2014 ANNUAL MEETING SUMMARY

APDES Permit No. AKS-052558 February 25, 2014

Municipality of Anchorage Daniel A. Sullivan, Mayor	Alaska Department of Transportation and Public Facilities

Watershed Management Services
Project Management and Engineering Division
Municipality of Anchorage

Meeting Agenda

2014 Watershed Update

Open House

Tuesday, February 25, 2014
At the BP Energy Center
900 E. Benson Blvd.

Open House between 9:15 and 1:30

The Municipality of Anchorage and Alaska Department of Transportation and Public Facilities
Welcome you to the APDES Watershed Update highlighting
Anchorage Storm Water Permit Compliance Activities

Break-out Sessions

BIRCH Room

- 9:30 APDES Program –2014 and Beyond
- 10:30 Watershed Mapping and Data
- 11:00 LID Pilot Projects and Design Criteria
- 12:30 Anchorage Stream Icings
- 1:30 Conclusion

COTTONWOOD Room

- 9:30 Infiltration Gallery Design, Stormtech

ASPEN Room

- 10:30 L. Campbell Creek Drainage Planning
- 11:30 Watershed Public Education
- 12:30 APDES 2014 Q&A

Posters

- Snow Disposal Site Assessment
- Monitoring
    - Wet Weather Monitoring
    - Dry Weather Monitoring
    - Pesticides Assessment
- Watershed Public Education
- Sweeping and OGS Performance Study
- Low Impact Development Projects
- L. Campbell Creek Wshed Drainage Planning
- Mapping and Drainage
- Construction
- Rain Gardens

We're pleased to have you join us for all or a portion of the 2014 Watershed Update
Refreshments provided

You can find additional information on the stormwater permit at anchoragestormwater.com

Program Slides

2014 Watershed Update

Open House

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!

Open House 9:15 – 1:30

Municipality of Anchorage and Alaska Department of Transportation and Public Facilities

Welcome you to the 2014 APDES Watershed Update highlighting Anchorage Storm Water Permit Compliance Activities

Today's Program

Break-out Sessions:

COTTONWOOD Room

9:30 Infiltration Gallery Design, Stormtech

ASPEN Room

10:30 L. Campbell Creek Drainage Planning

11:30 Watershed Public Education

12:30 APDES – 2014 Q&A

BIRCH Room

9:30 **APDES Program – 2014 and Beyond**

10:30 Watershed Mapping and Data

11:30 LID Pilot Projects and Design Criteria

12:30 Anchorage Stream Icings

1:30 Conclusion

APDES

2014 and Beyond

- Maintain Ongoing Activities
  - ✓ Monitoring
  - ✓Illicit Discharge/Industrial Discharge
  - ✓Construction
  - ✓New Development

Posters

- Snow Disposal Site Assessment
- Monitoring
  - Wet Weather Monitoring
  - Dry Weather Monitoring
  - Pesticides Assessment
- Watershed Public Education
- Sweeping and OGS Performance Study
- Low Impact Development Projects
- L. Campbell Creek Watershed Drainage Planning
- Mapping and Drainage
- Construction
- Rain Gardens

A P D E S

2014 and Beyond

Implement New Activities

- Permanent Storm Water Controls
  - ✓Transferable O&M Agreements
  - ✓Annual Inspection Program

After Recording Return to:
MOA Public Works, Watershed Management Section
P.O. Box 196550
4700 Elmore Road
Anchorage, AK 99519-6650

STORMWATER FACILITY OPERATION AND MAINTENANCE AGREEMENT

The Municipality of Anchorage (hereinafter the "Municipality") and (hereinafter the "Owner(s),") enter into the following AGREEMENT TO OPERATE AND MAINTAIN STORMWATER FACILITIES (hereinafter "this Agreement") which shall become effective on the date the Agreement is fully executed. This Agreement shall run with the land and shall be binding on the Owner(s) and his/her/their heirs, successors, and assigns.
The Owner(s) is/are a(n), and execute(s) this Agreement on behalf of the Owner(s) in the capacity of and warrant(s) he/she/they has/have authority to execute this Agreement on behalf of the Owner(s).
The Owner(s) own(s) a parcel of real property (hereinafter "the Property") described as:
per plat , located in the Anchorage Recording District, Third Judicial District, State of Alaska.
Parcel ID: ____________________________

APDES

2014 and Beyond

Implement New Activities

- Outfall Disconnects
  - ✓56th Avenue Right of Way, west of the Old Seward Highway
  - ✓Old Seward Highway and International Airport Road
- List of Riparian Areas prioritized for protection or acquisition

APDES

2014 and Beyond

Implement New Activities

- Keep and Manage 0.52 “ Runoff
  - ✓Design Criteria
  - ✓Implementation Plan*
    - -Pilot projects for information gathering
    - -Phased Start-up of linear and on-site projects

*per Permit Modification 11/6/13

DESIGN CRITERIA
CHAPTER 2

AND

ANCHORAGE
STORM WATER
MANUAL

Currently in Committee Review and Update

Today's Program

Propose Next Permit

Third Term of Phase One - Anchorage APDES Permit

- MS4 Programs
  - ✓ Construction
  - ✓ New Development
  - ✓ Industrial Discharge
  - ✓ Storm Water Infrastructure and Street Management
  - ✓ Illicit Discharge Management
  - ✓ Public Education and Involvement

Anticipate administrative extension of existing permit while ADEC considers proposal

Q & A Discussion

Anchorage MS4 Permit

Available Hydrologic Mapping and Data

Municipality of Anchorage

Watershed Management Services

What do we map??

- LOTS OF STUFF!!!!
  - Drainage Boundaries
    - Watersheds
    - Drainages (smaller divisions of watersheds)
    - Subbasins (the area contributing flow to an outfall)
  - Drainage Conveyances
    - Streams
    - Drainageways (flowing water that isn’t a stream)

What to we map??

- Discrete Features
  - Outfalls
  - Manholes
  - Catchbasins
- Other stuff
  - Lakes
  - Wetlands
  - Snow Disposal Sites
  - Hazardous Waste Sites
  - Floodplains

Data Types

- HGDB
  - What’s an HGDB?? = Hydrologic GeoDataBase
    - A geographic relational database of drainage features
      - Watersheds are composed of drainages, drainages are composed of subbasins
      - Ditches flow to outfalls on streams, streams flow to other streams, streams flow to oceans
- ArcGIS Shapefiles
  - Independent shapefiles of all of the HGDB features

More Data Types

- Online Interactive Maps
- Mobile Devices
  - Yes, you can view our data on your iPhone!!
  - Use the GPS features of you phone to tell what you are looking at
- Coming real soon – Mapping Services!!!
  - No more downloads
  - No more messing with symbology in your .MXD

Even More Data Types

- Map Books
  - Wetlands Atlas
  - Drainage Atlas
- Other Data
  - Flood Maps
  - FEMA Map Revisions
  - FEMA Elevation Certificates

How Can I Get the Data?

- Downloads
  - http://anchoragewatershed.com/datalibrary.html
  - http://anchoragestormwater.com/datalibrary.html
- Interactive Maps
  - http://anchoragewatershed.com/maps.html
  - http://anchoragestormwater.com/maps.html
- DVD or Email – Contact Us

Mapping Partners

- MOA Planning – Wetlands
- MOA CBERRRSA – Stormwater Features
- ADOT&PF – Stormwater Features
- Private Contractors – Project Specific Assistance
- GeoNorth – HGDB Maintenance

Let’s Take a Look

Questions?

MOA Watershed Mapping Data

- WMS Webpage:
  - http://anchoragewatershed.com

  OR
  - http://anchoragestormwater.com
- Online Data:
  - http://anchoragewatershed.com/datalibrary.html
- Interactive Mapper:
  - http://anchoragewatershed.com/maps.html
- Available Data Layers

Streams	Wetlands	Watersheds
Subbasins	Draingeways	Drainageway Nodes
Lakes	Marine	MS4 Storage Facilities
MS4 Parking Lots	MS4 Storage Facilities	Terrain Unit Mapping
Mapping Projects	FEMA Floodplain	Other Site-Specific Data

- Contact: Jeffrey Urbanus, urbanusjd@muni.org, 907-343-8023

MOA and ADOT&PF 2013 Low Impact Development Project Performance Monitoring

Janie Dusel, PE

AWR Engineering, LLC

Low Impact Development Pilot Projects

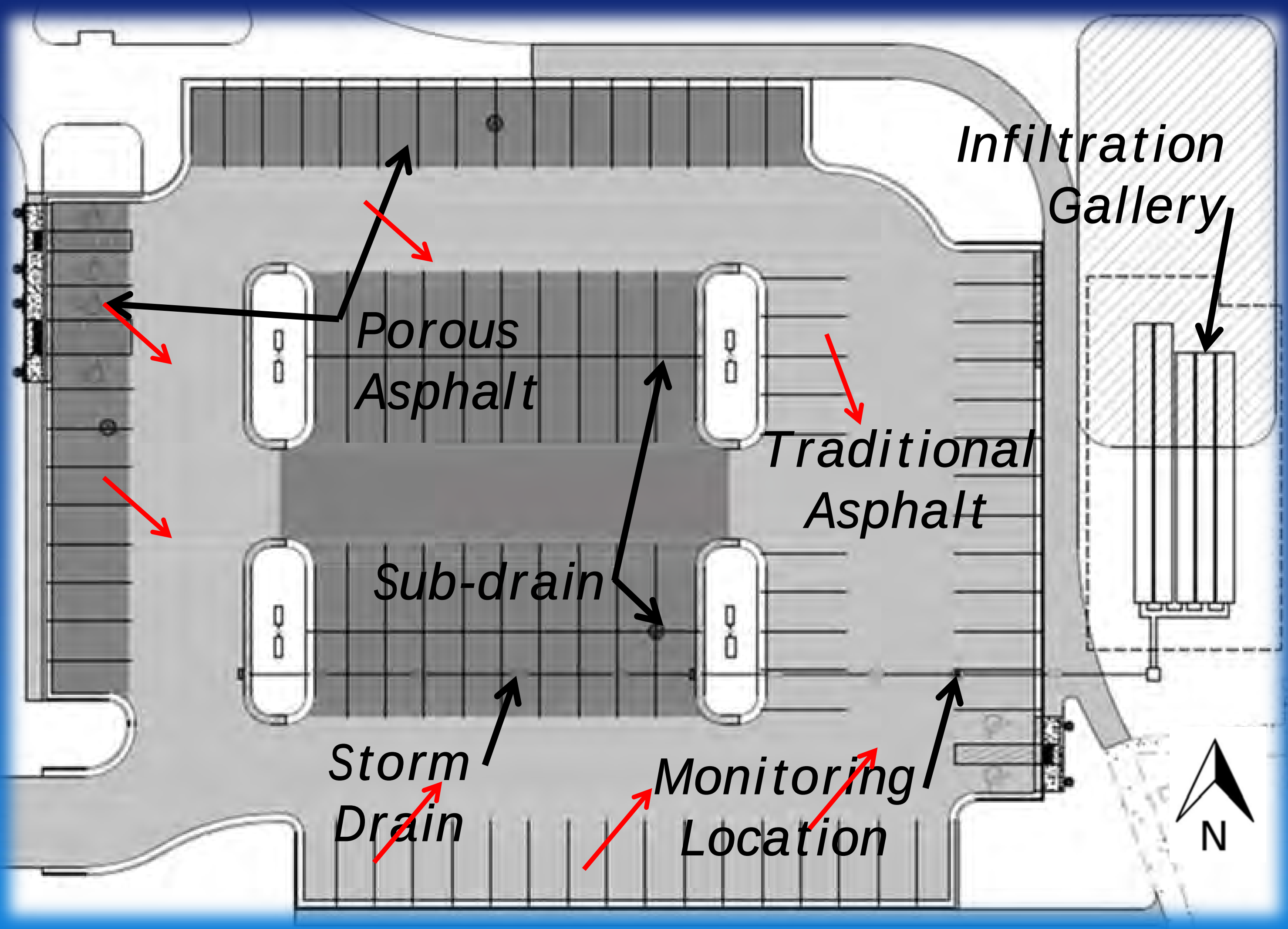
- APDES permit requires the MOA to complete two and DOT to complete three pilot projects.
- MOA Projects
  - Russian Jack Springs Park: Porous Asphalt and Infiltration Gallery
  - Taku Lake: Rain Garden (bioretention)
- DOT Projects
  - West Dowling Road: Bioswale
  - Muldoon Road: Landscaping
  - NSH-Dowling to Tudor (Retention ponds and infiltration). Will be monitored in 2014.

Low Impact Development Pilot Projects

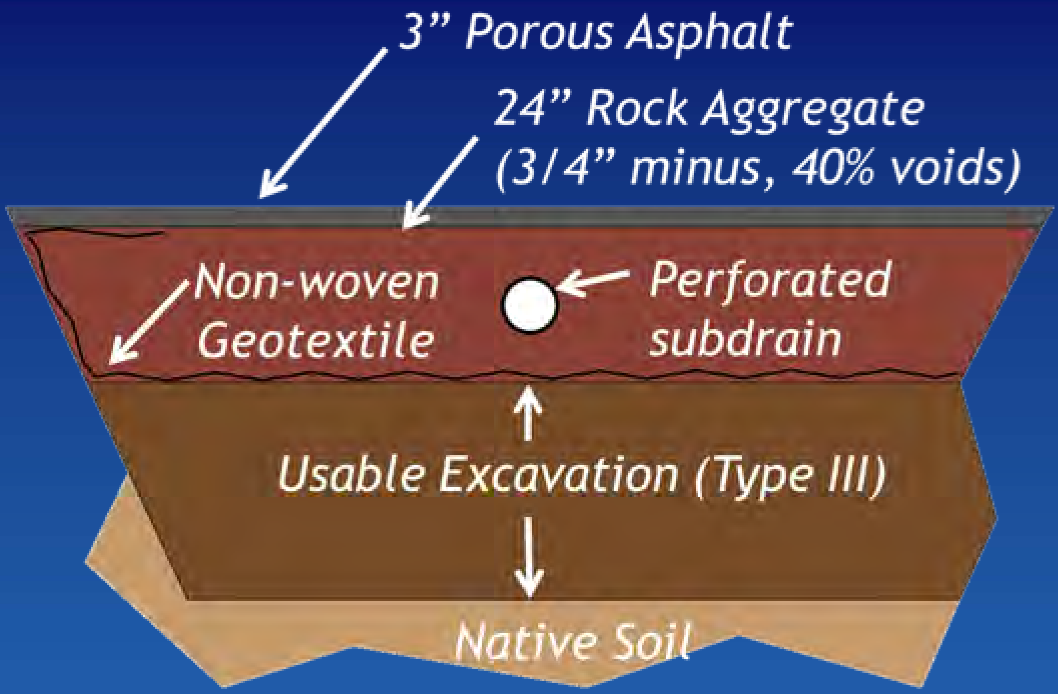
- Pilot projects require monitoring and analysis to determine how they are performing.
- This presentation presents the results of the 2013 monitoring and analysis for:
  - Russian Jack Springs Park Parking Lot
  - Taku Lake Rain Garden
  - West Dowling Road
  - Muldoon Road

Russian Jack Springs Park Vicinity Map

Russian Jack Springs Park



Russian Jack Springs Park



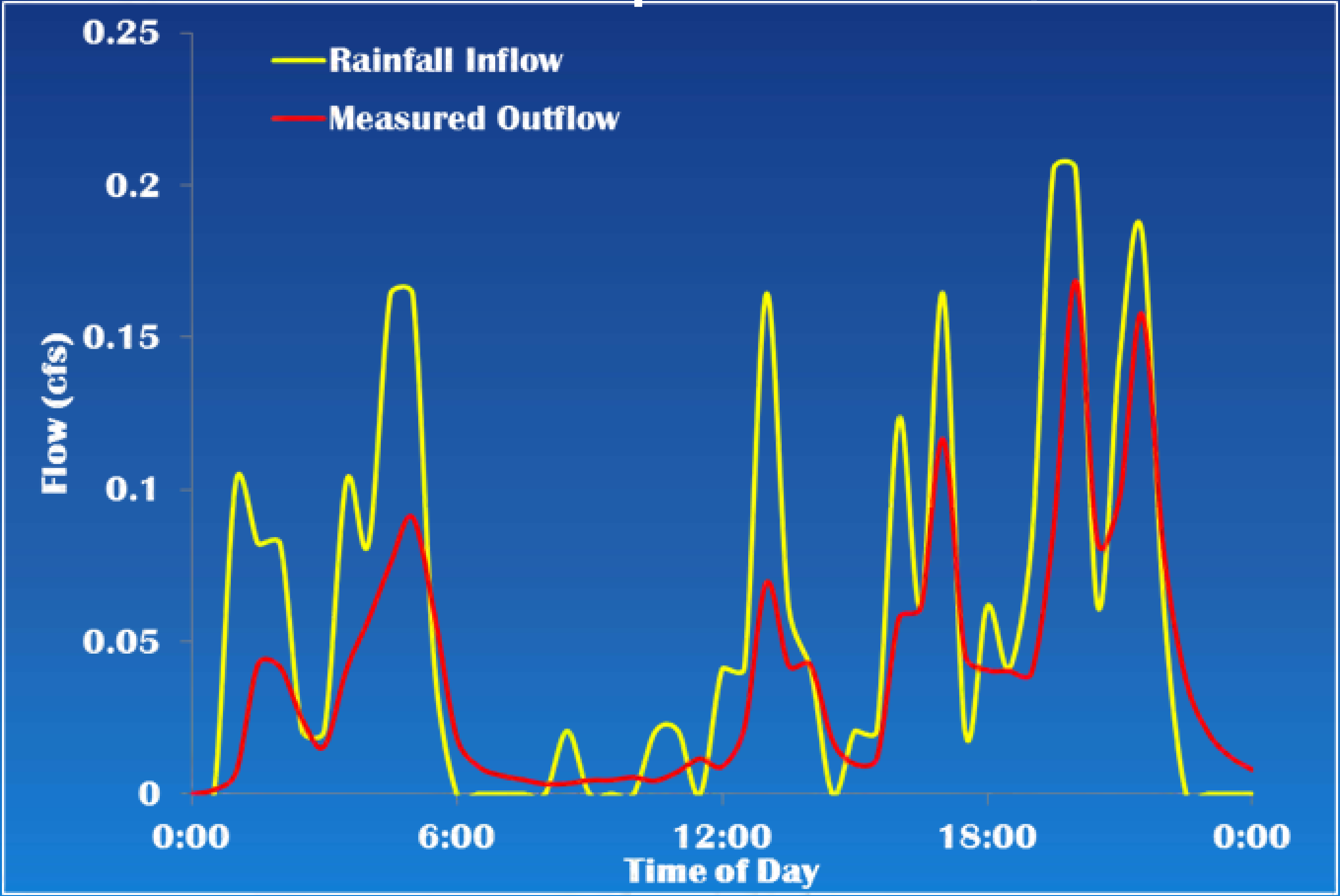
- Porous asphalt was designed to accept the 10-yr, 24-hour event (1.77 inches).
- Entire system was designed to accept the 100-year, 24-hour event (2.48 inches).

Russian Jack Springs Park

- Asphalt Monitoring:
  - A rain gauges was installed near the project site to measure rain events (inflow).
  - A v-notch weir and a pressure transducer were placed inside the last manhole upstream of the infiltration gallery.
  - Monitored from July – October of 2013
    - September of 2013 was 2nd wettest on record with 5.56 inches of rain.
  - Inflow and outflow hydrographs were developed for three rain events.

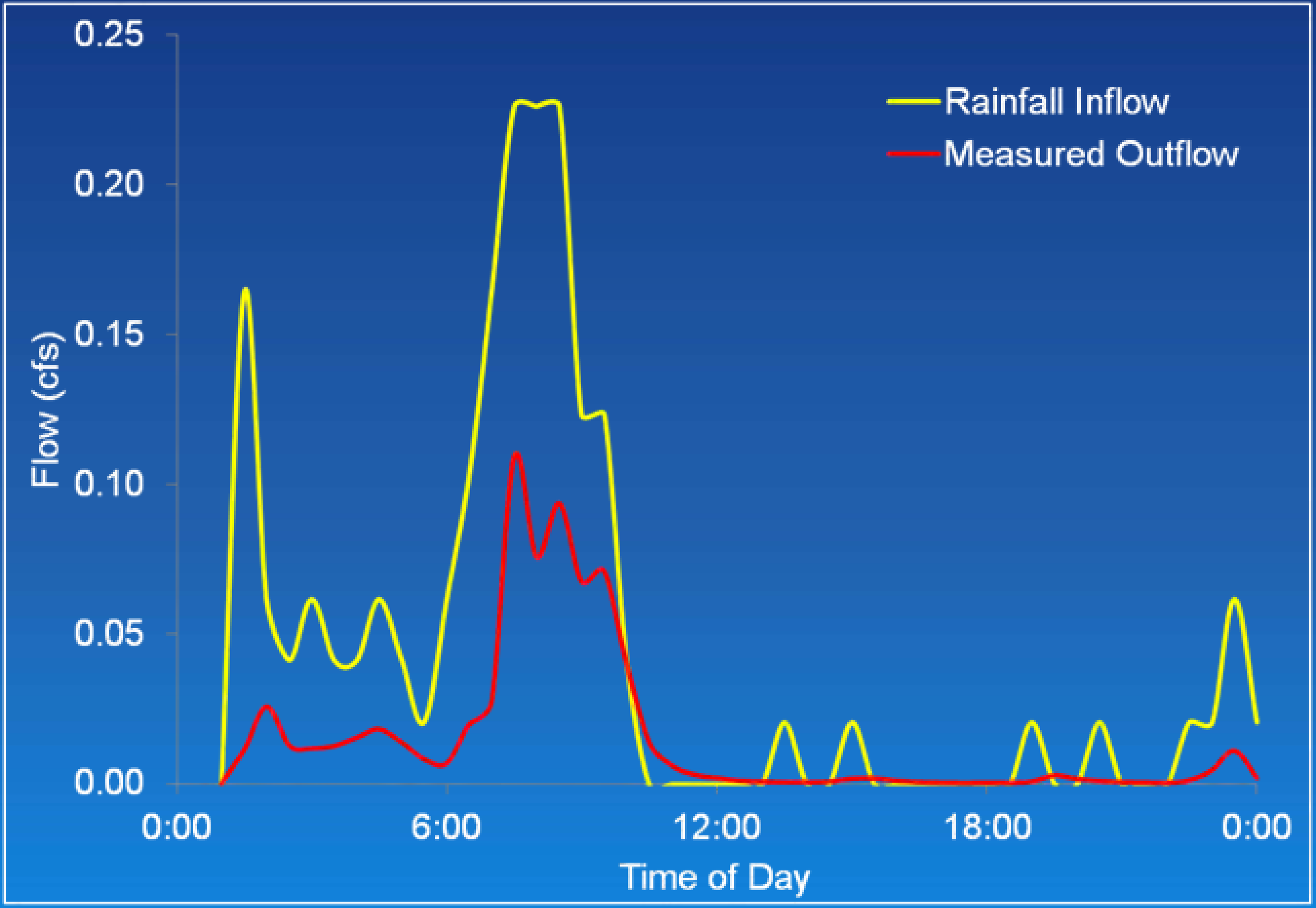
Russian Jack Springs Park

- Event 1: 1.33 inches in 24 hours. Occurred on September 4, 2013.



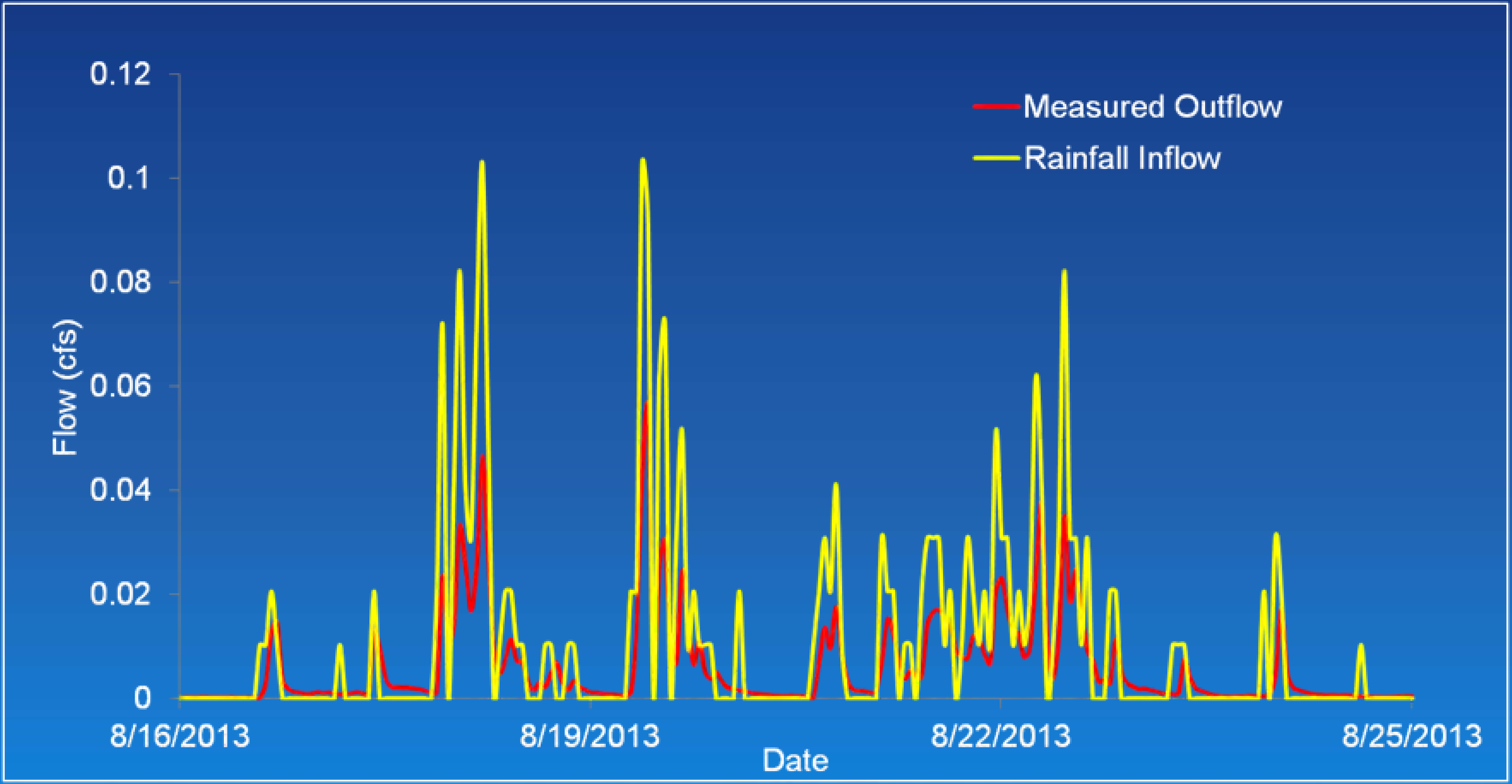
Russian Jack Springs Park

- Event 2: 0.99 inches in 24 hours. Occurred on September 25, 2013.



Russian Jack Springs Park

- Event 3: 2.31 inches in 8 days. Occurred from August 16 – August 23.



Russian Jack Springs Park

Storm Event	Runoff Volume			Peak Flow		
	Inflow Volume (cf)	Outflow Volume (cf)	Percent Decrease	Inflow Peak (cfs)	Outflow Peak (cf)	Percent Decrease
Event 1, September 4	4,919	3,443	30%	0.21	0.17	19%
Event 2, September 25	3,662	1,270	65%	0.23	0.11	52%
Event 3, August 16 to August 23	8,544	4,853	43%	0.10	0.06	40%

Russian Jack Springs Park

- Additional monitoring
  - Test hole levels in the porous asphalt were measured periodically during high rain events
  - Asphalt did not contribute flow (through the sub-drain system) to the infiltration gallery.
- Infiltration Gallery
  - Water levels were checked periodically during and following significant rain events, and standing water was not observed.
- System is working well

Russian Jack Springs Park

Taken last week of April 2013

Russian Jack Springs Park

Traditional Asphalt on May 1, 2013

Russian Jack Springs Park

Porous Asphalt on May 1, 2013

Taku Lake Rain Garden Vicinity Map

MOA and ADOT&PF LID Monitoring and Reporting Results

AWR ENGINEERING

HDR Alaska

Streams

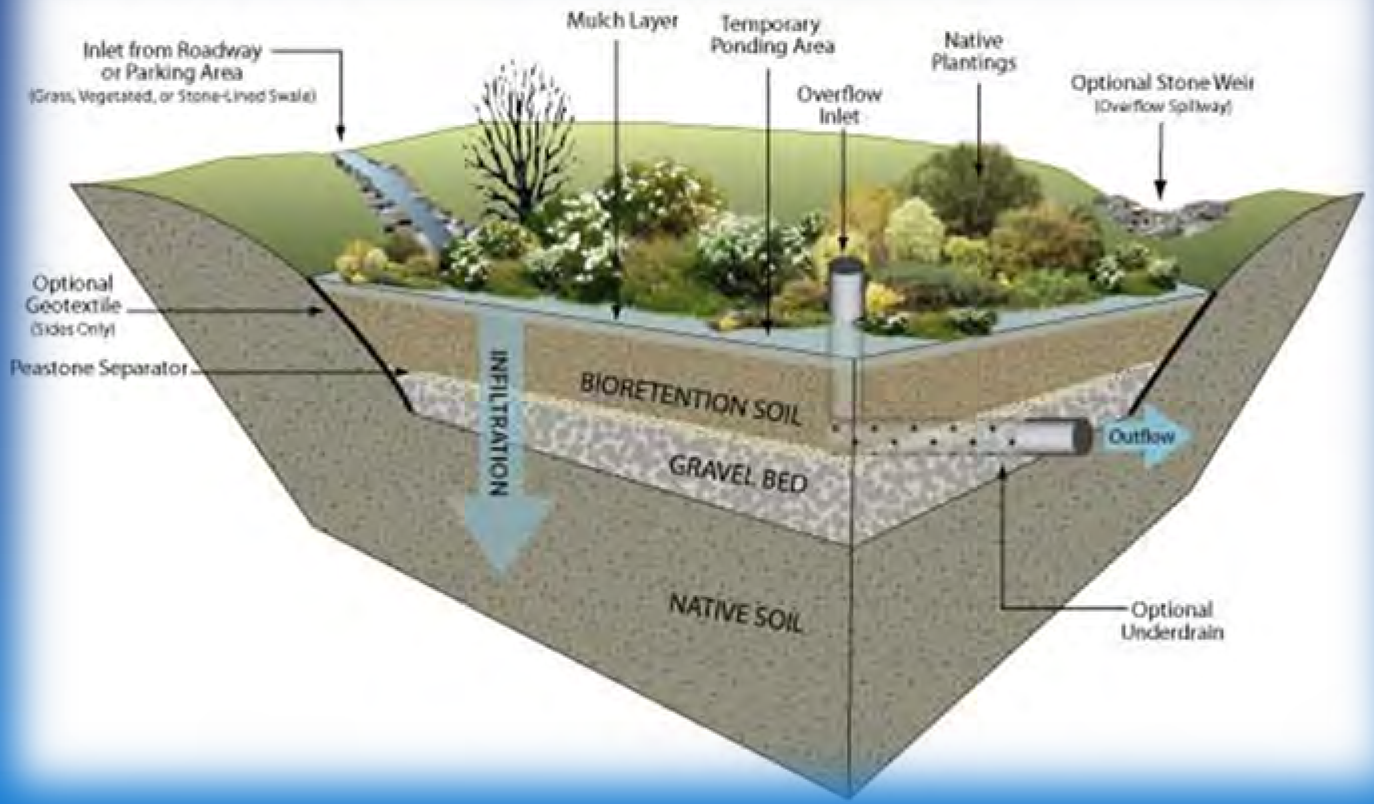
Project Area

0 0.25 0.5 Miles

N

Taku Lake Rain Garden Project Overview

Taku Lake Rain Garden Project Overview

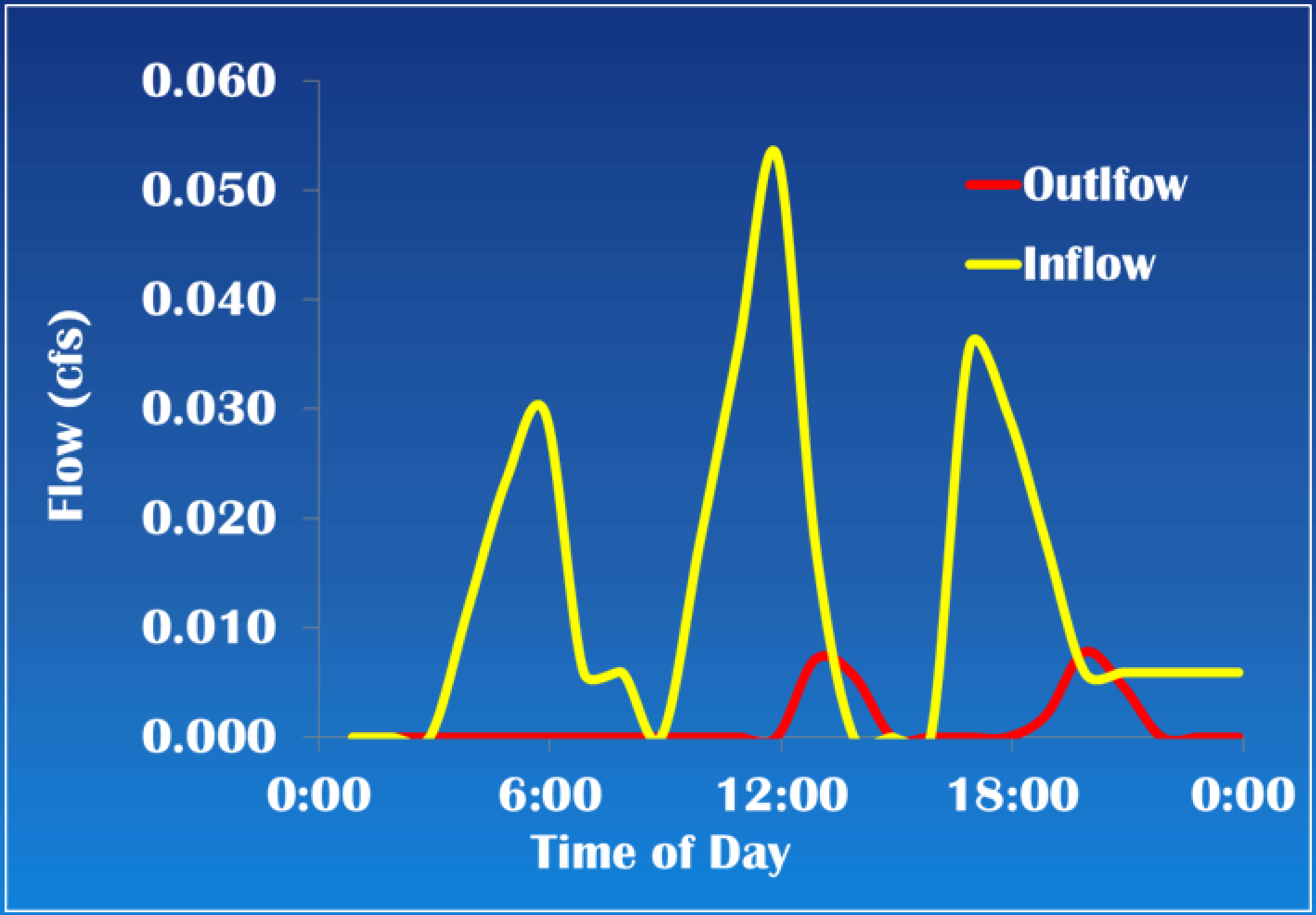


Taku Lake Rain Garden

- Designed to accept small, frequent rain events and bypass larger events.
- Monitoring (July to October of 2012)
  - September of 2012 was the wettest on record with 6.49 inches reported at AIA.
  - Onsite rain gauge was installed by appeared to be tampered with. Data from AIA was used.
  - A pressure transducer was installed on the rain garden’s subdrain outlet pipe to measure outflow.
  - Inflow and outflow hydrographs were developed for two rain events.

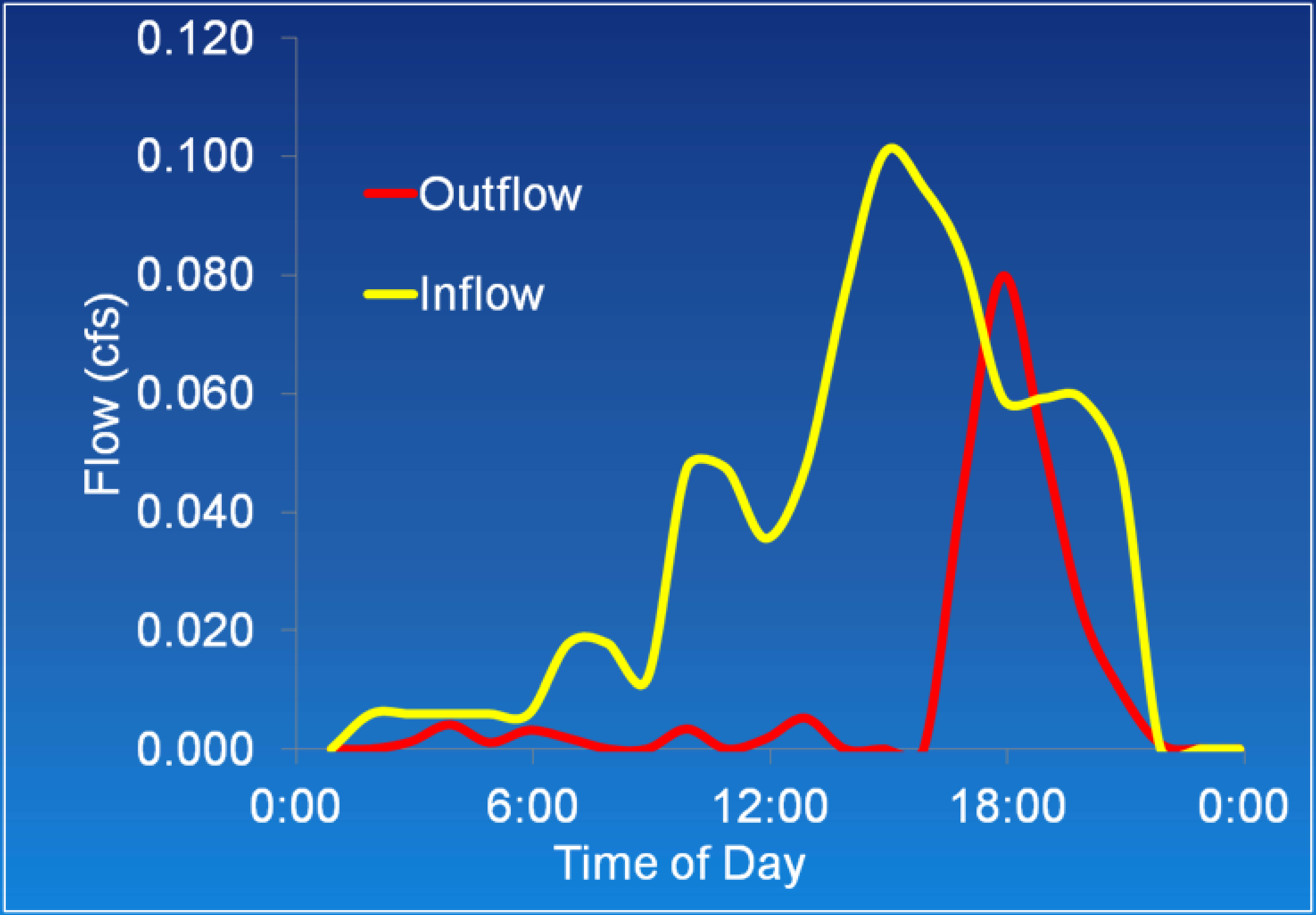
Taku Lake Rain Garden

- Event 1: 0.53 inches in 24 hrs on July 21



Taku Lake Rain Garden

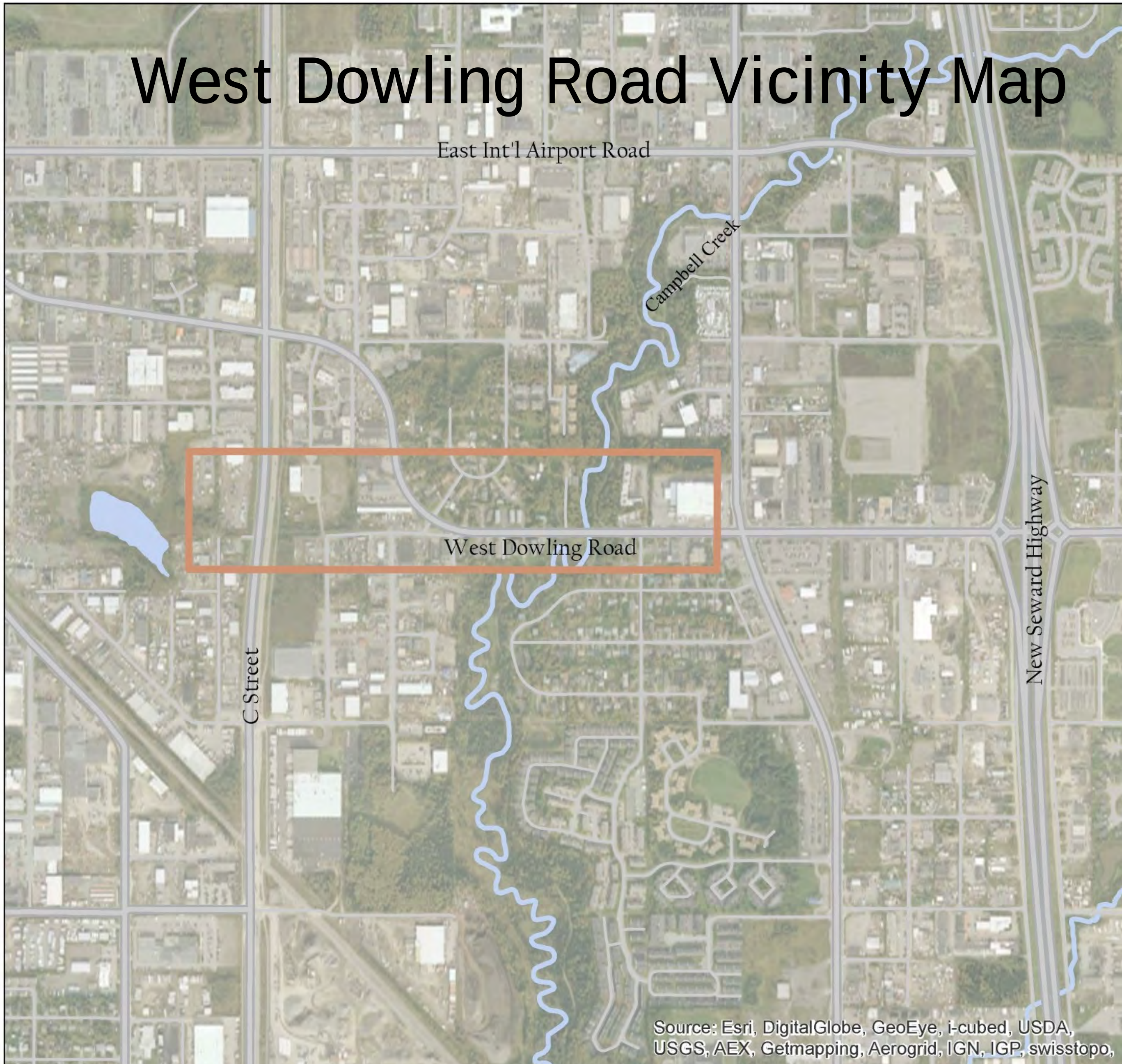
- Event 2: 1.41 inches in 24 hrs on Sept. 19



Taku Lake Rain Garden

Storm Event	Runoff Volume			Peak Flow		
	Inflow Volume (cf)	Outflow Volume (cf)	Percent Decrease	Inflow Peak (cfs)	Outflow Peak (cf)	Percent Decrease
July 21, 2012	1,130	98	91%	0.05	0.01	84%
September 19, 2012	3,006	1,589	47%	0.10	0.08	20%

West Dowling Road Vicinity Map



MOA and ADOT&PF LID Monitoring and Reporting Results

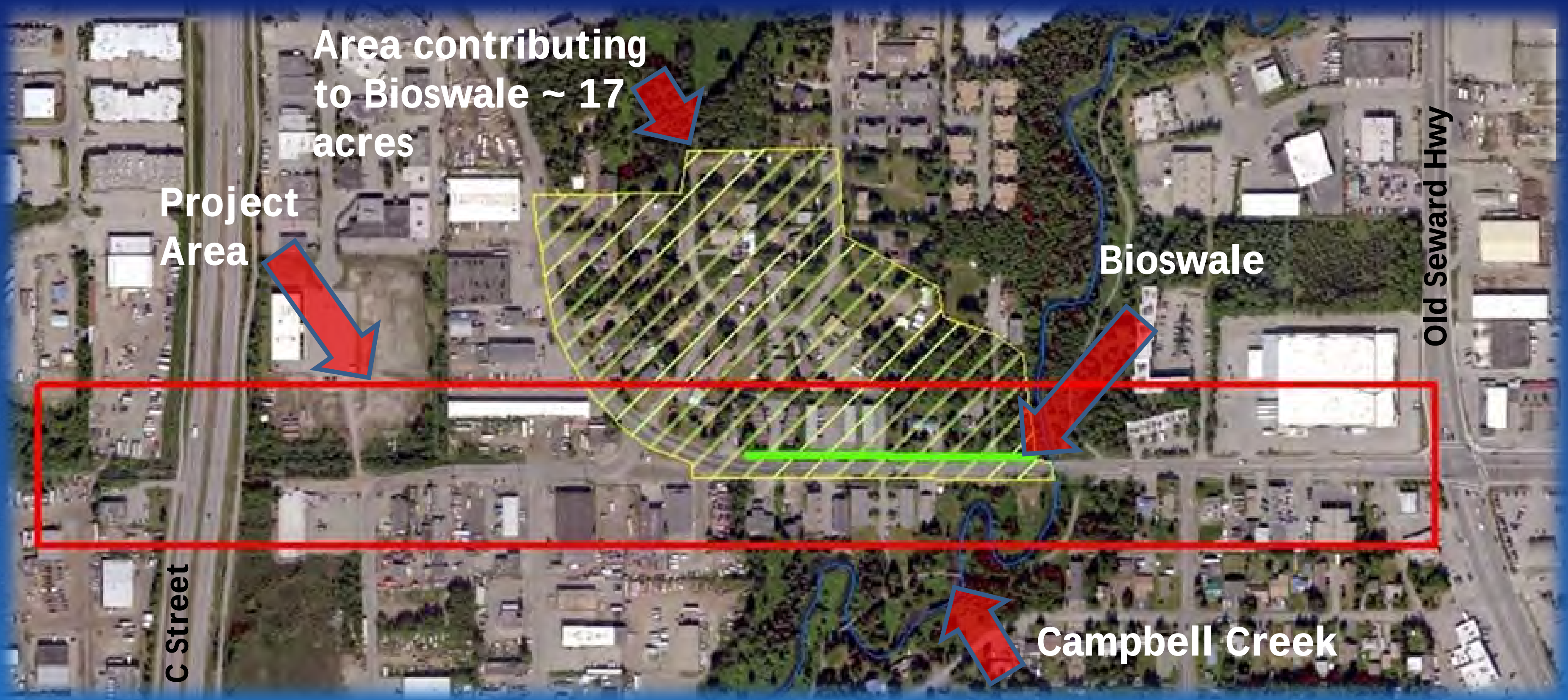
Streams

Project Area

0 0.25 0.5 Miles

N

West Dowling Road



West Dowling Road

- Project layout was not practical for on-site instrumentation.
- Performance was evaluated by modeling the bioswale in SWMM and completing visual inspection.
- Bioswale was designed for water quality treatment and for infiltration of small, frequent events.

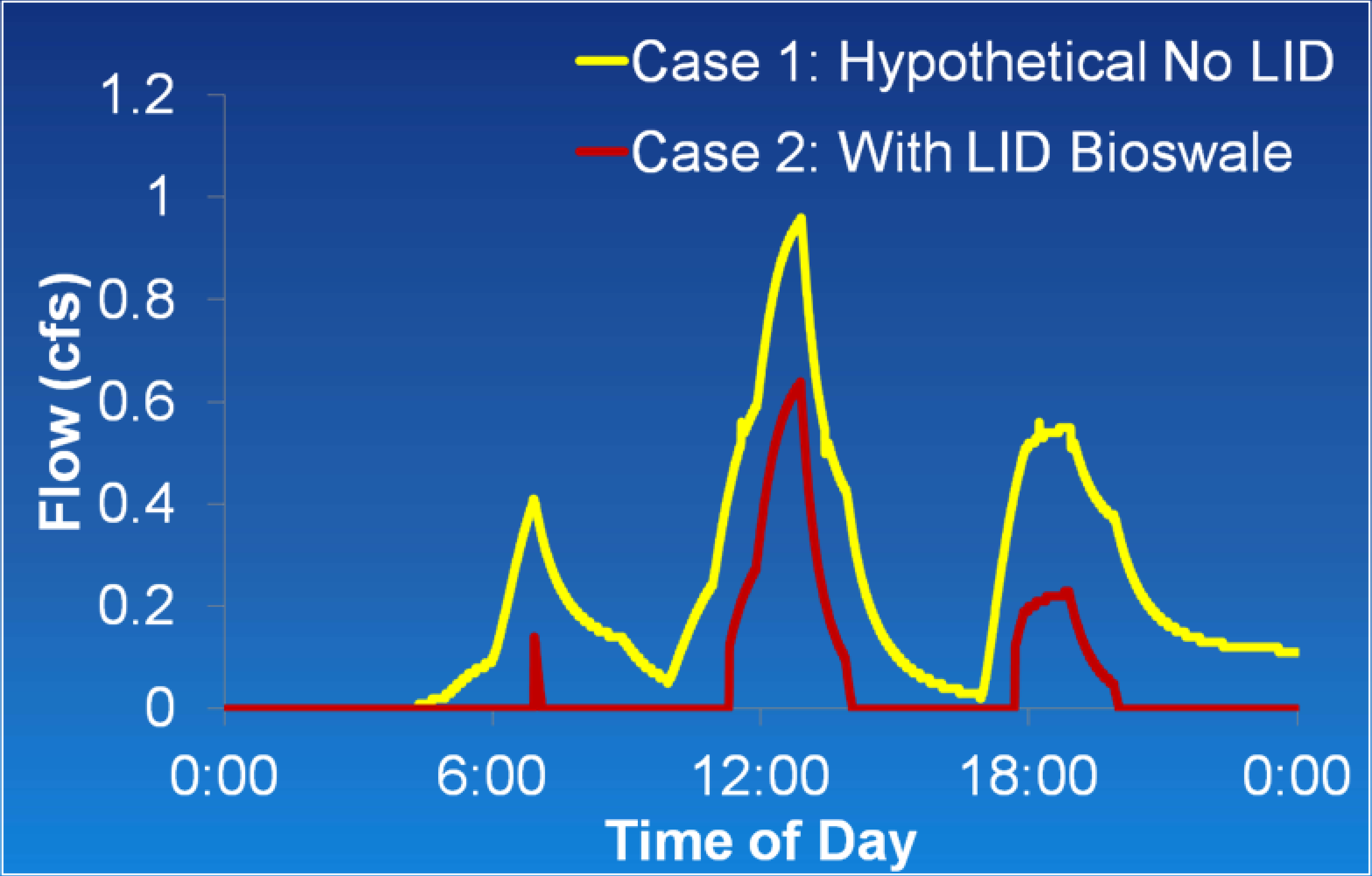
West Dowling Road

- Modeled 2 cases
  - Case 1:No LID, piped storm drain
  - Case 2: As constructed, with bioswale

- Outflow hydrographs were prepared for both cases, showing flow into Campbell Creek for different rain events.

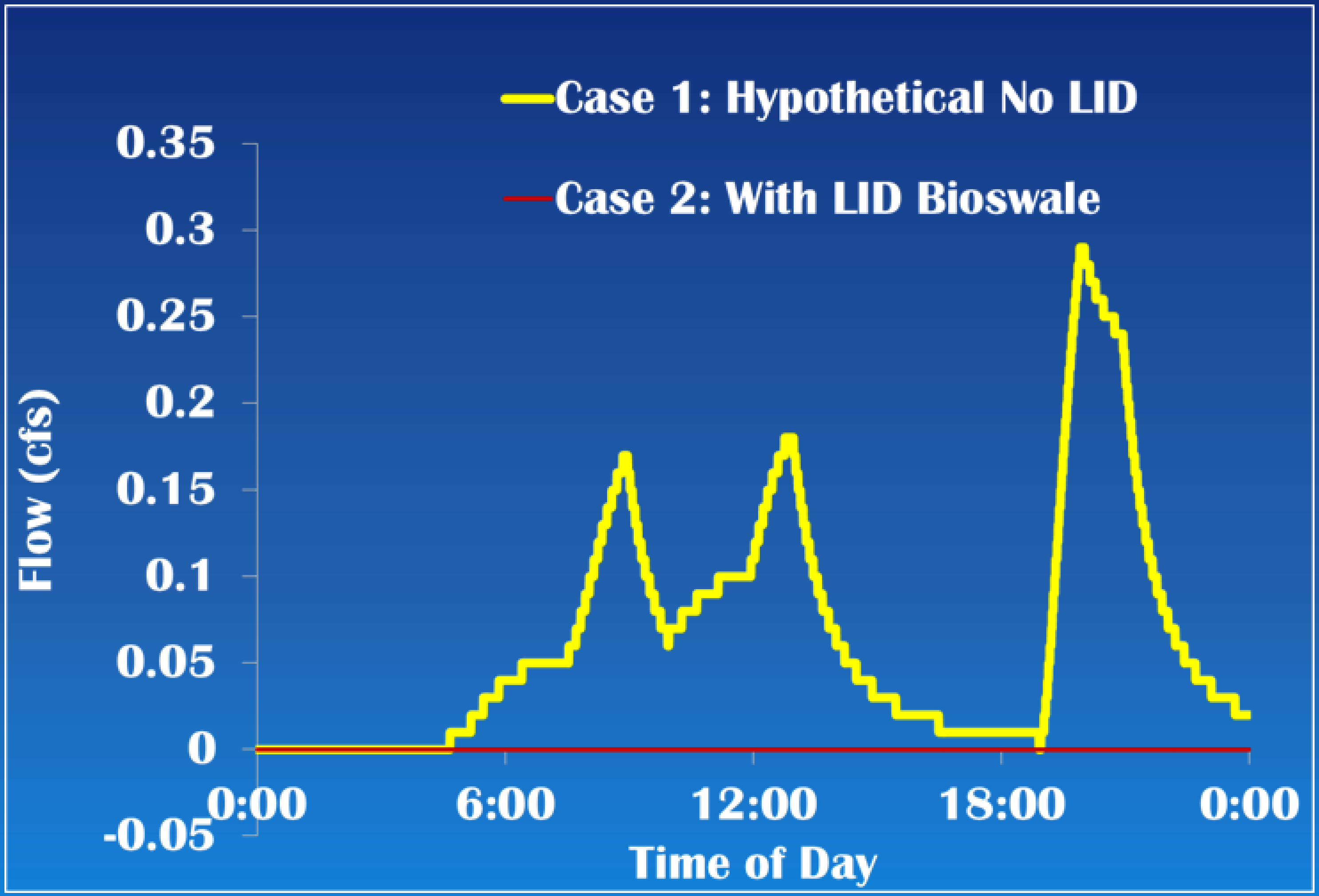
West Dowling Road

- Event 1: 0.53 inches in 24 hrs on July 21



West Dowling Road

- Event 2: 0.19 inches in 24 hrs on August 1



West Dowling Road

Case	July 21, 2012		August 1, 2012		10-year, 24-hour Rainfall (Synthetic)	
	Peak Flow (cfs)	Runoff Vol (cf)	Peak Flow (cfs)	Runoff Vol (cf)	Peak Flow (cfs)	Runoff Vol (cf)
Case 1 - No LID	0.96	18,426	0.29	5,576	11.87	593,375
Case 2 - Bioswale	0.64	4,617	0	0	11.56	405,033
% Decrease	33%	75%	100%	100%	3%	32%

Muldoon Road Landscaping Vicinity Map

Muldoon Road

- Project layout was not practical for on-site instrumentation.
- Performance was evaluated by modeling the project area in SWMM and completing visual inspection.


Muldoon Road

- Modeled 2 cases
  - Case 1:No LID, traditional impervious corridor
  - Case 2: As constructed, with landscaping
- Outflow hydrographs were prepared for both cases, showing flow out of the project area into downstream Chester Creek for 3 rain events.
  - Event 1: Synthetic 90th Percentile Event, 0.52 inches in 24 hours.
  - Event 2: 0.19 inches in 24 hrs, August 1, 2012
  - Event 3: Synthetic 10-yr, 24-hr event, 1.77 inches.

Muldoon Road

Case	90th Percentile Event		August 1, 2012		10-year, 24-hour Rainfall (Synthetic)	
	Peak Flow (cfs)	Runoff Vol (cf)	Peak Flow (cfs)	Runoff Vol (cf)	Peak Flow (cfs)	Runoff Vol (cf)
Case 1 - No LID	0.07	5,489	0.12	1,699	3.59	20,473
Case 2 - Landscape Areas	0.06	4,487	0.1	1,394	2.9	16,771
% Decrease	14%	18%	17%	18%	19%	18%

Muldoon Road

- Developed methods for improving performance of landscaping as LID
  - Allow water from surrounding areas to flow to landscaping.
  - Depress the final elevation of the landscaped areas to allow ponding and help minimize erosion of the top layer.
  - Consider omitting landscape walls.

Questions?

What's Next?

What will we do with the information from the Pilot Projects?

Design Criteria Manual Updates

- Committee has been providing input on existing design criteria and new criteria for LID concepts.

- Committee has helped identify several outstanding questions regarding implementing LID requirements for all projects.

Implementation Plan

- Process to phase projects into full permit compliance over the next 5 years.
- Plan will address outstanding questions and specific challenges to implementing LID.
- Perform more pilot projects to address specific items of concern.
- This idea was recently approved and is still in development.

Questions and Challenges

- What is the best way to handle site-specific challenges, (e.g. silty soils, narrow ROW widths, etc)?
- Should there be constraints of soil infiltration? Lower limit? Factor of safety?
- How can we best address downstream impacts?
- How can we best address maintenance needs?

Questions and Challenges

- Can we combine green infrastructure and required landscaping?
- What additional types of education and outreach are needed?
- Does our current project review process need modification?

Questions and Challenges

- How can we resolve potential conflicts with existing building code?

- Can we develop a process to treat all LID projects as “Pilot Projects” and get performance data?

Questions and Challenges

- Other ideas or questions?

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Questions and Challenges

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Factors Contributing to the Formation of Icings and Strategies for Control and Mitigation

Jeffrey Urbanus
Watershed Management Services
02/25/2014

…Or How to Keep This…

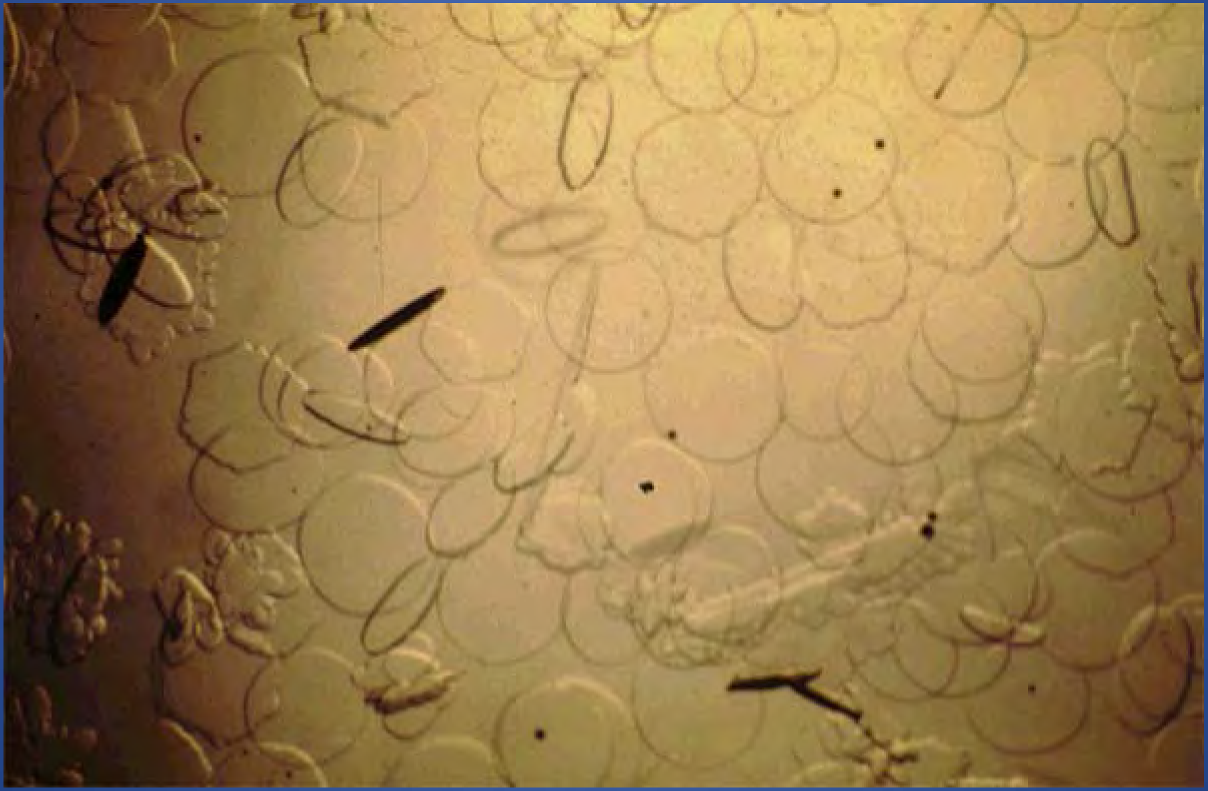


Photo from Daly 2010

…from Turning into This!!!

What do We Mean by Icing?

- Ice masses that are fed by the growth by of water freezing in successive layers.
- Ice and water can spread a great distance beyond normal flow area.
- Typically, two types of icings are encountered in Anchorage
  - Stream Icings
  - Groundwater Icings

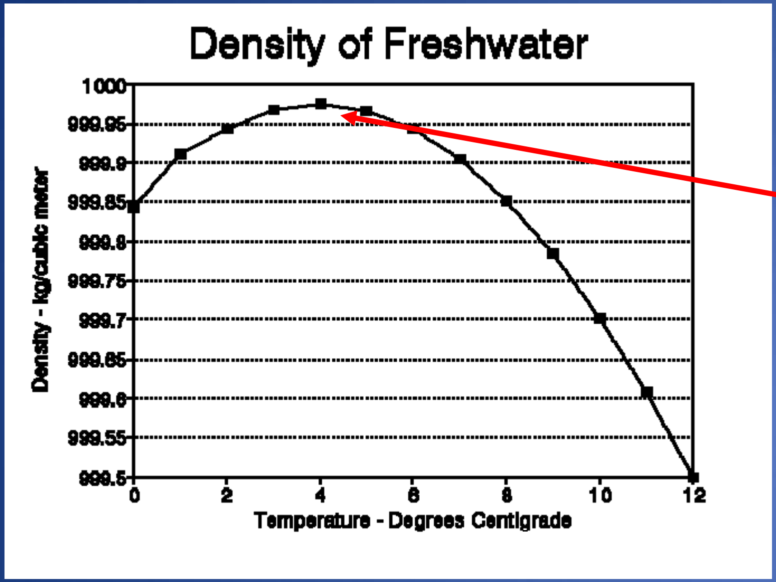
Icing Types

- Stream Icings
  - Driven by heat loss and turbulent flow
  - Blockage of drainage conveyance leads to flooding
- Groundwater Icings
  - Driven by heat loss (exposure) and sustained groundwater flow
  - Ice and water can spread extensively

Why is this Important?

- Generally happens somewhere in Anchorage EVERY year.
  - Sometimes EVERY year in the SAME place.
- Lots of $$$$ - Property damage and labor.
- In many cases can be avoided or minimized with some forethought.
- Avoid the worst question I've been asked….*"Should I chip the ice in my house and then remove it or should I let it melt first?"*

Some Basics-
Water Physics 101



Max Density @ 4°C or Below Freezing

Water Releases Heat as it Freezes A LOT of it!!!

Why do Orange Growers Spray Water when it Gets Cold?

Some Basics-

Factors Influencing Flow Conditions and Heat Loss

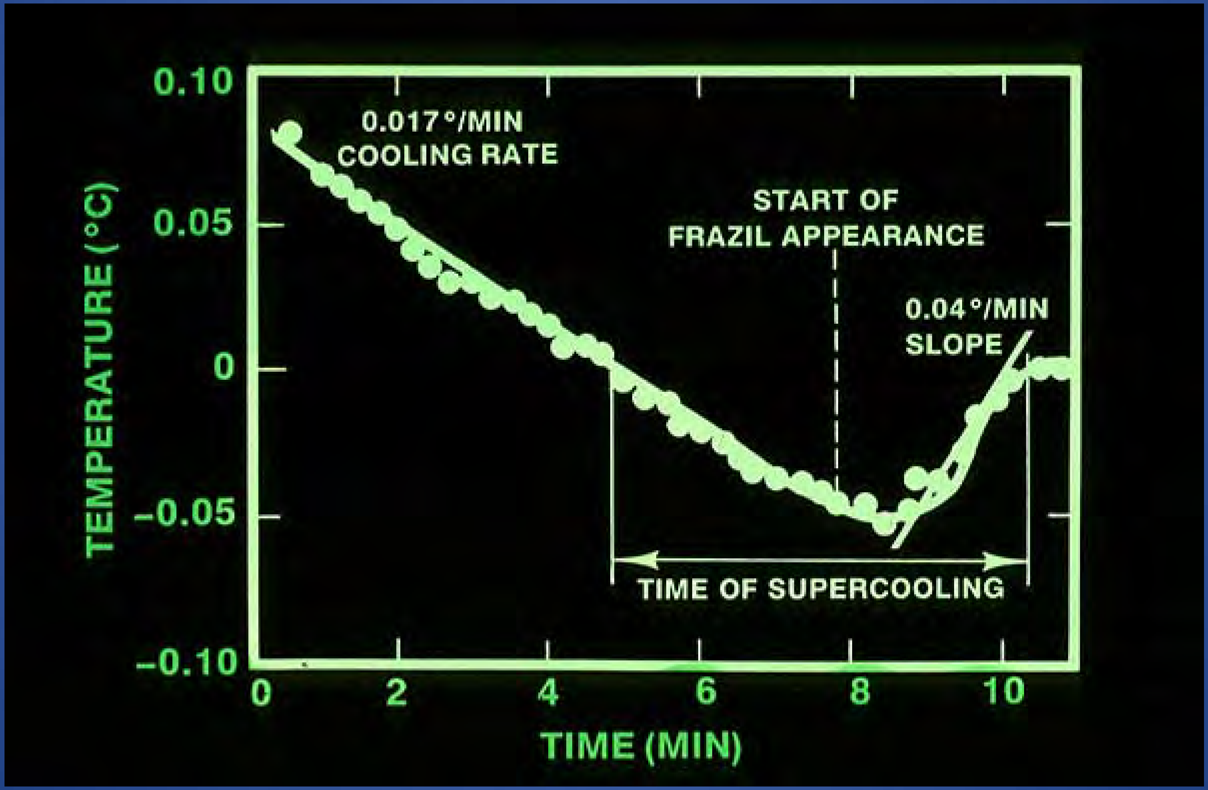
- Deep, narrow channels conserve heat loss better than wide, shallow channels.
- Steeper gradient channels create greater amounts of turbulence.
- Natural channels are more resistant to heat loss.
  - Vegetation
  - Stream Pattern
- Flow volumes can be greatest at freeze-up

Some Basics

Cold (Heat Loss)

- Heat loss occurs through convection, conduction, and radiation.
- Snow and ice provide insulation – particularly in the presence of an air gap.
- In order for most icings to occur cooling must be sustained (diurnal effects).
- In order for ice to form water must be supercooled.

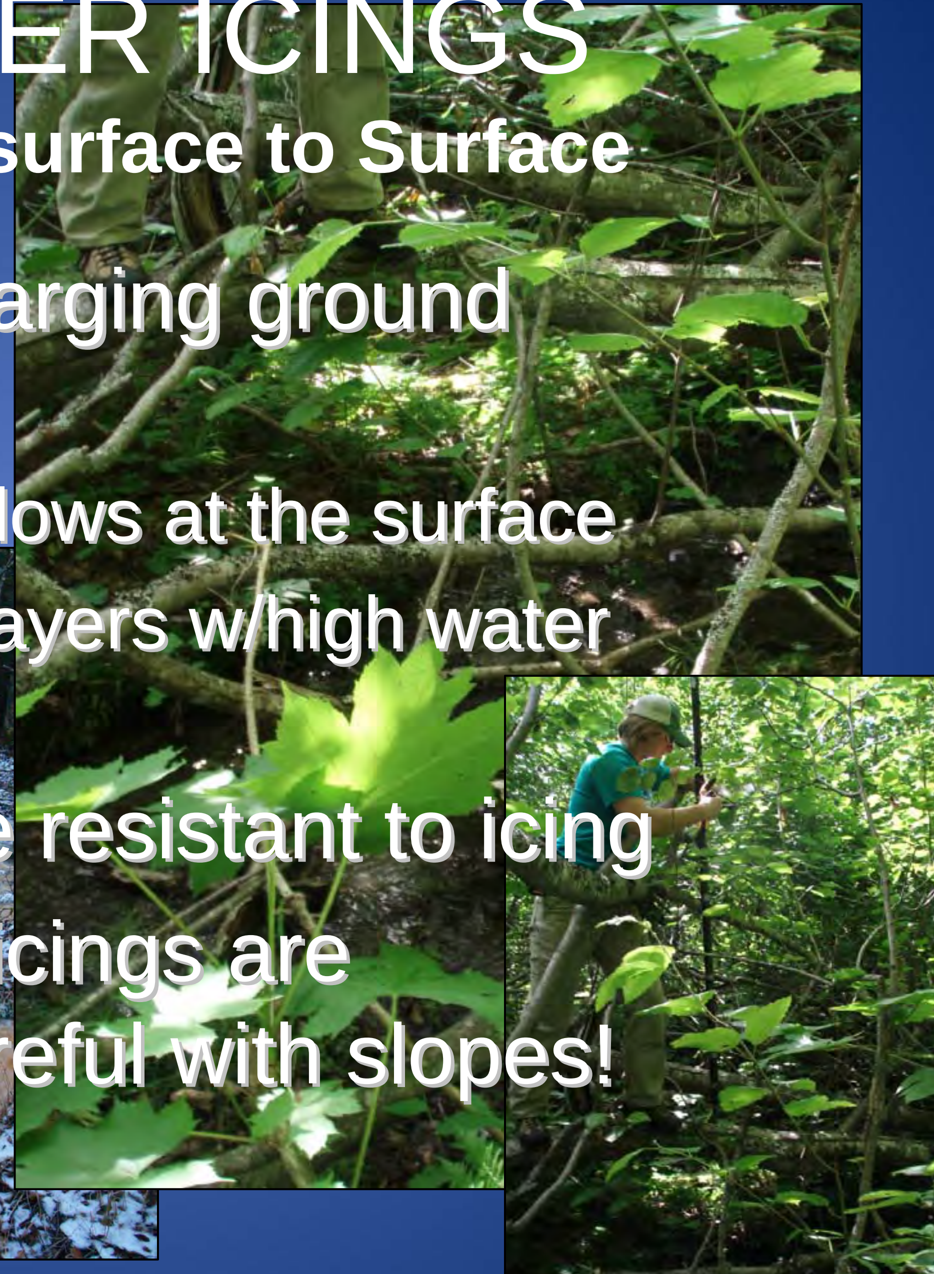
A Few 1/100ths of a Degree Makes a Big Difference!



GROUND WATER ICINGS

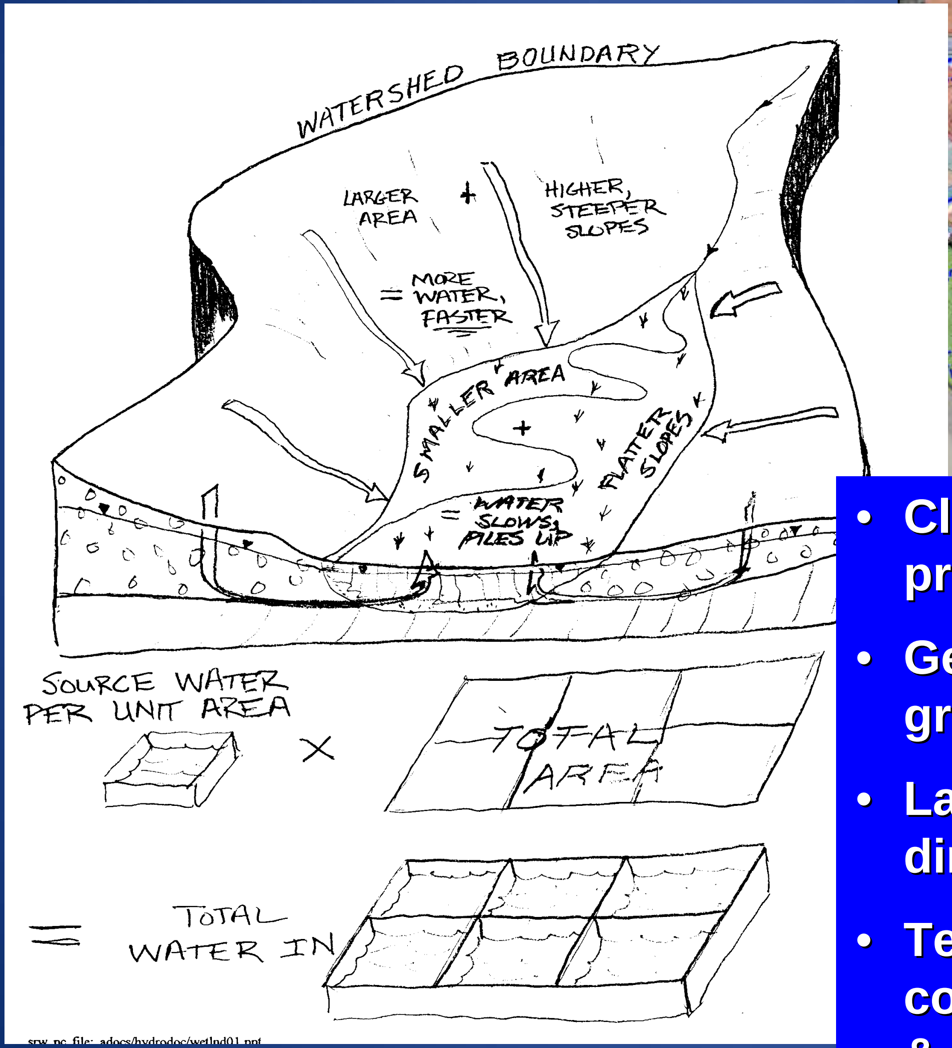
Exposure Driven: Subsurface to Surface

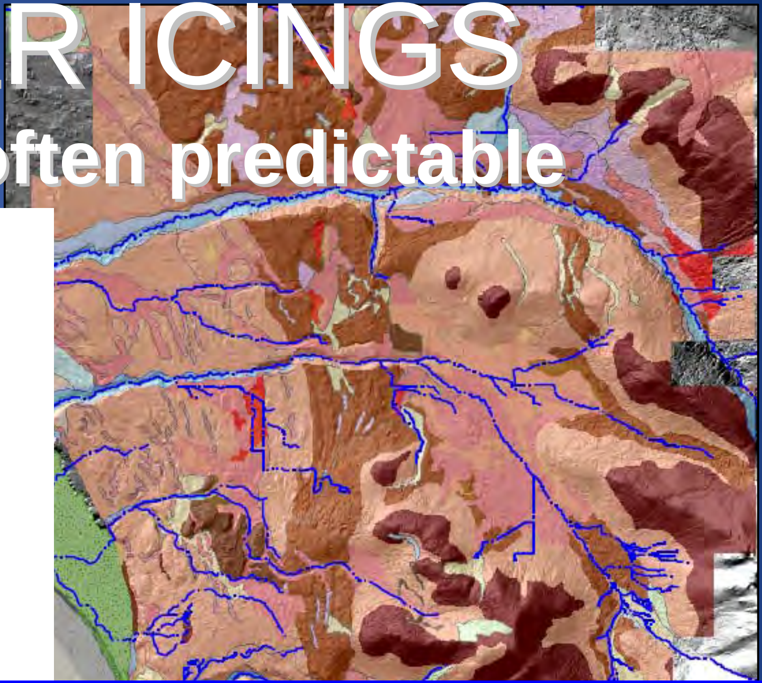
- Develop from discharging ground water
  - Divergent, shallow flows at the surface
  - Create laminar ice layers w/high water content
- Natural systems are resistant to icing
- Many groundwater icings are anthropogenic – careful with slopes!



GROUND WATER ICINGS

Groundwater icings are often predictable



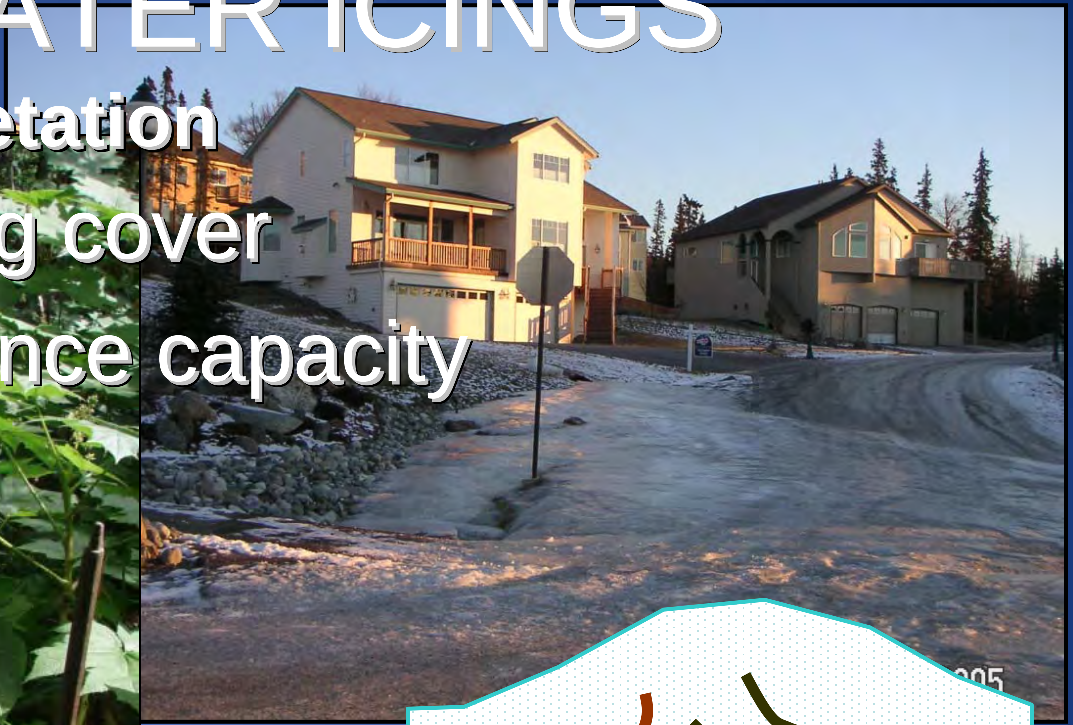


- Climate generates local precipitation patterns
- Geology conveys precipitation as ground & surface flows
- Landforms/frost concentrate and direct ground & surface waters
- Terrain changes reduce conveyance &/or insulating cover & redirect flows to the surface.

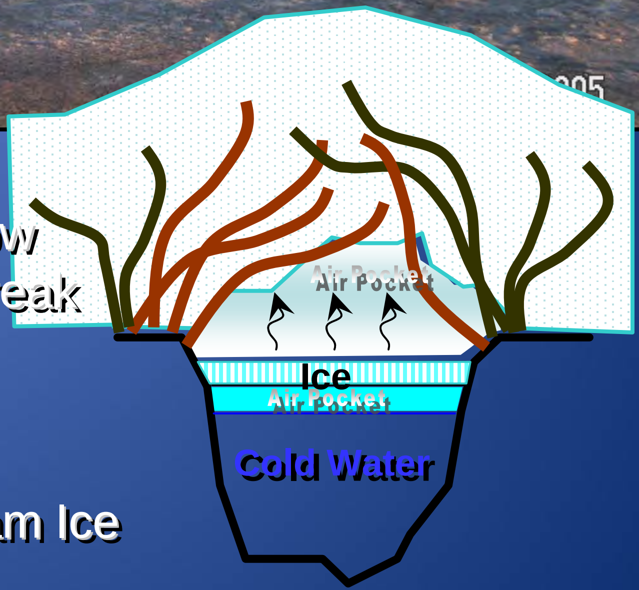
GROUND WATER ICINGS

Exposure: De-Vegetation

- Loss of insulating cover
- Loss of conveyance capacity



Brush:
•Enhances interflow
•Provides Wind Break
•Traps Snow
•Supports Snow
•Adds Air Trap
•'Unweights' Stream Ice



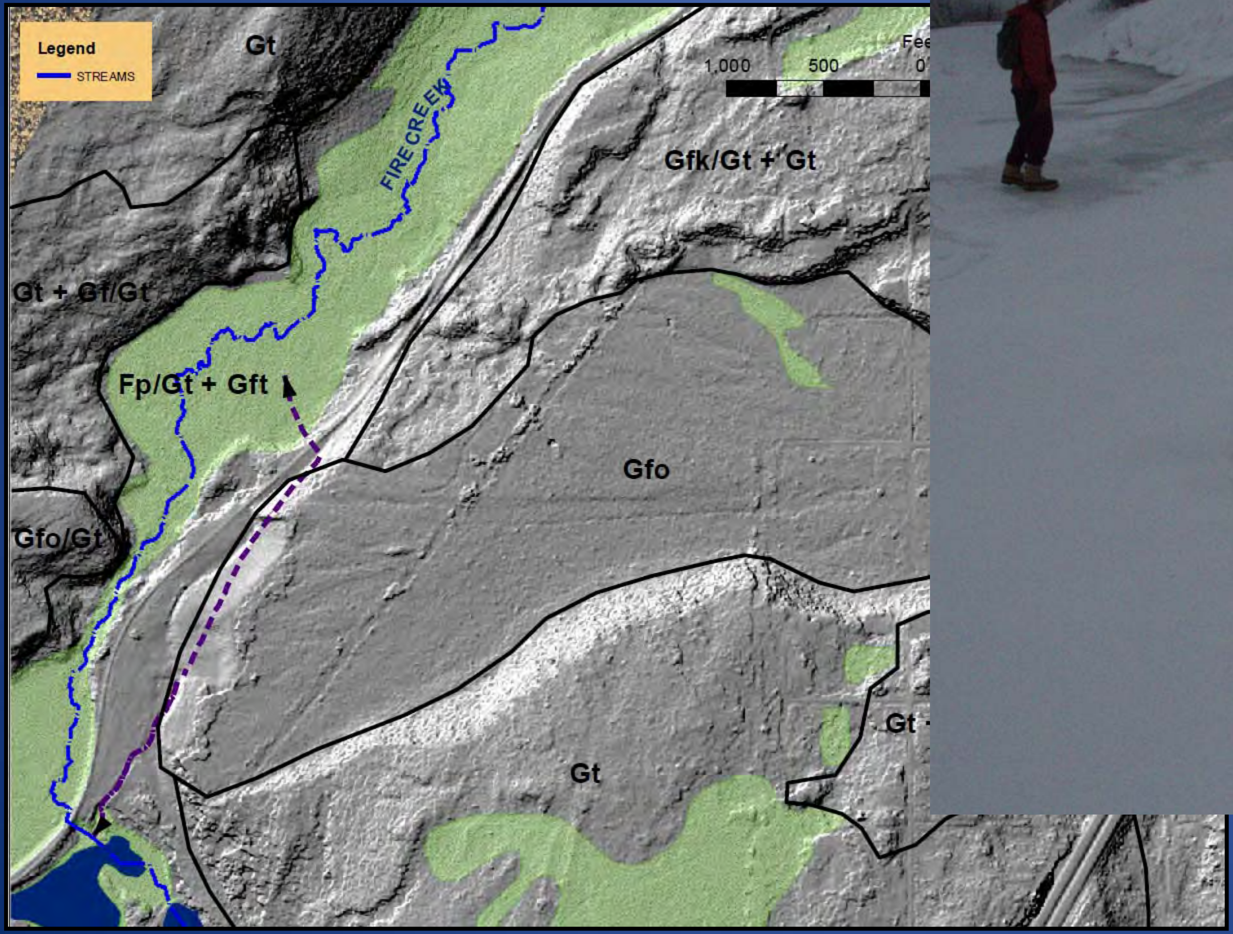
GROUND WATER ICINGS

Exposure: Obstruction and Diversion

Obstruction reveals wetland storage and ‘slow motion’ interflow

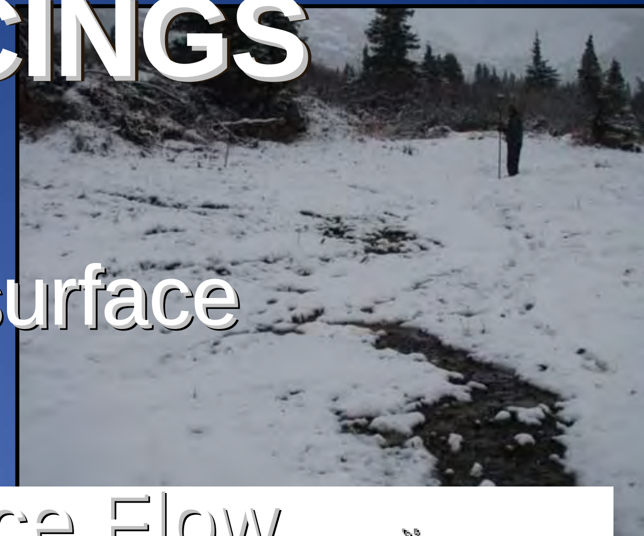
GROUND WATER ICINGS

Exposure: Excavation & Interception

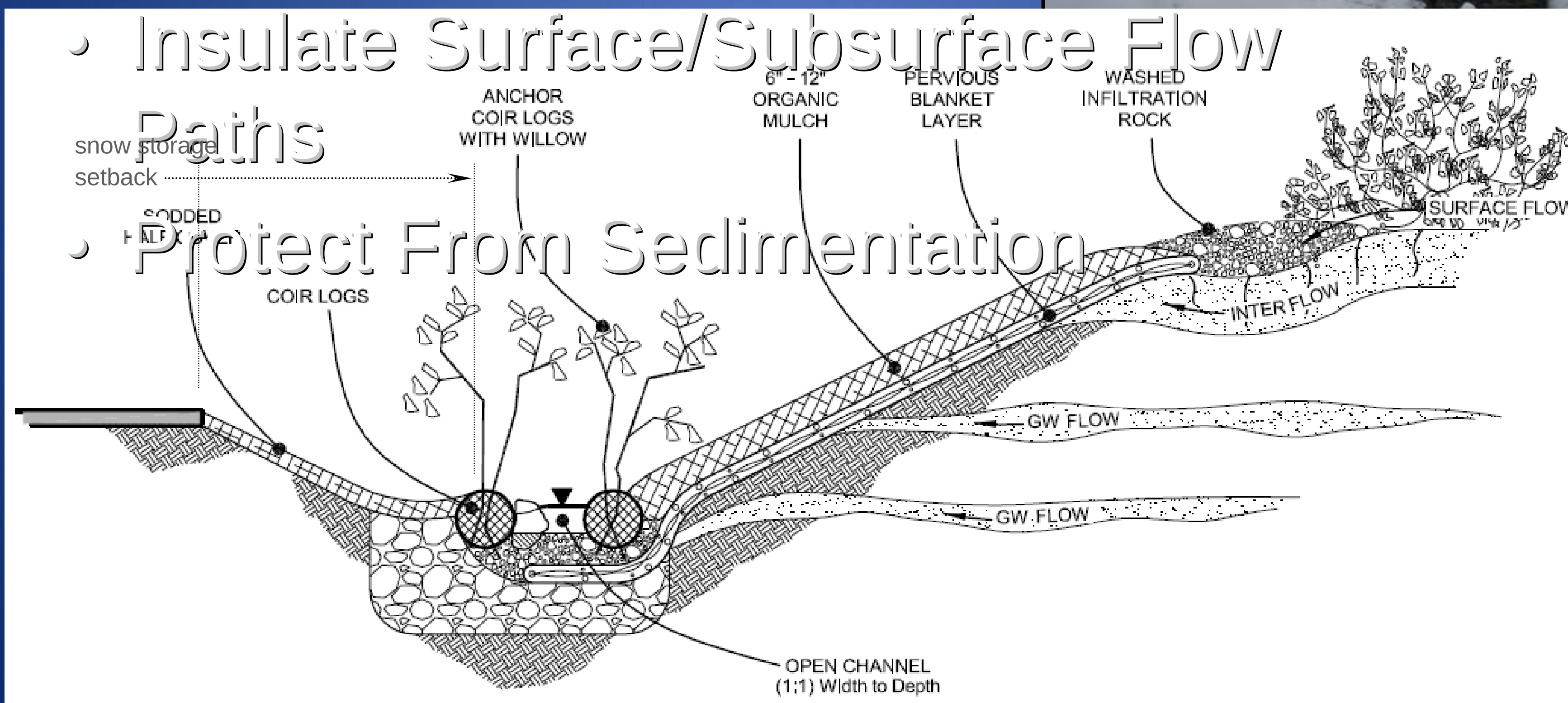


GROUND WATER ICINGS

Conceptual Solutions



- Capture and Convey Subsurface Flows
- Insulate Surface/Subsurface Flow Paths
- Protect From Sedimentation



STREAM ICINGS

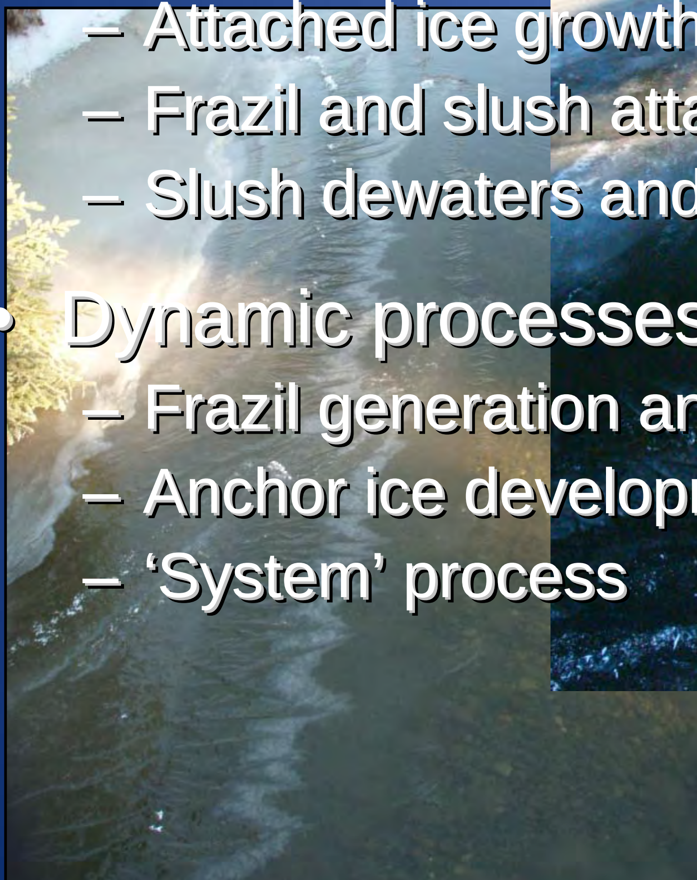
Thermal vs. Dynamic Ice Growth

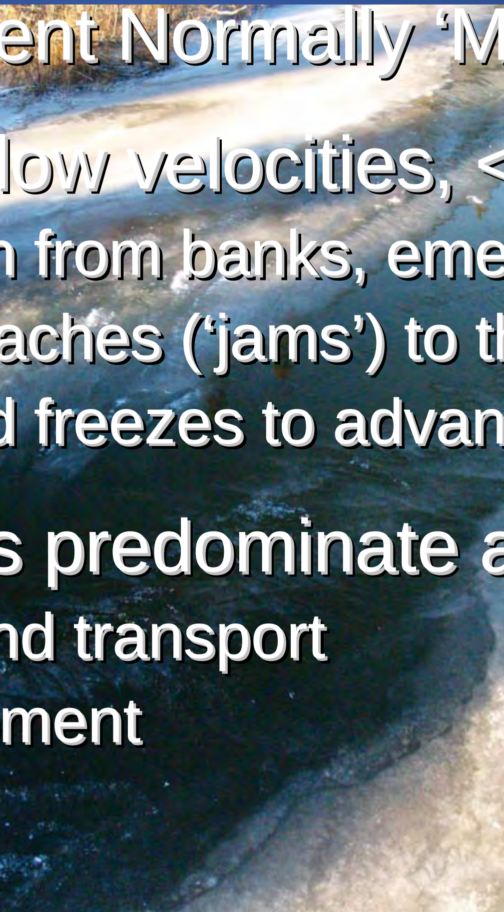
- Thermal Ice Growth
  - Develops at quiescent and very low flow velocities
  - Only surface (top) layer of water is supercooled
  - Ice layer grows to cover most or all of water surface
  - Continued growth dependent on heat loss through ice
    - Air temperature
    - Wind exposure
    - Snow cover
    - Heat gains

STREAM ICINGS

Ice Cover Development Normally 'Mixed'

- Thermal growth at low velocities, <0.35 m/s
  - Attached ice growth from banks, emergent materials
  - Frazil and slush attaches ('jams') to thermal ice
  - Slush dewaters and freezes to advance cover
- Dynamic processes predominate at 0.35-1.2 m/s
  - Frazil generation and transport
  - Anchor ice development
  - 'System' process



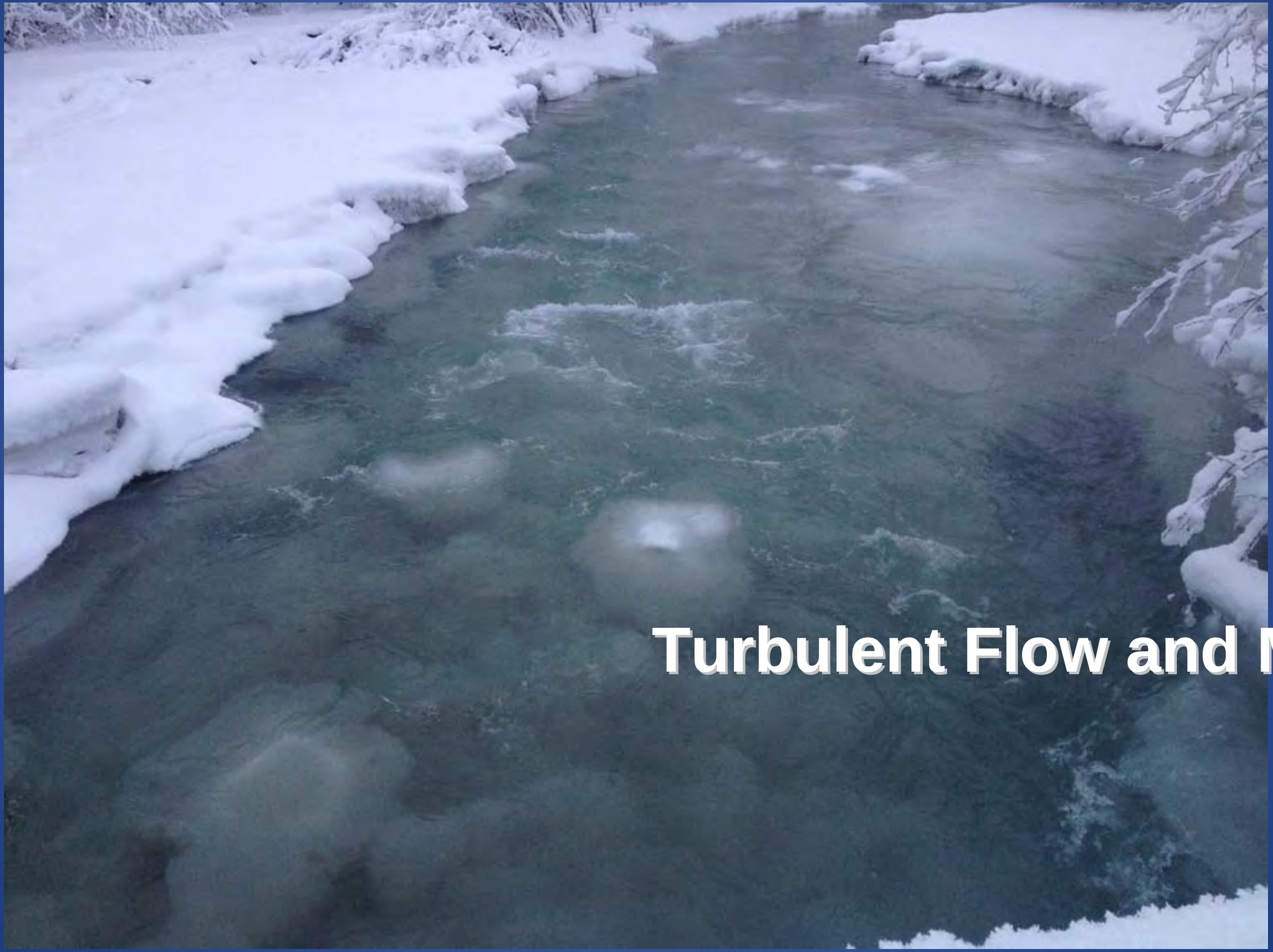


STREAM ICINGS

Dynamic Ice Growth in Small Streams

- Dynamic Growth Conditions
  - Turbulent flow, mixing from top to bottom
  - Sustained cold temperatures
  - Open water
- Dynamic Growth Stages
  - Frazil development
  - Frazil transformation/transport
  - Anchor ice development
  - Formation, of flocs, floes and pans
  - Backwater (flood stage)
  - Ice cover development
  - Thermal erosion (final stage)

How Come the Ice isn’t on the Top?



Turbulent Flow and Mixing!!

FRAZIL ICE IN RIVERS

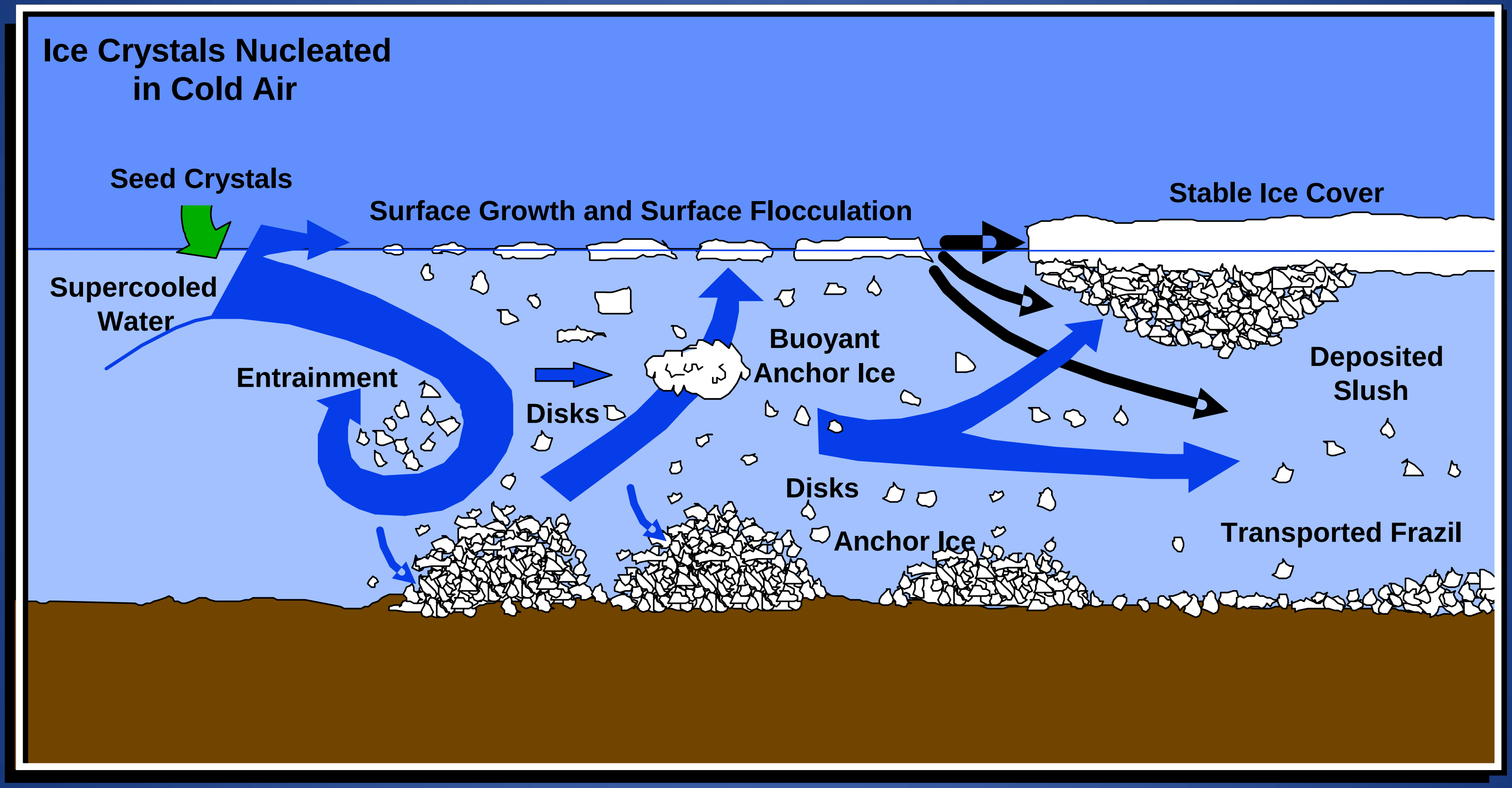
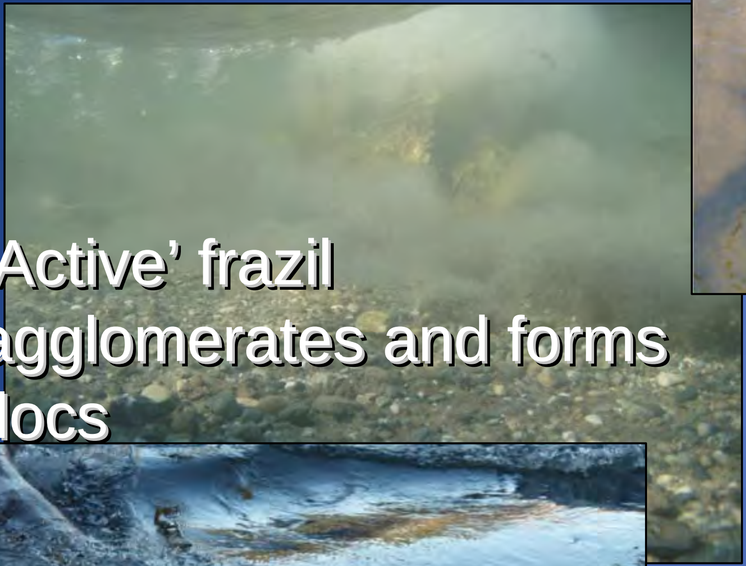
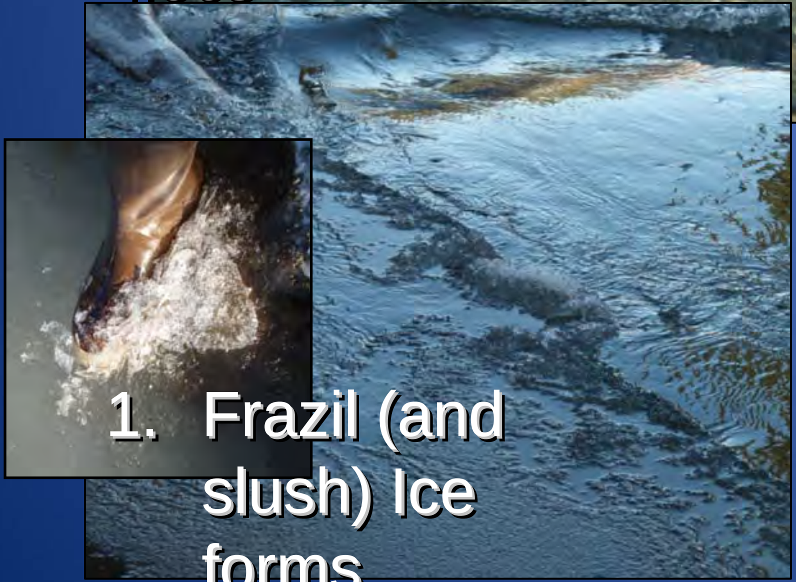


Figure from Daly 2010

STREAM ICINGS

Anchor Ice Development





3. ‘Active’ frazil & flocs attach & grow as submerged ‘anchor Ice’

2. ‘Active’ frazil agglomerates and forms flocs

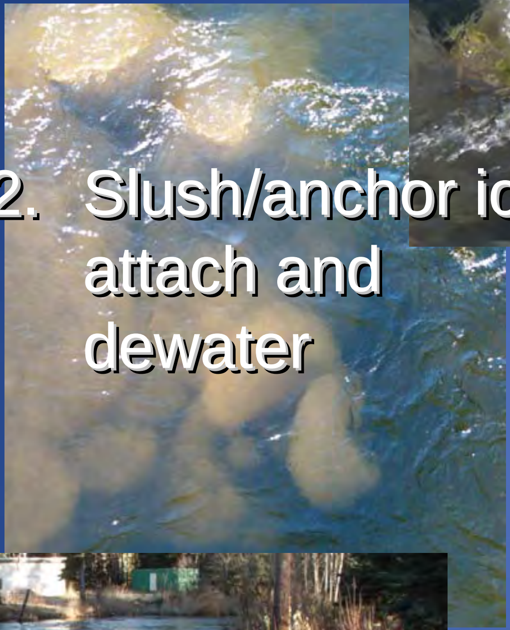
1. Frazil (and slush) Ice forms

4. Anchor ice merges, constricts hydraulic section

STREAM ICINGS

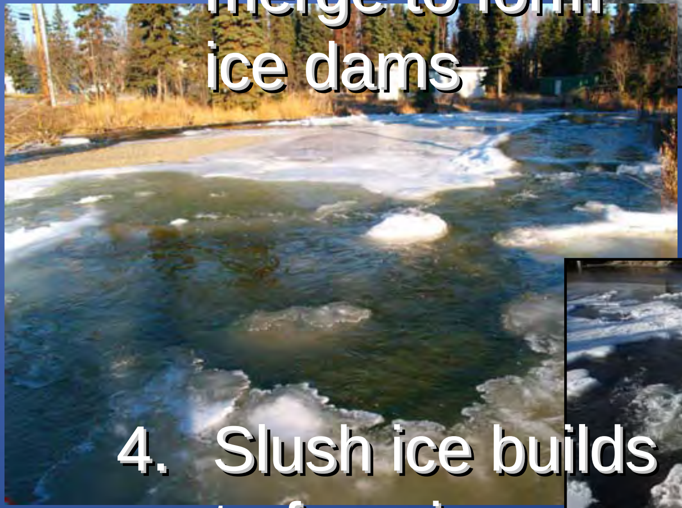
‘Ice Dam’ Formation

1. Rapids generate & transport frazil



2. Slush/anchor ice attach and dewater

3. Slush/anchor ice merge to form ice dams



4. Slush ice builds to form ice ‘levees’

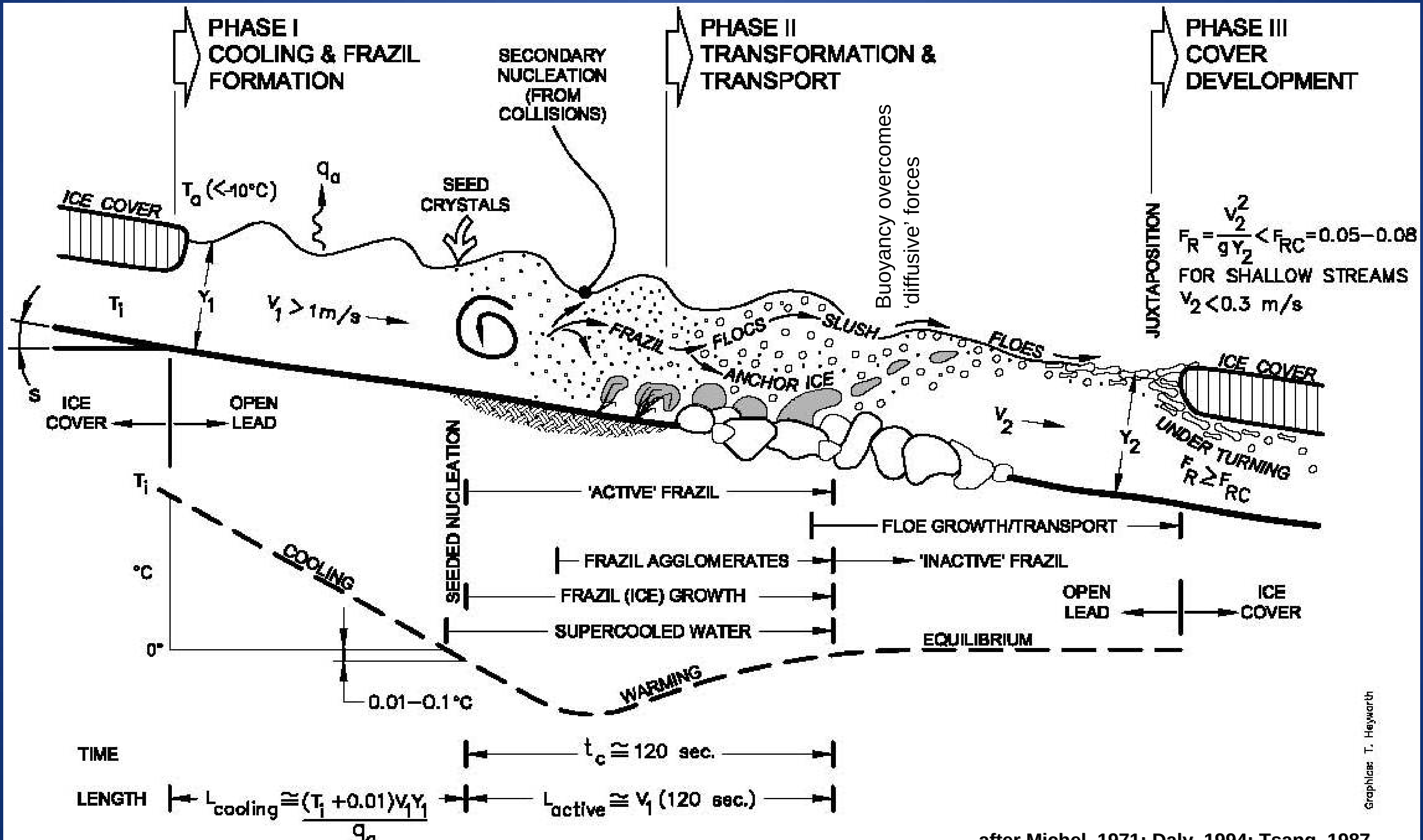
STREAM ICINGS

Ice Cover Development

1. Ice dams in place
2. Stage rises behind dams
3. Ice cover develops on quiet backwaters
4. Ice dams erode; stage drops
5. Ice cover stabilizes; (turbulence/exposure reduced)

STREAM ICINGS

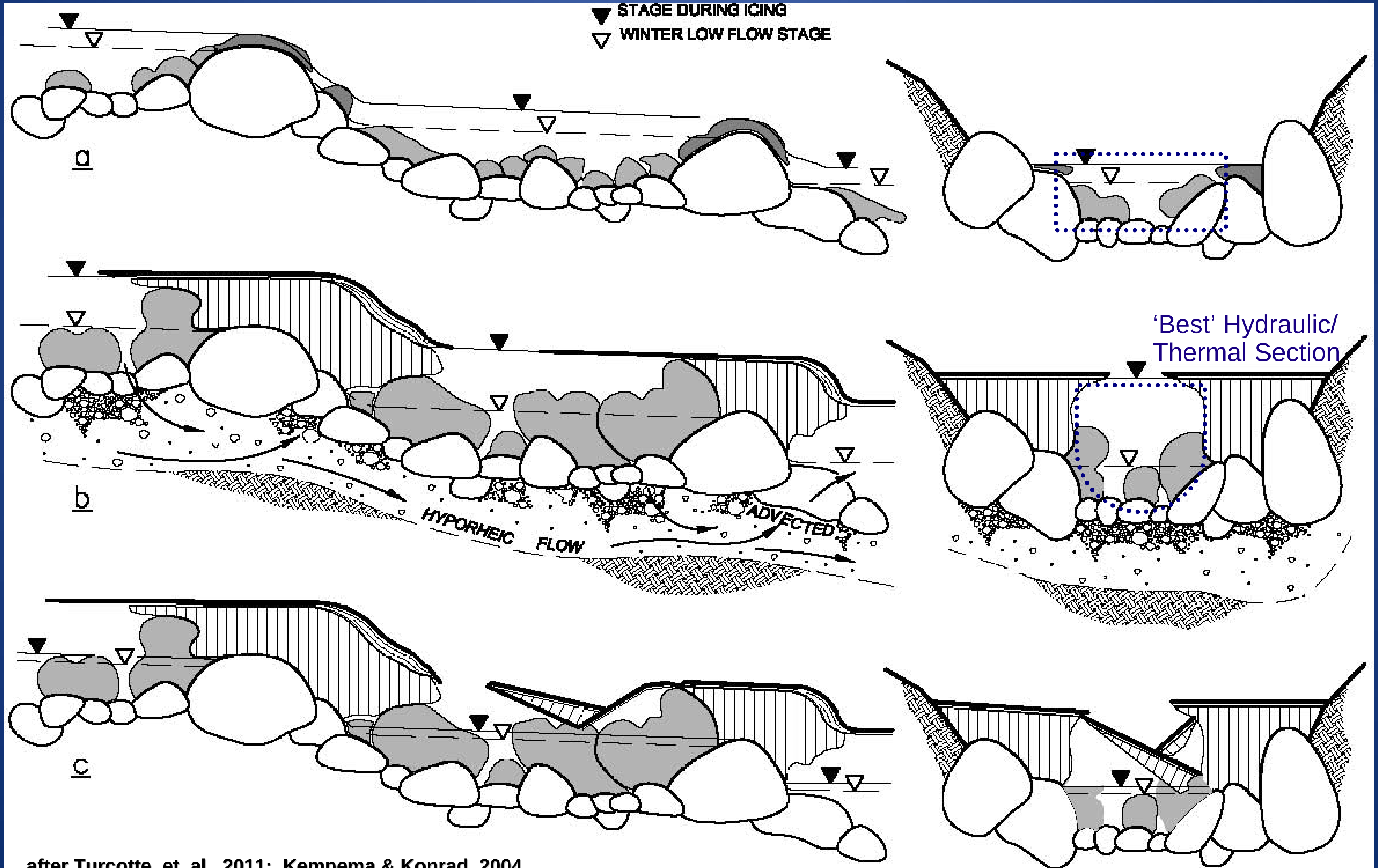
Putting it all Together ..a Spatial-Temporal Process



after Michel, 1971; Daly, 1994; Tsang, 1987

STREAM ICINGS

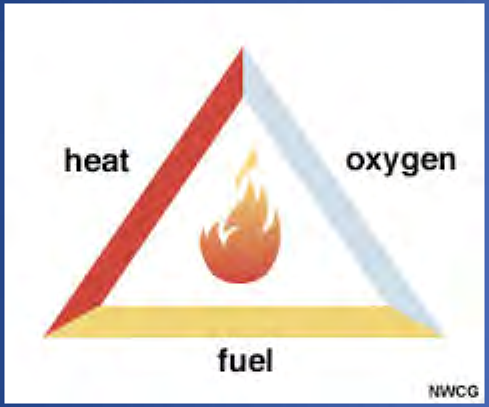
Ice Cover Development in High Gradient Streams



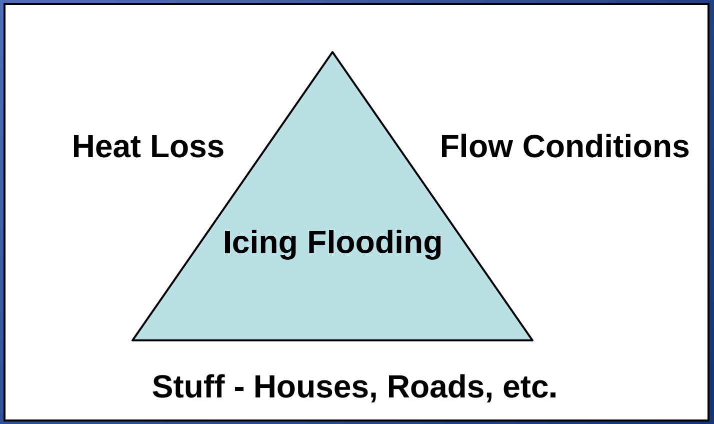
after Turcotte, et. al., 2011; Kempema & Konrad, 2004

A System-wide Approach to Fixing Stream Icings

The Fire Triangle



A Flooding Triangle for Icing?



What is the real problem?

- Minimize encroachments beforehand
  - Hard to move a house after the fact
- The ice causing the flooding here started up there
  - Address thermal conditions upstream
    - Vegetation
    - Warm water inputs? Success in other jurisdictions.
    - Re-sizing or resetting of culverts
  - Break-up long stretches over-steepened streams

The real problem (cont.)

- Catch/contain frazil ice upstream of the problem, possible
  - Open rock weirs?
  - Booms and nets have been used in other jurisdictions

Some Common Mistakes from Focusing too Narrowly

- “I’m flooding, better make the channel bigger.”
  - Big = Wide = Shallow = More Heat Loss
- “Let’s get rid of all this ice.”
  - I keep removing the scab and this cut keeps bleeding
  - There’s lots more ice where that came from
  - Just how much ice are you planning on removing, anyways?

…More Mistakes

- “These trees keep catching all this ice, better get rid of them.”
  - Loss of bridging vegetation to support ice and snow cover
  - Ice dams/weirs promote upstream ice cover and quiescent flows, stopping the formation of frazil
    - Remove trees where localized flooding is problematic, keep them where encroachments and channel geometry allow for backwatering

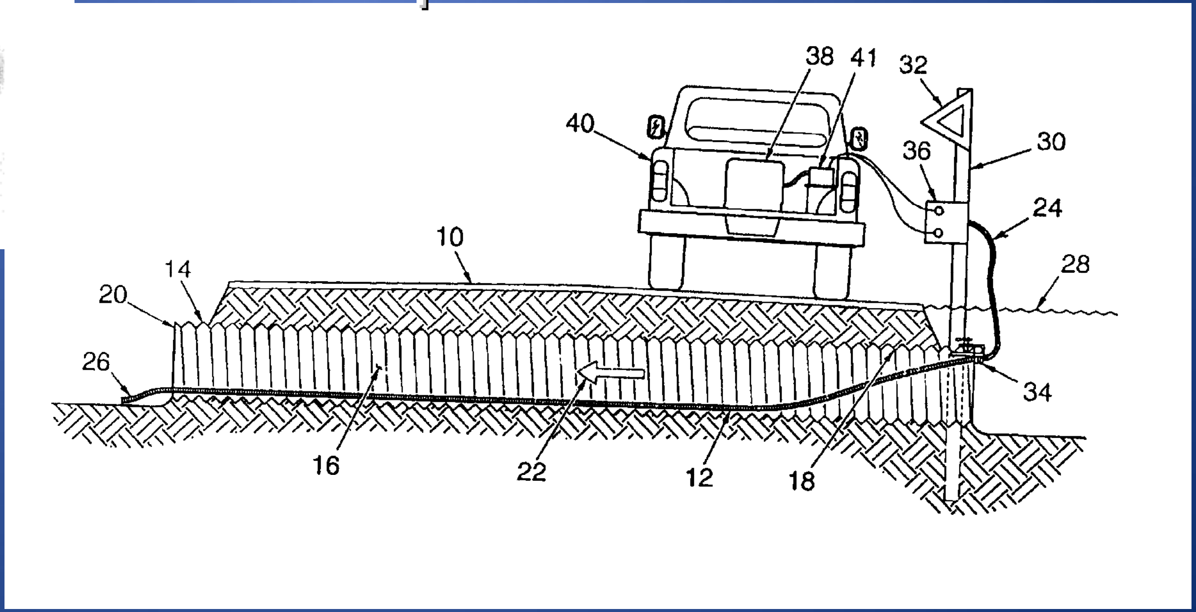
STREAM ICINGS

Mitigation Solutions –General Concerns

- Have a plan ahead of time!
  - Locate recurrent icings
  - Locate & flag channels
  - Train folks

Mitigation Solutions

- Electrical Thaw Systems
  - Sensor actuated or always on
  - Parallel circuit, self-limiting heating cable
  - PVs possible?



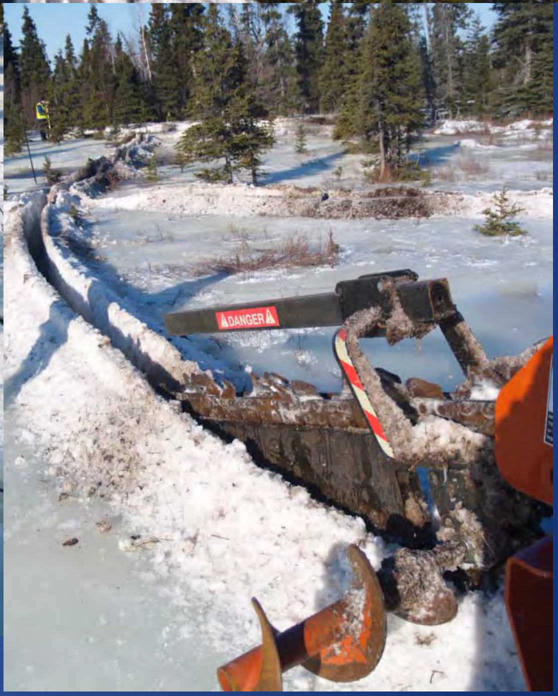
Mitigation Solutions

- Steam Thaw Systems
  - Slow
  - Effective
  - Expensive
  - Minimal damage

Mitigation Solutions

- Trenching Systems
  - Fast
  - Map your channel before
  - Slush Removal is Key!





The Case for Ice – Two Examples

Chester Creek 2014

Chester Creek 2014

Rabbit Creek 2014

What Happened When it got Cold Again?

- Chester Creek started the whole process over again, and again.
- Rabbit Creek was fine, no further problems this year
- Same for Peters Creek, Little Peters Creek, and others.
- The difference? A more natural channel with opportunities for a suspended ice cover. Protection from heat loss

The Case for Geometry and Vegetation

Remember this Place?

Geometry and Vegetation

Before

Limited Cover- Exposed Culvert
No Vegetation to Limit Heat Loss
Wide, Shallow Channel
LOTS OF ICE!!!!!

After

Insulated Culvert
Brushy Vegetation to Limit Heat Loss
Deep, Narrow Channel
Best of All – NO ICE

There's a lot of Resources out There!

- Archived Resources
  - CRREL (USACOE Ice Engineering Manual, http://www.crrel.usace.army.mil/)
  - NRCC (CRIPE archives, Com. on River Ice Processes & Eng., http://www.cripe.ca/)
- General References
  - Michel, 1971
  - Burgi & Johnson, 1971
  - Carey, 1973
  - Kane, 1981
- Ice Cover Development
  - Dingman & Assur, 1969
  - Michel et. al., 1980
  - Osterkamp & Gosink, 1983
  - Tsang, 1987
  - Daley ed., 1994
  - Hirayama et. al., 1997
  - Kempema & Konrad, 2004
  - Turcotte et. al., 2011
- Control & Mitigation
  - Zarling, 1981
  - Tuthill, 2008

Questions? Ideas?

Fun Stuff

- http://www.youtube.com/watch?v=9V9p4mFEYXc

2013 Little Campbell Creek Watershed Drainage Plan

Municipality of Anchorage

Public Works Department

February 25, 2014

Why Plan?

- **Planning sets priorities, solves problems, and identifies funding opportunities**
- **The LCC Plan provides a guide to manage and prioritize storm water and drainage improvement projects to meet WMS's water quality and drainage goals**

LCC Plan Outline

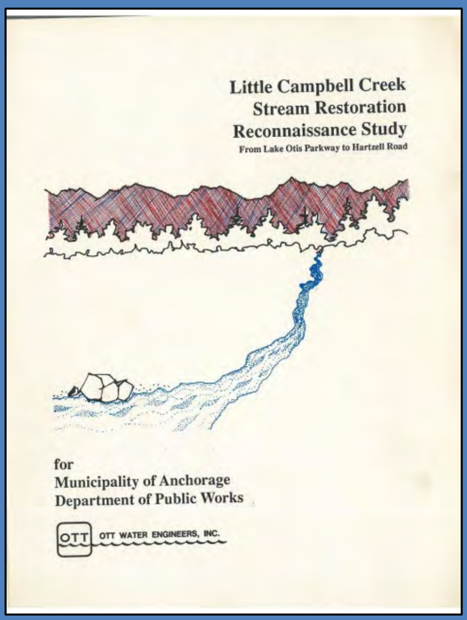
1. **Introduction and Background**
2. **Institutional Setting**
3. **Project Development**
4. **Drainage Alternatives Evaluation**
5. **Capital Improvement Project Cost Estimation**
6. **Implementation Strategy**

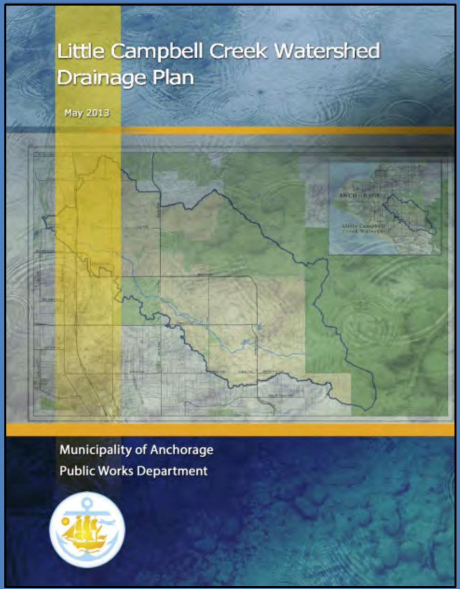
What we will cover

- **LCC History**
- **Jurisdictional Boundaries/Regulatory Authority**
- **Hydraulic Model Development**
- **Drainage Deficiencies**
- **Operation & Maintenance and Habitat Maintenance**
- **Evaluative Criteria and Project Ranking**
- **Cost Estimate Methodology**
- **Capital Improvement Program**
- **Implementation Strategy**

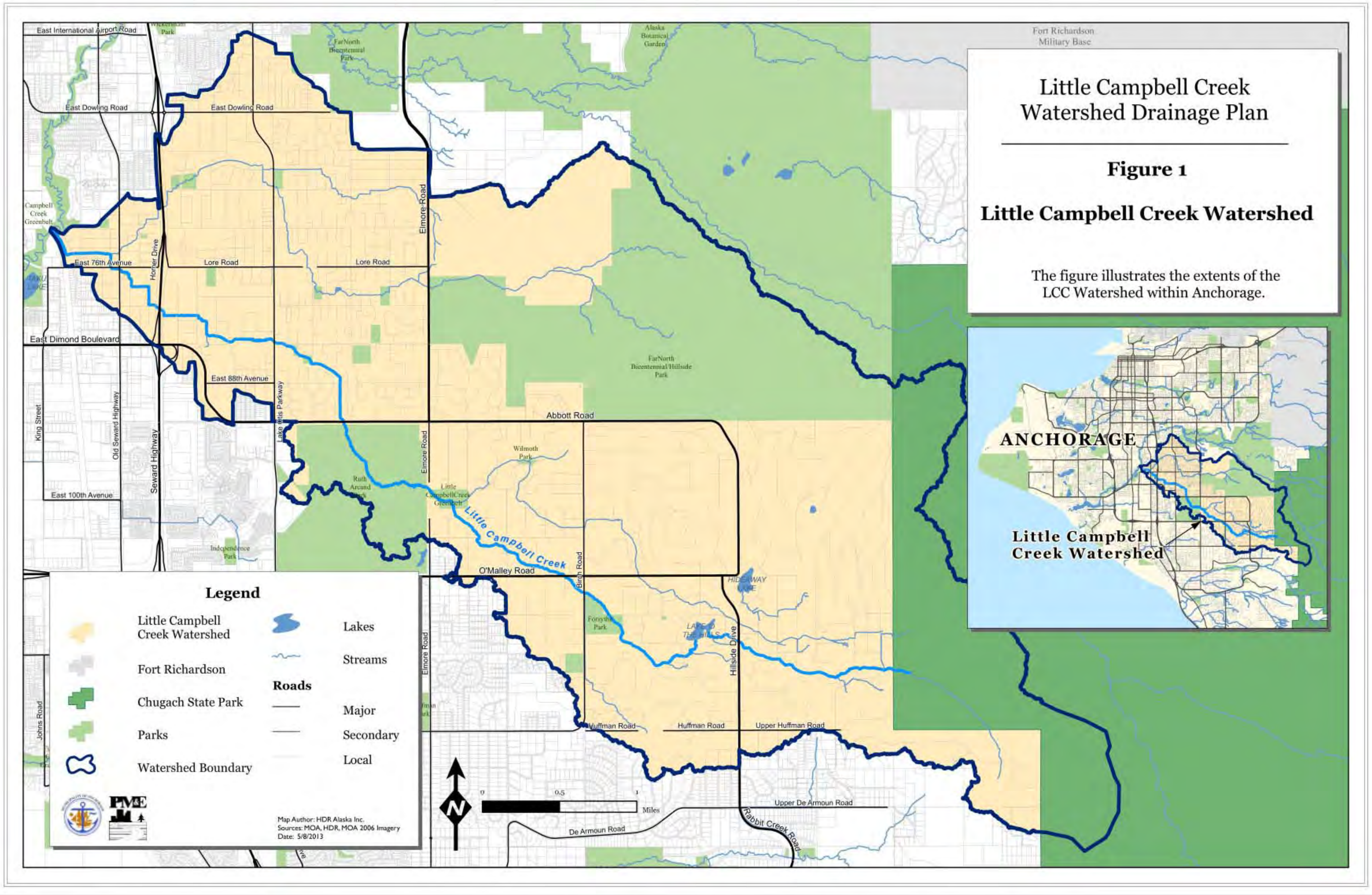
History of the LCC Plan

1983	2007	2013
Last LCC Plan	WMP	Updated

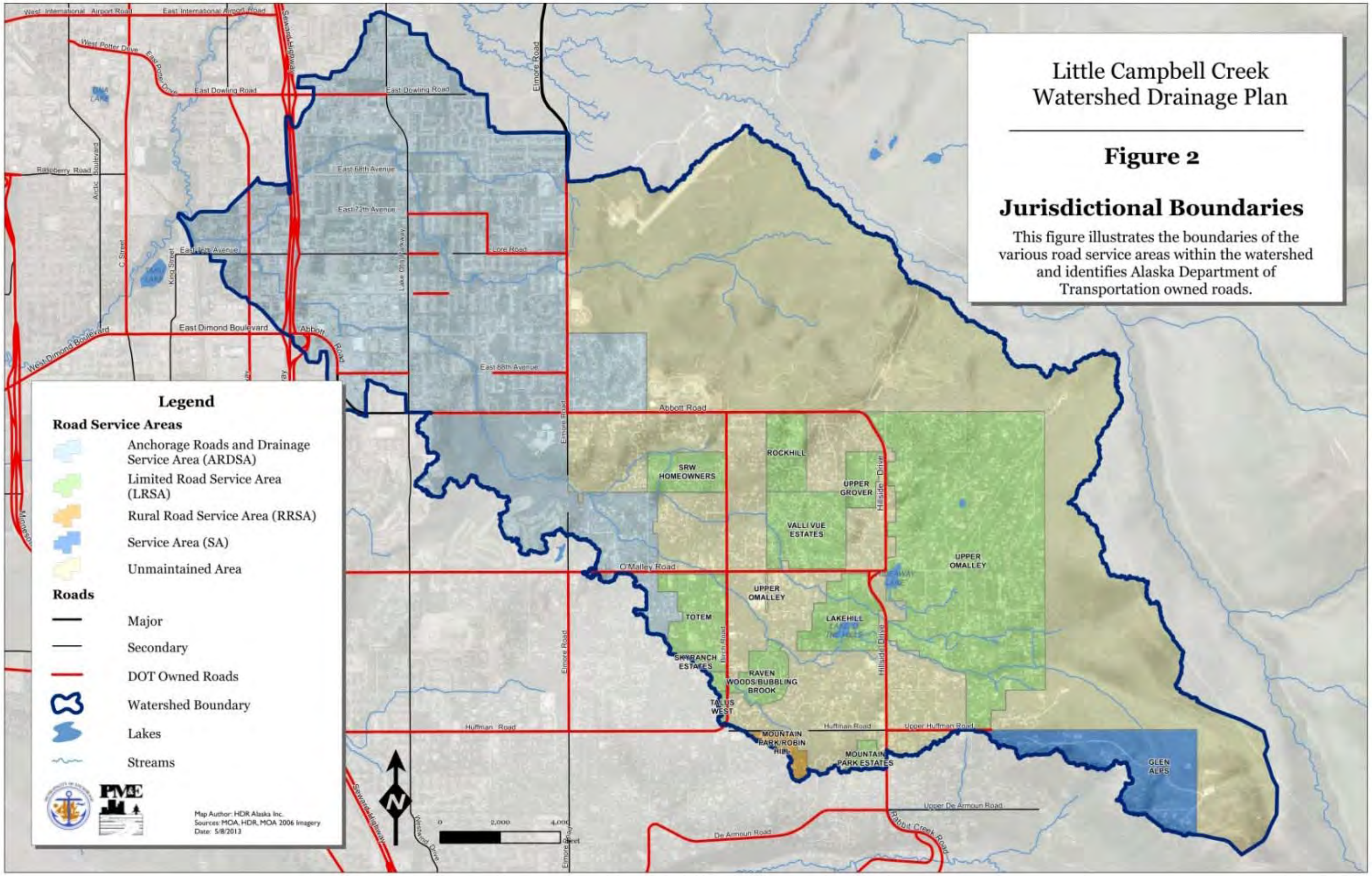




LCC Watershed Area Map

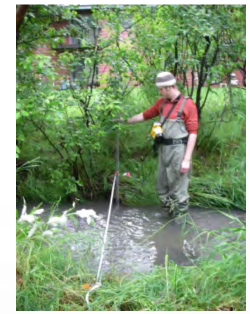


LCC Institutional Setting

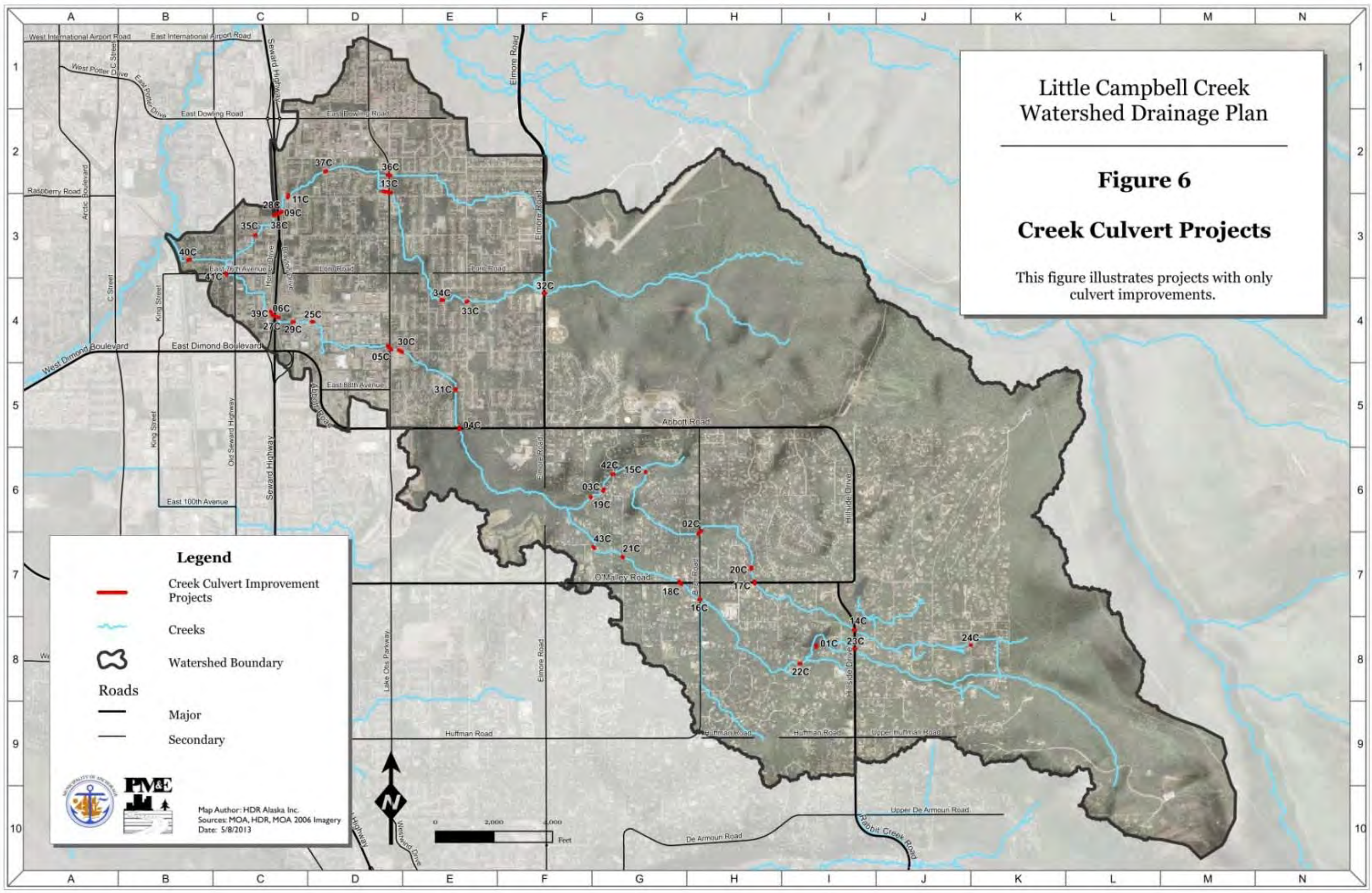


Data Collection and System Analysis

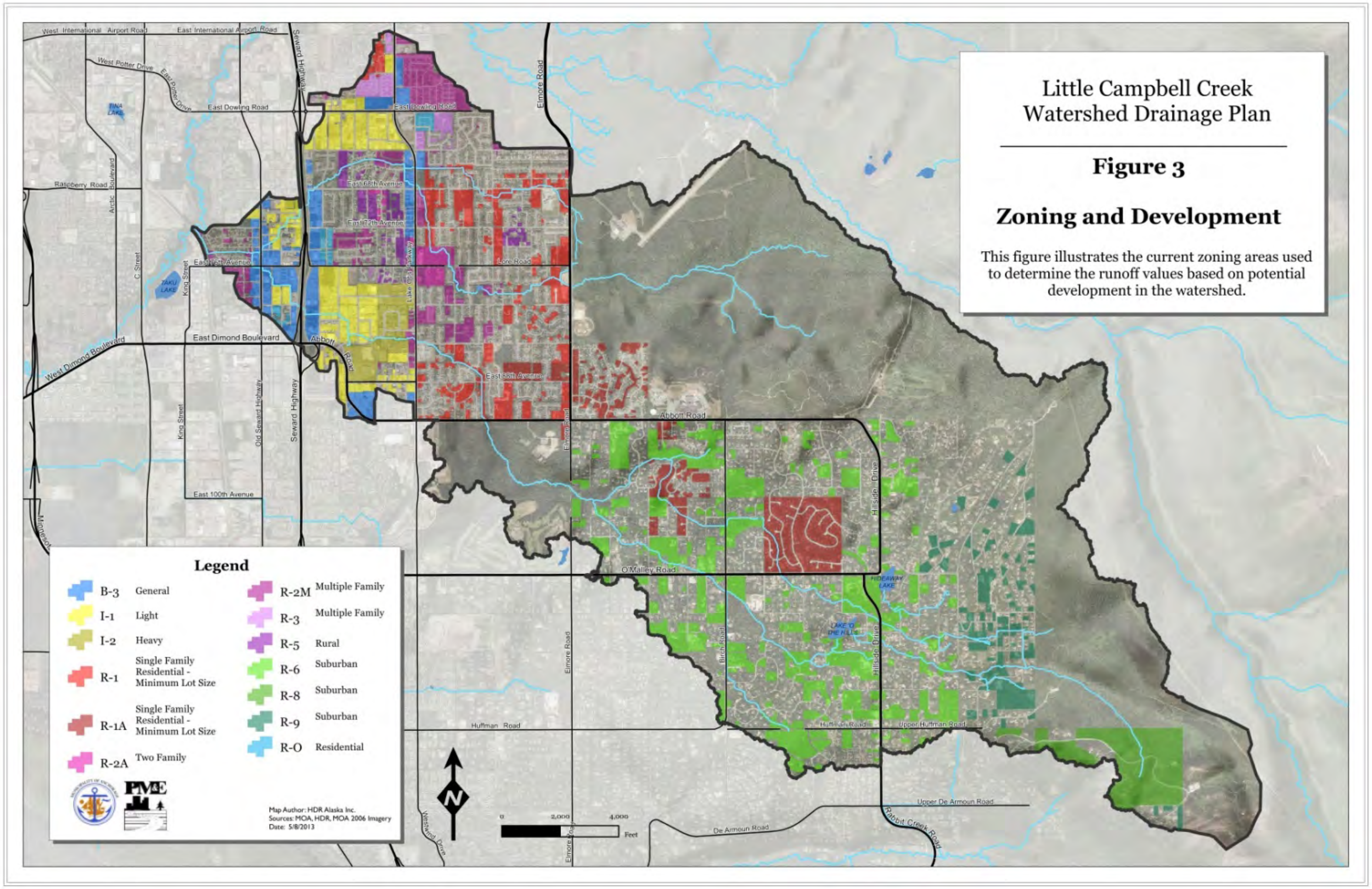
- **Data Collection**
  - *Collect data on LCC features*
  - *Verify sub-basin delineations*
- **System Analysis**
  - *Two separate H&H computer simulations*
  - *SWMM for lower, more urban area. HEC-HMS for more rural areas*



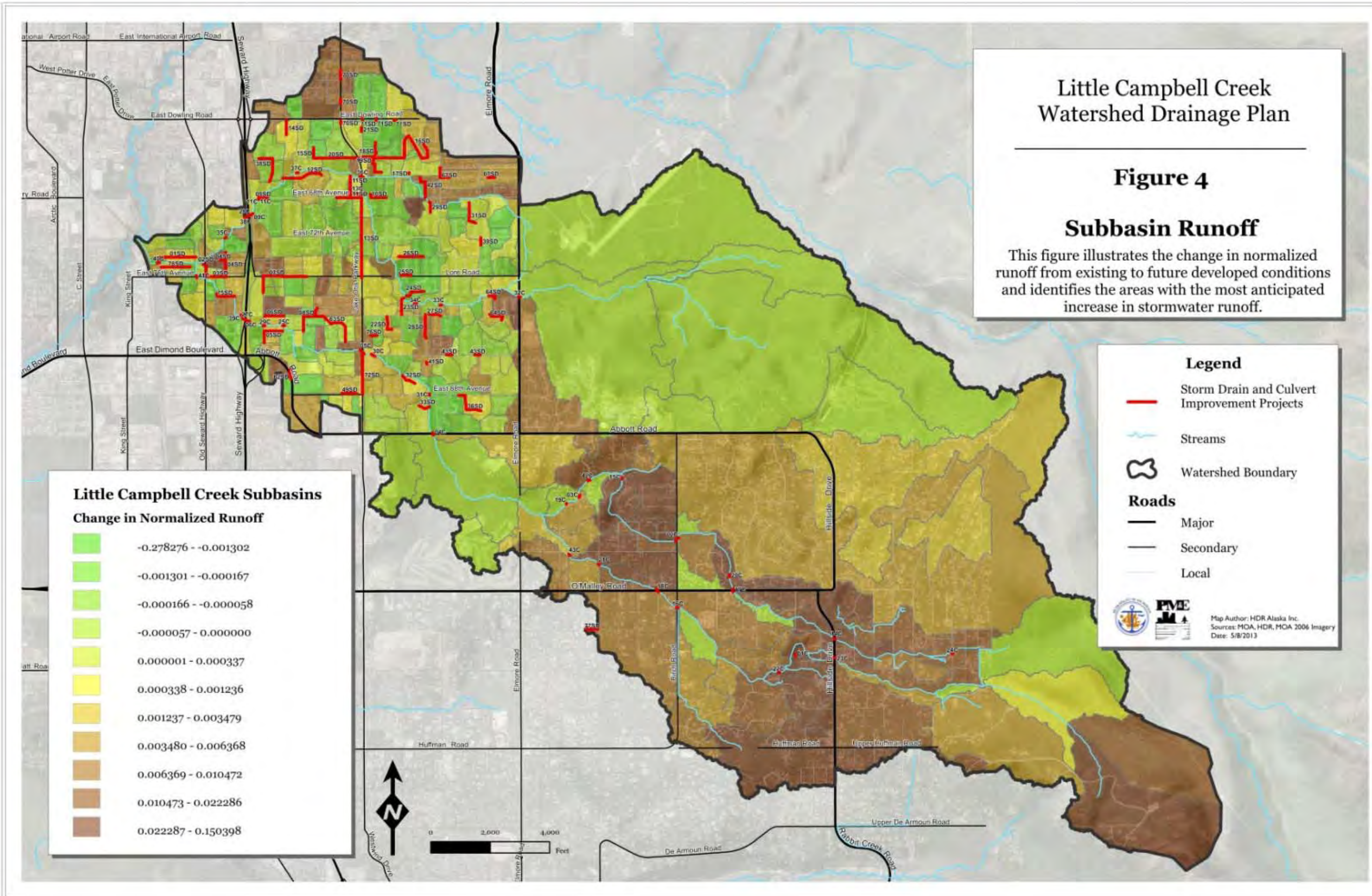
Model Development



Land Use Relationships



Subbasin Runoff



Operation and Maintenance

- **Street sweeping, hydrodynamic separator cleaning and maintenance, and dredging of sedimentation basins**

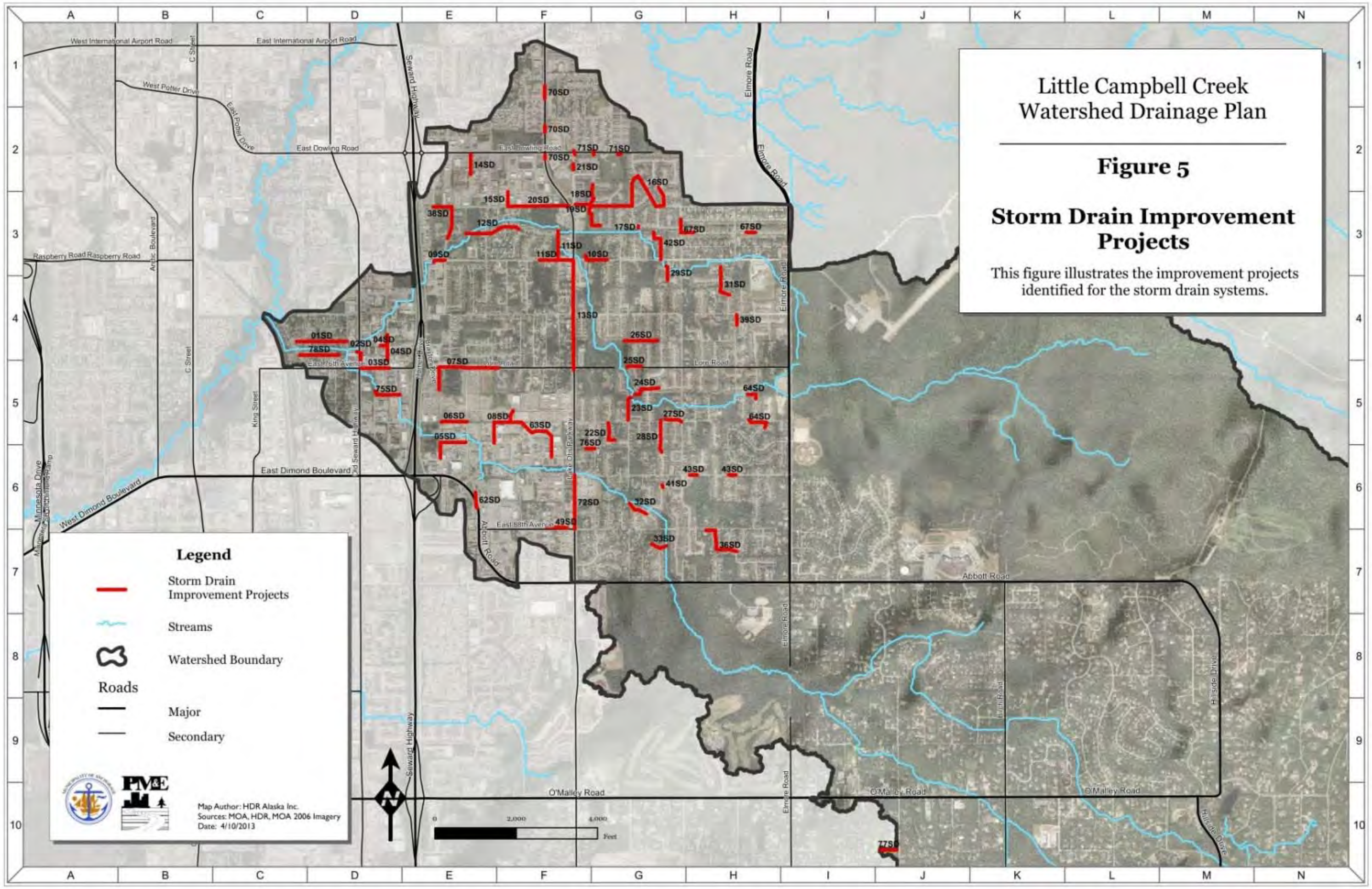
- **Flood control and pumping of flooded areas; debris and ice removal from culverts**

- **Emergency storm drain repairs**

Habitat Maintenance

- **Monitoring regulatory pressure to improve water quality**
- **Identifying culvert sites with inadequate natural fish habitat**
- **Identifies storm drain networks**

Project Development Summary



Evaluation Criteria

- **Water Quantity**
- **Water Quality**
- **Maintenance Deficiency**
- **Project and Policy**

Example Evaluation Document

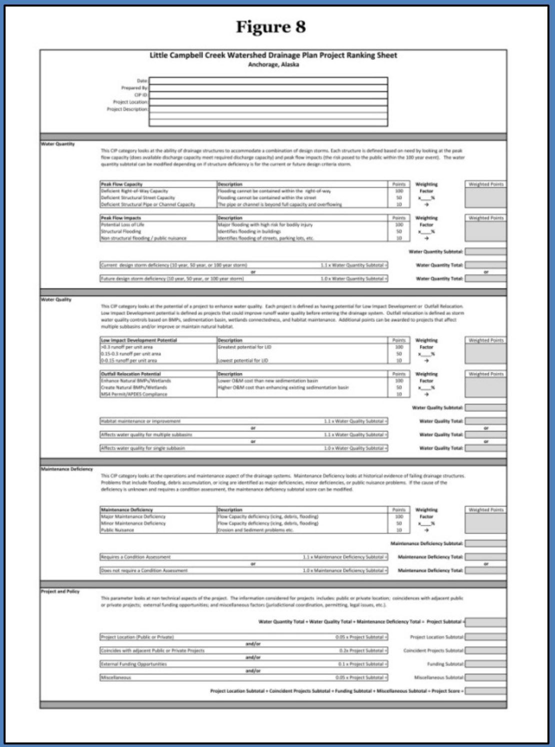


Figure 8

Little Campbell Creek Watershed Drainage Plan Project Ranking Sheet

Anchorage, Alaska

Water Quantity
Peak Flow Capacity

Peak Flow Capacity scores a deficient conveyance structure based on the difference between its flow capacity and flow demand placed on it. Capacity is evaluated on three tiers: capacity within the pipe or structure, capacity of the roadway or channel, and capacity of the right-of-way.

Peak Flow Capacity

Peak Flow Capacity	Description	Points	Weighting Factor	Weighted Points
Deficient Right-of-Way Capacity	Flooding cannot be contained within the right-of-way	100	x____%	
Deficient Structural Street Capacity	Flooding cannot be contained within the street	50	→	
Deficient Structural Pipe or Channel Capacity	The pipe or channel is beyond full capacity and overflowing	10		

Peak Flow Impacts	Description	Points	Weighting Factor	Weighted Points
Potential Loss of Life	Major flooding with high risk for bodily injury	100	x____%	
Structural Flooding	Identifies flooding in buildings	50	→	
Non structural flooding / public nuisance	Identifies flooding of streets, parking lots, etc.	10		

Water Quantity Subtotal:

Current design storm deficiency (10 year, 50 year, or 100 year storm)	1.1 x Water Quantity Subtotal =	Water Quantity Total:	
or			or
Future design storm deficiency (10 year, 50 year, or 100 year storm)	1.0 x Water Quantity Subtotal =	Water Quantity Total:	

Water Quantity

Peak Flow Impact

Peak Flow Impacts identifies the impacts of flooding in the area surrounding the conveyance structure. It identifies areas with the potential for flooding that may cause a public nuisance without property damage; potential for flooding of structures; and the potential for loss of life or bodily injury.

Peak Flow Impacts

Peak Flow Capacity	Description	Points	Weighting Factor	Weighted Points
Deficient Right-of-Way Capacity	Flooding cannot be contained within the right-of-way	100	x____%	
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Current design storm deficiency (10 year, 50 year, or 100 year storm)	1.1 x Water Quantity Subtotal =	Water Quantity Total:	
or			or
Future design storm deficiency (10 year, 50 year, or 100 year storm)	1.0 x Water Quantity Subtotal =	Water Quantity Total:	

Water Quality

Water quality criteria are largely based on regulatory and environmental concerns within the watershed. To meet water quality standards designated in the Municipality's MS4 permit, two approaches were focused on for the criteria development: low impact development implementation potential and outfall relocation potential.

Water Quality

Water Quality

This CIP category looks at the potential of a project to enhance water quality. Each project is defined as having potential for Low Impact Development or Outfall Relocation. Low Impact Development potential is defined as projects that could improve runoff water quality before entering the drainage system. Outfall relocation is defined as storm water quality controls based on BMPs, sedimentation basin, wetlands connectedness, and habitat maintenance. Additional points can be awarded to projects that affect multiple subbasins and/or improve or maintain natural habitat.

Low Impact Development Potential	Description	Points	Weighting Factor	Weighted Points
>0.3 runoff per unit area	Greatest potential for LID	100	x____% →	
0.15-0.3 runoff per unit area		50		
0-0.15 runoff per unit area	Lowest potential for LID	10		

Outfall Relocation Potential	Description	Points	Weighting Factor	Weighted Points
Enhance Natural BMPs/Wetlands	Lower O&M cost than new sedimentation basin	100	x____% →	
Create Natural BMPs/Wetlands	Higher O&M cost than enhancing existing sedimentation basin	50		
MS4 Permit/APDES Compliance		10		

Water Quality Subtotal:

Habitat maintenance or improvement	1.1 x Water Quality Subtotal =	**Water Quality Total:**	
or			**or**
Affects water quality for multiple subbasins	1.1 x Water Quality Subtotal =	**Water Quality Total:**	
or			**or**
Affects water quality for single subbasin	1.0 x Water Quality Subtotal =	**Water Quality Total:**	

Water Quality

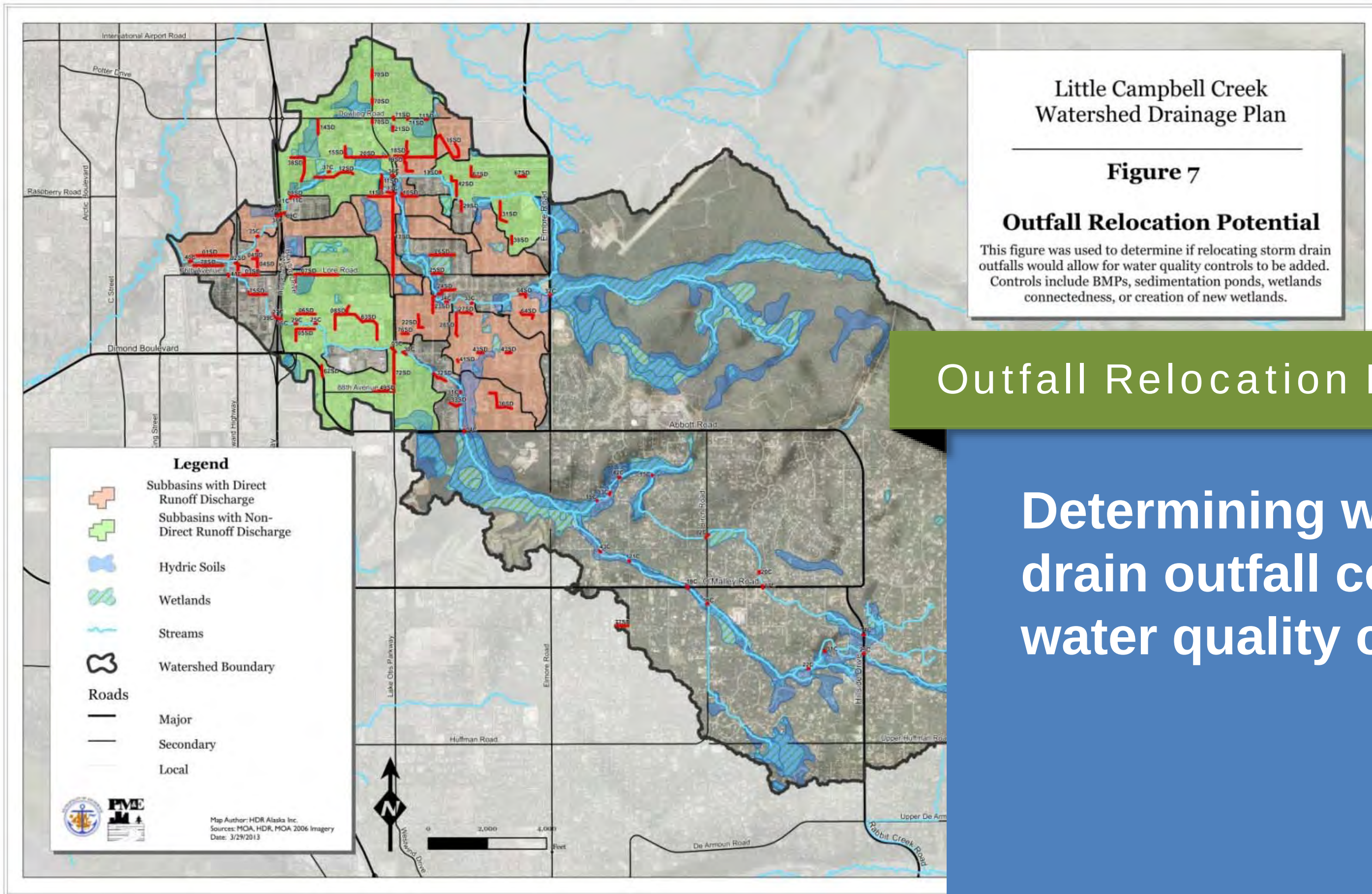
Low Impact Development Potential

LID Potential defined as:

Determining whether surface area modification projects could be constructed that could improve runoff water quality before entering the drainage system.

Example LID

Outfall Relocation Potential



Outfall Relocation Potential

Determining whether a storm drain outfall could have water quality controls added.

Maintenance Deficiency

This category addresses issues of existing aged or damaged assets placing an unnecessary cost on MOA resources. The parameter addresses known deficiencies such as frequent flooding, icing, debris accumulation, erosion and sediment aggradations or degradation, etc.

Maintenance Deficiency Figure

This CIP category looks at the operations and maintenance aspect of the drainage systems. Maintenance Deficiency looks at historical evidence of failing drainage structures. Problems that include flooding, debris accumulation, or icing are identified as major deficiencies, minor deficiencies, or public nuisance problems. If the cause of the deficiency is unknown and requires a condition assessment, the maintenance deficiency subtotal score can be modified.

Maintenance Deficiency	Description	Points	Weighting Factor	Weighted Points
Major Maintenance Deficiency	Flow Capacity deficiency (icing, debris, flooding)	100	x____%	
Minor Maintenance Deficiency	Flow Capacity deficiency (icing, debris, flooding)	50	→	
Public Nuisance	Erosion and Sediment problems etc.	10		

Maintenance Deficiency Subtotal:

Requires a Condition Assessment	1.1 x Maintenance Deficiency Subtotal =	**Maintenance Deficiency Total:**	
or			**or**
Does not require a Condition Assessment	1.0 x Maintenance Deficiency Subtotal =	**Maintenance Deficiency Total:**	

Project and Policy

The project and policy criterion reflects overarching non-technical aspects of the identified project. The categories in this criterion modify the combined and weighted project score given by the three previous criteria and include: project location, project coincidences, external funding, and miscellaneous factors.

Project and Policy Figure

This parameter looks at non technical aspects of the project. The information considered for projects includes: public or private location; coincidences with adjacent public or private projects; external funding opportunities; and miscellaneous factors (jurisdictional coordination, permitting, legal issues, etc.).

Water Quantity Total + Water Quality Total + Maintenance Deficiency Total = Project Subtotal =

Project Location (Public or Private)	0.05 x Project Subtotal =	Project Location Subtotal:	
and/or			
Coincides with adjacent Public or Private Projects	0.2x Project Subtotal =	Coincident Projects Subtotal:	
and/or			
External Funding Opportunities	0.1 x Project Subtotal =	Funding Subtotal:	
and/or			
Miscellaneous	0.05 x Project Subtotal =	Miscellaneous Subtotal:	

Project Location Subtotal + Coincident Projects Subtotal + Funding Subtotal + Miscellaneous Subtotal = Project Score =

Cost Estimate Methodology

- **The costs presented for each of the proposed CIP projects represents the Total Project Cost; which consists of Design Costs and Construction Costs.**

Construction Cost

- Construction contract
- Construction management
- Inspection
- Materials testing
- Construction survey
- PM&E overhead
- Construction contingency (30%)

Design Costs include

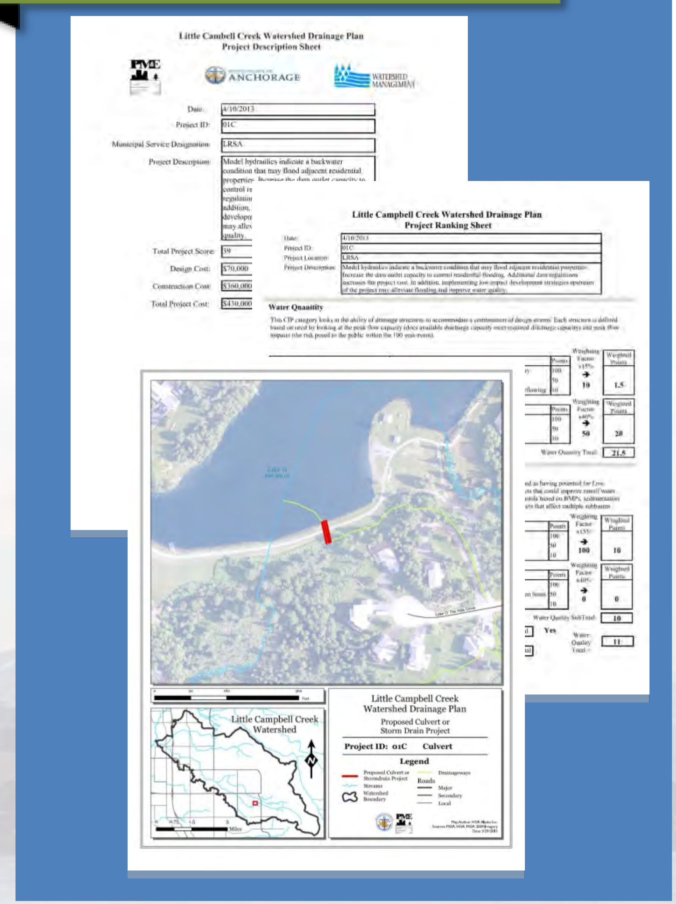
- Environmental assessment
- Permitting
- Survey
- Soils work
- Design services and management
- Utilities coordination
- Right-of-Way

Capital Improvement Plan

The MOA uses a 6-year CIP basis for budgeting the planning, design, and construction of needed projects.

The LCC Plan recommends projects for watershed improvements in prioritized order from most important to least important.

CIP Plan



Implementation Strategy

- **LCC Plan identifies 25 top projects in need of improvement**
- **Projects to be prioritized on an annual "critical needs" basis and 6-year basis**
- **Critical needs list updated annually based on input from**
  - ***Community Councils***
  - ***Citizens***
  - ***Elected officials***
  - ***Other Agencies***

Questions?

MOA Contacts

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Jacques Annandale
jacques.annandale@hdrinc.com

WATERSHED PUBLIC EDUCATION
A.P.D.E.S. Year 4

Cherie Northon, Ph.D.
Executive Director
Anchorage Waterways Council

Public Education and Involvement

- Conduct an ongoing education and public involvement program aimed at residents, businesses, industries, and others.
- The goal has been to reduce or eliminate behaviors and practices that cause or contribute to adverse storm water impacts.
- Target issues:
  - General impacts of storm water flows into surface water
  - Impacts from impervious surfaces
  - Source control BMPs, environmental stewardship, pet waste control/disposal, vehicle maintenance, landscaping and vegetative buffers

Audiences

- General public and businesses including home-based and mobile
- Homeowners, landscapers, and property managers regarding
  - yard practices (chemicals)
  - water use reduction (rain barrels, gutters, rain gardens)
  - Low Impact Development (LID) techniques

How?

- Tabling at a variety of events for pets, garden, career, Creek Cleanup, (~2,500)
- Scoop-the-Poop days at University Lake and Connors Bog
- Door hangers where needed
- Bus signs
- Bumper stickers
- Cards for DIYs (do it yourselfers) to equipment rental companies
- Storm drain markers
- Creeks as Classrooms (ConocoPhillips) (~5,000)
- Mutt-Mitt (pet waste station) assessment (ADEC)
- Invasive plant control (USFWS)
- Media: (ADN, KTVA, KAKM, KTUU, KSKA)

Pawstice by David Jensen

Alaska Botanical Garden Events

FRIENDS OF PETS

Scoop the Poop Day!


WARNING
AVISO

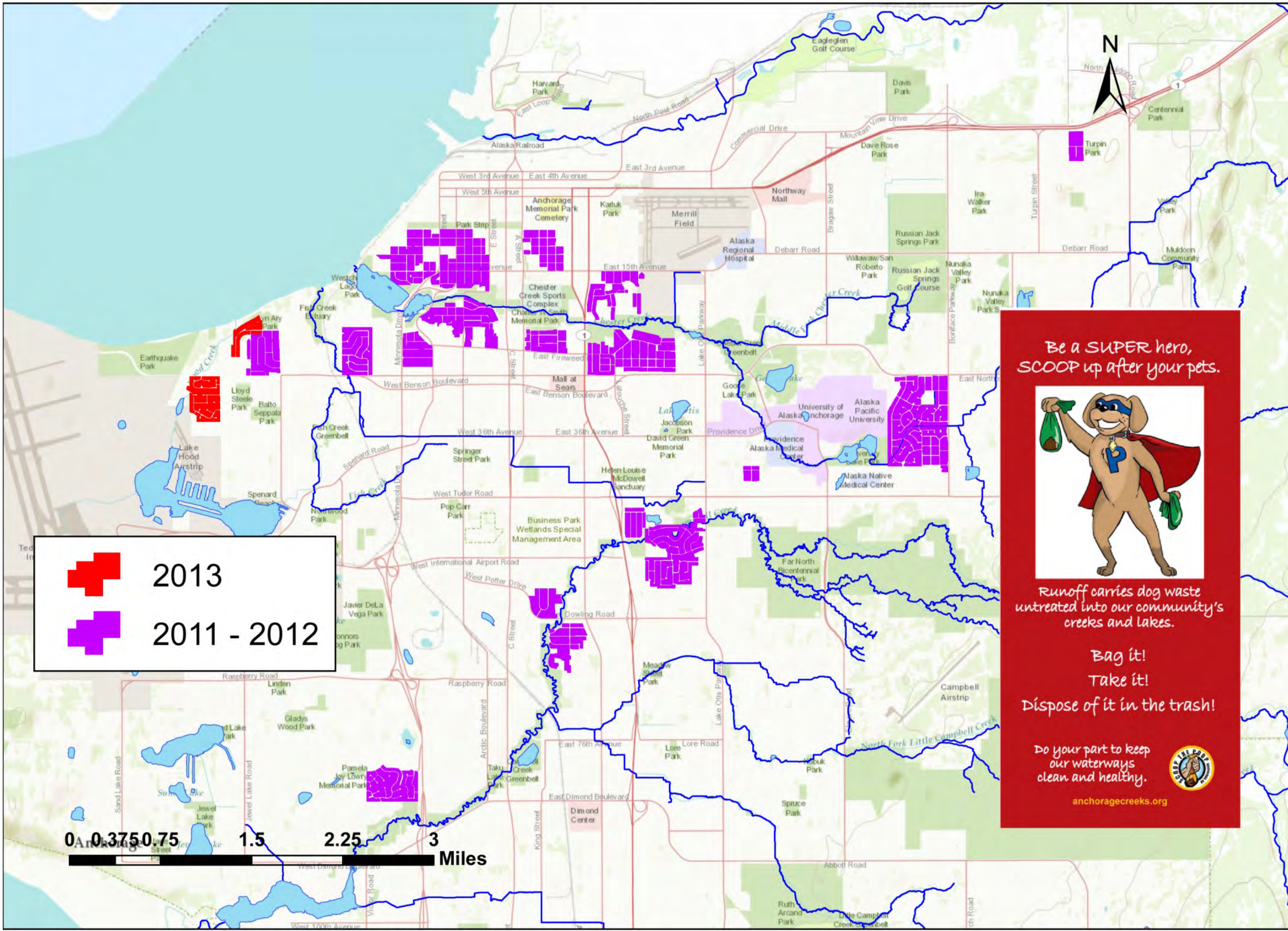
Creek Cleanup, May 18, 2013

Promoting the MOA's Rain Garden Program

Tri-fold brochure for veterinarians, groomers, pet stores, etc.

Door Hangers (one-sided)

Scoop the Poop Door Hangers (N~4,700), 2011-2013



Bus Signage

or Bumper Sticker

PRIOR TO ANY EXCAVATION OR GROUND DISTURBING WORK:

- Ensure you know how to safely operate the equipment.
- Call "811" for the "Locates" on underground power, water, sewer, gas, electrical, cable, or phone lines BEFORE you dig.
- Check to see if you need any permits before you begin work. The reverse side of this card provides information on the most commonly needed for small projects.
- Watch overhead power lines when operating equipment.
- Do not cut or disturb any trees with nesting birds in them.
- Familiarize yourself with Anchorage's creeks and tributaries as some resemble ditches more than creeks.

DID YOU KNOW?

- Almost every creek and river in the Municipality is anadromous (salmon spawning), so they are protected under Alaska's statute known as the Anadromous Fish Act (AS 16.05.871)
- It is a violation of the **Clean Water Act** to dump or plow materials, such as soil, debris, vegetation, aggregate, or snow, into any creek or down any storm drain.
- "Dewatering" (removal of excess water) must be properly managed and not discharged into storm drains or other areas where it may flow into a waterway.
- Because storm drains discharge directly to waterways, without treatment by the Municipal sewer system, do not pour any paint, chemicals, gas, oil, or other pollutants into them.
- When washing equipment after use, hose it down on a pervious surface (such as lawn or gravel), or use a commercial spray wash station because that water is treated by the Municipal sewer system.
- Anchorage Municipal Code TITLE 21 regulates land disturbance activities adjacent to streams and watercourses. These include clearing of vegetation; grading, fill or excavation; location of buildings or structures; and channel alteration. Check with the Municipality to ensure compliance with the current stream setback regulations at library.municode.com/index.aspx?clientId=12717.

WHERE YOU CAN CHECK FOR PERMIT & REGULATION INFORMATION:

- **Municipal:** If ground disturbance is 500 sq. ft. or greater, check permit criteria and storm water pollution control plans at:

  www.muni.org/Departments/OCPD/development/BSD/Handouts/handoutag21.pdf

- **State:** Alaska State statutes require notification and permit approval from the Alaska Department of Fish & Game before altering or affecting the "natural flow or bed" of a waterbody or stream. For full information, see:

  www.adfg.alaska.gov/index.cfm?adfg=habitatregulations.prohibited

- A useful, comprehensive guide for the state of Alaska that covers all levels of permits has been published by the Alaska Department of Environmental Conservation at:

  dec.alaska.gov/water/wnpspc/stormwater/Guidance.html

- **Federal.** Filling of waterways and wetlands is regulated by the Army Corps of Engineers. Information is at:

  www.poa.usace.army.mil/Missions/Regulatory/Permits.aspx

Thank you for taking the time to read and use this information. By adhering to these regulations, you help ensure that our waterways and fish habitat will not be damaged by sediment, fill, and other pollutants.

If you would like additional information, please visit our website or contact us at the listing below.

Anchorage Waterways Council
P.O. Box 241774
Anchorage AK 99524
907-272-7335
Website: anchoragecreeks.org
Email: awc@anchoragecreeks.org


Fish Creek – Lois Drive


N. Fork Little Campbell Creek at Brayton
Landscaping


Little Campbell Creek


R1
L2

How to Live With a Creek

The Municipality of Anchorage is about 2,000 mi^2 and has approximately 2,250 miles of creeks and rivers. These waterways are often listed as some of Anchorage's premier amenities. This handout endeavors to provide information on how to be a good neighbor to our creeks.

- **Be a steward for your local creek and keep an eye on it.** Report any issues online at anchoragecreeks.org and clean up any trash.

- **Don't alter the course of a creek.** Creeks have a mind of their own about where they want to go, which is protected by local, state, and federal law.

- **Stormwater and yard runoff, cigarette butts, pet waste, other pollutants and debris run directly into storm drains which lead to our creeks--NOT to the sewage plant.**

- **Don't water your driveway and paved areas, and don't overwater your yard.** Your yard only needs about 1" of water. Put an empty tuna can on the area you are watering, and when it is full--you have about 1" of water.

- **Sweep your driveway rather than power washing or hosing it.**

- **Direct your downspouts onto your yard and off of impermeable surfaces. Also consider rain barrels and rain gardens to reduce yard runoff.**

- **Use automatic car washes as their waste water is usually recycled and is directed into the sewage system--not our creeks.** If you wash at home, park your vehicle on grass or gravel, and use non-phosphate soap.

- **Ensure that storm drains and culverts are not clogged.** Obstructed culverts and storm drains can cause flooding and block fish passage.

- **Keep dogs and horses out of creeks and off of creek banks ESPECIALLY when salmon are spawning.** Bank trampling causes erosion and sediment to run off into waterways, which disturbs gravel beds where fish spawn and little ones grow.

- **Clean up pet waste because the fecal coliform bacteria found in it runs off into our creeks.** All the creeks in Anchorage (except Rabbit and Little Rabbit) are considered "impaired waters" due to fecal coliform contamination. Do your part to reduce this problem. SCOOP-the-POOP!

- **Protect and preserve shoreline vegetation and don't cut trees or remove vegetation within 25' of the creek.** This vegetation provides habitat, shade to keep the water cooler, protection from prey, and stabilization of the streambank. It also reduces bank erosion. Naturally fallen wood produces in-stream habitat and nutrients for fish and other aquatic organisms. Leave NATURAL vegetation in the creek.

- **Do not dump yard wastes into the creek or cut your lawn up to the creek's edge.** Yard waste contains chemical additives and high nitrogen and phosphorus. Rather than bag your grass clippings, leave them on the lawn as a source of fertilizing mulch. Yard waste that decomposes in streams and lakes will use up dissolved oxygen in the water that is essential for fish habitat. Leave native vegetation buffers creekside.

- **Don't disturb instream rocks or build dams and footbridges.** The undersides of rocks are habitat for macroinvertebrates, which are the food for fish, birds, and other aquatic organisms. Dams can block fish passage, and during high water events, dams and footbridges can catch debris and increase the likelihood of flooding in your yard.

- **Participate in the Anchorage Waterways Council's Annual Creek Cleanup (every spring), and become a member of the organization.** Memberships help support a variety of programs.

BE THE GUARDIAN OF YOUR CREEKS!

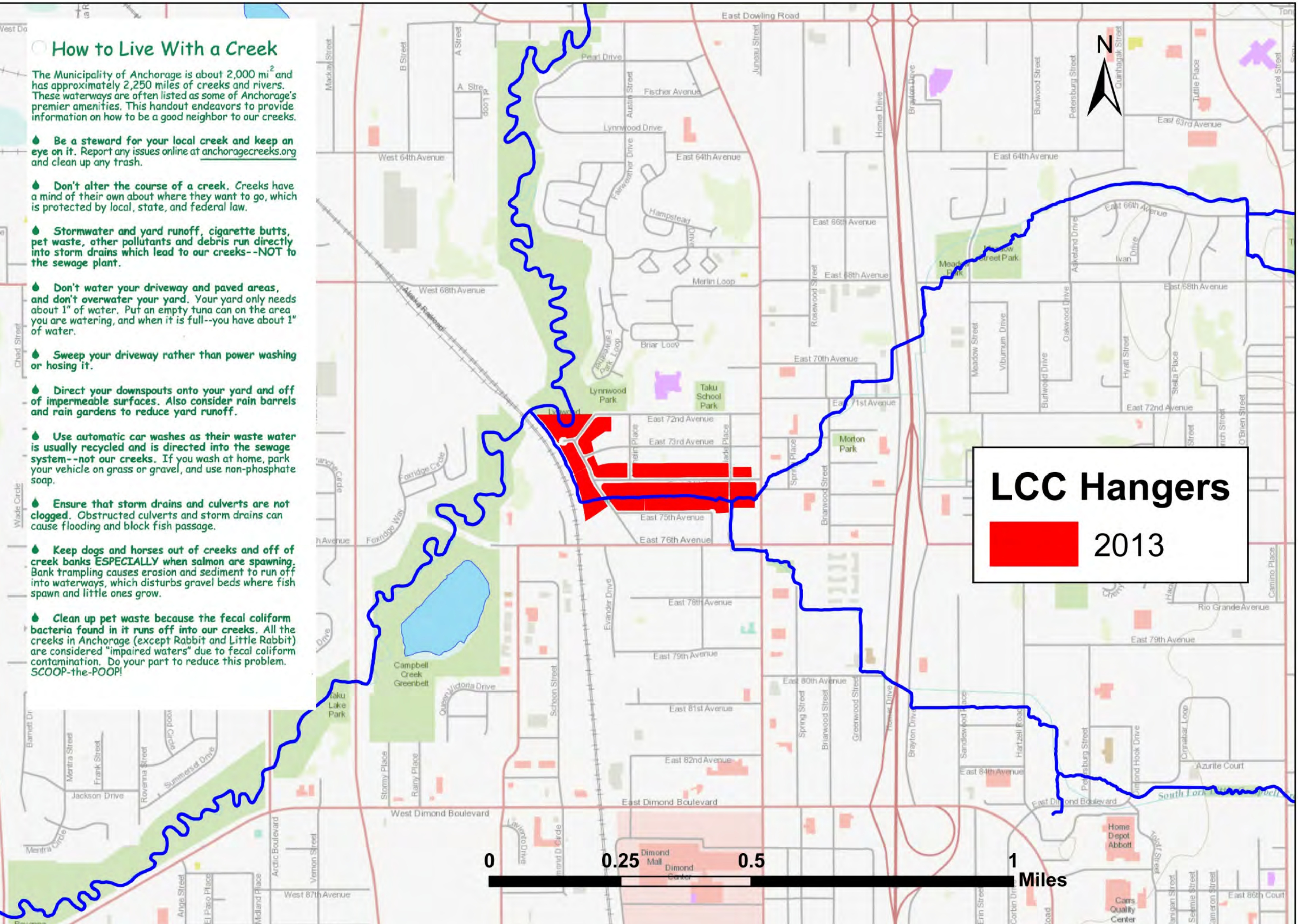
Anchorage Waterways Council is a non-profit 501 (c) (3) corporation that is funded by memberships, donations, and grants.

anchoragecreeks.org

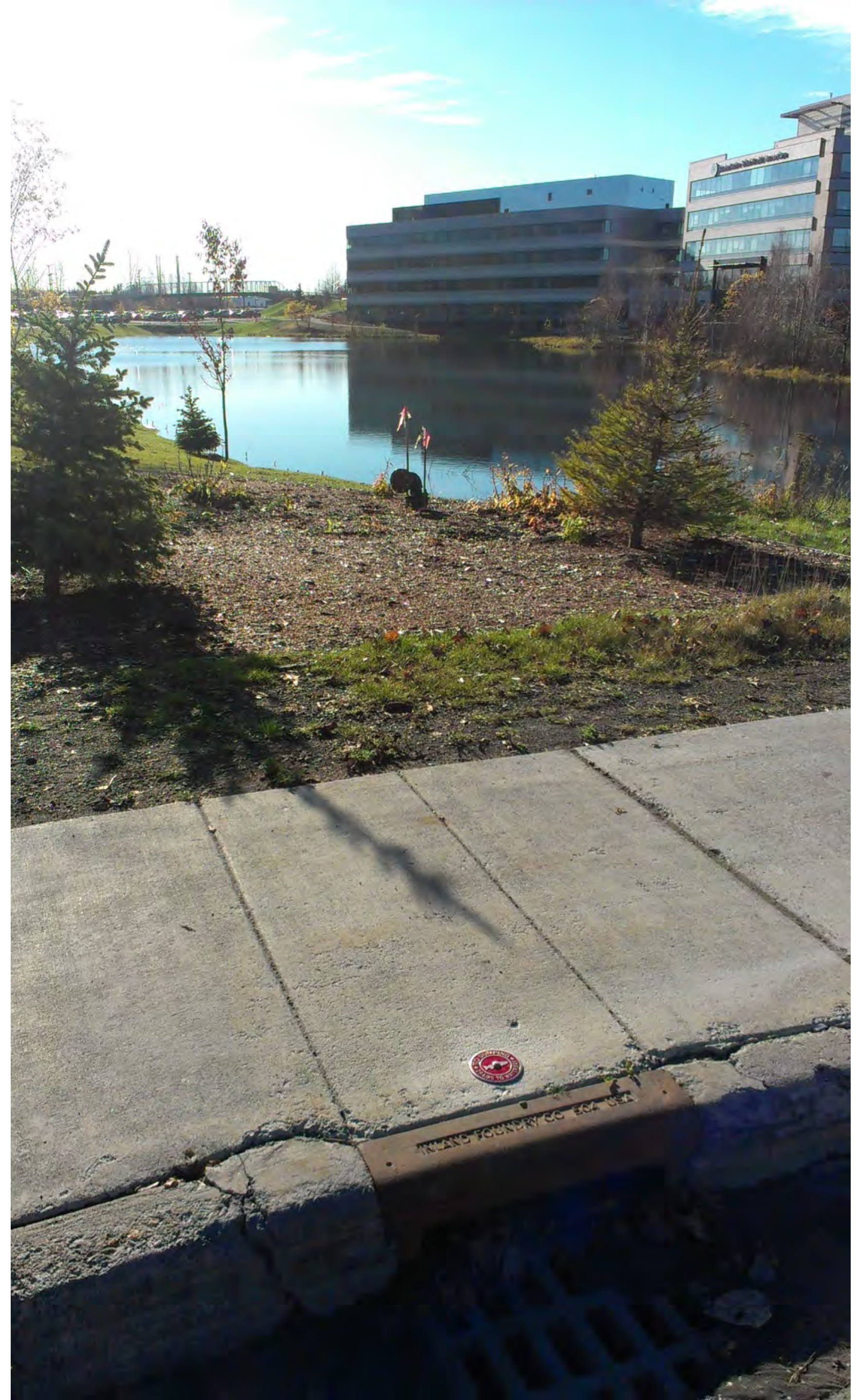
907 272-7335

Follow us on Facebook at Anchorage Waterways Council

"How to Live With a Creek" Hangers (n=76), Lower Little Campbell Creek, 2013

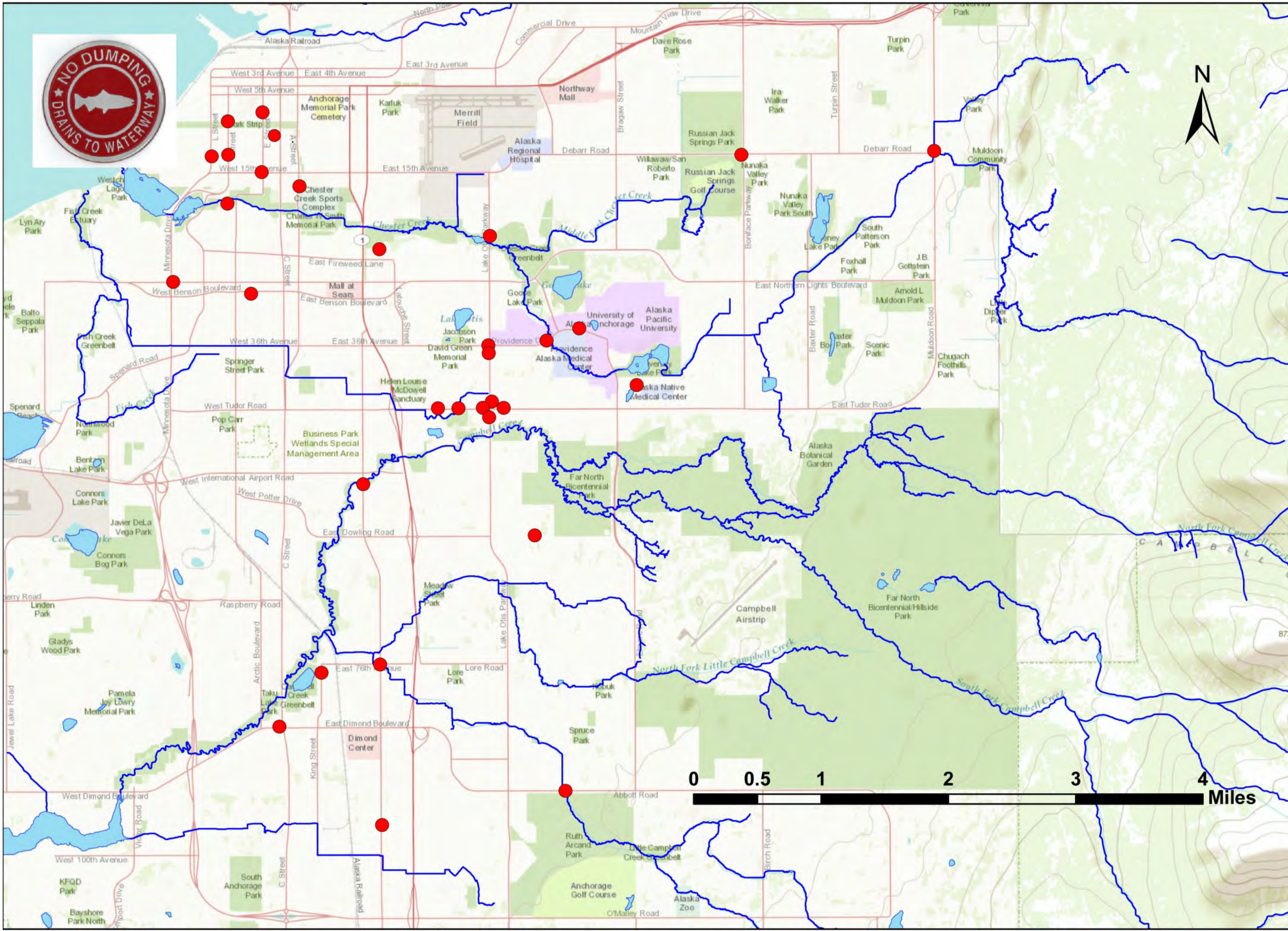


Stormwater Medallions



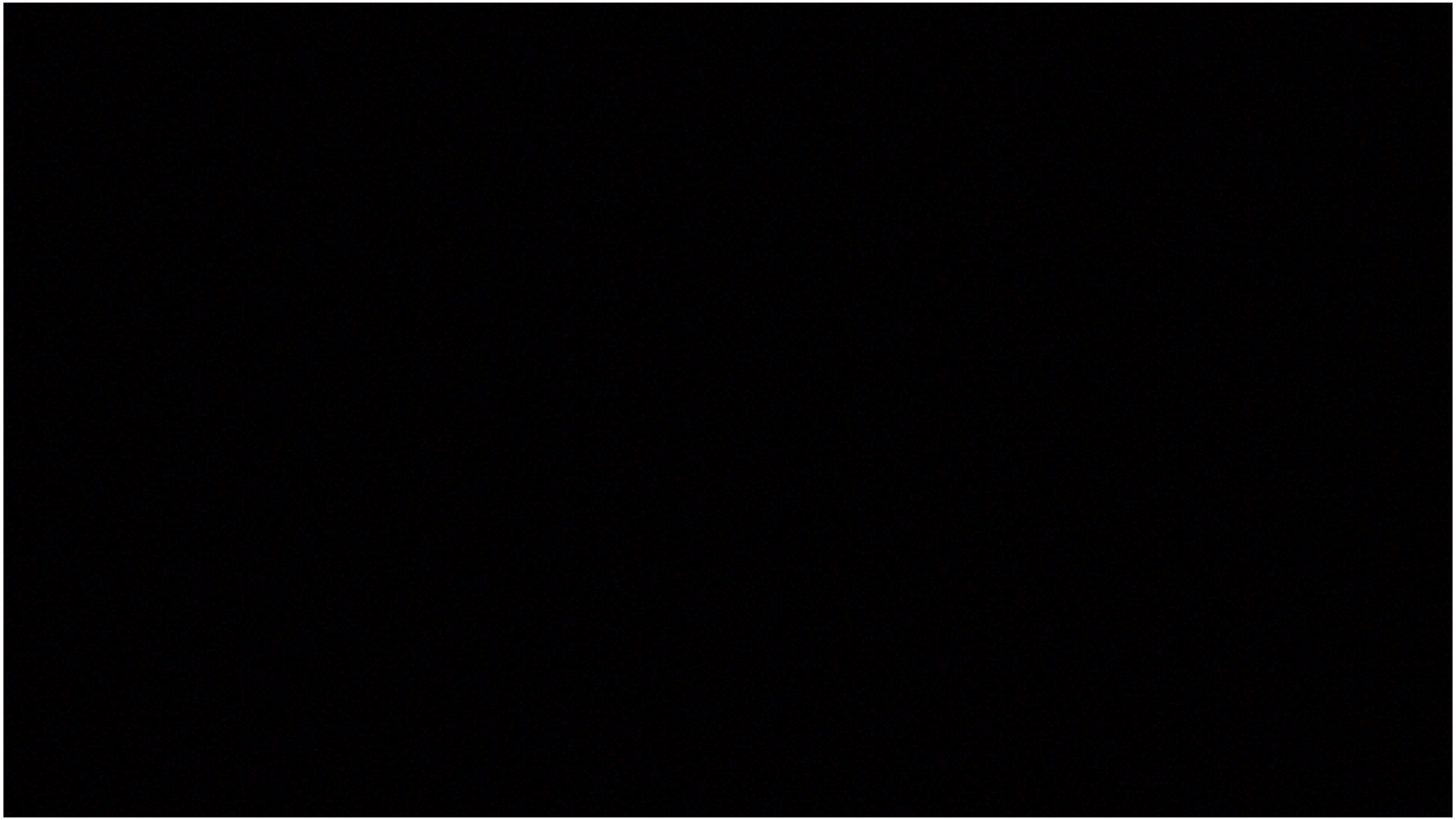
People Mover Bus Stop

Storm Drain Markers (N=32), December 1, 2013



Creeks as Classrooms

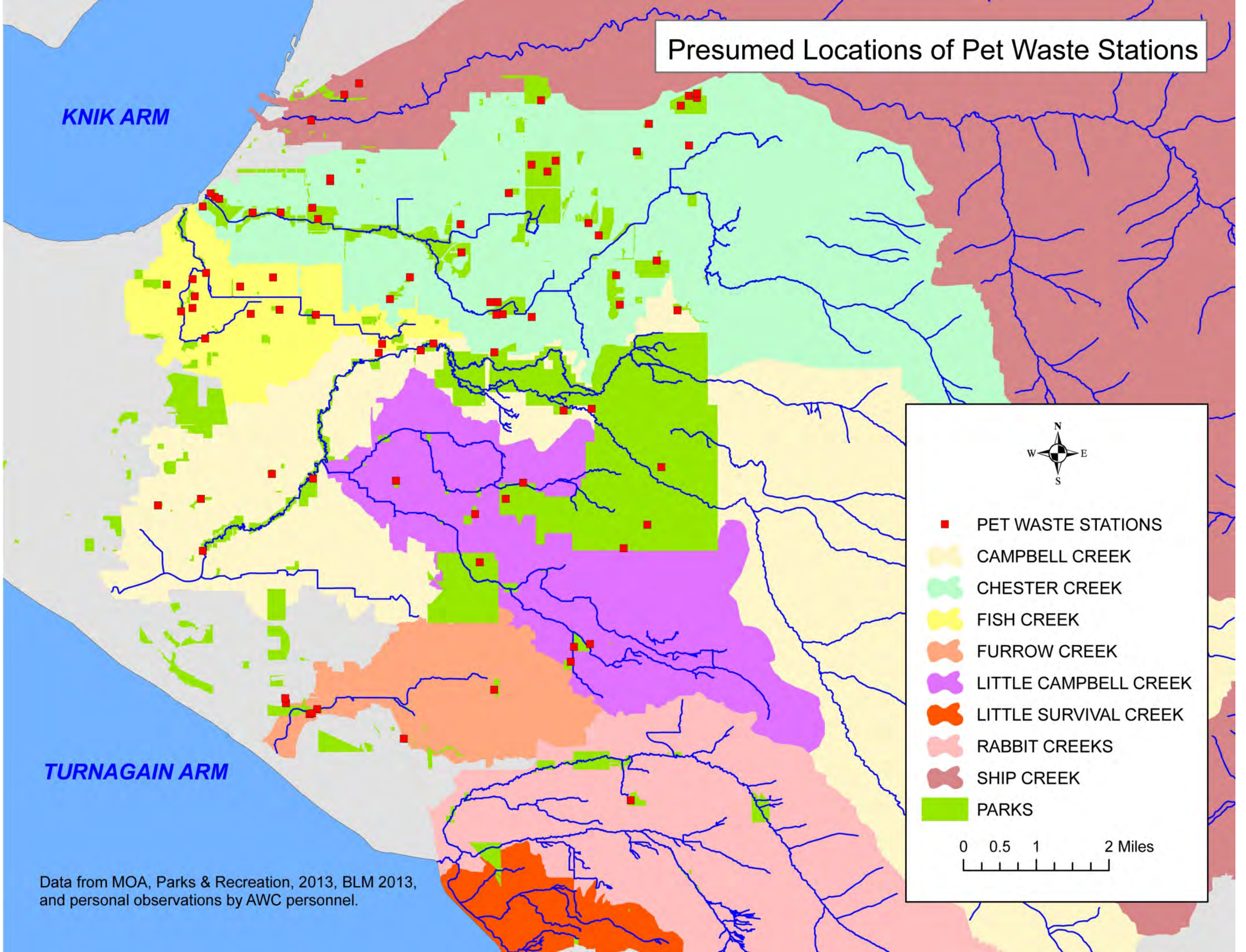
Girdwood School Video
from Creeks as Classrooms




Please...
Be a Responsible Pet Owner and Pick Up After Your Pet
Anchorage Animal
Care and Control Center
Hours of Operation


Mutt Mitt
Better than a Bag!
Degradable Pick-Up Mitt


CARLSON
PARK



Presumed Locations of Pet Waste Stations
KNIK ARM
TURNAGAIN ARM
N
W
E
S
PET WASTE STATIONS
CAMPBELL CREEK
CHESTER CREEK
FISH CREEK
FURROW CREEK
LITTLE CAMPBELL CREEK
LITTLE SURVIVAL CREEK
RABBIT CREEKS
SHIP CREEK
PARKS
0 0.5 1 2 Miles
Data from MOA, Parks & Recreation, 2013, BLM 2013,
and personal observations by AWC personnel.

Invasive Eradication – Reed Canarygrass

How healthy is the water in Anchorage creeks, streams and lakes?

"Hometown Alaska" on KSKA – May 10, 2013
Kathleen McCoy, Host
Cherie Northon and Tim Stevens, Guests

Prepared for: The Municipal Planning Department and Watershed Management Services
Prepared by: Anchorage Waterways Council
Rev. 2, February 2014 (Draft)

Year 5

- Finalize *Chester Creek Watershed Plan*
- Re-do the Year 1 general survey
- Continue efforts on:
  - Scoop the Poop
  - Cigarette butt waste
  - Yard chemicals
  - Education to young and old about being creek stewards

Thank you!

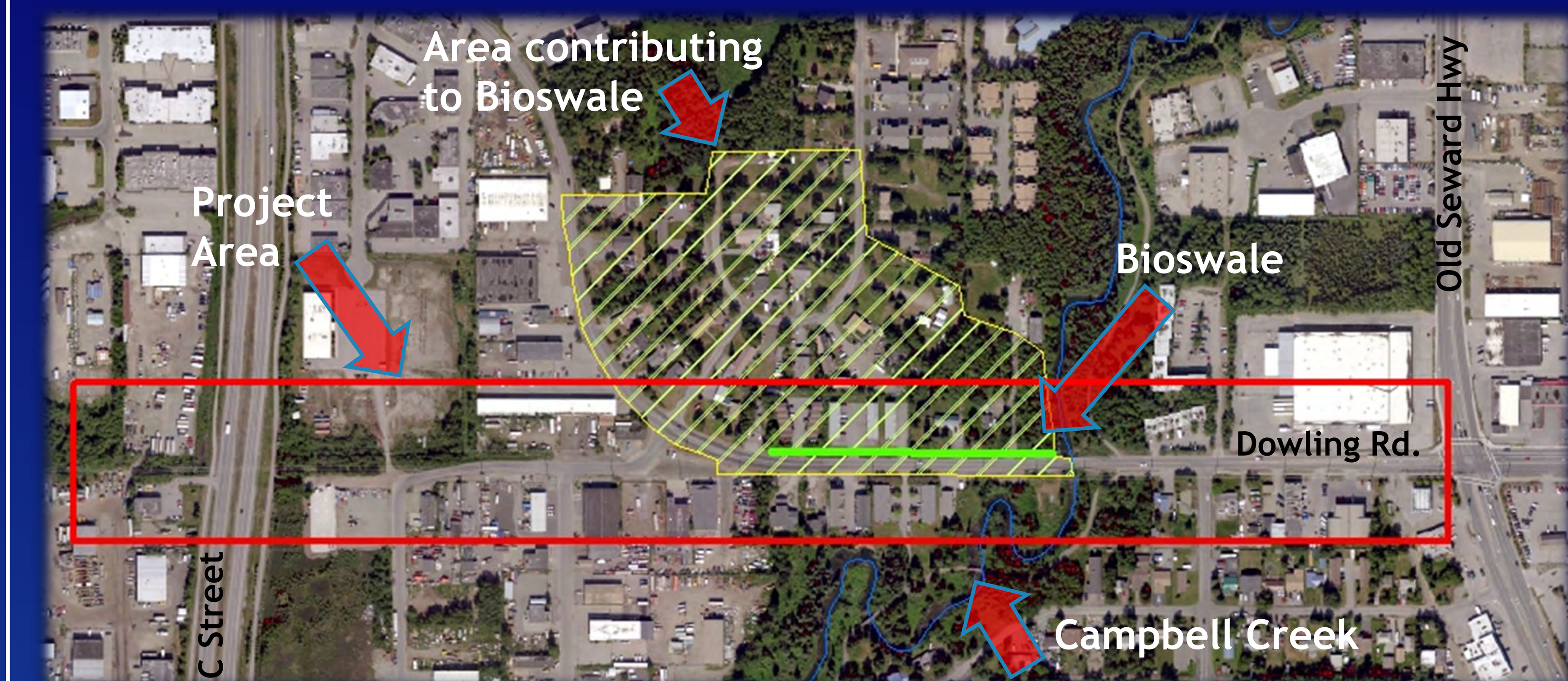
ANCHORAGE WATERWAYS COUNCIL

Posters

MOA and ADOT&PF – 2013 Low Impact Development Project Performance Monitoring

West Dowling Road - Bioswale

The West Dowling Road project used a bioswale to provide pre-treatment and infiltration for stormwater runoff before it enters Campbell Creek. The bioswale collects stormwater runoff from approximately 17.4 acres of residential development adjacent to the project. The functional area of the swale is approximately 2,800 square feet with a gentle slope of less than one percent. Water enters the swale from several storm drain pipes and outflows to Campbell Creek. The swale allows some water to infiltrate and provides cleaning and pollutant removal before excess water enters the creek.



Left: Project Overview

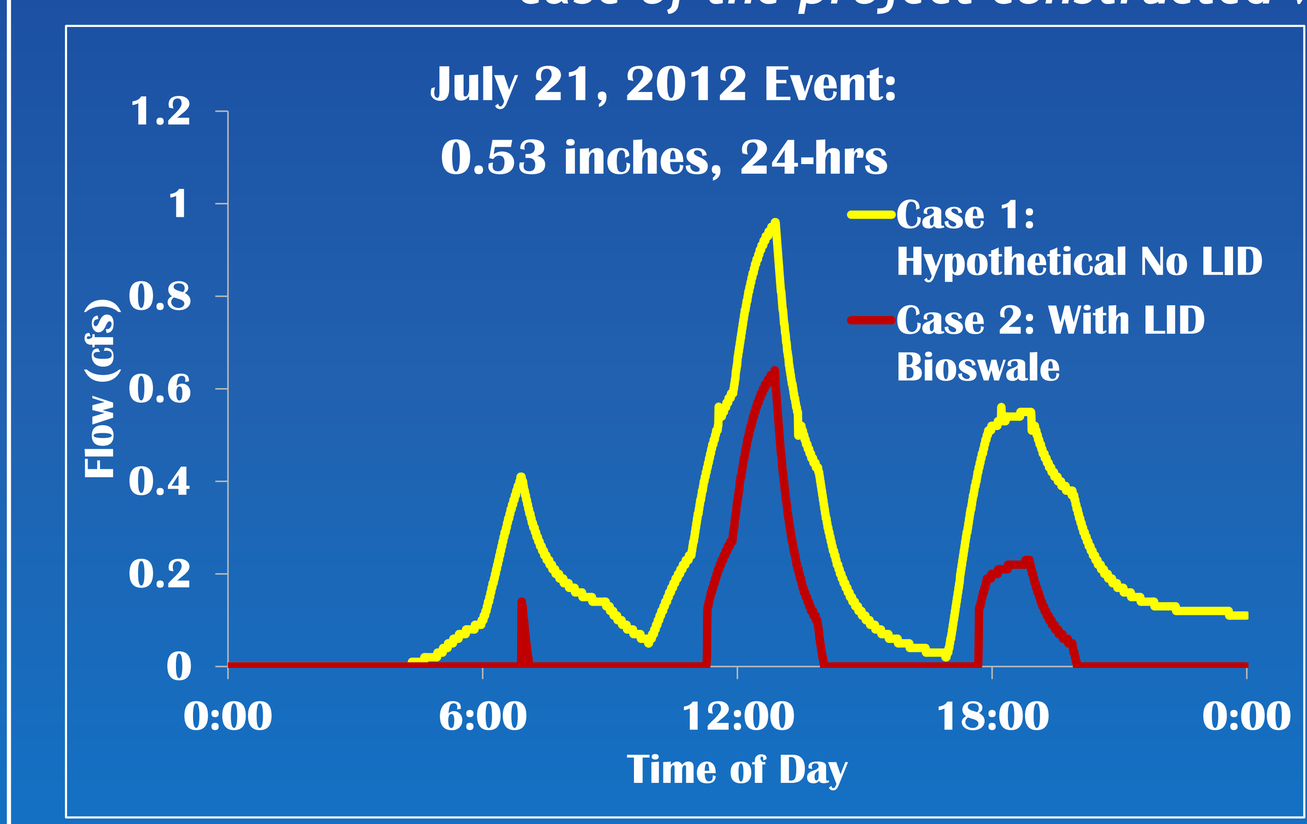
Above: West Dowling Bioswale, looking east

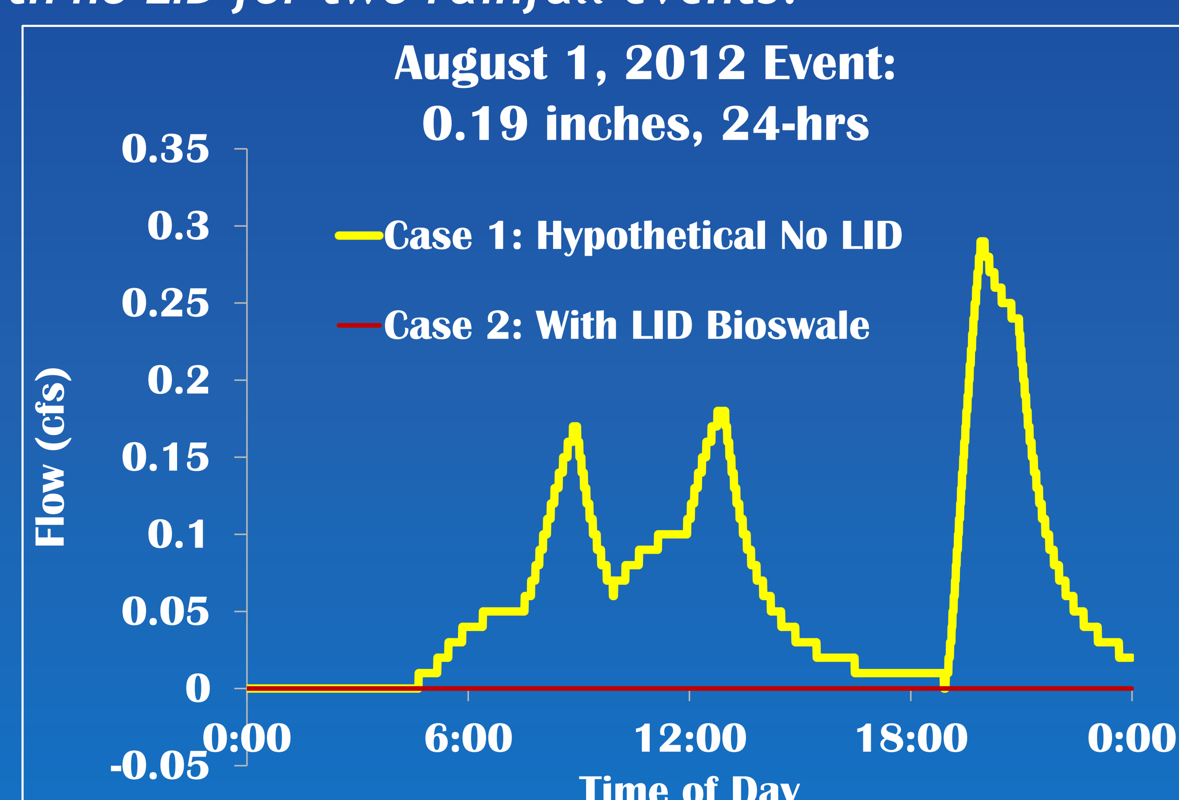
Monitoring

Inflow Inflow was computed based on rainfall data from Anchorage International Airport.

Outflow Due to the construction schedule and the project layout, instrumenting this site to obtain measured outflows was not practical. Instead, runoff hydrographs were computed by modeling the bioswale and the surrounding area in the EPA's Storm Water Management Model (SWMM). Infiltration in the swale was estimated based on project geotechnical data. The outflow hydrographs from the constructed LID case (Case 1) were compared to hydrographs generated from a hypothetical case of the project constructed with no LID (Case 2).

Hydrographs comparing the project constructed with a bioswale to a hypothetical case of the project constructed with no LID for two rainfall events.





This table shows the changes in peak flow and total runoff volume for the storm events above as well for the MOA's synthetic 10-yr, 24-hr event.

Case	July 21, 2012		August 1, 2012		10-year, 24-hour Rainfall (Synthetic)	
	Peak Flow (cfs)	Runoff Vol (cf)	Peak Flow (cfs)	Runoff Vol (cf)	Peak Flow (cfs)	Runoff Vol (cf)
Case 1 - No LID	0.96	18,426	0.29	5,576	11.87	593,375
Case 2 - Bioswale	0.64	4,617	0	0	11.56	405,033

Muldoon Road - Landscaping

The Muldoon Road Pedestrian and Landscaping Improvements project was designed to provide safer pedestrian facilities and install landscape features along Muldoon Road from just north of Debarr Road to just south of the Glenn Highway interchange. The project corridor is surrounded by commercial and industrial areas that are largely impervious. Before the project was constructed, all runoff from the project corridor flowed directly to the local storm drain system and was then discharged to nearby Chester Creek, which is an impaired water body. The project's LID goal was to reduce peak flows and total volume of runoff to the receiving water body by reducing impervious cover through the use of landscape features.

Above: Muldoon Landscaping Area

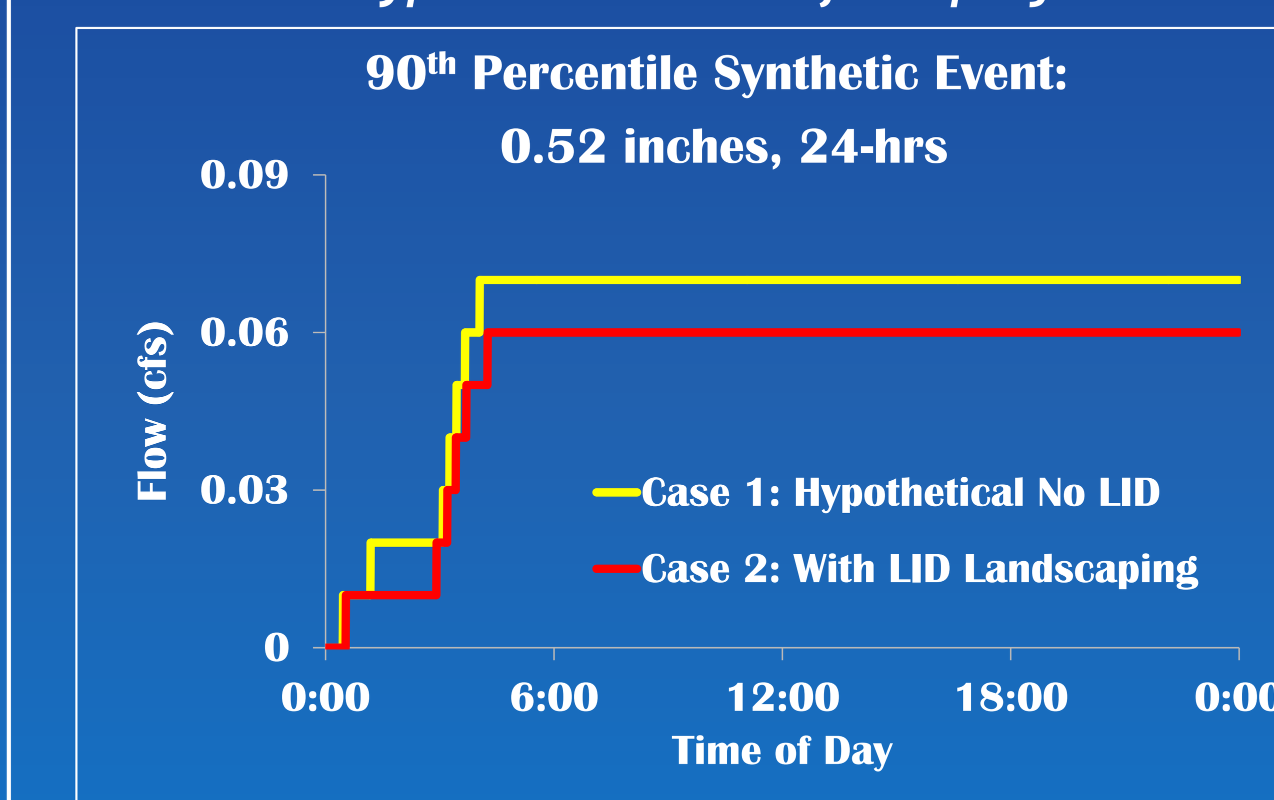
Monitoring

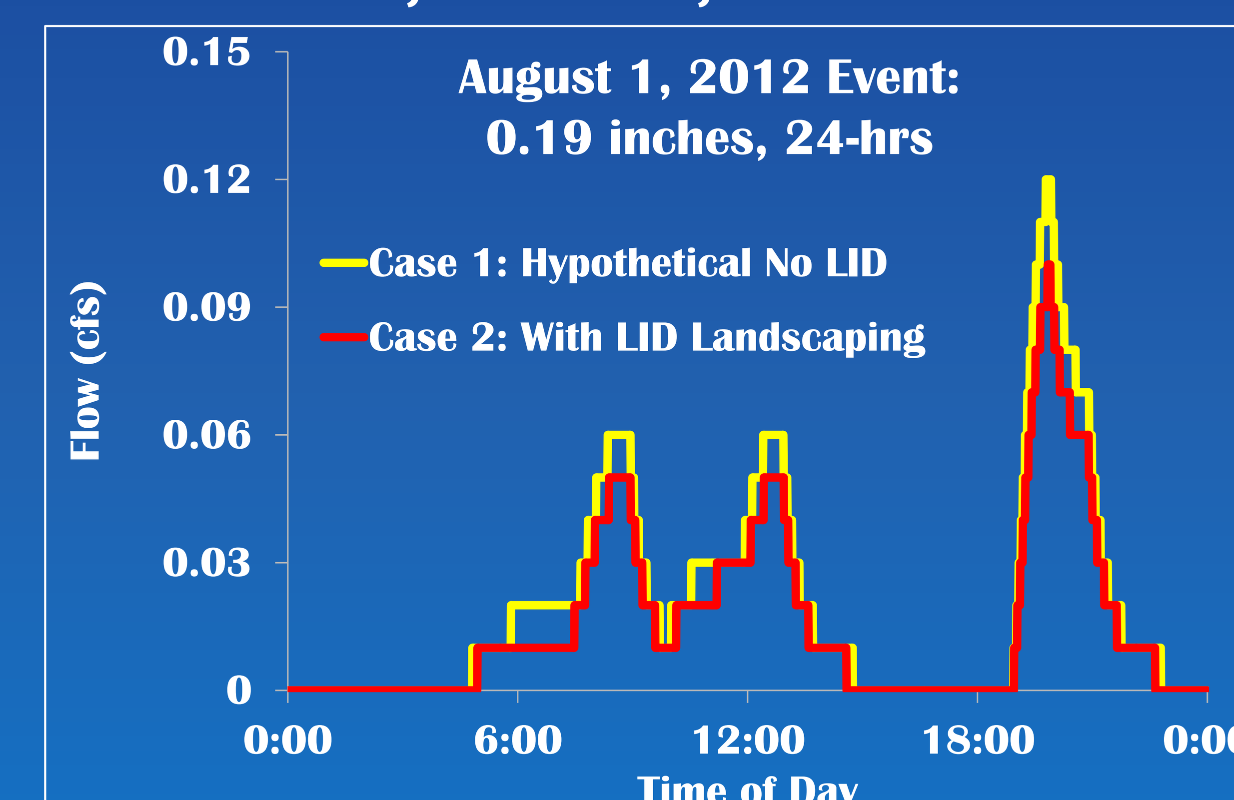
Inflow Inflow was computed based on rainfall data from Anchorage International Airport.

Outflow This LID technique made on-site instrumentation impractical. Instead, runoff hydrographs were computed by modeling the project area using the EPA's Storm Water Management Model (SWMM). Infiltration in the landscape features was estimated based on project geotechnical data. The outflow hydrographs for the constructed LID case (Case 1) were compared to outflow hydrographs from a hypothetical case of the project constructed with no LID (Case 2).

Below and right: Muldoon landscaped areas and decorative walls

Hydrographs comparing the project constructed with LID landscaping to a hypothetical case of the project constructed with no LID for two rainfall events





This table shows the changes in peak flow and total runoff volume for the storm events above as well for the MOA's synthetic 10-yr, 24-hr event.

Case	90th Percentile Event		August 1, 2012		10-year, 24-hour Rainfall (Synthetic)	
	Peak Flow (cfs)	Runoff Vol (cf)	Peak Flow (cfs)	Runoff Vol (cf)	Peak Flow (cfs)	Runoff Vol (cf)
Case 1 - No LID	0.07	5,489	0.12	1,699	3.59	20,473
Case 2 - Pervious Landscape Areas	0.06	4,487	0.1	1,394	2.9	16,771

The MOA – 2013 Low Impact Development Project Performance Monitoring

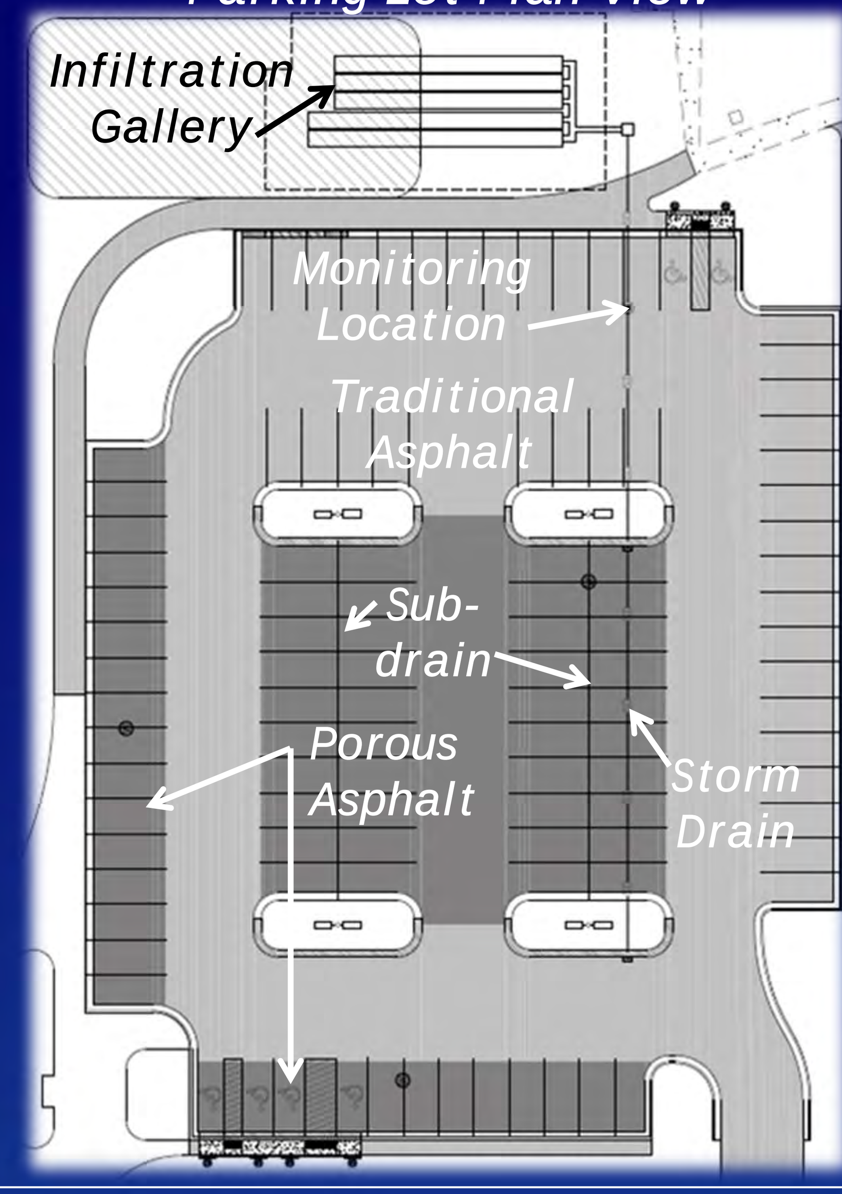
Russian Jack Springs Parking Lot

Porous Asphalt

This project used porous asphalt in combination with traditional asphalt to collect stormwater that falls onto the one-acre 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.

Left: The traditional asphalt produces runoff during a rain event, but the porous asphalt remains dry and free of ponding.

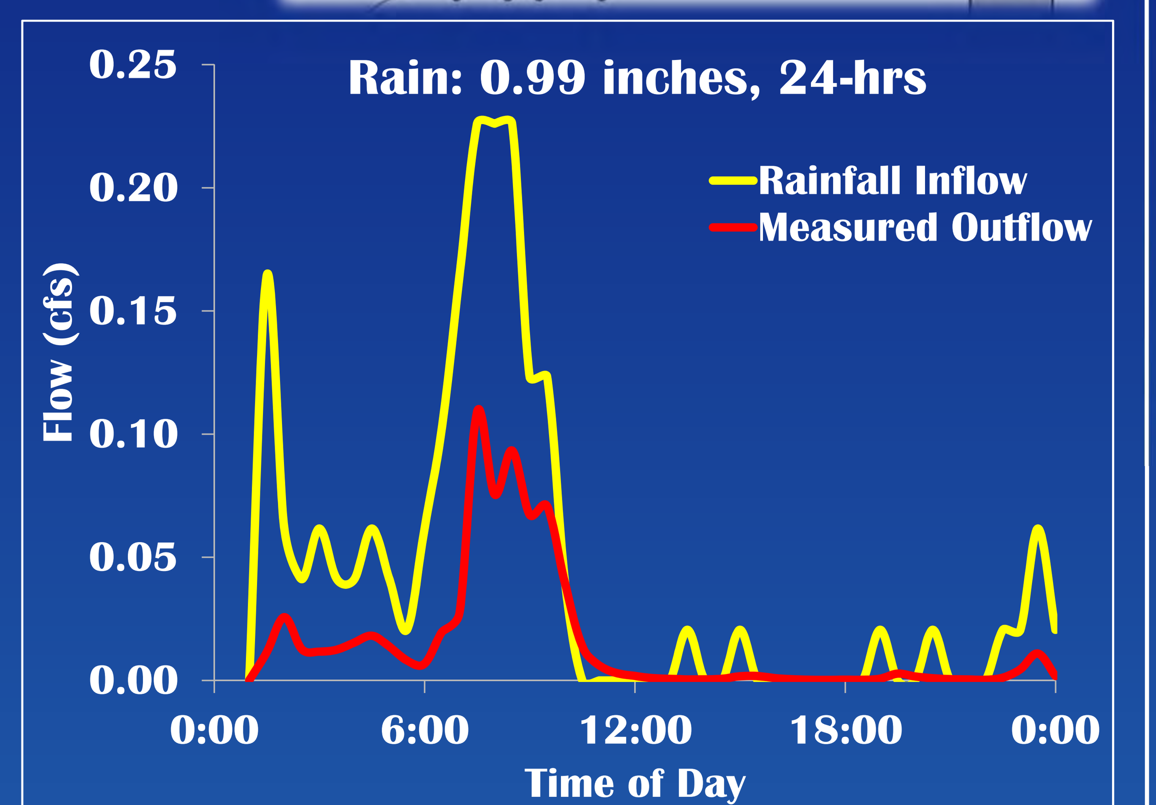
Parking Lot Plan View

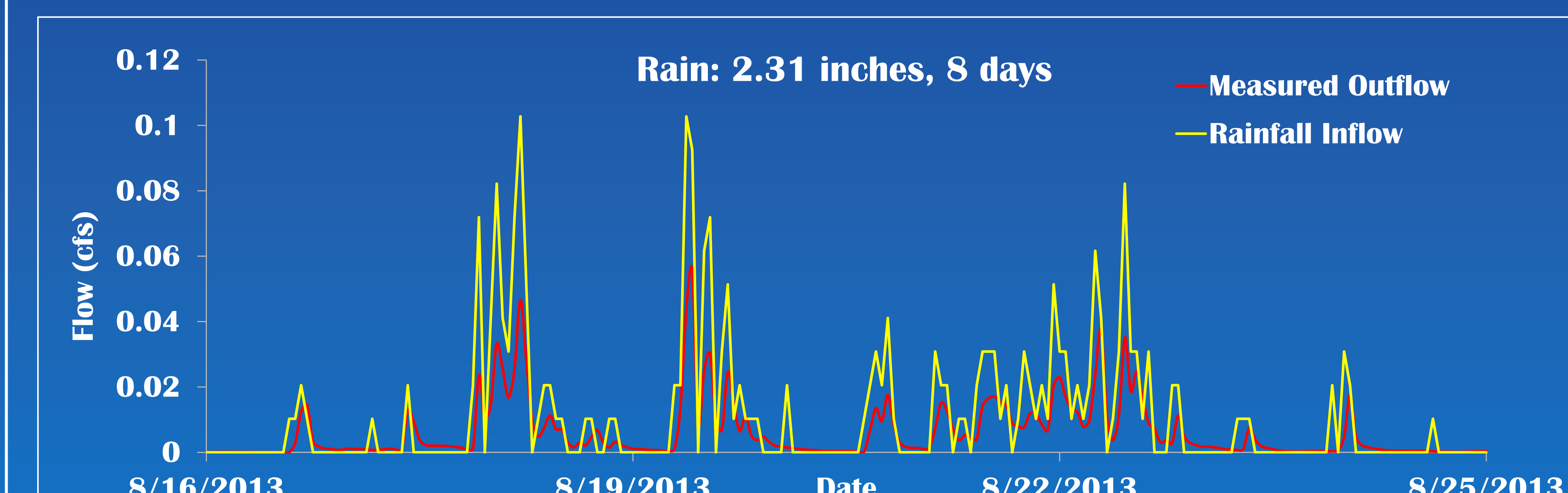


Monitoring

Inflow A rain gauge was installed near the site to measure rainfall events from July to October of 2013. The monitoring period included September of 2013 which is reported as the second wettest September on record for Anchorage.

Outflow Water that is not captured by the porous asphalt (including runoff from the traditional asphalt and water from underdrain system) is collected in a traditional storm drain system and directed to an infiltration gallery. A V-notch weir and a pressure transducer were installed just upstream of the infiltration gallery to measure outflow from the parking lot. The graphs below show the comparison between the rainfall inflow hydrographs and the measured outflow hydrographs for two different storm events.





Above: Inflow and Outflow Hydrographs from Sept. 25, 2013. Left: Inflow and Outflow Hydrographs from August 16-24, 2013

This table shows the changes in peak flow and total runoff volume for the two storm events above.

Storm Event	Runoff Volume			Peak Flow		
	Inflow Volume (cf)	Outflow Volume (cf)	Percent Decrease	Inflow Peak (cfs)	Outflow Peak (cf)	Percent Decrease
September 25, 2013	3,662	1,270	65%	0.23	0.11	52%
August 16 to August 24, 2013	8,544	4,853	43%	0.10	0.06	40%

Taku Lake Parking Lot

Rain Garden

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.

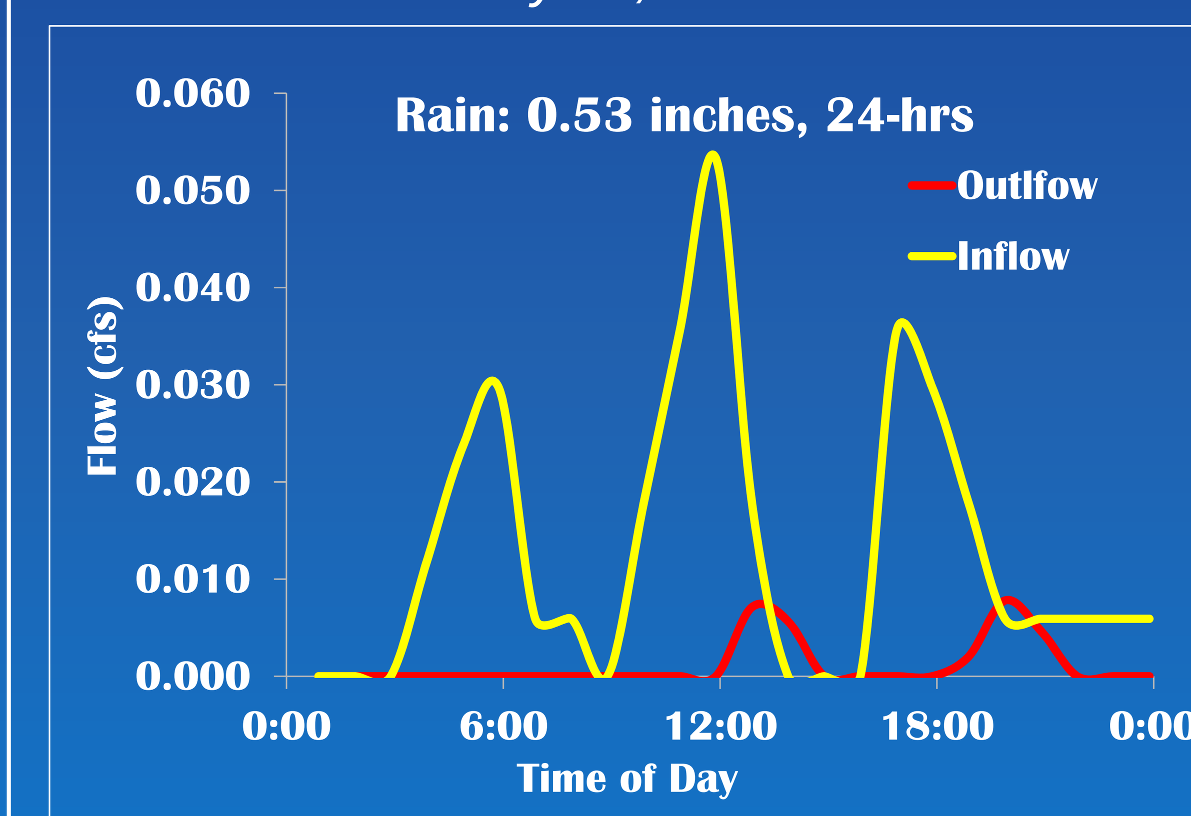
Above: Runoff from the Taku parking lot, heading toward the rain garden. Right: Taku Lake Rain Garden.

Monitoring

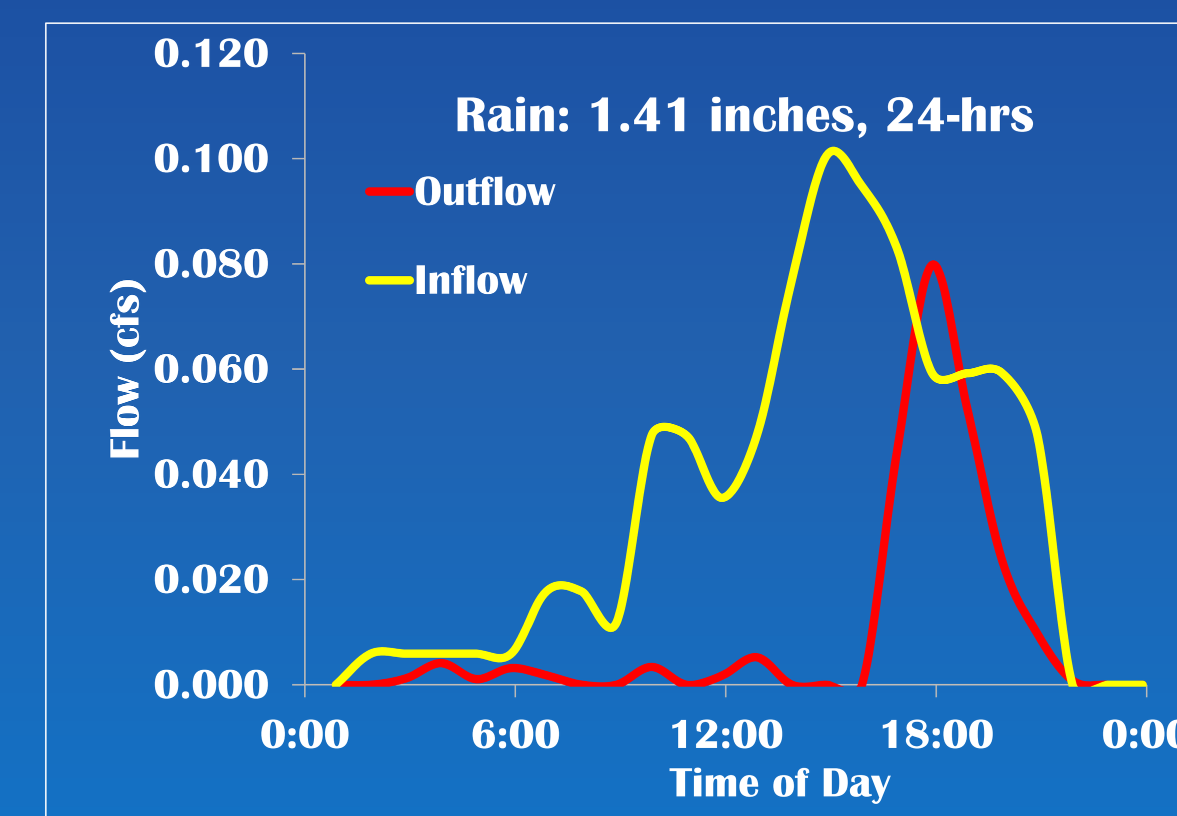
Inflow A rain gauge was installed on site to measure rain events from July to October of 2012. Unfortunately, the gauge records indicate that the gauge may have been tampered with, and the inflow hydrographs are based on rainfall records from Anchorage International Airport.

Outflow A pressure transducer was installed in the rain garden's outflow pipe to measure water leaving the rain garden. These measurements were converted to outflow using Manning's equation.

Inflow and Outflow Hydrographs July 21, 2012



Inflow and Outflow Hydrographs Sept 19, 2012



This table shows the changes in peak flow and total runoff volume for the two storm events above.

Storm Event	Runoff Volume			Peak Flow		
	Inflow Volume (cf)	Outflow Volume (cf)	Percent Decrease	Inflow Peak (cfs)	Outflow Peak (cf)	Percent Decrease
July 21, 2012	1,130	98	91%	0.05	0.01	84%
September 19, 2012	3,006	1,589	47%	0.10	0.08	20%

2013 Wet Weather Sampling

Year 3 of a 4-year Study of Pollutants in Storm Runoff

KINNETIC LABORATORIES INCORPORATED

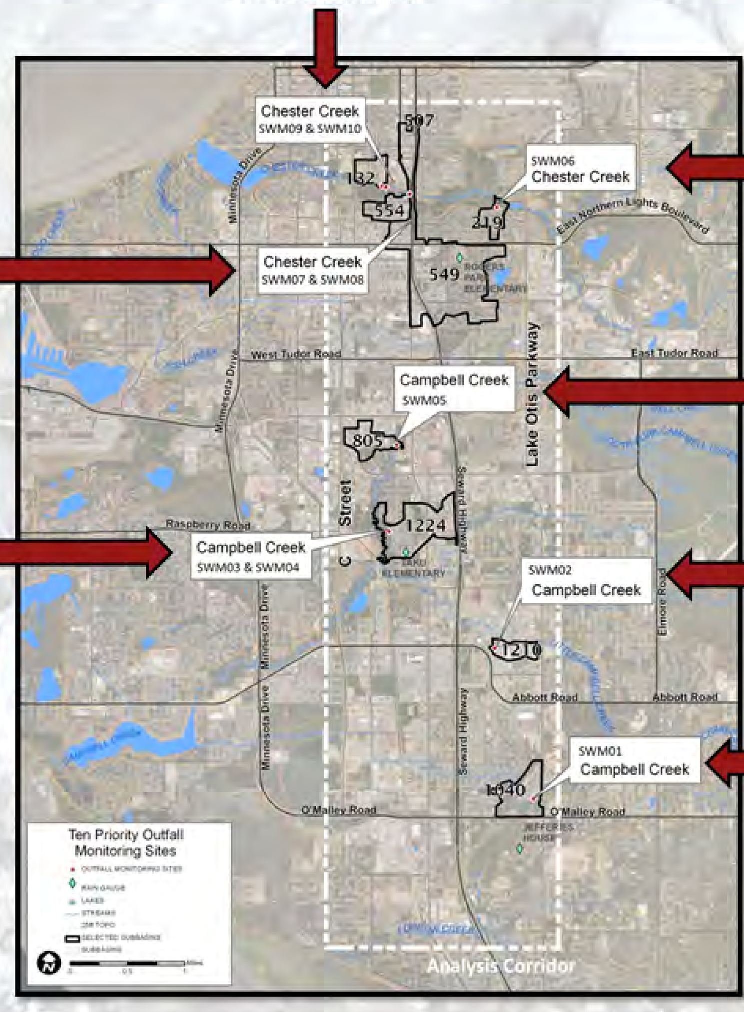
HDR Alaska

Ten Outfalls Monitored…

Contributing Land Use
Commercial

Contributing Land Use
Mixed

Contributing Land Use
Residential



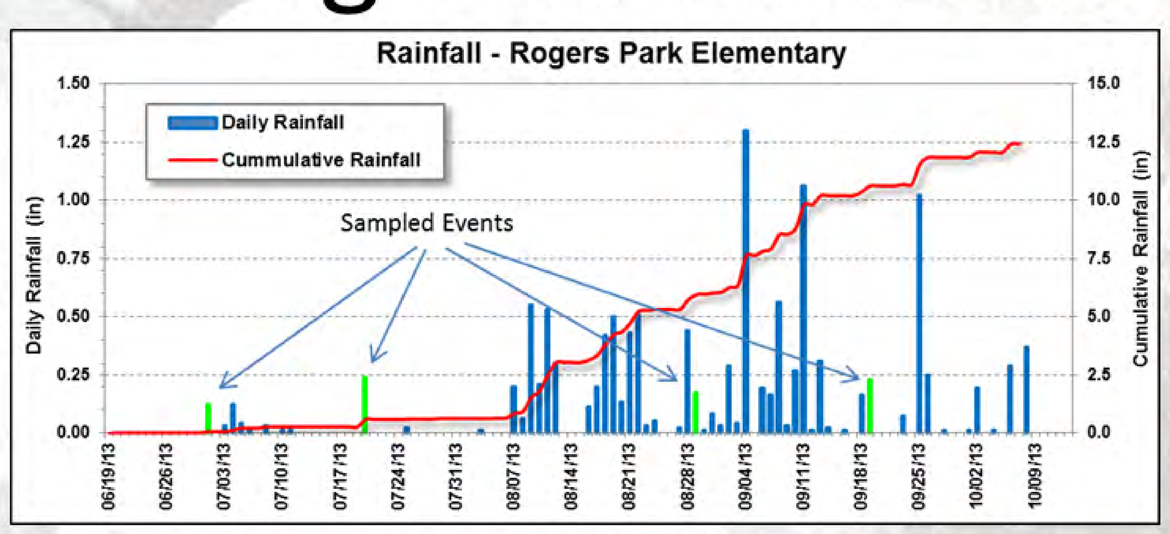
Contributing Land Use
Residential

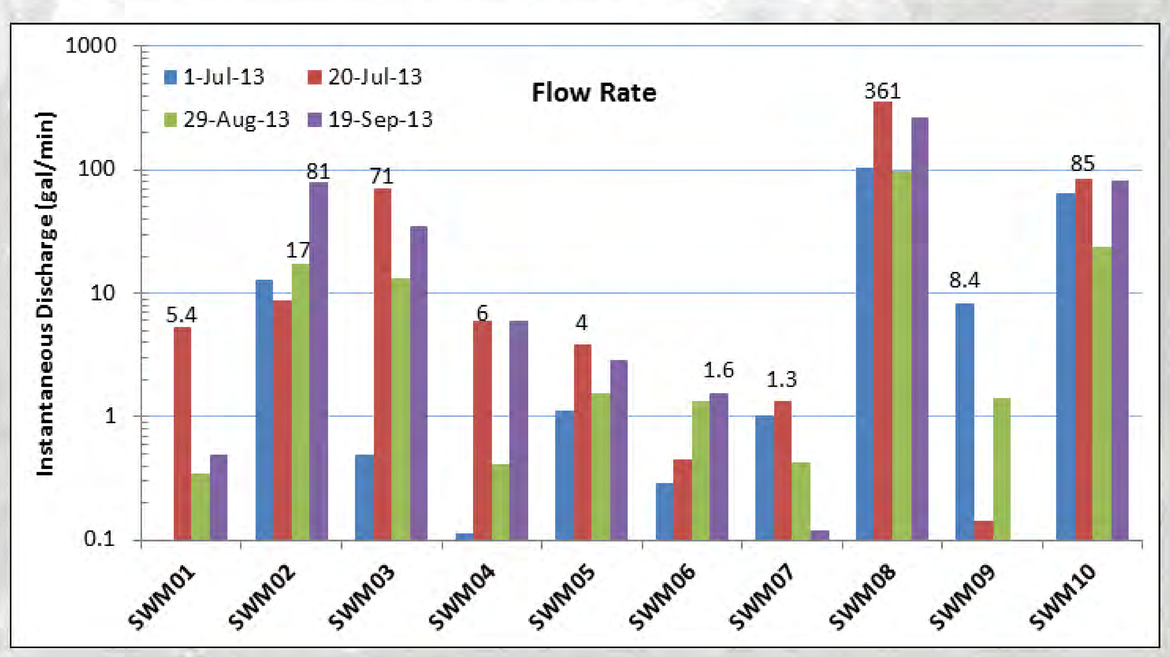
Contributing Land Use
Commercial

Contributing Land Use
Commercial

Contributing Land Use
Residential

During Four Storms…





For Ten Parameters

Flow (gal/min)	BOD_5 (mg/L)
DO (mg/L)	Fecal Coliform (CFU/100mL)
pH	TSS (mg/L)
Turbidity (NTU)	TAH (µg/L)*
Temperature (°C)	TAqH (µg/L)*
	*sampled at SWM02, SWM05, SWM07, SWM09

Wet Weather Team
Mark Savoie, Kinnetics Laboratories
Gary Lawley, Kinnetics Laboratories
Bailey Johnston, E.I.T, HDR Alaska
Cindy Helmericks, HDR Alaska

Objectives of Study

- Broadly estimate the annual pollutant loading for fecal coliform and petroleum hydrocarbon to specific watersheds
- Assess the effectiveness of existing stormwater controls
- Prioritize portions of the MS4 that need additional controls
- Provide feedback on whether Total Maximum Daily Load (TMDL) objectives are being met.

Methodology

- Stormwater outfall sampled after >0.1 inch of precipitation in 24 hours preceded by 24 hours of less than 0.1 inch of precipitation. Discharge from outfall calculated.
- Temperature, pH, dissolved oxygen and turbidity measured with field probe.
- Water quality samples collected for biological oxygen demand (BOD), total suspended solids (TSS), fecal coliform and aqueous hydrocarbons.
- Visual observations recorded.

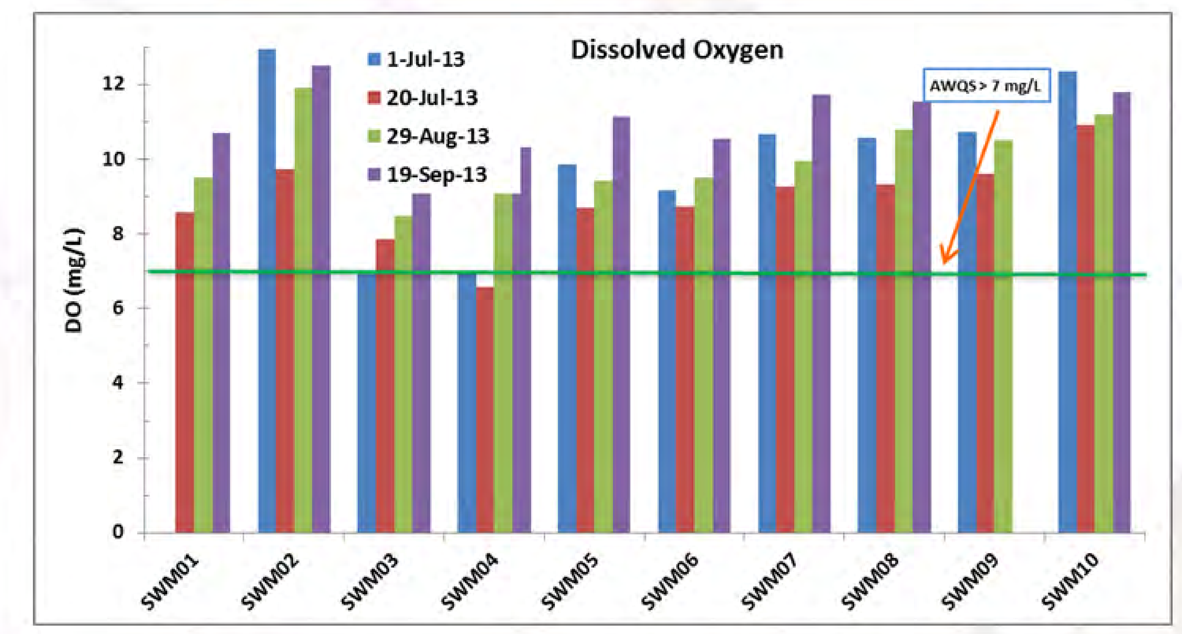
For 2014

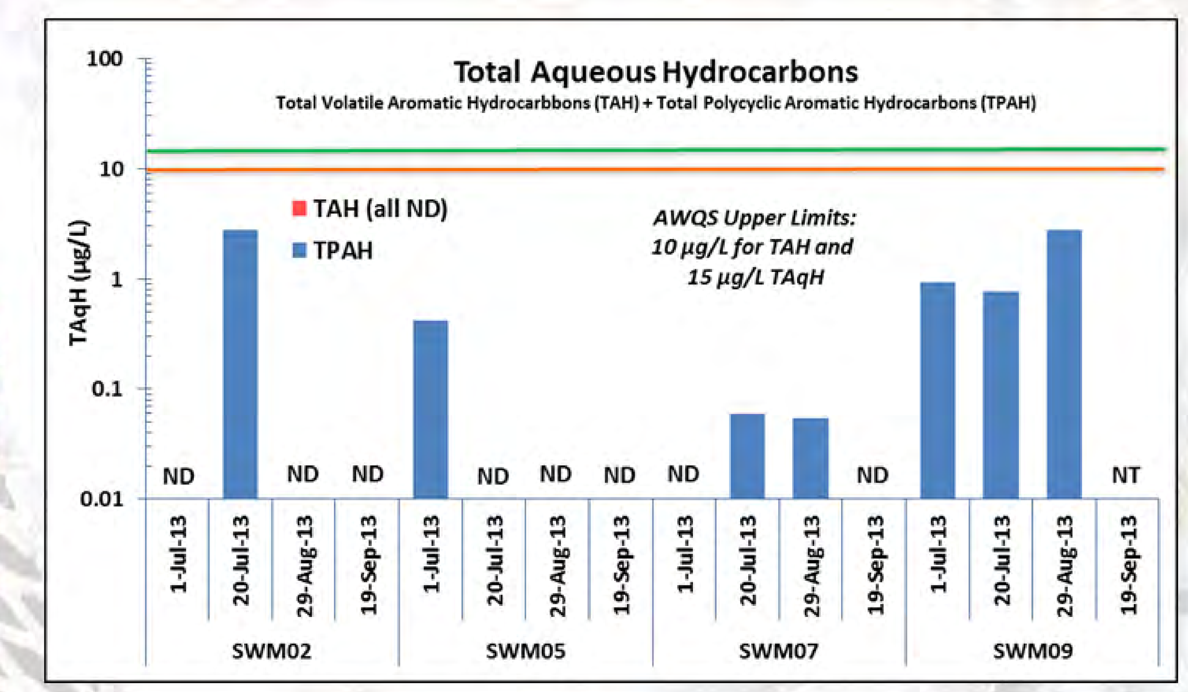
- Continuation of outfall sampling program (year 4)
- Summarize Study
  - Outfall selection
  - Sampling Methodology
  - Field and laboratory results
  - QA/QC
  - Analysis/Interpretation of results
    - Mean/Median/Range/90th percentile of each parameter
    - Evaluation by contributing land use.
    - Compare results for subbasins with and without oil and grit separators.
    - Estimate total volatile aromatic hydrocarbon (TAH) and total aqueous hydrocarbon (TAqH) loadings for commercial and industrial land use subbasins. Use these results to estimate loading across MOA MS4.

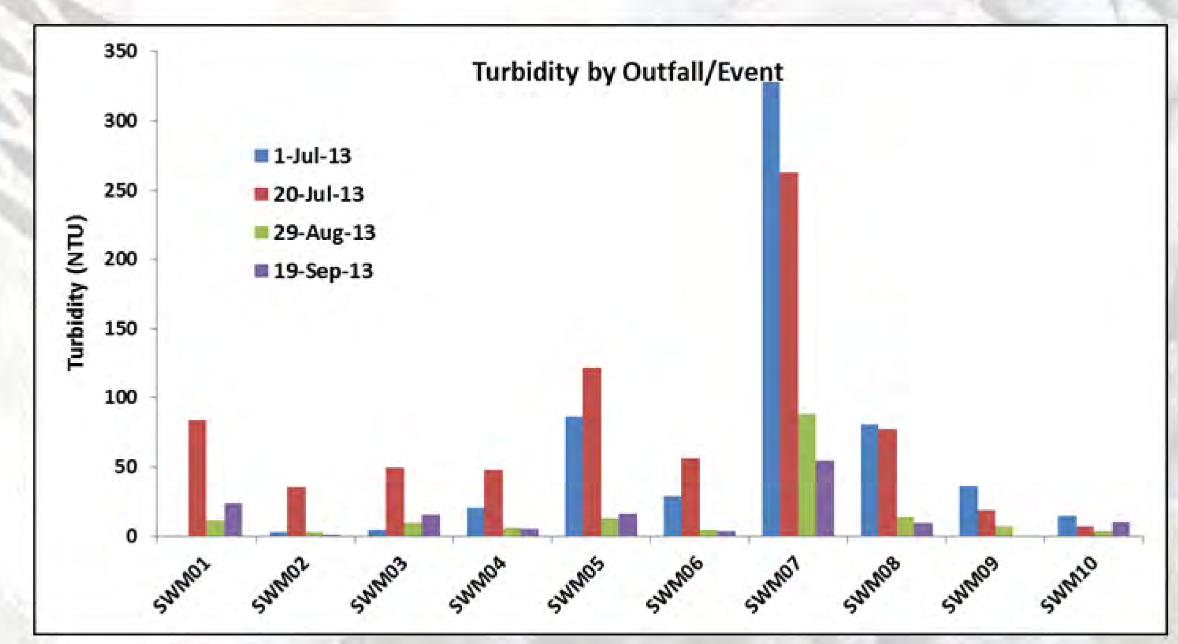
Results

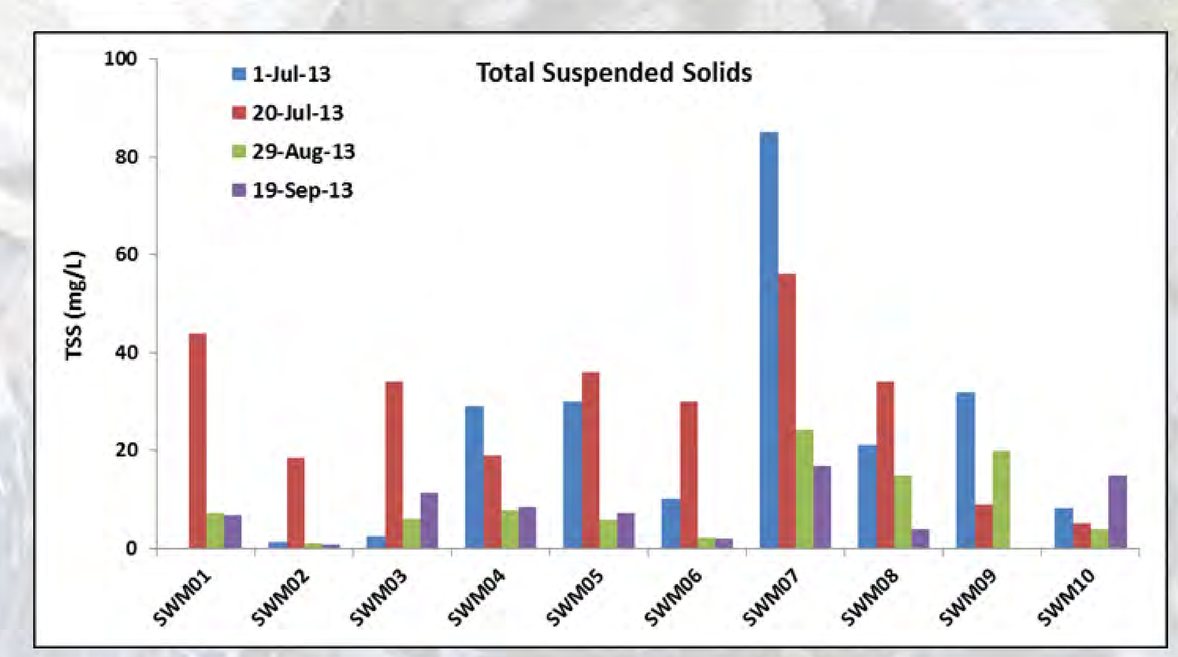
Fecal Coliform (CFU/100 ml)				
Station	Event-01 1-Jul-2013	Event-02 20-Jul-2013	Event-03 29-Aug-2013	Event-04 19-Sept-2013
SWM01	*	332	360	1320
SWM02	213	177	41	3
SWM03	470	172	5400	727
SWM04	147	106	1350	387
SWM05	209	14900	18500	130
SWM06	564	170	40	8
SWM07	32300	2500	964	173
SWM08	791	682	72	88
SWM09	275	745	17	**
SWM10	25	4	64	6

Highlighted cells exceed Alaska Water Quality Standards (AWQS) limit of 200 CFU/100 mL
(used for comparison - standard does not directly apply to storm water)
*Samples not taken due to lack of flow at the site.
**No samples due to storm drain cleaning.









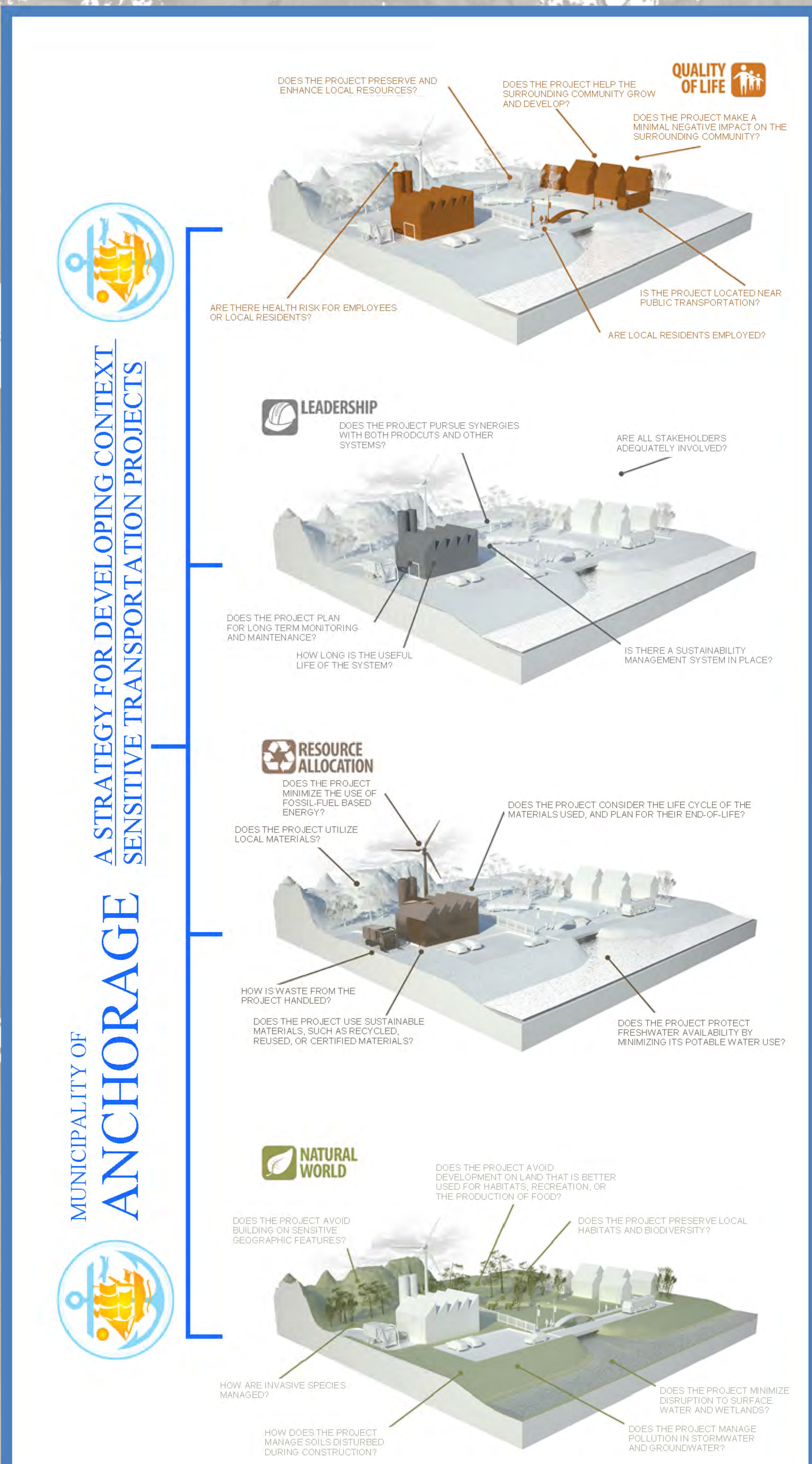
The Municipality of Anchorage Future Stormwater Sediment Treatment Facility

Anchorage Stormwater Treatment Facility

The MOA is required to comply with the latest Alaska Pollutant Discharge Elimination System (APDES) and Municipal Separate Storm Sewer System (MS4) permits. Compliance with these permits protects public health and the environment by minimizing point source pollution and discharge to lakes and streams within the Municipality of Anchorage (MOA). As part of the compliance effort, the MOA is required, on an annual basis, to clean over 250 oil and grit separator (OGS) structures and over 9,300 storm drain catch basins.

The proposed stormwater sediment treatment facility is needed to provide the MOA with the ability to safely treat stormwater sediment removed from the stormwater system structures. The treatment process would operate from June to September and the final annual volume of dried sediment is expected to be approximately 1,700 cubic yards. The treatment facility would serve the Anchorage Roads and Drainage Service Area (ARDSA) within the municipality.

Below: The MOA will use A Strategy for Developing Context Sensitive Transporation Projects as a guide to designing the Stormwater Sediment Treatment Facility. The diagrams were provided by Envision®.



Below: The MOA has initially identified four potential sites for the stormwater treatment facility. The facility location is to be determined using numerous input factors.

Above: The map displays the density of catch basins throughout the MOA. This can potentially be used to determine the most traveled vactor truck routes. Commonly traveled vactor truck routes could be an input for determining the facility location.

Northwood Site

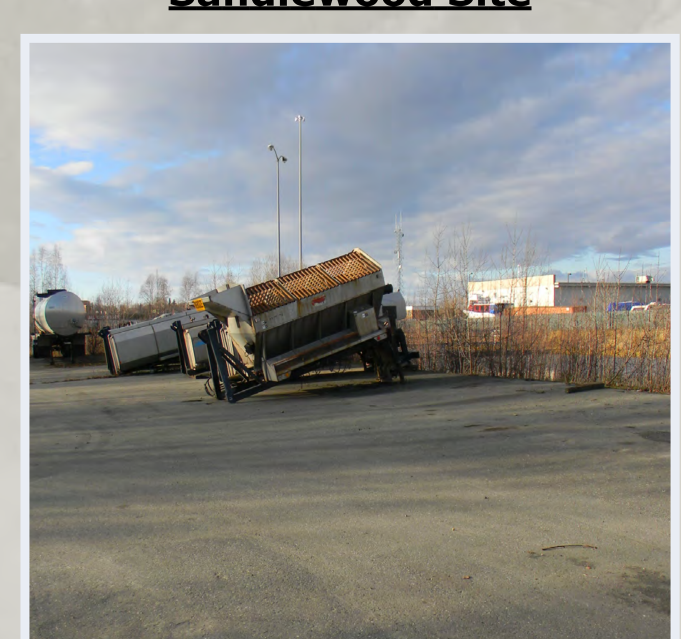
The Northwood Snow Disposal Site is a potential sediment treatment facility location. It is currently owned by the State of Alaska.

C Street Site

The C Street and 100th Avenue Snow Disposal Site is a potential location for the sediment treatment facility. This site is currently owned by MOA.

Sandlewood Site

The Sandlewood site is currently a stormwater treatment pond site. This site is currently owned by MOA.



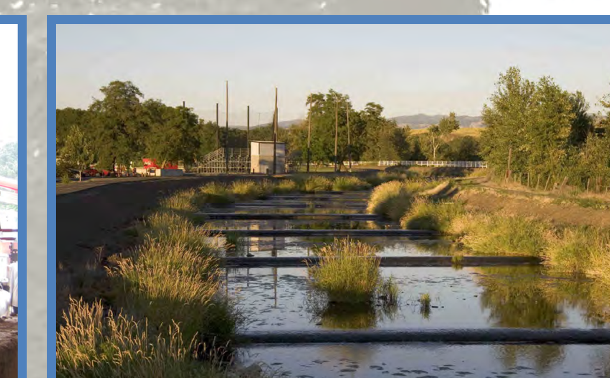
FCC Site

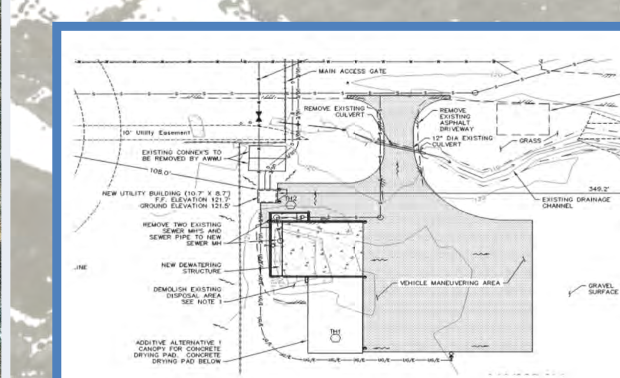
The FCC site is located north of Raspberry Road east of Kincaid Park. This property is currently owned by the federal government.

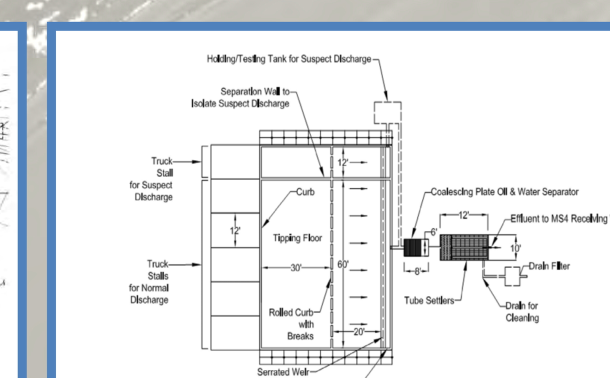
Facility Site Selection and Treatment Alternatives

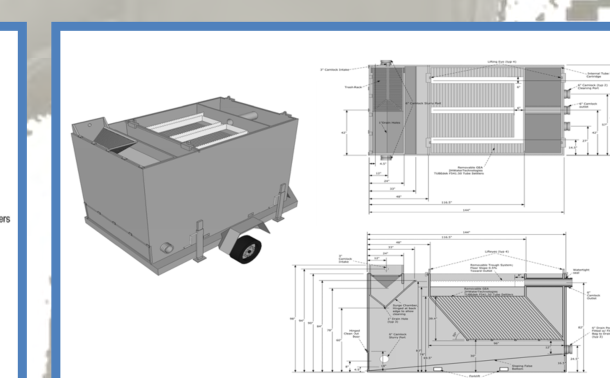
The treatment facility does not have a specified location yet. Since this is a brand new facility, the operations of current vactoring services and facility needs will be assessed to determine the best alternative. The treatment facility will be designed to service the operational requirements of vactor trucks as well as the best treatment alternative for a given site. Some treatment alternatives include on site treatment which discharges to sanitary sewer (per requirements of AWWU) or on site treatment which discharges to a receiving drainage system.

Bottom Row: Examples of vactor truck treatment designs
Middle Row (left to right): images of a vactor truck, sedimentation basin, and street sediment.
Top Row: Image of vactor truck catch basin and OGS sediment.

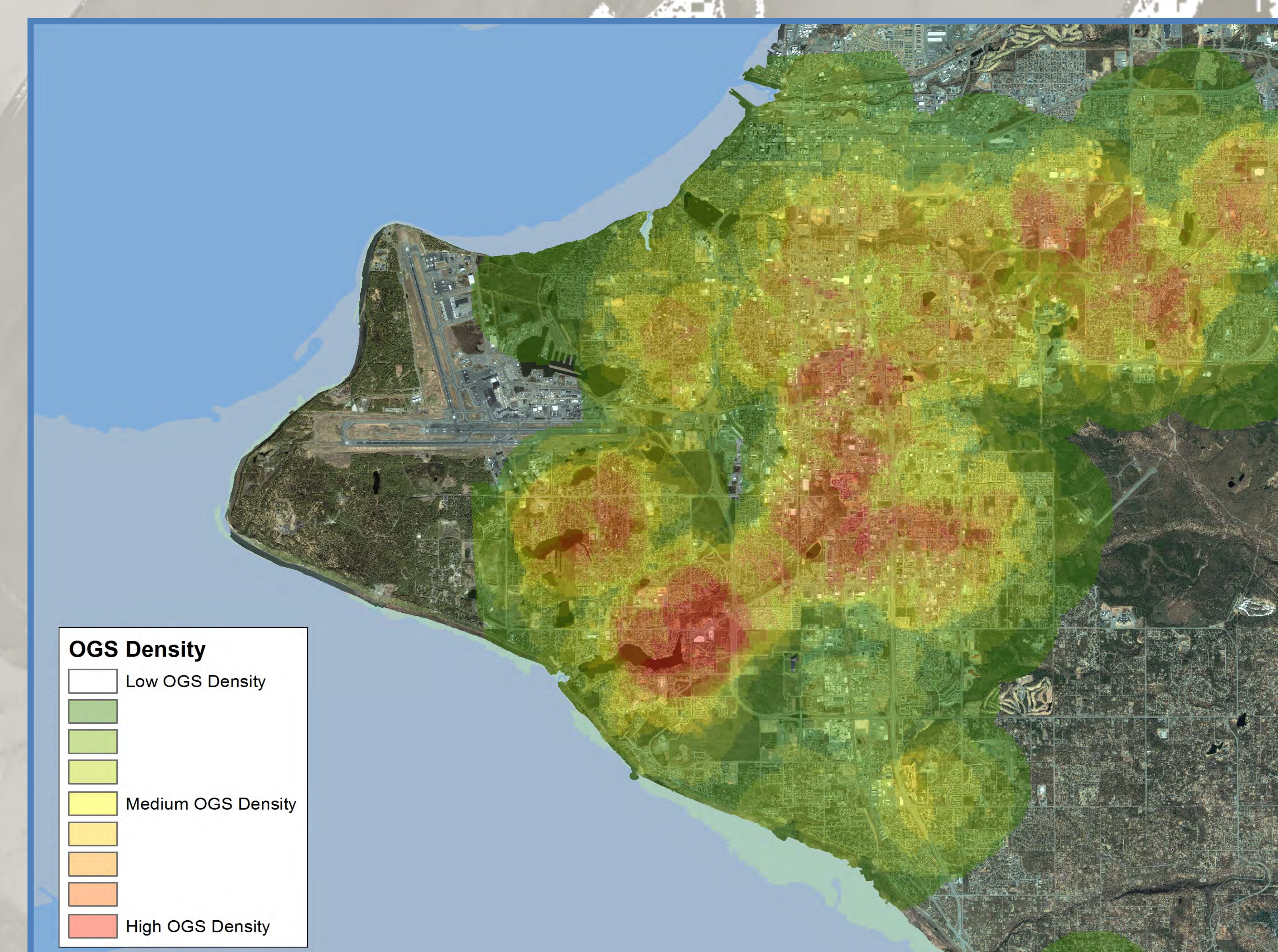








Below: The map displays the density of oil and grit separators (OGS) throughout the MOA. This can potentially be used in conjunction with the catch basin density map to determine the most traveled vactor truck routes. Commonly traveled vactor truck routes could be an input for determining the facility location.



Snow Site Processes and Water Quality

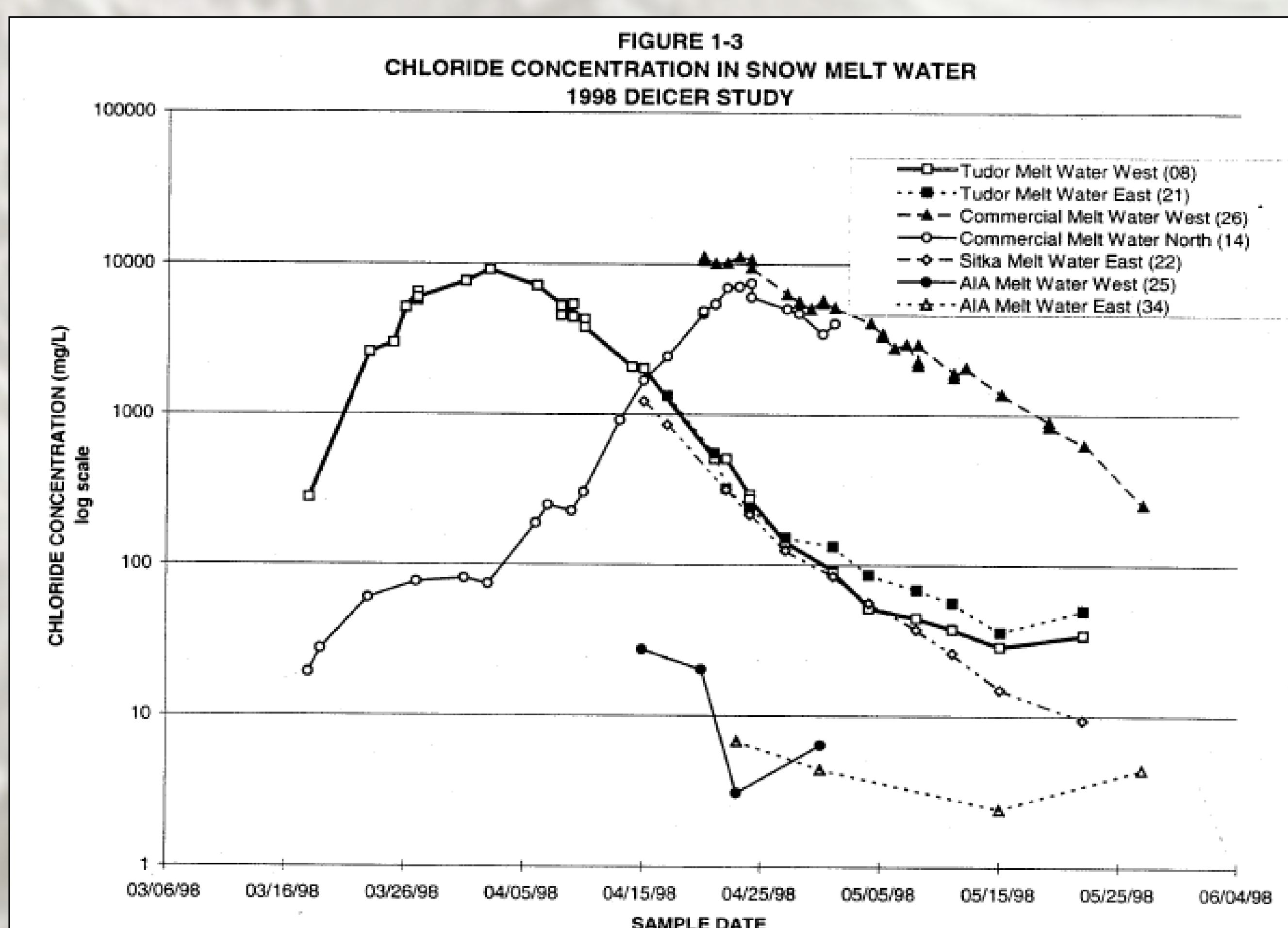
'Flat Pad' Snow Site Performance

Snow disposal site operations.

Melting at snow disposal sites.

As part of the municipal separate storm sewer system (MS4, AK-052558), MOA is required to address runoff from snow disposal sites MOA investigated existing snow disposal sites for potential improvements to manage snowmelt runoff.

Early Snow Site Tests

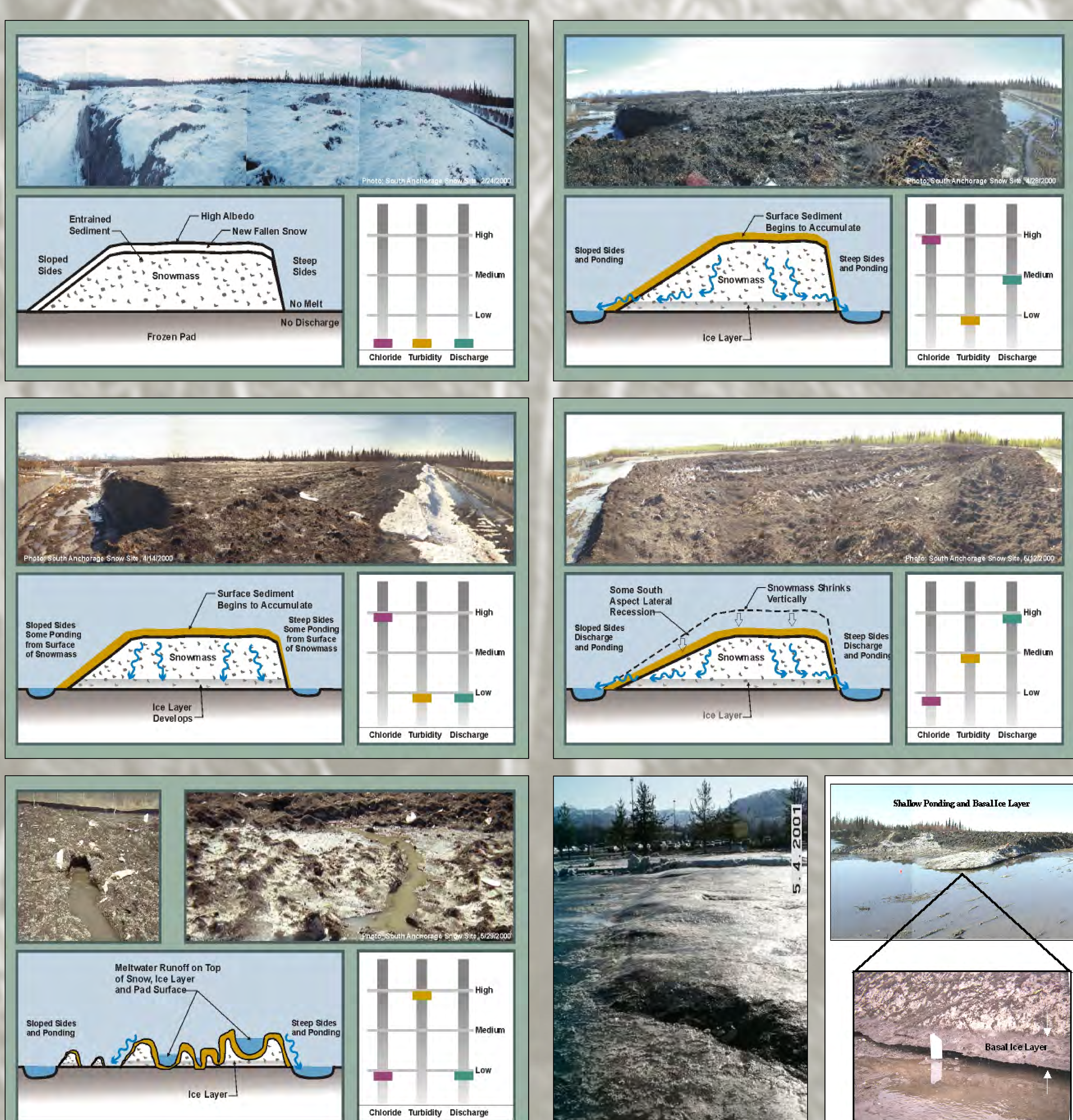


Tudor Snow Disposal Site 2000 Discharge Results

Date	Cl mg/L	EC µS/cm	Turb NTU	TSS mg/L	Flow cfs	TDS mg/L	TS mg/L	TDS:TSS	Fecal CFU/100ml	Fecal [C] CFU/100ml
4/7	344	2200	---	---	0.33	---	---	---	---	---
4/8	426	3000	297	170	0.15	---	---	---	---	---
4/13	387	2487	438	245	0.67	738	796	59	10	4
4/14	--	--	240	140	0.76	---	---	---	---	---
4/18	346	1330	116	74	0.18	---	---	---	---	---
4/20	198	1230	123	78	0.11	---	---	---	---	---
4/25	149	900	43	36	0.14	---	---	---	---	---
5/3	56	282	189	113	0.19	---	---	---	---	---
5/10	49	234	97	64	0.25	---	---	---	---	---
5/16	32	160	126	41	0.11	281	322	7	ND	ND
5/25	36	210	216	119	0.16	---	---	---	---	---
6/1	38	365	240	184	0.037	144	298	1	20	4
6/7	35	210	215	107	0.166	---	---	---	---	---
6/16	82	452	157	96	0.15	---	---	---	---	---
6/26	53	259	482	268	0.037	---	---	---	---	---
7/12	36	150	3500	1868	0.018	---	---	---	---	---
7/10	0	0	0	0	0	---	---	---	---	---

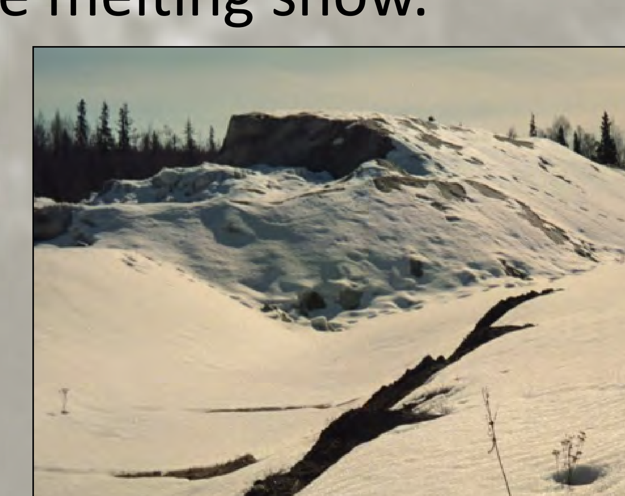
Preliminary test results indicated the major constituents of concern were chloride and TSS. All other constituents were within permissible levels. The need to address levels of chloride and TSS led to further investigations into the siting, design, and operation of snow disposal sites.

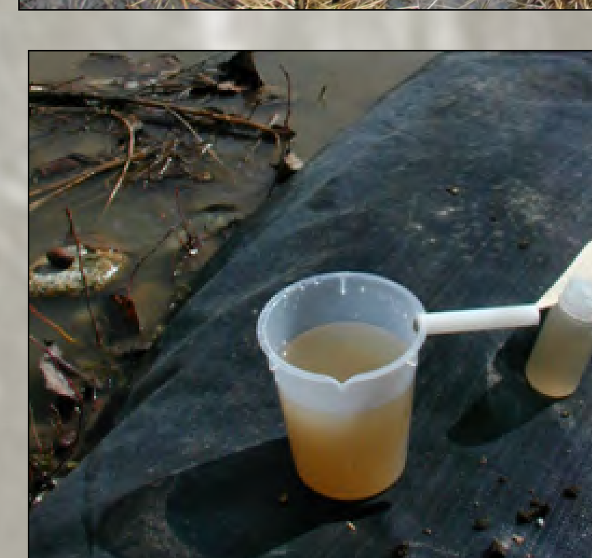
How Anchorage Snow Sites Melt



Early V-Swale Experiments

Initial small scale results indicated that subtle changes to disposal pads resulted in reduced pollutant runoff. Shallow pooling of meltwater allowed sediment to settle, thus reducing TSS. Avoiding large spikes in chloride runoff could be accomplished by trapping the chloride in the basal ice layer of the pads and allowing it to slowly release with the melting snow.



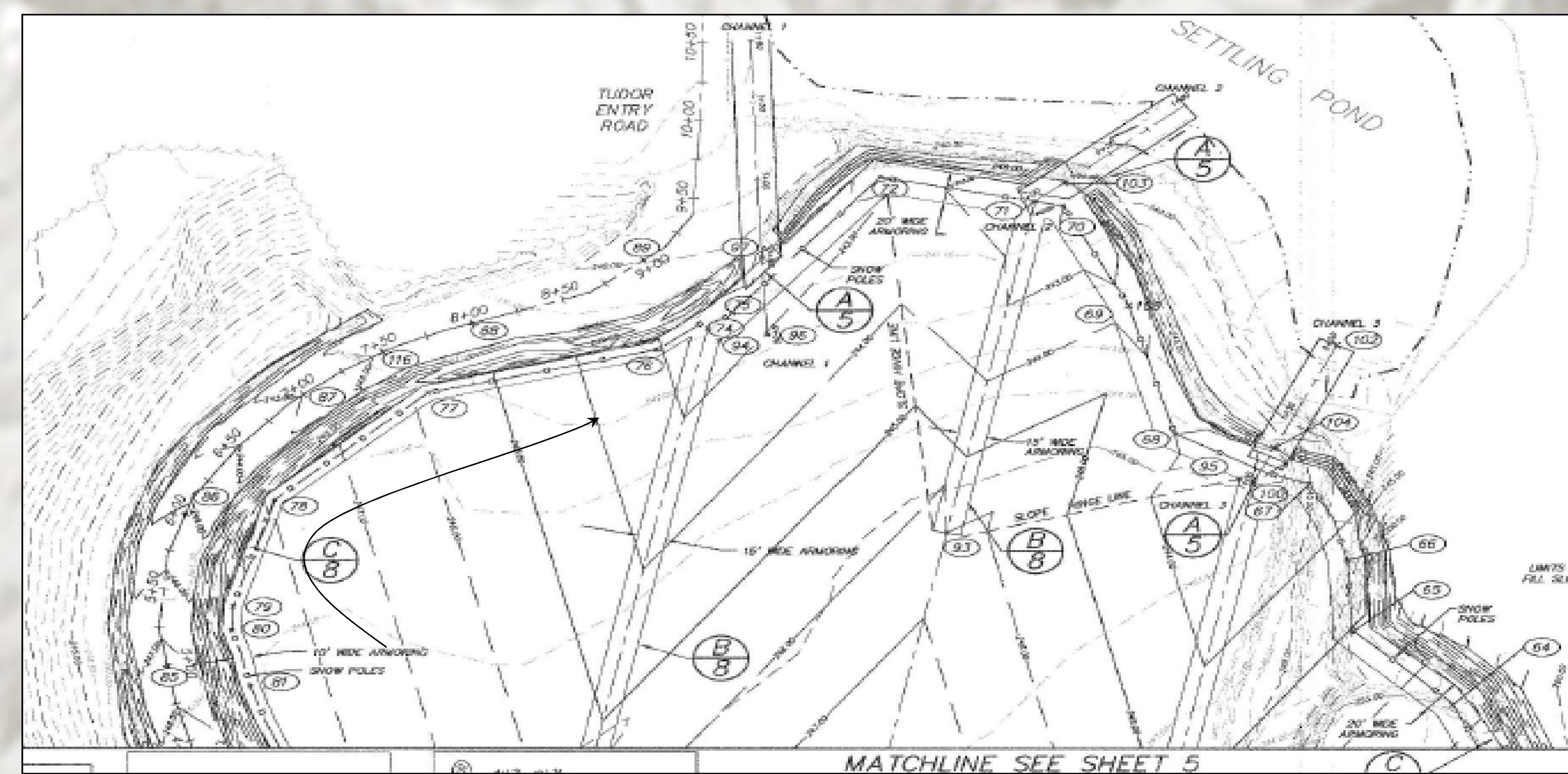


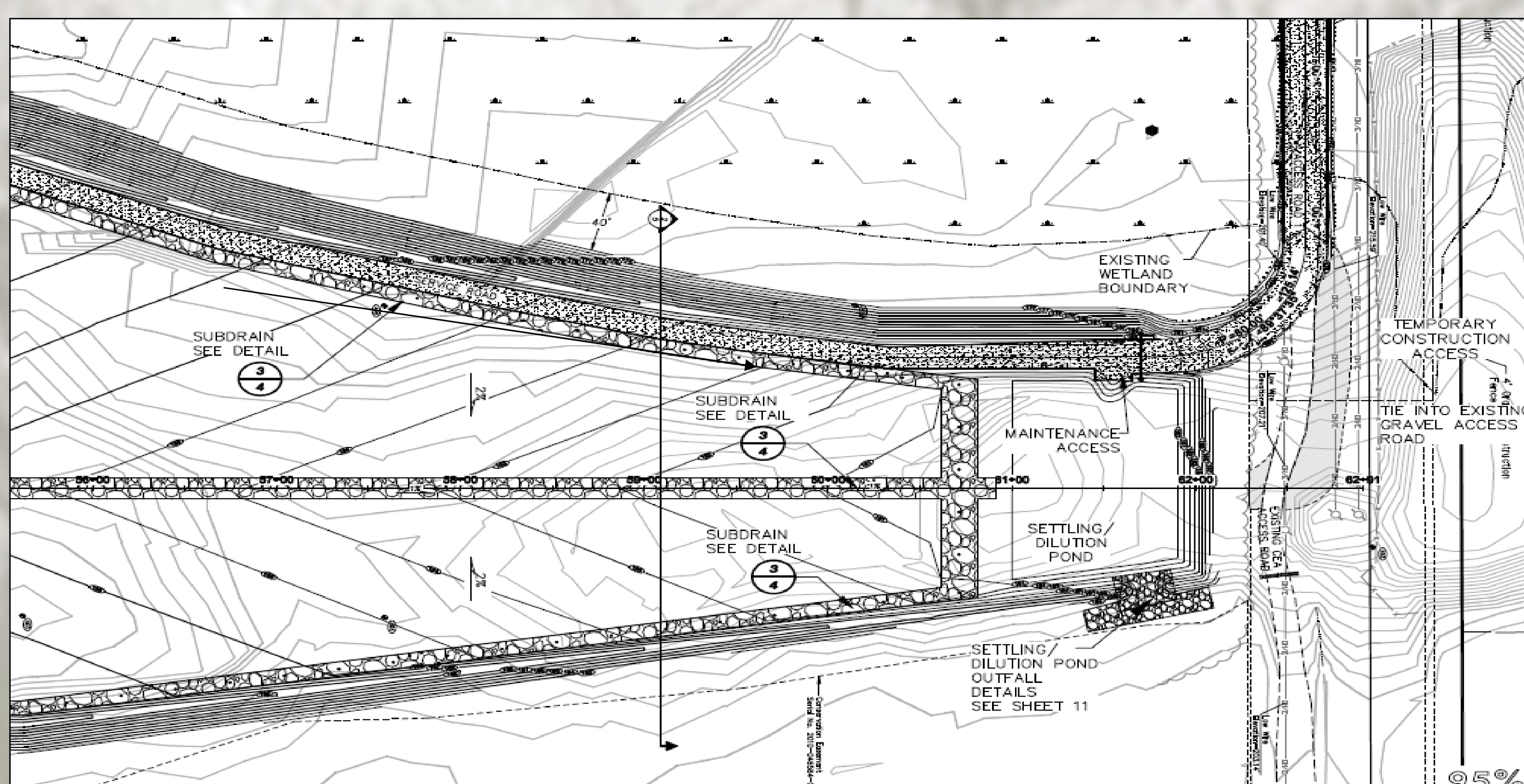
Top left: Sediment after ponding.
Top Right: Winter snow disposal site.
Bottom Left: Water sample prior to ponding.
Bottom Right: Water sample after ponding.

2013 Evaluation and Issues

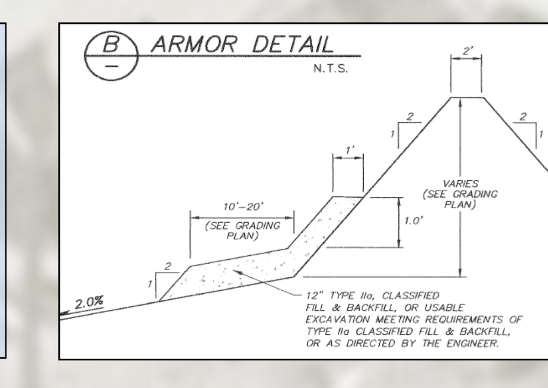
Design Issues

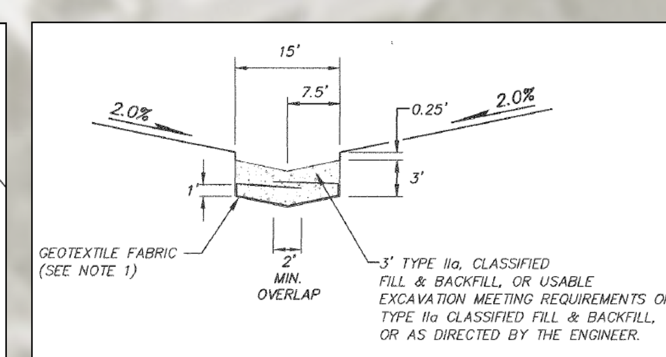
Vs.



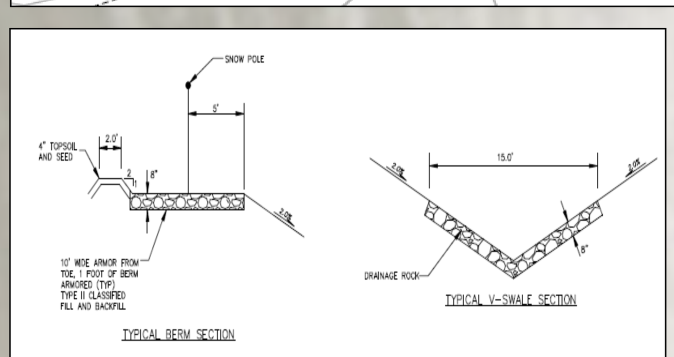


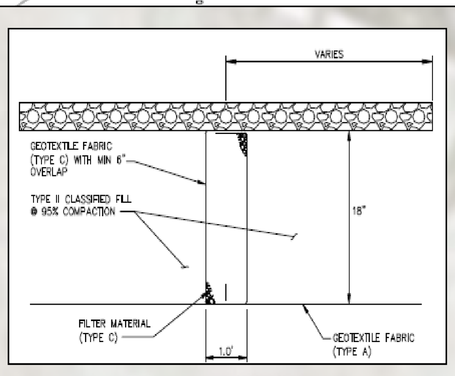
1. Asymmetric swales
2. Curvilinear Channels
3. Armor material type and placement





Dry Detention Volume
Draining/ice obstruction



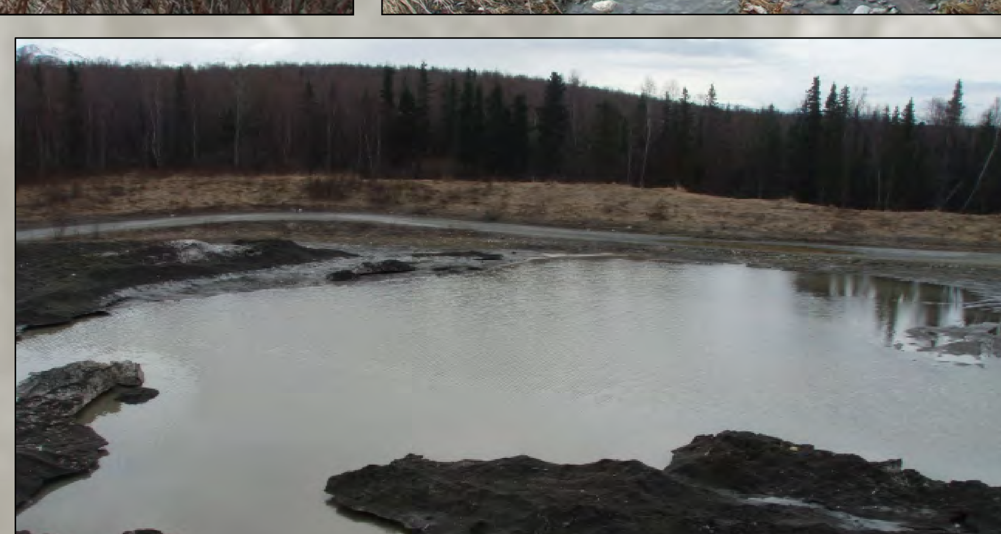


1. Broadly symmetric swales
2. Linear channels
3. Armor material type and placement

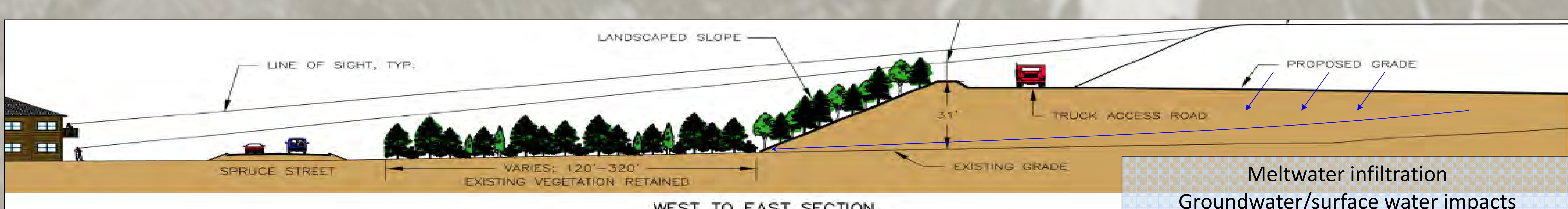
Operational Issues

Blowout!
"Snow wings" and blocked channels

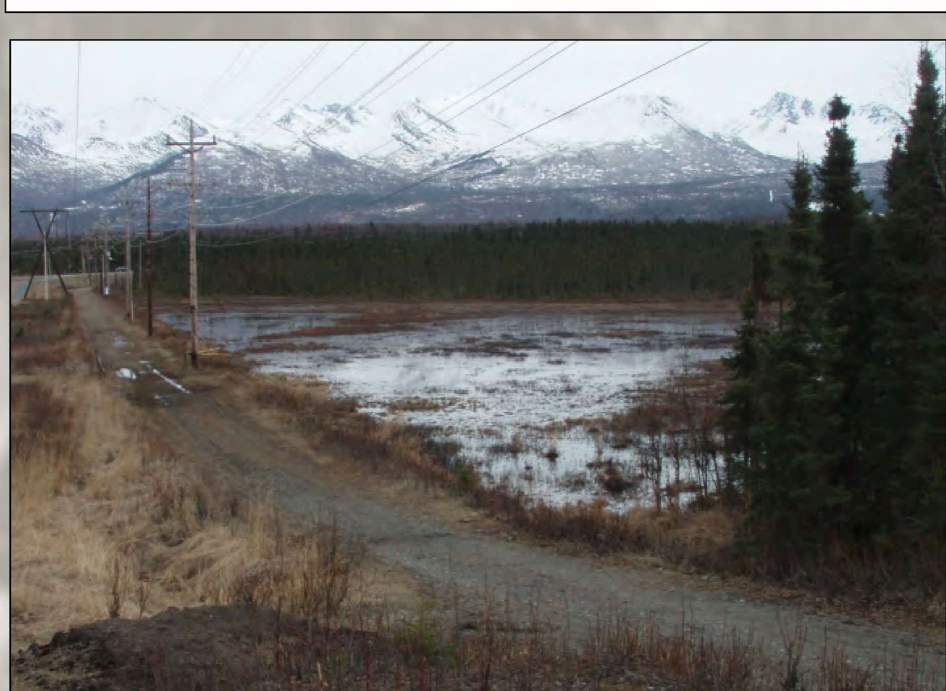
Erosion from uneven snow fill
Snow collapse below deep fill



Siting Issues



Meltwater infiltration
Groundwater/surface water impacts



Typical receiving water downstream from settling ponds.

Distribution to receiving water body and natural attenuation

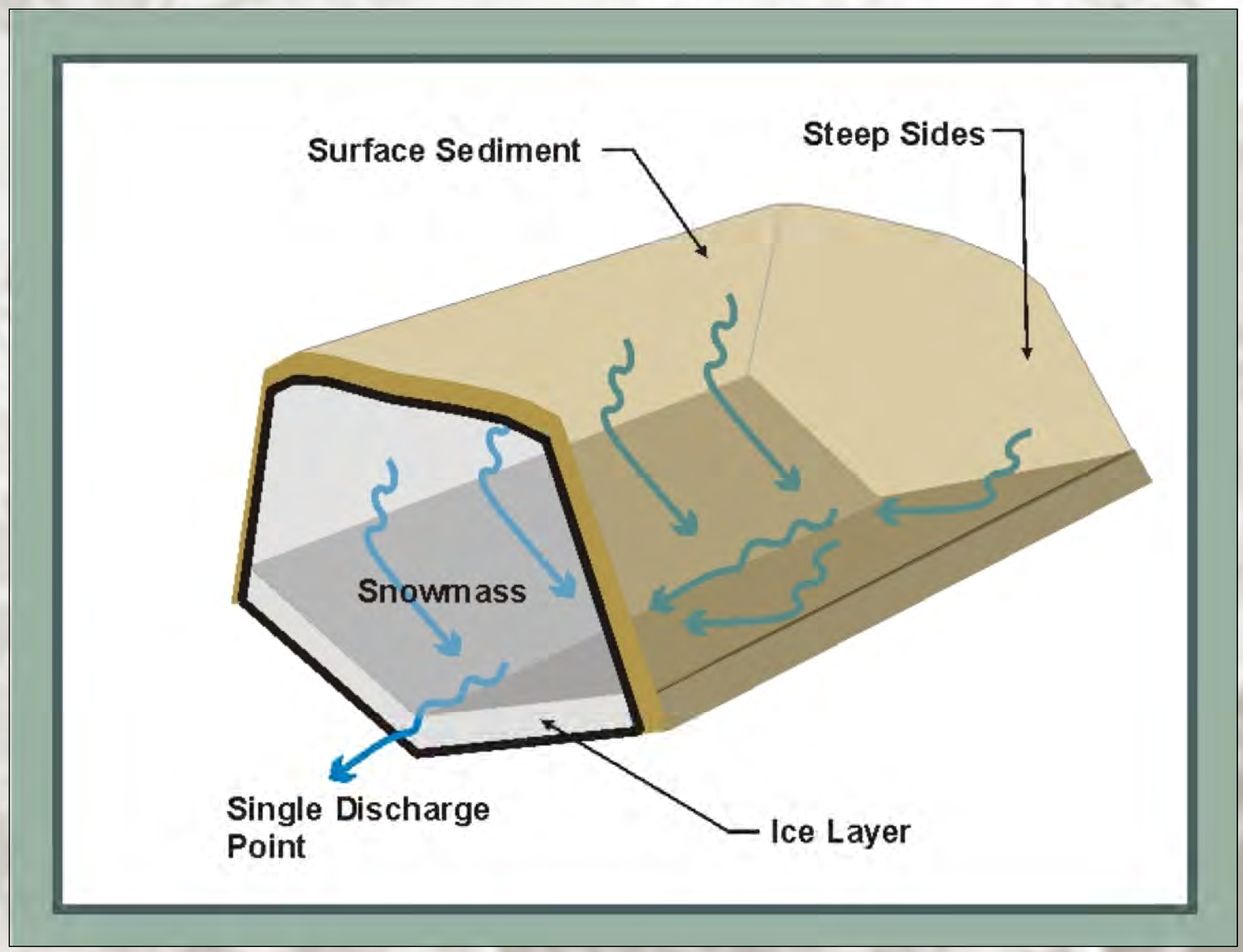
Typical settling pond located downstream from snow disposal sites.

End Results

- V-Swale design works
- Design improvements are possible with further research and testing.
- V-Swales require strict operational guidelines to ensure proper function.

Snow Disposal Site Evaluation

V-Swale Design and Performance



V-Swale Concept

The V-swale design relies on grading the pad into shallow 'V"s which provide a form that the basal ice can be shaped. The resulting ice troughs capture and direct meltwater across the surface of the basal ice to the main channel and down the central axis of the V-Swale. This meltwater is discharged at a single point, allowing for conveyance to early detention ponds to attenuate peak chloride concentrations. Grading V-Swales to drain to the north allows 'uphill' snow to collapse and melt first (melting from south to north). As a result, sediment trapped within the melting snow drops to the pad surface with minimal meltwater upslope to erode and carry the sediment to the settling ponds.

Early Performance Tests

Pilot scale basal ice experiments were conducted including shallow ponding and initial V-Swale pad design.

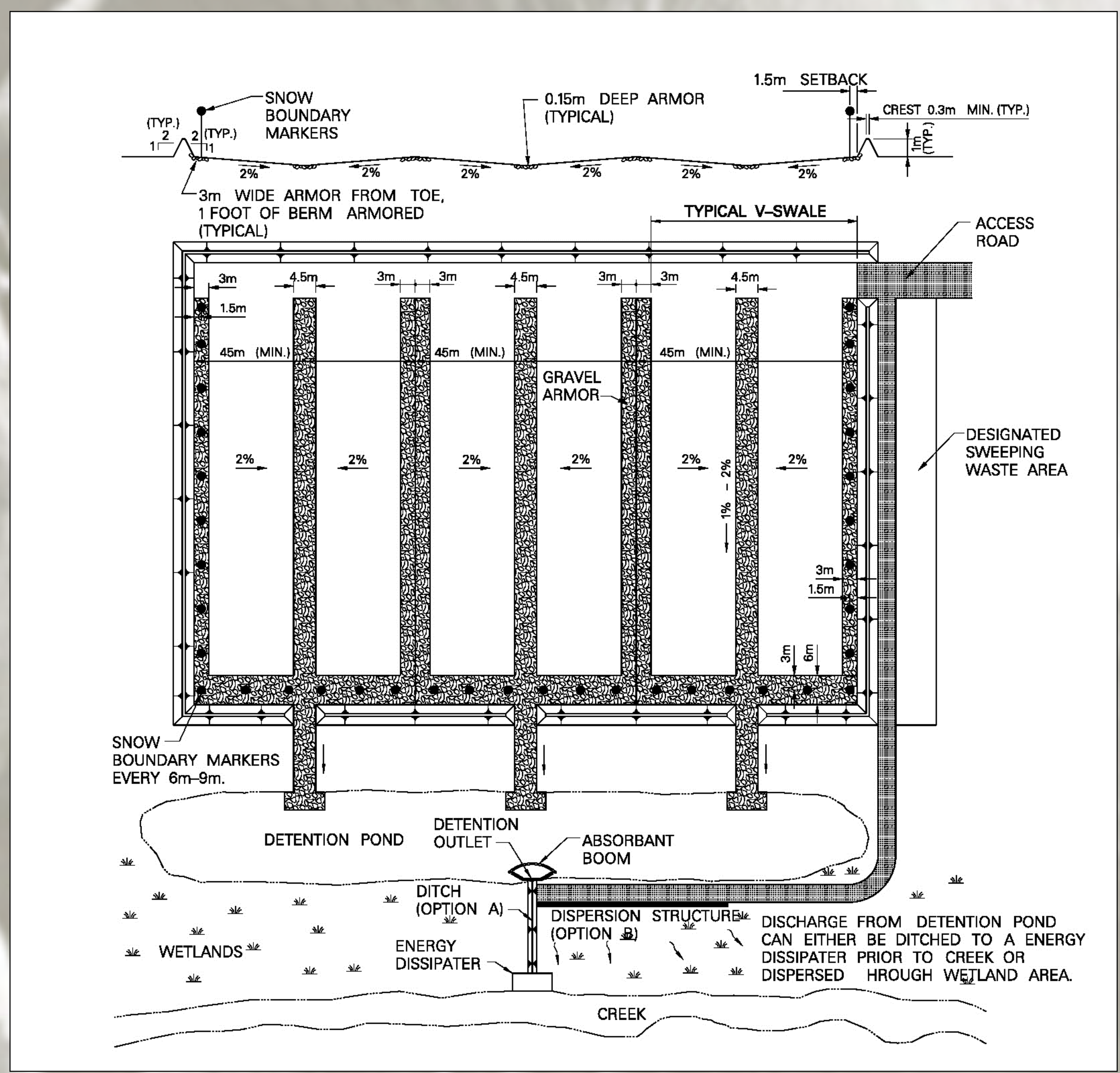
Performance Observations			
	Early Melt	Mid-Melt	Disintegration
Directly off Snowfill Turbidity (NTU) Chloride (mg/L)	150-350 1,000-10,000	350-500 100-500	>1,000 <100
Shallow Ponding Turbidity (NTU) Chloride (mg/L)	70-150 1,000-10,000	150-300 100-500	>500 <100
V-Swale Turbidity (NTU) Chloride (mg/L)	10-50 1,000-10,000	10-50 100-500	<200 <100

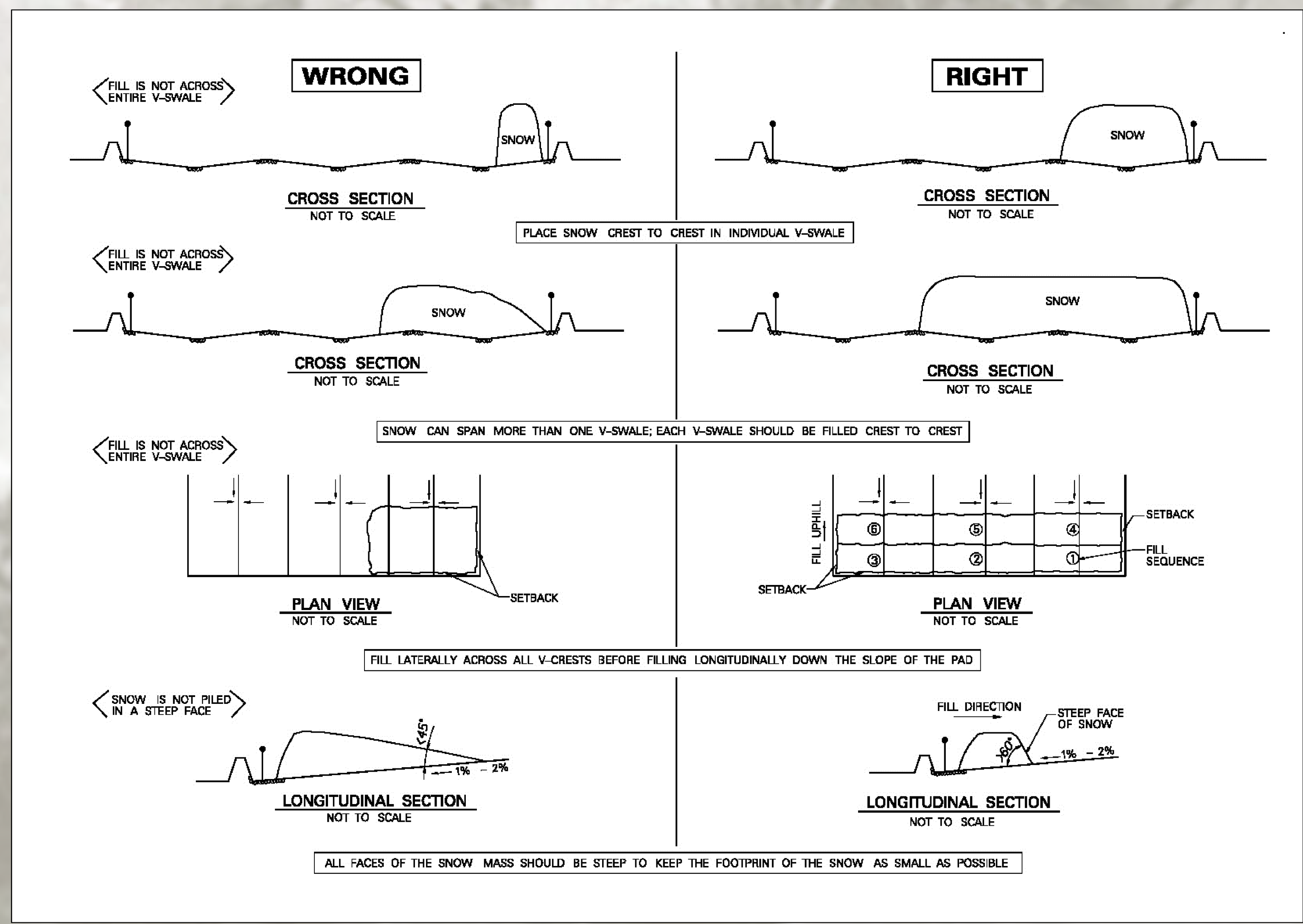
With positive results, the decision was made to move forward with large scale implementation of V-Swale disposal sites.

Design & Operational Criteria

Design criteria for V-Swales were incorporated into the DCM. Yet, even with a sound design, V-Swales can discharge larger pollutant loads than typical snow disposal sites unless the V-Swales are managed correctly. Therefore, strict adherence to the operational criteria is required for proper function.

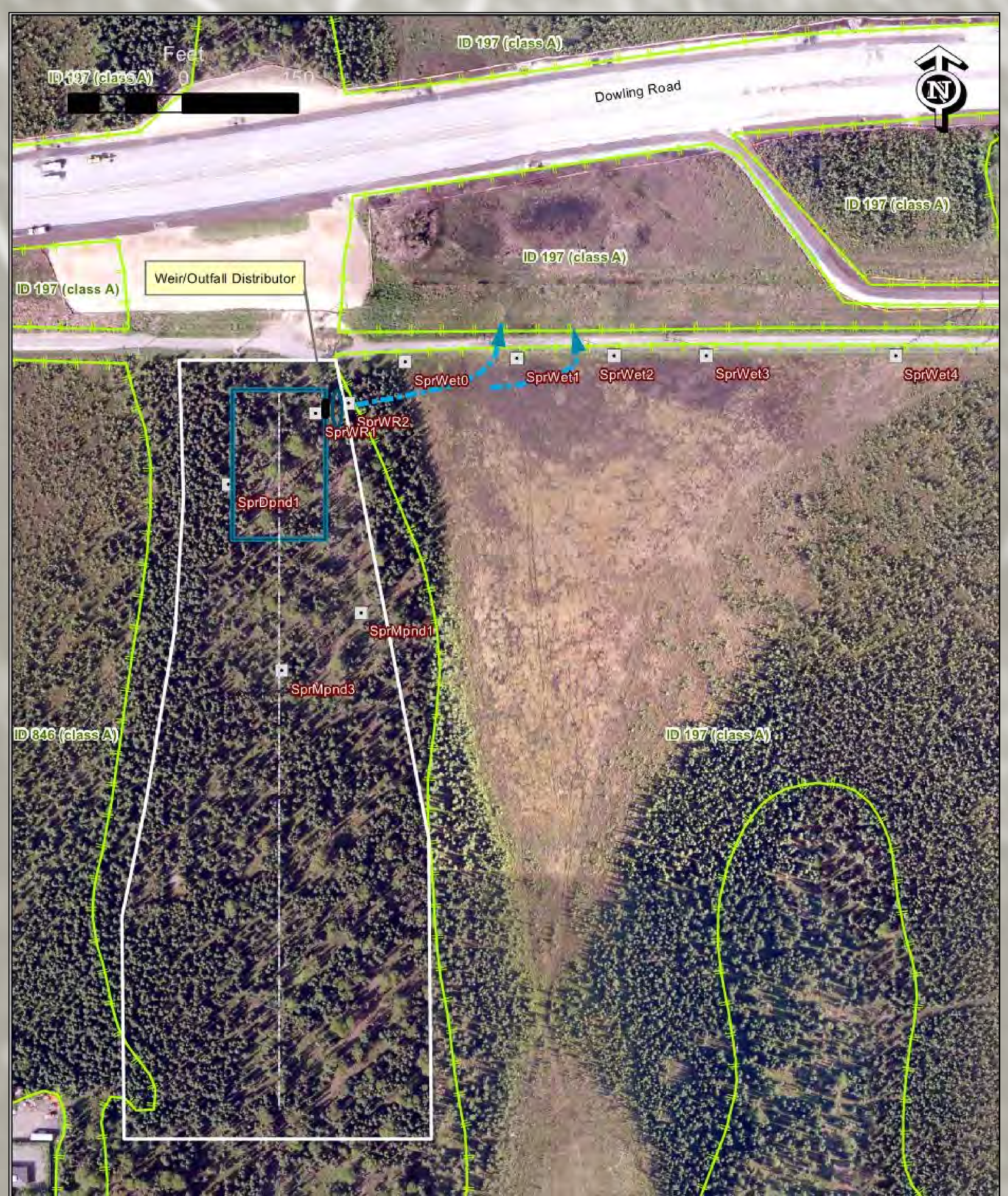
Two full-scale V-Swales were constructed as a result; the Spruce and Tudor snow disposal sites.



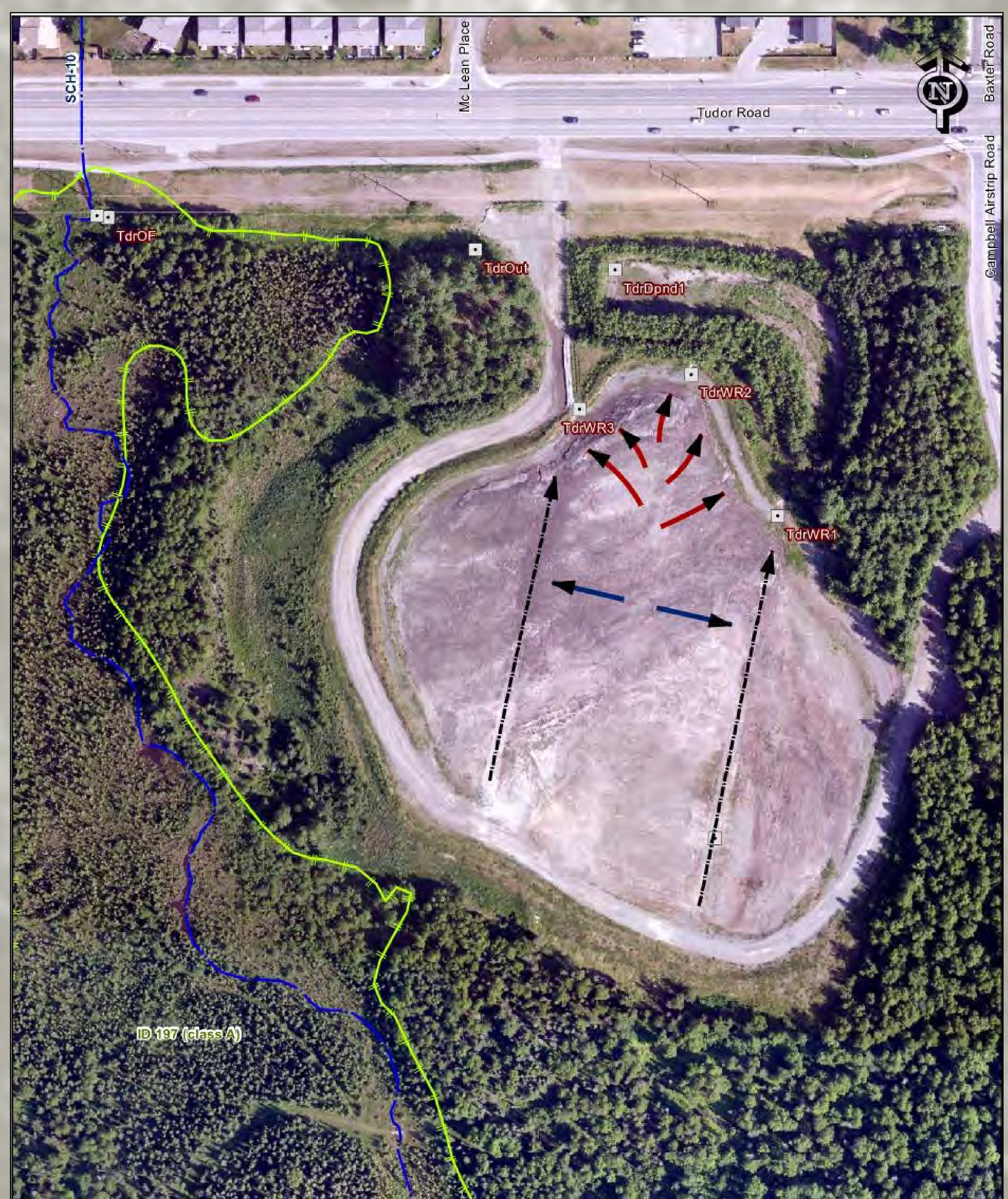


2013 Performance Test Sites

To assess the effectiveness of the V-Swales, samples were collected at both Spruce and Tudor snow disposal sites and analyzed for chloride and TSS concentrations.



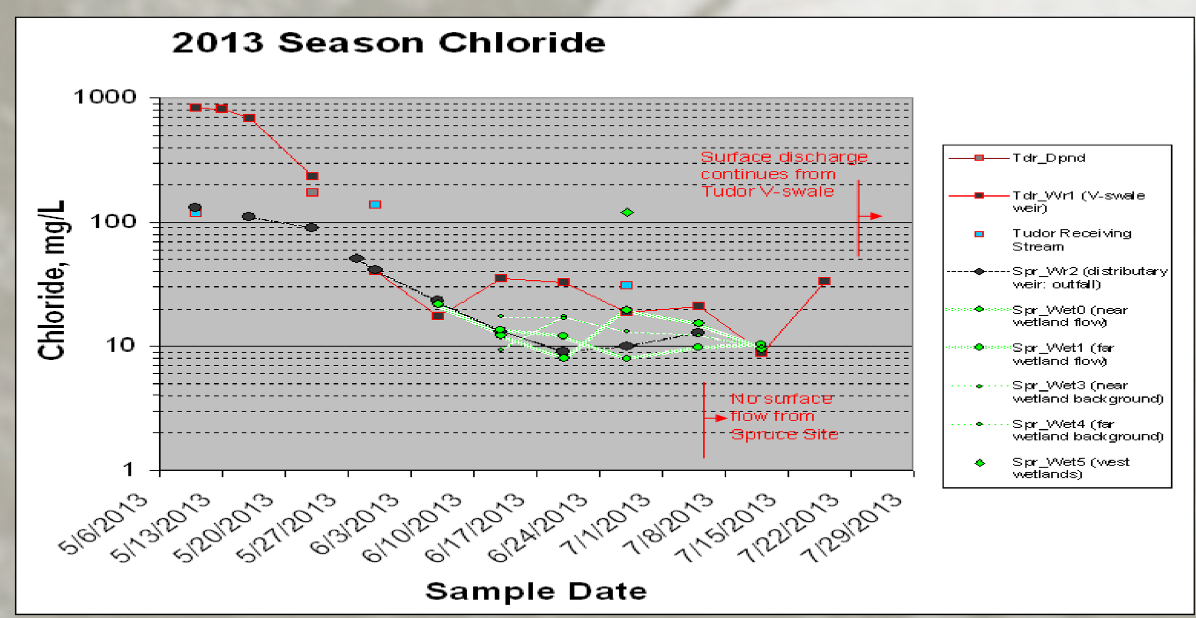
Spruce Snow Disposal Site and 2013 Sampling Stations

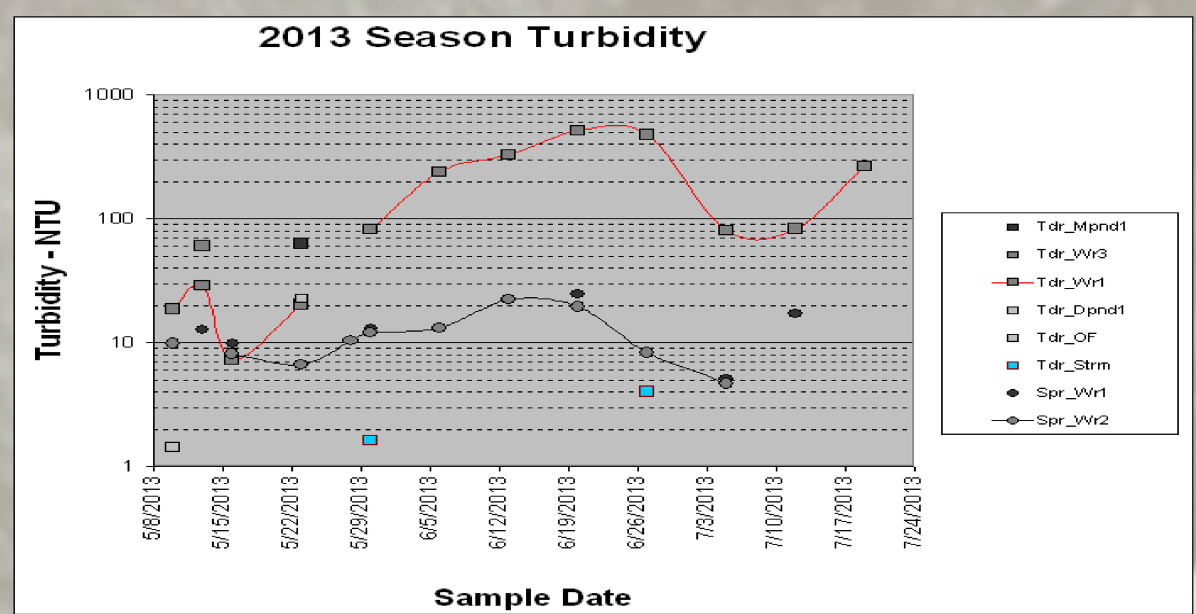


Tudor Snow Disposal Site and 2013 Sampling Stations

2013 Test Results

2013 season chloride concentration test results at both Spruce and Tudor snow disposal sites as collected between May 6 and July 29.



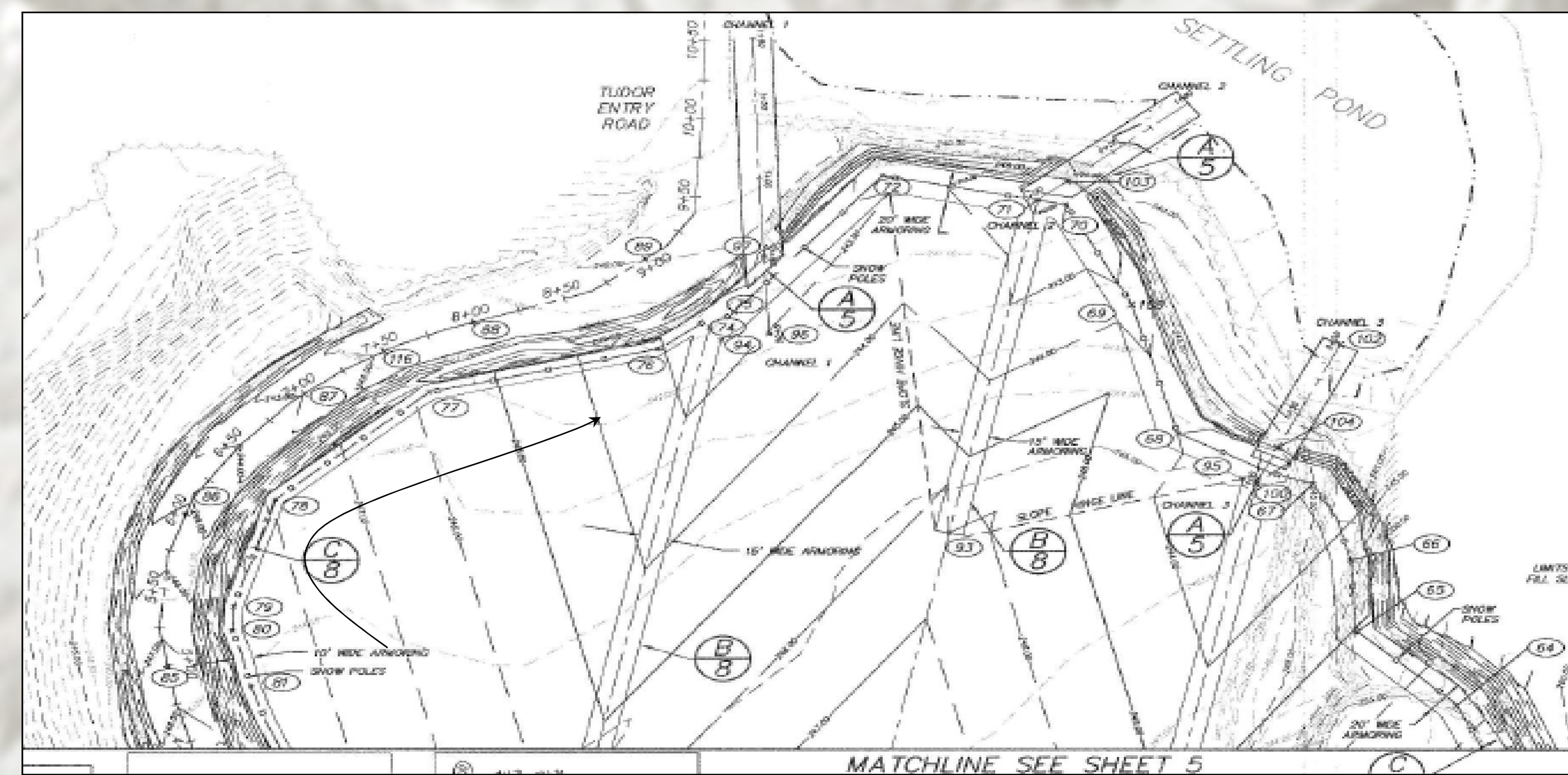


2013 season turbidity concentration test results at both Spruce and Tudor snow disposal sites as collected between May 8 and July 24.

2013 Evaluation and Issues

Design Issues

Vs.



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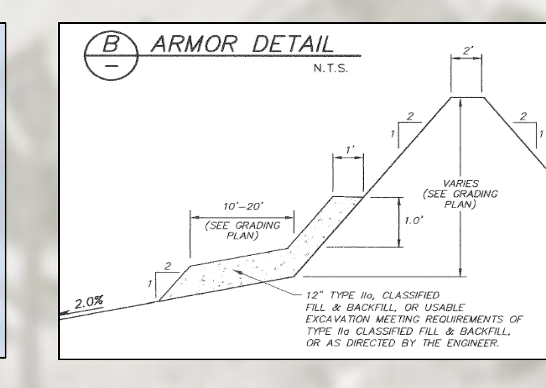

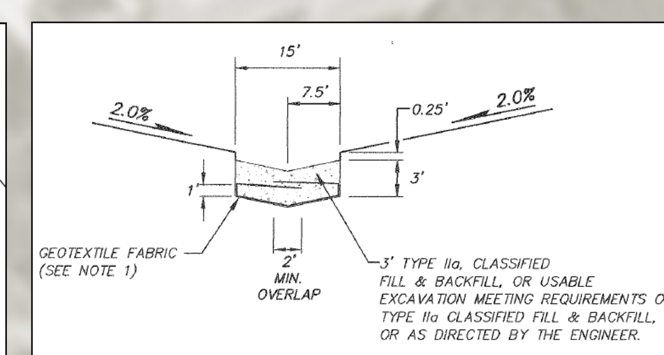

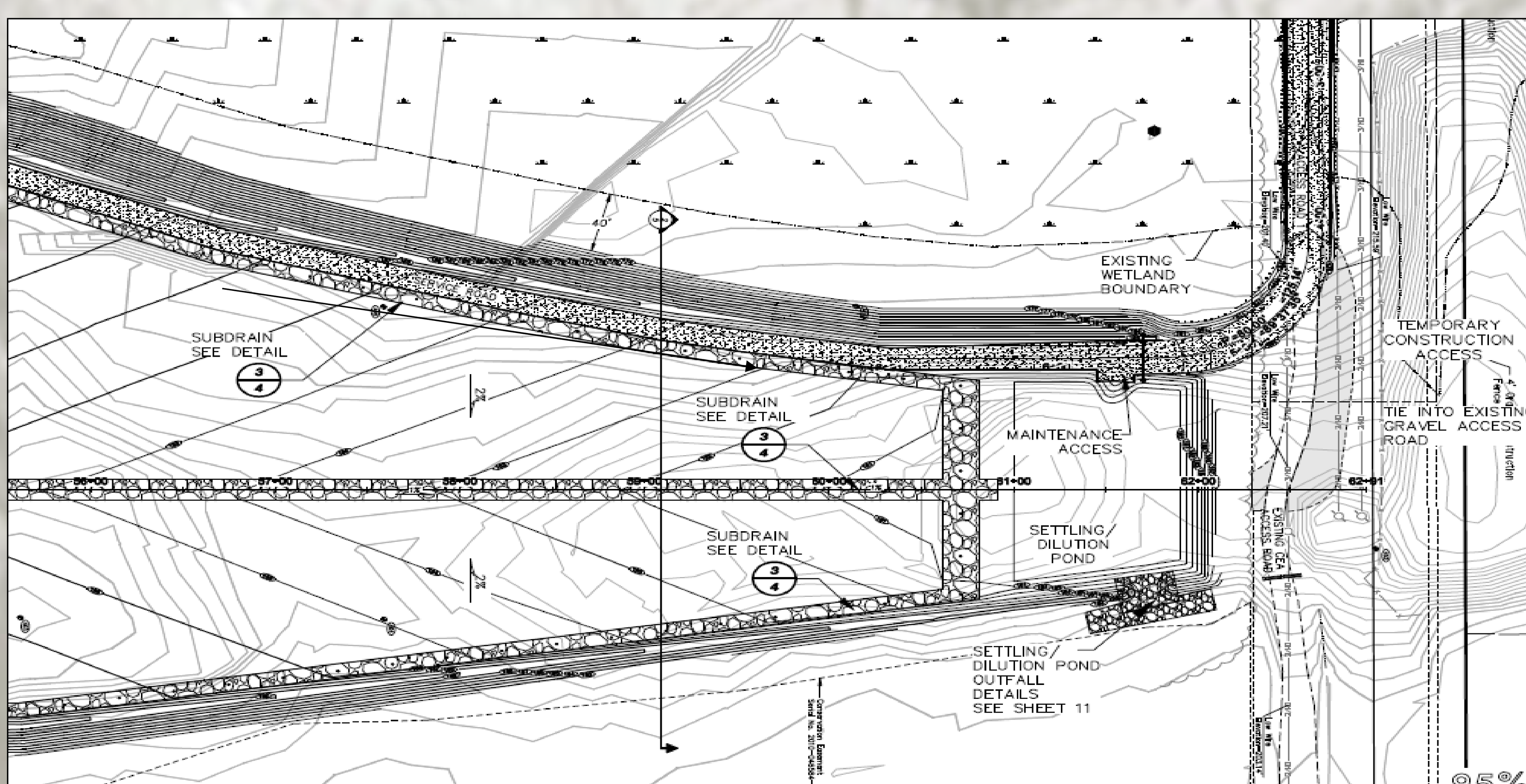

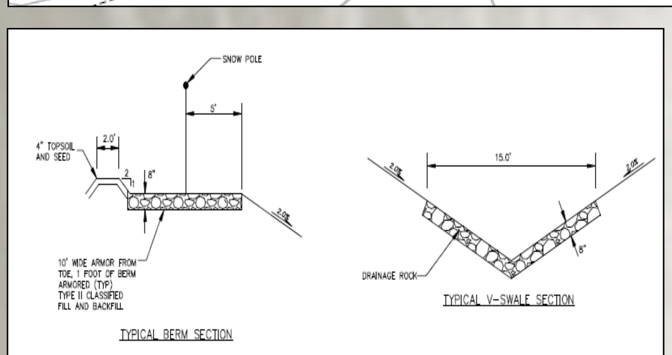

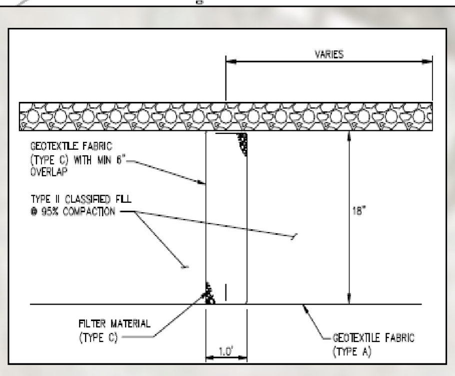

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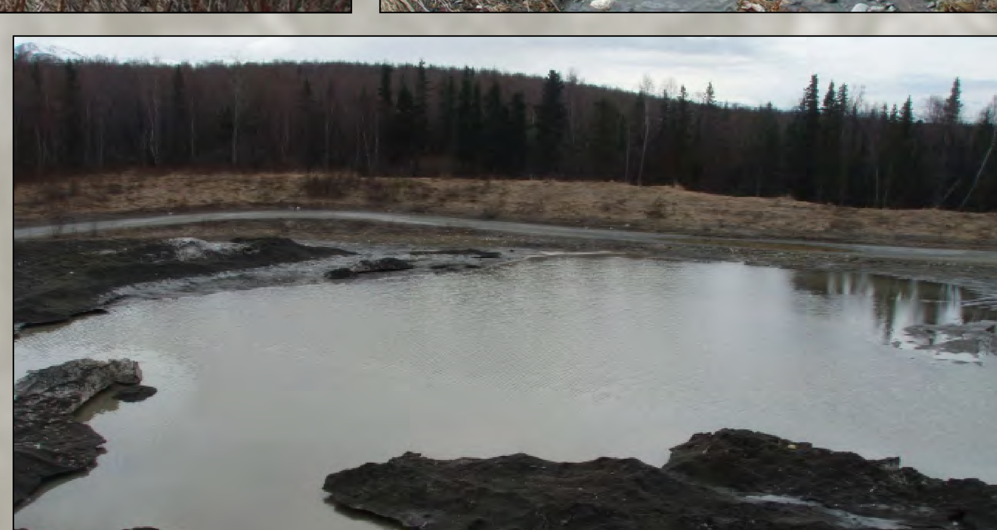

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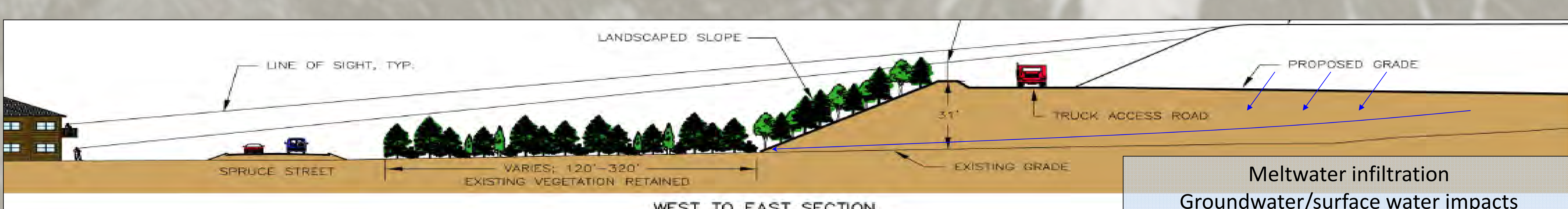

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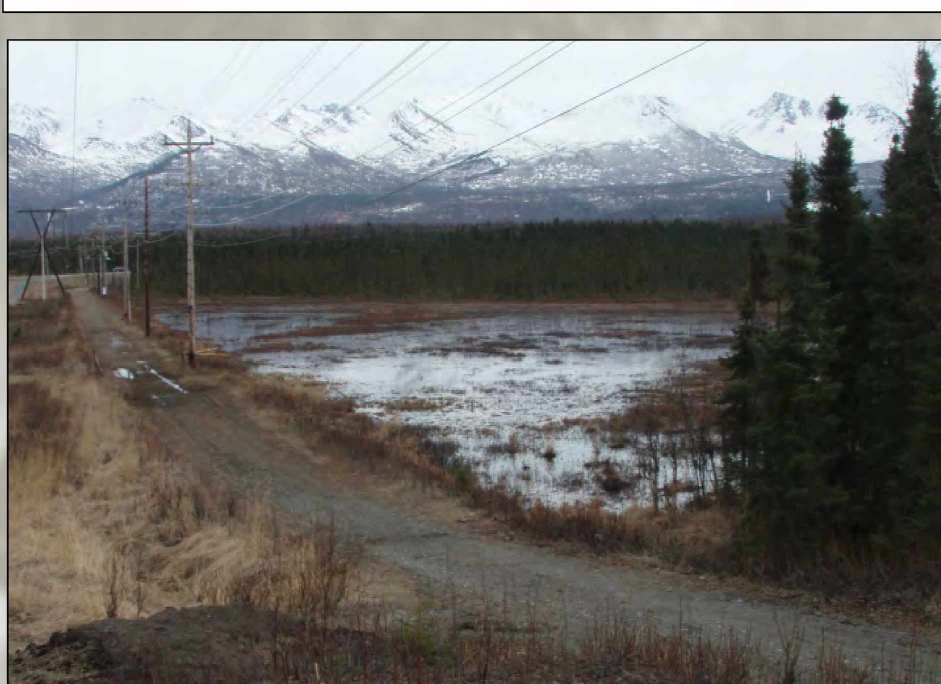

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- V-Swales require strict operational guidelines to ensure proper function.

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:

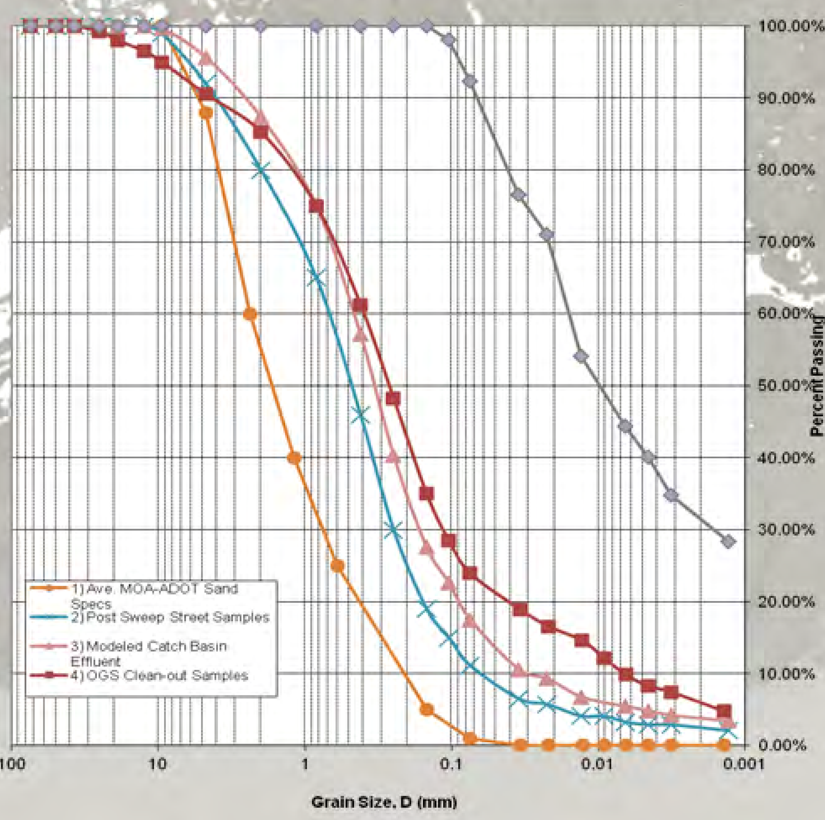
	Historic (1963-2010) Rainfall Statistics	2012 Rainfall Statistics
Mean Storm Volume inches	0.24	0.34
Mean Storm Intensity inches/hour	0.026	0.028
Mean Storm Duration hours	13.17	24.48
Separation time (dry hours between storms)	79	88
90 percent intensity inches/hour	0.12	0.08
Annual number of storms volume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

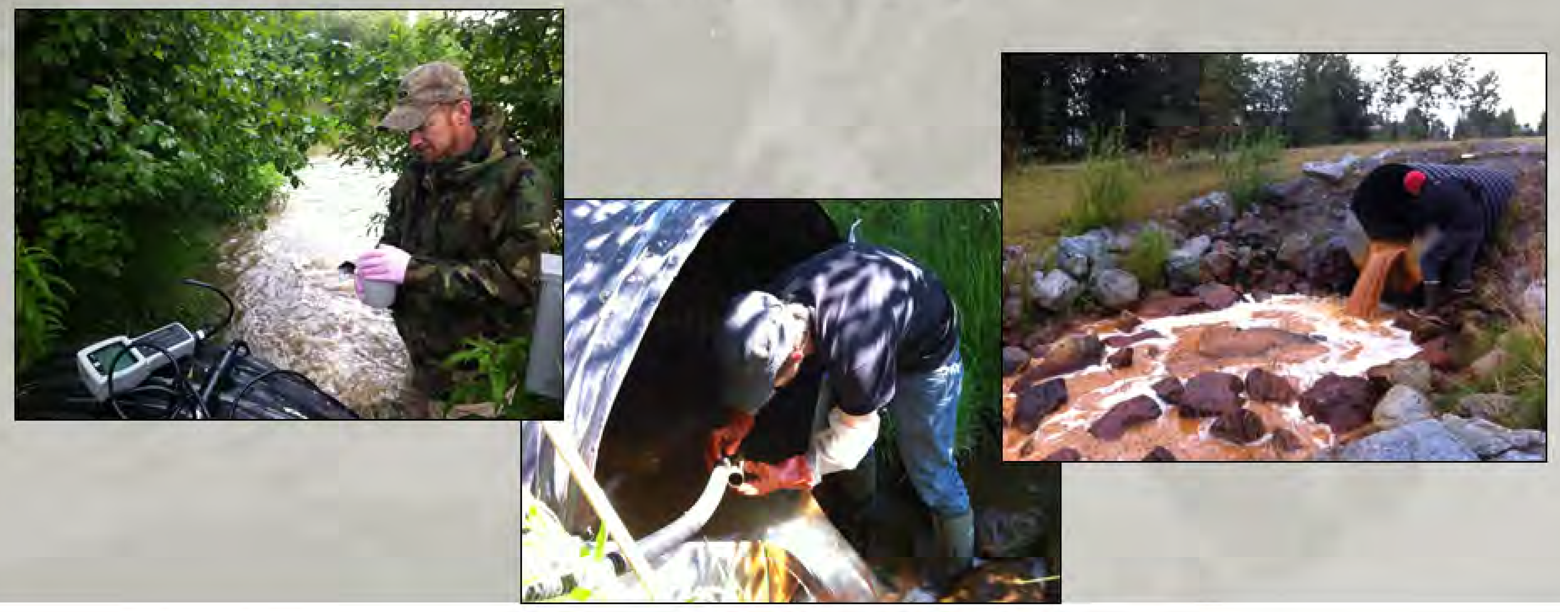
The graph to the right shows a series of particle size distributions (PSD) that follows the change in character of the sediment load as it moves through the system and components are captured by various devices.



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

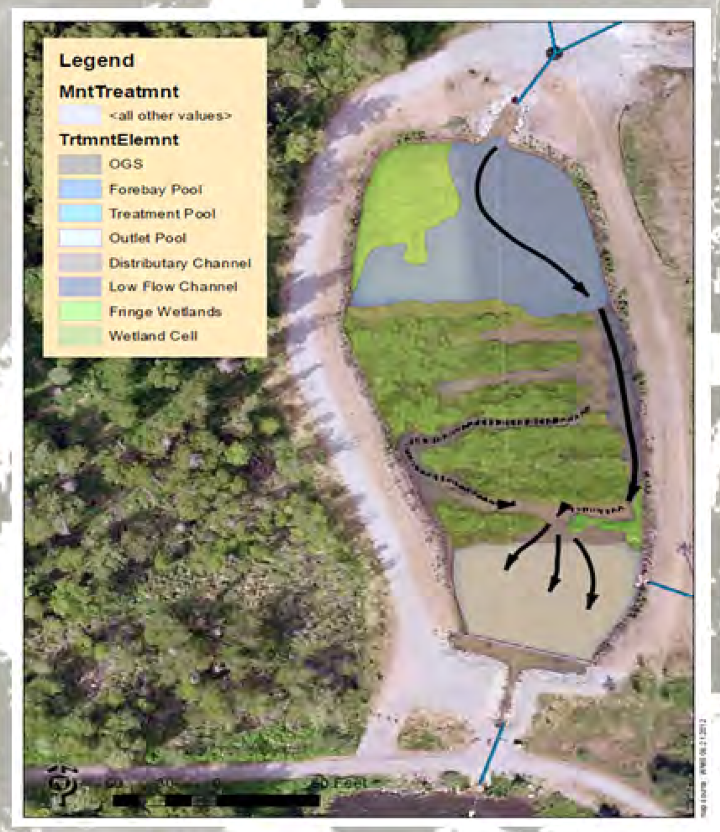
OGS Basin	Basin Area (sq. ft)	Total Curb miles in basin	Basin Type	OGS Unit Model	Time since last cleaning (years)	Estimated weight of sediments (lb)	Percent passing #200 sieve (75 micron)	Organic Content of sediments
Old Seward and 74th Ave	770,000	.82	Arterial	STC 3600	0.70	1656 lb	10%	3.9%
Juneau 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 Street Basin			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:

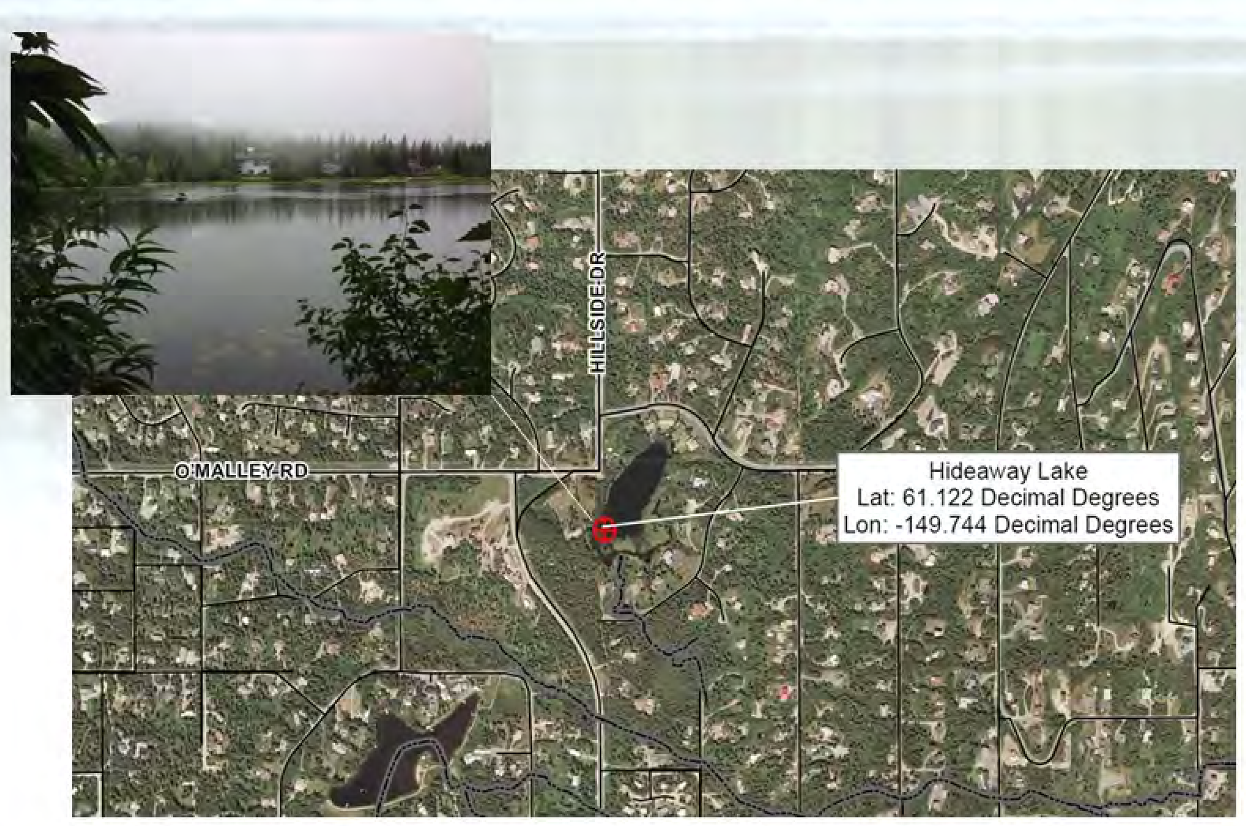
Recommendations for planning and design strategies of MS4 treatment devices are::

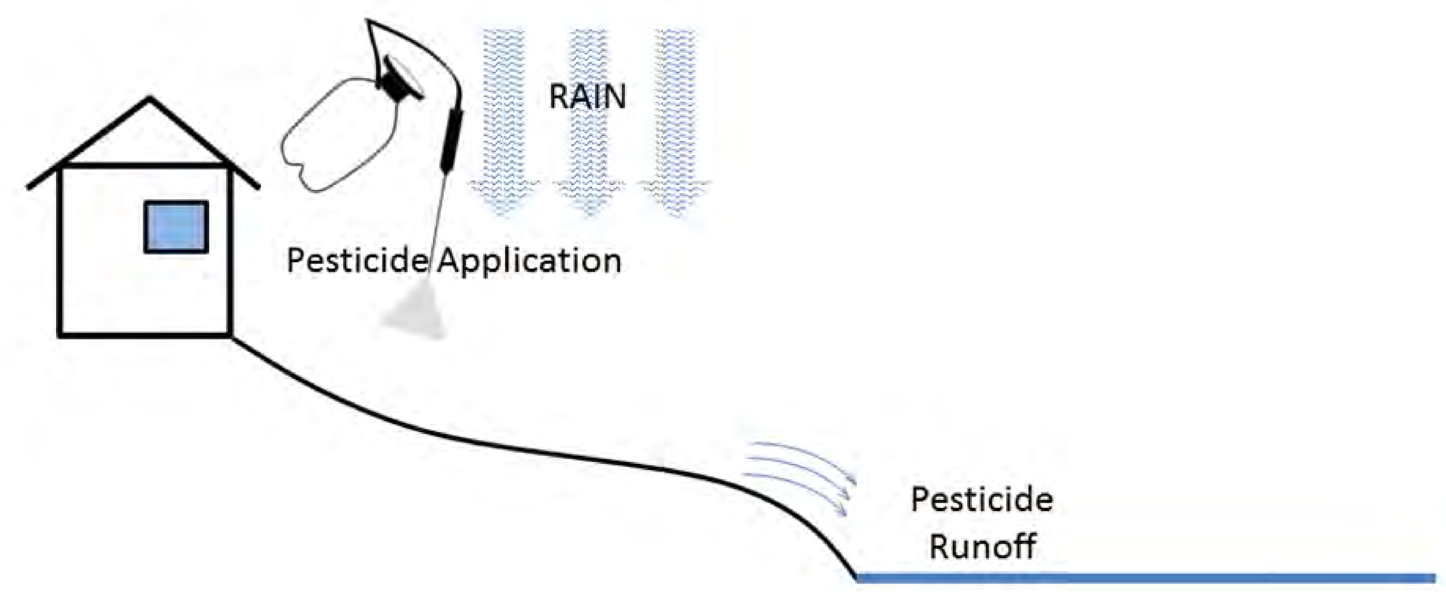
- Plan and design all water quality controls within a treatment train context.
- Design for and assess performance using seasonal sum-of-loads methods.
- Apply water quality design storms appropriate to Anchorage
- Apply 90th percentile rainfall intensity and waste storage criteria to OGS design.
- Identify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

Pesticide Screening

Objectives

- Determine whether two commonly used pesticides are present in three closed-basin lakes (two lakes in developed basins, one lake in an undeveloped basin as a control)
- Sample in 2013 under current MS4 permit
- Determine the need for an educational campaign to reduce pesticide pollution.





Methodology

- After a storm producing runoff, collect water sample at least 10 meters from shore and in the deepest portion of the lake.
- Use YSI 556 to measure temperature and pH at a depth of 1 meter.
- Collect water column sample using Niskin sampler lowered to 1 meter depth.
- Samples analyzed by laboratory.


Niskin Sampler

Pesticides Screened

- **2,4-D**
  - Broadleaf weed killer found in:
    - Weed B Gon MAX
    - PAR III
    - Trillion
    - Tri-Kil
    - Killex
    - Weedaway Premium 3-Way XP Turf Herbicide
- **Carbaryl**
  - Insecticide used for aphid and spruce beetle control found in:
    - Karbaspray
    - Nac
    - Ravyon
    - Septene
    - Sevin
    - Tercyl
    - Tricarnam

Results

2011 – Sampling in the three lakes showed no detection of either pesticide

2013 –2,4-D was detected and confirmed by a second sample in Hideaway Lake and Lake Otis. No pesticides were detected in the control lake. These low level detections, well below the 70 µg/L ADEC drinking water standard, were the first in the history of the sampling program.

Screening – July 2, 2013

Site	Temp (°C)	pH	2,4-D (µg/L) MRL = 0.1	Carbaryl (µg/L) MRL = 0.02
Lake Otis	18.01	6.17	0.60	Not Detected (ND)
Hideaway Lake	16.18	7.68	1.1	ND
Little Campbell Lake	16.98	7.25	ND	ND

Confirmation Screening – August 19, 2013

Site	Temp (°C)	pH	2,4-D (µg/L) MRL = 0.1	Carbaryl (µg/L) MRL = 0.02
Lake Otis	18.01	6.17	0.60	Not Detected (ND)
Hideaway Lake	16.18	7.68	1.1	ND

What May Have Contributed To A First-time Detection?

- Weather
  - Prolonged period of dry weather with warmer temperatures
    - Increased pesticide use due to increased weed growth and favorable weather for yard work, producing a build-up of pesticides
  - Subsequent rain event
    - Build-up of pesticides washed into lake

Mitigation

- Develop an educational program to alert the public to pesticide pollution

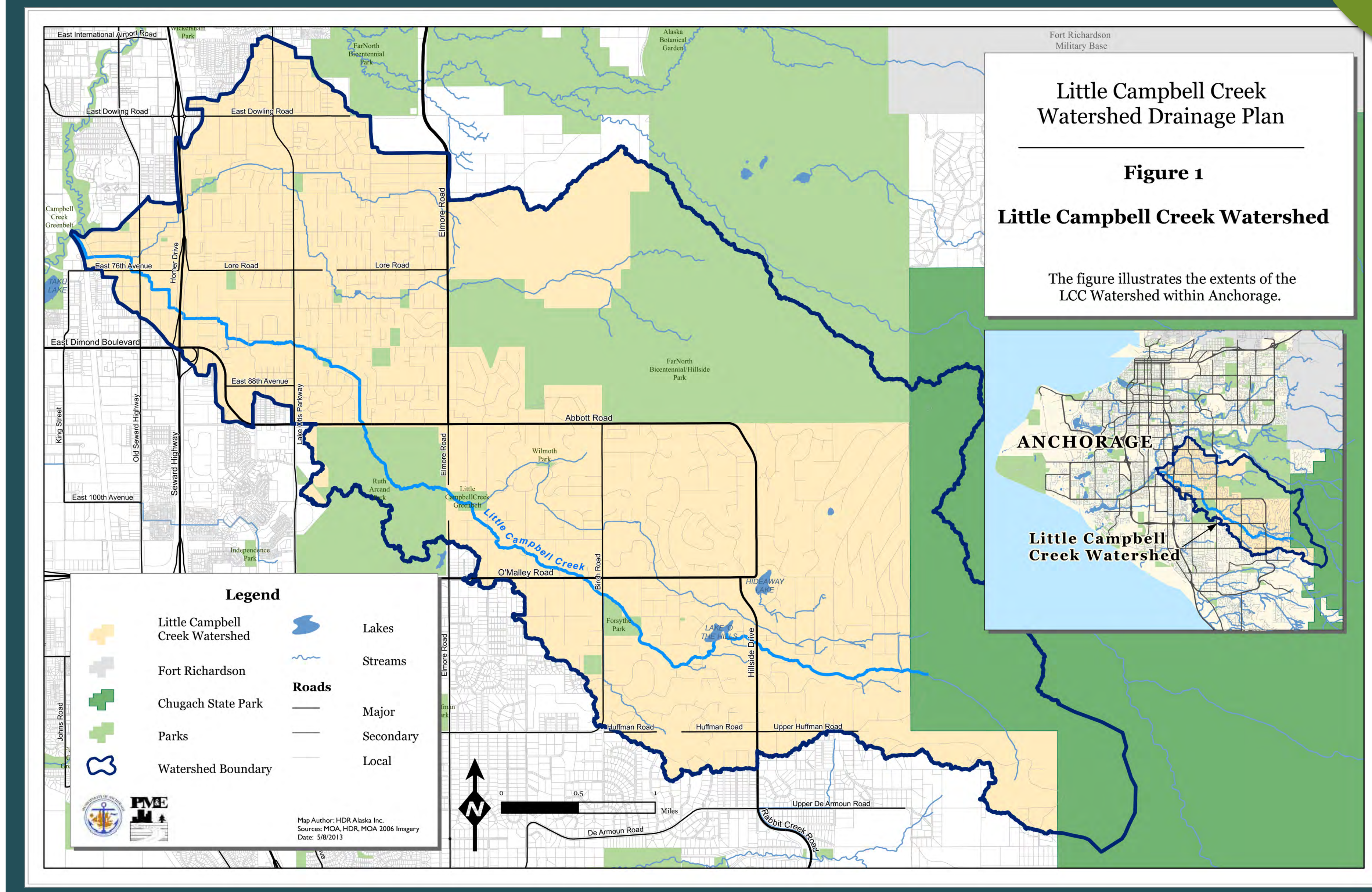
Pesticide Screening Team
Isaac Watkins, HDR Alaska
Ruth Hock, HDR Alaska
Cynthia Helmericks, HDR Alaska
Kyle Cunningham, HDR Alaska

Little Campbell Creek Watershed Drainage Plan

Why Plan?

Planning sets priorities, solves problems, and identifies funding opportunities.

The Plan provides a guide to manage and prioritize storm water and drainage improvement projects to meet WMS's water quality and drainage goals.



LCC Plan at a Glance

1. Introduction and Background
2. Institutional Setting
3. Project Development
4. Drainage Alternatives Evaluation
5. Capital Improvement Project Cost Estimation
6. Implementation Strategy

Watershed Facts

THE WATERSHED

The LCC is the largest tributary to Campbell Creek, which drains to Campbell Lake and into Turnagain Arm. The LCC is **23.7** miles long and descends from its headwaters in the Chugach Mountains to its confluence with Campbell Creek.

STUDY AREA

The LCC is home to **20,000** Anchorage residents and many businesses. It encompasses almost **19** square miles and contains **24** miles of stream habitat.

BENEFITS

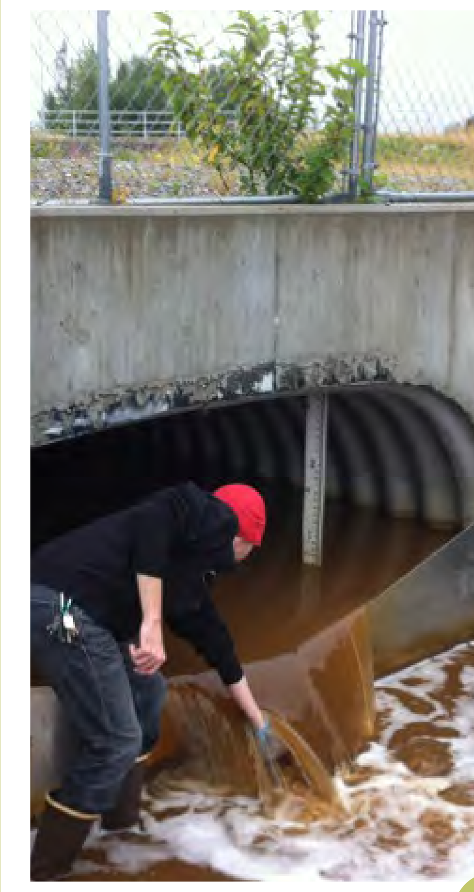
The watershed supports a diversity of fish and wildlife species and hosts numerous recreational opportunities.

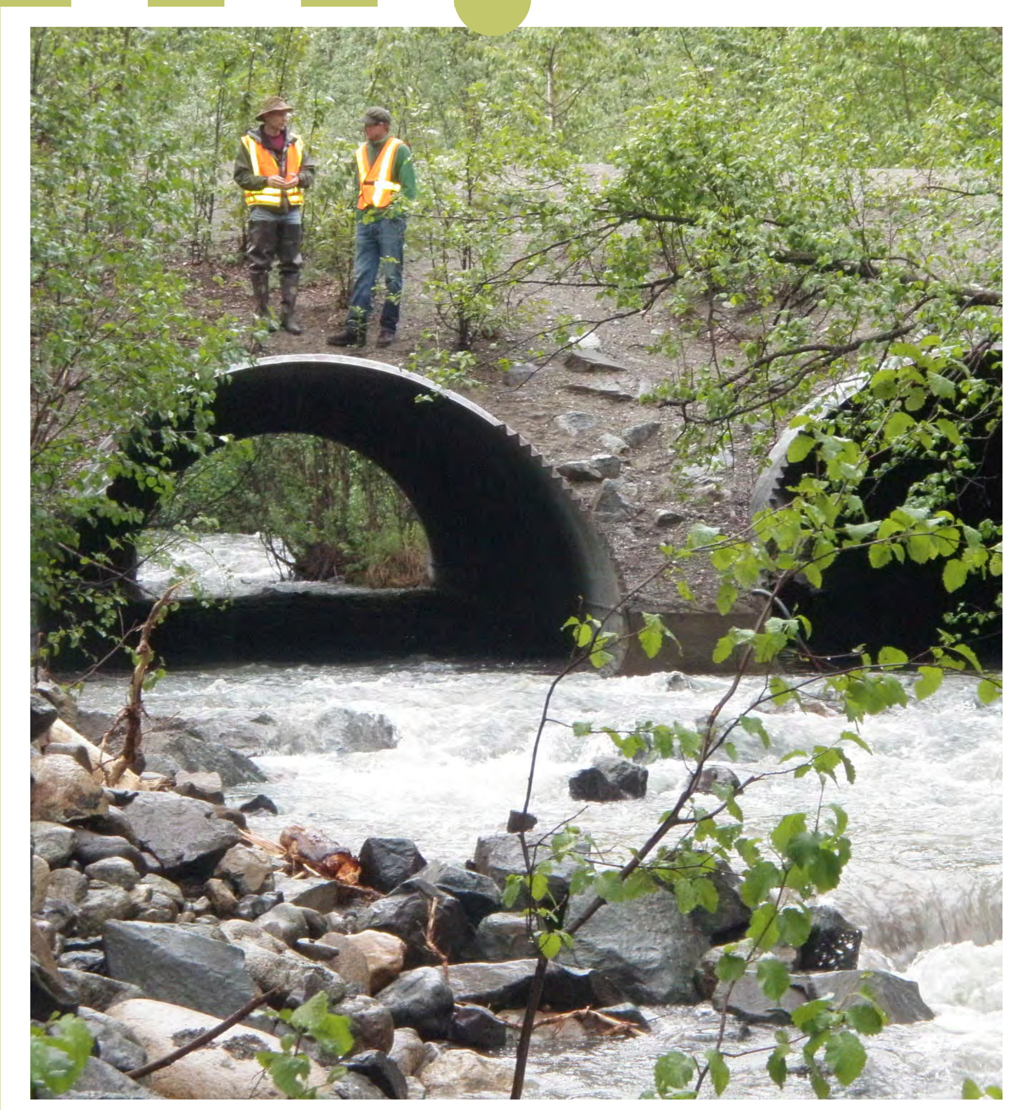
Little Campbell Creek Watershed Drainage Plan

Data Collection and Systems Analysis

A field survey was conducted to collect data on the watershed drainage features including photographs, GPS locations, and documentation of types, sizes, and Manning's roughness values of existing drainage features. The field survey also verified sub-basin delineations and allowed for fish passage assessment of channels and conveyance structures. In the lower watershed, parameters of buried pipe systems taken from record drawings were also field verified.

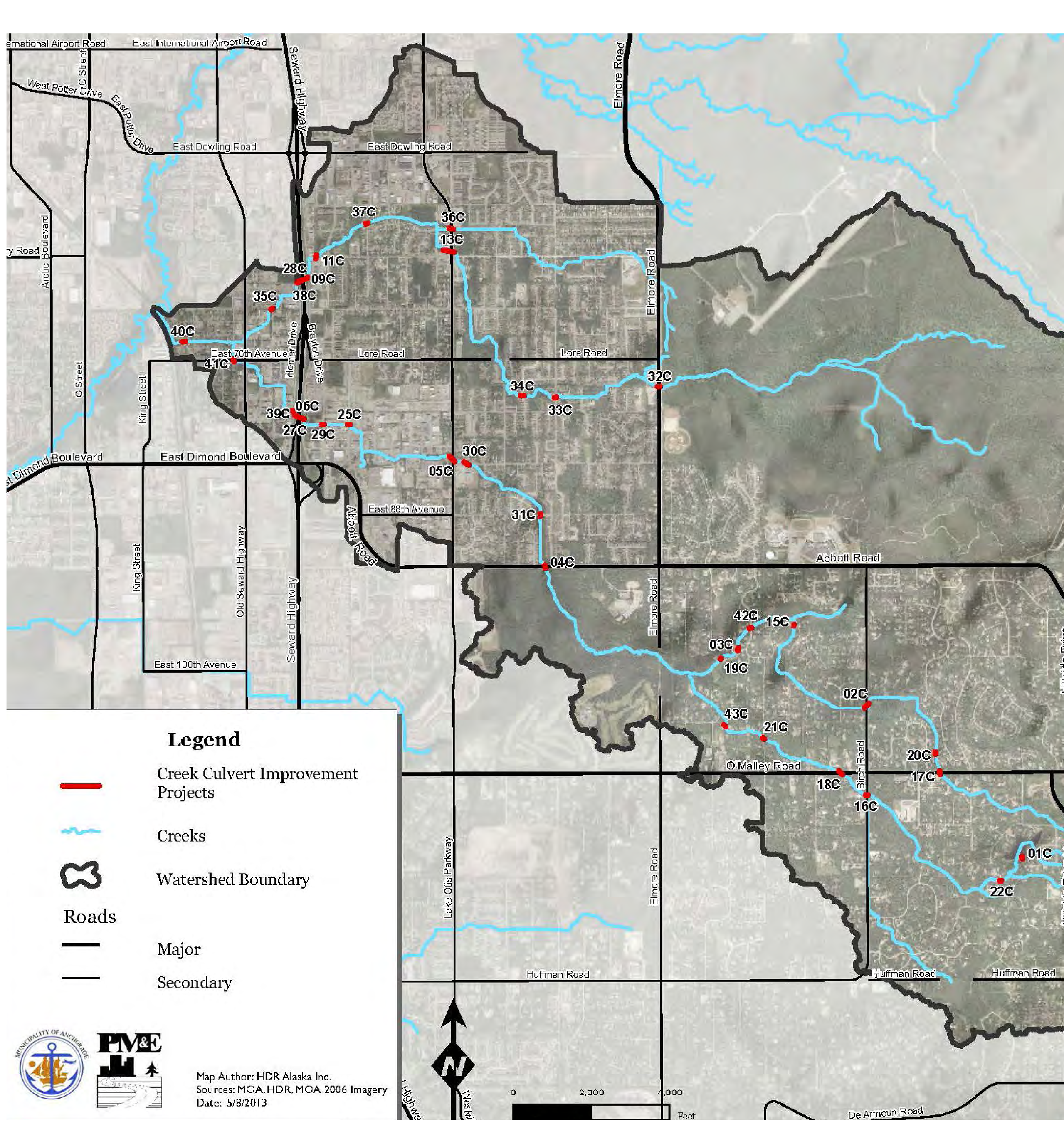
The hydraulics and hydrology (H&H) model developed for system analysis consists of two separate representative computer simulations of the Little Campbell Creek watershed. The Environmental Protection Agency's (EPA) SWMM Version 5.0 software was used to model the lower, more urban portion of the watershed and the US Army Corps of Engineers' (USACE) HEC-HMS Version 3.5 software was used to model the more rural upper two thirds of the watershed.





Model and Project Development

Model Development

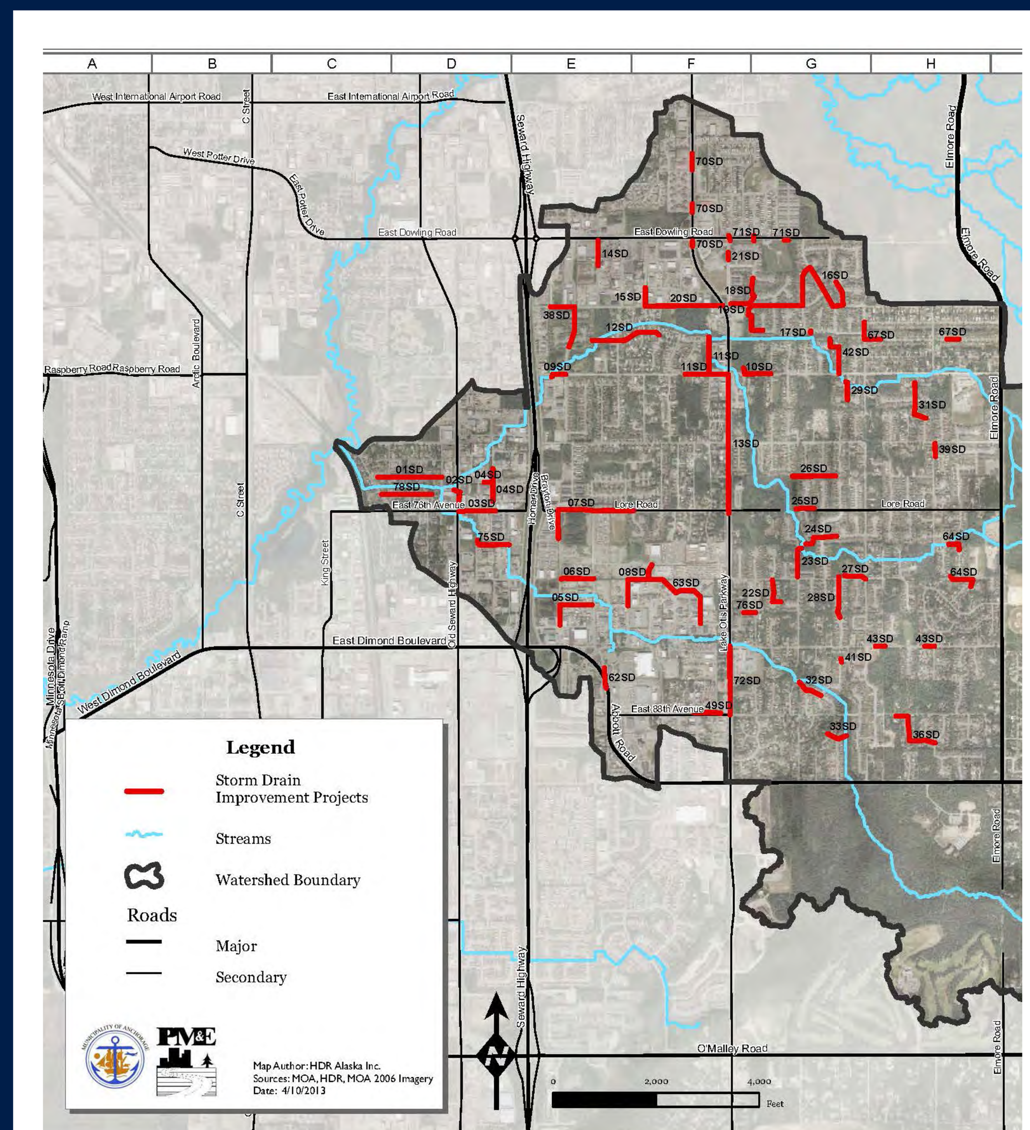


Collection and analysis of calibration data
Rainfall data was collected at three locations and stream flow data was also collected at nine surface water hydrology gaging stations.

HEC-HMS Model development
Rainfall-runoff simulation models were developed for the more rural upper two-thirds of the LCC watershed. HEC-HMS software was used to determine subbasin runoff hydrographs using the SCS Curve Number (CN) method.

SWMM Model development
Rainfall-runoff simulation models were developed for the urbanized, lower one-third of the LCC watershed. EPA SWMM was used to determine subbasin runoff peak flows using the SCS Curve Number (CN) method.

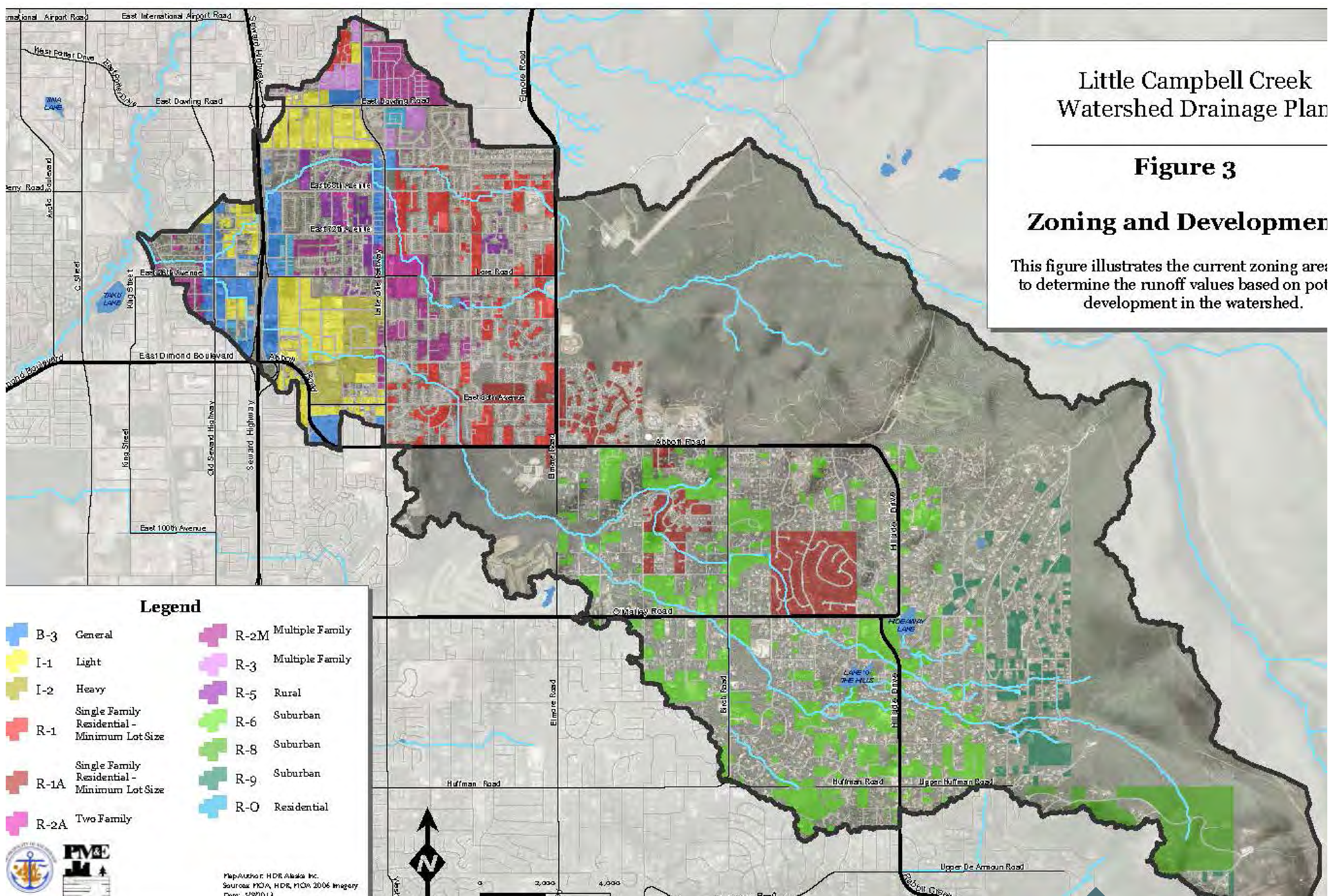
Culvert Deficiency Assessment
A culvert deficiency assessment for flow was performed on a selection of key hydraulic structures in the Little Campbell Creek (LCC) watershed. 59 culverts were selected for a flow deficiency analysis.



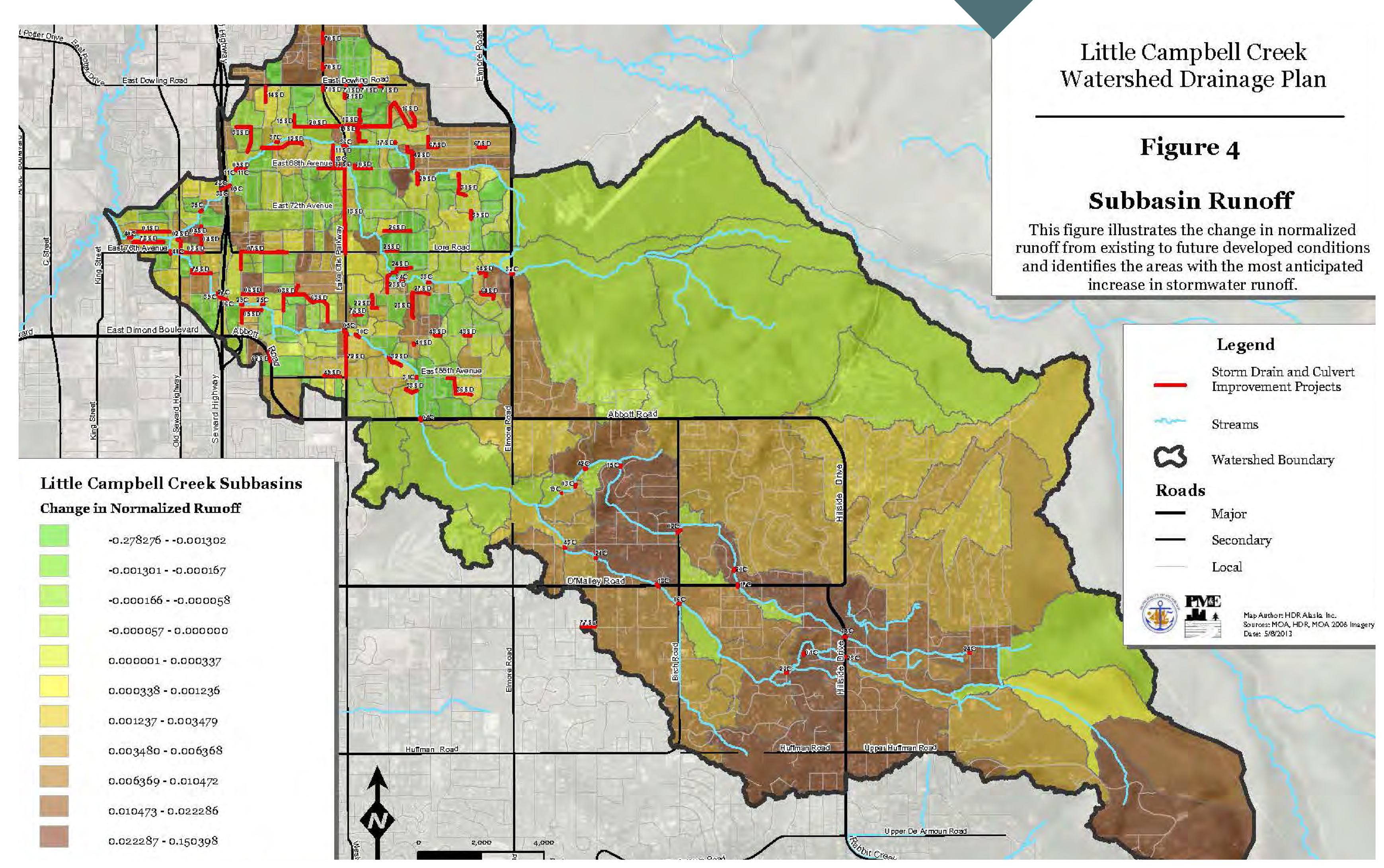
Alternatives Development: From the list of alternatives developed based on hydraulic deficiencies, land use relationships, operation and maintenance relationships and habitat maintenance, spatially coincident components were grouped within similar storm drain systems and channel systems to create projects. Because of significant design variations between storm drain systems and open channel culvert systems, two lists were developed. Storm drain projects were created by including spatially adjacent components (pipes/manholes) into a larger, grouped project. Culvert projects were considered to be stand-alone projects.

Little Campbell Creek Watershed Drainage Plan

Land Use Relationships and Subbasin Runoff



Subbasin Runoff. The composite CN method was used in model development and directly impacts the runoff and peak flows for the existing and future conditions. Figure 4 depicts the potential change in normalized runoff from existing to future developed conditions and identifies the areas within the watershed with the most anticipated increase in stormwater runoff. The areas determined to have the largest increase in runoff from existing to future conditions have been utilized in the project development and ranking system as those areas with the greatest potential to implement low impact development (LID) to reduce increases in runoff and pollution contribution is described in section 3.2 of the Plan.



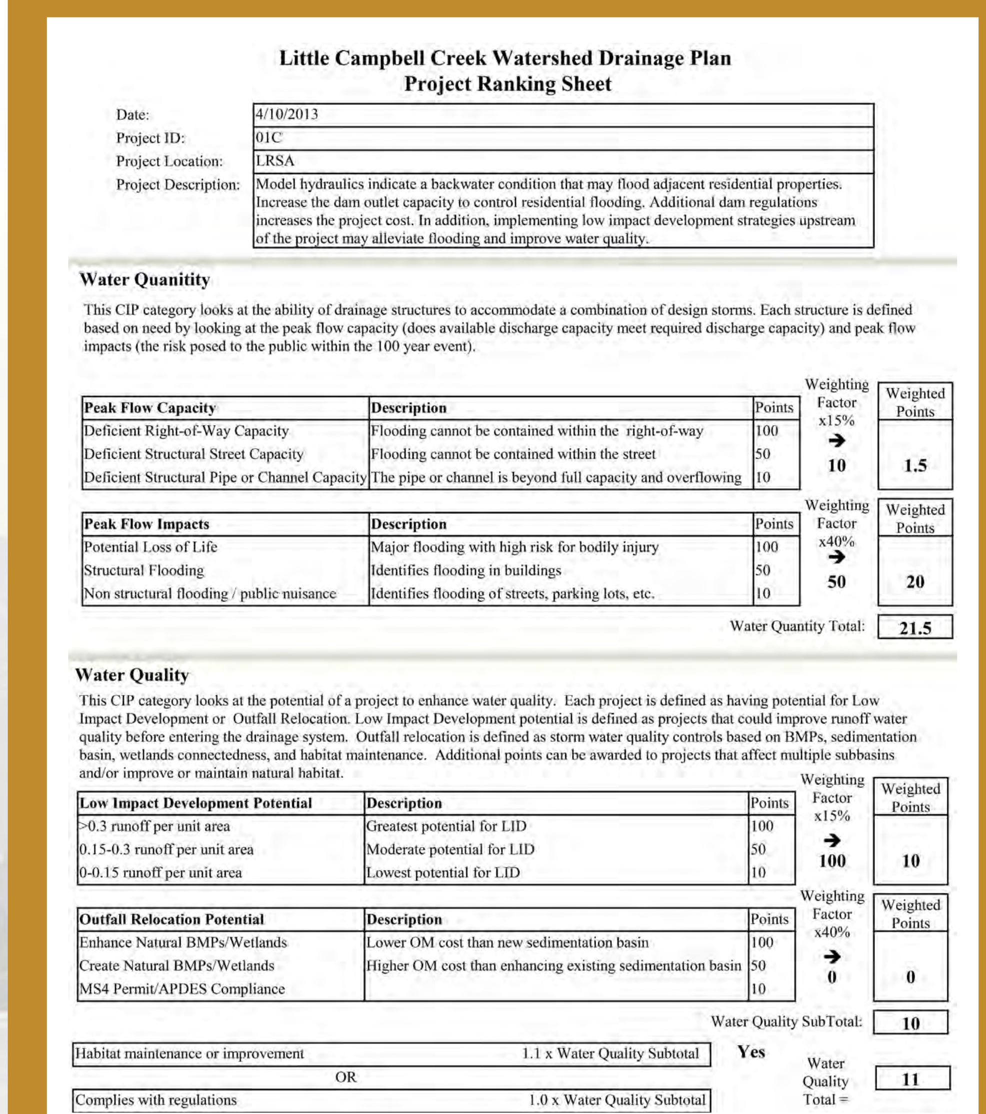
Land use relationships and development have a significant impact on the peak flow throughout the watershed. Model development incorporated basin characteristics for existing and future conditions using the curve number method to determine current and future runoff values. The method of determining the existing and future curve numbers, and ultimately the associated peak runoff, based on land use and other basin characteristics.

Capital Improvement Plan

89 total proposed Projects in the LCC watershed

25 of those projects represent the areas of greatest need and are identified as priority projects

The CIP project lists were selected based on an evaluation of the priority projects and the available budget. The MOA uses a 6-year CIP basis for budgeting the planning, design, and construction of needed projects. The LCC Plan recommends projects for watershed improvements in prioritized order from most important to least important.



Little Campbell Creek Watershed Drainage Plan
Project Ranking Sheet

Date:	4/10/2013
Project ID:	01C
Project Location:	LRSA
Project Description:	Model hydraulics indicate a backwater condition that may flood adjacent residential properties. Increase the dam outlet capacity to control residential flooding. Additional dam regulations increases the project cost. In addition, implementing low impact development strategies upstream of the project may alleviate flooding and improve water quality.

Water Quanitity

This CIP category looks at the ability of drainage structures to accommodate a combination of design storms. Each structure is defined based on need by looking at the peak flow capacity (does available discharge capacity meet required discharge capacity) and peak flow impacts (the risk posed to the public within the 100 year event).

Peak Flow Capacity	Description	Points	Weighting Factor x15%	Weighted Points
Deficient Right-of-Way Capacity	Flooding cannot be contained within the right-of-way	100	➔ 10	1.5
Deficient Structural Street Capacity	Flooding cannot be contained within the street	50		
Deficient Structural Pipe or Channel Capacity	The pipe or channel is beyond full capacity and overflowing	10		

Peak Flow Impacts	Description	Points	Weighting Factor x40%	Weighted Points
Potential Loss of Life	Major flooding with high risk for bodily injury	100	➔ 50	20
Structural Flooding	Identifies flooding in buildings	50		
Non structural flooding / public nuisance	Identifies flooding of streets, parking lots, etc.	10		

Water Quantity Total: **21.5**

Water Quality

This CIP category looks at the potential of a project to enhance water quality. Each project is defined as having potential for Low Impact Development or Outfall Relocation. Low Impact Development potential is defined as projects that could improve runoff water quality before entering the drainage system. Outfall relocation is defined as storm water quality controls based on BMPs, sedimentation basin, wetlands connectedness, and habitat maintenance. Additional points can be awarded to projects that affect multiple subbasins and/or improve or maintain natural habitat.

Low Impact Development Potential	Description	Points	Weighting Factor x15%	Weighted Points
>0.3 runoff per unit area	Greatest potential for LID	100	➔ 100	10
0.15-0.3 runoff per unit area	Moderate potential for LID	50		
0-0.15 runoff per unit area	Lowest potential for LID	10		

Outfall Relocation Potential	Description	Points	Weighting Factor x40%	Weighted Points
Enhance Natural BMPs/Wetlands	Lower OM cost than new sedimentation basin	100	➔ 0	0
Create Natural BMPs/Wetlands	Higher OM cost than enhancing existing sedimentation basin	50		
MS4 Permit/APDES Compliance		10		

Water Quality SubTotal: **10**

Habitat maintenance or improvement	1.1 x Water Quality Subtotal	**Yes**	Water Quality Total =	**11**
OR				
Complies with regulations	1.0 x Water Quality Subtotal			

Evaluation Criteria

The four categories discussed in the project development section (hydraulic deficiencies, land use relationships, operation and maintenance relationships and habitat maintenance) were used as the basis for developing deficiency scoring criteria. The four main criteria were defined as:

- Water Quantity
- Water Quality
- Maintenance Deficiency
- Project and Policy

Dry Weather Screening

Parameters for 15 outfalls yearly

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

cfu = colony forming unity

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

Program Objective

Water samples are collected during periods of at least 48 hours of dry weather (typically May and June) from storm drain outfalls that flow directly into creeks. The objective is to identify potential illicit discharges using laboratory tests and field screening techniques. Flow from storm drain outfalls during dry weather can be an indicator of improper discharges to the storm sewer system.

Program Outline

- 12 major watersheds were identified for sampling
- Watersheds were prioritized based on four criteria
  - Listed as impaired waterbody
  - Evidence of contamination in 3 years prior to ranking
  - Percentage of impervious cover
  - Proportion of commercial/industrial land use
- At least three watersheds are examined in a single year following the established prioritization
- The goal is to sample five outfalls in each watershed (15 in a year)
- Watersheds are divided into lower and upper portions and outfalls are divided between the two portions.
- Outfalls must be flowing during dry weather and not have been tested in a previous year during the permit cycle.

2011

Fifteen outfalls were sampled in the following watersheds:

- Fish Creek
- Campbell Creek
- Eagle River

The field team found one outfall on Campbell Creek clogged with sediments. The sample result exceeded the turbidity criteria. The outfall was cleaned and resampled and passed testing requirements.

2011 Campbell Creek Outfall on the day of initial sampling

2011 Campbell Creek Outfall after cleared by MOA .

2012

Fifteen outfalls were sampled in the following watersheds:

- Ship Creek
- Chester Creek
- Furrow Creek

2012 Ship Creek outfall – low tide

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

- Initial sample result: 76,400 cfu/100 mL
- Follow-up sample results: 754 cfu/100 mL
- Follow-up sample result at nearest up gradient manhole: 29 cfu/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.

2013

Sampling Effort Summary

Fifteen outfalls were sampled in the following watersheds:

- Rabbit Creek
- Hood Creek
- Potter Creek
- Fish Creek
- Campbell Creek

Outfalls with flowing water were not readily identified in smaller watersheds.

- No outfalls with flowing water in dry weather identified in the Mirror Creek, Peters Creek and Glacier Creek watersheds.
- Four outfalls sampled between Rabbit, Hood and Potter Creeks.
- Fish Creek and Campbell Creek (the highest priority watersheds) were revisited to sample a total of 15 sites.
- Fecal Coliform result exceeded the threshold at one outfall on Campbell Creek (follow-up tests were performed).

Dry Weather Screening Team: Isaac Watkins, Alyse Roberts, Zoe Meade – HDR Alaska

556-1 outlet from sedimentation pond

556-3 inlet to sedimentation pond

Initial Sampling - July 15th, 2013

A single parameter at a single outfall exceeded the threshold.

- Campbell Creek outfall 556-1 is the outlet of a sedimentation pond
  - Initial Fecal Coliform result = 413 cfu
- No exceedances at any other outfall for any parameter.

Follow-up Activities – July 24th, 2013

Fecal Coliform samples were collected at 556-1 and 556-3 on the same visit (outfall 556-2-1 was dry)

- Campbell Creek outfall 556-3 is the main inlet to the same sedimentation pond
  - Sampled to track potential up-network contamination source
  - Fecal Coliform result = Non-Detect
- Campbell Creek outfall 556-1
  - Fecal Coliform result = 327 cfu

Results indicate the sedimentation pond and/or surrounding area may be a potential source of the fecal coliform, not the piped portion of the network.

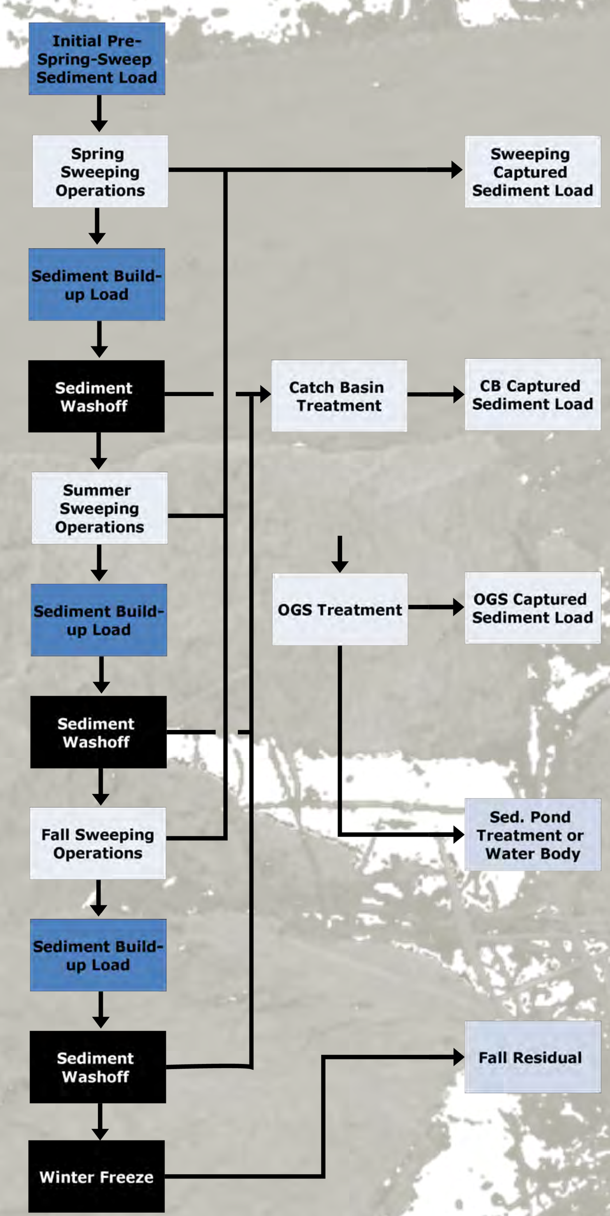
2013 Anchorage Street Sweeping and Storm Water Controls Evaluation

Scott R. Wheaton, WMS; Jacques Annandale, HDR Alaska; Eric Hohmann, PTS.

Street Sweeping and Storm Water Controls Evaluation Objective

As part of the Municipal Separate Storm Sewer System (MS4; AK-052558) Permit, Anchorage is required to report the performance of its storm water practices and devices that prevent street runoff from impacting United States receiving waters. This project looked at street sediment transport from the Anchorage Treatment Train perspective, which evaluated the annual capture performance of street sweeping, catch basins and Oil and Grit Separators (OGS).

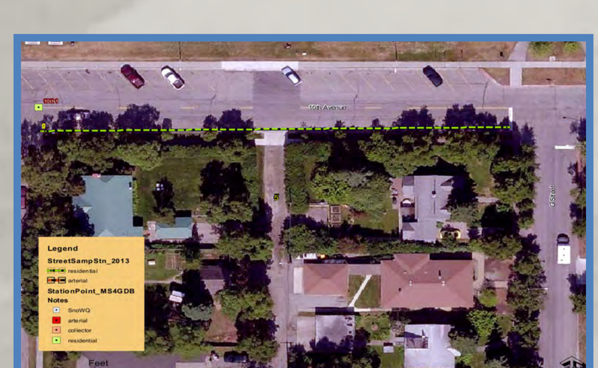
A conceptual model of the treatment train is represented in the diagram on the right. Time passes as one moves from the top of the chart to the bottom. As time passes, certain events occur such as street sweeping, buildup, and washoff. When washoff occurs a percent of street sediment enters the MS4 storm drain systems to be treated by a series of devices starting with catch basins, OGS and potentially sedimentation ponds. This multi-step treatment, including sweeping, is known as the Anchorage Treatment Train.

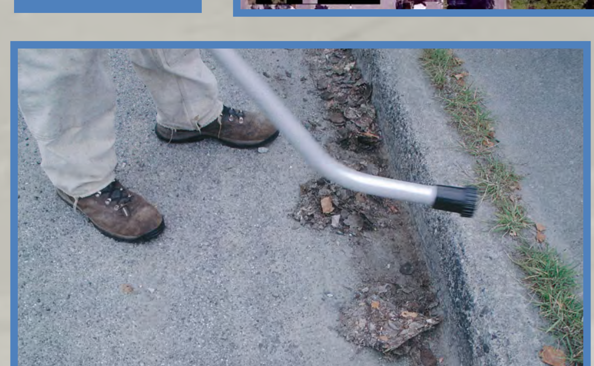


Above: A diagram illustrating the typical chronological street sediment transformations.

Below: A field picture exemplifying sediment trackout from a lot to the street.

Right: a field map showing a typical street sampling location at the park strip.

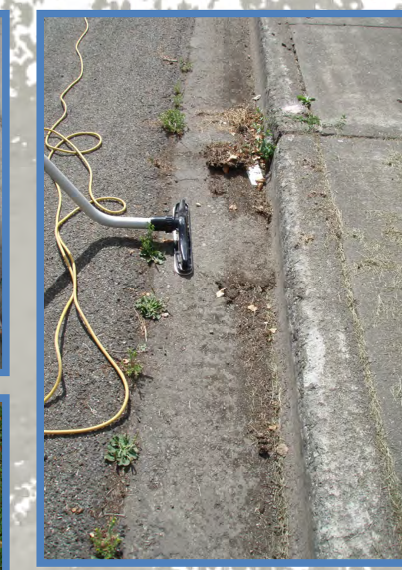




Left: Fibrous organics tend to fuse and create larger organic mats as shown in the gutter.

2013 Street Sedimet Sampling

The project sampled street sediment concentrations from spring to fall. These sampling events provided data points before and after sweeping events. They also helped develop build up and washoff rates through extrapolation. The 2013 data was used in conjunction with street sediment sampling data from 1996, 2000, 2002, 2010, 2011, and 2012 to help calibrate the capture performance of our street sweeper devices and street sweeping performance.



Top Middle: A newly paved road creating a depressed gutter.

Middle Middle: an old depressed gutter showing sediment and organics not captured or mobilized.

Bottom Middle: A depressed gutter with overgrown vegetation which hindered sweeping capture, and mobilization of sediment and organics.

Top Right: The fully assembled vacuum taking a sample measurement.

Bottom Right: Large groups of organics can clump together and form micro structures which change the flow patterns and stresses with a gutter. This can causes localized scour and deposition.

Bottom Left: Sections of street cannot be swept because parked cars are present.

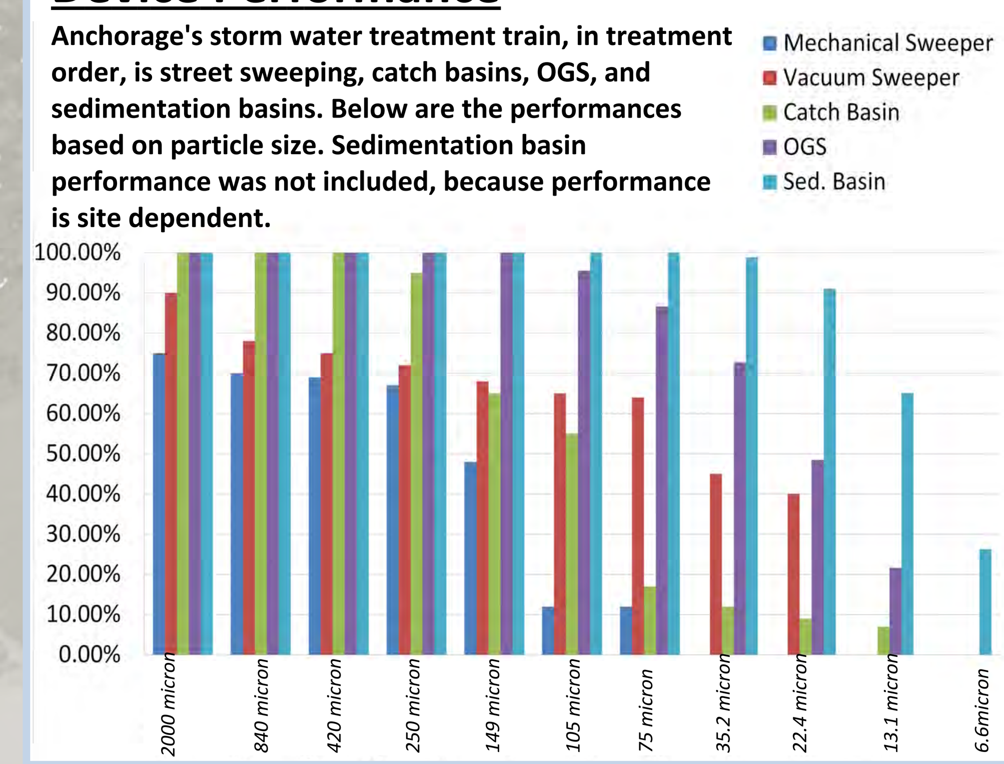
Anchorage Storm Water Performance

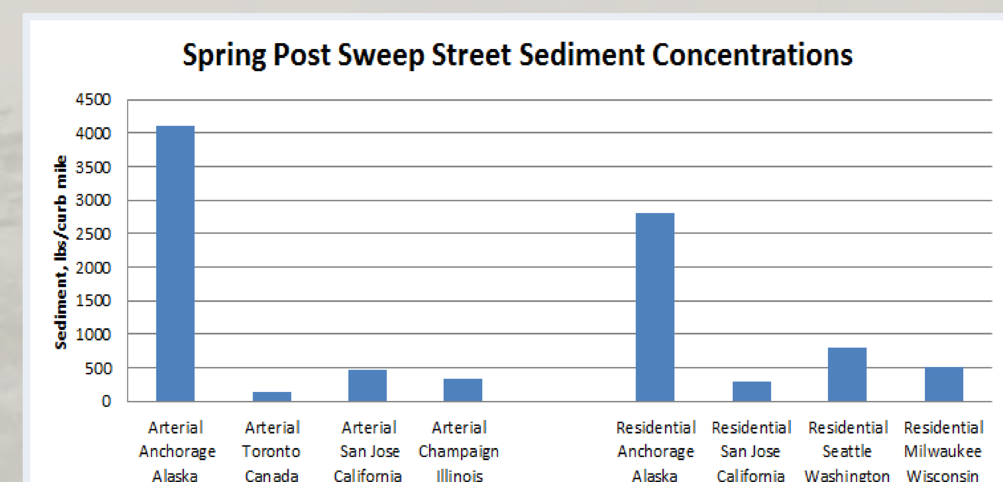
From the sampling and analysis, we determined that the end of winter street sediment load is much larger than any of the recorded studies reviewed. Our post spring sweep concentrations were also much larger than other municipalities. This consistency of increased street sediment concentrations is largely due to the fact that Anchorage accumulates sediment on the streets for approximately 6 months out of the year before they can be cleaned or mobilized.

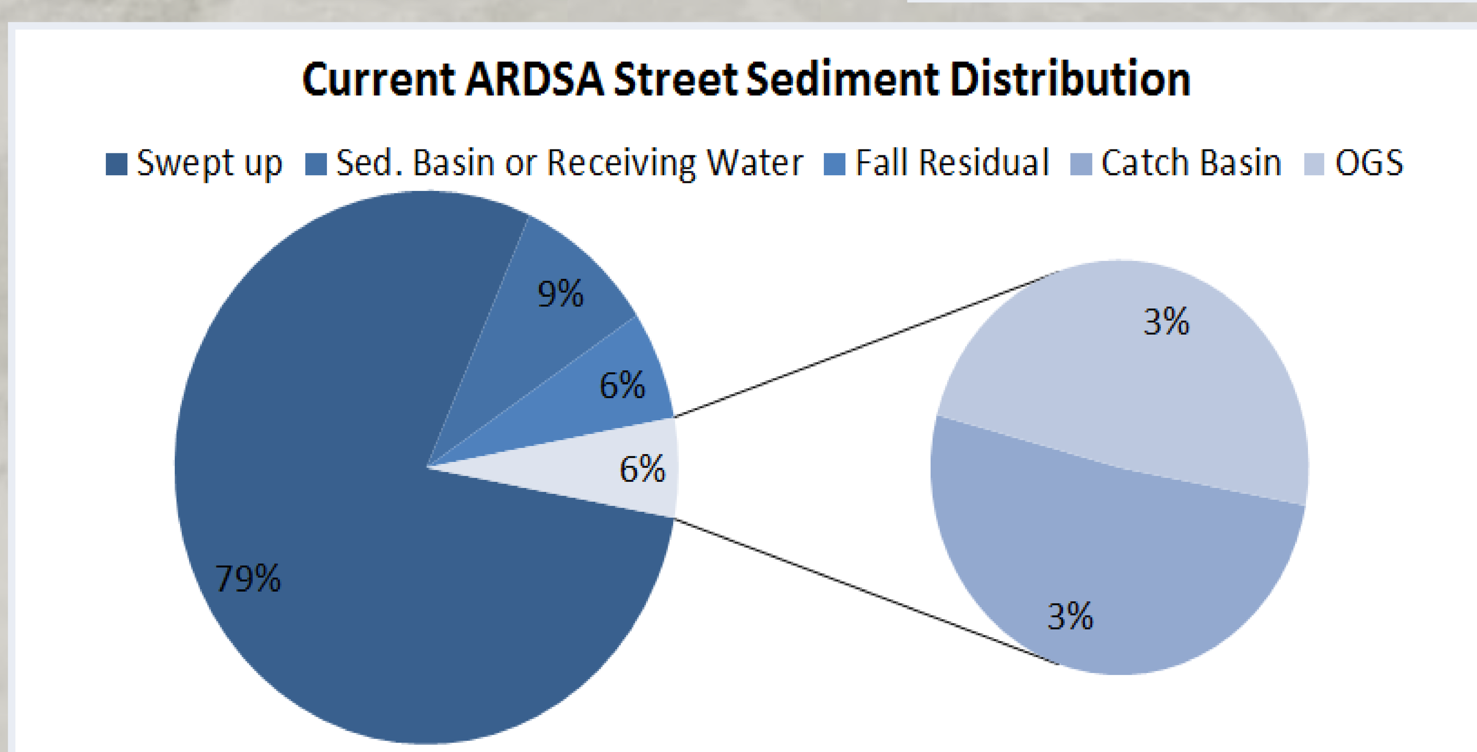
Sediment resides in one of five places in the Anchorage MS4 system: on the streets as residual; swept up; captured material in catch basins; captured material in OGS; in a sedimentation basin or receiving water. Approximately 79% of the street sediment load is swept up, 3% is treated by catch basins, 3% is treated by OGS, 6% is in sedimentation basins or receiving waters, and 9% is fall residual left on the street before freeze up.

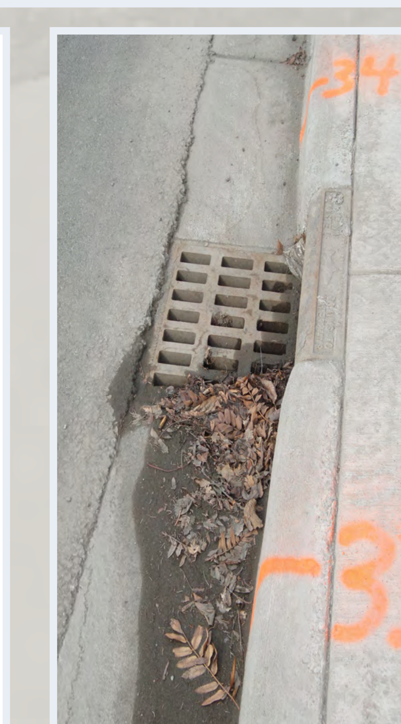
Device Performance

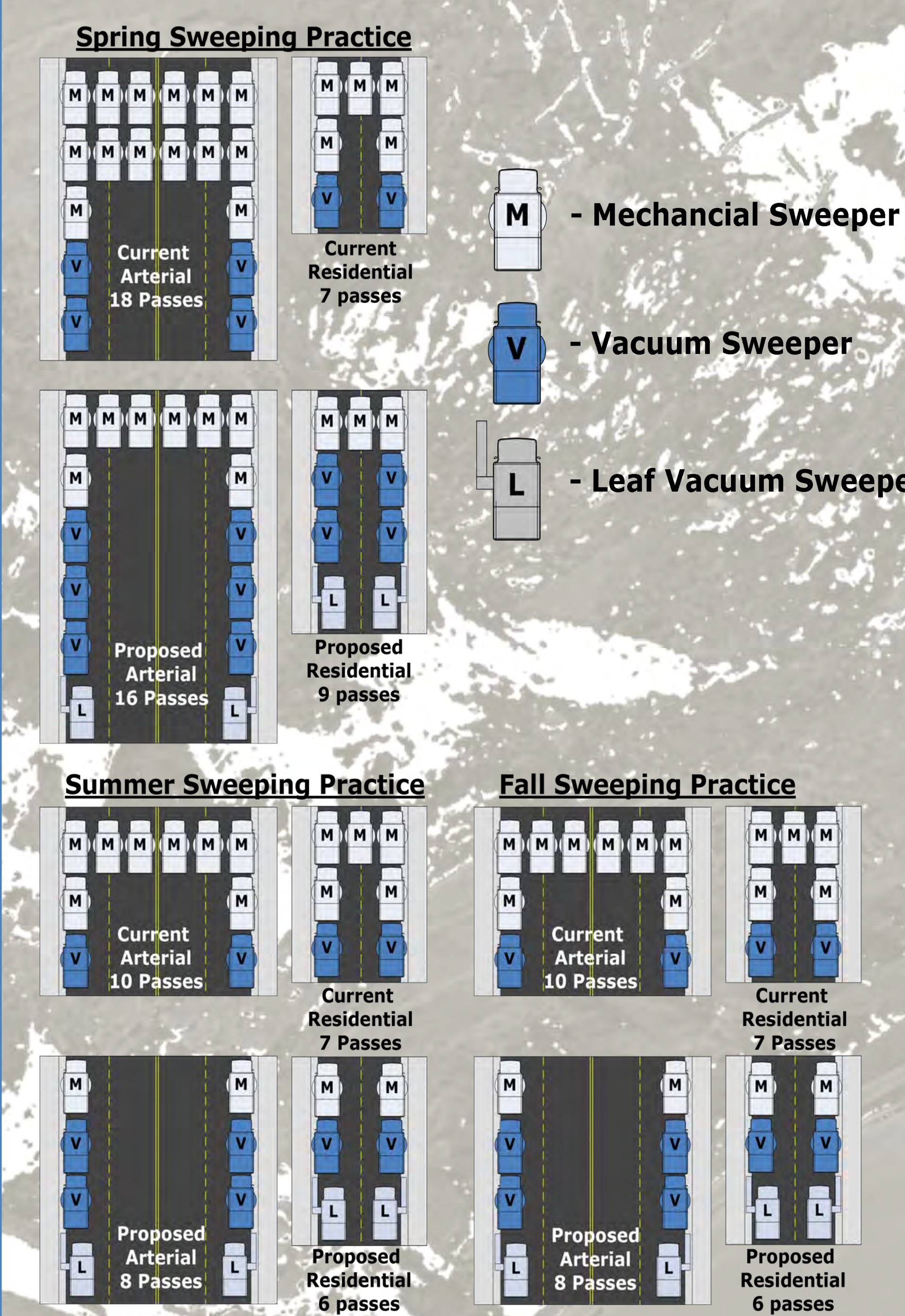
Anchorage's storm water treatment train, in treatment order, is street sweeping, catch basins, OGS, and sedimentation basins. Below are the performances based on particle size. Sedimentation basin performance was not included, because performance is site dependent.











Current vs. Proposed Sweeping Practice

Based on our performance evaluation, the project looked at a revised sweeping practice to improve sediment capture and determine the downstream impacts to catch basins, OGS, sedimentation ponds, and receiving waters. The major changes in the proposed sweeping practice are:

1)Decreased full width passes and increased gutter passes.

2)Implementation of a leaf vacuum sweeper with an articulated arm to address depressed gutters

3)Do not sweep wet street sediment

4)Fall leaf vacuum sweeper Timing - Leaf vacuum should be deployed after a majority of trees have lost their leaves.

The calculated street sweeping capture performance increases significantly. The residual street sediment concentration is estimated to be similar to nation wide studies. In addition to the increased sweeper sediment removal, the amount of sediment entering catch basins, OGS, sedimentation ponds and receiving waters is significantly reduced. It is calculated that about half the sediment entered the storm drain systems. This would result in reduced vactor cleaning frequency. The decreased operations efforts to maintain catch basins and OGS would result savings during the removal, disposal, and treatment of vactor truck wastes.

Top Left: The bar chart shows the post sweep street sediment concentration for the current sweeping practice and the proposed sweeping practice.

Top Right: The bar chart shows the potential costs if the proposed sweeping practices are implemented. If cost is proportional to the amount of sediment removed, then all three storm water controls should see reductions in annual O&M costs.

Bottom Left: The bar chart shows the washoff particle size distribution of residual street sediment from the current sweeping practice and the proposed sweeping practice. Note that the total washoff load is much smaller, and is primarily caused by the lower amount of fine sediment (-100 micron).

Bottom Right: The bar chart shows the sediment captured by catch basins, OGS, or sedimentation basins or water bodies. This indicates that catch basin, OGS and sedimentation basins do not need to be vactored as frequently because of reduced sediment accumulation.