



2022 CANADIAN CONSULTING ENGINEERING AWARDS

Drayton Valley Raw Water Pump Station

Category:

Project Management

Client/Owner:

Town of Drayton Valley
Chandos Bird Joint Venture

Consultants:

ISL Engineering and Land Services

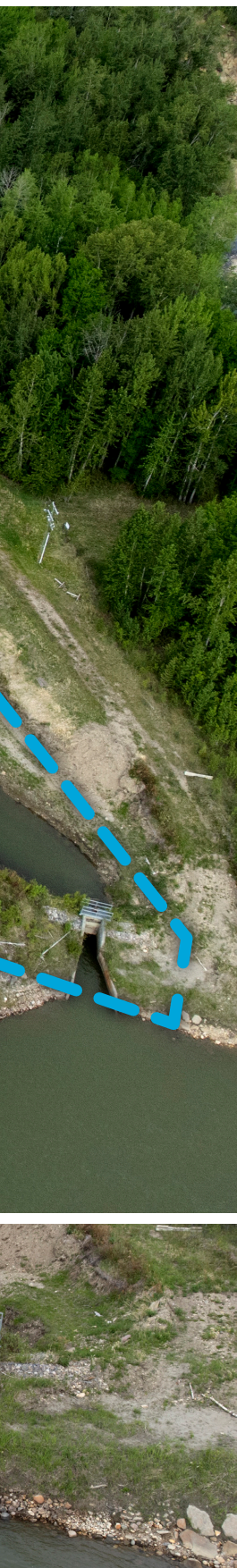
Subconsultants:

Magna IV Engineering
J.R. Paine & Associates
Group 2 Architecture

April 2022







PROJECT CONTEXT

Communities line the North Saskatchewan River's banks for its essential drinking water and highly valued recreational opportunities. Situated on these banks, the town of Drayton Valley's original water treatment plant had been abandoned in place, now used solely to pump raw water to their new water treatment plant.

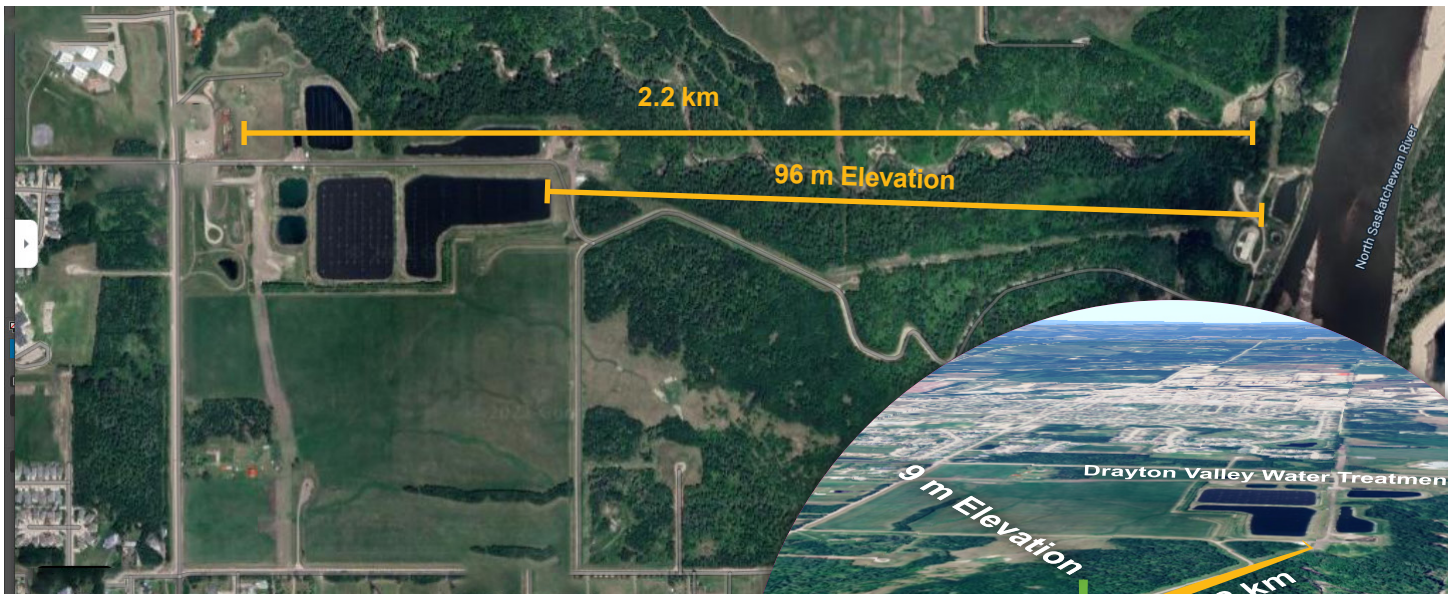
In a changing world that often bears new environmental and fiscal realities, two concerns were increasingly apparent. First, without raw water storage, rising water levels occasionally bypassed the protective berms surrounding the old plant, compromising the town's drinking water supply for weeks at a time. Second, it was prohibitively expensive to maintain an abandoned water treatment plant solely to pump raw water. It was clear Drayton Valley needed a new raw water pump station. No one predicted this would create a project delivery first for ISL and all of Canada: implementing a Canadian Construction Documents Committee (CCDC30) contract for Integrated Project Delivery (IPD) on a municipal infrastructure project.

This operation's first objective was to supply enough raw water to the new water treatment facility as it began operating. Meeting the new water treatment plant's capacity requirement allowed the town to focus on securing funding.

The town needed to ensure the residents maintained their most basic right: access to clean, potable water. ISL's expertise with similar projects and the facilities' sizes suggested the project warranted approximately \$6 million in funding for a conventional build (before design costs). It turned out that Drayton Valley was only able to secure \$4.2 million, not nearly enough to build a traditional facility and cover design costs. These substantial funding constraints opened the town to exploring how new project delivery methods can inform and enhance critical infrastructure projects.

This project could only succeed with early collaboration and innovative thinking that challenged traditional methods. As a forward-thinking municipality, Drayton Valley understood their best value came from Integrated Project Delivery (IPD). Unlike traditional methods, IPD integrates collaboration from all parties (owner, consultant, general contractor, major sub-consultants, and major trades) throughout each project phase.

Designing and building a visually unobtrusive pump station on a flood plain carried substantial design challenges. ISL was determined to deliver on all fronts, a seemingly impossible undertaking with a \$4.2 million budget. The mission had to change from building a fully encompassing pump station as its own independent building to determining how to move a molecule of water from the river up to the new facility, 96 m above water level and 2.2 km west of the river. This revolutionary approach required leveraging ISL's experience, ensuring construction informed design and eliminating the preventable adversity often seen in traditional project deliveries.



COMPLEXITY

Most importantly, despite now having an operational, newly commissioned water treatment plant, the town risked losing their water supply without this new pump station. Cost and timeline constrain most projects, but this extraordinary urgency added complexity. In high flow years, significant flooding compromised the community's raw water supply. Contamination events are costly and difficult to manage, so the design needed to ensure the pump could operate in high and low flow years, including extremes at both ends.

Owing to the building's location in a flood plain and relative age, this critical infrastructure had high operational costs. Minimizing these costs was an important project objective. The town started decommissioning the old water treatment facility in the mid-2010s, yet even once the new facility was online, the town still had to maintain the old one to pump raw water. Operational costs continued, despite the facility applying only 5% of its intended function. Daily visits to the pump station became weekly, and whenever possible, the team reused existing infrastructure and piping to optimize the project budget and avoid unnecessary expenditures.

ISL was the first to implement a Canadian Construction Documents Committee (CCDC30) contract for Integrated Project Delivery to a Canadian municipal infrastructure project. As the first project of its kind managed with this new contract, ISL solved many unique problems without having direct precedents to reference. While they could draw on a similar US contract customized for Canada that had been implemented on over 30 institutional projects, like schools, recreation centres and hospitals, the current project differed greatly from these other applications. This project delivered the first North American contract of its kind for a water treatment facility, a pump station or a project of this kind, period.

The site posed many topographical challenges, building on a flood plain, adjacent to both a steep hillside and a river. Navigating a steep hillside limited construction equipment



access, and river work is costly and potentially dangerous. Tremendous thought went into creating designs that didn't require direct river entry.

Lastly, in maximizing all reusable existing infrastructure, ISL faced additional challenges that needed creative, collaborative solutions. For example, the team found that years' worth of silt had accumulated while emptying the stilling basin, a design feature that slows the flow for incoming water. This complication for the town needed to be addressed promptly. The team collaborated through a live estimating session and determined that instead of waiting until it became a more urgent and costly problem, the best solution would be to immediately remove all silt from the basin. However, addressing this setback would also need to come from the same tight budget.



MEETING CLIENT NEEDS

The team met the clients' most important need: securing the town's water source from the routine contamination brought on by flooding and providing over 7000 residents with a reliable source of clean drinking water.

Managing the project, ISL applied Integrated Project Delivery (IPD) to keep these mandatory infrastructure upgrades affordable. The team started by developing the owner's requirements, goals and constraints at the project's outset to eliminate ambiguity and clarify priorities. Unlike traditional methods, IPD integrates collaboration from all parties throughout each project phase.

The clients needed creative solutions to meet funding constraints, on a capital budget of \$4.2 million. Creative solutions arising from intensive IPD collaborations saved the town 35% on total capital costs. Providing the clients with solutions for $\frac{2}{3}$ of what a facility like this traditionally costs saved Drayton Valley \$1.8 million in capital costs that they can apply to other community initiatives, such as accessible housing, mental health and family supports and local conservation programs. ISL also optimized their future operational and maintenance costs by designing the system with low operational complexity. This removed the need for exclusive, skilled operators to run and maintain the new facility—a common barrier many infrastructure upgrades often fail to address.

ISL reused as much existing infrastructure as possible, reducing the project's carbon footprint and controlling construction costs. In reusing the stilling basin that slows incoming water

flow, the team found years' worth of accumulated silt. Urgent complications mean change orders with other contract delivery methods; instead, this team collaborated through a timely, live estimating session. Rather than waiting until it became more urgent and costly, the team decided to immediately remove all silt from the basin, within the already tight budget.

The team created a visually unobtrusive pump station that did not look like traditional models, which can be unappealing to the community. The team managed all of this, despite the topographical challenges, of building on a flood plain adjacent to a steep hillside and a river. The project delivery method meant Drayton Valley could have the affordable, attractively designed pump station they needed to supply their residents with clean drinking water without affecting the natural landscape.

During the project, the site was also improved, despite the limited budget. The team also repaired the gravel access road and installed a fibre optic line connected to existing wastewater ultraviolet infrastructure, allowing remote monitoring and reducing future operational costs.

By emphasizing a collaborative, shared risk approach, instead of getting stuck debating challenges, the team was able to focus on a collective solution. Overall, this resulted in a 35% net cost savings within a \$4.2 million budget. No added costs were incurred, and all work was included in the project budget.



First IPD
horizontal
infrastructure
completed in
**North
America**

A pump station
that doesn't
look
**like a pump
station**

**35% cost
savings** to fit a
limited budget

**Reduced
operating
costs**

First project
to execute
**CCDC30
in North
America**

ENVIRONMENTAL BENEFITS

Sustainable principles permeate Drayton Valley's raw water pump station design and construction.

The town's existing pump station's susceptibility to flooding failed them. Resilient infrastructure must acknowledge the reality of climate change and accommodate ongoing environmental shifts, so the team designed the pump station to withstand extreme variations in river levels. The team also incorporated several other sustainable features into both the design and the construction process.

Integrated Project Delivery's collaborative design process also enabled unconventional solutions, like separating mechanical and electrical components. This helped the pump station resist flooding, reduced extensive excavation work, capital costs and overall carbon footprint. It also optimized the project to reduce future maintenance and operational costs, given that the combined facility space would have needed higher operational costs to maintain. Instead, those resources can be applied elsewhere in the town's planning and operations budgets.

Creatively finding ways to reuse as much existing infrastructure as possible allowed ISL to better control construction costs and manage time.



To achieve this, the team extended the operational life of the existing aging infrastructure. Longer, more reliable service life is far more environmentally sustainable than common disposable design models. Through extensive transient analysis and water hammer modelling, ISL controlled the pressure surges that create unnecessary wear on components. Additional minimalist design decisions further impacted sustainability. For example, using the existing steel well casing and not installing a concrete wet well saved concrete, eliminated the need for deep excavation and mitigated slope slippage risks in an unstable area. Finally, the design's simplicity also minimizes the project's impacts on the scenic natural environment at the riverbank.

The construction process itself reduced environmental impacts. The team used a spider plough to install fibre optic lines, further reducing the need for open excavation. This ecologically sustainable method quickly lays below-ground cable while minimizing ground and habitat disturbances. It speeds up the process by eliminating the need for

environmental impact assessments required with open excavations. Finally, technological advancements allowing timely virtual collaboration had the added benefit of reducing the greenhouse gases (GHGs) from unnecessary long-distance commutes to inter-municipality meetings.

INNOVATION

Drayton Valley's raw water pump station is North America's first municipal infrastructure project to implement a Canadian Construction Documents Committee (CCDC30) contract for Integrated Project Delivery (IPD).

Applying innovative project management models helped the town afford the costly critical infrastructure upgrades sooner. In IPD, construction informs design, with trades and contractors participating in design discussions from the beginning. The model also shares risk and reward, meaning all parties were equally invested.



The team established a risk register to identify and solve potential setbacks before problems developed. Other innovative conceptual models also permeated the decision-making strategies, such as Choosing by Advantages (CBA) for transparent decision-making. This contract style naturally aligns with Target Value Delivery (TVD), a management practice encouraging lean design strategies to answer clients' needs within fixed budget constraints.

ISL addressed common waste sources identified by lean construction practices—transportation, inventory, motion, waiting, overproduction, overprocessing, defects and unused skills. For example, streamlining roles to optimize skills usage, like the construction project manager doubling as the superintendent. The team also collaborated in live estimating sessions using market data. This helped the project schedule and eliminated waste by only providing what was needed. It meant the designers focused solely on implementation drawings the construction team needed, avoiding unnecessary iterations and eliminating the need to design for multiple outcomes.

Following these best practices help municipalities afford mandatory but costly critical infrastructure upgrades sooner. IPD promotes innovation by creating space for unconventional approaches. This allows ideas often prematurely dismissed to lead design, like separating the mechanical and electrical components. Traditionally, these exist in one building, needing substantial excavation. Instead, the team simplified the design, moving only the electrical room outside the flood plain. Using non-traditional submersible pumps found in the oil industry and as down hole pumps in more turbid environments, the new pump station functions even fully submerged in a flood. This creative solution reduced capital costs, and the project's physical and carbon footprints. The combined facility space would have needed more money and operator involvement to maintain. Installing a dedicated 2.2 km fibre optic line enables remote monitoring, replacing the need for daily inspections. Instead, those resources can be applied elsewhere in the town's operations. Moving work away from the river also reduced ecological impacts, mitigated safety risks, reduced project schedule impacts and helped the town avoid regulatory setbacks.

Reusing existing infrastructure whenever possible further reduced the project's carbon footprint, controlled construction costs and shortened the project timeline. To achieve this, ISL extended the operational life of the existing aging infrastructure. The team applied transient analysis and water hammer



modelling to control pressure surges that create unnecessary wear on components.

The team remained consistently accountable and available, avoiding delays in responding to challenges and the inevitable construction complications that accompany nearly all projects. ISL leveraged collaborative new technologies like Menti and Yammer to respond promptly to the inevitable construction complications, streamline real-time decisions and allow frequent project values check-ins.

SOCIAL & ECONOMIC BENEFITS

The former water treatment plant the town used as a raw water pump routinely flooded, annually contaminating their drinking water for weeks at a time. Drayton Valley's new pump station secures their water source, supplying raw water to a facility that treats up to 18 MLD (millions of liters per day), with 2800m³ of additional potable water storage. This provides over 7000 residents with clean drinking water—which the United Nations General Assembly explicitly recognizes as not only a basic human right in itself, but also one that's required to realize all other human rights.

Economically, the team completed the project with the lowest possible capital costs that also reduce future operational costs. The team delivered within the \$4.2 million budget on a project that typically warrants \$6 million in funding for a conventional build, before design costs. The initial estimate was \$4.5 million, but the town couldn't secure the full amount, so the team




reduced it \$300,000 further. Whenever possible, the team also favoured local services, trades and vendors to keep money in the community. ISL further emphasized local service reliance by designing a facility that didn't need maintenance performed exclusively by skilled operators—something infrastructure upgrades commonly neglect.

Saving the town money may seem like a purely economic interest, but it speaks to the opportunity cost of how the town can apply those savings to fund further initiatives. Integrated Project Delivery provided innovative solutions that ultimately saved the town of Drayton Valley \$1.8 million in capital costs that they can apply to other community initiatives. These explicitly include, but are not limited to: accessible housing, adult education, mental health and family supports, emergency services, post-secondary tuition supports and local conservation programs.

Moving beyond traditional design ideas also benefited the town aesthetically. The design's low visual impact provides unhindered scenery for users enjoying the natural beauty of the North Saskatchewan River. Typical pump stations also often attract unwanted attention, like vandalism, theft and other petty crimes. Because the new pump station blends into the scenery, it attracts less of this potentially costly negative behaviour for the town to contend with.

Ultimately, ISL's creative solutions arising from intensive Integrated Project Delivery collaborations simplified the design and gave the owner exactly what they needed for their raw water pump station. Together, the team made this critical infrastructure upgrade affordable so that Drayton Valley's 7000 residents have reliable access to clean drinking water.

DRAYTON VALLEY RAW WATER PUMP STATION AT A GLANCE

 Complexity	<ul style="list-style-type: none"> Designed a pump station to operate in extreme high and low flow years, and with minimal moving parts, capital costs and future maintenance Met the following design challenges: building on a flood plain, pumping water 96 m above water level and 2.2 km away, navigating a steep hillside that limited construction access and working next to a river, which is costly and dangerous Worked within an urgent framework because Drayton Valley risked losing their water supply without the new pump station Solved unique problems without precedents as the first North American project applying Integrated Project Delivery with a Canadian Construction Documents Committee (CCDC30) contract Ensured construction informed design, with trades and contractors participating in design discussions from the beginning
 Meeting Client Needs	<ul style="list-style-type: none"> Provided a visually unobtrusive pump station that provides Drayton Valley's 7000 residents with reliable, clean drinking water Applied Integrated Project Delivery to keep these mandatory infrastructure upgrades affordable, delivering what is traditionally a \$6M project within the town's \$4.2M budget Started project by developing the owner's requirements, goals and constraints at the project's outset to eliminate ambiguity and clarify priorities Involved project partners and end users in the design and construction activities throughout the project Designed a system that doesn't need skilled operators to maintain the facility (a common barrier infrastructure upgrades often fail to address) Reused infrastructure to control costs and reduce the project's carbon footprint Removed years' worth of silt accumulated in the stilling basin (a design feature that slows the flow for incoming water) from an already tight budget without requiring a change order Repaired a gravel access road and connected a fibre optic line to existing wastewater UV infrastructure, allowing remote monitoring and reducing future operational costs
 Environmental Benefits	<ul style="list-style-type: none"> Designed the pump station to withstand extreme variations in river levels to provide resilient infrastructure that accommodates ongoing environmental shifts for longevity Separated mechanical and electrical components to help the pump station resist flooding, reduced extensive excavation work, capital costs and overall carbon footprint, and optimized future maintenance and operational costs Longer, reliable service lives are more sustainable, so the team extended the existing infrastructure's operational life by controlling pressure surges that wear out components Reused infrastructure whenever possible, including the existing steel well casing instead of a concrete wet well. This saved concrete, eliminated deep excavation and mitigated slope slippage risks in an unstable area Used a spider plough for fibre optic installation to minimize ground disturbances Collaborated virtually, reducing greenhouse gases (GHGs) from unnecessary long-distance commutes to inter-municipality meetings

DRAYTON VALLEY RAW WATER PUMP STATION AT A GLANCE



Innovation

- Fulfilled North America's first municipal infrastructure project applying Integrated Project Delivery with a Canadian Construction Documents Committee (CCDC30) contract
- Established a risk register to identify and solve potential setbacks before problems develop
- Took a Choosing by Advantages (CBA) approach for transparent decision-making
- Practiced Target Value Delivery (TVD) to develop lean design strategies
- Facilitated prompt decisions by collaborating in live estimating sessions using market data
- Streamlined overlapping roles to optimize skills usage and reduce waste
- Moved work away from the river to reduce ecological impacts, mitigate safety risks, reduce project schedule impacts and avoid costly regulatory setbacks
- Separated mechanical and electrical components to reduce capital and operational costs and visibly impact the natural environment less
- Used non-traditional pumps to protect against flooding
- Applied transient analysis and water hammer modelling to control pressure surges and extend the existing infrastructure's operational life
- Leveraged technologies like Menti and Yammer to respond promptly to construction complications, facilitate real-time decisions and allow frequent project values check-ins



Social & Economic Benefits

- Secured the town's water source and provided 7000 residents with clean drinking water
- Managed the project within its \$4.2M budget where a conventional build warrants \$6M
- Favoured local services, trades and vendors to keep money in the community
- Further emphasized local service reliance by designing a facility that didn't need maintenance performed exclusively by expensive, skilled operators
- Saved Drayton Valley \$1.8 million to apply to accessible housing, mental health and family supports, emergency services, post-secondary tuition supports and conservation programs
- Designed a pump station with low visual impact to protect the North Saskatchewan River's natural beauty and prevent unwanted attention and petty crimes like vandalism and theft

