# 2. CURRENT AND FUTURE CONDITIONS

This section summarizes the future environment in the study area (Figure 1) relevant to stormwater management planning to maintain the expected level of service under future conditions. The environment of Parksville Community Park includes the physical, social, cultural, and natural environments. The physical environment includes climate, topography, geology, soils and surface/groundwater. The social environment includes existing and proposed development and the built components of the environment that alter or manage the quantity and quality of stormwater (Figure 2). The cultural environment includes modern, historic and archaeological heritage features that retain the evidence of human activity. The natural environment includes terrestrial and aquatic habitats and species as well as environmentally significant or sensitive features and areas. Section 2 of the Design Criteria Memo (Appendix D) provides additional detail about the baseline conditions of Parksville Community Park.

## 2.1. Physical Environment

### 2.1.1. Climate and Precipitation

#### 2.1.1.1. Historic Intensity-Duration-Frequency Curves

The City's current Engineering Standards and Specifications (City of Parksville 2018) include the Intensity-Duration-Frequency (IDF) curves that were developed as part of the City-wide Storm Drainage Master Plan. The IDF curves were developed by factoring the Environment Canada Nanaimo City Yard climate station (ID: 10253G0) IDF to the Environment Canada City of Parksville South climate station (ID: 1025977) based on the correlation between the rainfall data recorded at each station over the same time period (1983 to 1992). The Nanaimo City Yard station included a 25 year period of record from 1980 to 2005 (Koers & Associates Engineering Ltd. 2016). As part of the SWMMP for the Park, Dillon Consulting reviewed available climate data and developed updated IDF curves (Table 1) using the Nanaimo Airport data (1985-2017), including extending the curves to multi-day durations. More information, including a comparison with the current IDF curves included in the City of Parksville Engineering Standards, is provided in Appendix D.

**Table 1. Rainfall Depth-Duration-Frequency Curves (mm) based on Nanaimo Airport Station (1985-2017)**

| Duration | Return Period | | | | | |
|---|---|---|---|---|---|---|
| | 2 year | 5 year | 10 year | 25 year | 50 year | 100 year |
| 5-min | 2.8 | 3.7 | 4.3 | 5 | 5.6 | 6.1 |
| 10-min | 4.1 | 5.6 | 6.6 | 7.8 | 8.8 | 9.7 |
| 15-min | 5 | 7.1 | 8.5 | 10.3 | 11.6 | 13 |
| 30-min | 7.1 | 10.1 | 12.1 | 14.7 | 16.6 | 18.4 |
| 1-hour | 10 | 13.4 | 15.7 | 18.5 | 20.7 | 22.8 |
| 2-hour | 14.9 | 18.2 | 20.3 | 23.1 | 25.1 | 27.1 |
| 6-hour | 29.8 | 35.3 | 38.9 | 43.5 | 46.9 | 50.2 |
| 12-hour | 42 | 50.4 | 56 | 63 | 68.2 | 73.4 |
| 24-hour | 55.6 | 69.7 | 79 | 90.9 | 99.6 | 108.3 |
| 2-day | 69.8 | 85.6 | 96.0 | 109.2 | 119.0 | 128.7 |
| 3-day | 81.8 | 99.0 | 110.4 | 124.8 | 135.5 | 146.1 |
| 4-day | 96.1 | 117.0 | 130.9 | 148.4 | 161.4 | 174.3 |
| 5-day | 108.6 | 133.2 | 149.5 | 170.1 | 185.4 | 200.6 |
| 6-day | 118.1 | 142.9 | 159.4 | 180.1 | 195.5 | 210.8 |
| 7-day | 124.9 | 151.3 | 168.9 | 191.0 | 207.4 | 223.7 |
| 8-day | 133.5 | 162.1 | 181.0 | 204.9 | 222.6 | 240.3 |
| 9-day | 142.5 | 172.9 | 193.1 | 218.5 | 237.4 | 256.2 |
| 10-day | 150.6 | 183.5 | 205.3 | 232.9 | 253.4 | 273.6 |

Source: *Rainfall Design & Climate Change Guidance – Final Technical Report (See Appendix D)*

#### 2.1.1.2. Future Climate

Climate change in Parksville and across Canada has multiple implications for how we design, build and live in our cities. The first step for considering climate change in community plans is to estimate the climate change projections within each community. Key changes to anticipate in Parksville include wetter falls and winters as well as drier and much warmer summers, as illustrated by the projections in Figure 3. These anticipated climate changes in Parksville will introduce or exacerbate multiple risks to communities, built infrastructure and the natural environment.

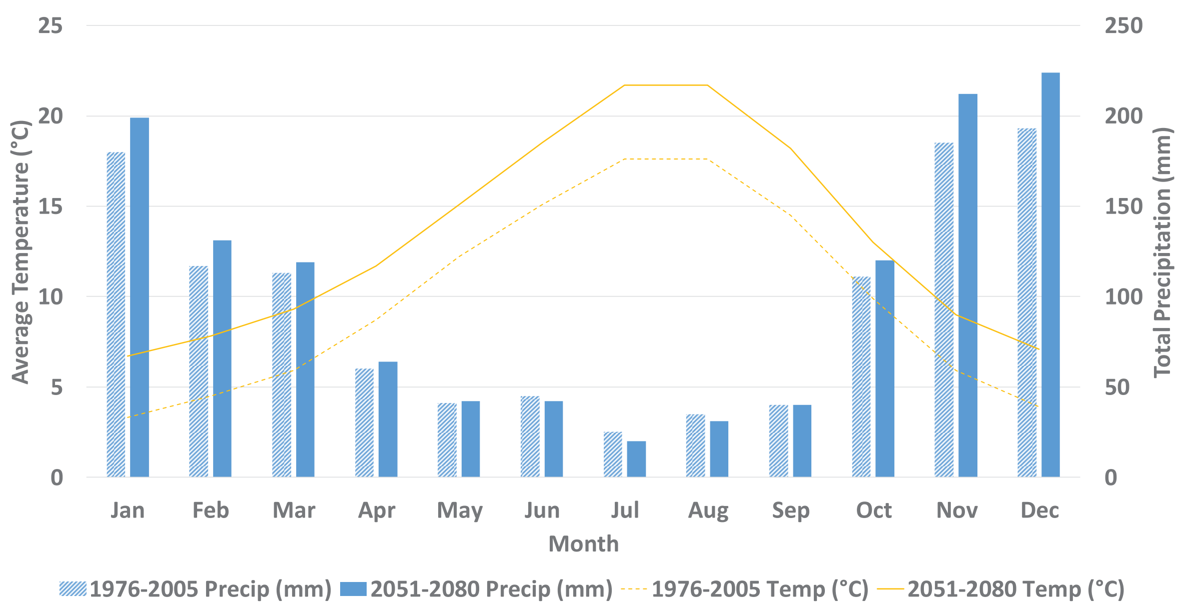



**Figure 3.** High Carbon Climate Change Projections for Parksville, BC (Prairie Climate Centre 2019)

#### 2.1.1.3. First Flush Event

The stormwater runoff during the early stages of a storm can deliver a potentially high concentrations of pollutants due to the washing effect of runoff from impervious areas directly connected to the storm drainage system. Managing this "first flush" of runoff is a common approach to mitigating non-point source pollution from stormwater. While some jurisdictions target the 90$^{th}$ percentile storm event for water quality treatment, this event is often based on the common expectation that rainfall events equal to or less than the 90$^{th}$ percentile event generate approximately 80% of the annual runoff volume, and as such corresponds to controlling approximately 80% of total suspended solids.

EOR conducted a precipitation frequency analysis of daily precipitation recorded at Environment Canada's Nanaimo Airport station to estimate the first flush event applicable to Parksville. The datasets were combined and sorted by daily rainfall depth. The cumulative runoff depth was calculated assuming a 5 mm runoff threshold (i.e. daily rainfall depths below 5 mm were excluded from the analysis). As shown in Figure 4, 24-hour rainfall events smaller than 30.7 mm produce approximately 80% of annual runoff volume and include approximately 93% of annual rainfall events. As such, water quality treatment in Parksville Community Park is recommended to manage at least the 31 mm, 24-hour rainfall event to provide 80% control of TSS on an average annual basis.

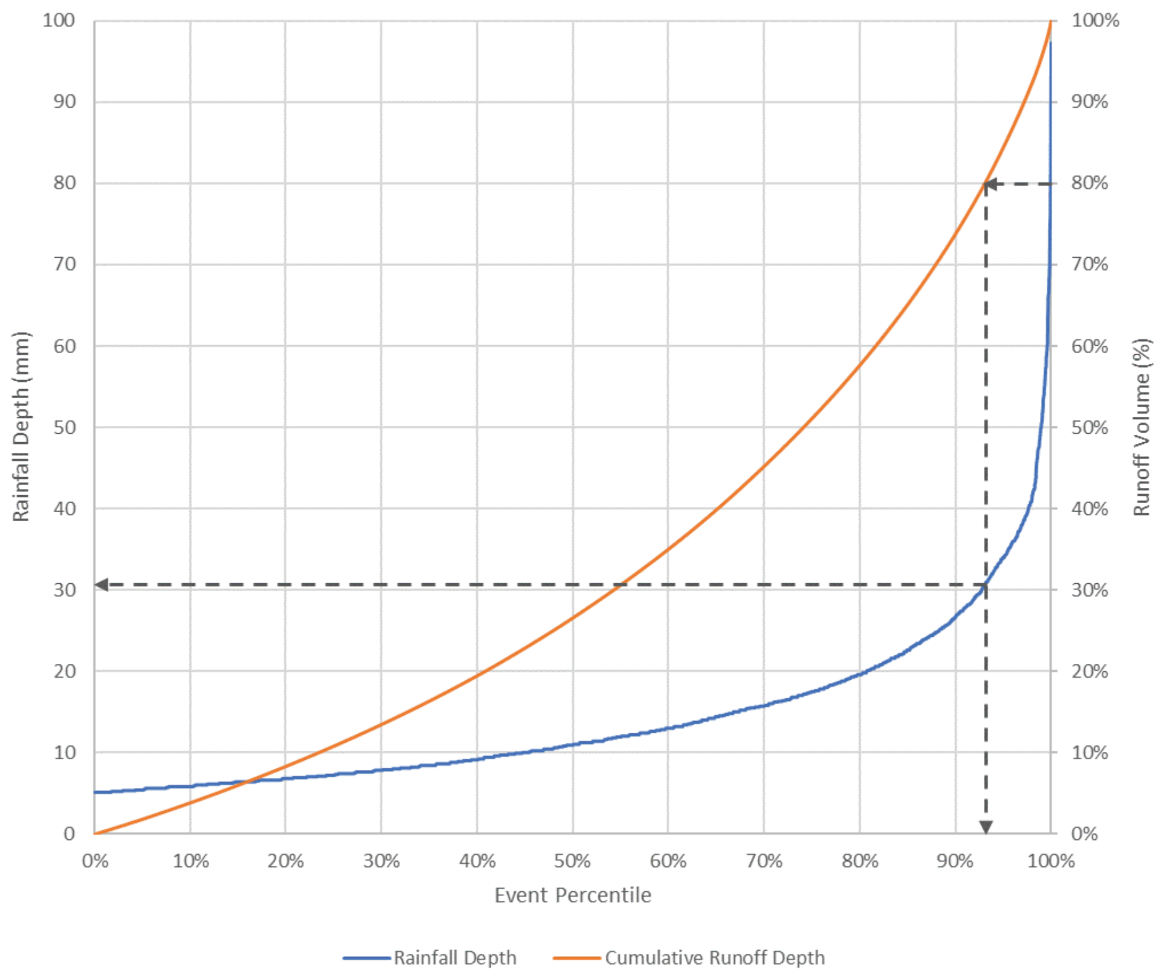



**Figure 4.** Rainfall Frequency Analysis, Nanaimo Airport (1947-2020)

### 2.1.1.4. Future Intensity-Duration-Frequency Curves and Hyetographs

As part of the SWMMP for the Park, Dillon Consulting developed projected IDF curves for mid- and late-century timeframes, representing the 2050s and 2080s, under the "worst case" representative concentration pathway (RCP) 8.5 (Intergovernmental Panel on Climate Change 2013). Although referred to as a "worst case" scenario, RCP 8.5 represents a "business as usual" carbon-intensive future emissions pathway with little greenhouse gas mitigation, which is an appropriate scenario to plan for based on the current progress in global greenhouse gas mitigation. The projected IDF curves provided for the 2080s, in Table 2 include multi-day rainfall events (2-10 days) in addition to sub-daily duration events for standard return periods (2-100 year events), and were used to estimate expected stormwater impacts on Parksville Community Park in the year 2100. Overall, the combination of the updated baseline IDF curves and the climate change projections result in significant increases in rainfall volumes. Additional details are provided in Appendix D.

**Table 2. Mean Future (2080s) Rainfall Depth-Duration-Frequency Curves for Parksville, BC (mm)**

| Duration | Return Period | | | | | |
|---|---|---|---|---|---|---|
| | 2 year | 5 year | 10 year | 25 year | 50 year | 100 year |
| 5-min | 3.7 | 4.9 | 5.7 | 6.6 | 7.4 | 8.1 |
| 10-min | 5.4 | 7.4 | 8.8 | 10.4 | 11.7 | 12.9 |
| 15-min | 6.6 | 9.4 | 11.3 | 13.7 | 15.4 | 17.3 |
| 30-min | 9.4 | 13.4 | 16.1 | 19.5 | 22.1 | 24.5 |
| 1-h | 13.3 | 17.8 | 20.9 | 24.6 | 27.5 | 30.3 |
| 2-h | 19.5 | 23.9 | 26.6 | 30.3 | 32.9 | 35.5 |
| 6-h | 37.0 | 43.8 | 48.2 | 53.9 | 58.2 | 62.2 |
| 12-h | 52.1 | 62.5 | 69.4 | 78.1 | 84.6 | 91.0 |
| 24-h | 68.9 | 86.4 | 98.0 | 112.7 | 123.5 | 134.3 |
| 2-day | 86.6 | 106.1 | 119.1 | 135.4 | 147.6 | 159.6 |
| 3-day | 101.4 | 122.8 | 136.9 | 154.7 | 168.0 | 181.1 |
| 4-day | 119.1 | 145.1 | 162.3 | 184.0 | 200.1 | 216.2 |
| 5-day | 134.6 | 165.2 | 185.4 | 210.9 | 229.9 | 248.7 |
| 6-day | 146.5 | 177.2 | 197.6 | 223.3 | 242.4 | 261.4 |
| 7-day | 154.8 | 187.6 | 209.4 | 236.8 | 257.2 | 277.4 |
| 8-day | 165.5 | 201.0 | 224.4 | 254.1 | 276.1 | 297.9 |
| 9-day | 176.7 | 214.4 | 239.4 | 271.0 | 294.4 | 317.6 |
| 10-day | 186.7 | 227.6 | 254.6 | 288.8 | 314.2 | 339.3 |

Source: *Rainfall Design & Climate Change Guidance – Final Technical Report (See Appendix D)*

The SWMMP will use a 1-hour AES BC Coast and the 24-hour SCS Type IA (Pacific Coast) distributions for assessing conveyance and retention capacity, respectively, which are both relevant to the stormwater management system in the Park. Multi-day events may be represented by the distributions of historic events observed in the region. Details regarding this approach are included in the Design Criteria Memo in Appendix D.

#### 2.1.1.5. Baseline & Future Water Balance

The final technical report titled "City of Parksville – Rainfall Design & Climate Change Guidance" (Dillon Consulting 2020) developed projected monthly water balances based on the Environment Canada weather station in Coombs, BC for mid- and late-century timeframes, representing the 2050s and 2080s, under the "worst case" RCP 8.5 (Intergovernmental Panel on Climate Change 2013). Overall, the projections indicate that the wettest winter months will become wetter (up to 18% by 2080s in the winter), the driest months will become even drier (up to a 22% decrease in the summer) increasing potential evaporation throughout the year. The difference between precipitation and potential evaporation is an indicator of the local water balance conditions. As shown in Figure 5, the water surpluses in the cooler months (October to April) and deficits in warmer months (May to September) are expected to increase. Cooler months may have surpluses up to approximately 175 mm, while warmer months can have a deficit of approximately 75 mm historically. Historic precipitation records indicate an increasing trend in summer dry periods from 20 days in 1984 to 24 days by 2009, which may continue into future summer periods since smaller rainfall events are expected to occur less frequently.

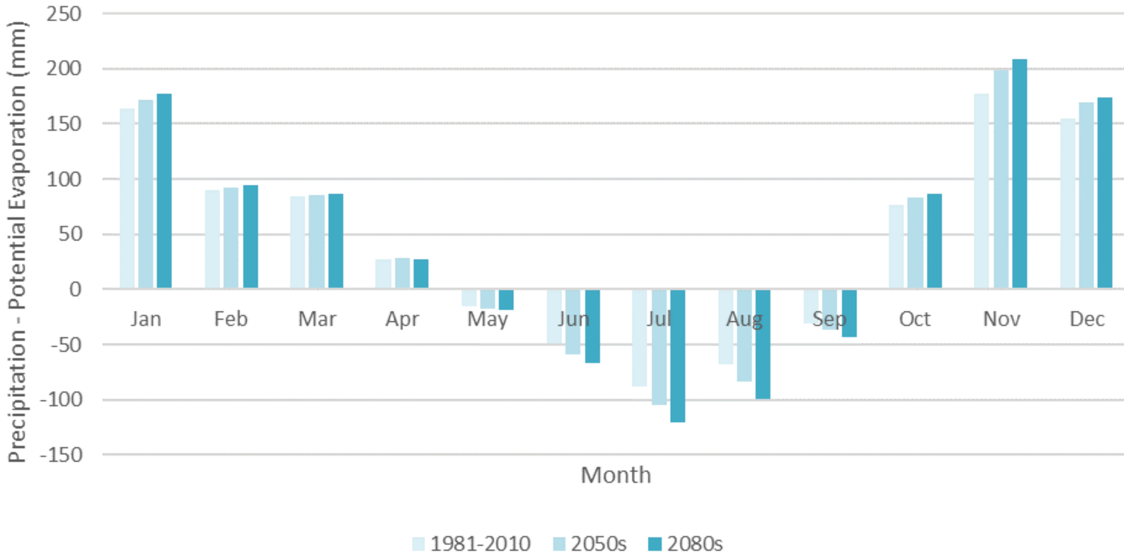



**Figure 5.** Water Balance (Precipitation - Potential Evaporation) in Coombs, BC (Adapted from Dillon Consulting, 2020)

### 2.1.2. Sea Level and Coastal Inundation

Extreme sea levels are often a result of high tides coinciding with storm surges. Storm surges are the temporary increases in sea levels caused by storms and their associated severe winds and decrease in atmospheric pressure. The 'storm tide level' is the combination of the astronomical tide level and storm surge, as shown in Figure 6, and is the effective 'still water level' during an extreme event. Wave effects are in addition to the storm tide level. Each of these contributing factors will be elevated in the future due to sea level rise (SLR) (Department of Sustainability and Environment 2012).

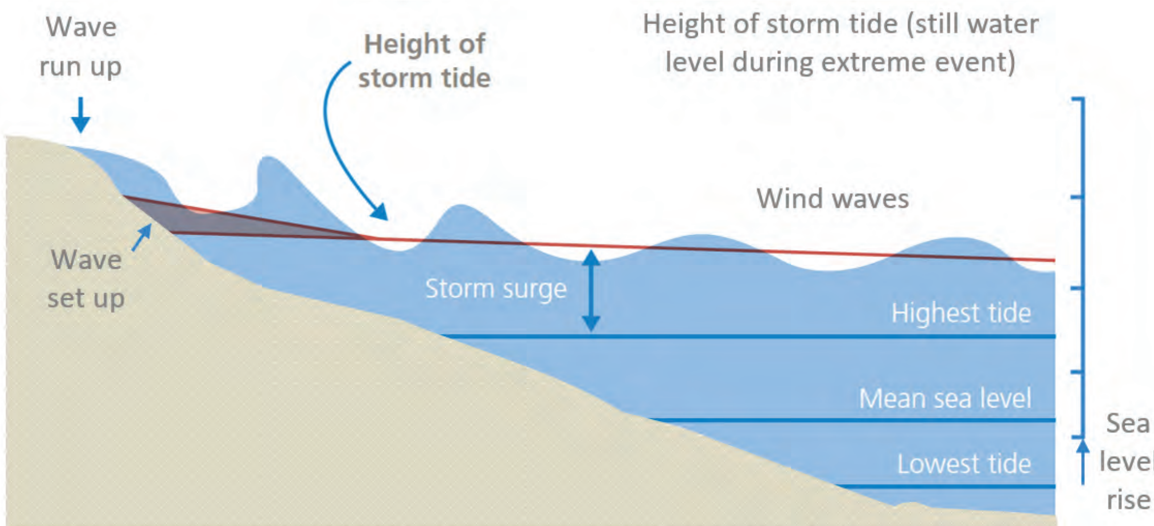



**Figure 6.** Impacts of Tides, Storm Surge and Wave Processes on Sea Level (Department of Sustainability and Environment 2012)

As part of the SWMMP, Northwest Hydraulics Consultants (NHC) conducted a study to assess sea level under existing and future climate conditions, considering the effects of global SLR on tides and storm surge, as well as wave effects. Future, late-century projections were estimated based on applicable guidelines from the BC Ministry of Environment (BC MOE 2018) and include considerable uncertainty. NHC also developed a time series of sea water levels from September 2019 to April 2020 based on measured levels at Point Atkinson transformed to the project site. The time series, included in the stormwater modeling, includes the measured astronomical tide as well as residuals from storm surge and wind/wave set-up (Northwest Hydraulics Consultants 2020a). Figure 7 illustrates the time series shifted to account for regional SLR by year 2100 (+0.79 m) relative to the Park's existing storm sewer outfall and a new outfall which was recently installed, but not connected, as part of shoreline improvements. Sea levels will back up into the Park's stormwater management system through the outfall and will submerge parts of the contributing system under extreme sea levels. This effect will occur with increasing frequency and duration under future climate conditions due to SLR, even when the system is connected to the new outfall.

Combining the tidal timeseries with the outfall elevation of the stub outfall, the free outfall time for the duration of design storm events ranging from 6 hours to 10 days was calculated. When compared, the drain time for rainfall depths associated with each design event are illustrated in Figure 8.

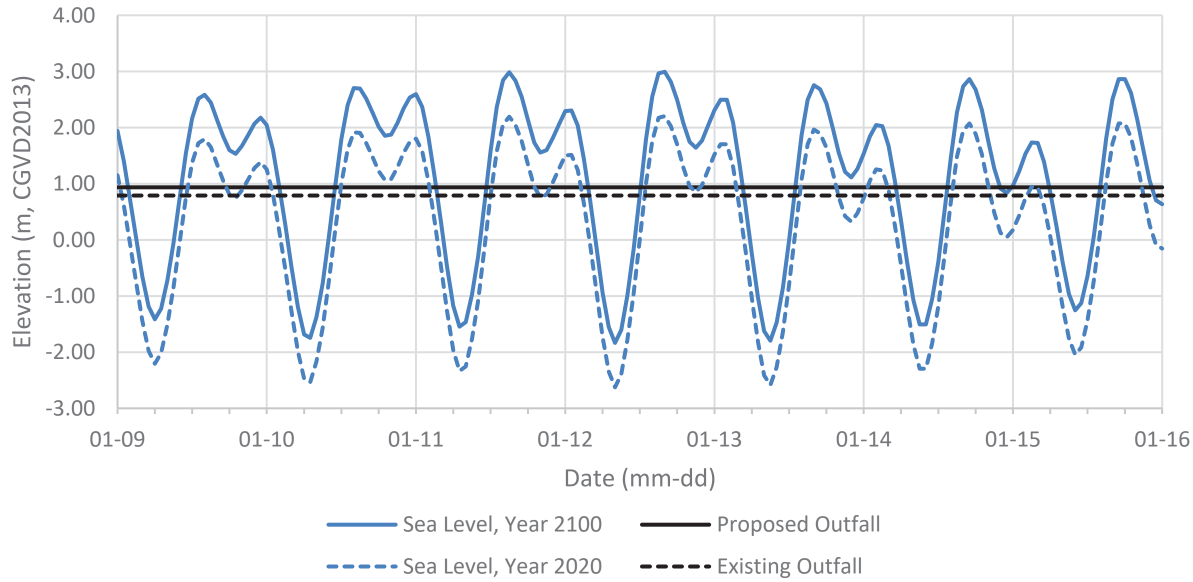



**Figure 7.** Existing and Future Sea Level Relative to Storm Sewer Outfall (Adapted from Northwest Hydraulics Consultants, 2020b)

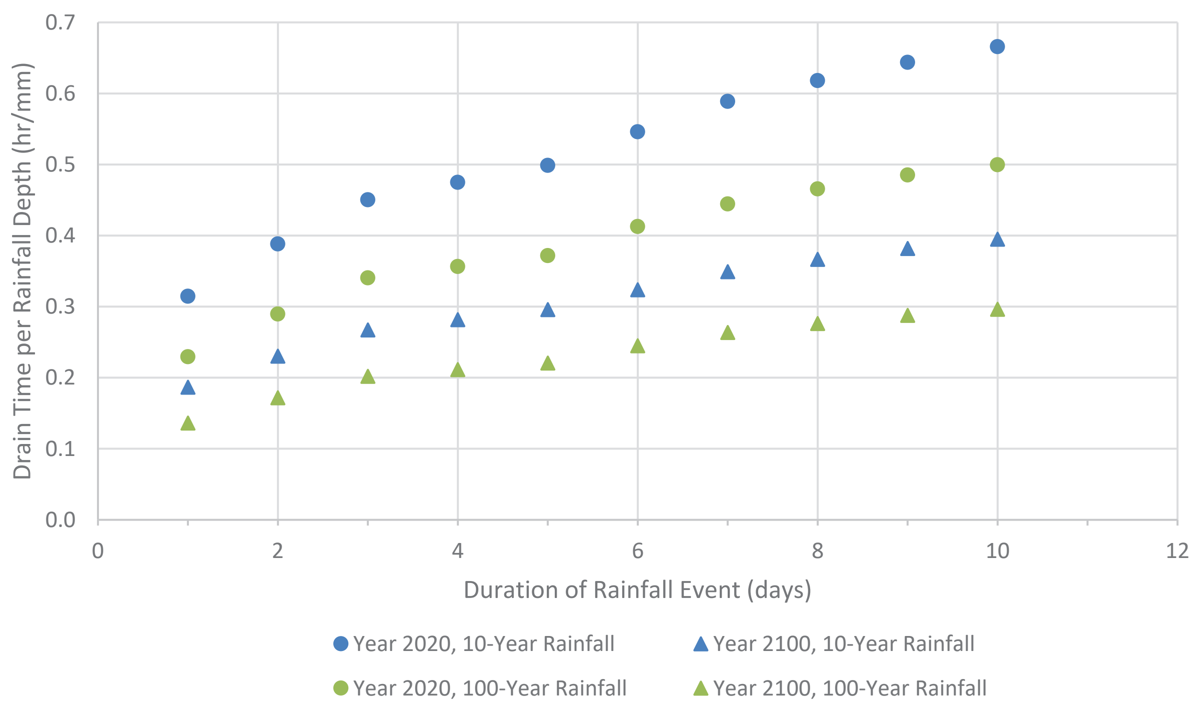



**Figure 8.** Design event drain times based on outfall elevation, tidal elevation fluctuations and event rainfall depth and duration

NHC identified the late century design water levels (Table 3) with 10, 100 and 200 year annual exceedance probabilities based on joint probabilities of tides and storm surge, and including global SLR (+1 m by 2100) and local uplift (0.21 m by 2100) due to isostatic rebound, tectonic uplift and/or sediment consolidation (Northwest Hydraulics Consultants 2020b). These design water levels represent 'still water level' during extreme events and do not include wave effects. Significant coastal inundation of the Park is likely to occur by Year 2100, based on the existing park topography relative to the design water levels, is shown in Figure 9 for 10-year and 100-year return periods. Present-day inundation will be limited to the beach. The duration of park inundation due to coastal flooding will typically be two to three hours due to the astronomical tides, however the ability of the coastal flood water to recede within the Park depends on drainage infrastructure (Northwest Hydraulics Consultants 2020b). Drainage infrastructure proposed in Section 5 is able to fully discharge expected coastal inundation waters. NHC assumed neighbouring properties will be raised to prevent coastal inundation via overland flow from those properties (G. Lamont personal communication, July 23, 2020).

**Table 3.** Design Water Levels for the Years 2020 and 2100 **(Northwest Hydraulics Consultants 2020b)**

| Annual Exceedance Probability | Year 2020 Water Level (m, CGVD2013) | Year 2100 Water Level (m, CGVD2013)* |
|---|---|---|
| **10-Year** | 2.78 | 3.57 |
| **100-Year** | 3.02 | 3.81 |
| **200-Year**** | 3.14 | 3.93 |

**Year 2020 Level + Regional Sea Level Rise (+0.79 m)*  ***Coastal Designated Flood Level*

NHC found that present day wave effects will be limited to the beach except for some overtopping and isolated ponding that will occur at the peak of a storm event, lasting two to three hours, at locations where the Park pathway has minimal freeboard (i.e. the western half of the Park shoreline, primarily to the southwest of the rock groyne where the beach crest elevation drops to approximately 3.1 m CGVD2013). Wave overtopping rates are dependent on the elevation of the beach crest, which may change based on the City's SLR adaptation strategy, and so the study developed this relationship for consideration in future planning. In Year 2100, wave heights within the inundated park area will likely be approximately 0.3 m, however additional analysis is required to assess the potential effects of wave breaking. The study considered potential wave runup under existing and future climate, with the latter assessment considering a scenario with future raised shoreline elevations. If the shoreline is not raised, then waves will break on the shoreline and impacts will be dependent on other factors needing further consideration (Northwest Hydraulics Consultants 2020b). Additional discussion regarding the coastal inundation analysis are included in the Design Criteria Memo and appendices, in Appendix D.

Typical risks related to sea levels in coastal areas include damage to coastal infrastructure, property and people from inundation, saltwater intrusion and coastal erosion due to SLR and storm surges. Although the projected extent of late-century coastal inundation is substantial in the Park, the establishment and management of the Park has protected this area from other developments which could have become more vulnerable to climate change than parklands. Implications of SLR on the Park's stormwater management system are assessed in Section 5, however implications on park layout and programming are beyond the scope of the SWMMP. The SWMMP will need to be updated and aligned with other City plans as they evolve with a growing understanding of climate change impacts and adaptation strategies.

For example, the SWMMP and Park Master Plan would need to be aligned with a SLR adaptation plan for Parksville Bay and the Englishman River Estuary.


**Figure 9.** Coastal Inundation Mapping for Year 2020 and Year 2100 (adapted from Northwest Hydraulics Consultants 2020b)

#### 2.1.2.1. Coastal Erosion

Shoreline erosion conditions at the Park are described as follows:

> "The Park is directly exposed to Northwesterly storms and is sheltered from Southeasterly waves by the Englishman River Estuary. However, Southeasterly storms are the source of significant longshore sediment transport, moving sediment from the Englishman River Estuary into Parksville Bay. A secondary source of sediment may be transported from the bluffs to the northwest of Parksville Bay during Northwesterly wave events. " *(Northwest Hydraulics Consultants Ltd. 2015)*

City staff have noted that sediment frequently accumulates in the existing storm sewer outfall from the Park at Arbutus Point. This condition is expected to continue when the system is connected to the new outfall stub installed during shoreline reconstruction.

### 2.1.3. Topography

Elevations throughout most of the Park range from sea level to approximately 5 m above sea level, with a steep slope on the southern boundary rising to 11 m above sea level. The topography of the Park is mapped in Figure 10 using light detection and ranging (LiDAR) provided by Regional District of Nanaimo. Additional topographic survey was conducted of the Park by JE Anderson in January and February 2020. Sims Associates Land Surveying Ltd. surveyed the right-of-way adjacent to the Park on Corfield Street North and Highway 19A in May 2020.

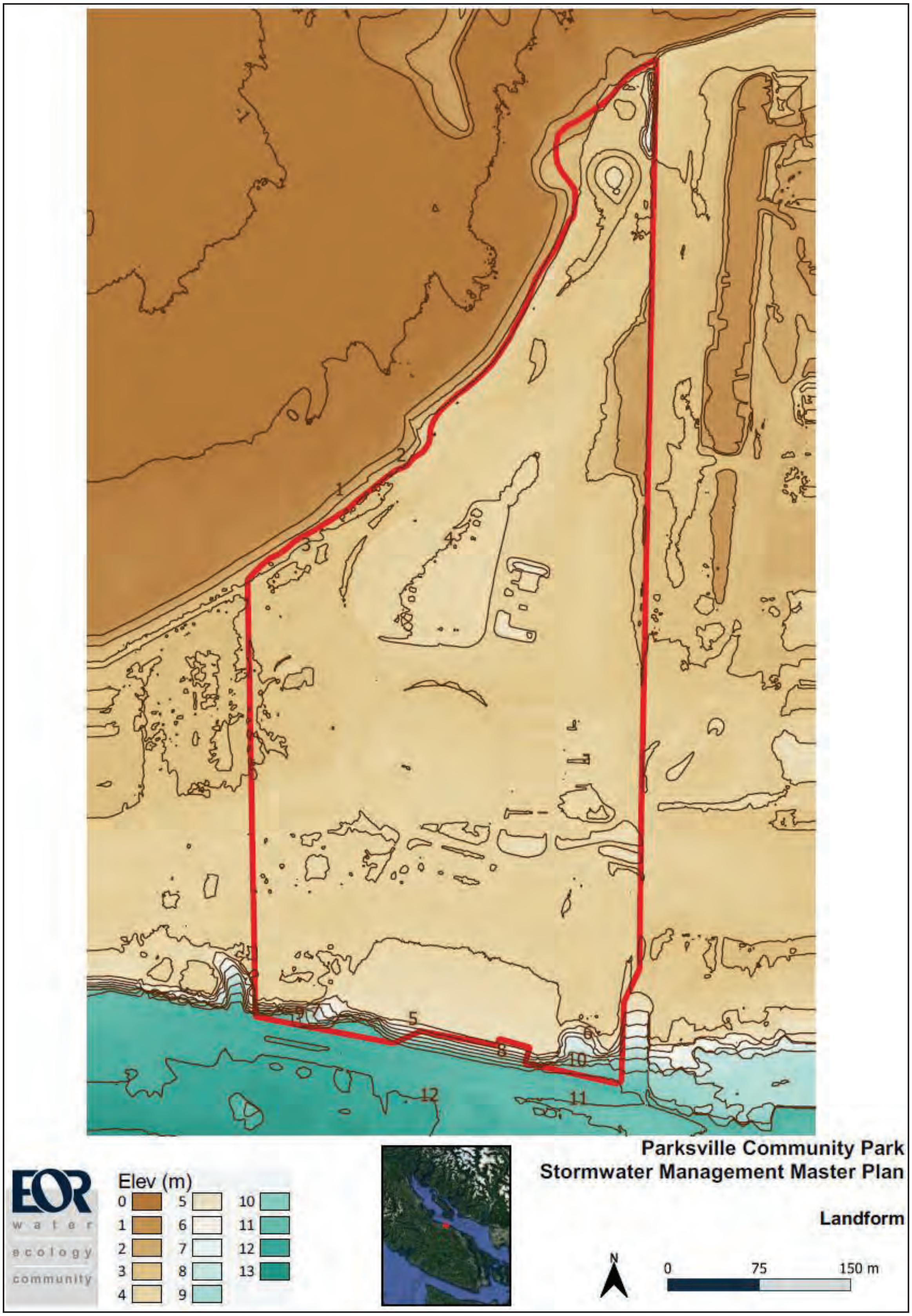



**Figure 10.** Topography

### 2.1.4. Surficial Soils

Surficial geology in the Park primarily consists of Salish Sediments (i.e. shore, deltaic and fluvial deposits composed of gravel, sand, silt, clay and peat) with a small area of terraced fluvial deposits at the southeast corner (i.e. deltaic deposits composed of gravel and sand underlain by silt and clay) (Fyles 1963). As part of the SWMMP, Thurber Engineering Ltd. conducted a geotechnical investigation of the Park (Thurber Engineering 2020) based on seven test pits, which found the following typical soil conditions:

- Topsoil consisted of organic silt up to 0.45 m thick.
- Fill soils (immediately below topsoil) consisted of sand, gravelly sand and sandy gravel up to 2.4 m deep, except for TP20-3 (east of lacrosse court at southeast corner of park) where fill consisted of organic silt with some sand and gravel to a depth of 2.3 m.

Native granular soils below the fill consisted of gravelly sand, or sand and gravel containing variable amounts of cobbles and silt. The grain size analysis confirmed that the confining layer at most test pit locations is poorly graded sand (SP), which has a design infiltration rate of 20.3 mm/hr. The exception to this finding is the organic silt encountered at TP20-3 to a depth of 2.3 m, indicating low potential for infiltration at this location.

### 2.1.5. Groundwater

The geotechnical investigation conducted by Thurber Engineering Ltd. characterized depth to groundwater at the time of the investigation (May 14, 2020). As shown in Figure 11, no groundwater was encountered at three of the test pits (TP20-4, TP20-5, TP20-6). Depth to groundwater in the three southernmost test pits (TP20-1, TP20-2, TP20-3) ranged from 2.3 to 2.7 m. The shallowest groundwater was observed 1.3 m below ground in the dry basin located northeast of the curling rink on the eastern boundary of the Park (TP20-7), which was also the lowest topographic point investigated. Additional information on the geotechnical investigation is provided in Appendix D.

An Archaeological Impact Assessment of the Park in early March also identified shallow groundwater in the dry basin at a depth of approximately 0.85 m. The assessment also identified indicators of groundwater (i.e. mottled soils) in a shallow test pit dug at the northeast corner of the volleyball courts approximately 0.34 m below the ground (Parsley and Thompson 2020).

Groundwater elevations below the Park are expected to fluctuate seasonally due to relationship to sea level and precipitation, and may potentially be influenced by irrigation of the Park as well. In addition, sea level rise associated with climate change may cause increased groundwater elevations. Prior to design of infiltration features in the Park, the extent of these influences should be characterized through a year long groundwater monitoring program at proposed infiltration facility locations.


**Figure 11.** Groundwater elevations observed during Geotechnical investigation

## 2.2. Cultural Environment

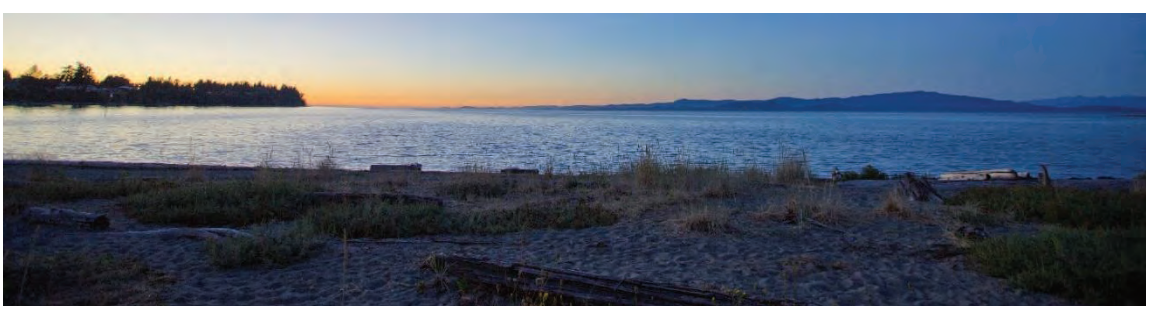
Cultural environmental features include any building, structure, site or object, including an underground or underwater site, of significance in the history, archaeology or culture of a study area and its communities.

The Parksville Community Park Master Plan describes the rich history of the Parksville Community Park, including First Nations' heritage and the history of the Park after European settlement. The City is located within the traditional territories of the Coast Salish Peoples who have lived in the region for thousands of years. The Park is within the asserted traditional territory of the Snaw-Naw-As, Qualicum and K'omoks First Nations. The Parksville Community Park Master Plan includes the goal, "to collaborate with local First Nations to provide meaningful recognition of traditional territory, First Nations' values, and culture in the Parksville Community Park."

A critical step towards honouring First Nations' heritage in the Park is understanding the extent and type of archaeological features in the Park to guide culturally sustainable development in the Park in the future. To take this first step, the City recently retained Aquilla Archaeology to conduct an Archaeological Impact Assessment and Inventory study. The purpose of the study was to confirm the boundary of archaeological site(s) at the Park, and to facilitate a shift towards inclusion and connectivity with the Snaw-Naw-As and Qualicum First Nation communities. The study identified two key findings relevant to the PCPSWMMP:

1. the presence of archaeological site[1] DhSb-2, dated to nearly 1000 years old, is substantially larger and extends through the southern third of the Park in a discontinuous fashion, and
2. the northern two-thirds of the Park are infilled former marine-riverine-deltaic intertidal areas.

The significance of this archaeological site is enhanced by its location in the popular Parksville Community Park, which provides more opportunity to educate the public of Indigenous presence in the past, present and future of the Park (Parsley & Thompson, 2020). The findings of this Archaeological Impact Assessment and Inventory study have been considered in development of the PCPSWMMP.



[1] Archaeological sites are locations on public or private land containing evidence of human activity pre-dating 1846.

## 2.3. Natural Environment

The terrestrial environment in the Park includes turf grass, gardens and over 500 trees, some of which are located within the Arboretum encircled by Salish Sea Drive. In total, there are 170 tree species within the Park, including native and ornamental species. The majority of trees in the Park were recently identified as being in good or excellent health and intercepting approximately 3.4 million litres of rainfall annually (City of Parksville 2019), which is equivalent to 19 mm of rainfall over the Park every year. The City currently irrigates approximately 11 ha (61%) of the Park year-round to support tree and turf health.

This SWMMP did not include an assessment of the terrestrial and aquatic ecosystems in the Park, or the risks associated with managing these natural resources over time. Additional details regarding the natural environment of the Park are included in the Design Criteria Memo in Appendix D.

## 2.4. Built and Social Environment

The social environment includes infrastructure and amenities built within the Park. As the built environment in the Park expands, there will be more demands on the stormwater management system. A functioning stormwater management system is required to protect the Park and its users from pluvial (i.e. overland) flood risk and drain down future coastal inundation. Flooding generally occurs when the volume of stormwater cannot be contained or conveyed by the stormwater management system, in addition to sea levels backing up the storm sewer system. Typical risks from flooding include impassable roads, delayed emergency response, utility damage, property damage, delayed re-occupancy, damage to trees, degradation of wetlands, and injury or loss of life. There are no essential community services within the Park that require emergency access.

While this plan considers how sea levels affect the performance of the Park's stormwater management infrastructure, managing other hazards related to coastal inundation of the Park and developing a sea level rise adaptation strategy are beyond the scope of this PCPSWMMP. This PCPSWMMP should be considered in any future coastal planning conducted for the Park.

### 2.4.1. Land Cover and Land Use

Land cover in the Park includes buildings, parking lots (paved and gravel), roads, trails, a skate park, beach volleyball courts, playgrounds, baseball diamonds, tennis courts, a basketball/lacrosse court, a sand castle exhibition space, a splash pad, a tree arboretum, and other open spaces, as shown in Figure 12. Anticipated improvements in the Park that will increase impervious cover were compiled from City staff, the Parksville Community Park Master Plan (CPMP) and the ongoing Pedestrian Connections and Circulation Plan, and include an amphitheatre, extension of Sandcastle Drive and pedestrian trail improvements, as shown in Figure 13. The proposed layout of various improvements is subject to change, but overall, the future improvements are expected to increase the impervious cover of the Park from approximately 5.6 to 5.9 ha (31 to 33%).


**Figure 12.** Existing Land Cover


**Figure 13.** Future Land Cover

### 2.4.2. Road and Trail Infrastructure

The existing road, parking and trail infrastructure in the Park is illustrated in Figure 14. The three roads in the Park are Sandcastle Drive, Salish Sea Drive and Ravenhill Road. The three main parking lots in the Park are the paved and gravel lot by the sports field, the paved lot west of the curling rink, and the large gravel overflow lot north of the curling rink. Additional parking is provided on the East side of the curling rink and in smaller, roadside parking along Sandcastle Drive. City staff noted some historic issues with accelerated asphalt deterioration in areas with frequent nuisance flooding issues. The City installed a section of permeable pavers in one of the roadside parking areas in 2015, which is functioning well so far. There are several limitations for pedestrians in the Park based on gaps between sidewalk and trail networks. The City sweeps the streets in the Park every two weeks.

The Parksville Community Park Pedestrian Connections Plan, under development at the time of writing, informed the future land cover within the Park illustrated in Figure 13. The improvements proposed through the Official Community Plan, Parksville Community Park Master Plan, Parks Trails and Open Spaces Master Plan, are reflected in the preliminary Parksville Community Park Pedestrian Connections & Circulation Plan concept illustrated in Figure 15.


**Figure 14.** Existing road and trail infrastructure in Parksville Community Park


**Figure 15.** Future road and trail infrastructure based on preliminary discussions around the Parksville Community Park Pedestrian Connections and Circulation Plan

### 2.4.3. Stormwater Management Infrastructure

The existing stormwater management system in the Park uses retention and conveyance strategies to manage stormwater runoff. Runoff from approximately half of the Park is retained by subsurface infiltration facilities (e.g. rock pits), a dry pond and landlocked topography. Runoff from another third of the Park drains to the storm sewer networks and ultimately to downstream outfalls. One of these areas is at the southeast corner of the Park, where the storm sewer network drains to an outfall to the Englishman River Estuary located northeast of the residential area east of Corfield Street North and north of Nerbus Lane. The second outfall is to Parksville Bay and is located at the northeast corner of the Park at Arbutus Point. Most of the remaining area of the Park also drains to the Parksville Bay storm sewer network, however a sag in the storm sewer network northwest of Salish Sea Drive prevents most drainage from reaching the Parksville Bay outfall, leaving the area partially isolated where runoff is retained at an infiltration manhole. Throughout the Park, the existing roads and parking lots direct runoff to the storm sewer network via curb and gutter systems.

The major stormwater catchments throughout the Park are illustrated in Figure 16. An inventory of the stormwater management infrastructure in the Park is summarized in Table 4 and illustrated in Figure 17. As shown in Figure 17, an outfall stub with larger capacity than the existing storm sewer was installed at Arbutus Point during shoreline stabilization improvements designed by NHC and built in 2017 (Northwest Hydraulics Consultants Ltd. 2017). The basic design parameters of the pipe (e.g. location and diameter) were selected by the City and the outfall invert elevation was set to the level of the beach at the base of the slope, approximately 0.15 m above the existing outfall. The City has noted that the existing outfall periodically clogs with sediment and debris, however it is unknown to what extent the new outfall will mitigate this issue.

**Table 4.** Inventory of Built Stormwater Infrastructure in the Park

| Type | Quantity | Intended Purpose |
|---|---|---|
| Storm Sewer | 2.1 km | Convey runoff away from roads and structures |
| Manholes | 14 | |
| Inlets (e.g. Catchbasins) | 37 | |
| Outfalls | 2 | |
| Ditches | 108 m | |
| Infiltration Manhole | 1 | Infiltrate runoff where system has insufficient outlet capacity |
| Soakaway Pits (e.g. Rock Pits) | 9 | Infiltrate runoff in isolated areas of the Park |
| Dry Pond | 1 | Infiltration |
| Lateral French Drain system | Unknown | Drain baseball fields |

There is no operation and maintenance program for stormwater infrastructure in the Park. This could be contributing to some nuisance flooding issues in addition to other factors. For example, flooding on Ravenhill Road may be due to debris clogging the catchbasin inlet or the existing rock pit. Inspection of the rock pits was not possible because there is no cleanout port or other means for access/inspection. The City has a well-established bi-weekly street sweeping program to maintain aesthetics in the Park, however it does not include clearing leaves and debris from stormsewer inlets.

The age of the stormwater management infrastructure is uncertain, however sewer conditions were considered based on CCTV inspections by Pipe-Eye Video Inspections (reports and digital video files provided to the City of Parksville Engineering Department). Sewer condition codes were assigned by Pipe-Eye Video Inspections based on findings observed on the CCTV videos. Sewer condition codes are from the North American Association of Pipeline Inspectors Sewer Condition Codes Index (NAAPI 2003) which uses the Water Research Centre (WRc) sewer conditions classifications (WRc 1993) outlined in Table 5. The codes assigned from the CCTV inspection, combined with the video records, were used to estimate a condition ranking for each pipe length using the ranking defined in (WRc 1993). This ranking is not weighted by risk of failure, nor are any financial implications associated with it. Approximately 1084 m (51 %) of the storm sewer network is asbestos cement. The estimated condition ranking is shown in Figure 18.

**Table 5.** Physical Condition and Recommended Action (WRc 1993)

| Condition Rank | Implication | Definition | Rehabilitation Priority |
|---|---|---|---|
| 0-1 | Excellent Condition | No defects were detected | None |
| 2 | Good Condition | Deficiencies have insignificant influence to tightness, hydraulic/static pressure of pipe (wide joints, badly torched intakes, minor deformation of plastic pipe, minor erosions, etc.) | Long Term |
| 3 | Fair Condition | Constructional deficiencies diminishing static/hydraulic/tightness (open joints, untorched intakes, minor drainage obstructions, cracks, protruding laterals, minor wall damage, individual root penetrations, corroded pipe walls, etc.) | Medium Term |
| 4 | Poor Condition | Constructional damages with nonsufficient static safety, hydraulic or tightness (pipe bursts, pipe deformations, noticeable in/exfiltration, cavities in pipe wall, severe protruding laterals, severe root penetrations, severe corrosion of pipe wall, etc.) | Short Term |
| 5 | Failed or Failure Imminent | Pipe is already or soon will be impermeable (collapsed, deeply rooted/obstructed, pipe loses water or poses danger of backwater in basements, etc.) | Urgent |

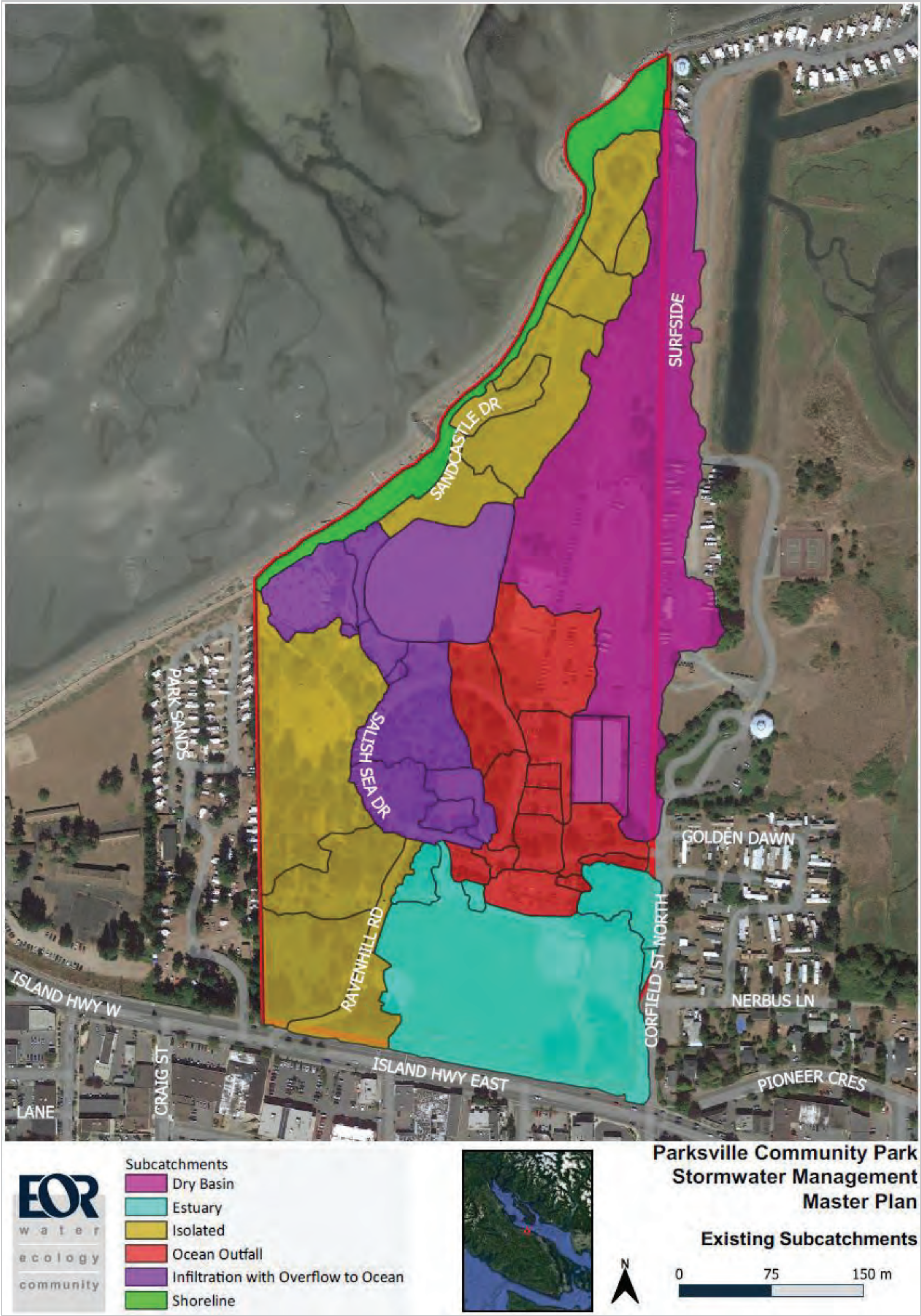



**Figure 16.** Current Park Catchments


**Figure 17.** Existing Stormwater Management System


**Figure 18.** Estimated Sewer Condition

Emergency overland flow capacity to the Parksville Bay is limited because the shoreline and trail system along the north boundary of the Park are elevated above inland areas of the Park. The City and park users have identified nuisance flooding issues along roads, in parking lots and along the walking trails. The nuisance flooding typically recedes within a day or so, however in the wet winter season it is common for some nuisance flooding areas to remain flooded for multiple days. Prolonged flooding may be causing premature deterioration of pavement. One maintenance building south of the playground has flooded, however no other structures have been flooded in the past based on the City's anecdotal records.

### 2.4.4. Utilities

Other utilities in the Park include sanitary, water (including irrigation), gas and electrical utilities. Key utility alignments are illustrated in Figure 20. The Park's underground irrigation system draws from the City's drinking water system, which was recently expanded to support on-going development in the region. The City irrigates approximately 11 ha (61%) of the Park year-round (see Figure 19) and is operated by staff based on precipitation recorded at the Parksville Operations Yard (City of Parksville). City staff estimate that the irrigation system applies over 38,000 $m^3$ of water annually at an equivalent cost of about $73,000 (2020 dollars) using Bylaw 1320 - Water Service System Bylaw charge rate of $1.9096/$m^3$.


**Figure 19.** Irrigation zones in Parksville Community Park


**Figure 20.** Park Utilities