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MEMORANDUM

February 18, 2021

To: Garrett Donaher & Marianne Alacoque
Organization: City of St. John's
From: Shanna McKinnon & Jeff Ciabotti
Project: Kelly's Brook Shared Use Path

Re: Kelly's Brook Shared Use Path Surfacing Comparison

As part of the design and construction of Kelly's Brook Shared Use Path, Toole Design has completed a comparison between various surface materials appropriate for the desired types of use identified. Details on five surface materials are provided and a comparison between each is shown. Based on this research and feedback from stakeholders, a preferred surface recommendation for the design and construction of this facility will be presented to Council.

Background

The City of St. John's approved the Bike St. John's Master Plan, including 3 catalyst projects, at the June 10, 2019 City Council meeting. The vision adopted by City Council commits the City of St. John's to enabling and encouraging more people to ride a bicycle by developing a safe, inclusive, and convenient cycling network that is well-connected, attractive, and reflective of the city's unique topography and climate. This project is for the design and construction of the Kelly's Brook Shared Use Path, which was the highest priority project identified in the plan.

The existing links that will be connected to form the Kelly's Brook Shared Use Path are predominantly granular with concrete sidewalks along roadways. Through discussion with City administration, Toole Design understands the material that is used to create shared use pathways has been a notable concern for the public, with some preferring the aesthetic of granular paths within naturalized areas and open spaces. As such, an evaluation of various surface treatments has been requested as part of the design and construction of the Kelly's Brook Shared Use Path.

Local Conditions

St. John's has a very wet climate. Standing water is a regular occurrence and trail undermining from water runoff is a frequent concern. Winters are relatively mild with considerable freeze-thaw cycles. Though the projected lifespan of a traditional granular trail is typically 10+ years, the trails in St. John's see frequent and significant routine maintenance to correct surface and subsurface wear resulting from trail use during wet periods, direct water damage, and undermining. Additionally, the existing granular trail along Rennies Mill River often becomes flooded due to high water levels.

St. John's is a city with steep and plentiful hills. The planned route of Kelly's Brook Shared Use Path is one of the flattest trail routes in the city, presenting greater opportunity to accommodate a wide range of ages and abilities of users including people with mobility challenges or invisible disabilities. Accommodating all ages and abilities is a

major objective of the City of St. John's. Users could include people: walking; running, using wheelchairs; using walkers and other mobility aids; pushing a stroller; using rollerblades/inline skates, skateboards, scooters, and other small, hard-wheeled devices; riding bicycles; and other active uses.

Trail Materials Comparison

Materials

The material of the shared pathway is of particular concern to the community. The Bike St. John's Master Plan makes universal accessibility a priority, however a familiar granular aesthetic is preferred by some. The original scope of the project required a comparison be done between asphalt and traditional granular surface treatments. Given the desire for a surface that is both familiar looking and wheelchair accessible, the team has also included two granular products that may be able to meet these needs, Organic-Lock™ and CORE™ Gravel Foundation Systems. (See below for brief product descriptions or use the hyperlinks to access product websites). Finally, the comparison includes concrete surfacing as there are locations along roadways that may be reconstructed as concrete pathway by widening the existing sidewalk.

"Organic-Lock™ is the strongest organic binder on the market today. Designed for stabilizing aggregate surfaces, its functionality allows you to create natural, aesthetically pleasing, permeable surfaces that hold up to extreme conditions". (https://www.organic-lock.com/)

"CORE Gravel™ is a gravel stabilizing system that consists of a foundation of connected honeycomb-celled panels with a geotextile backing. Once filled with gravel, this system is ideal for vehicle or pedestrian traffic with no compromise in strength and durability". (https://www.coregravel.ca/core-foundations/core-gravel/products/)

Considerations

Based on our experience in trail design, active transportation corridor, and accessibility projects across North America and in winter city contexts, the following considerations were noted as having an impact on the final choice of surface material:

Aesthetics
What is the visual appearance of the surface?

Accessibility
How well does the surface accommodate users with mobility impairments?

User Accommodation and Impact
What types of users does the trail accommodate and what type of physical impact does the surface have on users?

Environmental Sustainability
Does the surface use environmentally sustainable materials or can it be constructed in a way that is more environmentally sustainable?

Construction Impact
What is the scale of the construction impact based on the total structure depth and construction methods?

Surface Erosion
Is the material susceptible to surface erosion and undermining?

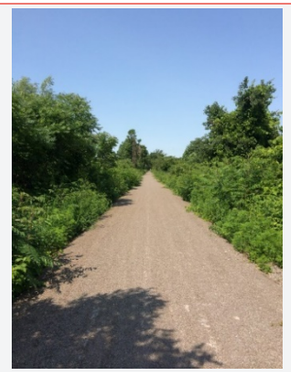
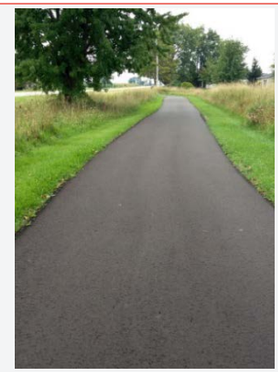
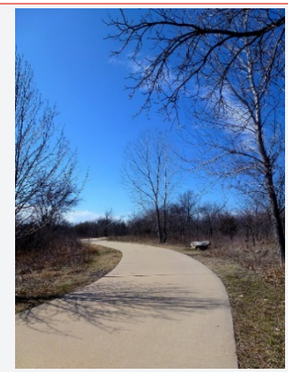
Maintenance
What type of routine maintenance is required? What type of winter maintenance activities or considerations are required?

Durability and Repairs
How durable is the surface to regular wear? What types of repairs are needed and how costly are they?

Lifespan
How long does the surface last?

Construction and Lifecycle Cost
How much does the surface cost to install and maintain?

Trail Materials Comparison Chart

	Non-Stabilized Granular (Traditional Granular Trail)	Stabilized Granular (Organic-Lock™)	CORE™ Gravel Foundation System	Asphalt	Concrete
Aesthetics					
Accessibility	Not Accessible Not accessible for wheelchair users or people who use walkers. Due to surface inconsistencies, people with vision impairments who use a cane may find the rough surface uncomfortable to navigate depending on the type of cane tip and their caning technique. Steep grades can pose accessibility issues due to loose gravel.	Limited Accessibility Not accessible for all wheelchair users or people who use walkers. People who use walkers and people who have wheelchairs with small, hard front casters may find the surface difficult to use as the loose stone can hinder the wheels from rolling smoothly. People with vision impairments who use a cane may find the surface uncomfortable to navigate depending on the type of cane tip and their caning technique.	Limited Accessibility Not accessible for all wheelchair users or people who use walkers. People who use walkers and people who have wheelchairs with small, hard front casters may find the surface difficult to use as the loose stone can hinder the wheels from rolling smoothly. People with vision impairments may find the surface uncomfortable to navigate depending on the type of cane tip and their caning technique.	Accessible A universally smooth surface that provides a comfortable path for users with mobility aids.	Accessible Provides a smooth surface; however, construction joints can impact the comfort of users if they are too frequent or pronounced. This can be mitigated by saw-cutting the joints or spacing joints out as far as possible and by smoothing the troweled edges.
User Accommodation and Impact	Some Users Non-stabilized granular is not suitable for people on scooters,	More Users Organic-Lock™ is not suitable for people on scooters, rollerblades or other small, hard-wheeled devices.	More Users CORE™ Gravel System is not suitable for people on scooters,	All Users Asphalt surfacing is adequate for all users.	All Users Concrete surfacing is adequate for all users, however the frequent construction jointing results in a

	rollerblades or other small, hard-wheeled devices. Loose stone, such as pea gravel, is not ideal for running as it shifts underfoot. Crushed stone, such as the typical quarter minus used in St. John's, works better as it "knits" together to create a more stable surface.	Organic-Lock™ is a flexible, shock-absorbing surface without shifting granular material.	rollerblades or other small, hard-wheeled devices. Loose stone, such as pea gravel, is not ideal for running as it shifts underfoot. Crushed stone, such as the typical quarter minus used in St. John's, works better as it "knits" together to create a more stable surface.	There is some research on the difference of the impact on musculoskeletal injuries between asphalt and concrete, much of it identifying that there is little difference, if any, between the two surface materials.[1] However, there is anecdotal information that runners prefer asphalt to concrete.	rougher surface for people on bikes, rollerblades, or scooters. This can be mitigated by saw-cutting the joints and/or by spacing joints out as far as possible and by smoothing the troweled edges. There is some research on the difference of the impact on musculoskeletal injuries between asphalt and concrete, much of it identifying that there is little difference, if any.[1] However, there is anecdotal information that runners prefer asphalt to concrete.
Environmental Sustainability[2,3]	Granular pathways are water permeable (unless highly compacted), contain aggregate that is often recycled content, can typically be sourced locally, and reduce the heat island effect by reflecting solar radiation, rather than retaining heat. Overland water flow can lead to granular wash-out, requiring the material to be replaced.	Organic-Lock™ pathways are water permeable, contain aggregate that is often recycled content, can typically be sourced locally, and reduce the heat island effect by reflecting solar radiation, rather than retaining heat. Additionally, Organic-Lock™ is made primarily from a rapidly renewable plant material and its additional additives are 100% naturally occurring materials.[4]	CORE™ Gravel Foundation pathways are water permeable, contain aggregate that is often recycled content, can typically be sourced locally, and reduce the heat island effect by reflecting solar radiation, rather than retaining heat. The CORE™ Gravel Foundation system is made of recycled plastic materials.	Traditional hot-mix asphalt is not considered an environmentally sustainable material. Asphalt can be made in sustainable ways by using recycled materials, warm & cold mix asphalt, or porous asphalt.[5] These methods, however, are not typically used in St. John's due to climate and freeze-thaw cycles and also have much higher maintenance costs.	Concrete can be considered moderately environmentally sustainable if the materials can be sourced locally, and by using lighter coloured concrete to reflect solar radiation rather than retaining heat. However, cement used in the creation of concrete is an emissions-intensive substance to produce.

[1] https://www.researchgate.net/profile/Ana_Ribeiro21/publication/23444709_In-shoe_plantar_pressure_distribution_during_running_on_natural_grass_and_asphalt_in_recreational_runners/links/5b2061770f7e9b0e373ef09e/In-shoe-plantar-pressure-distribution-during-running-on-natural-grass-and-asphalt-in-recreational-runners.pdf

[2] https://www.usgbc.org/credits?Version=%22v4.1%22&Rating+System=%22New+Construction%22

[3] https://www.sustainablesites.org/

[4] https://www.organic-lock.com/resources/product-faq/

[5] https://www.fhwa.dot.gov/pavement/sustainability/hif16012.pdf

Construction Scale	50mm granular surface 150mm granular base **Total Depth = 200mm** Structure based on City of St. John's Standard Dwg No. 10-530-03	75mm compacted Organic-Lock™ trail aggregate 150mm granular base **Total Depth = 225mm** Structure based on supplier detail	45mm for CORE™ Gravel Foundation System (35mm) and 10mm top-dress layer of granular 150mm granular base **Total Depth = 195mm** Structure based on supplier detail	75mm asphalt surface 150mm granular base **Total Depth = 225mm** Structure based on Toole Design typical detail for an asphalt trail	100mm concrete surface 100mm granular base **Total Depth = 200mm** Structure based on City of St. John's Standard Dwg No. 10-330-03 Required formwork increases the impact area by minimum 500mm on each side of the trail.
Surface Erosion	Significant erosion and undermining can happen in locations where high volumes of water are likely to flow across the trail. Surface erosion along trail segments with steeper grades will occur.	Resistant to surface erosion from water runoff but ponding with standing water will degrade the surface and can lead to undermining of the surface.	Resistant to significant surface erosion. Granular top-dress material may have to be replaced if water flow volumes are high. Standing water on the trail surface can lead to undermining.	Resistant to surface erosion and undermining.	Resistant to surface erosion and undermining.
Maintenance	Requires routine maintenance to repair displacement from water movement and general surface wear, especially along trail segments with steeper grades. Winter maintenance can be completed with a plow blade set 1-2" above the gravel. This leaves a 1-2" layer of snow on the trail surface, which will not be accessible for all users in the winter.	Requires routine maintenance to ensure no standing water. Winter maintenance can be completed with a plow blade set 1-2" above the gravel. This leaves a 1-2" layer of snow on the trail surface, which will not be accessible for all users in the winter.	Requires routine maintenance to redistribute granular after snow melt or heavy rainfall, and to ensure the CORE™ Gravel Foundation System remains covered to reduce UV damage. Wear of the top-dress layer along trail segments with steeper grades will require routine maintenance. Winter maintenance can be completed with a plow blade set 1-2" above the gravel. This leaves a 1-2" layer of snow on the trail surface, which will not be accessible for all users in the winter.	Minimal routine maintenance related to crack sealing. Winter maintenance can be completed with a brush or plow, removing all snow from the trail and creating an accessible surface for all users in the winter.	Minimal routine maintenance related to heaving and cracking. Winter maintenance can be completed with a brush or plow, removing all snow from the trail and creating an accessible surface for all users in the winter.

Durability and Repairs	Highly durable in dry conditions and properly draining conditions. Wet conditions degrade durability more quickly, especially in locations with high user traffic. Takes 2-3 years to settle and compact. If there is high probability of overland water flow, the granular will washout, requiring it to be replaced and the compaction process is slowed.	Highly durable in dry and properly draining conditions, however, standing water can be a major concern and reduce durability. Fixes to surface are relatively easy if damage occurs. Product is flexible and is self-healing if minor cracks occur	Highly durable. Will not shift or crack. Top-dress layer of gravel regrading is required after snow melt or heavy rain to ensure system remains covered.	Highly durable to surface wear. Spot repairs, such as potholes or minor cracks, can be easy to repair. Cracks caused by subbase settlement or slope movement result in major repairs and can be costly.	Highly durable to surface wear. Spot repairs vary in complexity and can be more costly than asphalt, though generally occur less often than asphalt.
Lifespan*	10 Years	20 Years	20 Years	20 Years	20 Years
Construction Cost**	$355,000	$1,170,000	$1,395,000	$710,000	$1,905,000
20-year Life Cycle Cost***	$1,090,000	$1,760,000	$2,110,000	$1,190,000	$3,150,000
Summary	The surface is not accessible for all user and lower capital costs are offset by higher cost of ongoing maintenance.	The surface is not accessible for all users. The material has a high cost of construction and reduced performance in wet climates.	The surface is not accessible for all users. The material has a high cost of construction and high overall costs.	Higher capital costs compared to the gravel surface are largely offset by lower ongoing maintenance relative to granular. This option provides an accessible surface.	This surface material is accessible for all users, but it has the highest capital cost and overall cost. of the materials reviewed

* Assuming regular maintenance and repairs as needed

** Approximate cost for supply of materials and construction of a 3.0m wide trail for the length of the project

*** Includes approximate cost of annual surface repairs over 20 years for 3.0m wide trail for the length of the project as detailed in the separate Life Cycle Cost Analysis memo. For ongoing maintenance items such as snow removal, it has been assumed the personnel and equipment used to complete this work will be common to all trail types.

Summary

There are several factors that need to be considered in selecting an appropriate trail surface material. This memo explored a number of important factors including accessibility, range of users, aesthetics, environmental sustainability, durability and maintenance, and lifecycle cost.

Accessibility is a critical factor based on the purpose and role of Kelly's Brook Shared Use Path within St. John's active transportation and recreation network. Traditional granular trails are not considered to be accessible. The CORE™ Gravel Foundation System and Organic-Lock™ are considered universally accessible by some regulating agencies (e.g., the United States Americans with Disabilities Act regulations), however they have limitations to the types of users and mobility aids they can accommodate. The CORE™ Gravel Foundation System cannot be fully cleared in the winter. Asphalt and concrete accommodate all types of users and can be fully cleared in the winter, providing surfaces that are accessible for all users in all seasons.

Range of users is also an important consideration for the trail. Because this trail connects to many significant St. John's destinations, links a number of neighbourhoods, and the grades on the trail allows it to be accessible for people using mobility aids, it is important that users of all ages and abilities, as well as on a wide range of active mode devices, are accommodated. Typical granular trails, Organic-Lock™, and the CORE™ Gravel Foundation System do not support devices such as scooters, inline skates, or skateboards, in addition to the limitations for walkers and some wheelchair users. Asphalt and concrete surfaces promote a wide range of uses for all ages and abilities.

As the existing trail is a granular material, there is a desire to maintain the existing aesthetic with the new trail. Traditional granular, Organic-Lock™, and the CORE™ Gravel Foundation System are also environmentally sustainable surfaces, providing infiltration and using material that is locally sourced. The depth of construction required for these materials is equivalent to or shallower than asphalt.

Finally, durability, maintenance, and cost are key considerations for choosing construction materials. All surfaces can be considered highly durable in ideal situations, however, because of the high precipitation all year-round, standing and flowing water are major concerns. Traditional granular trails and the CORE™ Gravel Foundation System would experience significant surface erosion from surface drainage and the durability of the trail is greatly reduced on all three granular installations when high user volumes are combined with standing water. Standing water on the Organic-Lock™ surface can break down the bonding material and although repairs can be done easily in occasional occurrences, continual repairs could end up costing a lot of time and money. Asphalt and concrete are highly durable surfaces in wet and dry weather and require less maintenance than the granular trail surfaces.

Construction costs and lifecycle costs vary between the surfaces. Traditional granular trails have the lowest construction and lifecycle cost while concrete has the highest construction cost and the CORE™ Gravel Foundation System has the highest lifecycle cost.

Sincerely,

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