# *2013 ANNUAL MEETING SUMMARY*

## *APDES Permit No. AKS-052558*

## *February 25, 2013*

| Municipality of Anchorage<br>Daniel A. Sullivan, Mayor | Alaska Department of Transportation and Public Facilities |
| --- | --- |


Watershed Management Services
Project Management and Engineering Department
Municipality of Anchorage

# Meeting Agenda

# 2013 Watershed Update

## Final Agenda

Monday, February 25, 2013 Municipality of Anchorage
Alaska Department of Transportation and Public Facilities
At the BP Energy Center

| | |
|---|---|
| Arrival: | 9:15 – 9:30, coffee provided, program will start promptly at 9:30. |
| **Welcome** | Municipality of Anchorage and Alaska Department of Transportation |
| **Opening Remarks** | Ron Thompson, P.E., Municipal Public Works Director |
| **Program** | APDES Storm Water Permit Compliance |

Poster Session of Projects

- Monitoring
  - Wet Weather Monitoring
  - Dry Weather Monitoring
  - OGS/Sed Basin Assessment
- LID
- Mapping
- Education

**Q&A** Panel Discussion – project team will be available to address questions

Adjourn

**Afternoon Training** Low Impact Development – Making it Work in Anchorage.
For those of you signed up to attend this workshop it will begin at 1:00 p.m. at the BP Energy Center.

# Program Slides

# 2013 Watershed Update

Municipality of Anchorage

Alaska Department of Transportation and Public Facilities

A.laska
P.ollutant
D.ischarge
E.limination
S.ystem

# *Welcome to the APDES Annual Meeting!*

**Jerry Hansen**

Municipality of Anchorage
Project Management and Engineering

# *Opening Remarks*

- **Ron Thompson, P.E.**

Municipality of Anchorage

Director of Public Works

# *Today's Program*

APDES Storm Water Permit Compliance

Poster Session of Projects

Monitoring - Wet and Dry Weather Monitoring

Assessment - OGS/Sediment Basin

Low Impact Development - State and Municipal Projects

Mapping

Education

Q&A Session

# *New in 2013*

APDES Storm Water Permit Compliance

- Runoff Reduction Techniques for Road and Parking Lot Repair (publicly owned or managed)

- Inspection and Enforcement of Permanent Stormwater Controls

# *Today's Program*

Poster Session of Projects
and Refreshments

Monitoring - Wet and Dry Weather Monitoring

Assessment - OGS/Sediment Basin

Low Impact Development - State/Municipal Projects

Mapping – State/Municipal Storm Sewer System

Public Education

Q&A Session ~11:00

# *Q & A Discussion*

Anchorage MS4 Permit

# Posters

# The Municipality of Anchorage - Low Impact Development Projects

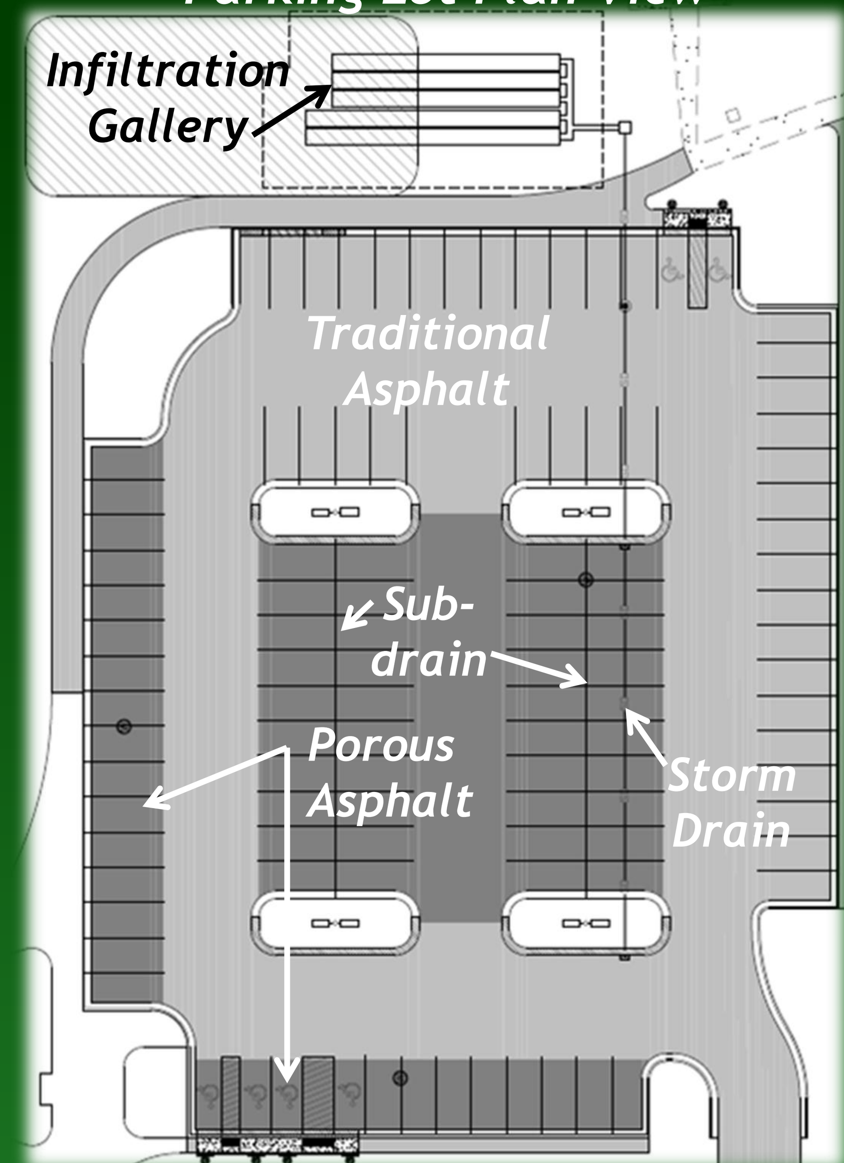
## Porous Asphalt and Infiltration

### Russian Jack Springs Parking Lot

Project Objectives:
- Improved and safer parking
- Safer pedestrian access around the parking lot
- Manage stormwater using Low Impact Development techniques

LID Features:
- Porous Asphalt
- Infiltration Gallery

Parking Lot Plan View



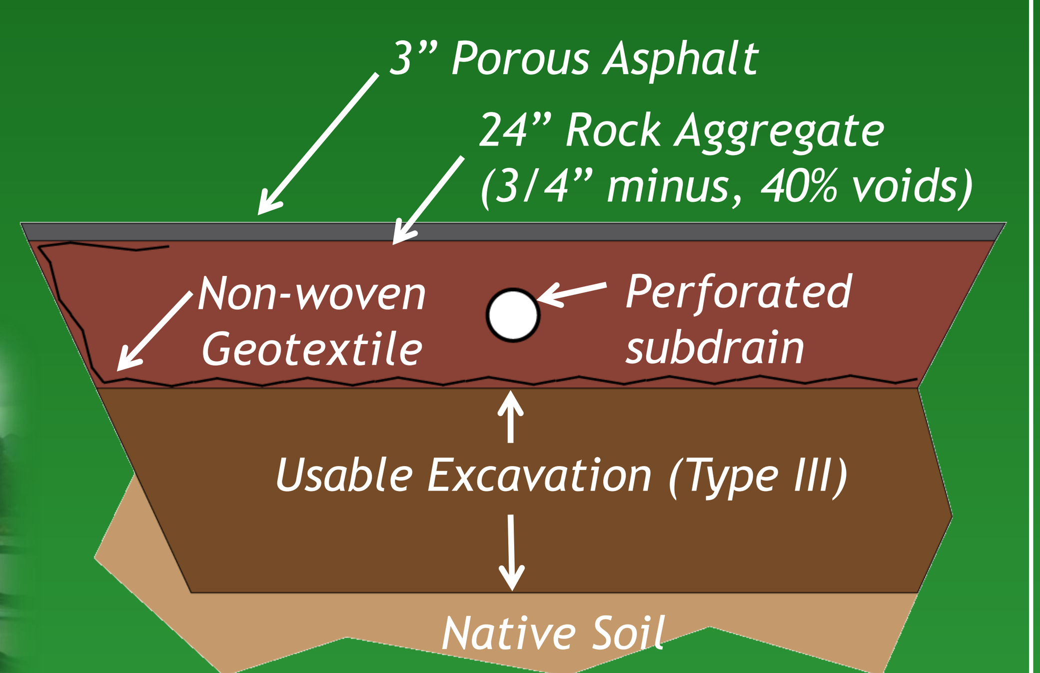

### Porous Asphalt

Porous asphalt was used in combination with traditional asphalt to collect stormwater that falls onto the parking lot. The porous asphalt locations were selected based on coordination with the MOA Parks and Recreation maintenance crew. Because this was the first porous asphalt of its kind in Anchorage, it was placed in locations of low winter use where it would not be regularly plowed and sanded.

Completed Type III Sub-base

Completed Rock Aggregate

Finished Pavement



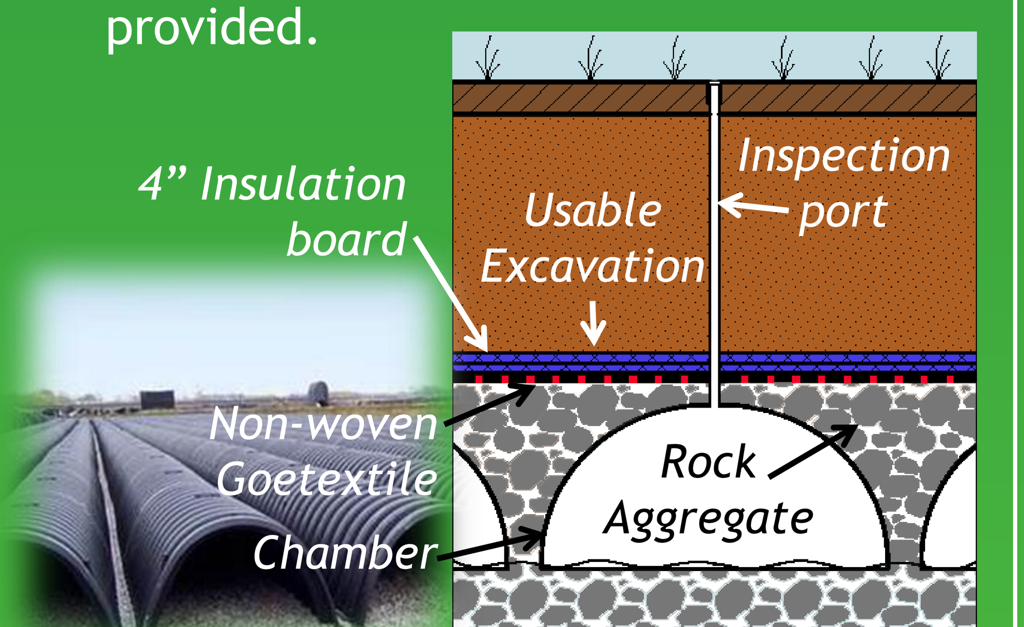

### Limitations - Native Soils

The characteristics of the native soils varied significantly with depth. Under the porous asphalt, native material was slow-draining with percolation rates generally less than 0.5 in/hr. Because the rainfall is distributed over a large area and because the rock aggregate provides storage capacity, porous asphalt works well even with poorly draining soils.

The bottom of the infiltration gallery was deeper than the porous asphalt subgrade. At this depth, native material was granular and well-draining with percolation rates of approximately 6 to 8 in/hr.

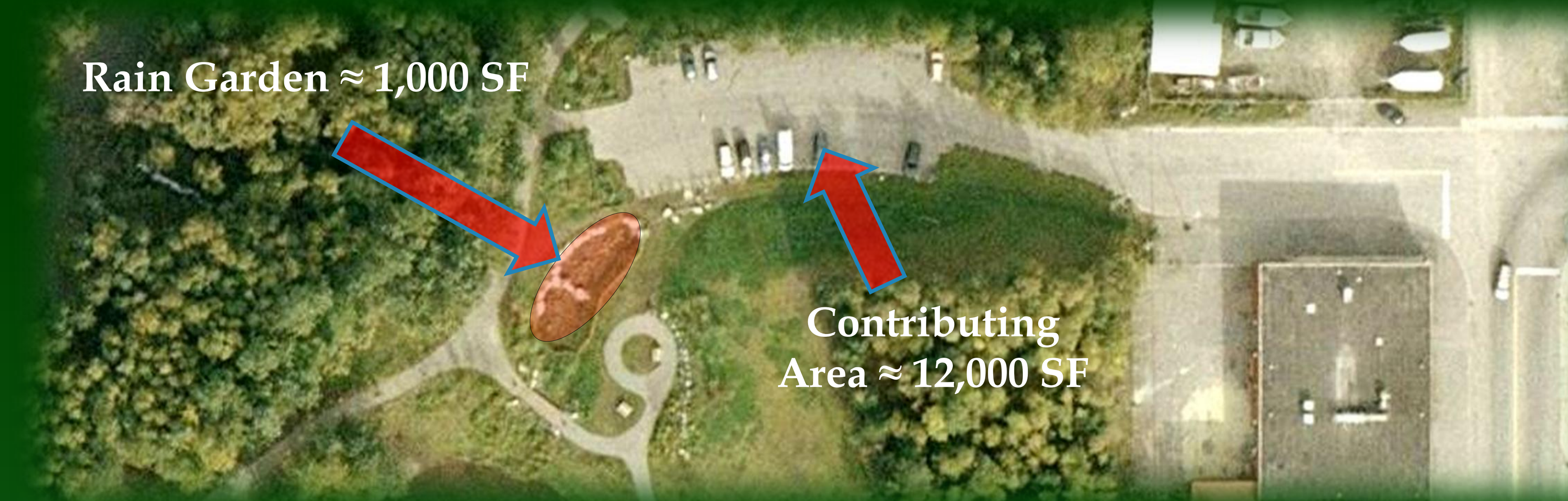
### Infiltration Gallery

Excess water not collected and infiltrated by the porous asphalt was directed to a subsurface infiltration gallery. To promote longevity of the facility, a pretreatment OGS was provided.




## Rain Garden

### Taku Lake Parking Lot

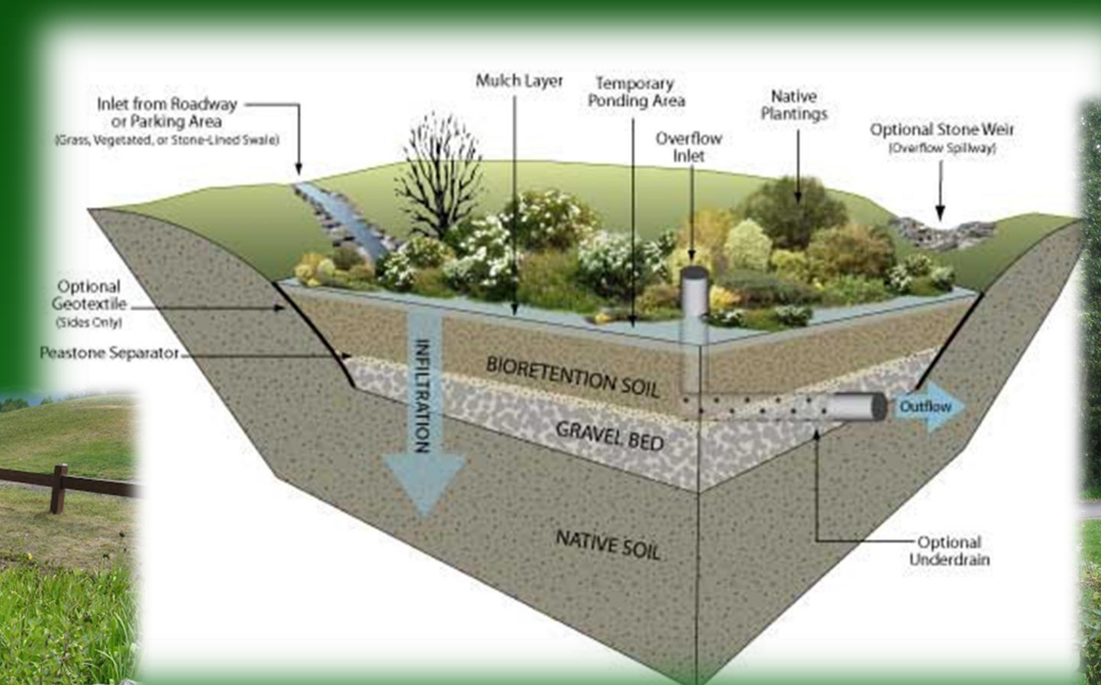



The Taku Lake Rain Garden was constructed to accept and treat stormwater runoff from the Taku Lake parking area and a portion of King Street. The rain garden collects stormwater and provides treatment and retention through plant uptake, top soil saturation, and infiltration. Excess water is collected in a perforated subdrain which outlets near Taku Lake. Preliminary monitoring results show that this pipe only flows under heavy rainfall conditions despite that fact that groundwater in this area is near the surface. This rain garden is functioning very well.

Project Objectives:
- Water quality treatment of runoff
- Stormwater Retention and Infiltration

LID Features:
- Bioretention (Rain Garden)

Rain garden after initial planting




Typical rain garden section (Photo from Douglas County, WA)

Rain garden after several growing seasons

## Bioretention

The MOA has completed several large and small scale stormwater bioretention areas at commercial, school, and residential sites across Anchorage. The size and design of the bioretention areas vary depending on the intended function, size of the contributing drainage area, and the surface the runoff comes from (parking lots, rooftops, etc.) In each case, the bioretention areas provide an opportunity for stormwater cleaning, infiltration, and storage. At the same time, the areas add aesthetic appeal!

*Left and Right: These residential rain gardens are collecting stormwater from roof downspouts and lawns.*

*Above: This bioretention area at Klapp Elementary School is collecting runoff from the roof and parking areas.*

*Right: This bioretention area at Central Middle School is collecting runoff from adjacent impervious and pervious areas.*

*Left: This commercial bioretention area is collecting runoff from a parking lot of a local business. The area is designed with an overflow inlet for large rainfall events.*

# Dry Weather and Wet Weather Sampling

## Dry Weather Screening:

A monitoring program where samples are collected during dry weather (typically May and June) from outfalls that flow directly into creeks. The objective is to measure indicators of pollutants to compare with thresholds to target outfalls with potentially on-going illicit discharges for follow-up action.

A total of 15 outfalls are sampled each year for:

| Parameter | Threshold |
|---|---|
| pH | ≤ 4 or ≥9 STD |
| Total Chlorine | ≥ 1.0 mg/L |
| Detergents | ≥ 1.0 mg/L |
| Total Copper | ≥ 1.0 mg/L |
| Total Phenols | ≥ 0.5 mg/L |
| Turbidity | ≥ 250 NTU |
| Fecal Coliform | ≥ 400 cfu/100 mL |

When a parameter exceeds the above threshold follow up sampling occurs.

In 2011, Fifteen outfalls were sampled in the following Watersheds:

- Fish Creek
- Campbell Creek
- Eagle River

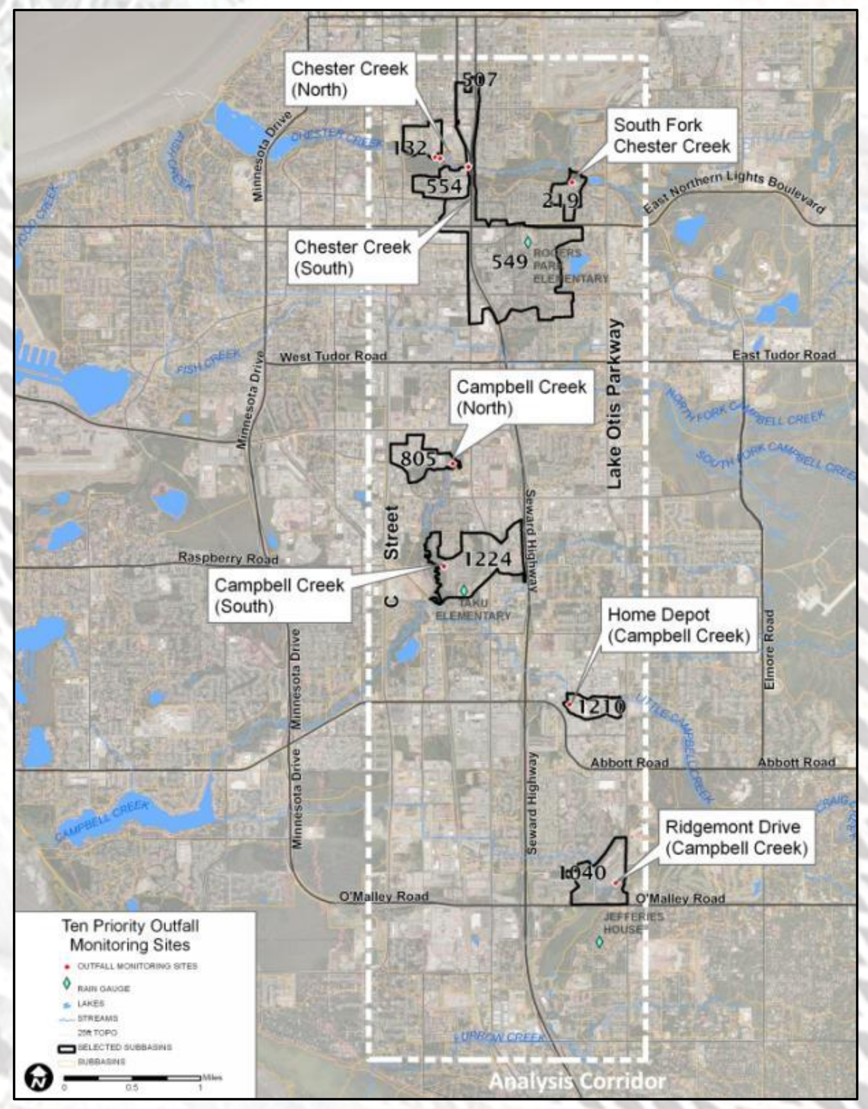
Results of sampling found one outfall on Campbell Creek clogged with sediments and exceeded the turbidity criteria. The outfall was cleaned and resampled and passed testing requirements.

In 2012 outfalls were sampled in the following watersheds:

- Ship Creek
- Chester Creek
- Furrow Creek

Sampling results showed an exceedance for fecal coliform at an outfall on Ship Creek.

- First Round Sampling Result: 76,400 colonies/100 mL
- Follow Up Testing Results: 754 colonies/100 mL
- Follow Up Testing at nearest up gradient manhole Result: 29 colonies/100 mL
    - During follow up sampling the outfall was submerged due to high tide. Sampling was performed after the tide receded.
    - It is likely that the source of fecal coliform is from high tide washing material into the outfall.




Wet Weather Sampling Locations

2011 Campbell Creek Outfall

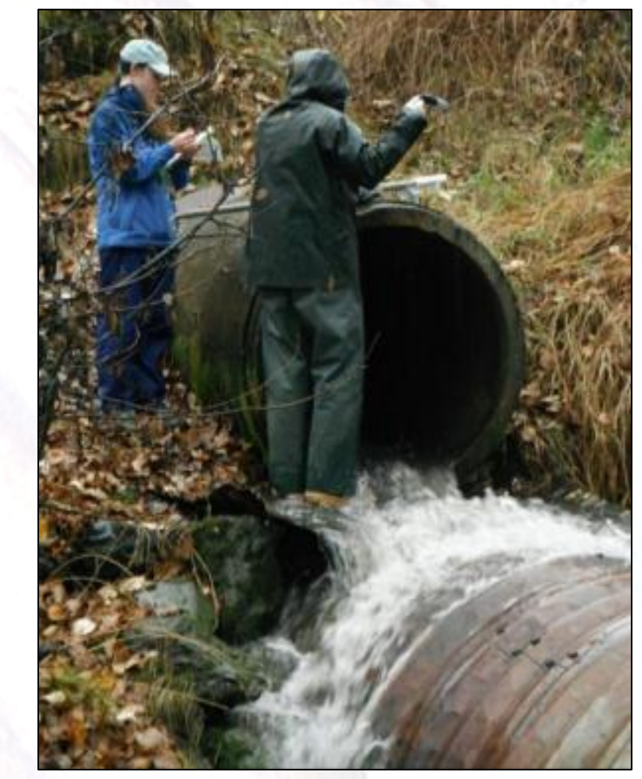
2012 Ship Creek Outfall

Dry Weather Team: Isaac Watkins, HDR Alaska; Alena Gerlek, HDR Alaska; Tom Gill, E.I.T., HDR Alaska; Dan Campbell, E.I.T., HDR Alaska; Zoe Meade, HDR Alaska, Cindy Milligan, HDR Alaska
Wet Weather Team: Mark Savoie, Kinnetics Laboratories; Gary Lawley, Kinnetics Laboratories, Cindy Milligan, HDR Alaska; Tom Gill, E.I.T, HDR Alaska

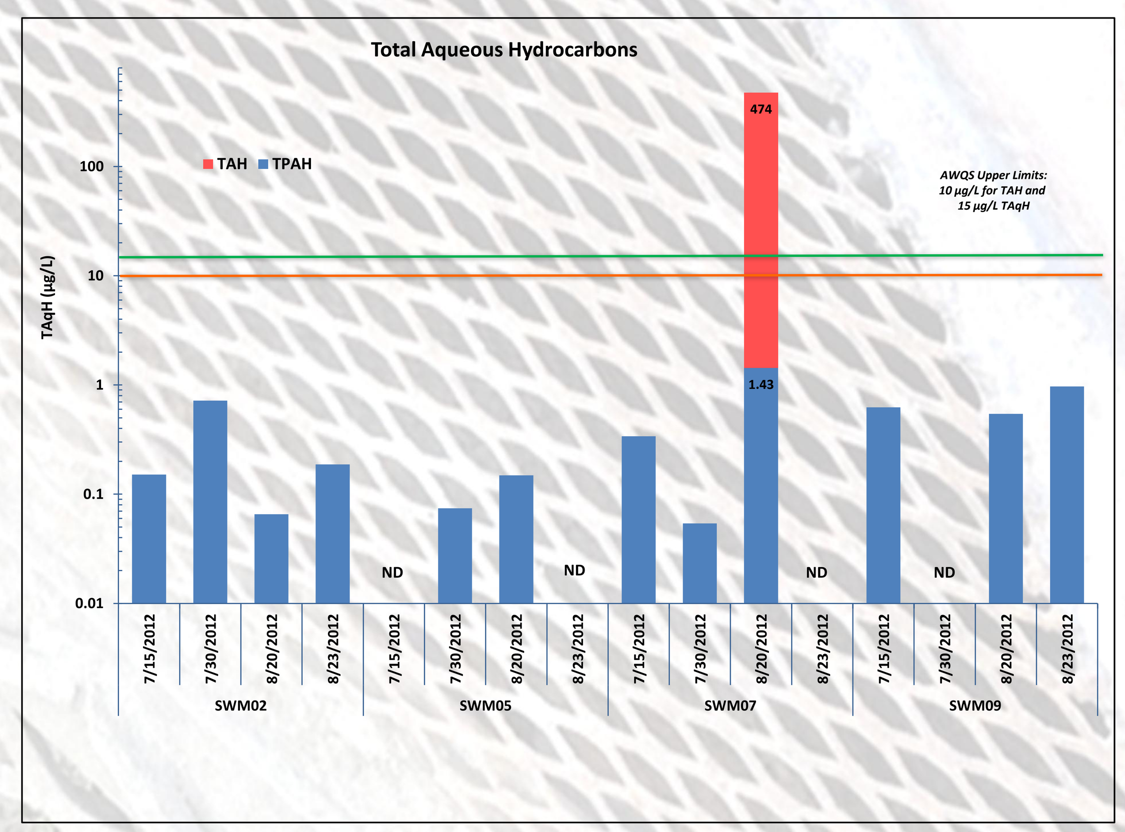
## Wet Weather Sampling:

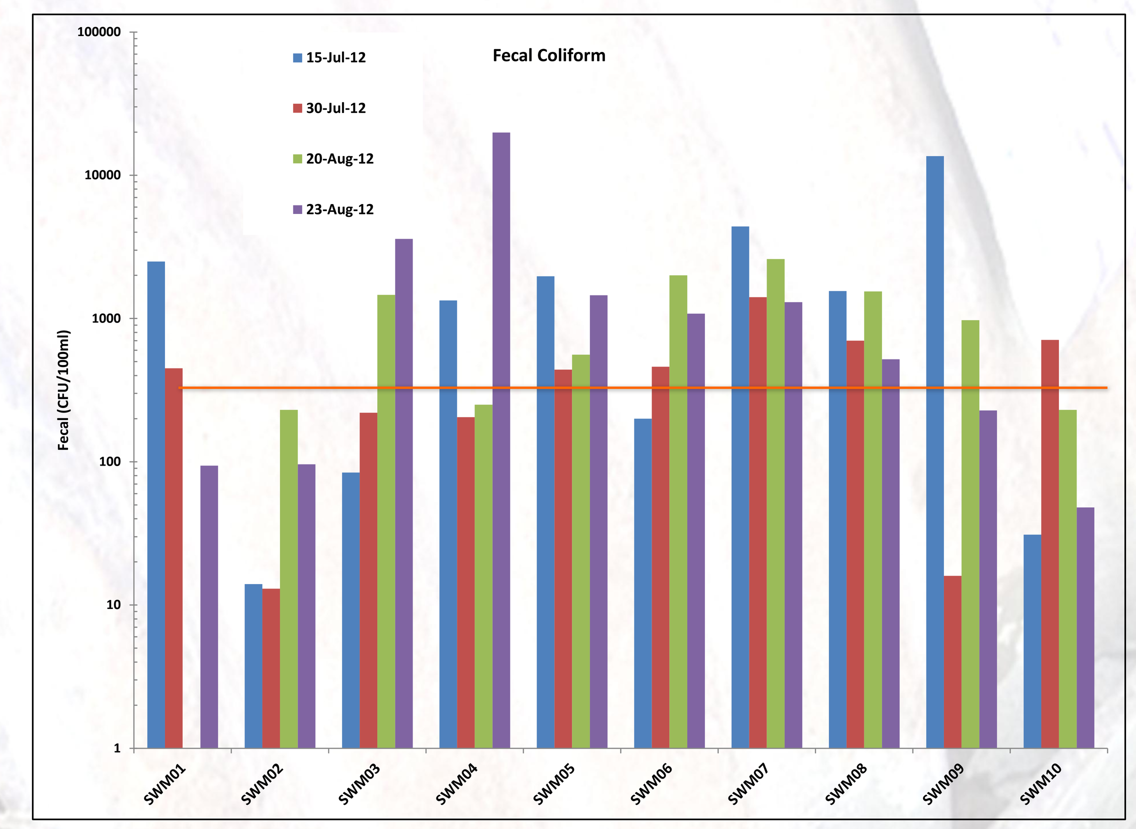
A monitoring program conducted during four storms (>0.1 inches) at ten outfalls to determine pollutant wash off from streets and parking lots into the MS4 . Parameters sampled are:

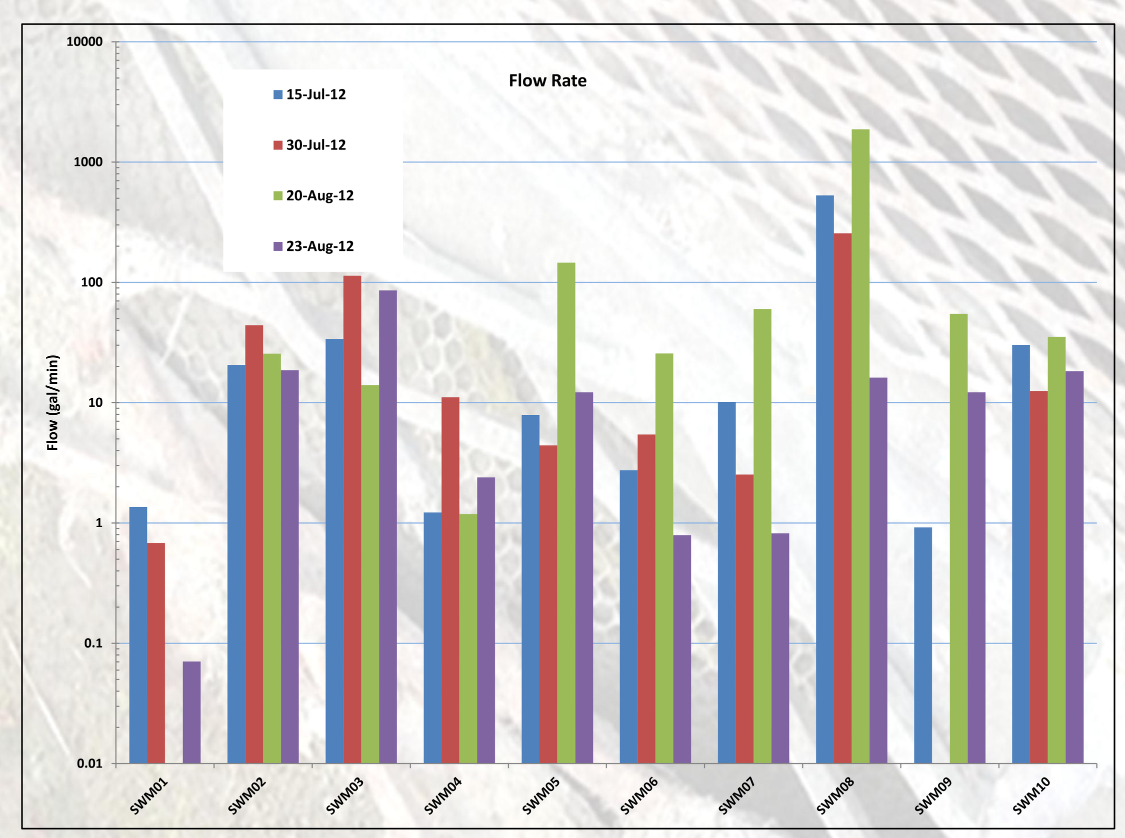
| Parameters | Frequency |
|---|---|
| Flow | 4 times/year |
| DO | 4 times/year |
| pH | 4 times/year |
| Turbidity | 4 times/year |
| Temperature | 4 times/year |
| $BOD_5$ | 4 times/year |
| Fecal Coliform | 4 times/year |
| TSS | 4 times/year |
| TAH | 4 times/year |
| TAqH | 4 times/year |

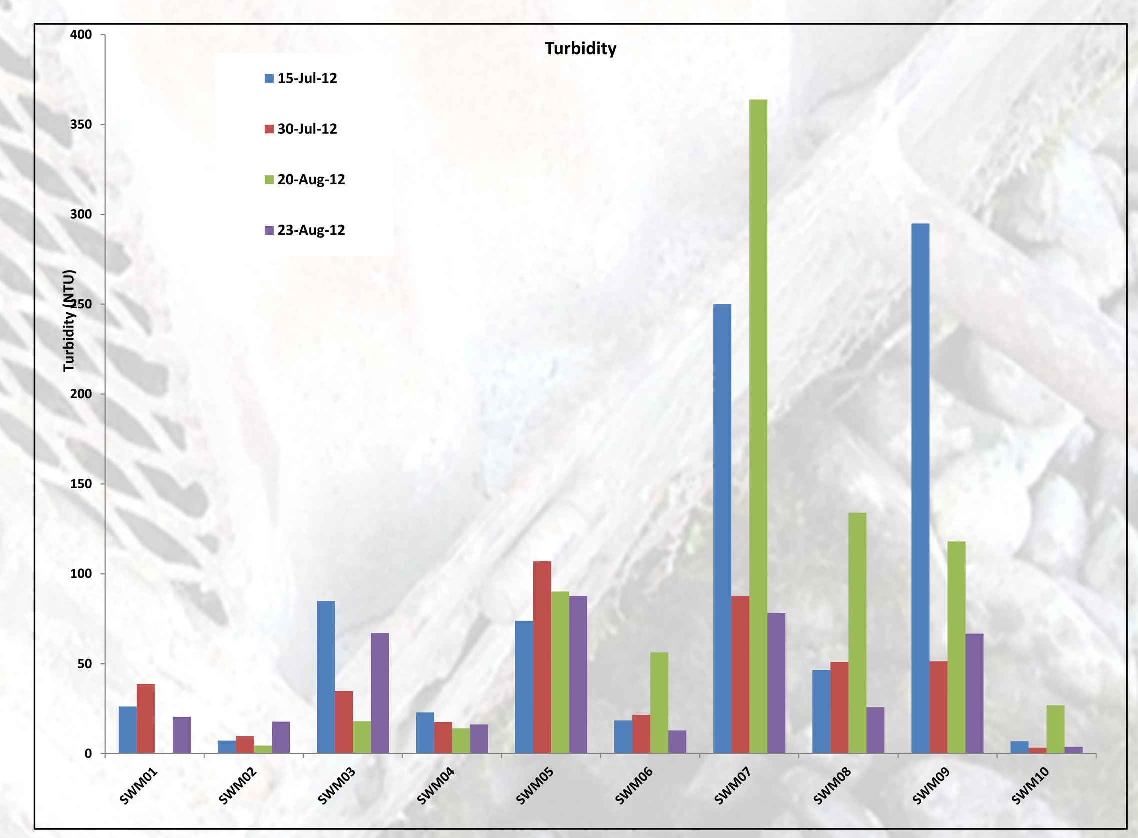


Some results from 2012 are as follows:




Sampling will continue in 2013 and 2014. In 2014, loading estimates, comparisons between basins, and other analysis will be completed using 4 years of data.

Findings from either 2011 or 2012 suggest there is no need for any special investigations. Except for high TSS/turbidity seen at one location in 2011, and one occurrence of high hydrocarbons in 2012, concentrations of target constituents in the grab samples and in the field measurements are within the range of expected values. Although fecal sampled data was higher than Alaska Water Quality Standards, the AWQS is used as a comparison only until there is enough data to determine trends and does not directly apply to storm water.

# Sedimentation Basin and OGS Efficiency Study

Scott R Wheaton, WMS; Bill Spencer, P.E., HDR Alaska; Cynthia Milligan, HDR Alaska; Jacques Annandale, EIT; HDR Alaska

**All storm water controls work in series along the length of the MS4. Street sediment load, street sweeping practices, and catch basin conditions control the performance of the system at the upstream end. OGS and Sedimentation Basins affect the downstream performance. All devices are part of a treatment train that must be considered as a whole in context with Anchorage's meteorological environment.**

## 1. Storm Runoff:

Rainfall runoff occurs in Anchorage typically from May to October. Storm events increase in occurrence and intensity towards the fall.

Snowmelt runoff occurs in a single a seasonal event three to six weeks in length. Snowmelt runoff is generally diurnal early in the season and becomes continuous towards the end of the event.

The following are statistics from historic and 2012 rainfall data:

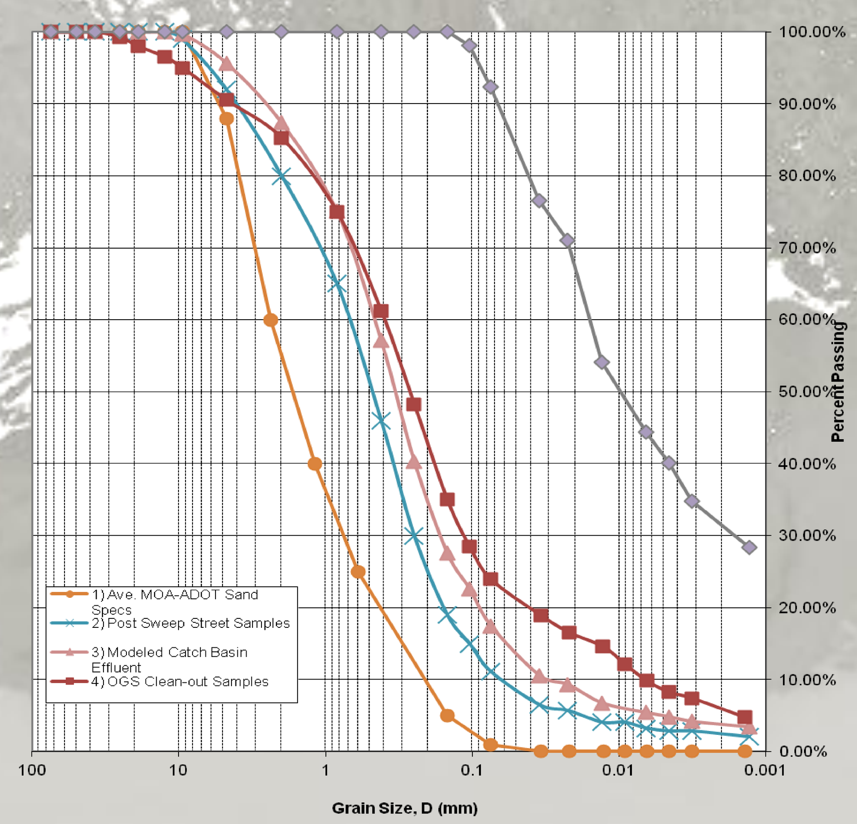
| | Historic (1963-2010) Rainfall Statistics | 2012 Rainfall Statistics |
|---|---|---|
| Mean Storm Volume inches | 0.24 | 0.34 |
| Mean Storm Intensity inches/hour | 0.026 | 0.028 |
| Mean Storm Duration hours | 13.17 | 24.48 |
| Separation time (dry hours between storms) | 79 | 88 |
| 90 percent intensity inches/hour | 0.12 | 0.08 |
| Annual number of storms volume >.02 inches | 40 | 29 |

## 2. Street Sediment Loading and Washoff:

Data suggests that a larger sediment load washes off Anchorage Streets during the summer rainfall season than during the snowmelt season. Although street sediment loads are greater during spring snow melt, the higher flow rates and sediment availability found during summer storms lead to greater wash off during the summer.

Modeling of street washoff suggest that most of the street sediments left after spring street sweeping are washed into the storm system during summer storms.

The graph to the right shows a series of particle size distributions (PSD) that follows the change in character of the sediment load as it moves through the system and components are captured by various devices.




## 3. Catch basins:

As the first treatment device in the treatment train, properly designed and maintained inlet catch basins can be very effective at treating headwater-mobilized particulates (40% reduction in the total storm water particulate load). This study's observations show that performance of these devices is directly related to their design geometry and maintenance practices. To perform optimally catch basins must have:

- Minimum spacing between catch basins at off-line locations
- Sump geometries designed to allow sediment settling and storage
- Schedule maintenance to remove accumulated sediments

## 4. $OGS_h$ 2012 Performance:

Oil and grit separators are installed into the treatment train to capture sediments, oil, and floatables in the MS4.

This study analyzed and evaluated Anchorage hydrodynamic oil/grit separators ($OGS_h$) through field sampling of in-place devices and full-scale benchtop testing.

Accumulated sediment from four OGS were sampled for the following :

- Volumetric measurements
- Particle Size Distribution
- Total Organic Content
- Information on accumulation interval

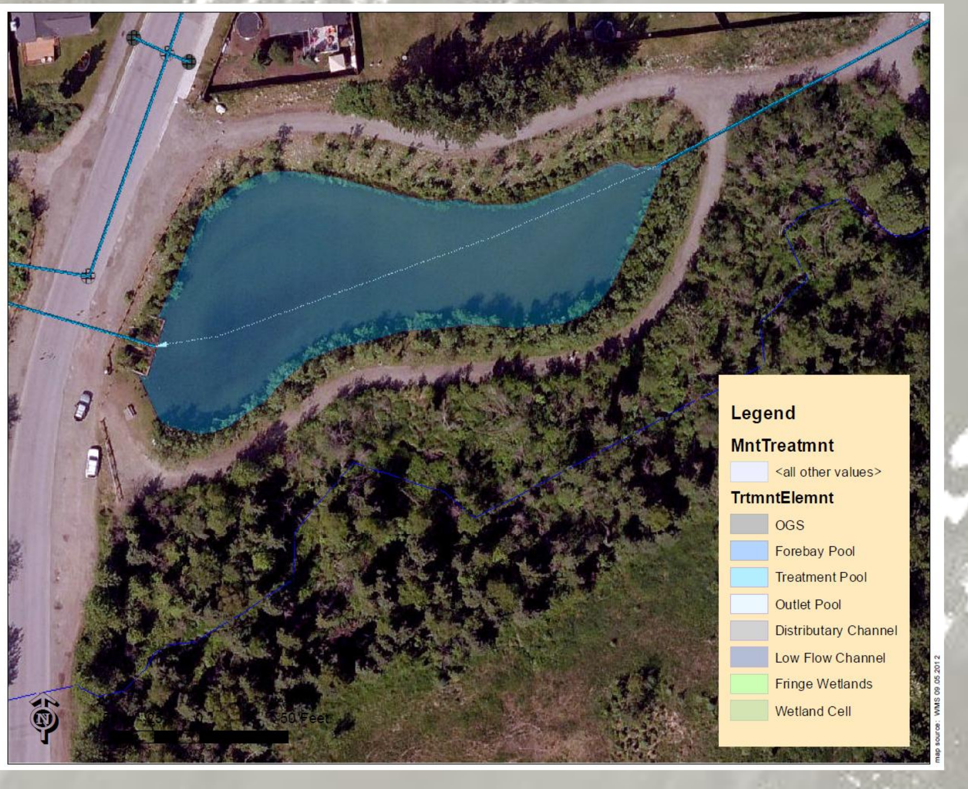
| OGS Basin | Basin Area (sq. ft) | Total Curb miles in basin | Basin Type | OGS Unit Model | Time since last cleaning (years) | Estimated weight of sediments (lb) | Percent passing #200 sieve (75 micron) | Organic Content of sediments |
|---|---|---|---|---|---|---|---|---|
| Old Seward and 74th Ave | 770,000 | .82 | Arterial | STC 3600 | 0.70 | 1656 lb | 10% | 3.9% |
| Juneau Street N. End | 4,568,000 | 7.17 | Residential | STC 13000 | 1 | 9034 lb | 33% | 20.7% |
| Tudor Rd West of Lake Otis | 400,000 | .57 | 6 lane arterial with divider | STC900 | 1.85 | 1016 lb | 17.2 | 4.4% |
| Mears Middle School | 447,600 | 1.07 | School Parking area | Vault | 0.85 | 602 lb | 34.9 | 9% |

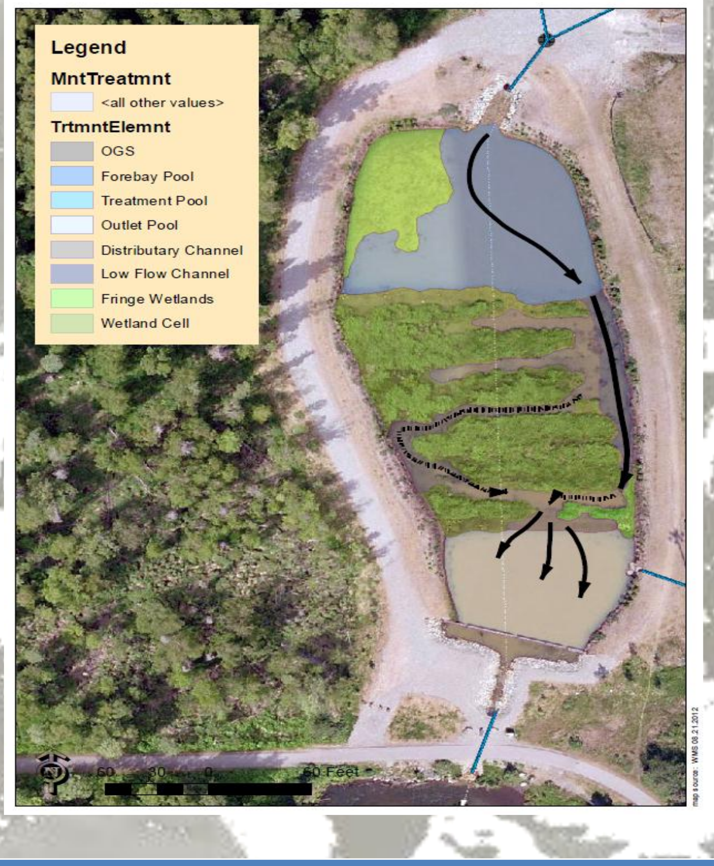
## Benchtop $OGS_h$ Test:

This study tested a full-scale hydrodynamic OGS using Anchorage street sediment.

Results from the benchtop test suggested very high removal rates for the OGS under Anchorage conditions of flow and street sediment character. Removal of >40% of 20 microns particles is attainable at flow rates equal to 90% of Anchorage storm runoff.

| Particle Size | | |
|---|---|---|
| Inch/Sieve size | Microns | OGS Removal Efficiency |
| #100+ | 149+ | 100.00% |
| #140 | 105 | 95.50% |
| #200 | 75 | 86.60% |
| | 35.2 | 72.70% |
| | 22.4 | 48.46% |
| | 13.1 | 21.67% |
| | 6.6 | 12.31% |
| | 4.6 | 9.80% |
| | 3.2 | 5.29% |
| | 1.3 | 2.29% |


## 5. Sedimentation Basin 2012 Performance:

Sedimentation basins are installed in the treatment train as a way to capture finer sediment. This study evaluated the sedimentation basins with a modeling effort and to capture real data for comparison.

Sedimentation basin performance was modeled on a sum-of-loads approach and then related to a range of design factors through storm-by-storm analysis of basin hydraulic efficiencies.

Weirs and continuous gages were installed at the inlet and outlet of three sedimentation basins: C Street, Minnesota Street, and Meadow Street. Measurements were taken every 15 minutes for flow, electrical conductivity, and turbidity. During storm events grab samples were collected for TSS, Fecal Coliform, and BOD. The parameters of pH and DO were collected onsite with a YSI 556 multiprobe or equivalent probe. Petroleum organics were collected using passive collection devices.

Data collected during 2012 was then taken and placed into removal model formulas to determine removal efficiencies and compared to the sum-of-loads model. The following are the results:

| 2012 SEDIMENTATION BASIN LOADING | C StreetBasin | | | Minnesota Basin | | | Meadow Street Basin | | |
|---|---|---|---|---|---|---|---|---|---|
| | C st In | C st Out | % capture | Minn In | Minn Out | % capture | Meadw In | Meadw Out | % capture |
| Spring | 5.3 | 2.9 | 45 | 8.6 | 5.7 | 68% | 1.4 | 1.2 | 16% |
| Summer/Fall | 13.5 | 4.6 | 66% | 6.8 | 3.8 | 45% | 2.9 | 2.3 | 20% |

| Sedimentation Basin Model Performance | Units | C Street Basin | Minnesota | Meadows |
|---|---|---|---|---|
| 2012 Calculated Removal Efficiency | % | 71.29% | 53.48% | 28.92% |
| 2012 Sum of Loads Measured Removal | % | 66% | 45% | 20% |

## Conclusions and Recommendations:

Recommendations for planning and design strategies of MS4 treatment devices are::

- Plan and design all water quality controls within a treatment train context.
- Design for and assess performance using seasonal sum-of-loads methods.
- Apply water quality design storms appropriate to Anchorage
- Apply 90th percentile rainfall intensity and waste storage criteria to OGS design.
- Identify and implement practicable maintenance SOPs to support designs.


Help clean our water
rain gardens
ANCHORAGE
Low Impact Development
Water and Development
Hydrographs!
A hydrograph shows flow in a stream, on the vertical axis, with respect to time, on the horizontal.
Think...
Water Cycle Changes
Watershed BEFORE Development
Watershed AFTER Development
Contaminents in Urban Runoff
What is a Rain Garden?
A Rain Garden is a facility to clean, retain, and utilize storm water runoff. When it rains water runs off hard surfaces and soaks into the rain garden.
You can recognize a rain garden by its flat or dish shaped surface, native plant coverage, and storm water runoff sources nearby.
Rain gardens are filled with hardy native plants, sandy soil for good drainage and are sized to fit the amount of runoff that will drain to them.
Think!
Pervious Pavement
Runoff
Berm Down Slope
What is Pervious Pavement?
Pervious Pavement is a hard drivable surface that allows rain to flow vertically into the ground where it falls.
-Prevents runoff, provides water treatment, and promotes ground water recharge through infiltration.
-Counteracts typical impacts from pavement.
How You Can Help
Grant Money
Do you live in the Municipality of Anchorage? You could qualify for a Rain Garden Grant!
Reimbursement for 50% of your cost up to $750
One-on-one consultation for every garden
Trained Landscapers and Nurseries
Rain Gardens in Anchorage
Getting Started
Add your name to the list!
Take a grant application!

Public Works Department
Hydrography Features
Mapping Logic
APDES MAPPING
www.anchoragestormwater.com/maps.html
Data Downloads
GIS DATA
• Hydrography Geodatabase (HGDB)
• Shapefiles
• Metadata
PUBLISHED MAPS
• Wetland Atlas
• Drainage Atlas
• FEMA Maps
Interactive Web Mapper
• Streams
• Subbasins and Outfalls
• Wetlands
• MS4 Streets
• Snow Disposal Sites
• ...and More!
DOT Drainageway Network Mapping
A Joint Digitization Effort by DOT and MOA
Before:
After:

# Support Slides for Q&A Session

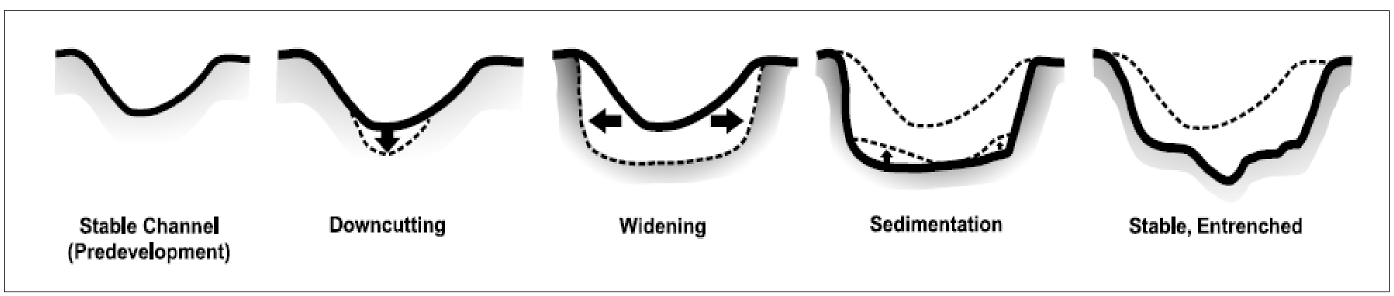
## *Low Impact Development*

- LID is an Ecosystem approach.
- Development should be *part* of a functioning ecosystem, not exist separately from it.

## *Why is LID needed?*

Source: Georgia Stormwater Manual

- Development results in:
  - Decreased infiltration
  - Loss of Groundwater Recharge
  - Faster runoff
  - Increased peak flow rates in receiving waters
  - Increased sedimentation and erosion




Source: Georgia Stormwater Manual

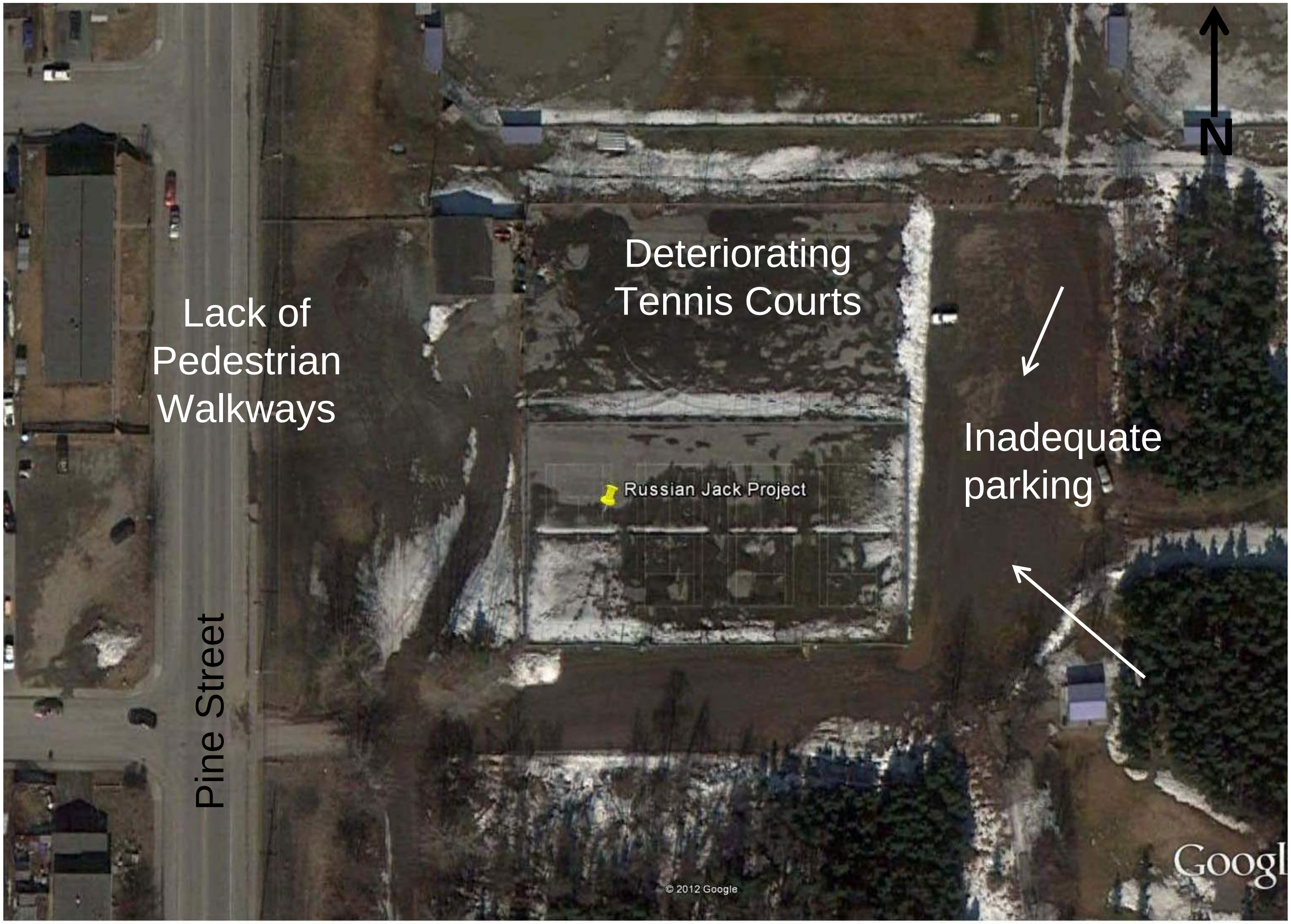
# *Why is LID needed?*


*Source: Low Impact Development – A Design Manual for Urban Areas*

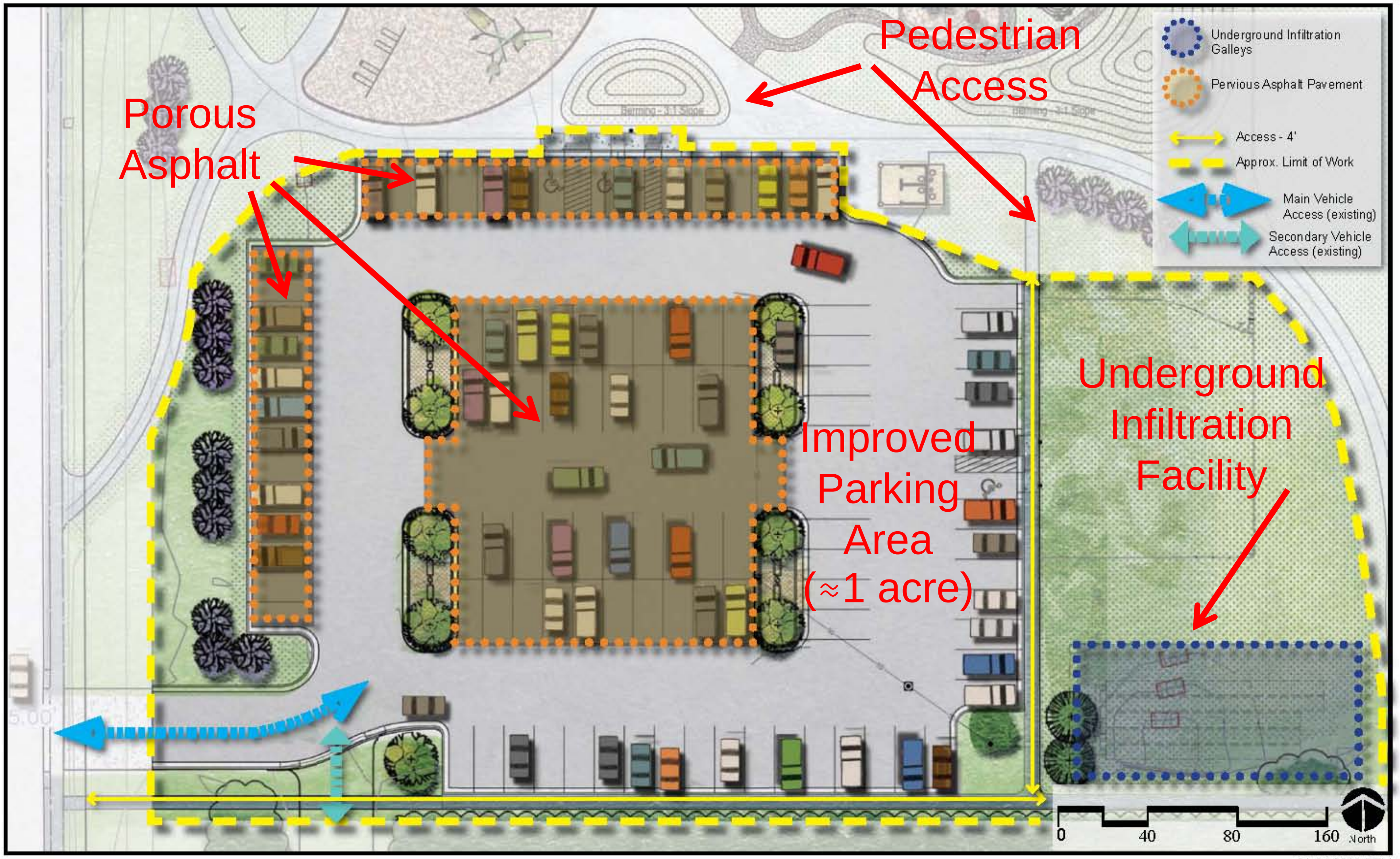
## *How does this impact Anchorage?*

- Anchorage's MS4 permit requires:
  - – Onsite capture of small storm events
    - Runoff from 0.52 inches (or less) of rainfall preceded by 24-hours of no precipitation
  - – Construction of LID "Pilot Projects"

# *Existing Russian Jack Park (Photo Via Google Earth)*



# *Proposed Parking Lot Improvements (Photo Courtesy of Corvus Design)*




*north Russian Jack Springs Park - Parking Lot & Low Impact Development Strategies*

01-24-2012 REV

## *Proposed LID Features*

- Porous Asphalt
  - – Designed to store and infiltrate up to the 10-year, 24-hour event (1.77 inches).
  - – Additional flow will surface flow to inlets
- Subsurface infiltration system
  - – Designed to store and infiltrate excess runoff from the porous and impervious pavement.

# *Porous Asphalt Pavement*

- What is porous asphalt pavement?

*Source: NAPA IS-131*

# *Porous Asphalt Pavement*

- What is porous asphalt pavement?

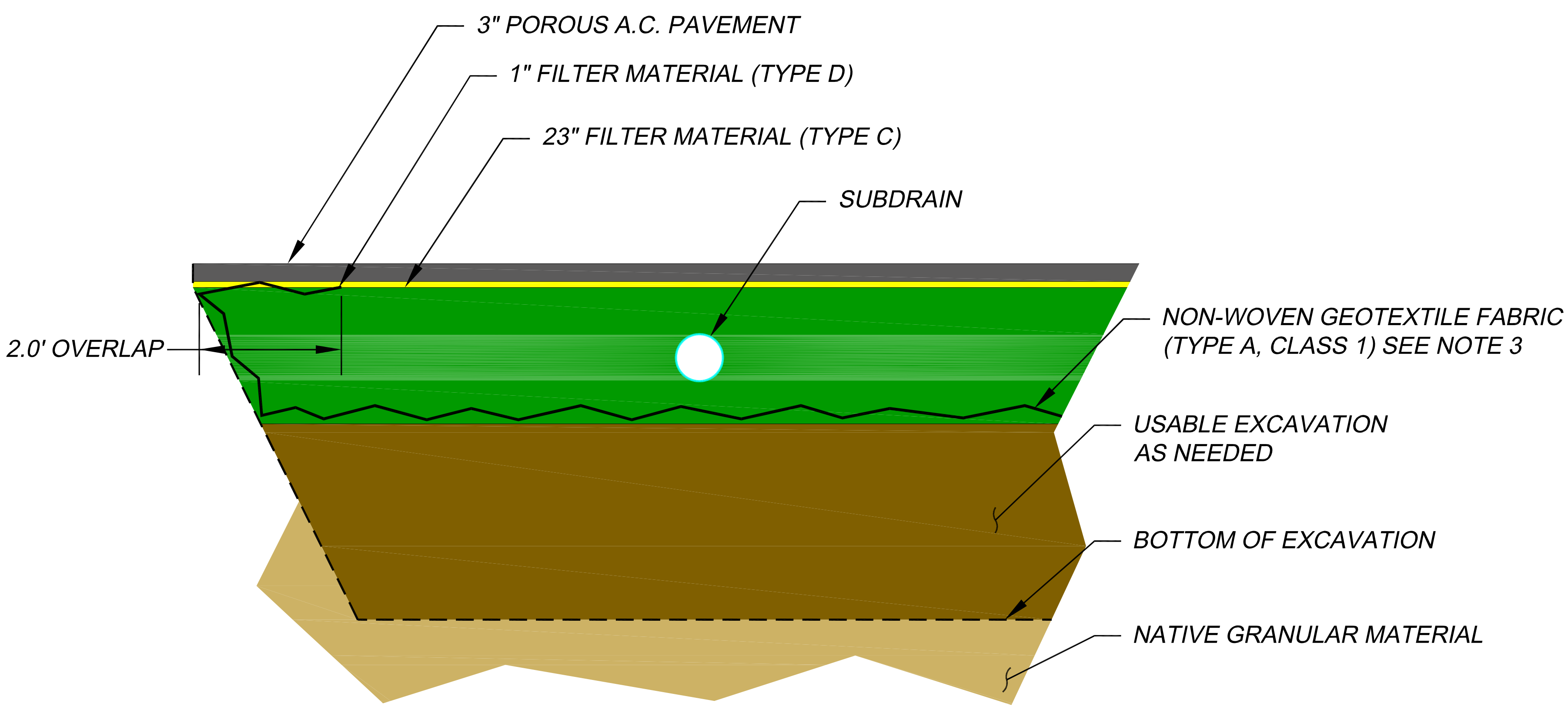
| Sieve Size | Porous Mix* | MOA Class E |
|---|---|---|
| | Percent Passing | |
| 3/4 - inch | 99-100 | 100 |
| 1/2 - inch | 85-100 | 78-96 |
| 3/8 - inch | 55-75 | 66-86 |
| #4 | 10-25 | 46-66 |
| #8 | 5-10 | 34-52 |
| #200 | 2-4 | 3-9 |

*UNH Stormwater Center Design Specifications

**Section 40.06 of MASS

# *Porous Asphalt Pavement*

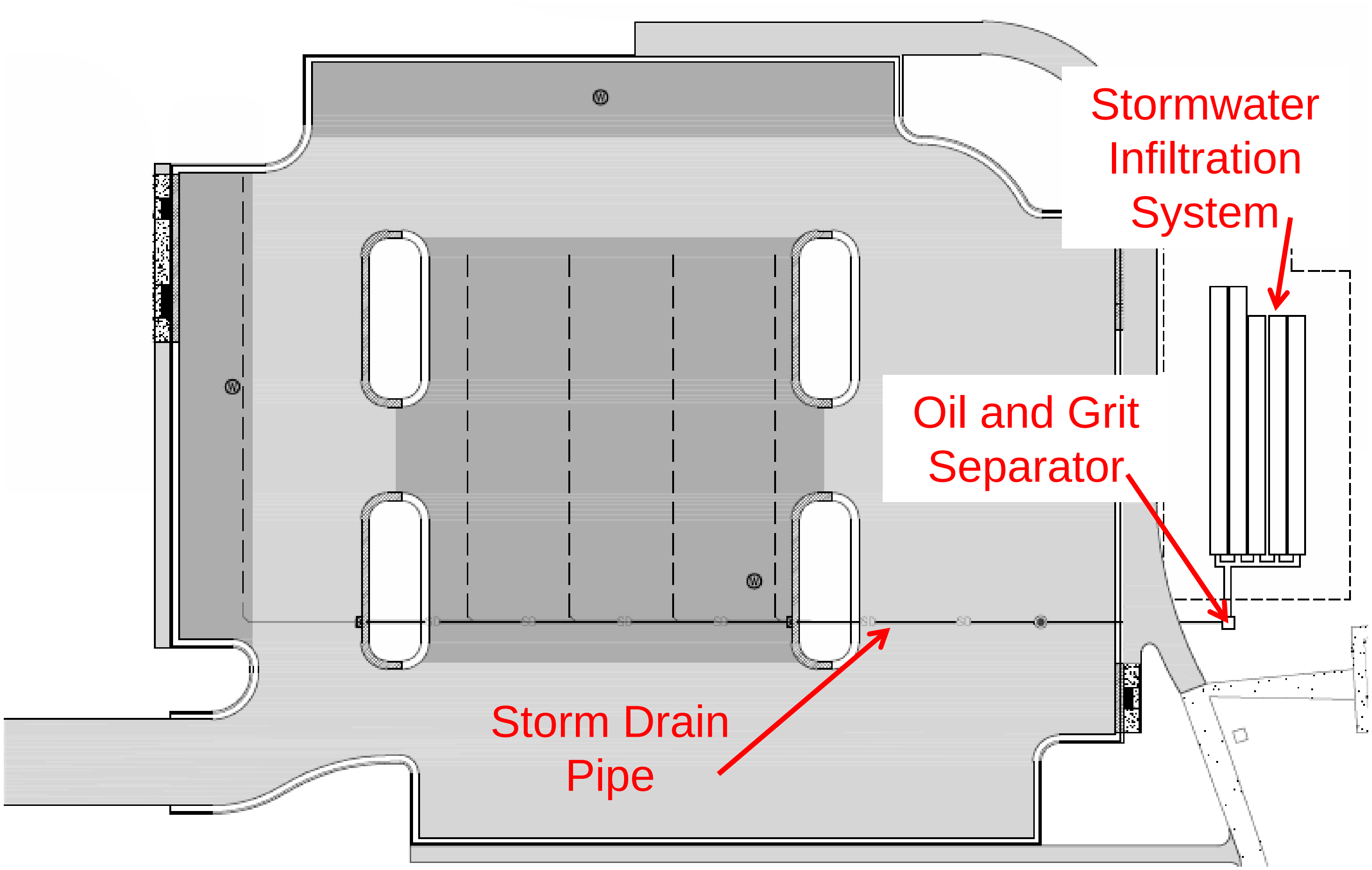
- Russian Jack LID Pilot Project Design



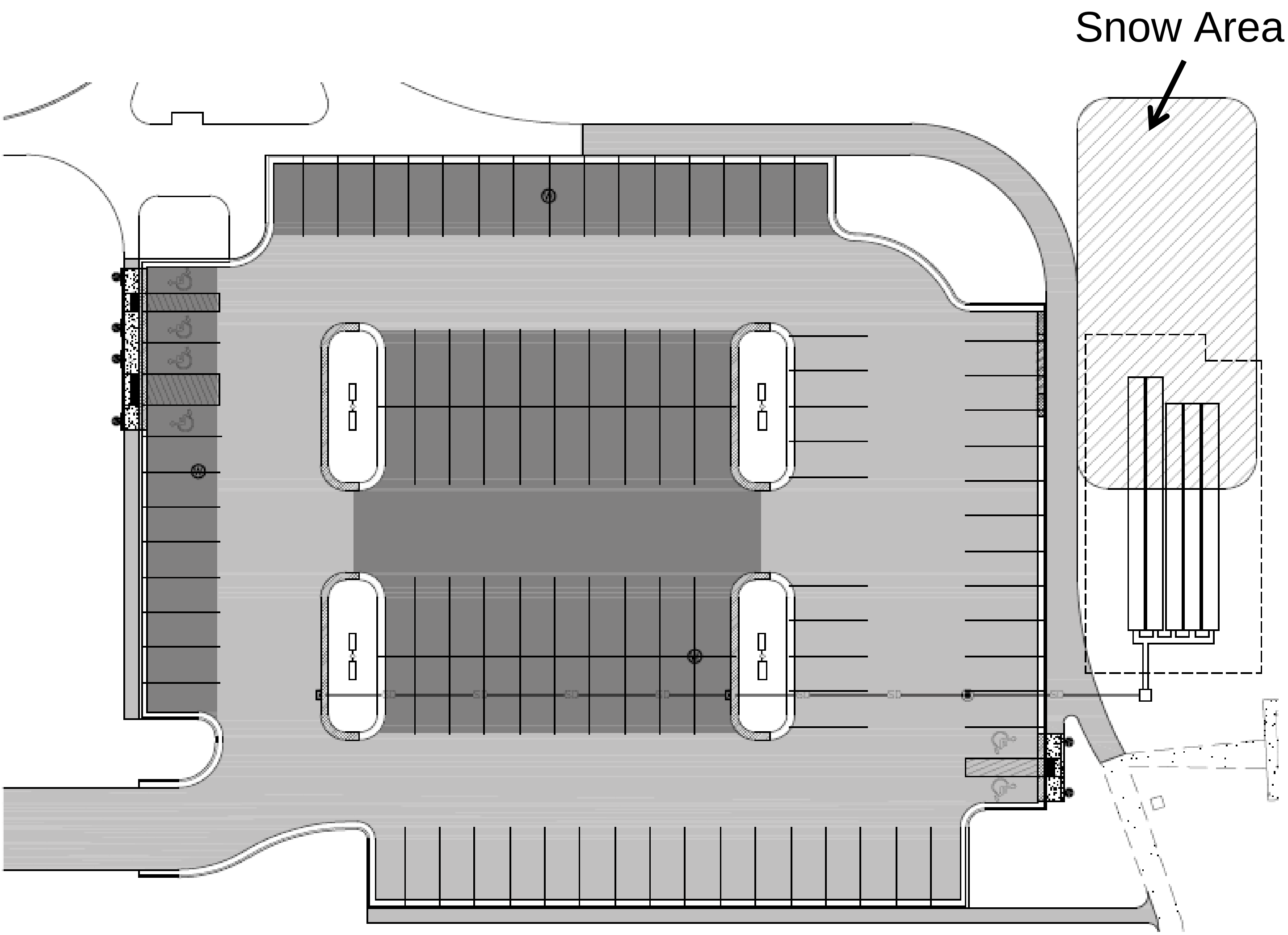
*Stormwater Infiltration System*

- Contech ChamberMaxx System

# *Stormwater Infiltration System*



# *Selection of LID Features*



## *Need for Other LID Project*

- The MOA would like to make YOUR project an LID Pilot project.
  - Any project disturbing more than 10,000 square feet of land is a candidate.
  - MOA Funding is available for design and construction support.
  - Designers would ensure redundancy in case of system failure.

# *Types of LID Infrastructure*

- Bioretention
  - Swales
  - Trenches
  - Rain Gardens
- Infiltration
  - Trenches
  - Soak-away pits
  - Ponds
- Retention
  - Ponds
  - Reservoirs
- Lots more!

*Anchorage Taku Lake Rain Garden*

## *Got a Possible LID Project?*

Please contact:

Kristi Bischofberger, MOA WMS

Email: *BischofbergerKL@ci.anchorage.ak.us*

Phone: 343-8058

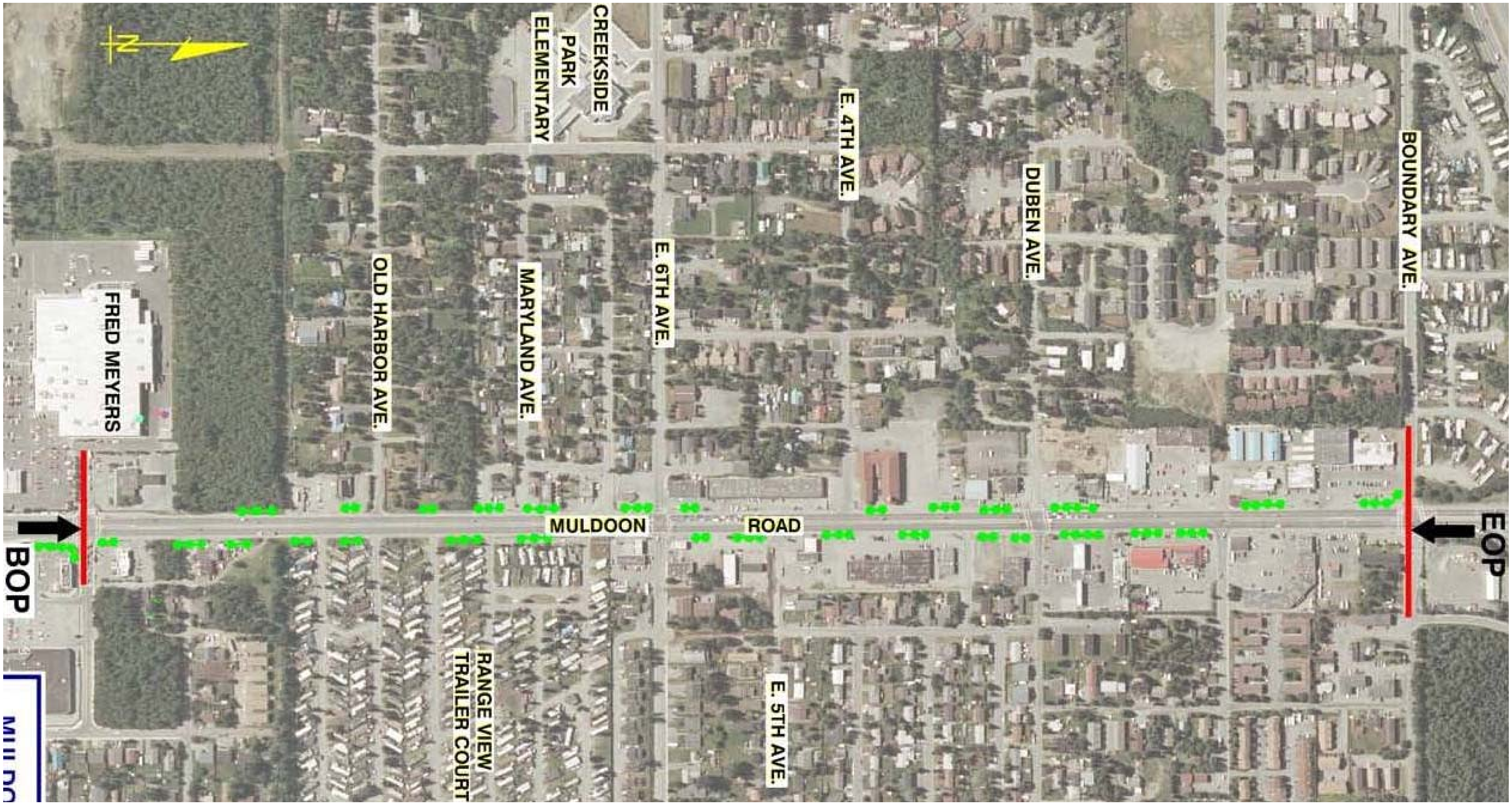
OR

Janie Dusel, HDL

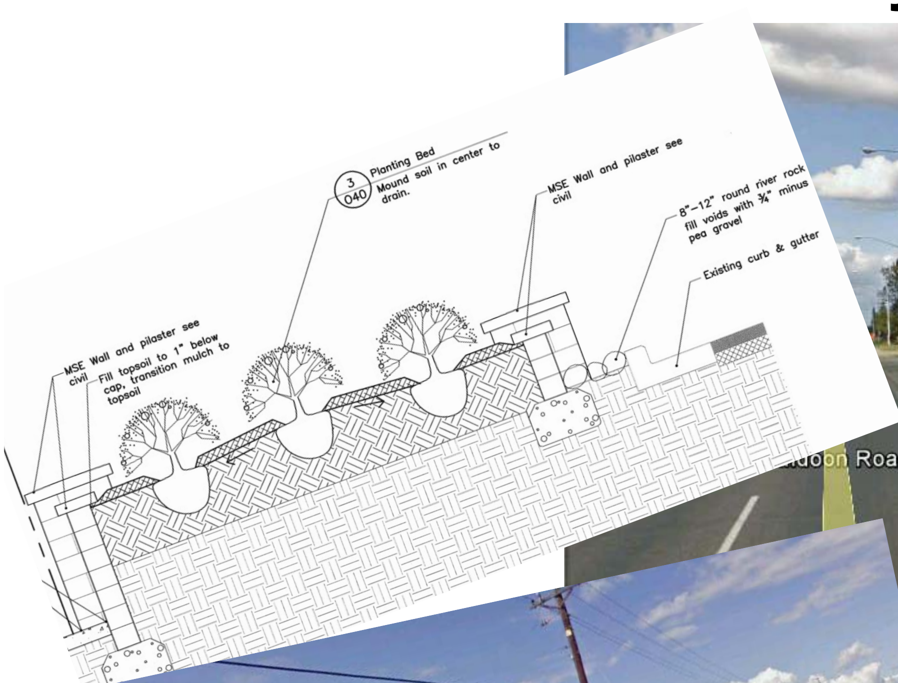
Email: *jdusel@hdlalaska.com*

Phone: 564-2120

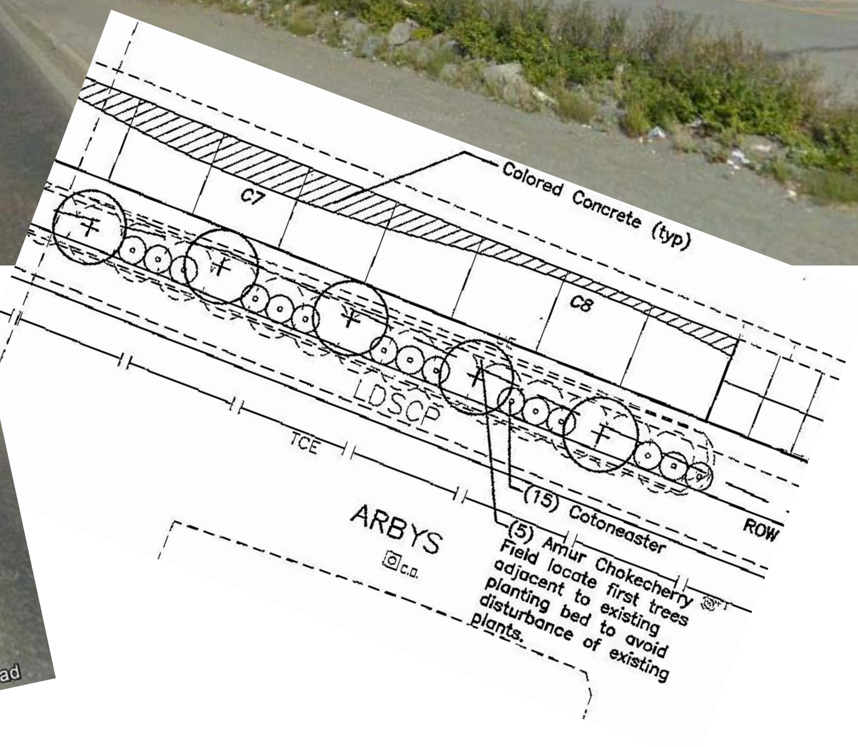
# Muldoon Road Project Area



# Muldoon Road Typical LID Elements







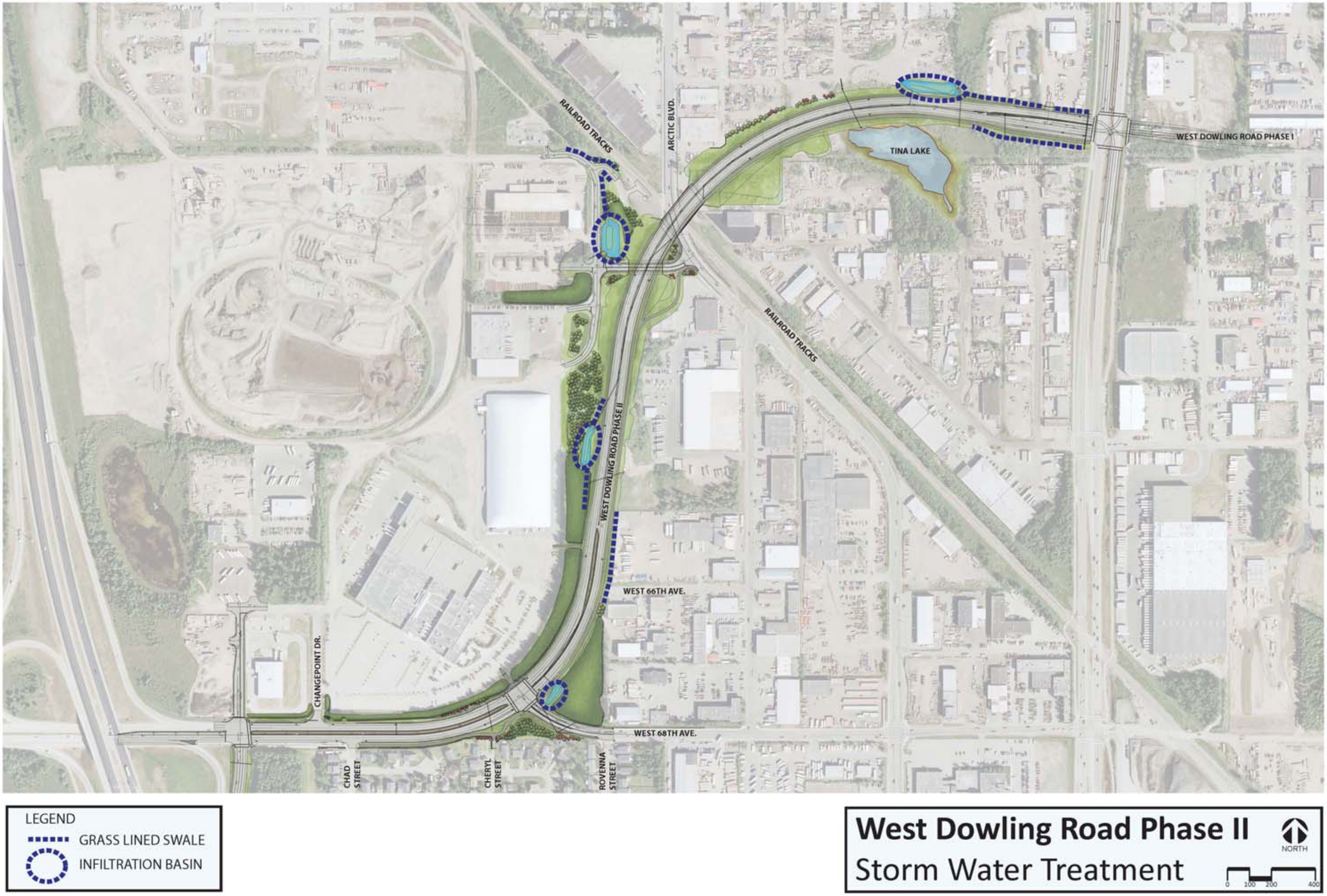
# West Dowling Road Phase I

Detention Swale with check dams

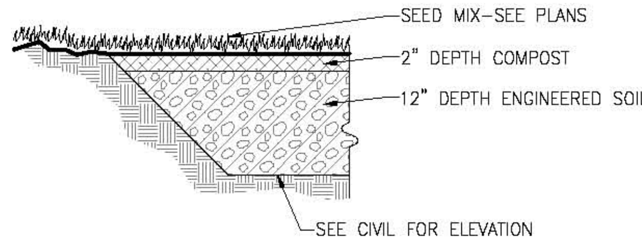
Rain Garden


Detention Pond

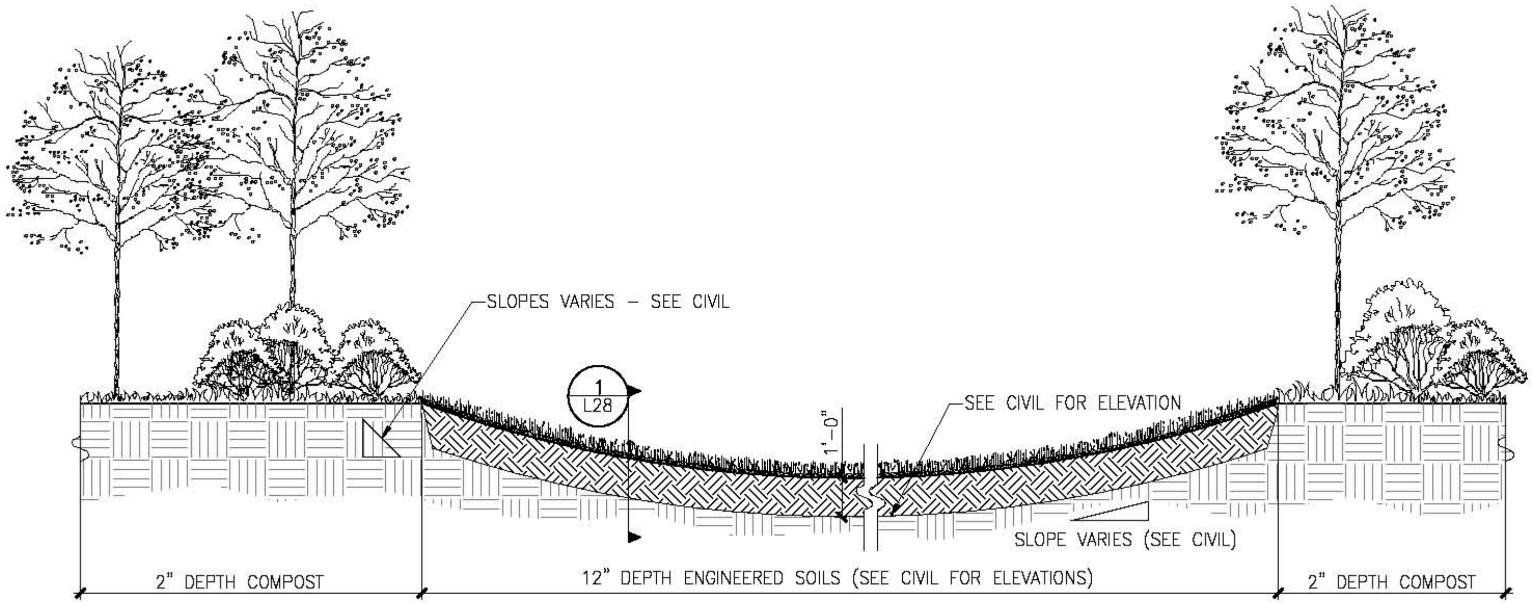
# West Dowling Road Phase II



# West Dowling Phase II Infiltration Basin Detail

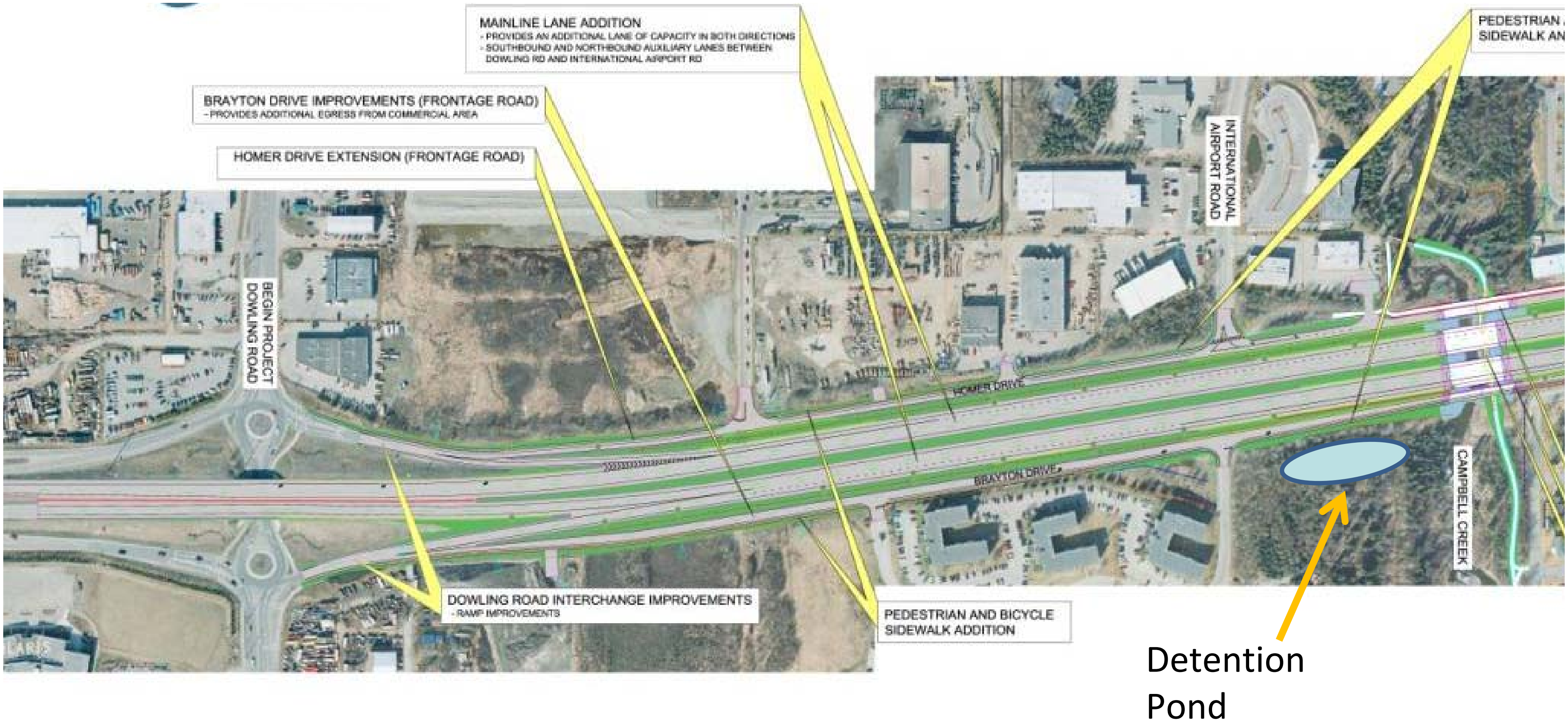



1 L28 INFILTRATION BASIN SECTION
SCALE: 1"=1'-0" dt-rain-grdn-sect.dwg

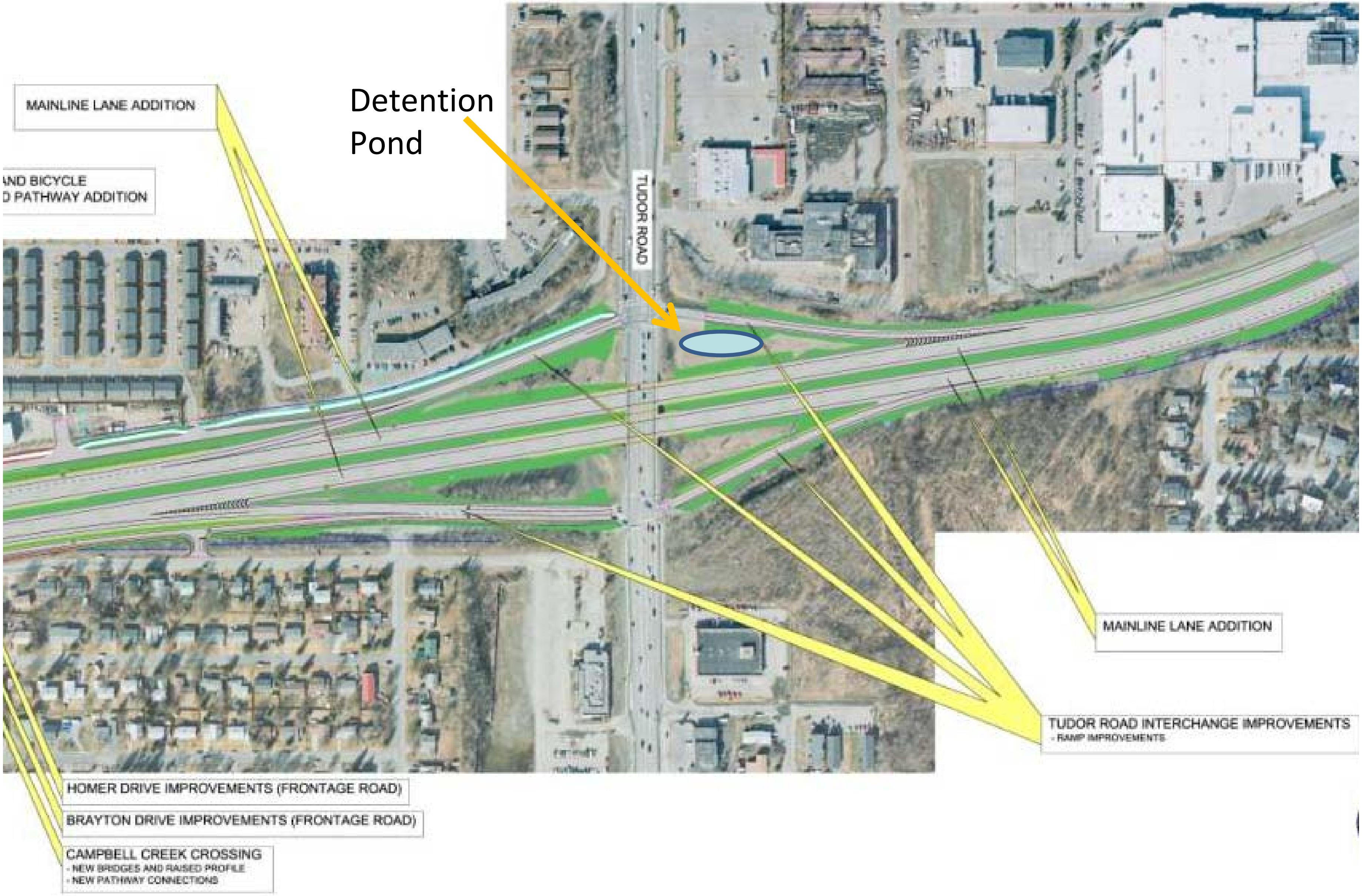



2 L28 INFILTRATION BASIN
SCALE: 3/8"=1'-0" dt-stel-tree-stencil.dwg

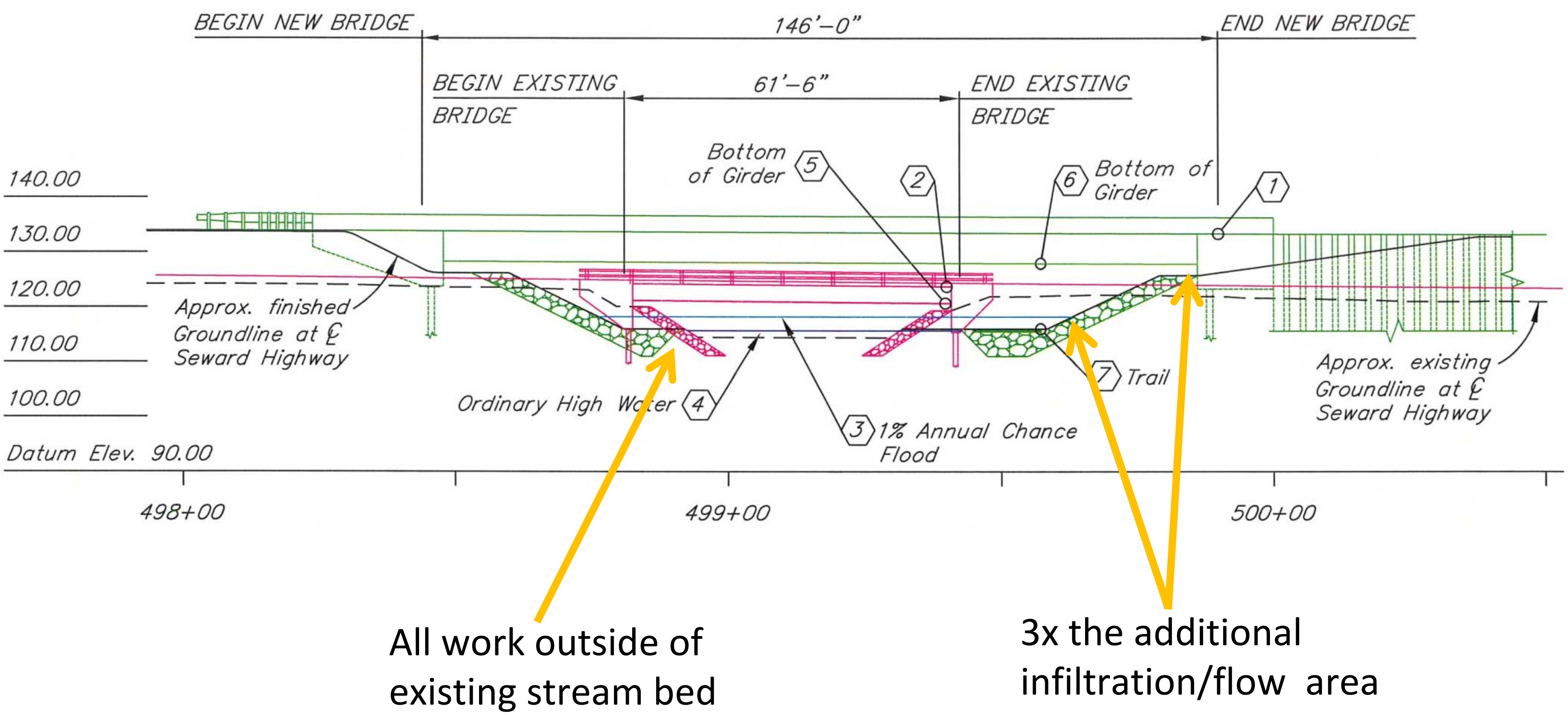
# Seward Highway – Tudor to Dowling



# Seward Highway – Tudor to Dowling

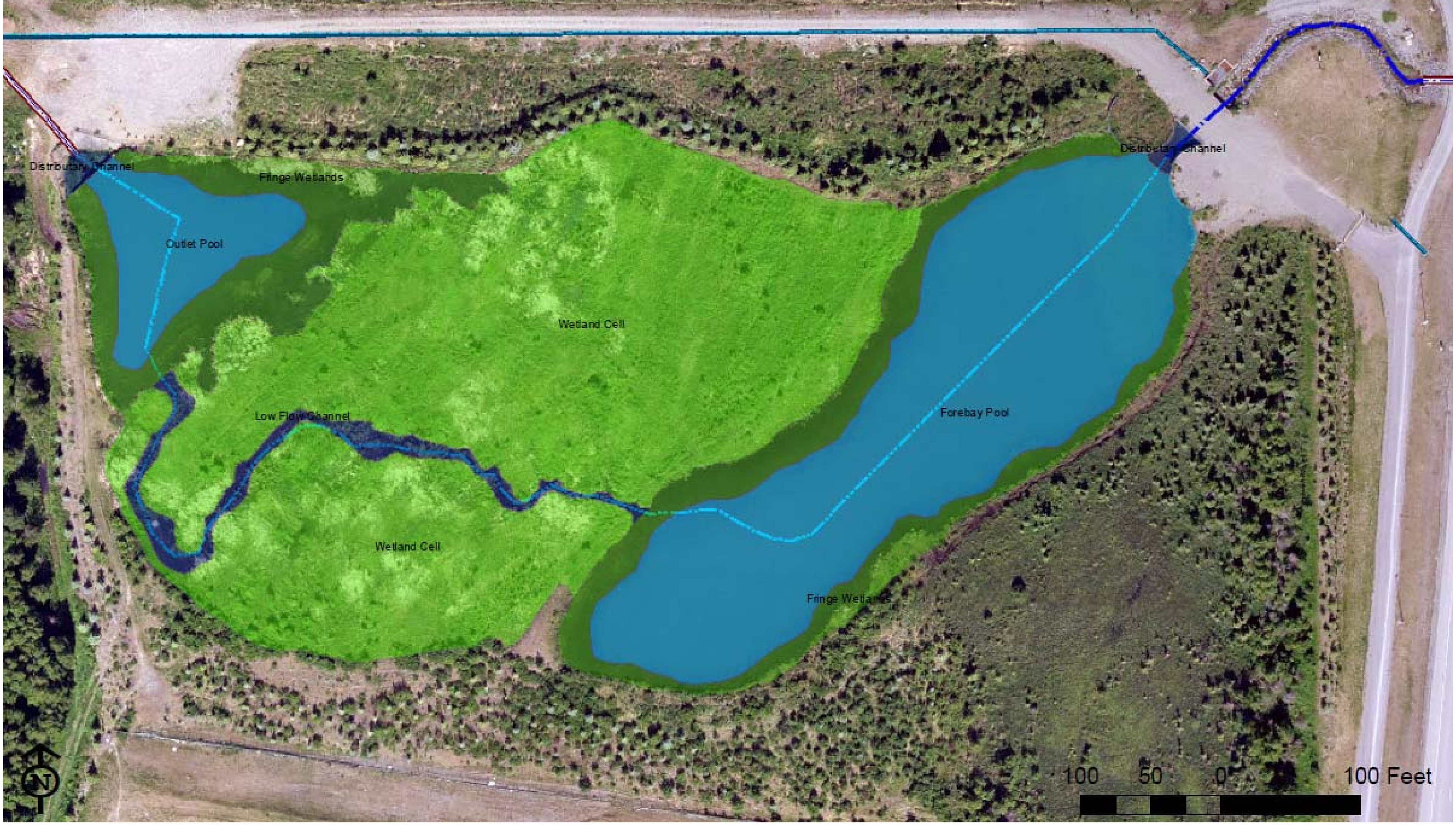


# Seward Highway – New Bridges



# Sedimentation Basin and OGS Effectiveness Evaluation

**Monitoring: Structural Controls Assessments**
**APDES Permit Requirement IV.A.8.**



# Handouts from Afternoon LID Training Session

# Low Impact Development – Making it Work in Anchorage

February 25, 2013

MOA Watershed Management Services

## What is Low Impact Development?

- LID is an innovative stormwater management that mimics nature: manage rainfall at the source using small, on-site, controls.
- Infiltrate, filter, store, evaporate, and detain runoff close to its source.
- Stormwater management should not be seen as stormwater disposal.
- Slow it down, spread it out, clean it up.

## LID Techniques

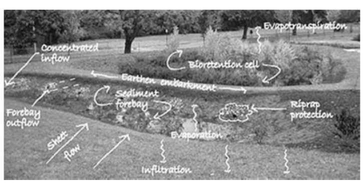
- MANY different types of techniques
- MANY *combinations* of techniques
- Focus on three concepts and making them work in Anchorage
  - **Bioretention**
  - Infiltration
  - Porous Pavements (Also infiltration)

**Considerations for LID in Anchorage**

- What are some limitations or constraints that we might face when implementing LID in Anchorage?
  - High Groundwater
  - Poorly infiltrating soils
  - Limited space
  - Bedrock or other limiting strata
  - Sanding and plowing
  - Frozen Ground/Winter Rainfall events

# Bioretention

- Bioretention: A shallow stormwater basin or landscaped area that utilizes engineered soils and vegetation to capture and treat runoff. Examples include rain gardens and bioretention swales.
- Cleans, Infiltrates, Detains




## Bioretention Examples

- High Point, Seattle
  - Photo during 25-year storm
  - Accepts water from road and sidewalks

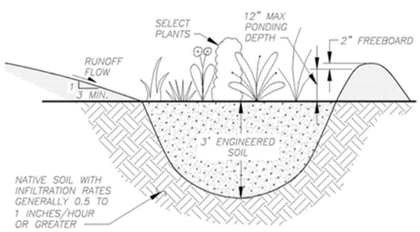
- Prince George's Co. Maryland
  - Adelphi Road
  - Used Bioretention instead of C&G
  - Accepts water from road surface

**Bioretention - Can we do it in Anchorage?**

- Yes!
- Taku Rain Garden – collects runoff from adjacent parking lot
- Lithia Chrysler Dodge of Anchorage (5th) – Bioretention swales collect water from pavement surfaces
- Dozens of rain gardens around Anchorage
- Upcoming West Dowling Road Phase II (C-Street to Minnesota) – Uses bioretention rain gardens in lieu of storm drain

Considerations for Anchorage
**Bioretention**

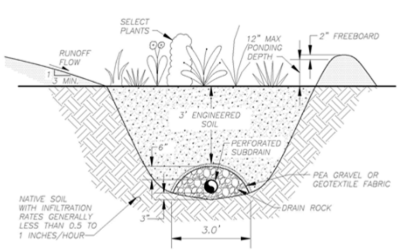
- Extremely Versatile
- Typical Section – Base Case




Considerations for Anchorage
**Bioretention**

- Modification 1

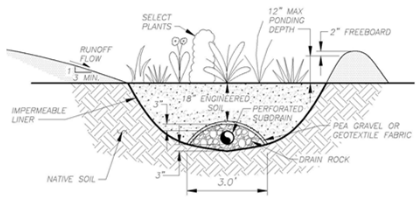
✓ Poorly infiltrating soils
✓ Limiting strata ≈ 4 feet from facility floor



## Considerations for Anchorage
**Bioretention**

- Modification 2
  - Groundwater less than 2 feet from the facility floor
  - Contaminated sites
  - Can't meet separation distances

✓ High Groundwater
✓ Limited space
✓ Contaminated soils




## Considerations for Anchorage
**Bioretention**

- Plowing  is generally not a problem—better if you don't pile snow in the faculty
- Sanding – impact on performance is related to facility size and if pretreatment is provided. (E.g. grass filter strips)
- Recommend that footprint is 5% of contributing area if area is impervious

✓ Plowing and Sanding

## Considerations for Anchorage
**Bioretention**

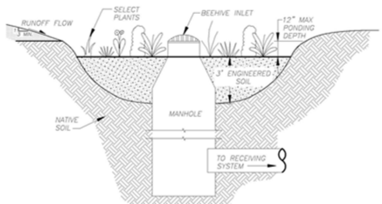
- Frozen Ground
  - Two conditions that cause concern
    - Spring break-up
    - Occasional wintertime rain-on-snow event
  - Consider this when you layout the site – what will happen if surface ponding occurs?
  - Is it a problem?  Does the Owner care?
  - What is down-gradient from the facility?
  - Put in an overflow if needed

Considerations for Anchorage

**Bioretention**

- Overflow
  - Pipe or surface flow
  - May be needed anyway for large storm events, depending on the design.
  - Can aid in permitting process

✓ Frozen Ground




Considerations for Anchorage

**Bioretention**

- Overflow

# Infiltration

- Also called Retention
- Versatile practice where water is collected, stored, and infiltrated into the ground.
- Can be used at the surface or at varying depths.
- Infiltration trenches, chambers, ponds, leach field., etc.

## Infiltration Example

- Medical Plaza Way, Clarksville, IN
- 75,000 SF Hospital and 40,000 SF Medical Building
- Local regulations required stormwater retention

*Photo from Chambermaxx website*

- Parking Lot was installed with **690** Contech Chambermaxx units for **33,810** cubic feet (**252,916 gallons**) of storage.

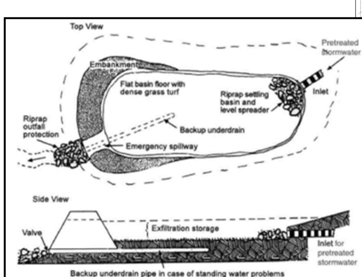
## Can we do this in Anchorage?

- **Infiltration (Also called Retention)**
  - Russian Jack Spring Park (Chambers)
  - Tacotna Commons (Ponds)
  - Unique Mechanics (Chambers)
  - Radio Shack/True Value (Chambers)
  - Anchorage Fire Station 5 (Leach-field Concept)
  - Providence Extended Care Facility (Pond)
  - UAA Health Science Building (Chambers and Pond)

## Considerations for Anchorage

**Infiltration - Basin**

- Basin
- Shallow depressions that collect and infiltrate water of a period of several days



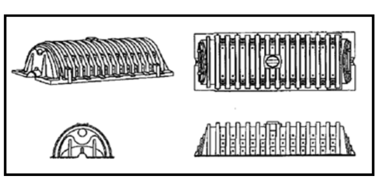
## Considerations for Anchorage
**Infiltration - Basin**


## Considerations for Anchorage
**Infiltration - Basin**

- When properly designed, can work well in cold climates.
- With ice cover or frozen conditions, water ponds on the surface—no problem.
- Limited use with high groundwater table
- Can work with poor soils, depending on space available and needed drain-down times.
- Plowing and Sanding – Pretreatment is recommended
  - Sediment forebay
  - Grit chamber

## Considerations for Anchorage
**Infiltration**

- Chambers
- Store and infiltrate water
- Versatile – can go below pavement or pervious surface
- Can be installed below frost depth
- Usually requires pretreatment for sediment



Considerations for Anchorage

**Infiltration**

- Chambers

Infiltration:
- ✓ Frozen Ground
- ✓ Poorly infiltrating soils
- ✓ Plowing and sanding
- X High ground water
- X Contaminated soils

## Porous Pavements

- A system that reduces impervious surfaces, thus increasing infiltration and reducing runoff.
- May include modular paving blocks or grids, porous concrete, porous asphalt, cast-in-place concrete grids, and soil enhancement technologies.

Porous Asphalt Examples

- Porous Asphalt Parking - Clark Township, Town Hall parking lot, New Jersey

- Porous Concrete Sidewalk - NE 79th Street, Redmond WA

## Can we do this in Anchorage?

- **Porous Pavements**
  - Russian Jack Springs Park (Porous Asphalt) – installed in parking bays in the parking lot.
  - Residential Condominium on Spenard (Pavers and Porous Concrete) – installed in three courtyard "common" areas for the Habitat for Humanity Project

## Considerations for Anchorage
**Porous Pavements**

- Several Types
  - Porous Asphalt
  - Porous Concrete
  - Porous Pavers
- Fairly new practice for Anchorage
- Porous asphalt – RJSP
  - Performance will be monitored
- Porous Pavers and Porous Concrete
  - Performance was monitored and results are presented in a technical paper by Tamás Deák.

## Considerations for Anchorage
**Porous Pavements**

- Requires engineering for the system, subgrade, and placement—don't just "throw it in"
- Consider location, use, and maintenance capabilities
- Works very well with poorly infiltrating soils—spreads out the water
- Impact of plowing and sanding depends on the facility design and frequency of maintenance
  - Habitat project is sanded and not vacuum swept, performing as designed
  - Russian Jack project was layed out to minimize impacts of sanding
- Research different types of systems
- One paver block may be locally manufactured starting this year.

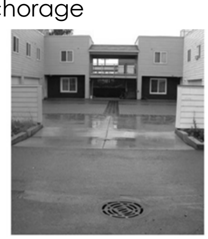
Considerations for Anchorage

**Porous Pavements**

Habitat for Humanity Project (2008)

Considerations for Anchorage

**Porous Pavements**



Photos and project information courtesy of Tamás Deák, kpb architects. "*Cold Climate Performance Evaluation of Permeable Interlocking Concrete Pavement and Porous Concrete Pavement Systems.*"

Considerations for Anchorage

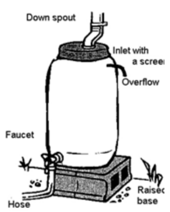
**Porous Pavements**

Infiltration:

- ✓ Frozen Ground
- ✓ **Poorly infiltrating soils**
- -- Plowing and sanding
- X High ground water
- X Contaminated soils

Considerations for Anchorage
**Other Easy Ideas**
- Slow your water down – increase the site Time of Concentration
  - Helps water soak into the ground
  - Can help reduce the peak flow
  - Example – Direct downspouts to lawn instead of driveway
- Capture water and use it later. (E.g. Rain Barrel)
- Send runoff from pervious areas to impervious areas.

Considerations for Anchorage
**Other Easy Ideas**




Rain Barrel

Downspout to pervious area

Low Impact Development
**Design Considerations**
- Infiltration (or percolation) rates
  - Look at the soils at facility depth and below
  - Onsite testing: In-place, At depth
  - Test value vs. design value
  - Choose appropriate FS
    - Consider long-term perc rates
    - Depends on facility, it's critical function, the consequences of failure, etc.
    - Involve a geotechnical engineer
  - Field verify design values during construction
  - For poorly draining soils, consider a subdrain and/or overflow.

Low Impact Development
**Design Considerations**

- Many site see success using multiple techniques
- Multiple Independent facilities
  - Habitat project – porous pavements + rain gardens
- Treatement “train”
  - UAA Health Science Building– Chambers→Pond→Receiving System
  - RJSP (train)—Porous Asphalt→Chambers

Combined Techniques

- Maplewood Mall, Minneapolis, MN suburb
  - Porous pavers, Rain gardens, tree trenches, planters,, and more.
  - Project will capture and infiltrate or filter at least 1 inch of runoff

For more info, visit http://www.stormh2o.com/SW/Articles/Green_Infrastructure_Makes_Sene_in_the_Twin_Cities_19789.aspx

Low Impact Development
**Example Work Session: Estimating Runoff and Sizing a Bioretention Facility**

- Simple method for determining flow into your facility
- Direct Determination Method (See handout)

Runoff = Rainfall – Depression storage – Infiltration

## Low Impact Development
**What about cost?**

- True representation of cost in Anchorage is TBD
  - Costs tend to be unpredictable due to uncertainty
  - The more LID practices are included on projects, the less the uncertainty
  - Contractors will become familiar with the practices

## Low Impact Development
**What about cost?**

- Uncertainty in RJSP Porous Asphalt
- Unit Prices on Bids for Porous Asphalt had a 154% increase from the low bid to the high bids
- Regular asphalt had a 48% increase from the low bid to the high bid
- Compared to regular asphalt, the percent increase in cost ranged from 8% to 134%.




## Low Impact Development
**What about cost?**

- What Communities are saying
  - Minneapolis/St. Paul
    - *"In most instances we have found that the green infrastructure costs will be considerably less than grey infrastructure costs in heavily urbanized environments where land costs are high and there is also the cost or impact of shutting down roads and whatnot on the existing owners and tenants"* – Peter MacDonagh, Principal and Cofounder of Kestrel Design Group
    - *"Green Infrastructure can be quite economical as compared to conventional stormwater management BMPs that can consume more land area. Green Infrastructure can reduce other stormwater conveyance and storage costs. With the added benefit of providing improved aesthetics and water conservation, some argue that the costs can be less over the long term."* – Cliff Aichinger, Administrator of the Ramsey-Washing Metro Watershed District, MN

## Low Impact Development
### What about cost?

- Banking on Green – A Look at how green infrastructure can save Municipalities Money and Provide Economic Benefits Community-wide. (April 2012)
- Discuses:
  - What's driving Green Infrastructure – Environment and Infrastructure deficit
  - Capital Costs
  - Long-term costs
  - Direct and Indirect Benefits

**Green Infrastructure Practices Offer Cost-Effective Solutions**

*American Society of Landscape Architect's Green Infrastructure Survey*

As part of its efforts to collect information about green infrastructure, EPA asked ASLA to collect case studies on projects that successfully and sustainably manage stormwater. ASLA members responded with 479 case studies from 43 states, the District of Columbia, and Canada. Not only do these projects showcase landscape architecture, they also demonstrate to policymakers the value of promoting green infrastructure policies. Green infrastructure and low-impact development (LID) approaches, which are less costly than traditional grey infrastructure projects, can save communities millions of dollars each year and improve the quality of our nation's water supply.

**Project type:**

| | |
|---|---|
| Institutional/Education | 21.5% |
| Open Space/Park | 21.3% |
| Other | 17.6% |
| Transportation Corridor/Streetscape | 11.9% |
| Commercial | 8.6% |
| Single Family Residential | 5.5% |
| Government Complex | 4.2% |
| Multifamily Residential | 3.7% |
| Open Space Garden/Arboretum | 2.9% |
| Mixed Use | 1.8% |
| Industrial | 1.1% |

**Green Infrastructure type:**

| | |
|---|---|
| Retrofit of existing property | 50.7% |
| New development | 30.7% |
| Redevelopment project | 18.6% |

**Did use of green infrastructure increase costs?**

| | |
|---|---|
| Reduced costs | 44.1% |
| Did not influence costs | 31.4% |
| Increased costs | 24.5% |

**Analysis**

- Over 300 ASLA members and other practitioners responded with 479 case studies from 43 states, the District of Columbia, and Canada.
- 55 percent of the projects were designed to meet a local ordinance.
- 88 percent of local regulators were supportive of the green infrastructure projects submitted.
- 68 percent of the projects received local public funding.

*Details about the study and its results are available here: www.asla.org/stormwater*

## Low Impact Development
### Other Considerations

- Maintenance:
  - Depends on the facility
  - Maintenance frequency and capabilities should be considered during design
    - Involve maintenance personnel
  - Small, Frequent maintenance
    - Mowing
    - Weeding
    - Caring for Vegetation
  - Larger maintenance
    - Structure repairs
    - Eventual rehabilitation
  - Involve maintenance staff in the design process
  - Be practical

Low Impact Development
**Other Considerations**

- Construction is KEY
  - Devil is in the details
  - On-site representative needs a thorough understanding of the entire project.
  - Special care is needed for low-bid projects vs. collaborative design-build efforts.

**Selecting the right LID Practice**

- Picking an LID technique right for your site is key
- Different techniques work better with different constraints
- Don't forget the purpose – small, frequent events.
- See Selection Considerations Handouts
- MOA is expanding their design criteria for LID and other stormwater management facilities to make implementation easier.

Low Impact Development
**Lots of Options!**

- There are MANY ways to incorporate LID
- Remember, think small. Little efforts can add up to a large success.

Low Impact Development

**Resources**

- **Low Impact Development Center** www.lowimpactdevelopment.org
- **Stormwater Magazine** http://www.stormh2o.com/SW/SWhome.aspx
- **Minnesota BMP Manual** http://www.pca.state.mn.us/index.php/water/water-types-and-programs/stormwater/stormwater-management/minnesotas-stormwater-manual.html
- Upcoming MOA revised stormwater design criteria manual

Instructor Contact Information

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AWR Engineering, LLC
jdusel@awr-eng.com
www.awr-eng.com

Thanks for coming!

**Bioretention Sizing Exercise**

We are going to design a bioretention area in just a few simple steps. In Part 1, we will calculate the runoff that will be collected in the bioretention area. In Part 2, we will size the bioretention area.

**Part 1 – Calculate Runoff using the Direct Determination Method.**

**Site Information**

| | |
|---|---|
| Total Site Area = | 1 Acre |
| Roof top Area = | 0.2 Acre |
| Parking Lot and Driveway Area = | 0.6 Acre |
| Lawn Area = | 0.2 Acre |
| Design Rainfall Event = | 0.5 inches in 24 hours |
| Soil Type = | Type B (Mostly sandy) |
| Design Soil Moisture Condition = | Partially Dried Out (At least 48-hours with no prior precipitation) |

***Runoff = Rainfall – Depression Storage – Infiltration Loss***

(See the attached sheet on the Direct Determination Method for depression storage values, estimates of maximum and minimum infiltration rates, and decay constant. Infiltration rates can also be based on field testing.)

Roof Runoff = 0.52" – 0.1" – 0" = 0.42"

Pavement Runoff (Parking lot and driveway) = ____________________________________________

Lawn Runoff = 0.52" – 0.25" – Lawn Infiltration (f)

***Lawn Infiltration Rate =*** $\boldsymbol{f_{min} + (f_{max} - f_{min}) * e^{-k\Delta t}}$

From the attached handout, for a sandy, Type B soil:

$f_{min} =$ _________ $\frac{in}{hour}$ and $f_{max} =$ ________ $\frac{in}{hour}$ and $k \cong$ _______ $hr^{-1}$

This equation is describing how fast the soil infiltration rate will change from maximum to minimum as the soils becomes saturated. For the sake of time in this example, you can choose Δt = 24 hours, or the whole storm. This basically assumes the minimum infiltration rate for the entire storm, and will result in less infiltration than if you looked at a smaller Δt, like 0.5 hours. (In the case of a smaller Δt, you would look at the infiltration loss every 30 minutes and sum them all up when you're finished.)

Lawn Infiltration Rate = ____________ inches/hour

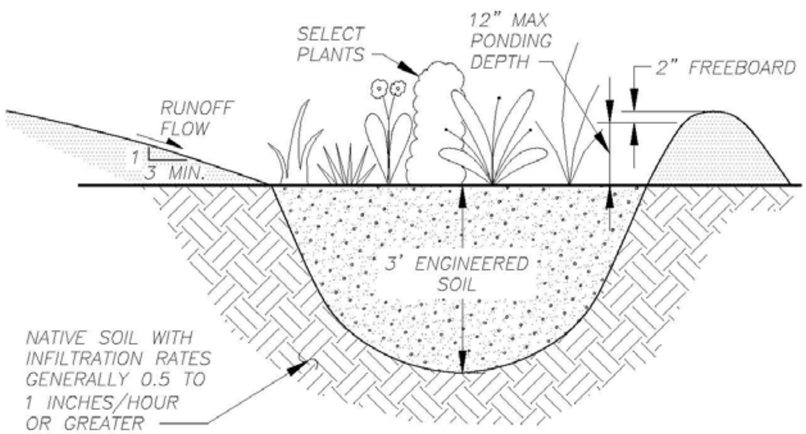
Then, total Lawn Infiltration = 0.15 in/hour * 24 hours = ________________inches

Lawn Runoff = 0.5” – 0.25” – 3.6” = __________________ inches. (Note: if you get a negative number, then runoff is zero)

$$Total\ Site\ Runoff\ (in\ inches\ per\ acre) = \frac{(Roof\ Runoff * Roof\ Area) + (Pavement\ Runoff * Pavement\ ARea) + (Lawn\ Runoff * Lawn\ Area)}{Site\ Area}$$

Total Site Runoff in *inches per unit area* = ___________________________ inches/acre.

**Part 2 – Size the bioretention area footprint.**




Sizing equation for a standard bioretention facility:

$$A_r = \left( \frac{TIV * d_{es}}{I * (P_d + d_{es}) * t} \right)$$

Where:
$A_r$ = Minimum bioretention area Footprint (square feet)
$TIV$ = Target Infiltration Volume (cubic feet)
$P_d$ = Depth of Ponded Water (ft)
$d_{es}$ = Depth of Engineered Soil (ft)
$I$ = Infiltration rate of the native soil at the bottom of the bioretention area (ft/hour)
t = Facility drain-down time (hours) (48 hours maximum)

To get TIV, convert the inches of runoff per acre from Part 1 to a volume in cubic feet.

TIV = 0.336 inches/acre * 1 acre* 43,560 $ft^2$/acre * 1 foot/12 inches = ______________ $ft^3$

The infiltration rate in the sizing equation should be the *design* infiltration rate, based on testing and an appropriate factor of safety. For this example, let’s assume that value is the same as the minimum infiltration rate used in Part 1 (0.15 inches/hour = 0.0125 ft/hour).

$$A_r = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$$

To achieve this area, what shape/dimensions would you recommend? ______________________

When designing the facility footprint, it is also important to consider the sediment loading of the contributing area. To improve the life of bioretention facilities that are accepting water from parking lots and roadways, the general rule of thumb is to make the facility footprint at least 5% of the contributing impervious area. So, let's compare:

Our contributing impervious area is 0.8 acres or 34,848 square feet. Five percent of that is **___________________ ft$^2$**. Should we make the footprint larger?

# Bioretention Sizing Exercise - *Solution*

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From the attached handout, for a sandy, Type B soil:

$f_{min} = \mathbf{0.15 \frac{in}{hour}}$ and $f_{max} = \mathbf{5 \frac{in}{hour}}$ and $k \cong \mathbf{2\ hr^{-1}}$

This equation is describing how fast the soil infiltration rate will change from maximum to minimum as the soils becomes saturated. For the sake of time in this example, you can choose Δt = 24 hours, or the whole storm. This basically assumes the minimum infiltration rate for the entire storm, and will result in less infiltration than if you looked at a smaller Δt, like 0.5 hours. (In the case of a smaller Δt, you would look at the infiltration loss every 30 minutes and sum them all up when you're finished.)

Then, Lawn Infiltration = 0.15 in/hour * 24 hours = *3.6 inches*.

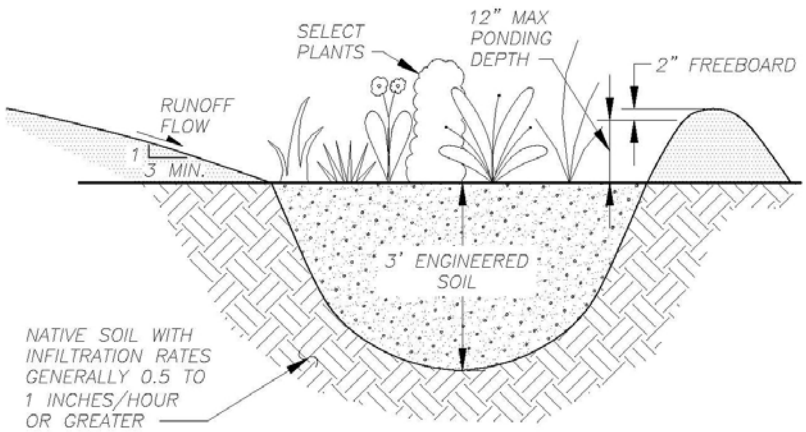
Lawn Runoff = 0.5" – 0.25" – 3.6" = *--3.35 inches (or no runoff) → 0"*

$$Total\ Site\ Runoff\ (in\ inches\ per\ acre) = \frac{(Roof\ Runoff * Roof\ Area) + (Pavement\ Runoff * Pavement\ ARea) + (Lawn\ Runoff * Lawn\ Area)}{Site\ Area}$$

Total Site Runoff in *inches per unit area* = *(0.42*0.2) + (0.42*0.5) + (0*0.2))/1*

= ***0.336 inches/acre***

**Part 2 – Size the bioretention area footprint.**

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Where:
$A_r$ = Minimum bioretention area Footprint (square feet)
*TIV* = Target Infiltration Volume (cubic feet)
$P_d$ = Depth of Ponded Water (ft)
$d_{es}$ = Depth of Engineered Soil (ft)
*I* = Infiltration rate of the native soil at the bottom of the bioretention area (ft/hour)
t = Facility drain-down time (hours) (48 hours maximum)

To get TIV, convert the inches of runoff per acre from Part 1 to a volume in cubic feet.

TIV = 0.336 inches/acre * 1 acre* 43,560 $ft^2$/acre * 1 foot/12 inches = ***1,219.7 $ft^3$***

The infiltration rate in the sizing equation should be the design infiltration rate, based on testing and an appropriate factor of safety. For this example, let's assume that value is the same as the minimum infiltration rate used in Part 1 (0.15 inches/hour = 0.0125 ft/hour).

$$A_r = \frac{1{,}219.7\ ft^3 * 3\ ft}{0.0125 \frac{ft}{hour} * (1\ ft + 3ft) * 48\ hours}$$

$$\underline{A_r = 1{,}524.6\ ft^2}$$

*The bioretention facility can take many different shapes, based on the site configuration. For example, a long linear facility would be approximately 15' x 100'.*

When designing the facility footprint, it is also important to consider the sediment loading of the contributing area. To improve the life of bioretention facilities that are accepting water from parking lots and roadways, the general rule of thumb is to make the facility footprint at least 5% of the contributing impervious area. So, let's compare:

Our contributing impervious area is 0.8 acres or 34,848 square feet. Five percent of that is *1,742.4 $ft^2$. So, we might consider increasing the size slightly to improve long-term performance.*

# LID Techniques for Common Site Constraints

| LID Technique | Common Local Site Constraints | | | | | |
|---|---|---|---|---|---|---|
| | Poorly Infiltrating Soils[1] | High Ground Water | Contaminated Soils or Runoff | Bedrock | Frozen Conditions with a bypass or overflow route[2] | Frozen Conditions[3] |
| **Bioretention** | ✔ | ✔ | ✔ | ✔ | ✔ | |
| Pervious Pavement | ✔ | | | | ✔ | ✓ |
| Filter Strips | ✔ | ✔ | ✔ | ✔ | ✔ | |
| Infiltration Basin | ✓ | | | | ✔ | ✔ |
| Chamber Systems | ✓ | | | | | ✔ |
| Vegetative Swale | ✔ | ✔ | ✔ | ✔ | ✔ | |

✔ Works well

✓ Works well under specific design conditions

# Stormwater Controls Recommended Selection Considerations

| Stormwater Control Technique | Type of Runoff Control | | Implementation Considerations | | |
|---|---|---|---|---|---|
| | Rate Control | Volume Reduction | Accepts Hotspot Runoff | Separation from Groundwater[8] (feet) | Separation from Drinking Water Lines (feet) |
| Bioretention Facilities | Moderate | Moderate | Yes[3] | 29 | 0 |
| Soakaway Pits | Moderate | High | No[4] | 4 | 25 |
| Infiltration Basins | Moderate | High | No[4] | 4 | 10 |
| Infiltration Trenches | Moderate | High | No[4] | 4 | 25 |
| Vegetative Swales | Moderate | Moderate | No[5] | 4 | 0 |
| Pervious Pavement | Moderate | High | No | 2 | 25 |
| Chamber Systems | High | High | No[4] | 4 | 25 |
| Wet Ponds | High | Low | Yes[6] | N/A[6] | 25 |
| Dry Ponds | High | Low[1] | Yes[6] | N/A[6] | 10 |
| Oversized Pipes | High | Low | Yes[7] | N/A | 10 |
| Sedimentation Basins | High | Low | No | 4 | 10 |
| Filter Strips | Low - Moderate[2] | Low – Moderate[2] | Yes | 4 | 0 |
| Oil and Grit Separators | Low | Low | Yes | N/A | 10 |
| Constructed Wetlands | Moderate - High | Moderate | Varies[5] | N/A | 25 |
| Rainwater Harvesting | Moderate | Moderate | No | Varies[9] | 10 |

(1) May provide some volume reduction depending on permeability of native soil.

(2) Increased performance when level spreaders are incorporated into the design.

(3) Appropriate plants and other vegetation must be selected for excepted pollutant load.

(4) Yes, if runoff pretreatment is provided.

(5) Yes, under specific conditions.

(6) If hotspot runoff is anticipated, required separation from groundwater is 4 feet.

(7) Hotspot runoff still requires treatment.

(8) Minimum separation distance between the seasonal high groundwater table elevation and the bottom of structural stormwater controls.

(9) Modifications are available for locations with high groundwater.