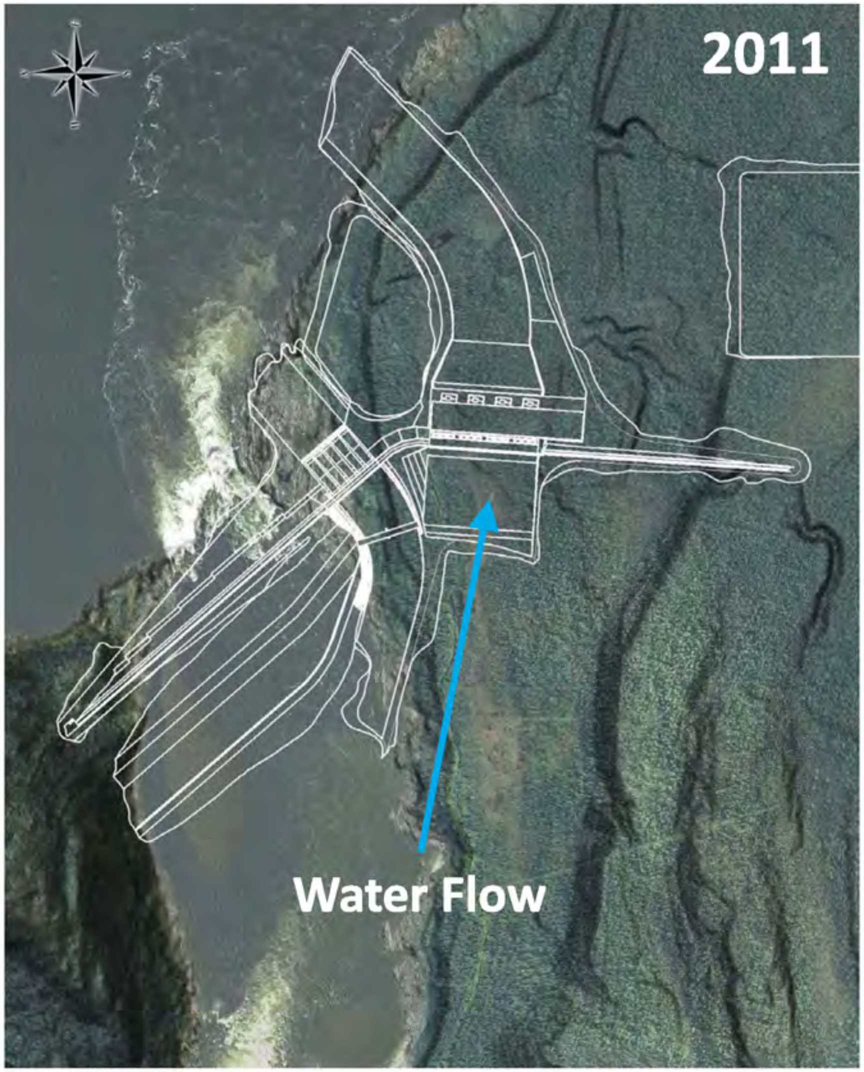
Numerical Modeling Identified Potential Operational Integrity Issues

- Hydraulic conditions near the surface upstream of the intake indicated the presence of eddies and flow velocity parallel to the intake at Unit 1 (at the top of the graph).
- These conditions indicate a possible problem at this unit, including the possibility of a vortex, increase of head losses at the intake or non-optimal flow conditions at the unit.

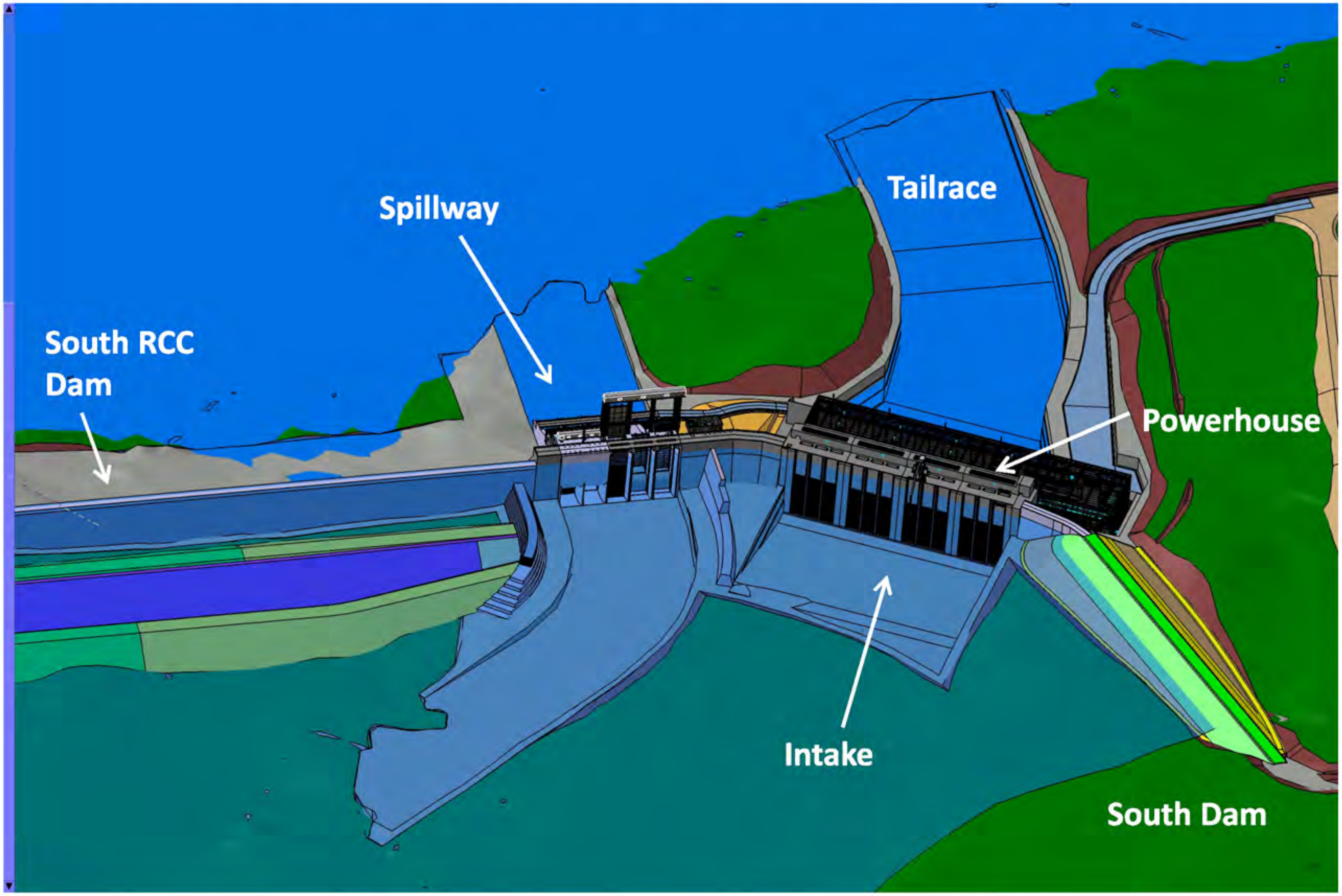


Solution: Plant Reorientation by 30º

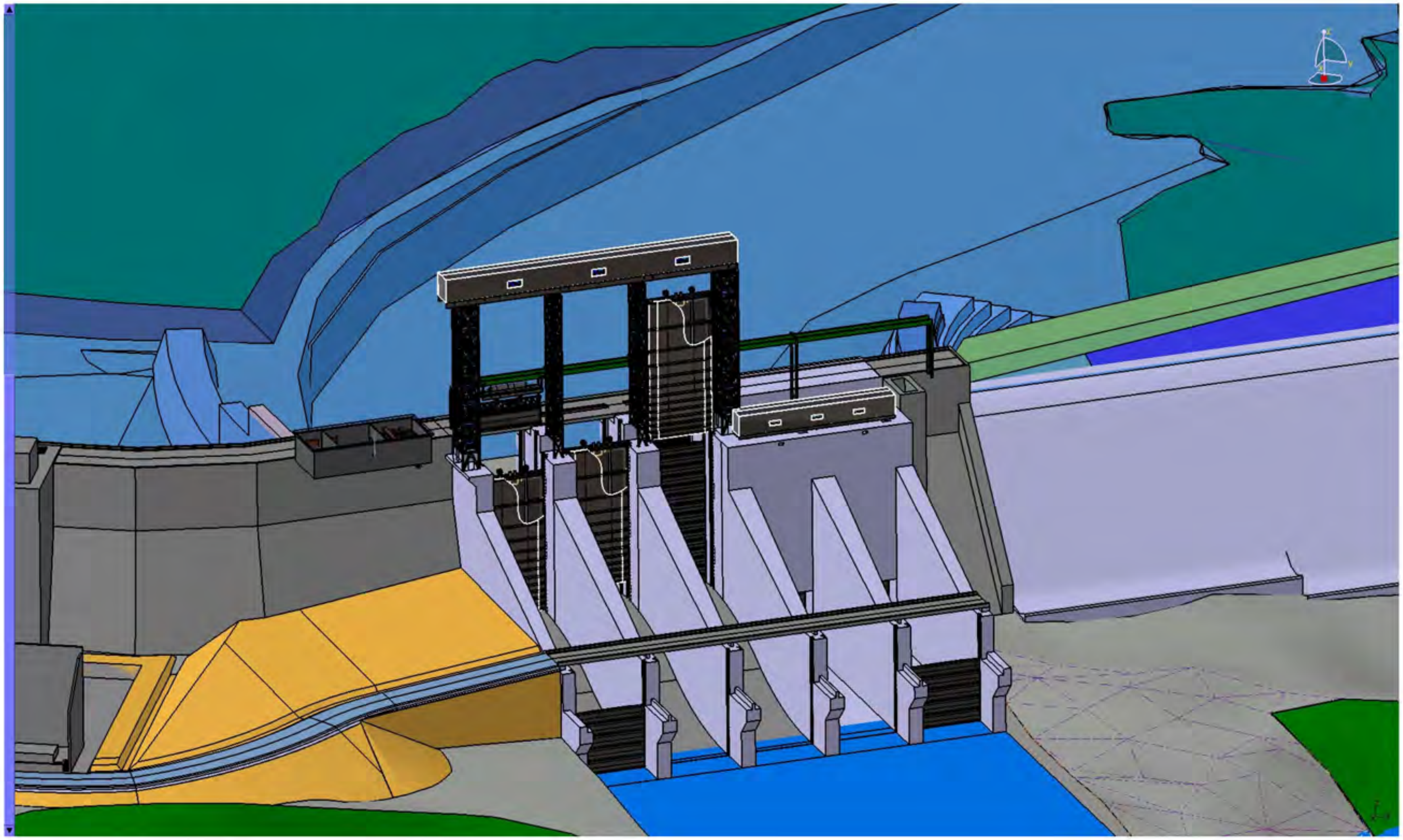




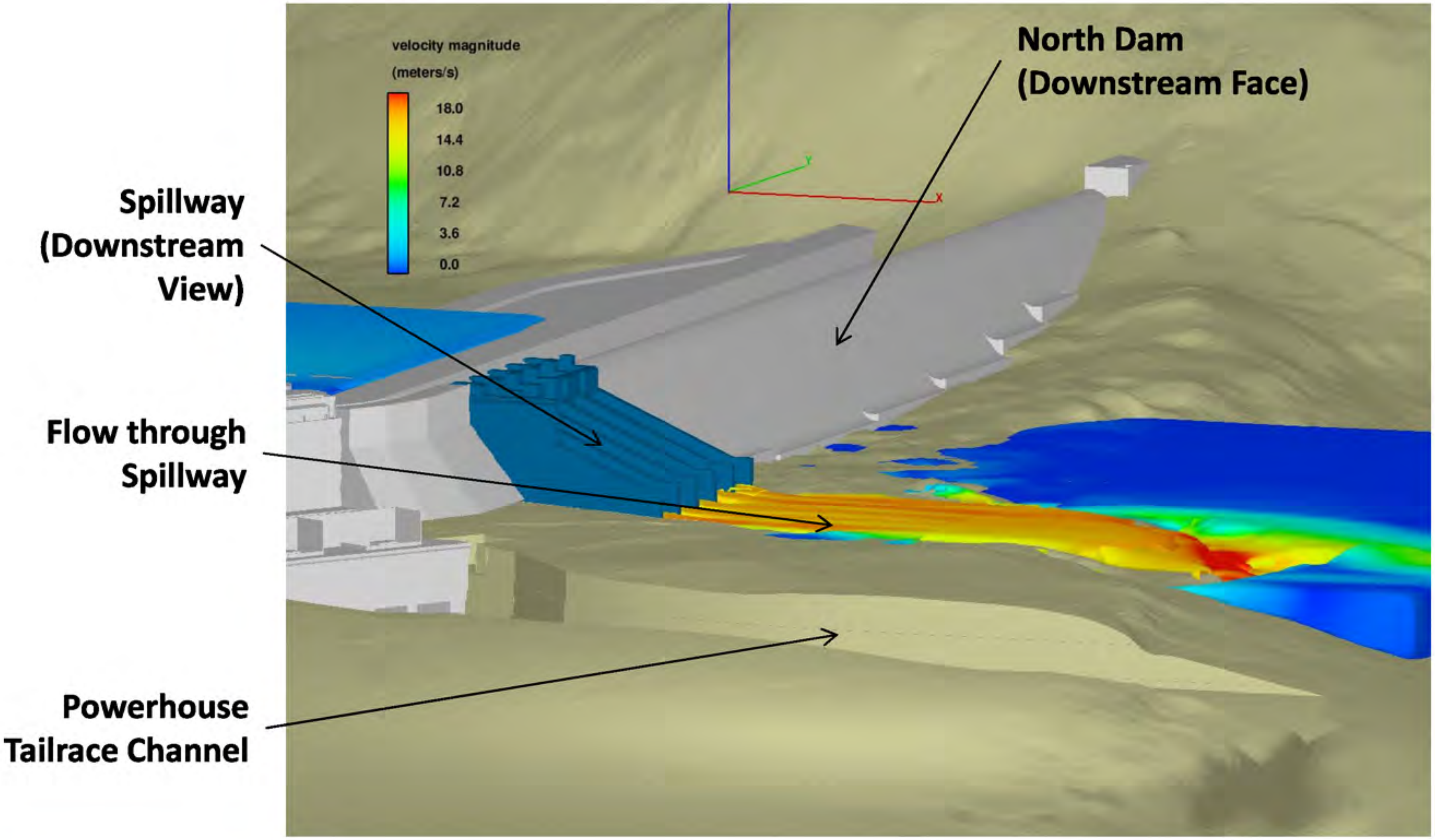
Revised Layout Designed in 3D CAD



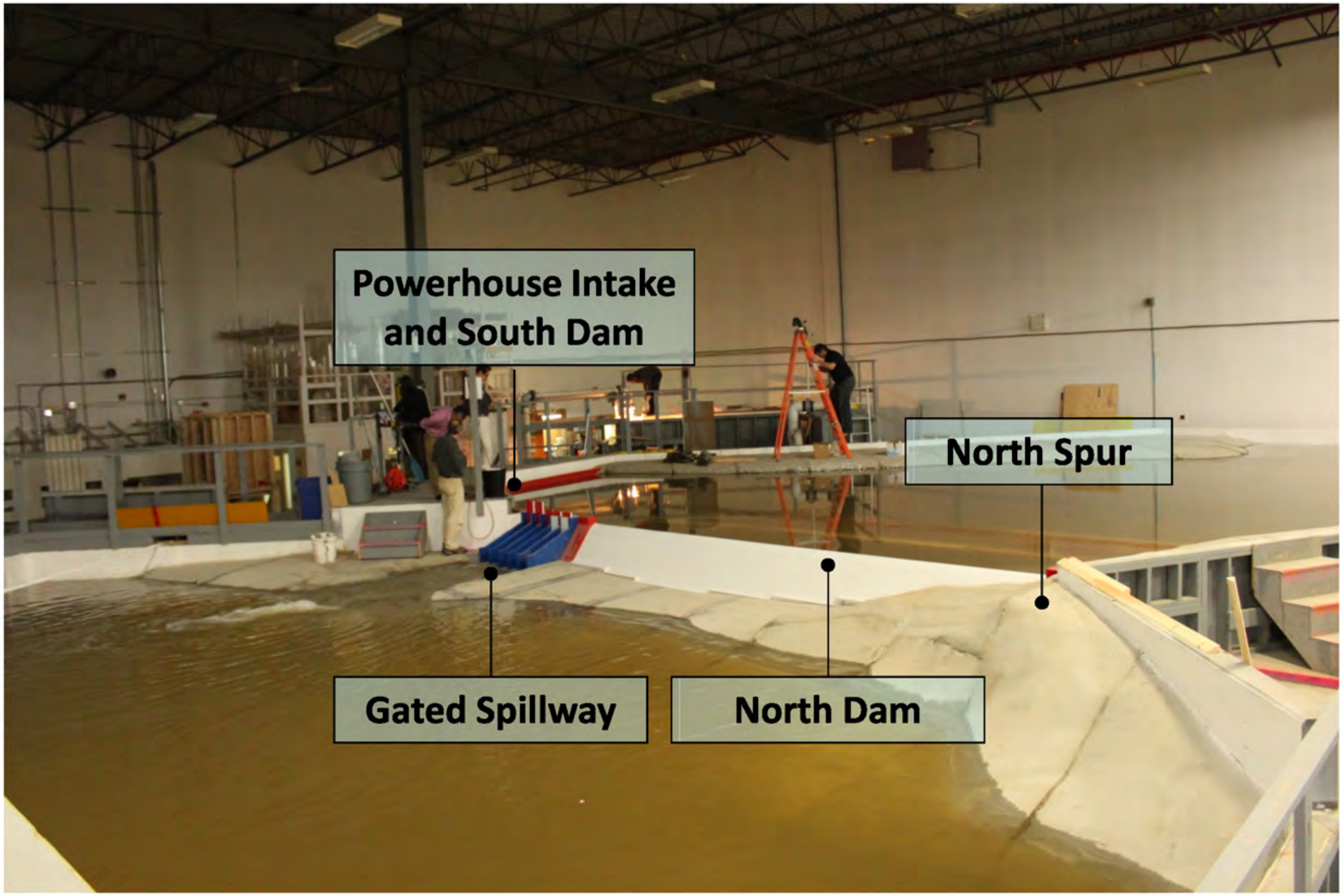
Design Optimization Continued
(Radial versus Vertical Spillway Gates)



Spillway – Assessing Downstream Erosion

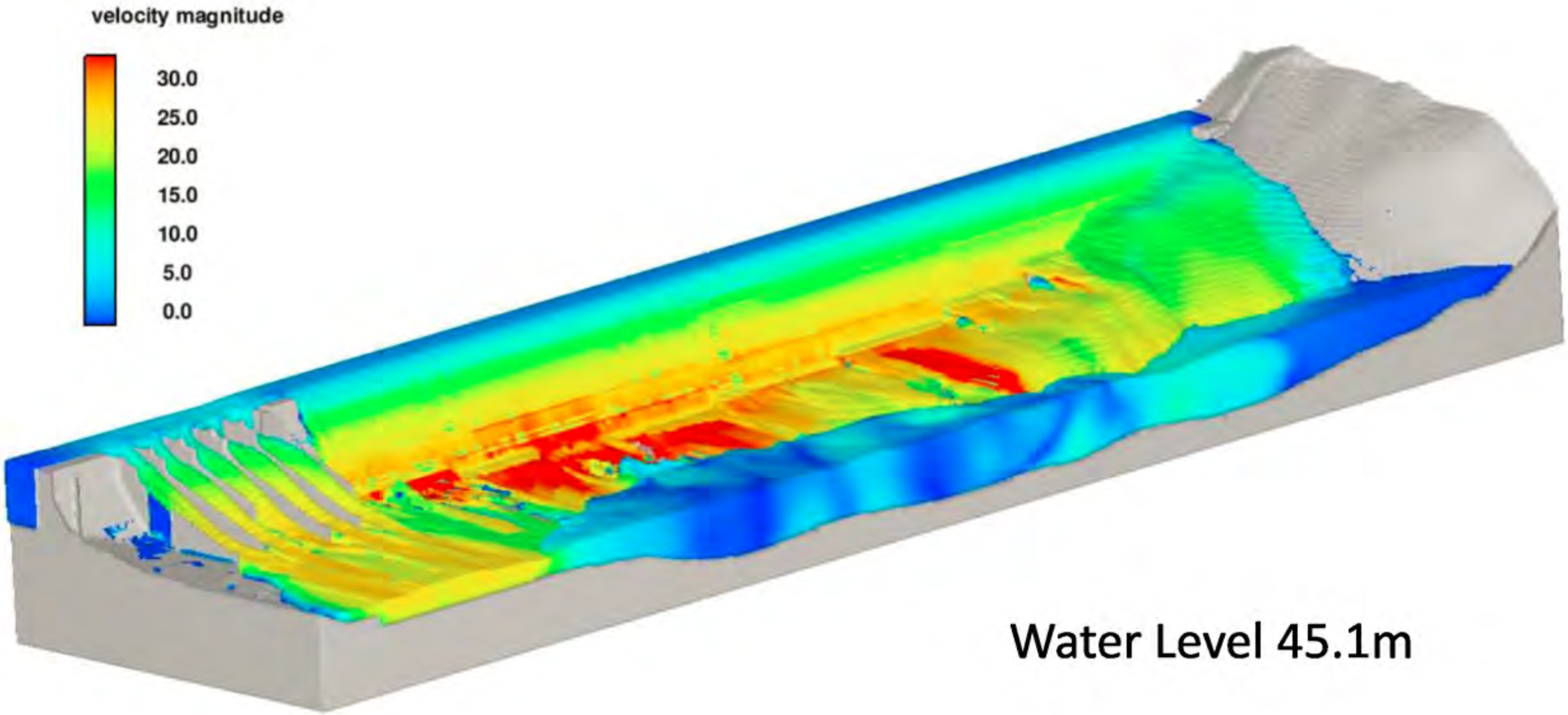


Layout Verified by Scaled Operational Model



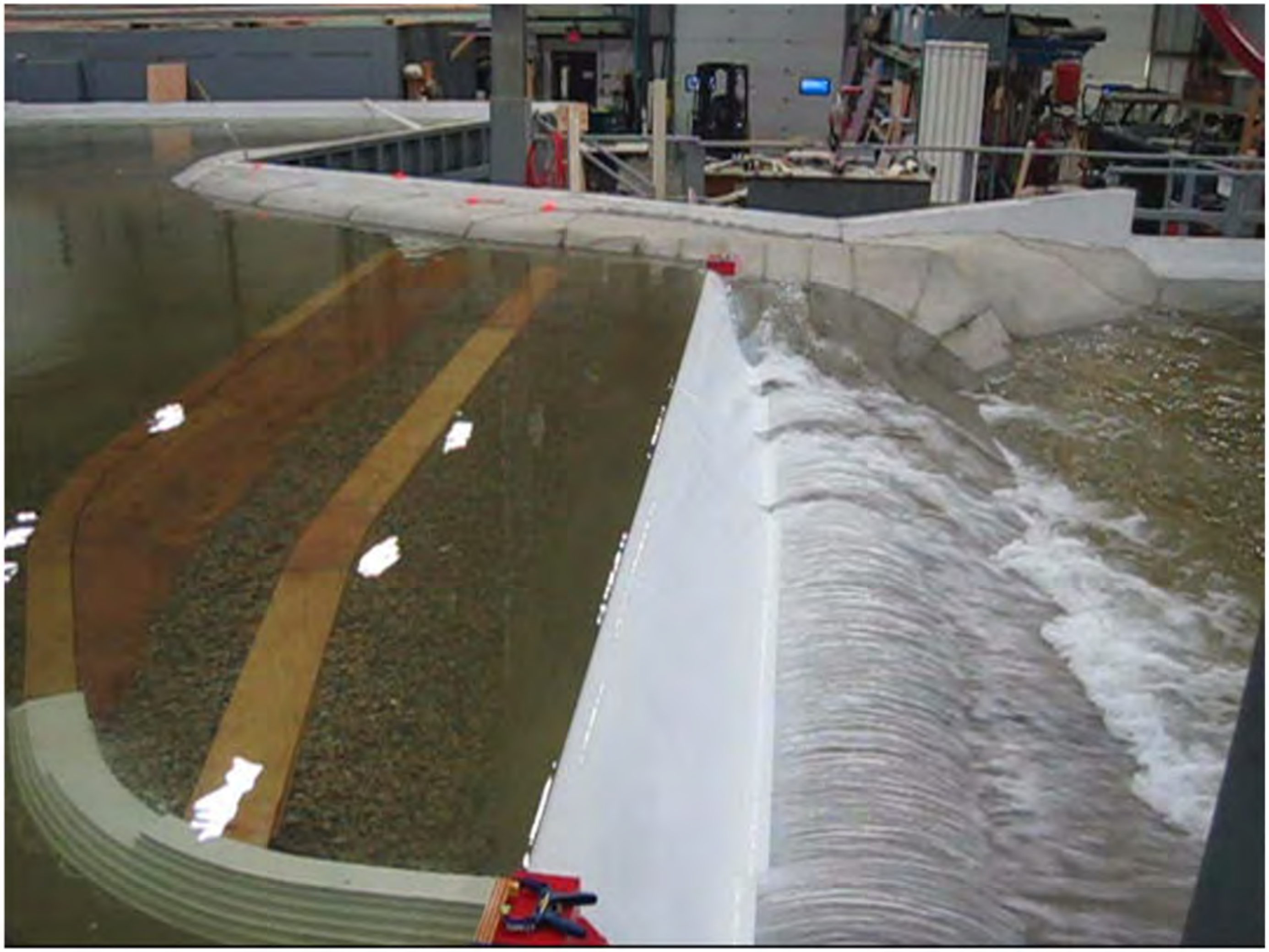
Muskrat Falls Spillway

Numerical Modelling of PMF Event



PMF – Probable Maximum Flow as defined under criteria established by Canadian Dam Association

Rare Operational Events Modelled
(North RCC Dam – Secondary Spillway)



Video

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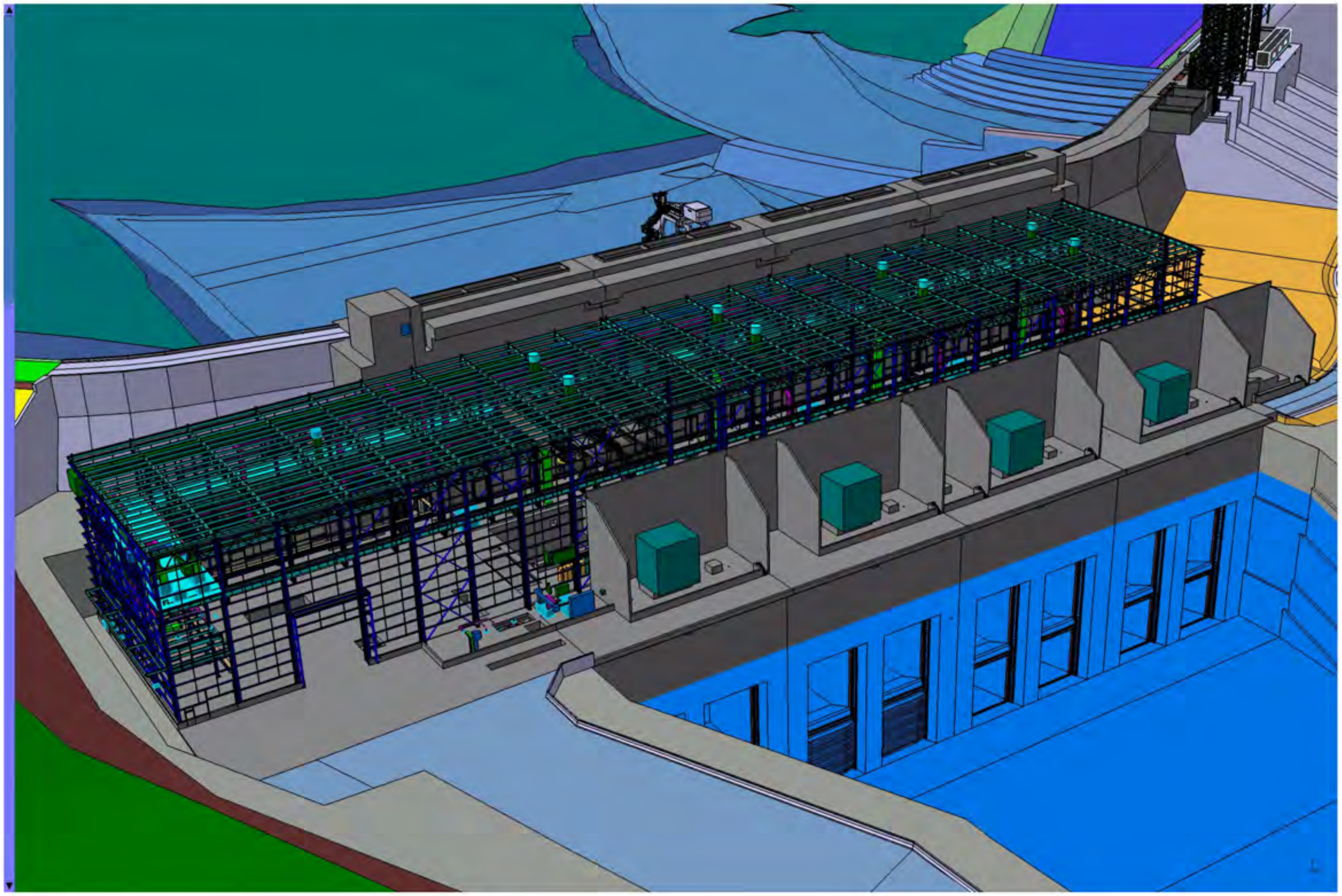
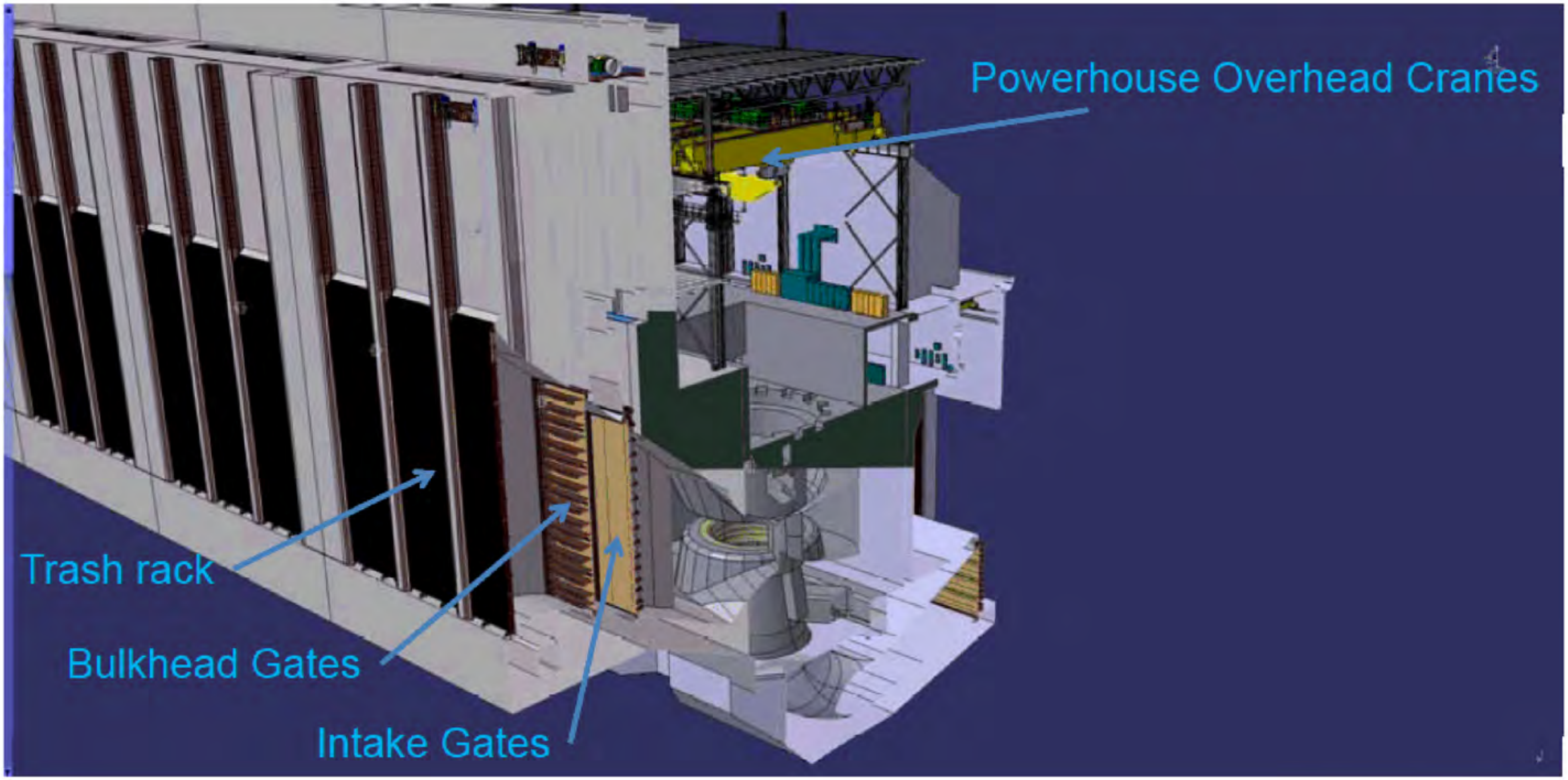
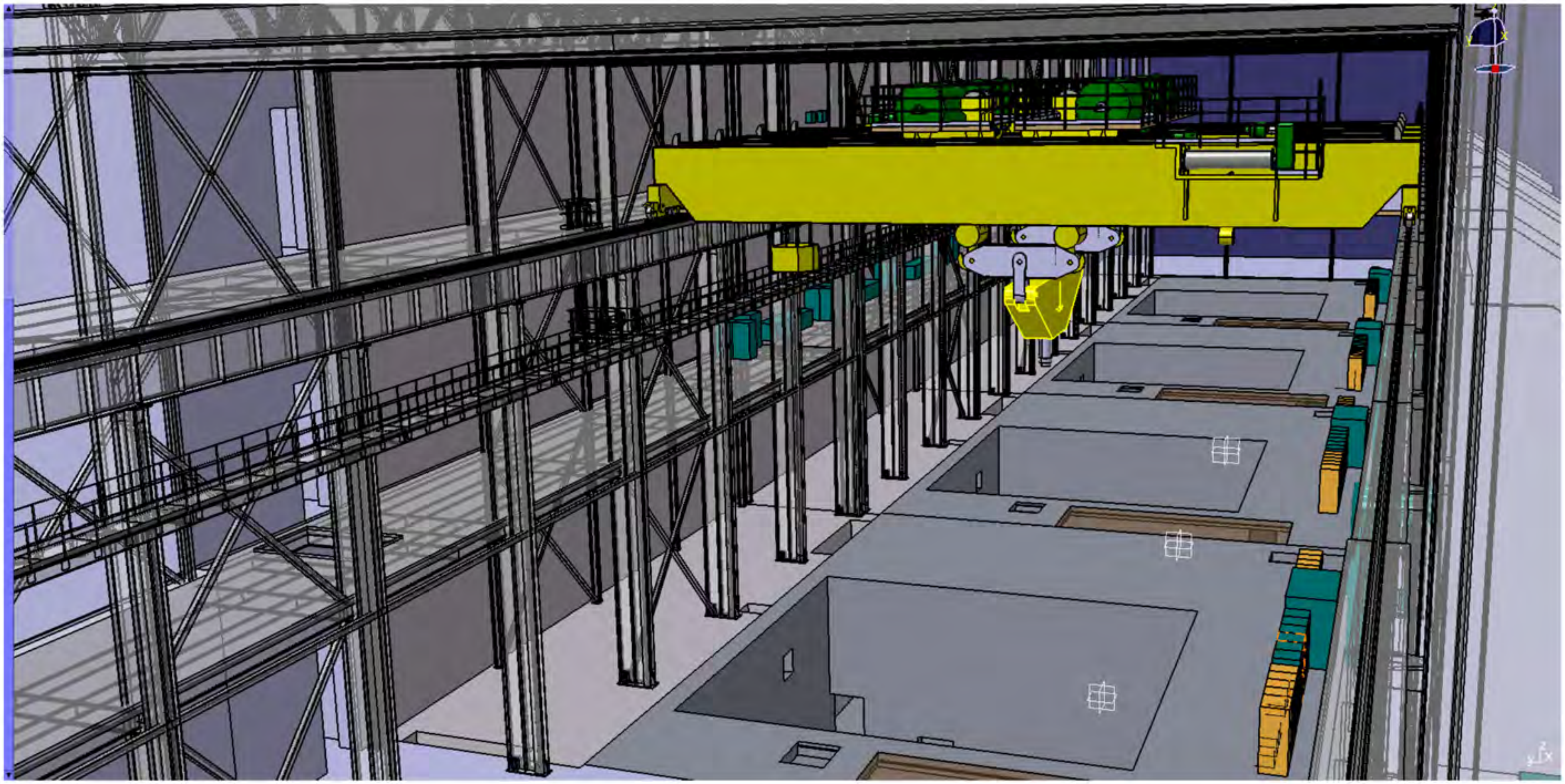
3D Model used for Construction Planning
(Superstructure under Construction)



Powerhouse Cross-Section

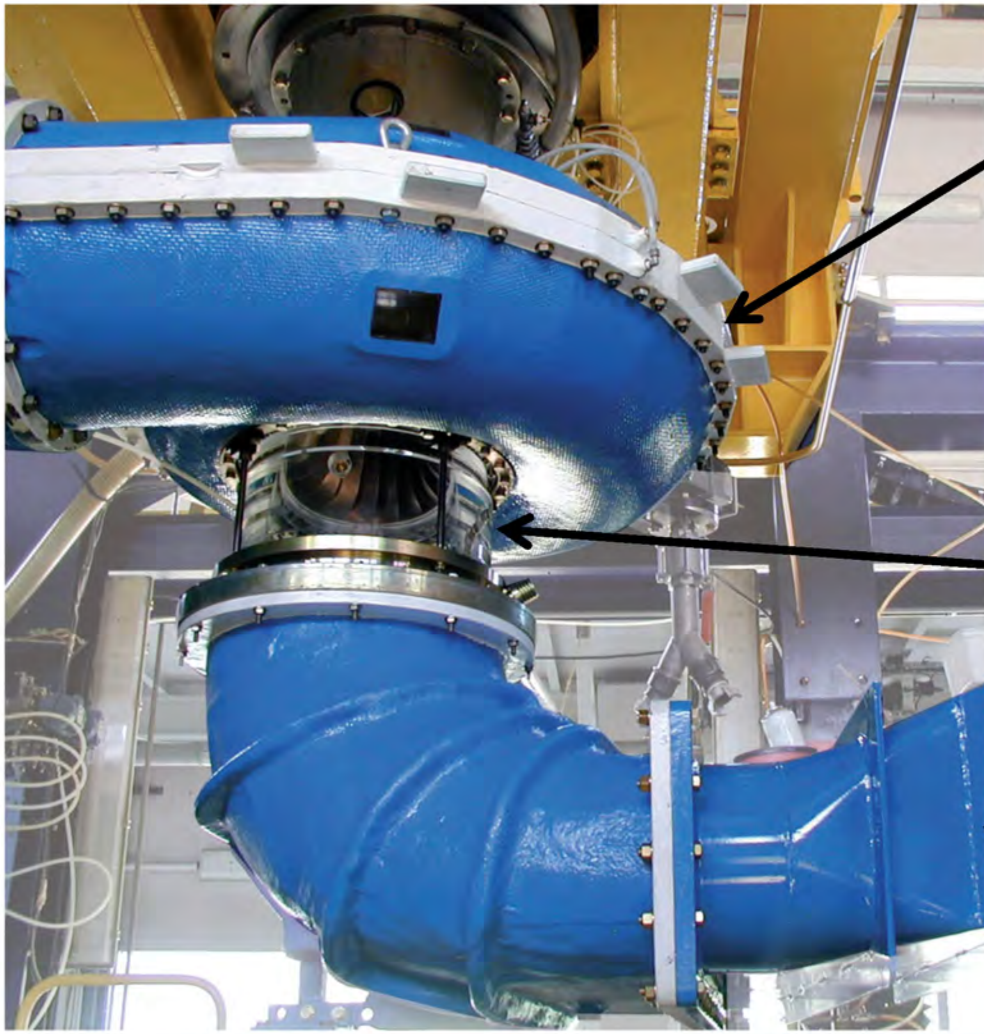


Powerhouse Cranes
(2 x 350 tons Working in Tandem)

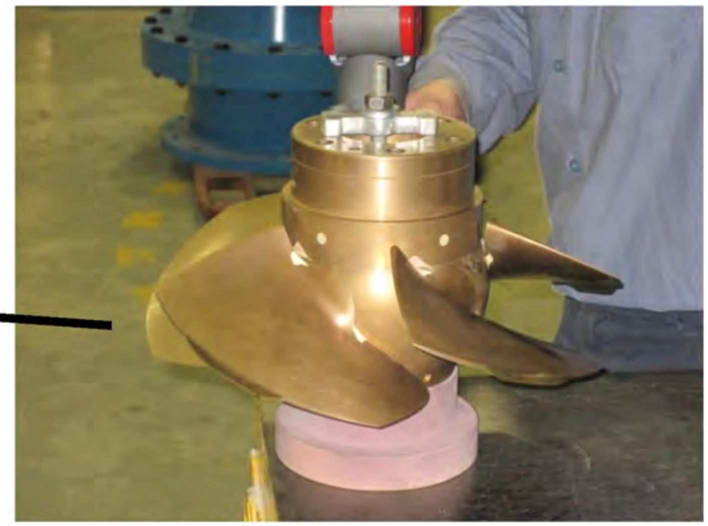


Operational and Schedule Risk Reduction

Turbine Model Testing



Scroll Case



Runner Model (Diameter = 0.380m)

Draft Tube

Maintaining Overall Schedule

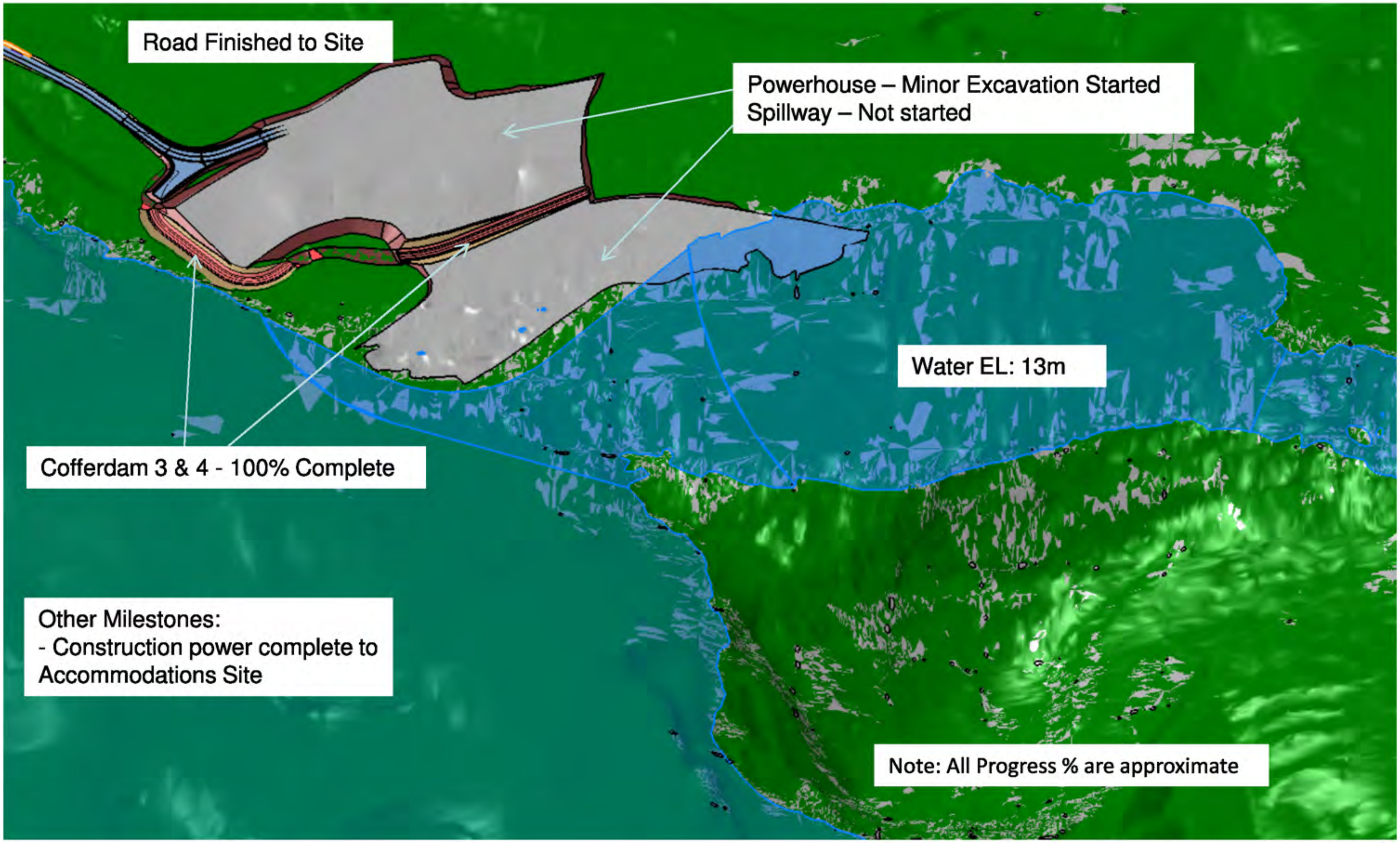
Investing in Early Infrastructure Works (As of August 13, 2012)

MF Access Road Construction

Placing poles on 25 kV Line

Muskrat Falls Construction Sequence

2012 – December: Mass Excavation Commenced



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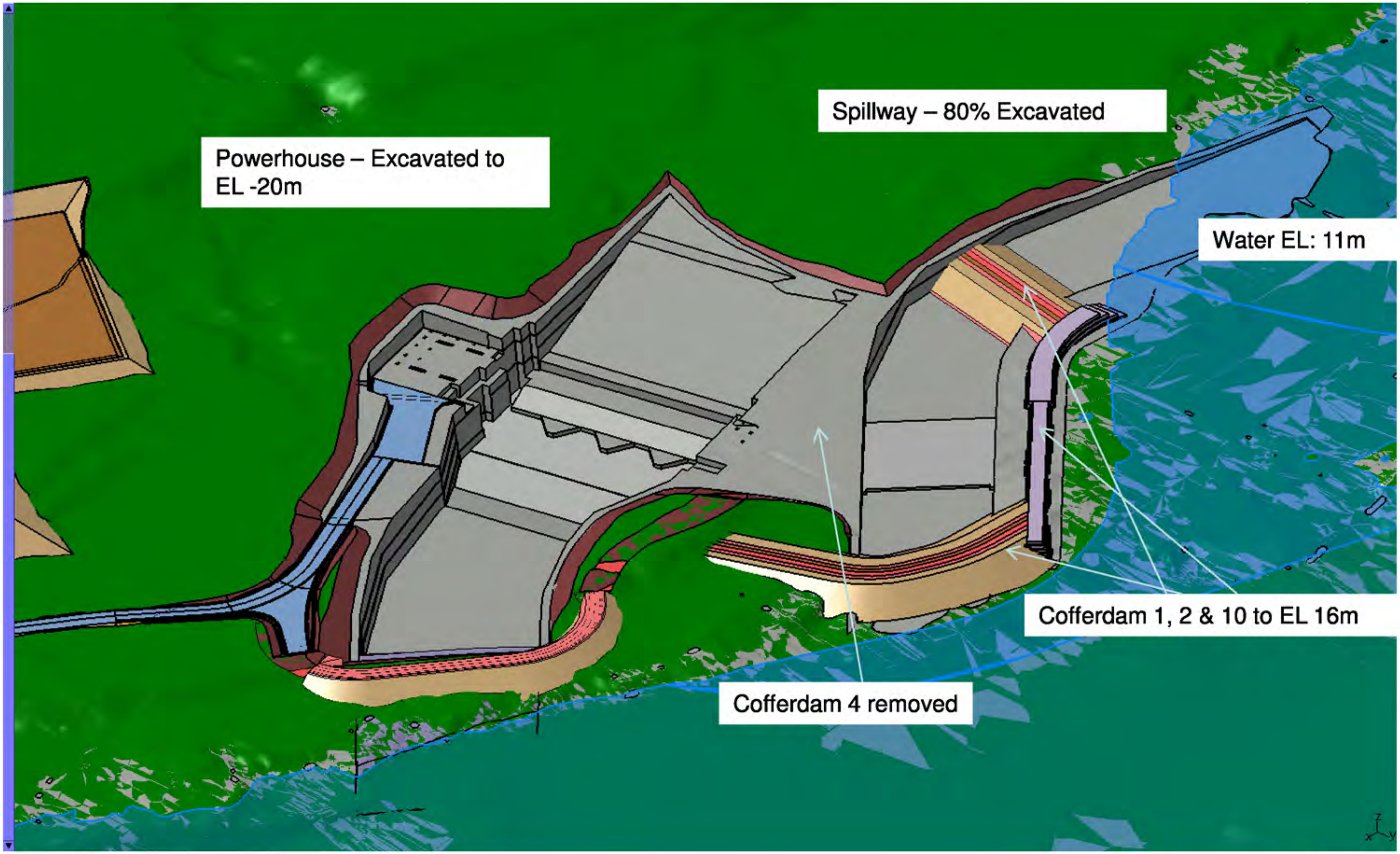
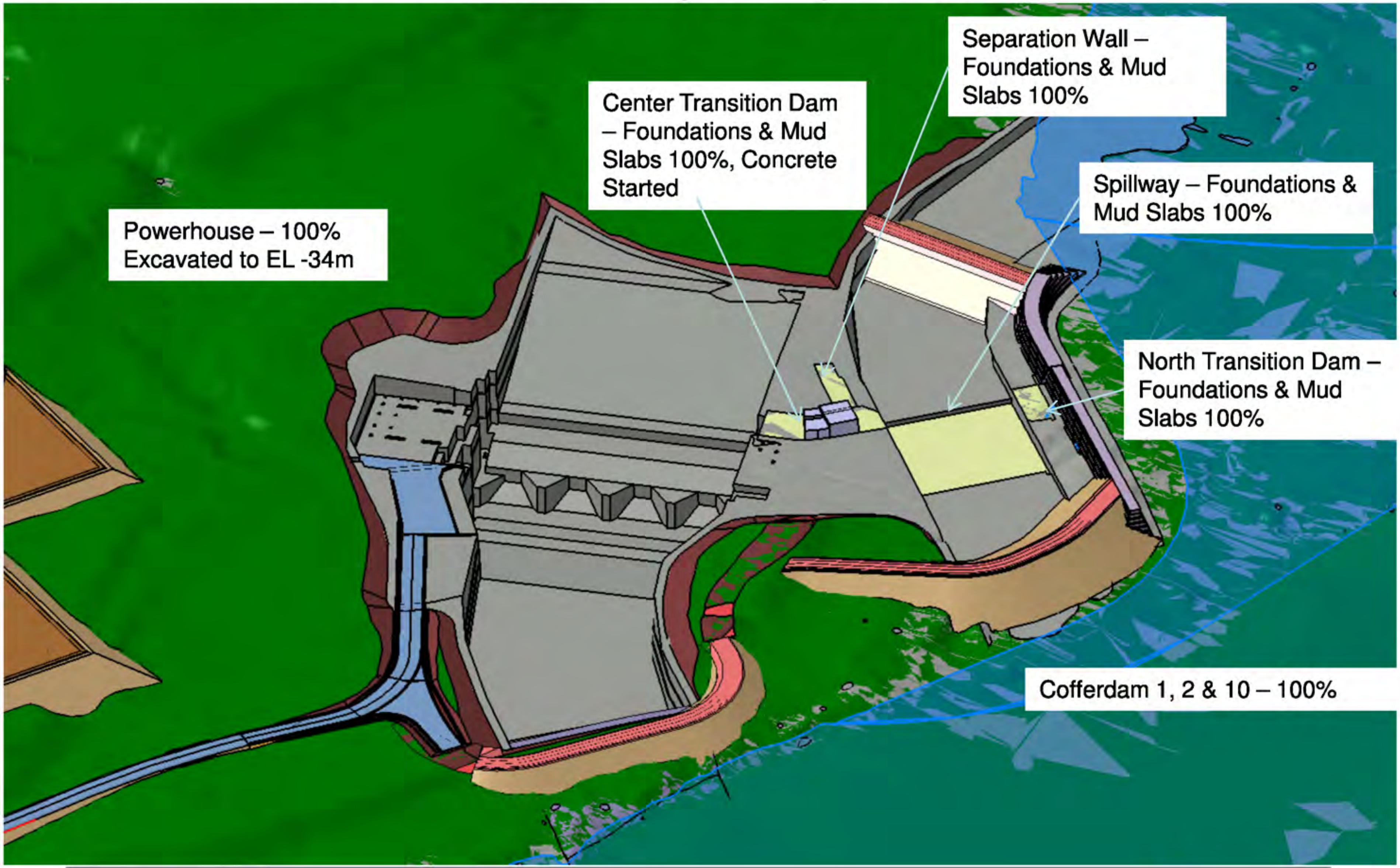
2013 – September: Excavation Well Progressed

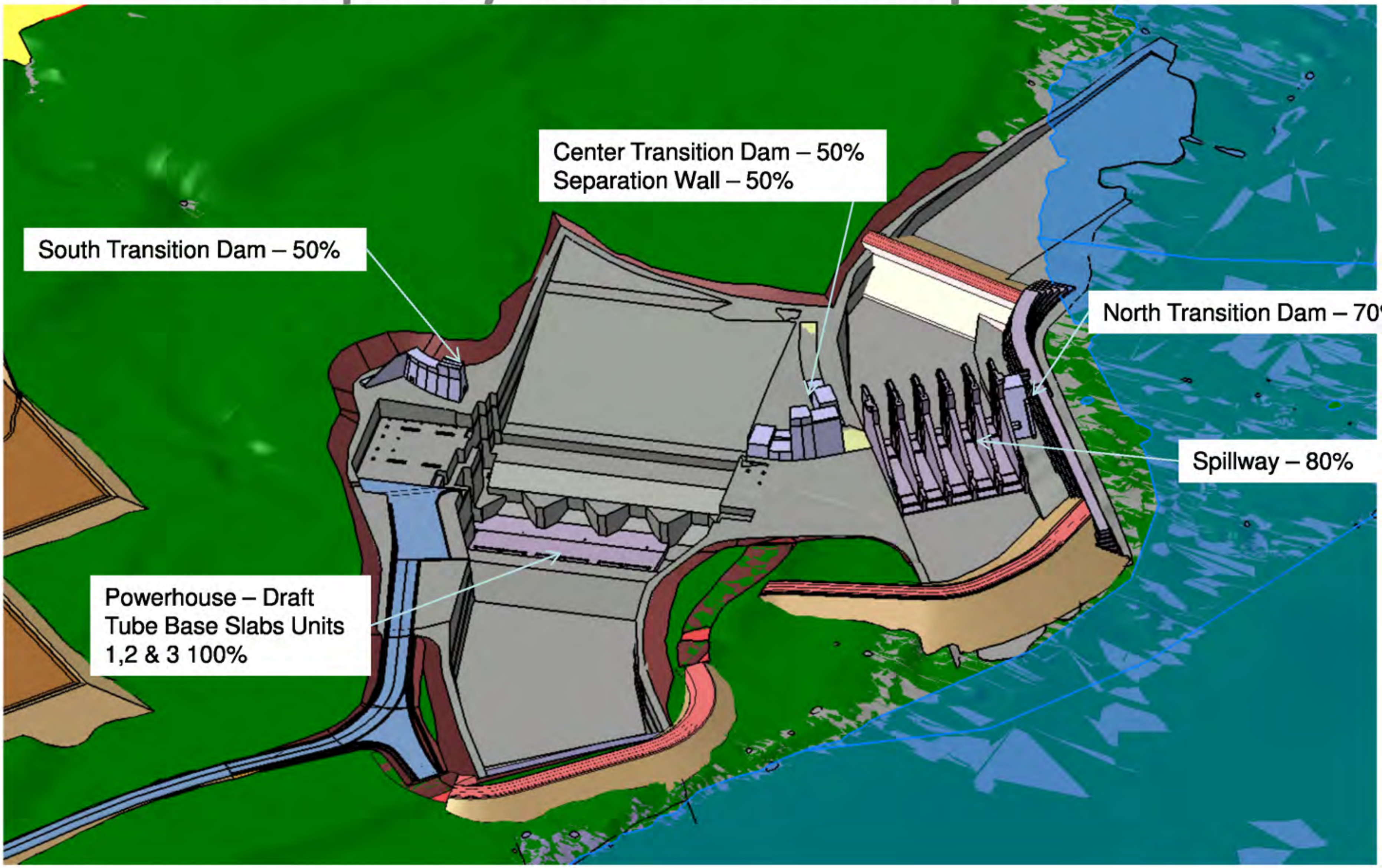


2013 – December: Focus on Spillway Foundation

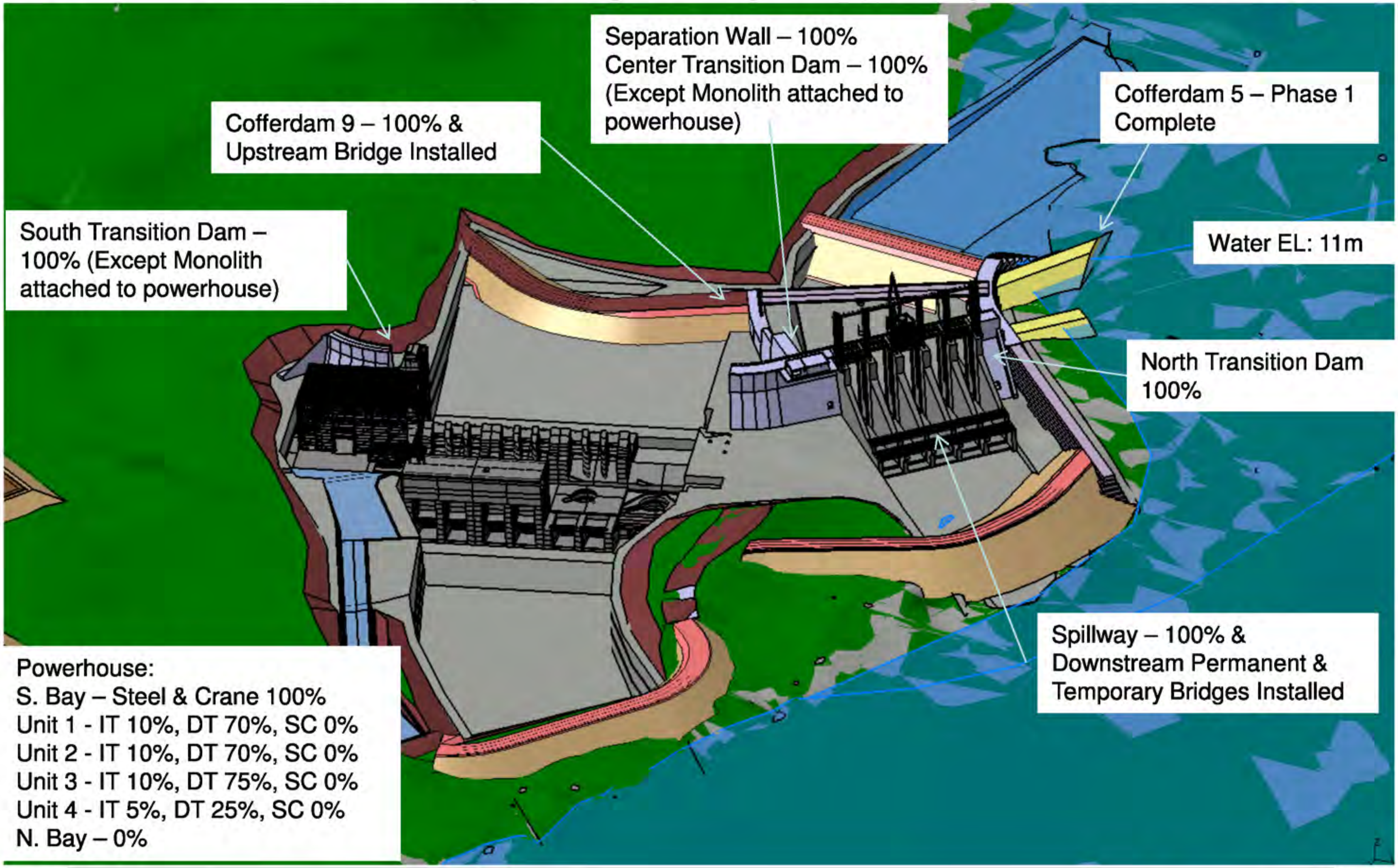


2013 – December: North Spur Stabilization Works Started

2014 – June: Spillway Concrete 80% Complete



2014 – December: Spillway Complete, Prep for Diversion



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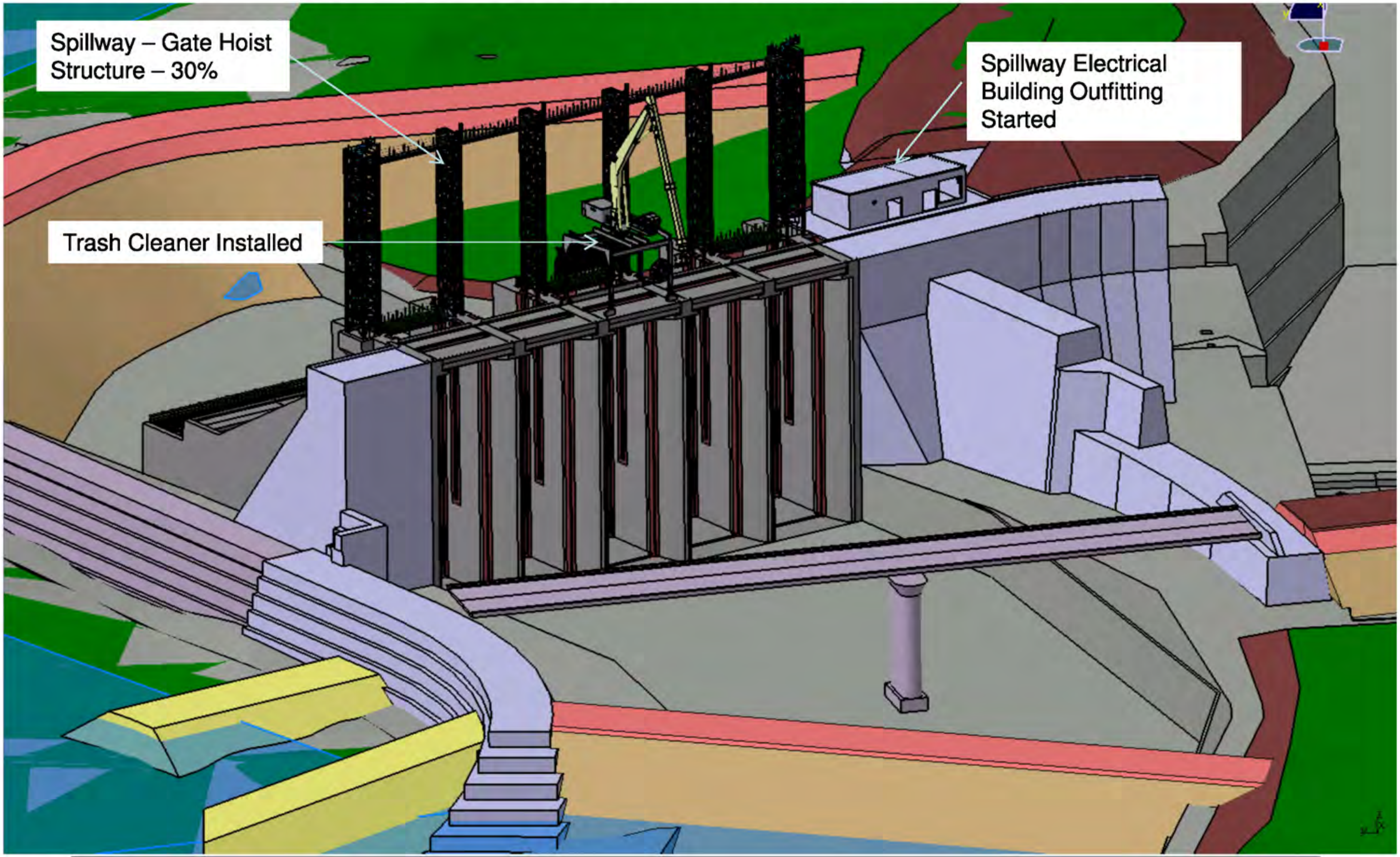
2014 – December: Trash Rack Cleaner Installed



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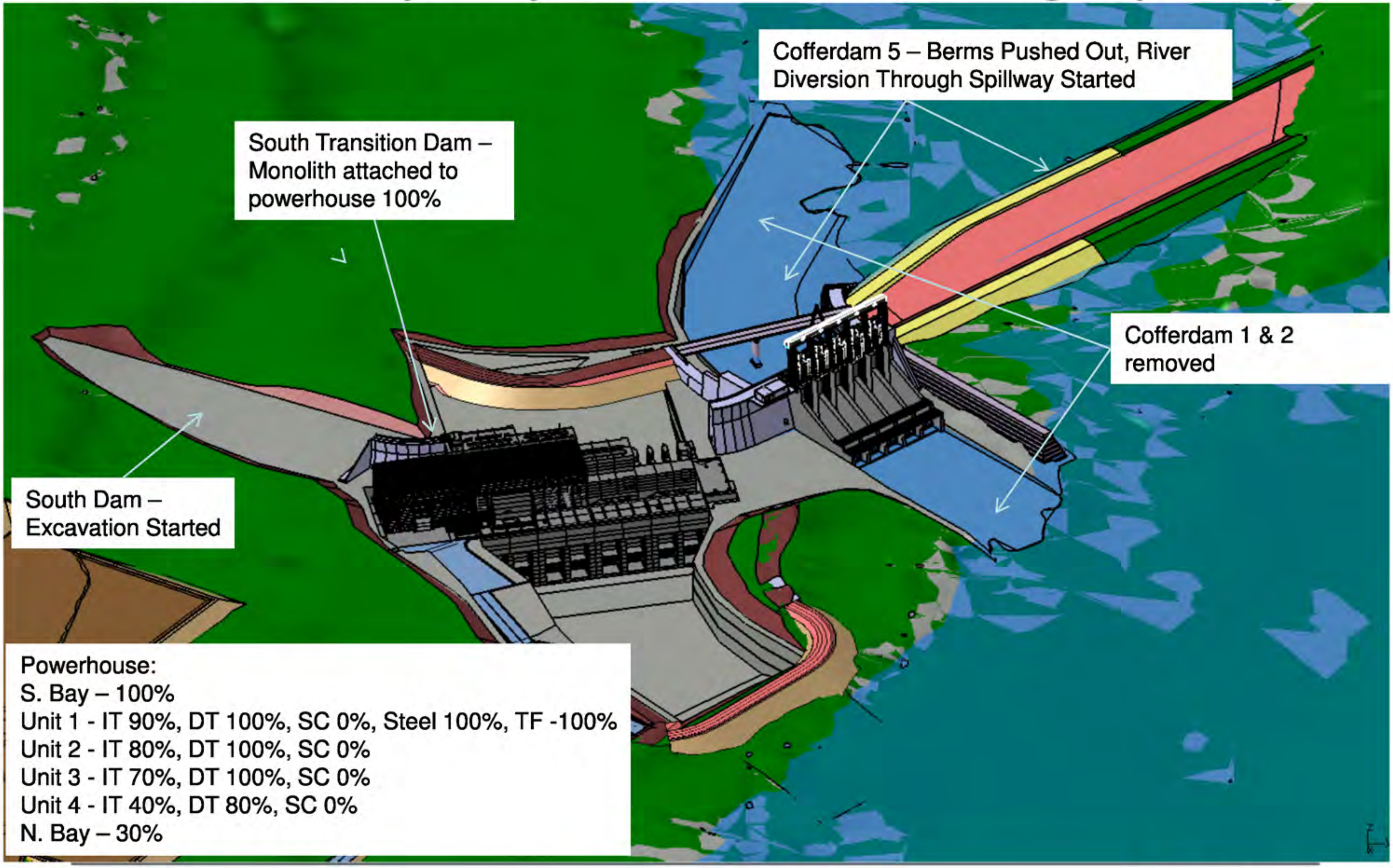
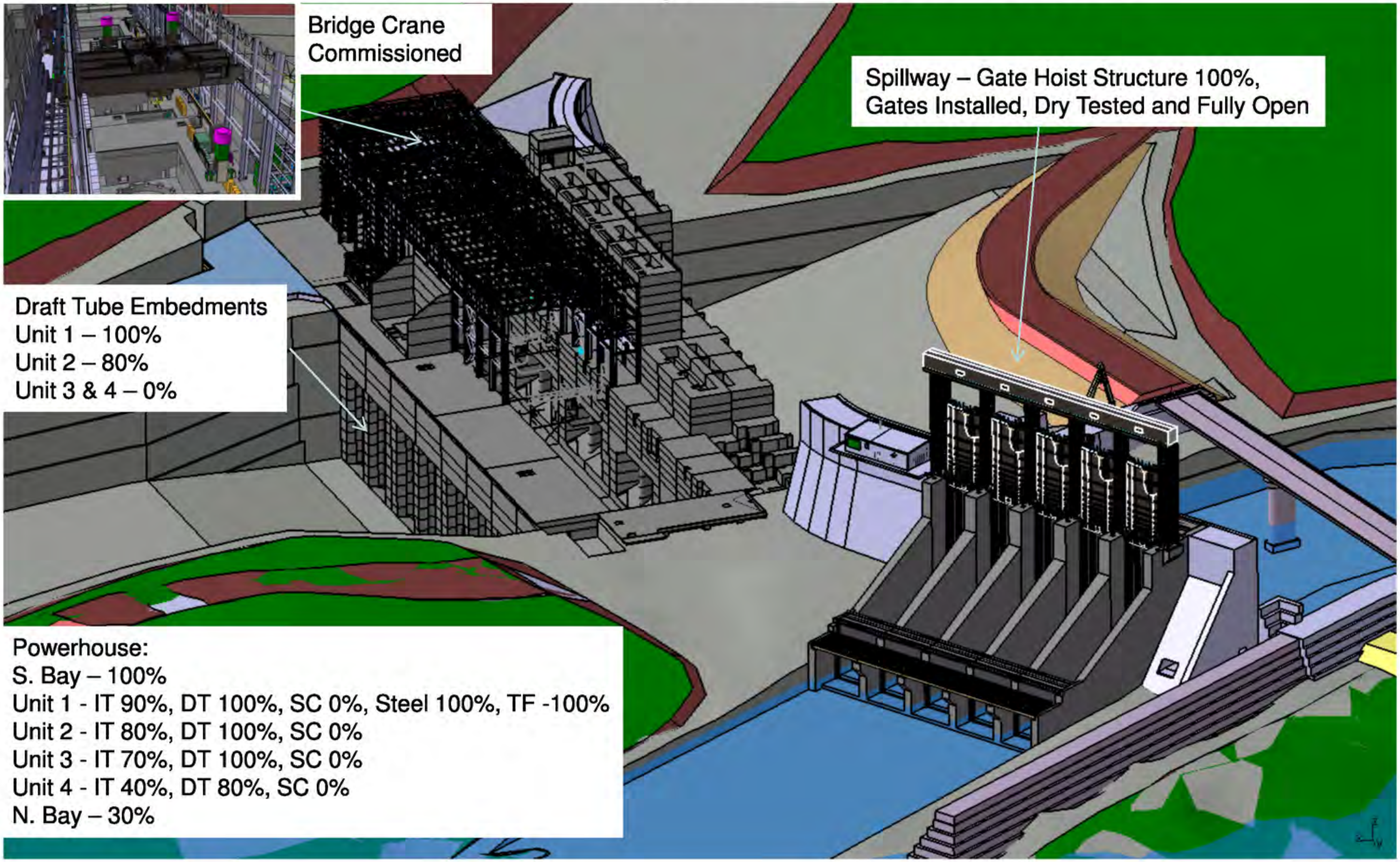
2015 – June: Temporary River Diversion through Spillway

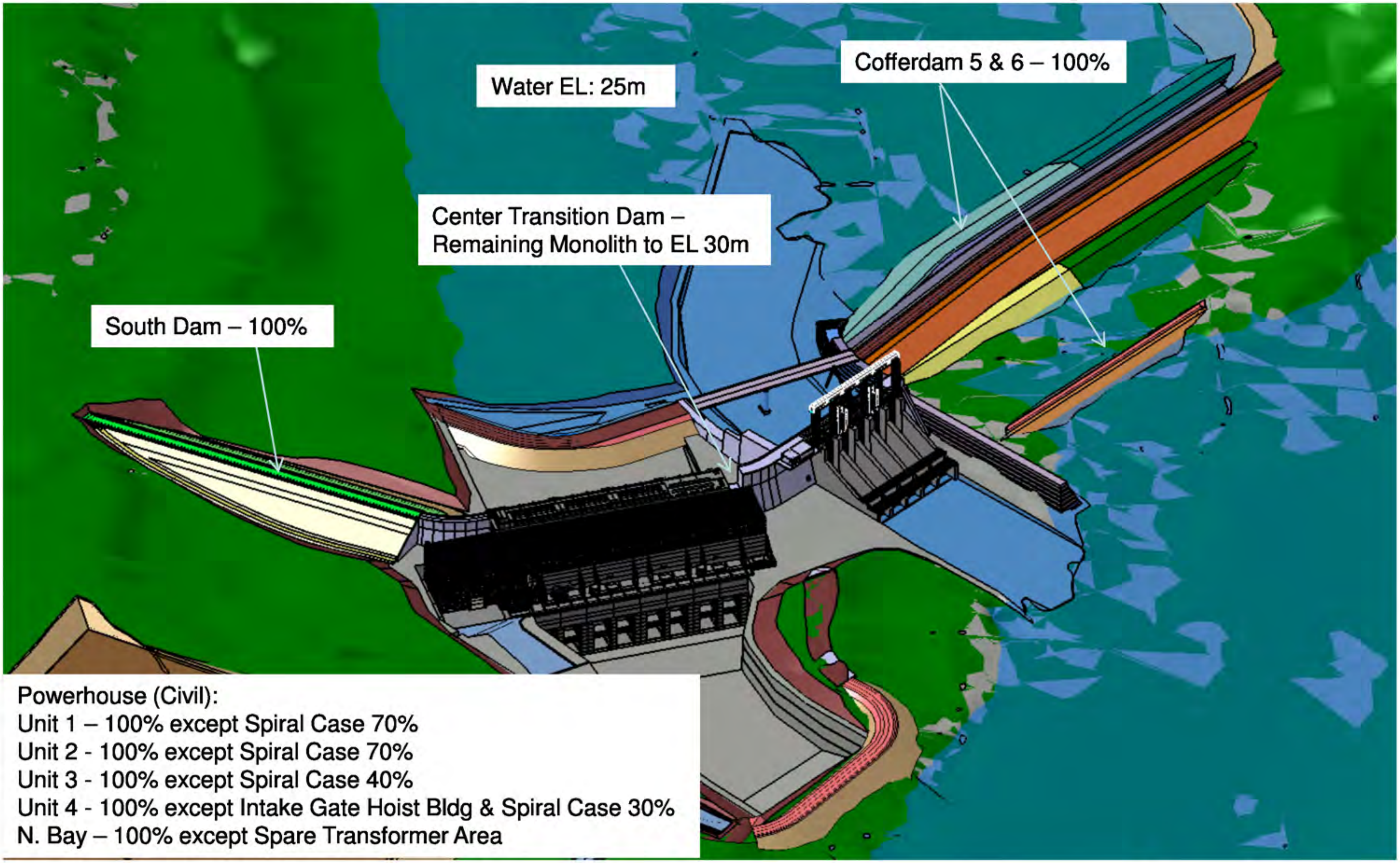


2015 – June: Powerhouse Superstructure Erection

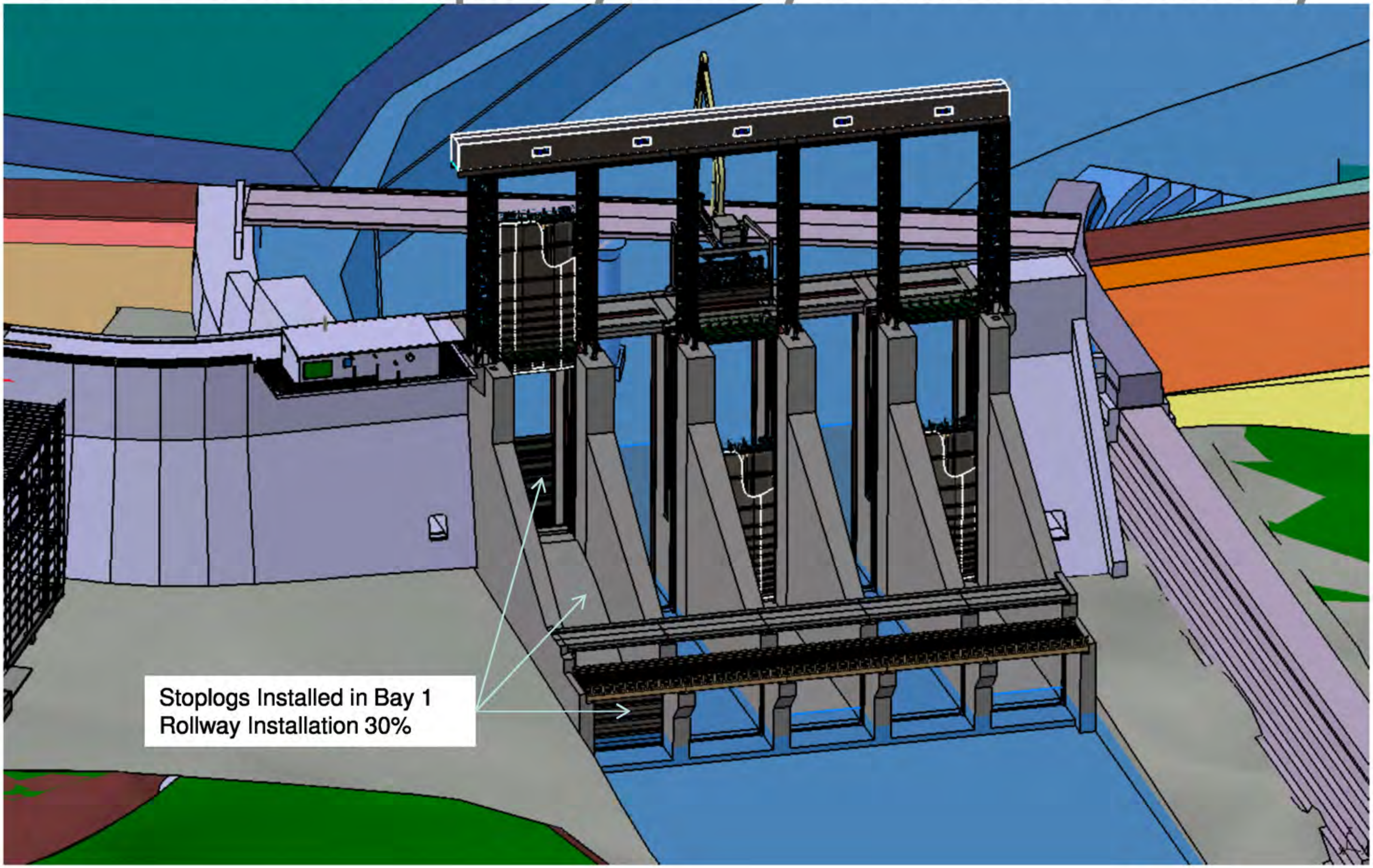


2015 – June: North Spur Ready for Diversion

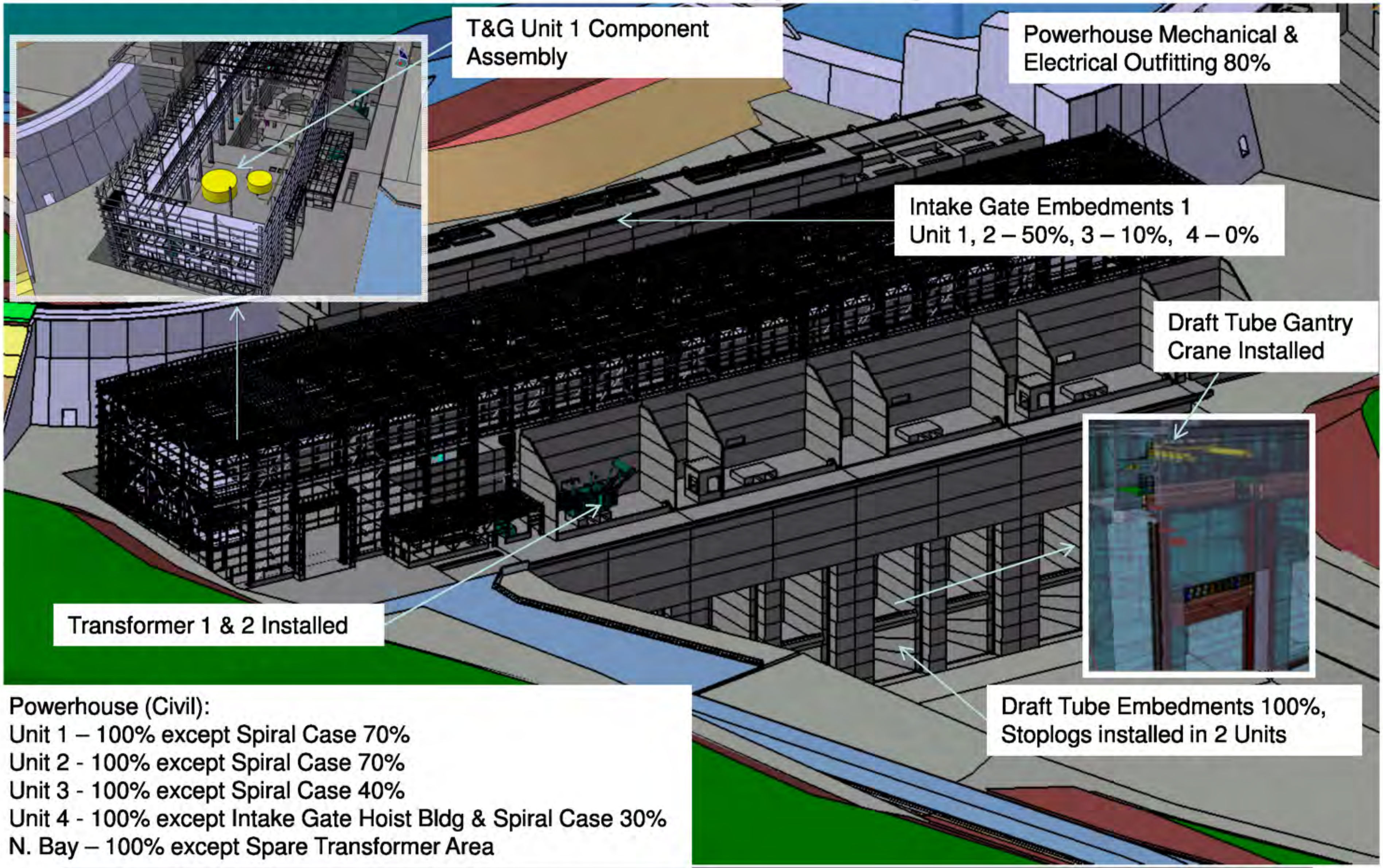
2015 – December: North Side Cofferdams Complete



2015 – December: Spillway Rollway Installation Underway

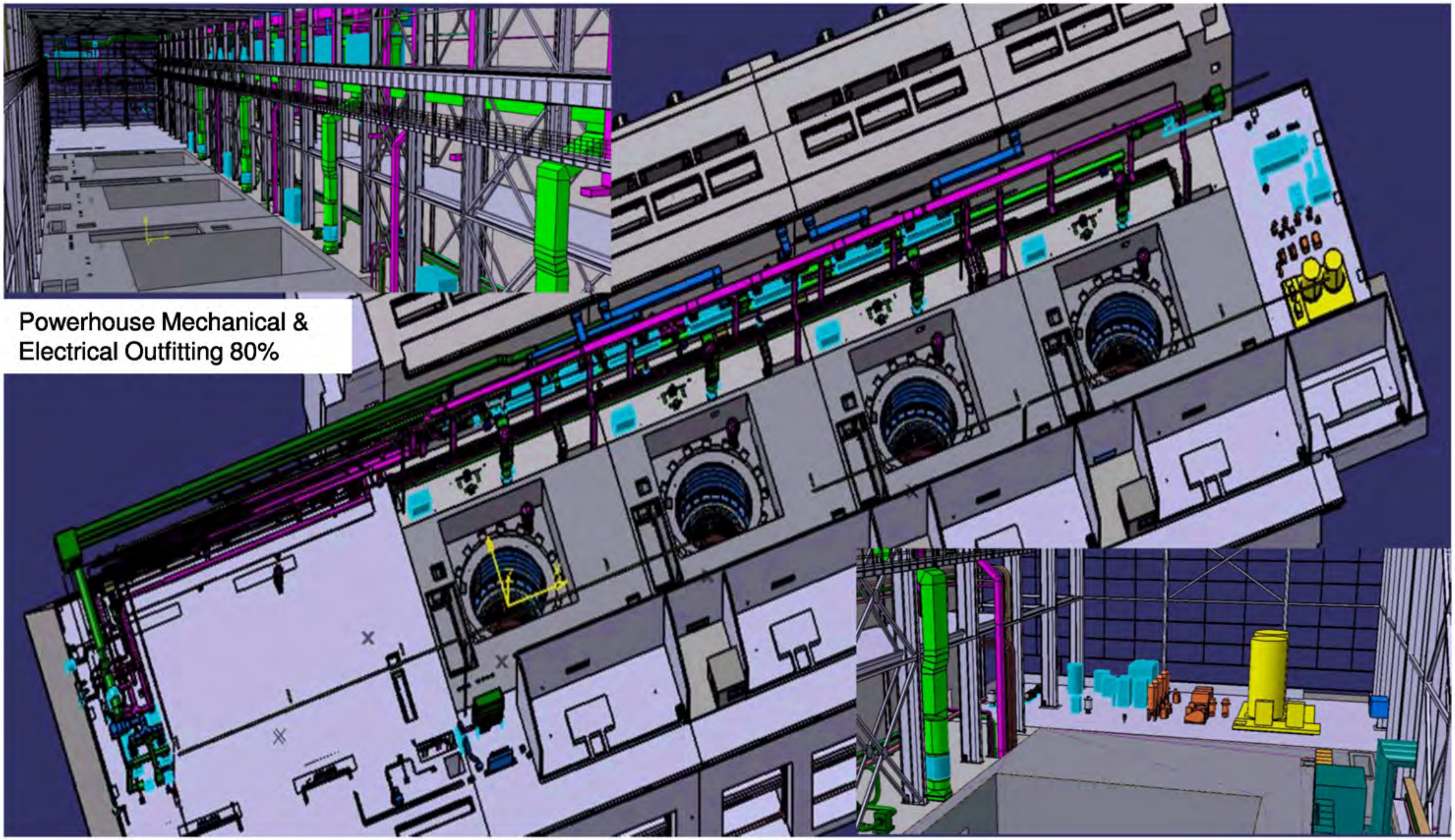


2015 – December: Concrete Nearly Complete



Powerhouse (Civil):
Unit 1 – 100% except Spiral Case 70%
Unit 2 - 100% except Spiral Case 70%
Unit 3 - 100% except Spiral Case 40%
Unit 4 - 100% except Intake Gate Hoist Bldg & Spiral Case 30%
N. Bay – 100% except Spare Transformer Area

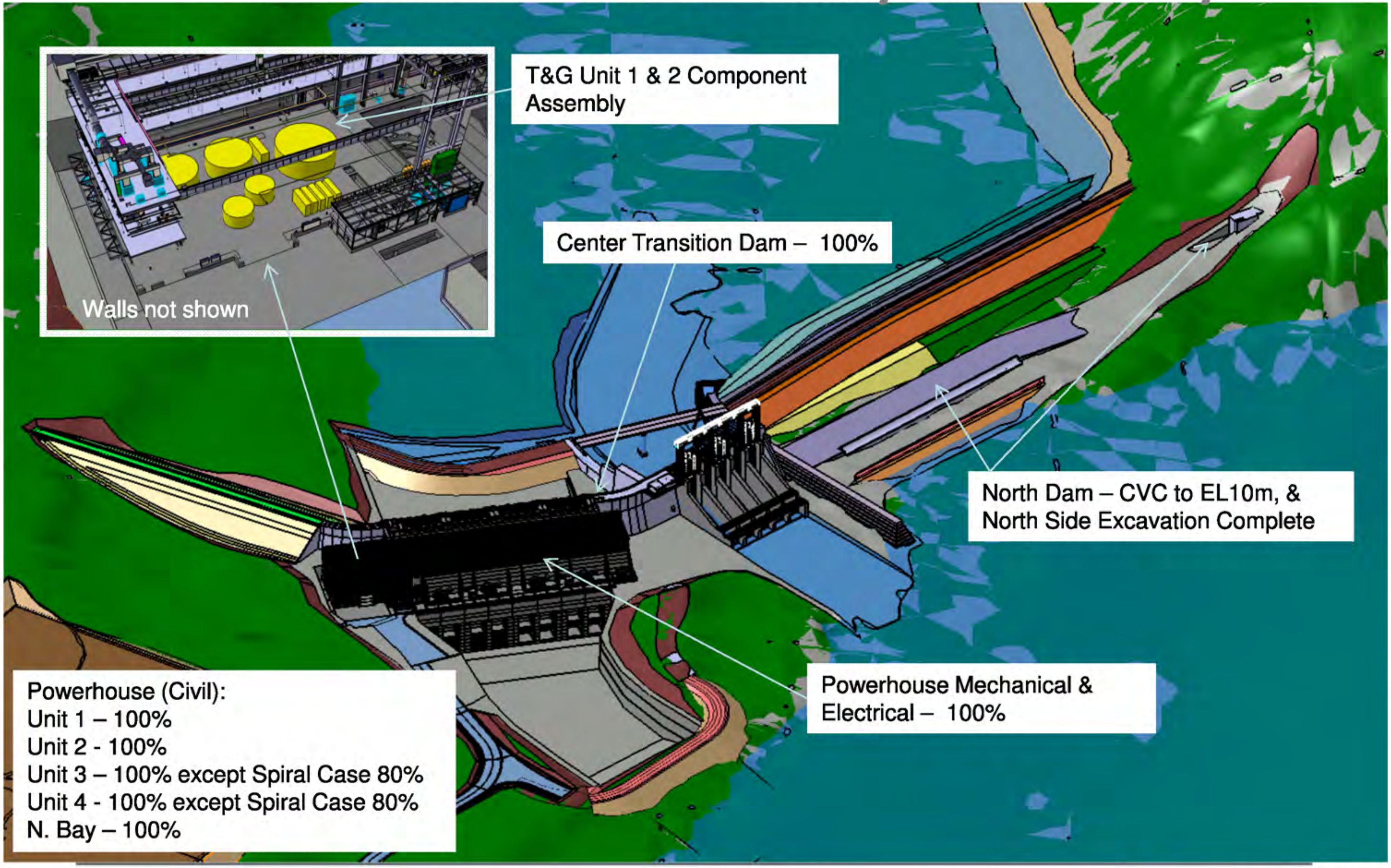
2015 – December: Powerhouse Outfitting 80% Complete



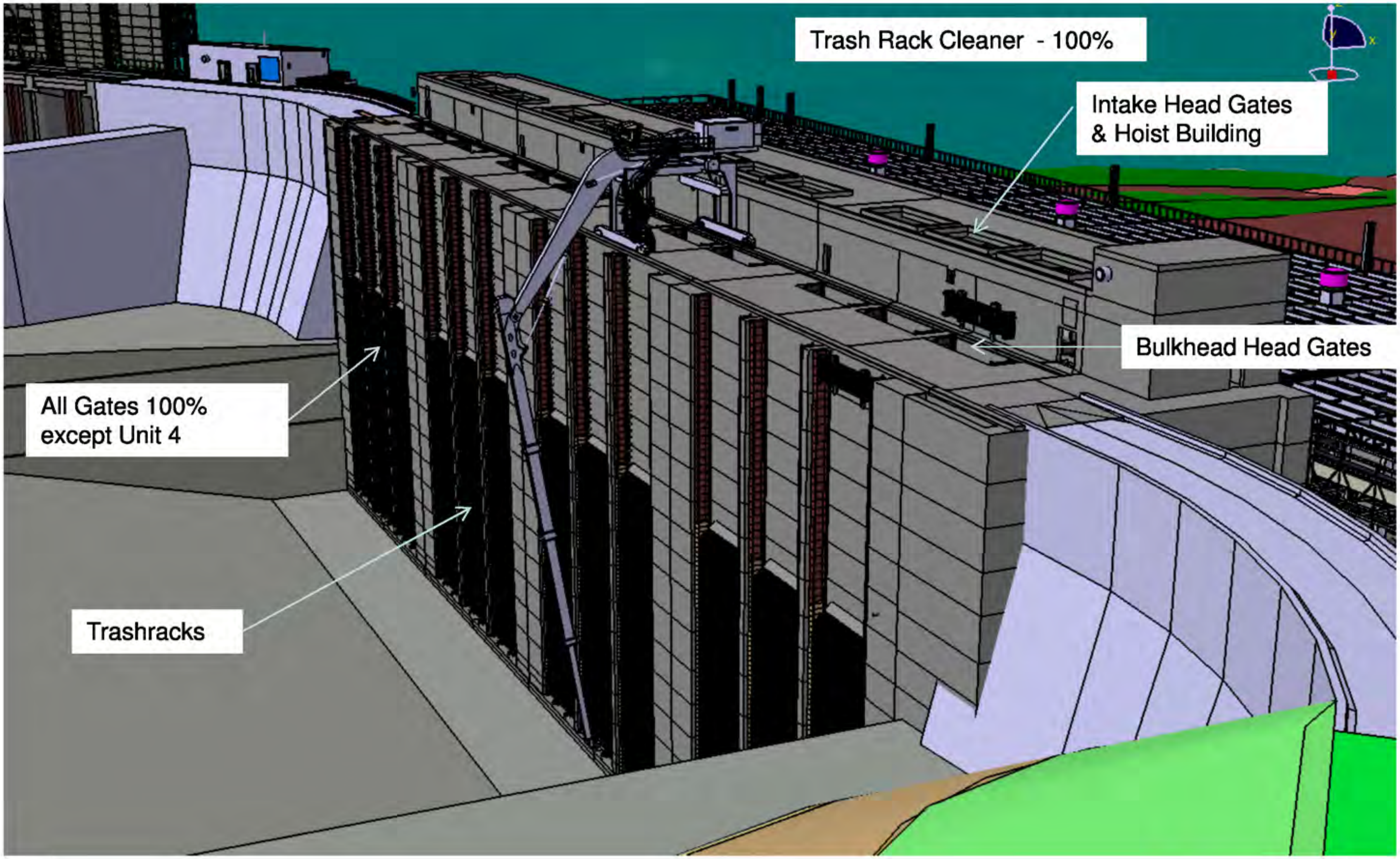
Powerhouse Mechanical & Electrical Outfitting 80%

2015 – December: North Spur Stabilization Complete

2016 – June: T&G Units 1 & 2 Assembly In Service Bay



2016 – June: Intake Gates 1, 2 & 3 Complete



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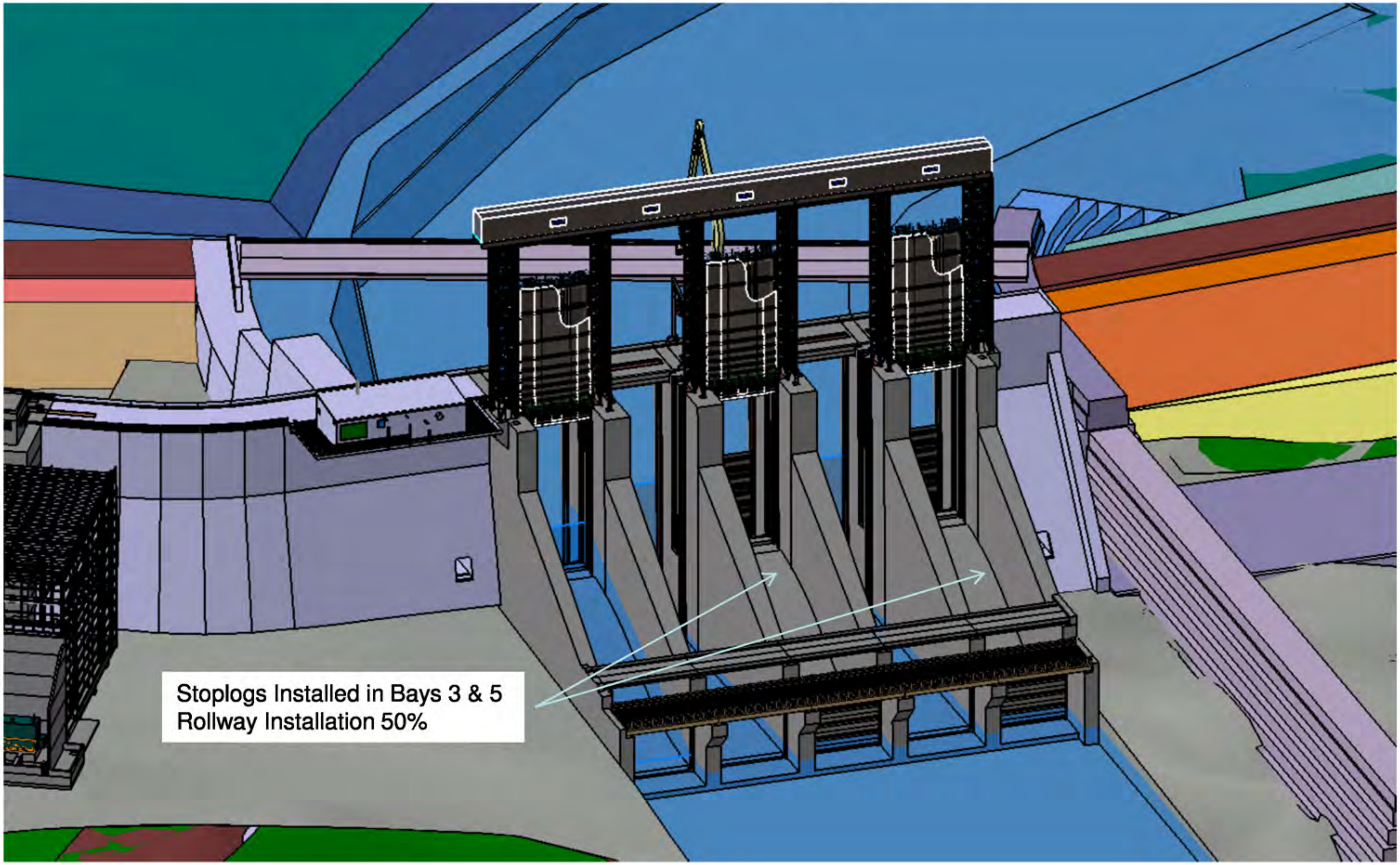
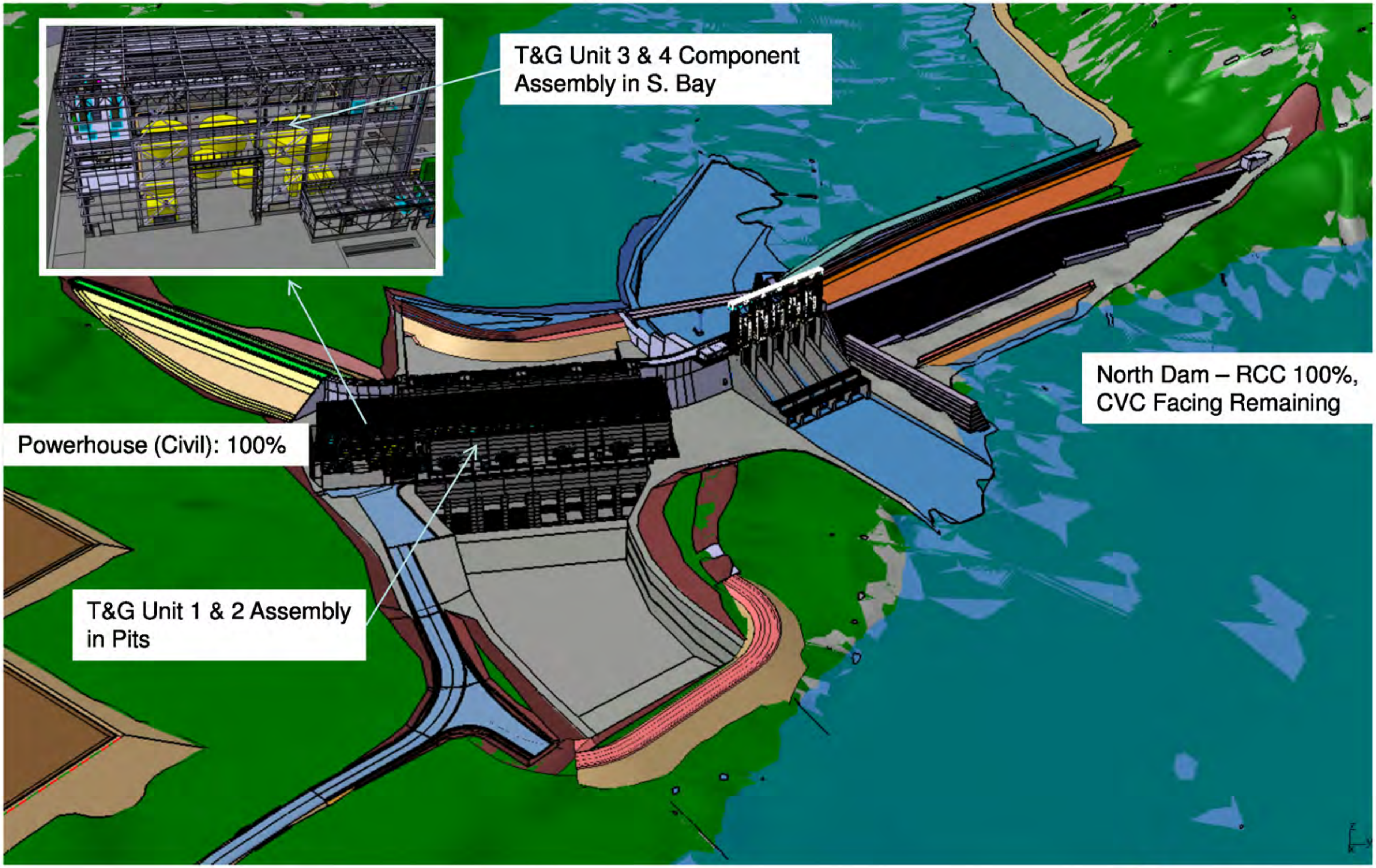
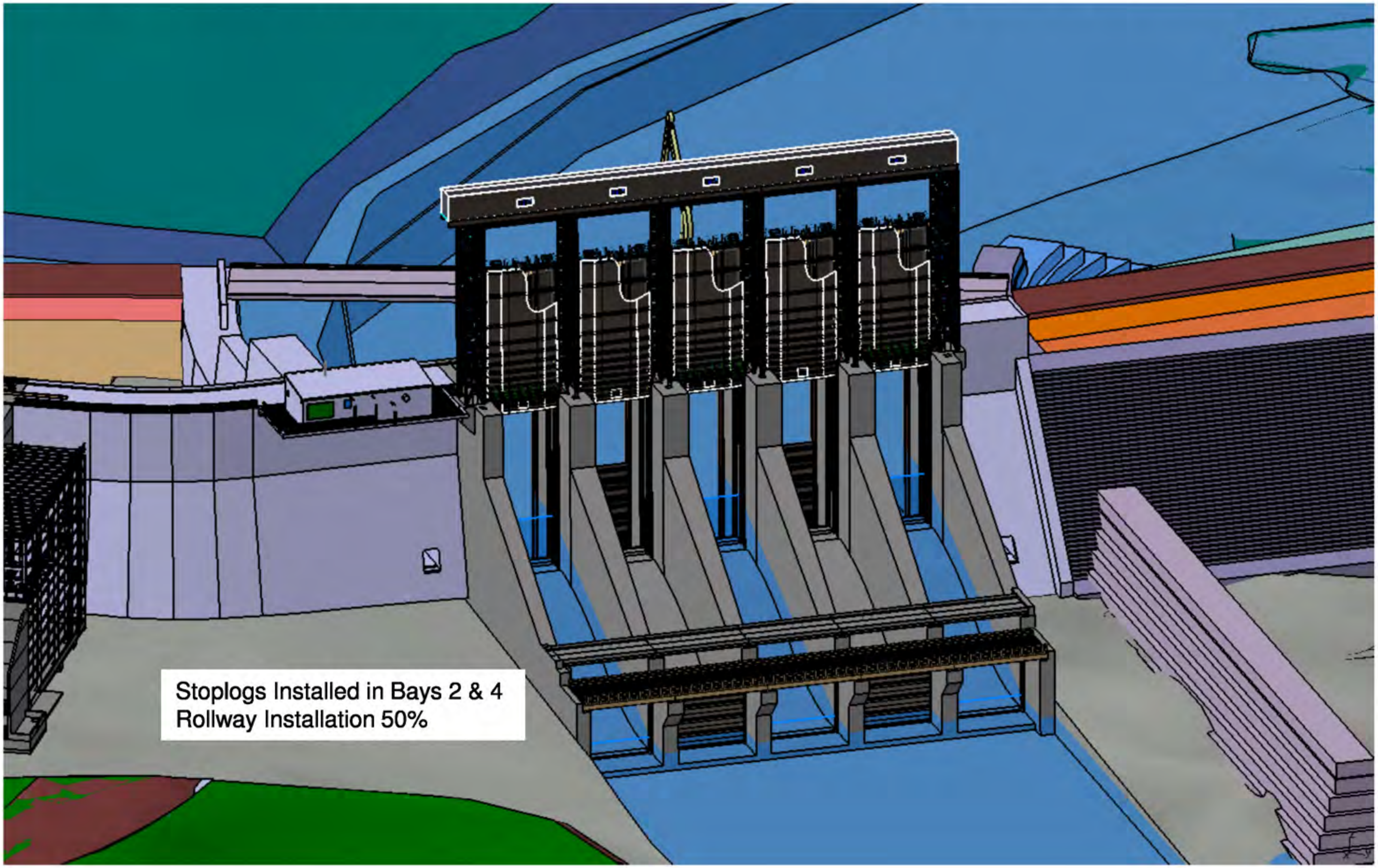
2016 – June: Rollway Installation Bays 3 & 5



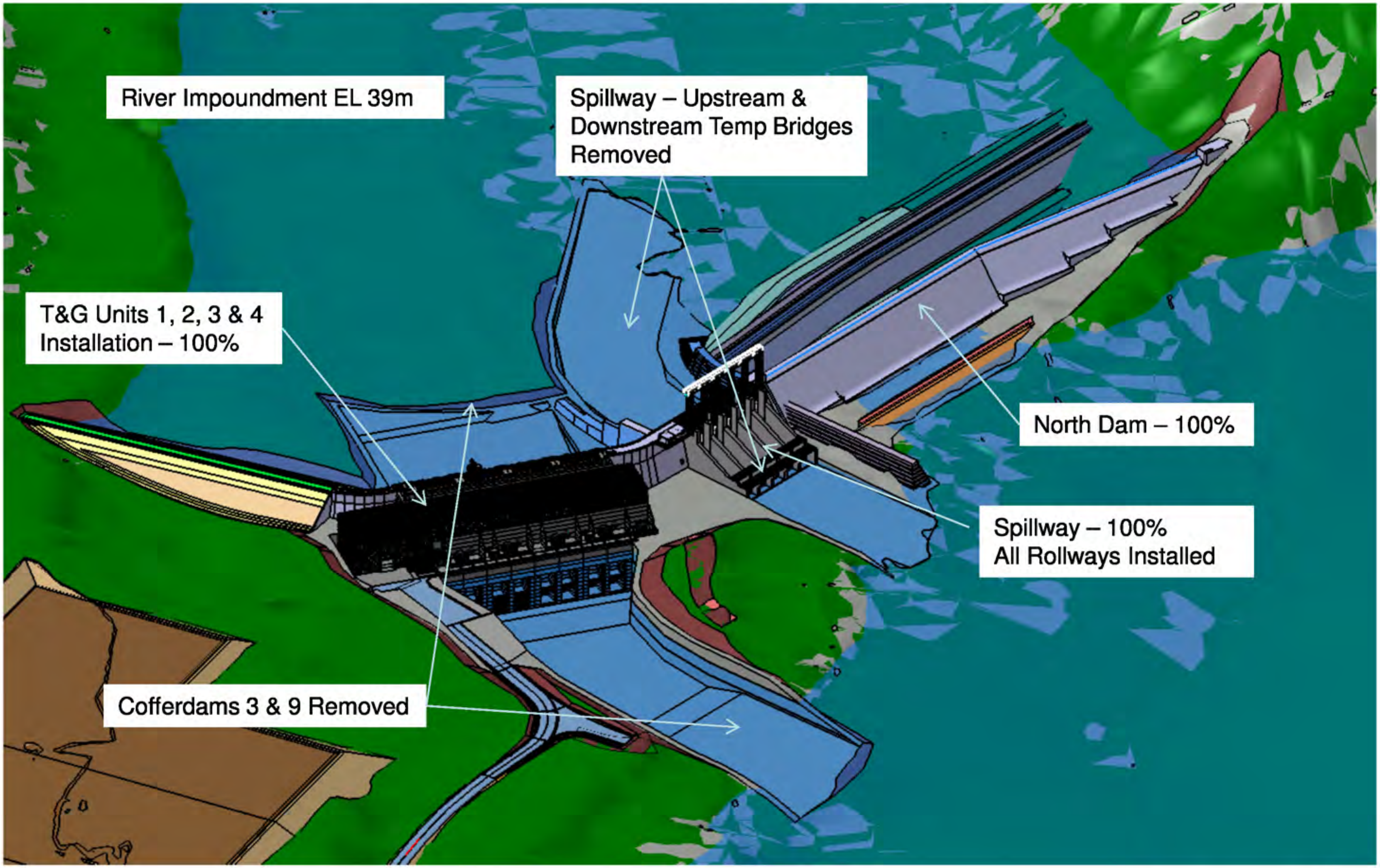
2016 – December: Turbine Unit 1 & 2 Assembly in Pit



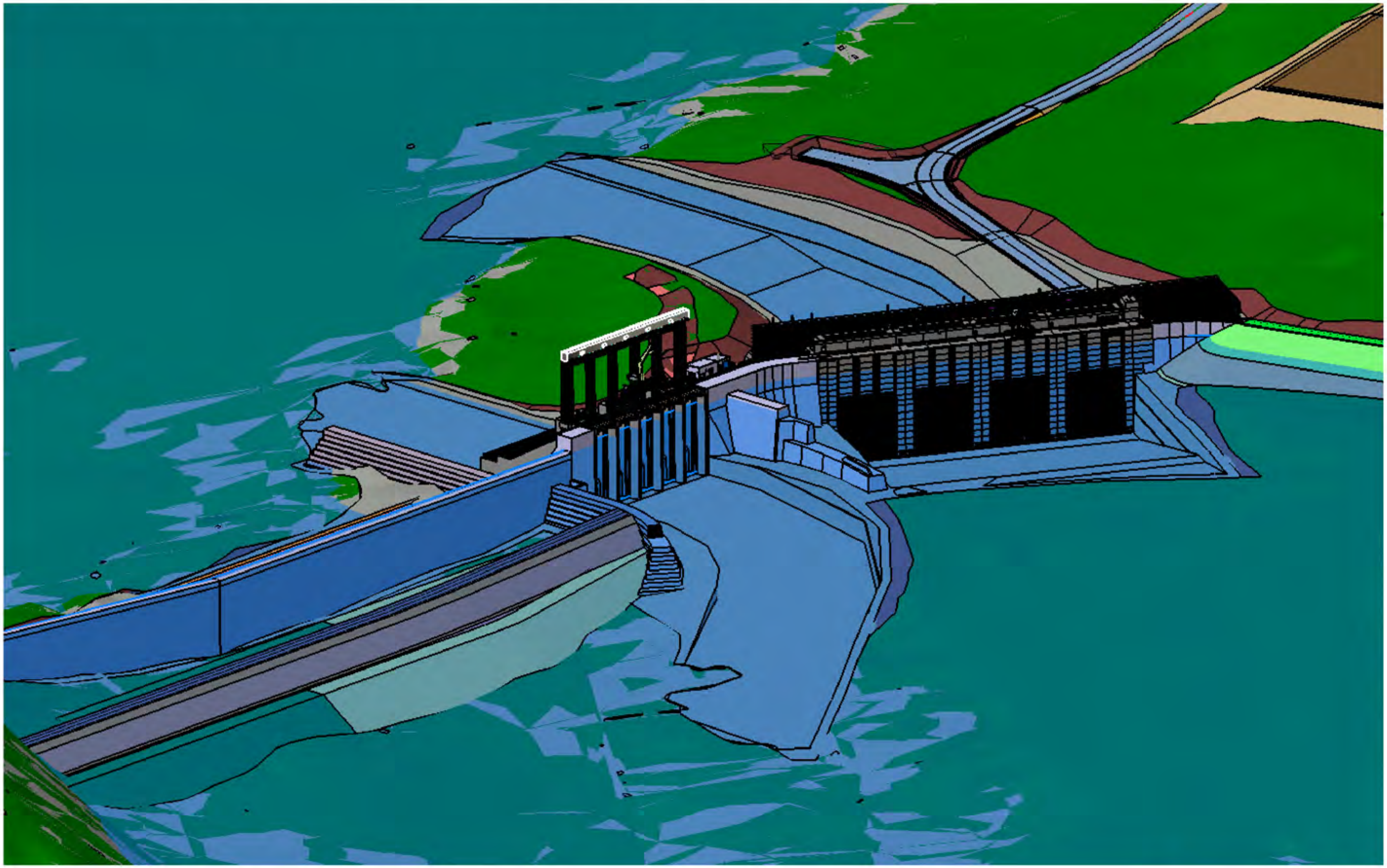
2016 – December: Rollway Installation Bays 2 & 4



2017 – June: Unit 1 Commissioned & Ready for First Power



2017 – June – First Power Achieved

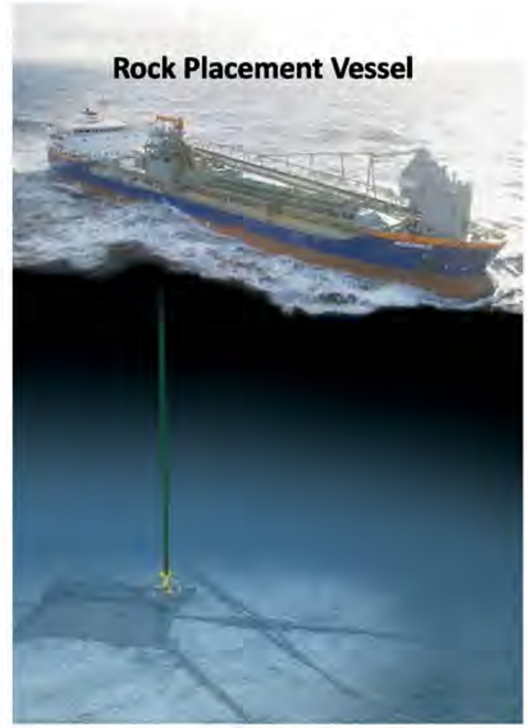


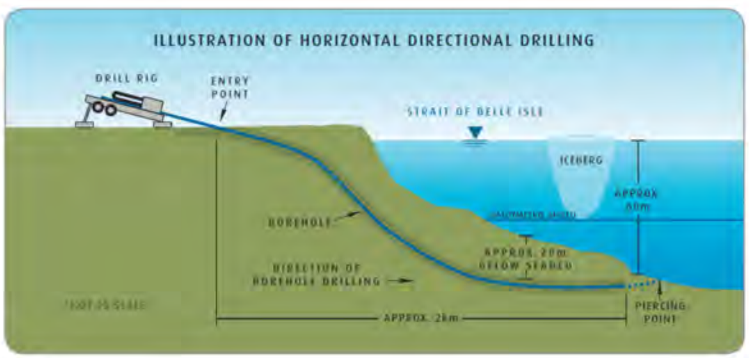
Project Definition – SOBI Crossing

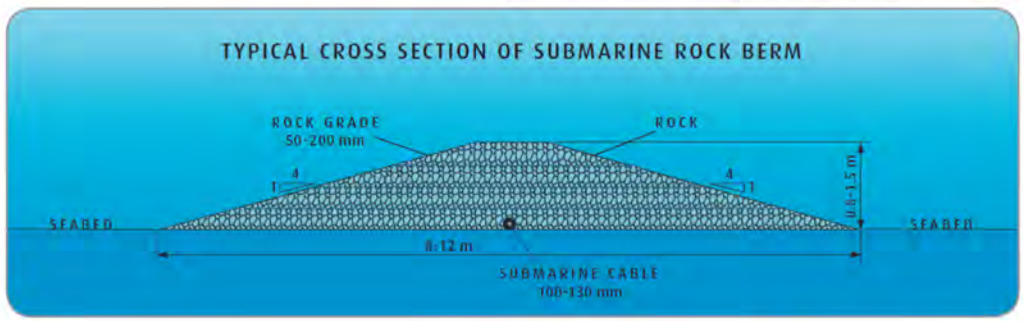
SOBI Crossing: A “deeper” look

Selected solution for the SOBI cable crossing builds upon team’s extensive experience in the design and installation of subsea infrastructure in harsh environments combined with learnings from global cable projects.

- Each of the 3 submarine cables will each have a dedicated horizontally directionally drilled (HDD) conduit to protect the cable from shore and pack ice at the landfall points.
- The conduits will take each cable to a water depth of between 60 to 80m, thus avoiding iceberg scour.
- The cables will then be laid on the sea bed and each protected with a separate rock berm which will protect against fishing gear and dropped objects







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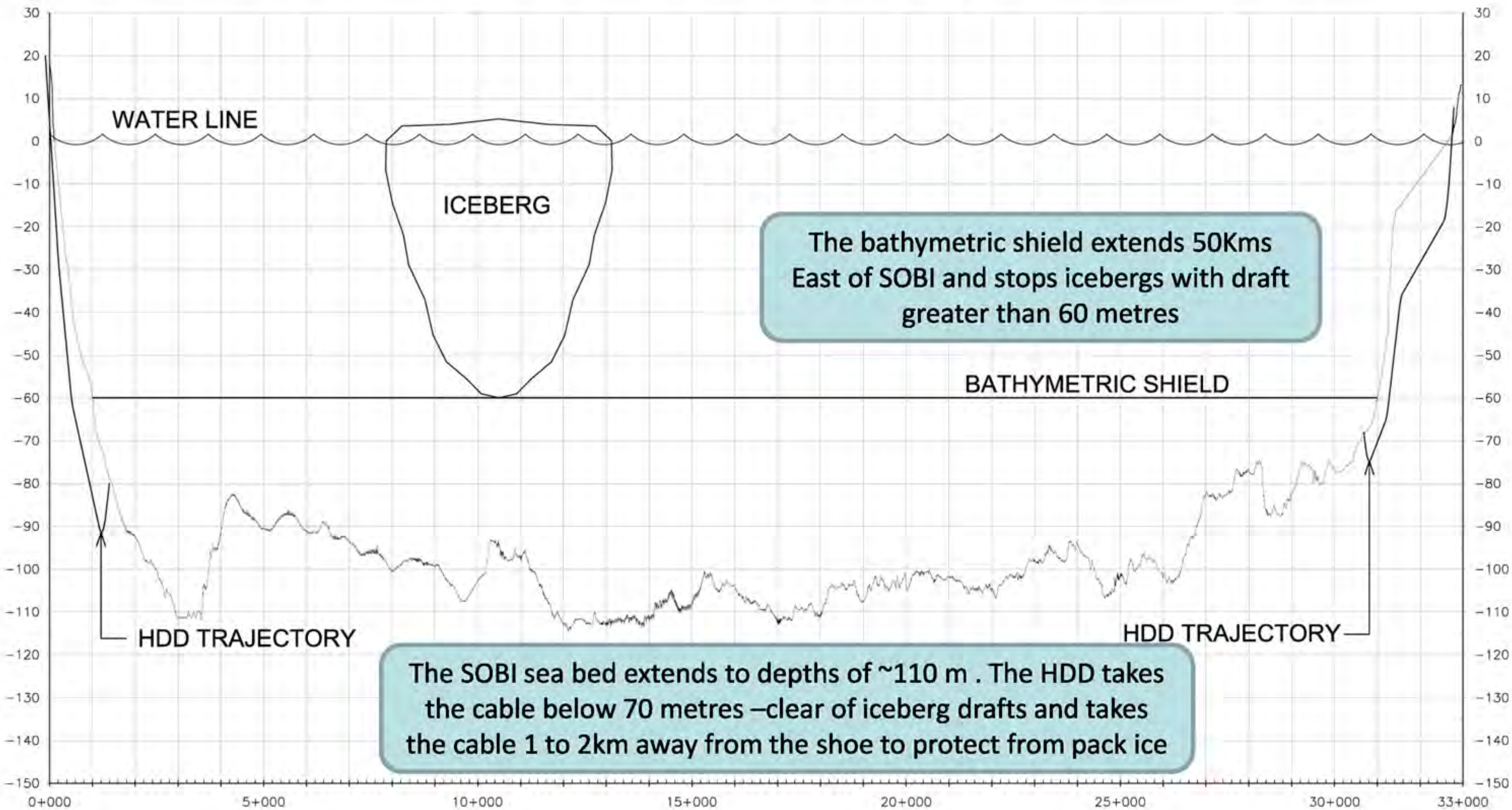
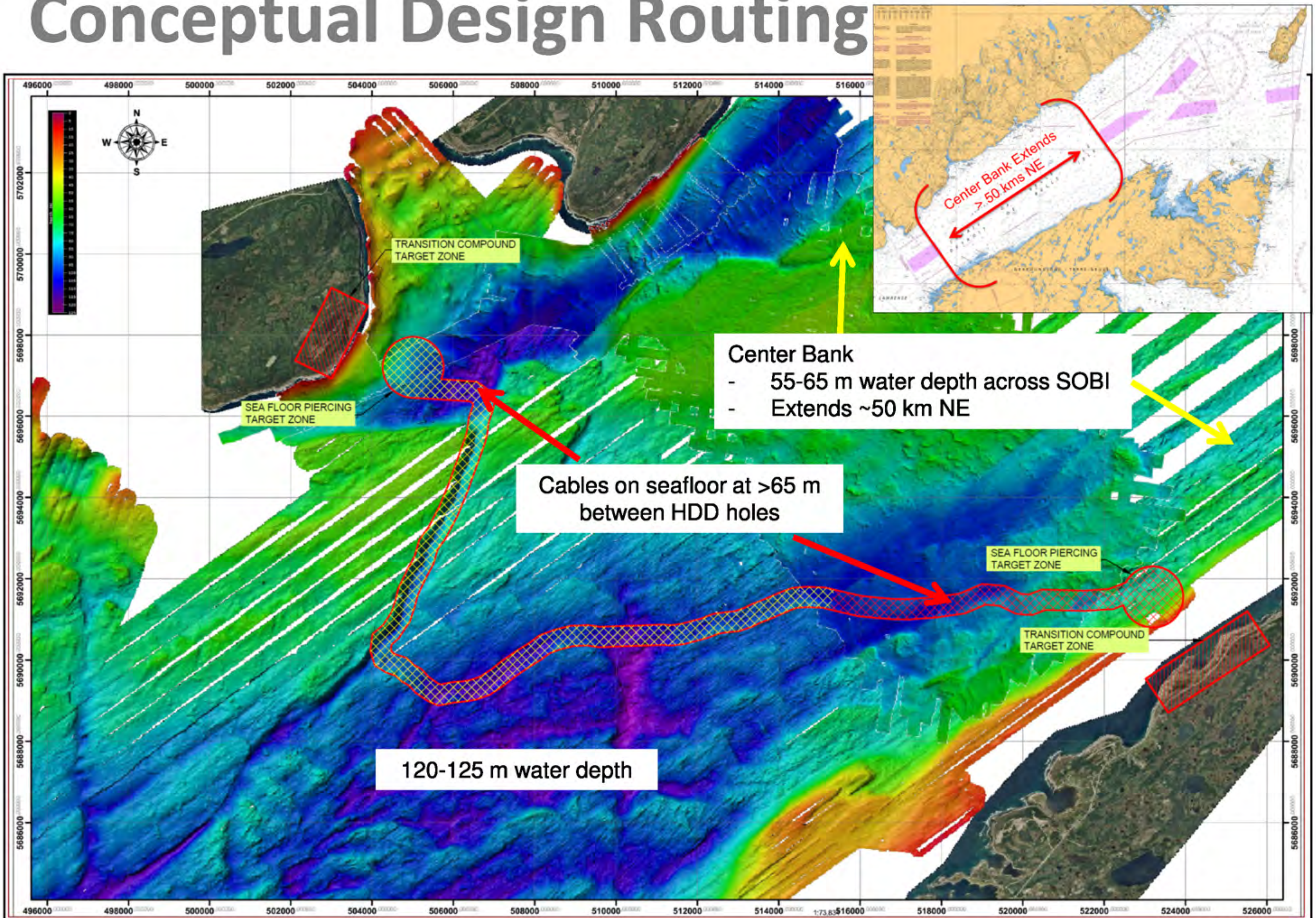
SOBI Iceberg and Pack Ice Protection



Conceptual Design Routing



Center Bank Extent

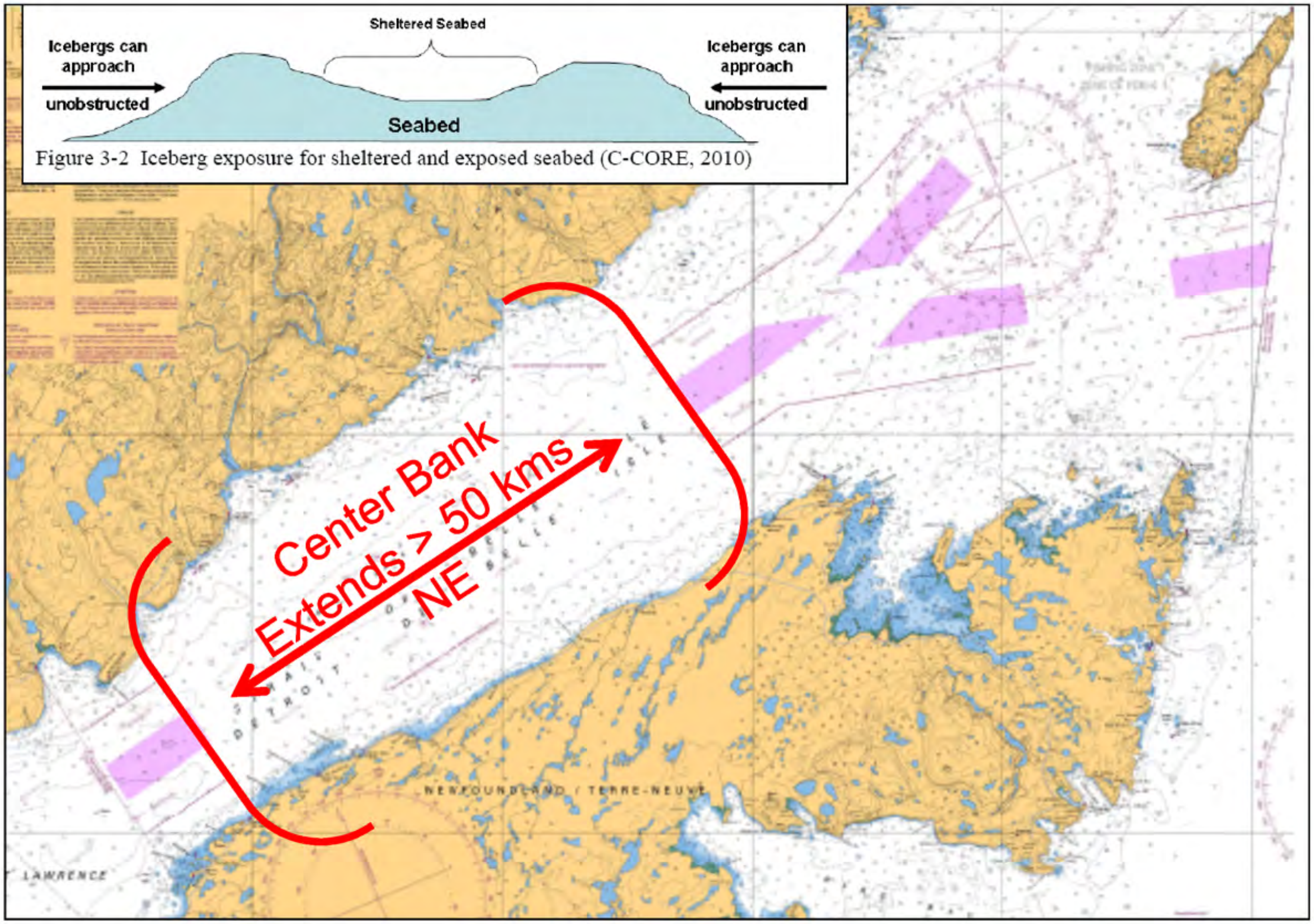


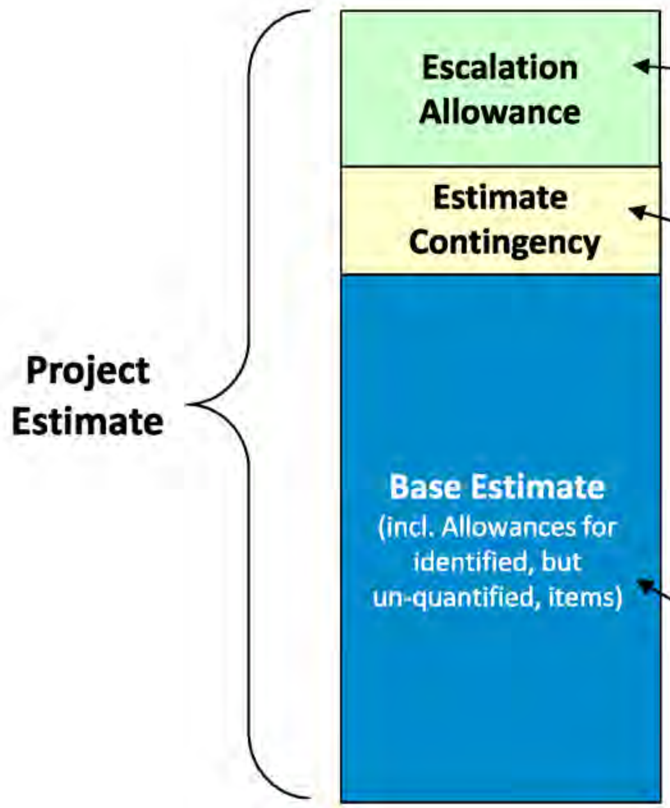
Figure 3-2 Iceberg exposure for sheltered and exposed seabed (C-CORE, 2010)

Nalcor's Estimating Approach

Nalcor's Estimating Approach

- Adopt industry recommended practice
  - Association for Advancement of Cost Engineering (AACE) International
- Focus on key cost drivers
- Fully engage project team
  - Combined Nalcor / SNC-Lavalin >400 FTEs
- Understand and apply lessons learnt from other projects
- Gather external and independent input

Cost Estimate Components



Escalation Allowance
Provision for changes in price levels driven by economic conditions. Includes inflation. Estimated using economic indices weighted against base estimate components.

Estimate Contingency
Provision made for variations to the basis of an estimate of time or cost that are likely to occur, that cannot be specifically identified at the time the estimate is prepared but, experience shows, will likely occur. It is not meant to cover scope changes outside the Project's parameters, events such as strikes or natural disasters, escalation or foreign currency impact, or changes that alter the basis upon which the control point for management of change as been established as captured in key project documents (e.g. basis of design, project execution plan).

Base Estimate
Reflects most likely costs for known and defined scope associated with project's specifications and execution plan as produced by the estimator.

DG3 Estimate – How it was produced

- Owner-led estimate team comprised of SNC-Lavalin and various 3rd parties
- Developed over a 12-month period
- Leveraged extensive historical data for Hydro and Transmission projects developed in Canada
- Reflects what a construction contractor would need to do to evaluate project costs for which a bid is being prepared
  - This approach could be best described as a bottom-up first principle estimate as opposed to a parametric or stochastic method
- Concurrent "Check" or validation estimates and Estimate Process Check completed by expert consultants

Establishing the Cost Estimate

The accuracy of the cost estimate is a function of the engineering, procurement and contracting carried out as shown below

DG2 Concept Selected Nov 2010 → **DG3 Sanction 2012** → **Financial Close 2013**

DG2 Concept Selected Nov 2010

- AACEI* Class 4 Estimate
- Some site investigation work
- Concept selected and feasibility work complete
- Project scope defined
- Quantities estimated based on previous studies
- Estimate based on earlier feasibility studies escalated and updated with latest data
- The estimate reflects the Basis of Design approved at DG2

DG3 Sanction 2012

- AACEI* Class 3 Estimate
- Includes latest geotechnical analysis
- Quantities based on 3D model and detailed engineering work
- Includes actual bid costs for SOBI cable contract, TG sets, tower steel, early infrastructure works plus updated market intelligence and quotes
- Labour rates will be updated based on Labour Agreement
- The estimate reflects the Basis of Design at DG3

Financial Close 2013

- AACEI* Class 2 Estimate
- Includes 100% of all critical / complex PO's and contracts which amount to 80% of all contracts
- Firm quantities with EPC, Lump sum and fixed unit price contracts as appropriate
- The estimate reflects the DG3 Basis of Design plus any approved project changes as per Management of Change process

** Association for the Advancement of Cost Engineering International*

The Estimators Consider 4 Elements

Definition Factors (Scope)	Construction Methodology & Timeline Factors	Price Factors	Performance Factors
What is to be built	How it will be done	Per Unit material / labor cost	Time to complete each work activity

Each Element has Extensive Information Set

Definition Factors (Scope) + **Construction Methodology & Timeline Factors** + **Price Factors** + **Performance Factors** = **Base Estimate**

Definition Factors (Scope)

- Design Criteria & Specifications
- General Arrangements & Layouts
- Design Drawings for major components – towers and hardware
- MF rock and concrete quantities from 3D CAD
- Master Equipment List
- Cable List
- Material Take-offs for Construction Bulks
- Equipment Specifications
- Geotech surveys
- WBS & Cost Codes

Construction Methodology & Timeline Factors

- Construction Philosophies
- Construction Execution Plan
- Constructability Reviews
- Construction Schedule
- Logistics and Access, incl. freight forwarding & marshaling yards
- Contract Package Dictionary
- Org. Design and Staff Plans
- Construction Equip. Types
- Labor Demand
- Labor Demarcation
- In-directs Strategies
- Site Services
- Pre-Fabrication Plans
- Crane & Access Studies
- Support Facilities
- Material Sourcing Strategies
- Seasonality Constraints
- Permit Register

Price Factors

- Labor Agreement
- Construction Equip. Rates
- Bid Analysis – T/G, SOBI Cable, Tower Steel, Accommodations, Road
- Budgetary Quotes – various equipment
- Site Services Costs – catering, air transport
- Construction Bulks Prices – Rebar, Cement, Diesel, etc.
- Helicopters and Aircrane
- Contracting Market Intelligence – overhead and profit
- Foreign Exchange Rates

Performance Factors

- Crew Make-up and Assignments
- Task durations
- Workface Restrictions
- Labor Productivity & Benchmarks
- Mobilization Constraints
- Work Front Stacking
- Seasonality Impacts
- Equipment Productivity
- In-Directs Usage
- Offsite Fabrication

Base Estimate

- Estimate organized by Project, Physical Component and by Contract Package
- Documented Basis of Estimate
- Foreign Currency Demand
- Person hours
- Trade demands
- Cash flows

Definition – Key Quantities

- Powerhouse, Intake and Spillway
  - Mass Excavation of 2.5M m^3
  - 390,000 m^3 of concrete
  - 200,000 m^2 of formwork
  - 57,000 tonnes of rebar
  - 88m high and 225m wide (the Peace Tower is 92.2m high)
- Dams and Cofferdams
  - 895,000 m^3 material
- Roller Compacted Concrete:
  - 226,000 m^3 RCC
- North Spur:
  - Overburden and rock excavation of 700,000 m^3
  - Rockfill of 1M m^3
- HVac LTA Transmission
  - 2 x 247 km in length
  - 1280 towers
- HVdc LITL Transmission
  - 1079 km in length
  - 3642 towers
- MF Reservoir
  - 1,800 hectares
  - 157 km of roads
  - 390,000 m^3 of merchantable wood

Third Party Validation

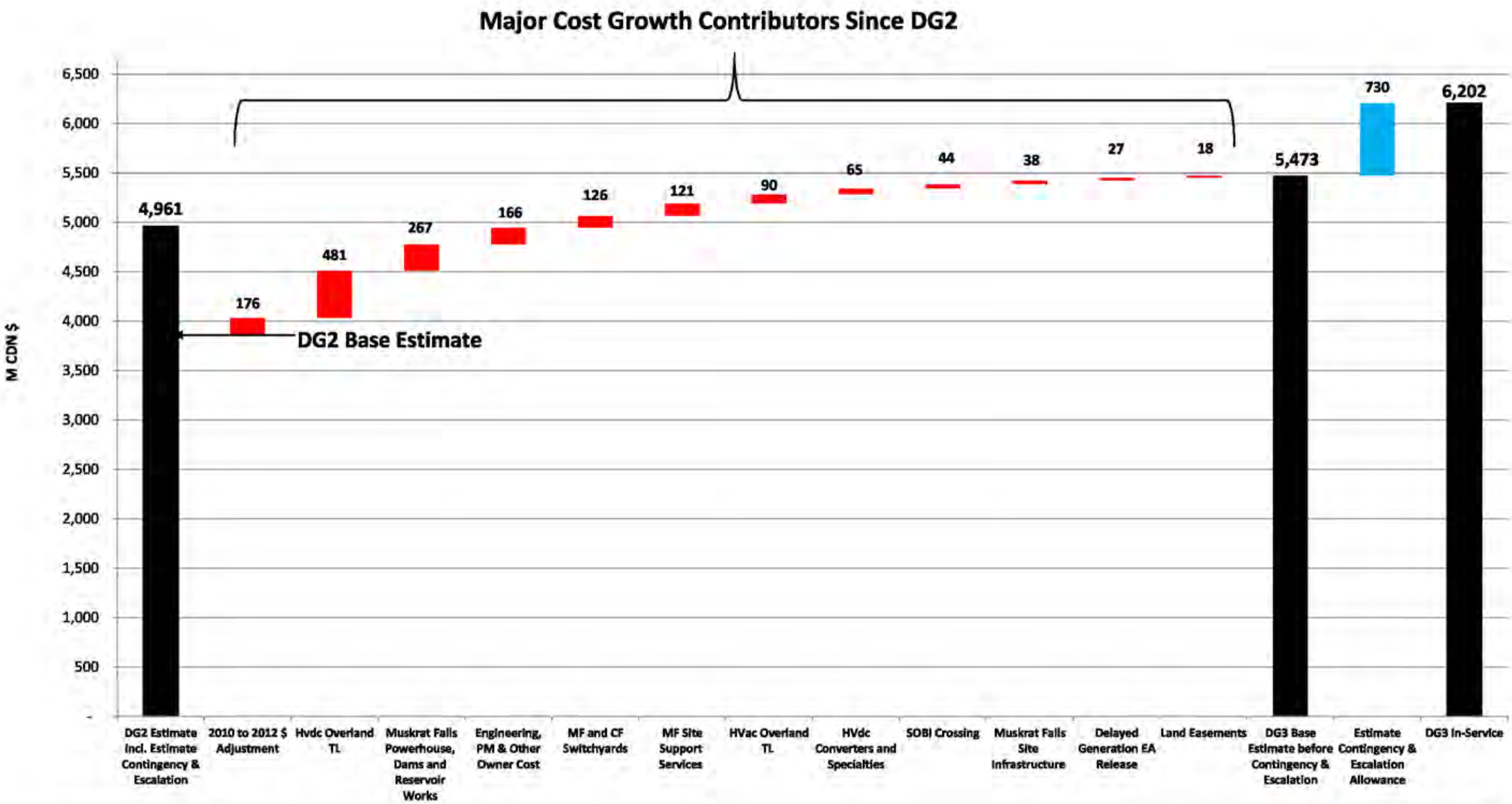
"… the LCP Gate 3 estimate in its current state is one of the best mega-project "base" estimates that this reviewer has seen in some time. My conclusion is that this is in large part due to the active involvement of the owner leads in striving for best practices and quality."

John K. Hollmann, PE CCE CEP, Owner – Validation Estimating LLC

(Recipient of AACE's highest honor, the Award of Merit, for editing/authoring the Total Cost Management Framework and authoring or assisting in developing many of AACE's Recommended Practices)

Key Drivers of DG3 Estimate

Cost Estimate Change Since DG2



Confidential and Commercially Sensitive

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HVdc Overland Transmission

- Operability / Reliability Driven Change
  - Operating voltage optimization (320 to 350kV) – less losses – results higher towers and different conductor
  - Ice loading criteria and physical data collection – results in more robust towers
- Constructability Driven Change
  - Access for remote Southern Labrador and LRM sections
  - Detailed line routing and construction methods, longer route (30 km) and more difficult access (e.g. helicopter construction)
  - Definition of ROW Clearing Scope – approx. $130M
  - Supporting infrastructure – marshalling yards, camps, etc.
- Market Driven Change
  - Increased Labor cost
  - Increased Material cost – budgetary prices or bids for all material

MF Powerhouse, Intake, Dams and Reservoir

- Operability / Reliability Driven Change influencing overall layout
  - Hydraulic flow conditions for T/G Unit 1
  - Stability of Intake Structure
  - Operability of Spillway Gates in winter
  - Flow conditions downstream of spillway – erosion mitigating
  - Results in significant increase in concrete quantities, thus materials and person-hours which is the major cost driver for MF
  - Changes identified with computer model were subsequently confirmed with Physical Model built in Edmonton (Northwest Hydraulics)
- Constructability Driven Change
  - Reservoir Clearing Execution
  - Winter Construction Constraints
  - River Management (i.e. riverside RCC cofferdam)
  - Site Indirect Services – power, batch plant, general services

Engineering, PM & Other Owner Cost

- Significant increases in EPCM and owner costs
  - EPCM contract awarded after DG2
  - Benefits strategy negotiated after DG2
  - 95% of engineering completed in NL. Significant premium to attract and retain workforce in St. John's
  - Strong competition for experienced personnel from Hebron, Vale Inco and across Canada
  - Release from generation EA two years later than expected resulting in delays to sanctioning, increased carrying costs for Nalcor
  - Additional unplanned reviews by PUB and MHI

MF and CF Switchyards

- Operability / Reliability Change:
  - Finalization of Single-Line Diagrams resulted in significantly larger footprint at Churchill Falls which could not be accommodated by simply expanding existing CF yard – hence large civil scope growth
  - Addition of 138kV capacity at MF Switchyard to facilitate future HVGB connection

- Constructability Driven Change
  - Site services support at CF for 2+ years
  - Poor foundation conditions at Muskrat Falls require material replacement
  - Logistics / transport cost for heavy lift items (i.e. transformers)

MF Site Support Services

- Primarily driven by the highly competitive market in Camps and services that has developed in Canada and NL since DG2 Including:
  - Operating costs for increased person-hours of construction effort for Muskrat Falls
  - Market costs for services such as catering and housekeeping
  - Laboratory and Surveying Scope increase for larger, more complex MF plant
  - Medical and security requirements
  - Increased Cost of services such as ground transportation, drug and alcohol testing, pre-employment medical screening, road maintenance, vehicles

HVac Overland Transmission

- Constructability Driven Change
  - Detailed line routing and construction methods resulted in detailed understanding of ROW clearing scope
  - Increased support services costs driven by highly competitive market in Canada regarding– marshalling yards, catering, camp, travel, medical support, etc.
- Market Driven Change
  - Increased Labor cost
  - Increased Material cost – budgetary prices or bids for all material are now in hand and are higher than estimated at DG2

HVdc Converters & Specialties, and Island Upgrades

- Operability / Reliability Driven Change
  - Operating voltage optimization (320 to 350kV) resulted in required stability with existing island system, less line losses which followed detailed system planning studies carried out post DG2
  - Requirement for Indoor Cable Transition compounds to reduce salt contamination risk
  - Redundancy/reliability requirements resulting in additional cable switching facilities to facilitate remote energization of the spare cable
- Design Evolution Driven Change
  - Increased scope of Holyrood Conversion for Synchronous Condenser support
  - Finalization of Electrodes Sites
    - The electrode line length in Labrador was increased to the SOBI in order to achieve the required technical grounding requirements, site investigation work to determine this was post DG2.

SOBI Crossing

- Market Driven Change
  - Confirmed cable supply / install prices from RFP
- Design Evolution Driven Change
  - Final project definition and cable routing
  - Confirmed ice protection requirements for shoreline and seabed
- Constructability Driven Change
  - Actual HDD drilling rates from 2011/12 pilot program were favorable compared to as-planned

MF Site Infrastructure

- Constructability Driven Change
  - Requirement to replace existing forestry access road, the condition of this road was found to be unsuitable when work started
  - Increase in construction power load following study work
  - Construction telecommunications
  - Movement of MF Accommodations Complex due to poor geotechnical issues at DG2 location
  - Allowances for offsite access upgrades – port facilities and bridging for movement of heavy items
- Market-Driven Change
  - The highly competitive market conditions for accommodation complexes across Canada

Questions