Integration of Design Factors into Post-Construction Ecological Restoration QA/QC
Agenda

- Restoration is a multi-decade process
- Communication
- Information handoffs
- Typical Challenges
- Vegetation as condition indicators
- Conclusions
Ecological restoration vs. a lawn

- **Complexity**
  - Numerous different plants and planting environments

- **Evolution**
  - The initial planting is just the beginning
  - Trees take decades to establish and create their own environment

- **Maintenance and monitoring is not just mowing**
  - Easy to get off-track during site evolution

- **Multi-disciplinary staff necessary**
  - Communication is critical
  - Knowledge is lost with personnel and team changes
Restoration is a multi-decade process

“Cover crops” needed for decades to establish a forest

Early ecological functions are important - may differ from long-term goal
Handoffs are communication opportunities

AS MARKETING REQUESTED IT
AS SALES ORDERED IT
AS ENGINEERING DESIGNED IT

AS WE MANUFACTURED IT
AS FIELD SERVICE INSTALLED IT
WHAT THE CUSTOMER WANTED!!!

"COMMUNICATION" MEANS: SAYING AND HEARING HAVE THE SAME MESSAGE
Key elements in handoffs

• Geometry
  ▪ Site designed to work when constructed
  ▪ Natural processes can change topography over time

• Soils
  ▪ Construction specifications are focused on initial gradation and properties
  ▪ USDA/wetland soil taxonomy requires *in situ* weathering over time

• Hydrology
  ▪ Design analyses are focused on flooding and erosion control
  ▪ Site evolution changes soil and vegetation retention of moisture

• Vegetation
  ▪ Initial establishment to prevent erosion
  ▪ Vegetation will evolve for years, decades, and centuries
Available Design & Construction Information

- Remedial Design Report
  - Goals and objectives
  - Analyses
  - Drawings
  - Specifications
  - Stormwater/Erosion Control

- Construction Completion Reports
  - As-built geometries
  - Design changes
  - Material submittals
  - Daily field reports with photos
  - Regulatory acceptance

Document filing & retention is under-appreciated
Handoffs from design to post-construction
Soil is important

Erosion, water retention, pH, etc.
Hydrology is important

Is it working as expected?
If you don’t know where you are.....

You probably won’t get there

• Vertical datum
  ▪ Site specific
  ▪ Local
  ▪ National Geodetic Survey: NGVD29 vs. NAVD88
    ▪ NGS datum conversion program: https://www.ngs.noaa.gov/TOOLS/Vertcon/vertcon.html

• Horizontal coordinates
  ▪ Site specific
  ▪ Local
  ▪ State plane
  ▪ Latitude/Longitude
  ▪ Linear stationing (highways, railroads, rivers, pipelines)

• Units
  ▪ Metric, US, Imperial
Surprises

5 years of design and construction and nobody ever mentioned “carp”
Design seed mixes to help identify actual site conditions

- Plants sensitive to:
  - Water
  - Soils
  - Nutrients
  - Light

- Include indicator plants to ID micro-variations:
  - Hydrology
  - Salinity
  - pH
  - Well-drained soil
  - Poorly-drained soil

- Increases bio-diversity

- Identify trends in QA/QC data
  - Define adaptive management opportunities
Vegetation as indicator example

Year 1: *Alisma subcordatum*
Salinity < 1 ppt

Year 2: *Typha latifolia*
1 ppt < Salinity < 7 ppt
Utility work over winter
Likely re-directed salt seep
Concluding remarks

- Site restoration includes long-term restoration
  - Duration and multi-discipline requires communication focus
- Design needs to set up post-construction monitoring and QA/QC
- Design and construction documentation is valuable
  - Hand off to post-construction team
- Vegetation is “free” site instrumentation
  - Incorporate indicator species in design
- Site variations and evolution require adaptive management